RECOMMENDATION ITU-R BR.1375-1*

High-definition television (HDTV) recording

(Question ITU-R 108/11)

(1998-2001)

The ITU Radiocommunication Assembly,

considering

a) that the common image format, having 1 080 × 1 920 square pixels, is now recommended as the image capture format for HDTV;

b) that the digital broadcasting service for HDTV programmes is gaining in momentum. There are several services in operation or under plan in many countries;

c) that various analogue and digital format video tape recorders (VTRs) for HDTV tape recording have been developed;

d) that many countries hold large archives of valuable, irreplaceable HDTV programmes, based on the signal formats defined in Recommendation ITU-R BT.709, Part 1;

e) that analogue HDTV open-reel recording formats are considered to be obsolete for use in programme production today, but the programmes recorded on those formats in the past are often valuable;

f) that digital recording of HDTV programmes is now widely used in HDTV production and post-production;

g) that there are several types of equipment available for digital HDTV recording today, that differ in the recording medium, in the recording format, or in the recorder model, e.g.: recorders that use or do not use bit-rate compression, recorders that use open-reel tape or cassettes, deck or portable/camcorder, etc.;

h) that bit-rate compression technique based on DCT and VLC coding can provide highly efficient methods of recording HDTV programmes, whose source data rate exceeds 1 Gbit/s;

j) that the operational and handling characteristics of digital HDTV VTRs have improved to the point that the VTRs can be used not only in the studios but also in the field, with a level of convenience similar to that of conventional VTRs;

k) that HDTV cameras using two-million pixel CCD imaging devices and digital signal processing with advanced VLSI chip(s) can provide high quality HDTV pictures while offering the operating features and small size of conventional cameras;

l) that the use of 24 frame formats will be used to supplement and augment film production,

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* This Recommendation should be brought to the attention of the International Electrotechnical Commission (IEC).

recommends

1 that digital HDTV recording should be preferred for HDTV programme origination and production, and for storage for programme exchange;

2 that analogue HDTV tape recordings should preferably be transferred to a digital recording format for postprocessing and archives;

3 that the 1080 x 1920 common image format specified in Recommendation ITU-R BT.709, Part 2 shall be preferred for HDTV recording, while the other image formats specified in Recommendation ITU-R BT.709, Part 1 will retain their value especially in view of the need to ensure the possibility to reuse archived HDTV programme assets;

4 that HDTV programmes intended for extensive and complex postprocessing should preferably be recorded on a digital format that does not use lossy compression, while HDTV programmes intended for limited or no postprocessing should preferably be recorded on a digital format, which may use a modest amount of compression.

NOTE 1 – The Tables in Annex 1 indicate specifications of commercially available recording devices for programme production in the HDTV formats specified in the latest version of Recommendation ITU-R BT.709.

ANNEX 1

Tables 1 to 6 describe the major features and specifications for the available HDTV storage devices:

Table 1: Tape recorder for 1125/60 (59.94) – *Overview*

Table 2: Disk recorder for 1125/60 (59.94) – *Overview*

Table 3: HDTV digital VTR for 1125/60 (59.94) – *Details*

Table 4: Tape recorder for 1125/50, 1250/50 – *Overview*

Table 5: HDTV digital VTR for 1125/50, 1250/50 – *Details*

Table 6: HDTV analogue VTR for 1125/60 – *Details*

TABLE 1

Tape recorder for 1125/60 (59.94) – *Overview*

Digital/analogue		Digital						Analogue
Compression/non-compression		Compression				Non-compression		
Package type		Cassette				Cassette	Open reel	Cassette
Format		A	B	C	D	D6	1'-C(mod)	UNIHI
Commercial name[1]		HDCAM[2]	HD-D5	DVCPRO HD	D-9 HD	GBR, DCR	HDD/HDDP	HDV, AU-HD
Recording/playback time (maximum)		40/124 min	23/63/124 min	46 min	62 min	64 min	96 min	63 min
Video specification	Luminance	23 MHz	1920 s/line	20 MHz		1920 s/line		20 MHz
	Chrominance	7 MHz	960 s/line	10 MHz		960 s/line		7 MHz
	Number of lines	1080 (1035)	1080					1036
Audio specification	Digital or analogue	PCM				PCM		PCM
	Number of channels	4		8	4/8	5 stereo pairs	8 (Digital) + 1 (Analogue)	4
	Sampling frequency	48 kHz, 20 bits		48 kHz, 16 bits	48 kHz, 20/16 bits	48 kHz, 20/24 bits	48 kHz, 16 bits	48 kHz, 16 bits
Ancillary data							5 VBI lines	
Media	Size of cassette (mm)	S: 156 × 96 L: 254 × 145	S: 161 × 98 M: 212 × 124 L: 296 × 167	125 × 78	188 × 104	366 × 206	14 inch reel	205 × 121.5
	Substance	Metal particle				Metal particle		Metal particle
Application example		Camcorder	Portable	Camcorder		Studio deck		Portable studio deck
Notes		1/2 inch Intra field/frame Field editable DCT (1/7)	1/2 inch (D5) Intra field DCT (1/4)	6.35 mm Intra frame DCT (1/10)	1/2 inch Intra frame DCT (1/10)	3/4 inch tape		1/2 inch tape

