



ARIB STD-B56
Version 1.1-E1

ENGLISH TRANSLATION

UHDTV SYSTEM PARAMETERS
for PROGRAMME PRODUCTION

ARIB STANDARD

ARIB STD-B56 Version 1.1

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Association of Radio Industries and Businesses

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Foreword

The Association of Radio Industries and Businesses (ARIB) investigates and summarizes the basic technical requirements for various radio systems in the form of "ARIB Standards". These standards are developed with the participation of and through discussions amongst radio equipment manufacturers, telecommunication operators, broadcasting equipment manufacturers, broadcasters and users.

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This ARIB Standard is developed for UHDTV System Parameters for Programme Production. In order to ensure fairness and transparency in the defining stage, the standard was set by consensus at the ARIB Standard Assembly with the participation of both domestic and foreign interested parties from radio equipment manufacturers, telecommunication operators, broadcasting equipment manufacturers, broadcasters and users.

ARIB sincerely hopes that this ARIB Standard will be widely used by radio equipment manufacturers, telecommunication operators, broadcasting equipment manufacturers, broadcasters and users.

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Attachment 1
(N/A)

(Selection of Option 1)

Attachment 2

(Selection of Option 2)

Patent Applicant/ Holder	Name of Patent	Registration No./ Application No.	Remarks
Sony Corporation	Submitted comprehensive confirmation of patents for ARIB STD-B56 Ver1.1 Note1		

Note 1 : Valid for ARIB STD-B56 Ver1.1 (received on March 11, 2014)

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Chapter 1: General Terms

1.1 Purpose

This standard specifies the UHDTV System Parameters for Programme Production and aims to implement program production by this system.

1.2 Scope

This standard applies to the video equipment for UHDTV programme production.

1.3 References

1.3.1 Normative References

- 1 Recommendation ITU-R BT. 2020 Parameter values for UHDTV systems for production and international programme exchange (2012)
- 2 SMPTE ST 2036-1:2013 Ultra High Definition Television – Image Parameter Values for Program Production

Chapter 2: System Parameters for UHDTV

2.1 Picture spatial characteristics

Table 1 shows the spatial characteristics of the picture.

2.2 Picture temporal characteristics

Table 2 shows the temporal characteristics of the picture.

2.3 System colorimetry

Table 3 shows the system colorimetry of the picture.

2.4 Signal format

Table 4 shows the signal format of the picture.

2.5 Digital representation

Table 5 shows the digital representation of the picture.

Table1 Picture spatial characteristics

Parameter	Values
Picture aspect ratio	16:9
Pixel count Horizontal × vertical	7 680 × 4 320 or 3 840 × 2 160
Sampling lattice	Orthogonal
Pixel aspect ratio	1:1 (square pixels)
Pixel addressing	Pixel ordering in each row is from left to right, and rows are ordered from top to bottom.

Table 2 Picture temporal characteristics

Parameter	Values
Frame frequency (Hz)	120, 120/1.001, 60, 60/1.001
Scan mode	Progressive

Table3 System colorimetry

Parameter	Values		
Opto-electronic transfer characteristics before non-linear pre-correction	Assumed linear ⁽¹⁾		
Primary colours and reference white ⁽²⁾	Chromaticity coordinates (CIE, 1931)	x	y
	Red primary (R)	0.708	0.292
	Green primary (G)	0.170	0.797
	Blue primary (B)	0.131	0.046
	Reference white (D65)	0.3127	0.3290

⁽¹⁾ Picture information can be linearly indicated by the tristimulus values of RGB in the range of 0-1.

⁽²⁾ The colorimetric values of the picture information can be determined based on the reference RGB primaries and the reference white.

Table4 Signal format

Parameter	Values
Signal format	$R'G'B' \text{ or } Y'C'_BC'_R$
Non-linear transfer function ⁽⁴⁾	$E' = \begin{cases} 4.5E, & 0 \leq E < \beta \\ \alpha E^{0.45} - (\alpha - 1), & \beta \leq E \leq 1 \end{cases}$ where E is voltage normalized by the reference white level and proportional to the implicit light intensity that would be detected with a reference camera colour channel R, G, B; E' is the resulting non-linear signal. α and β are the solutions to the following simultaneous equations: $\begin{cases} 4.5\beta = \alpha\beta^{0.45} - \alpha + 1 & (1) \\ 4.5 = 0.45\alpha\beta^{-0.55} & (2) \end{cases}$ The simultaneous equations provide the required condition to connect the two curve segments smoothly and yield $\alpha = 1.09929682680944...$ and $\beta = 0.018053968510807....$ For practical purpose, the following values can be used: $\alpha = 1.099$ and $\beta = 0.018$ for 10-bit systems $\alpha = 1.0993$ and $\beta = 0.0181$ for 12-bit systems
Derivation of Y'_C and Y'	$Y' = 0.2627 R' + 0.6780 G' + 0.0593 B'$
Derivation of colour difference signals	$C'_B = \frac{B' - Y'}{1.8814}$ $C'_R = \frac{R' - Y'}{1.4746}$

Table5 Digital representation

Parameters		Values		
Coded signal		$R', G', B' \text{ or } Y', C'_B, C'_R$		
Sampling lattice – R', G', B', Y'		Orthogonal, line and picture repetitive co-sited		
Sampling lattice – C'_B, C'_R		Orthogonal, line and picture repetitive co-sited with each other. The first (top-left) sample is co-sited with the first Y' samples.		
		4:4:4 system	4:2:2 system	4:2:0 system
		Each has the same number of horizontal samples as the Y' component.	Horizontally subsampled by a factor of two with respect to the Y' component.	Horizontally and vertically subsampled by a factor of two with respect to the Y' component.
Coding format		10 or 12 bits per component		
Quantization of $R', G', B', Y', C'_B, C'_R$		$DR' = \text{INT}[(219 \times R' + 16) \times 2^{n-8}]$ $DG' = \text{INT}[(219 \times G' + 16) \times 2^{n-8}]$ $DB' = \text{INT}[(219 \times B' + 16) \times 2^{n-8}]$ $DY' = \text{INT}[(219 \times Y' + 16) \times 2^{n-8}]$ $DC'_B = \text{INT}[(224 \times C'_B + 128) \times 2^{n-8}]$ $DC'_R = \text{INT}[(224 \times C'_R + 128) \times 2^{n-8}]$ where n is the number of bits of the video sample. INT [X] is a function that converts the value X to an integer by nearest-neighbour rounding.		
Quantization level assignment – Timing reference – Video data		10-bit coding	12-bit coding	
		0 - 3 and 1 020 - 1 023 4 through 1 019	0 - 15 and 4 080 - 4 095 16 through 4 079	
Quantization levels		10-bit coding	12-bit coding	
DR', DG', DB', DY'	Nominal Peak (100%)	940	3760	
	Black level (0%)	64	256	
DC'_B, DC'_R	Nominal Peak (+50%)	960	3840	
	Achromatic (0%)	512	2048	
	Nominal Peak (–50%)	64	256	

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