SMPTE 365M-2001

SMPTE STANDARD

for Digital Television Tape Recording — 12.65-mm Type D-10 Format for MPEG-2 Compressed Video — 525/60 and 625/50

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1 Scope

This standard specifies the formatting for the recording of data blocks containing MPEG-2 compressed video, multiple channels of AES3 audio, and associated data which form helical records on 12.65-mm (0.5-in) tape in cassettes. This standard also defines the helical track record parameters, the content and format of the longitudinal records, and the cassette physical specifications.

The compressed video uses the MPEG-2 compression which is defined by ISO/IEC 13818-2 , with constraints as defined by the associated SMPTE 356M. The compressed video channel supports frame frequencies of 30/1.001 Hz (hereafter referred to as 525/60) and 25 Hz (hereafter referred to as 625/50).

2 Normative references

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

AES3-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

CORRECTED August 13, 2002
Approved August 23, 2001

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and 4*f*sc Composite Digital Signals — Serial Digital Interface

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

SMPTE 326M-2000, Television — SDTI Content Package Format (SDTI-CP)

SMPTE 331M-2000, Television — Element and Metadata Definitions for SDTI-CP

SMPTE 356M-2001, Television — Type D-10 Stream Specifications — MPEG-2 4:2:2P@ML for 525/60 and 625/50

SMPTE RP 204-2000, SDTI-CP MPEG Decoder Templates

IEC 61213 (1993-11), Analogue Audio Recording on Video Tape — Polarity of Magnetization

IEC 61237-1 (1994-06), Broadcast Video Tape Recorders — Methods of Measurement — Part 1: Mechanical Measurements

ISO/IEC 13818-2:2000, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Video

3 Abbreviations and acronyms

For the purposes of this standard, the following abbreviations and acronyms apply:

AUX: Auxiliary
DCT: Discrete cosine transform
ECC: Error correcting code
EOB: End of block
I-NRZI: Interleaved nonreturn to zero inverted
MUX: Multiplex
VLC: Variable length coding

4 Environment and test conditions

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

– Temperature: 20ºC ± 1ºC
– Relative humidity: 50% ±2%
– Barometric pressure: 86 kPa to 106 kPa
– Tape tension: 0.3 N ±0.05 N
– Tape conditioning: Not less than 24 h

4.1 Calibration tape

Calibration tapes meeting the tolerances as specified below should be made available by manufacturers of digital television tape recorders and players in accordance with this standard.

4.2 Record locations and dimensions

Geometrical location and dimensions of the recordings on the tape and their relative positions in regard to timing relations of the recorded signals shall be as specified in figure 27, table 1, and clause 6.2. Tolerances shown in table 1 should, however, be reduced by 50% for calibration tapes.

5 Tape and cassette physical specifications

5.1 Magnetic tape specifications

5.1.1 Base

The base material shall be polyester or equivalent.

5.1.2 Tape width and width fluctuation

The tape width shall be 12.650 mm ± 0.01 mm. Tape width fluctuation shall not exceed 6 µm peak to peak. The value of tape width fluctuation shall be evaluated by measuring 10 points, each 20 mm apart, over a tape length of 200 mm.

5.1.3 Tape thickness

The tape thickness shall be from 12.3 µm to 14.5 µm.

5.1.4 Offset yield strength

The offset yield strength shall be greater than 15 N.

5.1.5 Magnetic coating

The magnetic tape used shall have a coating of metal particles or equivalent, longitudinally oriented. The coating coercivity shall be in the range of 118,000 A/m to 136,000 A/m, with an applied field of 800,000 A/m (10,000 oersted), as measured by a 50- or 60-Hz BH meter or vibrating sample magnetometer (VSM).

5.2 Cassette specifications

5.2.1 Cassette dimensions

Two sizes of cassettes shall be identified as follows:

S cassette: 96 ×156 ×25 mm (as shown in figures 1 to 13)
L cassette: 145 ×254 ×25 mm (as shown in figures 14 to 26)

5.2.2 Tape length and recording time

Maximum tape length and recording time are recommended as follows:

S cassette: 239 m + 2 m – 0 m — 60 minutes for 525/60 and 71 minutes for 625/50
L cassette: 725 m + 2 m – 0 m — 184 minutes for 525/60 and 220 minutes for 625/50

5.2.3 Datum planes

Datum plane Z shall be determined by three datum areas, A, B, and C, as shown in figures 3a and 16a. Datum plane X shall be orthogonal to datum plane Z and shall include the centers of datum holes (a) and (b). Datum plane Y shall be orthogonal to both datum plane X and datum plane Z and shall include the center of datum hole (a) as shown in figures 2 and 15.

5.2.4 Tape winding

The magnetic coating side of the magnetic tape shall face outside on both the supply reel and the take-up reel as shown in figures 4 and 17.

5.2.5 Label area and window area

The hatched areas shown in figures 1 and 14 are for the label and window. Labels attached to the cassette shall not protrude above the outside cassette surface plane.

5.2.6 Guiding groove

For correct insertion into the VTR, four guiding grooves for S cassettes as shown in figures 1 and 2, and three guiding grooves for L cassettes, as shown in figure 15, shall be provided.

5.2.7 Safety tab and safety plug for recording inhibition

For S cassettes, a safety plug at the supply reel side and a hole of minimum depth 10 mm from datum plane Z at the take-up reel side shall be provided as shown in figure 2.

For L cassettes, a safety plug shall be provided at the take-up reel side as shown in figure 15.

The safety plug shall not be deformed by 0.3 mm or more when a force of 2.0 N (204 gf) is applied to the center of it, using a 2.5-mm diameter rod (see figures 12 and 25).

5.2.8 Identification holes

Six identification holes (holes 1 to 6) shall be located as specified in figures 2 and 15. For this format, holes 1, 2, 3, and 6 shall be closed. Holes 4 and 5 shall be open.

5.2.9 Reels

The reels shall be automatically unlocked when the cassette is inserted into the video tape recorder and/or player unit and automatically locked when the cassette is ejected from it.

The locations of the reels, when in the unlocked position, are shown in figures 4 and 17. Dimensions of the reels are shown in figures 6 and 19. The height of the reels is shown in figures 7 and 20.

The reel shall be completely released when the cassette lid is opened 23.5 mm minimum from datum plane Z.

5.2.9.1 Reel spring force

The reels assembled in the cassette shall be pressed by the reel spring with a specified force under the conditions specified in figures 11 and 24. The spring force shall be 1.5 N ±0.5 N (153 gf ± 51 gf) for S cassettes and 3.5 N ±0.5 N (357 gf ±51 gf) for L cassettes when pressing on a reel 2.4 mm above datum plane Z as shown in figures 11 and 24.

5.2.9.2 Extraction force

The force (F1, F2) required to pull the tape out from the reel shall not exceed 0.17 N (17gf), as specified in figures 13a and 26a.

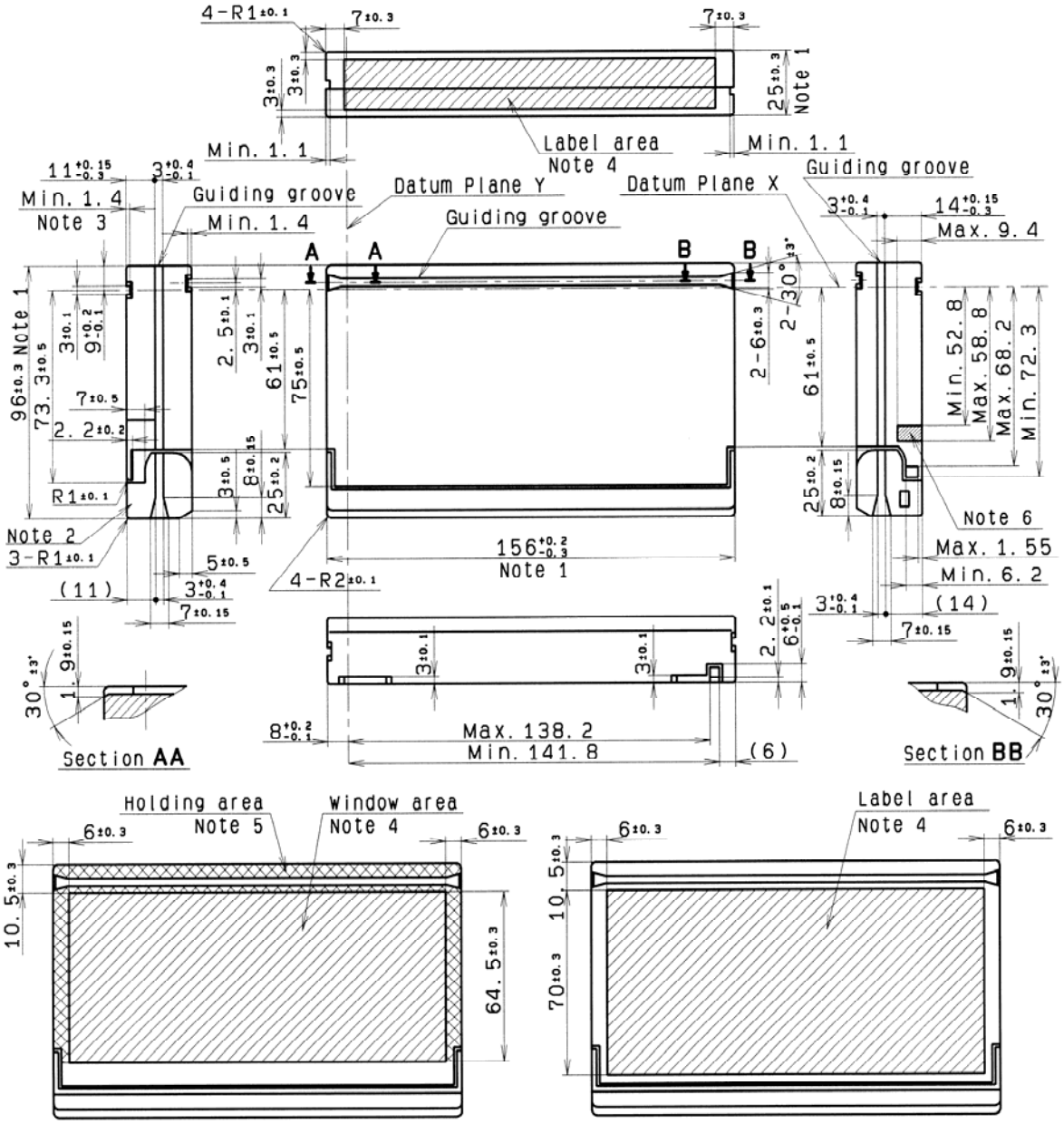
5.2.9.3 Friction torque

The torque required to wind the tape shall be less than 152 m/Nm (152 gf/cm) for S cassettes and less than 30 m/Nm (305 gf/cm) for L cassettes, as specified in figures 13b and 26b.

5.2.10 Protecting lid

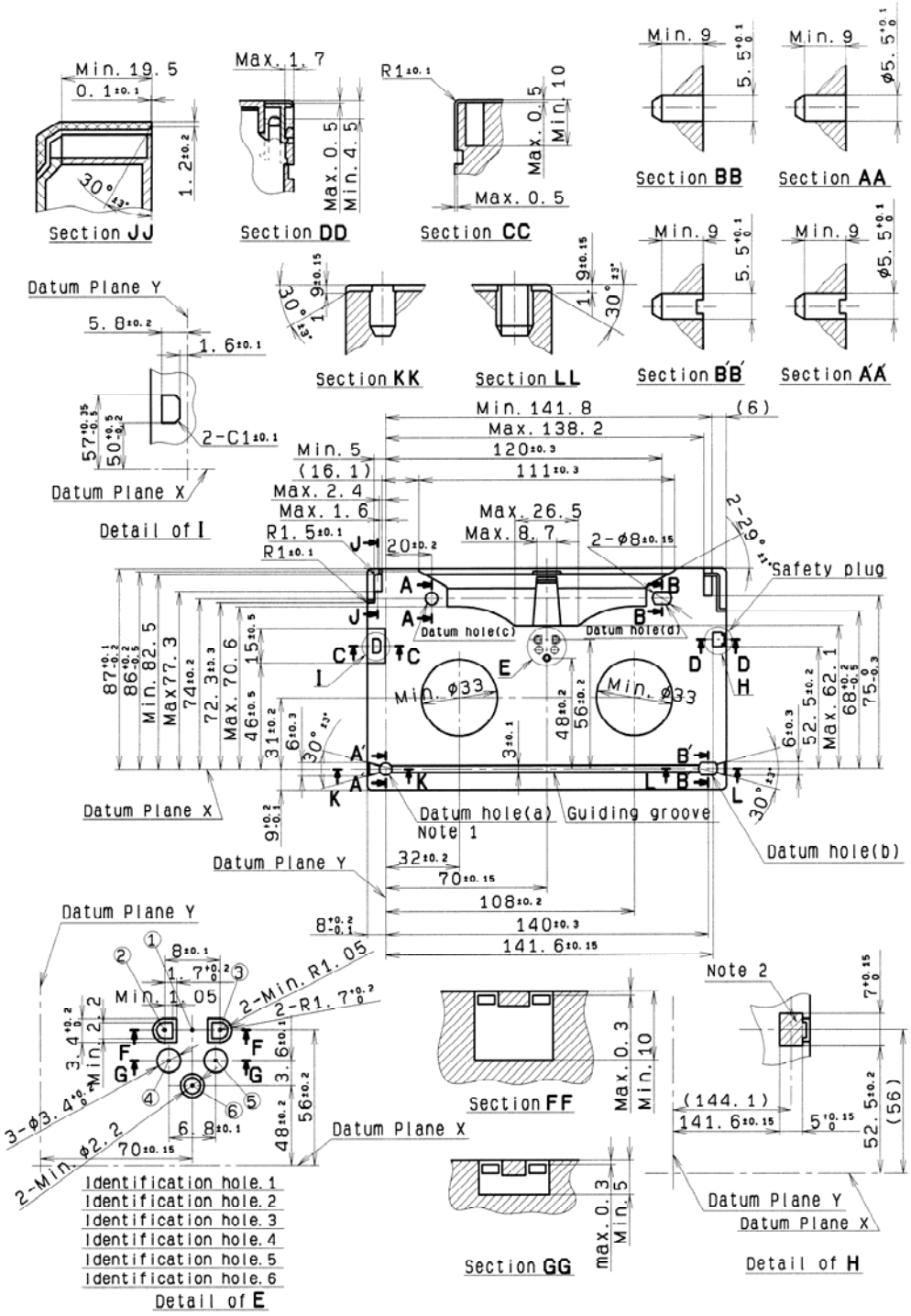
The cassette lid shall be automatically unlocked when the cassette is inserted into the video tape recorder and/or player unit and automatically locked when the cassette is ejected from it. The unlocking lever insertion area is specified in figures 8 and 21. The lid shall be unlocked when the lid lock lever is shifted in either direction A or B, as illustrated in figures 9 and 22. The force required to unlock the lid shall be less than 1 N (101 gf) in the A direction or less than 1.5 N (152 gf) in the B direction.

The lid shall open 29.0 mm with a force of 1.5 N (152 gf) or less as specified in figures 10 and 23.



NOTES
1 These dimensions are inspected by using limit gauges.
2 No part of the lid shall protrude beyond the bottom plane of the cassette when the lid opens or when it closes.
3 These dimensions shall be specified based on datum plane Z.
4 Label and/or window areas, shown by the hatched area, are available for the label and/or window.
5 The cassette may be held in position by the recorder and/or player unit on the holding area shown by the crosshatched area.
6 The fine hatched area shows the acceptable range of plug notch position and depth at the side.

Figure 1 – Top and side view dimensions (S-cassette)



NOTES
1 Datum hole (a) is primary.
2 The crosshatched area shows the VTR detection area.
3 Datum holes (a) and (b) may be utilized for screw holes.

Figure 2 – Bottom view dimensions (S-cassette)

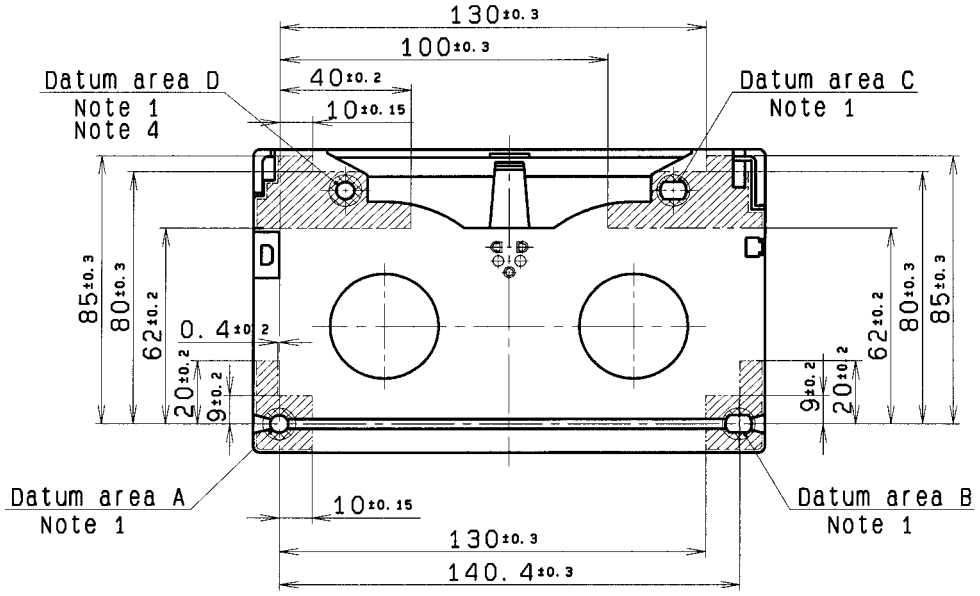


Figure 3a – Datum areas and supporting areas

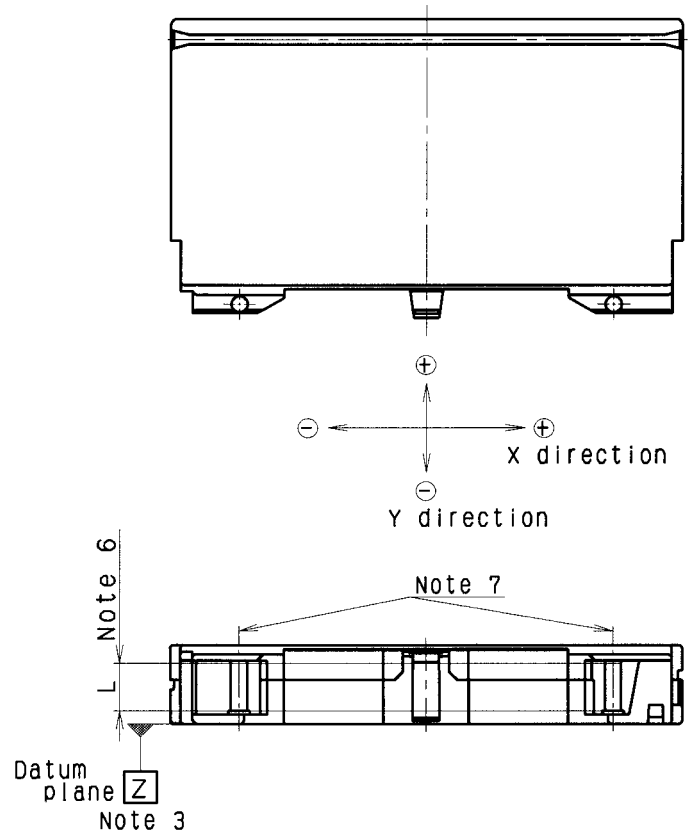


Figure 3b – Tape guides

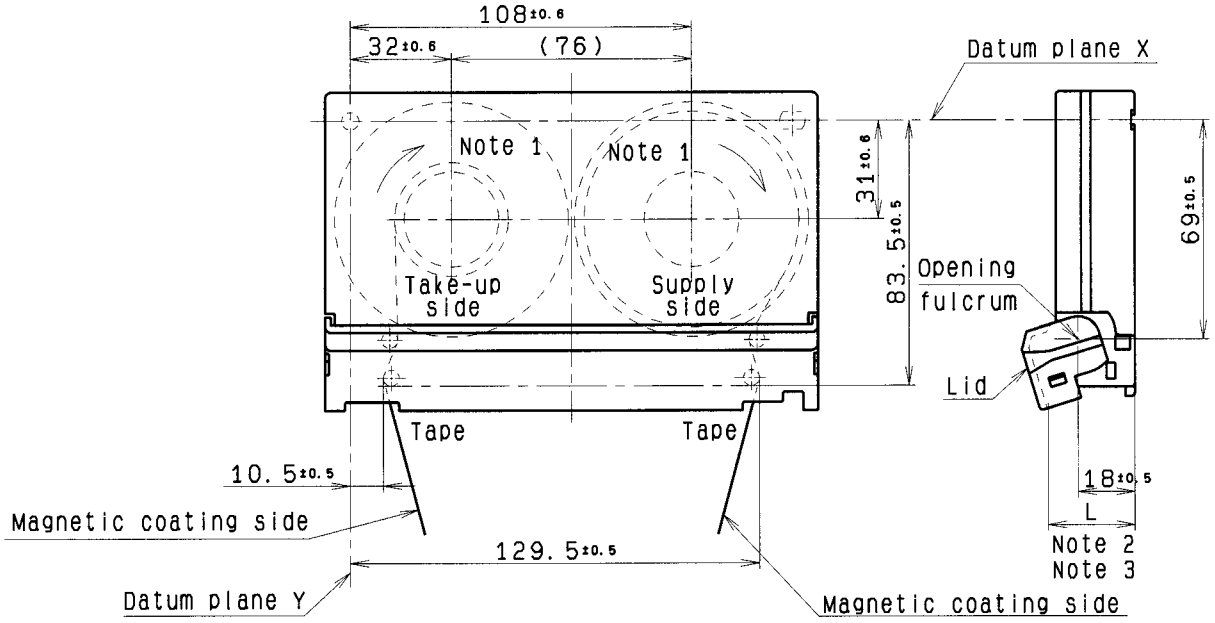
NOTES
1 The crosshatched areas 10 mm in diameter are datum areas.
2 The four supporting areas, shown by the hatched areas, shall be coplanar with their corresponding datum areas within 0.05 mm of each of them.
3 Datum plane Z shall be defined by the three datum areas, A, B, C.
4 Datum area D shall be coplanar, within 0.3 mm, with datum plane Z.
5 The areas within 1 mm of the edges of a cassette shall not be included in the supporting areas.
6 Measurement L: 15 mm.
7 Perpendicularity of tape guides is specified as follows (even if they themselves are tapered):

Direction / Tape guide	X	Y
Supple side	0 ± 0.15	0 ± 0.15
Take-up side	0 ± 0.15	0 ± 0.15

Dimensions in millimeters

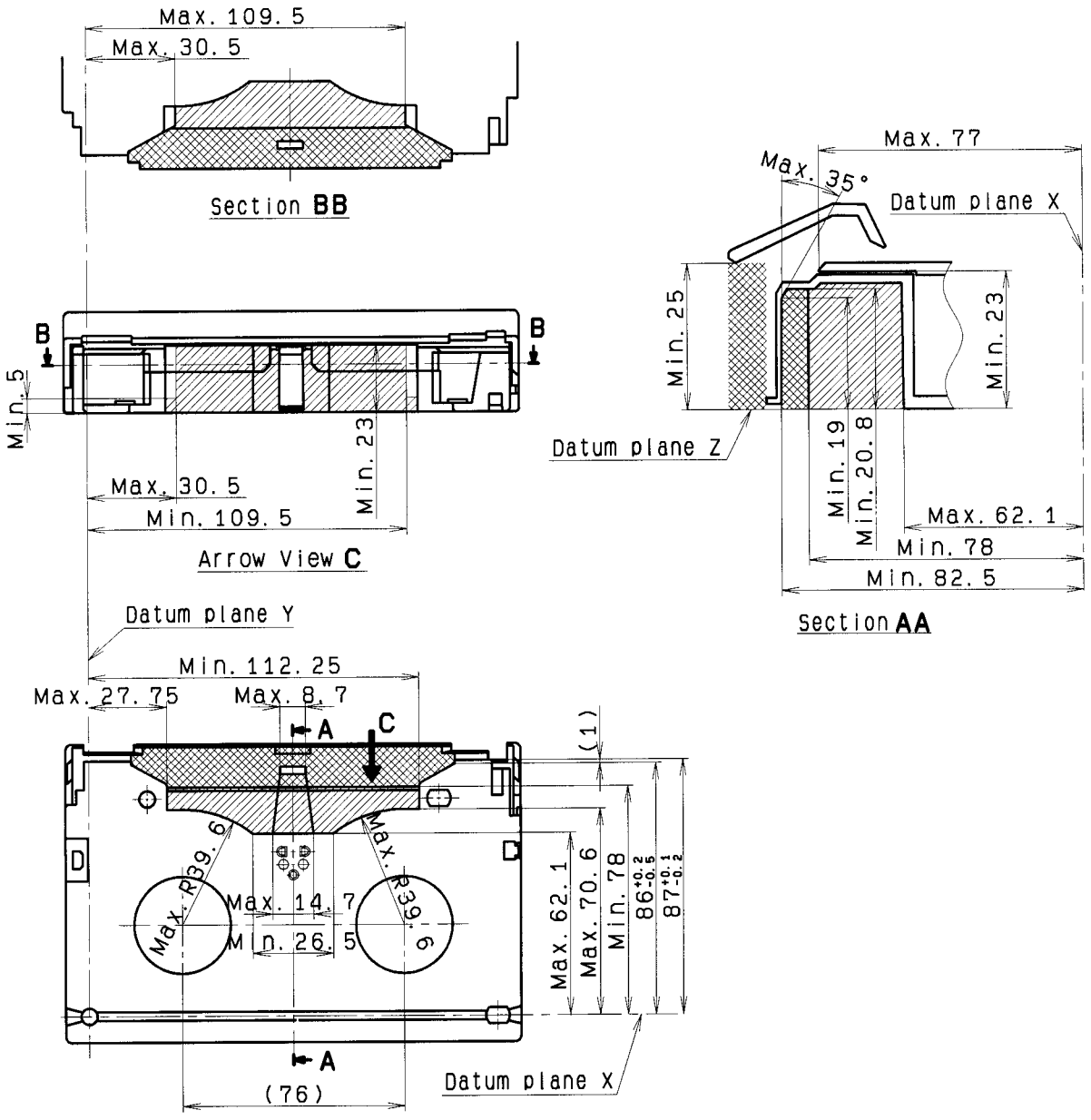
1 Direction X: Parallel to the tape running direction.
2 Direction Y: Horizontally orthogonal to direction X.

Figure 3 – Datum areas, supporting areas, tape guides and associated dimensions (S-cassette)



NOTES
1 The rotating direction of reels during forward operation.
2 The lid opening height L shall be 29 mm or more.
3 The reel shall be reset completely when the lid opening height L is 23.5 mm.

Figure 4 – Reel location in the unlocked position (S-cassette)

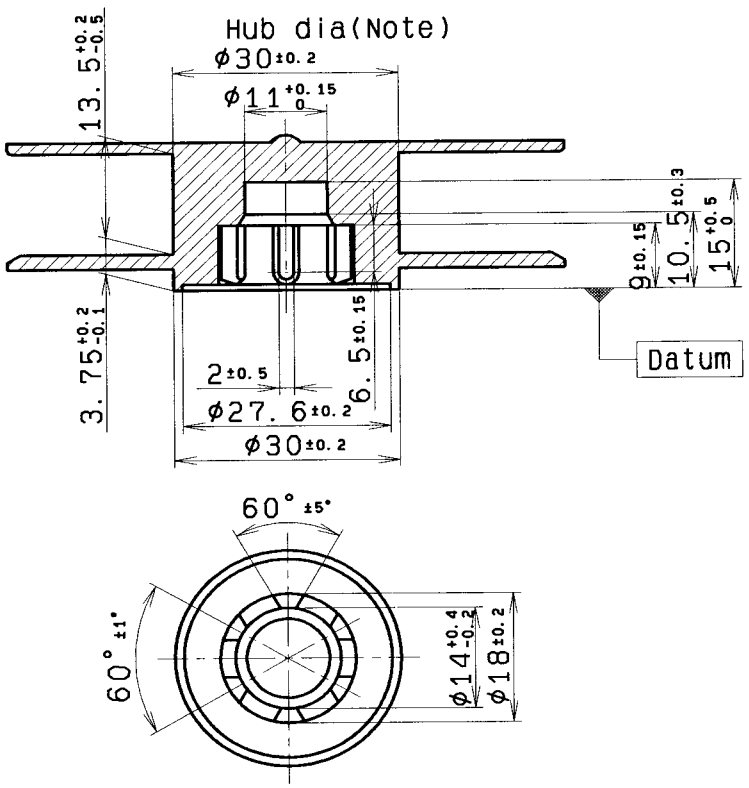


NOTES

1 The hatched area is where the loading mechanism of the video tape recorder and/or player unit positions the video cassette when it is inserted.

2 The hatched and crosshatched areas are so designed that the loading mechanism of the video tape recorder and/or player unit unwinds and extends the magnetic tape towards the head drum after the lid opens.

Figure 5 – Protecting lid dimensions (S-cassette)
(Minimum space for loading mechanism)



NOTE – The reels with large hubs (hub diameter 53.3 □0.2 mm) can be used for cassettes whose recording time is less than 12 minutes.

Figure 6 – Reel dimensions (S-cassette)

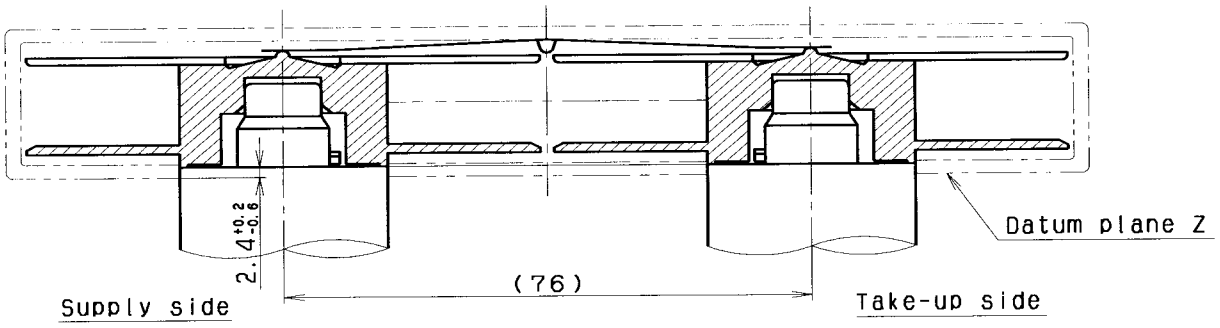
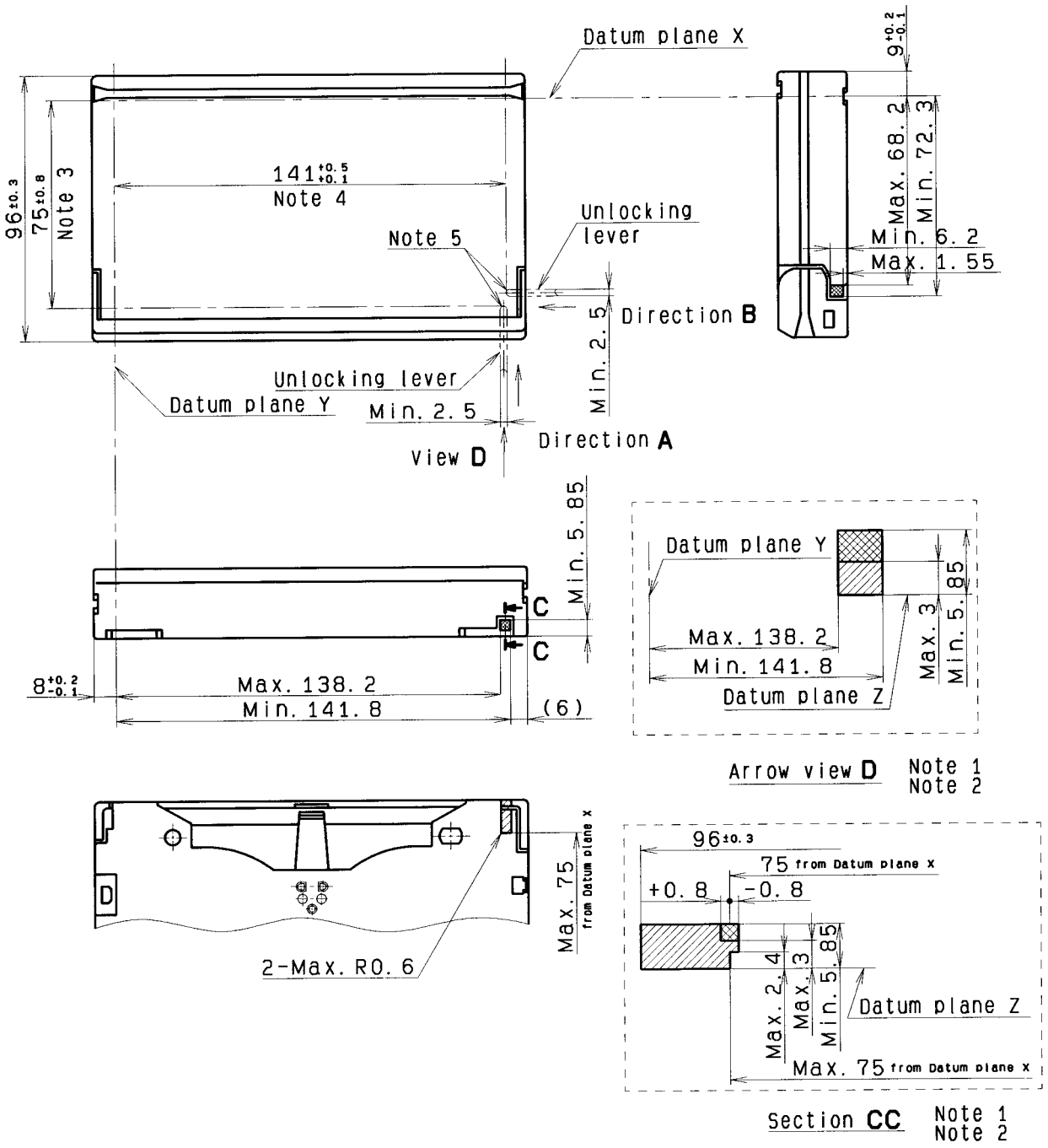
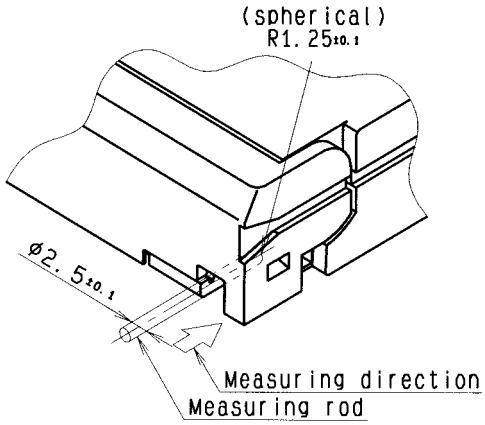


Figure 7 – Reel height in the unlocked position (S-cassette)



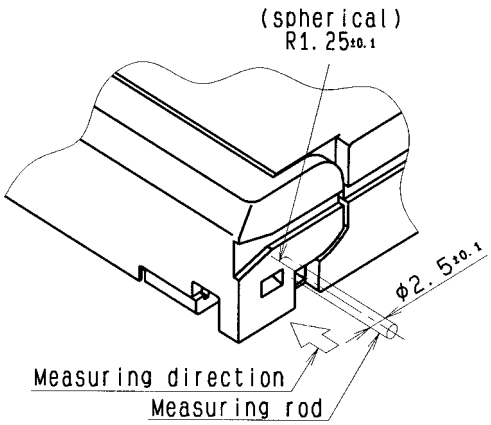
NOTES
1 The crosshatched and hatched areas show the allowable total area where the unlocking lever extending from the video tape recorder and/or player unit can be inserted into a cassette.
2 The crosshatched area shows the range of the unlocking lever insertion which permits the lid to be unlocked.
3 Allowable range within which the unlocking lever can be inserted in the A direction.
4 Allowable range within which the unlocking lever can be inserted in the B direction.
5 The tip of the unlocking lever shall be shaped into a semicircle or hemisphere whose radius is half of the unlocking lever width.

Figure 8 – Unlocking lever insertion area (S-cassette)



Direction A – The force to unlock the lid shall not be greater than 1.0 N in the A direction.

Refer to Figure 8 regarding the measuring ranges.



Direction B – The force to unlock the lid shall be less than 1.5 N in the B direction.

Refer to Figure 8 regarding the measuring ranges.

