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To: Users of CTA-861, *A DTV Profile for Uncompressed High-Speed Digital Interfaces*

From: CTA Technology & Standards Department

Date: November 1, 2017

Subject: CTA-861-E

This document has been revised from its original published version to remove references to a specific company. The company in question requested this change, citing the fact that its company name is trademarked. The specific revisions that have been made include:

2.1.2.1	Removal of informative reference 68
2.2	The term defined as "the optional RGB color space defined in IEC 61966-2-5" was renamed "opRGB."
2.2	The term defined as "the luma-chroma-chroma (YCC) color space defined in Annex A of IEC 61966-2-5. The ITU-R BT.601 color conversion matrix is used to transform RGB values to YCC values" was renamed "opYCC$_{601}$."
5.2.1	The new term "opYCC$_{601}$" replaced a company specific reference.
5.3	The new term "opYCC$_{601}$" replaced a company specific reference. Also, the new term "opRGB" replaced a company specific reference.
Table 13	The new term "opYCC$_{601}$" replaced a company specific reference. Also, the new term "opRGB" replaced a company specific reference.
Table 14	The new term "opYCC$_{601}$" replaced a company specific reference in two places. Also, the new term "opRGB" replaced a company specific reference.
6.4	The new term "opYCC$_{601}$" replaced a company specific reference. Also, the new term "opRGB" replaced a company specific reference.
Table 51	The new term "opYCC$_{601}$" replaced a company specific reference. Also, the new term "opRGB" replaced a company specific reference.
Table 52	The new term "opYCC$_{601}$" replaced a company specific reference. Also, the new term "opRGB" replaced a company specific reference.
7.5.6	The new term "opYCC$_{601}$" replaced a company specific reference in two places. Also, the new term "opRGB" replaced a company specific reference.

No other changes have been made to CTA-861-E today. Please note that there are also two errata associated with this document published on April 13, 2009 and July 20, 2011, respectively.

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To: Users of CEA-861-E, A DTV Profile for Uncompressed High Speed Digital Interfaces

From: CEA Technology & Standards Department

Date: April 13, 2009

Subject: Erratum

Please note that there are several errors in the published version of CEA-861-E (March 2008). Changed pages with the corrections are provided. We apologize for any inconvenience.

- Page 13, Section 3.1, line 1 – Sentence revised, “display” changed to “support”
- Page 65, Section 6.4, following Table 20 – New paragraphs, footnotes, and four new Tables 20a, 20b, 20c, & 20d inserted before existing text

1. **The first sentence in section 3.1 is revised to read:**

"Any sink complying with CEA-861-E shall support video conforming to the following video format:"

2. **Insert the following new paragraphs, footnotes, and four new Tables 20a, 20b, 20c, & 20d in Section 6.4, immediately after Table 20.**

"The equivalent pixel and line numbering scheme of CEA-861-E is shown in Table 20a."

VIC	Format	Coding Range Pixels x lines	Picture Pixel Number	Picture Line Number		
				Field 1	Field 2	Frame
6,7	480 Interlaced	720 x 480	1 – 720	Odd 1 – 479	Even 2 - 480	-
2,3	480 Progressive	720 x 480	1 – 720	-	-	1 – 480
21,22	576 Interlaced	720 x 576	1– 720	Odd 1 – 575	Even 2 - 576	-
17,18	576 Progressive	720 x 576	1 – 720	-	-	1 – 576
4, 19, 60-62	720 Progressive	1280 x 720	1 – 1280	-	-	1 – 720
5, 20	1080 Interlaced	1920 x 1080	1 – 1920	Odd 1 – 1079	Even 2 – 1080	-
16, 32-34	1080 Progressive	1920 x 1080	1 – 1920	-	-	1 – 1080

