

# CEA Standard

**A DTV Profile for Uncompressed  
High Speed Digital Interfaces**

**CEA-861-E**

**March 2008**



**CEA**<sup>®</sup>  
Consumer Electronics Association

[www.CE.org](http://www.CE.org)

## NOTICE

Consumer Electronics Association (CEA<sup>®</sup>) Standards, Bulletins and other technical publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for his particular need. Existence of such Standards, Bulletins and other technical publications shall not in any respect preclude any member or nonmember of CEA from manufacturing or selling products not conforming to such Standards, Bulletins or other technical publications, nor shall the existence of such Standards, Bulletins and other technical publications preclude their voluntary use by those other than CEA members, whether the standard is to be used either domestically or internationally.

Standards, Bulletins and other technical publications are adopted by CEA in accordance with the American National Standards Institute (ANSI) patent policy. By such action, CEA does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the Standard, Bulletin or other technical publication.

This CEA Standard is considered to have International Standardization implication, but the International Electrotechnical Commission activity has not progressed to the point where a valid comparison between the CEA Standard and the IEC document can be made.

This Standard does not purport to address all safety problems associated with its use or all applicable regulatory requirements. It is the responsibility of the user of this Standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations before its use.

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

Published by

©CONSUMER ELECTRONICS ASSOCIATION 2008  
Technology & Standards Department  
1919 S. Eads Street  
Arlington, Virginia 22202

**PRICE: Please call Information Handling Services, USA and Canada (1-800-854-7179)  
International (303-397-7956), or  
<http://global.ihs.com>**

All rights reserved  
Printed in U.S.A.

PLEASE!

DON'T VIOLATE  
THE  
LAW!

This document is copyrighted by the Consumer Electronics Association (CEA<sup>®</sup>)  
and may not be reproduced without permission.

Organizations may obtain permission to reproduce a limited number of copies by  
entering into a license agreement. For information contact:

Information Handling Services  
15 Inverness Way East  
Englewood, Colorado 80112-5704  
or call U.S.A. and Canada 1-800-854-7179, International (303) 397-7956  
See <http://global.ihs.com> or email [global@ihs.com](mailto:global@ihs.com)



# Contents

<b>1 Scope</b> .....	<b>1</b>
<b>2 General</b> .....	<b>1</b>
<b>2.1 References</b> .....	<b>1</b>
<b>2.1.1 Normative References</b> .....	<b>1</b>
2.1.1.1 Normative Reference List.....	1
2.1.1.2 Normative Reference Acquisition .....	3
<b>2.1.2 Informative References</b> .....	<b>3</b>
2.1.2.1 Informative Document List.....	4
2.1.2.2 Informative Document Acquisition .....	5
<b>2.2 Definitions</b> .....	<b>6</b>
<b>2.3 Symbols and Abbreviations</b> .....	<b>10</b>
<b>2.4 Compliance Notation</b> .....	<b>11</b>
<b>2.5 Hexidecimal Notation</b> .....	<b>11</b>
<b>2.6 HxV Video Timing Notation</b> .....	<b>11</b>
<b>2.7 Bit Naming Conventions</b> .....	<b>12</b>
<b>2.8 ASCII Codes, Characters &amp; Strings</b> .....	<b>12</b>
<b>3 Overview</b> .....	<b>12</b>
<b>3.1 General Video Format Requirements</b> .....	<b>13</b>
<b>4 Video Formats and Waveform Timings</b> .....	<b>14</b>
<b>4.1 Aspect Ratio</b> .....	<b>26</b>
<b>4.2 Frame Rate Relationships</b> .....	<b>29</b>
<b>5 Color Encoding, Sampling, &amp; Conversion</b> .....	<b>29</b>
<b>5.1 Default Encoding Parameters</b> .....	<b>29</b>
<b>5.2 Color Component Samples</b> .....	<b>30</b>
5.2.1 RGB-to-YC <sub>B</sub> C <sub>R</sub> Conversion Matrices.....	30
5.2.2 Sample Lattice.....	30
<b>5.3 Transfer Characteristic (e.g. gamma correction)</b> .....	<b>31</b>
<b>5.4 Color Coding &amp; Quantization</b> .....	<b>32</b>
<b>6—Auxiliary Information Carried from Source to Sink</b> .....	<b>32</b>
<b>6.1 Vendor Specific InfoFrames</b> .....	<b>33</b>
<b>6.2 Auxiliary Video Information (AVI) InfoFrame</b> .....	<b>34</b>
<b>6.3 Format of Version 1 AVI InfoFrame</b> .....	<b>35</b>
<b>6.4 Format of Version 2 AVI InfoFrame</b> .....	<b>35</b>
<b>6.5 Source Product Description (SPD) InfoFrame</b> .....	<b>46</b>
<b>6.6 Audio InfoFrame</b> .....	<b>47</b>
6.6.1 Audio Identification Information .....	48
6.6.2 Speaker Mapping and Down-mix Information .....	50
<b>6.7 MPEG Source InfoFrame</b> .....	<b>54</b>
<b>6.8 NTSC VBI InfoFrame</b> .....	<b>55</b>
<b>7 EDID Data Structure</b> .....	<b>55</b>
<b>7.1 Use of CEA Extensions</b> .....	<b>56</b>
<b>7.2 Describing Video Formats in EDID</b> .....	<b>57</b>
7.2.1 Use of EDID Detailed Timing Descriptors .....	57
7.2.2 Order of Dual-Aspect Ratio Detailed Timing Descriptors .....	58
7.2.3 Source Requirements and Recommendations.....	59
<b>7.3 CEA Extension Version 1</b> .....	<b>59</b>

