Colour Bar Test Pattern for Hybrid Log-Gamma (HLG) High Dynamic Range Television (HDR-TV) System

ARIB STANDARD

ARIB STD-B72 Version 1.2

Version 1.0 January 22, 2018
Version 1.2 April 23, 2021

Association of Radio Industries and Businesses

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 to the purpose of encouraging effective use of frequency and preventing interference with other spectrum users, and "private technical standards" (voluntary standards) that are defined 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 was developed for Colour Bar Test Pattern for the Hybrid Log-Gamma (HLG) High Dynamic Range Television (HDR-TV) System. In order to ensure fairness and transparency in the defining stage, the standard was set by consensus at the ARIB Standard Assembly. This was accomplished with the participation of both domestic and foreign interested parties including 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.

NOTE:

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 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 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

This standard establishes a colour bar test pattern for Hybrid Log-Gamma (HLG) high dynamic range television (HDR-TV) video format specified in ARIB standard STD-B67 to facilitate video level control and monitor adjustment.

1.2 Scope

This standard applies to the colour bar test pattern for Hybrid Log-Gamma (HLG) high dynamic range television (HDR-TV) system.

1.3 References

1.3.1 Normative References

(1) ARIB STD-B67 Version 2.0 (2018), “Parameter Values for the Hybrid Log-Gamma (HLG) High Dynamic Range Television (HDR-TV) System for Programme Production”

1.3.2 Informative References

(1) ARIB STANDARD BTA S-001 Version C1.0 (2009), “1125/60 HDTV Production Systems”

(2) ARIB STD-B56 Version 1.1 (2014), “UHDTV System Parameters for Programme Production”

(3) ARIB STD-B66 Version 1.2 (2016), “UHDTV Multi-format Color Bar”

(4) ARIB TR-B43 Version 1.2 (2019), “Operational guidelines for high dynamic range video programme production”

(5) Recommendation ITU-R BT.2100-2 (2018) “Image parameter values for high dynamic range television for use in production and international programme exchange”

(6) Recommendation ITU-R BT.2020-2 (2015), “Parameter values for ultra-high definition television systems for production and international programme exchange”

(7) Recommendation ITU-R BT.709-6 (2015), “Parameter values for the HDTV standards for production and international programme exchange”

(8) Recommendation ITU-R BT.2087-0 (2015), “Colour conversion from Recommendation ITU-R BT.709 to Recommendation ITU-R BT.2020”

(9) Recommendation ITU-R BT.2111-1 (2019), “Specification of colour bar test pattern for high dynamic range television systems”

(10) Report ITU-R BT.2407-0 (2017), “Colour gamut conversion from Recommendation ITU-R BT.2020 to Recommendation ITU-R BT.709”

1.4 Terminology

TABLE 1-1 defines the terms in this standard.

TABLE 1-1 Definitions

8K	A system that uses the 7680 × 4320 pixel video format as specified by ARIB STD-B67.
4K	A system that uses the 3840 × 2160 pixel video format as specified by ARIB STD-B67.
2K	A system that uses the 1920 × 1080 pixel video format as specified by ARIB STD-B67.

Chapter 2 Specifications of test pattern

2.1 Sections of test pattern[1]

The various sections of the test pattern for the HLG system are shown in FIGURE 2-1 while a colour diagram is shown in FIGURE 2-2. See also Attachments 1 and 2.

