ESSENTIAL PARAMETER VALUES FOR THE EXTENDED IMAGE DYNAMIC RANGE TELEVISION (EIDRTV) SYSTEM FOR PROGRAMME PRODUCTION

ARIB STANDARD

ARIB STD-B67 Version 1.0

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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.

ARIB Standards include "government technical regulations" (mandatory standard) that are set for the purpose of encouraging effective use of frequency and preventing interference with other spectrum users, and "private technical standards" (voluntary standards) that are defined in order to ensure compatibility and adequate quality of radio equipment and broadcasting equipment as well as to offer greater convenience to radio equipment manufacturers, telecommunication operators, broadcasting equipment manufacturers, broadcasters and users.

This ARIB Standard is developed for "ESSENTIAL PARAMETER VALUES FOR THE EXTENDED IMAGE DYNAMIC RANGE TELEVISION (EIDRTV) SYSTEM 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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Although this ARIB Standard contains no specific reference to any Essential Industrial Property Rights relating thereto, the holders of such Essential Industrial Property Rights state to the effect that the rights listed in the Attachment 1 and 2, which are the Industrial Property Rights relating to this standard, are held by the parties also listed therein, and that to the users of this standard, in the case of Attachment 1, such holders shall not assert any rights and shall unconditionally grant a license to practice such Industrial Property Rights contained therein, and in the case of Attachment 2, the holders shall grant, under reasonable terms and conditions, a non-exclusive and non-discriminatory license to practice the Industrial Property Rights contained therein. However, this does not apply to anyone who uses this ARIB Standard and also owns and lays claim to any other Essential Industrial Property Rights of which is covered in whole or part in the contents of the provisions of this ARIB Standard.

Attachment 1 (selection of option 1)
（N/A）

Attachment 2 (selection of option 2)
（N/A）

Contents

Chapter 1 : General Descriptions

1.1 Objective[1]

This standard specifies the system parameters essential for the extended image dynamic range television (EIDRTV) including system colorimetry, signal format and digital representation. The signal format is characterized by opto-electronic transfer function (OETF). For the other system parameters, other television system standards may be referred to.

1.2 Scope

This standard applies to the video equipment for programme production of the extended image dynamic range television.

1 In the interest of maintaining consistency with International Standards, when an ITU-R Recommendation on Extended Image Dynamic Range Television (EIDRTV) is approved, this standard should be reviewed.

Chapter 2 : System parameters for EIDRTV

2.1 System colorimetry

The system colorimetry specified in Table 1 should be used for EIDRTV.

2.2 Signal format

The signal format specified in Table 2 should be used for EIDRTV.

2.3 Digital representation

The digital representation specified in Table 3 should be used for EIDRTV.

TABLE 1　System colorimetry

Parameter	**Values**		
Opto-electronic transfer characteristics before non-linear pre-correction	Assumed linear		
Primary colors and reference white[1]	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] The colorimetric values of the picture information can be determined based on the reference RGB primaries and the reference white.

TABLE 2　Signal format

Parameter	Values
Signal format	R', G', B' or Y', C'_B, C'_R
Video level corresponding to reference white level, r	0.5
Reference non-linear transfer function (opto-electronic transfer function, OETF)	$$E' = \begin{cases} r\sqrt{E} & 0 \le E \le 1 \\ a \cdot \ln(E - b) + c & 1 < E \end{cases}$$ 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 color channel R, G, B; E' is the resulting non-linear signal. $$a = 0.17883277\ , b = 0.28466892\ , c = 0.55991073$$
Derivation of Y'	$$Y' = 0.2627\ R' + 0.6780\ G' + 0.0593\ B'$$
Derivation of color difference signals	$$C'_B = \frac{B' - Y'}{1.8814}$$ $$C'_R = \frac{R' - Y'}{1.4746}$$

TABLE 3 Digital representation

<table>
<tr><th>Parameter</th><th colspan="4">Values</th></tr>
<tr><td>Coded signal</td><td colspan="4">R', G', B' or Y', C'_B, C'_R</td></tr>
<tr><td>Sampling lattice
– R', G', B', Y'</td><td colspan="4">Orthogonal, line and picture repetitive co-sited</td></tr>
<tr><td rowspan="3">Sampling lattice
– C'_B, C'_R</td><td colspan="4">Orthogonal, line and picture repetitive co-sited with each other.
The first (top-left) sample is co-sited with the first Y’ samples.</td></tr>
<tr><td>4:4:4 system</td><td colspan="2">4:2:2 system</td><td>4:2:0 system</td></tr>
<tr><td>Each has the same number of horizontal samples as the Y' component.</td><td colspan="2">Horizontally subsampled by a factor of two with respect to the Y' component.</td><td>Horizontally and vertically subsampled by a factor of two with respect to the Y' component.</td></tr>
<tr><td>Coding format</td><td colspan="4">10 or 12 bits per component</td></tr>
<tr><td>Quantization of R', G', B', Y', C'_B, C'_R</td><td colspan="4">$$DR' = \mathrm{INT}\left[(219\times R' + 16)\times 2^{n-8}\right]$$
$$DG' = \mathrm{INT}\left[(219\times G' + 16)\times 2^{n-8}\right]$$
$$DB' = \mathrm{INT}\left[(219\times B' + 16)\times 2^{n-8}\right]$$
$$DY' = \mathrm{INT}\left[(219\times Y' + 16)\times 2^{n-8}\right]$$
$$DC'_B = \mathrm{INT}\left[(224\times C'_B + 128)\times 2^{n-8}\right]$$
$$DC'_R = \mathrm{INT}\left[(224\times C'_R + 128)\times 2^{n-8}\right]$$
The n represents the bit depth of coding format. INT [X] is the function that returns the integer closest to X.</td></tr>
<tr><td colspan="2">Quantization levels</td><td colspan="2">10-bit coding</td><td>12-bit coding</td></tr>
<tr><td colspan="2">Timing Reference</td><td colspan="2">0 - 3 and 1 020 - 1 023</td><td>0 - 15 and 4 080 - 4 095</td></tr>
<tr><td colspan="2">Video data</td><td colspan="2">4 - 1 019</td><td>16 - 4 079</td></tr>
<tr><td rowspan="3">DR', DG', DB', DY'</td><td>Nominal Peak (100%)</td><td colspan="2">940</td><td>3 760</td></tr>
<tr><td>Reference White (r)</td><td colspan="2">502</td><td>2 008</td></tr>
<tr><td>Black (0%)</td><td colspan="2">64</td><td>256</td></tr>
<tr><td rowspan="3">DC'_B, DC'_R</td><td>Nominal Peak (+50%)</td><td colspan="2">960</td><td>3 840</td></tr>
<tr><td>Achromatic (0%)</td><td colspan="2">512</td><td>2 048</td></tr>
<tr><td>Nominal Peak (-50%)</td><td colspan="2">64</td><td>256</td></tr>
</table>

To: Secretariat of Standard Assembly Meeting of the Association of Radio Industries and Businesses
FAX: +81-3-3592-1103 E-mail:std@arib.or.jp
Nittochi Bldg. 11th Floor, 1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013, Japan

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11F, Nittochi Building,
1-4-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-0013, Japan
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FAX 03-3592-1103

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