7.4 CEA Extension Version 2.....	60
7.5 CEA Extension Version 3.....	61
7.5.1 Video Data Block.....	65
7.5.2 Audio Data Block.....	65
7.5.3 Speaker Allocation Data Block.....	66
7.5.4 Vendor Specific Data Block.....	67
7.5.5 Colorimetry Data Block.....	67
7.5.6 Video Capability Data Block.....	68
7.5.7 Vendor-Specific Video Data Block.....	70
7.5.8 Vendor-Specific Audio Data Block.....	70
<b>Annex A Baseline Example EDID and Detailed Timing Descriptors (Informative).....</b>	<b>72</b>
A.1 Background.....	72
A.2 EDID Tables.....	72
A.2.1 EDID Table Construction.....	72
A.2.2 Detailed Explanation of EDID Block Zero.....	73
A.2.3 Block Zero Header Section.....	73
A.2.4 Vendor / Product Identification.....	73
A.2.5 EDID Version.....	75
A.2.6 Basic Display Parameters and Features.....	75
A.2.7 Color Characteristics.....	78
A.2.8 Established Timings.....	79
A.2.9 Standard Timing ID #1 – 8.....	80
A.2.10 Detailed Timing Descriptor Block.....	80
A.2.10.1 First Detailed Timing Descriptor.....	80
A.2.10.2 Second Detailed Timing Descriptor.....	81
A.2.10.3 First Monitor Descriptor (Monitor Name).....	82
A.2.10.4 Second Monitor Descriptor (Monitor Range Limits).....	83
A.2.11 Extension Flag and Checksum.....	84
A.2.11.1 Block One Details.....	85
A.2.12 Overview of Extensions.....	85
A.2.13 Block One CEA Extension Header.....	86
A.2.14 Third Detailed Timing Descriptor.....	87
A.2.15 Fourth Detailed Timing Descriptor.....	87
A.2.16 Descriptor Defined by Manufacturer.....	88
A.2.17 Monitor Serial Number.....	89
A.2.18 Residual Byte Padding and Check Sum.....	89
A.2.19 Hot Plugging Sequence.....	91
A.3 Complete Example EDID Table (Informative).....	92
A.4 Example EDID Detailed Timing Descriptors.....	99
<b>Annex B Application to DVI 1.0 (Normative).....</b>	<b>111</b>
B.1 Connector and Cable.....	111
B.2 Digital Content Protection.....	111
<b>Annex C Application to Open LDI (Normative).....</b>	<b>112</b>
C.1 Open LDI Data and Control Signals.....	112
C.2 Non DC Balanced Mode.....	112
C.3 OpenLDI Cabling Information.....	112
C.3.1 Cable Length.....	113
C.3.2 Number of Signal Conductors.....	113
C.3.3 Wire Gauge.....	113
C.3.4 Conductor Resistance.....	113
C.3.5 Insulation.....	113
C.3.6 Shield Requirement.....	113
C.3.7 Single Twisted Pair Transmission Skew.....	113