Figure 9 – Lid unlocking force (S-cassette)

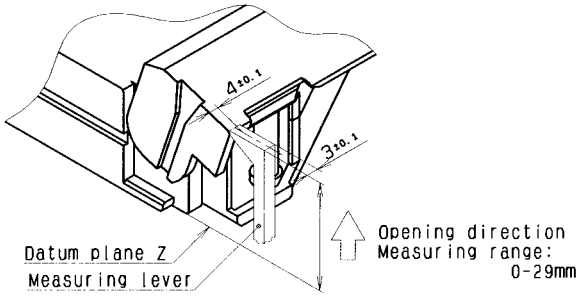


Figure 10 – Lid opening force (S-cassette)

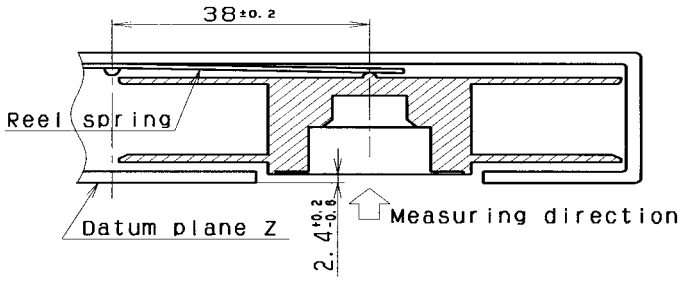


Figure 11 – Reel spring force (S-cassette)

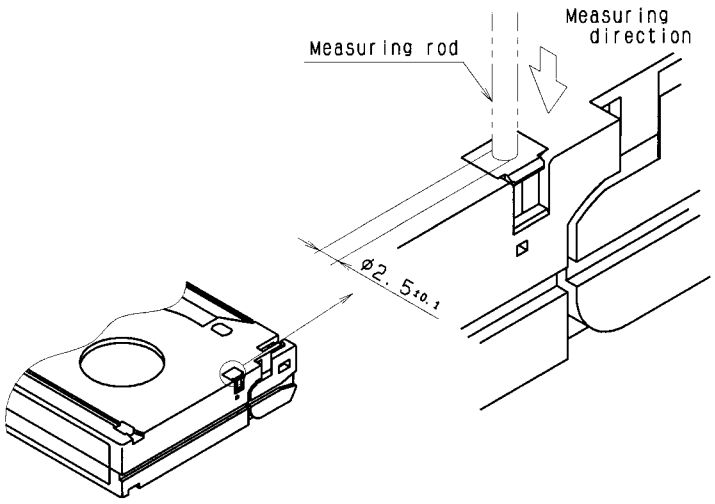


Figure 12 – Safety plug strength (S-cassette)

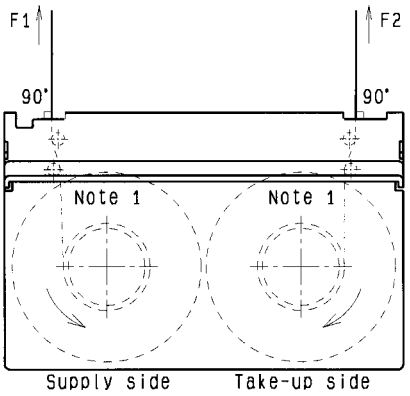


Figure 13a – Extraction force (F1, F2)

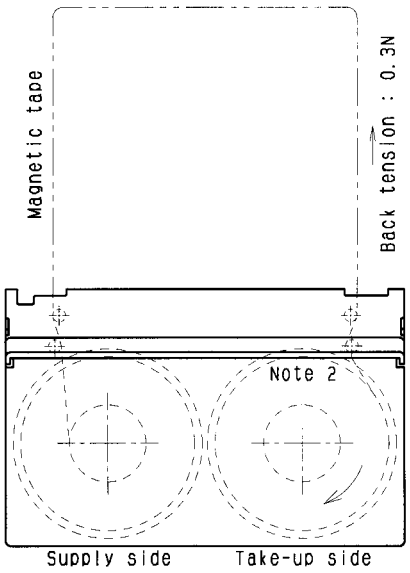
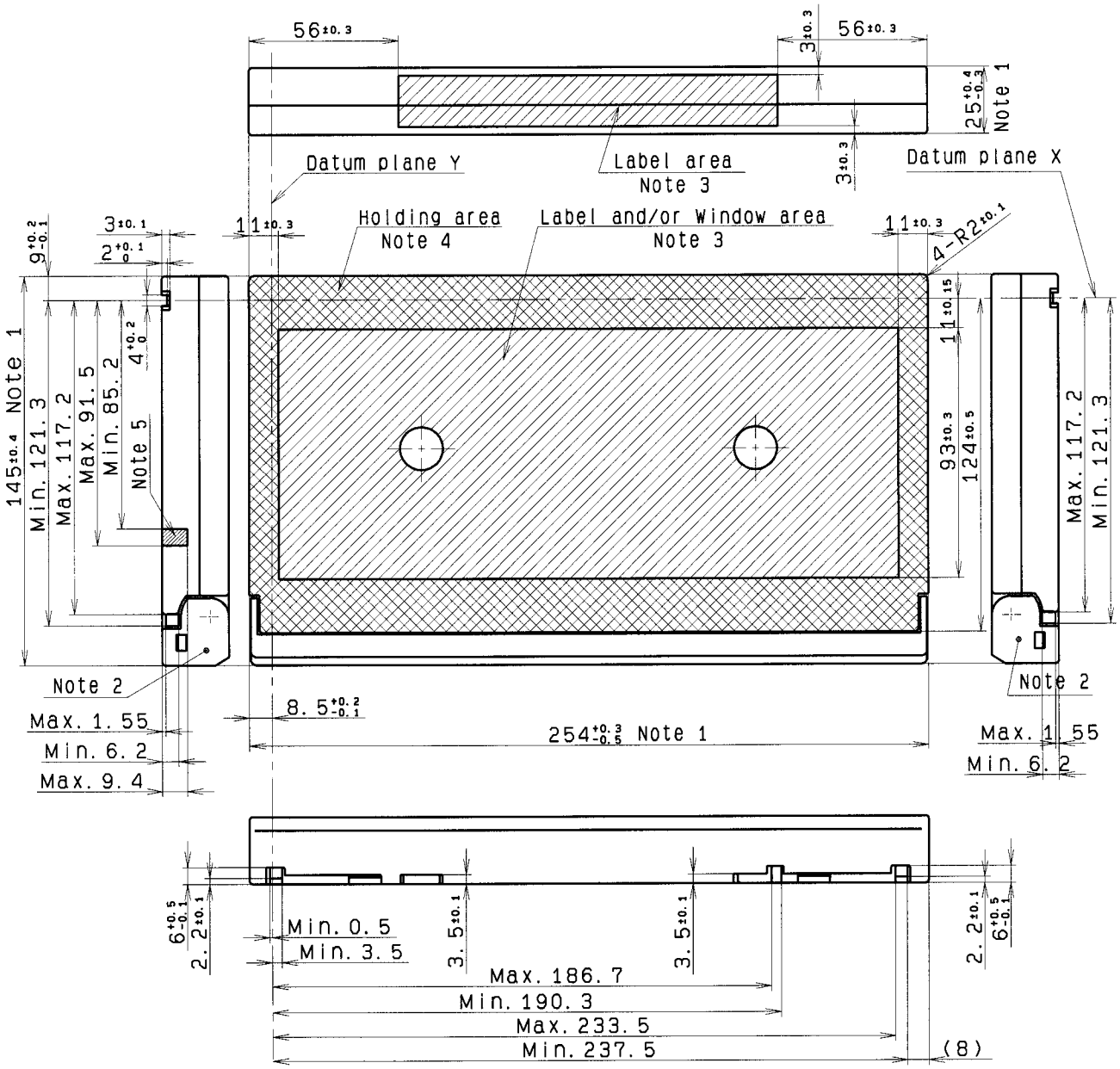


Figure 13B – Friction torque

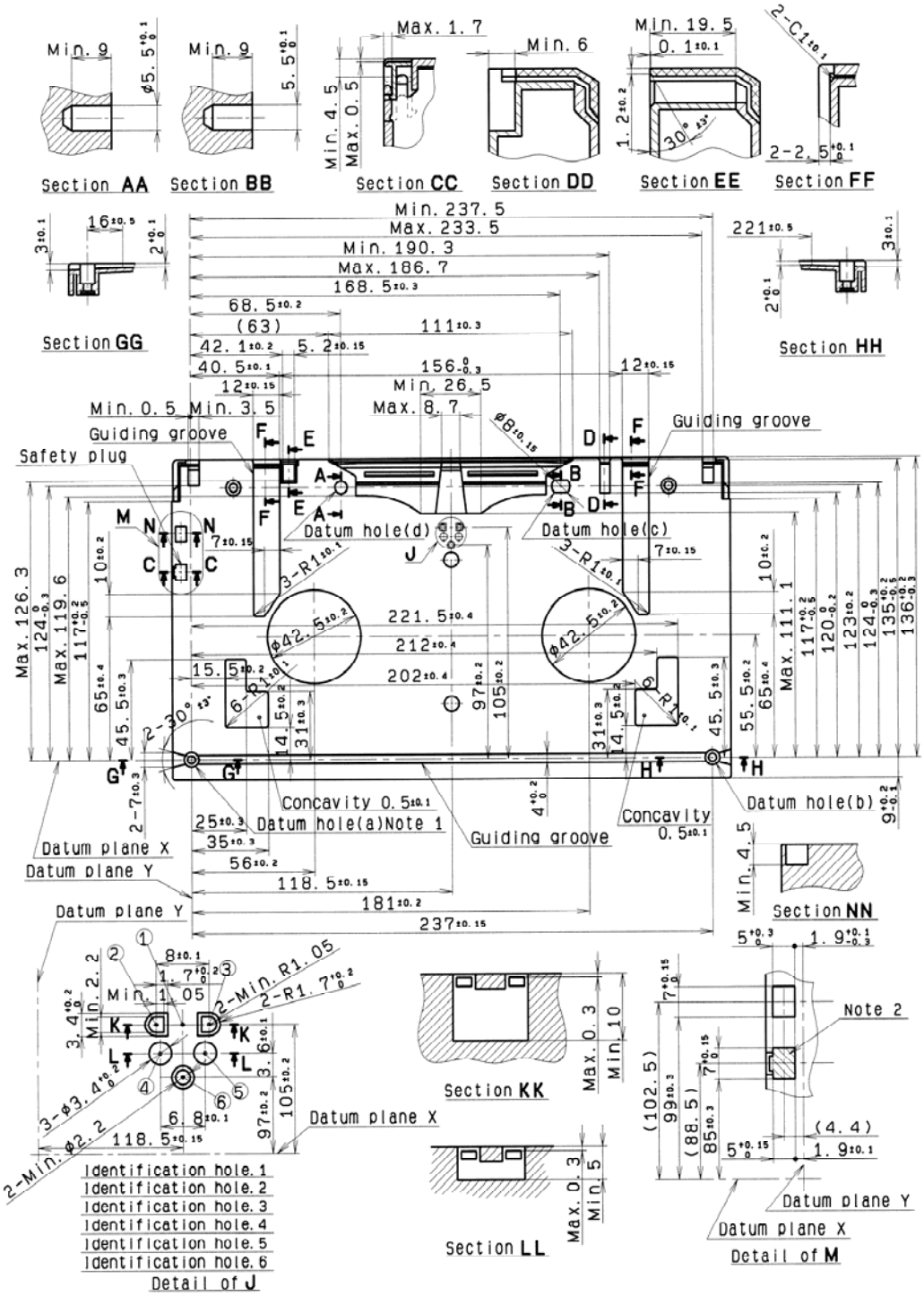
NOTES
1 Holdback torque of 1 m/Nm.
2 Friction torque to wind the tape.

Figure 13 – Extraction force (F1, F2) and friction torque (S-cassette)



NOTES
1 These dimensions are inspected by using limit gauges.
2 No part of the lid shall protrude beyond the bottom plane of the cassette when the lid opens or when it closes.
3 Label and/or window area shown by the hatched area is available for the label and/or window.
4 The cassette may be held in position by the recorder and/or player unit on the holding area shown by the crosshatched area.
5 The fine hatched area shows the acceptable range of plug notch position and depth at the side.

Figure 14 – Top and side views (L-cassette)



NOTES
1 Datum hole (a) is primary.
2 The crosshatched area shows the VTR detection area.
3 Datum holes (a) and (b) may be utilized for screw holes.

Figure 15 – Bottom view (L-cassette)

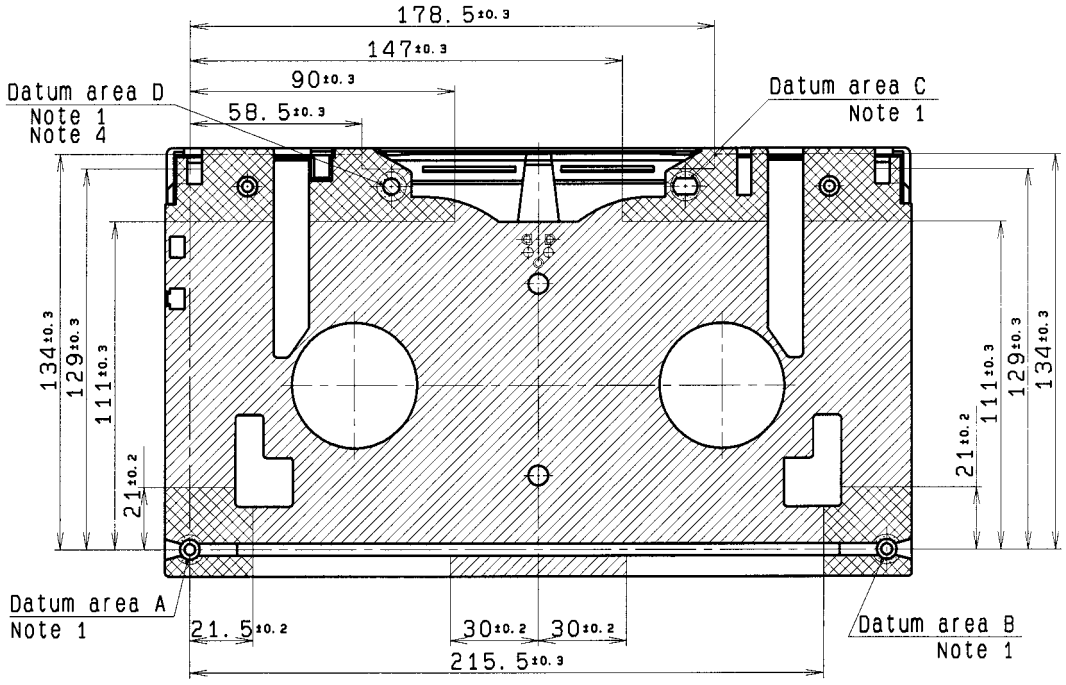


Figure 16a – Datum areas and supporting areas

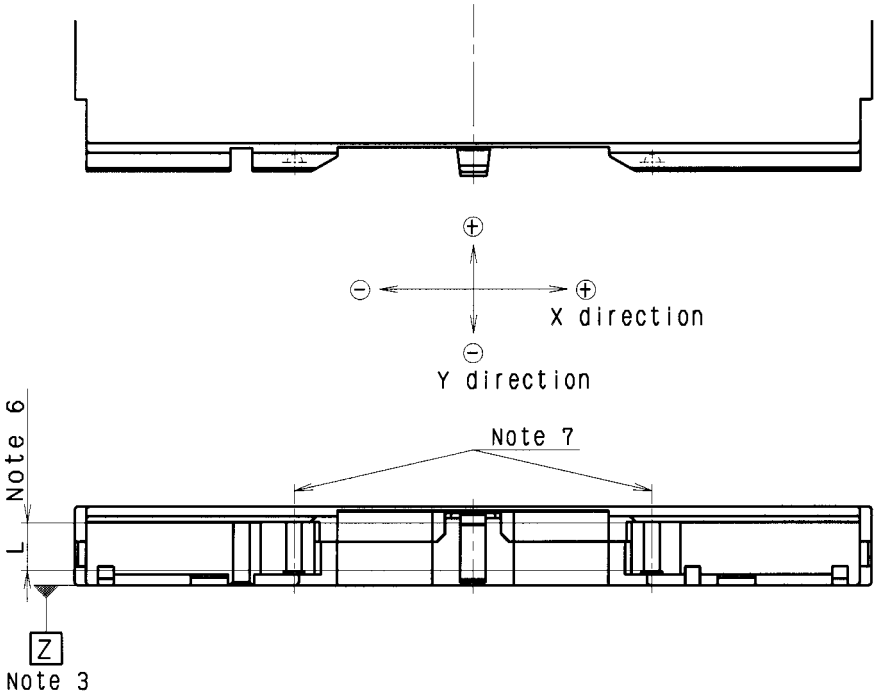


Figure 16b – Tape guides

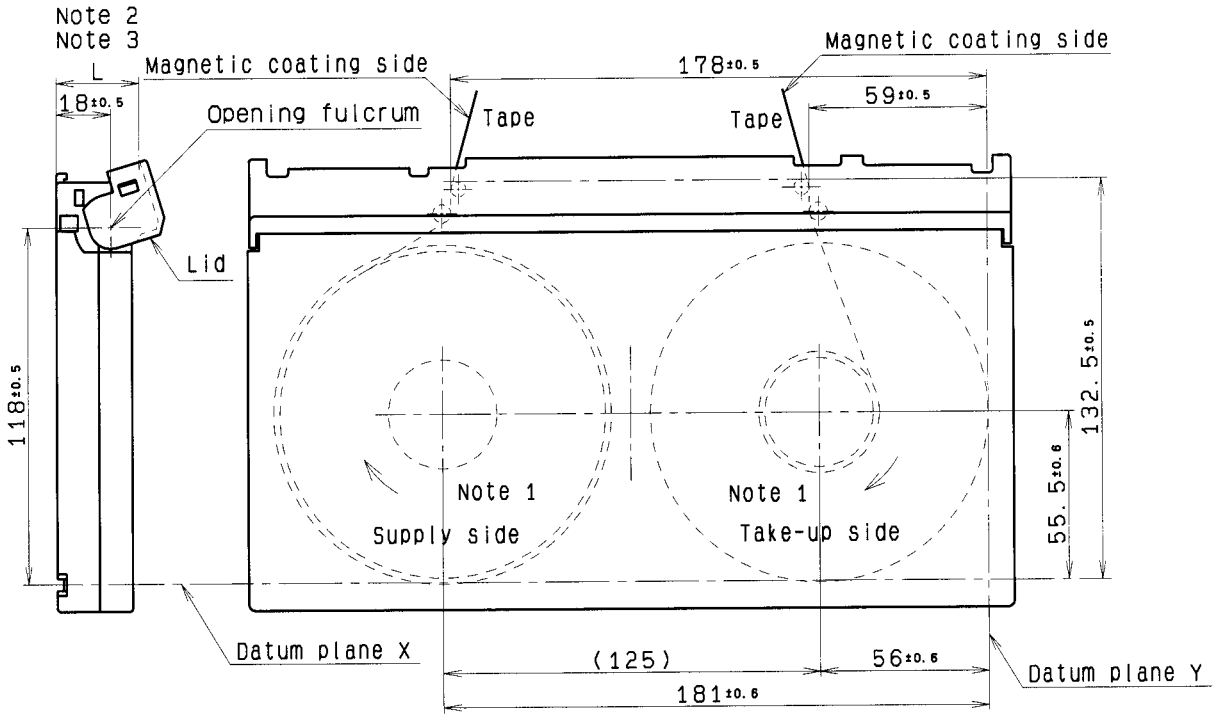
NOTES
1 The four round areas 10 mm in diameter are datum areas.
2 The four supporting areas, shown by the crosshatched areas, shall be coplanar with their corresponding datum areas within 0.05 mm of each of them and shall be coplanar with the hatched areas.
3 Datum plane Z shall be defined by the three datum areas, A, B, C.
4 Datum area D shall be coplanar within 0.3 mm with datum plane Z.
5 The areas within 1 mm of the edges of the cassette shall not be included in the supporting areas.
6 Measurement L: 15 mm.
7 Perpendicularity of tape guides is specified as follows (even if they themselves are tapered):

Direction / Tape guide	X	Y
Supple side	0 ± 0.15	0 ± 0.15
Take-up side	0 ± 0.15	0 ± 0.15

Dimensions in millimeters

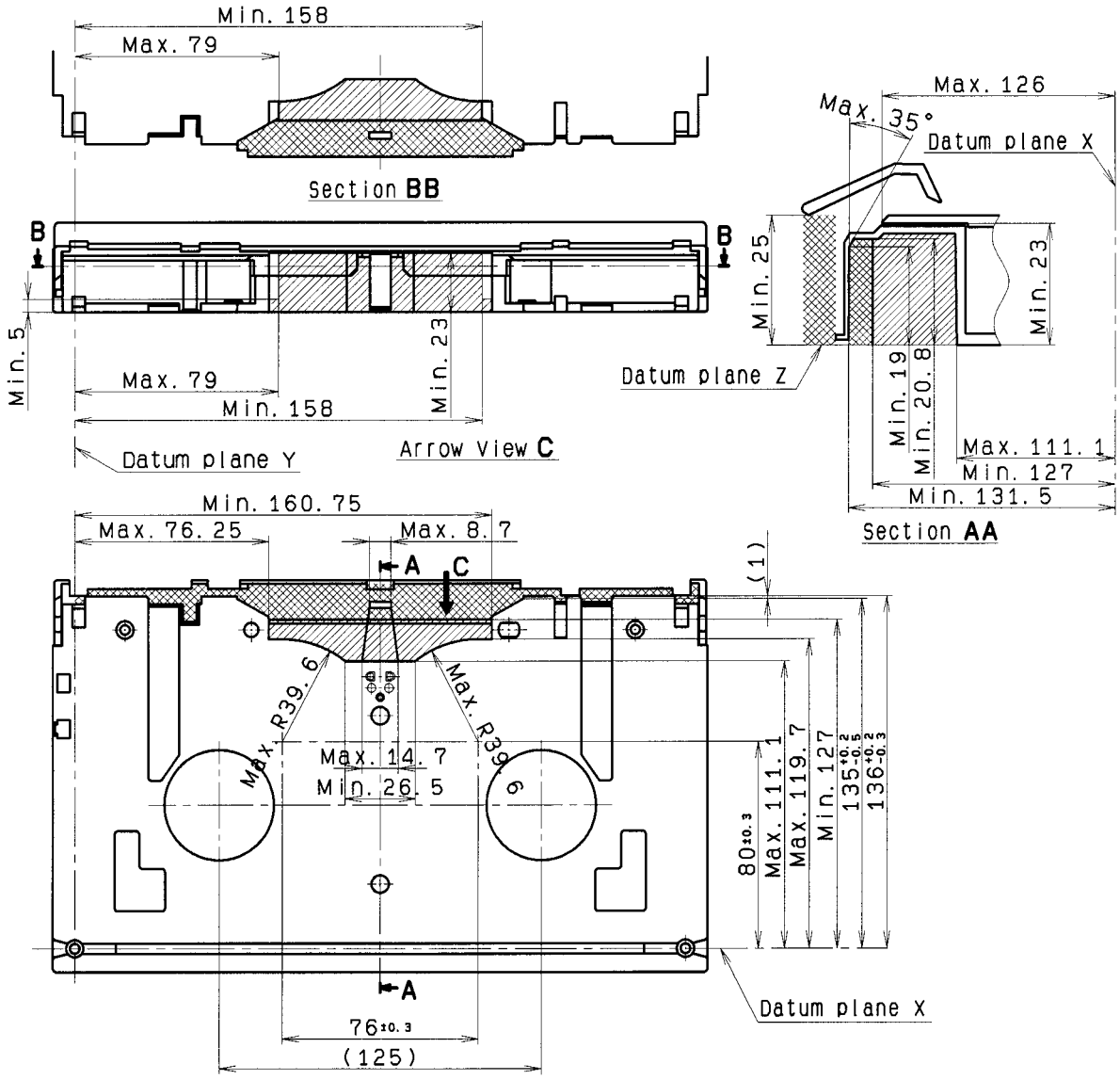
NOTES
1 Direction X: Parallel to the tape running direction.
2 Direction Y: Horizontally orthogonal to direction X.

Figure 16 – Datum areas, supporting areas and tape guides (L-cassette)



NOTES
1 The rotating direction of reels during forward operation.
2 The lid opening height L shall be 29 mm or more.
3 The reel shall be reset completely when the lid opening height L is 23.5 mm.

Figure 17 – Reel location in unlocked position (L-cassette)

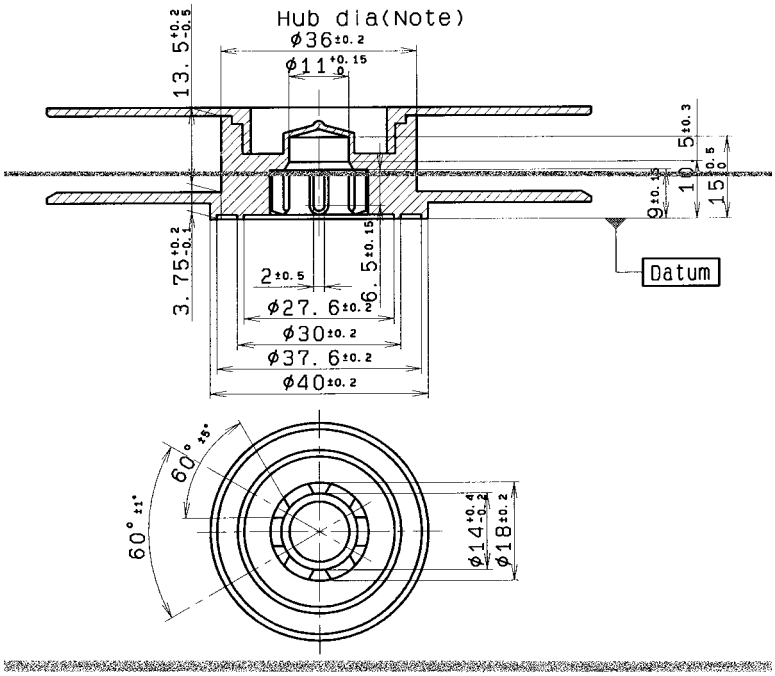


NOTES

1 The hatched area is where the loading mechanism of the video tape recorder and/or player unit positions the video cassette when it is inserted.

2 The hatched and crosshatched areas are so designed that the loading mechanism of the video tape recorder and/or player unit unwinds and extends the magnetic tape towards the head drum after the lid opens.

Figure 18 – Protecting lid (L-cassette)
(Minimum space for loading mechanism)



NOTE – Reels with large hubs (hub diameter 53.3 mm □0.2 mm) can be used for cassettes whose recording time is less than 34 minutes.

Figure 19 – Reel dimensions (L-cassette)

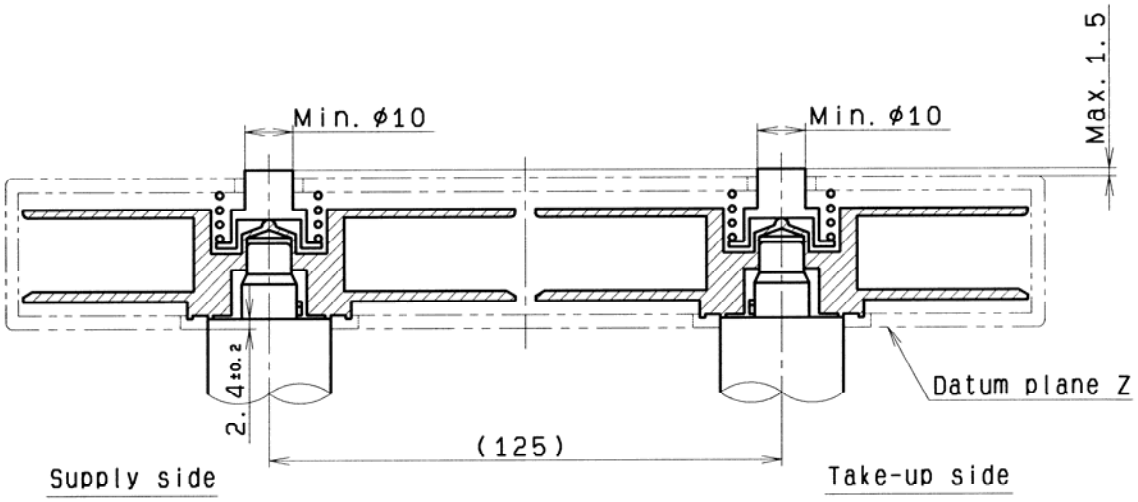
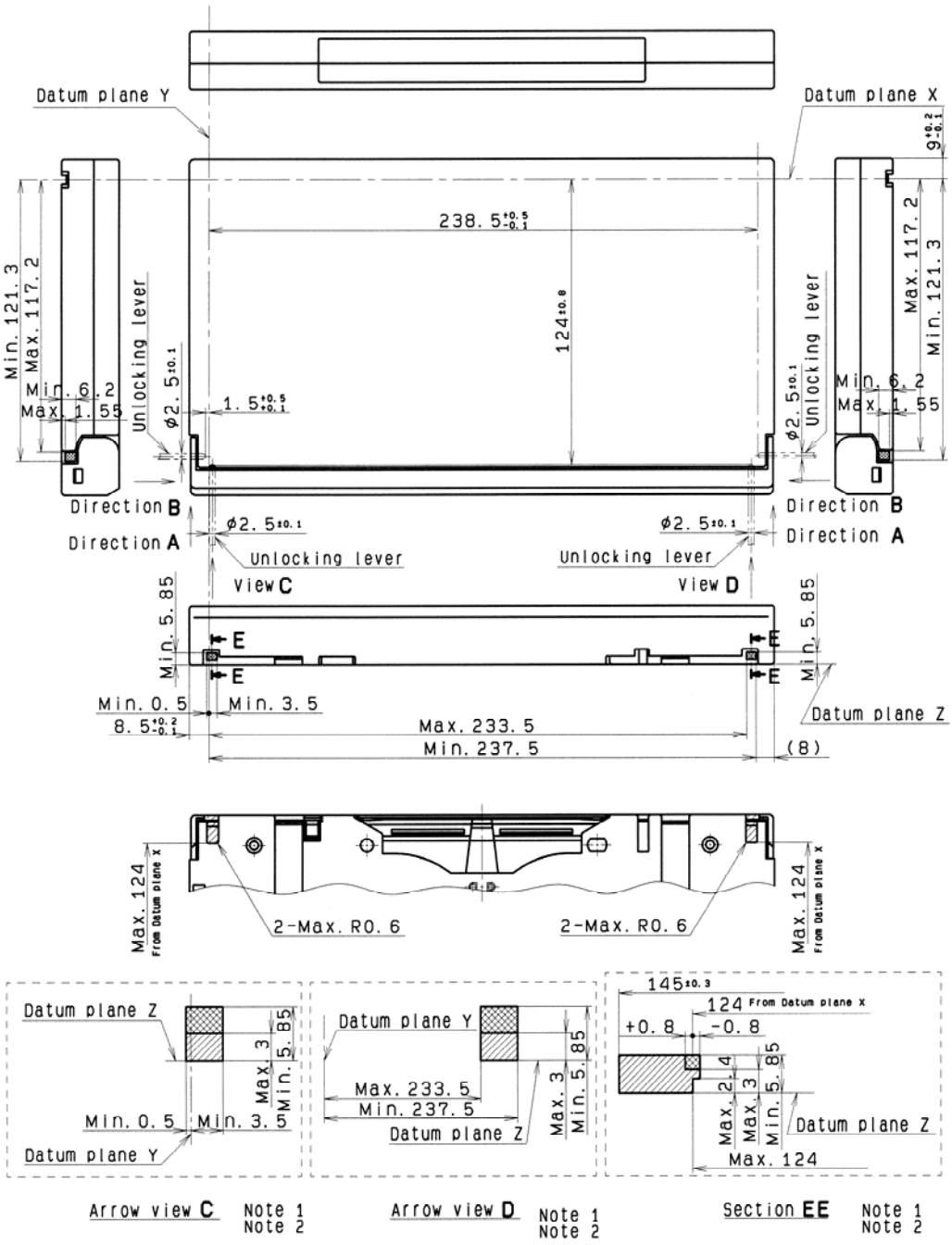


Figure 20 – Reel height in unlocked operation (L-cassette)



NOTES

1 The crosshatched and hatched areas show the allowable total area where the unlocking lever extending from the video tape recorder and/or player unit can be inserted into a cassette.
2 The crosshatched area shows the range of the unlocking lever insertion which permits the lid to be unlocked.
3 Allowable range within which the unlocking lever can be inserted in the A direction.
4 Allowable range within which the unlocking lever can be inserted in the B direction.
5 The tip of the unlocking lever shall be shaped into a semicircle or hemisphere whose radius is half of the unlocking lever width.

Figure 21 – Unlocking lever insertion area (L-cassette)

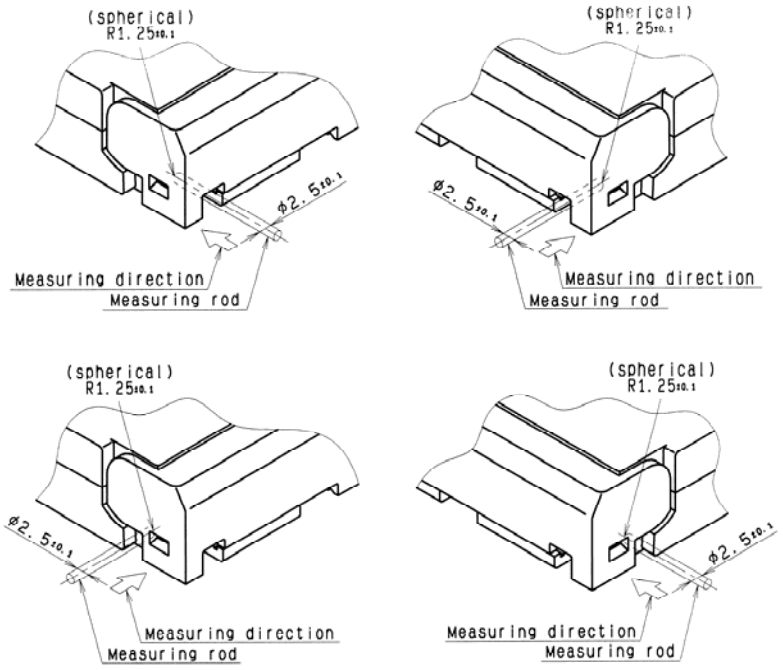


Figure 22 – Lid unlocking force (L-cassette)

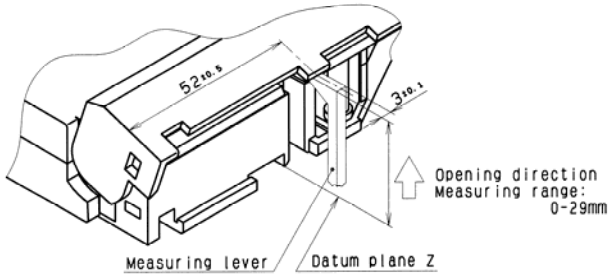


Figure 23 – Lid opening force (L-cassette)

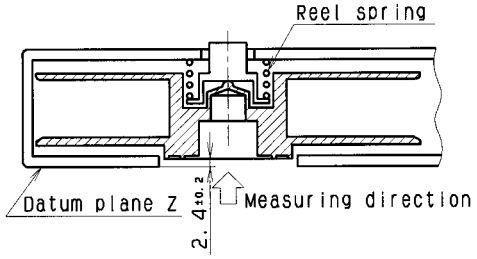


Figure 24 – Reel spring force (L-cassette)

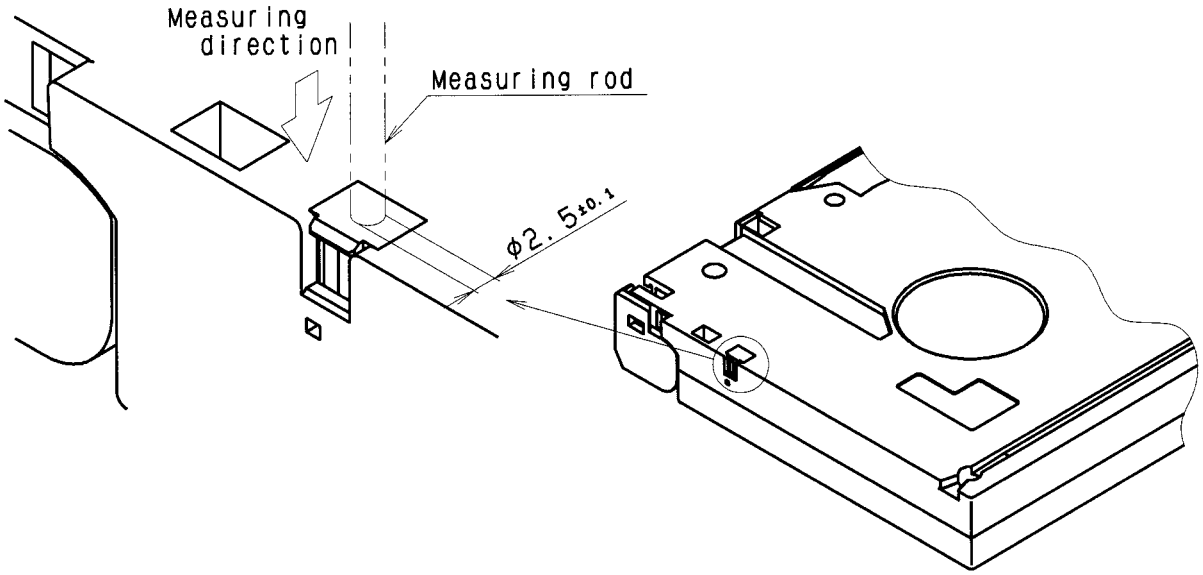


Figure 25 – Safety plug strength (L-cassette)

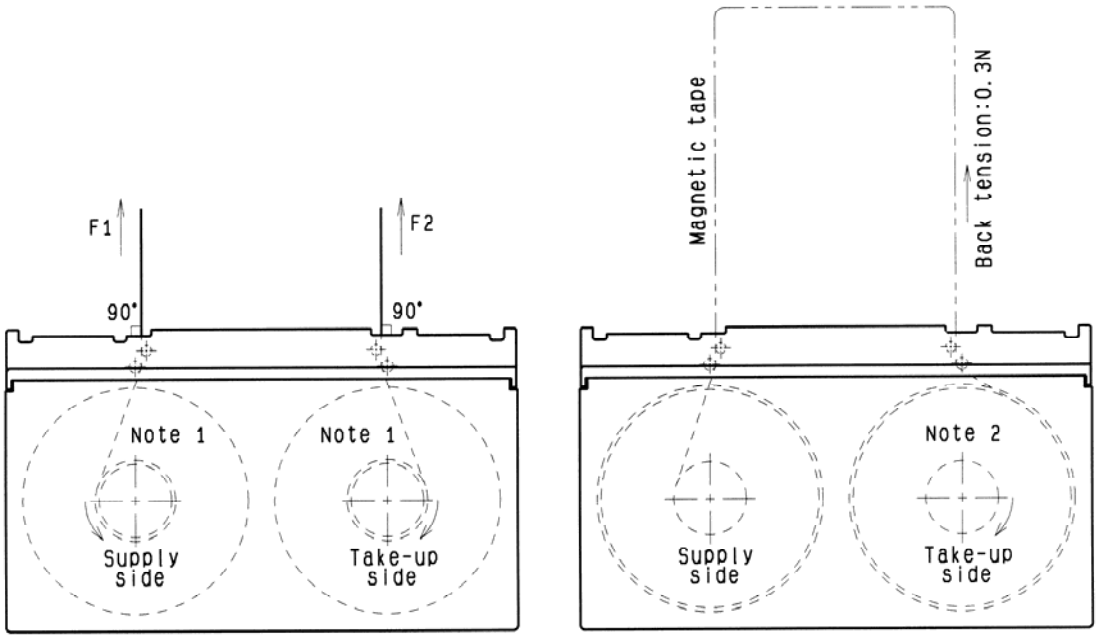


Figure 26a – Extraction force (F1, F2) **Figure 26B – Friction torque**

NOTES
1 Holdback torque of 1 m/Nm.
2 Friction torque to wind the tape.

Figure 26 – Extraction force (F1, F2) and friction torque (L-cassette)

6 Tape record physical parameters

6.1 Tape speed

The tape speed shall be 64.467 mm/s for the 525/60 system or 53.776 mm/s for the 625/50 system. The tape speed tolerance shall be ±0.2%.

6.2 Helical record physical parameters

6.2.1 Helical record location and dimensions

The reference edge of the tape for the dimensions specified in this standard shall be the lower edge as shown in figure 27. The magnetic coating, with the direction of tape travel, as shown in figure 27, is on the side facing the observer.

The program reference point for each video frame is determined by the intersection of a line which is parallel to the reference edge of the tape at the distance Y from the reference edge and the centerline of the first track in each video frame; that is track 0 of segment 1. The program reference point defines the start of the first video sector in the video frame.

The physical locations and dimensions of the helical recordings on the tape and their relative positions in regard to the time code start bit and the reference edge shall be as specified in figure 27 and table 1.

6.2.2 Helical track record tolerance zones

The lower edges of all four consecutive tracks shall be contained within the pattern of the four tolerance zones defined in figure 28.
Each zone is defined by two parallel lines which are inclined at an angle of 4.62644° with respect to the tape reference edge.

The centerlines of all zones shall be spaced apart by 0.0217 mm. The width of zones 2, 3, and 4 shall be 0.008 mm. The width of zone 1 shall be 0.004 mm. These zones are established to contain track angle errors, track straightness errors, and vertical head offset tolerance.

The measuring techniques are shown in IEC 61237-1.

6.2.3 Helical track gap azimuth

The azimuth angle of the head gaps used for recording the helical tracks shall be at an angle of α_0 or α_1 to the line perpendicular to the helical tracks, as specified in figure 27 and table 1.

The azimuth of the first track of every frame, that is the program reference point, shall be orientated in the counterclockwise direction with respect to the line perpendicular to the track direction when viewed from the side of the tape carrying the magnetic recording.

6.3 Longitudinal record physical parameters

6.3.1 Longitudinal record location and dimensions

The track widths and tolerances of the control and time code tracks shall be as defined in figure 27 and table 1.

6.3.2 Longitudinal track gap azimuth

The azimuth angle of the head gaps used for recording the longitudinal tracks shall be perpendicular to the tracks.

7 Longitudinal track signal and magnetic parameters

7.1 Longitudinal track record parameters

7.1.1 Method of recording

The control track and time code track signals shall be recorded using the hysteretic (nonbias) recording method.

7.1.2 Flux level

The recording level shall be at saturation of the magnetic domains which is defined as that point above which 0.5 dB increase in output level results from 1 dB increase of input level as indicated on an rms reading meter.

7.2 Control track record parameters

7.2.1 Control track pulse period

The control track pulse, at the point of recording, shall be a series of pulses with a period of 16.683 ms ± 6 µs (525/60 system) or 20.000 ms ±6 µs (625/50 system) as shown in figure 29 (525/60 system) and figure 30 (625/50 system).

7.2.2 Control track pulse definition

The rising edge of all control track pulses should be timed to coincide with the frame start point of the reference video delayed by 7.0 H + 12 µs.

For 525/60 systems, the frame start point is defined as the midway point of the leading sync edge position which identifies the start of line 4 in an analog video signal.

For 625/50 systems, the frame start point is defined as the midway point of the leading sync edge position which identifies the start of line 1 in an analog video signal.

