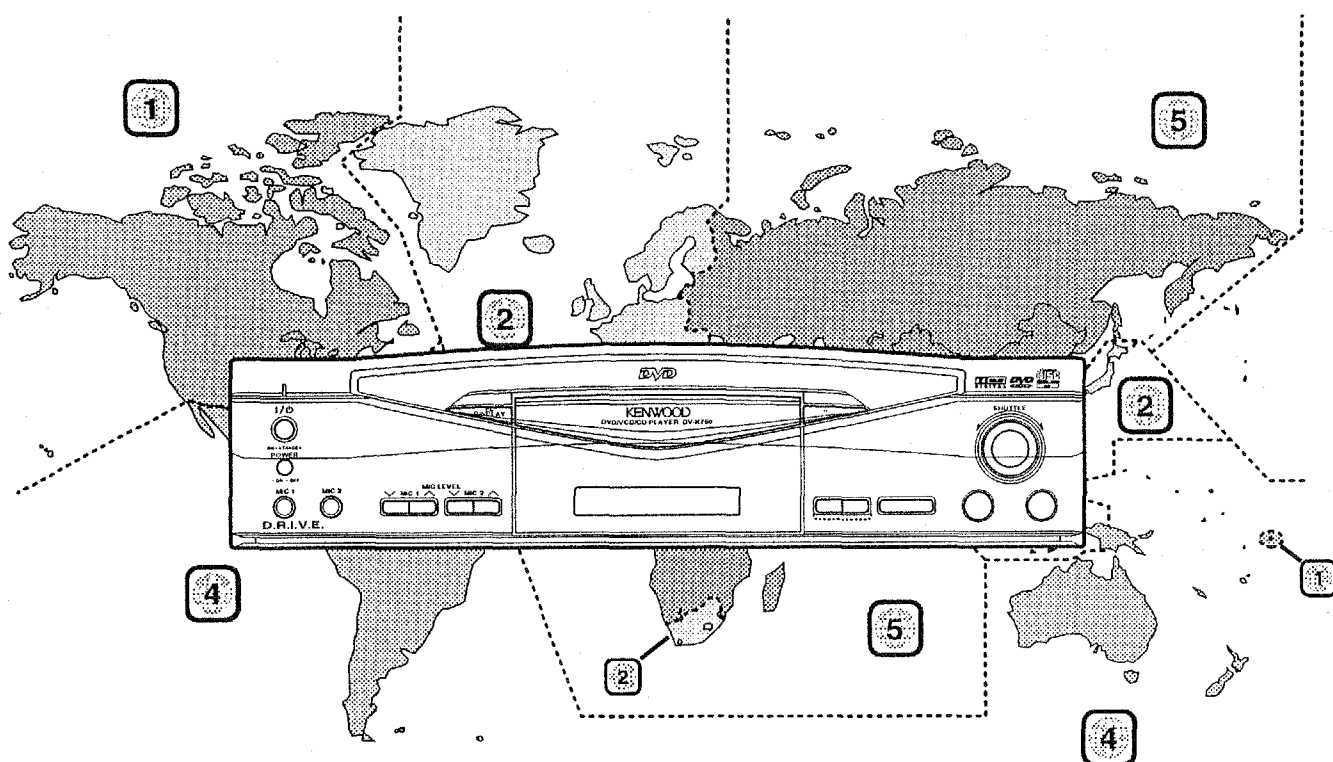


DVD TECHNOLOGY

page for DVD-Video Software Production Guide
(Japan Version) MAR 1998



1 2 3 4 5 6 ALL (4) 2 2... 4:3 LB 16:9 LB 16:9 PS 16:9 LB PS

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This chapter also introduces a disc manufacturing process and some matters that demand special attention. This chapter includes the contents which should be known before ordering any authoring and disc production.

Chapter 3 : Product indication item----- 71

This chapter describes recommended practices how to indicate the various features and notes for DVD-Video disc on disc package, and describes available labeling area on the disc. This chapter is recommended to be referred on package designing process.

The indication items described in this chapter were prepared in collaboration with Recording Industry Association of Japan [RIAJ]and Japan Video software Association [JVA].

Chapter 4 : Terminology----- 91

This chapter explains the terminology that are used in this book. Please refer this chapter for the terminology in the text.

This guide book is published for the software production companies in Japan.
The contents described here consist of the rules based on DVD-VIDEO format and the recommendations, in order to support smooth authoring and disc manufacturing. Therefore, it will minimize the issues on the disc production and for the user by producing the software accompanying with these contents.

Chapter 1

Introduction

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1-1 Introduction of DVD

To Software Producers,

DVD-Video format, a new video format media, was born in 1996.

Many industries had been involved in its development. Comparing with conventional disc media, DVD is not just a recording media for visual contents, but DVD is a versatile media whose format developments are planned to be extended to many variations such as DVD-Audio, ROM, RAM (Rewritable), R (Recordable), etc.

This "DVD-Video Software Production Guide Book (Reference information)" is published as a guideline book of DVD-Video software production, edited by the Authoring Group who will be in charge of DVD disc manufacturing and authoring, for readers who are in charge of practical software production.

The contents described here consist of rules based on the DVD-Video format and recommendations designed to support smooth authoring and disc manufacturing. Therefore, it is hoped that it will minimize the issues on disc production and for the user producing the software according to these contents.

This book gives an introduction of features and functions of DVD-Video disc to software producers and achieves the following three objectives:

1. To describe the information for understanding the capacity and features of DVD-Video and to support software production by explaining unique features of DVD-Video
2. To clarify the recording format of source material tape which contains recorded audio visual contents, etc. and to provide smooth a introduction of the ordering process of authoring companies and disc manufacturers.
3. To clarify necessary indications on the disc product (package) in order to minimize customer's confusion on the market.

The above three subjects are described each in its own chapter. This book consists of totally four chapters which includes the additional chapter on terminology.

DVD-Video, which applies advanced video compression technology and audio recording system, has been developed as a media to meet various needs of software production. We hope this book will be referenced in your software production, and we hope you will widely adopt DVD-Video for your various software contents.

1-2 Features of DVD-Video system

1-2.1 Disc categories and characteristics : Data capacity of disc and disc type

DVD-Video has two disc sizes and four disc structures as shown in Figure 1-1 and Figure 1-2, totaling eight categories of discs. As each category has a different data capacity, they are named by their symbols to indicate their structures. This book introduces DVD-Video which is used to record consumer audio visual software.

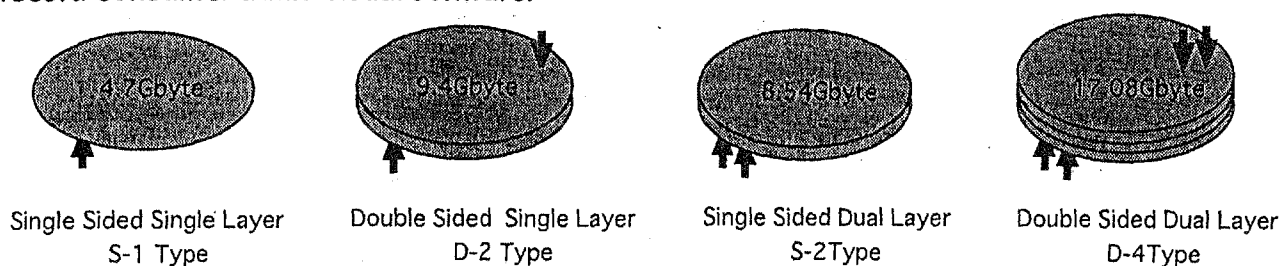


Figure 1-1 : DVD-Video disc category (12cm disc diameter)

The disc structure is defined as either single or dual layer. The single layer structure is called "S-1" and has a maximum capacity of 4.7Gbyte ($4.7 \times 10^9 \times 8$ bit). This corresponds to the capacity of about seven CD-ROM discs. Since the thickness of a single DVD-Video disc is half that of a CD, a "blank" disc is bonded with it for labeling. If a second DVD disc replaces the blank disc, a two sided disc is possible with a capacity of 9.4 Gbyte. This is called a "D-2" disc. On the other hand, there is "S-2" dual layer disc with an 8.54 Gbyte capacity. It is not necessary to flip the dual layer disc to play the opposite side because both layers are readable from one side. The player will change the readout layer and play according to the playback procedure recorded in the disc. In short, both layers can be handled as one disc. Another category of disc, called "D-4," bonds the above two dual layer discs together. Please note that the label area is limited for the D-2 and D-4 type discs since they are read from both sides. (Please refer to chapter 3, Section 1.2 for the details.) Therefore, currently S-1 and S-2 type have been prepared for general consumer use. In addition, the disc specification has defined 8cm disc diameter type which is the same size as CD-single. Each recording capacity is shown in Figure 1-2. Please consult an authoring company or disc manufacturer for the details of 8cm diameter type DVD disc.

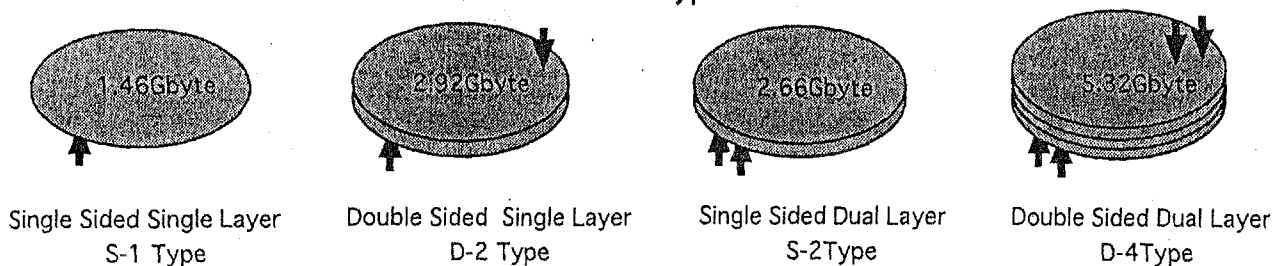


Figure 1-2 : DVD disc category (8cm disc diameter)

1-2.2 Reading dual layer discs from one side

The structure of a dual layer disc is shown in Figure 1-3. The disc consists of two 0.6mm thick polycarbonate discs. The disc for the first layer is covered by semi-reflective layer, and the disc for the second layer is covered by the full reflective layer, and both are to form information pits on each of the recorded layers. The two discs are bonded together by a transparent adhesive, allowing both sides of the information to be read from one side. Then, the upper disc (second layer) is recorded using a different cutting signal than side 2 of a two sided type disc. Thus it is to be recorded as the "Disc for second layer". This makes it playable on DVD-Video player from the same side, by simply adjusting the focus of player's optical pickup unit.

There are two types of usage for each layer as shown in the Figure 1-3. There is no difference in the user operation between "Parallel track path" and "Opposite track path". As the player will automatically perform layer change operation according to the playback procedure recorded in the disc, there is no limitation for the recorded contents with regard to their usage. Please consult with the person in charge of authoring regarding which type should be used for disc production, for long playback time Title thanks to large capacity of dual layer disc, interactive Title which requires random accessibility, etc.

Please note that any change of data length on one layer may affect the requirements for the other layer of dual layer type disc because of some common data on each layer are shared by each other.

Presentation continuity of video data and audio data at the layer changing point is not guaranteed in both the Parallel path and the Opposite track path types.

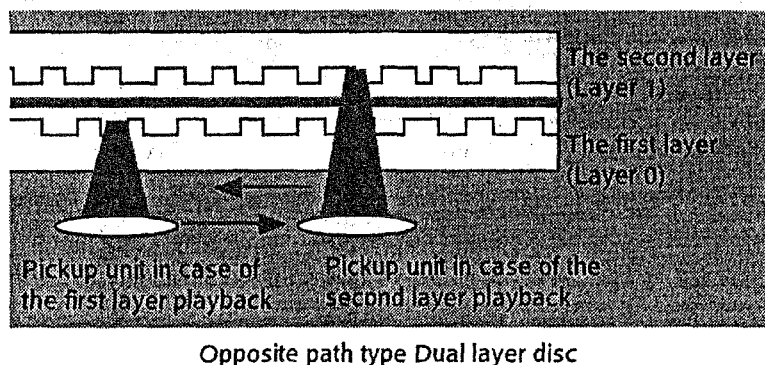
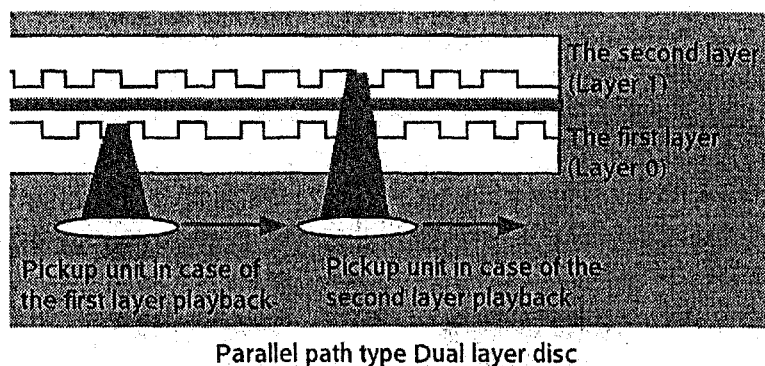


Figure 1-3 : Dual layer disc

1-3 Signal format and features of DVD-Video disc

1-3.1 Video compression system

DVD-Video has employed the MPEG-2 digital video compression system for video encoding. This compression technology includes some important elements which need to be understood in order to follow various features and DVD-Video.

1-3.1.1 Why compression is necessary?

DVD-Video stores a compressed digital component video signal derived from ITU-R Recommendation 601. This component video signal is known as PAL or SECAM in 50Hz countries (i.e., 625-line, 50Hz signal) and as NTSC in 60Hz countries (i.e., 525-line, 60Hz signal). They utilize a combination of a luminance signal and color differential signals as Y/Cr/Cb, or the three primary colors as G/B/R. The raw data rate of a ITU-R 601 signal is 27Mbyte/s. Even DVD, with its large capacity, could only record about 3 minutes of video without the use of compression. To allow a 130 minutes movie to be stored on a 4.7Gbyte disc (single sided / S-1) a compression ratio of more than 40:1 for video signal is required.

DVD-Video uses the MPEG-2 Video International Standard (ISO/IEC 13818-2) method of compressing the digital component video signal. MPEG-2 was developed to achieve a higher compression ratio than MPEG-1 system and to preserve good picture quality with low data transmission rate, while allowing trick play, random access, fast-play, etc. As a result, MPEG-2 takes a flexible video compression algorithm that achieves sufficient picture quality to an even lower data transfer rate. In DVD, a variable bit-rate encoding is used to maximize the overall picture quality for a given storage capacity.

1-3.1.1.1 Video source format

MPEG-2 uses a component video signal format (i.e., Y/Cr/Cb) as described above at the encoding stage, even if the original source signal was recorded in another form. This has some advantages over composite video signal formats such as PAL or NTSC system.

An advantage of the Y/Cr/Cb component signal format is that it is easy to constrain the amount of data representing the color differential signal Cr/Cb due to less visible damage of the quality of the displayed picture compared with constraining the luminance signal. In addition, this format avoids the "dot crawl" artifacts caused by the color sub-carrier and has a higher basic signal bandwidth. Thus, by utilizing those merits, it can bring good picture quality while undergoing compression. Therefore, component encoding at all stages in the authoring pathway, can be one method to achieve better picture quality. However, defects of the composite signal may be observed on the display if the composite video output of the player is used for the connection. The merits of a component signal, e.g., no dot crawl defect, is only valid when the video output of the player is connected to a TV monitor by using the cable and connectors which give proper connection of component signal such as S-video terminal etc.

Please note that MPEG-2 uses the same color representation format that is used in conventional television systems (Y = luminance signal, Cr/Cb = color difference signals), however it may be doing a sub sampling of pixels of the color differential signals called "4:2:0 sub-sampling pattern."

The normal resolution of the luminance signal is described as 720pixels by 576lines for the 50Hz system and 720 pixels by 480lines for the 60Hz system. The color difference signals are sub-sampled by a factor of 2:1 in both the horizontal and vertical directions with respect to the luminance signal. As a result, the resolution of the color difference signals will be half that of the luminance signal, both horizontally and vertically. If video output format of the VTR or the CG (Character Generator) tool, which have higher resolutions like 4:4:4 or 4:2:2, are used for software production, the production should be done considering the conversion results to luminance and color differential signals by 4:2:0 sub-sampling.

1-3.1.1.2 Video compression system

As described above, MPEG-2 system has some features to realize possible higher picture quality while using a lower data transfer rate. MPEG-2 works by reducing the redundancy in the signal and also discarding information that is irrelevant to the observer.

In general, display of motion is done by displaying several pictures continuously which are changed as time progresses. If 50Hz or 60Hz system is described, it means that motion is being realized by displaying a video frame 25 or 30 times in a second, where one frame consists of two fields. In such a case, each of the pixels in most of the pictures may have small differences, compared with the adjacent pixels. In the same manner, the pixel may contain same content among the adjacent frames.

For instance, if a car passed in front of a video camera, it could be said that there is no difference in brief figure of the car, like shape, color, etc., and the background of the car may have proper unchanged contents.

Once those unchanged contents are transferred, they can be used to display several pictures. In particular, in addition to the differential part transmission which was obtained in comparison among the current picture and its adjacent pictures, the differential signal between the predicted next picture and the actual next picture is transferred too, in order to obtain further compression efficiency. On the other hand, when there is a picture which has certain amount of change over the predicted value, it may contain unnecessary elements which is irrelevant to the observer. There is proper conditions to be relevant to the viewer. As proper irrelevant elements in picture have been proven through the experiments in the past, it is possible to reduce the amount of data by discarding such the elements on the signal until target data transfer rate is obtained.

Thus, MPEG-2 is not a lossless coding scheme - some data is irreversibly discarded during encoding. It may cause deterioration in the picture quality of the reproduced signal if the compression ratio was increased to reduce the data transfer rate until some elements which are relevant to picture quality are discarded. It is possible to trade-off the subjective picture quality on one hand and the bit-rate (and hence total play time) on the other.

The amount of the data per certain time is called the "transfer rate", and corresponds to the total play time of the software recorded on a disc. If the play time is too long, it is unavoidable to cause more deterioration of picture quality than the others in which the time is shorter. Even in such a situation, the MPEG-2 encoder needs to be operated by balancing all the conditions; momentary transfer rate, deterioration of picture quality and total amount of data, in order to minimize deterioration of picture quality.

1-3.1.1.3 Picture type

The MPEG-2 algorithm balances the conflicting requirements of high compression and random access. As described above, video sequences are highly redundant, and many of the pictures have unchanged picture contents in time domain. High compression requires that we remove this redundancy by using motion compensation to predict one frame from the previous one. However, the need for random accessibility and fast forward trick modes means that there must be breaks in the sequence of frame-to-frame prediction. Thus there must be the picture which is to be a reference for others and does not require any prediction process for decoding itself. The rate of these pictures is defined as one picture frame out of less than 15 frames in the case of 50Hz field frequency system and one frame out of 18 frames for the 60Hz system. This picture frame is called an "intra-frame", and requires a high transfer rate because it does not use the motion compensation scheme based on prediction. Therefore, there has to be a balance between coding intra-frame information without using any knowledge of previous pictures, and using motion compensated coding.

MPEG-2 defines three picture types. The intra-frame pictures, (I-pictures) are coded without reference to any previous pictures. Two types of motion compensated picture are defined; predictive-coded pictures (P-pictures) and bi-directionally predictive-coded pictures (B-pictures). Relations among each type of picture for the motion compensation scheme are shown in the Figure.

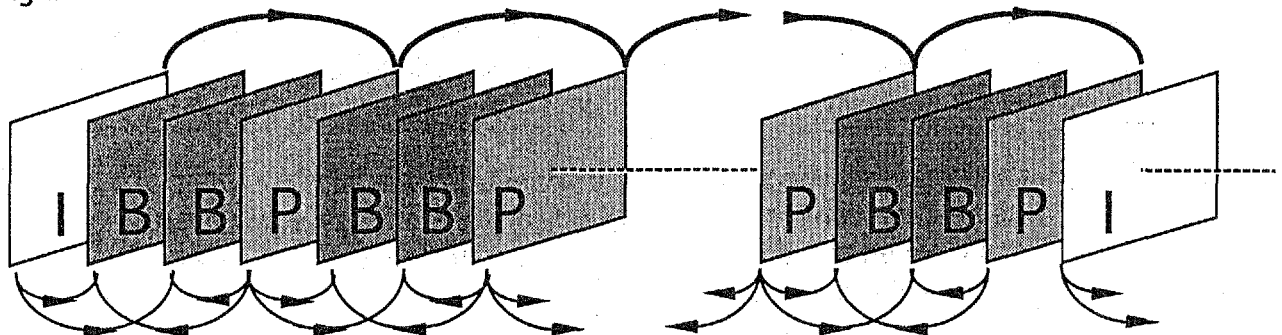


Figure 1-4 : Structure of GOP

I-pictures use no motion prediction and require a large number of bits to encode. P-pictures use motion prediction from a previous I-picture or P-picture. B-pictures use prediction from pictures that will be displayed in both the past or the future, and are not used for further predictions. B-pictures normally require fewer bits to encode than P-pictures and B-pictures are not referenced in the recursive prediction structure.

I-pictures break the recursive sequence of pictures and enable random access to the sequence, because they can each be decoded as one independent picture. Thanks to this feature, MPEG-2 can be a compression format which enables a feature to display reference pictures on random access playback, which can correspond to a fast forward trick feature. For this reason, it is essential to specify all Chapter breaks and other access points required (e.g. the first picture of a Chapter or any branches) in a Title before encoding.

A unit of sequence which includes only one I-picture is called a "GOP (Group of picture)."

1-3.1.1.4 Basics of video compression

MPEG-2 combines a number of different compression methods.

Firstly, block-based motion prediction on each macroblock in the picture (= one frame) removes the redundancy from frame to frame. A macroblock is made up of six 8 by 8 blocks which correspond to 16 by 16 pixels of the original picture. A macroblock consists of four blocks of luminance signal Y and one each of color difference signals Cr, Cb.

Motion compensation is a process where pictures that have already been coded are combined with data representing motion vectors to form a prediction of the current picture. In order to reproduce the current picture, the motion vector and prediction error signal, the difference between the actual picture and the picture which is predicted by the motion vector, are transferred. As the redundancy of picture is sufficiently high, the prediction error signal is normally small and often zero. Motion compensation is not performed in I-pictures. The error signal is processed to reduce the remaining redundancy in a video frame.

A discrete cosine transform (DCT), which is the most important technique in the current compression technology, is applied to each 8 by 8 block.

The DCT itself performs no compression, however, the DCT is a frequency domain analysis of the signal that concentrates the visually-important parts of the signal into a small number of coefficients. It transforms the signal into a representation where an adaptive quantizer is used to reduce the accuracy and discard coefficient data that is not visually important.

After quantization, the final stage of the processing removes the remaining redundancy by using variable length coding for the coefficients which were adaptive quantized. It reduces the redundancy of the code itself. This is a statistical method that uses short codes for common events and long codes for uncommon events to represent the quantized coefficients and other control and header information. Thus it enables maximum reduction of the total data amount.

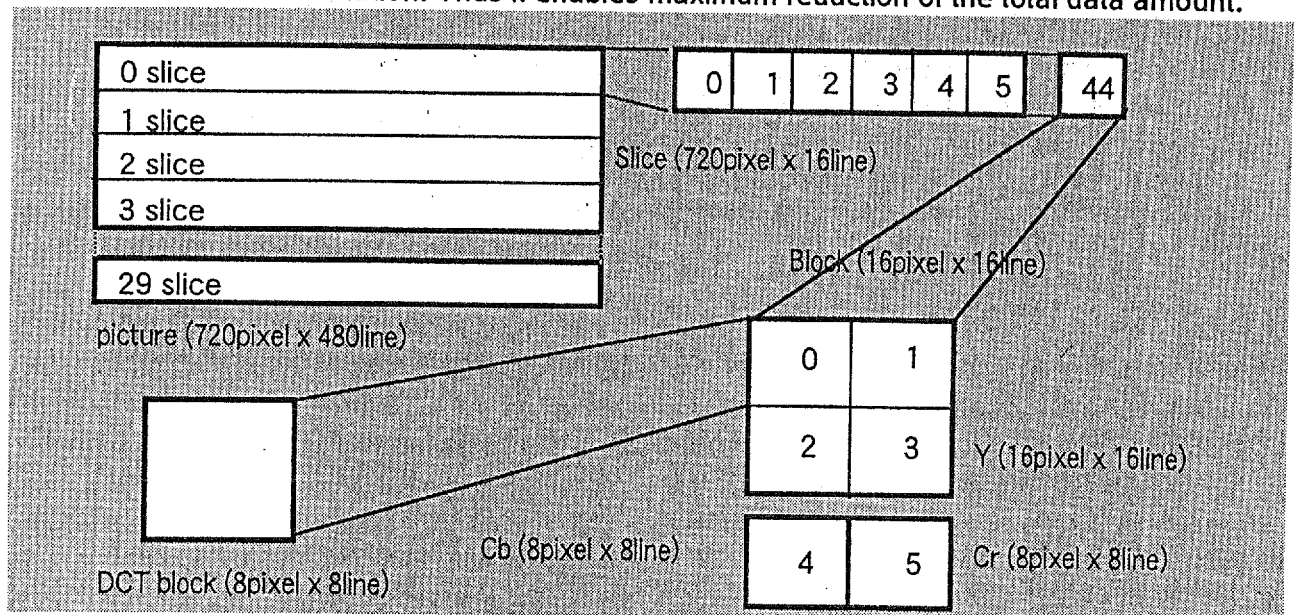


Figure 1-5 : Blocking of a picture for compression

1-3.1.1.5 Variable bit-rate encoding

For a given picture quality for MPEG-2 decoded pictures, the required data amount (number of bits), which are generated as the result of encoding, depends on the pictures.

This variation is a consequence of using variable length coding and depends on the efficiency of the motion compensation and the complexity of the scene. Simple scenes with regular motions and little detail will require very few bits. Scenes with many objects, at a high resolution with complex motion will generate many more bits.

MPEG-2 is an interchange format. It does not specify the detail of compression methods, but it provides a structure for decoding to ensure almost original picture quality by transferring the encoding result, which is done according to an approximate algorithm, and its process to the decoder.

Thus it is not guaranteed that any of encoders will generate the same encoding result for a video source. Therefore, many of the decoding results will not be same.

A Major part of the quality of a decoded picture depends on the bit-rate and the mechanism of how each encoder assigns bits to the picture. The bit-rate for video data transfer on MPEG-2 encoding depends on the total play time required for the disc and the number of audio and Sub-picture channels. For instance, the average data rate of common motion picture which has 2 hours content should be around 4.5Mbit/s (4.5x1,000,000-bit per 1 second.) This value is called "average transfer rate". It means that DVD is employing a variable transfer rate system for various amounts of the data which depend on the condition of encoded pictures.

Varying the data rate means we can increase the bit-rate for sections of the movie that are hard to encode, and balance this by reducing the bit-rate below its average value during easier sections.

This makes it possible to achieve a nearly constant picture quality at any playback point and makes the most efficient use of the available disc capacity. The cost is an increase in complexity in the encoder, where it is normally necessary to make at least two passes through a movie - one pass to estimate the encoding complexity of each picture and the variation of data amount in time domain and a second to encode it based on estimation results of the first pass.

1-3.1.2 Video output feature

The MPEG-2 system, which is used for video compression, has a feature for handling each of the different aspect ratios of display, i.e. 16:9 and 4:3. As described in the Figure 1-6, in the case of a DVD production, by using a 16:9 video source (i.e. "squeezed video", which corresponds to 4:3 aspect ratio of conventional NTSC system), the player can provide three choices of output; squeezed video output for 16:9 monitor (Wide TV), letterboxed type or panned (trimming) type for 4:3, depending on the user's preference. Therefore, in the case of the display on a wide TV, it is possible to keep the vertical resolution of the decoded picture by expanding it horizontally, which is better than expanding the letterboxed video vertically. Squeezed video can be enabled to be displayed on 4:3 monitor by using letterboxed or trimmed screen size. For the panned type output, it is necessary to specify trimming points at the software production stage. In DVD-Video, it is possible to limit the output modes. In short, software producer can specify the player not to provide letterboxed or panned video output for the disc.

