

Helical-scan video tape cassette system using 12,65 mm (0,5 in) magnetic tape on type VHS —

Part 5: D-VHS

The European Standard EN 60774-5:2004 has the status of a
British Standard

ICS 33.160.40

National foreword

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

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 162, an inside back cover and a back cover.

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Amendments issued since publication

Amd. No.	Date	Comments

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 8 February 2004

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ISBN 0 580 45341 3

**Helical-scan video tape cassette system
using 12,65 mm (0,5 in) magnetic tape on type VHS
Part 5: D-VHS
(IEC 60774-5:2004)**

Système de magnétoscope à cassette
à balayage hélicoïdal
utilisant la bande magnétique
de 12,65 mm (0,5 in) format VHS
Partie 5: D-VHS
(CEI 60774-5:2004)

Videoband-Kassettensystem mit
Schrägspuraufzeichnung auf Magnetband
12,65 mm (0,5 in) VHS-Format
Teil 5: D-VHS
(IEC 60774-5:2004)

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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 the International Standard IEC 60774-5:2004, prepared by IEC TC 100, Audio, video and multimedia systems and equipment, was submitted to the formal vote and was approved by CENELEC as EN 60774-5 on 2004-09-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2005-09-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-09-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60774-5:2004 was approved by CENELEC as a European Standard without any modification.

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HELICAL-SCAN VIDEO TAPE CASSETTE SYSTEM USING 12,65 mm (0,5 in) MAGNETIC TAPE ON TYPE VHS –

Part 5: D-VHS

1 Scope

This part of IEC 60774 applies to the MPEG TS (Transport Stream) packet recording for helical-scan video tape cassette system using 12,65 mm magnetic tape on type VHS.

This standard specifies the cassettes, the tape, the track configuration, the data structure, the recording method and the MPEG TS format for D-VHS.

D-VHS is formatted on the basis of the VHS system, aiming for digital data recording. D-VHS basic format, which is commonly used in various types of data recording application, is specified.

D-VHS records the MPEG TS packets directly compatible with digital broadcast systems.

D-VHS has three recording modes according to the data-rate: STD (Standard), HS (High Speed) and LS (Low Speed/four types), to accommodate various digital broadcasts and needs. MPEG2 recording format for D-VHS including trick play is specified.

The pack format is specified for recording ancillary data, except the MPEG TS packets.

D-VHS MPEG format (ID: MTRM) is specified. D-VHS MPEG format is used for pre-recorded software tape for D-VHS, and self-encoding of analog video and audio signal (for example conventional TV) to MPEG TS packet.

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 60774-1:1994, *Helical-scan video tape cassette system using 12,65 mm (0,5 in) magnetic tape on type VHS – Part 1: VHS and compact VHS video cassette system*

IEC 60774-3:1993, *Helical-scan video tape cassette system using 12,65 mm (0,5 in) magnetic tape on type VHS – Part 3: S-VHS*

ISO/IEC 11172-3:1993, *Information technology – Coding of moving pictures and associated audio for digital storage media at up to about 1,5 Mbit/s – Part 3: Audio*

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

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

ISO/IEC 13818-3:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*

ISO/IEC 13818-7:1998, *Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC)*

ISO 639-2:1998, *Codes for the representation of names of languages – Part 2: Alpha-3 code*

ISO 2015:1976, *Numbering of weeks*

ISO 3166-1:1997, *Codes for the representation of names of countries and their subdivisions – Part 1: Country codes*

ISO 3901:2001, *Information and documentation – International Standard Recording Code (ISRC)*

ISO 8859-1:1997, *Information technology – 8-bit single-byte coded graphic character sets - Part 1: Latin alphabet No. 1*

ISO 13818-9:1996, *Information technology – Generic coding of moving pictures and associated audio information – Part 9: Extension for real-time interface for system decoders*

ARIB STD-B5:1996, *Ver 1.0, Data multiplex broadcasting system for the conventional television using the vertical blanking interval*

ARIB STD-B10:2004, *Ver 3.8, Service Information for Digital Broadcasting System*

ARIB STD-B24:2004, *Ver 4, Data coding system and transmission specification for digital broadcasting*

ARIB TR-B15:2004, *Ver 2.9, Operational guidelines for digital satellite broadcasting services using broadcasting satellites*

ATSC A/52B:2001, *Digital audio Compression (AC-3)*

ATSC.A/53B:2001, *ATSC Digital Television Standard*

ATSC A/70:2000, *Conditional Access System for Terrestrial Broadcast*

EIA 708 B:1999, *Digital Television (DTV) closed captioning*

EN 300 468:1998, *V1.3.1, Digital Video Broadcasting (DVB) - Specification for Service Information (SI) in DVB systems*

ETR 211:1997, *Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)*

ETS 300 743:1997, *Digital Video Broadcasting (DVB) - Subtitling systems*

JIS X 208:1997, *7-bit and 8-bit double byte coded KANJI sets for information interchange*

PNG (Portable Network Graphic) Specification Ver1.0, W3C Rec.Oct.1996, available at <http://www.w3.org/Graphics/PNG/>

SMPTE 302M:2002, *Television – Mapping of AES3 Data into MPEG-2 Transport Stream*

3 Terms, definitions and abbreviations

3.1 Terms and definitions

For the purposes of this part of IEC 60774-5, the following terms and definitions apply.

3.1.1

absolute track number

22-bit code recorded in the ID area of the Subcode sync block. The absolute track number is counted up every track and indicates the tape absolute position

3.1.2

absolute track number support flag

SF

2-bit code recorded in the ID area of the subcode sync block. SF indicates the condition of absolute track number

3.1.3

application detail

in the case of MPEG2 mode or CTP STD mode 1, the application detail is recorded in the main header. Application detail indicates the contents of main data

3.1.4

application ID

the application ID is recorded in the format ID. The application ID provides the definitions of subcode data area and main data area

3.1.5

code word

code word in ECC

3.1.6

data-AUX

in the case of MPEG2 transport stream recording or CTP stream recording, data-AUX is the next 1 byte after the main header. 6 data-AUX from 6 subsequent sync blocks constitute the pack data

3.1.7

data detail

the data detail is recorded in the sync block information area. The contents of Data detail depend on the contents of data type

3.1.8

data type

DT

the data type is recorded in the sync block information area in the main header. The data type indicates the contents of the sync block data

3.1.9

ECC block size

indicates the size of data which constitute the product codes of main code

3.1.10

ECC block number per track

number of ECC blocks per track

3.1.11

format ID

block of ID data in the subcode sync block or main header which contains ECC block size, ECC block number per track, program mode, scanner rotation speed, recording

3.1.12

format information area

first 4 bits of the main header. The format information area contains format ID, application details, application information, etc.

3.1.13

group of pictures

GOP

layer defined in MPEG

3.1.14

ID parity

IDP

error detecting code for ID

3.1.15

index flag

indicates the start point of the index

3.1.16

inter block gap

IBG

edit gap between two data areas

3.1.17

local time stamp generator

in the case of MPEG2 mode or CTP STD mode 1, the local time stamp generator is the drum reference generator in recording and playback. Local time stamp generator provides the value of the time stamp to be recorded

3.1.18

main data sync block

sync block in main code area. One main data sync block is 112 bytes

3.1.19

main header

in the case of MPEG2 mode or CTP STD mode, the main header is the first 2 bytes of the main data area in each main data sync block and it consists of format information area and sync block information area

3.1.20

marker flag

indicates the remarkable data area

3.1.21

outer interleave

number of tracks which constitute one interleave block for the outer error correcting codes

3.1.22

pack data

contains ancillary data as specified in the pack data format

3.1.23

packet header

4-byte information area associated with the transport packet. The packet header is recorded in front of each transport packet

3.1.24

pack header

first byte of pack data

3.1.25

precoder

device for the first process of interleaved NRZI

3.1.26

program mode

indicates the structure of the main code area

3.1.27

sequence number

the sequence number is recorded in the ID area of the main data sync block. The sequence number indicates the number of interleave sequences

3.1.28

skip flag

indicates the skip start point

3.1.29

start flag

indicates the start point of the program

3.1.30

subcode sync block

sync block in the subcode area. One subcode sync block is 28 bytes

3.1.31

sync block

SB

indicates the main data sync block or the subcode sync block or a 112 byte (896 bits) data length

3.1.32

sync block count

SBC

the sync block count is recorded in the sync block information area. Sync block count indicates the relation between D-VHS and the transport packet

3.1.33

sync block information area

12-bit data area in the main header. The sync block information area consists of data type, sync block count and data detail

3.1.34

sync block number

the sync block number is recorded in the ID area of the main data sync block and the subcode sync block. The sync block number indicates the position of the sync block

3.1.35

time stamp

input time of the transport packet. The time stamp is recorded in packer header as the sampled value of the local time stamp generator

3.1.36

track pair number

the track pair number is recorded in the ID area of the main data sync block. The track pair number represents interleave sequence

3.2 Abbreviations

AAC	Advanced Audio Coding
ATSC	Advanced Television Systems Committee
ARIB	Association of Radio Industries and Businesses
bslbf	bit string, left bit first
C/N	Carrier to Noise ratio
CGMS	Copy Generation Management System
CRC	Cyclic Redundancy Check Code
CTP	Compact Transport Packet (different format from MPEG2 TS packet)
DIT	Discontinuity Information Table
DTS	Digital Theater System
DVB	Digital Video Broadcasting
ES	Elementary Stream
ETR	ETSI Technical Report
ETS	European Telecommunication Standard
ETSI	European Telecommunication Standards Institute
IEC	International Electrotechnical Commission
I-picture	Intra-coded Frame or Field
IRD	Integrated Receiver-Decoder
ISO	International Organisation for Standardisation
ITU	International Telecommunication Union
HDTV	High Definition Television
HL	High Level
MJD	Modified Julian Date
ML	Main Level
MP	Main Profile
MPEG	Moving Pictures Expert Group
MTRM	MPEG Transport stream for Recording Media
NIT	Network Information Table
NRZI	Non-Return to Zero Inverse
PAT	Program Association Table
PCR	Program Clock Reference
PES	Packetized Elementary Stream
PID	Packet Identifier
PLTE	Palette

PMT	Program Map Table
PNG	Potable Network Graphics
PSI	Program Specific Information
rpchof	remainder polynomial coefficients, highest order first
RS code	Reed-Solomon Code
SI	Service Information
SIT	Selection Information Table
SDTV	Standard Definition Television
STD	System Target Decoder
TS	Transport Stream
uimbsf	unsigned integer most significant bit first
UTC	Universal Time, Co-ordinated

4 Fundamental specifications

4.1 Cassette

4.1.1 General

The cassettes described here shall be used for recording and playback of signals conforming to the D-VHS system.

