DIGITAL STILL PICTURE SYSTEM OF AHD

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Abstract

High quality sound reproduction can be achieved by digital transmission technique, high quality still picture reproduction such as image sharpness, high image stability and faithfull color reproduction can be achieved by digital transmission technique as well.

AHD is a disc system that records and reproduces digital information signals with the same way as VHD does. AHD has four digital transmission channels, each transmitting 88.2 K bytes data per second. Each channel transmits digital data such as high quality audio, still picture and computer data. The memory size of the still picture is 384 KB, it requires 2.4 seconds to send full picture frame using two digital channels.

This paper discusses digital still picture systems in relation to AHD and high definition TV applications.

1. Introduction

The techniques for high quality sound recording and reproduction through audio-to-digital signal conversion have been established and put to practical use. Digitization of video signals eliminates distortion that occurs during recording or reproduction due to the non-linearity and possible defects of the recording medium, thus providing high quality image transmission. With video signal digitization, the standard for component system digital television signals is being discussed and established by CCIR and other organizations.

AHD has been developed as a high density recording disc system that records digital signals in the analog video band of a VHD video disc, and has already been proven in practice. AHD has four 88.2K bytes/sec digital transmission channels, each permitting 16-bit PCM audio signal recording and reproduction at a sampling frequency of 44.1 kHz. In addition to audio signals, each channel can transmit still pictures, character codes or computer programs, and compressed audio. In general, a still picture requires longer presentation time than a motion picture. Accordingly, as opposed to motion pictures, still pictures must meet specific requirements such as high resolution, high S/N ratio, high image stability, and faithful color reproduction.

In AHD, the amount of picture information transmitted is typically 384K bytes per frame, and transmission of one frame on two channels requires 2.4 sec. If the compressed picture mode is used, however, one frame can be transmitted in 1.2 sec. Furthermore, partial frame transfer can be performed for quick frame switchover. For a 16-division frame, motion pictures can also be transmitted. Fine picture recording and reproduction require long transmission time. However, the fine, high quality picture obtained by digital transmission satisfies the requirements for prolonged presentation.

This paper describes the outline of AHD, the still picture system, and the video signal mastering in relation to the current recording and editing systems, and also refers to the applications of AHD to high definition TV systems.

2. Outline of AHD

AHD has four digital data transmission channels, each permitting 88.1K bytes/sec signal recording and reproduction. Information transmitted through each channel includes hi-fi audio, compressed audio, still pictures, and character codes and other computer data. Table 1 lists the 12 reproduction modes of AHD and the kinds of information recorded.

Fig. 1 shows the block diagram of AHD recording and reproduction system.

The audio, video, and digital data signals to be recorded are input in digital form while the prefabricated PCM master tape is being run.

In reproduction, decoded digital data is converted by a dedicated demodulation unit into analog signal.

Table 1 12 Reproduction Modes and Their Recorded Channel Signals

Mode No.	Status of reproduction	Channel signal			
		1	2	3	4
1	Sound over 3 channel and still picture	Sound, left	Sound, right	Sound, center	Still picture
2	Quadraphonic stereo sound over 4 channels	Sound, left	Sound, right	Left front - left back	Right front - right back
3	2 systems of sound over 2 channels	Sound, left A	Sound, right A	Sound, left B	Sound, right B
4	Sound over 2 channels and still picture over 2 channels	Sound, left	Sound, right	Still picture	
5	2 systems (of monaural sound and still picture)	Sound A	Sound B	Still picture A	Still picture B
6	Data files	Digital data A		Digital data B	
7	Institutional use	—	—	—	—
8	Institutional use	—	—	—	—
9	Sound over 2 channels and picture and data	Sound, left	Sound, right	Digital data	Still picture
10	Institutional use	—	—	—	—
11	4 systems of monaural sound	Sound, A	Sound, B	Sound, C	Sound, D
12	Still picture and data file	Compressed sound and digital data		Still picture	

