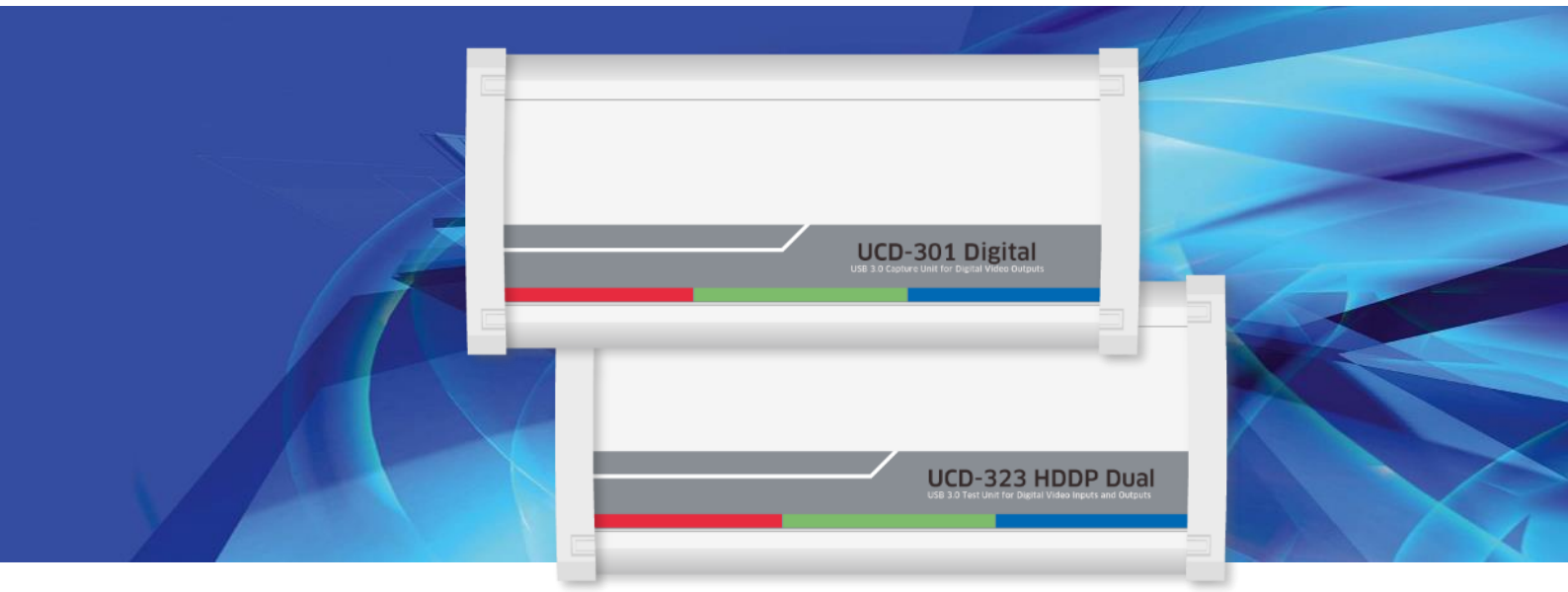
UCD Console for UCD-301 UCD-323



USER MANUAL

UNIGRAF

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UCD-300 products meet the essential health and safety requirements, is in conformity with and the CE marking has been applied according to the relevant EU Directives using the relevant section of the corresponding standards and other normative documents.

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1. ABOUT THIS MANUAL

Purpose

This guide is the User Manual of UCD-300, USB-connected video capture units for use in a PC with Windows® 10 Windows® 8 or Windows® 7 operating system.

The purpose of this guide is to

- Provide an overview of the product and its features.
- Provide instruction for the user on how to install the software and the drivers.
- Introduce the HW features of the UCD-300 units.
- Provide instructions for the user how to use UCD Console software.

Product and Driver Version

This manual explains features found in UCD Console Software Package **1.10.** 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 text is an important note

2. INTRODUCTION

Product Description

UCD-300 family consists of two high speed, USB 3.0 connected video capture units *UCD-323 HDDP Dual* and *UCD-301 Digital*. The UCD Console is the common graphical user interface (GUI) for all UCD-300 family units. UCD Console provides access to all functions of the unit.

UCD-300 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 the Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation for more details.

Product Features

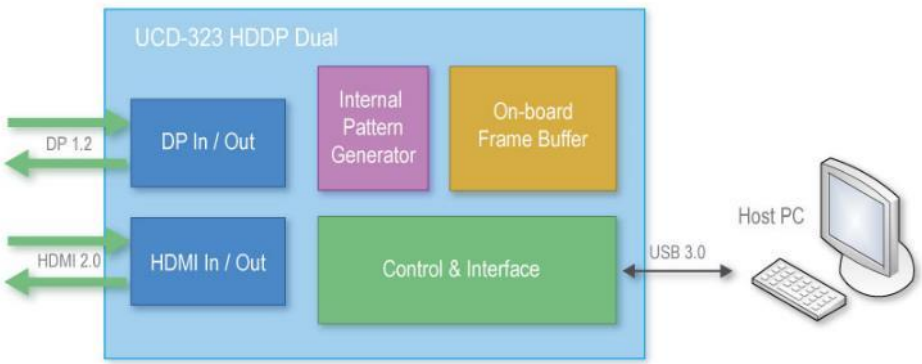
- High resolution video and audio capture up to 4K / UHD 60 Hz
- Support for multiple display interfaces including HDMI 2.0 and DP 1.2
- Compatible with HDCP versions 1.3/1.4 and 2.2/2.3
- 2 GB on-board high speed video buffer
- High speed USB 3.0 host PC interface

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

Functional Description

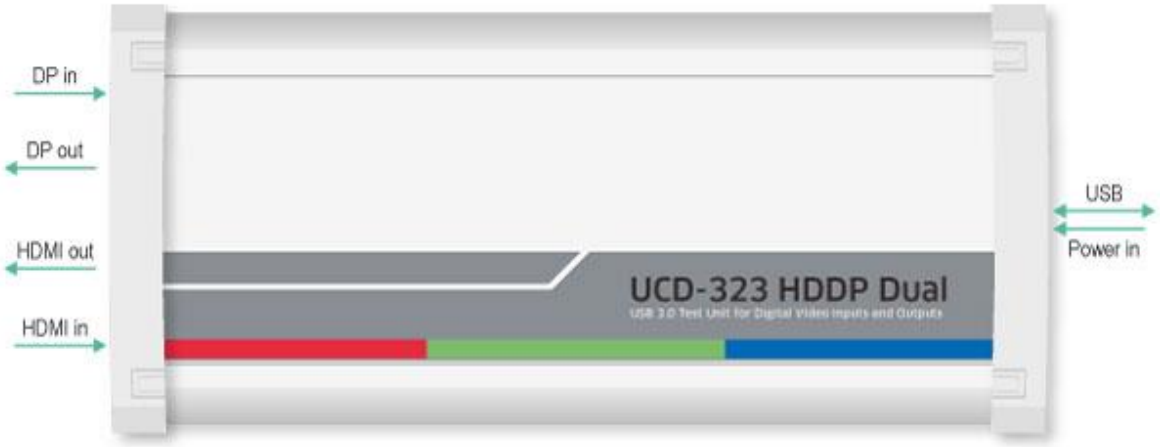
UCD-300 units consist of a multimedia signal input stage, a control stage with on-board frame buffer, an internal pattern generator (in some models) and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format. The Interface and Control stages are either passing 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-323 HDDP Dual



UCD-323 HDDP Dual

The image below describes the connections in **UCD-323 HDDP Dual**



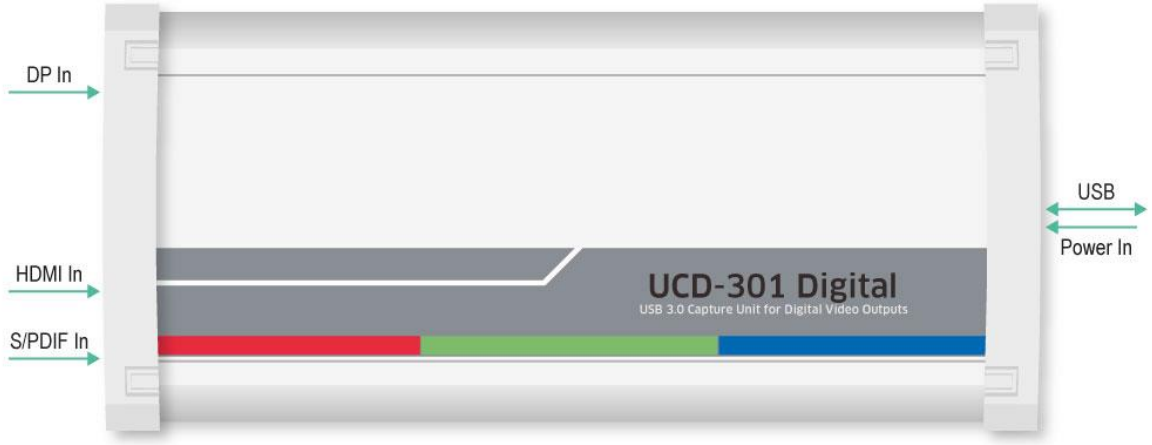
Name	Description
DP in	DisplayPort™ 1.2 compliant input from the upstream Source
DP out	DisplayPort™ 1.2 compliant output to the downstream Sink
HDMI in	HDMI 2.0 compliant input from the upstream Source
HDMI out	HDMI 2.0 compliant output to the downstream Sink
Power in	+12 Vdc Power Supply Input
USB	USB 3.0 connection to the host PC

Note	Capturing and sourcing high resolution video modes, especially 4K video modes set stringent requirements on the video cables and connectors. Unigraf has ensured the capabilities of the cables that are delivered with the UCD-323 HDDP Dual unit. Please contact Unigraf for assistance and details about evaluated cables.

Warning	In order to avoid damage to the unit and the PC, please **always attach the power cord (Power In) to the unit first**, and after that connect the USB cable to your PC.

UCD-301 Digital

The image below describes the connections in **UCD-301 Digital**



Name	Description
DP In	DisplayPort 1.2 compliant input from the upstream Source
HDMI In	HDMI 2.0 compliant input from the upstream Source
S/PDIF In	Optical digital audio input
Power In	+12 Vdc Power Supply Input
USB	USB 3.0 connection to the host PC

Note	Capturing and sourcing high resolution video modes, especially 4K video modes set stringent requirements on the video cables and connectors. Unigraf has ensured the capabilities of the cables that are delivered with the UCD-301 Digital unit. Please contact Unigraf for assistance and details about evaluated cables.

Warning	In order to avoid damage to the unit and the PC, please **always attach the power cord (Power In) to the unit first**, and after that connect the USB cable to your PC.

3. INSTALLATION

Unpacking

The UCD-300 product shipment contains:

- The UCD-323 or UCD-301unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
- USB 3.0 compliant cable

Installation Package

The UCD-300 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)
- UCD Configuration Utility (installed during set up)
- TSI SDK
- User Manuals including this document.

In some cases, you will need to also update the firmware of the unit. If in doubt, please contact Unigraf.

Note:	The software should be installed before connecting the UCD-300 unit in your 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. In the next dialogs, you will be able to define the software components installed.

The next two dialogs will allow you to define the installation folder in your PC and the Start Menu folder used.

▶ When you are ready with the selections, click **Install** to start the installation.

▶ Click **Finish** to exit the installation dialog.

4. FIRMWARE UPDATE

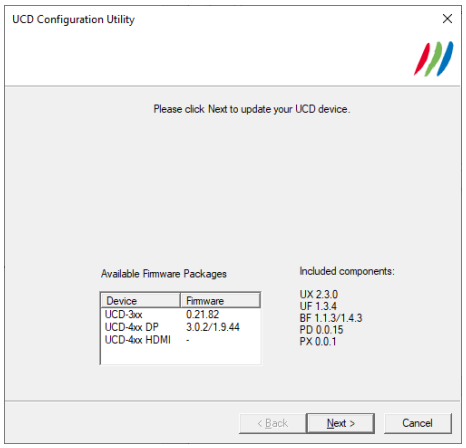
UCD Configuration Utility is used to load an updated firmware to the device. As an option, UCD Configuration Utility enables the user to select the operation roles present in the UCD-300 unit. The utility configures a firmware set for the selected operation roles and programs the firmware set to the device. Please contact Unigraf for details.

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.

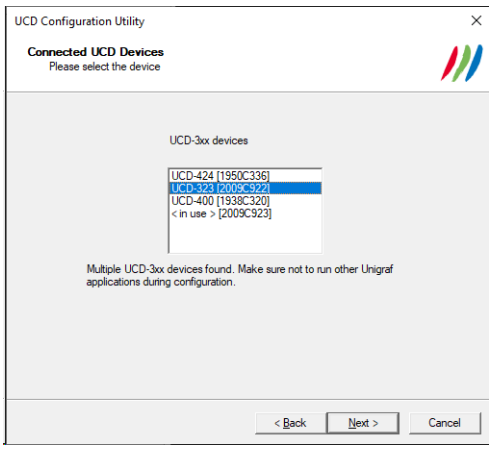
To update the firmware or create a new configuration on a UCD-300 device, please perform the following steps:

- Connect the UCD-300 unit to a power supply and connect the USB cable.
- Open **UCD Console**. Select **Tools > Firmware update.**

  You can launch the utility alternatively by running the **UCD Firmware Configuration** in Start Menu > Unigraf.



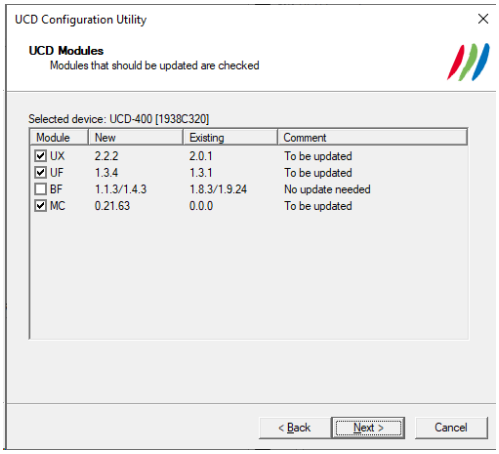
The first page of the utility indicates the firmware component versions present in the package. Please click **Next**.



- From the list of connected UCD-300 devices please select the one that you want to update. Click **Next**.

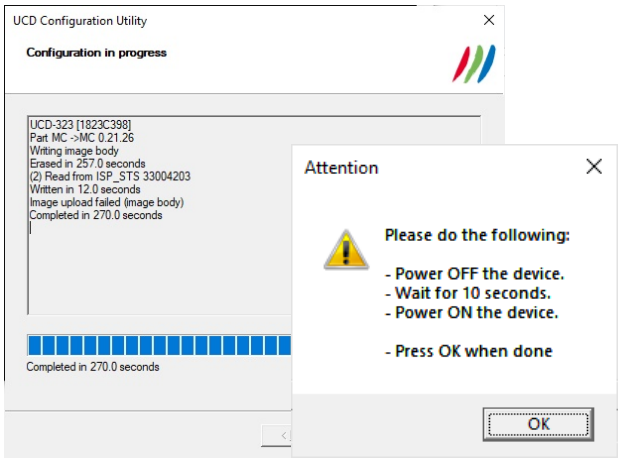
Updated Modules

The tool prompts you 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.



▶ When you are done, click **Next**.

While the configuration is in progress you will be asked to **power cycle** (Power OFF > Wait for 10 sec > Power On) the device between some parts.



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

▶ When completed, power cycle the device.

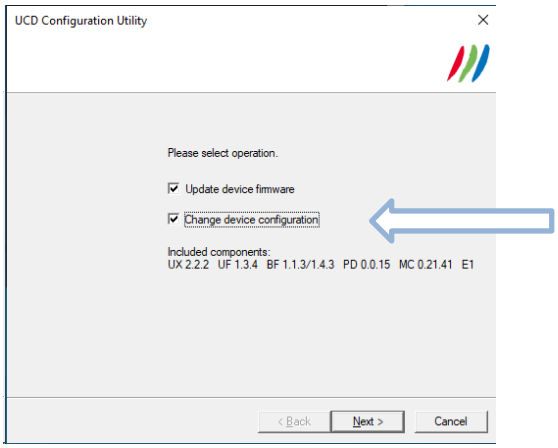
Note:	The new firmware will be taken in use only when the device is powered up next time.

Change Device Configuration

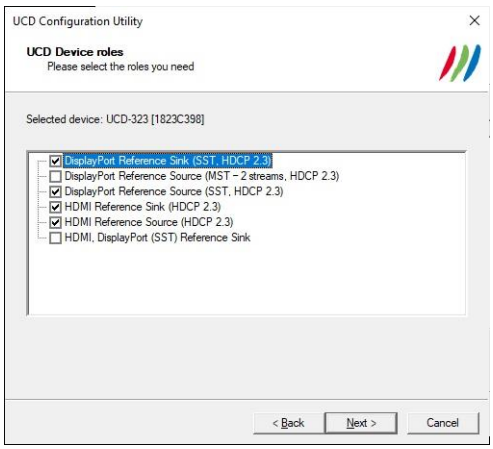
UCD-300 devices can feature four simultaneous interface Roles (please refer to *UCD Console > Select Role below*). Changing the role configuration is done by selecting the firmware packages loaded to the UCD-300 device. For selecting you need to open *UCD Firmware Configuration* utility in a special mode. The easiest way is to create a batch file with Notepad (e.g. config.bat) with the following content:

▶ ucdconfig config

In the special mode, you will be able to initiate the configuration dialogs. For that, select **Change device configuration** check box.



In the third dialog *UCD Device Roles* select the four roles that you prefer to be available in *UCD Console*.



After selection, please click **Next** to proceed to firmware update as described above.

5. 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

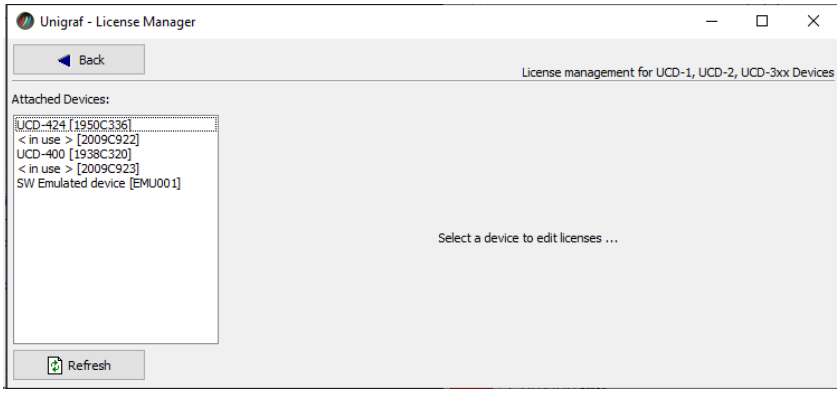
License keys are managed with Unigraf **License Manager**. By default, shortcut to Unigraf License Manager can be found in Start Menu under: **All programs/Unigraf/TSI.**

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

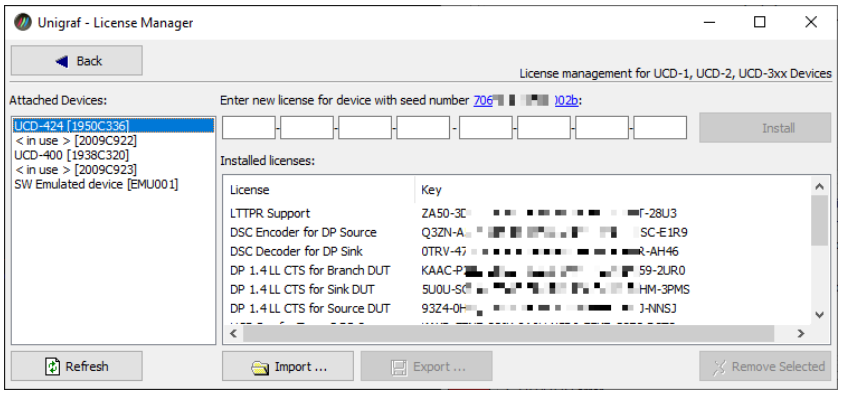
Once the application starts up, it will look for any licensing enabled Unigraf device. If no suitable device families are detected, License Manager will exit. Please first select one of the available device families by clicking one of the device family selector buttons.



In the list of Attached Devices please select the device in question. You can find the *serial number* and the *seed number* of your device in a sticker attached to the bottom of your device.

The **Back** button will bring you back to the device family selection screen. The **Refresh** button will re-scan the system for installed hardware.

Managing Licenses



Seed Number

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

The Seed Number link in the dialog will allow you to copy & paste the Seed Number of the selected device 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 as you type. If you have the key 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 you have typed the key 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 you to save all installed licenses for the currently selected device into an INI file for backup and distribution to other PCs. 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.

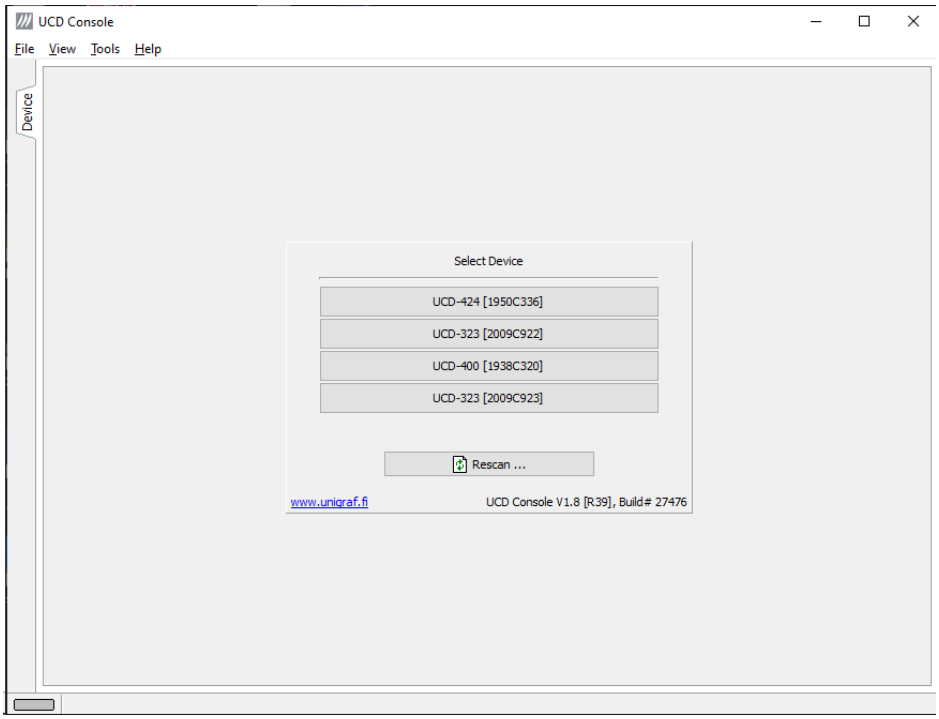
6. UCD CONSOLE

UCD Console is the graphical user interface (GUI) of UCD-300 family 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-300 are divided into interface specific screens and tabs. Each tab contains data and controls for a specific feature.

Device Selection

You can find the shortcut of UCD Console by default under Start Menu path **All programs/Unigraf/UCD-300.** Once UCD Console GUI is launched the dialog provides a list of UCD-300 devices connected in the PC. Please select your target device by clicking on the appropriate button. If you cannot find your device in the list, please confirm the power and USB connection to the device and click the **Rescan …** button.



Select Role

The use of UCD-300 devices with UCD Console is divided in display interface specific roles. The structure of UCD Console varies between roles by having a varying set of tabs dedicated to functionalities available in the enabled role. The table below lists the roles and tabs available in each role. Please find a detailed description of each role in the later chapters of this manual.

Each UCD-300 model features a unique set of modes available. In special occasions, Unigraf can create custom configurations. Please contact Unigraf Support for details.

Available Mode Configurations for UCD-301

In addition to the separate HDCP 2.3 enabled HDMI and DP Reference Sink roles, in UCD-301 you can select a combined mode where three roles are available in one configuration.

Role		Tabs available
HDMI Reference Sink (HDCP 2.3)		Video preview and saving (Video). Audio monitoring and saving (Audio). Status information and control of the upstream link (Link). EDID editor (EDID). HDCP 1.4 and 2.3 status monitor and control (HDCP). Monitor InfoFrame data (InfoFrames). Executing TSI Test cases (Source DUT Testing).
DisplayPort Reference Sink (HDCP 2.3)		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 1.3 and 2.3 status monitor and control (HDCP). Monitor Secondary-Data Packets (SDP) Event log (Event log) Executing TSI Test cases (Source DUT Testing). Executing HDCP 2.3 CTS Tests (Source DUT Testing).
Combined Mode	HDMI Reference Sink	Video preview and saving (Video). Audio monitoring and saving (Audio). Status information and control of the upstream link (Link). EDID editor (EDID). HDCP 1.4 status monitor and control (HDCP). Read InfoFrame data (InfoFrames). Executing TSI Test cases (Source DUT Testing).
	DisplayPort Reference Sink	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 1.3 status monitor and control (HDCP). Executing TSI Test cases (Source DUT Testing).
	SPDIF Reference Sink	Audio monitoring and saving (Audio).

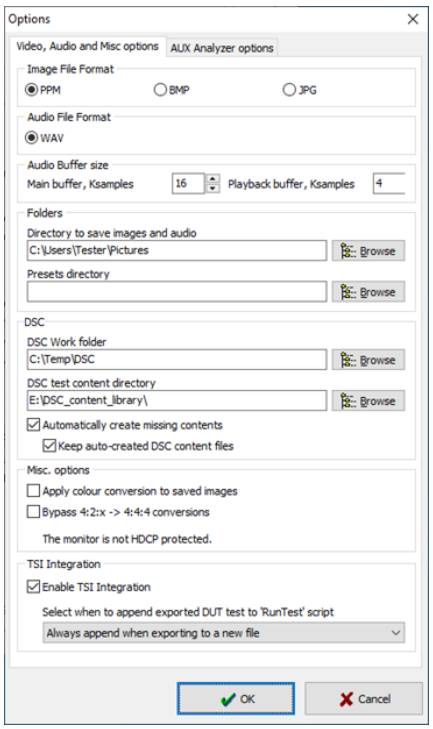
Available Mode Configurations for UCD-323

Role	Tabs available
HDMI Reference Sink (HDCP 2.3)	Video preview and saving (Video). Audio monitoring and saving (Audio). Status information and control of the upstream link (Link). EDID editor (EDID). HDCP 1.4 and 2.3 status monitor and control (HDCP). Monitor InfoFrame data (InfoFrames). Executing TSI Test cases (Source DUT Testing).
DisplayPort Reference Sink (HDCP 2.3)	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 1.3 and 2.3 status monitor and control (HDCP). Monitor Secondary-Data Packets (SDP) Event log (Event log) Executing TSI Test cases (Source DUT Testing). Executing HDCP 2.3 CTS Tests (Source DUT Testing).
HDMI Reference Source (HDCP 2.3)	Video pattern generator (Pattern Generator). Status information and control of the downstream link (Link). EDID editor (EDID). HDCP status monitor and control (HDCP).
DisplayPort Reference Source (MST – 2 streams, HDCP 2.3)	Video pattern generator 2 stream MST (Pattern Generator). Status information and control of the downstream link (Link). EDID editor (EDID). DPCD monitor (DPCD) HDCP status monitor and control (HDCP).
DisplayPort Reference Source (SST, HDCP 2.3)	Video pattern generator with custom patterns and SST (Pattern Generator). Status information and control of the downstream link (Link). EDID editor (EDID). DPCD monitor (DPCD) HDCP status monitor and control (HDCP). Executing HDCP 2.3 CTS Tests (Sink DUT Testing).

A full description of the functions and the licensing can be found in Appendix B Licensing.

Options

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



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

You can define how much memory is allocated in the PC for captured audio. 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 and the saved Presets. DSC Related presets can be omitted with UCD-323 and UCD-301.

DSC

Omitted when using UCD-323 or UCD-301

Misc. options

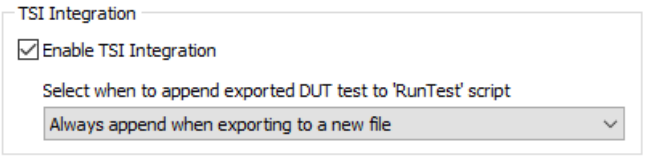
Apply color conversions to saved images: When saving captured frames, the Color Mode selected in *Video* tab will be applied also to saved images.

Bypass 4:2:x –> 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.