4.1.2 Name

The following type name shall be used for D-VHS cassettes in order to indicate that they conform to the D-VHS system.

DF – xxx (xxx indicates tape length in minutes in STD mode)

for 160 min: DF – 160	for 300 min: DF – 300
for 180 min: DF – 180	for 360 min: DF – 360
for 240 min: DF – 240	for 420 min: DF – 420

4.1.3 Magnetic tape

4.1.3.1 General

- The magnetic tape used in this cassette shall conform to 4.2.
- After incorporation into the cassette, performance shall fulfil all items of the above-mentioned “magnetic tape” specifications. However, dropout measurements shall exclude the initial and final 1 min segments at the start and the end of tape length.
- The magnetic tape wound shall be a single length and shall not include interim splices.

4.1.3.2 Length

The relationship between tape length and time for recording and playback is defined by the following formula.

$$L = \left[1,01 \ t + 3,0 \right] \begin{matrix} +3 \\ 0 \end{matrix} \quad (\text{m})$$

where

L is the tape length (m)

t is the recording or playback time (min)

NOTE L shall be an integer obtained by rounding up decimal fractions.

4.1.3.3 Thickness and strength

DF - 160, DF - 180
 DF - 240, DF - 300 : $Th = 17,5 \begin{matrix} +0,4 \\ -0,5 \end{matrix} \mu\text{m}$

DF - 360 : $Th = 14,4 \pm 0,5 \mu\text{m}$; $Sd = 0,64 \text{ N}$; $E = 1,03 \times 10^4 \text{ N/mm}^2$

DF - 420 : $Th = 12,4 \pm 0,4 \mu\text{m}$; $Sd = 0,64 \text{ N}$; $E = 1,37 \times 10^4 \text{ N/mm}^2$

where

Th : Tape thickness (μm)

Sd : Dynamic collapse strength (N)

The Sd is measured with the "VG-5 dynamic collapse strength measuring instrument" manufactured by JVC or its equivalent.

E : Young's modulus (N/mm^2)

$$E = El + Et$$

El : Young's modulus of longitudinal direction (N/mm^2)

Et : Young's modulus of transverse direction (N/mm^2)

4.1.3.4 Others

Other items not specified herein shall conform to the "S-VHS Video Tape Cassette" specified in IEC 60774-3:1993.

4.1.4 Leader tape and trailer tape

Leader tape and trailer tape shall conform to the "VHS Video Tape Cassette" specified in IEC 60774-1:1994.

4.1.5 Reel and cassette

For identification, D-VHS cassettes shall have identification holes (ID holes) defined in Figure 1. Other items, shape and dimensions shall conform to the "S-VHS Video Tape Cassette" specified in IEC 60774-3:1993.

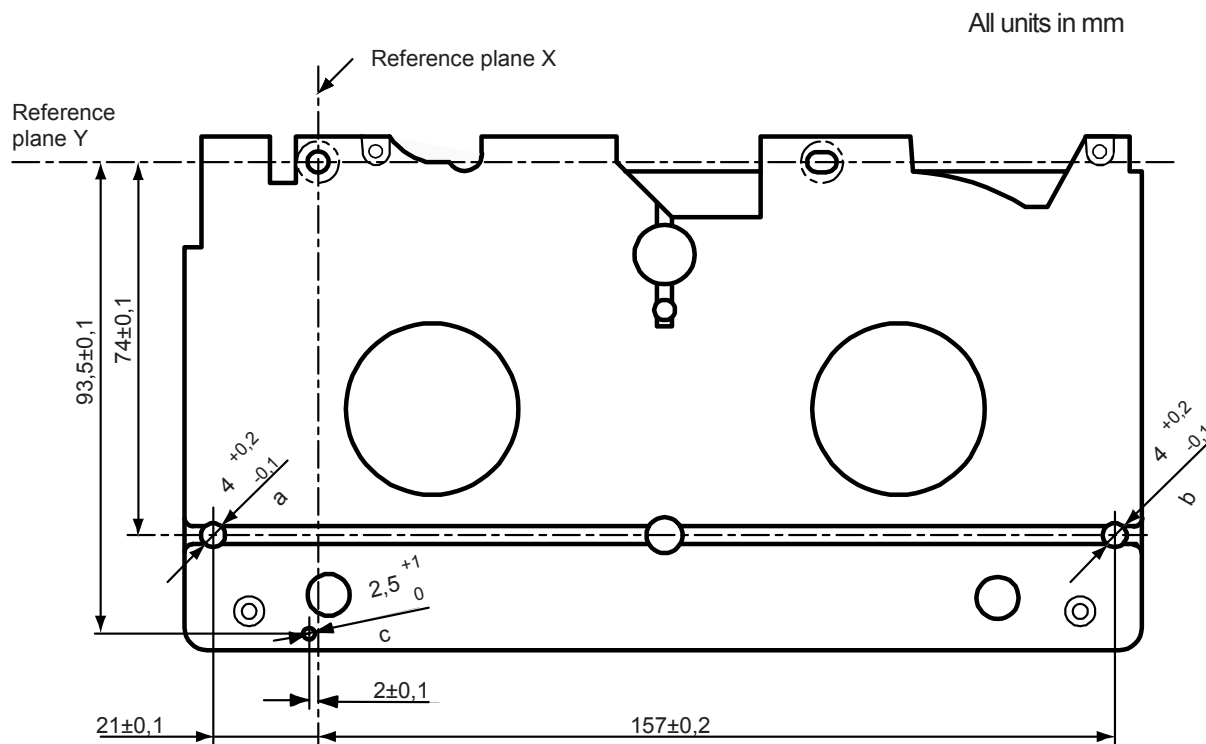
Colors of cassettes shall be defined as follows.

a) Windows and upper flanges of reels:

Clear to indicate the remaining tape.

b) Cassette case:

The colour of the cassette case, except the windows and upper flanges, shall be selected so that the light transmission is 0,45 % or less when measured with the cassette optical tester VT-2M manufactured by JVC or equivalent measuring instrument. In this case, the judgement shall be made with the higher value of either supply reel side or take-up reel side.



- a Identification hole A: the depth shall be more than 3,8 mm from the reference plane Z.
- b Identification hole B: the depth shall be more than 3,8 mm from the reference plane Z.
- c Identification hole C: the depth shall be more than 3,0 mm from the reference plane Z.

Figure 1 – D-VHS cassette ID holes

4.2 Magnetic tape

4.2.1 General

This clause covers the technical details pertaining to the magnetic tape used in the D-VHS system, including technical descriptions other than those specified in 4.1. The recording characteristics are specified based on the standard tape "SRT-1 (S-VHS standard tape)".

4.2.2 Test conditions

4.2.2.1 Environment

All tests shall be performed at room temperature of $(20 \pm 2) ^\circ\text{C}$ and relative humidity of $(65 \pm 5) \%$ (hereinafter referred to as normal temperature and humidity), unless otherwise specified.

However, if there is no doubt about judgment, all tests may be performed at room temperature from $5 ^\circ\text{C}$ to $30 ^\circ\text{C}$ and relative humidity from 30 % to 80 %.

4.2.2.2 Test tape recorder

A cassette recorder conforming to D-VHS standards and S-VHS standards or equivalent measuring instruments shall be used.

4.2.3 Data recording properties

4.2.3.1 Reference RF recording current

The reference RF recording current is defined as the recording current which is necessary to obtain the maximum playback output level from the standard tape on which a 9,6 MHz square wave signal has been recorded.

4.2.3.2 Playback output

When a 9,6 MHz square wave signal is recorded with the reference RF recording current, then the output signal of 9,6 MHz is measured, it should be as follows with respect to the RF playback output of the standard tape.

9,6 MHz: + 1,0 dB or more

4.2.3.3 Carrier to noise ratio

When a 9,6 MHz square wave signal is recorded using the reference RF recording current, and the ratio between the playback output level and the noise level is measured, it should be as follows with respect to that of the standard tape.

Noise level: the average of 8,6 MHz and 10,6 MHz noise level

(Measuring condition of the noise level: resolution bandwidth 30 kHz)

C/N: + 1,0 dB or more

4.2.3.4 Dropout

Measuring method: When a 4,8 MHz square wave signal is recorded with the reference RF recording current, then the playback output level is measured, using the dropout counter VH06AZ manufactured by Shibasoku or its equivalent. A dropout is defined as a decline in the RF envelope output below -6 dB for a period exceeding 0,5 μ s.

Dropout: there should be 200 dropouts or less per minute over the entire tape length.

4.2.4 Conformance with S-VHS specifications

Every item described in the IEC 60774-3: 1993, shall be fulfilled.

4.3 Basic format

4.3.1 Track configuration and dimensions

See Table 1.

Table 1 – Track configuration and dimensions

Item				Value	Figure number
1.	(A)	Tape width	mm	12,65 ± 0,01	2
2.	(Vt)	Tape speed	mm/s	(See ^{a)})	
3.	(ϕ)	Drum diameter (upper drum)	mm	62 ± 0,01	
4.	(Vh)	Relative writing speed	m/s	(See ^{a)})	
5.	(P)	Data track pitch	mm	(See ^{a)})	2
6.	(B)	Total data width	mm	10,60	2
7.	(W)	Effective data width	mm	10,07	2
8.	(L)	Data track center (measures from reference edge)	mm	6,198	2
9.	(T)	Data track width	mm	(See ^{a)})	2
10.	(C)	Control track width (^{b)})	mm	0,75 ± 0,1	2, 4
11.	(R)	Linear track width (mono track)	mm	1,0 ± 0,03	2, 4
12.	(D)	Linear track width (channel 2)	mm	0,35 ± 0,03	2, 4
13.	(E)	Linear track width (channel 1)	mm	0,35 ± 0,03	2, 4
14.	(F)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03	2
15.	(h)	Linear-to-linear guardband width	mm	0,3	2, 4
16.	(θ_0)	Data track angle (tape stationary)		5° 56' 7,4"	
17.	(θ)	Data track angle (tape running)		(See ^{a)})	
18.	(α)	Data head gap azimuth angle		(See ^{c)})	
19.	(X)	Position of linear and control head	mm	(See ^{a)})	2
20.		Position of subcode sync (inside the bottom edge of W)		3 850 to 5 110 bits	2, 3
21.		Position of main code sync (inside the bottom edge of W)		13 706 to 14 966 bits	2, 3
22.		Tape back-tension (at the tape beginning and the entrance to drum)		30 to 45 g	
23.		Track shift error (from logical value)	µm	(See ^{a)})	
24.		Track bend (peak-to-peak value)	µm	(See ^{a)})	
25.		Number of tracks	tracks/s	(See ^{a)})	
26.		Transmission rate	bits/s	(See ^{a)})	
^{a)} The value of the parameter depends on Application ID. ^{b)} The control signal shall be recorded from the tape reference edge. ^{c)} The value of the parameter depends on Format ID. Remarks 1) Where tolerances are not given, the quoted values are nominal. 2) Tests and measurements shall be carried out under the following condition. Temperature: 20 ± 2 °C, Relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, Relative humidity: 30 % to 80 %.					