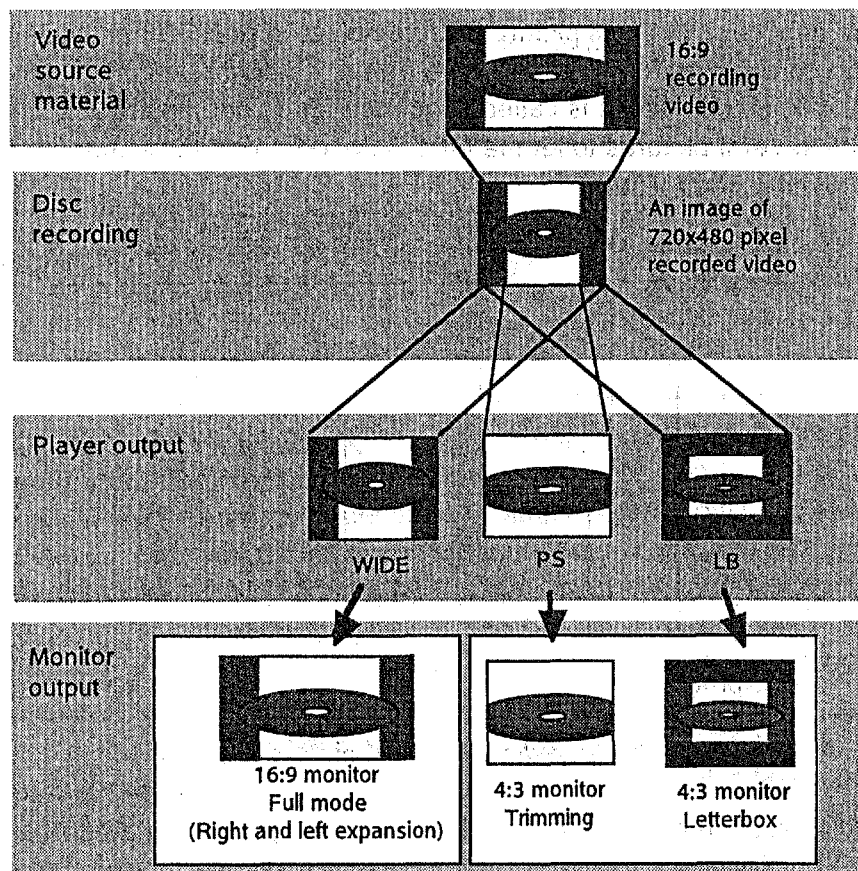


Figure 1-6 : Aspect conversion feature on MPEG-2 decoder

1-3.1.3 Still picture presentation feature

As described above in the case of decoding MPEG encoded signal, a picture which appears on one occasion, is to be reproduced by a calculation using several types of picture data. This complex calculation process is aimed at realizing efficient data transfer of the motion picture which changes with the progression of time. However, there is a more efficient data transfer system for a picture which has a small change along the time scale, i.e. data transfer for still picture.

As is already described above, a MPEG encoded motion picture is transferred only the difference signal part due to motion of the pictures. When a video which has continuous still pictures is MPEG-encoded, there is no difference signal generation because no motion is found in the sequence. More practically, B- and P-pictures which were already explained in section "Picture type", will contain zero data since there is no difference signal with I-picture generated along progression of time.

However, this is an ideal case of a still picture with no noise. In practice, as there is noise which is generated with no correlation from present video frame, it will not be completely zero data. As described in Figure 1-7, a code which is called sequence_end code, is applied after transferring a still picture image by several pictures to let the MPEG decoder end the video data transfer and keep the output of last decoded video.

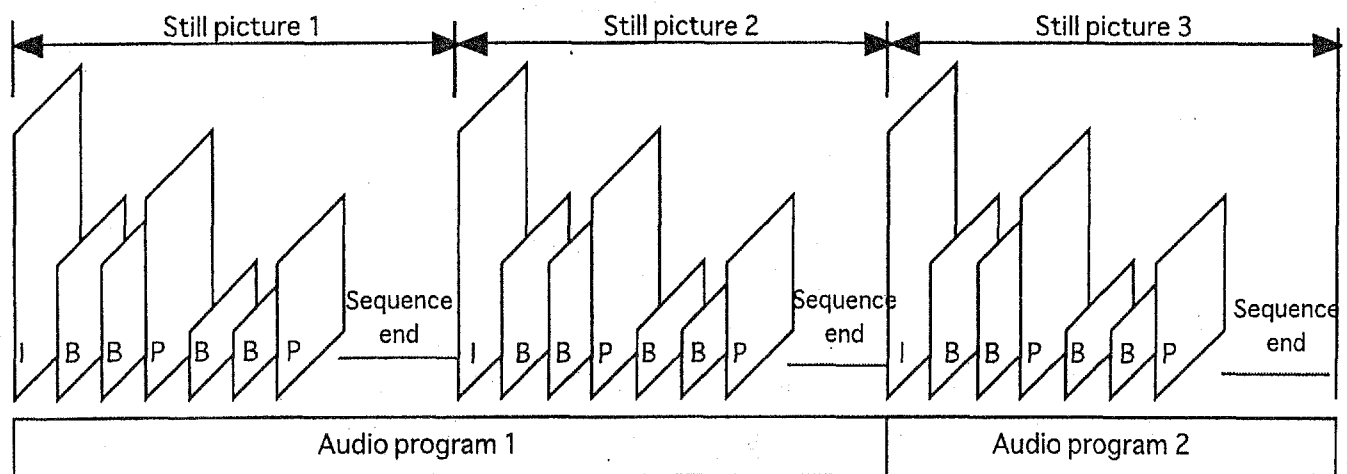


Figure 1-7 : An example of still picture recording

As display of the last still picture will be kept until the next still picture data comes, usage of "slide show" which consists of several still pictures and a continuous audio program as shown in Figure 1-7, can be an effective application to save the recording capacity of the disc.

1-3.2 Audio format

The following 3 formats for audio recording are used in DVD-Video.

- 1) Linear PCM audio
- 2) AC-3 compressed audio
- 3) MPEG compressed audio

The Linear PCM format supports 2 different sampling frequencies and 3 different levels of amplitude resolution (bits per sample). Therefore, by combination, 6 total modes are provided. A compression process is not applied to this method and it provides higher fidelity compared to the compressed audio formats. However, the amount of information and the data transfer rate increase in accordance with the sampling rate and the number of quantization bits. On the other hand, although the AC-3 format and the MPEG audio format do not use the same method, both formats apply a sub-band compression method where the original signal is split into several frequency components and is compressed. These methods prevent quality degradation, even at low data transfer rate, by applying psycho-acoustic model to suppress redundant components to which the human ear is not sensitive.

Regarding these 3 audio formats, DVD-Video players support different audio formats depending on which TV system they are supporting. DVD-Video players for the 525/60 TV system ("NTSC") have to support the Linear PCM audio format and the AC-3 compressed audio format. DVD-Video players for the 625/50 TV system ("PAL"/"SECAM") have to support the Linear PCM format and the MPEG audio format. Therefore, it is required that a DVD-Video disc for 525/60 TV system contains the audio signal coded in either linear PCM format or in AC-3 audio format; and a DVD-Video disc for 625/50 TV system contains the audio signal coded in either linear PCM format or in MPEG audio format.

DVD format allows a maximum of 8 audio tracks. The audio coding format can be chosen independently for each track. Each audio track can contain only 1 language content. In the case of multi-language, the same number of tracks as the number of languages is required.

1-3.2.1 Linear PCM audio

A digital audio signal does not require as much data as a video signal. You may understand this from the fact a CD with linear PCM can play more than 74 minutes. Therefore, the large capacity DVD supports several modes of linear PCM audio format which enables it to carry non-compressed audio signals.

As shown in Table 1-1, DVD allows for PCM formats with a higher sampling frequency to expand the recording audio frequency range and with more quantization bits for a wider dynamic range to realize higher audio quality. Moreover, functionally, the number of channels are also increased to allow multi-channel.

In the near future, when the equipment for 96kHz/24bit recording etc. is introduced and the production environment is set in the field, high quality audio software production will become possible and the packaged media will require the performance to reproduce the higher quality audio. DVD is ready to meet these requirements.

However, due to the limitation of the maximum bit rate of each individual audio stream to 6,144 kbps, the only restriction which is taken into account is the combination between the sampling frequency, the number quantization bits, the number of channels and the transfer rate as shown in Table 1-2.

Sampling frequency	Quantization	Recording ch.No.
48kHz	16bit	1~8ch
	~20bit	1~6ch
	~24bit	1~5ch
96kHz	16bit	1~4ch
	~20bit	1~3ch
	~24bit	1or2ch

Table 1-1 Number of channels of the linear PCM

Linear PCM						
Sampling frequency	48kHz	48kHz	48kHz	96kHz	96kHz	96kHz
Quantization	16bit	20bit	24bit	16bit	20bit	24bit
Ch.No.	Bit rate (kbps)					
1	768	960	1,152	1,536	1,920	2,304
2	1,536	1,920	2,304	3,072	3,840	4,608
3	2,304	2,880	3,456	4,608	5,760	
4	3,072	3,840	4,608	6,144		
5	3,840	4,800	5,760			
6	4,608	5,760				
7	5,376					
8	6,144					

Table 1-2 Linear PCM transfer rate

1-3.2.2 AC-3 compressed audio

AC-3 is the name of the high efficiency digital multi-channel audio signal coding method developed by Dolby Laboratory, USA, which has also been adopted by ATSC (United States Advanced Television System Committee) as a standard.

With AC-3 encoded digital multi channel sound(called 5.1 channels), three front channels, two rear channels (totally 5 channels with wide bandwidth and full range), and a Low Frequency Effects channel for a sub-woofer (called 0.1 channel), are used. Compared to the conventional Dolby Surround which encodes four channel of source audio material into two analog audio signal, AC-3 encodes the 5.1 channel of discrete audio into a compressed digital signal. Dolby Surround AC-3 uses the 5.1 channels for stereophonic surround sound which is superior to the conventional Dolby Surround in sound field effects such as channel separation, number of channels and frequency response of each channel.

Moreover, the AC-3 decoder has a down-mixing function to enable multi-channel encoded material which contains more than 2 channels of surround sound to be played with 2 channel system.

The so-called "1+1" prepared as a coding mode in AC-3, which is a method to record two kinds of monaural audio signals with different contents between them, is not used in DVD-Video, because multi-language functionality can be obtained by changing up to eight sound tracks prepared in DVD-Video.

AC-3 is renamed officially to Dolby Digital in 1995. Care must be taken that all the consumer equipment or discs which use AC-3 indicate "Dolby Digital".

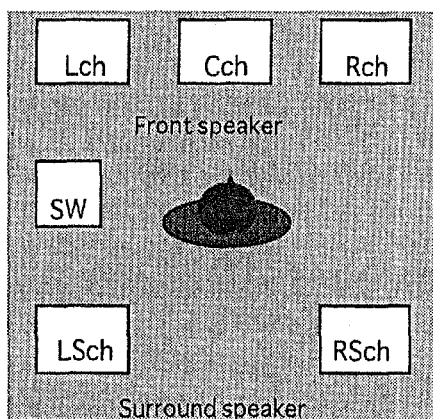


Figure 1-8 : 5.1 ch. Dolby Digital system layout

AC-3 ch. mode	2ch.mix output
1/0	Mono
2/0	Stereo
3/0	Stereo
2/1	Dolbysurround
3/1	Dolbysurroundpro logic
2/2	Dolbysurround
3/2	Dolbysurroundpro logic

Table 1-3 : AC-3 channel mode

1-3.2.3 MPEG compressed audio

MPEG-2 Audio is the name of the International Standard (ISO13818-3) for a high efficiency digital multi-channel audio coding method developed by audio coding experts in the MPEG group. With MPEG-2 encoded digital surround sound, three front channels, two full range rear channels and a low frequency effects channel for a sub-woofer (called 0.1 channel) are encoded. MPEG-2 encodes the 5.1 channel of discrete audio into a compressed digital signal. MPEG-2 Audio uses up to 5.1 channels for stereophonic surround sound which have excellent sound field effects such as channel separation, number of channels, and frequency response of each channel.

MPEG-2 in DVD-Video offers an extension feature of up to 7.1 channels of surround sound.

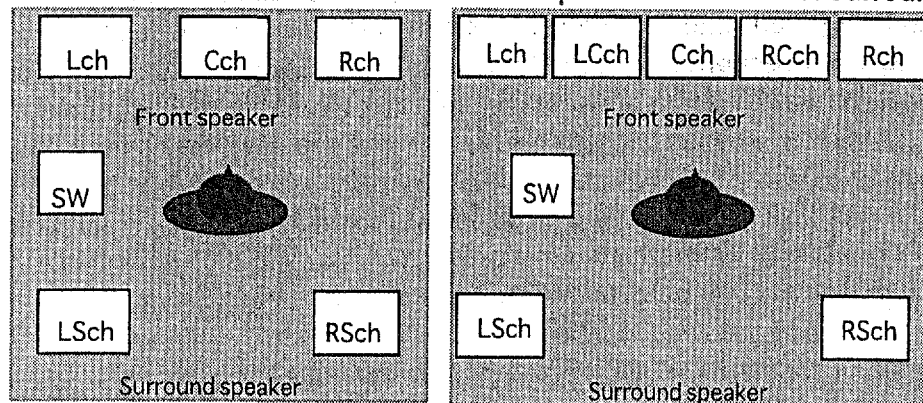


Figure 1-9 : 5.1ch MPEG-2 audio system and 7.1ch system layout

MPEG-1 audio is a method to compress a maximum of two audio channel signals. MPEG-2 audio format is an extension of the MPEG-1 audio format and is compatible with MPEG-1 audio. Two channel compatible coding is achieved by encoding an appropriate downmix of the multichannel sound program in the multichannel bitstream, as depicted in Figure 1-10. Therefore, an MPEG-1 stereo decoder can directly retrieve the two-channel downmix signal (Lo/Ro) from the bitstream without a downmix process in the decoder.

Multi-language capability extended in MPEG-2 is not used in DVD-Video because multi-language functionality can be obtained by changing up to eight sound tracks prepared in DVD-Video.

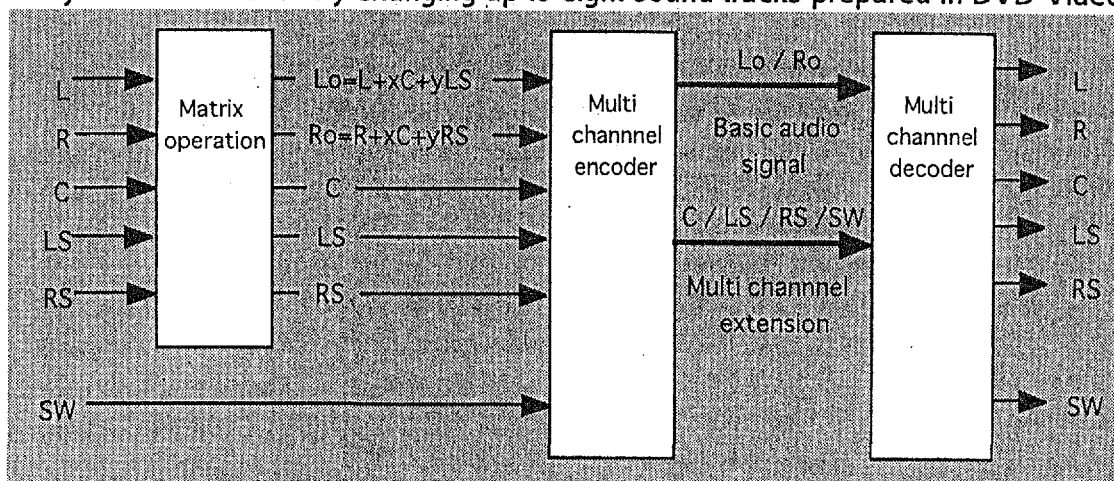


Figure 1-10 : MPEG-2 audio multi-channel encoding and decoding

1-3.3 Sub-picture

The Sub-picture system for DVD is known as Sub-picture, in comparison with the main picture of MPEG encoded video. Sub-picture can be categorized into the following two purposes; One is Subtitles for movie caption etc. which are superimposed on a main picture, and another is for Menus to provide some visual operation environments for the user of the player.

1-3.3.1 Subtitle

DVD allows movie Subtitles to be recorded as Sub-pictures.

On a DVD disc, it is called "Subtitle" because it has been prepared for storing captions. Since the disc can have a maximum of 32 tracks for Subtitles, they can be used for various applications, for example, as Subtitles in different languages or other information to be displayed.

When using the Sub-picture for subtitling, since display of the Sub-pictures can be controlled by the user, the feature can meet the needs of those that do not want to view the Sub-pictures, too. Further, Subtitles that would result in an off screen display or deformation caused by wide screen (16:9) TV monitors, can be adjusted by preparing different sets of Subtitles according to the output aspect ratio options.

The Sub-picture for subtitling color and contrast are set at the production stage. However, the display colors in each Sub-picture are limited to four since the palette information allocated to a Sub-picture is defined by 2-bits.

Subtitle letters are expressed with four basic signals; transparency of the color superimposing on the background, the edge used to highlight the letters, letter signal, and intermediate signal to prevent the zigzag of the borders between letters and edge.

If the Sub-pictures are used for other than Subtitle, up to 16 colors can be displayed with an extended function.

Some Subtitles superimposed in video in the conventional way, express more levels of color than the Sub-picture of DVD. Therefore, if any Subtitle needs for a higher quality than the features of DVD's Sub-picture, please record them as conventionally superimposed Subtitles on master tape at the studio. In this case, the Subtitle cannot be turned off by the user.

A "forced display" to output a Sub-picture forcibly can be programmed. Even if the player has the Subtitle display off, the Subtitle is displayed anyway. For example, in an English movie with a Japanese talking scene, a English Subtitle can be set to always appear if the English Subtitle is recorded as a Sub-picture for forced display.

"Forced display" function is valid only when a Subtitle display is turned off. There may be a case that the content of forced-displayed Subtitle is different according to the player's status of "Subtitle display OFF."

Please note that a difference can occur due to the player's status of display off in the following two cases:

- 1) A Subtitle track is selected, however the display is turned off.
- 2) No Subtitle track is selected.

In the case of 1), the player automatically selects the Subtitle track for forced display, whose language is recorded with the same language as the current Subtitle being selected, then continues to decode. Only the content of the Subtitle which is specified to be forced-displayed, is displayed on the screen during the specified period. In the case of 2), the player automatically selects the Subtitle track for forced display, whose language is recorded with the same language as the current audio being presented, then continues to decode. Only the content of the Subtitle which is specified to be forced-displayed, is displayed on the screen during the specified period. In both above cases, the default Subtitle track to be decoded is defined as the "Subtitle track for forced display" which is recorded with the corresponding language. However, if there is no Subtitle track for forced display in the Title, the current Subtitle track which is being selected at that time is continued to be selected in case of the above 1).

And, the Subtitle track which is available to be selected and which Subtitle track number is the smallest among the available Subtitle tracks, is automatically selected in case of the above 2). Further, in case of the above 2), no Subtitle track will be selected and no forced display will be carried out, if there is no Subtitle track which is recorded with the corresponding language among the available Subtitle tracks, or if no audio track is being selected.

It is necessary to prepare appropriate Subtitle tracks at the software production stage in view of the above cases. This function is possible to associate with the Subtitle tracks which have different aspect ratio of displayed video.

Naturally, all the contents of the current displayed Subtitle which is being selected and whose display is turned on, are displayed on the screen according to the programmed commands, regardless to the current track and the presentation period being presented are programmed as forced display or not.

On the other hand, all the Menus are programmed as for forced display. Because, the user of the player can not select any selection items on the Menus if they were not displayed. In case of selection items on a Menu which are not necessary to be displayed on the screen, they can be programmed on the Menu by using transparent color.

Up to 32 languages of Subtitles can be recorded in the Subtitle tracks. However, these tracks may be used for Menu displays during the program such as multi aspect ratio, graphic character of game, or other track application depending on software. Therefore application of the tracks should be set up according to features of the software.

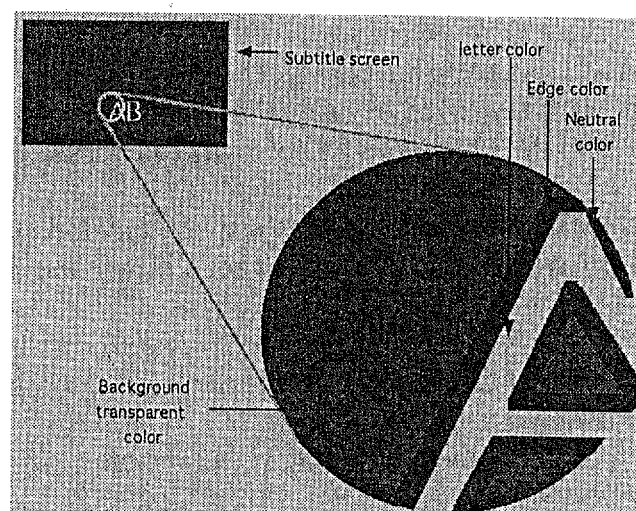


Figure 1-11 : An example of Subtitle display

1-3.3.2 Menu

Menus are created to let the user select between several video segments, audio, Sub-pictures, parental levels(* described later), multi-Angles (* described later) and multi-story presentation of Title etc. which are recorded on a DVD-Video disc.

There are two kinds of Menus, the System Menus and other In-Title Menus.

First, the System Menus are displayed and operated at startup of or during the playback of the disc or from the stop state. They are mainly used to select how the disc is to be played. The types of System Menus are listed below:

1. Title selection Menu
2. Chapter selection Menu
3. Audio track selection Menu
4. Subtitle track selection Menu
5. Angle selection Menu
6. Root Menu

When a disc which contains those Menus is played, the user can select a Title to be played through the above Menu 1. at the beginning of the disc playback or from the Stop state.

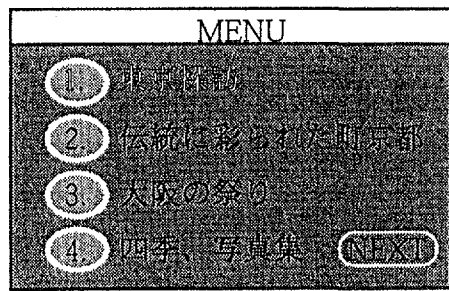
Furthermore for the selected Title, the user can select each item through the above Menus 2 to 5. Menus 2 to 5 are accessible during a Title playback from the Root Menu. The Root Menu is displayed when it is called by a Menu Call function of the player during playback of the disc.

Second, In-Title Menus can be programmed as a combination of Sub-picture and Highlight commands to be displayed during playback of the disc. These Menus can be designed freely using combinations of the available Navigation Commands.

Although both Menus may not always be necessary for every DVD-Video disc, they can be a convenient and user friendly interface which can simplify the conventional remote control operation by means of highlighting and selecting items on the display. However, it may be troublesome for the user to display the Menu in some cases (e.g., a disc which contains only one Title does not have to change the Title.) Please apply the Menu functions carefully depending on the requirements of each disc. An example of the displayed items that make up a Menu are shown in the Figure 1-12. Video or audio can also be recorded for the Menus.

The System Menus are recorded for each language which is used for displaying the characters. The player will display only the Menu whose language corresponds to the user's setup. Namely, when a disc contains Menus in Japanese, English, and German, and the user has set up the language of the player as Japanese, then the Japanese Menu will be displayed while the Menu is called during a Title playback or from the Stop state regardless of the language selections of current audio or Subtitle. If there is no corresponding Menu on the disc which has the same language as the player's setup, the default Menu for each Menu category which is programmed by software production will be displayed. Therefore it is recommended to specify a default language for each of the Menus.

On the other hand, selection of In-Title Menus depends on the language of the currently selected Subtitle.



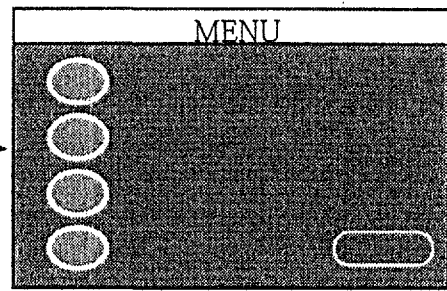
Menu screen

1) Background : The MPEG encoded video which is used as background of the Menu. It can be applicable to display any still picture while the programmed Still time, windowed- or full screen-video etc. There is no limitation of colors etc. to be displayed. Black-back screen may be applicable, too.

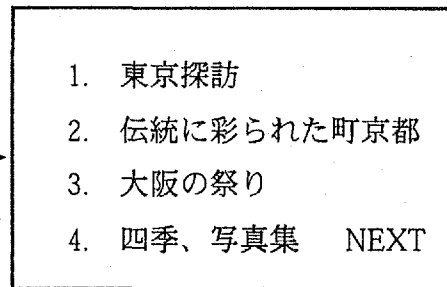
2) Sub-picture : A main component of the menu, mainly to display selection number, selectable items etc. As one color is used for transparent color to look through the background, maximum number of the colors which can be used at once are up to 15 out of 16 colors even for the extended function. When it is already using three colors for subtitle of the current Title, three out of the 15 colors shall be same as the subtitle's. However, if the Sub-picture utilizes Highlight Information, only three color display is available due to limitation of the extended function.

3) Highlight Information : To display the one item on the menu with framing by the specified color and luminance according to the Highlight Information, to indicate which item is being selected. (= Selection Color) To display the one item on the menu with framing by the specified color and luminance according to the Highlight Information, to indicate which item is being activated. (= Action Color)

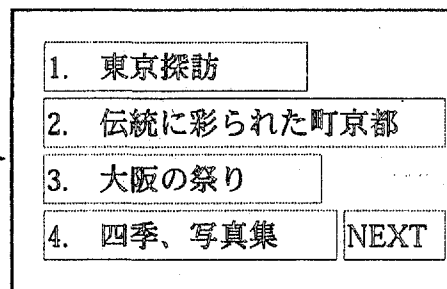
4) Highlight Command : A command which is programmed to instruct how the DVD player to act according to the command of the selected item. Content of the command is written to not be shown on the display, but is to be acknowledged only by the player.



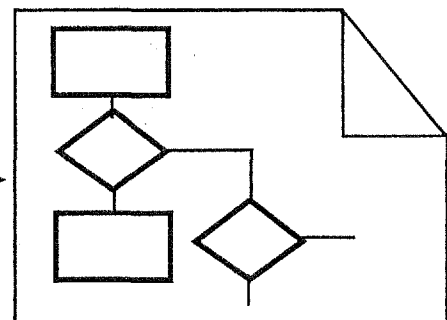
1) Background (MPEG video)



2) Sub-picture



3) Highlight information



4) Highlight command

Figure 1-12 An example of Menu display

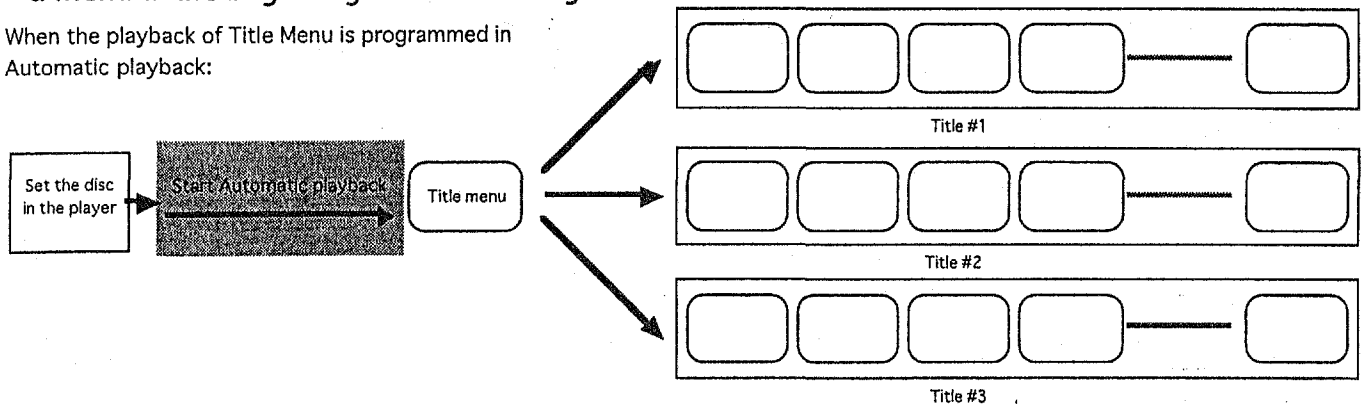
1-3.4 Automatic playback function

DVD-Video disc has a data area to record special information to allow automatic start as in most Compact Disc and Laser Disc players. Since the disc requires some setup selections to be made at the start of playback, it is difficult for it to be played as soon as the disc is set in the player the same as Compact Disc or Laser Disc. By recording the so-called "Automatic playback" information to instruct the player of the playback procedure, playback of the disc can be made easy for the user.

