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INTERNATIONAL STANDARD

Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 11: HDV format for 1080i and 720p systems

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RECORDING – HELICAL-SCAN DIGITAL VIDEO CASSETTE RECORDING SYSTEM USING 6,35 MM MAGNETIC TAPE FOR CONSUMER USE (525-60, 625-50, 1125-60 AND 1250-50 SYSTEMS) –

Part 11: HDV[1] format for 1080i and 720p systems

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1 HDV is the trademark of Sony Corporation and Victor Company of Japan, Limited (JVC).

International Standard IEC 61834-11 has been prepared by TA 7: Moderate data rate storage media, equipment and systems, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

The text of this standard is based on the following documents:

CDV	Report on voting
100/1229/CDV	100/1306/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The list of all the parts of the IEC 61834 series, under the general title, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems)*, can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under http://webstore.iec.ch in the date related to the specific publication. At this date, the publication will be

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RECORDING – HELICAL-SCAN DIGITAL VIDEO CASSETTE RECORDING SYSTEM USING 6,35 MM MAGNETIC TAPE FOR CONSUMER USE (525-60, 625-50, 1125-60 AND 1250-50 SYSTEMS) –

Part 11: HDV[2] format for 1080i and 720p systems

1 Scope

This part of IEC 61834 specifies the content, format, and recording method of data blocks containing video, audio, and system data on the helical scan digital video cassettes using 6,35 mm tape as defined in IEC 61834-1 for recording MPEG-2 streaming HD signals.

The MPEG-2 streaming HD signals defined in this standard have the following modes.

The HD1 mode is designed for the following systems:

- 525-line progressive with a frame frequency of 59,94 Hz (hereinafter referred to as 480p/60 system)
- 625-line progressive with a frame frequency of 50,00 Hz (hereinafter referred to as 576p/50 system)
- 525-line interlace with a field frequency of 59,94 Hz (hereinafter referred to as 480i/60 system)
- 625-line interlace with a field frequency of 50,00 Hz (hereinafter referred to as 576i/50 system)
- 525-line progressive with a frame frequency of 29,97 Hz (hereinafter referred to as 480p/30 system)
- 625-line progressive with a frame frequency of 25,00 Hz (hereinafter referred to as 576p/25 system)
- 750-line progressive with a frame frequency of 29,97 Hz (hereinafter referred to as 720p/30 system)
- 750-line progressive with a frame frequency of 25,00 Hz (hereinafter referred to as 720p/25 system)
- 750-line progressive with a frame frequency of 59,94 Hz (hereinafter referred to as 720p/60 system)
- 750-line progressive with a frame frequency of 50,00 Hz (hereinafter referred to as 720p/50 system)

The main specifications shall be as defined in IEC 61834-9 and IEC 61834-10.. Other information, such as details about MPEG-2 stream descriptors, trick play data, system data, etc., are defined in Clause 7.

The HD2 mode is designed for the following systems:

- 1125-line interlace with a field frequency of 59,94 Hz (hereinafter referred to as 1080i/60 system)

2 HDV is the trademark of Sony Corporation and Victor Company of Japan, Limited (JVC).

- 1125-line interlace with a field frequency of 50,00 Hz (hereinafter referred to as 1080i/50 system)

The main specifications for helical recordings and the program track data format shall be as defined in Clauses 5 and 6 of this standard. Other information, such as details about main data, PES data, search data, subcode data, MPEG-2 stream descriptors, etc., are defined in Clause 8.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61834-1, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 1: General specifications*

IEC 61834-2, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 2: SD format for 525-60 and 625-50 systems*

IEC 61834-4, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 4: Pack header table and contents*

IEC 61834-9, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 9: DVB format*

IEC 61834-10, *Recording – Helical-scan digital video cassette recording system using 6,35 mm magnetic tape for consumer use (525-60, 625-50, 1125-60 and 1250-50 systems) – Part 10: DTV format*

ISO/IEC 11172-3, *Coding of moving pictures and associated audio for digital storage – Part 3: Audio*

ISO/IEC 13818-1, *Information technology – Generic coding of moving pictures and associated audio information: Systems*

ISO/IEC 13818-2, *Information technology – Generic coding of moving pictures and associated audio information: Video*

ISO/IEC 13818-3, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 13818-9, *Information technology – Generic coding of moving pictures and associated audio information – Part 9: Extension for real time interface for systems decoder*

ITU-R Recommendation BT.709-5, *Parameter values for the HDTV standards for production and international programme exchange*

ETSI EN 300 468, V1.5.1:2003, *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB Systems*

ARIB STD-B10, *Service Information for Digital Broadcasting System*

ARIB STD-B20, *Transmission System for Digital Satellite Broadcasting*

3 Terms, definitions, symbols, abbreviations and conventions

For the purposes of this document, the following terms and definitions apply.

AAU Audio access unit

ABST Absolute track number

AP3 Application ID of area 3

APM Application ID of MIC

APS Analogue protection system

APT Application ID of a track

AUX Auxiliary

BF Blank flag

DAR Display aspect ratio

DCF Discontinuity flag

DCT Discrete cosine transform

DIT Discontinuity information table

DTCP Digital transmission content protection

DTS Decoding time stamp

DV Digital video

ECC Error correction code

ECCTB Error correction code table block

ES Elementary stream

ETN Extended track number

FR ID First half ID

GF Galois field

GOP Group of picture

HDTV High definition TV

ID Identification

IDP ID parity

ITI Insert and track information

LSB Least significant bit of data

MPEG Moving picture expert group

MSB Most significant bit of data

NRZI	Non-return to zero inverted
PAT	Program association table
PCR	Program clock reference
PES	Packetized elementary stream
PF	Progressive frame
PID	Packet identifier
PMT	Program map table
PP	Picture/photo ID
PSI	Program specific information
PTS	Presentation time stamp
RF	Repeat first field
SB	Sync block
SBSC	Sync block scramble control
SH	Search header
SIT	Selection information table
SPH	Search phase
SSA	Start-sync block area
STA	Status of the compressed macro block
STI	Second track information of a TI-sync block
TIA	Track information area
TPH	Higher trick play speed
TPL	Lower trick play speed
TTC	TITLE TIME CODE
TS	Transport stream

When data bits are fewer than the defined field, data is packed and stored in the LSB side, and the remaining bits are set to zero.

“[m:n]” means the inclusive range of bits between bit m and bit n.

4 Environment and test conditions

4.1 Environment

Tests and measurements for checking conformity with the requirements of this standard shall be carried out under the following conditions.

– Temperature: 20 ˚C ± 1 ˚C
– Relative humidity: 50 % ± 2 %

– Barometric pressure: from 86 kPa to 106 kPa
– Tape conditioning: not less than 24 h

4.2 Reference tape

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

5 Helical recordings

5.1 HD1 mode

5.1.1 Tape speed

The tape speed shall be 18,831/1,001 mm/s (30/60 frame system) or 18,831 mm/s (25/50 frame system).

The tolerance shall be ± 0,5 %.

5.1.2 Record location and dimensions

Record location and dimensions for continuous recording shall be as specified in Figure 1 of IEC 61834-2. For recording, dimensions of helical tracks shall be within the tolerance specified in Table 3 of IEC 61834-1.

Each sector location from the start of the SSA shall be as specified in Figure 2 of IEC 61834-2, Table 1 (525-60 system) of IEC 61834-2 and Table 2 (625-50 system) of IEC 61834-2. The track centre lines shall serve as their position references for specifying the pattern on tape.

5.1.2.1 The effective area upper edge

Same as defined in IEC 61834-2.

5.1.2.2 Record and playback guarantee

Same as defined in IEC 61834-2.

5.1.2.3 Overwrite margin (OM)

Same as defined in IEC 61834-2.

5.1.2.4 Switching margin for recording amplifiers

Same as defined in IEC 61834-2.

5.1.2.5 Scanner example

Same as defined in IEC 61834-2.

5.2 HD2 mode

5.2.1 Tape speed

The tape speed shall be 18,831/1,001 mm/s for the 1080i/60 system and 18,831 mm/s for the 1080i/50 system.

The tolerance shall be ±0,5 %.

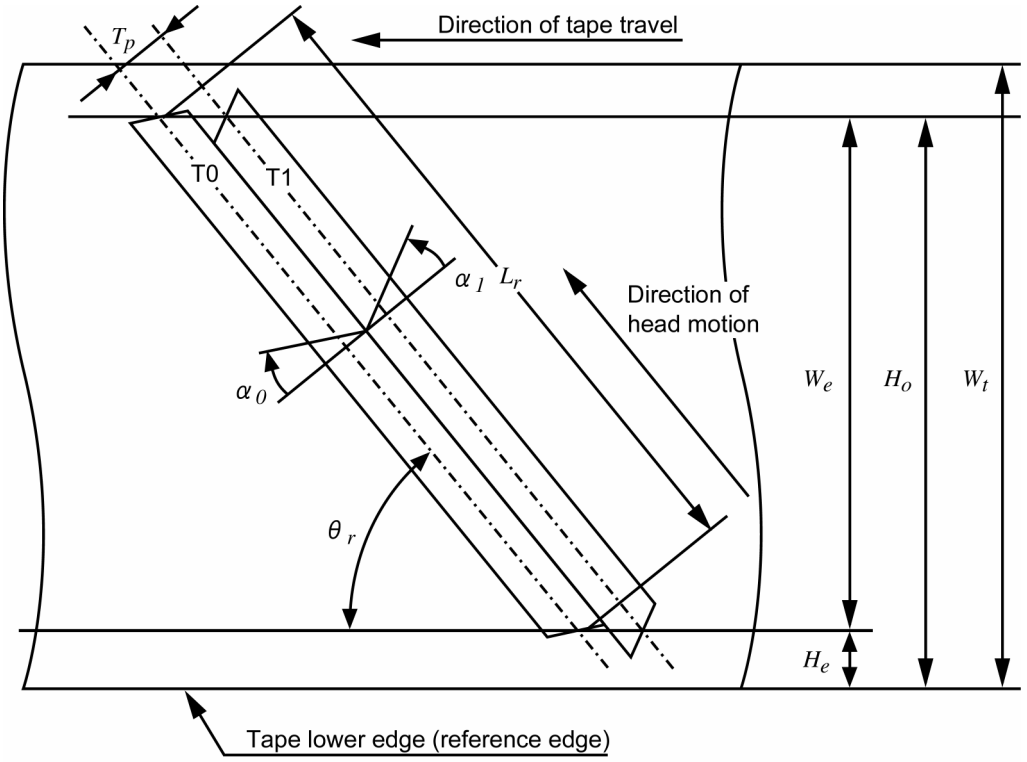
5.2.2 Sectors

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

5.2.3 Record location and dimensions

Record location and dimensions for continuous recording shall be as specified in Figure 1. Each value is described in Table 1. For recording, the helical track shall be contained within the tolerances specified in Table 1.

Each sector location from the start of the SSA shall be as specified in Figure 2 and Table 2 (1080i/60 system) or Table 3 (1080i/50 system). Physical tape pattern shall be specified by the centre-line of each track.



NOTE 1 T0 and T1 are track numbers.
NOTE 2 Tape is viewed from magnetic coating side.

IEC 135/08

Figure 1 – Location and dimensions of recorded track

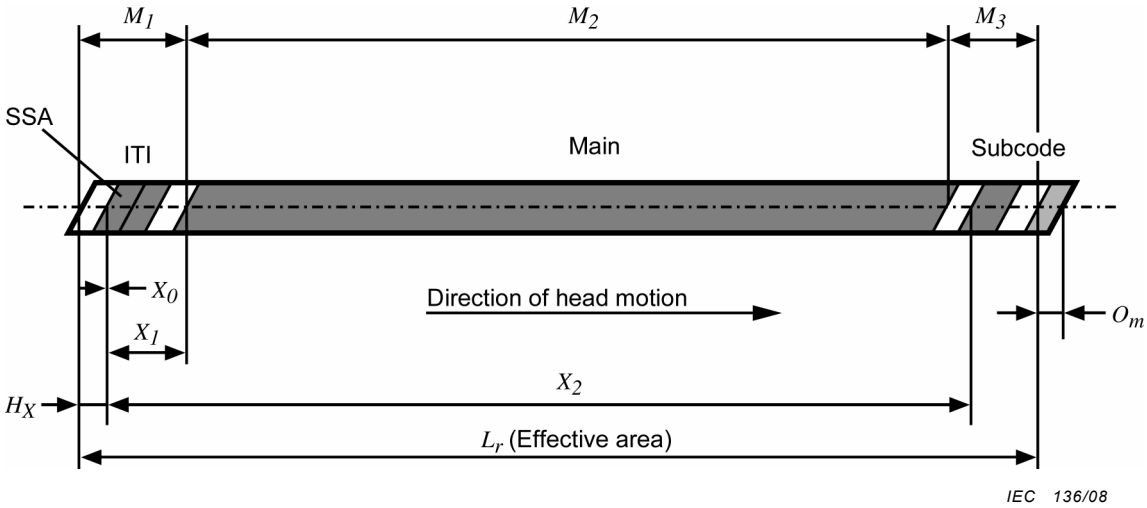


Figure 2 – Sector location from SSA

Table 1 – Record location and dimensions

Dimensions		Nominal	Tolerance
T_p	Helical track pitch	10,00 μm	Reference
θ_r	Track angle	9,1668°	Reference
L_r	Total length of helical track	32,890 mm	± 0,122
W_t	Tape width	6,350 mm	± 0,005
H_e	Effective area lower edge	0,560 mm	± 0,025
H_o	Effective area upper edge	5,800 mm	± 0,045
W_e	Effective area width	5,240 mm	Derived
α_0	Azimuth angle (track 0)	-20°	± 0,150°
α_1	Azimuth angle (track 1)	+20°	± 0,150°

NOTE 1 Tolerances shall be satisfied under all guaranteed conditions of the recorder. These tolerances shall be measured in the tape's standard environment..

NOTE 2 This table shows the values for recording the standard video signal.

Table 2 – Length of each area (1080i/60 system)

Dimensions		Nominal	Tolerance
H_x	Length of ITI pre-amble	0,341 mm	Derived
X_0	Beginning of SSA	0 mm	-
X_1	Beginning of main sync blocks	0,536 mm	Derived
X_2	Beginning of subcode sync blocks	31,894 mm	Derived
M_1	Length of ITI sector	0,877 mm	Derived
M_2	Length of main sector	31,328 mm	Derived
M_3	Length of subcode sector	0,682 mm	Derived
O_m	Length of overwrite margin	0,305 mm	Derived

Table 3 – Length of each area (1080i/50 system)

Dimensions		Nominal	Tolerance
H_x	Length of ITI pre-amble	0,341 mm	Derived
X_0	Beginning of SSA	0 mm	-
X_1	Beginning of main sync blocks	0,537 mm	Derived
X_2	Beginning of subcode sync blocks	31,896 mm	Derived
M_1	Length of ITI sector	0,878 mm	Derived
M_2	Length of main sector	31,360 mm	Derived
M_3	Length of subcode sector	0,652 mm	Derived
O_m	Length of overwrite margin	0,305 mm	Derived

5.2.3.1 Reference edge

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

5.2.3.2 Effective area

The effective area lower edge (He) is specified by the intersection of the beginning line of the ITI pre-amble and the centre-line of the track.

The effective area upper edge (Ho) is specified by the intersection of the ending line of the subcode post-amble and the centre-line of the track.

The effective area width (We) is derived from He and Ho.

5.2.3.3 Record and playback guaranteed heights

Every recorder or player shall record or play back the track data from the beginning of the ITI preamble to the end of the subcode sync blocks with interchangeability.

5.2.3.4 Track pitch

As indicated in Figure 1, there shall be no guard band between recorded tracks in this standard. The track pitch shall be 10,00 µm. The track pitches for the 1080i/60 system and 1080i/50 system shall be the same.

5.2.3.5 Overwrite margin (OM)

When whole sectors (ITI, main, subcode) are overwritten, the overwrite margin (OM) shall be recorded concatenations of run pattern A and run pattern B in order to erase the old subcode data. For the areas which are outside the guaranteed heights, there is no need to record or play back the areas, as they have no effective data.

5.2.3.6 Scanner example

Scanner dimensions in Table 4 are one possible configuration. Other mechanical configurations are permitted, if the same footprint of recorded information is produced on tape.

Table 4 – Scanner example

Dimensions		1080i/60 system	1080i/50 system
D	Scanner diameter	ϕ 21,7 mm	ϕ 21,7 mm
θ_s	Scanner lead angle	9,150°	9,150°
R_S	Scanner rotation speed	150/1,001 rps	150 rps
N_t	Track/scanner rotation	2	2
θ_e	Effective wrap angle	174°	174°

NOTE The scanner rotation speed and the tape speed should be changed in proportion to an average frame frequency of an input video signal.

6 Programme track data arrangement

6.1 HD1 mode

6.1.1 Labelling conversion

Same as defined in IEC 61834-2.

6.1.2 Audio sector

Same as defined in IEC 61834-2.

6.1.3 Video sector

Same as defined in IEC 61834-2, except AP2 as shown in Table 5.

Table 5 – Application ID of video area

$AP2_2$	$AP2_1$	$AP2_0$	Meaning
0	0	0	Consumer digital VCR
0	0	1	MPEG2-TS
0	1	0	Reserved
0	1	1	Reserved
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	No information

6.1.4 Subcode sector

Same as defined in IEC 61834-2.

6.2 HD2 mode

6.2.1 General

6.2.1.1 Scope

The helical tracks contain digital data from the ITI sector, main sector, and subcode sector. The ITI sector contains the start sync and track information. The main sector contains video data, audio data, AUX data and search data. The subcode sector contains the time and

control code data and it may also include other optional data. Figure 3 shows the arrangement of the ITI sector, the main sector and the subcode sector on the tape.

For the generation of low-frequency tracking information, the helical data stream is converted by 24-25 modulation to obtain the following conditions.

- Track F0: Attenuation of 465,0 kHz and 697,5 kHz frequency components by at least 9 dB
- Track F1: Generation of 465,0 kHz component of at least 16 dB, but not more than 19 dB
- Track F2: Generation of 697,5 kHz component of at least 16 dB, but not more than 19 dB

Tracks are recorded in the repeated cycle of F0 - F1- F0 - F2 sequence.

Each track is numbered in order, and a track which has track number i (i = 0 to 63) is referred to as track i. The track number is a 6-bit round counter and the track pair number is equal to 5 bits of higher ranks of the track number (see Table 13). Figure 4 shows the placement of F0, F1 and F2 tracks, and the relation between servo information (F0, F1, F2), track pair number[2:0], and track number[3:0]. The 16 tracks with a track pair number[2:0] and a track number[3:0], starting from track 0, are designated an ECC unit.

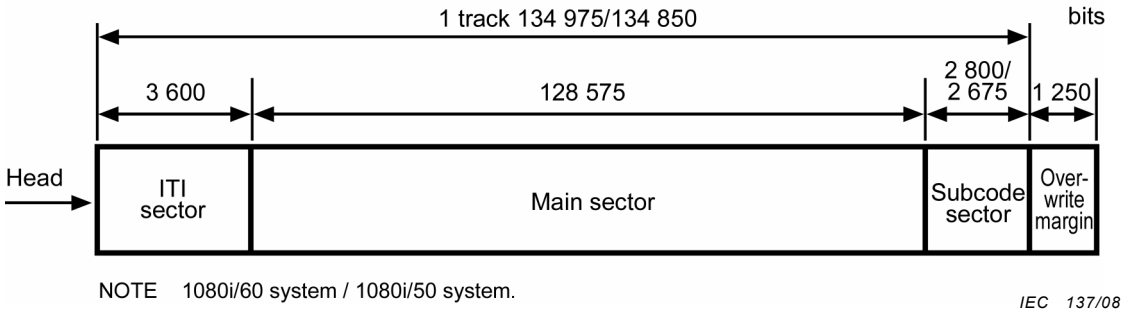


Figure 3 – Sector arrangement on helical track

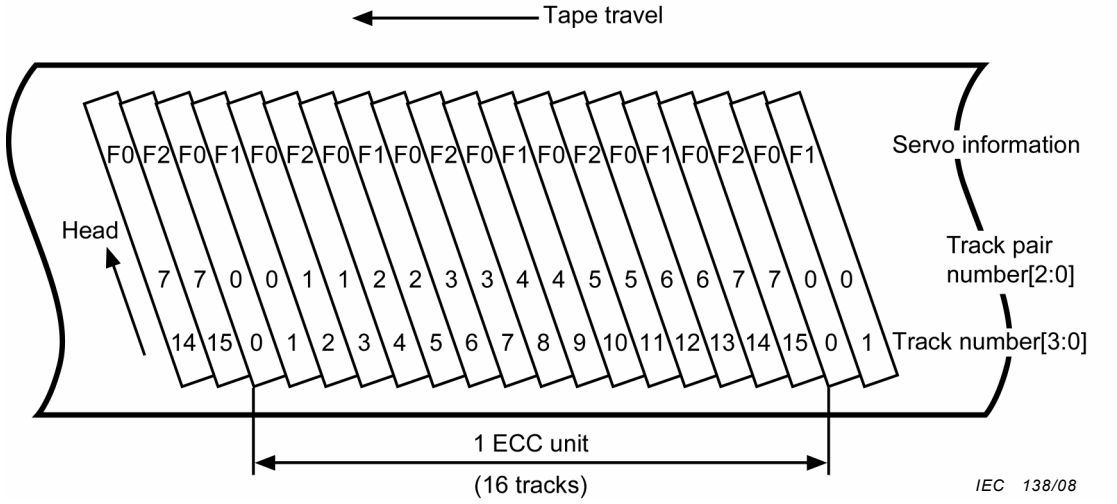


Figure 4 – Servo information and tracks

6.2.1.2 Labelling convention

The most significant bit is written on the left and is the first recorded on the tape. The lowest numbered byte is shown on the top left and is the first encountered in the input data stream. Byte values are expressed in binary coded decimal notation unless otherwise noted. An "h" indicates a hexadecimal value. A "b" indicates a binary value.

6.2.1.3 Signal processing

In this standard the modulation adopts a randomization distribution and a 24-25 modulation.

6.2.1.3.1 Randomization

Bit streams of data except sync patterns shall be randomized. Randomized distribution is equivalent to the performance of the exclusive OR operation between the serial data stream and the serial stream generated by the polynomial function below.

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

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

The first term is the most significant and the first to enter the division computation.

The randomization limits the run length of the same binary value.

Tables 6 and 7 show the randomization pattern used for the data sync blocks of the main sector and the subcode sector, respectively. In the tables, the randomization pattern was divided into bytes from first serial bit to the end in order and is expressed in hexadecimal notation. This randomization pattern is performed by the exclusive OR operation to byte position number 2 to 110 for data sync blocks of the main sector, and 2 to 11 for data sync blocks of the subcode sector with consistency from MSB to LSB.

Table 6 – Randomization pattern used for data sync blocks of the main sector

Byte position number	Randomization pattern	Byte position number	Randomization pattern	Byte position number	Randomization pattern	Byte position number	Randomization pattern
2	29h	30	7Bh	58	8Ch	86	95h
3	7Dh	31	87h	59	88h	87	98h
4	50h	32	F1h	60	12h	88	36h
5	B7h	33	D8h	61	69h	89	BAh
6	9Ch	34	A5h	62	EEh	90	32h
7	ACh	35	F5h	63	1Fh	91	20h
8	C1h	36	42h	64	C7h	92	49h
9	B5h	37	DEh	65	62h	93	A7h
10	D1h	38	72h	66	97h	94	B8h
11	91h	39	B3h	67	D5h	95	7Fh
12	02h	40	06h	68	0Bh	96	1Dh
13	4Dh	41	D7h	69	79h	97	8Ah
14	3Dh	42	46h	70	CAh	98	5Fh
15	C3h	43	44h	71	CCh	99	54h
16	F8h	44	09h	72	1Bh	100	2Dh
17	ECh	45	34h	73	5Dh	101	E7h
18	52h	46	F7h	74	19h	102	2Bh
19	FAh	47	0Fh	75	10h	103	30h
20	A1h	48	E3h	76	24h	104	6Dh
21	6Fh	49	B1h	77	D3h	105	74h
22	39h	50	4Bh	78	DCh	106	64h
23	59h	51	EAh	79	3Fh	107	40h
24	83h	52	85h	80	8Eh	108	93h
25	6Bh	53	BCh	81	C5h	109	4Fh
26	A3h	54	E5h	82	2Fh	110	70h
27	22h	55	66h	83	AAh		
28	04h	56	0Dh	84	16h		
29	9Ah	57	AEh	85	F3h		

Table 7 – Randomization pattern used for data sync blocks of the subcode sector

Byte position number	Randomization pattern
2	29h
3	7Dh
4	50h
5	B7h
6	9Ch
7	ACh
8	C1h
9	B5h
10	D1h
11	91h

6.2.1.3.2 Modulation

Same as defined in IEC 61834-1.

6.2.2 ITI sector

6.2.2.1 Introduction

Same as defined in IEC 61834-1.

6.2.2.2 ITI preamble

Same as defined in IEC 61834-1.

6.2.2.3 SSA (start-sync block area)

Same as defined in IEC 61834-1.

6.2.2.4 TIA (track information area)

Same as defined in IEC 61834-1.

The ID of track information as shown in Table 8 and the bit stream specified in Tables 9 to 11 shall be recorded as TIA.

Table 8 – ID of track information

APT_2	APT_1	APT_0	TP_1	TP_0	PF
0	1	0	1	1	0

Table 9 – Bit stream of TIA for track F0

Order of recording	Codeword MSB LSB
0	0010011101
1	0101101001
2	0110010101
3	0010011101
4	0101101001
5	0110010101
6	0010011101
7	0101101001
8	0110010101

Table 10 – Bit stream of TIA for track F1

Order of recording	Codeword MSB LSB
0	0111001000
1	0101101011
2	0110010111
3	1000110111
4	0101101011
5	0110010101
6	0111001000
7	1010010100
8	1001101000

Table 11 – Bit stream of TIA for track F2

Order of recording	Codeword MSB LSB
0	0111001000
1	0101101011
2	0110010111
3	1000110111
4	1010010100
5	1001101000
6	0111001000
7	0101101011
8	0110010111

6.2.2.5 ITI postamble

Same as defined in IEC 61834-1.

6.2.3 Main sector

6.2.3.1 Structure

The main sector consists of 139 data sync blocks as shown in Figure 5. Each data sync block is comprised of 2 sync bytes, ID code of 3 bytes, outer parity of 96 bytes, and inner parity of 10 bytes, or 2 sync bytes, ID code of 3 bytes, SB header, main data of 95 bytes, and inner parity of 10 bytes.

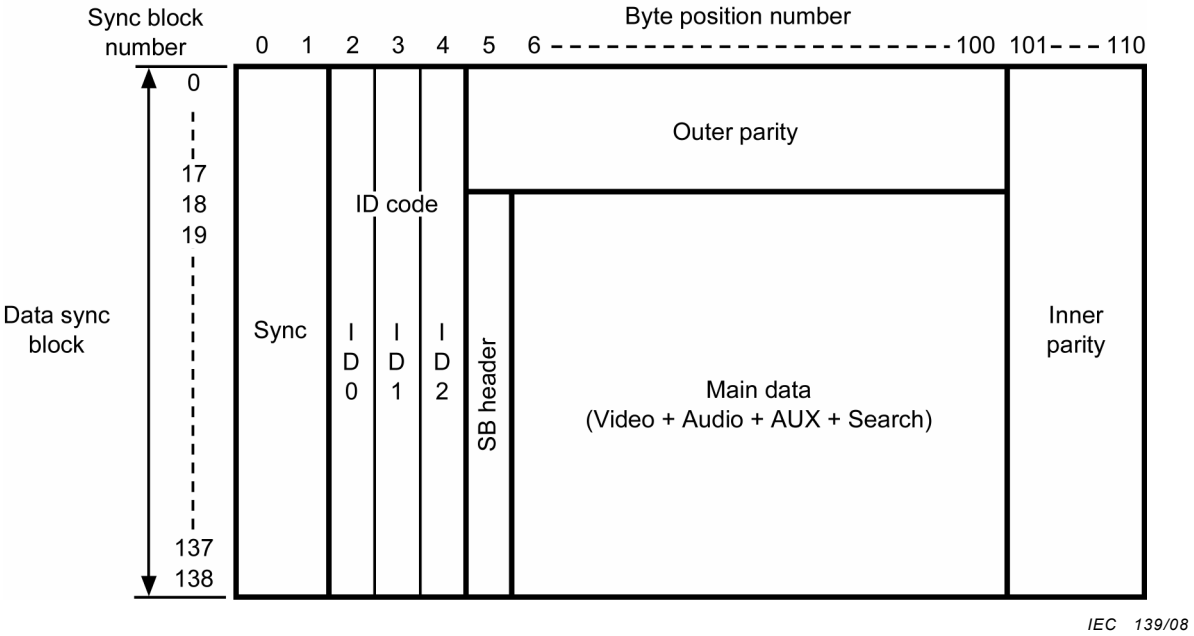


Figure 5 – Structure of main sector

6.2.3.2 Sync patterns

Two types of sync patterns are defined as shown below:

	MSB														LSB
Sync pattern M0:	0	1	0	1	1	1	1	1	1	1	1	1	0	0	0	0
Sync pattern M1:	1	0	1	0	0	0	0	0	0	0	0	0	1	1	1	1

A sync pattern to be recorded shall be chosen from the above two sequences according to the criteria as described for 24-25 modulation. The length of the sync shall be 17 bits as recorded on tape.

6.2.3.3 ID code

The ID code consists of 3 ID data bytes (ID0, ID1, ID2). As shown in Figure 6, the ID code consists of format type ($Ftyp_2$, $Ftyp_1$, $Ftyp_0$), track pair number (Trp_4, Trp_3, Trp_2, Trp_1, Trp_0), sync block number (Syb_7, Syb_6, Syb_5, Syb_4, Syb_3, Syb_2, Syb_1, Syb_0), and OWP (overwrite protection). ID0 contains the format type ID and the track pair number. The format type shall be as given in Table 12. The track pair number shall be as defined in Table 13.

ID1 contains the sync block number. The sync block number is numbered from 0 to 138.

ID2 contains the overwrite protection (OWP). The length of the OWP shall be 8 bits before modulation. Details are described in 6.2.3.4.

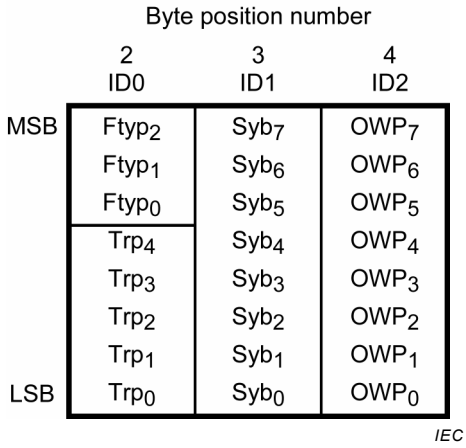


Figure 6 – Main sync block ID code word bit assignments

Table 12 – Format type

$Ftyp_2$	$Ftyp_1$	$Ftyp_0$	Meaning
0	0	0	Consumer format
0	0	1	Reserved
0	1	0	Reserved
0	1	1	Reserved
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	Reserved

Table 13 – Track pair number

Track pair number	Trp_4	Trp_3	Trp_2	Trp_1	Trp_0	Meaning
0	0	0	0	0	0	Track 0 & 1
1	0	0	0	0	1	Track 2 & 3
2	0	0	0	1	0	Track 4 & 5
3	0	0	0	1	1	Track 6 & 7
4	0	0	1	0	0	Track 8 & 9
5	0	0	1	0	1	Track 10 & 11
6	0	0	1	1	0	Track 12 & 13
7	0	0	1	1	1	Track 14 & 15
8	0	1	0	0	0	Track 16 & 17
9	0	1	0	0	1	Track 18 & 19
10	0	1	0	1	0	Track 20 & 21
11	0	1	0	1	1	Track 22 & 23
12	0	1	1	0	0	Track 24 & 25
13	0	1	1	0	1	Track 26 & 27
14	0	1	1	1	0	Track 28 & 29
15	0	1	1	1	1	Track 30 & 31

Track pair number	Trp_4	Trp_3	Trp_2	Trp_1	Trp_0	Meaning
16	1	0	0	0	0	Track 32 & 33
17	1	0	0	0	1	Track 34 & 35
18	1	0	0	1	0	Track 36 & 37
19	1	0	0	1	1	Track 38 & 39
20	1	0	1	0	0	Track 40 & 41
21	1	0	1	0	1	Track 42 & 43
22	1	0	1	1	0	Track 44 & 45
23	1	0	1	1	1	Track 46 & 47
24	1	1	0	0	0	Track 48 & 49
25	1	1	0	0	1	Track 50 & 51
26	1	1	0	1	0	Track 52 & 53
27	1	1	0	1	1	Track 54 & 55
28	1	1	1	0	0	Track 56 & 57
29	1	1	1	0	1	Track 58 & 59
30	1	1	1	1	0	Track 60 & 61
31	1	1	1	1	1	Track 62 & 63

6.2.3.4 Overwrite protection

OWP is used to detect the end recording position on the tape during playback, as well as the undeleted part of the tape base after overwriting. Byte position number 4 of the data sync

block in the main sector contains the OWP value, with a range of 0 to 255. Before recording on the tape, the value of the OWP is determined according to the following rules.

