PCM MULTI-TRACK SYSTEM ON THE 8mm VTR

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Abstract

In order to accomplish international unification, standardization of the 8mm video format was generally agreed upon at the 8mm Video Conference in April, 1984.
Subsequently, we examined how the format might be applied to expand PCM multitrack audio areas into the allocated video tracks.
As a result, five additional PCM tracks can be recorded in the video area. Adaptation of this function can be made without appreciably raising the cost of the equipment.

1. Introduction

In the development of consumer electronics, audio equipment has had a long history with remarkable achievements made during that period. The VTRs, on the other hand, have had a relatively short history. Ten years have not yet passed since 1976, "the first year of home video". In the past ten years, however, significant improvements have been made in both audio and video techniques and products. Audio equipment has spread to all areas of the world and its production has already reached the saturation point. Reproduction of sound at a high-fidelity level has become a daily experience. It is now possible to obtain with ease and at low cost general audio equipment capable of broad-band reproduction with very low distortion.

The VTR, on the other hand, has since its coming into existence gone through many stages of improvements, such as longer play, multi-functional operation, miniaturization and lighter weight, and established its present standing in home electronics, a market share of 30%. In the meantime, the function of the VTR has been extended from time shift of TV programs to reproduction of prerecorded software. Following America and Europe, Japan has been developing a prospering tape business. Under these circumstances quality improvement of the audio channel has come to be demanded by the consumers. It is natural, in the current of the times, for consumers who have an ear for good sound to have made the demand for improvement of the sound quality of VTRs. This had been overlooked previously because the long play capability was given the higher priority. As a consequence, HIFI video was born in 1983. Only two years since its introduction to the market, one third of new VTRs are of the HIFI video type.

Remarkable achievements in the VTR techniques have also been made. That is, the magnetic recording technique for higher recording density, which is most fundamental to audio and video recording technology, has been advanced. One of the evidences of this was the development of high-energy tapes which were put into practice in the form of metal powder tape and

evaporated tape. The 8mm VTR, standardized last spring, was founded on the use of the high-energy tape as against the 1/2 inch VTR oxide tape used previously. The results of higher recording density attained on the basis of the high-energy tape was embodied advantageously into the smaller-sized 8mm cassette tape. The standardization was advanced, in line with the present tendency for higher fidelity, with new high-level audio technology taken as a prerequisite and with a degree of freedom for future expansion of applications reserved. Namely, as a way for recording audio signals, three systems were included in the standard: 1) recording of audio signals frequency-modulated in the video track in a frequency multiplex manner. 2) making the wrap angle of the video track larger than 180° and recording audio signals, pulse-code modulated and compressed, in the video track. and 3) recording audio signals by a fixed head in the traveling direction of the tape in the same manner as in older VTRs. Implementation of the first system was designated to be mandatory in the standard, whereas those of the second and third systems were made to be optional. Such degrees of freedom were considered to afford a good foundation for producing products that will be suited for the new era of audio and video integration beneficial to users growing out of products from the earlier stages where the two were developed independently of each other. The PCM multitrack system to be described below is one which was developed under these circumstances to provide the VTR with an additional function as an audio recorder.

2. The Way for Advancing to a Multi-Track System

As apparent from Fig. 1 in section 3, the PCM recorded area of the 8mm VTR tape corresponds to 1/5 of the video area, therefore, if the video area is wholly used for PCM recordings, it will be possible to form six independent PCM tracks. This means that a VTR and an audio deck can use the same cassette tape through identical mechanism. In order to use an 8mm VTR, including a PCM encoder/decoder, as a PCM multitrack audio deck, it is necessary only to separate the video circuit and to provide the VTR with means for timing signals to be switched among these PCM tracks. It is not required to change the circuits for the servo system, PCM audio control system, and so on because they are included in the standard VTR. An 8mm video tape recorder with a built-in PCM encoder/decoder can serve also as a PCM multitrack audio deck without requiring much additional cost and will be an appliance suitable for the new audio video (AV) era.