For the initial play of the disc with this Automatic playback information, the player has to complete the programmed procedure of the Automatic playback. The user cannot access operation from the point of reading the Automatic playback information until the playback of a Menu or a Title according to the procedure is completed.

An example of player's action in response to Automatic playback information would be to display a Menu at the beginning as shown in Figure 1-13.

When the playback of Title Menu is programmed in Automatic playback:



When no Automatic playback is programmed in the disc:

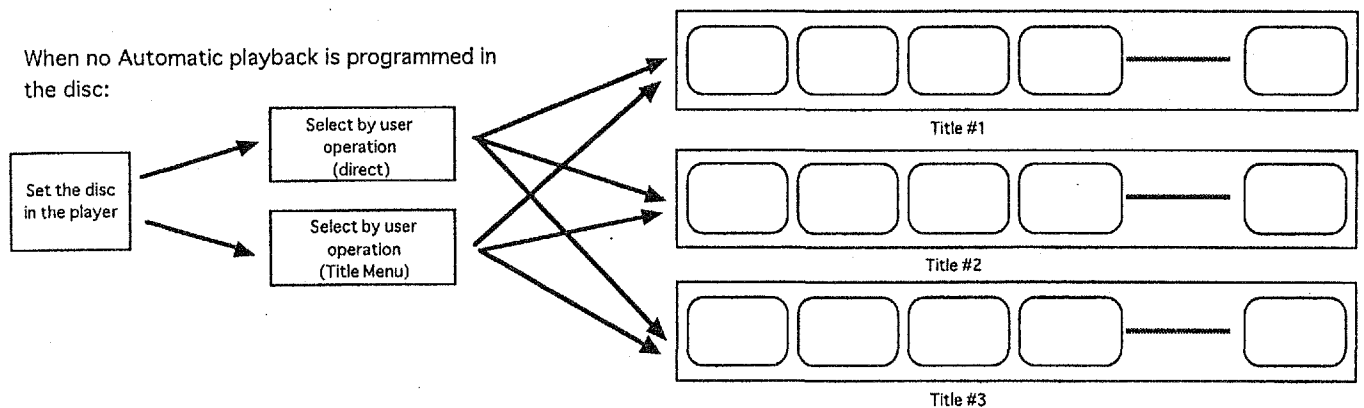


Figure 1-13 : An example of Automatic playback function

1-3.5 Parental control function

Parental control is a function of DVD-Video player which causes the player to play only the appropriate contents of video and audio by comparing the upper limit setting of the parental level of the player and the levels set on the disc.

However, this function is an option for both the player and the disc. Therefore the programmed parental level is not always functional.

As there are different regulations of video and audio contents for each country regarding the age limit of watching, please program appropriate parental levels according to the references of video and audio for each the country in which the DVD disc is to be sold.

In Japanese law, it is not allowed to import a disc which contains illegal video or audio, even with this function, because it is assumed that the video and audio exceeding the limit of the law in the country has been made legal by treating it at the software production stage.

There are two practical application examples of parental automatic control; one is for the Title unit and the other is for particular video or audio sections within a Title.

In the first case, i.e. on a per-Title basis, each Title can be set to only one parental level. At the time of playback of the disc, only Titles whose parental level is below the parental level set in the player, can be selected to be played back. For instance, even if several Titles which have different parental levels are prepared on a Menu screen, it is possible to select only the Title whose parental level is below the upper limit of the playable parental level set in the player. Therefore, it may be necessary to have a caution screen to display a message that the disc can not be played if there is no playable Title recorded on the disc with respect to parental levels.

In the second case, i.e. on a per-scene basis, several sequences of video and audio are edited in advance by cutting or modifying some scenes that are to be recorded within the Title. On a DVD disc, the area which contains several video and audio tracks for different parental levels, is called a "Parental block." As shown in Figure 1-14, according to the parental level set by the user, the player automatically plays back the video and audio whose parental level is the closest to, but below the level set in the player. In this case, it is not necessary to imply the existence of a parental level on the Title Selection Menu for the user. However, it is not recommended to use this feature for a Title whose story is hurt when a parentally acceptable sequence is played back, such as the Title which contains less appropriate sequences for younger age bracket. Moreover, it may be necessary to have some caution screen to display the message that it may not be playable if no parental rated sequence in the Title is applicable for the parental level set in the player.

Parental level applies not only to video, but also to audio and Subtitles. That is, when the audio is recorded using each different parental level in several audio tracks, a limitation exists for the selection of the audio according to the parental level set in the player.

Furthermore, on a player which does not support Parental control function, all Titles may be user-selectable regardless of their per-Title parental level. But, when there is per-scene Parental Level information, only the scene which was specified at the software production stage in the block may be playable.

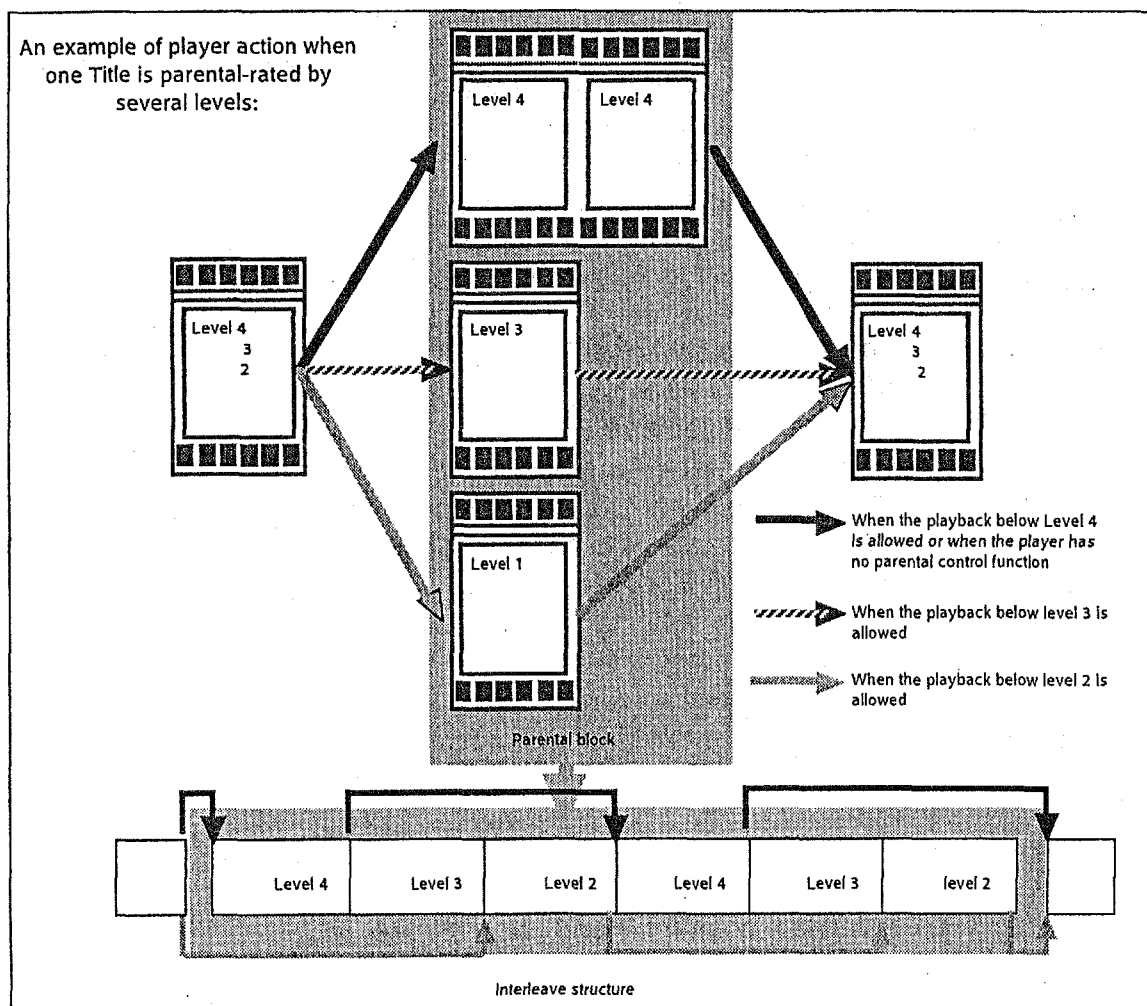
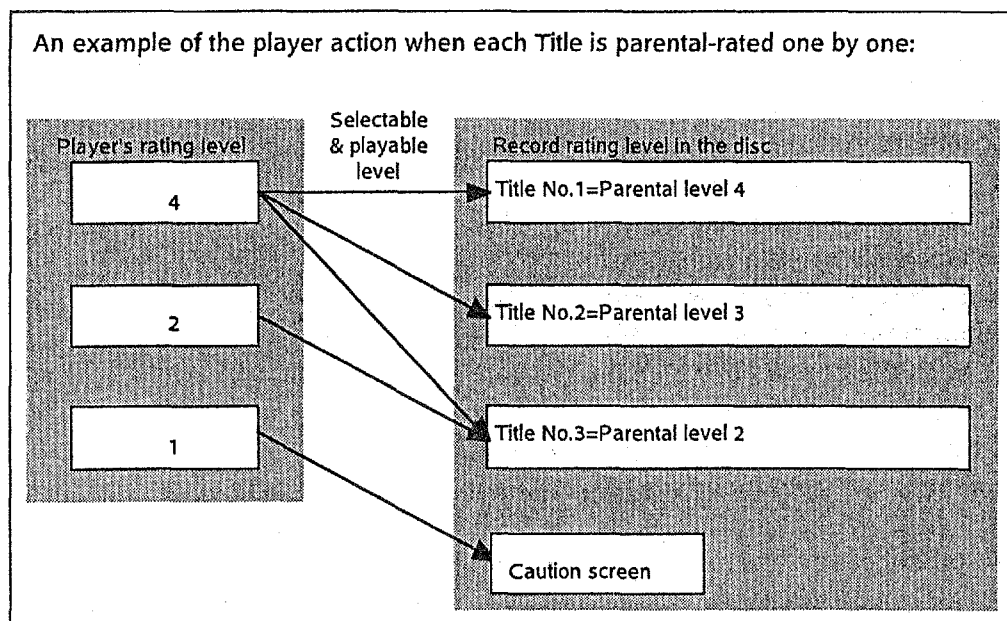


Figure 1-14 : An example of operation of the player in view of parental control

1-3.6 Direct access restriction function

In Direct access, the programmed playback procedure on the disc is not followed. The player searches to the point in the program to start playback by moving the player's optical pickup directly to the point where the targeted information is recorded by using a search function or the fast forward trick play feature of the player.

Direct access provides a simple method to access a specific piece of information quickly from an enormous amount of information.

On the other hand, it may not be preferable to allow such easy access to certain information, such as an answer in a game software which should be obtained only through a complicated procedure. Therefore, DVD has an option to prohibit the direct access to certain portions of information. The area which is prohibited direct access cannot be accessed except by a regular playback procedure or Chapter search (if proper Chapter exists).

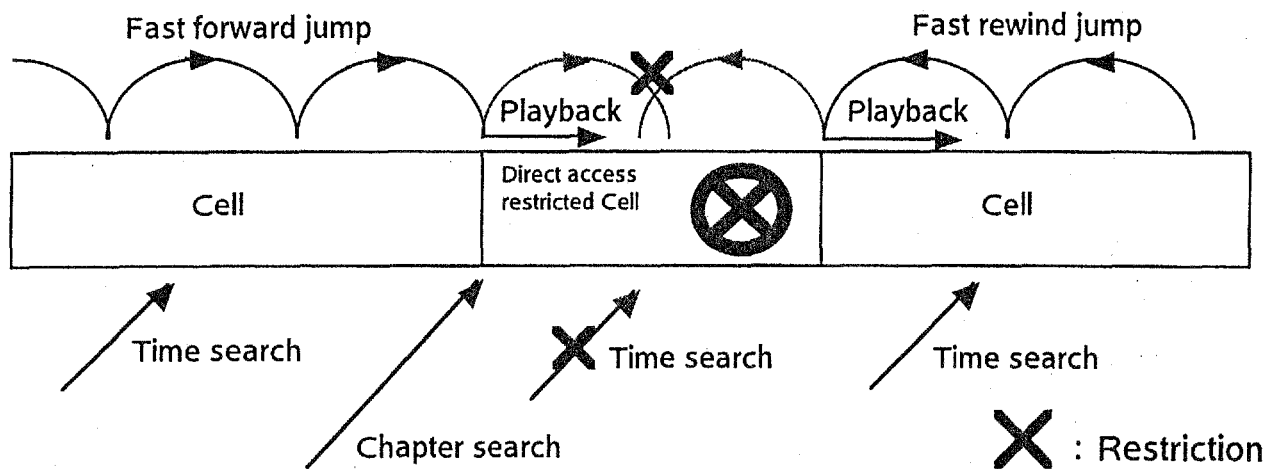


Figure 1-15 : An example of Direct access restriction function

1-3.7 Automatic picture stop function

The automatic picture stop is a function which allows the player to present a still picture automatically at a pre-determined point in a program during the playback of DVD-Video disc. There are several methods to realize this function, hence it is necessary to understand the purposes and differences of several data structures on the disc. This part introduces two simple examples for slide show.

In the case of a slide show application, such as a photo album which does not have any corresponding audio and Sub-picture, it is possible to provide playback of still pictures in the order of the GOPs (which is a unit of MPEG's compression) during the still picture display period that contains the GOPs, having one still picture for each. The period for storing the still pictures is called a "Cell". (Please refer to 1-5.2) In this case, one GOP can record one still picture (one video frame) by using the time of 1 to 18 of video frame periods. The player decodes the still picture in each GOP of the Cell by its own MPEG decoder, and displays the current still picture while waiting until the next instruction comes. When the player receives some playback instruction, it will decode the still picture in next GOP and replace the current still picture with the next one to display, thus enabling the player to play back all of the still pictures recorded within a given programmed time.

As another method, there is a function of still pictures which acts like an In-Title Menu by recording a motion picture and a following still picture in one Cell and by using the combination of Sub-picture and Highlight command. As applications of this still picture, other than Menu, any text information to guide the software's instruction or to make the operation of the software easier can be realized by playing it during the playback time period (proper time * infinite time) programmed at the software production stage.

These two types of picture stop are called GOP picture stop in the first case and Cell picture stop in the second case.

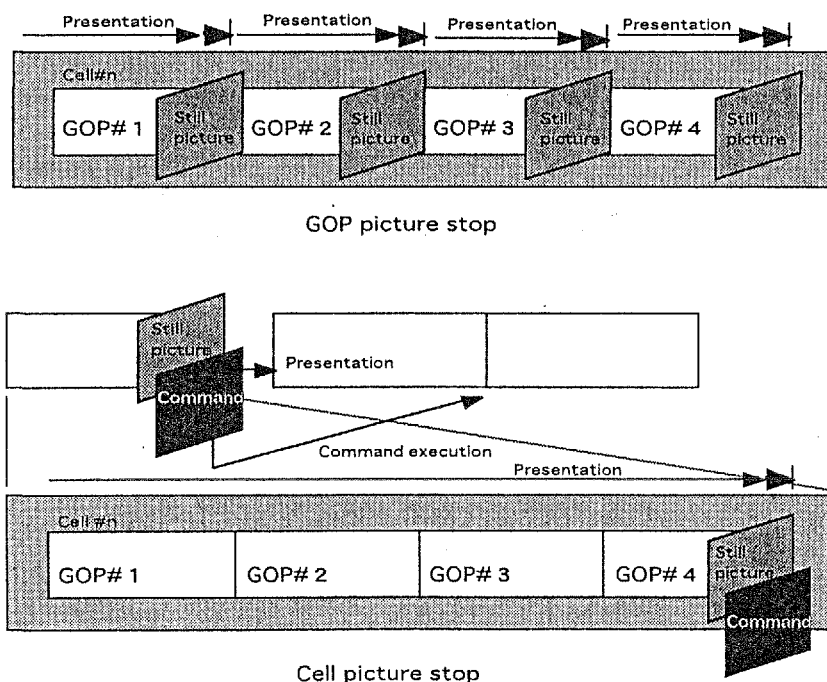


Figure 1-16 : An example of picture stop function

1-3.8 Multi Angle feature

Multi-Angle is similar to multi-channel use in audio. As described in Figure 1-17, it lets the user optionally select one of up to 9 Angles of video recorded in parallel. Each is to be played with one common time progression.

To realize this function, several Cells which make up a Multi-Angle Block, are recorded in a video track. The user specifies the Angle which determines which Cell should be used while the Multi-Angle Block is being played back.

As for the conditions of Multi-Angle Block structure, the recording time of each Cell in a Block must be same for each Angle.

When playback of the DVD-Video disc approaches a Multi-Angle Block, the player will continue to play back the video and audio content the same as conventional playback unless the user has made an Angle change. Then, it is necessary to indicate to the user that the current playback is in an Angle changeable period. Therefore, it is recommended to record some indication at the software production stage for showing the existence of multiple Angles.

Multi-Angle Blocks can be used several times in a Title. However, the number of Angles in each Multi-Angle Block shall be the same throughout the Title. On the other hand, the Multi-Angle Block structure can be used as a multi-video track for a Title by letting the Title be composed of several Cells with each being used for one track. In addition, it is possible to have several Chapters in a Multi-Angle Block.

As explained for Multi-Angle and Parental control, the disc has the function to switch the video to be played automatically or at the user's will. A special signal recording method called "interleave" is utilized for Multi-Angle and Parental block to avoid a video break at the branch caused by these functions. The video and audio of each Angle is divided into several blocks, and recorded in the manner of Interleaved Blocks as shown in the Figure 1-17. In a normal playback case, it does continuous playback, following the playback order for the selected Angle, by skipping unnecessary blocks.

When the user makes an Angle change operation during the playback of an Multi-Angle Block, the player performs the switching operation according to the switching method specified in the disc. There are two methods for the switching.

For a Seamless Change, the player continues playing back until the interleaved switching point of the current Angle comes (approximately 1 second). Then to change the playback path is changed to the specified Angle while keeping on the continuous time progression from the previous Angle. For Non-seamless play, the Angle is switched anytime, at the user's will, with some break of video and audio while searching for the specified Angle. In this case, it is possible to specify the switching position of next Angle to be connected at the software production stage. As shown in the Figure 1-17, it specifies the next time position in general. In addition, the contents of audio and Sub-picture can also be changed for each Angle in the case of Non-seamless play. Please contact authoring company for detail.

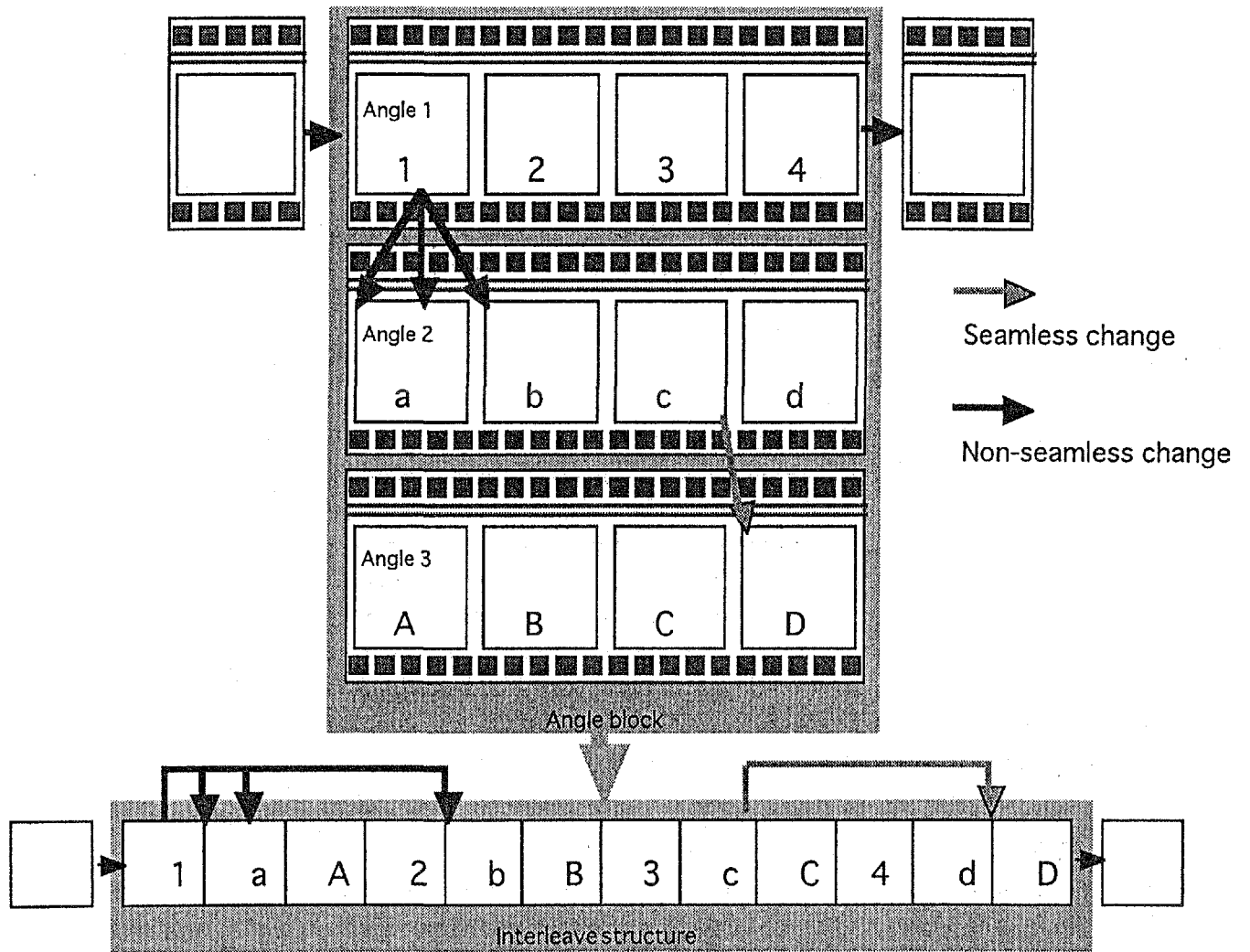


Figure 1-17 : An example of Multi-Angle Block structure

1-3.9 Karaoke features

Any Titles which are recorded as DVD-Video are categorized by a so-called "Application type" defined by DVD-Video format. Currently two of the Application type are defined; Karaoke and non specified use. DVD-Video player can support special features for Karaoke by referring this. Especially, in case of Karaoke, various purposes other than general music Titles can be expected. For this reason, if one tune is assigned to one Title on the disc's layer structure, it makes possible to search and play a tune through Menus, to display a Title selection Menu at the end of each tune, to divide a tune into several songs by Chapter unit, and to divide a song into introduction, climax, interlude etc. by Cell unit. By discriminating this unique Karaoke software according to Application type, the DVD-Video player which corresponds to these Karaoke features can realize unique functions by using player manufacturer's proprietary methods like one song play, introduction skip, climax only play etc. which are achieved by some professional use Karaoke systems.

In addition, there are some known unique features of audio for karaoke. Especially in consumer karaoke systems, multi-channel mixing which uses multiplexed audio is widely adopted for supporting assistant vocal, duet, and chorus feature etc. For such multiplexed audio application, the audio systems as Linear PCM, AC-3 and MPEG audio which are to be recorded in some audio tracks have defined Surround sound for stereophonic presentation by using multi-channel and the format for Karaoke. In case of the Title for Karaoke, they can support up to 5 channels per track regardless of audio recording system, and it is possible to realize various Karaoke features such as multiplexed audio Karaoke etc. which has been expanded for consumer and professional use. Furthermore it allows the player which has no special Karaoke features to be compatible.

Especially if the Audio application mode for AC-3 system is set to Karaoke, when the audio is recorded by the format as shown in Figure 1-18, normal player will provide two channel audio output by downmixing the karaoke plus guide melody. At that time, no assistance vocal part will be played by normal player.

On the AC-3 Karaoke capable player, it will allow to switch or select the channel separately by either muting the guide melody which is to be downmixed into two channel stereo, or by selecting one and / or the other of up to two channels of the assistance vocal recorded in the rear channel (in case of the vocal 1 and vocal 2 are used separately on a duet tune) to be mixed into Karaoke channels at a certain amplification gain set by the player, and to output as multiplexed sound Karaoke.

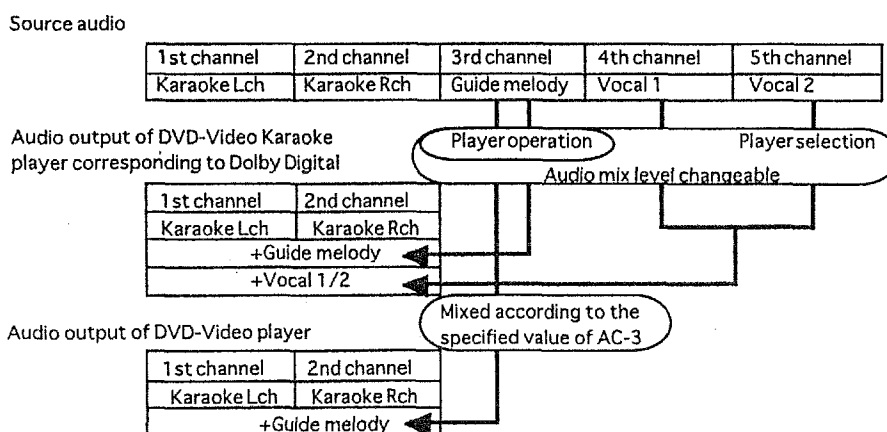


Figure 1-18 : Recorded audio and output in case of AC-3 <An example of Karaoke>

Similar functions as with AC-3's channel mixing are possible for Linear PCM audio by utilizing multi-channel structure, however normal DVD-Video player has no function to downmix any channels other than No. 1 or 2.

Therefore it is necessary to prepare the first two channels to contain premixed guide melody for Karaoke. In this case, as the guide melody is not recorded as separate channel, switching on / off of the guide melody will not be available even on the player with Karaoke functions.

Please note that from any multi-channel audio by Linear PCM only the first two channels are presented by normal player, not depending on Karaoke application. And recordable channel number of Linear PCM multi-channel audio is depending on the sampling frequency and number of bit of quantization of source signal. Please set up audio specification of the disc by referring to Figure 1-19.

