

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

The European Standard EN 61834-9:2001 has the status of a British Standard

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment, which has the responsibility to:

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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 9: DVB format
(IEC 61834-9:2001)**

Enregistrement –
Système de magnétoscope numérique
à cassette à balayage hélicoïdal utilisant
la bande magnétique de 6,35 mm,
destiné au grand public (systèmes
525-60, 625-50, 1125-60 et 1250-50)
Partie 9: Format DVB
(CEI 61834-9:2001)

Aufzeichnungstechnik -
Videokassettensystem mit digitaler
Schrägschraufzeichnung auf Magnetband
6,35 mm für den Heimgebrauch (Systeme
525-60, 625-50, 1125-60, 1250-50)
Teil 9: DVB-Format
(IEC 61834-9:2001)

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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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 100B/283/FDIS, future edition 1 of IEC 61834-9, prepared by SC 100B, Audio, video and multimedia information storage systems, of 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 61834-9 on 2001-05-01.

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Annexes designated "normative" are part of the body of the standard.

In this standard, annex ZA is normative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61834-9:2001 was approved by CENELEC as a European Standard without any modification.

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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 9: DVB format

1 General

1.1 Scope

This part of IEC 61834 specifies the content, format and recording method for the data blocks forming the helical records on the tape containing audio, video and system data. This part describes the specifications for the recording of single DVB programmes. The DVB data is delivered to the digital video cassette recorder via a digital interface or by a built-in tuner (IRD). The DVB data consist of an MPEG2 transport stream containing one or more programmes.

In DVB, the MPEG2 MP@ML is specified to encode the video signal. The maximum bit rate for the video signal is 15 Mbps. One programme may consist of one video bit stream or several audio bit streams and data bit streams.

Due to the varied bit rates of single DVB programmes, several recording modes are specified in order to make efficient use of the storage capacity of the digital video cassette recorder.

In addition to the normal play data stream of DVB recording, one or two special trick play data streams may optionally be generated and recorded in the video area.

In this part 9, the data structure of a track is defined by APT = 000b which consists of four areas as described in 4.3.2 of IEC 61834-1 and AP1 = AP3 = 000b. The data structure of MIC is the same as in clause 10 of IEC 61834-2.

1.2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61834. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61834 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61834-1:1998, *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*
Amendment 1

IEC 61834-2:1998, *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 61834-4:1998, *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 61834-6, *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 6: SDL format*

IEC 61883-1:1998, *Consumer audio/video equipment – Digital interface – Part 1: General*

IEC 61883-4:1998, *Consumer audio/video equipment – Digital interface – Part 4: MPEG2-TS data transmission*

ETS 300 468:1998, *Specification for Service Information (SI) in DVB systems*

EBU SBP 492:1992, *Teletext specifications*

1.3 Abbreviations

For the purposes of this part of IEC 61834, the following abbreviations apply.

AAUX	Audio auxiliary data
BCH code	Base-Chaudhuri-Hocquenghem code, one of the well-known error correction codes
CGMS	Copy Generation Management System
DCT	Discrete cosine transform
DTV	Digital Television (MPEG transmission in USA) (differs from ATV)
DVB	Digital Video Broadcast (used for organization and the signal)
DVCR	Digital Video Cassette Recorder
ECC	Error Correction Code
ECC1	Inner error correction (within the SB)
ECC2	Outer error correction (within one track)
ECC3	Extra outer error correction (several tracks)
EIT	Event Information Table
FEC	Forward Error Correction (used in MPEG transmission)
GF	Galois field
IRD	Integrated Receiver Decoder
MIC	Memory in Cassette
MP@ML	Main Profile at Main Level
MPEG	Motion Pictures Expert Group
NP	Normal play

PAT	Programme Association Table
PCR	Programme Clock Reference
PID	Programme Identification
PMT	Programme Map Table
PSI	Programme-Specific Information
SB	Sync block
SD/HD	Standard Definition/High Definition (recording modes on DVCR)
SI	Service Information
STB	Set-Top-Box
Tp	Track pitch
TP	Trick play
TPH	Higher Trick play speed
TPL	Lower Trick play speed
TS	Transport Stream
TSH	Most significant part of timestamp_counter value
TSL	Least significant part of timestamp_counter value
TSP	Transport Stream Packet
VAUX	Video Auxiliary data

1.4 Environment and test conditions

Same as those of IEC 61834-2.

2 Helical recordings

2.1 Tape speed, recording location and dimensions

One of three recording modes can be used. The tape speed and track angle depend on the recording mode as shown in table 1. The tape speed tolerance shall be less than $\pm 0,5\%$.

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 tolerances specified in table 3 of IEC 61834-1, except that, where applicable, parameters in table 1 shall override those 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 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.

The values for the effective area upper edge, record and playback guarantee, overwrite margin (Om) and switching margin for recording amplifiers shall be the same as those in IEC 61834-2.

2.2 Scanner configuration

If the recorder supports more than one recording mode, the scanner configuration shall be used as shown in table 2.

3 Programme track data arrangement

3.1 Labelling convention

Same as 3.2 of IEC 61834-2.

3.2 Audio sector

Same as 3.3 of IEC 61834-2.

3.3 Video sector

Same as 3.4 of IEC 61834-2, except AP2 as shown in table 3.

3.4 Subcode sector

Same as 3.5 of IEC 61834-2.

4 Audio signal processing

The audio sector may be used for recording audio data or for recording other application data. This is indicated in the bit assignment of AP1. The reserved bit assignments may be specified in future for new applications.

If the audio sector is used for audio data, the track arrangement and processing shall comply with IEC 61834-2.

5 DVB signal processing

5.1 Introduction

The DVB data format is based on MPEG2 transport stream packets of 188 bytes in length at MP@ML. The transport stream packets are delivered to the recorder via a digital interface, or received from a built-in tuner (IRD).

Data for a single programme of the MPEG2 transport stream are recorded on tape for normal play (NP).

In addition to the normal play data stream, one or two special trick play (TP) data streams may optionally be generated and recorded.

MPEG2 coded pictures are more sensitive to errors than pictures coded according to the SD specifications of IEC 61834-2. Therefore, optionally, additional ECC may be applied to improve error correction capability for the MPEG2 data on tape.

In many cases, the recording bit rate does not match the bit rate of NP and TP data. In this situation, stuffing data shall be recorded for compensation.

5.2 Formatting for DVB recording

The video area is used for recording the DVB NP and TP data streams. The recording of MPEG2 transport stream data in the video area is indicated in AP2 (see 3.3).

Sync blocks 31 to 155 shall be used for recording MPEG2 transport stream data.

Sync blocks 21 to 30 are reserved for additional error protection (ECC3).

For DVB recording, a set of MPEG packs is specified (see IEC 61834-4). These packs shall be recorded in sync blocks 19, 20 and 156 (see 7.2).

5.3 5_SB unit

The video area from sync block 21 to 155 is organized in 27 units of five sync blocks (5_SB_unit) each. Every sync block of a 5_SB-unit shall contain an "SB_extra_header" of one byte at byte position number five as shown in figure 1.

5.4 SB_extra_header

The contents of the SB_extra_header shall conform to figure 2.

Bit 7 shall indicate the type of data (NP or TP) in the area of sync blocks 31 to 155. It shall indicate the presence of ECC3 data in sync blocks 21 to 30, if ECC3 is applied.

If TP data are recorded, a frame_toggle bit shall be used at the border between one frame and another in the TP data stream.

In the TP data stream, the 5_SB units are repeated several times (see 5.9.3). A 5_SB-unit counter of four bits is used to distinguish the repetitions of 5_SB units in the TP data stream. The 5_SB unit counter shall be reset by every frame toggle. Care has to be taken that never more than one frame toggle occurs within one track (insert stuffing data, if needed).

5.5 Mapping TS packets onto sync blocks

The sync byte shall be removed from the 188-byte transport stream packets before recording on tape. Two of these 187-byte packets shall be recorded in five sync blocks as shown in figure 3. A TSP_extra_header of three bytes shall be added to each transport stream packet.

5.6 TSP_extra_header

A timestamp is added to every TS packet. The timestamp shall be transmitted in the TSP_extra_header. The timestamp shall be derived from a 27 MHz clock. The 27 MHz clock should be locked to the PCR values in the MPEG2 data stream (see 9.3).

The timestamp represents the value of the timestamp_counter at the time of arrival of the transport stream packet. The timestamp_counter value consists of a most significant part (TSH) and a least significant part (TSL). Bit allocation is shown in figure 4.

TSL is a modulo N counter incremented by the clock frequency of 27 MHz. N shall be 180 000 for all 50 Hz systems. N represents the number of clock intervals during one revolution at 9 000 r.p.m. of the head drum.

The timestamp_counter should be synchronized to the recorder timing (formatting of the tracks). In this way, the same timebase is created for record and playback, as described in 9.3.

TSH is a 3-bit binary counter, which shall increment when the TSL counter value changes from N-1 to 0.

5.7 Location of MPEG data

The data arrangement on tracks shall be as shown in figure 5. The track format repeats every four tracks. This period corresponds to the repetition sequence of the pilot frequencies.

The transport stream packets for NP shall be recorded only once and in the order of arrival. If needed, stuffing data is inserted. Packets shall be recorded in such a way that proper timing can be achieved during playback by using a buffer of 100 transport packets, assuming the buffer model as shown in clause 9.

Recording of TP data is optional. If TP data is applied, it shall be recorded in 5_SB units in accordance with figure 3.

There may be two separate TP data streams, TPH and TPL:

- TPH is used for high search speeds in the forward and reverse directions. 5_SB units used for TPH data are selected in such a way that the TPH data, subcode and ITI can be read at a search speed of 18 times normal speed in the 25 Mbps mode.
- TPL is meant for viewing the programme in less than real time. 5_SB units used for TPL data are selected in such a way, that the TPL data and subcode can be read at a search speed of four times normal speed in the 25 Mbps mode.

If needed, normal play data may be written in those 5_SB units foreseen for TP, which have not been used for recording trick play data.

5.8 Normal play data

A single programme will be selected from a number of programmes present in the transmitted transport stream. In general, the content of the single programme stream is as follows.

- Transport packets from the video elementary stream(s).
- Transport packets from the audio elementary stream(s).
- Transport packets from the data stream(s).
- Programme-specific Information.
- SI information.
- Other relevant information.

Appropriate data from the transport stream should be extracted to update MPEG VAUX packs (see 7.2).

5.9 Trick play data

Space is provided in the recording format to accommodate the recording of two separate trick play data streams TPL and TPH.

TPH data should be recorded for searching at high speed. Formatting of the TPH data in the tracks is such as to allow the use of servo systems which only support speed-lock.

TPL data should be recorded for viewing the programme in less than real time. In general, servo systems, which support phase-lock, should be implemented for playback of TPL data.

5.9.1 Trick play data content

To derive TP data from a programme, all the elementary streams belonging to one programme are descrambled before recording. To create transport streams for TP, I-frame information from the NP data stream should be used. The characteristics of this new TP transport stream shall be the same as for the NP transport stream, except for the timing information.

5.9.2 Search speeds in different modes

The maximum search speed (referring to picture display, not tape speed) depends on the number of repetitions of the TP data. Typical search speeds and the corresponding bit rates during playback are listed in table 4.

5.9.3 Repetition of TP data

To reduce the requirements on the servo system during trick play, the TP data, if recorded, shall be repeated several times. The repetition cycle and the numbering of the TP data areas are given in figure 6. The number of repetitions for the different recording modes is specified in table 5.

The repetition cycle shall remain constant throughout a programme.

5.10 Stuffing data

If insufficient NP or TP data is available to fill the NP or TP data area, or to avoid more than one frame toggle within one track (see 5.4), stuffing data is recorded. Stuffing methods are shown in figures 7 to 10. For NP, one of the methods shown in figures 7, 8 or 9 shall be used. For TP, one of the methods shown in figures 7, 9 or 10 shall be adopted.

5.11 Error correction code

Inner ECC (hereinafter referred to as ECC1) and outer ECC (hereinafter referred to as ECC2) are the same as those in IEC 61834-2.

Optionally, a third layer of error correction may be applied for the DVB NP data, hereinafter referred to as ECC3. The presence of ECC3 parities is indicated in the SB_extra_header.

The ECC3 parity, as shown in figure 11, is defined as a code word of the ECC3 error correction code. This ECC3 error correction code is a (135,125) Reed-Solomon code in GF(256), of which the field generator polynomial is as shown below:

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

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

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

$$g_3(X) = (X+1)(X+a)(X+a^2)(X+a^3)(X+a^4) \dots (X+a^7)(X+a^8)(X+a^9),$$

where "a" is given by 02h in GF(256).

Parities $K_9, K_8, K_7, K_6, K_5, K_4, K_3, K_2, K_1, K_0$ are given by the following equation:

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

which is the residue of $X^{10} D(X)$ divided by $g_3(X)$, where the data polynomial $D(X)$ is defined as follows:

$$D(X) = D_{124}X^{124} + D_{123}X^{123} + D_{122}X^{122} + \dots + D_1X + D_0$$

and the code word polynomial is given by the following equation:

$$CW = D_{124}X^{134} + D_{123}X^{133} + \dots + D_1X^{11} + D_0X^{10} + K_9X^9 + \dots + K_1X + K_0$$

There are 912 code words in one ECC3 block.

Bytes in code word CW_n are indicated by $CW_n[i]$

where n = code word number ($n = 0.. 911$)

i = index for byte in the code word ($i = 0.. 134$)

Bytes within one ECC3 block (see figure 12) are numbered by

b = byte position number in the sync block

s = sync block number in the track

t = track number in the ECC3 block

The relation between the bytes from a code word and the bytes in the ECC3 block is as follows:

$$b = (n-i) \bmod(76) + 6$$

$$s = \lfloor n/21 \rfloor$$

$$t = \{n \div 76 + i \times 7\} \bmod(12)$$

6 Subcode signal processing

Same as IEC 61834-2 and IEC 61834-6, except for the repetition number of subcode flags. The duration of subcode flags for the different recording modes shall conform to table 6.

7 System data

7.1 AAUX

If the audio sector is used for audio data, the AAUX is treated as specified in IEC 61834-2.

7.2 VAUX

The main area of each track consists of 12 packs, i.e. video pack numbers 0 to 5 and 39 to 44. MPEG packs with pack header 90h to 95h shall be recorded in the main area of VAUX to enable reading during trick play in the phase-lock mode (see figure 13). The set of MPEG packs is specified in IEC 61834-4, table 1. The content of the MPEG packs is given in 7.4.

The contents of the MPEG packs shall be updated in accordance with the information recorded in the MPEG stream (see also 5.8).