



# **Unigraf DisplayPort™ CTS Tools**



## **Guide to Product Options**

 **UNIGRAF**

## Copyright

This manual © Unigraf Oy. All rights reserved

Reproduction of this manual in whole or in part without written permission of Unigraf Oy is prohibited.

## Notice

The information given in this manual is verified in the correctness on the date of issue. The authors reserve the rights to make any changes to this product and to revise the information about the products contained in this manual without an obligation to notify any persons about such revisions or changes.

## Edition

Guide to DP CTS Tool Options, rev 27

Date: 12 April 2018

## Company information

Unigraf Oy  
Piispantilankuja 4, FI-02240 ESPOO, Finland

info@unigraf.fi

<https://www.unigraf.fi>

# Table of Content

Copyright.....	2
Notice.....	2
Edition .....	2
Company information.....	2
General .....	4
Reference Standards .....	4
Released Versions.....	4
DP 1.4 Link Layer CTS .....	5
DP 1.4 Link CTS Test Software Product Options.....	5
Description of DP 1.4 Link CTS .....	6
Normative DP 1.4 LL CTS for testing Source DUT – 26 <sup>th</sup> September 2018.....	6
Informative DP 1.4 LL CTS for testing Source DUT - Under VESA review .....	7
Normative DP 1.4 LL CTS for testing Sink DUT – 26 <sup>th</sup> September 2018 .....	8
Informative DP 1.4 LL CTS for testing Sink DUT – Under VESA Review .....	9
DP 1.2 Link CTS .....	10
DP 1.2 Reference Sink Hardware Products .....	10
DP 1.2 CTS Test Software Product Options for Reference Sinks.....	10
Description of CTS Tests for DPR-120 .....	11
Set A of Link Layer Tests for Testing Transmitter DUT.....	11
Set B of Link Layer Tests for Testing Transmitter DUT.....	12
Set C of Link Layer Tests for Testing Transmitter DUT .....	13
Set D of Link Layer Tests for Testing Transmitter DUT .....	14
HDCP 2.2 CTS for DisplayPort Sink, Source and Repeater DUT .....	15
DP HDCP 2.2 CTS Compliant Hardware Products .....	15
CTS Test Software Product Options .....	15
Description of HDCP 2.2 CTS Transmitter Tests .....	16
1A. Downstream procedure with Receiver .....	16
1B. Downstream procedure with Repeater .....	16
Description of HDCP 2.2 CTS Receiver Tests .....	17
2C. Upstream procedure with Transmitter .....	17
Description of HDCP 2.2 CTS Repeater Tests .....	18
3A. Downstream Procedure with Receiver.....	18
3A. Downstream Procedure with Repeater .....	18
3C. Downstream Procedure with Transmitter .....	18
DP 1.1 RefSink CTS Tools .....	20
DP Reference Sink Hardware Products.....	20
CTS Test Software Product Options for Reference Sinks.....	20
Description of CTS Tests for Reference Sinks.....	20
HDCP 1.3 CTS for Testing Transmitter DUT .....	20
Extended HDCP 1.3 CTS for Testing Transmitter and Repeater DUT.....	21
Audio CTS for Testing Transmitter DUT .....	22
DP 1.1 RefSource CTS Tools .....	23
Reference Source and Sink Hardware Products.....	23
CTS Test Software Product Options for Reference Sources .....	23
Description of CTS Tests for Reference Sources .....	23
Link Layer CTS for testing Receiver DUT .....	23
HDCP 1.3 CTS for Testing Receiver DUT .....	25
Extended HDCP 1.3 CTS for Testing Repeater DUT.....	25
Audio CTS for Testing Receiver DUT .....	25
Version History.....	26

## GENERAL

---

### Reference Standards

VESA® DisplayPort® Link Layer Compliance Test Specification  
Version 1.2 Core Revision 1.1 December 8, 2012

VESA® DisplayPort® Link Layer Compliance Test Specification: Extension Set 1, Rev  
1.1, December 28, 2012

High-bandwidth Digital Content Protection, Revision 2.2 on DisplayPort,  
Compliance Test Specification. Rev 1.1, 4 November 2016.

HDCP Specification v1.3; Amendment for DisplayPort rev 1.1,  
15 Jan 2010

Reduced lane count link training Test Proposal  
[James Choate, VESA, 2016-01-20]

### Released Versions

This document explains features found in the following versions of the software:

Tool	Version
Unigraf DP Reference Source CTS	3.3.5
Unigraf DP Reference Sink CTS	3.3.7
Unigraf DP LL CTS Ext1 and Core, Set A+B+C+D	1.11
HDCP 2.2 CTS: UCD Console	1.7
DP 1.4 CTS: UCD Console	1.7