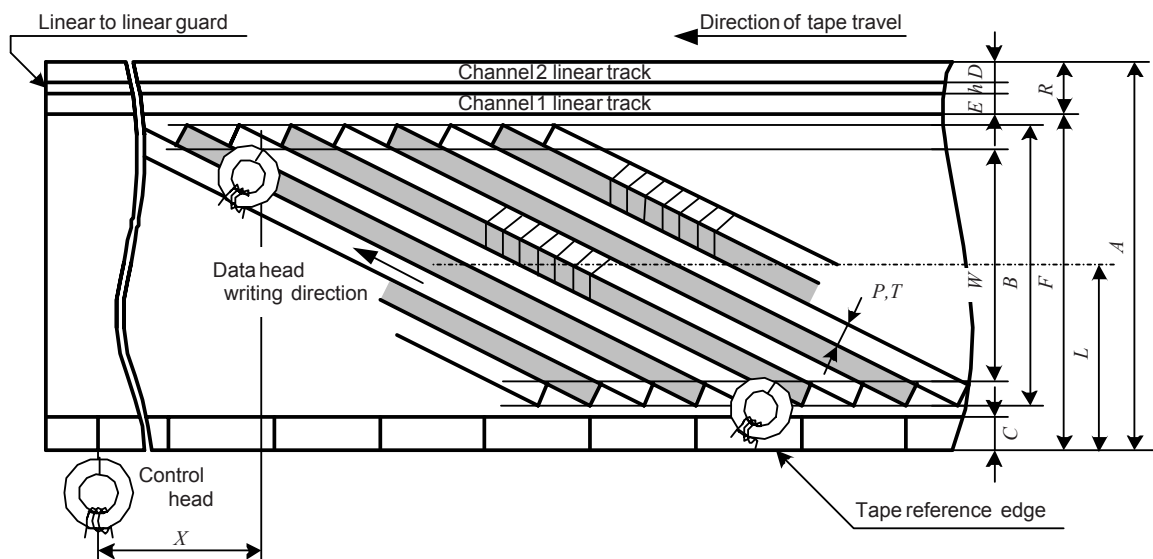
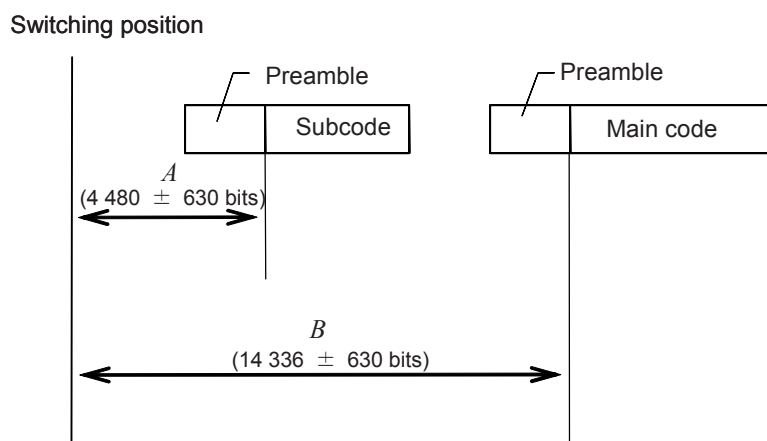


Figure 2– Magnetic tape position



NOTE Specification of signal allocation is shown in 4.3.2.4. Signal allocation (Table 10)

In recording, the following rule shall apply.

$$3\,850\text{ bits} \leq A \leq 5\,110\text{ bits}$$

$$13\,706\text{ bits} \leq B \leq 14\,966\text{ bits}$$

Figure 3 – Switching position

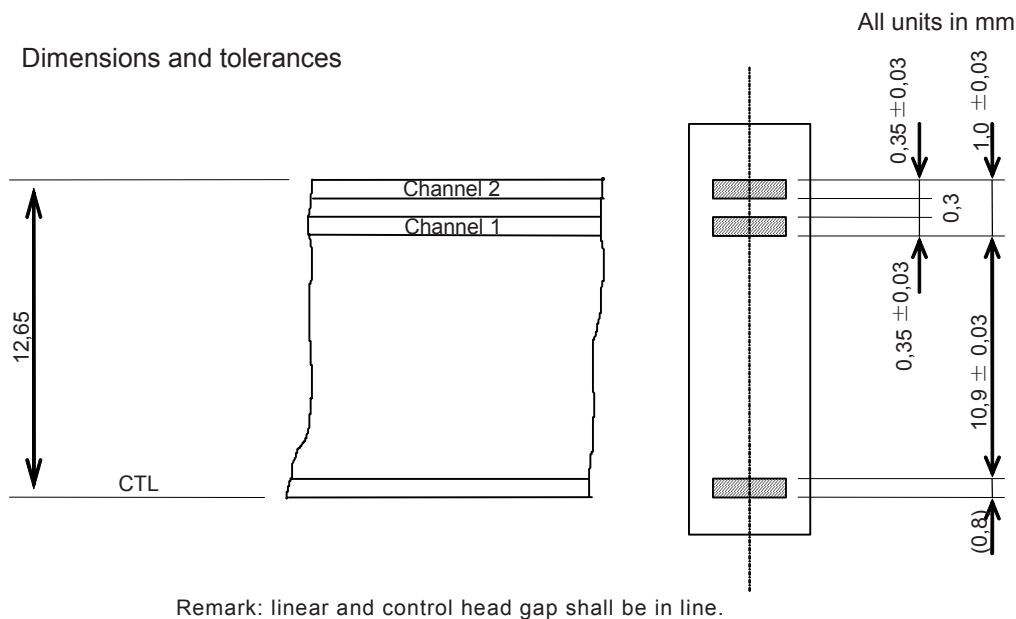


Figure 4 – Linear and control head (reference)

4.3.2 D-VHS basic format

4.3.2.1 Recording data structure

Unless otherwise specified, MSB shall be written from the left and recorded first.

4.3.2.1.1 Track structure

A track consists of 356 sync blocks. However, when 1,001 flag in Format ID (see 4.3.2.1.3.3) is set to 1, a track consists of 356,356 sync blocks. Each of sync blocks is composed of 896 bits.

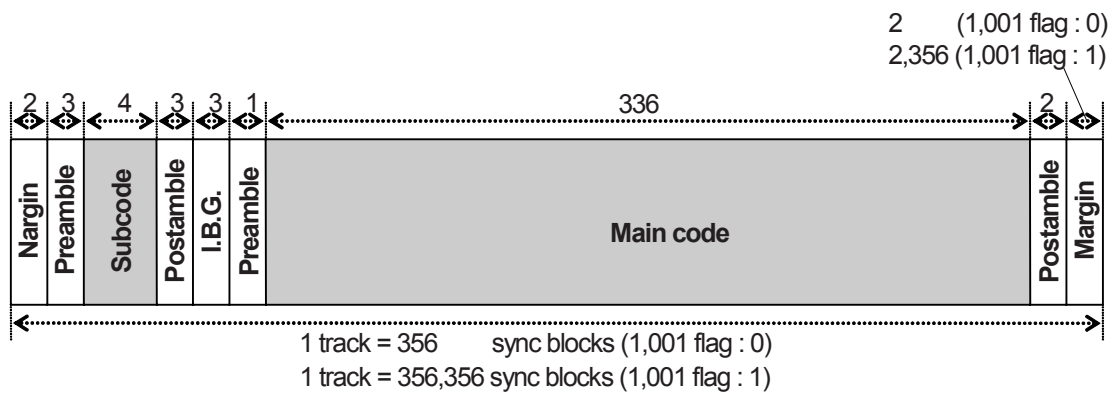


Figure 5 – Track structure

a) Main code area

Main code area consists of main data sync blocks.

b) Subcode area

Subcode area consists of subcode sync blocks. One sync block consists of 4 subcode sync blocks.

4.3.2.1.2 Main data sync block

Main data sync block consists of sync, ID, main data and inner parity.

One main data sync block has 99 symbols of main data and 8 symbols of inner parity.

One symbol is composed of 8 bits.

See Figure 6.

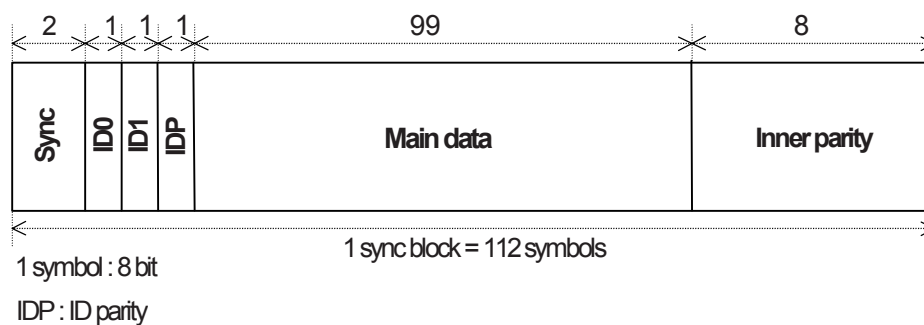


Figure 6 – Main data sync block

4.3.2.1.2.1 Sync

Synchronization pattern of main data sync block is defined before pre-coding.