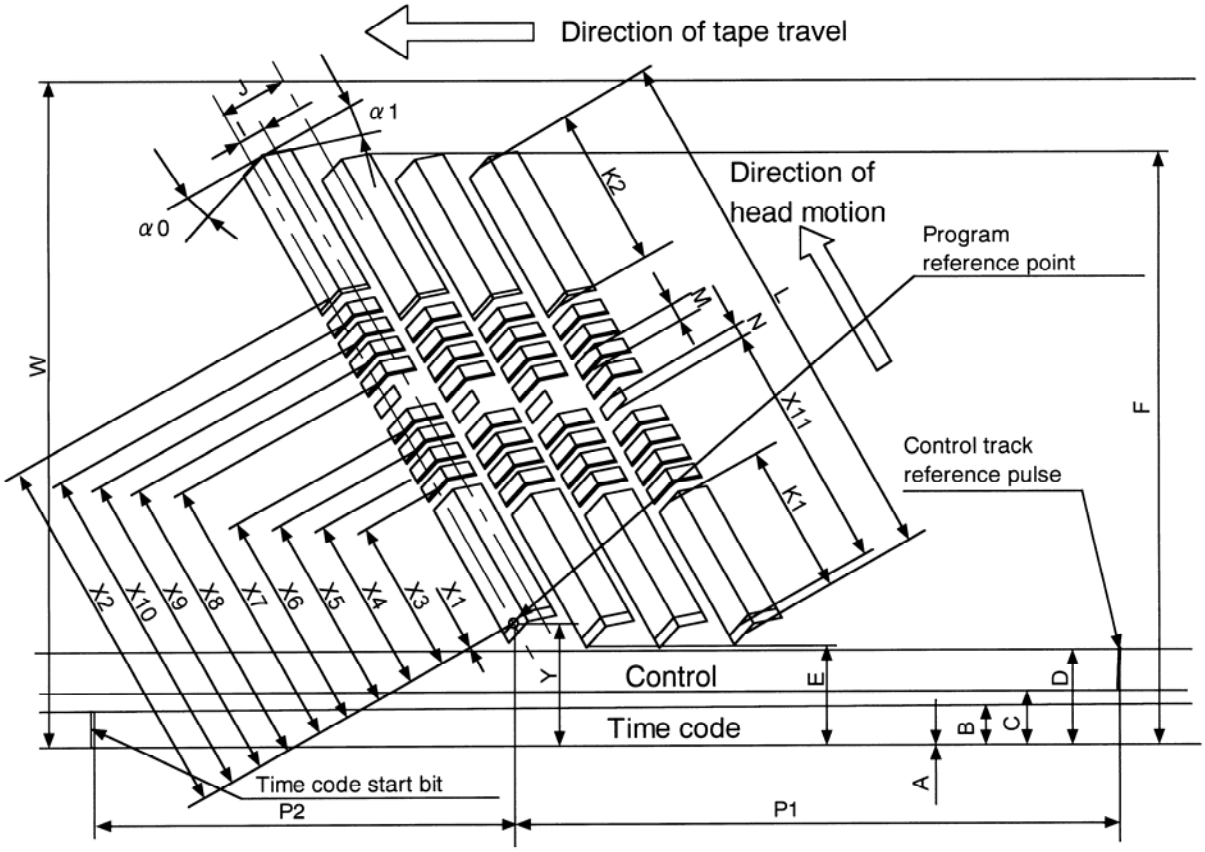
The control track pulses shall have nominal periods of 35T, 50T, or 65T between the rising and falling edges where T is equal to 0.1668 ms (525/60 system) or 0.200 ms (625/50 system) as shown in figure 29 (525/60 system) or figure 30 (625/50 system).

7.2.3 Color frame timing

A color frame sequence at the time of the start of each recording shall be indicated by the leading edges of 65T-width pulses. The color frame commences with color frame A field 1 for the 525/60 system or field 1 for the 625/50 system.

7.2.4 Audio sequence timing

The audio sequence consists of five fields for the 525/60 system as shown in figure 29. A 35T-width pulse indicates the first field of the audio sequence. If the first field coincides with the color frame field, a 65T-width pulse indicates the first field of the audio sequence.



NOTE – Not to scale.

Figure 27 – Locations and dimensions of recorded tracks

Table 1 – Record location and dimensions for 525/60 and 625/50 systems

Dimensions		Dimensions in millimeters Nominal 525/60	625/50	Tolerance
A	Time code track lower edge	0	0	Basic
B	Time code track upper edge	0.4	0.4	± 0.065
C	Control track lower edge	0.7	0.7	± 0.065
D	Control track upper edge	1.1	1.1	± 0.065
E	Program area lower edge	2.327	1.597	Derived
F	Program area upper edge	11.465	11.465	Derived
I	Helical track pitch (± azimuth)	0.02	0.02	Ref.
J	Helical track pitch (± azimuth)	0.0434	0.0434	Ref.
K1	Vector sector 1 length	44.11	47.032	Derived
K2	Vector sector 2 length	44.11	47.032	Derived
L	Helical track total length	113.04	122.092	Derived
M	Audio sector length	2.573	2.973	Derived
N	Tracking data area length	1.002	1.002	Derived
P1	Control track reference to program reference	56.249	47.228	± 0.1
P2	TC start bit to program reference	169.775	178.792	± 0.2
W	Tape width	12.65	12.65	± 0.01
X1	Location of start of video sector 0	0	0	± 0.07
X2	Location of start of video sector 1	68.931	75.06	± 0.07
X3	Location of start of audio sector 0	44.635	47.558	± 0.07
X4	Location of start of audio sector 1	47.422	50.745	± 0.07
X5	Location of start of audio sector 2	50.208	53.932	± 0.07
X6	Location of start of audio sector 3	52.994	57.119	± 0.07
X7	Location of start of audio sector 4	57.585	62.111	± 0.07
X8	Location of start of audio sector 5	60.371	65.298	± 0.07
X9	Location of start of audio sector 6	63.158	68.485	± 0.07
X10	Location of start of audio sector 7	65.944	71.673	± 0.07
X11	Location of start of tracking data	56.182	60.708	± 0.07
Y	Program area reference	2.359	1.629	Basic
Dimensions		Angles (°) Nominal 525/60	625/50	Tolerance
θ	Track angle	4.62644	4.62644	Basic
α0	Azimuth angle	– 15.269	– 15.269	± 0.17
α1	Azimuth angle	15.231	15.231	± 0.17

NOTE – The above measurements shall be made under the conditions specified in clause 4.

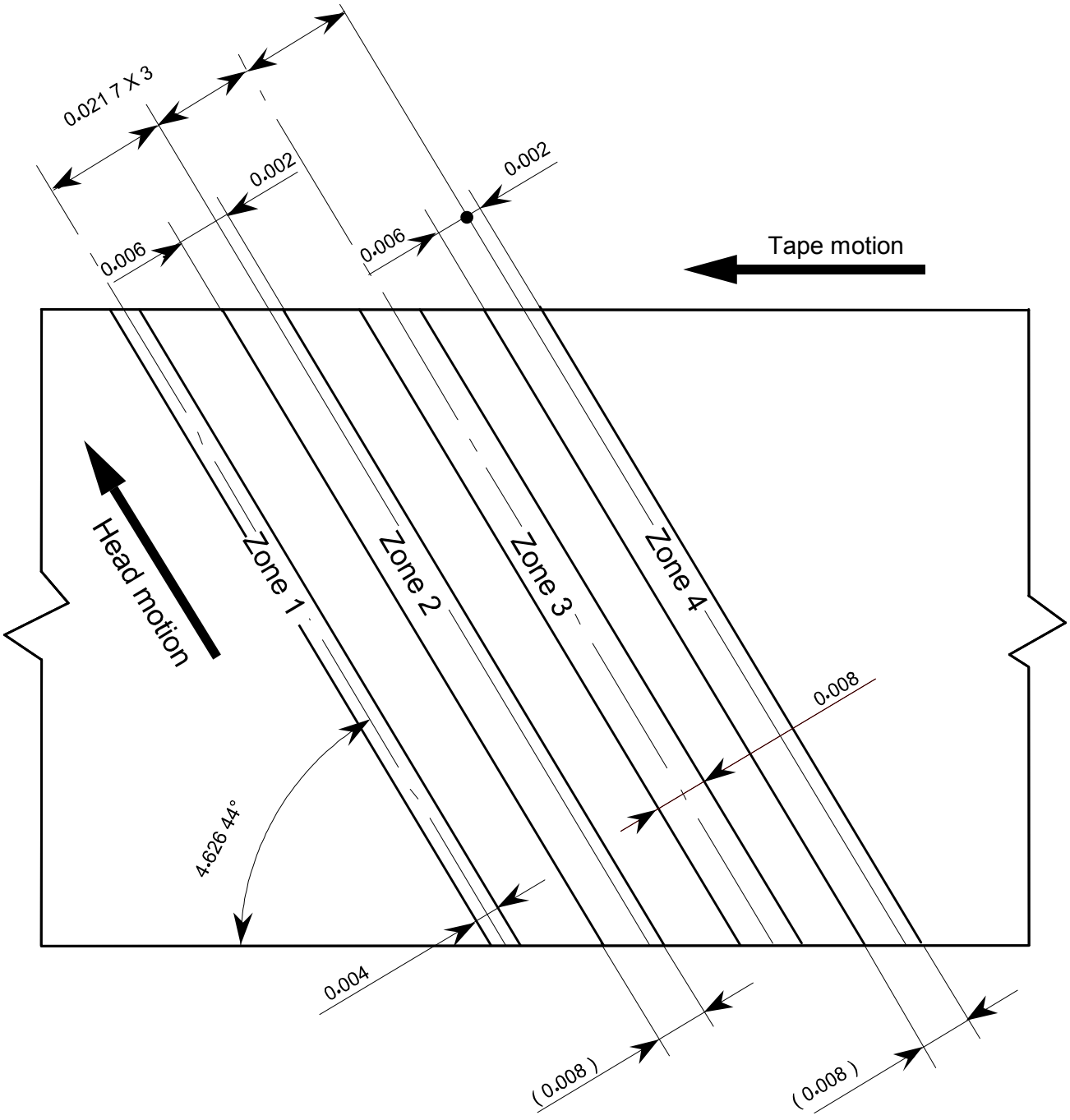
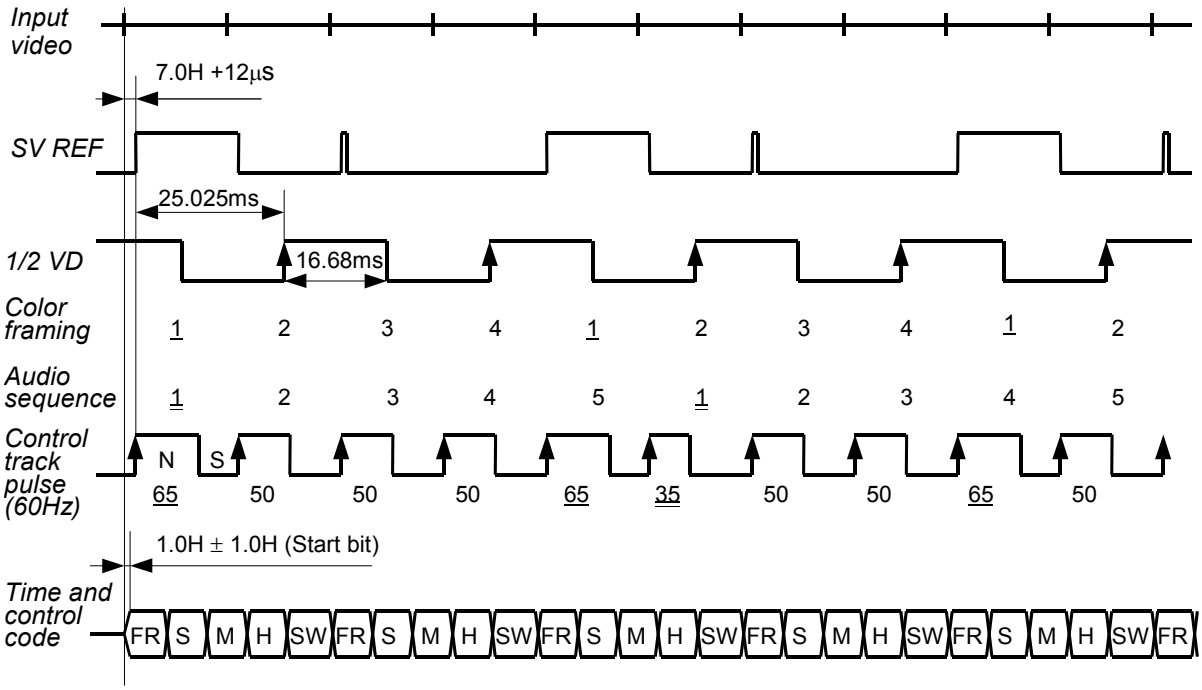
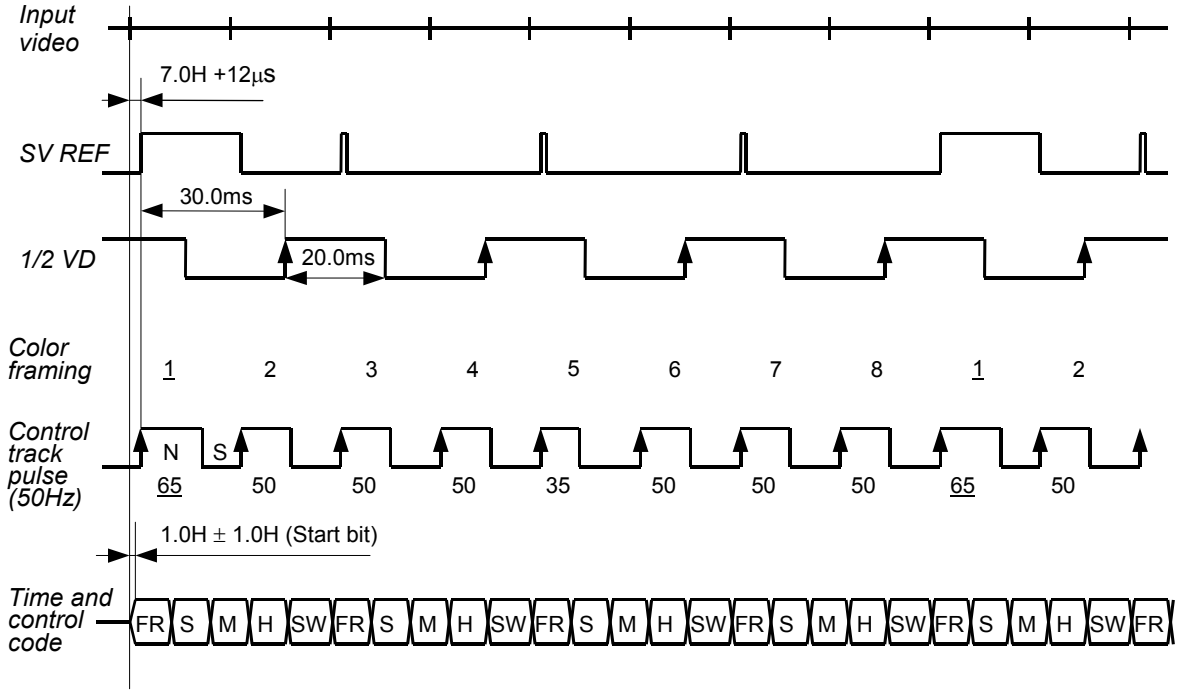


Figure 28 – Location and dimensions of tolerance zones of helical track records



NOTE – The following definitions are used in figures 29 and 30: SV REF: servo reference; 1/2 VD: a half rate vertical drive pulse; FR: frame; S: second; M: minute; H: hour; SW: sync word.

Figure 29 – Recorded control code waveform for 525/60 system



NOTE – See note to figure 29.

Figure 30 – Recorded control code waveform for 625/50 system

7.2.5 Flux polarity

The polarity of the tracking control recording flux shall be defined by IEC 61213 clause 5 and figure 29 (525/60 system) or figure 30 (625/50 system).

7.3 Time and control code record parameters

7.3.1 Time and control code signal definition

The signal format recorded on this track shall be in accordance with SMPTE 12M.

7.3.2 Relationship to the helical track records

The time and control code information shall refer to the video frame during which it is recorded.

7.3.3 Time and control code signal timing

An external record time and control code input that meets the specifications described in SMPTE 12M or a time and control code that is internally generated within the recorder shall be timed for recording such that the relationship between the start of address of the time and control code and the program reference point of a track with an even field address (count) for the video data is defined by figure 27 and table 1.

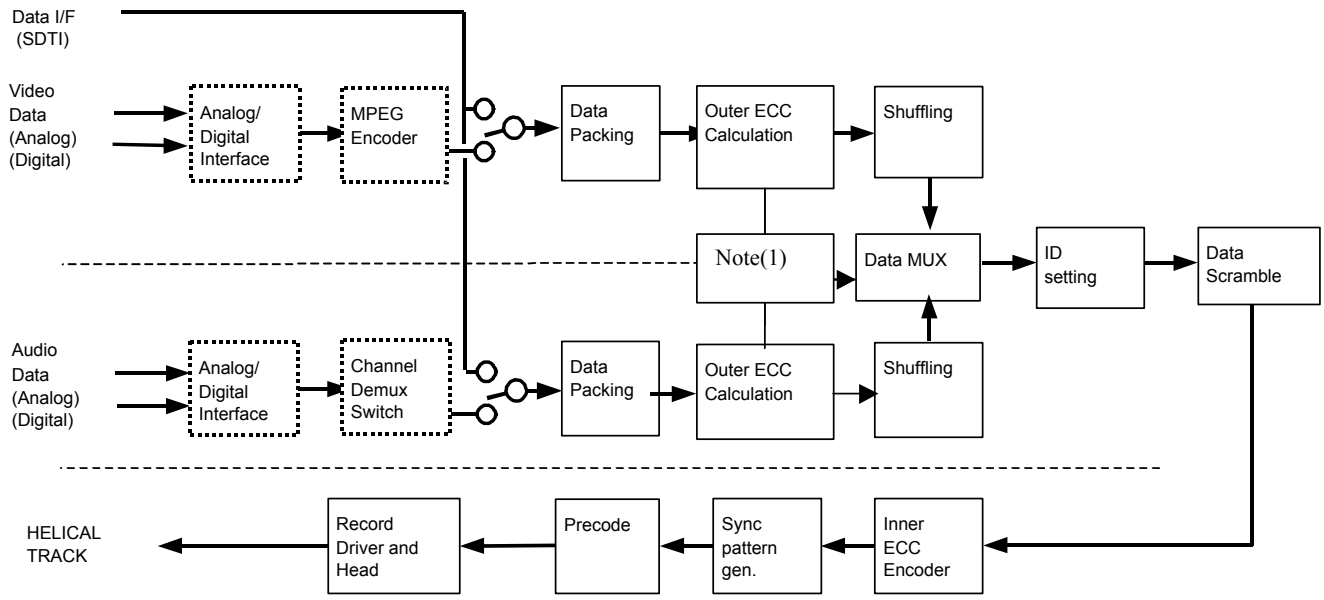
8 Helical track signal parameters and magnetization

8.1 Introduction

This clause defines how input signal data streams comprising an MPEG-2 video elementary stream and multiple AES3 data streams are mapped to the helical track records.

Figure 31 shows the recorder block diagram, identifying the basic schematic signal processing blocks used to map the video elementary stream and AES3 audio streams to create the helical track data streams. Figure 31 also includes a 4:2:2P@ML MPEG encoder block with constrained parameters as defined in SMPTE 356M. The MPEG encoder block is not part of this standard. The video, audio, and data interfaces are defined in annex B of this standard.

Figure 32 shows the playback block diagram identifying the basic schematic signal processing blocks used to map the helical track data streams to the video elementary stream and AES3 streams. Figure 32 also includes an input to a 4:2:2P@ML MPEG decoder block which is not part of this standard. The video, audio, and data interfaces are defined in annex B of this standard.



NOTE – Outer ECC data values are not shuffled.

Figure 31 – Helical recording block diagram

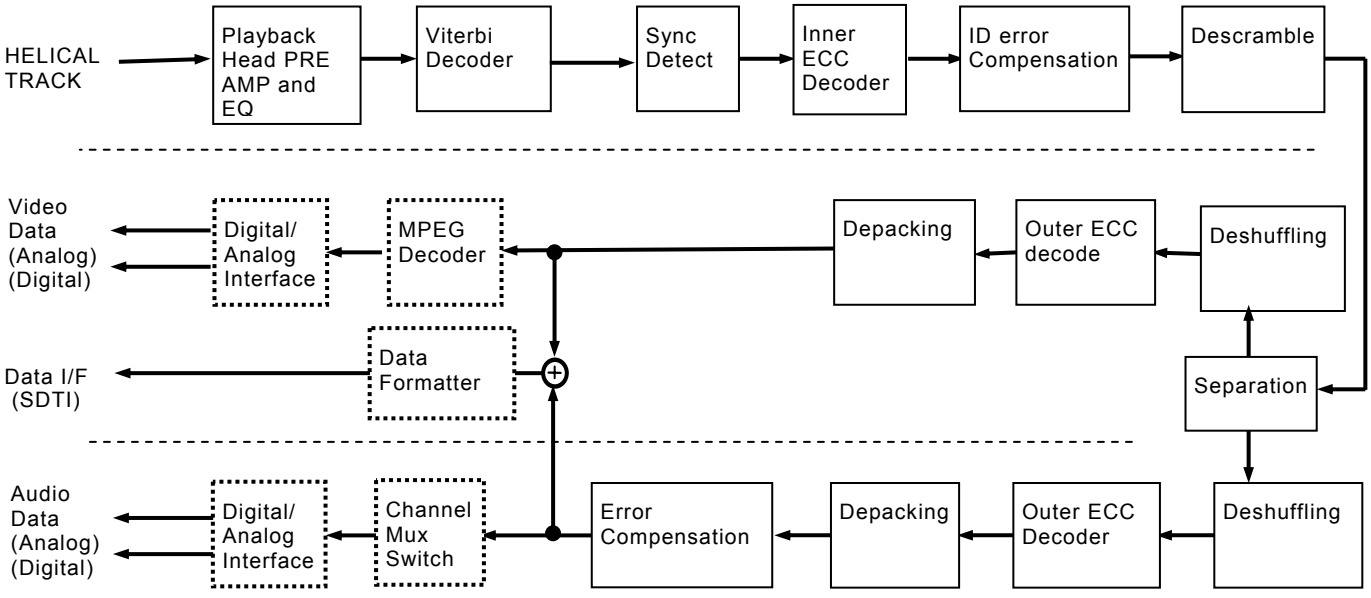


Figure 32 – Helical playback block diagram

8.2 Helical track data parameters

The MPEG-2 4:2:2P@ML video elementary stream data from each television frame is recorded on four sequential helical track pairs together with the associated AES3 data channels and tracking data.

Each helical track is subdivided into two sectors for video, eight sectors for audio, and one sector space for servo tracking data with edit guard bands between each sector.

The layout of the sectors and guard bands is shown in figure 27.

Each audio and video sector shall be divided into the following components:

a) a preamble comtaining a clock run-up sequence;

b) a sequence of sync blocks each containing a sync pattern, an identification pattern, a fixed length data block, and terminated with an error control block;

c) a postamble containing a sync pattern and an identification pattern.

The servo tracking sector is defined in 8.2.7 and occurs only on the four tracks with the same azimuth alignment as illustrated in figure 27.

8.2.1 Labeling convention

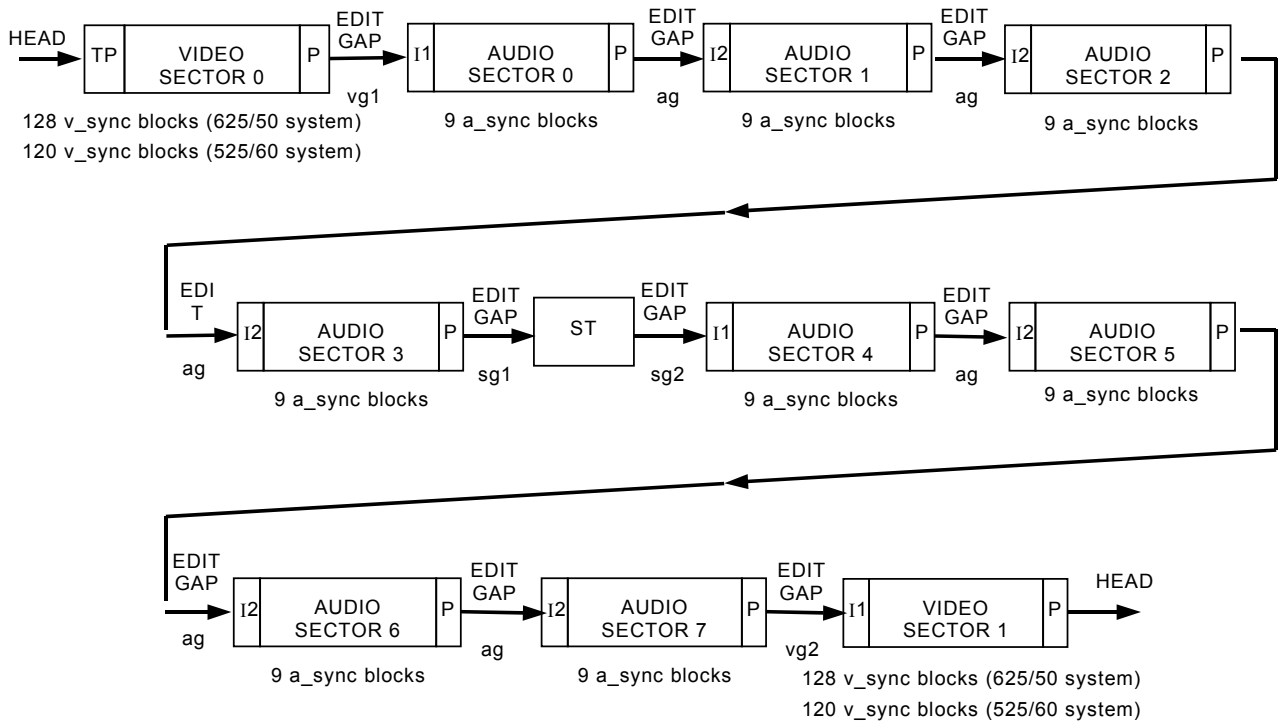
The least significant bit is written to the left and is the first recorded to tape. The lowest numbered byte is shown at the top-left and is the first encountered in the input data stream. Byte values are expressed in hexadecimal notation unless otherwise stated. A suffix *h* indicates a hexadecimal value.

8.2.2 Primary data components on the eight helical tracks

Figure 33 shows the general arrangement of preambles, postambles, sync blocks, edit gaps, and the tracking data blocks (where applicable) as a group for each of the eight helical tracks.

NOTE – The ST block is only present on the four helical tracks as identified in figure 27.

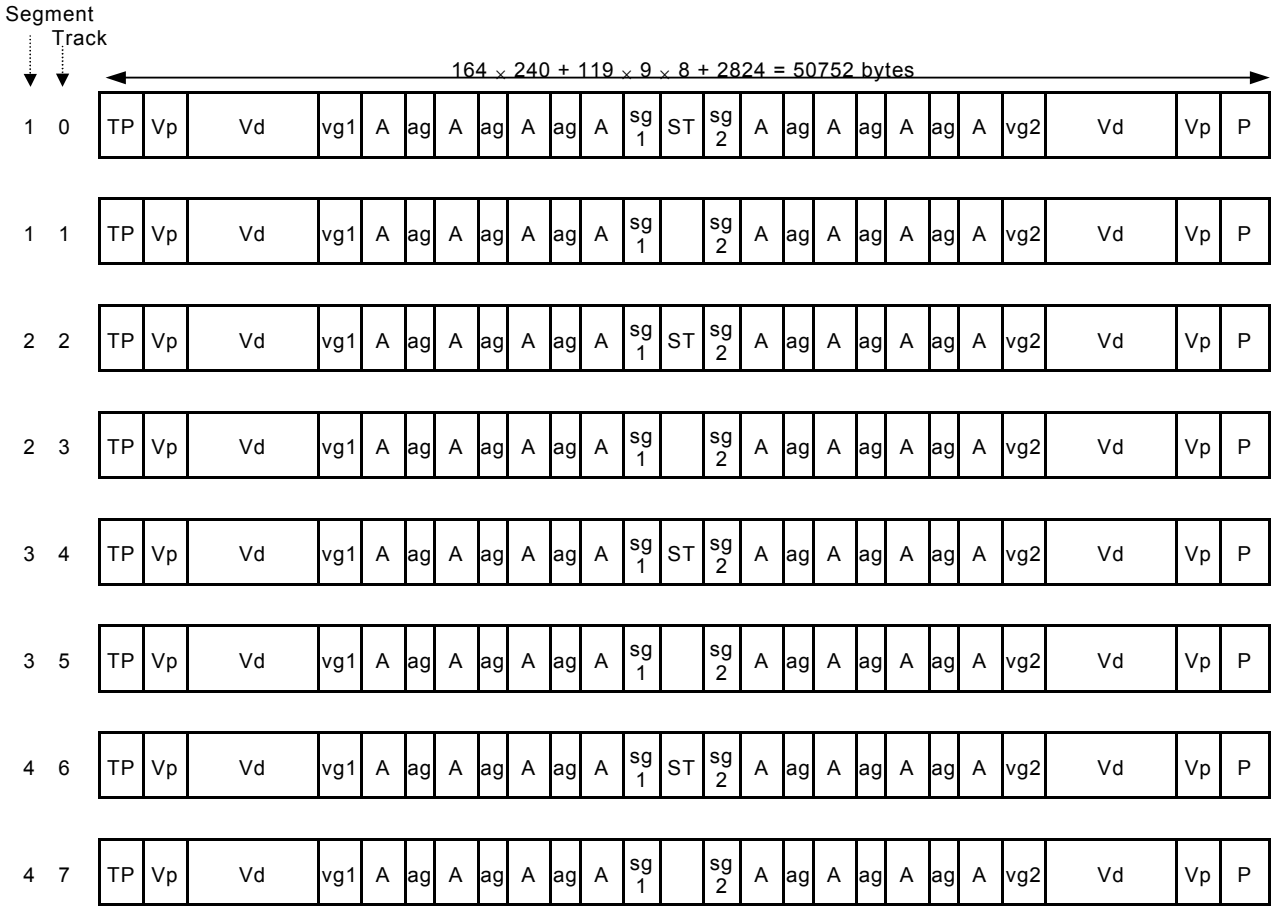
Figure 34 shows the specific data arrangement and data sizes for 525/60 operation and figure 35 shows the specific data arrangement and data sizes for 625/50 operation.



NOTE
TP = track preamble
I1 = in-track preamble 1
I2 = in-track preamble 2
P = postamble (4 bytes)
vg1 = P + edit gap + I1
vg2 = P + edit gap + I2
ag = P + edit gap + I2
sg1 = P + edit gap
sg2 = P + edit gap + I1
Video sync block 164 bytes
Audio sync block 119 bytes (525/60 system)
139 bytes (625/50 system)
ST: servo tracking data

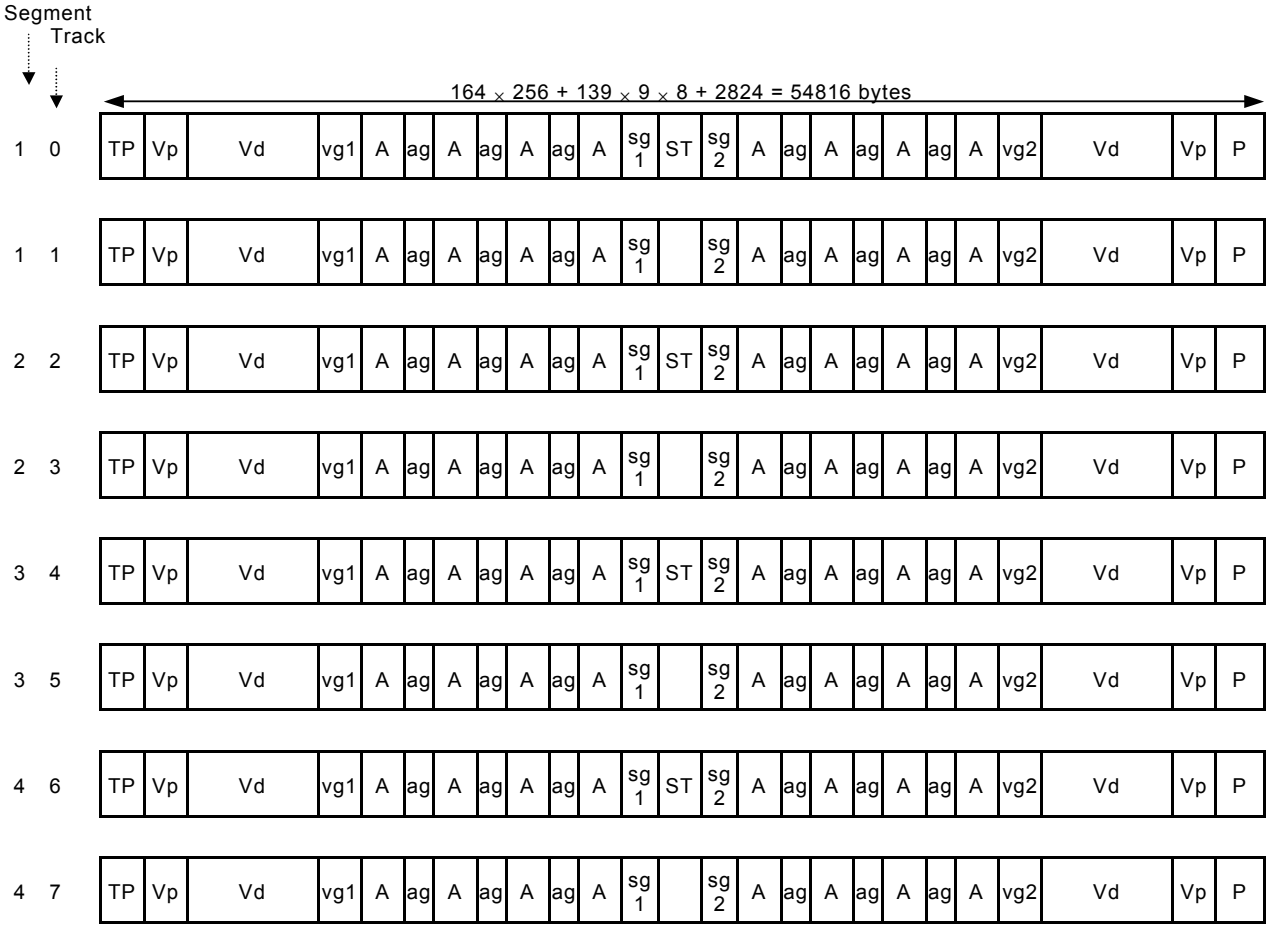
	525/60	625/50
TP	120	120 (bytes)
I1	120	120 (bytes)
I2	80	80 (bytes)
P	4	4 (bytes)
vg1	360	360 (bytes)
vg2	270	270 (bytes)
ag	180	180 (bytes)
sg1	360	360 (bytes)
sg2	180	180 (bytes)
ST	450	450 (bytes)

Figure 33 – Sector arrangement on helical track



Vd:	video data	92	v_sync blocks
Vp:	video outer parity	28	v_sync blocks
A:	audio sector	9	a_sync blocks
ST:	servo tracking data	450	bytes
vg1:	post-amble + Edit gap + preamble	360	bytes
vg2:	post-amble + Edit gap + preamble	270	bytes
ag:	post-amble + Edit gap + preamble	180	bytes
sg1:	post-amble + Edit gap	360	bytes
sg2:	post-amble + Edit gap + preamble	180	bytes
TP:	track preamble	120	bytes
P:	Post-amble	4	bytes

Figure 34 – Sector arrangement on helical track (525/60 system)



Vd:	video data	108	v_sync blocks
Vp:	video outer parity	20	v_sync blocks
A:	audio sector	9	a_sync blocks
ST:	servo tracking data	450	bytes
vg1:	post-amble + Edit gap + preamble	360	bytes
vg2:	post-amble + Edit gap + preamble	270	bytes
ag:	post-amble + Edit gap + preamble	180	bytes
sg1:	post-amble + Edit gap	360	bytes
sg2:	post-amble + Edit gap + preamble	180	bytes
TP:	track preamble	120	bytes
P:	Post-amble	4	bytes

Figure 35 – Sector arrangement on helical track (625/50 system)

8.2.3 Sector details

8.2.3.1 Sync block

The sync block contains a sync pattern (2 bytes) and an inner code block (video: 162 bytes; audio: 117 bytes for 525/60 and 137 bytes for 625/50). Each inner code block shall contain a sync identification pattern (2 bytes), a data identification pattern (1 byte), data, and an inner check code (12 bytes). Figures 36, 37, and 38 show the sync block format for, respectively, video sync blocks, audio sync blocks in 525/60 systems, and audio sync blocks in 625/50 systems.

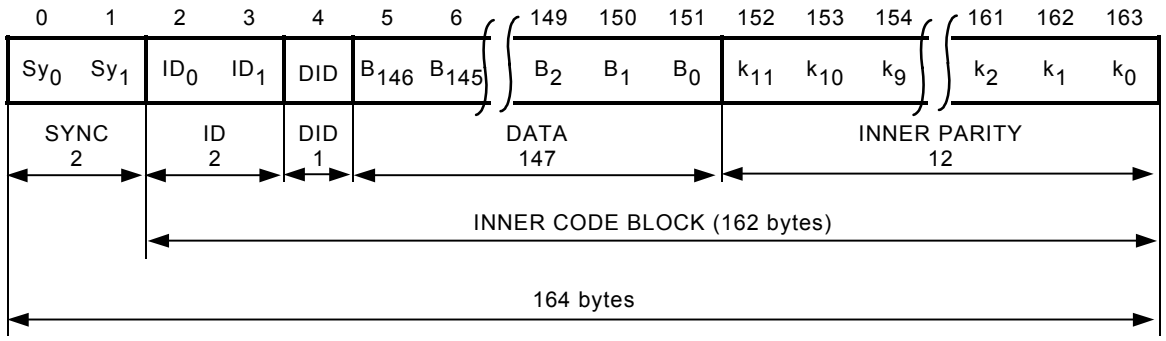


Figure 36 – Video sync block format

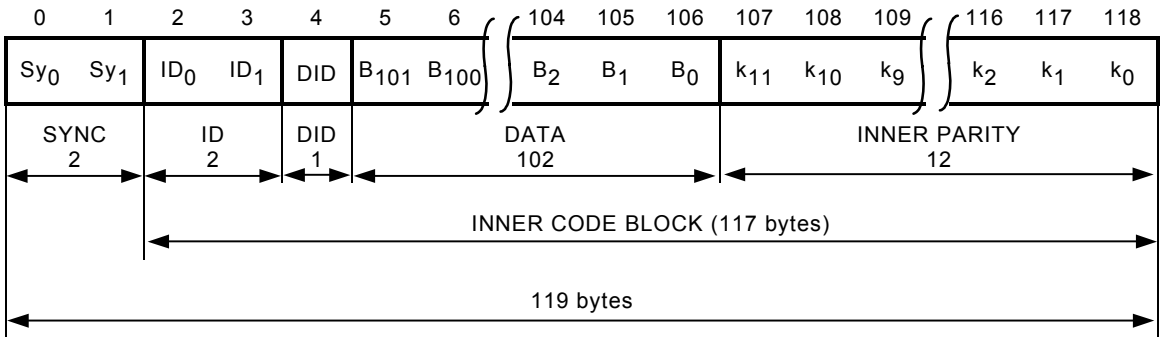


Figure 37 – Audio sync block format (525/60 system)

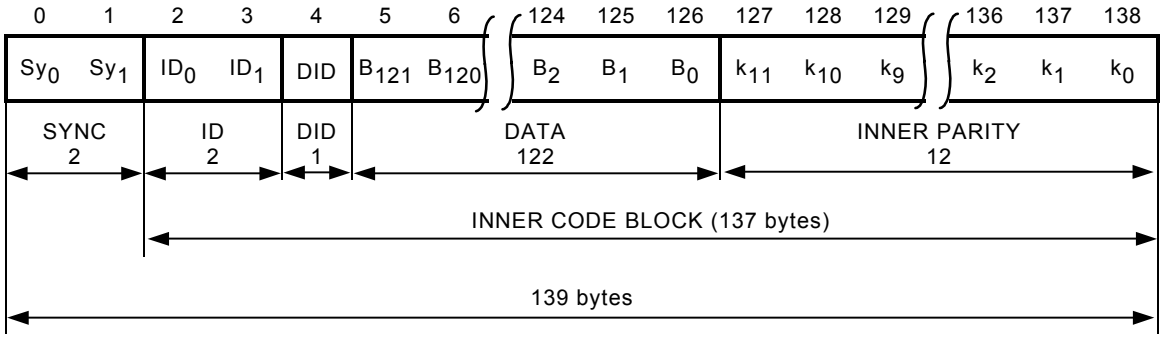


Figure 38 – Audio sync block format (625/50 system)

8.2.3.2 Sync pattern

The length of the sync pattern shall be 2 bytes. The byte values shall be 76_h, $B4_h$ leading to the bit sequence as shown below:

							MSB	
Byte 0 (Sy 0)	0	1	2	3	4	5	6	7
LSB	0	1	1	0	1	1	1	0

							MBS	
Byte 1 (Sy 1)	0	1	2	3	4	5	6	7
LSB	0	0	1	0	1	1	0	1

8.2.3.3 Sync identification pattern

The length of the sync block identification (ID) pattern shall be 2 bytes. The first byte of the ID (ID0) shall be used to uniquely identify every sync block within each helical track. The second byte of the ID (ID1) shall be used to identify the sector, track, and segment. Figure 39 shows the pattern of the sync block identification.

The first sync ID byte (ID0) follows a coded sequence as shown in figures 40 and 41. The last ID0 code of each sector shall be reserved for postamble identification (see table 2). The second sync ID byte (ID1) shall be used to define several data fields as shown in figure 39.

The VA bit shall be used to distinguish between audio (= 0) and video (= 1) sectors. The TR bit shall be used to distinguish between the adjacent frames corresponding to TR 0 and 1. The SG bits (SG0, SG1, SG2, and SG3) shall be used to identify among four segments corresponding to segments 1, 2, 3, and 4. The bit assignments for each segment shall be defined as follows:

	SG_0	SG_1	SG_2	SG_3
Segment 1:	1	0	0	0
Segment 2:	0	1	0	0
Segment 3:	1	1	0	0
Segment 4:	0	0	1	0

Bit 6 is reserved but undefined. The UL bit shall be used to identify between lower sector block (= 0) and upper sector block (= 1).