## DP 1.4 LINK LAYER CTS

---

### DP 1.4 Link CTS Test Software Product Options

Product	P/N	Tests included
DP 1.4 LL CTS for testing Sink DUT	MT6635	DP 1.4 Link Layer compliance tests (HBR3) for testing Sink DUT.
DP 1.4 LL CTS for testing Source DUT		DP 1.4 Link Layer compliance tests (HBR3) for testing Source DUT

## Description of DP 1.4 Link CTS

### Normative DP 1.4 LL CTS for testing Source DUT – 26<sup>th</sup> September 2018

Test Reference	Test Name
4.2.1.1	Source DUT Retry on No-Reply During AUX Read after HPD Plug Event
4.2.1.2	Source Retry on Invalid Reply During AUX Read after HPD Plug Event
4.2.1.3	Source Device HPD Event Pulse Length Test
4.2.1.4	Source Device IRQ_HPDPulse Length Test
4.2.1.5	Source Device Inactive HPD / Inactive AUX Test

4.2.2.1	DPCD Receiver Capability and EDID Read upon HPD Plug Event
4.2.2.2	DPCD Receiver Capability Read upon HPD Plug Event
4.2.2.3	EDID Read
4.2.2.6	Source Device Inactive HPD / Inactive AUX test
4.2.2.7	Branch Device Detection upon HPD Plug Event
4.2.2.8	EDID Read on IRQ HPD Event after Branch Device Detection
4.2.2.9	E-DDC Four Block EDID Read
4.2.2.10	Link Status-Adjust Request AUX read interval during Link Training

4.3.1.1	Successful Link Training at All Supported Lane Counts and Link Speeds
4.3.1.2	Successful Link Training Upon HPD Plug Event
4.3.1.3	Successful Link Training with Request of Higher Differential Voltage Swing During Clock Recovery Sequence
4.3.1.4	Successful Link Training to a Lower Link Rate #1: Iterate at Maximum Voltage Swing
4.3.1.5	Successful Link Training to a Lower Link Rate #2: Iterate at Minimum Voltage Swing
4.3.1.6	Successful Link Training with Request of a Higher Pre-emphasis Setting During Channel Equalization Sequence
4.3.1.7	Successful Link Training at Lower Link Rate Due to Loss of Symbol Lock During Channel Equalization Sequence
4.3.1.8	Unsuccessful Link Training at Lower Link Rate #1: Iterate at Maximum Voltage Swing
4.3.1.9	Unsuccessful Link Training at Lower Link Rate #2: Iterate at Minimum Voltage Swing
4.3.1.10	Unsuccessful Link Training due to Failure in Channel Equalization Sequence (loop count > 5)
4.3.1.11	Successful LT with Simultaneous Request for Differential Voltage Swing and Pre-emphasis during Clock Recovery Sequence
4.3.1.12	Source Device Link Training CR Fallback Test
4.3.1.13	Source Device Link Training EQ Fallback Test

4.3.2.1	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Symbol Lock
4.3.2.2	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Clock Recovery Lock

4.3.2.3	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Inter-lane Alignment Lock
4.3.2.4	Handling of IRQ HPD Pulse with No Error Status Bits Set
4.3.2.5	Lane Count Reduction
4.3.3.1	Video Time Stamp Generation

4.4.2	Main Video Stream Format Change Handling
4.4.3	Power Management

## Informative DP 1.4 LL CTS for testing Source DUT - Under VESA review

Test Reference	Test Name (will get new numbers in DP 1.4 later)
4.2.2.4	EDID Read Failure #1: I2C-Over-AUX NACK
4.2.2.5	EDID Corruption Detection
4.4.1.1	Data Packing and Steering
4.4.1.2	Main Stream Data Packing and Stuffing - Least Packed TU
4.4.1.3	Main Stream Data Packing and Stuffing - Most Packed TU
4.4.4.2	Audio Stream Header Synchronization
4.4.4.3	Audio Time Stamp Generation
4.4.4.4	Audio InfoFrame Packet
4.4.4.5	Audio Stream Transmission
4.4.4.6	Audio Start Sequence

## Normative DP 1.4 LL CTS for testing Sink DUT – 26<sup>th</sup> September 2018

Test Reference	Test Name
5.2.1.1	Read One Byte from Valid DPCD Address
5.2.1.2	DPCD Receiver Capability Read (Read 12 Bytes from Valid DPCD Address)
5.2.1.3	Write One Byte to Valid DPCD Address
5.2.1.4	Write Nine Bytes to Valid DPCD Addresses
5.2.1.5	Write EDID Offset (One Byte I2C-Over-AUX Write)
5.2.1.6	Read One EDID Byte (One Byte I2C-Over-AUX Read)
5.2.1.7	EDID Read (1 Byte I2C -Over-AUX Segment Write, 1 Byte I2C-Over-AUX Offset Write, 128 Byte I2C-Over-AUX Read)
5.2.1.8	Illegal AUX Request Syntax
5.2.1.9	Glitch Rejection
5.2.1.10	Interleaved EDID and DPCD Receiver Capability Read
5.2.1.11	Downstream Stop on MOT Reset
5.2.1.12	Downstream Stop on Timeout

