ENGLISH TRANSLATION

Data Coding and Transmission Specification for Digital Broadcasting

ARIB STANDARD

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Association of Radio Industries and Businesses (ARIB)

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Preface

ARIB (Association of Radio Industries and Businesses) establishes the "ARIB Standards" for the basic technical conditions of standard specifications related to variety of radio communication equipments, broadcasting transmission equipments, and its reception equipments using radio wave with the participation of radio communication equipment manufacturers, broadcasting equipment manufacturers, electric communication companies, service providers and other users.

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This standard is established for "Data Coding and Transmission Specification for Digital Broadcasting" by the approval of the standardization committee, participated by radio communication equipment manufacturers, broadcast equipment manufacturers, electric communication companies, service providers and users irrespectively, to secure impartiality and clearness.

For data broadcasting of digital broadcasting, it is directed by the Telecommunications Technology Council on July 21, 1999 that it is desired that the most desirable multimedia coding specification in Japan at this point should be based on an XML-based specification, which is superior in many points such as "function", "contents production environment", "compatibility with other media", "data processing at terminal side", "extension ability of coding method", and "future direction of engineering development", etc., and that the detailed specifications should be standardized by the nongovernmental standardization organization with flexibility.

This standard is established as nongovernmental standard of data broadcasting specification used in Japan based on this direction, and consists of three parts: mono-media coding, multimedia coding, and data transmission specification. Compatibility with multiplex data broadcasting specification, which is already used in Japan is considered for mono-media coding. Compatibility with network usage or data broadcasting method in Europe and America is considered for multimedia coding and the coding scheme is based on XML coding specified in W3C specification adding necessary specifications for broadcasting. Each coding scheme in this standard is applied to whole broadcasting media generally and the conditions proper to broadcasting media derived from transmission methods and service requirements should be specified as operational restrictions.

Though this standard is mainly applied to BS digital broadcasting as the first step, the specification should be completed adding necessary specifications for other broadcasting media, considering trends of international standardization and new technological trends which cannot be assumed yet.

We hope that this standard will be put to practical use actively by radio communication equipment manufacturers, broadcast equipment manufacturers, electric communication companies, service providers, users, and so on.

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Annexed table

Patent applicant	Name of invention	Patent number	Remarks
Matsushita Electric Industrial Co., Ltd.	情報処理装置	特開平 04-205415号	Japan
	データサーバ装置及び端末装置	特開平 06-139173号	Japan
	放送を用いて対話性を実現する送信装置、受信装置、受信方法、その受信プログラムを記録した媒体、通信システム	特開平 10-070712号	Japan
	データ入出力端末装置	特開平 10-074134号	Japan
	情報処理装置	特開平 10-083270号	Japan
	ﾃﾞｰﾀの提示を制御するﾃﾞｰﾀ提示制御装置、ﾃﾞｰﾀの提示を～情報を送信するﾃﾞｰﾀ送信装置及びﾃﾞｰﾀ～ﾃﾞｰﾀ提示制御情報編集装置	特開平 10-164530号	Japan
	ﾃﾞｼﾞﾀﾙ放送ｼｽﾃﾑ、ﾃﾞｼﾞﾀﾙ放送装置及びﾃﾞｼﾞﾀﾙ放送における受信装置	特開平 10-304325号	Japan
	ﾃﾞｼﾞﾀﾙ放送装置、受信装置、ﾃﾞｼﾞﾀﾙ放送ｼｽﾃﾑ、受信装置に適用するﾌﾟﾛｸﾞﾗﾑ記録媒体	特開平 10-313449号	Japan
	番組編集装置および番組受信装置	特願平 10-020585号	Japan
	放送局ｼｽﾃﾑ及び受信機	特願平 10-195093号	Japan
	ﾃﾞｼﾞﾀﾙ放送のための記録再生装置および方法	特願平 11-367308号	Japan
	ﾃﾞｰﾀ送受信ｼｽﾃﾑおよびその方法	特願平 11-103619号	Japan
	ﾃﾞｼﾞﾀﾙﾃﾞｰﾀ送受信ｼｽﾃﾑおよびその方法	特願平 11-124986号	Japan
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver3.8 *5		
TOSHIBA CORPORATION	多重放送ｼｽﾃﾑとこのｼｽﾃﾑで使用される放送送信装置および放送受信装置	特開平 09-162821号	Japan

Patent applicant	Name of invention	Patent number	Remarks
	ﾃﾞｼﾞﾀﾙ放送装置及びﾃﾞｼﾞﾀﾙ放送方法、ﾃﾞｼﾞﾀﾙ放送受信装置及びﾃﾞｼﾞﾀﾙ放送受信方法、ﾃﾞｼﾞﾀﾙ放送受信ｼｽﾃﾑ*16	特許第3621682号	Japan
NHK (Japan Broadcasting Corporation)	文書情報出力装置および方法	特開平 9-244617号	Japan
	入力データの自動選択処理装置	特開平 11-328189号	Japan
	ﾏﾙﾁﾒﾃﾞｨｱ型情報ｻｰﾋﾞｽ方式およびその方式の実施に使用する装置	特開平 11-331104号	Japan
Sony Corporation *1	音声信号圧縮方法及びメモリ書き込み方法	特許第 1952835号	Japan
	オーディオ信号処理方法	特許第 3200886号	Japan
	オーディオ信号処理方法	特許第 3141853号	Japan
	信号符号化又は複合化装置、及び信号符号化又は複合化方法、並びに記録媒体	WO94/28633	Japan
	信号符号化方法及び装置、信号複合化方法及び装置、並びに記録媒体	特開平 7-168593	Japan
	符号化音声信号の複合化方法	特開平 8-63197	Japan
	音声信号の再生方法、再生装置及び伝送方法	特開平 9-6397	Japan
	音声信号の再生方法及び装置、並びに音声複合化方法及び装置、並びに音声合成方法及び装置、並びに携帯無線端末装置	特開平 9-190196	Japan
	音声符号化方法、音声複合化方法及び音声符号化複合化方法	特開平 8-69299	Japan
	音声符号化方法及び装置、音声複合化方法及び装置	特開平 9-127991	Japan
	符号化データ複合化方法及び符号化データ複合化装置	特許 2874745号	Japan
	映像信号符号化方法	特許 2877225号	Japan
	符号化データ編集方法及び符号化データ編集装置	特許 2969782号	Japan
	動画像データエンコード方法及び装置、並びに動画像データデコード方法および装置	特許 2977104号	Japan
	動きベクトル伝送方法及びその装置並びに動きベクトル複合化方法及びその装置	特許 2712645号	Japan
Mitsubishi Electric Corporation	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver3.1 *2		
	マルチメディア多重方式*3	特許第 3027815号	Japan

Patent applicant	Name of invention	Patent number	Remarks
	マルチメディア多重方式*3	特許第 3027816号	Japan
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.4 *15		
Motorola Japan Ltd.	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver3.6 *4		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver3.8 *5		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver3.9 *6		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.0 *7		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.1 *9		
NTT DoCoMo, Inc. *11	動画像符号化方法、動画像複合方法、動画像符号化装置、及び動画像複合装置*11	特許第 3504256号	Japan, EPC, USA, Korea, China, Taiwan
	動画像符号化方法、動画像複合方法、動画像符号化装置、動画像複合装置、動画像符号化プログラム、及び動画像複合プログラム*11	特許第 3513148号	Japan, EPC, USA, Korea, China, Taiwan
	動画像複合方法、動画像複合装置、及び動画像複合プログラム*11	特許第 3534742号	Japan, EPC, USA, Korea, China, Taiwan
	信号符号化方法、信号複合方法、信号符号化装置、信号複合装置、信号符号化プログラム、及び、信号複合プログラム*11	特許第 3491001号	Japan, EPC, USA, Korea, China, Taiwan
	インターリーブを行うための方法および装置並びにデ・インターリーブを行うための方法および装置*13	特許第 3362051号	Japan, USA, Korea, Singapore, Australia, China

Patent applicant	Name of invention	Patent number	Remarks
	誤り保護方法および誤り保護装置*13	特許第 3457335号	Japan, USA, UK Korea, Germany, France Italy, Singapore, Australia, China
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.4 *15		
Sharp Corporation *5	画像符号化装置および画像復号装置	特許第 2951861号	Japan
NEC Corporation *5	画像信号の動き補償フレーム間予測符号化・複合化方法とその装置	特許第 1890887号	Japan
	圧縮記録画像の再生方式	特許第 2119938号	Japan
	圧縮記録画像の対話型再生方式	特許第 2134585号	Japan
	適応変換符号化の方法及び装置	特許第 2778128号	Japan
	符号化方式および復号方式	特許第 2820096号	Japan
	変換符号化複合化方法及び装置	特許第 3070057号	Japan
	改良DCTの順変換計算装置および逆変換計算装置	特許第 3185214号	Japan
	適応変換符号化方式および適応変換複合方式	特許第 3255022号	Japan
Philips Japan, Ltd	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.0 *8		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.1 *10		
	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.2 *12		
Philips Electronics Japan, Ltd.	Submitted comprehensive confirmation of patents applied to the revised parts of ARIB STD-B24 Ver4.3 *14		

Note) *1: valid for the revised parts of ARIB STD-B24 Ver3.0
*2: valid for the revised parts of ARIB STD-B24 Ver3.1
*3: valid for the revised parts of ARIB STD-B24 Ver3.3
*4: valid for the revised parts of ARIB STD-B24 Ver3.6
*5: valid for the revised parts of ARIB STD-B24 Ver3.8
*6: valid for the revised parts of ARIB STD-B24 Ver3.9（accepted on October 9,2003)
*7: valid for the revised parts of ARIB STD-B24 Ver4.0（accepted on January 8,2004)
*8: valid for the revised parts of ARIB STD-B24 Ver4.0（accepted on January 29,2004)
*9: valid for the revised parts of ARIB STD-B24 Ver4.1（accepted on November 17,2004)
*10: valid for the revised parts of ARIB STD-B24 Ver4.1（accepted on December 7,2004)

*11: valid for the revised parts of ARIB STD-B24 Ver3.8（accepted on January 7,2005)
*12: valid for the revised parts of ARIB STD-B24 Ver4.2（accepted on March 14,2005)
*13: valid for the ARIB STD-B24 Ver1.0（accepted on September 26,2005)
*14: valid for the revised parts of ARIB STD-B24 Ver4.3（accepted on September 27,2005)
*15: valid for the revised parts of ARIB STD-B24 Ver4.4（accepted on March 6,2006)
*16: valid for the revised parts of ARIB STD-B24 Ver3.6（accepted on March 14,2006)

Contents

VOLUME 1

Data Coding

Part 1 Reference Model for Data Broadcasting

Contents

Chapter 1 Purpose

This standard specifies a reference model enabling data broadcasting, which is carried out as part of the digital broadcasting that is specified as Japanese standard specification.

Chapter 2 Scope

This standard is applied to reference model of data broadcasting service that is carried out as part of the digital broadcasting.

Chapter 3 Definitions and Abbreviations

3.1 Definitions

α blending:	Mixing composition of pictures by α value.
Carousel transmission specification:	Repeated transmission specification such as data carousel.
Colorimetry:	Specification for colour reproduction
Colour index:	Index value for directing colour information
Colour map data:	Data set in CLUT
CLUT:	Table to convert index value to physical value of the colour information.
CLUT conversion:	Conversion of colour information by CLUT
Data carousel:	Transmission specification to send various data by broadcasting repeatedly. (Specified in part 3)
Data stream:	PES based data transmission format. Used for data associated with video or audio service or data requiring real time transmission
Display coordinate:	Coordinate system when displaying on TV monitor.
Logical coordinate:	Logical coordinate system of model of receiver with decoder of presentation process. It exists for each plane of video plane, still picture plane, character figure plane, subtitle plane, video and still picture-switching plane
Monomedia:	Individual media for presentation source E.g. video, audio, character, and still picture, etc.
Palette:	Table to convert index value to physical value of the colour information (synonymous with CLUT).
PES packet:	Data format used to transmit elementary stream and consists of packet header and PES packet payload following to it.
Plane:	Display screen to display mono-media
Reference model:	Model to refer to as standard related to system, protocol, receiver, and presentation process etc., in data broadcast coding and transmission formats.
Section:	Syntax structure used for mapping data for data carousel or service information to TS packet.
Subtitle:	Of all superimpose onto the TV broadcast video, the service of overlaying words over video which is associated with the video
Superimpose :	Subtitling service not synchronizing with main video, audio or data. E.g. news flash, program remarks, time signal, etc.
TS packet:	Packet of fixed length 188 bytes specified in ISO/IEC 13818-1.

3.2 Abbreviations

CLUT: Colour Look Up Table

PES: Packetized Elementary Stream

TS: Transport Stream

Chapter 4 System

For data broadcasting service offered through digital broadcasting, some interfaces from transmission to reception should be specified. For the viewer to receive transmitted data and provided with service exactly as designed by transmission operator, specification of the receiver is also necessary. In this chapter, the reference model of the whole system related to data broadcasting offered through digital broadcasting is specified. System to implement data broadcasting service in digital broadcasting is shown in Figure 4-1.

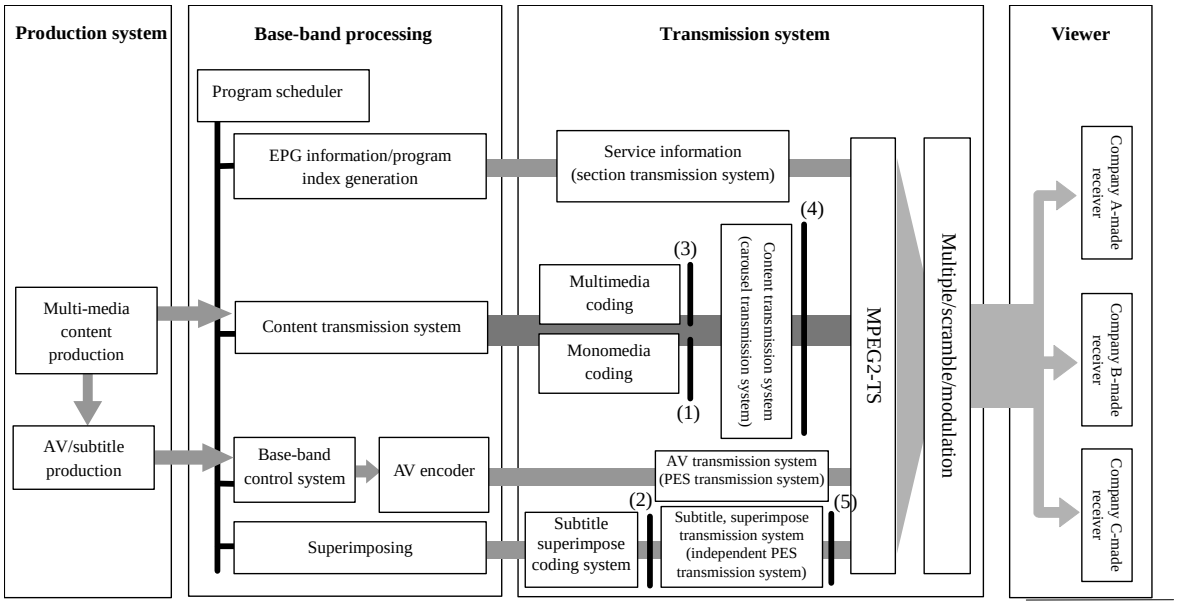

Figure 4-1 System structure

Detailed specification is made as follows for each interface from (1) to (5) in Figure 4-1.

(1) Coding of mono-media

Coding system for character string and bit map etc. used in multimedia is specified in Volume 1 part 2 of this standard.

(2) Coding of subtitle, superimpose

Coding system of subtitle and superimpose is specified in Volume 1 part 3 of this standard.

(3) Multimedia coding

Coding system of XML system adopted as multimedia coding system and its profile is specified in Volume 2 of this standard.

(4) Content transmission format

Content transmission format of data carousel transmission method etc. to transmit content is specified in Volume 3 of this standard.

(5) Subtitle and superimpose transmission format

Independent PES transmission format to transmit subtitle and superimpose is specified in Volume 1 part 3 of this standard.

Chapter 5 Protocol

In this system, video, audio and all data on service are multiplexed on broadcasting radio wave for transmission in packetized transport stream (TS) specified in MPEG-2 Systems (ITU-T H.222.0, ISO/IEC 13818-1). Interactive channel telecommunication is provided through interactive channel network such as fixed network or portable network. Protocol stack is shown in Figure 5-1.

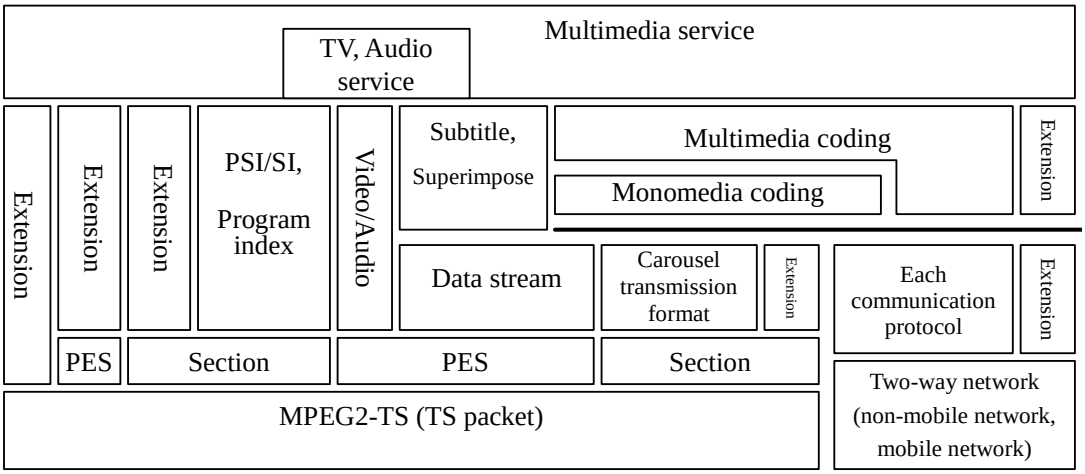

Figure 5-1 Protocol stack

Following three types of data transmission system are shown in Figure 5-1. The item [3] described below will be specified when it becomes necessary as expanded specification.

[1] Data transmission system by storing in PES packet as stream

This system is mainly used for real time type service and used basically for data which needs time control in decoding and reproducing such as video, audio or subtitle, or data which should be synchronous with other stream. This is specified as data stream.

[2] Data transmission system using section

This system is mainly used for storage type service. Data transmitted repeatedly is once downloaded to the receiver. This is specified as data carousel.

[3] Data is directly stored in payload of TS packet

Chapter 6 Receiver

Basic functions of receivers are specified to receive multimedia service by the greater part of the receivers. The receiver, which can receive multimedia service, should have functions to receive/display /store /communicate with the data broadcasting service in addition to basic functions to view normal TV program. With such functions, various multimedia services can be made available.

6.1 Receiving and storing function

It is desired that multimedia type service carried out by the digital broadcasting can employ low priced receivers for storage of broadcasting service. To carry out these services, the specifications for storage devices and storage capacity to receive and store the services are required.

There are two types in storage-based service. One is made available only by storing data transmitted by data broadcasting and another is by storing both data broadcasting and normal video broadcasting. For video storing, secondary storage device is mandatory such as hard disk or tape and for data broadcasting, it may be made available by primary storage device such as flash memory, when some restriction is set to data broadcasting capacity.

During normal viewing, function to receive data in background mode is necessary in some cases and as it is closely related to receiving function, it should be specified.

For receiving and storing functions of the receiver considering above points, refer to "Informative explanation 2: Example of receiver architecture ".

6.2 Presentation function

To reproduce the multimedia service sent from the broadcaster on screen just as the producer intended through the receiver, display and playback function on the receiver should be specified. Therefore, specification related to presentation function is necessary as a basic requirement of the receiver. Presentation function is designed based on the logic structure of display screen composed of video plane, still picture plane, text and graphic plane, subtitle plane, and control plane switching and controlling video and still picture.

Desirable logic structure of display screen for multimedia service by data broadcasting is shown in Figure 6-1.

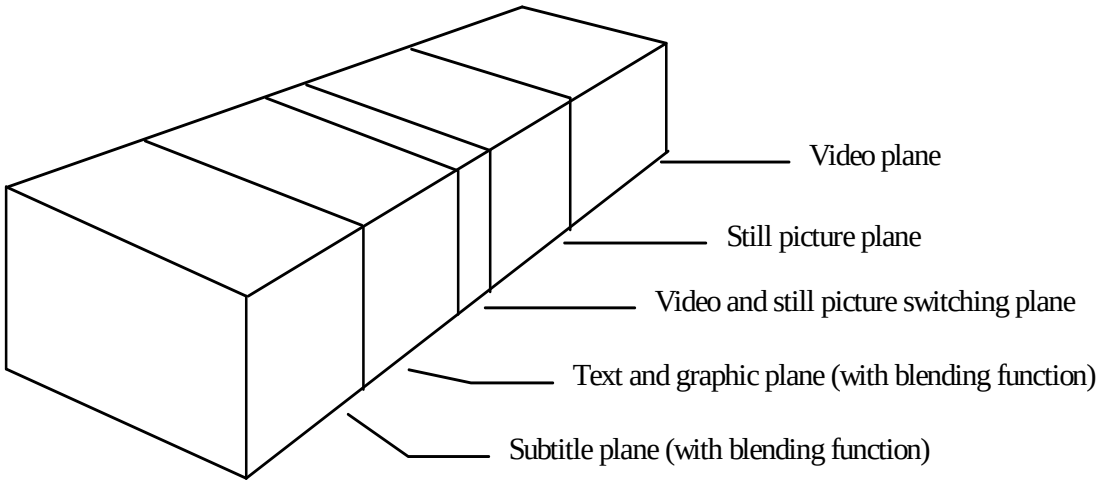

Figure 6-1 Logical structure of screen display

6.3 Decoding process and display

Model structure of decoding function in receiver is indicated in Figure 6-2, showing how data is processed.

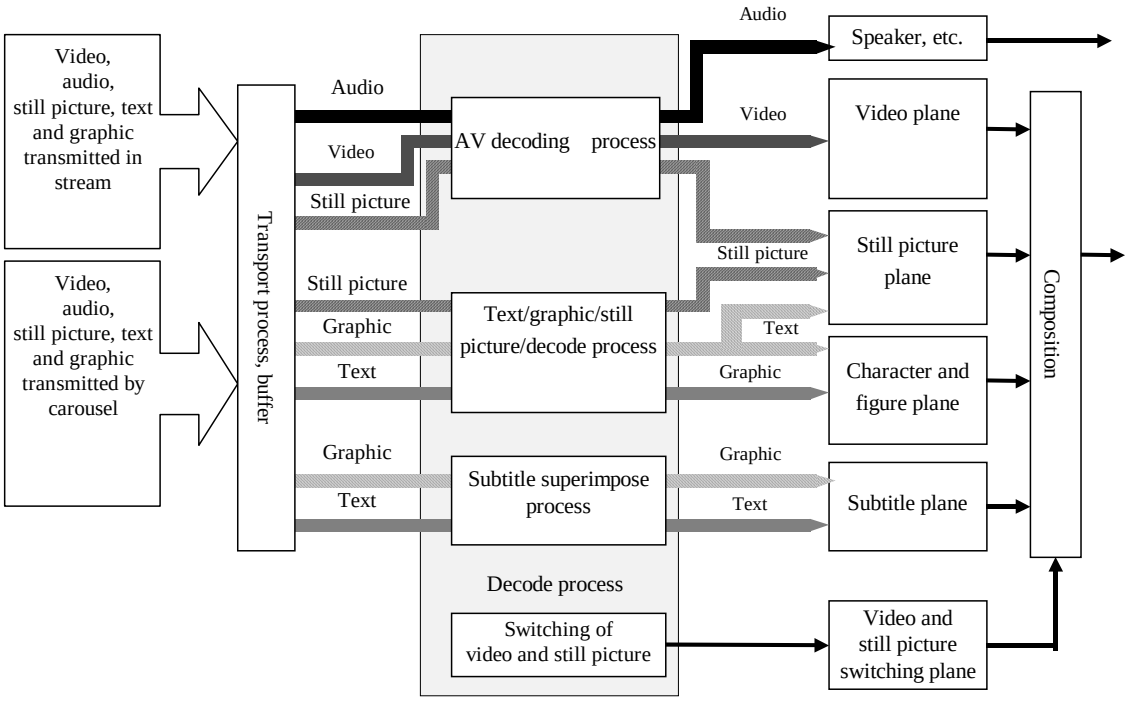

Figure 6-2 Model decoder in receiver showed with data processing flow

As shown in Figure 6-2, process in the receiver can be divided in following three steps.

(1) Transmission data decoding process

Mono-media such as character figure, still picture, video, and audio are transmitted in data stream or data carousel. Those data are decoded and divided to be coded into monomedia data individually.

(2) Mono-media decoding process

Coded monomedia data is decoded by an appropriate decoder. Generally, video or audio are decoded by exclusive hardware decoder, but there may be the case where they are decoded by software decoding function such as still picture, etc.

(3) Presentation process

Text, graphic, still picture, and video are displayed by text graphic plane, still picture plane and video plane respectively and composed by switching control plane. Scaling may be adopted when displayed in each plane.

In multimedia service, these monomedia presentation control is made in the specified frame by the multimedia coding. For superimpose, presentation control is made by subtitle and superimpose coding specification.

Chapter 7 Presentation process

Presentation process model is specified in this chapter.

7.1 Logical coordinate

Five planes of video, still picture, text and graphic, subtitle, and video and still picture switching are specified as logical rectangular coordinates system.

7.1.1 Logical coordinate and display coordinate in square pixel format

Bit number and colour format indicating horizontal and vertical logical coordinate value and pixel of five logic planes in square pixel format is shown in Table 7-1.

Table 7-1 Planes in square pixel format

Plane	Specification scope
Video plane	1920 x 1080 x 16 Y, CB, CR (4:2:2) each 8 bit
Still picture plane	1920 x 1080 x 16 Y, CB, CR (4:2:2) each 8 bit
Video and still picture switching plane	1920 x 1080 x 1 1 bit switching control
Text and graphic plane	1920 x 1080 x 24 Y, CB, CR (4:4:4) each 8 bit α blending in 256 steps
Subtitle plane	1920 x 1080 x 8 8 bit colour map address α blending in 256 steps

As these planes are specified as logical rectangular coordinates, mapping should be made to physical display plane when displayed on the receiver unit. As shown in figure 7-1, logical coordinate is horizontal direction (Xs, Xe) and vertical direction (Ys, Ye) and mapping to display coordinate system is horizontal direction (Xs/N, Xe/N) and vertical direction (Ys/N, Ye/N), where N is 1, 1.5 and 2.

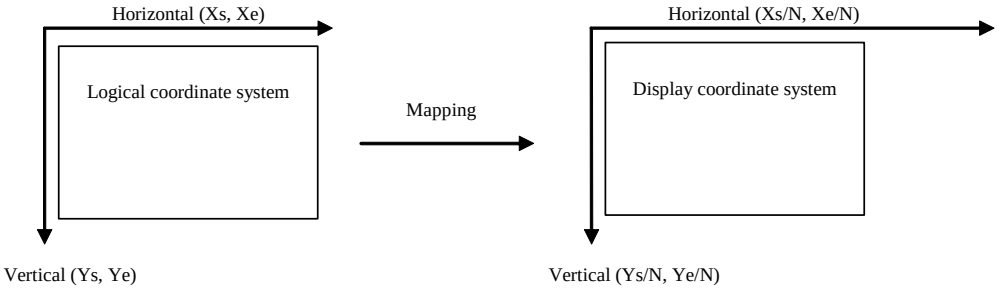

Figure 7-1 Mapping for logical coordination system

In case of square pixel format, value of N should be 1, 1.5, 2. When N is 1, mapping is made in 1: 1 and mapping is made on the display coordinate of 1920 x 1080. When N is 1.5, mapping is made on the display coordinate of 1280 x 720. When N is 2, mapping is made on the display coordinate of 960 x 540.

7.1.1.1 Logical coordinate of video plane and still picture plane

Logical coordinate of video plane in case of square pixel is shown in Figure 7-2. It is defined as logical rectangular coordinates of horizontal direction (0, 1919) and vertical direction (0, 1979). Colorimetry is displayed by the 4:2:2 format of Y, CB, CR specified in Rec. ITU-R BT709 (BT 1361). Therefore, coordinate specification is made in 2*n unit. (However, n should be integer of 0 or more)

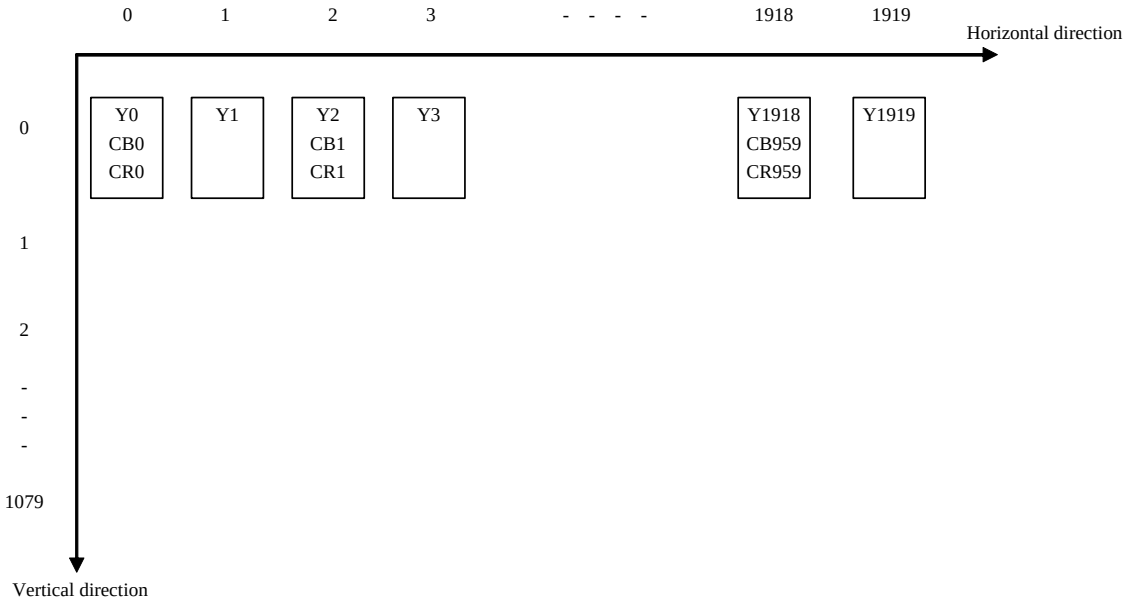

Figure 7-2 Logical coordinate system of video plane and still picture plane

Coordination system of still picture plane should be the same as video plane.

7.1.1.2 Text and graphic plane

Logical coordinate of text and graphic plane is shown in Figure 7-3. It is specified as Y, CB, CR 4:4:4 format. Also α value which sets mixing ration of each pixel is added.

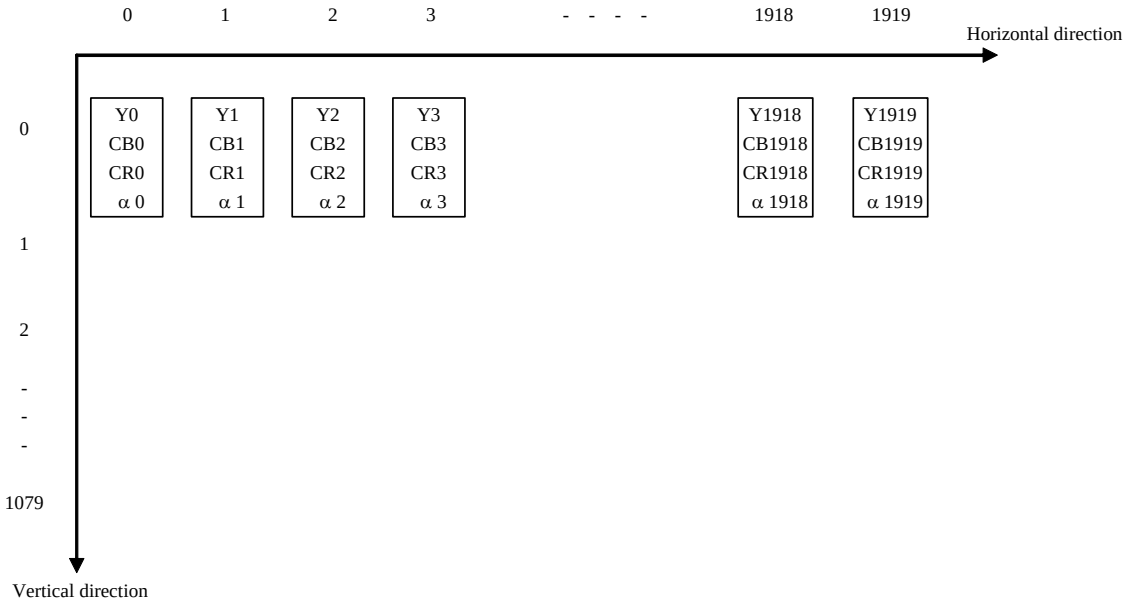

Figure 7-3 Logical coordinate system of text and graphic plane

7.1.1.3 Subtitle plane

Subtitle plane is specified by colour map address of each 8-bit pixel. It is transformed to Y, CB, CR 4:4:4 format by CLUT (colour lookup table). Transformation by CLUT and coordinating system is shown in Figure 7-4. α value which set mixing ratio is output at the same time. α value is specified by 8 bit which can be mapped. There is no regulation of display start position.

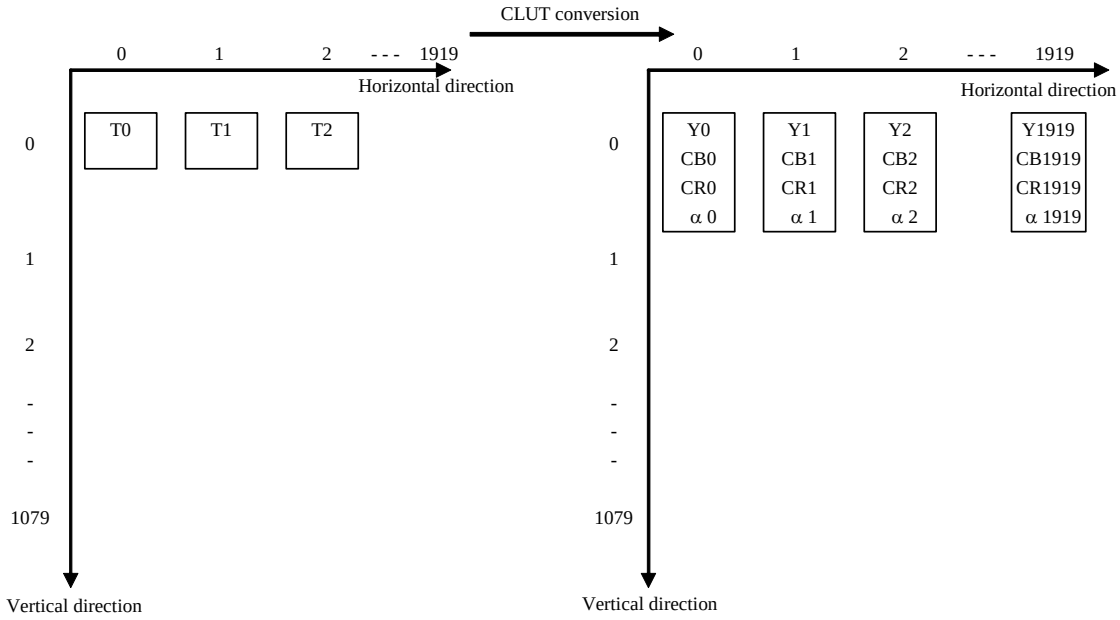

Figure 7-4 Logical coordinate system of subtitle plane

7.1.1.4 Video and still picture switching plane

As both video plane and still picture plane is Y, CB, CR 4:2:2 format, coordinate system is the same, but as switching control is in 2-pixel unit, information is decreased to half in horizontal direction, as shown in Figure 7-5.

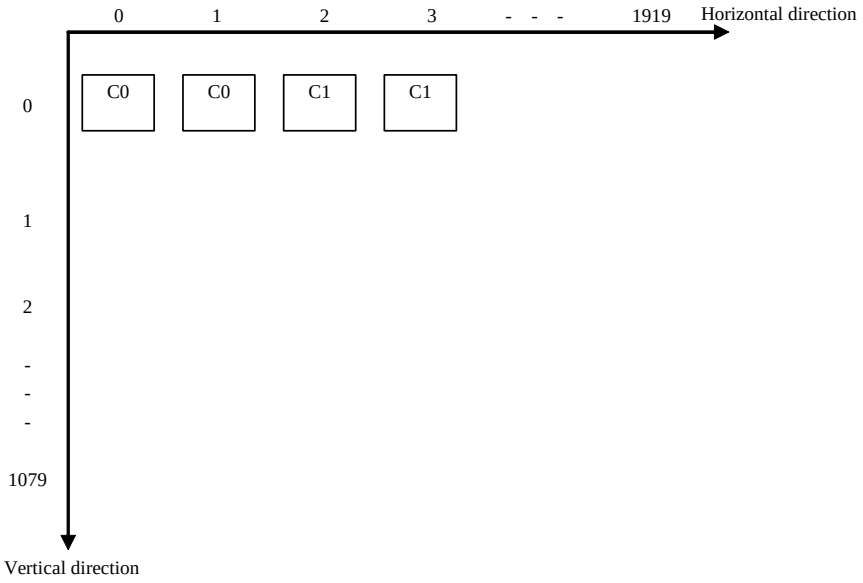

Figure 7-5 Logical coordinate of video, still picture switching plane

Composing control between video plane and still picture plane is shown in Figure 7-6. Pixel of video plane and still picture plane is switched in 1-bit value of video and still picture switching plane.

