SMPTE STANDARD

for Television — 6.35-mm Type D-12 Component Format – Digital Recording at 100 Mb/s 1080/60i, 1080/50i, 720/60p

Table of contents

1 Scope

This standard specifies the content, format, and recording method of the data blocks containing video, audio, and associated data which form the helical records on 6.35-mm tape in cassettes as specified in SMPTE 307M.

In addition, this standard specifies the content, format, and recording method for longitudinal cue and control tracks.

One compressed video channel, eight independent audio channels and sub-code data are recorded on tape in the digital form. Each of these channels is capable of independent editing.

The helical recordings are synchronized to on the following digital video formats:

– 1080-line/59.94-Hz field frequency
– 1080-line/50-Hz field frequency
– 720-line/59.94-Hz frame frequency

Approved
August 7, 2002

These are hereafter referred to as the 1080/60i, 1080/50i, and 720/60p systems, respectively. Similarly, in this document, the 60-Hz system nomenclature refers to both 1080/60i and 720/60p systems; whereas, the 50-Hz system refers only to the 1080/50i system. Nomenclature 1080-line system refers to both 1080/60i and 1080/50i systems, while,the 720-line system refers only to the 720/60p system.

The recorded digital video signal shall be compressed according to the DV-based 100-Mb/s specification. The recorded digital video signal, eight audio channels, and sub-code data shall be defined by the data structure according to the DV-based 100-Mb/s specification.

2 Normative references

The following standard contains provisions which, through reference in this text, constitute provisions of the standard. At the time of publication, the edition indicated was 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 standard indicated below.

AES3-1992 (R1997), Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ANSI/SMPTE 276M-1995, Television — Transmission of AES/EBU Digital Audio Signals Over Coaxial Cable

SMPTE 12M-1999, Television, Audio and Film — Time and Control Code

SMPTE 307M-2002, Television Digital Recording — 6.35-mm Type D-7 and Type D-12 Component Format — Tape Cassette

SMPTE 321M-2002, Television — Data Stream Format for the Exchange of DV-Based Audio, Data and Compressed Video over a Serial Data Transport Interface

SMPTE 370M-2002, Television — Data Structure for DV-Based Audio, Data and Compressed Video at 100 Mb/s 1080/60i, 1080/50i, 720/60p

3 Environment and test conditions

3.1 Environment

Tests and measurements made on the system to check the requirements of this standard shall be carried out under the following conditions:

- Temperature: 20°C ± 1°C
- Relative humidity: (50 ± 2)%
- Barometric pressure: From 86 kPa to 106 kPa
- Tape conditioning: Not less than 24 h
- Center tape tension: 0.09 N ± 0.02 N (see annex A)

3.2 Reference tape

A blank tape for reference recordings shall be available from the format holder or approved source.

3.3 Calibration tapes

The calibration tapes meeting the requirements of 3.3.1, 3.3.2, and clause 4 are available from manufacturers who produce digital television tape recorders and players in accordance with this standard.

3.3.1 Record locations and dimensions

All tolerances shown in table 1 or table 2 and clause 4.2 will be reduced by 50%.

3.3.2 Calibration signals

Two sets of signals shall be recorded on the calibration tape:

a) – Video: 100 / 0 / 100 / 0 color bars compressed according to SMPTE 370M
   – Audio: 1 kHz tone at 20 dB below full scale on each audio channel
   – Cue: 1 kHz and 6 kHz tone at the analog recording reference level

b) A signal of constant recorded frequency (i.e., the Nyquist frequency) for the purpose of mechanical alignment. Recording level shall conform to 6.1.4.3

4 Tape

4.1 Base

The base material shall be polyester or equivalent.

4.2 Width

The tape width shall be 6.350 mm ± 0.005 mm. The tape, covered with glass, is measured without tension at a minimum of five different positions along the tape using a calibrated comparator having an accuracy of 0.001 mm (1 μm). The tape width shall remain within the above specifications at any measuring position.

4.3 Width fluctuation

Tape width fluctuation shall not exceed 5 μm peak-to-peak. Measurement of tape width fluctuation shall be taken over a tape length of 900 mm. The tape width fluctuation shall be within the aforementioned specification at each of ten equally spaced points in the 900 mm span.

4.4 Reference edge straightness

The maximum deviation of the reference edge straightness is 6 μm peak-to-peak. Edge straightness fluctuation is measured at the edge of a moving tape guided by three guides having contact on the same edge and having a distance of 85 mm from the first to second guide and 85 mm from the second to third guide. Edge measurements are averaged over a 10 m length and are made 5 mm from the midpoint between the first and second guide towards the first guide.

4.5 Tape thickness

The total tape thickness shall be 8.8 μm + 0.0 μm – 0.8 μm and 6.7 μm + 0.0 μm – 0.4 μm.

4.6 Transmissivity

Transmissivity shall be less than 5%, measured over the range of wavelengths 800 nm to 1000 nm.

4.7 Offset yield strength

The offset yield strength shall be greater than 3 N. The force to produce 0.2% elongation of a 1000-mm test sample with a pull rate of 10 mm per minute shall be used to confirm the offset yield strength. The line beginning at 0.2% elongation parallel to the initial tangential slope is drawn and then read at the point of intersection of the line and the stress-strain curve.

4.8 Magnetic coating

The magnetic layer of the tape shall consist of a coating of metal particles or equivalent.

4.9 Coating coercivity

The magnetic coating coercivity shall be a class 2300 (approximately 2300 Oe / 184000 A/m), with an applied field of 10000 Oe / 800000 A/m measured by a vibrating sample magnetometer.

5 Helical recordings

5.1 Tape speed

The tape speed shall be 135.2801 mm/s for the 60-Hz system and 135.4154 mm/s for the 50-Hz system. The tolerance shall be ± 0.2%.

5.2 Sectors

Each recorded track contains an ITI sector, an audio sector, a video sector and a subcode sector.

5.3 Record location and dimensions

The record location and dimensions for continuous recording shall be as specified in figures 1 and 2 and table 1 or table 2. In recording, sector locations on each helical track shall be contained within the tolerance specified in figure 1 and table 1 or table 2.

The reference edge of the tape for dimensions specified in this standard shall be the lower edge as shown in figure 1. The magnetic coating, with the direction of tape travel as shown in figure 1, is on the side facing the observer.

As indicated in figure 1, this standard anticipates a zero guard band between recorded tracks. The nominal record head width shall be equal to the track pitch of 18 μm. The scanner head configuration should be chosen such that the recorded track widths are contained within the limits of 16 μm to 20 μm.

The format requires flying erasure for recording. In insert editing, this standard provides a guard band of 3 μm ± 1.5 μm between the previously recorded track and the inserted track at editing points only. A typical track pattern for insert editing is shown in figure B.1 of annex B.

5.4 Helical track record tolerance zones

The lower edge of eight consecutive tracks starting at the first track in each frame shall be contained within the pattern of the eight tolerance zones established in figure 3. Each zone is defined by two parallel lines which are inclined at an angle of 9.1784° basic with respect to the tape reference edge. The centerlines of each zone shall be spaced apart 18.0 μm basic. The width of zone 2 shall be 3 μm and the width of zones 1, 3 to 8 shall be 5 μm. These zones are established to contain track angle errors, track straightness errors, and vertical head offset tolerance (the measuring technique is shown in annex C).

5.5 Relative positions of recorded information

5.5.1 Relative positions of longitudinal tracks

Audio, video, control track and cue track with information intended to be time coincident shall be positioned as shown in figures 1 and 2.

5.5.2 Program area reference point

The program area reference point is determined by the intersection of a line parallel to the reference edge of the tape at a distance Y_0 from the reference edge and the centerline of track 0 in each ITI sector (see figures 1 and 2).

The end of the preamble and beginning of SSA in the ITI sector shall be recorded at the program area reference point, and the tolerance of dimension X_0. The locations are shown in figures 1 and 2; dimensions X_0 and Y_0 are specified in tables 1 and 2. The relationship between sectors and contents of each sector is specified in clause 6.

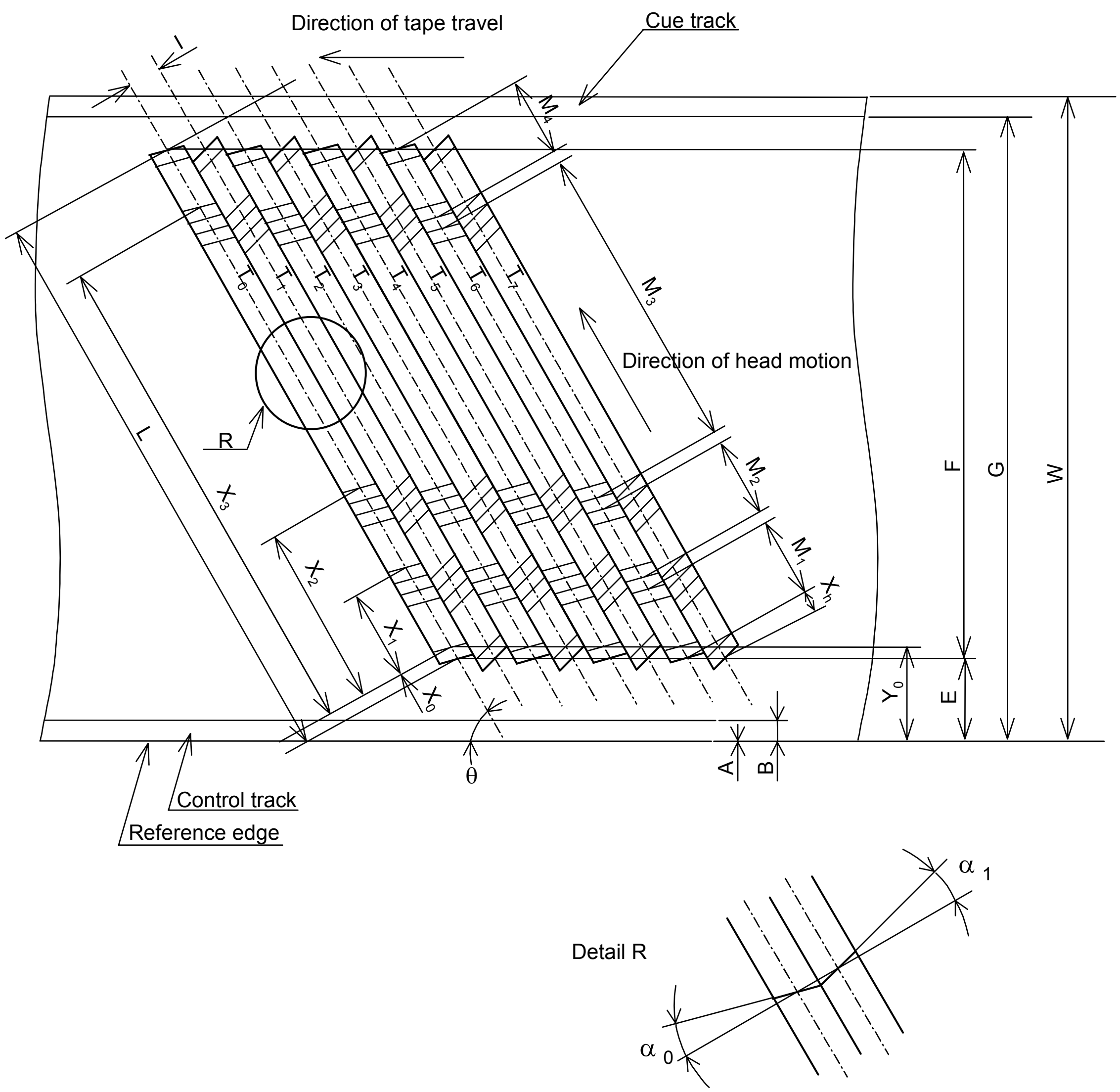


Figure 1 – Location and dimensions of recorded tracks

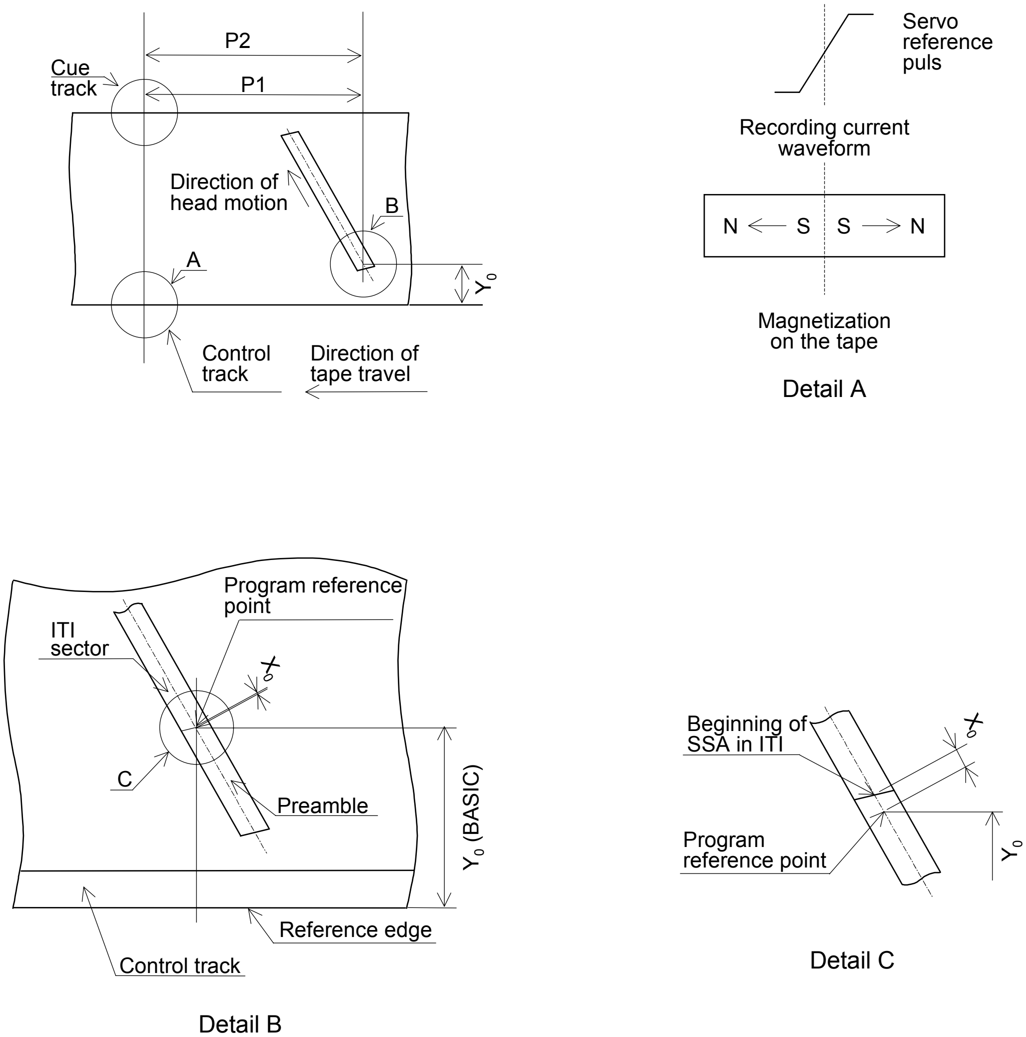


Figure 2 – Location of recorded cue and control track

Table 1 – Record location and dimensions for the 60-Hz system

Dimensions in millimeters

Dimensions		Nominal	Tolerance
A	Control track lower edge	0	Basic
B	Control track upper edge	0.400	± 0.050
E	Program area lower edge	0.56	Derived
F	Program area width	5.24	Derived
G	Cue track lower edge	6.000	± 0.050
I	Helical track pitch	0.018	Ref.
L	Total length of helical track	32.842	Derived
M_1	Length of ITI sector with pre and post-amble	0.876	Derived
M_2	Length of audio sector with pre and post-amble	2.810	Derived
M_3	Length of video sector with pre and post-amble	27.548	Derived
M_4	Length of subcode sector with pre and post-amble	0.906	Derived
P_1	Control track reference pulse to program reference point (see figure 2)	67.500	± 0.030
P_2	Cue signal, start of codeword of cue to program reference point (see figure 2)	67.500	± 0.300
W	Tape width	6.350	± 0.005
X_0	Location of beginning of SSA in ITI sector	0	± 0.050
X_1	Location of start of audio data sync blocks	0.809	± 0.050
X_2	Location of start of video data sync blocks	3.790	± 0.050
X_3	Location of start of subcode data sync blocks	31.885	± 0.050
Xh	Head stagger and inline tolerance	0.111	± 0.021
Y_0	Program track reference point	0.615	Basic
θ	Track angle	9.1784 °	Basic
α_0	Azimuth angle (track 0, 2, 4, 6)	19.97 °	± 0.150 °
α_1	Azimuth angle (track 1, 3, 5, 7)	20.03 °	± 0.150 °

NOTE – Measurements shall be made under the conditions specified in 3.1. The measurements shall be corrected to account for actual tape speed (see figures C.1 and C.2)

Table 2 – Record location and dimensions for the 50-Hz system

Dimensions in millimeters

Dimensions		Nominal	Tolerance
A	Control track lower edge	0	Basic
B	Control track upper edge	0.400	± 0.050
E	Program area lower edge	0.56	Derived
F	Program area width	5.24	Derived
G	Cue track lower edge	6.000	± 0.050
I	Helical track pitch	0.018	Ref.
L	Total length of helical track	32.842	Derived
M1	Length of ITI sector with pre and post-amble	0.877	Derived
M2	Length of audio sector with pre and post-amble	2.813	Derived
M3	Length of video sector with pre and post-amble	27.576	Derived
M4	Length of subcode sector with pre and post-amble	0.877	Derived
P1	Control track reference pulse to program reference point (see figure 2)	67.500	± 0.030
P2	Cue signal, start of codeword of cue to program reference point (see figure 2)	67.500	± 0.300
W	Tape width	6.350	± 0.005
X0	Location of beginning of SSA in ITI sector	0	± 0.050
X1	Location of start of audio data sync blocks	0.810	± 0.050
X2	Location of start of video data sync blocks	3.793	± 0.050
X3	Location of start of subcode data sync blocks	31.917	± 0.050
Xh	Head stagger and inline tolerance	0.111	± 0.021
Y0	Program track reference point	0.615	Basic
θ	Track angle	9.1784 °	Basic
α0	Azimuth angle (track 0, 2, 4, 6)	19.97 °	± 0.150 °
α1	Azimuth angle (track 1, 3, 5, 7)	20.03 °	± 0.150 °

NOTE – Measurements shall be made under the conditions specified in 3.1. The measurements shall be corrected to account for actual tape speed (see figures C.1 and C.2)

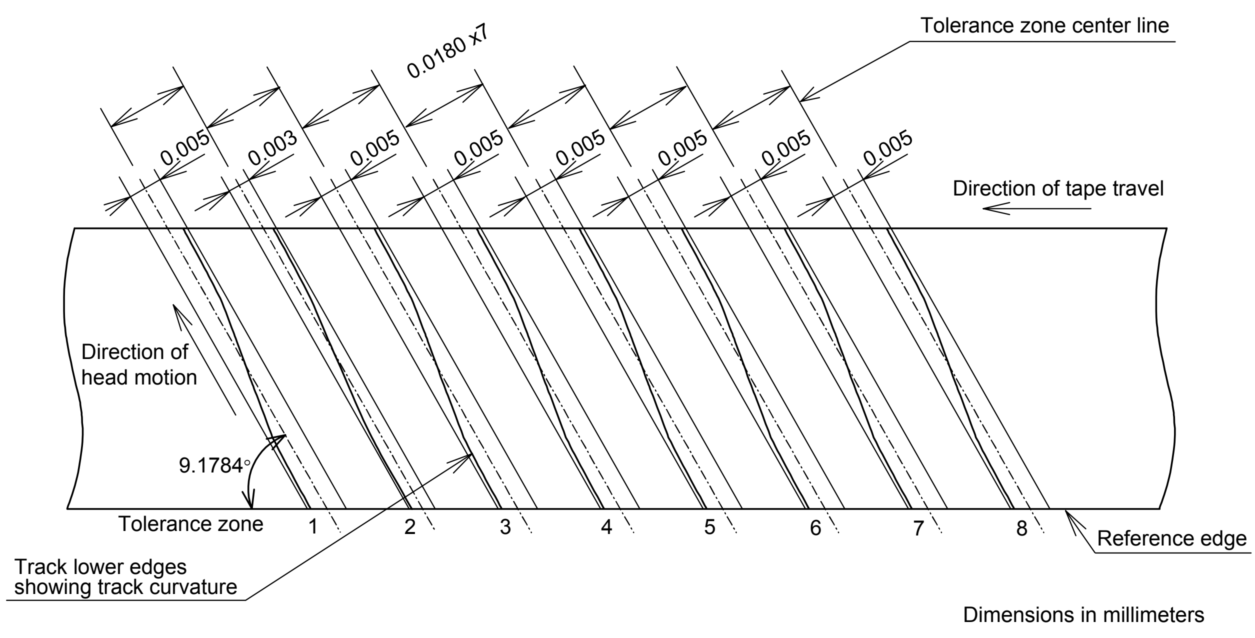


Figure 3 – Location and dimensions of tolerance zone of recorded helical tracks

5.6 Gap azimuth

5.6.1 Cue and control track

The angle of the cue and control track head gaps used to produce longitudinal track records shall be perpendicular to the track record.