3. Method for Recording and Reproduction

3.1 Track Pattern

Fig. 1 compares the track pattern according to the previous 8mm video standard with that in accordance with the latest PCM multitrack video standard. Each of the PCM track formats is identical to the PCM track specified in the 8mm video standard as shown in Fig. 2 and Table 1. The PCM area for one field consists of (a) clock run-in, (b) encoded data (including ID word), (c) end-of-record margin, and (d) guard area.

The transmission data rate on the tape is approximately 5.8 Mb/s. In PCM multitrack recording, each track contains a time-compressed PCM signal recorded in the area originally allocated to video signals. Therefore, the PCM multi-

track format can support up to six stereo PCM tracks, one of which is the original track (the first track in the PCM-video format).

3.2 Implementation

A multitrack design, extending from the first to sixth PCM-tracks, is shown in Fig. 1. By arranging the timing of generation of PCM recording signals for one track to be delayed from another by the period corresponding to 36° (180/5) of the rotational angle of the head, six tracks may be laid down in sequence for each sweep.

The PCM circuit, of Fig. 3, shows how a reference pulse from the detected signal of the rotating head position is for the generation of the PCM recording signal. The PCM multi-track system is made practicable by providing the PCM circuit with time delay circuits for delaying the reference signal by a desired period of time. The variable delay circuit as shown in Fig. 3 is arranged selectively to provide delay times of 0 - 5 times (16.7ms/5 = 3.34ms) for the case of a 60-field system.

At the time of reproduction, it is necessary that tracking is practiced within the area corresponding to the selected PCM tracks. To realize this, a tracking control signal for the area to be reproduced is used and a sample/hold circuit is provided for other periods. Therefore, switching between audio tracks for reproduction is easily practiced by changing only the timing for the control of signal sampling. Since the PCM multitrack system is achieved by only electronic means, an 8mm VTR with a built-in PCM function can be adapted to operate as a PCM audio deck.

3.3 Performance

If the unit is exclusively used as an audio deck in the PCM multitrack mode, a 120 minute cassette tape can be used for recording and reproducing for 15 hours, (6 x 120 minutes). The audio characteristics of the recording are: bandwidth 12KHz, and the dynamic range approximately 90dB. Therefore the 8mm PCM recording characteristics are almost equivalent to those of the compact disc. As to the error rate peculiar to the PCM system, there is almost no difference between the tracks as shown in Fig. 4. From this data, it may be said that the unit can sufficiently support the use as a long play (12 hours) audio deck.

4. Application

4.1 Reverse Recording and Reproduction

There are some types of VTRs on the market having a reverse reproducing function. By development of this function, a PCM multitrack audio deck will become capable of reverse recording and reproducing. In such a case, only the tape running direction is reversed while the rotating direction of the head is kept unchanged, therefore only precision in the mechanism and stability in the tape movement are required. If such problems are solved, a PCM recorder having recording and reproducing capability to operate continuously up to 12 hours (NTSC) will come into existence.

4.2 Multitrack sound recorder

Basically, the tracks, 1 thru 6, are used sequentially, but if a recorder is provided with 6 PCM encoder/decoder systems, it will be capable of recording and reproducing all the tracks simultaneously, and thus a multitrack

sound recorder capable of recording up to 12 channels will emerge.

4.3 Cueing for a Specific Program

Since the tape is provided with a new ID mode-7 marker for the PCM multitrack purpose, it is possible to record the tape running direction, blank marks, cue marks, and so forth. Thus, cueing can easily be practiced.

5. Conclusion

The new 8mm VTR was founded on advancements in recording technology, and it is clear that it can further be developed into a recorder of video and sound of quality suitable for the coming AV era. Efforts are being made to provide a VTR with a longer play mode which will enable continuous recording of 24 hours or more as an audio deck by using a thinner tape, half-size track width, and so on. From such efforts and accumulation of the achievements, to date, it is expected that excellent new consumer products will evolve.