1) All OWP values shall be set to the same value within the same ECC unit.
2) For overwriting previously recorded tape, or recording adjacent to a previously recorded section, an OWP value different from that of the base (pre-recorded sync block in that position on the tape) shall be input at the beginning of the recording.

6.2.3.5 Error correction code addition

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

6.2.3.5.1 Inner error correction code

The inner parity, as shown in Figure 5, is defined as the codeword of an inner error correction code.

The inner error correction code is a (109, 99) Reed-Solomon code over the GF(2^8) of which the field generator polynomial is:

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

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

The generator polynomial of the code over the GF(2^8) is:

$$g_{in}(X) = (X + 1)(X + \alpha)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4)(X + \alpha^5)(X + \alpha^6)(X + \alpha^7)(X + \alpha^8)(X + \alpha^9)$$

where α is given by 2h.

Parities K_9, K_8, K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0, as shown in Figure 7, are given by the polynomial:

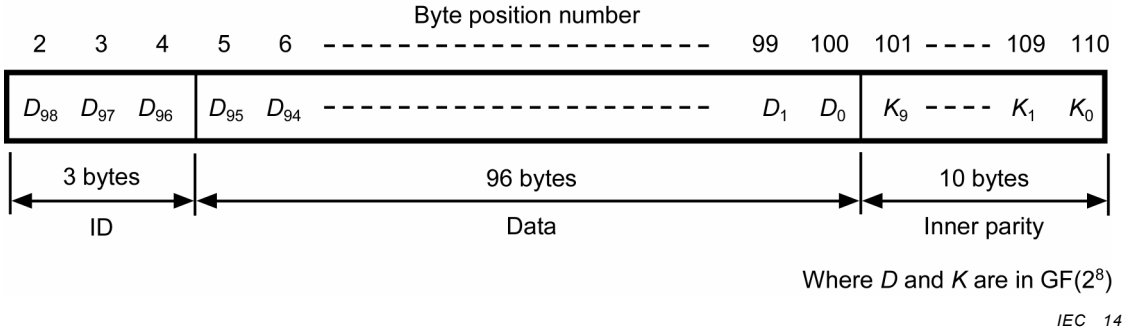
$$K_9X^9 + K_8X^8 + K_7X^7 + K_6X^6 + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

which is a remainder of $X^{10}D(X)$ divided by $g_{in}(X)$, where the data polynomial $D(X)$ is defined as:

$$D(X) = D_{98}X^{98} + D_{97}X^{97} + \bullet\bullet\bullet + D_2X^2 + D_1X + D_0$$

and the codeword polynomial is given by the following polynomial:

$$D_{98}X^{108} + D_{97}X^{107} + \bullet\bullet\bullet + D_1X^{11} + D_0X^{10} + K_9X^9 + K_8X^8 + \bullet\bullet\bullet + K_1X + K_0$$



IEC 141/08

Figure 7 – Data and inner parity of a data sync block for the main sector

6.2.3.5.2 Outer error correction code

The outer parity as shown in Figure 5 is defined as a codeword of an outer error correction code.

The outer error correction code is a (139, 121) Reed-Solomon code in GF(2^8) of which the field generator polynomial is:

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

where X^i are place-keeping variables in GF(2), the binary field. The generator polynomial of the code in GF(2^8) is:

$$g_{out}(X) = (X + 1)(X + \alpha)(X + \alpha^2)(X + \alpha^3)(X + \alpha^4) \bullet\bullet\bullet (X + \alpha^{15})(X + \alpha^{16})(X + \alpha^{17})$$

where α is given by 2h.

Parities K_{17}, K_{16}, K_{15}, $\bullet\bullet\bullet$ K_5, K_4, K_3, K_2, K_1, K_0, as shown in Figure 8, are given by the polynomial:

$$K_{17}X^{17} + K_{16}X^{16} + K_{15}X^{15} + \bullet\bullet\bullet + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

which is a remainder of $X^{18}D(X)$ divided by $g_{out}(X)$, where the data polynomial $D(X)$ is defined as:

$$D(X) = D_{120}X^{120} + D_{119}X^{119} + \bullet\bullet\bullet + D_2X^2 + D_1X + D_0$$

and the codeword polynomial is given by the following polynomial:

$$D_{120}X^{138} + D_{119}X^{137} + D_{118}X^{136} + \bullet\bullet\bullet + D_1X^{19} + D_0X^{18} + K_{17}X^{17} + K_{16}X^{16} + K_{15}X^{15} + \bullet\bullet\bullet + K_1X + K_0$$

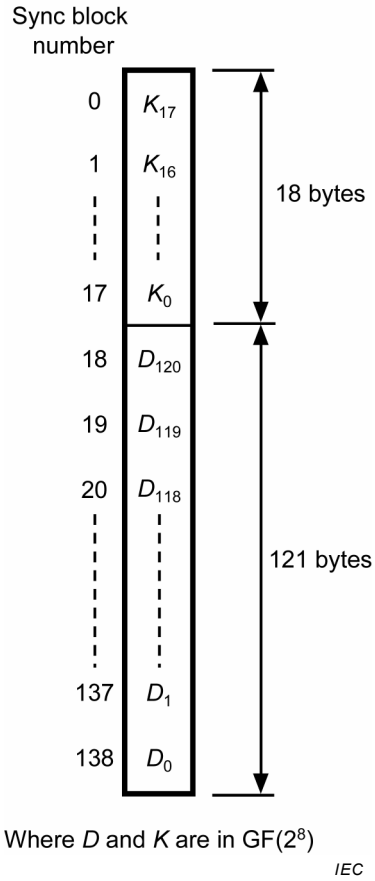


Figure 8 – Data and outer parity of a data sync block for the main sector

6.2.3.5.3 Outer parity interleaving

There are 1 536 codewords in 1 ECC unit block.

Bytes in codeword CW*n* are indicated by CW*n*[*i*]

where

n is the codeword number (*n* = 0..1 535);
i is the index for byte in the codeword (*i* = 0..138).

Bytes within 1 ECC unit block (see Figure 9) are numbered by

b = byte position number in the sync block
s = sync block number in the track
t = track number in the ECC unit block

The relation between the bytes from a codeword and the bytes in the ECC unit block is as follows.

$b = n \bmod (96) + 5$

$s = 17 - i$ (when $i < 18$)
$156 - i$ (when $i \geq 18$)

$t = \{n \text{ div } (96) \times 5 + (17 - i) \times 11\} \bmod (16)$ (when $i < 18$)
$\{n \text{ div } (96) \times 5 + (156 - i) \times 11\} \bmod (16)$ (when $i \geq 18$)

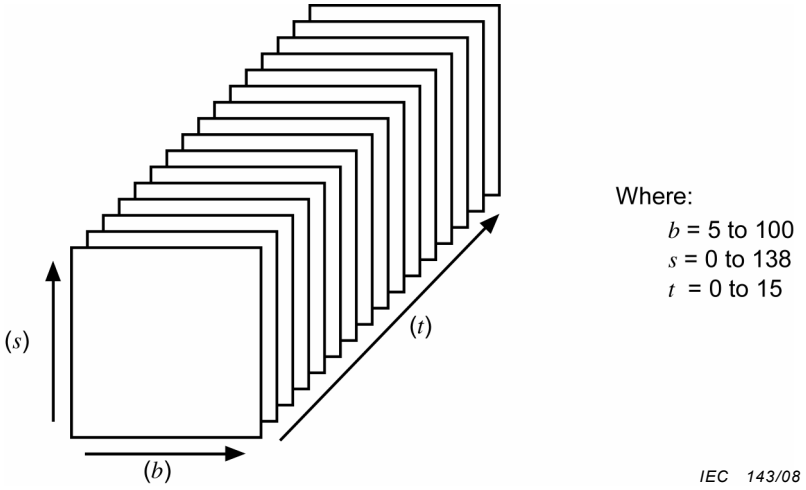


Figure 9 – Interleaving on a 16-track basis (ECC unit)

6.2.4 Subcode sector

6.2.4.1 Structure

The subcode sector consists of a subcode preamble, 12 data sync blocks and subcode postamble as shown in Figure 10. The subcode preamble has a run-up of modulated 275 bits. The subcode postamble begins with a run-up of modulated 1 325 bits (1080i/60 system) or modulated 1 200 bits (1080i/50 system).

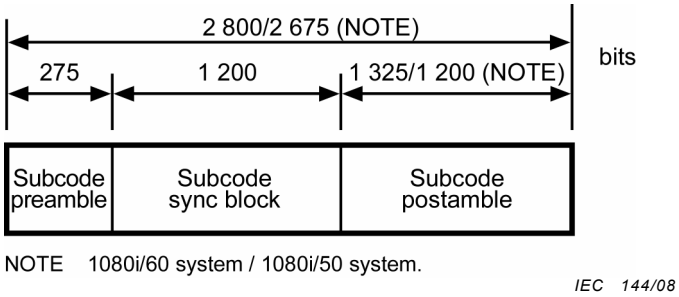


Figure 10 – Structure of subcode sector

6.2.4.2 Sync patterns

Same as defined in IEC 61834-1.

6.2.4.3 ID part

The ID part consists of 2 ID data bytes (ID0, ID1) and 1 ID parity byte (IDP). Figure 11 shows the ID data in the subcode sector. ID data consists of application ID ($AP3_2$, $AP3_1$, $AP3_0$ (see Table 14), FR ID, Index ID, Skip ID, PP ID, absolute track number (ABST) and sync block number (Syb_3, Syb_2, Syb_1, Syb_0). Sync block numbering goes from 0 to 11 and is stored in ID1 in binary notation. Sync block number = Fh means no information. More details are described in 8.5.

ID parity is same as defined in IEC 61834-1.

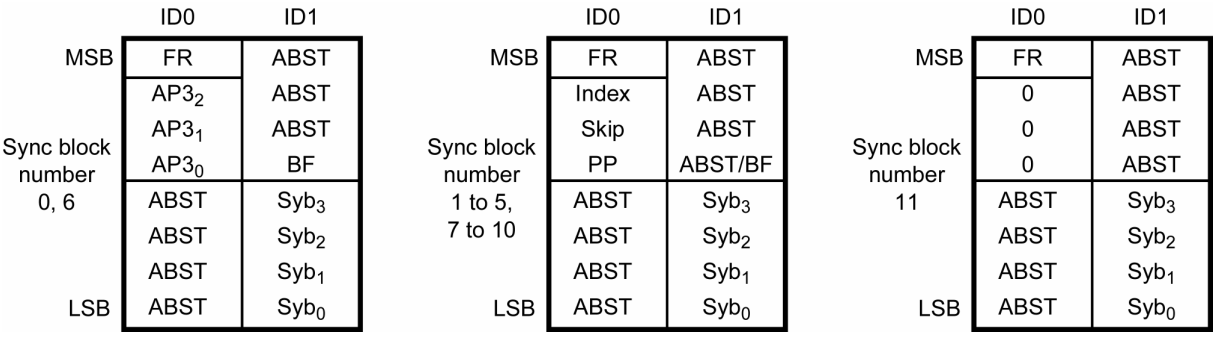


Figure 11 – ID data in subcode sector

Table 14 – Application ID of area 3 (AP3)

AP3$_2$	AP3$_1$	AP3$_0$	Meaning
0	0	0	Consumer digital VCR

6.2.4.4 Error correction codes

Same as defined in IEC 61834-1.

7 HD1 mode for 480, 576 and 720 systems

7.1 General

Clause 7 describes the HD1 mode format extensions to IEC 61834-9 and IEC 61834-10. The 25 Mbps data rate mode shall be used for HD1 recordings.

7.2 Normal play data

7.2.1 Introduction

This section defines the MPEG stream that is generated by an encoder which is compliant with the HD1 mode of HDV recording format.

7.2.2 System layer

1) ISO/IEC 13818-1 compliant transport stream.
2) NULL packet or adaptation field stuffing shall be used, if required.
3) This stream shall be fully MPEG compliant with reference to ISO 13818-9.
4) The limit peak data rate is recommended to be close to the average data rate.

7.2.3 Transport packet layer

1) NULL packets shall be encoded as specified in ISO/IEC13818-1. (PID with value of 1FFFh.) NULL packets are intended for padding in transport stream.
2) values for service information are given in EN 300 468. Partial TS as defined in EN 300 468 is used for this system.

7.2.4 Adaptation field

The time interval between two consecutive PCR values of the same program shall not exceed 100 ms. It is recommended that this interval be no greater than 40 ms.

7.2.5 PES packet

The PES_scrambling_control bit shall be set to 00b.

7.2.6 PSI

7.2.6.1 PMT and SIT descriptors

The use of PMT and SIT descriptors is mandatory. Possible descriptor locations are shown in Table 15.

Table 15 – Possible descriptor locations

Descriptor	Tag value	PMT	SIT
registration_descriptor	05h	P	
maximum_bitrate_descriptor	0Eh	P	
DTCP_descriptor	88h	P	
video_stream_descriptor	02h	E	
stream_identifier_descriptor	52h	E	
partial transport_stream_descriptor	63h		T

NOTE P:program info loop, E:ES info loop, T:transmission info loop

7.2.6.2 PAT

The PAT shall list one program. In addition, the network_PID reference shall be assigned the value of the SIT_PID instead of the NIT_PID.

The PAT shall be repeated with a maximum time interval of 120 ms between repetitions. It is recommended that this interval be no greater than 100 ms.

7.2.6.3 PMT

The PMT shall be repeated with a maximum time interval of 120 ms between repetitions. It is recommended that this interval be no greater than 100 ms.

7.2.6.3.1 Descriptors in program info loop

7.2.6.3.1.1 Registration_descriptor

Table 16 – Registration_descriptors (descriptor_tag = 05h)

Syntax	No. of bits	Identifier
registration_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
format_identifier	32	uimsbf
subset_format_identifier	5	bslbf
subset_version	3	bslbf
version	8	bslbf
reserved	32	bslbf
}		

descriptor_tag – This field shall be set to 05h (as specified in ISO/IEC 13818-1).

descriptor_length – This field is fixed to 0Ah.

format_identifier – This field shall be set to 4d54524dh (“MTRM” in ASCII – MPEG transport stream for recording media).

subset_format_identifier – This field contains 5-bit value for subset of MTRM format. The value of the subset_format_identifier shall be set to 01h.

subset_version – This 3-bit field defines the version number of the subset specification defined by subset_format_identifier. The value of the subset_version shall be set to 1h.

version – This field defines the version number of this specification. The first 4 bits indicates the major version number, and the last 4 bits indicates the minor version number. The value of the version shall be set to 10h.

Reserved – These bits are reserved for future definition and are currently defined to have a value of one.

7.2.6.3.1.2 DTCP_descriptor

Table 17 – DTCP_descriptor (descriptor_tag = 88h)

Syntax	No. of bits	Identifier
DTCP_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
CA_System_ID	16	uimsbf
For (i=0; i < descriptor_length - 2; i++) {		
private_data_byte	8	bslbf
}		
}		

Syntax	No. of bits	Identifier
private_data_byte {		
reserved	5	bslbf
EPN	1	bslbf
DTCP_CCI	2	bslbf
reserved	5	bslbf
Image_Constraint_Token	1	bslbf
APS	2	bslbf
}		

CA_System_ID – This field shall be set to 0FFFh (DTLA – Digital transmission licensing administrator).

EPN - This encryption plus non-assertion bit signals the prevention of Internet retransmission of content that is not otherwise copy-controlled.

DTCP_CCI - This copy control information field indicates the digital copy generation management information shown in Table 18.

Table 18 – DTCP_CCI

DTCP_CCI	description
00b	Copy-free
01b	No-more-copies
10b	Copy-one-generation
11b	Copy-never

Image_Constraint_Token – This bit controls whether high-definition resolution content shall be image-constrained when being transmitted over unprotected analogue component outputs. The two states of the Image_Constraint_Token bit have the meaning as shown in Table 19.

Table 19 – Image_Constraint_Token

Image_Constraint_Token	Description
0	The content must be image constrained to no greater than 520 000 pixels (Active horizontal pixels multiplied by active vertical lines).
1	The content need not be image constrained

APS – This field defines analogue video output control for the associated program. When DTCP_CCI is equal to 00b, APS shall be set to 00b. When DTCP_CCI is equal to 10b, APS defines the analogue video output control for the copied program. Copy protection signals shall be applied to the analogue output as described in Table 20.

Table 20 – APS

APS	Description
00b	Copy-free
01b	APS is on: Type 1 (AGC)
10b	APS is on: Type 2 (AGC + 2L colorstripe)
11b	APS is on: Type 3 (AGC + 4L colorstripe)

7.2.6.3.2 Descriptors in ES info loop

7.2.6.3.2.1 Stream_identifier_descriptor

Table 21 – Stream_identifier_descriptor (descriptor_tag = 52h)

Syntax	No. of bits	Identifier
stream_identifier_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
component_tag	8	uimsbf
}		

component_tag – This field indicates the default elementary stream for each type. Within a program map section, each stream identifier descriptor shall have a different value for this field. The value of component_tag shall be constrained as shown in Table 22.

Table 22 – Component_tag

Component	Value of component_tag
video	00h – 0Fh (00h shall indicate default ES)
audio	10h – 2Fh (10h shall indicate default ES)
subtitling data	30h – 4Fh (30h shall indicate default ES)
reserved	50h – FFh

7.2.6.4 SIT

The SIT shall be packetized into the transport stream packet starting from the beginning of the payload, i.e. in a packet with payload_unit_start_indicator in the transport stream packet header set to 1 and with the pointer_field set to 00h. Furthermore, it is recommended that the SIT be packetized into a single transport stream packet if possible.

7.2.6.4.1 Descriptors in transmission info loop

7.2.6.4.1.1 Partial_transport_stream_descriptor

Table 23 – Partial_transport_stream_descriptor (descriptor_tag = 63h)

Syntax	No. of bits	Identifier
partial_transport_stream_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	2	bslbf
peak_rate	22	uimsbf
reserved_future_use	2	bslbf
minimum_overall_smoothing_rate	22	uimsbf
reserved_future_use	2	bslbf
maximum_overall_smoothing_buffer	14	uimsbf
}		

descriptor_tag – This field shall be set to 63h (as specified in EN 300 468).

peak_rate – The maximum momentary transport packet rate (i.e., 188 bytes divided by the time interval between start times of two succeeding transport stream packets). An upper bound for this peak_rate should be given. This field is coded as a positive integer in units of 400 bits/s.

minimum_overall_smoothing_rate – Minimum smoothing buffer leak rate for the overall transport stream (all packets are covered). This field is coded as a positive integer in units of 400 bits/s. The value 3FFFFFh is used to indicate that the minimum smoothing rate is undefined.

maximum_overall_smoothing_buffer – Maximum smoothing buffer size for the overall transport stream (all packets are covered). This field is coded as a positive integer in units of 1 byte. The value 3FFFh is used to indicate that maximum smoothing buffer size is undefined.

7.2.6.5 DIT

At a transition, the bit stream may be discontinuous with respect to any of the SI information (including PAT and PMT). The DIT shall be inserted at this transition points except for seamless playback (see 7.4.3). It is recommended that the DIT be inserted at the following points.

Recording mode:

1) The end point of the recording.
2) The start point of the recording (in the cases where GOP frame management is impossible (see 7.4.3)).

Playback mode:

3) The start point of playback.
4) The start point of trick play.

Whenever a partial bit stream discontinuity occurs, two transport packets labelled with PID 001Eh shall be inserted directly at the transition point, with no other packets in between. The first one shall have 184 bytes of adaptation field stuffing with the discontinuity_flag set to 1. The second of these transport packets shall contain the DIT and shall not have the discontinuity_flag set to 1.

Table 24 – DIT (PID = 001Eh/table_id = 7Eh)

Syntax	No. of bits	Identifier
discontinuity_information_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transition_flag	1	bslbf
reserved_future_use	7	bslbf
}		

table_id – This field shall be set to 7Eh.

section_syntax_indicator – This field shall be set to 0.

section_length – This field shall be set to 001h.

transition_flag – This flag indicates the type of transition in the transport stream. When the bit is set to "1", it indicates that the transition is due to a change of the originating source. The change of the originating source can be a change of originating transport stream and/or a change of the position in the transport stream (for example, in the case of time-shift). When the bit is set to "0", it indicates that the transition is due to a change of the selection only, i.e., while staying within the same originating transport stream at same position.

7.2.7 Video

7.2.7.1 Video PES packet

It is recommended that one PES packet contain one picture. PES packets containing either I or P-pictures should contain PTS and DTS, and PES packets containing B-picture should contain PTS.

7.2.7.2 Video ES

1) The video elementary stream shall have GOP structure. In normal play stream, the video sequence header shall be immediately followed by an I-picture, and should be encoded at least once every 36 display fields in the case of the 525-60 system, and at least once every 30 display fields in the case of the 625-50 system.
2) If quantiser matrices other than the default value are used, the appropriate intra_quantiser_matrix and/or non_intra_quantiser_matrix shall be included in every sequence header.

7.2.7.3 30/60 frame system

The encoded picture shall have a full screen luminance resolution of following values in Table 25.

Table 25 – MPEG-2 parameters constraints for 30/60 frame system

vertical_size_ value	horizontal_size_ value	aspect_ratio_ information	frame_rate_ code	progressive_ sequence	profile_and_level_ indication
480	720	2/3	4	1	01001000b
480	720	2/3	4	0	01001000b
480	720	2/3	7	1	01000110b
720	1280	3	4	1	01000110b
720	1280	3	7	1	01000100b

aspect_ratio_information:

2 = 4:3 DAR

3 = 16:9 DAR

frame_rate_code:

4 = 30 ÷ 1,001 Hz

7 = 60 ÷ 1,001 Hz

progressive_sequence:

0 = interlace or progressive

1 = progressive

profile_and_level_indication:

01001000b = MP@ML

01000110b = MP@H-14

01000100b = MP@HL

7.2.7.4 25/50 frame system

The encoded picture shall have a full screen luminance resolution of following values in Table 26.

Table 26 – MPEG-2 parameters constraint for 25/50 frame system

vertical_size_ value	horizontal_size_ value	aspect_ratio_ information	frame_rate_ code	progressive_ sequence	profile_and_level_ indication
576	720	2/3	3	1	01001000b
576	720	2/3	3	0	01001000b
576	720	2/3	6	1	01000110b
720	1280	3	3	1	01000110b
720	1280	3	6	1	01000110b or 01000100b

aspect_ratio_information:

2 = 4:3 DAR

3 = 16:9 DAR

frame_rate_code:

3 = 25 Hz

6 = 50 Hz

progressive_sequence:

0 = interlace or progressive

1 = progressive

profile_and_level_indication:

01001000b = MP@ML

01000110b = MP@H-14

01000100b = MP@HL

7.2.7.5 24p recording

When the video of frame rate 24/1,001Hz is to be recorded, the video shall be processed by the 2-3 pulldown method and shall be recorded using the 30/60 frame system. It is recommended that the 2-3_pulldown field in the embedded pack data (7.2.9) should be set to 1. Each of the 24 source frames is repeated 2 or 3 times according to the 2-3 pulldown process. The number of frame repetitions is indicated using the repeat_first_field and top_field_first shown in Table 27. This encoding method is compliant with ARIB STD-B20, 4.4. The following MPEG-2 parameters shall be used for the 24p recording.

vertical_size_value = 480 or 720

frame_rate_code = 7

progressive_sequence = 1

Table 27 – Expression method of the number of repetitions

repeat_first_field	top_first_field	number of repetitions
0	0	1
1	0	2
1	1	3

7.2.8 Audio

7.2.8.1 Audio stream

- The encoded stream shall comply with the MPEG-1 Layer II stereo specification (layer = 10b, mode = 00b)
- The CRC word shall be included in the encoded stream (protection_bit = 0)
- The bit rate shall be 384 kbps (bitrate_index = 1110b)
- The sampling frequency shall be 48 kHz (sampling_frequency = 01b)
- Padding is unnecessary (padding_bit = 0)
- The encoding stream shall not have emphasis (emphasis = 00b)
- When multiple audio streams are recorded, each audio stream shall be assigned a different PID. It is recommended that the PID of the most important audio stream should appear first in the audio stream PID listing in the PMT and that the component_tag in the stream_identifier_descriptor paired with the most important audio stream is set to 10h (default ES)
- For audio dubbing during non-linear editing, the sub audio stream may be recorded in advance. It is recommended that this sub audio stream should be the clone stream of the main audio stream except for the PID and PCR

- The PID value of the sub audio stream should be larger than the PID value of the main audio stream

7.2.8.2 Audio area

Audio data formatted according to IEC 61834-2 may be recorded in the audio area and be used for audio dubbing. The validity of audio data can be determined by checking that AP1 equals “000b” and REC_MODE of AAUX SOURCE CONTROL pack does not equal “111b”. Playback of audio formatted according to IEC 61834-2 is optional.

7.2.9 Embedding of pack data

Pack data as defined in IEC 61834-4 may be embedded into the transport stream. The data should be structured as shown in Table 28 and embedded as private_data in the adaptation field of the TS packets.

The PID of the TS packet shall be 0F02h and the stream_type in the PMT shall be A2h.

The embedded_pack_data shall be embedded within one TS packet and this packet shall be inserted only once within 3 ms after the first byte of the “head video TS packet” of each GOP. The “head video TS packet” contains the first byte of the PES packet that contains the GOP header. The information in the embedded pack corresponds to the first frame of the GOP.

When embedding the pack data by this method, pack header values of 90h and 91h shall be used.

When a stream that includes embedded pack data is to recorded via a digital interface, the recording’s VAUX data should be based on the pack data.

Table 28 – Embedded pack data

Syntax	No. of bits	Identifier
embedded_pack_data() {		
identification_string	32	uimsbf
seamless_playback_point	1	bslbf
2-3_pulldown	1	bslbf
pulldown_repetition	1	bslbf
reserved	5	bslbf
for (i = 0; i < N; i++) {		
PC0	8	uimsbf
PC1	8	uimsbf
PC2	8	uimsbf
PC3	8	uimsbf
PC4	8	uimsbf
}		

identification_string – The value of this field shall be 4456504bh (DVPK in ASCII).

seamless_playback_point – If this bit is set to 1, it indicates that this GOP period is the first GOP of the transition at which the seamless playback is possible. For all other conditions this bit shall be set to 0.

2-3_pulldown – When the 2-3 pull-down source is recorded, it is recommended that this bit is set to 1.

pulldown_repetition – If this bit is set to 1 and the 2-3_pulldown is set to 1, this indicates that the first frame of the GOP is repeated 3 times. If this bit is set to 0 and the 2-3_pulldown is set to 1, this indicates that the first frame of GOP is repeated 2 times. When the 2-3_pulldown is set to 0, this bit shall be set to 0.

reserved – The value of these reserved bits shall be set to 11111b.

7.2.10 Bit rate

Even though no trick play data is recorded (see 7.3.1), the bit rate of normal play data shall not exceed the following values.

525-60system: (38 + 50 + 38 + 50) / 4 × 188 × 300 × 1,001 × 8 = 19,83 Mbps

625-50system: (38 + 50 + 38 + 50) / 4 × 188 × 300 × 8 = 19,85 Mbps

7.3 Trick play data

7.3.1 TPH and TPL

Trick play data recording is not mandatory but is strongly recommended. If trick play data is used, TPH shall be recorded, but the recording of TPL remains optional.

7.3.2 PES packet

7.3.2.1 Recording

In order to simplify trick play processing, the PES packet is prepared as follows.

The DSM_trick_mode_flag shall be set to 1, but the values in the 8-bit field for

trick_mode_control, field_id, intra_slice_refresh, frequency_truncation, rep_cntrl

are arbitrary.

7.3.2.2 Playback

The 8-bit field prepared at recording shall be overwritten according to the playback speed.

7.3.3 Transport stream

7.3.3.1 Recording

The PAT and PMT shall be inserted into the trick play data. It is recommended that one or more sets of PAT and PMT be recorded in the trick play data for each frame. The data size of the TPH and TPL TS packets for one frame shall be 750kbit or less, respectively.

7.3.3.2 Playback

The time interval between PSI packets shall comply with the specification for normal play (see 7.2.6). The value of PCR shall be accurate. A DIT shall be inserted when starting trick play.

7.3.4 Transmission via digital interface

When the trick play stream is transmitted through a digital interface, time periods between I-frame data which contain no output video packets may occur, and the PTS and DTS in the video PES packet of trick play streams may be inaccurate.

7.4 Seamless playback at transition point

In order to realize seamless playback, the methods described in this subclause in addition to 7.2 are recommended.

7.4.1 Management method of GOP recording position

7.4.1.1 GOP frame management pack

The GOP frame management pack shown in Table 29 is used to synchronize the GOP of the recording stream with the servo frame recorded on the tape. The length of the servo frame is shown in Table 30. The servo frames shall begin on the tracks numbered “0”. The video TS packets equivalent to one GOP shall not be recorded so as to straddle both periods of GOP_FRAME_SIZE servo frame(s). The GOP frame management pack shall be written in the optional area of the subcode sector. When GOP frame management cannot be accomplished, GOP_FRAME_SIZE shall be set to 0 and GOP_FRAME_NUMBER shall be set to 31.

Table 29 – GOP frame management pack

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
PC0	1	1	1	1	0	0	0	0	F0h
PC1	0	1	0	1	1	0	0	0	58h
PC2	0	0	0	0	0	0	0	1	01h
PC3	1	1	1	1	1	1	0	0	FCh
PC4	0	0	0	0	0	0	1	0	02h

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
PC0	1	1	1	1	0	0	0	1	F0h
PC1	1	1	1	1	1	0	0	1	F9h
PC2	FUNCTION								00h
PC3	INTER LACE	V_SIZE	Reserved	GOP_FRAME_SIZE					
PC4	FRAME_RATE			GOP_FRAME_NUMBER					

Table 30 – Servo frame length

525-60 system	625-50 system
10 tracks	12 tracks

FUNCTION:

0 = GOP frame management

Others = Reserved

GOP_FRAME_SIZE:

GOP_FRAME_SIZE is the number of servo frames equivalent to one GOP period. A value of (GOP size) shall be used to make the following expression yield a positive and even integer.

GOP_FRAME_SIZE = (GOP size) × (servo frame rate) ÷ (MPEG frame rate)

EXAMPLE: 525-60 System, GOP size = 12 frame, 720p/60

GOP_FRAME_SIZE = 12 × (30 ÷ 1,001) ÷ (60 ÷ 1,001) = 6

0 shall mean “No information”

GOP_FRAME_NUMBER:

GOP_FRAME_NUMBER is modulo GOP_FRAME_SIZE counter incremented by a servo frame. The value of GOP_FRAME_NUMBER of the servo frame just after a GOP boundary is 0.

0 to 30 (GOP_FRAME_SIZE -1)

31 - No information

Unless GOP_FRAME_SIZE and GOP_FRAME_NUMBER indicate “No information”, INTERLACE, V_SIZE, Reserved and FRAME_RATE field shall be compliant with the following:

INTERLACE:

0: Progressive

1: Interlace

V_SIZE:

0: 480 line or 576 line

1: 720 line

Reserved:

It is recommended that this field should be set to 0b.

FRAME_RATE:

0: 24 ÷ 1,001Hz

1: 25Hz

2: 30 ÷ 1,001Hz

3: reserved

4: 50Hz

5: 60 ÷ 1,001Hz

6: reserved

7: No information

When either the GOP_FRAME_SIZE or GOP_FRAME_NUMBER fields indicates “No information”:

It is recommend that each of the INTERLACE, FRAME_SIZE and Reserved field should be set to 0b and the FRAME_RATE field should be set to 111b.

7.4.1.2 Recording data

GOP frame management is shown in Figure 12.

1) The video stream shall be encoded using closed GOP method.
2) Using the pack information described in 7.4.1.1, recording shall start from the first track of the boundary of recorded GOP.
3) The VBV buffer consumption just before removing the I-picture data from VBV buffer shall be equal to the following values.

   480i/60, 480p/30, 480p/60, 576i/50, 576p/25, 576p/50 : 1 802 240 bit

   720p/30, 720p/60, 720p/25, 720p/50 : 3 670 016 bit
4) At the beginning of a recording, ten or more packets which are NULL or PSI or audio TS packet (not video TS packet) shall be recorded.
5) At a transition point valid video TS packets might be discarded as duplicate packets if they have the same continuity_counter values before and after the transition point. In order to prevent this, a dummy video TS packet shall be inserted just before the first

video TS packet of the GOP. When embedding the pack data using the method described in 7.2.9, this dummy packet precedes the embedded pack data.