5.6.2 Helical track

The azimuth of the head gaps which are used for the helical track shall be inclined at angles α_0 and α_1 as specified in table 1 or table 2 with respect to a line perpendicular to the helical track (see figure 1). The azimuth of track No. 0, 2, 4, and 6 for every field shall be oriented in a clockwise direction with respect to a line perpendicular to the helical track direction when viewed from the side of the tape containing the magnetic record.

5.7 Transport and scanner

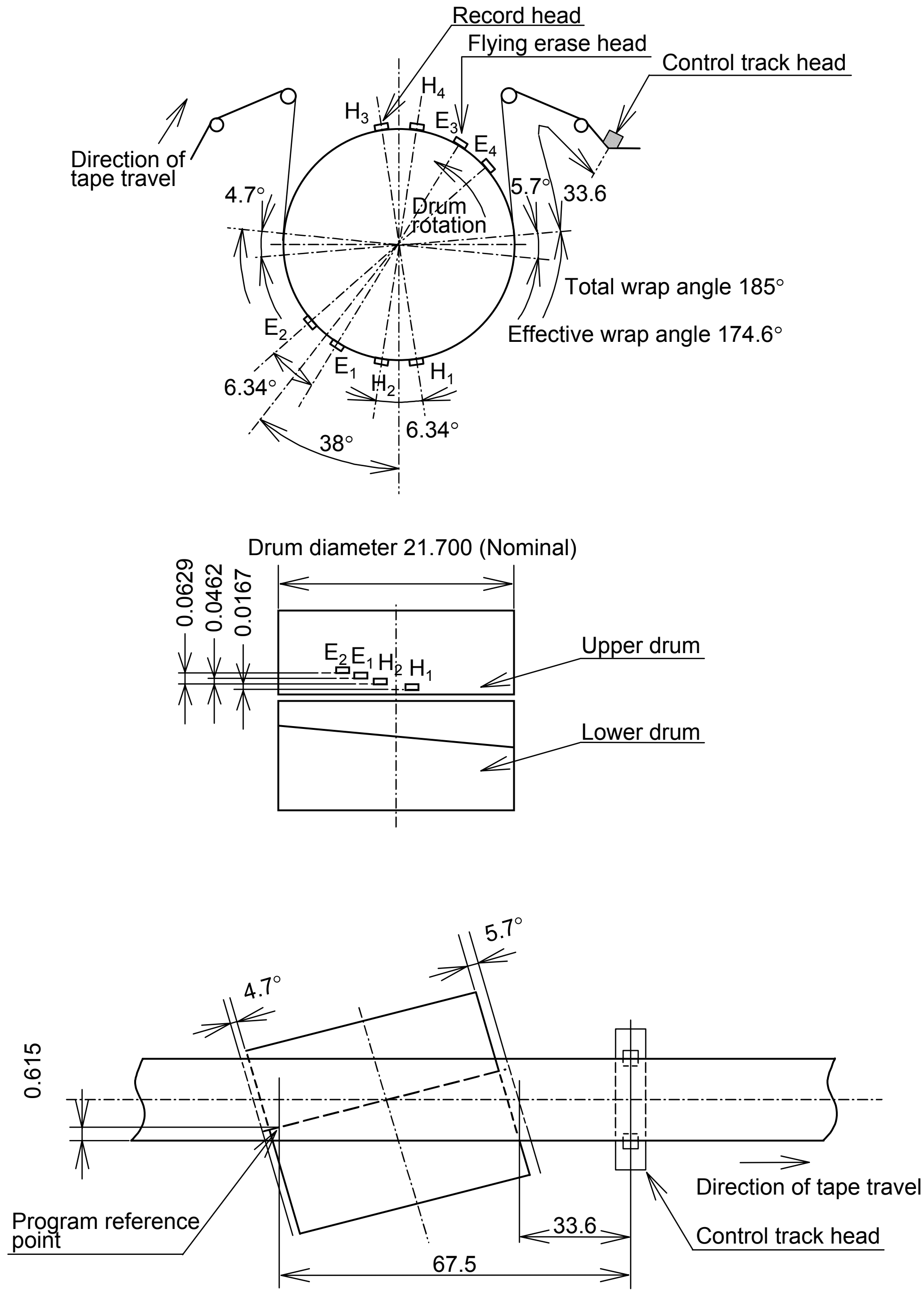
The effective drum diameter, tape tension, helix angle, and tape speed taken together determine the track angle. Different methods of design and/or variations in drum diameter and tape tension can produce equivalent recordings for interchange purposes.

A possible configuration of the transport uses a scanner with an effective diameter of 21.700 mm. Scanner rotation is in the same direction as tape motion during normal playback mode.

Data are recorded by two pairs of heads each mounted 180° apart or four pairs of heads each mounted 90° apart. Figures 4 and 5 shows a possible mechanical configuration of the scanner and the relationship between the longitudinal heads and the scanner. Table 3 shows the corresponding mechanical parameters. Other mechanical configurations are allowable provided the same footprint of recorded information is produced on tape.

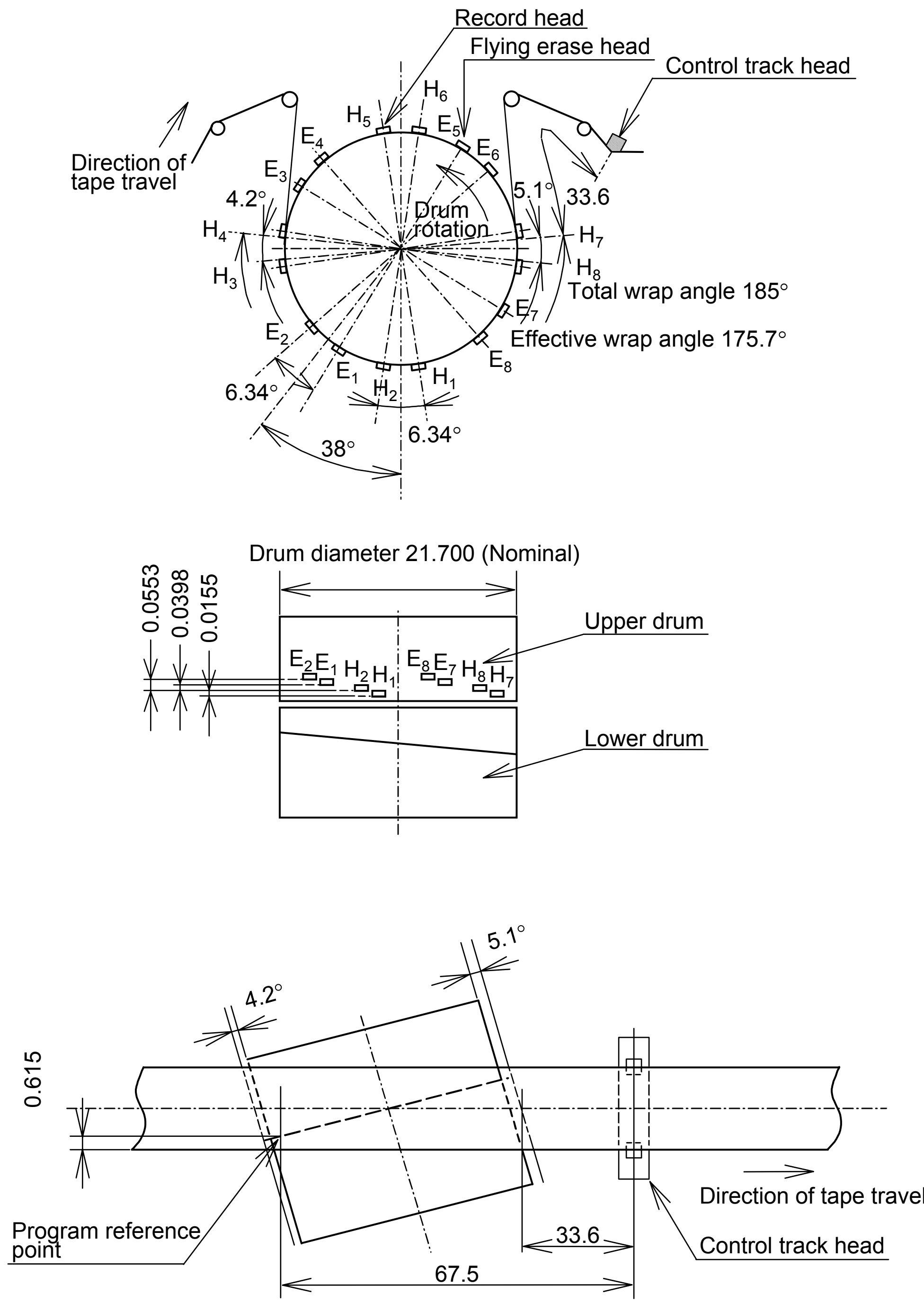
Table 3 – Parameters for a possible scanner design

Parameters	configuration			
	60 Hz system		50 Hz system	
Scanner rotation speed (rpm)	18000/1.001	9000/1.001	18000	9000
Number of tracks per rotation	4	8	4	8
Drum diameter (mm)	21.700	21.700	21.700	21.700
Center span tension (N)	0.09	0.09	0.09	0.09
Helix angle (degrees)	9.1197	9.0592	9.1197	9.0592
Effective wrap angle (degrees)	174.6	175.7	174.6	175.7
Scanner circumferential speed (m/s)	20.298	10.082	20.318	10.092
Bit frequency f_b (Hz)	83430000	41438200	83430000	41438200
H1, H3 over wrap head entrance (degrees)	4.7	4.2	4.7	4.2
H1, H3 over wrap head exit (degrees)	5.7	5.1	5.7	5.1
Maximum tip projection (μm)	20	20	20	20
Record head track width (μm)	18	18	18	18



Dimensions in millimeters

Figure 4 – Possible scanner configuration and tape wrap for four heads construction



Dimensions in millimeters

Figure 5 – Possible scanner configuration and tape wrap for eight heads construction

6 Program track data

6.1 General

6.1.1 Introduction

The helical tracks contain digital data from the ITI sector, audio sector, video sector, and subcode sector. The ITI sector contains the start sync and track information. The subcode sector contains the time and control code data and it may also include other optional data.

Figure 6 shows a block diagram of the typical recording circuit. The compression part in the dotted line rectangle refers to SMPTE 370M. Figure 7 shows the arrangement of the ITI sector, audio and video sectors, and the subcode sector on the tape. All edit gaps between sectors accommodate timing errors during editing.

In 1080/60i and 1080/50i systems, video frame data, audio frame data and subcode data are processed in each frame. The audio frame is defined as an audio-processing unit. In the 720/60p system, data of two video frames are processed within one frame duration of the 1080/60i system. Consequently, video frame can be edited in frame pairs, and audio data and subcode data are processed exactly the same way as the 1080/60i system.

NOTE – SMPTE 12M does not allow distinction between the two identical time code assigned to two adjacent frames in the 720p system.

Each video frame is recorded on 40 tracks in the 1080/60i system, 48 tracks in the 1080/50i system, and 20 tracks in the 720/60p system. Each audio frame is recorded on 40 tracks in the 1080/60i system, 48 tracks in the 1080/50i system, and 40 tracks in the 720/60p system. One audio frame equals two video frames (frames 1 and 2) in the 720/60p system.

Each frame of time code shows a frame number that corresponds to each video frame in 1080-line system, and two video frames each in 720/60p system. Therefore, time codes of the 1080/60i and 720/60p systems are the same.

6.1.2 Labeling convention

The most significant bit is written on the left and 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. An h subscript indicates a hexadecimal value.

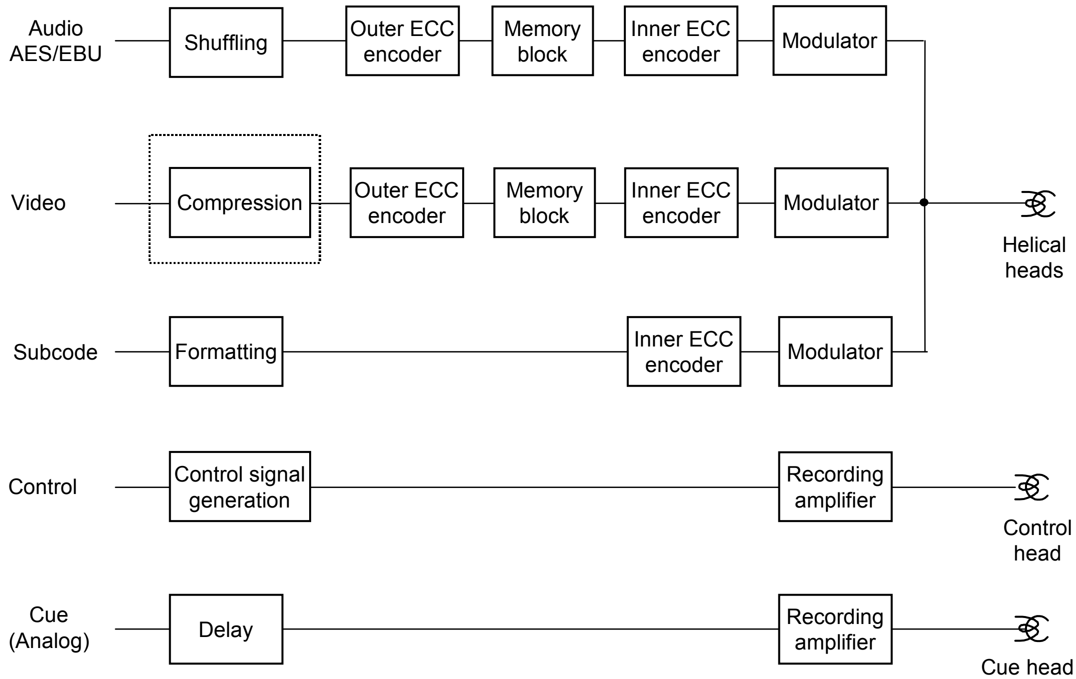
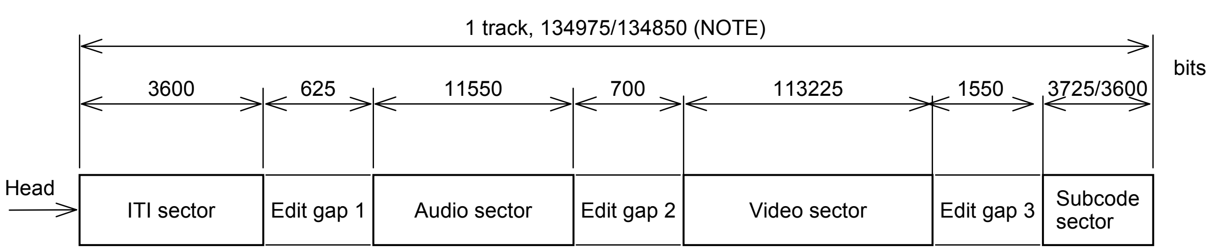


Figure 6 – Possible recording system configuration



NOTE – 60-Hz system / 50-Hz system

Figure 7 – Sector arrangement on helical track

6.1.3 Signal processing

The modulation of this standard adopts the randomization and the 24-25 modulation. The randomization limits the run length of a same binary value. The 24-25 modulation is defined as insertion of an extra bit to the 24 bits data and interleaved NRZI modulation.

Figures 8 to 10 show the processing of modulation related to the recorded signals. The program track data with the exception of ID0 shall be processed through three operations as shown below:

- Randomization;
- 24-25 modulation;
- Precoding.

The program track data of ID0 shall be processed through two operations as shown below:

- Randomization;
- Precoding.

The preamble and postamble shall be 24-25 modulated by selecting pattern A or B according to the modulation rule in 6.1.3.2.

The sync pattern shall not be processed through 24-25 modulation, but is selected from pattern F or G for audio and video sync blocks and pattern D or E for subcode sync block according to modulation rules in 6.1.3.2.

Figure 11 shows a possible block diagram of the process.

6.1.3.1 Randomization

The data except sync patterns shall be randomized. The randomizing is equivalent to performing the exclusive-or operation between the input serial data and the serial data generated by the polynomial function below:

$$X^7 + X^3 + 1$$

where X^i are place-keeping variables in GF(2), the binary field. The first term is the most significant and the first to enter the division computation. The randomization is reset at ID0. The randomization limits the run length of the same binary value.