Table 20a CEA-861 Picture Pixel & Line Numbers

"Note that the pixel and line numbering schemes used to encode AFD bar data for program material conforming to SMPTE 2016-1 are incompatible with those specified in CEA-861-E. With respect to pixel numbering, SMPTE 2016-1 begins with zero, while CEA-861-E begins with one. With respect to line numbering, SMPTE 2016-1 and CEA-861 timing-based line numbering schemes have been harmonized. However, where SMPTE 2016-1 uses timing-based line numbering for encoding its AFD bar data, CEA-861-E uses a separate picture-based line-numbering scheme to encode its InfoFrame AFD bar data. Timing-based line numbering begins with one and at a prescribed line in the blanking interval 1-Ln lines relative to the leading line of Vsync. CEA-861-E's picture-based line numbering also begins with one, but always begins at the leading line of Vactive (i.e. the topmost line of the picture).

Sources that receive bar data from external media (e.g. media carrying bar data in accordance with SMPTE 2016-1) and output it to sink via AVI InfoFrame bar data, should convert the bar data according to CEA-861-E standard line number and pixel number conventions (given below) prior to outputting. The equation for converting SMPTE 2016-1 coded pixel numbers (P_{SMPTE}) to equivalent CEA-861-E picture pixel numbers (P_{CEA}) is shown in Table 20b. The equations for converting interlaced and progressive format SMPTE 2016-1 coded line numbers (L_{SMPTE}) to equivalent CEA-861-E picture line numbers (L_{CEA}) are shown in Table 20c and Table 20d, respectively. The equations in Table 20b, Table 20c, and Table 20d only apply when a bar is present. CEA-861-E utilizes special values (given below) when a bar is omitted. The variables Ln, Vsync, Vback, Vfront, Vactive, in the equations come from Table 2 and Table 3 of CEA-861-E."

Format	SMPTE 2016-1 Coded Pixel Number to CEA-861 Picture Pixel Number Conversion Equation
All formats	$P_{CEA} = P_{SMPTE}+1$

Table 20b Bar Data Pixel Number Normalization Equation

Format	SMPTE 2016-1 Coded Line Number to CEA-861 Picture Line Number Conversion Equations	
	Field 1 $L_{SMPTE} <= [L_n + (V_{total}/2)]$	Field 2 $L_{SMPTE} > [L_n + (V_{total}/2)]$
480 Interlaced[6a]	$L_{CEA} = 2*[L_{SMPTE}-L_n-V_{sync}-V_{back}]-1$	$L_{CEA} = 2*[L_{SMPTE}-L_n-V_{front}-2*(V_{sync}+V_{back})-(V_{active}/2)-1]$
Other Interlaced	$L_{CEA} = 2*[L_{SMPTE}-L_n-V_{sync}-V_{back}+1]-1$	$L_{CEA} = 2*[L_{SMPTE}-L_n-V_{front}-2*(V_{sync}+V_{back})-(V_{active}/2)]$

Table 20c Interlaced Bar Data Line Number Normalization Equations

Format	SMPTE 2016-1 Coded Line Number to CEA-861 Picture Line Number Conversion Equation
All Progressive	$L_{CEA} = L_{SMPTE}-L_n-V_{sync}-V_{back}+1$

Table 20d Progressive Bar Data Line Number Normalization Equation

"The general procedure for converting a SMPTE 2016-1 coded pixel number (pixel_number_end_of_left_bar or pixel_number_start_of_right_bar) to an equivalent CEA-861-E picture pixel number (ELB or SRB) and setting the CEA-861-E vertical bar data bit (B0) is:

1. Determine if a left vertical bar is present by inspecting the SMPTE 2016-1 left_bar_flag value. If the left vertical bar is present, then use the equation in Table 20b (i.e. simply add one) to calculate ELB. If the left vertical bar is not present, then use the special value zero for ELB.
2. Determine if a right vertical bar is present by inspecting the SMPTE 2016-1 right_bar_flag value. If the right vertical bar is present, then use the equation in Table 20b (i.e. simply add one) to calculate SRB. If the right vertical bar is not present, then use the special value (Hactive+1) for SRB.
3. If either vertical bar is present, set B0 bit to one. Otherwise, if neither vertical bar is present, set B0 bit to zero."