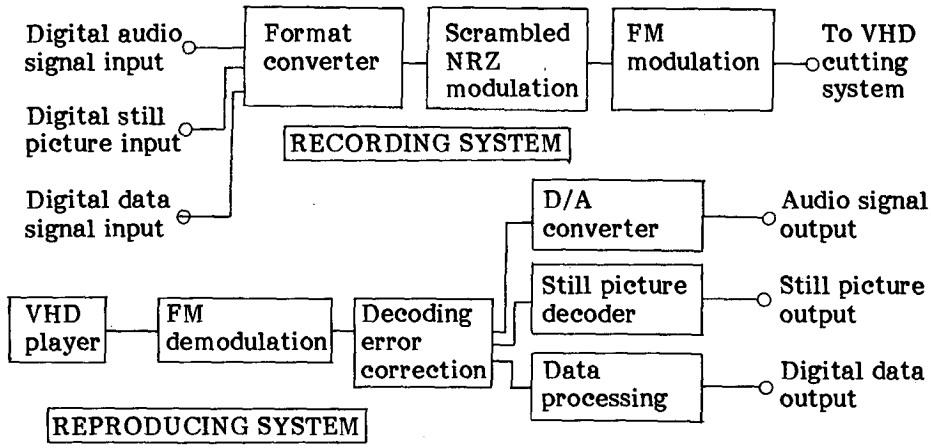

Fig. 1 Block Diagram of Recording and Reproducing System of AHD

3. Still Picture System

Table 2 shows the specifications for the 625/525-line still picture system. In the field of digital television, efforts are now being made toward establishing a world component encoding standard. AHD also employs the component encoding disc system, a common format the world over. Signal recording on a disc is made using the 625-line system. For NTSC systems using 525 scanning lines, necessary line conversion is made by the reproduction decoder for video signal output. This system uses 9 MHz, two-thirds the frequency specified by CCIR, as the sampling frequency to provide the 2.4 sec standard picture transmission and a picture memory size of 384K bytes.

Table 2 Specification of 625-line Still Picture

Encoding	Component
Signal system	Y, R-Y, B-Y
Sampling rate	Y; 9 MHz R-Y, B-Y; 2.25 MHz
Sampling points	576 (R-Y, B-Y; 144)
Active pixcells	456 (R-Y, B-Y; 114)
Scanning lines	625
Active lines	572
Arrangement of sampling points	Orthogonal
Quantization	8 bits linear for each signal
Quantization level	Y; 26-235 R-Y, B-Y; center = 128

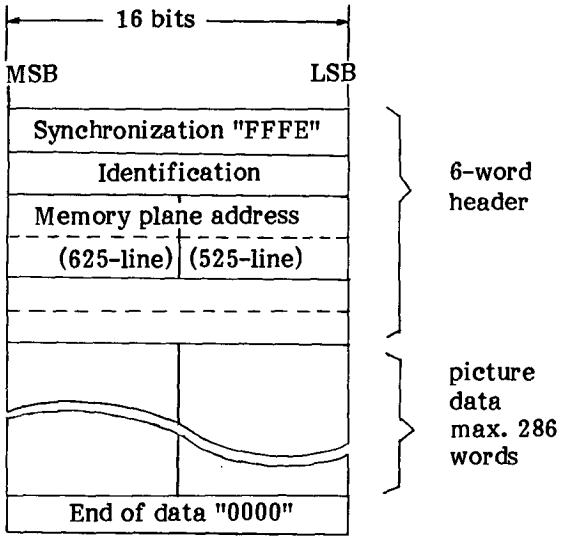

Fig. 2 Signal Format of 625-line Still Picture

Fig. 2 shows the signal record format for 625-line still pictures. Following the 6-word header, the picture data is sent from the top to the bottom of the frame. One frame consists of 456 vertical lines, each being transmitted together with the respective header.

The first word of the 6-word header is a sync signal FFFE which is indicated in hexadecimal notation. The second word is an identification code that specifies the content of picture to be transmitted. The third and fourth words specifiy the picture memory address. More specifically, the address of the first pixel to be transmitted is designated in both the 625-line picture memory and the 525-line picture memory for storage after 6:5 scanning line conversion. A detail description of the identification code is given below.

The high order two bits of the indentification code constitute a system code that determines whether the data following the header is 625/525 line system picture information, 1125 line system high-definition picture, document data transmitted in 2 values, or computer data.

Furthermore, the identification code further specifies whether the 625 line system picture data is ordinary or compressed, whether special reproduction effects are to be employed, and whether the signal is luminance or color difference. Still further, the identification code is used for selecting the picture number among 0 to 7, specifying picture decoder memory plane reading or writing, and specifying the start or end of full frame writing operation.

Part of the motion picture can be transmitted first specifying partial feed using the identification code and then designating the address for starting picture data transmission using the third and fourth words. In addition to the common cut frame switching, wiping to the right or left, opening from the center, and comb-like wiping can be carried out in the similar manner.

