

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**

ICS 33.160.40

National foreword

This British Standard is the UK implementation of EN 61834-11:2008. It is identical to IEC 61834-11:2008.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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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 format for 1080i and 720p systems
(IEC 61834-11:2008)**

Enregistrement -
Système de magnétoscope numérique
à cassette à balayage hélicoïdal utilisant
une bande magnétique de 6,35 mm,
destiné au grand public
(systèmes 525-60, 625-50,
1125-60 et 1250-50) -
Partie 11: Format HDV destiné
aux systèmes 1080i et 720p
(CEI 61834-11:2008)

Aufzeichnungstechnik -
Videokassettensystem mit
digitaler Schrägschraufzeichnung
auf Magnetband 6,35 mm
für den Heimgebrauch (Systeme 525-60,
625-50, 1125-60, 1250-50) -
Teil 11: HDV-Format für
1080i- und 720p-Systeme
(IEC 61834-11:2008)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 100/1229/CDV, future edition 1 of IEC 61834-11, prepared by IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61834-11 on 2008-03-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
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national standard or by endorsement (dop) 2008-12-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2011-03-01

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The IEC and CENELEC take no position concerning the evidence, validity and scope of this patent right.

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Annex ZA has been added by CENELEC.

Endorsement notice

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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: HDV² 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 $\pm 0,5$ %.

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 $\pm 0,5$ %.

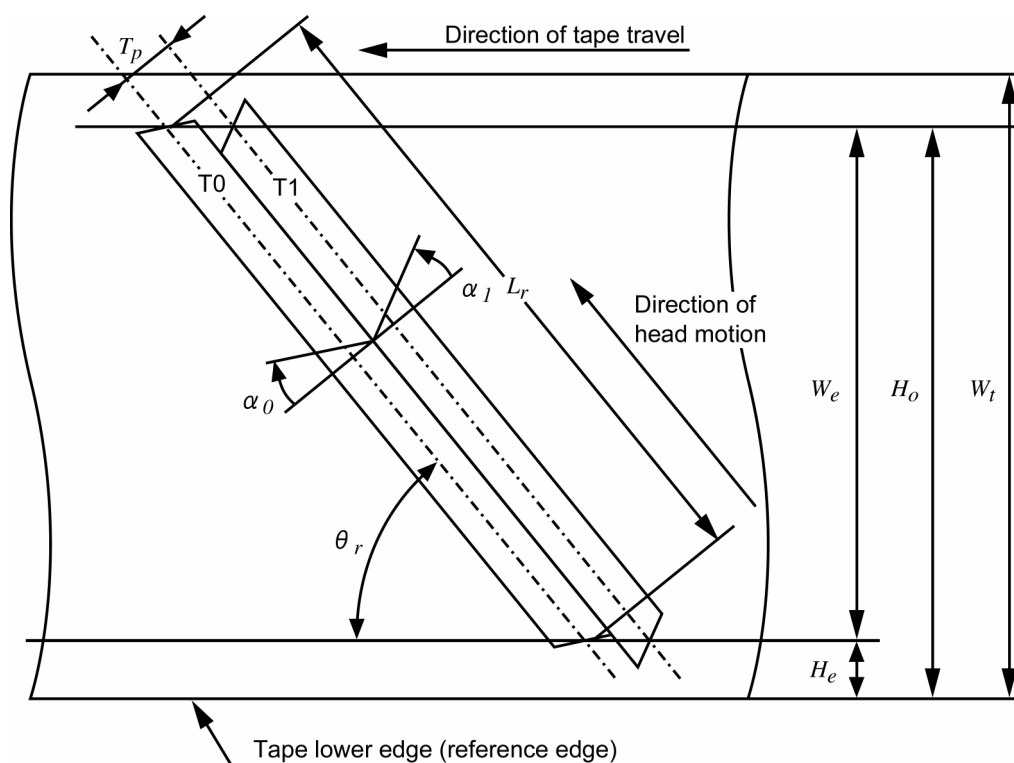
5.2.2 Sectors

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.