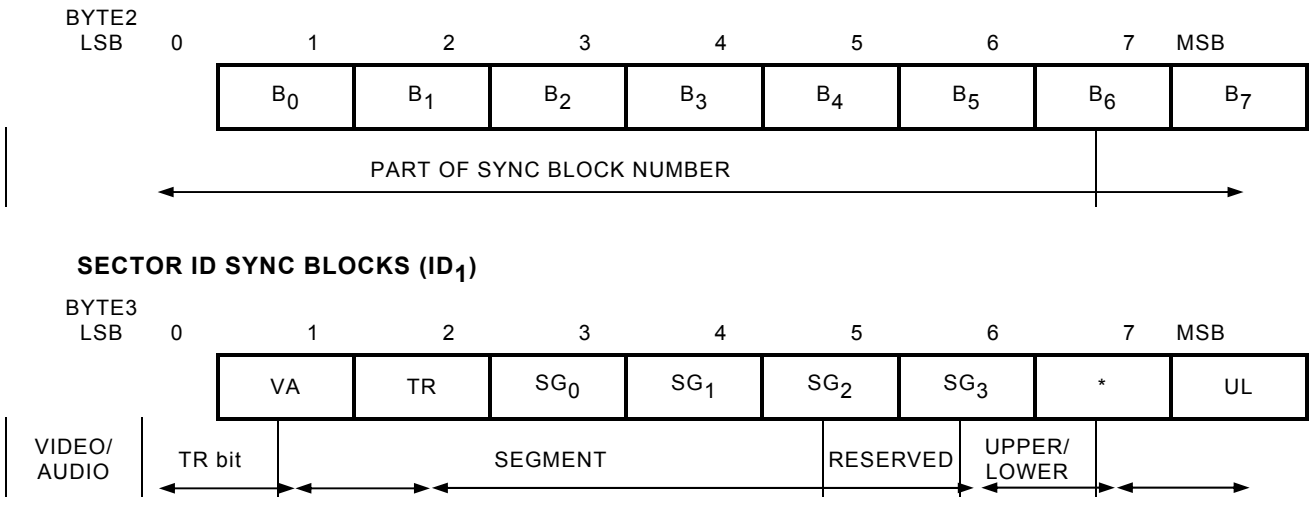


Figure 39 – Sync block identification bytes

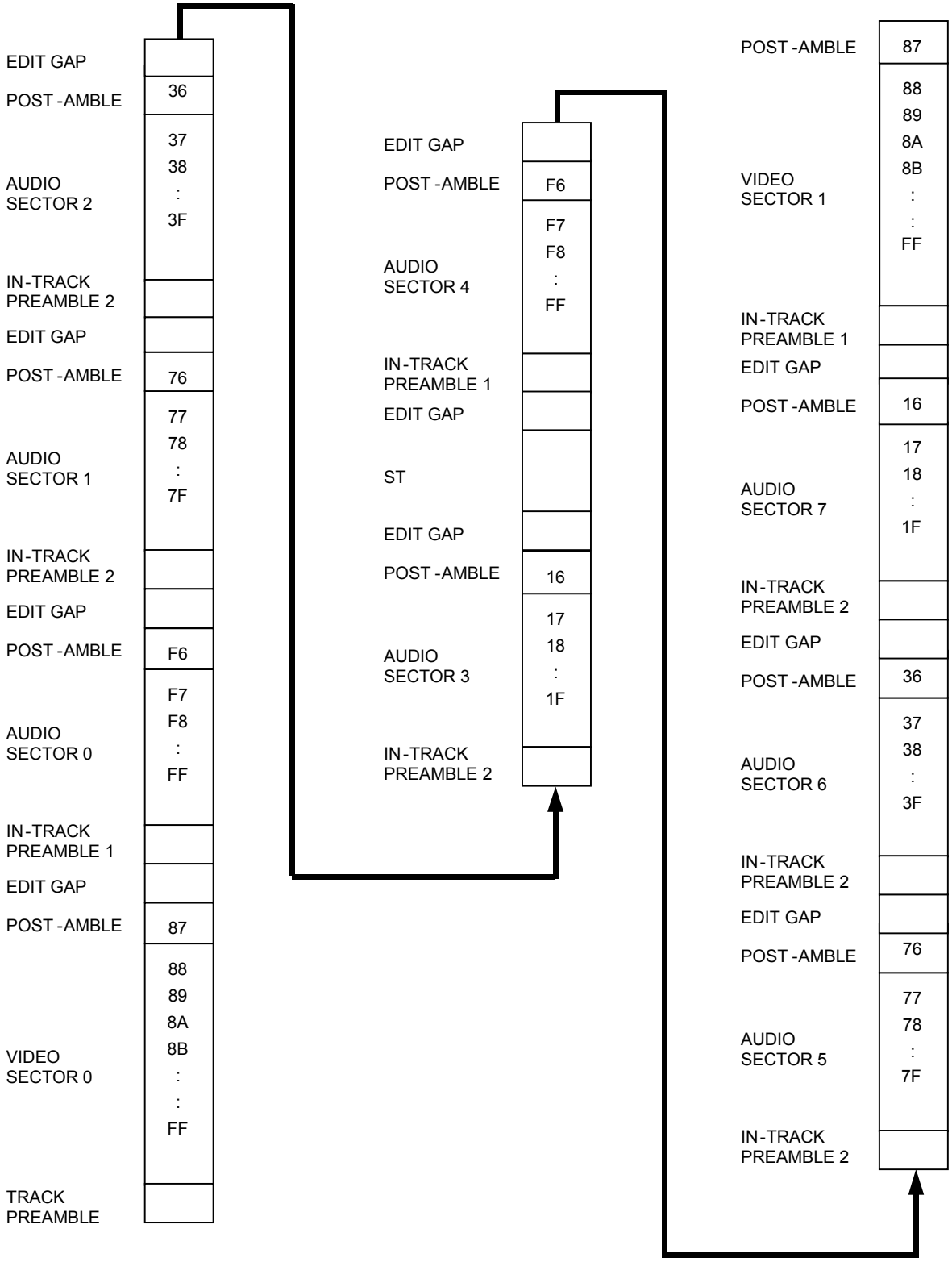


Figure 40 - ID_0 : sync block number (525/60 system)

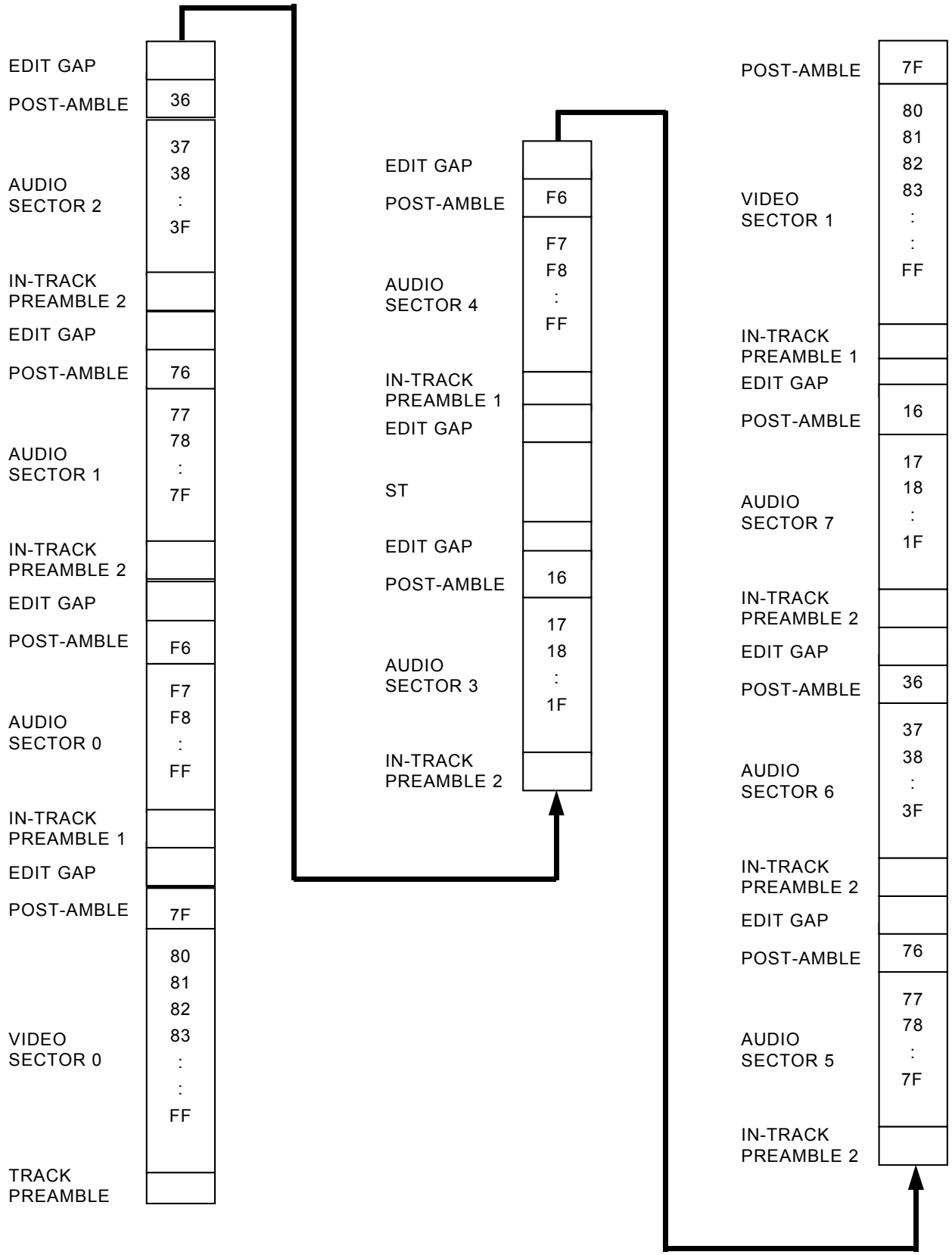


Figure 41 – ID0: sync block number (625/50 system)

Table 2 – ID_0 sync block number

Sector	Sync block number	
	525/60	625/50
Video sector V0	FF_h to 88_h	FF_h to 80_h
Video sector V1	FF_h to 88_h	FF_h to 80_h
Audio sector A0	FF_h to $F7_h$	FF_h to $F7_h$
Audio sector A1	$7F_h$ to 77_h	$7F_h$ to 77_h
Audio sector A2	$3F_h$ to 37_h	$3F_h$ to 37_h
Audio sector A3	$1F_h$ to 17_h	$1F_h$ to 17_h
Audio sector A4	FF_h to $F7_h$	FF_h to $F7_h$
Audio sector A5	$7F_h$ to 77_h	$7F_h$ to 77_h
Audio sector A6	$3F_h$ to 37_h	$3F_h$ to 37_h
Audio sector A7	$1F_h$ to 17_h	$1F_h$ to 17_h

8.2.3.4 Data identification for video data sync blocks

The first byte of the sync ID (ID0) identifies each video data sync block within a helical track. The single data identification (DID) byte for video data sync blocks shall be used to identify the contents of the video data sync block. The bits of the video data sync block identification byte are as follows:

LSB 0	1	2	3	4	5	6	MSB 7
Reserved	Reserved	PM_0	PM_1	Reserved	Reserved	Reserved	Reserved

The payload mode bits (PM_0 and PM_1) shall be used to identify the payload carried by the video sync block.

PM_0	PM_1	Data type
0	0	Video elementary stream data
1	0	Slice 0 (see 8.5.3.3)
0	1	Video AUX data (see 8.5.3.5)
1	1	Null sync (see 8.5.2)

All other bits are reserved but not defined.

8.2.3.5 Data identification for audio data sync blocks

The first byte of the sync ID (ID0) identifies each audio data sync block within a helical track.

The single data identification (DID) byte for audio data sync blocks shall be used to identify the 5-field audio sequence in 525/60 systems and the audio mode (linear PCM audio or nonaudio data as follows):

LSB 0	1	2	3	4	5	6	MSB 7
FD_0	FD_1	FD_2	DATA	Reserved	Reserved	Reserved	Reserved

The FD bits (FD_0, FD_1, and FD_2) shall be used to identify the audio 5-field sequence into which a predefined number of audio samples are assigned (see table 3).

Each audio field number shall represent the audio data sync blocks for either the first set of two sequential helical track pairs or the second set of two sequential helical track pairs in the helical track sets that represent the frame.

For the 525/60 system, the FD bits with values in the range 0 to 4 shall identify a 5-field sequence for the number of audio samples as below.

Table 3 – Audio samples

Audio sequence mode	FD_0, FD_1, FD_2	Audio samples	
		525/60	625/50
Field 0 [1)]	0 0 0	800 samples	960 samples
Field 1 [2)]	1 0 0	801 samples	Not used
Field 2 [2)]	0 1 0	801 samples	Not used
Field 3 [2)]	1 1 0	801 samples	Not used
Field 4 [2)]	0 0 1	801 samples	Not used
AUX 0	1 0 1	See 8.6.2.2 and figure 53	
AUX 1	0 1 1	See 8.6.2.2 and figure 53	
AUX 2	1 1 1	See 8.6.2.2 and figure 53	

NOTES
[1)] for 525/60 and 625/50.
[2)] for 525/60.

For the 625/50 system, the FD bits shall be set to 0 for the number of audio samples.

Where the FD bits have values in the range of 5 to 7, they shall be used to identify auxiliary audio sync blocks which contain audio auxiliary information as well as audio data as defined in 8.6.2.2.

The DATA bit shall be used to identify whether the audio data represents linear PCM audio (= 0) or nonaudio data (=1).

All other bits are reserved but not defined.

8.2.3.6 Data identification for video and audio data sync blocks

Figure 42 summarizes the DID byte for the identification of both video and audio data sync blocks.

8.2.3.7 Inner ECC

Inner ECC blocks are defined as the sync block without the 2-byte sync pattern.

Data shall be scrambled before generation of inner ECC as defined in 8.3.

The inner ECC shall be of the Reed-Solomon (RS) type having 12 check words placed at the end of each sync block. Details of the RS code common to all sync blocks shall be as follows:

- Galois Field: GF (256)
- Field generator polynomial: $X^8 + X^4 + X^3 + X^2 + 1$

where X^i are placekeeping variables in GF (2), the binary field. Note that the + sign indicates a modulo binary addition.

The code generator polynomial (GF (256)) is defined as:

$$G(X) = (X + \alpha^0)(X + \alpha^1)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)(X + \alpha^8)(X + \alpha^9)(X + \alpha^{10})(X + \alpha^{11})$$

where α is given by 02_h in GF (256). Note that the + sign for this and the following equations indicates a modulo 256 addition.

The RS check characters are defined as:

$K_{11}, K_{10}, K_9, K_8, K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0$ in
$K_{11}X^{11} + K_{10}X^{10} + K_9X^9 + K_8X^8 + K_7X^7 + K_6X^6 + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X^1 + K_0$

obtained as the remainder after dividing the polynomial $X^{12}D(X)$ by G(X), where Ki are bit-inverted words of ki shown in figures 36, 37, and 38, and D(X) is the polynomial given by:

a) for video data sync blocks:

$$D(X) = ID_0X^{149} + ID_1X^{148} + DID\ X^{147} + B_{146}X^{146} + B_{145}X^{145} + B_{144}X^{144} + ... + B_2X^2 + B_1X^1 + B_0$$

b) for audio data sync blocks (525/60 system):

$$D(X) = ID_0X^{104} + ID_1X^{103} + DID\ X^{102} + B_{101}X^{101} + B_{100}X^{100} + ... + B_2X^2 + B_1X^1 + B_0$$

c) for audio data sync blocks (625/50 system):

$$D(X) = ID_0X^{124} + ID_1X^{123} + DID\ X^{122} + B_{121}X^{121} + B_{120}X^{120} + ... + B_2X^2 + B_1X^1 + B_0$$

The polynomial full code is defined as:

d) for video data sync blocks:

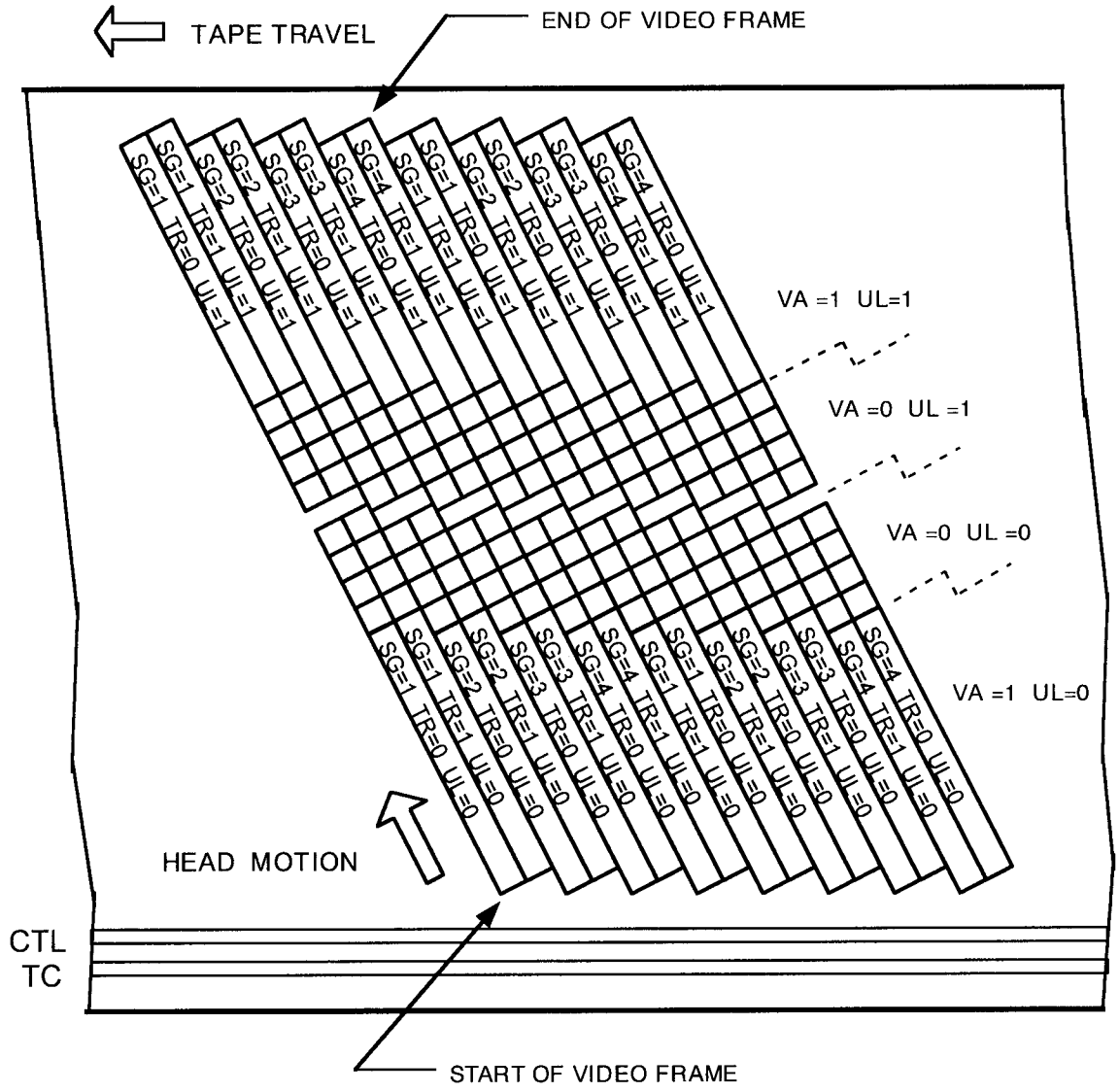
$$ID_0X^{161} + ID_1X^{160} + DID\ X^{159} + B_{146}X^{158} + B_{145}X^{157} + ... + B_2X^{14} + B_1X^{13} + B_0X^{12} + K_{11}X^{11} + K_{10}X^{10} + ... + K_2X^2 + K_1X^1 + K_0 = O \pmod{G(X)}$$

e) for audio data sync blocks (525/60 system):

$$ID_0X^{116} + ID_1X^{115} + DID\ X^{114} + B_{101}X^{113} + B_{100}X^{112} + ... + B_2X^{14} + B_1X^{13} + B_0X^{12} + K_{11}X^{11} + K_{10}X^{10} + ... + K_2X^2 + K_1X^1 + K_0 = O \pmod{G(X)}$$

f) for audio data sync blocks (625/50 system):

$$ID_0X^{136} + ID_1X^{135} + DID\ X^{134} + B_{121}X^{133} + B_{120}X^{132} + ... + B_2X^{14} + B_1X^{13} + B_0X^{12} + K_{11}X^{11} + K_{10}X^{10} + ... + K_2X^2 + K_1X^1 + K_0 = O \pmod{G(X)}$$



NOTES
1 SG = Segment (1, 2, 3, 4)
2 TR = TR bit (0, 1)
3 VA = Video audio flag (video = 1)
4 UL = Upper/lower flag (upper = 1)

Frame number	F1								F3							
SG (segment)	:1	1	2	2	3	3	4	4	1	1	2	2	3	3	4	4
TR (TR bit)	:0	1	0	1	0	1	0	1	1	0	1	0	1	0	1	0
Track	:0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7

Frame number	F3							
SG (segment)	1	1	2	2	3	3	4	4
TR (TR bit)	0	1	0	1	0	1	0	1
Track	0	1	2	3	4	5	6	7

Figure 42 – Track, segment and frame/field counts

8.2.4 Sector preamble

All sectors shall be preceded by data bytes having a value of FF_h.

NOTE – This value is converted to a sector preamble having a value of CC_h by the channel coding described in 8.3. This preamble provides a clock run-in sequence.

The preamble which precedes a video sector or the first audio sector in a track shall be 120 bytes long. The preamble that precedes either the second, the third, or the fourth audio sector in a track shall be 80 bytes long.

8.2.4.1 Track preamble

A track preamble (TP) immediately precedes the first video data sector of every track. The length is 120 bytes for both the 525/60 and 625/50 systems.

8.2.4.2 In-track preamble types 1 and 2

An in-track preamble type 1 shall precede the first and fifth audio sectors and the second video sector of every track. The total length shall be 120 bytes long. An in-track preamble type 2 shall precede the second, third, fourth, sixth, seventh, and eighth audio sector of every track. The total length shall be 80 bytes long.

8.2.5 Sector postamble

All sectors are followed by a postamble, the length of which shall be 4 bytes. Each postamble shall consist of a sync pattern and an identification pattern.

8.2.6 Edit gap

The space between sectors on a track, exclusive of postamble and preamble, is used to accommodate timing errors during editing. In an original recording, the edit gap shall contain the pattern CC_h after channel coding. The length of the edit gap varies according to the position on the track.

8.2.7 Tracking servo signal

A tracking servo signal shall be recorded on the helical tracks. This signal shall be recorded between the fourth and fifth audio sectors on azimuth α0 track as indicated in figure 27, table 1, and figure 33. The signal shall be a rectangular waveform with an eighth of the Nyquist frequency. The frequency of the signal is 3.43 MHz for the 525/60 system and 2.86 MHz for the 625/50 system as shown in annex C.

8.3 Scrambling and channel coding

The channel code shall be scrambled I-NRZI modulation code, and partial response class IV precoding shall be employed.

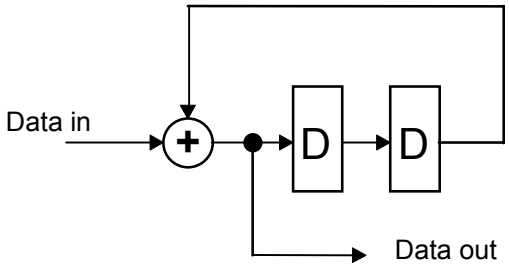
a) Data shall be scrambled before generation of inner ECC as shown in figure 31 by the field generator polynomial:

$X^8 + X^4 + X^3 + X^2 + 1$ Seed: ID_0 Start: DID

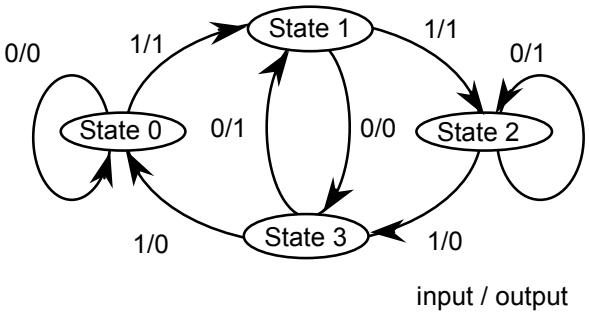
NOTE – The value of ID_0 is loaded into the scrambler at the timing point defined by the location of the DID word. Thus, the DID word carries the ID_0 value as a seed to preset the field generator polynomial with a unique value for each sync block.

b) The scrambled ECC encoded and sync pattern generated data shall be precoded as shown in figure 31.

The precoding is established by the polynomial generator $g(x) = x^2 + 1$ as shown below:



c) The state transition diagram of I-NRZI is as shown below:



d) The LSB shall be written first to tape.

8.4 Magnetization

8.4.1 Polarity

The channel coding ensures that the recorded flux on the helical tracks is polarity insensitive. Therefore, the flux polarity is not specified.

8.4.2 Record level

The level of the recording current applied to the head of a channel shall be optimized for the best signal-to-noise ratio in reproduction in the range from half the Nyquist frequency to the Nyquist frequency.

8.4.3 Record equalization

The frequency characteristics of the recording current applied to the head shall be such that the Nyquist frequency is emphasized by 3 dB with reference to the response at 1 MHz which is very low frequency compared to the Nyquist frequency.

8.5 Data arrangement in video sectors

8.5.1 Introduction

This clause explains the arrangement of the data in the video sectors. The video data in one video frame are recorded in 16 video sectors on the four pairs of helical tracks.

The compressed MPEG-2 elememary stream shall be reordered, packed, and shuffled by the process defined in this clause.

8.5.2 Video data packing algorithm into sync blocks

The D-10 type MPEG-2 4:2:2P@ML stream specification, defined in SMPTE 356M, specifies that each slice shall contain only one macroblock.

The data from each macroblock (as a slice) shall be mapped into a sync block.

The sequence header, GOP header, and picture header shall be mapped to the first sync block and identified as slice 0.

The sync blocks identified as null sync shall be used for packing only.

8.5.3 Reordering of coefficient data

ISO/IEC 13818-2 (video) adopts a 2-D VLC code which codes the quantized DCT coefficients as a combination of run length and level. The maximum number of the VLC codes in a block is less than 65 including EOB code (figure 43a). The transmission order of VLC codes in each block of every macroblock is defined in ISO/IEC 13818-2 (clause 6.1.3, figure 6-11), as the following sequence:

Y1 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Y2 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Y3 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Y4 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Cb1 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Cr1 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB
Cr2 block: DC, AC1, AC2, AC3, ..., AC63 + EOB or EOB

An example of the transmission order of codes in a macroblock is shown in figures 43a and 43b.

The transmission order of VLC codes in each macroblock shall be modified so that all the lower frequency coefficients are transmitted first regardless of blocks as shown in figure 43c.

This leads to the following sequence of VLC codewords:

Y1:DC, Y2:DC, Y3:DC, Y4:DC, Cb1:DC, Cr1:DC, Cb2:DC, Cr2:DC
Y1:AC1, Y2:AC1, Y3:AC1, Y4:AC1, Cb1:AC1, Cr1:AC1, Cb2:AC1, Cr2:AC1
...
...
...
Y1:AC63,Y2:AC63,Y3:AC63,Y4:AC63, Cb1:AC63, Cr1:AC63, Cb2:AC63, Cr2:AC63
Y1:EOB, Y2:EOB, Y3:EOB, Y4:EOB, Cb1:EOB, Cr1:EOB, Cb2:EOB, Cr2:EOB

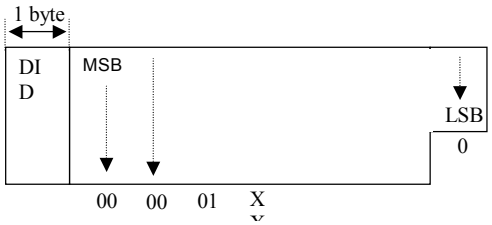
In the event that any block has an EOB value before the AC63 coefficient, the scanning shall continue for all the other blocks until the last EOB is found.

The coded data and picture quality are not changed by this reordering of the VLC code transmission.

For mapping the macroblock and block code words into sync blocks, the syntax shall be modified as specified in tables 4 and 5.

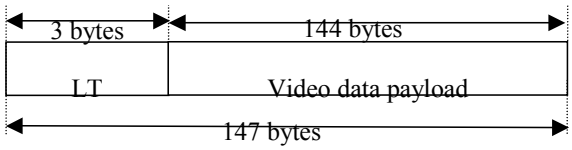
8.5.3.1 Bit mapping order

The MPEG-2 video elementary stream data are expressed as MSB (most significant bit) first. In each sync block, the video elementary stream video data shall follow the MPEG-2 convention of MSB-first and aligned as follows. Each slice data shall start with the slice_start_code 00_h. 00_h. 01_h. XX.



8.5.3.2 Length information

The data area of all video sync blocks shall contain 3 bytes of LT (length) information as shown below.



Structure of the data area of video sync blocks

The length information has 3 bytes in sync block location bytes 5, 6, and 7 which shall be defined as shown in figure 44.

Bits Lg_{19} to Lg_0 shall be used to define the number of bytes of slice data.
Bits 4 and 5 of sync block byte 7 are reserved but not defined.
Bits 6 and 7 of sync block byte 7 shall define the payload mode as defined in 8.2.3.4.

The length information shall be used to define the length of each macroblock in bytes. In the MPEG-2 video syntax, each macroblock and slice has a start code of value 00_h, 00_h, 01_h, XX_h where XX_h defines the type of start code.

The three word start code prefix 00_h, 00_h, 01_h shall be replaced by the length information and the start code identification word XX_h is placed in byte 8 of the video sync word.

Table 4 – Modified syntax of ISO/IEC 13818-2 macroblock (clause 6.2.5)

macroblock( ){	No. of bits	Mnemonic
while (nextbits( ) == 0000 0001 000)		
macroblock_escape	11	bslbf
macroblock_address_increment	1-11	vlclbf
macroblock_modes( )		
if (macroblock_quant)		
quantizer_scale_code	5	uimsbf
if (macroblock_motion_forward | |		
(macroblock_intra && concealment_motion_vectors))		
motion_vectors(0)		
if (macroblock_motion_backward)		
motion_vectors(1)		
if (macroblock_intra && concealment_motion_vectors)		
marker_bit	1	bslbf
if (macroblock_pattern)		
coded_block_pattern( )		
dct_block()		
}		

Table 5 – Modified syntax of ISO/IEC 13818-2 block (clause 6.2.6)

dct_block( ){	No. of bits	Mnemonic
for (i=0; j<block_count; i++){		
if (pattern_code[i]{		
if (macroblock_intra){		
if (i<4){		
dct_dc_size_luminance	2-9	vlclbf
if (dct_dc_size_luminance !=0)		
dct_dc_differential	1-11	uimsbf
} else {		
dct_dc_size_chrominance	2-10	vlclbf
if (dct_dc_size_chrominance !=0)		
dct_dc_differential	1-11	uimsbf
}		
} else {		
First DCT coefficient	2-24	
}		
}		
}		
for (i=0; i<block_count; i++)		
EOB_find[i] = 0 /*EOB Not find*/		
for (j=0; j<=64; j++){		
for (i=0; i<block_count; i++){		
if ((pattern_code[i] && (EOB_find[i] ! = 1)){		
if (nextbits( ) == End of block){		
END of block	2 or 4	vlclbf
EOB_find[i] = 1		
} else {		
DCT_coefficient[i]		
}		
}		
}		
}		
}		
NOTE – The EOB_find [ ] is a temporary variable used only in this pseudo code. It is not used anywhere else in this standard		

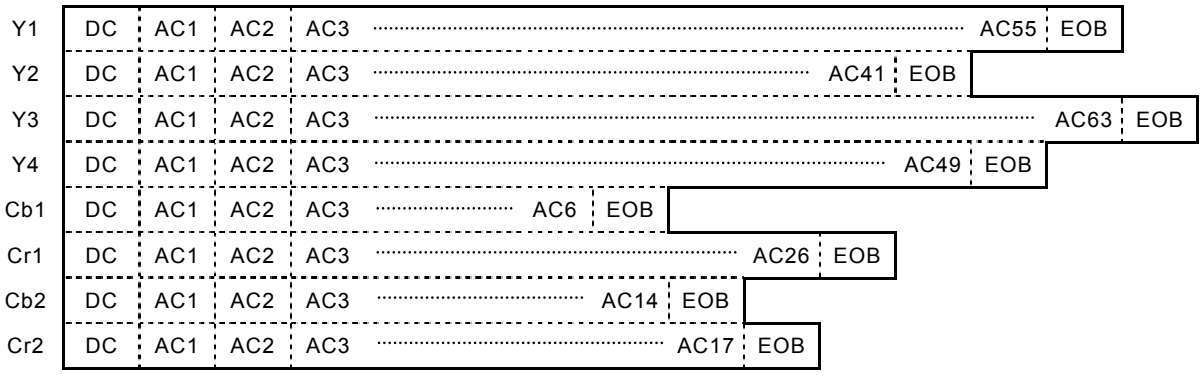


Figure 43a

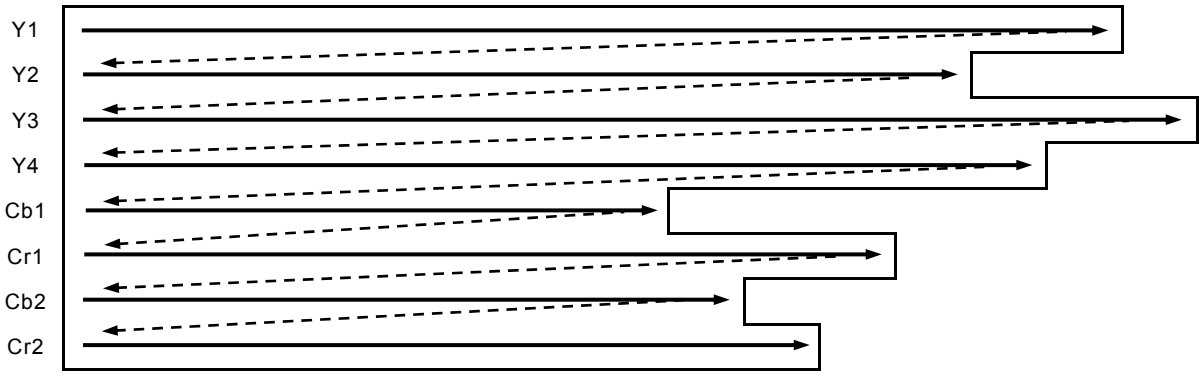


Figure 43b

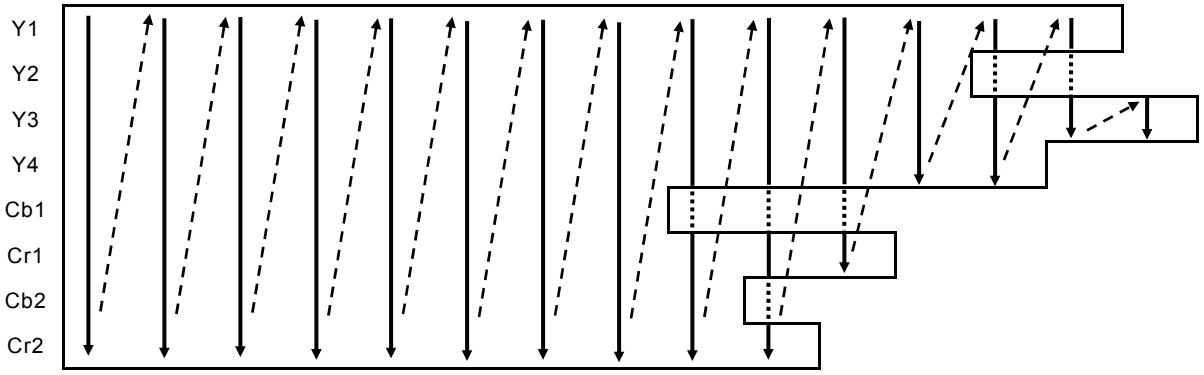


Figure 43c

Figure 43 – Reordering of coefficient data

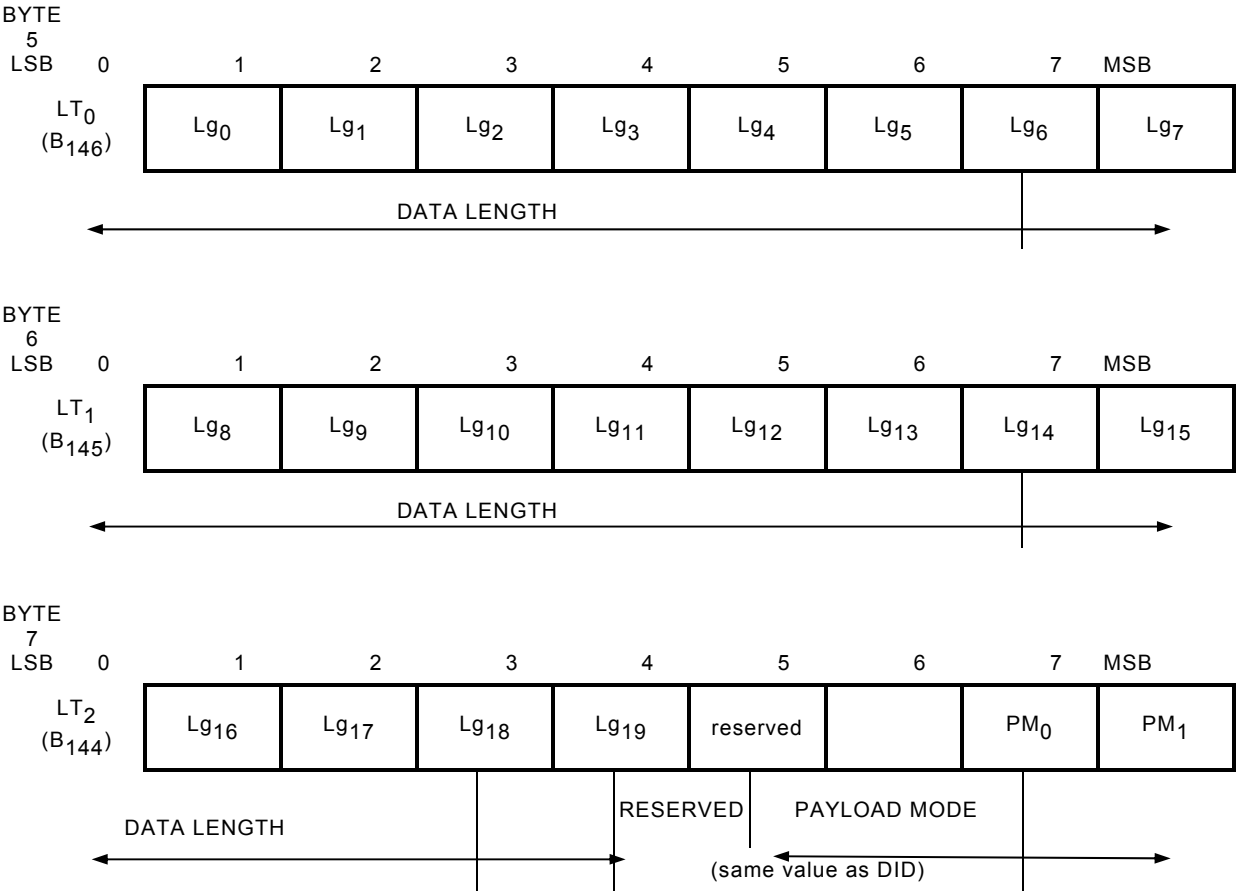


Figure 44 – Length information for video data

8.5.3.3 Slice 0

Slice 0 shall contain the sequence of data as follows:

- Sequence header followed by the sequence data;
- GOP header followed by the GOP data;
- Picture header followed by the picture data.

As with all other video data sync blocks, the first 3 bytes of the sequence_header_code shall be replaced by the length bytes. The length bytes shall be used to define the total length of the header codes and their associated data. All start codes shall be byte aligned to comply with MPEG-2 video.

8.5.3.4 Data packing

Macroblock data has variable length data packed into a fixed length sync block. Where the macroblock data exceeds the video data sync block capacity, the overflow data shall be transferred to other video data sync blocks where the macroblock data is smaller than the video data sync block capacity. The process of data transfer between sync blocks is shown in figure 45.