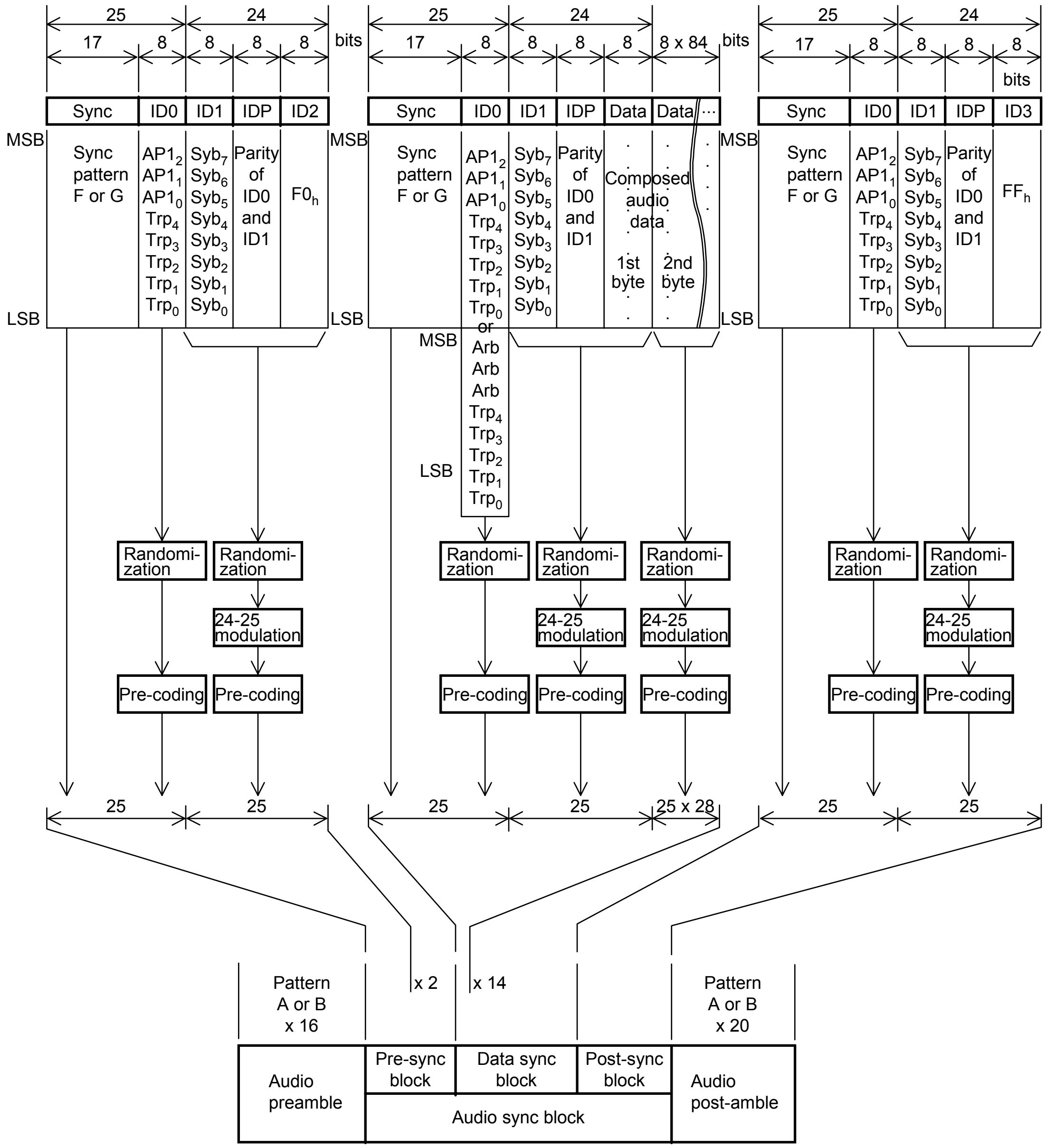


Figure 8 – Modulation for audio sector

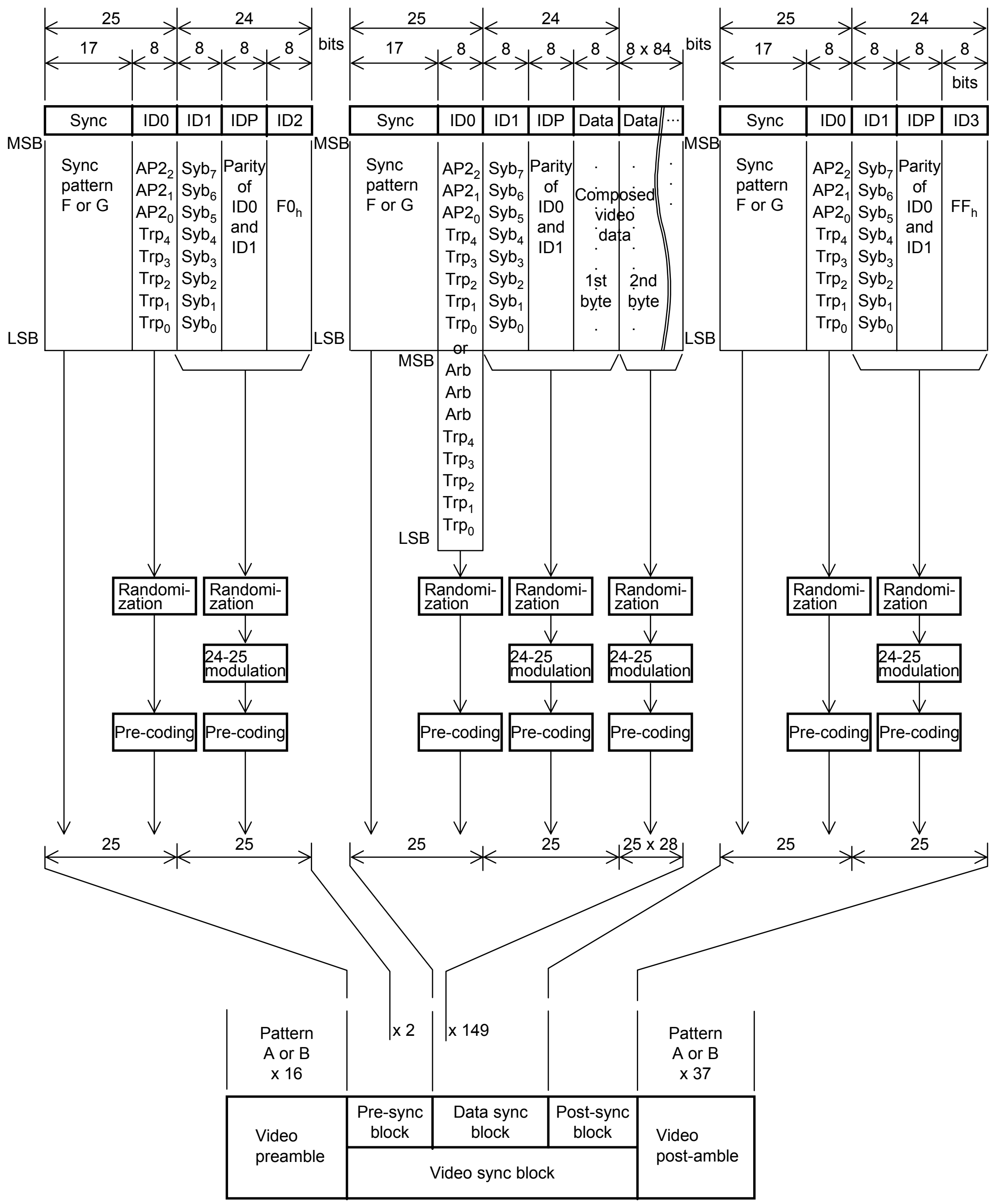


Figure 9 – Modulation for video sector

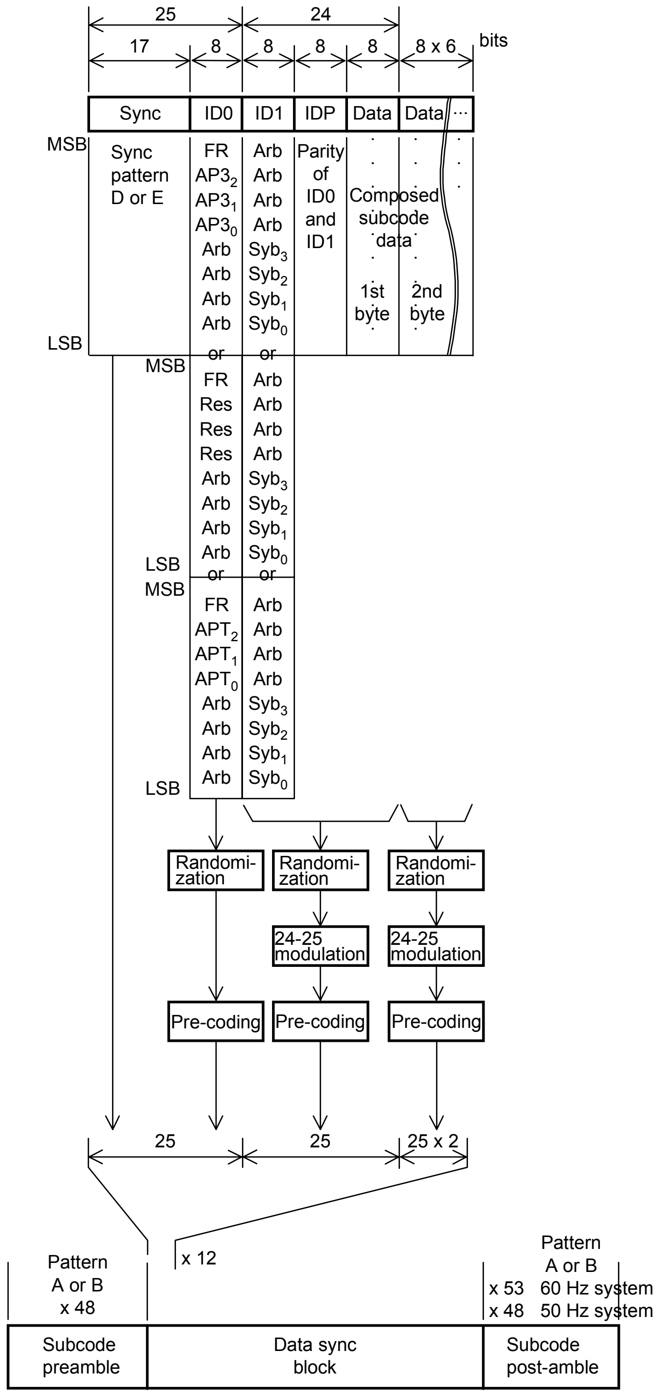


Figure 10 – Modulation for subcode sector

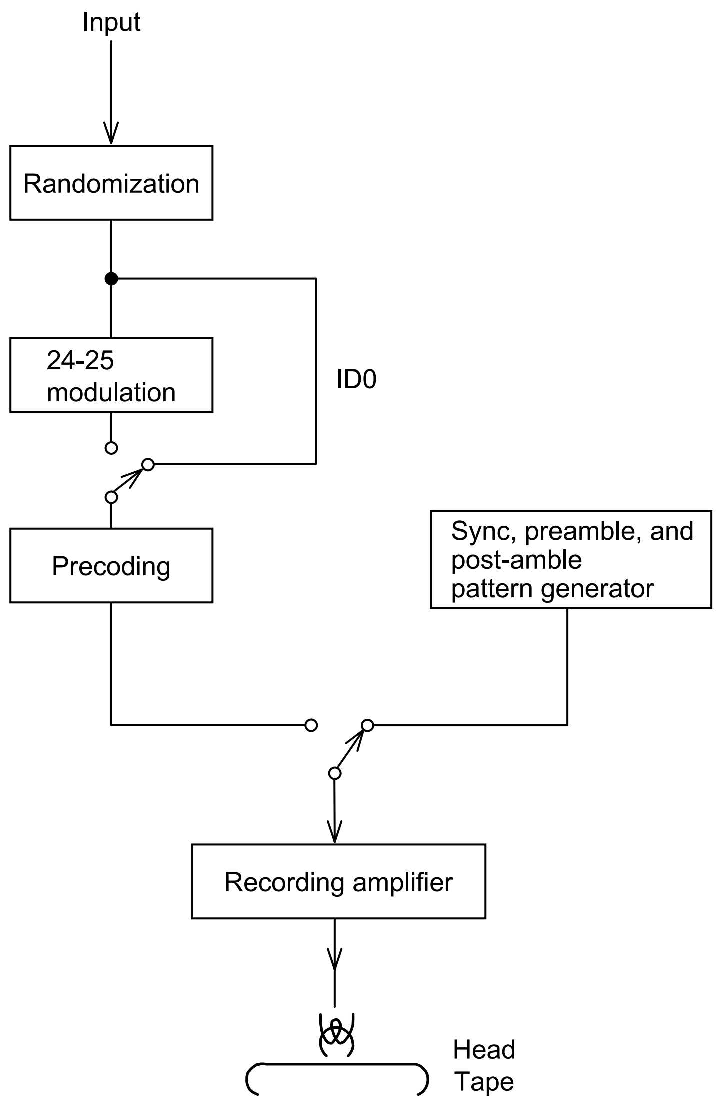


Figure 11 – Possible block diagram for signal processing

6.1.3.2 24-25 modulation

The 24-25 modulation is applied to the randomized data. An extra bit is inserted before the three consecutive randomized bytes as shown in figure 12. The modulated output, 25 bit data, is referred to as a codeword. The following criteria are used to insert the extra bit:

1) If the run length of 0s or 1s is ten or more, including the extra bit to be inserted at the junction, then the value of the extra bit shall be chosen so as not to make the run length any longer except in the case that the value of the bit in front and behind the junction is different and the run length is the same.

2) If the run length is 9 or less, including the extra bit to be inserted at the junction, then the value of the extra bit shall be chosen to make the frequency characteristics of the pre-coded data nearer to the pilot signal as shown in figures 13 and 14.

3) If the value of the bit in front and behind the junction are different and each run length is same, the value of the extra bit shall be chosen to make the frequency characteristics of the pre-coded data nearer to the pilot signal as shown in figures 13 and 14.

For the generation of the ATF signal, 24-25 modulation is applied to the data. The converted data satisfies the following conditions:

– Track F_0: Attenuation of f_1 and f_2 frequency components by at least 9 dB;
– Track F_1: Generation of f_1 component of at least 16 dB, but not more than 19 dB;
– Track F_2: Generation of f_2 component of at least 16 dB, but not more than 19 dB.

where $f_1 = f_b / 90$ (Hz)
$f_2 = f_b / 60$ (Hz)
f_b =The frequency whose period is a time interval of one channel bit(Hz)

The modulated data are recorded on the tracks in the repeated cycle of F_0 - F_1 - F_0 - F_2 sequence. Table 4 shows the relation between track and servo information.

6.1.3.3 Precoding

The modulated bit stream shall be converted to interleaved NRZI as shown in figure 15.

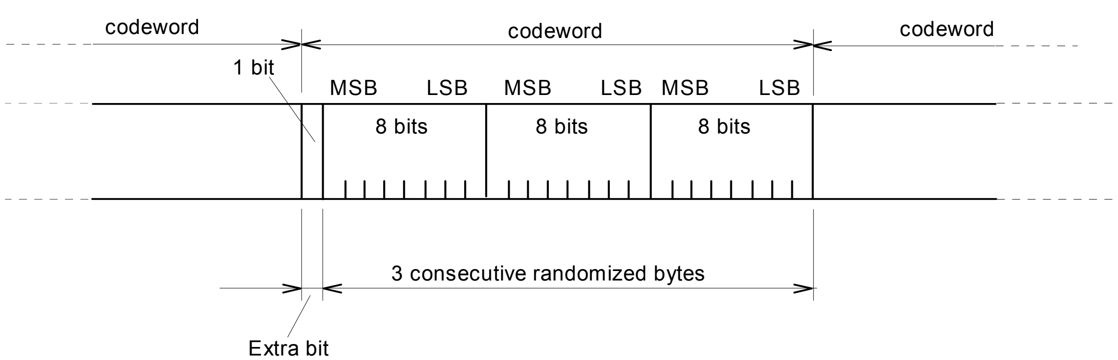
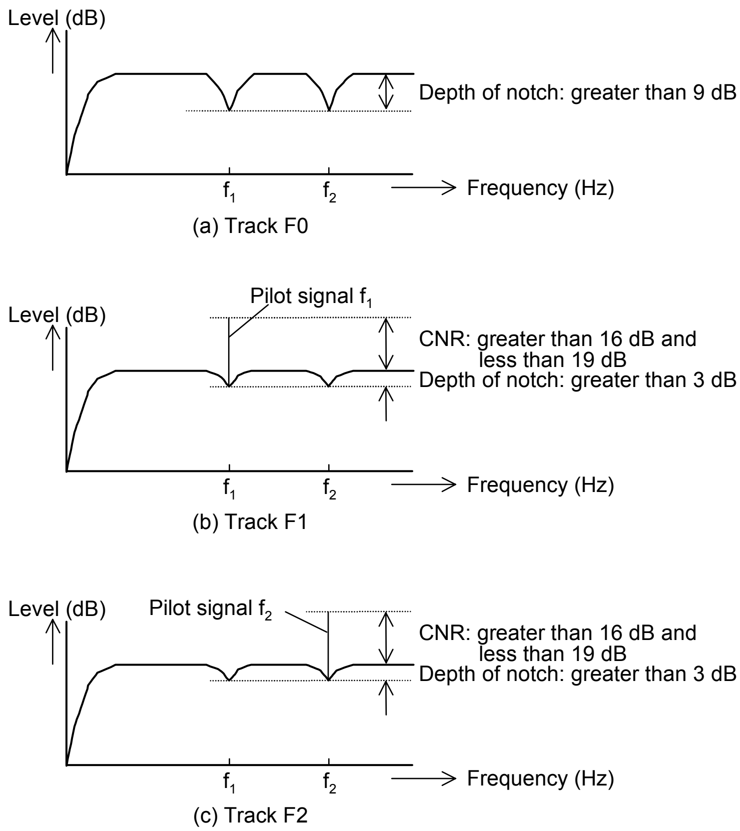


Figure 12 – Bit stream before interleaved NRZI modulation



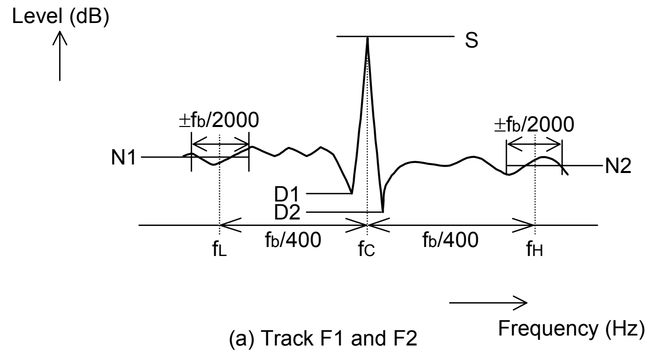
NOTES

1 $f_1 = f_b / 90$ (Hz)
$f_2 = f_b / 60$ (Hz)
f_b =The frequency whose period is a time interval of one channel bit(Hz)
Resolution bandwidth $=f_b/20925$(Hz)
Data is obtained by integration over 30 repeated cycles

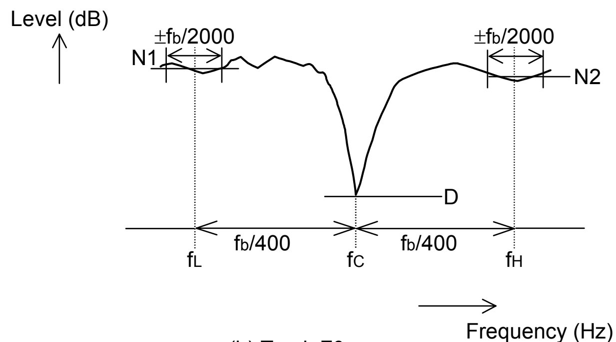
2 CNR =[S - (N1 + N2) / 2] (dB)
Depth of Notch with peak = [(N1+N2) / 2 - (D1+D2) / 2] (dB)
Depth of Notch without peak = [(N1+N2) / 2 - D] (dB)
N1 is defined as an average value over $f_L \pm f_b / 2000$ (dB)
N2 is defined as an average value over $f_H \pm f_b / 2000$ (dB)
f_L is defined as $fc - f_b / 400$ (Hz)
f_H is defined as $fc + f_b / 400$ (Hz)
fc means a peak or notch frequency (Hz)

3 DC free

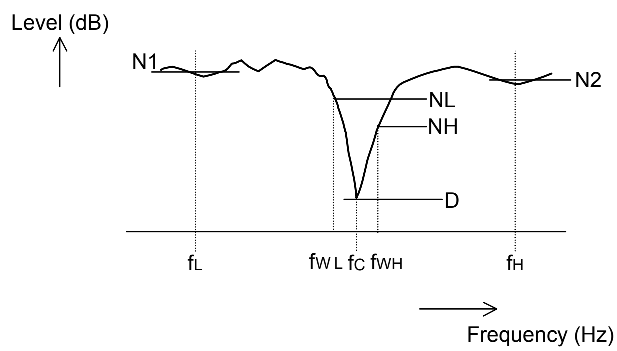
Figure 13 – Frequency characteristics of tracks



(a) Track F1 and F2



(b) Track F0



(c) Track F0

NOTE – The recommended frequency characteristics of the F_0 track shall be defined as follows:

[(N1+N2)/2] - [(NL+NH)/2] > 5 [dB]

f_{WL} is defined as fc - fb/4000.
f_{WH} is defined as fc + fb/4000.
NL is defined as amplitude at the f_{WL}.
NH is defined as amplitude at the f_{WH}.

Figure 14 – Frequency characteristics of tracks(detail)

Table 4 – Servo information

50-Hz system		60-Hz system	
Track number	Servo information	Track number	Servo information
T0	F0	T0	F0
T1	F1	T1	F1
T2	F0	T2	F0
T3	F2	T3	F2
T4	F0	T4	F0
T5	F1	T5	F1
T6	F0	T6	F0
T7	F2	T7	F2
T8	F0	T8	F0
⋮	⋮	⋮	⋮
⋮	⋮	T36	F0
⋮	⋮	T37	F1
⋮	⋮	T38	F0
⋮	⋮	T39	F2
T44	F0	nonexistent	
T45	F1		
T46	F0		
T47	F2		

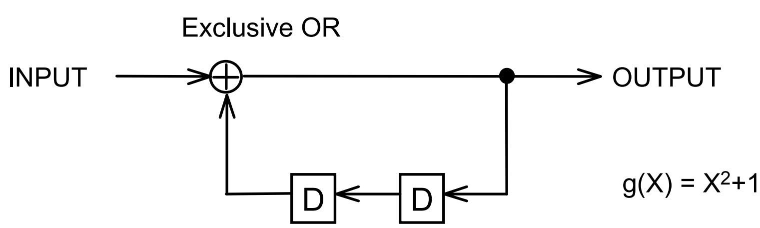


Figure 15 – Precoding

6.1.4 Magnetization

6.1.4.1 Polarity

The recorder shall operate in reproduction without regard to the polarity of the recorded flux on the helical tracks.

6.1.4.2 Record equalization

The record current shall generate a record head gap flux level that is constant within ± 1 dB between and f_1 and $f_b/2$.

6.1.4.3 Record current level

The optimum record current is 6 dB higher than the lower side of the current value producing 1 dB below the maximum playback output at $f_b/2$.

6.2 ITI sector

6.2.1 Structure

The ITI sector is located at the entrance side of each track for accurate placement of the reproducing head. The ITI sector, after initial recording, is not replaced in an editing operation.

The ITI sector contains the following elements:

- ITI preamble;
- Start sync area (SSA);
- Track information area (TIA);
- ITI postamble.

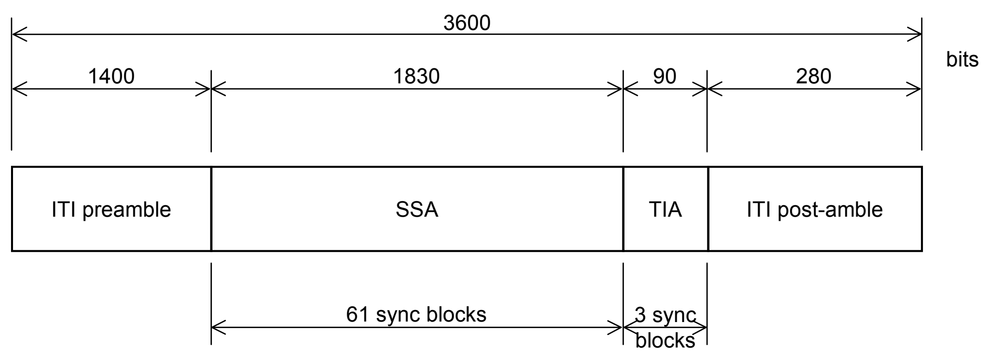
Figure 16 shows the structure of the ITI sector.

6.2.2 ITI preamble

The bit stream of the ITI preamble before the recording shall be defined in tables 5 to 7 in accordance with the ATF signal for each track. The length of the ITI preamble shall be 1400 bits as recorded on tape.

6.2.3 SSA

SSA consists of 61 sync blocks and each sync block consists of 30 bits. Every start-sync block has a number which indicates the position of the sync block from the beginning of the SSA from zero. The bit stream of the SSA after the modulation shall be as defined in tables 8 to 10 in accordance with the ATF signals. The length of the SSA shall be 1830 bits as recorded on tape.



NOTE – Each sync block has 30 bits.