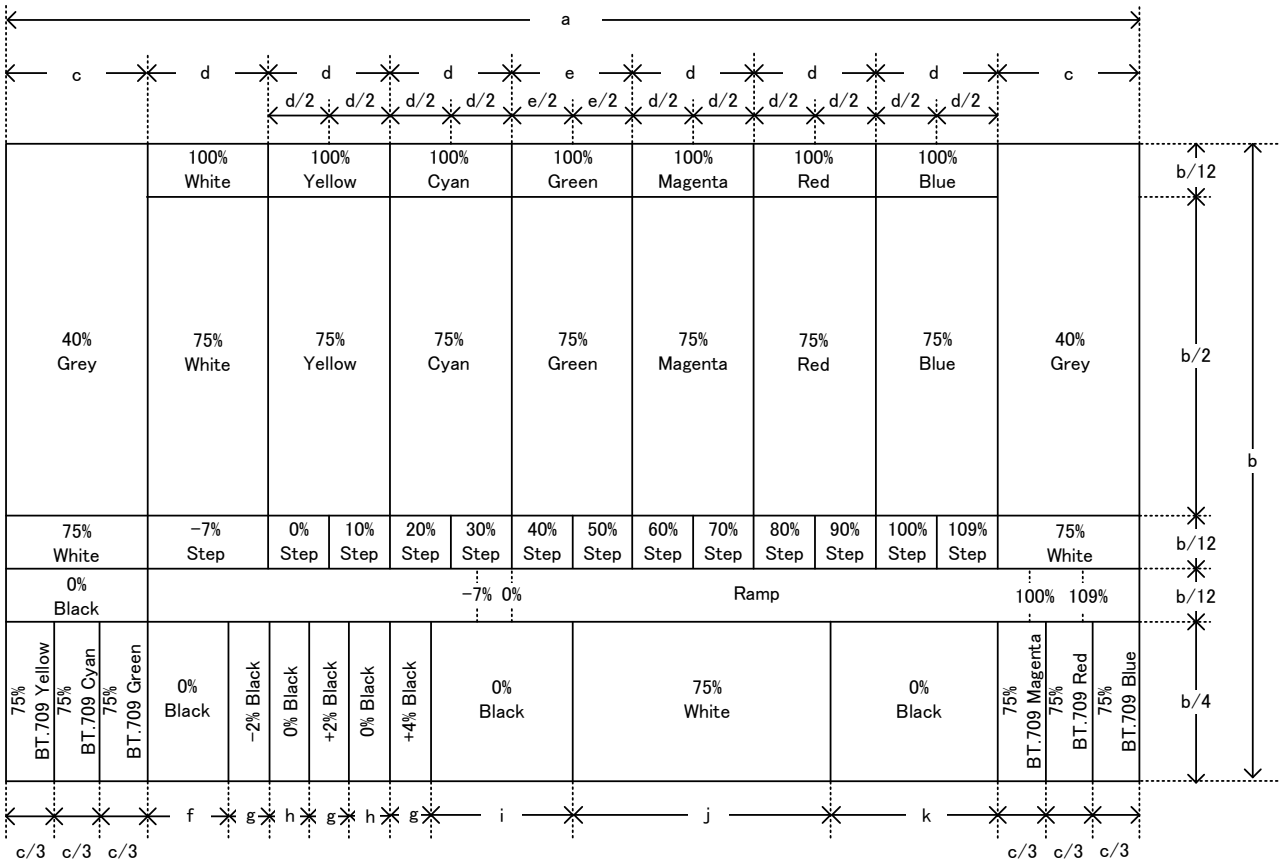

FIGURE 2-1 Test pattern details

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1 It is desirable that implementers should include in this test signal some visual identification of the signal format (e.g. HLG). The test pattern includes grey bars (top right and top left) that may optionally be used for this and/or other purposes (see Attachment 1).

TABLE 2-1 Bar size to 2K, 4K and 8K format

Bar size (pixel)	2K	4K	8K
a	1920	3840	7680
b	1080	2160	4320
c	240	480	960
d	206	412	824
e	204	408	816
f	136	272	544
g	70	140	280
h	68	136	272
i	238	476	952
j	438	876	1752
k	282	564	1128