The author actually prepared AHD sample software which proved that the partial motion picture capabilities and the varied frame switching techniques are very effective in preparing program software.

4. Picture Mastering

Fig. 3 shows the picture mastering process. The entire process is divided into three stages: material tape, formatted tape, and cutting edited master. In each stage, picture data is repeatedly recorded on or reproduced from the VTR through the PCM processor (VP-900), but the digital picture quality is not degraded.

Positive film 35 mm or wider is used for pictures and telops for characters. These materials are taken by a 625-line RGB television camera.

The material tape is used for recording information in the form of digitized television signal, while the formatted tape stores 6-word headers and vertically scanned pictures at equal time intervals.

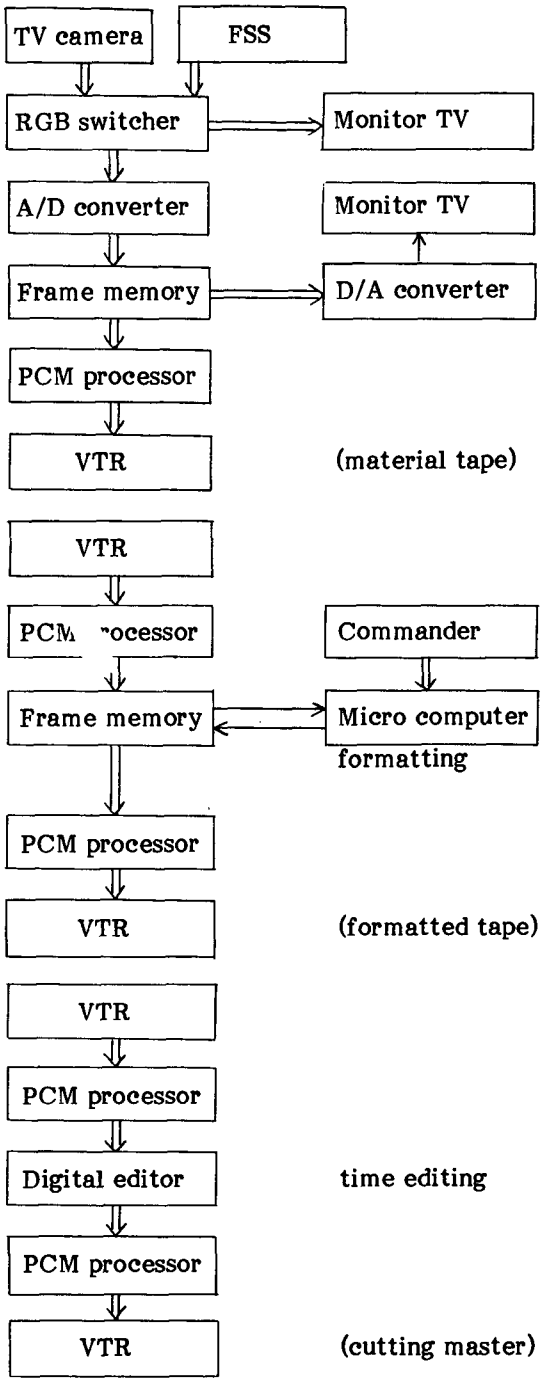

Fig. 3 Block Diagram of the Still Picture Mastering System

5. Application to High Definition TV systems

The research and development of high definition television are now being pursued by NHK and other organizations. The high definition television system is a component system and uses wide signal band to provide extremely sharp image display. The picture format for the 625/525 line system is shown in Fig. 2. The recording or reproduction of high definition data is specified by the system code in the identification code.

When the luminance signal sampling frequency is 51. 8 MHz, 1536 times the horizontal sync frequency, and the number of effective pixels is 1280 x 1024, 1.32M bytes are required for the luminance signal memory. If a memory with the same capacity is used for color-difference signal, the full frame (baseband) transmission time is 15 seconds. If the transmission is made after conversion into MUSE pictures, the transmission time is reduced to 7.5 seconds.

6. Conclusion

A digital still picture system which also records digital audio signals has been described by way of application examples. While VHD records 2 hours of analog motion picture information in CAV on both sides of a disc, AHD can record 2.54G bytes of digital data on both sides. These systems are suitable for differing kinds of information. However, since VHD and AHD discs can be played back on the same player, the VHD/AHD system will find a wide range of applications as a high density disc medium in the coming full-scale information-oriented society.

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