5.2.2.1	Sink Organizationally Unique Identifier (OUI)
5.2.2.2	Sink Count
5.2.2.3	Sink Status
5.2.2.4	Sink Error Count
5.2.2.5	DPCD Address Range
5.2.2.6	Number of Receiver Ports
5.2.2.7	Main Link Channel Coding
5.2.2.8	ESI Field Mapping
5.2.2.9	Sink Device Symbol Error Count



5.3.1.1	Successful Link Training at All Supported Lane Counts and Link Speeds
5.3.1.2	Successful Link Training with Request of Higher Differential Voltage Swing During Clock Recovery Sequence
5.3.1.3	Successful Link Training to a Lower Link Rate Due to Clock Recovery Lock Failure During Clock Recovery Sequence
5.3.1.4	Successful Link Training with Request of a Change to Pre-Emphasis and/or Voltage Swing Setting During Channel Equalization Sequence
5.3.1.5	Successful Link Training at Lower Link Rate Due to Loss of Symbol Lock During Channel Equalization Sequence
5.3.1.6	Lane Count Reduction
5.3.1.7	Lane Count Increase
5.3.1.8	2-Lane Link Training CR/EQ Fallback Test
5.3.1.9	1-Lane Link Training CR/EQ Fallback Test
5.3.2.1	IRQ HPD Pulse Due to Loss of Symbol Lock and Clock Recovery Lock
5.3.2.2	IRQ HPD Pulse Due to Loss of Inter-lane Alignment Lock

## Informative DP 1.4 LL CTS for testing Sink DUT – Under VESA Review

Test Reference	Test Name (will get new numbers in DP 1.4 later)
5.4.1.1	Pixel Data Reconstruction
5.4.1.2	Main Stream Data Unpacking and Unstuffing – Least Packed TU
5.4.1.3	Main Stream Data Unpacking and Unstuffing – Most Packed TU
5.4.1.4	Pixel ClockRecovery
5.4.2	Main Video Stream Format Change Handling
5.4.3.1	Entering and Exiting Power Save Mode
5.4.3.2	Resumption of Main Link Activity After Extended Idle
5.4.4.2	Audio Startup and Format Change
5.4.4.3	RS Error Correction
5.4.4.4	Audio InfoFrame Packet
5.4.4.5	Audio Clock Recovery
5.4.4.6	Audio Stream Reception

## DP 1.2 LINK CTS

---

### DP 1.2 Reference Sink Hardware Products

Product	P/N	Description
DPR-120	065912	HBR2 and MST compliant Reference Sink

### DP 1.2 CTS Test Software Product Options for Reference Sinks

Product	P/N	Tests included
Unigraf DP LL CTS Ext1	065913	Sets A+B containing link training related tests from DP LL CTS Extensions1 (pls. see lists below)
Unigraf DP LL CTS Ext1 and Core, Set A+B+C	MC5912	Sets A+B+C containing link training related tests from DP LL CTS Extensions1 and selected tests from DP LL CTS Core. (pls. see lists below)
Unigraf DP LL CTS Extensions, Upgrade	065914	Upgrade from Set A to Sets A+B
DP RefSink LL CTS Upgrade from A+B to A+B+C	MD5912	Upgrade from Sets A+B to Sets A+B+C
DP RefSink LL CTS Set D	MF5912	Set D (Reduced Lane Count Tests)

## Description of CTS Tests for DPR-120

### Set A of Link Layer Tests for Testing Transmitter DUT

- DP 1.2 Link Ext1 tests for basic link training functions, HBR2 extension. (Tests 400.3.1.1 to 400.3.1.9)
- Additional DPCD handling tests. (Tests 700.1.1.1, 700.1.1.2)

Test Reference	Test Name
400.3.1.1 (4.3.1.2)	Successful Link Training at All Supported Lane Counts and Link Speeds: HBR2 Extension.
400.3.1.2 (4.3.1.3)	Successful Link Training with Request of Higher Differential Voltage Swing During Clock Recovery Sequence: HBR2 Extension
400.3.1.3 (4.3.1.4)	Successful Link Training to a Lower Link Rate #1: Iterate at Max Voltage Swing: HBR2 Extension
400.3.1.4 (4.3.1.5)	Successful Link Training to a Lower Link Rate #2: Iterate at Minimum Voltage Swing: HBR2 Extension
400.3.1.5 (4.3.1.6)	Successful Link Training with Request of a Higher Pre-emphasis and Post Cursor 2 Setting During Channel Equalization Sequence
400.3.1.6 (4.3.1.7)	Successful Link Training at Lower Link Rate Due to Loss of Symbol Lock During Channel Equalization Sequence: HBR2 Extension
400.3.1.7 (4.3.1.8)	Unsuccessful Link Training at Lower Link Rate #1: Iterate at Max Voltage Swing: HBR2 Extension
400.3.1.8 (4.3.1.9)	Unsuccessful Link Training at Lower Link Rate #2: Iterate at Minimum Voltage Swing: HBR2 Extension
400.3.1.9 (4.3.1.10)	Unsuccessful Link Training due to Failure in Channel Equalization Sequence (loop count > 5): HBR2 Extension
700.1.1.1 (7.1.1.1)	Additional DPCD Handling Test 1
700.1.1.2 (7.1.1.2)	Additional DPCD Handling Test 2

In column Test Reference, the test in (parenthesis) indicates the corresponding test in DP 1.2 Link Core.