FIGURE 2-2 Colour diagram of the test pattern

TABLE 2-2 Signal level

	10bit			12bit		
Image Area	**R´**	**G´**	**B´**	**R´**	**G´**	**B´**
100% White	940	940	940	3760	3760	3760
100% Yellow	940	940	64	3760	3760	256
100% Cyan	64	940	940	256	3760	3760
100% Green	64	940	64	256	3760	256
100% Magenta	940	64	940	3760	256	3760
100% Red	940	64	64	3760	256	256
100% Blue	64	64	940	256	256	3760
75% White	721	721	721	2884	2884	2884
75% Yellow	721	721	64	2884	2884	256
75% Cyan	64	721	721	256	2884	2884
75% Green	64	721	64	256	2884	256
75% Magenta	721	64	721	2884	256	2884
75% Red	721	64	64	2884	256	256
75% Blue	64	64	721	256	256	2884
40% Grey	414	414	414	1656	1656	1656
–7% Step	4	4	4	16	16	16
0% Step	64	64	64	256	256	256
10% Step	152	152	152	608	608	608
20% Step	239	239	239	956	956	956
30% Step	327	327	327	1308	1308	1308
40% Step	414	414	414	1656	1656	1656
50% Step	502	502	502	2008	2008	2008
60% Step	590	590	590	2360	2360	2360
70% Step	677	677	677	2708	2708	2708
80% Step	765	765	765	3060	3060	3060
90% Step	852	852	852	3408	3408	3408
100% Step	940	940	940	3760	3760	3760
109% Step	1019	1019	1019	4076	4076	4076
Ramp	See FIGURE 2-3 and TABLE 2-3					
75% BT.709 Yellow	713	719	316	2852	2876	1264
75% BT.709 Cyan	538	709	718	2152	2836	2872
75% BT.709 Green	512	706	296	2048	2824	1184
75% BT.709 Magenta	651	286	705	2604	1144	2820
75% BT.709 Red	639	269	164	2556	1076	656
75% BT.709 Blue	227	147	702	908	588	2808
0% Black	64	64	64	256	256	256
–2% Black	48	48	48	192	192	192
+2% Black	80	80	80	320	320	320
+4% Black	99	99	99	396	396	396

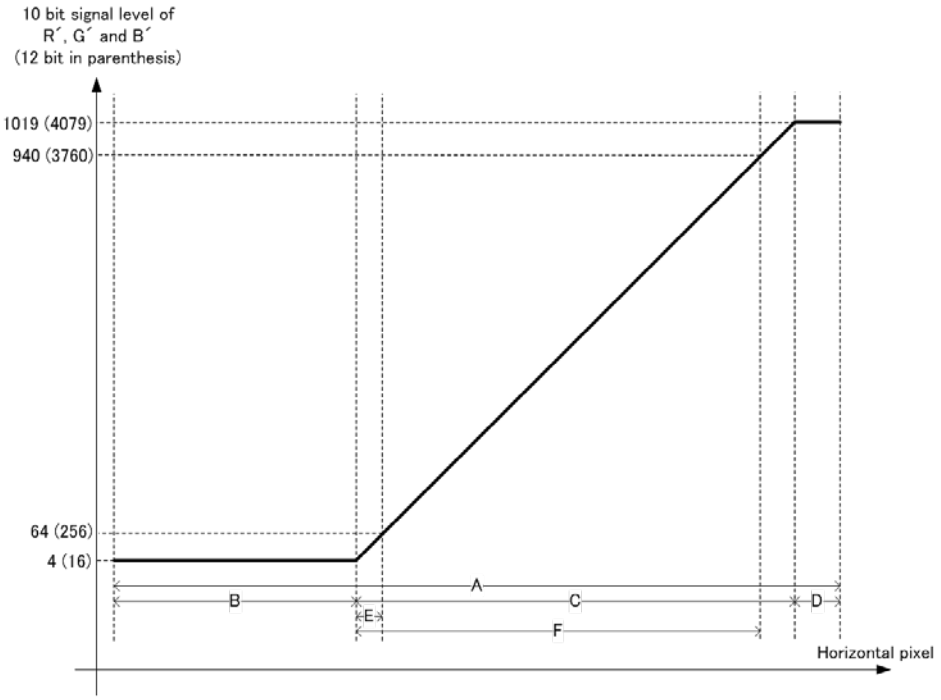

FIGURE 2-3 Signal levels of the ramp

TABLE 2-3 Ramp width to 2K, 4K and 8K format

Width (pixel)	2K		4K		8K	
	10 bit	12 bit	10 bit	12 bit	10 bit	12 bit
A	1680	1680	3360	3360	6720	6720
B	559	559	1118	1117	2236	2233
C *1	1014	1015	2028	2031	4056	4062
D	107	106	214	212	428	425
E *2	59	59	118	119	236	239
F *3	935	935	1870	1871	3740	3743

∗ 1 – C corresponds to the signal level range from 5 to 1018 in 10 bit and from 17 to 4078 in 12 bit.

∗ 2 – E corresponds to the signal level range from 5 to 63 in 10 bit and from 17 to 255 in 12 bit.

∗ 3 – F corresponds to the signal level range from 5 to 939 in 10 bit and from 17 to 3759 in 12bit.

