

A MAGNIFICENT NEW RECORDING SYSTEM.



The Improved DENON PCM (Pulse-Code Modulation) Recording System (DN-034R)



FEATURES

- Wide dynamic range (more than 89 dB in practical use).
- Low distortion factor (less than 0.1% at operating level).
- No wow and flutter (not measurable).
- No crosstalk.
- A flat frequency response over the wide range (DC-19kHz ± 0.2 dB, DC-20kHz $+0.2 -1.0$ dB).
- Multi-channel recording and reproduction (8,4 and 2 channels).
- An ordinary VTR is used as the recorder.
- Synchronized recording with two VTRs.
- High Quality duplication with two VTRs.
- Editing and splicing.
- No ghosts; recordings can be stored for long periods of time.

Introduction

Professional sound recording requires a recorder with uniform input and output signals. This compares with an ordinary tape recorder which records music waveforms on tape as analog variations in magnetic force and which displays a slight difference in tone quality between the input and output signals. Various experiments have been conducted in an attempt to minimize this difference.

Conventional tape recorders using proportional magnetization are far from ideal because of the nonlinear distortion, noise, modulation noise and other adverse factors caused by the tape itself and tape transport fluctuations. Although it is becoming increasingly difficult to achieve further improvements in this area, there is fortunately an entirely different method which solves all the problems. It is called the Pulse-Code Modulation (PCM) method, and it is being actively adopted for computers, space communications, telephone system and others, because it can transmit a great deal of information accurately under restrictive conditions. Fig. 1 shows the difference between PCM and conventional recording methods.

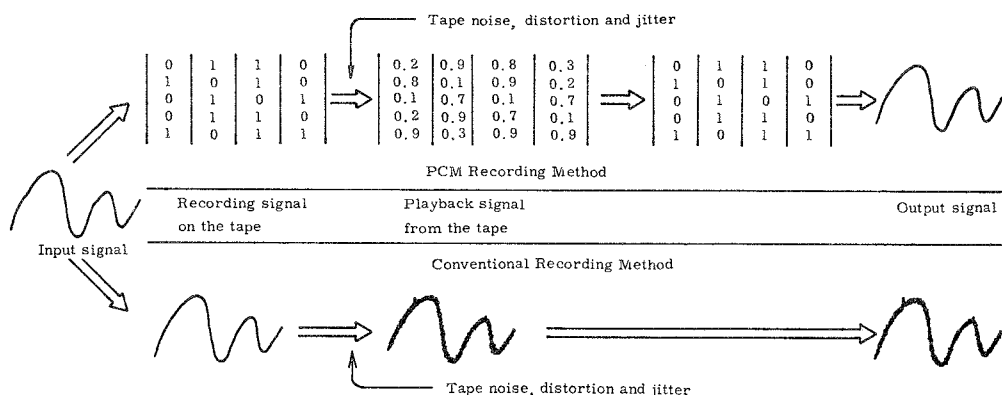


Fig. 1 The difference between PCM and conventional recording methods

PCM Recording

Under the PCM method, music waveforms are not directly recorded on tape as with ordinary tape recorders but are converted into a pulse code. This is then recorded onto a magnetic tape or other device. For reproduction, the code is reconverted into the original music waveforms by synchronizing the recordings with a reference signal so that the playback time domain will be the same as for the original recording. Any errors in the code are detected and corrected. Since the tape is recorded using only a train of pulses, there is no distortion or noise attributable to the tape.

However, the PCM method needs such a wide range of frequencies that a video tape recorder or an other wide-band recorder must be used for recording.

The first PCM recording system (DN-023R) for studio use and a portable PCM recording system (DN-023RA) were developed by Nippon Columbia in 1972 and 1974, respectively. These systems were used by the company for recording sessions in studios, halls and churches to manufacture more than 150 disc titles.

Although the quality of the systems was better than expected, Nippon Columbia was not satisfied. This is why it has undertaken in the past few years experiments to improve the dynamic range, enhance the quality of duplicating, achieve synchronized recording and the systems easier to handle.

In 1977, Nippon Columbia unwrapped a new improved PCM recording system, the DN-034R.

The Improved DENON PCM Recording System (DN-034R)

The DN-034R is capable of eight-channel recording and reproduction.

It is an improved version of the system (DN-023R) described in the Journal of AES published in September 1973 (volume 21, 7). Both systems are compatible and a four-head low-band video tape recorder is used as the mechanical part of the recording system.