Synchronization pattern has 2 undefined bits and 14 defined bits.

Synchronization pattern is defined as follows.

Synchronization pattern of main data sync block is “**01001011100011”.

4.3.2.1.2.2 ID

a) Configuration

See Table 2.

Table 2 – Configuration of ID (maindata sync block)

ID0								ID1							
MSB				LSB				MSB				LSB			
bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
Sequence number				Track pair number				Sync block number							

b) Sequence number

Sequence number is a 4-bit code.

The system to count the sequence number is defined in accordance with the application ID (see 4.3.2.1.3.3).

c) Track pair number

Track pair number is a 3-bit code.

Track pair number is counted up every track pair (plus and minus azimuth track).

The system to count track pair number is defined in accordance with the application ID (see 4.3.2.1.3.3).

d) Sync block number

Sync block number is a 9-bit code.

Sync block number is counted up every sync block and counted from 000000000 to 101001111.

The sync block number 000000000 shall be assigned to the first sync block of main code area.

e) ID parity

ID parity is an error detection code for ID0 and ID1.

ID parity is generated as follows.

Symbol definition

ID0 bit 7 to bit 4 → symbol 0, ID0 bit 3 to bit 0 → symbol 1, ID1 bit 7 to bit 4 → symbol 2,

ID1 bit 3 to bit 0 → symbol 3, ID parity bit 7 to bit 4 → symbol 4, ID parity bit 3 to bit 0 → symbol 5

See Table 3.

Table 3 – Symbol definition of ID parity (maindata sync block)

	MSB				LSB			
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
ID0	symbol 0				symbol 1			
ID1	symbol 2				symbol 3			
IDP	symbol 4				symbol 5			

RS code over GF(2⁴)

Primitive polynomial : $P(X) = X^4 + X + 1$

Generator polynomial : $G(X) = (X + \alpha)(X + 1)$ $\alpha = 0010$

$$Codeword = \sum_{i=0}^5 Symbol_i \times X^{5-i}$$

The last 2 symbols are parity symbols.

4.3.2.1.2.3 Main data

One main data sync block has 99 symbols of main data.

4.3.2.1.2.4 Inner parity

See 4.3.2.2.

4.3.2.1.3 Subcode sync block

Subcode sync block consists of sync, ID, format ID, subcode data and inner parity.

One subcode sync block has 18 symbols of subcode data and 4 symbols of inner parity.

One symbol is composed of 8 bits.

See Figure 7.

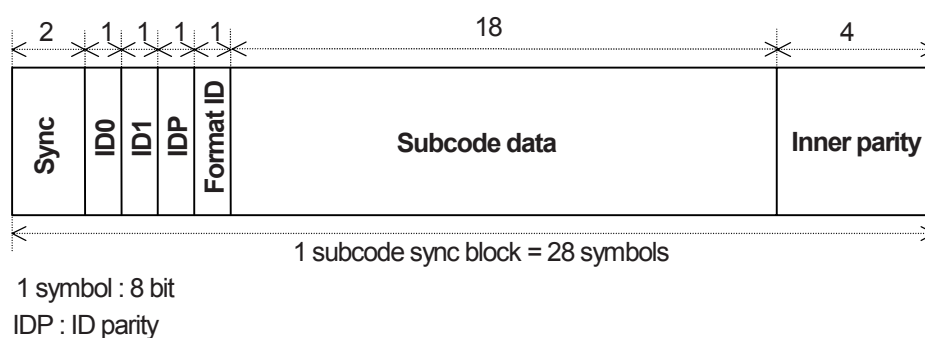


Figure 7 – Subcode sync block

4.3.2.1.3.1 Sync

Synchronization pattern of subcode sync block is defined before pre-coding.

Synchronization pattern has 2 undefined bits and 14 defined bits.

Synchronization pattern is defined as follows.

Synchronization pattern of subcode sync block is “**10110100011100”.

4.3.2.1.3.2 ID

a) Configuration

See Table 4.

Table 4 – Configuration of ID (subcode sync block)

SB#	ID0								ID1							
	MSB				LSB				MSB				LSB			
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
4n	Reserved								Tag				Sync block number			
4n + 1	SF		Absolute track number (Upper byte)						Tag				Sync block number			
4n + 2	Absolute track number (Middle byte)								Tag				Sync block number			
4n + 3	Absolute track number (Lower byte)								Tag				Sync block number			

Reserved bits shall be set to “0”.

b) Absolute track number

Absolute track numbers are counted up every track and recorded as a 22 bit binary word.

The beginning of the tape is provided for the lead-in area.

The system to count the absolute track number is defined for each application with reference to the following formula. Only the lower 2 bits are counted differently for each data track pitch.

$$ATNo = \text{int}\left(\frac{n \times Tp}{14,5}\right)$$

where

ATNo: Absolute track number

Tp: data track pitch (µm)

n = 0, 1, 2, 3, ...

Also, the starting point of the absolute track number (000000H) shall be located on a point within 30 s from the beginning of the tape without regard to the program.

For pre-recorded tapes however, the starting point of absolute track number can be located at the starting point of the program.

c) SF: Absolute track number support flag

SF is used for the absolute track number support flag.

SF shall be recorded according to the definition shown in Table 5.

Table 5 – Absolute track number support flag

SF	Contents
00	Absolute track number is not supported.
01	Absolute track number is the estimated value and it is not necessarily unique.
10	Absolute track number is the estimated value and it is unique from the beginning of the tape to the present position, but a discontinuity may exist at the beginning of the present recording.
11	Absolute track number is continuous from the beginning of the tape.

If the recording of the absolute track number begins in the midst of the tape, an estimated value by the recorder can be recorded. In that case, the support flag shall be 01 during the double of the error (the difference between the estimated value and the value to be recorded if the absolute track number is kept recording continuously from the beginning). After that, the support flag shall be recorded as 10.

d) Tag

The tag is defined as shown in Table 6.

Table 6 – Tag

ID1			
Bit 7	Bit 6	Bit 5	Bit4
Start flag	Index flag	Skip flag	Marker flag

When the tag is in use, the following rules shall apply.

- 1) Start flag
The start flag shall be set to "1" from the start point of the program for 300 tracks.
- 2) Index flag
The index flag shall be set to "1" from the start point of index for 300 tracks.
- 3) Skip flag
The skip flag shall be set to "1" from the skip start point for 120 tracks. All the data from the start point of Skip flag to the next start point of start or index flag shall be skipped. If both skip flag and start flag or index flag are set to "1", skip flag shall have priority over the other flag.
- 4) Marker flag
Marker flag shall be set to "1" from the beginning of the data area to be marked for at least 120 tracks.

e) Sync block number

Sync block number is 4 bit code.

Sync block number is counted up every subcode sync block and counted from 0000 to 1111. Sync block number 0000 shall be assigned to the first subcode sync block of subcode area.

f) ID parity

ID parity is an error detecting code for ID0 and ID1.

ID parity is generated as follows.

Symbol definition

ID0 bit 7 to bit 4 → symbol 0, ID0 bit 3 to bit 0 → symbol 1, ID1 bit 7 to bit 4 → symbol 2,

ID1 bit 3 to bit 0 → symbol 3, ID parity bit 7 to bit 4 → symbol 4, ID parity bit 3 to bit 0 → symbol 5

See Table 7.

Table 7 – Symbol definition of ID parity (subcode sync block)

	MSB				LSB			
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
ID0	symbol 0				symbol 1			
ID1	symbol 2				symbol 3			
IDP	symbol 4				symbol 5			

RS code over GF(2⁴)

Primitive polynomial : $P(X) = X^4 + X + 1$

Generator polynomial : $G(X) = (X + \alpha)(X + 1)$ $\alpha = 0010$

$$\text{Codeword} = \sum_{i=0}^5 \text{Symbol}_i \times X^{5-i}$$

Last 2 symbols are parity symbols.

4.3.2.1.3.3 Format ID

Format ID is defined as follows according to the sync block number. One set of format ID data is recorded in four consecutive sync blocks. See Table 8.

Table 8 – Format ID

SB#	MSB				LSB			
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
$4n$	ECC block size	ECC block number per track		Program mode			Scanner rotation speed	
$4n + 1$	1,001 flag	Outer interleave			Recording mode			
$4n + 2$	Reserved							
$4n + 3$	Application ID					Reserved		

Reserved bits shall be set to “0”.

Application ID is defined as shown in Table 9.

Table 9 – Application ID

0xxxx	Consumer use
1xxxx	Professional or special use

The D-VHS recorders that are designed to record or playback the signal having the application ID value of 1xxxx shall not have the playback capability of the recorded signal having the application ID value of 0xxxx.

4.3.2.1.3.4 Subcode data

One subcode sync block has 18 symbols of subcode data. The definition of subcode data area varies according to the application ID in format ID.

4.3.2.1.3.5 Inner parity

See 4.3.2.2.

4.3.2.2 Error correcting code (inner parity)

4.3.2.2.1 Main code area

4.3.2.2.1.1 Data position definition

One main code area is composed of 336 main data sync blocks.

One main data sync block is composed of 107 symbols (without Sync, ID0, ID1, and ID parity). 99 symbols are main data and 8 symbols are inner parity.

The symbols in one main data sync block are numbered from 0 to 106 along recording direction.

The main data sync blocks in one main code area (one track) are numbered from 0 to 335 in the recording direction.

See Figure 8.

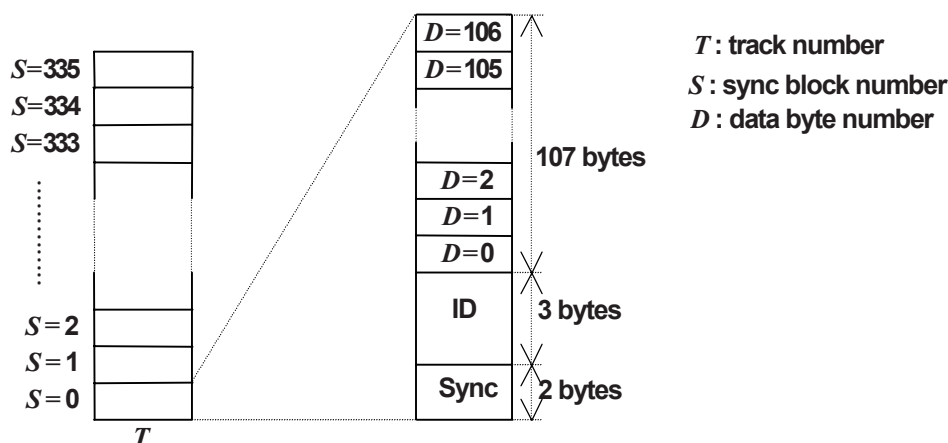


Figure 8 – Data position definition (main code)

4.3.2.2.1.2 ECC definition

Inner error correcting code: (107,99,9) RS code over GF(2⁸).