Attachment 1 Sections comprising the test pattern

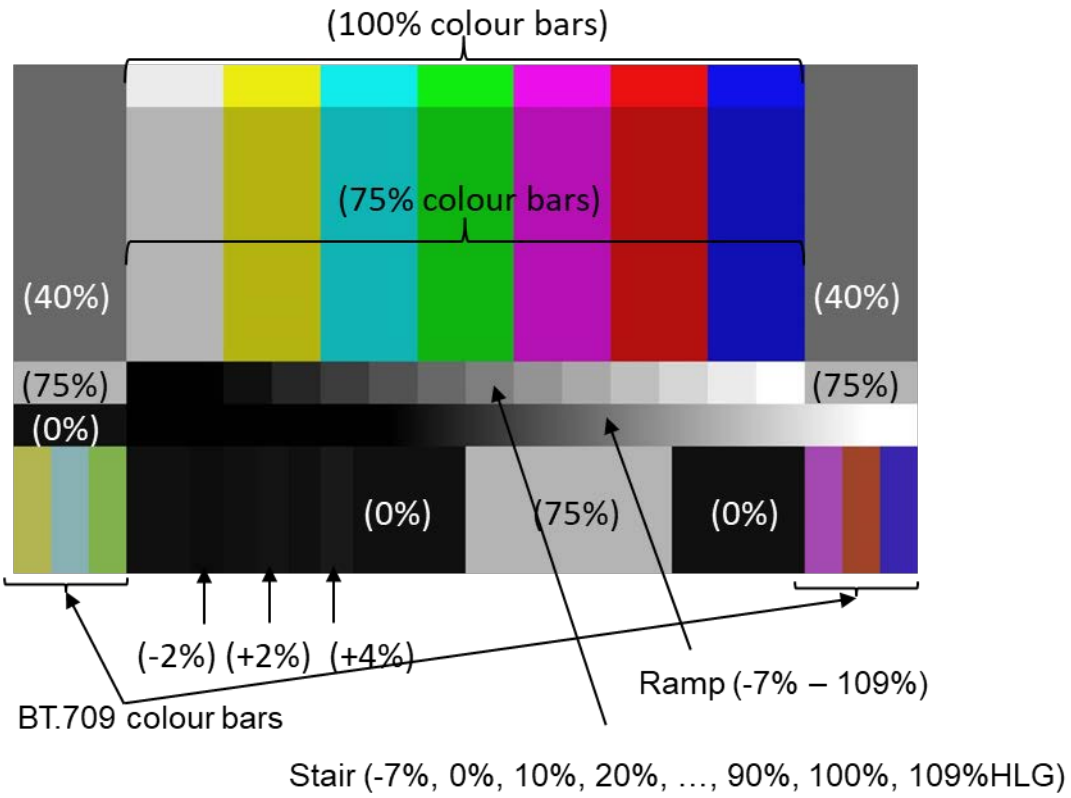

FIGURE G1-1 Sections comprising the test pattern

Colour bars: The main colour bars are 75%HLG, with 100%HLG colour bars at the top.

BT.709 colour bars: Generated by using the HLG OETF and a linear matrix specified in BT.2087. BT.709 colour bars are placed at the left and right bottom to avoid overlaps with the main colour bars on a waveform monitor.

Ramp: Levels are from –7%HLG to 109%HLG. 0% video level is at the left edge of the Green bar.

Stair: Levels are from –7%HLG to 109%HLG. Left edge of the 0% step is at the left edge of the Yellow bar. 10% interval between 0%HLG and 100%HLG. The width of each step is a half of the colour bar. The step signal and the ramp signal are placed not to overlap on a waveform monitor.

Black set signal: consisting of 0%, –2%, 0%, +2%, 0%, +4% and 0% video levels are placed at the lower left away from the bright areas for better visibility.

Grey bars (right and left): These areas may optionally be used to include other patterns for specific needs[2].

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2 For example, these area may be used for including the magenta strip (horizontal, vertical) and/or the cyclone pattern specified in ARIB STD-B66. The signal levels may be adjusted accordingly for Hybrid Log-Gamma (HLG) high dynamic range television (HDR-TV) video format.

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Attachment 2 Waveform on a waveform monitor

FIGURE G2-1 shows the waveform of the test pattern on a waveform monitor.