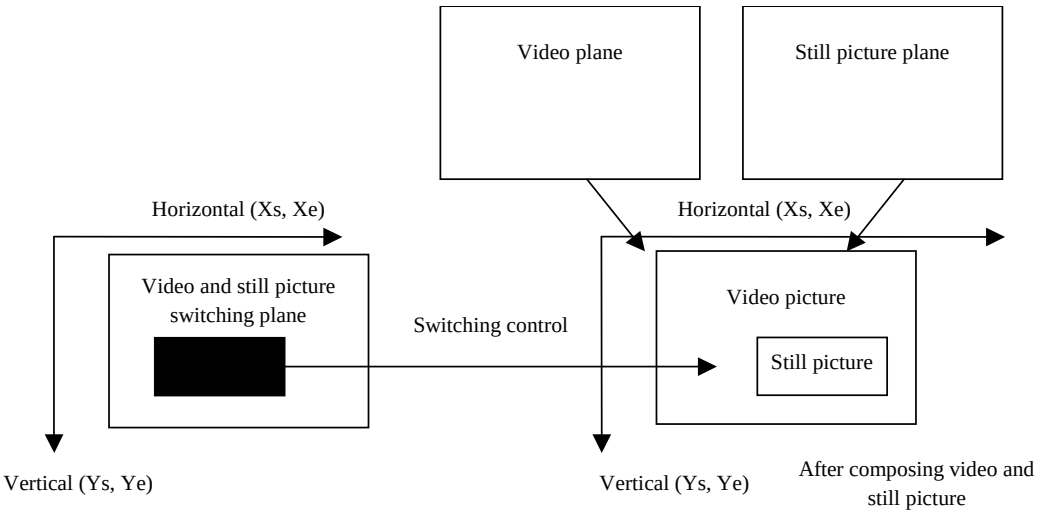

Figure 7-6 Switching control of video and still picture plane

Figures can be written on still picture plane. However, as still picture plane does not have blending function, video and still picture switching plane bit corresponding to the pixel set which α value is not 0, should be set when writing a figure which α value is designated, to the still picture plane. Writing can be made when pixel of video and still picture switching control plane is CP, by the following formula.

CP= { 1: when α value is not 0
0: when α value is 0

7.1.2 Logical coordinate and display coordinate in non-square pixel format

Five planes of video, still picture, text and graphic, sub-title and video and still picture switching are specified as logical rectangular coordinates system.

Horizontal and vertical logic coordinate value, bit number indicating pixel and colour format of five logical planes in non-square pixel is indicated in Table 7-2.

Table 7-2 Planes in non-square pixel format

Plane	Specification scope
Video plane	720 x 480 x 16 Y, CB, CR (4:2:2) each 8-bit
Still picture plane	720 x 480 x 16 Y, CB, CR (4:2:2) each 8-bit
Video and still picture switching plane	720 x 480 x 1 1-bit switching control
Text and graphic plane	720 x 480 x 24 Y, CB, CR (4:4:4) each 8-bit α blending in 256 steps
Subtitle plane	720 x 480 x 8 8-bit colour map address α blending in 256 steps

As these planes are specified as logical rectangular coordinates, it should be mapped to physical display plane when displayed on the receiver unit. Mapping process is shown in figure 7-7.

When logical coordinate system is horizontal direction (Xs, Xe) and vertical direction (Ys, Ye), mapping to display coordinate system is horizontal direction (Xs/N, Xe/N) and vertical direction (Ys/M, Ye/M), where values of N and M should be as follows.

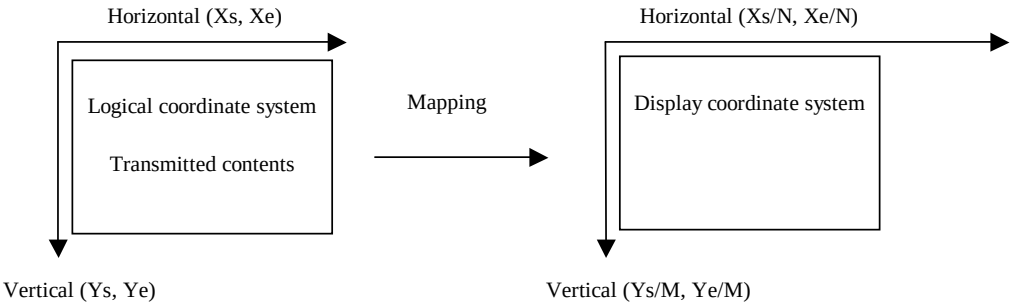

Figure 7-7 Mapping of logical coordinate system

In case of displaying picture of 720 x 480 on 16:9 screen, N= 16 x 480/9 x 720, M= 1 and in this case, pixel of width become 1.18518 times of height. In case of displaying on 4:3 screen, N= 4 x 480/3 x 720, M = 1 and in this case, pixel of width become 0.888889 times the height.

7.2 Colorimetry

Y, CB, CR should be 8-bit each. Y is allocated with 220 level, and black level is 16, and white peak level is 235. For CB, CR, 225 level is allocated, and signal should be in the range of 16 to 240 and 0-signal level should be 128. Specification for colorimetry should be in accordance with Rec. ITU-R BT 709 (BT. 1361) "Worldwide Unified colorimetry and Related Characteristics of Future Television and Imaging Systems".

Transform from 8-bit signals of R, G, B in the same range with Y to Y, CB, CR should be made according to the following formula.

$$\begin{pmatrix} Y \\ CB \\ CR \end{pmatrix} = \mathrm{Round}\left\{ \begin{pmatrix} 0.2126 & 0.7152 & 0.0722 \\ -(0.2126/1.8556)*(224/219) & -(0.7152/1.8556)*(224/219) & 0.5*(224/219) \\ 0.5*(224/219) & -(0.7152/1.5748)*(224/219) & -(0.0722/1.5748)*(224/219) \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} \right\} + \begin{pmatrix} 0 \\ 128 \\ 128 \end{pmatrix}$$

Transform from R, G, B signal with level scope of 0 to 255 of black level 0 and peak level 255 to Y, CB, CR should be made by the following formula.

$$\begin{pmatrix} Y \\ CB \\ CR \end{pmatrix} = \mathrm{Round}\left\{ \begin{pmatrix} 0.2126*(219/255) & 0.7152*(219/255) & 0.0722*(219/255) \\ -(0.2126/1.8556)*(224/255) & -(0.7152/1.8556)*(224/255) & 0.5*(224/255) \\ 0.5*(224/255) & -(0.7152/1.5748)*(224/255) & -(0.0722/1.5748)*(224/255) \end{pmatrix} \begin{pmatrix} R \\ G \\ B \end{pmatrix} \right\} + \begin{pmatrix} 16 \\ 128 \\ 128 \end{pmatrix}$$

Transform of (Y, CB, CR) and (R, G, B) in this case is restricted so that value which cannot be figured within the above range is not designated.

7.3 Composition between planes

Function of composition control between planes is indicated in Table 7-3.

Table 7-3 Composition control function between planes

Planes	Specification range
Between video and still picture plane and other plane	Switching in 2-pixel unit
Between text and graphic plane and other plane	α blending in pixel unit 1/256 steps
Between subtitle plane and other plane	α blending in pixel unit 1/256 steps

Composition control between planes is shown in Figure 7-8. Pixel of still picture plane (SP) and pixel of video plane (VP) is switched by 1-bit value of video and still picture switching plane (CP). Therefore, pixel of composition plane (SVP) of video plane and still picture plane should be in accordance with following formula.

$$SVP = \begin{cases} SP: \text{when } CP = 1 \\ VP: \text{when } CP = 0 \end{cases}$$

Pixel of composed plane of video and still picture is composed again by α value output by text and graphic plane pixel TP and CLUT. When the α value is $\alpha 1$, pixel of composed plane (TSVP) is calculated by the following formula.

$$TSVP = (1 - \alpha 1) * SVP + \alpha 1 * TP$$

Pixel of subtitle plane (GP) is composed further by α value output by subtitle plane CLUT. When the α value is $\alpha 2$, composed plane pixel GTSVP is calculated by the following formula.

$$GTSVP = (1 - \alpha 2) * TSVP + \alpha 2 * GP$$

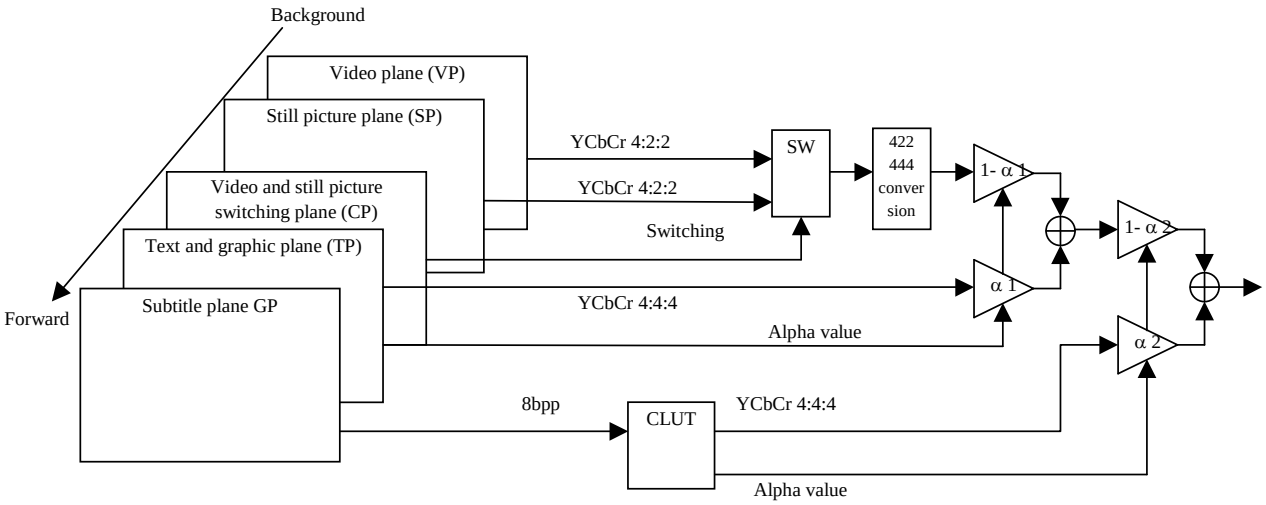

Figure 7-8 Composition control between planes

Here, α value indicates opaque degree and when α value is 255, it is 100% and when 0, 0%. When the value is 100%, foreground screen is completely displayed and when 0%, background is completely displayed.

Colour map data stored in CLUT used in subtitle plane can be downloaded and specified as part of character coding and multimedia coding. Function of CLUT is indicated in Table 7-4.

Table 7-4 Specification scope of I/O

	Specification scope
Input/output	Input address 8-bit, output data 8 x 4 bit, Y, CB, CR, α output

Pallet output of subtitle plane is shown in Figure 7-9.

Mapping of α value can be made in receiver unit side. When α value when deciding mixing ratio using transmitted 8-bit α value is α max and when α value after mapping is α map, mapping is made in the receiver unit side by the following formula.

α map = α max/2**N, where N is integer of positive number.

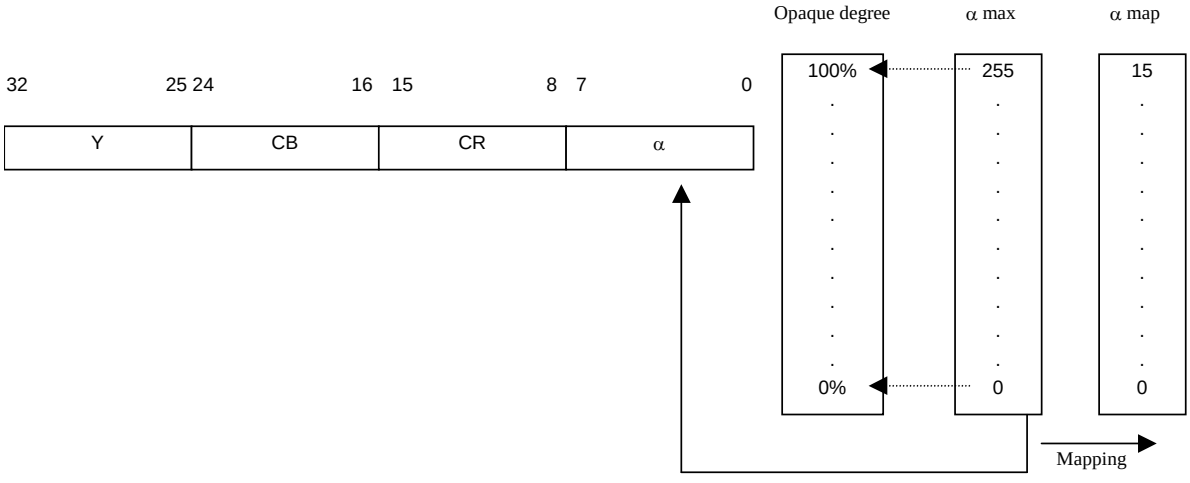

Figure 7-9 Pallet output

Informative explanation

1 Requirements of data broadcasting and outline of the services

In the digital broadcasting, technical conditions of television service including high definition television and audio broadcasting service were reported from the Telecommunications Technology Council of Ministry of Posts and Telecommunications (MPT) in Japan in February 1998. Standardized specification is provided based on this report, and the study of the ARIB specification considering operation verification is now progressing. On the other hand, data broadcasting which enables various services combining data such as text, graphics, video, still pictures, audio and control information shall be considered to have various needs and development according to further engineering progress, so that flexibility and extendibility for coding system should be fully considered. In the case adopting different coding system in each service and contents provider, it shall not preferable for viewer's usage or price on the receiver by means of lacking of inter-operability.

The advanced data broadcasting system working-group (hereafter referred to as advanced data WG) has started studying data broadcasting specification for the purpose of standardizing since July 1997. Regarding to the data services, it shall be assumed multimedia services, which integrate subtitles and superimposes layered television screen and video, audio and data. Multimedia services mean the service by use of media, which enables to view integrated multiple presentation media interactively utilizing digitizing features. Requirement conditions for advanced data broadcasting service, multimedia services including subtitle and superimpose, and outlines of necessary display functions are discussed in this chapter.

1.1 Requirements of data broadcasting for digital broadcasting

Requirements of advanced data broadcasting are as follows.

(1) Overall system

Service	Service contents	- Enable to display of subtitles or superimpose overlapped on HDTV and SDTV. - Enable to view HDTV, SDTV and audio services or independent multimedia information. Multimedia information means the information which enables to view integrated multiple media such as text, still pictures, video and audio, etc. interactively. - Consider possibilities of service not only other broadcast service but also combination with various services such as communication field and package services, etc. - Consider interactive services utilizing communication system such as public telephone networks, etc. - Consider service corresponding to various viewers such as aged persons or handicapped persons.
	Accessibility	- Enable to add EPG, index and automatic recording function etc. for easier program selection. - Enable to do access controls variously by viewer's operations. - Consider the time range for smooth program switching not to be a hindrance to viewer's actual operations.
	Extensibility	- Consider extensibilities of service styles, coding specification, conditional access system and receivers. - Consider possibilities to correspond the new service in the future.

Inter-operability	- Enable receiving by the ordinary receiver, similar to existing HDTV or SDTV broadcasting. - Broadcasting media such as broadcasting station satellite broadcasting, terrestrial broadcasting, and CATV should be able to use commonly as far as possible. - Consider coordination of communication system and package media as far as possible. - Use of common receiver for various broadcasting media, communication system and package media should be considered as far as possible.
Control ability of system	- Consider flexible system control by using transmission capacity effectively, by transmission control of HDTV, SDTV and audio in the digital broadcasting. - Consider control function for appropriate copyright protection. - Consider automatic reception control functions such as emergency broadcast.
Display timing	- In service related to HDTV, SDTV and audio services, timing error of displaying subtitle, superimpose and multimedia information should be operated within the range so that viewers would not feel that something is wrong.

(2) Broadcasting quality

Display quality	- Display quality of data services should be able to produce programs with good balance with display quality of picture and sound of HDTV, SDTV and audio services.
Characteristics at transmission difficulties	- Consider quality balance of picture, sound and data in transmission trouble by rain attenuation, etc. - In case of temporary disconnection due to transmission trouble, consider possibilities of countermeasures not to display of error information as far as possible. - In case of transmission trouble, consider duration from temporary disconnection of reception to returning to normal reception as short as possible.

(3) Technical specification

General technical specification	Data coding	- Consider coordination with existing data coding - Consider future extensions. - Consider possibilities of software downloading and data interface for securing extendibility.
	Data multiplexing specification	- Enable multiplexing for various and flexible service. - Consider multiplexing service by multiple service providers. - Consider realizing good transmission characteristics and efficient multiplexing.
	Data conditional access system	- Enable conditional access system for flexible operation on service contents and service style. - Enable suitable secret security and safety on service contents and service style - Consider securing independent operations by multiple service providers.
Subtitle, superimpose coding		- Enable realizing program production, which comes up to intention of program producer. - Standardized multimedia type service of digital broadcasting should be maintained as far as possible to coordinate with existing

	broadcast service. - International standardization should be considered by referring international standards.
Multimedia service coding	- Enable realizing program production, which comes up to intention of program producer. - On the condition of displaying the multimedia information such as HDTV, SDTV, audio services, or independent multimedia information, it should enable to realize multimedia-displaying function such as displaying or linking presentation object for the specific duration on the specified position. - Consider the development to various services such as storage-based and interactive type service. - Consider the standardization among digital broadcastings and other media such as communications and packages. - International standardization should be considered by referring international standards.

(4) Receiver

Operability	- Operation method of basic function is unified and easy operation can be made. - Setting of advanced operation should be enabled according to the requests of users or service providers. - Selection of service should be considered so that it can be made by unified operation. - Operation setting appropriate for aged persons or handicapped persons should be also considered.
Inter-operability	- Enables to realize adapters to receive this new service by connecting to existing broadcasting receiver. - Consider the inter-operability between broadcasting media such as satellite broadcasting, terrestrial broadcasting and CATV. - Coordination with communication system and package media should be considered as far as possible.
Realization	- Inexpensive receiver as consumer products having function and characteristics appropriate for service contents should be realized. - Realization of various terminals (mono-function, advanced function etc.) should be considered.
Extendibility	- Consider the extension corresponding to new service in the future. - Consider the possibility to connect to multiple devices.

1.2 Data service for digital broadcasting

Regarding to the data service for digital broadcasting, existing broadcasting service and data service which is studied to make are investigated, and outline of advanced data broadcasting services are settled as shown in Table 1, in addition to technical elements.

Table 1 Outline of advanced data broadcasting service

Classification		Example of service	Example of contents	Function	Necessary mono-media				Meta-data	Necessity of up-line	Display timing			Study of coding
					Text and graphics	Still picture	Video	Audio			Asynchronous	Program synchronous	Time synchronous	
Broadcasting service	Relation	EPG	Program table Program guide	Program selection, program scheduling, category search	O	O	O	O	O		O	O	O	O
		Index	Program title Category of each item	Program selection Item selection	O				O		O	O		O
		Subtitle	For hearing handicapped person For foreigner	Outline subtitle Multi-lingual display	O							O	O	O
		Commentary audio	For visually handicapped person	Commentary audio				O				O	O	O
		Program supplemental information	Cast, outline, program, product information, jacket, and news from the station, etc.	Additional information of the program, detail information of the program	O	O	O	O	O		O	O	O	O
		Multi-view television	Multi-view TV	Display and control of program using plural camera angle			O	O	O			O		O
		Participation program	Shopping, questionnaires, etc.	Access from the viewers to the program	O	O	O	O	O	O	O	O	O	O
	Independent	Independent information	News, weather forecast, traffic information, market information, disaster, election, etc.	Information service selectable anytime to view	O	O	O	O	O		O		O	O
		Inquiry	Inquiries	Corresponding to access from the viewers	O				O	O	O			O
		Software distribution	PC software, data, game software, program downloading	Application software distribution					O	O	O			O
Function service	Automatic reception		Emergency information	Automatic power on, automatic reception										
	Mail function		Individual mail, sending information for the whole user	Individual information	O				O					
	Download		IRD (Integrated Receiver Decoder) bug fix Version up	Decoding software downloading					O					O
	Data distribution		Various data	Data downloading										

When the above services are received, data is stored in the receiver memory and displayed interactively according to the viewer's operation. It shall be realized the function such as automatic revision recording, scheduled recording, digest playback, chasing playback and zapping playback, etc. of television program by use of storing function of video and audio. Furthermore, it should be enables to record programs on different channels, to acquire data in advance by use of multiple tuner units.

2. Example of receiver construction

Reference model of the receiver is constructed of receiving function, storing function, telecommunication function and presentation function. For the specification of receiver to receive multimedia services, it should be specified the following functions through the operation at least.

(1) Receiving and storing function

Table 2 Receiving and storing function

Function	Class A	Class B
Receiving function	Simultaneous TS decode number: 1	Simultaneous TS decode number: 2 or more Decoded number is specified in the operational standard.
Storing function	Primary memory (semiconductor memory) Minimum capacity is specified in the operational standard.	Primary memory + Secondary memory Minimum capacity is specified in the operational standard.

(2) Telecommunication function

As only outline is denoted here, specification should be made otherwise.

(3) Presentation function

Table 3 Presentation function

Function	Level A	Level B
Presentation function	Indicated as assumed function example	Indicated as specification range

Examples of the receiver constructed by the above combination are shown here.

Figure 1 shows an example of the receiver constructed in the condition of presentation function level A, and receiving/storing function class A. Example of this receiver is rather inexpensive, and it should be set up restriction to view the storage-based broadcasting. That is, storing operations for different TS is only possible when the user is not viewing the program. Due to this restriction, the receiver may have only one tuner and TS decoder. For the receiver with class A, data storage can be made to RAM etc, for small capacity data broadcasting.

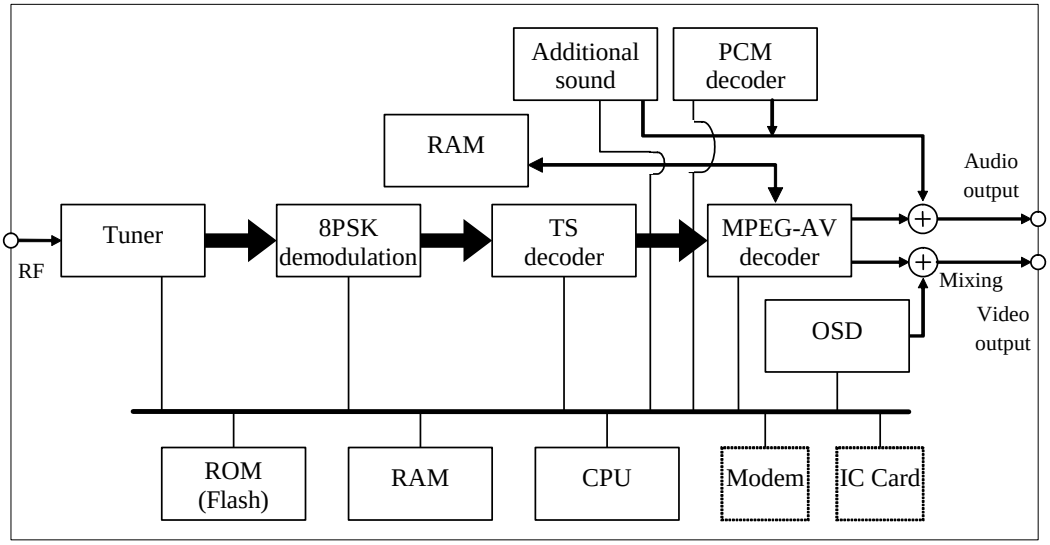

Figure 1 Construction example of the receiver with class A and presentation function level A

Figure 2 shows an example of the receiver constructed in the condition of presentation function level A, and receiving/storing function class B. For operating multimedia service by storing large amount of capacity, it should be necessary to equip two systems of tuner and TS decoder so that another reception for storage may be made during programs viewing.

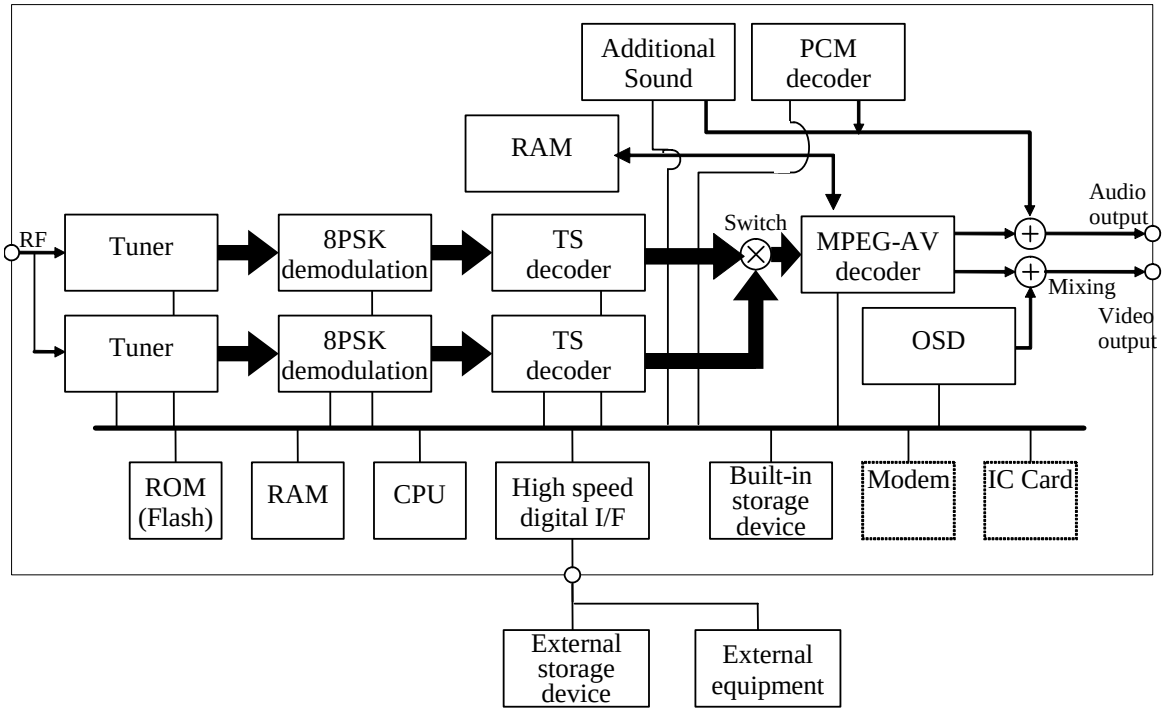

Figure 2 Construction example of the receiver with class B and presentation function level A

References

(1) ISO/IEC 13818-1 (2000) "Information Technology - Generic Coding of Moving Pictures and Associated Audio: SYSTEMS Recommendation H.220.0"

(2) ITU-R BT709 (BT.1361) "Worldwide Unified Colorimetry and Related Characteristics of Future Television and Imaging Systems"

(3) Telecommunication Technology Council of Ministry of Posts and Telecommunications (MPT) in Japan "Technical Requirements for Satellite Digital Broadcasting Using Radio Wave Over 11.7GHz and Below 12.2GHz" of Submission No. 74 (Feb.1998)"Technical Requirements for Digital Broadcasting Systems"

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Part 2 Monomedia Coding

Contents

Chapter 1 Purpose

This standard is specifies mono-media coding related to data broadcasting, which is carried out as part of digital broadcasting that is specified as Japanese standard.

Chapter 2 Scope

This standard is applied to mono-media coding of data broadcasting carried out as part of digital broadcasting.

Chapter 3 Definitions and Abbreviations

3.1 Definitions

Following definitions apply in this standard.

Component:	Element constructing the program such as video, audio, and each data. In digital broadcasting multiplex system, it is a unit for multiplex and transmission with one PID given.
Chunk:	Name of structure of a section of PNG coded or MNG coded data.
Geometric:	Function to express figure by combining graphic description command directing dots, lines and arcs.
I frame:	Video frame constructed of coding data completed within the frame. (Intra Frame)
Monomedia:	Independent expression media such as video, still picture, graphic, sound and text. Monomedia is presentation media that can be presented only by own data without referring to other media.
Synthesized sound:	Presentation media for music playback using electronic sound etc.

3.2 Abbreviations

Following abbreviations are used in this standard.

AAC	Advanced Audio Coding
AIFF	Audio Interchange File Format
BC	Backward Compatible
DAVIC	Digital Audio Visual Council
DRCS	Dynamically Re-definable Character Set
DTS	Decoding Time Stamp
ISO	International Organization for Standardization
IEC	International Electrotechnical Commission
ITU	International Telecommunication Union
JIS	Japanese Industrial Standard
JPEG	Joint Photographic Coding Experts Group
LC	Low Complexity
MNG	Multiple-image Network Graphics
PCM	Pulse Code Modulation
PES	Packetized Elementary Stream
PNG	Portable Network Graphics
PTS	Presentation Time Stamp
W3C	World Wide Web Consortium
UCS	Universal multi-octet coded Character Set

Chapter 4 Video coding

4.1 MPEG-1 Video

ISO/IEC 11172-2 shall be used for MPEG-1 Video coding with constraints specified in Table 4-1.

Table 4-1 Constraints of MPEG-1 coding parameter

Constraints of Sequence Header				Other parameter
vertical_size	horizontal_size	pel_aspect_ratio	picture_rate	
240	352	6,12	4	Constrained parameters
120	176			

Meaning of each code number of MPEG-1 coding parameters in Table 4-1	
pel_aspect_ratio	6= 16:9 display (525 lines), 12 = 4:3 display (525 lines)
picture_rate	4 = 30/1.001 Hz,

4.2 MPEG-2 Video

ISO/IEC 13818-2 (ITU-T H.262)shall be used for MPEG-2 Video with constraints specified in Table 4-2.

Table 4-2 Constraints of MPEG-2 Video coding parameter

Constraints of sequence header				Constraints of sequence extension	Constraints of sequence display extension (Note 6)			Other parameter (Note 7)
vertical_ size_value	horizontal_ size_ value	aspect_ ratio_ information	frame_ rate_ code	progressive_ sequence	color_ primaries	transfer_ characteristics	matrix_ coefficients	
1080 (Note 1)	1440, 1920	3	4 (Note 5)	0	1	1	1	Value specified for MP@HL
720	1280	3	7 (Note 5)	1				Value specified for MP@H14L
480	720	3	7 (Note 5)	1				
480	352, 480, 544(Note 3), 720	2, 3	4 (Note 4, 5)	0				Value specified for MP@ML
240	352			1				Value specified for MP@LL
120 (Note 2)	176							
480 or less	720 or less	1		0, 1				Value specified for MP@ML

Note 1: In MPEG-2 coding (ITU-T H.262), 1088 lines are coded actually. Eight lines of fictional video data (dummy data) are added under the valid lines using at the encoder, and coding process is made as video data of 1088 lines actually. Video signals with 1080 lines of valid line excluding dummy data, which are 1080 lines from the top of the 1088 lines of video data, shall be output from the decoder.

Note 2: In MPEG-2 coding, 128 lines are coded actually.

Note 3: In case of 544 samples, center position should be adjusted with that in case of 720 samples. Additional 2 samples of fictional video data (i.e. black color) on the both sides of the actual video data of 540 samples shall be added, resulting 544 samples.

Note 4: In the case of very low bit-rate coding, encoding method lowering coding frame rate using skipped macroblock etc., would be also practical.

Note 5: In case of encoding of film material, controlling flags of repeat_first_field, top_field_first, and progressive_frame, without changing frame_rate_code can be used. (See Part 1, Chapter 5 of Annex of ARIB STD-B32.)

Note 6: When sequence_display_extension is not transmitted, each value of color_primaries, transfer_characteristics and matrix_coefficients are processed in the receiver unit side as is equal to "1".

Note 7: Value specified in ITU-T H.262 (ISO/IEC 13818-2) is adapted to each level of main profile. Value of bit_rate_value should be the maximum transmittable capacity for MP@ HL and MP@ H14 and for MP@ ML, 15Mbps or less. It is operated by variable bit rate and vbv_delay shall be always 0xFFFF.

Meaning of each code number of MPEG-2 coding parameter in Table 4-2	
aspect_ratio_information	1= square pixel, 2 = 4:3, 3 = 16:9
frame_rate_code	4 = 30/1.001 Hz, 7 = 60/1.001 Hz
progressive_sequence	0 = Interlaced scan, 1 = Progressive scan
color_primaries	1 = Specification value of Rec. ITU-R BT:709 (BT:1361)
transfer_characteristics	1 = Specification value of Rec. ITU-R BT:709 (BT:1361)
matrix_coefficients	1 = Specification value of Rec. ITU-R BT:709 (BT:1361)

4.3 MPEG-4 Video

ISO/IEC 14496-2 shall be used for MPEG-4 Video.

The encoding condition shall bein accordance with simple and core profile.

Table4-3 shows constraints of coding parameters. The other parameters which are not shown in table 4-3, such as the number of objects and buffer size, shall be compliant with the specification of ISO/IEC 1496-2:1999/Amd.1:2000.

Table 4-3 Constraints of MPEG-4 coding parameter

parameter	Constraints
Picture format	YC_BC_R 4:2:0
Input pixel depth	8 bit
Scanning method	Progressive scan
Maximum size of picture	Specified in Table 4-4
Maximum frame rate	30000/1001 Hz
Time interval of VOP (Video Object Plane)	Within 0.7seconds
Colour description	Rec. ITU-R BT.1361 (Rec. ITU-R BT.709)

Table 4-4 Maximum picture size and bit rate

Profile	Level	Maximum picture size Horizontal pixels x vertical lines	Maximum bit rate (specified by ISO/IEC 14496-2)
Simple	Level 1	176 x 144	64kbps
	Level 2	352 x 288	128kbps
	Level 3	352 x 288	384kbps
Core	Level 1	176 x 144	384kbps
	Level 2	352 x 288	2Mbps

4.4 H.264|MPEG-4 AVC

ITU-T Rec. H.264|ISO/IEC 14496-10 shall be used for H.264|MPEG-4 AVC.

The encoding condition shall be in accordance with the Baseline or Main profile. The level must be one of the following options: 1, 1.1, 1.2, 1.3, 2 and 2.1.

Table 4-5 shows constraints of coding parameters. For a buffer size parameter and any other parameter which is not in the table, ITU-T Rec. H.264|ISO/IEC 14496-10 should be applied to it.

Table 4-5 Constraints of H.264|MPEG-4 AVC coding parameter

Parameter	Constraints
Picture format	YC_BC_R 4:2:0
Input pixel depth	8 bit
Scanning method	progressive or interlaced (in case of level 2.1 only)
Maximum size of picture	Specified in Table 4-6
Maximum frame rate	Specified in Table 4-6
Time interval of pictures	Within 0.7 seconds
Colour description	Rec. ITU-R BT.1361 (Rec. ITU-R BT.709)

Table 4-6 Maximum picture size and bit rate

Profile	Level	Maximum picture size [in macro blocks] (typical horizontal pixels x vertical lines)	Maximum bit rate (specified by ITU-T Rec. H.264 | ISO/IEC 14496-10)
Baseline or Main	Level 1	99 (176 x 144)	64 kbps
	Level 1.1	396 (352 x 288)	192 kbps
	Level 1.2	396 (352 x 288)	384 kbps
	Level 1.3	396 (352 x 288)	768 kbps
	Level 2	396 (352 x 288)	2 Mbps
	Level 2.1	792 (352 x 576)	4 Mbps

Chapter 5 Still picture and Graphics coding

5.1 MPEG-I picture

5.1.1 MPEG-2 I frame

ISO/IEC 13818-2 shall be used for MPEG-2 I frame with constraints specified in Table 5-1.

One frame of I picture between sequence_header_code and sequence_end_code shall be coded as onestill picture.

Table 5-1 Constraints of MPEG-2 still picture coding parameter

Constraints of sequence header				Constraints of sequence extension		Constraints of sequence display extension (Note 5)			Other parameter (Note 6)
vertical_ size_value	horizontal_ size_value	aspect_ ratio_ information	frame_ rate_code (Note 2)	progressive_ sequence	low_ delay	color_ primaries	transfer_ characteristics	matrix_ coefficients	
1080 (Note 1)	1440, 1920	3	4	0 (Note 3)	1 (Note 4)	1	1	1	Value specified for MP@HL
720	1280	3	7	1					Value specified for MP@H14L
480	720	3	7	1					Value specified for MP@H14L
		2, 3	4	0 (Note 3)					Value specified for MP@ML
240	352	2, 3	4	1					Value specified for MP@LL
1080 or less	1920 or less	1	4	1					Value specified for MP@HL

Note 1: In MPEG-2 coding (ITU-T H.262), 1088 lines are coded actually. Eight lines of fictional video data (dummy data) are added under the valid lines using at the encoder and coding process is made as video data of 1088 lines actually. Video signals with 1080 lines of valid line excluding dummy data, which are 1080 lines from the top of the 1088 lines of video data, shall be output from the decoder.

Note 2: Timing of decoding and display is controlled by the time stamp value in PES header and value of vbv_delay shall be 0xFFFF.

Note 3: When sequence_end_code is available at the decoder, the receiver should hold the last presented image.In that case, if progressive_frame = 0 (with timing difference due to interlaced scanningof 2 fields in the frame) , the field image should be presented, otherwise progressive_frame = 1 (2 fields in the frame is the same timing), the frame image shpuld be presented.

Note 4: When low_delay = 1, time stamps of decoding and presentation are the same value (DTS = PTS). For I (intra) frame of the still picture, only PTS should be sent out.

Note 5: When sequence_display_extension is not transmitted, each value of color_primaries, transfer_characteristics, matrix_coefficients are processed as is the same with "1".

Note 6: Values of vbv_buffer_size_value, etc., adopt values specified for each level of main profile of ISO/IEC 13818-2. Value of bit_rate_value should be the maximum value of each level; i.e. MP@LL is 4Mbps, MP@ML is 15Mbps, and MP@H14L and MP@HL should be the maximum transmittable capacity.

Meaning of each code number of MPEG-2 coding parameter in Table 5-1	
aspect_ratio_information	1= square pixel, 2 = 4:3, 3 = 16:9
frame_rate_code	4 = 30/1.001 Hz, 7 = 60/1.001 Hz
progressive_sequence	0 = Interlaced scan, 1 = Progressive scan
low_delay	1 = B Picture is not included.
color_primaries	1 = Rec.ITU-R BT.709(BT.1361)
transfer_characteristics	1 = Rec.ITU-R BT.709(BT.1361)
matrix_coefficients	1 = Rec.ITU-R BT.709(BT.1361)

5.1.2 MPEG-4 I-VOP

ISO/IEC 14496-2 shall be used for MPEG-4 I-VOP with constraints of MPEG-4 Video coding specifications written in section 4.3.