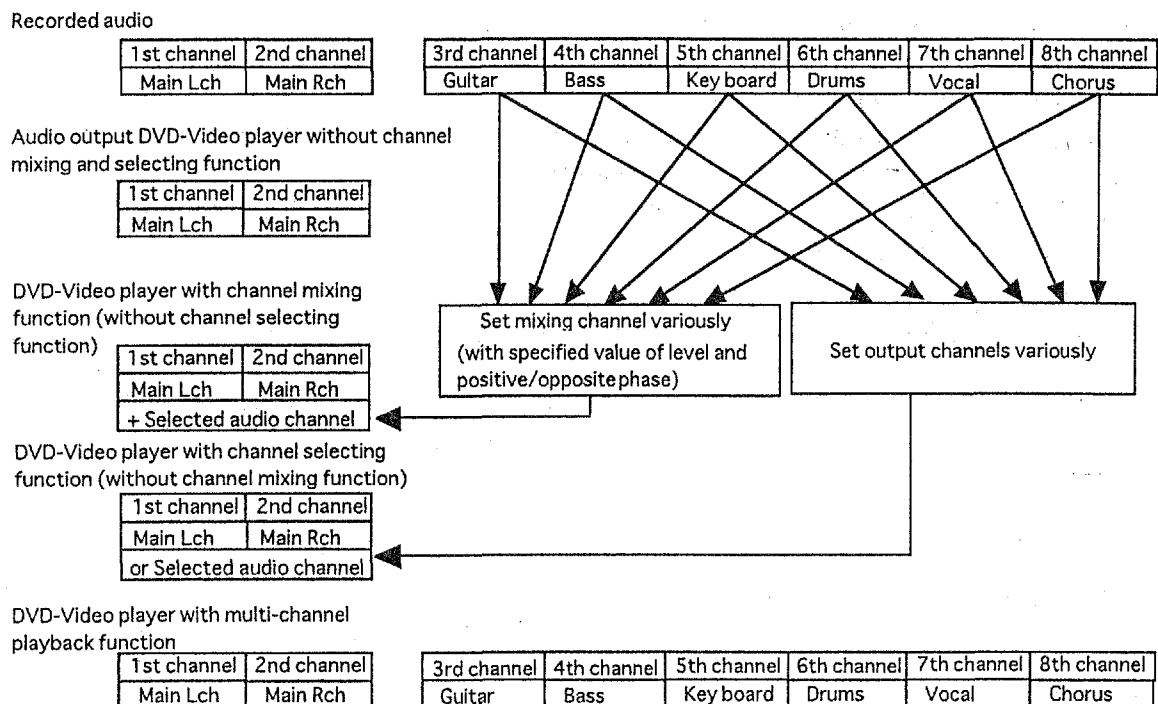


Figure 1-19 : Recorded audio and output in case of Linear PCM multi-channel audio

1-3.10 Copy guard feature

DVD-Video is providing several copy guard features on the playback signals for each output form. Most popular method of output signal format from the player is analog signal system for both video and audio. Any DVD-Video player provides the function to add an analog copy guard signal to the video signal output, when the output is not allowed to be copied by consumer VCR etc. The analog Copy Guard signal will be applied to composite video output signal and to separate video output signal (Y/C).

There are three types of analog copy guard signal, and the DVD-Video player will apply one of them according to copy guard information recorded on the disc. Accordingly, whether or not to apply the copy guard signal can be specified for each disc, each Title, or for each scene. The analog copy guard signals provide different effects as copy guard and may give side effects on TV, depending on the type. In addition, it is necessary to be careful changing the type of copy guard signal during the continuous playback, because it may give too much effect to the TV. Besides analog Copy Guard, corresponding copy guard features are standardized for digital signal system and for the restriction for the copy of computer data.

Please consult with authoring company or disc manufacturer for detail of the copy guard features

1-3.11 Regional playback control function

Regional playback control function is a function to allow playback of DVD-Video disc for specified Regions only.

Each DVD-Video player owns only one Region No. which is assigned for the Region where the player is sold, and the user can not modify the Region No. by himself. On the other hand, each DVD-Video disc can apply Region control for each disc side, and can specify a set of Region No. to allow playback by the players for the corresponding Region.

If a DVD-Video player prohibits playback of a disc that has no Region No. for the player to allow playback, some caution message like "Playback prohibited in this Region" will be provided on the display.

1-4 Overview of mandatory functions for DVD-Video players

There are certain functions and operation methods that are required by DVD format on designing of any DVD player. It is important to understand these functions / operation methods on producing DVD software, because they are guaranteed to be available on all DVD-Video players.

Video track playback

- MPEG-1 and MPEG-2 video track playback function,
Analog video output (composite output)
- Video aspect ratio select function.....Letterbox / Pan converted output
DVD-Video disc can record 16:9 video. This function enables the conversion from 16:9 video to the letterboxed / panned 4:3 to display on 4:3 TV monitor according to user selection. On the disc it can be specified to allow the user selection or not.
- Multi-Angle playback function..... Angle change at the user's will
Angle selection is available on Angle block playback during the playback of a Title. Angle change during the playback is done at the available switching points specified in the disc. There are two methods of Angle change; Seamless Angle change and Non-seamless Angle change in which the video is paused at the switching point. Either way can be specified for each Angle block at the disc production. DVD-Video player can do Angle change operation with either way during the playback.
- Automatic picture stop function
This is the function to do Still mode playback automatically at the point specified at the disc production stage. Once in automatic picture stop, a DVD-Video player needs user input to quit this state.

Audio track playback

- Audio track switching function

For Titles with several audio tracks, the player allows to switch the audio track depending on user operation during playback. The DVD-VIDEO format allows to share common parts of video, audio and Subtitle etc. partially by several Titles on the disc, in order to increase the recording efficiency of the disc. (This is called "Cell sharing." Please refer to 1-5.2.) In case of shared Cell, it has a feature to specify playable audio tracks among the up to 8 tracks for each Title. Please consult with authoring company for detail.

- Linear PCM audio track playback function

..... 2-channel analog audio output (corresponding to 48kHz/16-bit quality or more)
As for the combinations of 48, 96kHz audio sampling rate / 16, 20, 24-bit quantization, the playback with 48kHz / 16-bit audio quality is at least guaranteed for the main Left (L) and Right (R) channels. Any playback function for other Linear PCM Audio channels is option. This rule is valid for both 525/60 ("NTSC") and 625/50 ("PAL/SECAM") system players.

- AC-3 audio track playback function (for 525/60 ["NTSC"] TV system player)

..... 2-channel analog audio output (downmixed output)
Any DVD-Video player for the 525/60 ("NTSC") TV system can playback downmixed 2-channel for 2/1, 2/2, 3/0, 3/1, 3/2 mode except the 2/0 mode. Full decoding is an optional function.

- MPEG-1 and MPEG-2 audio track playback function (for 625/50 ["PAL/SECAM"] TV system player)..... 2-channel analog audio output
Any DVD-Video player for the 625/50 ("PAL/SECAM") TV system can playback L/R 2 channel for MPEG-1 (layer2) and MPEG-2 (layer2) audio. Only basic L/R audio signal which is compatible with MPEG-1 can be played for MPEG-2 audio. Full decoding is an optional function.

Subtitle track playback

- Subtitle track select function

For Titles with several Subtitle tracks, the player allows to switch the Subtitle track depending on user operation during playback. The DVD-VIDEO format allows to share common parts of video, audio and Subtitle etc. partially by several Titles on the disc, in order to increase the recording efficiency of the disc. (This is called "Cell sharing." Please refer to 1-5.2.) In case of shared Cell, it has a feature to specify playable Subtitle tracks among up to 32 tracks for each Title. Please consult with authoring company.

- Display On/Off function and forced display function

Any DVD-Video player has not only a Subtitle display on/off function but also a "no Subtitle selection" function. Regardless of the display on/off setting, the player is continuously decoding a Subtitle track during playback. When the Subtitle display is off, the player will decode the Subtitle track for forced display in the same language as the currently selected Subtitle track.

When no Subtitle track is selected, the player will decode the Subtitle track in the same language as the currently selected audio track. Then, the Subtitle track for forced display will be decoded as described above. Therefore, only the forced Subtitle picture which was programmed for the currently decoding Subtitle track will be displayed. Preparation of Subtitle track must be properly done without any contradiction at the software production stage.

- Automatic selection playback function according to video aspect ratio

When Subtitles corresponding to more than one aspect ratio are prepared, the player will automatically select the appropriate Subtitle track which corresponds to that aspect ratio, thanks to a video track playback function of video aspect ratio change.

Playback control

- Title selection and playback function

This is a function of the player to search and to start playback of the selected Title by Menu or the direct key.

- Automatic set start function

This is a function of the player to start playback operation according to the automatic set start procedure specified in the disc right after the disc was inserted.

- Menu Call function

This is a function of the player to call the Title selection Menu and Root Menu recorded in the disc on demand from the user.

Title selection Menu can be called from the Stop state of the disc or at just before startup of the disc playback, and Root Menu can be called after certain title is selected.

Also called Resume function is also mandatory function for the player in which the player resumes the original condition of Title playback if no effective user operation is done for the Menu operation which Menu was called during a Title playback. Depending on the existence of Subtitle while the Title is played back, the resumed playback position does not always match the position at the Menu Call operation was made.

- Menu language select function

The player has a function to select a language when the System Menus are provided in several languages.

Additionally, it has a function to set System Menu default language. These selections are possible to be done when the player is in the Stop state.

If there is no System Menu in the System Menu default language, the Menu which is written in the default language of the disc will be called.

- Menu operation function

DVD-Video player has selecting and activating functions for all the Menu operations as mandatory.

Playback controlled by command

- Disc command execute function.....Highlight command execution (at any Menu execution etc.)

This is a function of the player to react to the Highlight command at Sub-picture display used with a Menu display in general. The DVD-Video player mandatory supports the commands which are specified in the format (such as Random / Shuffle playback, branching, etc.)

Please consult with authoring company for detail.

1-5 DVD-Video disc data structure

1-5.1 Volume and Title

The data structure of a DVD-Video disc is a hierarchical structure as represented in Table 1-4. A "volume" is the first layer in a disc. Each side of a disc can have one volume. A volume in DVD-Video corresponds to that used in the structure of computer hard disk. It is not necessary to be aware of the volume for the DVD-Video application containing video program such as movies, but will be necessary when used as DVD-ROM.

Another layer called "Title" is under the volume layer. A Title does not have any particular shape, structure or size; but because a Title collects playback procedures for video and audio data groups called Cells, it can in general be thought of as a time chart. There are basically two kinds of Title. One is called linear type which does not have any branches from the beginning to the end. The second is called non-linear type which has some branches (by user operation or by programmed procedures to make automatic operation etc.) during the Title playback. When there are several Titles in a disc, one of them is to be selected through the Menu explained above (Please refer to 1-3.3.2). DVD-Video disc can record maximum 99 Titles in one volume.

Generally, one Title is assigned to one movie work for movie software, and to one tune for Karaoke software. Within a Title, parameters such as the number of audio tracks, the number of Subtitle tracks and their structures, the number of Angles should be consistent.

	Movie	Music	Karaoke
Title	one Work	one Album	one Song
Chapter	one Chapter (scene)	one Song	one Chorus

Table 1-4 : Example of layered structure for each software application

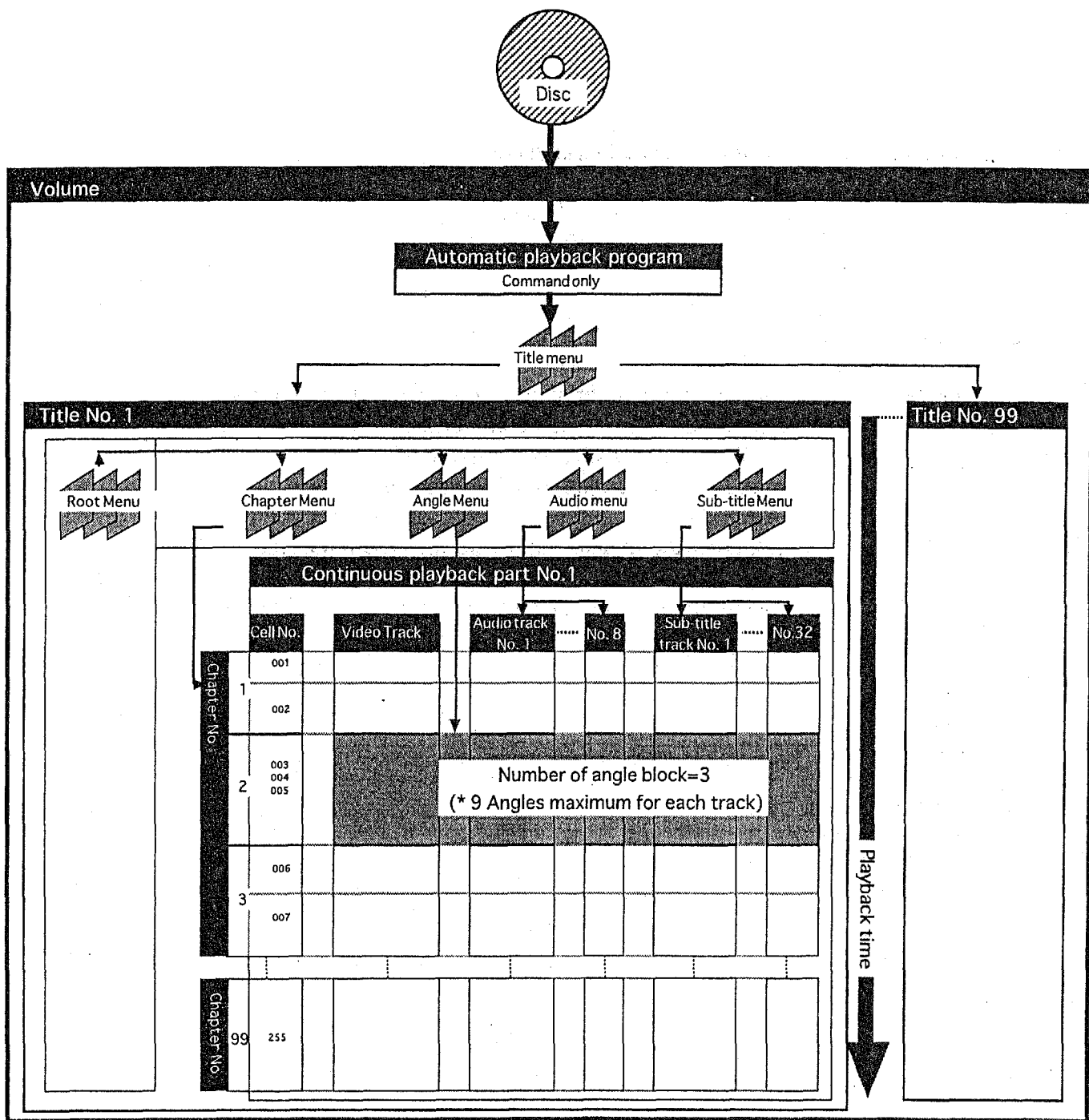


Figure 1-20 : A typical example of disc layer

1-5.2 Chapter and Cell

There is a unit called "Cell" several of which constitute a Title. Each Cell comprises a certain amount of video, audio and Subtitle etc. Cell number is assigned continuously according to the order of playback.

In case of linear type Title which is used for general movie and music software, Cell number is assigned as integer number from 1 to 255, and in case of non-linear type Title, Cell number is integer number assigned from 1 to 255 for each continuous playback part. Cells which contain common video, audio and Sub-picture are possible to be shared by several Titles. This is called Cell sharing. As for the audio and Sub-picture track, each Title which shares a Cell can specify the selectable tracks independently. However, it is necessary to make the number of selectable audio tracks, their audio recording system, the number of Sub-picture tracks be the same through the Title, even for non shared Cells.

A Chapter can be composed of one or several Cells. The Chapter is used for searching video and audio. Each Chapter has an integer number from 1 to 99 that can be set according to the order of the playback. The maximum number of Chapter is up to 99 for the linear type (as shown in Figure 1-21), however the Chapter is not applied for non-linear type.

As the contents of this book are written aiming at production of linear type Title, restrictions for non-linear type Title. are not included.

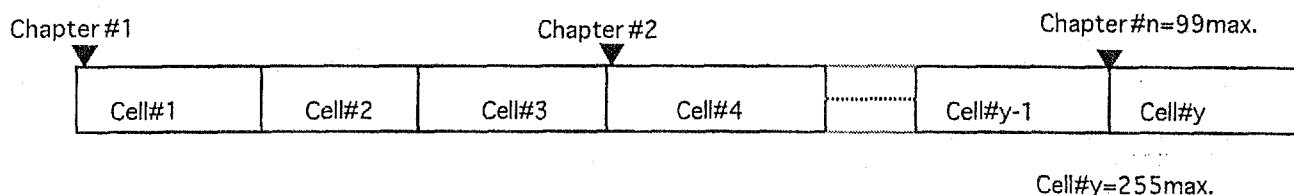


Figure 1-21 : Cells in case of linear type Title

1-5.3 Track

Whereas the hierarchical data structure of DVD-VIDEO format is defined as same as that of computer's system, the so called "Track" is defined here so that a disc can be handled in continuous time range like a tape by adopting the concept of a master tape which is used in the video software production.

A track corresponds to a area on which continuous video (MPEG encoded), audio (Linear PCM, AC-3 or MPEG encoded) and Sub-pictures are recorded and played along with a same time progression.

In other words, comparing to VHS video tape which has one video and four audio (two normal audio and two hi-fi audio) tracks, DVD-Video does not have dedicated physical recording areas for these signals but just recording area. DVD-VIDEO format allows to have one track for video data, eight tracks for audio data and 32 tracks for Sub-picture.

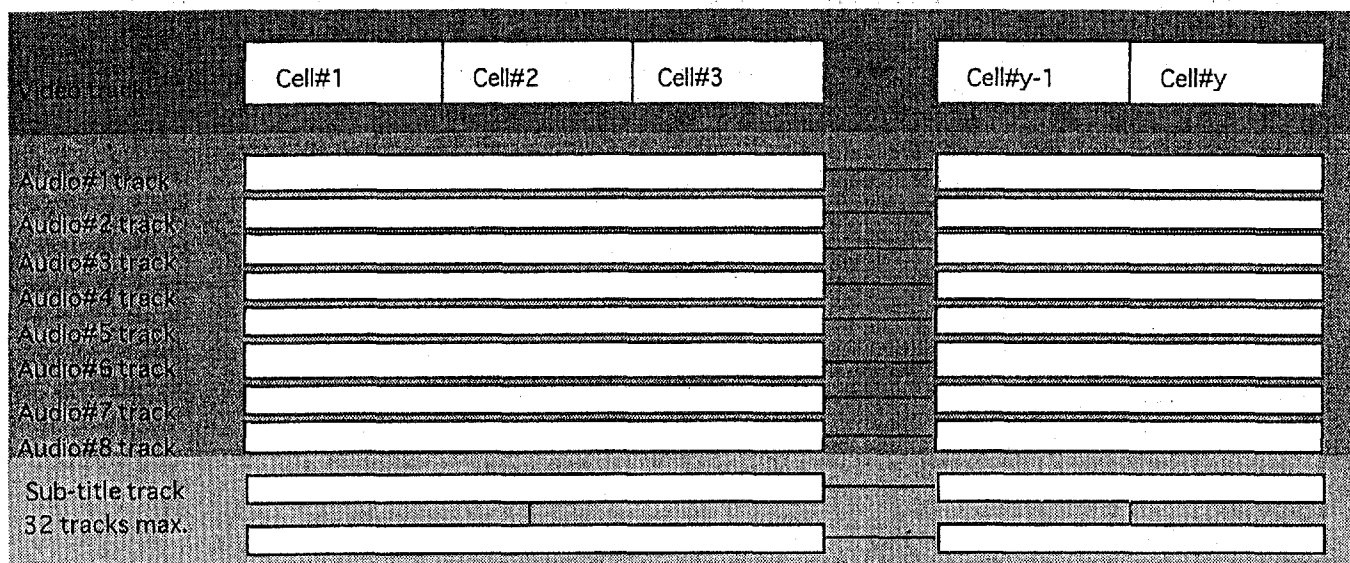


Figure 1-22 : Explanation of Track

1-6 Data capacity and maximum transfer rate on DVD-Video disc

1-6.1 Data capacity and transfer rate

The information recorded in a disc is handled as data comprising video, audio, Sub-picture and Menu. The recording capacity has a limit based on the disc specifications introduced in Section 1-2 "Features of DVD-Video system".

In the following, an example of calculation for a single layer disc with 4.7 Gbyte of data capacity will be given. The data capacity of a disc can be considered as a water tank filled with water as shown in Figure 1-23. The data is illustrated as the water in the tank, similarly, the maximum data capacity is illustrated as the maximum volume of water which does not overflow from the tank.

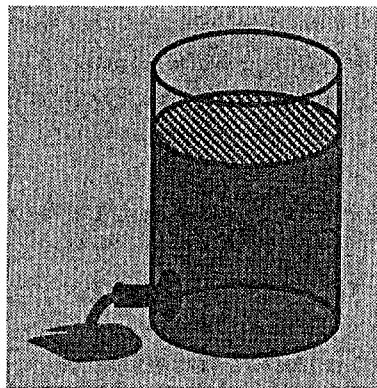


Figure 1-23 : An image of disc capacity and transfer rate

In this example, the water is a mixture of video, audio and other information.

The water can be taken out through a tap with an appropriate amount as needed for the application. The data recorded in the DVD disc plays the same role as the recorded data by being read from the disc. Like the amount of water flow will depend on the water pressure, the required amount of data taken out of a disc is different depending on the purpose (such as video, audio, Sub-picture or etc.). The amount of data per second is called the transfer rate. The total maximum transfer rate of the DVD is limited to 10.08 Mbps. This total transfer rate is given by the sum of video transfer rate (which total is up to 9.8Mbps), audio transfer rate, Sub-picture transfer rate and some other transfer rates. The unit Mbps used to express the transfer rate means 1,000,000 bits transferred per second. A bit is the minimum unit of the digital signal. A lower transfer rate would allow to play the recorded data over a longer time, however, some bad effects of less data in a unit time may result such as low video and audio quality or limited number of audio stream breakout.

In order to appropriately choose the transfer rate of each signal several factors have to be considered as follows The first item to be considered is the total playing time of all programs to be recorded in the DVD disc. That calculation is as follows:

$$R = (D \times 1000 \times 8) / (T \times 60)$$

R = Transfer rate (Mbps), D = Disc maximum data capacity(Gbyte), 1G = 1000M

T = total playing time (min.)

If a 135 minutes program is to be recorded with 4.7 Gbyte, this results in:

$$R = (4.7 \times 1000 \times 8) / (135 \times 60) = 37600 / 8100 \approx 4.642 \text{ Mbps}$$

The transfer rate given here is called the "average transfer rate" of the 135 minutes program. Figure 1-24 illustrates the concept of average transfer rate. As can be seen, the actual transfer rate may either exceed or fall below the average transfer rate. Nevertheless, it must never exceed 10.08 Mbps which is the maximum transfer rate. This is a condition for producing DVD-Video.

This undulation is caused by adoption of the variable transfer rate to the video data compression of MPEG-2 encoding. The encoder identifies the parts of the video which can be compressed effectively and the parts that are difficult to compress according to the picture characteristics and then optimizes the transfer rate to record them within the calculated average transfer rate. In general calculations described in this book are based on average transfer rate.

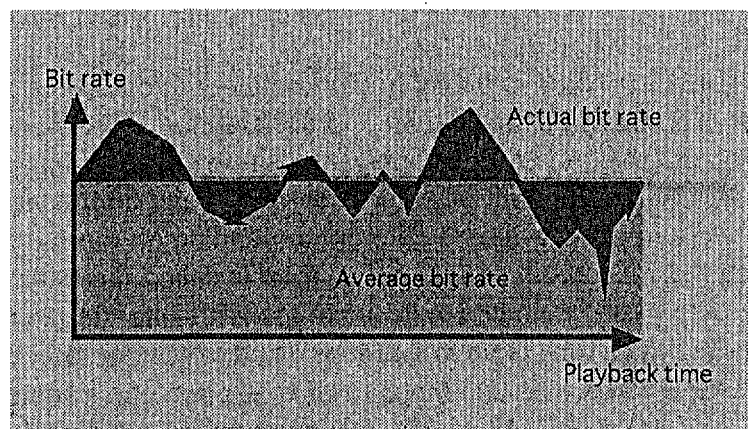


Figure 1-24 : An image of video transfer rate

The calculation of the average transfer rate can also be used to obtain the required data capacity (in Gbyte) by giving a specific transfer rate. For example, when several Titles are recorded in one disc, different average transfer rates can be set for each Titles according to their individual characteristics. However, the limits of maximum data capacity and maximum transfer rate must be considered.

1-6.2 Relation of transfer rate between audio and video data

After the average transfer rate is calculated, the rate for each information element (video, audio, and Sub-picture) needs to be calculated. Video needs particular consideration since the picture noise and other compression artifacts will depend on the transfer rate and the picture characteristics. The average transfer rate of the video signal is calculated by subtracting the total of the fixed transfer rate which is found in Table 1-5 and the required transfer rate of the Sub-picture and the other control signal from the average transfer rate.

AC-3 (+0.1ch)		Linear PCM					
Sampling frequency	48kHz	Sampling frequency	48kHz	48kHz	48kHz	96kHz	96kHz
Quantization	Compressed	Quantization	16bit	20bit	24bit	16bit	20bit
						24bit	
No. of ch.	Transferrate(kbps)	No. of ch.	Transferrate(kbps)				
1/0	64~448	1	768	960	1,152	1,536	1,920
2/0	128~448	2	1,536	1,920	2,304	3,072	3,840
3/0or2/1	192~448	3	2,304	2,880	3,456	4,608	5,760
3/1or2/2	256~448	4	3,072	3,840	4,608	6,144	
3/2	320~448	5	3,840	4,800	5,760		
		6	4,608	5,760			
		7	5,376				
		8	6,144				
MPEG(+0.1ch)							
Sampling frequency	48kHz						
Quantization	Compressed						
No. of ch.	Transferrate(kbps)						
1/0	64~192						
2/0	128~384						
3/0or2/1	192~912						
3/1or2/2	256~912						
3/2	320~912						
5/2	448~912						

Table. 1-5 : Audio transfer rate

For example, from Table 1-5, in the case where two AC-3 audio, 3/2 mode and 2/0 mode, are recorded in the disc and if each with a fixed transfer rate of 384 kbps, the available transfer rate excluding audio is calculated by subtracting $0.384 \text{ Mbps} \times 2$ from the average transfer rate of 4.642 Mbps.

$$4.642 - 0.384 \times 2 = 3.874 \text{ Mbps}$$

This is the transfer rate available for signals such as video, Subtitles and disc control etc. The required data amount for Subtitles and disc control signal for common subtitling of movie are usually negligible for the transfer rate calculation except some cases (where full display size Subtitles are changing at nearly every frame.) In short, the value acquired here is near the average transfer rate available for the video signal.

1-6.3 Compression of 2-3 pull down source (in case of NTSC)

There is a process called 2-3 pull-down used in converting a film shot at 24 frame per second to the 60 fields per second of the NTSC video. As shown in Figure 1-25, this is done by converting one film frame into 2 video fields and the next film frame into 3 fields, and so on. Hence, the difference of frame rate between film and video is compensated to keep the program time almost same.

As explained before, MPEG-2 video compression predicts a change of the continuous video signal. Encoded signal information can be saved if the correlation of the continuous video signal is high.

The video signal converted by 2-3 pull down has only 24 pictures of moving video information in the 60 fields per second. This means the video to be MPEG-2 encoded is just 24 picture per second. If the source video to be recorded on a DVD-Video disc has a portion of continuous 2-3 pull down, the compression efficiency can be increased at the MPEG encoding stage by means of 24 frame compression.

Please consult with authoring company for detail.