Enable TSI Integration: When selected, TSI Integration tool (*Tools > TSI Integration*) is enabled. When exporting test parameters in Sink / Source DUT Testing, test code is also appended for execution with TSI.

Please refer to *TSI Integration* and *Exporting Tests for TSI* later in this document.

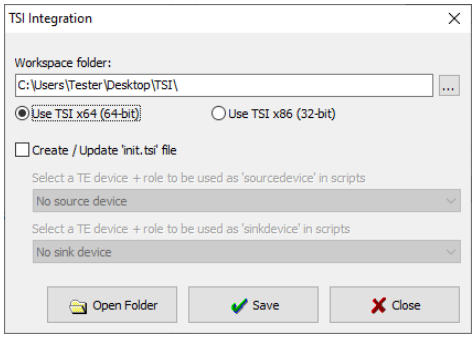
AUX Analyzer Options

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.

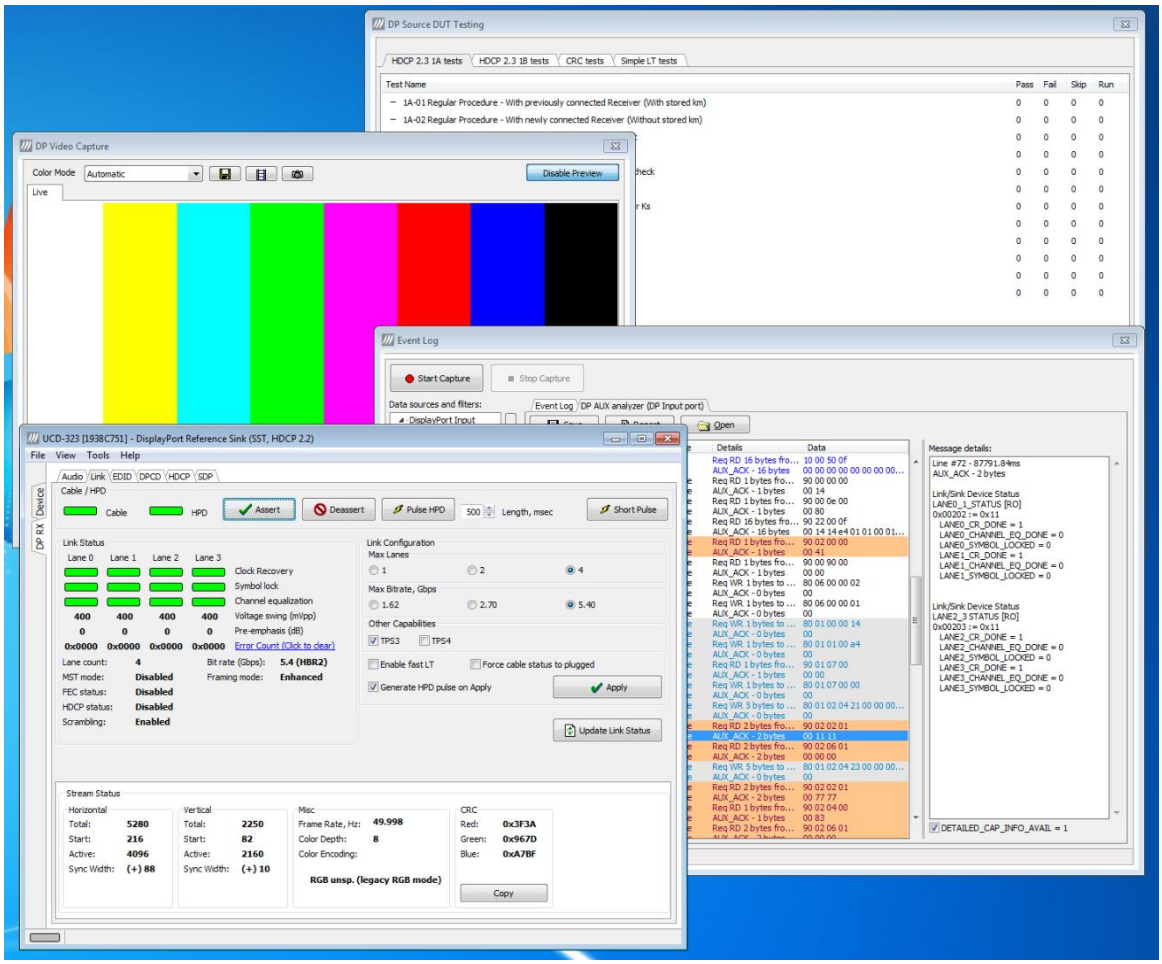


TSI Integration enables automatic creation of the necessary configuration files for executing tests exported from UCD Console's Sink DUT testing or Source DUT Testing.

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

Detaching Tabs

You can detach most of the UCD Console tabs into a separate window for being able to monitor and control 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 your keyboard.

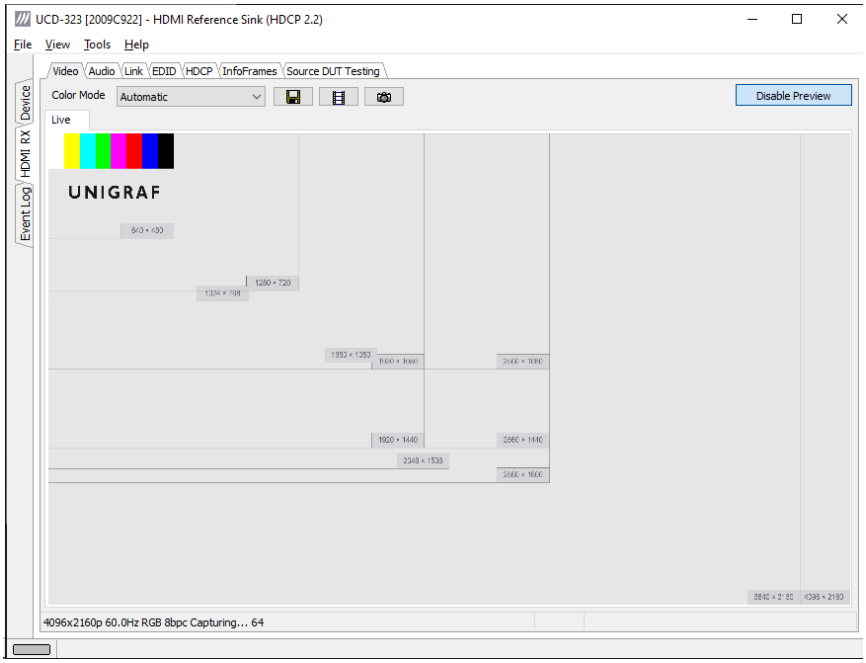


7. HDMI REFERENCE SINK

HDMI Reference Sink function is available in *UCD-323 HDDP Dual* and UCD-*301 Digital*. In HDMI Reference Sink role, the device is using one input channel, HDMI Sink (HDMI RX). 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 input channel. HDMI RX features the following tabs. Some of the tabs are enabled by default, some only when an applicable license is included.

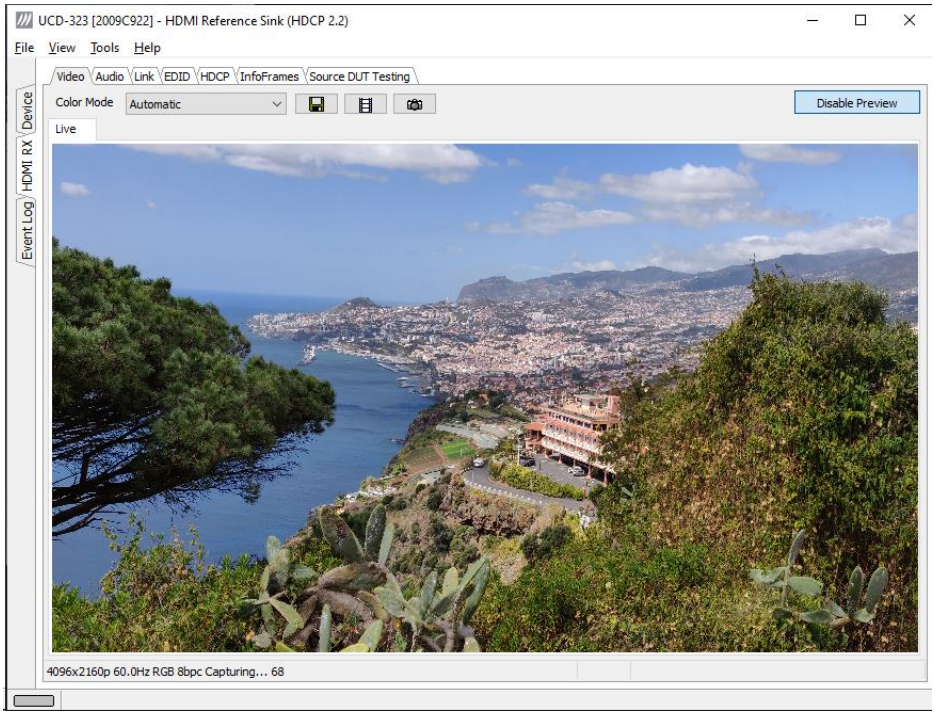
- Video preview and saving (Video). *Enabled by default.*
- Audio monitoring and saving (Audio). *Enabled by default.*
- Status information and control of the upstream link (Link). *Enabled by default.*
- EDID editor (EDID).
- HDCP status monitor and control (HDCP).
- Read InfoFrame data (InfoFrames).
- Executing TSI Test cases (Source DUT Testing).



Video Tab

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

Input video mode

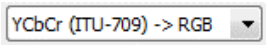


The measured input resolution, frame rate and color format is shown below the preview window. The indication of the number of frames captured to the PC shows you the pace of the image data transfer to the PC.

Disable / Enable Preview

Click the button to start or stop capturing video frames.

Color Mode for preview



- 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.

Save one frame

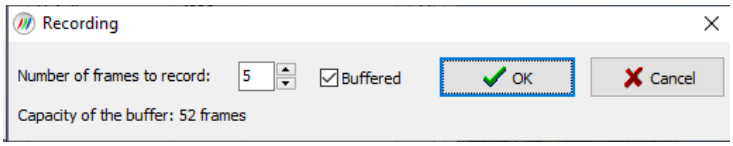
Capture and save one video frame as a bitmap file in the PC. The format and storage location can be selected in Tools > Options pull-down menu. The available bitmap formats are PPM, BMP and JPG.

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.

Note	Please note that when HDCP is enabled, i.e. when HDCP protected content is received, no content can be saved.

Sequence recording

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



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.

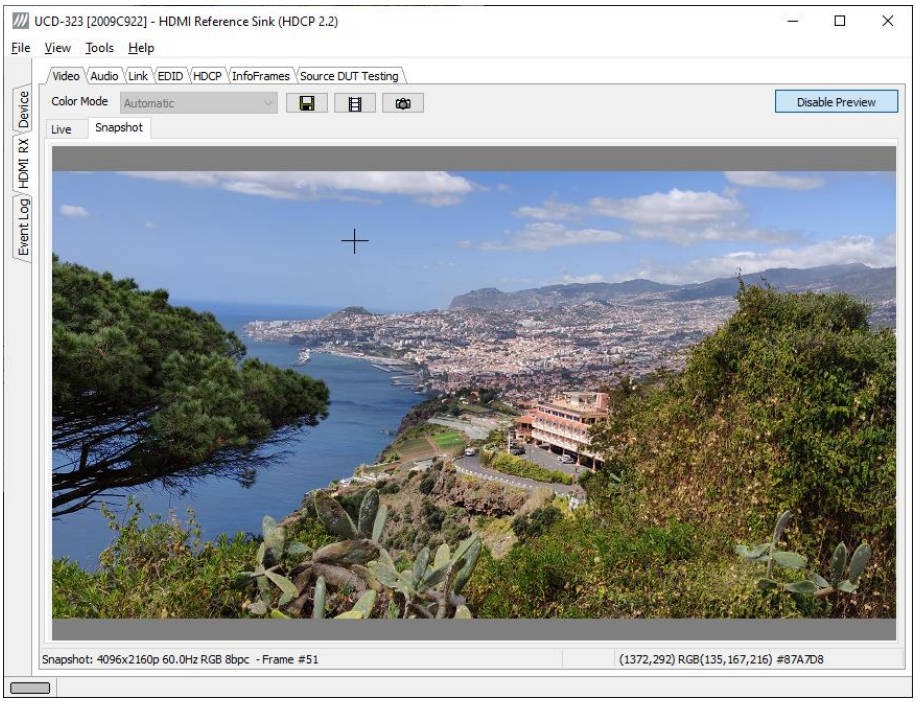
In non-buffered mode, only one input frame is buffered at a time. Frames will be skipped if the transfer of the data to the PC is slower than the input data rate.

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

Note	Please note that when HDCP is enabled, i.e. when HDCP protected content is received, no content can be saved.

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

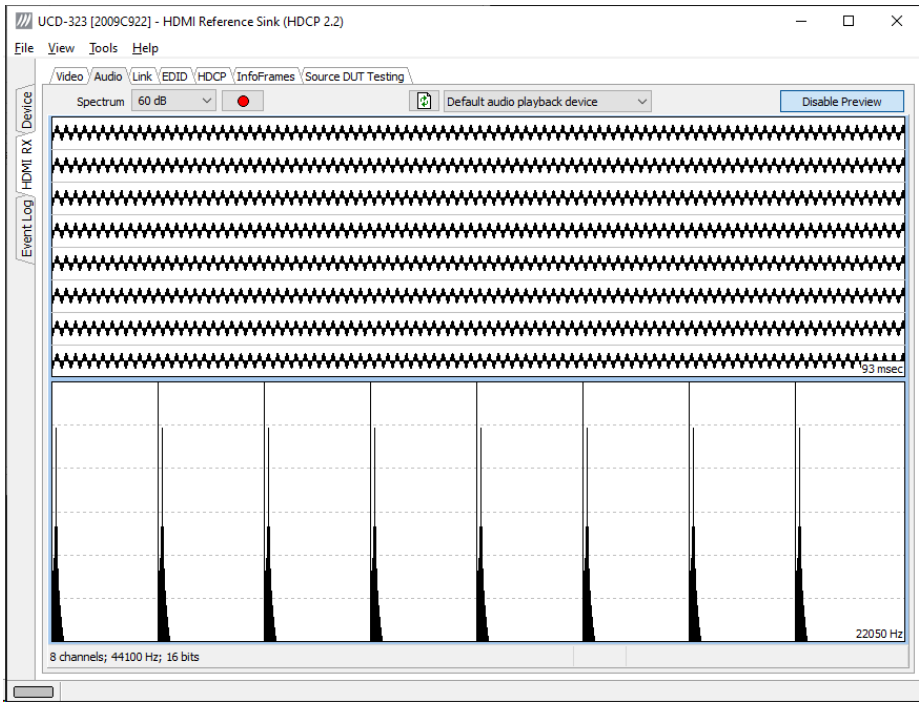
Zoom of the Preview Image can be altered by right clicking on top of the preview image and selecting between

- 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

Audio Tab

Audio tab is enabled by default. Audio tab has a preview of the audio signal format and the controls for audio playback and recording.



The audio signal format is shown in two 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.

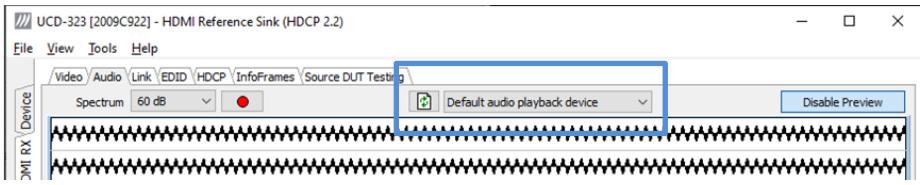
The span of the preview window is defined with **Audio preview size** found in Tools > Options dialog. The value is given in ksamples (1024 samples). The relation between the preview window span in milliseconds (msec) and the value given in *Audio preview* size depends on the sampling frequency. Please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

Disable / Enable Preview

Use this button to control capturing the audio data.

Playback device selection

You can enable audio playback in your PC by selecting the **Playback** check-box. Use the combo-box to select the audio device in the host PC through which the captured audio is played. By default, the Default Audio device of your PC is chosen. Please **Disable Preview** to make changes.



Note	Please note that the audio capabilities of the audio playback device of your PC are not automatically reflected in the audio capabilities description in UCD-300 EDID. Since UCD-300 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

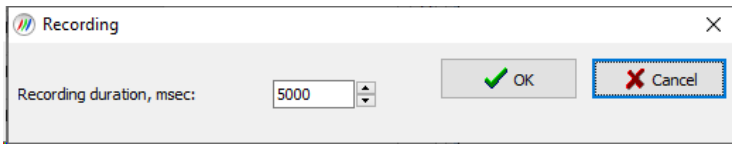
Click here to re-read the list of audio devices after making changes to the host PC configuration.

Audio Buffer Size

You can define the amount of buffering used in the data transfer between the UCD-300 unit and the PC. **Audio buffer size** can be found 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

Clicking the button, you can start or stop recording the captured audio in the PC using WAVeform audio format (*.wav) format. In the pop-up dialog, you can define the recording duration. The folder where the audio file will be saved can be selected in File > Options.

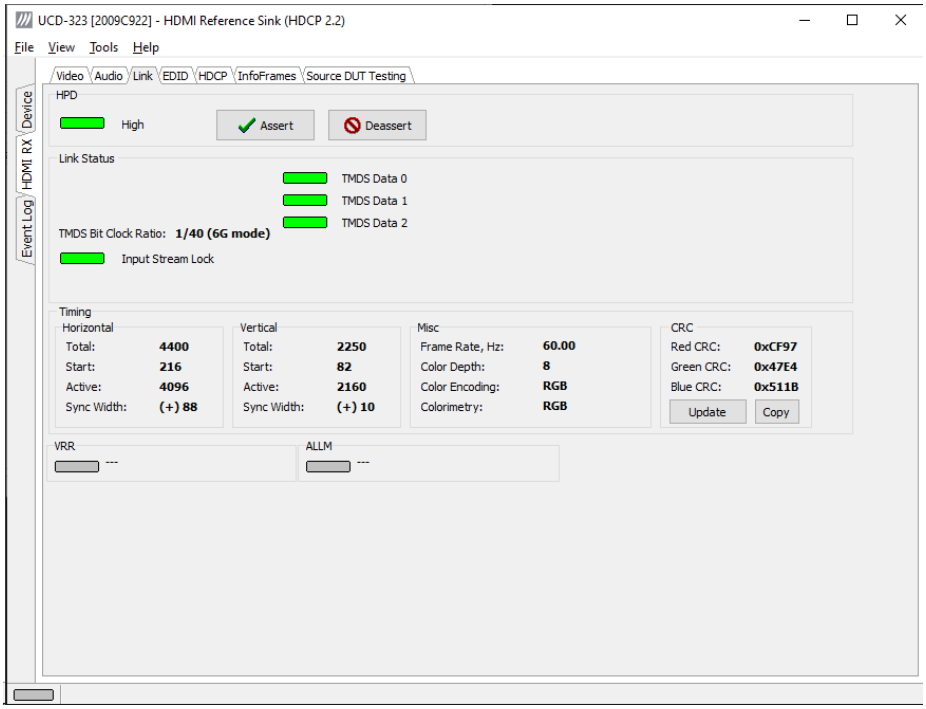


Input audio mode

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

Link Tab

Link tab is enabled by default.



Link tab contains four panels: HPD, Link Status, Timing and Audio Return Channel.

HPD

Status of the Hot Plug Detect (HPD) signal. Click **Assert** to permanently set the HPD signal to logical “High” state. Click **Deassert** to permanently set the HPD signal to logical “Low” state (de-activate).

Link status

This panel contains three indicators:

- The *TMDS Bit Clock Ratio* detected
- *Input Stream Lock* indicator
- Status of the three *TMDS data channels*

Timing

Measured timing information, frame rate and color format details are shown in this panel.

CRC

This panel contains the CRC (Cyclic redundancy check) calculated of all the red, green and blue sub-pixels correspondingly. Click **Update** to re-read.

Audio Return Channel (ARC) (UCD-301 only)

Select **Enable** to enable ARC function.

You can select the ARC audio **Source** to be either

- Loopback of captured HDMI audio, or
- Audio received in the S/PDIF input

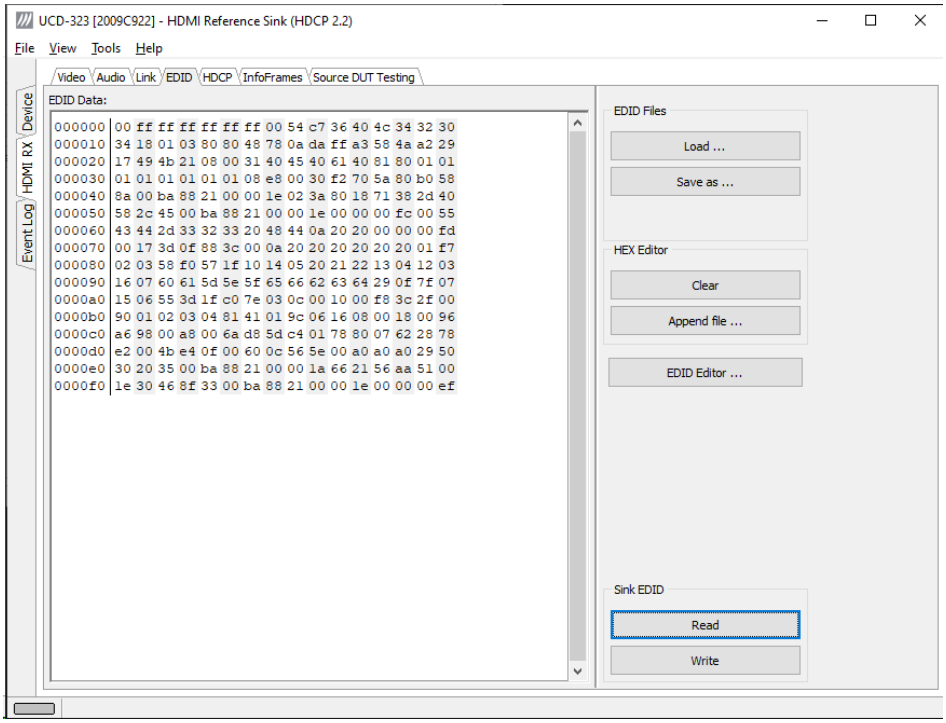
Select one of the ARC modes via the **Mode** radio buttons

- Single mode (Utility line only)
- Common Mode (Utility and HPD line).

The *Timing*, *CRC* and *ARC* panels are enabled with *UCD Pro for HDMI Sink* license.

EDID Tab

EDID Tab is enabled with *UCD Pro for HDMI Sink* license.



This tab provides tools for accessing the EDID of the UCD-300 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 hardware EDID memory

EDID Files

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

Note	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. You can however modify hex EDID files with the HEX Editor or load and program externally generated hex EDID files that have Display ID content.

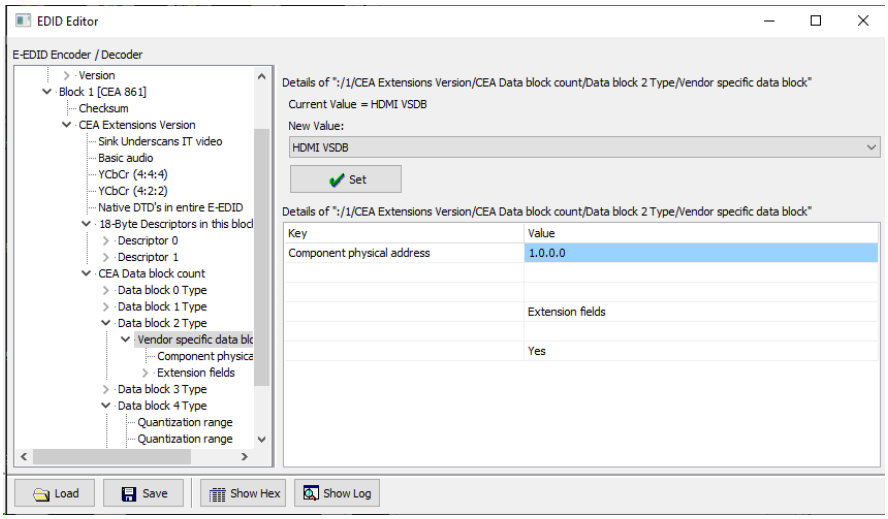
HEX Editor

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. You can edit the EDID contents by typing over the existing values. The 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.

Once you are done with editing the data, you can either save it to an *.ecd file in your PC with **Save as…** or program it to the hardware EDID memory with **Write**.

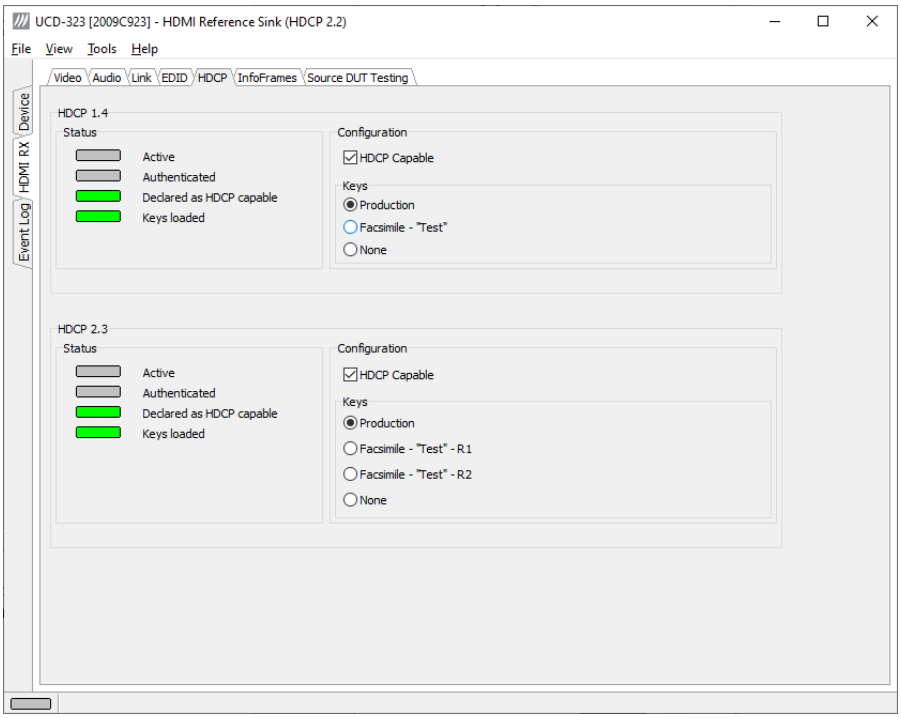
EDID Editor

You can edit the EDID structures of the data in the *HEX Editor* by clicking **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.



HDCP Tab

HDCP Tab is enabled with *UCD Pro for HDMI Sink* license.



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-300 device.

Status

The status field indicates the HDCP status of the connected UCD-300 device.

- *Active*: The link between UCD-300 and the upstream source has been encrypted.
- *Authenticated*: The HDCP handshake between the UCD-300 and the upstream source has been completed successfully.
- *Declared as HDCP capable*: The UCD-300 unit recognizes HDCP handshake messages.
- *Keys loaded*: The HDCP keys are loaded to the UCD-300 unit.

Configuration

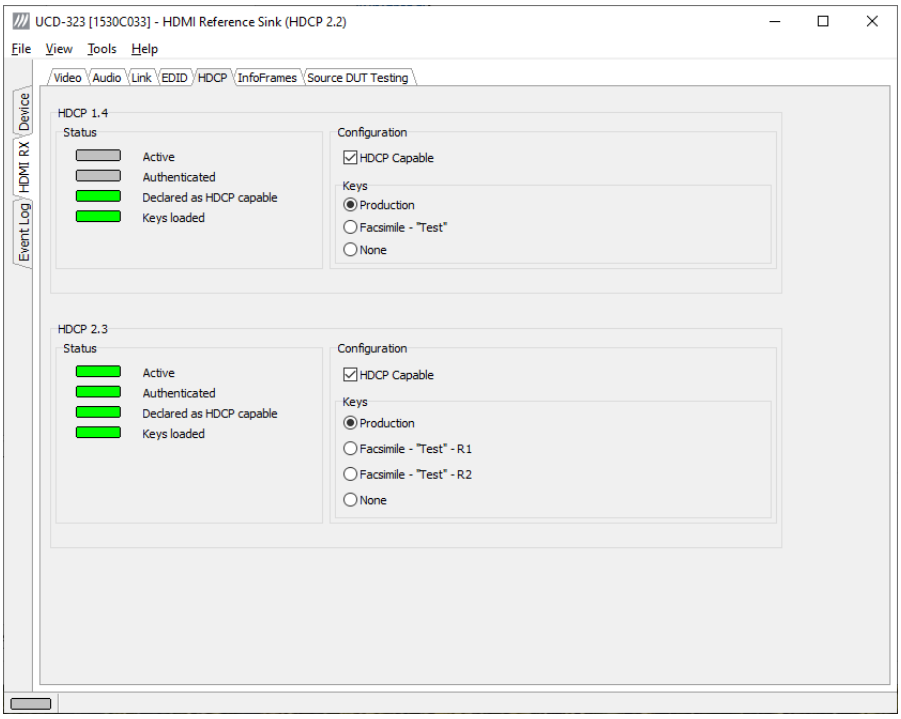
- *HDCP Capable*: Uncheck the box to disable HDCP.

Keys

You can select if you are using *Production* or *Facsimile* HDCP keys. To remove the keys, select *None*.

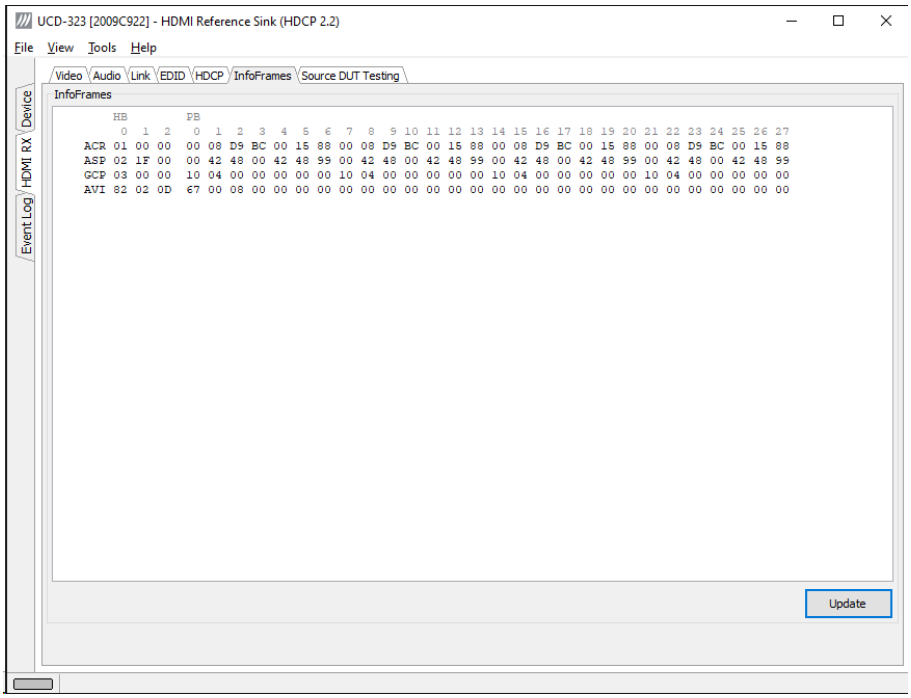
HDCP 1.4 vs. HDCP 2.3

UCD-300 devices support by default HDCP 1.4 standard with HDMI. HDCP 2.3 support is enabled with *HDCP 2.3 Support* license



InfoFrame Tab

InfoFrame Tab is enabled with *UCD Pro for HDMI Sink* license.



InfoFrames tab displays in hexadecimal format the following received infoframes:

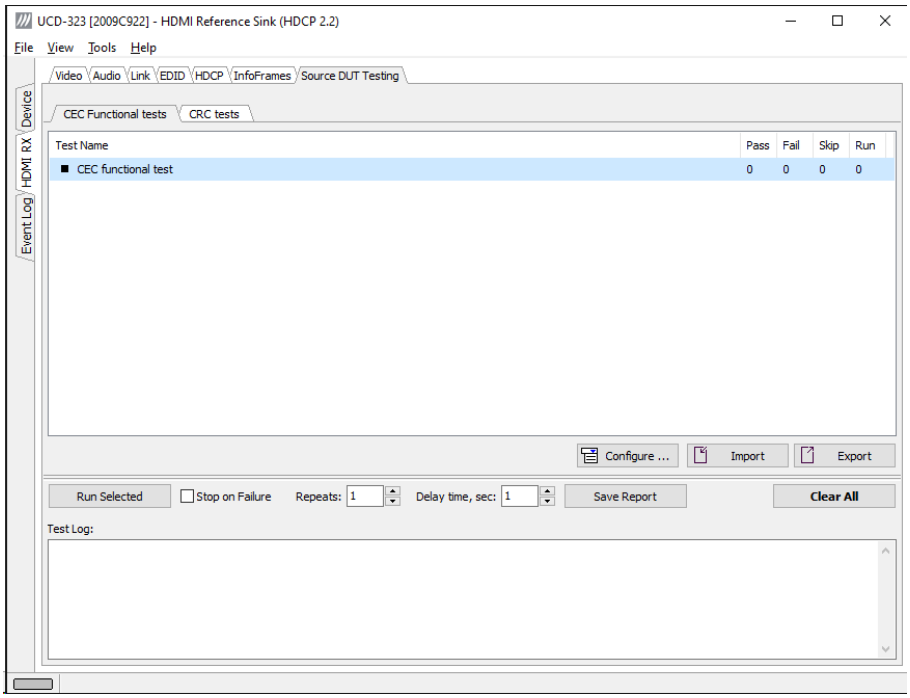
- ACR (Audio Clock Regeneration)
- ASP (Audio Sample Packet)
- GCP (General Control Packet)
- ACP (Audio Content Protection Packet)
- ISRC1 (International Standard Recording Code)
- ISRC2 (International Standard Recording Code)
- OBA (One Bit Audio sample packet)
- DTS (DTS Audio packet)
- HBR (High Bitrate Audio stream packet)
- GMP (Gamut Metadata packet)
- 3D ASP (3D Audio Sample packet)
- 3D OBA (3D One Bit Audio sample packet)
- AMP (Audio Metadata Packet)
- MST_ASP (Multi-stream audio sample packet)
- MST_OBA (One Bit Multi-stream audio sample packet)
- VSI (Vendor Specific InfoFrame)
- AVI (Auxiliary Video Information)
- SPD (Source Product Descriptor)
- AIF (Audio InfoFrame)
- MPEG (MPEG Source InfoFrame)
- DRM (Dynamic Range and Mastering InfoFrame)

Please click **Update** to re-read the InfoFrame data.

Source DUT Testing Tab

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

Please refer to **Appendix B** later in this document for description of the tests available. Source DUT Testing enables testing of a HDMI Source 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 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.

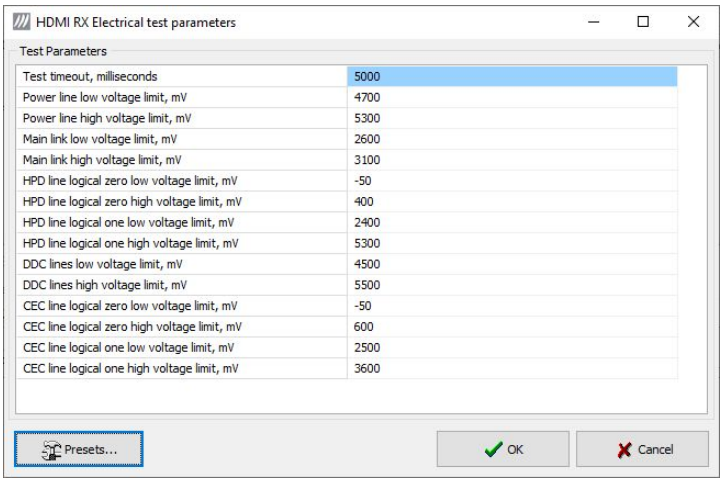
Click **Save Report** to generate a HTML report file for sharing the results with other parties for viewing without UCD Console.

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

Test Parameters

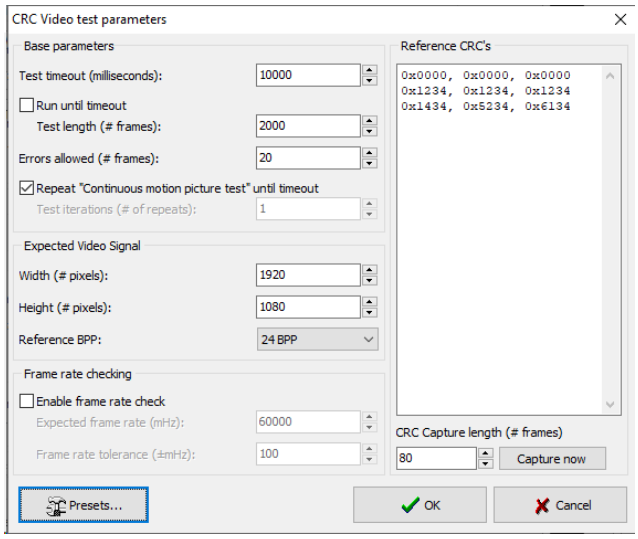
Each test set has its dedicated set of test parameters. Open a dialog for defining the parameters by clicking **Configure…**.

Parameters of Electrical Test Group



Each test in the Electrical test set uses parameters to control test execution and acceptance criteria. Parameters for all tests are collected in the dialog *Electrical test parameters*.

Parameters of CRC Test Set



CRC Video test parameters dialog allows you to define the test duration, number of frames captured, and errors allowed. It allows you to define the frame size and capture.

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.

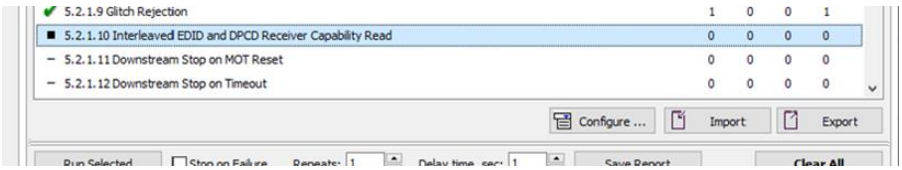
Presets

In both dialogs you can save the selected parameters as Presets. Please click **Presets…** to save your configuration. If you have saved configuration Presets, you can load one of the saved ones, save a new Preset or delete a Preset.

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.



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. DISPLAYPORT REFERENCE SINK

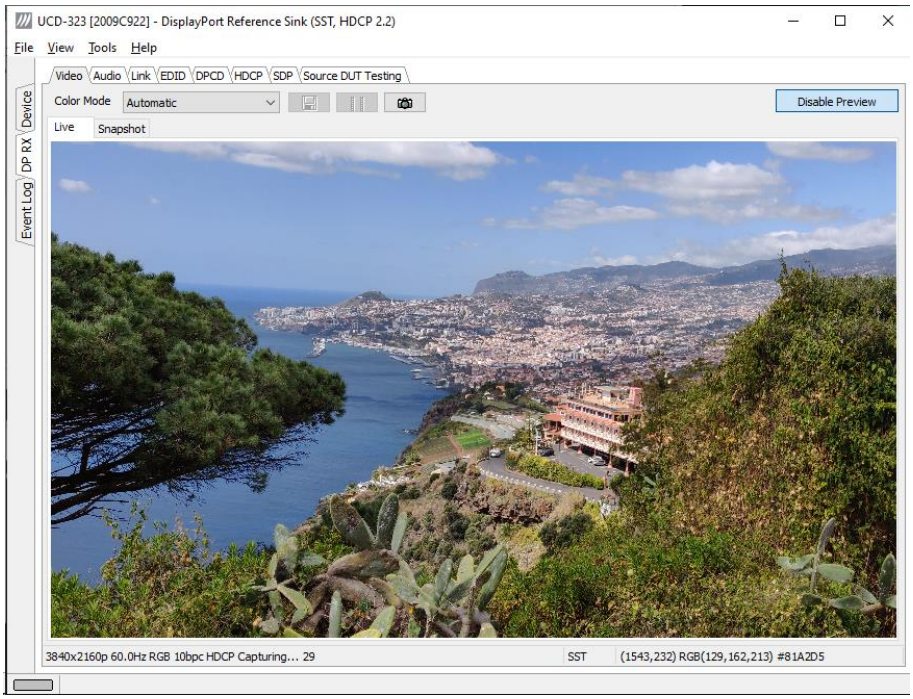
DisplayPort Reference Sink function is available in *UCD-323 HDDP Dual* and *UCD-301 Digital*. In DisplayPort Reference Sink role, the device is using one input channel, DisplayPort Sink (DPRX). The corresponding vertical tab can be seen on the left edge of the GUI.

The horizontal tabs on the top of the GUI enable the various functions available for the 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). *Enabled by default.*
- Audio monitoring and saving (Audio). *Enabled by default.*
- Status information and control of the upstream link (Link). *Partly enabled by default.*
- EDID editor (EDID).
- DPCD editor (DPCD).
- HDCP status monitor and control (HDCP).

Video Tab

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



Input video mode

4096x2160p 60.0Hz RGB 8bpc Capturing... 85

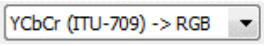
The measured input resolution, frame rate and color format is shown below the preview window. The indication of the number of frames captured to the PC shows you the pace of the image data transfer to the PC.

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



- 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.

Save one frame

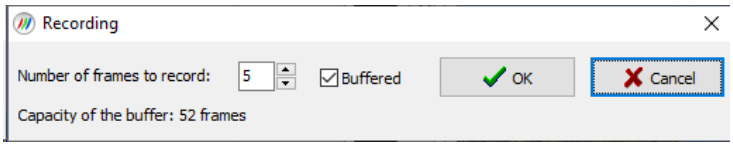
Capture and save one video frame as a bitmap file in the PC. The format and storage location can be selected in Tools > Options pull-down menu. The available bitmap formats are PPM, BMP and JPG.

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.

Note	Please note that when HDCP is enabled, i.e. when HDCP protected content is received, no content can be saved.

Sequence recording

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



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.

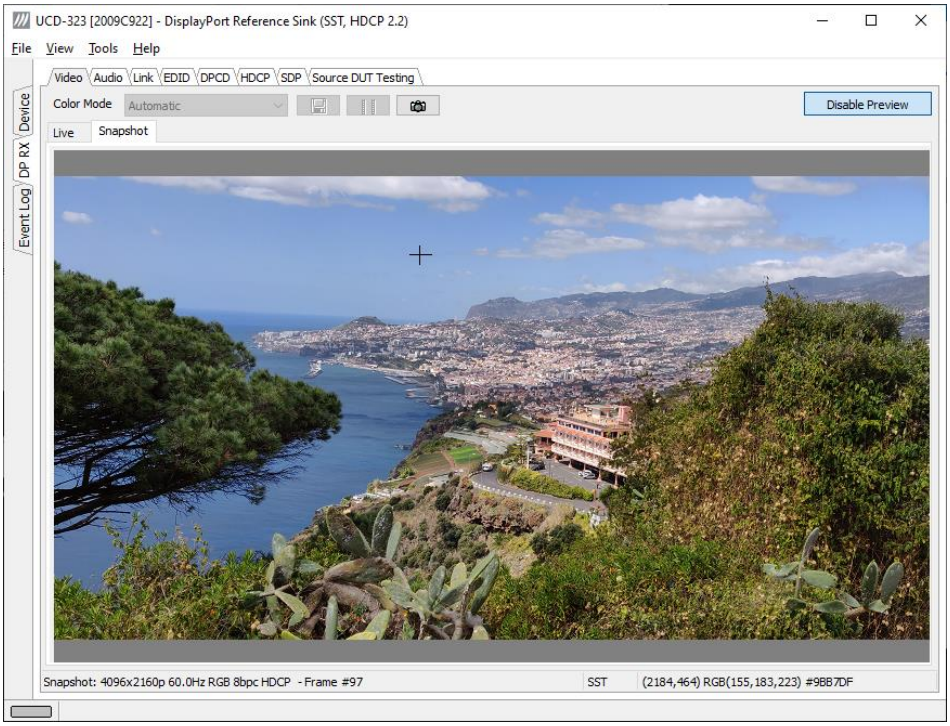
In non-buffered mode, only one input frame is buffered at a time. Frames will be skipped if the transfer of the data to the PC is slower than the input data rate.

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

Note	Please note that when HDCP is enabled, i.e. when HDCP protected content is received, no content can be saved.

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

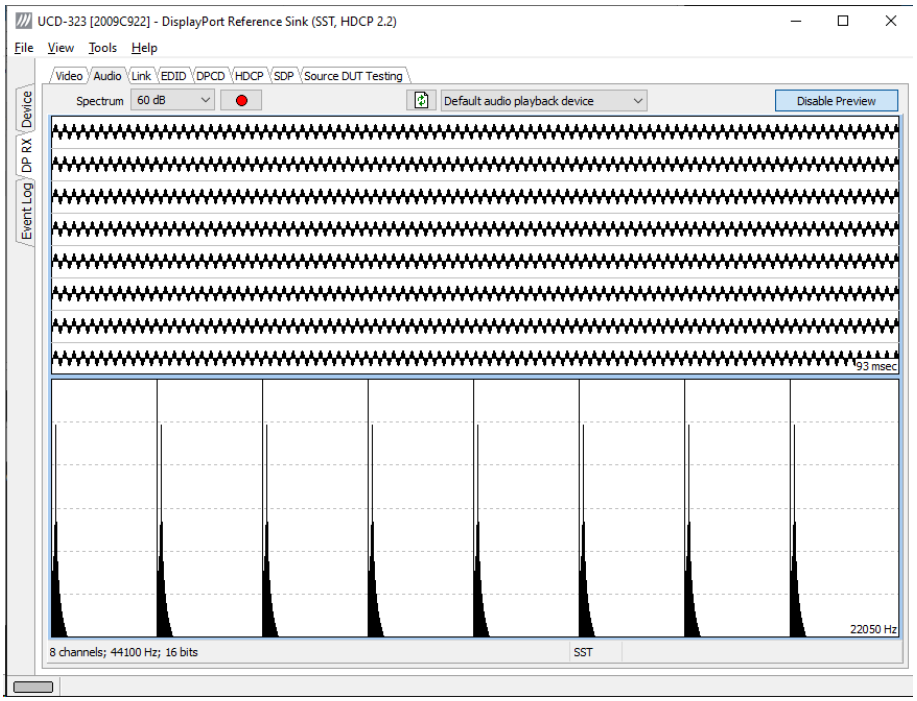
Zoom of the Preview Image can be altered by right clicking on top of the preview image and selecting between

- 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

Audio Tab

Audio tab is enabled by default. Audio tab has a preview of the audio signal format and the controls for audio playback and recording.



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.

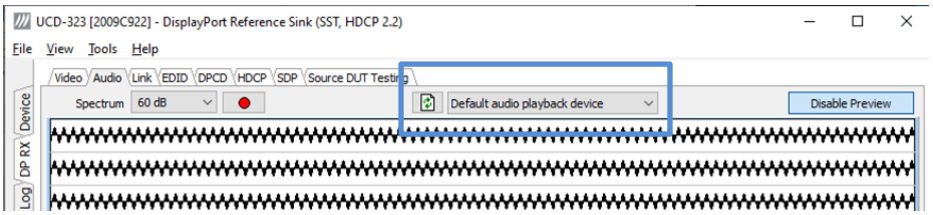
The span of the preview window is defined with **Audio preview size** found in Tools > Options dialog. The value is given in ksamples (1024 samples). The relation between the preview window span in milliseconds (msec) and the value given in *Audio preview* size depends on the sampling frequency. Please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

Disable / Enable Preview

Use this button to control capturing the audio data.

Playback device selection

You can enable audio playback in your PC by selecting the **Playback** check-box. Use the combo-box to select the audio device in the host PC through which the captured audio is played. By default, the *Default Audio* device of your PC is chosen. Please **Disable Preview** in order to make changes.



Note	Please note that the audio capabilities of the audio playback device of your PC are not automatically reflected in the audio capabilities description in UCD-300 EDID. Since UCD-300 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

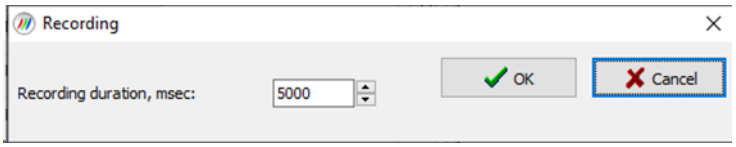
Click here to re-read the list of audio devices after making changes to the host PC configuration.

Audio Buffer Size

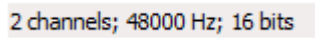
You can define the amount of buffering used in the data transfer between the UCD-300 unit and the PC. **Audio buffer size** can be found in Tools > Options dialog. Increased buffer size will ensure a smooth audio output but will also increase the delay between the capture of the audio stream and its playback.

Start audio recording

Clicking the button, you can start or stop recording the captured audio in the PC using Waveform Audio File Format, WAV (*.wav) format. In the pop-up dialog, you can define the recording duration. The folder where the audio file will be saved can be selected in Tools > Options.



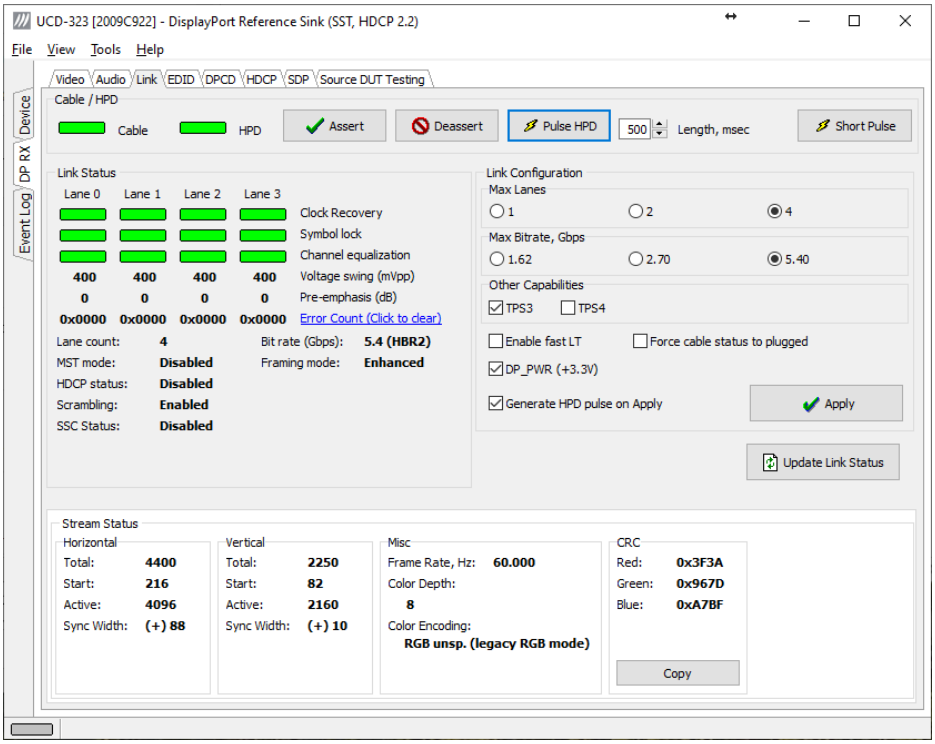
Input audio mode



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

Link Tab

Link tab is partly enabled by default, partly with license: *UCD Pro for DP Sink*.



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

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

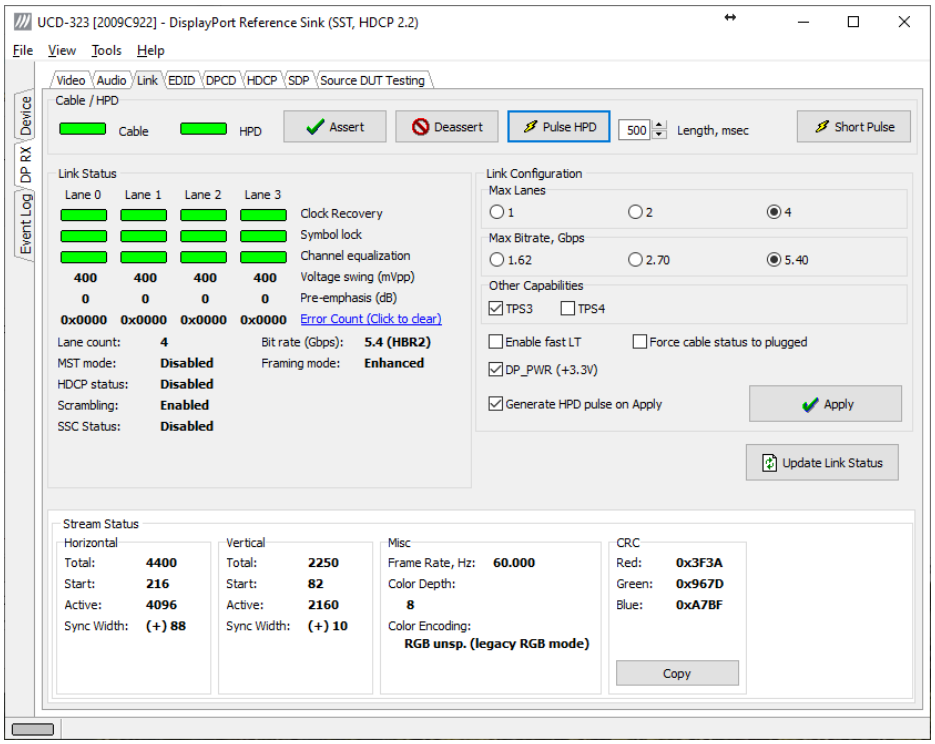
For applying a short pulse click **Short Pulse**. Pulse duration is 1 msec.

Link Status

Link Status displays the status of the link training and the link parameters negotiated between UCD-300 Sink and the Upstream Source. The data is retrieved from the DPCD registers of the UCD-300 Sink. The status is updated automatically.

Link Configuration

Link configuration is enabled with *UCD Pro for DP Sink* license.



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-300 Sink and the Upstream Source. The data is retrieved from the DPCD registers of the UCD-300 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-300 Sink. Maximum Lane Count and Maximum Link Rate are set with their appropriate radio buttons. To update the new status to the DPCD registers click **Apply**.

Other Capabilities section includes controls of features like TPS3 and TPS4

Click **Enable Fast LT** to enable support for a link training without AUX transactions.

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.

DP_PWR (+3.3V) Enable +3.3 Vdc in pin 20 of DP connector (Available depends on hardware version. Please contact Unigraf if in doubt.).

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-300 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-300 Local Sink.

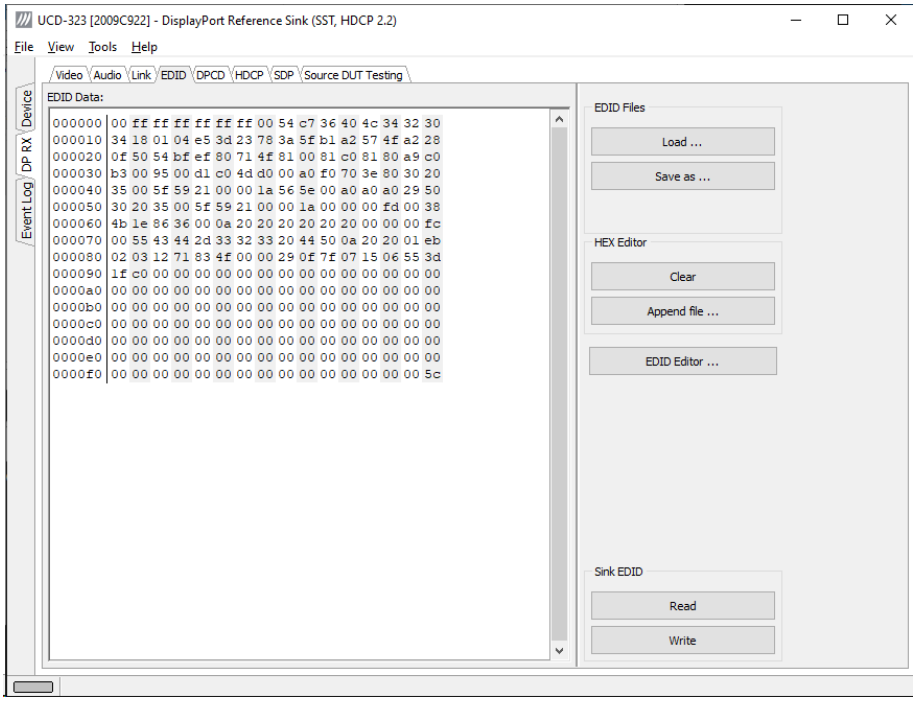
CRC

The 16-bit **CRC** (checksum, cyclic redundancy check) values of the three color components 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 1st, 4th, 7th … byte, "**Value 1**" from 2nd, 5th, 8th … byte and "**Value 2**" from 3rd, 6th, 9th … byte.

EDID Tab

EDID Tab is enabled with *UCD Pro for DP Sink* license.



This tab provides tools for accessing the EDID of the UCD-300 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 hardware EDID memory

EDID Files

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

Note	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. You can however modify hex EDID files with the HEX Editor or load and program externally generated hex EDID files that have Display ID content.

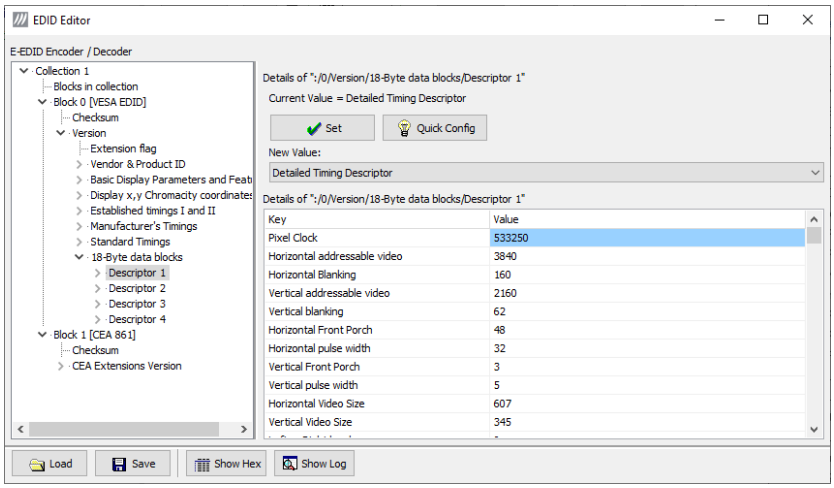
HEX Editor

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. You can edit the EDID contents by typing over the existing values. The 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.

Once you are done with editing the data, you can either save it to an *.ecd file in your PC with **Save as…** or program it to the hardware EDID memory with **Write**.

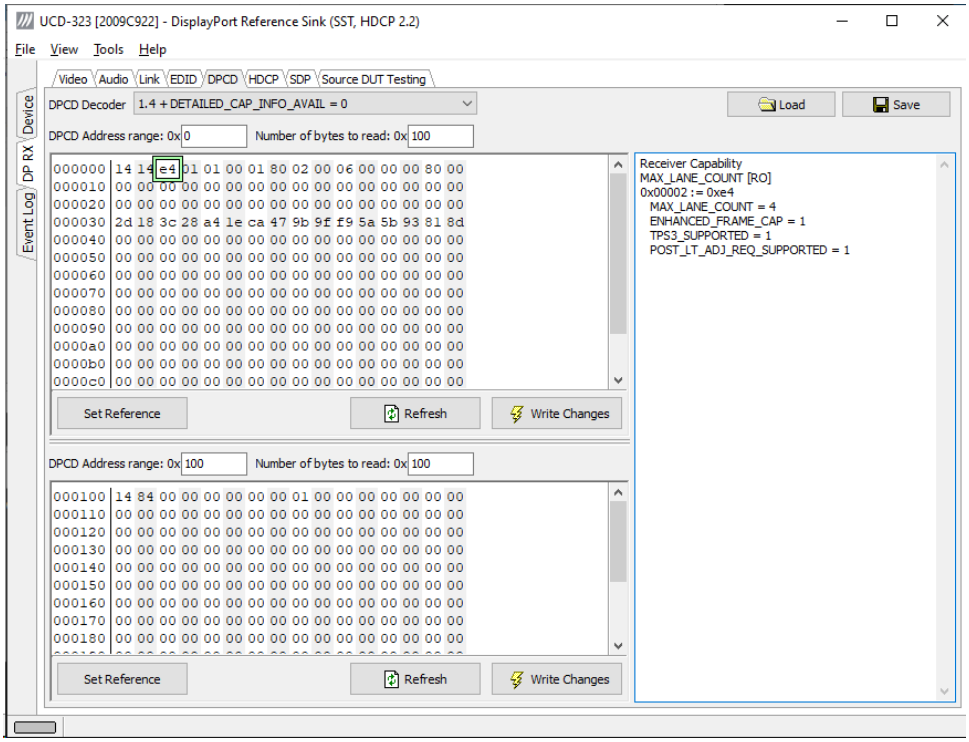
EDID Editor

You can edit the EDID structures of the data in the *HEX Editor* by clicking **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.



DPCD Tab

The DPCD tab is enabled with *UCD Pro for DP Sink* license.



DPCD tab is a tool for monitoring and editing the DPCD registers of the UCD-300 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.

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).

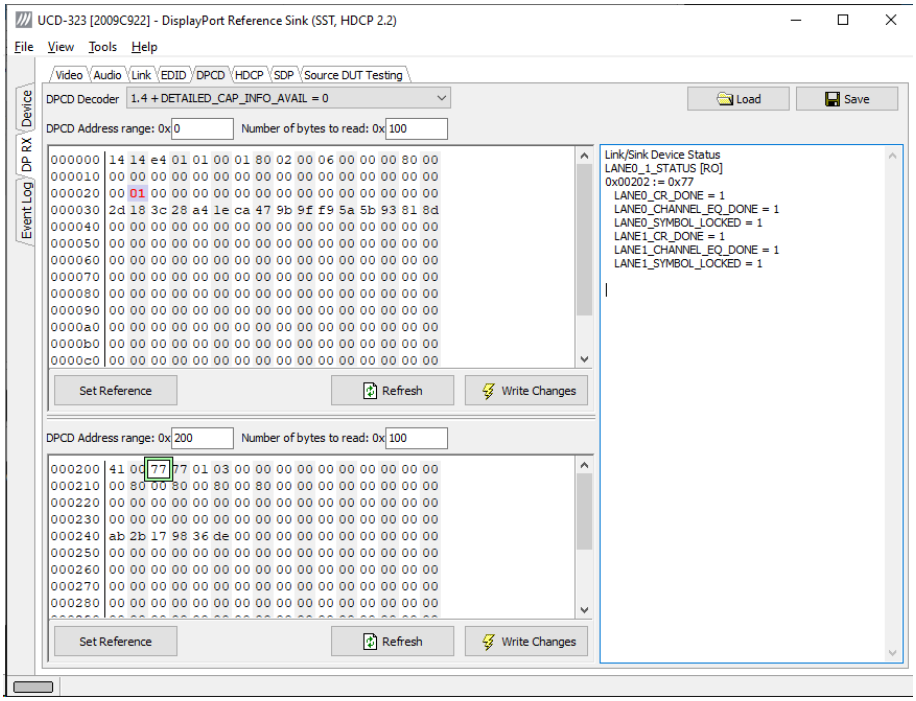
By clicking **Refresh** you can re-read the data from the DPCD registers to the window in question.

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.



Saving and Loading DPCD Content

You can save the DPCD data in the address areas that you selected for the two windows as a file in your PC. You can save the content in 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.

▶ By Clicking **Save** you will be able to select the location and the format of the file.

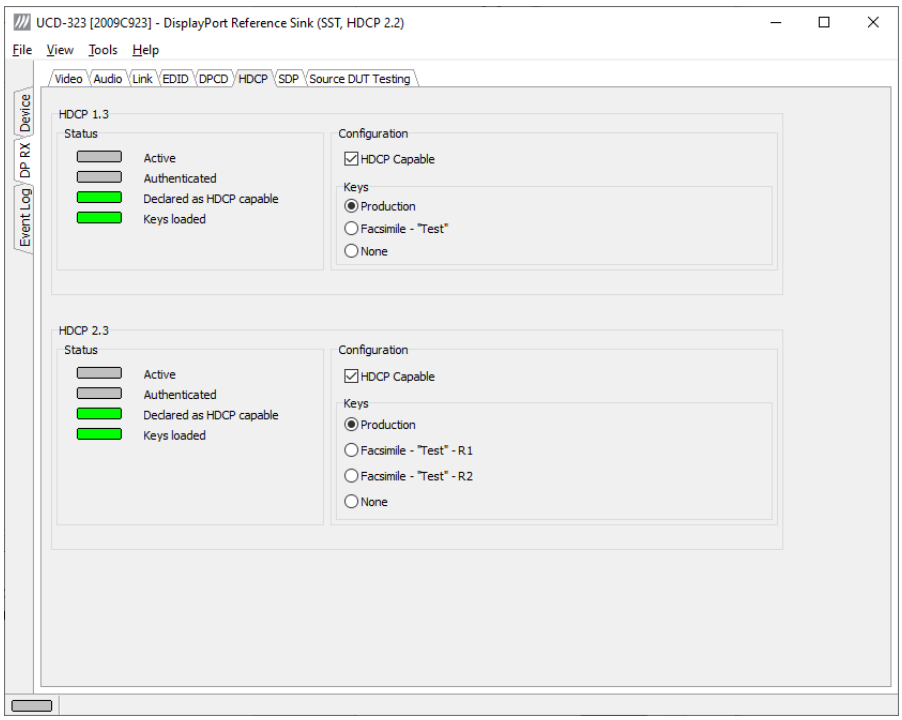
▶ By Clicking **Load** you can load DPCD data saved in *DPCD Data File* (*.DPD) format to the editor.

▶ To program the data into the DPCD registers of UCD-300 Local Sink click **Write Changes**.

Note	- Writing DPCD data to the DPCD registers of the UCD-300 Local Sink will potentially affect the status and capabilities of UCD-300 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-300 the DPCD registers will be returned to their default values

HDCP Tab

HDCP tab is enabled with *UCD Pro for DP Sink* license.



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-300 device.

Status

The status field indicates the HDCP status of the connected UCD-300 device.

Active: The link between UCD-300 and the upstream source has been encrypted.

Authenticated: The HDCP handshake between the UCD-300 and the upstream source has been completed successfully.

Declared as HDCP capable: The UCD-300 unit recognizes HDCP handshake messages.

Keys loaded: The HDCP keys are loaded to the UCD-300 unit.

Configuration

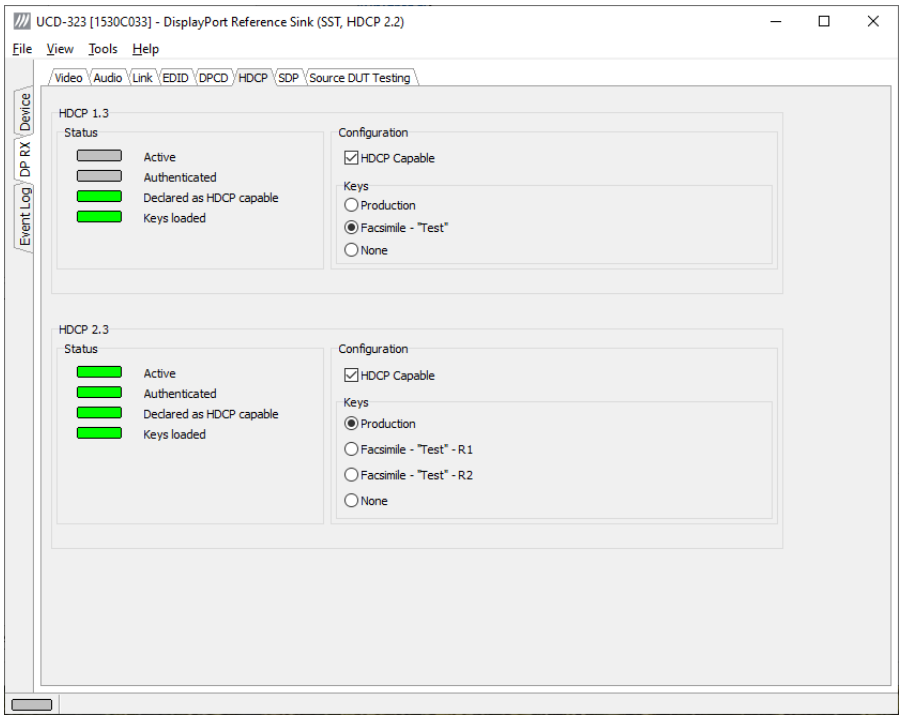
HDCP Capable: To disable HDCP uncheck the box.

Keys

You can select if you are using *Production* or *Facsimile* HDCP keys. To remove the keys, select *None*.

HDCP 1.3 vs. HDCP 2.3

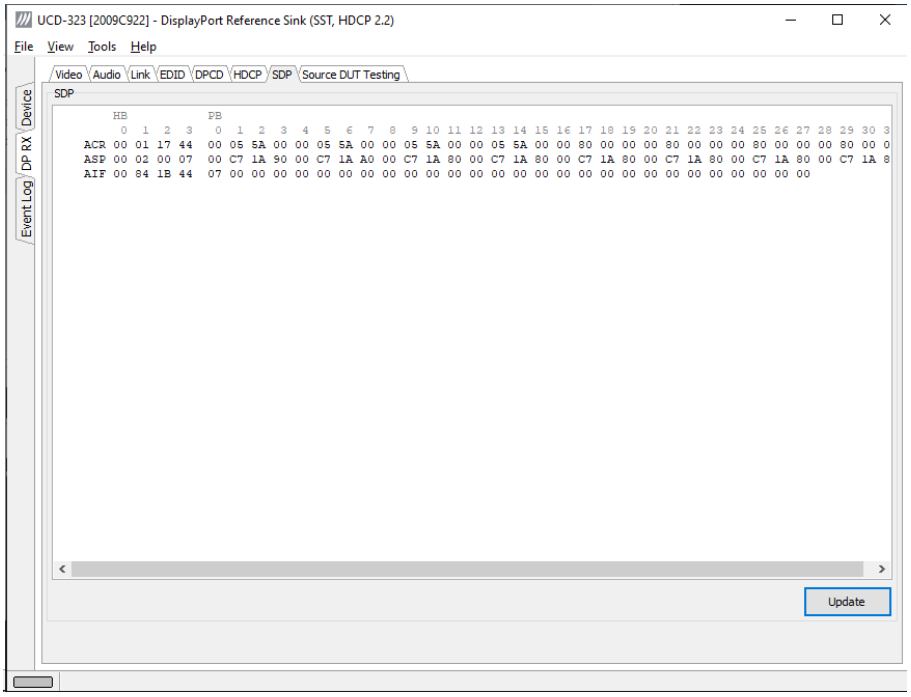
UCD-300 devices support by default HDCP 1.3 standard with DisplayPort. The functionality supporting HDCP 2.3 is enabled with *HDCP 2.3 Support* license



SDP Tab

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

In SDP Tab you will be able to monitor the *Secondary-Data Packets* sent by the Source device. Click **Update** to re-read the data.



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

- Audio_TimeStamp
- Audio_Stream
- Extension
- Audio_CopyManagement
- ISRC
- 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)

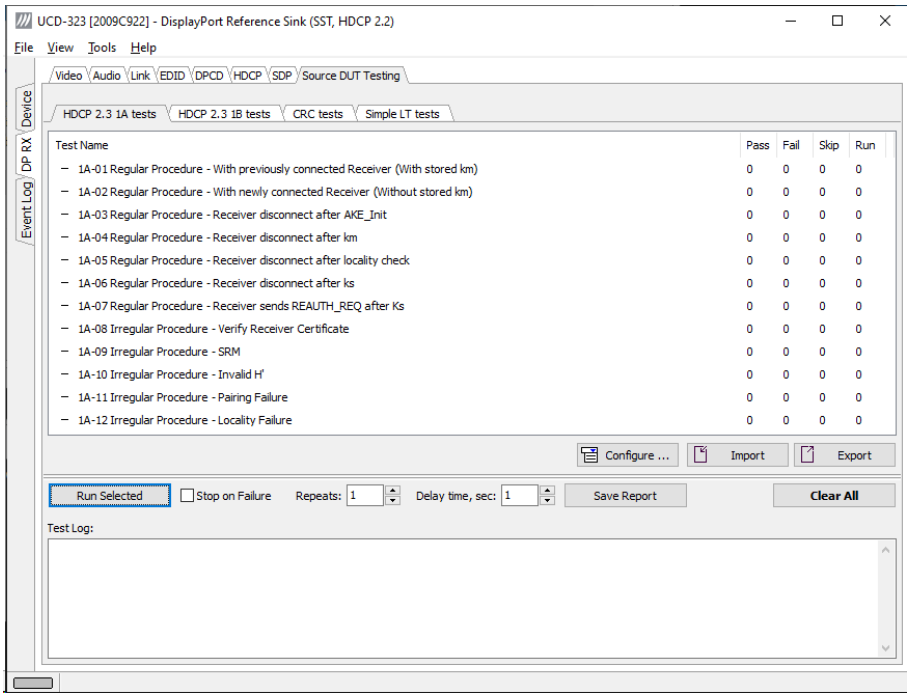
Source DUT Testing Tab

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. Source DUT Testing enables the execution of HDCP 2.3 Compliance Tests for a DP Source DUT.

Source DUT Testing enables testing of a DP Source 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 selector ▫ in the left hand side of 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.

▶ Run the tests by clicking **Run Selected**. By clicking **Abort** you can stop the sequence.

You can control the test flow either 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.

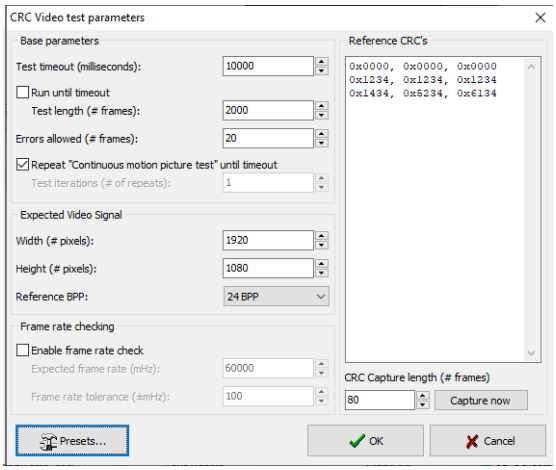
By clicking **Clear All** you can clear all results – the test log and the results matrix.

Test Parameters

Each test set has its dedicated set of test parameters. You can open a dialog for defining the parameters by clicking button in the set header.

Parameters of CRC Test Set

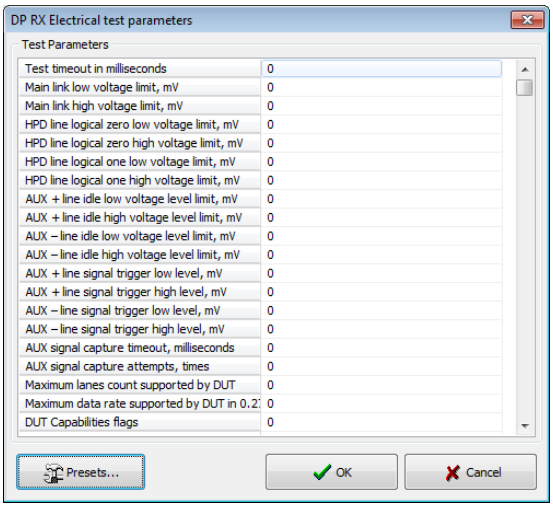
CRC Video test parameters dialog allows you to define the test duration, number of frames captured, and errors allowed. It allows you to define the frame size and capture.



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.

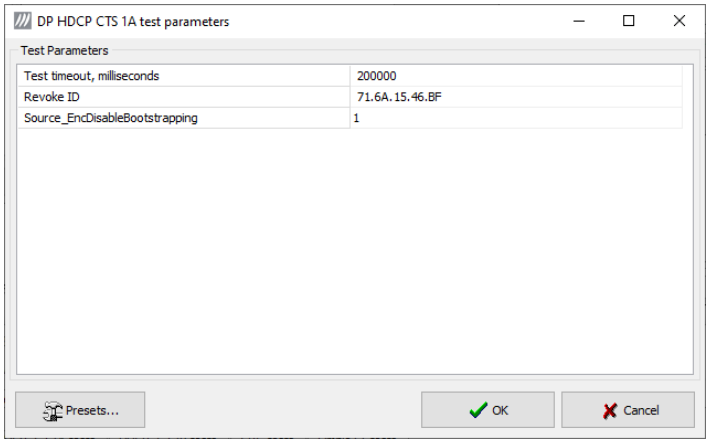
Parameters of Electrical Test Group (UCD-301 only)

Each test in the Electrical test set uses parameters to control test execution and acceptance criteria. Parameters for all tests are collected in the dialog *Electrical test parameters*.



HDCP CTS Test Set

The HDCP Tests have their own dialog



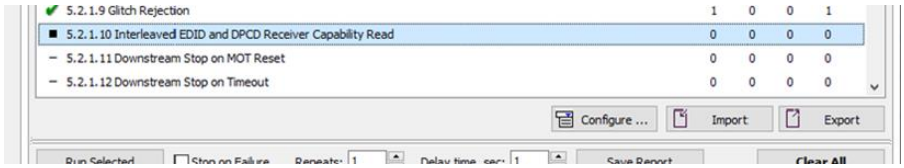
Presets

In both dialogs you can save the selected parameters as Presets. Please click **Presets…** to save your configuration. If you have saved configuration Presets, you can load one of the saved ones, save a new Preset or delete a Preset.

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.



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

9. HDMI REFERENCE SOURCE

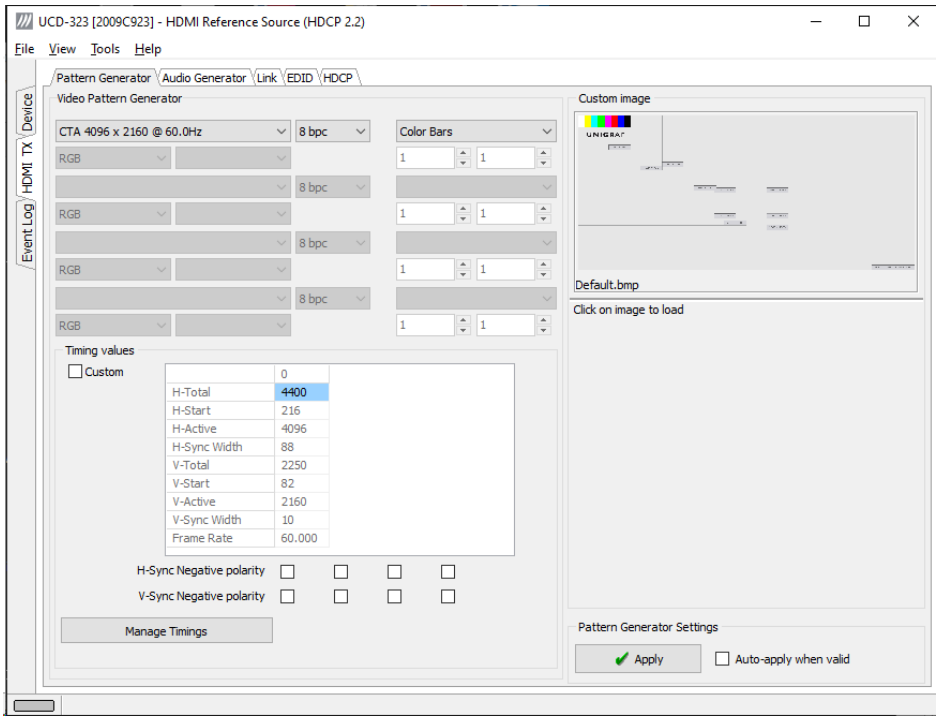
HDMI Reference Source function is available in *UCD-323 HDDP Dual*. In HDMI Reference Source role, the device is using one output channel, HDMI Source (HDMI TX). The corresponding vertical tab can be seen on the left edge of the GUI.

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). *Enabled by default.*
- Status information and control of the downstream link (Link). *Enabled by default.*
- EDID editor (EDID).
- HDCP status monitor and control (HDCP).

Pattern Generator Tab

Pattern Generator tab is enabled by default.



Predefined Timings

UCD-300 includes a set of common predefined video timings. Please find a list of the timings with their major details in Appendix C of this document.

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 Appendix D of this document.

Color Depth

You can set the color depth used. The available color depths are: 8, 10, 12 and 16 bpc.

Predefined Video Patterns

UCD-300 has a set of predefined patterns and a possibility to user defined custom pattern. You can select the pattern in the provided combo box. By selecting **Disabled** you can have the links activated but no video data transferred.

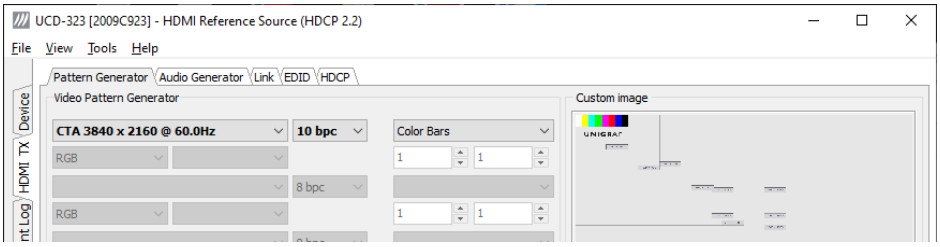
Please find a description of the available test patterns in Appendix D of this document.

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. Select **Custom Image** pattern.

Pattern Generator Settings

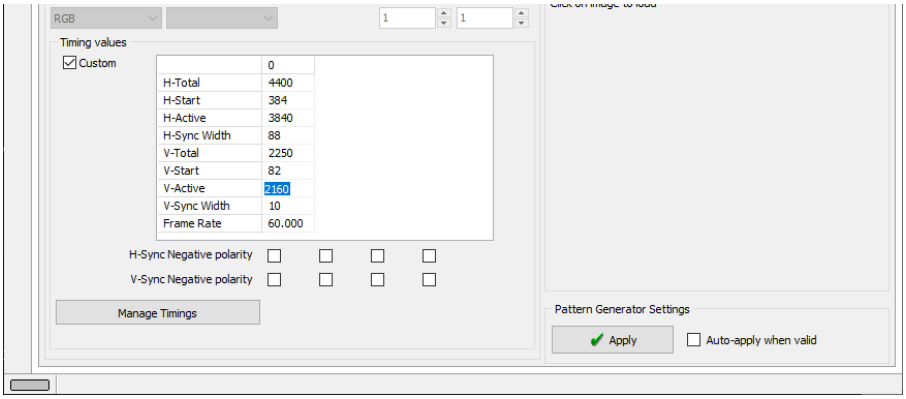
In order to avoid sourcing invalid video mode combinations, the new settings need to be validated by the user by clicking **Apply**. Automatic validation will be applied when **Auto-apply when valid** is checked. The situation that parameters have been changed but not applied is indicated by **bold values** of the parameter.



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

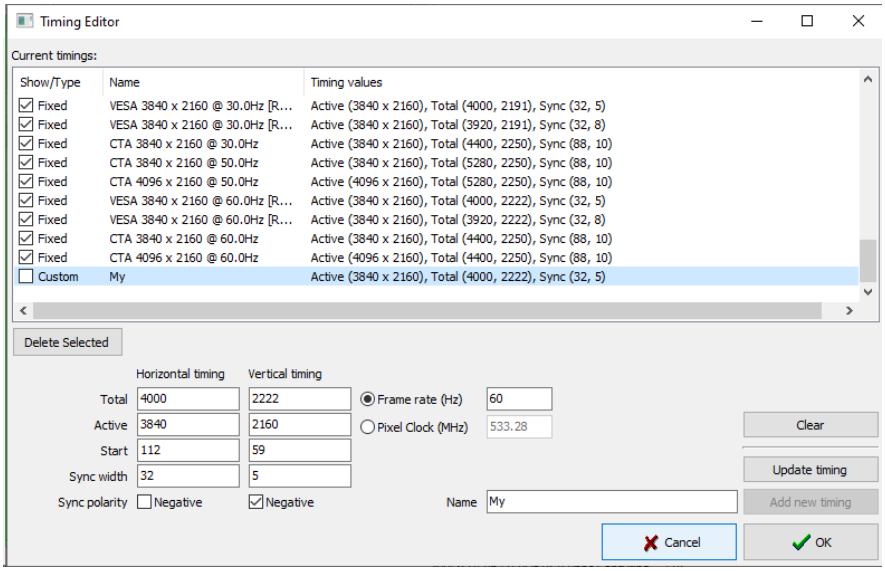
Custom Timing feature is enabled with *UCD Pro for HDMI Source* license.



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**.



- 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.**

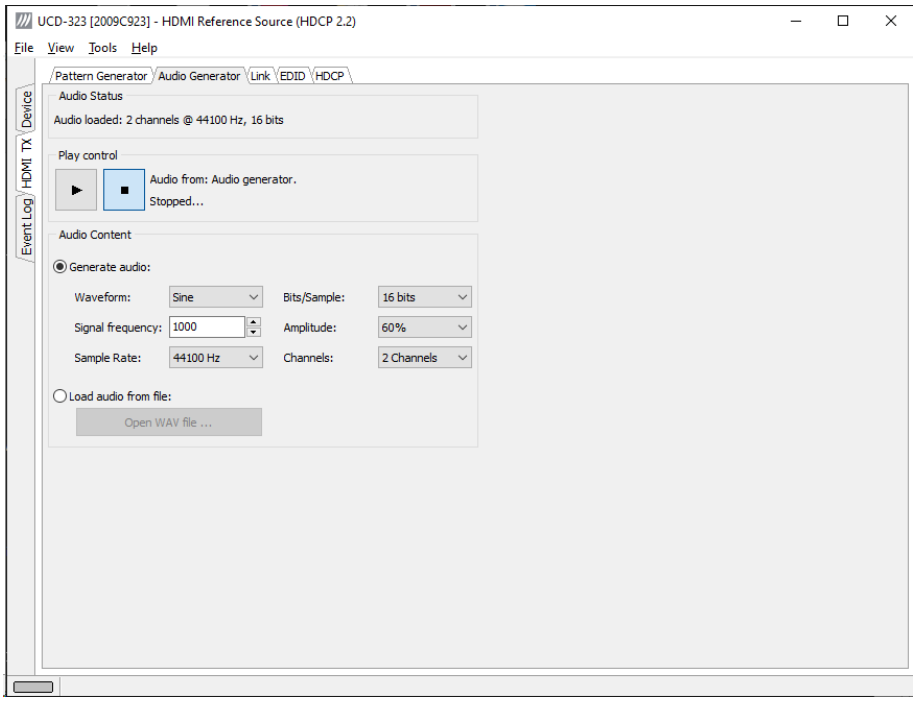
The dialog will make a sanity check for the values entered and will warn the user for any combinations that cannot be used.

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.

Audio Generator Tab

Audio Generator tab is enabled by default.



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

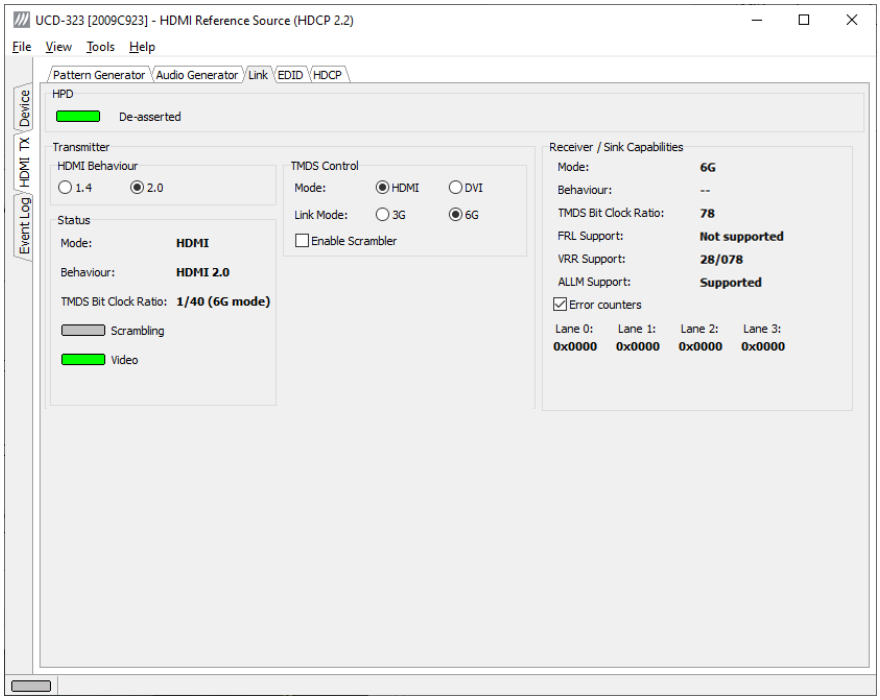
- To load internally generated audio, select **Generate audio**, and adjust the controls to the desired audio format.
- To load an audio file from your PC, select **Load audio from file**, click the **Open WAV file…** button, browse and select the file and click **Open**
- To play the selected audio 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 is enabled by default.



The Link tab shows the status and control items for the HDMI link.

HPD

The status LED indicates the state of the HPD signal Asserted (logical “high”) or De-asserted (logical “low”).

Transmitter

The panel shows the link mode used, the clock information and the status of the video and data scrambling.

HDMI Behavior

Select between HDMI 1.4 and HDMI 2.0 behaviors

TMDS Control

Mode: Select between HDMI and DVI modes. In DVI mode no audio and metadata are sent and color depth limited to 24 bpp maximum.

Link Mode: Select between 3.4 Gbps (3G) and 6.0 Gbps (6G) TMDS Link Rate

Enable Scrambler: Enable or disable scrambling of the TMDS data channels.

Status

Mode: Indication of the HDMI/TMDS mode (HDMI/DVI) In DVI mode no audio and metadata are sent, and color depth limited to 24 bpp maximum.

Behavior: Status of the HDMI Mode (HDMI 1.4 / HDMI 2.0).

TMDS Bit Clock Ratio: Status of (TMDS Bit Period) / (TMDS Clock Period) ratio (1/10 or 1/40)

Scrambling: Status of Scrambling_Enable bit (1=LED on; 0=LED off)

Video: Status of video sent.

Receiver / Sink Capabilities

Status of connected HDMI Sink device.

Mode: Status of Max_TMDS_Character_Rate byte in the sink's VSBD

Behaviour: Used HDMI mode

TMDS Bit Clock Ratio: Status of the TMDS_Bit_Clock_Ratio (1/10 / 1/40)

FRL Support: Sink's FRL support level as indicated in sink's HF-VSDB

VRR Support: Lowest frame rate and upper limit of the frame rate that sink is able to support using Variable Refresh Rate as indicated in sink's HF-VSDB

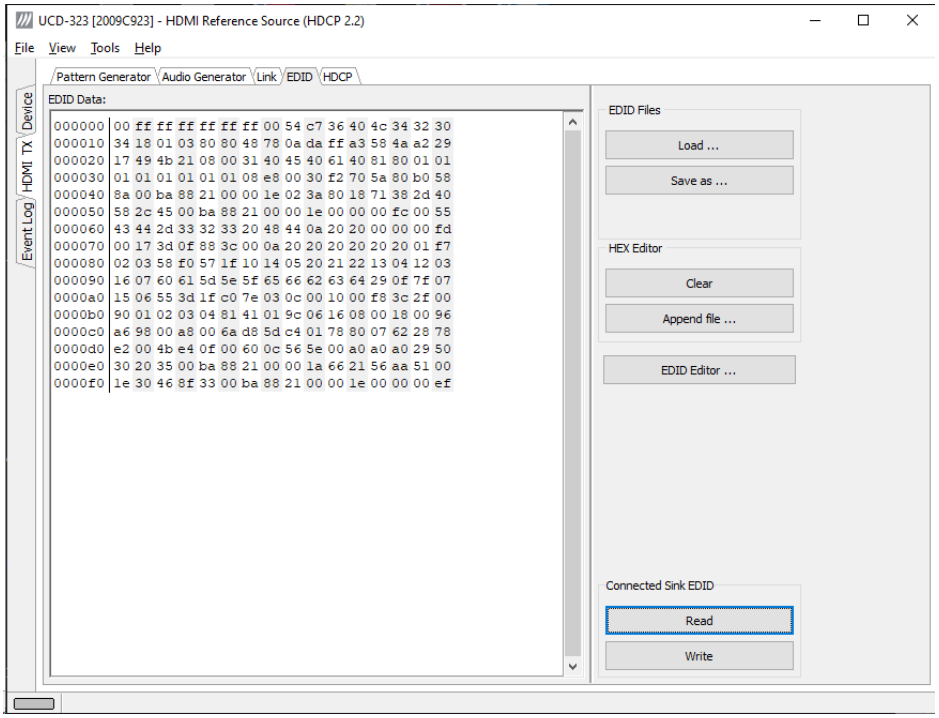
ALLM Support: Indication of Auto Low-Latency Mode support in sink's HF-VSDB

Error Counters

Status of SCDCS Character Error Detection registers. Only counters Lane 0 to Lane 2 are used in UCD-323.

EDID Tab

EDID tab is enabled with *UCD Pro for HDMI Source* license.



EDID tab will enable 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 HDMI link.
- Load and save EDID data files in the host PC
- Edit the EDID contents

EDID Files

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

Note	Currently the EDID Editor does not support Display ID. You can however modify hex EDID files with the HEX Editor or load and program externally generated hex EDID files that have Display ID content.

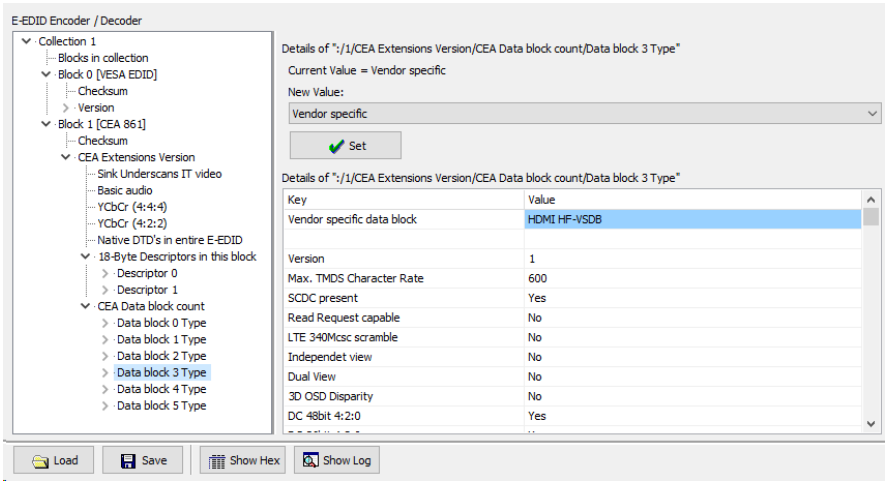
HEX Editor

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. You can edit the EDID contents by typing over the existing values. The 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.

Once you are done with editing the data, you can either save it to an *.ecd file in your PC with **Save as…** or program it to the hardware EDID memory with **Write**.

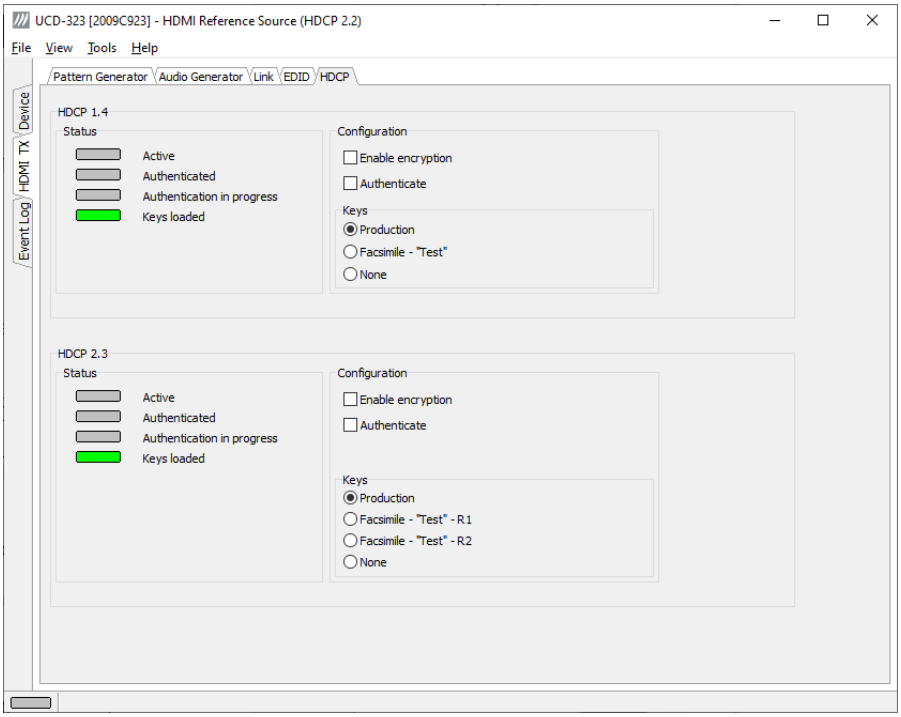
EDID Editor

You can edit the EDID structures of the data in the *HEX Editor* by clicking **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.



HDCP Tab

HDCP tab is enabled with *UCD Pro for HDMI Source* license.



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-300 device.

Status

The status field indicate the HDCP status of the connected UCD-300 device.

Active: The stream between UCD-300 and the downstream sink has been encrypted.

Authenticated: The HDCP handshake between the UCD-300 and the sink unit has been completed successfully.

Authentication in progress: The HDCP handshake is in process between the UCD-300 and the downstream sink unit.

Keys loaded: The HDCP keys are loaded to the UCD-300 unit.

Configuration

Authenticate: Perform the HDCP initiation handshake between the UCD-300 and the sink unit.

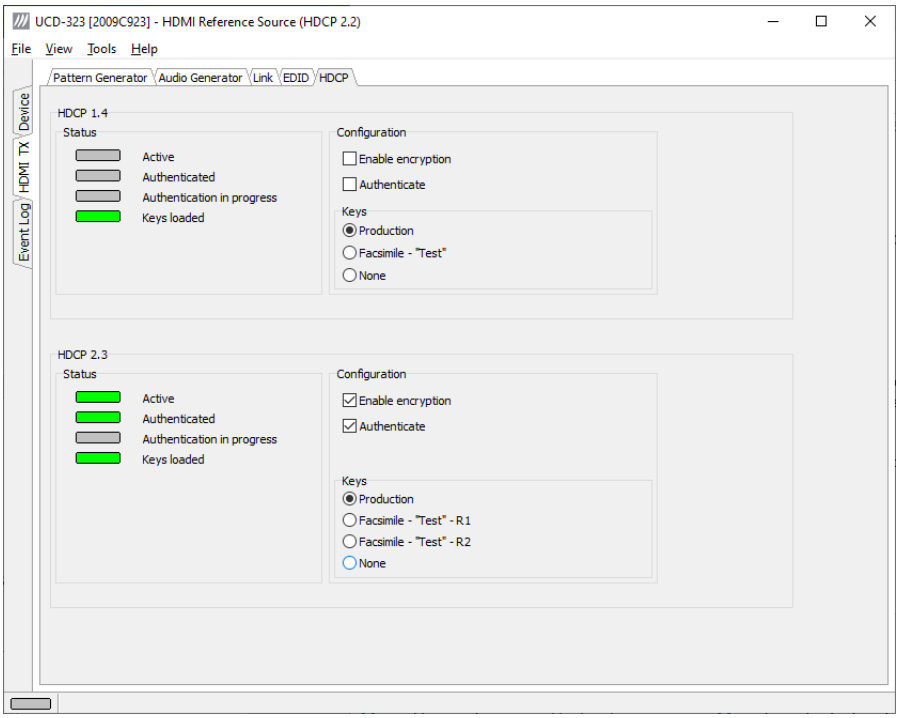
Enable encryption: Check to enable the encryption of the stream between UCD-300 and the downstream sink.

Keys

You can select if you are using *Production* or *Facsimile* HDCP keys. To remove the keys, select *None*.

HDCP 1.4 vs. HDCP 2.3

UCD-300 devices support by default HDCP 1.4 standard with HDMI. HDCP 2.3 support is enabled with *HDCP 2.3 Support* license.



10. DISPLAYPORT REFERENCE SOURCE

DP Reference Source function is available in *UCD-323 HDDP Dual*. In DisplayPort Reference Source role, the device is using one output channel, DisplayPort Source (DPTX). 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.

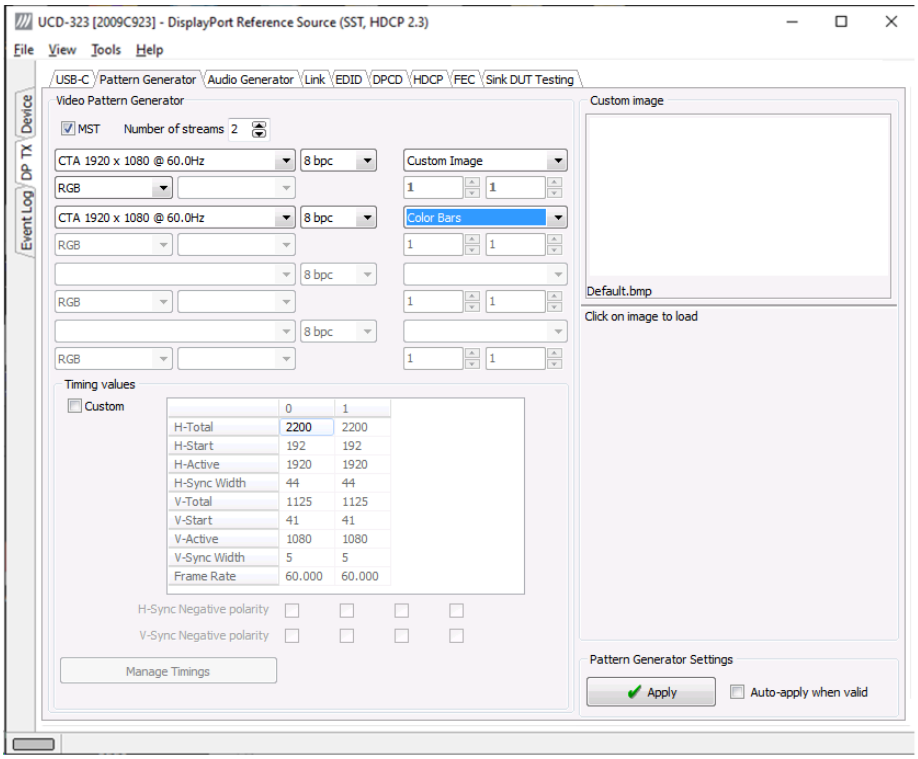
- Video pattern generator (Pattern Generator). *Enabled by default.*
- Status information and control of the downstream link (Link). *Enabled by default.*
- EDID editor (EDID).
- DPCD monitor (DPCD)
- HDCP status monitor and control (HDCP).

Pattern Generator Tab

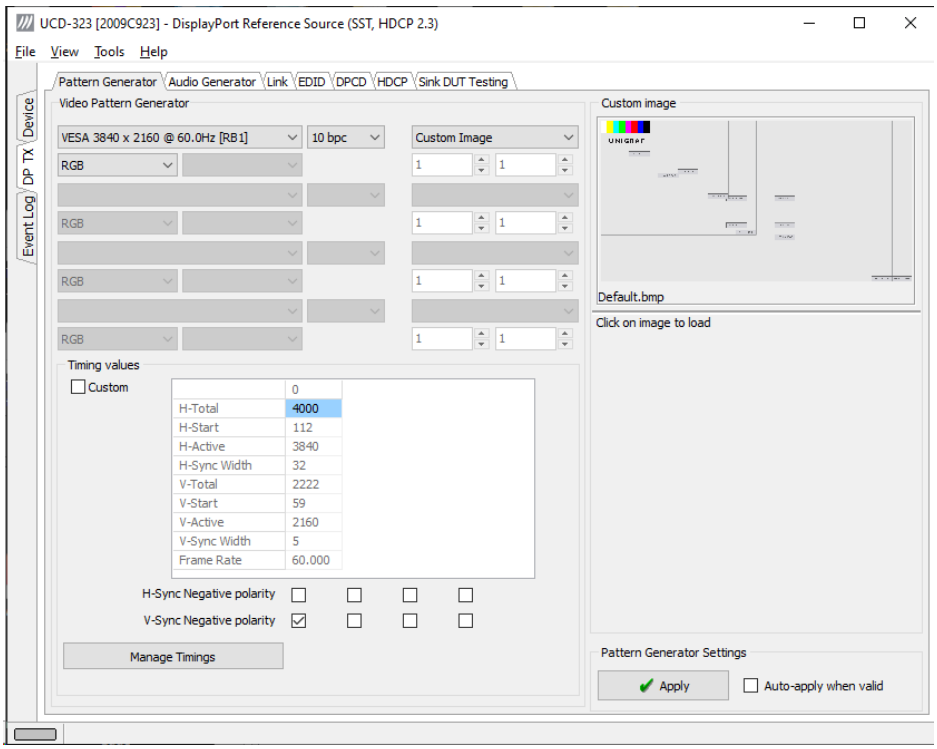
You can enable the DP Reference Source role either with or without the support to Multi-streaming (MST). The names of the roles are *DisplayPort Reference Source MST2* and *DisplayPort Reference Source SST*. The two roles have a slightly different pattern generator functionality.

Role	Features
DisplayPort Reference Source SST	Single stream only • 7 fixed patterns • 3 adjustable and 2 special patterns • Custom bitmap patterns • Deep color HDCP 1.3 and HDCP 2.3. support
DisplayPort Reference Source MST2	Up to two DP streams • 7 fixed patterns HDCP 1.3 and HDCP 2.3. support

Please find below Pattern Generator tab in *DisplayPort Reference Source MST2* mode.



Please find below Pattern Generator tab in *DisplayPort Reference Source SST* mode.



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-300 includes a set of common predefined video timings. Please find a list of the timings with their major details in Appendix C of this document.

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 Appendix D 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-300 has a set of predefined patterns and a possibility to user defined custom pattern. You can select the pattern in the provided combo box. By selecting **Disabled** you can have the links activated but no video data transferred.

Please find a description of the available test patterns in Appendix D of this document.

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

Custom Image Patterns

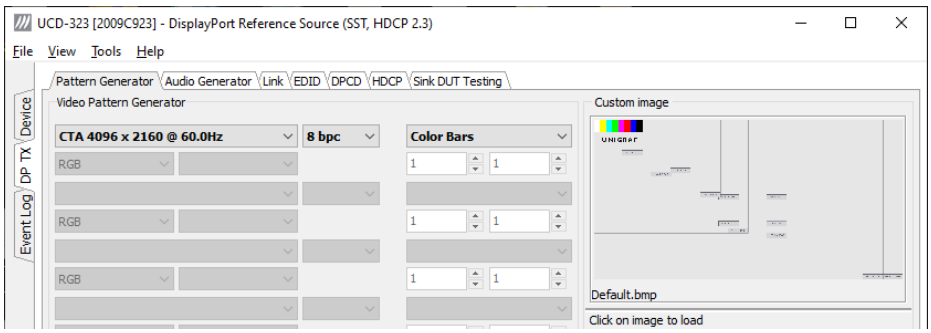
BMP, PNG, JPG and TIFF files can be loaded from the PC to be used as custom images. The bitmaps will be aligned to the top left hand side corner, displayed at the original resolution, no scaling, cropped to the active area. Select **Custom Image** pattern.

Enable / Disable Multistreaming

In *DisplayPort Reference Source MST2* mode you can switch between Single Stream and Multistream operation of the source with **MST** check box. When **MST** is selected you can define the number of streams enabled in **Number of streams**. Currently only up to 2 streams are supported.

Pattern Generator Settings

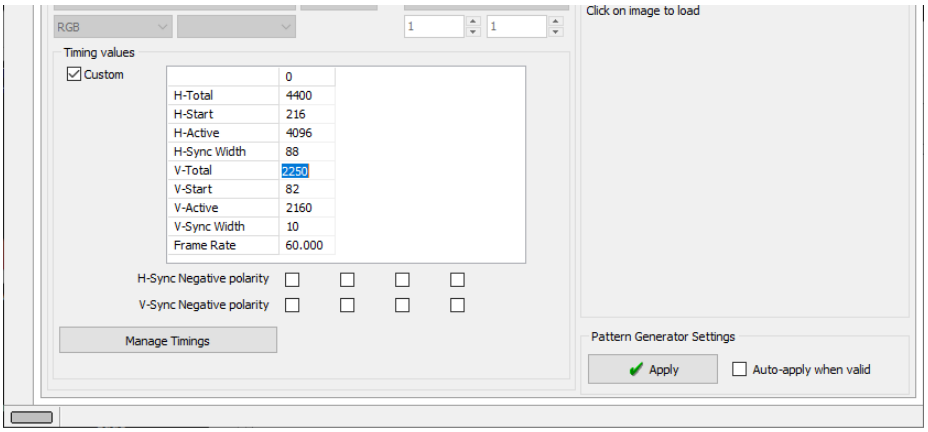
In order to avoid sourcing invalid video mode combinations, the new settings need to be validated by the user by clicking **Apply**. Automatic validation will be applied when **Auto-apply when valid** is checked. The situation that parameters have been changed but not applied is indicated by **bold values** of the parameter.



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

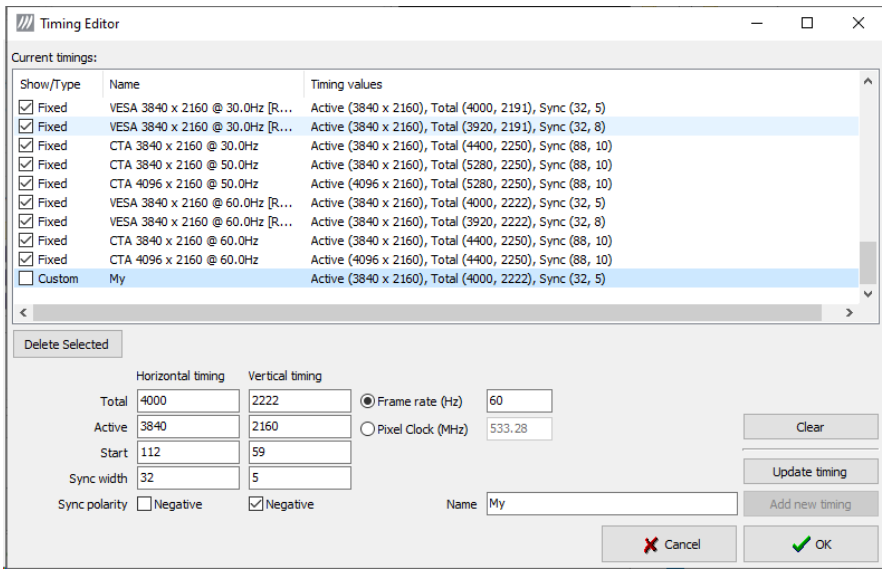
Custom Timing feature is enabled with *UCD Pro for DP Source* license.



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**.



- 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.**

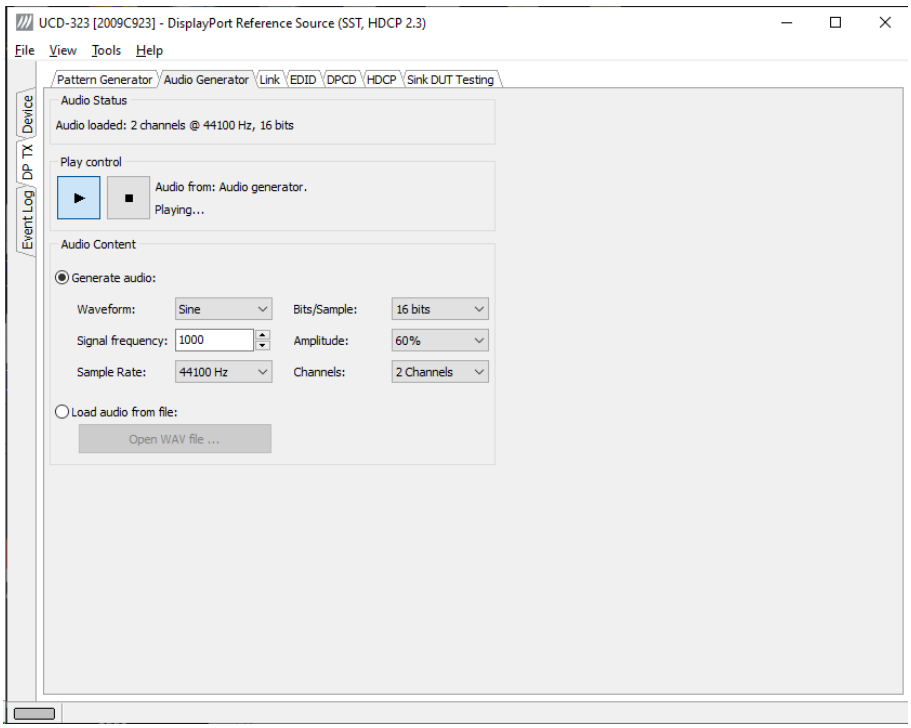
The dialog will make a sanity check for the values entered and will warn the user for any combinations that cannot be used.

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.

Audio Generator

Audio Generator tab is enabled by default.



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

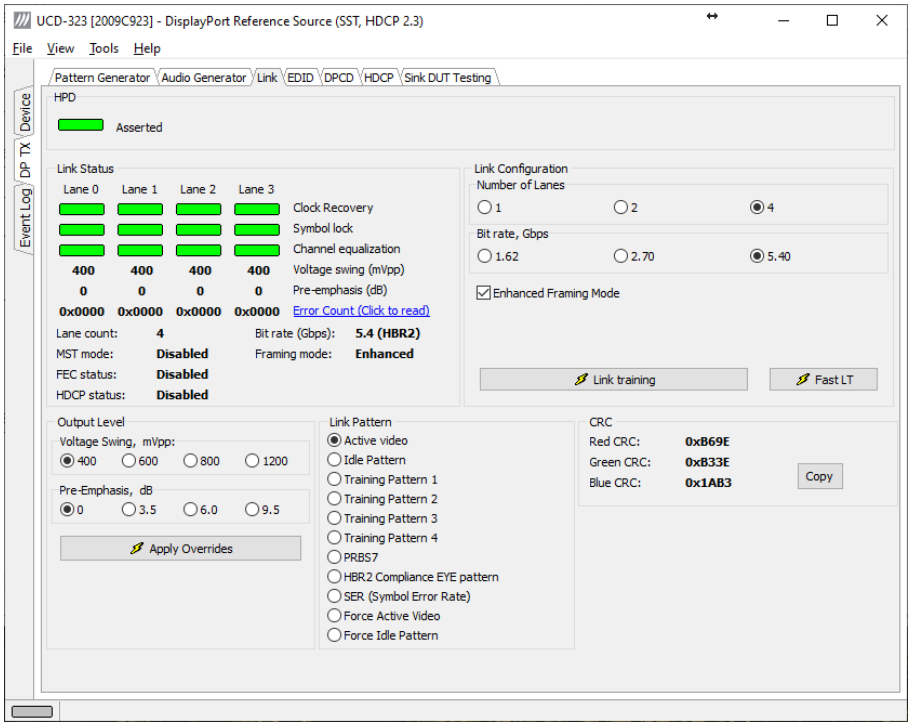
- To load internally generated audio, select **Generate audio**, and adjust the controls to the desired audio format.
- To load an audio file from your PC, select **Load audio from file**, click the **Open WAV file…** button, browse and select the file and click **Open**
- To play the selected audio 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 is enabled with *UCD Pro for DP Source* license. The 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 De-asserted (logical “low”).

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 maximum Link Rate,
- Enable Enhanced Framing Mode

Click **Fast LT** to initiate a link training without AUX transactions.

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 replug.

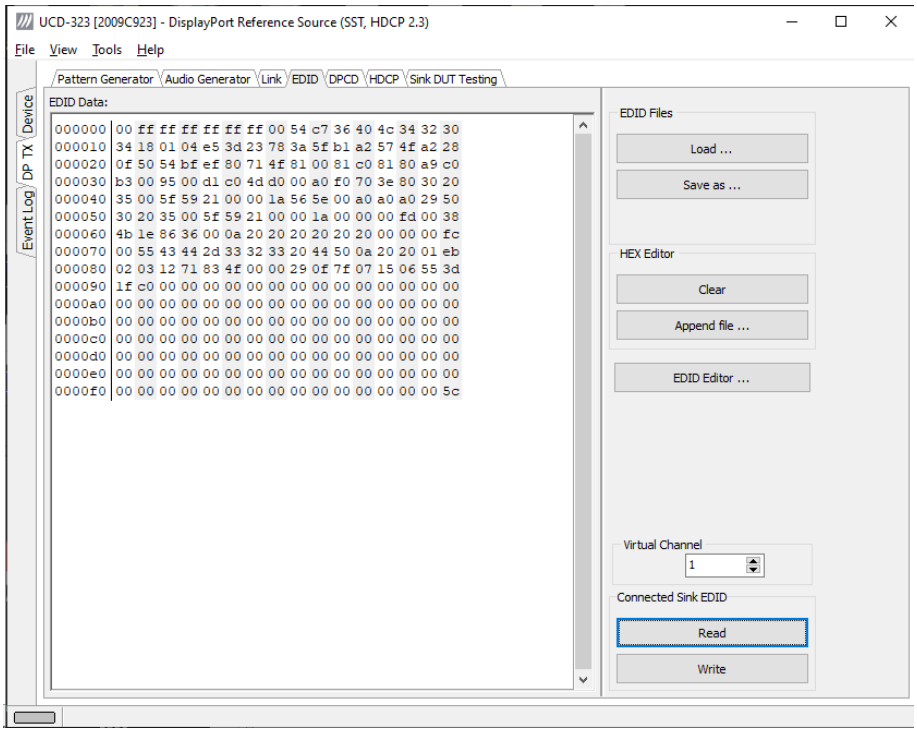
Note	Please note that except *Active video*, the patterns do not carry video and audio. They are special bit combinations used for development purposes. When selecting **Active Video** (or **Force Active Video**) normal audio and video are being transmitted over the link.

CRC

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

EDID Tab

EDID tab is enabled with *UCD Pro for DP Source* license.



EDID tab will enable 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

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

Note	Currently the EDID Editor does not support Display ID. You can however modify hex EDID files with the HEX Editor or load and program externally generated hex EDID files that have Display ID content.

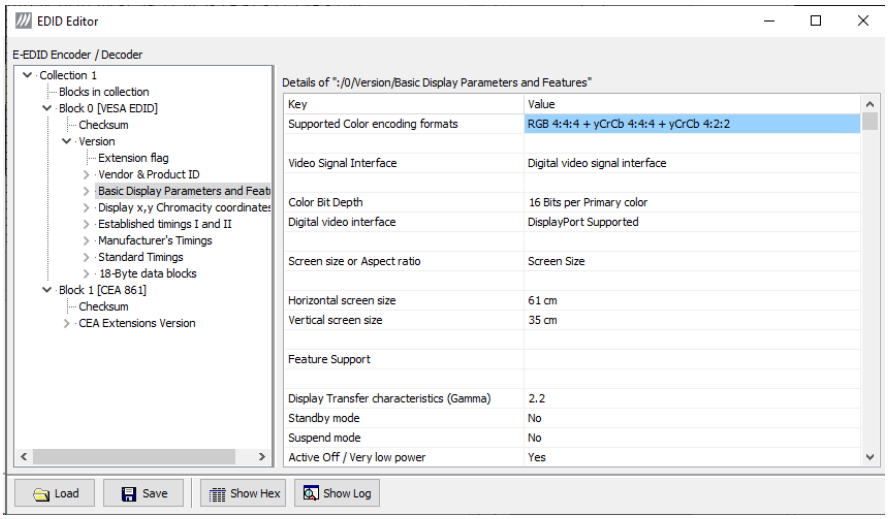
HEX Editor

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. You can edit the EDID contents by typing over the existing values. The 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.

Once you are done with editing the data, you can either save it to an *.ecd file in your PC with **Save as…** or program it to the hardware EDID memory with **Write**.

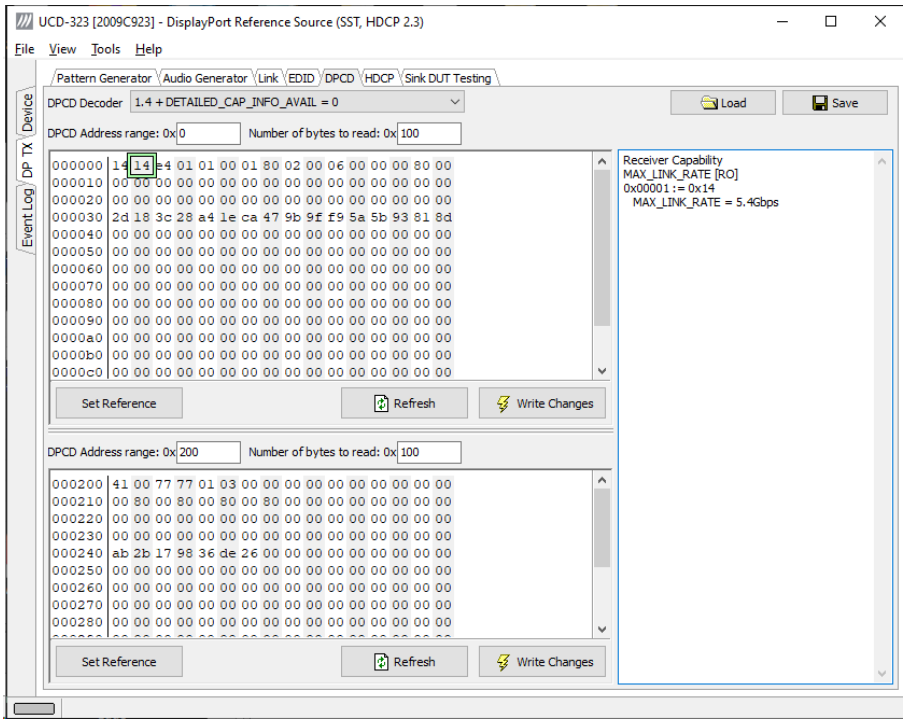
EDID Editor

You can edit the EDID structures of the data in the *HEX Editor* by clicking **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.



DPCD Tab

The DPCD tab is enabled with *UCD Pro for DP Source* license.



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

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).

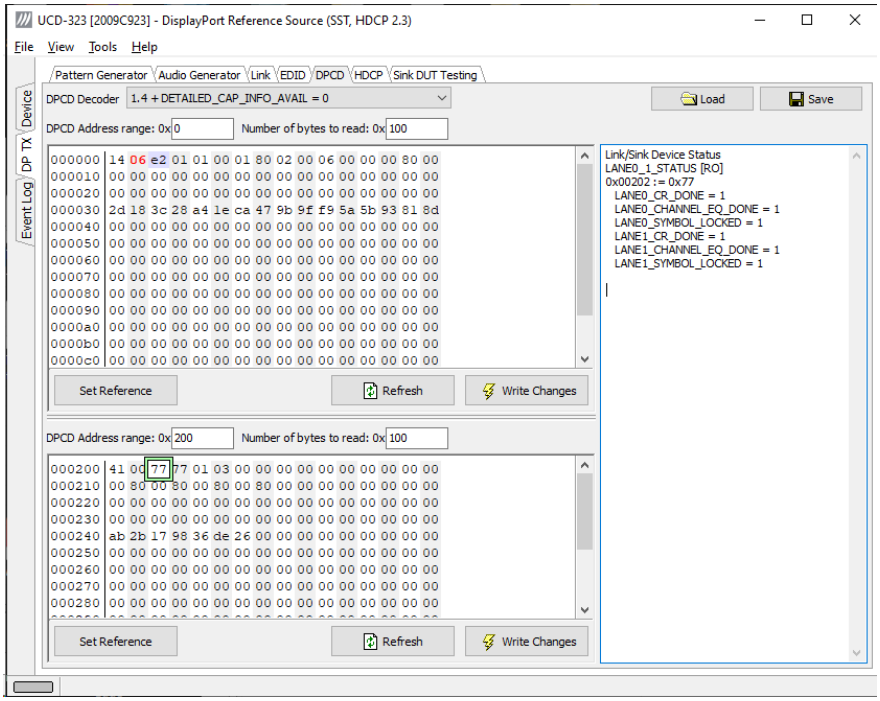
By clicking **Refresh** you can re-read the data from the DPCD registers to the window in question.

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.



Saving and Loading DPCD Content

You can save the DPCD data in the address areas that you selected for the two windows as a file in your PC. You can save the content in 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.

▶ By Clicking **Save** you will be able to select the location and the format of the file.

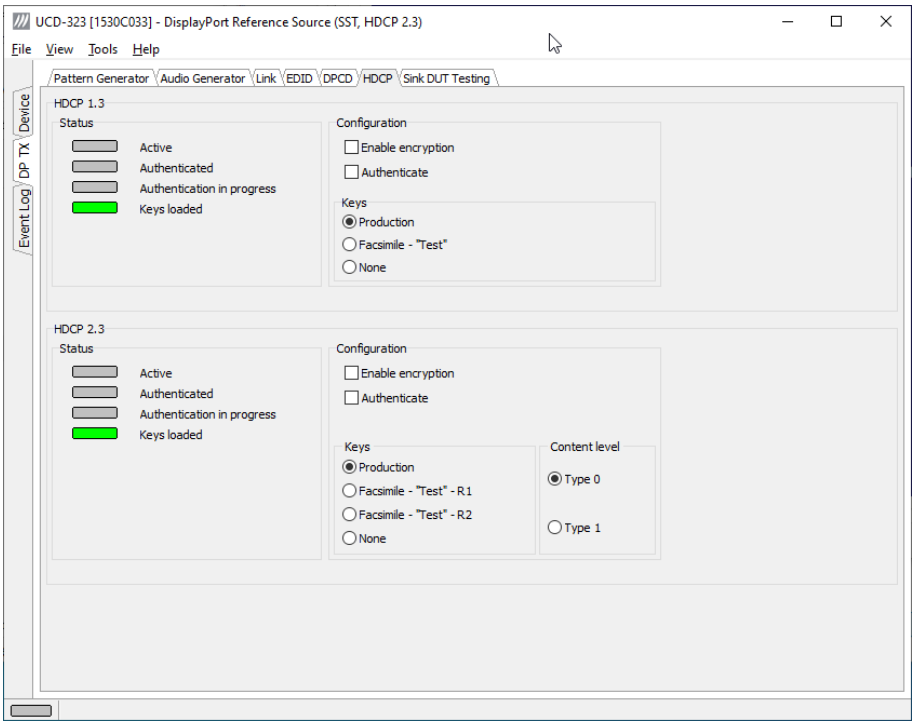
▶ By Clicking **Load** you can load DPCD data saved in *DPCD Data File* (*.DPD) format to the editor.

▶ In order to program the data into the DPCD registers of UCD-300 Local Sink click **Write Changes**.

Note	- 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 enabled with *UCD Pro for DP Source* license.



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-300 device.

Status

The status field indicate the HDCP status of the connected UCD-300 device.

Active: The stream between UCD-300 and the downstream sink has been encrypted.

Authenticated: The HDCP handshake between the UCD-300 and the sink unit has been completed successfully.

Authentication in process: The HDCP handshake is in process between the UCD-300 and the downstream sink unit.

Keys loaded: The HDCP keys are loaded to the UCD-300 unit.

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

Configuration

Authenticate: Perform the HDCP initiation handshake between the UCD-300 and the sink unit.

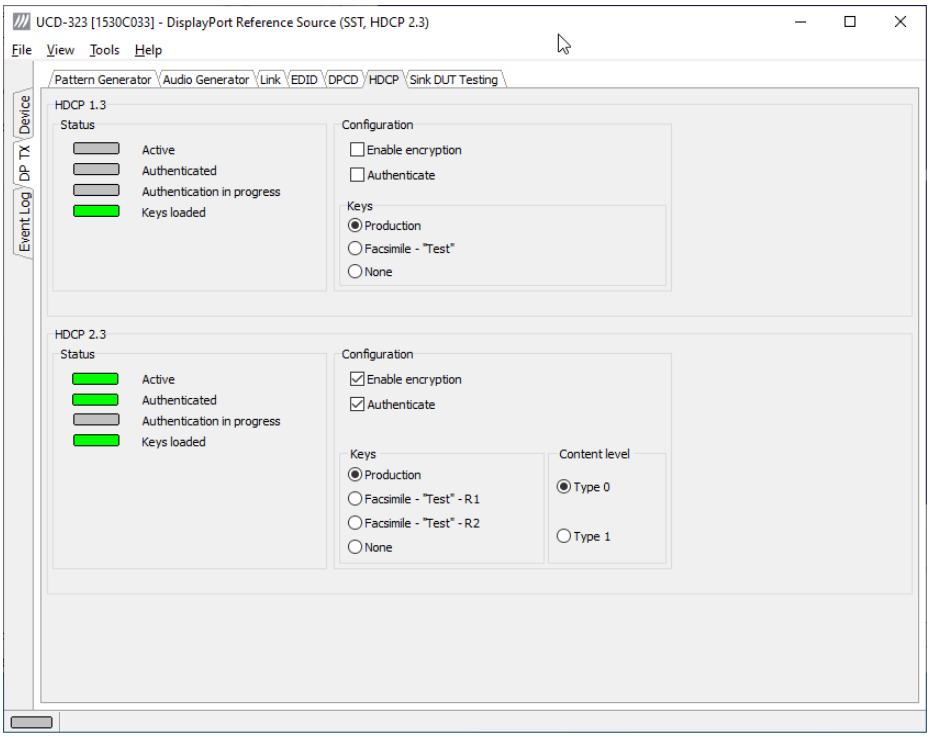
Enable encryption: Check to enable the encryption of the stream between UCD-300 and the downstream sink.

Keys

You can select if you are using *Production* or *Facsimile* HDCP keys. To remove the keys, select *None*.

HDCP 1.3 vs. HDCP 2.3

UCD-300 devices support by default HDCP 1.3 standard with DisplayPort. The functionality supporting HDCP 2.3 is enabled with *HDCP 2.3 Support* license.

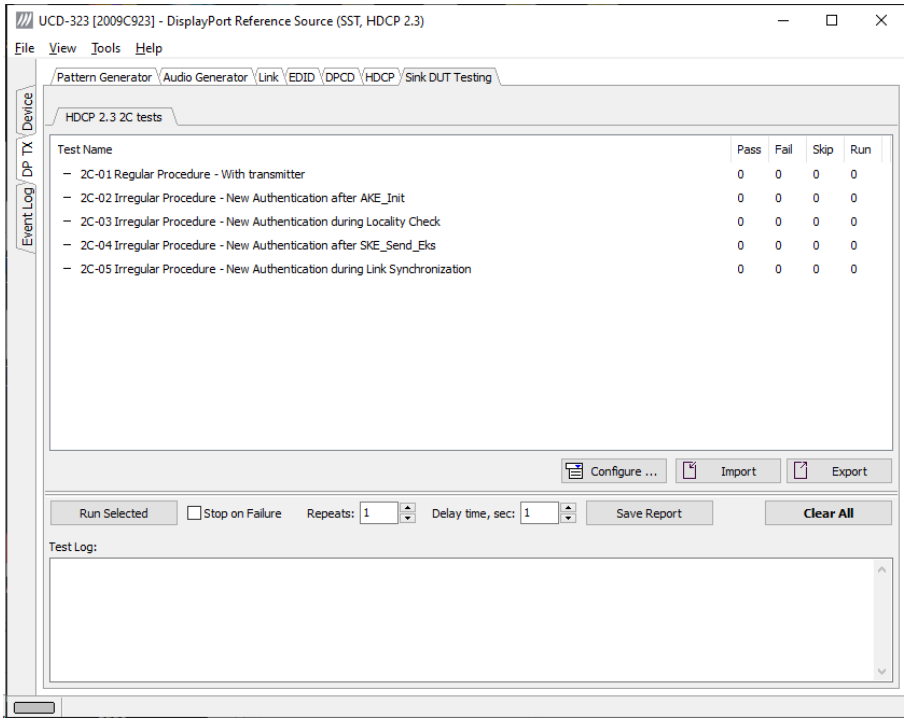


Sink DUT Testing Tab

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 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…**.

HDCP CTS Test Set

The HDCP Tests have test timeout as a given parameter.

Presets

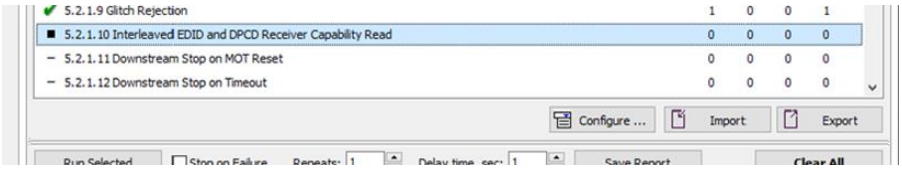
You can save the selected parameters as Presets. Please click **Presets…** to save your configuration. If you have saved configuration Presets, you can load one of the saved ones, save a new Preset or delete a Preset.

Click **Clear Results** to clear the result panel.

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.



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.

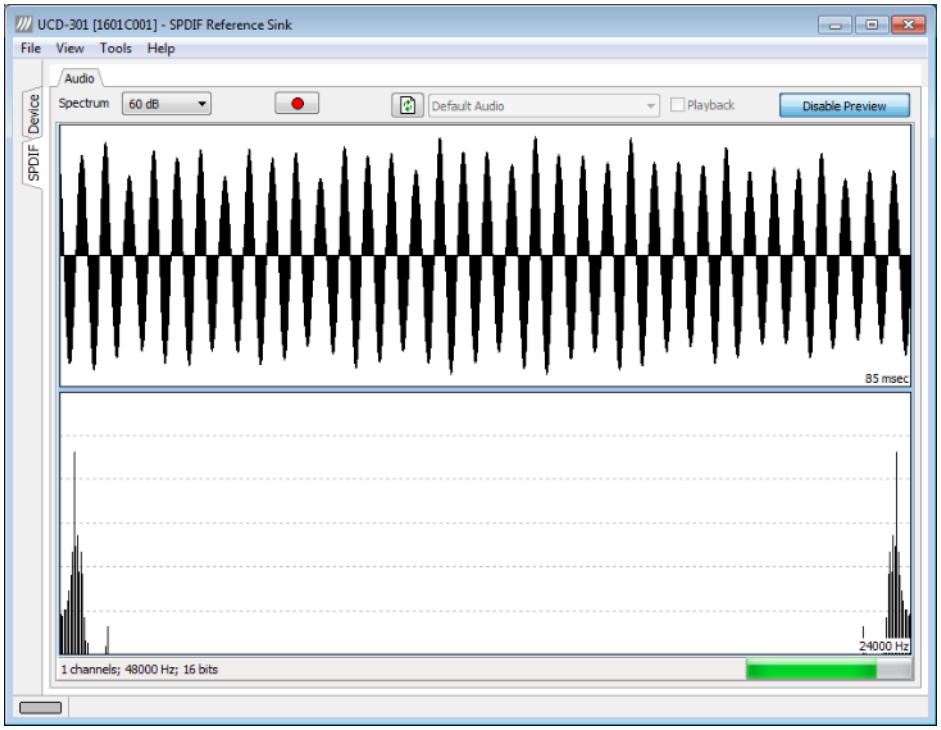
Import: Recall parameters from configuration file. If TSI Integration is enabled in Tools > Options, parameters are imported from a file in TSI workspace folder

11. S/PDIF REFERENCE SINK

S/PDIF Reference Sink function is available in *UCD-301 Digital*. In S/PDIF Reference Sink role the device is using one input channel, S/PDIF (SPDIF). The corresponding vertical tab can be seen on the left edge of the GUI.

This role contains only one tab:

- Audio monitoring and saving (Audio). *Enabled by default.*



Audio Tab

Audio tab is enabled by default. Audio tab has a preview of the audio signal format and the controls for audio playback and recording.

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 24 000 Hz. 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.

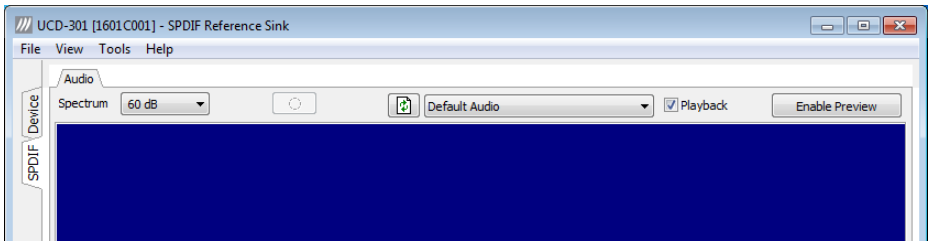
The span of the preview window is defined with **Audio preview size** found in Tools > Options dialog. The value is given in ksamples (1024 samples). The relation between the preview window span in milliseconds (msec) and the value given in *Audio preview* size depends on the sampling frequency. Please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

Disable / Enable Preview

Use this button to control capturing the audio data.

Playback device selection

You can enable audio playback in your PC by selecting the **Playback** check-box. Use the combo-box to select the audio device in the host PC through which the captured audio is played. By default, the *Default Audio* device of your PC is chosen. Please **Disable Preview** in order to make changes.



Note	Please note that the audio capabilities of the audio playback device of your PC are not automatically reflected in the audio capabilities description in UCD-300 EDID. Since UCD-300 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 in order to monitor the waveforms in UCD Console.

Refresh audio device list

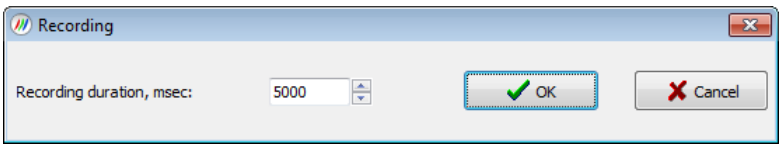
Click here to re-read the list of audio devices after making changes to the host PC configuration.

Audio Buffer Size

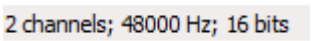
You can define the amount of buffering used in the data transfer between the UCD-300 unit and the PC. **Audio buffer size** can be found in Tools > Options dialog. Increased buffer size will ensure a smooth audio output, but will also increase the delay between the capture of the audio stream and its playback.

Start audio recording

Clicking the button you can start or stop recording the captured audio in the PC using WAVeform audio format (*.wav) format. In the pop-up dialog you can define the recording duration. The folder where the audio file will be saved can be selected in File > Options.



Input audio mode



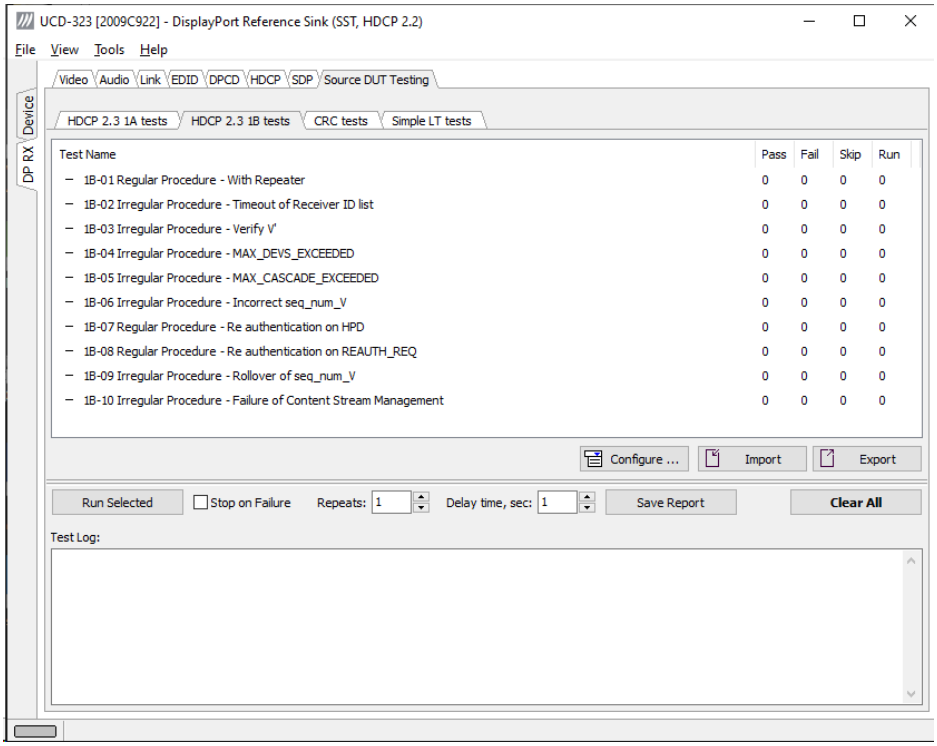
This field (in the bottom of the dialog) indicates detected audio mode in the input stream.

12. COMPLIANCE TESTS

Compliance test capability 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 *DP CTS Tool Options for Unigraf UCD-3XX.pdf*. 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.

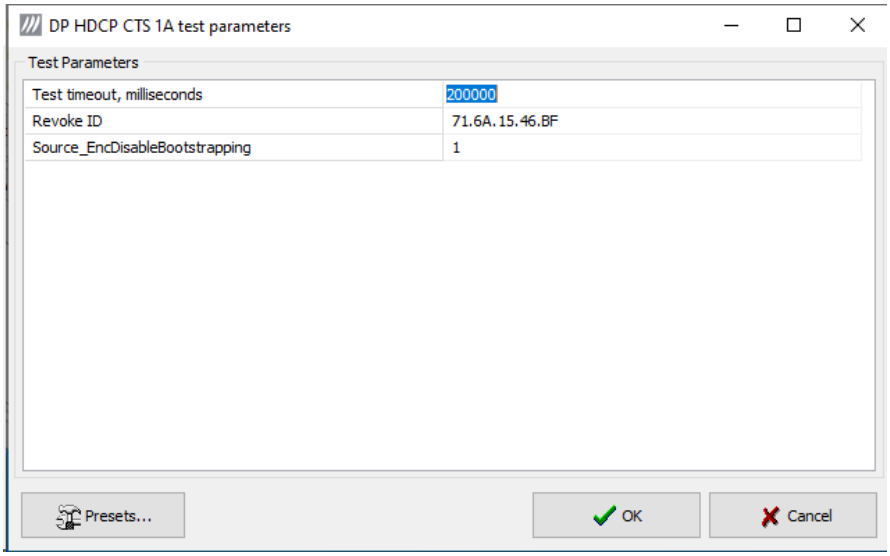
Compliance tests (CTS Tests) are part of tests included in **Source DUT Testing** tab of **DP RX** and **Sink DUT Testing** tab of **DP TX**.



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 *5 License Manager* earlier in this document.

Test Parameters

Before running the tests, capabilities of the DUT has to be defined 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.



For a detailed description of capabilities listed on the tab please refer to document *HDCP 2.3 on DisplayPort 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.

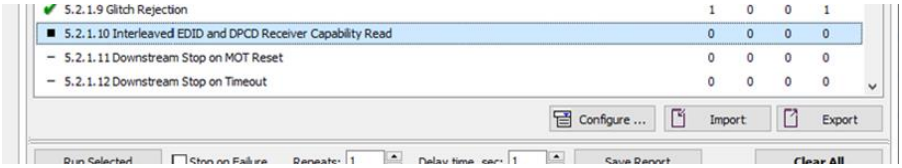
In *parameter dialog* the parameter set can be saved as an internal **Preset**.

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.

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.



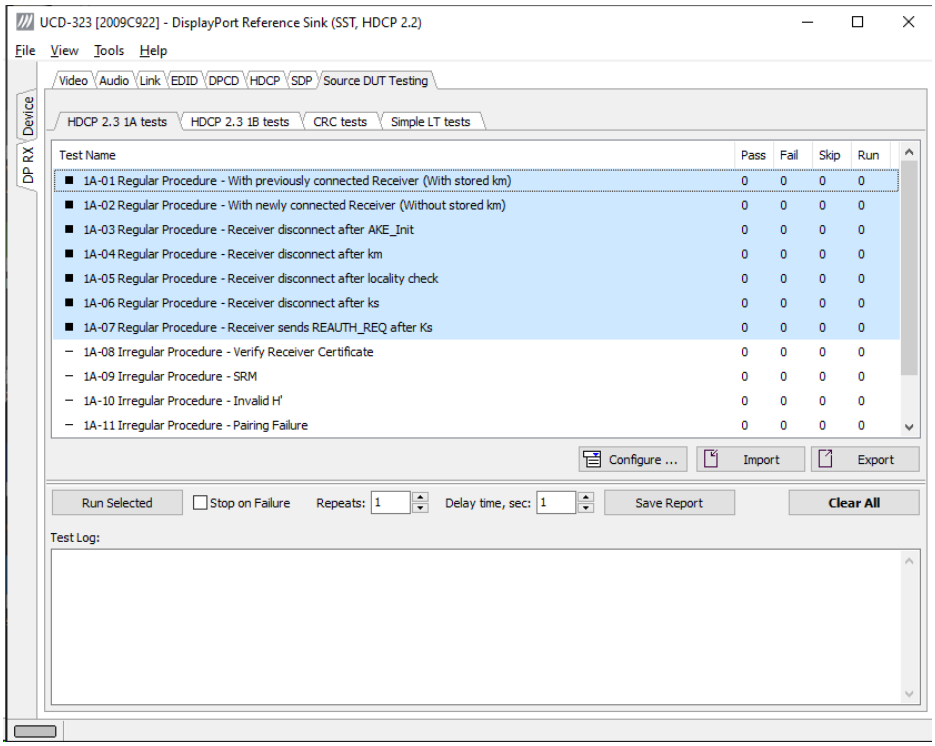
Export: Save parameters of the selected test to a file. If TSI Integration is enabled in Tools > Options, also the test is appended into 'Run Test' file in TSI workspace folder.

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

Running CTS Tests

Source DUT Testing 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-300 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.



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…**.

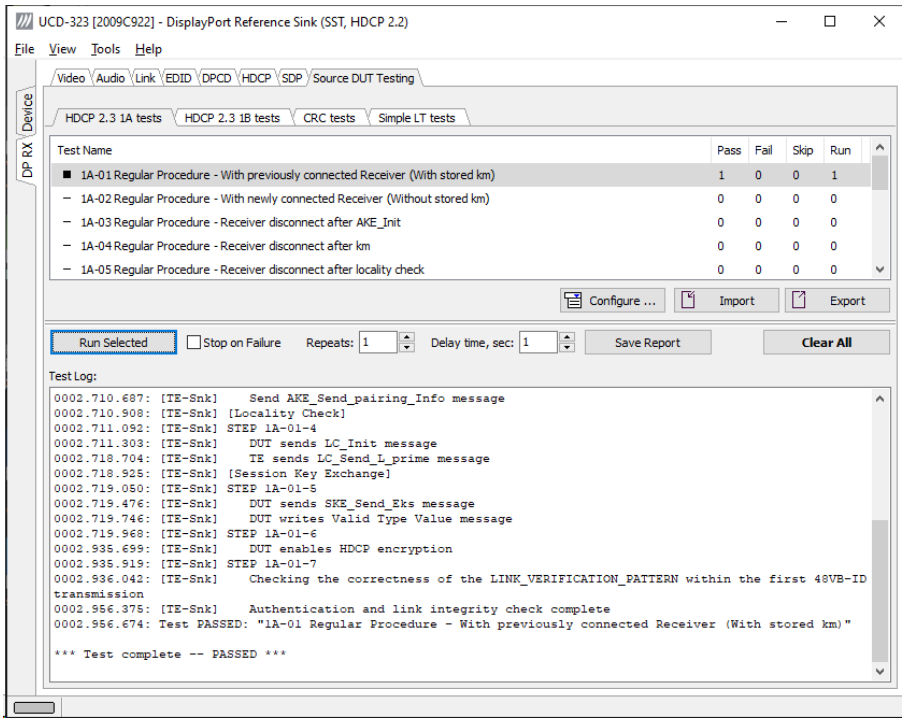
Selecting **Stop on Failure** stops execution of a series of tests in case a failure is found.

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

Evaluating CTS Test Results

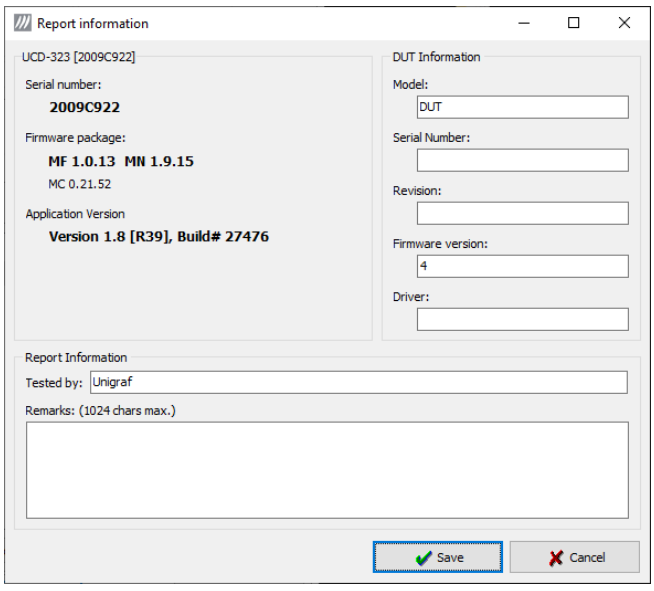
The test procedure advancement can be monitored in the *Test Log* panel. It describes the steps of each individual test in the way defined in the corresponding VESA Compliance Test Specification. Please use the Status Log and Specification side by side when interpreting the results.

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.



Test Report

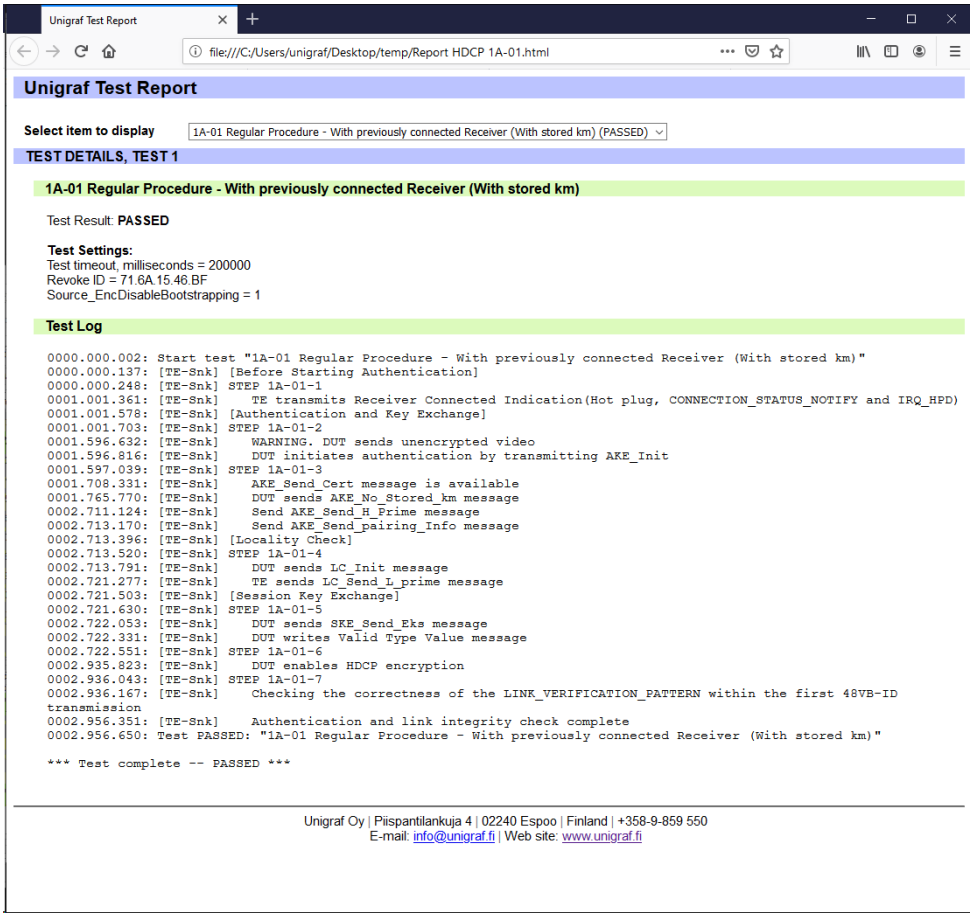
Results of the test can be saved as a report in HTML format.



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.

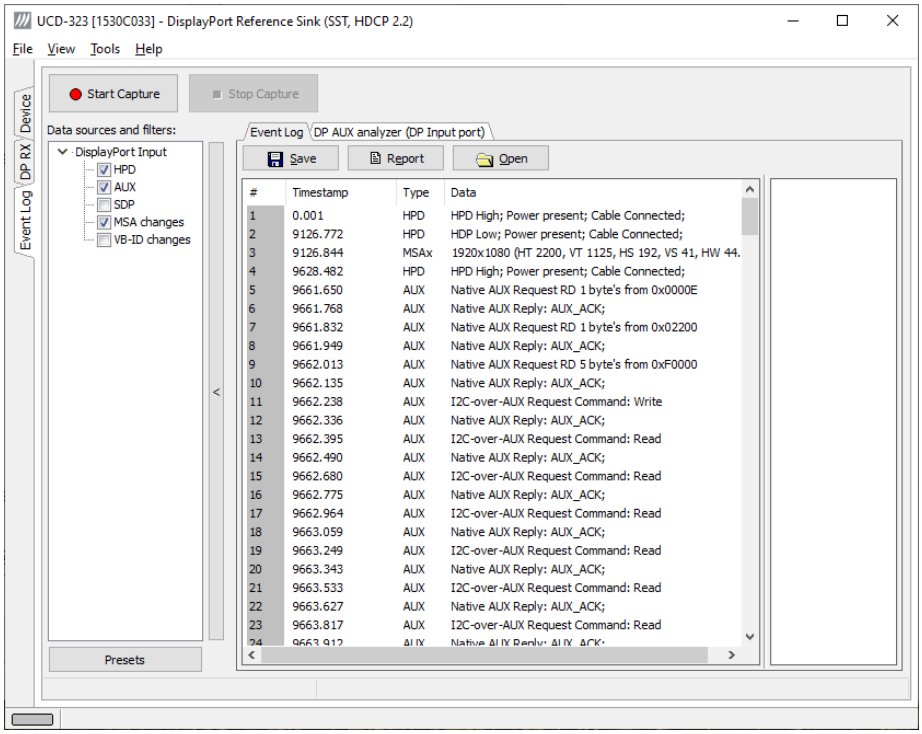
Viewing the CTS Test Report

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.



13. EVENT LOG

The *Event Logger* (Event Log) vertical tab can be seen on the left edge of the GUI. Event Log is enabled with *UCD Pro for HDMI Sink, UCD Pro for HDMI Source*, *UCD Pro for DP Sink* and *UCD Pro for DP Source* license.



Event Log dialog is divided into three panels: *Data sources and filters* panel on the left enables selection of the items to be logged. The selection of data sources is dependent on the role selected: DP Input, DP Output, HDMI Input, HDMI Output.

Data Source	HDMI Input	DP Input	HDMI Output	DP Output
HPD status	●	●	●	●
I2C transactions	●		●	
AUX transaction		●		●
HDMI InfoFrames	●			
DP SDP messages		●		
Changes in MSA		●		
Changes in VB-ID		●		

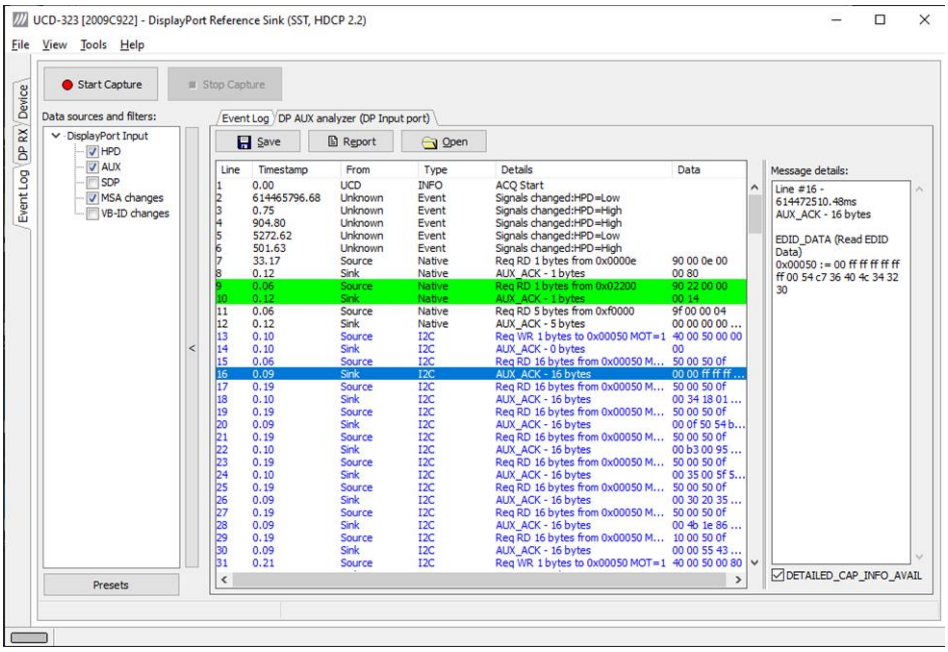
Transaction list in the center panel lists all transactions captured, and the right panel shows the parsed transaction data for the line selected in the center panel.

The transactions are with Time stamps, Type indications, 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.**
- You can save transactions in binary *.evt Event Log files by clicking **Save**. You can recall saved Event Log files by clicking **Open**.
- By clicking **Report** you can store event logs as html reports to be shared and viewed with any web browser. You are first asked to indicate the file name and location, then you can add detailed information about the DUT and the test in free-text *Report information*.

DP AUX Analyzer

DP AUX Analyzer functionality is enabled with *UCD Pro for DP Sink* and *UCD Pro for DP Source* license.



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.
- “**UCD-300**” for error and information lines.
- “**Unknown**” for signal state change events.

Type

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

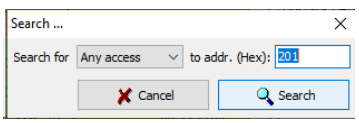
This column contains an abbreviated description of the line content in textual form.

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**.



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:

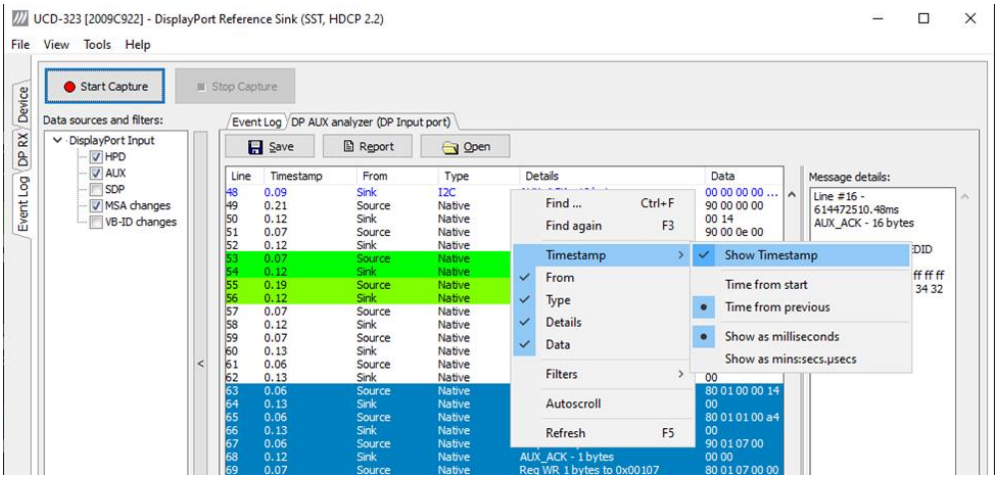
- All data bytes read or written.
- All DPCD memory locations affected.
- The name of the locations and of each of their bit fields.
- All bit field's numeric and binary values, together with their decoded value.
- The Replies outcome (AUX_ACK, AUX_NACK, I2C_DEFER, etc.).

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.

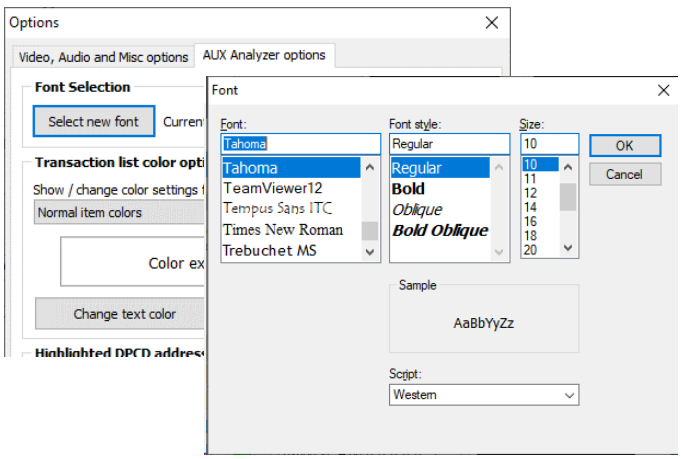
Selecting Data Columns

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.



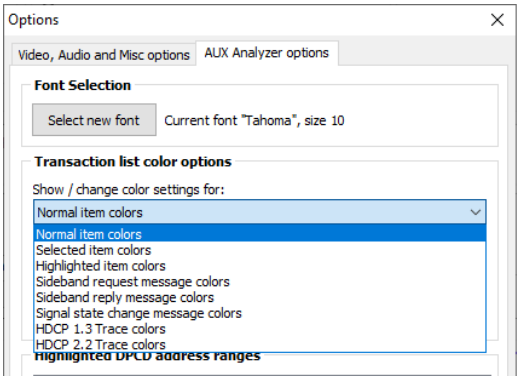
Selecting Font and Colors

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*.



Transaction List Color Options

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



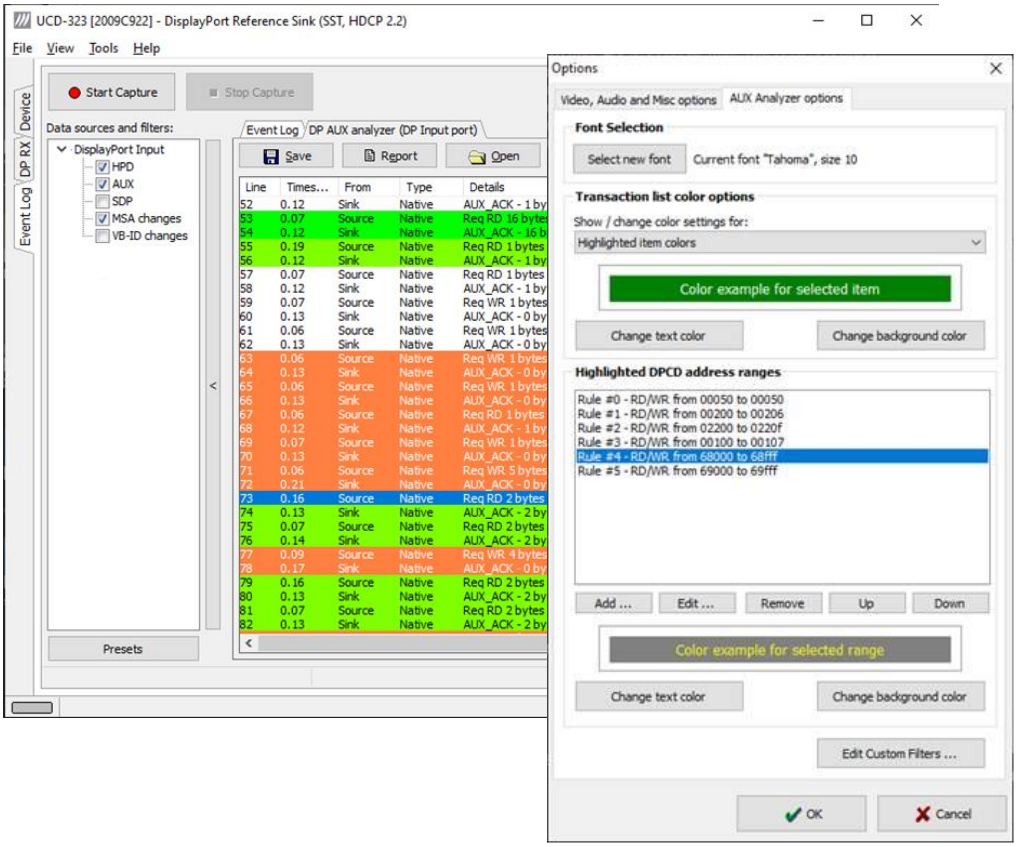
Highlighted DPCD Address Ranges

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.

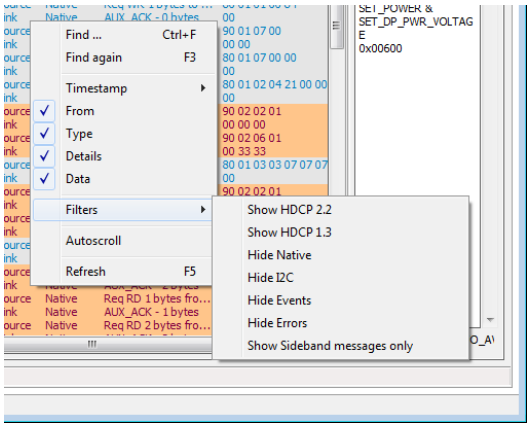


Filtering

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

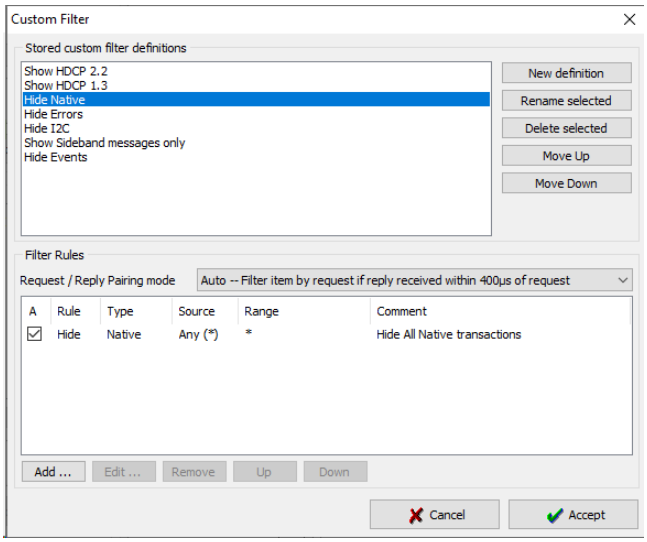
- The type of data line
- The origin of the message
- The DPCD address range

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



Editing Filters

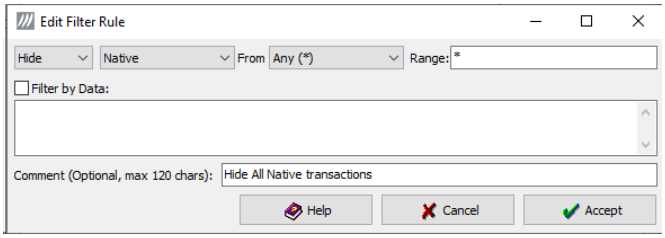
From *Custom Filter* dialog (Tools > Options > Edit Custom Filters …) allows for adding and modifying filters. The pre-programmed filters are listed in the dialog. Their structure can be copied as bases of your custom filters. It is advisable not to modify the pre-programmed filters directly but make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



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.



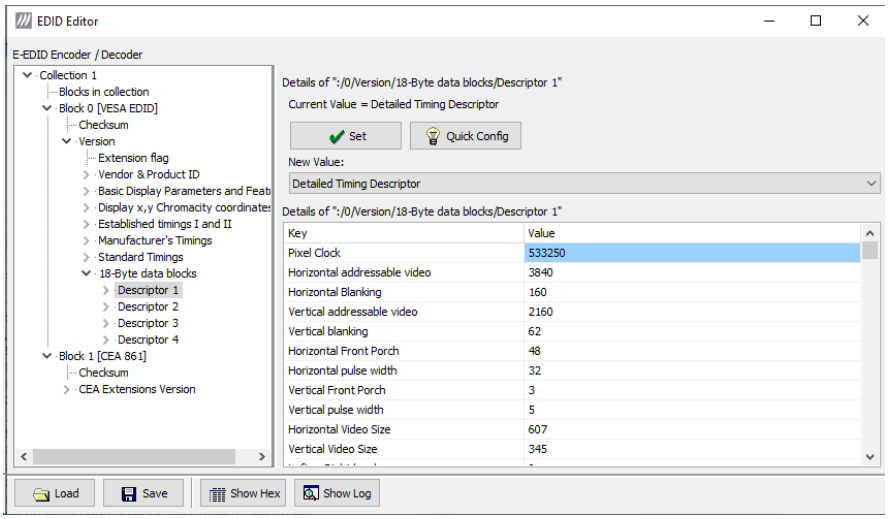
Click **Help** to show "Help" text also attached to Appendix F of this document.

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.

14. EDID EDITOR

The Main Window



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-323 HDDP Dual

Inputs	DisplayPort™ 1.4a compliant with HBR2 max bit rate (DP in) HDMI 2.0 compliant (HDMI in)
Outputs	DisplayPort™ 1.4a compliant with HBR2 max bit rate (DP out) HDMI 2.0 compliant (HDMI out)
Max video mode	4096 × 2160 p60 input and output
Audio	LPCM, 2 – 8 channels, 44.1 to 192 kHz
Features	DisplayPort Tx supports Link Training with LT-Tunable PHY Repeaters
Computer interface	USB 3.0 and USB 2.0
Software	Windows 10, 8 and 7 compatible software driver UCD Console application for Windows Compatible with Unigraf TSI
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
Mechanical Size	281 × 128 × 62 mm
Weight	0.9 kg w/o power supply

UCD-301 Digital

Inputs	DisplayPort™ 1.4a compliant with HBR2 max bit rate HDMI 2.0 compliant S/PDIF audio (192 kHz max)
Max video mode	4096 × 2160 p60 input
Audio	LPCM, 2 – 8 channels, 44.1 to 192 kHz
Electrical Test	Verify electrical continuity of input signals
Computer interface	USB 3.0 and USB 2.0
Software	Windows 10, 8 and 7 compatible software driver UCD Console application for Windows Compatible with Unigraf TSI
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
Mechanical Size	281 × 128 × 62 mm
Weight	0.9 kg w/o power supply

All specifications are subject to change without notice.

APPENDIX B. LICENSING

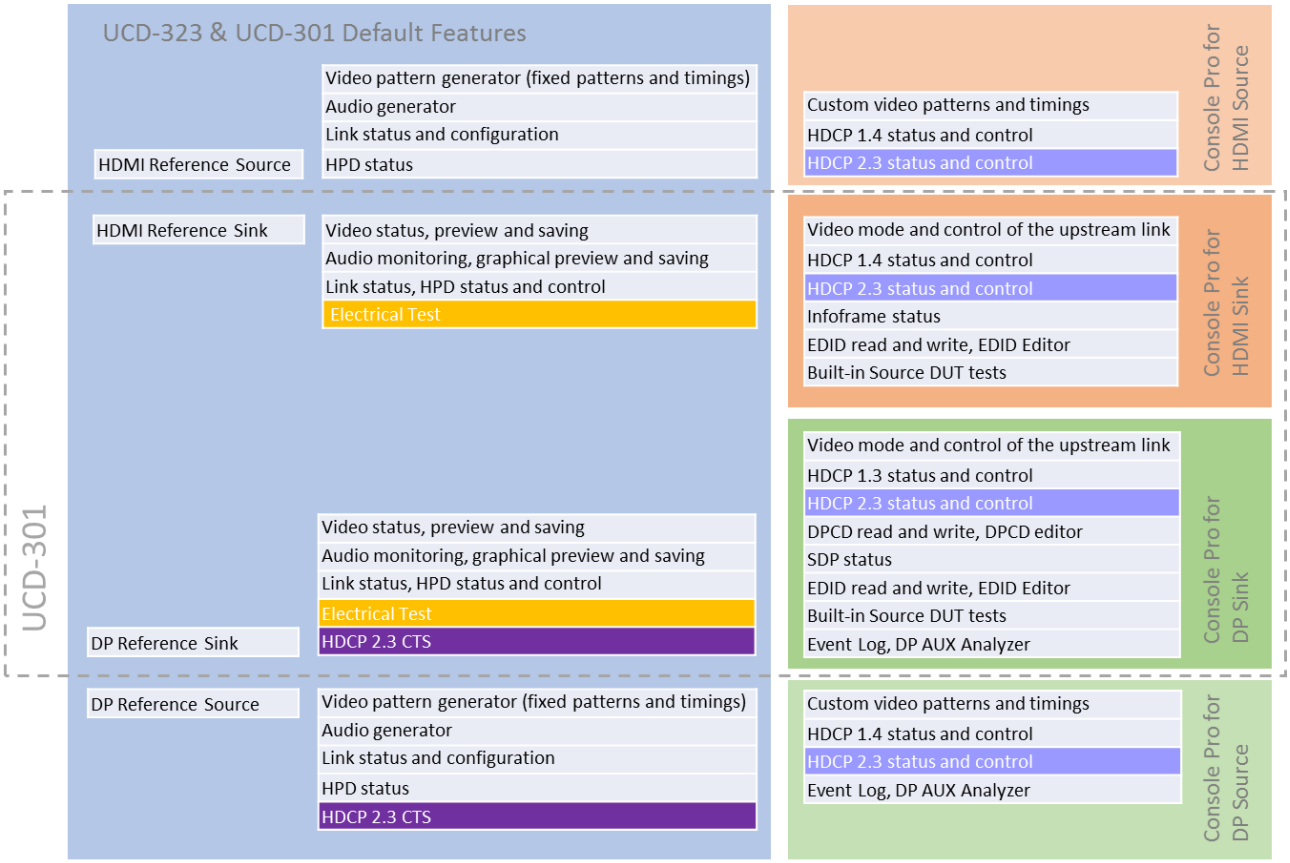
The table below lists all functions in UFG-323 and UCD-301 devices and their licensing.

Overview

Input / Output Role	Tab	Default	Pro License	HDCP 2.3	HDCP 2.3 CTS	TSI Basic (default)	TSI Advanced	Electrical Test
HDMI Reference Sink (HDMI RX)	Video preview and saving (Video).	●	●			▲	▲	
	Audio monitoring and saving (Audio).	●	●			▲	▲	
	Status information of the upstream link (Link).	●	●			▲	▲	
	EDID editor (EDID).		●				▲	
	HDCP status monitor and control (HDCP)		●	●			▲	
	InfoFrames		●				▲	
	Source DUT Testing		●				▲	▲
	Electrical Test							▲
DisplayPort Reference Sink (DPRX)	Video preview and saving (Video).	●	●			▲	▲	
	Audio monitoring and saving (Audio).	●	●			▲	▲	
	Status information of the upstream link (Link).	●	●			▲	▲	
	Video mode and control of the upstream link (Link).		●				▲	
	EDID editor (EDID).		●				▲	
	DPCD editor (DPCD).		●				▲	
	HDCP status monitor and control (HDCP)		●	●			▲	
	Source DUT Testing		●		■		▲	▲
	Event Log, DP AUX Analyzer		●					
HDMI Reference Source (HDMI TX)	Video pattern generator (Pattern Generator).	●	●			▲	▲	
	Audio generator	●	●					
	Status information of the downstream link (Link).	●	●					
	Control of the downstream link (Link)		●					
	EDID editor (EDID).		●					
	HDCP status monitor and control (HDCP)		●	●				
DisplayPort Reference Source (DPTX)	Video pattern generator (Pattern Generator).	●	●			▲	▲	
	Audio generator	●	●					
	Status information of the downstream link (Link).	●	●			▲	▲	
	Control of the downstream link (Link)		●					
	EDID editor (EDID).		●					
	HDCP status monitor and control (HDCP)		●	●				
	Sink DUT Testing				■			
	Event Log, DP AUX Analyzer		●					
SPDIF Reference Sink (SPDIF)	Audio monitoring and saving (Audio).	●						

In the following pages, please find detailed explanation of the functions and the licensing. Please refer to TSI documentation on detailed description of TSI features.

Features in UCD-323 and UCD-301



Electrical Test	Available in UCD-301 Digital (P/N 066510) with TSI Electrical Test Set (P/N MT6502) license
HDCP 2.3 status and control	Available with HDCP 2.3 support (P/N MT6504) license
HDCP 2.3 CTS	Available with HDCP 2.3 CTS for testing Source on DP DUT (P/N MT6634) or HDCP 2.3 CTS for testing Sink on DP DUT (P/N MT6636) license

Features Available in UCD-323 and UCD-301 with Default Feature Set

		Console Basic	Basic TSI API
HDMI Reference Sink	Video status, preview and saving	■	⚙
	Audio monitoring, graphical preview and saving	■	⚙
	Link status, HPD status and control	■	⚙
	Electrical Test*	□	⚙
DP Reference Sink	Video status, preview and saving	■	⚙
	Audio monitoring, graphical preview and saving	■	⚙
	Link status, HPD status and control	■	⚙
	Electrical Test*	□	⚙
	HDCP 2.3 CTS **	□	⚙
HDMI Reference Source	Video pattern generator (fixed patterns and timings)	■	⚙
	Audio generator	■	
	Link status and configuration	■	
	HPD status	■	
DP Reference Source	Video pattern generator (fixed patterns and timings)	■	⚙
	Audio generator	■	
	Link status and configuration	■	⚙
	HPD status	■	
	HDCP 2.3 CTS **	□	⚙
SPDIF Reference Sink	Audio monitoring, graphical preview and saving	■	

*) Available in *UCD-301 Digital* (P/N 066510) with *TSI Electrical Test Set* (P/N MT6502) license

**) Available with *HDCP 2.3 CTS for testing Source on DP DUT* (P/N MT6634) or *HDCP 2.3 CTS for testing Sink on DP DUT* (P/N MT6636) license

■	□	Feature available in UCD Console
⚙	⚙	Feature available in TSI SDK and API

Features Available in UCD-323 and UCD-301 with Console Pro Feature Set *

		Console Pro *	TSI Advanced *
HDMI Reference Sink	Video status, preview and saving	✓	✓
	Audio monitoring, graphical preview and saving	✓	✓
	Link status, HPD status and control	✓	✓
	HDCP 1.4 status and control	✓	✓
	HDCP 2.3 status and control ***	○	✓
	Infoframe status	✓	✓
	EDID read and write, EDID Editor	✓	✓
	Built-in Source DUT tests (ARC, CEC, CRC tests)	✓	✓
	Electrical Test **	○	✓
DP Reference Sink	Video status, preview and saving	✓	✓
	Audio monitoring, graphical preview and saving	✓	✓
	Link status, HPD status and control	✓	✓
	Video mode and control of the upstream link	✓	✓
	HDCP 1.3 status and control	✓	✓
	HDCP 2.3 status and control ***	○	✓
	DPCD read and write, DPCD editor	✓	✓
	Infoframe status	✓	✓
	EDID read and write, EDID Editor	✓	✓
	Built-in Source DUT tests (LT test, CRC tests)	✓	✓
	Electrical Test **	○	✓
	HDCP 2.3 CTS ****	○	✓
	Event Log, AUX Analyzer	✓	
HDMI Reference Source	Video pattern generator (fixed patterns and timings)	✓	✓
	Custom video patterns and timings	✓	✓
	Audio generator	✓	
	Link status and configuration	✓	✓
	HPD status	✓	✓
	HDCP 1.4 status and control	✓	✓
	HDCP 2.3 status and control ***	○	✓

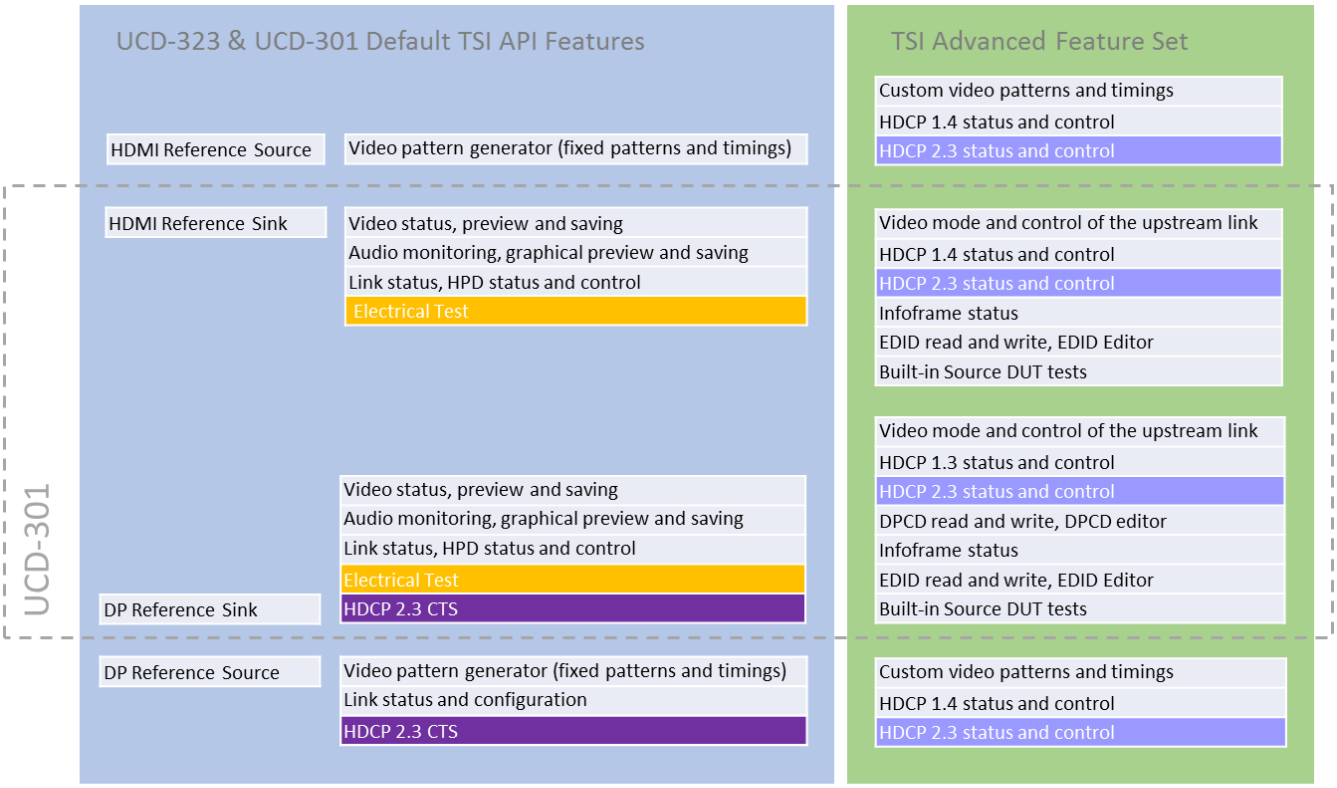
contd. …

DP Reference Source	Video pattern generator (fixed patterns and timings)	📁	⚙
	Custom video patterns and timings	📁	⚙
	Audio generator	📁	
	Link status and configuration	📁	⚙
	HPD status	📁	⚙
	HDCP 1.4 status and control	📁	⚙
	HDCP 2.3 status and control ***	🗀	⚙
	HDCP 2.3 CTS ****	🗀	⚙
	Event Log, AUX Analyzer	📁	
SPDIF Reference Sink	Audio monitoring, graphical preview and saving	📁	

*) *Console Pro* can be enabled with each interface (DP / HDMI; Sink / Source) separately. *TSI Advanced* feature is delivered with *Console Pro* feature.
**) Available in *UCD-301 Digital* (P/N 066510) with *TSI Electrical Test Set* (P/N MT6502) license
***) Available with *HDCP 2.3 support* (P/N MT6504) license
****) Available with *HDCP 2.3 CTS for testing Source on DP DUT* (P/N MT6634) or *HDCP 2.3 CTS for testing Sink on DP DUT* (P/N MT6636) license

📁	🗀	Feature available in UCD Console
⚙	⚙	Feature available in TSI SDK and API

TSI API Features in UCD-323 and UCD-301



Electrical Test	Available in UCD-301 Digital (P/N 066510) with TSI Electrical Test Set (P/N MT6502) license
HDCP 2.3 status and control	Available with HDCP 2.3 support (P/N MT6504) license
HDCP 2.3 CTS	Available with HDCP 2.3 CTS for testing Source on DP DUT (P/N MT6634) or HDCP 2.3 CTS for testing Sink on DP DUT (P/N MT6636) license

Features Available in UCD-323 and UCD-301 with TSI Advanced Test Set (P/N MT6501)

		Console Basic	TSI Advanced
HDMI Reference Sink	Video status, preview and saving	■	■
	Audio monitoring, graphical preview and saving	■	■
	Link status, HPD status and control	■	■
	Video mode and control of the upstream link		■
	HDCP 1.4 status and control		■
	HDCP 2.3 status and control **		■
	Infoframe status (ARC, CEC, CRC tests)		■
	EDID read and write, EDID Editor	■	■
	Built-in Source DUT tests (ARC, CEC, CRC tests)		■
	Electrical Test *	□	■
DP Reference Sink	Video status, preview and saving	■	■
	Audio monitoring, graphical preview and saving	■	■
	Link status, HPD status and control	■	■
	Video mode and control of the upstream link		■
	HDCP 1.3 status and control		■
	HDCP 2.3 status and control **		■
	DPCD read and write, DPCD editor	■	■
	SDP status		■
	EDID read and write, EDID Editor	■	■
	Built-in Source DUT tests (LT test, CRC tests)		■
	Electrical Test *	□	■
	HDCP 2.3 CTS ***	□	■
HDMI Reference Source	Video pattern generator (fixed patterns and timings)	■	■
	Custom video patterns and timings		■
	Link status and configuration	■	■
	HPD status	■	■
DP Reference Source	Video pattern generator (fixed patterns and timings)	■	■
	Custom video patterns and timings		■
	Link status and configuration	■	■
	HPD status	■	■
	HDCP 2.3 CTS ***	□	■
SPDIF Reference Sink	Audio monitoring, graphical preview and saving	■	

*) Available in *UCD-301 Digital* (P/N 066510) with *TSI Electrical Test Set* (P/N MT6502) license
**) Available with *TSI SDK Advanced Test Set with HDCP 2.3 support* (P/N MT6516) license
***) Available with *HDCP 2.3 CTS for testing Source on DP DUT* (P/N MT6634) or *HDCP 2.3 CTS for testing Sink on DP DUT* (P/N MT6636) license

■ □ Feature available in UCD Console

■ ■ Feature available in TSI SDK and API

APPENDIX C: PREDEFINED TIMINGS

DisplayPort Sink and Source Capability (RGB)

Description	TSI*	H active	V active	H total	V total	Frame rate	RGB 4:4:4				
							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	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	●	●			

DisplayPort Sink and Source Capability (YCbCr)

Description	TSI*	H active	V active	H total	V total	Frame rate	YCbCr 4:2:0 (bpc)				YCbCr 4:2:2 (bpc)			
							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	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	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	●	●	●	●	●	●	●	

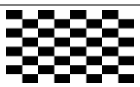
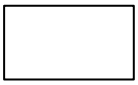
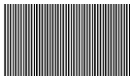
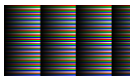
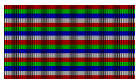
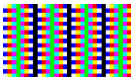
HDMI Sink and Source Capability (RGB and YCbCr)

Description	TSI*	H active	V active	H total	V total	Frame rate	YcbCr 4:2:0 (bpc)				YCbCr 4:2:2	4:4:4 (bpc)			
							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	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	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 video mode and color depth (● HDMI 1.4a, ■ HDMI 2.0)

*) TSI Timing ID

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			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 AND SOURCE DUT TESTS

The tables below list the Unigraf TSI SDK Test Cases that you can run in *Sink DUT Testing* / *Source DUT Testing* tabs of UCD Console, their definition in *TSI Reference Manual* and the licensing needed.

Source DUT Testing		Pro License	DP HDCP 2.3 CTS*	Electrical Testing
Electrical Test Set (UCD-301) HDMI RX				
	Power test (`TSI_TEST_HDMI_EL_POWER_LINE`)			✓
	TMDS test (`TSI_TEST_HDMI_EL_TMDS_LINES`)			✓
	HPD test (`TSI_TEST_HDMI_EL_HPD_LINE`)			✓
	DDC and CEC test (`TSI_TEST_HDMI_EL_DDC_CEC_LINES`)			✓
Electrical Test Set (UCD-301) DP RX				
	HPD test (TSI_TEST_DP_EL_HPD_LINE)			✓
	Main Link test (TSI_TEST_DP_EL_MAIN_LINK)			✓
	AUX test (TSI_TEST_DP_EL_AUX_LINE)			✓
CEC functional Test Set HDMI RX				
	CEC functional test (`TSI_TEST_HDMI_CEC`)	✓		
CRC based Video Test Set				
	CRC based single frame reference video test (`TSI_TEST_VIDEO_CRC_SINGLE_REF`)	✓		
	CRC based single frame stability test (`TSI_TEST_CRC_VIDEO_STABILITY`)	✓		
	CRC based sequence of frames reference video test (`TSI_TEST_CRC_VIDEO_SEQUENCE`)	✓		
Link Test Set DP RX				
	Link Training at All Supported Lane Counts and Link Rates (`TSI_TEST_DP_SIMPLE_LINK`)	✓		
HDCP 2.3 CTS 1A Test Set DP RX	HCDP2.3 CTS 1A-01 – HCDP2.3 CTS 1A-13		✓	
HDCP 2.3 CTS 1B Test Set DP RX	HCDP2.3 CTS 1B-01 – HCDP2.3 CTS 1B-10		✓	

Sink DUT Testing		DP HDCP 2.3 CTS*
HDCP 2.3 CTS 2C Test Set DP TX		
	HCDP2.3 CTS 2C-01 – HCDP2.3 CTS 2C-06	✓

*) Separate licenses for testing Sink and Source DUT

Electrical Test Set – HDMI Rx

Electrical Tests verify the continuity of the interface signals and the voltage levels applied by the driving electronics.

Power Test

Power Test verifies the voltage level on the +5 V power line (Pin 18) of the DUT source. The accepted value in HDMI specification is 4.7 V to 5.3 V on the sink side connector. (Called "TP2" in the HDMI specification).

The test will measure the power line voltage using two loads: 0 mA and 55 mA. The latter is the test setup in HDMI CTS specification (HDMI CTS 1.4b: Test ID 7-11: +5V Power). The test will fail if voltage level on the power line is below or above the voltage range set by the parameters.

Parameters in use

- Test Timeout (default 5 000 ms)
- Power line low voltage limit (default 4 700 mV)
- Power line high voltage limit (default 5 300 mV)

TMDS Test

TMDS Test verifies average voltage levels on TMDS signal lines (8 lines: CLK+/-, D0+/- D1+/- and D2+/-). The positive and negative lines of the TMDS differential pair are measured separately.

TMDS uses DC balanced signaling. Sink pulls the lines up to 3.3 V (AVcc) and source applies the TMDS signal by pulling the line down to ground. On an active TMDS line average voltage level is half of the voltage swing below AVcc (AVcc – Vswing/2). By default, 2.6 V to 3.1 V.

TMDS line voltages outside of the above range might indicate an abnormal situation like short circuit of two TMDS lines, short to ground, open circuit or a broken output driver.

If the measured values fall outside the criteria set by the parameters, test result is FAIL.

Note:	Fail criteria for each test set-up should be considered separately depending on the source DUT and test cable configuration.

Parameters in use

- Test Timeout (default 5 000 ms)
- Main link low voltage limit (default 2 600 mV)
- Main link high voltage limit (default 3 100 mV)

HPD Test

HPD Test verifies HPD line (pin 19) for short circuits to power or ground.

The test runs in two steps:

Step 1. HPD line is driven to logical low state and after a delay voltage level is measured. If the measured value is outside the limits set by the parameters for "zero" voltage minimum and maximum the test result is FAIL. The judgement is "Short to ground" or "Short to power" depending if the measured value is below the allowed window, or above it.

Step 2. HPD line is driven to logical high state and after a delay voltage level is measured. If the measured value is outside the limits set by the parameters for "one" voltage minimum and maximum the test result is FAIL. The judgement is "Short to ground" or "Short to power" depending if the measured value is below the allowed window, or above it.

Parameters in use

- Test Timeout (default 5 000 ms)
- HPD line logical zero low voltage limit (default -50 mV)
- HPD line logical zero high voltage limit (default 400 mV)
- HPD line logical one low voltage limit (default 2 400 mV)
- HPD line logical one high voltage limit (default 5 300 mV)

DDC and CEC Test

DDC and CEC Test verifies voltage level of SCL (pin 15), SDA (pin 16) and CEC (pin 13) lines. HPD signal is driven low to de-activate any transmission in the tested lines. After a delay of 100 ms voltage level is measured in the three signal lines.

If the measured voltage levels are outside the limits set by the parameters, the test result is FAIL.

- Test Timeout (default 5 000 ms)
- DDC lines low voltage limit (default 4 500 mV)
- DDC lines high voltage limit (default 5 500 mV)
- CEC line logical zero low voltage limit (default -50 mV)
- CEC line logical zero high voltage limit (default 600 mV)
- CEC line logical one low voltage limit (default 2 500 mV)
- CEC line logical one low voltage limit (default 3 600 mV)

Electrical Test Set – DP Rx

Electrical Tests verify the continuity of the interface signals and the voltage levels applied by the driving electronics.

HPD Test

HPD Test verifies HPD line for short circuits to power or ground.

The test runs in two steps:

Step 1. HPD line is asserted to logical high state and after a delay voltage level is measured. If the measured value is outside the limits set by the parameters for “one” voltage minimum and maximum the test result is FAIL. The judgement is “Short to ground” or “Short to power” depending if the measured value is below the allowed window, or above it.

Step 2. HPD line is de-asserted to logical low state and after a delay voltage level is measured. If the measured value is outside the limits set by the parameters for “zero” voltage minimum and maximum the test result is FAIL. The judgement is “Short to ground” or “Short to power” depending if the measured value is below the allowed window, or above it.

Parameters in use

- Test Timeout (default 5 000 ms)
- HPD line logical zero low voltage limit (default -100 mV)
- HPD line logical zero high voltage limit (default 799 mV)
- HPD line logical one low voltage limit (default 2 000 mV)
- HPD line logical one high voltage limit (default 3 600 mV)

Main Link Test

The test utilizes a dedicated microchip to determine the power of DP Main Link input signal. The test verifies that the measured values lies within the window defined by provided parameters.

The measured values provide a relative voltage value that depends on the signal waveform and selected pre-emphasis and voltage swing. The values do not represent any absolute value, e.g. input signal voltage level.

“No signal” level is initially set to 2.3V. Note that even a disconnected line will give a relatively high value. Good signal levels are expected to be within range 2.6 V to 4.0 V. The allowed voltage window should be set separately for each device model after testing of several units.

Measured values are expected to be close to each other within a differential pair. Also, all main link differential pair measurements should produce a value close to each other if link training result is the same for all pairs.

Measurement results are given in volt, but this is only the voltage level of power measurement circuitry output and does not relate to the actual input signal. The positive and negative lines of main link differential pairs are measured separately.

Note	The measured values provide a relative voltage value that depends on the signal waveform and selected pre-emphasis and voltage swing. The values do not represent any absolute value, e.g. input signal voltage level.

Parameters in use

- Test Timeout (default 5 000 ms)
- Main link low voltage limit (default 2 600 mV)
- Main link high voltage limit (default 4 000 mV)
- Maximum lanes count supported by DUT (default 0)
- Maximum data rate supported by DUT in 0.27 Gbps (default 0)

AUX Test

The test verifies voltage levels on AUX lines, and AUX connectivity to DUT.

The test verifies two issues:

1. The idle AUX voltage level is measured and compared to provided parameters. The voltages are expected to match values defined by resistor dividers set by connected DisplayPort sink and source devices.

2. The TE creates a short HPD pulse to have the DUT to generate an AUX request. The DUT is expected to read DPCD register address range 0x200 – 0x205. Test captures the sync sequence of the AUX transaction and verifies the unit interval timings.

The test is first done to AUX- line and then to AUX+ line.

Parameters in use

- Test Timeout (default 5 000 ms)
- AUX+ line idle low voltage limit (default 2 400 mV)
- AUX+ line idle high voltage limit (default 3 600 mV)
- AUX– line idle low voltage limit (default 2 400 mV)
- AUX– line idle high voltage limit (default 3 600 mV)
- AUX+ line signal trigger low level (default 150 mV)
- AUX+ line signal trigger high level (default 200 mV)
- AUX– line signal trigger low level (default 200 mV)
- AUX– line signal trigger high level (default 5 mV)
- AUX signal capture timeout (default 4 ms)
- AUX signal capture attempts (default 20 times)

CEC Functional Test Set – HDMI Rx

CEC Functional Test

TE verifies that source DUT correctly handles an HPD event, reads the sink EDID and broadcasts a CEC “Report physical address” message.

First, the TE allocates the physical address provided as a parameter and issues an HPD pulse simulating cable detach/attach. After that the TE waits for DUT to broadcast the CEC “Report physical address” message.

The test is considered passed if DUT sends a correct “Report physical address” message.

Note:	The default physical address in UCD-300 EDID is 1:0:0:0. In order to simulate a change in the address, please use another address range

Note:	As a side effect, the CEC will also verify functionality of HPD and EDID reading if the test passes.

Parameters in use

- Test Timeout (default 5 000 ms)
- Local CEC physical address (default 4.0.0.0)

CRC Based Video Test Set – HDMI & DP Rx

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 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.