The new system features an emphasis circuit and 14-bit A/D and D/A conversions are introduced to improve the dynamic range, while selection circuit for the digital data is adopted for improved duplicating and synchronized recording, using two video tape recorders and one converter.

As shown in Fig. 2, the system digitizes eight audio signals and records PCM transmission waveforms (Fig. 3) recorded as FM on the tape with the VTR.

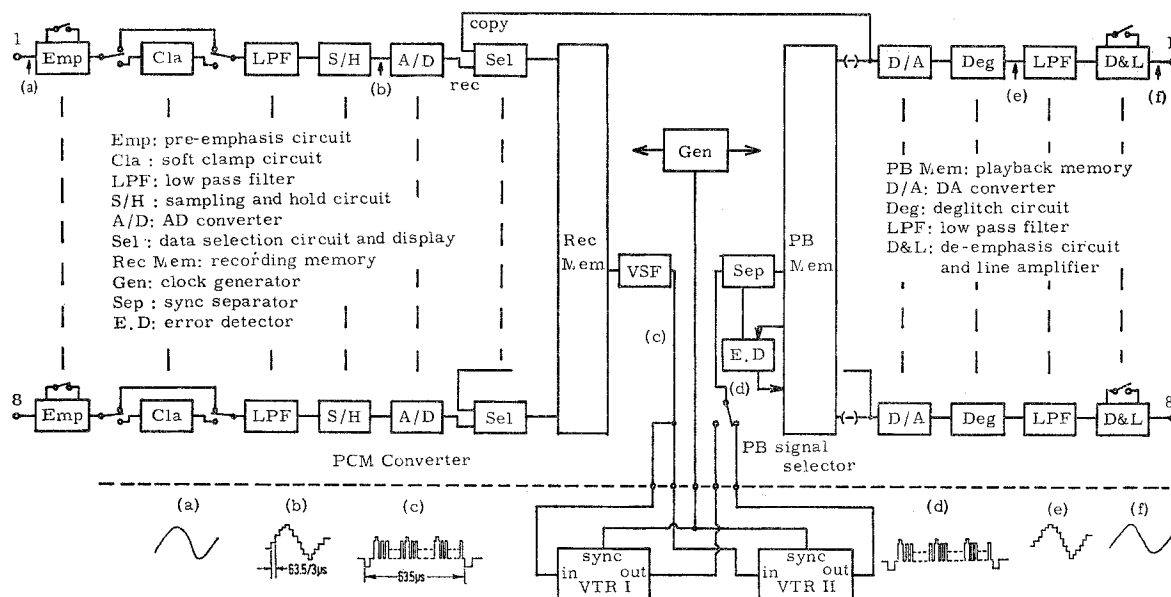


Fig. 2 Block diagram

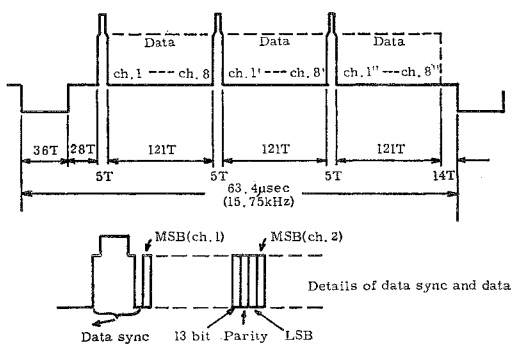


Fig. 3 Transmission waveforms

For reproduction, the recorded signal is demodulated first, data are extracted by the clock signal and stored in a shift register.

Data errors are then detected and corrected, whereupon the data are converted into the recorded audio signals.

In the practical recording process, the input and output of the recording system are connected to the mixing console, monitor system and disc cutting system. An emphasis circuit is adopted to improve the system's dynamic range. The emphasis curve employed is shown in Fig. 4.

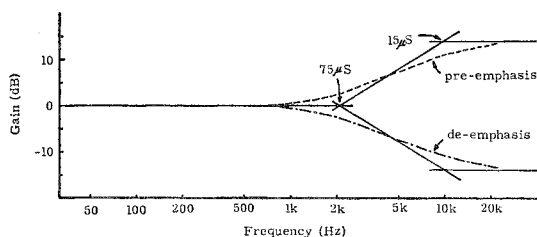


Fig. 4 Emphasis curves

In addition a soft clamp circuit which has saturation characteristics resembling those of an ordinary tape, is also featured. But the signals bypass this circuit except when special effects are required.

