DisplayPort™ CTS Tool Options for UCD-500

Guide to Product Options

//// UNIGRAF

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Reference Standards

VESA DisplayPort v1.4a Link Layer Compliance Test Specification (Link CTS),
Revision 1.0, June 12, 2019

VESA® DisplayPort® DSC Link Layer Compliance Test Specification, Version 1.4a,
Revision 1.1, Draft 6, Nov 18, 2019

VESA® DisplayPort® DP 2.0 Link Layer Compliance Test Specification, Version 2.0,
Revision 1.0, Phase 1, Draft 5, Aug 2, 2021

VESA DisplayPort v2.x DisplayID EDID Link Layer Compliance Test Specification, Version 1.4, 16
December, 2021

VESA DisplayPort v2.x Adaptive-Sync Link Layer Compliance Test Specification, Version 1.0, 16
December 2021

High-bandwidth Digital Content Protection, Revision 2.3 on DisplayPort,
Compliance Test Specification, Revision 1.1, 4 March 2019

DP 2.1 Reference Hardware Products

Product	P/N	Description
UCD-500 Tester	066700	DP 2.1 capable test unit for DisplayPort Sink and Source up to 10K@60Hz 24bpp. Support DP and USB-C connectors. USB 3.0 Interface to Host PC.

DP Link CTS Test Software Product Options

Product	P/N	Description
DP 1.4a LL CTS for testing Source DUT	MT6637	DP 1.4a LL, FEC & Audio compliance tests for testing Source DUT.
DP 1.4a LL CTS for testing Sink DUT	MT6635	DP 1.4a LL, FEC & Audio compliance tests for testing Sink DUT.
DP 2.1 LL CTS for testing Sink DUT	MT6660	DP 2.1 LL compliance tests for testing Sink DUT. Audio, DSC and FEC CTS included.
DP 2.1 LL CTS for testing Source DUT	MT6662	DP 2.1 LL compliance tests for testing Source DUT. Audio, DSC and FEC CTS included.
DP 2.1 + DP 1.4a LL CTS for testing Sink DUT	MT6660 + MT6635	DP 1.4a & DP 2.1 LL compliance tests for testing Sink DUT. Audio, DSC and FEC CTS included.
DP 2.1 + DP 1.4a LL CTS for testing Source DUT	MT6662 + MT6637	DP 1.4a & DP 2.1 LL compliance tests for testing Source DUT. Audio, DSC and FEC CTS included.
DP 1.4a DSC CTS for testing Source DUT	MT6642	Display Stream Compression compliance tests for testing Source DUT.
DP 1.4a DSC CTS for testing Sink DUT	MT6643	Display Stream Compression compliance tests for testing Sink DUT.
DP 2.1 DisplayID/EDID CTS for testing Source DUT	MT6646	DisplayID CTS for testing Source DUT.
DP 2.1 DisplayID/EDID CTS for testing Sink DUT	MT6647	DisplayID CTS for testing Sink DUT.
DP 2.1 Adaptive-Sync CTS for testing Source DUT	MT6648	Adaptive-Sync CTS for testing Source DUT.
DP 2.1 Adaptive-Sync CTS for testing Sink DUT	MT6649	Adaptive-Sync CTS for testing Sink DUT.

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DP 2.1 Link Layer CTS	4.2.2.11 – 4.2.2.12; 4.3.1.1 – 4.3.1.5; 4.3.1.14 – 4.3.1.23			●		
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Adaptive-Sync LL CTS**	4.8.1.1 – 4.8.1.2, 4.8.2.1 – 4.8.2.2					●

*) Separate licenses for testing Sink, Source, Branch (LL CTS, DSC, DisplayID) DUT