	DID	length	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
slice 0	DID	“x0000F”	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-a	0-b	0-c	0-d	0-e	0-f	0-g
slice 1	DID	“x0000D”	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-a	1-b	1-c	1-d	1-e		
slice 2	DID	“x00003”	2-1	2-2	2-3												
slice 3	DID	“x00001”	3-1														
slice 4	DID	“x00007”	4-1	4-2	4-3	4-4	4-5	4-6	4-7								
slice 5	DID	“x0000B”	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-a	5-b	5-c				
slice 6	DID	“x0000F”	6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8	6-a	6-b	6-c	6-d	6-e	6-f	6-g
slice 7	DID	“x00008”	7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8							
slice 8	DID	“x0000D”	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-a	8-b	8-c	8-d	8-e		
slice 9	DID	“x00005”	9-1	9-2	9-3	9-4	9-5										
Video AUX1	DID	“x00008”	System			User			Reserved								
Video AUX2	DID	“x00008”	System			User			Reserved								
null 1	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”							
null 2	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”							
null 3	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”							
null 4	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”							
null 5	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”							

	DID	length	1	2	3	4	5	6	7	8
slice 0	DID	“x0000F”	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8
slice 1	DID	“x0000D”	1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8
slice 2	DID	“x00003”	2-1	2-2	2-3	0-a	0-b	0-c	0-d	0-e
slice 3	DID	“x00001”	3-1	0-f	0-g	1-a	1-b	1-c	1-d	1-e
slice 4	DID	“x00007”	4-1	4-2	4-3	4-4	4-5	4-6	4-7	5-a
slice 5	DID	“x0000B”	5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8
slice 6	DID	“x0000F”	6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8
slice 7	DID	“x00008”	7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8
slice 8	DID	“x0000D”	8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8
slice 9	DID	“x00005”	9-1	9-2	9-3	9-4	9-5	5-b	5-c	6-a
Video AUX1	DID	“x00008”	System			User			Reserved	
Video AUX2	DID	“x00008”	System			User			Reserved	
null 1	DID	“x00000”	6-b	6-c	6-d	6-e	6-f	6-g	8-a	8-b
null 2	DID	“x00000”	8-c	8-d	8-e	“00”	“00”	“00”	“00”	“00”
null 3	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”
null 4	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”
null 5	DID	“x00000”	“00”	“00”	“00”	“00”	“00”	“00”	“00”	“00”

Figure 45 – Example of packing 10 slices into 10 sync blocks

Null data sync blocks shall be used for any overflow data from the video data sync blocks. Video AUX sync blocks shall be used to contain auxiliary data only and shall not be used to carry overflow data from any video data or null data sync blocks.

In order to aid understanding of the packing process, figure 45 shows an example of the total number of slices limited to 10 and the length of the video data block is shortened to 8 bytes. In this example, the shuffling procedure has not been applied.

The data space required for each slice is variable depending on the total data space required by the VLC data. Each sync block is filled with its associated slice data and the length value identifies whether the slice data will underflow, overflow, or exactly fit the sync block space.

Considering the sync blocks in time order (top to bottom in the figure), any overflow slice data from the topmost overflowed sync block are placed into space left in the topmost partially filled sync block and then in subsequent partially filled sync blocks until the overflow data are completely placed. When the data from the first overflowing slice are completely placed into the available sync block spaces, the next overflowing slice data follow the same process until its data are completely placed into the available sync block spaces. This process continues with successive overflow slices until all the data are placed into the available sync block data spaces.

The null video sync blocks are not assigned to a specific slice number, but shall be used to carry overflow slice data which cannot be accommodated within the assigned sync blocks. The overflow algorithm is the same as that defined in the above paragraph.

For 525/60 operation, 1440 sync blocks are assigned as macroblock slices, 1 sync block is assigned to carry the header as slice 0, and 23 null sync blocks shall be available for the video data packing process in a frame. Therefore, the total bit rate of the video elementary stream is calculated as follows:

$$147 \times (1440 + 1 + 23) = 215208 \text{ bytes/frame} = 51.598 \text{ Mb/s}$$

For 625/50 operation, 1710 sync blocks are assigned as macroblock slices, 1 sync block is assigned to carry the header as slice 0, and 9 null sync blocks shall be available for the video data packing process in a frame. Therefore, the total bit rate of the video elementary stream is calculated as follows:

$$147 \times (1710 + 1 + 9) = 252840 \text{ bytes/frame} = 50.568 \text{ Mb/s}$$

The D-10 type MPEG-2 4:2:2P@ML stream specification, defined in SMPTE 356M, specifies that the maximum bit rate shall be 50 Mb/s. The recorded bit rate may be less than this value. Any sync blocks which underflow shall pad with 00h data in unused byte positions.

8.5.3.5 Video AUX data sync blocks

There are 8 video auxiliary sync blocks per frame located as defined in figure 47 (525/60) and figure 48 (625/50). These auxiliary sync blocks shall be used to convey system information and user data as defined in figure 46.

8.5.4 Shuffling

There are 1440 macroblocks in a 525/60 video frame and 1710 macroblocks in a 625/50 video frame. Each macroblock (which is contained in one slice) shall be distributed and interleaved in outer ECC blocks together with video data, auxiliary data, and null data, in order to maximize ability of error correction.

8.5.4.1 Block interleave

For the 525/60 system:

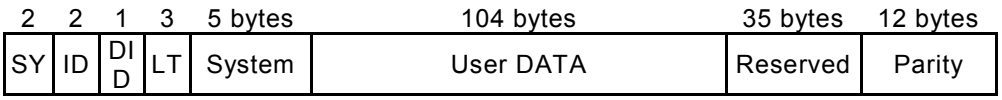
The 1472 video data sync blocks per frame comprising 1440 blocks for slice-macroblock data, 1 block for header data, 8 blocks for auxiliary data, and 23 blocks for null data are separated into 32 outer ECC blocks. The resulting 46 video data sync block groups shall be arranged in each outer ECC block array as shown in figure 47.

For the 625/50 system:

The 1728 video data sync blocks per frame comprising 1710 blocks for slice-macroblock data, 1 block for header data, 8 blocks for auxiliary data, and 9 blocks for null data are separated into 32 outer ECC blocks. The resulting 54 video data sync block groups shall be arranged in each outer ECC block array as shown in figure 48.

8.5.4.2 Shuffling tables

Each slice, as identified by its slice number, shall be placed into the video data sync block as identified in the video shuffling tables defined in annex A. There is a first set of tables for 525/60 operation and a second set of tables for 625/50 operation. The video data sync blocks shall be shuffled across the 16 sectors to produce the video data sync block sequence as defined in figure 40 for 525/60 and figure 41 for 625/50 taking due regard to the identification of the track number as listed in the shuffling tables.



Video AUX sync block position on the helical track

(525/60 system)	SG = 1,2,3,4	Track = 0,2,4,6	UL = 0 ID_0 = E3
	SG = 1,2,3,4	Track = 1,3,5,7	UL = 0 ID_0 = 88
(625/50 system)	SG = 1,2,3,4	Track = 0,2,4,6	UL = 0 ID_0 = EB
	SG = 1,2,3,4	Track = 1,3,5,7	UL = 0 ID_0 = 80

System data (5 bytes)

Byte 1

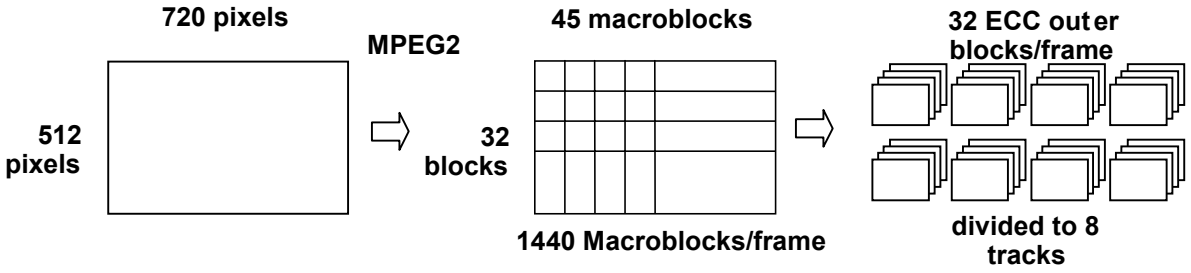
CF sequence	(bit 0,1,2)	Color frame sequence	
Component/Composite	(bit 3)	0: Component	1: Composite source
Reserved	(bit 4,5)	(0)	
Edit flag	(bit 6,7)	0 0:Normal	
		0 1: Edit in point	
		1 0: Edit out point	
		1 1: reserved	

Byte 2-5

Reserved

User data (104 bytes)

Figure 46 – Video AUX sync block

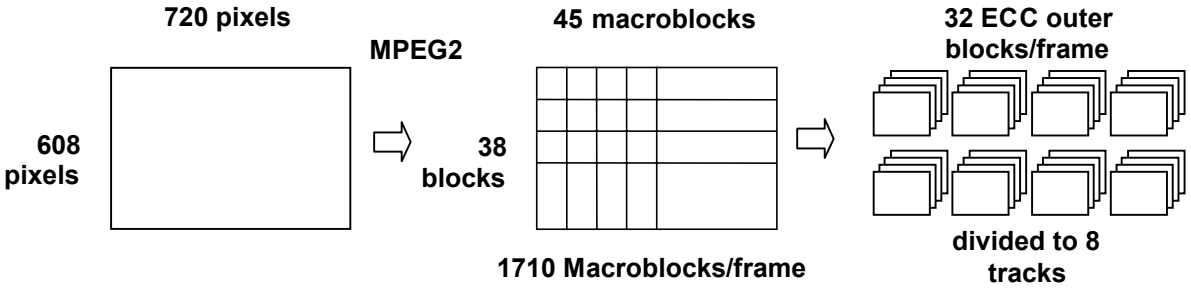


DCT blocks 8 x 8
Macroblock = 4 DCT

Macroblock sync block	→ (1 MB/sync block)	→	1440 sync block
Video AUX sync block	→ (1 AUX/sync/Track)	→	8 sync block
Slice zero sync block	→ (1 sync/Frame)	→	1 sync block
Null sync block		→	23 sync block

1472 sync block (46 sync x 32ECCblock)

Figure 47 – Block interleave (525/60 system)



DCT blocks 8 x 8
Macroblock = 4 DCT block

Macroblock sync block	→ (1 MB/sync block)	→	1710 sync block
Video AUX sync block	→ (1 AUX/sync/Track)	→	8 sync block
Slice zero sync block	→ (1 sync/Frame)	→	1 sync block
Null sync block		→	9 sync block

1728 sync block (46 sync x 32ECCblock)

Figure 48 – Block interleave (625/50 system)

8.5.5 Video data outer correction

The parameters for the video outer error correction code (ECC) are defined in this clause.

8.5.5.1 525/60 system

The outer ECC shall be of the Reed-Solomon (RS) type having 14 check bytes placed at the end of each group of 46 video data bytes.

Details of the RS code common to all 525/60 outer ECC blocks shall be as follows:

– Galois Field: GF (256)
– Field generator polynomial: $X^8 + X^4 + X^3 + X^2 + 1$

where X^i are placekeeping variables in GF (2), the binary field. Note that the + sign indicates a modulo binary addition.

The code generator polynomial (GF (256)) is defined as:

$$G(X) = (X + \alpha^0)(X + \alpha^1)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)(X + \alpha^8)(X + \alpha^9)(X + \alpha^{10})(X + \alpha^{11})(X + \alpha^{12})(X + \alpha^{13})$$

where α is given by 02_h in GF (256). Note that the + sign for this and the following equations indicates a modulo 256 addition.

The check characters are defined as:

$P_{13}, P_{12}, P_{11}, P_{10}, P_9, P_8, P_7, P_6, P_5, P_4, P_3, P_2, P_1, P_0$ in
$P_{13}X^{13} + P_{12}X^{12} + P_{11}X^{11} + P_{10}X^{10} + P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0$

obtained as the remainder after dividing the polynomial $X^{14}D(X)$ by G(X), where Pi are bit-inverted words of PVi shown in figure 49, and D(X) is the polynomial given by:

$$D(X) = D_{45}X^{45} + D_{44}X^{44} + D_{43}X^{43} + D_{42}X^{42} + ... + D_2X^2 + D_1X^1 + D_0$$

The polynomial full code is defined as:

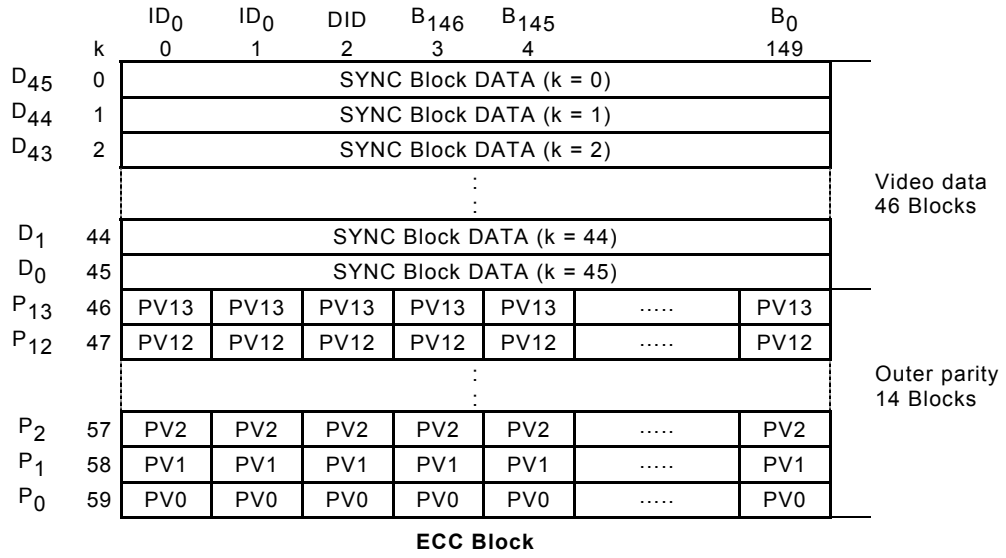
$$D_{45}X^{59} + D_{44}X^{58} + D_{43}X^{57} + ... + D_1X^{15} + D_0X^{14} + P_{13}X^{13} + P_{12}X^{12} + P_{11}X^{11} + P_{10}X^{10} + P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0 = O \pmod{G(X)}$$

The distribution of data for each outer error correction code shall be as shown in figure 49.

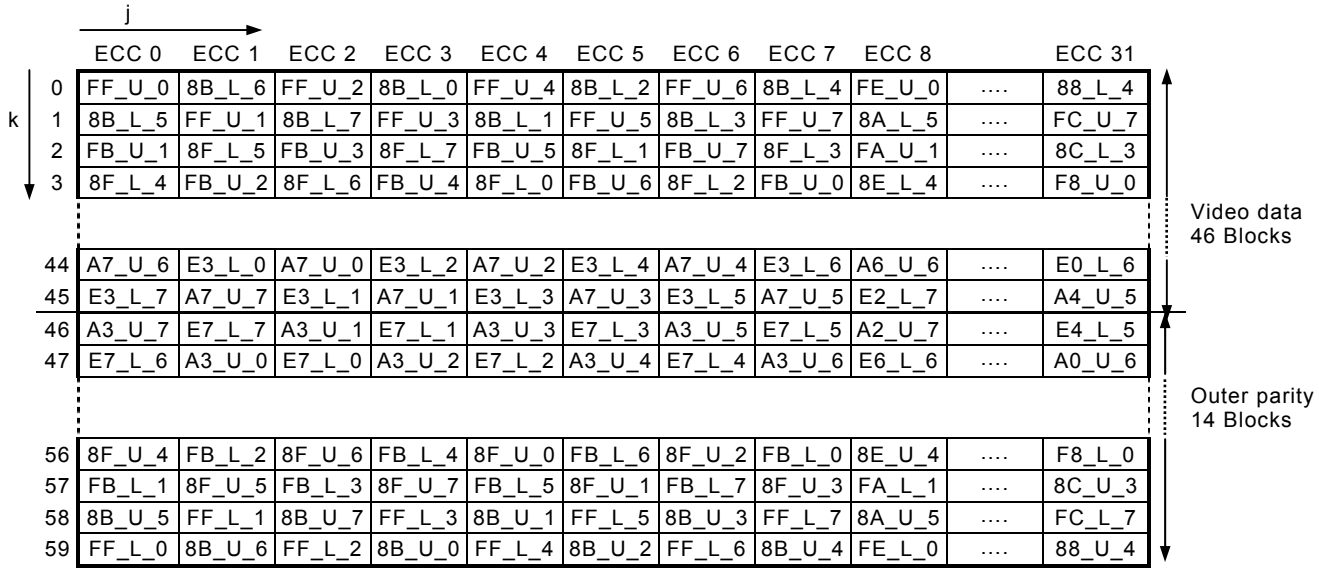
There are 32 outer ECC blocks per frame where each outer ECC block comprises 60 video data sync blocks which shall be organized as shown in the upper half of figure 49. The horizontal axis is aligned with the video data sync block and the vertical axis is aligned with the outer error correction code.

The lower half of figure 49 shows the 32 outer ECC blocks as 32 columns. Within each column, there are the 60 video data sync blocks identified by the sync block ID, the upper or lower half of the scan, and the track number. The algorithm for determining the video data sync block address shall be as follows:

$0 <= k < 60,\ 0 <= j < 32$
ECC (j,k): $k \bmod 2 = j \bmod 2 \rightarrow (FF_h - int(k/2) \times 4 - j/8)\_U\_(j + (k/2)) \bmod 8$
$k \bmod 2 <> j \bmod 2 \rightarrow (FF_h - int((59 - k)/2) \times 4 - j/8)\_L\_(j+int(59 - k)/2) \bmod 8$



ECC Block



n_U_t : ID_0 = n, Upper sector, Track = t

n_L_t : ID_0 = n, Lower sector, Track = t

NOTE – Data output is read left to right and top to bottom.

Figure 49 – Video outer ECC (525/60 system)

8.5.5.2 625/50 system

The outer ECC shall be of the Reed-Solomon (RS) type having 10 check bytes placed at the end of each group of 54 video data bytes.

Details of the RS code common to aII 625/50 outer ECC blocks shall be as follows:

– Galois Field: GF (256)
– Field generator polynomial: $X^8 + X^4 + X^3 + X^2 + 1$

where X^i are placekeeping variables in GF (2), the binary field. Note that the + sign indicates a modulo binary addition.

The code generator polynomial (GF (256)) is defined as:

$$G(X) = (X + \alpha^0)(X + \alpha^1)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)(X + \alpha^8)(X + \alpha^9)$$

where α is given by 02_h in GF (256). Note that the + sign for this and the following equations indicates a modulo 256 addition.

The check characters are defined as:

$P_9, P_8, P_7, P_6, P_5, P_4, P_3, P_2, P_1, P_0$ in
$P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0$

obtained as the remainder after dividing the polynomial $X^{10}D(X)$ by G(X), where Pi are bit-inverted words of PVi shown in figure 50, and D(X) is the polynomial given by:

$$D(X) = D_{53}X^{53} + D_{52}X^{52} + D_{51}X^{51} + D_{50}X^{50} + ... + D_2X^2 + D_1X^1 + D_0$$

The polynomial full code is defined as:

$$D_{53}X^{63} + D_{52}X^{62} + D_{51}X^{61} + ... + D_1X^{11} + D_0X^{10} + P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0 = O \pmod{G(X)}$$

The distribution of data for each outer error correction code shall be as shown in figure 50.

There are 32 outer ECC blocks per frame where each outer ECC block comprises 64 video data sync blocks which shall be organized as shown in the upper half of figure 50. The horizontal axis is aligned with the video data sync block and the vertical axis is aligned with the outer error correction code.

The lower half of figure 50 shows the 32 outer ECC blocks as 32 columns. Within each column, there are 64 video data sync blocks identified by the sync block ID, the upper or lower half of the scan, and the track number. The algorithm for determining the video data sync block address shall be as follows:

$0 <= k < 64, 0 <= j < 32$
ECC (j,k): k mod 2 = j mod 2 → $(FF_h – int(k/2) × 4 – j/8)\_U\_(j + (k/2)) \bmod 8$
k mod 2 <> j mod 2 → $(FF_h – int((63 – k)/2) × 4 – j/8)\_L\_(j+int(63 – k)/2) \bmod 8$

	k	ID_0 0	ID_0 1	DID 2	B_{146} 3	B_{145} 4		B_0 149	
D_{53}	0	SYNC Block DATA (k = 0)							Video data 54 Blocks
D_{52}	1	SYNC Block DATA (k = 1)							
D_{51}	2	SYNC Block DATA (k = 2)							
		:							
D_1	52	SYNC Block DATA (k = 52)							
D_0	53	SYNC Block DATA (k = 53)							
P_9	54	PV9	PV9	PV9	PV9	PV9	.....	PV9	Outer parity 10 Blocks
P_8	55	PV8	PV8	PV8	PV8	PV8	.....	PV8	
		:							
P_2	61	PV2	PV2	PV2	PV2	PV2	.....	PV2	
P_1	62	PV1	PV1	PV1	PV1	PV1	.....	PV1	
P_0	63	PV0	PV0	PV0	PV0	PV0	.....	PV0	

ECC Block

k	ECC 0 (j)	ECC 1	ECC 2	ECC 3	ECC 4	ECC 5	ECC 6	ECC 7	ECC 8		ECC 31	
0	FF_U_0	83_L_0	FF_U_2	83_L_2	FF_U_4	83_L_4	FF_U_6	83_L_6	FE_U_0	....	80_L_6	Video data 54 Blocks
1	83_L_7	FF_U_1	83_L_1	FF_U_3	83_L_3	FF_U_5	83_L_5	FF_U_7	82_L_7	....	FC_U_7	
2	FB_U_1	87_L_7	FB_U_3	87_L_1	FB_U_5	87_L_3	FB_U_7	87_L_5	FA_U_1	....	84_L_5	
3	87_L_6	FB_U_2	87_L_0	FB_U_4	87_L_2	FB_U_6	87_L_4	FB_U_0	86_L_6	....	F8_U_0	
52	97_U_2	EB_L_6	97_U_4	EB_L_0	97_U_6	EB_L_2	97_U_0	EB_L_4	96_U_2	....	E8_L_4	
53	EB_L_5	97_U_3	EB_L_7	97_U_5	EB_L_1	97_U_7	EB_L_3	97_U_1	EA_L_5	....	94_U_1	
54	93_U_3	EF_L_5	93_U_5	EF_L_7	93_U_7	EF_L_1	93_U_1	EF_L_3	92_U_3	....	EC_L_3	Outer parity 10 Blocks
55	EF_L_4	93_U_4	EF_L_6	93_U_6	EF_L_0	93_U_0	EF_L_2	93_U_2	EE_L_4	....	90_U_2	
60	87_U_6	FB_L_2	87_U_0	FB_L_4	87_U_2	FB_L_6	87_U_4	FB_L_0	86_U_6	....	F8_L_0	
61	FB_L_1	87_U_7	FB_L_3	87_U_1	FB_L_5	87_U_3	FB_L_7	87_U_5	FA_L_1	....	84_U_5	
62	83_U_7	FF_L_1	83_U_1	FF_L_3	83_U_3	FF_L_5	83_U_5	FF_L_7	82_U_7	....	FC_L_7	
63	FF_L_0	83_U_0	FF_L_2	83_U_2	FF_L_4	83_U_4	FF_L_6	83_U_6	FE_L_0	....	80_U_6	

n_U_t : ID_0 = n, Upper sector, Track = t

n_L_t : ID_0 = n, Lower sector, Track = t

NOTE – Data output is read left to right and top to bottom.

Figure 50 – Video outer ECC (625/50 system)

8.6 Data arrangement in audio data sectors

8.6.1 General

The D-10 tape format shall provide the capability of recording 8 channels of AES3 data at 16 bits resolution or 4 channels of AES3 data at 24 bits resolution. Each audio data channel shall be independently editable through assignment to defined audio data sectors on the tape. The encoding process is common to all channels except for the recorded position on the tape and the audio data sync block identification pattern (ID, DID).

The digital audio input data shall meet the following conditions:

8.6.1.1 Sampling clock

The AES data sample clock frequency shall be 48 kHz and synchronized to the video frame rate.

8.6.1.2 Audio to video timing

For the 525/60 system:

The first audio data sampling time in each field shall be defined to coincide with line 10 (± 6 lines) of the reference video. The timing details are shown in figure 51a.

The D-10 tape format shall record 4004 samples of audio data in every five fields. There shall be 800 samples of audio data recorded in audio field 1 and 801 samples shall be recorded in fields 2 and 5. The associated audio five field sequence number shall be recorded in the audio data sync block data identification pattern (DID), in the audio auxiliary data area, and on the longitudinal control track.

For the 625/50 system:

The first audio data sampling time in each field shall be defined to coincide with line 6 (± 6 lines) of the reference video. The timing details are shown in figure 51b.

The D-10 tape format shall record 960 samples of audio data in every field.

8.6.2 Data arrangement

8.6.2.1 Audio data words

The input audio data words may be 16 or 24 bits. The audio data words may represent either linear PCM audio or data as defined by AES3. The use of the bits in the audio data words is specified by the B and D bits in the audio auxiliary data words, as described in 8.6.2.2.

The D-10 format records 8 independent audio data channels of 16 bits per channel.

The mapping of each input 16-bit audio data word into 2 bytes of one audio data channel shall be as defined in figures 52 (1) and (2).

The mapping of each input 24-bit audio data word into 4 bytes of one audio data channel pair shall be defined in figures 52 (3) and (4).

Figure 52 also shows how audio bit-wise data are mapped into byte pairs. Each audio data sync block has a data space of 102 bytes for 525/60 operation and 122 bytes for 625/50 operation (see figures 37 and 38). The first byte of the first byte pair shall be placed into the first byte of the data area of each audio data sync block.

In the case of 4-channel 24-bit audio data mode, the eight channel sectors shall be combined as follows:

8.6.2.2 Audio auxiliary data words

Audio auxiliary data words shall be recorded to identify the audio system parameters.

	16 bit/8 CH	24 bit/4 CH
Sector 0	CH1	CH1 (A8-A23)
Sector 1	CH2	CH2 (A8-A23)
Sector 2	CH3	CH3 (A8-A23)
Sector 3	CH4	CH4 (A8-A23)
Sector 4	CH5	CH1 (A0-A7)
Sector 5	CH6	CH2 (A0-A7)
Sector 6	CH7	CH3 (A0-A7)
Sector 7	CH8	CH4 (A0-A7)

There shall be three auxiliary data words of 16 bits per word as defined in figure 53. The three auxiliary data words shall be specified as shown in figure 53. These three words shall be recorded twice per field as specified in figure 54 for 525/60 operation and figure 55 for 625/50 operation.

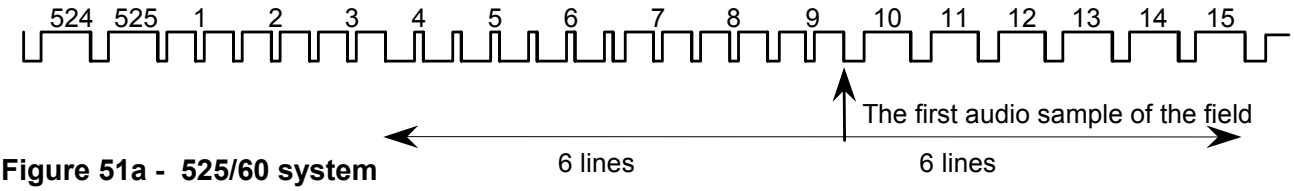


Figure 51a - 525/60 system

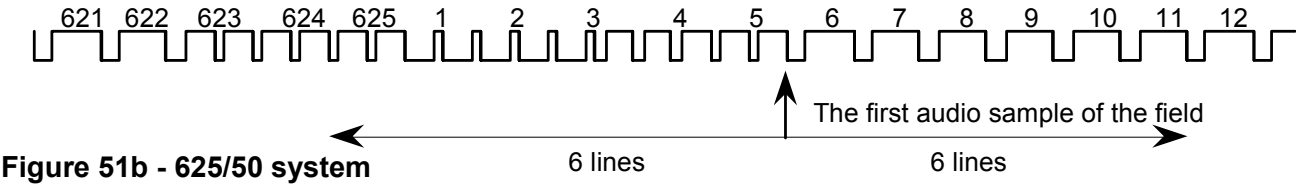
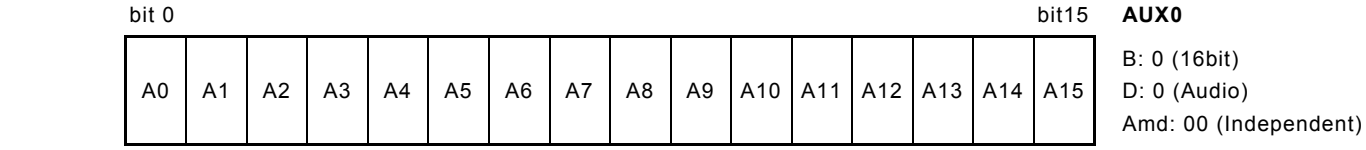


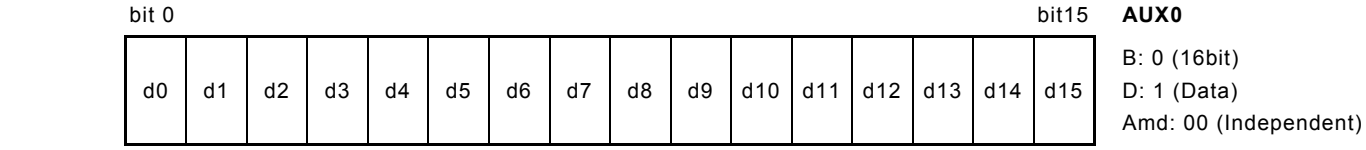
Figure 51b - 625/50 system

Figure 51 – Audi video timing

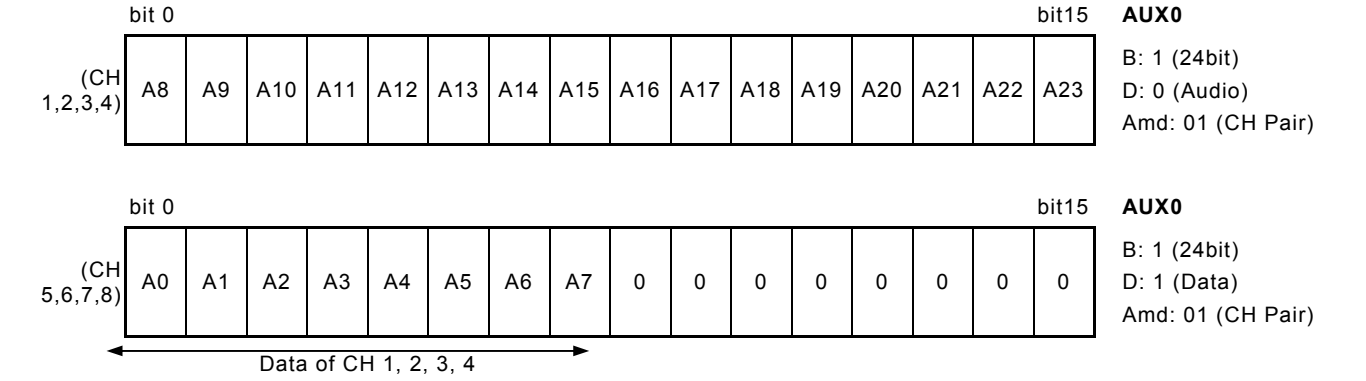
(1) 16 bit AUDIO × 8ch



(2) 16 bit DATA × 8ch



(3) 24 bit AUDIO (CH1 and 5, CH2 and 6, CH3 and 7, CH4 and 8) × 4ch



(4) 24 bit DATA (CH1 and 5, CH2 and 6, CH3 and 7, CH4 and 8) × 4ch

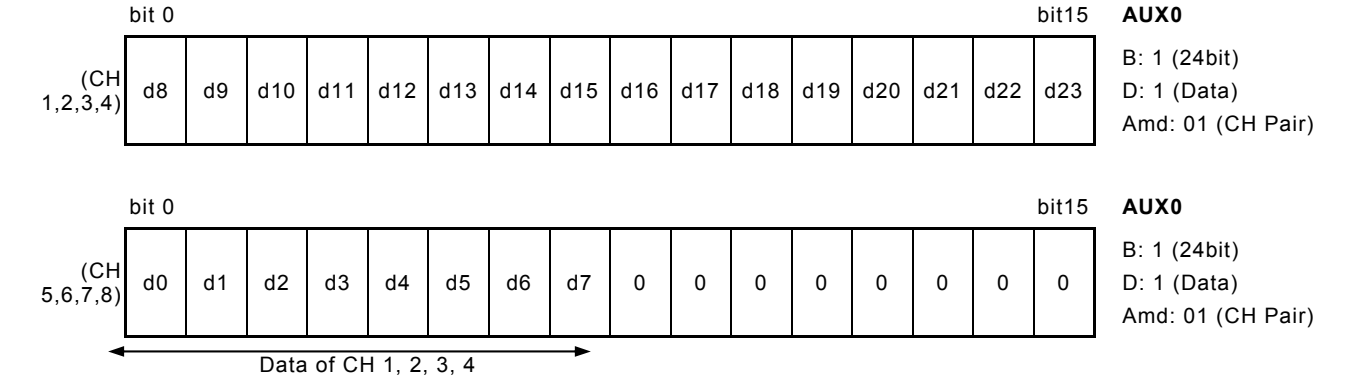
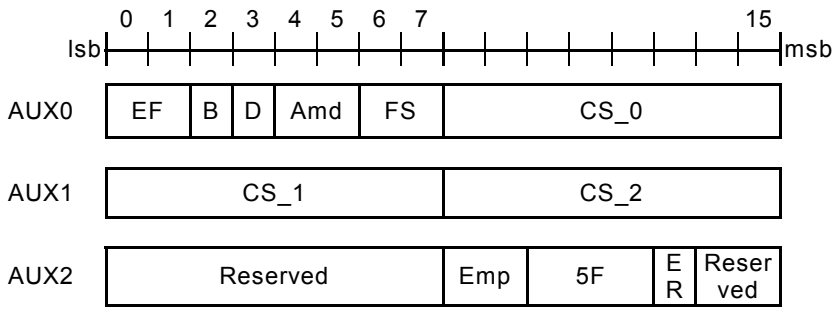


Figure 52 – Audio data word assignment



AUX 0:	Edit (EF)	(bit 0,1)	0 0: Normal 0 1: Edit in point 1 0: Edit out point 1 1: Reserved
	Bit length (B)	(bit 2)	0: 16bit 1: 24 bit
	Data/Audio (D)	(bit 3)	0: Audio 1: Data
	mode (Amd)	(bit 4,5)	0 0: Independent CH (16bit audio or data) 1 0: Reserved 0 1: CH Pair (24bit audio or data) 1 1: Reserved
	FS	(bit 6,7)	0 0: 48 kHz sampling 1 0: Reserved 0 1: Reserved 1 1: Reserved
	CS_0	(bit 8-15)	The channel status specified in AES3.
AUX 1:	CS_1	(bit 0-7)	The channel status specified in AES3.
	CS_2	(bit 8-15)	The channel status specified in AES3.
AUX 2:	Reserved	(bit 0-7)	
	Emphasis (Emp)	(bit 8,9)	0 0: No emphasis 1 0: 50/15 µsec emphasis 0 1: CCITT emphasis 1 1: Reserved
	5F seq (5F)	(bit 10, 11, 12)	5 Field sequence (625 = 000)
	Error (ER)	(bit 13)	1: error
	Reserved	(bit 14, 15)	

Figure 53 – Audio auxiliary data words

		ECC1 Word number						ECC2 Word number						
		B_{101} B_{100} B_{99} B_{98} B_{97} B_{96} B_{95} B_{94}					B_1 B_0	B_{101} B_{100} B_{99} B_{98} B_{97} B_{96} B_{95} B_{94}					B_1 B_0	
ROW number		0	1	2	3		50	0	1	2	3		50	
D_7	R0	AUX0	10	26	42	....	794	R1	AUX0	11	27	43	....	795
D_6	R2	AUX1	12	28	44	....	796	R3	AUX1	13	29	45	....	797
D_5	R4	AUX2	14	30	46	....	798	R5	AUX2	15	31	47	....	799
D_4	R6	0	16	32	48	....	800	R7	1	17	33	49	....	(799)
D_3	R8	2	18	34	50	....	(800)	R9	3	19	35	51	....	(799)
D_2	R10	4	20	36	52	....	(800)	R11	5	21	37	53	....	(799)
D_1	R12	6	22	38	54	....	(800)	R13	7	23	39	55	....	(799)
D_0	R14	8	24	40	56	....	(800)	R15	9	25	41	57	....	(799)
P_9	R16	PV9	PV9	PV9	PV9	....	PV9	R17	PV9	PV9	PV9	PV9	....	PV9
P_8	R18	PV8	PV8	PV8	PV8	....	PV8	R19	PV8	PV8	PV8	PV8	....	PV8
P_7	R20	PV7	PV7	PV7	PV7	....	PV7	R21	PV7	PV7	PV7	PV7	....	PV7
P_6	R22	PV6	PV6	PV6	PV6	....	PV6	R23	PV6	PV6	PV6	PV6	....	PV6
P_5	R24	PV5	PV5	PV5	PV5	....	PV5	R25	PV5	PV5	PV5	PV5	....	PV5
P_4	R26	PV4	PV4	PV4	PV4	....	PV4	R27	PV4	PV4	PV4	PV4	....	PV4
P_3	R28	PV3	PV3	PV3	PV3	....	PV3	R29	PV3	PV3	PV3	PV3	....	PV3
P_2	R30	PV2	PV2	PV2	PV2	....	PV2	R31	PV2	PV2	PV2	PV2	....	PV2
P_1	R32	PV1	PV1	PV1	PV1	....	PV1	R33	PV1	PV1	PV1	PV1	....	PV1
P_0	R34	PV0	PV0	PV0	PV0	....	PV0	R35	PV0	PV0	PV0	PV0	....	PV0

Audio data 8 Blocks

Outer parity 10 Blocks

NOTES
1 Two ECC blocks/field.
2 Numeric table entries are audio sample numbers.
3 PV0 to PV9 present outer check bytes corresponding to audio data of each column.

Figure 54 – Audio data block layout (525/60 system)

		ECC1 Word number						ECC2 Word number						
		B_{121} B_{120} B_{119} B_{118} B_{117} B_{116} B_{115} B_{114}					B_1 B_0	B_{121} B_{120} B_{119} B_{118} B_{117} B_{116} B_{115} B_{114}					B_1 B_0	
ROW number		0	1	2	3		60	0	1	2	3		60	
D_7	R0	AUX0	10	26	42	....	954	R1	AUX0	11	27	43	....	955
D_6	R2	AUX1	12	28	44	....	956	R3	AUX1	13	29	45	....	957
D_5	R4	AUX2	14	30	46	....	958	R5	AUX2	15	31	47	....	959
D_4	R6	0	16	32	48	....	(958)	R7	1	17	33	49	....	(959)
D_3	R8	2	18	34	50	....	(958)	R9	3	19	35	51	....	(959)
D_2	R10	4	20	36	52	....	(958)	R11	5	21	37	53	....	(959)
D_1	R12	6	22	38	54	....	(958)	R13	7	23	39	55	....	(959)
D_0	R14	8	24	40	56	....	(958)	R15	9	25	41	57	....	(959)
P_9	R16	PV9	PV9	PV9	PV9	....	PV9	R17	PV9	PV9	PV9	PV9	....	PV9
P_8	R18	PV8	PV8	PV8	PV8	....	PV8	R19	PV8	PV8	PV8	PV8	....	PV8
P_7	R20	PV7	PV7	PV7	PV7	....	PV7	R21	PV7	PV7	PV7	PV7	....	PV7
P_6	R22	PV6	PV6	PV6	PV6	....	PV6	R23	PV6	PV6	PV6	PV6	....	PV6
P_5	R24	PV5	PV5	PV5	PV5	....	PV5	R25	PV5	PV5	PV5	PV5	....	PV5
P_4	R26	PV4	PV4	PV4	PV4	....	PV4	R27	PV4	PV4	PV4	PV4	....	PV4
P_3	R28	PV3	PV3	PV3	PV3	....	PV3	R29	PV3	PV3	PV3	PV3	....	PV3
P_2	R30	PV2	PV2	PV2	PV2	....	PV2	R31	PV2	PV2	PV2	PV2	....	PV2
P_1	R32	PV1	PV1	PV1	PV1	....	PV1	R33	PV1	PV1	PV1	PV1	....	PV1
P_0	R34	PV0	PV0	PV0	PV0	....	PV0	R35	PV0	PV0	PV0	PV0	....	PV0

Audio data 8 Blocks

Outer parity 10 Blocks

NOTES
1 Two ECC blocks/field.
2 Numeric table entries are audio sample numbers.
3 PV0 to PV9 present outer check bytes corresponding to audio data of each column.

Figure 55 – Audio data block layout (625/50 system)

8.6.3 Audio data shuffling

8.6.3.1 Intrafield shuffling

In 525/60 operation, for each of the 8 audio data channels in a field, the 801 audio data samples (16-bit) together with the 6 samples of auxiliary data shall be arranged into two 51 × 8 rectangular outer ECC blocks as shown in figure 54. The top 8 rows of the outer ECC matrix shall be appended with 10 rows of outer error correction (see 8.6.4). There shall be 102 outer error correction codes for each ECC block.

