

RECOMMENDATION ITU-R BR.1442

**USER'S REQUIREMENTS FOR DIGITAL HDTV
TAPE CASSETTE RECORDERS**

(Question ITU-R 108/11)

(2000)

The ITU Radiocommunication Assembly,

considering

- a) that HDTV is defined as one of the picture formats in DTV standards;
- b) that compression technology is widely used and provides adequate picture quality in SDTV and HDTV applications not only for secondary distribution to the home but also for broadcasting studio equipment;
- c) that devices for HDTV signal compression have been developed by several integrated circuit manufacturers and are available economically in the market;
- d) that compression technology makes it possible to produce digital HDTV tape cassette recorders not only for studio production applications but also for field acquisition applications;
- e) that there are several different frame frequencies used in HDTV applications in the various regions in the world,

recommends

- 1** that a unified tape format for HDTV recording should be recommended to facilitate international exchange of programmes;
- 2** that the digital HDTV tape cassette recorder should be designed to be switchable to various frame frequencies depending on the requirements of services in each region of the world;
- 3** that the compression scheme for HDTV recording in the studio should be based on the ability:
 - to interoperate with other applications in the production and transmission chain while minimizing loss in quality (this may imply that similar coding technologies should be applied across the production/transmission path);
 - to provide production editability performance with minimal loss in quality (this may imply intra-frame or inter-frame coding over a small number of frames).

NOTE 1 – Further information is provided in Annex 1 that provides a text of the Association of Radio Industries and Business (ARIB) (Japan) and applies to 60 Hz field rate.

**User's requirements for the digital HDTV tape cassette recorder by
the high-definition digital video cassette recorder (HD-DVCR)
Working Group, ARIB (Japan)**

Preface

Several types of HD-DVCR are currently available in different formats for high-definition production and broadcast applications. The 3/4 inch-type HD-DVCR records baseband (non-compressed) HD signals and the 1/2 inch-type one records compressed HD signals.

Recently, to fulfil the increasing market demands in field acquisition in the high-definition quality, a new 1/2 inch format of the HD-DVCR has been introduced in camcorder form and also stand-alone recorder form.

In the process of discussing user's requirements for the HD-DVCR in ARIB of Japan, a unified tape format for the HD-DVCR has been strongly requested by the majority of members.

Considering the current multiple tape formats and the availability of several products, this Annex summarizes user's requirements in terms of specifications, required functions, and tape interchange. The user requirements shown here in this Annex can be applied to the HD-DVCR in broadcast and production applications. To specify user requirements for the HD-DVCR, ARIB Standards BTA S-001B, S-004B, S-005B and S-006B are normative.

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1 The application areas of the user's requirements

The user requirements defined in this Recommendation are applicable to the HD-DVCR for use in broadcast and production applications. The digital representation of the HDTV signal and the interface specifications are defined in the normative ARIB Standards BTA S-001B, S-004B, S-005B and S-006B.

2 Requirements for picture quality

Acceptable picture quality of the HD-DVCR is one of the main user requirements.

The compression scheme commonly used in the DVCR is designed to remove redundancy in the digitized pictures in temporal and/or spatial domains. The redundancy originated in high correlation both between successive pictures and as spatial correlation within pictures. The loss of quality by dubbing occurs mainly by picture shifts at each stage of the dubbing.

2.1 The picture quality requirements for the compression-based DVCR (under regular recording/playback operations)

For studio programme productions through a dubbing process, the picture quality of television programmes shall be evaluated by a predetermined method. The measurement method and the picture sources used for the evaluation are listed as below.

– *A method of the evaluation:*

The double stimulus continuous quality scale (DSCQS) subjective evaluation method specified in Recommendation ITU-R BT.710 shall be used.

– *Pictures used in the evaluation:*

- Pictures generated by simple multiple dubbing, between the HD-DVCRs (about nine times, no clear definitions or indications have been set yet).
- Pictures generated by multiple dubbing with picture shifts between each dubbing, both in the spatial and temporal domains (about four times, no clear definitions or indications have been set yet).