**) Unigraf UCD-400 was used by VESA for TE correlation of the tests

Sink DUT Testing		DP 1.4a LL CTS*	DP 1.4a DSC CTS*	DP 2.1 LL CTS*	DisplayID/EDID CTS*	AdaptiveSync CTS*
DP 1.4a Link Layer CTS	5.2.1.1 – 5.2.1.12, 5.2.2.1 – 5.2.2.9, 5.3.1.1 – 5.3.1.9, 5.3.2.1 – 5.3.2.2, 5.4.1.1 – 5.4.1.4, 5.4.2, 5.4.3.1 – 5.4.3.2, 5.4.4.1 – 5.4.4.6, 5.5.1.1 – 5.5.1.7	●				
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DisplayID/EDID CTS**	5.7.1.1 – 5.7.1.2, 5.7.1.3.1 – 5.7.1.3.4, 5.7.1.4.1 – 5.7.1.4.9, 5.7.1.5, 5.7.2.1 – 5.7.2.3.5, 5.7.4.1 – 5.7.4.2, 5.7.2.5.1 – 5.7.2.5.2, 5.7.2.6.1 – 5.7.2.6.2, 5.7.2.7.1, 5.7.2.8, 5.7.3.1 – 5.7.3.5, 5.7.4.1 – 5.7.4.3, 5.7.4.5, 5.7.5.1, 5.7.6.1 – 5.7.6.5, 5.7.7.1 – 5.7.7.6, 5.7.8.1 – 5.7.8.6, 5.7.9.1 – 5.7.9.3, 5.7.10.1 – 5.7.10.3, 5.7.11.1 – 5.7.12.5, 5.7.12.1 – 5.7.12.3				●	
Adaptive-Sync LL CTS**	5.8.1.1 – 5.8.1.3 (Tests are in VESA correlation)					●

*) Separate licenses for testing Sink, Source, Branch (LL CTS, DSC, DisplayID) DUT

**) DP DisplayID/EDID CTS and Adaptive-Sync CTS will be supported in future versions of UCD-500

2. LINK CTS FOR TESTING SOURCE DUT

DP 1.4a LL CTS for testing Source DUT (P/N: MT6637)

AUX Reads after HPD Plug Event

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DP 2.1 LL CTS for testing Source DUT (P/N: MT6637)

AUX Reads after HPD Plug Event

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*) Test available. VESA Status: TE Correlation process not started

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DisplayID/EDID CTS for testing Source DUT (P/N: MT6646)

Note: Unigraf UCD-400 was used by VESA for TE correlation of the tests

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Source Device Test Procedures (Adaptive-Sync)

Test Reference	Test Name
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*) Test available. VESA Status: In TE Correlation process

Adaptive-Sync CTS for testing Source DUT (P/N: MT6648)

Note: Unigraf UCD-400 was used by VESA for TE correlation of the tests

Fixed-Average VTotal Mode Support Validation

Test Reference	Test Name
(4.8.1.1)*	Fixed-Average VTotal Mode Support over the Declared Frame Rate Range
(4.8.1.2)*	Fixed-Average VTotal Mode Duration Increase and Decrease Constraint Value Support

*) Test available. VESA Status: In TE Correlation process

Adaptive VTotal Mode Support Validation

Test Reference	Test Name
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(4.8.2.2)*	Adaptive VTotal Mode Support with Unconstrained Duration Increase and Decrease

*) Test available. VESA Status: In TE Correlation process

3. LINK CTS FOR TESTING SINK DUT

DP 1.4a LL CTS for testing Sink DUT (P/N MT6635)

AUX Channel Protocol

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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

Sink Device DPCD Field Implementation Addendum

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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
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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
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5.5.1.7	Correctable Parity Bit error count

DP 1.4a DSC CTS For testing Sink DUT (P/N MT6643)

Sink Device DSC Test Procedures

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5.6.2.7	DSC Native 4:2:0 min and max bits-per-pixel test
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5.6.2.10	DSC Native 4:2:0 most pack test
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5.6.2.13	DSC interrupt test for RC buffer under-run error
5.6.2.14	DSC interrupt test for RC buffer overflow error

DP 2.1 LL CTS for testing Sink DUT (P/N MT6660)

AUX Channel Protocol

Test Reference	Test Name
(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

*) Test available. VESA Status: In TE Correlation process

Sink Device DPCD Field Implementation Addendum

(5.2.2.1)*	Sink Organizationally Unique Identifier (OUI)
(5.2.2.2)*	Sink Count
(5.2.2.3)*	Sink Status
(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

*) Test available. VESA Status: In TE Correlation process

Link Training

(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
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*) Test available. VESA Status: In TE Correlation process

Link Maintenance

Test Reference	Test Name
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*) Test available. VESA Status: In TE Correlation process

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(5.5.1.5)*	Correctable Bit error count
(5.5.1.6)*	Correctable Parity Block error count
(5.5.1.7)*	Correctable Parity Bit error count

*) Test available. VESA Status: In TE Correlation process

DisplayID/EDID CTS for testing Sink DUT (P/N MT6647)

Note:	Unigraf UCD-400 was used by VESA for TE correlation of the tests

EDID Block 0

Test Reference	Test Name
5.7.1.1	VESA E-EDID Verification Guide (Syntax Verification Only)
5.7.1.2	Physical Display Characteristics

EDID Block 0 (Basic Display Parameters and Features)

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5.7.1.4.6	Test for Valid Established Timings III Descriptor (tag #F7h)
5.7.1.4.7	Test for Valid String Descriptors (tags #FFh, #FEh, #FCh)
5.7.1.4.8	Unused – Reserved Data Tag Number (Tags #11h to #F6h)
5.7.1.4.9	Test for Valid Dummy Descriptors (tag #10h)

5.7.1.5	Test for Valid Extension Flag and Checksum

CTA Block Validation (CTA Extension Format)

5.7.2.1	CEA Extension Version Number
5.7.2.2	Byte #2 (18-byte Descriptor Offset 'd')
5.7.2.3.1	Byte #3 - Underscan support
5.7.2.3.2	Byte #3 - Basic audio support
5.7.2.3.3	Byte #3 - YCbCr Support
5.7.2.3.4	Byte #3 - Native DTD Count
5.7.2.3.5	Byte #3 - Byte 3 Consistency

Data Block Collection (Type Validation)

5.7.2.4.1	Duplicate Data Block Validation
5.7.2.4.2	Validity of Data Block Types

Short Video Descriptors (SVDs)

5.7.2.5.1	Validity of SVDs
5.7.2.5.2	SVD/DTD Ordering

Audio Data Block

Test Reference	Test Name
5.7.2.6.1	Duplicate Audio Format Codes
5.7.2.6.2	Audio Output Validation

Speaker Allocation Data Block

Test Reference	Test Name
5.7.2.7.1	Verify Max Number of Channels

5.7.2.8	Test for Detailed Timing Descriptors

DisplayID Extension Block Framework Validation

5.7.3.1	DisplayID EDID Extension Block Tag (Byte#0) and extension version (Byte#1)
5.7.3.2	DisplayID Section Size, Byte#2
5.7.3.3	DisplayID Product Identifier/ Primary Use Case, Byte#3
5.7.3.4	DisplayID Extension Count, Byte#4
5.7.3.5	DisplayID Section Checksums

DisplayID Extension Block Tiled Display Topology Block

5.7.4.1	Block Revision (Byte#1)
5.7.4.2	Number of Payload Bytes in Block (Byte#2)
5.7.4.3	Tiled Display Capabilities (Byte#3, bit 6 and bit 7)
5.7.4.5	Tile Size (Byte#7 to Byte#10)

DisplayID Extension with Stereo Display Interface Data Blocks

5.7.5.1	Block Revision and Other Data (Byte #1)
5.7.5.2	Number of Payload Bytes in Block (Byte#2)

DisplayID Extension with Type VII Detailed Timing Block

5.7.6.1	Block Revision (Byte#1)
5.7.6.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.6.3	Pixel Clock (Bytes #0 through #2 of each Descriptor)
5.7.6.4	Descriptor Payload Verification (Bytes #3 through #19 of each Descriptor)
5.7.6.5	Timing Support Validation

DisplayID Extension with Type VIII Detailed Timing Block

5.7.7.1	Block Revision and Other Data (Byte#1)
5.7.7.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.7.3	DMT Timing Codes
5.7.7.4	CTA Timing Codes
5.7.7.5	HDMI Timing Codes
5.7.7.6	Timing Support Validation

DisplayID Extension with Type IX Detailed Timing Block

Test Reference	Test Name
5.7.8.1	Block Revision and Other Data (Byte#1)
5.7.8.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.8.3	Timing Options (Byte #0 of each Descriptor)
5.7.8.4	Horizontal Active Image Pixels and Vertical Active Image Lines (Bytes #1-4 of each Descriptor)
5.7.8.5	Refresh Rate and Pixel Clock (Byte #5 of each Descriptor)
5.7.8.6	Timing Support Validation

CTA Data Blocks in a DisplayID Extension

5.7.9.1	Block Revision (Byte#1)
5.7.9.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.9.3	Validity of Data Block Types

DisplayID Vendor-Specific Data Blocks

5.7.10.1	Block Revision (Byte#1)
5.7.10.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.10.3	Manufacturer/Vendor ID Field

Dynamic Video Timing Range Limits Data Block

5.7.11.1	Block Revision (Byte#1)
5.7.11.2	Block Number of Payload Bytes in Block (Byte#2)
5.7.11.3	Minimum and Maximum Pixel Clock (Bytes #3 through #8)
5.7.11.4	Minimum and Maximum Vertical Refresh Rate (Bytes #9 and #10)
5.7.11.5	Dynamic Video Timing Range Support Flags (Byte #11)