Figure 16 – Structure of ITI sector

Table 5 – Bit stream of ITI preamble for servo information F_0

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1000101110	40	1000101110	80	1000101110	120	1000101110
1	1000101110	41	1000101110	81	1000101110	121	1000101110
2	1000101110	42	1000101110	82	1000101110	122	1000101110
3	1000101110	43	1000101110	83	1000101110	123	1000101110
4	1000101110	44	1000101110	84	1000101110	124	1000101110
5	1000101110	45	1000101110	85	1000101110	125	1000101110
6	1000101110	46	1000101110	86	1000101110	126	1000101110
7	1000101110	47	1000101110	87	1000101110	127	1000101110
8	1000101110	48	1000101110	88	1000101110	128	1000101110
9	1000101110	49	1000101110	89	1000101110	129	1000101110
10	1000101110	50	1000101110	90	1000101110	130	1000101110
11	1000101110	51	1000101110	91	1000101110	131	1000101110
12	1000101110	52	1000101110	92	1000101110	132	1000101110
13	1000101110	53	1000101110	93	1000101110	133	1000101110
14	1000101110	54	1000101110	94	1000101110	134	1000101110
15	1000101110	55	1000101110	95	1000101110	135	1000101110
16	1000101110	56	1000101110	96	1000101110	136	1000101110
17	1000101110	57	1000101110	97	1000101110	137	1000101110
18	1000101110	58	1000101110	98	1000101110	138	1000101110
19	1000101110	59	1000101110	99	1000101110	139	1000101110
20	1000101110	60	1000101110	100	1000101110		
21	1000101110	61	1000101110	101	1000101110		
22	1000101110	62	1000101110	102	1000101110		
23	1000101110	63	1000101110	103	1000101110		
24	1000101110	64	1000101110	104	1000101110		
25	1000101110	65	1000101110	105	1000101110		
26	1000101110	66	1000101110	106	1000101110		
27	1000101110	67	1000101110	107	1000101110		
28	1000101110	68	1000101110	108	1000101110		
29	1000101110	69	1000101110	109	1000101110		
30	1000101110	70	1000101110	110	1000101110		
31	1000101110	71	1000101110	111	1000101110		
32	1000101110	72	1000101110	112	1000101110		
33	1000101110	73	1000101110	113	1000101110		
34	1000101110	74	1000101110	114	1000101110		
35	1000101110	75	1000101110	115	1000101110		
36	1000101110	76	1000101110	116	1000101110		
37	1000101110	77	1000101110	117	1000101110		
38	1000101110	78	1000101110	118	1000101110		
39	1000101110	79	1000101110	119	1000101110		

Table 6 – Bit stream of ITI preamble for servo information F_1

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1101110001	40	1000101110	80	0010001110	120	1101110001
1	1101110001	41	0010001110	81	1101110001	121	1000101110
2	1101110001	42	0010001110	82	1101110001	122	0010001110
3	1101110001	43	0010001110	83	1101110001	123	0010001110
4	1000101110	44	0010001110	84	1101110001	124	0010001110
5	0010001110	45	1101110001	85	1000101110	125	0010001110
6	0010001110	46	1101110001	86	0010001110	126	1101110001
7	0010001110	47	1101110001	87	0010001110	127	1101110001
8	0010001110	48	1101110001	88	0010001110	128	1101110001
9	1101110001	49	1000101110	89	0010001110	129	1101110001
10	1101110001	50	0010001110	90	1101110001	130	1000101110
11	1101110001	51	0010001110	91	1101110001	131	0010001110
12	1101110001	52	0010001110	92	1101110001	132	0010001110
13	1000101110	53	0010001110	93	1101110001	133	0010001110
14	0010001110	54	1101110001	94	1000101110	134	0010001110
15	0010001110	55	1101110001	95	0010001110	135	1101110001
16	0010001110	56	1101110001	96	0010001110	136	1101110001
17	0010001110	57	1101110001	97	0010001110	137	1101110001
18	1101110001	58	1000101110	98	0010001110	138	1101110001
19	1101110001	59	0010001110	99	1101110001	139	1000101110
20	1101110001	60	0010001110	100	1101110001		
21	1101110001	61	0010001110	101	1101110001		
22	1000101110	62	0010001110	102	1101110001		
23	0010001110	63	1101110001	103	1000101110		
24	0010001110	64	1101110001	104	0010001110		
25	0010001110	65	1101110001	105	0010001110		
26	0010001110	66	1101110001	106	0010001110		
27	1101110001	67	1000101110	107	0010001110		
28	1101110001	68	0010001110	108	1101110001		
29	1101110001	69	0010001110	109	1101110001		
30	1101110001	70	0010001110	110	1101110001		
31	1000101110	71	0010001110	111	1101110001		
32	0010001110	72	1101110001	112	1000101110		
33	0010001110	73	1101110001	113	0010001110		
34	0010001110	74	1101110001	114	0010001110		
35	0010001110	75	1101110001	115	0010001110		
36	1101110001	76	1000101110	116	0010001110		
37	1101110001	77	0010001110	117	1101110001		
38	1101110001	78	0010001110	118	1101110001		
39	1101110001	79	0010001110	119	1101110001		

Table 7 – Bit stream of ITI preamble for servo information F_2

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1101110001	40	0010001110	80	1101110001	120	1101110001
1	1101110001	41	0010001110	81	0010001110	121	1101110001
2	1101110001	42	1101110001	82	0010001110	122	1101110001
3	0010001110	43	1101110001	83	0010001110	123	0010001110
4	0010001110	44	1101110001	84	1101110001	124	0010001110
5	0010001110	45	0010001110	85	1101110001	125	0010001110
6	1101110001	46	0010001110	86	1101110001	126	1101110001
7	1101110001	47	0010001110	87	0010001110	127	1101110001
8	1101110001	48	1101110001	88	0010001110	128	1101110001
9	0010001110	49	1101110001	89	0010001110	129	0010001110
10	0010001110	50	1101110001	90	1101110001	130	0010001110
11	0010001110	51	0010001110	91	1101110001	131	0010001110
12	1101110001	52	0010001110	92	1101110001	132	1101110001
13	1101110001	53	0010001110	93	0010001110	133	1101110001
14	1101110001	54	1101110001	94	0010001110	134	1101110001
15	0010001110	55	1101110001	95	0010001110	135	0010001110
16	0010001110	56	1101110001	96	1101110001	136	0010001110
17	0010001110	57	0010001110	97	1101110001	137	0010001110
18	1101110001	58	0010001110	98	1101110001	138	1101110001
19	1101110001	59	0010001110	99	0010001110	139	1101110001
20	1101110001	60	1101110001	100	0010001110		
21	0010001110	61	1101110001	101	0010001110		
22	0010001110	62	1101110001	102	1101110001		
23	0010001110	63	0010001110	103	1101110001		
24	1101110001	64	0010001110	104	1101110001		
25	1101110001	65	0010001110	105	0010001110		
26	1101110001	66	1101110001	106	0010001110		
27	0010001110	67	1101110001	107	0010001110		
28	0010001110	68	1101110001	108	1101110001		
29	0010001110	69	0010001110	109	1101110001		
30	1101110001	70	0010001110	110	1101110001		
31	1101110001	71	0010001110	111	0010001110		
32	1101110001	72	1101110001	112	0010001110		
33	0010001110	73	1101110001	113	0010001110		
34	0010001110	74	1101110001	114	1101110001		
35	0010001110	75	0010001110	115	1101110001		
36	1101110001	76	0010001110	116	1101110001		
37	1101110001	77	0010001110	117	0010001110		
38	1101110001	78	1101110001	118	0010001110		
39	0010001110	79	1101110001	119	0010001110		

Table 8 – Bit stream of SSA for servo information F_0

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	0010011101	50	0101010101	100	0110101001	150	0010011101
1	0101010101	51	0010011101	101	0101011001	151	0110010101
2	0101010101	52	0101101001	102	0010011101	152	0101101001
3	0010011101	53	0101011001	103	0110101001	153	0010011101
4	0101010101	54	0010011101	104	0101101001	154	0110010101
5	0101011001	55	0101101001	105	0010011101	155	0101100101
6	0010011101	56	0101101001	106	0110101001	156	0010011101
7	0101010101	57	0010011101	107	0101100101	157	0110010101
8	0101101001	58	0101101001	108	0010011101	158	0110101001
9	0010011101	59	0101100101	109	0110101001	159	0010011101
10	0101010101	60	0010011101	110	0110101001	160	0110010101
11	0101100101	61	0101101001	111	0010011101	161	0110100101
12	0010011101	62	0110101001	112	0110101001	162	0010011101
13	0101010101	63	0010011101	113	0110100101	163	0110010101
14	0110101001	64	0101101001	114	0010011101	164	0110010101
15	0010011101	65	0110100101	115	0110101001	165	0010011101
16	0101010101	66	0010011101	116	0110010101	166	0110010101
17	0110100101	67	0101101001	117	0010011101	167	0110011001
18	0010011101	68	0110010101	118	0110101001	168	0010011101
19	0101010101	69	0010011101	119	0110011001	169	0110011001
20	0110010101	70	0101101001	120	0010011101	170	0101010101
21	0010011101	71	0110011001	121	0110100101	171	0010011101
22	0101010101	72	0010011101	122	0101010101	172	0110011001
23	0110011001	73	0101100101	123	0010011101	173	0101011001
24	0010011101	74	0101010101	124	0110100101	174	0010011101
25	0101011001	75	0010011101	125	0101011001	175	0110011001
26	0101010101	76	0101100101	126	0010011101	176	0101101001
27	0010011101	77	0101011001	127	0110100101	177	0010011101
28	0101011001	78	0010011101	128	0101101001	178	0110011001
29	0101011001	79	0101100101	129	0010011101	179	0101100101
30	0010011101	80	0101101001	130	0110100101	180	0010011101
31	0101011001	81	0010011101	131	0101100101	181	0110011001
32	0101101001	82	0101100101	132	0010011101	182	0110101001
33	0010011101	83	0101100101	133	0110100101		
34	0101011001	84	0010011101	134	0110101001		
35	0101100101	85	0101100101	135	0010011101		
36	0010011101	86	0110101001	136	0110100101		
37	0101011001	87	0010011101	137	0110100101		
38	0110101001	88	0101100101	138	0010011101		
39	0010011101	89	0110100101	139	0110100101		
40	0101011001	90	0010011101	140	0110010101		
41	0110100101	91	0101100101	141	0010011101		
42	0010011101	92	0110010101	142	0110100101		
43	0101011001	93	0010011101	143	0110011001		
44	0110010101	94	0101100101	144	0010011101		
45	0010011101	95	0110011001	145	0110010101		
46	0101011001	96	0010011101	146	0101010101		
47	0110011001	97	0110101001	147	0010011101		
48	0010011101	98	0101010101	148	0110010101		
49	0101101001	99	0010011101	149	0101011001		

Table 9 – Bit stream of SSA for servo information F_1

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	0111001000	50	0101010111	100	1001010100	150	1000110111
1	1010101000	51	1000110111	101	1010100100	151	0110010111
2	1010101000	52	0101101011	102	0111001000	152	0101101001
3	0111001000	53	0101011001	103	0110101011	153	0111001000
4	0101010111	54	0111001000	104	0101101011	154	1001101000
5	0101011011	55	1010010100	105	1000110111	155	1010011000
6	1000110111	56	1010010100	106	0110101011	156	0111001000
7	0101010111	57	0111001000	107	0101100101	157	0110010111
8	0101101001	58	0101101011	108	0111001000	158	0110101011
9	0111001000	59	0101100111	109	1001010100	159	1000110111
10	1010101000	60	1000110111	110	1001010100	160	0110010111
11	1010011000	61	0101101011	111	0111001000	161	0110100101
12	0111001000	62	0110101001	112	0110101011	162	0111001000
13	0101010111	63	0111001000	113	0110100111	163	1001101000
14	0110101011	64	1010010100	114	1000110111	164	1001101000
15	1000110111	65	1001011000	115	0110101011	165	0111001000
16	0101010111	66	0111001000	116	0110010101	166	0110010111
17	0110100101	67	0101101011	117	0111001000	167	0110011011
18	0111001000	68	0110010111	118	1001010100	168	1000110111
19	1010101000	69	1000110111	119	1001100100	169	0110011011
20	1001101000	70	0101101011	120	0111001000	170	0101010101
21	0111001000	71	0110011001	121	0110100111	171	0111001000
22	0101010111	72	0111001000	122	0101010111	172	1001100100
23	0110011011	73	1010011000	123	1000110111	173	1010100100
24	1000110111	74	1010101000	124	0110100111	174	0111001000
25	0101011011	75	0111001000	125	0101011001	175	0110011011
26	0101010101	76	0101100111	126	0111001000	176	0101101011
27	0111001000	77	0101011011	127	1001011000	177	1000110111
28	1010100100	78	1000110111	128	1010010100	178	0110011011
29	1010100100	79	0101100111	129	0111001000	179	0101100101
30	0111001000	80	0101101001	130	0110100111	180	0111001000
31	0101011011	81	0111001000	131	0101100111	181	1001100100
32	0101101011	82	1010011000	132	1000110111	182	1001010100
33	1000110111	83	1010011000	133	0110100111		
34	0101011011	84	0111001000	134	0110101001		
35	0101100101	85	0101100111	135	0111001000		
36	0111001000	86	0110101011	136	1001011000		
37	1010100100	87	1000110111	137	1001011000		
38	1001010100	88	0101100111	138	0111001000		
39	0111001000	89	0110100101	139	0110100111		
40	0101011011	90	0111001000	140	0110010111		
41	0110100111	91	1010011000	141	1000110111		
42	1000110111	92	1001101000	142	0110100111		
43	0101011011	93	0111001000	143	0110011001		
44	0110010101	94	0101100111	144	0111001000		
45	0111001000	95	0110011011	145	1001101000		
46	1010100100	96	1000110111	146	1010101000		
47	1001100100	97	0110101011	147	0111001000		
48	0111001000	98	0101010101	148	0110010111		
49	0101101011	99	0111001000	149	0101011011		

Table 10 – Bit stream of SSA for servo information F_2

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1000110111	50	1010101000	100	0110101011	150	1000110111
1	1010101000	51	0111001000	101	0101011011	151	1001101000
2	1010101000	52	0101101011	102	1000110111	152	1010010100
3	0111001000	53	0101011011	103	1001010100	153	0111001000
4	0101010111	54	1000110111	104	1010010100	154	0110010111
5	0101011011	55	1010010100	105	0111001000	155	0101100111
6	1000110111	56	1010010100	106	0110101011	156	1000110111
7	1010101000	57	0111001000	107	0101100111	157	1001101000
8	1010010100	58	0101101011	108	1000110111	158	1001010100
9	0111001000	59	0101100111	109	1001010100	159	0111001000
10	0101010111	60	1000110111	110	1001010100	160	0110010111
11	0101100111	61	1010010100	111	0111001000	161	0110100111
12	1000110111	62	1001010100	112	0110101011	162	1000110111
13	1010101000	63	0111001000	113	0110100111	163	1001101000
14	1001010100	64	0101101011	114	1000110111	164	1001101000
15	0111001000	65	0110100111	115	1001010100	165	0111001000
16	0101010111	66	1000110111	116	1001101000	166	0110010111
17	0110100111	67	1010010100	117	0111001000	167	0110011011
18	1000110111	68	1001101000	118	0110101011	168	1000110111
19	1010101000	69	0111001000	119	0110011011	169	1001100100
20	1001101000	70	0101101011	120	1000110111	170	1010101000
21	0111001000	71	0110011011	121	1001011000	171	0111001000
22	0101010111	72	1000110111	122	1010101000	172	0110011011
23	0110011011	73	1010011000	123	0111001000	173	0101011011
24	1000110111	74	1010101000	124	0110100111	174	1000110111
25	1010100100	75	0111001000	125	0101011011	175	1001100100
26	1010101000	76	0101100111	126	1000110111	176	1010010100
27	0111001000	77	0101011011	127	1001011000	177	0111001000
28	0101011011	78	1000110111	128	1010010100	178	0110011011
29	0101011011	79	1010011000	129	0111001000	179	0101100111
30	1000110111	80	1010010100	130	0110100111	180	1000110111
31	1010100100	81	0111001000	131	0101100111	181	1001100100
32	1010010100	82	0101100111	132	1000110111	182	1001010100
33	0111001000	83	0101100111	133	1001011000		
34	0101011011	84	1000110111	134	1001010100		
35	0101100111	85	1010011000	135	0111001000		
36	1000110111	86	1001010100	136	0110100111		
37	1010100100	87	0111001000	137	0110100111		
38	1001010100	88	0101100111	138	1000110111		
39	0111001000	89	0110100111	139	1001011000		
40	0101011011	90	1000110111	140	1001101000		
41	0110100111	91	1010011000	141	0111001000		
42	1000110111	92	1001101000	142	0110100111		
43	1010100100	93	0111001000	143	0110011011		
44	1001101000	94	0101100111	144	1000110111		
45	0111001000	95	0110011011	145	1001101000		
46	0101011011	96	1000110111	146	1010101000		
47	0110011011	97	1001010100	147	0111001000		
48	1000110111	98	1010101000	148	0110010111		
49	1010010100	99	0111001000	149	0101011011		

6.2.4 TIA

TIA consists of three sync blocks and each sync block consists of 30 bits. Every sync block has the same track information as APT = 001 and TP = 01. The bit stream of the TIA after the modulation shall be as defined in tables 11 to 13 in accordance with the ATF signals. The length of the TIA shall be 90 bits as recorded on tape.

Table 11 – Bit stream of TIA for servo information F_0

Order of recording	Codeword MSB LSB
0	0010011101
1	0101011001
2	0101101001
3	0010011101
4	0101011001
5	0101101001
6	0010011101
7	0101011001
8	0101101001

Table 12 – Bit stream of TIA for servo information F_1

Order of recording	Codeword MSB LSB
0	0111001000
1	0101011011
2	0101101011
3	1000110111
4	0101011011
5	0101101001
6	0111001000
7	1010100100
8	1010010100

Table 13 – Bit stream of TIA for servo information F_2

Order of recording	Codeword MSB LSB
0	0111001000
1	0101011011
2	0101101011
3	1000110111
4	1010100100
5	1010010100
6	0111001000
7	0101011011
8	0101101011

6.2.5 ITI postamble

The bit stream of the ITI postamble before recording shall be as defined in tables 14 to 16 in accordance with the ATF signals. The length of the ITI postamble shall be 280 bits as recorded on tape.

Table 14 – Bit stream of ITI post-amble for servo information F_0

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1000101110	10	1000101110	20	1000101110
1	1000101110	11	1000101110	21	1000101110
2	1000101110	12	1000101110	22	1000101110
3	1000101110	13	1000101110	23	1000101110
4	1000101110	14	1000101110	24	1000101110
5	1000101110	15	1000101110	25	1000101110
6	1000101110	16	1000101110	26	1000101110
7	1000101110	17	1000101110	27	1000101110
8	1000101110	18	1000101110		
9	1000101110	19	1000101110		

Table 15 – Bit stream of ITI post-amble for servo information F_1

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	0010001110	10	1101110001	20	1101110001
1	1101110001	11	1101110001	21	1101110001
2	1101110001	12	1101110001	22	1101110001
3	1101110001	13	1101110001	23	1000101110
4	1101110001	14	1000101110	24	0010001110
5	1000101110	15	0010001110	25	0010001110
6	0010001110	16	0010001110	26	0010001110
7	0010001110	17	0010001110	27	0010001110
8	0010001110	18	0010001110		
9	0010001110	19	1101110001		

Table 16 – Bit stream of ITI post-amble for servo information F_2

Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB	Order of recording	Codeword MSB LSB
0	1101110001	10	1101110001	20	0010001110
1	0010001110	11	1101110001	21	0010001110
2	0010001110	12	1101110001	22	1101110001
3	0010001110	13	0010001110	23	1101110001
4	1101110001	14	0010001110	24	1101110001
5	1101110001	15	0010001110	25	0010001110
6	1101110001	16	1101110001	26	0010001110
7	0010001110	17	1101110001	27	0010001110
8	0010001110	18	1101110001		
9	0010001110	19	0010001110		

6.3 Audio sector

6.3.1 Structure

The audio sector consists of the following elements:

- audio preamble;
- audio postamble.

The audio sync block contains the following elements:

- presync block;
- data sync block;
- postsync block.

Figure 17 shows the structure of an audio sector.

6.3.2 Audio preamble and postamble

Two types of the audio preamble and postamble pattern are defined as shown below:

```
             MSB                                                         LSB
Pattern A :  0 0 0 1 1 1 0 0 0 1 1 1 0 0 0 0 1 1 1 0 0 0 1 1
Pattern B :  1 1 1 0 0 0 1 1 1 0 0 0 1 1 1 1 0 0 0 1 1 1 0 0
```

Before the recording, a preamble pattern shall be chosen from the above two sequences according to the criteria as described in 6.1.3.2. The length of the audio preamble shall be 400 bits and the length of the audio post-amble shall be 500 bits as recorded on tape.

6.3.3 Audio sync block

Three components, two pre-sync blocks, 14 data sync blocks, and one post-sync block constitute the overall audio sync block structure. Each presync and postsync block consists of a two-byte sync word and a four-byte ID word. The audio data sync block consists of a two-byte sync word, a three-byte ID, and 85 bytes of audio data including inner parity, or 85 bytes of outer and inner parity data, as shown in figure 18.

