

Kaoru Yamamoto
Nippon Columbia Co. Ltd.
Tokyo, Japan

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AN AUDIO ENGINEERING SOCIETY PREPRINT

A Programmable PCM Processor

Kaoru Yamamoto

Nippon Columbia Co. Ltd., Minato-ku, Tokyo 107, Japan

A programmable PCM processor is described. Fast signal processing units have been adopted, and modification of the operating program allows wider compatibility to different formats.

1. Introduction

More than ten years has passed since the first PCM recorder was introduced in the commercial recording activities in 1972.

During the decade, especially with the revelation of Compact Disc among others, digital recording has been realizing its significant role. And the application fields have been growing far wider than ever expected.

In order to cope with varieties of requirements arising from varieties of application, a programmable PCM processor has been developed.

2. Design Considerations

The actual use of the PCM recording unit such as for disc

record mastering, broadcasting, CD mastering and others have been considered in order to fulfil the following requirements.

- 1) As a recording medium, video cassette tapes are to be used, in view of cost, availability, operationability and storage.
- 2) Stabilized recording/reproduction over 75 minutes (maximum recording length of the CD) can be performed in the 2-channel mode (with a single cassette).
- 3) At the 44.1KHz sampling frequency for the CD, 2- or more- audio channels of 16 bits each can be recorded and reproduced.
- 4) The sub-coding signals (8 bits from P to W channels) for CD can be recorded and reproduced when 44.1KHz sampling frequency is used.
- 5) Synchronized recording and reproduction to NTSC color TV signal should be possible.
- 6) Simple editing jobs with cross-fade effect at the precision of 1/30 second can be performed on the recording unit alone without employment of separate editing devices.
- 7) Special care should be taken against adhesion of dirt on the VTR heads so that music can be reproduced even when the heads are

blocked.

- 8) Four-channel recording and reproduction which is especially important for recording classical music and the like, can be performed.
- 9) Zero-cross distortion during A/D and D/A conversion which greatly deteriorates the tonal quality should be suppressed to less than 1/4 LSB. The quality of analog section should be totally improved.

3. Construction

In order to cope with these requirements, the digital processing stage is constructed around fast signal processing units. Modification of software (program) allows flexibility of adapting for varieties of formats. Fig. 1 shows the block diagram. Two types of Digital Signal Processors (DSP) are employed. The ALU uses Am 29116, a 16-bit bipolar processor. TMS 32010 functions as signal formatter and signal separator.

4. Recording Format

This PCM processor uses a VTR for NTSC TV signals as a recording unit. For different purposes, four different formats can be

selected as shown in Table 1.

Each recording format is shown in Fig. 2. In this illustration, (a) and (b) are overlapped for about 160 samples between frames of the TV signal. In the actual frame editing work, these data enable cross-fading of the signal. (c) and (d) can be recorded with auxiliary data of 16 bits per 3 samples, such as CD subcodes accompanying audio signals.

5. Conclusion

Along with the growth of application fields as described above, higher versatility to different formats will be demanded on a PCM recorder. Extensive research and development will continue to cope with other formats than reported here.

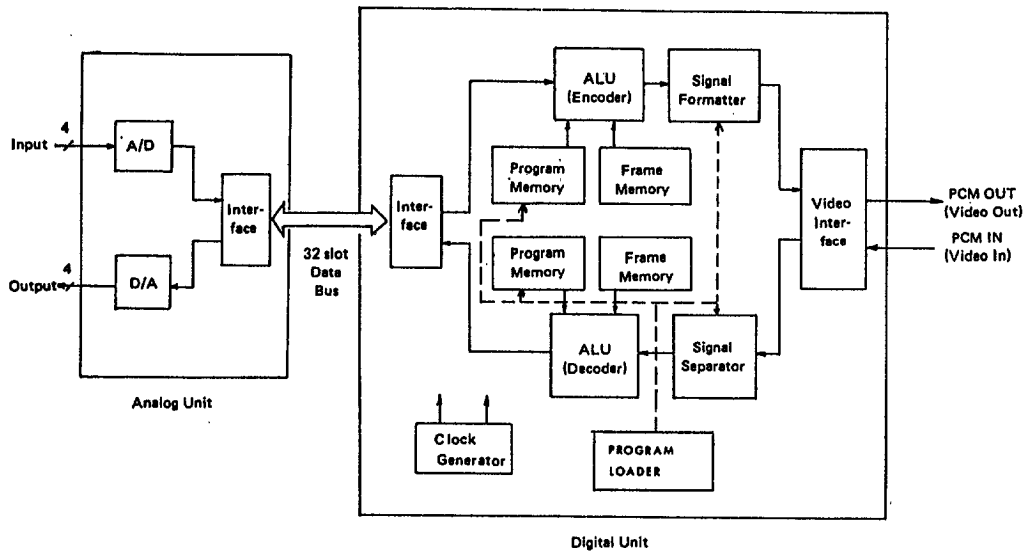


Fig. 1

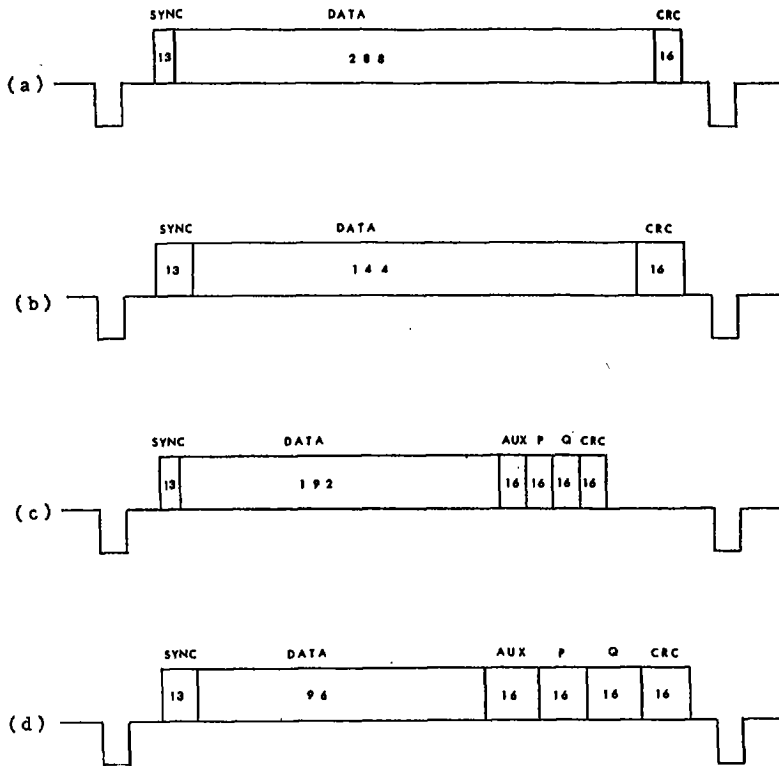


Fig. 2

Sampling Frequency		Channel	Ability of AUX Data	Recorder	Bit rate
a	4 8 KHz	4	NO	V-maticVTR	6.0 MHz
b	4 8 KHz	2	NO	V-maticVTR or VHS VTR	3.2 MHz
c	4 4.1 KHz	4	Yes(235.2Kbit/sec)	V-maticVTR	6.0 MHz
d	4 4.1 KHz	2	Yes(235.2Kbit/sec)	U-maticVTR or VHS VTR	3.2 MHz

Table-1