In 625/50 operation, for each of the 8 audio data channels in a field, the 960 audio data samples (16-bit) together with the 6 samples of auxiliary data shall be arranged into two 61 × 8 rectangular outer ECC blocks as shown in figure 55. The top 8 rows of the outer ECC matrix shall be appended with 10 rows of outer error correction (see 8.6.4). There shall be 122 outer error correction codes for each ECC block.

8.6.3.2 Sync block shuffling

After calculation of the outer ECC, each row shown in figures 54 and 55 makes up the data portion of an audio data sync block as shown in figures 37 and 38. The 36 rows in a field shall be mapped to four segments where each segment shall be made up of nine sync blocks. The four segments shall be mapped to two track pairs as shown in figure 56. Figure 56 also defines the assignment of row numbers to the audio data sync blocks in each of the four segments.

8.6.3.3 Channel sector shuffling

In each track, the eight channels of audio data shall be recorded, with each channel in one sector, as shown in figure 57.

8.6.4 Outer ECC

For both 525/60 operation and 625/50 operation, the outer ECC shall be of the Reed-Solomon (RS) type having 10 check bytes placed at the end of each group of 8 audio data bytes.

Details of the RS code common to all audio outer ECC blocks shall be as follows:

– Galois Field: GF (256)
– Field generator polynomial: $X^8 + X^4 + X^3 + X^2 + 1$

where X^i are placekeeping variables in GF (2), the binary field. Note that the + sign indicates a modulo binary addition.

The code generator polynomial (GF (256)) is defined as:

$$G(X) = (X + \alpha^0)(X + \alpha^1)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)(X + \alpha^8)(X + \alpha^9)$$

where α is given by 02_h in GF (256). Note that the + sign for this and the following equations indicates a modulo 256 addition.

The check characters are defined as:

$P_9, P_8, P_7, P_6, P_5, P_4, P_3, P_2, P_1, P_0$ in
$P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0$

obtained as the remainder after dividing the polynomial $X^{10}D(X)$ by G(X), where Pi are bit-inverted words of PVi shown in figures 54 and 55, and D(X) is the polynomial given by:

$$D(X) = D_7X^7 + D_6X^6 + D_5X^5 + D_4X^4 + D_3X^3 + D_2X^2 + D_1X^1 + D_0$$

The polynomial full code is defined as:

$$D_7X^{17} + D_6X^{16} + D_5X^{15} + D_4X^{14} + D_3X^{13} + D_2X^{12} + D_1X^{11} + D_0X^{10} + P_9X^9 + P_8X^8 + P_7X^7 + P_6X^6 + P_5X^5 + P_4X^4 + P_3X^3 + P_2X^2 + P_1X^1 + P_0 = O \text{ (mod } G(X))$$

HEAD MOTION

		ID0								
audio sector 0, 4		FF	FE	FD	FC	FB	FA	F9	F8	F7
audio sector 1, 5		7F	7E	7D	7C	7B	7A	79	78	77
audio sector 2, 6		3F	3E	3D	3C	3B	3A	39	38	37
audio sector 3, 7		1F	1E	1D	1C	1B	1A	19	18	17
SG=1	Track=0	R19	R21	R0	R4	R8	R12	R16	R23	R25
	Track=1	R18	R20	R3	R7	R11	R15	R22	R24	R26
SG=2	Track=2	R27	R29	R2	R6	R10	R14	R31	R33	R35
	Track=3	R28	R30	R1	R5	R9	R13	R17	R32	R34
SG=3	Track=4	R19	R21	R0	R4	R8	R12	R16	R23	R25
	Track=5	R18	R20	R3	R7	R11	R15	R22	R24	R26
SG=4	Track=6	R27	R29	R2	R6	R10	R14	R31	R33	R35
	Track=7	R28	R30	R1	R5	R9	R13	R17	R32	R34

field 1

field 2

Intra field shuffling

Figure 56 – Sync block shuffling

HEAD MOTION ⇨

		audio sector	0	1	2	3	4	5	6	7
SG=1	TR=0		CH=1	CH=3	CH=2	CH=4	CH=5	CH=7	CH=6	CH=8
	TR=1		CH=1	CH=3	CH=2	CH=4	CH=5	CH=7	CH=6	CH=8
SG=2	TR=0		CH=5	CH=7	CH=6	CH=8	CH=1	CH=3	CH=2	CH=4
	TR=1		CH=5	CH=7	CH=6	CH=8	CH=1	CH=3	CH=2	CH=4
SG=3	TR=0		CH=2	CH=4	CH=1	CH=3	CH=6	CH=8	CH=5	CH=7
	TR=1		CH=2	CH=4	CH=1	CH=3	CH=6	CH=8	CH=5	CH=7
SG=4	TR=0		CH=6	CH=8	CH=5	CH=7	CH=2	CH=4	CH=1	CH=3
	TR=1		CH=6	CH=8	CH=5	CH=7	CH=2	CH=4	CH=1	CH=3

Figure 57 – Channel sector shuffling

Annex A (normative)
Video shuffling tables

Table A.1 is the shuffling pattern for the 525/60 system and table A.2 for the 625/50 system.

Table A.1 – Shuffling pattern for 525/60 system

Slice	ID_0	UL	Track
0	e3	Lower	0
1	b9	Lower	0
2	ba	Lower	0
3	bb	Lower	0
4	bc	Lower	0
5	bd	Lower	0
6	be	Lower	0
7	c9	Lower	0
8	ca	Lower	0
9	cb	Lower	0
10	cc	Lower	0
11	cd	Lower	0
12	ce	Lower	0
13	ce	Lower	2
14	cd	Lower	2
15	cc	Lower	2
16	cb	Lower	2
17	ca	Lower	2
18	bd	Lower	2
19	bc	Lower	2
20	bb	Lower	2
21	ba	Lower	2
22	b9	Lower	2
23	b8	Lower	2
24	b9	Lower	4
25	ba	Lower	4
26	bb	Lower	4
27	bc	Lower	4
28	bd	Lower	4
29	ca	Lower	4
30	cb	Lower	4
31	cc	Lower	4
32	cd	Lower	4
33	ce	Lower	4
34	ce	Lower	6
35	cd	Lower	6
36	cc	Lower	6
37	cb	Lower	6
38	ca	Lower	6
39	c9	Lower	6
40	be	Lower	6
41	bd	Lower	6
42	bc	Lower	6
43	bb	Lower	6
44	ba	Lower	6
45	b9	Lower	6
46	b8	Lower	0
47	b7	Lower	0
48	b6	Lower	0
49	c1	Lower	0
50	c0	Lower	0
51	bf	Lower	0
52	c8	Lower	0
53	c7	Lower	0
54	d2	Lower	0
55	d1	Lower	0
56	d0	Lower	0
57	cf	Lower	0
58	cf	Lower	2
59	d0	Lower	2
60	c7	Lower	2
61	c8	Lower	2
62	c9	Lower	2
63	be	Lower	2
64	bf	Lower	2
65	c0	Lower	2
66	b5	Lower	2
67	b6	Lower	2
68	b7	Lower	2
69	b8	Lower	4
70	b7	Lower	4
71	c0	Lower	4
72	bf	Lower	4
73	be	Lower	4
74	c9	Lower	4
75	c8	Lower	4
76	c7	Lower	4
77	d0	Lower	4
78	cf	Lower	4
79	cf	Lower	6
80	d0	Lower	6
81	d1	Lower	6
82	d2	Lower	6
83	c7	Lower	6
84	c8	Lower	6
85	bf	Lower	6
86	c0	Lower	6
87	c1	Lower	6
88	b6	Lower	6
89	b7	Lower	6
90	b8	Lower	6
91	b3	Lower	0
92	b4	Lower	0
93	b5	Lower	0
94	c2	Lower	0
95	c3	Lower	0
96	c4	Lower	0
97	c5	Lower	0
98	c6	Lower	0
99	d3	Lower	2
100	d4	Lower	2
101	d5	Lower	2
102	d3	Lower	2
103	d2	Lower	2
104	d1	Lower	2
105	c6	Lower	2
106	c5	Lower	2
107	c4	Lower	2
108	c3	Lower	2
109	c2	Lower	2
110	c1	Lower	2
111	b4	Lower	2
112	b3	Lower	2
113	b2	Lower	2
114	b5	Lower	4
115	b6	Lower	4
116	c1	Lower	4
117	c2	Lower	4
118	c3	Lower	4
119	c4	Lower	4
120	c5	Lower	4
121	c6	Lower	4
122	d1	Lower	4
123	d2	Lower	4
124	d3	Lower	4
125	d5	Lower	6
126	d4	Lower	6
127	d3	Lower	6
128	c6	Lower	6
129	c5	Lower	6
130	c4	Lower	6
131	c3	Lower	6
132	c2	Lower	6
133	b5	Lower	6
134	b4	Lower	6
135	b3	Lower	6
136	b2	Lower	0
137	b1	Lower	0
138	b0	Lower	0
139	af	Lower	0
140	ae	Lower	0
141	ad	Lower	0
142	da	Lower	0
143	d9	Lower	0
144	d8	Lower	0
145	d7	Lower	0
146	d6	Lower	0

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
147	d4	Lower	2
148	d5	Lower	2
149	d6	Lower	2
150	d7	Lower	2
151	d8	Lower	2
152	d9	Lower	2
153	ac	Lower	2
154	ad	Lower	2
155	ae	Lower	2
156	af	Lower	2
157	b0	Lower	2
158	b1	Lower	2
159	b4	Lower	4
160	b3	Lower	4
161	b2	Lower	4
162	b1	Lower	4
163	b0	Lower	4
164	d9	Lower	4
165	d8	Lower	4
166	d7	Lower	4
167	d6	Lower	4
168	d5	Lower	4
169	d4	Lower	4
170	d6	Lower	6
171	d7	Lower	6
172	d8	Lower	6
173	d9	Lower	6
174	da	Lower	6
175	ad	Lower	6
176	ae	Lower	6
177	af	Lower	6
178	b0	Lower	6
179	b1	Lower	6
180	b2	Lower	6
181	a7	Lower	0
182	a8	Lower	0
183	a9	Lower	0
184	aa	Lower	0
185	ab	Lower	0
186	ac	Lower	0
187	db	Lower	0
188	dc	Lower	0
189	dd	Lower	0
190	de	Lower	0
191	df	Lower	0
192	df	Lower	2
193	de	Lower	2
194	dd	Lower	2
195	dc	Lower	2
196	db	Lower	2
197	da	Lower	2
198	ab	Lower	2
199	aa	Lower	2
200	a9	Lower	2
201	a8	Lower	2
202	a7	Lower	2
203	aa	Lower	4
204	ab	Lower	4
205	ac	Lower	4
206	ad	Lower	4
207	ae	Lower	4
208	af	Lower	4
209	da	Lower	4
210	db	Lower	4
211	dc	Lower	4
212	dd	Lower	4
213	de	Lower	4
214	df	Lower	4
215	df	Lower	6
216	de	Lower	6
217	dd	Lower	6
218	dc	Lower	6
219	db	Lower	6
220	ac	Lower	6
221	ab	Lower	6
222	aa	Lower	6
223	a9	Lower	6
224	a8	Lower	6
225	a7	Lower	6
226	a6	Lower	0
227	a5	Lower	0
228	a4	Lower	0
229	97	Lower	0
230	96	Lower	0
231	95	Lower	0
232	94	Lower	0
233	93	Lower	0
234	e2	Lower	0
235	e1	Lower	0
236	e0	Lower	2
237	e0	Lower	2
238	e1	Lower	2
239	e2	Lower	2
240	95	Lower	2
241	96	Lower	2
242	97	Lower	2
243	98	Lower	2
244	99	Lower	2
245	9a	Lower	2
246	a5	Lower	2
247	a6	Lower	2
248	a9	Lower	4
249	a8	Lower	4
250	a7	Lower	4
251	9a	Lower	4
252	99	Lower	4
253	98	Lower	4
254	97	Lower	4
255	96	Lower	4
256	95	Lower	4
257	e2	Lower	4
258	e1	Lower	4
259	e0	Lower	4
260	e0	Lower	6
261	e1	Lower	6
262	e2	Lower	6
263	93	Lower	6
264	94	Lower	6
265	95	Lower	6
266	96	Lower	6
267	97	Lower	6
268	a4	Lower	6
269	a5	Lower	6
270	a6	Lower	6
271	a1	Lower	0
272	a2	Lower	0
273	a3	Lower	0
274	98	Lower	0
275	99	Lower	0
276	9a	Lower	0
277	91	Lower	0
278	92	Lower	0
279	89	Lower	0
280	8a	Lower	0
281	8b	Lower	0
282	8b	Lower	2
283	8a	Lower	2
284	89	Lower	2
285	94	Lower	2
286	93	Lower	2
287	92	Lower	2
288	9d	Lower	2
289	9c	Lower	2
290	9b	Lower	2
291	a4	Lower	2
292	a3	Lower	2
293	a4	Lower	4
294	a5	Lower	4
295	a6	Lower	4
296	9b	Lower	4
297	9c	Lower	4
298	9d	Lower	4
299	92	Lower	4
300	93	Lower	4
301	94	Lower	4
302	89	Lower	4
303	8a	Lower	4
304	8b	Lower	4
305	8b	Lower	6
306	8a	Lower	6
307	89	Lower	6
308	92	Lower	6

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
309	91	Lower	6
310	9a	Lower	6
311	99	Lower	6
312	98	Lower	6
313	a3	Lower	6
314	a2	Lower	6
315	a1	Lower	6
316	a0	Lower	0
317	9f	Lower	0
318	9e	Lower	0
319	9d	Lower	0
320	9c	Lower	0
321	9b	Lower	0
322	90	Lower	0
323	8f	Lower	0
324	8e	Lower	0
325	8d	Lower	0
326	8c	Lower	0
327	8c	Lower	2
328	8d	Lower	2
329	8e	Lower	2
330	8f	Lower	4
331	90	Lower	4
332	91	Lower	4
333	9e	Lower	4
334	9f	Lower	4
335	a0	Lower	4
336	a1	Lower	4
337	a2	Lower	4
338	a3	Lower	4
339	a2	Lower	4
340	a1	Lower	4
341	a0	Lower	4
342	9f	Lower	4
343	9e	Lower	4
344	91	Lower	4
345	90	Lower	4
346	8f	Lower	4
347	8e	Lower	4
348	8d	Lower	4
349	8c	Lower	4
350	8c	Lower	6
351	8d	Lower	6
352	8e	Lower	6
353	8f	Lower	6
354	90	Lower	6
355	9b	Lower	6
356	9c	Lower	6
357	9d	Lower	6
358	9e	Lower	6
359	9f	Lower	6
360	a0	Lower	6
361	b9	Lower	1
362	ba	Lower	1
363	bb	Lower	1
364	bc	Lower	1
365	bd	Lower	1
366	be	Lower	1
367	c9	Lower	1
368	ca	Lower	1
369	cb	Lower	1
370	cc	Lower	1
371	cd	Lower	1
372	ce	Lower	1
373	ce	Lower	3
374	cd	Lower	3
375	cc	Lower	3
376	cb	Lower	3
377	ca	Lower	3
378	bd	Lower	3
379	bc	Lower	3
380	bb	Lower	3
381	ba	Lower	3
382	b9	Lower	3
383	b8	Lower	3
384	b9	Lower	5
385	ba	Lower	5
386	bb	Lower	5
387	bc	Lower	5
388	bd	Lower	5
389	ca	Lower	5
390	cb	Lower	5
391	cc	Lower	5
392	cd	Lower	5
393	ce	Lower	5
394	ce	Lower	7
395	cd	Lower	7
396	cc	Lower	7
397	cb	Lower	7
398	ca	Lower	7
399	c9	Lower	7
400	be	Lower	7
401	bd	Lower	7
402	bc	Lower	7
403	bb	Lower	7
404	ba	Lower	7
405	b9	Lower	7
406	b8	Lower	1
407	b7	Lower	1
408	b6	Lower	1
409	c1	Lower	1
410	c0	Lower	1
411	bf	Lower	1
412	c8	Lower	1
413	c7	Lower	1
414	d2	Lower	1
415	d1	Lower	1
416	d0	Lower	1
417	cf	Lower	1
418	cf	Lower	3
419	d0	Lower	3
420	c7	Lower	3
421	c8	Lower	3
422	c9	Lower	3
423	be	Lower	3
424	bf	Lower	3
425	c0	Lower	3
426	b5	Lower	3
427	b6	Lower	3
428	b7	Lower	3
429	b8	Lower	5
430	b7	Lower	5
431	c0	Lower	5
432	bf	Lower	5
433	be	Lower	5
434	c9	Lower	5
435	c8	Lower	5
436	c7	Lower	5
437	d0	Lower	5
438	cf	Lower	7
439	cf	Lower	7
440	d0	Lower	7
441	d1	Lower	7
442	d2	Lower	7
443	c7	Lower	7
444	c8	Lower	7
445	bf	Lower	7
446	c0	Lower	7
447	c1	Lower	7
448	b6	Lower	7
449	b7	Lower	7
450	b8	Lower	7
451	b3	Lower	1
452	b4	Lower	1
453	b5	Lower	1
454	c2	Lower	1
455	c3	Lower	1
456	c4	Lower	1
457	c5	Lower	1
458	c6	Lower	1
459	d3	Lower	1
460	d4	Lower	1
461	d5	Lower	1
462	d3	Lower	3
463	d2	Lower	3
464	d1	Lower	3
465	c6	Lower	3
466	c5	Lower	3
467	c4	Lower	3

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
468	c3	Lower	3
469	c2	Lower	3
470	c1	Lower	3
471	b4	Lower	3
472	b3	Lower	3
473	b2	Lower	3
474	b5	Lower	5
475	b6	Lower	5
476	c1	Lower	5
477	c2	Lower	5
478	c3	Lower	5
479	c4	Lower	5
480	c5	Lower	5
481	c6	Lower	5
482	d1	Lower	5
483	d2	Lower	5
484	d3	Lower	5
485	d5	Lower	7
486	d4	Lower	7
487	d3	Lower	7
488	c6	Lower	7
489	c5	Lower	7
490	c4	Lower	7
491	c3	Lower	7
492	c2	Lower	7
493	b5	Lower	7
494	b4	Lower	7
495	b3	Lower	7
496	b2	Lower	1
497	b1	Lower	1
498	b0	Lower	1
499	af	Lower	1
500	ae	Lower	1
501	ad	Lower	1
502	da	Lower	1
503	d9	Lower	1
504	d8	Lower	1
505	d7	Lower	1
506	d6	Lower	1
507	d4	Lower	3
508	d5	Lower	3
509	d6	Lower	3
510	d7	Lower	3
511	d8	Lower	3
512	d9	Lower	3
513	ac	Lower	3
514	ad	Lower	3
515	ae	Lower	3
516	af	Lower	3
517	b0	Lower	3
518	b1	Lower	3
519	b4	Lower	5
520	b3	Lower	5
521	b2	Lower	5
522	b1	Lower	5
523	b0	Lower	5
524	d9	Lower	5
525	d8	Lower	5
526	d7	Lower	5
527	d6	Lower	5
528	d5	Lower	5
529	d4	Lower	5
530	d6	Lower	7
531	d7	Lower	7
532	d8	Lower	7
533	d9	Lower	7
534	da	Lower	7
535	ad	Lower	7
536	ae	Lower	7
537	af	Lower	7
538	b0	Lower	7
539	b1	Lower	7
540	b2	Lower	7
541	a7	Lower	1
542	a8	Lower	1
543	a9	Lower	1
544	aa	Lower	1
545	ab	Lower	1
546	ac	Lower	1
547	db	Lower	1
548	dc	Lower	1
549	dd	Lower	1
550	de	Lower	1
551	df	Lower	1
552	df	Lower	3
553	de	Lower	3
554	dd	Lower	3
555	dc	Lower	3
556	db	Lower	3
557	da	Lower	3
558	ab	Lower	3
559	aa	Lower	3
560	a9	Lower	3
561	a8	Lower	3
562	a7	Lower	3
563	aa	Lower	5
564	ab	Lower	5
565	ac	Lower	5
566	ad	Lower	5
567	ae	Lower	5
568	af	Lower	5
569	da	Lower	5
570	db	Lower	5
571	dc	Lower	5
572	dd	Lower	5
573	de	Lower	5
574	df	Lower	5
575	df	Lower	7
576	de	Lower	7
577	dd	Lower	7
578	dc	Lower	7
579	db	Lower	7
580	ac	Lower	7
581	ab	Lower	7
582	aa	Lower	7
583	a9	Lower	7
584	a8	Lower	7
585	a7	Lower	7
586	a6	Lower	1
587	a5	Lower	1
588	a4	Lower	1
589	97	Lower	1
590	96	Lower	1
591	95	Lower	1
592	94	Lower	1
593	93	Lower	1
594	e2	Lower	1
595	e1	Lower	1
596	e0	Lower	1
597	e0	Lower	3
598	e1	Lower	3
599	e2	Lower	3
600	95	Lower	3
601	96	Lower	3
602	97	Lower	3
603	98	Lower	3
604	99	Lower	3
605	9a	Lower	3
606	a5	Lower	3
607	a6	Lower	3
608	a9	Lower	5
609	a8	Lower	5
610	a7	Lower	5
611	9a	Lower	5
612	99	Lower	5
613	98	Lower	5
614	97	Lower	5
615	96	Lower	5
616	95	Lower	5
617	e2	Lower	5
618	e1	Lower	5
619	e0	Lower	5
620	e0	Lower	7
621	e1	Lower	7
622	e2	Lower	7
623	93	Lower	7
624	94	Lower	7
625	95	Lower	7
626	96	Lower	7

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
627	97	Lower	7
628	a4	Lower	7
629	a5	Lower	7
630	a6	Lower	7
631	a1	Lower	1
632	a2	Lower	1
633	a3	Lower	1
634	98	Lower	1
635	99	Lower	1
636	9a	Lower	1
637	91	Lower	1
638	92	Lower	1
639	89	Lower	1
640	8a	Lower	1
641	b8	Lower	1
642	8b	Lower	3
643	8a	Lower	3
644	89	Lower	3
645	94	Lower	3
646	93	Lower	3
647	92	Lower	3
648	9d	Lower	3
649	9c	Lower	3
650	9b	Lower	3
651	a4	Lower	3
652	a3	Lower	3
653	a4	Lower	5
654	a5	Lower	5
655	a6	Lower	5
656	9b	Lower	5
657	9c	Lower	5
658	9d	Lower	5
659	92	Lower	5
660	93	Lower	5
661	94	Lower	5
662	89	Lower	5
663	8a	Lower	5
664	8b	Lower	5
665	8b	Lower	7
666	8a	Lower	7
667	89	Lower	7
668	92	Lower	7
669	91	Lower	7
670	9a	Lower	7
671	99	Lower	7
672	98	Lower	7
673	a3	Lower	7
674	a2	Lower	7
675	a1	Lower	7
676	a0	Lower	1
677	9f	Lower	1
678	9e	Lower	1
679	9d	Lower	1
680	9c	Lower	1
681	9b	Lower	1
682	90	Lower	1
683	8f	Lower	1
684	8e	Lower	1
685	8d	Lower	1
686	8c	Lower	1
687	8c	Lower	3
688	8d	Lower	3
689	8e	Lower	3
690	8f	Lower	3
691	90	Lower	3
692	91	Lower	3
693	9e	Lower	3
694	9f	Lower	3
695	a0	Lower	3
696	a1	Lower	3
697	a2	Lower	3
698	a3	Lower	5
699	a2	Lower	5
700	a1	Lower	5
701	a0	Lower	5
702	9f	Lower	5
703	9e	Lower	5
704	91	Lower	5
705	90	Lower	5
706	8f	Lower	5
707	8e	Lower	5
708	8d	Lower	5
709	8c	Lower	5
710	8c	Lower	7
711	8d	Lower	7
712	8e	Lower	7
713	8f	Lower	7
714	90	Lower	7
715	9b	Lower	7
716	9c	Lower	7
717	9d	Lower	7
718	9e	Lower	7
719	9f	Lower	7
720	a0	Lower	7
721	d6	Upper	0
722	d7	Upper	0
723	d8	Upper	0
724	d9	Upper	0
725	da	Upper	0
726	db	Upper	0
727	e6	Upper	0
728	e7	Upper	0
729	e8	Upper	0
730	e9	Upper	0
731	ea	Upper	0
732	eb	Upper	0
733	eb	Upper	2
734	ea	Upper	2
735	e9	Upper	2
736	e8	Upper	2
737	e7	Upper	2
738	da	Upper	2
739	d9	Upper	2
740	d8	Upper	2
741	d7	Upper	2
742	d6	Upper	2
743	d5	Upper	2
744	d6	Upper	4
745	d7	Upper	4
746	d8	Upper	4
747	d9	Upper	4
748	da	Upper	4
749	e7	Upper	4
750	e8	Upper	4
751	e9	Upper	4
752	ea	Upper	4
753	eb	Upper	4
754	eb	Upper	6
755	ea	Upper	6
756	e9	Upper	6
757	e8	Upper	6
758	e7	Upper	6
759	e6	Upper	6
760	db	Upper	6
761	da	Upper	6
762	d9	Upper	6
763	d8	Upper	6
764	d7	Upper	6
765	d6	Upper	6
766	d5	Upper	0
767	d4	Upper	0
768	d3	Upper	0
769	de	Upper	0
770	dd	Upper	0
771	dc	Upper	0
772	e5	Upper	0
773	e4	Upper	0
774	ef	Upper	0
775	ee	Upper	0
776	ed	Upper	0
777	ec	Upper	0
778	ec	Upper	2
779	ed	Upper	2
780	e4	Upper	2
781	e5	Upper	2
782	e6	Upper	2
783	db	Upper	2
784	dc	Upper	2
785	dd	Upper	2
786	d2	Upper	2
787	d3	Upper	2
788	d4	Upper	2

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
789	d5	Upper	4
790	d4	Upper	4
791	dd	Upper	4
792	dc	Upper	4
793	db	Upper	4
794	e6	Upper	4
795	e5	Upper	4
796	e4	Upper	4
797	ed	Upper	4
798	ec	Upper	4
799	ec	Upper	6
800	ed	Upper	6
801	ee	Upper	6
802	ef	Upper	6
803	e4	Upper	6
804	e5	Upper	6
805	dc	Upper	6
806	dd	Upper	6
807	de	Upper	6
808	d3	Upper	6
809	d4	Upper	6
810	d5	Upper	6
811	d0	Upper	0
812	d1	Upper	0
813	d2	Upper	0
814	df	Upper	0
815	e0	Upper	0
816	e1	Upper	0
817	e2	Upper	0
818	e3	Upper	0
819	f0	Upper	0
820	f1	Upper	0
821	f2	Upper	0
822	f0	Upper	2
823	ef	Upper	2
824	ee	Upper	2
825	e3	Upper	2
826	e2	Upper	2
827	e1	Upper	2
828	e0	Upper	2
829	df	Upper	2
830	de	Upper	2
831	d1	Upper	2
832	d0	Upper	2
833	cf	Upper	2
834	d2	Upper	4
835	d3	Upper	4
836	de	Upper	4
837	df	Upper	4
838	e0	Upper	4
839	e1	Upper	4
840	e2	Upper	4
841	e3	Upper	4
842	ee	Upper	4
843	ef	Upper	4
844	f0	Upper	4
845	f2	Upper	6
846	f1	Upper	6
847	f0	Upper	6
848	e3	Upper	6
849	e2	Upper	6
850	e1	Upper	6
851	e0	Upper	6
852	df	Upper	6
853	d2	Upper	6
854	d1	Upper	6
855	d0	Upper	6
856	cf	Upper	0
857	ce	Upper	0
858	cd	Upper	0
859	cc	Upper	0
860	cb	Upper	0
861	ca	Upper	0
862	f7	Upper	0
863	f6	Upper	0
864	f5	Upper	0
865	f4	Upper	0
866	f3	Upper	0
867	f1	Upper	2
868	f2	Upper	2
869	f3	Upper	2
870	f4	Upper	2
871	f5	Upper	2
872	f6	Upper	2
873	c9	Upper	2
874	ca	Upper	2
875	cb	Upper	2
876	cc	Upper	2
877	cd	Upper	2
878	ce	Upper	2
879	d1	Upper	4
880	d0	Upper	4
881	cf	Upper	4
882	ce	Upper	4
883	cd	Upper	4
884	f6	Upper	4
885	f5	Upper	4
886	f4	Upper	4
887	f3	Upper	4
888	f2	Upper	4
889	f1	Upper	4
890	f3	Upper	6
891	f4	Upper	6
892	f5	Upper	6
893	f6	Upper	6
894	f7	Upper	6
895	ca	Upper	6
896	cb	Upper	6
897	cc	Upper	6
898	cd	Upper	6
899	ce	Upper	6
900	cf	Upper	6
901	c4	Upper	0
902	c5	Upper	0
903	c6	Upper	0
904	c7	Upper	0
905	c8	Upper	0
906	c9	Upper	0
907	f8	Upper	0
908	f9	Upper	0
909	fa	Upper	0
910	fb	Upper	0
911	fc	Upper	0
912	fc	Upper	2
913	fb	Upper	2
914	fa	Upper	2
915	f9	Upper	2
916	f8	Upper	2
917	f7	Upper	2
918	c8	Upper	2
919	c7	Upper	2
920	c6	Upper	2
921	c5	Upper	2
922	c4	Upper	2
923	c7	Upper	4
924	c8	Upper	4
925	c9	Upper	4
926	ca	Upper	4
927	cb	Upper	4
928	cc	Upper	4
929	f7	Upper	4
930	f8	Upper	4
931	f9	Upper	4
932	fa	Upper	4
933	fb	Upper	4
934	fc	Upper	4
935	fc	Upper	6
936	fb	Upper	6
937	fa	Upper	6
938	f9	Upper	6
939	f8	Upper	6
940	c9	Upper	6
941	c8	Upper	6
942	c7	Upper	6
943	c6	Upper	6
944	c5	Upper	6
945	c4	Upper	6
946	c3	Upper	0
947	c2	Upper	0

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
948	c1	Upper	0
949	b4	Upper	0
950	b3	Upper	0
951	b2	Upper	0
952	b1	Upper	0
953	b0	Upper	0
954	ff	Upper	0
955	fe	Upper	0
956	fd	Upper	0
957	fd	Upper	2
958	fe	Upper	2
959	ff	Upper	2
960	b2	Upper	2
961	b3	Upper	2
962	b4	Upper	2
963	b5	Upper	2
964	b6	Upper	2
965	b7	Upper	2
966	c2	Upper	2
967	c3	Upper	2
968	c6	Upper	4
969	c5	Upper	4
970	c4	Upper	4
971	b7	Upper	4
972	b6	Upper	4
973	b5	Upper	4
974	b4	Upper	4
975	b3	Upper	4
976	b2	Upper	4
977	ff	Upper	4
978	fe	Upper	4
979	fd	Upper	4
980	fd	Upper	6
981	fe	Upper	6
982	ff	Upper	6
983	b0	Upper	6
984	b1	Upper	6
985	b2	Upper	6
986	b3	Upper	6
987	b4	Upper	6
988	c1	Upper	6
989	c2	Upper	6
990	c3	Upper	6
991	be	Upper	0
992	bf	Upper	0
993	c0	Upper	0
994	b5	Upper	0
995	b6	Upper	0
996	b7	Upper	0
997	ae	Upper	0
998	af	Upper	0
999	a6	Upper	0
1000	a7	Upper	0

Slice	ID_0	UL	Track
1001	a8	Upper	0
1002	a8	Upper	2
1003	a7	Upper	2
1004	a6	Upper	2
1005	b1	Upper	2
1006	b0	Upper	2
1007	af	Upper	2
1008	ba	Upper	2
1009	b9	Upper	2
1010	b8	Upper	2
1011	c1	Upper	2
1012	c0	Upper	2
1013	c1	Upper	4
1014	c2	Upper	4
1015	c3	Upper	4
1016	b8	Upper	4
1017	b9	Upper	4
1018	ba	Upper	4
1019	af	Upper	4
1020	b0	Upper	4
1021	b1	Upper	4
1022	a6	Upper	4
1023	a7	Upper	4
1024	a8	Upper	4
1025	a8	Upper	6
1026	a7	Upper	6
1027	a6	Upper	6
1028	af	Upper	6
1029	ae	Upper	6
1030	b7	Upper	6
1031	b6	Upper	6
1032	b5	Upper	6
1033	c0	Upper	6
1034	bf	Upper	6
1035	be	Upper	6
1036	bd	Upper	0
1037	bc	Upper	0
1038	bb	Upper	0
1039	ba	Upper	0
1040	b9	Upper	0
1041	b8	Upper	0
1042	ad	Upper	0
1043	ac	Upper	0
1044	ab	Upper	0
1045	aa	Upper	0
1046	a9	Upper	0
1047	a9	Upper	2
1048	aa	Upper	2
1049	ab	Upper	2
1050	ac	Upper	2
1051	ad	Upper	2
1052	ae	Upper	2
1053	bb	Upper	2

Slice	ID_0	UL	Track
1054	bc	Upper	2
1055	bd	Upper	2
1056	be	Upper	2
1057	bf	Upper	2
1058	c0	Upper	4
1059	bf	Upper	4
1060	be	Upper	4
1061	bd	Upper	4
1062	bc	Upper	4
1063	bb	Upper	4
1064	ae	Upper	4
1065	ad	Upper	4
1066	ac	Upper	4
1067	ab	Upper	4
1068	aa	Upper	4
1069	a9	Upper	4
1070	a9	Upper	6
1071	aa		6
1072	ab	Upper	6
1073	ac	Upper	6
1074	ad	Upper	6
1075	b8	Upper	6
1076	b9	Upper	6
1077	ba	Upper	6
1078	bb	Upper	6
1079	bc	Upper	6
1080	bd	Upper	6
1081	d6	Upper	1
1082	d7	Upper	1
1083	d8	Upper	1
1084	d9	Upper	1
1085	da	Upper	1
1086	db	Upper	1
1087	e6	Upper	1
1088	e7	Upper	1
1089	e8	Upper	1
1090	e9	Upper	1
1091	ea	Upper	1
1092	eb	Upper	1
1093	eb	Upper	3
1094	ea	Upper	3
1095	e9	Upper	3
1096	e8	Upper	3
1097	e7	Upper	3
1098	da	Upper	3
1099	d9	Upper	3
1100	d8	Upper	3
1101	d7	Upper	3
1102	d6	Upper	3
1103	d5	Upper	3
1104	d6	Upper	5
1105	d7	Upper	5
1106	d8	Upper	5

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
1107	d9	Upper	5
1108	da	Upper	5
1109	e7	Upper	5
1110	e8	Upper	5
1111	e9	Upper	5
1112	ea	Upper	5
1113	eb	Upper	5
1114	eb	Upper	7
1115	ea	Upper	7
1116	e9	Upper	7
1117	e8	Upper	7
1118	e7	Upper	7
1119	e6	Upper	7
1120	db	Upper	7
1121	da	Upper	7
1122	d9	Upper	7
1123	d8	Upper	7
1124	d7	Upper	7
1125	d6	Upper	7
1126	d5	Upper	1
1127	d4	Upper	1
1128	d3	Upper	1
1129	d3	Upper	1
1130	dd	Upper	1
1131	dc	Upper	1
1132	e5	Upper	1
1133	e4	Upper	1
1134	ef	Upper	1
1135	ee	Upper	1
1136	ed	Upper	1
1137	ec	Upper	1
1138	ec	Upper	3
1139	ed	Upper	3
1140	e4	Upper	3
1141	e5	Upper	3
1142	e6	Upper	3
1143	db	Upper	3
1144	dc	Upper	3
1145	dd	Upper	3
1146	d2	Upper	3
1147	d3	Upper	3
1148	d4	Upper	3
1149	d5	Upper	5
1150	d4	Upper	5
1151	dd	Upper	5
1152	dc	Upper	5
1153	db	Upper	5
1154	e6	Upper	5
1155	e5	Upper	5
1156	e4	Upper	5
1157	ed	Upper	5
1158	ec	Upper	5
1159	ec	Upper	7
1161	ee	Upper	7
1162	ef	Upper	7
1163	e4	Upper	7
1164	e5	Upper	7
1165	dc	Upper	7
1166	dd	Upper	7
1167	de	Upper	7
1168	d3	Upper	7
1169	d4	Upper	7
1170	d5	Upper	7
1171	d0	Upper	1
1172	d1	Upper	1
1173	d2	Upper	1
1174	df	Upper	1
1175	e0	Upper	1
1176	e1	Upper	1
1177	e2	Upper	1
1178	e3	Upper	1
1179	f0	Upper	1
1180	f1	Upper	1
1181	f2	Upper	1
1182	f0	Upper	3
1183	ef	Upper	3
1184	ee	Upper	3
1185	e3	Upper	3
1186	e2	Upper	3
1187	e1	Upper	3
1188	e0	Upper	3
1189	df	Upper	3
1190	de	Upper	3
1191	d1	Upper	3
1192	d0	Upper	3
1193	cf	Upper	3
1194	d2	Upper	5
1195	d3	Upper	5
1196	de	Upper	5
1197	df	Upper	5
1198	e0	Upper	5
1199	e1	Upper	5
1200	e2	Upper	5
1201	e3	Upper	5
1202	ee	Upper	5
1203	ef	Upper	5
1204	f0	Upper	5
1205	f2	Upper	7
1206	f1	Upper	7
1207	f0	Upper	7
1208	e3	Upper	7
1209	e2	Upper	7
1210	e1	Upper	7
1211	e0	Upper	7
1212	df	Upper	7
1213	d2	Upper	7
1214	d1	Upper	7
1215	d0	Upper	7
1216	cf	Upper	1
1217	ce	Upper	1
1218	cd	Upper	1
1219	cc	Upper	1
1220	cb	Upper	1
1221	ca	Upper	1
1222	f7	Upper	1
1223	f6	Upper	1
1224	f5	Upper	1
1225	f4	Upper	1
1226	f3	Upper	1
1227	f1	Upper	3
1228	f2	Upper	3
1229	f3	Upper	3
1230	f4	Upper	3
1231	f5	Upper	3
1232	f6	Upper	3
1233	c9	Upper	3
1234	ca	Upper	3
1235	cb	Upper	3
1236	cc	Upper	3
1237	cd	Upper	3
1238	ce	Upper	3
1239	d1	Upper	5
1240	d0	Upper	5
1241	cf	Upper	5
1242	ce	Upper	5
1243	cd	Upper	5
1244	f6	Upper	5
1245	f5	Upper	5
1246	f4	Upper	5
1247	f3	Upper	5
1248	f2	Upper	5
1249	f1	Upper	5
1250	f3	Upper	7
1251	f4	Upper	7
1252	f5	Upper	7
1253	f6	Upper	7
1254	f7	Upper	7
1255	ca	Upper	7
1256	cb	Upper	7
1257	cc	Upper	7
1258	cd	Upper	7
1259	ce	Upper	7
1260	cf	Upper	7
1261	c4	Upper	1
1262	c5	Upper	1
1263	c6	Upper	1
1264	c7	Upper	1
1265	c8	Upper	1
1266	c9	Upper	1

(continued)

Table A.1 (continued)

