UCD Console for UCD-400 UCD-411



User Manual



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Table of Contents

1.	About This Manual	6
	Purpose	6
	Product and Driver Version	6
	Notes	6
2.	Introduction	7
	Unpacking	9
	Installation Package	9
	Software Installation	9
3.	License Manager 1	0
4.	Firmware Update Procedure1	2
5.	UCD Console1	5
	Options1	7
	TSI Integration	
	Detaching Tabs1	
6.	DisplayPort Reference Sink 2	0
	Video Tab 2	0
	Audio Tab2	4
	Link Tab 2	6
	EDID Tab 2	9
	DPCD Tab 3	51
	HDCP Tab 3	3
	SDP Tab 3	4
	DSC Tab 3	5
	FEC Tab 3	6
	Source DUT Testing Tab 3	
7.	DisplayPort Reference Source 4	0
	Pattern Generator Tab 4	0
	Audio Generator Tab 4	5
	Link Tab 4	
	EDID Tab 4	
	DPCD Tab5	
	HDCP Tab5	2
	FEC Tab 5	
_	Sink DUT Testing Tab5	
8.	Compliance Tests 5	8
	Running CTS Tests 6	0
	Test Report 6	
9.	Event Log 6	3
	DP AUX Analyzer 6	4
10.	EDID Editor7	0

Appendix A. Product Specification	72
UCD-400 / UCD-411	72
Appendix B. Licensing	73
UCD Console & TSI: DisplayPort Reference Sink (DPRX)	73
UCD Console & TSI: DisplayPort Reference Source (DPTX)	74
Appendix C: Predefined Timings	75
DisplayPort Sink and Source Capability (RGB) (4 lanes capability)	75
DisplayPort Sink and Source Capability (YCbCr) (4 lanes capability)	77
DisplayPort Sink and Source Capability (RGB) (2 lanes capability)	79
DisplayPort Sink and Source Capability (YCbCr) (2 lanes capability)	
DisplayPort Sink and Source Capability (RGB) (1 lane capability)	
DisplayPort Sink and Source Capability (YCbCr) (1 lane capability)	
Appendix D: Predefined Patterns	87
Appendix E: Sink, Source and Repeater DUT Tests	88
CRC Based Video Test Set – DP RX	90
Link Test Set – DP RX	93
Appendix F: Advanced Filters	94
Appendix G: Firmware Recovery Procedure with Quartus Prime	96
FW Update Tool	96
Connect to the UCD-400 Unit	98
Programming the FW	98

1. ABOUT THIS MANUAL

Purpose

This guide is User Manual of UCD-400 and UCD-411. They are USB-connected video interface test units for use with a PC with Windows® 10 Windows® 8 or Windows® 7 operating system.

All instructions in this manual are valid when using either UCD-400 and UCD-411 except the instructions for DisplayPort Sink (DP RX) functionality, which is only for UCD-400.

The purpose of this guide is to

- Provide an overview of the product and its features.
- Provide instructions for the user on how to install the software and the drivers.
- Provide instructions for the user on how to update the FW of the unit.
- Introduce the HW features of the UCD-400 and UCD-411 units.
- Provide instructions for the user on how to use UCD Console software.

All instructions in this manual are valid both for UCD-400 and UCD-411 except the instructions for DisplayPort Sink (DP RX) functionality.

Product and Driver Version

This manual explains features found in UCD Console Software Package **1.12**. Please consult Unigraf for differences or upgrades of previous versions.

Please consult the Release Notes document in the installation package for details of the SW and FW versions and changes to previous releases.

Notes

On certain sections of the manual, when important information or notification is given, text is formatted as follows. Please read these notes carefully.

Note This

This text is an important note

2. INTRODUCTION

Product Description

UCD-400 is a high speed, USB 3.0 connected video interface test unit. *UCD Console* is the common graphical user interface (GUI) for Unigraf's UCD-400 and UCD-300 family units. The outlook and details of UCD Console will be different depending on the capabilities of the connected unit reflecting the features enabled.

UCD-400 units feature a high-level Software Development Kit (SDK) for use in automated testing. It is called Test Software Interface (TSI). TSI allows for an easy integration of Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation found in additional Unigraf manuals for more details.

Product Features

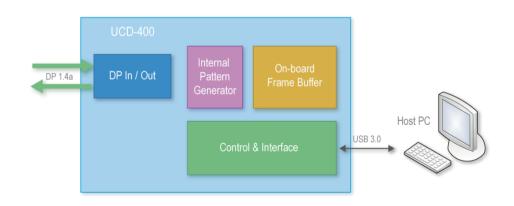
- UCD-400: Simultaneous DisplayPort 1.4a source and sink capability
- UCD-411: DisplayPort 1.4a source capability
- Supports HBR3 feature of DP 1.4a
- Supports Display Stream Compression, DSC
- High resolution video and audio capture up to 8K 30 Hz, 4K / UHD 120 Hz, 8K 60 Hz with DSC (UCD-411 N/A)
- Compatible with HDCP versions 1.3 and 2.3
- 2 GB on-board high-speed video buffer
- High speed USB 3.0 host PC interface

Please refer to Product Specifications in the appendix of this document for details.

Functional Description

UCD-400 units consist of a multimedia signal input stage (UCD-411 N/A), an internal pattern generator, a control stage with on-board frame buffer and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format. The Interface and Control stages are either passing the captured data directly to the USB interface or storing it to the frame buffer. The internal pattern generator is able to source a signal for testing sink and branch units. The Interface & Control stages are receiving instructions from the host PC to configure and control the functionality of the unit.

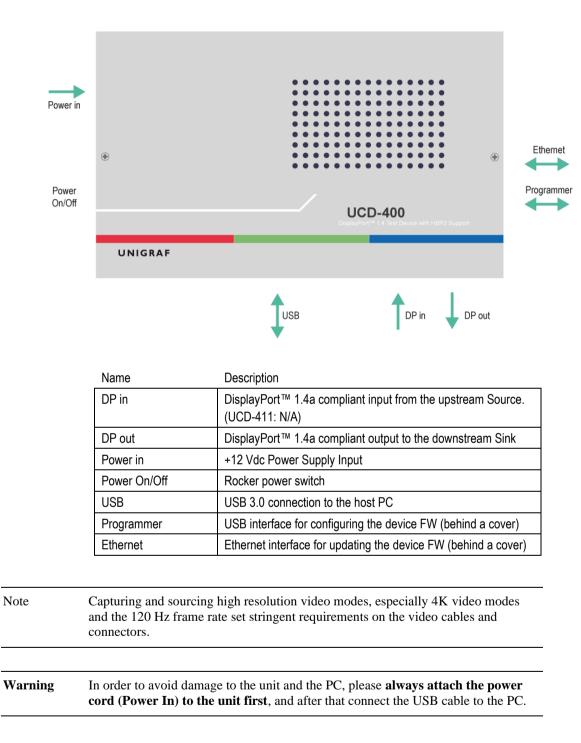
Please find below logical diagram of UCD-400 unit. UCD-411 contains only source functionality



Introduction

UCD-400

The image below indicates the connections in **UCD-400** unit and their description.



USB Type-C Interface

UCD-400 delivery package includes a "C to DP Bi-directional Cable" to enable testing of Sink or Source devices with USB-C interface.

Unpacking

The UCD-400 product shipment contains:

- The UCD-400 or UCD-411 unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
- USB 3.0 compliant cable for host PC connection
 - Micro-USB type B compatible cable for FW programming
 - USB-C to DP Bi-directional Cable for testing USB-C sinks or sources

Installation Package

The UCD-400 software installation package can be obtained from Unigraf download page at https://www.unigraf.fi/downloads/

The installation package is a bundle between the components needed for UCD Console and for TSI SDK. The bundle contains the following items:

- Windows drivers (installed during set up)
- UCD Console software GUI (installed during set up)
- License Manager (installed during set up)
- DSC Test Content and DSC compression tools (optionally installed during set up)
- TSI SDK (optionally installed during set up)
- User Manuals including this document.

In some cases, also the firmware of the unit needs to be updated. If in doubt, please contact Unigraf.

Note: The software should be installed before connecting the UCD-400 unit in the PC.

Note:

►

System administrator's privileges are required for performing the installation.

Software Installation

Start the installation by running Unigraf Software Bundle Setup.exe

Once the installer has started, a welcome page is displayed. The welcome page shows the software package release version.

Click Next to continue. The next dialog you need to agree to Unigraf Software End User License and select the components installed.

Note The size of the DSC Content Library	Generator with supporting files is 2.6 Gbytes
--	---

- Next dialogs define the installation folder in your PC and the Start Menu folder used.
- When the selections are ready, click **Install** to start the installation.
- Click **Finish** to exit the installation dialog.

3. LICENSE MANAGER

Licensing

The features of UCD Console GUI are divided into groups based on the target use of the device. Some basic features can be used without licenses. Advanced feature groups have their dedicated licenses that open the related part of the GUI or enable the related control.

Unigraf licenses are provided as strings of characters, **License Keys**. Each License Key enables a dedicated function in one device. Each device has its dedicated **Seed Number**. Each **License Key** is tied to one **Seed Number**. License Keys can be freely used in any number of PCs

License keys are managed with Unigraf License Manager. By default, shortcut to Unigraf License Manager can be found in Start Menu under: All programs/Unigraf/UCD-400.

Please click **Yes** in the first dialog. License Manager can be run only with Administrator rights.

Note:

System administrator's privileges are required for accessing the licenses.

License Manager GUI

When run, License Manager will list the licensing enabled Unigraf devices. If no suitable device families are detected, License Manager will exit. Please first select one of the available device families by clicking one of the device family selector buttons.

🕖 Unigraf - License Manager					-	×
		Please, Select device fa	mily	-		
	www.unigraf.fi		About version 1.2 [R0]			

In the list of Attached Devices please select the device in question. The *serial number* and the *seed number* of your device are printed in a sticker attached to the bottom of the device.

-			
🕖 Unigraf - License Manager	-		\times
d Back	License management for UCD-1, UCD-	2, UCD-3xx	Devices
Attached Devices:			
UCD-400 [1949C335] SW Emulated device [EMU001]	Select a device to edit licenses		

The **Back** button opens the device family selection screen. The **Refresh** button will re-scan the system for installed hardware.

Managing Licenses

Seed Number

🕖 Unigraf - License Manager			-		×
d Back		License management for UCD-1	, UCD-2	, UCD-3xx	Devices
Attached Devices: [UCD-400 [1949(2335) SW Emulated device [EMU001]	Enter new license for device with se Installed licenses: License TSI Advanced Set with HDCP2.2 UCD Pro for DP Sink UCD Pro for DP Source HDCP 2.2 Support	ed number <u>70b076560100005f</u> ; 		Insta	1
🕅 Refresh	import	Export	Z	Remove Se	elected

Each license is tied to a hardware unit with the help of the **Seed Number**. Each unit has a unique Seed Number. Seed Number of the selected unit can be found in the top of the dialog.

Seed Number of the selected device can be copied from dialog link for e.g. ordering Licenses.

Adding New License Keys

To add a new license key for a device, please enter the characters from the license sticker to the boxes provided. The License Manager will automatically move the caret across the edit boxes during typing. If the key is given in text format, copy it and paste to the leftmost box.

Once the license key is fully entered, click the **Install**. The license is authenticated and if it is valid, the license will appear in the list of installed licenses. If the key fails to authenticate, an error message is displayed. If this happens, please make sure that the key has been typed correctly and that the seed number on the license key sticker matches the seed number displayed seed number for the device.

Please note that to avoid confusion, some letters will never appear in a license key because they resemble numbers: For example, capital 'G' and number '6' are very similar when printed with small font. When in doubt, use numbers.

Also, please notice, that characters that can't be part of valid license key are not accepted as input. When appropriate an automatic conversion is applied while typing: For example, lower case letters are converted to upper case automatically.

Managing Installed Licenses

The Installed licenses list shows all currently installed licenses for the currently selected device. The list shows the actual license key, and what that key unlocks.

Remove Selected will uninstall selected licenses. To uninstall a license, click on the license and then click the Remove Selected button.

Export will allow all installed licenses for the currently selected device to be saved into an INI file for backup and distribution to other PCs. To export a license, click on the license and then click the Export button. Please notice that licenses from multiple devices can be exported into the same INI file.

Import will install licenses from an INI file for the currently selected device.

4. FIRMWARE UPDATE PROCEDURE

UCD Configuration Utility is used to load an updated firmware to the device. As an option, UCD Configuration Utility enables the user to select the operation roles present in the UCD-400 unit. The utility configures a firmware set for the selected operation roles and programs the firmware set to the device. Please contact Unigraf for details.

Updating from Earlier FW Versions

UCD Firmware versions earlier than 1.8.52 (Pls see Help > About) do not support the procedure described here. Please follow instructions in *Appendix G Firmware Recovery Procedure with Quartus Prime* in this manual.

Note: Firmware update is a sensitive process. Please do not disconnect the device from the PC and do not power it off before the operation is completed unless specially requested. Avoid plugging and unplugging other USB devices when the firmware update is in progress.

FW Update

To update the firmware or create a new configuration on a UCD-400 device, please perform the following steps:

Connect the UCD-400 unit to a power supply and connect the USB cable.

• Open UCD Console. Select Tools > Firmware update.

UCD Firmware Configuration tool can alternatively be launched in Start Menu.

The first page of the utility indicates the firmware component versions present in the package. Please click **Next**.

UCD Configuration Utility			×
			///
Please	e click Next to updat	e your UCD device.	
Available Firmware	Packages	Included components	
Device UCD-3ox UCD-4ox DP UCD-4ox HDMI	Firmware 0.0.23 2.1.0/1.9.30	UX 2.3.0 UF 1.3.4 BF 1.1.3/1.4.3 PD 0.0.15 PX 0.0.1	
	<	Back <u>N</u> ext >	Cancel

If several UCD units are connected to the PC, in next dialog please select the device to be updated. Click **Next**.

UCD Configuration Utility Connected UCD Devices Please select the device		× ///
Multiple UCD dev applications durin	UCD-3ox devices UCD-424 (1950C336) UCD-400 (1938C320) ices found. Make sure not to run other Unigraf g configuration.	
	< <u>B</u> ack <u>N</u> ext >	Cancel

Updated Modules

The tool indicates the firmware file to be used and prompts for selection of the firmware modules to be updated. It compares the modules in the selected device and omits the ones that are the same.

UCD Modules Modules that should be updated are checked						
Selected de	evice: UCD-424 [1]	950C336]				
Module	New	Existing	Comment			
VX 🔽	2.2.2	2.0.1	To be updated			
UF UF	1.3.4	1.3.1	To be updated			
🗆 BF	1.1.3/1.4.3	2.0.1/1.9.27	No update needed			
PX PX	0.0.1	0.0.0	To be updated			
MC 🗹	0.21.45	0.0.2	To be updated			
			< Back	Cancel		

When you are done, click Next.

Power Cycle

When updating certain parts of the firmware, the whole process cannot be done during one session and the UCD device need to be restarted between steps. Therefore, on certain point, user needs to **power cycle** the device (switch off power > wait for 10 seconds > turn on power).

UCD Configuration Utility Configuration in progress	× ///
UCD-323 [1823C398] Part MC ->MC 0.21.26 Writing image body Erased in 257.0 seconds (2) Read from ISP_STS CF000203 Written in 26.0 seconds Completed in 285.0 seconds	Attention × Please do the following: Power OFF the device. Wait for 10 seconds. Power ON the device. Press OK when done
< <u>B</u> ack	

Click **OK** button on the dialog.

Note: The procedure may take several minutes depending on the speed of the USB connection of the host PC.

Once the FW Update procedure has been completed, power cycle the device (switch off power > wait for 10 seconds > turn on power).

Recovering Failures in FW Procedure

If FW Update procedure fails e.g., when updating from an earlier FW that does not support the procedure described here, please refer to Appendix G of this manual for instructions on *Firmware Recovery Procedure with Quartus Prime*.

UCD Configuration Utility	×
Configuration in progress	///
UCD-400 [1938C320] Pre-MC-0-0-22 *** Fatal error: cannot enter ISP mode.]
	-
Completed in 25.0 seconds	
	< Back Completed Cancel

Once FW Recovery procedure has been done and a FW version supporting UCD Firmware Configuration tool has been installed, all future updates can be done using this tool.

5. UCD CONSOLE

UCD Console is the graphical user interface (GUI) of UCD-400 for desktop use. It provides the user access to all features of the unit. UCD Console also includes powerful debugging and analysis tools enabling the user to monitor the status of the display interfaces and assist in the problem detection.

The various features of the UCD-400 are divided into interface specific screens and tabs. Each tab contains data and controls for a specific feature.

Device Selection

A shortcut of UCD Console can be found by default under Start Menu path All programs/Unigraf/UCD-400. Once UCD Console GUI is launched the dialog provides a list of UCD-400 devices connected in the PC. Please select the target device by clicking on the appropriate button. If your device cannot be found in the list, please confirm the power and USB connection to the device and click the **Rescan**... button.

///	UCD Co	nsole			-	\times
<u>F</u> ile	<u>V</u> iew	<u>T</u> ools	<u>H</u> elp			
Device						
				Select Device UCD-400 [1924C312]		
				Rescan Www.unigraf.fi UCD Console V1.9 [R0], Build# 25582		

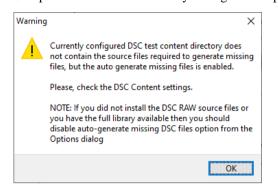
Analyzer and Pattern Generator Roles

The use of UCD-400 devices with UCD Console is divided by Analyzer (DisplayPort Sink), Pattern Generator (DisplayPort Source) and Event Logger (Event Log). The functionalities of the three roles can be found in tabs. This User Manual will explain all roles and their functionalities.

When using UCD-411 only Pattern Generator (DisplayPort Source) and Event Logger (Event Log) roles are available.

Warning about DSC Test Content

When running DSC Compliance Tests, UCD-400 needs to have access to DSC content used as test patterns. The content can be created from the source bitmap files downloaded during installation (optional) either with Unigraf DSC Content Creator or created by the Compliance Test Tool on-the-fly during the compliance test.



If *Automatically create missing content* is selected in Tools > Options menu, but the source files have not been installed a *Warning* dialog will open. Clicking **OK** will open the *Option* menu.

You can either re-install the whole SW package with DSC Content Library or deselect *Automatically create missing content* in Option menu.

Applying Changes

In various UCD Console dialogues the user needs to update several parameter or fields to make the changes needed. In order to avoid false combinations of parameters the new parameters are applied to UCD-400 only after **Apply** is clicked. In UCD Console the situation that parameters have been changed but not applied is indicated by **bold values** of the parameter.

<i>///</i> U	JCD-400 [1924	C312] - DisplayPort So	ource and Sink				-	
<u>F</u> ile	<u>V</u> iew <u>T</u> ools	<u>H</u> elp						
	Pattern Gen	erator Audio Generato			EC Sink DUT Te	sting		
8	Video Patter	n Generator					Custom image	
Device	MST	Number of streams 1	•			^		
ĭ¥	VESA 4096	5 x 2160 @ 60.0Hz	✓ 10 bpc	→ Whit	e Vertical Strij	pes v		
RX DP	RGB	~	\sim	1	▲ 1	•		
8			✓ 8 bpc	\sim		\sim		
8	RGB	\sim	\sim	1	* 1	A V	*i.w	
Event Log			✓ 8 bpc	\sim		\sim		
Ē	RGB		\sim	1	* 1		Default.bmp	

Options

Options can be found in **Tools > Options**.

otions	ad Mas ankana			
	nd Misc options	AUX Analyzer o	ptions	
Image File F	ormat			
PPM	0	BMP	() JPG	
Audio File Fo	ormat			
WAV				
Audio Buffer	size			
Main buffer,	Ksamples	16 🔶 Pla	yback buffer, Ksa	amples 4
Folders				
Directory to	save images and	l audio		
C:\Users\Te	ster\Pictures			Browse
Presets dire	ctory			
				Browse
DSC				
DSC Work fo	older			
C:\Temp\DS	C			Erowse
DSC test cor	ntent directory			
E:\DSC_con	tent_library\			Browse
Automati	cally create missi	ng contents		
Keep	auto-created DS	C content files		
Misc. option	s			
Apply col	our conversion to	saved images		
Bypass 4	:2:x -> 4:4:4 cor	nversions		
The moni	tor is not HDCP p	rotected.		
TSI Integrat	ion			
Enable TS	SI Integration			
Select wit	nen to append ex	norted DLIT test	to 'RunTest' scri	nt
	append when exp			
randyar	append Anten exp	on any to a new		
		1	ж	X Cancel

Video Audio and Misc. Options

Image File Format

You can save the captured frames either in PPM, BMP or JPG bitmap file format. In PPM format the files are stored with the captured color depth, with other formats the color depth is truncated to 8 bits per color.

Audio File Format

Audio files are stored in WAV format

Audio Buffer size

Main buffer: Length of the buffer in the PC memory storing audio samples for monitoring audio format in DP RX / Audio tab. Increased buffer length will enable longer time span to be monitored.

Playback buffer: Length in the buffer in the PC for transferring captured audio to PC sound system. Increased buffer size will ensure a smooth audio output but will also increase the delay between the capture of the audio stream and its playback.

Folders

Please select the directories in the PC for saving the captured images and audio, the saved Presets

DSC

DSC Work folder: Folder for DSC Work files.

DSC test content directory: Folder where DSC source bitmap files, related configuration files and DSC conversion tools are stored.

Automatically create missing content: When selected, compliance test tool During execution of DSC Compliance Tests, the tool automatically creates the DSC compressed content used for testing the DUT.

Keep auto-created DSC content files: By default, the DSC compressed content is deleted after use. If selected, the content is not deleted.

Warning Keeping the automatically created DSC compressed content will shorten the time needed for running the DSC compliance tests.

Please note, that the space needed for storing the full library **can be very large** (appr. 400 GBytes). Please make sure that the content will be stored in a medium that has the required space available.

Misc. options

Apply color conversions to saved images: When saving captured frames, the Color Mode selected in *Video* tab will be applied also to saved images.

Bypass 4:2:x \rightarrow *4:4:4 conversions*: 4:2:2 and 4:2:0 images are previewed and stored as received, without pixel doubling.

HDCP protected monitor: Text appearing if the monitor where UCD Console is viewed is HDCP compliant and HDCP is enabled. This feature enables preview of captured HDCP encrypted content in *Video* tab.

TSI Integration

Selections for generating a workspace for TSI usage.

TSI Integration	
Enable TSI Integration	
Select when to append exported DUT test to 'RunTest' script	
Always append when exporting to a new file	\sim

AUX Analyzer Options

Options for configuring the way data is presented in AUX Analyzer tab in Event Log.

Please find full description of the controls in chapter *Event Log / DP AUX Analyzer* later in this document.

TSI Integration

Tools > TSI Integration. Selections for generating a workspace for TSI usage.