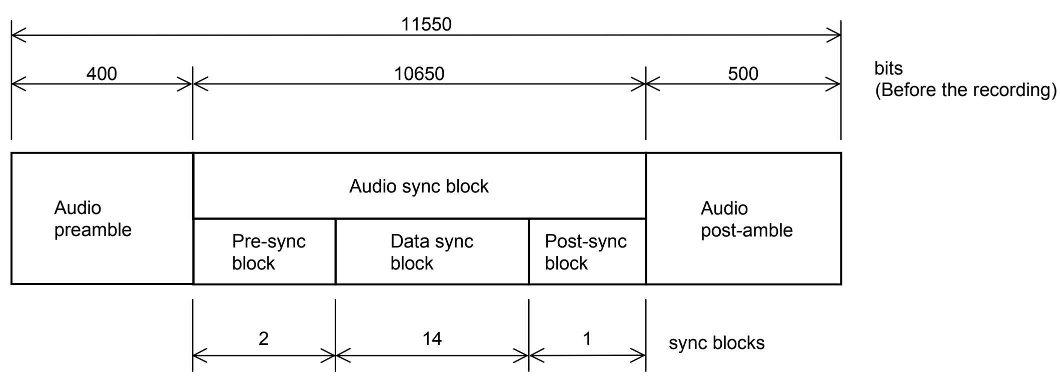
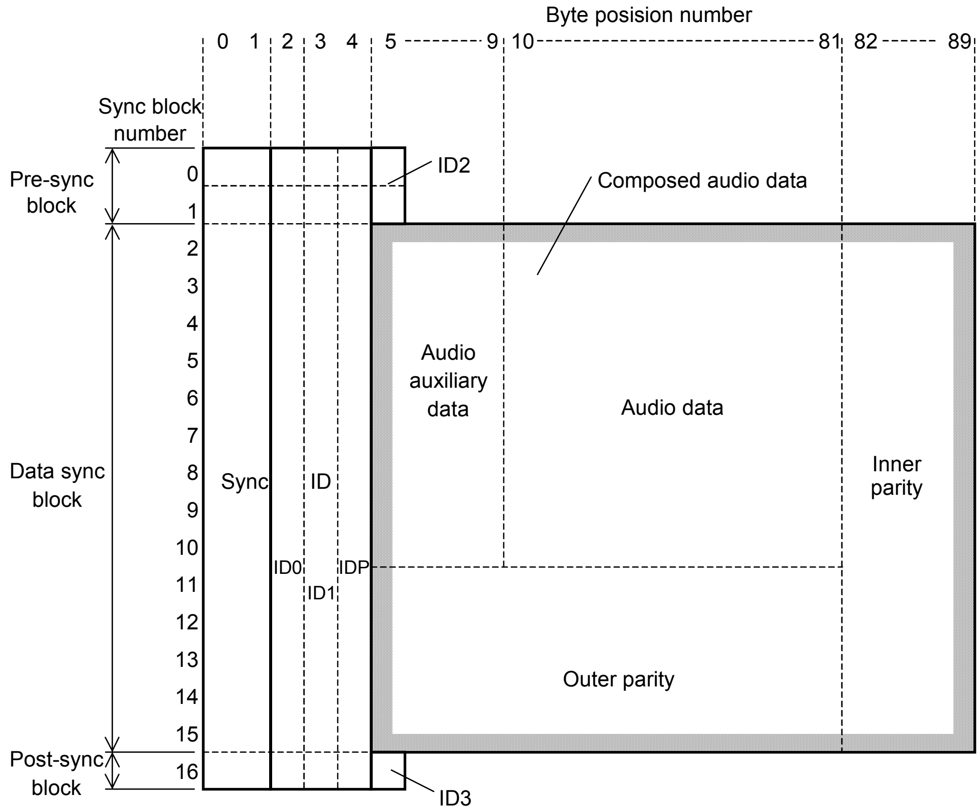


Figure 17 – Structure of audio sector



Note – Sync in byte position 0 and 1 shows the position. It is a 17-bit pattern as specified in 6.3.3.1.

Figure 18 – Structure of sync blocks in audio sector

6.3.3.1 Sync

Two types of sync patterns are defined as shown below:

	MSB	LSB
Sync pattern F :	0 0 0 1 1 1 1 1 1 1 1 1 1 0 0 0 1	
Sync pattern G :	1 1 1 0 0 0 0 0 0 0 0 0 0 1 1 1 0	

A sync pattern to be recorded shall be chosen from the above two sequences according to the criteria as described in 6.1.3.2. The length of the sync shall be 17 bits as recorded on tape.

6.3.3.2 ID

The ID consists of ID data (ID0, ID1) of 2 bytes, and ID parity (IDP) of 1 byte. As shown in tables 17 to 19, the ID data consists of the audio application ID ($AP1_2$, $AP1_1$, $AP1_0$), track pair number (Trp_4, Trp_3, Trp_2, Trp_1, Trp_0), and sync block number (Syb_7, Syb_6, Syb_5, Syb_4, Syb_3, Syb_2, Syb_1, Syb_0).

– ID0

ID0 contains the information defined in table 17. The length of ID0 shall be 8 bits before modulation. Audio application ID shall be as given in table 18. The track pair number shall be as defined in table 19.

Table 17 – ID data in audio sector

Bit position	Sync block number 0, 1, 11 to 16		Sync block number 2 to 10	
	ID0	ID1	ID0	ID1
b7	AP12	Syb7	Arb	Syb7
b6	AP11	Syb6	Arb	Syb6
b5	AP10	Syb5	Arb	Syb5
b4	Trp4	Syb4	Trp4	Syb4
b3	Trp3	Syb3	Trp3	Syb3
b2	Trp2	Syb2	Trp2	Syb2
b1	Trp1	Syb1	Trp1	Syb1
b0	Trp0	Syb0	Trp0	Syb0

Table 18 – Audio application ID

Audio application ID			Format type
$AP1_2$	$AP1_1$	$AP1_0$	
0	0	0	Not used
0	0	1	D7 and Dxx
0	1	0	Reserved
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	Not used

Table 19 – Track pair number

Track number	Track pair number									
	50 Hz system					60 Hz system				
	Trp3	Trp2	Trp1	Trp0	Trp4	Trp3	Trp2	Trp1	Trp0	Trp4
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	1	0	0	0	0	1
3	0	0	0	0	1	0	0	0	0	1
4	0	0	0	1	0	0	0	0	1	0
5	0	0	0	1	0	0	0	0	1	0
6	0	0	0	1	1	0	0	0	1	1
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
35	1	0	0	0	1	1	0	0	0	1
36	1	0	0	1	0	1	0	0	1	0
37	1	0	0	1	0	1	0	0	1	0
38	1	0	0	1	1	1	0	0	1	1
39	1	0	0	1	1	1	0	0	1	1
40	1	0	1	0	0	nonexistent				
41	1	0	1	0	0					
42	1	0	1	0	1					
43	1	0	1	0	1					
44	1	0	1	1	0					
45	1	0	1	1	0					
46	1	0	1	1	1					
47	1	0	1	1	1					

– ID1

ID1 contains the sync block number defined in table 17. The length of ID1 shall be 8 bits before modulation. The sync block numbers shall be numbered from 0 to 16 as shown in figure 18. Modulation shall be applied together with ID1, IDP, and ID2 or ID3 or the first audio data as shown in figure 8.

– IDP

IDP is a parity byte of ID0 and ID1. The length of the IDP shall be 8 bits before modulation. IDP is defined as a (12, 8, 3) BCH code of which the generator polynomial is $X^4 + X + 1$. The ID code is divided into two ID codewords (ID-CW0, ID-CW1). The bit assignment of ID codewords is shown in table 20.

ID-CW0: C14, C12, C10, C8, C6, C4, C2, C0, P6, P4, P2, P0
ID-CW1: C15, C13, C11, C9, C7, C5, C3, C1, P7, P5, P3, P1

Parity bits P0 to P7 are given by the following equations:

$$P6 = C14 \oplus C10 \oplus C6 \oplus C4$$
$$P4 = C14 \oplus C12 \oplus C8 \oplus C4 \oplus C2$$
$$P2 = C14 \oplus C12 \oplus C10 \oplus C6 \oplus C2 \oplus C0$$
$$P0 = C12 \oplus C8 \oplus C6 \oplus C0$$

$$P7 = C15 \oplus C11 \oplus C7 \oplus C5$$
$$P5 = C15 \oplus C13 \oplus C9 \oplus C5 \oplus C3$$
$$P3 = C15 \oplus C13 \oplus C11 \oplus C7 \oplus C3 \oplus C1$$
$$P1 = C13 \oplus C9 \oplus C7 \oplus C1$$

where $\oplus$ is the symbol of an exclusive -or.

Modulation shall be done together with ID1, IDP, and ID2 or ID3 or the first audio data as shown in figure 8.

Table 20 – Bit assignment of ID codewords

	Byte position number		
	2 ID0	3 ID1	4 IDP
MSB	C15	C7	P7
	C14	C6	P6
	C13	C5	P5
	C12	C4	P4
	C11	C3	P3
	C10	C2	P2
	C9	C1	P1
LSB	C8	C0	P0

– Additional ID (ID2, ID3)

Byte position number 5 of the pre-sync block (ID2) shall be set to $F0_h$ before modulation. Byte position number 5 of post-sync block (ID3) shall be set to FF_h before modulation.

6.3.3.3 Composed audio data

As shown in figure 18, composed audio data contain the audio data, audio auxiliary data, inner error code, and outer error code.

The composed audio data length shall be 85 bytes. By including the last two bytes of the ID, the length of the composed audio data shall be 87 bytes, divisible into 3-byte length sections for additional processing.

6.4 Video sector

6.4.1 Structure

The video sector contains the following elements:

- video preamble;
- video sync block;
- video postamble.

The video sync block contains the following elements:

- pre-sync block;
- data sync block;
- post-sync block.

Figure 19 shows the structure of the video sector.

6.4.2 Video pre and post-amble

The video preample and postamble shall be the same as the audio preamble described in 6.3.2 except for the length. The length of the video preamble shall be 400 bits and the length of the video postamble shall be 925 bits as recorded on tape.

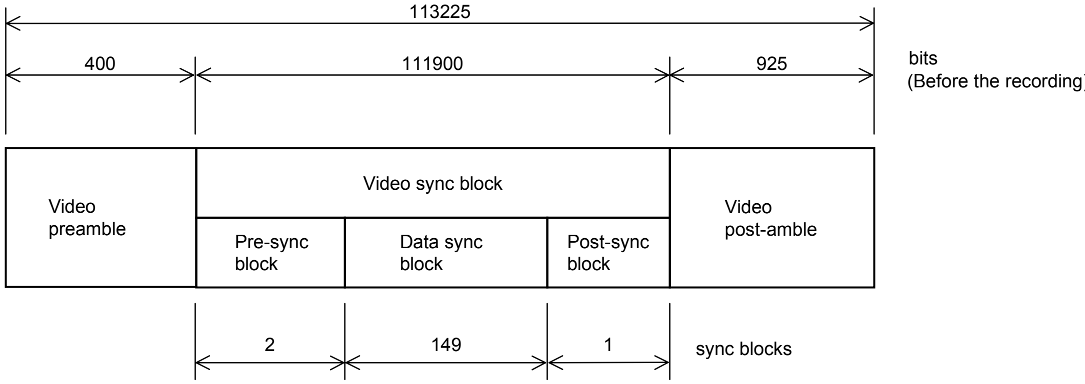


Figure 19 – Structure of video sector

6.4.3 Video sync block

Three components, 2 presync blocks, 149 data sync blocks, and 1 postsync block constitute the overall video sync block structure. Each presync and postsync block consists of a two-byte sync word and a four-byte ID. Each data sync block is comprised of either 1) two-byte sync block word, three-byte ID, 77 bytes of data and 8 inner parity bytes, or 2) two-byte sync block word, three-byte ID, 77 bytes of outer parity, and 8 inner parity bytes, as shown in figure 20.

6.4.3.1 Sync

The sync shall be the same as the audio sync described in 6.3.3.1. The length of the sync shall be 17 bits as recorded on tape.

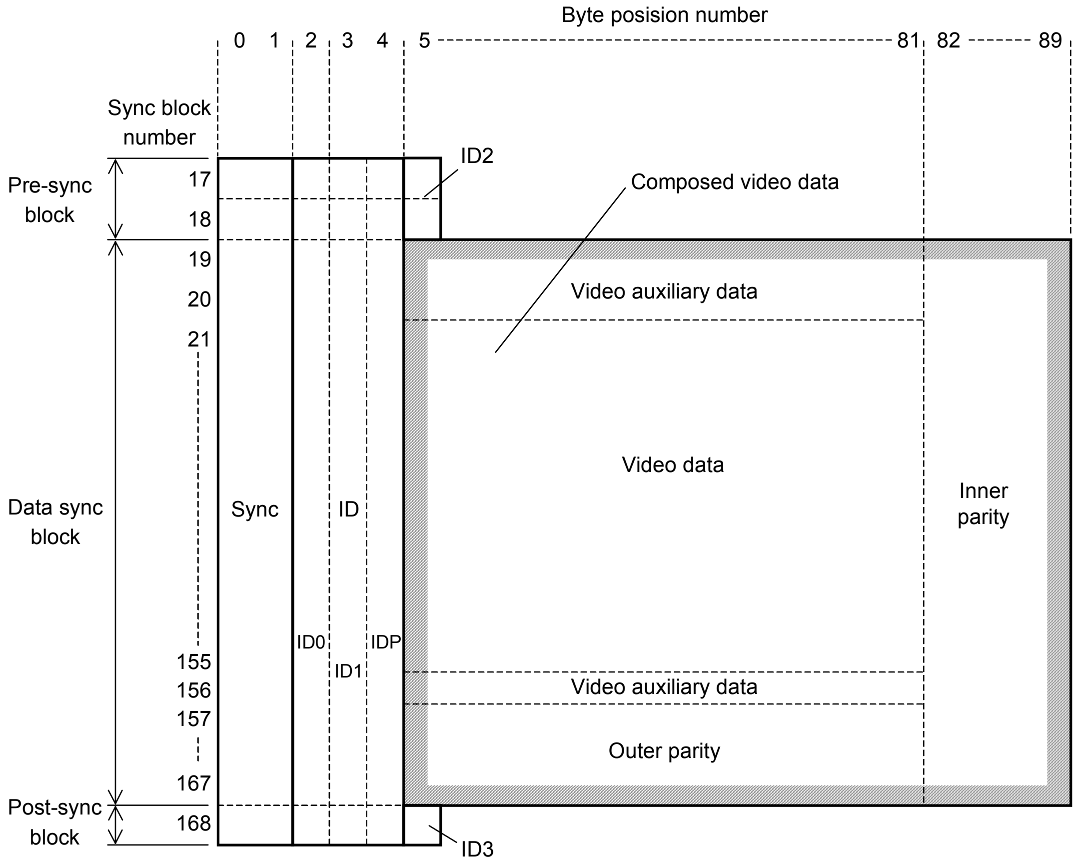
6.4.3.2 ID

The ID consists of ID data (ID0, ID1) of 2 bytes and ID parity (IDP) of 1 byte. ID data consist of the video application ID ($AP2_2$, $AP2_1$, $AP2_0$), track pair number (Trp_4, Trp_3, Trp_2, Trp_1, Trp_0), and sync block number (Syb_7, Syb_6, Syb_5, ……, Syb_0).

– ID0

ID0 contains the information given in table 21. The length of ID0 shall be 8 bits before modulation.

The video application ID shall be as specified in table 22. The track pair number shall be the same as that in table 19.



Note – Sync in byte position 0 and 1 shows the position. It is a 17-bit pattern as specified in 6.3.3.1.

Figure 20 – Structure of sync blocks in video sector

Table 21 – ID data in video sector

Bit position	Sync block number 17 to 18 and 157 to 168		Sync block number 19 to 156	
	ID0	ID1	ID0	ID1
b7	AP22	Syb7	Arb	Syb7
b6	AP21	Syb6	Arb	Syb6
b5	AP20	Syb5	Arb	Syb5
b4	Trp4	Syb4	Trp4	Syb4
b3	Trp3	Syb3	Trp3	Syb3
b2	Trp2	Syb2	Trp2	Syb2
b1	Trp1	Syb1	Trp1	Syb1
b0	Trp0	Syb0	Trp0	Syb0

Table 22 – Video application ID

Video application ID			Format type
$AP2_2$	$AP2_1$	$AP2_0$	
0	0	0	Not used
0	0	1	D7 and Dxx
0	1	0	Reserved
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	Not used

– ID1

ID1 contains the sync block number defined in table 21. The length of ID1 shall be 8 bits before modulation. The sync block numbers shall be numbered from 17 to 168 as shown in figure 20. Modulation shall be done together with ID1, IDP, and ID2 or ID3 or the first video data as shown in figure 9.

– IDP and additional ID (ID2, ID3)

IDP and additional ID shall be the same as that in audio ID.

6.4.3.3 Composed video data

Composed video data contains the video data, video auxiliary data, inner error code, and outer error code as shown in figure 20.

The composed video data length shall be 85 bytes. By including the last two bytes of ID, the length of the composed video data shall be 87 bytes, divisible into 3 byte-length sections for additional processing.

6.5 Subcode sector

6.5.1 Structure

The subcode sector contains the following elements:

- subcode preamble;
- subcode sync block;
- subcode postamble.

Figure 21 shows the structure of a subcode sector.

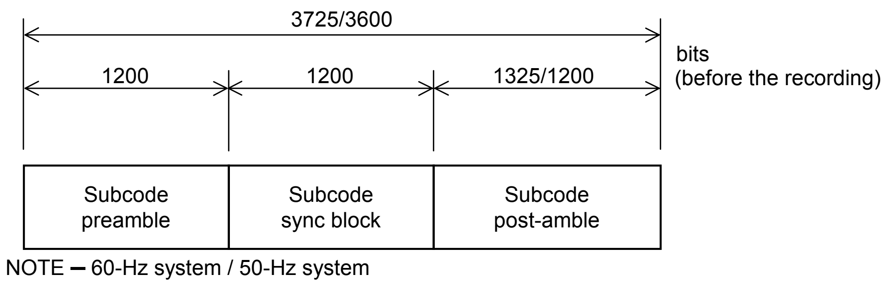


Figure 21 – Structure of subcode sector

6.5.2 Subcode preamble and postamble

The subcode preamble and postamble shall be the same as the audio preamble described in 6.3.2 except for the length. The length of the subcode preamble shall be 1200 bits as recorded on tape. The length of the subcode postamble shall be 1325 bits for the 60-Hz system and 1200 bits for the 50-Hz system as recorded on tape.

6.5.3 Subcode sync block

The subcode sync block contains 12 sync blocks. Each sync block contains the sync of 2 bytes, the ID of 3 bytes, and the composed subcode data of 7 bytes. Figure 22 shows a structure of the subcode sync block.

6.5.3.1 Sync

Two types of sync patterns are defined as shown below:

	MSB	LSB
Sync pattern D:	0 0 0 0 0 1 1 1 1 1 1 1 1 1 1 0 1	
Sync pattern E:	1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 1 0	

A sync pattern to be recorded shall be chosen from the above two sequences according to the criteria described in 6.1.3.2. The length of the sync shall be 17 bits as recorded on tape.

6.5.3.2 ID

The ID consists of ID data (ID0, ID1) of 2 bytes and ID parity (IDP) of 1 byte. ID data consists of the FRID, sync block number (Syb_3, Syb_2, Syb_1, Syb_0), and subcode application ID ($AP3_2$, $AP3_1$, $AP3_0$), or track application ID (APT_2, APT_1, APT_0).

– ID0

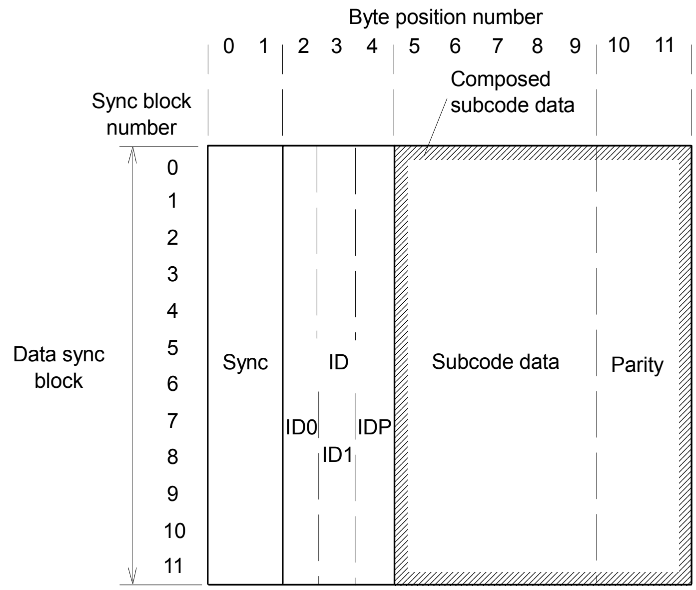
ID0 contains the information given in table 23. The length of ID0 shall be 8 bits before modulation.
Subcode application ID shall be as specified in table 24.

– ID1

ID1 contains the sync block number defined in table 23. The length of ID1 shall be 8 bits before modulation. The sync block numbers shall be numbered from 0 to 11 as shown in figure 22. Modulation shall be applied together with ID1, IDP, and the first subcode data as shown in figure 22.

– IDP

IDP shall be the same as that in audio ID.



Note – Sync in byte position 0 and 1 shows the position. It is a 17-bit pattern as specified in 6.3.3.1.

Figure 22 – Structure of sync blocks in subcode sector

Table 23 – ID data in subcode sector

Bit position	Sync block number 0 and 6		Sync block number 1 to 5 and 7 to 10		Sync block number 11	
	ID0	ID1	ID0	ID1	ID0	ID1
b7	FR	Arb	FR	Arb	FR	Arb
b6	AP32	Arb	Res	Arb	APT2	Arb
b5	AP31	Arb	Res	Arb	APT1	Arb
b4	AP30	Arb	Res	Arb	APT0	Arb
b3	Arb	Syb3	Arb	Syb3	Arb	Syb3
b2	Arb	Syb2	Arb	Syb2	Arb	Syb2
b1	Arb	Syb1	Arb	Syb1	Arb	Syb1
b0	Arb	Syb0	Arb	Syb0	Arb	Syb0

FR: The identification for the first or second half of each frame
1 = the first half of each frame
0 = the second half of each frame

The first half of each frame
Track number 0, 1, 2, ..., 19 for 60 Hz system
Track number 0, 1, 2, ..., 23 for 50 Hz system
The second half of each frame
Track number 20, 21, 22, ..., 39 for 60 Hz system
Track number 24, 25, 26, ..., 47 for 50 Hz system

Res: Reserved bit for future use
Default value shall be set to 1.