The calculation is defined on GF(2⁸) driven by the following polynomial.

$$P(X) = X^8 + X^4 + X^3 + X^2 + 1$$

A primitive element α is defined as follows.

$$\alpha = 00000010$$

One inner code word is made of following symbols.

$$\text{Codeword}(S) = \sum_{D=0}^{106} \text{Data}_{S,D} \times X^{(106-D)}$$

(S = 0 to 335)

where Data_{S,D} means a symbol defined by the sync block number: S, and data byte number: D.

Last 8 symbols (D = 99 to 106) are parity.

This equation indicates the inner codeword defined by the sync block number: S.

The generator polynomial for the inner error correcting code is as follows.

$$G(X) = \prod_{i=0}^7 (X + \alpha^i)$$

4.3.2.2.2 Subcode area

4.3.2.2.2.1 Data position definition

One subcode area is composed of 16 subcode sync blocks.

One subcode sync block is composed of 23 symbols (without Sync, ID0, ID1, and ID parity).

19 symbols are data and 4 symbols are inner parity.

The symbols in one sync block are numbered from 0 to 22 along the recording direction.

The subcode sync blocks in one subcode area (one track) are numbered from 0 to 15 along the recording direction.

See Figure 9.

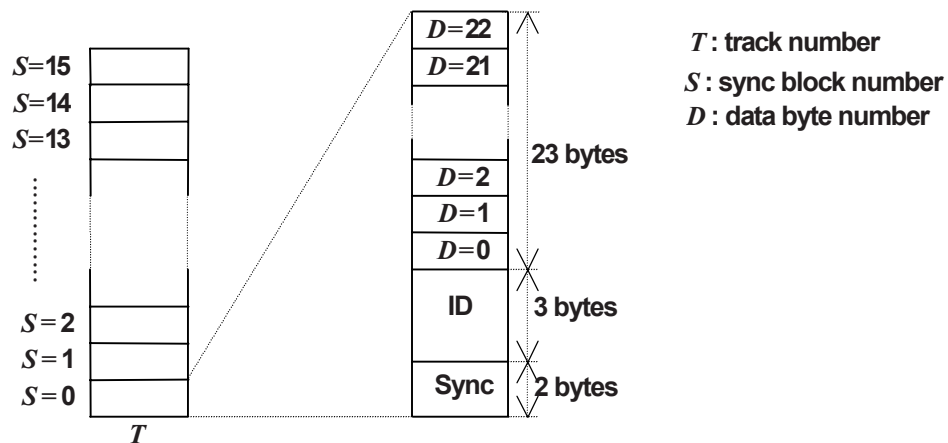


Figure 9 – Data position definition (subcode)

4.3.2.2.2 ECC definition

Inner error correcting code: (23,19,5) RS code over GF(2⁸).

The calculation is defined on GF(2⁸) driven by the following polynomial.

$$P(X) = X^8 + X^4 + X^3 + X^2 + 1$$

A primitive element α is defined as follows.

$$\alpha = 00000010$$

One inner code word is made of following symbols.

$$\text{Codeword}(S) = \sum_{D=0}^{22} \text{Data}_{S,D} \times X^{(22-D)}$$

(S = 0 to 15)

where Data_{S,D} means a symbol defined by the sync block number: S and data byte number: D.

Last 4 symbols (D = 19 to 22) are parity.

This equation indicates the inner codeword defined by the sync block number: S.

The generator polynomial for inner error correcting code is as follows.

$$G(X) = \prod_{i=0}^3 (X + \alpha^i)$$

4.3.2.3 Channel coding

Scrambled interleaved NRZI is used for this system.

4.3.2.3.1 Scrambler, descrambler

Prior to recording, the data in the main code area and subcode area shall be processed by the scramblers specified for the respective areas. In playback, respective descrambler processes shall be applied.

4.3.2.3.2 Precoder

After scrambling, all data (sync, ID, data and parity, but not including preamble, postamble, margin and IBG) is inverted and precoded. See Figure 10.

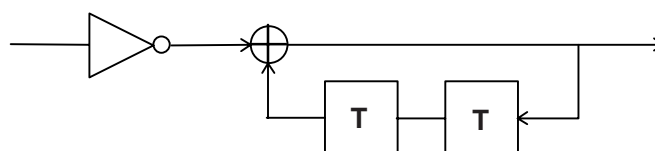


Figure 10 – Precoder

4.3.2.3.3 Margin, preamble, postamble, IBG

The recording pattern of margin, preamble, postamble, and IBG areas is as follows.

.....111000111000111000111000..... on the tape

This recording pattern shall be continuous for each 1 sync block length (112×8 bits).

At sync block boundaries the recording pattern need not be continuous.

Discontinuities in the tape pattern due to editing are allowed only in the IBG and margin areas.

4.3.2.4 Signal allocation

See Table 10.

Table 10 – Signal allocation

		number of SB	number of bits
margin		2	1 792
preamble		3	2 688
subcode		4	3 584
postamble		3	2 688
IBG		3	2 688
preamble		1	896
main code		336	301 056
postamble		2	1 792
margin	1,001 flag: 0	2	1 792
	1,001 flag: 1	2,356	2 111
total	1,001 flag: 0	356	318 976
	1,001 flag: 1	356,356	319 295

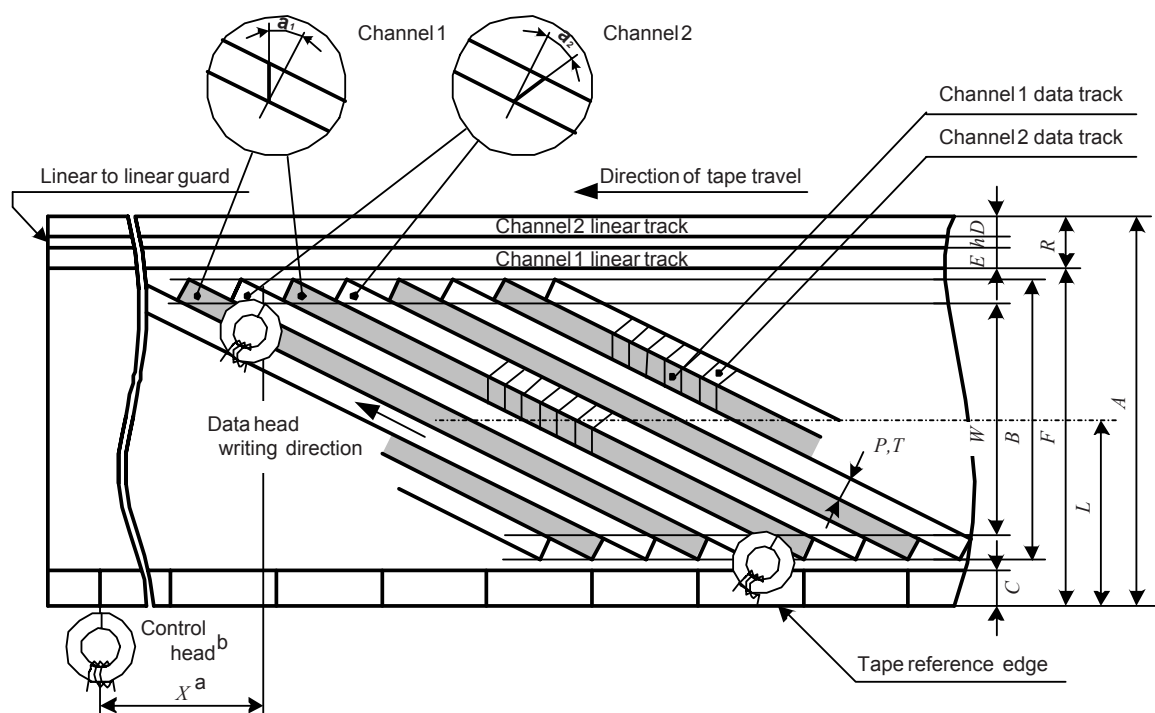
If all data in a subcode area or a main code area are rewritten, the tolerance for the errors of IBG shall be ± 440 bits as far as the provisions of switching position (see 4.3.1) are satisfied.

5 MPEG2 format

5.1 Track configuration and dimensions

Table 11 – Track configuration and dimensions (STD mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>Vt</i>)	Tape speed	mm/s	16,67 ± 0,5 %
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>Vh</i>)	Relative writing speed	m/s	5,827 (5,821)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°57'8,4" (5°57'8,5")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 g to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	60 (59,94)
26.	Transmission rate per channel	bits/s	(19 138 560 ± 500) ppm
^{a)} The control signal shall be recorded from the tape reference edge. Remarks 1) When number of tracks is 59,94 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses. 2) Where tolerances are not given, the quoted values are nominal. 3) Tests and measurements shall be carried out under the following conditions. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80 %. 4) The items in bold text are basic values and the items in normal text are calculated values.			



