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SMPTE STANDARD

for Television Digital Recording — 19-mm Type D-2 Composite Format — Helical Data and Control Records



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1 Scope

1.1 This standard specifies the content, format, and recording method of the data blocks forming the helical records on the tape containing video, audio, and ancillary data in the 19-mm type D-2 helical-scan television recorder. In addition, clause 4 of this standard specifies the content, format, and recording method of the longitudinal record containing tracking information for the scanning head associated with the helical records. Track dimensions and locations are specified in ANSI/SMPTE 245M.

1.2 The standard applies to recorders operating in the 525-line television system with a frame frequency of 29.97 Hz nominal and in accord with SMPTE 244M. One video channel and four independent audio channels are recorded. Audio channels operate in accord with ANSI S4.40 at a nominal 48-kHz sampling frequency.

1.3 Figures 1 and 2 show a block diagram of the processes involved in the recorder.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI S4.40-1992 (R1998), Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ITU-R BT.470-6 (11/98), Conventional Television Systems

3 Helical record content

3.1 Introduction

Six helical tracks are used to record each TV field.

The helical track is recorded with the digital data from the video channel and the four audio channels. The audio data is contained in four recorded sectors per track, two at the beginning of the track and two at the end of the track. The audio data is recorded twice. The video data is recorded in a sector in the middle part of each track. An edit gap between sectors accommodates timing errors during editing. Figure 3 shows the arrangement of video and audio sectors on the tape.