"The general procedure for converting a SMPTE 2016-1 coded line number (line_number_end_of_top_bar or line_number_start_of_bottom_bar) to a CEA-861-E picture line number (ETB or SBB) and setting the CEA-861-E horizontal bar data bit (B1) is:

1. Determine if top horizontal bar is present by inspecting the SMPTE 2016-1 top_bar_flag value. If the top horizontal bar is not present, then use the special value zero for ETB. If the top horizontal bar is present and the video format is progressive, then use the equation in Table 20d to calculate ETB. Otherwise, use one of the four equations as described in step 3 below to calculate ETB.
2. Determine if bottom horizontal bar is present by inspecting the SMPTE 2016-1 bottom_bar_flag value. If the bottom horizontal bar is not present, then use the special value (Vactive+1) for SBB. If the bottom horizontal bar is present and the video format is progressive, then use the equation in Table 20d to calculate SBB. Otherwise, use one of the four equations as described step 3 below to calculate SBB.
3. If a horizontal bar is present and the video format is interlaced, then use one of the four equations in Table 20c as follows:
   a. Determine if the SMPTE 2016-1 line number is in the first field by comparing the number with the value [Ln + (Vtotal/2)]. If the SMPTE 2016-1 number is less than or equal to the value [Ln + (Vtotal/2)], then use one of the equations from the "Field 1" column of Table 20c. Otherwise, use one of the equations from the "Field 2" column of Table 20c.

[6a] The 480 interlaced format is a special case, where the line number conversion equations are slightly modified due to the fact that SMPTE 2016-1 Vactive is offset relative to CEA-861-E Vactive by one line (e.g. the bottom-most line in SMPTE 2016-1 Vactive ends on timing line number 525, while in CEA-861-E, it ends one line earlier on timing line number 524). All of the other interlaced video timings align perfectly.

b. If the incoming video format is 480i, then use the appropriate equation from the "480 Interlaced" row of Table 20c. Otherwise, use the appropriate equation from the "Other Interlaced" row of Table 20c.

4. If either horizontal bar is present, set B1 bit to one. Otherwise, if neither horizontal bar is present, set B1 bit to zero."

"Example bar data conversions are shown in Annex M."

3. A new annex (Annex M) is created and shall read as follows:

"Annex M AFD Bar Data Conversion Examples (Informative)
This section provides AFD bar data conversion examples. The input bar data is taken from two examples given in Annex B of SMPTE 2016-1. Each example is worked below to demonstrate the proper calculation of equivalent CEA-861-E bar data.

M.1 Converting 720p 2.4:1 Letterbox Bar Data
The first example (B.1) is a progressive scan 720p video format with 2.4:1 centered letterbox (93-line horizontal bar at top, 533-line active image, and 94-line horizontal bar at bottom) with bar data top_bar_flag=1, bottom_bar_flag=1, left_bar_flag=0 and right_bar_flag=0, line_number_end_of_top_bar=118, and line_number_start_of_bottom_bar=652.

SMPTE 2016-1 bar flags top_bar_flag=1 and bottom_bar_flag=1 indicate that horizontal bar data is present and that bar data values line_number_end_of_top_bar and line_number_start_of_bottom_bar need to be converted to equivalent CEA-861-E InfoFrame bar data values ETB and SBB using the equation from Table 20d as follows:

ETB = line_number_end_of_top_bar – Ln – Vsync – Vback + 1 = 118-1-5-20+1 = 93

SBB = line_number_start_of_bottom_bar – Ln – Vsync – Vback + 1 = 652-1-5-20+1 = 627

Since horizontal bars are present (top_bar_flag=1 or bottom_bar_flag=1), B1=1.