Slice	ID_0	UL	Track
1267	f8	Upper	1
1268	f9	Upper	1
1269	fa	Upper	1
1270	fb	Upper	1
1271	fc	Upper	1
1272	fc	Upper	3
1273	fb	Upper	3
1274	fa	Upper	3
1275	f9	Upper	3
1276	f8	Upper	3
1277	f7	Upper	3
1278	c8	Upper	3
1279	c7	Upper	3
1280	c6	Upper	3
1281	c5	Upper	3
1282	c4	Upper	3
1283	c7	Upper	5
1284	c8	Upper	5
1285	c9	Upper	5
1286	ca	Upper	5
1287	cb	Upper	5
1288	cc	Upper	5
1289	f7	Upper	5
1290	f8	Upper	5
1291	f9	Upper	5
1292	fa	Upper	5
1293	fb	Upper	5
1294	fc	Upper	5
1295	fc	Upper	7
1296	fb	Upper	7
1297	fa	Upper	7
1298	f9	Upper	7
1299	f8	Upper	7
1300	c9	Upper	7
1301	c8	Upper	7
1302	c7	Upper	7
1303	c6	Upper	7
1304	c5	Upper	7
1305	c4	Upper	7
1306	c3	Upper	1
1307	c2	Upper	1
1308	c1	Upper	1
1309	b4	Upper	1
1310	b3	Upper	1
1311	b2	Upper	1
1312	b1	Upper	1
1313	b0	Upper	1
1314	ff	Upper	1
1315	fe	Upper	1
1316	fd	Upper	1
1317	fd	Upper	3
1318	fe	Upper	3
1319	ff	Upper	3
1320	b2	Upper	3
1321	b3	Upper	3
1322	b4	Upper	3
1323	b5	Upper	3
1324	b6	Upper	3
1325	b7	Upper	3
1326	c2	Upper	3
1327	c3	Upper	3
1328	c6	Upper	5
1329	c5	Upper	5
1330	c4	Upper	5
1331	b7	Upper	5
1332	b6	Upper	5
1333	b5	Upper	5
1334	b4	Upper	5
1335	b3	Upper	5
1336	b2	Upper	5
1337	ff	Upper	5
1338	fe	Upper	5
1339	fd	Upper	5
1340	fd	Upper	7
1341	fe	Upper	7
1342	ff	Upper	7
1343	b0	Upper	7
1344	b1	Upper	7
1345	b2	Upper	7
1346	b3	Upper	7
1347	b4	Upper	7
1348	c1	Upper	7
1349	c2	Upper	7
1350	c3	Upper	7
1351	be	Upper	1
1352	bf	Upper	1
1353	c0	Upper	1
1354	b5	Upper	1
1355	b6	Upper	1
1356	b7	Upper	1
1357	ae	Upper	1
1358	af	Upper	1
1359	a6	Upper	1
1360	a7	Upper	1
1361	a8	Upper	1
1362	a8	Upper	3
1363	a7	Upper	3
1364	a6	Upper	3
1365	b1	Upper	3
1366	b0	Upper	3
1367	af	Upper	3
1368	ba	Upper	3
1369	b9	Upper	3
1370	b8	Upper	3
1371	c1	Upper	3
1372	c0	Upper	3
1373	c1	Upper	3
1374	c2	Upper	5
1375	c3	Upper	5
1376	b8	Upper	5
1377	b9	Upper	5
1378	ba	Upper	5
1379	af	Upper	5
1380	b0	Upper	5
1381	b1	Upper	5
1382	a6	Upper	5
1383	a7	Upper	5
1384	a8	Upper	5
1385	a8	Upper	7
1386	a7	Upper	7
1387	a6	Upper	7
1388	af	Upper	7
1389	ae	Upper	7
1390	b7	Upper	7
1391	b6	Upper	7
1392	b5	Upper	7
1393	c0	Upper	7
1394	bf	Upper	7
1395	be	Upper	7
1396	bd	Upper	1
1397	bc	Upper	1
1398	bb	Upper	1
1399	ba	Upper	1
1400	b9	Upper	1
1401	b8	Upper	1
1402	ad	Upper	1
1403	ac	Upper	1
1404	ab	Upper	1
1405	aa	Upper	1
1406	a9	Upper	1
1407	a9	Upper	3
1408	aa	Upper	3
1409	ab	Upper	3
1410	ac	Upper	3
1411	ad	Upper	3
1412	ae	Upper	3
1413	bb	Upper	3
1414	bc	Upper	3
1415	bd	Upper	3
1416	be	Upper	3
1417	bf	Upper	3
1418	c0	Upper	5
1419	bf	Upper	5
1420	be	Upper	5
1421	bd	Upper	5
1422	bc	Upper	5
1423	bb	Upper	5
1424	ae	Upper	5
1425	ad	Upper	5

(continued)

Table A.1 (concluded)

Slice	ID_0	UL	Track
1426	ac	Upper	5
1427	ab	Upper	5
1428	aa	Upper	5
1429	a9	Upper	5
1430	a9	Upper	7
1431	aa	Upper	7
1432	ab	Upper	7
1433	ac	Upper	7
1434	ad	Upper	7
1435	b8	Upper	7
1436	b9	Upper	7
1437	ba	Upper	7
1438	bb	Upper	7
1439	bc	Upper	7
1440	bd	Upper	7
aux	88	Lower	0

Slice	ID_0	UL	Track
aux	e3	Lower	1
aux	88	Lower	2
aux	e3	Lower	3
aux	88	Lower	4
aux	e3	Lower	5
aux	88	Lower	6
aux	e3	Lower	7
null	88	Lower	1
null	e3	Lower	2
null	88	Lower	3
null	e3	Lower	4
null	88	Lower	5
null	e3	Lower	6
null	88	Lower	7
null	a4	Upper	0
null	a5	Upper	0

Slice	ID_0	UL	Track
null	a4	Upper	1
null	a5	Upper	1
null	a4	Upper	2
null	a5	Upper	2
null	a4	Upper	3
null	a5	Upper	3
null	a4	Upper	4
null	a5	Upper	4
null	a4	Upper	5
null	a5	Upper	5
null	a4	Upper	6
null	a5	Upper	6
null	a4	Upper	7
null	a5	Upper	7

Table A.2 – Shuffling pattern for 625/50 system

Slice	ID_0	UL	Track
0	eb	Lower	0
1	b9	Lower	0
2	bb	Lower	0
3	bc	Lower	0
4	bf	Lower	0
5	c0	Lower	0
6	c1	Lower	0
7	ce	Lower	0
8	cf	Lower	0
9	d1	Lower	0
10	d2	Lower	0
11	d3	Lower	0
12	d1	Lower	2
13	d0	Lower	2
14	cf	Lower	2
15	cc	Lower	2
16	cb	Lower	2
17	ca	Lower	2
18	b9	Lower	2
19	b8	Lower	2
20	b7	Lower	2
21	b4	Lower	2
22	b3	Lower	2
23	b2	Lower	2
24	b5	Lower	4
25	b6	Lower	4
26	b8	Lower	4
27	b9	Lower	4
28	ba	Lower	4
29	c8	Lower	4
30	c9	Lower	4
31	ca	Lower	4

Slice	ID_0	UL	Track
32	cc	Lower	4
33	cd	Lower	4
34	ce	Lower	4
35	ce	Lower	6
36	cd	Lower	6
37	cc	Lower	6
38	ca	Lower	6
39	c9	Lower	6
40	c8	Lower	6
41	ba	Lower	6
42	b9	Lower	6
43	b8	Lower	6
44	b6	Lower	6
45	b5	Lower	6
46	b8	Lower	0
47	ba	Lower	0
48	bd	Lower	0
49	be	Lower	0
50	c2	Lower	0
51	c3	Lower	0
52	cd	Lower	0
53	cc	Lower	0
54	d0	Lower	0
55	d5	Lower	0
56	d4	Lower	0
57	d2	Lower	2
58	d3	Lower	2
59	ce	Lower	2
60	cd	Lower	2
61	c8	Lower	2
62	c9	Lower	2
63	bb	Lower	2

Slice	ID_0	UL	Track
64	ba	Lower	2
65	b6	Lower	2
66	b5	Lower	2
67	b0	Lower	2
68	b1	Lower	4
69	b4	Lower	4
70	b3	Lower	4
71	b7	Lower	4
72	bc	Lower	4
73	bb	Lower	4
74	c7	Lower	4
75	c6	Lower	4
76	c5	Lower	4
77	cb	Lower	4
78	d0	Lower	4
79	cf	Lower	6
80	cf	Lower	6
81	d0	Lower	6
82	cb	Lower	6
83	c5	Lower	6
84	c6	Lower	6
85	c7	Lower	6
86	bb	Lower	6
87	bc	Lower	6
88	b7	Lower	6
89	b3	Lower	6
90	b4	Lower	0
91	b6	Lower	0
92	b7	Lower	0
93	af	Lower	0
94	ae	Lower	0
95	c4	Lower	0

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
96	c5	Lower	0
97	ca	Lower	0
98	cb	Lower	0
99	d6	Lower	0
100	d7	Lower	0
101	d8	Lower	0
102	d6	Lower	2
103	d5	Lower	2
104	d5	Lower	2
105	c7	Lower	2
106	c5	Lower	2
107	c3	Lower	2
108	be	Lower	2
109	bd	Lower	2
110	bc	Lower	2
111	af	Lower	2
112	ae	Lower	2
113	ad	Lower	2
114	b0	Lower	4
115	b1	Lower	4
116	b2	Lower	4
117	bd	Lower	4
118	bf	Lower	4
119	c2	Lower	4
120	c3	Lower	4
121	c4	Lower	4
122	d1	Lower	4
123	d2	Lower	4
124	d3	Lower	4
125	d3	Lower	6
126	d2	Lower	6
127	d1	Lower	6
128	c4	Lower	6
129	c3	Lower	6
130	c2	Lower	6
131	bf	Lower	6
132	bd	Lower	6
133	b2	Lower	6
134	b1	Lower	6
135	b0	Lower	6
136	b5	Lower	0
137	b3	Lower	0
138	b0	Lower	0
139	ad	Lower	0
140	c6	Lower	0
141	c7	Lower	0
142	c8	Lower	0
143	c9	Lower	0
144	de	Lower	0
145	dc	Lower	0
146	d9	Lower	0
147	d7	Lower	2
148	d9	Lower	2
149	dc	Lower	2
150	c6	Lower	2
151	c4	Lower	2
152	c2	Lower	2
153	bf	Lower	2
154	a5	Lower	2
155	a6	Lower	2
156	a6	Lower	2
157	ab	Lower	2
158	ac	Lower	2
159	af	Lower	4
160	ac	Lower	4
161	ab	Lower	4
162	be	Lower	4
163	c0	Lower	4
164	c1	Lower	4
165	db	Lower	4
166	da	Lower	4
167	d9	Lower	4
168	d4	Lower	4
169	d5	Lower	4
170	d5	Lower	6
171	d4	Lower	6
172	d9	Lower	6
173	da	Lower	6
174	db	Lower	6
175	c1	Lower	6
176	c0	Lower	6
177	be	Lower	6
178	ab	Lower	6
179	ac	Lower	6
180	af	Lower	6
181	b4	Lower	0
182	b2	Lower	0
183	b1	Lower	0
184	ac	Lower	0
185	ab	Lower	0
186	aa	Lower	0
187	e0	Lower	0
188	df	Lower	0
189	dd	Lower	0
190	db	Lower	0
191	da	Lower	0
192	d8	Lower	2
193	da	Lower	2
194	db	Lower	2
195	dd	Lower	2
196	de	Lower	2
197	c1	Lower	2
198	c0	Lower	2
199	a3	Lower	2
200	a4	Lower	2
201	a8	Lower	2
202	a9	Lower	2
203	aa	Lower	2
204	ae	Lower	4
205	ad	Lower	4
206	aa	Lower	4
207	a9	Lower	4
208	8f	Lower	4
209	8e	Lower	4
210	dd	Lower	4
211	dc	Lower	4
212	d8	Lower	4
213	d7	Lower	4
214	d6	Lower	4
215	d6	Lower	6
216	d7	Lower	6
217	d8	Lower	6
218	dc	Lower	6
219	dd	Lower	6
220	8e	Lower	6
221	8f	Lower	6
222	a9	Lower	6
223	aa	Lower	6
224	ad	Lower	6
225	ae	Lower	6
226	a4	Lower	0
227	a5	Lower	0
228	a6	Lower	0
229	a7	Lower	0
230	a8	Lower	0
231	a9	Lower	0
232	e1	Lower	0
233	e2	Lower	0
234	e3	Lower	0
235	e5	Lower	0
236	e6	Lower	0
237	e6	Lower	2
238	e5	Lower	2
239	e4	Lower	2
240	e0	Lower	2
241	df	Lower	2
242	8a	Lower	2
243	8b	Lower	2
244	a2	Lower	2
245	a1	Lower	2
246	9d	Lower	2
247	9c	Lower	2
248	9b	Lower	2
249	a5	Lower	4
250	a6	Lower	4
251	a7	Lower	4
252	a8	Lower	4
253	90	Lower	4
254	8d	Lower	4
255	de	Lower	4
256	e0	Lower	4
257	e3	Lower	4
258	e4	Lower	4
259	e5	Lower	4
260	e5	Lower	6

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
261	e4	Lower	6
262	e3	Lower	6
263	e0	Lower	6
264	de	Lower	6
265	8d	Lower	6
266	90	Lower	6
267	a8	Lower	6
268	a7	Lower	6
269	a6	Lower	6
270	a5	Lower	6
271	a3	Lower	0
272	a2	Lower	0
273	a1	Lower	0
274	8e	Lower	0
275	8d	Lower	0
276	8c	Lower	0
277	8b	Lower	0
278	8a	Lower	0
279	e4	Lower	0
280	e8	Lower	0
281	e7	Lower	0
282	e8	Lower	2
283	e7	Lower	2
284	e3	Lower	2
285	e2	Lower	2
286	e1	Lower	2
287	89	Lower	2
288	8c	Lower	2
289	a0	Lower	2
290	9f	Lower	2
291	9e	Lower	2
292	99	Lower	2
293	9a	Lower	2
294	a4	Lower	4
295	a3	Lower	4
296	93	Lower	4
297	92	Lower	4
298	91	Lower	4
299	8c	Lower	4
300	df	Lower	4
301	e1	Lower	4
302	e2	Lower	4
303	e7	Lower	4
304	e6	Lower	4
305	e6	Lower	6
306	e7	Lower	6
307	e2	Lower	6
308	e1	Lower	6
309	df	Lower	6
310	8c	Lower	6
311	91	Lower	6
312	92	Lower	6
313	93	Lower	6
314	a3	Lower	6
315	a4	Lower	6
316	9e	Lower	0
317	9f	Lower	0
318	a0	Lower	0
319	8f	Lower	0
320	90	Lower	0
321	91	Lower	0
322	88	Lower	0
323	89	Lower	0
324	81	Lower	0
325	ea	Lower	0
326	e9	Lower	0
327	ea	Lower	2
328	e9	Lower	2
329	82	Lower	2
330	83	Lower	2
331	88	Lower	2
332	87	Lower	2
333	8f	Lower	2
334	8e	Lower	2
335	8d	Lower	2
336	98	Lower	2
337	97	Lower	2
338	96	Lower	2
339	a1	Lower	4
340	a2	Lower	4
341	94	Lower	4
342	95	Lower	4
343	96	Lower	4
344	8a	Lower	4
345	8b	Lower	4
346	83	Lower	4
347	82	Lower	4
348	e8	Lower	4
349	e9	Lower	4
350	e9	Lower	6
351	e8	Lower	6
352	82	Lower	6
353	83	Lower	6
354	8b	Lower	6
355	8a	Lower	6
356	96	Lower	6
357	95	Lower	6
358	94	Lower	6
359	a2	Lower	6
360	a1	Lower	6
361	9d	Lower	0
362	9c	Lower	0
363	98	Lower	0
364	97	Lower	0
365	94	Lower	0
366	92	Lower	0
367	87	Lower	0
368	85	Lower	0
369	82	Lower	0
370	ea	Lower	1
371	e9	Lower	1
372	81	Lower	1
373	80	Lower	1
374	81	Lower	2
375	84	Lower	2
376	85	Lower	2
377	86	Lower	2
378	90	Lower	2
379	91	Lower	2
380	92	Lower	2
381	93	Lower	2
382	94	Lower	2
383	95	Lower	2
384	a0	Lower	4
385	9d	Lower	4
386	9c	Lower	4
387	99	Lower	4
388	97	Lower	4
389	89	Lower	4
390	87	Lower	4
391	84	Lower	4
392	81	Lower	4
393	ea	Lower	4
394	eb	Lower	4
395	eb	Lower	6
396	ea	Lower	6
397	81	Lower	6
398	84	Lower	6
399	87	Lower	6
400	89	Lower	6
401	97	Lower	6
402	99	Lower	6
403	9c	Lower	6
404	9d	Lower	6
405	a0	Lower	6
406	9b	Lower	0
407	9a	Lower	0
408	99	Lower	0
409	96	Lower	0
410	95	Lower	0
411	93	Lower	0
412	86	Lower	0
413	84	Lower	0
414	83	Lower	0
415	e7	Lower	1
416	e8	Lower	1
417	83	Lower	1
418	82	Lower	1
419	80	Lower	3
420	83	Lower	3
421	84	Lower	3
422	85	Lower	3

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
423	99	Lower	3
424	9b	Lower	3
425	9c	Lower	3
426	9f	Lower	3
427	d5	Lower	5
428	d6	Lower	5
429	9f	Lower	4
430	9e	Lower	4
431	9b	Lower	4
432	9a	Lower	4
433	98	Lower	4
434	88	Lower	4
435	86	Lower	4
436	85	Lower	4
437	e8	Lower	7
438	e9	Lower	7
439	ea	Lower	7
440	80	Lower	7
441	83	Lower	7
442	84	Lower	7
443	85	Lower	6
444	86	Lower	6
445	88	Lower	6
446	98	Lower	6
447	9a	Lower	6
448	9b	Lower	6
449	9e	Lower	6
450	9f	Lower	6
451	d3	Lower	1
452	d4	Lower	1
453	d5	Lower	1
454	d8	Lower	1
455	d9	Lower	1
456	da	Lower	1
457	e4	Lower	1
458	e5	Lower	1
459	e6	Lower	1
460	85	Lower	1
461	84	Lower	1
462	e9	Lower	3
463	ea	Lower	3
464	81	Lower	3
465	82	Lower	3
466	87	Lower	3
467	86	Lower	3
468	98	Lower	3
469	9a	Lower	3
470	9d	Lower	3
471	9e	Lower	3
472	a0	Lower	3
473	d4	Lower	5
474	d7	Lower	5
475	d8	Lower	5
476	db	Lower	5
477	dc	Lower	5
478	dd	Lower	5
479	e8	Lower	5
480	e9	Lower	5
481	ea	Lower	5
482	e7	Lower	7
483	e6	Lower	7
484	e5	Lower	7
485	81	Lower	7
486	82	Lower	7
487	85	Lower	7
488	87	Lower	7
489	88	Lower	7
490	94	Lower	7
491	95	Lower	7
492	96	Lower	7
493	97	Lower	7
494	98	Lower	7
495	99	Lower	7
496	d2	Lower	1
497	d1	Lower	1
498	d6	Lower	1
499	d7	Lower	1
500	dc	Lower	1
501	db	Lower	1
502	e3	Lower	1
503	e2	Lower	1
504	e1	Lower	1
505	87	Lower	1
506	86	Lower	1
507	e8	Lower	3
508	e7	Lower	3
509	e6	Lower	3
510	8a	Lower	3
511	89	Lower	3
512	88	Lower	3
513	97	Lower	3
514	96	Lower	3
515	95	Lower	3
516	a2	Lower	3
517	a1	Lower	3
518	d3	Lower	5
519	d2	Lower	5
520	d9	Lower	5
521	da	Lower	5
522	df	Lower	5
523	de	Lower	5
524	e7	Lower	5
525	e6	Lower	5
526	e5	Lower	5
527	82	Lower	5
528	81	Lower	5
529	80	Lower	5
530	e4	Lower	7
531	e3	Lower	7
532	86	Lower	7
533	8a	Lower	7
534	89	Lower	7
535	93	Lower	7
536	92	Lower	7
537	91	Lower	7
538	9c	Lower	7
539	9b	Lower	7
540	9a	Lower	7
541	cf	Lower	1
542	d0	Lower	1
543	cb	Lower	1
544	ca	Lower	1
545	c9	Lower	1
546	dd	Lower	1
547	e0	Lower	1
548	8d	Lower	1
549	8c	Lower	1
550	88	Lower	1
551	89	Lower	1
552	e3	Lower	3
553	e4	Lower	3
554	e5	Lower	3
555	8b	Lower	3
556	8c	Lower	3
557	8d	Lower	3
558	92	Lower	3
559	93	Lower	3
560	94	Lower	3
561	a3	Lower	3
562	a4	Lower	3
563	d0	Lower	5
564	d1	Lower	5
565	cc	Lower	5
566	cb	Lower	5
567	e0	Lower	5
568	e1	Lower	5
569	e2	Lower	5
570	e3	Lower	5
571	e4	Lower	5
572	83	Lower	5
573	84	Lower	5
574	85	Lower	5
575	e1	Lower	7
576	e2	Lower	7
577	dd	Lower	7
578	dc	Lower	7
579	8b	Lower	7
580	8e	Lower	7
581	8f	Lower	7
582	90	Lower	7
583	9d	Lower	7
584	9e	Lower	7

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
585	9f	Lower	7
586	ce	Lower	1
587	cd	Lower	1
588	cc	Lower	1
589	c8	Lower	1
590	c7	Lower	1
591	de	Lower	1
592	df	Lower	1
593	8f	Lower	1
594	8e	Lower	1
595	8b	Lower	1
596	8a	Lower	1
597	e2	Lower	3
598	e1	Lower	3
599	e0	Lower	3
600	df	Lower	3
601	de	Lower	3
602	8e	Lower	3
603	91	Lower	3
604	a8	Lower	3
605	a7	Lower	3
606	a6	Lower	3
607	a5	Lower	3
608	cf	Lower	5
609	ce	Lower	5
610	cd	Lower	5
611	ca	Lower	5
612	c9	Lower	5
613	c8	Lower	5
614	8b	Lower	5
615	8a	Lower	5
616	89	Lower	5
617	88	Lower	5
618	87	Lower	5
619	86	Lower	5
620	e0	Lower	7
621	df	Lower	7
622	de	Lower	7
623	db	Lower	7
624	8c	Lower	7
625	8d	Lower	7
626	a4	Lower	7
627	a3	Lower	7
628	a2	Lower	7
629	a1	Lower	7
630	a0	Lower	7
631	be	Lower	1
632	c0	Lower	1
633	c1	Lower	1
634	c4	Lower	1
635	c6	Lower	1
636	a9	Lower	1
637	a8	Lower	1
638	90	Lower	1
639	93	Lower	1
640	94	Lower	1
641	96	Lower	1
642	d5	Lower	3
643	d7	Lower	3
644	d8	Lower	3
645	db	Lower	3
646	dd	Lower	3
647	8f	Lower	3
648	90	Lower	3
649	a9	Lower	3
650	aa	Lower	3
651	af	Lower	3
652	b0	Lower	3
653	be	Lower	5
654	c0	Lower	5
655	c1	Lower	5
656	c5	Lower	5
657	c6	Lower	5
658	c7	Lower	5
659	8c	Lower	5
660	8d	Lower	5
661	8e	Lower	5
662	93	Lower	5
663	94	Lower	5
664	95	Lower	5
665	d3	Lower	7
666	d4	Lower	7
667	d5	Lower	7
668	d8	Lower	7
669	da	Lower	7
670	bd	Lower	7
671	a5	Lower	7
672	a6	Lower	7
673	a8	Lower	7
674	a9	Lower	7
675	aa	Lower	7
676	bd	Lower	1
677	bf	Lower	1
678	c2	Lower	1
679	c3	Lower	1
680	c5	Lower	1
681	aa	Lower	1
682	a7	Lower	1
683	91	Lower	1
684	92	Lower	1
685	95	Lower	1
686	97	Lower	1
687	d4	Lower	3
688	d6	Lower	3
689	d9	Lower	3
690	da	Lower	3
691	dc	Lower	3
692	c1	Lower	3
693	c0	Lower	3
694	be	Lower	3
695	ab	Lower	3
696	ae	Lower	3
697	b1	Lower	3
698	bd	Lower	5
699	bf	Lower	5
700	c2	Lower	5
701	c4	Lower	5
702	ac	Lower	5
703	aa	Lower	5
704	a9	Lower	5
705	a7	Lower	5
706	8f	Lower	5
707	92	Lower	5
708	96	Lower	5
709	97	Lower	5
710	d1	Lower	7
711	d2	Lower	7
712	d6	Lower	7
713	d7	Lower	7
714	d9	Lower	7
715	be	Lower	7
716	bc	Lower	7
717	bb	Lower	7
718	a7	Lower	7
719	ab	Lower	7
720	ac	Lower	7
721	bc	Lower	1
722	bb	Lower	1
723	ba	Lower	1
724	ad	Lower	1
725	ac	Lower	1
726	ab	Lower	1
727	a6	Lower	1
728	a5	Lower	1
729	9e	Lower	1
730	99	Lower	1
731	98	Lower	1
732	d3	Lower	3
733	d2	Lower	3
734	d1	Lower	3
735	c4	Lower	3
736	c3	Lower	3
737	c2	Lower	3
738	bf	Lower	3
739	bd	Lower	3
740	ac	Lower	3
741	ad	Lower	3
742	b2	Lower	3
743	bc	Lower	5
744	bb	Lower	5
745	ba	Lower	5
746	c3	Lower	5

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
747	ad	Lower	5
748	ab	Lower	5
749	a8	Lower	5
750	a6	Lower	5
751	90	Lower	5
752	91	Lower	5
753	99	Lower	5
754	98	Lower	5
755	d0	Lower	7
756	cf	Lower	7
757	ce	Lower	7
758	c1	Lower	7
759	c0	Lower	7
760	bf	Lower	7
761	ba	Lower	7
762	b9	Lower	7
763	af	Lower	7
764	ae	Lower	7
765	ad	Lower	7
766	b7	Lower	1
767	b8	Lower	1
768	b9	Lower	1
769	ae	Lower	1
770	af	Lower	1
771	b0	Lower	1
772	a3	Lower	1
773	a4	Lower	1
774	9f	Lower	1
775	9d	Lower	1
776	9a	Lower	1
777	ce	Lower	3
778	cf	Lower	3
779	d0	Lower	3
780	c5	Lower	3
781	c6	Lower	3
782	c7	Lower	3
783	bb	Lower	3
784	bc	Lower	3
785	b7	Lower	3
786	b6	Lower	3
787	b3	Lower	3
788	b8	Lower	5
789	b9	Lower	5
790	b4	Lower	5
791	b3	Lower	5
792	ae	Lower	5
793	af	Lower	5
794	a4	Lower	5
795	a5	Lower	5
796	a0	Lower	5
797	9f	Lower	5
798	9a	Lower	5
799	9b	Lower	5
800	cc	Lower	7
801	cd	Lower	7
802	c8	Lower	7
803	c2	Lower	7
804	c3	Lower	7
805	c4	Lower	7
806	b8	Lower	7
807	b5	Lower	7
808	b4	Lower	7
809	b0	Lower	7
810	b1	Lower	7
811	b6	Lower	1
812	b5	Lower	1
813	b4	Lower	1
814	b3	Lower	1
815	b2	Lower	1
816	b1	Lower	1
817	a2	Lower	1
818	a1	Lower	1
819	a0	Lower	1
820	9c	Lower	1
821	9b	Lower	1
822	cd	Lower	3
823	cc	Lower	3
824	cb	Lower	3
825	ca	Lower	3
826	c9	Lower	3
827	c8	Lower	3
828	ba	Lower	3
829	b9	Lower	3
830	b8	Lower	3
831	b5	Lower	3
832	b4	Lower	3
833	b7	Lower	5
834	b6	Lower	5
835	b5	Lower	5
836	b2	Lower	5
837	b1	Lower	5
838	b0	Lower	5
839	a3	Lower	5
840	a2	Lower	5
841	a1	Lower	5
842	9e	Lower	5
843	9d	Lower	5
844	9c	Lower	5
845	cb	Lower	7
846	ca	Lower	7
847	c9	Lower	7
848	c7	Lower	7
849	c6	Lower	7
850	c5	Lower	7
851	b7	Lower	7
852	b6	Lower	7
853	b3	Lower	7
854	b2	Lower	7
855	c6	Upper	6
856	c5	Upper	0
857	c4	Upper	0
858	c3	Upper	0
859	c2	Upper	0
860	c1	Upper	0
861	c0	Upper	0
862	b2	Upper	0
863	b1	Upper	0
864	af	Upper	0
865	ae	Upper	0
866	ad	Upper	0
867	ac	Upper	2
868	ad	Upper	2
869	ae	Upper	2
870	b0	Upper	2
871	b1	Upper	2
872	b2	Upper	2
873	c3	Upper	2
874	c4	Upper	2
875	c5	Upper	2
876	c6	Upper	2
877	c7	Upper	2
878	cb	Upper	4
879	ca	Upper	4
880	c9	Upper	4
881	c7	Upper	4
882	c6	Upper	4
883	c5	Upper	4
884	b8	Upper	4
885	b7	Upper	4
886	b6	Upper	4
887	b3	Upper	4
888	b2	Upper	4
889	b1	Upper	4
890	ac	Upper	6
891	ad	Upper	6
892	ae	Upper	6
893	af	Upper	6
894	b0	Upper	6
895	bd	Upper	6
896	be	Upper	6
897	bf	Upper	6
898	c4	Upper	6
899	c5	Upper	6
900	c7	Upper	6
901	c6	Upper	0
902	c7	Upper	0
903	c8	Upper	0
904	bd	Upper	0
905	be	Upper	0
906	bf	Upper	0
907	b3	Upper	0
908	b4	Upper	0

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
909	b0	Upper	0
910	ab	Upper	0
911	ac	Upper	0
912	ab	Upper	2
913	aa	Upper	2
914	a9	Upper	2
915	af	Upper	2
916	b4	Upper	2
917	b3	Upper	2
918	c2	Upper	2
919	c1	Upper	2
920	c0	Upper	2
921	c9	Upper	2
922	c8	Upper	2
923	cc	Upper	4
924	cd	Upper	4
925	ce	Upper	4
926	c8	Upper	4
927	c3	Upper	4
928	c4	Upper	4
929	b9	Upper	4
930	ba	Upper	4
931	b5	Upper	4
932	b4	Upper	4
933	af	Upper	4
934	b0	Upper	4
935	ab	Upper	6
936	aa	Upper	6
937	a9	Upper	6
938	b2	Upper	6
939	b1	Upper	6
940	bc	Upper	6
941	bb	Upper	6
942	c0	Upper	6
943	c3	Upper	6
944	c9	Upper	6
945	c8	Upper	6
946	cb	Upper	0
947	ca	Upper	0
948	c9	Upper	0
949	bc	Upper	0
950	bb	Upper	0
951	ba	Upper	0
951	b7	Upper	0
953	b5	Upper	0
954	aa	Upper	0
955	a9	Upper	0
956	a8	Upper	0
957	a7	Upper	2
958	a8	Upper	2
959	a0	Upper	2
960	9f	Upper	2
961	b5	Upper	2
962	b6	Upper	2
963	bd	Upper	2
964	be	Upper	2
965	bf	Upper	2
966	ca	Upper	2
967	cb	Upper	2
968	d2	Upper	4
969	d1	Upper	4
970	d0	Upper	4
971	cf	Upper	4
972	c2	Upper	4
973	c0	Upper	4
974	bc	Upper	4
975	bb	Upper	4
976	a5	Upper	4
977	a6	Upper	4
978	ae	Upper	4
979	ad	Upper	4
980	a6	Upper	6
981	a7	Upper	6
982	a8	Upper	6
983	b3	Upper	6
984	b5	Upper	6
985	b8	Upper	6
986	ba	Upper	6
987	c1	Upper	6
988	c2	Upper	6
989	ca	Upper	6
990	cb	Upper	6
991	cc	Upper	0
992	ce	Upper	0
993	d1	Upper	0
994	d2	Upper	0
995	d3	Upper	0
996	b9	Upper	0
997	b8	Upper	0
998	b6	Upper	0
999	a2	Upper	0
1000	a6	Upper	0
1001	a7	Upper	0
1002	a6	Upper	2
1003	a5	Upper	2
1004	a1	Upper	2
1005	9e	Upper	2
1006	b8	Upper	2
1007	b7	Upper	2
1008	bc	Upper	2
1009	d1	Upper	2
1010	d0	Upper	2
1011	cf	Upper	2
1012	cc	Upper	2
1013	d3	Upper	4
1014	d5	Upper	4
1015	d8	Upper	4
1016	d9	Upper	4
1017	c1	Upper	4
1018	bf	Upper	4
1019	be	Upper	4
1020	bd	Upper	4
1021	a4	Upper	4
1022	a7	Upper	4
1023	ac	Upper	4
1024	ab	Upper	4
1025	a5	Upper	6
1026	a4	Upper	6
1027	a1	Upper	6
1028	b4	Upper	6
1029	b6	Upper	6
1030	b7	Upper	6
1031	b9	Upper	6
1032	d2	Upper	6
1033	d1	Upper	6
1034	ce	Upper	6
1035	cc	Upper	6
1036	cd	Upper	0
1037	cf	Upper	0
1038	d0	Upper	0
1039	d4	Upper	0
1040	d5	Upper	0
1041	d6	Upper	0
1042	a0	Upper	0
1043	a1	Upper	0
1044	a3	Upper	0
1045	a4	Upper	0
1046	a5	Upper	0
1047	a4	Upper	2
1048	a3	Upper	2
1049	a2	Upper	2
1050	9d	Upper	2
1051	b9	Upper	2
1052	ba	Upper	2
1053	bb	Upper	2
1054	d3	Upper	2
1055	d2	Upper	2
1056	ce	Upper	2
1057	cd	Upper	2
1058	d4	Upper	4
1059	d6	Upper	4
1060	d7	Upper	4
1061	da	Upper	4
1062	db	Upper	4
1063	dc	Upper	4
1064	a1	Upper	4
1065	a2	Upper	4
1066	a3	Upper	4
1067	a8	Upper	4
1068	a9	Upper	4
1069	aa	Upper	4
1070	a3	Upper	6

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
1071	a2	Upper	6
1072	a0	Upper	6
1073	9f	Upper	6
1074	9e	Upper	6
1075	d5	Upper	6
1076	d4	Upper	6
1077	d3	Upper	6
1078	d0	Upper	6
1079	cf	Upper	6
1080	cd	Upper	6
1081	dc	Upper	0
1082	db	Upper	0
1083	da	Upper	0
1084	d9	Upper	0
1085	d8	Upper	0
1086	d7	Upper	0
1087	9f	Upper	0
1088	9e	Upper	0
1089	9d	Upper	0
1090	9c	Upper	0
1091	9b	Upper	0
1092	97	Upper	2
1093	98	Upper	2
1094	99	Upper	2
1095	9c	Upper	2
1096	ef	Upper	2
1097	ed	Upper	2
1098	ec	Upper	2
1099	eb	Upper	2
1100	d4	Upper	2
1101	d7	Upper	2
1102	d8	Upper	2
1103	e2	Upper	4
1104	e1	Upper	4
1105	e0	Upper	4
1106	df	Upper	4
1107	de	Upper	4
1108	dd	Upper	4
1109	a0	Upper	4
1110	9f	Upper	4
1111	9e	Upper	4
1112	9d	Upper	4
1113	9c	Upper	4
1114	9b	Upper	4
1115	99	Upper	6
1116	9a	Upper	6
1117	9b	Upper	6
1118	9c	Upper	6
1119	9d	Upper	6
1120	d6	Upper	6
1121	d7	Upper	6
1122	d8	Upper	6
1123	d9	Upper	6
1124	da	Upper	6
1125	db	Upper	6

Slice	ID_0	UL	Track
1126	dd	Upper	0
1127	de	Upper	0
1128	df	Upper	0
1129	f2	Upper	0
1130	f3	Upper	0
1131	f4	Upper	0
1132	f5	Upper	0
1133	f6	Upper	0
1134	f7	Upper	0
1135	99	Upper	0
1136	9a	Upper	0
1137	96	Upper	2
1138	95	Upper	2
1139	9a	Upper	2
1140	9b	Upper	2
1141	f0	Upper	2
1142	ee	Upper	2
1143	ea	Upper	2
1144	e9	Upper	2
1145	d5	Upper	2
1146	d6	Upper	2
1147	d9	Upper	2
1148	e3	Upper	4
1149	e4	Upper	4
1150	e5	Upper	4
1151	f2	Upper	4
1152	f3	Upper	4
1153	f4	Upper	4
1154	f5	Upper	4
1155	f6	Upper	4
1156	f7	Upper	4
1157	98	Upper	4
1158	99	Upper	4
1159	9a	Upper	4
1160	98	Upper	6
1161	97	Upper	6
1162	f6	Upper	6
1163	f5	Upper	6
1164	f4	Upper	6
1165	f3	Upper	6
1166	f2	Upper	6
1167	f1	Upper	6
1168	de	Upper	6
1169	dd	Upper	6
1170	dc	Upper	6
1171	e2	Upper	0
1172	e1	Upper	0
1173	e0	Upper	0
1174	f1	Upper	0
1175	f0	Upper	0
1176	ef	Upper	0
1177	fa	Upper	0
1178	f9	Upper	0
1179	f8	Upper	0
1180	98	Upper	0

Slice	ID_0	UL	Track
1181	97	Upper	0
1182	fd	Upper	2
1183	fe	Upper	2
1184	ff	Upper	2
1185	f9	Upper	2
1186	f1	Upper	2
1187	f2	Upper	2
1188	e7	Upper	2
1189	e8	Upper	2
1190	e0	Upper	2
1191	df	Upper	2
1192	da	Upper	2
1193	e8	Upper	4
1194	e7	Upper	4
1195	e6	Upper	4
1196	f1	Upper	4
1197	f0	Upper	4
1198	ef	Upper	4
1199	fa	Upper	4
1200	f9	Upper	4
1201	f8	Upper	4
1202	97	Upper	4
1203	96	Upper	4
1204	95	Upper	4
1205	95	Upper	6
1206	96	Upper	6
1207	f7	Upper	6
1208	f8	Upper	6
1209	f9	Upper	6
1210	ee	Upper	6
1211	ef	Upper	6
1212	f0	Upper	6
1213	df	Upper	6
1214	e0	Upper	6
1215	e1	Upper	6
1216	e3	Upper	0
1217	e5	Upper	0
1218	e8	Upper	0
1219	e9	Upper	0
1220	ec	Upper	0
1221	ee	Upper	0
1222	fb	Upper	0
1223	fd	Upper	0
1224	ff	Upper	0
1225	96	Upper	0
1226	95	Upper	0
1227	fc	Upper	2
1228	fb	Upper	2
1229	fa	Upper	2
1230	f8	Upper	2
1231	f7	Upper	2
1232	f3	Upper	2
1233	e6	Upper	2
1234	e5	Upper	2
1235	e1	Upper	2

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
1236	de	Upper	2
1237	db	Upper	2
1238	e9	Upper	4
1239	ea	Upper	4
1240	eb	Upper	4
1241	ec	Upper	4
1242	ed	Upper	4
1243	ee	Upper	4
1244	fb	Upper	4
1245	fc	Upper	4
1246	fd	Upper	4
1247	fe	Upper	4
1248	ff	Upper	4
1249	f8	Upper	7
1250	f7	Upper	7
1251	f6	Upper	7
1252	fe	Upper	6
1253	fd	Upper	6
1254	fa	Upper	6
1255	ed	Upper	6
1256	ec	Upper	6
1257	e8	Upper	6
1258	e7	Upper	6
1259	e5	Upper	6
1260	e2	Upper	6
1261	e4	Upper	0
1262	e6	Upper	0
1263	e7	Upper	0
1264	ea	Upper	0
1265	eb	Upper	0
1266	ed	Upper	0
1267	fc	Upper	0
1268	fe	Upper	0
1269	f8	Upper	1
1270	f9	Upper	1
1271	fa	Upper	1
1272	fa	Upper	3
1273	f9	Upper	3
1274	f8	Upper	3
1275	f6	Upper	2
1276	f5	Upper	2
1277	f4	Upper	2
1278	e4	Upper	2
1279	e3	Upper	2
1280	e2	Upper	2
1281	dd	Upper	2
1282	dc	Upper	2
1283	e2	Upper	3
1284	df	Upper	5
1285	e0	Upper	5
1286	e5	Upper	5
1287	e6	Upper	5
1288	e7	Upper	5
1289	f5	Upper	5
1290	f6	Upper	5
1291	f8	Upper	5
1292	fc	Upper	5
1293	fd	Upper	5
1294	fa	Upper	7
1295	f9	Upper	7
1296	f5	Upper	7
1297	ff	Upper	6
1298	fc	Upper	6
1299	fb	Upper	6
1300	eb	Upper	6
1301	ea	Upper	6
1302	e9	Upper	6
1303	e6	Upper	6
1304	e4	Upper	6
1305	e3	Upper	6
1306	e5	Upper	1
1307	e6	Upper	1
1308	e7	Upper	1
1309	e8	Upper	1
1310	e9	Upper	1
1311	ea	Upper	1
1312	f5	Upper	1
1313	f6	Upper	1
1314	f7	Upper	1
1315	fc	Upper	1
1316	fb	Upper	1
1317	fb	Upper	3
1318	fd	Upper	3
1319	f7	Upper	3
1320	f6	Upper	3
1321	f5	Upper	3
1322	f4	Upper	3
1323	e8	Upper	3
1324	e7	Upper	3
1325	e6	Upper	3
1326	e4	Upper	3
1327	e3	Upper	3
1328	e1	Upper	3
1329	de	Upper	5
1330	e1	Upper	5
1331	e4	Upper	5
1332	e8	Upper	5
1333	e9	Upper	5
1334	f4	Upper	5
1335	f7	Upper	5
1336	f9	Upper	5
1337	fb	Upper	5
1338	fe	Upper	5
1339	fb	Upper	7
1340	fd	Upper	7
1341	f4	Upper	7
1342	f3	Upper	7
1343	f2	Upper	7
1344	f1	Upper	7
1345	e5	Upper	7
1346	e4	Upper	7
1347	e3	Upper	7
1348	e2	Upper	7
1349	e1	Upper	7
1350	e0	Upper	7
1351	e4	Upper	1
1352	e3	Upper	1
1353	e2	Upper	1
1354	ed	Upper	1
1355	ec	Upper	1
1356	eb	Upper	1
1357	f4	Upper	1
1358	f3	Upper	1
1359	ff	Upper	1
1360	fe	Upper	1
1361	fd	Upper	1
1362	fc	Upper	3
1363	fe	Upper	3
1364	ff	Upper	3
1365	f1	Upper	3
1366	f2	Upper	3
1367	f3	Upper	3
1368	e9	Upper	3
1369	ea	Upper	3
1370	e5	Upper	3
1371	de	Upper	3
1372	df	Upper	3
1373	e0	Upper	3
1374	dd	Upper	5
1375	e2	Upper	5
1376	e3	Upper	5
1377	eb	Upper	5
1378	ea	Upper	5
1379	f3	Upper	5
1380	f2	Upper	5
1381	f1	Upper	5
1382	fa	Upper	5
1383	ff	Upper	5
1384	fc	Upper	7
1385	fe	Upper	7
1386	ff	Upper	7
1387	ee	Upper	7
1388	ef	Upper	7
1389	f0	Upper	7
1390	e6	Upper	7
1391	e7	Upper	7
1392	e8	Upper	7
1393	dd	Upper	7
1394	de	Upper	7
1395	df	Upper	7
1396	df	Upper	1
1397	e0	Upper	1
1398	e1	Upper	1
1399	ee	Upper	1
1400	ef	Upper	1