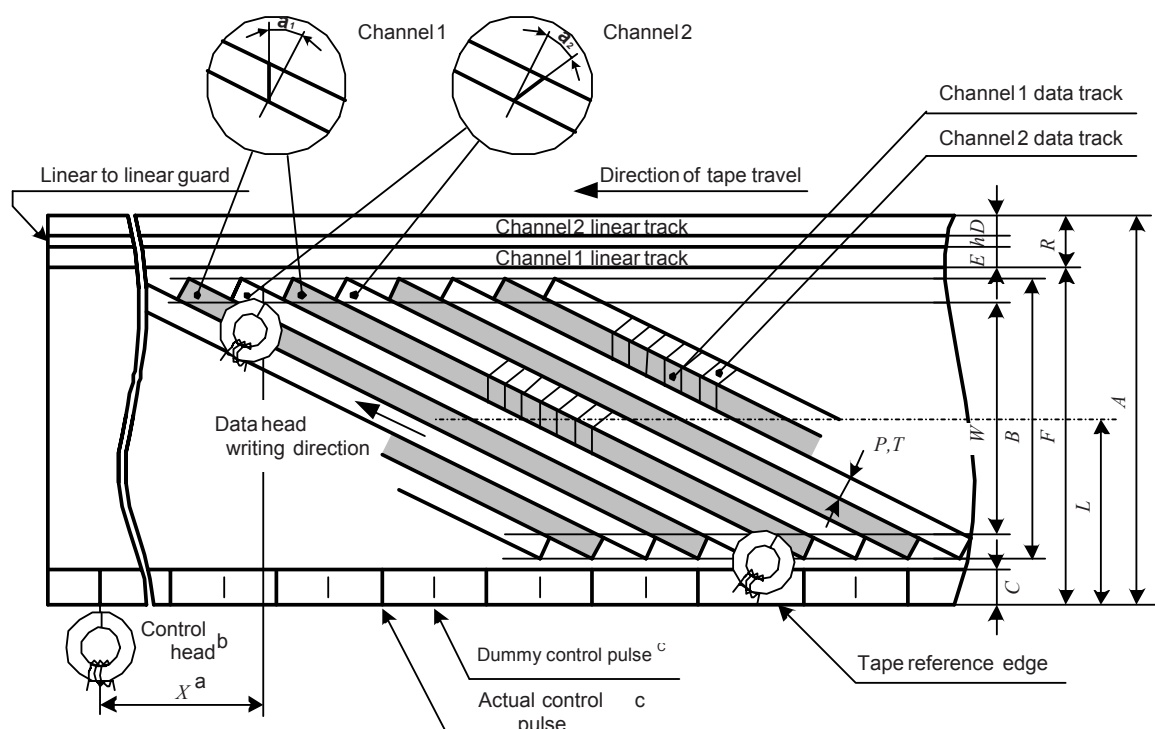
Key

- a X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape.
 The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- b The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than 200 μ s.
 A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning.
 The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.

Figure 11 – Magnetic tape position (STD mode)

Table 12 – Track configuration and dimensions (LS2 mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>V_t</i>)	Tape speed	mm/s	8,33 ± 0,5 %
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>V_h</i>)	Relative writing speed	m/s	5,835 (5,829)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°56'37,9" (5°56'37,9")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 g to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	30 (29,97)
26.	Transmission rate per channel	bits/s	(19 138 560) ± 500 ppm
^{a)} The control signal shall be recorded from the tape reference edge.			
Remarks			
1) When number of tracks is 29,97 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses.			
2) Where tolerances are not given, the quoted values are nominal.			
3) Tests and measurements shall be carried out under the following conditions. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80 %.			
4) The items in bold text are basic values and the items in normal text are calculated values.			



- a X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape.
 The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- b The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than 200 μ s.
 A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning.
 The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.
- c Control pulse frequency during recording shall be 30 Hz.
 When the number of tracks is 29,97 tracks/s, the frequency shall be 29,97 Hz.

Figure 12 – Magnetic tape position (LS2 mode)

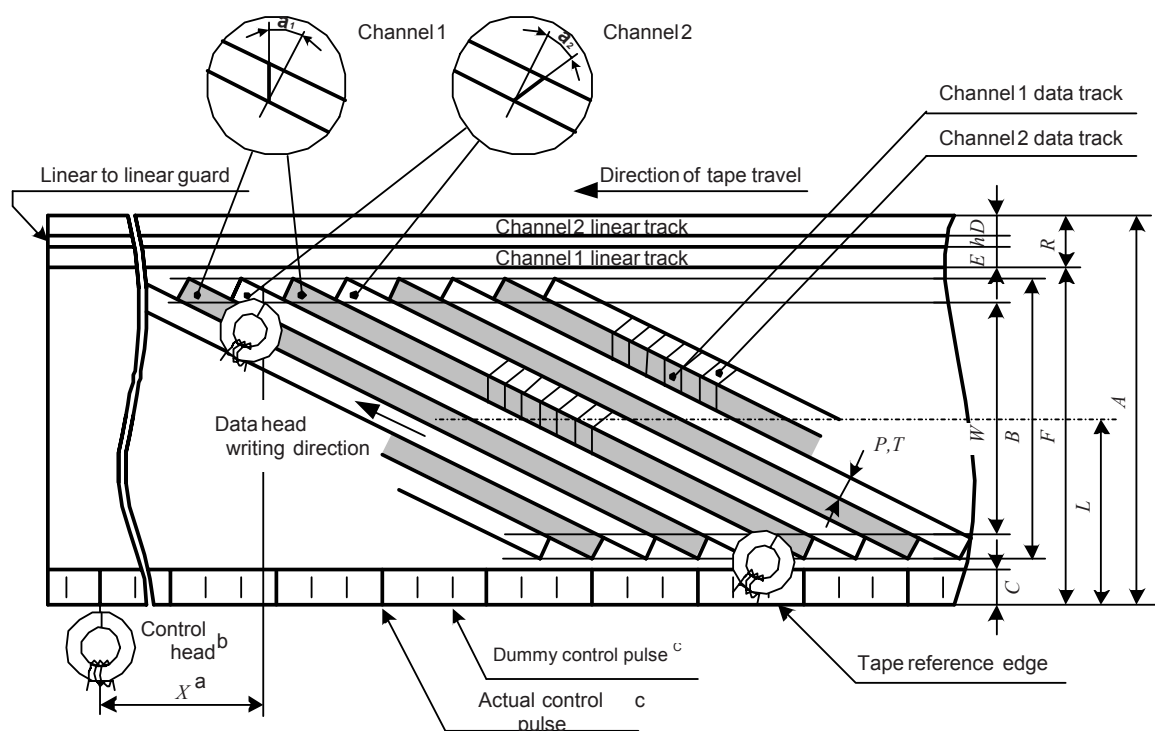
Table 13 – Track configuration and dimensions (LS3 mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>V_t</i>)	Tape speed	mm/s	5,55 ± 0,5%
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>V_h</i>)	Relative writing speed	m/s	5,838 (5,832)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°56'27,7" (5°56'27,7")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 g to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	20 (19,98)
26.	Transmission rate per channel	bits/s	(19 138 560) ± 500 ppm

^{a)} The control signal shall be recorded from the tape reference edge.

Remarks

- 1) When the number of tracks is 19,98 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses.
- 2) Where tolerances are not given, the quoted values are nominal.
- 3) Tests and measurements shall be carried out under the following conditions. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgement is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80 %.
- 4) The items in bold text are basic values and the items in normal text are calculated values.



- A X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape.
 The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- B The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than $200 \mu\text{s}$.
 A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning.
 The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.
- C Control pulse frequency during recording shall be 30 Hz.
 When the number of tracks is 19,98 tracks/s, the frequency shall be 29,97 Hz.

Figure 13 – Magnetic tape position (LS3 mode)

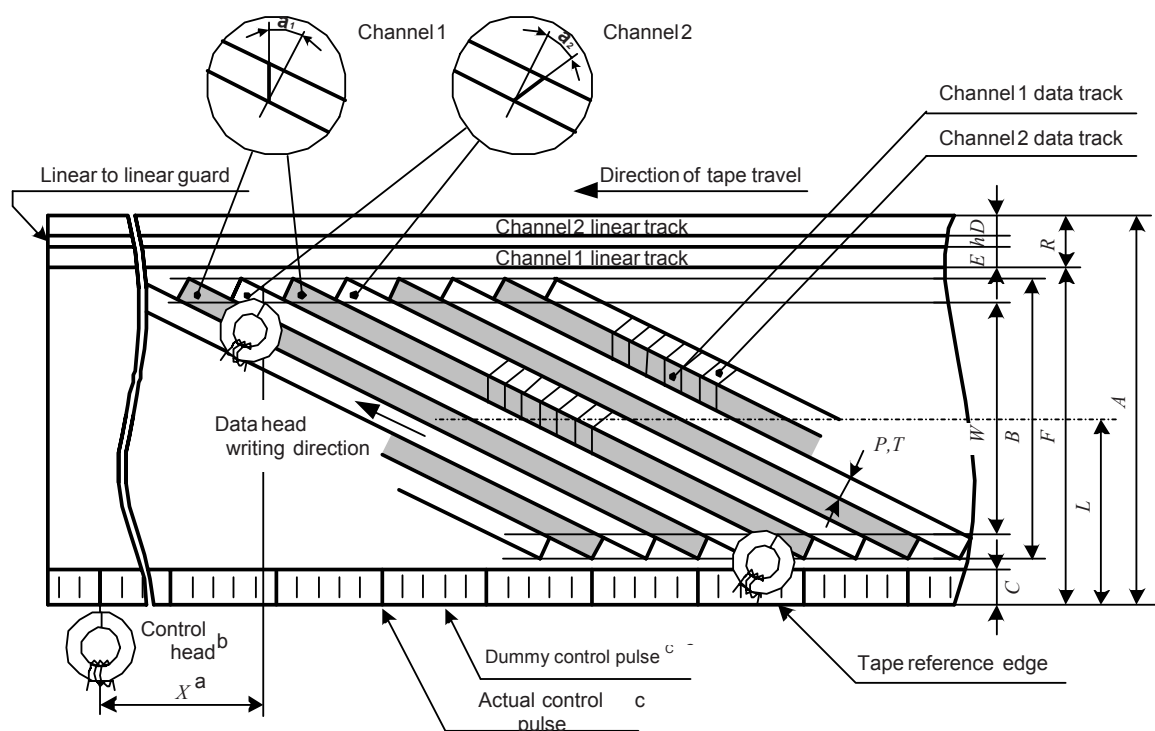
Table 14 – Track configuration and dimensions (LS5 mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>V_t</i>)	Tape speed	mm/s	3,33 ± 0,5%
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>V_h</i>)	Relative writing speed	m/s	5,840 (5,834)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°56'19,6" (5°56'19,6")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	12 (11,99)
26.	Transmission rate per channel	bits/s	(19 138 560 ± 500) ppm

^{a)} The control signal shall be recorded from the tape reference edge.

Remarks

- When the number of tracks is 11,99 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses.
- Where tolerances are not given, the quoted values are nominal.
- Tests and measurements shall be carried out under the following conditions. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80%.
- The items in bold text are basic values and the items in normal text are calculated values.