Since SMPTE 2016-1 left bar flag indicates that no left vertical bar is present (left_bar_flag=0), CEA-861-E InfoFrame left bar data ELB is set to a special value as follows:

ELB = 0

Since SMPTE 2016-1 right bar flag indicates that no right vertical bar is present (right_bar_flag=0), CEA-861-E InfoFrame right bar data SRB is set to a special value as follows:

SRB = Hactive+1 = 1280+1 = 1281.

Since neither vertical bars are present (left_bar_flag=0 and right_bar_flag=0), B0=0.

M.2 Converting 1080i 2.4:1 Letterbox Bar Data
The second example (B.2) is an interlaced scan 1080i video format with 2.4:1 centered letterbox (140-line horizontal bar at top, 800-line active image, and 140-line horizontal bar at bottom) with bar data top_bar_flag=1, bottom_bar_flag=1, left_bar_flag=0, right_bar_flag=0, line_number_end_of_top_bar=653, and line_number_start_of_bottom_bar=491.

SMPTE 2016-1 bar flags top_bar_flag=1 and bottom_bar_flag=1 indicate that horizontal bar data is present and that bar data values line_number_end_of_top_bar and line_number_start_of_bottom_bar need to be converted to equivalent CEA-861-E InfoFrame bar data values ETB and SBB using equations from Table 20c as follows:

Since 653 > [1 + (1080/2)] and 1080i is not "480 Interlaced", use Field 2 "Other Interlaced" equation for ETB calculation.

ETB = 2*[line_number_end_of_top_bar – Ln – Vfront – 2*(Vsync + Vback) – (Vactive/2)]
= 2*[653-1-2-2*(5+15)-(1080/2)] = 140

Since 491 <= [1 + (1080/2)] and 1080i is not “480 Interlaced”, use Field 1 “Other Interlaced” equation for SBB calculation.

SBB = 2*[line_number_start_of_bottom_bar – Ln – Vsync – Vback + 1] -1
= 2*[491-1-5-15+1]-1 = 941

Since horizontal bars are present (top_bar_flag=1 or bottom_bar_flag=1), B1=1.

Since SMPTE 2016-1 left bar flag indicates that no left vertical bar is present (left_bar_flag=0), CEA-861-E InfoFrame left bar data ELB is set to a special value as follows:

ELB = 0

Since SMPTE 2016-1 right bar flag indicates that no right vertical bar is present (right_bar_flag=0), CEA-861-E InfoFrame right bar data SRB is set to a special value as follows:

SRB = Hactive+1 = 1920+1 = 1921.

Since neither vertical bars are present (left_bar_flag=0 and right_bar_flag=0), B0=0.”

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To: Users of CEA-861-E, A DTV Profile for Uncompressed High Speed Digital Interfaces

From: CEA Technology & Standards Department

Date: 7/20/2011

Subject: Errata

Please note that there are several errors in the published version of CEA-861-E (March 2008). Changed pages with the corrections are provided. We apologize for any inconvenience.

- Page 28, Section 4.1, note 2 at the bottom of Table 4 – Sentence revised, “1 to 10” changed to “9 to 0”.
- Page 28, Section 4.1, note 3 at the bottom of Table 4 - Sentence revised, “vary from 1 to 2” changed to “be set to 0 or 1”.
- Page 28, Section 4.1, note 4 at the bottom of Table 4 - Sentence revised, “1, 2, to 4” changed to “set to 0, 1, or 3”.
- Page 41, Section 6.4, Table 15 – Heading revised, delete “(PR+1)”.
- Page 42, Section 6.4, 3rd paragraph following Table 15 - Sentence revised, “10-to-1” changed to “9-to-0".
- Page 42, Section 6.4, 4th paragraph following Table 15 - Sentence revised, “2 or 1” changed to“1, or 0”.
- Page 42, Section 6.4, 5th paragraph following Table 15 - Sentence revised, “4, 2, or 1” changed to “3, 1, or 0”.