	Contents	525 line – 60 field system	625 line – 50 field system
a	Clock run-in	2.06° (3.0H)	2.09° (3.6H)
b	Data area	26.32° (38.4H)	26.29° (45.6H)
c	After-rec margin including f5 (see clause 26)	2.06° (3.0H)	2.09° (3.6H)
d	Video overlap	2.62° (3.8H)	2.62° (4.5H)

Table-1 Track Dimensions

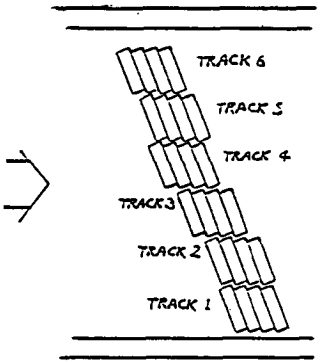

Fig 1. TAPE PATTERN

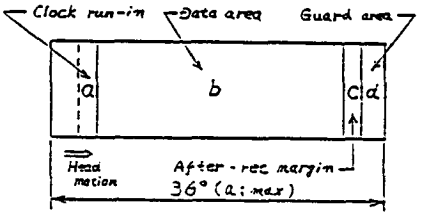

Fig 2. PCM AREA ALLOCATION

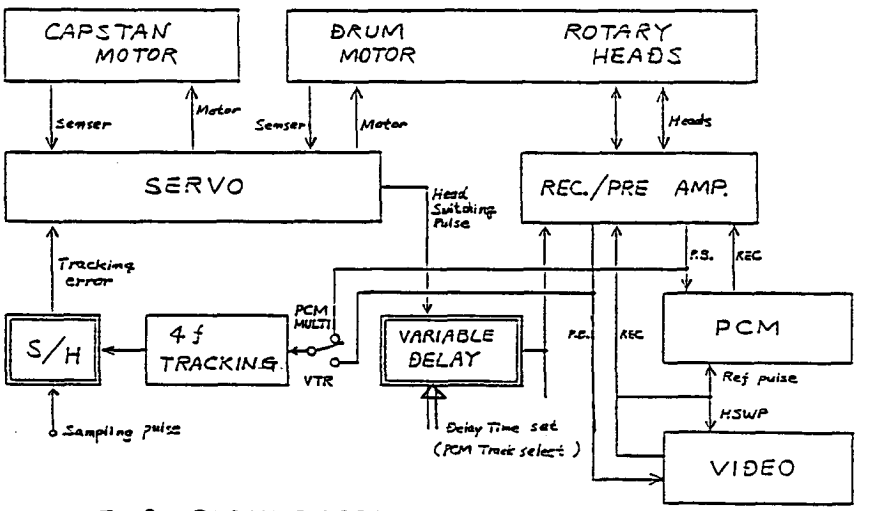

Fig 3. BLOCK DIAGRAM

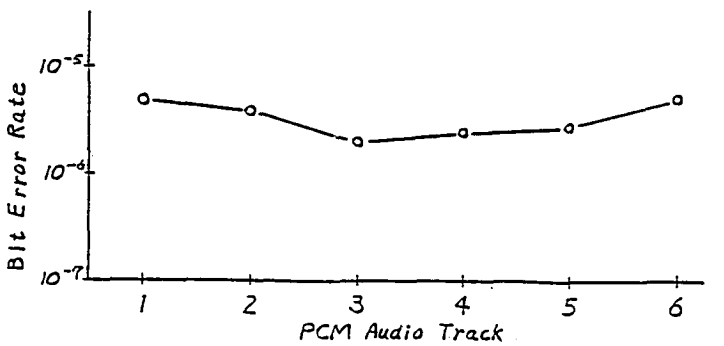

Fig 4. B.E.R. vs Track