Table 24 - Subcode application ID

Subcode application ID			Format type
$AP3_2$	$AP3_1$	$AP3_0$	
0	0	0	Not used
0	0	1	D7 and Dxx
0	1	0	Reserved
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	Not used

6.5.3.3 Composed subcode data

The composed subcode data structure consists of 12 subcode data blocks. Each subcode data block is composed of a 2-byte sync word, 3-byte ID, and 7 bytes of subcode data and parity.

6.6 Edit gap

The space between areas on a track is used to accommodate timing errors during editing. In an original recording, the concatenations of run patterns A and B shall be recorded in the edit gap.

During an edit, the edit gap may be partially rewritten with the run patterns provided that the preamble and the postamble of adjacent unedited areas are not overwritten. The preamble of each area except the ITI area begins with the run-up. The postamble of each area except the ITI area ends with the guard area. The concatenations of run patterns A and B shall be recorded in the run-up area and the guard area.

The length of the edit gaps shall be as follows:

- edit gap 1: 625 bits;
- edit gap 2: 700 bits;
- edit gap 3: 1550 bits as recorded on tape.

7 Audio processing

This clause describes the audio source coding as applied to this recording format. It adds application information to the source coding as described in SMPTE 370M.

7.1 Introduction

The audio data accompanying the video data is processed simultaneously. The audio data shall be recorded on 40 consecutive tracks for the 60-Hz system and 48 consecutive tracks for the 50-Hz system.

Each audio sector consists of audio data, audio auxiliary data (AAUX), and inner and outer parity data as shown in figure 18. Audio data are shuffled within the audio data block of 77 columns x 9 rows prior to the addition of parity data. Each audio channel is identically but independently processed. Audio data are modulated by 24-25 code prior to recording. The total audio data processing sequence is shown in figure 8.

7.2 Encoding mode

7.2.1 Source coding

Each audio input signal is sampled at 48 kHz, which is locked to the video signal, with 16-bit quantization. The system provides eight channels of simultaneous recording.

7.2.2 Emphasis

Audio encoding is carried out with the first order preemphasis of 50/15µs. For the analog-input recording, emphasis should be off in the default state.

7.2.3 Audio error code

In the audio encoded data, 8000_h shall be assigned as the audio error code to indicate the invalid audio sample. This code corresponds to the negative full-scale value in ordinary twos complement representation. When the encoded data include 8000_h, it shall be converted to 8001_h before audio processing and recording.

7.2.4 Relative audio-video timing

1080 line system –

The audio frame duration equals a video frame period as shown in figure 23 and 24. An audio frame begins with an audio sample acquired within the duration of minus 50 samples relative to zero samples from the start of line number 1.

720 line system –

The audio frame duration equals two video frames period as shown in figure 25. An audio frame begins with an audio sample acquired within the duration of minus 50 samples relative to zero samples from the start of line number 1 of video frame 1.

7.2.5 Audio frame processing

The audio data is processed in audio frames. Each audio frame contains 1602 or 1600 audio samples for the 60-Hz system or 1920 audio samples for the 50-Hz system for an audio channel with associated status, user, and validity data. For the 60-Hz system, the number of audio samples per audio frame shall follow the five-frame sequence as shown below:

1600, 1602, 1602, 1602, 1602 samples.

Audio recording capacity is 1620 samples per audio frame for the 60Hz system or 1944 samples per audio frame for the 50 Hz system. The unused space at the end of each audio frame is filled with arbitrary values. In addition, a number of control and user words are added to the data.

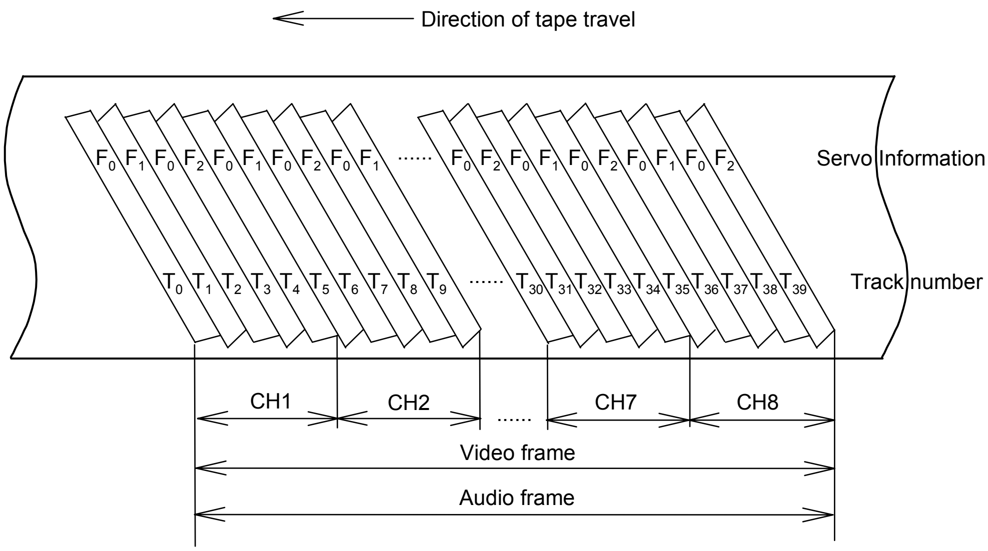


Figure 23 – Video and audio frame for the 1080/60i system

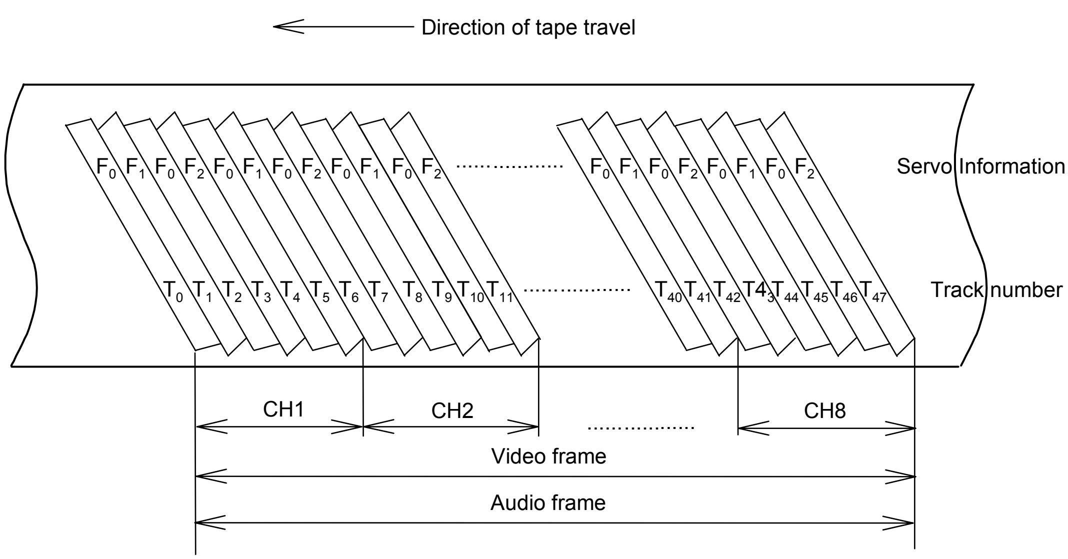


Figure 24 – Video and audio frame for the 1080/50i system

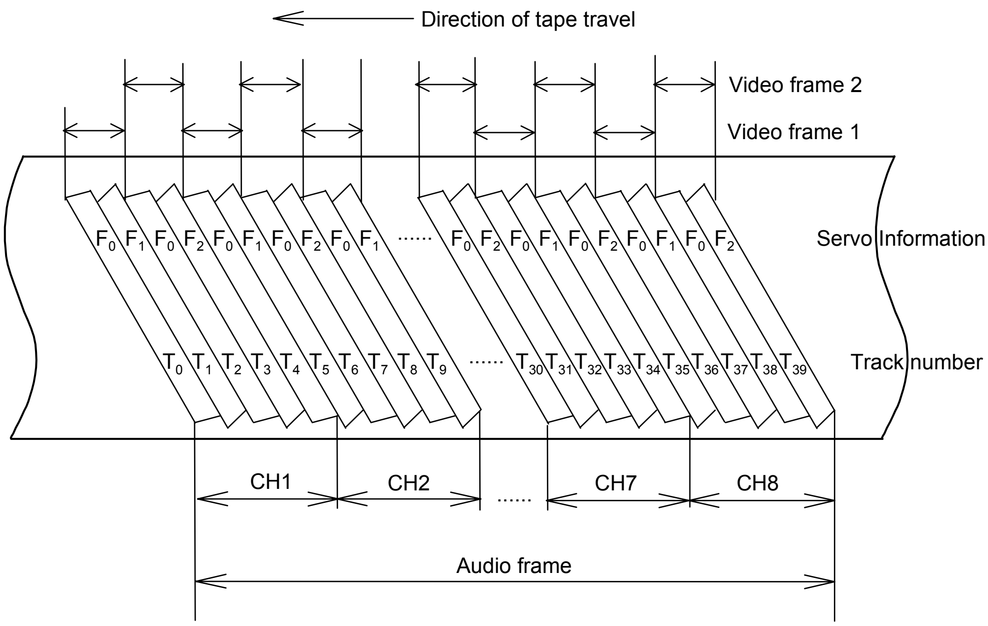


Figure 25 – Video and audio frame for the 720/60p system

7.3 Audio shuffling

The 16-bit audio data word is divided into two bytes: the upper byte which contains the MSB and the lower byte with the LSB, as shown in figure 26. Audio data shall be shuffled over tracks and data-sync blocks within an audio frame. The data bytes are defined as D_n (n = 0, 1, 2, ...) which is sampled at nth order within an audio frame and shuffled by each D_n unit.

The data shall be shuffled through a process as expressed by the following equations:

60 Hz system –

Track number: (INT (n/3) + 2 x (n mod 3)) mod 5 for audio CH1
(INT (n/3) + 2 x (n mod 3)) mod 5 + 5 for audio CH2
(INT (n/3) + 2 x (n mod 3)) mod 5 + 10 for audio CH3
(INT (n/3) + 2 x (n mod 3)) mod 5 + 15 for audio CH4
(INT (n/3) + 2 x (n mod 3)) mod 5 + 20 for audio CH5
(INT (n/3) + 2 x (n mod 3)) mod 5 + 25 for audio CH6
(INT (n/3) + 2 x (n mod 3)) mod 5 + 30 for audio CH7
(INT (n/3) + 2 x (n mod 3)) mod 5 + 35 for audio CH8

Sync block number: 2 + 3 x (n mod 3) + INT ((n mod 45) / 15)

Byte position number: 10 + 2 x INT(n/45) for the most significant byte
11 + 2 x INT(n/45) for the least significant byte

where n = 0 to 1619

50 Hz system –

Track number: (INT (n/3) + 2 x (n mod 3)) mod 6 for audio CH1
(INT (n/3) + 2 x (n mod 3)) mod 6 + 6 for audio CH2
(INT (n/3) + 2 x (n mod 3)) mod 6 + 12 for audio CH3
(INT (n/3) + 2 x (n mod 3)) mod 6 + 18 for audio CH4
(INT (n/3) + 2 x (n mod 3)) mod 6 + 24 for audio CH5
(INT (n/3) + 2 x (n mod 3)) mod 6 + 30 for audio CH6
(INT (n/3) + 2 x (n mod 3)) mod 6 + 36 for audio CH7
(INT (n/3) + 2 x (n mod 3)) mod 6 + 42 for audio CH8

Sync block number: 2 + 3 x (n mod 3) + INT ((n mod 54) / 18)

Byte position number: 10 + 2 x INT(n/54) for the most significant byte
11 + 2 x INT(n/54) for the least significant byte

where n = 0 to 1943

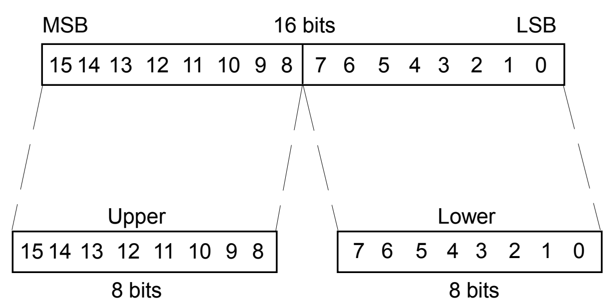


Figure 26 – Sample to audio data bytes conversion

7.4 Audio auxiliary data (AAUX)

The AAUX shall be added to the shuffled audio data as shown in figure 18. The AAUX packet shall include the pack header, the data of the AAUX source pack (AS), and the AAUX source control pack (ASC). The length of AS and ASC shall be a fixed value of 5 bytes as shown in figure 27, which shows the AAUX pack arrangement for each track. One audio auxiliary data packet consists of nine sync blocks, numbers 2 through 10. Byte positions 5 through 9 of each sync block constitute the data, with byte position 5 constituting the pack header. Packs are numbered 0 to 8 from the entrance side of the audio sector in the order as shown in figure 27. This number is called the audio pack number.

Table 25 shows the AAUX data which include the AAUX source pack and the AAUX source control pack.

The AAUX has a reserved data area as shown below:

60-Hz system: 5 bytes x 7 packs x 40 tracks x 30 frames = 42000 bytes/s
50-Hz system: 5 bytes x 7 packs x 48 tracks x 25 frames = 42000 bytes/s

The reserved area shall be filled with FF_h.

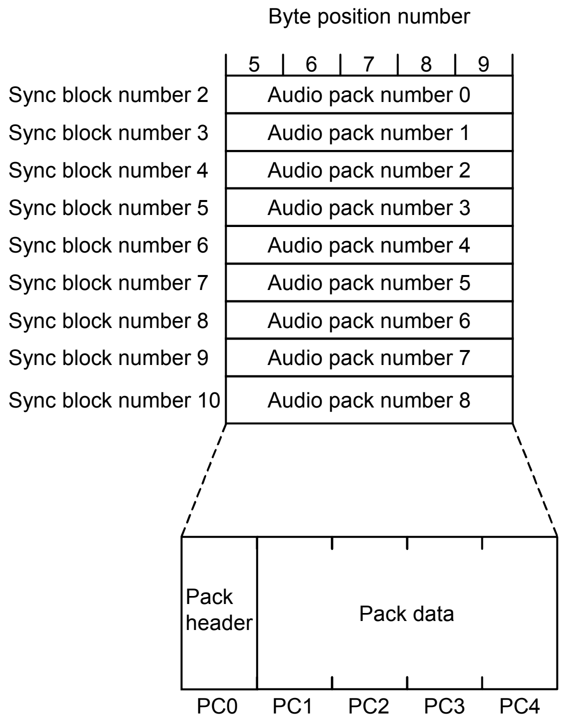


Figure 27 – Arrangement of AAUX packs in audio auxiliary data

Table 25 –AAUX data

Audio pack number		AAUX data of a frame
Track A	Track B	
3	0	AS
4	1	ASC

NOTES
AS: AAUX source pack (pack header = 50h)
ASC: AAUX source control pack (pack header = 51h)
Unused AAUX packs shall be reserved.

60 Hz system
Track A: Track number 0, 1, 2, 3, 8, 9, 10, □□□ 32, 33, 34, 35
Track B: Track number 4, 5, 6, 7, 12, 13, 14, □□□ 36, 37, 38, 39

50 Hz system
Track A: Track number 0, 1, 2, 3, 8, 9, 10, □□□ 40, 41, 42, 43
Track B: Track number 4, 5, 6, 7, 12, 13, 14, □□□ 44, 45, 46, 47

7.4.1 AAUX source pack (AS)

The AAUX source pack shall be configured as shown in table 26.

Table 26 - Mapping of AAUX source pack

	MSB						LSB
PC0	0	1	0	1	0	0	0	0
PC1	LF	Res	AF SIZE					
PC2	0	CHN		0	AUDIO MODE			
PC3	Res	Res	50/60	STYPE				
PC4	Arb	Res	SMP			QU		

LF: Locked mode flag
Locking condition of audio sampling frequency with video signal
0 = Locked mode
1 = Reserved

AF SIZE: The number of audio samples per frame
0 1 0 1 0 0 b = 1600 samples / frame
0 1 0 1 1 0 b = 1602 samples / frame
0 1 1 0 0 0 b = 1920 samples / frame
Others = Reserved

CHN: The number of audio channels within an audio block
0 0 b = One channel per audio block
Others = Reserved
The audio block is composed of five audio sectors in five consecutive tracks for the 60-Hz system and six audio sectors in six consecutive tracks for the 50-Hz system.

AUDIO MODE: The contents of the audio signal on each channel
0 0 0 0 b = CH1,CH3,CH5,CH7
0 0 0 1 b = CH2,CH4,CH6,CH8
1 1 1 1 b = Invalid audio data
Others = Reserved

50/60:
0 = 60-Hz system
1 = 50-Hz system

STYPE: Audio blocks for each audio frame
0 0 0 1 1 b = 8 audio blocks
Others = Reserved

SMP: Sampling frequency
0 0 0 b = 48 kHz
Others = Reserved

QU: Quantization
0 0 0 b = 16 bit linear
Others = Reserved

Res: Reserved bit for future use
Default value shall be set to 1.

7.4.2 AAUX source control pack (ASC)

Table 27 shows a mapping of the AAUX source control pack.

Table 27 – Mapping of AAUX source control pack

	MSB							LSB
PC0	0	1	0	1	0	0	0	1
PC1	EDIT ST		EDIT END		CGMS		EFC	
PC2	Arb	Arb	0	0	Res	Res	Res	Res
PC3	Res	0	Res	0	0	0	0	0
PC4	Arb	Res	Res	Res	Res	Res	Res	Res

EDIT ST: Start position of insert edit
0 0 b = Unedited portion
0 1 b = Editing point without fading
1 0 b = Editing point with fading
1 1 b = Reserved
The duration of recording EDIT ST shall be one audio block period for each channel.

EDIT END: End position of insert edit
0 0 b = Unedited portion
0 1 b = Editing point without fading
1 0 b = Editing point with fading
1 1 b = Reserved
The duration of recording EDIT END shall be one audio block period for each channel.

CGMS: Copy generation management system
0 0 b = Copy free
Others = Reserved

EFC: Emphasis channel flag
0 0 b = Emphasis off
0 1 b = Emphasis on
Others = Reserved
EFC shall be set for each audio block.

Res: Reserved bit for future use
Default value shall be set to 1.

7.5 Error correction code addition

The audio data are protected by inner and outer error correction codes.

7.5.1 Inner error correction code

The inner parity as shown in figure 18 is defined as the codeword of an inner error correction code. The inner error correction code is a (85, 77) Reed-Solomon code in GF(256) of which the field generator polynomial is:

$$X^8 + X^4 + X^3 + X^2 + 1$$

where X^i are place-keeping variables in GF(2), the binary field.

The generator polynomial of the code in GF(256) is:

$$g_{in}(X) = (X + 1)(X + \alpha)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)$$

where α is given by 2h in GF(256).

Parties K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0 as shown in figure 28 are given by the equation:

$$K_7X^7 + K_6X^6 + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

which is a residue of $X^8D(X)$ divided by $g_{in}(X)$, where the data polynomial D(X) is defined as:

$$D(X) = D_{76}X^{76} + D_{75}X^{75} + \text{........} + D_2X^2 + D_1X + D_0$$

and the codeword polynomial is given by the following equation:

$$D_{76}X^{84} + D_{75}X^{83} + \text{........} + D_1X^9 + D_0X^8 + K_7X^7 + K_6X^6 + \text{.........} + K_1X + K_0$$

7.5.2 Outer error correction code

The outer parity as shown in figure 18 is defined as a codeword of an outer error correction code. The outer error correction code is a (14, 9) Reed-Solomon code in GF(256) of which the field generator polynomial is:

$$X^8 + X^4 + X^3 + X^2 + 1$$

where X^i are place-keeping variables in GF(2), the binary field.

The generator polynomial of the code in GF(256) is:

$$g_{aout}(X) = (X + 1)(X + \alpha)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)$$

where α is given by 2h in GF(256).

Parties K_4, K_3, K_2, K_1, K_0 as shown in figure 29, are given by the equation:

$$K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

which is a residue of $X^5D(X)$ divided by $g_{aout}(X)$, where the data polynomial D(X) is defined as:

$$D(X) = D_8X^8 + D_7X^7 + \text{........} + D_2X^2 + D_1X + D_0$$

and the codeword polynomial is given by the following equation for every column of the byte position number 5 to 81:

$$D_8X^{13} + D_7X^{12} + \text{........} + D_1X^6 + D_0X^5 + K_4X^4 + K_3X^3 + \text{.......} + K_1X + K_0$$

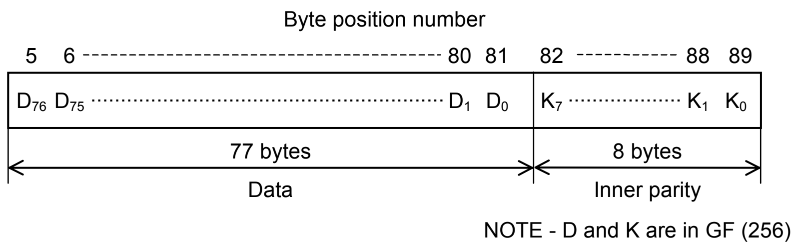


Figure 28 – Data and inner parity of a data sync block

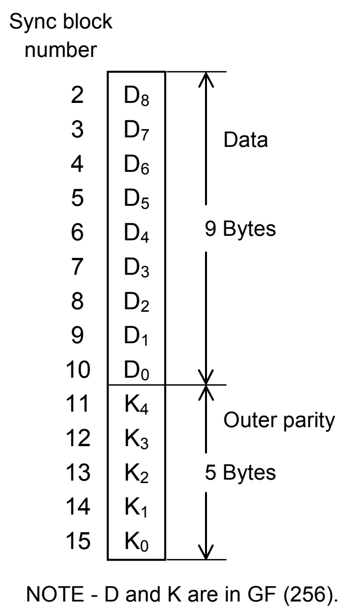


Figure 29 – Data and outer parity of a data sync block for audio sector

8 Video processing

8.1 Introduction

The video signal is compressed in compliance with SMPTE 370M and formatted into recording stream.