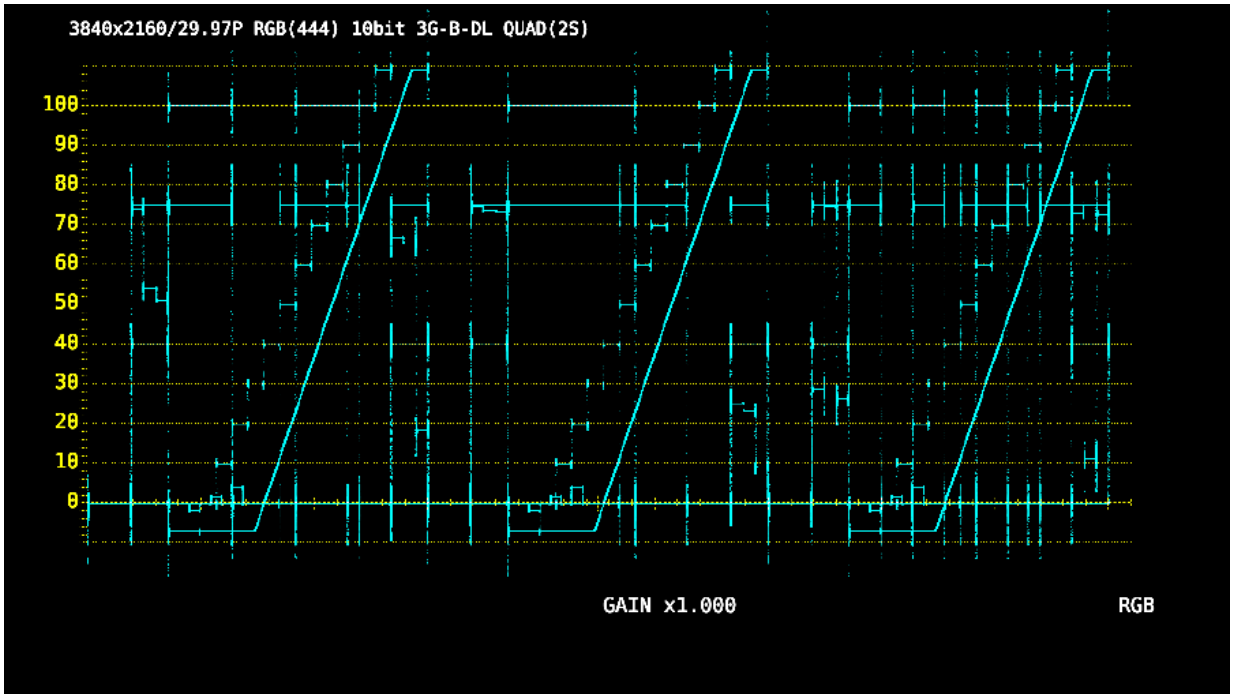

FIGURE G2-1 Waveform on waveform monitor (Red, Green, and Blue, respectively)

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Attachment 3 Sample image files

Image files of the colour bar test pattern for Hybrid Log-Gamma (HLG) high dynamic range television (HDR-TV) system of 2K, 4K and 8K with a 10-bit and a 12-bit depth are appended to the PDF version of this standard specification. An application program that can display 16-bit Tagged Image File Format (TIFF) images is needed to view the files.

The followings are sample image files of the HLG colour bar test pattern.

ARIB_HLGCB_10bit2K.tif
ARIB_HLGCB_10bit4K.tif
ARIB_HLGCB_10bit8K.tif
ARIB_HLGCB_12bit2K.tif
ARIB_HLGCB_12bit4K.tif
ARIB_HLGCB_12bit8K.tif

Attachment 4 Information on conversion of HLG/BT.2020 colour bars to SDR/BT.709

FIGURE G4-1 shows the HLG/BT.2020 colour bars including the BT.709-equivalent colour bars and their snapshots of the waveform and vectorscope set to BT.2020 colorimetry.

FIGURE G4-3 shows the colour bars converted from HLG/BT.2020 to SDR/BT.709 using the scene-referred conversion method depicted in FIGURE G4-2, which is the inverse of the "SDR to HDR mapping (scene-referred)" described in FIGURE A1-1 of ARIB TR-B43. Note this method does not include tone-mapping. HDR signals are hard-clipped when converted to SDR. The BT.709-equivalent colour bars land on the vectorscope targets after the scene-referred conversion.

FIGURE G4-5 shows the colour bars converted from HLG/BT.2020 to SDR/BT.709 using the display-referred conversion method depicted in FIGURE G4-4, which is the inverse of the "SDR to HLG mapping (display-referred)" described in FIGURE A1-2 of ARIB TR-B43. Note this method does not include tone-mapping. HDR signals are hard-clipped when converted to SDR. The BT.709-equivalent colour bars land on slightly different positions of the vectorscope targets.