One frame of I-VOPbetween visual_object_sequence_start_code and visual_object_sequence_end_ code should be coded as still picture.

5.1.3 H.264|MPEG-4 AVC I-picture

ITU-T Rec. H.264|ISO/IEC 14496-10 shall be used for H.264|MPEG-4 AVC I-picture with constraints of H.264|MPEG-4 AVC Video coding specifications written in section 4.4.

5.2 JPEG

ISO/IEC 10918-1 shall be used for JPEG encoding of bit map.

5.3 PNG

, W3C Recommendation (PNG specification Ver 1.0 W3C Rec. Oct. 1996) shall be used for PNG (Portable Network Graphics) file format of graphics. Detail of coding format is specified in appendix specification B.

5.3.1 Constraints of PNG

Operation of PNG should be in accordance with the following specification.

- When colour type is "3" (palette index), PLTE chunk in the PNG data is omitted. In this case, CLUT should be presented in the multimedia contents and the receiver should not refer PLTE chunk but should refer the outside CLUT.

5.4 MNG

The specification based on MNG Format Version 0.96-19990718 shall be used for file format of animation graphics by MNG (Multiple-image Network Graphics).

5.4.1 Constraints of MNG

Operation of MNG should be in accordance with the following specification.

- Plural PNG pictures are included in MNG file and should be presented sequently.
- Object only with Object ID = 0 can be used.
- Only following frame rewriting constraints shall be enabled
    1) frame mode of the previous frame shall be used (framing mode = 0)
    2) PNG picture is overwritten one by one in every 1 frame cycle (framing mode = 1)
    3) After erasing background with transparent colour, PNG picture is displayed in every 1 frame cycle (framing mode = 3)
- For animation repeating process, only following two methods should be enabled.
    1) The last PNG picture should be presented continuously. (default)
    2) All of the pictures starting from the first picture in the file should be repeated

for the specified times.(termination action = 3)

5.4.2 Available chunk

Available chunk is specified in this clause and when value of each field is restricted, constraints are also specified.

5.4.2.1 MHDR

There is always one MHDR in the head. Field is fixed in 28 byte.

Field Name	BYTE NUMBER	Meaning	Constrain
Frame width	4	Frame width	
Frame height	4	Frame height	
Ticks per second	4	Unit time between frame	Other than 0
Nominal layer count	4	Number of layers	Fixed to 0
Nominal frame count	4	Number of frames	Fixed to 0
Nominal play time	4	Playing time	Fixed to 0
Simplicity profile	4	Profile information of the file	Fixed to 0

5.4.2.2 MEND

There is always one MEND at the end. There is no field.

5.4.2.3 IHDR, PNG chunks, IEND

IHDR, PNG chunks, IEND should be same as PNG picture specified in clause 5.3.

5.4.2.4 TERM

TERM can be omitted. In case when it exists, there is only one immediately after the MHDR chunk. Field is fixed to 10 bytes. When TERM chunk is omitted, the last PNG picture at the end of file is continued to be presented.

Field	BYTE NUMBER	Meaning	Constrain
Termination action	1	Specification of repeating process	Fixed to 3
Action after iterations	1	Action after repeating process	Fixed to 0
Delay	4	Delay time after repeating start	Fixed to 0
Iteration max	4	Repeating time	

5.4.2.5 FRAM

Plural FRAM can be existed. Field should be fixed to 1 byte or fixed to 10 bytes.

Field	BYTE NUMBER	Meaning	Constrain
Framing mode	1	Frame rewriting mode directed	Restricted either of 0, 1, 3

Following fields can be omitted.

Subframe name, Separator	1	Frame name	Fixed to 0

Change interframe Delay	1	Time changing flag between frames	Fixed to 2
Change sync timeout and termination	1	Timeout value changing flag	Fixed to 0
Change subframe Clipping boundaries	1	Clip value changing flag	Fixed to 0
Change sync id list	1	Sync id changing flag	Fixed to 0
Interframe delay	4	Time between frames	

5.4.2.6 DEFI

Plural DEFI can be existed. Display position of following PNG picture should be settled. Field should be 12 bytes fix.

Field	BYTE NUMBER	Meaning	Constrain
Object id	2	Object ID	Fixed to 0
Do not show flag	1	Object non-display flag	Fixed to 0
Concrete flag	1	Object attribute flag	Fixed to 0
X location	4	X coordinate of the object	
Y location	4	Y coordinate of the object	

5.5 GIF

Any graphics file in GIF (Graphics Interchange Format) must be coded by using the methodology "GRAPHICS INTERCHANGE FORMAT Version 89a" specified by Compuserve Incorporated (a U.S.-based company).

Chapter 6 Audio coding

6.1 MPEG-2 Audio

LC profile of AAC method specified in ISO/IEC 13818-7 shall be used for audio coding by MPEG-2 audio.

Audio coding of BC method specified in ISO/IEC 13818-3 can be also used when necessary.

6.2 PCM (AIFF-C)

AIFF-C (Audio Interchange File Format) specified in DAVIC 1.4 Specification Part 9 Annex B shall be used for audio coding file format using PCM with constraints specified in Table 6-1.

Table 6-1 Constraints of PCM coding parameter

Sampling frequency of television sound	Condition of PCM coding	
	Sampling frequency	Bit length
32kHz	32kHz, 16kHz, 8kHz	8 bit or 16 bit
48kHz	48kHz, 24kHz, 12kHz	8 bit or 16 bit

6.3 MPEG-4 audio

ISO/IEC 14496-3 shall be used for audio coding by MPEG-4 audio.

The appropriate coding method should be selected according to types (music, audio) and bit rate. Relation of each coding method and appropriate bit rate of MPEG-4 audio is described in informative explanation 1.

6.4 Coding of synthesized sound

For coding of synthesized sound, a method specified in transmission standard related to television data multiplex broadcasting (ARIB STD-B5 "Data multiplex broadcasting for the conventional television using vertical blanking interval") shall be used.

Chapter 7 Character coding

7.1 JIS 8bit character code (8bit-character code)

8bit character code in this standard is an enhanced method of ARIB STD-B5 "DATA MULTIPLEX BROADCASTING SYSTEM FOR THE CONVENTIONAL TELEVISION USING THE VERTICAL BLANKING INTERVAL" (Ver. 1.0, Aug. 6, 1996).

7.1.1 Types and structure of character sets

7.1.1.1 Coding structure and code extension techniques

The code table of 8bit-code is shown in Figure 7-1 and structure of 8-bit code (extension techniques) is shown in Figure 7-2. Coded representation of invocation of code elements (to invoke the code element G0, G1, G2 and G3 in the 8-bit code table in use) is listed in Table 7-1. Coded representation for designation of graphic character sets (to designate one character set from the graphic character sets for G0, G1, G2 or G3) is listed in Table 7-2. Classification of code set and Final Byte is listed in Table 7-3.

7.1.1.2 Type of character code set

The types of character code sets available to the specification shall be Kanji set, alphanumerical set, Hiragana set, Katakana set, mosaic set, supplemental character (Gaiji) set, macro-code set, JIS compatible Kanji Plane 1 set, JIS compatible Kanji Plane 2 set, and additional symbols set.

7.1.1.3 Code table of character code set

The graphic symbols of the Kanji set, alphanumerical set, Hiragana set, Katakana set and mosaic set are shown in Tables 7-4 to 7-9. The JIS compatible Kanji Plane 1 set is identical with the Kanji Set for Information Interchange, Plane 1, as specified in JIS X213: 2004. The JIS compatible Kanji Plane 2 set is identical with the Kanji Set for Information Interchange, Plane 2, as specified in JIS X213: 2004. The additional symbols set consists of additional symbols and additional Kanji characters, as shown in Tables 7-10 and 7-11. When the Kanji Set for Information interchange, Plane 1 is not used, the range of Row 1 to Row 84 in Table 7-4 is imported to the JIS compatible Kanji Plane 1. Note that any glyph contained in the specification is provided for the purpose of reference.

7.1.1.4 Non-spacing character

Non-spacing character shall be row 1 cell 13 to 18 in Table 7-4 (1) (Kanji set (1)) and row 2 cell 94 in Table 7-4 (2) (Kanji set (2)) and non-spacing mosaic shall be the mosaic in (3) and (4) of Table 7-8.

Non-spacing character and non-spacing mosaic is displayed by cumulating character, mosaic or space, etc. specified by the successive code.

Codes, which can be used between codes of character, mosaic or space in combination with non-spacing character and non-spacing mosaic codes, are shown in Table 7-33.

7.1.1.5 Supplemental characters (Gaiji)

Codes used for Gaiji character code shall be 1-byte code or 2-byte code.

1-byte Gaiji character code shall be 15 sets from DRCS-1 to DRCS-15 and each set consists of 94 characters. (2/1 to 7/14 is used. When column number is indicated in one digit by indication method of column number/row number, column number is indicated by binary notation in 3 bit from b7 to b5.)

Gaiji character code set in 2 byte shall be the set of DRCS-0. DRCS-0 is a code table of 2 bytes and consists of 8836 characters from Row 1, Cell 1 to Row 94, Cell 94.

Coding of DRCS pattern data shall be in compliance with "AnnexD Coding of DRCS pattern data".

7.1.1.6 Macro coding

Macro coding is a coding of functions composed by a sequence of code(hereafter referred to as "macro sentence") consisting of character code (including patterns of both mosaic and DRCS) and control code (hereafter referred to as "macro definition").

Macro definition is made by macro control in Table 7-16.

Macro code set is 1 byte code set and consists of 94 characters (in range from 2/1 to 7/14). When the macro character is appeared, sequence of code of macro sentence is decoded. When macro definition is not made, it shall be in accordance with default macro sentence indicated in Table 7-18 shall be applied.

7.1.2 Coding of control function

7.1.2.1 C0 control set

Structure of C0 control set and its function shall be in compliance with Tables 7-14 and 7-15 respectively. When it is accompanied with parameters, its parameters are sent immediately after each code.

7.1.2.2 C1 control set

Structure of C1 control set and its function shall be in compliance with Table 7-14 and 7-16 respectively. When it is accompanied with parameters, its parameters are sent immediately after each code.

7.1.2.3 SP and DEL

SP (space) makes the entire specified current character field in background colour and DEL (delete) makes the entire specified current character field in foreground color.

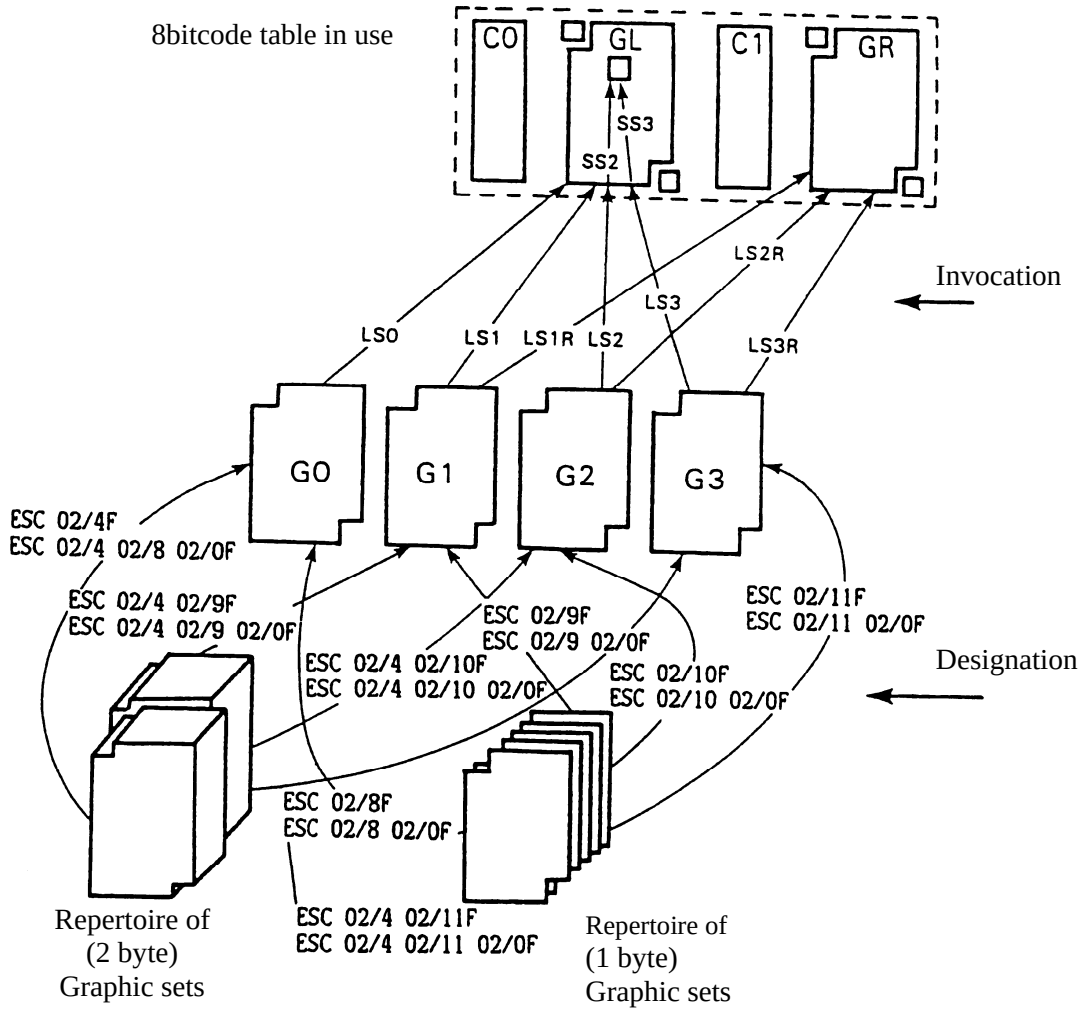
7.1.2.4 CSI

Control code extension by CSI (control sequence introducer) code is as shown in Table 7-17.

				b8	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
				b7	0	0	0	1	1	1	1	1	0	0	0	1	1	0	0	1
				b6	0	0	1	1	0	0	1	1	0	0	1	0	1	1	1	1
				b5	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
b4	b3	b2	b1	Column / Row	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	0	0	0	0	C0 area		*1	GL area					C1 area		*2	GR area				
0	0	0	1	1																
0	0	1	0	2																
0	0	1	1	3																
0	1	0	0	4																
0	1	0	1	5																
0	1	1	0	6																
0	1	1	1	7																
1	0	0	0	8																
1	0	0	1	9																
1	0	1	0	10																
1	0	1	1	11																
1	1	0	0	12																
1	1	0	1	13																
1	1	1	0	14																
1	1	1	1	15								*3								*4

Note: *1 to *4 are for special code area described as follows; Geometric coding shall add *1 (SP) and *3 (DEL) to GL area and *2 (10/0) and *4 (15/15) to GR area.
*1--- SP, *2---10/0, *3---DEL, *4---15/15

Figure 7-1 Code Table



Note: Returning from other coding method to 8bit-code is made by data size of the data unit.

Figure 7-2 Structure of 8-bit code (Extension techniques)

Table 7-1 Invocation of code elements

Acronym	Codes Representation		Function		
			Code element	Invocation area	Invocation effect
LS0	00/15		G0	GL	Locking shift
LS1	00/14		G1	GL	Locking shift
LS2	ESC	06/14	G2	GL	Locking shift
LS3	ESC	06/15	G3	GL	Locking shift
LS1R	ESC	07/14	G1	GR	Locking shift
LS2R	ESC	07/13	G2	GR	Locking shift
LS3R	ESC	07/12	G3	GR	Locking shift
SS2	01/9		G2	GL	Single shift
SS3	01/13		G3	GL	Single shift

(1) ESC shall be 01/11.

(2) Locking shift means to invoke in GL or GR area the specific code element and keep it in the same area until another locking shift invokes in the same area the specific code element.

(3) Single shift means to invoke one code following to it in the GL or GR area temporary.

Table 7-2 Designation of graphic sets

Codes Representation					Function	
					Classification of Graphic sets	Designated element
ESC	02/8	F			1-byte G set	G0
ESC	02/9	F				G1
ESC	02/10	F				G2
ESC	02/11	F				G3
ESC	02/4	F			2-byte G set	G0
ESC	02/4	02/9	F			G1
ESC	02/4	02/10	F			G2
ESC	02/4	02/11	F			G3
ESC	02/8	02/0	F		1-byte DRCS	G0
ESC	02/9	02/0	F			G1
ESC	02/10	02/0	F			G2
ESC	02/11	02/0	F			G3
ESC	02/4	02/8	02/0	F	2-byte DRCS	G0
ESC	02/4	02/9	02/0	F		G1
ESC	02/4	02/10	02/0	F		G2
ESC	02/4	02/11	02/0	F		G3

Table 7-3 Classification of code set and Final Byte

Classification of graphic sets	Graphic sets	Final Byte (F)	Remarks
G set	Kanji	04/2	2-byte code
	Alphanumeric	04/10	1-byte code
	Hiragana	03/0	1-byte code
	Katakana	03/1	1-byte code
	Mosaic A	03/2	1-byte code
	Mosaic B	03/3	1-byte code
	Mosaic C	03/4	1-byte code, non-spacing
	Mosaic D	03/5	1-byte code, non-spacing
	Proportional alphanumeric	03/6	1-byte code
	Proportional hiragana	03/7	1-byte code
	Proportional katakana	03/8	1-byte code
	JIS X 0201 katakana	04/9	1-byte code
	JIS compatible Kanji Plane 1	03/9	2-byete code
	JIS compatible Kanji Plane 2	03/10	2-byete code
	Additional symbols	03/11	2-byete code
DRCS	DRCS-0	04/0	2-byte code
	DRCS-1	04/1	1-byte code
	DRCS-2	04/2	1-byte code
	DRCS-3	04/3	1-byte code
	DRCS-4	04/4	1-byte code
	DRCS-5	04/5	1-byte code
	DRCS-6	04/6	1-byte code
	DRCS-7	04/7	1-byte code
	DRCS-8	04/8	1-byte code
	DRCS-9	04/9	1-byte code
	DRCS-10	04/10	1-byte code
	DRCS-11	04/11	1-byte code
	DRCS-12	04/12	1-byte code
	DRCS-13	04/13	1-byte code
	DRCS-14	04/14	1-byte code
	DRCS-15	04/15	1-byte code
	Macro	07/0	1-byte code
Remark: Macro shall be in compliance with Clause 7.1.1.6.			

Table 7-4 (1) Kanji Set (1)

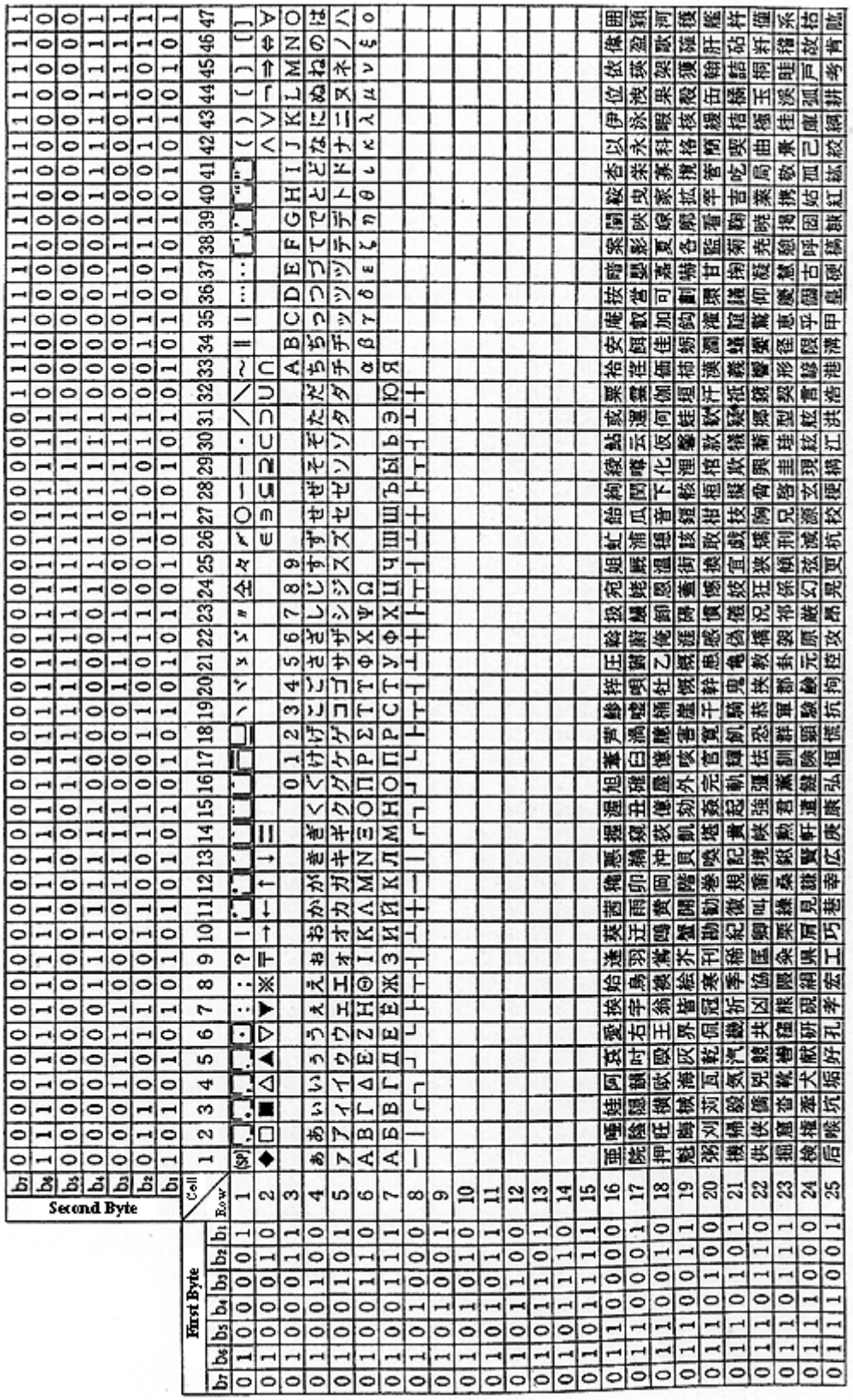


Table 7-4 (2) Kanji Set (2)

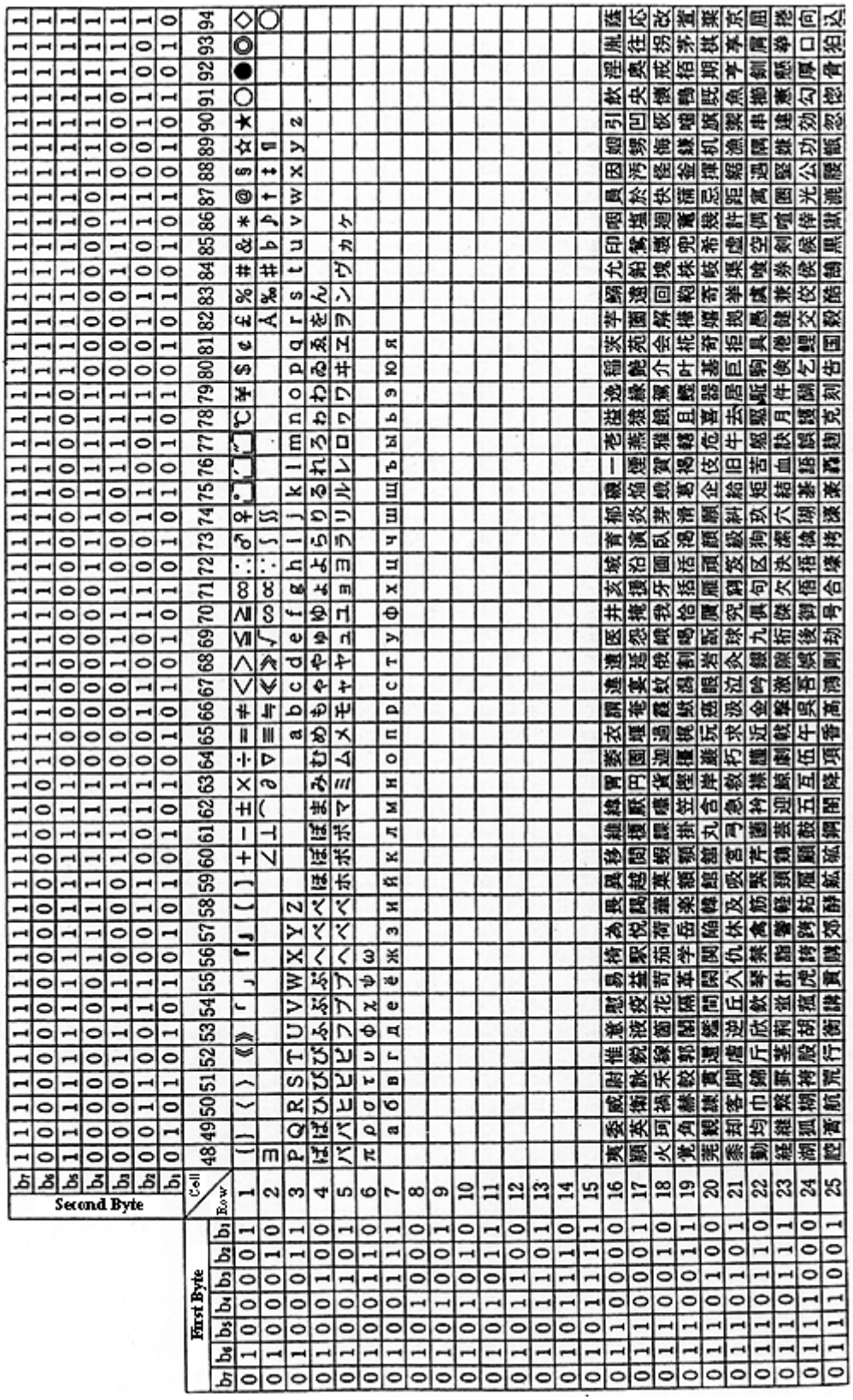


Table 7-4 (3) Kanji Set (3)

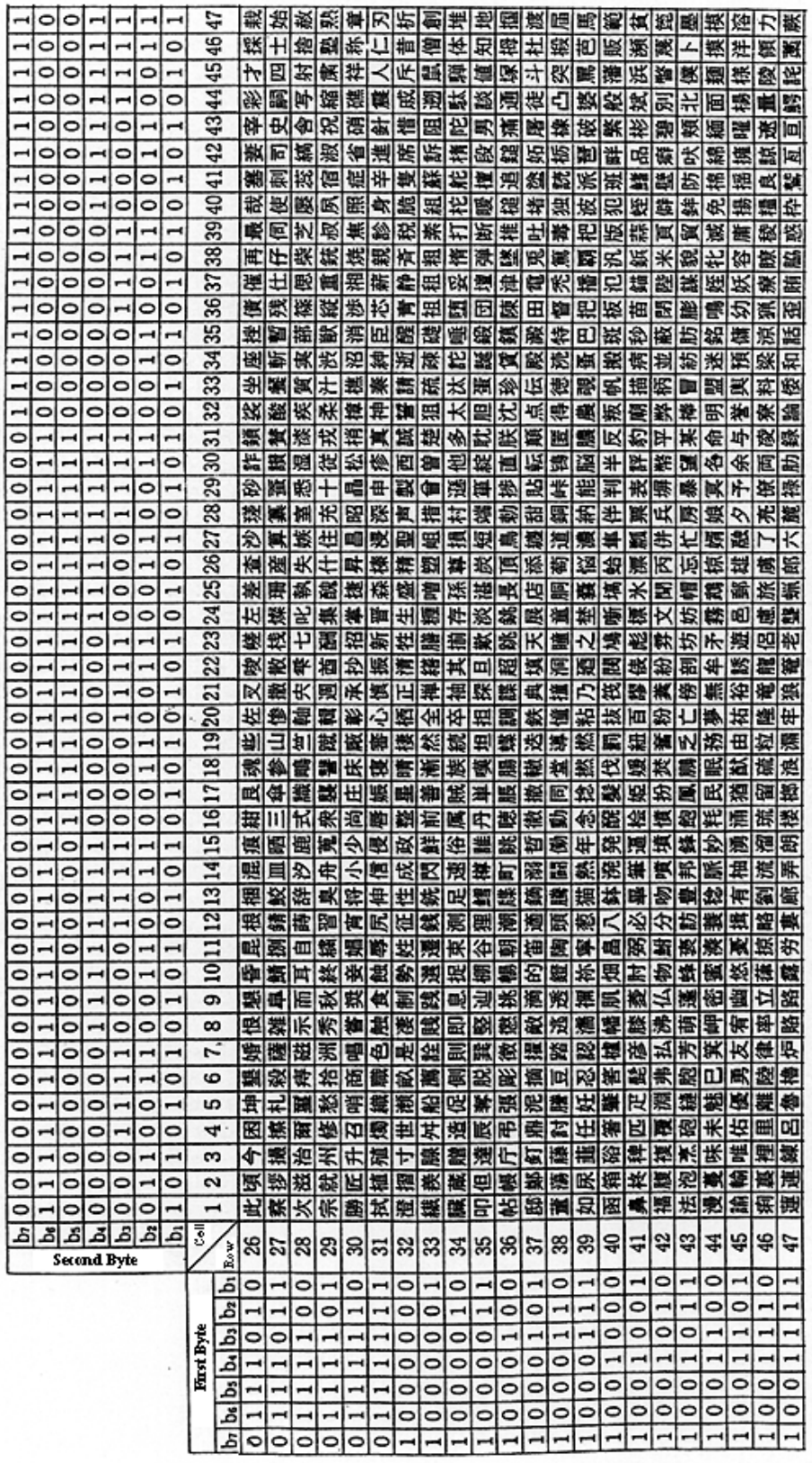


Table 7-4 (4) Kanji Set (4)

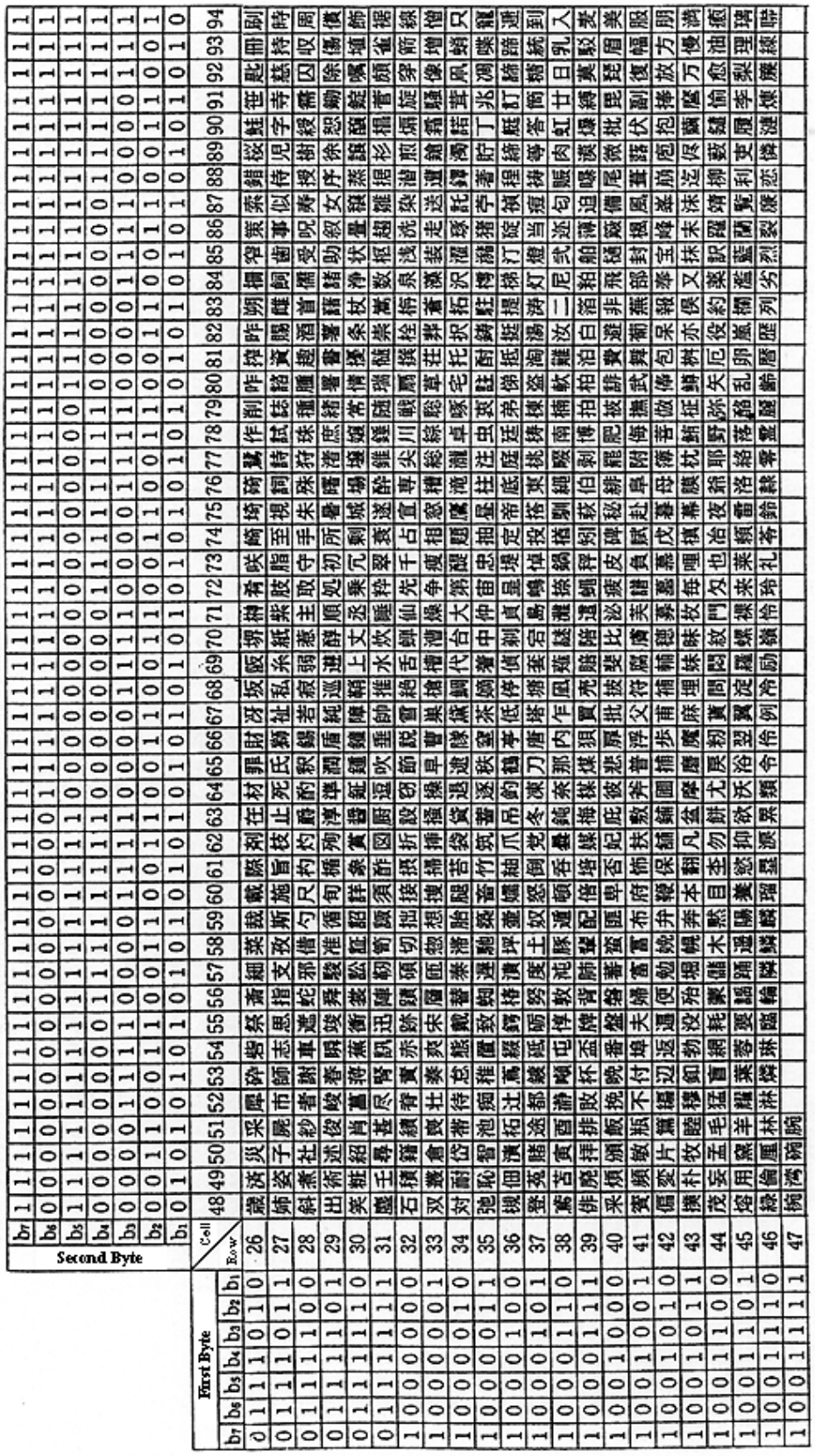


Table 7-4 (5) Kanji Set (5)

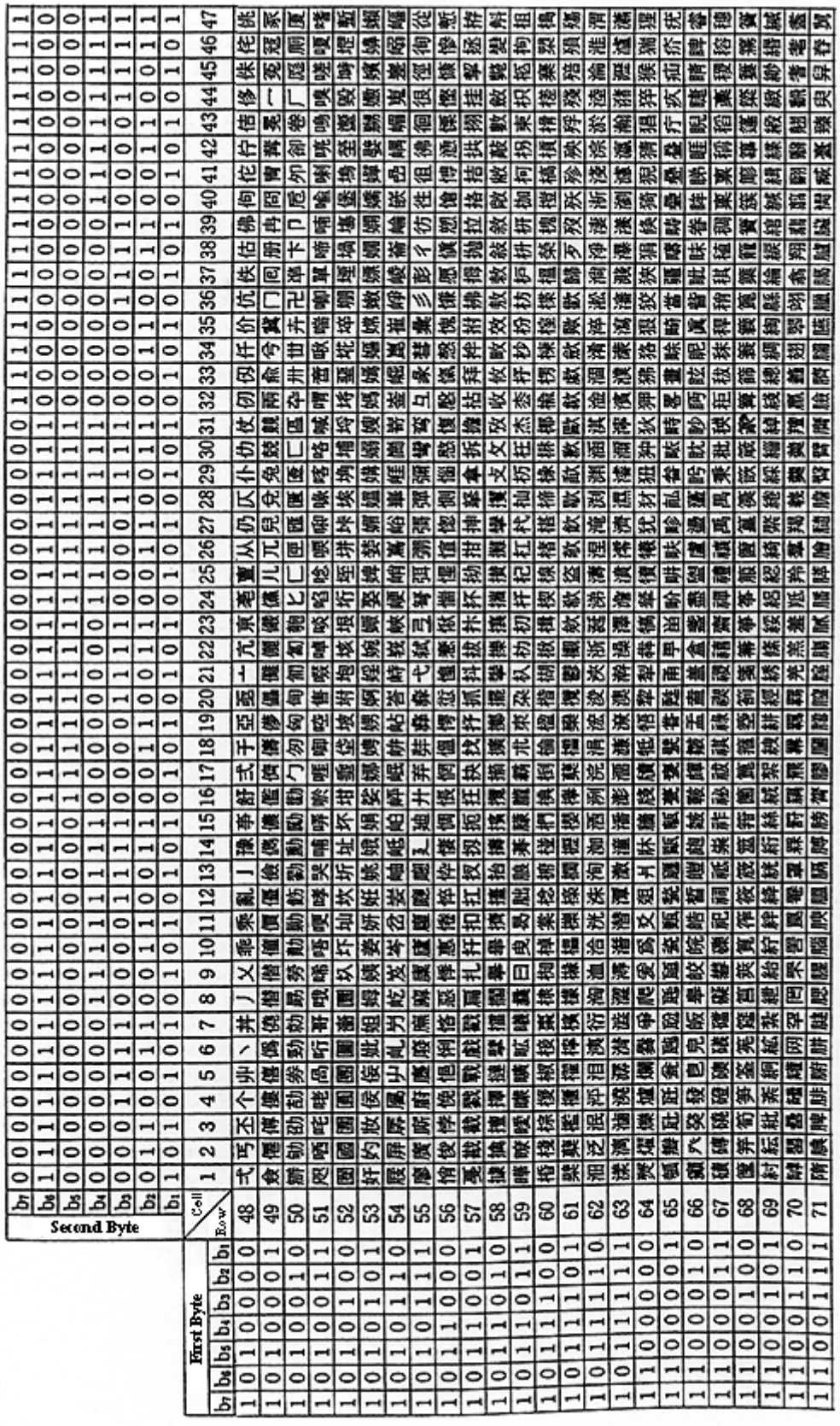


Table 7-4 (6) Kanji Set (6)