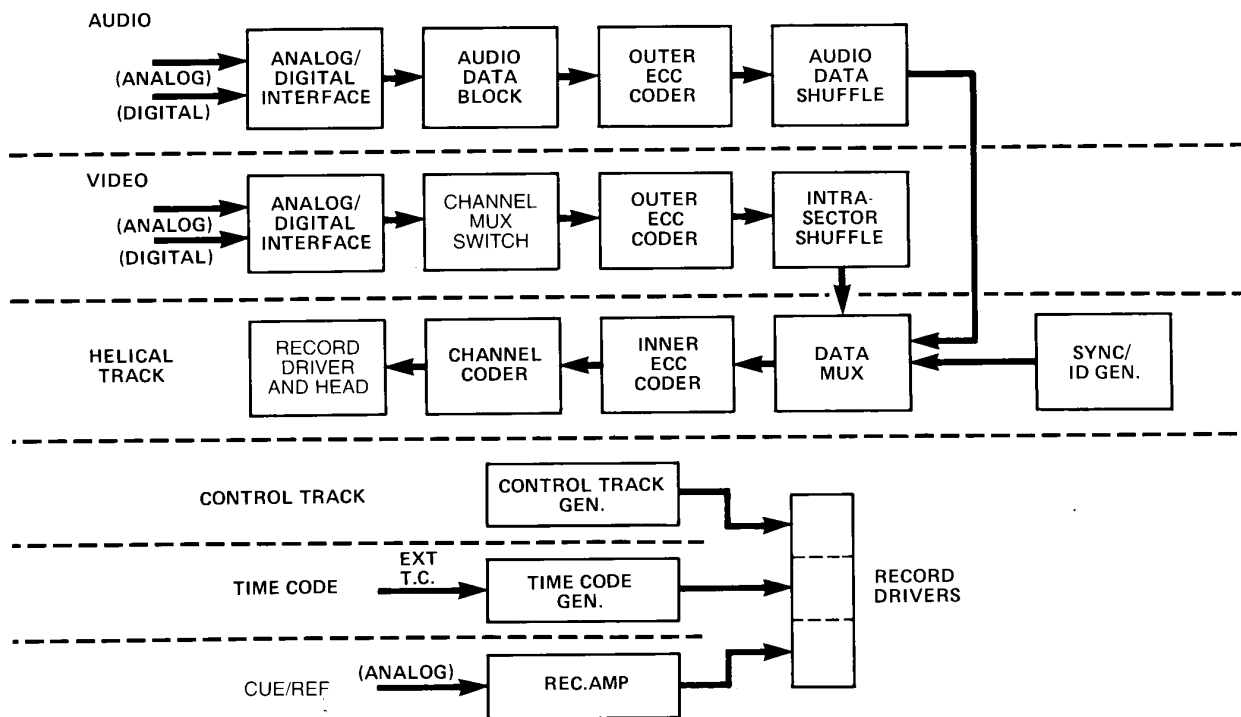


Figure 1 – Block diagram – Record