C.3.8 Multiple Twisted Pair Transmission Skew.....	113
C.3.9 USB Cable Requirements.....	113
C.3.10 DDC Cable Requirements.....	113
<b>Annex D Application to HDMI (Informative) .....</b>	<b>114</b>
D.1 InfoPackets .....	114
D.2 EDID.....	114
D.3 Audio .....	114
D.4 HDCP .....	114
D.5 Additional Information.....	114
D.6 Example EDID Using Elements of CEA Block Tag Extension (Applicable to HDMI) .....	114
D.6.1 First Monitor Descriptor (Monitor Name) and Second Monitor Descriptor (Monitor Range Limits) .....	114
D.6.2 Extension Flag and Checksum .....	115
D.6.3 CEA Extension Header (Block 1).....	115
D.6.4 CEA Data Block Collection.....	115
D.6.5 Video Data Block.....	115
D.6.6 CEA Audio Block.....	116
D.6.7 Speaker Allocation Block.....	116
D.6.8 Vendor Specific Block .....	117
D.6.9 Complete CEA-861-E Example with Block Tag Extension.....	118
<b>Annex E [Reserved for Future Use] .....</b>	<b>127</b>
<b>Annex F Guidance for Source &amp; Sinks (Informative) .....</b>	<b>128</b>
F.1 Overview.....	128
F.2 Background.....	128
F.3 Guidance for Sources .....	128
F.3.1 Stable Video Format.....	129
F.3.2 Changing Video Format .....	129
F.3.3 Optional User Controlled Setting.....	131
F.3.4 Non-Default Scenarios .....	131
F.3.5 Errors Reading the EDID.....	132
F.4 Guidance for Sinks.....	132
F.4.1 Valid Read-Only EDID .....	133
F.4.2 Ordering of the Video Formats in the EDID .....	133
F.4.3 Video Information Code (VIC) Transition .....	133
<b>Annex G InfoPacket Framework (Informative).....</b>	<b>134</b>
<b>Annex H Active Format Description (Informative).....</b>	<b>135</b>
H.1 ATSC Active Format Description .....	135
H.2 DVB Active Format Description.....	137
<b>Annex I Picture Aspect Ratio Conversion Example (Informative) .....</b>	<b>140</b>
<b>Annex J [ Intentionally Omitted ].....</b>	<b>141</b>
<b>Annex K Audio Speaker Placement &amp; Channel Allocation Compatibility (Informative).....</b>	<b>142</b>
<b>Annex L Video Timing Examples (Informative).....</b>	<b>144</b>

## Figures

Figure 1. General Progressive Video Format Timing (Negative Sync).....	21
Figure 2. General Progressive Video Format Timing (Positive Sync).....	22
Figure 3 General Interlaced Video Format Timing (Negative Sync).....	23
Figure 4. General Interlaced Video Format Timing (Positive Sync).....	24
Figure 5 Special Interlaced Video Format Timing (Even Vtotal).....	25
Figure 6 Speaker Placement.....	51
Figure 7 OpenLDI Synchronization.....	112
Figure 8 Video Processing Chain.....	128
Figure 9 Example of Options for Format Conversion.....	130
Figure 10 Multiple Conversions Example.....	131
Figure 11. Active Format Illustration (ATSC).....	135
Figure 12 Active Format Illustration (DVB).....	138
Figure 13 Example of Problem Resulting from Double Stretch.....	140
Figure 14 General Progressive Example for Video ID Codes 2 & 3 (720x480p @ 60 Hz).....	144
Figure 15 General Interlace Example for Video ID Code 5 (1920x1080i @ 60 Hz).....	145
Figure 16 Special Interlace Example for Video ID Code 39 (1920x1080i-1250 Vtotal @ 50 Hz).....	146