For studio applications, the results of the evaluation must indicate that the quality difference between the original picture and the picture under test shall be within the predetermined value.

Pictures for evaluation shall be selected from various picture sources, such as pictures supplied by the Broadcasting Technology Association (BTA) as standard pictures for evaluation.

2.2 The picture quality requirements for the compression-based DVCR (for off-the-track playback operations)

Following is a set of picture quality requirements for off-the-track playback operations.

- Under variable speed playback operations, such as still and slow-motion, no picture quality degradation shall be subjectively observed.
- Under high-speed shuttle playback, picture contents shall be recognizable to facilitate operational compatibility with current video tape recorders (VTRs).
- Even under overload condition of the error correction scheme, degradation of the picture quality has to be kept minimum.

3 Operations under 1125/60.00 and 1125/59.94

The current practice in HDTV studio in Japan requires two different field rates for daily operations depending on the application services. The HD-DVCR is required to be operable under the different frame rates, such as 60.00 and 59.94 Hz. The following are the user's requirements for the HD-DVCR operations in terms of adaptability to different reference sync systems.

3.1 Switchability between 1125/60.00 and 1125/59.94

The HD-DVCR shall function under one of the two system modes. The system mode can be selected by the following ways:

- a) mode selection via a control panel;
- b) mode selection via a remote control panel;
- c) both a) and b).

3.2 System modes of the HD-DVCR under recording and playback

3.2.1 Recording

The following are the recommended ways of setting system modes of the HD-DVCR in recording:

- The system mode shall be set by the mode selection on a DVCR control panel.
- The Mode ID signal (see Note 1) on HD serial digital interface (SDI) shall set the modes of the HD-DVCR.
- For a portable type HD-DVCR, if CAMERA-IN is active, the mode shall be set by the control command defined in BTA S-1005B.

Preservation of the system mode status on the tape is recommended.

NOTE 1 – Mode ID signal is a tentative naming. It is to identify the system mode, that is 1125/60.00 or 1125/59.94. If the Mode ID signal can be recovered off the tape, it shall be maintained and used accordingly.

3.2.2 Playback

The following are ways of selecting system modes of the HD-DVCR in playback. A portable type of the HD-DVCR shall be exempt from this condition:

- a) Automated selection of the system mode depending on the external sync applied (1125/60.00, 1125/59.94 only).
- b) System modes shall be set by the mode selection mechanism on the DVCR control panel.
- c) Automated selection of system mode depending on the information recovered off the tape.

If external sync is not available in § 3.2.2, a), the system mode shall be selected depending on § 3.2.2, b).

The portable HD-DVCR shall facilitate a feature that can use its input signal as external reference.

3.3 Mode indication in recording and playback

The mode indication of 1125/60.00 and 1125/59.94 shall be as follows:

– *Recording:*

System mode should be indicated properly on the control panel of HD-DVCR.

The system mode status shall be output for display on a monitor and at a remote terminal.

– *Playback:*

The system mode should be indicated on the control panel and should also be sent out for display on a monitor and at a remote terminal.

A warning light should indicate when the HD-DVCR is functioning in a system mode which differs from the one on the tape.

3.4 External control interface for system mode selections

A new highly adaptable control interface should be defined to be implemented or integrated into the current system.

4 Input/output (I/O) specifications of the HD-DVCR

For each type of stand-alone and portable/camcorder HD-DVCR, the following I/O capabilities are recommended as part of the user's requirements.