## Set B of Link Layer Tests for Testing Transmitter DUT

- DP 1.2 Link Ext1 tests for link configuration changes, HBR2 extension.  
(Tests 400.3.1.12 to 400.3.1.15; 400.3.2.1 to 400.3.2.3)
- Video stamp generation (Test 400.3.3.1)

In column Test Reference, the test in parenthesis indicates the corresponding test in DP 1.2 Link Core.

Test Reference	Test Name
400.3.1.12	Successful Link Training to a Lower Link Rate #3: Iterate at Max Voltage Swing
400.3.1.13	Successful Link Training to a Lower Link Rate #4: Iterate at Minimum Voltage Swing
400.3.1.14	Successful Link Downgrade to Lowest Link Rate: Failed Clock Recovery at HBR2, Loss of Clock Recovery during Channel Equalization at HBR
400.3.1.15	Successful Link Training with Simultaneous Request for Differential Voltage Swing and Post Cursor during Clock Recovery & Channel Equalization Sequences
400.3.2.1 (4.3.2.1)	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Symbol Lock: HBR2 Extension
400.3.2.2 (4.3.2.2)	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Clock Recovery Lock: HBR2 Extension
400.3.2.3 (4.3.2.3)	Successful Link Re-training After IRQ HPD Pulse Due to Loss of Inter-lane Alignment Lock: HBR2 Extension
400.3.3.1 (4.3.3.1)	Video Time Stamp Generation

In column Test Reference, the test in (parenthesis) indicates the corresponding test in DP 1.2 Link Core.

Set C of Link Layer Tests for Testing Transmitter DUT

- Partial set of tests from DP 1.2 CTS Core not covered by Ext1.

Test Reference	Test Name
4.2.1.1	Source DUT Retry on No-Reply During AUX Read after HPD Plug Event
4.2.1.2	Source Retry on Invalid Reply During AUX Read after HPD Plug Event
4.2.2.1	EDID Read upon HPD Plug Event
4.2.2.2	DPCD Receiver Capability Read upon HPD Plug Event
4.2.2.3	EDID Read
4.2.2.4	EDID Read Failure #1: I2C-Over-AUX NACK
4.2.2.5	EDID Read Failure #2: I2C-Over-AUX DEFER
4.2.2.6	EDID Corruption Detection
4.2.2.7	Branch Device Detection upon HPD Plug Event
4.2.2.8	EDID Read on IRQ HPD Event after Branch Device Detection
4.2.2.9	E-DDC Four Block EDID Read
4.3.2.4	Handling of IRQ HPD Pulse with No Error Status Bits Set
4.3.2.5	Lane Count Reduction
4.3.2.6	Lane Count Increase
4.4.1.1	Data Packing and Steering
4.4.1.2	Main Stream Data Packing and Stuffing - Least Packed TU
4.4.1.3	Main Stream Data Packing and Stuffing - Most Packed TU
4.4.2	Main Video Stream Format Change Handling
4.4.3	Power Management

In column Test Reference, the test in (parenthesis) indicates the corresponding test in DP 1.2 Link Core.

## Set D of Link Layer Tests for Testing Transmitter DUT

- From document: DP1.4 LL CTS Additions Draft 3.pdf  
Additional DP Link layer tests for inclusion in DP1.4 CTS

Test Reference	Test Name
400.1.1.	Source Device HPD Event Pulse Length Test
400.1.2.	Source Device IRQ_HPDP Pulse Length Test
400.1.3.	Source Device Inactive HPD / Inactive AUX Test
400.2.1.	Source Device Link Training CR Fallback Test
400.2.2.	Source Device Link Training EQ Fallback Test

## HDCP 2.2 CTS FOR DISPLAYPORT SINK, SOURCE AND REPEATER DUT

---

### DP HDCP 2.2 CTS Compliant Hardware Products

Product	P/N	Description
UCD-323 HDDP *	066512	4K capable test unit for digital video inputs and outputs. USB 3.0 Interface to Host PC.
UCD-400 DP 1.4 Test Device *	066600	DP1.4 / HBR3 capable test unit for DisplayPort Sink, Source and Repeater. USB 3.0 Interface to Host PC.
UCD-340 USB-C DP Alt Mode Tester	066514	4K capable test unit for USB-C DP Alt Mode Sinks or Sources. USB 3.0 Interface to Host PC. TSI SDK Basic Test Set included
UCD-340 USB-C DP Alt Mode Tester with Electrical Test	066515	4K capable test unit for USB-C DP Alt Mode Sinks or Sources with Electrical Test. USB 3.0 Interface to Host PC. TSI SDK Basic Test Set included.
UCD-301 Digital *	066510	4K capable test unit for digital video outputs. USB 3.0 Interface to Host PC.