Video auxiliary data (VAUX) are multiplexed with the compressed video data, and the multiplexed data are processed in a product block of 77 columns by 138 rows. The data in the product block are protected with the error correction codes added to the product block. Prior to recording, 24-25 modulation is applied (see figure 9).

8.2 Compressed macro block and data-sync block

A compressed macro block data is distributed to data-sync blocks as shown in tables 28 and 29. A compressed macro block whose compressed macro block number is CM h, i, j, k is distributed to a data-sync block of sync block numbers and track numbers as follows:

60-Hz system –

```
for (h=0; h<4; h++){
    for (s=0; s<2; s++){
        for (k=0; k<27; k++){
            for (t=0; t<5; t++){
                a = (4h + s + 2t + 2) mod 10;
                b = (4h + s + 2t + 6) mod 10;
                c = (4h + s + 2t + 8) mod 10;
                d = (4h + s + 2t + 0) mod 10;
                e = (4h + s + 2t + 4) mod 10;
                m = (5t + 25k) mod 135 + 21;
                n = 4 x INT((5t + 25k + 675s) / 135) + h;

                Sync block  m of Track n = CM h,a,2,k
                Sync block  (m + 1) of Track n = CM h,b,1,k
                Sync block  (m + 2) of Track n = CM h,c,3,k
                Sync block  (m + 3) of Track n = CM h,d,0,k
                Sync block  m + 4) of Track n = CM h,e,4,k
            }
        }
    }
}
```

where

m: Sync block number
n: Track number
h: Divided block
s, t: Vertical order of the super block
k: Macro block order in the super block

Table 28 – Relation between the compressed macro block number and the data-sync block for the 60-Hz system

Sync block number	Track number 0	1	.....	38	39
156	VAUX	VAUX	.....	VAUX	VAUX
155	CM 0, 6, 4, 5	CM 1, 0, 4, 5	.....	CM 2, 1, 4, 26	CM 3, 5, 4, 26
154	CM 0, 2, 0, 5	CM 1, 6, 0, 5	.....	CM 2, 7, 0, 26	CM 3, 1, 0, 26
153	CM 0, 0, 3, 5	CM 1, 4, 3, 5	.....	CM 2, 5, 3, 26	CM 3, 9, 3, 26
152	CM 0, 8, 1, 5	CM 1, 2, 1, 5	.....	CM 2, 3, 1, 26	CM 3, 7, 1, 26
151	CM 0, 4, 2, 5	CM 1, 8, 2, 5	.....	CM 2, 9, 2, 26	CM 3, 3, 2, 26
⋮	⋮	⋮	⋮	⋮	⋮
25	CM 0, 4, 4, 0	CM 1, 8, 4, 0	.....	CM 2, 9, 4, 21	CM 3, 3, 4, 21
24	CM 0, 0, 0, 0	CM 1, 4, 0, 0	.....	CM 2, 5, 0, 21	CM 3, 9, 0, 21
23	CM 0, 8, 3, 0	CM 1, 2, 3, 0	.....	CM 2, 3, 3, 21	CM 3, 7, 3, 21
22	CM 0, 6, 1, 0	CM 1, 0, 1, 0	.....	CM 2, 1, 1, 21	CM 3, 5, 1, 21
21	CM 0, 2, 2, 0	CM 1, 6, 2, 0	.....	CM 2, 7, 2, 21	CM 3, 1, 2, 21
20	VAUX	VAUX	.....	VAUX	VAUX
19	VAUX	VAUX	.....	VAUX	VAUX

50-Hz system –

```
for (h=0; h<4; h++){
   for (k=0; k<27; k++){
      for (i=0; i<11; i++){
              a = (4h + i + 2) mod 11;
              b = (4h + i + 6) mod 11;
              c = (4h + i + 8) mod 11;
              d = (4h + i + 0) mod 11;
              e = (4h + i + 4) mod 11;
              m = (5i + 55k) mod 135 + 21;
              n = 4 x INT((5i + 55k) / 135) + h;

              Sync block m of Track n = CM h,a,2,k
              Sync block (m + 1) of Track n = CM h,b,1,k
              Sync block (m + 2) of Track n = CM h,c,3,k
              Sync block (m + 3) of Track n = CM h,d,0,k
              Sync block (m + 4) of Track n = CM h,e,4,k
      }
   }
}
for (k=0; k<27; k++){
              m = 5k + 21;
              n = 44;

              Sync block  m of Track n = CM 0,11,0,k
              Sync block  (m + 1) of Track n = CM 0,11,1,k
              Sync block  (m + 2) of Track n = CM 0,11,2,k
              Sync block  (m + 3) of Track n = CM 0,11,3,k
              Sync block  (m + 4) of Track n = CM 0,11,4,k
}
```

where

m: Sync block number
n: Track number
h: Divided block
i: Vertical order of the super block
k: Macro block order in the super block

Table 29 – Relation between the compressed macro block number and the data-sync block for the 50-Hz system

Sync block number	Track number 0	1	…	43	44	45	46	47
156	VAUX	VAUX	…	VAUX	VAUX	VAUX	VAUX	VAUX
155	CM 0, 8, 4, 2	CM 1, 1, 4, 2	…	CM 3, 4, 4, 26	CM 0, 11, 4, 26	—	—	—
154	CM 0, 4, 0, 2	CM 1, 8, 0, 2	…	CM 3, 0, 0, 26	CM 0, 11, 3, 26	—	—	—
153	CM 0, 1, 3, 2	CM 1, 5, 3, 2	…	CM 3, 8, 3, 26	CM 0, 11, 2, 26	—	—	—
152	CM 0, 10, 1, 2	CM 1, 3, 1, 2	…	CM 3, 6, 1, 26	CM 0, 11, 1, 26	—	—	—
151	CM 0, 6, 2, 2	CM 1, 10, 2, 2	…	CM 3, 2, 2, 26	CM 0, 11, 0, 26	—	—	—
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
25	CM 0, 4, 4, 0	CM 1, 8, 4, 0	…	CM 3, 0, 4, 24	CM 0, 11, 4, 0	—	—	—
24	CM 0, 0, 0, 0	CM 1, 4, 0, 0	…	CM 3, 7, 0, 24	CM 0, 11, 3, 0	—	—	—
23	CM 0, 8, 3, 0	CM 1, 1, 3, 0	…	CM 3, 4, 3, 24	CM 0, 11, 2, 0	—	—	—
22	CM 0, 6, 1, 0	CM 1, 10, 1, 0	…	CM 3, 2, 1, 24	CM 0, 11, 1, 0	—	—	—
21	CM 0, 2, 2, 0	CM 1, 6, 2, 0	…	CM 3, 9, 2, 24	CM 0, 11, 0, 0	—	—	—
20	VAUX	VAUX	…	VAUX	VAUX	VAUX	VAUX	VAUX
19	VAUX	VAUX	…	VAUX	VAUX	VAUX	VAUX	VAUX

8.3 Video auxiliary data (VAUX)

VAUX shall be added to the compressed video data as shown in figure 20.

VAUX is formed using the fixed length pack structure. Figure 30 shows the VAUX pack arrangement of each track. There are 15 packs following the ID code of the data-sync block of which the sync block number is 19, 20, and 156. Therefore, there are 45 packs in each track, and there are two reserved bytes in each data-sync block for VAUX. The default value of the reserved byte is FF_h. VAUX packs are sequentially numbered from 0 to 44 from the entrance side of the video sector in the order as shown in figure 30. This number is called the video pack number.

Table 30 shows the VAUX data. The VAUX source pack and the VAUX source control pack include mandatory data for playback video signals which is recorded.

The other area of VAUX consists of 43 packs per track. The reserved area of VAUX in each second is as follows:

60-Hz system: (5 bytes x 43 packs + 6 bytes) x 40 tracks x 30 frames = 265200 bytes/s
50-Hz system: (5 bytes x 43 packs + 6 bytes) x 48 tracks x 25 frames = 265200 bytes/s

The reserved area shall be filled with FF_h.

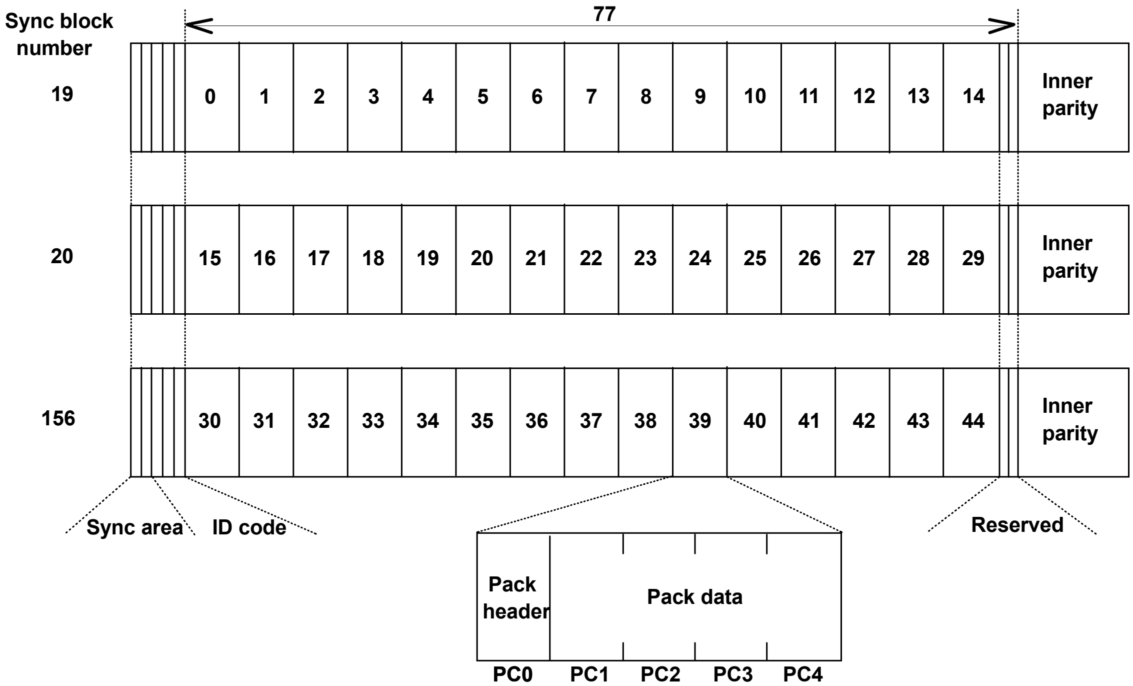


Figure 30 – Arrangement

Table 30 – VAUX data

Video pack number		VAUX data of a frame
Track A	Track B	
39	0	VS
40	1	VSC

NOTES
VS: VAUX source pack (pack header = 60_h)
VSC: VAUX source control pack (pack header = 61_h)

60-Hz system
Track A: Track number 0, 1, 2, 3, 8, 9, 10, □□□ 32, 33, 34, 35
Track B: Track number 4, 5, 6, 7, 12, 13, 14, □□□ 36, 37, 38, 39

50-Hz system
Track A: Track number 0, 1, 2, 3, 8, 9, 10, □□□ 40, 41, 42, 43
Track B: Track number 4, 5, 6, 7, 12, 13, 14, □□□ 44, 45, 46, 47

8.3.1 VAUX source pack (VS)

Table 31 shows a mapping of the VAUX source pack.

Table 31 – Mapping of VAUX source pack

	MSB						LSB
PC0	0	1	1	0	0	0	0	0
PC1	Res	Res	RR		Res	Res	Res	Res
PC2	Res	Res	Res	Res	Res	Res	Res	Res
PC3	Arb	Arb	50/60	STYPE				
PC4	Res	Res	Res	Res	Res	Res	Res	Res

RR: Total recording video rate
0 0 b = Reserved
0 1 b = 100 Mb/s
1 0 b = 50 Mb/s
1 1 b = 25 Mb/s

50/60: 0 = 60-Hz system
1 = 50-Hz system

STYPE: Signal type of video signal.

For 60-Hz system
0 0 0 0 0 b = 4:1:1 compression (D-7, 25 Mb/s)
0 0 1 0 0 b = 4:2:2 compression (D-7, 50 Mb/s)
1 0 1 0 0 b = 1080/60i - 100 Mb/s compression (active line 1080)
1 0 1 0 1 b = 1080/60i - 100 Mb/s compression (active line 1035)
1 1 0 0 0 b = 720/60p - 100 Mb/s compression
Others = Reserved

For 50-Hz system
0 0 0 0 0 b = 4:1:1 compression (D-7, 25 Mb/s)
0 0 1 0 0 b = 4:2:2 compression (D-7, 50 Mb/s)
1 0 1 0 0 b = 1080/50i - 100 Mb/s compression
Others = Reserved

Res: Reserved bit for future use
Default value shall be set to 1.

8.3.2 VAUX source control pack (VSC)

Table 32 shows a mapping of the VAUX source control pack.

Table 32 – Mapping of VAUX source control pack

	MSB						LSB
PC0	0	1	1	0	0	0	0	1
PC1	CGMS		0	0	Res	Res	Res	Res
PC2	Arb	Res	0	0	Res	DISP		
PC3	FF	FS	FC	Res	Res	Res	0	0
PC4	Res	Res	Res	Res	Res	Res	Res	Res

CGMS: Copy generation management system
0 0 b = Copy free
Others = Reserved

DISP: Display select mode
0 1 0 b = 16:9
Others = Reserved

FF: Frame/field flag

For 1080-line system (see table 33)
FF indicates whether two consecutive fields are delivered, or one field is repeated twice during each video frame period.
0 = Only one of two fields is delivered twice.
1 = Both fields are delivered in order.

For 720-line system (see table 34)
FF indicates whether two consecutive video frames are delivered, or one video frame is repeated twice during each two video frames period.
0 = Only one of two video frames is delivered twice.
1 = Both video frames are delivered in order.

FS: First/second field flag

For 1080-line system (see table 33)
FS indicates a field which is delivered during the field one period.
0 = Field 2 is delivered.
1 = Field 1 is delivered.

For 720-line system (see table 34)
FS indicates a video frame which is delivered during the video frame one period.
0 = Video frame 2 is delivered.
1 = Video frame 1 is delivered.

Res: Reserved bit for future use
Default value shall be set to 1.

Table 33 – FF/FS for the 1080 line system

FF	FS	Output field
1	1	Field 1 and field 2 are output in this order (1,2 sequence).
1	0	Field 2 and field 1 are output in this order (2,1 sequence).
0	1	Field 1 is output twice.
0	0	Field 2 is output twice.

Table 34 – FF/FS for the 720 line system

FF	FS	Output video frame
1	1	Video frame 1 and video frame 2 are output in this order (1,2 sequence).
1	0	Video frame 2 and video frame 1 are output in this order (2,1 sequence).
0	1	Video frame 1 is output twice.
0	0	Video frame 2 is output twice.

FC: Frame change flag

For 1080-line system
FC indicates whether the picture of the current video frame is repeated based on the video frame immediately preceding.
0 = Same picture as the previous video frame
1 = Different picture than the previous video frame

For 720-line system
FC indicates whether the picture of the current two video frames is repeated based on immediate previous two video frames.
0 = Same picture as the previous two video frames
1 = Different picture than the previous two video frames

Res: Reserved bit for future use
Default value shall be set to 1.

8.4 Error correction code addition

Video data are protected by inner and outer error correction codes.

8.4.1 Inner error correction code

The inner parity as shown in figure 20 is defined as a codeword of an inner error correction code. This coding is identical to that specified in clause 7.5.1.

8.4.2 Outer error correction code

The outer parity as shown in figure 20 is defined as a codeword of an outer error correction code.
The outer error correction code is a (149, 138) Reed-Solomon code in GF(256) of which the field generator polynomial is shown as:

$$X^8 + X^4 + X^3 + X^2 + 1$$

where X^i are place-keeping variables in GF(2), the binary field.

The generator polynomial of the code in GF(256) is:

$$g_{vout}(X) = (X + 1)(X + \alpha)(X + \alpha^2)(X + \alpha^3) \ldots (X + \alpha^9)(X + \alpha^{10})$$

where α is given by 2h in GF(256).

Parties, K_{10}, K_9, K_8, K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0 as shown in figure 31 are given by the equation:

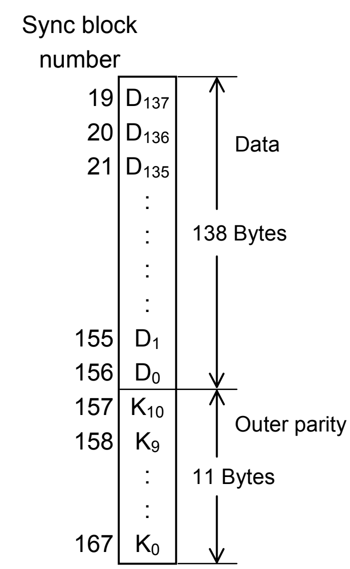
$$K_{10}X^{10} + K_9X^9 + K_8X^8 + K_7X^7 + K_6X^6 + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

which is a residue of $X^{11}D(X)$ divided by $g_{vout}(X)$, where the data polynomial D(X) is defined as:

$$D(X) = D_{137}X^{137} + D_{136}X^{136} + \ldots\ldots.. + D_2X^2 + D_1X + D_0$$

and the codeword polynomial is given by the following equation for every column of the byte position number 5 to 81:

$$D_{137}X^{148} + D_{136}X^{147} + \ldots\ldots.. + D_1X^{12} + D_0X^{11} + K_{10}X^{10} + K_9X^9 + \ldots\ldots. + K_1X + K_0$$



NOTE - D and K are in GF (256)

Figure 31 – Data and outer parity of a data sync block for video sector

9 Subcode processing

9.1 Introduction

Subcode data shall be recorded in 40 consecutive tracks for the 60-Hz system and 48 consecutive tracks for the 50-Hz system in the frame. Each subcode sector is a block of 5 columns by 12 rows as shown in figure 22. Subcode data with the addition of an error correction code (ECC) shall be modulated prior to recording. A typical block diagram of the subcode processing is shown in figure 10.

9.2 Subcode data

As shown in figure 32, each subcode row consists of a pack header byte and 4 data bytes. Within the 12 columns of the subcode data pack, a time code pack (TC) and a binary group pack (BG) are included as shown in table 35.

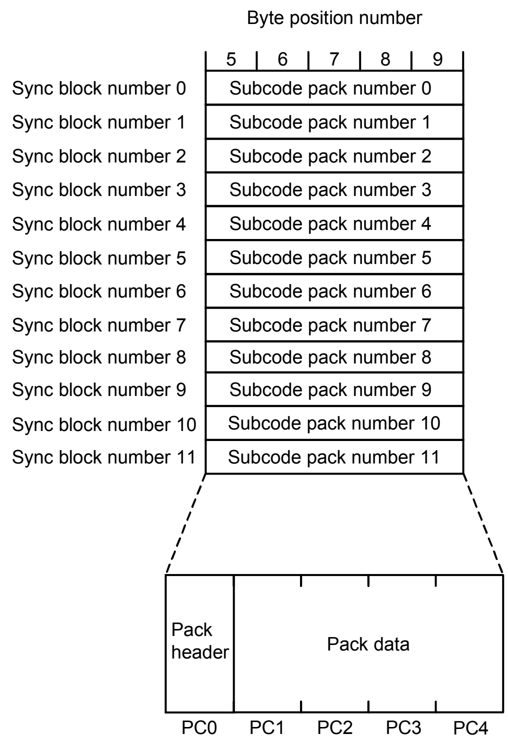


Figure 32 – Arrangement of subcode data

Table 35 – Mapping of subcode pack

Subcode pack number	First half of a frame	Second half of a frame
0	Reserved	Reserved
1	Reserved	Reserved
2	Reserved	Reserved
3	TC	TC
4	BG	Reserved
5	TC	Reserved
6	Reserved	Reserved
7	Reserved	Reserved
8	Reserved	Reserved
9	TC	TC
10	BG	Reserved
11	TC	Reserved

TC: Time code pack (Pack header = 13 h)
BG: Binary group pack (Pack header = 14 h)

60-Hz system: The first half of a frame: Track number 0, 1, ..., 19
The second half of a frame: Track number 20, 21, ..., 39

50-Hz system: The first half of a frame: Track number 0, 1, ..., 23
The second half of a frame: Track number 24, 25, ..., 47

The reserved subcode data area is as follows:

60-Hz system: 5 bytes x 16 packs x 20 track pairs x 30 frames = 48000 bytes/s
50-Hz system: 5 bytes x 16 packs x 24 track pairs x 25 frames = 48000 bytes/s

9.2.1 Time code pack (TC)

Table 36 shows a mapping of the time code pack.

Table 36 – Mapping of time code pack

60-Hz system

	MSB							LSB
PC0	0	0	0	1	0	0	1	1
PC1	CF	DF	TENS of FRAMES		UNITS of FRAMES			
PC2	PC	TENS of SECONDS			UNITS of SECONDS			
PC3	BGF0	TENS of MINUTES			UNITS of MINUTES			
PC4	BGF2	BGF1	TENS of HOURS		UNITS of HOURS			

50-Hz system

	MSB							LSB
PC0	0	0	0	1	0	0	1	1
PC1	CF	Arb	TENS of FRAMES		UNITS of FRAMES			
PC2	BGF0	TENS of SECONDS			UNITS of SECONDS			
PC3	BGF2	TENS of MINUTES			UNITS of MINUTES			
PC4	PC	BGF1	TENS of HOURS		UNITS of HOURS			

NOTE – Detailed information is given in SMPTE 12M.