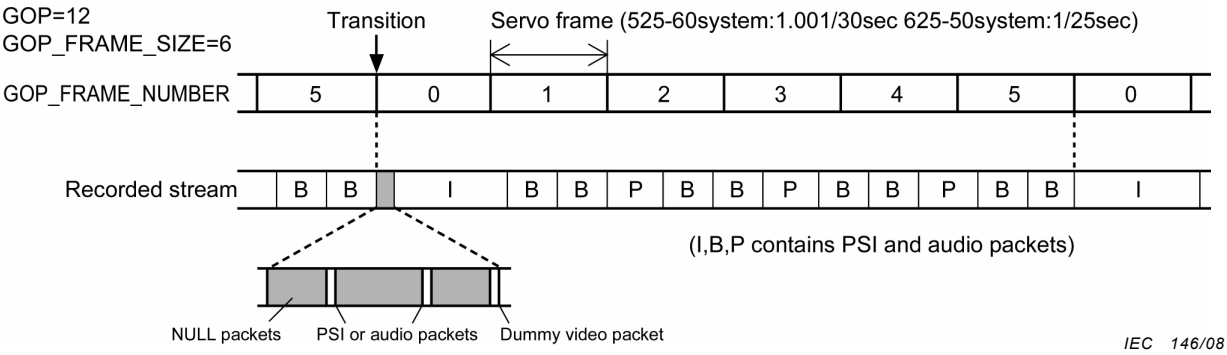


Figure 12 – GOP frame management

7.4.2 PID

For seamless playback, PIDs of the recording stream shall use the following values.

PMT: 006Eh

PCR: 0FFFh

Video: 1000h

Audio: 1002h, 1004h (sub audio stream for audio dubbing)

7.4.3 DIT

No DIT shall be recorded at the start point of a recording where GOP frame management can be continued since the tape was previously recorded with GOP frame management. A DIT shall be inserted at the start point of a recording when the stream received from a digital interface is recorded or when the self-encoded stream is recorded on a tape that was previously recorded without GOP frame management. A DIT shall be inserted at the end point of a recording. At the playback the insert points of the DITs shall be compliant with section 7.2.6.5.

7.4.4 Recording data

1) GOP frame management is possible if the recording video frame is synchronized with the servo frame. Therefore, if the servo frame rate is 30/1.001Hz the 30/60 frame system parameters shall be used, and, if the servo frame rate is 25Hz, the 25/50 frame system parameters shall be used.
2) As the stream may be discontinuous at transition points, there is no guarantee that the PTS, DTS, PCR and continuity_counter are continuous at these points.
3) At a transition point, there is no guarantee that the time stamps appended to TS packets (TSH and TSL) are continuous.
4) At the start of playback, up to 10 packets recorded at the start point of a transition may be discarded.

7.4.5 Seamless playback stream

Since the values of the PCRs are discontinuous at transition points of the stream, playback is impossible using PTS and DTS. It is therefore necessary to determine whether seamless playback is possible or not by checking the GOP frame management pack and the REC START/REC END field in the SOURCE CONTROL pack (pack header = 91h). If it is possible, special processing for seamless playback (for example, “free run mode”) may be performed.

8 HD2 mode for 1080 system

8.1 Data structure

This section specifies the data structure for the HD2 mode for 1080i/60 and 1080i/50 systems. In the HD2 mode, the helical tracks contain an ITI sector, a main sector and a subcode sector.

8.1.1 Main data

The main data in the main sector shall consist of 121 data sync blocks in each track (see Figure 5). The first byte of each main sync block is a SB header (at byte position number = 5), the other 95 bytes are SB data (byte position number = 6 to 100) as shown in Figure 13. The SB header indicates the SB data type which can be AUX data, audio PES data, video PES data, search data or null data (see 8.1.2).

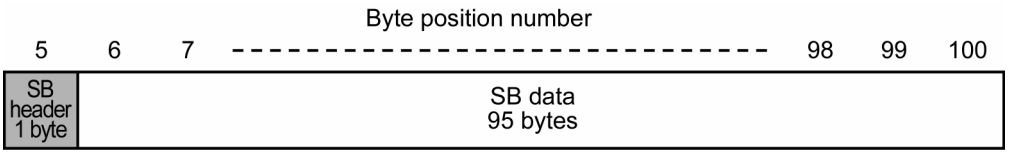


Figure 13 – Structure of main sync block

8.1.2 Structure of SB header

The SB header bits are defined in Table 31. The sync block data types are indicated through the use of 1 of the 5 defined header types: AUX sync block, PES-A sync block, PES-V sync block, search sync block and null sync block. The SB data type is indicated by the first three bits. The remainder of the bits are defined as follows.

Table 31 – Structure of SB header

	Data type							
	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Null sync block	0	0	0	0	0	0	0	0
AUX sync block	0	0	1	SBSC	CC			
PES-A sync block	0	1	0	PET	CC			
PES-V sync block	0	1	1	PET	CC			
Reserved	1	0	0	Reserved				
Reserved	1	0	1	Reserved				
Search sync block	1	1	0	SBSC	SSPD			0
Reserved	1	1	1	Reserved				

SBSC: Sync block scramble control (used in AUX and search headers)

0 = Sync block scramble off

1 = Sync block scramble on

CC: Continuity counter (used in AUX, PES-A and PES-V headers)

This continuity counter is a 4-bit field incrementing by the sync block unit. Its purpose is to detect data continuity over multiple sync blocks. The sync block CC of AUX-A, AUX-V, PES-A and PES-V increment independently. However, the ECCTB pack CC in the AUX-SYS group has a fixed value of 000b.

PET: PES type (used in PES-A and PES-V headers)

This flag indicates the PES-A sync block and PES-V sync block types (see 8.2.1).

0 = Full PES structure

1 = Partial PES structure

SSPD: Search speed (used in search header)

010b = 8x speed search

100b = 24x speed search

Others = Reserved

8.1.3 Null sync block

A null sync block contains 000b in the data type field. Null sync blocks may be used to adjust the recording position of Pack-Units.

Table 32 – Null sync block

Byte position No.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
5	Data type (000b)			0	0	0	0	0	SB header
6	0	0	0	0	0	0	0	0	
100	0	0	0	0	0	0	0	0	

8.2 PES data

8.2.1 PES sync block

Audio PES data and video PES data are packed into multiple PES sync blocks. 95 bytes of PES data are recorded as a Full-PES (PET = 0), and less than 95 bytes are recorded as a Partial-PES (PET = 1) as shown in Figure 14. The Partial-PES PES data are recorded from byte position number 7, with the remainder recorded as null data (00h). The value of the length shall be between 1 and 94. Partial-PES shall use only a sync block which contains the last byte of video PES data or audio PES data.

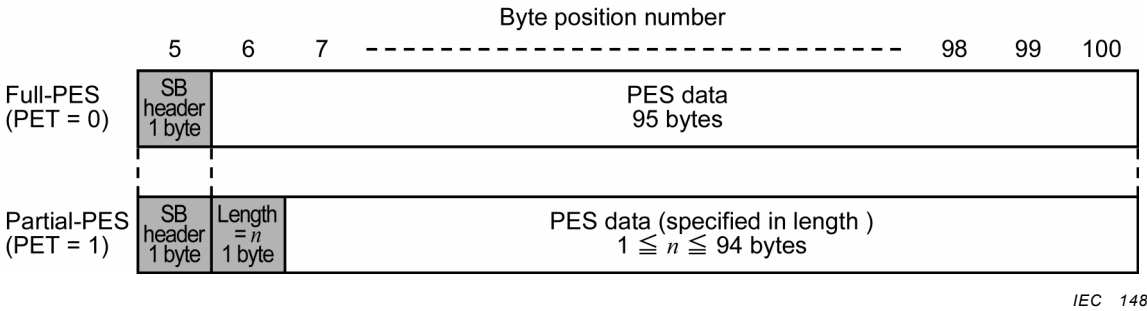


Figure 14 – Recording pattern of PES sync block

8.2.2 PES-A and PES-V

PES-A sync blocks are defined as containing audio stream data equal to 1 AAU. The PES-V sync blocks are defined as containing video stream data equal to 1 frame of video. Both PES-A and PES-V are recorded according to the order of the sync block number of the inside track. A PES sync block shall not contain more than one PES-A or one PES-V unit.

8.2.3 PES construction

PES-A and PES-V units are combined as follows and recorded on the tape.

8.2.3.1 Pack-A, Pack-V, Pack-Pair, Pack-Unit

A Pack-V is a unit containing a certain number of PES-V video frames. A Pack-A is a unit equal in length to the corresponding Pack-V and contains PES-A data. They are subject to the following rules.

Pack-V:

- The leading PES-V in each Pack-V shall be an I-picture or a P-picture.
- A Pack-V shall contain 3 or fewer video frames. In the case of 2 or fewer frames, the leading PES-V should be a P-picture.
- Pack-V of 2 or less frames shall not be followed by a Pack-V of 2 or less frames, but may be followed by an Edit Pack-V (see 8.2.3.2) of 2 or less frames.

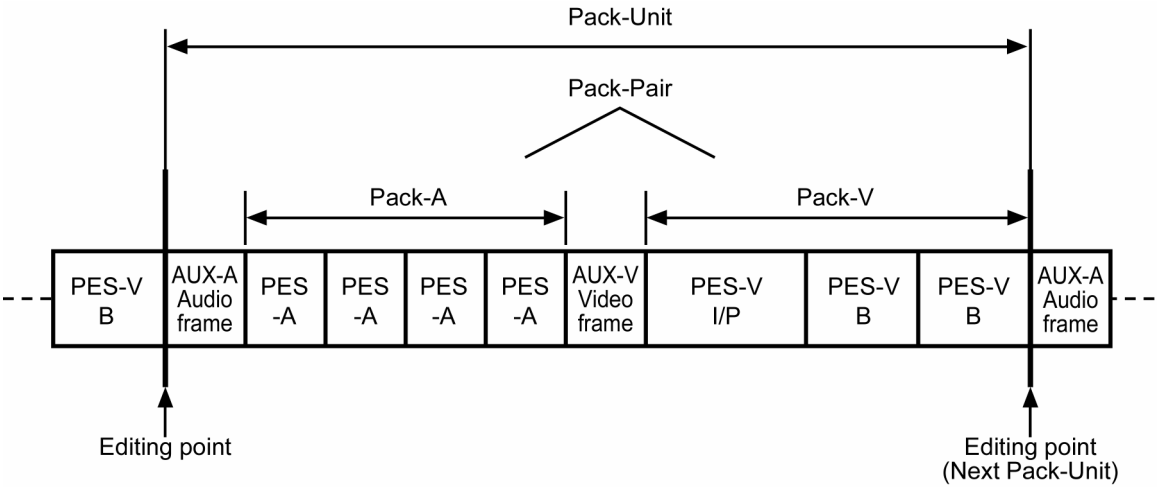
Pack-A:

- For each corresponding frame of PES-V, the time stamp value of the earliest PTS is labelled PTS1, while the time stamp value of the latest PTS plus 1 frame is labelled PTS2. Pack-A contains PES-A for all original PTS such that PTS1 ≤ PTS < PTS2.
- Even if the PTS increases to the maximum value and returns to zero, the inequality above is satisfied.

A pair of corresponding Pack-A and Pack-V units is defined as a Pack-Pair. An AUX-A sync block containing the audio frame pack is inserted before Pack-A, and an AUX-V sync block containing the video frame pack is inserted before Pack-V.

The combined Pack-Pair, AUX-A and AUX-V sync blocks is defined as a Pack-Unit, and is recorded in order beginning with AUX-A. The points before the Pack-Pair are available as editing points (see Figure 15).

Within a Pack-Unit, up to 2 optional AUX sync blocks may be inserted between the AUX-A audio frame pack and Pack-A, or between the AUX-V video frame pack and Pack-V (see Figure 16). If a Pack-Unit consists of 2 or fewer video frames, optional AUX sync blocks shall not be inserted.



IEC 149/08

Figure 15 – PES construction (1-1)

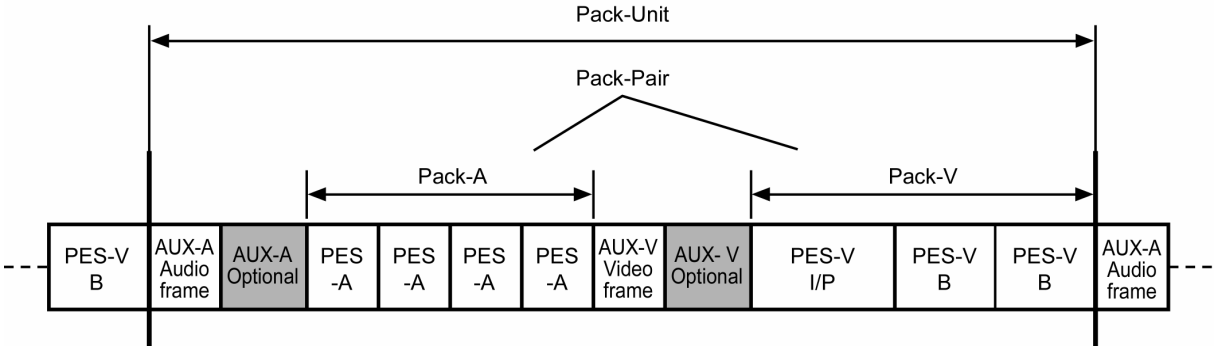


Figure 16 – PES construction (1-2)

8.2.3.2 Edit Pack-A, Edit Pack-V, Edit Pack-Pair, Edit Pack-Unit

An Edit Pack-V is defined as a Pack-V which contains copy-pictures and PES-V stuffing and lies between editing points (see Figures 18 and 19). A copy-picture is a repeated P-picture from the previous frame and can include stuffing. PES-V stuffing is a PES packet containing in continuous null data (00h).

An Edit Pack-A is defined as the Pack-A unit which corresponds to an Edit Pack-V.

An Edit Pack-Pair is defined as a set of corresponding Edit Pack-A and Edit Pack-V units.

An Edit Pack-Unit is an Edit Pack-Pair combined with AUX-A sync block containing an audio frame pack, and AUX-V sync block, containing a video frame pack. AUX-A and AUX-V of an Edit Pack-Unit are respectively defined as Edit AUX-A and Edit AUX-V (see Figure 17).

Edit Pack-A and Edit Pack-V units are subject to the following rules.

Edit Pack-A:

- The value of the PTS in the leading AAU shall be rewritten so that it continues from the PTS in the last AAU within the previously recorded Pack-Pair. Edit Pack-A can include PES-A mute which encodes the mute data (see Figure 18).
- If an Edit Pack-V contains only PES-V stuffing, a corresponding Edit Pack-A does not exist, but an Edit AUX-A does exist, as shown in Figure 19.

Edit Pack-V:

- When a copy-picture of 4 or more sequential video frames is inserted, the 3 video frames starting from the lead video frame are combined and become an Edit Pack-V. The remaining video frame becomes the last Edit Pack-V (see Figure 18).
- PES-V stuffing used with copy-pictures should be inserted after the first copy-picture and should not be the first PES-V of the Edit Pack-V (see Figure 18).
- No more than one PES-V stuffing shall be inserted into a continuous Edit Pack-Unit.
- PES-V stuffing is not counted as a video frame. Therefore, when 3 copy-pictures and a PES-V stuffing are combined, they are counted as an Edit Pack-V containing 3 video frames.
- An Edit Pack-V only containing PES-V stuffing shall not follow other Edit Pack-V (see Figure 19).
- An Edit Pack-V of 2 or less frames should not be followed by an Edit Pack-V of 2 or less frames.

Optional AUX sync blocks shall not be inserted into an Edit Pack-Unit.

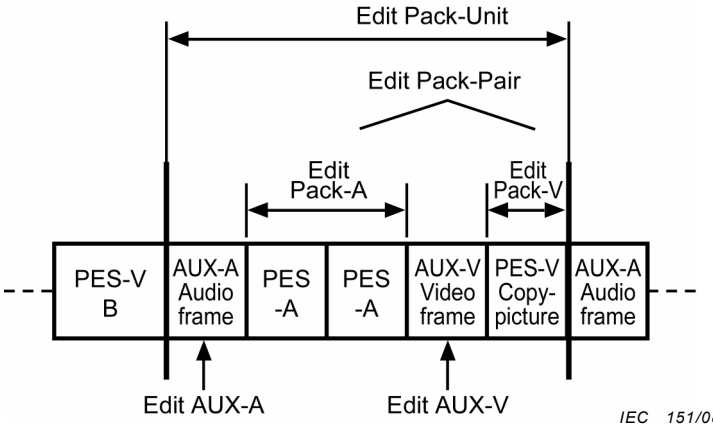


Figure 17 – PES construction (2-1)

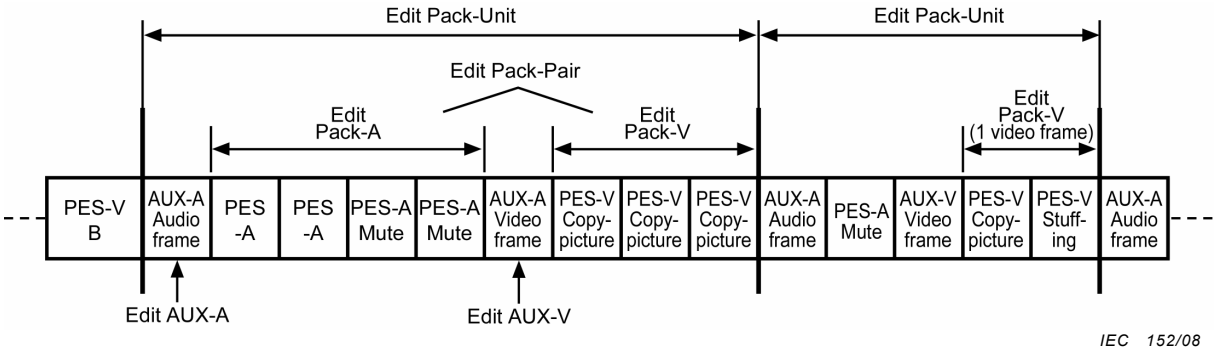


Figure 18 – PES construction (2-2)

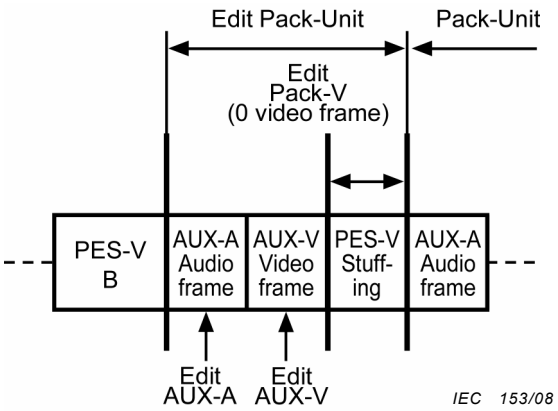


Figure 19 – PES construction (2-3)

8.2.4 PES packet restrictions

The stream which is recorded in PES-A and PES-V shall comply with ISO/IEC 13818-1and shall be restricted according to Table 33. Additional restrictions on the audio stream and video streams are as follows.

Restrictions on audio stream

- One PES-A shall consist of the stream data of one AAU.
- PES-A has PTS.

Restrictions on video stream

- One PES-V shall consist of one picture or stuffing.
- PES-V units containing I- or P-pictures shall have a PTS and a DTS.
- PES-V units containing a B-picture shall have a PTS.
- PES-V units containing only stuffing shall be have the PTS_DTS_flag set to 00b.

Table 33 – PES packet restrictions

	Number of bits	Allowed value	
		Video stream	Audio stream
Stream_id	8	E0h (ISO/IEC 13818-2 video stream #0)	C0h (ISO/IEC 11172-3 audio stream #0)
PES_packet_length	16	0000h	0488h
PES_scrambling_control	2	00b	00b
data_alignment_indicator	1	0	0
PTS_DTS_flag	2	I-picture =11b	10b
		P-picture = 11b	
		B-picture = 10b	
		Stuffing only = 00b	
ESCR_flag	1	0	0
ES_rate_flag	1	0	0
DSM_trick_mode_flag	1	0	0
PES_CRC_flag	1	0	0
PES_header_data_length	8	I-picture = 0Ah	05h
		P-picture = 0Ah	
		B-picture = 05h	
		Stuffing only = 00h	

8.2.5 Audio processing

8.2.5.1 Introduction

Audio streams shall comply with the syntax and semantics as specified in ISO/IEC 11172-3. For the coded audio bit stream syntax specification, see ISO/IEC 13818-1.

8.2.5.2 Audio ES specification

- Additional constraints on the MPEG-1 audio ES are specified as follows.
- The encoded stream shall be MPEG-1 Layer II stereo (layer = 10b, mode = 00b)
- The CRC word shall be included in the encoded stream (protection_bit = 0)
- The bit rate shall be 384 kbps for Layer II (bitrate_index = 1110b)
- The sampling frequency shall be 48 kHz (sampling_frequency = 01b)
- Padding is not used (padding_bit = 0)
- Emphasis shall not be used (emphasis = 00b)
- Ancillary data shall be recorded as the optional data

8.2.6 Video processing

8.2.6.1 Introduction

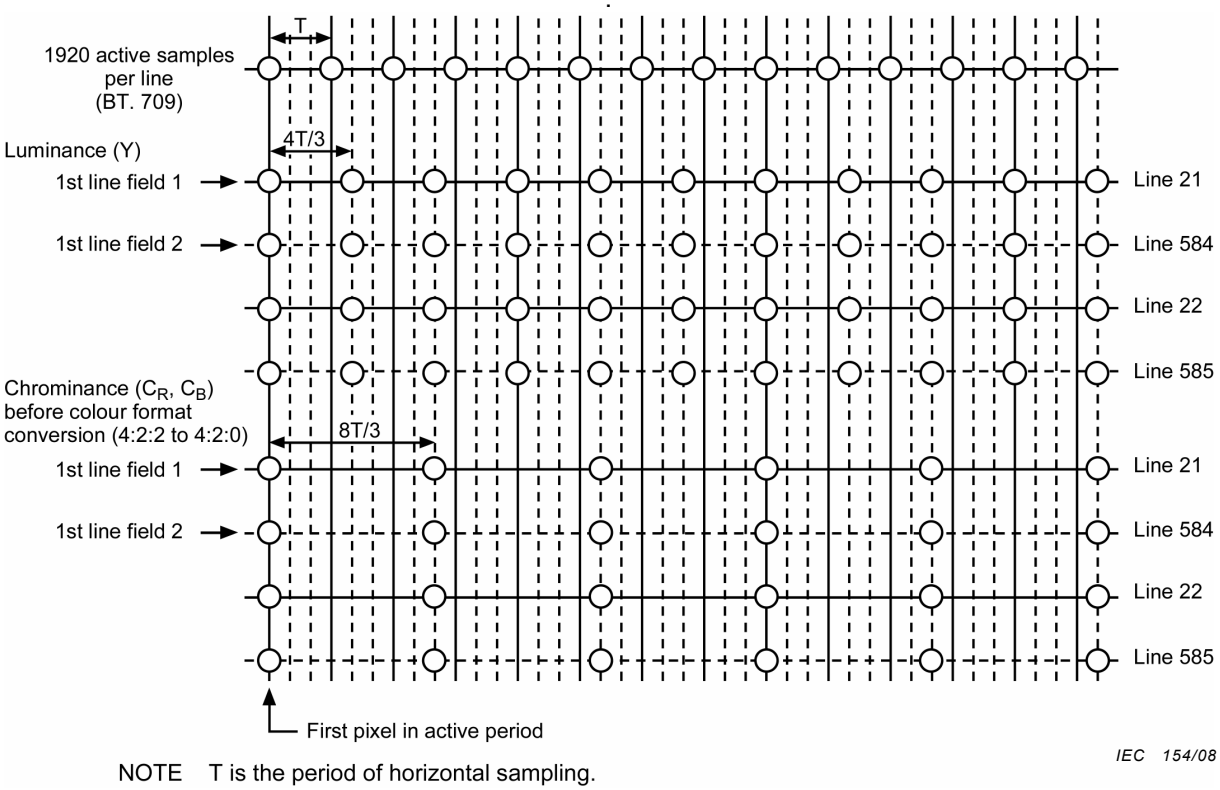
Video streams shall comply with MP@H-14 as specified in ISO/IEC 13818-2. For the coded video bit stream syntax specification, see ISO/IEC 13818-1.

8.2.6.2 Sampling structure

Sampling structure of luminance (Y) and two colour difference signals (C_R, C_B) are shown in Table 34. Horizontal sampling timing of Y, C_R and C_B signals before colour format conversion (4:2:2 to 4:2:0) are illustrated in Figure 20. The 4:2:0 format is specified in ISO/IEC 13818-2. The sampling starting point in the active period of each signal shall be the same as defined in ITU-R Recommendation BT.709-5.

Table 34 – Construction of video signal sampling

		1080i/60 system	1080i/50 system
Sampling frequency	Y	55,6875 / 1,001 MHz	55,6875 MHz
	C_R, C_B	27,84375 / 1,001 MHz	27,84375 MHz
Total number of pixels per line	Y	1 650	1 980
	C_R, C_B	825	990
The number of active pixel per line	Y	1 440	
	C_R, C_B	720	
Total number of lines per frame		1 125	
Total number of active lines per frame		1 080	
The active line numbers	Field 1	21 to 560	
	Field 2	584 to 1 123	



NOTE T is the period of horizontal sampling.

Figure 20 – Horizontal sampling timing

8.2.6.3 Video ES specification

Additional constraints on the MPEG-2 video ES are specified as follows.

- The video stream shall use GOP_headers.
- Every GOP_header shall be proceeded by a sequence header.
- It is recommended that the GOP structure have the following values for self-encoding.

N=15, M=3 (1080i/60 system)

N=12, M=3 (1080i/50 system)

The values N, M may differ according to the insertion of Edit Pack-V units during editing.

- The encode mode shall be CBR (constant bit rate).
- Sequence_end_code shall not be used.
- I-pictures shall not be used anywhere other than at the head of a GOP.
- All pictures shall be processed as frames, and not as fields.

8.2.6.3.1 Sequence_header

The values allowed for horizontal_size_value, vertical_size_value, aspect_ratio_information, frame_rate_code, bit_rate_value, vbv_buffer_size_value are listed in Table 35.

Table 35 – Definition 1 of video ES

Sequence_header syntactic element		Allowed value	Meaning
horizontal_size_value		5A0h	1 440
vertical_size_value		438h	1 080 (NOTE)
aspect_ratio_information		0011b	16 : 9
frame_rate_code	1080i/60 system	0100b	30÷1,001 Hz
	1080i/50 system	0011b	25 Hz
bit_rate_value		F424h	25 Mbps
vbv_buffer_size_value		1C0h	7 340 032 bits

NOTE The actual state is that 8 lines of dummy data are attached under the active line for encoding, being processed as 1 088 lines of video data.

8.2.6.3.2 User_data

User data shall not be used.

8.2.6.3.3 Sequence_extension

The allowed values for profile_and_level_indication, progressive_sequence, chroma_format and low_delay are listed in Table 36.

Table 36 – Definition 2 of video ES

Sequence_extension syntactic element	Allowed value	Meaning
profile_and_level_indication	46h	MP@H-14
progressive_sequence	0	Interlace
chroma_format	1	4:2:0
low_delay	0	B-picture included

8.2.6.3.4 Sequence_display_extension

The allowed values for video_format, colour_primaries, transfer_characteristics and matrix_coefficients are listed in Table 37.

Table 37 – Definition 3 of video ES

Sequence_display_extension syntactic element	Allowed value	Meaning
video_format	0	Component
colour_primaries	1	NOTE
transfer_characteristics	1	NOTE
matrix_coefficients	1	NOTE

NOTE It shall comply with Recommendation ITU-R BT.709.

8.2.6.3.5 Picture header

The vbv_delay shall take the actual value which shall be greater than 3 003 (1080i/60 system) or 3 600 (1080i/50 system). It shall not be assigned the value FFFFh.

8.2.6.3.6 Picture coding extension

Concealment_motion_vectors shall be set to 0 as defined in Table 38.

Table 38 – Definition 4 of video ES

Picture coding extension syntactic element	Allowed value	Meaning
concealment_motion_vectors	0	No motion vectors

8.2.6.3.7 Other extensions

Copyright_extension and picture_display_extension shall not be used.

8.3 AUX data

8.3.1 Structure of AUX sync block

AUX data is stored in the AUX sync block, with a data type of 001b. As shown in Table 39, the data structure of the AUX sync block is 95 bytes, proceeded by a SB header. If the AUX data occupies less than 95 bytes, the remaining bytes are filled with 00h.

Table 39 – AUX sync block

Byte position No.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
5	Data type (001b)			SBSC	CC				SB header
6	DCF	Length							
7	0	Keyword							
8									
100									

DCF: Discontinuity flag

This flag indicates discontinuities in the recording stream and is valid for the ECCTB pack (see 8.3.8). For the other AUX sync blocks, DCF shall be 0.

0 = Stream is continuous

1 = Stream is not continuous

If DCF = 1, a DIT should be inserted into the TS.

Length:

This field indicates the number of bytes of AUX data including the keyword.

Keyword:

See 8.3.2.

8.3.2 Keyword

Keyword is a 7-bit code indicating the AUX pack data type. Constant length AUX (00h to 3Fh) and variable length AUX (40h to 7Fh) are defined in Table 40.

Table 40 – Keyword

Keyword	AUX group	Meaning	Reference
00h	AUX-V	TTC	IEC 61834-4
01h	AUX-V	BINARY GROUP	IEC 61834-4
02h	AUX-V	Reserved	
03h	AUX-V	Reserved	
04h	AUX-V	Reserved	
05h	AUX-V	REC DATE	IEC 61834-4
06h	AUX-V	REC TIME	IEC 61834-4
07h	AUX-V	ETN pack	8.3.4
08h	Reserved	Reserved	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
:	:	:	
3Fh	AUX-N	NO INFO	8.3.9.1

< Constant length AUX >

Keyword	AUX group	Meaning	Reference
40h	AUX-A	Audio frame pack	8.3.5
41h	AUX-A	Reserved	
42h	AUX-A	Reserved	
43h	AUX-A	Reserved	
44h	AUX-V	Video frame pack	8.3.6
45h	AUX-V	VBV pack	8.3.9.4
46h	AUX-V	Reserved	
47h	AUX-V	Reserved	
48h	AUX-N	DV multi-pack	8.3.7
49h	AUX-N	DV multi-pack V1	8.3.7
4Ah	AUX-N	DV multi-pack V2	8.3.7
4Bh	AUX-N	DV multi-pack V3	8.3.7
4Ch	AUX-N	Reserved	
4Dh	AUX-N	Reserved	
4Eh	AUX-N	Reserved	
4Fh	AUX-N	Reserved	
50h	AUX-SYS	ECCTB pack	8.3.8
51h	AUX-SYS	Reserved	
52h	AUX-SYS	Reserved	
53h	AUX-SYS	Reserved	
54h	Reserved	Reserved	
:	:	:	
70h	Reserved	Maker option pack	8.3.9.2
:	:	:	
7Fh	AUX-N	Null pack	8.3.9.3

< Variable length AUX >

NOTE AUX-SYS is AUX pack data for system, AUX-N is AUX pack data that has not been categorized.

The sync block numbered 18 in the head track of every ECC unit is reserved for AUX data.
And an ECCTB pack should be recorded at the head of the sync block.
Packs in AUX-N group whose Keyword are from 48h to 4Fh or Maker option packs whose Keyword are from 70h to 7Eh can be recorded just behind the ECCTB pack. However, the pack data don't have to be consistent with the same data in the AUX-A or AUX-V.

8.3.3 Structure of AUX pack data

As shown in Figure 21, constant length AUX consists of a keyword and 4 bytes of data. Variable length AUX consists of n bytes of data following keyword and length.