\*) Approved as Authorized Test Tool for DP Sinks and Sources

### CTS Test Software Product Options

Product	P/N	Tests included
HDCP 2.2 CTS for testing Source DUT on DP	MT6634	HDCP 2.2 on DisplayPort compliance tests for testing Source DUT. (Sets 1A + 1B)
HDCP 2.2 CTS for testing Sink DUT on DP	MT6636	HDCP 2.2 on DisplayPort compliance tests for testing Sink DUT. (Set 2C)
HDCP 2.2 CTS for testing Sink, Source and Repeater DUT on DP	MT6638	HDCP 2.2 on DisplayPort CTS for testing Sink, Source and Repeater DUT. (Sets 2C + 1A + 1B + 3A + 3B + 3C)

## Description of HDCP 2.2 CTS Transmitter Tests

### 1A. Downstream procedure with Receiver

HDCP2.2 CTS 1A-01	Regular Procedure – With previously connected Receiver (With stored km)
HDCP2.2 CTS 1A-02	Regular Procedure – With newly connected Receiver (Without stored km)
HDCP2.2 CTS 1A-03	Regular Procedure – Receiver disconnect after AKE_Init
HDCP2.2 CTS 1A-04	Regular Procedure – Receiver disconnect after km
HDCP2.2 CTS 1A-05	Regular Procedure – Receiver disconnect after locality check
HDCP2.2 CTS 1A-06	Regular Procedure – Receiver disconnect after ks
HDCP2.2 CTS 1A-07	Regular Procedure – Receiver sends REAUTH_REQ after ks
HDCP2.2 CTS 1A-08	Irregular Procedure – Verify Receiver Certificate
HDCP2.2 CTS 1A-09	Irregular Procedure – SRM
HDCP2.2 CTS 1A-10	Irregular Procedure – Invalid H'
HDCP2.2 CTS 1A-11	Irregular Procedure – Pairing Failure
HDCP2.2 CTS 1A-12	Irregular Procedure – Locality Failure
HDCP2.2 CTS 1A-13	Regular Procedure – Encryption Disable Bootstrapping

### 1B. Downstream procedure with Repeater

HDCP2.2 CTS 1B-01	Regular Procedure – With Repeater
HDCP2.2 CTS 1B-02	Irregular Procedure – Timeout of Receiver ID list
HDCP2.2 CTS 1B-03	Irregular Procedure – Verify V'
HDCP2.2 CTS 1B-04	Irregular Procedure – MAX_DEVS_EXCEEDED
HDCP2.2 CTS 1B-05	Irregular Procedure – MAX_CASCADE_EXCEEDED
HDCP2.2 CTS 1B-06	Irregular Procedure – Incorrect seq_num_V
HDCP2.2 CTS 1B-07	Regular Procedure – Re-authentication on HPD
HDCP2.2 CTS 1B-08	Regular Procedure – Re-authentication on REAUTH_REQ
HDCP2.2 CTS 1B-09	Irregular Procedure – Rollover of seq_num_V
HDCP2.2 CTS 1B-10	Irregular Procedure – Failure of Content Stream Management



## Description of HDCP 2.2 CTS Receiver Tests

### 2C. Upstream procedure with Transmitter

HDCP2.2 CTS 2C-01	Regular Procedure – With transmitter
HDCP2.2 CTS 2C-02	Irregular Procedure – New Authentication after AKE_Init
HDCP2.2 CTS 2C-03	Irregular Procedure – New Authentication during Locality Check
HDCP2.2 CTS 2C-04	Irregular Procedure – New Authentication after SKE_Send_Eks
HDCP2.2 CTS 2C-05	Irregular Procedure – New Authentication during Link Synchronization
HDCP2.2 CTS 2C-06	Regular Procedure – Encryption Disable Bootstrapping

## Description of HDCP 2.2 CTS Repeater Tests

### 3A. Downstream Procedure with Receiver

HDCP2.2 CTS 3A-01	Regular Procedure - With previously connected Receiver (With stored $k_m$ )
HDCP2.2 CTS 3A -02	Regular Procedure - With newly connected Receiver (Without stored $k_m$ )
HDCP2.2 CTS 3A -03	Irregular Procedure - Verify Receiver Certificate
HDCP2.2 CTS 3A -04	Irregular Procedure - invalid H'
HDCP2.2 CTS 3A -05	Irregular Procedure - Pairing Failure
HDCP2.2 CTS 3A -06	Irregular Procedure - Locality Failure