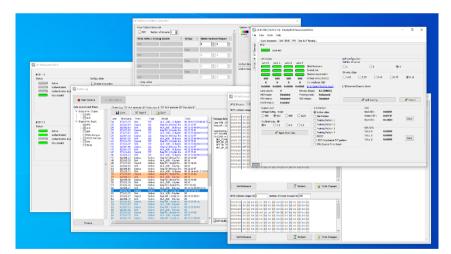
Workspace folder:		_
C:\Users\Tester\Desktop\TSI\		
Use TSI x64 (64-bit)	O Use TSI x86 (32-bit)	
Create / Update 'init.tsi' file		
	be used as 'sourcedevice' in scripts	
Select a TE device + role to No source device		

TSI Integration enables automatic creation of the necessary configuration files for executing tests exported from UCD Console's Sink DUT testing or Source DUT Testing.

Please refer to chapters *Source DUT Testing Tab* and *Sink DUT Testing Tab* later in this document for description about exporting tests.

Detaching Tabs

Most of the UCD Console tabs can be detached into a separate window for monitoring and controlling separate features simultaneously. To detach a tab **Right-click** on a tab and select **Detach Page**. To glue the tab back to the main window, click on the red **Close button** in the top right-hand corner of the window or press <**Alt**> + **F4** on the keyboard.



6. DISPLAYPORT REFERENCE SINK

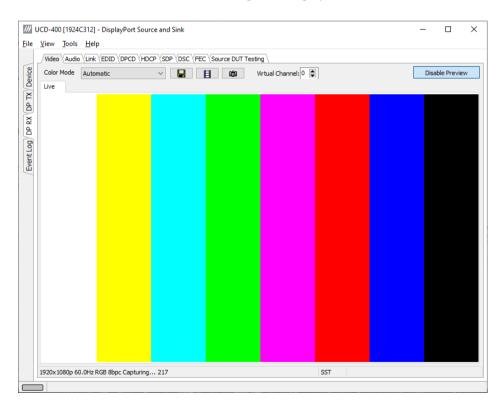
DP Sink functionality not available when using UCD-411.

DisplayPort Reference Sink dialog (DP RX) can be selected from the vertical tab on the left edge of the GUI. The horizontal tabs on the top of the GUI enable the various functions available for the input channel. Some of the tabs are enabled by default, some only when an applicable license is included. DPRX features the following functions.

- Video preview and saving (Video)
- Audio monitoring and saving (Audio)
- Status information and control of the upstream link (Link)
- EDID editor (EDID)
- DPCD editor (DPCD)
- HDCP status monitor and control (HDCP)
- SDP sent by the Source device (SDP)
- Display Stream Compression (DSC)
- FEC feature control and status (FEC)
- Source DUT Testing.

Video Tab

Video tab is the Preview window for the captured DisplayPort stream.



Input video mode

7680x4320p 30.0Hz RGB 8bpc Capturing... 76

The measured input resolution, frame rate and color format are shown below the preview window. The indication of the number of frames captured to the PC indicates the pace of the image data transfer to the PC.

Disable / Enable Preview

Click here the button to start or stop capturing video frames.

The top ribbon of the tab has the following controls:

Color Mode for preview

YCbCr (ITU-709) -> RGB <

- No Conversion: The captured color components are interpreted as R, G and B respectively. No color conversion will be done.
- Automatic: The color mode is selected based on the information in the MSA. If there is no color information available, "No Conversion" is used.
- YCbCr (ITU-709) -> RGB: The captured data components are interpreted as Y, Cb, and Cr respectively. Color conversion to RGB is done based on ITU-709 standard.
- SMPTE 170M > RGB: The captured data components are interpreted as Y, U, and V respectively. Color conversion to RGB is done based on SMPTE 170M standard.

Note: Please note that the color mode selection applies to the preview window only. All internal functions use the raw image data as captured from the input channel.

Select Virtual Channel

When Multistreaming (MST) is enabled, the monitored stream can be selected here.

Save one frame



Capture and save one video frame as a bitmap file in the PC. The format and storage location can be selected in Tools > Options pull-down menu. The available bitmap formats are PPM, BMP and JPG.

The selections in Tools > Options menu define if the frame bitmap will be stored as captured from the display interface or if the color mode conversion selected for preview will be applied.

Sequence recording



Clicking the button opens a dialog for definition of number of frames recorded. Buffered mode can also be enabled in this dialog.

Recording				×
Number of frames to record:	5	Buffered	🗸 ок	X Cancel
Capacity of the buffer: 211 fra	ames			

In buffered mode, all input frames are captured non-drop until the on-board frame buffer will be full. The dialog also informs the capacity of the buffer with the selected video mode.

In non-buffered mode, only one input frame is buffered at a time. Frames will be skipped if the transfer of the data to the PC is slower than the input data rate.

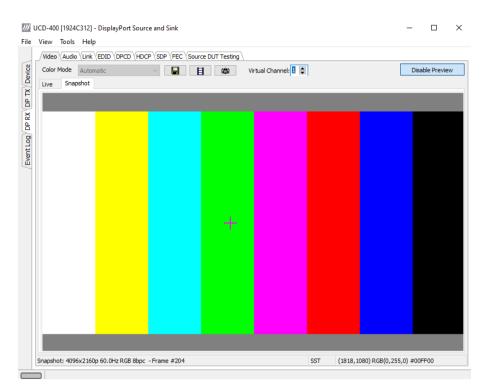
Note: Please note that buffered mode cannot be used when Audio preview is enabled.



Snap preview



When clicked, one frame of the incoming video is captured and shown in a new *Snapshot* tab. The captured bitmap can be saved with **Save one frame** function described above.



Color Information of the Captured Bitmap can be evaluated by placing the mouse cursor on top of the preview image. The lower right-hand side ribbon of the GUI lists

- Location of the cross cursor on the bitmap
- The intensity of the Red, Green and Blue components of the pixel on the cursor location
- The HTML HEX color code of the pixel on cursor location

Zoom of the Preview Image can be altered by right clicking on top of the preview image and selecting between

- Fit Window
- Zoom 25%
- Zoom 50%
- Zoom 100%
- Zoom 200%
- Zoom 500%

While in the *Snap preview mode* clicking on the "Camera" icon will take additional snapshots

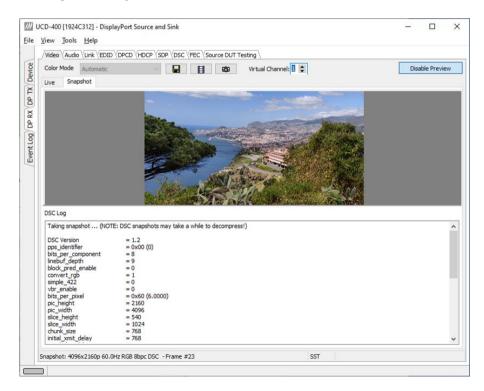
Preview DSC Decompressed Stream

In order to capture and preview DSC compressed video DSC must be enabled by selecting **DSC Capable** checkbox in *DSC* tab.



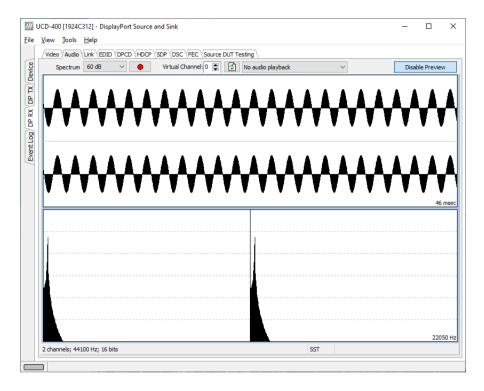
Select Enable Preview to verify that DSC compressed stream is received.

Click **Snap a Frame** button to capture one frame and start the decompressor (offline in the PC). Once the decompression is ready, the frame is shown, and *DSC Log* lists the details of the compressed image.



Audio Tab

Audio tab has a preview of the audio signal format and the controls for audio playback and recording. Up to eight channels will be shown based on the received audio stream.



The audio signal format is shown in three ways

- The 'oscilloscope' panel displays the waveforms of the received audio channels.
- The frequency spectrum of the audio is shown in the lower panel. The range of the spectrum display is from 0 to 1/2 of the input sampling rate. The amplitude scale of the spectrum display can be selected between 'Linear' to 80 dB.
- The horizontal sound level indicator is in the bottom of the dialog.

The span of the preview window is defined with **Audio preview size** found in Tools > Options dialog. The value is given in ksamples (1024 samples). The relation between the preview window span in milliseconds (msec) and the value given in *Audio preview* size depends on the sampling frequency. Please do not exceed the *Audio buffer size* set in the same dialog.

Disable / Enable Preview

This button controls capturing the audio data.

Select Virtual Channel

When Multistreaming (MST) is enabled, the monitored stream can be selected here.



Playback device selection

The captured audio can be played back in the PC. The combo-box defines the audio device in the host PC through which the captured audio is played. By default, the *No audio playback* is chosen.

UCD-400 [1924C312] - DisplayPort Source and Sink	-	$\square \rightarrow$	ζ
<u>File View T</u> ools <u>H</u> elp			
/Video / Audio / Link / EDID / DPCD / HDCP / SDP / DSC / FEC / Source DUT Testing /			_
Spectrum 60 dB Virtual Channel: Image: Comparison of the sector of t	D	isable Preview	
]
	A A 4		

Note

Please note that the audio capabilities of the audio playback device of the PC are not automatically reflected in the audio capabilities description in UCD-400 EDID. Since UCD-400 is not performing any audio format conversion, it might occur that the source provides an audio format that the selected playback device is not supporting. In case a conflict occurs, please change manually the EDID content or disable audio playback to monitor the waveforms in UCD Console.

Refresh audio device list

1

Click here to re-read the list of audio devices after making changes to the host PC configuration.

Audio Buffer Size

The amount of buffering used in the data transfer between the UCD-400 unit and the PC in **Audio buffer size** in Tools > Options dialog. Increased buffer size will ensure a smooth audio output but will also increase the delay between the capture of the audio stream and its playback.

Start audio recording



The captured audio can be recorded in the PC using Waveform Audio File Format, WAV (*.wav) format. The pop-up dialog defines recording duration. The folder where the audio file will be saved can be selected in File > Options.

Recording			×
Recording duration, msec:	5000	🗸 ОК	X Cancel

Input audio mode

2 channels; 48000 Hz; 16 bits

This field (in the bottom of the dialog) indicates detected audio mode in the input stream.

Link Tab

Link tab contains four panels: Cable / HPD, Link Status, Link Configuration and Stream Status.

	Help			EC VSource DUT Test					
Cable / HPD	LINK (EDID (DP	CD (HDCP (SUP (USC (FE	C (Source DOT Test	ung (
Cable / 11PD Cab	ole 🗖	HPD	🗸 Assert	: O Deasse	rt 💋 Pulse HPD	500 🜩	Length, msec		🍠 Short P
Link Status					Link Configuration				
Lane 0 La	ne 1 Lane 2	Lane 3			Max Lanes				
			Clock Recov	rery	01	(⊇ 2	۲	4
			Symbol lock		Max Bitrate, Gbps				
			Channel equ		0 1.62	2.70	0 5.40	06.75	• 8.10
	500 600	600	Voltage swir		eDP Bitrate, Gbps				
0	0 0	0	Pre-emphas		○ None	2.16	02.43	0 3.24	0 4.32
	0000 0x000			(Click to clear)	Other Capabilities			-	
Lane count:	4			8.1 (HBR3)		3 🔽 TPS4	FEC	Dsc	
MST mode: FEC status:	Disabled Disabled			Enhanced Disabled	Scrambler reset				
HDCP status:	Disabled	DSC	status:	Disabled	● FFFFh (DP) ○ F	EEEb (aDD ASS	R) OCustor	n Ox FFFF	
Scrambling:	Enabled								
SSC Status:	Disabled				Enable fast LT	Force	e cable status to	plugged	
					Generate HPD pu	se on Apply			🖌 Apply
									Update Link State
Stream Status Horizontal		Vertical		Maa		CRC		DSC CRC	
Horizontal Total:	2200	Total:	1125	Misc Frame Rate, Hz	59.995		0xB69E	Value 0: -	
Start:	192	Start:	41	Color Depth:				Value 0: - Value 1: -	
Active:	1920	Active:	1080	8			0x1AB3	Value 2: -	
Sync Width:		Sync Width:		Color Encoding:	(legacy RGB mode)				
						Co		Сору	

Cable / HPD

Indicator lights of the state of the cable. **Cable** indicates that the hardware has detected an upstream cable. **HPD** indicates that the HPD signal is Asserted (logical "high").

Clicking the **Deassert** button will cause HPD line to be set to logical "low" (de-asserted) and hence no HPD pulse can be generated. Click the **Assert** to re-activate the HPD line (set to logical "high").

To apply an HPD Pulse with programmable duration click **Pulse HPD**. The duration will be defined in the provided field.

For applying a short pulse click Short Pulse. Pulse duration is 1 ms.

Link Status

Link Status displays the status of the link training and the link parameters negotiated between UCD-400 Sink and the Upstream Source. The data is retrieved from the DPCD registers of the UCD-400 Sink. The status is updated automatically.

Link Configuration

Link Configuration allows the user to change the way the Sink capabilities are announced in the DPCD registers of the UCD-400 Sink. Maximum Lane Count, Maximum Bitrate and supported eDP Bitrate are set with their appropriate radio buttons.

To update the new status to the DPCD registers click **Apply**.

Note: Please note that UCD Console Link Tab currently supports for announcing one bitrate from the pre-selected rates to be used with eDP protocol. The user can apply alternative schemes by editing DPCD register content in the DPCD Tab.

Other Capabilities

Enable or disable features like MST, FEC and DSC

Scrambler Reset

Selection of the value to which the Linear Feedback Shift Register (LFSR) is reset during scrambler reset.

In **Auto** mode UCD verifies that connected DP Sink supports eDP and Alternate Scrambler Seed, and then applies FFFEh. If not, FFFFh will be used.

When **Force cable status to plugged** is checked, sink functionality is active regardless of a failure of upstream device detection e.g., due to incorrect AUX Channel electrical termination.

To apply a Hot-Plug Detect pulse automatically after updating the status, select **Generate HPD pulse on Apply**. HPD pulse duration will be defined in the *Pulse* HPD field.

Stream Status

Stream status is enabled with UCD Pro for DP Sink license.

Video Timing Details are retrieved from the Main-Stream Attributes (MSA) of the monitored stream. Frame rate is measured by UCD-400 Local Sink.

Note:

Please note that the MSA information used for Video Timing Details is provided by the Upstream Source, it is not measured by the UCD-400 Local Sink.

CRC

The 16-bit **CRC** (checksum, cyclic redundancy check) values of the three color components of the captured video frame; calculated by the Sink hardware. To re-calculate, click **Update Link Status**.

The 16-bit **DSC CRC** values of the captured DSC compressed frame. "**Value 0**" is calculated from 1^{st} , 4^{th} , 7^{th} ... byte, "**Value 1**" from 2^{nd} , 5^{th} , 8^{th} ... byte and "**Value 2**" from 3^{rd} , 6^{th} , 9^{th} ... byte.

Multistreaming

When Multistreaming (MST) is enabled, and the source sends a multi-stream signal the details of the received virtual channels is shown in a table in *Stream Status* field.

Cable / H			.D (HDCP (SUP (USC (FE	C (Sourc	e DUT T	esting \									
	Cable		HPD	🗸 Assert	(🚫 Deas	sert	🕫 Puls	se HPD	500 🔹	Length, ms	ec			8	Short
Link Stat	us						Link Co	nfigura	tion							
Lane 0	Lane 1	Lane 2	Lane 3				Max La									
) 💼			Clock Recove	ery		01			(○ 2			0 4		
) 💼			Symbol lock			Max Bi	trate, G	bps							
				Channel equ			0 1.6	2	С	2.70	O 5.	40	06.7	5	8.10	
600	600	600	600	Voltage swin			eDP Bi	rate, G	bps							
0	0	0	0	Pre-emphasi			ONor			2.16	O 2.	43	03.2	4	04.32	
0x0000							Other	Capabil	ities		-					
Lane cou		4			B.1 (HBR		MS		TPS3	TPS4	FEC	: 🗆	SC			
MST mod FEC stat		Enabled Disabled		-	Enhance Disabled		Scramb									
HDCP stat		Disabled	DSC	itatus:	Disabled	•	● FFFFh (DP) ○ FFFEh (eDP ASSR) ○ Custom 0x FFFF									
Scramblin		Enabled							-							
SSC Stat	-	Disabled					Ena Ena	ble fas	t LT	Force	e cable statu	is to plugge	d			
							🗹 Ger	erate H	IPD pulse	on Apply					🖌 🗸	ply
														Ø	Update Li	nk Stai
Monitore	ed virtual c	hannel:	Stream #	‡0	~	Frame ra	ate, Hz: 59.9	95								
Monitore H-Total	ed virtual c H-Start	hannel: H-Active H-			✓ /-Active '		ate, Hz: 59.9 CEF	995 BPC	Port #	Stream ID	Req. PBN	Alloc. PBN	First slot	Slot num		
		H-Active H-		tal V-Start N	/-Active			BPC	Port #	Stream ID	Req. PBN 532	Alloc. PBN 540	First slot	Slot num 9	_	
H-Total	H-Start	H-Active H- 1920 (+	Sync V-Tot	tal V-Start V 41 1	/-Active /	V-Sync	CEF	BPC 8								
H-Total 2200	H-Start 192	H-Active H- 1920 (+ 1920 (+	Sync V-Tot) 44 1125	tal V-Start V 41 1 41 1	/-Active / .080 (.080 (V-Sync (+) 5	CEF RGB unsp. (k	BPC 8 8	0	1	532	540	1	9		

Port#: Port number where the virtual channel is directed.

Stream ID: Stream identification number of the virtual channel

Req. PBN: Requested PBN (payload Bandwith Number) value for the virtual channel

Alloc.PBN: PBN value allocated for the virtual channel

First slot: Time slot where the first VC Payload for the virtual channel is stored

Slot number: Number of VC Payload slots reserved for the virtual channel.

EDID Tab

EDID Tab provides tools for accessing the EDID of the UCD-400 Sink presented to the Upstream Source Device. There are three basic functions:

- Load and save EDID data files in the host PC
- Edit the EDID contents
- Program and read the contents of the EDID memory of up to four virtual MST Ports

///	JCD-400 [1924C312] - DisplayPort Source and Sink	– 🗆 X
<u>F</u> ile	<u>V</u> iew <u>T</u> ools <u>H</u> elp	
	/Video \Audio \Link \EDID \DPCD \HDCP \SDP \DSC \FEC \Source DUT Testing \	
8	EDID Data:	
Device	000000 00 ff ff ff ff ff ff 00 54 c7 36 40 4c 34 32 30	EDID Files
Ă	000010 34 18 01 04 e5 3d 23 78 3a 5f b1 a2 57 4f a2 28	Load
P	000020 0f 50 54 bf ef 80 71 4f 81 00 81 c0 81 80 a9 c0	
X	000030 b3 00 95 00 d1 c0 4d d0 00 a0 f0 70 3e 80 30 20 000040 35 00 5f 59 21 00 00 1a 56 5e 00 a0 a0 a0 29 50	Save as
Å	000050 30 20 35 00 5f 59 21 00 00 1a 00 00 00 fd 00 38	
	000060 4b 1e 86 36 00 0a 20 20 20 20 20 20 00 00 00 fc	
Event Log	000070 00 55 43 44 2d 34 30 30 20 44 50 31 0a 20 01 de 000080 02 03 12 71 83 4f 00 00 29 0f 7f 07 15 06 55 3d	HEX Editor
Ven	000000 02 03 12 71 83 41 00 00 29 01 71 07 15 08 55 5d	Clear
	0000a0 00 00 00 00 00 00 00 00 00 00 00	Cicai
	0000b0 00 00 00 00 00 00 00 00 00 00 00	Append file
	0000e0 00 00 00 00 00 00 00 00 00 00 00	EDID Editor
	0000f0 00 00 00 00 00 00 00 00 00 00 00	
		Virtual Channel
		1
		Sink EDID
		Dead
		Read
		Write
	×	

EDID Files

Note

With **Load...** and **Save as...** a hex EDID file can be read and written from the PC. Please note that the program does not alter the contents of the EDID file or verify its integrity during load and save operation.

Four blocks (512 bytes) of EDID code is read. If the device is not supporting all four blocks, the non-supported area is replaced with zeroes.

Currently the EDID Editor does not support Display ID. Hex EDID files can however be modified with the HEX Editor or externally generated hex EDID files that have Display ID content can be load and programmed into the hardware.

HEX Editor

When EDID content is either loaded from a file or read from the hardware EDID memory, it is shown in the *EDID Data* panel on the left hand side of the dialog. EDID contents can be edited by typing over the existing values. Altered content is highlighted with **RED**. Please note that Hex Editor itself does not alter the contents of the EDID data or verify its integrity.

After editing the data can either be saved to an *.ecd file in the PC with **Save as...** or programmed it to the hardware EDID memory with **Write**.

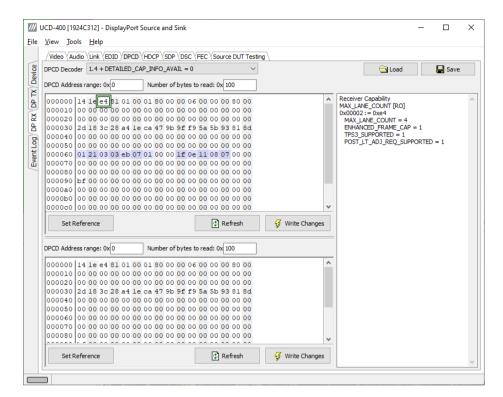


EDID Editor

EDID Editor is launched in a separate pop-up window. Please see the description of the EDID editor in Chapter $\underline{EDID \ Editor}$ later in this document.

Collection 1 Blocks in collection	Details of ":/0/Version/18-Byte data blocks	Descriptor 1"	
✓ Blocks in collection	Current Value = Detailed Timing Descripto	r	
Checksum	New Value:		
✓ · Version	nen rolder		
Extension flag	Detailed Timing Descriptor		
> Vendor & Product ID	🖌 Set 🛛 😨 Quick Con	fig	
> Basic Display Parameters and F	a for a for the former of the		
> Display x,y Chromacity coordin;	Details of ":/0/Version/18-Byte data blocks	Descriptor 1"	
> Established timings I and II	Key	Value	
> · Manufacturer's Timings	Pixel Clock	533250	
> Standard Timings			
 18-Byte data blocks 	Horizontal addressable video	3840	
> Descriptor 1	Horizontal Blanking	160	
> Descriptor 2	Vertical addressable video	2160	
> Descriptor 3	Vertical blanking	62	
> · Descriptor 4 • · Block 1 [CEA 861]	Horizontal Front Porch	48	
- Checksum	Horizontal pulse width	32	
 CEA Extensions Version 	Vertical Front Porch	3	
···· Sink Underscans IT video	Vertical pulse width	5	
Basic audio	Horizontal Video Size	607	
YCbCr (4:4:4)	Vertical Video Size	345	
	the second secon	-	

DPCD Tab



DPCD tab is a tool for monitoring and editing the DPCD registers of the UCD-400 Sink.