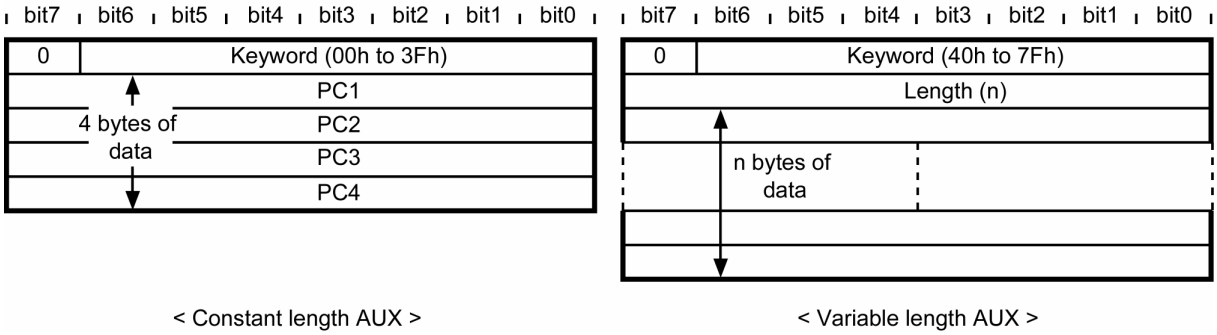
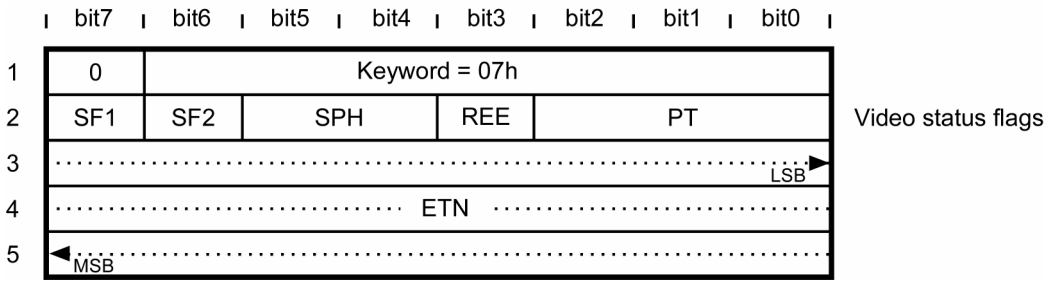


Figure 21 – Structure of AUX pack data

8.3.4 ETN pack

The ETN pack consists of video status flags and ETN (extended track number) as shown in Table 41.

Table 41 – ETN pack



SF1: Search flag 1

This flag indicates whether the 8x speed search helper data has been recorded from the recording start point to recording end point.

0 = 8x speed search helper data is not recorded

1 = 8x speed search helper data is recorded

SF2: Search flag 2

This flag indicates whether the 24x speed search data has been recorded from the recording start point to recording end point.

0 = 24x speed search data is not recorded

1 = 24x speed search data is recorded

SPH: Search phase

This counter increases by each ECC unit. The value is defined as (ETN/16) mod 3. The 24x speed search data is included in ECC unit which is “SPH = 0” (see Figure 26).

REE: REC end ECC unit

REE indicates whether the ECC unit lies at the recording end point.

0 = Not a recording end point

1 = Recording end point

REE shall be set to 1, starting with the ECC unit containing an ECCTB DATA-H field signalling “V-END” (101b), through the following ECC unit at the end of the recording.

PT: Picture type

PT indicates the type of the picture at DTS time which the value of ETN × 300,3 (1080i/60 system) or ETN × 300 (1080i/50 system) indicates in video stream.

000b = Stuffing

001b = I-picture

010b = B-picture

011b = P-picture

100b = Copy-picture

101b = V-END

110b = Reserved

111b = No information

ETN: Extended track number

ETN is a 24-bit track number counter which shall be increased by 1 for each successive recording track. The relation between ETN, track pair number, and ECC unit shall be as follows.

- Track pair number (Trp_4 to $Trp_{0)}$ recorded in the same track in the main sector is the same as b_5 to b_1 of ETN (b_{23} to b_0)
- The track numbers in the ECC unit (b_3 to b_0) are the same as in ETN (which ranges from b_{23} to b_0)
- ABST (ranging from b_{22} to b_0) are the same as in ETN (b_{23} to b_0)

The relationships are specified in Figure 22.

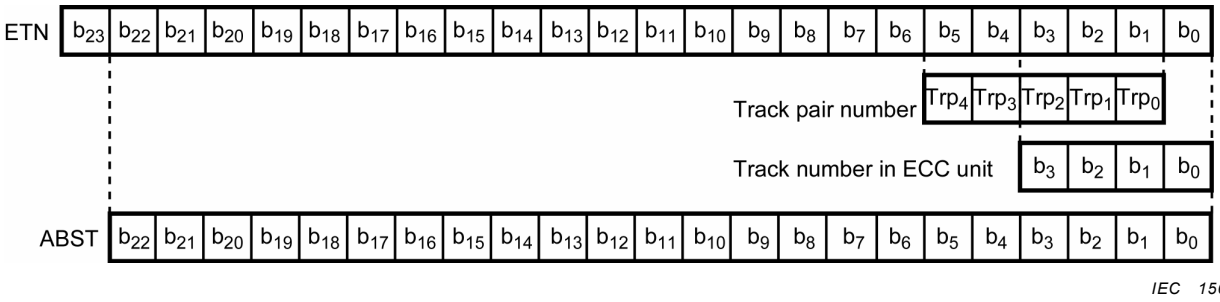
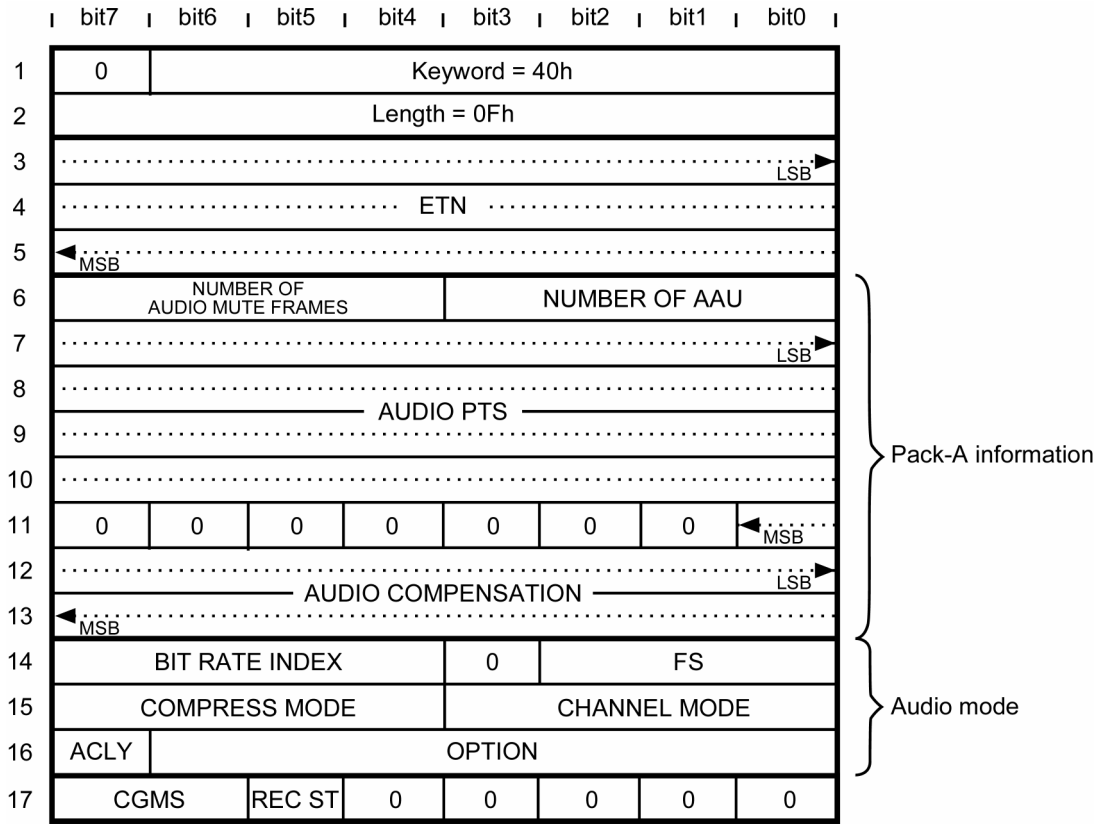


Figure 22 – Relation between ETN and track number

8.3.5 Audio frame pack

The audio frame pack is defined with keyword = 40h and is placed within the AUX-A group. It has the structure shown in Table 42. The audio frame pack shall be configured as the header for the audio stream at the start of an AUX-A sync block proceeding Pack-A (see 8.2.3).

Table 42 – Audio frame pack



ETN: Extended track number

This field takes same value as the ETN of the video frame pack of a Pack-Unit's AUX-V.

The Pack-A information section indicates the structure and timing of the Pack-A unit.

NUMBER OF AUDIO MUTE FRAMES:

This field indicates the number of PES-A mute frames included in Pack-A.

NUMBER OF AAU:

This field indicates the number of AAU included in Pack-A. However, it indicates no information in the case of Fh.

AUDIO PTS:

This field indicates the PTS value for the first AAU of the Pack-A unit immediately following AUX-A.

AUDIO COMPENSATION:

This 16-bit signed-integer field indicates the amount of compensation required for the audio PTS restamp to match the original audio PTS with video PTS. To avoid the accumulation of lip-sync error during editing, this value stores the PTS increments in 90 kHz units and corrects the value within the range of -0,5 AAU to 2 AAU.

It compares the original value during recording and stores a 0 if it cannot detect any lip sync error. The compensation value is determined at the recording start point. During recording through a digital interface, the compensative calculation is conducted when the audio compensation input data changes, at which time the value shall be updated (see Figures 23, 24 and 25). However, this information is a playback option.

The audio mode section contains information regarding the recorded audio ES.

BIT RATE INDEX:

1110b = 384 kbps

Others = Reserved

FS: Sampling frequency

001b = 48 kHz

Others = Reserved

COMPRESS MODE:

0010b = MPEG-1 Layer II

Others = Reserved

CHANNEL MODE:

0000b = Stereo

Others = Reserved

ACLY: Ancillary

Signals whether the PES-A includes the ancillary data or not.

0 = Does not include the ancillary data

1 = Includes the ancillary data

OPTION: Ancillary option

This field indicates options for the ancillary data. If ancillary data is not included, this field should be set to 0000000b.

0001100b: Includes ancillary data which conform to ISO/IEC 13818-3. It configures the two-channel stereo in 2/0 + 2/0 mode and does not include a centre channel, a low-frequency enhancement channel, or multilingual audio data.

ext_bit_stream_present = 0

centre = 00b

surround = 11b

lfe = 0

no_of_multi_lingual_ch = 0

All field values in the audio frame pack, such as PTS, shall be applied to all channels of multi-channel audio.

CGMS: Copy generation management system for audio stream.

00b = Copying permitted without restriction

01b = Not used

10b = One generation of copies permitted

11b = No copying permitted

If CGMS information encoded in the incoming signal is “00b”, a digital VCR may make a copy and shall encode “00b” on “CGMS”.

If CGMS information encoded in the incoming signal is “10b”, a digital VCR may make a copy and shall encode “11b” on “CGMS”.

If CGMS information encoded in the incoming signal is “11b”, a digital VCR shall not make a copy.

REC ST: Recording start point

This flag indicates whether a Pack-A is included in the Pack-Unit at the recording start point.

0 = Included

1 = Not included

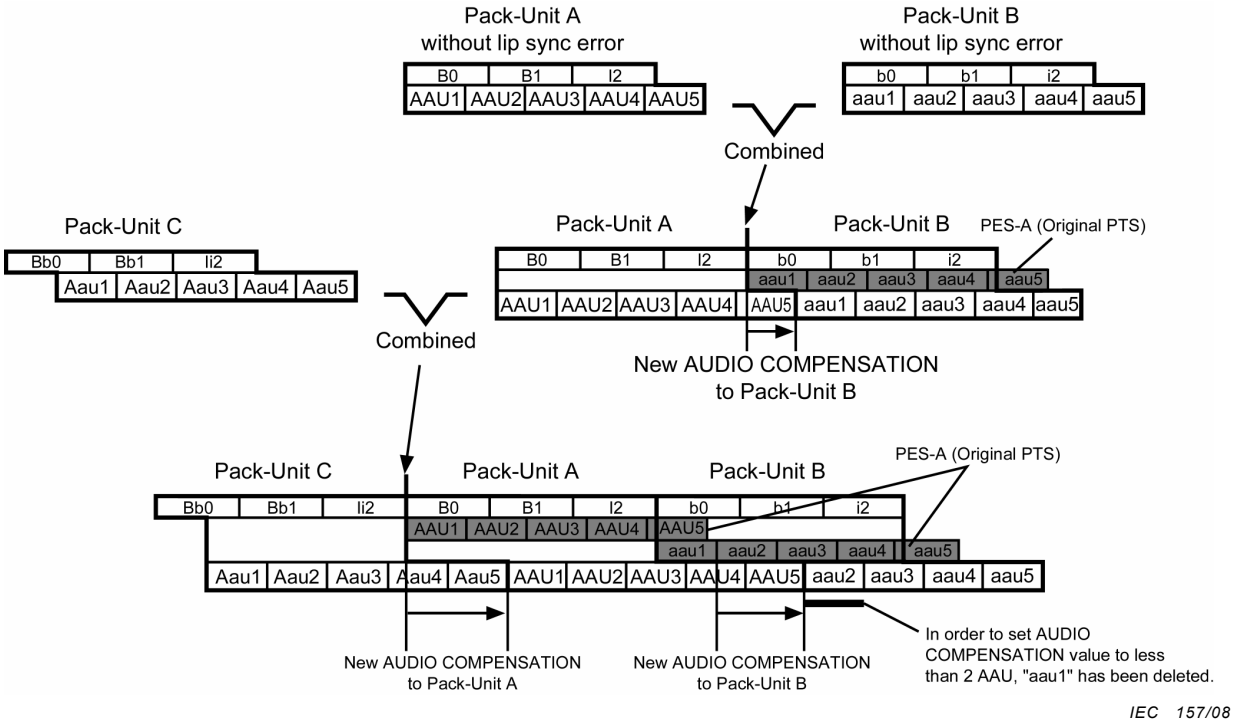


Figure 23 – Audio compensation 1

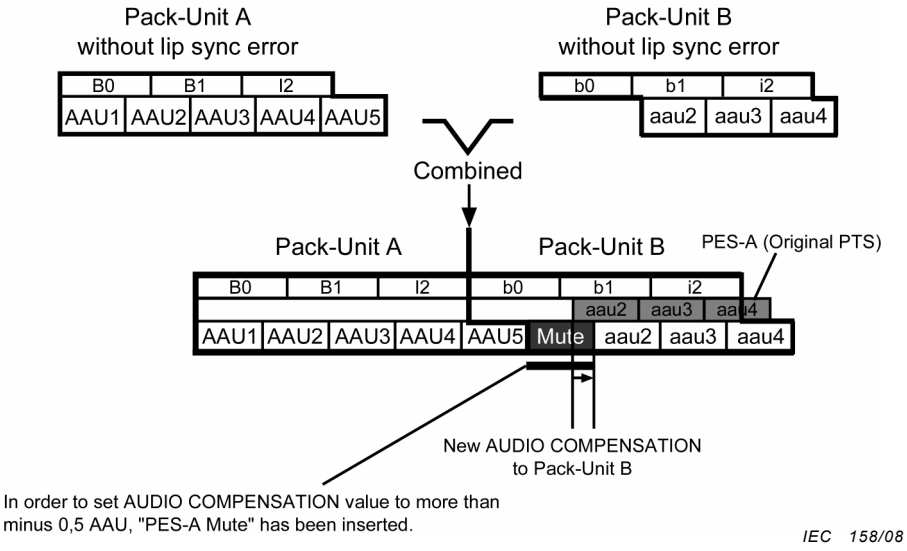


Figure 24 – Audio compensation 2

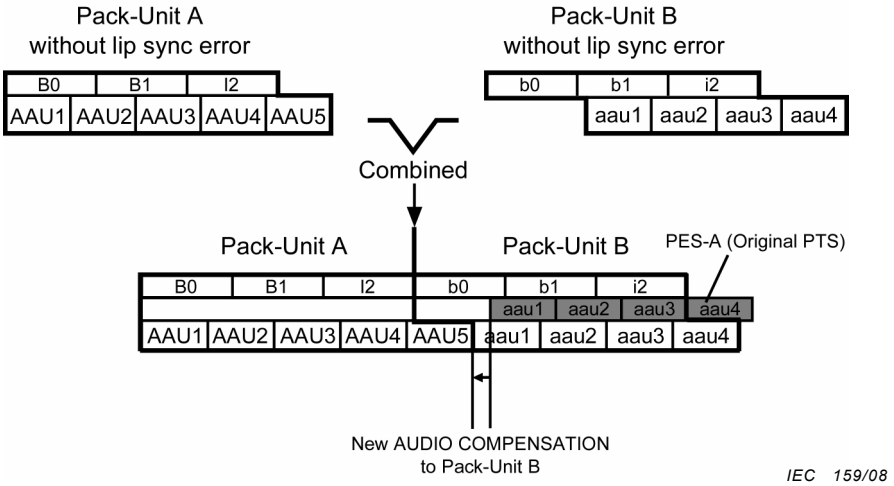
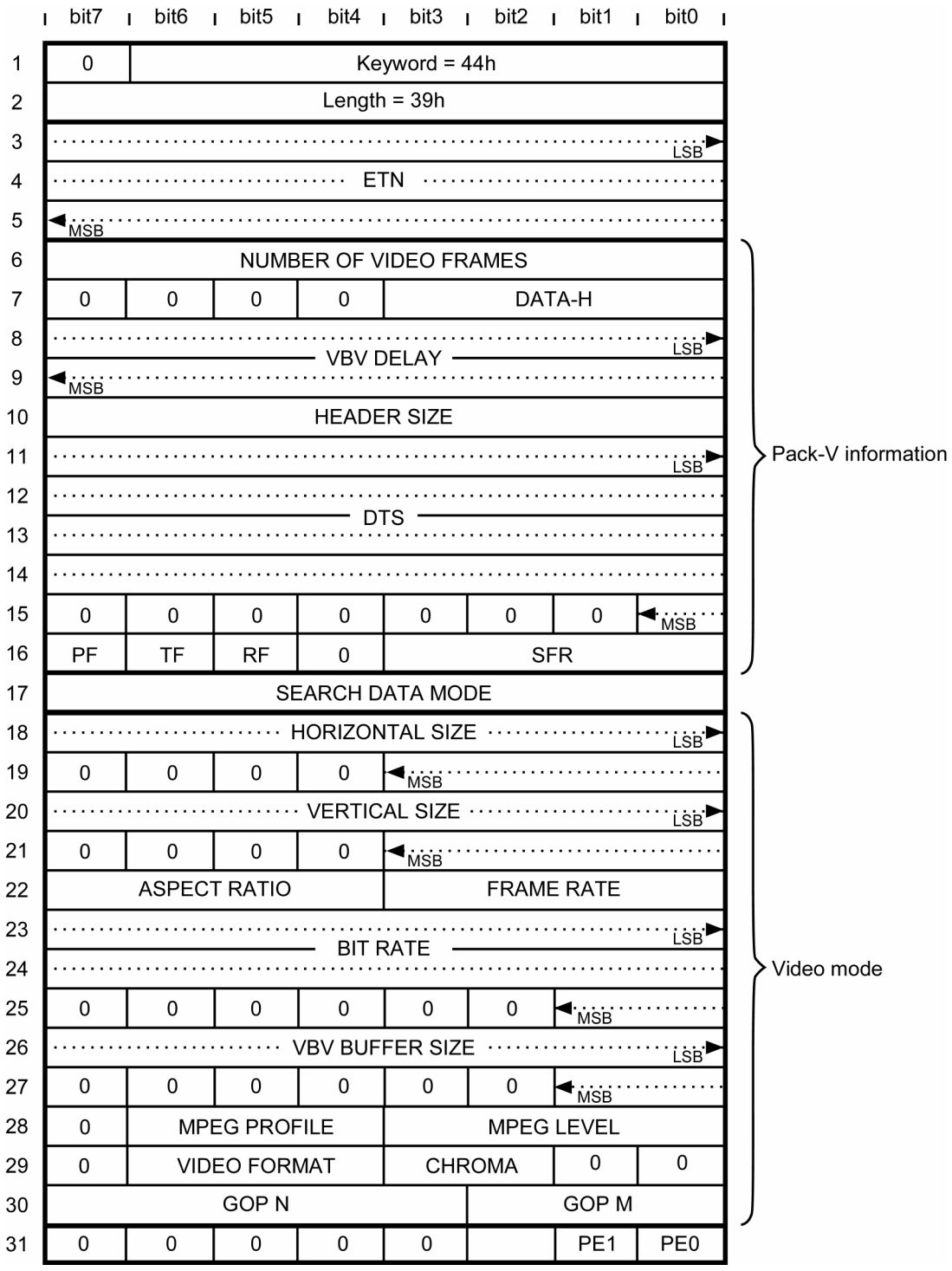


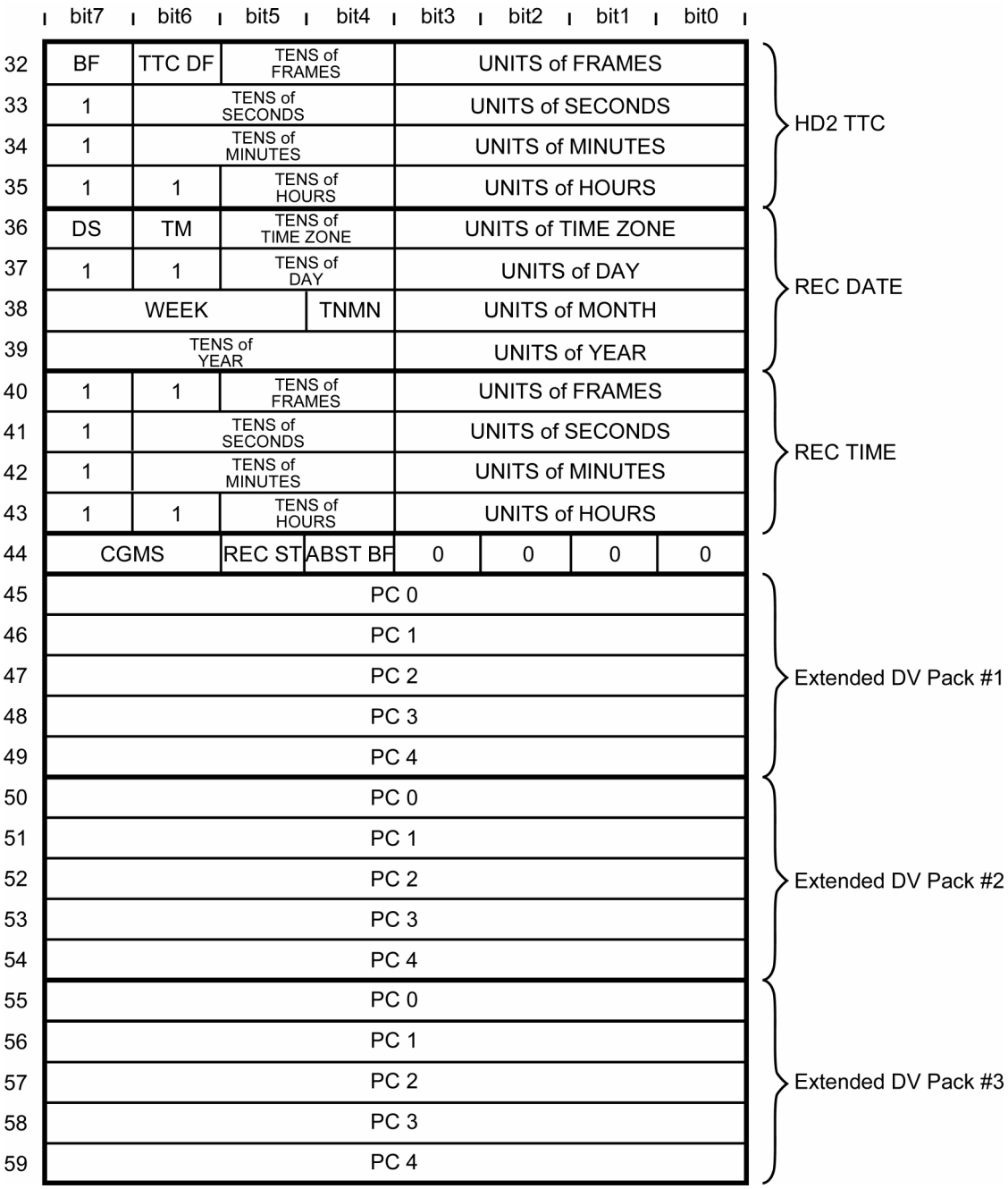
Figure 25 – Audio compensation 3

8.3.6 Video frame pack

The pack data in the AUX-V group defined with keyword = 44h is the video frame pack and has the structure shown in Table 43. The video frame pack shall be configured as the header for the video stream at the start of an AUX-V sync block proceeding Pack-V (see 8.2.3).

Table 43 – Video frame pack





ETN: Extended track number

This field indicates the ETN acquired from the DTS of the first PES-V unit in the Pack-V. If the number of video frames is 0, it indicates the ETN acquired from the DTS of the first PES-V in the next Pack-V.

The Pack-V information section indicates the structure and timing of the Pack-V unit.

NUMBER OF VIDEO FRAMES:

This field indicates the number of PES-V units in Pack-V. PES-V stuffing is not counted as the video frame. When DATA-H is “0101b” (= V-END), the number of video frames shall be set to FFh.

DATA-H:

This data header indicates the Pack-V's leading PES-V picture type.

0000b = Stuffing

0001b = I-picture

0010b = B-picture

0011b = P-picture

0100b = Copy-picture

0101b = V-END

0110b = Reserved

0111b = No information

1000b = No picture

1001b = Not editable

1010b = Reserved

1011b = Reserved

1100b = Reserved

1101b = Reserved

1110b = Reserved

1111b = Reserved

NOTE V-END indicates that Pack-V is the recording end point.

VBV DELAY:

This field indicates the vbv_delay of the first PES-V in the Pack-V unit.

HEADER SIZE:

This field indicates the total header size which is input to vbv_buffer divided by the video rate step for a 90 kHz unit. Its value is calculated as follows, with a maximum value of 8 800 bytes.

HEADER SIZE = header_size ÷ video_rate_step

(numbers should be round up after the decimal point)

where

header_size:

when Pack-V begins with an I-picture,

from the first byte of the sequence_header_code to the last byte of the picture_start_code;

when Pack-V begins with a P-picture,

from the first byte of the picture_start_code to the last byte of the picture_start_code.

DTS:

The DTS value of the first PES-V unit in Pack-V.

PF: Progressive frame

This flag indicates whether the video source is interlace or progressive.

0 = Interlace

1 = Progressive

TF: Top field first

This flag takes the same value as the top_field_first of the PES-V having the earliest PTS among Pack-V.

RF: Repeat first field

This flag takes the same value as the repeat_first_field of the PES-V having the earliest PTS among Pack-V.

SFR: Source frame rate

This field indicates the progressive source frame rate.

0100b = 30 ÷ 1,001 Hz

0011b = 25 Hz

0001b = 24 ÷ 1,001 Hz

Others = Reserved

24 ÷ 1,001 Hz corresponds only to the 1080i/60 system.

SEARCH DATA MODE:

This field indicates the type of recorded search data from the recording start point to the recording end point.

b0: Reserved

b1: 8x speed search base data

b2: 8x speed search helper data

b3: Reserved

b4: 24x speed search data

b5: Reserved

b6: Reserved

b7: Reserved

The video mode section contains information about the video ES.

HORIZONTAL SIZE:

5A0h = 1 440 pixels

Others = Reserved

VERTICAL SIZE:

438h = 1 080 lines

Others = Reserved

ASPECT RATIO:

0011b = 9 ÷ 16

Others = Reserved

FRAME RATE:

0011b = 25

0100b = 30 ÷ 1,001 Hz

Others = Reserved

BIT RATE:

It is measured in units of 400 bits/s.

F424h = 62 500 (25 Mbps)

VBV BUFFER SIZE:

It is defined as 16 × 1 024 × vbv_buffer_size.

1C0h = 448 (7 340 032 bits)

MPEG PROFILE:

100b = “Main”

Others = Reserved

MPEG LEVEL:

0110b = “High-1440”

Others = Reserved

VIDEO FORMAT:

0000b = Component

Others = Reserved

CHROMA:

01b = 4:2:0

Others = Reserved

GOP N:

01100b = 12 (1080i/50 system or 24p recording)

01111b = 15 (1080i/60 system)

Others = Reserved

GOP M:

011b = 3

Others = Reserved

PE0, PE1, PE2: Pack data enable

This field indicates whether the pack data in the successive HD2 TTC, REC DATE and REC TIME fields is valid or not.

PE0 = 0: HD2 TTC is invalid

PE0 = 1: HD2 TTC is valid

PE1 = 0: REC DATE is invalid

PE1 = 1: REC DATE is valid

PE2 = 0: REC TIME is invalid

PE2 = 1: REC TIME is valid

HD2 TTC: HD2 title time code

The TTC value of the PES-V which has the earliest PTS in the Pack-V unit. Each field except TTC DF field should be the same as defined in IEC 61834-4.

TTC DF: TTC drop frame flag

0 = Non-drop frame time code

1 = Drop frame time code

The value of this TTC DF shall be set to 1b in 1080i/50 system.

REC DATE:

The REC DATE of the PES-V which has the earliest PTS in the Pack-V unit. Each field should be the same as defined in IEC 61834-4.

REC TIME:

The REC TIME of the PES-V which has the earliest PTS in the Pack-V unit. Each field should be the same as defined in IEC 61834-4.

CGMS: Copy generation management system for video stream.

Definition is the same as for the audio frame pack (see 8.3.5).

REC ST: Recording start point

This flag indicates whether a Pack-V is included in the Pack-Unit at the recording start point.

0 = Included

1 = Not included

ABST BF: ABST blank flag

0 = There exists discontinuity

1 = There does not exist discontinuity

Take the same value as the BF in the subcode sector whose ETN matches that acquired from the DTS value of the current video frame pack.

Extended DV packs:

Those data shall be recorded for the CLOSED CAPTION packs (VAUX 5) or TR packs (VAUX 6) specified in IEC 61834-4. Extended DV Pack #1 complies with the first PES-V in Pack-V, extended DV Pack #2 complies with the second PES-V in Pack-V and extended DV Pack #3 complies with the third PES-V in Pack-V. If extended DV data packs are not used, a NO INFO pack shall be recorded as specified in IEC 61834-4.

8.3.7 DV multi-pack

The optional DV multi-pack (Table 44) may be used to store multiple instances of DV pack data as specified in IEC 61834-4. Each DV pack contains 5 bytes. It can store CAMERA pack, etc.

Keyword = 48h: Valid for all PES-V blocks in the Pack-V unit

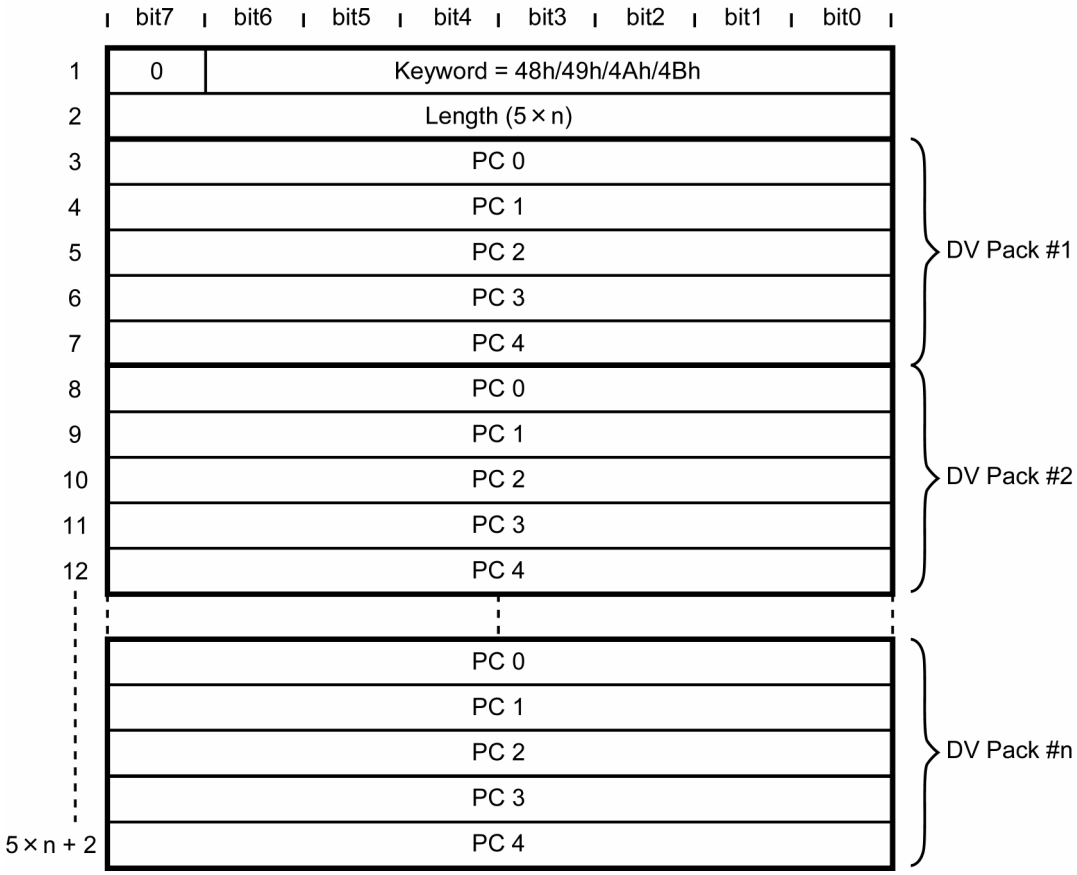
Keyword = 49h: Valid for the first PES-V in Pack-V

Keyword = 4Ah: Valid for the second PES-V in Pack-V

Keyword = 4Bh: Valid for the third PES-V in Pack-V

As shown in Table 44, one DV multi-pack can store multiple DV pack data.

