Yoshiaki Fukuda
Shigeru Onda
Kenwood Corporation

Presented at the 2nd Regional Convention 1987 June 17-19 Tokyo

AES

AN AUDIO ENGINEERING SOCIETY PREPRINT

MEASUREMENT OF R-DAT PLAY BACK SIGNAL

Yoshiaki Fukuda, Shigeru Onda

Test & Measuring Instruments Division
Kenwood Corporation

Abstract

In the R-DAT system, it had been a serious problem for the circuit designers, production line workers, and inspectors when considering what to measure when evaluating the performance of the deck and tape.
We've targeted on the deck's playback signal. This signal is capable of various errors within the recording system, tape and transportation system.
With the Kenwood Corporation's Model DR-5750 R-DAT DECODER, the playback signal can be measured as digital data.
This paper contains an overview of the decoder along with the measurements involved and their results.

1. Introduction

Anyone who develops, manufactures and inspects R-DAT decks and tapes must consider what to measure when evaluating their performance.
The R-DAT system can be roughly divided into tape, head mechanism assembly, servo circuitry and signal processing circuitry.
Tape performance is determined by transport characteristics, durability, physical characteristics and electrical characteristics.
Head mechanism assembly performance is determined by transport characteristics (which includes the electrical characteristics of the servo system), durability and the head's electrical characteristics.
To evaluate the tape's electrical characteristics and the head's electrical characteristics, it is a common practice to measure the playback signal.
If the deck's signal processing circuitry is functionally divided into the recording and playback systems, measurement of the playback signal means that the recording system is also measured in addition to the front end of the playback system.
Measurement of the playback signal can be divided into analog measurement which measures the signal as a conventional RF (HF) signal and digital measurement which measures the signal as digital data.
This paper describes the configuration, measurement method, and measurement results of the Kenwood DR-5750 R-DAT decoder which was developed to measure the playback signal as digital data.

2. R-DAT Decoder

The DR-5750 decodes the format signal based on the DAT recommended design standard established by the DAT conference. During decoding, this decoder is capable of various error measurements and ID code displays.
The error measurements consist of random error measurement and burst error measurement. During random error measurement, the SYNC error, 10-8 conversion error, C1 error, C2 error, parity error and correction error are counted. During burst error measurement, the correlation of error in C1 and the burst error for tape direction and track direction is measured.
Various statistical operations can be performed since measurements are divided into tracks A and B, and areas SUB1, PCM and SUB2.

Fig.2 shows the block diagram of the DR-5750.
The DR-5750 performs measurements by inputting from the R-DAT deck an RF signal (equalizer output), or a logic signal after the slicer.
The signal which is input by the decoder from the deck is buffered and converted from NRZ1 to NRZ. Then the signal enters the synchronization pattern detection circuit at which point it is converted from serial data to parallel data. Here, the erroneous patterns created during 10-8 conversion are detected and counted. These symbols are stored in the frame memory according to the detected block address. During block address detection, a parity check is performed and the parity errors are counted.

The data stored in the frame memory is read out by the ECC circuit and decoded. At this time, the C1 error blocks, C2 error blocks and correction symbols are counted.
The error detection and correction algorithm used in this decoder conform to the algorithm stated in the recommended design standard established by the DAT conference. As a result, circuits employing different algorithms (such as those which differ according to the type of commercially available LSI chips) are not used. This permits correlation with the data obtained from compatible tests conducted by the DAT conference working group.

3. Error Measurements

Measurements on the DR-5750 can be divided into random error and burst error. For the random error measurement, C1 and C2 signal processing, counting of the error blocks during parity check, and counting of the error symbols during 10-8 conversion are performed. Especially for the C1 error measurement, the result is output as a block error rate. The synchronization pattern detection and protection numbers which become the background of these errors are counted. Fig.3 shows a result after performing measurements every 33 frames.
Burst error, defined as a consecutive occurrence of error blocks, is measured during C1 signal processing. When a burst error is detected, the burst error length (number of blocks), block address and error location (PCM/SUB1/SUB2) are stored. Fig.4 shows the burst errors occurring over 33 frames and listed according to burst length.
The interval during which measurement data is gathered can be set from a minimum of 33 frames up to a maximum of 500 frames. A maximum of 754 measurement results can be stored. Thus, micro-type measurements over a period of approximately 10 minutes to macro-type measurements over a period of approximately 3 hours can be performed.

Fig.5 shows the measurement result as a time transition of the C1 block error rate over a period of 10 minutes.
Fig.6 shows the measurement result for burst errors with a burst length of 3 blocks or more.
The vertical direction represents the tape transport direction. The horizontal direction represents the track direction, corresponding to, from the right, the SUB1 area, PCM area and SUB2 area. The white areas represent the error-free blocks while the black areas represent the error blocks.
In Fig.6, the SUB area contains only error blocks since a tape in which the SUB area was not recorded was measured. Burst errors can be observed in the middle of the screen.

4. Conclusion

The DR-5750 R-DAT decoder was developed as a measurement equipment which measures the R-DAT playback signal as digital data.
The R-DAT playback signal contains errors which are dependent on various factors such as recording system, tape and transport system. To separate the errors and to perform a single measurement (for the tape, mechanism and electric circuit, etc.), an accumulation of measurement data and its correlative analysis become necessary.
For this purpose, an overview of the DR-5750 was given in this paper along with the measurements involved and their results.
Analysis of the measurement results is to be a future topic.