The tool consists of two independent monitoring and editing windows for the DPCD data. The user can freely select the the DPCD address areas shown on each panel.

The *DPCD Decoder* panel on the right hand side shows the interpretation of the DPCD byte selected on the monitoring windows. The selected byte is shown with a green outline.

The combo box above the DPCD Decoder window allows selection of how the DPCD data is interpreted. It can be either as $DP \ 1.4 \ DPCD$, or as $DP \ 1.4 \ DPCD$ with Detailed Capability Info selected or not (DETAILED_CAP_INFO_AVAIL = 1/0).

Click Refresh to re-read the data from the DPCD registers to the window in question.

Click **Write Changes** to write the portion of data shown in the window in question to the DPCD registers.

Click Set Reference to store currently shown data as a reference for comparison.

When the data is *Refreshed* from the DPCD registers the changed bytes will be highlighted with gray background.

The fields edited by the user will be highligted with **red** color.

/Video (Audio (Link (ED)		FEC Source DUT Testing			
DPCD Decoder 1.4 + DE	TAILED_CAP_INFO_AVAIL = 0	\sim		🔄 Load	Save
DPCD Address range: 0x	0 Number of bytes	to read: 0x 100			
000010 00 00 00 00 000020 00 00 00 000030 2d 18 3c 2 000040 00 00 00 00 000050 00 00 00 00 000050 01 21 03 0 000070 00 00 00 00 000080 00 00 00 00 000090 bf 00 00 00 000080 00 00 00 00	$\begin{array}{c} \textbf{31} \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ 0 \ $	0 00 00 00 00 00 0 00 00 00 00 0 00 00 00 00 5 5 5 5 9 3 1 8d 0 00 00 00 00 00 1 1 08 07 00 00 0 00 00 00 0 00 00 00 0 00 00 00 0 0 00 0 0 00 00 0 0 0 0	LANE2_ 0x0020 LANE: LANE: LANE: LANE: LANE:	k Device Status 3 sTATUS [RO] 3 := 0x77 _ CR_DONE = 1 _ CHANNEL_EQ_DONE = 1 _ SYMBOL_IOCKED = 1 _ CHANNEL_EQ_DONE = 1 _ CHANNEL_EQ_DONE = 1 _ SYMBOL_LOCKED = 1	
DPCD Address range: 0x	200 Number of bytes	to read: 0x 100			
000210 00 80 00 000220 00 00 00 000230 00 00 00 000240 65 3a 7c f 000250 00 00 00 000250 00 00 00 000270 00 00 00	77 10 03 11 11 00<	0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00 0 00 00 00 00			

Saving and Loading DPCD Content

DPCD data in the selected address areas can be saved as a file in your PC. There are three alternative formats:

- Binary *DPCD Fata File* format (*.DPD). This is Unigraf proprietary format. You can also load the DPCD content stored in this format.
- Comma Separated Values (*.CSV) for loading the data to a spreadsheet.
- *HEX Dump* (*.HEX) in a human readable text format.
- Click **Save** to select the location and the format of the file.
- Click Load to load DPCD data saved in DPCD Data File (*.DPD) format to the editor.
- To program the data into the DPCD registers of UCD-400 Local Sink click Write Changes.

Writing DPCD data to the DPCD registers of the UCD-400 Local Sink will potentially affect the status and capabilities of UCD-400 as seen by the upstream source.
 User control like Link Training or mode changes will modify the content of the DPCD registers
 During a reboot of UCD-400 the DPCD registers will be returned to their default values

HDCP Tab

HDCP tab is the dialog for monitoring the HDCP (for *High-Bandwith Digital Content Protection*) status and controlling the HDCP capabilities of the UCD-400 device.

<u>F</u> ile	View Tools H /Video (Audio (L HDCP 1.3		DSC \FEC \Source DUT Testing \	-	×
/Event Log/DP RX (DP TX / Device	Status	Active Authenticated Declared as HDCP capable Keys loaded	Configuration HDCP Capable Keys Production Facsimile - "Test" None		
	HDCP 2.3 Status	Active Authenticated Declared as HDCP capable Keys loaded	Configuration HDCP Capable Keys Production Facsimile - "Test" - R1 Facsimile - "Test" - R2 None		

Status

The status field indicates the HDCP status of the UCD-400 device.

Active: The link between UCD-400 and the upstream source has been encrypted.

Authenticated: The HDCP handshake between the UCD-400 and the sink unit has been completed successfully.

Declared as HDCP capable: The UCD-400 unit recognizes HDCP handshake messages.

Keys loaded: The HDCP keys are loaded to the UCD-400 unit.

Configuration

HDCP Capable: To disable HDCP uncheck the box.

Keys

Select between Production or Facsimile HDCP keys. To remove the keys, select None.

HDCP 1.3 vs. HDCP 2.3

UCD-400 devices support by default both HDCP 1.3 and HDCP 2.3 standard.

SDP Tab

SDP Tab is enabled with UCD Pro for DP Sink license.

In SDP Tab shows the *Secondary-Data Packets* sent by the Source device. Click **Update** to re-read the data.

	ICD-40 View					splay	/Port	t So	urce	and	Sink	c																			_				×
<u>L</u> ine		<u>l</u> oo Auc					DPCE) (H	DCP	SDE	⊳ ∖D	sc \	FEC	So	urce	DUT	Tes	ting																	
8	SDP																																		
/Event Log/ DP RX (DP TX / Device		ACR ASP AIF	00	1 01 02	17 00	01	00	1 03 61	91 B6	00 80	00	61	вє	AO	00	03 1F	91 B8	00 98	00 00	03 1F	91 B8	00 A8	80	00	00	00	80	00	00	00	80	26 00 00	00	28	
	<																															l	Upda		>

SDP Tab displays in hexadecimal format the following received SDP packets:

- Audio_TimeStamp
- Audio_Stream
- Extension
- Audio_CopyManagement
- ISRC (International Standard Recording Code)
- Video Stream Configuration (VSC)
- Camera Generic 0
- Camera Generic 1
- Camera Generic 2
- Camera Generic 3
- Camera Generic 4
- Camera Generic 5
- Camera Generic 6
- Camera Generic 7
- Vendor-Specific Infoframe packet
- AVI InfoFrame packet
- Source Product Descriptor InfoFrame packet
- Audio InfoFrame packet
- MPEG Source InfoFrame packet
- Dynamic Range and Mastering InfoFrame
- Picture Parameter Set (PPS)

DSC Tab

DSC Tab is enabled with DSC Decoder license.

DSC tab contains control of the Display Stream Compression (DSC) feature, and definition of DSC support capabilities that UCD-400 defines in its DPCD register.

	JCD-400 [1750C250] - DisplayPo <u>V</u> iew <u>T</u> ools <u>H</u> elp	rt Source and Sink		-	- 0	×
	Video Audio Link EDID OPC		e DUT Testing			
Event Log\DP RX\DP TX\Device	DSC Capable	DSC Enabled				
	DSC Major Version:	1	DSC Minor Version:	2		
B	RC block size:	65536 bytes	RC buffer size, in blocks:	4		
X	Bits per Pixel Increment:	1/16 bpp	Block Prediction:	Supported \sim		
	Throughput mode 0:	340MP/s	Throughput mode 1:	340MP/s \checkmark		
tLoc	Line Buffer depth:	16 bits	Maximum Slice Width:	2560		
Len	Supported Color Depths	Supported Color formats	H-Slice Capabilities			
5	8 Bits per color channel	RGB	✓ 1 Slice / DSC Sink	10 Slices / DSC Sink		
	☑ 10 Bits per color channel	VCbCr 4:4:4	2 Slices / DSC Sink	12 Slices / DSC Sink		
	✓ 12 Bits per color channel	Simple YCbCr 4:2:2	4 Slices / DSC Sink	16 Slices / DSC Sink		
		Native YCbCr 4:2:2	6 Slices / DSC Sink	20 Slices / DSC Sink		
		YCbCr 4:2:0	8 Slices / DSC Sink	24 Slices / DSC Sink		
		A Reset De	efaults	🖌 Apply		
				• • • • • •		

Enabling DSC

Enabling DSC feature is controlled by the connected source device. When connected, a source verifies corresponding registers in DPCD (0x00060) of UCD-400 sink to find out if DSC capability is declared.

DSC Capable: Control of UCD-400 DPCD register 0x00060 bit 0. Please click **Apply** to enable the change.

DSC Enabled: Connected source has enabled DSC

DSC Support Capabilities

The various controls in this tab change the content of UCD-400 sink DPCD register address range (0x00061 through 0x0006F) related to DSC. Please click **Apply** to enable the change.

Apply

Write changes to UCD-400 sink DPCD registers

Refresh

Re-read the content of UCD-400 sink DPCD and update the control status.

Reset Defaults

Reset the content of UCD-400 DSC related DPCD registers (0x00060 through 0x0006F) to the default values as defined in UCD-400 firmware.

FEC Tab

FEC Tab is enabled as a basic feature.

FEC tab contains control of the FEC (Forward Error Correction) feature, Error Detection table and FEC Status Log.

	JCD-400 [1924C312] - Displa View <u>T</u> ools <u>H</u> elp	ayPort Sourc	ce and Sinl	k				_	×
	/Video (Audio (Link (EDID)				ource DUT Testin	g \			
ice	FEC Capable Gen						FEC Status Log		
TX Device	Error Counters (DPCD)						Enabled, ready		
Ĕ		Lane #0	Lane #1	Lane #2	Lane #3				
B	Uncorrected block errors	0	0	0	0				
X	Corrected block errors	0	0	0	0				
8	Bit errors	0	0	0	0				
R	Parity block errors		0	0	0				
Event Log	Parity bit errors	0	0	0	0				
Ver			_						
	🗗 U	pdate		눱 Clear o	ounters				
							Charal has		
	FEC Status: Decode Enable I	Detected					Clear log		
						_			 _

Enabling FEC

Enabling FEC feature is controlled by the source device. When connected, source verifies corresponding registers in sink DPCD to find out if sink is FEC capable. This register in UCD-400 sink can be controlled by **FEC Capable** checkbox.

Since source normally polls sink DPCD mainly after a new connection, selecting **Generate HPD on change** will force a new connection after the change of the FEC capability status.

- Click **Update** to read the FEC Error Counters
- Click **Clear** to clear the counters.

FEC Status Log lists FEC events.

Source DUT Testing Tab

Source DUT Testing Tab is enabled with UCD Pro for DP Sink license.

Please refer to Appendix E later in this document for description of the tests available.

UCD-400 [1924C312] - DisplayPort Source and Sink				>
/Video \/Audio \/Link \/EDID \/DPCD \/HDCP \/SDP \/DSC \/FEC \/Source DUT Testing \				
/ Link-Layer Tests) HDCP 2.3 1A tests \ HDCP 2.3 1B tests \ HDCP 2.3 3A tests \ HDCP 2.3 3B tests \ CRC	tests V Simple	LT tests	7	
Test Name	Pass	Fail	Skip	Run
Test Name International Action of the state	0	0	1	
	1	0 0	0	1
 1A-02 Regular Procedure - With newly connected Receiver (Without stored km) 1A-03 Regular Procedure - Receiver disconnect after AKE Init 	1	0	0	1
	1	0	0	1
1A-04 Regular Procedure - Receiver disconnect after km 1A-05 Regular Procedure - Receiver disconnect after locality check 1A-05 Regular Procedure - Receiver disconnect after locality check	0	0	0	0
TA-06 Regular Procedure - Receiver disconnect after ks	0	0	0	0
 1A-07 Regular Procedure - Receiver sends REAUTH_REQ after Ks 	0	0	0	0
 1A-08 Irregular Procedure - Verify Receiver Certificate 	0	0	0	0
- 1A-09 Irregular Procedure - SRM	0	0	0	0
– 1A-10 Irregular Procedure - Invalid H'	0	0	0	0
- 1A-11 Irregular Procedure - Pairing Failure	0	0	0	0
- 1A-12 Irregular Procedure - Locality Failure	0	0	0	0
E Configure	🖞 Import	Ľ] Б	port
Run Selected Stop on Failure Repeats: 1	rt		Clear /	All
Test Log:				
0002_956.604: [TE-Snk] STEP 1A-04-1 0003_556.827: [TE-Snk] WARNING. DUT sends unencrypted video 0003.556.957: [TE-Snk] DUT initiates authentication by transmitting AKE_Init 0003.557.512: Test PASSED: "1A-04 Regular Procedure - Receiver disconnect after km" *** Test complete PASSED ***				

Select the tests for execution by clicking the corresponding row.

Clicking **Configure...** opens a dialog for defining the test parameters for that set. Please refer to *Test Parameters* below for description.

Clicking Configure... opens a dialog for defining the test parameters for that set. Please refer to Test Parameters below for description.

Tests are started by clicking **Run Selected**. By clicking **Abort** the sequence is stopped.

Test flow can be controlled with **Repeats** of the test sequence, **Delay time** between individual tests or **Stop on Failure** that stops the whole sequence if one of the tests fail.

At the completion of each test the result of the test is indicated in the matrix on the right hand side of the test panel. For each test the matrix lists the number of occurrences of each result and the number of tries performed.

Click **Save Report** to generate a HTML report file for sharing the results with other parties for viewing without UCD Console.

By clicking Clear All the test log and the results matrix are cleared.

Test Parameters

Each test set has its dedicated set of test parameters. Open a dialog for defining the parameters by clicking **Configure...**

Parameters of Link Layer CTS

Link Layer CTS parameters includes DUT capabilities defined in *Source Device Capability Question List* in document *DisplayPort Link Layer Compliance Test Specification*. The capabilities are grouped into tabs based on the tested feature.

Test timeouts		Colori	metry					
est timeout (milliseconds):	5000	•	RGB		YCbCr 4:2:2		YCbCr 4:4:4	
	1000		DC VESA	□ sh	DC CTA (ITU.601)		bpc CTA (ITU.601)	
ong HPD pulse duration (milliseconds):			DC VESA	_	bpc CTA (ITU.601)		Obpc CTA (ITU.601)	
T Start timeout (milliseconds):	5000		bpc VESA		DC CTA (ITU, 709)	_	bpc CTA (ITU. 709)	
'est cycle delay (milliseconds):	5000		DC CTA		bpc CTA (ITU.709)		Obpc CTA (ITU.709)	
DUT Capabilities			bpc CTA					
1ax lanes supported:	4 Lanes	~						_
fax bit rate supported:	HBR3 (8.10 Gbps)	✓ Se	ect All					
Voltage Swing level 3 (1.2V) supporte	d	Video	Modes					
Pre-Emphasis level 3 (9.5dB) supporte	d	Fail-sz	ife video mode:		640x480 @ 60Hz 6 B	PC		
Fixed timing DUT		Massia	um supported video m	ada.	3840×2160 @ 60Hz 4			~
Spread Spectrum Supported		Maxin	un supporteu video m	oue.	3640X2100 @ 60H2 6	5 DFC		Ŷ
Video format change without LT support		Most	Packed Timings					
Lane count reduction without LT supp	orted	1 Lan	CTA 1440 x 576p		in 9 hos			\sim
E-DDC supported								
Audio Info Frame supported for 2 cha	nnel audio	2 Lan						~
DUT is Type-C Device		4 Lan	CVT 2048 x 1536	ip @ 60	Hz, RB1, 8 bpc			\sim
FEC supported		Time	stamp generation					
FEC disable sequence supported		rine-	1 Lane		2 Lanes		41 anes	
Audio without Video supported		RBF		~	1280x720@60 Hz	~ 1	4 Lanes	
Test Automation							-	~
TEST_LINK_TRAINING		HBF			1280x960@60 Hz		1920x1080@60 Hz	~
TEST_EDID_READ		HBR	2 1280x960@60 Hz	• ×	1920x1080@60 Hz	~ 1	1920×1080@120 Hz	\sim
TEST_VIDEO_PATTERN		HBR	3 1920x1440@60H	z v	3840x2160@30Hz	~ 3	3840x2160@60Hz	\sim
vent indicating DUT ready:	Active Video	~						

Parameters of CRC Test Set

CRC Video test parameters dialog contains fields for defining the test duration, number of frames captured, errors allowed and expected video format.

CRC Video test parameters			>
Base parameters			Reference CRC's
Test timeout (milliseconds):	10000	▲ ▼	0x3F3A, 0x967D, 0xA7BF 🔨
Run until timeout			0x3F3A, 0x967D, 0xA7BF 0x3F3A, 0x967D, 0xA7BF
Test length (# frames):	2000	* *	
Errors allowed (# frames):	20	* *	
Repeat "Continuous motion picture te	est" until timeout		
Test iterations (# of repeats):	1	*	
Expected Video Signal			
Width (# pixels):	4096	A	
Height (# pixels):	2160	•	
Reference BPP:	24 BPP	\sim	
Frame rate checking			
Enable frame rate check			
Expected frame rate (mHz):	60000	×.	CRC Capture length (# frames)
Frame rate tolerance (±mHz):	100	×.	3 Capture now
Presets			V OK X Cancel

Click **Capture now** to record *Reference CRCs*. Please define the number of frames used as reference – either one or the number of frames in the predefined test sequence.

Parameters of DP RX Simple LT Tests

The parameters for DP RX Simple LT test set is a subset of DUT capabilities.

Test timeout, milliseconds	5000		
Max lanes count supported by DUT	4		
Max lane rate supported by DUT in 0.27Gbps	20		
Reserved for DUT Capabilities flags	0		
Reserved for DUT Test automation capabilities flags	0		
Long HPD pulse duration, milliseconds	1000		
Link training start timeout, milliseconds	5000		
Delay between test cycles, milliseconds	3000		

Presets

In all parameter dialogs the selected parameters can be saved as Presets. Please click **Presets...** to save or recall a configuration.

Exporting Tests for TSI

Unigraf UCD Console includes a feature rich Software Development Kit (SDK) for use in automated testing. The SDK is called Test Software Interface (TSI). TSI allows for an easy integration of Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation found in additional Unigraf manuals for details.

The tests included in UCD Console's Source DUT Testing tab and Sink DUT Testing tab can be executed in TSI environment. A straightforward way is to use UCD Console's *Tools* > *TSI Integration* dialog to create the necessary files for TSI environment and use *Export* function in *DUT Testing* tabs to include the intended tests.

	Configure	Ľ	Impo	ort		Expo	rt
- 5.2.1.12 Downstream Stop on Timeout			0	0	0	0	v
 5.2.1.11 Downstream Stop on MOT Reset 			0	0	0	0	
5.2.1.10 Interleaved EDID and DPCD Receiver Capability Read			0	0	0	0	
5.2.1.9 Glitch Rejection			1	0	0	1	_

Export: Save parameters of the selected test to a file. If TSI Integration is enabled in Tools > Options, also the test is appended into 'Run Test' file in TSI workspace folder.

Import: Recall parameters from configuration file. If TSI Integration is enabled in Tools > Options, parameters are imported from a file in TSI workspace folder

7. DISPLAYPORT REFERENCE SOURCE

DP Source functionality available when using both UCD-400 and UCD-411.

DP Reference Source function is using one output channel, DisplayPort Source (DP TX). The corresponding vertical tab can be seen on the left edge of the GUI.

The horizontal tabs on the top of the GUI enable the various functions available for the output channel. Some of the tabs are enabled by default, some only when an applicable license is included. DPTX features the following functions.

- Video pattern generator (Pattern Generator)
- Audio generator (Audio Generator)
- Status information and control of the downstream link (Link)
- EDID editor (EDID)
- DPCD monitor (DPCD)
- HDCP status monitor and control (HDCP)
- FEC feature control and status (FEC)
- Sink DUT Testing Tab.

Pattern Generator Tab

Video Pattern Ger	r \Audio Generator \ nerator	Cant (201	0 (0.1			e (entreer r	coung (Custom image
MST Num	ber of streams 4	¢ [Force	EDID	preferre	d timing after I	.T	
CTA 1920 x 1080	@ 60.0Hz	~ 8	bpc	\sim	Color B	ars	~ ^	
RGB		\sim			1	1	A	
		~ 8	bpc				~	
		0	ope					
RGB		\sim			1	× 1		
		~ 8	bpc					
RGB	\sim	\sim			1	* 1	*	Default.bmp
			1					Click on image to load
		~ 8	bpc		_		~	
RGB		\sim			1	× 1	A V	
Timing values								Adaptive-Sync
Custom		0						Auto-enable if supported by sink
	H-Total	2200	1					Disabled \checkmark
	H-Start	192						
	H-Active	1920						
	H-Sync Width	44						
	V-Total	1125						
	V-Start	41						
	V-Active	1080						
	V-Sync Width	5						
	Frame Rate	60.0	00					DSC Status and Configuration
н	-Sync Negative polari	ty 🗌					_	Enable DSC
V	-Sync Negative polari	ty 🗌						Pattern Generator Settings

Note

The video modes that can be used in MST streams are limited by the overall capability of the DisplayPort link and the capability of the connected DisplayPort Sink or Branch device.

Predefined Timings

UCD-400 includes a set of common predefined video timings. Please find a list of the timings with their major details in <u>Appendix C</u> of this document.

Force EDID Preferred Timing After LT

After Link Training (= plug-in) UCD applies the timing indicated as the Preferred Timing in VESA block of Sink device EDID.

The feature is disabled when MST mode is used.

Color Mode

RGB color mode with full range quantization levels will be used with all patterns except with *Color Square Pattern*. This pattern allows the user to select RGB, YCbCr 4:4:4, YCbCr 4:2:2 and YCbCr 4:2:0 color modes. When YCbCr is selected, the Colorimetry dropdown box is enabled and allows selection between ITU-709 and ITU-601. Please find a description of the available test patterns in <u>Appendix D</u> of this document.

Color Depth

You can set the color depth used. The available color depths are: 6, 8, 10, 12 and 16 bpc. Color depth 6 bpc is only available with RGB.

Predefined Video Patterns

UCD-400 has a set of predefined patterns and a possibility to user defined custom patterns. The predefined patterns are selected from the list in the combo box. By selecting **Disabled** you can have the links activated but no video data transferred.

Please find a description of the available predefined patterns in <u>Appendix D</u> of this document.

When MST mode is selected, full selection of test patterns is available only in stream 0

Custom Image Patterns

BMP, PNG, JPG and TIFF files can be loaded from the PC to be used as custom images. The bitmaps will be aligned to the top left hand side corner, displayed at the original resolution, no scaling, cropped to the active area.

MST Operation

Multi-streaming can be enabled from **MST** check box and selecting the number of streams. Please click **Apply** to enable.

Note Please note that MST and DSC features and cannot be used simultaneously

Adaptive-Sync Control

User controls in the four Adaptive-Sync modes are the following.