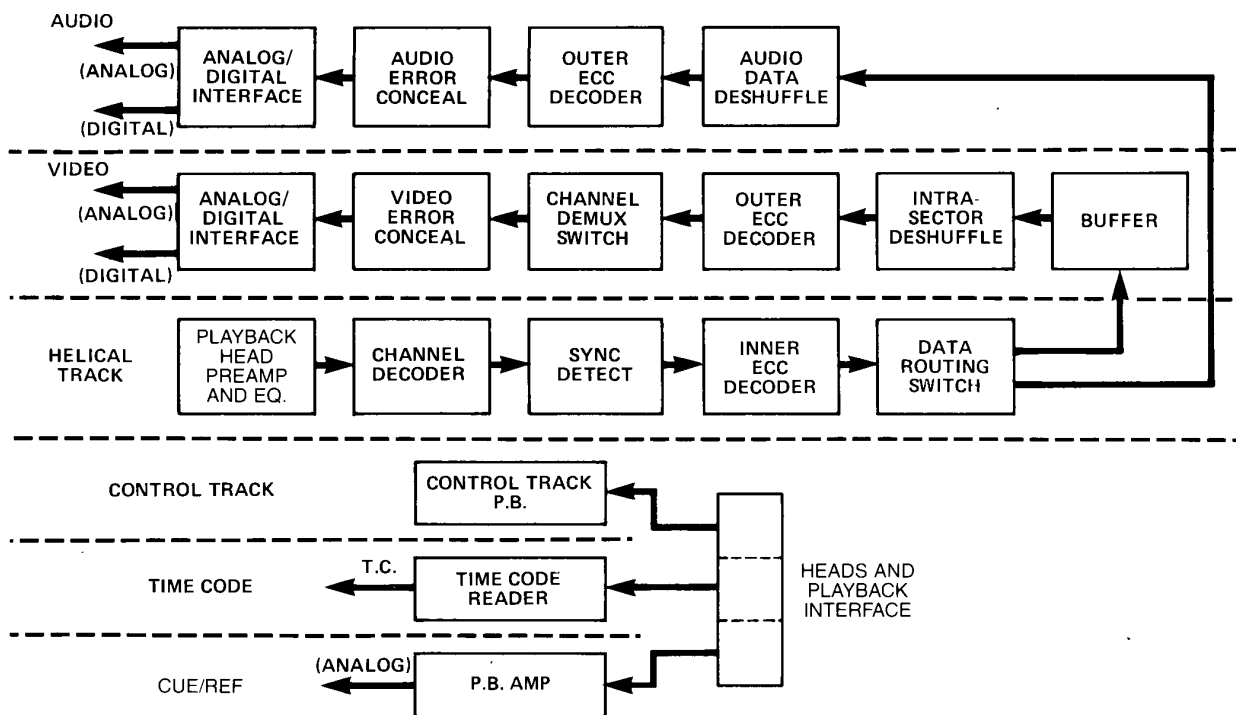
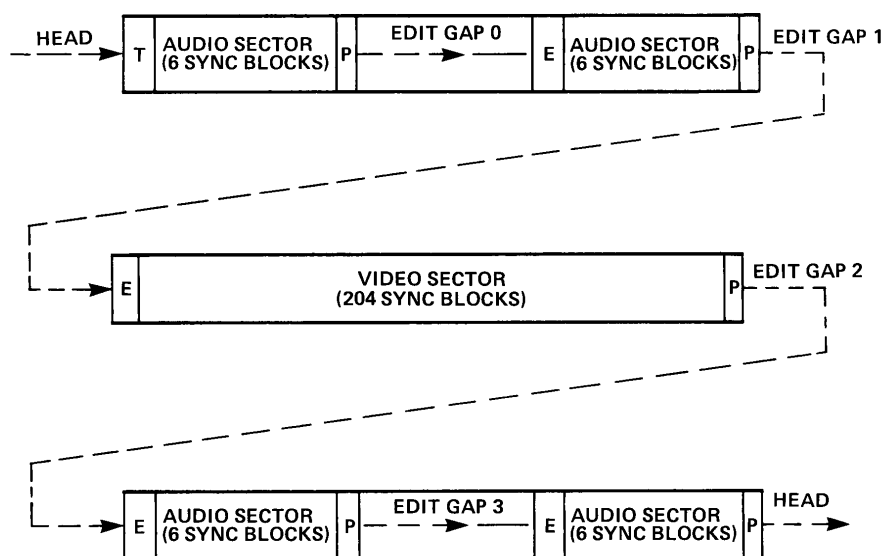