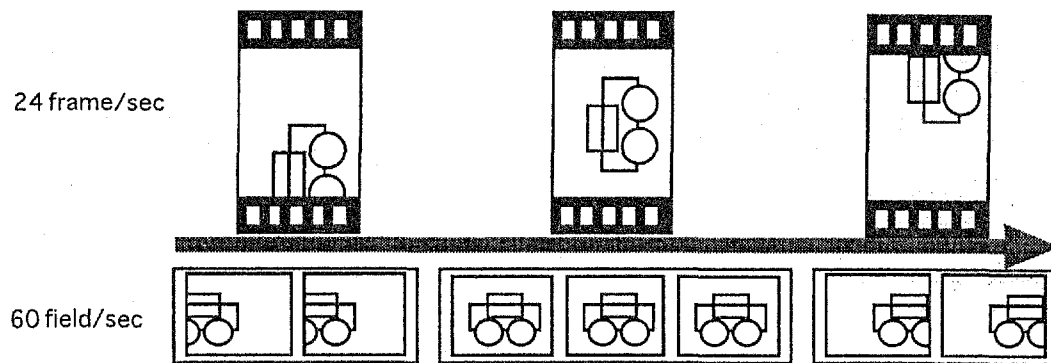


Figure 1-25 : 2-3 pull down source

Chapter 2

Software Production manual

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2-1. Software production manual (525/60 NTSC, 625/50 PAL & SECAM)

2-1.1 Video and audio source tape specification

(NTSC/PAL & SECAM: D-1,D-2,D-5 component digital VTR,
Digital beta-cam VTR, Beta-cam SP, DCT, D-2 composite digital VTR etc.)

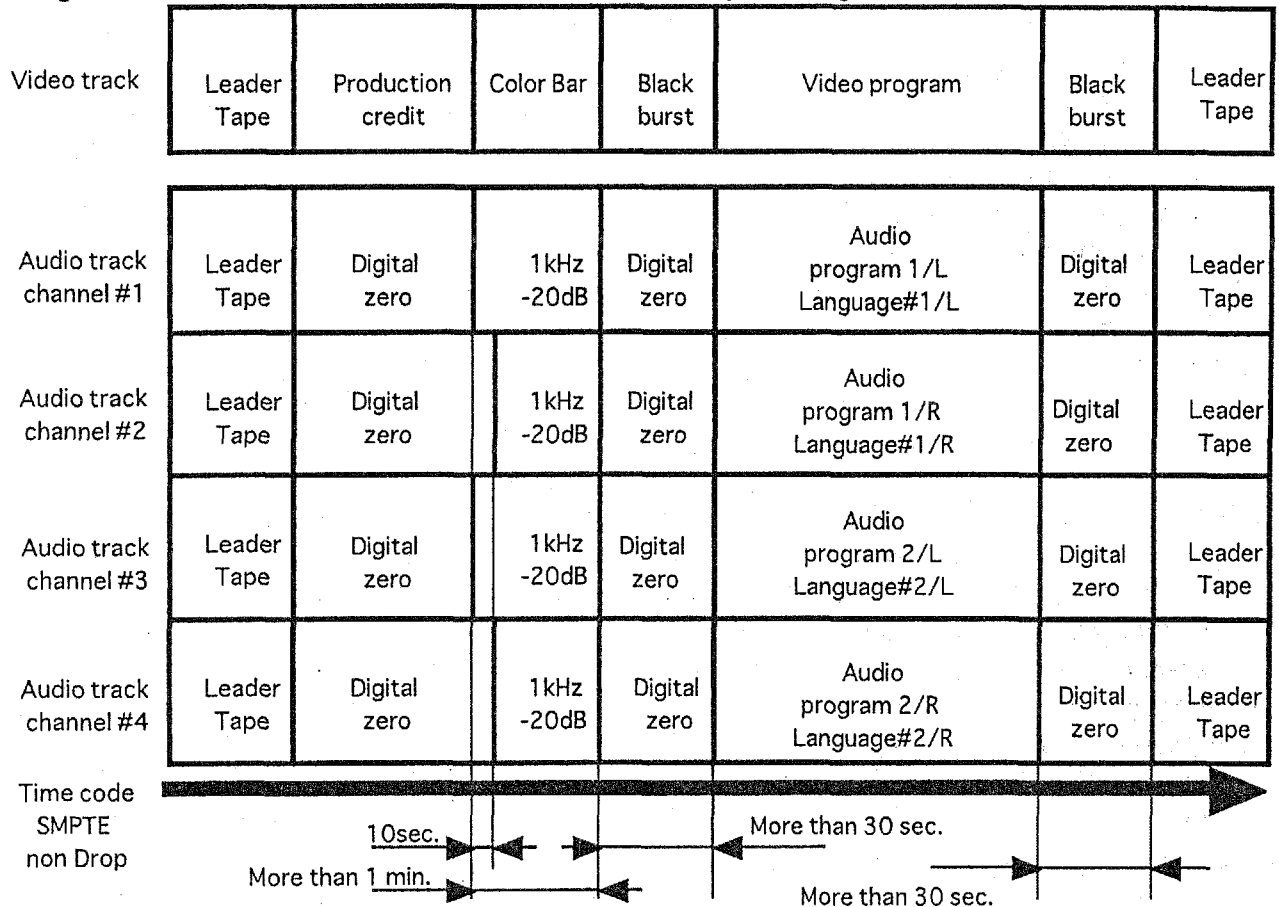


Figure 2-1

2-1.1.1 Video recording format

(525/60 NTSC)

- For recording of a component signal, maintain the level at 0.7 Vp-p or less for each of the G/B/R channel in the 525/60 system.
- For recording of a composite signal, maintain the peak video level of 110 IRE or less including chroma signal (100% max.) in the 525/60 system. Composite signal is converted into component signal at the MPEG encoding.

(625/50 PAL & SECAM)

- For recording of a component signal, maintain the level at 0.7 Vp-p or less for each of the G/B/R channel in the 625/50 system.
- For recording of a composite signal, maintain the peak video level of 110 %IRE or less including chroma signal (100% max.) in the 625/50 system. Composite signal is converted into component signal at the MPEG encoding.

2-1.1.2 Audio recording format

- Record the audio with the same specification (sampling frequency and quantization bits) as the audio to be recorded in a disc.
- Converting into higher sampling frequency using a sampling converter, etc. does not necessarily improve the sound quality. It is recommended to record sound with the required recording system.

2-1.1.3 Test signal

- For the composite video test signal, use the SMPTE or the EIA standard color bars (a setup level of 0 or 7.5% should be used according to the setup level of the recorded program). Clearly describe the type of color bar on the material information sheet.
- The SMPTE/EBU N10 Standard 100% color bar is used as the standard component video test signal. However, other color bar signals which are generally used as a standard for VTRs are also allowed. When a signal other than the SMPTE/EBU N10 Standard 100% color bar is used, clearly describe the type of color bar on the material information sheet.
- A 1 kHz sine wave at -20 dB (from full bit) is used as the standard audio test signal. However, the standard recording level of the VTR or of the editing system is also allowed. When a signal other than the 1 kHz sine wave, -20 dB (from full bit) is used, clearly describe the signal and its recording level on the material information sheet.
- To discriminate and check the odd and even numbered channels, mute (digital zero) the audio test signal in the even channels for the first 10 seconds.

2-1.1.4 Time code

- Non-drop frame time code based on the SMPTE/EBU Standard should be continuously recorded from the recording start point of the color bar to the end point of black picture after the end of active program.
- Drop time code may be used only for the linear (sequential) program which does not require a description of search point on the printing material nor have branch sequence.
- Clearly describe the type of time code used on the material information sheet.
- Regardless of the type, time code should not cross over 24h at any point on a tape.

2-1.1.5 Program editing

- Be sure to maintain proper color framing from the first field at the editing tape with a composite VTR. Editing from a second field may be necessary with 2-3 pull down recorded video in order to maintain the 2-3 field sequence of the edited tape. Even in this case, be sure to consider color framing by properly setting the edit point or editor color frame control.

2-1.1.6 Audio recording

- Record the audio according to the audio channel assignment as shown in the Figure 2-1.
- Do not record audio tracks which are to be recorded on the same audio track of a disc into different tapes.
- A separate audio tape should have a recording time identical to that of video tape (including muting time if necessary).
- On/off states of the emphasis should be consistent through all the channels in a recording track. Emphasis on/off should not be changed during any continuous playback.
- Mute one second from the start of each Title.

2-1.2 Audio source recording

(Separate audio tape: DTRS digital audio tape 8mm 8 tracks/ DAT/ DASH format etc.)

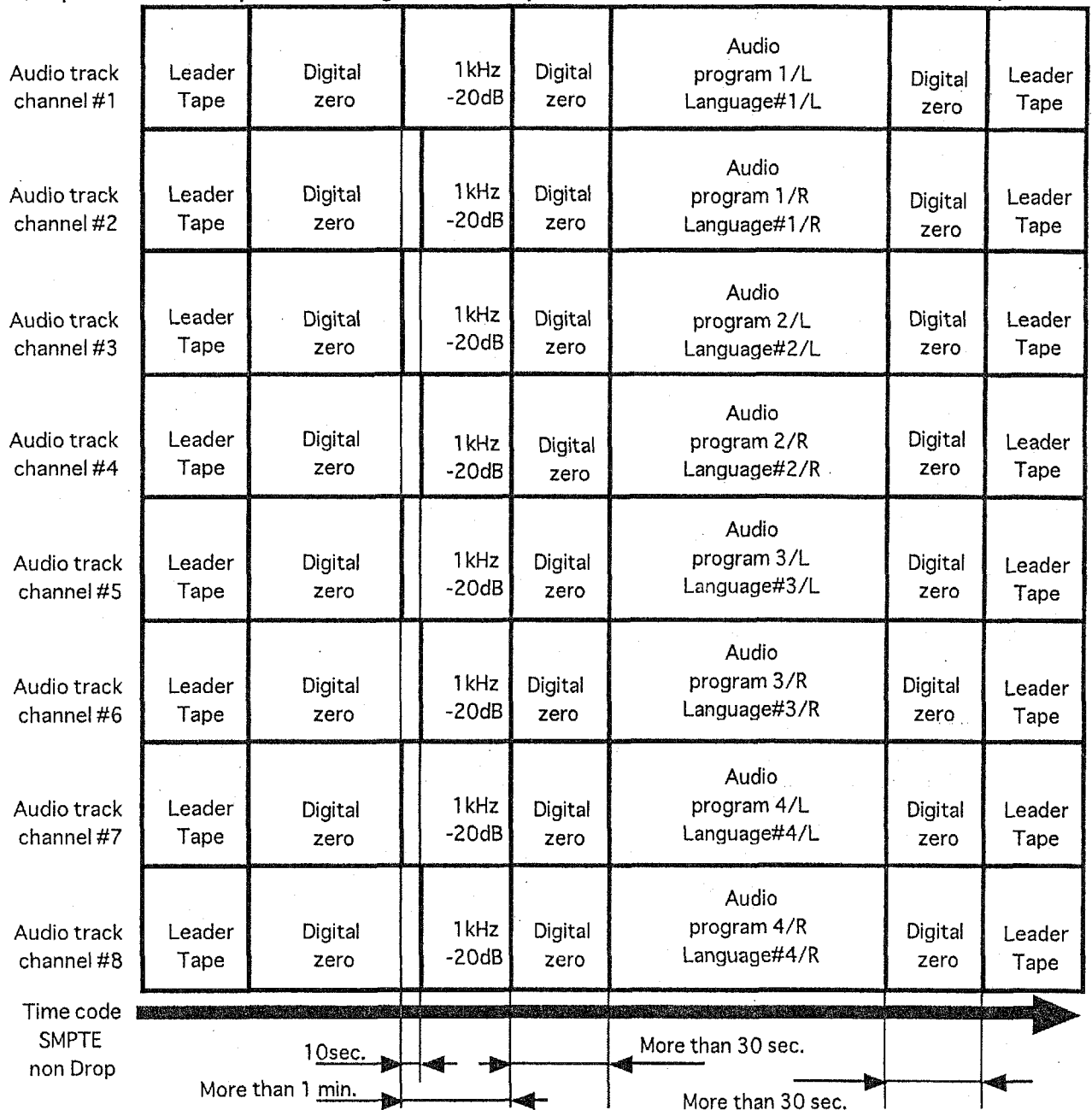


Figure 2-2

2-1.2.1 Recording format

- Record the audio with the same specification (sampling frequency and quantize bits) as the audio to be recorded in a disc.
- Converting into higher sampling frequency using a sampling converter, etc. does not necessarily improve the sound quality. It is recommended to record sound with the required recording system.

2-1.2.2 Test signal

- A 1 kHz sine wave at -20 dB (from full bit) is used as the standard audio test signal. However, the standard recording level of the VTR or of the editing system is allowed. When a signal other than the 1 kHz sine wave, -20 dB (from full bit) is used, clearly describe the recording level on the material information sheet.
- To discriminate and check the odd and even numbered channels, mute (digital zero) the audio test signal in the even channels first 10 seconds.

2-1.2.3 Time code

- Use the same value of the time code which is synchronous with the video signal for separate audio tapes.

2-1.2.4 Program recording

- Be sure to lock the audio with the video sync at the recording.
- Recording channels in the audio track should be assigned as decided for each audio recording type show in Figure 2-2.
- Do not record audio channels which will be recorded in the same audio track of a disc into separate tapes.
- A separate audio tape should have a recording time identical to the video tape (including muting time if necessary).
- On/off of the emphasis function in recording should be consistent within the channels recorded on the same audio track. No switching should be made during the continuous playback section.
- Same sampling rate and quantization should be used for recording channels in the same track of a disc.
- Specify the condition of all channel assignment for multi channel material in the same track of a disc on the material information sheet.
- Mute at least one second from the start of each Title.

2-1.2.4.1 Recording of Linear PCM

- Record a number of channels within the maximum number defined of sampling rate and quantization shown in Table 2-1.
- In the case of producing a Title with one or more than three channel, please inquire to the authoring company.
- Make emphasis off for 96 kHz linear PCM regardless of the quantization.
- Mute at least one second from the start of each Title.

Sampling frequency	Quantization	Number of recording channel							
48kHz	16bit	1	2	3	4	5	6	7	8
	~20bit	1	2	3	4	5	6		
	~24bit	1	2	3	4	5			
96kHz	16bit	1	2	3	4				
	~20bit	1	2	3					
	~24bit	1	2						

Table 2-1

2-1.2.4.2 Recording a material which requires AC-3 encoding

- The recording channels should be assigned according to Table 2-2 for each AES/EBU output from VTR/ATR used for the recording.
- Use a sampling frequency of 48.0 kHz and a 16 bit quantization for audio material.
- Turn emphasis off at the recording.
- Mute at least one second from the start of each Title.

AC-3 ENCODER INPUT		
AES/EBU INPUT#1	AES/EBU INPUT#2	AES/EBU INPUT#3
chA/chB	chA/chB	chA/chB
L/R	Ls/Rs	C/LFE
L/C	R/Ls	Rs/LFE
L/Ls	C/Rs	R/LFE
L/R	C/LFE	Ls/Rs
L/C	Rs/R	Ls/LFE
C/L	R/Ls	Rs/LFE

L= Left channel, R= Right channel

C= Center channel

Ls= Rear Left channel, Rs= Rear Right channel

LFE= Sub-woofer channel

Table 2-2

2-1.2.4.3 Recording a material which requires MPEG encoding

- The recording channel should be assigned according to Table 2-3 for each AES/EBU output from the VTR/ATR used for the recording.
- Turn emphasis off at the recording.
- Mute at least one second from the start of each Title.

MPEG Audio ENCODER INPUT			
AES/EBU INPUT#1	AES/EBU INPUT#2	AES/EBU INPUT#3	AES/EBU INPUT#4
chA/chB	chA/chB	chA/chB	chA/chB
L/R	C/LFE	Ls/Rs	Lc/Rc

L= Left channel, R= Right channel

C= Center channel

Ls= Rear Left channel, Rs= Rear Right channel

Lc= Effect Left channel, Rc= Effect Right channel

LFE= Sub-woofer channel

Table 2-3

2-1.2.4.4 Recording a Karaoke material which requires AC-3/MPEG encoding

- The recording channels should be assigned according to Table 2-4 for each AES/EBU output from VTR/ATR used for the recording.
- Use a sampling frequency of 48.0 kHz and a 16 bit quantization for audio material.
- Turn emphasis off at the recording.
- Mute at least one second from the start of each Title.

AC-3 ENCODER INPUT <KARAOKE>		
AES/EBU INPUT#1	AES/EBU INPUT#2	AES/EBU INPUT#3
chA/chB	chA/chB	chA/chB
L/R	GV1/GV2	GM/(LFE)
L/GM	R/GV1	GV2/(LFE)
L/GV1	GM/GV2	R/(LFE)
L/R	GM/(LFE)	GV1/GV2
L/GM	GV2/R	GV1/(LFE)
GM/L	R/GV1	GV2/(LFE)

MPEG Audio ENCODER INPUT <KARAOKE>		
AES/EBU INPUT#1	AES/EBU INPUT#2	AES/EBU INPUT#3
chA/chB	chA/chB	chA/chB
L/R	GM/(LFE)	GV1/GV2

L= Left channel, R= Right channel

GM= Guide Melody channel

GV1= Guide Vocal #1 channel, GV2= Guide Vocal #2 channel

Table 2-4

2-1.3 Tape recording of AC-3 encoded bit stream (Example)

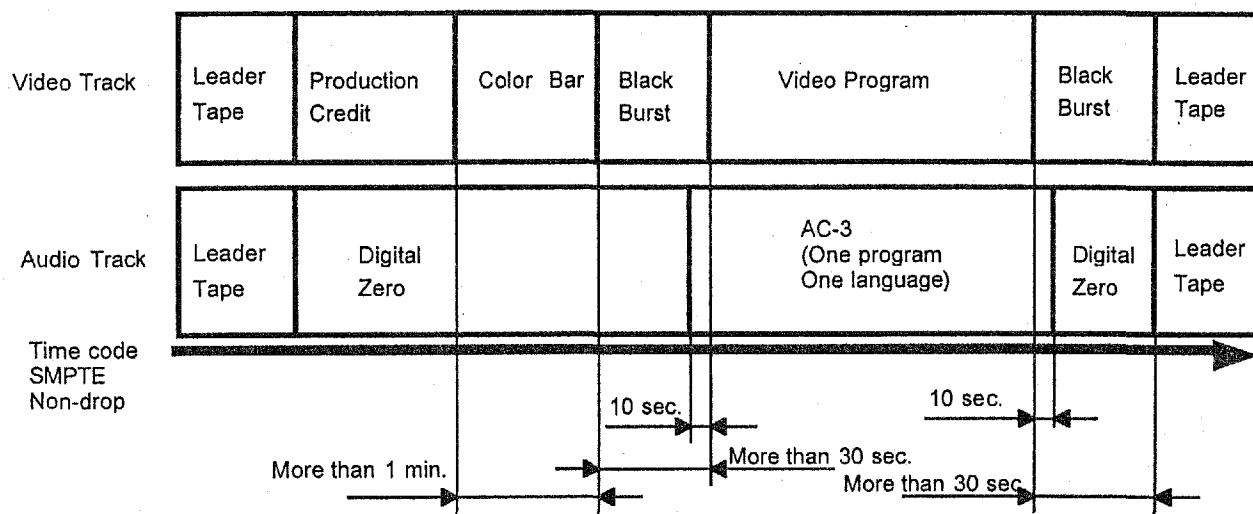


Figure 2-3

- Set the upper limit of AC-3 data rate at 448 kbps
- Set the sampling rate of the AC-3 encoder at 48.0 kHz
- Set the output format of the AC-3 encoder in professional mode.
- Set the audio coding mode in any one of the following modes: 1/0, 2/0, 3/0, 2/1, 2/2, 3/2(excluding 1+1)
- Set surround mix level at -dB for AC-3 in Karaoke mode (Bsmode=8).
- The recording area of a continuous AC-3 bit stream should be in the continuous video recording area and 10 sec. before and after that (mute section).
- Mute at least one second from the start of each Title.
- Please consult with the authoring company for details on this matter.

2-1.4 Recording a program on multiple tape

(including multi-Angle material or the case of recording a program on multiple tape which is to be played continuous as it is longer than the tape recording time capacity.)

- Please consult with the authoring company for details on this matter.

2-1.5 Recording video and audio for Menu

- Refer to Chapter 2-4.5 for details on making Menus.
- Follow the VTR tape format in the Chapter 2-1.1 for the recording video and audio material for Menus.
- The authoring company will provide further information on Menu production.

2-1.6 Materials for Subtitle

- Refer to Chapter 2-4.6 for details on making Subtitles.
- The authoring company will provide further information on the authoring of Subtitles.

2-2 Information sheet

A list of sheets are introduced as follows.

- Video and audio material information sheet
- Disc specifications information sheet
- Title list information sheet
- Chapter information sheet

Although the information required in each sheet will depends on the authoring company, all of these are important to the production of DVD-Video discs.

Sheets other than above may be required to input additional information such as Karaoke, picture stop, contents explanation recorded on the disc or text information for product control like the release date. Therefore, make inquiries to the authoring company as for writing a information sheet.

2-3. Manufacturing process of DVD

A typical DVD disc production procedure is shown in Figure 2-4. Encompassing all major process steps from the software planning to the disc delivery. Most of software will be produced according to this procedure.

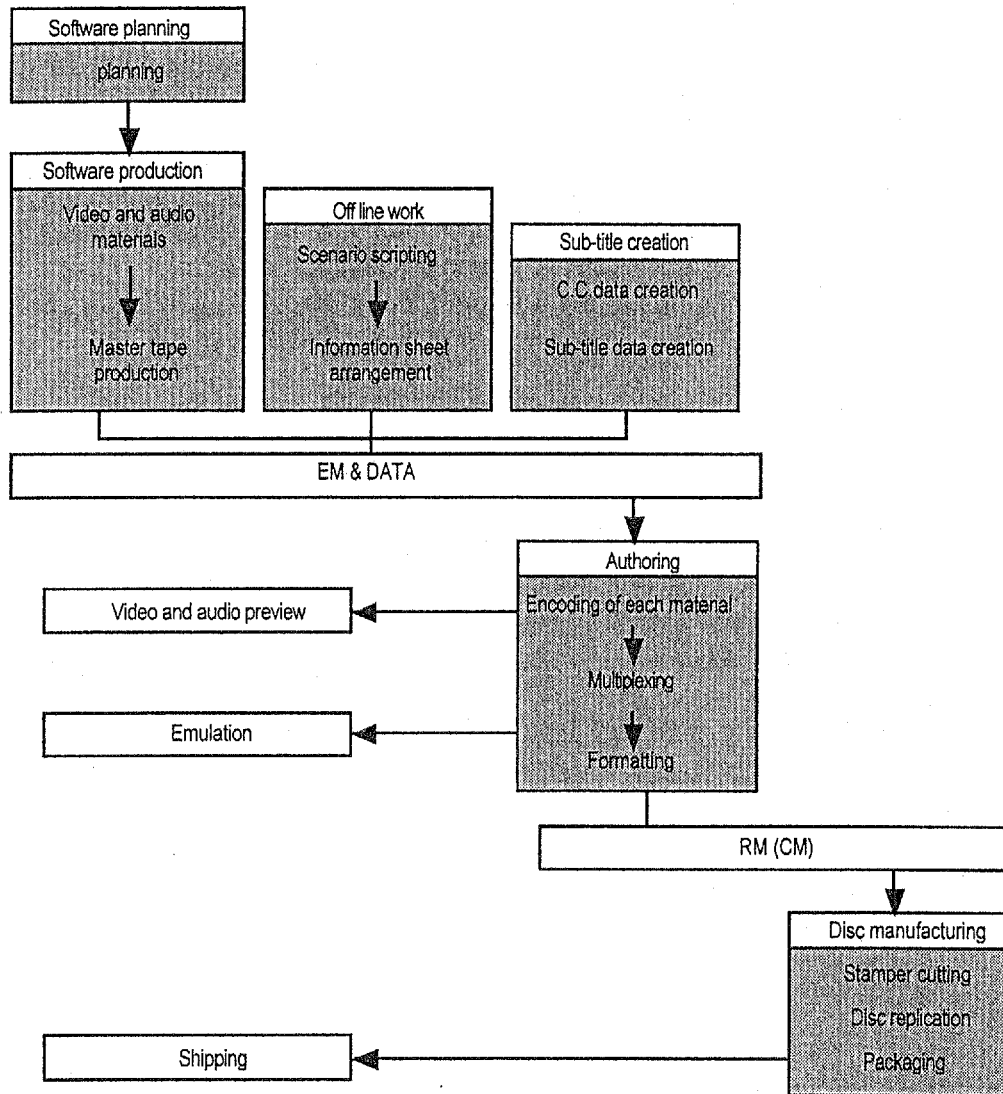


Figure 2-4 Production flow of discs

The material for authoring and production of DVD-Video discs is limited to only those programs in which copyright and all the other rights are legally treated.

2-4. Notes for software production

2-4.1 Title

- The number of Titles in one side (one volume) must start from No.1 and is counted in integer to No.99 at maximum. Therefore, the number of Titles should be 99 or less.
- The minimum playback time for both video and audio in a Title is 12 video frames (525/60.NTSC) and 10 video frames (625/50.PAL & SECAM).
- Record at least 5 seconds of black burst and audio mute between Titles when two or more Titles are recorded in a tape.

2-4.2 Chapter No.

- The Chapter number in a Title must start from No.1 and is counted in integer to No.99 at maximum in the order of playback. The Chapter at the starting point of the Title must be No. 1.
- The Chapter number from a side to the next side cannot be continuous even when one program is recorded in two or more sides.
- The minimum Chapter length is 12 video frames (525/60 NTSC) and 10 video frames (625/50 PAL & SECAM).

2-4.3 Direct access restriction

- The minimum program time which can be designated for a direct access restriction period is 12 video frames (for 525/60 NTSC) and 10 video frames (for 625/50 PAL & SECAM).

2-4.4 Dividing a Karaoke song

- Assign one song as one Title when the type of a Title is Karaoke application.
- The Chapter No. can be used to divide into the chorus (e.g. 1st or 2nd chorus) when they are recorded as a Karaoke application. Set the Chapter number from 1 for the start of the song (Title) to 99 max. in the order of the chorus.
- A song can be divided based on the following configuration using the Cells in the Chapter (chorus) when they are recorded as a Karaoke application. Cells in a song (Title) is limited to 255 max.
 1. Title picture
 2. Introduction of the song
 3. Text of the song (excluding climax "sabi")
 4. Climax "sabi 1"
 5. Climax "sabi 2"
 6. Interlude of the song
 7. Ending 1 of the song
 8. Ending 2 of the song
- The minimum program time which can be designated for the period is 12 video frames (for 525/60 NTSC) and 10 video frames (for 625/50 PAL & SECAM).

2-4.5 Menu

- Sub-picture size (W x H) of a Menu is 720 x 480 pixels (525/60 NTSC) and 720 x 576 pixels (625/50 PAL & SECAM). However, top two lines will be masked in the display from a player. Design a display considering the Title safety frame corresponding to the aspect ratio of each television format as this video size is almost full screen(100%) regardless of the the aspect size.
- Make the minimum dot size to 2 x 2 pixel considering the view on the composite video signal in the case of making bitmap for Subtitle using a computer
- Design a display so that an important text information is set in the Title safety frame applied for each television format as the third line of the Sub-picture data is imposed to the 24th line of the main video with interlace system.
- Make one file for each Menu Sub-picture (using the file format of PICT, TIFF or RAW for example). And make inquiries to the authoring company if data for existing Subtitles or the other computer graphics file need to be converted.
- The transparent part to be super imposed over a background should be a single color of G, B or R.
- The text in a Menu are to be displayed with three values including edge. Therefore, make a Subtitle with three value to ensure the text appearance during production.
- Please consult with the authoring company if and how sixteen colors can be used for the production of Menus with the Subtitle extended function without highlight information.
- Use fonts which is legally available.
- The video for the Menu background can be taken from a video tape (for moving pictures or still pictures) or from a computer graphic files (for still pictures). In the case of a video tape, follow the same tape format as the program video. Computer graphic files can be prepared in the PICT, TIFF or RAW format for example. At this time, there is no limit for the number of colors, however, the picture should be 720 x 480 pixel (525/60.NTSC) or 720x576 pixel (625/50.PAL & SECAM). Background picture is recorded to a disc after the MPEG compression.
- Only one audio track can be recorded regardless of the recording format.
- The maximum pictures (pages) for each System Menus are;
 - 99 pictures (pages) for the Title selection Menu of the Volume.
 - 99 pictures (pages) for the Chapter selection Menu of a Title.
 - 99 pictures (pages) for the Audio track selection Menu of a Title.
 - 99 pictures (pages) for the Subtitle track selection Menu of a Title.
 - 99 pictures (pages) for the Angle selection Menu of a Title.
 - 99 pictures (pages) for the Root Menu of a Title.
- For multi page Menus, it is recommended to provide buttons in the Menu display that allow to page forward or back.
- Maximum three track of Subtitle for Menu can be recorded according to the aspect ratio.
- When the text display location or text size needs to be changed according to output aspect ratio, separate Sub-pictures corresponding to the aspect ratios should be prepared.