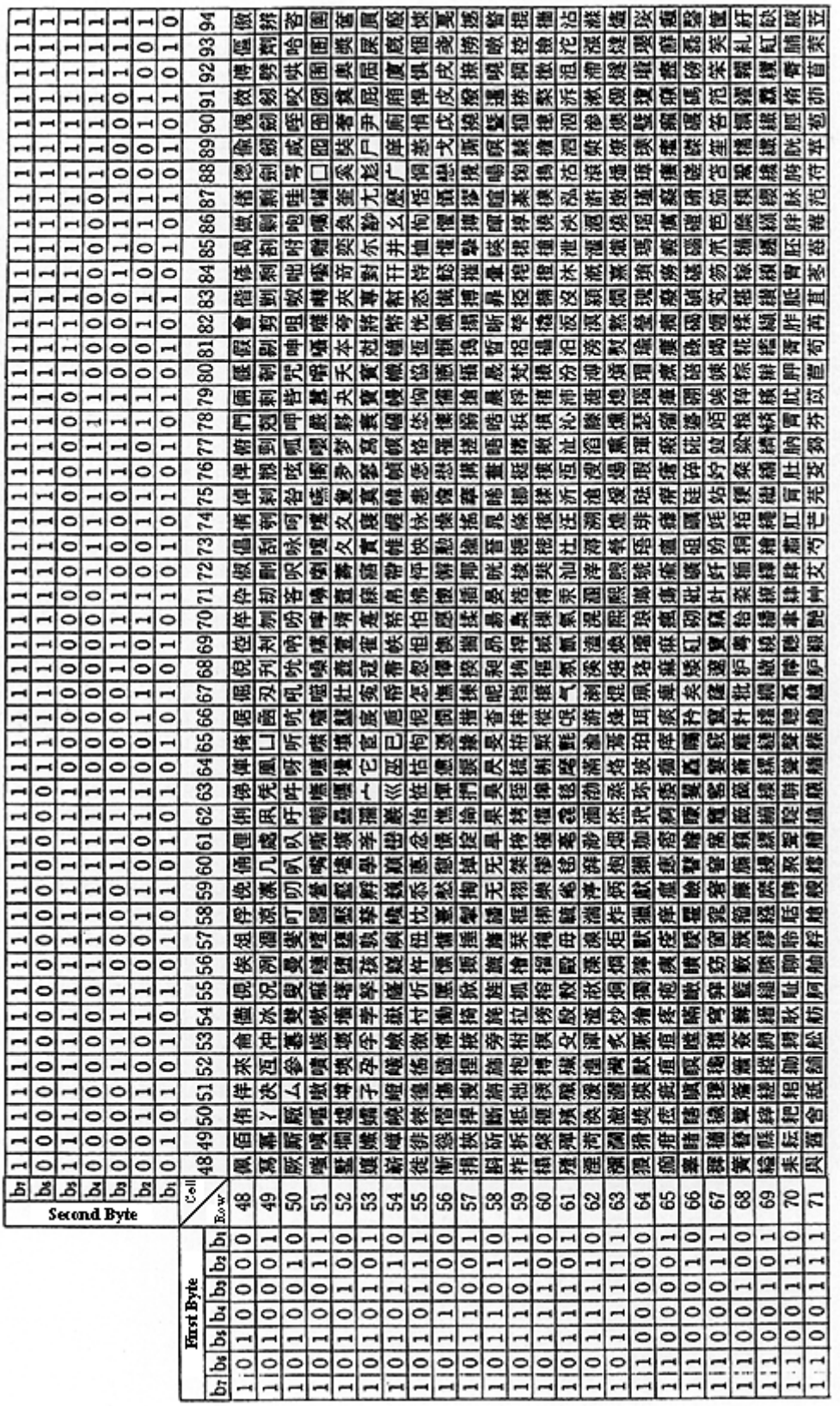


Table 7-4 (7) Kanji Set (7)

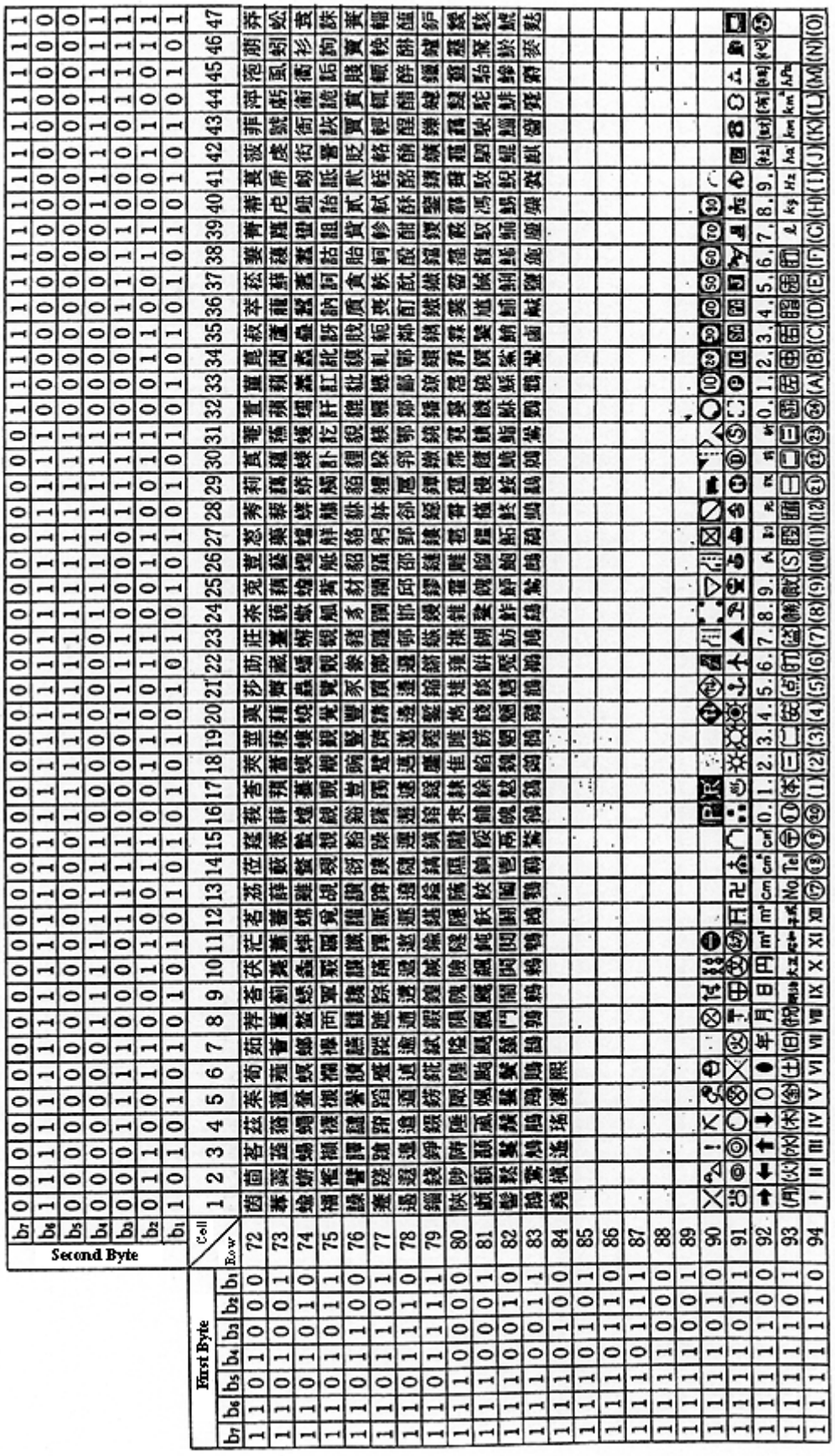


Table 7-4 (8) Kanji Set (8)

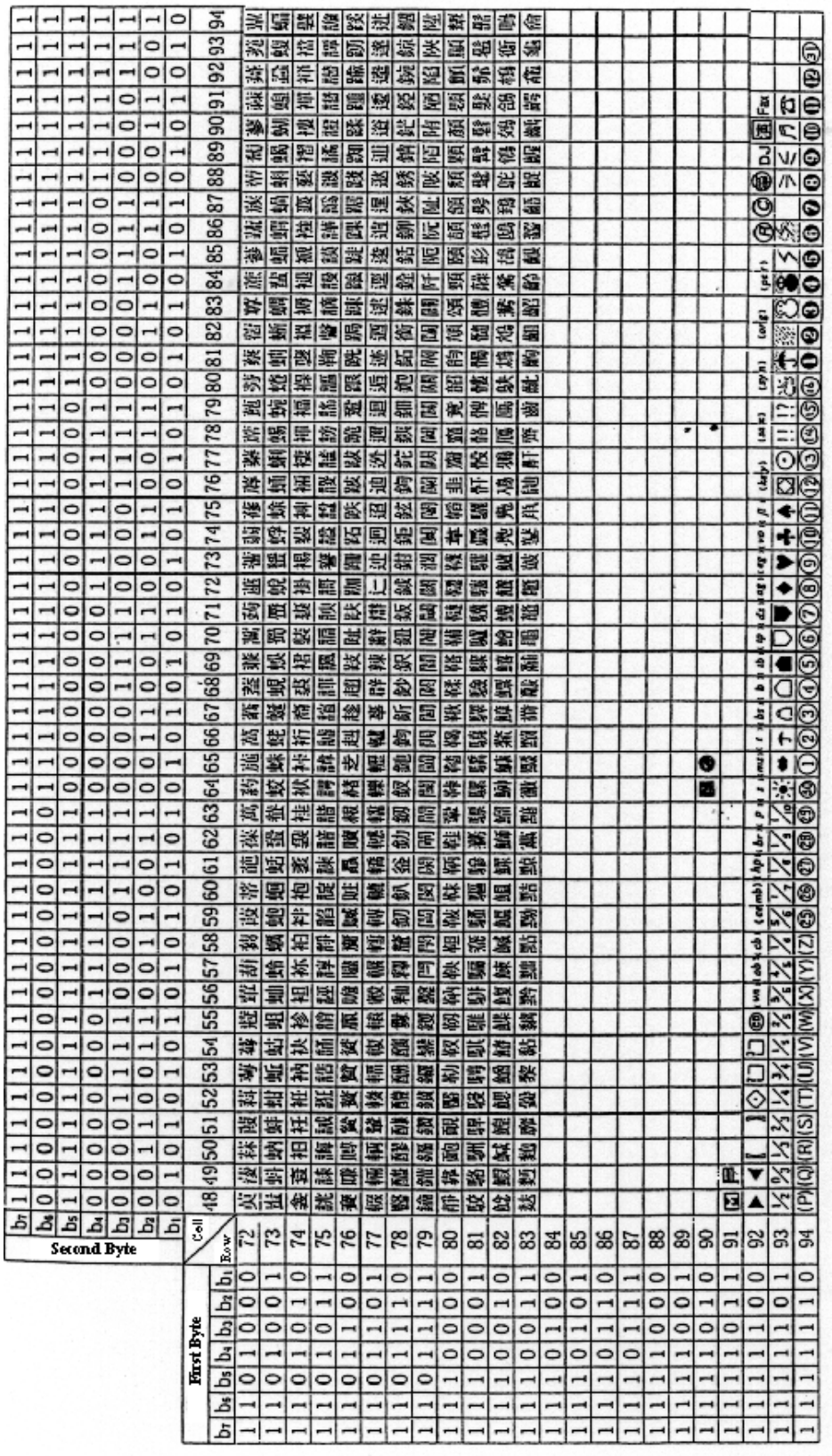


Table 7-5 Alphanumeric set and proportional alphanumeric set

					b_7	0	0	1	1	1	1
					b_6	1	1	0	0	1	1
					b_5	0	1	0	1	0	1
						2	3	4	5	6	7
b_4	b_3	b_2	b_1								
0	0	0	0	0			0	@	P	`	p
0	0	0	1	1		!	1	A	Q	a	q
0	0	1	0	2		"	2	B	R	b	r
0	0	1	1	3		#	3	C	S	c	s
0	1	0	0	4		$	4	D	T	d	t
0	1	0	1	5		%	5	E	U	e	u
0	1	1	0	6		&	6	F	V	f	v
0	1	1	1	7		'	7	G	W	g	w
1	0	0	0	8		(	8	H	X	h	x
1	0	0	1	9		)	9	I	Y	i	y
1	0	1	0	10		*	:	J	Z	j	z
1	0	1	1	11		+	;	K	[	k	{
1	1	0	0	12		,	<	L	¥	l	|
1	1	0	1	13		−	=	M	]	m	}
1	1	1	0	14		.	>	N	^	n	‾
1	1	1	1	15		/	?	O	_	o	

Table 7-6 Katakana set and proportional katakana set

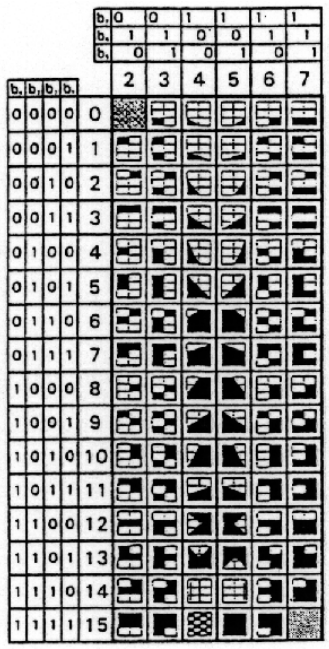
b_4	b_3	b_2	b_1		b_7 0	0	1	1	1	1
					b_6 1	1	0	0	1	1
					b_5 0	1	0	1	0	1
					2	3	4	5	6	7
0	0	0	0	0		グ	ダ	バ	ム	ｷ
0	0	0	1	1	ァ	ケ	チ	パ	メ	ｸ
0	0	1	0	2	ア	ゲ	デ	ヒ	モ	ｦ
0	0	1	1	3	ィ	コ	ッ	ビ	ャ	ﾝ
0	1	0	0	4	イ	ゴ	ツ	ピ	ヤ	ヴ
0	1	0	1	5	ゥ	サ	ヅ	フ	ュ	ｶ
0	1	1	0	6	ウ	ザ	テ	ブ	ユ	ｹ
0	1	1	1	7	ェ	シ	デ	プ	ョ	ﾞ
1	0	0	0	8	エ	ジ	ト	ヘ	ヨ	ﾟ
1	0	0	1	9	ォ	ス	ド	ベ	ラ	ｰ
1	0	1	0	10	オ	ズ	ナ	ペ	リ	。
1	0	1	1	11	カ	セ	ニ	ホ	ル	「
1	1	0	0	12	ガ	ゼ	ヌ	ボ	レ	」
1	1	0	1	13	キ	ソ	ネ	ポ	ロ	、
1	1	1	0	14	ギ	ゾ	ノ	マ	ワ	・
1	1	1	1	15	ク	タ	ハ	ミ	ワ	

Table 7-7 Hiragana set and proportional hiragana set

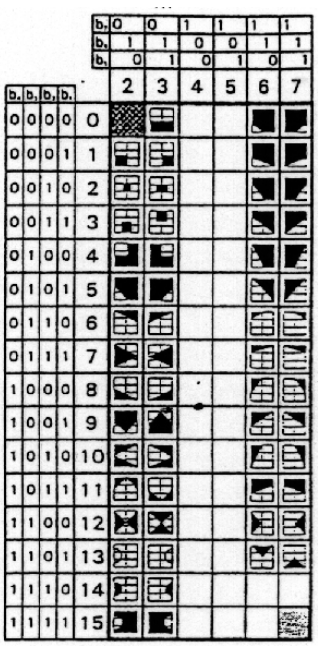
				b_7	0	0	1	1	1	1
				b_6	1	1	0	0	1	1
				b_5	0	1	0	1	0	1
					2	3	4	5	6	7
b_4	b_3	b_2	b_1							
0	0	0	0	0		ぐ	だ	ば	む	ゐ
0	0	0	1	1	ぁ	け	ち	ぱ	め	ゑ
0	0	1	0	2	あ	げ	ぢ	ひ	も	を
0	0	1	1	3	ぃ	こ	っ	び	ゃ	ん
0	1	0	0	4	い	ご	つ	ぴ	や	
0	1	0	1	5	ぅ	さ	づ	ふ	ゅ	
0	1	1	0	6	う	ざ	て	ぶ	ゆ	
0	1	1	1	7	ぇ	し	で	ぷ	ょ	ゝ
1	0	0	0	8	え	じ	と	へ	よ	ゞ
1	0	0	1	9	ぉ	す	ど	べ	ら	ー
1	0	1	0	10	お	ず	な	ぺ	り	。
1	0	1	1	11	か	せ	に	ほ	る	「
1	1	0	0	12	が	ぜ	ぬ	ぼ	れ	」
1	1	0	1	13	き	そ	ね	ぽ	ろ	、
1	1	1	0	14	ぎ	ぞ	の	ま	ゎ	・
1	1	1	1	15	く	た	は	み	わ	

Table 7-8 Mosaic set

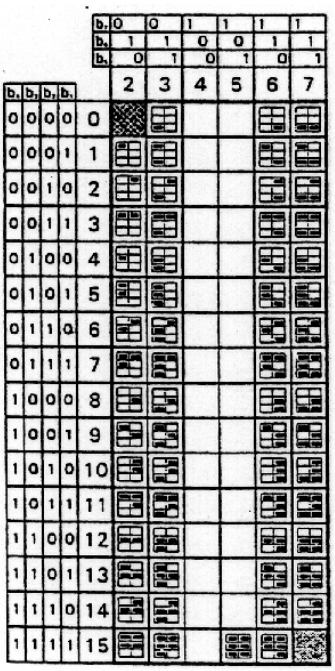
(1) Mosaic set A



(2) Mosaic set B



(3) Mosaic set C (non-spacing)



(4) Mosaic set D (non-spacing)

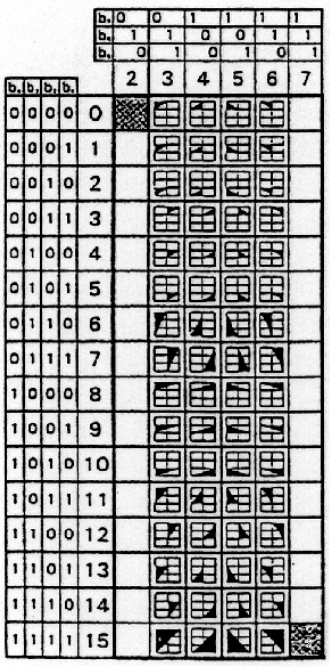


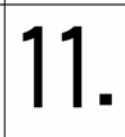
Table 7-9 JIS X0201 Katakana set

b7	0	0	1	1	1	1
b6	1	1	0	0	1	1
b5	0	1	0	1	0	1
b4 b3 b2 b1	2	3	4	5	6	7
0 0 0 0 0		―	タ	ミ	Undefined	
0 0 0 1 1	。	ア	チ	ム		
0 0 1 0 2	「	イ	ツ	メ		
0 0 1 1 3	」	ウ	テ	モ		
0 1 0 0 4	、	エ	ト	ヤ		
0 1 0 1 5	・	オ	ナ	ユ		
0 1 1 0 6	ヲ	カ	ニ	ヨ		
0 1 1 1 7	ァ	キ	ヌ	ラ		
1 0 0 0 8	ィ	ク	ネ	リ		
1 0 0 1 9	ゥ	ケ	ノ	ル		
1 0 1 0 10	ェ	コ	ハ	レ		
1 0 1 1 11	ォ	サ	ヒ	ロ		
1 1 0 0 12	ャ	シ	フ	ワ		
1 1 0 1 13	ュ	ス	ヘ	ン		
1 1 1 0 14	ョ	セ	ホ	゛		
1 1 1 1 15	ッ	ソ	マ	゜		

Note: Proportional alphanumeric set, proportional hiragana set and proportional katakana set are character code set intended to use proportional font in the area of alphanumeric set, hiragana set and katakana set. Proportional font is the font of which width is defined in each character individually. Definition of width and height of each character (94 characters in range from 02/1 to 07/14, excluding any spacing) is decided by each proportional character set and font, by the ratio of width and height of each character and width of the given display area of the character. Table of this proportion is specified in the operational guidelines. For proportional alphanumeric set, only width for horizontal writing is prescribed.

Table 7-10 Additional Symbols

Row	Cell	Description	Symbol	Row	Cell	Description	Symbol
90	1	accident		90	10	tire chains required	
	2	disabled car			11	no thoroughfare	
	3	obstacles on the road			16	parking space (empty, full)	
	4	under construction			17	parking space (closed)	
	5	Icy road			20	two-way traffic 1	
	6	maintenance			21	two-way traffic 2	
	8	road closed			22	lane merge 1	
	9	alternate one-way traffic			23	lane merge 2	
					24	drive slow 1	

	25	drive slow 2			36	40km/h	
	26	closed entry 1			37	50km/h	
	27	closed entry 2			38	60km/h	
	28	closed to large cars 1			39	70km/h	
	29	closed to large cars 2			40	80km/h	
	30	restricted entry 1			45	time of day (10:00)	
	31	restricted entry 2			46	time of day (11:00)	
	32	basic symbol for speed limit			47	time of day (12:00)	
	33	10km/h			48	HDTV	
	34	20km/h			49	SDTV	
	35	30km/h			50	progressive broadcasting	

	51	wide -format (16:9) broadcasting service	W		62	B-mode stereo compression broadcasting service	B
	52	multi-view television	MV		63	news	N
	53	broadcasting service along with sign language interpretation	手		64	background, rectangle	■
	54	closed-captioned broadcasting	字		65	background, circle	●
	55	two-way broadcasting service	双		66	weather forecast	天
	56	data broadcasting service linked with a main program	デ		67	traffic information	交
	57	stereo broadcasting service	S		68	drama film	映
	58	bilingual broadcasting service	二		69	free broadcasting service	無
	59	sound-multiplex broadcasting service	多		70	pay broadcasting service	料
	60	commentary broadcasting	解		71	parental lock	⚿
	61	surrounding stereo broadcasting service	SS		72	the first part	前

	73	the latter part	後		84	and others	ほか
	74	rebroadcast	再	91	1	public office, governmental agency	〒
	75	new series of programs	新		2	prefectural office	㊀
	76	first released program	初		3	municipal office (including the 23-ku ward offices in Tokyo)	◎
	77	the last episode	終		4	town office, village office (including other ward offices than Tokyo)	○
	78	live broadcast	生		5	police office	⊗
	79	mail-order	販		6	police satellite office	×
	80	voice actors	声		7	fire station	㊋
	81	dubbed version	吹		8	post office	〒
	82	pay-per-view	PPV		9	hospital, clinic	🏥
	83	confidential	㊙		10	school	⊗

	11	kindergarten			22	airport	
	12	shrine			23	mountain	
	13	temple			24	bathing beach	
	14	church			25	park	
	15	remains of a castle			26	golf course	
	16	historic site, place of scenic beauty			27	ferryboat terminal	
	17	hot spring			28	marina, yacht harbor	
	18	factory			29	hotel	
	19	power plant, power substation			30	department store	
	20	lighthouse			31	station	
	21	harbor			32	intersection	

	33	parking space			44	bank	
	34	interchange, ramp (part of the highway system)			45	graveyard, memorial park, cemetery	
	35	service area (part of the highway system)			46	gas station	
	36	parking area (part of the highway system)			47	drive-in restaurant	
	37	junction (part of the highway system)			48	museum, cultural center	
	38	skiing field			49	Self-Defense-Forces site	
	39	ice skating field		92	1		
	40	track and field, gymnasium			2		
	41	camping site			3		
	42	leisure center			4		
	43	telephone company			5		

	6		●		17		1.
	7		年		18		2.
	8		月		19		3.
	9		日		20		4.
	10		円		21		5.
	11		m^2		22		6.
	12		m^3		23		7.
	13	centimeter	cm		24		8.
	14	square centimeter	cm^2		25		9.
	15	cubic centimeter	cm^3		26	70% size of the Kanji character “氏”	氏
	16		O.		27	70% size of the Kanji character “副”	副

	28	70% size of the Kanji character “元”	元		39		7,
	29	70% size of the Kanji character “故”	故		40		8,
	30	70% size of the Kanji character “前”	前		41		9,
	31	70% size of the Kanji character “新”	新		42	zaidanhouzin (corporation aggregate)	〔社〕
	32		0,		43	syadanhouzin (incorporated foundation)	〔財〕
	33		1,		44	yu-ugenkaisya	〔有〕
	34		2,		45	kabushikikaisya	〔株〕
	35		3,		46	representation	〔代〕
	36		4,		47		㊕
	37		5,		48		▶
	38		6,		49		◀

	50		〔		62	baritone	(br)
	51		〕		63	piano	(p)
	52		◈		64	soprano	(s)
	53		2		65	mezzo-soprano	(ms)
	54		3		66	tenor	(t)
	55	circled "CD"	ⓒⓓ		67	basso	(bs)
	56	violin	(vn)		68	bass	(b)
	57	oboe	(ob)		69	trombone	(tb)
	58	contrabass	(cb)		70	trumpet	(tp)
	59, 60	cembalo	(cemb)		71	drums	(ds)
	61	harp	(hp)		72	acoustic guitar	(ag)

	73	electric guitar	(eg)		89	disc jockey	DJ
	74	vocal	(vo)		90	performed by	演
	75	flute	(fl)		91	facsimile	Fax
	76, 77	keyboard	(key)	93	1		月
	78, 79	saxophone	(sax)		2		火
	80, 81	synthesizer	(syn)		3		水
	82, 83	organ	(org)		4		木
	84, 85	percussion	(per)		5		金
	86	disc record	®		6		土
	87	single disc record, compact disc	©		7		日
	88	koto (Japanese harp)	箏		8		祝

	9	the Meiji era	明治		20		〔安〕
	10	the Taisho era	大正		21		〔点〕
	11	the Showa era	昭和		22		〔打〕
	12	the Heisei era	平成		23		〔盗〕
	13		No.		24		〔勝〕
	14		Tel		25		〔敗〕
	15		㊡		26		〔S〕
	16				27		投
	17		〔本〕		28		捕
	18		〔三〕		29		一
	19		〔二〕		30		二

	31		三		42	hectare	ha
	32		遊		43	kilometer	km
	33		左		44	square kilometer	km²
	34		中		45	hectopascal	hPa
	35		右		48	a half	1/2
	36		指		49		0/3
	37		走		50	one third	1/3
	38		打		51	two thirds	2/3
	39	liter	ℓ		52	a quarter	1/4
	40	kilogram	kg		53	three quarters	3/4
	41	hertz	Hz		54	one fifth	1/5

	55	two fifths	2/5		66		
	56	three fifths	3/5		67		
	57	four fifths	4/5		68		
	58	one sixth	1/6		69		
	59	five sixths	5/6		70		
	60	one seventh	1/7		71		
	61	one eighth	1/8		72		
	62	one ninth	1/9		73		
	63	one tenth	1/10		74		
	64				75		
	65				76		

	77				88		
	78				89		
	79				90		
	80	cloudy or fair			91		
	81	shower		94	1		
	82	rain			2		
	83	snow			3		
	84	heavy snow			4		
	85	thunder			5		
	86	thunderstorm			6		
	87				7		

	8		Ⅷ		19		⑶
	9		Ⅸ		20		⑷
	10		Ⅹ		21		⑸
	11		Ⅺ		22		⑹
	12		Ⅻ		23		⑺
	13	circled number seventeen	⑰		24		⑻
	14	circled number eighteen	⑱		25		⑼
	15	circled number nineteen	⑲		26		⑽
	16	circled number twenty	⑳		27		⑾
	17		⑴		28		⑿
	18		⑵		29	circled number twenty-one	㉑

	30	circled number twenty-two	㉒		41		(I)
	31	circled number twenty-three	㉓		42		(J)
	32	circled number twenty-four	㉔		43		(K)
	33		(A)		44		(L)
	34		(B)		45		(M)
	35		(C)		46		(N)
	36		(D)		47		(O)
	37		(E)		48		(P)
	38		(F)		49		(Q)
	39		(G)		50		(R)
	40		(H)		51		(S)

	52		(T)		63	circled number twenty-nine	㉙
	53		(U)		64	circled number thirty	㉚
	54		(V)		65	circled digit one	①
	55		(W)		66	circled digit two	②
	56		(X)		67	circled digit three	③
	57		(Y)		68	circled digit four	④
	58		(Z)		69	circled digit five	⑤
	59	circled number twenty-five	㉕		70	circled digit six	⑥
	60	circled number twenty-six	㉖		71	circled digit seven	⑦
	61	circled number twenty-seven	㉗		72	circled digit eight	⑧
	62	circled number twenty-eight	㉘		73	circled digit nine	⑨

	74	circled number ten	⑩		85		❺
	75	circled number eleven	⑪		86		❻
	76	circled number twelve	⑫		87		❼
	77	circled number thirteen	⑬		88		❽
	78	circled number fourteen	⑭		99		❾
	79	circled number fifteen	⑮		90		❿
	80	circled number sixteen	⑯		91		⓫
	81		❶		92		⓬
	82		❷		93	circled number thirty-one	㉛
	83		❸				
	84		❹				

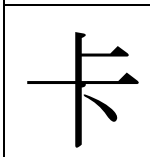
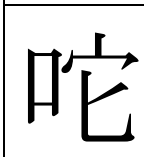
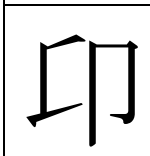
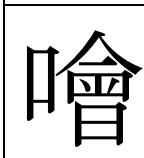
The table 7-10 contains the same characters as those in the table 7-4 except the range from Row 90, Cell 45 to Cell 63, and the range from Row 90, Cell 66 to Cell 84. The characters in Row 90 and 91 rows (except the characters from Cell 45 to Cell 63Cell 66 to Cell 84 in Row 90) are the characters for the system for road and traffic information communication, as specified in ARIB STD-B3 " ARIB Standard for Operation of The FM Multiplex Broadcasting System", version 1.0(August, 1996).
The following table maps each character of the range from Row 90, Cell 45 to Cell 63, and from Row 90, Cell 66 to Cell 84, onto a corresponding code, which is used in the GL area, for the purpose of the reference.

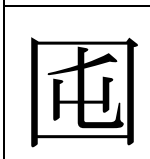
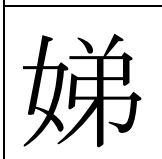
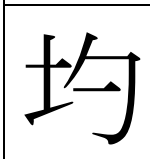
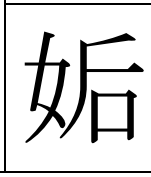
Cell	Code	Cell	Code
45	7A4D	66	7A62
46	7A4E	67	7A63
47	7A4F	68	7A64
48	7A50	69	7A65
49	7A51	70	7A66
50	7A52	71	7A67
51	7A53	72	7A68
52	7A54	73	7A69
53	7A55	74	7A6A
54	7A56	75	7A6B
55	7A57	76	7A6C
56	7A58	77	7A6D
57	7A59	78	7A6E
58	7A5A	79	7A6F
59	7A5B	80	7A70
60	7A5C	81	7A71
61	7A5D	82	7A72
62	7A5E	83	7A73
63	7A5F	84	7A74

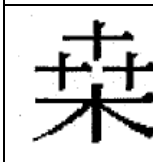
Table 7-11 Addtional Kanji Characters

JIS X0221-1:2001
Universal Multiple-Octet Coded Character Set (UCS)
JIS X0213:
7-bit and 8-bit double byte coded extended KANJI sets for information interchange (including Amendment 1)
JIS X0212-1990
Code of the supplementary Japanese graphic character set for information interchange
ISO/IEC 10646:2003
Universal Multiple-Octet
Character Set (UCS)

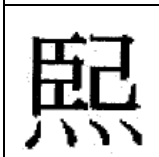
1	JIS X0213: 1-14-3 JIS X0221: U+3402	5	JIS X0213: 2-1-46 JIS X0212: 17-12 JIS X0221: U+4F9A
			
2	ISO/IEC 10646: U+20158	6	JIS X0213: 1-14-25 JIS X0212: 17-27 JIS X0221: U+4FC9
			
3	JIS X0213: 1-14-9 JIS X0212: 16-47 JIS X0221: U+4EFD	7	JIS X0213: 2-1-78 JIS X0212: 18-06 JIS X0221: U+509C
			
4	JIS X0213: 1-14-10 JIS X0212: 16-49 JIS X0221: U+4EFF	8	JIS X0213: 1-14-45 JIS X0212: 18-56 JIS X0221: U+511E
			
		9	JIS X0213: 2-3-16 JIS X0212: 18-91 JIS X0221: U+51BC
			
		10	JIS X0213: 2-3-40 JIS X0221: U+351F
			

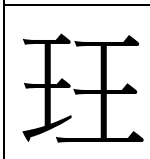
11	JIS X0213: 1-14-76 JIS X0221: U+5307	17	JIS X0213: 1-14-93 JIS X0212: 21-09 JIS X0221: U+5496
			
12	JIS X0213: 1-14-79 JIS X0212: 20-27 JIS X0221: U+5361	18	JIS X0213: 1-14-88 JIS X0212: 21-10 JIS X0221: U+549C
			
13	JIS X0213: 2-3-53 JIS X0212: 20-30 JIS X0221: U+536C	19	JIS X0213: 1-15-1 JIS X0212: 21-15 JIS X0221: U+54A9
			
14	JIS X0213: 1-92-8 JIS X0221: U+8A79	20	JIS X0213: 1-15-4 JIS X0212: 21-44 JIS X0221: U+550E
			
15	ISO/IEC 10646: U+20BB7	21	JIS X0213: 2-4-5 JIS X0212: 21-57 JIS X0221: U+554A
			
16	JIS X0213: 1-14-87 JIS X0212: 20-82 JIS X0221: U+544D	22	JIS X0213: 1-15-25 JIS X0212: 22-50 JIS X0221: U+5672
			

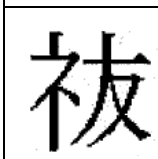
23	JIS X0212: 22-87 JIS X0221: U+56E4	29	JIS X0213: 1-15-82 JIS X0212: 25-52 JIS X0221: U+5A23
			
24	JIS X0213: 1-15-37 JIS X0212: 23-23 JIS X0221: U+5733	30	JIS X0213: 2-5-61 JIS X0212: 25-65 JIS X0221: U+5A55
			
25	JIS X0213: 1-15-38 JIS X0212: 23-24 JIS X0221: U+5734	31	JIS X0213: 1-47-58 JIS X0221: U+5BEC
			
26	JIS X0213: 1-15-55 JIS X0221: U+FA10	32	JIS X0213: 1-47-82 JIS X0221: U+FA11
			
27	JIS X0212: 24-27 JIS X0221: U+5880	33	JIS X0213: 1-47-79 JIS X0221: U+37E2
			
28	JIS X0213: 2-5-50 JIS X0212: 25-36 JIS X0221: U+59E4	34	JIS X0213: 2-12-5 JIS X0212: 28-42 JIS X0221: U+5EAC
			

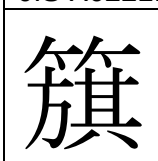
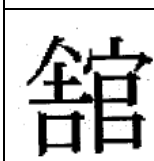
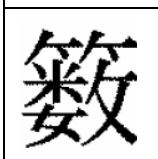
35	JIS X0213: 1-84-22 JIS X0212: 28-77 JIS X0221: U+5F34	41	JIS X0213: 1-85-18 JIS X0212: 34-05 JIS X0221: U+6624
			
36	JIS X0213: 1-84-26 JIS X0212: 28-84 JIS X0221: U+5F45	42	JIS X0213: 1-85-40 JIS X0212: 34-66 JIS X0221: U+66C8
			
37	JIS X0213: 1-84-37 JIS X0221: U+5FB7	43	JIS X0221: U+66D9 (JIS X0213: 1-29-76の異体字)
			
38	JIS X0213: 2-12-39 JIS X0212: 29-54 JIS X0221: U+6017	44	JIS X0213: 1-85-44 JIS X0212: 34-77 JIS X0221: U+66FA
			
39		45	JIS X0213: 1-85-23 JIS X0212: 34-31 JIS X0221: U+66FB
			
40	JIS X0213: 1-84-58 JIS X0212: 30-41 JIS X0221: U+6130	46	
			

47		53	ISO/IEC 10646: U+233CC
			
48	JIS X0212: 36-25 JIS X0221: U+6911	54	ISO/IEC 10646: U+233FE
			
49	JIS X0213: 2-15-11 JIS X0212: 36-33 JIS X0221: U+693B	55	JIS X0213: 1-85-82 ISO/IEC 10646: U+235C4
			
50	JIS X0213: 1-86-12 JIS X0212: 37-06 JIS X0221: U+6A45	56	JIS X0213: 2-78-13 JIS X0212: 38-31 JIS X0221: U+6BF1
			
51	JIS X0213: 2-15-62 JIS X0212: 37-29 JIS X0221: U+6A91	57	JIS X0213: 1-86-61 JIS X0212: 39-03 JIS X0221: U+6CE0
			
52	JIS X0213: 1-22-91 JIS X0221: U+6ADB	58	JIS X0213: 1-86-67 JIS X0212: 39-23 JIS X0221: U+6D2E
			

59	JIS X0213: 1-86-73 JIS X0221: U+FA45	65	JIS X0213: 1-87-25 JIS X0212: 41-07 JIS X0221: U+6FF9
			
60	JIS X0213: 1-86-80 JIS X0212: 39-52 JIS X0221: U+6DBF	66	JIS X0213: 1-87-35 JIS X0212: 41-34 JIS X0221: U+7064
			
61	JIS X0212: 39-55 JIS X0221: U+6DCA	67	
			
62	JIS X0221: U+6DF8	68	ISO/IEC 10646: U+242EE
			
63	JIS X0213: 1-86-87 JIS X0221: U+FA46	69	JIS X0213: 1-87-51 JIS X0212: 41-85 JIS X0221: U+7147
			
64	JIS X0213: 1-87-11 JIS X0212: 40-60 JIS X0221: U+6F5E	70	JIS X0213: 1-87-62 JIS X0212: 42-19 JIS X0221: U+71C1
			

71	JIS X0213: 1-87-66 JIS X0212: 42-30 JIS X0221: U+7200	77	JIS X0221: U+7421
			
72	JIS X0213: 1-87-84 JIS X0212: 43-58 JIS X0221: U+739F	78	JIS X0213: 1-88-5 JIS X0221: U+FA4A
			
73	JIS X0213: 2-80-64 JIS X0221: U+73A8	79	JIS X0213: 1-88-6 JIS X0212: 44-11 JIS X0221: U+7426
			
74	JIS X0213: 1-87-89 JIS X0212: 43-74 JIS X0221: U+73C9	80	JIS X0213: 1-88-8 JIS X0212: 44-14 JIS X0221: U+742A
			
75	JIS X0213: 1-87-91 JIS X0212: 43-80 JIS X0221: U+73D6	81	JIS X0213: 1-88-10 JIS X0212: 44-16 JIS X0221: U+742C
			
76	JIS X0213: 1-88-4 JIS X0212: 44-09 JIS X0221: U+741B	82	JIS X0213: 2-80-80 JIS X0212: 44-22 JIS X0221: U+7439
			

83	JIS X0213: 1-88-17 JIS X0212: 44-28 JIS X0221: U+744B	89	JIS X0213: 2-82-48 JIS X0212: 48-05 JIS X0221: U+78C8
			
84	ISO/IEC 10646: U+3EDA	90	JIS X0213: 2-82-52 JIS X0212: 48-16 JIS X0221: U+78E0
			
85	JIS X0221: U+7575	91	JIS X0213: 1-21-32 JIS X0221: U+7947
			
86	JIS X0213: 2-81-35 JIS X0212: 45-35 JIS X0221: U+7581	92	JIS X0221: U+79AE (JIS X0213: 1-67-25の異体字)
			
87	JIS X0213: 2-82-9 JIS X0212: 47-06 JIS X0221: U+7772	93	
			
88	JIS X0213: 2-82-25 JIS X0221: U+4093	94	
			

95		101	JIS X0213: 1-90-7 JIS X0212: 51-88 JIS X0221: U+7D8B
			
96	JIS X0212: 48-92 JIS X 0221: U+79DA	102	JIS X0212: 53-14 JIS X0221: U+7FA1
			
97	JIS X0213: 2-82-92 JIS X0212: 49-19 JIS X0221: U+7A1E	103	JIS X0213: 1-90-46 JIS X0212: 54-12 JIS X0221: U+8118
			
98	JIS X0213: 2-83-41 JIS X0221: U+7B7F	104	JIS X0212: 54-21 JIS X0221: U+813A
			
99	JIS X0213: 1-89-72 JIS X0212: 50-77 JIS X0221: U+7C31	105	
			
100	JIS X0213: 1-89-77 JIS X0221: U+4264	106	JIS X0213: 1-90-67 JIS X0212: 55-37 JIS X0221: U+82AE
			

107	JIS X0213: 1-19-75 JIS X0221: U+845B	113	JIS X0213: 1-91-66 JIS X0221: U+87EC
	葛		蟬
108	JIS X0213: 2-86-53 JIS X0212: 57-01 JIS X 0221: U+84DC	114	JIS X0213: 2-87-92 JIS X0212: 59-77 JIS X0221: U+880B
	酘		蠋
109	JIS X0213: 1-43-9 JIS X0221: U+84EC	115	JIS X0213: 1-91-77 JIS X0212: 60-51 JIS X0221: U+88F5
	蓬		裹
110	JIS X0213: 1-91-24 JIS X0212: 57-40 JIS X0221: U+8559	116	JIS X0221: U+89D2 (JIS X0213: 1-19-49の異体字)
	蕙		
111	JIS X0213: 1-91-34 JIS X0212: 57-83 JIS X0221: U+85CE	117	JIS X0213: 1-92-13 JIS X0212: 62-21 JIS X0221: U+8AF6
	蟲		諶
112	JIS X0213: 1-31-10 JIS X0221: U+8755	118	JIS X0213: 1-92-33 JIS X0212: 63-68 JIS X0221: U+8DCE
	蝕		跎