PCM: pulse code modulation

VBI: vertical blanking interval

S: small, M: medium, L: large

(1) Each format as commercially known is listed here.

(2) HDCAM is a handy camera-recorder type VTR. Studio decks also exist.

TABLE 2

Disk recorder for 1125/60 (59.94) – *Overview*

Digital/analogue		Digital				Analogue		
Compression/non-compression		Compression		Non-compression		Removable		
Handling		Removable	(Non-removable)	(Removable)	Non-removable			
Recording and/or playback		Recording and playback			Recording and playback	Playback only	Write-once	Recording and playback
Format		MO			HDD (RAID)	Optical	Wobbling	MO
Commercial name(1)						HDL-2000	HDL-5800	
Recording/playback time		32 min				15 min (CLV)	20 min (CLV)	
Video specification	Luminance	44.55 MHz, 8 bits				20 MHz		
	Chrominance	14.85 MHz, 8 bits				6 MHz		
	Number of lines	1088						
Audio specification	Digital or Analogue	PCM				PCM		
	Number of channels	4				2		
	Sampling frequency	48 kHz, 20 bits				48 kHz, 16 bits		
Ancillary data		256 Kbytes/frame						
Media	Size of cassette (mm)	300				300		
	Substance	Magnetic coat				Aluminium coated	Alloy coat	
Notes		Intra frame 94 Mbit/s drive, double sided				Single sided		

CLV: constant linear velocity

MO: magneto optical

HDD (RAID): hard disk drive (redundant array of inexpensive disks)

(1) Each format as commercially known is listed here.

TABLE 3

HDTV digital VTR for 1125/60 (59.94) – *Details*

Format		1 inch	D-6	A	B	C	D
Commercial name[1]		HDD/HDDP	GBR, DCR	HDCAM	HD-D5	DVCPRO HD	D-9 HD
Sampling frequency	Video (MHz)	74.25					
	Audio (kHz)	48					
Quantization	Video (bits)	8			10/8	8	
	Audio (bits)	20	20/24	20		16	20/16
Number of audio channels		8 (Digital) + 1 (Analogue)	10	4		8	4 (20 bits) 8 (16 bits)
Compression (video)		–	–	Intra field/frame DCT (1/7)[2]	Intra field DCT (1/4)	Intra frame DCT (1/10)[3]	
Channel coding		8-8 map	8-12 map	S-NRZI	8-14 map	24-25 I-NRZI	
Total rate (Mbit/s)		1.188	1.212	185	301	167	198
Video rate (Mbit/s)		958.5		140	235	100	
Number of recording RF channels		8		4 (camcorder) /2 (studio)	4	4 (camcorder) /2 (studio)	4
ECC	Inner	110, 104	227, 211	231, 219	95, 87	85, 77	
	Outer	64, 60	254, 240	250, 226	128, 120	149, 138	
Drum diameter (mm)		134.6	96.5	81.4	76.0	21.7	62
Drum rotation (rps)		120	150	45 (camcorder) /90 (studio)	90	149.85 (camcorder) /299.70 (studio)	75
Number of tracks (/field)		16	40	6	12	40/frame	20/frame
Tape speed (mm/s)		805.2	497	96.8	167.228	135.28	115.474
Track pitch (μm)		37	22	21.7	20.0	18	20.0
Minimum wavelength (μm)		0.69	0.81	0.49	0.63	0.49	0.587
Width of tape (mm)		25.4	19.01	12.65		6.35	12.65
Media substance		Metal particle					
Tape Hc (kA/m)		115	127	135	143	184	
Cassette size (mm)		11.75/14 inch reel	S: 172 × 109 M: 254 × 150 L: 366 × 206	S: 156 × 96 L: 254 × 145	S: 161 × 98 M: 212 × 124 L: 296 × 167	125 × 78	188 × 104
Recording time (min)		63/94	8/28/64	40/124	32/63/124	46	62

ECC: error correction code

(1) Each format as commercially known is listed here.