### 3A. Downstream Procedure with Repeater

HDCP2.2 CTS 3B-01	Regular Procedure - With Repeater
HDCP2.2 CTS 3B -02	Irregular Procedure - Timeout of Receiver ID list
HDCP2.2 CTS 3B -03	Irregular Procedure - Verify V'
HDCP2.2 CTS 3B -04	Irregular Procedure - MAX_DEVS_EXCEEDED
HDCP2.2 CTS 3B -05	Irregular Procedure - MAX_CASCADE_EXCEEDED
HDCP2.2 CTS 3B -06	Irregular Procedure - Rollover of $seq\_num\_V$
HDCP2.2 CTS 3B -07	Irregular Procedure - Failure of Content Stream Management

### 3C. Downstream Procedure with Transmitter

Repeater (DUT) Connected to Transmitter (TE pseudo-Source) and Receiver (TE pseudo-Sink)

HDCP2.2 CTS 3C-01	Regular Procedure - Transmitter - DUT - Receiver
HDCP2.2 CTS 3C -02	Regular Procedure - Receiver Disconnect Propagation when an Active Receiver is Disconnected Downstream
HDCP2.2 CTS 3C -03	Regular Procedure - Receiver Connected when an Active Receiver is Connected Downstream
HDCP2.2 CTS 3C -04	Irregular Procedure - New Authentication after AKE_init
HDCP2.2 CTS 3C -05	Irregular Procedure - New Authentication during Locality Check
HDCP2.2 CTS 3C -06	Irregular Procedure - New Authentication after SKE_Send_Eks
HDCP2.2 CTS 3C -07	Irregular Procedure - New Authentication during Link Synchronization
HDCP2.2 CTS 3C -08	Irregular Procedure - Rx Certificate invalid
HDCP2.2 CTS 3C -09	Irregular Procedure - invalid H'
HDCP2.2 CTS 3C -10	Irregular Procedure - Locality Failure

Repeater (DUT) Connected to Transmitter (TE pseudo-Source) and Receiver (TE pseudo-Repeater)

HDCP2.2 CTS 3C-11	Regular Procedure - Transmitter - DUT - Repeater (With stored km)
HDCP2.2 CTS 3C-12	Regular Procedure - Receiver disconnect after AKE_Init
HDCP2.2 CTS 3C-13	Regular Procedure - Receiver disconnect after $k_m$
HDCP2.2 CTS 3C-14	Regular Procedure - Receiver disconnect after locality check
HDCP2.2 CTS 3C-15	Regular Procedure - Receiver disconnect after $K_s$
HDCP2.2 CTS 3C-16	Irregular Procedure - Timeout of Receiver ID list
HDCP2.2 CTS 3C-17	Irregular Procedure - Verify V'
HDCP2.2 CTS 3C-18	Irregular Procedure - DEVICE_COUNT
HDCP2.2 CTS 3C-19	Irregular Procedure - DEPTH
HDCP2.2 CTS 3C-20	Irregular Procedure - MAX_DEVS_EXCEEDED
HDCP2.2 CTS 3C-21	Irregular Procedure - MAX_CASCADE_EXCEEDED
HDCP2.2 CTS 3C-22	Regular Procedure - Repeater with zero downstream device
HDCP2.2 CTS 3C-23	Regular Procedure - Propagation of HDCP2_0_REPEATER_DOWNSTREAM flag
HDCP2.2 CTS 3C-24	Regular Procedure - Propagation of HDCP1_DEVICE_DOWNSTREAM flag
HDCP2.2 CTS 3C-25	Regular Procedure - Content Stream Management

## DP 1.1 REFSINK CTS TOOLS

---

### DP Reference Sink Hardware Products

Product	P/N	Description
DPR-100	065910	Compact sized DP 1.1 compliant Reference Sink with DP Sink Console software

### CTS Test Software Product Options for Reference Sinks

Product	P/N	Tests included
DP RefSink HDCP CTS	065035	HDCP 1.3 CTS for Testing Transmitters
DP RefSink Extended HDCP CTS Upgrade	065039	Extended HDCP 1.3 CTS for testing Transmitters and Repeaters
DP RefSink Audio CTS	065043	Audio CTS for Testing Transmitters

## Description of CTS Tests for Reference Sinks

### HDCP 1.3 CTS for Testing Transmitter DUT

Test Reference	Test Name
(1A-01)	Regular Procedure: With Receiver
(1A-02)	Regular Procedure: HPD After Writing Aksv
(1A-03)	Regular Procedure: HPD During Link Integrity Check Stage
(1A-04)	Irregular Procedure: (First Part of Authentication) Failure to Read Bcaps HDCP_CAPABLE Bit
(1A-05)	Irregular Procedure: (First Part of Authentication) Verify Bksv
(1A-06)	Irregular Procedure: (First Part of Authentication) Verify R0'
(1A-07)	Irregular Procedure: (Link Integrity Check) Link Integrity Failure
(1A-08)	Irregular Procedure: SRM
(1A-09)	Regular Procedure: Encryption Disable Bootstrapping