DisplayID Data Block Version Validation

5.7.12.1	DisplayID Version 1.x Blocks
5.7.12.2	DisplayID Version 2.x Blocks
5.7.12.3	DisplayID Version 2.x Multiple Instances of Data Blocks

Adaptive-Sync CTS for testing Sink DUT (P/N MT6649)

Note: Unigraf UCD-400 was used by VESA for TE correlation of the tests

Adaptive-Sync Operation Validation

Test Reference	Test Name
(5.8.1.1)*	Fixed-Average VTotal Mode Support over the Declared Frame Rate Range
(5.8.1.2)*	Duration Increase and Decrease Constraint Value Support in Adaptive VTotal Mode
(5.8.1.3)*	Adaptive VTotal Mode Support

*) Test available. VESA Status: In TE Correlation process

4. HDCP CTS FOR DISPLAYPORT

Note: With SW version 2.3 HDCP is supported only when 8b/10b link coding is enabled

DP HDCP 2.3 CTS Capable Hardware Products

Product	P/N	Description
UCD-500 DP 2.1 Test Device	066700	DisplayPort™ 2.1 Video Generator and Analyzer unit for testing DisplayPort Sinks and Sources up to 8K@60Hz and 16K@60 Hz (with DSC) video modes with UHBR 20 Max Bit Rate Capability.

DP HDCP 2.3 CTS Test Software Product Options

Product	P/N	Description
HDCP 2.3 CTS for testing Source DUT on DP	MT6634	HDCP 2.3 on DisplayPort compliance tests for testing Source DUT. (Sets 1A + 1B)
HDCP 2.3 CTS for testing Sink DUT on DP	MT6636	HDCP 2.3 on DisplayPort compliance tests for testing Sink DUT. (Set 2C)
HDCP 2.3 CTS for Repeater DUT on DP	MT6638	HDCP 2.3 on DisplayPort CTS for testing Sink, Source and Repeater DUT. (Sets 1A + 1B + 2C + 3A + 3B + 3C)

Description of HDCP 2.3 CTS Tests

Note:	With SW version 2.3 HDCP is supported only when 8b/10b link coding is enabled

DP HDCP 2.3 CTS for testing Source DUT (P/N MT6634)

1A. Downstream procedure with Receiver

Test Reference	Test Name
HDCP2.3 CTS 1A-01	Regular Procedure – With previously connected Receiver (With stored km)
HDCP2.3 CTS 1A-02	Regular Procedure – With newly connected Receiver (Without stored km)
HDCP2.3 CTS 1A-03	Regular Procedure – Receiver disconnect after AKE_Init
HDCP2.3 CTS 1A-04	Regular Procedure – Receiver disconnect after km
HDCP2.3 CTS 1A-05	Regular Procedure – Receiver disconnect after locality check
HDCP2.3 CTS 1A-06	Regular Procedure – Receiver disconnect after ks
HDCP2.3 CTS 1A-07	Regular Procedure – Receiver sends REAUTH_REQ after ks
HDCP2.3 CTS 1A-08	Irregular Procedure – Verify Receiver Certificate
HDCP2.3 CTS 1A-09	Irregular Procedure – SRM
HDCP2.3 CTS 1A-10	Irregular Procedure – Invalid H'
HDCP2.3 CTS 1A-11	Irregular Procedure – Pairing Failure
HDCP2.3 CTS 1A-12	Irregular Procedure – Locality Failure

1B. Downstream procedure with Repeater

HDCP2.3 CTS 1B-01	Regular Procedure – With Repeater
HDCP2.3 CTS 1B-02	Irregular Procedure – Timeout of Receiver ID list
HDCP2.3 CTS 1B-03	Irregular Procedure – Verify V'
HDCP2.3 CTS 1B-04	Irregular Procedure – MAX_DEVS_EXCEEDED
HDCP2.3 CTS 1B-05	Irregular Procedure – MAX CASCADE_EXCEEDED
HDCP2.3 CTS 1B-06	Irregular Procedure – Incorrect seq_num_V
HDCP2.3 CTS 1B-07	Regular Procedure – Re-authentication on HPD
HDCP2.3 CTS 1B-08	Regular Procedure – Re-authentication on REAUTH_REQ
HDCP2.3 CTS 1B-09	Irregular Procedure – Rollover of seq_num_V
HDCP2.3 CTS 1B-10	Irregular Procedure – Failure of Content Stream Management

DP HDCP 2.3 CTS for testing Sink DUT (P/N MT6636)

| Note: | With SW version 2.3 HDCP is supported only when 8b/10b link coding is enabled |

2C. Upstream procedure with Transmitter

Test Reference	Test Name
HDCP2.3 CTS 2C-01	Regular Procedure – With transmitter
HDCP2.3 CTS 2C-02	Irregular Procedure – New Authentication after AKE_Init
HDCP2.3 CTS 2C-03	Irregular Procedure – New Authentication during Locality Check
HDCP2.3 CTS 2C-04	Irregular Procedure – New Authentication after SKE_Send_Eks
HDCP2.3 CTS 2C-05	Irregular Procedure – New Authentication during Link Synchronization

DP HDCP 2.3 CTS for testing Sink, Source and Repeater DUT (P/N MT6638)

Note:	With SW version 2.3 HDCP is supported only when 8b/10b link coding is enabled

1A. Downstream procedure with Receiver

Please see above

1B. Downstream procedure with Repeater

Please see above

2C. Upstream procedure with Transmitter

Please see above

3A. Downstream procedure with Receiver

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

3B. Downstream Procedure with Repeater

HDCP2.3 CTS 3B-01	Regular Procedure – With Repeater
HDCP2.3 CTS 3B -02	Irregular Procedure – Timeout of Receiver ID list
HDCP2.3 CTS 3B -03	Irregular Procedure – Verify V'
HDCP2.3 CTS 3B -04	Irregular Procedure – MAX_DEVS_EXCEEDED
HDCP2.3 CTS 3B -05	Irregular Procedure – MAX_CASCADE_EXCEEDED
HDCP2.3 CTS 3B -06	Irregular Procedure – Rollover of *seq_num_V*
HDCP2.3 CTS 3B -07	Irregular Procedure – Failure of Content Stream Management

3C. Downstream Procedure with Transmitter

Test Reference	Test Name
HDCP2.3 CTS 3C-01	Regular Procedure – Transmitter – DUT – Receiver
HDCP2.3 CTS 3C -02	Regular Procedure – Receiver Disconnect Propagation when an Active Receiver is Disconnected Downstream
HDCP2.3 CTS 3C -03	Regular Procedure – Receiver Connected when an Active Receiver is Connected Downstream
HDCP2.3 CTS 3C -04	Irregular Procedure – New Authentication after AKE_init
HDCP2.3 CTS 3C -05	Irregular Procedure – New Authentication during Locality Check
HDCP2.3 CTS 3C -06	Irregular Procedure – New Authentication after SKE_Send_Eks
HDCP2.3 CTS 3C -07	Irregular Procedure – New Authentication during Link Synchronization
HDCP2.3 CTS 3C -08	Irregular Procedure – Rx Certificate invalid
HDCP2.3 CTS 3C -09	Irregular Procedure – invalid H'
HDCP2.3 CTS 3C -10	Irregular Procedure – Locality Failure
HDCP2.3 CTS 3C-11	Regular Procedure – Transmitter – DUT – Repeater (With stored km)
HDCP2.3 CTS 3C-12	Regular Procedure – Receiver disconnect after AKE_Init
HDCP2.3 CTS 3C-13	Regular Procedure – Receiver disconnect after km
HDCP2.3 CTS 3C-14	Regular Procedure – Receiver disconnect after locality check
HDCP2.3 CTS 3C-15	Regular Procedure – Receiver disconnect after Ks
HDCP2.3 CTS 3C-16	Irregular Procedure – Timeout of Receiver ID list
HDCP2.3 CTS 3C-17	Irregular Procedure – Verify V'
HDCP2.3 CTS 3C-18	Irregular Procedure – DEVICE_COUNT
HDCP2.3 CTS 3C-19	Irregular Procedure – DEPTH
HDCP2.3 CTS 3C-20	Irregular Procedure – MAX_DEVS_EXCEEDED
HDCP2.3 CTS 3C-21	Irregular Procedure – MAX_CASCADE_EXCEEDED
HDCP2.3 CTS 3C-22	Regular Procedure – Repeater with zero downstream device
HDCP2.3 CTS 3C-23	Regular Procedure – Propagation of HDCP2_0_REPEATER_DOWNSTREAM flag
HDCP2.3 CTS 3C-24	Regular Procedure – Propagation of HDCP1_DEVICE_DOWNSTREAM flag
HDCP2.3 CTS 3C-25	Regular Procedure – Content Stream Management