5. Acknowledgement

The authors wish to thank Mr. Morioka and Mr. Kumatani of the Audio Production Division for their cooperation in the development of the DR-5750 and Mr. Yoshida, Mr. Takai and the other members of the Test & Measuring Instruments Division for being given this opportunity.

6. References

* "DIGITAL AUDIO TAPERECORDER SYSTEM (R-DAT) RECOMMENDED DESIGN STANDARD" DAT CONFERENCE

* "COOLING THEORY" by Miyakawa, Iwadare and Imai.

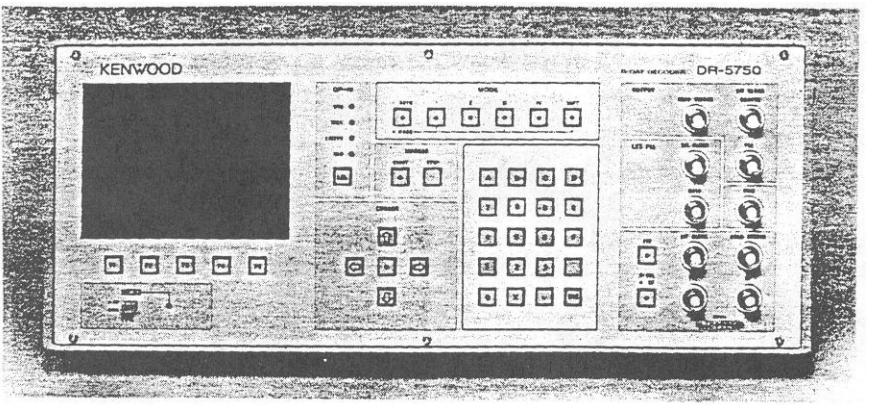

FIG.1 The Kenwood DR-5750 R-DAT decoder

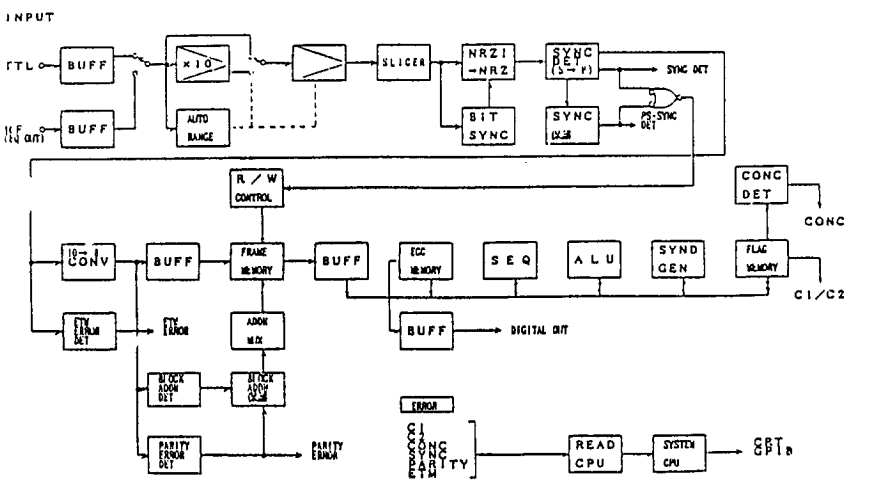

FIG.2 Block diagram of DR-5750

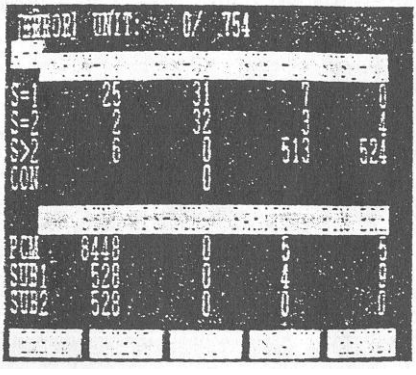

FIG.3 A picture of random error measurement

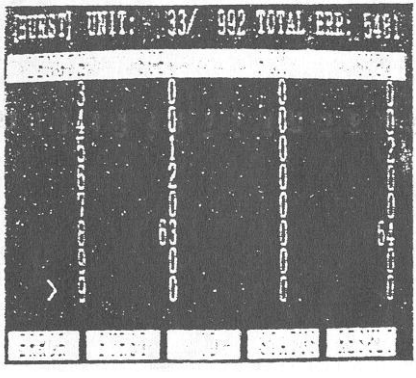

FIG.4 A picture of burst error measurement

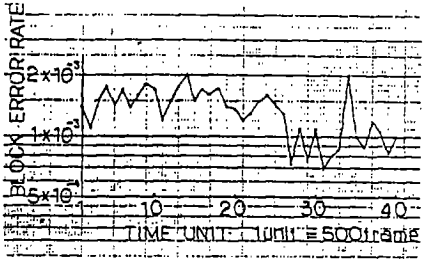

FIG.5 C1 error rate

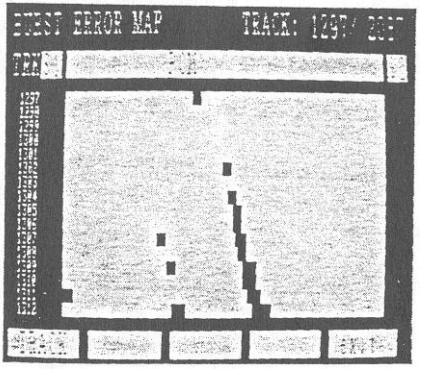

FIG.6 Burst map