4.1 I/O requirements of stand-alone HD-DVCR

Input	Connector	Connector	Output
REF IN(1125)	BNC	BNC	REF OUT(1125)
REF IN(525)	BNC	BNC	REF OUT(525)
		BNC	WFM OUT
HD-SDI IN	BNC	BNC	HD-SDI OUT
		"	"
		"	"
		"	" (W/CHAR)
Digital AUDIO IN 1/2	BNC	BNC	Digital AUDIO OUT 1/2
Digital AUDIO IN 3/4	BNC	BNC	Digital AUDIO OUT 3/4
Analogue AUDIO IN 1	XLR	XLR	Analogue AUDIO OUT 1
Analogue AUDIO IN 2	"	"	Analogue AUDIO OUT 2
Analogue AUDIO IN 3	"	"	Analogue AUDIO OUT 3
Analogue AUDIO IN 4	"	"	Analogue AUDIO OUT 4
CUE IN	XLR	XLR	CUE OUT
TIME CODE IN	BNC	BNC	TIME CODE OUT
REMOTE IN	D-9P	D-9P	REMOTE OUT
RS 232C	D-25P		
VIDEO CONTROL	D-15P		
PARALLEL CONT	D-50P		
		BNC	525-SDI OUT
		"	"
		"	" (W/CHAR)
		BNC	NTSC OUT
		"	" (W/CHAR)
		XLR	L-CH MONITOR OUT
		"	R-CH "

4.2 I/O requirements of portable-type HD-DVCR

Input	Connector	Connector	Output
LINE IN ⁽¹⁾			LINE OUT
Analogue video ⁽²⁾ (Y)	BNC	BNC	Analogue video ^{(2), (3)} (Y)
(Pb)	"	"	(Pb)
(Pr)	"	"	(Pr)
Analogue audio ⁽⁴⁾ (1CH)	XLR	XLR	Analogue audio ⁽⁴⁾ (1CH)
" (2CH)	"	"	" (2CH)
CAMERA IN	26P ⁽⁵⁾	26P ⁽⁵⁾	CAMERA RETURN
Analogue video (Y, Pb, Pr)			
Analogue audio (1,2 CH)			
Control			
TIME CODE IN	BNC	BNC	TIME CODE OUT
REMOTE IN	D-9P	Stereo Mini Jack	HEAD PHONE ⁽⁶⁾
DC IN	XLR	BNC	NTSC OUT ⁽⁷⁾

(1) Video input signal, analogue or SDI (option), will be used as an external reference signal in playback mode.

(2) An SDI video input shall be available as an option. The selection of analogue input and SDI input should be mutually exclusive.

(3) Warnings and various set-up parameters shall be super-imposed in output for monitoring.

(4) Digital audio of 4 channels shall be available as an option. The selection of analogue input and digital input should be mutually exclusive. A BNC connector can be used instead of a XLR.

(5) The connector specifications are defined in BTA S-1005B. The digital connection with a camera unit needs further study.

(6) Each recorded audio channel can be assigned to either L or R channel output independently.

(7) An NTSC output as an output of down converter shall be available as option.

5 Reference signals

The following are the user's requirements for a system reference regarding various modes of the HD-DVCR:

- a) For confidence playback in recording and E-to-E, video and audio timing need to be adjusted depending on the system reference sync of the HD-DVCR, such as an external reference, an input video or a selected reference in auto mode. If a large size of memory is necessary to output the video in external sync timing, this requirement is not mandatory (EXT*, refer to Tables in § 5.1 and 5.2).

- b) Under any system reference selections, recording of internal signal generator should be done correctly.
- c) E-to-E output of an internal signal generator should be synchronized with the external reference sync. Preferably, the E-to-E output timing should coincide with the output reference sync (INP**, refer to Tables in § 5.1 and 5.3).
- d) In recording, synchronization to the external reference sync is not required.
- e) The following tables show the relationships between the system reference sync and reference sync to be used internally for each output in various system modes, such as recording, playback, and E-to-E, etc.