## Tables

Table 1 Video Format Timings—Support Requirements and Recommendations.....	14
Table 2 Video Format Timings—Detailed Timing Information.....	16
Table 3 Video Format Timings—Detailed Sync Information.....	18
Table 4 Video Formats—Video ID Code and Aspect Ratios.....	27
Table 5 Frame Rate Relationships—Base to High Frame Rate VICs.....	29
Table 6 List of InfoFrame Type Codes.....	33
Table 7 Vendor Specific InfoFrame.....	34
Table 8 Auxiliary Video Information InfoFrame format (Version 1).....	35
Table 9 Auxiliary Video Information (AVI) InfoFrame Format (Version 2).....	36
Table 10 AVI InfoFrame Data Byte 1.....	37
Table 11 AVI InfoFrame Data Byte 2.....	38
Table 12 Common Active Formats.....	39
Table 13 AVI InfoFrame Data Byte 3.....	39
Table 14 Picture Colorimetry Indicated by the RGB or YC <sub>B</sub> C <sub>R</sub> (Y), Colorimetry (C) and Extended Colorimetry (EC) Field Settings.....	41
Table 15 AVI InfoFrame Pixel Repetition Field, Data Byte 5.....	41
Table 16 AVI Info Frame IT Contents Type, Data Byte 5.....	42
Table 17 AVI Info Frame YCC Quantization Range, Data Byte 5.....	43
Table 18 Valid Pixel Repeat Values for Each Video Format Timing.....	44
Table 19 Typical Gaming Format AVI InfoFrame Parameters.....	45
Table 20 Video Format Information (Informative).....	45
Table 21 Source Product Description InfoFrame Format.....	46
Table 22 Source Product Description InfoFrame Data Byte 25.....	47
Table 23 Audio InfoFrame Format.....	48
Table 24 Audio InfoFrame Data Byte 1.....	49
Table 25 Audio InfoFrame Data Byte 2.....	50
Table 26 Audio Format Code Extension (Data Byte 3).....	50
Table 27 Speaker Placement.....	51
Table 28 Audio InfoFrame Data Byte 4.....	53
Table 29 Audio InfoFrame Data Byte 5, Level Shift Value.....	53