## Extended HDCP 1.3 CTS for Testing Transmitter and Repeater DUT

### Tests for Transmitter DUT:

Test Reference	Test Name
(1B-01)	Regular Procedure: With Repeater
(1B-02)	Irregular Procedure: Spurious CP_IRQ Interrupt
(1B-03)	Regular Procedure: HPD after Reading R0'
(1B-04)	Irregular Procedure: (Second part of Authentication) Timeout of KSV List READY
(1B-05)	Irregular Procedure: (Second part of Authentication) Verify V'
(1B-06)	Irregular Procedure: (Second part of Authentication) MAX_DEVS_EXCEEDED
(1B-07)	Irregular Procedure: (Second part of Authentication) MAX_CASCADE_EXCEEDED

### Tests for Repeater DUT:

Test Reference	Test Name
(3A-01)	Regular Procedure: With Receiver
(3A-02)	Irregular Procedure: (First part of Authentication) Failure to Read Bcaps HDCP_CAPABLE Bit
(3A-03)	Irregular Procedure: (First part of Authentication) Verify Bksv
(3A-04)	Irregular Procedure: (First part of Authentication) Verify R0'
(3B-01)	Regular Procedure: With Repeater
(3B-02)	Irregular Procedure: (Second part of Authentication) Timeout of KSV List READY
(3B-03)	Irregular Procedure: (Second part of Authentication) Verify V'
(3B-04)	Irregular Procedure: (Second part of Authentication) MAX_DEVS_EXCEEDED
(3B-05)	Irregular Procedure: (Second part of Authentication) MAX_CASCADE_EXCEEDED

## Audio CTS for Testing Transmitter DUT

Test Reference	Test Name
(4.4.4.2)	Audio Stream Header Synchronization <i>(Note: Always Skipped, HW does not support the test procedure)</i>
(4.4.4.3)	Audio Time Stamp Generation
(4.4.4.4)	Audio InfoFrame Packet
(4.4.4.5)	Audio Stream Transmission
(4.4.4.6)	Audio Start Sequence

# DP 1.1 REFSOURCE CTS TOOLS

---

## Reference Source and Sink Hardware Products

Product	P/N	Description
DPT-200	065921	Compact sized DP 1.1 compliant Reference Source with DP Source Console software
VTG-5225 DP	065031	DP 1.1 compliant Reference Source and Pattern Generator with WinVTG GUI software
DPR-100	065910	DPR-100 Reference Sink can be used as Pseudo Sink or Pseudo Repeater in HDCP CTS. <i>Please contact Unigraf for details.</i>

## CTS Test Software Product Options for Reference Sources

Product	P/N	Tests included
DP RefSource CTS LL	065032	- Link Layer CTS for testing Receivers
DP RefSource CTS LL & HDCP	065036	- Link Layer CTS for testing Receivers - HDCP 1.3 CTS for Testing Receivers
DP RefSource CTS LL & HDCP & EXT HDCP	065045	- Link Layer CTS for testing Receivers - HDCP 1.3 CTS for Testing Receivers - Extended HDCP 1.3 CTS for Testing Repeaters

## Description of CTS Tests for Reference Sources

### Link Layer CTS for testing Receiver DUT

Test Reference	Test Name
(5.2.1.1)	Read One Byte from Valid DPCD Address
(5.2.1.2)	DPCD Receiver Capability Read (Read Twelve Bytes from Valid DPCD Address)
(5.2.1.3)	Write One Byte to Valid DPCD Address
(5.2.1.4)	Write Nine Bytes to Valid DPCD Addresses
(5.2.1.5)	Write EDID Offset (One Byte I2C-Over-Aux Write)
(5.2.1.6)	Read One EDID Byte (One Byte I2C-Over-Aux Read)
(5.2.1.7)	EDID Read (1 Byte I2C-Over-Aux Segment Write, 1 Byte I2C-Over-Aux Offset Write, 128 Byte I2C-Over-Aux Read)
(5.2.1.8)	Illegal Aux Request Syntax
(5.2.1.9)	Glitch Rejection