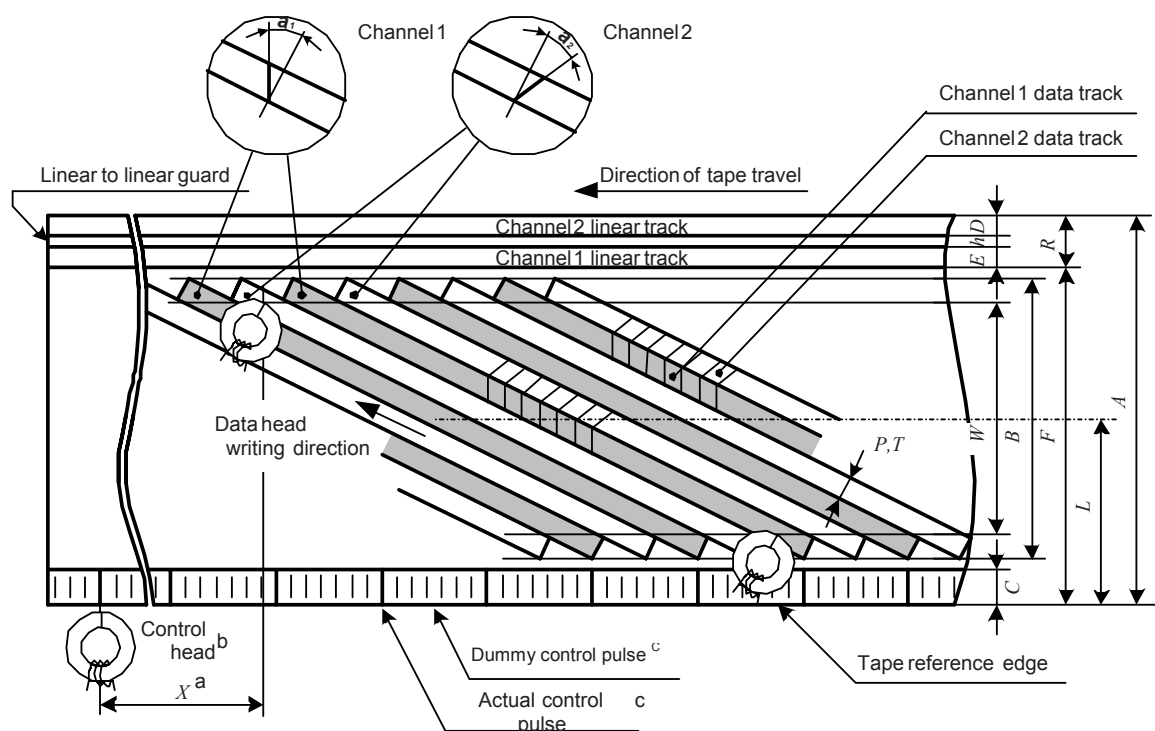


- a X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape.
 The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- b The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than $200 \mu\text{s}$.
 A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning.
 The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.
- c Control pulse frequency during recording shall be 30 Hz.
 When the number of tracks is 11,99 tracks/s, the frequency shall be 29,97 Hz.

Figure 14 – Magnetic tape position (LS5 mode)

Table 15 – Track configuration and dimensions (LS7 mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>V_t</i>)	Tape speed	mm/s	2,38 ± 0,5 %
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>V_h</i>)	Relative writing speed	m/s	5,841 (5,835)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°56'16,1" (5°56'16,1")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 g to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	8,57 (8,56)
26.	Transmission rate per channel	bits/s	(19 138 560 ± 500) ppm
^{a)} The control signal shall be recorded from the tape reference edge.			
Remarks			
1) When number of tracks is 8,56 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses.			
2) Where tolerances are not given, the quoted values are nominal.			
3) Tests and measurements shall be carried out under the following conditions. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80 %.			
4) The items in bold text are basic values and the items in normal text are calculated values.			

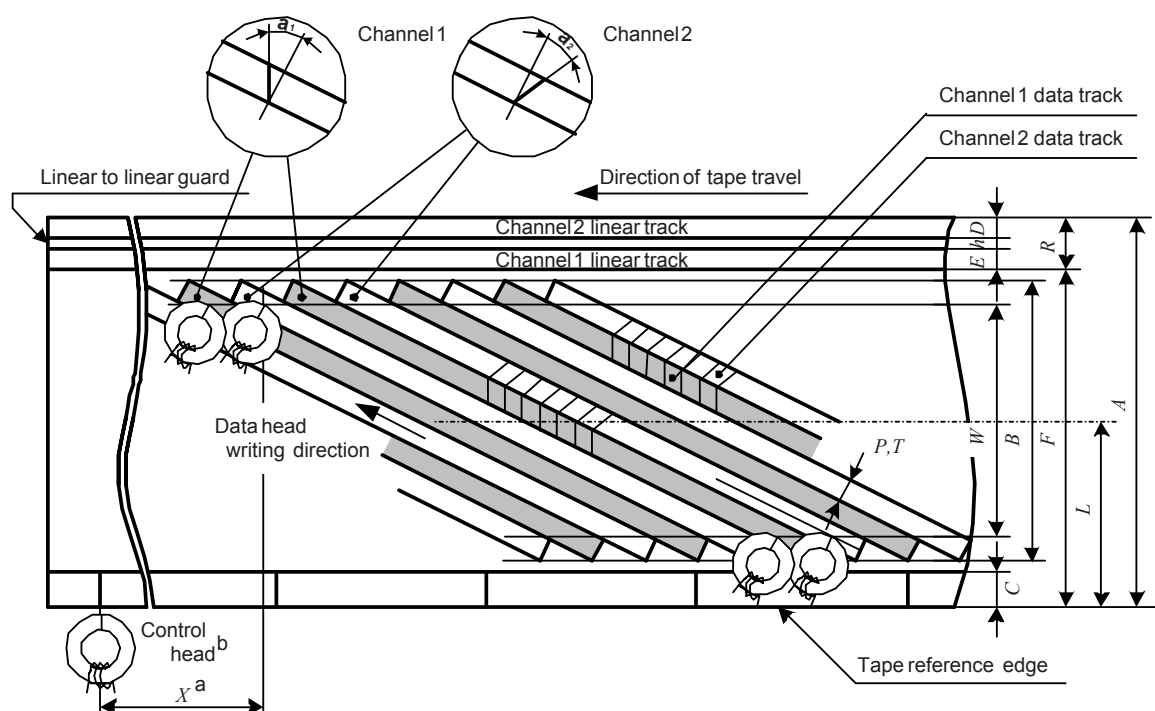


- a X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape.
 The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- b The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than 200 μ s.
 A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning.
 The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.
- c Control pulse frequency during recording shall be 30 Hz.
 When the number of tracks is 8,56 tracks/s, the frequency shall be 29,97 Hz.

Figure 15 – Magnetic tape position (LS7 mode)

Table 16 – Track configuration and dimensions (HS mode)

Item			Value
1. (<i>A</i>)	Tape width	mm	12,65 ± 0,01
2. (<i>V_t</i>)	Tape speed	mm/s	33,35 ± 0,5%
3. (<i>φ</i>)	Drum diameter (upper drum)	mm	62 ± 0,01
4. (<i>V_h</i>)	Relative writing speed	m/s	5,810 (5,804)
5. (<i>P</i>)	Data track pitch	mm	0,029
6. (<i>B</i>)	Total data width	mm	10,60
7. (<i>W</i>)	Effective data width	mm	10,07
8. (<i>L</i>)	Data track center (measures from reference edge)	mm	6,198
9. (<i>T</i>)	Data track width	mm	0,029
10. (<i>C</i>)	Control track width ^{a)}	mm	0,75 ± 0,1
11. (<i>R</i>)	Linear track width (mono track)	mm	1,0 ± 0,03
12. (<i>D</i>)	Linear track width (channel 2)	mm	0,35 ± 0,03
13. (<i>E</i>)	Linear track width (channel 1)	mm	0,35 ± 0,03
14. (<i>F</i>)	Linear track reference line (measured from reference edge)	mm	11,65 ± 0,03
15. (<i>h</i>)	Linear-to-linear guardband width	mm	0,3
16. (<i>θ₀</i>)	Data track angle (tape stationary)		5°56'7,4"
17. (<i>θ</i>)	Data track angle (tape running)		5°58'9,8" (5°58'10,8")
18. (<i>α₁, α₂</i>)	Data head gap azimuth angle		30° ± 9'
19. (<i>X</i>)	Position of linear and control head	mm	79,248
20.	Position of subcode sync (inside the bottom edge of <i>W</i>)		3 850 bits to 5 110 bits
21.	Position of main code sync (inside the bottom edge of <i>W</i>)		13 706 bits to 14 966 bits
22.	Tape back-tension (at the tape beginning and the entrance to drum)		30 g to 45 g
23.	Track shift error (from logical value)	μm	±7
24.	Track bend (peak-to-peak value)	μm	7 or less
25.	Number of tracks	tracks/s	120 (119,88)
26.	Transmission rate per channel	bits/s	(19 138 560 ± 500) ppm
^{a)} The control signal shall be recorded from the tape reference edge. Remarks 1) When number of tracks is 119,88 tracks/s, relative writing speed and data track angle (tape running) are given in parentheses. 2) Where tolerances are not given, the quoted values are nominal. 3) Tests and measurements shall be carried out under the following condition. Temperature: (20 ± 2) °C, relative humidity: (65 ± 5) %. However, provided no discrepancy in judgment is caused, these may also be done under the following conditions. Temperature: 5 °C to 35 °C, relative humidity: 30 % to 80 %. 4) The items in bold text are basic values and the items in normal text are calculated values.			



- a X shall be measured from the end of the 180° scan of channel 2 to the recorded control signal on the tape. The reference point on the control track is the transition point of the polarity of remanent magnetization on the tape, from south poles representing the direction of tape travel to its opposite.
- b The control signal shall be recorded on the control track with sufficient current for saturation and the rise time of recording current shall be less than 200 μ s. A positive going edge of the recorded control signal shall be in coincidence with the start of channel 1 track scanning. The control signal shall be recorded so that the rotating drum side of the control head poles would be north polarized when the pulse signal is positive.

Figure 16 – Magnetic tape position (HS mode)

5.2 MPEG2 recording format

5.2.1 General

When the application ID is set to 00000, recording data complies with MPEG2 recording mode format. In MPEG2 recording mode format, format ID data are defined in Tables 18 to 25.