(2) 5/8 Horizontal prefiltering and 1/4.4 DCT.

(3) 2/3 Horizontal prefiltering and 1/6.6 DCT.

TABLE 4

Tape recorder for 1125/50, 1250/50 – *Overview*

Digital/analogue		Digital			
Compression/non-compression		Compression			Non-compression
Package type		Cassette			
Format		A	B	C	D6
1125 or 1250		1125/50			
Commercial name[1]		HDCAM	HD-D5	DVCPRO HD	
Recording/playback time (maximum)		124 min	27/75/148 min	46 min	64 min
Video specification	Luminance (MHz)	23	30	23	
	Chrominance (MHz)	7	15	11	
	Number of lines	1080			
Audio specification	Digital or analogue	PCM			
	Number of channels	4	8		5 stereo pairs
	Audio sampling	48 kHz, 24 bits		48 kHz, 16 bits	
Ancillary data					
Media	Size of cassette (mm)	S: 156 × 96 L: 254 × 145	S: 161 × 98 M: 212 × 124 L: 296 × 167	125 × 78	S: 172 × 109 M: 254 × 150 L: 366 × 206
	Substance	Metal particle			
Application example		Camcorder	Portable	Camcorder	Studio deck
Notes		1/2 inch Intra field/frame Field editable DCT (1/7)	1/2 inch Intra field DCT (1/4)	6.35 mm Intra frame DCT (1/6.6)	3/4 inch tape

(1) Each format as commercially known is listed here.

TABLE 5

HDTV digital VTR for 1125/50, 1250/50 – *Details*

Format			D-6	A	B	C
		1125/1250	1250/50	1125/50		
Commercial name(1)				HDCAM	HD-D5	DVCPRO HD
Sampling frequency	Video (MHz)		74.25			
	Audio (kHz)		48			
Quantization	Video (bits)		8		8/10 map	8
	Audio (bits)		20/24	20	24	16
Number of audio channels			10	4	8	
Compression (video)			Non-compression	Intra field/frame DCT (1/7)	Intra field DCT (1/4)	Intra frame DCT (1/10)
Channel coding			8-12 map	S-NRZI	8-14 map	24/25 I-NRZI
Total rate (Mbit/s)			1.212	154	269	167
Video rate (Mbit/s)			958.5	117	196	100
Number of recording RF channels			8	4/2	4	4 (camcorder) /2 (studio)
ECC	Outer		227, 211	231, 219	95, 87	85, 87
	Inner		254, 240	250, 226	128, 120	149, 138
Drum diameter (mm)			96.5	81.4	76.0	21.7
Drum rotation (rps)			150	37.5/75	75	150 (camcorder) /300 (studio)
Number of tracks (/field)			48	6	12	48/frame
Tape speed (mm/s)			497	80.7	139.496	135.415
Track pitch (μm)			22	21.7	20	18
Minimum wavelength (μm)			0.81	0.49	0.59	0.49
Width of tape (mm)			19.01	12.65		6.35
Media substance			Metal particle			
Tape Hc (kA/m)			127	132	144	184
Cassette size (mm)			S: 172 × 109 M: 254 × 150 L: 366 × 206	S: 156 × 96 L: 254 × 145	S:161 × 98 M: 212 × 124 L: 296 × 167	125 × 78
Recording time (min)			8/28/64	48/149	27/75/148	46

(1) Each format as commercially known is listed here.

TABLE 6

HDTV analogue VTR for 1125/60 – *Details*

Format		1125/60	
Commercial name(1)		1 inch	UNIHI
Video	Luminance (MHz)	20	
	Chrominance (MHz)	10	7
Audio sampling (kHz)		–	48
Number of audio channels		2 analogue channels	4
Number of recording RF channels		4	2
Drum diameter (mm)		134.6	76
Drum rotation (rsp)		60	90
Number of tracks (/field)		4	6
Tape speed (mm/s)		483	119.709
Track pitch (μm)		89	24.8
Width of tape (mm)		25.4	12.650
Media substance			Metal particle
Tape Hc (kA/m)			
Cassette size (mm)		–	205 × 121.5
Recording time (min)		63	

(1) Each format as commercially known is listed here.