TABLE G4-1 summarises the signal levels for input 75%HLG and BT.709-equivalent colour bars and the converted SDR/BT.709 colour bars. The BT.709-equivalent colour bars are converted to the same signal levels as the original SDR/BT.709 colour bars by the scene-referred conversion. Some of the signal levels of the resultant SDR colour bars by the scene-referred conversion are not exactly the same levels as the original SDR/BT.709, for example the signal levels of the Green bar are not (64, 940, 64) but (71, 939, 66) due to rounding errors.

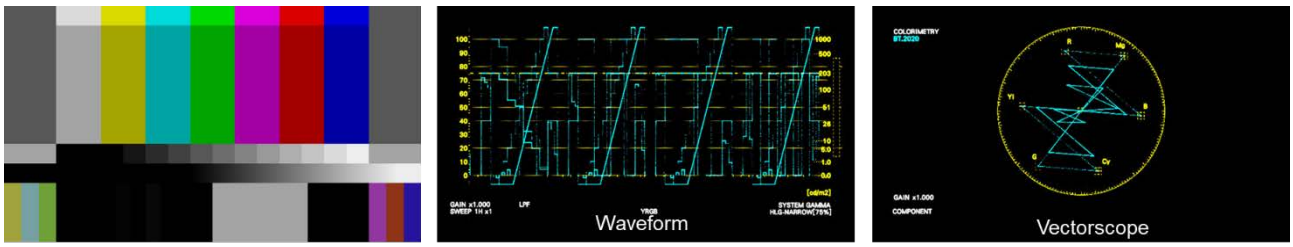

FIGURE G4-1 HLG/BT.2020 colour bars and their snapshots of the waveform and vectorscope set to BT.2020 colorimetry

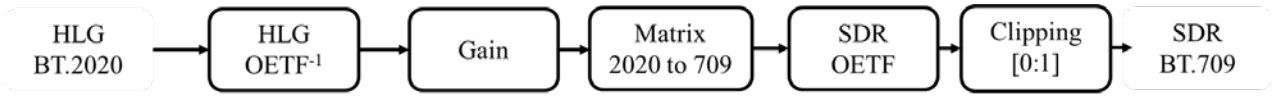

FIGURE G4-2 Scene-referred conversion method from HLG/BT.2020 to SDR/BT.709

NOTE – The gain is set so that 75%HLG corresponds to 100%SDR. The colour conversion matrix is as described in section 2 of Report ITU-R BT.2407 – "Simple conversion from BT.2020 to BT.709 based on linear matrix transformation".

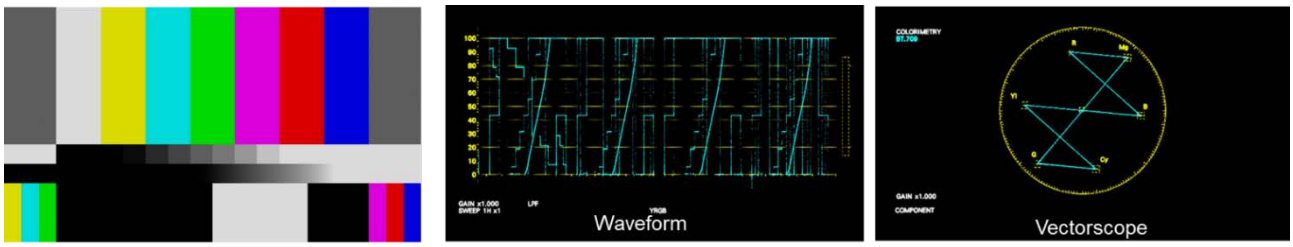

FIGURE G4-3 Colour bars converted to SDR/BT.709 using the scene-referred conversion and their snapshots of the waveform and vectorscope set to BT.709 colorimetry.

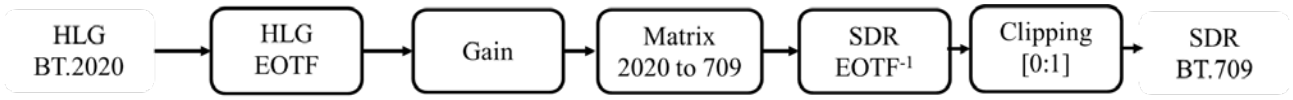

FIGURE G4-4 Display-referred conversion method from HLG/BT.2020 to SDR/BT.709

NOTE – The gain is set so that 75%HLG corresponds to 100%SDR. The colour conversion matrix is the same as that in FIGURE G4-2.