- Although a maximum of 36 items can be selected in one display for both the System Menu and the In-Title Menus, consider the smaller TV sizes when setting the number of selection items displayed on one Menu page.
- When separate Sub-pictures are prepared for each aspect ratio, Highlight command can not be used for all even if same kind of selection item as the selection setting location is different. Therefore, limit the total selection item of the Sub-picture display for all aspect ratio to less than 36.
- System Menus are recorded as a block for every used language. More than one language can be recorded for each System Menu. A player can display a Menu which language matches with the language selected by the user. The first (default) language in order of each system Menu is called when there is no Menu which language matches with the language selected by user. Each the language of the block and its order should be consistent within a disc, to avoid user's confusion.
- The In-Title Menu is forcedly displayed automatically. Refer to 1-3.3.1 and 2-4.7 for details.
- Consult with the authoring company in the case of recording a Menu for any caution. (e.g. playback is not available because of parental level mismatched)
- In the case where text information is displayed requiring user action, use a prompt such as:

"Select with cursor/ ten keys, and execute with SELECT/ ENTER."

- Consult with the authoring company for other details of Menu production.

2-4.6 Subtitle

- Subtitles are created as bit map graphics with the size of 720 x 480 (525/60.NTSC) and 720 x 576 (625/50.PAL & SECAM). However, top two lines will be masked in the display from a player. Design a display considering the Title safety frame corresponding to the aspect ratio of each television format as this video size is almost full screen(100%) regardless of the aspect size,
- Make the minimum dot size to 2 x 2 pixel considering the view on the composite video signal in the case of making bitmap for Subtitle using a computer
- The number of colors used for a Subtitle are, for a example, any one for text, any one for edge and any one for border, and the transparent portion superimposing over the video signal should be any single color from solid G, B or R.
- The text in a Subtitle are to be displayed with three values including edge. Therefore, make a Subtitle with three value to ensure the text appearance during production.
- Please consult with the authoring company if and how sixteen colors can be used for the production of Menus with the Subtitle extended function.
- Use fonts which is legally available.
- In the case where the text display location or text size needs to be changed each time the output aspect size is switched, separate Subtitles corresponding to the aspect sizes should be prepared.
- Make one computer graphics file for each Subtitle (PICT, TIFF or RAW format for example).
- A time event file should be created in order to set the display timing of the Subtitles. The file name and the time code of the IN (starting) point and OUT (ending) points of the Subtitle display based on the SMPTE or EBU time codes of the corresponding video to be imposed, are to be included.
- Time event file should be created in a text file format for each Subtitle track (each language). For a computer graphics file designated for forcibly display, a file as the forcibly display time event should be created separate from the regular time event information.

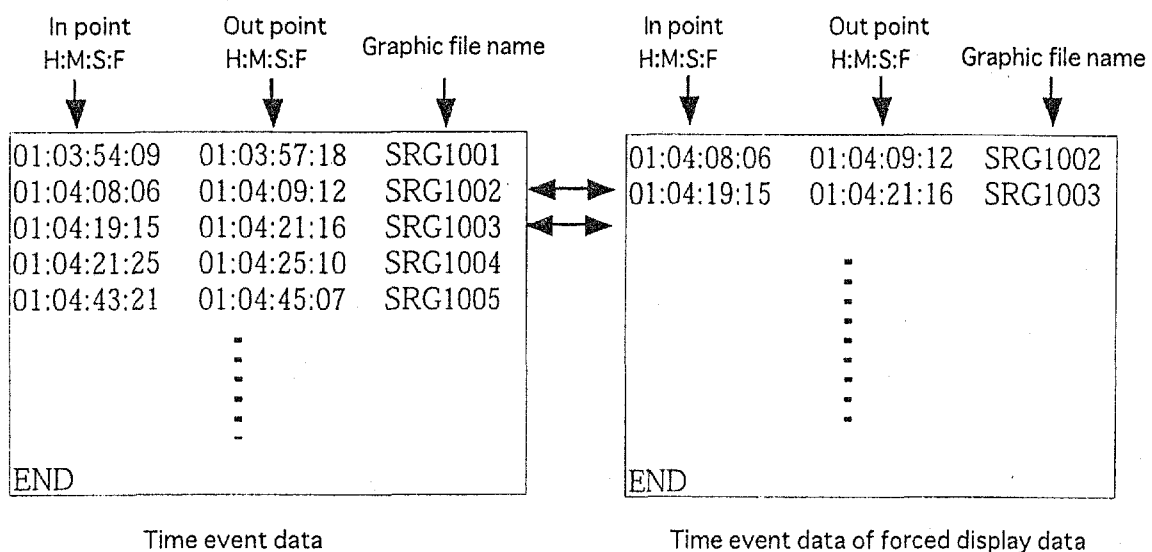


Figure 2-5: An example of time event data

- Even when the player is in normal playback, it may occur that the Subtitle is not temporarily not displayed after disc searching (e.g. time, FF and REW). If there is a Subtitle which must be displayed after any search operation, please consult with the authoring company.
- Please consult with the authoring company about more detail information of Subtitle production and the conversion of data from existing Subtitles.

2-4.7 Forced display of Subtitle

- Forced display function is to display a Sub-picture automatically by the player according to the user's settings for presentation, and is realized by programming forced display commands for the Sub-picture in the specified Subtitle track.

Examples of Subtitle track arrangement are described below, to avoid any confusion while forced display function is applied.

Please contact with authoring company for details and the other applications.

It is recommended to satisfy the following conditions when forced display function is applied:

- (1) When a Title comprises several Subtitle tracks, only one Subtitle track for forced display should be prepared for each language which is recorded in Subtitle tracks.
- (2) When a Title comprises several audio tracks, only one Subtitle track for forced display should be prepared for each the language which is recorded in audio tracks. Then it is not necessary to prepare the Subtitle tracks additionally for the languages which are already provided by the above (1) case.

The Title which satisfies above conditions is to have only one Subtitle track for forced display for each language. Only then, operation of forced display function will be guaranteed regardless of the user's setup, e.g. a Subtitle track is selected or not, Subtitle display is turned on or off.

In practical case, this forced display function will provide its effect when the user selects a Subtitle track and the display is turned off.

In this case, the player is automatically decoding the Subtitle track for forced display whose language is recorded with the same language as the current selected Subtitle track. Then, only the contents which is specified in the Subtitle to be forced-displayed will be displayed.

This function is not always guaranteed when there is no Subtitle track for forced display.

All the contents of current Subtitle track which the user is selecting and which display is turned on, will be presented (displayed) according to the commands for Sub-picture display, regardless current track is for forced display or not.

On the other hand, the player may have a feature to not select any Subtitle on a disc. Even then it is possible to make the Title to realize the forced display function effectively. In this case, the player is to decode the Subtitle track for forced display whose language is the same language as the audio track currently selected by the user. From this Subtitle track, only the contents which is specified to be forced-displayed will be displayed according to the commands for Sub-picture display.

Therefore, by making a Title so that it satisfies the conditions of (1) and (2), forced display can be realized for any of the user's setting on the player.

2-4.8 Closed Caption (CC) data recording

- The closed caption signal recorded in the video tape can be recorded in the disc.
- Please consult with the authoring company if text data for caption need to be encoded.

2-4.9 Parental level

- The parental level setting is limited to the applicable Regions.
- As for the parental level assignment, a guideline chart for Japan is shown as an example. However, as the details of the judgment standards are different depending on the examination organization, It is recommended that the rating be based on the rules in the Region to which the parental level is set and to assign a level according to those judgments.
- Do not set a parental level for the software which does not require parental level control.

Parental level	Standard	Limitation
8	Adult only	Prohibited under 18
7		
6		
5		
4	R rated	Prohibited under 16
3		
2		
1	General	No limitation

Table 2-5 <Parental Level Assignment Guideline Sample>

2-4.10 Production of a still picture album (with automatic picture stop function)

- A minimum of 15 video frames is required for each still picture (avoiding cross fielding).
- The 15th frame of the recorded picture is displayed as the still picture (automatic picture stop point).
- Mute audio for the duration of the still picture.
- In the case where text information is used to indicate a required user operation to cancel the still status, please use a prompt similar to the following:

"Execute Play/Playback"

or

"Play/Playback"

- Please consult with the authoring company for detail.

2-4.11 AC-3 bit stream recording (An example of using a tape)

- Audio coding mode is limited to 1/0, 2/0, 3/0, 2/1, 3/1, 2/2 or 3/2 except 1+1. However, do not encode the same audio into two or more channel other than L and R to avoid excess audio output level at the two channel mixing.
- Audio data bit rate should be set depending on the audio coding mode as follows:
 - 64 to 448 Kbps----- for 1/0
 - 128 to 448 Kbps----- for 2/0
 - 192 to 448 Kbps----- for 3/0, 2/1
 - 256 to 448 Kbps----- for 3/1, 2/2
 - 320 to 448 Kbps----- for 3/2
- Bit stream mode is set as "Main audio service" for the programs other than karaoke, and is set as "Voice over (karaoke)" for material which is recorded to perform a karaoke function (Please refer to P.24).
- Sampling frequency of the audio signal is 48 kHz.
- Set the AC-3 output format as Professional mode.
- In the case audio for rear speaker channels are encoded into AC-3 signal, the surround down mix level, which is required for 2 channel down mixing with the AC-3 decoder, may be set. Set the level at 0 (- infinite dB) only when the sound for special karaoke functions such as assistant vocal, etc. is recorded in the rear speaker channel of a karaoke Title.
- In the case audio where a center speaker channel is encoded into the AC-3 signal, the center mix level required for 2 channel down mixing with the AC-3 decoder may be set.
- The audio track on which the AC-3 bit stream is recorded may be copied to the other D-1, D-2 or DAT, etc. in an AES/EBU digital audio channel. However, make sure that the AC-3 bit stream can be completely decoded by using a decoder during the copy operation. Do not make partial copy nor edit the AC-3 stream at this time.
- It is not possible to detect any non-continuous point of bit stream by the playback check of the tape on which the AC-3 bit stream is recorded using a decoder. It is recommended to encode AC-3 in a single pass from the conformed audio master when an AC-3 master tape for DVD is produced.
- Be sure to record the bit stream as continuous where the disc is played continuous.
- Confirm the video and the audio from AC-3 decoder is synchronized when the AC-3 bit stream is recorded in a VTR.
- Record the AC-3 time stamp as the time code recorded in the audio source tape (which matches the phase with the video tape with the same time code before the encoding) before the encoding.

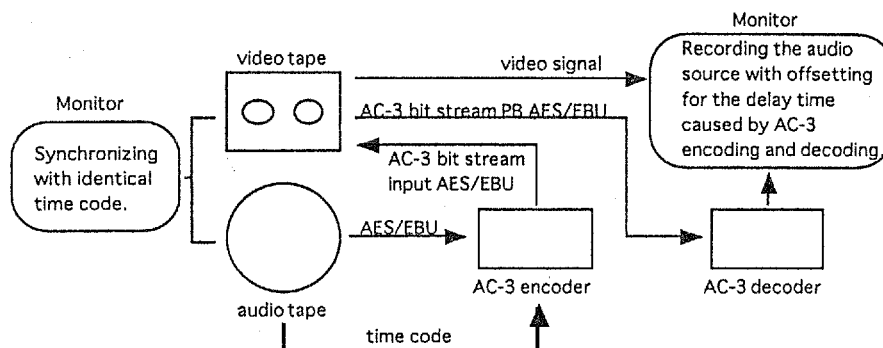


Figure 2-5 Connection sample at the AC-3 encoding

2-4.12 Setup level of NTSC

- Setup level does not exist on component signal which is the signal recording system for DVD. In authoring process, the setup is removed at the MPEG video encoding stage after checking for the existence of setup in the color bar recorded on the material tape. Therefore, don't mix video with different setup levels in one tape.
- Be careful for some component VTR may utilize setup as a standard.
- The DVD player automatically sets the setup on composite output based on the system in the Region where they are used.

2-4.13 Copy guard system

- One of the three kinds of copy guard type can be selected for DVD discs in order to add the copy guard signal on the analog output of DVD player video signal. Avoid to switch the copy guard type in a continuous program as it is possible to make a noise on TV display.
- Please consult with the authoring company for details.

2-4.14 Regional playback control function

- Set the Region No. to "2" for discs which are aimed to be played in JAPAN.
- A disc need to be authored so that the disc can be playable by setting appropriate Region No., when the disc need to be played in other than JAPAN. Refer to "DVD-Video Region Map" and "DVD-Video Region Table" in the appendix as for the Region No of each countries.
- A disc must be set at least one Region No. in it. Set all Region No.1 through 6 in the case the playback is allowed regardless of Region. Set a Region No. in each side for a two side disc.
- Please consult with the authoring company for detail.

Chapter 3

Product indication item

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3-1. Labeling the disc

3-1.1 Indication item

3-1.1.1 Format logo



- Indicate the logo mark larger than $X = 4$ mm on a disc.

3-1.1.2 Disc type

- Indicate the disc type according to the above Table.
- Indicate the disc size is 8 cm if applicable.

3-1.1.3 Regional playback control code

<Sample>



NTSC

日本国内向

- Indicate the logo mark of the specified "Region No." to the disc with the caution.
- Indicate the recorded video television system format name under the mark.
- Indicate the sales area around the mark.

3-1.1.4 Color mode

<Sample>

Japanese	English
カラー	COLOR
モノクローム または モノクロ	MONOCHROME

- Indicate the color mode of the video.

3-1.1.5 Video compression system

<Sample>

MPEG-1 or MPEG-2

- Indicate the name of video compression system.

3-1.1.6 Other indication items

- Disc program name.
- Disc no. (less than 11 letters)
- Copyright and Manufacturer
- Side No. (when more than one)
- Prohibition of rental (if applicable)

<Sample>

レンタル禁止

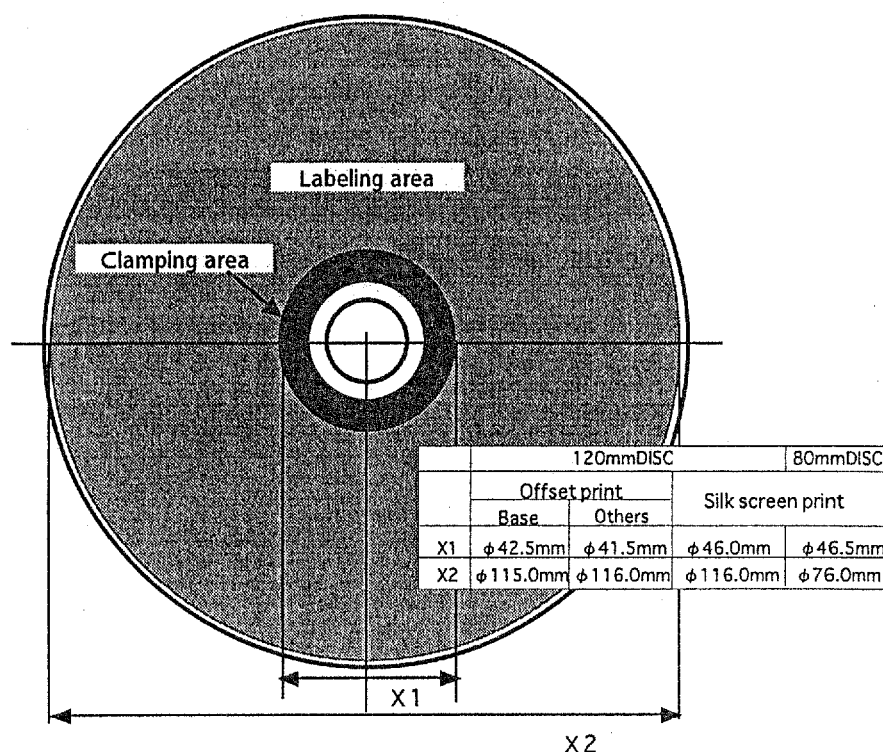
- [JASRAC] mark

3-1.2 Labeling method

- The label is indicated on the disc which is bonded to the recorded disc.
- In the case of a single sided disc, printing on the blank disc or pit art which letters or pictures are indicated by Laser cutting is possible at the area shown in Figure 11-1.
- In the case of a double sided disc, it will need special attention for printing as both sides are recorded. In this case, there is an indication method of Pit art which uses inside the disc cutting area by laser cutting. Please consult with the disc manufacturing company for detail.

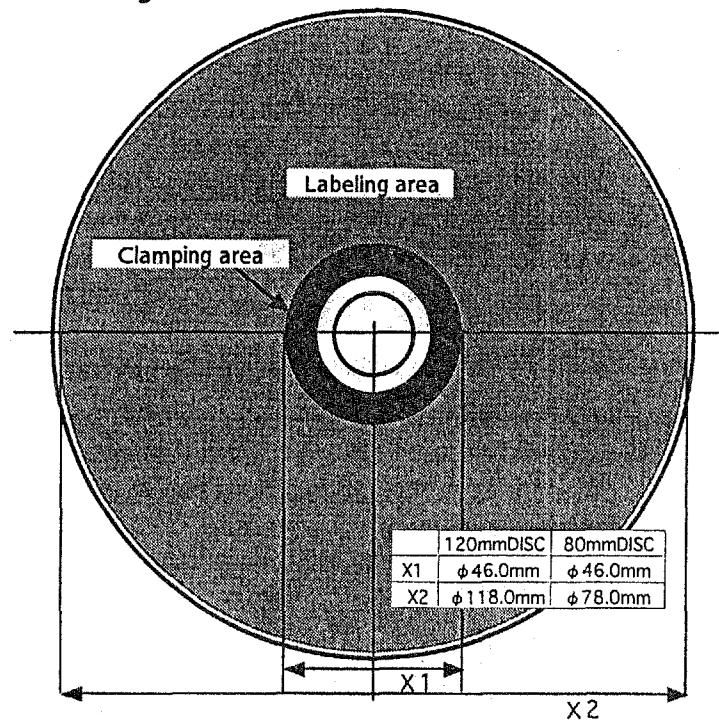
3-1.3 Labeling area (in the case of silk screen print, offset print or pit art)

- Print area for a single sided disc



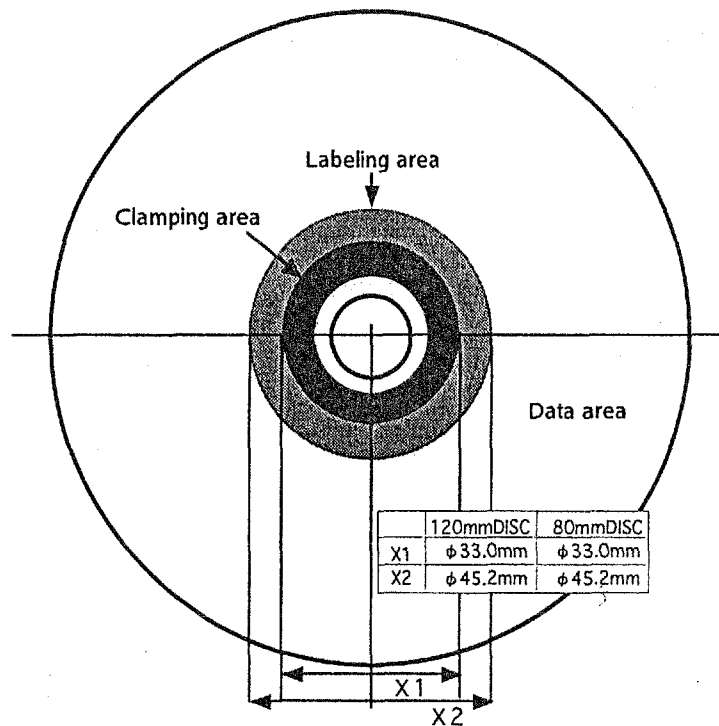
- Please consult with the disc manufacturing company for detail of the available print area.

- Pit art available area for a single sided disc



- Please consult with the disc manufacturing company for the pit art.

- In the case of a double sided disc



- Be sure to make the printing art design within the area shown in the above Figure.

3-2. Indication on the printing material

3-2.1 Front cover

3-2.1.1 Format logo



- Indicate the logo mark larger than $X=10$ mm with solid color clearly on the cover 1.

3-2.2 Inlay card

3-2.2.1 Format logo



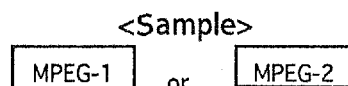
- Indicate the logo mark larger than $X=4$ mm with solid color clearly on the cover 4 and the back.

3-2.2.2 Disc type

Disc type name		Code
Japanese	English	
片面・一層	Single Sided Single Layer	S-1 Type
片面・二層	Single Sided Dual Layer	S-2 Type
両面・一層	Double Sided Single Layer	D-2 Type
両面・二層	Double Sided Dual Layer	D-4 Type

- Indicate the disc type according to the above Table.
- Indicate the size is 8 cm if applicable.

3-2.2.3 Video compression system



- Indicate the name of video compression system.

3-2.2.4 Regional playback control code

<Sample>



NTSC

日本国内向

- Indicate the logo mark of the specified "Region No." to the disc.
- Indicate the recorded video television system format name under the mark.
- Indicate the sales area around the mark.

3-2.2.5 Audio recording mode and contents category

<Sample>



音声トラックNo.	音声仕様	録音方式	音声内容	言語
1	リニアPCM	ステレオ	サウンドトラック	日本語
2	DOLBY DIGITAL	5.1chサラウンド	サウンドトラック	英語
3	DOLBY DIGITAL	ステレオ	監督の解説	英語
4	MPEG	ステレオ	サウンドトラック	オランダ語

- Indicate the mark which shows more than one audio tracks are recorded.
- Indicate the audio compression type, the recording mode, the contents category and the language along with the audio track No..
- Indicate the Dolby Digital or Dolby Surround logo mark and the trade mark notes specified by Dolby Laboratory Licensing Corporation in the case those signal were recorded in a disc.

3-2.2.6 Subtitle

<Sample>

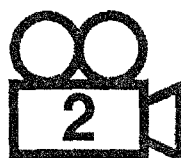


サブタイトルNo.	内容
1	英語字幕
2	日本語字幕

- Indicate the mark which shows single or multiple language is recorded and the contents recorded in each track.

3-2.2.7 Multi-Angle

- The following mark is decided to indicate various additional function. Indicate functions adopted in the disc.



- Indicate the mark which shows this disc has multi-Angle function with the number of Angles.

3-2.2.8 Video aspect ratio

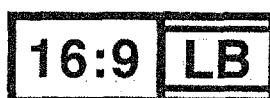
<When 16:9 picture is recorded>

- Indicate the recorded 16:9 aspect ratio and a mark which shows the aspect switching available display type from following 3 types.

(1) When conversion from 16:9 to both letter box and pan-scan are available



(2) When conversion from 16:9 to only letter box is available



(3) When conversion from 16:9 to only pan-scan is available



<When 4:3 picture is recorded>

- Indicate the recorded 4:3 aspect ratio and a mark which shows the picture display type from following 2 types.

(1) When recorded by letter box



(2) When recorded by 4:3



3-2.2.9 Copy right, manufacturer and distributor

- Indicate the copy right, manufacturer and distributor

3-2.2.10 Unauthorized copy, broadcasting or showing prohibition

- Indicate the caution similar to the following sentence if applicable.

"Unauthorized reproduction (including to the different TV system format), broadcasting (cable or radio), show or rental of this disc is prohibited by the relevant law and subject to criminal prosecution."

3-2.2.11 Other indication items

- [JASRAC] mark
- Indicate the disc program name.
- Disc no. (less than 11 letters)
- Prohibition of rental (if applicable)

<Sample>
レンタル禁止

- Copy guard (if applicable)

<Sample>
複製不能

3-2.3 Insert

3-2.3.1 Disc contents

- Indicate the side No. for the program which has multiple side.
- Indicate Title names and No. for the disc containing multiple Title.

<sample>
SIDE 1
Title 1 XXXXXX
Title 2 XXXXXX.....

- Indicate Chapter names and No. for the Titles which set multiple Chapter No..

<sample>
SIDE 1
Title 1 XXXXXX
Chapter 1 XXXXXX
Chapter 2XXXXXX.....
Title 2XXXXXX.....
Chapter 1XXXXXX
Chapter 2XXXXXX.....
Title 3XXXXXX.....
Chapter 1XXXXXX
Chapter 2XXXXXX.....

SIDE 2
Title 1XXXXXX
Chapter 1XXXXXX
Chapter 2XXXXXX.....
Title 2XXXXXX.....
Chapter 1XXXXXX
Chapter 2XXXXXX.....

- Indicate the following instruction manual if necessary.

"This disc has multiple Titles. Player reproduces your preferable Title by the Title select operation."

"In this Title, your preferable video and audio can be called back by the Chapter number search operation".

"Please refer to the player operation manual as for the Title select and Chapter number search operation".

3-2.3.2 Regional playback control code

<Sample>



NTSC

日本国内向

- Indicate the logo mark of the specified "Region No." to the disc.
- Indicate the recorded video television system format name under the mark.
- Indicate the sales area around the mark.

3-2.3.3 Audio recording mode and contents category

<Sample>



音声トラックNo.	音声仕様	録音方式	音声内容	言語
1	リニアPCM	ステレオ	サウンドトラック	日本語
2	DOLBY DIGITAL	5.1chサラウンド	サウンドトラック	英語
3	DOLBY DIGITAL	ステレオ	監督の解説	英語
4	MPEG	ステレオ	サウンドトラック	オランダ語

- Indicate the mark which shows more than one audio tracks are recorded.
- Indicate the audio compression type, the recording mode, the contents category and the language along with the audio track No..
- Indicate the Dolby Digital or Dolby Surround logo mark and the trade mark notes specified by Dolby Laboratory Licensing Corporation in the case those signal were recorded in a disc.
- Indicate the following sentence if necessary.

"In this Title, your preferable audio can played by the audio select operation."

3-2.3.4 Subtitle

<Sample>



サブタイトルNo.	内容
1	英語字幕
2	日本語字幕

- Indicate the mark which shows single or multiple language is recorded and the contents recorded in each track.
- Indicate the following sentence if necessary.

"In this Title, your preferable Subtitle can be displayed by the Subtitle select operation."

3-2.3.5 Automatic playback

- Indicate a sentence similar to the following one for the disc which is set as the automatic playback.

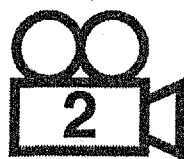
"A player will start playing the Menu picture or the program automatically after inserting this disc."

3-2.3.6 Automatic picture stop

- Indicate a sentence similar to the following one for the Title with automatic picture stop.

"This Title contains instances of automatic still frame. Operate the player according to the instruction displayed."

3-2.3.7 Multi-Angle



- Indicate the number of channels and a mark which shows the Title or the Chapter has the multi Angle function.
- Indicate the following sentence if necessary.

"Your preferable Angle can be displayed by the Angle select operation in this Title (or Chapter)."