There are three duplication methods; audio signal, transmission signal, and data duplication. With the first method, quantizing noise increases and with the second data errors multiply because of the noise and jitter in the transmission signal. The best method is therefore data duplication which is achieved in this system to select the data.

Synchronized recording is also possible using two VTRs and the data selection circuit.

The system's frequency response and distortion characteristics are shown Fig. 5 and 6.

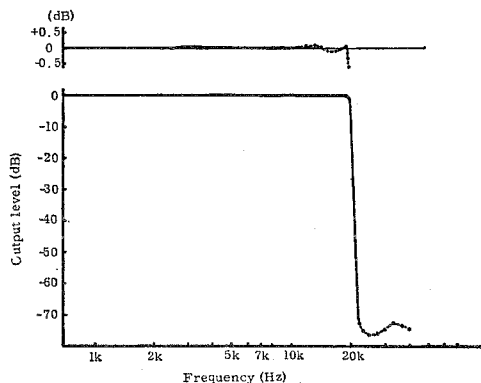


Fig. 5 Frequency response

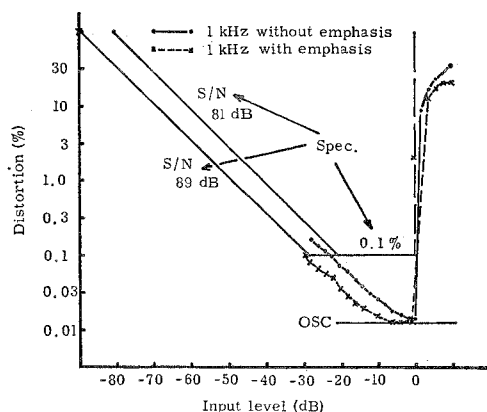


Fig. 6 Distortion characteristics

Applications

The improved DENON PCM recording system (DN-034R) is so superior to conventional recorders in its dynamic range, frequency response, distortion factor and quality of duplication that it can be used not only as a studio or disc cutting recorder, but also as a standard sound generator for developing or testing sound equipment and as a data recorder for recording and analyzing vibration, noise, music and other signals and the characteristics of sound equipment.

This system also has input and output connectors for digital data.

Therefore, a very wide-ranging variety of purposes can be served by combining the system with a digital mixing console and a computer.

DENON PCM Recording System (DN-034R)

Specifications

Modulation; pulse-code modulation.

Coding; 14-bit sign and magnitude binary code.

Transmission clock frequency; 7.1825 MHz.

Audio sampling frequency; 47.25 kHz.

Transmission waveform; standard TV signal (except vertical sync signal).

Number of audio channels; 8/4/2 selectable.

Tape speed; 38.1 cm/s.

Usable tape; 2-inch video tape.

Electrical performance

Frequency response: DC—19 kHz ± 0.2 dB, DC—20 kHz $+0.2$ dB—1.0 dB

Dynamic range: more than 81 dB (without emphasis)
more than 89 dB (with emphasis)

Distortion: less than 0.1% (at operating level)

Interchannel crosstalk: less than -80 dB

Wow and flutter: not measurable

Configuration of DN-034R

PCM converter, dimensions; 760(W) x 400(H) x 570(D)mm, weight; 62 kg.

Magnetic tape recorder (four-head low-band VTR), dimensions; 760(W) x 480(H) x 550(D)mm, weight; 100 kg.

Audio monitor, dimensions; 500(W) x 110(H) x 310(D)mm, weight; 8 kg.

Video & waveform monitor, dimensions; 500(W) x 155(H) x 360(D)mm, weight; 12 kg.

**In 1979, we developed new PCM (digital) Recording Equipment DENON DN-035R.
The outlines below :-**

(Specifications)

Modulation: pulse code modulation

Coding: 16-bit 2's complement code

Transmission clock frequency: 3.0713 MHz

Audio sampling frequency: 47.25 kHz (44—54 kHz selectable)

Transmission waveform: standard TV signal

Number of audio channels: 4/2 selectable

Usable tape transport: U-matic VTR/4-head-type VTR

(Electrical performance)

Frequency response: dc—20 kHz ± 0.5 dB

Dynamic range: more than 93 dB (without emphasis)
more than 98 dB (with emphasis)

Distortion: less than 0.03%

Interchannel crosstalk: less than -90 dB

Wow and flutter: not measurable