Table 30 Audio InfoFrame Data Byte 5, Down-mix Inhibit Flag.....	53
Table 31 Audio InfoFrame Data Byte 5, LFE Playback Level Information.....	54
Table 32 MPEG Source InfoFrame format .....	54
Table 33 MPEG Source InfoFrame Data Byte 5.....	55
Table 34 NTSC VBI InfoFrame.....	55
Table 35 Video Timing Code 39 Detailed Timing Descriptor .....	58
Table 36 CEA Extension Version 1.....	60
Table 37 CEA Extension Version 2.....	61
Table 38 CEA Extension Version 3.....	62
Table 39 General Format of “CEA Data Block Collection” .....	63
Table 40 Data Block Header Byte .....	64
Table 41 CEA Data Block Tag Codes .....	64
Table 42 Extended Tag Format (2 <sup>nd</sup> Byte of Data Block).....	64
Table 43 CEA Data Block Tag Codes .....	64
Table 44 Short Video Descriptor .....	65
Table 45 CEA Short Audio Descriptor for Audio Format Code = 1 (LPCM) .....	66
Table 46 CEA Short Audio Descriptor for Audio Format Codes 2 to 8 .....	66
Table 47 CEA Short Audio Descriptor for Audio Format Codes 9 to 13 .....	66
Table 48 CEA Short Audio Descriptor for Audio Format Code 14 (WMA Pro) .....	66
Table 49 CEA Short Audio Descriptor for Audio Format Code 15 (extension).....	66
Table 50 Speaker Allocation Data Block Payload.....	67
Table 51 Colorimetry Data Block.....	67
Table 52 Data Byte 3 Colorimetry Support Flags .....	67
Table 53 Data Byte 4 Colorimetry Metadata Support Flags.....	68
Table 54 Video Capability Data Block (VCDB) .....	68
Table 55 Video Capability Descriptor Data Byte 3.....	68
Table 56 Vendor-Specific Video Data Block (VSVDB).....	70
Table 57 Vendor-Specific Audio Data Block (VSADB) .....	71
Table 58 Standard Data Lengths .....	73
Table 59 Block Zero Header .....	73
Table 60 Vendor / Product Identification; Showing Manufacturer Week and year.....	75
Table 61 Vendor / Product Identification .....	75
Table 62 Example 0x15, 0x16 EDID Screen Size Data and Certain Display Categories .....	76
Table 63 Feature Support Detail .....	77
Table 64 Basic Display Parameters and Features Block .....	78
Table 65 Binary to Decimal Conversion Example .....	78
Table 66 Color Characteristics Block .....	79
Table 67 Established Timings Block.....	79
Table 68 Standard Timing ID Block.....	80
Table 69 First Detailed Timing Descriptor Block (1920x1080i Example).....	81
Table 70 Second Detailed Timing Descriptor Block (720x480p, 4:3 Example).....	82
Table 71 First Monitor Descriptor Block (Monitor Name) .....	83
Table 72 Second Monitor Descriptor Block (Monitor Range Limits) .....	84
Table 73 Extension Flag Block .....	85
Table 74 Block One CEA Extension Header .....	86
Table 75 Third Detailed Timing Descriptor Block (720p, 16:9 Example) .....	87
Table 76 Fourth Detailed Timing Descriptor Block (480i, 4:3 Example).....	88
Table 77 Descriptor Defined by Manufacturer Block .....	89
Table 78 Monitor Serial Number Block .....	89
Table 79 Residual Byte Stuffing and Check Sum Block .....	90
Table 80 Complete EDID Example.....	92
Table 81 Example EDID Detailed Timing Descriptor for 1280x720p (60 Hz, 16:9).....	99
Table 82 Example EDID Detailed Timing Descriptor for 1920x1080i (60 Hz, 16:9) .....	100
Table 83 Example EDID Detailed Timing Descriptor for 720x480p (59.94 Hz, 4:3).....	101
Table 84 Example EDID Detailed Timing Descriptor for 720x480p (59.94Hz, 16:9).....	102
Table 85 Example EDID Detailed Timing Descriptor for 720x480i (59.94Hz, 4:3).....	103

Table 86 Example EDID Detailed Timing Descriptor for 720x480i (59.94Hz, 16:9) .....	104
Table 87 Example EDID Detailed Timing Descriptor for 1280x720p (50 Hz, 16:9).....	105
Table 88 Example EDID Detailed Timing Descriptor for 1920x1080i (50 Hz, 16:9) .....	106
Table 89 Example EDID Detailed Timing Descriptor for 720x576p (50 Hz, 4:3).....	107
Table 90 Example EDID Detailed Timing Descriptor for 720x576p (50 Hz, 16:9).....	108
Table 91 Example EDID Detailed Timing Descriptor for 720x576i (50 Hz, 4:3) .....	109
Table 92 Example EDID Detailed Timing Descriptor for 720x576i (50 Hz, 16:9) .....	110
Table 93 OpenLDI Control Signals .....	112
Table 94 CEA Extension Header (Block 1) .....	115
Table 95 Video Data Block .....	116
Table 96 Audio Data Block.....	116
Table 97 Speaker Data Block .....	117
Table 98 Vendor Specific Data Block.....	117
Table 99 CEA-861-E EDID Example with Block Tag Extension .....	118
Table 100 Illustrated ATSC AFD Coding.....	137
Table 101 Illustrated DVB AFD Coding .....	139
Table 102 SMPTE/CEA Audio Channel Description & Abbreviation Comparison .....	142
Table 103 SMPTE/CEA Audio Channel Assignment Comparison .....	143

## **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.

(This page intentionally left blank.)

# 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