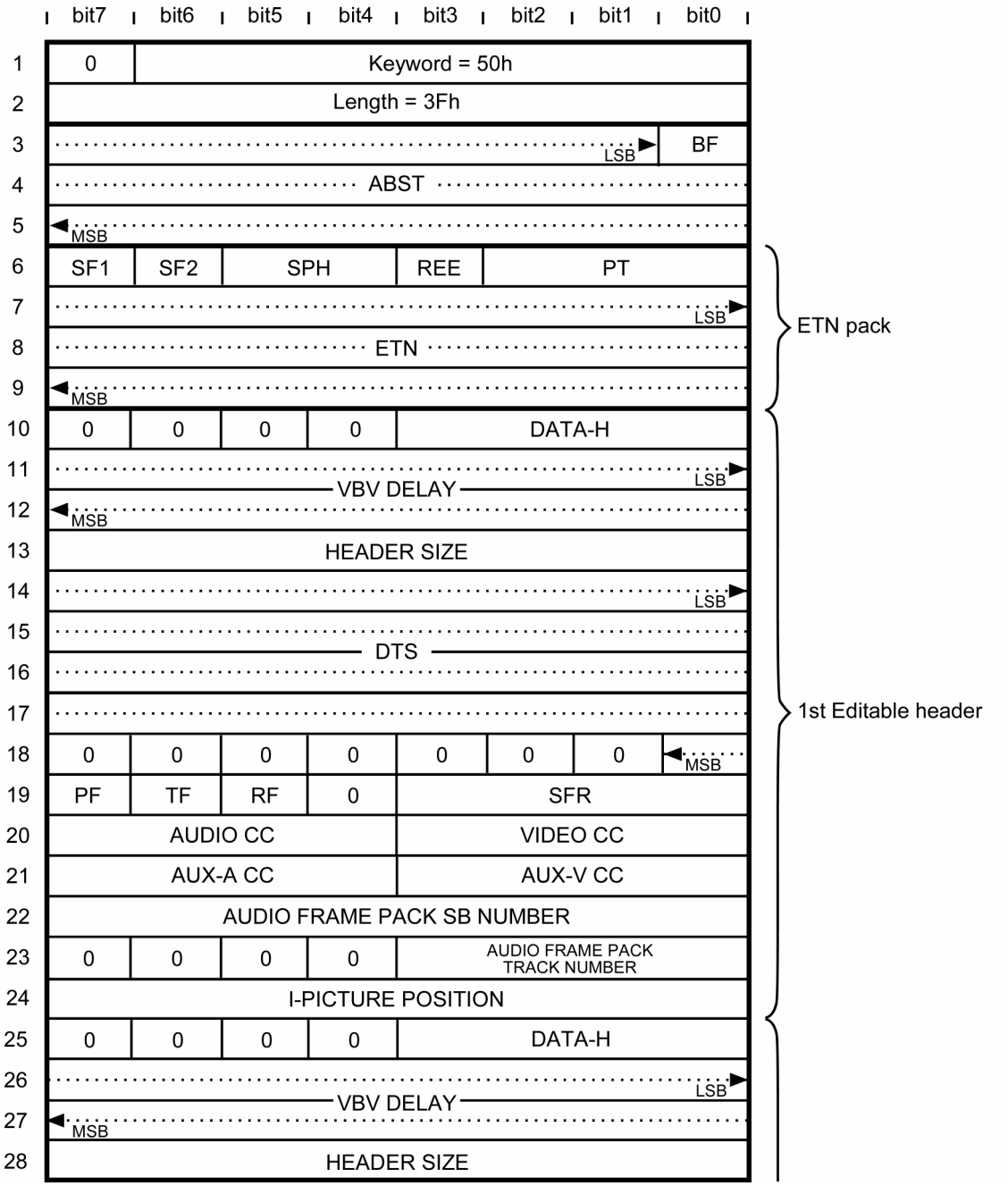
Table 44 – DV multi-pack

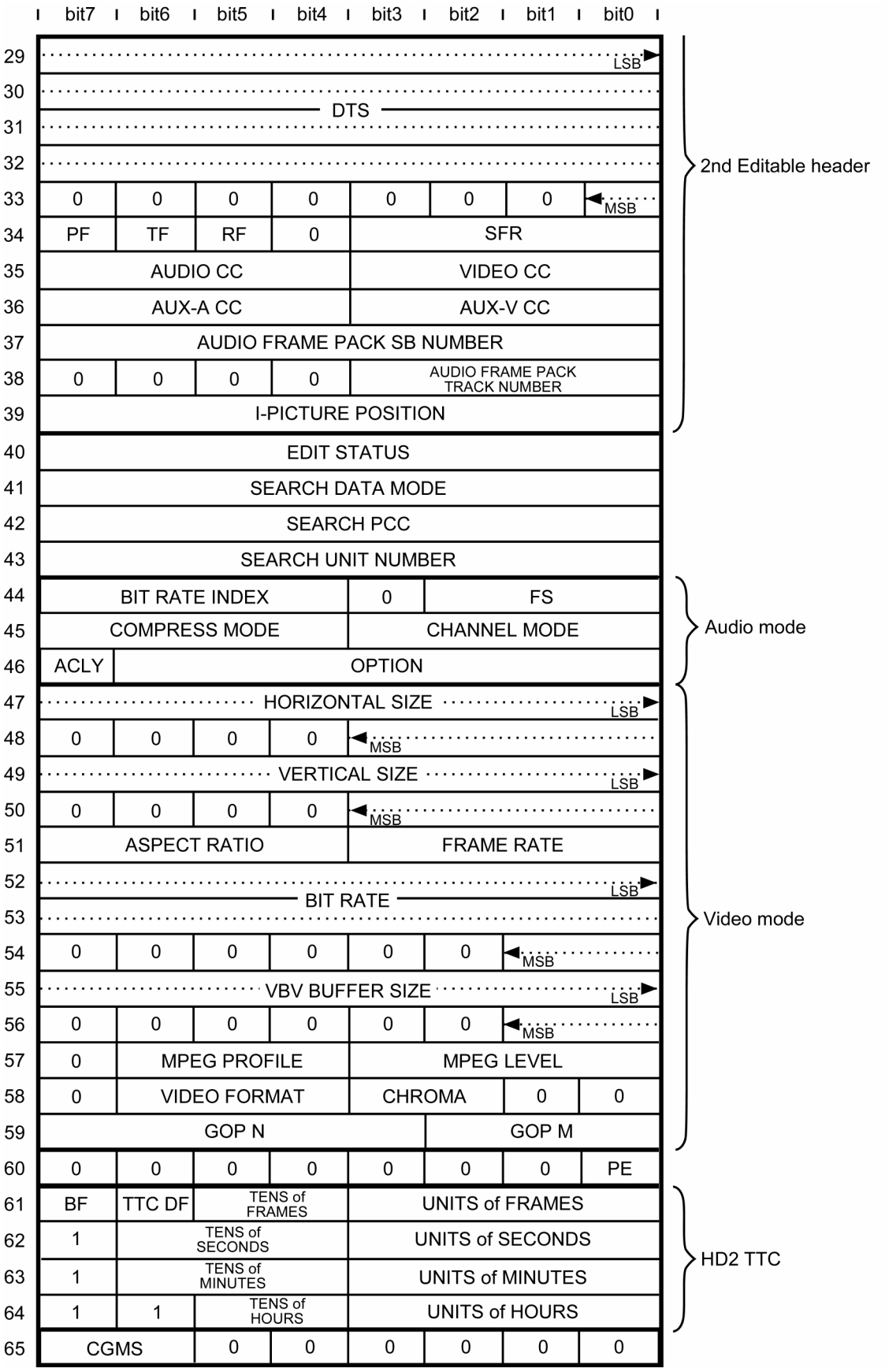


8.3.8 ECCTB pack

This pack resides in the AUX-SYS group (see note in Table 40) and is specified by keyword = 50h. It has the structure shown in Table 45. The AUX-SYS sync block associated with this ECCTB pack shall be recorded in a fixed position at the start of each ECC unit's 16 tracks group, and at the beginning of the main data area (track number [3:0] = 0000b, sync block number = 18).

Table 45 – ECCTB pack





ABST: Absolute track number

The same value as the ABST of the subcode on the track where this ECCTB pack is recorded.

BF: Blank flag

0 = Discontinuity exists before this absolute track number

1 = Discontinuity does not exist before this absolute track number

ETN pack:

The same value as ETN pack of the subcode on the track where this ECCTB pack is recorded.

1st edit point header / 2nd edit point header:

When the lead-byte of Pack-Unit or Edit Pack-Unit is recorded in the ECC unit, two sets of Pack-Unit or Edit Pack-Unit information may be recorded in the 1st and 2nd edit point header sections of the ECCTB in the ECC unit.

The information of the first edit point is recorded in the 1st edit point header.

The video mode section of the ECCTB records the same values as the video frame pack of the Pack-Unit specified by the 1st edit point header.

When there is no edit point in the ECC unit, DATA-H of the edit point header is set to 0111b, and the video mode section inherits the information of the last Pack-Unit.

When Edit Pack-Units occur in sequence, only the information of the first Edit Pack-Unit is recorded in the edit point header.

This eliminates old Edit Pack-Units as much as possible whenever editing is repeated.

DATA-H:

DATA-H value for the first PES-V in the Pack-Unit. It has the same value as DATA-H of the associated video frame pack. If an editing point does not exist then the value should be 0111b.

VBV DELAY:

The value of vbv_delay of the first PES-V in the Pack-Unit. It is the same value as vbv_delay of the video frame pack.

HEADER SIZE:

The value of header size of the first PES-V in the Pack-Unit. It takes the same value as the header size field in the video frame pack.

DTS:

DTS of the first PES-V in the Pack-Unit.

AUDIO CC:

The CC value of the first PES-A sync block in the Pack-Unit.

VIDEO CC:

The CC value of the first PES-V sync block in the Pack-Unit.

AUX-A CC:

The CC value of the first AUX-A sync block in the Pack-Unit.

AUX-V CC:

The CC value of the first AUX-V sync block in the Pack-Unit.

AUDIO FRAME PACK SB NUMBER:

Sync block number of the audio frame pack that exists in the ECC unit.

AUDIO FRAME PACK TRACK NUMBER:

The 4 bits by the side of LSB of the track number of the audio frame pack in the ECC unit.

I-PICTURE POSITION:

The number of frames from the last I-picture (DTS order) to the first frame of the present Pack-V.

EDIT STATUS:

This counter is reset to 0 at the recording start point and increases to FFh with each ECC unit. It is used to identify edited points.

SEARCH DATA MODE:

This field indicates the type of recorded search data available from the recording start point to the recording end point.

b0: Reserved

b1: 8x speed search base data

b2: 8x speed search helper data

b3: Reserved

b4: 24x speed search data

b5: Reserved

b6: Reserved

b7: Reserved

SEARCH PCC: Search picture change counter

This field is reset to 0 at the recording start and recording end points. This field counts cyclically from 1 to 3 whenever a scene change occurs (see 8.4.3.6).

b0, b1: PCC in 8x speed search SB header (see 8.4.3.2)

b4, b5: PCC in 24x speed search SB header (see 8.4.3.2)

Others: Reserved

SEARCH UNIT NUMBER:

This field indicates the 8x speed search unit number of the ECC unit. When the search sync block contains valid search picture data, its value increments cyclically from 00h to 08h with each ECC unit. When the search sync block does not exist in the ECC unit, its value shall be set to 09h. When the search sync block contains invalid search picture data, its value shall be set to FFh.

PE: Pack data enable

This flag indicates whether the pack data in the following HD2 TTC section is valid.

PE = 0: HD2 TTC is invalid

PE = 1: HD2 TTC is valid

HD2 TTC: HD2 title time code

FRAMES, SECONDS, MINUTES and HOURS shall be same as the TTC of the subcode on the track where this ECCTB pack is recorded.

BF shall be same as the ABST of the subcode on the track where this ECCTB pack is recorded.

TTC DF: TTC drop frame flag

0 = Non drop frame time code

1 = Drop frame time code

The value of this TTC DF shall be set to 1b in 1080i/50 system.

CGMS: Copy generation management system

This value shall be the same as that contained in the video frame pack (see 8.3.6).

8.3.9 Other packs

8.3.9.1 NO INFO pack

This pack is the constant length AUX which is defined with keyword = 3Fh. The 4 bytes of data shall be set to FFh and have no information.

Table 46 – NO INFO pack

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	0	Keyword = 3Fh						
2	1	1	1	1	1	1	1	1
3	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1

8.3.9.2 Maker option pack

This pack is reserved for each manufacturer to realize the maker's options. The keyword range is defined as 70h to 7Eh.

Table 47 – Maker option pack

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	0	Keyword = 70h to 7Eh						
2	Length = n							
3	MAKER CODE							
4	Option							
n+2	Option							

MAKER CODE:

To be defined.

Option:

To be defined.

8.3.9.3 Null pack

This pack is the variable length AUX which is defined by keyword = 7Fh. The data are set to FFh except for the keyword and the length value.

Table 48 – Null pack

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
1	0	Keyword = 7Fh						
2	Length = n							
3	1	1	1	1	1	1	1	1
4	1	1	1	1	1	1	1	1
n+2	1	1	1	1	1	1	1	1

8.3.9.4 VBV pack

The VBV pack is optional data in the AUX-V group and defined with keyword = 45h. It contains VBV information for each PES-V unit in the Pack-V. The value assigned to the length byte is 5x the number of PES-V units in the Pack-V (see Table 49).

Table 49 – VBV pack

	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
1	0	Keyword = 45h							
2	Length = (5 x n)								
3	LSB ◄ VBV DELAY								for 1st PES-V in Pack-V
4	MSB ►								
5	HEADER SIZE								
6	LSB ◄ PICTURE SIZE								
7	MSB ►								
8	LSB ◄ VBV DELAY								for 2nd PES-V in Pack-V
9	MSB ►								
10	HEADER SIZE								
11	LSB ◄ PICTURE SIZE								
12	MSB ►								
13	LSB ◄ VBV DELAY								for 3rd PES-V in Pack-V
14	MSB ►								
15	HEADER SIZE								
16	LSB ◄ PICTURE SIZE								
17	MSB ►								

VBV DELAY:

This field indicates the PES-V vbv_delay value.

HEADER SIZE:

This field indicates the PES-V total header size. Its value is calculated in the same manner as the HEADER SIZE of the video frame pack.

PICTURE SIZE:

This field indicates the PES-V picture size. Its value is calculated as follows.

PICTURE SIZE = picture_size ÷ video_rate_step

(numbers should be rounded up after the decimal point)

where

picture_size:

indicates the number of bytes, counting from the next byte of picture_start_code to the last byte of picture_data in the PES-V;

video_rate_step = 25 000 000 / 8 ÷ 90 000.

8.3.10 AUX data at the editing point

8.3.10.1 Audio frame pack at the editing point

The edit AUX-A in an Edit Pack-Unit with only PES-V stuffing (see Figure 19) shall include an audio frame pack with the following field restrictions.

- NUMBER OF AUDIO MUTE FRAMES: This field shall be set to 0h.
- NUMBER OF AAU: This field shall be set to 0h.

When the previous Edit Pack-Unit contains only PES-V stuffing, the present Edit AUX-A shall include an audio frame pack with the following field restrictions.

- ETN: This field shall be set to the value of ETN in the previous Pack-Unit.
- AUDIO PTS: This field shall be set to the value of AUDIO PTS in the previous Pack-Unit.

8.3.10.2 Video frame pack at the editing point

An edit AUX-V in an Edit Pack-Unit which contains only PES-V stuffing (see Figure 19) shall include a video frame pack with the following field restrictions.

- NUMBER OF VIDEO FRAMES: This field shall be set to 00h.

When the previous Edit Pack-Unit contains only PES-V stuffing, the present edit AUX-V shall include a video frame pack with the following field restrictions.

- ETN, DTS: These fields shall take the same value as those in the previous Pack-Unit's video frame pack.
- VBV_DELAY, HEADER_SIZE: These fields shall take the same value as those in the pre-recorded Pack-Unit's video frame pack.

8.4 Search data

8.4.1 Introduction

In the recording format, search sync blocks are allocated for the recording of search data. There are two recording patterns, one for 8x speed search data and the other for 24x speed search data. Recording of 8x speed search data is mandatory while that of 24x speed search data is optional.

8.4.2 Recording pattern of search data

The recording positions for both 8x speed search data and 24x speed search data are defined below. Refer to Figure 26 for the arrangement of the search sync blocks in the ECC unit.

8x speed search data is recorded repeatedly, once within each ECC unit, 34 units of search sync block data (search data number 0 to 33) are recorded on some three minus azimuth tracks. Those track number and sync block number are shown in Table 50.

24x speed search data is recorded repeatedly, once within each 3 ECC units, 12 units of search sync block data (search data number 0 to 11) are recorded on some three plus azimuth track. Those track number and sync block number are shown in Table 51.

The 24x speed search data shall be recorded within the SPH = 0 interval (see 8.3.4 for SPH details).

Table 50 – Configuration of search sync blocks for 8x speed search

Azimuth = -

Track pair No.[2:0]	Sync block No.	Search data No.
0	86	17
	87	18
	88	19
	89	20
	90	21
	91	22
	92	23
	93	24
	94	25
	95	26
	96	27
	97	28
	98	29
	99	30
	100	31
	101	32
	102	33
	103	17
	104	18
	105	19
	106	20
	107	21
	108	22
	109	23
	110	24
	111	25
	112	26
	113	27
	114	28
	115	29
	116	30
	117	31
	118	32
	119	33

Track pair No.[2:0]	Sync block No.	Search data No.
1	44	0
	45	1
	46	2
	47	3
	48	4
	49	5
	50	6
	51	7
	52	8
	53	9
	54	10
	55	11
	56	12
	57	13
	58	14
	59	15
	60	16
	61	0
	62	1
	63	2
	64	3
	65	4
	66	5
	67	6
	68	7
	69	8
	70	9
	71	10
	72	11
	73	12
	74	13
	75	14
	76	15
	77	16

Track pair No.[2:0]	Sync block No.	Search data No.
1	78	0
	79	1
	80	2
	81	3
	82	4
	83	5
	84	6
	85	7
	86	8
	87	9
	88	10
	89	11
	90	12
	91	13
	92	14
	93	15
	94	16

Track pair No.[2:0]	Sync block No.	Search data No.
2	95	17
	96	18
	97	19
	98	20
	99	21
	100	22
	101	23
	102	24
	103	25
	104	26
	105	27
	106	28
	107	29
	108	30
	109	31
	110	32
	111	33
	112	17
	113	18
	114	19
	115	20
	116	21
	117	22
	118	23
	119	24
	120	25
	121	26
	122	27
	123	28
	124	29
	125	30
	126	31
	127	32
	128	33

Table 51 – Configuration of search sync blocks for 24x speed search

Azimuth = +

Track pair No.[2:0]	Sync block No.	Search data No.
5	45	0
	46	1
	47	2
	48	3
	51	0
	52	1
	53	2
	54	3
	57	0
	58	1
	59	2
	60	3
	63	0
	64	1
	65	2
	66	3
	72	8
	73	9
	74	10
	75	11
	77	8
	78	9
	79	10
	80	11
	82	8
	83	9
	84	10
	85	11
	87	8
	88	9
	89	10
	90	11

Track pair No.[2:0]	Sync block No.	Search data No.
6	62	4
	63	5
	64	6
	65	7
	67	4
	68	5
	69	6
	70	7
	72	4
	73	5
	74	6
	75	7

Track pair No.[2:0]	Sync block No.	Search data No.
7	47	0
	48	1
	49	2
	50	3
	52	0
	53	1
	54	2
	55	3
	57	0
	58	1
	59	2
	60	3
	62	0
	63	1
	64	2
	65	3
	71	8
	72	9
	73	10
	74	11
	77	8
	78	9
	79	10
	80	11
	83	8
	84	9
	85	10
	86	11
	89	8
	90	9
	91	10
	92	11

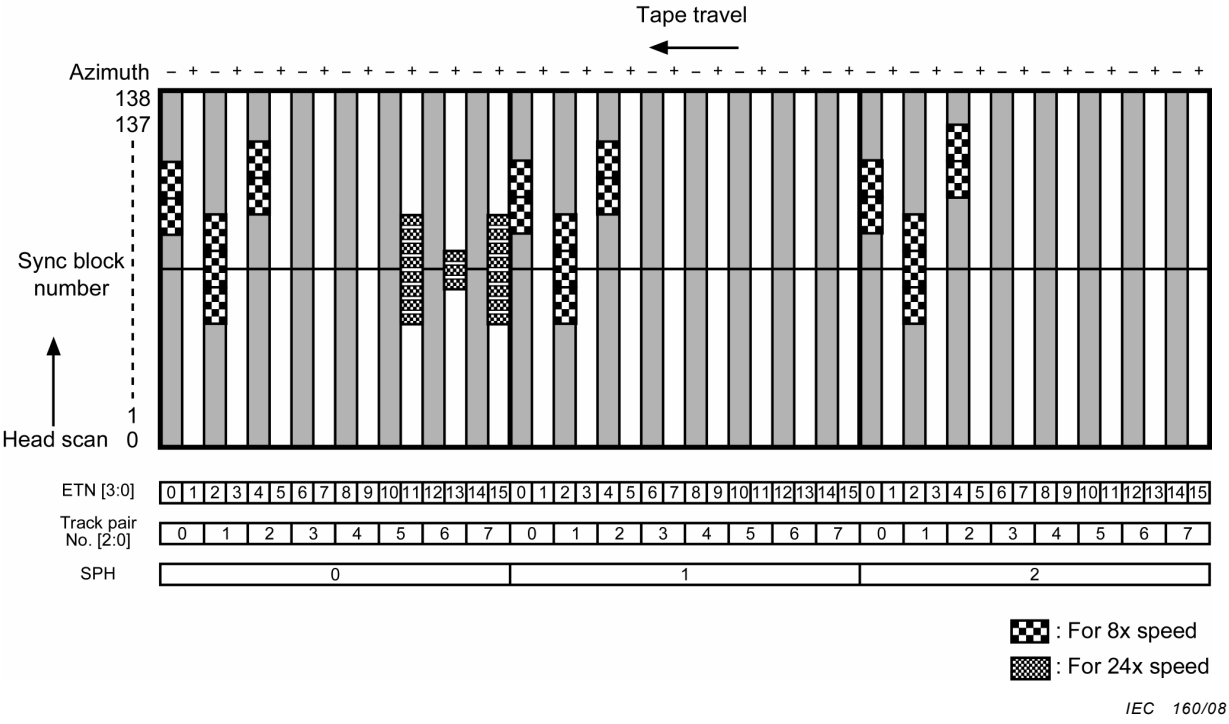


Figure 26 – Recording pattern of search data

8.4.3 Search data processing

8.4.3.1 Search sync block

The search sync block consists of a 1 byte SB header (byte position number 5), a 5 bytes search SB header (byte position number 6 to 10) and a 90 bytes of search picture data (byte position numbers 11 to 100) as shown in Figure 27. The search sync block parameters are stored in the search SB header (see 8.4.3.2), and 720 bits of data are stored in the search picture data area. Search picture data are described in 8.4.3.4.

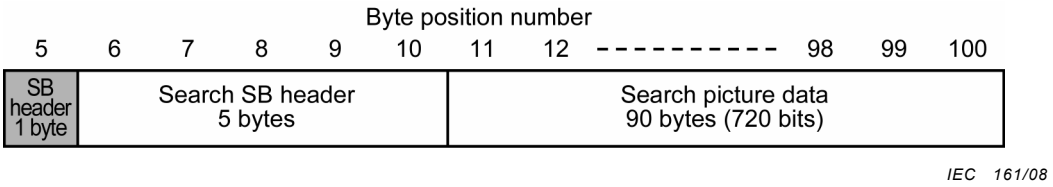


Figure 27 – Structure of search sync block

8.4.3.2 SB header and search SB header

The SB and Search SB headers are shown in Table 52.

Table 52 – SB header and search SB header

Byte position No.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
5	Data type(110b)			SBSC	SSPD			0	SB header
6	DCF	SB X ADDRESS							Search SB header
7	0	SB Y ADDRESS							
8	PCID	PCC	PACK HEADER						
9	SEARCH PACK DATA 1								
10	SEARCH PACK DATA 2								

Table 53 – Search pack data

PACK HEADER	SEARCH PACK DATA	L/H	Meaning
00000b	SH	L	The first half of search header (see 8.4.3.4)
00001b	SH	H	The second half of search header (see 8.4.3.4)
00010b	HD2 TTC	L	The first half of HD2 TTC
00011b	HD2 TTC	H	The second half of HD2 TTC
00100b	REC TIME	L	The first half of REC TIME
00101b	REC TIME	H	The second half of REC TIME
00110b	REC DATE	L	The first half of REC DATE
00111b	REC DATE	H	The second half of REC DATE
01000b	ETN	L	SEARCH PACK DATA1 = 00000000b, SEARCH PACK DATA2 = ETN [7:0]
01001b	ETN	H	SEARCH PACK DATA1 = ETN [15:8], SEARCH PACK DATA2 = ETN [23:16]
01010b	BINARY GROUP	L	The first half of BINARY GROUP
01011b	BINARY GROUP	H	The second half of BINARY GROUP
01100b to 11110b	Reserved		Reserved
11111b	NO INFO		No information

SB header:

See 8.1.2.

DCF: Discontinuity flag

0 = Stream is continuing

1 = Stream is not continuing

If DCF = 1, a DIT shall be inserted into the TS.

SB X ADDRESS:

X address of the first macro block in the search sync block.

SB Y ADDRESS:

Y address of the first macro block in the search sync block. In the case when SB Y ADDRESS = 0, all search picture data is 0 and invalid.

PCID: Picture class ID

0 = Base data

1 = Helper data

PCC: Picture change counter

This field is reset to 0 at the recording start and recording end points. This field counts cyclically from 1 to 3 whenever a scene change occurs (see 8.4.3.6).

PACK HEADER:

The 5-bit pack header defines the type of SEARCH PACK DATA as shown in Table 53.

SEARCH PACK DATA:

2 bytes of search data information can be stored in SEARCH PACK DATA 1 and SEARCH PACK DATA 2 (see Table 52).

The values of HD2 TTC, REC DATE and REC TIME take the same values as those of the Pack-Unit containing the I-picture that was used to create the search picture data with earliest PTS or DTS.

ETN takes the same value as the ETN of the Pack-Unit containing the I-picture that was used to create the search picture data.

8.4.3.2.1 SH pack

If PACK HEADER = 00000b, the SH-L pack is stored in SEARCH PACK DATA 1. If PACK HEADER = 00001b, SH-H is stored in SEARCH PACK DATA 2. The SH-L and SH-H packs describe the video stream recorded in the main sector. The data structure is defined in Table 54.

Table 54 – Data structure of search header

	Byte position No.	bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0	
SH-L	8	PCID	PCC	PACK HEADER = 00000b						
	9	SFR				CGMS		REC ST	ABST BF	SEARCH PACK DATA 1
	10	ASPECT RATIO				FRAME RATE				SEARCH PACK DATA 2
SH-H	8	PCID	PCC	PACK HEADER = 00001b						
	9	HORIZONTAL SIZE								SEARCH PACK DATA 1
	10	VERTICAL SIZE								SEARCH PACK DATA 2

SFR: Source frame rate

This field indicates the source frame rate.

0100b = 30 ÷ 1,001 Hz

0011b = 25 Hz

0001b = 24 ÷ 1,001 Hz

Others = Reserved

CGMS: Copy generation management system

This value shall be the same as that contained in the video frame pack (see 8.3.6).

REC ST: Recording start point

This flag takes the same value as REC ST in the video frame pack in the Pack-Unit that contains the I-picture used to create the search picture data.

ABST BF: ABST blank flag

0 = There exists discontinuity

1 = There does not exist discontinuity

The value shall be the same as the value of ABST BF in the video frame pack of the Pack-Unit that contains the I-picture used to create the search picture data.

ASPECT RATIO:

0011b = 9 ÷ 16

Others = Reserved

FRAME RATE:

0011b = 25

0100b = 30 ÷ 1,001

Others = Reserved

HORIZONTAL SIZE:

Number of active pixels per line/8

B4h = 1 440/8 pixels (fixed)

VERTICAL SIZE:

Number of active lines per frame/8

87h = 1 080 / 8 pixels (fixed)

8.4.3.3 Configuration of search pack

8.4.3.3.1 Configuration of search pack for 8x speed search

The SEARCH PACK DATA for the 8x speed search is shown in Table 55.

Table 55 – Configuration of search pack for 8x speed search

Search data No.	SEARCH PACK DATA	L/H
0	SH	L
1	SH	H
2	HD2 TTC	L
3	HD2 TTC	H
4	REC TIME / NO INFO	L
5	REC TIME / NO INFO	H
6	REC DATE / NO INFO	L
7	REC DATE / NO INFO	H
8	SH	L
9	SH	H
10	ETN	L
11	ETN	H
12	BINARY GROUP / NO INFO	L
13	BINARY GROUP / NO INFO	H
14	BINARY GROUP / NO INFO	L
15	BINARY GROUP / NO INFO	H
16	NO INFO	

Search data No.	SEARCH PACK DATA	L/H
17	SH	L
18	SH	H
19	ETN	L
20	ETN	H
21	BINARY GROUP / NO INFO	L
22	BINARY GROUP / NO INFO	H
23	BINARY GROUP / NO INFO	L
24	BINARY GROUP / NO INFO	H
25	SH	L
26	SH	H
27	HD2 TTC	L
28	HD2 TTC	H
29	REC TIME / NO INFO	L
30	REC TIME / NO INFO	H
31	REC DATE / NO INFO	L
32	REC DATE / NO INFO	H
33	NO INFO	

8.4.3.3.2 Configuration of search pack for 24x speed search

The SEARCH PACK DATA for the 24x speed search is shown in Table 56.

Table 56 – Configuration of search pack for 24x speed search

Search data No.	SEARCH PACK DATA	L/H
0	SH	L
1	SH	H
2	HD2 TTC	L
3	HD2 TTC	H
4	REC TIME / NO INFO	L
5	REC TIME / NO INFO	H
6	REC DATE / NO INFO	L
7	REC DATE / NO INFO	H
8	ETN	L
9	ETN	H
10	BINARY GROUP / NO INFO	L
11	BINARY GROUP / NO INFO	H

8.4.3.4 Search picture data

I-pictures from the video stream should be used to create search picture data. As shown in figure 28 an I-picture, equal to 1 440 pixels horizontally and 1 088 lines vertically, consists of 90 × 68 macro blocks (MB). Each macro block consists of 6 types of 8 × 8 pixel DCT blocks

Y0, Y1, Y2, Y3, C_B, C_R. Search picture data for the 8x and 24x speed search modes is made from the DC coefficient of each DCT block as described below.

8x speed search data

8x speed search data consists of base data and helper data. This base data consists of 6 bits of Y0 data and 5 bits C_B, C_R data which provide the basic outline of the search picture, and 6 bits Y1, Y2 and Y3 helper data, which improves the quality of the search picture.

These data are packed into the 720 bits of search picture data in the search sync block (Figure 29). 8x speed search data divides each frame into 9 ECC units. The base data is recorded in the first 4 ECC units and the helper data in the latter 5 ECC units (see Figure 30). Every ECC unit is assigned the 8x speed search unit number (0 to 8). Figures 31 and 32 illustrate both the layout of the base data and the helper data in relation to the video screen, and also the relationship between the 8x speed search unit number and the search data number (see 8.4.2).

24x speed search data

24x speed search data consists of 6 bits of Y0 data and 5 bits of C_B, C_R data. 24x speed search data from 1 frame is recorded into 12 ECC units (see Figures 33 and 34). As shown in the figures, every ECC unit is assigned the 24x speed search unit number (0 to 11). Figure 35 illustrates the layout of the 24x speed search data in relation to the video screen, and the relationship between the 24x speed search unit number and the search data number (see 8.4.2).