5.1 With both external reference and input video signal at input of the VCR

REC reference	OUT reference	REC Processing	PLAYBACK Processing	E-to-E Confidence	SG output
INP	INP	INP	INP	INP	INP**
	EXT	INP	EXT	EXT*	EXT
	AUTO	INP	EXT	INP	EXT

5.2 With external reference but without input video signal

REC reference	OUT reference	REC Processing	PLAYBACK Processing	E-to-E Confidence	SG output
INP	INP	INT	INT	INT	INT
	EXT	INT	EXT	EXT*	EXT
	AUTO	INT	EXT	INT	EXT

5.3 Without external reference but with input video signal

REC reference	OUT reference	REC Processing	PLAYBACK Processing	E-to-E Confidence	SG output
INP	INP	INP	INP	INP	INP**
	EXT	INP	INT	INT	INT
	AUTO	INP	INT	INP	INT

5.4 Without either external reference and input video signal

REC reference	OUT reference	REC Processing	PLAYBACK Processing	E-to-E Confidence	SG output
INP	INP	INT	INT	INT	INT
	EXT	INT	INT	INT	INT
	AUTO	INT	INT	INT	INT

Definition of words and abbreviations:

Confidence:	Simultaneous playback during recording mode
E-to-E:	Output through recording and playback circuitry
EXT:	External reference sync
INP:	Input video signal
INT:	Internal sync signal
REC reference:	System reference sync in recording mode
OUT reference:	Reference sync to output the video signal
SG output	Sync generator output.

6 Recording time and battery operations

6.1 Recording time

Greater than 60 min of recording time is recommended for a portable type of the HD-DVCR. For a stand-alone type of the HD-DVCR, cassette capacity of more than 120 min, is recommended.

6.2 Portable HD-DVCR operations with a battery

A battery should supply sufficient power for a full cassette length of recording. It is recommended that specifications for a battery connector be standardized.

6.3 Weight and physical dimensions

Mechanical specifications are preferably comparable to those of conventional TV equipment.

7 HD-DVCR tapes and tape interchange

A stable supply of HD-DVCR tapes is important to secure HDTV production operations. To do so, considerations should be given to the following.

7.1 Tape supply

- VCR manufacturers are requested to open necessary information for tape manufacturing soon after their VCR shipping in the market. At least two independent tape manufactures are considered to be essential for secured tape supply.
- Tape manufacturers are requested to maintain their tape production facility for secured tape supply. Disclosure of relevant information for stable production of tapes is considered to be important. Any changes in tape specifications should be supplied to tape users and VCR manufacturers in appropriate ways.

7.2 Interchange of tapes among different tape manufactures

Tape manufacturers are advised to accept the fact that tapes from a multiple number of manufacturers are commonly used in the production environment. Tape manufacturers are asked to manufacture interchangeable and thus reliable tapes according to the information supplied by DVCR manufacturers. They must clear the conditions of manufacturing variance within their plant.

8 Background

In § 2, the following criterion should be adopted for quality evaluation:

The result of the evaluation must show that the difference of quality between the original and the picture under test shall be within the predetermined value for studio applications. Though the expression is vague in its meaning, it is the intent of the authors, since in Japan evaluation of picture quality for the compression based HD-DVCR has been performed by individual organizations and no official evaluation reports have been yet published.

Until recently, a compression based HD-DVCR has not been available in the market. All of the available DVCRs are based on the baseband recording of HDTV signals which is specified in the ARIB and Society of Motion Picture and Television Engineers (SMPTE) standards, and the compression based DVCR has not been used commonly in studio applications. We still do not have sufficient knowledge about the picture quality of the compression based HD-DVCRs.

Concerning the quality evaluation of the compressed HDTV signals, several ITU-R Recommendations have been published in digital transmission application areas, such as emission, secondary transmission, transmission through contribution, and primary distribution.

The repetition counts of dubbing used in this Recommendation, i.e. nine and four times, are used without a firm basis of practical user experiences. The count indicates the current practices in post-production operations.

Since several DVCR models are now available based on compression technology for both SDTV and HDTV, it is a consensus of the members that some form of evaluation criterion for picture quality will soon be required.