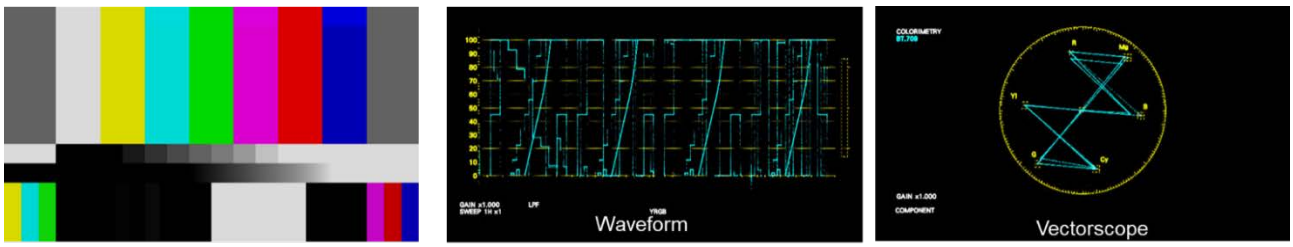

FIGURE G4-5 Colour bars converted to SDR/BT.709 using the display-referred conversion and their snapshots of the waveform and vectorscope set to BT.709 colorimetry

TABLE G4-1 Signal levels in 10 bits for input 75%HLG and BT.709-equivalent colour bars and output SDR/BT.709 colour bars converted by the methods in FIGUREs G4-2 and G4-4

Image Area	Input signal level (HLG/BT.2020, 10 bits)			Output signal level (SDR/BT.709, 10 bits) (No tone-mapping applied, simple colour conversion)					
				Scene-referred conversion			Display-referred conversion		
	R	G	B	R	G	B	R	G	B
75% White	721	721	721	940	940	940	940	940	940
75% Yellow	721	721	64	940	940	64	940	939	64
75% Cyan	64	721	721	64	940	940	64	940	924
75% Green	64	721	64	64	940	64	64	940	64
75% Magenta	721	64	721	940	64	940	940	64	894
75% Red	721	64	64	940	64	64	940	64	64
75% Blue	64	64	721	64	64	940	64	64	789
75% BT.709 Yellow	713	719	316	939	940	64	933	934	64
75% BT.709 Cyan	538	709	718	64	940	939	64	924	922
75% BT.709 Green	512	706	296	71	939	66	124	915	99
75% BT.709 Magenta	651	286	705	940	65	940	854	89	853
75% BT.709 Red	639	269	164	940	64	64	835	64	64
75% BT.709 Blue	227	147	702	66	64	940	93	64	768

Version 1.2 Revision History

Page	Item No.	Description	Reason
1	1.3.2	(4) ARIB TR-B43 Version 1.2 (2019), “Operational guidelines for high dynamic range video programme production” (10) Report ITU-R BT.2407-0 (2017), “Colour gamut conversion from Recommendation ITU-R BT.2020 to Recommendation ITU-R BT.709”	Add two new references that are referenced in the new attachment 4. References are renumbered.
3	2.1	The various sections of the test pattern for the HLG system are shown in FIGURE 2-1 while a colour diagram is shown in FIGURE~~.~~ 2-2.	Editorial correction.
7	Attachment 1	Sections comprising the test pattern ~~(Informative)~~	Delete unnecessary proviso.
7	Attachment 1	Replace FIGURE G1-1 with the same figure with corrected text description.	Editorial correction.
7	Attachment 1	Colour ~~B~~bars: The main colour bars are 75%HLG, with 100%HLG colour bars at the top. BT.709 ~~C~~colour ~~B~~bars: Generated by using the HLG OETF and a linear matrix specified in BT.2087.	Editorial correction.
9	Attachment 2	Waveform on a waveform monitor ~~(Informative)~~	Delete unnecessary proviso.
12-14	Attachment 4	Added new attachment (whole text).	Add new information