3-2.3.8 Video aspect ratio

<When 16:9 picture is recorded>

- Indicate a mark which shows recorded 16:9 aspect ratio and the aspect switching available display type from following three.

(1) When conversion from 16:9 to both letter box and pan-scan are available

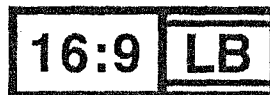


- Indicate the following sentence if necessary.

"This Title is recorded in 16:9 aspect ratio, and can be displayed in 4:3 ratio by aspect ratio switch operation of a player."

"4:3 letter box type or 4:3 trimming type is displayed after the switching."

(2) When conversion from 16:9 to only letter box is available

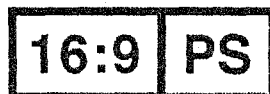


- Indicate the following sentence if necessary.

"This Title is recorded in 16:9 aspect ratio, and can be displayed in 4:3 ratio by aspect ratio switch operation of a player."

"4:3 letter box type is displayed after the switching."

(3) When conversion from 16:9 to only pan-scan is available



- Indicate the following sentence if necessary.

"This Title is recorded in 16:9 aspect ratio, and can be displayed in 4:3 ratio by aspect ratio switch operation of a player."

"4:3 trimming type is displayed after the switching."

<When 4:3 picture is recorded>

- Indicate recorded 4:3 aspect ratio and a mark which shows the picture display type from following 2 types.

(1) When recorded by letter box



- Indicate the following sentence if necessary.

"This Title is recorded in 4:3 aspect ratio (letter box)."

(2) When recorded by 4:3



- Indicate the following sentence if necessary.

"This Title is recorded in 4:3 aspect ratio."

3-2.3.9 Menu operation

- Indicate the languages prepared in the system Menu.

"Menu language : Recorded in the following three language, English, French and Spanish"

- For a disc or a Title which has the System Menu, indicate the following instruction instead of before-mentioned select operation described above if necessary.

"Preferable Title can be selected from the Title selection Menu."

"Preferable Chapter can be selected from the Chapter Menu."

"Preferable Audio can be selected from the Audio Menu."

"Preferable Subtitle can be selected from the Subtitle Menu."

"Preferable Angle can be selected from the Angle Menu."

- Indicate the following instruction if the Title XXX Menu is recorded in the root Menu if necessary.

"XXX Menu can be called during the playback by Menu Call operation in this Title."

3-2.3.10 Copyright, manufacturer and distributor

- Indicate the copyright, manufacturer and distributor.

3-2.3.11 Product No. (Disc No.)

3-2.3.12 Unauthorized copy, broadcasting or showing prohibition

- Indicate the caution similar to the following sentence if necessary.

"Unauthorized reproduction (including to the different TV system format), broadcasting (cable or radio), show or rental of this disc is prohibited by the relevant law and subject to criminal prosecution."

3-2.3.13 Handling caution

- Indicate the cautions referring to the following samples.

"Never use discs with any crack, deformation or repaired by glue as it is dangerous. The use of anti static chemical or spray may cause a crack."

"Please handle discs not to put finger print, contamination nor scratch on both sides."

"Please clean a dirty disc wiping lightly from inner to outer with a little moistened soft cloth."

"Don't write picture, letters nor put sticker on the surface of the discs."

"Please remove discs from players after use and store it in the disc case at the location without high temperature, high humidity or direct sun shine exposure."

"You may be injured with broken disc case if putting something heavy on the case or dropping it."

3-2.3.14 Subtitle caution

- Indicate the caution similar to the following sentence in the case Subtitle is superimposed video.

"In this Title, the Japanese Subtitle is originally prerecorded on the main video."

3-2.3.15 DVD instruction

- Indicate the following sentence if necessary.

"DVD-Video is the high density recording disc for video and audio. Playback with the player corresponding to the DVD-Video."

"Refer to the instruction manual of your player as for the operation for each function."

3-2.4 Other printing material

- In the case some printing material such as a sticker is attached on front or back of the product, be sure not to hide the disc specification or the caution about handling indicated on the front cover or the back cover. Indicate them on the other printing material if they are hidden.
- It is preferable to indicate the DVD-Video format logo mark of which size is more than $X=4\text{mm}$, and the following caution on the front of a product in order to be recognized as a DVD disc easily.



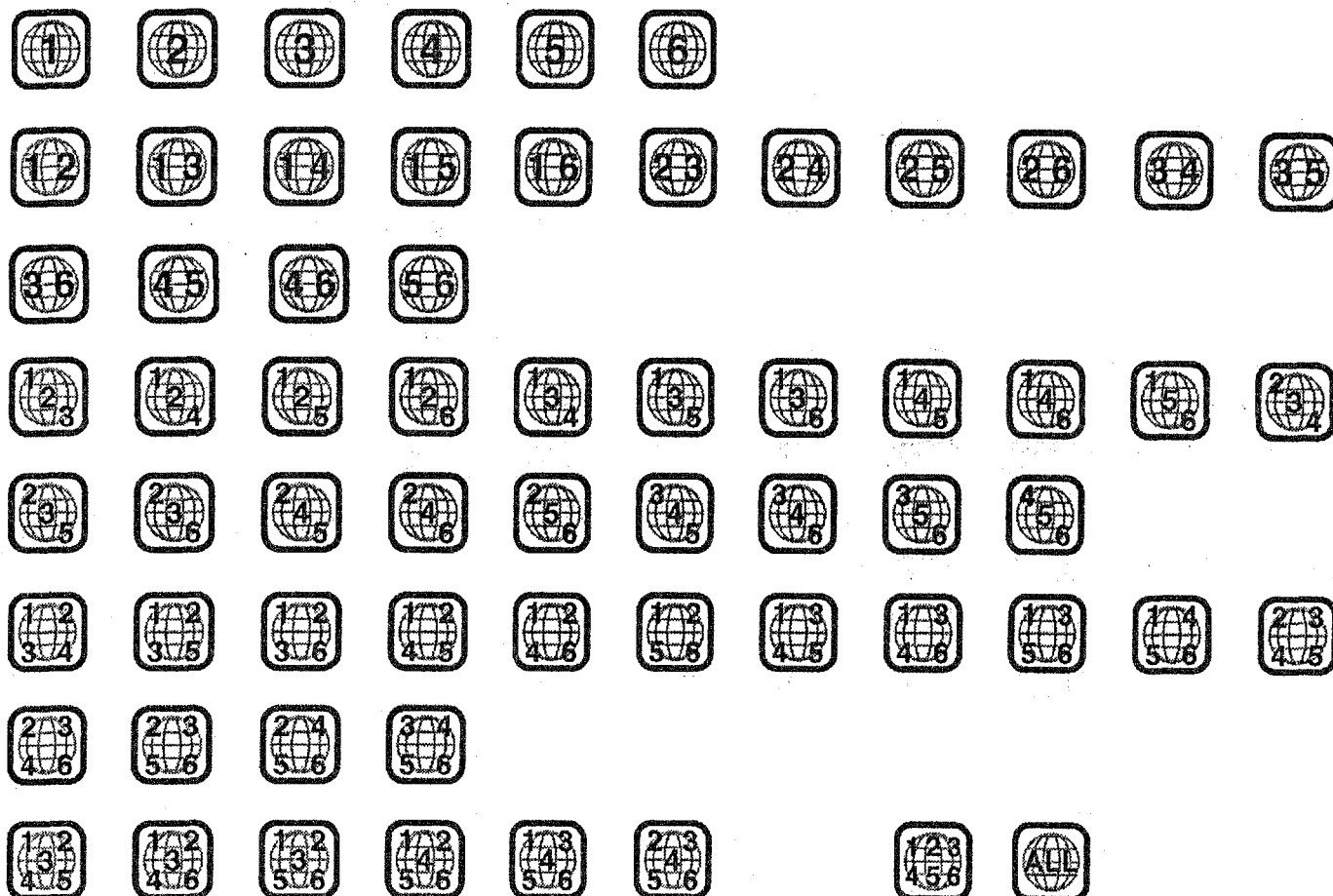
"DVD-Video is the high density recording disc for video and audio. Play back with the player corresponding to the DVD-Video."

Please refer to the DVD (RIS 403-1996) and DVD (RIS 206-1996) which are published by Recording Industry Association of Japan (RIAJ) for detail of Product indication.

3-3 Application of each function mark

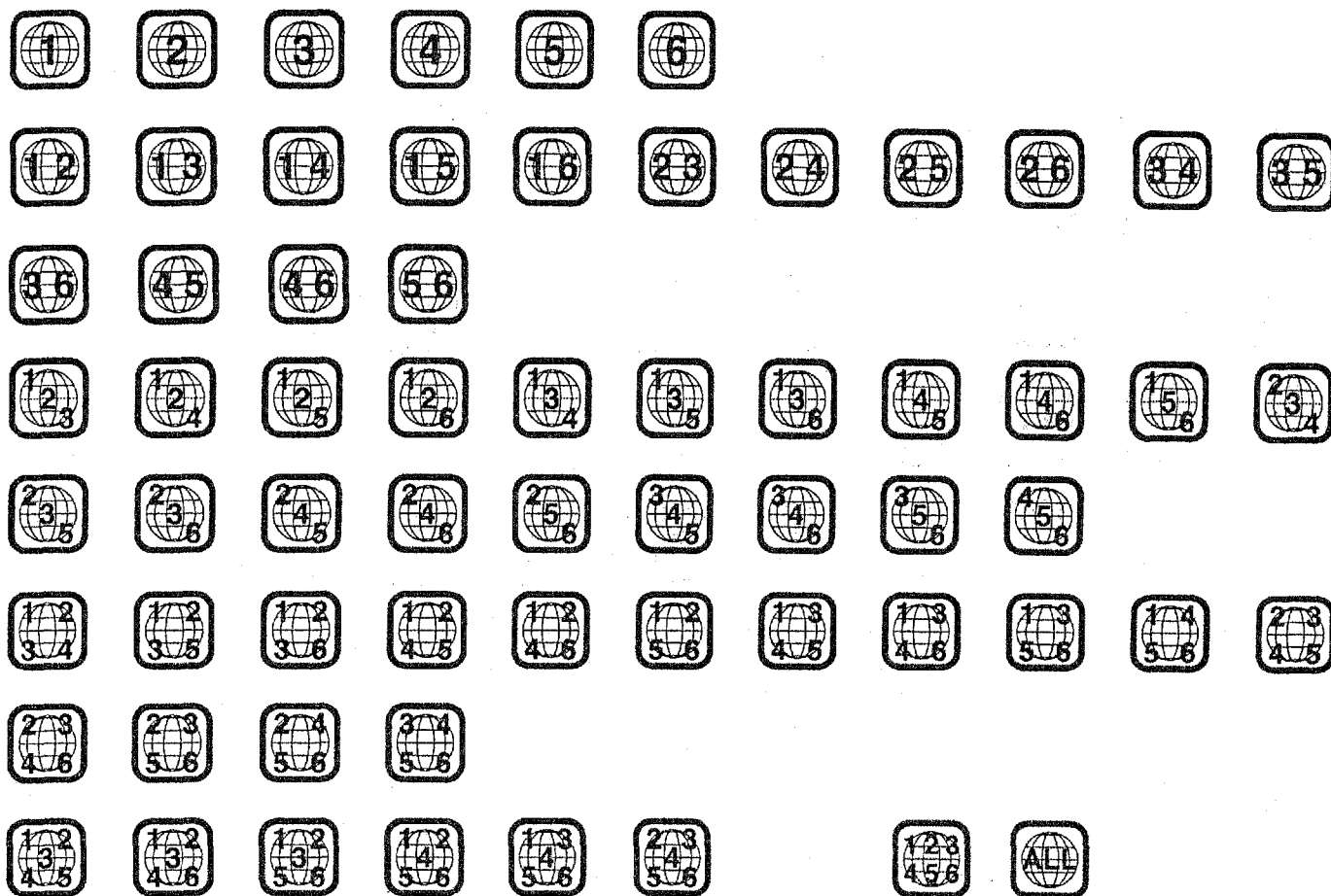
- The size and the color of each function mark is free to modify as long as a solid color is used and the mark remains well visible.

3-3.1 Region No. indication mark



- Select the mark matching the "Region No." which is set to the disc from the above list and indicate it.

- The following mark can also be used if the shadow of the above mark is not visible because of the printed material or the indication size.

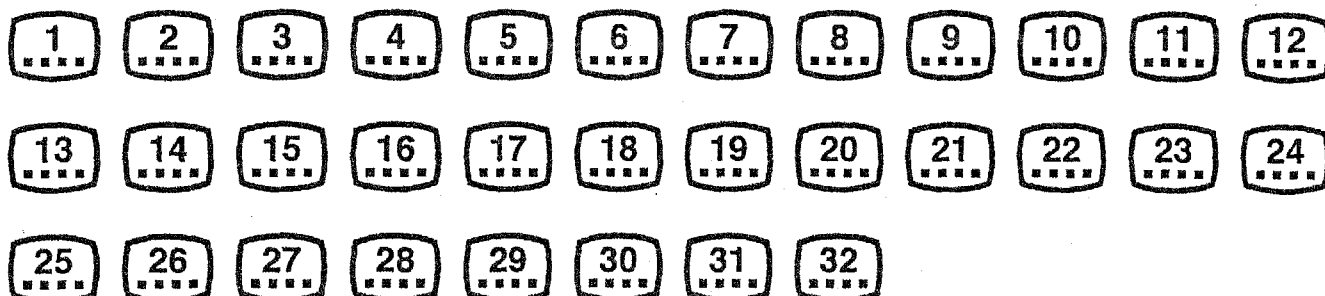


3-3.2 Audio track indication mark



- Indicate the number matching to the "number of audio track" which is set to the Title.
- Don't indicate the mark for Titles with only one audio track.

3-3.3 Subtitle function indication mark



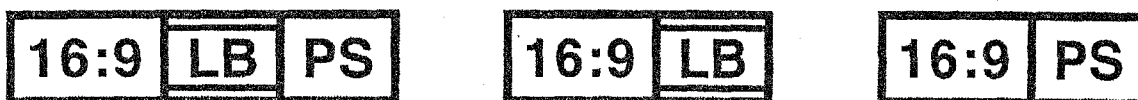
- Indicate the number matching to the user selectable "number of Subtitle track" which is set to the Title.
- The Subtitle function indication mark must not be used for Titles where Subtitles have been prerecorded into the main video without using the Subtitle track.

3-3.4 Multi Angle indication mark



- Indicate the number matching to the "number of Angles" which is set to the Title or the Chapter.

3-3.5 Video aspect ratio indication mark



- Indicate a mark selecting from the above ones corresponding to the user selectable "aspect ratio" for the Title which contains 16:9 aspect ratio picture. Here, a detail screen size may be indicated around the mark.



- Indicate a mark selecting from the above ones corresponding to the "recorded picture size" for the Title which contains 4:3 aspect ratio picture. Here, a detail screen size may be indicated around the logo mark in the case of letter box size.

Chapter 4

Terminology

4-1 DVD related terminology

0 to 9

2-3 Conversion : A method to convert 24 frames/sec film sources into NTSC signal. One frame from a film sources is repeatedly fed to two consecutive fields in NTSC, and the next film frame is repeatedly fed to the succeeding three consecutive fields in NTSC. This conversion process is ever continued. Refer to 1-6-3 for details.

10 Keys : Numerical number input key (button). "Ten key" is a Japanese. In English it is called "Numeric key".

A

AC-3 Compressed Audio : One of consumer type stereophonic surrounding systems developed by Dolby Laboratories in USA. The system employs a digital compression for audio signals and can reproduce maximum 5.1 channels, namely, three channels for the front, two channels for the rear and 0.1 channel (Super-woofer) for the low frequency reproduction. This system is properly called "Dolby Digital".

AES/EBU Digital Output : The standard output signal format of digital audio signal transmission among professional use audio equipment defined by Audio Engineering Society (AES) and European Broadcasting Union (EBU) is called "AES/EBU" format. This system can transmit altogether the sub-data and user-data in addition to the audio data of maximum 24 bits.

Assistant Vocal : Vocal part of Karaoke songs, often also called "Guide Vocal". This is for a leading guide function to sing a song. The audio track for Karaoke in DVD-Video is defined to be applicable for a multi-channel setup with 5 channels maximum. When this vocal part is recorded mainly in the track 4 and 5 except the main 2 channels, the users can enjoy many different playback modes by Karaoke type DVD players equipped with Vocal ON/OFF switch.

Aspect Ratio : The ratio of the horizontal to the vertical size of displayed image. A normal TV has the aspect ratio of 4:3, and the ratio of wide TVs and HDTVs is 16:9.

Audio Coding Mode : In genera this is often used to show an audio coding method such as Linear PCM, AC-3 or MPEG Audio, etc., but in the text (2-1.3) it refers to the channel constitution in AC-3 tracks and the speaker layout.

Authoring : In the text, it means the encoding process of various sources and all the conversion processes of the encoded data and the required control signals etc. for playback sequences etc. into DVD-Video Format. The system to carry out the task is called Authoring System. The authored output data are, in making the disc, to be again converted to the DVD defined data format for recording (mainly digital modulation, etc.)

Automatic playback Function : A function in disc players to start the playback automatically by leading the users easily to set the playback conditions and the operation procedures when a disc is loaded on player. This automatic control function can be coded in discs. An automatic mode to go straight to Menu Display once a disc is loaded etc. can be the example. In this case the player has to be such designed that the commands from the users are not accepted during this function. Refer to 1-3.4 for details.

Automatic Picture Stop Function : A function to stop the playback in a pre-set scene of picture in a Title and display a still picture. By using this function, such a feature as picture selection function in still picture playback mode can be added in the Menu of the Title playback. Refer to 1-3.7 for details.

B

Bit Stream: In the text, digital data generated by various encoding processes.

B Picture : One of the three picture types defined in the MPEG system. "B Picture" is an abbreviation of "Bi-directionally predictive-coded picture", namely, a frame image coded by applying movement prediction method derived from images in the past and in the future. Generally the number of the bits is less than those of P picture. Refer to 1-3. 1.1.4 for details.

C

Cell: This is a unit which specifies playback order and playback manner for various kind of scene in the Title, and is defined in authoring work process. "Cell" always has video data in its lead. Generally, it is structured together with necessary data to play back such as audio data and sub picture data. This unit is used as well when more than one Titles in a disc use the same scene. Assembly of different Cells is called "Chapter", and assembly of many Chapters is called "Title". In the case of multi Angle application, each of the multi Angles consists of one Cell, and these have an interleaved structure.

Channels: Mainly used for describing the configuration of audio tracks. The audio track has maximum 5 channels(5.1 channels) for Dolby digital(AC-3), and maximum 8 channels for linear PCM, and maximum 7 multiple channels(7.1 channels) for MPEG audio. In addition, two audio playback functions, one is "down mix 2-channel playback" for max. 5.1 channels in case of AC-3, and the other is the "main 2-channel playback" in case of linear PCM and MPEG audio, are mandatory for DVD player.

Chapter: One Title is divided into multiple blocks, and it is made so that each block can be handled as one unit, called one Chapter, which is consisted of more than one Cell. As it literally means, the one unit is generally allocated for one Chapter in a Title.

Chorus : Each of the song number in the text.

Clamping area : The area in disc to clamp the disc onto the player. The area from inner diameter of 22 mm to 33 mm of DVD disc is defined for this purpose. The clamping area in the read-out side can not be used for labeling.

Color difference signal: Signals obtained by subtracting luminance signal(Y signal) from each of G/B/R signals. These signals represent hue and tint.

Closed caption : Teletext method in USA to display on TV screen dialogues and status sounds, etc. of software contents. In USA, the teletext broadcasting service was started for auditory disabled persons in 1980, and it is made mandatory now to include the closed caption decoder in all the TV receivers over 13-inches.

Component : Video signal system to transmit in each different lines the three primary color signals. To transmit in G/B/R, Y/Cb/Cr or Y/I/Q etc. are the examples.

Composite : Composite video signal composed of the video signal which is frequency-multiplexed out of the luminance and chroma signals, burst signals to be used for a color reference and synchronous signals.

Cross Field : For video picture data directly edited from film sources by 2-3 Conversion, one frame in the video(composed of two fields) has a chance to have two fields with an entirely different picture content from one another from the conversion principle when a frame content in film changes rapidly. When this particular video frame is played in still mode, two different pictures are displayed overlapped on screen. This is called "cross field". Editors should pay attention to avoid this when producing video Titles etc. with still-pictures from film sources.

Cursor : In general, it is insert point or mouse pointer. In the text, specially, the operation function to select each Menu freely in horizontal and vertical direction out of the Menu screen is called cursor selection function.

D

DCT : An abbreviation of "Discrete Cosine Transform", and one of the element technologies for signal compression applied in the major international standard systems. Video signals are divided into several small blocks, and split into fine image contents vertically and horizontally (high resolution signal) and less fine signal contents(low resolution signal). DCT converts the signal block composed of 8 x 8 pixels into frequency components by the cosine function, and relocates the transformed components to the upper left corner block starting from a lower frequency component. Consequently, gathered at the upper left corner are the signal information with a high correlatively spatially and temporally, and this nature is utilized for data compression to discard less-perceptible compositions coming from the human visual characteristics. This DCT is one of the key technologies applied in MPEG.

Decode: In general, this means a signal process of re-conversion from coded signal(encoded) to its original signal based on a certain rule. In the text, it means the process in players to get right output signals out of encoded and recorded MPEG data, Dolby digital(AC-3) sound data and Sub-picture data.

Digital Zero: In the text, it is referred to the case when digitally converted sound data are all zeros. In general, converted digital signals from analog sound does not become digitally zero even when controlled by sound fader to make zero sound in analog editing.

Direct Access restriction function: A function to inhibit a fly-in playback in specified area of a Title when a trick playback function such as fast forward is selected. This feature could be applied for software of games and educational programs etc. which require a specified procedure to access to the information area, and thus it can protect a careless access to the specified information area. A normal playback and/or Chapter search to the head portion of the area is permitted for "the direct playback inhibit" area. A minimum unit to define the inhibit function is one Cell, but it is also possible to define the inhibit function for one overall Title. Refer to 1-3.6 for details.

Dolby Digital: The Dolby digital(AC-3) system developed for home-use digital surround system. It features 5.1 channels system which consists of three channels max. for the front, two channels for the rear and one for the super woofer (one sub-woofer channel is counted as 0.1 channel).

Dolby Surround: 4-channel surround sound system based on the Dolby Stereo system. This system was developed for the application of cinema. It is an analog audio surround system of which the 4-channel information of left (L), right (R), center (C) and surround (S) are 2 channel-encoded. This system is getting popular for home use with the spread of its decoder. There exists also another system with an enhanced directivity, namely the Dolby pro-logic surround system.

Double Sided Disc: A DVD disc type to read out signals from both sides of disc. When one Title is recorded on both the sides, each side has its own Chapter number starting from 1.

Downmix: In the text, it means the sound playback function in player in stereo 2-channel sound mode converted from the multiple channel sound track(s) recorded by surround system(more than 3 channels). Video players for NTSC application adopts the Dolby Digital(AC-3) sound and this function of "down mix 2-channel playback" is a mandatory function in player.

E

Encode : To code a signal by a set of rules. In the text, "Encode" means the process like DVD video data compressed by MPEG-2, the audio data coded into Dolby Digital (AC-3) or MPEG Audio data format, or the caption data being transformed to Sub-picture data etc.

Emphasis : To amplify in recording a given frequency range of signals and to regain the original signal in playback. In general this is referred to the process to amplify a higher frequency component of signals in recording and to get the original signal in playback by a reverse processing. As a result of the process, noise components in high frequency range are reduced and the S/N ratio is improved in playback.

F

Fixed rate (fixed transfer rate) : Transfer rate is send-out digital data volume in one second. A method that compresses and records with variable data rate effectively in a specified manner depending on the image complexity, in encoding information, is called "variable transfer rate" method. On the other hands, a method that applies fixed data volume continuously at encoding regardless the image complexity, is called "fixed rate method". In this case, information of more complex picture details is thrown away by referring to a preset data transfer rate, and redundant data are added in case when the picture content to encode is simple one. However the signal processing for the fixed rate is simpler than for the variable transfer rate.

Forced display : One of the DVD functions to force to display Sub-pictures on screen in a given scene from the disc by disregarding the users set not to display Sub-picture. For example, in case a film with English language has any scenes by other language than English, and if the English translation of the scene is recorded in the disc as "forced Subtitle display", then the translation is displayed on screen even if the player is set for Sub-picture off. Basically, each Menu in a Title is treated as in "Sub-picture track" with "forced Sub-picture display" preset. The picture displayed on screen from the "forced display" scene in a player is different between the two cases of setting in the player, one with the Subtitle set for OFF, and the other case with all Subtitles not at all activated. Refer to 1-3.3.1 for details.

G

GOP : An abbreviation of "Group of Picture". One group of picture is composed of one or more I picture(s) and the succeeding P and B pictures. For MPEG encoded picture signals, GOP is processed as one basic unit for editing and this unit can not be split further. In DVD-Video , one GOP can be composed of up to 18 frames in 525/60 ("NTSC") disc, and of up to 15 frames for 625/50 ("PAL/SECAM") disc.

Guide melody : Melody of vocal part recorded to assist singers in Karaoke. Voice track for Karaoke in DVD-Video is designed for multi-channel structure with maximum 5 channels, and the users can enjoy several different play-back modes with a "player with karaoke function including channel-mixing ON/OFF function", by recording this "guide melody" part on other channel except the main two channels. Furthermore it is possible to play back Karaoke melody with guide melody on "standard video-player for AC-3", by recording this guide melody on the third channel.

Guide vocal : It is also called "assistant vocal" (refer to Assistant vocal).

H

Half Transparent Film : The half transparent layer which a part of light comes through is made of gold, etc. In two-layer type DVD discs, the pits are formed on the both layers. The first layer is processed by the half transparent film and the second layer is made by conventional aluminum reflective layer. This technology is developed for high density discs readable for the two layers from only one side of the disc.

Highlight Command: A command text to command a player to function for a selected subject on a Menu. It is possible to record such highlight commands as for track selection and for playback position indication etc. In general this command is executed in player after displaying the execution color when a command to execute is selected in a Menu.

Highlight Information: A display information to emphasize a selected item on Menu screen by a brighter level to clearly show which function is executed.. In addition, following can be recorded on a disc as highlight information; 1) a first selection when a Menu is initially called, 2) a compulsory indication to select a specific item after a certain period if no selection be made, 3) a numbering information for Menus spreading over multiple pages.

I

Interleave : This is in general used to describe one of digital data arrangement methods. But in DVD-Video, "Interleave" is used to indicate a recording structure on a disc, to realize Multi-Angle capability etc. This "interleave" is a data structure defined in DVD-Video as a means to implement a seamless playback under such different scenes as described in the main text 1-3.8, and this is used for "multi-Angle" and "parental-lock" features etc.

I picture : One of the three picture types defined in MPEG system. An abbreviation of "Intra-coded Picture", the picture coded directly from input video signals without motion prediction. Refer to 1-3.1.1.4 for details.

L

Layer: In the text, this is referred to a signal layer(pit layer) recorded on DVD disc. In the DVD discs readable only from one side of the disc, there are two types of disc, viz., one-layer type and two-layer type. When a disc is single side read out type with only one pit layer, or with two pit layers, the pit layer closer to the read-out side is called 1st layer.

Letter Box: This is referred to the method to display full picture on 4:3 TV screen a cinema sized horizontally long picture, and when this method is applied black picture panels appear on both the upper and the lower sides of the screen like a letter-box for mails, with the main picture in the center. In order to display on 4:3 TV screen a 16:9 squeeze recorded picture in DVD-video disc system, following three display modes are defined to control the player, namely, the letter box type or the pan type or the both possibility.

Linear PCM Audio: One of the systems to convert an analog sound signal to a digital signal, and it does not include any compression process during the conversion.

M

Menu: A graphic image which is provided in Title for assisting selection of picture, sound, Sub-picture and multi Angle etc. recorded on disc. There are two kinds of Menu; system Menu and In-Title Menu. The system Menu appears on screen to control when to start playback, in stop, or during playback, aiming to command a player how the set disc is played back. The In-Title Menu is included in the Title and displayed on screen during playback, to command any change of playback conditions or to select story in the Title. By the two Menus and with the Sub-picture and the high-light command users can control his player easily how the Title is played back. Refer to 1-3.3.2 for details.

Motion Compensation : One of the data rate reduction techniques using temporal redundancy. Moving picture content is detected from continuous video signals to reduce repeated transmission of still picture content, aiming at reduction of total picture data rate. In general moving portion of pictures tends to have a similar content among continuous frames. This similarity among frames is utilized to achieve a high compression efficiency.

MPEG : An abbreviation of Moving Picture Expert Group, a study group of the joint committee of ISO and IEC. The group studied digital compression and decompression technology for media use, and decided an International Standard of the technology. This standard is applied in the DVD-Video System. Refer to 1-3.1.

Multi Angle: A function which allows a user to select a scene from multiple simultaneously progressive scenes within one Title. It is so named because the recording is done for each scene from different Angles by using multiple cameras. It is possible to store maximum 9 scenes simultaneously from different Angles. In playing back multi Angle operated by the users, there are two ways, one is to play in a seamless manner for any Angle changing and another is to switch from one Angle to another after a moment of still play. The conditions for these cases are defined precisely for the production of those Titles with this feature.

Multi Channel: DVD-Video defines that one sound track shall have one sound field. The configuration of sound track with more than 3 channels is called a multi channel. It is possible to make a multi channel recording for all the sound tracks for variously defined modes such as AC-3(Dolby digital), MPEG audio and linear PCM etc., but in doing this multi channel recording it is required to consider and meet the recording conditions of each mode and mandatory playback functions in player. Refer to 1-3.2 and 1-4 for details. In addition, NTSC disc players have to be provided with 2-channel stereo down mix function as mandatory for AC-3(Dolby digital) sound with max. 5.1 channels.

Multi Language: It is generally called multi language application when a Title is produced for multiple languages. DVD-Video can realize the multi language application by means of the multiple sound tracks and the Subtitle tracks each allocated for each language. A user can choose his language for audio and Subtitle easily by selecting his track. The multi language function is also applicable for the Menu language. Refer to 1-3.3.2 for details.

Multi Story: A configuration of a Title having different stories in one Title. In general, the story to playback can be selected in a Menu in advance, or in the Menu arranged at the branch points in the Title. Those Titles with multiple parental levels composed of parental block are also a kind of the Title with multi story.

O

Opposite path: A type of single side readout dual layer discs that the signal is started to be recorded from the inner to the outer diameter direction on the first layer (close layer to readout side) and the continuous signal to the second layer, when the first layer is finished, is started to record from around the same outer radius position of first layer program being ended, to inner direction of the second layer (opposite layer from readout side). The layer change-over in playback is automatically done.

P

Pan (Panscan) : In the text, it is referred to the system which convert a squeeze recorded 16:9 picture to a 4:3 picture size by trimming out a part of the horizontally wide picture. DVD-Video limits this pan scanning of the 16:9/4:3 picture conversion only to horizontal direction(vertical direction is unchanged) and its trimming position can be defined in disc by software producers. In general, this kind of picture trimming process is called trimming. DVD-Video system can define in disc three different playback modes in terms of displayed picture style on screen, namely, "pan" "letter box", and the both.

Parallel Path: In two-layer type discs with single side reading, parallel path is for a type of disc on which signals are recorded starting from the inner track to the outer track for both the first layer (nearest layer to reading side) and the second layer (farther layer from reading side). In playing back this type of disc, the viewers do not need to select a right layer to playback as DVD players have the function to select automatically a right layer to playback.

Parental Control Function : A parental level is provided in a software to detect whether the contents of picture and sound are adequate to be watched by the users or not(e.g. extremely violence scene and undesirable scene for education.) The player automatically judges before starting the playback by comparing the Parental Level in the software disc with the upper limit level of Permissible Playback Parental Level preset by the users in the player. This is Parental Control Function. Refer to 2-4-9 for details.

Parental Level : A permissible level to be observed on screen depending on the age of the users for such programmed contents as with excessive violence and undesirable scenes from educational aspect. This parental level can be set differently for each of the Titles in one disc. However, the level being preset in a disc shall respect the permissible limit by the laws of the country where the disc is played back. There are two methods in setting the parental level, one is single level setting for one Title and the other is multiple setting for one Title. In the latter case, one Title is constructed by multiple stories having different parental levels, and this way of parental level arrangement is called parental block.

PICT : One of the standard graphic formats in Macintosh of Apple Computer Inc. PICT is a short form for picture.

Pit Art System: A method to make a visible artistic design such as disc label etc. formed on disc utilizing recorded pattern of pits. This is not related to the recorded pit stream of signal data, but merely a method to allocate pits on a disc only considering their visibility by human eyes.

P picture : One of the three picture types defined by MPEG system. (Predictive-coded picture. A coded picture frame derived only from previous pictures using motion prediction techniques. Refer to 1-3.1.1.4 for details.

Pixel: Picture element. A minimum unit composing one picture, and it means a point or a dot. The maximum pixel number of DVD-Video is 720 x 480 for NTSC and 720 x 576 for and PAL (horizontal x vertical).

Professional Mode: A mode that only single channel of AES/EBU 2-channel output is used to transmit when a bit stream encoded by AC-3(Dolby digital) is to be transmitted through AES/EBU transmission system. This mode is widely used for a higher recording efficiency on tape media,etc.

R

RAW : One of the computer formats for image data processing. One picture element is quantized by 8 bits each for the Green, Blue and Red components. Therefore the volume of data of one picture frame is high.

Regional playback control function : A system to control a playable Region of any DVD disc. By splitting the whole world into six Regions and give each of them a Region number. All the DVD discs are given more than one Region No.(maximum six numbers in case when the disc is playable all over the world), and one model of DVD player is given only one Region No.. A DVD disc can be played back only when the Region No. of the disc coincides with that of the player to reproduce. In case when not coincided, the DVD player must indicate "not playable", which is required for all DVD players as mandatory.

S

Sampling frequency: This is a frequency used in converting from analog signal to digital signal. This frequency number shows how often in one second analog level is taken out(sampling) from original analog signal to convert to digital signal. It is necessary to sample at least twice the highest frequency of the frequency range of original analog signals in order to convert to the digital without losing information of the original signal.

Seamless : It is called seamless playback when a disc is played back without interruption. The seamless playback is interrupted if the user call the operation Menu during playback, even if the Title is produced for seamless playback. And seamless playback is not generally guaranteed throughout one Title in case when the Title has a scene to start playing back after frozen scene by branches in it.

Setup: SMPTE specifies that the black level of video signals is set to 7.5IRE higher value than blanking level in order to separate it from the black level of the luminance signal in the composite signal. This black level is called setup. Thanks to recent TV monitor's performance being improved, black levels can still be well recognized with 0 IRE (zero setup level for black). Therefore the black levels are often set to 0 IRE in Japan in order to give a wider dynamic range to pictures. The concept of the setup is not applicable to "component signals" because of the different nature of the signal format.

SMPTE : An abbreviation of "Society of Motion Picture and Television Engineers". This is one of the internationally recognized research institutes, where technical studies and investigations for movies and televisions are carried out and recommendations for the related norms etc. come from this society. The SMPTE time-code is defined by this group.

Single Side Disc : DVD disc that signal read-out layer(s) is(are) in only one side of disc. There are two types of "Single Side Disc", namely one is "Single Side Single Layer" disc and the other is "Single Side Double Layer" disc.

Squeezed picture: 16:9 picture data is compressed horizontally to convert to 4:3 picture data size, to record in a disc. DVD-video adopts this method to record 16:9 video data. And, in this case, considering the case when a 4:3 display is connected to the player, it is required to write in disc the indication for display method by either letter box conversion or by pan scan conversion(or both). And moreover, in case of pan conversion, the position to trim the picture horizontal has to be indicated.

Storage media: This is a generic name of media for storing data. Though this generally indicates the recording media for digital data such as floppy disc, hard disc and optical disc, it can be also widely used for the recording media for analog signal such as consumer type VTRs and cassette tape recorders.

Sub-picture: DVD video disc offers a recording possibility of compressed bitmap data(run length) in addition to record video data by MPEG encoding(this is called main video). This is called sub-picture. This sub- picture is additionally used in playing back the disc due to the data format restriction. This has two applications of Menu and Subtitle(caption). This enables multi-language capability, various kind of display formats(letter box etc.), setting forced display, and also enables user's display on/off operation. Refer to 1-3.3 in the text for details.

Subtitle: In the text this is referred to Sub-pictures for caption display.

Surround: This is a system to produce a vivid and stereophonic sound environment by arranging more than one speakers around listeners. One example is a surround system with " front 3 channels and rear 2 channels".

System Menu: This is an operation Menu displayed to control when a disc is ready to start when during playback or in stop mode. This Menu is mainly used to select how to play back discs. It has two types, namely, Title Menu and root Menu. The Title Menu is for selecting Titles to play back before starting to play a disc(disc is in stop mode), and the root Menu is to select Chapters, audio tracks, Subtitle tracks and Angle etc. before starting to play back any Title. Refer to 1-3.3.2 for details.

T

Text File: A file of text information. It is possible to contain specific information such as Title name and author's name, and writer notes of production episodes, publication date and management information such as ISRC code etc. of each of Titles on disc, each for a Title, for a Chapter and for audio tracks etc. This gives broad applications such as on-screen display, search-information and building the data base etc.

TIFF : An abbreviation of "Tagged Image File Format". A format for image data in bit map.

Title: This is a group of Cells which constitute a story content. One work of movie, one music album or one karaoke song typically corresponds to this. Titles are roughly separated into two types, one is a linear type Title which has no branches from start to end, and the other is a non linear type Title which has more than one branches(This guide book only describes this linear type). It is possible to record many Titles in one DVD disc. Within one Title numbers of both audio and sub picture tracks, those structure, and the number of "Angles", etc. can not be changed(various track attribute shall be the same). All DVD players are provided as mandatory with function to select one Title before starting playback by a Title Menu operation(if the Title Menu is recorded on the disc) or by the user's direct operation.

Time Code: A recorded-signal location information consisted of hour, minute, second and frame number, and used for assisting in Title editing to find out position of recorded signal. The SMPTE time code and EBU time code are conventionally used for NTSC system and PAL system respectively. In general, the frame frequency of NTSC is 29.97 Hz, therefore when 30 frames are counted in one second period, it results in a small difference between actual time and display time. On this account, the "Drop Frame" system, which skips some frame numbers in order to match up between actual time and display time, is also applied in the time code for NTSC system. However in this case, it gives a discontinuity of time code and is not suitable to apply for a disc system which features a random access.

Track: One of the elements composing one Title with video, sound and Sub-pictures simultaneously playing back. There is always one video track corresponding to one Title, and for the sound maximum 8 tracks is possible, and maximum 32 tracks for the Sub-picture. On a disc for multi-language application, one track is allocated to one language of each of the different language sounds and the different language Sub-pictures, therefore selection of a playback language is simply done by switching a playback track. In NTSC disc audio track, at least one track must be for AC-3 (Dolby digital) or for linear PCM sound, and in the case of PAL audio, one track must record MPEG or linear PCM sound at least. Moreover, in making a system Menu, it is allowed zero or one for each of the languages, and for the Subtitle track maximum three tracks can be used depending on the aspect ratio.

Transfer Rate: The quantity of digital data sent out in one second. The MPEG-2 video compression adopts a variable transfer rate system (Please refer to the subject of variable transfer rate.) In recording by this variable transfer rate system, both the average transfer rate and the maximum transfer rate in the process are considered important parameters. The average transfer rate is a factor to determine a recordable total data quantity on a disc (recording time) and the average picture quality. While the maximum transfer rate determines the maximum allocatable data quantity (for a best picture) for a complicated picture scene. The maximum transfer rate of DVD-Video is defined as 10.08Mbps (however, it is 9.8Mbps for each data track such as video track). For example the average transfer rate can be 4.6Mbps in maximum to record 135 minutes video data in one disc with 4.7Gbyte capacity.

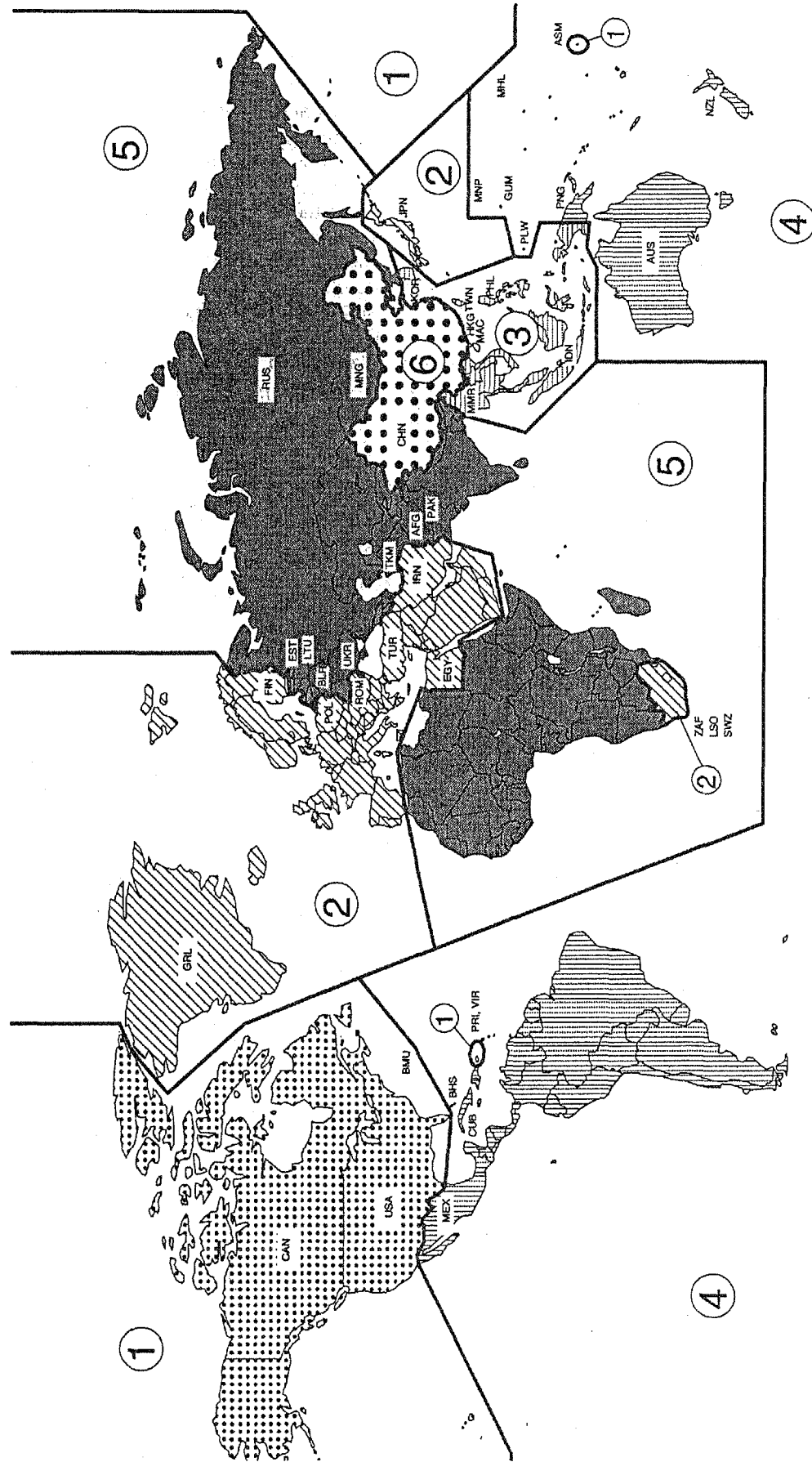
Trimming: In general, it means to produce picture data for display by means of trimming a part of original picture. In case of DVD-Video, it is possible to command in disc a pan- scan display on screen in order that any Title containing 16:9 pictures, which is squeeze-recorded in disc, can be displayed on 4:3 TV screen, and in this case, the trimming points (only for horizontal direction) for 16:9 picture shall be indicated in disc.

V

Variable Transfer Rate : Transfer rate is digital data volume sent out in one second. In this book, the "variable transfer rate" is referred to the method applied in DVD-Video disc for the compression and the recording, in MPEG encoding, to vary efficiently the data volume handled in a given time depending on the complexity of input video signals. This efficient method is adopted for DVD to cope with the large volume of data to be recorded in a disc.

Volume: A unit to represent all the Titles recorded in one disc, and it is equivalent to one side of disc. Therefore, one side of a single layer disc and a dual layer disc have always one volume, and a double side disc has always two different volumes. Long playing time Titles such as recorded on both sides of a disc or on more than one discs have always multiple volumes.

DVD-Video Region Map



Annex "DVD-Video Region Table"

Region No. 1

Common Names-----	Names of Nations and Areas
Canada-----	Canada
United States-----	United States of America
American Samoa-----*	American Samoa
Bermuda-----*	Bermuda
Johnston Island-----*	Johnston Island
Midway Islands-----*	Midway Islands
Puerto Rico-----*	Puerto Rico
St. Pierre and Miquelon-----*	St. Pierre and Miquelon
United States Virgin-----*	United States Virgin
Wake Island-----*	Wake Island

* represents Area Name

Common Names-----	Names of Nations and Areas
Albania-----	Republic of Albania
Andorra-----	Principality of Andorra
Austria-----	Republic of Austria
Bahrain-----	State of Bahrain
Belgium-----	Kingdom of Belgium
Bosnia and Herzegovina-----	Bosnia and Herzegovina
Bulgaria-----	Republic of Bulgaria
Croatia-----	Republic of Croatia
Cyprus-----	Republic of Cyprus
Czech-----	The Czech Republic
Denmark-----	Kingdom of Denmark
Egypt-----	Arab Republic of Egypt
Finland-----	Republic of Finland
France-----	French Republic
Germany-----	Federal Republic of Germany
Greece-----	Hellenic Republic
Hungary-----	Republic of Hungary
Iceland-----	Republic of Iceland
Iran-----	Islamic Republic of Iran
Iraq-----	Republic of Iraq
Ireland-----	Ireland
Israel-----	State of Israel
Italy-----	Republic of Italy
Japan-----	Japan
Jordan-----	Hashemite Kingdom of Jordan
Kuwait-----	State of Kuwait
Lebanon-----	Republic of Lebanon
Lesotho-----	Kingdom of Lesotho
Liechtenstein-----	Principality of Liechtenstein
Luxembourg-----	Grand Duchy of Luxembourg
Macedonia-----	The Former Yugoslav Republic of Macedonia
Malta-----	Republic of Malta
Monaco-----	Principality of Monaco
Netherlands-----	Kingdom of the Netherlands
Norway-----	Kingdom of Norway
Oman-----	Sultanate of Oman
Poland-----	Republic of Poland
Portugal-----	Portuguese Republic
Qatar-----	State of Qatar
Romania-----	Romania
San Marino-----	Republic of San Marino
Saudi Arabia-----	Kingdom of Saudi Arabia
Slovakia-----	The Slovak Republic
Slovenia-----	Republic of Slovenia
South Africa-----	Republic of South Africa
Spain-----	Spain
Swaziland-----	Kingdom of Swaziland
Sweden-----	Kingdom of Sweden
Switzerland-----	Swiss Confederation
Syrian Arab Republic-----	Syrian Arab Republic

Common Names-----	Names of Nations and Areas
Turkey-----	Republic of Turkey
United Arab Emirates-----	United Arab Emirates
United Kingdom-----	United Kingdom of Great Britain and Northern Ireland
Vatican City State-----	State of the City of Vatican
Yemen-----	Republic of Yemen
Yugoslavia-----	Federal Republic of Yugoslavia
Channel Islands-----*	Channel Islands
Faeroe Islands-----*	Faeroe Islands
Gibraltar-----*	Gibraltar
Greenland-----*	Greenland
Isle of Man-----*	Isle of Man
Svalbard and Jan Mayen Islands-----*	Svalbard and Jan Mayen Islands

* represents Area Name

Common Names-----	Names of Nations and Areas
Brunei Darussalam-----	Brunei Darussalam
Cambodia-----	Kingdom of Cambodia
Indonesia-----	Republic of Indonesia
Korea-----	Republic of Korea
Laos-----	Lao People's Democratic Republic
Malaysia-----	Malaysia
Myanmar-----	Union of Myanmar
Philippines-----	Republic of the Philippines
Singapore-----	Republic of Singapore
Thailand-----	Kingdom of Thailand
Viet Nam-----	Socialist Republic of Viet Nam
East Timor----- *	East Timor
Hong Kong----- *	Hong Kong
Macau----- *	Macau
Taiwan----- *	Taiwan

* represents Area Name

Common Names-----	Names of Nations and Areas
Antigua and Barbuda-----	Antigua and Barbuda
Argentina-----	Argentine Republic
Australia-----	Australia
Bahamas-----	Commonwealth of The Bahamas
Barbados-----	Barbados
Belize-----	Belize
Bolivia-----	Republic of Bolivia
Brazil-----	Federative Republic of Brazil
Chile-----	Republic of Chile
Colombia-----	Republic of Colombia
Costa Rica-----	Republic of Costa Rica
Cuba-----	Republic of Cuba
Dominica-----	Commonwealth of Dominica
Dominican Republic-----	Dominican Republic
Ecuador-----	Republic of Ecuador
El Salvador-----	Republic of El Salvador
Fiji-----	Republic of Fiji
Grenada-----	Grenada
Guatemala-----	Republic of Guatemala
Guyana-----	Co-operative Republic of Guyana
Haiti-----	Republic of Haiti
Honduras-----	Republic of Honduras
Jamaica-----	Jamaica
Kiribati-----	Republic of Kiribati
Marshall Islands-----	Republic of the Marshall Islands
Mexico-----	United Mexican States
Micronesia-----	Federated States of Micronesia
Nauru-----	Republic of Nauru
New Zealand-----	New Zealand
Nicaragua-----	Republic of Nicaragua
Palau-----	Republic of Palau
Panama-----	Republic of Panama
Papua New Guinea-----	Papua New Guinea
Paraguay-----	Republic of Paraguay
Peru-----	Republic of Peru
Saint Christopher and Nevis-----	Saint Christopher and Nevis
Saint Lucia-----	Saint Lucia
Saint Vincent and the Grenadines-----	Saint Vincent and the Grenadines
Samoa-----	Western Samoa
Solomon Islands-----	Solomon Islands
Suriname-----	Republic of Suriname
Tonga-----	Kingdom of Tonga
Trinidad and Tobago-----	Republic of Trinidad and Tobago
Tuvalu-----	Tuvalu
Uruguay-----	Oriental Republic of Uruguay
Vanuatu-----	Republic of Vanuatu
Venezuela-----	Republic of Venezuela

Common Names-----		Names of Nations and Areas
Anguilla-----	*	Anguilla
Aruba-----	*	Aruba
British Virgin Islands-----	*	British Virgin Islands
Cayman Islands-----	*	Cayman Islands
Christmas Island-----	*	Christmas Island
Cocos Islands-----	*	Cocos Islands
Cook Islands-----	*	Cook Islands
Falkland Islands-----	*	Falkland Islands(Malvinas)
French Guiana-----	*	French Guiana
French Polynesia-----	*	French Polynesia
Guadeloupe-----	*	Guadeloupe
Guam-----	*	Guam
Martinique-----	*	Martinique
Montserrat-----	*	Montserrat
Netherlands Antilles-----	*	Netherlands Antilles
New Caledonia-----	*	New Caledonia
Niue-----	*	Niue
Norfolk Island-----	*	Norfolk Island
Northern Mariana Islands-----	*	Northern Mariana Islands
Pitcairn-----	*	Pitcairn
Tokelau-----	*	Tokelau
Turks and Caicos Islands-----	*	Turks and Caicos Islands
Wallis and Futuna Islands-----	*	Wallis and Futuna Islands

* represents Area Name

Common Names-----	Names of Nations and Areas
Afghanistan-----	Islamic State of Afghanistan
Algeria-----	Democratic People's Republic of Algeria
Angola-----	Republic of Angola
Armenia-----	Republic of Armenia
Azerbaijan-----	Azerbaijan Republic
Bangladesh-----	People's Republic of Bangladesh
Belarus-----	Republic of Belarus
Benin-----	Republic of Benin
Bhutan-----	Kingdom of Bhutan
Botswana-----	Republic of Botswana
Burkina Faso-----	Burkina Faso
Burundi-----	Republic of Burundi
Cameroon-----	Republic of Cameroon
Cape Verde-----	Republic of Cape Verde
Central Africa-----	Central African Republic
Chad-----	Republic of Chad
Comoros-----	Federal Islamic Republic of the Comoros
Congo-----	Republic of Congo
Cote d'Ivoire-----	Republic of Cote d'Ivoire
Djibouti-----	Republic of Djibouti
Equatorial Guinea-----	Republic of Equatorial Guinea
Eritrea-----	State of Eritrea
Estonia-----	Republic of Estonia
Ethiopia-----	Ethiopia
Gabon-----	Gabonese Republic
Gambia-----	Republic of The Gambia
Georgia-----	Republic of Georgia
Ghana-----	Republic of Ghana
Guinea-----	Republic of Guinea
Guinea-Bissau-----	Republic of Guinea-Bissau
India-----	India
Kazakhstan-----	Republic of Kazakhstan
Kenya-----	Republic of Kenya
Kyrgyz Republic-----	Kyrgyz Republic
Latvia-----	Republic of Latvia
Liberia-----	Republic of Liberia
Libya-----	Socialist People's Libyan Arab Jamahiriya
Lithuania-----	Republic of Lithuania
Madagascar-----	Republic of Madagascar
Malawi-----	Republic of Malawi
Maldives-----	Republic of Maldives
Mali-----	Republic of Mali
Mauritania-----	Islamic Republic of Mauritania
Mauritius-----	Republic of Mauritius
Moldova-----	Republic of Moldova
Mongolia-----	Mongolia
Morocco-----	Kingdom of Morocco
Mozambique-----	Republic of Mozambique
Namibia-----	Republic of Namibia
Nepal-----	Kingdom of Nepal
Niger-----	Republic of Niger
Nigeria-----	Federal Republic of Nigeria
North Korea-----	Democratic People's Republic of Korea

Common Names-----	Names of Nations and Areas
Pakistan-----	Islamic Republic of Pakistan
Russia-----	Russian Federation
Rwanda-----	Republic of Rwanda
Sao Tome and Principe-----	Democratic Republic of Sao Tome and Principe
Senegal-----	Republic of Senegal
Seychelles-----	Republic of Seychelles
Sierra Leone-----	Republic of Sierra Leone
Somalia-----	Somali Democratic Republic
Sri Lanka-----	Democratic Socialist Republic of Sri Lanka
Sudan-----	Republic of Sudan
Tadzhikistan-----	Republic of Tadzhikistan
Tanzania-----	United Republic of Tanzania
Togo-----	Republic of Togo
Tunisia-----	Republic of Tunisia
Turkmenistan-----	Turkmenistan
Uganda-----	Republic of Uganda
Ukraine-----	Ukraine
Uzbekistan-----	Republic of Uzbekistan
Zaire-----	Republic of Zaire
Zambia-----	Republic of Zambia
Zimbabwe-----	Republic of Zimbabwe
British Indian Territory-----*	British Indian Territory
Jammu and Kashmir-----*	Jammu and Kashmir
Mayotte-----*	Mayotte
Reunion-----*	Reunion
St. Helena ex. dep.-----*	St. Helena ex. dep.
Western Sahara-----*	Western Sahara

* represents Area Name

Region No. 6

Common Names----- Names of Nations and Areas

China----- People's Republic of China

* represents Area Name

Region No. 7

Common Names----- Names of Nations and Areas

Country has not been assigned.

Region No. 8

Common Names----- Names of Nations and Areas

Country has not been assigned.