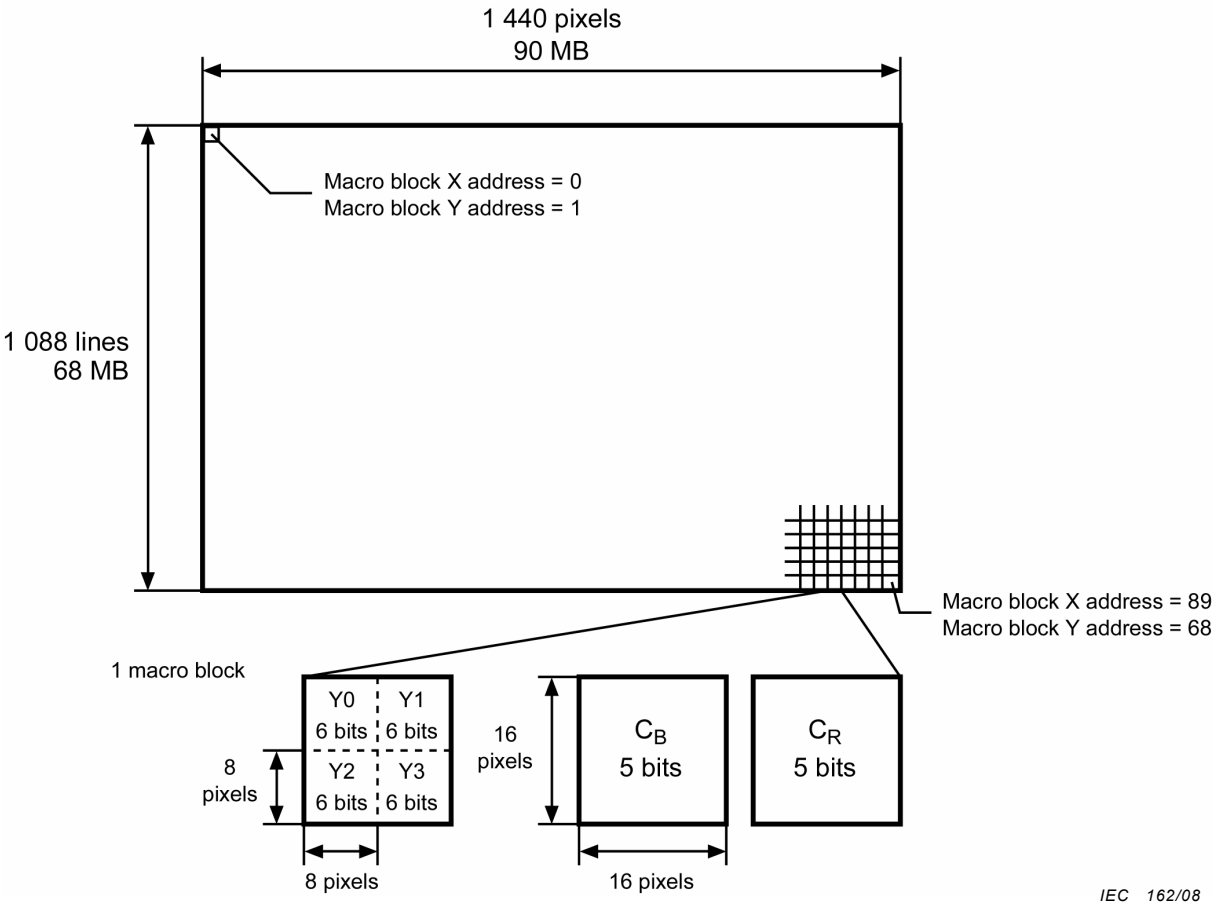


Figure 28 – Macro blocks for search picture

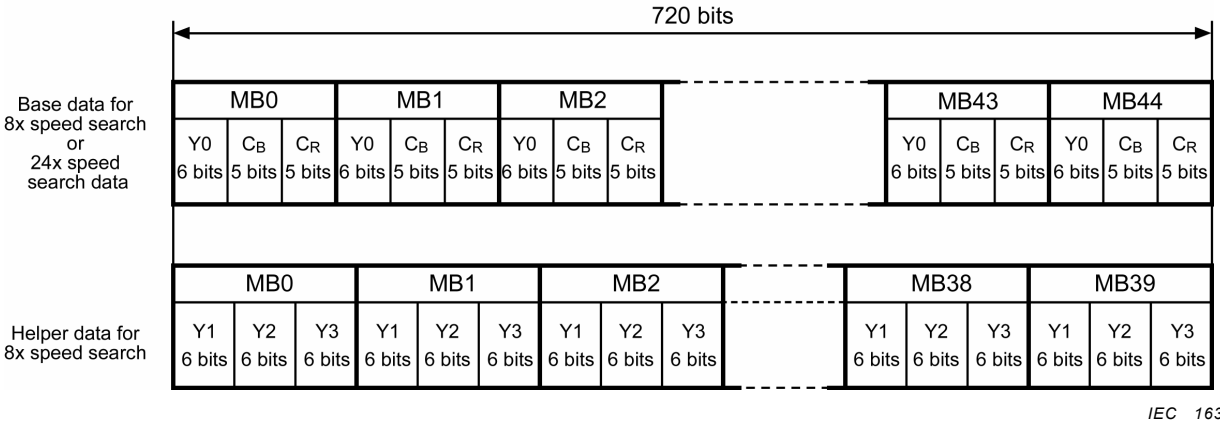


Figure 29 – Structure of search picture data

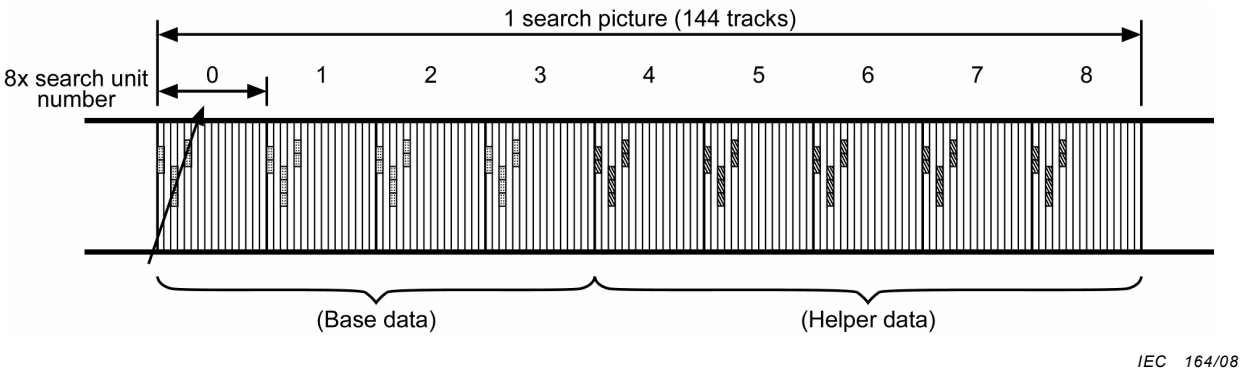


Figure 30 – Configuration of 8x speed search data

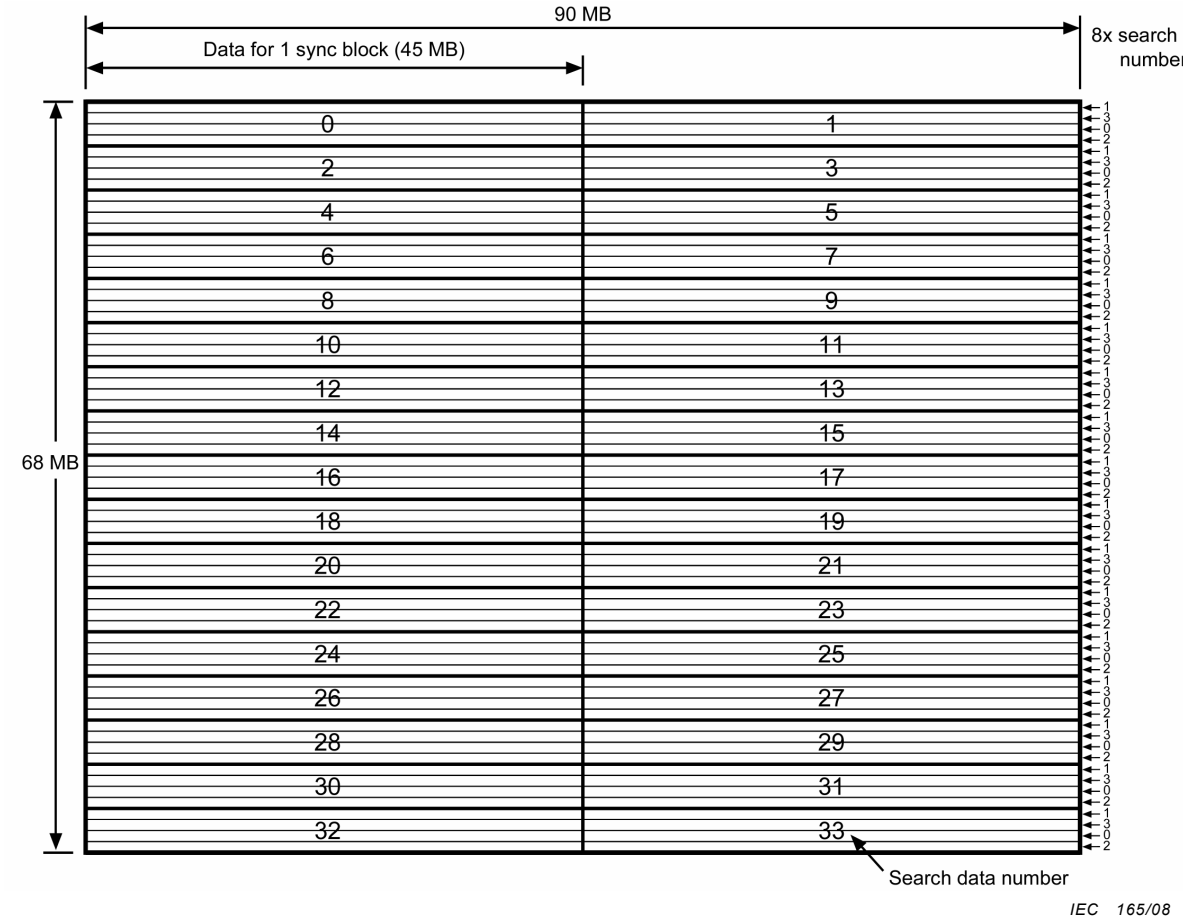


Figure 31 – 8x speed search base data on video screen

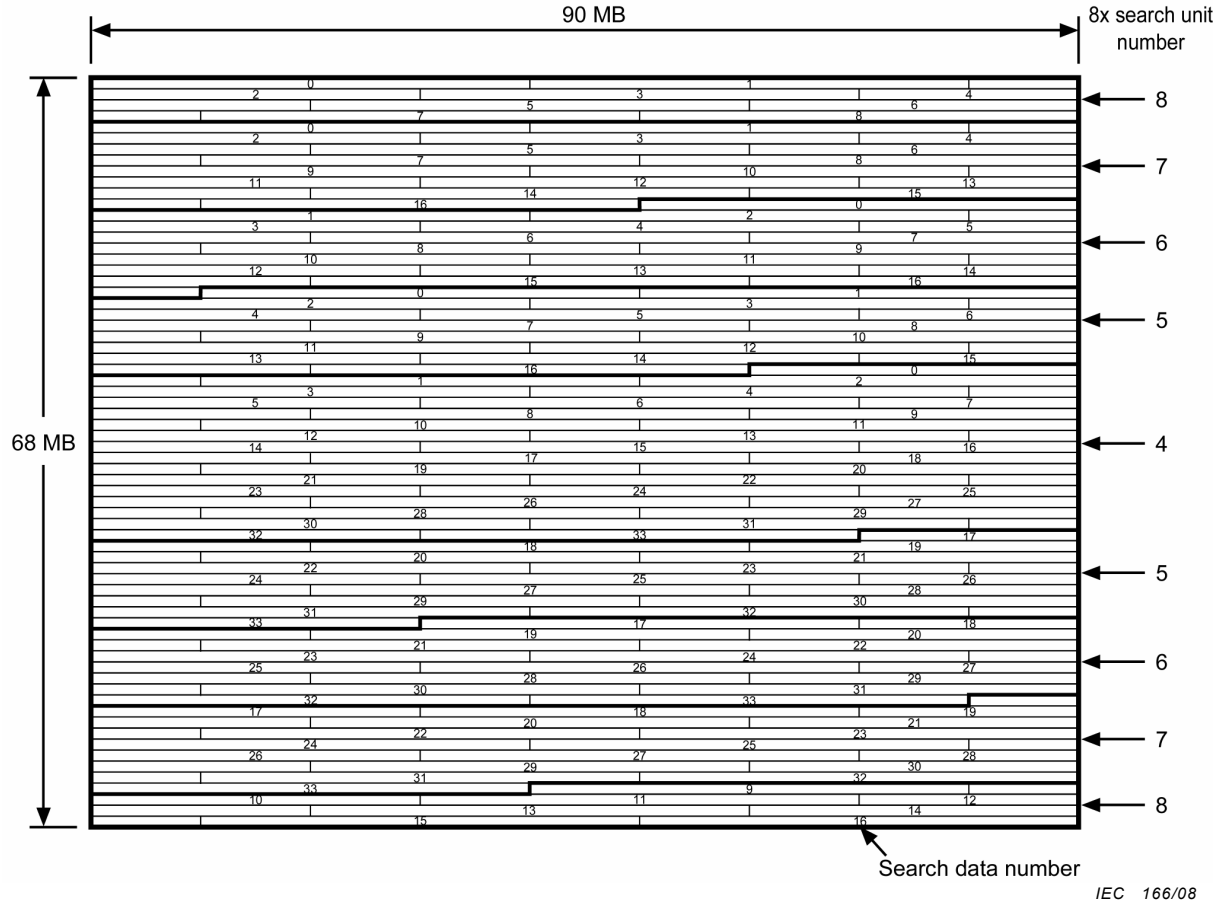


Figure 32 – 8x speed search helper data on video screen

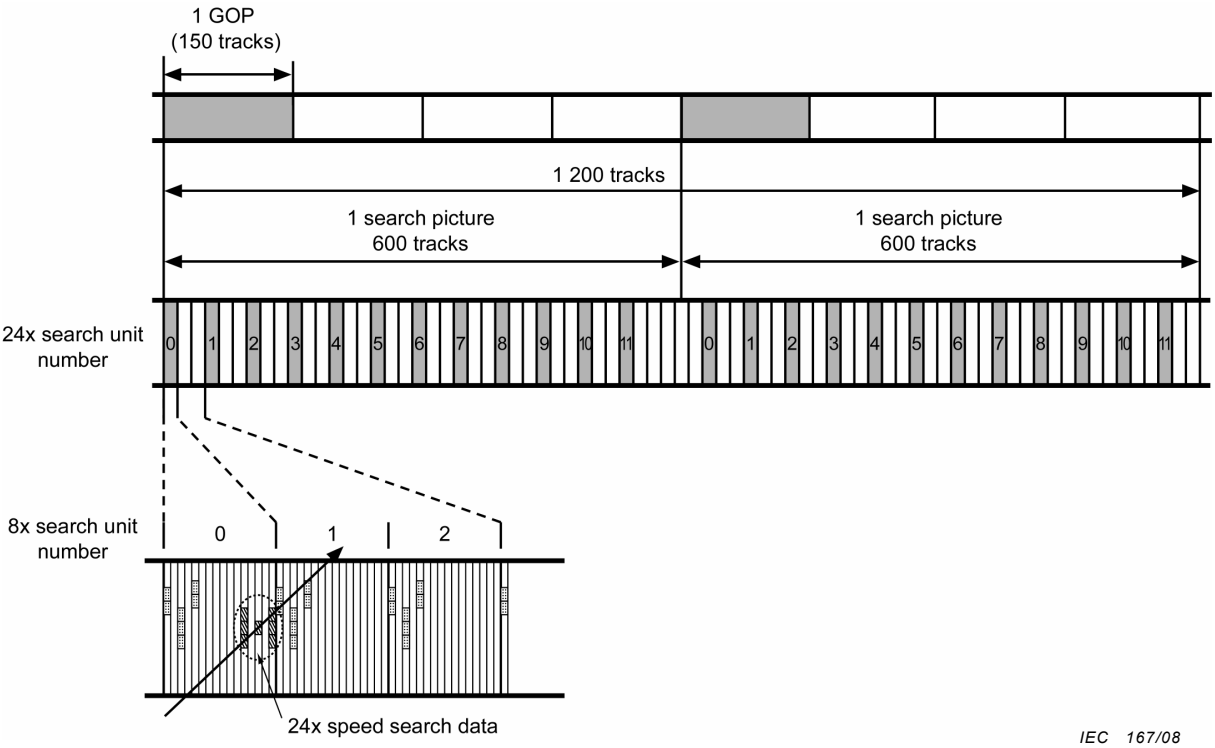


Figure 33 – Configuration of 24x speed search data (1080i/60 system)

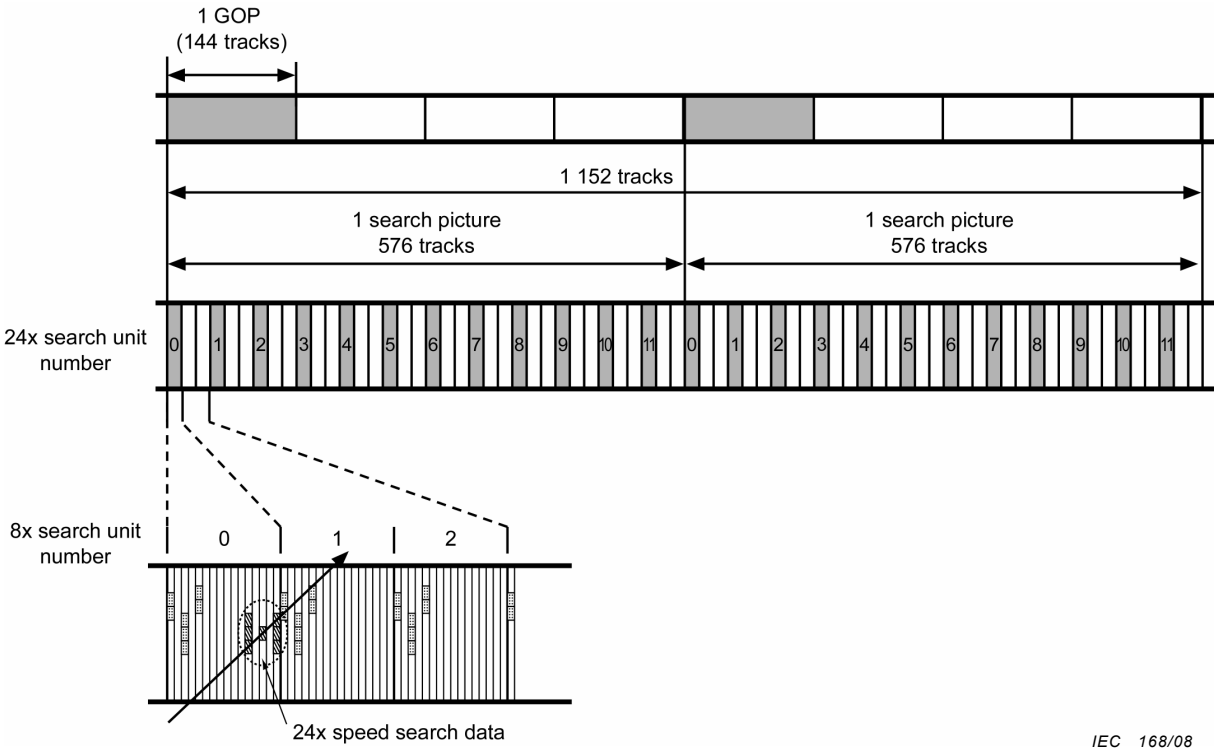


Figure 34 – Configuration of 24x speed search data (1080i/50 system)

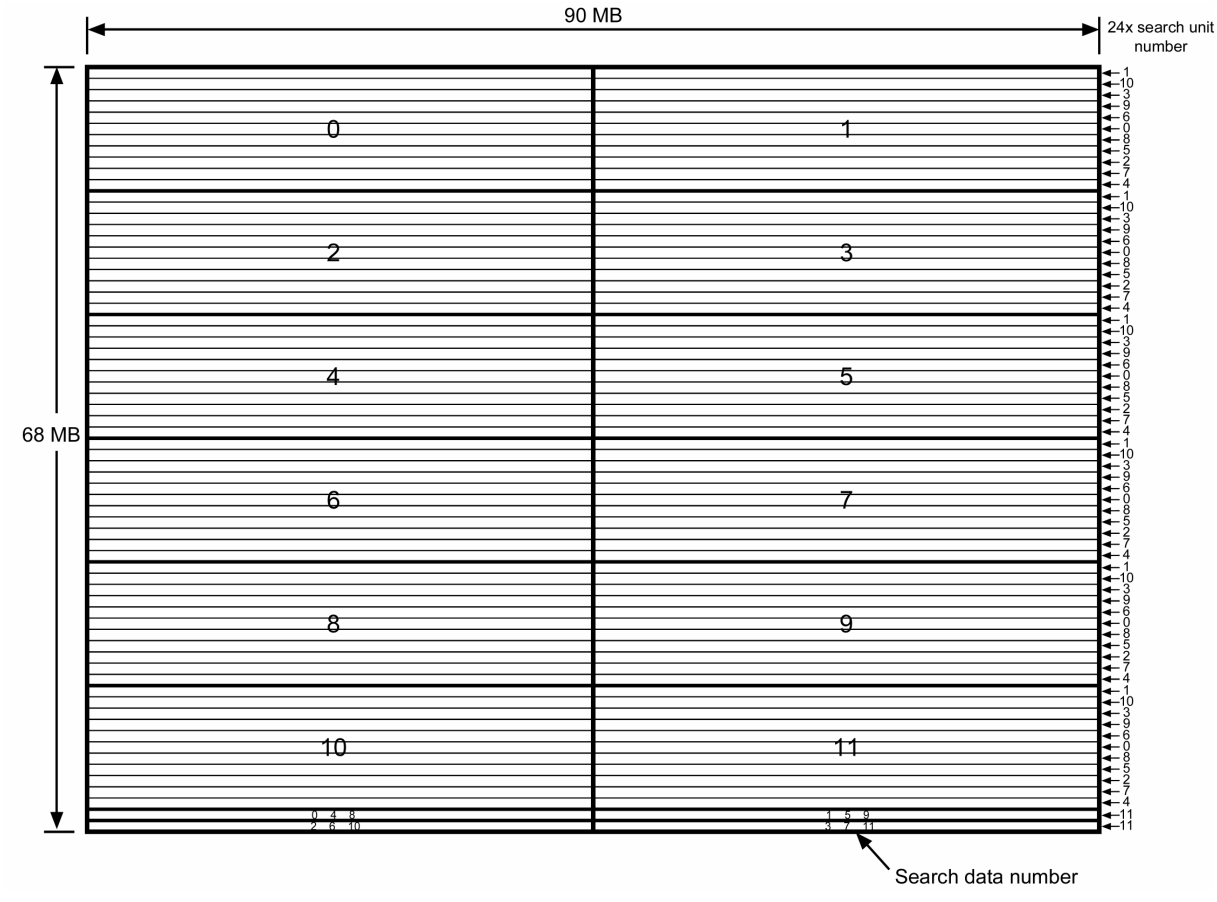


Figure 35 – 24x speed search data on video screen

8.4.3.5 Relation between search data and video frame

The relationship between the search data and the video frame is specified in Figures 36 (1080i/60 system) and 37 (1080i/50 system).

8x speed search

9 search picture data (derived from an I-picture) are recorded to first contiguous 9 ECC units corresponding to 1 GOP of video frames.

24x speed search

12 search picture data (derived from an I-picture) are recorded repeatedly, once every 3 ECC units, in the area corresponding to 4 GOPs of video frames.

Subclauses 8.4.2 and 8.4.3.4 should be referred to for the ECC unit positions with search picture data.

The first search picture data derived from the I-picture is inserted into the ECC unit according to the following condition.

$(A - 16) < B \leq A$

A: ETN of ECCTB of the ECC unit including the first search picture data.

B: ETN obtained from DTS of I-picture.

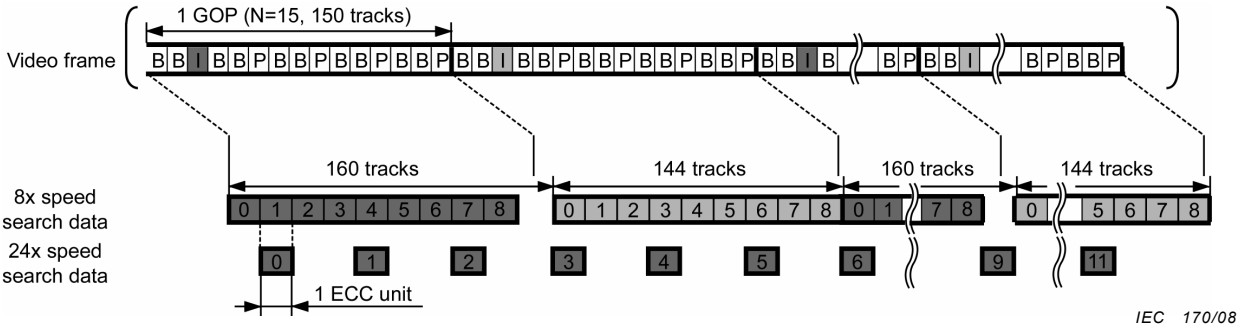


Figure 36 – Relation between search data and video frame (1080i/60 system)

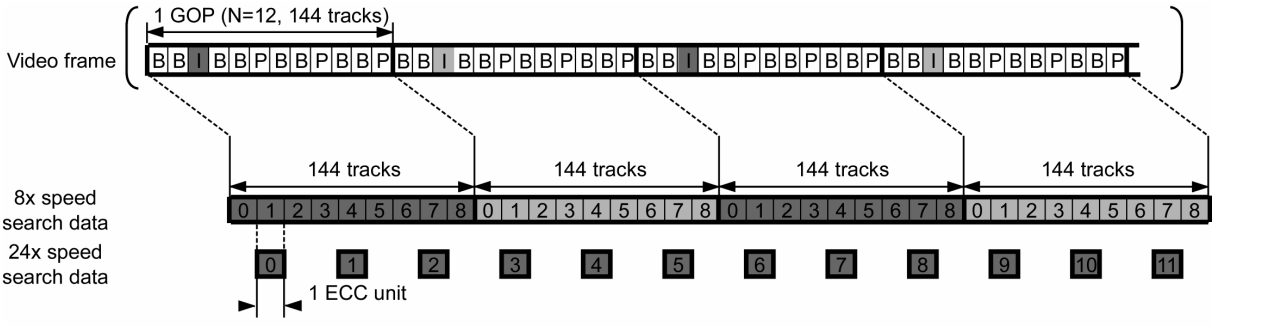


Figure 37 – Relation between search data and video frame (1080i/50 system)

8.4.3.6 Search system data

Search system data records invalid search picture data in invalid tracks at the start of discontinuous recording (see Figures 38 and 39) or in ECC unit at the end of recording (see Figures 40 and 41). PCC shall be set to 00b.

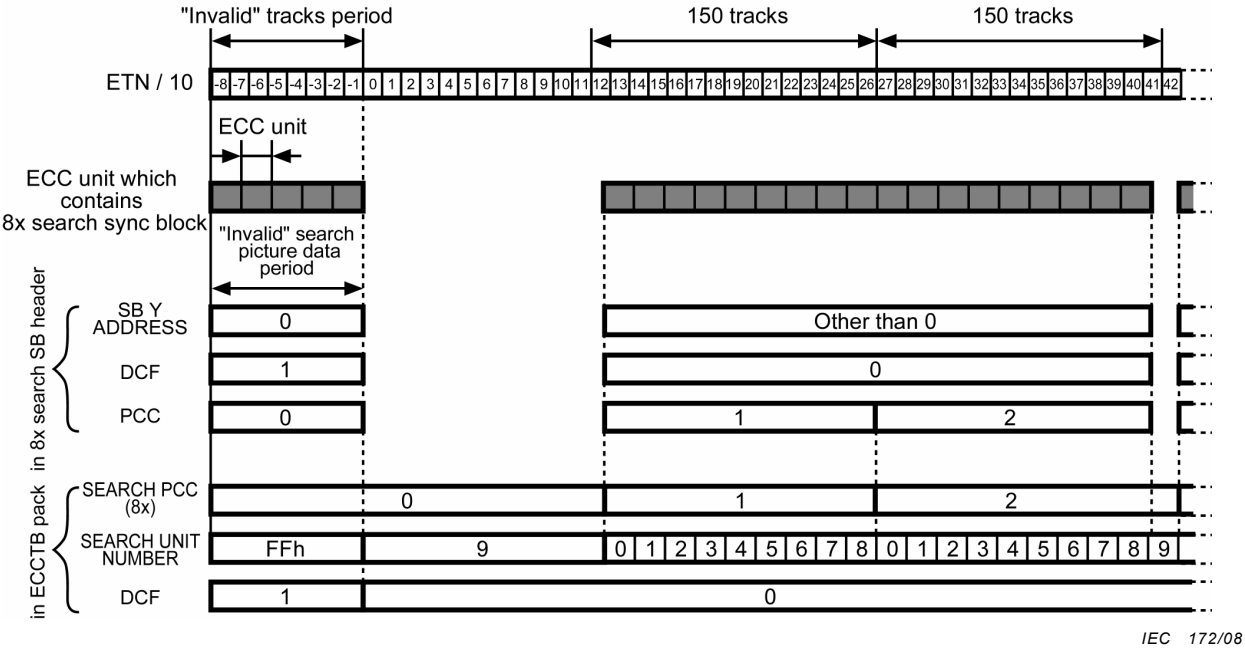


Figure 38 – Management example at the start of discontinuous recording (1080i/60 system)

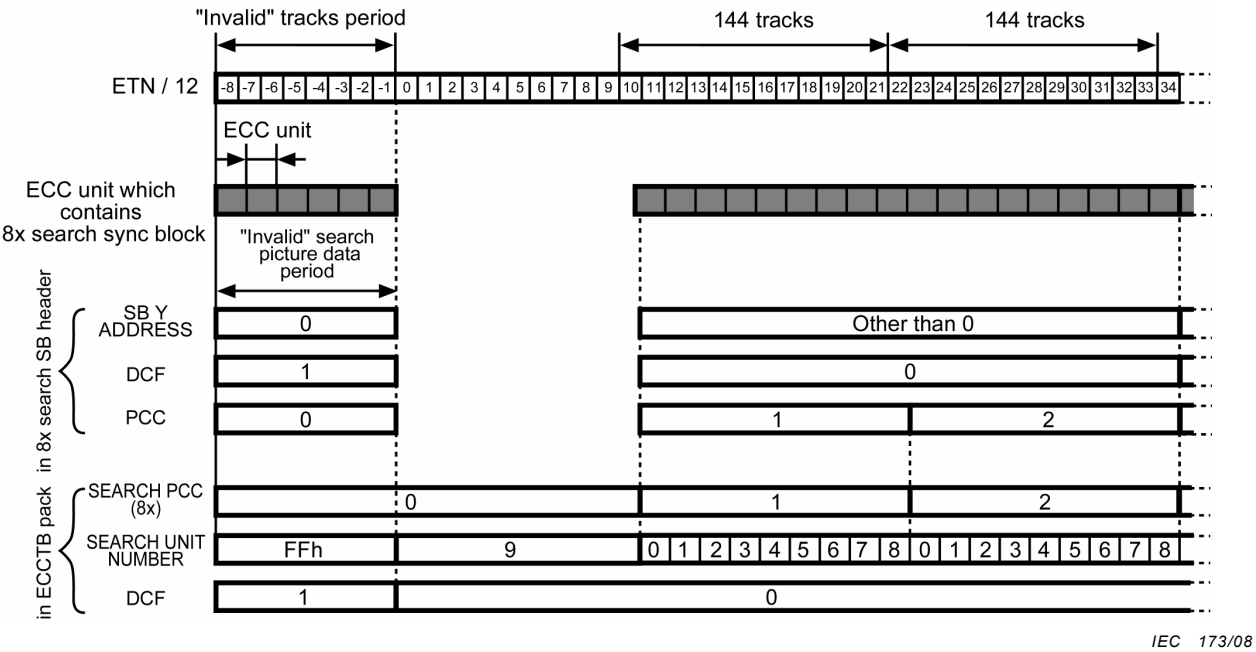


Figure 39 – Management example at the start of discontinuous recording (1080i/50 system)

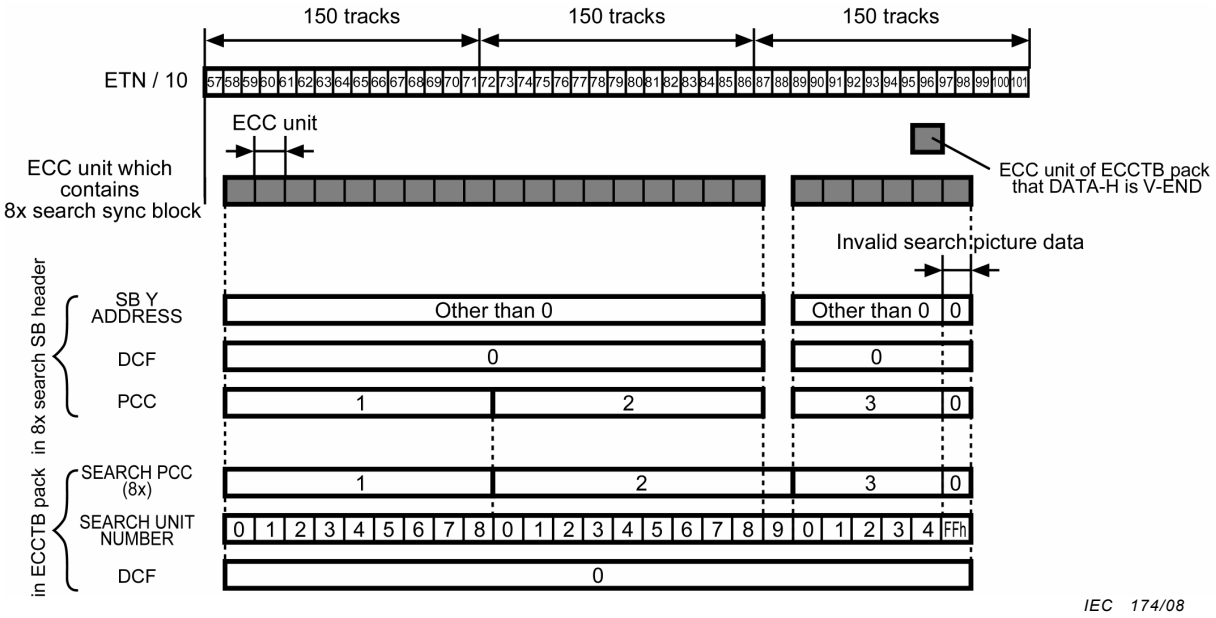


Figure 40 – Management example at the end of recording (1080i/60 system)

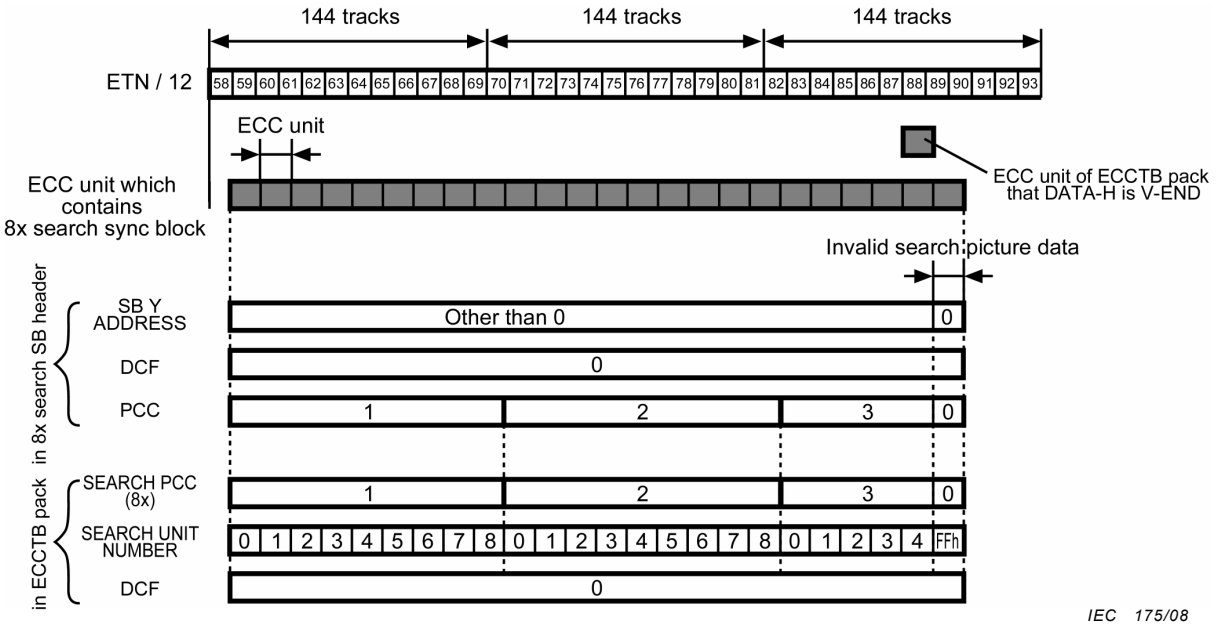


Figure 41 – Management example at the end of recording (1080i/50 system)

8.5 Subcode signal processing

8.5.1 Introduction

The subcode signal shall conform to IEC 61834-2, Clause 8. However, in this format, the subcode data does not support the APT saving area (see Figure 11).