Figure 2 – Block diagram – Reproduce



NOTES

- 1 T = Track preamble (62 bytes)
- 2 E = in-track preamble (28 bytes)
- 3 P = Postamble (6 bytes)
- 4 Sync block = 190 bytes
- 5 Edit gap = 156 bytes nominal

Figure 3 – Sector arrangement on helical track

Each sector (audio or video) is divided into the following elements:

- Preamble containing clock run-up sequence, sync pattern, and identification pattern;
- Sync blocks containing sync pattern and identification pattern, followed by a fixed length data block with error control;
- Postamble containing sync pattern and identification pattern.

3.2 Labelling conventions for audio and video data

In this standard, the least significant bit is shown on the left and is the first recorded to tape. The lowest numbered byte is shown at the left/top and is the first encountered in the input data stream.

Byte values are expressed in hexadecimal notation unless otherwise noted.

3.3 Sync block

The sync block format is common to both audio and video sectors. Each sync block contains a sync pattern (2 bytes), and two inner code blocks. Each inner code block contains 85 data bytes (outer check bytes are considered data) plus 8 inner check bytes. Inner code block 0 includes and protects the two bytes of an identification pattern.

Figure 4 shows the sync block format.

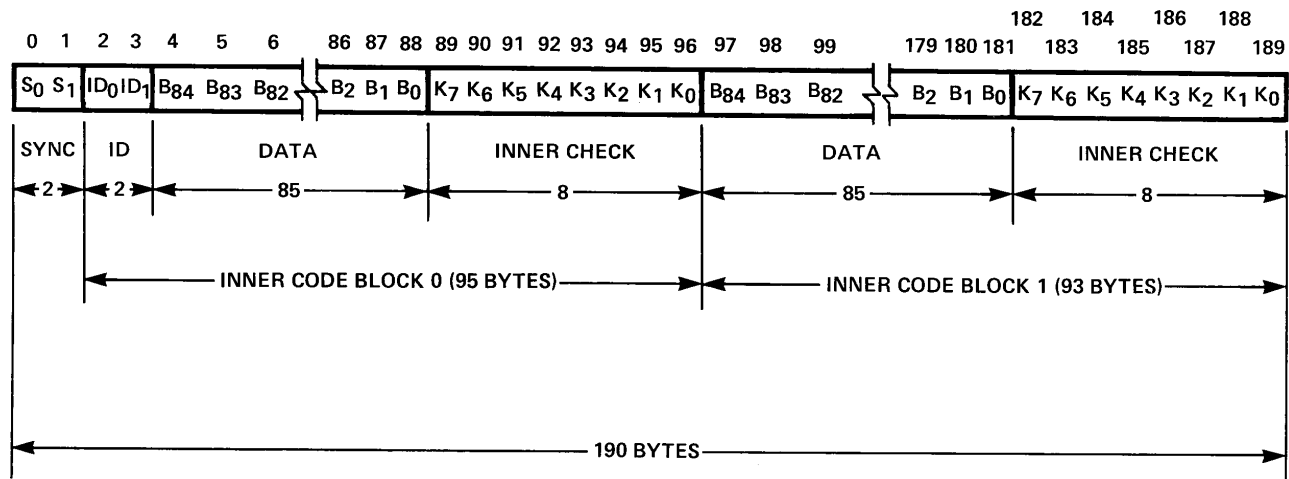


Figure 4 – Sync block format

3.3.1 Sync pattern

- (a) Length: 16 bits (2 bytes)
- (b) Pattern: 30 F5 (in hexadecimal notation)

	LSB				MSB			
Byte 0 —	0	0	0	0	1	1	0	0
Byte 1 —	1	0	1	0	1	1	1	1

- (c) Protection: None

3.3.2 Identification pattern

The first byte of the identification pattern identifies a particular sync block of a helical track. The second byte of the identification pattern identifies a particular track. Figure 5 shows the format of the identification pattern.

The first and second audio copies have the same segment numbers. The audio segment number located at the start of a track (second copy) is the same as the video segment number on the same track. Each audio field is composed of 3 segments, the first segment number is 0_h.

- (a) Length: 16 bits (2 bytes)
- (b) Arrangement:

The sync block number (byte 2) follows a coded sequence along the track. Figure 6 shows the sequence of sync block numbers.

The sector ID (byte 3) identifies a particular sector. The V/A bit distinguishes between audio and video sectors. The T bit distinguishes between two tracks corresponding to channels 0 and 1.

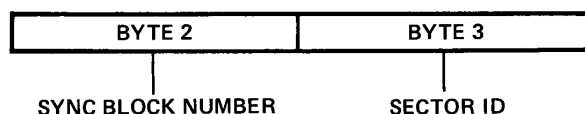
The segment count is modulo 3, the field count for video sectors is modulo 4, and the field count for audio sectors is modulo 5. (See figure 7.)

c) The field address F₀, F₁ (bits 4 and 5 of the sector ID for video sync blocks) shall identify the 4-field color sequence as defined in ITU-R BT.470-6, figure 5(c), and has the following values:

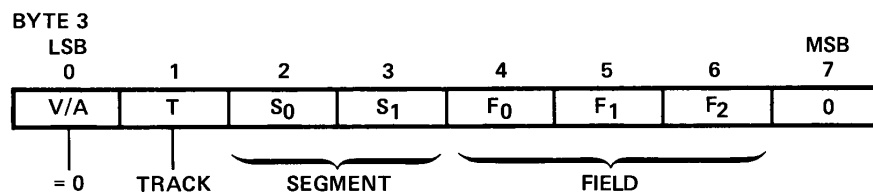
		F ₀	F ₁
Color frame A	Field I	0	0
Color frame A	Field II	1	0
Color frame B	Field III	0	1
Color frame B	Field IV	1	1

(d) Protection: The identification pattern is protected by inner code block 0.