## Link Layer CTS for testing Receiver DUT (cont.d)

(5.2.1.10)	Interleaved EDID and DPCD Receiver Capability Read
(5.2.1.11)	Downstream Stop on MOT Reset
(5.2.1.12)	Downstream Stop on MOT Timeout
(5.3.1.1)	Successful Link Training at All Supported Lane Counts and Link Speeds
(5.3.1.2)	Successful Link Training with Request of Higher Differential Voltage Swing During Clock Recovery Sequence
(5.3.1.3)	Successful Link Training to a Lower Link Rate Due To Clock Recovery Lock Failure During Clock Recovery Sequence
(5.3.1.4)	Successful Link Training with Request of a Change to Pre-Emphasis and/or Voltage Swing Setting During Channel Equalization Sequence
(5.3.1.5)	Successful Link Training at Lower Link Rate Due to Loss of Symbol Lock During Channel Equalization Sequence
(5.3.1.6)	Lane Count Reduction
(5.3.1.7)	Lane Count Increase
(5.3.2.1)	IRQ_HPDPulse Due to Loss of Symbol Lock and Clock Recovery Lock
(5.3.2.2)	IRQ_HPDPulse Due to Loss of Inter-lane Alignment Lock
(5.4.1.1)	Pixel Data Reconstruction
(5.4.1.2)	Main Stream Data Unpacking and Unstuffing – Least Packed TU
(5.4.1.3)	Main Stream Data Unpacking and Unstuffing – Most Packed TU
(5.4.1.4)	Pixel Clock Recovery ( <i>Note: Informative, HW does not support SSC</i> )
(5.4.2)	Main Video Stream Format Change Handling
(5.4.3.1)	Entering and Exiting Power Save Mode
(5.4.3.2)	Resumption of Main Link Activity After Extended Idle
(7.2.1.1)	Sink Organizationally Unique Identifier (OUI)
(7.2.1.2)	Sink Count
(7.2.1.3)	Sink Status
(7.2.1.4)	Symbol Error Count
(7.2.1.5)	Device Identifications
(7.2.1.6)	Number of Receiver Ports
(7.2.1.7)	Main Link Channel Coding



## HDCP 1.3 CTS for Testing Receiver DUT

Test Reference	Test Name
(2A-01)	Regular Procedure: With Transmitter
(2A-02)	Irregular Procedure: (First Part of Authentication) New Authentication
(2A-03)	Irregular Procedure: (Link Integrity Check) New Authentication
(2A-04)	Regular Procedure: Encryption Disable Bootstrapping

## Extended HDCP 1.3 CTS for Testing Repeater DUT

Test Reference	Test Name
(3C-01)	Regular Procedure: Transmitter - DUT - Receiver
(3C-02)	Regular Procedure: HPD Propagation when an Active Receiver is Disconnected and Reconnected Downstream
(3C-03)	Regular Procedure: HPD Propagation when an Active Receiver is Disconnected Downstream
(3C-04)	Regular Procedure: HPD Propagation when an Active Receiver is Connected Downstream
(3C-05)	Irregular Procedure: (First part of Authentication) New Authentication
(3C-06)	Irregular Procedure: (Second part of Authentication) New Authentication
(3C-07)	Irregular Procedure: (Link Integrity Check) New Authentication
(3C-08)	Irregular Procedure: (Second part of Authentication) Verify Bksv
(3C-09)	Irregular Procedure: (Second part of Authentication) Verify R0'
(3C-10)	Regular Procedure: Transmitter - DUT - Repeater
(3C-11)	Regular Procedure: HPD After Writing Aksv
(3C-12)	Regular Procedure: HPD After Reading R0'
(3C-13)	Regular Procedure: HPD After Starting Third part of Authentication
(3C-14)	Irregular Procedure: (Second part of Authentication) Verify V'
(3C-15)	Irregular Procedure: (Second part of Authentication) DEVICE_COUNT
(3C-16)	Irregular Procedure: (Second part of Authentication) DEPTH
(3C-17)	Irregular Procedure: (Second part of Authentication) MAX_DEVS_EXCEEDED
(3C-18)	Irregular Procedure: (Second part of Authentication) MAX_CASCADE_EXCEEDED

---

Note                      Please contact Unigraf for details on using DPR-100 Reference Sink as Pseudo Sink or Pseudo Repeater in HDCP CTS.

---

## Audio CTS for Testing Receiver DUT

Currently not available

## Version History

Rev.	Date	Author	Description
24	15.06.2016	JSa	-
25 DRAFT	07.12.2017	JSa	<ul style="list-style-type: none"> <li>- Modified old titles to HDCP &gt; HDCP 1.3</li> <li>- Added DP HDCP 2.2 compliant HW products</li> <li>- Added DP HDCP 2.2 SW products</li> <li>- Added descriptions of 1A, 1B and 2C</li> <li>- Added DP 1.4. TE basic description</li> <li>- Updated document reference to Reduced Lane Count Tests (p 11)</li> <li>- Updated / corrected contents of DP 1.2 CTS Set D</li> </ul>
26	14.12.2017	JSa	<ul style="list-style-type: none"> <li>- Added descriptions of 3A, 3B and 3C</li> <li>- Added definitions of DP 1.4 LL CTS 4.3.1.1 - 4.3.1.10</li> <li>- Added "DP 1.4 LL CTS Additions for testing Source DUT"</li> </ul>
27	12.04.2018	JSa	- Added UCD-400 and UCD-301 as approved test device
			-
			-
			-
			-
			-