119	JIS X0213: 1-36-52 JIS X0221: U+8FBB	125	JIS X0213: 2-90-56 JIS X0212: 67-48 JIS X0221: U+9233
			
120	JIS X0212: 65-40 JIS X 0221: U+8FF6	126	JIS X0213: 1-93-14 JIS X0212: 67-88 JIS X0221: U+9288
			
121	JIS X0213: 1-92-70 JIS X0212: 66-10 JIS X0221: U+90DD	127	JIS X0213: 1-93-23 JIS X0212: 68-62 JIS X0221: U+9321
			
122	JIS X0213: 1-92-80 JIS X0212: 66-39 JIS X0221: U+9127	128	JIS X0213: 1-93-25 JIS X0212: 68-73 JIS X0221: U+9348
			
123	JIS X0213: 1-37-2 JIS X0221: U+912D	129	JIS X0221: U+9592
			
124	JIS X0212: 66-88 JIS X0221: U+91B2	130	JIS X0213: 1-93-66 JIS X0212: 70-88 JIS X0221: U+96DE
			

131	JIS X0221: U+9903 (JIS X0213: 1-81-13の異体字)
	餃
132	JIS X0213: 2-92-68 JIS X0212: 72-72 JIS X 0221: U+9940
	餡
133	JIS X0221: U+9AD9
	髙
134	JIS X0213: 1-27-10 JIS X0221: U+9BD6
	鯖
135	JIS X0213: 1-94-69 JIS X0212: 76-31 JIS X0221: U+9DD7
	鷗
136	JIS X0213: 1-94-79 JIS X0212: 76-79 JIS X0221: U+9EB4
	麹

137	JIS X0213: 1-94-80 JIS X0212: 76-80 JIS X0221: U+9EB5
	麺

Row	Cell	Graphic Symbol	Row	Cell	Graphic Symbol
85	1	1	85	48	48
	2	2		49	49
	3	3		50	50
	4	4		51	51
	5	5		52	52
	6	6		53	53
	7	7		54	54
	8	8		55	55
	9	9		56	56
	10	10		57	57
	11	11		58	58
	12	12		59	59
	13	13		60	60
	14	14		61	61
	15	15		62	62
	16	16		63	63
	17	17		64	64
	18	18		65	65
	19	19		66	66
	20	20		67	67
	21	21		68	68
	22	22		69	69
	23	23		70	70
	24	24		71	71
	25	25		72	72
	26	26		73	73
	27	27		74	74
	28	28		75	75
	29	29		76	76
	30	30		77	77
	31	31		78	78
	32	32		79	79
	33	33		80	80
	34	34		81	81
	35	35		82	82
	36	36		83	83
	37	37		84	84
	38	38		85	85
	39	39		86	86
	40	40		87	87
	41	41		88	88
	42	42		89	89
	43	43		90	90
	44	44		91	91
	45	45		92	92
	46	46		93	93
	47	47		94	94

Row	Cell	Graphic Symbol

86	1	95
	2	96
	3	97
	4	98
	5	99
	6	100
	7	101
	8	102
	9	103
	10	104
	11	105
	12	106
	13	107
	14	108
	15	109
	16	110
	17	111
	18	112
	19	113
	20	114
	21	115
	22	116
	23	117
	24	118
	25	119
	26	120
	27	121
	28	122
	29	123
	30	124
	31	125
	32	126
	33	127
	34	128
	35	129
	36	130
	37	131
	38	132
	39	133
	40	134
	41	135
	42	136
	43	137

Note:

When the JIS compatible Kanji Plane 1 set is operated, glyph of each Kanji character in Table 7-12 is the same as that in the JIS compatible Kanji Plane 1 set. Note that this does not imply that the added Kanji characters in Table 7-12 are not operated as added Kanji characters.

Table 7-12 Additional kanji characters that have identical characters in JIS compatible

Kanji Plane 1

Additional Kanji Character in Row-Cell in the additional Kanji set	Characters in Row-Cell in the JIS compatible Kanji Plane 1 set
85-52	1-22-91
85-91	1-21-32
86-13	1-19-75
86-15	1-43-9
86-18	1-31-10
86-25	1-36-52
86-29	1-37-2
86-40	1-27-10

Table 7-13 Types and area of codes

Types	Code, etc.	Using condition		
		In combination by non-spacing character	In code sequence repeated by RPC	During starting till ending of CCC combination
Null	NUL	O	O	O
Active position control	APF, PAPF, APB, APD, APU, APR, APS, ACPS	-	-	-
Extension control	Control function of designation and invocation	O	O	O
Information separator	RS, US	-	-	-
Bell	BEL	-	-	-
Clear screen	CS	-	-	-
Cancel	CAN	-	-	-
Special function	SP, DEL	T	T	O
Colouring	BKF ~ WHF, COL	-	O *1	-
Character size	SSZ ~ NSZ, SZX	-	O	-
Flashing	FLC	-	O	-
Conceal	CDC	-	O *2	-
Pattern polarity	POL	-	O	-
Writing mode	WMM	-	-	-
Macro definition	MACRO	-	-	-
Highlighting control	HLC	-	O	-
Repeat character	RPC	-	-	-
Lining	STL, SPL	-	O	-
Time control	TIME	-	-	-
Set writing format	SWF	-	-	-
Character composition	CCC	T	T	-
Character set	Spacing character, mosaic A, B, external character	T	T	O
	Non-spacing character, mosaic C, D	O	O	O

Note 1: O: Usable, -: Not usable, T: Usable in termination
Note 2: In macro character, usable area is decided for developed code sequence.
Note 3: *1: Palette selection is excluded.
*2: Only for simple conceal

Table 7-14 Control function character set code table

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
0	NUL		SP						BKF	COL	10/0					
1									RDF	FLC						
2									GRF	CDC						
3									YLF	POL						
4									BLF	WMM						
5									MGF	MACRO						
6		PAPF							CNF							
7	BEL								WHF	HLC						
8	APB	CAN							SSZ	RPC						
9	APF	SS2							MSZ	SPL						
10	APD								NSZ	STL						
11	APU	ESC							SZX	CSI						
12	CS	APS														
13	APR	SS3								TIME						
14	LS1	RS														
15	LS0	US						DEL								15/15
	C0 area								C1 area							

Note 1: RS: Record separator, US: Unit separator
Note 2: Blanks of C0 area and C1 area are undefined.

Table 7-15 C0 control set

C0 control code	Control function	Function represented
NUL	Null	Control code, which can be added or deleted without effecting to information content.
BEL	Bell	Control code used when calling attention (alarm or signal)
APB	Active position backward	Active position goes backward along character path in the length of character path of character field. When the reference point of the character field exceeds the edge of display area by this movement, move in the opposite side of the display area along the character path of the active position, for active position up.
APF	Active position forward	Active position goes forward along character path in the length of character path of character field. When the reference point of the character field exceeds the edge of display area by this movement, move in the opposite side of the display area along the character path of the active position, for active position down.
APD	Active position down	Moves to next line along line direction in the length of line direction of the character field. When the reference point of the character field exceeds the edge of display area by this movement, move to the first line of the display area along the line direction.
APU	Active position up	Moves to the previous line along line direction in the length of line direction of the character field. When the reference point of the character field exceeds the edge of display area by this movement, move to the last line of the display area along the line direction.
APR	Active position return	Active position down is made, moving to the first position of the same line.
PAPF	Parameterized active position forward	Active position forward is made in specified times by parameter P1 (1 byte). Parameter P1 shall be within the range of 04/0 to 07/15 and time shall be specified within the range of 0 to 63 in binary value of 6-bit from b6 to b1. (b8 and b7 are not used.)
APS	Active position set	Specified times of active position down is made by P1 (1 byte) of the first parameter in line direction length of character field from the first position of the first line of the display area. Then specified times of active position forward is made by the second parameter P2 (1 byte) in the character path length of character field. Each parameter shall be within the range of 04/0 to 07/15 and specify time within the range of 0 to 63 in binary value of 6-bit from b6 to b1. (b8 and b7 are not used.)
CS	Clear screen	Display area of the display screen is erased.
CAN	Cancel	From the current active position to the end of the line is covered with background colour in the width of line direction in the current character field. Active position is not moved.
ESC	Escape	Code for code extension.
LS1	Locking shift 1	Code to invoke character code set.
LS0	Locking shift 0	Code to invoke character code set.
SS2	Single shift 2	Code to invoke character code set.
SS3	Single shift 3	Code to invoke character code set.
RS	Record separator	It is information division code and declares identification and introduction of data header.
US	Unit separator	It is information division code and declares identification and introduction of data unit.

Table 7-16 C1 control set

C1 control code	Function	Description
BKF	BLACK FOREGROUND	Foreground colour: black , CMLA: 0 (This indicates that foreground colour is set to black and colour map lower address (CMLA) specifying colouring value of the portrayal plane is set to 0. Same as follows.)
RDF	Red Foreground	Foreground colour: red , CMLA: 1
GRF	Green Foreground	Foreground colour: green , CMLA: 2
YLF	Yellow Foreground	Foreground colour: yellow , CMLA: 3
BLF	Blue Foreground	Foreground colour: blue , CMLA: 4
MGF	Magenta Foreground	Foreground colour: magenta , CMLA: 5
CNF	Cyan Foreground	Foreground colour: cyan , CMLA: 6
WHF	White Foreground	Foreground colour: white , CMLA: 7
COL	Colour Controls	Colour control COL P1 (1 byte) Sets foreground colour, background colour, half foreground colour, half background colour and CMLA by the parameter. Colour between foreground and background in gradation font is defined that colour near to foreground colour is half foreground colour and colour near to background colour is half background colour. COL 04/8: foreground colour - transparent , CMLA 8 COL 04/9: foreground colour - half intensity red , CMLA 9 (Half intensity: intensity reduced than the full intensity) COL 04/10: foreground colour - half intensity green , CMLA 10 COL 04/11: foreground colour - half intensity yellow , CMLA 11 COL 04/12: foreground colour - half intensity blue , CMLA 12 COL 04/13: foreground colour - half intensity magenta , CMLA 13 COL 04/14: foreground colour - half intensity cyan , CMLA 14 COL 04/15: foreground colour - half intensity white , CMLA 15 COL 05/0: background colour - black , CMLA 0 COL 05/1: background colour - full intensity red , CMLA 1 COL 05/2: background colour - full intensity green , CMLA 2 COL 05/3: background colour - full intensity yellow , CMLA 3 COL 05/4: background colour - full intensity blue , CMLA 4 COL 05/5: background colour - full intensity magenta , CMLA 5 COL 05/6: background colour - full intensity cyan , CMLA 6 COL 05/7: background colour - full intensity white , CMLA 7 COL 05/8: background colour -transparent , CMLA 8 COL 05/9: background colour - half intensity red , CMLA 9 COL 05/10: background colour - half intensity green , CMLA 10 COL 05/11: background colour - half intensity yellow , CMLA 11 COL 05/12: background colour - half intensity blue , CMLA 12 COL 05/13: background colour - half intensity magenta , CMLA 13 COL 05/14: background colour - half intensity cyan , CMLA 14 COL 05/15: background colour - half intensity white , CMLA 15 COL 06/0: half foreground colour - black , CMLA 0 COL 06/1: half foreground colour - full intensity red , CMLA 1 COL 06/2: half foreground colour - full intensity green , CMLA 2 COL 06/3: half foreground colour - full intensity yellow , CMLA 3 COL 06/4: half foreground colour - full intensity blue , CMLA 4

C1 control code	Function	Description
		COL 06/5: half foreground colour - full intensity magenta , CMLA 5 COL 06/6: half foreground colour - full intensity cyan , CMLA 6 COL 06/7: half foreground colour - full intensity white , CMLA 7 COL 06/8: half foreground colour - transparent , CMLA 8 COL 06/9: half foreground colour - half intensity red , CMLA 9 COL 06/10: half foreground colour - half intensity green , CMLA 10 COL 06/11: half foreground colour - half intensity yellow , CMLA 11 COL 06/12: half foreground colour - half intensity blue , CMLA 12 COL 06/13: half foreground colour - half intensity magenta , CMLA 13 COL 06/14: half foreground colour - half intensity cyan , CMLA 14 COL 06/15: half foreground colour - half intensity white , CMLA 15 COL 07/0: half background colour - black , CMLA 0 COL 07/1: half background colour - full intensity red , CMLA 1 COL 07/2: half background colour - full intensity green , CMLA 2 COL 07/3: half background colour - full intensity yellow , CMLA 3 COL 07/4: half background colour- full intensity blue , CMLA 4 COL 07/5: half background colour - full intensity magenta , CMLA 5 COL 07/6: half background colour- full intensity cyan , CMLA 6 COL 07/7: half background colour - full intensity white , CMLA 7 COL 07/8: half background colour- transparent , CMLA 8 COL 07/9: half background colour- half intensity red , CMLA 9 COL 07/10: half background colour- half intensity green , CMLA 10 COL 07/11: half background colour - half intensity yellow , CMLA 11 COL 07/12: half background colour - half intensity blue , CMLA 12 COL 07/13: half background colour - half intensity magenta , CMLA 13 COL 07/14: half background colour- half intensity cyan , CMLA 14 COL 07/15: half background colour - half intensity white , CMLA 15
		Palette control COL P1 (1 byte) P2 (1 byte) Specifies palette number by parameter COL 02/0 04/0 : Palette number 0 COL 02/0 04/1 : Palette number 1 COL 02/0 04/2 : Palette number 2 COL 02/0 04/3 : Palette number 3 COL 02/0 04/4 : Palette number 4 COL 02/0 04/5 : Palette number 5 COL 02/0 04/6 : Palette number 6 COL 02/0 04/7 : Palette number 7 COL 02/0 04/8 : Palette number 8 COL 02/0 04/9 : Palette number 9 COL 02/0 04/10 : Palette number 10 COL 02/0 04/11 : Palette number 11 COL 02/0 04/12 : Palette number 12 COL 02/0 04/13 : Palette number 13 COL 02/0 04/14 : Palette number 14 COL 02/0 04/15 : Palette number 15
POL	Pattern Polarity Controls	Specifies the pattern polarity of the character and the mosaic indicating the code after POL P1 (1 byte). When non-spacing character is included, it specifies the pattern polarity after composition. For intermediate colour in the gradation font, half foreground colour is converted to the half background colour and the half background colour is converted to half foreground colour. POL 04/0: normal polarity POL 04/1: inverted polarity 1 (Foreground and background colours are inverted in the whole display block) POL 04/2: inverted polarity 2

C1 control code	Function	Description
		(Foreground and background colours are inverted in the design frame)
SSZ	Small Size	Specifies the character size is small.
MSZ	Middle Size	Specifies the character size is middle.
NSZ	Normal Size	Specifies the character size is normal.
SZX	Character Size Controls	The character size is set in parameter P1 (1 byte). SZX 06/0: Tiny size SZX 04/1: Double height SZX 04/4: Double width SZX 04/5: Double height and width SZX 06/11 : Special 1 SZX 06/4: Special 2
FLC	Flashing control	Specifies the beginning and the end of flashing and the differences of the normal phase and the reverse phase by the parameter P1 (1 byte). FLC 04/0: Start normal phase flashing (This indicates the flashing which first starts in the same screen.) FLC 04/7: Start inverted phase flashing (This indicates the flashing of bright and dark phases are inverted to the normal phase flashing.) FLC 04/15: Stop flashing
CDC	Conceal Display Controls	Specifies the beginning and end of concealing and the type of concealing by the parameter. (1) Single concealment mode CDC P1 (1 byte) CDC 04/0: Start conceal CDC 04/15: Stop conceal For decoding and displaying in single concealment mode, the display function in the code line from the beginning and the end of concealing is taken over and the whole display block is in background colour. (2) Replacing conceal CDC P1 (1 byte) P2 (1 byte) CDC 02/0 04/0 : Simple replacing conceal start CDC 02/0 04/1 : Start 1st-step replacing conceal CDC 02/0 04/2 : Start 2nd-step replacing conceal CDC 02/0 04/3 : Start 3rd-step replacing conceal CDC 02/0 04/4 : Start 4th-step replacing conceal CDC 02/0 04/5 : Start 5th-step replacing conceal CDC 02/0 04/6 : Start 6th-step replacing conceal CDC 02/0 04/7 : Start 7th-step replacing conceal CDC 02/0 04/8 : Start 8th-step replacing conceal CDC 02/0 04/9 : Start 9th-step replacing conceal CDC 02/0 04/10 : Start 10th-step replacing conceal CDC 04/15 : Stop conceal (only P1 (1 byte)) For decoding and displaying the conceal status, the code line from the simple replacing conceals starts or from replacing conceal 1st step to replacing conceal 10th step start to conceal end are omitted and succeeding of the display function of those code lines are not made. Canceling of conceal status is made by displaying decoded code lines of simple replacing conceal start or replacing conceal 1st step start and replacing conceal 10th step start to conceal end of the corresponding conceal sentence.
WMM	Writing Mode Modification	This Specifies the changing of the writing mode to the memory of display by parameter P1 (1 byte). For middle colour of gradation font, both set portions of half foreground colour and half background colours are to be treated as foreground colour. WMM 04/0: Mode to write portions set as foreground colour and background colour. WMM 04/4: Mode to write portion only set as foreground colour. WMM 04/5: Mode to write portion only set as background colour

<table>
<tr><th>C1 control code</th><th>Function</th><th>Description</th></tr>
<tr><td>TIME
(Note 1)</td><td>Time Controls</td><td>The time control designation is made by parameter P1 (1 byte) and P2 (1 byte)
(1) Wait for process: TIME 02/0 P2
Processing of code as of this code is stopped for set duration by parameter P2. Parameter P2 is in the range of 04/0 to 07/15 and set by binary of 6 bit from b6 to b1. (b7 and b8 are not used.) Designating time should be 0.1 sec.
(5) Time control mode (TMD): TIME 02/8 P2
TIME 02/8 04/0: Free
TIME 02/8 04/1: Real
TIME 02/8 04/2: Offset
TIME 02/8 04/3: Unique
(6) Presentation start time (STM), Playback time (DTM), Offset time (OTM), Performance time (PTM), Display end time (ETM): TIME, P, P11--- P1i, I1, P21 --- P2j, I2, P31 --- P3k, I3, P41 --- P4m, I, F P = 02/9
P11 --- P1i = 03/0 - 03/9 (decimal) time
P21 --- P2j = 03/0 - 03/9 (decimal) minute
P31 --- P3k = 03/0 - 03/9 (decimal) second
P41 --- P4m = 03/0 - 03/9 (decimal) millisecond
I1 ~ I3 = 03/11
I = 02/0
F = 04/0 Presentation start time, playback time, F = 04/1 Offset time, F = 04/2 Performance time, F = 04/3 Display end time
At performance time, I3, P41 --- P4m is not sent out.</td></tr>
<tr><td>MACRO</td><td>Macro
Command</td><td>Macro definition start, macro definition mode and macro definition end is set by parameter P1 (1 byte).
MACRO 04/0: Macro definition starts
MACRO 04/1: Macro definition starts and defined macro statement is executed once.
MACRO 04/15: The definition or execution of macro ends.
Macro definition code lines the examples of are constructed by macro definition start, macro numbers (MC) from 02/1 to 07/14, macro body of optional code line and macro definition end. However, macro body does not include macro definitions. End of macro statement is set by macro definition end,new macro definition start, new macro definition start and execution. The structure is shown as below.
<table>
<tr><td>MACRO</td><td>04/0</td><td>MC</td><td>Macro body</td><td>MACRO</td><td>04/15</td></tr>
</table></td></tr>
<tr><td>RPC</td><td>Repeat
Character</td><td>The repeat code RPC with one parameter P1 (1 byte) causes a displayable character or mosaic that immediately follows the code, to be displayed a number of times specified by the parameter P1.
The byte should be from columns 04/0 through 07/15. The repeat count is given by the binary number, comprising bits b6 through b1. (b7 and b8 are not used.)
RPC 04/0 has a special meaning that repeat to the end of line. Without changing the character field, active position down is made, moving to the first position of the same line.
The displayed character or mosaic means that the characters after when composition of non-spacing characters, non-spacing mosaic or composition by composition command is made.
Codes and characters displayed repeatedly and codes which can be used between mosaics should be as shown in table 7-10.</td></tr>
<tr><td>STL</td><td>Start Lining</td><td>The composition of mosaic A and B in the display after this code, is not made. When mosaic is included during composing non-spacing and composition command, dividing process (mosaic element is classified in small elements by 1/2 across direction and 1/3 length making space surrounding them) should be made after composition. In other cases, make underlines.
Underline is added at the bottom of the display division with the width of 1/24 of the standard display block height (1/10 in case of horizontal writing form).</td></tr>
</table>

C1 control code	Function	Description
SPL	Stop Lining	Underlining and mosaic division process is terminated.
HLC	HIGHLIGHTING CHARACTER BLOCK	Starting and ending of enclosure are set by parameter P1 (1 byte). HLC 04/0 : Enclosure ends HLC 04/1 : Enclosure 1 starts HLC 04/2 : Enclosure 2 starts HLC 04/3 : Enclosure 3 starts HLC 04/4 : Enclosure 4 starts HLC 04/5 : Enclosure 5 starts HLC 04/6 : Enclosure 6 starts HLC 04/7 : Enclosure 7 starts HLC 04/8 : Enclosure 8 starts HLC 04/9 : Enclosure 9 starts HLC 04/10 : Enclosure 10 starts HLC 04/11 : Enclosure 11 starts HLC 04/12 : Enclosure 12 starts HLC 04/13 : Enclosure 13 starts HLC 04/14 : Enclosure 14 starts HLC 04/15 : Enclosure 15 starts Enclosure command controls to add frame composed of the external four sides of the display block. Designation of the side to add the frame is made by b4 to b1 of parameter P1. B1 Specifies the side of the next line, b2, the side of next character, b3, the side of the previous line, and b4, the side of the previous character, respectively. When each of them are "1", frame is added and when "0", frame is not added. Line width of enclosure should be 1/24 of the standard display block height and in case of horizontal writing form, the width should be 1/10 of the height.
CSI	Control Sequence Introducer	Code for code system extension indicated in table 7-14.

Note 1: TMD, STM, DTM, OTM, PTM and ETM are added to TIME.

Table 7-17 Extension control code (CSI)

Control code	Function	DESCRIPTION
SWF	Set Writing Format	Select initialization with parameter P1 (1 or multiple codes) and initializing is done. Code sequence: CSI P11 ~ P1i I1F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (decimal number specifying format) I1: 02/0 (intermediate character) F: 05/3 (final character) *Decimal numbers specifying format are as follows. 0: horizontal writing form in standard density 1: vertical writing form in standard density 2: horizontal writing form in high density 3: vertical writing form in high density 4: horizontal writing form in Western language 5: horizontal writing form in 1920 x 1080 6: vertical writing form in 1920 x 1080 7: horizontal writing form in 960 x 540 8: vertical writing form in 960 x 540 9: horizontal writing form in 720 x 480 10: vertical writing form in 720 x 480 11: horizontal writing form in 1280 x 720 12: vertical writing form in 1280 x 720 The character display direction, character size, which is the unit of character numbers and lines, character numbers in a line and line numbers are given to set the character format by using four types of parameter, P1 (1 code), P2 (1 code), P3 (1 or multiple codes) and P4 (0 or multiple codes). Code sequence: CSI P1 I1 P2 I2 P31 ~ P3i I3 P41 ~ P4j I4F CSI: 09/11 (control sequence introducer) P1: 03/8 (horizontal writing form) P2: 03/0 (small size) 03/1 (middle size) 03/3 (standard size) P31 ~ P3i: 03/0 ~ 03/9 (character numbers in one line in decimal) P41 ~ P4j: 03/0 ~ 03/9 (line numbers in decimal) I1 ~ I3: 03/11 (middle character) I4: 02/0 (middle character) F: 05/3 (final character) *In P3 and P4, 03/0 to 03/9 indicate 0 to 9. *When the line number is not set, I3 and P4 can be omitted.
CCC	Composite Character Composition	Composition command pattern of characters and mosaic etc. can be set by parameter P1 (1 code). Code sequence: CSI P1 I1 F CSI: 09/11 (control sequence introducer) P1: 03/2 OR composition starts 03/3 AND composition starts 03/4 XOR composition starts 03/0 composition ends I1: 02/0 (middle character) F: 05/4 (final character)
RCS	Raster Colour command	Raster colour is set by parameter P1 (1 or multiple codes). Code sequence: CSI P11 ~ P1i IF CSI: 09/11 (control sequence introducer)

Control code	Function	DESCRIPTION
		P11 ~ P1i: 03/0 ~ 03/9 (decimal number specifying colour) I: 02/0 (middle character) F: 06/14 (final character) *In P, 03/0 to 03/9 indicates 0 to 9. *Decimal numbers specifying colour are as follows; 0: black 1: full intensity red 2: full intensity green 3: full intensity yellow 4: full intensity blue 5: full intensity magenta 6: full intensity cyan 7: full intensity white 8: transparent 9: half intensity red 10: half intensity green 11: half intensity yellow 12: half intensity blue 13: half intensity magenta 14: half intensity cyan 15: half intensity white
ACPS	Active Coordinate Position Set	Reference active point of character display block is set by coordinates measured by left upper corner of logical plane using parameter P1 (1 or multiple codes) and P2 (1 or multiple codes). Code sequence: CSI P11 ~ P1i I1 P21 ~ P2j I2 F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (coordinates in horizontal direction) P21 ~ P2j: 03/0 ~ 03/9 (coordinates in vertical direction) 1: 03/11 (middle character) I2: 02/0 (middle character) F: 06/1 (final character)
SDF	SET DISPLAY FORMAT	Display dot number is set using parameter P1 (1 or multiple codes) and P2 (1 or multiple codes). Code sequence: CSI P11 ~ P1i I1 P21 ~ P2j I2 F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (dot numbers in horizontal direction) P21 ~ P2j: 03/0 ~ 03/9 (dot numbers in vertical direction) I1: 03/11 (middle character) I2: 02/0 (middle character) F: 05/6 (final character)
SDP	Set Display Position	The display position of character display is set by position coordinates of left upper angle, using parameter P1 (1 or multiple codes) and P2 (1 or multiple codes). Code sequence: CSI P11 ~ P1i I1 P21 ~ P2j I2F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (coordinates in horizontal direction) P21 ~ P2j: 03/0 ~ 03/9 (coordinates in vertical direction) I1: 03/11 (middle character) I2: 02/0 (middle character) F: 05/15 (final character)
SSM	Character composition dot designation	Character dot is set using parameter P1 (1 or multiple codes) and P2 (1 or multiple codes). Code sequence: CSI P11 ~ P1i I1 P21 ~ P2j I2 F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (dot numbers in horizontal direction) P21 ~ P2j: 03/0 ~ 03/9 (dot numbers in vertical direction) I1: 03/11 (middle character) I2: 02/0 (middle character) F: 05/7 (final character)

Control code	Function	DESCRIPTION
PLD	Partially Line Down	Active position moves towards the next line along line direction in half-length of line direction of the design frame. When reference point exceeds the display area by this movement, its PLD is ignored. Code sequence: CSI 5/11
PLU	Partialyl Line Up	Active position moves towards the previous line along line direction in half-length of line direction of the design frame. When reference point exceeds the display area by this movement, its PLU is ignored. Code sequence: CSI 5/12
SHS	Set Horizontal Spacing	Length of operation direction in the character field is set using parameter P1 (1 or multiple codes). By this operation, active point movement is made by the unit of length of frame design adding character spacing. Code sequence: CSI P11 ~ P1iI1F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 - 03/9 (Dot number in operation direction) I1: 02/0 (middle character) F: 05/8 (final character)
SVS	Set Vertical Spacing	Length of line direction of character field is set using parameter P1 (1 or multiple code). By this operation, the line movement transition's unit becomes the length of the space between the lines added to the frame design. Code sequence: CSI P11 ~ P1I I1 F CSI: 09/11 (control sequence introducer) P11 ~ P1I: 03/0 - 03/9 (Dot number in operation direction) I1: 02/0 (middle character) F: 05/9 (final character)
GSM	Character deformation	Deformation of a character is set using parameter P1 (1 or multiple codes) and P2 (1 or multiple codes). Code sequence: CSI P11 ~ P1i I1 P21 ~ P2j I2 F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 (magnification in line direction x 10) P21 ~ P2j: 03/0 ~ 03/9 (magnification in operation direction x 10) I1: 03/11 (middle character) I2: 02/0 (middle character) F: 04/2 (final character)
GAA	Colouring block	Colouring block of character is set using parameter P1 (1 code). CSI: 09/11 (control sequence introducer) P1: 03/0 whole display block 03/1 design frame I1: 02/0 (middle character) F: 05/13 (final character)
SRC	Raster Colour Designation	Designation of superimpose display is made using parameter P1 (1 code) and designation of Raster colour is made using P2 (4 codes). Code sequence: CSI P1 I1 P21 P22 P23 P24 I2 F CSI: 09/11 (control sequence introducer) P1: 03/0 background is Raster colour and boxing display 03/1 background is transparent and simple superimpose 03/2 background is transparent and superimposed with hemming 03/3 background is transparent and superimposed with shadow I1: 03/11 (middle character)

Control code	Function	DESCRIPTION
		P21 P22: 03/0 ~ 03/9 (upper 4 bit of colour map address) P23 P24: 03/0 ~ 03/9 (lower 4 bit of colour map address) I2: 02/0 (middle character) F: 05/14 (final character) Relation of colour map and colouring is decided for each service.
TCC	Switch control	Specifies the switching of the subtitle by setting the switching mode on Parameter P1 (1 code) by setting the switch direction on Parameter P2 (1 code) and by Parameter P3 (one or multiple codes) Switching method of display of character groups composed by one character immediately after the switching control code or characters followed immediately after the switching control code is set. After control to a character or one character group is finished, it returns to display of normal overwriting condition. Code sequence: CSI P1 I1 P2 I2 P31 ~ P3i I3 F CSI: 09/11 (control sequence introducer) P1: 03/0 ~ 03/9 switching mode designation 03/0: character group, cut 03/1: character group, dissolve 03/2: character group, wipe 03/3: character group, roll 03/4: character group, slide 03/5: each character, cut 03/6: each character, dissolve 03/7: each character, wipe 03/8: each character, roll 03/9: each character, slide P2: 03/0 ~ 03/3 switching, direction 03/0: left to right 03/1: right to left 03/2: up to down 03/3: down to up P31 ~ P3i: 03/0 ~ 03/9 switching time designation (decimal in 0.1 sec. unit) I1 ~ I2: 03/11 (middle character) I3: 02/0 (middle character) F: 06/2 (final character) *In P3, 03/0 to 03/9 indicates 0 to 9.
CFS	Character Font Set	The character font is set using parameter P1 (1 or multiple codes) Code sequence CSI P11 ~ P1i I1 F CSI: 09/11 (control sequence introducer) P11 ~ P1i: 03/0 ~ 03/9 font designation (decimal) I1: 02/0 (middle character) F: 06/5 (final character) When font designation is 0, font is not to be set. Font designation number and actual font correspondence is specified differently in operational guideline.
ORN	Ornament Control	Character ornament designation is made using parameter P1 (1 code) and character ornament colour is set using parameter P2 (4 codes) Code sequence: CSI P1 I1 P21 P22 P23 P24 I2 F CSI: 9/11 (control sequence introducer) P1: 03/0: without character decoration 03/1: with hemming 03/2: with shade 03/3: with hollow I1: 3/11 (middle character) P21 P22: 03/0 ~ 03/9 (upper 4 bit of colour map address) P23 P24: 03/0 ~ 03/9 (lower 4 bit of colour map address) I2: 02/0 (middle character) F: 06/3 (final character)

Control code	Function	DESCRIPTION
		Except for hemming and shade, I1, P2 can be omitted. Relation of colour map and colouring is decided in each service.
MDF	Font	The Character is set using parameter P1 (1 code) Code sequence: CSI P1 I1 F CSI: 09/11 (control sequence introducer) P1: 03/0: standard 03/1: bold character 03/2: slanted character 03/3: bold slanted character I1: 02/0 (middle character) F: 06/4 (final character) Character field is deformed by character designation. In this case active position should not be changed.
XCS	External Character Set	When DRCS or third-level characters or forth-level characters cannot be displayed, following defined code sequence is used to display for substitution. Code sequence: CSI P1 I1 F CSI: 09/11 (control sequence introducer) P1: 03/0 definition starts 03/1 definition ends I1: 02/0 (middle character) F: 06/6 (final character) It is placed immediately after DRCS or third or fourth level character code. When DRCS, third or fourth level character is displayed correctly, code lines from the definition start to definition end are ignored.
PRA	Built-in sound replay	Set built-in sound is replayed using parameter P1 (1 or multiple codes). Code sequence: CSI P1 ~ P1i I1 F CSI: 09/11 (control sequence introducer) PI1 ~ P1i: 03/0 ~ 03/9 built-in sound designation (decimal) I1: 02/0 (middle character) F: 06/8 (final character) Built-in sound played back when built-in sound designation is 0 should be the same as that of BEL of C0 control code.
ACS	ALTERNATIVE CHARACTER SET	Set source characters and define alternative characters Code sequence: CSI P1 I1 F CSI: 09/11 (control sequence introducer) P1: 03/0: source character definition start 03/1: source character definition end 03/2: alternative character (alphabet, numeric and katakana) definition start 03/3: alternative character (alphabet, numeric and katakana) definition end 03/4: alternative character (for speech synthesis) definition start 03/5: alternative character (for speech synthesis) definition end I1: 02/0 (middle character) F: 06/9 (final character) More than two alternative characters can be defined for one source character. “Alternative character definition start” is placed immediately after “source character definition end” or another “alternative character definition end”. Coding method of alternative character is specified differently in operational guideline.

Control code	Function	DESCRIPTION
SCS	Skip Character Set	Extended control code immediately after SCS can not be process by receiver, this control code must be skipped to final character of this control code. Code sequence: CSI F CSI: 09/11 (control sequence introducer) F: 06/15 (final character)

Table 7-18 Default macro code strings

Macro code	Default macro code string
6/0	ESC 02/4 F1 ESC 02/9 F2 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/1	ESC 02/4 F1 ESC 02/9 F4 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/2	ESC 02/4 F1 ESC 02/9 02/0 F10 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/3	ESC 02/8 F5 ESC 02/9 F7 ESC 02/10 F8 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/4	ESC 02/8 F5 ESC 02/9 F6 ESC 02/10 F8 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/5	ESC 02/8 F5 ESC 02/9 02/0 F10 ESC 02/10 F8 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/6	ESC 02/8 02/0 F10 ESC 02/9 02/0 F11 ESC 02/10 02/0 F12 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/7	ESC 02/8 02/0 F13 ESC 02/9 02/0 F14 ESC 02/10 02/0 F15 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/8	ESC 02/8 02/0 F16 ESC 02/9 02/0 F17 ESC 02/10 02/0 F18 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/9	ESC 02/8 02/0 F19 ESC 02/9 02/0 F20 ESC 02/10 02/0 F21 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/10	ESC 02/8 02/0 F22 ESC 02/9 02/0 F23 ESC 02/10 02/0 F24 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/11	ESC 02/4 F1 ESC 02/9 02/0 F11 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/12	ESC 02/4 F1 ESC 02/9 02/0 F12 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/13	ESC 02/4 F1 ESC 02/9 02/0 F13 ESC 02/10 F3 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/14	ESC 02/8 F4 ESC 02/9 F3 ESC 02/10 F2 ESC 02/11 02/0 F9 LS0 ESC 07/13
6/15	ESC 02/8 F2 ESC 02/9 F5 ESC 02/10 02/0 F10 ESC 02/11 02/0 F9 LS0 ESC 07/13

Note 1: F1: Kanji, F2: Alphanumeric, F3: Hiragana, F4: Katakana
F5: Mosaic A, F6: Mosaic B, F7: Mosaic C, F8: Mosaic D
F9: Macro, F10: DRCS-1, F11: DRCS-2, ---
F23: DRCS-14, F24: DRCS-15

Note 2: When macro code is 2/1 to 5/15 and 7/0 to 7/14, default macro code string should be left blank.