Unless otherwise specified, MSB shall be written from the left and recorded first.

In this document, definition of k is as shown in Table 17.

Table 17 – Definition of k

Mode	k
STD	1
LS2	2
LS3	3
LS5	5
LS7	7
HS	—

1) ECC block size

Table 18 – ECC block size

0	112 sync blocks per 1 ECC block
---	---------------------------------

2) ECC block number per track

Table 19 – ECC block number per track

00	3 ECC blocks per track
----	------------------------

3) Program mode

Table 20 – Program mode

000	1 program per track (1 editable area per track)
-----	---

4) Scanner rotation speed

Table 21 – Scanner rotation speed

00	1 800 rpm
----	-----------

5) 1,001 flag

Table 22 – 1,001 flag

0	Scanner rotation speed $\times$ 1
1	Scanner rotation speed $\times$ 1/1,001

6) Outer interleave

Table 23 – Outer interleave

000	6 tracks
-----	----------

7) Recording mode

Table 24 – Recording mode

0000	STD mode
0001	HS mode
0010	LS2 mode
0011	LS3 mode
0101	LS5 mode
0111	LS7 mode

8) Application ID

Table 25 – Application ID

00000	MPEG2
-------	-------

NOTE Tables 19 and 23 describe ECC structure for the main code area.

5.2.2 Number of tracks

5.2.2.1 Recording mode

5.2.2.1.1 NTSC

In case the function of D-VHS is added to the NTSC model of VHS, the number of tracks is as follows.

STD mode and LS mode: 60/*k* or 59,94/*k* tracks/s

HS mode: 120 or 119,88 tracks/s

5.2.2.1.2 PAL/SECAM

In case the function of D-VHS is added to the PAL/SECAM model of VHS, the number of tracks is as follows.

STD mode and LS mode: 60/*k* or 59,94/*k* tracks/s

HS mode: 120 or 119,88 tracks/s

5.2.2.2 Playback mode

In D-VHS playback mode, the number of tracks shall support both values (STD mode and LS mode: 60/*k* and 59,94/*k* tracks/s, HS mode: 120 and 119,88 tracks/s).

5.2.3 Recording data structure

5.2.3.1 Subcode data structure

5.2.3.1.1 General

In case of MPEG2 mode, subcode data area has 3 pack data as shown in Figure 17. One pack data is composed of 6 bytes. The first byte of each pack data is provided for pack header. Specification of the pack data is shown in 6.1.

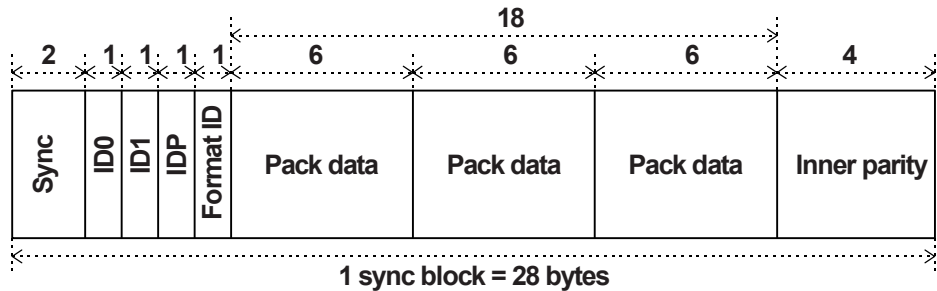


Figure 17 – Subcode sync block (MPEG2 mode)

5.2.3.1.2 ID

- 1) Absolute track number

The lower 2 bits of Absolute track number shall be increased as follows.

00 → 10 → 00 → 10 ...

5.2.3.2 Main data structure

5.2.3.2.1 General

In the case of MPEG2 mode, the first 2 bytes of the main data area in each sync block are provided for the main header and the next 1 byte of main data area is provided for data-AUX.

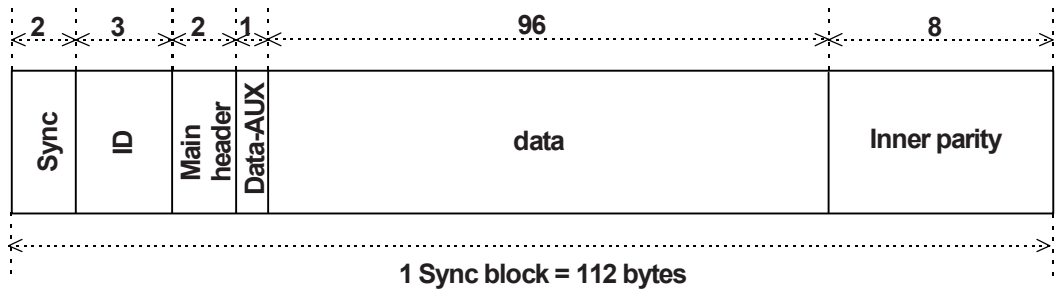


Figure 18 – Main data sync block (MPEG2 mode)

5.2.3.2.2 ID

- 1) Sequence number

The sequence number is counted up when track pair number returns to zero and sequence number repeats from 0000 to 1111.

2) Track pair number

The track pair number is counted up every track pair and repeats from 000 to 010 in MPEG2 recording mode. The first track of a track pair having the same track pair number is channel 1 and the second track is channel 2.

The track pair number also represents 6 track (3 track pair) interleave sequence.

5.2.3.2.3 Main header

The main header consists of the format information area and the sync block information area.

According to the sync block number, the format information area and the sync block information area are defined as shown in Table 26.

Table 26 – Configuration of main header

SB#	1st byte								2nd byte							
	MSB				LSB				MSB				LSB			
	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
	Format info.				Sync block info.											
$26n$	Format ID				DT		SBC		Data detail							
$26n + 1$					DT		SBC		Data detail							
$2(6n + 1)$					DT		SBC		Data detail							
$2(6n + 1) + 1$					DT		SBC		Data detail							
$2(6n + 2)$					DT		SBC		Data detail							
$2(6n + 2) + 1$					DT		SBC		Data detail							
$2(6n + 3)$					DT		SBC		Data detail							
$2(6n + 3) + 1$					DT		SBC		Data detail							
$2(6n + 4)$	Application detail				DT		SBC		Data detail							
$2(6n + 4) + 1$	App. detail extension				DT		SBC		Data detail							
$2(6n + 5)$	CGMS		Reserved		DT		SBC		Data detail							
$2(6n + 5) + 1$	Reserved				DT		SBC		Data detail							

Reserved bits shall be set to "0".

Format ID is defined as shown in Table 27.

Table 27 – Format ID

SB#	$m = 0$				$m = 1$			
	bit 7	bit 6	bit 5	bit 4	bit 7	bit 6	bit 5	bit 4
$26n + m$	ECC block size	ECC block number per track		Program mode			Scanner rotation speed	
$2(6n + 1) + m$	1,001 flag	Outer interleave			Recording mode			
$2(6n + 2) + m$	Reserved							
$2(6n + 3) + m$	Application ID					Reserved		
Reserved bits shall be set to “0”.								

Application ID is defined as shown in Table 28.

Table 28 – Application ID

0xxxx	Consumer use
1xxxx	Professional or special use

The D-VHS recorders that are designed to record or playback the signal having the Application ID value of 1xxxx shall not playback the recorded signal having the Application ID value of 0xxxx.

- | | |
|-------------------------------|---|
| 1) ECC block size | See 5.2.1, 1) ECC block size. |
| 2) ECC block number per track | See 5.2.1, 2) ECC block number per track. |
| 3) Program mode | See 5.2.1, 3) Program mode. |
| 4) Scanner rotation speed | See 5.2.1, 4) Scanner rotation speed. |
| 5) 1,001 flag | See 5.2.1, 5) 1,001 flag. |
| 6) Outer interleave | See 5.2.1, 6) Outer interleave. |
| 7) Recording mode | See 5.2.1, 7) Recording mode. |
| 8) Application ID | See 5.2.1, 8) Application ID. |
| 9) Application detail | See Table 29. |

Table 29 – Application detail

0000	MPEG2 transport stream
0001	CTP stream
1xxx	Encrypted MPEG2 transport stream

Other codes are reserved.

The D-VHS recorders that are not designed to process the recorded data having the application detail value of 1xxx shall not output the playback signal of such data.

When the application detail value is 1xxx, the three bits (xxx) represent the lower three bits of the region code. (Region code A)

10) Application detail extension

When the application detail value is 0000, the four bit application detail extension represents the Time compression ratio defined in Table 30.

The detail specification for the time compression function is to be determined.

Table 30 – Time compression ratio

Application detail Extension	Time compression ratio	lt^1	Application detail Extension	Time compression ratio	lt^1
0000	1: 1	1	0101	1: 5	5
0010	1: 2	2	0110	1: 6	6
0011	1: 3	3	0111	1: 7	7
0100	1: 4	4	Other codes are reserved		
1 " lt " is the coefficient of Time compression ratio.					

When the application detail value is 1xxx, the application detail extension represents the upper four bits of the region code (region code B).

The region code structure is defined as shown in Table 31.

Region Management Flag (RMF) N is the flag to indicate the permission of playback on players assigned to region number N.

The region management flag is defined as shown in Table 31.

- 0: may be played back in the corresponding region.
- 1: shall not be played back in the corresponding region.

Table 31 – Region management flag

Application detail				Application detail extension			
bit 7	bit 6	bit 5	bit 4	bit 7	bit 6	bit 5	bit 4
1	Region code A			Region code B			
	RMF 8	RMF 6	RMF 5	RMF 4	RMF 3	RMF 2	RMF 1

11) CGMS

See Table 32.

Table 32 – CGMS

00	Copy permitted
01	Reserved
10	One generation of copy permitted
11	Copy restricted

Two bits of CGMS shall be recorded as which is the inverse of the two bits.

CGMS information shall be the same within a track. In case of multi-program recording, the priority of CGMS information shall be 11,10,00. When input CGMS information is different among programs, the CGMS information of the highest priority shall be recorded.

12) Data Type (DT)

Data type indicates the contents of sync block data.

See Table 33.

Table 33 – Data type

Data type	Contents
00	Normal play data
01	Dummy data
10	Trick play data (for Track Select system)
11	Reserved

13) Sync Block Count (SBC)

Sync block count indicates the identification data to distinguish the contents of the main data (except main header and Data-AUX).