(continued)

Table A.2 (continued)

Slice	ID_0	UL	Track
1401	f0	Upper	1
1402	f1	Upper	1
1403	f2	Upper	1
1404	95	Upper	1
1405	96	Upper	1
1406	97	Upper	1
1406	97	Upper	3
1408	96	Upper	3
1409	95	Upper	3
1410	f0	Upper	3
1411	ef	Upper	3
1412	ee	Upper	3
1413	ed	Upper	3
1414	ec	Upper	3
1415	eb	Upper	3
1416	dd	Upper	3
1417	dc	Upper	3
1418	db	Upper	3
1419	dc	Upper	5
1420	d9	Upper	5
1421	d8	Upper	5
1422	ec	Upper	5
1423	ed	Upper	5
1424	ee	Upper	5
1425	ef	Upper	5
1426	f0	Upper	5
1427	95	Upper	5
1428	96	Upper	5
1429	97	Upper	5
1430	96	Upper	7
1431	95	Upper	7
1432	99	Upper	7
1433	ed	Upper	7
1434	ec	Upper	7
1435	eb	Upper	7
1436	ea	Upper	7
1437	e9	Upper	7
1438	dc	Upper	7
1439	db	Upper	7
1440	da	Upper	7
1441	de	Upper	1
1442	dd	Upper	1
1443	dc	Upper	1
1444	db	Upper	1
1445	da	Upper	1
1446	d9	Upper	1
1447	9c	Upper	1
1448	9b	Upper	1
1449	9a	Upper	1
1450	99	Upper	1
1451	98	Upper	1
1452	98	Upper	3
1453	99	Upper	3
1454	9a	Upper	3
1455	9b	Upper	3
1456	9c	Upper	3
1457	9d	Upper	3
1458	d5	Upper	3
1459	d6	Upper	3
1460	d7	Upper	3
1461	d8	Upper	3
1462	d9	Upper	3
1463	da	Upper	3
1464	db	Upper	5
1465	da	Upper	5
1466	d7	Upper	5
1467	d6	Upper	5
1468	d5	Upper	5
1469	9d	Upper	5
1470	9c	Upper	5
1471	9b	Upper	5
1472	9a	Upper	5
1473	99	Upper	5
1474	98	Upper	5
1475	97	Upper	7
1476	98	Upper	7
1477	9a	Upper	7
1478	9b	Upper	7
1479	9c	Upper	7
1480	9d	Upper	7
1481	d5	Upper	7
1482	d6	Upper	7
1483	d7	Upper	7
1484	d8	Upper	7
1485	d9	Upper	7
1486	cf	Upper	1
1487	d0	Upper	1
1488	d2	Upper	1
1489	d5	Upper	1
1490	d7	Upper	1
1491	d8	Upper	1
1492	9d	Upper	1
1493	9e	Upper	1
1494	a0	Upper	1
1495	a1	Upper	1
1496	a2	Upper	1
1497	a7	Upper	1
1498	a6	Upper	3
1499	a5	Upper	3
1500	a0	Upper	3
1501	9f	Upper	3
1502	9e	Upper	3
1503	d4	Upper	3
1504	d3	Upper	3
1505	d2	Upper	3
1506	cf	Upper	3
1507	ce	Upper	3
1508	cc	Upper	3
1509	cc	Upper	5
1510	cd	Upper	5
1511	d2	Upper	5
1512	d3	Upper	5
1513	d4	Upper	5
1514	9e	Upper	5
1515	9f	Upper	5
1516	a0	Upper	5
1517	a5	Upper	5
1518	a6	Upper	5
1519	a7	Upper	5
1520	a7	Upper	7
1521	a6	Upper	7
1522	a5	Upper	7
1523	a0	Upper	7
1524	9f	Upper	7
1525	9e	Upper	7
1526	d4	Upper	7
1527	d2	Upper	7
1528	cd	Upper	7
1529	cd	Upper	7
1530	cc	Upper	7
1531	ce	Upper	1
1532	d1	Upper	1
1533	d3	Upper	1
1534	d4	Upper	1
1535	d5	Upper	1
1536	bb	Upper	1
1537	ba	Upper	1
1538	b8	Upper	1
1539	9f	Upper	1
1540	a3	Upper	1
1541	a4	Upper	1
1542	a8	Upper	3
1543	a9	Upper	3
1544	a4	Upper	3
1545	a1	Upper	3
1546	b4	Upper	3
1547	b6	Upper	3
1548	b7	Upper	3
1549	b9	Upper	3
1550	d1	Upper	3
1551	d0	Upper	3
1552	cd	Upper	3
1553	cb	Upper	3
1554	cb	Upper	5
1555	ce	Upper	5
1556	d1	Upper	5
1557	be	Upper	5
1558	bc	Upper	5
1559	bb	Upper	5
1560	b9	Upper	5
1561	a1	Upper	5
1562	a4	Upper	5
1563	a9	Upper	5
1564	a8	Upper	5
1565	a9	Upper	7

(continued)

Table A.2 (concluded)

Slice	ID_0	UL	Track
1566	a8	Upper	7
1567	a4	Upper	7
1568	a1	Upper	7
1569	b7	Upper	7
1570	b8	Upper	7
1571	d3	Upper	7
1572	d1	Upper	7
1573	d0	Upper	7
1574	cf	Upper	7
1575	cb	Upper	7
1576	cd	Upper	1
1577	cc	Upper	1
1578	cb	Upper	1
1579	be	Upper	1
1580	bd	Upper	1
1581	bc	Upper	1
1582	b9	Upper	1
1583	b7	Upper	1
1584	a8	Upper	1
1585	a7	Upper	1
1586	a6	Upper	1
1587	a5	Upper	3
1588	aa	Upper	3
1589	a3	Upper	3
1590	a2	Upper	3
1591	b3	Upper	3
1592	b5	Upper	3
1593	b8	Upper	3
1594	ba	Upper	3
1595	c7	Upper	3
1596	c8	Upper	3
1597	c9	Upper	3
1598	ca	Upper	3
1599	ca	Upper	5
1600	cf	Upper	5
1601	d0	Upper	5
1602	bf	Upper	5
1603	bd	Upper	5
1604	ba	Upper	5
1605	b8	Upper	5
1606	a2	Upper	5
1607	a3	Upper	5
1608	ab	Upper	5
1609	aa	Upper	5
1610	aa	Upper	7
1611	ab	Upper	7
1612	a3	Upper	7
1613	a2	Upper	7
1614	b6	Upper	7
1615	b9	Upper	7
1616	ba	Upper	7
1617	bb	Upper	7
1618	c8	Upper	7
1619	c9	Upper	7
1620	ca	Upper	7
1621	c8	Upper	1
1622	c9	Upper	1
1623	ca	Upper	1
1624	bf	Upper	1
1625	c0	Upper	1
1626	c1	Upper	1
1627	b5	Upper	1
1628	b6	Upper	1
1629	a9	Upper	1
1630	aa	Upper	1
1631	ab	Upper	1
1632	ac	Upper	1
1633	ad	Upper	1
1634	ab	Upper	3
1635	ad	Upper	3
1636	b2	Upper	3
1637	b1	Upper	3
1638	bc	Upper	3
1639	bb	Upper	3
1640	c0	Upper	3
1641	c6	Upper	3
1642	c5	Upper	3
1643	c4	Upper	3
1644	c8	Upper	5
1645	c9	Upper	5
1646	c5	Upper	5
1647	c0	Upper	5
1648	c1	Upper	5
1649	b6	Upper	5
1650	b7	Upper	5
1651	b2	Upper	5
1651	b1	Upper	5
1653	ac	Upper	5
1654	ad	Upper	5
1655	ad	Upper	7
1656	ab	Upper	7
1657	c1	Upper	7
1658	b2	Upper	7
1659	b5	Upper	7
1660	be	Upper	7
1661	bd	Upper	7
1662	bc	Upper	7
1663	c7	Upper	7
1664	c6	Upper	7
1665	c5	Upper	7
1666	c7	Upper	1
1667	c6	Upper	1
1668	c5	Upper	1
1669	c4	Upper	1
1670	c3	Upper	1
1671	c2	Upper	1
1672	b4	Upper	1
1673	b3	Upper	1
1674	b2	Upper	1
1675	b1	Upper	1
1676	b0	Upper	1
1677	af	Upper	1
1678	ae	Upper	1
1679	ac	Upper	3
1680	ae	Upper	3
1681	af	Upper	3
1682	b0	Upper	3
1683	bd	Upper	3
1684	be	Upper	3
1685	bf	Upper	3
1686	c1	Upper	3
1687	c2	Upper	3
1688	c3	Upper	3
1689	c7	Upper	5
1690	c6	Upper	5
1691	c4	Upper	5
1692	c3	Upper	5
1693	c2	Upper	5
1694	b5	Upper	5
1695	b4	Upper	5
1696	b3	Upper	5
1697	b0	Upper	5
1698	af	Upper	5
1699	ae	Upper	5
1700	ae	Upper	7
1701	af	Upper	7
1702	b0	Upper	7
1703	b3	Upper	7
1704	b4	Upper	7
1705	bf	Upper	7
1706	c0	Upper	7
1707	c1	Upper	7
1708	c2	Upper	7
1709	c3	Upper	7
1710	c4	Upper	7
aux	80	Lower	0
aux	eb	Lower	1
aux	80	Lower	2
aux	eb	Lower	3
aux	80	Lower	4
aux	eb	Lower	5
aux	80	Lower	6
aux	eb	Lower	7
null	94	Upper	0
null	94	Upper	1
null	94	Upper	2
null	94	Upper	3
null	94	Upper	4
null	94	Upper	5
null	94	Upper	6
null	94	Upper	7
null	eb	Lower	2

Annex B (normative)
Digital interfaces

B.1 Introduction

Equipment which provides digital audio, digital video, and SDTI (SMPTE 305M) interfaces to the D-10 format VTR shall conform to the following general specifications.

B.2 Video interface

B.2.1 Encoding parameters

The digital component signal to be processed shall comply with the 4:2:2 encoding parameters as defined in ITU-R BT.601-5, operating only at 13.5-MHz luminance sampling frequency.

B.2.2 Serial digital interface

The interface of the digital component video signal, if present, shall conform to the component serial digital interface format as defined in ANSI/SMPTE 259M for both 525/60 and 625/50 systems.

B.2.3 MPEG-2 4:2:2 profile @ main level coding

Any incoming digital component video signal shall be coded by an MPEG-2 4:2:2P@ML encoder with constrained parameters as defined in SMPTE 356M. For maximum picture quality, the video-ES bit-rate should be to the maximum allowed rate of 50 Mb/s.

If an output digital component video signal is required, the replayed video-ES data should be decoded by an MPEG-2 4:2:2P@ML decoder.

B.3 Audio interface

B.3.1 Encoding parameters

The digital audio signal shall be encoded according to the following parameters:

a) The sampling frequency (Fs) is 48 kHz and is related to the horizontal frequency FH as follows:

- for 525/60 system

  $Fs = F_H \times 1144/375 = 48$ kHz;

- for 625/50 system

  $Fs = F_H \times 384/125 = 48$ kHz.

b) The resolution of each sample is 24 bits maximum.

c) The coding is twos complement linear PCM.

B.3.2 Serial digital signal interface

The bit serial interface, if present, should conform to AES3.

B.4 Serial data interface

The serial data transport interface (SDTI), if present, shall conform to SMPTE 305M.

The SDTI data mapping format shall conform to SDTI-CP defined by the following three standards:

- SDTI-CP format: SMPTE 326M (specification for the SDTI content package format)
- SDTI-CP E&M: SMPTE 331M (element and metadata definitions for SDTI-CP)
- SDTI-CP templates: SMPTE RP 204 (MPEG-2 4:2:2P@ML templates)

The SDTI-CP template type value should be 01_h, which specifies the MPEG-2 4:2:2P@ML baseline template as follows:

– Transfer modes: 0 (synchronous)
– Timing modes: 0 (normal) and 2 (dual)
– Multiplexing: Not supported
– FEC: Supported
– Items: System, picture, audio, and auxiliary
– 305M: 270 Mb/s

Annex C (informative)
Tape 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.

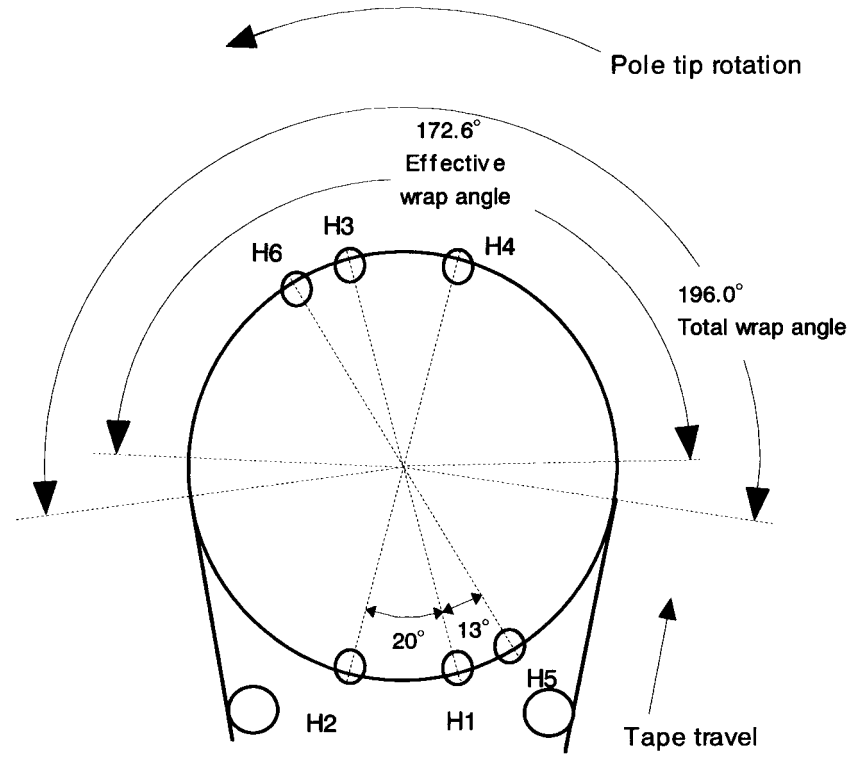
A possible configuration of the transport uses a scanner with an effective diameter of 81.400 mm. Scanner rotation is in the same direction as tape motion during normal playback mode. Data are recorded by two head pairs mounted at 180º from each other. Figure C.1 shows a possible mechanical configuration of the scanner and table C.1 shows the corresponding mechanical parameters. Figure C.2 shows the relationship between the longitudinal heads and the scanner.

Other mechanical configurations are allowable, providing the same footprint of recorded information is produced on tape.

For the scanner configuration defined in table C.1, the recorder data rate and the shortest recorded wavelength are given by table C.2, provided for reference only.

Table C.1 – Parameters for a possible scanner design

Parameter		Value	
		525/60 system	625/50 system
Scanner rotation speed (rps)		60/1.001	50
Number of tracks per rotation		4	4
Drum diameter (mm)		81.4	81.4
Center span tension (N)		0.3	0.3
Helix angle (degrees)		4.607	4.607
Effective wrap angle (degrees)		159.8	172.6
Scanner circumferential speed (m/s)		15.3	12.8
H1, H3 over wrap head entrance (degrees)		33.26	20.46
H1, H3 over wrap head exit (degrees)		2.94	2.94
Angular relationship (degrees)	H1 – H2:	20.0	20.0
	H3 – H4:	20.0	20.0
	H1 – H3:	180.0	180.0
Vertical displacement (mm)	H1 – H2:	0.0152	0.0152
	H3 – H4:	0.0152	0.0152
Maximum tip projection (µm)		40	40
Record head track width (µm)		20	20



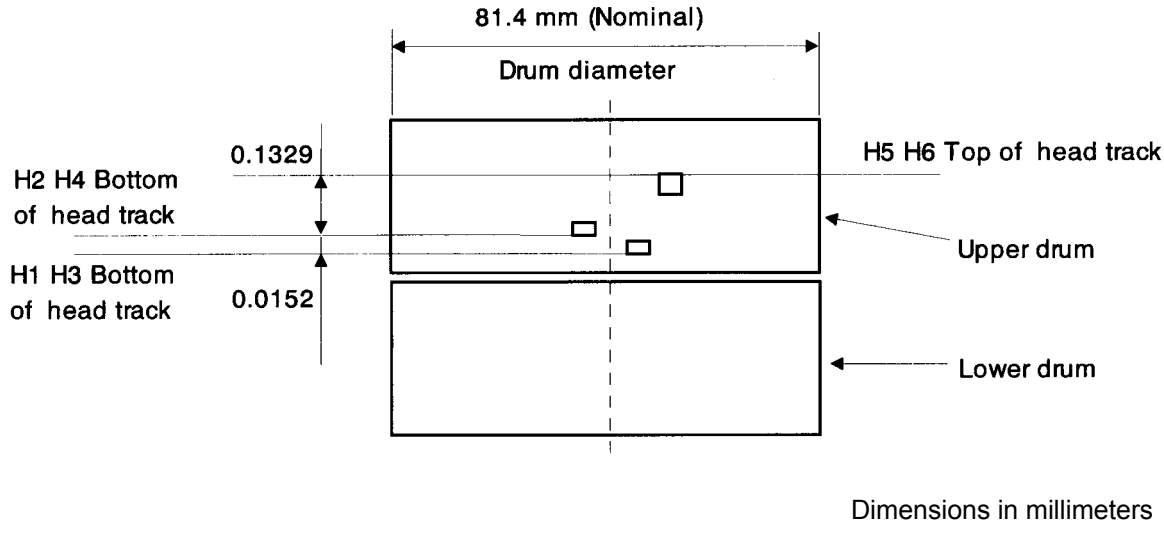
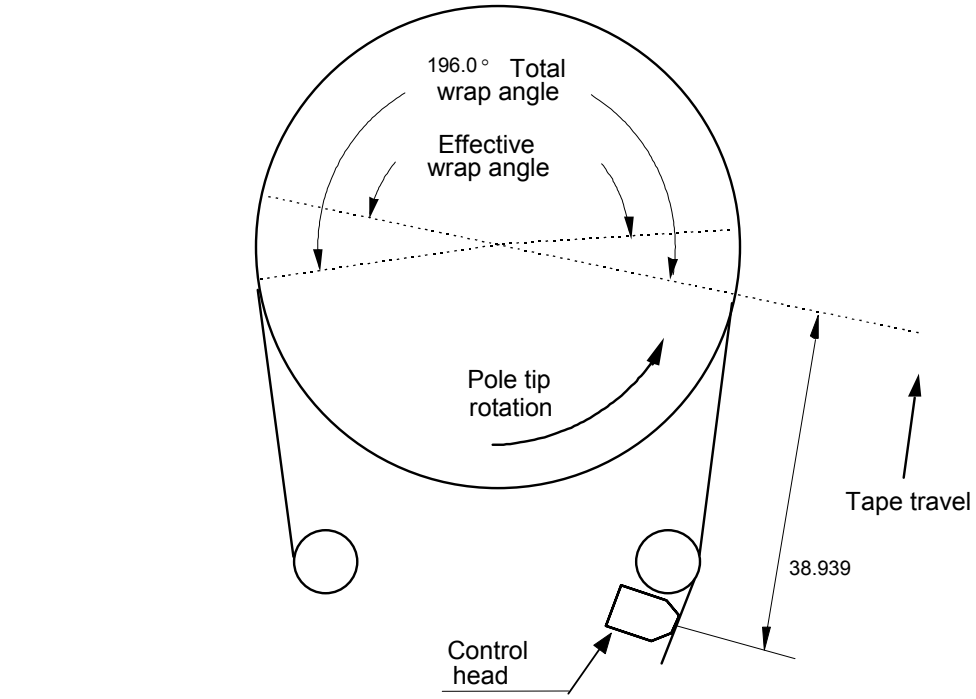


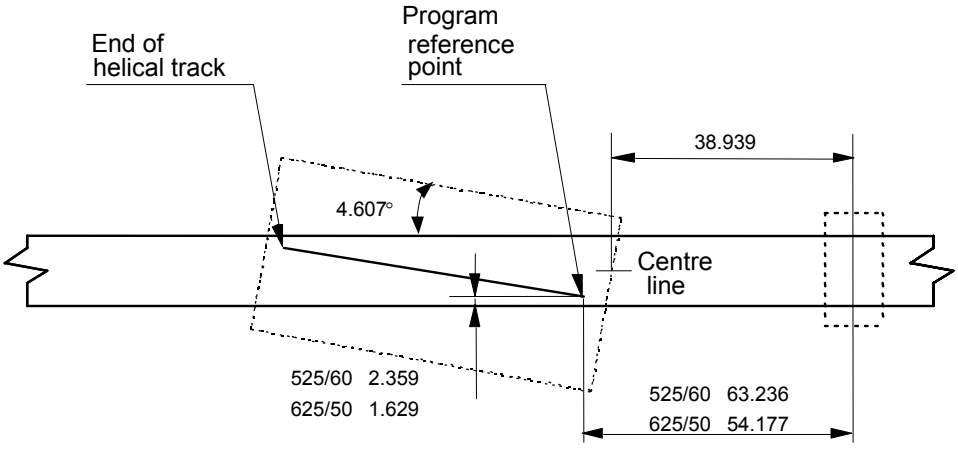
Figure C.1 – Possible scanner configuration (525/60 and 625/50 systems)

Table C.2 – Data rate and wavelength

Parameter	525/60 system	625/50 system
Total data rate	97.346 Mb/s	87.706 Mb/s
Instantaneous channel data rate (maximum rate per channel)	54.8247 Mb/s	45.7329 Mb/s
Shortest recorded wavelength	0.557 µm	0.557 µm



Top view



Dimensions in millimeters

Figure C.2 – Possible longitudinal head location and tape wrap (525/60 and 625/50 systems)

Annex D (informative)
Compatibility with other digital formats using type L derivative cassettes

The physical format parameters selected for the D-10 digital tape format provide for the possibility of backwards compatibility with other digital formats using format L derivative cassettes.

A scanning drum diameter of 81.4 mm and an associated lead angle of 4.607º provide the basis for achieving playback compatibility with other formats.

Automatic detection of a given tape format is provided by the cassette tape format identification holes.

Annex E (informative)
Compatibility with analog type L

It is possible to manufacture hardware that can replay SMPTE type L analog recordings as well as recording and playing D-10 formatted tapes. Physical dimensions of the D-10 format, such as the time and control code track and the control track, are in identical locations for both formats.

As a result of differing drum diameters between the analog type L format and the D-10 format, additional signal processing, beyond the normal TBC functions, is required when replaying analog tapes. These additional functions relate to the handling of the AFM signals that may have been <%4>subject to some time compression during the replay process.

Automatic detection of a given tape format is provided by the cassette tape format identification holes. Tape format and transport parameters such as drum rotational speed, capstan speed, and tape tension control will need to be optimized.

Annex F (informative**)**
Type D-10 MPEG-2 4:2:2P@ML stream specifications for 525/60 and 625/50

NOTE – Annexes which are embedded as part of this annex should be considered informative. For the purpose of this annex, the normative references should also be considered informative.

F.1 Scope

This standard specifies the compression constraints and bit stream characteristics of an MPEG-2 video elementary stream operating at bit rates up to 50 Mb/s. One of the intended applications is to provide a bit stream compatible with the type D-10 format digital recorder. The video compression format defined and constrained by this standard is fully compliant with the MPEG-2 video standard (ISO/IEC 13818-2 [4:2:2P@ML]).

F.2 References

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

F.2.1 Normative references

SMPTE 326M-2000, Television — SDTI Content Package Format (SDTI-CP)

SMPTE 328M-2000, Television — MPEG-2 Video Elementary Stream Editing Information

ISO/IEC 13818-2:2000, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Video (clause 6.1 describes the structure of coded video data along with a cross reference to ISO/IEC 13818-1)

F.2.2 Informative references

AES3-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Signals — Serial Digital Interface

SMPTE 331M-2000, Television — Element and Metadata Definitions for the SDTI-CP

SMPTE 365M, Digital Television Tape Recording — 12.65-mm Type D-10 Format for MPEG-2 Compressed Video — 525/60 and 625/50 (NOTE – For the purpose of this annex, this reference should be ignored.)

SMPTE RP 204-2000, SDTI-CP MPEG Decoder Templates

ISO/IEC 13818-1:2000, Information Technology — Generic Coding of Moving Pictures and Associated Audio Information: Systems

F.3 Specification of the type D-10 MPEG-2 4:2:2P@ML elementary stream

The video-ES bitstream as defined in this standard shall comply with the syntax of SMPTE 328M.

In order to provide accurate editing, playback in slow-motion, and variable-speed replay including pictures in shuttle, this clause defines encoding parameter specifications suitable for the type D-10 recording format capable of recording MPEG video-ES streams at bit rates up to 50 Mb/s. The MPEG-2 video-ES bitstream constrained to these parameter specifications is fully compliant with the MPEG-2 video-ES syntax and can be successfully decoded by a compliant MPEG-2 4:2:2P@ML decoder.

F.3.1 General characteristics

Table F.1 – Basic bit stream constraints

Source format	SDTV 525/60/1.001 and 625/50
Bit rate	Up to 50 Mb/s constrained bytes per GOP (CBG)
GOP structure	I-picture only
Maximum coded frame size	Up to 208.541 bytes net (30/1.001 I-frames/second) Up to 250.000 bytes net (25 I-frames/second)

F.3.2 MPEG compression parameter constraints

The compression scheme is fully compliant with ISO 13818-2. In addition, the following defined constraints shall apply:

The bit_rate_value in sequence_header shall be set with a value up to 50 Mb/s. The sequence_extension parameter shall be set with the following value:

– sequence_extension: bit_rate_extension = 0_h

F.3.3 VBV_delay constraint

The vbv_delay parameter shall be constrained to a 1-frame delay for each GOP by defining the following values:

525/60 systems:

– picture_header: vbv-delay = $0BBB_h$

625/50 systems:

– picture_header: vbv-delay = $0E10_h$

F.3.4 4:2:2 profile@main level

The sequence_extension parameters shall be constrained to the following values:

– sequence_extension: profile_and_level_indication = 85_h (4:2:2P@ML)

– sequence_extension: chroma_format = 2_h (4:2:2 format)

F.3.5 All I-picture encoding

The picture_header parameter shall be constrained to the following values:

– picture_header: temporal_reference = 0_h (1 picture in a GOP)

– picture_header: picture_coding_type = 1_h (I-picture only)

F.3.6 Picture structure is frame picture only

The picture_coding_extension parameter shall be set to constrain the picture coding to frame pictures only by constraining to the following value:

– picture_coding_extension: picture_structure = 3_h (frame picture)

F.3.7 Frame frequency

The sequence_header parameters shall be constrained to the following values:

525/60 systems:

– sequence_header: frame_rate_code = 4_h (30/1.001 Hz)

625/50 systems:

– sequence_header: frame_rate_code = 3^h (25 Hz)

F.3.8 Picture coding parameter constraints

The picture coding constraints shall be defined as follows:

– picture_coding_extension(): intra_dc_precision = 2_h (10-bit DC)

– picture_coding_extension(): frame_pred_frame_dct = 0_h (field/frame adaptive)

– picture_coding_extension(): q_scale_type = 1_h (non-linear quantizer)

– picture_coding_extension(): intra_vic_format = 1_h (use intra-VLC table)

– picture_coding_extension(): alternate_scan = 0_h (zig-zag scan)

– picture_coding_extension(): top_field_first = 1_h (top field first only)

– picture_coding_extension(): repeat_first_field = 0_h (no repeat first field)

– picture_coding_extension(): progressive_frame = 0_h (interlace frames only)

– sequence_extension(): progressive_sequence = 0_h (interlace frames only)

F.3.9 Slice structure

All slices shall contain only one macroblock. Each macroblock shall have a slice header as a sync code. In case of any errors occurring during transmission/recording, the error propagation will be less than one macroblock. The slice structure syntax shall be as follows:

slice() {	No. of bits	Mnemonic
slice_start_code	32	bslbf
if (vertical_size > 2800		
slice_vertical_position_extension	3	uimsbf
if (<sequence_scalable_extension() is present in the bitstream>) {		
if (scalable_mode == data partioning) priority_breakpoint	7	uimsbf
}		
quantizer_scale_code	5	uimsbf
if (nextbits () == 1) {		
intra_slice_flag	1	bslbf
intra_slice	1	uimsbf
reserved_bits	7	uimsbf
while (nextbits () == 1) {		
extra_bit_slice (with the value 1)	1	uimsbf
extra_information_slice	8	uimsbf
}		
}		
extra_bit_slice (with the value 0)	1	uimsbf
macroblock()		
next_start_code()		
}		

F.3.10 Sequence_header and sequence_extension

The sequence_header and sequence_extension shall be present for every picture (as per SMPTE 328M), specified as follows:

```
video_sequence() {                                          No. of bits     Mnemonic
   next_start_code ()
   sequence_header ()
   if (nextbits () == extension_start_code) {
      sequence_extension
      do {
         extension_and_user_data (0)
         if (nextbits() == group_start_code) }
            group_of_pictures_header()
            extension_and_user_data (1)
         }
         picture_header ()
         picture_coding_extension()
         extension_and_data (2)
         picture_data ()
         if (nextbits() !=sequence_end_code) {
            sequence_heade ()
            sequence_extension ()
         }
      } while (nextbits () !=sequence_end_code)
   } else {
      (ISO/IEC 11172-2)
   }
   sequence_end_code                                        32              bslbf
}
```

F.4 Interfaces

An example and definition of an interface carrying the type D-10 stream is given in annex F.A and annex F.C. Other interfaces may be defined in future revisions of this standard.

Annex F.A (informative)
Type D-10 ES stream operating points

F.A.1 Operating point values

The bit stream defined in this standard is primarily intended to be a signal source compatible with the type D-10 recording format. It is possible that this same bit stream will be used in other studio applications, in particular, in those applications where it can be expected that the signal will be recorded by a VTR.

When used as a signal source for the type D-10 recording format, the bit stream is carried by SDTI-CP as defined in SMPTE 326M, using recommended operating point bit rates as defined in this annex. Other bit rates may be used. However, users are cautioned that other system design parameters within the studio may not support all bit rates.

Table F.A.1 indicates recommended operating points to<%0> simplify studio operations and to provide users with a tool to be used in designing systems.

Table F.A.1 – Operating points

D-10 Profile	Bit rate	sequence_header bit_rate_value	Comments
Operating point A	50 Mb/s	$1E848_h$	To be used when compliant with EBU statement D84/85
Operating point B	40 Mb/s	$186A0_h$	May be used for interfaces to T3 telco circuits and other content production
Operating point C	30 Mb/s	$124F8_h$	May be used for E3 telco interfaces and non-critical content production

Annex F.B (informative)
Type D-10 recording format compression model

F.B.1 Introduction

This annex specifies the recommended implementation of the compression model for the type D-10 format digital recorder with an MPEG-2 video-ES bit rate capacity of up to 50 Mb/s. This model includes the recommended input and output interfaces for the type D-10 recording format.

F.B.2 Digital recorder compression model

Figure F.B.1 shows a digital recorder compression model.

An internal type D-10 compression encoder shall encode the baseband video input signal to an MPEG-2 video-ES at 50 Mb/s.

Alternatively, the type D-10 format can record bit streams using the SDTI-CP data interface at bit rates up to and including 50 Mb/s as defined in annex A. The SDTI-CP interface extracts the MPEG-2 video-ES from the SDTI-CP stream and the type D-10 format transfers that stream transparently to the SDTI-CP output interface (or to an MPEG-2 decoder for conversion to a baseband video signal).

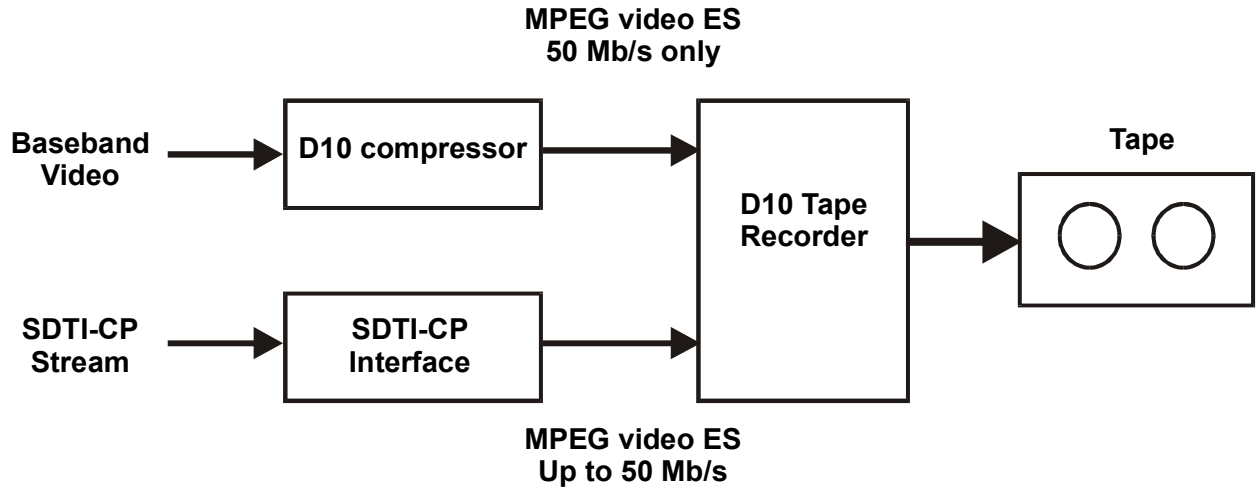


Figure F.B.1 – Digital recorder compression model

Annex F. C (informative)
Type D-10 recording format digital interfaces

F.C.1 Introduction

Equipment which provides digital video, digital audio, and SDTI (SMPTE 305.2M) interfaces to the type D-10 format digital recorder is recommended to meet the following general interface specifications.

F.C.2 Digital video interfaces

F.C.2.1 Encoding parameters

The digital component signal to be processed should comply with the 4:2:2 encoding parameters as defined in ITU-R BT.656 or ANSI/SMPTE 125M operating only at 13.5 MHz luminance sampling frequency.

F.C.2.2 Serial digital video interfaces

The interface of any digital component video signal should conform to the component serial digital interface format as defined in ANSI/SMPTE 259M for both 525/60 and 625/50 systems.

F.C.3 Digital audio interface

F.C.3.1 Encoding parameters

The digital audio signal should be encoded according to the following parameters:

- The sampling frequency (Fs) shall be 48 kHz for both 525/60 and 625/50 operation;
- The resolution of each sample is 24 bits maximum;
- The audio coding is twos complement linear PCM.

NOTE – Video compression encoding may introduce delays in the video signal path; these delays may need an equivalent audio delay.

F.C.3.2 Serial digital audio interface

The interface of any bit-serial digital audio bitstream should conform to AES3.

F.C.4 Serial data interface

The serial data transport interface (SDTI) should conform to SMPTE 305.2M.

The SDTI data mapping format should conform to SDTI-CP defined by the following three standards:

- SDTI-CP format: SMPTE 326M (specification for the SDTI content package format);
- SDTI-CP E&M: SMPTE 331M (element and metadata definitions for SDTI-CP);
- SDTI-CP templates: SMPTE RP 204 (MPEG-2 4:2:2P@ML templates).

The SDTI-CP template type value should be 01_h, which specifies the MPEG-2 4:2:2P@ML baseline template as follows:

- Transfer modes: 0 (synchrnous)
- Timing modes: 0 (normal) and 2 (dual)
- Multiplexing: Not supported
- FEC: Supported
- Items: System, picture, audio, and auxiliary
- 305M: 270 Mb/s

Annex G (information)
Type D-10 document reference tree

The purpose of this annex is to provide the reader with a diagrammatic representation of how the normative references used in this standard are linked (see figure G.1).

Referenced standards:

AES3-1992, Digital Audio Engineering — Serial Transmission Format for Two-Channel Linearly Represented Digital Audio Data

ANSI/SMPTE 125M-1995, Television — Component Video Signal 4:2:2 — Bit-Parallel Digital Interface

ANSI/SMPTE 259M-1997, Television — 10-Bit 4:2:2 Component and $4f_{SC}$ Composite Digital Video Signals — Serial Digital Interface

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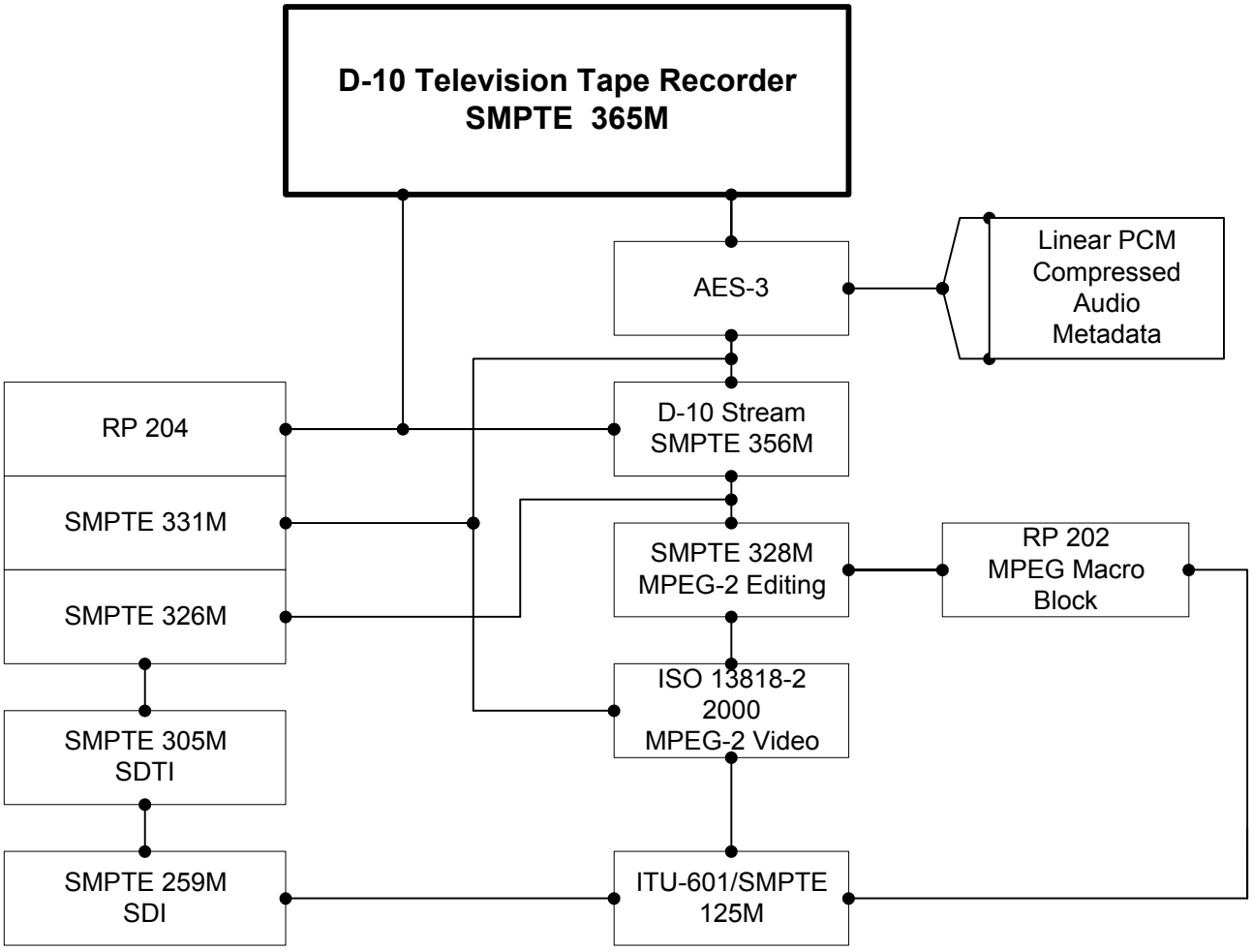

Figure G.1 – D-10 document reference tree

Annex H (informative)
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