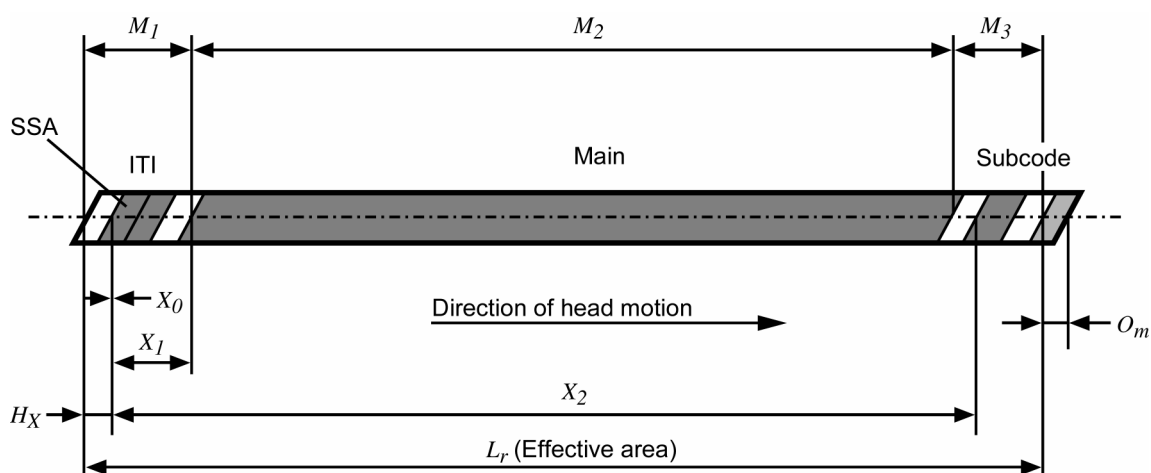


NOTE 1 T0 and T1 are track numbers.

NOTE 2 Tape is viewed from magnetic coating side.

IEC 135/08

Figure 1 – Location and dimensions of recorded track



IEC 136/08

Figure 2 – Sector location from SSA

Table 1 – Record location and dimensions

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

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 (H_e) 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 (H_o) 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 H_e and H_o .

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.