8.5.2 ID data

The structure of the ID data is shown in figure 42. The value of AP3 shall be set to 000b.

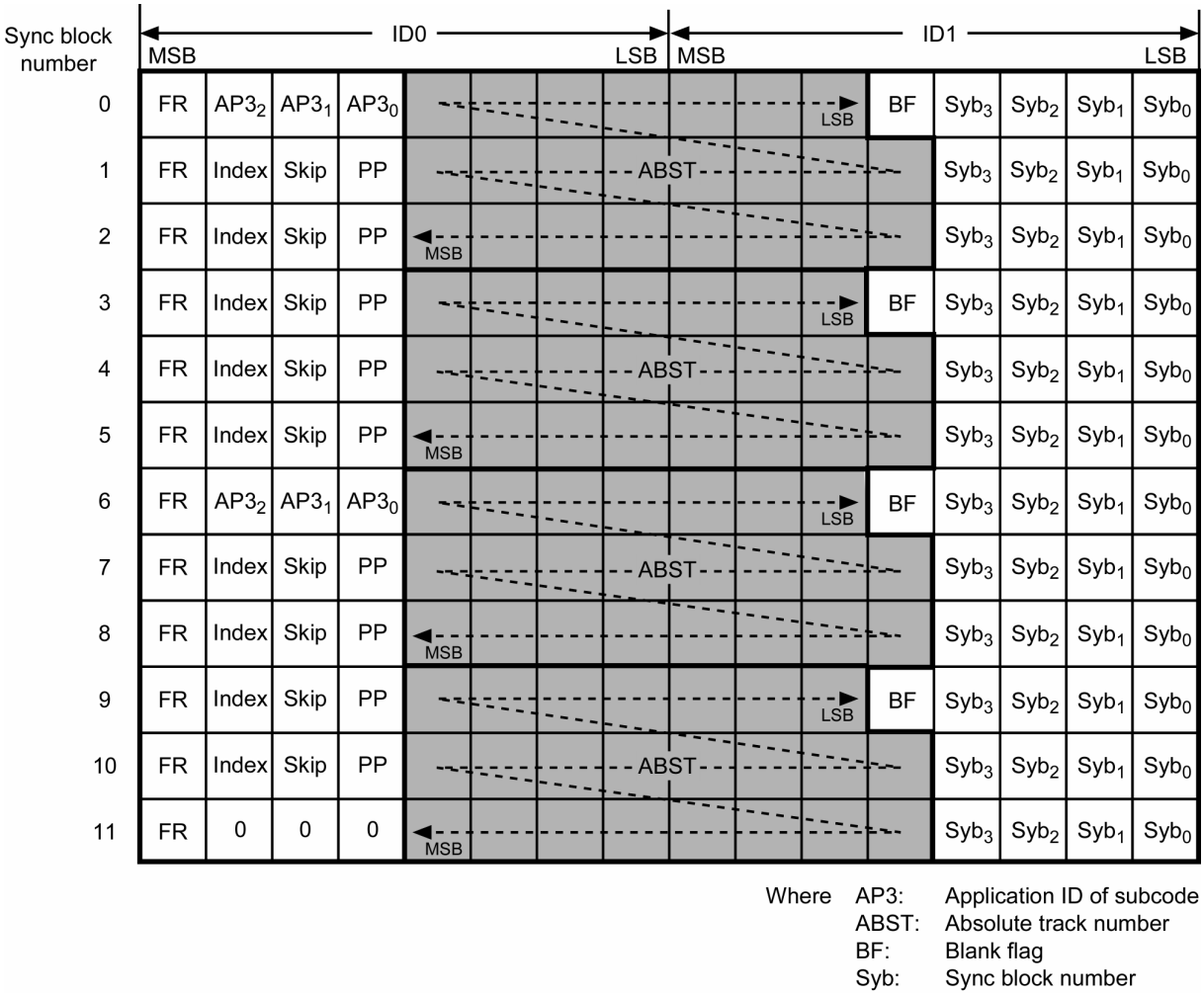


Figure 42 – Structure of ID data

8.5.3 Subcode data

The subcode consists of 5 bytes in a subcode sync block, which makes a pack as described in IEC 61834-4.

8.5.3.1 Subcode data for user's tape

Table 57 shows the subcode data for user's tape. The ETN pack (see 8.3.4) and TITLE BINARY GROUP pack shall be recorded in the optional area. The ETN pack header shall be assigned the value 97h. The subcode data for a video frame are separated into two halves. The first half contains an ETN pack, a TITLE TIME CODE pack, a TITLE BINARY GROUP pack and a NO INFO pack. The second half contains an ETN pack, a TITLE TIME CODE pack, a VAUX REC DATE pack, a VAUX REC TIME pack, an AAUX REC DATE pack, an AAUX REC TIME pack and a NO INFO pack. Details of each pack are given in IEC 61834-4.

Table 57 – Subcode data for user's tape

Sync block number	Subcode data		
	First half of a video frame	Second half of a video frame	
0	ETN	ETN	Optional area
1	ETN or TBG	ETN	
2	ETN	ETN	
3	TTC	TTC	
4	TTC or TBG or NOI	VRD or ARD or NOI	
5	TTC	VRT or ART or NOI	
6	ETN	ETN	Optional area
7	ETN or TBG	ETN	
8	ETN	ETN	
9	TTC	TTC	
10	TTC or TBG or NOI	VRD or ARD or NOI	
11	TTC	VRT or ART or NOI	

Where ETN: ETN pack (Pack header = 97h)
TTC: TITLE TIME CODE pack (Pack header = 13h)
TBG: TITLE BINARY GROUP pack (Pack header = 14h)
NOI: NO INFO pack (Pack header = FFh)
VRD: VAUX REC DATE pack (Pack header = 62h)
VRT: VAUX REC TIME pack (Pack header = 63h)
ARD: AAUX REC DATE pack (Pack header = 52h)
ART: AAUX REC TIME pack (Pack header = 53h)

8.5.3.2 Subcode data for pre-recorded tape

Table 58 shows the subcode data for a pre-recorded tape. The ETN pack and TITLE BINARY GROUP pack shall be recorded in the optional area. The following packs are defined: ETN, TITLE BINARY GROUP, TITLE TIME CODE, PART NO. and CHAPTER START. The same data shall be recorded in the first half and the second half of a video frame. Details of each pack are given in IEC 61834-4.

Table 58 – Subcode data for pre-recorded tape

Sync block number	Subcode data for a video frame	
0	ETN	Optional area
1	ETN or TBG	
2	ETN	
3	TTC	
4	PTN or TTC	
5	CST or TTC	
6	ETN	Optional area
7	ETN or TBG	
8	ETN	
9	TTC	
10	PTN or TTC	
11	CST or TTC	

Where ETN: ETN pack (Pack header = 97h)
TTC: TITLE TIME CODE pack (Pack header = 13h)
PTN: PART NO. pack (Pack header = 32h)
CST: CHAPTER START pack (Pack header = 2Bh)

8.6 Recording positions on tape

8.6.1 Relation between TTC and stream data

The relationship between the TTC and stream data is specified as follows. It is recommended that TTC and stream data are recorded as shown in Figures 43 and 44.

- Relationship between TTC and ETN

  TTC = (ETN - α) / 10 (1080i/60 system) "α" is an arbitrary multiple of 10

  TTC = (ETN - β) / 12 (1080i/50 system) "β" is an arbitrary multiple of 12

- Relationship between DTS and ETN

  DTS = (ETN × 3 003) / 10 (1080i/60 system)

  DTS = (ETN × 3 600) / 12 (1080i/50 system)

The recording position is adjusted for every Pack-Unit. The first byte of the Pack-Unit is recorded within the 16 track margin relative to [ETN – vbv_delay/(3 003 ÷ 10) tracks] (1080i/60 system) or [ETN – vbv_delay/(3 003 ÷ 12) tracks] (1080i/50 system). The value of ETN and vbv_delay are taken from the video frame pack in the Pack-Unit.

NOTE "÷" is used to denote division in mathematical equations where no truncation or rounding is intended.

The subcode TTC increases every frame.

The video frame pack's HD2 TTC follows the subcode TTC discretely.

Whenever each other's ETN accords, the TTCs of the subcode and the video frame pack take the same value, and subcode TTC runs by itself until the HD2 TTC of next video frame pack appears (see Figure 45).

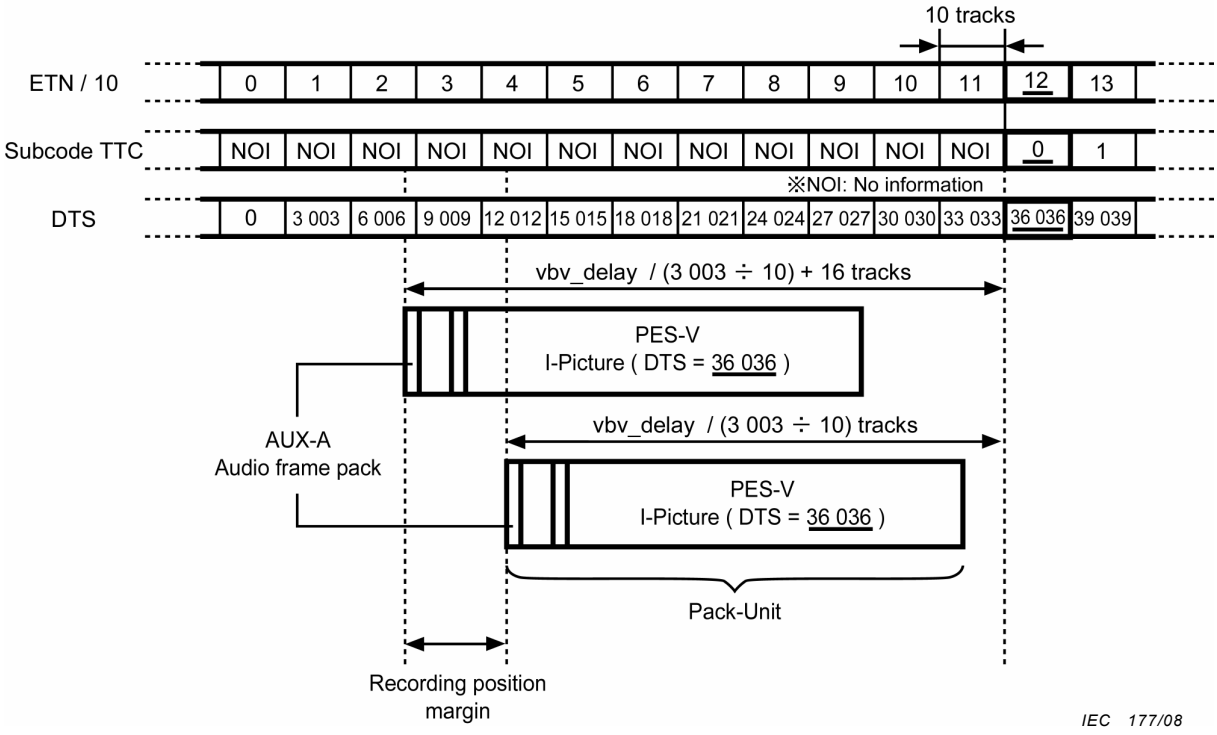


Figure 43 – Subcode TTC interrelation (1080i/60 system)

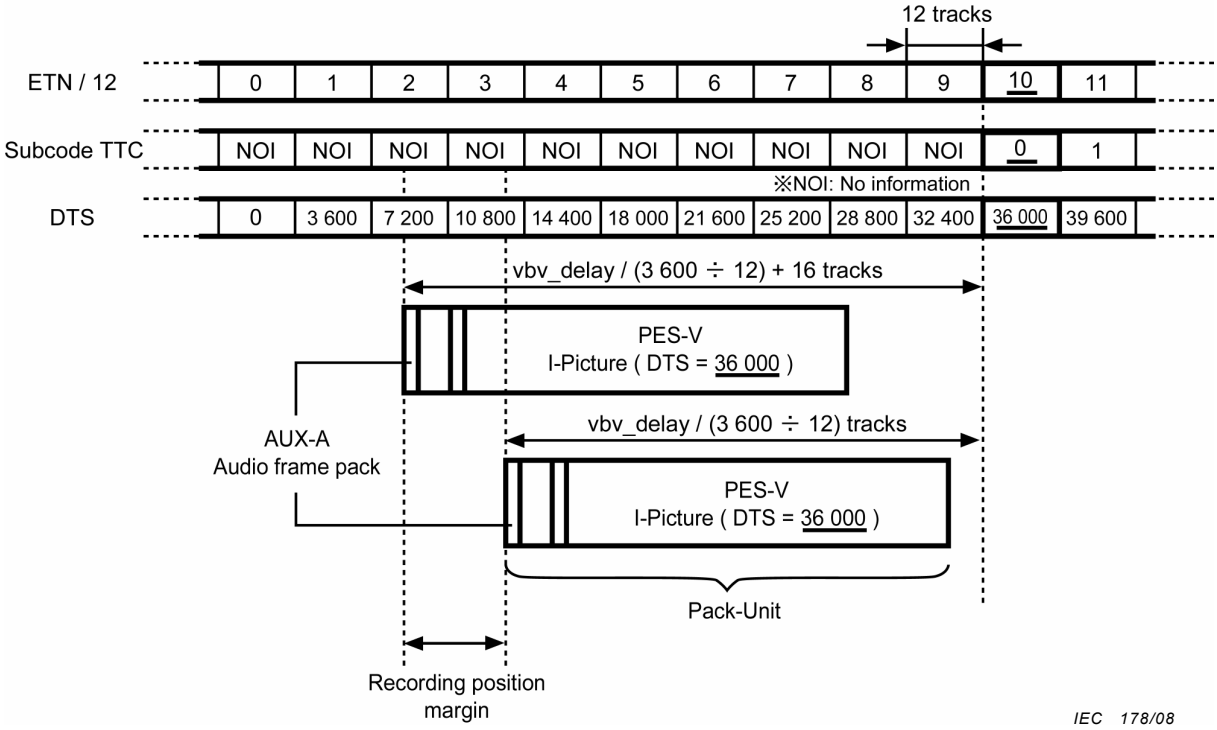


Figure 44 – Subcode TTC interrelation (1080i/50 system)

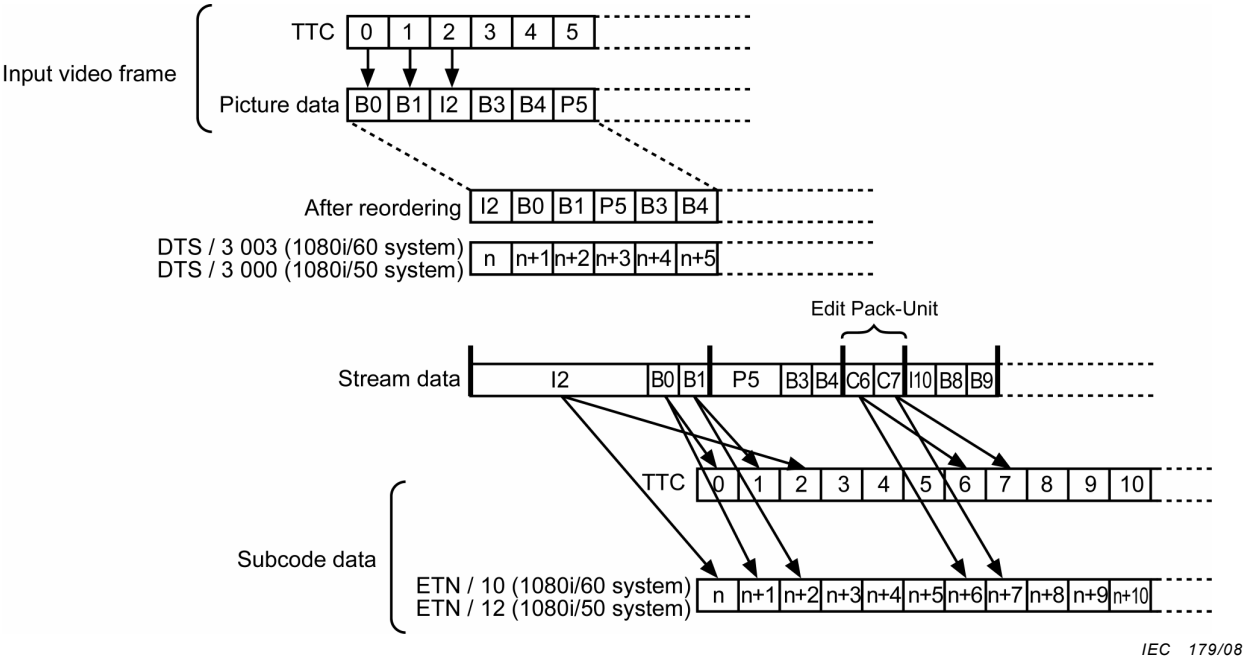


Figure 45 – Relation between subcode TTC and video frame

8.6.2 Recommendation for the recording start position

As shown in Figure 46, the effective recording start position on the tape should be the track flagged ABST = 0 and ETN = 0 for the benefit of maintaining inter-changeability. L_{ST} is the length from the end position of the leader tape to the recording start position of the ITI preamble in the track flagged ABST = 0 and ETN = 0.

It is permitted to record “invalid tracks” from recording start position of the tape "L_{RST}" to effective recording start position of the tape "L_{ST}".

“Invalid tracks” are specified below.

ITI sector:

Same as a valid track.

Main sector:

All PES data and AUX data except ECCTB pack should not be taken into account.

The ECCTB pack and search sync data should be recorded in the ordinary position as DCF = 1.

ABST and ETN in ECCTB pack shall be as specified in Figure 47.

TTC, REC DATE, REC TIME packs in ECCTB pack shall be invalid.

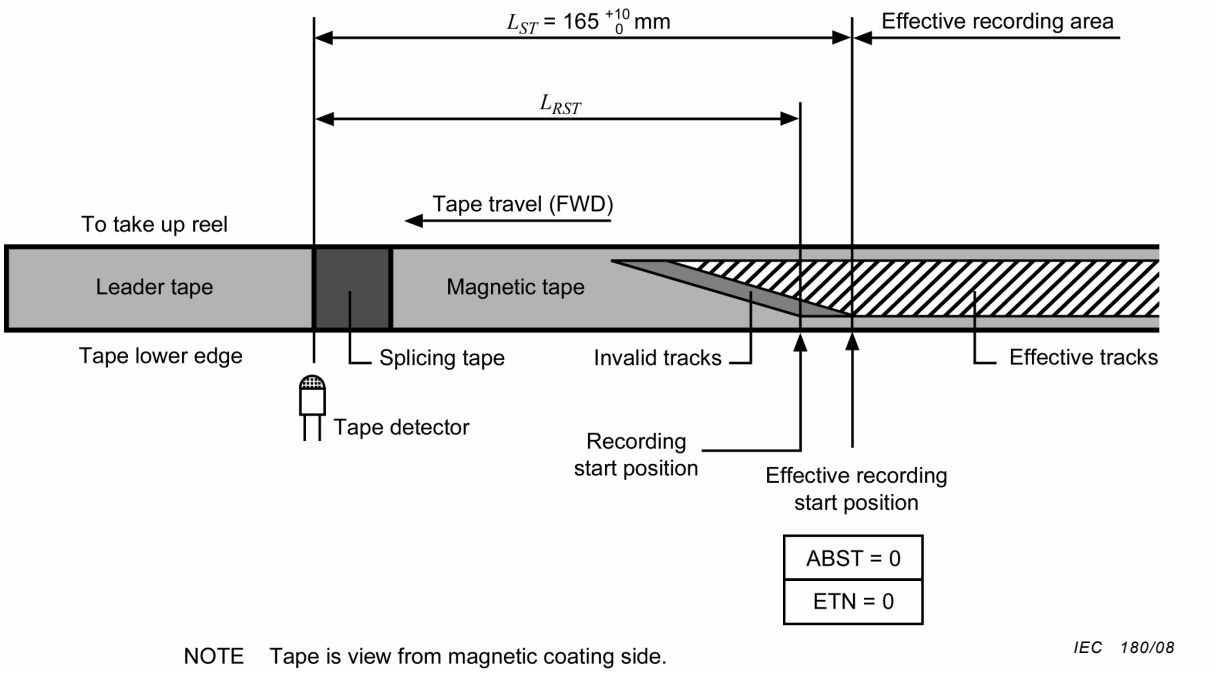
Subcode sector:

AP3 shall be set to 000b.

ABST and ETN shall be as specified in Figure 47.

TTC pack shall not be recorded. NO INFO packs shall be recorded instead.

As shown in Figures 48 and 49, after the effective recording start position the effective tracks shall be recorded with DCF = 0. It is recommended that the DTS time for the first I-picture be the position ETN = 120 and the effective TTC shall be recorded after that point. SPH shall be continuous across the boundary of an invalid track and a valid track.



NOTE Tape is view from magnetic coating side.

Figure 46 – Recommendation for the recording start position of a tape

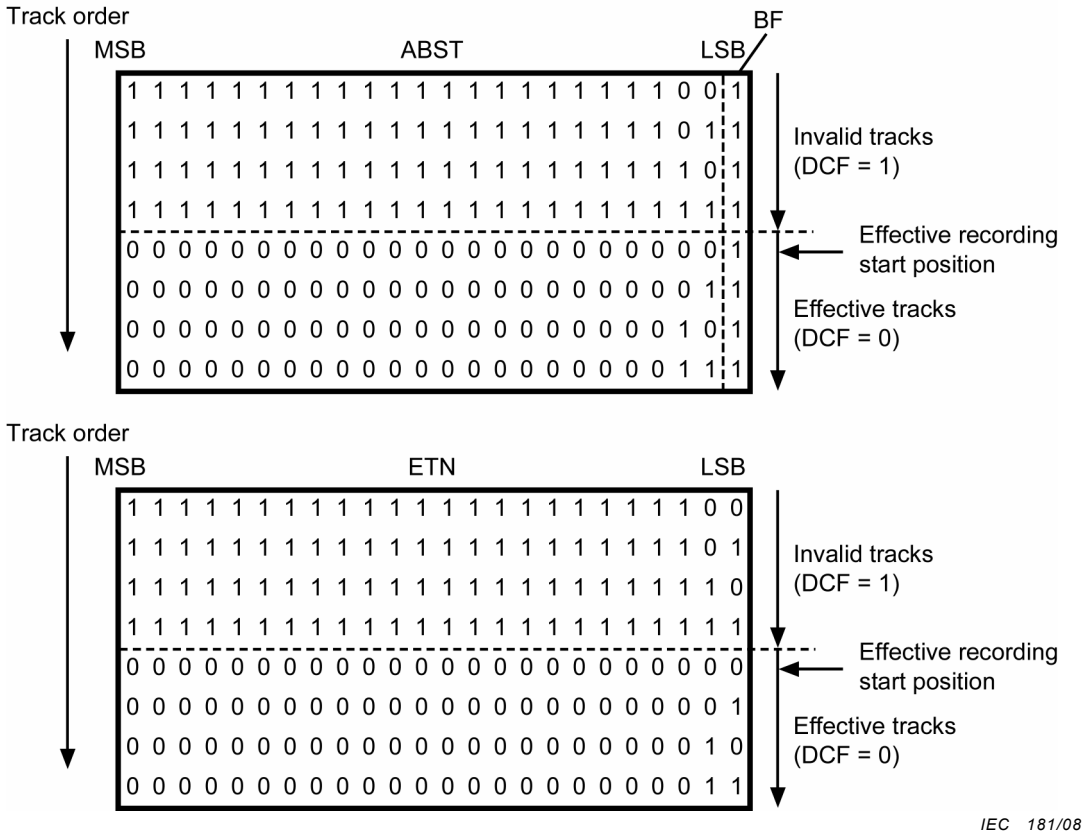


Figure 47 – Numbering of ABST and ETN for invalid tracks

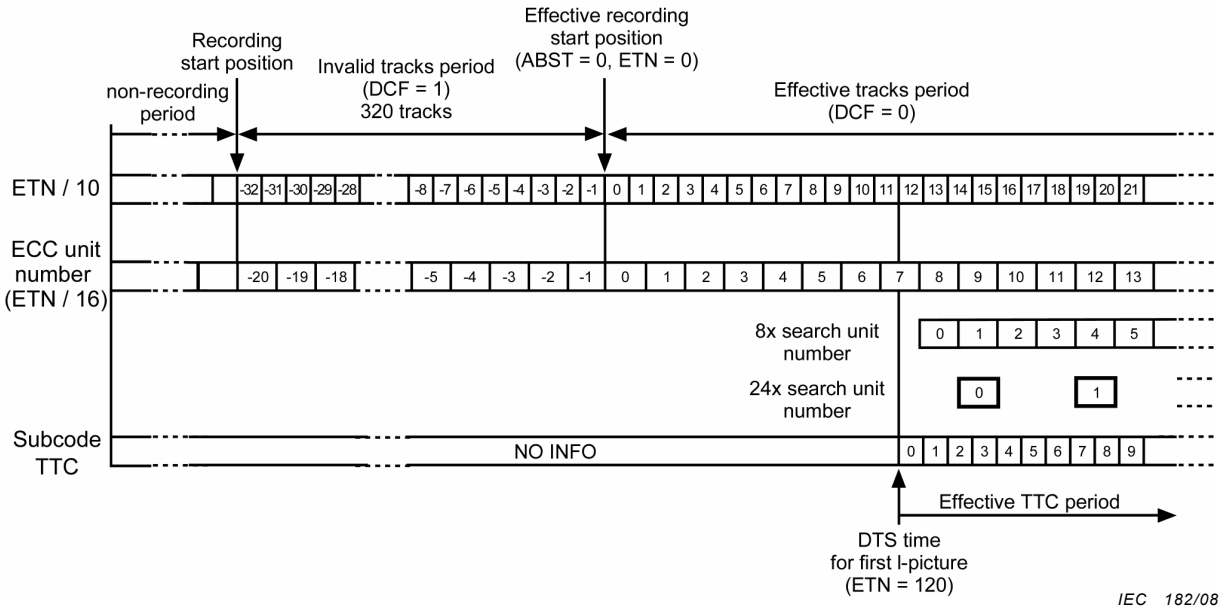


Figure 48 – Recording start position (1080i/60 system)

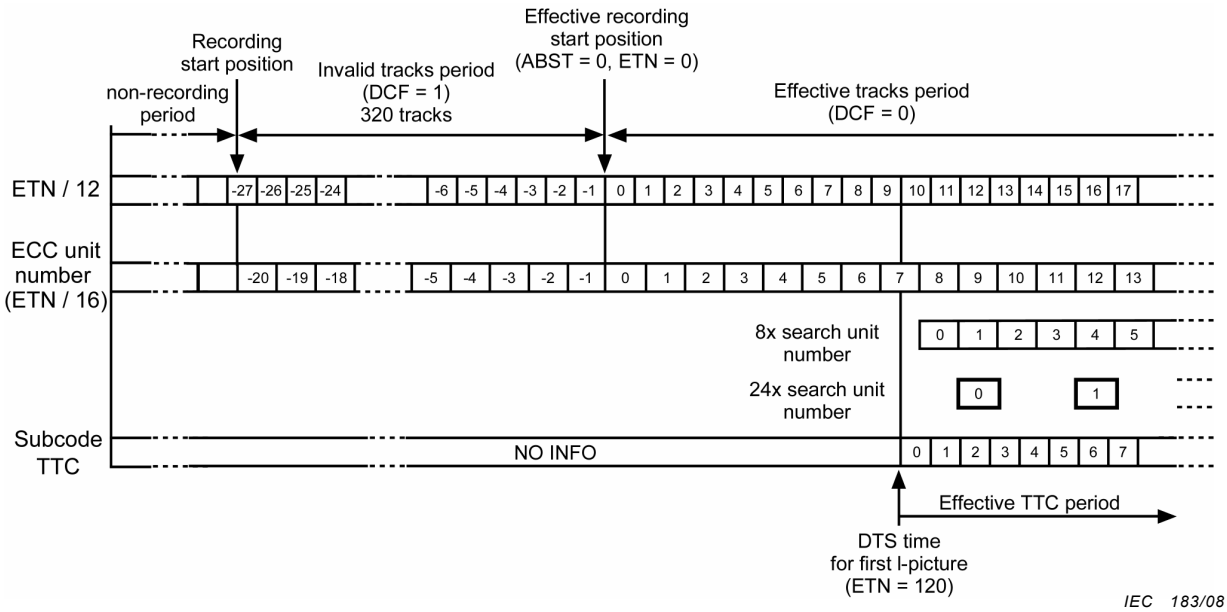


Figure 49 – Recording start position (1080i/50 system)

8.6.3 Recording end position

At the recording end point, a Pack-Unit containing AUX-A, Pack-A and AUX-V is recorded immediately following the Pack-Unit containing the last Pack-V.