Version 1.1 Revision History

<table>
<tr><th>Page</th><th>Item No.</th><th>Description</th><th>Reason</th></tr>
<tr><td>1</td><td>1.3.1</td><td>(1) ARIB STD-B67 Version 2.0 (201~~x~~8), …</td><td rowspan="2">Ensure consistency with references.</td></tr>
<tr><td>1</td><td>1.3.2</td><td>(4) Recommendation ITU-R BT.2100-~~1~~2 (201~~7~~8) …
…
(8) Recommendation ITU-R BT.~~[HDR-BARS]~~2111-1 (201~~7~~9), …</td></tr>
<tr><td>5</td><td>TABLE 2-2</td><td>Ramp See FIGURE. 2-3 and TABLE 2-3</td><td rowspan="2">Clarification of specified contents.</td></tr>
<tr><td>6</td><td>TABLE 2-3</td><td>(Replace TABLE 2-3)
(Deleted)
<table>
<tr><th>~~Width (pixel)~~</th><th>~~2K~~</th><th>~~4K~~</th><th>~~8K~~</th></tr>
<tr><td>~~A~~</td><td>~~1680~~</td><td>~~3360~~</td><td>~~6720~~</td></tr>
<tr><td>~~B~~</td><td>~~559~~</td><td>~~1118~~</td><td>~~2236~~</td></tr>
<tr><td>~~C~~</td><td>~~1015~~</td><td>~~2030~~</td><td>~~4060~~</td></tr>
<tr><td>~~D~~</td><td>~~106~~</td><td>~~212~~</td><td>~~424~~</td></tr>
<tr><td>~~E~~</td><td>~~60~~</td><td>~~120~~</td><td>~~240~~</td></tr>
<tr><td>~~F~~</td><td>~~936~~</td><td>~~1872~~</td><td>~~3744~~</td></tr>
</table>
(Added)
<table>
<tr><th rowspan="2">Width (pixel)</th><th colspan="2">2K</th><th colspan="2">4K</th><th colspan="2">8K</th></tr>
<tr><th>10 bit</th><th>12 bit</th><th>10 bit</th><th>12 bit</th><th>10 bit</th><th>12 bit</th></tr>
<tr><td>A</td><td>1680</td><td>1680</td><td>3360</td><td>3360</td><td>6720</td><td>6720</td></tr>
<tr><td>B</td><td>559</td><td>559</td><td>1118</td><td>1117</td><td>2236</td><td>2233</td></tr>
<tr><td>C *1</td><td>1014</td><td>1015</td><td>2028</td><td>2031</td><td>4056</td><td>4062</td></tr>
<tr><td>D</td><td>107</td><td>106</td><td>214</td><td>212</td><td>428</td><td>425</td></tr>
<tr><td>E *2</td><td>59</td><td>59</td><td>118</td><td>119</td><td>236</td><td>239</td></tr>
<tr><td>F *3</td><td>935</td><td>935</td><td>1870</td><td>1871</td><td>3740</td><td>3743</td></tr>
</table>
* 1 – C corresponds to the signal level range from 5 to 1018 in 10 bit and from 17 to 4078 in 12 bit.
* 2 – E corresponds to the signal level range from 5 to 63 in 10 bit and from 17 to 255 in 12 bit.
* 3 – F corresponds to the signal level range from 5 to 939 in 10 bit and from 17 to 3759 in 12bit.</td></tr>
<tr><td>7</td><td>Attachment 1</td><td>Generated by using the HLG OETF~~E~~ and a linear matrix specified in BT.2087.</td><td>Editorial revision</td></tr>
<tr><td>11</td><td>Attachment 3</td><td>Attachment 3 Sample image files
~~An i~~Image files off~~or~~ the colour bar test pattern for Hybrid Log-Gamma (HLG) high dynamic range television (HDR-TV) system off~~or~~ 2K, 4K and 8K ~~systems~~ with a 10-bit and a 12-bit depth ~~is~~ are appended to the PDF</td><td>Add attached file</td></tr>
</table>

		version ~~file~~ of this standard specification. An application program that can display 16-bit Tagged Image File Format (TIFF) images is needed to view the files. The followings are s~~S~~ample image files of the HLG colour bar test pattern. ARIB_HLGCB_10bit2K.tif ARIB_HLGCB_10bit4K.tif ARIB_HLGCB_10bit8K.tif ARIB_HLGCB_12bit2K.tif ARIB_HLGCB_12bit4K.tif ARIB_HLGCB_12bit8K.tif	

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