A ARRANGEMENT



B SECTOR/TRACK ID FOR AUDIO SYNC BLOCKS



C SECTOR/TRACK ID FOR VIDEO SYNC BLOCKS

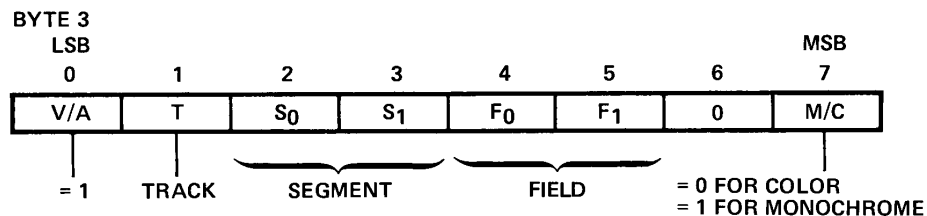


Figure 5 – Sync block identification format

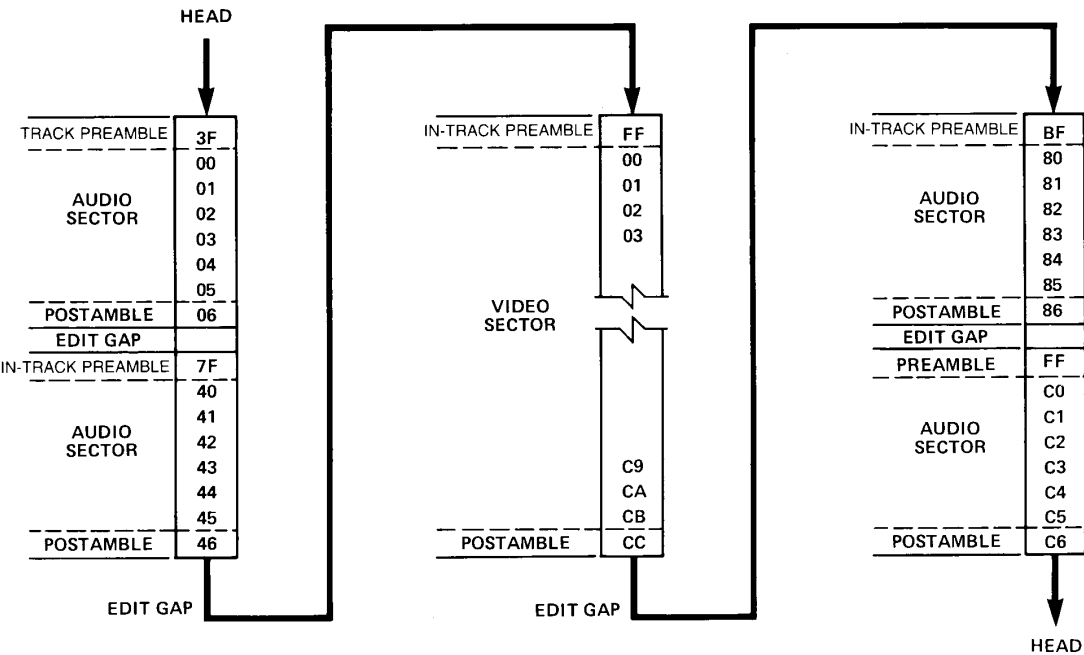
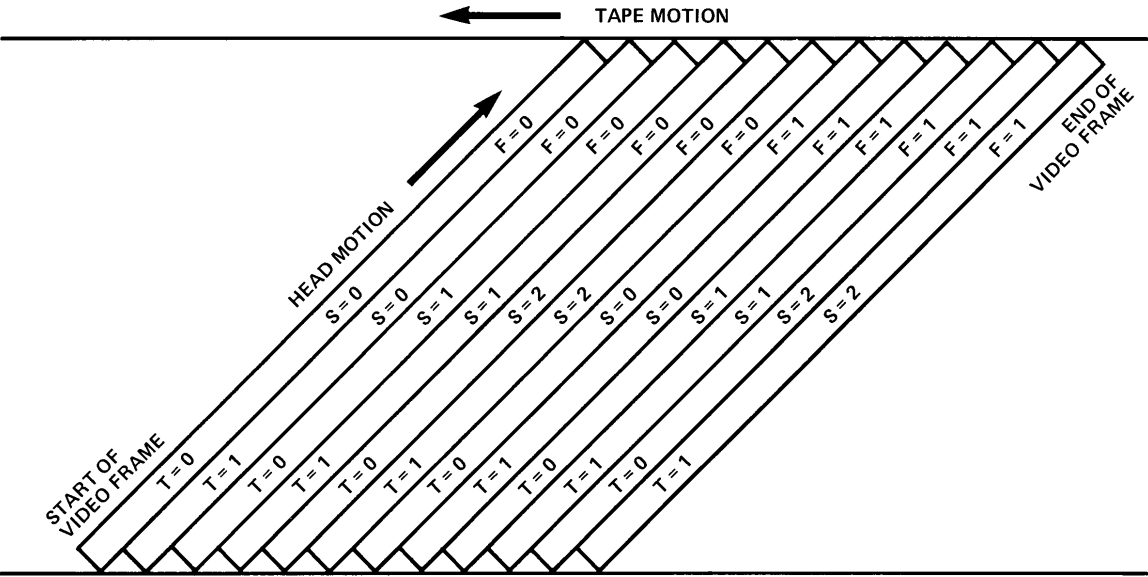


Figure 6 – Sync block ID number



- NOTES
- 1 T = Track number (0, 1)
 - 2 S = Segment number (0...2)
 - 3 F = Field number (0...3)
 - 4 Audio sectors not shown

Figure 7 – Track, segment and field numbers

3.3.3 Sync block data field/error correction coding

The sync block format is common to both audio and video data, and the associated inner ECC code blocks.

(a) Length: 2 inner code blocks. Inner code block 0 contains 95 bytes consisting of two identification pattern bytes, 85 data bytes (outer ECC check bytes are considered data), plus 8 inner ECC check bytes. Inner code block 1 contains 93 bytes consisting of 85 data bytes plus 8 inner ECC check bytes.

(b) Arrangement: See figure 4

(c) Interleaving: None

(d) Protection: (Inner ECC code)

Type: Reed Solomon

Galois field: GF(256)

Field generator polynomial: $x^8 + x^4 + x^3 + x^2 + 1$, where x^i are place-keeping variables in GF(2), the binary field.

Order of use: Left-most term is most significant.

Code generator polynomial GF(256): $G(x) = (x + 1)(x + a)(x + a^2)(x + a^3)(x + a^4)(x + a^5)(x + a^6)(x + a^7)$, where a is given by $(02)_H$ in GF(256).

Check characters are $K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0$ in $K_7x^7 + K_6x^6 + K_5x^5 + K_4x^4 + K_3x^3 + K_2x^2 + K_1x + K_0$ obtained as the remainder after dividing $x^8D(x)$ by $G(x)$, where for

Inner code block 0: $D(x) = ID_0x^{86} + ID_1x^{85} + B_{84}x^{84} + \dots + B_2x^2 + B_1x + B_0$

Inner code block 1: $D(x) = B_{84}x^{84} + B_{83}x^{83} + \dots + B_2x^2 + B_1x + B_0$

Equation of full inner code block 0: $ID_0x^{94} + ID_1x^{93} + B_{84}x^{92} + B_{83}x^{91} + \dots + B_1x^9 + B_0x^8 + K_7x^7 + K_6x^6 + \dots + K_2x^2 + K_1x + K_0$

Equation of full inner code block 1: $B_{84}x^{92} + B_{83}x^{91} + \dots + B_1x^9 + B_0x^8 + K_7x^7 + K_6x^6 + \dots + K_2x^2 + K_1x + K_0$

3.4 Preamble

All sectors are preceded by a preamble consisting of a clock run-up sequence, sync pattern (2 bytes), identification pattern (2 bytes), and fill pattern (4 bytes). The clock run-up sequence varies in length and pattern depending on the sector. The remaining elements of the preamble have the same format for all sectors.

When a sector is edited, the appropriate preamble, including run-up sequence, shall be recorded.

3.4.1 Track preamble for start of field track pair

This preamble precedes the first sector of the first pair of tracks of every field (segment 0). The run-up sequence is 54 bytes long and consists of 18 repetitions of the three-byte pattern $B6_H, 6D_H, DB_H$.

(a) Length: 62 bytes

(b) Arrangements: See figure 8A

(c) Run-up pattern: $B6_H, 6D_H, DB_H$