The Pack-A records those audio data, which have continuity with the adjacent Pack-A. This data is used to compensate the audio data during editing if necessary.

The AUX-V contains only a video frame pack, and DATA-H shall be V-END (0101b).

The final recorded ECC contains null sync blocks and search sync blocks, and the DATA-H of the ECCTB records No information (0111b) (see Figure 50).

ETN:

Set to the value of the ETN acquired from the DTS of the first PES-V (if a PES-V exists in the Pack-V flagged as V-END).

NUMBER OF VIDEO FRAMES:

Shall be set to FFh.

DATA-H:

Shall be set to V-END (0101b).

VBV_DELAY:

Set to the value of VBV_DELAY in the first PES-V (if a PES-V exists in the Pack-V flagged as V-END).

HEADER_SIZE:

Set to the value of HEADER_SIZE in the first PES-V (if a PES-V exists in the Pack-V flagged as V-END).

DTS:

Set to the value of DTS in the first PES-V (if a PES-V exists in the Pack-V flagged as V-END).

PF: Progressive frame

Set to the same value as the adjacent video frame pack.

TF: Top field first

Set to the same value as the adjacent video frame pack.

RF: Repeat first field

Set to the same value as the adjacent video frame pack.

SFR: Source frame rate

Set to the same value as the adjacent video frame pack.

SEARCH DATA MODE:

Set to the same value as the adjacent video frame pack.

Video mode:

Set to the same value as the adjacent video frame pack.

HD2 TTC, REC DATE, REC TIME:

These fields record the value which have continuity with the adjacent video frame pack. If this is impossible, pack data enable should be set to 0.

CGMS:

Set to the same value as the adjacent video frame pack.

Extended DV packs:

Set to the same value as the adjacent video frame pack, or else PC0 should be set to FFh (NO INFO PACK).

Subcode data shall be recorded continuously until the recording ends.

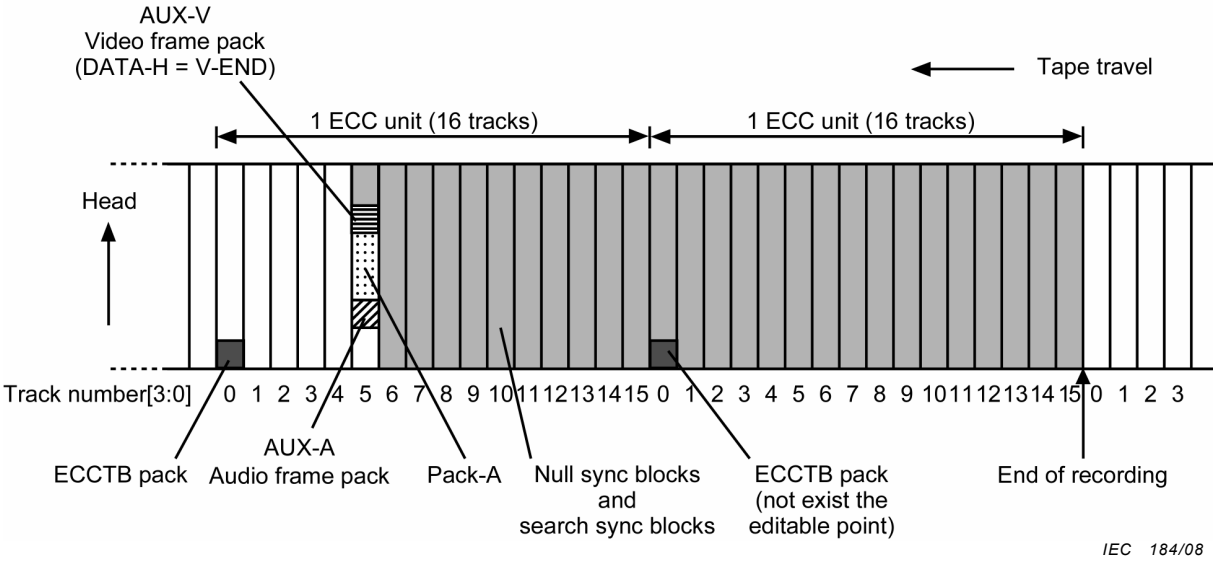


Figure 50 – Recording end position

8.6.4 Recording other positions

In the case of overwriting a pre-recorded tape, continuous recording by means of effective tracks (DCF = 0) is recommended. If this is impossible, the sequence for recording at the start position as described in 8.6.2 shall be used. However, it is recommended that the invalid tracks (DCF = 1) span more than 5 ECC units (80 tracks). When recording invalid tracks (DCF = 1) on the tape in which DIT is input from digital interface, it is recommended to record subcode ETN continuously.

8.7 TS specifications

8.7.1 Definition of transport streams

This subclause defines the MPEG stream that is generated by the HD2 mode of the HDV recording format on the tape.

8.7.2 System layer

1) An ISO/IEC 13818-1 compliant transport stream shall be produced.
2) Null packet or adaptation field stuffing shall be used if required.
3) The stream shall be fully compliant with ISO/IEC 13818-9.
4) The average data rate of the transport rate shall not exceed 27 Mbps.
5) The peak data rate shall not exceed 33 Mbps.
6) It is recommended that the peak data rate of the transport rate be close to the average data rate.
7) Transmission of duplicate packets is prohibited.

8.7.3 Transport packet layer

The PID values for the SI information (SIT/DIT) are defined in EN 300 468. If AUX data is included, the AUX PID shall be written in the PMT. Null packets shall conform to ISO/IEC 13818-1 and be assigned a PID value of 1FFFh.

8.7.4 Adaptation field

The time interval between two consecutive PCR values in the same program shall not exceed 100 ms. It is recommended that this interval should be no greater than 40 ms.

8.7.5 PSI

The transport streams shall contain the following PSI/SI tables.

Program Association Table (PAT)

Program Map Table (PMT)

Selection Information Table (SIT)

The transport streams may contain Discontinuity Information Tables (DIT). SIT and DIT shall comply with the syntax and semantics as specified in EN 300 468. The transport streams shall not contain any PSI and SI tables other than PAT, PMT, SIT and DIT.

8.7.5.1 PAT

The PAT contains only one program association section. The PAT shall be configured in one section and shall be contained within one TS packet. In addition, the network_PID reference shall take the value of the SIT_PID instead of the NIT_PID. The PAT shall be repeated with a maximum time interval of 120 ms between repetitions, but a time interval of 100 ms is recommended.

Table 59 – PAT

Syntax	No. of bits	Identifier
program_association_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
'0'	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transport_stream_id	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
for (i = 0; i < N; i++) {		
program_number	16	uimsbf
reserved	3	bslbf
if (program_number == '0') {		
network_PID	13	uimsbf
}		
else {		
program_map_PID	13	uimsbf
}		
}		
CRC_32	32	rpchof
}		

table_id – This field shall be set to 00h.

transport_stream_id – This field has no meaning and may take any value.

section_number – This field shall be set to 00h.

last_section_number – This field shall be set to 00h.

SIT_PID – This field specifies the PID of the SIT. The PID value is 001Fh.

program_map_PID – See Table 60.

Table 60 – PID assignments

PID value	Meaning
0081h	program_map_PID
0134h	PCR_PID
0810h	The PID of the transport packets which carry the TSHV MPEG-2 video stream.
0811h	The PID of the transport packets which carry the TSHV video auxiliary data.
0814h	The PID of the transport packets which carry the TSHV MPEG-1 audio stream.
0815h	The PID of the transport packets which carry the TSHV audio auxiliary data.

8.7.5.2 PMT

The PMT consists of only one program association section. The PMT shall be configured in one section and shall be contained within one TS packet. The PMT shall be repeated with a maximum time interval of 120 ms between repetitions, but a time interval of 100 ms is recommended.

Table 61 – PMT

Syntax	No. of bits	Identifier
program_map_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
'0'	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
program_number	16	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved	3	uimsbf
PCR_PID	13	uimsbf
reserved	4	uimsbf
program_info_length	12	uimsbf
for (i = 0; i < N1; i++) {		
descriptor()		
}		
for (i = 0; i < N1; i++) {		
stream_type	8	uimsbf
reserved	3	bslbf
elementary_PID	13	bslbf
reserved	4	bslbf
ES_info_length	12	bslbf
for (j = 0; j < M; j++) {		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

table_id – This field shall be set to 02h.

PCR_PID – See Table 60.

stream type – See Table 62.

Table 62 – Stream_type assignments

Value	Description
02h	MPEG-2 video stream
03h	MPEG-1 audio stream
A0h	AUX-A stream
A1h	AUX-V stream

elementary_PID – See Table 60.

8.7.5.3 SIT

The SIT consists of only one selection information section. The SIT shall be configured in one section and shall be contained within one TS packet. The SIT shall be repeated with a maximum time interval of 1 s between repetitions, but a time interval of less than 1 s is recommended.

Table 63 – SIT

Syntax	No. of bits	Identifier
selection_information_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
ISO_reserved	2	bslbf
section_length	12	uimsbf
reserved_future_use	16	bslbf
ISO_reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved_future_use	4	bslbf
transmission_info_loop_length	12	uimsbf
for (i = 0; i < N; i++) {		
descriptor()		
}		
for (i = 0; i < N; i++) {		
service_id	16	uimsbf
reserved_future_use	1	bslbf
running_status	3	uimsbf
service_loop_length	12	uimsbf
for (j = 0; j < N; j++) {		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

table_id – This field shall be set to 7Fh.

service_id – Set equal to program_number in the program map section.

running_status – This field shall be set to 0.

8.7.6 DIT

The DIT is inserted at the point where the SI information discontinues. The DIT consists of a single section using the following data configuration. The DIT shall be contained in one TS packet with a PID value of 001Eh. The table_id shall be 7Eh. At every point where a discontinuity occurs in the transport stream, two transport packets with PID 001Eh shall be inserted at the discontinuity. The first transport packet is a 184-byte adaptation field stuffing with the discontinuity indicator set to 1. The second transport packet shall include a DIT and the discontinuity indicator shall not be set at 1. Other packets shall not be inserted between these two packets.

The source shall insert a DIT in the follow cases.

- When changing the stream type of the Registration_descriptor
- When the stream's time stamp becomes discontinuous

When the sink receives the DIT, an ECCTB pack (DCF=1) shall be recorded on the tape (see 8.6.4).

Table 64 – DIT (PID = 001Eh / table_id = 7Eh)

Syntax	No. of bits	Identifier
discontinuity_information_section(){		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
transition_flag	1	bslbf
reserved_future_use	7	bslbf
}		

table_id – This field shall be set to 7Eh.

section_length – This field is fixed to 001h.

transition_flag – This field indicates the type of change in the transport stream. Refer to ARIB STD- B10 for greater detail.

8.7.7 Descriptors

The descriptors are listed in Table 65, with their tags and the locations. The TS may contain additional descriptors other than those in this list, but TS decoders may ignore them.

Table 65 – Descriptors

Descriptor name	Descriptor_tag	Location of descriptor	Note
registration_descriptor	05h	PMT 1st loop	Mandatory
partial_transport_stream_descriptor	63h	SIT 1st loop	Mandatory

PMT 1st loop – The for-loop that contains one or more descriptor()s for a program in the TS_program_map_section(); this for-loop immediately follows the program_info_length field, as specified in ISO/IEC 13818-1.

SIT 1st loop – The for-loop that contains one or more descriptor()s for a partial transport stream in the Selection_information_section(); this for-loop immediately follows the transmission_info_loop_length field, as specified in EN 300 468.

8.7.7.1 Registration_descriptor

Table 66 – Registration_descriptor (descriptor_tag = 05h)

Syntax	No. of bits	Identifier
registration_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
format_identifier	32	uimsbf
reserved	8	bslbf
version_number	8	bslbf
stream_type	8	bslbf
reserved	32	bslbf
}		

descriptor_tag – This field shall be set to 05h (as specified in ISO/IEC 13818-1).

descriptor_length – This field shall be set to Bh.

format_identifier – This field shall be set to 54534856h (TSHV in ASCII).

version_number – This field defines the version number of this specification.

bit 7 - bit 4: Major version number (0001b).

bit 3 - bit 0: Minor version number (0000b).

stream_type – This field shall be constrained as shown in Table 67.

Table 67 – Stream_type in the registration_descriptor

bit 7	bit 6 - bit 0	Stream type
0		60 Hz (59,94 Hz)
1		50 Hz
	0000000	Original encoded stream
	1000010	Jog encoded stream
	Others	Reserved

An original encoded transport stream contains multiplexed video, audio, AUX-A and AUX-V streams and PSI data. The AUX-A stream is under timing restrictions described in 8.7.10.4 and AUX-V is under timing restrictions described in 8.7.10.6. PSI is under timing restrictions described in 8.7.5.

A jog encoded stream is only used across a digital interface, and the jog encoded stream is only generated in the case of 8x and 24x speed search playback modes.

A jog encoded Pack-Unit consists of 1 PES-V and 1 AUX-V unit. The PES-V unit consists of an I-picture, and the AUX-V unit begins with a Video frame pack.

Table 68 shows the video frame pack data in a jog encoded stream.

The GOP structure, video ES rate and encoding system (CBR) in the jog encoded stream is not necessarily the same as in an original encoded stream.

Table 68 – Video frame pack data in jog encode stream

Field	Parameter
ETN	(Same as search pack data)
NUMBER OF VIDEO FRAMES	01h
DATA-H	0001b (I-picture)
VBV DELAY	FFFFh
HEADER SIZE	00h
DTS	(Same as DTS of PES-V in Pack-Unit)
PF	(Depends on the attribute of the jog encode stream)
TF	1b (Top field is the first field)
RF	0b (Continuous)
SFR	(Same as search pack data)
SEARCH DATA MODE	02h (x8) or 10h (x24)
HORIZONTAL SIZE	(The value which multiplied search pack data by 8)
VERTICAL SIZE	(The value which multiplied search pack data by 8)
ASPECT RATIO	(Same as search pack data)
FRAME RATE	(Same as search pack data)
BIT RATE	F424h (25Mbps)
VBV BUFFER SIZE	1C0h
MPEG PROFILE	100b (Main)
MPEG LEVEL	100b (High-1440)
VIDEO FORMAT	0110b (Component)
CHROMA	01b (4:2:0)
GOP N	00001b (1)
GOP M	001b (1)
PE2, REC TIME	(Same as search pack data)
PE1, RET DATE	(Same as search pack data)
PE0, HD2 TTC	(Same as search pack data)
CGMS	(Same as search pack data)
REC ST	(Same as search pack data)
ABST BF	(Same as search pack data)
(Extended DV Pack #1,#2,#3)	(NO INFO)

8.7.8 Partial_transport_stream_descriptor

Table 69 – Partial_transport_stream_descriptor (descriptor_tag = 63h)

Syntax	No. of bits	Identifier
partial_transport_stream_descriptor(){		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
reserved_future_use	2	bslbf
peak_rate	22	uimsbf
reserved_future_use	2	bslbf
minimum_overall_smoothing_rate	22	uimsbf
reserved_future_use	2	bslbf
maximum_overall_smoothing_buffer	14	uimsbf
}		

descriptor_tag – This field shall be set to 63h (as specified in EN 300 468).

peak_rate – The maximum momentary transport packet rate (i.e. 188 bytes divided by the time interval between start times of two succeeding transport stream packets). As a minimum, an upper bound for this peak_rate should be given. This field is coded as a positive integer in units of 400 bits/s.

minimum_overall_smoothing_rate – The minimum smoothing buffer leak rate for the overall transport stream. This field is coded as positive integer in units of 400 bits/second. The value 0x3FFFFF is used to indicate that the minimum smoothing rate is undefined.

maximum_overall_smoothing_rate – The maximum smoothing buffer size for the overall transport stream. This field is coded as a positive integer in units of 1 byte. The value 0x3FFF is used to indicate that the maximum smoothing buffer size is undefined.

8.7.9 Transport stream system target decoder

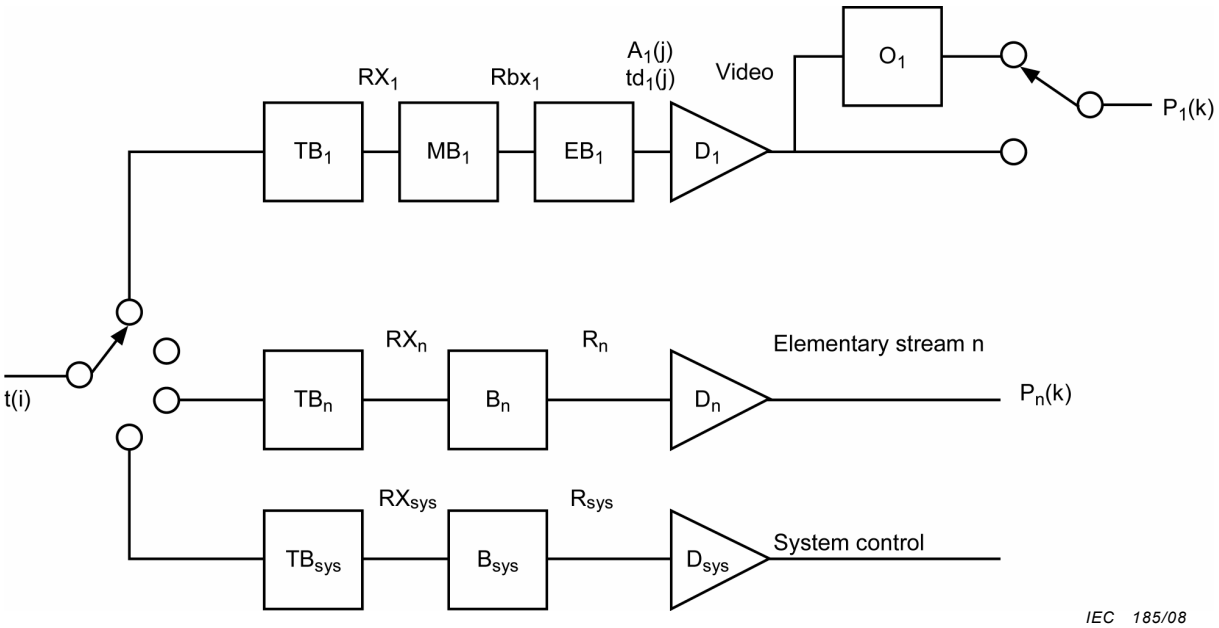


Figure 51 – Transport stream system target decoder

Table 70 – TB_n, B_n, RX_n for AUX-A data and AUX-V data stream

	TB_n	B_n	R_n	RX_n
AUX-A stream	512 bytes	1 536 bytes	50 000 bits/second	1 000 000 bits/second
AUX-V stream	512 bytes	1 536 bytes	50 000 bits/second	1 000 000 bits/second

- The notations of "n, TB_n, MB_n, EB_n, TB_{sys}, B_{sys}, R_{bx_1}, RX_n, RX_{sys}, D_n, D_{sys}, O_n and $P_n(k)$" have the same meanings as defined in T-STD of ISO/IEC 13818-1.
- For TSHV MPEG-2 video streams, the values of RX_n and R_{bx_n}, the size of buffer MB_n and the size of buffer EB_n are the same as defined for the T-STD of MP@H-14.
- For TSHV MPEG-1 audio streams, the value of RX_n and the size of buffer B_n are the same as defined for the T-STD.

8.7.10 AUX PES packet

8.7.10.1 Packetization of AUX-A data

AUX-A data are packetized in PES packets for every Pack-Unit.

Table 71 – AUX-A PES packet

Syntax	No. of bits	Identifier
AUX-A PES packet {		
packet_start_code_prefix	24	bslbf
stream_id	8	uimsbf
PES_packet_length	16	uimsbf
Audio frame pack	8*17	bslbf
for (i = 0; i < N; i++) {		
other AUX-A pack		bslbf
}		
}		

stream_id – This field shall be set to BFh (private_stream_2).

Audio frame pack – This field contains Audio frame pack data (see 8.3.5).

other AUX-A pack – This field contains other AUX-A pack data.

8.7.10.2 Packetization of AUX-V data

AUX-V data are packetized in PES packets for every Pack-Unit.

Table 72 – AUX-V PES packet

Syntax	No. of bits	Identifier
AUX-V PES packet {		
packet_start_code_prefix	24	bslbf
stream_id	8	uimsbf
PES_packet_length	16	uimsbf
Video frame pack	8*59	bslbf
for (i = 0; i < N; i++) {		
other AUX-V pack		bslbf
}		
}		

stream_id – This field shall be set to BFh (private_stream_2).

Video frame pack – This field contains video frame pack data (see 8.3.6).

other AUX-V pack – This field contains other AUX-V pack data.

8.7.10.3 Transport stream packet restrictions for audio stream

It is recommended that the packet including the first byte of the ES is transported between 1,5 to 3,0 AAU before the PTS time.

8.7.10.4 Transport stream packet restrictions for AUX-A

The last byte of the AUX-A PES packet shall be transported at the PTS time of the audio frame pack. It shall be transported before the first byte of the first PES-A in the same Pack-Unit and after the first byte of the last PES-A in the previous Pack-Unit (see Figure 52). If an audio frame pack with the same PTS time is continuously played back (for example, the PTS in the Edit Pack-Unit containing only PES-V stuffing is the same value as the previous Pack-Unit), the AUX-A PES packet shall be sent in accordance with the order recorded on the tape.

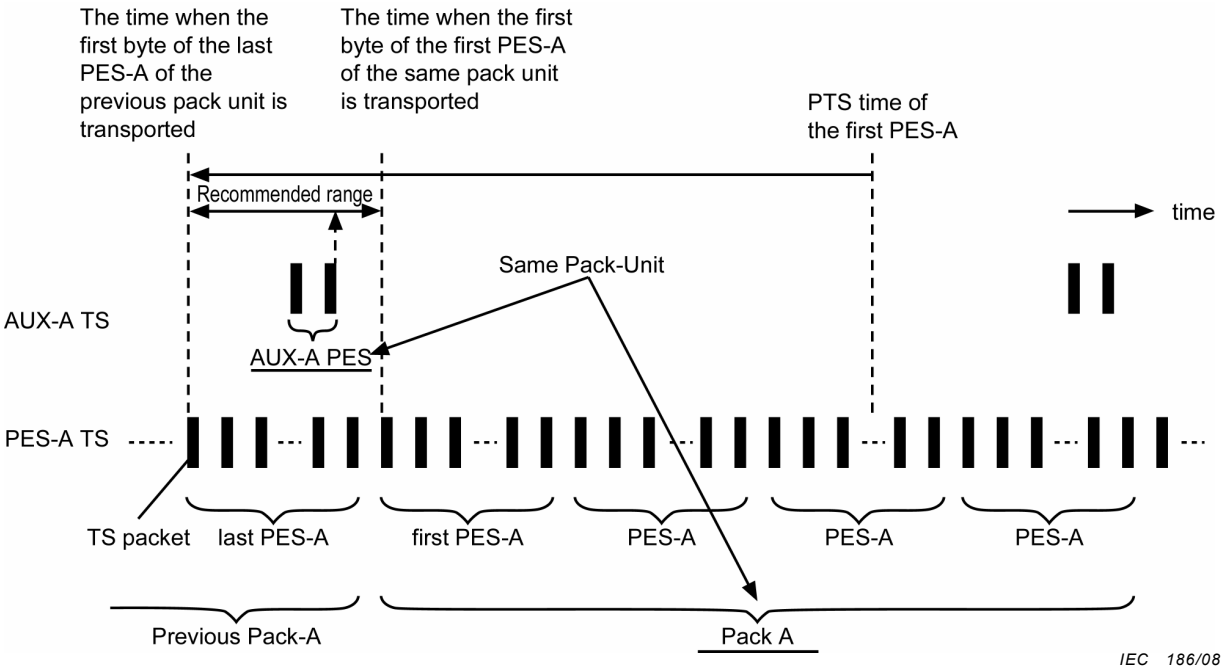


Figure 52 – Transport timing between PES-A and AUX-A

8.7.10.5 Transport stream packet restrictions for video stream

It is recommended that the packet that includes the last byte of picture_start_code should be transported within plus or minus 3,3 ms to (DTS - vbv_delay) time.

8.7.10.6 Transport stream packet restrictions for AUX-V

The last byte of AUX-V PES packet shall be transported 3 to 4 frames before the DTS time of the Pack-V in the video frame pack (see Figure 53). If a video frame pack with the same DTS time is continuously played back (for example, when an Edit Pack-Unit contains only PES-V stuffing, and the PTS has the same value as the previous Pack-Unit), the AUX-V PES packet shall be sent in accordance with the order recorded on the tape.

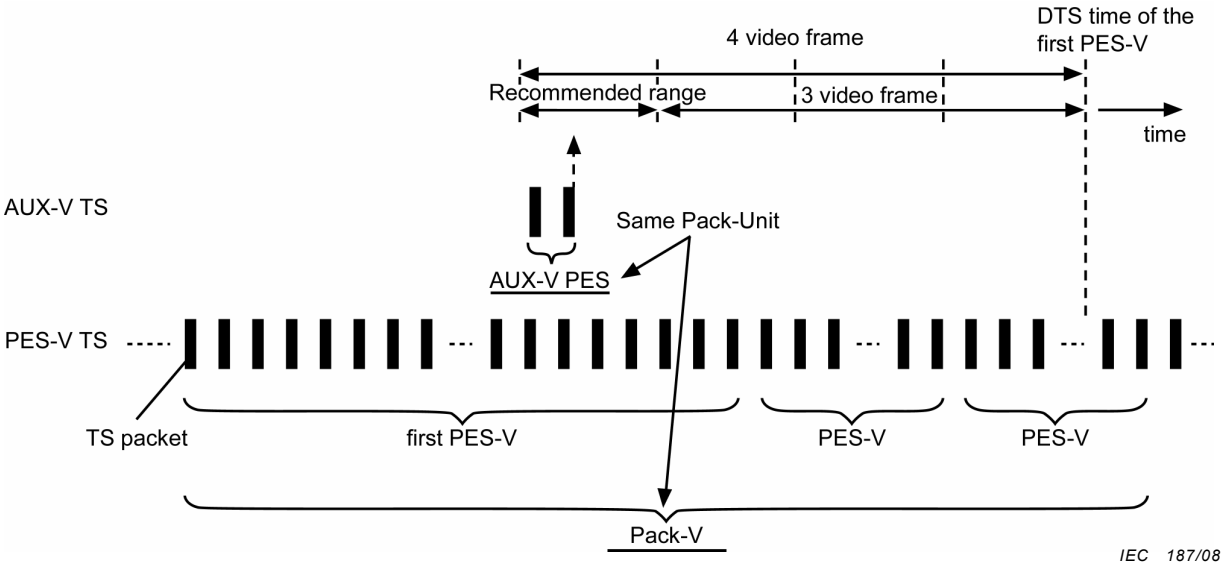


Figure 53 – Transport timing between PES-V and AUX-V

8.8 MIC (memory in cassette)

There are two types of cassette, one with memory, the other without. The MIC data structure shall comply with IEC 61834-2, Clause 10. For a new cassette tape, the APM data area shall be set to 111b. For compatibility with the consumer format, APM shall be set to 000b during the initial recording.

8.9 Progressive video processing

8.9.1 Progressive recording

When the 2 fields of a frame are from the same time instant, the progressive_frame flag in video ES should be set to 1. In this case the PF flag in the video frame pack and in the ECCTB pack shall also be set to 1. 25p recording is used only in the 1080i/50 system. 30p recording and 24p recording are used only in the 1080i/60 system (see Table 73).

Table 73 – Progressive recording parameters

		Video frame pack / ECCTB pack		
		FRAME_RATE	SFR	PF
1080i/50 system	50i recording	0011b	0011b	0b
	25p recording			1b
1080i/60 system	60i recording	0100b	0100b	0b
	30p recording			1b
	24p recording		0001b	

8.9.2 24p recording

When a video whose frame rate is 24/1,001Hz is recorded, it shall be processed by the 2-3 pull-down method. The top_field_first and repeat_first_field flags in the video ES shall be set in accordance with ARIB STD-B20, 4.4, and ISO/IEC 13818-2, Clause C.11. The TF flag shall be equal to the top_field_first flag of the PES-V which contains the earliest PTS among the Pack-Vs. The RF flag shall be equal to the repeat_first_field flag of the PES-V which contains the earliest PTS among the Pack-Vs. The SFR field shall be set to 0001b, GOP N should be set to 12, and the vbv_delay of each I-picture shall take the actual value which is more than 4 505.

The picture consisting of 3 fields and the picture consisting of 2 fields shall be recorded alternately. Top fields shall alternate with bottom fields. The sequence of pictures such as 2-3-3-2-2-3-3-2 is prohibited. At a recording point that changes from 60i to 24p, the first 24p picture that has the earliest PTS shall consist of 3 fields. At the recording point that changes from 24p to 60i, the last 24p picture that has the latest PTS shall consist of 2 fields. When it is impossible to continue following these constraints, the same sequence for recording at a start position shall be conducted as described in 8.6.2.

The ETN for each PES-V shall correspond to its decoding time. When the decoding time interval between two successive PES-Vs is 3 × 1,001/60 s, the ETN interval between them shall be 15. When the decoding time interval is 2 × 1,001/60 s, the ETN interval shall be 10. The DTS and TTC for each PES-V shall be calculated from the ETN as follows.

DTS = (ETN × 3 003) / 10

TTC = (ETN - α) / 10 "α" is an arbitrary multiple of 10.

The calculated values are rounded down after the decimal point. Figure 54 shows the relationship between ETN, DTS and TTC for 24p recording.

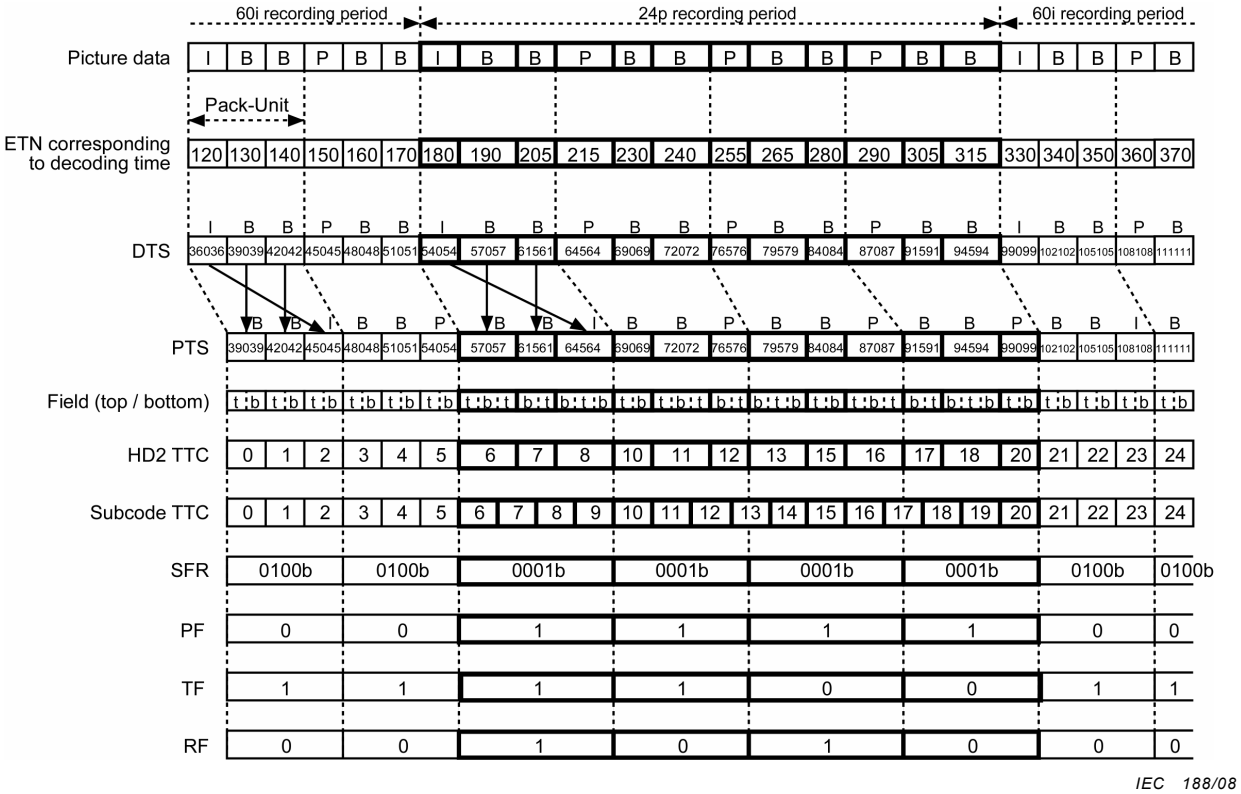


Figure 54 – Relation between ETN, DTS and TTC for 24p recording

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