



Recommendation ITU-R BT.709-6
(06/2015)

**Parameter values for the HDTV standards
for production and international
programme exchange**

BT Series
Broadcasting service
(television)



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RA	Radio astronomy
RS	Remote sensing systems
S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.

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RECOMMENDATION ITU-R BT.709-6

**Parameter values for the HDTV¹ standards for production
and international programme exchange**

(Question ITU-R 27/11)

(1990-1994-1995-1998-2000-2002-2015)

Scope

This Recommendation defines the image format parameters and values for HDTV².

Keywords

HDTV (high definition television), Image format, EOTF (electro optical transfer function), OETF (optical electrical transfer function), PsF (progressive segmented frame)

The ITU Radiocommunication Assembly,

considering

- a) that for many years HDTV programmes have been produced worldwide;
- b) that parameter values for HDTV production standards should have maximum commonality;
- c) that the parameters defined for all these systems meet the quality goals set for HDTV;
- d) that film productions are an important programme source for HDTV broadcasting and, conversely, the use of HDTV production systems has significant benefits for film programme production;
- e) that high-quality conversion between the various HDTV systems, as well as down-conversion to 525/625 television systems, has been successfully implemented;
- f) that programmes produced and archived will have a long shelf life,

recommends

that for HDTV programme production and international exchange, one of the systems described in this Recommendation, should be used.

¹ “A high-definition system is a system designed to allow viewing at about three times the picture height, such that the system is virtually, or nearly, transparent to the quality of portrayal that would have been perceived in the original scene or performance by a discerning viewer with normal visual acuity”. Report ITU-R BT.801.

² Previous versions of this Recommendation that may contain historic information can be found on the ITU website.

HDTV system with square pixel common image format

Introduction

The common image format (CIF) is defined to have common picture parameter values independent of the picture rate. The following picture rates are specified: 60 Hz, 50 Hz, 30 Hz, 25 Hz and 24 Hz. For the 60, 30 and 24 Hz systems, picture rates having those values divided by 1.001 are also specified.

Pictures are defined for progressive (P) capture and interlace (I) capture. Progressive captured pictures can be transported with progressive (P) transport or progressive segmented frame (PsF) transport. Interlace captured pictures can be transported with interlace (I) transport. Refer to Attachment 2 for a description of segmented frame transport.

This results in the following combinations of picture rates and transports:

System	Capture (Hz)	Transport
60/P	60 or 60/1.001 progressive	Progressive
30/P	30 or 30/1.001 progressive	Progressive
30/PsF	30 or 30/1.001 progressive	Segmented frame
60/I	30 or 30/1.001 interlace	Interlace
50/P	50 progressive	Progressive
25/P	25 progressive	Progressive
25/PsF	25 progressive	Segmented frame
50/I	25 interlace	Interlace
24/P	24 or 24/1.001 progressive	Progressive
24/PsF	24 or 24/1.001 progressive	Segmented frame

1 Opto-electronic conversion

Item	Parameter	System Values	
1.1	Opto-electronic transfer characteristics before non-linear pre-correction	Assumed linear	
1.2	Overall opto-electronic transfer characteristics at source ⁽¹⁾	$V = 1.099 L^{0.45} - 0.099$ for $1 \geq L \geq 0.018$ $V = 4.500 L$ for $0.018 > L \geq 0$ where: L : luminance of the image $0 \leq L \leq 1$ V : corresponding electrical <i>signal</i>	
1.3	Chromaticity coordinates (CIE, 1931) Primary – Red (R) – Green (G) – Blue (B)	x	y
		0.640	0.330
		0.300	0.600
		0.150	0.060
1.4	Assumed chromaticity for equal primary signals (Reference white) $E_R = E_G = E_B$	D_{65}	
		x	y
		0.3127	0.3290

- ⁽¹⁾ In typical production practice the encoding function of image sources is adjusted so that the final picture has the desired look, as viewed on a reference monitor having the reference decoding function of Recommendation ITU-R BT.1886, in the reference viewing environment defined in Recommendation ITU-R BT.2035.

2 Picture characteristics

Item	Parameter	System Values
2.1	Aspect ratio	16:9
2.2	Samples per active line	1 920
2.3	Sampling lattice	Orthogonal
2.4	Active lines per picture	1 080
2.5	Pixel aspect ratio	1:1 (square pixels)

3 Signal format

Item	Parameter	System Values
3.1	Conceptual non-linear pre-correction of primary signals	$\gamma = 0.45$ (see item 1.2)
3.2	Derivation of luminance signal E'_Y	$E'_Y = 0.2126 E'_R + 0.7152 E'_G + 0.0722 E'_B$
3.3	Derivation of colour-difference signal (analogue coding)	$E'_{CB} = \frac{E'_B - E'_Y}{1.8556}$ $= \frac{-0.2126 E'_R - 0.7152 E'_G + 0.9278 E'_B}{1.8556}$ $E'_{CR} = \frac{E'_R - E'_Y}{1.5748}$ $= \frac{0.7874 E'_R - 0.7152 E'_G - 0.0722 E'_B}{1.5748}$
3.4	Quantization of <i>RGB</i> , luminance and colour-difference signals ^{(1), (2)}	$D'_R = \text{INT}[(219 E'_R + 16) \cdot 2^{n-8}]$ $D'_G = \text{INT}[(219 E'_G + 16) \cdot 2^{n-8}]$ $D'_B = \text{INT}[(219 E'_B + 16) \cdot 2^{n-8}]$ $D'_Y = \text{INT}[(219 E'_Y + 16) \cdot 2^{n-8}]$ $D'_{CB} = \text{INT}[(224 E'_{CB} + 128) \cdot 2^{n-8}]$ $D'_{CR} = \text{INT}[(224 E'_{CR} + 128) \cdot 2^{n-8}]$
3.5	Derivation of luminance and colour-difference signals via quantized <i>RGB</i> signals	$D'_Y = \text{INT}[0.2126 D'_R + 0.7152 D'_G + 0.0722 D'_B]$ $D'_{CB} = \text{INT}\left[\left(-\frac{0.2126}{1.8556} D'_R - \frac{0.7152}{1.8556} D'_G + \frac{0.9278}{1.8556} D'_B\right) \cdot \frac{224}{219} + 2^{n-1}\right]$ $D'_{CR} = \text{INT}\left[\left(\frac{0.7874}{1.5748} D'_R - \frac{0.7152}{1.5748} D'_G - \frac{0.0722}{1.5748} D'_B\right) \cdot \frac{224}{219} + 2^{n-1}\right]$

⁽¹⁾ “*n*” denotes the number of the bit length of the quantized signal.

⁽²⁾ The operator INT returns the value of 0 for fractional parts in the range of 0 to 0.4999... and +1 for fractional parts in the range of 0.5 to 0.9999..., i.e. it rounds up fractions above 0.5.