- Adaptive Total, constant refresh rate: Added blank lines.
- Adaptive Total, Square pattern: Added blank lines, min; Added blank lines, max; Period, frames.
- Adaptive Vtotal, Zigzag pattern: : Added blank lines, min; Added blank lines, max; Increase, lines; Decrease, lines.
- Fixed Average VTotal: Target refresh rate, Hz; Increase, lines; Decrease, lines.

Auto enabled if supported by Sink enables the feature based on connected Sink status.

Note Please note that MST and Adaptive-Sync features and cannot be used simultaneously



Pattern Generator Settings

In order to avoid sourcing invalid video mode combinations new settings are being validated when the user is clicking **Apply**. Automatic validation will be applied when **Auto-apply when valid** is checked. The situation that parameters have been changed but not applied is indicated by **bold values** of the parameter. If new settings cannot be supported by e.g. the selected link configuration, an error dialog will be shown.

View Tools He				DCP VFEC VSink DUT T	esting		
Video Pattern Ger					Custom image		
VESA 4096 x 21			pc v	White Ve	UNIGAR	X	1
RGB		~		1		^	
NOD							
		✓ 8 bpc	· ·		Stream 0 setup failed due to: - Video pixel clock exceeds hardware capab	ilities	
RGB	~	✓ 8 bpc	~			ilities	

Note

Please note that the changes in Pattern Generator tab will not be applied unless the user validates them by clicking **Apply** or when **Auto-apply when valid** is checked.

Custom Timing

Custom Timing feature is enabled with UCD Pro for DP Source license.

Custom		0	1	2	3	
	H-Total	2200	2200	2200	2200	
	H-Start	192	192	192	192	
	H-Active	1920	1920	1920	1920	
	H-Sync Width	44	44	44	44	
	V-Total	1125	1125	1125	1125	
	V-Start	41	41	41	41	
	V-Active	1080	1080	1080	1080	DSC Status and Configuration
	V-Sync Width	5	5	5	5	
	Frame Rate	60.000	60.000	60.000	60.000	Enable DSC
H-S	Sync Negative polarity					Send PPS
V-5	Sync Negative polarity					Pattern Generator Settings
Maria	ge Timings	1				 Apply Auto-apply when valid

The timing parameters can be modified by selecting the **Custom** check-box and editing the fields of the matrix. Enable the new parameters by clicking **Apply** button.



Manage Timings

Custom timings can also be created and edited with pop-up *Timing Editor*. Launch the editor by clicking **Manage Timings**.

1 Timing E	ditor							-		×
urrent timings	:									
Show/Type	Nam	e		Timing	alues					1
Fixed Fixed	VESA CTA VESA CTA Othe VESA VESA CTA	7680 x 4320 @ 30 7680 x 4320 @ 30.	.0Hz [R DHz 0.0Hz [0.0Hz [.0Hz .0Hz [R .0Hz [R DHz	Active (Active (Active (Active (Active (Active (Active (Active (5120 x 2160), Total (5 5120 x 2460), Total (7 7680 x 4320), Total (7 7680 x 4320), Total (7 7680 x 4320), Total (7	2200, 2222), Sync (32, 500, 2250), Sync (88, 280, 2287), Sync (32, 200, 2287), Sync (32, 500, 2250), Sync (32, 280, 2962), Sync (32, 760, 4381), Sync (32, 760, 4381), Sync (32,	6) 10) 10) 8) 10) 5) 5) 8) , 20)			>
Sync	Total Active Start : width	Horizontal timing 5500 5120 216 88 Negative	Vertical tin 2250 2160 82 10 Negatir		Frame rate (Hz) Pixel Clock (MHz) Name	120 1485 Can't modify fixed ti CTA 5120 x 2160 @	2	_	Clear pdate timi id new tim	-

- ► In order to create a new custom timing based on one of the standard fixed, timings select the fixed timing and change its name and click **Add new timing** to store.
- ▶ In order to modify an existing custom timing, select it, modify and click Update timing.

The dialog will make a sanity check for the values entered and will warn the user for any combinations that cannot be used.

Customize Timings List

The timings are shown on the pull-down menu by un-checking the **Show** box. The timings will remain in the list and can be brought back to the pull-down menu, when needed.

Sourcing DSC Compressed Patterns

DSC compressed pattern files can be created with a separate tool called *DSC Compressor*. It can be launched from Tools > DSC Compressor.

DSC Compressor						>
File to compress						
Source File:	C:\Te	mp\Your-image.pn	g			
	4096	x 2160, 32bpp				
Sink DSC capabili	ty regis	ters (DPCD range	0x60 -> 0x6f,	hex)		
						Update
Compression opti Color space to use		Output resolution	ıs:			
RGB	\sim	2560 x 1080	^	Compression Ratio:	8bpc -> 6bpp (4	4.0 to 1) ~
Color depth to use	2:	2560 x 1600 2880 x 1440		Horizontal Slices:	1 Slice	~
8 bpc	~	4096 x 2160 3840 x 2160				
Resize mode:		5120 x 2160		Vertical Slices:	1 Slice	~
Tile / Crop	\sim	5120 x 2880 7680 x 4320				
Parallel compression	on:	1080 x 2280	¥			
2 threads	\sim	Refresh	Custom	S	tart Compressor(s)
						Close

- Select the source bitmap file in Source File field. Define the Output Resolution, the color depth, compression ratio and number of horizontal and vertical slices in the frame.
- Click Start Compressor(s).

A DSC compressed file named e.g. *Your_Picture_4096_2160_8.dsc* will be created in the same folder are your source file *Your_Picture*. The selected resolution and bit depth will be added to the file name.

Video Pattern Gen		INK (LDID (DPCD (II	DCP \FEC \Sink DUT Testing \	Custom image
	er of streams 1 🌲	3		
CTA 4096 x 2160		✓ 8 bpc	DSC Image	
			-	
RGB	\sim	\sim		
		✓ 8 bpc		V
RGB		~	1 1 4	
KGD				
		\sim 8 bpc \sim		×
RGB	\sim	\sim	1 1	Your-image_4096_2160_8.dsc
				Click on image to load
		\sim 8 bpc \sim		v
RGB			1 1	
Timing values				
Custom		0		
	H-Total	4400		
	H-Start	216		
	H-Active	4096		
	H-Sync Width	88		
	V-Total	2250		
	V-Start	82		
	V-Active	2160		
	V-Sync Width Frame Rate	10 60.000		DSC Status and Configuration
	Frame Rate	60.000		Enable DSC
H-S	Sync Negative polarit	/ 🗆 🗆		
V-9	Sync Negative polarity	<u>, </u>		Send PPS
	, menegative polarie			
	ge Timings			Pattern Generator Settings

Select Enable DSC and click Apply.

Note	Please note that the output resolution has to match the size of the used compressed DSC image.
Note	Please note that MST and DSC features and cannot be used simultaneously

Audio Generator Tab

Audio generator allows the user to play LPCM audio generated internally or from files in WAV format.

UCD-400 [1924C312] - DisplayPort Source and Sink <u>View Tools H</u> elp	-	
/Pattern Generator Audio Generator Link EDID DPCD HDCP FEC Sink DUT Testing		
Audio loaded: 2 channels @ 44100 Hz, 16 bits		
Play control		
Audio from: Audio generator.		
Stopped		
Audio Content		
Generate audio:		
Waveform: Sine \checkmark Bits/Sample: 16 bits \checkmark		
Signal frequency: 1000 Amplitude: 60%		
Sample Rate: 44100 Hz V Channels: 2 Channels V		
O Load audio from file:		
Open WAV file		
		-

To load internally generated audio, select **Generate audio**, and adjust the controls to the desired audio format.

- ► To load an audio file from your PC, select Load audio from file, click the Open WAV file... button, browse and select the file and click Open
- ► To play the selected audio content, click the Play ► button.

The content will be looped until the **Stop** • button is clicked.

Audio Status in the top of the tab indicates the type of the currently played audio content.

Link Tab

Link tab shows the status and control items for the DisplayPort link.

HPD

The status LED indicates the state of the HPD signal Asserted (logical "high") or Deasserted (logical "low").

/Pattern Generator Audio Generator	/Link (EDID (DPCD (HDCP (FEC (sin)	k DUT Testing \					
Link Status Lane 0 Lane 1 Lane 2 La	ane 3	Link Configurat					
	Lane 1 Lane 2 Lane 3 Lane 1 Lane 2 Clock Recovery Symbol lock Symbol lock Channel equalization Colds Recovery 0 0 Over equalization 0 0 Over equalization 0 0 0 0 0 Pre-emphasis (dB) 0 0x0000 Error Count (Clck to read) nht: 4 Bit rate (Gbps): 8.1 (HBR3) eie: Disabled Framing mode: Enhanced us: Disabled DSC status: Disabled	01		○ 2	• 4		
		Bit rate, Gbps					
600 600 600 6		0 1.62	0 2.70	0 5.40	06.75	8.10)
		Additional bit r	ates, Gbps				
0x0000 0x0000 0x0000 0x	0000 Error Count (Click to read)	0 2.16	02.43	03.24	0 4.32		
FEC status: Disabled	DSC status: Disabled	Downspread Enable SSC		Freq (Hz)	31500		
FEC status: Disabled	DSC status: Disabled	Enable SSC			ustom 0x FFFF	Fast LT	
FEC status: Disabled	DSC status: Disabled	Enable SSC	et EFFFh (DP) OFFFE		ustom 0x FFFF	Fast LT	
FEC status: Disabled HDCP status: Disabled	DSC status: Disabled SSC Status: Disabled	Enable SSC	et FFFFh (DP) OFFFE J Link training CRC Red CRC:	Eh (eDP ASSR) O Co	ustom 0x FFFF	F astLT	
FEC status: Disabled HDCP status: Disabled	DSC status: Disabled SSC Status: Disabled	Enable SSC Scrambler rese	tt FFFFh (DP) OFFFE Link training CRC Red CRC: Green CRC:	Eh (eDP ASSR) O G OxB69E OxB33E	ustom 0x FFFF	⁷ Fast LT	
FEC status: Disabled HDCP status: Disabled Output Level Voltage Swing, mVpp: @ 400 600 800 (0 Pre-Emphasis, dB	DSC status: Disabled SSC Status: Disabled Unk Pattern () Active video) Idle Pattern () Training Pattern 1 () Training Pattern 1	Enable SSC Scrambler rese	et FFFFh (DP) OFFFE J Link training CRC Red CRC:	Eh (eDP ASSR) O Co	ustom 0x FFFF	' Fast LT	
FEC status: Disabled HDCP status: Disabled Output Level Voltage Swing, mVpp: ⊚ 400	DSC status: Disabled SSC Status: Disabled Unk Pattern () Active video) Idle Pattern 1 () Training Pattern 2 () Training Pattern 3	Enable SSC Scrambler rese	tt TFFFh (DP) OFFFE Link training CRC Red CRC: Green CRC: Blue CRC: DSC CRC	0xB69E 0xB33E 0x1AB3	ustom 0x FFFF	FastLT	
FEC status: Disabled HDCP status: Disabled Output Level Voltage Swing, mVpp: @ 4000	DSC status: Disabled SSC Status: Disabled @ Active video 0 1200 0 1200 0 1200 0 1200 0 1201 0 Training Pattern 1 0 Training Pattern 2 0 Training Pattern 4 0 Training Pattern 4	Enable SSC Scrambler rese	et FFFFh (DP) OFFFE S Link training CRC Red CRC: Green CRC: Blue CRC: DSC CRC Value 0:	Ch (eDP ASSR) () Co OxB69E OxB33E Ox1AB3 Ox0000	ustom 0x FFFF	' Fast LT	
FEC status: Disabled HDCP status: Disabled Output Level Voltage Swing, mVpp: @ 400 600 800 Pre-Emphasis, dB 0 0 0 @ 3.5 0.6.0 0	DSC status: Disabled SSC Status: Disabled Unk Pattern () Active video) Idle Pattern 1 () Training Pattern 2 () Training Pattern 3	E pattern	tt TFFFh (DP) OFFFE Link training CRC Red CRC: Green CRC: Blue CRC: DSC CRC	0xB69E 0xB33E 0x1AB3	ustom 0x FFFF	' Fast LT	

Link status

The panel shows the result of the link training with the connected downstream sink and status of connection features.

Output Level

Override output level and pre-emphasis values selected during link training. Click **Apply Overrides** to validate changes.

Note Please note that connected Sink and Source actively maintain the link. If the override settings result in link failure, the link will be automatically re-trained and proper values set.

Link configuration

Set target capabilities for the link training. Click Link Training to apply.

- Set the Number of Lanes used,
- Set the Link Rate, from standard DP link rates or Additional 'eDP' link rates
- Enable Enhanced Framing Mode
- Force eDP mode (If set, only link rates announced in SUPPORTED_LINK_RATES table (DPCD 00010h 0001Fh) will be used when determining supported link rates.

Downspread

Select Enable SSC to enable down spreading of link frequency (SSC).

Set **Amp (‰)** to SSC Spreading Amplitude. Allowed amplitude range is 1 to 10‰ (per mil, 0.1%) (It is mandatory for a DP Rx to support up to 0.5% down spread).

Set Freq (Hz) to SSC Modulation frequency. Allowed Frequency range is 30 to 35 kHz.

Scrambler Reset

Selection of the value to which the Linear Feedback Shift Register (LFSR) is reset during scrambler reset.

In **Auto** mode UCD verifies that connected DP Sink supports eDP and Alternate Scrambler Seed, and then applies FFFEh. If not, FFFFh will be used.

Fast Link Training

Click **Fast LT** to initiate a link training without AUX transactions. The procedure will be the following:

- 1. Send idle for $10 \,\mu s$
- 2. Send TPS1 for 1 ms
- 3. Send TPS2/3/4 for 1 ms
- 4. Send idle for $10 \,\mu s$
- 5. Send video

Link Pattern

Select between Active video and audio, Idle pattern, or special bit patterns.

When **Force Active Video** option is selected, character error messages from sink will not interrupt video transmission.

When **Force Idle Pattern** is selected, Link Training and Active Video will not be initiated even after a re-plug.

Note Please note that except *Active video*, the patterns do not carry video and audio. They are special bit combinations used for development purposes. When selecting **Active Video** (or **Force Active Video**) normal audio and video are being transmitted over the link.

CRC

The 16-bit **CRC** (checksum, cyclic redundancy check) values of the three color components calculated by the Sink hardware.

The 16-bit **DSC CRC** values of the captured DSC compressed frame. "**Value 0**" is calculated from 1^{st} , 4^{th} , 7^{th} ... byte, "**Value 1**" from 2^{nd} , 5^{th} , 8^{th} ... byte and "**Value 2**" from 3^{rd} , 6^{th} , 9^{th} ... byte.

EDID Tab

	v <u>T</u> ools <u>H</u> elp	
/Pa	ttern Generator $Audio Generator Link EDID OPCD HDCP FEC Sink DUT Testing$	\
EDI	Data:	EDID Files
EDI	0000 00 ff ff ff ff ff ff 00 54 c7 36 40 4c 34 32 30	
	0010 34 18 01 04 e5 3d 23 78 3a 5f b1 a2 57 4f a2 28	Load
	0020 0f 50 54 bf ef 80 71 4f 81 00 81 c0 81 80 a9 c0	
	0030 b3 00 95 00 d1 c0 4d d0 00 a0 f0 70 3e 80 30 20	Save as
	0040 35 00 5f 59 21 00 00 1a 56 5e 00 a0 a0 a0 29 50 0050 30 20 35 00 5f 59 21 00 00 1a 00 00 00 fd 00 38	
	0060 4b 1e 86 36 00 0a 20 20 20 20 20 20 00 00 00 fc	
00	0070 00 55 43 44 2d 34 30 30 20 44 50 31 0a 20 01 de	HEX Editor
	0080 02 03 12 71 83 4f 00 00 29 0f 7f 07 15 06 55 3d	
	0090 1f c0 00 00 00 00 00 00 00 00 00 00 00 00	Clear
	00a0 00 00 00 00 00 00 00 00 00 00 00 00	
		Append file
00	00 00 00 00 00 00 00 00 00 00 00 00 00	
	00e0 00 00 00 00 00 00 00 00 00 00 00 00	EDID Editor
00	00f0 00 00 00 00 00 00 00 00 00 00 00 00	
		Virtual Channel
		Connected Sink EDID
		Read
		Read
		Write

EDID tab enables analyzing and saving the EDID read from the connected Sink device.

There are three basic functions:

- Read the contents of the EDID of the downstream sink over the DisplayPort link.
- Load and save EDID data files in the host PC
- Edit the EDID contents

EDID Files

Note

With **Load...** and **Save as...** a hex EDID file can be read and written from the PC. Please note that the program does not alter the contents of the EDID file or verify its integrity during load and save operation.

Four blocks (512 bytes) of EDID code is read. If the device is not supporting all four blocks, the non-supported area is replaced with zeroes.

Currently the EDID Editor does not support Display ID. Hex EDID files can however be modified with the HEX Editor or externally generated hex EDID files that have Display ID content can be load and programmed into the hardware.

HEX Editor

When EDID content is either loaded from a file or read from the hardware EDID memory, it is shown in the *EDID Data* panel on the left hand side of the dialog. EDID contents can be edited by typing over the existing values. Altered content is highlighted with **RED**. Please note that Hex Editor itself does not alter the contents of the EDID data or verify its integrity.

After editing the data can either be saved to an *.ecd file in the PC with **Save as...** or programmed it to the hardware EDID memory with **Write**.



EDID Editor

EDID Editor is launched in a separate pop-up window. Please see the description of the EDID editor in Chapter **EDID Editor** later in this document.

DID Editor			-	×
Z EDID Editor E-EDID Encoder / Decoder	Details of ":/0/Version/Vendor_Product Key ID Manufacturer Name ID Product Code ID Serial Number Manufacture or Model year Week of manufacture Year of manufacture	ID* Value UFG 0x4036 0x3032344c Manufacture Year and Week Week 52 Year 2014	-	×
- Sink Underscans IT video - Basic audio - YCbCr (4:4:4) - YCbCr (4:2:2) - Native DTD's in entire E-EDID - 18-8yte Descriptors in this block > CEA Data block count Carton Carton Control Contr	2 Show Log			

DPCD Tab

DPCD tab is a tool for monitoring and editing the DPCD registers of the connected Downstream Sink.

/// UCD-400 [1924C312] -	DisplayPort Source and Sink			-	- 🗆	×
<u>File View Tools H</u> elp						
/Pattern Generator	Audio Generator (Link (EDID) DPC		JT Testing \			
DPCD Decoder 1.4 +	DETAILED_CAP_INFO_AVAIL = 0	~		🔄 Load	🚽 Save	
DPCD Decoder 1.4 + DPCD Address range: (0x 0 Number of bytes to	o read: 0x 100				
a 000000 14 14 e 000010 14 14 e 000010 00 00 000010 00 00 00 000000 00 00 000010 00 00 00 000010 00 00 000040 00 00 00 00 000010 00 00 000050 00 00 00 00 000010 00 00 000050 00 00 00 00 000000 00 00 000050 00 00 00 00 000000 00 00 000050 00 00 00 00 000000 00 00 000050 00 00 00 000000 00 00 000050 00 00 00 000000 00 00	$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \begin{array}{c} \begin{array}{c} \end{array} \\ \begin{array}{c} \end{array} \\ \end{array} $	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	↑ ✓ ✓ Write Changes	Receiver Capability MAX_LANE_COUNT [RO] 0x00002 := 0xe4 MAX_LANE_COUNT = 4 ENHANCED_FRAME_CAP = 1 TPS3_SUPPORTED = 1 POST_LT_ADJ_REQ_SUPPOR	TED = 1	^
DPCD Address range: (0x 200 Number of bytes to	read: 0x 100				
000210 00 80 0 000220 00 00 0 000230 00 00 0 000240 9e b6 3 000250 00 00 0 000260 00 00 0 000270 00 00 0	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓ ↓			<

The tool consists of two independent monitoring and editing windows for the DPCD data. The user can freely select the the DPCD address areas shown on each panel.

The *DPCD Decoder* panel on the right hand side shows the interpretation of the DPCD byte selected on the monitoring windows. The selected byte is shown with a green outline.

In the combo box above the DPCD Decoder window you can select how the DPCD data is interpreted, either as *DP 1.1 DPCD*, or as *DP 1.2 DPCD* with *Detailed Capability Info* selected or not (DETAILED_CAP_INFO_AVAIL = 1/0).

By clicking **Refresh** you can re-read the data from the DPCD registers to the window in question.

By clicking **Write Changes** you can write the portion of data shown in the window in question to the DPCD registers.

By clicking **Set Reference** you can store currently shown data as a reference for comparison.

When you refresh the data from the DPCD registers the changed bytes will be highlighted with gray background.

The fields edited by the user will be highligted with **red** color.

	312] - DisplayPor	t Source and Sink				-	
<u>V</u> iew <u>T</u> ools	Help						
/Pattern Gene	rator \Audio Genera	ator \Link \EDID \DP	CD HDCP FEC Sink D	JT Testing \			
DPCD Decoder	1.4 + DETAILED_C	CAP_INFO_AVAIL = 0) ~			🔄 Load	🚽 Save
DPCD Address	range: 0x 0	Number of bytes	to read: 0x 100				
000010 00 000020 00 000030 2d 000040 00 000050 00 000050 00 000070 00 000080 00 000090 00 000080 00 000080 00	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		LANEC 0x002 LANI LANI LANI LANI LANI	ink Device Status), 1_STATUS [RO] 102:= 0X77 E0_CR_DONE = 1 E0_CHANNEL_E0_DONE = 1 E0_STMBOL_LOCKED = 1 E1_CR_DONE = 1 E1_CHANNEL_E0_DONE = 1 E1_SYMBOL_LOCKED = 1	
Set Refe			Refresh	🞸 Write Changes			
DPCD Address	range: 0x 200	Number of bytes	to read: 0x 100				
000210 00 000220 00 000230 00	80 00 80 00 8 00 00 00 00 0 00 00 00 00 0 3f 7d 96 bf a	0 00 80 00 00 0 0 00 00 00 00 0 0 00 00 00 00	0 00 00 00 00 00 00 0 00 00 00 00 00 0 00 0		^		
000250 00 000260 00 000270 00	00 00 00 00 0 00 00 00 00 0	0 00 00 00 00 0 0 00 00 00 00 0	0 00 00 00 00 00 00 0 00 00 00 00 00 0 00 0		*		

Saving and Loading DPCD Content

DPCD data in the selected address areas can be saved as a file in your PC. There are three alternative formats:

- Binary *DPCD Fata File* format (*.DPD). This is Unigraf proprietary format. You can also load the DPCD content stored in this format.
- Comma Separated Values (*.CSV) for loading the data to a spreadsheet.
- *HEX Dump* (*.HEX) in a human readable text format.
- Click Save to select the location and the format of the file.
- Click Load to load DPCD data saved in DPCD Data File (*.DPD) format to the editor.
- ▶ To program the data into the DPCD registers of UCD-400 Local Sink click Write Changes.

- Writing DPCD data to the DPCD registers of the Sink will potentially affect the
status and capabilities of sink as seen by the source.
- User control like Link Training or mode changes will modify the content of the
DPCD registers

HDCP Tab

HDCP tab is the dialog for monitoring the HDCP (for *High-Bandwith Digital Content Protection*) status and controlling the HDCP capabilities of the connected UCD-400 device.

File View Tools	UUD-400 [1845C291] - DisplayPort Source and Sink - C X Yiew Jools Help Pattern Generator (Audo Generator \Link \EDID \DPCD) HDCP \FEC \Sink DUT Testing HDCP 1.3 Status Active Authenticated Authenticated Authenticate Bable encryption Facsimile - Test* None HDCP 2.3 Configuration Bable encryption Authenticated Authenticated Authenticated Authenticated Authenticated Bable encryption Authenticated Authenticated Bable encryption Configuration Facsimile - Test* None Facsimile - Test* - R1 Facsimile - Test* - R1 Facsimile - Test* - R2 None Facsimile - Test* - R2 Type 1	~			
× 40	Authenticated Authentication in progress	Enable encryption Authenticate Keys Production Facsimile - "Test"			
Status	Authenticated Authentication in progress	Enable encryption Authenticate Keys Production Facsimile - "Test" - R1 Facsimile - Test" - R2	• Type 0		

Status

The status fields indicate the HDCP status of the connected UCD-400 device.

Active: The stream between UCD-400 and the downstream sink has been encrypted.

Authenticated: The HDCP handshake between the UCD-400 and the sink unit has been completed successfully.

Authentication in process: The HDCP handshake is in process between the UCD-400 and the downstream sink unit.

Keys loaded: The HDCP keys are loaded to the UCD-400 unit.

Configuration

Enable encryption: Check to enable the encryption of the stream between UCD-400 and the downstream sink.

Authenticate: Perform the HDCP initiation handshake between the UCD-400 and the sink unit.

Keys

Select between Production or Facsimile HDCP keys. To remove the keys, select None.

Content level

Selection of **Type 1** content ensures that content encryption is done with HDCP version 2.2 or higher.

HDCP 1.3 vs. HDCP 2.3

UCD-400 devices support by default HDCP 1.3 and HDCP 2.3.

FEC Tab

Forward Error Correction (FEC) can be enabled if connected sink supports it. For debug purposes, error injection to main-link is possible. There is an error type for each standard sink DPCD error counter.

	View Tools Help ∕Pattern Generator ∕Audio Gen FEC	erator \Link \E			C Sink DUT Tes	sting
DP TX Device	FEC Enabled	Prefer FEC E	Enabled	ļ	Enable FEC	👸 Disable FEC
E E	Error generator					FEC Status Log
	Number of errors to genera	te for Lane #0:		0	•	Sink FEC Status: Decode Disable Detected / Sequence NOT detected Sink FEC Status: Decode Enable Detected
DP RX	Number of errors to genera	te for Lane #1:		0	+	Sink TEC Status, Decode Enable Detected
	Number of errors to genera	te for Lane #2:		0		
Event Log	Number of errors to genera			0	▼	
Ř	-	te for Lane #3.		-	•	
	Generate errors of type:		Corre	cted parity 1		
	Delay between steps (in mic	roseconds):		100	•	
				💋 Ap	ply	
	Sink Error Counters (DPCD)					
		Lane #0	Lane #1	Lane #2	Lane #3	
	Uncorrected block errors	0	0	0	0	
	Corrected block errors	0	0	0	0	
	Bit errors	0	0	0	0	
	Parity block errors Parity bit errors	0	0	0	0	
					Ŭ	
	5	🛚 Update		💋 Clear co	ounters	
	Debug FEC Sequencing					
	Send FEC Enable Sec	quence	🗣 Send	FEC Disable !	Sequence	
	Sink FEC Status: Decode Enabl					Clear log

FEC

Clicking **Enable FEC** UCD-400 will verify if connected sink supports FEC and begins the handshake for enabling FEC.

Clicking **Disable FEC** UCD-400 will start the FEC disable handshake.

If **Prefer FEC Enabled** is selected and the connected sink supports FEC, UCD-400 will start the FEC Enable Sequence after a successful connection.

Error Generator

Generate errors of type: selection will set how many errors will be inserted into one FEC block and to which link symbols. There are five options:

- Uncorrected block: 3 symbol errors with 3 error bits together
- Corrected block: 2 symbol errors with 2 error bits together
- Corrected parity: 2 parity byte errors with 2 error bits together
- Corrected block 1 error
- Corrected parity 1 error

Note: FEC must be enabled and running before errors can be added.

Each lane can have its individual error amount. Errors can be injected to even and odd decoders by using **lane #0** and **lane #1** counters when link is configured to one lane.

Clicking Apply will start error injection.

Clicking Update will read sink DPCD FEC error counter registers.

Clicking Clear counters will clear sink DPCD FEC error counter registers.

Note: Link training will reset sink FEC error counters.

Debug FEC Sequencing

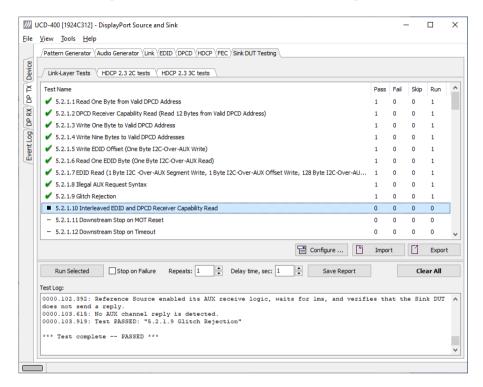
When clicking **Send FEC Enable Sequence** UCD-400 will start adding *FEC Enable Sequence* in its main link data.

When clicking **Send FEC Disable Sequence**, UCD-400 will start adding *FEC Disable Sequence* in its main link data.

Sink DUT Testing Tab

Sink DUT Testing Tab is enabled with UCD Pro for DP Source license.

Please refer to **Appendix E** later in this document for description of the tests available. Sink DUT Testing enables the execution of HDCP 2.3 Compliance Tests for a DP Sink DUT. Sink DUT Testing enables testing of a DP Sink DUT. Please refer to **Appendix E** of this document to get a full definition of the Test Cases and test parameters.



Select the tests for execution by clicking the corresponding row.

Clicking **Configure...** opens a dialog for defining the test parameters for that set. Please refer to Test Parameters below for description.

Parameters from Test descriptor files can be loaded with Import and stored with Export. Please refer to chapter *Exporting Tests for TSI* later in this document.

• Tests are started by clicking **Run Selected**. By clicking Abort the sequence is stopped.

Test flow can be controlled with **Repeats** of the test sequence, **Delay** between individual tests or **Stop on Failure** that stops the whole sequence if one of the tests fail.

At the completion of each test the result of the test is indicated in the matrix on the right hand side of the test panel. For each test, the matrix lists the number of occurrences of each result and the number of tries performed.

Click **Save Report** to generate a HTML report file for sharing the results with other parties for viewing without UCD Console.

By clicking Clear All the test log and the results matrix are cleared.

Test Parameters

Each test set has its dedicated set of test parameters. To open a dialog for defining the parameters click **Configure...**

Parameters of LL CTS Tests

Link-Layer Tests parameter panel defines which resolutions and video modes are used for testing.

They can be defined in the matrix in the dialog by selecting **Use test configuration (below)** or determined by evaluating content of DUT EDID by selecting **Use sink DUT EDID**.

DP 1.4 LL CTS: Sink DUT C	apabilities			—		×
Test Parameters						
Test timeout, milliseconds	10000	Most packed video mode(s)	Use sink D	UT EDID		\sim
DSC video mode(s) 1920 x 1080 @ 30 Hz 1920 x 1080 @ 60 Hz 1920 x 1080 @ 120 Hz 3840 x 2160 @ 30 Hz 3840 x 2160 @ 60 Hz 3840 x 2160 @ 120 Hz 5120 x 2160 @ 100 Hz 5120 x 2160 @ 100 Hz 7680 x 4320 @ 500 Hz 7680 x 4320 @ 100 Hz	Use test configuration (below) ✓ CTA RB1 RB2 <tr td=""> </tr>	1 Iane CVT 1280 x 800 @ 60p [R81] DMT 1280 x 768 @ 60p [R81] DMT 300 x 600 @ 60.317p 33 DMT 1024 x 768 @ 60p 18bp CTA 1440 x 480 @ 59.94p 2- CTA 1440 x 576 @ 50p 24bp 2 Ianes DMT 1280 x 1024 @ 60p 24bp DMT 1280 x 960 @ 60p 24bp DMT 1280 x 960 @ 60p 30bp CVT 1280 x 800 @ 60p 30bp CVT 1280 x 800 @ 60p 30bp CVT 1280 x 768 @ 60p 30bp CVT 1280 x 768 @ 60p 30bp CVT 1280 x 768 @ 60p 30bp CVT 1600 x 1200 @ 60p [R8] 4 Ianes CVT 2048 x 1536 @ 60p [R8]] 18bpp 95% Dbpp 93% p 90% 4bpp 100% p 100% p 100% p 100% p 97% 1] 24bpp 94% p 92% 1] 18bpp 90% 1] 24bpp 97%	/a 6		
Display ID Visual Checks	Never skip 🗸 🗸	DMT 1792 x 1344 @ 60p 24b				
DSC Simple 422 CRC	YCbCr 444 bitstream \sim	CTA 1920 x 1080 @ 60p 30b	pp 86%			
Presets		~	ОК	>	Cancel	

Parameters of HDCP CTS Tests

HDCP CTS Tests have their own parameter dialog.

DP HDCP CTS 3C test parameters			-		×
Test Parameters					
Test timeout, milliseconds	200000				
Repeater_MultipleOutputs	1				
Number of Sinks connected to Repeater	0				
Presets		🗸 ок		🗙 Cancel	

Saving and Loading Presets

In all parameter dialogs the selected parameters can be saved as Presets. Please click **Presets...** to save or recall a configuration.

Exporting Tests for TSI

Unigraf UCD Console includes a feature rich Software Development Kit (SDK) for use in automated testing. The SDK is called Test Software Interface (TSI). TSI allows for an easy integration of Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation found in additional Unigraf manuals for details.

The tests included in UCD Console's Source DUT Testing tab and Sink DUT Testing tab can be executed in TSI environment. A straightforward way is to use UCD Console's *Tools* > *TSI Integration* dialog to create the necessary files for TSI environment and use *Export* function in *DUT Testing* tabs to include the intended tests.

	Configure	Ľ	Imp	ort		Expo	rt
 5.2.1.12 Downstream Stop on Timeout 			0	0	0	0	
 5.2.1.11 Downstream Stop on MOT Reset 			0	0	0	0	
5.2.1.10 Interleaved EDID and DPCD Receiver Capability Read			0	0	0	0	
5.2.1.9 Glitch Rejection			1	0	0	1	_

Export: Save parameters of the selected test to a file. If TSI Integration is enabled in Tools > Options, also the test is appended into 'Run Test' file in TSI workspace folder.

Import: Recall parameters from configuration file. If TSI Integration is enabled in Tools > Options, parameters are imported from a file in TSI workspace folder

8. COMPLIANCE TESTS

Compliance test functionality is a license enabled add-on to UCD Console.

The tests are included in the GUI software, license codes enable the tests for use. Please refer to *Appendix B Licensing* for details. The list of compliance tests that UCD Console supports, please refer to document *DisplayPort Compliance Test Tool Options for* UCD-400. It can be downloaded in Unigraf Document Center at https://www.unigraf.fi/documents/. If you have any additional questions, please contact Unigraf or your local representative.

Compliance tests (CTS Tests) are part of tests included in **Source DUT Testing** tab of **DP RX** and **Sink DUT Testing** tab of **DP TX**. **Source DUT Testing** tab is not available when using UCD-411.

<i>///</i> เ	UCD-400 [1924C312] - DisplayPort Source and Sink		-	-		×
<u>F</u> ile	<u>V</u> iew <u>T</u> ools <u>H</u> elp					
	Video \Audio \Link \EDID \DPCD \HDCP \SDP \FEC \Source DUT Testing \					
Device						
Dev	/ Link-Layer Tests (HDCP 2.3 1A tests (HDCP 2.3 1B tests HDCP 2.3 3A tests (HDCP 2.3 3B tests CRC tests	Simp	le LT te	ests \		
Ĩ	Test Name	Pass	Fail	Skip	Run	^
B	- 4.2.1.1 Source DUT Retry on No-Reply During AUX Read after HPD Plug Event	0	0	0	0	
X	 4.2.1.2 Source Retry on Invalid Reply During AUX Read after HPD Plug Event 	0	0	0	0	
B	 4.2.1.3 Source Device HPD Event Pulse Length Test 	0	0	0	0	
Log	 4.2.1.4 Source Device IRQ_HPD Pulse Length Test 	0	0	0	0	
Event Log	 4.2.1.5 Source Device Inactive HPD / Inactive AUX Test 	0	0	0	0	
U.	 4.2.2.1 DPCD Receiver Capability and EDID Read upon HPD Plug Event 	0	0	0	0	
	 4.2.2.2 DPCD Receiver Capability Read upon HPD Plug Event 	0	0	0	0	
	- 4.2.2.3 EDID Read	0	0	0	0	
	– 4.2.2.4 EDID Read Failure #1: I2C-Over-AUX NACK	0	0	0	0	
	 4.2.2.5 EDID Read Failure #2: I2C-Over-AUX DEFER 	0	0	0	0	
	- 4.2.2.6 EDID Corruption Detection	0	0	0	0	
	- 4.2.2.7 Branch Device Detection upon HPD Plug Event	0	0	0	0	~
	🗎 Configure	Impor	rt		Export	:
	Run Selected Stop on Failure Repeats: 1 🔹 Delay time, sec: 1 🔹 Save Report			Cle	ar All	
	Test Log:					
						\sim
						\sim
		_				
				_		

The tests cases are divided to test categories as described in *Appendix E* of this document. Each test category can be found in its dedicated sub-tab. The sub-tabs as in turn enabled by the licenses present in user's PC. Please refer to chapter 3 *License Manager* earlier in this document.

DSC Test Content

When running DSC Compliance Tests, UCD-400 needs to have access to DSC content used as test patterns. The content can be created from the source bitmap files downloaded during installation (optional) either with Unigraf DSC Content Creator or created by the Compliance Test Tool on-the-fly during the compliance test.

Options

In Tools > Options menu you can define DSC Work folder DSC test content directory.

When *Automatically create missing content*, is selected automatically create the DSC compressed content used for testing the DUT.

You can also *Keep auto-created DSC content files:* By default, the DSC compressed content is deleted after use. If selected, the content not deleted.

Warning Keeping the automatically created DSC compressed content will shorten the time needed for running the DSC compliance tests.

Please note, that the space needed for storing the full library **can be very large** (appr. 400 GBytes). Please make sure that the content will be stored in a medium that has the required space available.

Test Parameters

Before running the tests, the user needs to define the capabilities of the DUT for the test engine. Each test category has its dedicated test parameter dialog. Click **Configure...** in *Source DUT Testing* or *Sink DUT Testing* tab to open the parameter dialog.

Test timeouts est timeout (milliseconds):							
est timeout (milliseconds):		Colorimet	гу				
	5000	-	RGB		YCbCr 4:2:2	YCbCr 4:4:4	
Long HPD pulse duration (milliseconds):			/ESA	🗌 8b	pc CTA (ITU.601)	8bpc CTA (ITU.601)	
		8bpc 1	/ESA	10	bpc CTA (ITU.601)	10bpc CTA (ITU.601)	
	5000	10bor	VESA	🗌 8b	pc CTA (ITU. 709)	8bpc CTA (ITU. 709)	
est cycle delay (milliseconds):	5000	8bpc	TA	10	bpc CTA (ITU.709)	10bpc CTA (ITU.709)	
DUT Capabilities	41	10bpc	CTA				
lax lanes supported:	4 Lanes	✓ Select	All				
lax bit rate supported:	HBR3 (8.10 Gbps)	~					
Voltage Swing level 3 (1.2V) supported		Video Mo	des				
Pre-Emphasis level 3 (9.5dB) supporte	d	Fail-safe	video mode:		640x480 @ 60Hz 6 BP	C	
Fixed timing DUT		Maximum	supported video mo	ode:	3840x2160 @ 60Hz 8	BPC	\sim
Spread Spectrum Supported Video format change without LT suppo	rtod						
Video format change without LT suppo Lane count reduction without LT suppo		Most Pac	ked Timings				
E-DDC supported	ried	1 Lane	CTA 1440 x 576p	@ 50H	z, 8 bpc		\sim
Audio Info Frame supported for 2 char	nel audio	2 Lanes	CVT 1600 x 1200	p @ 60	Hz, RB1, 6 bpc		\sim
DUT is Type-C Device		4 Lanes	4 Lanes CVT 2048 x 1536p @ 60Hz, RB1, 8 bpc				
7 FEC supported		rearies	CTT 2010 X 1000	p @ 00	nzy rozy o opc		
FEC disable sequence supported		Time-star	np generation				
Audio without Video supported			1 Lane		2 Lanes	4 Lanes	
Test Automation		RBR	848x480@60 Hz	~	1280x720@60 Hz	✓ 1920x1080@60 Hz	\sim
TEST_LINK_TRAINING		HBR	1280x720@60 Hz	~	1280x960@60 Hz	✓ 1920x1080@60 Hz	\sim
TEST_EDID_READ		HBR2	1280x960@60 Hz	~	1920x1080@60 Hz	✓ 1920x1080@120 Hz	~
TEST_VIDEO_PATTERN		HBR 3	1920x1440@60H	, ~	3840x2160@30Hz	3840x2160@60Hz	~
TEST_AUDIO_PATTERN		TIDICS	192021-10@0018	• •	30-1072100@30112	- 3640X2100@0012	
TEST_AUDIO_PATTERN vent indicating DUT ready:	Active Video	~					

For a detailed description of capabilities listed on the tab please refer to *Chapter 3 Compliance Test Operation* of document *VESA DisplayPort v1.4a Link Layer Compliance Test Specification*.

Note

Please make sure that the capability tables are completed before running the tests. The result of the test might be misleading if the DUT capabilities and the table do not match.

Saving Test Parameters

Test parameters can be saved for later use in two ways: internally or externally in a file.

In parameter dialog the parameter set can be saved as an internal Preset.

In *Source* or *Sink DUT Testing* tab **Export** saves test definitions of each selected test in a separate file. **Import** loads the parameters back to UCD Console. They can be run with Unigraf TSI. Please refer to chapter *7.3.6 Running Tests* in document *TSI-X_Reference.pdf* in UCD Console release package.

Running CTS Tests

Source DUT Testing (UCD-411 N/A) and *Sink DUT Testing* tabs include the tests enabled with the set of licenses present in UCD Console. The tests are grouped in test set tabs. In tabs the tests are listed by the test name and reference number as presented in applicable compliance test specification. UCD-400 firmware implements the test according to the test specification.

For running a test, select it and click **Run selected**. For selecting multiple consecutive tests in the list hold down the **Shift** key of your keyboard while selecting the tests. For selecting multiple individual tests hold down the **Ctrl** key in your keyboard while selecting.

	UCD-400 [1924C312] - DisplayPort Source and Sink		-	-		×
<u>F</u> ile						
T a	/Video \Audio \Link \EDID \DPCD \HDCP \SDP \FEC \Source DUT Testing \					
Device	/ Link-Layer Tests & HDCP 2.3 1A tests & HDCP 2.3 1B tests & HDCP 2.3 3A tests & HDCP 2.3 3B tests & CRC tests	Simp	le LT t	ests		
XT 90	Test Name	Pass	Fail	Skip	Run	^
	4.2.1.1 Source DUT Retry on No-Reply During AUX Read after HPD Plug Event	0	0	0	0	
X	4.2.1.2 Source Retry on Invalid Reply During AUX Read after HPD Plug Event	0	0	0	0	
B	4.2.1.3 Source Device HPD Event Pulse Length Test	0	0	0	0	
Event Log	4.2.1.4 Source Device IRQ_HPD Pulse Length Test	0	0	0	0	
ent	 4.2.1.5 Source Device Inactive HPD / Inactive AUX Test 	0	0	0	0	
μ	 4.2.2.1 DPCD Receiver Capability and EDID Read upon HPD Plug Event 	0	0	0	0	
	 – 4.2.2.2 DPCD Receiver Capability Read upon HPD Plug Event 	0	0	0	0	
	- 4.2.2.3 EDID Read	0	0	0	0	
	 4.2.2.4 EDID Read Failure #1: I2C-Over-AUX NACK 	0	0	0	0	
	 4.2.2.5 EDID Read Failure #2: I2C-Over-AUX DEFER 	0	0	0	0	
	- 4.2.2.6 EDID Corruption Detection	0	0	0	0	
	 4.2.2.7 Branch Device Detection upon HPD Plug Event 	0	0	0	0	~
	E Configure	Impor	rt		Export	t
	Run Selected Stop on Failure Repeats: 1 🔹 Delay time, sec: 1 🔹 Save Report]		Cle	ar All	
	Test Log:					
						^
						~
		_				

Repeats defines number of test-runs and the **Delay time** delay between the tests. When repeating a sequence of tests, all selected tests are performed in each repetition. E.g. when you repeat tests 1, 2 and 3 two times, the sequence is: 1, 2, 3, 1, 2, 3.

Test flow parameters like **Test timeout** and **Test cycle delay** can be defined in *Test Parameter* dialog launched by clicking **Configure...**.

Selecting **Stop on Failure** stops execution of a series of tests in case a failure is found.

For clearing the Status Log and the Results matrix, click Clear All.

Evaluating CTS Test Results

The test procedure advancement can be monitored in the *Test Log* panel. It describes the steps of each individual test in the way defined in the corresponding VESA Compliance Test Specification. Please use the Status Log and Specification side by side when interpreting the results.

At the completion of each test the result of the test is indicated in the matrix on the right hand side of the test panel. For each test, the matrix lists the number of occurrences of each result and the number of tries performed.

UCD-400 [1924C312] - DisplayPort Source and Sink		-		×
<u>File View Tools H</u> elp				
/Video \Audio \Link \EDID \DPCD \HDCP \SDP \FEC \Source DUT Testing \				
Unk-Layer Tests / HDCP 2.3 1A tests / HDCP 2.3 1B tests / HDCP 2.3 3A tests / HDCP 2.3 3B tests / CRC test			_	
/ Link-Layer Tests / HDCP 2.3 1A tests / HDCP 2.3 1B tests / HDCP 2.3 3A tests / HDCP 2.3 3B tests / CRC test	ts 👋 Simple L	T tests	1	
Test Name	Pass	Fail	Skip	Run
▲ IA-01 Regular Procedure - With previously connected Receiver (With stored km)	1	0	0	1
Image: State	1	0	0	1
△ IA-03 Regular Procedure - Receiver disconnect after AKE_Init	1	0	0	1
S 1A-04 Regular Procedure - Receiver disconnect after km	1	0	0	1
IA-04 Regular Procedure - Receiver disconnect after km IA-05 Regular Procedure - Receiver disconnect after locality check IA-05 Regular Drocedure - Receiver disconnect after locality check	0	0	0	0
A-06 Regular Procedure - Receiver disconnect after ks	0	0	0	0
 1A-07 Regular Procedure - Receiver sends REAUTH_REQ after Ks 	0	0	0	0
- 1A-08 Irregular Procedure - Verify Receiver Certificate	0	0	0	0
- 1A-09 Irregular Procedure - SRM	0	0	0	0
- 1A-10 Irregular Procedure - Invalid H'	0	0	0	0
- 1A-11 Irregular Procedure - Pairing Failure	0	0	0	0
 1A-12 Irregular Procedure - Locality Failure 	0	0	0	0
E Configure	j Import	Ľ] E	kport
Run Selected Stop on Failure Repeats: 1 😴 Delay time, sec: 1 😴 Save Report			Clear	All
Test Log:				
0002.454.648: [TE-Snk] STEP 1A-04-1 0002.553.641: [TE-Snk] WARNING. DUT sends unencrypted video 0002.553.675: [TE-Snk] DUT initiates authentication by transmitting AKE_Init 0002.554.081: Test PASSED: "1A-04 Regular Procedure - Receiver disconnect after km"				^
*** Test complete PASSED ***				*

Test Report

Results of the test can be saved as a report in HTML format.

Click **Save Report** in UCD Console. A dialog will open where information about the DUT and remarks about the test can be included in the report. Details of the used test equipment and the software and firmware version will be added automatically.

/// Report information	- 🗆 ×
UCD-400 [1924C312]	DUT Information
Serial number:	Model:
1924C312	ABC
Firmware package:	Serial Number:
MN 1.8.11 MF 1.7.9	1234567890
	Revision:
Application Version	XX
Version 1.9 [R0], Build# 25582	Firmware version:
	Driver:
Report Information	
Tested by: Tester	
Remarks: (1024 chars max.)	
	🖌 Save 🗙 Cancel
	V Save K Cancel

Viewing the CTS Test Report

The report file can be viewed with any HTML browser. The report has built-in views for Report Summary, Test Summary, and individual Test Logs.

Unigraf Test Report	×	+		-		ľ
) → C' û	Q	file:///C:/Users/aaa/Desktop/test.html	Ŧ	lii\ C		
Total number of test runs Passed test runs: 4	s: 4					
Failed test runs: 0						
Skipped test runs: 0 Aborted test runs: 0						
EST DETAILS, TEST 1						
1A-01 Regular Procee	dure - Wi	th previously connected Receiver (With stored km)				
Test Result: PASSED						
Test Settings:						
Test timeout, millisecond Revoke ID = 71.6A.15.46		0				
Source EncDisableBoot		= 1				
Testion						
Test Log						
		"1A-01 Regular Procedure - With previously connected Receiver (With store	ed km)"			
0000.000.146: [TE- 0000.000.258: [TE-		efore Starting Authentication]				
0001.000.916: [TE-		TE transmits Receiver Connected Indication (Hot plug, CONNECTION STATUS N	NOTIFY and IRQ	HPD)		
0001.001.163: [TE-	-Snk] [A	uthentication and Key Exchange]				
0001.001.290: [TE-						
		WARNING. DUT sends unencrypted video				
0001.100.309: [TE-		DUT initiates authentication by transmitting AKE_Init EP 1A-01-3				
		AKE Send Cert message is available				
0001.256.170: [TE-	-Snk]	DUT sends AKE_No_Stored_km message				
0002.232.047: [TE-	-Snk]	Send AKE Send H Frime message Send AKE_Send_pairing_Info message				
0002.234.260: [TE- 0002.234.810: [TE-	-Snk]	Send AKE_Send_pairing_Info message				
0002.234.939: [TE-						
		DUT sends LC Init message				
		TE sends LC_Send_L_prime message				
0002.243.708: [TE- 0002.243.836: [TE-		ession Key Exchange]				
		DUT sends SKE Send Eks message				
		DUT writes Valid Type Value message				
0002.244.611: [TE-						
		DUT enables HDCP encryption				
0002.504.852: [TE- 0002.504.982: [TE-		Checking the correctness of the LINK VERIFICATION PATTERN within the fit	rst 48VB-TD tra	namia	sion	
0002.525.970: [TE-	-Snk]	Authentication and link integrity check complete				
0002.526.347: Test	PASSED	: "1A-01 Regular Procedure - With previously connected Receiver (With sto	ored km)"			
*** Test complete	PASS	ED ***				
EST DETAILS, TEST 2						
		the new terms and a Describer (MPth and also address)				1
1A-02 Regular Proces	dure - Wi	th newly connected Receiver (Without stored km)				
Test Result: PASSED						

9. EVENT LOG

Event Logger (Event Log) vertical tab can be seen on the left edge of the GUI. Event Log is enabled with *UCD Pro for DP Sink* (UCD-411 N/A) or *UCD Pro for DP Source* license.

Event Log dialog is divided into two panels: the left panel lists all transactions, and the right panel shows the parsed transaction data for the line selected in the list on the left.

Start Capture	III S	top Capt	ure				
Data sources and filters:		/Event	Log DP AUX	analyzer (DP Ou	Itput port) OP AUX analyzer (DP In	put port)	
V · DisplayPort Output			<u>S</u> ave	Report	Copen		
AUX		#	Timestamp	Туре	Data ^	178: 4615.908ms	
OisplayPort Input Input Input		175	4615.699	AUX	Native AUX Request RD 2	TIMESTAMP: 0:0:4:61	5908
AUX		176	4615.833	AUX	Native AUX Reply: AUX_A	Device ID	= 03
SDP		177	4615.833	AUX	Native AUX Reply: AUX_A	[DisplayPort TX]	
MSA changes		178	4615.908	AUX	Native AUX Request RD 2	Flag	$= 0 \times 0 0$
VB-ID changes		179	4615.908	AUX	Native AUX Request RD 2	[Data message] Packet size	= 4
		180	4616.043	AUX	Native AUX Reply: AUX_A	[bvtes]	- 1
		181	4616.043	AUX	Native AUX Reply: AUX_A	Content size	= 3
		182	4616.122	AUX	Native AUX Request WR	[bytes]	
		183	4616.123	AUX	Native AUX Request WR	Direction	= Source
		184	4616.318	AUX	Native AUX Reply: AUX A	to Sink Native AUX Request	= Read
	<	185	4616.318	AUX	Native AUX Reply: AUX A	Length	= 2
		186	4616.780	AUX	Native AUX Request RD 2	Address	= 0x00206
		187	4616.780	AUX	Native AUX Request RD 2		
		188	4616.913	AUX	Native AUX Reply: AUX A	Packet Raw Data: [#1 01	.78] 90 02 0
		189	4616.913	AUX	Native AUX Reply: AUX A	1 ott	
		190	4616.988	AUX	Native AUX Request RD 1		
		191	4616.988	AUX	Native AUX Request RD 1		
		192	4617.119	AUX	Native AUX Reply: AUX_A		
		193	4617.119	AUX	Native AUX Reply: AUX A		
		194	4617.186	AUX	Native AUX Request RD 2		
		195	4617.186	AUX	Native AUX Request RD 2		
		196	4617.322	AUX	Native AUX Reply: AUX_A		
		197	4617.322	AUX	Native AUX Reply: AUX_A		
		198	4617.401	AUX	Native AUX Request WR		
Presets		199	4617 401	ΔΠΧ	Native ALIX Request WR		

Event Logger captures the following items (DP RX not available in UCD-411)

- HPD status (DP TX and DP RX)
- AUX transaction (DP TX and DP RX)
- DP SDP messages (DP RX)
- Changes in MSA (DP RX)
- Changes in VB-ID (DP RX)

Each item line includes Time stamp, Type indication, Message source, and raw message data. The right panel lists the content of one message. Messages belonging together with the selected one are shown in red color.

- Start event logging by clicking **Start Capture** and stop it by clicking **Stop Capture**.
- The transactions can be saved in binary *.evt Event Log files by clicking **Save**. Saved Event Log files can be recalled by clicking **Open**.
- Clicking **Report** stores event logs as html reports to be shared and viewed with any web browser. The save dialog allows inclusion of detailed information about the DUT and the test in free-text *Report information*.

DP AUX Analyzer

	ew <u>T</u> ools <u>H</u> elp		Stop Capt						
Da	ata sources and filters:				analyzar (DR	Output port	DP AUX analyzer (DP	Input port)	
	✓ · DisplayPort Output	1						Tubor bor Q /	
	- HPD			Save	Report		Open		
	AUX		Line	Timestamp	From	Type	Details	Data	Message details:
	 DisplayPort Input 		172	1575443.74	Sink	Native	AUX ACK - 16 bytes	00 3e e3 🔥	Line #179 - 1575444.68ms
	V HPD		173	1575443.94	Source	Native	Reg RD 16 bytes fro		CERT(rx) - DPCD Address
2 III -	V AUX		174	1575444.05	Sink	Native	AUX_ACK - 16 bytes	00 a4 a0	range trace
	- SDP		175	1575444.25		Native	Req RD 16 bytes fro		runge date
	MSA changes		176	1575444.37		Native	AUX_ACK - 16 bytes		0x6900b - 0x69214
			177	1575444.56		Native	Req RD 10 bytes fro		No extended trace decoding
	VB-ID changes		178	1575444.68		Native	AUX_ACK - 10 bytes		available.
			179	1575444.68		Trace	CERT(rx) - DPCD Ad		
			180	1575444.82		Native	Req RD 8 bytes fro	96 92 15 00 97 32	Block dump
			181 182	1575444.93 1575444.93		Native	AUX_ACK - 8 bytes R(rx) - DPCD Addres		0x000 : da 68 4e 8b a6 b9 b0
			182	1575445.06		Native	Reg RD 3 bytes fro		b5 df f0 ff 2d fe 2a 83 0d
			183	1575445.17		Native	AUX ACK - 3 bytes	00 02 00	0x010 : e8 96 e0 fa bc 08 e3 f1
		<	185	1575445.17		Trace	RxCaps - DPCD Add		87 5a ab 07 b8 1c a6 a8
			186	1575486.46		Native	Reg WR 16 bytes to		0x020 : 2f d5 a0 f7 b8 19 c6 3d 64 2b 53 ba f3 69 ea 36
			187	1575486.71		Native	AUX ACK - 0 bytes	00	0x030 : 9a 60 ee f7 6b 08 cc
			188	1575486.78		Native	Reg WR 16 bytes to		1e 12 9f 62 be b2 06 1e a4
			189	1575487.03		Native	AUX ACK - 0 bytes	00	0x040 : 53 a0 76 c2 41 33 a0
			190	1575487.09	Source	Native	Reg WR 16 bytes to	. 86 92 40	30 d6 1f da 7b e7 03 ba 12
			191	1575487.35	Sink	Native	AUX ACK - 0 bytes	00	0x050 : 17 66 bb 44 15 53 49
			192	1575487.41	Source	Native	Req WR 16 bytes to	. 86 92 50	93 6a ed 76 22 b2 9d 53 96
			193	1575487.67	Sink	Native	AUX_ACK - 0 bytes	00	0x060 : fd 78 b8 1c ad 81 8a
			194	1575487.73		Native	Req WR 16 bytes to		36 fe 46 7a b0 91 15 e0 7f
			195	1575487.99		Native	AUX_ACK - 0 bytes	00	0x070 : 3c 65 6f 30 dd de 2f 31
			196	1575488.05		Native	Req WR 16 bytes to		6a d0 07 6c 37 f5 4c 5d
			197	1575488.30		Native	AUX_ACK - 0 bytes	00	0x080 : d0 6f 49 99 ad 01 00
			198	1575488.37		Native	Req WR 16 bytes to		01 10 00 95 d7 7c cd e4 3e
			199	1575488.62		Native	AUX_ACK - 0 bytes	00	0x090 : 00 6d ca fb ca 16 04
			200	1575488.69 1575488.69		Native	Req WR 16 bytes to E(kpub) k(m) - DPC		8e e3 09 a3 68 fc b1 42 6e
			201	1575488.94		Trace Native	AUX ACK - 0 bytes	00 🗸	0x0a0 : a5 46 17 c1 fe bb ef a1
				1575408.94	SINK	Nauve	AUX_ACK - 0 Dytes		DETAILED CAP INFO AVAIL
	Presets		<					>	DETAILED_CAP_IN O_AVAIL

DP AUX Analyzer functionality is enabled in UCD-400 and UCD-411 by default.

The AUX Analyzer tabs collect AUX Channel Transactions from the Event Log in the *Transaction list*. The user can parse the content of each transaction by clicking the corresponding *transaction line*. The parsed content is in the *Message Details* panel on the right.

Please refer to chapter *Customizing the Main Window* below for details on how to modify the content and look of the *Transaction list*.

Lines

The data is organized in lines, each numbered starting from 1 and marked with a timestamp. There are four kinds of lines:

1. Information lines

Identified by the text "INFO" in their Type column, they provide some useful information like the time acquisition has started and stopped or the logical state of the inputs, etc.

2. Transaction lines

Identified by the text "Native" or "I2C" in their Type column, they report an AUX channel data transfer, either a data Request or a data Reply.

- **3.** Event lines Identified by the text "Event" in their Type column, they signal the state change in one or more of the monitored inputs.
- 4. Sideband Channel Messages The Isochronous Transport Service uses the sideband communications over sideband channel (AUX CH and HPD) for the management of topology/virtual channel connection/Main Link and performs Main Link symbol mapping.

5. Error lines

A line Type reading "Error" marks the detection of an illegal AUX channel data packet. An irregular start condition, an irregular stop condition or transfer of a number of bits which is not a multiple of 8 are all conditions that cause an error line.

6. Trace lines

Combines the data from several lines of a HDCP related message to one entry in *Message details* panel for easier readability.

Columns

The data on each line is ordered in columns. Each column provides additional information about the data line, facilitating its viewing and interpretation:

Line

This column displays the line number, starting from 1, and cannot be hidden.

Timestamp

Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started. The timestamp can be displayed as a time delay from the start of the acquisition (absolute) or from the previous line (relative). The timestamp can be displayed in milliseconds or in minutes, seconds and microseconds.

From

This column indicates the originator of the data line:

- "Source" and "Sink" for an AUX channel transaction, respectively a data Request and a data Reply.
- "Source Trace" and "Sink Trace" respectively for Sideband Message data Request and Reply.
- "DPA-400" for error and information lines.
- "Unknown" for signal state change events.

Туре

This column provides additional information about the type of the line:

- "Native" marks Native AUX channel Requests and Replies.
- "I2C" marks I2C AUX channel Requests and Replies.
- "Sideband Request" and "Sideband Reply" to mark the Sideband Channel messages
- "Event" is used for signal state change events.
- "INFO" is used with information lines.
- "Error" is used for illegal conditions detected on the AUX channel.

Details

This column contains an abbreviated description of the line content in textual form.

Data

The binary data exchanged during AUX channel transactions, in hexadecimal notation.

Find

To locate an access to a DPCD location right-click on the list and select **Find...** or select **Ctrl+F** from keyboard. To **Find again** select **F3**.

Search		×
Search for	Any access $~~$ to a	ddr. (Hex):
	🗶 Cancel	🔍 Search

Message Details

The *Message details* panel is used to provide a detailed explanation of the line currently selected in the *Transaction list*. For AUX channel transaction lines, for each of the DPCD memory locations affected, the panel lists:

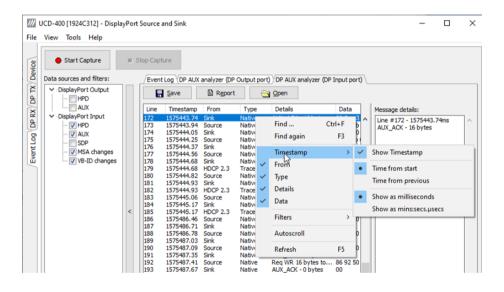
- All data bytes read or written.
- All DPCD memory locations affected.
- The name of the locations and of each of their bit fields.
- All bit field's numeric and binary values, together with their decoded value.
- The Replies outcome (AUX_ACK, AUX_NACK, I2C_DEFER, etc.).

Customizing the Main Window

Format of the data shown in the *Transaction list* and the *Message details* panels can be altered in order to highlight the details of your interest.

Selecting Data Columns

The *Transaction list* can be customized by right-clicking over the list. The pop-up menu allows choosing which columns to display, the style of the timestamp and switch between absolute and relative timestamps. *Filters* limit the transactions shown in the list. Please see *Filtering* later in this document.



Selecting Font and Colors

Select **Tools > Options > AUX Analyzer options** tab. Click **Select new font** and choose the font and size used for displaying the *Transaction list* and the *Message details*.

Options			×	
Video, Audio and Misc options AU	X Analyzer options			
Font Selection	Font			×
Select new font Current f	Tahoma	Font style: Regular	Size:	OK
Transaction list color option Show / change color settings for	Tababus Shins ITC	Regular Bold Oblique Bold Oblique	^ 10 ^ 11 12 14 16	Cancel
Normal item colors	Trebuchet MS	v bola oblique	v 18 v	
Color exar		Sample	γZz	
Change text color		Script:		
		Western	~	
- Hinhlinhted DPCD address r				

Transaction List Color Options

Select the colors for the font and background of various items.

tions	
deo, Audio and Misc options AUX Analyzer options	
Font Selection	
Select new font Current font "Tahoma", size 10	
Transaction list color options	
Show / change color settings for:	
Show / change color settings for: Normal item colors	~
	~
Normal item colors Normal item colors Selected item colors	~
Normal item colors Normal item colors Selected item colors Highlighted item colors	~
Normal item colors Normal item colors Selected item colors Highlighted item colors Sideband request message colors	~
Normal item colors Normal item colors Selected item colors Highlighted item colors Sideband request message colors Sideband regly message colors	~
Normal item colors Normal item colors Selected item colors Highlighted tiem colors Sideband request message colors Sideband reply message colors Signal state change message colors	~
Normal item colors Normal item colors Selected item colors Highlighted item colors Sideband request message colors Sideband reply message colors Signal state change message colors HDCP 1.3 Trace colors	~
Normal item colors Normal item colors Selected item colors Highlighted tiem colors Sideband request message colors Sideband reply message colors Signal state change message colors	~

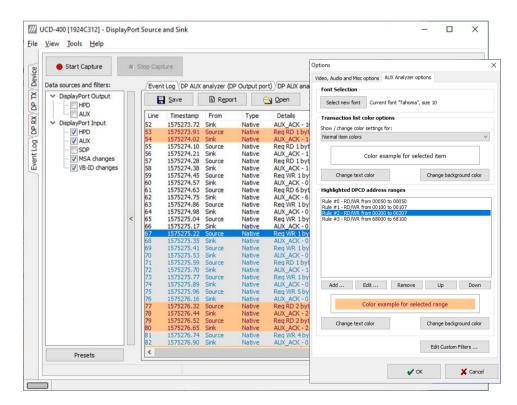
Highlighted DPCD Address Ranges

In order to improve the readability of the *Transaction list*, you can mark the AUX channel transactions where a certain DPCD register address or address range is highlighted with a color of choice.

Click **Add...**, select the access type, start DPCD address and end DPCD address of the range in Hex. Click **Accept**.

Select the range you just created from the **Highlighted DPCD addresses ranges** list and click the **Change test color** and **Change background color** buttons to select the colors desired.

You can create multiple simultaneous coloring rules to help you get a better view of the data captured.

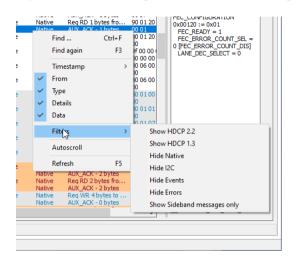


Filtering

Transactions lines shown in the transaction list can be limited by *Filtering*. The shown lines can be selected by:

- The type of data line
- The origin of the message
- The DPCD address range

Right click > Filters drop down menu lists a set of pre-programmed filters.



Editing Filters

From *Custom Filter* dialog (Tools > Options > Edit Custom Filters ...) allows for adding and modifying filters. The pre-programmed filters are listed in the dialog. Their structure can be copied as bases of your custom filters. It is advisable not to modify the pre-programmed filters directly but make copies of them.

usto	m Filter					>
Stor	ed custor	m filter defini	tions			
	WHDCP 2					New definition
Hide	Native					Rename selected
	Events					Delete selected
	Errors v Sidebar	nd messages	only			Move Up
			,			Move Down
	r Rules est / Rep	ly Pairing mo	de Auto	Filter item by request i	f reply received within 40	0µs of request →
Α	Rule	Туре	Source	Range	Comment	
	Show	Native	Src/Sink	0x069000-0x069fff	Show HDCP 2.2. addre	ess range
					-	
Ad	ld	Edit	Remove	Up Down		

In the *Stored custom filter definitions* panel, lists currently defined Filters. On the right hand side buttons, you can define new Filters, rename, or delete them. Their appearance in the *Filters* pull-down menu can also be altered.

In the *Filter Rules* panel lower in the dialog, you can review and change the *Rules* in the selected *Filter*. Add... creates new rules, Edit... enables review and editing existing Filters and **Remove** deletes from the Filter definition.

When clicking Add... or Edit... *Edit Filter Rule* dialog opens. The dialog defines the action of the rule, events, and event details.

/// Edit Filter Rule			-		×
Show \checkmark Native	✓ From Source or Sink	✓ Range: 0x06900	0-0x069fff		
Filter by Data:					
					\sim
					~
Comment (Optional, max 120 chars): Show HDCP 2.2. address range					
	🔗 Help	🗶 Cancel		🗸 Accep	t

Click **Help** to show "Help" text also attached to Appendix F of this document.

Note	Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.	
Note	Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.	

10. EDID EDITOR

Value UFG 0x4036 0x3032344c
0x4036
0x3032344c
Manufacture Year and Week
Week 52
Year 2014

The EDID Editor main window is divided into three logical areas. The bottom part of the

window contains the command buttons, and the log view. The top-left portion shows the currently edited E-EDID blocks in a tree-form, and the top-right portion shows an edit control for the currently selected item, possibly a list of sub-keys and their names (The list is not shown for all values) and the HEX-view of the block collection.

Command Buttons

Load: Load an EDID block collection file from disk. Save: Save the current block collection to a disk file. Show Hex: Show or Hide the HEX view. Show Log: Show or Hide the Log view.

EDID Editor Features

The EDID Editor currently supports VESA E-EDID block versions 1.3 and 1.4. As the standard defines, the versions 1.0, 1.1 and 1.2 are supposed to be backward compatible, and therefore the VESA E-EDID decoder will also show their contents. However, in these cases it should be noted that the error checking is not compliant with restrictions given in these older versions of the standard. In addition to VESA E-EDID block, the CEA-861 versions 1, 2 and 3 EDID blocks are also fully supported as well as the VESA Block Map Extension blocks.

Practically unlimited number of extension blocks may exist in a single collection. The number of blocks is limited by VESA Specifications and possibly by available system resources. Most EDID blocks contain a structure that is very similar to a tree-structure. The EDID Editor decodes each block into a tree-view of the block. The tree-view then contains all values contained within the EDID block. The contents can then be easily browsed, using only a few mouse clicks. The EDID Editor has a support for automatic variables, such as the block checksum. When the user changes a value in an EDID block, the tool will update the checksum accordingly. The automatic variables appear as read only values for the user. A log print will be made when an automatic variable is updated by the editor.

HEX View: An optional HEX data display of all blocks in the collection. The view also shows the latest changes highlighted.

LOG View: An optional LOG view, which will contain log prints generated by the editor. Mostly it will list values that have been automatically updated due to edits.

Editing Tips

Editing an EDID block is very straightforward, but there are some special cases where the user must know how to accomplish certain types of tasks.

- Enter key will apply text-edit values and combo-box selection.
- To apply new setting to *binary* values (ones that show a check-box), please click the **Set** button.
- When you see a **Quick Config** button appear below an editor, you can access a configuration menu that allows you to quickly select one of multiple pre-defined setup options.
- In CEA-861 blocks, you can add and remove 18-byte descriptors and CEA data blocks by setting the values "18-byte Descriptors in this block" and "CEA Data block count". Unfortunately re-arranging the descriptors and CEA data blocks is not supported yet, so you need to be careful when editing these.
- Enter hex values with prefix "0x" or "\$", no prefix means a decimal value.
- You can always enter HEX or DEC, even if the value is presented as HEX, and/or value range is given in HEX.
- Floating point values must be given with period "." as decimal separator, even if your localization setting defines decimal separator as comma (or other).
- Remember to click **Set** after changing a bit-value presented as a single check-box if you want the new value applied.

Note It is recommended that you back up the un-edited EDID contents to a file before editing and writing it to the card.

Saving EDID Data

When you are done with editing you can either save the EDID contents to a file in the PC or bring it in the *HEX Editor*.

For saving the data to a file in your PC click Save.

For bringing the data to the HEX Editor close the EDID Editor window by clicking the **Window Close** button in the top right-hand corner of the window. You will be asked if you would like to copy and replace the EDID data in the HEX Editor. Click **Yes** to replace the data, click **No** to discard the modifications.

When you are back in the *HEX Editor*, the bytes that the *EDID Editor* changed are highlighted with **BLUE BACKGROUND**.

APPENDIX A. PRODUCT SPECIFICATION

UCD-400 / UCD-411

Input	UCD-400: DisplayPort™ 1.4a compliant (DP Rx) UCD-411: Not available	
Output	UCD-400 & UCD-411: DisplayPort™ 1.4a compliant (DP Tx)	
Max video mode	7680 × 4320 p30 input and output 3840 × 2160 p120 input and output	
Audio	LPCM, 2 – 8 channels, 44.1 to 192 kHz	
Content Protection	HDCP 2.3, HDCP 1.3	
DSC Capability	DSC Sink with off-line decompression (UCD-411 N/A) DSC Source using pre-compressed content DSC 1.2a support. Support RGB / YCbCr up to 12 bits per component. 24 slices, max width 7680 pixels Up to 8K@60 Hz	
Additional features	MST, FEC, LTTPR DP 1.4a LL CTS, DP DSC CTS HDCP 2.3 CTS	
Computer interface	USB 3.0	
Software	Windows 10, 8 and 7 compatible software drivers, UCD Console application for Windows. TSI API with interface specific Test Sets.	
Power supply	+12 Vdc 100 to 240 Vac 50/60 Hz AC/DC converter included	
Module Size	272 × 170 × 60 mm	
Weight	1.2 kg w/o power supply	

APPENDIX B. LICENSING

The following tables provide detailed explanation of the functions and their availability and licensing. DPRX functionality is not available when using UCD-411.

UCD Console & TSI: DisplayPort Reference Sink (DPRX)

					1		r
Тар	Function	Basic*	TSI Basic**	DSC Decoder	DP 1.4a LL CTS for testing Source DUT	HDCP 2.3 CTS for testing Source DUT	HDCP 2.3 CTS for testing Repeater DUT
Video							
	Preview, Capture, Snap preview	•	•				
	Status	•	•				
Audio		-	-				
	Monitor, Capture, and graphical preview	•	•				
	Status	•	•				
Link			-				
	Link Status, Link Configuration	•	•				
	Stream Status (video, audio)	•	•				
	HPD Status, HPD Assert / De-assert, HPD Long Pulse, HPD Short Pulse	•	•				
	MST Feature (up to 4 streams)	•	•				
	FEC Feature	•	•				
	DSC Decoder, DSC Control						
EDID							
	Read / Write, Save / Load	•	•				
	EDID Editor	•					
DPCD							
	Read/Write, Save/Load	•	•				
	DPCD Decoder	•					
HDCP							
	HDCP 1.3 and HDCP 2.3 Support	•	•				
	Authentication status, Encryption status	•	•				
Event Log							
	Event Log	•	•				
	DP AUX Analyzer	•					
Source DUT Testing							
	Execute TSI Tests	•	•				
	Execute DP LL, Audio and FEC CTS						
	Execute DSC CTS						
	HDCP 2.3 CTS for testing DP Source DUT						
	HDCP 2.3 CTS for testing DP Repeater DUT						

*) UCD-400 is delivered by default with UCD Console Pro DP Sink, UCD Console Pro DP Source and HDCP 2.3 support enabling license keys. UCD-411 is delivered by default with UCD Console Pro DP Source and HDCP 2.3 support enabling license keys.

**) UCD-400 and UCD-411 are delivered by default with TSI SDK Advanced with HDCP 2.3 support key

UCD Console & TSI: DisplayPort Reference Source	(DPTX)
---	--------

			1		- (-	,	1	1
Tab	Function	Basic*	TSI Basic**	DSC Encoder	LTTPR	DP 1.4a LL CTS for testing Sink DUT	HDCP 2.3 CTS for testing Sink DUT	HDCP 2.3 CTS for testing Repeater DUT
Pattern Generator								
	Fixed and custom Video Timings	•	•					
	Fixed and custom Video Patterns	•	•					
	Adaptive-Sync Feature	•	•					
Audio Generator								
	Play audio files	•	•					
Link			İ		İ	İ	İ	
	Link Status	•	•					
	HPD Status: (Asserted / De-asserted)	•	•					
	Link Configuration: (Lane count, Link Rate, Framing mode, Clock mode)	•	•					
	MST Feature (up to 4 streams)	•	•					
	FEC Feature	•	•					
	DSC Encoder							
	LTTPR Feature							
EDID								
	Read / Write, Save / Load	•	•					
	EDID Editor	•						
DPCD								
	Read / Write, Save / Load	•	•					
	DPCD Decoder	•						
HDCP								
	HDCP 1.3 Support	•	•					
	Control: (Enable / Disable, authenticate only, Encryption Enable / Disable)	•	•					
	Status: (Authentication status, Encryption status)	•	•					
	HDCP 2.3 Support	٠	•					
Event Log								
	Event Log	•	•					
	DP AUX Analyzer	•						
Sink DUT Testing								
	Execute TSI Tests	٠	•					
	Execute DP LL, Audio and FEC CTS							
	Execute DSC CTS							
	HDCP 2.3 CTS for testing DP Sink DUT							
	HDCP 2.3 CTS for testing DP Repeater DUT							

*) UCD-400 is delivered by default with UCD Console Pro DP Sink, UCD Console Pro DP Source and HDCP 2.3 support enabling license keys. UCD-411 is delivered by default with UCD Console Pro DP Source and HDCP 2.3 support enabling license keys.

**) UCD-400 and UCD-411 are delivered by default with TSI SDK Advanced with HDCP 2.3 support key

APPENDIX C: PREDEFINED TIMINGS

DisplayPort Sink and Source Capability (RGB) (4 lanes capability)

Description	TSI*	H	V	H	V	Frame			GB 4:4		
·		active	active	total	total	rate	6	8	10	12	16
VESA 640 x 480 @ 60Hz	0	640	480	800	525	60	•	•	•	•	•
VESA 800 x 600 @ 60Hz	1	800	600	1056	628	60	•	•	•	•	•
VESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	•
VESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	•
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	•
VESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	•
VESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	•
VESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	•
VESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	•
VESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	•
VESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	•
VESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	•
VESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•	•	
VESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•	•	•	•
VESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•	•	•	•
VESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•	•	•	•
VESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•	•	•	•	•
VESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	•
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	•	•	•	•
VESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•	•	•
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•	•	•	
VESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120	•	•	•	•	
VESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120	•	•	•	•	
CTA 1920 x 1080 @ 120Hz	26	1920	1080	2200	1125	120	•	•	•	•	
VESA 1920 x 1440 @ 60Hz	27	1920	1440	2600	1500	60	•	•	•	•	
VESA 2048 x 1536 @ 60Hz	28	2048	1536	2208	1580	60	•	•	•	•	
VESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60	•	•	•	•	
VESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•	•	•	•	
VESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•	•	•	•	
VESA 2560 x 1600 @ 60Hz	32	2560	1600	3504	1658	60	•	•	•	•	
VESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60	•	•	•	•	
Other 2880 x 1440 @ 60Hz	34	2880	1440	2976	1456	60	•	•	•	•	
VESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60	•	•	•		
VESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30	•	•	•	•	
VESA 3840 x 2160 @ 30Hz [RB2]	37	3840	2160	3920	2191	30	•	•	•		
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2191	30				•	
	39	3840	2160	4400 5280	2250		•	•	•	•	
CTA 3840 x 2160 @ 50Hz						50 50	•	•			
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50 60	•	•			
VESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60	•	•	•		
VESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60	•	•	•		
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60	•	•		•	
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60	•	•			

Supported

Supported with HBR3

Supported with DSC

Description	TSI*	Н	V	Н	V	Frame		R	GB 4:4	1:4	
Description	101	active	active	total	total	rate	6	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120					
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120					
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120					
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30	•	•	•	•	•
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30	•	•	•	•	•
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30	•	•	•	•	
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60	•	•			
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60	•	•			
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60	•				
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120					
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120					
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120					
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60	•				
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30					
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30					
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30					
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60					
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60					
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60					
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100					
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100					
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100					

DisplayPort Sink and Source Capability (RGB) (4 lanes capability) contd.

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (4 lanes capability)

Description	TSI*	H	V	Н	V	Frame		bCr 4		. ,			:2:0 (b	pc)
·		active	active	total	total	rate	8	10	12	16	8	10	12	16
VESA 640 x 480 @ 60Hz	0	640	480	800	525	60	•	•	•	•	•	•	•	•
VESA 800 x 600 @ 60Hz	1	800	600	1056	628	60	•	•	•	•	•	•	•	•
VESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	•	•	•	•
VESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	•	•	•	•
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	•	•	•	-
VESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	•	•	•	-
VESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	•	•	•	
VESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	•	•	•	
VESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	•	•	•	
VESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	•	•	•	
VESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	•	•	•	
VESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	•	•	•	
VESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	•	•	•	
VESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	•	•	•	
VESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•	•	•	•	•	
VESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•	•	•	•	•	•	
VESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•	•	•	•	•	•	
VESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•	•	•	•	•	•	•	
/ESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 120Hz	26	1920	1080	2200	1125	120	•	•	•	•	•	•	•	
VESA 1920 x 1440 @ 60Hz	27	1920	1440	2600	1500	60	•	•	•	•	•	•	•	
VESA 2048 x 1536 @ 60Hz	28	2048	1536	2208	1580	60	•	•	•	•	•	•	•	
VESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60	•	•	•	•	•	•	•	
VESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•	•	•	•	•	•	•	
/ESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•	•	•	•	•	•	•	
VESA 2560 x 1600 @ 60Hz	32	2560	1600	3504	1658	60	•	•	•	•	•	•	•	
/ESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60	•	•	•	•	•	•	•	
Other 2880 x 1440 @ 60Hz	34	2880	1440	2976	1456	60	•	•	•	•	•	•	•	
/ESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60	•	•	•		•	•	•	
VESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30	•	•	•	•	•	•	•	
/ESA 3840 x 2160 @ 30Hz [RB2]	37	3840	2160	3920	2191	30	•	•	•	•	•	•	•	
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2250	30	•	•	•	•	•	•	•	
CTA 3840 x 2160 @ 50Hz	39	3840	2160	5280	2250	50	•	•	•		•	•	•	
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50	•	•	•		•	•	•	
VESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60	•	•	•	•	•	•	•	
VESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60	•	•	•	•	•	•	•	
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60	•	•	•		•	•	•	
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60	•	•	•		•	•	•	

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (4 lanes capability) contd.

Description	TSI*	Н	V	Н	V	Frame	YC	CbCr 4	:2:2 (bj	pc)	Y	CbCr 4	:2:0 (b	pc)
Description	131	active	active	total	total	rate	8	10	12	16	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120					•	•		
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120					•	•		
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120					•			
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30	•	•	•	•	•	•	•	•
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30	•	•	•	•	•	•	•	•
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30	•	•	•	•	•	•	•	•
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60	•	•	•		•	•	•	•
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60	•	•	•		•	•	•	•
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60	•	•			•	•	•	
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120								
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120					•			
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120								
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60	•				•	•	•	
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30	•				•	•		
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30	•				•	•		
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30					•			
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60								
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60								
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60								
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100								
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100								
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100								

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (RGB) (2 lanes capability)

Description	TSI*	H active	V active	H total	V total	Frame rate		1	GB 4:4	1	
/ESA 640 x 480 @ 60Hz	0	640	480	800	525	60	6	8	10	12	1
/ESA 800 x 600 @ 60Hz	-	800	600	1056	628	60	•			•	
•	1						•	•	•	•	
/ESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	
/ESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	•
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	-
/ESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	
/ESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	
/ESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	
/ESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	
/ESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	
/ESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	
/ESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	
/ESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	
/ESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	
/ESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•	•	
/ESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•	•	•	
/ESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•	•	•	
/ESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•	•	•	
/ESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•	•	•	•	
/ESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	٠	•	•	
/ESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•	•	
/ESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•	•	
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•	•	•	
/ESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120	•	•	•		
/ESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120	•	•	•		
CTA 1920 x 1080 @ 120Hz	26	1920	1080	2200	1125	120	•	•			
/ESA 1920 x 1440 @ 60Hz	27	1920	1440	2600	1500	60	•	•	•	•	
/ESA 2048 x 1536 @ 60Hz	28	2048	1536	2208	1580	60	•	•	•	•	
/ESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60	•	•	•		
/ESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•	•	•	•	
/ESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•	•	•	•	
/ESA 2560 x 1600 @ 60Hz [(\B1]	32	2560	1600	3504	1658	60	•	•			
/ESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60	•	•	•		
Other 2880 x 1440 @ 60Hz							•	•	•		
0	34	2880	1440	2976	1456	60					
/ESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60					4
/ESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30	•	•	•		
/ESA 3840 x 2160 @ 30Hz [RB2]	37	3840	2160	3920	2191	30	•	•	•		
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2250	30	•	•			4
CTA 3840 x 2160 @ 50Hz	39	3840	2160	5280	2250	50					4
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50					4
/ESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60					4
/ESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60					4
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60					4
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60					

Supported

Supported with HBR3

Supported with DSC

DisplayPort Sink and Source Capability (RGB) (2 lanes capability) contd.

Description	TSI*	Н	V	Н	V	Frame		R	GB 4:4	:4	
Description	131	active	active	total	total	rate	6	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120					
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120					
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120					
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30	•	•			
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30	•	•			
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30	•				
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60					
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60					
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60					
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120					
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120					
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120					
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60					
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30					
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30					
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30					
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60					
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60					
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60					
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100					
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100					
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100					

• Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (2 lanes capability)

Description	TSI*	H	V	Н	V	Frame		bCr 4				1	:2:0 (b	pc)
·		active	active	total	total	rate	8	10	12	16	8	10	12	16
VESA 640 x 480 @ 60Hz	0	640	480	800	525	60	•	•	•	•	•	•	•	•
VESA 800 x 600 @ 60Hz	1	800	600	1056	628	60	•	•	•	•	•	•	•	•
VESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	•	•	•	•
VESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	•	•	•	•
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	•	•	•	•
VESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	•	•	•	•
VESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	•	•	•	•
VESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	•	•	•	•
VESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	•	•	•	•
VESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	•	•	•	
VESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	•	•	•	
VESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	•	•	•	
VESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•	•	•	•	•	•
VESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•	•	•	•	•	•	
VESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•	•	•	•	•	•	
VESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•	•	•	•	•	•	
VESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120	•	•	•		•	•	•	
VESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120	•	•	•		•	•	•	
CTA 1920 x 1080 @ 120Hz	26	1920	1080	22000	1125	120	•	•	•	•	•	•	•	
VESA 1920 x 1440 @ 60Hz	20	1920	1440	2600	1500	60			•	•		•		-
VESA 1920 x 1440 @ 60Hz VESA 2048 x 1536 @ 60Hz	28	2048	1536	2000	1500	60	•	•		•	•		•	1
v									•			•		- 1
VESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60	•	•	•	•	•	•	•	
VESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•	•	•	•	•	•	•	-
VESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•	•	•	•	•	•	•	- 1
VESA 2560 x 1600 @ 60Hz	32	2560	1600	3504	1658	60	•	•	•		•	•	•	- 1
VESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60	•	•	•	•	•	•	•	-
Other 2880 x 1440 @ 60Hz	34	2880	1440	2976	1456	60	•	•	•	•	•	•	•	
VESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60					•	•		
VESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30	•	•	•	•	•	•	•	
VESA 3840 x 2160 @ 30Hz [RB2]	37	3840	2160	3920	2191	30	•	•	•	•	•	•	•	
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2250	30	•	•	•		•	•	•	
CTA 3840 x 2160 @ 50Hz	39	3840	2160	5280	2250	50					•			4
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50					•			4
VESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60	•				•	•		I
VESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60	•				•	•		
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60					•			
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60					•			

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (2 lanes capability) contd.

	TOIt	Н	V	Н	V	Frame	YC	bCr 4	2:2 (bp	oc)	Y(CbCr 4	:2:0 (b	pc)
Description	TSI*	active	active	total	total	rate	8	10	12	16	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120								
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120								
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120								
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30	•	•	•		•	•	•	•
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30	•	•	•		•	•	•	•
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30	•	•			•	•	•	
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60					•			
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60					•			
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60								
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120								
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120								
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120								
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60								
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30								
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30								
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30								
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60								
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60								
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60								
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100								
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100								
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100								

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (RGB) (1 lane capability)

Description	TSI*	H active	V active	H total	V total	Frame rate		1	GB 4:4	1	
VESA 640 x 480 @ 60Hz	0	640	480	800	525	60	6	8	10	12	1
VESA 800 x 600 @ 60Hz	1	800	600	1056	628	60					
•							•	•	•	•	
VESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	
VESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	
VESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	
VESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	
/ESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	
VESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	
/ESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	
/ESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	
/ESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	
/ESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	
/ESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	
VESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•		
/ESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•			
VESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•		-	
VESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•	•	•	
/ESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•				
/ESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	•	•	•	
VESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•		
VESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•		
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•			
VESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120					
VESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120					
CTA 1920 x 1080 @ 120Hz	26	1920	1080	2200	1125	120					
VESA 1920 x 1440 @ 60Hz	27	1920	1440	2600	1500	60	•				
VESA 2048 x 1536 @ 60Hz	28	2048	1536	2208	1580	60	•				
VESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60					
VESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•				
VESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•				
VESA 2560 x 1600 @ 60Hz	32	2560	1600	3504	1658	60					
VESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60					
Other 2880 x 1440 @ 60Hz	34	2880	1440	2976	1456	60					
VESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60					
VESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30					
VESA 3840 x 2160 @ 30Hz [RB2]		3840	2160			30					
•	37			3920	2191						
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2250	30					
CTA 3840 x 2160 @ 50Hz	39	3840	2160	5280	2250	50					\vdash
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50					\vdash
VESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60					L
VESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60					L
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60					L
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60					

Supported

Supported with HBR3

▲ Supported with DSC

Description	TSI*	Н	V	Н	V	Frame		R	GB 4:4	:4	
Description	101	active	active	total	total	rate	6	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120					
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120					
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120					
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30					
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30					
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30					
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60					
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60					
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60					
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120					
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120					
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120					
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60					
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30					
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30					
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30					
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60					
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60					
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60					
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100					
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100					
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100					

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (1 lane capability)

Description	TSI*	H active	V	H	V	Frame		bCr 4	· · ·	,			:2:0 (b	· ,
-			active	total	total	rate	8	10	12	16	8	10	12	1
VESA 640 x 480 @ 60Hz	0	640	480	800	525	60	•	•	•	•	•	•	•	
VESA 800 x 600 @ 60Hz	1	800	600	1056	628	60	•	•	•	•	•	•	•	
VESA 848 x 480 @ 60Hz	2	848	480	1088	517	60	•	•	•	•	•	•	•	•
VESA 1024 x 768 @ 60Hz	3	1024	768	1344	806	60	•	•	•	•	•	•	•	•
CTA 1280 x 720 @ 60Hz	4	1280	720	1650	750	60	•	•	•	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	5	1280	768	1664	798	60	•	•	•	•	•	•	•	•
VESA 1280 x 960 @ 60Hz	6	1280	960	1800	1000	60	•	•	•	•	•	•	•	•
VESA 1280 x 800 @ 60Hz [RB1]	7	1280	800	1440	823	60	•	•	•	•	•	•	•	
VESA 1280 x 800 @ 60Hz	8	1280	800	1680	831	60	•	•	•	•	•	•	•	•
VESA 1280 x 768 @ 60Hz	9	1280	768	1440	790	60	•	•	•	•	•	•	•	•
VESA 1280 x 1024 @ 60Hz	10	1280	1024	1688	1066	60	•	•	•	•	•	•	•	•
VESA 1360 x 768 @ 60Hz	11	1360	768	1792	795	60	•	•	•	•	•	•	•	•
VESA 1400 x 1050 @ 60Hz	12	1400	1050	1560	1080	60	•	•	•	•	•	•	•	•
VESA 1600 x 1200 @ 60Hz [RB1]	13	1600	1200	1760	1235	60	•	•	•	•	•	•	•	•
VESA 1600 x 1200 @ 60Hz	14	1600	1200	2160	1250	60	•	•	•	•	•	•	•	•
VESA 1680 x 1050 @ 60Hz	15	1680	1050	2240	1089	60	•	•	•	-	•	•	•	-
VESA 1680 x 1050 @ 60Hz [RB1]	16	1680	1050	1840	1080	60	•	•	•	•	•	•	•	
VESA 1792 x 1344 @ 60Hz	17	1792	1344	2448	1394	60	•	•			•	•	•	
VESA 1920 x 1080 @ 30Hz [RB1]	18	1920	1080	2080	1096	30	•	•	•	•	•	•	•	-
VESA 1920 x 1080 @ 30Hz [RB2]	19	1920	1080	2000	1096	30	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 30Hz	20	1920	1080	2200	1125	30	•	•	•	•	•	•	•	-
VESA 1920 x 1080 @ 60Hz [RB1]	21	1920	1080	2080	1111	60	•	•	•		•	•	•	-
VESA 1920 x 1080 @ 60Hz [RB2]	22	1920	1080	2000	1111	60	•	•	•	•	•	•	•	
CTA 1920 x 1080 @ 60Hz	23	1920	1080	2200	1125	60	•	•	•		•	•	•	
VESA 1920 x 1080 @ 120Hz [RB1]	24	1920	1080	2080	1144	120					•	•		4
VESA 1920 x 1080 @ 120Hz [RB2]	25	1920	1080	2000	1144	120					•	•		4
CTA 1920 x 1080 @ 120Hz	26	1920	1080	2200	1125	120					•			4
VESA 1920 x 1440 @ 60Hz	27	1920	1440	2600	1500	60	•		-		•	•	•	
VESA 2048 x 1536 @ 60Hz	28	2048	1536	2208	1580	60	•	•			•	•	•	
VESA 2560 x 1440 @ 60Hz	29	2560	1440	2720	1481	60	•				•	•		
VESA 2560 x 1080 @ 60Hz	30	2560	1080	3424	1120	60	•				•	•	•	
VESA 2560 x 1080 @ 60Hz [RB1]	31	2560	1080	2720	1111	60	•	•			•	•	•	
VESA 2560 x 1600 @ 60Hz	32	2560	1600	3504	1658	60					•			
VESA 2560 x 1600 @ 60Hz [RB1]	33	2560	1600	2720	1646	60	•				•	•		
Other 2880 x 1440 @ 60Hz	34	2880	1440	2976	1456	60	•				•	•		
VESA 4096 x 2160 @ 60Hz	35	4096	2160	4176	2222	60								
VESA 3840 x 2160 @ 30Hz [RB1]	36	3840	2160	4000	2191	30	•				•	•		
VESA 3840 x 2160 @ 30Hz [RB2]	37	3840	2160	3920	2191	30	•				•	•		
CTA 3840 x 2160 @ 30Hz	38	3840	2160	4400	2250	30					•			
CTA 3840 x 2160 @ 50Hz	39	3840	2160	5280	2250	50								
CTA 4096 x 2160 @ 50Hz	40	4096	2160	5280	2250	50								
VESA 3840 x 2160 @ 60Hz [RB1]	41	3840	2160	4000	2222	60								
VESA 3840 x 2160 @ 60Hz [RB2]	42	3840	2160	3920	2222	60								
CTA 3840 x 2160 @ 60Hz	43	3840	2160	4400	2250	60								
CTA 4096 x 2160 @ 60Hz	44	4096	2160	4400	2250	60								

Supported

Supported with HBR3

▲ Supported with DSC

DisplayPort Sink and Source Capability (YCbCr) (1 lane capability) contd.

Description	TOIt	Н	V	Н	V	Frame	YC	bCr 4	:2:2 (bp	c)	Y(CbCr 4	:2:0 (b	pc)
Description	TSI*	active	active	total	total	rate	8	10	12	16	8	10	12	16
VESA 3840 x 2160 @ 120Hz [RB1]	45	3840	2160	4000	2287	120								
VESA 3840 x 2160 @ 120Hz [RB2]	46	3840	2160	3920	2287	120								
CTA 3840 x 2160 @ 120Hz	47	3840	2160	4400	2250	120								
VESA 5120 x 2160 @ 30Hz [RB1]	48	5120	2160	5280	2191	30					•			
VESA 5120 x 2160 @ 30Hz [RB2]	49	5120	2160	5200	2191	30					•			
CTA 5120 x 2160 @ 30Hz	50	5120	2160	6000	2200	30								
VESA 5120 x 2160 @ 60Hz [RB1]	51	5120	2160	5280	2222	60								
VESA 5120 x 2160 @ 60Hz [RB2]	52	5120	2160	5200	2222	60								
CTA 5120 x 2160 @ 60Hz	53	5120	2160	5500	2250	60								
VESA 5120 x 2160 @ 120Hz [RB1]	54	5120	2160	5280	2287	120								
VESA 5120 x 2160 @ 120Hz [RB2]	55	5120	2160	5200	2287	120								
CTA 5120 x 2160 @ 120Hz	56	5120	2160	5500	2250	120								
Other 5120 x 2880 @ 60Hz	57	5120	2880	5280	2962	60								
VESA 7680 x 4320 @ 30Hz [RB1]	58	7680	4320	7840	4381	30								
VESA 7680 x 4320 @ 30Hz [RB2]	59	7680	4320	7760	4381	30								
CTA 7680 x 4320 @ 30Hz	60	7680	4320	9000	4400	30								
VESA 7680 x 4320 @ 60Hz [RB1]	61	7680	4320	7840	4443	60								
VESA 7680 x 4320 @ 60Hz [RB2]	62	7680	4320	7760	4443	60								
CTA 7680 x 4320 @ 60Hz		7680	4320	9000	4400	60								
VESA 7680 x 4320 @ 100Hz [RB1]		7680	4320	7840	4529	100								
VESA 7680 x 4320 @ 100Hz [RB2]		7680	4320	7760	4529	100								
CTA 7680 x 4320 @ 100Hz		7680	4320	10560	4500	100								

• Supported

Supported with HBR3

▲ Supported with DSC

APPENDIX D: PREDEFINED PATTERNS

Selection	TSI *	Pattern	Description
Disabled		N/A	The links are activated but no video data transferred
Color Bar	0		100% intensity color bars of all primaries and mixed combinations.
Chessboard	1	***	8 by 8 chessboard with black (0%) and 100% intensity white
Solid Black	2		0% luminance
Solid White	3		100% white
Solid Red	4		100% red
Solid Green	5		100% green
Solid Blue	6		100% blue
White Vertical Stripes	7		Vertical stripes of black (0%) and white (100%). Parameters set the widths of the black and white stripes in pixels respectively. Default black / white = 20 / 20 pixels. Parameter range 0 to 5000.
Gradient Vertical Stripes	8		16 pixels high horizontal red green, blue and white stripes. Intensity is increased from 0 to 100% with steps defined by the given parameter (n). (step = n*color_depth/256). "n" range 0 to 5000 (default 120).
Color Ramp	9		Color Ramp test pattern defined by VESA DisplayPort Link Layer Compliance Test Specification.
Color Square	10		Color Square test pattern defined by VESA DisplayPort Link Layer Compliance Test Specification. Color mode can be selected between RGB, YCbCr 4:4:4, 4:2:2, 4:2:0 (ITU Rec 601 / 709)
White Square			100% intensity white square horizontally and vertically centered. Height and width defined by parameter as the percentage of height and width of the frame (default 30).
Motion Pattern	11		Horizontally moving color bar pattern. The pattern is shifted to left one pixel in each frame in a sequence. The length of the sequence is defined with parameter. Range 0 to 34 (default is 20)
Custom Image		UNIGRAF	Bitmap image uploaded by the user. Click on the Custom Images panel to browse.

*) TSI Pattern ID

More test patterns can be downloaded e.g. from https://sid.org/Publications/ICDM.aspx#7327477-test-patterns

APPENDIX E: SINK, SOURCE AND REPEATER DUT TESTS

Source DUT Testing (UCD-411 N/A)		Default	DP 1.4a LL CTS*	DP DSC Decoder CTS*	DisplayID CTS*	Adaptive Sync CTS*	DP HDCP 2.3 CTS*
CRC based Video Test Set	CRC based single frame reference video test	~					
	CRC based single frame stability test	~					
	CRC based sequence of frames reference video test	✓					
	CRC based continuous sequence of frames reference video test	~					
Link Test Set	Link Training at All Supported Lane Counts and Link Rates	✓					
DP 1.4a Link Layer CTS	4.2.1.1 – 4.2.1.5, 4.2.2.1 – 4.2.2.10, 4.3.1.1 – 4.3.1.13, 4.3.2.1 – 4.3.2.5, 4.3.3.1, 4.4.1.1 – 4.4.1.3, 4.4.2, 4.4.3, 4.4.4.2 – 4.4.4.6, 4.5.1.1 – 4.5.1.2		~				
DP 1.4a DSC CTS	4.6.1.1 – 4.6.1.9			*			
DisplayID / EDID CTS	4.7.1.1 – 4.7.1.4, 4.7.2.1 – 4.7.2.2, 4.7.3.1 – 4.7.3.3, 4.7.4.1				~		
Adaptive-Sync CTS	4.8.1.1 – 4.8.1.2, 4.8.2.1 – 4.8.2.2,					>	
HDCP 2.3 CTS 1A Test Set	HCDP2.3 CTS 1A-01 – HCDP2.3 CTS 1A-13						 Image: A start of the start of
HDCP 2.3 CTS 1B Test Set	HCDP2.3 CTS 1B-01 – HCDP2.3 CTS 1B-10						~

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

Sink DUT Testing		Default	DP 1.4a LL CTS*	DP DSC Encoder CTS*	DisplayID CTS*	Adaptive Sync CTS*	DP HDCP 2.3 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		<				
DP 1.4a DSC CTS	5.6.1.1. – 5.6.1.26, 5.6.2.1 – 5.6.2.14			~			
DisplayID / EDID CTS	$\begin{array}{l} 5.7.1.1-5.7.1.2, 5.7.1.3.1-5.7.1.3.4, 5.7.1.4.1-5.7.1.4.9,\\ 5.7.2.1-5.7.2.3.5, 5.7.2.4.1-5.7.2.4.2, 5.7.2.5.1-5.7.2.5.2,\\ 5.7.2.6.1-5.7.2.6.2, 5.7.2.7.1, 5.7.2.8, 5.7.3.1-5.7.3.5,\\ 5.7.4.1-5.7.4.3, 5.7.4.5, 5.7.5.1-5.7.5.2, 5.7.6.1-5.7.6.5,\\ 5.7.7.1-5.7.7.6, 5.7.8.1-5.7.8.6, 5.7.9.1-5.7.9.3, 5.7.10.1\\ -5.7.10.3, 5.7.11.1-5.7.11.5, 5.7.12.1-5.7.12.3 \end{array}$				>		
Adaptive Sync CTS	5.8.1.1 – 5.8.1.3					>	
HDCP 2.3 CTS 2C Test Set	HCDP2.3 CTS 2C-01 – HCDP2.3 CTS 2C-06						 Image: A start of the start of

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

Repeater DUT Testing		Default		DP HDCP 2.3 CTS*
HDCP 2.3 CTS 3A Test Set	HCDP2.3 CTS 3A-01 – HCDP2.3 CTS 3A-06			~
HDCP 2.3 CTS 3B Test Set	HCDP2.3 CTS 3B-01 – HCDP2.3 CTS 3B-07			~
HDCP 2.3 CTS 3C Test Set	HCDP2.3 CTS 3C-01 – HCDP2.3 CTS 3C-25			✓

*) Separate licenses for testing Sink, Source, Branch (LL CTS) and Repeater (HDCP CTS) DUT.

LL Branch license and HDCP Repeater license also cover Source DUT and Sink DUT testing.

CRC Based Video Test Set – DP RX

DisplayPort Sink (DP RX) functionality is not available when using UCD-411

CRC Based Single Reference Frame Video Test

The test compares captured frames to a provided reference.

TE compares the video mode (Frame Width, Height, BPP and optionally Frame rate) to provided parameters and after that captures frames and compares the CRC (check sum) of their three color components to the provided reference until the number of bad frame limit provided is detected or the provided total number of frames is reached.

The test is judged FAIL if video mode does not match, or the number of bad frames is exceeded.

The test optionally captures the failed frames as bitmap images and stores them into the hard disc.

Parameters in use

- Test Timeout (default 100 000 ms)
- Total number of frames (default 2 000 ms)
- Number of bad frames allowed (default 2)
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz)
- Frame rate tolerance (mHz)
- Reference CRCs (R, G, B)

CRC Based Single Frame Video Stability Test

The test verifies that the captured video is stable.

TE captures a frame and sets the CRC of its color components as reference. After that TE captures frames and compares their CRC (check sum) to the reference until the number of bad frame limit provided is detected or the provided total number of frames is reached.

The test is judged FAIL if the number of bad frames is exceeded.

The test optionally captures the failed frames as bitmap images and stores them into the hard disc.

Parameters in use

- Test Timeout (default 100 000 ms)
- Total number of frames (default 2 000 ms)
- Number of bad frames allowed (default 2)

CRC Based Sequence of Reference Frames Test

The verifies that a sequence of frames is captured in the right order.

TE compares the video mode (frame Width, Height, BPP and optionally Frame rate) to provided parameters. After that captures frames to find a frame with matching CRC (check sum) of their three color components to the first provided reference. After the first matching CRC is found it compares the CRC of the following frames until the Number of frames tested parameter is reached.

The test is judged FAIL if video mode does not match, the first frame in the list is not found or the CRC of the following frames do not match the provided list.

The test optionally captures the failed frames as bitmap images and stores them into the hard disc.

Parameters in use

- Test Timeout (default 100 000 ms)
- Number of frames to be tested (default 20)
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz)
- Frame rate tolerance (mHz)
 - Reference CRCs (R, G, B)

Note: Please note that in order for the TE to maintain the sequence, all CRCs in the reference frame list should be different.

CRC Based Continuous Sequence of Reference Frames Test

The test verifies that a sequence of frames is captured in the right order many times repeatedly.

TE compares the video mode (frame Width, Height, BPP and optionally Frame rate and Color format) to provided parameters. After that captures frames to find a frame with matching CRC (check sum) of their three color components to the first provided reference. After the first matching CRC is found it compares the CRC of the following frames until the Number of frames tested parameter is reached. After that it resets the list and starts from the first CRC. The list is repeated until timeout or until the provided number of repetitions is reached.

The test is judged FAIL if video mode does not match, the first frame in the list is not found or the CRC of the following frames do not match the provided list.

The test optionally captures the failed frames as bitmap images and stores them into the hard disc.

Parameters in use

- Test Timeout (default 100 000 ms)
- Number of frames to be tested (default 20)
- Number of iterations
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz)
- Frame rate tolerance (mHz)
- Expected color format
 - Reference CRCs (R, G, B)

Note: Please note that in order for the TE to maintain the sequence, all CRCs in the reference frame list should be different.

Link Test Set – DP RX

Link Training at All Supported Lane Counts and Link Rates

Test requests link training on all supported lane counts and link rates. Each link training must be successfully completed in order to pass the test.

Parameters in use

- Test Timeout (default 5 000 ms)
- Max lane count supported by DUT (default 4)
- Max lane rate supported by DUT as multiple of 0.27 Gbps. (valid settings 6, 10 and 20; default 20)
- Long HPD pulse duration (default 1 000 ms)
- Link training start timeout (default 5 000 ms)
- Delay between test cycles (default 3 000 ms)

APPENDIX F: ADVANCED FILTERS

This the description of the advanced methods for filtering transactions in *DP AUX analyzer* in *Event Log*. The following help text can be seen as well by clicking the Help button of the *Edit Filter Rule* dialog.

Note Please note that Filters are a very powerful tool. They can however unintentionally hide valuable data from you. Please be careful when applying custom filters. A good practice is to start from an existing filter and gradually add new rules while testing their performance.

Note Filtering and selecting the columns for display do not affect the actual data acquisition. All transactions and their full data are always captured.

Data pattern expressions

A data-pattern expression is a string that describes how to determine if a data-block should be considered as "matched" or "unmatched". The syntax used with data-pattern expressions in Aux Channel Analyzer is described below

The data-block must be covered completely by the data-pattern expression. If the data block is shorter, or longer than the expression, then the data block is determined as "not matched". The '*' wildcard can be used to allow data blocks of any size to match.

Whitespaces and new-lines are ignored and are allowed anywhere; White spaces and new-lines can be used strategically to make the expression more readable.

For example: "*!(10)??(10)" is the same as "* ! (10) ? ? (10)"

Comment blocks:

Comments must be written enclosed in curly-braces '{' and '}'.

Wildcards

Wildcards used are '*' and '?'

? = Match any single data byte only.

* = Match any number of any data bytes. (including the possibility of matching NO data bytes)

For data matching, the byte value must be enclosed in braces '(' and ')'. Use prefixes '\$' to indicate HEX value, '%' to indicate BIN. No prefix indicates DEC.

Examples:

* (\$10) (\$00) : Matches any data pattern that has the bytes \$10, \$00 at end of data.

? (\$10) (\$00) : Matches 3-byte data pattern that has \$10 as second byte and \$00 as third byte.

* (\$10) * (\$00) : Matches any data pattern that has \$10 and ending to a \$00 byte.

* (\$10) * (\$00) *: Matches any data pattern that has \$10 and \$00 after it.

(\$10) ? * (\$20) * : Matches any data pattern that has \$10 as first byte, followed by \$20 with at least one other byte in between. (i.e. will not match \$10, \$20)

Use '!' to invert the match:

!(\$00) = Match any data byte that isn't \$00.

Use '?' within HEX or BIN value to ignore that bit in comparison:

(\$??) = ? = Any data Byte.

(\$?0) = Any data byte with bits 0-3 cleared.

(%1??????) = Any data byte with bit 7 set.

(%0?????1) = Any data byte with bit 7 cleared and bit 0 set.

The '!' inversion can still be used:

!(%?????00) = Matches any data byte ending to %10, %11, %01 but not %00.

To match a single data byte with more than one value, separate the values with comma ',':

(0, 1, 100, 200, 254): Matches a data byte whose value is 0, 1, 100, 200 or 254.

Invert the value group match with '!'. Value wildcard '?' is also allowed.

Example:

!(1, 2, 3): Match any data byte other than 1, 2 or 3.

!(\$?f, \$f?): Don't match data bytes with bits 0-3 set to 1, or data bytes that have bits 7-4 set.

APPENDIX G: FIRMWARE RECOVERY PROCEDURE WITH QUARTUS PRIME

FW Update Tool

The chapter below describes a procedure for updating UCD-400 or UCD-411 Firmware in a case when e.g. the normal FW Update procedure failed because a critical error.

- Download the latest UCD-300/400 SW Bundle version from Unigraf website <u>https://www.unigraf.fi/downloads/</u> and install it. Please do not launch UCD Console yet.
- Recovery.zip file will be by default installed in <u>C:\Program Files (x86)\Unigraf\TSI\UCD-400\Recovery</u>. Perform the Recovery procedure according to the instruction in the following pages.
- ▶ Without removing power from the UCD-400 device perform FW update procedure as described in section 4 FIRMWARE UPDATE PROCEDURE earlier in this manual.

Note The FW patch loaded in the UCD device during Recovery procedure is stored in a temporary memory. When power is removed from UCD device, the content of the temporary memory will be erased. Therefore, please do not power down the UCD device after performing the *Recovery* before instructed in the end of the FW Update procedure.

If power will accidentally be removed before the FW Update procedure, Recovery procedure needs to be re-initiated.



The Recovery patch is programmed to UCD Device with a separate tool called **Quartus Prime (includes Nios II EDS)**. The tool can be downloaded from **Intel® FPGA** website:

https://www.intel.com/content/www/us/en/software-kit/665990/intel-quartus-prime-lite-edition-design-software-version-18-1-for-windows.html

On the download page, please **Select release 18.1.** Please download **Quartus Prime** (includes Nios II EDS).

Note:	Registering is needed for the download.	
	Please download and install the tool in the PC.	
intel.		Search Intel.com
FPGA S	Software Download Center	
	Intel® Quartus® Prime Lite Edition Design Software Version 18.1 Windows	for
	ID Date Version 665990 9/23/2018 18.1 ~	
	A newer version of this software is available, which includes functional and security updates. Customers should click here to update to the late	est version.
	The Intel® Quartus® Prime Lite Edition Design Software, Version 18.1 is subject to removal from the web when support for all devices in this relea available in a newer version, or all devices supported by this version are obsolete. If you would like to receive customer notifications by e-mail, pl subscribe to our subscribe to our customer notification mailing list. Critical Issues and Patches for the Intel® Quartus® Prime Lite Edition Software, Version 18.1. Knowledge Base: Search for Errata. Also see Critical Issues and Patches. Problems and Answers on specific IP or Products.	
	Downloads	
	Multiple Download Individual Files Additional Software Copyleft Licensed Source Updates	
	Intel® Quartus® Software	
	ModelSim-Intel® FPGA Edition (includes Starter Edition)	~
	Download Size: 1.1 GB ModelSimSetup-18.1.0.625-windows.exe SHA1: f4b428584c780016d119c0b1fd16c26dee880dcc	
	Intel® Quartus® Prime (includes Nios® II EDS)	
	Download Size: 1.7 GB QuartusLiteSetup-18.1.0.625-windows.exe SHA1: 70faf36e2c8d69aa5243de767242a75832fa749e	
	Devices	
		~

Connect to the UCD-400 Unit

- Power on the UCD-400.
 - Connect UCD-400 with a USB cable to the PC through Programmer connector. (Pls refer to page 8 of this document)

Programming the FW

	Please locate the <i>Recovery.zip</i> file. It is by default installed in <u>C:\Program Files (x86)\Unigraf\TSI\UCD-400\Recovery</u> . Extract the content of the zip file in a folder in your PC, e.g., c:\Temp
►	Run Nios II 18.1 Command Shell application as Administrator
Note	Nios II 18.1 Command Shell application needs to be run as Administrator (Right click with mouse and select Run as Administrator)
Hint	Right click on the top edge of <i>Command Shell</i> and select Edit > Paste to paste the commands below
►	Select the folder location where the content of the <i>Recovery.zip</i> file was extracted. For example (c:\Temp) cd /cygdrive/c/Temp
►	Run the loader.
	source recovery.sh
	This instruction will load a temporary patch to the FW of the UCD Device to enable normal FW Update procedure
►	Once the upload has completed, please close the commend shell.
►	Launch UCD Console and initiate FW Update by selecting Tools > Firmware update. Please follow the instructions given in section 4 FIRMWARE UPDATE PROCEDURE earlier in this manual.
Note	The FW patch loaded in the UCD device during Recovery procedure is stored in a temporary memory. When power is removed from UCD device, the content of the temporary memory will be erased. Therefore, please do not power down the UCD device after performing the Recovery before instructed in the end of the FW Update procedure.
	If power will accidentally be removed before the FW Update procedure, Recovery procedure needs to be re-initiated.
►	Once FW update procedure has completed, cycle power on the UCD Device (switch off power > wait for 10 seconds > turn on power).
Note	Please cycle the power on the UCD-400 unit to enable the FW update (switch off power > wait for 10 seconds > turn on power).
	After Recovery procedure has been completed, you can delete the files stored in e.g., C_{1} /Temp

C:/Temp.