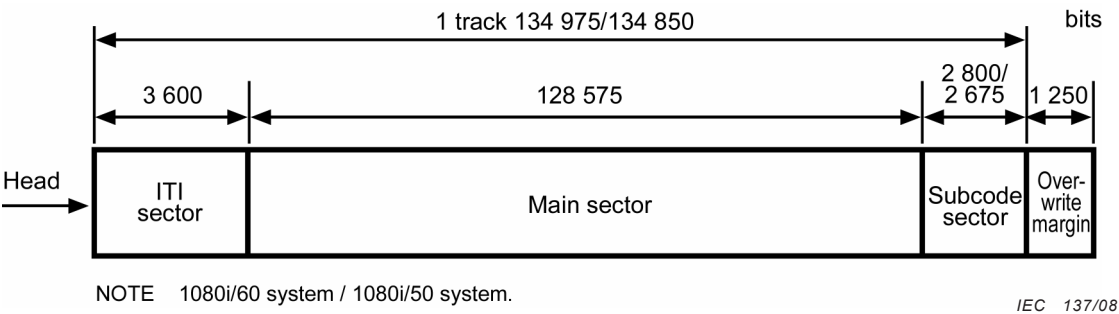


Figure 3 – Sector arrangement on helical track

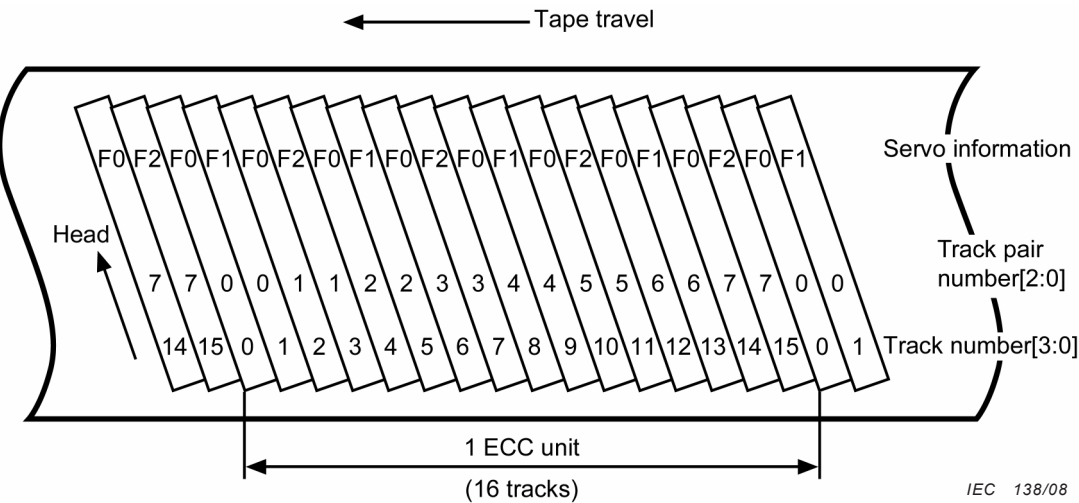


Figure 4 – Servo information and tracks

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	ACCh	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	A Eh	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.

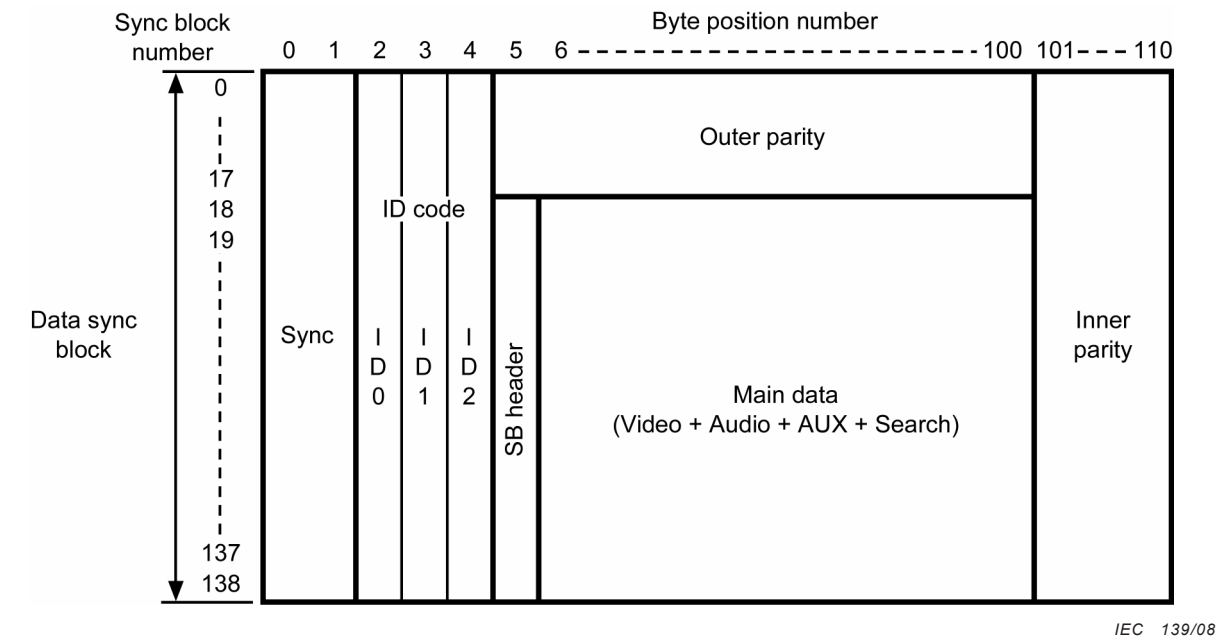


Figure 5 – Structure of main sector

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 (Ftyp₂, Ftyp₁, Ftyp₀), track pair number (Trp₄, Trp₃, Trp₂, Trp₁, Trp₀), sync block number (Syb₇, Syb₆, Syb₅, Syb₄, Syb₃, Syb₂, Syb₁, Syb₀), 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.