CEA Standard

A DTV Profile for Uncompressed High Speed Digital Interfaces

CEA-861-E

March 2008

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(Formulated under the cognizance of the CEA's **R4.8 DTV Interface Subcommittee**.)

Published by
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Technology & Standards Department
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FOREWORD

This standard was developed under the auspices of the Consumer Electronics Association (CEA) R4.8 DTV Interface Subcommittee.

CEA-861-E supersedes CEA-861-D.

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A DTV Profile for Uncompressed High Speed Digital Interfaces

1 Scope

CEA-861-E establishes protocols, requirements, and recommendations for the utilization of uncompressed digital interfaces by consumer electronics devices such as digital televisions (DTVs), digital cable, satellite or terrestrial set-top boxes (STBs), and related peripheral devices including, but not limited to DVD players/recorders, and other related sources or sinks.

CEA-861-E is applicable to a variety of standard DTV-related high-speed digital physical interfaces - such as Digital Visual Interface (DVI) 1.0 [4], Open LVDS Display Interface (LDI) [8], and High-Definition Multimedia Interface (HDMI) [50] specifications. Protocols, requirements, and recommendations that are defined include video formats and waveforms; colorimetry and quantization; transport of compressed and uncompressed, as well as Linear Pulse Code Modulation (LPCM), audio; carriage of auxiliary data; and implementations of the Video Electronics Standards Association (VESA*) Enhanced Extended Display Identification Data Standard* (E-EDID) [10], which is used by sinks to declare display capabilities and characteristics.

CEA-861-E adopters are strongly encouraged to implement High-bandwidth Digital Content Protection (HDCP) [3] content protection, defined by the Digital Content Protection, LLC (DCP) method, in order to be compatible with digital cable STBs as authorized by 47 C.F.R. § 76.602 [48] and 47 C.F.R. §76.640 [49]. HDCP [3] permits viewing of high-value content that may be available from other video sources in a home network.

2 General

2.1 References

CEA-861-E includes mechanisms that allow a digital video source (such as a cable, satellite or terrestrial STB, digital VCR, or DVD player) to supply displayable, baseband, digital video to High Definition Television (HDTV) and Enhanced Definition Television (EDTV) devices, as well as peripheral devices such as repeaters, switchers, and recorders, as defined in *CEA Expands Definitions for Digital Television Products* [43].

2.1.1 Normative References

The following standards contain provisions that, through reference in this text, constitute normative provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed in Sec. 2.1.1.1. If the referenced standard is dated, the reader is advised to use the version specified.

2.1.1.1 Normative Reference List

1. SMPTE 170M (2004), Composite Analog Video Signal—NTSC for Studio Applications
2. SMPTE 274M (2005), SMPTE Standard for Television—1920x1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple-Picture Rates
3. DCP, L.L.C., HDCP Specification, Revision 1.1, June 9, 2003
4. DDWG, Digital Visual Interface, Revision 1.0, April 2, 1999
5. IEC 61966-2-4: Multimedia systems and equipment - Colour measurement and management - Part 2-4: Colour management - Extended-gamut YCC colour space for video applications, January 2006
6. ITU-R BT.601-5, Studio Encoding parameters of digital television for standard 4:3 and wide-screen 16:9 aspect ratios, 1995
7. ITU-R BT.709-5, Parameter Values for the HDTV standards for production and International Programme Exchange, 2002
8. Open LVDS Display Interface (Open LDI) Specification, Version 0.95, May 13, 1999
9. VESA E-DDC™ Standard, VESA Enhanced Display Data Channel Standard, Version 1.1, March 24, 2004
10. VESA E-EDID™ Standard, VESA Enhanced Extended Display Identification Data Standard, Release A, Revision 1, February 9, 2000 --- Defines EDID Structure Version 1, Revision 3