DF: Drop frame flag
0 = Nondrop frame time code
1 = Drop frame time code

CF: Color frame
0 = Unsynchronized mode
1 = Synchronized mode

PC: Biphase mark polarity correction
0 = Even
1 = Odd

BGF: Binary group flag

9.2.2 Binary group pack (BG)

Table 37 shows the mapping of a binary group pack.

Table 37 – Mapping of a binary group pack

	MSB							LSB
PC0	0	0	0	1	0	1	0	0
PC1	Binary group 2				Binary group 1			
PC2	Binary group 4				Binary group 3			
PC3	Binary group 6				Binary group 5			
PC4	Binary group 8				Binary group 7			

9.3 Error correction code addition

Subcode error correction code shall be a (14, 10) Reed-Solomon code on GF (16) of which the field generator polynomial is:

$$X^4 + X + 1$$

where X^i are place-keeping variables in GF(2) the binary field.

The generator polynomial of the code in GF (16) is:

$$g_{sub} (X) = (X+1) (X + \alpha) (X + \alpha^2) (X + \alpha^3)$$

where α is giving by 2h in GF (16).

Parities, K_3, K_2, K_1, K_0, as shown in figure 32, are given by the equation:

$$K_3 X^3 + K_2 X^2 + K_1 X + K_0$$

which is a residue of X^4 D (X) divided by g_{sub} (X), where the data polynomial D (X) is defined as:

$$D (X) = D_9X^9 + D_8X^8 + \text{---} + D_2X^2 + D_1X+D_0$$

and the codeword polynomial is given by the equation:

$$D_9X^{13} + D_8X^{12} + \text{---}\ D_1X^5 + D_0X^4 + K_3 X^3 + K_2 X^2 + K_1 X + K_0$$

Byte position number

MSB	$d_{9,3}$	$d_{7,3}$	$d_{5,3}$	$d_{3,3}$	$d_{1,3}$	$k_{3,3}$	$k_{1,3}$
	$d_{9,2}$	$d_{7,2}$	$d_{5,2}$	$d_{3,2}$	$d_{1,2}$	$k_{3,2}$	$k_{1,2}$
	$d_{9,1}$	$d_{7,1}$	$d_{5,1}$	$d_{3,1}$	$d_{1,1}$	$k_{3,1}$	$k_{1,1}$
	$d_{9,0}$	$d_{7,0}$	$d_{5,0}$	$d_{3,0}$	$d_{1,0}$	$k_{3,0}$	$k_{1,0}$
	$d_{8,3}$	$d_{6,3}$	$d_{4,3}$	$d_{2,3}$	$d_{0,3}$	$k_{2,3}$	$k_{0,3}$
	$d_{8,2}$	$d_{6,2}$	$d_{4,2}$	$d_{2,2}$	$d_{0,2}$	$k_{2,2}$	$k_{0,2}$
	$d_{8,1}$	$d_{6,1}$	$d_{4,1}$	$d_{2,1}$	$d_{0,1}$	$k_{2,1}$	$k_{0,1}$
LSB	$d_{8,0}$	$d_{6,0}$	$d_{4,0}$	$d_{2,0}$	$d_{0,0}$	$k_{2,0}$	$k_{0,0}$
	Subcode data					Subcode parity	

Dn = (dn,3 dn,2 dn,1 dn,0) 9 >= n >= 0
Kn = (kn,3 kn,2 kn,1 kn,0) 3 >= n >= 0

Figure 33 – Bit assignment for subcode data and parity

10 Longitudinal tracks

10.1 Control track

10.1.1 Method of recording

The control track shall be recorded using the hysteresis (direct recording) method.

10.1.2 Servo reference pulse

The control track servo reference pulse, as recorded on the tape, shall be a series of pulses with a period of 6673 µs ± 10 µs as shown in figure 34 for the 60-Hz system and 6667 µs ± 10 µs as shown in figure 35 for the 50-Hz system .

10.1.3 Flux polarity

The polarities of the recorded flux shall be as shown in figure 2.

10.1.4 Flux level

The recording level shall be at the saturation level. The recording shall attenuate any previous recording by at least 25 dB.

10.1.5 Pulse width

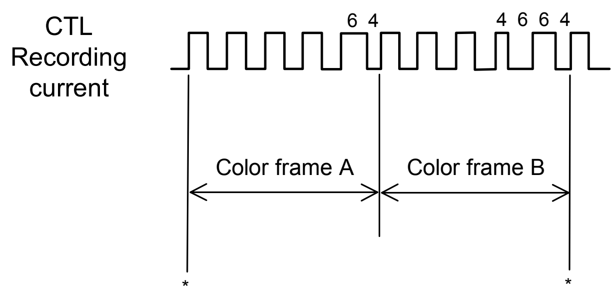
The recorded pulses shall have periods of 4T, 5T, or 6T where T equals 667.3 µs nominal for the 60 Hz system and 666.7 µs nominal for the 50 Hz system. The rise and fall times of the record current (10% to 90% points) shall be less than 150 µs.

10.1.6 Servo reference pulse timing

As shown in figure 2, the servo reference pulse timing point and the helical track program reference point shall be time coincident.

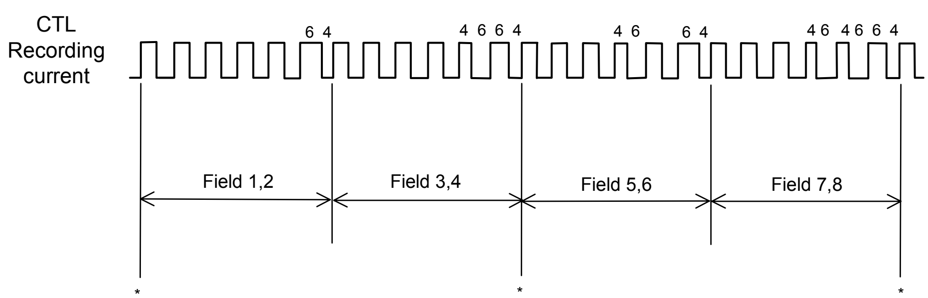
10.1.7 Color frame indication

Information on the color frame sequence, upconverted from the input composite video signal, shall be encoded into the servo reference pulse as a pulse rise transmission point following the 6T or 4T duration pulse. Details are shown in figure 34.



NOTE – * : Control track reference pulse position for measurement of P1.

Figure 34 – Recorded control code waveform timing for the 60-Hz system



NOTE – * : Control track reference pulse position for measurement of P1.

Figure 35 – Recorded control code waveform timing for the 50-Hz system

10.2 Cue track

10.2.1 Method of recording

The signals shall be recorded using the anhysteresis (AC bias) method.

10.2.2 Flux level

The recorded reference audio level shall correspond to an rms magnetic short-circuit flux level of 23 nWb/m ± 3 nWb/m of track width at 1000 Hz.

10.2.3 Relative timing

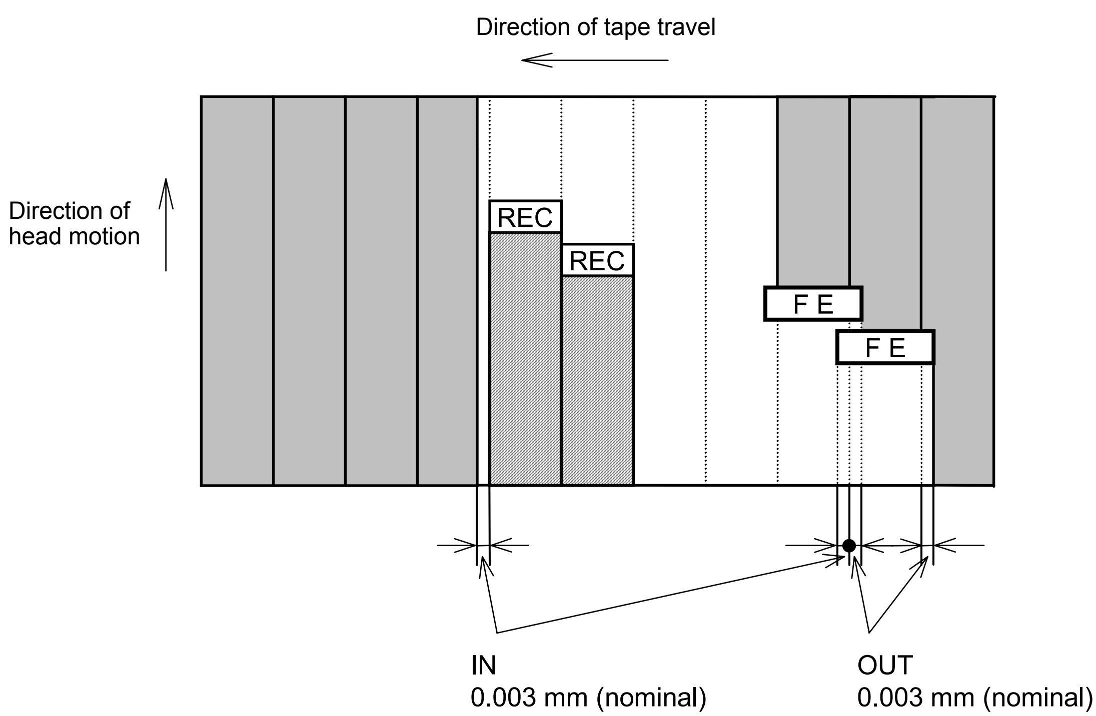
Cue information shall be recorded on the tape at a point referenced to the associated video information as defined by dimension P2 of figure 2 and table 1 or table 2.

Annex A (normative)
Tape tension

The value measured with a tension monitor on the entrance side of the scanner may vary among manufacturers, but would typically be 0.09 N ± 0.02 N.

Annex B (normative)
Track pattern during insert editing

A guard band of 3 μm (nominal) at editing points only is shown in figure B.1.



NOTES 1 REC is a recording head.
2 FE is a flying erase head.

Figure B.1 – Typical track pattern during insert editing

Annex C (normative)
Cross-tape track measurement technique

The cross-tape track measuring technique utilizes the fact that all tracks of a helical-scan video recording, recorded by the same head at constant tape speed, have the same longitudinal track pitch, the same track angle, and the same track curvature.

From a ferrofluid development, measurements are made of the actual track positions and the distance between a minimum of 300 control track pitches. All measurements shall be made under the environmental conditions described in 3.1 except that the measurements are made without tape tension (see table C.1). The tape is then mathematically stretched to account for tape tension (see figure C.1). The theoretical track position is calculated from the corrected longitudinal track pitch and the theoretical track angle. The track location error is calculated as the difference between the theoretical track position and the actual track position (see table C.1 and figure C.3).

Track location error, which shall be expressed by the error for the center of the tracks, includes track angle errors, track straightness errors, and track pitch errors. The starting point for calculations and measurements is, for example, the cross point of the center of the track containing the program reference point and the line along the measurement path in figure C.3. The values for each eighth track are the errors for tolerance zone one. Shifting one track, the second tolerance zone can be measured. It is not necessary to measure all tracks; a suitable number can be 35 samples per zone. A plot of the track location error against the track number must be computed (see figure C.2). The peak-to-peak value shall lie within the tolerance zones specified in 5.4.

Table C.1 – Nomenclature and calculation of track location error

Y_0	Program area reference (basic)	0.615
θ	Track angle (basic)	9.1784 °
T	Tension	0.09 N
E	Young's modulus	8000 N/mm^2 for 8.8 μm tape
A	Cross-sectional area	Thickness × Width
CTM	Distance of n control track pitches without tape tension	
CTM'	Distance of n control track pitches with tape tension	$CTM' = CTM(1 + T/(A \times E))$
λ	Longitudinal track pitch	$\lambda = CTM'/n$
i	Track number, i = 0 for track containing reference point	
Y_i	Measured position of track i at the recorded pattern	
ΔY	Cross-section track pitch	$\Delta Y = l \times \tan \theta$
Y_{it}	Theoretical position of track i at the recorded pattern	$Y_{it} = Y_0 + i \times \Delta Y$
l	Track pitch	$l = \lambda \times \sin \theta$
TLE	Track location error	$TLE = Y_i - Y_{it}$
Z	Tolerance zone	Z1 = 0.005 mm Z2 = 0.003 mm Z3 = 0.005 mm Z4 = 0.005 mm Z5 = 0.005 mm Z6 = 0.005 mm Z7 = 0.005 mm Z8 = 0.005 mm

NOTE - For the tolerance zone,
Z1: i = ... –8, 0, +8, +16, ...
Z2: i = ... –7, +1, +9, +17, ...
Z3: i = ... –6, +2, +10, +18, ...
Z4: i = ... –5, +3, +11, +19, ...
Z5: i = ... –4, +4, +12, +20, ...
Z6: i = ... –3, +5, +13, +21, ...
Z7: i = ... –2, +6, +14, +22, ...
Z8: i = ... –1, +7, +15, +23, ...

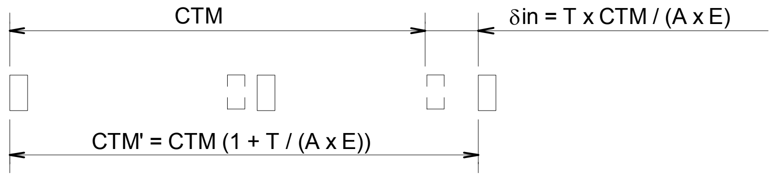


Figure C.1 – Correction factors (actual tape speed, tension)

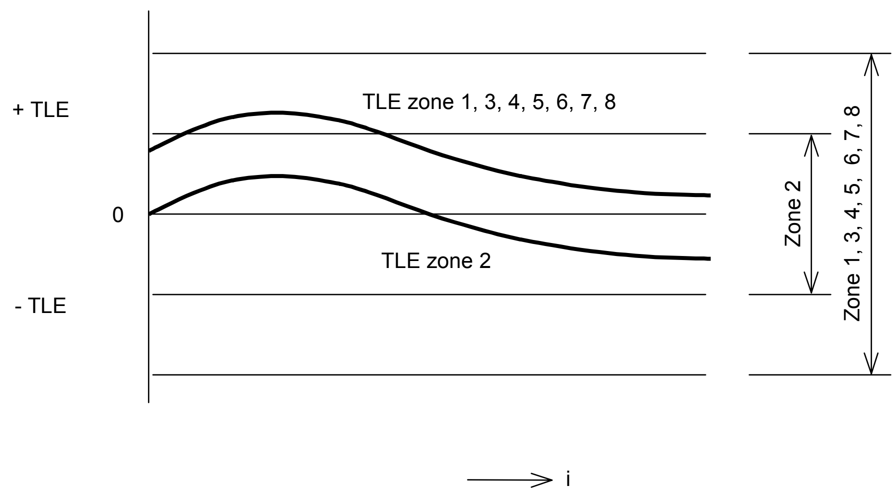
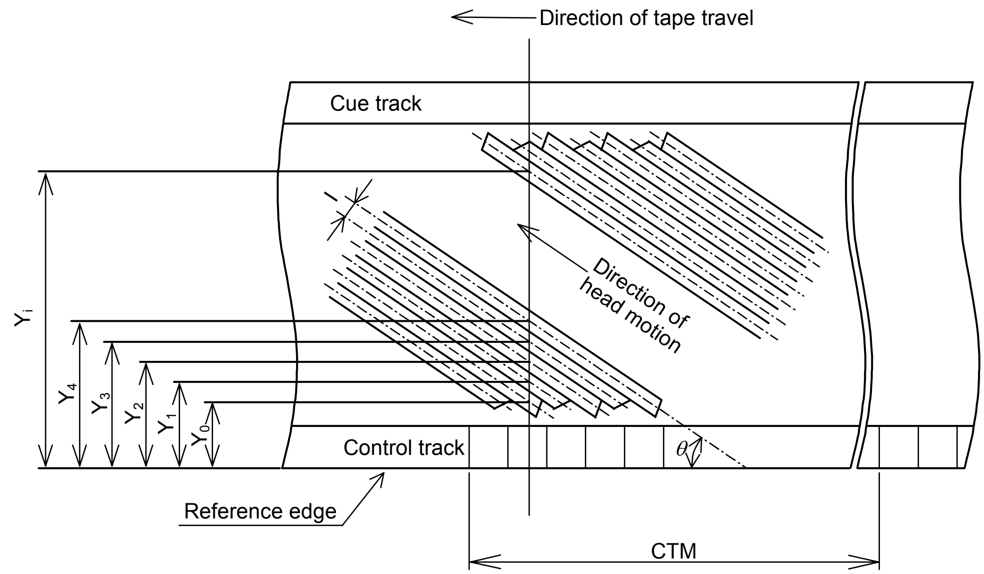


Figure C.2 – Track location error plot (example)



NOTE – The same head must be used for Yi measurement. (i.e. every 8th track). CTM is the distance of n control track pitches (n = 300 minimum).

Figure C.3 – Cross-tape measurement technique

Annex D (informative)
Tape length and recording time

Table D.1 shows the relationship between tape length and recording time for M, L and EL cassette.

Table D.1 – Tape length, thickness, and recording time

Cassette size	Tape thickness (μm)	Tape length (m)	Recording time (min.)
L	8.8	190	23
		263	32
EL	6.7	377	46

Annex E (informative)
Abbreviations and acronyms

AAUX	Audio auxiliary data
ATF	Automatic track finding
AP1	Audio application ID
AP2	Video application ID
AP3	Subcode application ID
APT	Track application ID
Arb	Arbitrary
AS	AAUX source pack
ASC	AAUX source control pack
CGMS	Copy generation management system
DCT	Discrete cosine transform
DIF	Digital interface
ECC	Error correction code
EFC	Emphasis channel flag
EOB	End of block
IDP	ID parity
ITI	Insert and track information
LF	Locked mode flag
QNO	Quantization number
QU	Quantization
Res	Reserved for future use
SMP	Sampling frequency
SSA	Start sync area
Syb	Sync block number
TIA	Track information area
Trp	Track pair number
VAUX	Video auxiliary data
VS	VAUX source pack
VSC	VAUX source control pack

Annex F (informative)
Interface

Figure F.1 shows the relationship between the recording format (this document) and other formats on the recorder. In the recording format, video data processing refers to the compression format.

F.1 Video interface

F.1.1 Video encoding parameter

The source component signal to be processed should comply with the video parameters as defined by SMPTE 274M and SMPTE 296M.

F.1.2 Serial digital interface

The interface of the digital video signal, if present, should conform to the component serial digital interface format as defined in SMPTE 292M.

F.2 Audio interface

F.2.1 Audio encoding parameter

The audio signal is sampled at 48 kHz, with 16-bit quantization defined by AES3.

F.2.2 Audio digital interface

The digital interface, if present, should conform to AES 3 and ANSI/SMPTE 276M.

F.3 Subcode interface

F.3.1 Time and control code parameter

The time and control code format in subcode area should conform to SMPTE 12M.

F.3.2 Subcode digital interface

The digital interface, if present, should conform to SMPTE 12M.

F.4 Serial data transport interface

The serial data transport interface (SDTI), if present, should conform to SMPTE 321M.

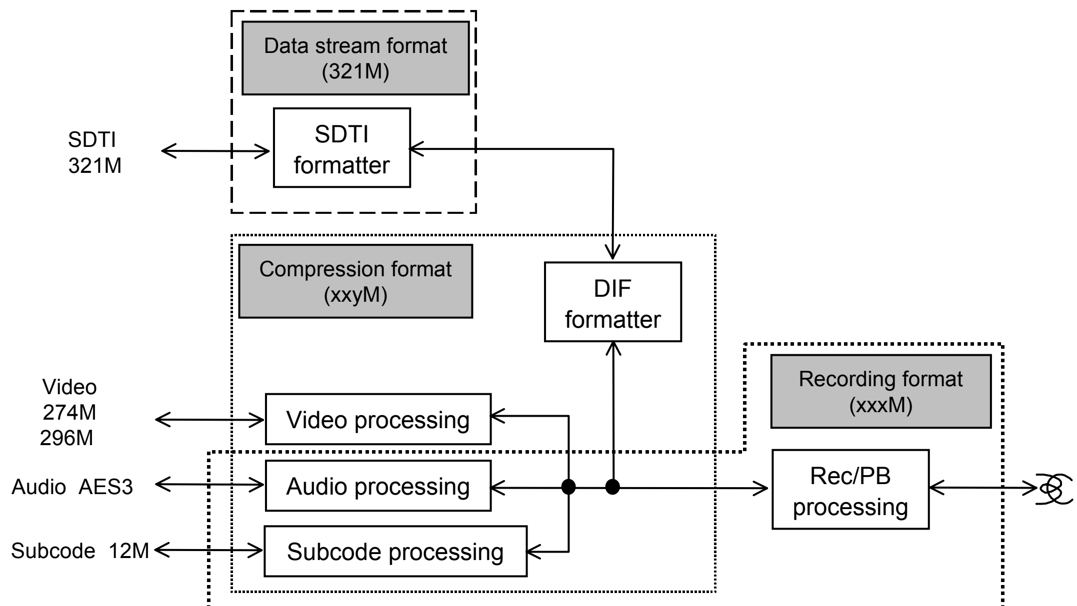


Figure F.1 – Block diagram of HD recorder

Annex G (informative)
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