Byte position number			
	2	3	4
	ID0	ID1	ID2
MSB	Ftyp ₂	Syb ₇	OWP ₇
	Ftyp ₁	Syb ₆	OWP ₆
	Ftyp ₀	Syb ₅	OWP ₅
	Trp ₄	Syb ₄	OWP ₄
	Trp ₃	Syb ₃	OWP ₃
	Trp ₂	Syb ₂	OWP ₂
	Trp ₁	Syb ₁	OWP ₁
	Trp ₀	Syb ₀	OWP ₀
LSB			

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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:

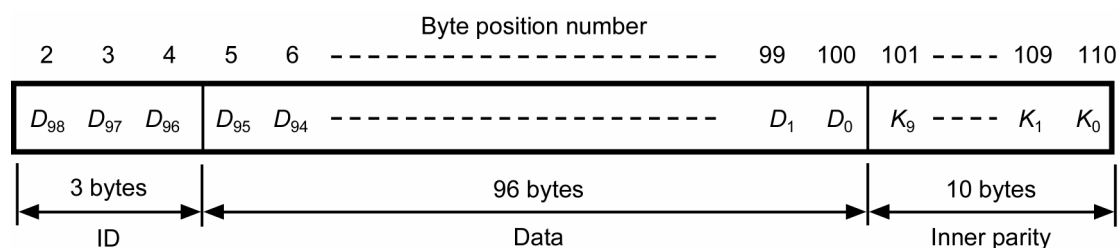
$$K_9X^9 + K_8X^8 + K_7X^7 + K_6X^6 + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

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

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

and the codeword polynomial is given by the following polynomial:

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



Where D and K are in $GF(2^8)$

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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:

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

where α is given by 2h.

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

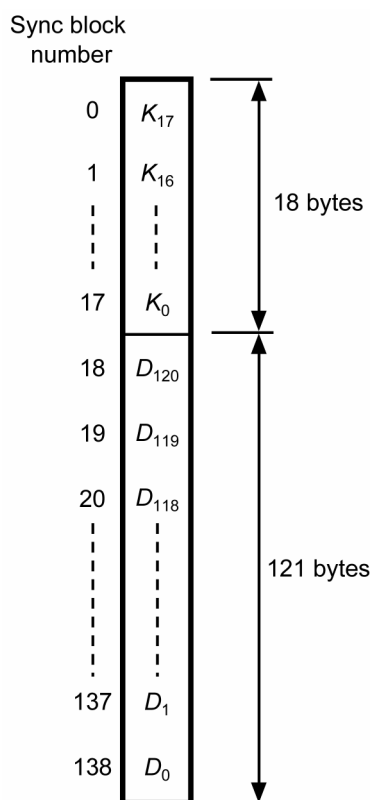
$$K_{17}X^{17} + K_{16}X^{16} + K_{15}X^{15} + \dots + K_5X^5 + K_4X^4 + K_3X^3 + K_2X^2 + K_1X + K_0$$

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

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

and the codeword polynomial is given by the following polynomial:

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



Where D and K are in $GF(2^8)$

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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.

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

$$s = 17 - i \quad (\text{when } i < 18)$$

$$156 - i \quad (\text{when } i \geq 18)$$

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

$$\{n \bmod (96) \times 5 + (156 - i) \times 11\} \bmod (16) \quad (\text{when } i \geq 18)$$

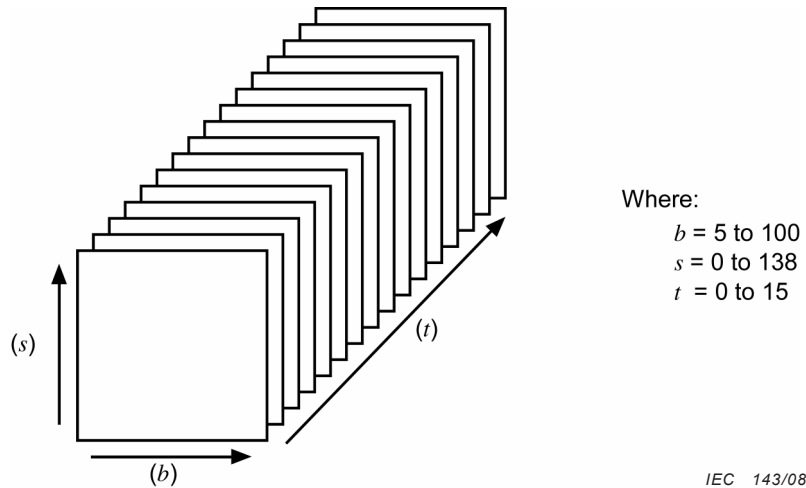


Figure 9 – Interleaving on a 16-track basis (ECC unit)

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).