7.2 Universal multi-octet coded Character Set

The Character coding of Universal multi-octet coded Character Set (UCS) shall be in accordance with JIS X0221.

7.2.1 Classes and coding structure of character code set

7.2.1.1 Coding architecture and coding structure

The coding architecture shall be based on the 2-octet format and the coding architecture shall be in compliance with ISO/IEC 10646:2003 Information technology -- Universal Multiple-Octet Coded Character Set (UCS). When other characters than those in the Basic Multilingual Plane (BMP) are needed for reference, UTF-16 or UCS-4 should be used. The coded character set that is valid for this standard consists of the coded character set defined in ISO/IEC 10646:2003. However, the following basic character set can be used as a subset instead of support of whole characters define in ISO/IEC 10646:2003..

Basic character set

The basic character set defines the set that consists of the Kanji set, alphanumerical set, Hiragana set, Katakana set and additional symbols set defined in Clause 7.1.1.2[1]. To reference any character belonging to Rows 90 to 94 in the Kanji set, the corresponding character defined in the additional symbols set should be used. For more code values of the characters in the Kanji set, Hiragana set, and Katakana set, refer to JIS X 0213:2004. For code values of the alphanumerical set, refer to JIS X 0201-1997. For code values of the additional symbols set, refer to Tables 7-19 and 7-20[2]

Table 7-19 Code Values for Added Symbols Set

Cell Row	1	2	3	4	5	6	7	8	9	10	11	12
85	E080	E081	4EFD	4EFF	4F9A	4FC9	509C	511E	51BC	E082	5307	5361
86	E093	79DA	7A1E	7B7F	7C31	E094	7D8B	7FA1	8118	813A	E095	82AE
87-89												
90	E0C9	E0CA	E0CB	E0CC	E0CD	E0CE	E0CF	E0D0	E0D1	E0D2	E0D3	E0D4
91	E1A7	E1A8	E1A9	E1AA	E1AB	E1AC	E1AD	E1AE	E1AF	E1B0	E1B1	E1B2
92	E285	E286	E287	E288	E289	E28A	E28B	E28C	E28D	E28E	33A1	33A5
93	322A	322B	322C	322D	322E	322F	3230	3237	337E	337D	337C	337B
94	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	216A	216B

Cell Row	13	14	15	16	17	18	19	20	21	22	23	24
85	536C	E083	E084	544D	5496	549C	54A9	550E	554A	5672	56E4	5733
86	845B	84DC	84EC	8559	85CE	8755	87EC	880B	88F5	89D2	8AF6	8DCE
87-89												
90	E0D5	E0D6	E0D7	E0D8	E0D9	E0DA	E0DB	E0DC	E0DD	E0DE	E0DF	E0E0

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1 The basic character set includes characters of which operation started before the specification was revised into 4.4 Version.

2 Character code values specified in Table 7-19 are assigned with consideration of backward compatibility with existing systems in Japan. Table 7-20 makes the character code values of the additional symbols set specified in Table 7-19 compatible with JIS X0213:2004. Therefore, Table 7-20 shall not be used alone. Use of Table 7-19 should be careful because use of Table 7-19 not accompanied with Table 7-20 results that some characters of the additional character Set are incompatible with JIS X0213:2004.

91	E1B3	E1B4	E1B5	E1B6	E1B7	E1B8	E1B9	E1BA	E1BB	E1BC	E1BD	E1BE
92	339D	33A0	33A4	E28F	2488	2489	248A	248B	248C	248D	248E	248F
93	E2CA	E2CB	3036	E2CC	E2CD	E2CE	E2CF	E2D0	E2D1	E2D2	E2D3	E2D4
94	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	247A	247B

Cell Row	25	26	27	28	29	30	31	32	33	34	35	36
85	5734	585A	5880	59E4	5A23	5A55	5BEC	E085	E086	5EAC	5F34	5F45
86	8FBB	8FF6	90DD	9127	912D	91B2	9233	9288	9321	9348	9592	96DE
87-89												
90	E0E1	E0E2	E0E3	E0E4	E0E5	E0E6	E0E7	E0E8	E0E9	E0EA	E0EB	E0EC
91	E1BF	E1C0	E1C1	E1C2	E1C3	E1C4	E1C5	E1C6	E1C7	E1C8	E1C9	E1CA
92	2490	E290	E291	E292	E293	E294	E295	E296	E297	E298	E299	E29A
93	E2D5	E2D6	E2D7	E2D8	E2D9	E2DA	E2DB	E2DC	E2DD	E2DE	E2DF	E2E0
94	247C	247D	247E	247F	E2FF	E380	E381	E382	E383	E384	E385	E386

Cell Row	37	38	39	40	41	42	43	44	45	46	47	48
85	5FB7	6017	E087	6130	6624	66C8	66D9	66FA	66FB	E088	E089	6911
86	9903	9940	9AD9	9BD6	9DD7	9EB4	9EB5	E096	E097	E098	E099	E09A
87-89												
90	E0ED	E0EE	E0EF	E0F0	E0F1	E0F2	E0F3	E0F4	E0F5	E0F6	E0F7	E0F8
91	E1CB	E1CC	E1CD	E1CE	E1CF	E1D0	E1D1	E1D2	E1D3	E1D4	E1D5	E1D6
92	E29B	E29C	E29D	E29E	E29F	3233	3236	3232	3231	3239	E2A0	25B6
93	E2E1	E2E2	2113	338F	3390	33CA	339E	33A2	3371	E2E3	E2E4	00BD
94	E387	E388	E389	E38A	E38B	E38C	E38D	E38E	E38F	E390	E391	E392

Cell Row	49	50	51	52	53	54	55	56	57	58	59	60
85	693B	6A45	6A91	6ADB	E08A	E08B	E08C	6BF1	6CE0	6D2E	6D77	6DBF
86	E09B	E09C	E09D	E09E	E09F	E0A0	E0A1	E0A2	E0A3	E0A4	E0A5	E0A6
87-89												
90	E0F9	E0FA	E0FB	E0FC	E0FD	E0FE	E0FF	E180	E181	E182	E183	E184
91	E1D7	E1D8	E1D9	E1DA	E1DB	E1DC	E1DD	E1DE	E1DF	E1E0	E1E1	E1E2
92	25C0	3016	3017	E2A1	E2A2	E2A3	E2A4	E2A5	E2A6	E2A7	E2A8	E2A9
93	E2E5	2153	2154	00BC	00BE	2155	2156	2157	2158	2159	215A	E2E6
94	E393	E394	E395	E396	E397	E398	E399	E39A	E39B	E39C	E39D	E39E

Cell Row	61	62	63	64	65	66	67	68	69	70	71	72
85	6DCA	6DF8	6E1A	6F5E	6FF9	7064	E08D	E08E	7147	71C1	7200	739F
86	E0A7	E0A8	E0A9	E0AA	E0AB	E0AC	E0AD	E0AE	E0AF	E0B0	E0B1	E0B2
87-89												
90	E185	E186	E187	E188	E189	E18A	E18B	E18C	E18D	E18E	E18F	E190
91	E1E3	E1E4	E1E5	E1E6	E1E7	E1E8	E1E9	E1EA	E1EB	E1EC	E1ED	E1EE
92	E2AA	E2AB	E2AC	E2AD	E2AE	E2AF	E2B0	E2B1	E2B2	E2B3	E2B4	E2B5
93	215B	E2E7	E2E8	2600	2601	2602	E2E9	E2EA	E2EB	E2EC	E2ED	2666
94	E39F	E3A0	E3A1	E3A2	2460	2461	2462	2463	2464	2465	2466	2467

Cell Row	73	74	75	76	77	78	79	80	81	82	83	84
85	73A8	73C9	73D6	741B	7421	7422	7426	742A	742C	7439	744B	E08F
86	E0B3	E0B4	E0B5	E0B6	E0B7	E0B8	E0B9	E0BA	E0BB	E0BC	E0BD	E0BE
87-89												
90	E191	E192	E193	E194	E195	E196	E197	E198	E199	E19A	E19B	E19C
91	E1EF	E1F0	E1F1	E1F2	E1F3	E1F4	E1F5	E1F6	E1F7	E1F8	E1F9	E1FA
92	E2B6	E2B7	E2B8	E2B9	E2BA	E2BB	E2BC	E2BD	E2BE	E2BF	E2C0	E2C1
93	2665	2663	2660	E2EE	E2EF	203C	E2F0	E2F1	E2F2	E2F3	E2F4	E2F5
94	2468	2469	246A	246B	246C	246D	246E	246F	2776	2777	2778	2779

Cell Row	85	86	87	88	89	90	91	92	93	94		
85	7575	7581	7772	E090	78C8	78E0	7947	79AE	E091	E092		
86	E0BF	E0C0	E0C1	E0C2	E0C3	E0C4	E0C5	E0C6	E0C7	E0C8		
87-89												
90	E19D	E19E	E19F	E1A0	E1A1	E1A2	E1A3	E1A4	E1A5	E1A6		
91	E1FB	E1FC	E1FD	E1FE	E1FF	E280	E281	E282	E283	E284		
92	E2C2	00AE	00A9	E2C3	E2C4	E2C5	E2C6	E2C7	E2C8	E2C9		
93	E2F6	E2F7	E2F8	E2F9	E2FA	266C	E2FB	E2FC	E2FD	E2FE		
94	277A	277B	277C	277D	277E	277F	E3A3	E3A4	E3A5	E3A6		

Table 7-20 Revision to Table 7-19: Modification of code values of Additional Symbols Set to comply with JIS X0213:2004

Row	Cell	Code Value	Row	Cell	Code Value
85	1	U+3402	93	79	U+2049
	10	U+351F	94	29	U+3251
	14	U+8A79		30	U+3252
	26	U+FA10		31	U+3253
	32	U+FA11		32	U+3254
	33	U+37E2		59	U+3255
	59	U+FA45		60	U+3256
	63	U+FA46		61	U+3257
	78	U+FA4A		62	U+3258
	84	U+3EDA		63	U+3259
	88	U+4093		64	U+325A
86	6	U+4264		91	U+24EB
92	86	U+E3A7		92	U+24EC
	87	U+E3A8		93	U+325B

7.2.1.2 Supplemental characters (Gaiji)

Any Gaiji character code shall be a 2-octet code.

The Gaiji character code set shall be the DRCS-0 set. The DRCS-0 set is defined as a table consisting of 2-octet codes, representing 3328 characters from Row EC, Cell 00 to Row F8, Cell FF.

DRCS pattern data shall be coded in compliance with Annex D Coding of DRCS pattern data.

7.2.2 Coding of control code

The control codes available to this standard are limited to 0x007F (DEL); 0x000D and 0x000A (CR/LF); and 0x0009 (TAB).

7.2.3 Character encoding scheme

Character encoding scheme when using the UCS character set shall be as follows.

UTF-8 and UTF-16 specified in ISO/IEC 10646:2003 should be employed for transmission.

When sending data, the upper byte shall be sent at first. That is, transmission shall be done in the “big endian” manner. Byte Order Mark must not be omitted to identify big endian.

7.3 Shift-JIS Character Codes

Any character coding using Shift-JIS shall be in compliance with Appendix 1 of JIS X0208:1997. Note that the characters in the range from Row 90 to Row 94 of the Kanji Character Set (2-byte code) specified in ARIB STD-B5 “Data Multiplex Broadcasting System for the Conventional Television using the Vertical Blanking Interval” (Ver. 1.0, ’96 Aug. 6) are added to Kanji Character Set. The character set of Shift JIS are shown in Table 7-21.

Table 7-21 Shift-JIS Code Set

Code Set	Character Set	Remarks
Single-byte (Halfwidth) Characters Byte range: 21~7F, A1~DF	JIS X 0201-1997 (JIS Roman Characters and Halfwidth Katakana)	
Double-byte Characters First byte range: 81~9F,E0~EF Second byte range: 40~7E,80~FC	JIS X 0208-1997 (Those of ARIB-STD-B5 Kanji character set is allocated to Rows 90 to 94 [Free Area].)	
Control Codes	Space character (20)	
	Delete character (7F)	
	Carriage Return/Line Feed (0D0A)	
	Tab (09)	

Chapter 8 Coding of graphics display command

8.1 Geometric

Coding of graphics display command by geometric should be the extended format based on that of ARIB STD-B5 "DATA MULTIPLEX BROADCASTING SYSTEM FOR THE CONVENTIONAL TELEVISION USING THE VERTICAL BLANKING INTERVAL "(Ver. 1.0, '96 Aug. 6).

8.1.1 Code set of graphics by geometric graphics display

Code set of graphics by geometric display should be graphics command code set, geometric macrocode set, C0 control code, and C1 control code. Each of them should be called into GL code area of 8 bit code table, GR code area, C0 control code area and C1 control code area, respectively.

8.1.2 Coding of graphics display command code set

Structure of graphics display command code set should be as shown in figure 8-3.

Graphics display command executes using opcode and zero, one or more operand which is transmitted successively to the opcode.

Opcode specifies type of command and operand specifies content of the command.

8.1.2.1 Structure of operand

Operand structure of each command

Operand structure of each command is shown in Table 8-1.

Operand structure of each operand type

Fixed operand length is one byte or more and specified by opcode. The Single-value operands consist of one to four bytes as determined by the domain command. The multi-value operands consist of one to eight bytes as determined by the domain command. As for the operand structure, when it is used to specify coordinate value ,the operand structure should be as shown in Figure 8-4 and when it is used to specify colour (SET COLOR) , the operand structure should be as shown in figure 8-5. Coordinates should be within the unit screen and positive value is specified by binary decimal, and negative value is specified by two’s complement notation.

8.1.2.2 Control commands

DOMAIN

A) Operand structure of DOMAIN

Operand of DOMAIN is composed of a 1 byte fixed format operand followed by a multi value operand.

B) Function and indicating method of fixed format operand

As for fixed format operand, one value operand length of each command is specified by b2 and b1, as for multi value operand the length is specified by b5 to b3, and dimensionality is specified by b6. Each indicating method is as shown in Tables 8-2 to 8-4.

C) Function of multi value operand and indication method

Multi value operand specifies logical picture element size.

The logical picture element size is specified in case of drawing POINT, LINE, RC, RECT and POLY.

Default logical picture element size should be "0" for both dx and dy.

In this case, drawing point should be upper left corner and minimum picture element size specified by the receiver display mode is drawn as the logical picture element size. Therefore in case of 1920 x 1080 and 1280 x 720, the logical picture element size is 1/2048 and in case of 960 x 540 and 720 x 480, it is 1/1024.

D) Relation between drawing point and drawing position

Relation between drawing point and drawing position should be as shown in Figure 8-6.

E) Effective period of indication by DOMAIN

Indication by DOMAIN is effective until RESET or new indication is made.

F) Process when specified operand length and actual data length differs

When operand length of each command is shorter than the length specified by DOMAIN, b6 to b1 in lacked byte is considered as "0". When operand length of each command is longer than the length specified by DOMAIN, additional operand in Table 8-1 should be applied. Multi value operand length of the DOMAIN itself is specified by fixed format operand of DOMAIN.

TEXTURE

Operand should be 1 byte fixed format operand and the structure is as shown in Figure 8-1.

B8	B7	B6	B5	B4	B3	B2	B1
0	1	Texture pattern			Highlight	Line texture	

Figure 8-1 Operand structure of TEXTURE

A) Function of line texture

Line texture specifies the type of drawing line (hereafter referred to as "line type") and the structure is shown in Table 8-5.

Specified line type is used when drawing LINE, ARC and RECT of the outline drawing and POLY.

It is not used for highlight.

Relation between line type and logical picture element size is shown in Figure 8-7.

Start point and end point of line and arc, and each vertex point of polygon should necessarily be drawn and never kept blank. When dx of logic picture element size is "0", all lines except vertical line should be solid line and when dy is "0", all lines except horizontal line should be solid line.

In colour mode 1 specified by SELECT COLOR, only the drawing area by line texture should be drawn in forward colour and in colour mode 2, drawing area is drawn in forward colour and lines between drawing areas are drawn in background colour.

B) Function of highlight

Highlight specifies whether the outline exist or not when ARC, RECT, and POLY are drawn in filled mode. In case of "1", outline is applied and in case of "0", outline is not applied. However, for chord of the ARC, outline is not applied.

Line type should be solid line of logical picture element width, regardless of line texture indication.

As for colour, the colour is black when the colour mode is 1, and background colour when the colour mode is 2.

C) Function of texture pattern

Structure of texture pattern is shown in figure 8-8.

Texture pattern is used for fill out pattern of ARC, RECT and POLY.

In case of fill out, specified pattern by the texture pattern is filled in all inside area including outline area, without drawing outline.

In case of colour mode 1, only drawn part is drawn in forward colour and in case of colour mode 2, drawn part is drawn in forward colour and the other part is drawn in background colour.

SET COLOR

SET COLOR specifies colour map data and the structure of operand is shown in figure 8-5.

Colour map address should be the value specified by SELECT COLOR and in case of colour mode 2, it should be the value specifies as forward colour.

When there are plural multi value operands, the colour map address is regarded as incremented respectively.

When operand is omitted, it should be transparent. (Allocate colour map address so that α value = 0%)

SELECT COLOR

SELECT COLOR specifies colour mode and drawing colour by the single value operand (2 byte) of one or two and the structure is shown in figure 8-9.

When one value operand is single, colour mode is 1 and specifies forward colour.

One value operand specifies pallet number with b1, b2 (LSB) of the first byte and b1 (MSB), b2 of the second byte by binary value and specifies colour map lower address with b3 (MSB) to b6 (LSB) of the first byte.

Pallet number should be 0 to 15.

When there are two one-value operands colour mode is 2. The first operand specifies forward colour and the second operand specifies background colour.

BLINK

BLINK specifies to change colour for the colour map.

Structure of operand consist of single one-value operand and three fixed-operands.

Single value operand specifies the colour specified by blink (hereafter referred as "blink-to") as colour map address. The first fixed operand specifies the period (hereafter referred to as "ON interval") during the colour of blink-to. The second fixed operand specifies the period (hereafter referred to as "OFF interval") during the colour of currently specified by the SELECT COLOR (hereafter referred as "blink-from"). The third fixed operand specifies the start delay time of blink which is specified previously, using multiple of the unit of 0.1 sec. (max. 63).

When ON interval or OFF interval is "0", present drawing colour is set as the blink-from colour and finishes the blink process where the colour specified by the first operand of this command as the blink-to colour.

When all operands are omitted, all blinks where the current drawing colour is set as the blink-from colour terminate.

Blink process, which is simultaneously defined, should be 16 or less.

RESET

RESET initializes DOMAIN, BLINK, TEXURE and the macro statement of geometric macrocode set.

RESET has 2 byte of fixed operand and specifies initialization of DOMAIN by b1 of the first byte, BLINK by b2, TEXTURE by b4, and geometric macrocode set by b5 of the second byte. Other bits are undefined.

When each bit is "1", it is in default condition and when "0", initialization of respective item is not made.

SET PATTERN

SET PATTERN has function to specify line texture and pattern texture in picture element unit, in place of TEXTURE. Operand is composed of multi value operand. Basic structure of operand consist of 3 bytes and should be as shown in figure 8-2.

Picture element used in SET PATTERN should be the minimum picture element specified by the receiver display mode, which is not affected by DOMAIN.

First operand

B8	B7	B6	B5	B4	B3	B2	B1
0	1	Pattern type		Pattern data			

Second operand

B8	B7	B6	B5	B4	B3	B2	B1
0	1	Pattern data					

Third operand

B8	B7	B6	B5	B4	B3	B2	B1
0	1	Pattern data					

Figure 8-2 Structure of SET PATTERN operand

B6 and b5 of the first operand specifies the pattern type. When b6, b5 = 0,0, it specifies line pattern (repetition of 16 picture elements) type. When b6, b5 = 0,1, it specifies fill pattern (repetition of 8 picture elements). When b6, b5 = 1,0, it specifies fill pattern (repetition of 16 picture element). B6, b5 = 1,1 is undefined.

In each pattern data bit, "1" specifies picture element to draw, and "0" specifies background colour.

In each fill pattern type, b4 of the first operand is set as MSB and scanning is done in such way that MSB is pointed at the top left then it is scanned from the left to the right , from the top to the bottom.

Operand structure and function of each pattern type is as follows.

A) Line pattern

In the line pattern, line texture is specified by 16 bit data in 3-byte operand.

Specified line texture is used when drawing LINE, and ARC, RECT of outline form and POLY.

It is not used for highlight.

Line, or start point and end point of the arc and each vertex of polygon should be drawn and blank is not allowed.

In the colour mode 1 which is specified by SELECT COLOR, only drawing area with line texture is drawn with forward colour, and in the colour mode 2, drawing area is drawn with forward colour and line between drawing areas is drawn in background colour.

B) Fill pattern (repetition of 8 picture elements)

Fill pattern specifies pattern texture for fill out. Pattern texture in case of 8-picture element repetition is structured by repeating rectangle texture data of dx = 8-picture element, dy = 2-picture element for necessary times and by piling them up in y direction. For example, when defining pattern texture of dx = 8-picture element, dy = 8-picture element, it consists of 12 byte in total, that is ,4 sets of 3 byte-operand.

In colour mode 1 specified by SELECT COLOR, drawing area by pattern texture is drawn with forward colour and in colour mode 2, drawing area is drawn with forward colour and line between drawing areas is drawn in background colour.

C) Fill pattern (16 picture elements repetition)

Fill pattern specifies pattern texture for fill out. Pattern texture in case of 16-picture element repetition is structured by repeating data of dx = 16-picture element, dy = 1-picture element for necessary times. For example, when defining pattern texture of dx = 16-picture element, dy = 16-picture element, it consists of 48 byte operand in total, that is 16 sets of 3 byte-operand.

In colour mode 1 specified by SELECT COLOR, drawing area by pattern texture is drawn in forward colour and in colour mode 2, drawing area is drawn with forward colour and line between drawing areas is drawn in background colour.

8.1.2.3 Drawing command

POINT

POINT establishes the coordinate of drawing and draws a point.

Specifying the coordinate is made using absolute coordinates value (X, Y) on the unit screen or relative coordinate value (dx, dy) from the point drawn immediately before by one multi-value operand.

After POINT is executed, the drawing point moves to the last specified point.

Coordinate of drawing point specifies inside of the square area which is composed of the points (-1, -1), (-1, 2), (2, 2), (2, -1). When drawing is specified to draw exceeding the main text display area, geometric graphics drawn out of text display area, is not displayed. (This should be applied to the following drawing commands.)

Type and operation of POINT is as shown in Table 8-6.

LINE

Line is drawn using current colour and line texture specified by the size of logic picture element from the start point to the end point.

Start point is the point specified by absolute coordinates value (X, Y) or current drawing point and end point is the point specified by absolute coordinates value (X, Y) or relative coordinates value (dx, dy).

After line is executed, end point will be the new current drawing point.

Type and operation of LINE is as shown in Table 8-7.

ARC

ARC draws circle or segment of circle.

Start point of arc is the point specified by the absolute coordinates value (X, Y) or current drawing point. Intermediate point and end point are specified by the relative coordinates value (dx, dy) from the start point and the intermediate point, respectively.

After ARC is executed, end point will be the new current drawing point.

When start point, intermediate point and end point is aligned, draw a straight line between the start point and end point.

When start point and intermediate point coincides or when intermediate point and end point coincides, draw a straight line.

When start point and end point coincides, draw a circle whose diameter is from the start point to the intermediate point.

When end point is omitted, draw a circle regarding the start point as end point.

Even if highlight is specified, the chord is not highlighted.

Type and operation of ARC is as shown in Table 8-8.

RECT

RECT draws a rectangular area with width (dx) and height (dy) from the start point.

Start point is the point specified by the absolute coordinate value (X, Y) or current drawing point and the width and the height are specified by the relative coordinate value (dx, dy) from the start point.

After RECT is executed drawing point moves from the start point to dx toward X direction and Y direction does not change.

Type and operation of RECT is as shown in Table 8-9.

POLY

POLY draws polygon by specifying coordinates of three or more vertices.

Start point is the point specified by the absolute coordinate value (X, Y) or current drawing point.

Polygon should be a single closed area and its vertex should be specified by the relative coordinate value (dx, dy) from the previous vertex and next vertex is specified as such.

Numbers of vertices should be 256 maximum.

End point and start point should coincide and coordinate value of the end point is not specified.

Type and operation of POLY is as shown in Table 8-10.

8.1.3 Geometric macrocode set

Geometric macrocode set should be from 10/0 to 15/15.

All default macro statement should be NUL.

8.1.4 Coding of control function

8.1.4.1 C0 control code

C0 control code should be only NUL and CS shown in Table 7-11.

However, CS should be used only within sentence indication area.

8.1.4.2 C1 control code

C1 control code should be only MACRO and TIME shown in Table 7-11.

However, parameters of macro definition start, macro definition start and execution and macro definition end in this case should be 05/0, 05/1 and 05/15 respectively and macro number should be from 02/0 to 07/15.

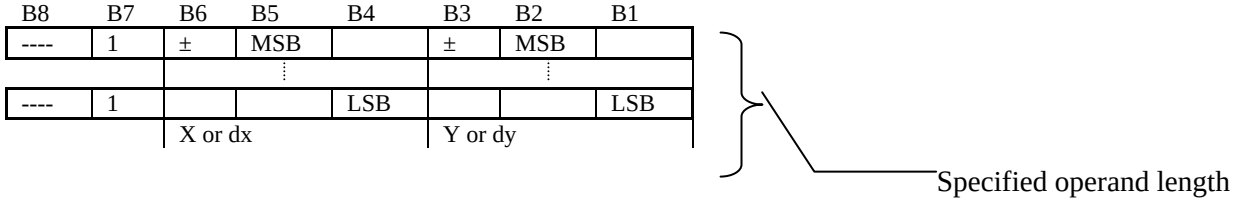
				B7	0	0	1	1	1	1
				B6	1	1	0	0	1	1
				B5	0	1	0	1	0	1
B4	B3	B2	B1		2	3	4	5	6	7
0	0	0	0	0	RESET	RECT OUTLINED	Value data			
0	0	0	1	1	DOMAIN	RECT FILLED				
0	0	1	0	2		SET & RECT OUTLINED				
0	0	1	1	3	TEXTURE	SET & RECT FILLED				
0	1	0	0	4	POINT SET ABS	POLY OUTLINED				
0	1	0	1	5	POINT SET REL	POLY FILLED				
0	1	1	0	6	POINT ABS	SET & POLY OUTLINED				
0	1	1	1	7	POINT REL	SET & POLY FILLED				
1	0	0	0	8	LINE ABS					
1	0	0	1	9	LINE REL					
1	0	1	0	10	SET & LINE ABS					
1	0	1	1	11	SET & LINE REL					
1	1	0	0	12	ARC OUTLINED	SET COLOR				
1	1	0	1	13	ARC FILLED	SET PATTERN				
1	1	1	0	14	SET & ARC OUTLINED	SELECT COLOR				
1	1	1	1	15	SET & ARC FILLED	BLINK				

Opcode Operand

Figure 8-3 Graphics display command code

Table 8-1 Structure of operand and additional operand for each command

Command	structure of operand	Additional operand
RESET	Fixed (2 byte)	Invalid
DOMAIN	Fixed (1 byte) and multi-value	Invalid
TEXTURE	Fixed (1 byte)	Invalid
POINT	Multi-value	Understood as operand with the same opcode
LINE	Multi-value	Understood as operand with the same opcode
ARC	Multi-value	Understood as operand with the same opcode
RECT	Multi-value	Understood as operand with the same opcode
POLY	Multi-value	Understood as operand with the same opcode
SET COLOR	Multi-value	Understood as operand with the same opcode
SET PATTERN	Multi-value	Understood as operand with the same opcode
SELECT COLOR	Single value	Invalid
BLINK	Single value and fixed (3-bite)	Invalid



Note 1: ± specifies code bit length and in case of positive, specifies "0" and negative, "1".
Note 2: In the following table including appendix, MSB is the most significant bit and LSB is the least significant bit.

Figure 8-4 Structure of operand when coordinates value is designated

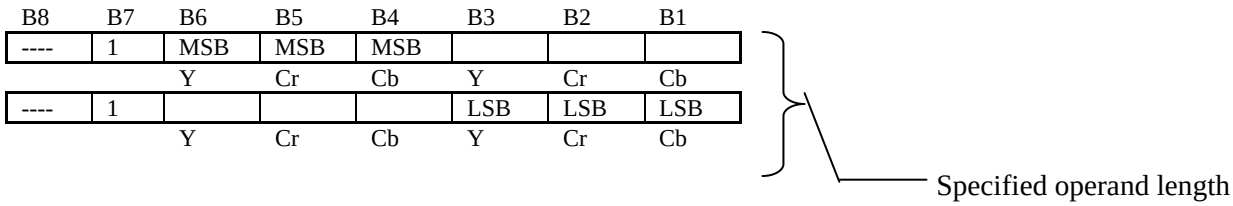


Figure 8-5 Structure of operand when colour indication is used

Table 8-2 Single value operand length

B2	B1	Single value operand length
0	0	1
0	1	2 (default)
1	0	3
1	1	4

Note: On and after this table, default means the condition after initialize.

Table 8-3 Multi-value operand length

B5	B4	B3	Multi-valued operand length
0	0	0	1
0	0	1	2
0	1	0	3
0	1	1	4 (default)
1	0	0	5
1	0	1	6
1	1	0	7
1	1	1	8

Table 8-4 Dimension

B6	Dimension
0	2 dimensional (default)
1	Undefined

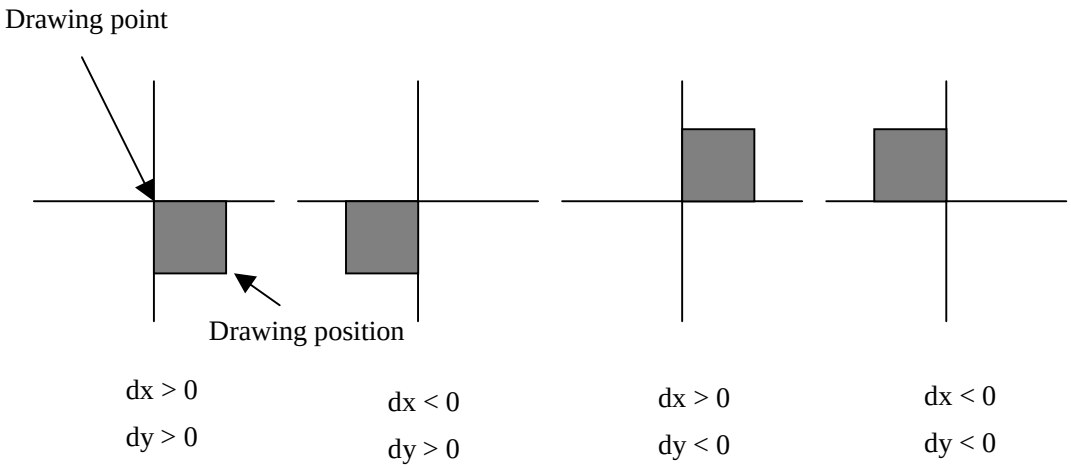


Figure 8-6 Drawing point and drawing position

Table 8-5 Structure of line texture

B2	B1	Line type
0	0	Solid line (default)
0	1	Dotted line
1	0	Broken line
1	1	Dotted and broken line

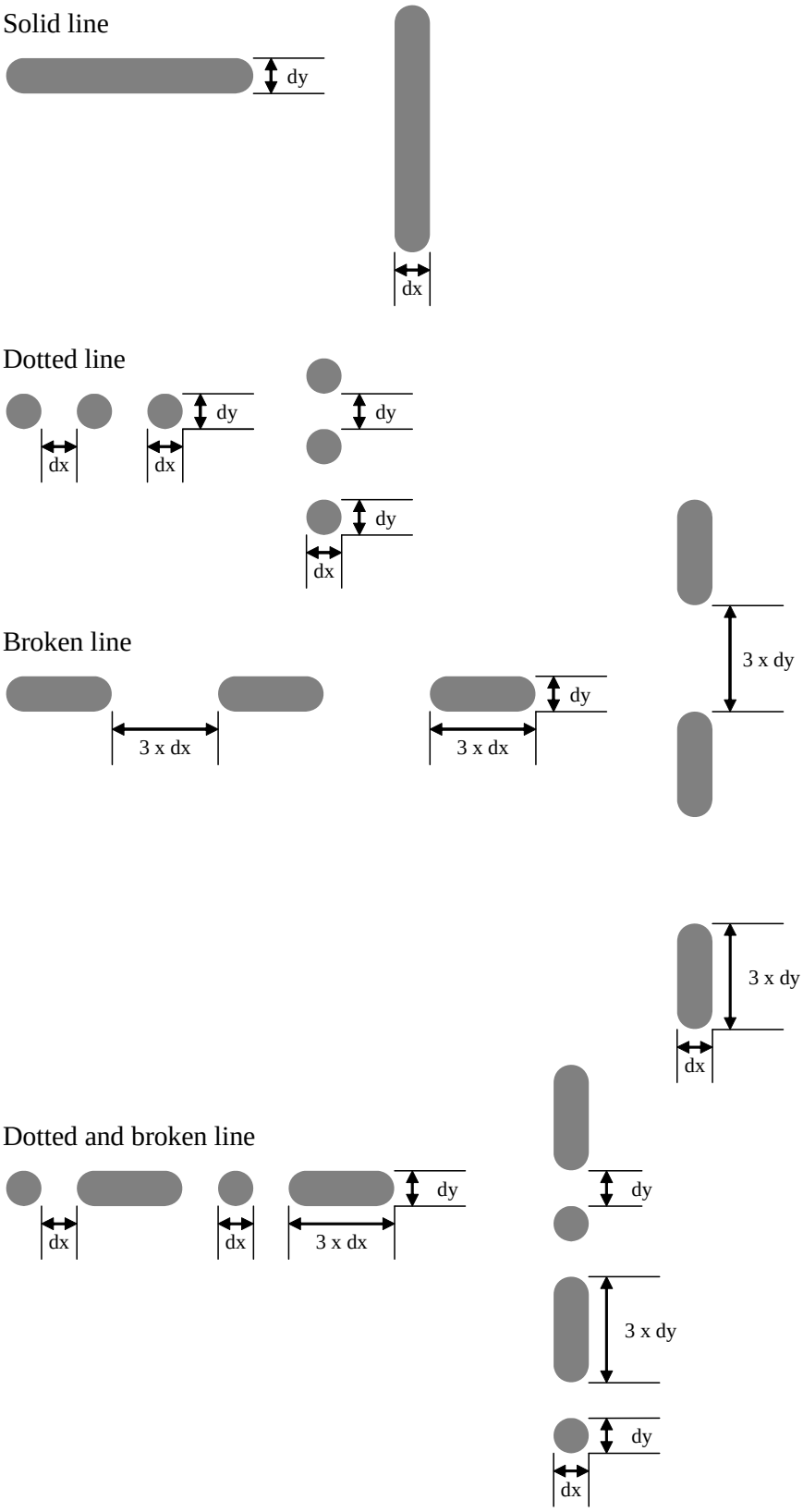


Figure 8-7 Relation between line type and size of logical picture element

B6	B5	B4	Texture pattern
0	0	0	Complete fill out (default)
0	0	1	Vertical hatching
0	1	0	Horizontal hatching
0	1	1	Cross hatching

Note: Fill out pattern of texture pattern should be as follows. When both dx and dy are 0, it is completely filled out.

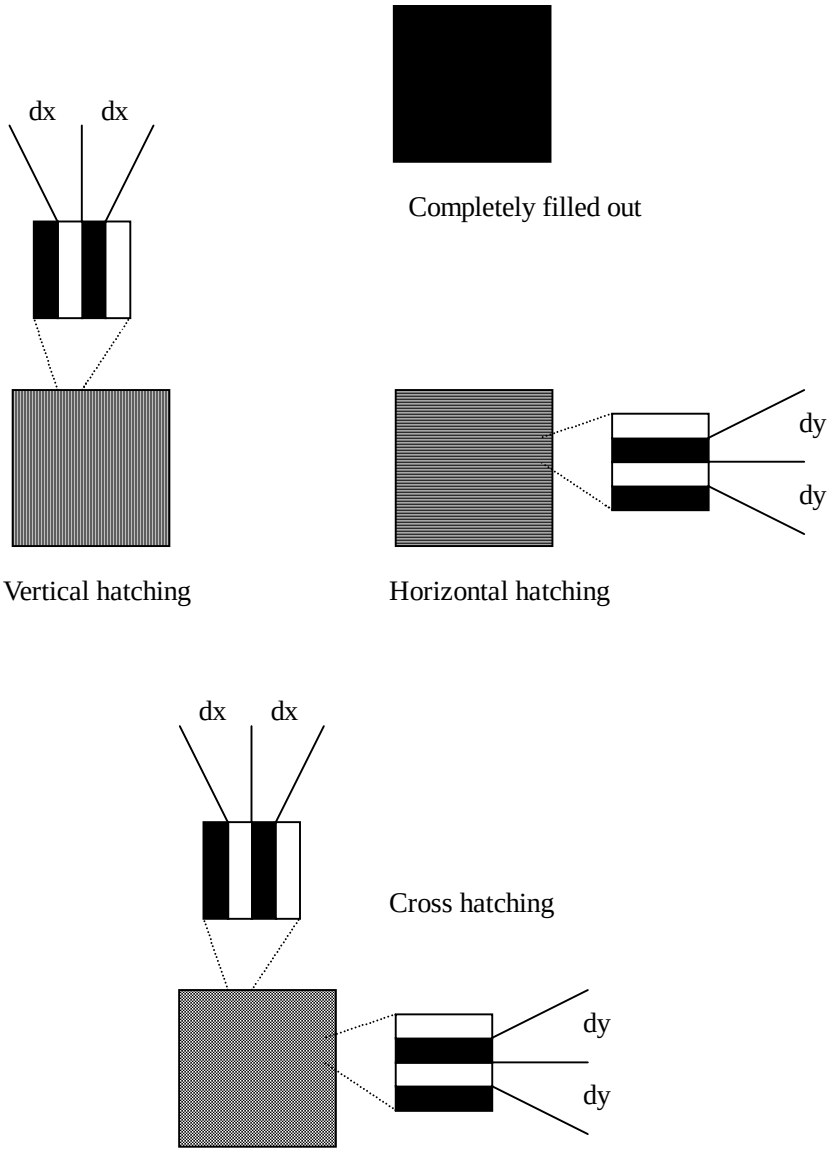


Figure 8-8 Structure of texture pattern

B8	B7	B6	B5	B4	B3	B2	B1	
----	1							Forward colour
----	1	0	0	0	0			
----	1							Background colour
----	1	0	0	0	0			

Note: Background colour is used only when there are two one-value operands.

Figure 8-9 Structure of SELECT COLOR

Table 8-6 Type and operation of POINT

Type of point	Operation
POINT SET ABS (One multi-value operand)	Drawing point is set to the absolute coordinate-value specified by the operand but drawing is not executed.
POINT SET REL (One multi-value operand)	New drawing point of the relative coordinates value specified by the operand is set in addition to the coordinates value of the current drawing point but drawing is not executed.
POINT ABS (One multi-value operand)	Drawing point is set to the absolute coordinate-value specified by the operand and drawing is executed by the forward colour with logical picture element size.
POINT REL (One multi-value operand)	Drawing point is set to the relative coordinate-value from the current drawing point specified by the operand and drawing is executed by the forward colour with logical picture element size.

Note: Comments in the parentheses indicate type and number of operand.
Same as in Tables 8-7 to 8-9.

Table 8-7 Type and operation of LINE

Type of LINE	Operation
LINE ABS (One multi-value operand)	Setting current drawing point as the start point, set the end point at the absolute coordinate-value specified by multi-value operand.
LINE REL (One multi-value operand)	Setting current drawing point as the start point, set the end point at the relative coordinate-value from the start point specified by multi-value operand.
SET & LINE ABS (Two multi-value operand)	Start point and end point are specified by the absolute coordinate-value with the first and second multi-value operand.
SET & LINE REL (Two multi-value operand)	Start point is specified by the absolute coordinate-value with the first operand. End point is specified by the relative coordinate-value from the start point with the second multi-value operand.

Table 8-8 Type and operation of ARC

Type of ARC	Operation
ARC OUTLINED (Two multi-value operand)	Start point is the current drawing point and intermediate point is specified by the first operand and end point is specified by the second operand. Arc or circle is drawn with the colour and line texture which is currently specified.
ARC FILLED (Note) (Two multi-value operand)	Fill out the inside area of arc, chord which is determined by ARC OUTLINED with the specified colour and texture pattern.
SET & ARC OUTLINED (Three multi-value operand)	Start point is specified by the first operand, intermediate point by the second operand and end point by the third operand. And draw arc or circle by the colour and line texture which is currently specified.
SET & ARC FILLED Note) (Three multi-value operand)	Fill out the inside area of arc, chord which is determined by SET & ARC OUTLINED with the specified colour and texture pattern.

Note: Outline width of arc and chord is the current logical picture element size.

Table 8-9 Type and operation of RECT

Type of RECT	Operation
RECT OUTLINED (One multi-value operand)	Start point is the current drawing point and width and height is specified by the operand. And four sides of the rectangle are drawn by the specified colour and line texture.
RECT FILLED (Note) (One multi-value operand)	Fill out the inside area of rectangle which is determined by RECT OUTLINED with the specified colour and texture pattern.
SET & RECT OUTLINED (Two multi-value operand)	Start point is specified by the first operand. Width and height of the rectangle is specified by the second operand. Four sides of the rectangle are drawn by the specified colour and line texture.
SET & RECT FILLED Note) (Two multi-value operand)	Fill out the inside area of rectangle which is determined by SET & RECT OUTLINED with the specified colour and texture pattern n.

Note: Width of the side line is the current logical picture element size.

Table 8-10 Type and operation of POLY

Type of POLY	Operation
POLY OUTLINED	Start point is the current drawing point and coordinate of each vertex is specified by the multi-value operand. And each side of polygon is drawn using the specified colour and line texture.
POLY FILLED (Note)	Polygon and inside area determined by POLY OUTLINED are filled out using the specified colour and texture pattern.
SET&POLY OUTLINED	Start point is specified by the first multi-value operand and coordinates of each vertex are specified by succeeding multi-value operand. And each side of polygon is drawn using the specified colour and line texture.
SET&POLY FILLED (Note)	Polygon and inside area determined by SET & POLY OUTLINED are filled out using the specified colour and texture pattern.

Note: Side line width is the actual logical picture element size.

Annex A Operation of video scaling

The receiver unit shall handle the presentation position and scaling of video in accordance with instruction of multimedia coding or video syntax.

A.1 When multimedia coding is not used together with video

When multimedia coding is not used together with video, horizontal and vertical scaling is designated by using display_horizontal_size and display_vertical_size of sequence_display_extension, respectively.

Position of decoded picture and decoder output picture is designated using frame_centre_horizontal_offset and frame_centre_vertical_offset of picture_display_extension. frame_centre_vertical_offset having value of 0 is recommended for actual operation.

A.2 When multimedia coding is used together with video

When multimedia coding is used together with video, both frame_centre_horizontal_offset and frame_centre_vertical_offset should be zero. Designations of position and scaling are specified by multimedia coding.

Annex B PNG coding

B.1 File format of PNG

File format of PNG is constructed as shown in Figure B-1, which chunk of blocked information is aligned after PNG file signature.

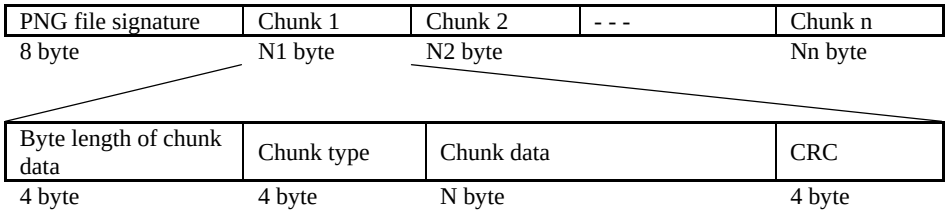


Figure B-1 File format of PNG

PNG file signature is in 8 byte and has following value (decimal).

137 80 78 71 13 10 26 10 (In hexadecimal 89 50 4E 47 0D 0A 1A 0A)

B.2 Structure of chunk

Structure of chunk is as shown in the figure below of Figure B-1. Chunk type is defined in four alphabetic letters and has each attribute shown of Table B-1 according to whether the four letters are in capital letter of small letter (whether the fifth bit of the character code is 0 or 1).

Table B-1 Meaning of four letters of chunk type

	Capital letter	Small letter
FIRST LETTER	Chunk necessary for display	Chunk for supplemental information
Second letter	Chunk for public information	Chunk for private information
Third letter	Should be always capital in the actual PNG specification	(Reserved for the future)
Fourth letter	Chunk which depends on picture. Cannot be copied.	Chunk which can be copied

Standard chunk types are shown in Table B-2. Name of the chunk type in Table B-2 is in accordance with the rule in Table B-1. For example, 1HDR - 1END is the necessary chunk and followings are supplemental chunk.

Table B-2 Standard chunk type table

Chunk type	Meaning	Description	Arrangement in plural	Constraint of chunk order
IHDR	Image header	Designation of vertical and horizontal pixel number, bit depth, colour type (*1), image compression method (*2), filter type, and with or without interlace.	-	Always placed at the beginning.
PLTE	Palette	Have 1 to 256 palette entries. In some cases, this chunk is unnecessary according to colour type.	-	Before IDAT.
IDAT	Image data	Image data itself.	O	Plural IDAT should be always put successively.
IEND	Image trailer	Indicates the end of PNG data stream and chunk data is empty.	-	Always placed at the end.
bKGD	Background	Background colour data	-	After PLTE.

Chunk type	Meaning	Description	Arrangement in plural	Constraint of chunk order
	colour			Before IDAT.
cHRM	Chromaticity and white point	Data of chromaticity and white reference point	-	Before PLTE and IDAT.
gAMA	Image gamma	Gamma value when image is generated.	-	Before PLTE and IDAT.
hIST	Image histogram	Frequency data of each colour of colour palette. Exists only when there is palette chunk.	-	After PLTE. Before IDAT.
pHYs	Physical pixel dimension	Designates pixel number per each unit length in vertical and horizontal, or aspect ratio.	-	Before IDAT.
sBIT	Significant bit	Bit depth of original image.	-	Before PLTE and IDAT.
tEXt	Text data	Have 79 byte key word data with information of title and writer and optional length text data.	O	None
tIME	Image final revision date	Date and time of the latest revision is indicated in 7 byte.	-	None
tRNS	Transparent colour	Setting transparent colour	-	After PLTE. Before IDAT.
zTXt	Compressed text data	Having keyword data same format as tEXt (not compressed), text compression method (*2), compressed text data (optional length).	O	None

(*1) Colour type

There are five designated colour types. Permitted combination of those and bit depth are shown in Table B-3.

Table B-3 The combination of colour type and bit depth

Colour type	Permitted bit depth	Explanation
0	1,2,4,8,16	Grey scale
2	8,16	R, G, B colour
3	1,2,4,8	Palette index (PLTE chunk is necessary)
4	8,16	Alpha is supported with grey scale
6	8,16	Alpha is supported with R, G, B colour.

(*2) Designation of compression method

Only "0" (Deflate/Inflate compression) is specified for compression method designated in 1 byte using 1HDR and zTXt. Deflate/Inflate compression file is based on zlib format and in accordance with RFC-195 specification. Compression algorithm and coding of zlib is in accordance with RFC-1951. Compression method other than "0" should be extended in the future.

Annex C Operation guideline related to audio coding

C.1 Reference audio level

Reference audio level of each audio coding shall be FS-18dB.

C.2 Mix process at receiver unit

In data broadcasting operation, mixed signal coded by two or more audio coding may be output to receiver unit speaker. Guideline for this mixing process is specified in this clause.

C.2.1 Recommended operation in the receiver unit

As it is hard to transmit the same sound in different coding, in data broadcasting receiver unit, it is recommended to output the signal with the same reference audio level.

In product planning of the receiver unit, volume setting may be made for the audio uniquely for special usage coded in a certain method. Audio output is not always made according to the above setting. However, in order to avoid listener's confusion, original mix down specification, which can be played back with the volume balance that the broadcast station intended is recommended to be the basic condition.

C.2.2 Operation in broadcasting station side

In broadcasting station, audio signal with volume management shall be transmitted , presupposing that output is made in the above audio balance in receiver unit side.

Annex D Coding of DRCS pattern data

DRCS coding in this standard is the enhancement of the method specified on ARIB STD-B5 p.151 to p.155. Syntax of DRCS structure description is shown in Table D-1.

Table D-1 DRCS structure syntax

Syntax	No. of bits	Mnemonic
Drcs_data_structure(){		
NumberOfCode	8	uimsbf
For (i=0;I<numberOfCode;I++){		
CharacterCode	16	uimsbf
NumberOfFont	8	uimsbf
for (j=0;j<numberOfFont;j++){		
fontId	4	uimsbf
mode	4	bslbf
if (mode == '0000'|| mode=='0001'){		
depth	8	uimsbf
width	8	uimsbf
height	8	uimsbf
for (k=0;k<N;k++){		
patternData	8	uimsbf
}		
else{		
regionX	8	uimsbf
regionY	8	uimsbf
geometricData_length	16	uimsbf
for (k=0;k<N;k++){		
geometricData	8	uimsbf
}		
}		
}		
}		

numberOfCode (Number of code): Indicates number of sent out supplemental character (Gaiji) code.

CharacteCode (Assigned code value of supplemental character): Indicates code value of supplemental character (Gaiji) code. The value is assigned as follows; In case of 1 byte DRCS, the first byte shall designate the DRCS set used.04/1 is for DRCS-1, 04/2 is for DRCS-2, ... and 04/15 is for DRCS-15. The second byte shall designate assigned code value of the character within the DRCS set specified by the first byte. The second byte shall have the value in the range of 2/1 to 7/14.In case of 2 byte DRCS, the first byte and the second byte shall designate the code value of the supplemental character (Gaiji).

NumberOfFont (Number of font): Indicates number of font to be defined at the same time.

Font Id (Font identification): Indicates font number. Definition of font number is as follows; Font number identifies typeface of DRCS font sent out and the values are 0 to 15. Font number of 0 indicates that DRCS does not care for typeface.

** Correspondence of other font number and actual typeface will be specified otherwise.*

mode (transmission mode): Indicates whether to use compression or not. Semantics of this field is defined in Table D-2.

Table D-2 Transmission mode

b4 b3 b2 b1	Compression
0 0 0 0	2 gradation, without compression
0 0 0 1	Multi-graduation, without compression

0 0 1 0	2 colour, with compression
0 0 1 1	Multi-colour, with compression

depth (Depth of gradation): Indicates value of font gradation number with subtraction of 2. (0: 2 gradations, 1: 3 gradations .....)

width (Horizontal size): Indicates horizontal size of DRCS pattern in pixel.

height (Vertical size): Indicates vertical size of DRCS pattern in pixel.

patternData (Pattern data): In case of non-compression, pattern data is organized by the scanned pixel data from left to right and top to bottom in the area specified by the value of the width and height fields. Each pixel data is indicated by bits of which number is decided by the gradation number. The data value corresponding to each gradation color is '0' for background and the maximum value for foreground. Such pixel data are arranged from the first byte in the order of b8 ... b1.

region X,region Y (Logical pixel area): Indicates area used when pattern data is described in geometric. Logical area is represented as (1.0 x 1.0) and the area of rectangle of (0,0), (regionX,0), (regionY,0), (regionX, regionY) represents the area used for the DRCS character by 1/256 unit. In the receiver, this area is converted to actual character size area to display. Reference position of conversion should be left bottom when written horizontally and middle of the top when written vertically.

geometricData_length (Geometric data length): Indicates number of bytes of following geometric data.

geometricData (Geometric data): Geometric data is a geometric code sequence composing DRCS pattern. Character attribute when designating color, flashing, polarity, writing mode, enclosure, and underline, excluding designation of size is not applied to multi-color geometric data [mode = 11]. These character attributes are stored and used for the following characters.

Annex E Conversion from 8bit-Code, EUC-JP, and Shift JIS to UCS and Handling of Additional Characters and DRCS in UCS

1. General Rules for Coding Conversion

Mapping a character code in the tables defined in JIS X0201, JIS X0208, JIS X0212, and JIS X0213:2004 onto a corresponding character code in UCS complies with Appendix 2, JIS X0221-1:2001. When a difference is found between Appendix 2, JIS X0221-1:2001 and JIS X0213:2004, JIS X0213:2004 should be used.

2. Conversion from Shift JIS to UCS

To convert Shift JIS to UCS, OVER LINE (0x7E) defined in JIS X 0201 is converted to TILDE (0x007E). Any conversion of a 2-byte character in the range from Rows 90 to 94 complies with Table 7-10in Chapter 7.

3. Conversion of EUC-JP to UCS

To convert EUC-JP to UCS, OVER LINE (0x7E) defined in JIS X 0201 is converted to TILDE (0x007E). Any conversion of a 2-byte character in the range from Rows 90 to 94 complies with Table 7-10in Chapter 7.

4. Conversion of 8bit-Code to UCS

To convert 8bit-code to UCS, OVER LINE (0x7E) defined in JIS X 0201 is converted to TILDE (0x007E).

Any conversion of a non-spacing character in the range of Row 1, Cells 13 to 18 and Row 2, Cell 94 in the Kanji set to a UCS code complies with Table E-1. Any resulting UCS code should be handled as specified in " ISO/IEC 10646:2003 Annex B(normative) List of combining characters ."

Any character in the proportional character sets is mapped onto a corresponding monospaced character before the proportional character is converted to a UCS code. Any character in the mosaic set is ignored. Any C1 control code and CSI control code excluding XCS is also ignored.

Table E-1 Conversion of Non-spacing Character

Row/Cell	Character Description	UCS Code Value	UCS Character Name
1-13	ACUTE ACCENT	0x0301	COMBINING ACCUTE ACCENT (Oxia)
1-14	GRAVE ACCENT	0x0300	COMBINING GRAVE ACCENT (Varia)
1-15	DIAERESIS	0x0308	COMBINING DIAERESIS(Dialytika)
1-16	CIRCUMFLEX ACCENT	0x0302	COMBINING CIRCUMFLEX ACCENT
1-17	OVERLINE	0x0305	COMBINING OVERLINE
1-18	LOW LINE	0x0332	COMBINING LOW LINE
2-94	LARGE CIRCLE	0x20DD	COMBINING ENCLOSING CIRCLE

To convert the additional symbols set to UCS, the set of Table 7-19 and Table 7-20 is used. The following Table E-2 shows how the conversion involves the basic character set, which is defined in 7.2.1.1. The symbol '+' in the table indicates that the two tables should be used together.

Table E-2 8bit-Code Repertoire and Basic Character Set

To convert Octet Code \ into UCS	Basic Character Set is operated based on
When JIS X0213:2004 is not used	Table 7-19 alone [3] Table 7-19 + Table 20[4]
When JIS X0213:2004 is used	N/A[5]

5. DRCS

Any character in DRCS is mapped into the Private Use Area in the Basic Multilingual Plane. The area available to DRCS starts with Row EC, Cell 00.

---

3 If Table 7-19 is employed and Table 7-20 is not, the conversion involves incompatibility with JIS X0213:2004, requiring substantial consideration.

4 The table 7-20 is provided as the revision to Table 7-19 to map a UCS code value onto a corresponding code in JIS X0213:2004. This implies that Table 7-20 shall be used only when Table 7-19 is used.

5 When JIS X0213:2004 is used, any conversion of 8bit-code to UCS complies with JIS X0213:2004.

Annex F Operation guideline related for MPEG-4 video coding

F.1 Video coding

The maximum number of macro blocks per unit time is specified in ISO/IEC 14496-2, so that picture size and frame rate should be decided under consideration of receiver function and resource format. Recommended operation guidelines are as follows:

(1) The first VOP(Video Object Plane) in VOL(Video Object Layer) should be I-VOP.

(2) The vop_coded of first VOP in VOL should be "1".

(3) Configuration information (Visual Object Sequence Header, Visual Object Header, Video Object Header, Video Object Layer Header) should be inserted within 5 seconds interval.

(4) The interval of VOP must be integral multiple of 1001/vop_time_increment_ resolution seconds.

(5) Synthesis and display of VOP must be done at maximum frame rate (30000/1001 Hz).

(6) Aspect ratio of pixel must be same as that on the same screen and of the display screen size in table F-2.

(7) VOP of video_object_layer_shape="10" (binary only) should not be displayed.

Examples of constraints of coding parameters in operation guideline are shown in table F-1.

Table F-1 Constraints of coding parameter

<table>
<tr><th colspan="6">Constraints of VOL</th><th colspan="3">Constraints of video_signal_type (Note 3)</th><th rowspan="2">Other parameter in Profile @Level</th><th rowspan="2">Typical VOP size</th></tr>
<tr><th>video_ object_ layer_ width (Note1)</th><th>video_ object_ layer_ height (Note1)</th><th>aspect_ ratio_ info</th><th>vop_time_ increment_ resolution (Note2)</th><th>fixed_ vop_ rate (Note2)</th><th>fixed_ vop_ time_ increment (Note2)</th><th>colour_ primaries</th><th>transfer_ characteristics</th><th>matrix_ coefficients</th></tr>
<tr><td rowspan="2">352>=</td><td rowspan="2">288>=</td><td rowspan="2">2</td><td>30000, 24000</td><td rowspan="4">1, 0</td><td rowspan="4">Integral multiple of 1001</td><td rowspan="4">1</td><td rowspan="4">1</td><td rowspan="4">1</td><td>Simple@L3 or Core@L2</td><td rowspan="2">CIF</td></tr>
<tr><td>15000, 12000, 10000</td><td>Simple@L2 or Core@L2</td></tr>
<tr><td rowspan="2">352>=</td><td rowspan="2">240>=</td><td rowspan="2">3, 5</td><td>30000, 24000</td><td>Simple@L3 or Core@L2</td><td rowspan="2">SIF</td></tr>
<tr><td>15000, 12000, 10000</td><td>Simple@L2 or Core@L2</td></tr>
<tr><td rowspan="2">320>=</td><td rowspan="2">240>=</td><td rowspan="2">1</td><td>30000, 24000,</td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td rowspan="6"></td><td>Simple@L3 or Core@L2</td><td rowspan="2">QVGA</td></tr>
<tr><td>15000, 12000, 10000</td><td>Simple@L2 or Core@L2</td></tr>
<tr><td rowspan="2">176>=</td><td rowspan="2">144>=</td><td rowspan="2">2</td><td>30000, 24000</td><td>Simple@L2 or Core@L1</td><td rowspan="2">QCIF</td></tr>
<tr><td>15000, 12000, 10000</td><td>Simple@L1 or Core@L1</td></tr>
<tr><td rowspan="2">176>=</td><td rowspan="2">120>=</td><td rowspan="2">3, 5</td><td>30000, 24000</td><td>Simple@L2 or Core@L1</td><td rowspan="2">QSIF</td></tr>
<tr><td>15000, 12000, 10000</td><td>Simple@L1 or Core@L1</td></tr>
</table>

Constraints of VOL						Constraints of video_signal_type (Note 3)			Other parameter in Profile @Level	Typical VOP size
video_ object_ layer_ width (Note1)	video_ object_ layer_ height (Note1)	aspect_ ratio_ info	vop_time_ increment_ resolution (Note2)	fixed_ vop_ rate (Note2)	fixed_ vop_ time_ increment (Note2)	colour_ primaries	transfer_ characteris tics	matrix_ coefficients		
160>=	120>=	1	30000, 24000						Simple@L2 or Core@L1	SQVGA
			15000, 12000, 10000						Simple@L1 or Core@L1	
128>=	96>=	2	30000, 24000						Simple@L2 or Core@L1	SQCIF
			15000, 12000, 10000						Simple@L1 or Core@L1	

Meaning of each code number of MPEG-4 coding parameter in Table F-1.	
colour_primaries	1 = Rec. ITU-R BT.709 (BT.1361)
transfer_characteristics	1 = Rec. ITU-R BT.709 (BT.1361)
matrix_coefficients	1 = Rec. ITU-R BT.709 (BT.1361)
aspect_ratio_info	1 = square pixel 2 = 12:11 (625 lines 4:3 display) 3 = 10:11 (525lines 4:3display) 5 = 40:33 (525lines 16:9 display)
fixed_vop_rate	1 = fixed VOP rate, 0 = variable VOP rate

Note 1: In a case of using arbitrary shaped object (video_object_layer_shape!="rectangular"), width and height of VOP are specified by vop_width and vop_height respectively. When video_object_layer_width and video_object_layer_height (or vop_width and vop_height)are not integral multiple of the number sixteen, dummy data are added to make them integral multiple of 16. The dummy data are added at right of active samples or below of active lines. In practice encoding process is conducted in these samples and lines. By removing dummy data, output video data are made from effective samples or lines in decoder.

Note 2: Frame rate calculation method for fixed_vop_rate=1(fixed VOP rate) is as follows:
Fixed VOP rate = vop_time_increment_resolution/fixed_vop_time_increment

Example: 29.97....Hz=30000/1001
23.97....Hz=24000/1001
14.98....Hz=15000/1001
11.98....Hz=12000/1001
9.99....Hz=10000/1001

Note 3: In the case of video_signal_type = "0", or video_signal_type = "1" and colour_description = "0", each value of colour_primaries, transfer_characteristics and matrix_coefficients is processed as "1" in the receiver side.

Screen size of one VOP or synthesized some VOPs are shown in table F-2.

When screen size is 16:9 in QVGA or SQVGA format, the number of vertical pixels are reduced, but aspect of pixel is not changed on display.

Table F-2 Display screen size

Format	video_object_layer_width or vop_width	video_object_layer_height or vop_height
CIF(4:3)	352	288
SIF(4:3. 16:9)	352	240
QVGA(4:3)	320	240
QVGA(16:9)	320	180
QCIF(4:3)	176	144
QSIF(4:3, 16:9)	176	120
SQVGA(4:3)	160	120
SQVGA(16:9)	160	90
SQCIF(4:3)	128	96

Annex G Operation guidelines for H.264|MPEG-4 AVC video coding

To implement H.264|MPEG-4 AVC video coding, the Baseline or Main profile must be applied and the level must be one of the following options: 1, 1.1, 1.2, 1.3, 2, 2.1.
Under the specification, the maximum picture size and the frame rate (in number of macro blocks per second) are defined for each level. This implies selecting a level and a video coding format to be operated is recommended to be based on a careful consideration of resource formats, receivers, and their behaviors. Each profile consists of coding tools that provide different functionalities. This means selecting a profile is recommended to be based on requirements and services to be operated.

G.1 Picture formats and parameters

G.1.1 Supposed picture formats

Table G-1 shows the supposed picture formats and their syntax. The sample aspect ration of a 16:9 display image in SQVGA and QVGA must be equal to one of a 4:3 display image in SQVGA and QVGA, respectively. This requires that the number of vertical pixels must be reduced.

Table G-1 Supposed picture formats

Format	Picture size	Aspect ratio	seq_parameter_set_rbsp( )		vui_parameters( )	
			pic_width_in_mbs_minus1	pic_height_in_map_units_minus1	aspect_ratio_info_present_flag	aspect_ratio_info
SQVGA	160x120	4:3	9	7 (Note)	1	1
SQVGA	160x 90	16:9	9	5 (Note)		1
525QSIF	176x120	4:3	10	7 (Note)		3
525QSIF	176x120	16:9	10	7 (Note)		5
QCIF	176x144	4:3	10	8		2
QVGA	320x240	4:3	19	14		1
QVGA	320x180	16:9	19	11 (Note)		1
525SIF	352x240	4:3	21	14		3
525SIF	352x240	16:9	21	14		5
CIF	352x288	4:3	21	17		2
525HHR	352x480	4:3	21	29		3
525HHR	352x480	16:9	21	29		5

Note : In case that the width or the height of pictures are not an integer multiple of 16, dummy data must be added to the right of the active samples or below the active lines to make the value an integer multiple of 16. The result is that coding is processed on the assumption of the number of samples or lines is an integer multiple of 16. A decoder removes the added dummy data to output only the active samples or active lines.

G.1.2 Frame rate

To calculate the frame rate, a variable in vui_parameters( ) must be used on the assumption that a frame rate equals time_scale/num_units_in_tick to ensure that the frame rate is an integer multiple of 1000/1001. Note that the maximum frame rate [Hz] for a picture format at each level is shown in Table G-2.

Table G-2 Maximum frame rate [Hz] at each level

	1	1.1	1.2	1.3	2	2.1
SQVGA(4:3)	15000/1001	30000/1001	30000/1001	30000/1001	30000/1001	30000/1001
SQVGA(16:9)	24000/1001	30000/1001	30000/1001	30000/1001	30000/1001	30000/1001
525QSIF(4:3)	15000/1001	30000/1001	30000/1001	30000/1001	30000/1001	30000/1001
525QSIF(16:9)	15000/1001	30000/1001	30000/1001	30000/1001	30000/1001	30000/1001

	1	1.1	1.2	1.3	2	2.1
QCIF	15000/1001	30000/1001	30000/1001	30000/1001	30000/1001	30000/1001
QVGA(4:3)	-	10000/1001	15000/1001	30000/1001	30000/1001	30000/1001
QVGA(16:9)	-	12000/1001	24000/1001	30000/1001	30000/1001	30000/1001
525SIF(4:3)	-	15000/2002	15000/1001	30000/1001	30000/1001	30000/1001
525SIF(16:9)	-	15000/2002	15000/1001	30000/1001	30000/1001	30000/1001
CIF	-	15000/2002	15000/1001	30000/1001	30000/1001	30000/1001
525HHR(4:3)	-	-	-	-	-	30000/1001
525HHR(16:9)	-	-	-	-	-	30000/1001

G.1.3 Colour description

Any colour description must be complied with Rec. ITU-R BT.1361 (Rec. ITU-R BT.709). When video_signal_type_present_flag = 0 or colour_description_present_flag = 0 for VUI Parameters, colour_primaries, transfer_characteristics, and matrix_coefficients have the value 2 (Unspecified), which must be interpreted as the value 1, as specified by Rec. ITU-R BT.709.

G.2 Operation guidelines related to channel hopping

(1) IDR type I-pictures must be inserted at an interval of two seconds in a typical case. The longest interval must be five seconds.
(2) When Sequence Parameter Set parameters differ between the channels, different seq_parameter_set_id value is recommended to be used.

G.3 Recommended operation guidelines for Baseline profile

(1) Supposed service requirements
- Bit rates: 64 kbps through 384 kbps
- Video formats: SQVGA, 525QSIF, QCIF, QVGA, 525SIF, CIF
- Frame rates: 5 Hz, 10 Hz, 12 Hz, 15 Hz, 24 Hz, 30 Hz (actual number must be an integral multiple of 1000/1001)
  Frame skips are allowed.
- Picture display aspect ratio: 4:3, 16:9

(2) Levels
- Depending on a video coding format, a level must be selected among the applicable options: Level 1, 1.1, and 1.2.

(3) Other major operational constraint
- FMO (Flexible Macroblock Ordering), ASO (Arbitrary Slice Order), and RS (Redundant Slices) must not be operated. Sequence Parameter Set must contain constraint_set0_flag =1and constraint_set1_flag =1.

G.4 Recommended operation guidelines for Main profile

(1) Supposed service requirements
- Bit rate: up to 4 Mbps
- Video formats: SQVGA, 525QSIF, QCIF, QVGA, 525SIF, CIF, 525HHR
- Frame rates: 5 Hz, 10 Hz, 12 Hz, 15 Hz, 24 Hz, 30 Hz (actual number must be an integral multiple of 1000/1001)
  Frame skips are allowed.
- Picture display aspect ratio: 4:3, 16:9
- Interlace pictures can be used.

(2) Levels
- Depending on a video coding format, a level must be selected among the applicable options: Level 1, 1.1, 1.2, 1.3, 2 and 2.1.

Informative explanation

1 Coding of MPEG-4 and scope

The optimum coding according to coding type (music, audio) and bit rate should be selected for MPEG-4 audio. List and applied information quantity of MPEG-4 audio is shown in Table 1-1 and applied area is shown in Figure 1-1 for information.

Table 1-1 Structure of MPEG-4 audio coding scheme and applied information quantity

Coding Scheme		Bit rate (k bit/s)
T/F coder (time/frequency conversion coding)		
	In accordance with AAC	24 - 64
	TwinVQ	6 - 40
CELP coder (code excitation line estimation code)		
	WB-CELP	14 - 24
	NB-CELP	4 - 12
Parametric coder		
	HILN	4 - 16
	HVXC	2 - 4
SNHC(Synthetic Natural Hybrid Coding)		
	SA coder (composition with music)	-
	TTS coder (composition with audio)	-

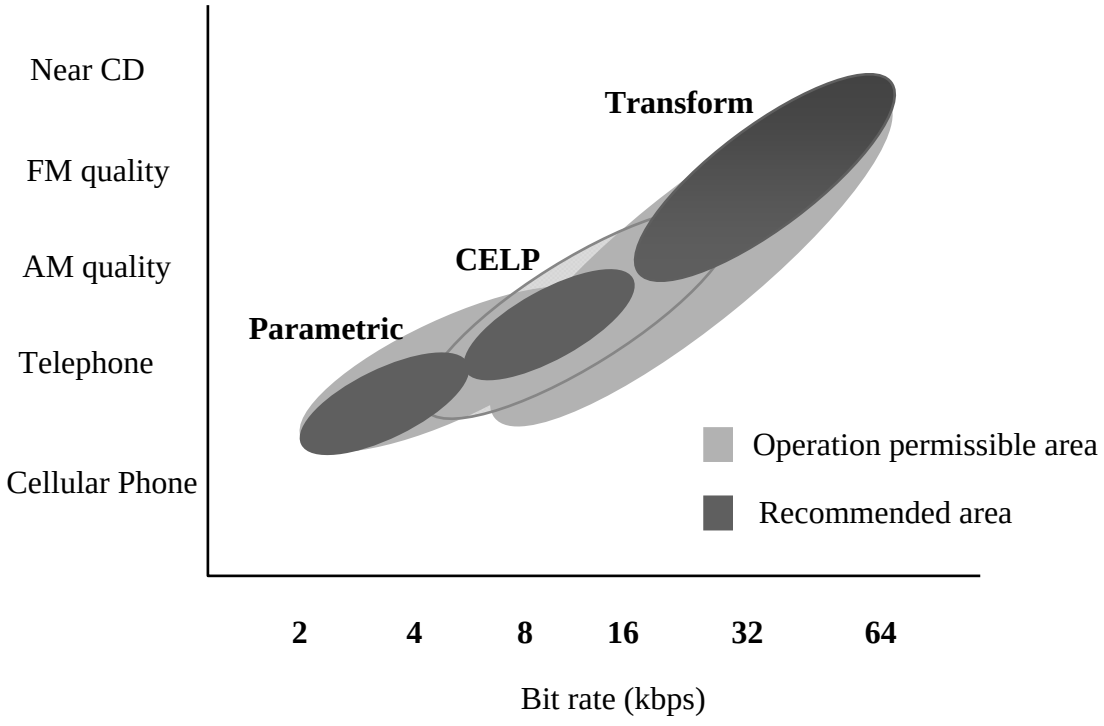


Figure 1-1 Main application area of MPEG-4 codec

2 Extension part in 8bit-character code

Character coding of 8bit-code is based on ARIB STD-B5 "Standard television data multiplex broadcasting by transmission method using vertical blanking interval"(Ver. 1.0, '96 Aug. 6). with partly extensions. Extended parts are as described below.

2.1 Extension in C1 control set

COL: color designation

To correspond to 256 color palette, palette designation is extended to palette number 15.

2.2 Extension for CSI (newly definition)

RCS: Raster color designation

SDF: Display composition, dot designation

SDP: Display position designation

SSM: Character composition, dot designation

PLD: Partially Line Down

PLU: Partially Line Up

SHS: Designation of character spacing

SVS: Designation of line spacing

GSM: Character deformation

GAA: Coloring block

SRC: Raster designation

TCC: Switching control

CFS: Character font set

ORN: Designation of character ornament

MDF: Designation of font

PRA: Playback of built-in sound

XCS: Character substitution code sequence definition

ACS: Alternative character set

SCS: Skip character set

3 Extension part of geometric

Description command coding of geometric is based on ARIB STD-B5 "Standard television data multiplex broadcasting by transmission method using vertical blanking interval"(Ver. 1.0, '96 Aug. 6) with extension. Extended parts are described below.

3.1 Additional definition of new command

SET PATTERN is defined as new extended command. By using this command, line texture or pattern texture is specified in pixel in place of TEXTURE.

3.2 Modification of relation between drawing point and drawing position

When drawing position is dx > 0 and dy > 0, relation of drawing point and drawing position is changed to be in the fourth quadrant.

4 Profiles and levels of H.264 | MPEG-4 AVC

This section explains the profiles and levels specified by ITU-T Rec. H.264|ISO/IEC 14496-10 AVC (2003).

(1) Profiles

Profile	Description	Major features
Baseline	Basic tools	4:2:0 I and P slices (no B slices) Arithmetic coding (CABAC) is not applicable (Note 1) Frame MB is applicable; Other MBs are not applicable Weighted Prediction is not applicable (Note 2) Error- resilience tools are applicable (Note 3)
Main	High compression tools	4:2:0 I, P, and B slices Arithmetic coding (CABAC) is applicable Weighted Prediction is applicable Error resilience tools for Baseline Profile are not applicable
Extended	Extended specification containing Baseline Profile	4:2:0 I, P, and B slices Arithmetic coding (CABAC) is not applicable Data Partition is applicable (Note 4) Weighted Prediction is applicable Switching I and P slices are applicable (Note 5)

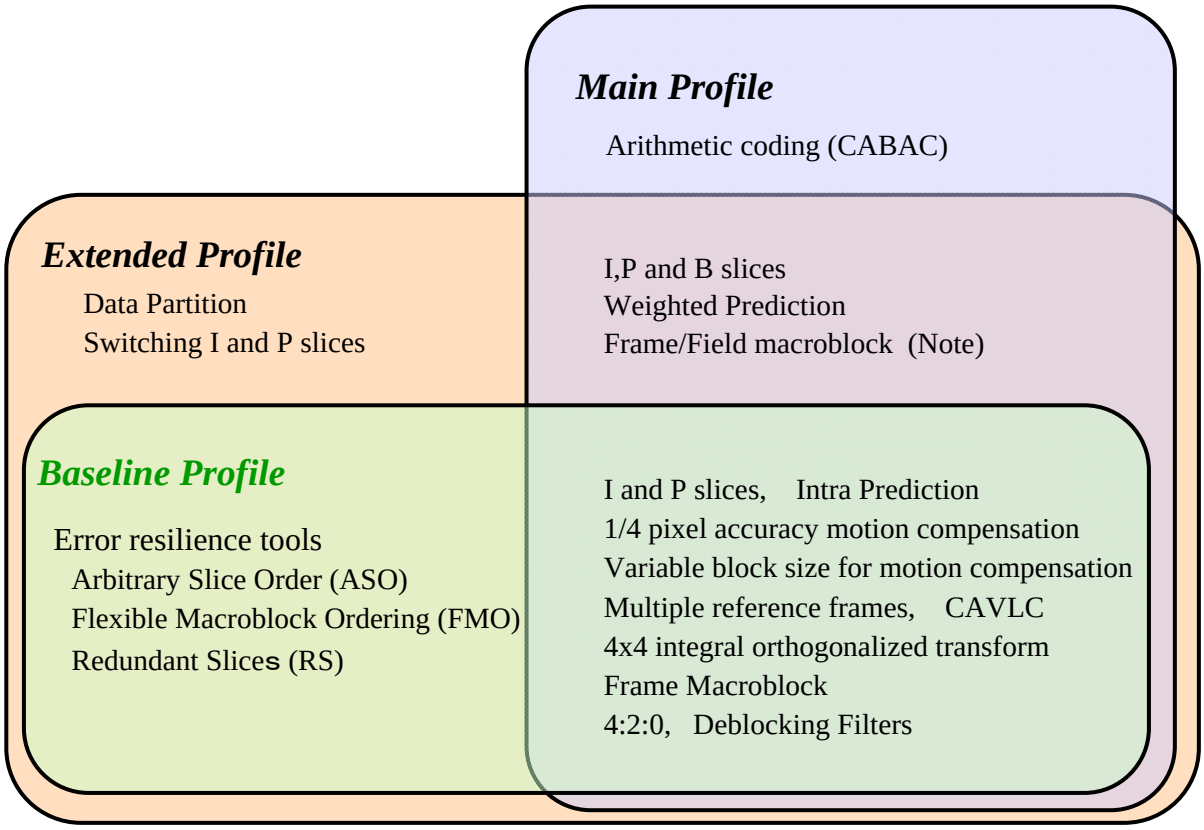
Note 1: Under the H.264 specification, there are two entropy coding methods: CABAC (Context-based Adaptive Binary Arithmetic Code) and CAVLC (Context-based Adaptive Variable Length Code). One of the two can be used. Note that, CABAC is not applicable to the Baseline and Extended profiles. CABAC, as an adaptive arithmetic coding, has an advantage of high coding efficiency and a disadvantage of requiring more complicated hardware.

Note 2: Weighted Prediction: A methodology that is used to apply weighted addition to two or more pictures in order to increase motion prediction efficiency.

Note 3: The Baseline profile contains error resilience tools including FMO (Flexible Macroblock Ordering), ASO (Arbitrary Slice Order), and RS (Redundant Slices). These tools may affect an implementation of a decoder to a large extent.

Note 4: Data Partition: A methodology that is used to divide a coded bit stream to transmit, resulting in a greater error resilience and partial decoding

Note 5: Switching slices: A switching method that is for a switching among two or more bitstreams. This method is used to facilitate a switching among bitstreams with a pointer other than I slice, by transmitting a Switching slice that refers to a previous picture. This is a solution to a normal switching, in which decoding must wait until the next I slice appears.



Note: Depending on the level, only Frame Macroblock is applicable.

Figure 1-2 Relationship between profiles and tools

(2) Level

Level	Maximum frame rate (Hz)						Maximum bit rate (kbps)
	SQCIF	QCIF	QVGA	525 SIF	CIF	525HHR	
1	30.9	15.0	-	-	-	-	64
1.1	62.5	30.3	10	9.1	7.6	-	192
1.2	125	60.6	20	18.2	15.2	-	384
1.3	172	120	39.6	36	30	-	768
2	172	120	39.6	36	30	-	2 000
2.1	172	172	66	60	50	30	4 000

Note 6 The H.264 specification contains levels for higher resolutions: 2.2, 3, 3.1, 3.2, 4, 4.1, 5, and 5.1.

Note 7 For the Main and Extended Profiles, no other MB than Frame MB is applicable to the 1, 1.1, 1.2, 1.3, 2, 5, and 5.1 levels.

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(3) ISO/IEC 11172-2 (1993) Information Technology - Coding of Moving Pictures and Associated Audio for Digital Storage Media at up to About 1,5 Mbit/s - Part 2: Video

(4) ISO/IEC 13818-2 (1996) Information Technology - Generic Coding of Moving Pictures and Associated Audio Information: Video

(5) ISO/IEC 13818-3 (1998) Information Technology - Generic Coding of Moving Pictures and Associated Audio Information-Part3 Audio

(6) ISO/IEC 13818-7 (1997) Information Technology - Generic Coding of Moving Pictures and Associated Audio Information - Part 7:Advanced Audio Coding (AAC)

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(9) PNG Specification Ver1.0 W3C Rec.Oct.1996[1]

(10) MNG Format Version 0.96-19990718[2]

(11) DAVIC 1.4 Specification Part9 (1998)(AnnexB)

(12) RECOMMENDATION ITU-R BT.709 (1990) Basic Parameter Values for the HDTV Standard for the Studio and for International Program Exchange

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(14) JIS X 0201 (1997) "Coding character set for information exchanging for 7-bit and 8-bit"

(15) JIS X 0221-1:2001 (2001) "Universal Multiple-Octet Coded Character Set (UCS) -- Part 1: Architecture and Basic Multilingual Plane"(ISO/IEC 10646-1:2000)

(16) JIS X 0208:1997 (1997) " 7-bit and 8-bit double byte coded KANJI sets for information interchange"

(17) JIS X 0212:1990 (1990) "Code of the supplementary Japanese graphic character set for information interchange"

(18) JIS X 0213:2000 (2000) "7-bit and 8-bit double byte coded extended Kanji sets for information interchange"

(19) JIS X 0213:2000/AMENDMENT 1:2004 "7-bit and 8-bit double byte coded extended KANJI sets for information interchange (Amendment 1) "

(20) ISO/IEC 646:1991(1991) " Information technology – ISO 7-bit coded character set for information interchange"

(21) ISO/IEC 14496-2 (2003) " Information technology – Coding of audio-visual objects – Part 2: Visual"

(22) ISO/IEC 14496-3 (2003) "Information technology – Coding of audio-visual objects – Part 3: Audio"

(23) ISO/IEC FDIS 14496-10 & ITU-T Rec. H.264 (2003) " Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding"

(24) GRAPHICS INTERCHANGE FORMAT(sm) Version 89a (c)1987,1988,1989,1990Copyright CompuServe Incorporated Columbus, Ohio [3]

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1 (http://www.w3.org/pub/WWW/TR/REC-png-multi.html)

2 (ftp://swrinde.nde.swri.edu/pub/mng/documents/mng-0.96-19990718-pdg.html)

3 (http://www.w3.org/Graphics/GIF/spec-gif89a.txt)

Part 3 Coding of Caption and Superimpose

Contents

Chapter 1 Purpose

This standard specifies the coding scheme of caption and superimposes as part of the data broadcasting, which is carried out as part of the digital broadcasting that is specified as Japanese standard.

Chapter 2 Scope

This standard is applied for the coding scheme of caption and superimposes in data broadcasting carried out as part of the digital broadcasting.

Chapter 3 Definitions and Abbreviation

3.1 Definitions

Following definitions are used in this standard.

Synthesized sound:	A function to play music using sound generation device such as electronic sound using information of basic element of sound pitch, length, and loudness and additional element such as timbre.
Asynchronous PES:	PES without PTS
Audio PES:	Audio ES by packet format.
Color map:	Color information table for converting from the index value to the physical values (same as CLUT).
Color map data:	Data to be set to color map.
Color map data unit data:	Color map data of data unit format.
Geometric:	Graphics coding to draw graphics combining graphics description command.
Independent PES:	PES to transmit stream for data broadcasting (specified in Volume 3.)
Roll-up mode:	A service to convert caption data transmitted in a page format into a line format to present caption in a pre-configured small area, typically in a rectangle with three lines height. When the fourth line appears, the first line disappears.
Synchronous PES:	PES with PTS
Video PES:	Video ES by packet format.

3.2 Abbreviations

AIFF	Audio Interchange File Format
CLUT	Color Look Up Table
DRCS	Dynamically Redefinable Character Sets
ES	Elementary Stream
PCM	Pulse Code Modulation
PES	Packetized Elementary Stream
PNG	Portable Network Graphics
PSI	Program Specific Information
PTS	Presentation Time Stamp
SI	Service Information
TS	Transport Stream

Chapter 4 Presentation function of caption and superimpose

Among service to display characters overlapping on video of television broadcasting, service related to contents of video is called caption and all others is called superimpose. When transmitting and coding, these are not classified, and both of them are called caption generally.

Presentation function of the caption is shown in Table 4-1.

Table 4-1 Presentation function of caption

Display function	Format	1920 x 1080, 960 x 540, 1280 x 720, 720 x 480 (each of them is mixed with vertical and horizontal writing format)
	Character set	Kanji, hiragana, katakana, symbol, alphanumerical, Greece characters, Russian characters, ruled line, DRCS
	Font	Plural typeface can be designated
	Supplemental Characters (Gaiji)	By DRCS graphics
	Character display size	Size designation and deformation in pixel unit, standard, 1 x 2, 2 x 1, 2 x 2, 1/2 x 1, and 1/2 x 1/2 are directly designated using control code.
	Coloring	256 colors are displayed simultaneously (color map used, output: color value of YCBCR and α value (8-bit x 4))
	Character coloring unit	Each character (outer frame of character or character display block)
	Character attribute	Reversing polarity, flashing, underline, enclosure, shading, bold, italic, bold and italic
	Graphics	Geometric, bitmap
Display control	Timing control	Display timing, erase timing
	Switching control	Cut, dissolve, wipe, slide, and roll
Others	Language	up to 8 languages per 1 ES
	Music data	For coding synthesized sound, coding method shall be in accordance with standard method of transmission related to television superimpose broadcasting (ARIB STD-B5).
	ROM sound	PCM (AIFF-C)

Table 4-2 Caption display mode

Display mode		Display function
When received	Automatic display	Always displayed during reception irrelevant to viewer's operation
	Automatic non-display	Always non-displayed during reception irrelevant to viewer's operation
	Selectable display	Displayed according to the viewer's operation and receiver unit setting (or non-displayed)
	Automatic display/Non-display under specific condition	Displayed (or non-displayed) according to specific condition in the receiver unit side
When recording and playback	Automatic display	Recorded automatically when recording and always displayed irrelevant to viewer's operation when playing back
	Automatic non-display	Non-displayed when playback
	Selectable display	Recorded automatically when recording and displayed (or non-displayed) by the viewer's operation when playback

By combining display mode at a time of reception and recording playback, following five functions from a to e shown below, related to control function of caption display, proposed by ARIB Enhanced data broadcasting working group is achieved.

Table 4-3 Example of caption display control function

a Always displayed (both in reception and recording playback)
b Always displayed when reception and can be erased in recording playback
c Displayed (or non-displayed) according to viewer's operation
d Displayed (or non-displayed) under specific condition in the receiver unit side
e Not displayed when reception and displayed when recording playback

Chapter 5 Character coding

5.1 Format

Vertical, horizontal and mixture of these two writing format in resolution of 1920 x 1080, 960 x 540, 1280 x 720 and 720 x 480 should be supported.

Table 5-1 Display formats and display-area size

Display format	Size of display area
1920 x 1080	W(Width) 1920 x H(Height) 1080
960 x 540	W 960 x H 540
1280 x 720	W 1280 x H 720
720 x 480	W 720 x H 480

Initial drawing position in the formats above is the first position of the first line determined by the character size.

Display format of vertical writing and horizontal writing can be mixed in one density format but not mixed in different density formats.

5.2 Character set

Standard character set should be kanji, hiragana, katakana, symbol, alphanumeric, Greece characters, Russian characters, box drawing, and DRCS. Supported character set can be changed to others depending on the language.

5.3 Size

Character size can be designated in pixel. Character deformation can be directly designated in width 1/2 x height 1/2 (small size), 1/2 x 1 (middle size), 1 x 1 (standard), 2 x 1 (double width), 1 x 2 (double height), 2 x 2 (double width and height). Furthermore, character deformation can be designated control code.

5.4 Coloring

Coloring is made in each character (outer frame of character or character display block).

By using the color map, 256 colors in maximum can be displayed simultaneously (output: YCBCRα (8 bit x 4)).

5.5 Character coding

For character coding, 8bitcode shall be used.

5.6 Control code

Control code used for caption is in compliance with Volume 1, Part 2 of this standard. Types of control code for caption are listed in Table 5-2. BEL (bell), CAN (cancel), CDC (conceal control), PLD (Partially Line Down) and PLU (Partially Line Up) should not be used. Function of TCC is partially changed as shown in Table 5-3.

In addition to those control codes, extended control code shown in Table 5-4 can be used.

Table 5-2 Range of control code

Control code set	Types of used control code
C0 Control code	NUL, APB, APF, APD, APU, APR, PAPF, APS, CS, ESC, LS1, LS0, SS2, SS3
C1 control code	BKF, RDF, GRF, YLF, BLF, MGF, CNF, WHF, COL, POL, SSZ, MSZ, NSZ, SZX, FLC, WMM, TIME (STM, TMD, DTM, OTM, PTM are not used), MACRO, RPC, STL, SPL, HLC, CSI
Extension control code (CSI)	SWF, RCS, ACPS, SDF, SDP, SSM, SHS, SVS, GSM, GAA, TCC (function is changed), CFS, ORN, MDF, XCS, PRA, SRC, CCC, SCR

Table 5-3 Changing function of switching controls (TCC)

TCC	Switching control	Switching mode of caption is designated using parameter P1 (1 code), switching direction of caption is designated using parameter P2 (1 code) and switching time of caption is designated using parameter P3 (1 or plural codes). Switching method of the whole display picture constructed of caption statement data including each character, character line (character group) or switching control code after the switching control code is designated. End of the character line of character group is immediately before the next switching control (TCC). (To return to the initial condition, cutting each character is designated.) Code sequence: CSI P1 I1 P2 I2 P31 ~ P3i I3 F CSI: 09/11 (control sequence introducer) P1: 03/0 ~ 03/10 switching mode designation 03/3: cutting each character, 03/1: dissolving each character, 03/2: sliding each character, 03/3: cutting character group, 03/4: dissolving character group, 03/5: wiping character group, 03/6: whole picture cut, 03/7: whole picture dissolve, 03/8: whole picture wipe, 03/9: whole picture slide, 03/10: whole picture roll P2: 03/0 ~ 03/3 switching direction 03/0: from left to right, 03/1: from right to left, 03/2: from up to down, 03/3: from down to up P31 ~ P3i: 03/0 ~ 03/9 designating switching time (decimal in 0.1sec. unit) I1 ~ I2: 03/11 (middle character) I3: 02/0 (middle character) F: 06/2 (final character) *In P3, 03/0 - 03/9 indicates 0 to 9. Whole screen means the rectangle area designated by SDF and SDP. Slide and roll is made within the rectangle area and drawing other than the rectangle area is not made. In case of cutting each character, cutting character group and whole screen cut, I1 to P3 are omitted. In case of dissolving each character, dissolving character group and whole picture dissolve, I2 and P2 are omitted. Designation of switching control to the whole picture is placed in the head of the statement data unit at the beginning of the data group and switching control is not designated again in the same data group. Time control (excluding ETM) is not made.

Table 5-4 Added extension control code (CSI)

SCR	Scroll designation	Scroll mode of the caption is designated using parameter P1 (1 code) and scroll speed is designated using parameter P2 (1 or plural codes). Coding sequence: CSI P1 I1 P21 ~ P2i I2 F CSI: 09/11 (control sequence introducer)

		P1:	03/0: fixed display (without scroll) 03/1: one line scroll to character direction (without roll out) 03/2: one line scroll to character direction (with roll out) 03/3: whole display scroll to line direction (without roll out) 03/4: whole display scroll to line direction (with roll out)
		P21 ~ P2i:	03/0 ~ 03/9: scroll speed (logic picture element/sec., decimal)
		I1:	03/11 (middle character)
		I2:	02/0 (middle character)
		F:	06/7 (final character)
		*In P2, 03/0 to 03/9 indicates 0 to 9. Scroll is made within the rectangle area designated by SDF and SDP and drawing other than the rectangle area is not made. In case without roll out, stop scrolling after the final character is displayed. In case with roll out, scroll continues until characters disappear on the display.	

Chapter 6 Coding of graphics

6.1 Coding of geometric graphics

Description command graphics coding using geometric shall be in compliance with Volume 1, Part 2 of this standard.

6.2 Coding of bitmap graphics

Bitmap graphics-coding should be in compliance with PNG coding defined in Volume 1, Part 2 of this standard, adding position header (position_header) and flashing header (flc_header). Syntax of bitmap graphics coding is shown in Table 6-1.

Table 6-1 Syntax of bitmap graphics coding

Syntax	No. of bits	Mnemonic
bitmap_data(){		
position_header(){		
x_position	16	simsbf
y_position	16	simsbf
}		
flc_header(){		
num_of_flc_colors	8	uimsbf
for(i=0;i<num_of_flc_colors;i++){		
color_index	8	uimsbf
}		
}		
for (j=0;j<M;j++){		
png_data_bytes	8	bslbf
}		
}		

x_position : x coordinate of PNG drawing start position when left upper angle of the display area is 0. When this value is negative, area of negative coordinates is not displayed on the picture.

y_position : y coordinate of PNG drawing start position when left upper angle of the display area is 0. When this value is negative, area of negative coordinates is not displayed on the picture.

num_of_flc_colors : Number of color to be flashed.

color_index : Index value of the color to be flashed.

png_data_bytes : PNG coding data. File format of PNG coding data should be in compliance with PNG coding defined in Volume 1, Part 2 of this standard.

Chapter 7 Coding of definition data

7.1 Coding of DRCS

Coding of DRCS shall be in compliance with Volume 1, Part 2 of this standard.

7.2 Coding of color map

For coding of color map, Clause 10.2.7 "Color map data coding" of ARIB STD-B5 should be used with modification of the color value from RGB to Y, CB and CR and enhancement of placement of α immediately after Cr of the sequence of color value YCBCR to support half transparent color (α value). Structure of color map data-unit data is shown in Figure 7-1. In Figure 7-1, PB means byte data of data unit data and should be transmitted PB1, PB2 and PB3 ... in order.

	b8 b7 b6 b5 b4 b3 b2 b1
PB1	Luster color value Y
PB2	CB
3	CR
4	α
5	Head color map address
6	Color value Y
7	CB
8	CR
9	α
:	:
	Color value Y
	CB
	CR
	α

Figure 7-1 Structure of color map data unit data

7.3 Coding of synthesized sound data

Coding of synthesized sound data should be in compliance with ARIB STD-B5 "Standard television data multiplex broadcasting by transmission method using vertical blanking interval".

7.4 Coding of ROM sound

ROM sound to indicate the flash provided by superimpose should be built-in sound of the receiver unit which is engaged to playback by the control code of character coding.

Chapter 8 Initialization

Any initialization shall be in compliance with Table 8-1. Initial status as a result of an initialization shall be as shown in Table 8-2.

Table 8-1 Data header, data unit and control code and initialization

Initialization / Data header, data unit and control code		Display	Playback of synthesized sound	Definition data	Declaration data	Invocation and designation of the code	operation	state
Data header	Caption control when updated	O	O	O	O			
	Caption statement			O (Note 1)	O			O (Note 5)
Data unit	Text					O (Note 2)	O (Note 2, 7)	O (Note 2, 6)
	Geometric					O (Note 3)	O (Note 3)	O (Note 7)
Control code	Clear screen (CS)	O (Note 7)				O (Note 7)	O (Note 7)	O (Note 7)
	Selection of format (SWF)					O	O	O (Note 4)

Note 1: When definition data exists in the caption management, initialized in its status.
Note 2: Initialized for character coding
Note 3: Initialized for geometric graphics coding
Note 4: Initialized for character coding excluding display format, macro designation and switching control
Note 5: Initialized only for switching control and scroll control
Note 6: Exclude switching control
Note 7: In the roll-up mode, no initializing operation should be done.

Table 8-2 Initial status

Item	Initial status		
Display picture	Display picture	(Cleared screen)	
		Pattern	Background color (0)
		Background color	Transparent
		Flashing	No area assigned
		Luster	Transparent (television video)
	Display operation	Blink	Stop status
		Time control	Not operated
Synthesized sound		stop	
Definition data	DRCS	Data cleared	
	Color map	Color map default value specified otherwise	
	Synthesized sound	Default value specified otherwise	
Declaration data	Macro definition	Default macro statement specified otherwise (Clause 2.3 in ARIB STD-B3)	
	Geometric macro statement definition	All NUL	
Invocation and designation of code	Character coding	Designation	G0 Kanji system set
			G1 Alphanumeric set
			G2 Hiragana set
			G3 Macro code set
		Invocation	GL LS0 (G0)
			GR LS2R (G2)

Item	Initial status		
	Geometric graphics coding	C0	NUL and CS
		C1	MACRO and TIME
		GL	Graphics description command code set
		GR	Geometric macrocode set
		One-valued operand	1 byte
		Multi-valued operand	4 byte
operation	Character coding	Operation position	Designated for each font
		Time control	No Operation status
		Character repetition	No Operation status
	Geometric graphics coding	Drawing point	Origin of display area
		Blink	Finish status for all drawing color
		Time control	No Operation status
state	Character coding	Display format	Designated by caption management data
		Character size	1 x 1 (standard)
		Palette number	0 (COL 02/0 04/0)
		Foreground color	Maximum brightness white (CMLA 7)
		Background color	Transparent (CMLA 8)
		Half foreground color	Defined in the operational guideline
		Half background color	Defined in the operational guideline
		Flushing control	Flushing end (FLC 04/15)
		Underline control	Underline end and mosaic Division finished (SPL)
		Enclosure control	Enclosure control finished (HLC 04/0)
		Polarity control	Normal polarity (POL 04/0)
		Write mode	NEW writing (WMM 04/0)
		Macro designation	Macro definition finished (MACRO 04/15)
		Composition control	Composition finished (CSI 03/0 02/0 05/4)
		Character spacing	Length to character direction in the character display block
		Line spacing	Length to character direction in the character display block
		Character deformation	Without deformation (CSI 03/1 03/0 03/11 03/1 03/0 02/0 04/2)
		Coloring block	Whole display block (CSI 03/0 02/0 05/13)
		Scroll designation (SCR)	Fixed Display (End of Scroll designation)
		Definition of code string substituted by external character (XCS)	End of definition (XCS 03/1 I1 F)
		Switching control	Cutting each character (CSI 03/0 02/0 06/2)
		Hemming designation	Without hemming (CSI 03/0 02/0 06/3)
		Type designation	Standard (CSI 03/0 02/0 06/4)
		Character font setting	Without font setting (CSI 03/0 02/0 06/1)
		In the roll-up mode, only the values for character size, palette number, foreground color, background color, half foreground color, half background color, and hemming designation are initialized.	
	Coding of geometric graphics	Dimension	2
		Logic picture element size	dx = 0, dy = 0 Color mode 1 (only forward color, pallet number 0, CMLA 7 maximum brightness white)

Item	Initial status		
		Line texture	Solid line
		Texture pattern	Completely painted out
		Highlight	Without highlight process
		Macro designation (MACRO 04/15)	Macro definition finish

Chapter 9 Transmission of caption and superimpose

9.1 Recommended transmission method and assumed operation

9.1.1 Caption and superimpose

Caption and superimpose can be transmitted in three types of PES (independent, video, and audio). For transmission method of caption and superimpose, independent PES is recommended.

9.1.2 Assumed transmission operation

Transmission method of caption and superimpose shown below specifies the format in PES_data_byte so that multiple language and display mode can be conveyed in a single ES. However, in digital broadcasting, it is possible that caption data of single language and display mode occupies one ES and that selection of caption language, etc., is achieved by selection of ES according to the information provided in SI/PSI. When such operation is made, caption and superimpose data of single language and display mode shall be transmitted by the method specified in this clause for PES and descriptor(s) in SI/PSI shall control the information of caption data.

9.2 Structure of data group

Caption data is data-grouped by the structure shown in Table 9-1 and transmitted as payload of independent PES (asynchronous/synchronous type). One caption data is composed of 256 data groups maximum.

Table 9-1 Data group

Syntax	No. of bits	Mnemonic
data_group(){		
data_group_id	6	uimsbf
data_group_version	2	bslbf
data_group_link_number	8	uimsbf
last_data_group_link_number	8	uimsbf
data_group_size	16	uimsbf
for(i=0;i<N;i++){		
data_group_data_byte	8	bslbf
}		
CRC_16	16	rpchof
}		

Semantics of data group:

data_group_id (Data group identification; DGI): This 6-bit field indicates data group identification and identifies types of caption management data and caption statement data. Table 9-2 shows allocation of data group identification to each caption data. Data group is switched to group A and group B each time when the caption management data is updated.

Table 9-2 Correspondence to caption data and data group identification

Caption data type	Data group identification (DGI)	
	Group A	Group B
Caption management	0 x 0	0 x 20
Caption statement (1st language)	0 x 1	0 x 21
Caption statement (2nd language)	0 x 2	0 x 22
Caption statement (3rd language)	0 x 3	0 x 23
Caption statement (4th language)	0 x 4	0 x 24

Caption statement (5th language)	0 x 5	0 x 25
Caption statement (6th language)	0 x 6	0 x 26
Caption statement (7th language)	0 x 7	0 x 27
Caption statement (8th language)	0 x 8	0 x 28

data_group_version (Data group version): This 2-bit field indicates version of the data group. Each time when content is updated within the same DGI, 1 shall be added.

data_group_link_number (Data group link number): When a large amount of caption data which cannot be contained in one data group is transmitted, the caption data is fragmented to multiple data groups for transmission. This 8-bit field indicates link number of the data groups. The first data group link number of the data group in the caption data shall be 0 x 00.

last_data_group_link_number (Last data group link number): This 8-bit field indicates the last data group link number of the caption data in the data group.

data_group_size (Data group size; DGS): This field indicates the size of following data of the data group in byte..

data_group_data_byte (Data group data; DGD): Data group data to be transmitted.

CRC_16 (Redundant bit; CRC): This is a cyclic redundancy check code in 16-bit and the generation polynomial should be as follows.

$$G(X) = x^{16} + x^{12} + x^5 + 1$$

The coded block starts from the beginning of the data_group_id and ends at the end of the data_group_data_byte. When number of the information bits of the coded block for error detection is (n-16), the values of the information bits are coefficients of the terms for the following expression:

$$C_{n-1}X^{n-1}+C_{n-2}X^{n-2}+ \text{----} +C_{16}X^{16}$$

and the expression is divided by the generation polynomial $G(X)=X^{16}+X^{12}+X^5+1$, CRC_16 is given by the coefficients of the remaining polynomial $S_{15}X^{15}+S_{14}X^{14}$ ---- S_0X^0 and located in the order starting from the most significant digit after the data_group_data_byte.

9.3 Data group data

Caption service is transmitted by caption management data and caption statement data of zero or up to 8 languages.

9.3.1 Caption management data

Caption management data consists of caption management data header indicating language or transmission mode of the caption and zero or more than one data unit, following it. Structure of caption management data is shown in Table 9-3.

Table 9-3 Structure management data

Syntax	No. of bits	Mnemonic
caption_management_data(){		
TMD	2	bslbf
Reserved	6	bslbf
if(TMD==’10’){		
OTM	36	uimsbf
Reserved	4	bslbf
}		
num_languages	8	uimsbf

for(i=0;i<N;i++){		
language_tag	3	bslbf
reserved	1	bslbf
DMF	4	bslbf
if (DMF==’1100’ || DMF==’1101’ || DMF==’1110’){		
DC	8	bslbf
}		
ISO_639_language_code	24	uimsbf
Format	4	bslbf
TCS	2	bslbf
rollup_mode	2	bslbf
}		
data_unit_loop_length	24	uimsbf
for(i=0;i<N;i++){		
data_unit()		
}		
}		

Semantics of caption management data:

TMD (Time control mode): This 2-bit field indicates time control mode when receiving and playback. Time control mode is listed in Table 9-4.

Table 9-4 Time control mode

b2 b1	Time control mode	Reference
0 0	Free	Playback time is not restricted to synchronize to the clock.
0 1	Real time	Playback time is in accordance with the time of the clock, which is calibrated by clock signal (TDT). Playback time is given by PTS.
1 0	Offset time	Playback time added with offset time should be the new playback time and played back according to the calibrated clock using the clock signal.
1 1	(Reserved)	Undecided

OTM (Offset time): This 36-bit field indicates offset time to add to the playback time when the clock control mode is in offset time mode. Offset time is coded in the order of hour, minute, second and millisecond, using nine 4-bit binary coded decimals (BCD).

num_languages (Number of languages): Number of languages included in the ES of the caption and superimpose.

language_tag (Identification of language): Numbers to identify the language. 0 means the 1st language, and 7, the 8th language, and so on.

DMF (Display mode): This 4-bit field indicates the display mode of the caption statement. Display mode is indicated in reception and recording playback in 2 bit each. The modes controlled by DMF are listed in Table 9-5.

Table 9-5 Display mode

b4 b3	b2 b1	Display mode
0 0		Automatic display when received
0 1		Non-displayed automatically when received
1 0		Selectable display when received
1 1		Automatic display/non-display under specific condition when received
	0 0	Automatic display when recording and playback
	0 1	Non- displayed automatically when recording and playback

	1 0	Selectable display when recording and playback
	1 1	Reserved

DC (Display condition designation): This 8-bit field indicates condition of display or non-display when the display mode is "Automatic display/non-display under specific condition". Display condition is shown in Table 9-6.

Table 9-6 Designation of display condition

Display condition designation (DC)	Display condition
0x00	Message display of attenuation due to rain
0x01 - 0xFF	Specified otherwise

ISO_639_language_code (Language code): This 24-bit field indicates the language code corresponding to the language identified by the language_tag in three-letters representation specified in ISO 639-2. Each character is coded in 8-bit representation of ISO 8859-1 and inserted to 24-bit field in that order.

Example: Japanese is expressed as "jpn" by 3-letter code and is coded as follows:

"0110 1010 0111 0000 0110 1110"

format (display format): This 4-bit field indicates the initial status of the display format of caption display screen. The status of the display format is listed in Table 9-7.

Table 9-7 Display format

b4 b3 b2 b1	Display format
0 0 0 0	Horizontal writing in standard density
0 0 0 1	Vertical writing in standard density
0 0 1 0	Horizontal writing in high density
0 0 1 1	Vertical writing in high density
0 1 0 0	Horizontal writing of Western language
0 1 1 0	Horizontal writing in 1920 x 1080
0 1 1 1	Vertical writing in 1920 x 1080
1 0 0 0	Horizontal writing in 960 x 540
1 0 0 1	Vertical writing in 960 x 540
1 1 0 0	Horizontal writing in 1280 x 720
1 1 0 1	Vertical writing in 1280 x 720
1 0 1 0	Horizontal writing in 720 x 480
1 0 1 1	Vertical writing in 720 x 480

TCS (Character coding): This 2-bit field indicates the type of character coding. Character coding is listed in Table 9-8.

Table 9-8 Character coding

b2 b1	Character coding
0 0	8bit-code
0 1	Reserved for UCS
1 0	Reserved
1 1	Reserved

rollup_mode: This 2-bit field indicates whether the caption data is transmitted in the roll-up mode or not. The applicable values are shown in Table 9-9.

Table 9-9 Roll-up mode

b2 b1	Roll-up mode

0 0	Non roll-up
0 1	Roll-up
1 0	Reserved for future use
1 1	Reserved for future use

data_unit_loop_length (Data unit loop length): This is 24-bit indicates the byte length of the following data unit. When data unit is not placed, the value should be 0.

data_unit() (Data unit): This data_unit() is valid data unit to all the caption program transmitted in the same ES.

9.3.2 Caption statement data

Caption statement data is the body of the caption and consists of caption statement data header composed of presentation time information and following one or more data unit groups. Structure of caption statement data is shown in Table 9-9.

Table 9-10 Caption statement data

Syntax	No. of bits	Mnemonic
caption_data(){		
TMD	2	bslbf
Reserved	6	bslbf
if(TMD=='01'||TMD=='10'){		
STM	36	uimsbf
Reserved	4	bslbf
}		
data_unit_loop_length	24	uimsbf
for(i=0;i<N;i++){		
data_unit()		
}		
}		

Semantics of caption statement data:

TMD (Time control mode): This 2-bit field indicates time control mode when receiving and playback.

STM (Presentation start-time): This 36-bit field indicates presentation start time of the following caption statement. Presentation start time is coded in the order of hour, minute, second and millisecond, using nine 4-bit binary coded decimals (BCD). Time to finish presentation is designated by the character code of the caption statement.

data_unit_loop_length (Data unit loop length): This is 24-bit field and specifies the byte length of the following data unit.

data_unit () (Data unit): This is the data unit of the caption statement. At least one data unit should be placed.

9.4 Structure of data unit

Structure of data unit used for caption management data and caption statement data is shown in Table 9-10.

Table 9-11 Data unit

Syntax	No. of bits	Mnemonic
data_unit(){		

unit_separator	8	uimsbf
data_unit_parameter	8	uimsbf
data_unit_size	24	uimsbf
for(i=0;i<data_unit_size;i++){		
data_unit_data_byte	8	bslbf
}		
}		

Semantics of data unit:

unit_separator (Data unit separator code: US): Data unit separator code should be 0x1F.

data_unit_parameter (Data unit parameter): Data unit parameter identifies the type of data unit. Types of data unit used in the caption, data unit parameter and function are listed in Table 9-11.

Table 9-12 Types of data unit

Data unit	Data unit parameter	Function
Statement body	0x20	Character data of caption statement is transmitted. Setting data of display area in caption management is transmitted.
Geometric	0x28	Geometric graphics data is transmitted
Synthesized sound	0x2c	Synthesized sound information data is transmitted.
1-byte DRCS	0x30	1-bite DRCS pattern data is transmitted.
2-byte DRCS	0x31	2-bite DRCS pattern data is transmitted.
Color map	0x34	Color map data is transmitted.
Bit map	0x35	Bitmap data is transmitted.

data_unit_size (Data unit size): Data unit size indicates byte length of the following data unit data.

data_unit_data_byte (Data unit data): Data unit data to be transmitted.
Assignment of data unit to data group is listed in Table 9-13.

Table 9-13 Assignment of the data unit to data group

Contents of data unit	Data group data	
	Caption management	Caption statement
Statement body	O	O
Geometric	-	O
Additional sound	-	O
1-byte DRCS	O	O
2-byte DRCS	O	O
Color map	O	O
Bit map	-	O

9.5 Relationship of independent PES and time control mode

Relationship of time control mode (TMD) in case of transmission of data group by asynchronous and synchronized PES and synchronization method of receiver unit is shown in Table 9-13.

Table 9-14 Synchronization method of time control mode and receiver unit

Transmission method / TMD	Asynchronous type PES	Synchronized PES	
		Receiver unit which PTS can be processed	Receiver unit which PTS cannot be processed

Free	Asynchronous	Program synchronous (Synchronized by PTS)	Synchronization impossible (Displayed immediately after reception)
Real time/offset time	Time synchronous (Synchronized by STM)	Program synchronous (Synchronized by PTS)	Time synchronous (Synchronized by STM)

Operation of TMD and STM for PES (asynchronous type/synchronized type) should be specified otherwise.

9.6 Descriptor of SI/PSI in transmission of caption and superimpose

In case of transmission of caption and superimpose employing 8bit-code characters by independent PES, it is recommended to allocate data_component_id[1], and to describe information belowin the specified field of both data component descriptor and data contents descriptor where its format is specified for each coding method.

9.6.1 Data component descriptor

The additional identification information (additional_data_component_info) of data component descriptor in PMT has the syntax shown in Table 9-14 for the transmission of caption and superimpose.

Table 9-15 Additional data component of caption and superimpose

Syntax	No. of bits	Mnemonic
additional_arib_caption_info(){		
DMF	4	bslbf
Reserved	2	bslbf
Timing	2	bslbf
}		

Semantics of additional_arib_caption_info():

DMF (Display mode flag): This field indicates display mode at a time of reception and of recording playback. When the same DMF value is used without changing in the caption management data for the whole language in the ES, its DMF value is described. When this DMF value of caption management changes, it should be b4b3b2b1 = "1111". When there is '00' in b2b1 or b4b3 of DMF bit, bit representation should be b4b3b2b1 = "0011". In this case, it indicates that language which automatic presentation is needed is included in the ES.

Timing (display timing): This field indicates timing of caption display. Definition of timing value is shown in Table 9-15

Table 9-16 Definition of timing value

Timing value	Meaning
0 0	Asynchronous
0 1	Program synchronous
1 0	Time synchronous

[1] The data_component_id of caption and superimpose coding scheme specified by ARIB shall be 0x0008.

9.6.2 Data content descriptor

In transmission of caption, one descriptor shall be prepared for one ES for EIT data content descriptor. However, when it is not scheduled beforehand such as superimpose of flash, operation without inserting data content descriptor in EIT is acceptable.

Syntax of selector area of data content descriptor for caption and superimpose transmission is shown in Table 9-16.

Table 9-17 Data construction of selector area

Syntax	No. of bits	Mnemonic
arib_caption_info(){		
num_languages	8	uimsbf
for(i=0;i<N;i++){		
language_tag	3	bslbf
reserved	1	bslbf
DMF	4	bslbf
ISO_639_language_code	24	uimsbf
}		
}		

Semantics of arib_caption_Info():

num_languages: Numbers of languages included in this caption and superimpose ES.

language_tag: This tag identifies language by number. The value '0' represents the first language and the value '7' represents the 8th language.

DMF: When the DMF value of the caption management data of the language indicated by the language_tag does not change in ES, its caption management DMF value is described after each language_tag. When the value changes, it should be '1111'. When there is '00" in b2b1 or b4b3 of DMF bit, bit representation should be b4b3b2b1 = "0011". "0011" indicates that automatic presentation is needed.

ISO_639_language_code (Language code): This 24-bit field indicates the language code of the language identified by the language_tag in three-letter code specified in ISO 639-2. Each character is coded in 8-bit representation of ISO 8859-1 and inserted to this 24-bit field in that order.

Example: Japanese is expressed as "jpn" by 3-letter code and is coded as follows:

"0110 1010 0111 0000 0110 1110"

References

(1) ARIB STD-B5 Version 1.0 "STANDARD TELEVISION DATA MULTIPLE BROADCASTING USING VERTICAL BLANKING DURATION TRANSMISSION METHOD" (1996 August)

(2) ISO 639-2 (1996) Codes for the representation of names of languages - Part 2: Alpha-3 code

(3) DAVIC 1.4 Specification Part9 (1998) (Annex B): AIFF-C

(4) ISO 8859-1 (1987) Information processing - 8 bit single-byte coded graphic character sets – Part 1: Latin alphabet No.1

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