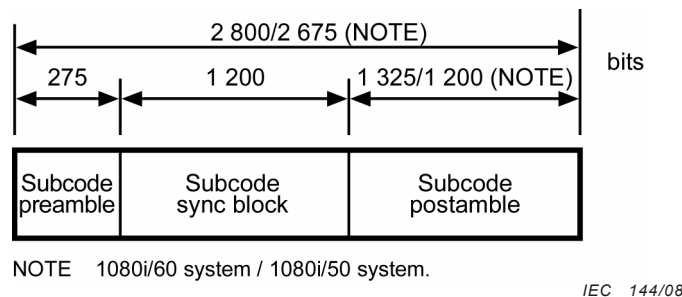


Figure 10 – Structure of subcode sector

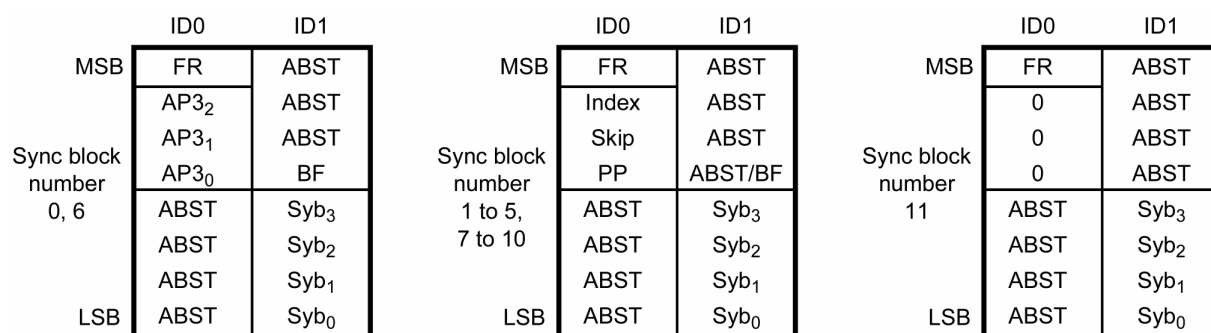
6.2.4.2 Sync patterns

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 (AP₃₂, AP₃₁, AP₃₀) (see Table 14), FR ID, Index ID, Skip ID, PP ID, absolute track number (ABST) and sync block number (Syb₃, Syb₂, Syb₁, Syb₀). 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.



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Figure 11 – ID data in subcode sector

Table 14 – Application ID of area 3 (AP3)

AP ₃₂	AP ₃₁	AP ₃₀	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 descriptor_length CA_System_ID For (i=0; i < descriptor_length - 2; i++) { private_data_byte } }	8 8 16 8	uimsbf uimsbf uimsbf bslbf

Syntax	No. of bits	Identifier
private_data_byte { reserved EPN DTCP_CCI reserved Image_Constraint_Token APS }	5 1 2 5 1 2	bslbf bslbf bslbf bslbf bslbf 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
<code>partial_transport_stream_descriptor() {</code>		
<code>descriptor_tag</code>	8	uimsbf
<code>descriptor_length</code>	8	uimsbf
<code>reserved_future_use</code>	2	bslbf
<code>peak_rate</code>	22	uimsbf
<code>reserved_future_use</code>	2	bslbf
<code>minimum_overall_smoothing_rate</code>	22	uimsbf
<code>reserved_future_use</code>	2	bslbf
<code>maximum_overall_smoothing_buffer</code>	14	uimsbf
<code>}</code>		

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 3FFFFFFh 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: