UCD-323 Gen2
UCD-323
UCD-301

User Manual
UCD Console SW Version 3.9

UNIGRAF

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Edition

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CE Mark

UCD-300 family 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 User Manual of UCD-301, UCD-323 and UCD-323 Gen2, USB-connected video interface test units for use with a PC with Windows® 11, Windows® 10 or Windows® 8 operating system.

The purpose of this guide is to

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

Product and Software Version

This manual explains features found in UCD Console Software Bundle **3.5.** 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

Note:	This version of the User Manual describes features in UCD Console software version 2 based on the functionality in Microsoft Windows operating system. UCD Console is available also for macOS operating system to be used in iMac and MacBook computers and for Linux operating system. Detailed description of the macOS and Linux versions will be added later.

2. INTRODUCTION

Product Description

UCD-300 family are high speed, USB 3.0 connected video interface test unit. UCD-300 series consists of the following units:

UCD-301	DisplayPort 1.4 and HDMI 2.0 analyzer
UCD-323	HDMI 2.0 and DisplayPort 1.4a (limited to HBR2) video generator and analyzer for Dolby and HDR10+ testing
UCD-323 Gen2	HDMI 2.0 and DisplayPort 1.4a (limited to HBR2) video generator and analyzer. UCD-323 Gen2 is a companion tool for PHY test equipment to perform automated DP 2.0 PHY compliance testing for Source and Sink DUTs.

UCD Console is user interface (GUI) for UCD family test equipment for desktop use. The outlook and details of UCD Console will vary depending on the capabilities of the connected unit and will reflect the features enabled.

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

UCD-301

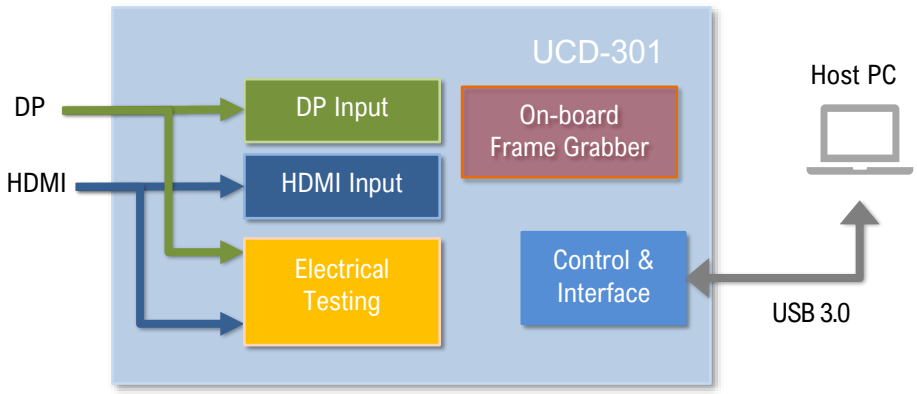
Product Features

- UHD / 4K@60Hz compliant video analyzer for testing DisplayPort™ and HDMI Sources.
- Enables testing all aspects of HDMI 2.0 and DP 1.4a with HBR2 max bit rate capability.
- High resolution video and audio capture up to up to 4K / UHD 60 Hz
- 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

Functional Description

UCD-301 units consist of a multimedia signal input stage, a control stage with on-board frame buffer and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format. The Interface and Control stages are either passing the captured data directly to the USB interface or storing it to the frame buffer. 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-301 unit



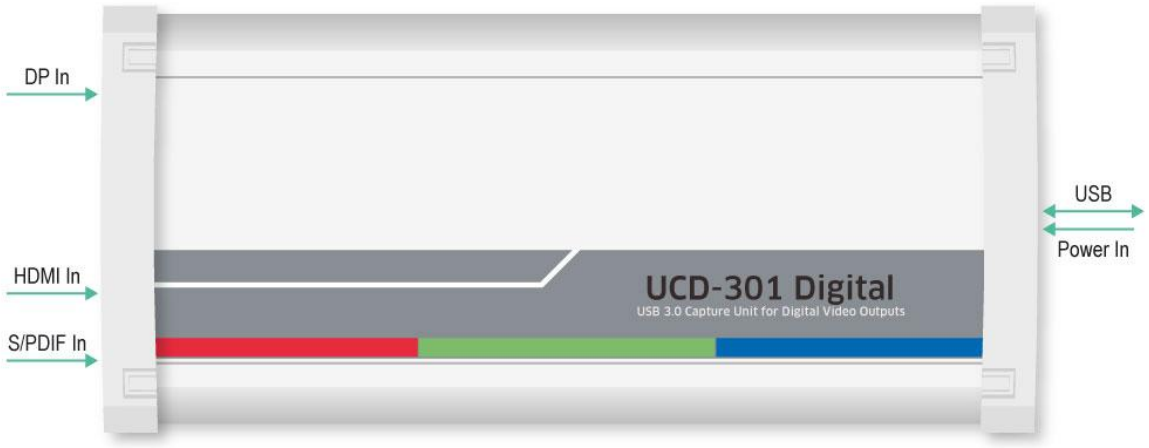
Delivery Content

UCD-301 product shipment contains:

- The UCD-301unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output), System input: 12Vdc, 3A
- USB 3.0 compliant cable

Connections

The image below indicates the connections in UCD-301 unit and their description



Name	Description
DP In	DisplayPort 1.4 compliant input from the upstream Source
HDMI In	HDMI 2.0 compliant input from the upstream Source
S/PDIF In	Test input for ARC Function
Power In	+12 Vdc Power Supply Input
USB	USB 3.0 connection to the host PC

UCD-323 and UCD-323 Gen2

Product Features

- UHD / 4K@60Hz compliant video generator and analyzer for testing DisplayPort™ and HDMI sinks and sources.
- Enables testing all aspects of HDMI 2.0 and DP 1.4a with HBR2 max bit rate capability.
- High resolution video and audio capture an generation up to up to 4K / UHD 60 Hz
- Compatible with HDCP versions 1.3 / 1.4 and 2.2 / 2.3
- 4 GB on-board 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-323 units consist of a multimedia signal input stage, an internal pattern generator, a control stage with on-board frame buffer and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format.

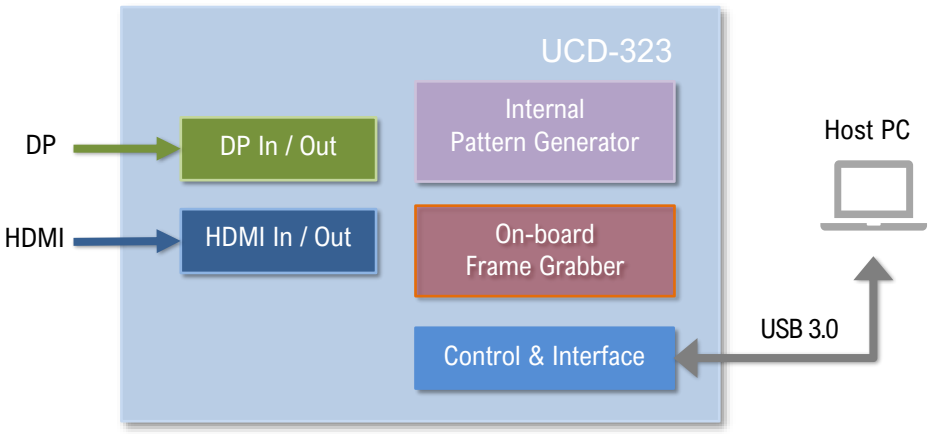
The Interface and Control stages are either passing the captured data directly to the USB interface or storing it to the frame buffer.

The internal pattern generator is able to source a signal for testing sink and branch units. The Interface & Control stages are receiving instructions from the host PC to configure and control the functionality of the unit.

UCD-323 Gen2 • AUX Controller for PHY CTS

UCD-323 Gen2 is a companion tool for PHY test equipment to perform automated DP 2.0 PHY compliance testing for Source and Sink DUT. AUX controller is supported using Unigraf TSI API.

Please find below logical diagram of UCD-323 unit



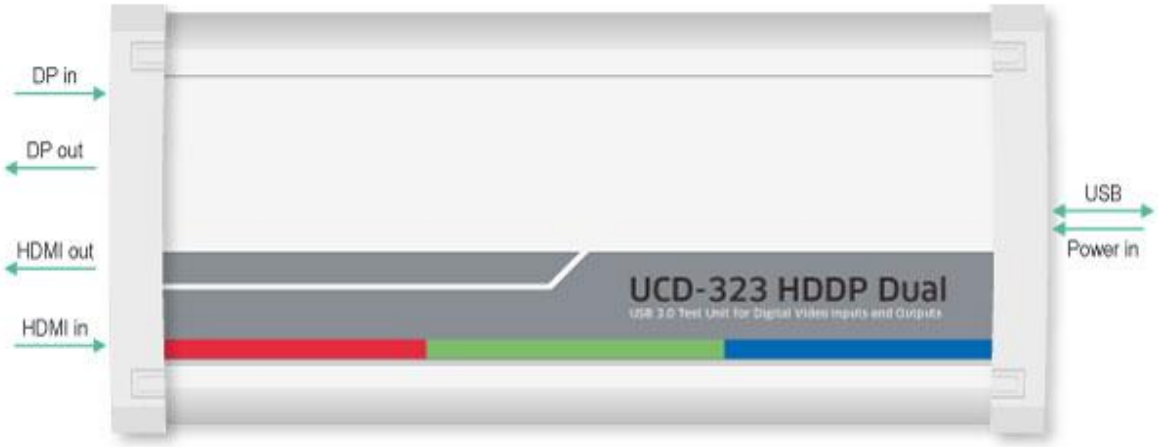
Delivery Content

UCD-323 product shipment contains:

- The UCD-323 unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output), System input: 12Vdc, 3A
- USB 3.0 compliant cable

Connections

The image below indicates the connections in UCD-323 unit and their description



Name	Description
DP in	DisplayPort™ 1.4 compliant input from the upstream Source
DP out	DisplayPort™ 1.4 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

⚠ Safety and Operational Precautions

Please find below the **Safety Precautions** for using the Unigraf UCD test instrument. Please also carefully read the **Notes and Warnings** within the text of this manual.

These **Precautions and Warnings** are provided to enable a safe use of the UCD test equipment. Therefore, Unigraf assumes no liability when the user fails to follow the expressed **Precautions and Warnings.**

- The product is intended to be supplied by an IEC/EN 61010-1 or IEC/EN 62368-1 certified adapter or DC power source, suitable for operation at a minimum ambient temperature of 40°C, providing an output that meets PS2 (or LPS) requirements, rated at 12 V DC, 3A, with a compatible mating connector.

  Note: UCD-300 devices are IEC certified. Please use them **only** with the power adapter provided in the box; do not use third-party or external power sources. Unigraf does not authorize the use of non-original power components. Please ensure that the connectors and cabling to the power adapter are intact. If there are any doubts regarding the condition of the adapter or cabling, stop using it immediately.
- It is important to ensure that the used AC input voltage is within the specified range (100 to 240 Vac 50/60 Hz) and the fuses in the AC lines are of the specified type. If in doubt, do not connect the device.
- UCD devices are rated for indoor use only. They are rated for Pollution Degree 2 as defined in IEC 61010-1. This classification corresponds to usage in a typical office or home environment. Under normal use, only dry, non-conductive pollution occurs. Occasionally, temporary conductivity caused by condensation can be expected. Temporary condensation occurs only when the product is out of service.
- Maximum Operating Altitude: 2000m
- To ensure compliance with all applicable EMC standards, use high-quality shielded interface cables. The clamp-on ferrite supplied with the product must be installed on the USB cable.

- When installing the unit, connect the Power Adapter to the UCD device first, after that connect the AC plug. Please disconnect the USB cable to the controlling PC and remove cabling to DUT while connecting the power input cables.
- It is forbidden to open the housing of the UCD device without written permission from Unigraf. Failure to comply with this rule will void the warranty of the unit.
- UCD devices are intended for use as Electrical Test Instrument only. Use for other purposes is forbidden.
- Use UCD equipment only in its specified ambient temperature and humidity.
- In order to ensure that the UCD device and associated SW will operate properly, please ensure that the PC used for controlling the UCD device complies with the minimum requirement set by Unigraf.
- Please keep UCD software updated by regularly checking the updates on Unigraf download page (https://www.unigraf.fi/downloads/). Please update the device firmware to match the installed software.

Compliance Information

This section lists all the applicable Safety, Electromagnetic Compatibility (EMC), and Environmental standards with which the instrument complies as well as the end-of-life handling requirements for proper disposal of the instrument. This product is intended for use by professionals and trained personnel only; it is not designed for use in households or by children. The following certifications and compliance markings are applicable to the product.

CE Certification

CE marking is a certification mark that indicates conformity with health, safety, and environmental protection standards for products sold within the European Economic Area.

The product meets intent of the European Council Directives 2014/35/EU for Product Safety, 2014/30/EU for Electromagnetic Compatibility (EMC) and 2011/65/EU for Restriction of Hazardous Substances (RoHS). Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:

Safety Compliance

- EN 61010-1:2010+A1:2019 Safety requirements for electrical equipment for measurement, control and laboratory use.
- EN IEC 61010-2-030:2021 Particular requirements for testing and measuring circuits.

EMC Compliance[1]

- EN IEC 61326-1:2021 EMC requirements for electrical equipment for measurement, control, and laboratory use.
- EN IEC 61326-2-1:2021 Particular requirements for sensitive test and measurement equipment for EMC unprotected applications.

1 This product is intended for use in nonresidential areas only. Use in residential areas may cause electromagnetic interference. To ensure compliance with all applicable EMC standards, use high-quality shielded interface cables. The clamp-on ferrite supplied with the product must be installed on the USB cable.

RoHS Compliance

- EN 63000:2018 Technical documentation for the assessment of electrical and electronic products with respect to the restriction of hazardous substances

Unless otherwise specified, all the materials and processes are compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU in its entirety, inclusive of any further amendments or modifications of said Directive.

End-of-life Handling

WEEE Certification

WEEE marking indicating separate collection for WEEE- Waste of electrical and electronic equipment. The instrument is marked with this symbol to indicate that it complies with the applicable European Union requirements of Directives 2012/19/EU and 2006/66/EC on Waste Electrical and Electronic Equipment (WEEE) and Batteries.

CHINA RoHS Certification

China RoHS 10 marking is a certification mark that indicates conformity with the Chinese government regulation to control the restriction of hazardous substances for products shipped to China.

Unless otherwise specified, all the materials and processes are compliant with the latest requirements of China RoHS 2. The hazardous substances contained in the instrument are disclosed in accordance with the standards SJ/T 11364-2014 (Marking for the restricted use of hazardous substances in electronic and electrical products) and GB/T 26572-2011 (Requirements on concentration limits for certain restricted substances in electrical and electronic products). The instrument is marked with an appropriate Environment Friendly Use Period (EFUP) symbol.

中國 RoHS

The information in the following table is applicable for products manufactured on or after January 1, 2015 for sale in the People's Republic of China.

产品中有害物质的名称及含量

部件 名称	鉛 (Pb)	汞 (Hg)	鎘 (Cd)	六價鉻 (Cr(VI))	多溴联苯 (PBB)	多溴二苯醚 (PBDE)
風扇組件	O	-	O	O	O	O
軟排線	O	-	O	O	-	-
印刷電路板組件	O	-	O	O	-	-
連接器組件	O	X	O	-	O	O
导电布	O	-	O	-	O	O
银色焊锡	O	-	O	-	-	-

注： 本表依据 SJ/T 11364 的规定编制。

O：表示该有害物质在该部件所有均质材料中的含量均 在 GB/T 26572 标准规定的限量要求以。

X：表示该有害物质至少在该部件的某一均质材料中的 含量超出 GB/T 26572 标准规定的限量要求。

-：表示该项为排除项目。

标记 "X"的部件，皆因全球技术发展水平限制而无法实现 有害物质的替代。印刷电路板组件包括印刷电路板 （PCB）及其组件、集成电路（IC）和连接器。某些 型号的产品可能不包含上表中的某些部件，请以实际购 买机型为准。

3. INSTALLATION

Installation Package

The UCD software installation package can be obtained from Unigraf download page at https://www.unigraf.fi/downloads/. Please, note that there are separate packages for Windows and macOS.

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

- Windows/macOS drivers (installed during set up)
- UCD Console SW (installed during set up)
- License Manager (installed during set up)
- Device configuration utility (installed during set up)
- Packet Editor (installed during set up)
- TSI SDK
- User Manuals including this document.
- In some cases, also the firmware of the unit needs to be updated. If in doubt, please contact Unigraf.

Note:	The software should be installed before connecting the UCD unit to the PC.

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

Software Installation

Windows

- ▶ Install *.exe file from the package.
- ▶ Start installation by running application **SoftwareBundle_X.X.XXXX.**

The welcome page is displayed and shows the software package release version.

The user is also asked if he/she wants to:

- Create a desktop shortcut
- Install the Visual C++ redistributable (needs to be present on Windows)
- Install Unigraf USB drivers

- ▶ Confirm by selecting *Next* dialog button. Select *Install* to start the installation.
- ▶ Select *Finish* to exit the installation dialog.

macOS

- ▶ Install *.pkg file from the package. This is a universal binary for ARM and Intel x86.
- ▶ Start installation by running application **SoftwareBundle_X.X.XXXX.**
- ▶ Confirm by selecting *Next* dialog button. Select *Install* to start the installation.
- ▶ Select *Finish* to exit the installation dialog.

Note: If you are downgrading, please remove the *Unigraf UCD Tools* folder from the *Applications* folder before starting installation.

Note: If installation fails, remove the *Unigraf UCD Tools* folder and any possible copies from the *Applications* directory and try again.

Linux

- Linux extract the *.tar.gz file. You will find two install scripts (*install-libfuse.sh* and install.sh).
- In the Files app select each script in turn, right click and select *Properties* to open the *Properties dialog*. Toggle the *Executable as Program* button.
- In the Files app open a terminal window by unselecting any selected files and right clicking and selecting *Open in Terminal* to run the scripts (order is important).
- In the terminal type: *sudo ./install-libfuse.sh*
- You will be prompted for you password.
- Type: *sudo ./install.sh*
- You will be prompted with:

  Please proceed to 'Software & updates' application to tab 'Other Software' and uncheck checkboxes or remove 'cdrom' entry from /etc/apt/sources.list file. Otherwise you will have problems during UCD Console package installation. If you are already done, enter the key 'y'. If not - 'n'
- For Ubuntu just enter y. For debian follow instruction.
- You will then be prompted again with:

  Please proceed to 'Software & updates' application to the first tab and set check box 'Officially supported (main)'. Otherwise you will have problems during UCD Console package installation. If you are already done, enter the key 'y'. If not - 'n'
- For Ubuntu just enter *y*. For debian follow instruction
- Answer y for additional prompts.
- The Ucd Tool Installer Setup app should now be running.
- Select *Next>*
- Select radio button for *Install for all users* or *Install just for me*.
- You are asked to Choose Installation Directory. Do NOT choose the default (/root/Unigraf/Unigraf UCD Tools at time of writing). Select a directory that is easy to access and remember.

  Note the warning: Installing in existing directory. It will be wiped on uninstallation.
- Select *Next> Install* and *Finnish*.
- Navigate to the *Unigraf UCD Tools* directory under the installation directory and double click the app you want to run (*UCDConsole.AppImage* for example).

Firmware Update Procedure

UCD Configuration Utility is used to load an updated firmware to the device. As an option, UCD Configuration Utility can be used to select possible operation roles present in the UCD unit. A firmware set for the selected operation roles is created and the firmware set is programmed to the device. Please contact Unigraf for details.

Updating from Earlier FW Versions

UCD Firmware versions prior to 1.8.52 (see Help > About on Consol) do not support the procedure described here. Follow the instructions in *Appendix G Firmware Recovery Procedure with Quartus Prime* in this manual.

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

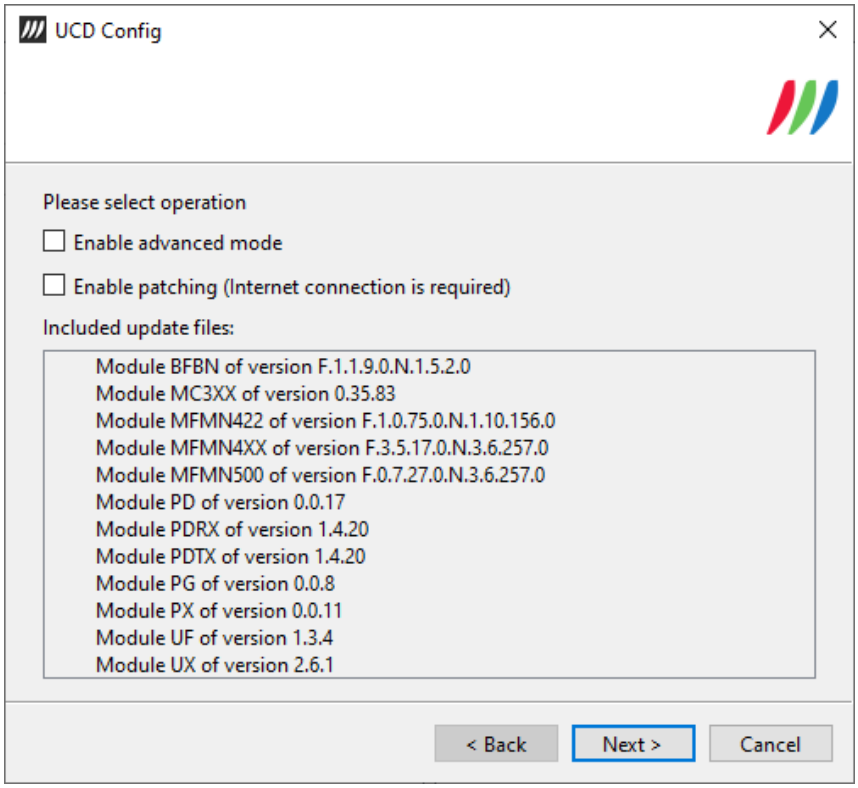
To update the firmware or create a new configuration on a UCD-4XX device, perform the following steps:

- Connect the UCD unit to a power supply and connect the USB cable.
- Open UCD Console SW. Select **Tools** > **Firmware Update**. UCD Config will open.

UCD Config

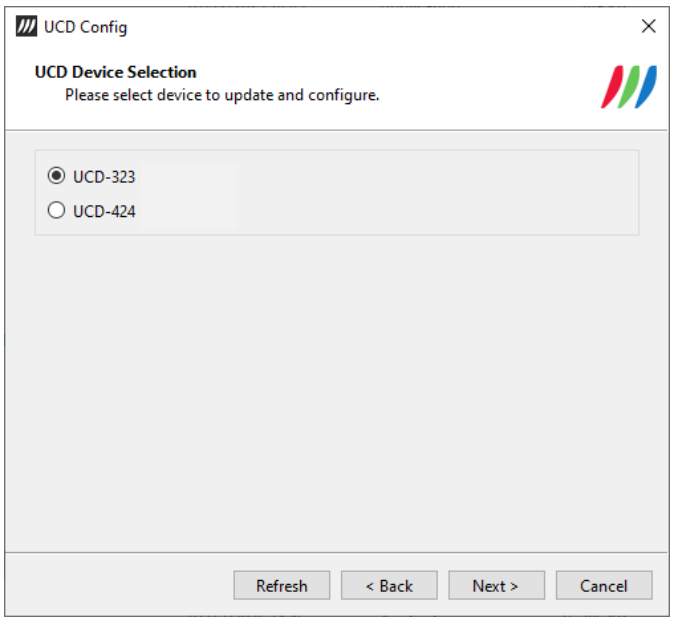
The first page of the utility indicates the firmware component versions present in the package. Select **Enable advanced mode** checkbox if you want to customize the installation (possibly to downgrade firmware for example)..

Select ***Next*** to proceed.



UCD Device Selection

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



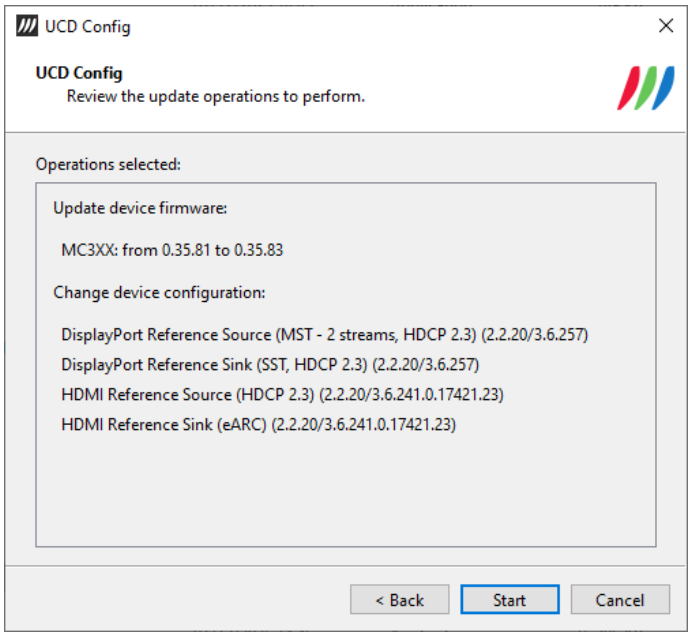
Review updates

A new dialog lists:

- FW components available in the UCD device
- Current FW version (from)
- FW to be installed (to)

Note:	Selecting individual components for update is only enabled in **Advanced Mode**.

Click **Start** to start the FW update procedure.



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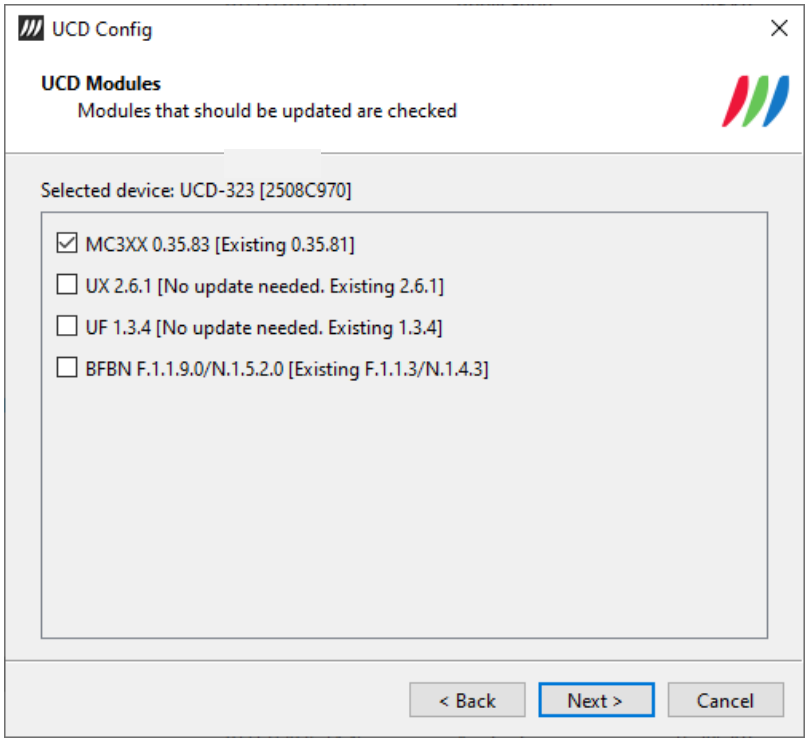
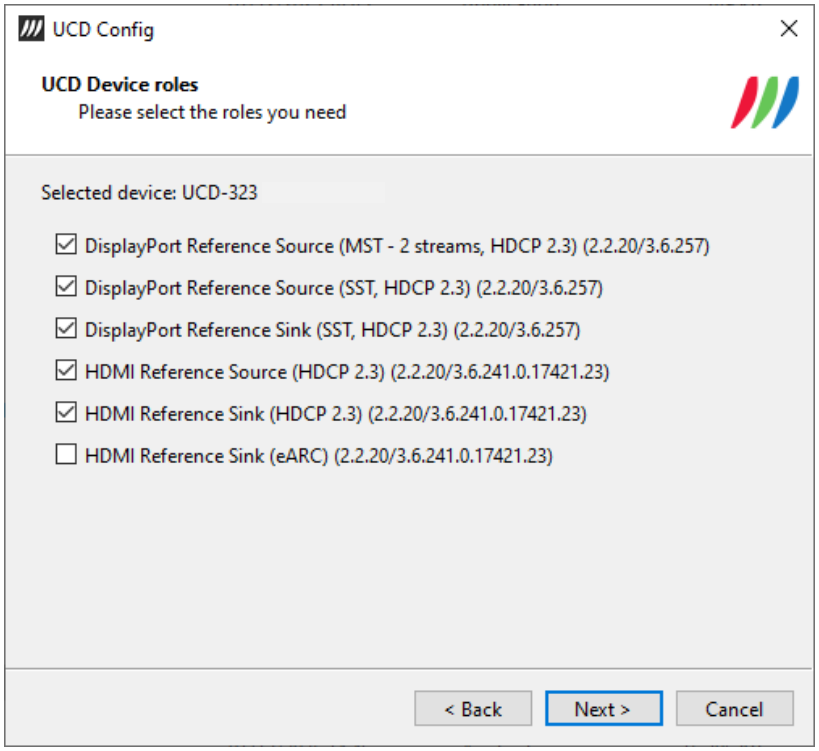
Advanced Mode

Advanced mode allows users to select individual components to update. Click **Next** to review the components and start the update procedure.

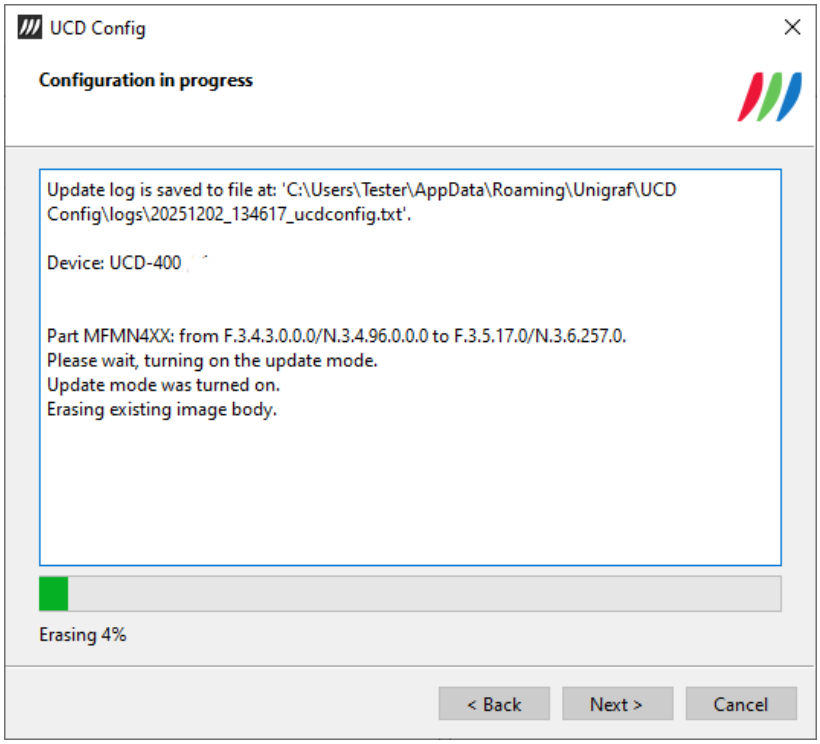


UCD Device roles

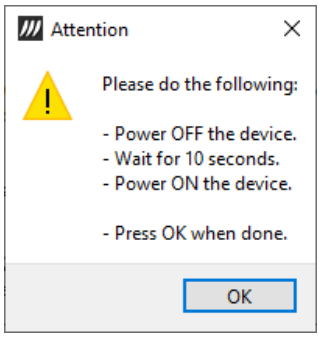
Select the available roles for your UCD-3XX device. Click **Next** to proceed. For detailed explanation of the device roles, please refer to the next chapter on this manual.



Configuration in progress



During the installation, you will be prompted to power cycle the device (power off, wait for 10 seconds and then power the device on again). Select *OK* to proceed.



After the update has finished, click **Next** to see a summary and select **Finish** to complete.

Please note that the update proceedure may take several minutes to complete.

Recovering Failures in FW Update Procedure

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

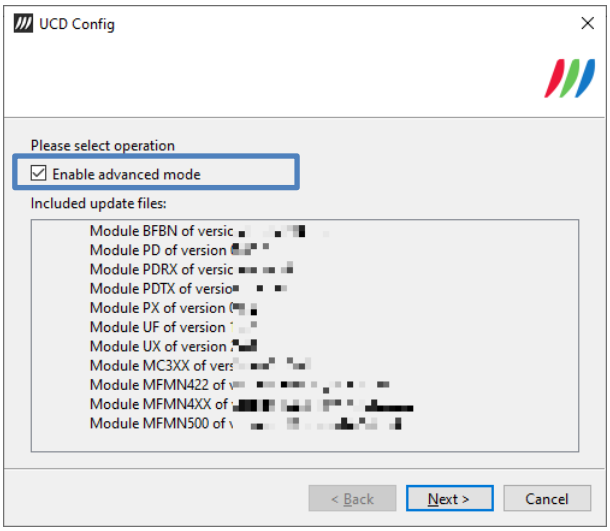
Once FW Recovery procedure has been done and a Firmware version supporting UCD Firmware Configuration tool has been installed, all future updates can be done using this tool.

Firmware Downgrading

The previously released Unigraf SW Bundle 2.4.XX package does not contain UCD Device Firmware (FW). In case UCD device has been installed with the FW delivered with Unigraf 3.X SW Bundle, and version downgrade is needed, also UCD Device Firmware has to be rolled back.

Please follow the procedure below:

1. Download the latest **Console 2 SW Bundle (2.4.XX)** from Unigraf download page at unigraf.fi/downloads.
2. Run the application **SoftwareBundle_2.4.XX.exe** in the package to install the package. Please do not launch UCD Console application yet.
3. Download **Console 2: FW Package 2.3.38** from the same download page
4. Run the application **FirmwarePackage_2.3.38.exe** to copy UCD device FW in a proper folder in your PC
5. Launch **UCD Console**
6. Select **Tools > Firmware Update** to start **UCD Config** utility
7. In UCD Config select **Enable advanced mode**



8. Select the device. **Click Next.**
9. In **UCD Modules** select the module titled MC3XX F.X.X.X/N.X.X.X
10. Click **Next**. Click **Start** to start programming FW to the connected UCD Device

Device Roles

The use of UCD-3XX devices with UCD Console is divided in interface specific roles. The structure of UCD Console varies between roles by having a varying set of tabs dedicated to functionalities available in the selected 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. Please find a description on changing device configuration later in this document.

Available Roles UCD-301

- DisplayPort Reference Sink (SST, HDCP 2.3)
- HDMI Reference Sink (HDCP 2.3)
- HDMI, DisplayPort (SST). SPDIF Reference Sink
    - Enables SPDIF audio testing

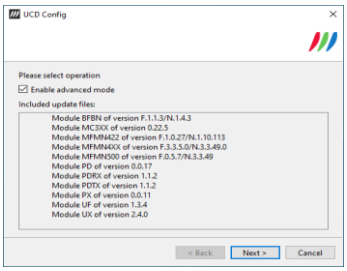
Available Roles for UCD-323 and UCD-323 Gen2

- DisplayPort Reference Sink (SST, HDCP 2.3)
- DisplayPort Reference Source (SST, HDCP 2.3)
- DisplayPort Reference Source (MST – 2 streams, HDCP 2.3)
- HDMI Reference Source (HDCP 2.3)
- HDMI Reference Sink (HDCP 2.3)
- HDMI Reference Sink (eARC)

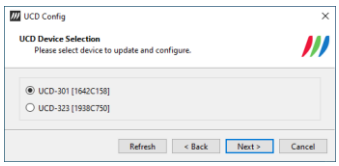
Change Device Configuration

UCD-300 devices can feature up to four simultaneous Roles. Changing the role configuration is done by selecting the firmware packages loaded to the UCD-300 device. For selecting you need to open UCD Config.

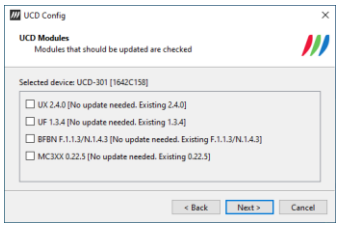
In the first window, select **Enable advanced mode.** Click next.



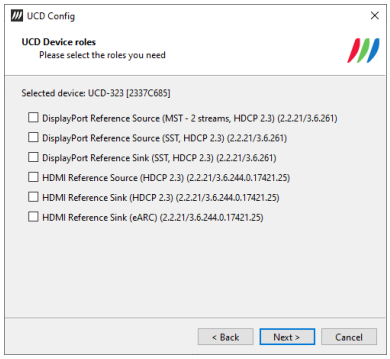
In the second window, select the device you want to configure. Click next.



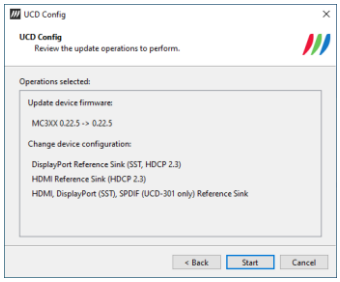
In the third window select MC3XX. Click next.



In the fourth window, select the roles for the device. Click next.



In the fifth window click Start.



License Manager

Licensing

The features of UCD Console GUI are divided into groups based on the target use of the device. Most basic features can be used by default, and more advanced feature groups are enabled by dedicated licenses. When the licenses are present, the related part of the GUI will be shown, or the related control will be enabled.

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 **UCD License Manager**. License manager can be found in the **Tools** menu of UCD Console .

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

License Manager GUI

When run, License Manager will list the licensing enabled Unigraf devices. In the list of Devices please **Select** the device in question. The *serial number* and the *seed number* of your device are printed in a sticker attached to the bottom of the device.

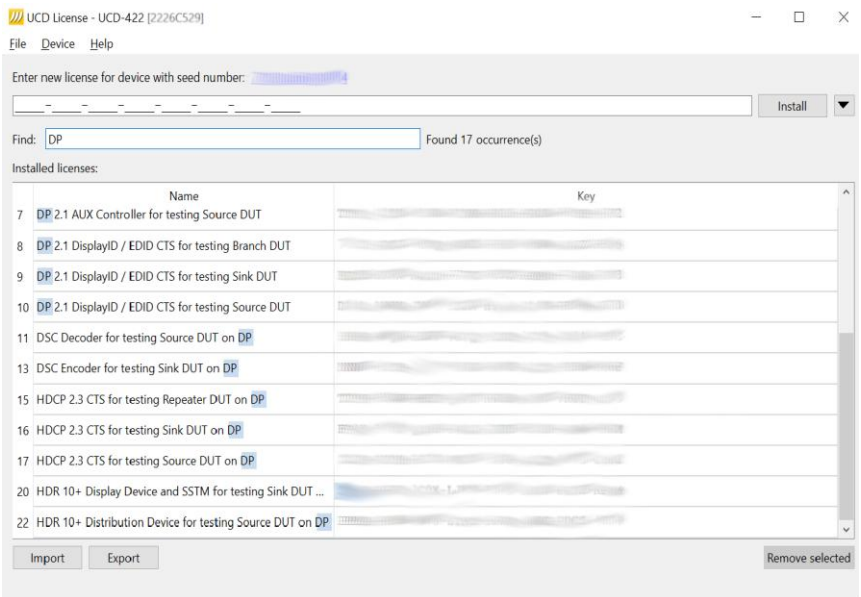
The **Rescan…** button will re-scan the system for installed hardware.

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. Seed Number of the selected unit can be found in the top of the dialog.

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



Adding New License Keys

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

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

Click the Search inverted triangle at the upper right to view the *Find* edit control. Enter a search keyword: The license list is updated to show names that contain the keyword.

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 cannot 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 installed licenses for the selected device. The list shows the name of the license and the actual license key characters.

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

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

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

UCD Console

UCD Console is graphical user interface (GUI) for UCD family test equipment for desktop use. UCD Console 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 problem detection.

In UCD Console the various features of the UCD unit are divided into interface specific screens and tabs. Each tab contains data and controls for a specific feature.

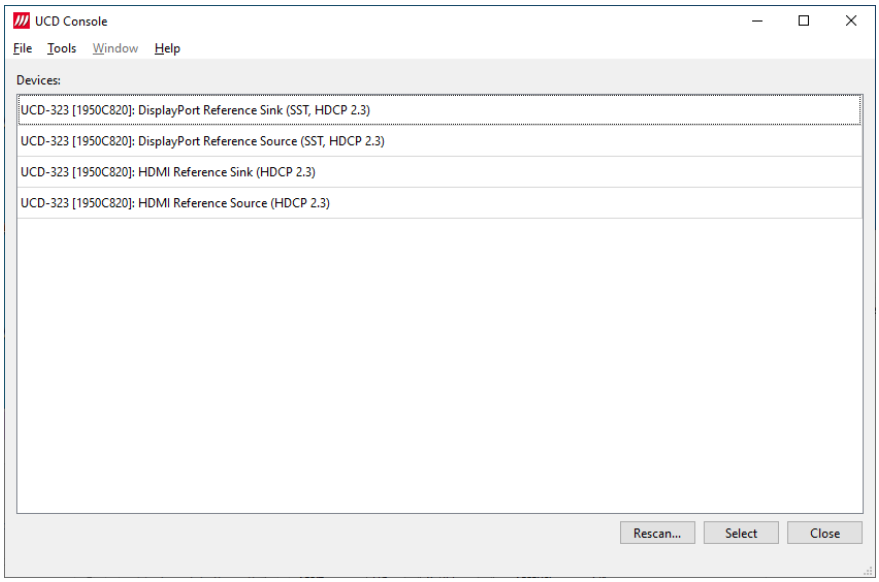
Note: This version of the User Manual describes features in UCD Console software based on the functionality in Microsoft Windows operating system.

UCD Console is also available for macOS operating system to be used in iMac and MacBook computers and for Linux operating system. Detailed description of the macOS and Linux versions will be added later.

Device Selection

A shortcut of UCD Console can be found by default under Start Menu**.**

Once UCD Console GUI is launched, the dialog provides a list of Unigraf UCD devices connected in the PC. Please select the target device by clicking on the appropriate button. If your device cannot be found in the list, please confirm the power and USB connection to the device and click the **Rescan …** button.



Analyzer and Generator Operation

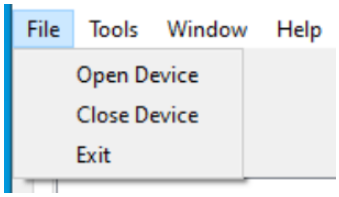
Most UCD devices can be used with UCD Console as Analyzer (a Sink device) and as Generator (a Source device). In default configuration UCD-3XX devices can operate in one role at a time.

The operating role is selected when the device is opened in UCD Console. For changing a role, please close the device (File > Close Device), click Rescan … if needed, and select the new role.

This User Manual will explain all roles available for UCD-3XX devices and the functionalities available for each role.

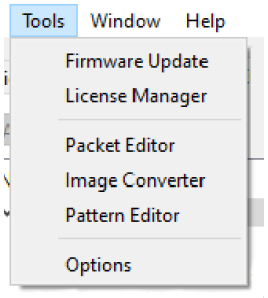
UCD Console Menu

File



Open Device	Open a device. You can have several UCD Consoles open simultaneously with different devices.
Close Device	Closes device. The device selection window will open.
Exit	Close UCD Console.

Tools



Firmware Update	Opend UCD Config for firmware update.
License Manager	Opens License Manager.
Packet Editor	Opens packet editor.
Image Converter	Opens UICL converter.
Pattern Editor	Opens pattern editor.
Options	See below.

Options

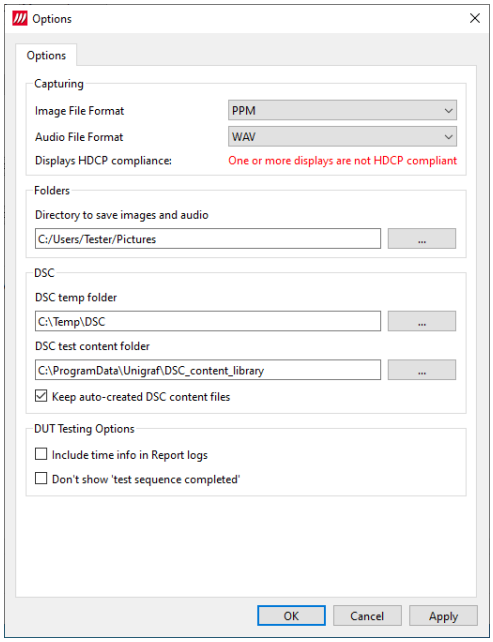


Image File Format

You can save the captured frames either in PPM, BMP, JPG or PNG 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.

Displays HDCP compliance

Shows if the monitors used are HDCP compliant. Previewing HDCP encrypted content is only possible with HDCP compatible displays.

Folders

Please select the directories in the PC for saving the captured images and audio.

DSC

DSC temp folder	Folder for DSC Work files.
DSC test content folder:	Folder where DSC source bitmap files, related configuration files and DSC conversion tools are stored.
Keep auto-created DSC content files	By default, the DSC compressed content is deleted after use. If selected, the content is not deleted

Warning

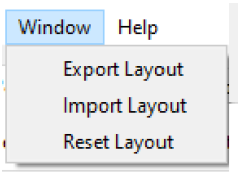
Keeping the automatically created DSC compressed content will shorten the time needed for running the DSC compliance tests.

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

DUT Testing Options

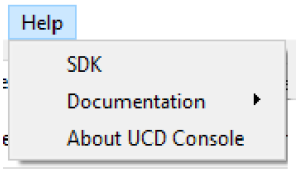
Include time info in report logs	Include time info in reports of tests run in Sink / Source DUT testing tab.
Don't show 'test sequence completed'	Don't show dialog after tests run in Sink / Source DUT testing tab.

Window



In the window menu you can export and import layout of UCD Console including the tab order. You can also reset layout to factory settings.

Help

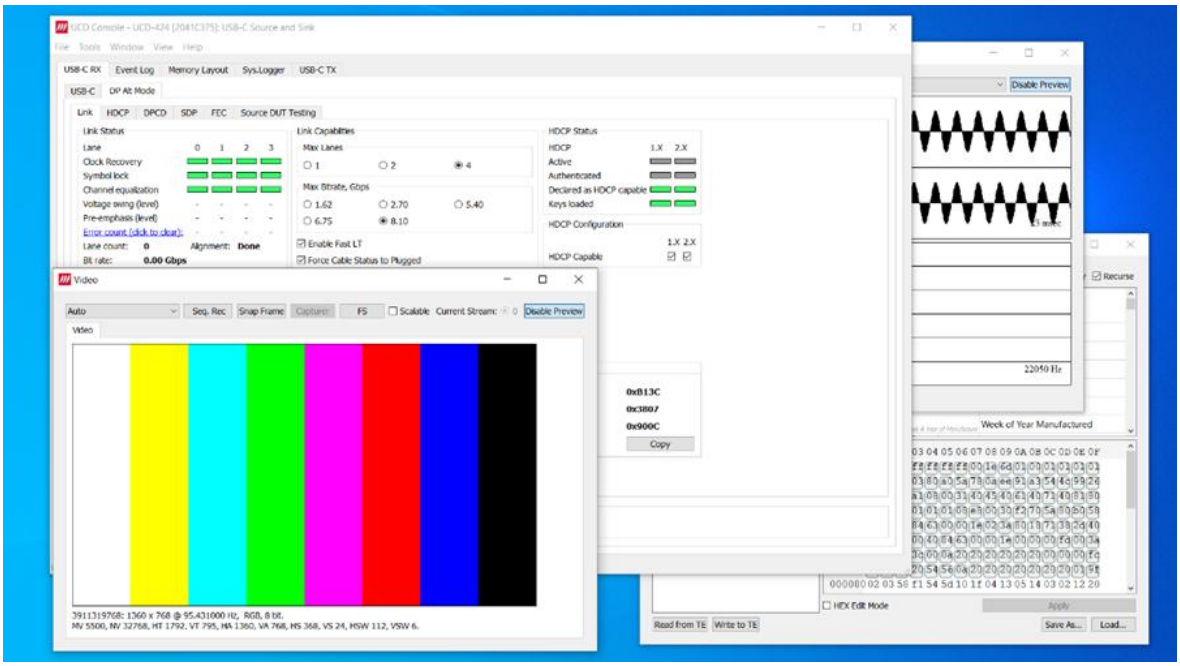


SDK	Opens SDK folder installed during installation of UCD Console. Folder inclused C, python and test automation scripts
Documentation	Open UCD Console User Manual.
About UCD Console	Show UCD Console information including software and firmware versions.

Detaching and Cloning Tabs

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

Tabs can also be cloned (duplicated) in order to e.g., monitor various areas of DisplayPort DPCD or HDMI SCDC simultaneously without swapping addresses. To clone a tab **Right-click** on a tab and select **Clone Tab** or **Clone and Detach** to the two actions simultaneously.



4. ANALYZER OPERATION

When used as an *Analyzer*, UCD-3XX devices act as DisplayPort o HDMI Sink or Receiver devices.

User is selecting device role when opening the Device when launching UCD Console. Selecting *DP Reference Sink* or *HDMI Reference Sink,* UCD Console operates as Analyzer.

Functionality Tabs

UCD Console features are presented in tabs. Standard tabs are similar in all functional roles, Interface Specific tabs present features and controls that are only available for a particular interface.

Some of the tabs are enabled by default, some only when an applicable license is included.

Standard Tabs

Analyzer role features the following standard tabs:

- Video preview and saving (Video)
- Capturing video, audio and metadata. (Capture)
- Audio monitoring and saving (Audio)
- EDID editor (EDID)
- HDCP status monitor and control (HDCP)
- Source DUT Testing tab
- Event Log

Interface Specific Tabs

Based on the connected UCD device, additional interface specific tabs will be available.

DP Reference Sink

Tab:	Description:
Link	Status information and control of the upstream link
DPCD	For monitoring and editing the DPCD registers of the DP Sink
SDP	Showing the *Secondary-Data Packets* sent by the Source device
AUX Controller	AUX controller allows UCD-323 to make Source DUT to train link at a specific link configuration or to output a test pattern.

HDMI Reference Sink

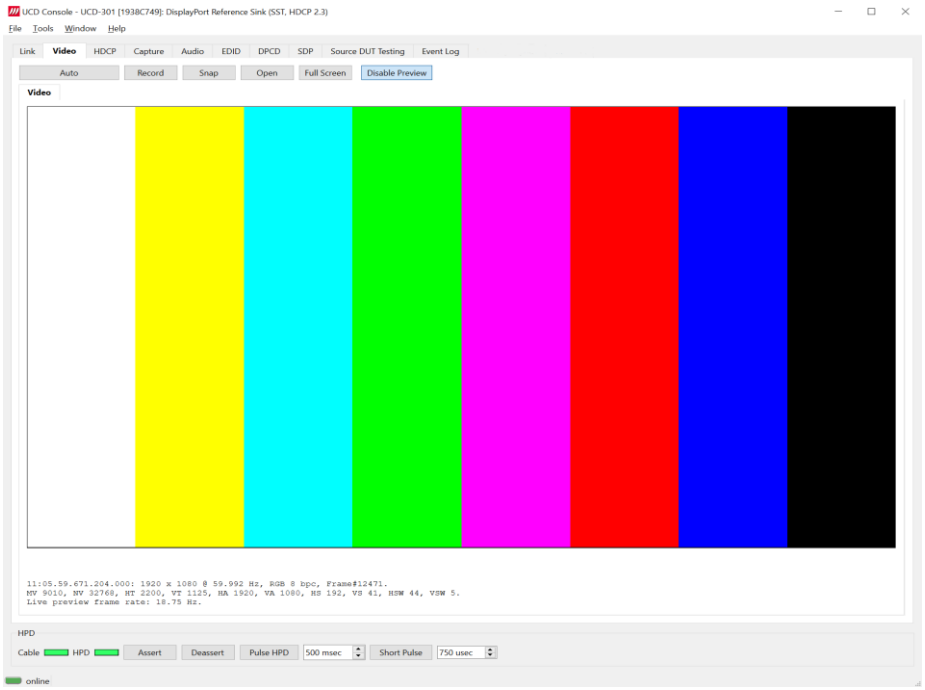
Tab:	Description:
Link	Status information and control of the upstream link
InfoFrames	Received InfoFrame packets
CEC	For sending and receiving CEC protocol messages and data.

Note: Some of the tabs are enabled by default, some only when an applicable license is included. Please refer to Appendix B Licensing of this document for description of features and licensing.

Standard Tabs

Video Tab

Video tab is the Preview window for the captured video frames.

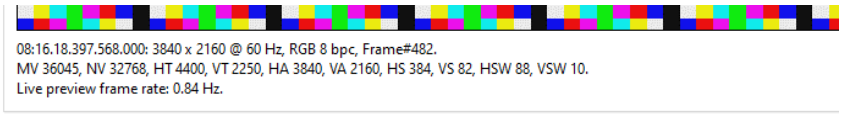


Disable / Enable Preview

Click the button to start or stop capturing video frames.

Video Status

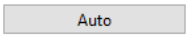
The details of the captured video are presented below the preview window.



First row:	Counter, frame size, frame rate, color mode, color depth, frame counter.
Second row:	Mvid, Nvid, Horiz Total, Vert Total, Horiz Active, Vert Active, Horiz Start, Vert Start, Hor Sync Width, Vert Sync Width.
Third row:	Live preview frame rate.

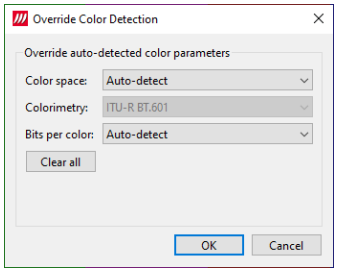
Note: Please note that UCD test equipment are able to capture video at full frame rate. *Live preview frame rate* indicates the rate of updating captured video on UCD Console preview screen. Live preview frame rate is limited e.g by the USB communication between UCD test equipment and the PC.

Override Color Detection



The captured video will be by default automatically converted to RGB 8 bpc for preview and saving based on the information in video metadata.

By clicking Auto button, a dialog opens for overriding the automatic conversion. Captured image data will be interpreted based on the values set in the dialog.

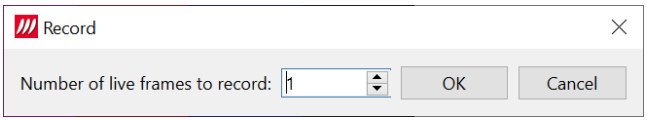


Color space:	Define as which format captured data will be interpreted. (Auto-detect, RGB, YCbCr4:4:4, YCbCr4:2:2, YCbCr4:2:0)
Colorimetry:	Define as which colorimetry captured data will be interpreted. (ITU-R BT.601, ITU-R BT.709, ITU-R BT.2020)
Bits per color	Define as which color depth captured data will be interpreted. (Auto-detect, 6, 8, 10, 12, 16)

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.

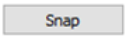
Frame recording

Clicking the button opens a dialog for definition of number of frames recorded.



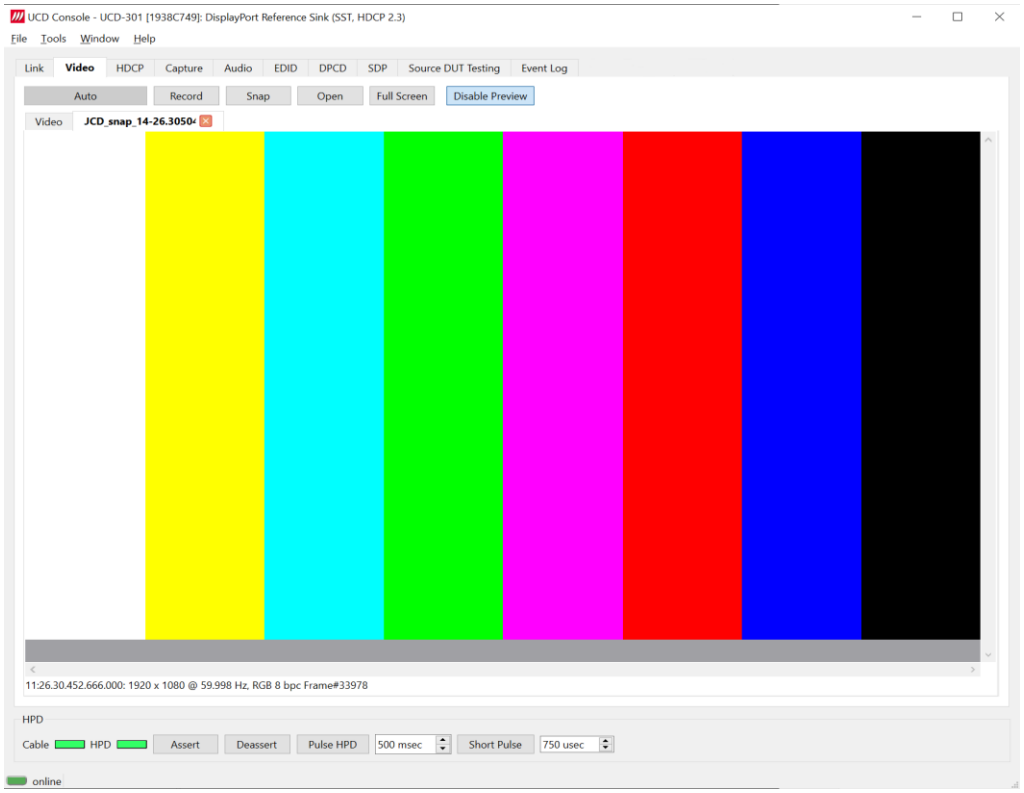
Note: Please note that buffered mode cannot be used when Audio preview is enabled.

Snap Frame



When clicked, one frame of the incoming video is captured and shown in a new tab. Each click captures a new frame and opens a new tab.

Color Information of the captured frame can be evaluated by placing the mouse cursor on top of the preview image.



Info field in the lower right side of the bottom panel lists:

- Location of the cross cursor on the bitmap stating from the upper left corner
- The intensity of the color components of the pixel on the cursor location in HEX. Expressed as RGB and YCbCr.

Zoom

Zoom level of the captured frame 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%

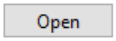
Save Frame

The captured frame current tab can be saved to a bitmap file in the PC by right clicking on top of the preview image and selecting **Save as…**. The format and storage location can be selected in the opening dialog. The available bitmap formats are BMP, JPG, PNG, and PPM.

Note:	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.

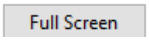
The selections in Tools > Options menu define if the frame bitmap will be stored as captured from the display interface or if the color mode conversion selected for preview will be applied.

Open



Open folder where captured frames are stored. Double click or click **Open** to select a frame file for viewing. You can select the storage folder in **Tools > Options.**

Full Screen

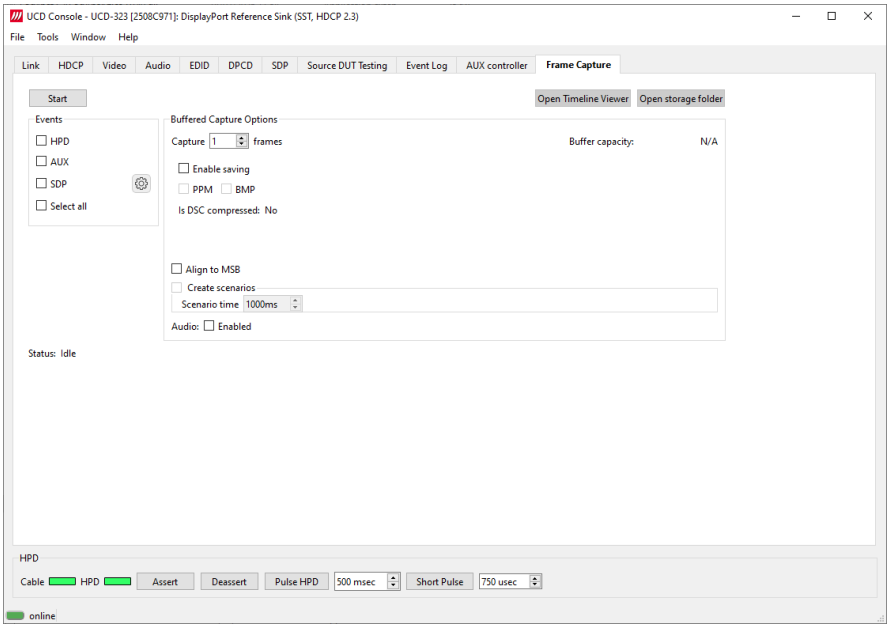


Preview captured video full screen, scaled to vertically fit the screen.

Double-click on the screen or press Esc to exit full screen mode.

Frame Capture Tab

UCD device has an internal frame buffer that can be used for continuous capture of video data. In addition, audio and metadata can be captured and saved for later analysis. Video can be stored as RGB or RAW data.

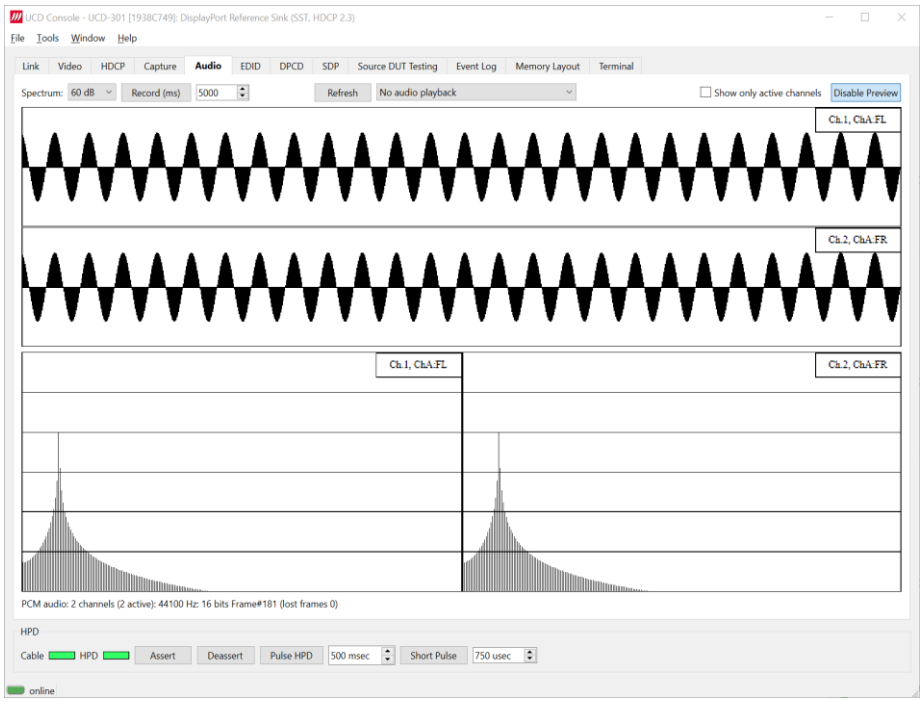


Start / Stop	Start or stop capturing. When capturing *Start* button label changes to *Stop*.
Capture N frames …:	The number of video frames captured.
Format:	Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PPM, BIN + BMP.
Capacity of buffer:	The number of video frames that can be stored to UCD frame buffer using current video signal format
Align to MSB	Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked, the binary data is aligned to the Least Significant Bit (LSB).
Create scenarios	Define the length of the scenario
Events:	Please refer to chapter *Event Log* for details of the captured events.
Audio	Enable audio.
Status:	Status of the capture.
Open Timeline Viewer	Open Timeline Viewer to view the captured data.
Open storage folder:	Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is “buffered_capture_yyyymmdd_hhmmss” (e.g., buffered_capture_20210301_130532).

Note:	Video Preview needs to be disabled to use Data Capture functionality.

Audio Tab

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



The audio signal format is shown in three ways

- The ‘oscilloscope’ panel displays the waveforms of the received audio channels.
- The frequency spectrum of the audio is shown in the lower panel. The range of the spectrum display is from 0 to 1/2 of the input sampling rate. The amplitude scale of the spectrum display can be selected between ‘Linear’ to 100 dB.

The span of the oscilloscope preview window is defined with **Playback buffer** 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 *Playback buffer* depends on the sampling frequency. Please do not exceed the *Main buffer* set in the same dialog. Please refer to description of the *Video Audio and Misc Options* earlier in this document.

Enable Preview / Disable Preview

This button controls capturing the audio data.

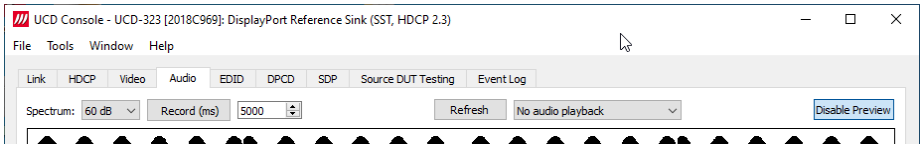
Select Monitored Stream

When Multistreaming (MST) is enabled, the monitored stream can be selected from **Current Stream** selection in the bottom of the dialog.

Note: Please note that if the captured audio signal is constant, and audio signal frequency and audio sampling rate (e.g. 1000 Hz audio and 32 KHz sampling) match audio preview sampling rate, the ‘oscilloscope’ panel will seem static. Signal capture can be verified by ensuring that Frame # below the panels is increasing.

Playback device selection

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

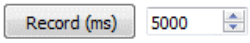


Note: Please note that the audio capabilities of the audio playback device of the PC are not automatically reflected in the audio capabilities description in UCD-300 EDID. Since UCD-300 is not performing any audio format conversion, it might occur that the source provides an audio format that the selected 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

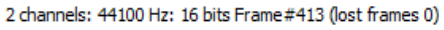
Click here to re-read the list of audio devices after making changes to the host PC configuration.

Start audio recording



The captured audio can be recorded in the PC using Waveform Audio File Format, WAV (*.wav) format. Recording duration is defined in milliseconds (ms). The folder where the audio file will be saved can be selected in Tools > Options.

Input audio mode

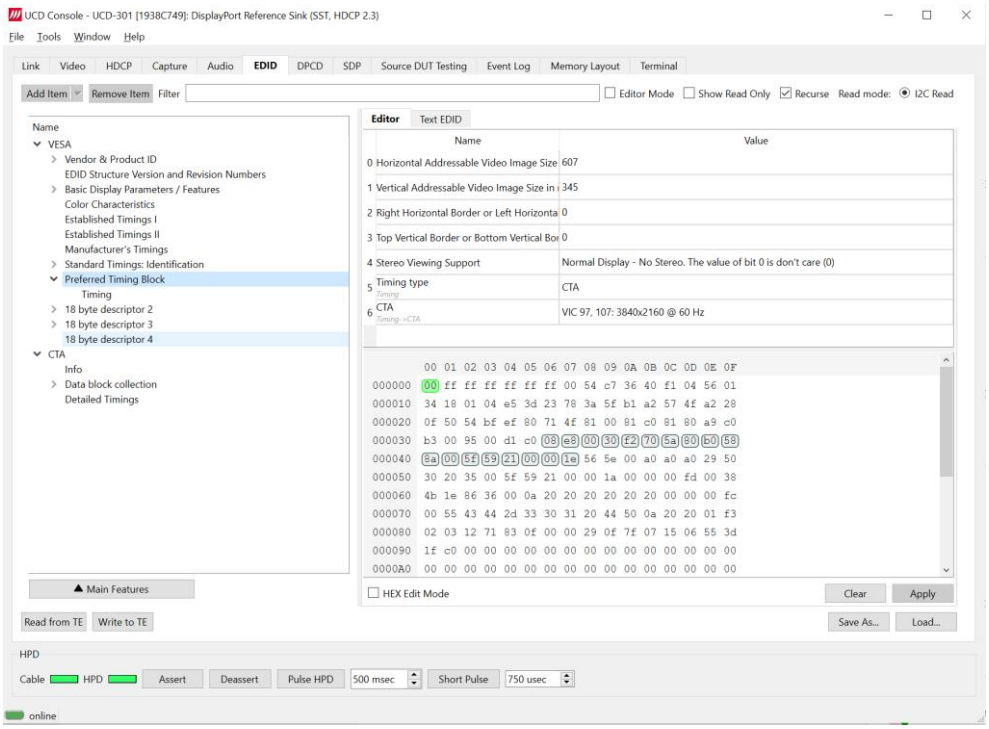


This field (in the bottom of the dialog) indicates detected audio mode in the input stream and the number of audio packets captured.

EDID Tab

EDID Tab provides tools for accessing the EDID and Display ID 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 either in EDID Editor or in hex format
- Program and read the contents of the EDID memory of up to two virtual MST Ports (with UCD-323 special configuration)



EDID Files

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

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 blanks.

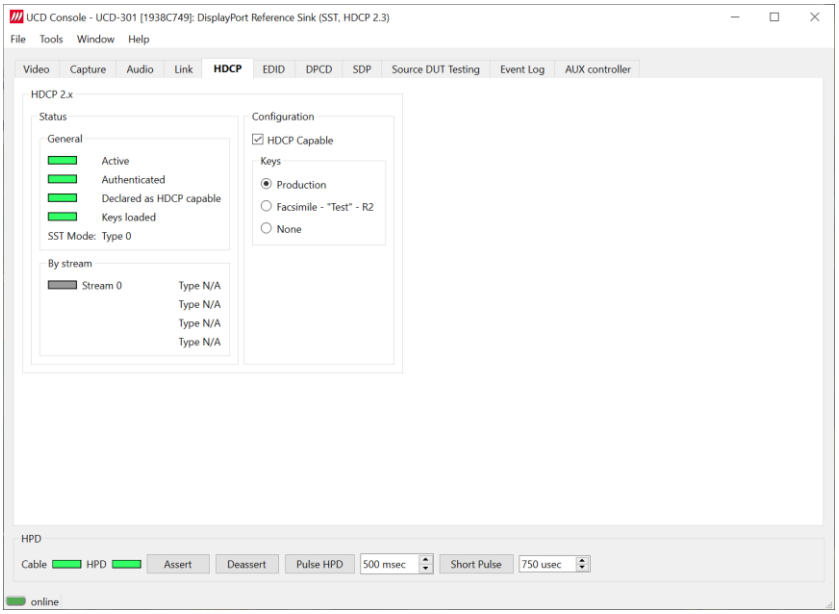
EDID Editor

Please see the description of the EDID editor in Chapter EDID Editor later in this document.

HDCP Tab

HDCP tab is the dialog for monitoring the HDCP (for *High-Bandwith Digital Content Protection*) status and controlling the HDCP capabilities of the UCD-300 device.

Note:	Please note that HDCP 1.3 is not supported in 3.9 release.



Status

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

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

Configuration

HDCP Capable:	To disable HDCP uncheck the box.

Keys

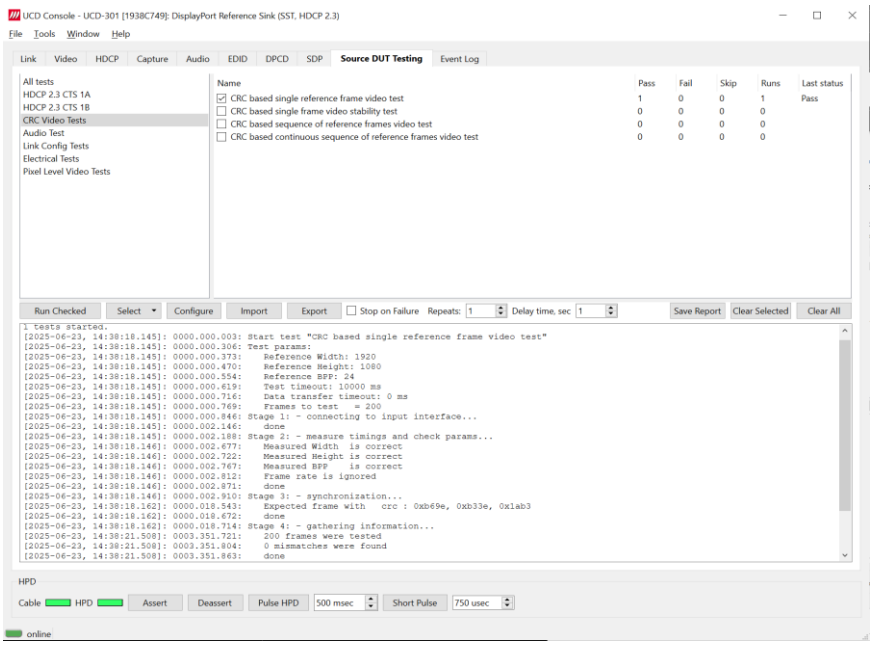
Select between *Production* or *Facsimile* HDCP keys. To remove the keys, select *None*.

HDCP 1.3 / 1.4 vs. HDCP 2.3

UCD-3XX devices support by default HDCP 1.3 / 1.4 standard. The functionality for supporting HDCP 2.2 / 2.3 is enabled with HDCP 2.3 Support license

Source DUT Testing Tab

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



Run:	Run a selected test. You can select a test for running by clicking on the corresponding row. When selected, the row will be highlighted in blue.
Run Checked:	Click to start checked tests. By clicking *Abort* the sequence is stopped.
Select:	Includes the following options for creating templates for tests execution: Select All, Clear All, Invert All, Save, Import and Export
Configure:	Clicking opens a dialog for defining the test parameters for the selected test set. Please refer to *Test Parameters* below for details.
Import:	Load saved test parameter files (*.td or *.json).
Export:	Save test parameters for later use or for use in test automation. For saving parameters for later use in UCD Console, either format can be used. For saving parameters for TSI scripting, please use *.td files. For use with Python applications, please use *.json files.
Stop on Failure:	Stops execution of the selected tests if one of the tests fail
Repeats:	Repeat the selected test several times
Delay time:	Delay in seconds between individual tests.

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.

Save Report:	Click to generate a HTML report file for sharing the results with other parties for viewing without UCD Console.
Clear Selected:	Clear the results matrix for selected tests
Clear All:	Clear the test log and the results matrix

Test Parameters

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

Description of parameters for each test set can be found within the description of tests in Appendix E of this document.

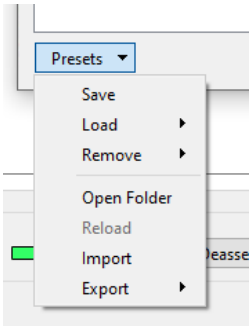
Saving Test Parameters

Test parameters can be saved in various ways.

- Export parameters in *Sink DUT Testing* tab to a *.td file for later use in UCD Console or with TSI scripting or sharing.
- Export parameters in *Sink DUT Testing* tab to a *.json file for later use in UCD Console or with Python applications or sharing.
- Save parameters in *Configure* dialog as Presets to be later used in Console. Please find a description below.

Presets

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



DP Reference Sink

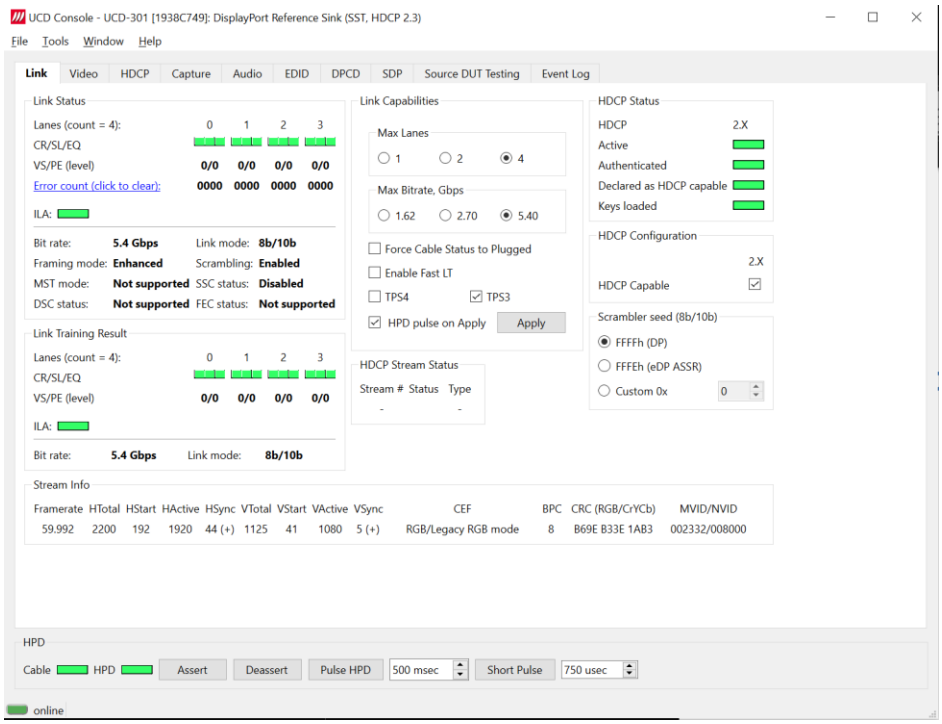
Role:	Product:
DP Reference Sink (DP RX)	UCD-323, UCD-323 Gen2, UCD-301

When roles *DP Reference Sink* is in use, the following interface specific tabs are available:

Tab:	Description:
Link	Status information and control of the upstream link
DPCD	For monitoring and editing the DPCD registers of the DP Sink
SDP	Showing the *Secondary-Data Packets* sent by the Source device
AUX Controller	AUX controller allows UCD-323 to make Source DUT to train link at a specific link configuration or to output a test pattern.

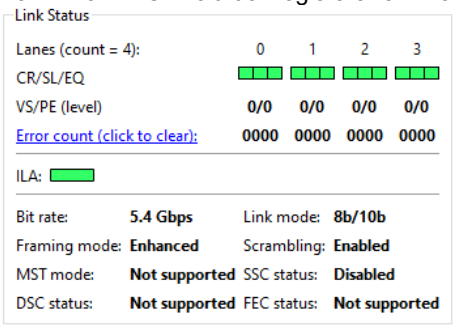
DP Link Tab

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



Link Status

Link Status displays the status of the link training and the link parameters negotiated between UCD Sink and the Upstream Source. It also lists status of other link modes. The data is retrieved from the DPCD status registers of the UCD Sink. The status is updated automatically.

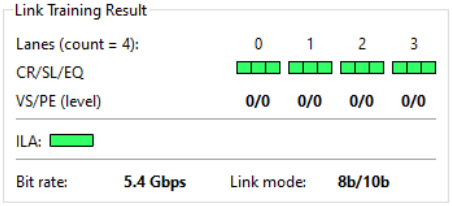


Lanes: Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.

Lanes:	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
CR/SL/EQ:	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization for each of the four lanes
VS/PE (level):	Voltage Swing / Pre-emphasis level
Error count:	Content of DPCD Error Count registers
ILA:	LED indicator for 'Inter lane Alignment Done'
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (8b/10b)
Framing mode:	Currently enabled Framing Mode (Normal or Enhanced)
Scrambling:	Status of link data scrambling (Enabled or Disabled)
MST mode:	Not Supported
SSC Status:	Status of Spread-Spectrum Clock (Enabled or Disabled)
DSC Status:	Not Supported
FEC status:	Not Supported

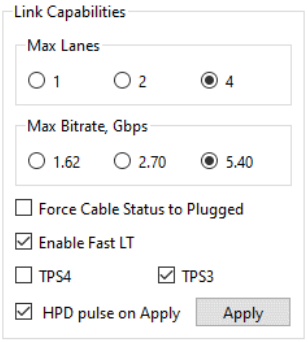
Link Training Result

The result of the previous Link Training and values of some key parameters.



Link Capabilities

Link capabilities allow the user to change the way the Sink capabilities are announced in the DPCD capability registers of the UCD Sink. Maximum Lane Count and Maximum Link Rate are set with their corresponding radio buttons.

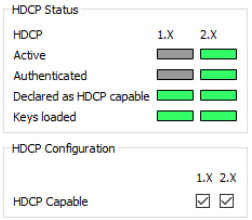


Force cable status to plugged:	When checked, sink functionality is active regardless of a failure of upstream device detection e.g., due to incorrect AUX Channel electrical termination.
Enable Fast LT:	Indicates support for link training without AUX transactions.
TPS4, TPS3:	Indicate support for Link Training Pattern Sequence 4 and 3 correspondingly.
HPD pulse on Apply:	Select to apply a Hot-Plug Detect (HPD) pulse automatically after updating the status. HPD pulse duration will be defined in the *Pulse HPD* field in *HPD* dialog in the bottom of the tab.

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

HDCP Status

Copy of the status from HDCP Tab. Please refer to chapter HDCP Tab later in this document for detailed description.



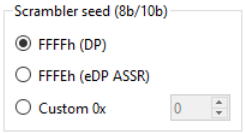
Note: Please note that HDCP 1.3 is not supported in 3.9 release.

HDCP Configuration

Enable and disable HDCP 1.3 or HDCP 2.3 capability of UCD Sink. Duplicates of the controls found in HDCP tab

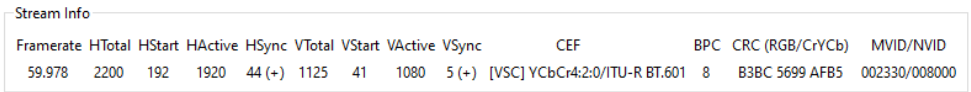
Scrambler seed (8b/10b)

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



Stream Info

Video Stream Info are retrieved from the Main-Stream Attributes (MSA) and SDP packets of the monitored stream. Frame rate is measured by UCD Local Sink.

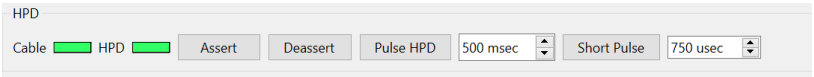


The content of *Stream Info* table can be copied by right-clicking on the table and selecting *Copy*.

Framerate	Vertical refresh rate
HTotal	Horizontal total of transmitted main video stream, measured in pixel count.
HStart	Horizontal active start from leading edge of HSync, measured in pixel count.
HActive	Horizontal active, number of active pixels in video line
HSync	HSync width, measured in pixel count.
VTotal	Vertical total of transmitted main video stream, measured in line count.
VStart	Vertical active start from leading edge of VSync, measured in line count.
VActive	Vertical active, number of active lines in video frame
VSync	VSync width, measured in line count.
CEF	Used color mode: Color format + subsampling / colorimetry. In case of YCbCr formats detailed info gained from VSC SDP.
BPC	Color depth in bits per color (BPC)
CRC (RGB/CrYCb)	16-bit Cyclic redundancy check (CRC) value per color component calculated from active pixels. Value order in YCbCr color format: Cr, Y, Cb.
MVID/NVID	Mvid and Nvid video time stamp values

The MSA information used for Video Timing Details is provided by the Upstream Source, it is not measured by the UCD Local Sink.

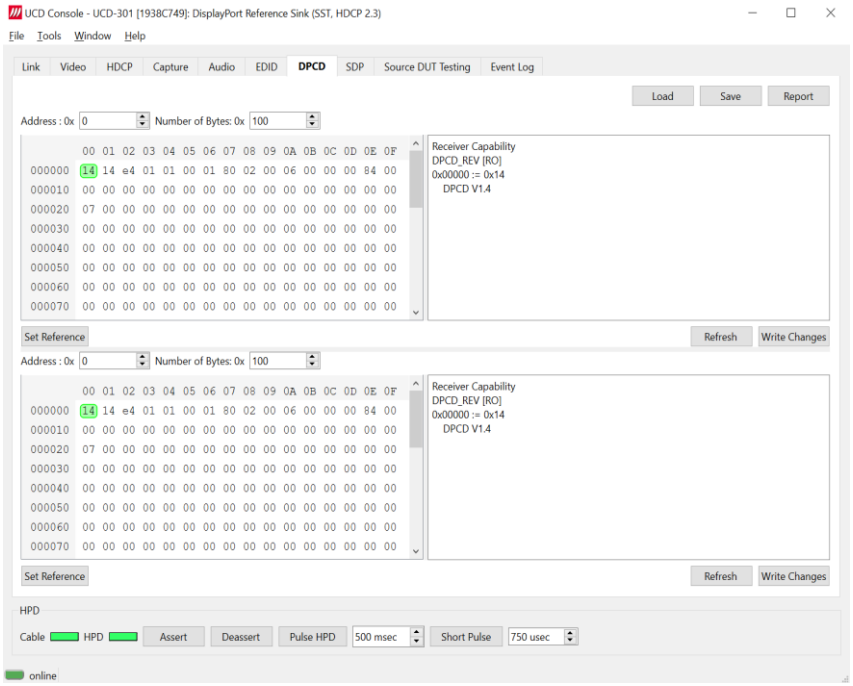
HPD



Cable:	LED indicates that the hardware has detected an upstream cable.
HPD:	LED indicates that the HPD signal is Asserted (logical “high”).
Deassert:	Click button to set HPD line to logical “low” (de-asserted) and hence no HPD pulse can be generated.
Assert:	Click to re-activate the HPD line (set to logical “high”).
Pulse HPD:	Click to apply an HPD Pulse with programmable duration. Duration will be defined in the provided field.
Short Pulse:	Click to apply a short pulse. Duration will be defined in the provided field.

DPCD Tab

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



The *DPCD Decoder* panels on the right show the interpretation of the DPCD byte selected on the monitoring windows. The selected byte is shown with a green background.

DPCD Decoder flags in Tools > Options contain control of DETAILED_CAP_INFO_AVAILABLE flag.

	Refresh:	Re-read the data from the DPCD registers to the window in question
	Write Changes:	Write the portion of data shown in the window in question to the DPCD registers.
	Set Reference:	Store currently shown data as a reference for comparison

When the data is *Refreshed* from the DPCD registers the changed bytes will be highlighted in *blue*. The fields edited by the user will be highlighted in *red*.

Saving and Loading DPCD Content

DPCD data in the selected address areas can be saved as a file in your PC. There are two alternative formats listed below. Please select the format when saving:

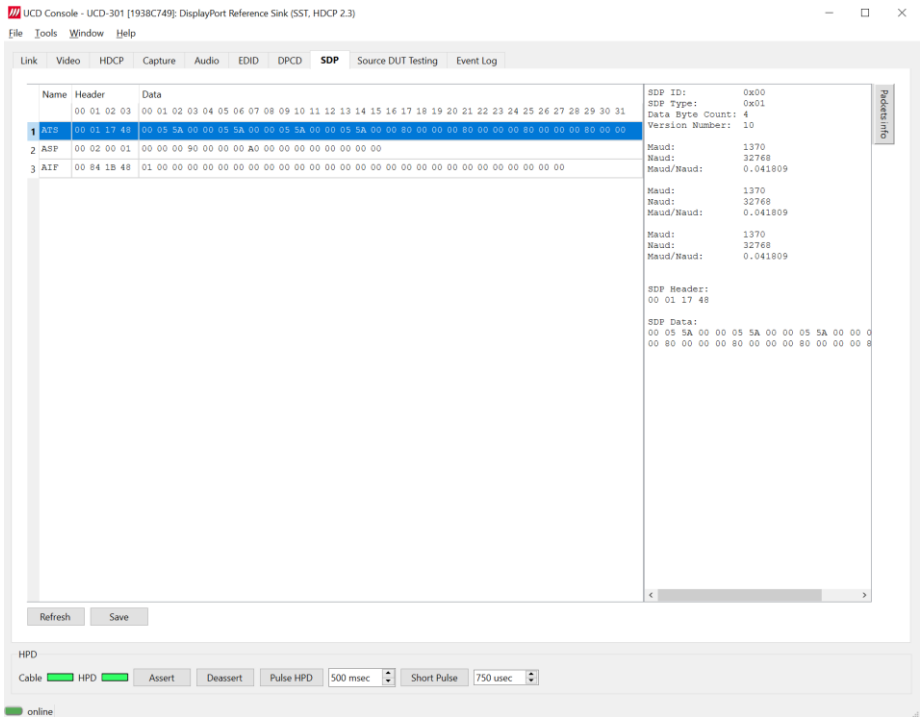
- Binary *DPCD Fata File* format (*.DPD). This is Unigraf proprietary format. You can also load the DPCD content stored in this format.
- *HEX Dump* (*.HEX) in a human readable text format.

Save: Store DPCD content to a file.

Load: Recall DPCD data saved in DPCD Data File (*.DPD) format to the editor.

SDP Tab

In SDP Tab shows the *Secondary-Data Packets* sent by the Source device. Click **Refresh** to re-read the data. Show / hide the parsed data by clicking on the arrow in the divider bar.



The following packets are recognized:

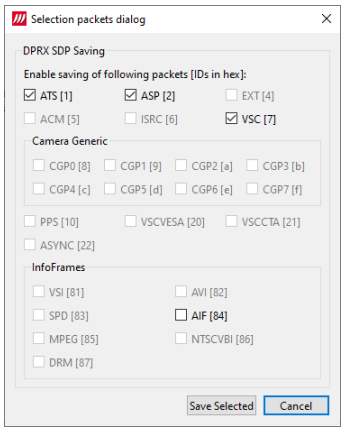
- Audio_TimeStamp
- Audio_Stream
- Extension
- Audio_CopyManagement
- ISRC (International Standard Recording Code)
- Video Stream Configuration (VSC)
- Camera Generic 0
- Camera Generic 1
- Camera Generic 2
- Camera Generic 3
- Camera Generic 4
- Camera Generic 5
- Camera Generic 6
- Camera Generic 7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

- Picture Parameter Set (PPS)

Saving SDP Packets

Packets can be saved in a file in binary format. Click *Save* and in the dialog select the packet types of choice. File name will be of format *ATS_2022-07-28T15_54_24.bin,* where *ATS* is the packet type and *2022-07-28T15_54_24* the time stamp.

Saved packets can be evaluated and edited using *Packet Editor*. Please see section *Packet Editor* later in this document.



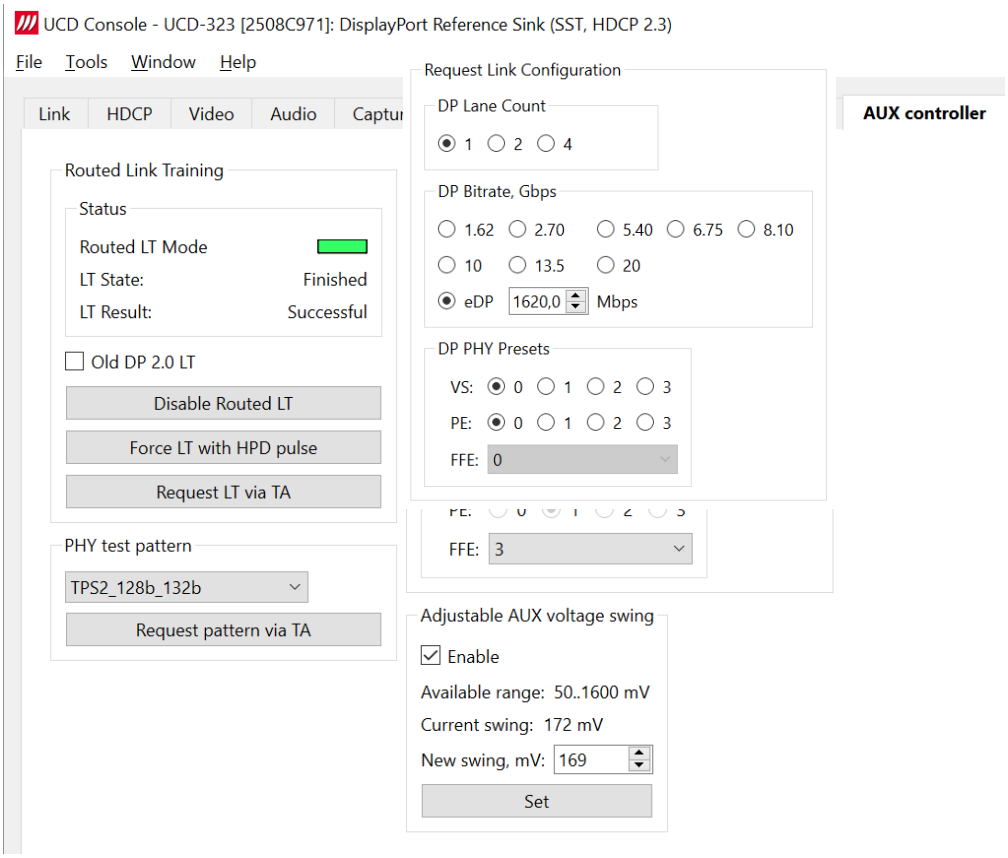
AUX Controller Tab

AUX controller allows UCD-323 to make Source DUT to train link at a specific link configuration or to output a test pattern. It does this in so-called Routed LT mode in which UCD-323 sends predefined responses to source's AUX requests, ignoring actual main link data.

AUX controller supports both 8b/10b and 128b/132b rates. Link presets are different: VS/PE for 8b/10b and FFE for 128b/132b. Test patterns are also different for 8b/10b and 128b/132b and 128b/132b. Select a 128b/132b rate to see the difference.

Old DP2.0 LT is an older procedure for 128b/132b LT (2-stage instead of new 3-stage LT). It is needed sometimes for debugging

Note: AUX Controller tab is enabled with a separata license. For detailed information, refer to Appendix B in this document.



Routed Link Training

Status displays: the *Routed LT* Mode (colored means it is active), the *LT State* (*Not Started or Finished*) and the *LT Result* (*Successful* or blank).

Old DP 2.0 LT checkbox lets you do old type 2.0 (128b/132b) link training (see above).

Select *Disable/Enable* button to toggle *Routed Link Training*.

Select *Force LT with HPD pulse* to send HPD pulse and initiate Link Trainging.

Select *Request LT via TA* to train via test automation.

PHY test pattern

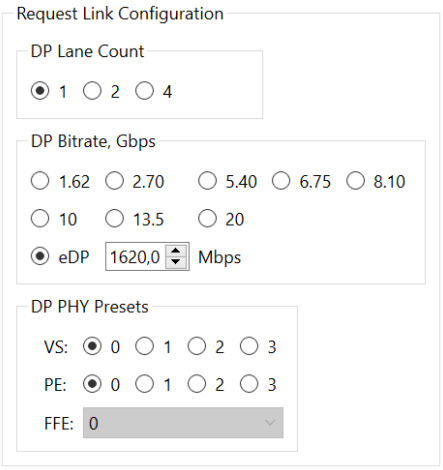
Select test pattern via combo box:

For 8b/10b: *CP2520_1, CP2520_2, PRBS7, SERM, TPS1* and *TPS2.*

For 128b/132b: *LTTPR CLOCK SWITCH test, PRBS11, PRBS15, PRBS23, PRBS31, PRBS9, SQnum, SQnum_Pre_Dis_Post_Dis, SQnum_Pre_Dis_Post_En, SQnum_Pre_En_Post_Dis, TPS1_128b_132b, TPS1_128b_132b.*

Press *Request pattern via TA* to request pattern via test automation.

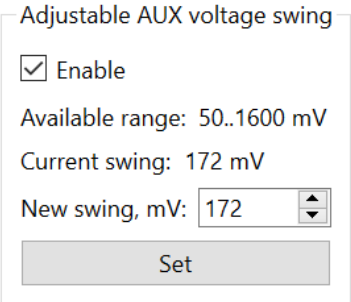
Request Link Configuration



Select the desired parameters for Link Training via radio buttons:

DP Lane Count:	Choose between 1, 2 or 4 lanes
DP Bitrate, Gbps	Available options: 1.62, 2.70, 5.40, 6.75, 8.10, 10, 13.5, 20
eDP Bitrate, Mbps:	Set the eDP bitrate in Mbps
DP PHY Presets	VS and PE levels
Pulse HPD:	Click to apply an HPD Pulse with programmable duration. Duration will be defined in the provided field.
Short Pulse:	Click to apply a short pulse. Duration will be defined in the provided field.

Adjustable AUX voltage swing



Select *Enable* checkbox to enable, Choose desired swing in edit control and press *Set* to apply.

Note:	Adjustable AUX voltage swing is only available wth UCD-323 Gen2.

HDMI Reference Sink

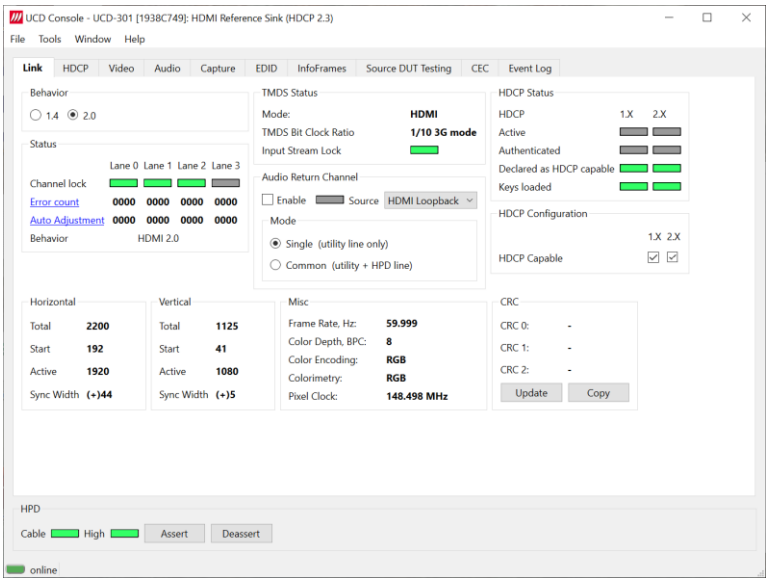
Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323, UCD-323 Gen2

When *HDMI Reference Sink* role is in use, the following interface specific tabs are available:

Tab:	Description:
Link	Status information and control of the upstream link
InfoFrames	Received InfoFrame packets
CEC	For sending and receiving CEC protocol messages and data.
eARC	eARC status and control

HDMI Link Tab

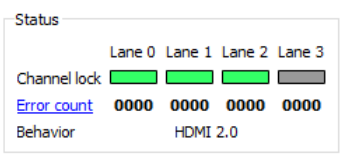
Link tab contains four panels: Behavior, Status, Audio Return Channel, HDCP Status and Configuration, Video Status and HPD.



Behavior

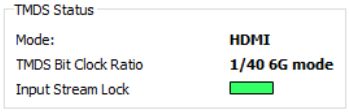
Selection of HDMI operation mode: HDMI 1.4 or HDMI 2.0 Please perform HPD **Deassert -Assert** after change of mode.

Status



Channel lock	Indication of channel lock status in TMDS links 0 to 2
Error count	Status of SCDC Error Count Registers

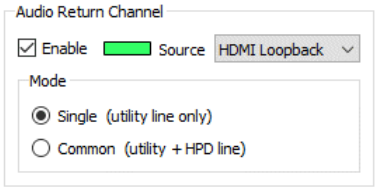
Behavior	HDMI operation mode (HDMI 1.4 or HDMI 2.0)



TMDS Status

Mode:	Indication of HDMI / DVI mode
TMDS Bit Clock Ratio:	TMDS Bit Period / TMDS Clock Period ratio (1/10 or 1/40)
Input Stream Lock:	Indication of TMDS character lock

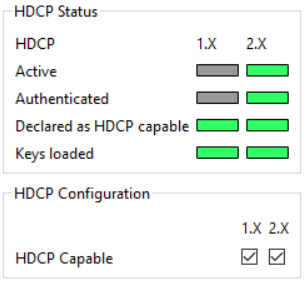
Audio Return Channel



Enable:	Select to enable eARC function.
Source:	Select the eARC audio Source to be either - Loopback of captured HDMI audio, or - Audio received in the S/PDIF input
Mode:	Select eARC mode

HDCP Status

Copy of the status from HDCP Tab. Please refer to chapter *HDCP Tab* later in this document for detailed description.



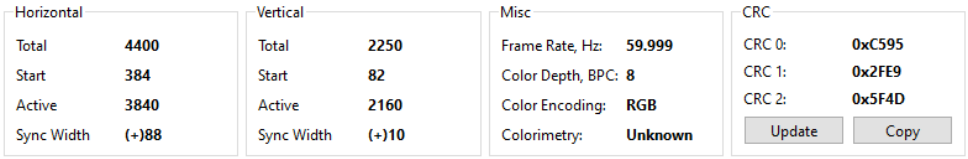
Note:	Please note that HDCP 1.3 is not supported in 3.9 release.

HDCP Configuration

Enable and disable HDCP 1.3 or HDCP 2.3 capability of UCD Sink. Duplicates of the controls found in HDCP tab.

Video Mode

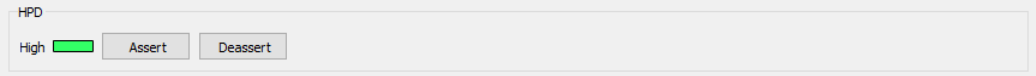
Timing and color mode details of the video as retrieved from stream metadata. Frame rate is measured by UCD Local Sink.



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**. Click **Copy** to store the information in Windows clipboard.

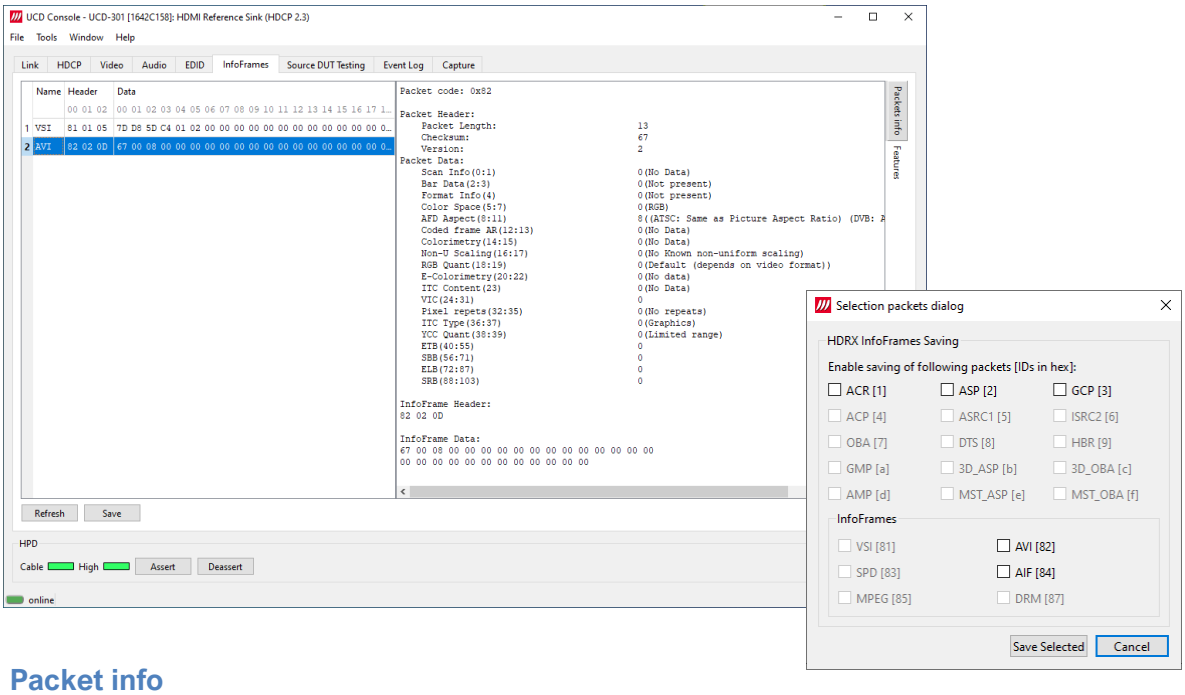
HPD



HPD LED:	Indicates that the HPD signal is Asserted (logical “high”).
Assert:	Click to re-activate the HPD line (set to logical “high”).
Deassert:	Click button to set HPD line to logical “low” (de-asserted) and hence no HPD pulse can be generated.

InfoFrames Tab

InfoFrames Tab is enabled with *UCD Pro for HDMI Sink* license. Please click **Refresh** to re-read the InfoFrame data.

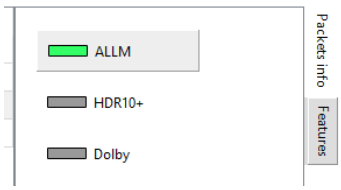


Packet info

When you select an infoframes, the corresponding row is highlighted in blue and the information of the infoframes is shown on the right hand.

Features

Features Tab shows indicators for ALLM, HDR10+ and Dolby. Please, note that the indicators are show only when compatible content is played.



Note: When the played content changes, users must use the HPD controls to first *Deassert* and then *Assert* to update the upcoming infoframes. After HPD asserting, click *Refresh.*

Save

Click **Save** to open the selection packs dialog. The following received infoframes are available:

- 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)

Saving Infoframes

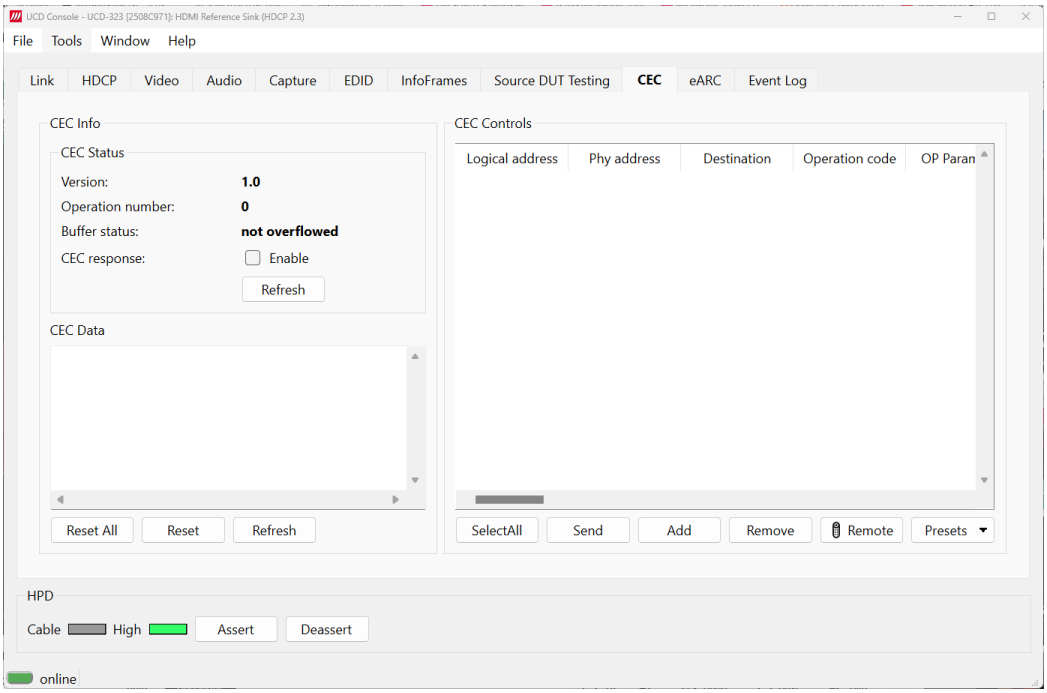
Infoframe packets can be saved in a file in binary format. Click *Save* and in the dialog select the packet types of choice. File name will be of format *EMP_2022-07-28T15_54_24.bin,* where *EMP* is the packet type and *2022-07-28T15_54_24* the time stamp.

Saved packets can be evaluated and edited using *Packet Editor*. Please see section *Packet Editor* later in this document

CEC Tab

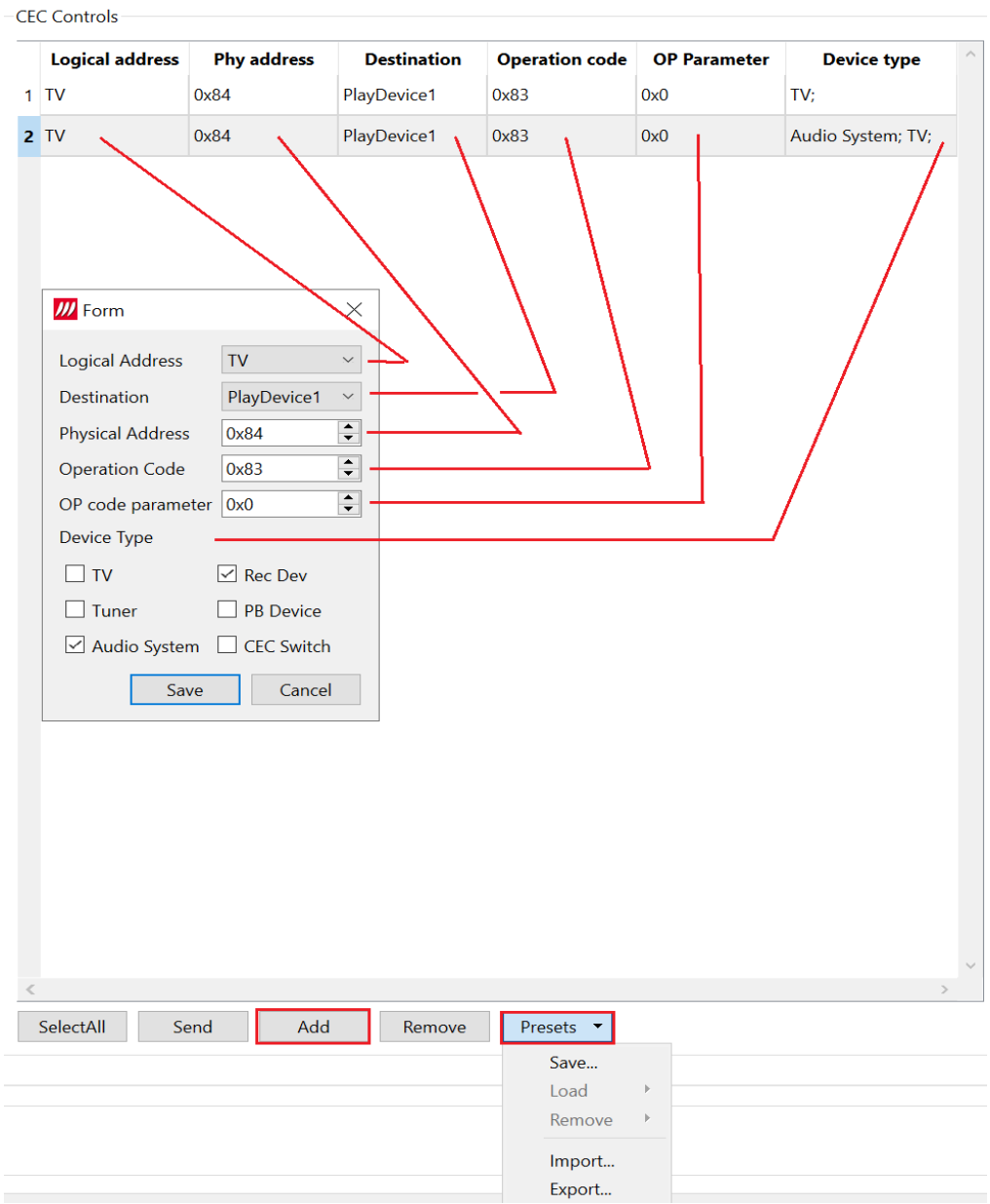
The *CEC Tab* is used for sending and receiving CEC (Consumer Electronics Control) protocol messages and data.

The *CEC Tab* is grouped into two panels: *CEC Info and CEC Controls.*



CEC Controls

Use *CEC Controls* to send data a HDMI follower via CEC protocol. Select *Add* button to add an *Operation code* with parameters to be sent to various devices.



Logical address:	*Logical address of destination*
Phy address:	*Physical address of destination*
Destination:	*Destination device*
Operation code:	*Operation code to send*
OP Parameter:	*Operation code parameter to send*
Device type:	*Sender device type*

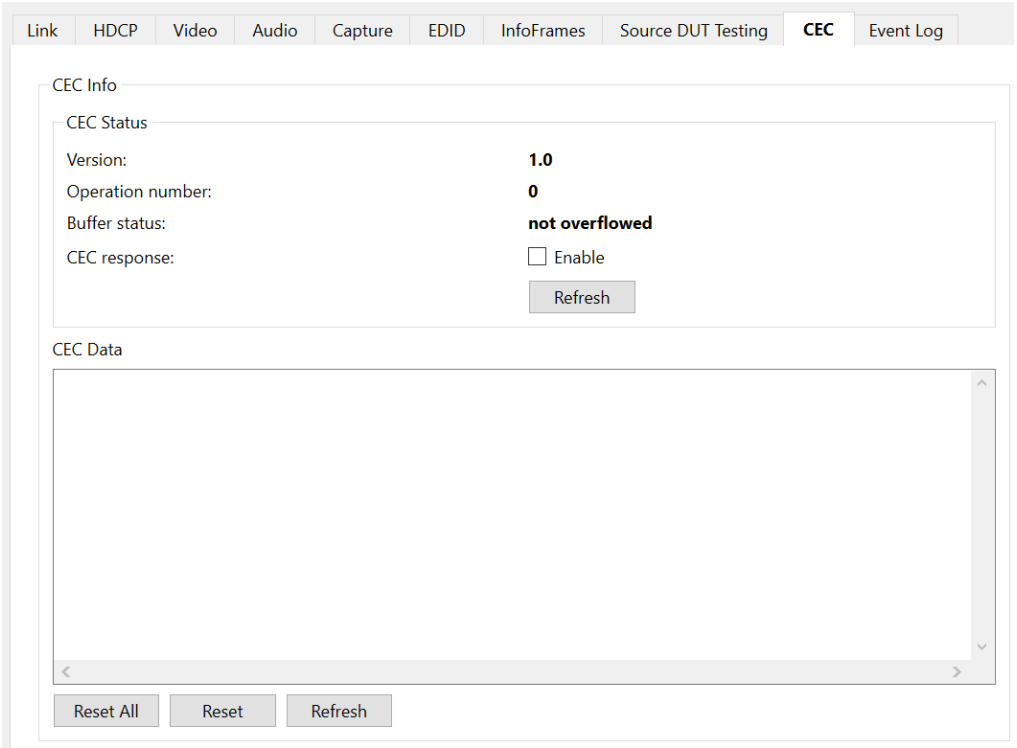
Select the rows of items in the table (or press the *Select AlII button*) and press *Send* button to transmit via HDMI CEC protocol.

Select the rows of items in the table (or press the *Select AlII button*) and press *Rermove* to delete items.

Select the *Presets* button to *Save… , Load, Remove, Import… ,* or *Export* item sets as shown above.

CEC Info

CEC data and status received can be seen in the *CEC info* panel.



CEC Status shows the CEC *Version, Operation number* and *Buffer status.* You can also enable CEC response. Press *Refresh* button to refresh.

CEC Data shows the CEC data received. Select *Reset All* or *Reset* to remove all or selected rows. Select *Refresh* to check for new data.

Remote

The interface simulates the function of a remote control.

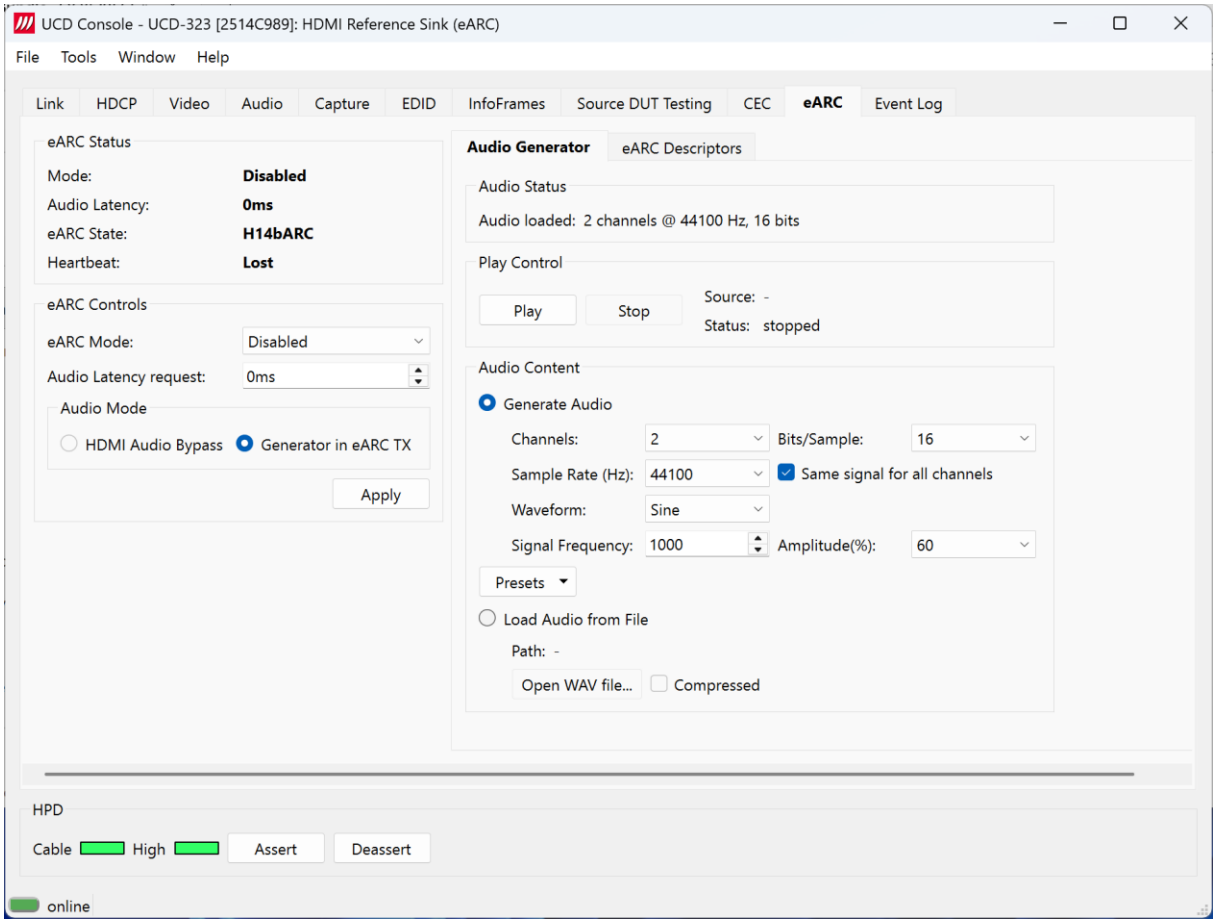
	Power Toggle		*Up*
	Power on		*Down*
	Power off		*Left*
	Root menu		*RIght*
	Exit		*Select*
CH	*Channel up* *Channel down*	Vol	*Volume up* *Volume down*

CEC Flow

	Logical address (initiator)
	Logical address (destination)
ADDR	*Physical address*

eARC Tx (enhanced Audio Return Channel Transmitter)

Note: The eARC role needs to be enabled for HDMI RX in device configuration. For instructions, refer to Change Device Configuration.



eARCTx Status

Mode:	*Active eARC mode(Arc/eArc/None)*
Audio Latency:	*Audio latency of eArcRX in milliseconds*
eARC State:	*Active eARC state (H14bARC, IDLE1, IDLE2, DISC1, DISC2, EARC)*
Heartbeat:	*Heartbeat status (only for eARC mode)*

eARCTx Controls

eARC Mode:	*Select disabled, eARC, legacy ARC or None*
Audio Latency request:	*Set the audio latency request in milliseconds*
Audio Mode:	*Set audio mode as HDMI audio bypass or generator in eARC TX*
Apply:	*Click to apply settings*

eArcTX Audio Generator

Audio Status

Audio status shows the info on the loaded audio content: amount of channels, sample rate (Hz) and bits/sample.

Play Control

Start or stop playing audio. Audio source and status also shown.

Audio Content

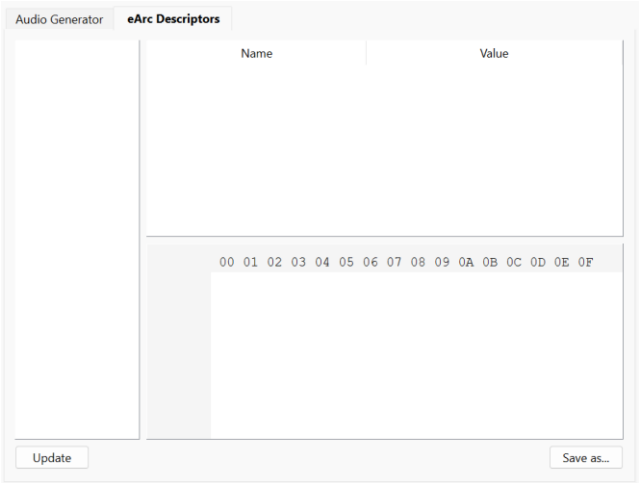
Either generate audio or load audio from a file.

Channels:	*Select 1, 2, 3, 4, 5, 6, 7 or 8*
Bits/Sample:	*Select 16, 20 or 24*
Sample Rate (Hz):	*Select 32000, 44100, 48000, 88200, 96000, 176400 or 192000*
Waveform:	*Select sine, sawtooth, square, incremental or ping*
Signal Frequency:	*Set a value between 1 and 20000*
Amplitude (%):	*Select 10, 20, 30, 40, 50, 60, 70, 80, 90 or 100*
Same signal for all channels:	*Uses same sample rate, waveform, signal frequency and amplitude for all channels. If not checked, values are selected for each channel individually.*
Presets:	*Save, Load, Remove, Import and Export audio content settings.*

Path:	*Audio file location*
Open WAV file…:	*Load WAV audio file*
Compressed:	*Compressed audio*

eARC Descriptors

This is eARC Rx EDID. eARC EDID is presented with Audio block and describes Audio capabilities for eARC RX.



5. GENERATOR OPERATION

When used as a *Generator* UCD-3XX devices act as DisplayPort or HDMI Source or Transmitter devices.

User is selects device role when opening the Device when launching UCD Console. Selecting *DP Reference Source* or *HDMI Reference Source*, UCD Console operates as Generator.

Functionality Tabs

UCD Console features are presented in tabs. Standard tabs are similar in all functional roles, Interface Specific tabs present features and controls that are only available for a particular interface.

Some of the tabs are enabled by default, some only when an applicable license is included.

Standard Tabs

Generator role features six standard tabs:

- Video pattern generator (Pattern Generator).
- Content Playback (Playback)
- Audio generator (Audio)
- EDID editor (EDID).
- HDCP status monitor and control (HDCP).
- Sink DUT Testing
- Event Log

Interface Specific Tabs

Based on the connected UCD device, additional interface specific tabs will be available.

UCD-323, UCD-323 Gen2

DisplayPort Reference Source:

Tab:	Description:
Link	Status information and control of the upstream link
DPCD	For monitoring and editing the DPCD registers of the connected DisplayPort sink

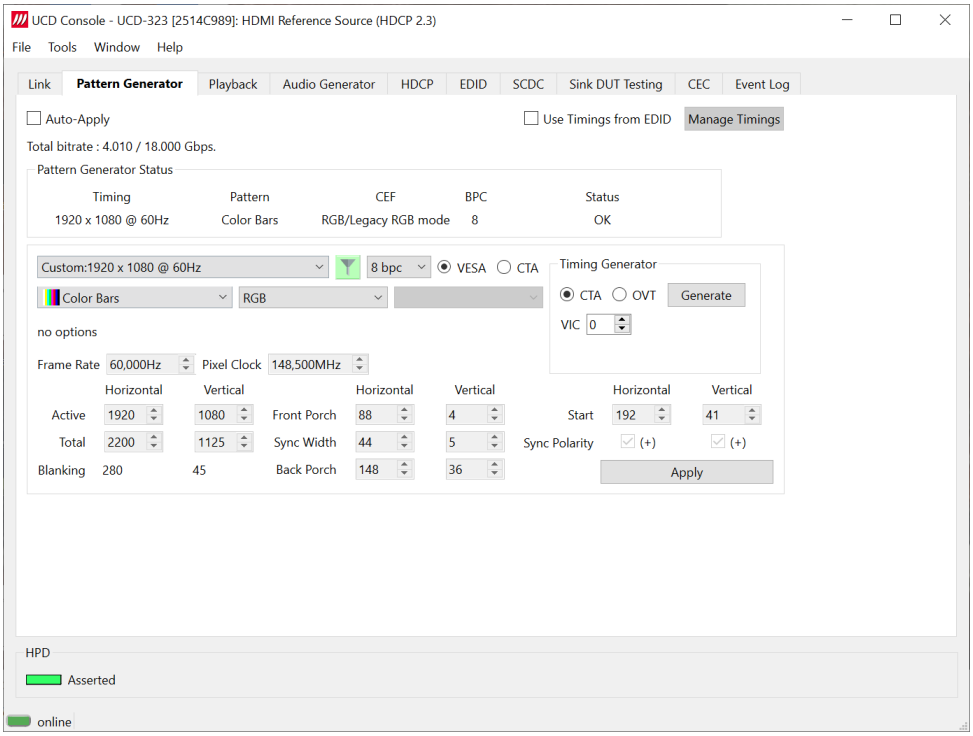
HDMI Reference Source:

Tab:	Description:
Link	Status information and control of the upstream link
SCDC	Presents content of HDMI Status and Control Data Channel

Note:	Some of the tabs are enabled by default, some only when an applicable license is included. Please refer to Appendix B Licensing of this document for description of features and licensing.

Standard Tabs

Pattern Generator Tab



Auto-Apply	In order to avoid sourcing invalid video mode combinations new settings are being validated when the user is clicking Apply. Automatic validation will be applied when *Auto-Apply* is checked.
Use timings from EDID	UCD reads the EDID of the connected Sink and lists only timings that are featured there.
Manage Timings	Please see chapter *Manage Timings* later in this manual
Total bitrate	Used link payload / Total link capability in Gbps
Apply	Apply recent changes

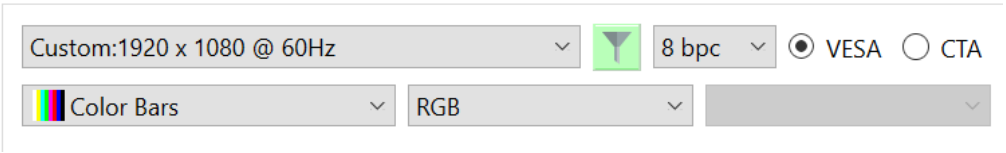
Pattern Generator Status

Pattern Generator Status

Timing	Pattern	CEF	BPC	Status
1920 x 1080 @ 60Hz	Color Bars	RGB/Legacy RGB mode	8	OK

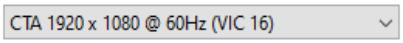
Pattern Generator Status window shows the current state of the video stream including timing, pattern, CEF, BPC and status.

Timing and Pattern Controls



Controls include selection of Predefined Timings, Color Depth, Video Pattern and Pattern Options.

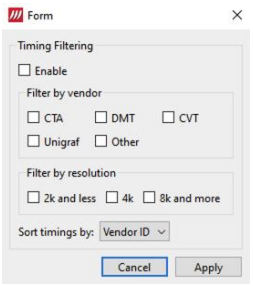
Predefined Timings



The list includes a set of common fixed video timings. Please find a list of the timings with their major details in Appendix C of this document. With *Manage Timings* function the user can add timings to the list and limit which timings are shown in the selection.

Filter

Filter timings by specific vendors and resolutions. Click **Enable** to use filters. Timings can be sorted by Vendor ID or width.



Color Depth

Available color depths are: 6, 8, 10, 12 and 16 bpc. Color depth 6 bpc is only available when using RGB color format in DisplayPort.

Quantization Range

VESA 8 bits per color ranges transmitted with full color bits: 0 to 255.

CTA 8 bits per color ranges transmitted with limited color bits: 16 to 235.

Video Pattern

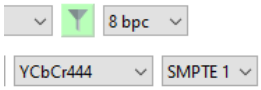
The selection includes a set of predefined patterns and a possibility to load user defined custom patterns. Please find a description of the available predefined patterns in Appendix D of this document. By selecting **Disabled** you can have the links activated but no video data transferred.

Custom Image Patterns

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

Please refer to *Link Pattern* in description of *DP Reference Source* role *Link tab* later in this manual for sending special binary patterns in the link instead of video.

Color Mode, Color Depth and Colorimetry

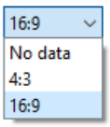


The table below lists the available color modes and related available color depths. Please, note that YCbCr color modes are only available with specific patterns such as color square pattern.

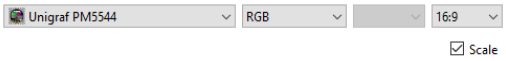
Selection	Color Format	Subsampling	Available Color Depths	Available Colorimetry
RGB:	RGB	4:4:4	6, 8, 10, 12 and 16 bpc	N/A
YCbCr444:	YCbCr	4:4:4	8, 10, 12 and 16 bpc	SMPTE 1 and ITU 709
YCbCr422:	YCbCr	4:2:2	8, 10, 12 and 16 bpc	SMPTE 1 and ITU 709
YCbCr420:	YCbCr	4:2:0	8, 10, 12 and 16 bpc	SMPTE 1 and ITU 709

Aspect Ratio

Available in UCD-323 with HDMI Tx role. Aspect ratio data for infoframes. Available options are no data, 4:3 and 16:9.



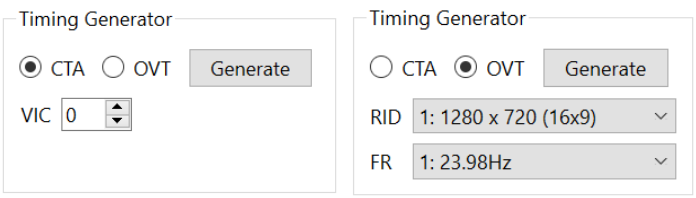
Pattern Options



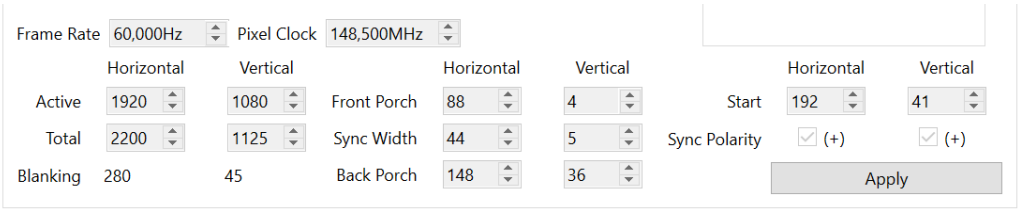
Some of the predefined patterns include additional configuration parameters. The controls for the parameters appear below the pattern selection when the pattern in question has been selected. Please find a description of patterns options in Appendix D of this document.

Timing Generator

Generate CTA or OVT timings.



Timing controls



Users can use the fields to modify the timing details.

MST (UCD-323 special FW configuration)

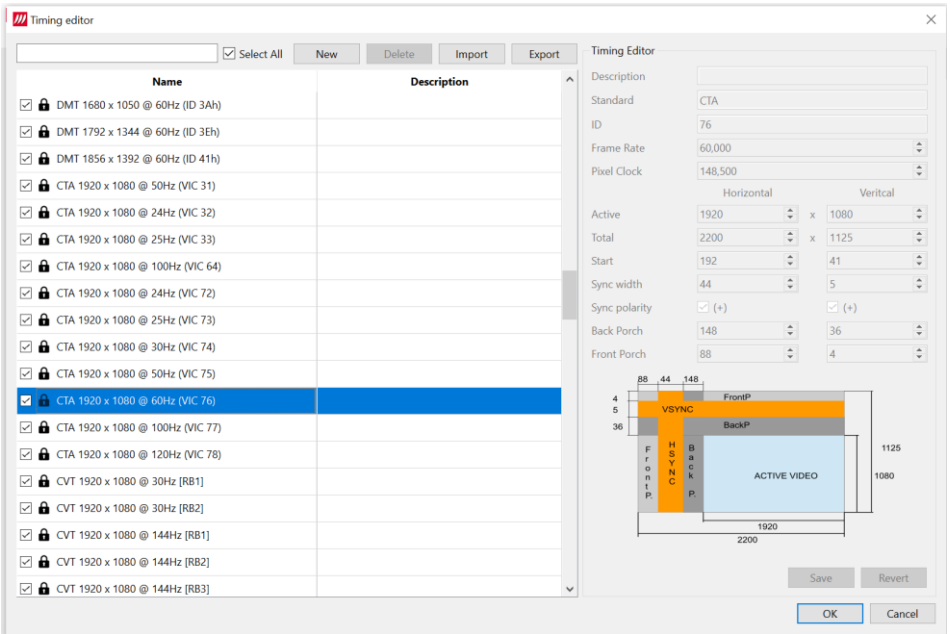
Multistreaming is available with UCD-323 FW configuration:
“DisplayPort Reference Source (MST – 2 streams, HDCP 2.3)”

Check-box for enabling Multi-stream mode and number of streams sourced. Duplicate of controls in *Link* tab. When *MST* is enabled, the streams can also be enabled and disabled from the check-boxes next to stream name.

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.

Manage Timings

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



Customizing Timings List

The list of timings that are shown on the pull-down menu in Pattern Generator and Link tabs can be limited by un-checking the check-box in the left edge of *Name* column. The timings will remain in the list and can be brought back to the pull-down menu, when needed.

Editing Timings

Video timing Name and Description are shown in the list. Lock icon 🔒 indicates that a timing is a fixed timing which cannot be edited or deleted. Custom timings are indicated with a head icon 👤.

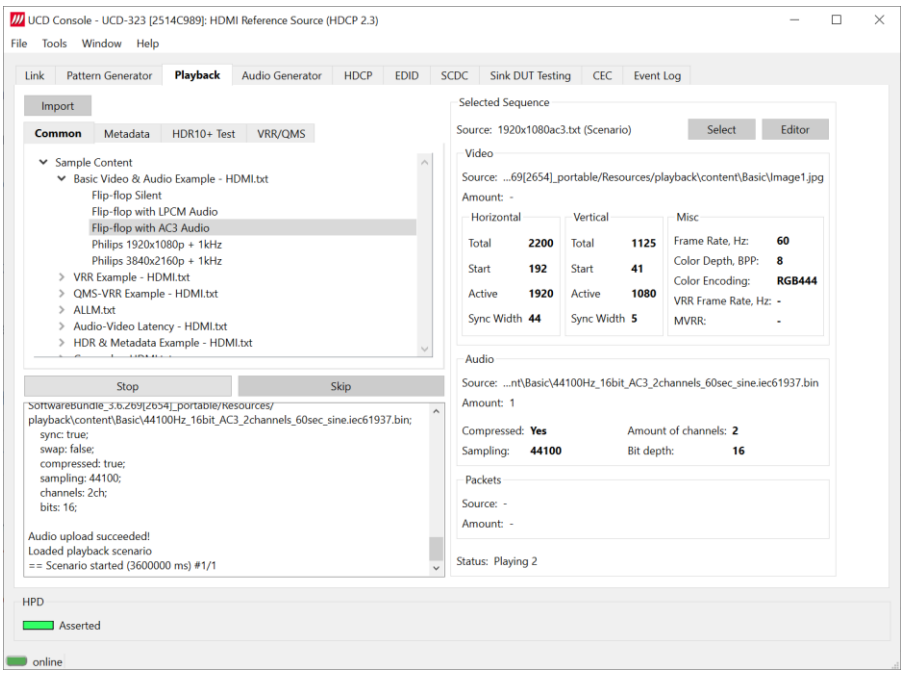
New: Create a new custom timing based on the selected fixed timing.

Save: Save changes in the selected custom timing.

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

Playback Tab

Playback allows for running predefined *Playlist* files. Playlist contains a set of *Scenarios* with definitions of the timing, video pattern, audio content and related metadata packets and their duration. You can import playlists by clicking *Import.*



Term	Functionality
Playlist	*Playlists* (text files) specify the UCD devices and output protocol for transmission. It lists *scenarios* to be transmitted.
Scenario	Scenarios (text files) allow users to select video frames, metadata packets and audio to be transmitted and their order.
Advanced Playlists	Unigraf UCD devices can be used as compatibility test tools for dedicated standards such as Dolby Vision™ and HDR10+. Contact Unigraf for details.

Note:	Please note that Playlists and Scenarios are protocol dependent. The provided examples are also somewhat different for HDMI and DisplayPort.

Common Tab

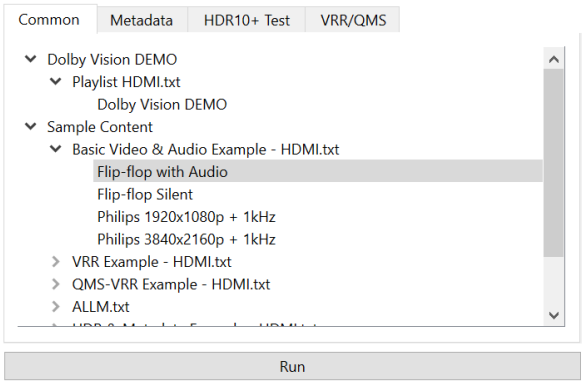
The *Import* button is for importing *.json files into the *common* tab treeview. Sample content on windows can be found at C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\basic_library.json. Be **warned** that once imported, items cannot at present be removed. Actually you can but it involves using *Windows Register Editor* to remove values from (uninstall will not help):

Computer\HKEY_CURRENT_USER\SOFTWARE\Unigraf\UCD Console\Playback

Computer\HKEY_CURRENT_USER\SOFTWARE\Unigraf\UCD Console\MetadataScenario

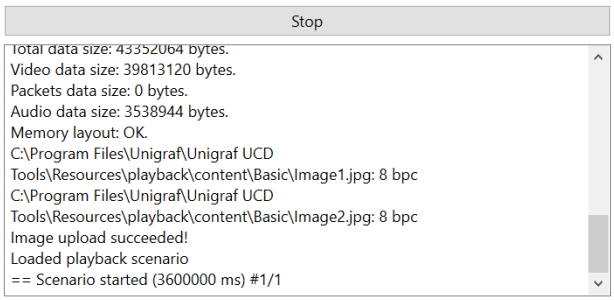
Sample playlists are included in UCD Console. Select a sequence (a playlist or scenario) from the *Sample Content treeview* and press *Run* (or double click it) to play.

The *Run* button label changes to *Stop* as a *Scenarios* run. Press *Stop* to stop playing the scenario. Press *Skip* to skip to next scenario (available when there are multiple scenarios in a playlist) while playing. While the *scenario* is loading the *Run* button label changes to *Cancel* to allow cancelation.



Status Log

Scenario commands are listed in the *Status Log* as they are run.



Selected Sequence

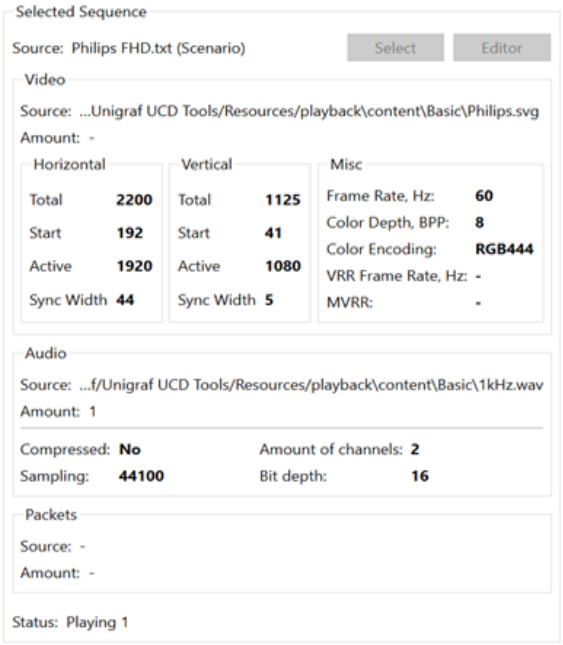
Running scenario video and audio details and their sources are shown in the *Selected Sequence* group panel.

Note that the triggered scenario or playlist to be run is the last selected: If an item was selected via the *treeview*, it is the triggered item to be run. If the *Select* button was used to select an item, it is the triggered item to be run (regardless of what is selected in the tree control).

Press the *Select* button to load a *playlist* or *scenario* to be run (selecting a sample from the *Sample Content treeview* will load them as the *playlist* or *scenario* to be run). It will also be the *scenario* used as a template if the *Scenario Editor* is launched: default scenario values will be set if a playlist is selected.

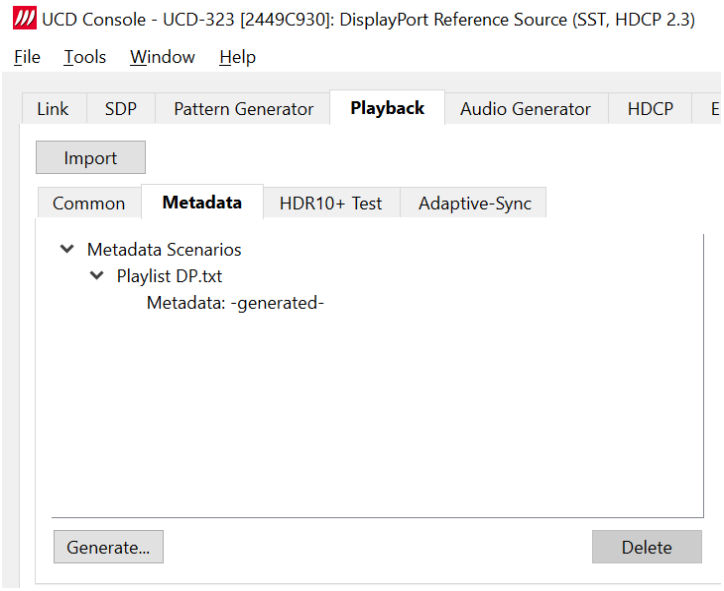
Press the *Editor* button to launch the *Scenario Editor* (see below).

The *Selected Sequence* group panel displays transmission parameters.

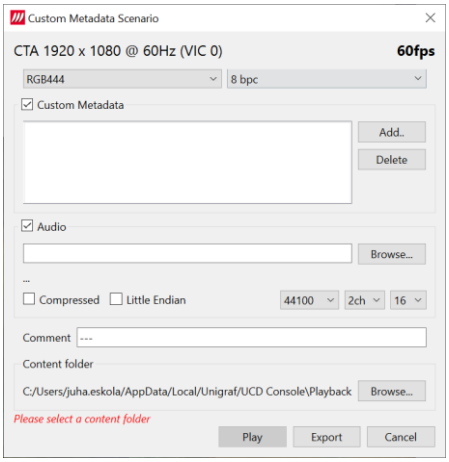


Metadata Tab

The *Metadata tab* is for creating scenarios with metadata.



Select the *Delete* button to delete a *scenario* or the *Generate* button to launch the *Custom Metadata Scenario* dialog (shown below).



Current *Pattern Generator* timing details are shown at the top (CTA 1920 x 1080 @ 60Hz (VIC 0) above). You can change the color mode (RGB444, YUV444, YUV422, YUV420) and color depth (8 bpc, 10 bpc, 12 bpc, 16 bpc) via the dropdown combo boxes.

Select the *Add* or *Delete* buttons to add or remove metadata from the scenario.

Check the *Audio* checkbox and then the *Browse…* button to add an audio file. Sampling, channels and bits can be selected via the combo boxes.

The *scenario Comment* can be added in line edit box after the three dashes (---).

Use the *Content folder Browse…* button to select save location.

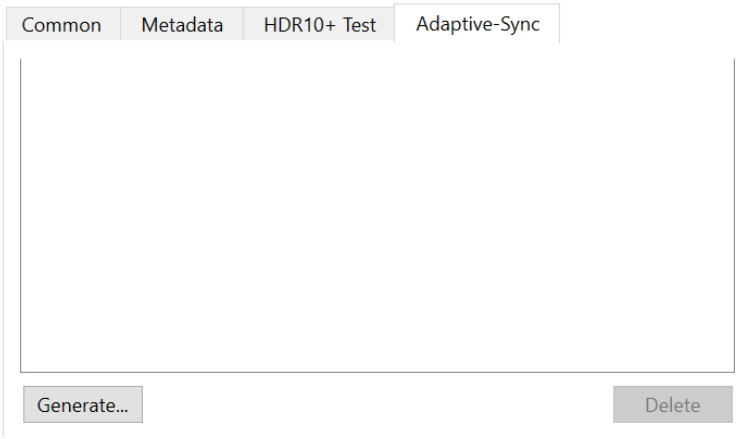
You can press Play to run the *scenario*, *Export* to save it or *Cancel* to cancel.

Export will create a folder something like Metadata1920x1080@60-RGB444-8bpc in the *Content folder.* In it you will find generated files frame.svg (displayed while running), the metadata files you selected and a scenario.txt file. You may edit and rename these files.

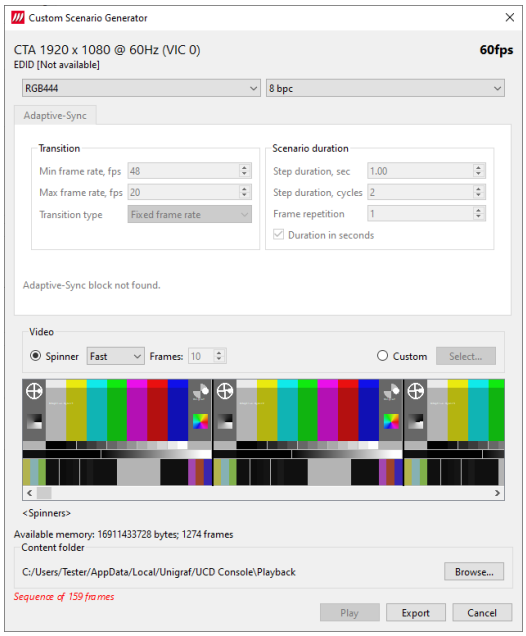
HDR10+ Test Tab

Please refer to HDR10+ CTS User Manual for detailed description of the tab.

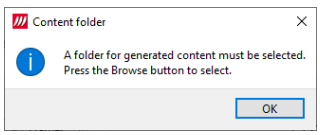
Adaptive-Sync Tab



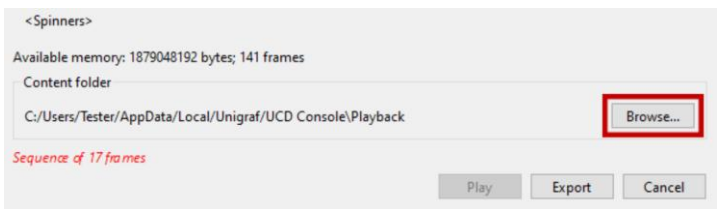
Select *Generate* to generate custom Adaptive-Sync scenarios. Custom Scenario Generator window will open.



First you are asked to select the folder where the generated content will be stored.



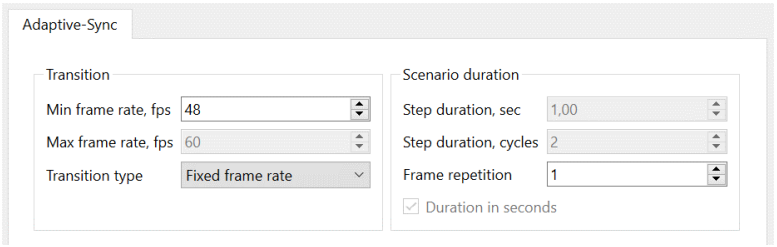
Click *Browse…* to select the folder.



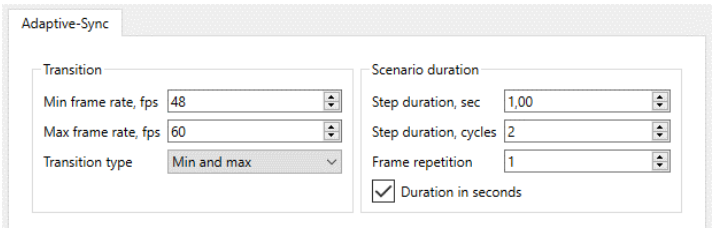
Adaptive-Sync settings

In the Adaptive-Sync section you can set the transition and scenario duration parameters. Different transition types are Fixed frame rate, Min and max and Gradual.

When *fixed frame rate* is selected, the scenario is played at the minimum frame rate set in the first field. In scenario duration, select how many times frame is repeated.

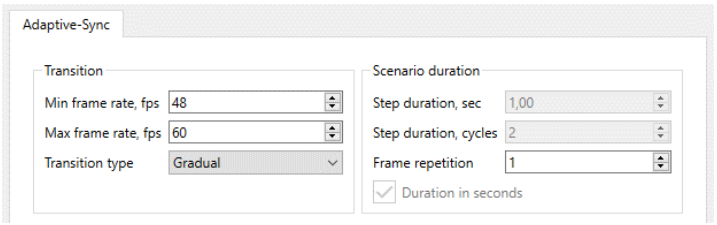


When *min and max* is selected, the output scenario will alter the framerate between the two values set in the drop down menus. You can also set the duration for step in seconds and select how many times frames are repeated.

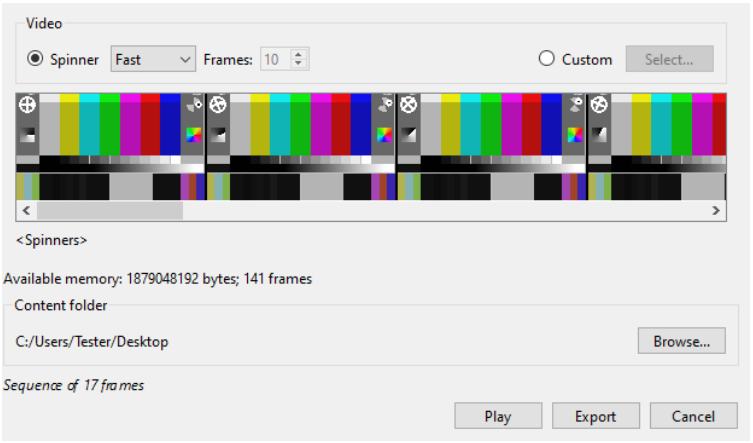


When *gradual* is selected, the frame rate is changed with each frame. For example, when min frame rate is set at 20 and max is set at 60 and the scenario has 40 frames, frame rate would be incremented by 1 with each frame.

Info at the bottom of the segment shows the minimum and maximum values for VRR framerate defined in EDID, and the base frame rate set in the pattern generator.



Video

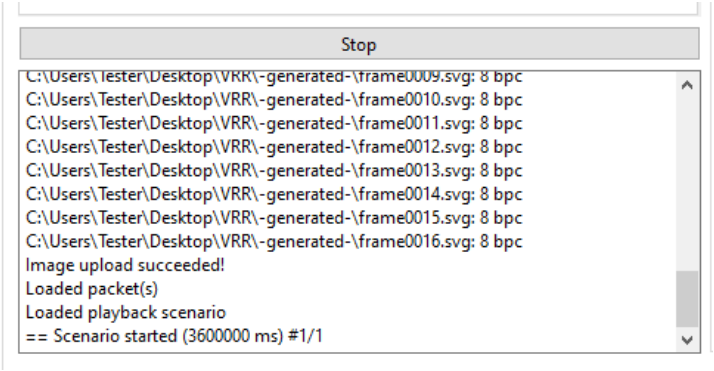


The section at the bottom shows details of the output video. The default pattern is a spinner. You can select the speed of the spinner video from the predefined options in the drop-down menu or you can set a number of frames it takes for the spinner to rotate a full circle. You can also select a custom video. The supported file types are .jpg, .png, .gif, .bmp, .tiff, .ppm and .tif

Available memory is shown in bytes and frames. Below, the folder selected for the sequence is shown. You can change the folder by clickin Browse… Lastly, the duration of the sequence is shown in frames.

You can export the scenario by clicking *Export.* When exporting, you are asked to select a location for the export. The content folder will be automatically created in the chosen location. The folder inlcudes the image files, packets and scenario parameters.

You can play the scenario by clickin *Play.* When the scenario starts playing, the scenario generator window will close. You can now inspect the progress in the log in the palyback tab as shown below.

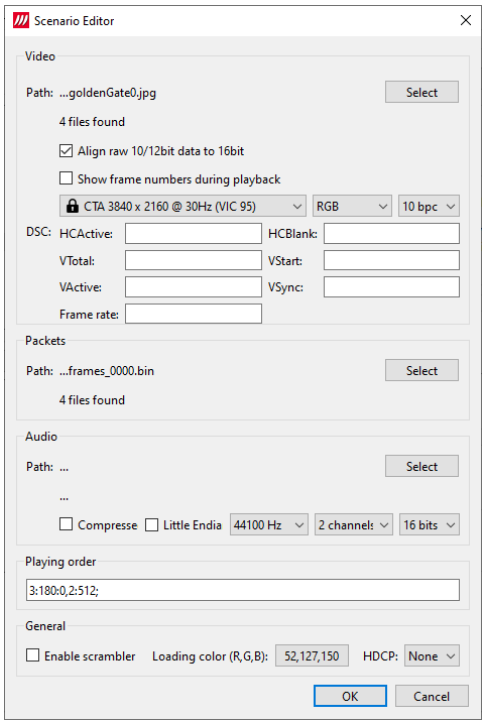


Scenario Editor

Press the *Select* button (shown above) to select a playlist scenario desired to use as a template for creating a new scenario. Press the *Editor* button to launch the *Scenario Editor*. The the dialog parameters will be generated from the scenario file shown under the panel *Source* label (*Philips FHD.txt* as seen above) or default values if a *playlist* is selected.

Press *OK* to save. You are presented with a save dialog. You need to navigate to a directory you can save to. Run Console 2 with **administration rights** if you want to save to default locations on windows such as: C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\content.

Refer to Appendix H: Playlists and Scenarios later in this manual for details.

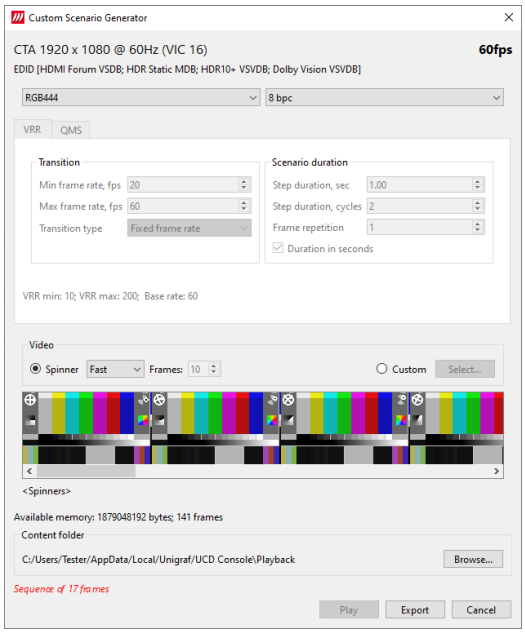


HDR10+ Test Tab

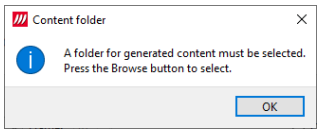
Please refer to HDR10+ CTS User Manual for detailed description.

VRR/QMS tab

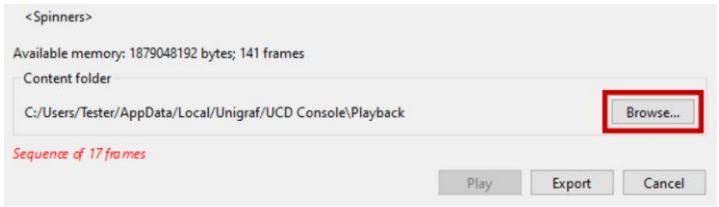
Click *Generate* to generate custom VRR and QMS scenarios. Custom Scenario Generator window will open.



First you are asked to select the folder where the generated content will be stored.

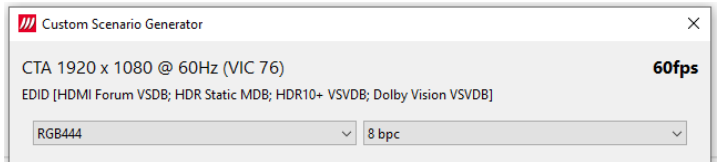


Click *Browse…* to select the folder.



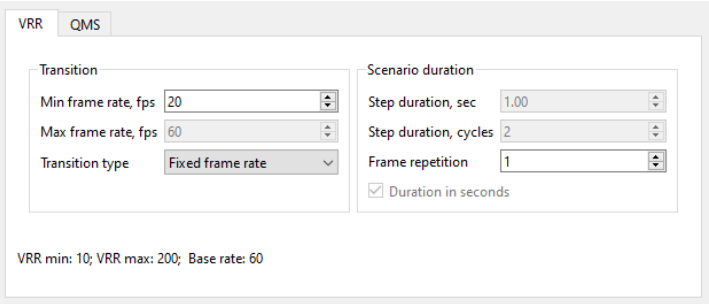
Timing details

The uppermost part of the window shows the timing details. Please, note that the timing is set on the pattern generator tab. You can change the color mode (RGB444, YUV444, YUV422, YUV420) and color depth (8 bpc, 10 bpc, 12 bpc, 16 bpc).

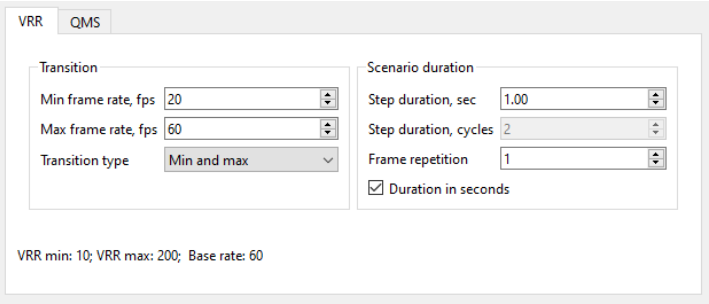


VRR settings

In the VRR tab you can set the transition and scenario duration parameters. Different transition types are Fixed frame rate, Min and max and Gradual. When *fixed frame rate* is selected, the scenario is played at the minimum frame rate set in the first field. Please, note that when the fixed frame rate is selected, you can only select the number of times the frame is repeated.

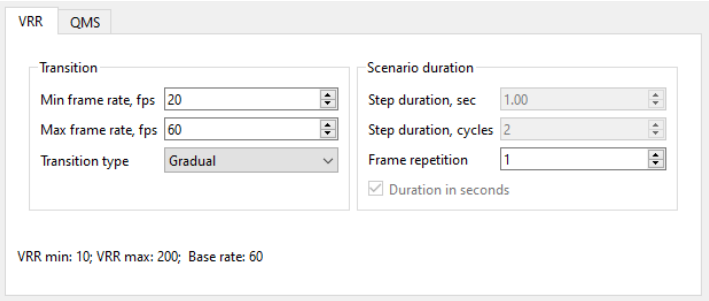


When *min and max* is selected, the output scenario will alter the framerate between the specified values. You can also set the duration for step in seconds and select how many times frames are repeated.



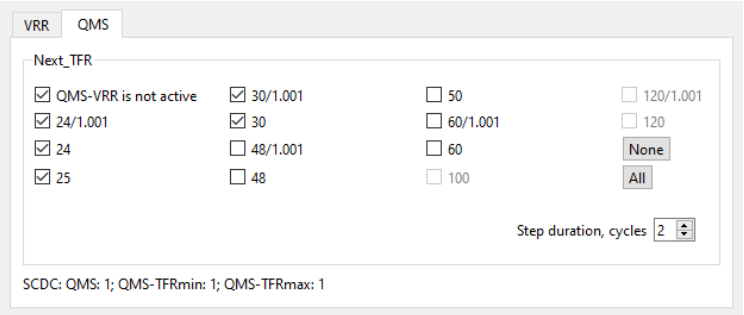
When *gradual* is selected, the frame rate is changed with each frame. For example, when min frame rate is set at 20 and max is set at 60 and the scenario has 40 frames, frame rate would be incremented by 1 with each frame.

Info at the bottom of the segment shows the minimum and maximum values for VRR framerate range defined in EDID, and the base frame rate set in the pattern generator.

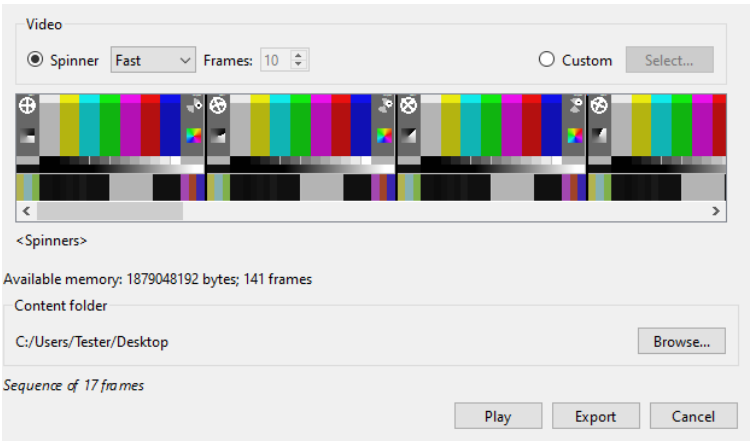


QMS settings

In the QMS settings dialogue you find all the frame rates included in the QMS specification. Select which frame rates you want to include in your scenario. Also select the step duration in cycles. In the lower left corner details of the scenario as shown.



Video

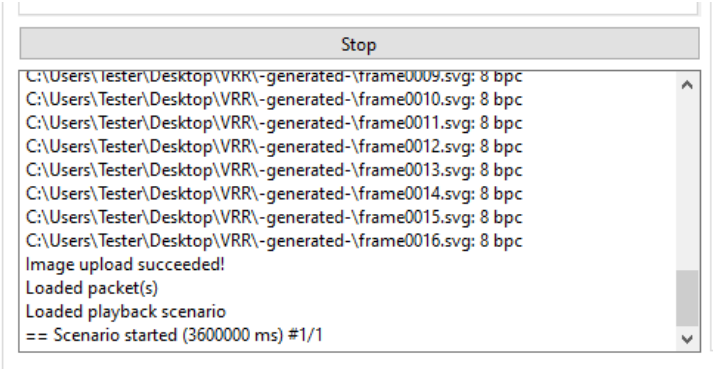


The section at the bottom shows details of the output video. The default pattern is a spinner. You can select the speed of the spinner video from the predefined options in the drop-down menu or you can set a number of frames it takes for the spinner to rotate a full circle. You can also select a custom video. The supported file types are .jpg, .png, .gif, .bmp, .tiff, .ppm and .tif

Available memory is shown in bytes and frames. Below, the folder selected for the sequence is shown. You can change the folder by clicking Browse… Lastly, the duration of the sequence is shown in frames.

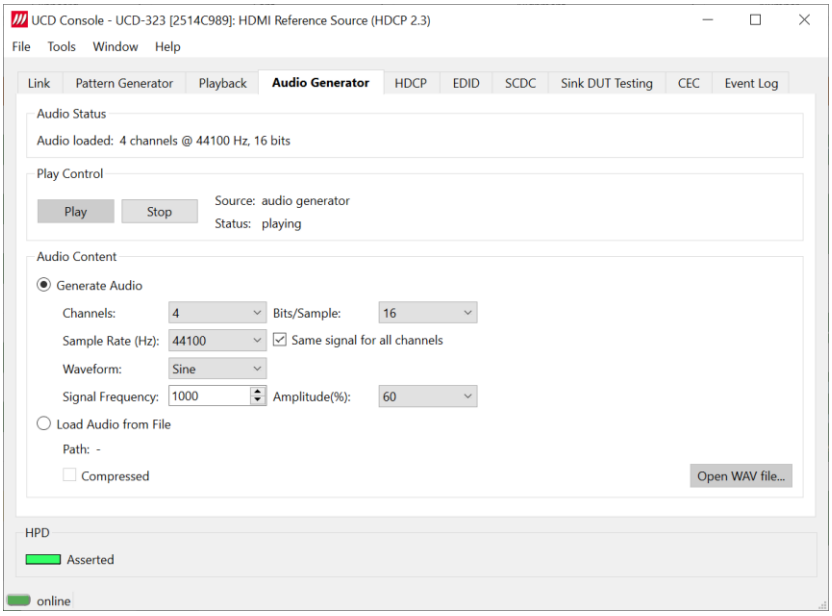
You can export the scenario by clicking *Export.* When exporting, you are asked to select a location for the export. The content folder will be automatically created in the chosen location. The folder includes the image files, packets, and scenario parameters.

You can play the scenario by clicking *Play.* When the scenario is ready for playing, the scenario generator window will close. You can now inspect the progress in the log in the playback tab as shown below.



Audio Generator Tab

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 *Open*.

The *Compressed* checkbox indicates that the audio loaded from the selected file is compressed.

To play the selected audio content, click *Play*.

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

Audio Status displays current audio content status.

Audio Content

Sent audio can be generated internally or used a WAV file loaded from the PC.

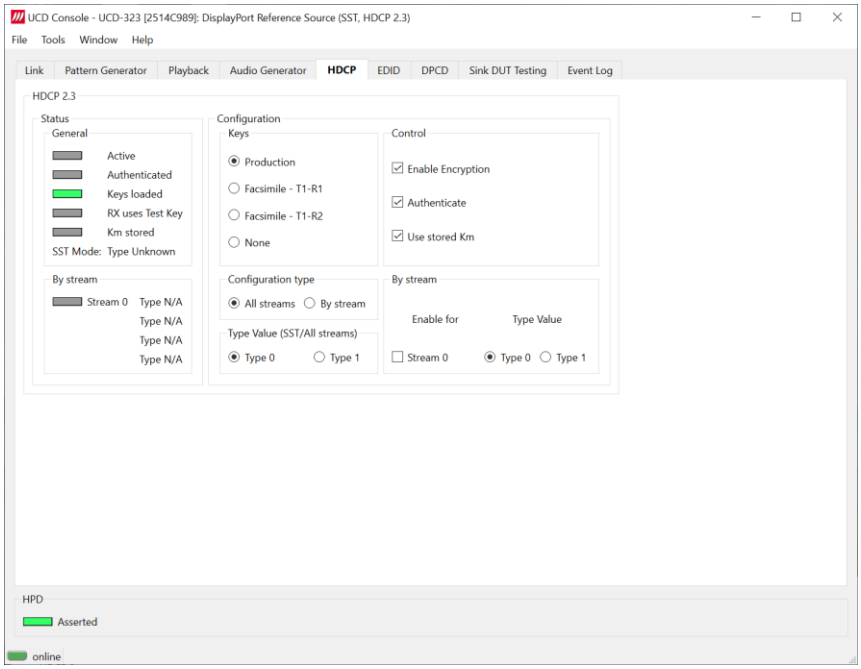
In case of a WAV audio file, the parameters stored in the file will be used. When generating audio internally, the user sets the details of the LPCM Audio signal.

Channels	Audio channels available: 1, 2, …, 7, 8. Channels transmit LPCM (uncompressed) Audio.
Sample Rate (Hz)	Selection of audio sampling rate: 32000, 44100 (default), 48000, 88200, 96000, 176400, 192000.
Waveform	Selection of audio waveform: Sine, Sawtooth, Square, or Incremental.
Signal Frequency	Setting audio signal frequency in Hz.
Bits/Sample	Selection of sample bit depth: 16, 20, 24.
Amplitude(%)	Selection of audio amplitude: 10%, 20%, …, 90%, 100%.
Same signal for all channels	When deselected, you can choose the waveform, amplitude, signal frequency and shift separately for each individual channel

HDCP Tab

HDCP tab is the dialog for monitoring the HDCP (for *High-Bandwith Digital Content Protection*) status and controlling the HDCP capabilities of the UCD-300 device.

Note:	Please note that HDCP 1.3 is not supported in 3.9 release.



Status

The status fields indicate the HDCP status of the UCD device.

Active:	The stream between UCD and the downstream sink has been encrypted.
Authenticated:	HDCP handshake between the UCD and the sink unit has been completed successfully.
Keys loaded	HDCP keys are loaded to the UCD unit.
RX uses Test ey	
Km stored	

Control

Enable encryption	Check to enable the encryption of the stream between UCD and the downstream sink.
Authenticate:	Perform the HDCP initiation handshake between the UCD and the sink unit.

Keys

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

Content level

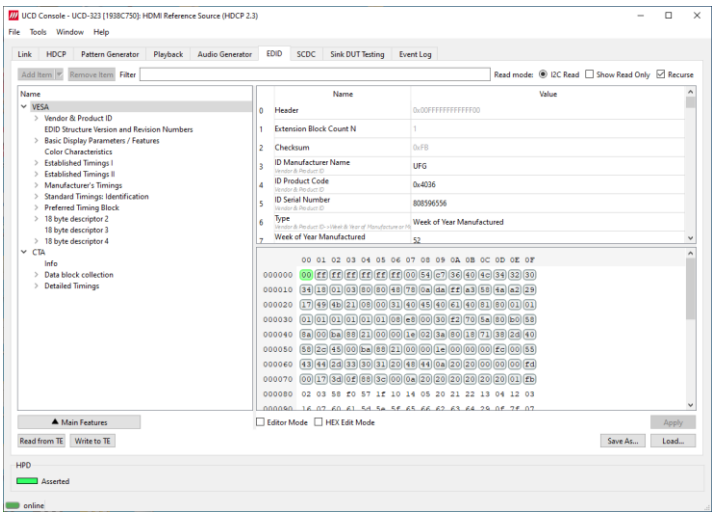
Selection of Type 1 content ensures that content encryption is done with HDCP version 2.2 or higher.

HDCP 1.3 / 1.4 vs. HDCP 2.3

UCD-300 devices support by default HDCP 1.3 / 1.4 standard. The functionality for supporting HDCP 2.2 / 2.3 is enabled with HDCP 2.3 Support license

EDID Tab

EDID Tab provides tools for accessing the EDID and Display ID of the connected DisplayPort sink. There are three basic functions:



- Load and save EDID data files in the host PC
- Edit the EDID contents either in EDID Editor or in hex format
- Program and read the contents of the EDID of the connected sink

EDID Files

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

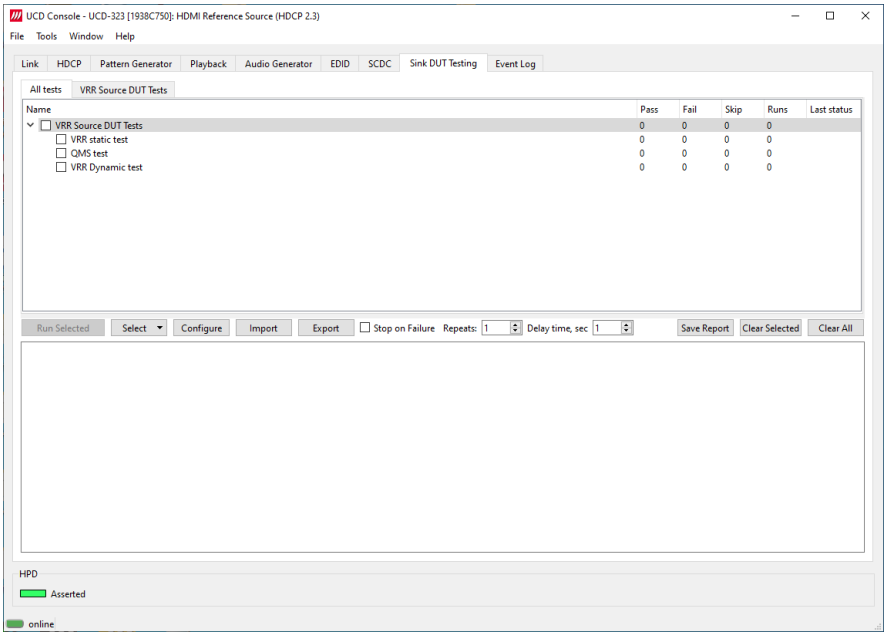
Note: Four blocks (512 bytes) of EDID code is read. If the device is not supporting all four blocks, the non-supported area is replaced with blanks.

EDID Editor

Please see the description of the EDID editor in Chapter EDID Editor later in this document

Sink DUT Testing Tab

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.

Run:	Run a selected test. You can select a test for running by clicking on the corresponding row. When selected, the row will be highlighted in blue.
Run Checked:	Click to start checked tests. By clicking *Abort* the sequence is stopped.
Select:	Includes the following options for creating templates for tests execution: Select All, Clear All, Invert All, Save, Import and Export
Configure:	Clicking opens a dialog for defining the test parameters for the selected test set. Please refer to *Test Parameters* below for details.
Import:	Load saved test parameter files (*.td or *.json).
Export:	Save test parameters for later use or for use in test automation. For saving parameters for later use in UCD Console, either format can be used. For saving parameters for TSI scripting, please use *.td files. For use with Python applications, please use *.json files.
Stop on Failure:	Stops execution of the selected tests if one of the tests fail
Repeats:	Repeat the selected test several times
Delay time:	Delay in seconds between individual tests.

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.

Save Report:	Click to generate a HTML report file for sharing the results with other parties for viewing without UCD Console.
Clear Log:	Clear the test log and the results matrix

Test Parameters

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

Description of parameters for each test set can be found within the description of tests in Appendix E of this document.

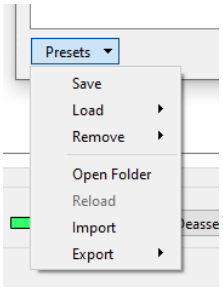
Saving Test Parameters

Test parameters can be saved in various ways.

- Export parameters in *Sink DUT Testing* tab to a *.td file for later use in UCD Console or with TSI scripting or sharing.
- Export parameters in *Sink DUT Testing* tab to a *.json file for later use in UCD Console or with Python applications or sharing.
- Save parameters in *Configure* dialog as Presets to be later used in Console. Please find a description below.

Presets

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



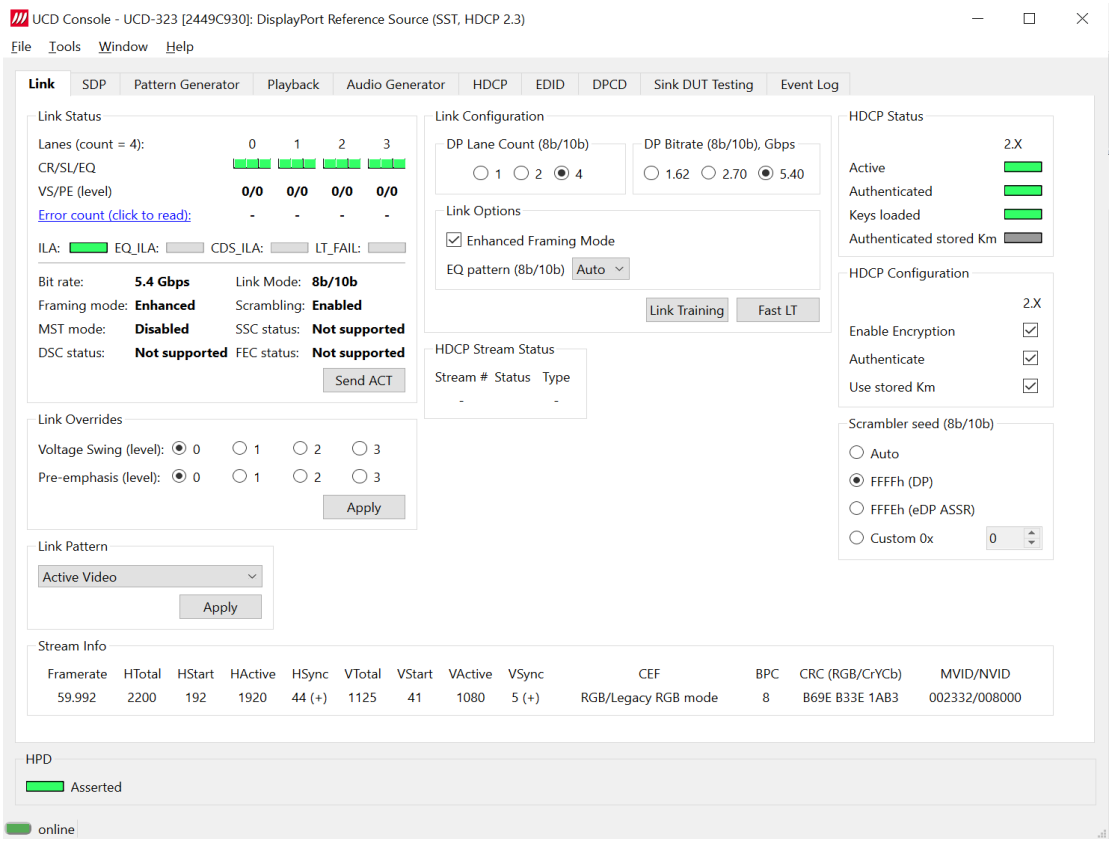
DP Reference Source

When role *DP Reference Source* is in use, the following interface specific tabs are available:

Tab:	Description:
Link	Status information and control of the upstream link
DPCD	For monitoring and editing the DPCD registers of the connected DisplayPort sink
MST 2 Streams	MST 2 streams in pattern generator

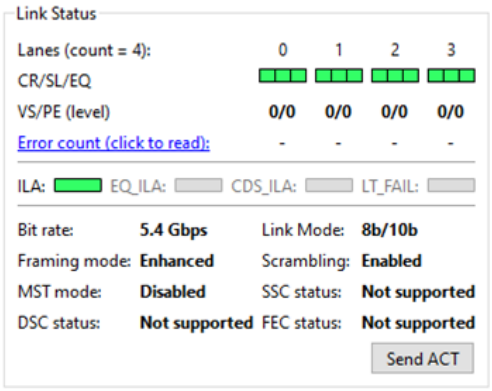
DP Link Tab

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



Link Status

Link Status displays the status of the link training and the link parameters negotiated between the connected Sink and the UCD Source. It also lists status of other link modes. The data is retrieved from the DPCD status registers of the connected Sink. The status is updated automatically.

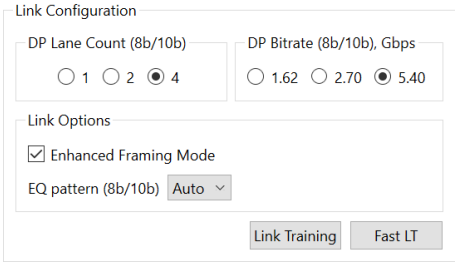


Lanes:	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
CR/SL/EQ:	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization.
VS/PE (level):	Voltage Swing / Pre-emphasis level.
Error count:	Content of DPCD Error Count registers.
ILA:	LED indicator for 'Inter lane Alignment Done.
EQ_ILA:	Disabled with 8b/10b link coding.
CDS_ILA:	Disabled with 8b/10b link coding.
LT_FAIL:	Disabled with 8b/10b link coding.
Bit rate:	Currently enabled link bit rate.
Link mode:	Currently enabled channel coding (8b/10b).
Framing mode:	Currently enabled Framing Mode (Normal or Enhanced).
Scrambling:	Status of link data scrambling (Enabled or Disabled).
MST mode:	Status of the Multistreaming (MST) mode (only in UCD-323 special FW configuration).
SSC Status:	Not Supported.
DSC Status:	Not Supported.
FEC status:	Not Supported.

Send ACT:	Force sending an Allocation Change Trigger (ACT) sequence over Main-Link.

Link configuration

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

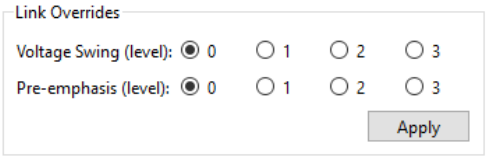


DP Lane Count (8b/10b)	Lane count used.

DP Bitrate (8b/10b), Gbps	Link rate used .
Enhanced Framing Mode	Enable Enhanced Framing Mode.
EQ pattern (8b/10b)	Pattern (8b/10b) to be used for equalization: auto, TPS2, TPS3,TPS4.

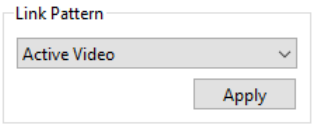
Link Overrides

Override Voltage Swing and Pre-emphasis selected during link training. Click **Apply** to validate changes. Overrides are applied immediately to DPTX transceiver when 'Apply' is clicked. Please note, that It affects main link signal amplitude and pulse shape only. No AUX exchange takes place. The change can be checked only with a scope. Overrides are removed at the beginning of the next link training.



Link Pattern

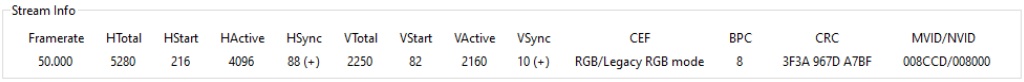
Select between Active video and audio, Idle pattern, or special bit patterns.



Active Video	Transmit Video Pattern, Audio and Metadata
Idle Pattern	Link is active but no stream data is being transmitted
Training Pattern 1	Send Link Training Pattern Sequence 1 (TPS1)
Training Pattern 2	Send Link Training Pattern Sequence 2 (TPS2)
Training Pattern 3	Send Link Training Pattern Sequence 3 (TPS3)
Training Pattern 4	Send Link Training Pattern Sequence 4 (TPS4)
PRBS7	Send PRBS7 Link Quality Test Pattern
HBR2 Compliance EYE pattern	Send HBR2 Compliance EYE pattern
SER (Symbol Error Rate)	Send Symbol Error Rate Measurement pattern
Force Video	Character error messages from sink will not interrupt video transmission.
Force Idle	Link Training and Active Video will not be initiated even after a re-plug

Stream Info

Stream Info is retrieved from the Main-Stream Attributes (MSA) of the monitored stream.

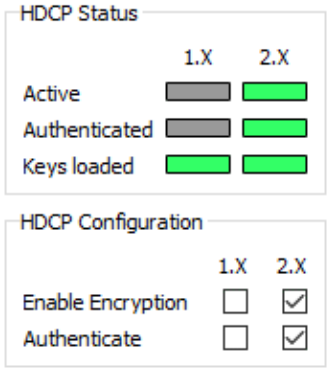


The content of *Stream Info* table can be copied by right-clicking on the table and selecting **Copy**.

Framerate	Vertical refresh rate
HTotal	Horizontal total of transmitted main video stream, measured in pixel count.
HStart	Horizontal active start from leading edge of HSync, measured in pixel count.
HActive	Horizontal active, number of active pixels in video line
HSync	HSync width, measured in pixel count. (+)/(-) positive / negative sync.
VTotal	Vertical total of transmitted main video stream, measured in line count.
VStart	Vertical active start from leading edge of VSync, measured in line count.
VActive	Vertical active, number of active lines in video frame
VSync	VSync width, measured in line count. (+)/(-) positive v.s. negative sync.
CEF	Used color mode: Color format + subsampling / colorimetry
BPC	Color depth in bits per color (BPC)
CRC	16-bit Cyclic redundancy check (CRC) value per color component calculated from active pixels
VFREQ	Video Frequency (128b/132b channel coding only)

HDCP Status

Duplicate of the status from HDCP Tab. Please refer to chapter *HDCP Tab* later in this document for detailed description.

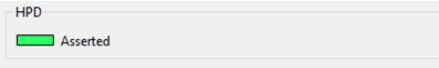


HDCP Configuration

Enable and disable HDCP 1.3 or HDCP 2.3 encryption. Duplicates of the controls found in HDCP tab.

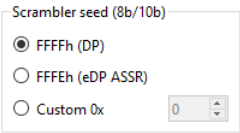
Note:	Please note that HDCP 1.3 is not supported in 3.9 release.

HPD



Asserted: LED indicates status of Hot Plug Detect (HPD) signal

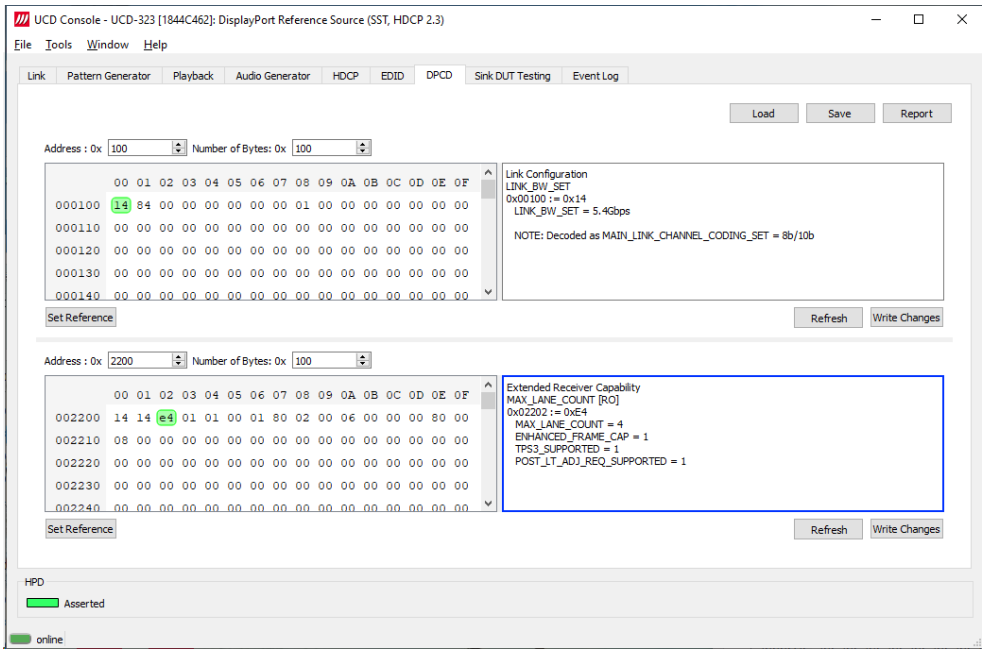
Scrambler seed (8b/10b)



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

DPCD Tab

DPCD tab is a tool for monitoring and editing the DPCD registers of the connected DisplayPort or DisplayPort Alt Mode Sink.



The *DPCD Decoder* panels on the right show the interpretation of the DPCD byte selected on the monitoring windows. The selected byte is shown with a green background.

Save:	Select DPCD content to a binary *DPCD Data* file (*.DPD).
Load:	Select previously saved binary *DPCD Data* file (*.DPD).
Report:	Save parsed content of selected DPCD register ranges as HTML file
Refresh:	Re-read the data from the DPCD registers to the window in question
Write Changes	Write the portion of data shown in the window in question to the DPCD registers.
Set Reference	Store currently shown data as a reference for comparison

When the data is *Refreshed* from the DPCD registers the changed bytes will be highlighted with **blue** color. The fields edited by the user will be highlighted with **red** color.

Saving and Loading DPCD Content

DPCD data in the selected address areas can be saved as a file in your PC. There are three alternative formats listed below. Please select the intended format when saving:

- Binary *DPCD Data File* format (*.DPD). This is Unigraf proprietary format. You can also load the DPCD content stored in this format.
- *Comma Separated Value* format (.CSV)
- *HEX Dump* (*.HEX) in a human readable text format.

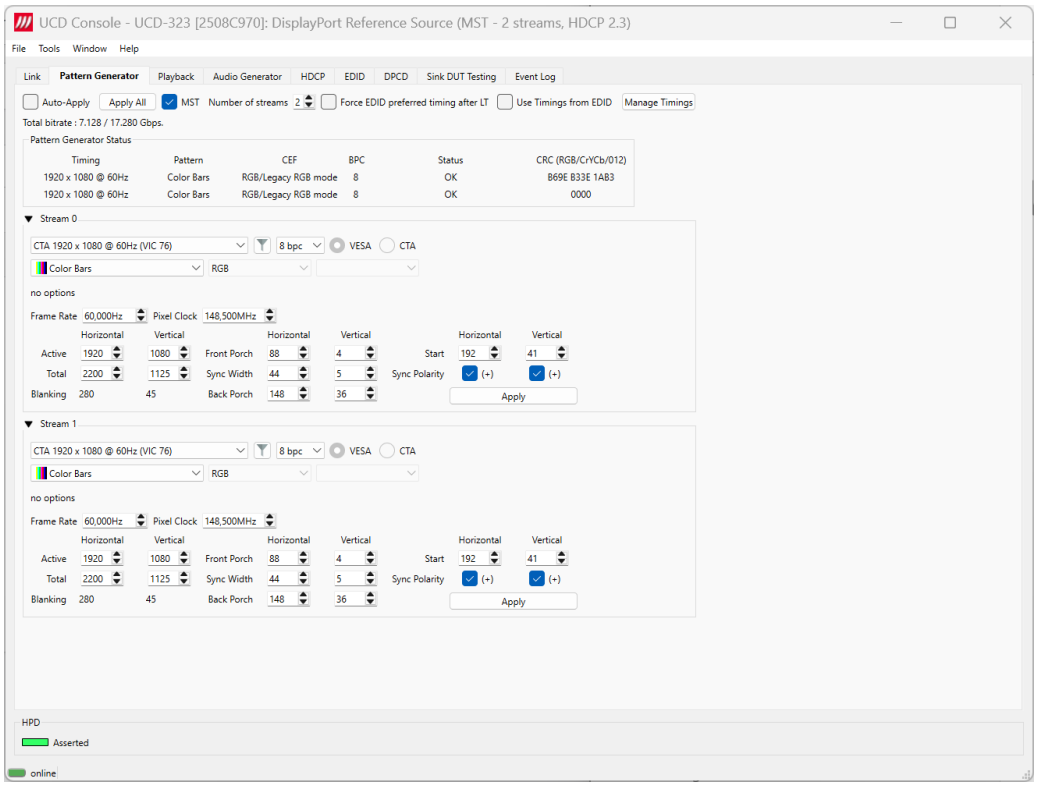
MST – 2 Streams

MST – 2 streams role enables two streams for the pattern generator. For detailed description of the pattern generator, please refer to Patten Generator Tab.

Note: The MST – 2 Streams role needs to be enabled for DP TX in device configuration. For instructions, refer to Change Device Configuration.

MST-2 pattern generator supports only predefined patterns. Custom patterns are not supported.

Apply all:	Appl settings for streams 0 and 1
MST:	Enable MST



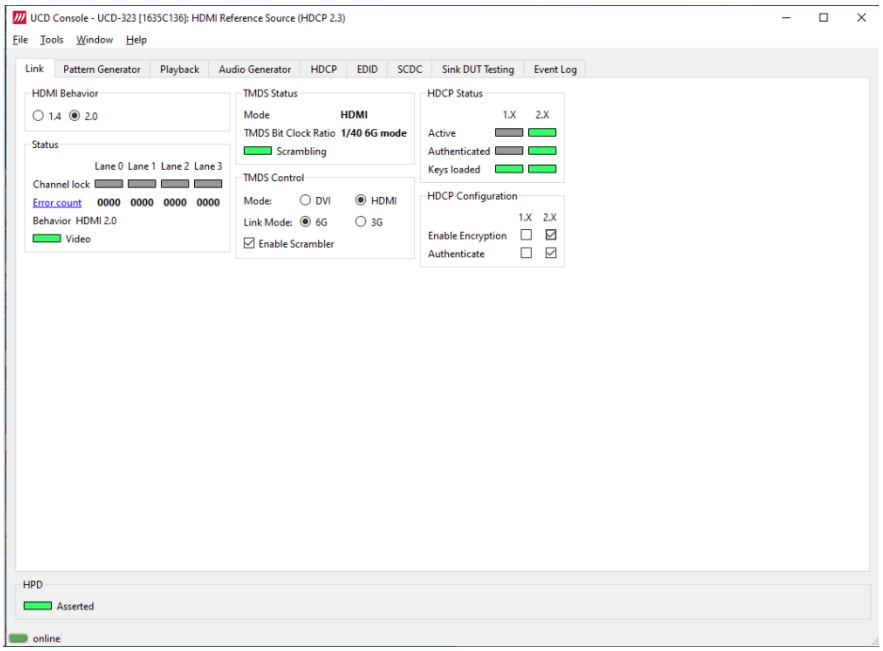
HDMI Reference Source

When roles *HDMI Source* is in use, the following interface specific tabs are available:

Tab:	Description:
Link	Status information and control of the upstream link
SCDC	Presents content of HDMI Status and Control Data Channel

HDMI Link Tab

Link tab is enabled by default.



HDMI Behavior

Selection of the HDMI version to be used (HDMI 1.4 or HDMI 2.0).

Status

Channel lock	Indication of channel lock status in TMDS links 0 to 2
Error count	Status of SCDC Error Count Registers
Behavior	HDMI operation mode (HDMI 1.4 or HDMI 2.0)
Video:	Video data available

TMDS Status

Mode	TMDS mode (HDMI or DVI)
TMDS Bit Clock Ratio:	Status of TMDS_Bit_Clock_Ratio bit in SCDC – TMDS Configuration (1/10 or 1/40)
Scrambling:	Status of TMDS_Scrambler_Status bit in SCDC – TMDS Scrambler Status (1=LED on; 0=LED off)

HDCP Status

Note:	Please note that HDCP 1.3 is not supported in 3.9 release.

Copy of the status from HDCP Tab. Please refer to chapter *HDCP Tab* later in this document for detailed description.

HDCP Configuration

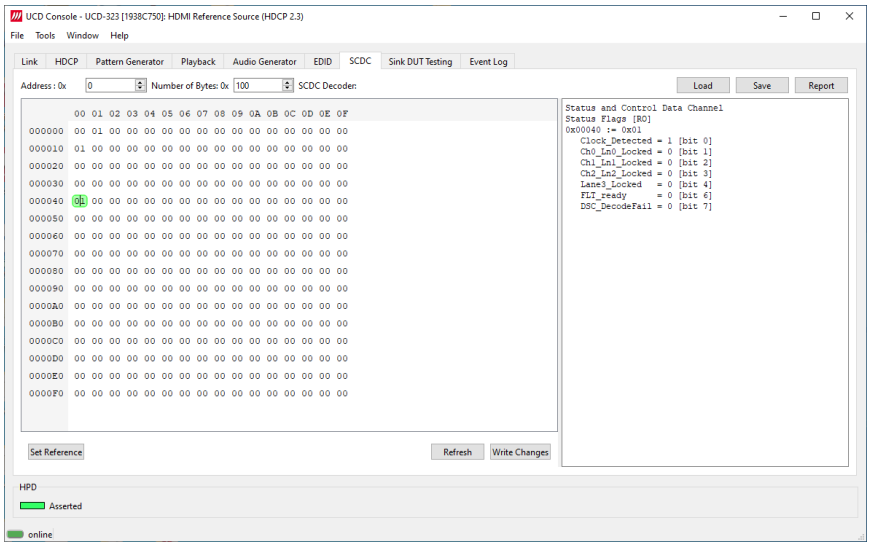
Enable and disable HDCP 1.3 or HDCP 2.3 capability of UCD-422 Sink. Duplicates of the controls found in HDCP tab.

HPD

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

SCDC Monitor

SCDC monitor presents content of HDMI Status and Control Data Channel (SCDC) structured by its address range.



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

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

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

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

When the data is *Refreshed* from the SCDC registers the changed bytes will be highlighted with blue color.

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

Saving and Loading SCDC Content

SCDC data in the selected address areas can be saved as a file in your PC. There are two alternative formats listed below. Please add the intended format when saving:

- Binary *SCDC Fata File* format (*.DPD). This is Unigraf proprietary format. You can also load the SCDC content stored in this format.
- *HEX Dump* (*.HEX) in a human readable text format.

▶ Click Save to select the location and the format of the file.

▶ Click Load to load SCDC data saved in SCDC Data File (*.DPD) format to the editor.

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

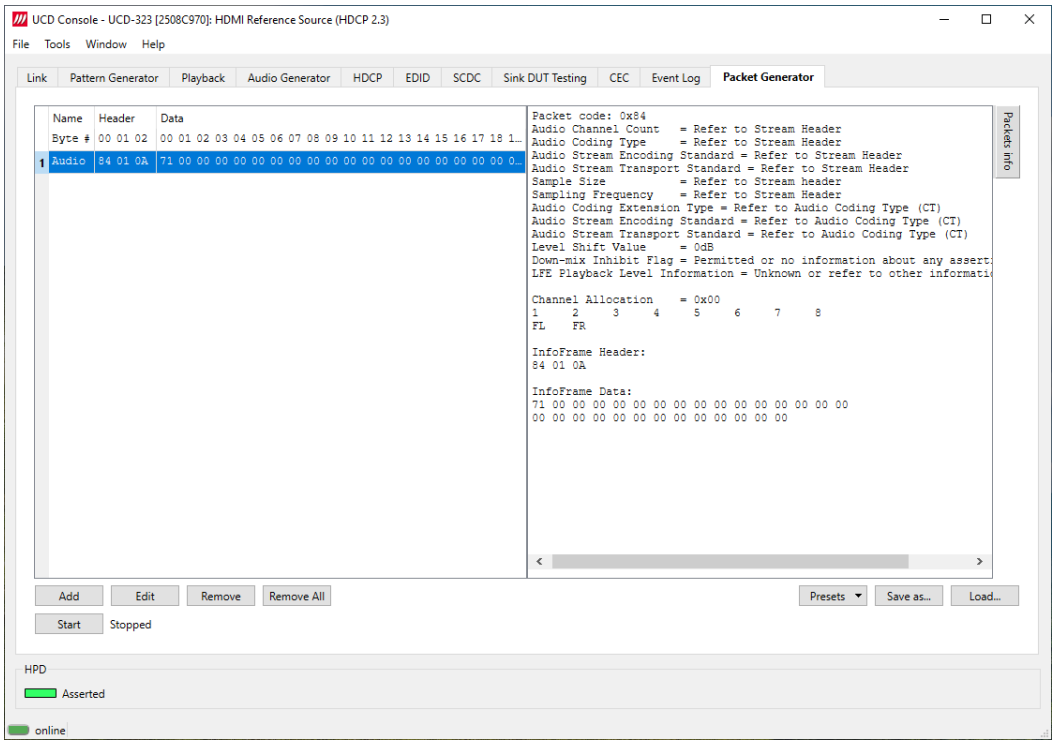
CEC Tab

Source *CEC Tab* functions in exactly the same manner as for Sink CEC Tab CEC Tab.

Packet Generator

Packet generator enables configuring and generating Custom SDP independently from the Audio and Video Pattern Generators.

Note:	In Packet Generator the packet generation time is limited. After limitation generator must be restarted manually. For UCD-323 the limit is approximately 1 hour.



Add:	Add new packets. Opens packet editor.
Edit:	Edit existing packets
Remove:	Remove selected packet
Remove All:	Remove all packets
Start:	Start transferring the packets
Presets:	Save, Load, Remove, Import or Export packets
Save as…	Save packet
Load:	Load packets

Packet editor

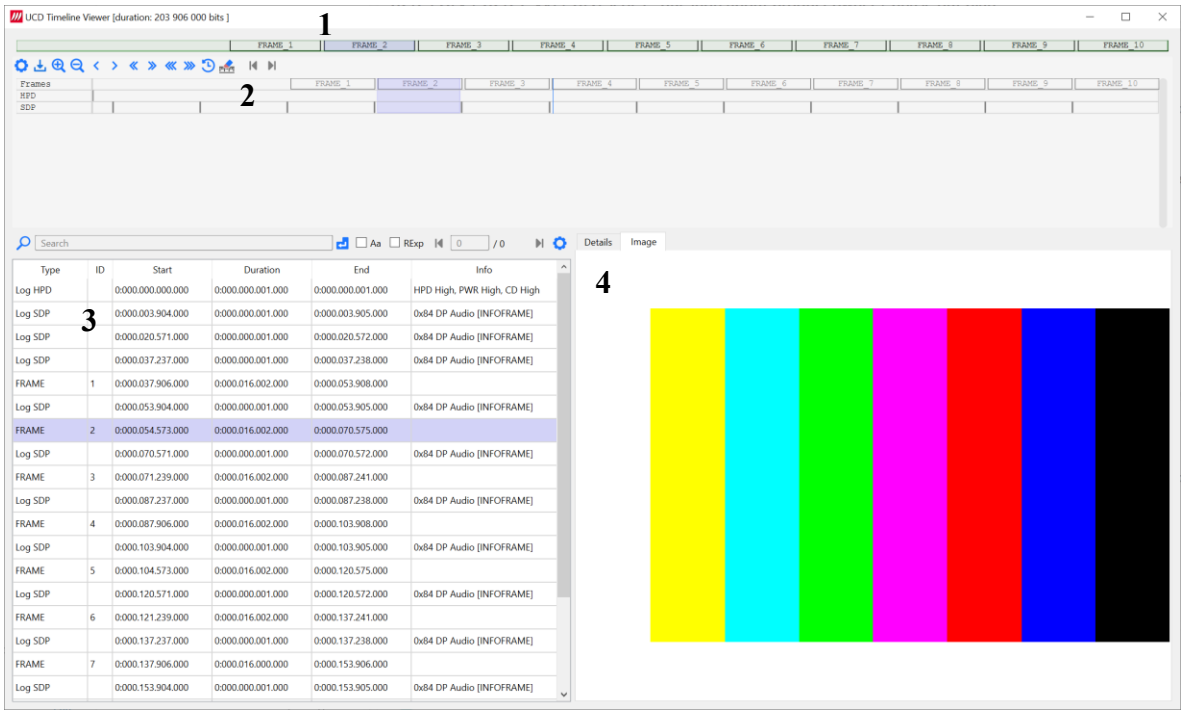
For detailed information on the packet editor, please refer to Packet Editor chapter in this manual.

6. UCD TIMELINE VIEWER

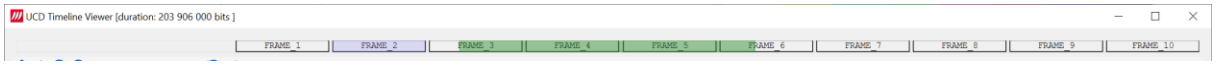
Role:	Product:
DP Reference Sink (DP RX)	UCD-323 Gen2, UCD-323, UCD-301
HDMI Reference Sink (HDMI RX)	UCD-323 Gen2, UCD-323, UCD-301

UCD Timeline Viewer is an application for inspecting data captured in capture tab. It consists of four areas.

1. Frame View
2. Event View
3. Event Log
4. Details / Image



Frame View



The uppermost panel shows the captured frames. The selected frame is highlighted in purple. You can select a frame by double-clicking it. The area highlighted in green indicates the area shown in the Events view. Please, note that you cannot zoom in or out in the frame view.

Event View

The view below shows all frames and events selected in the capture tab. The are highlighted in green in frame view indicates the are shown in events view.

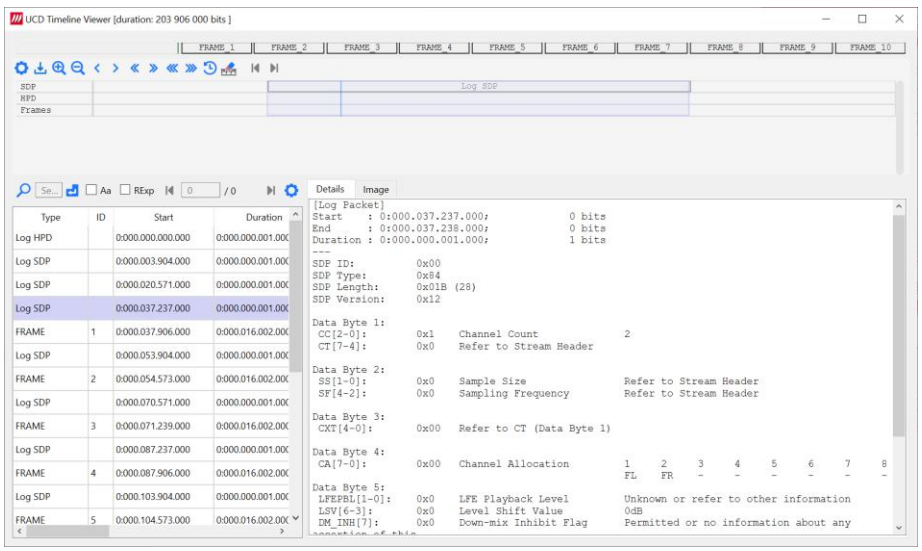
Tools

Tool	Function
Gear Icon	Hide / add events on the timeline
Save Icon	Save, load, remove, import, export and remove presets
Magnifying Glass Icons	Zoom in/out on the timeline
Arrow Icons	Move on the timeline. More arrows moves the timeline more. You can also move by clicking and dragging in the timeline.
Move to a time point	Move to a certain time point on the timeline by double clicking on the timeline. The selected event is highlighted in the event log. By right clicking on the timeline and right clicking again you can measure distance between two time points.
Erase all rulers	Erase all measurements made.

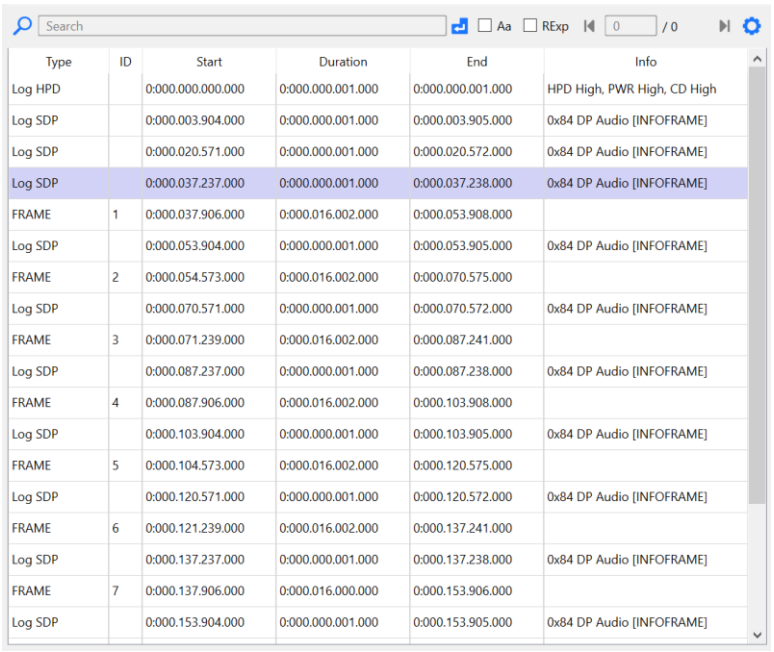
Zooming on the timeline

Went the timeline is zoomed out, you can see events as grey lines. When you zoom in you can see the event block. You can zoom in either with the magnifying glass icons or by scrolling with your mouse.

When you double click on event or frame, the corresponding event or frame is selected in the event log and highlighted in purple.



Event Log



Type	ID	Start	Duration	End	Info
Log HPD		0:000.000.000.000	0:000.000.001.000	0:000.000.001.000	HPD High, PWR High, CD High
Log SDP		0:000.003.904.000	0:000.000.001.000	0:000.003.905.000	0x84 DP Audio [INFOFRAME]
Log SDP		0:000.020.571.000	0:000.000.001.000	0:000.020.572.000	0x84 DP Audio [INFOFRAME]
Log SDP		0:000.037.237.000	0:000.000.001.000	0:000.037.238.000	0x84 DP Audio [INFOFRAME]
FRAME	1	0:000.037.906.000	0:000.016.002.000	0:000.053.908.000	
Log SDP		0:000.053.904.000	0:000.000.001.000	0:000.053.905.000	0x84 DP Audio [INFOFRAME]
FRAME	2	0:000.054.573.000	0:000.016.002.000	0:000.070.575.000	
Log SDP		0:000.070.571.000	0:000.000.001.000	0:000.070.572.000	0x84 DP Audio [INFOFRAME]
FRAME	3	0:000.071.239.000	0:000.016.002.000	0:000.087.241.000	
Log SDP		0:000.087.237.000	0:000.000.001.000	0:000.087.238.000	0x84 DP Audio [INFOFRAME]
FRAME	4	0:000.087.906.000	0:000.016.002.000	0:000.103.908.000	
Log SDP		0:000.103.904.000	0:000.000.001.000	0:000.103.905.000	0x84 DP Audio [INFOFRAME]
FRAME	5	0:000.104.573.000	0:000.016.002.000	0:000.120.575.000	
Log SDP		0:000.120.571.000	0:000.000.001.000	0:000.120.572.000	0x84 DP Audio [INFOFRAME]
FRAME	6	0:000.121.239.000	0:000.016.002.000	0:000.137.241.000	
Log SDP		0:000.137.237.000	0:000.000.001.000	0:000.137.238.000	0x84 DP Audio [INFOFRAME]
FRAME	7	0:000.137.906.000	0:000.016.000.000	0:000.153.906.000	
Log SDP		0:000.153.904.000	0:000.000.001.000	0:000.153.905.000	0x84 DP Audio [INFOFRAME]

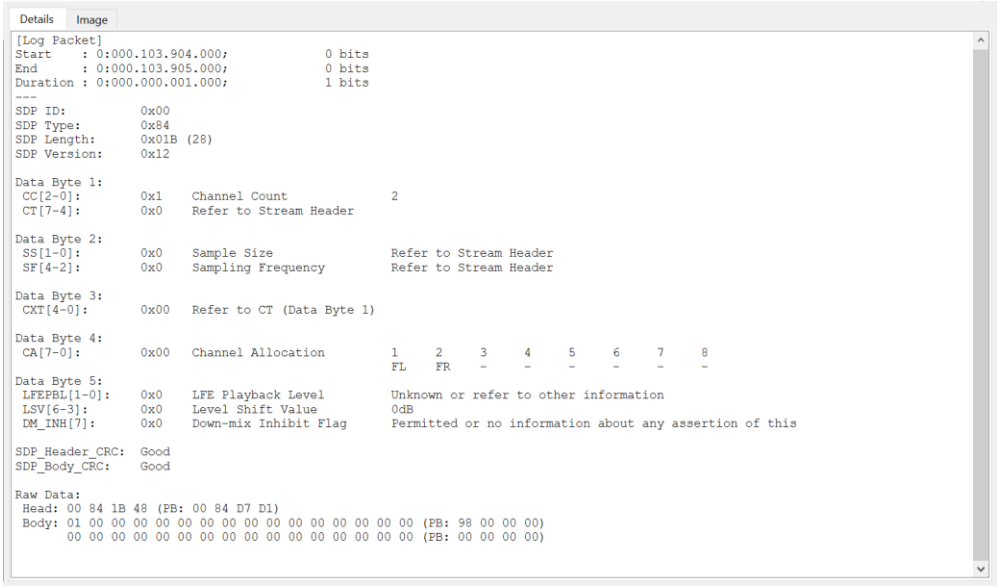
Event log shows all captured events and frames. The following info is presented in the table:

Type	Function
ID	Number of captured frame
Start	Start of the event
Duration	Duration of the event
End	End of the event
Info	Additional information about the event.

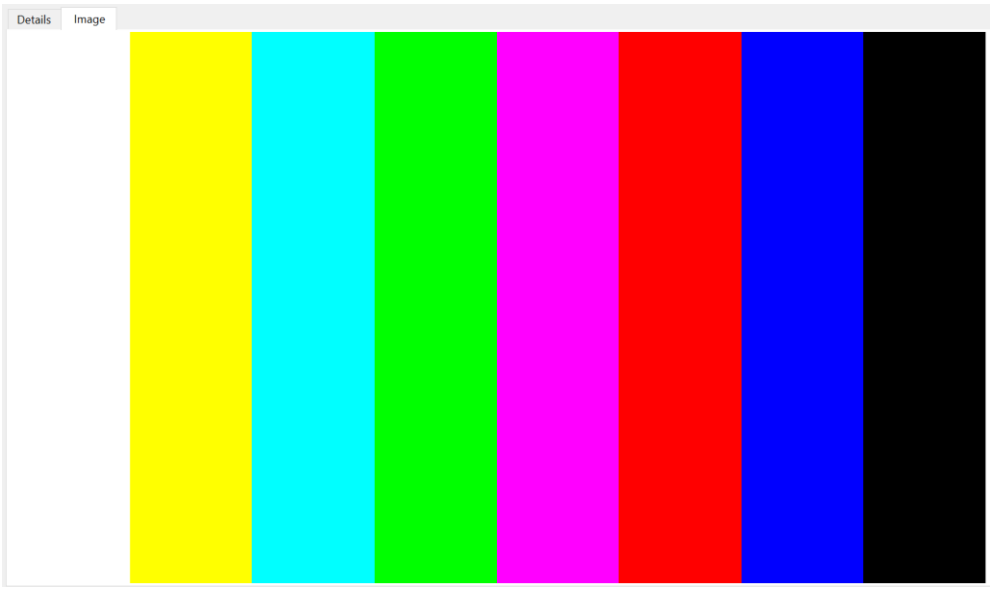
Event Log Tools

Search Search	Search events from the event log. Search results are highlighted in purple.
Apply search filters	Apply filters.
Aa RExp Search filters	Aa filter: Make search case sensitive RExp: Use regular expressions in search
7 / 12 Search results	Shows search results. Move from one search result to another by clicking the arrows.
Configure	Selec which columns are shown in event log.

Details / Image



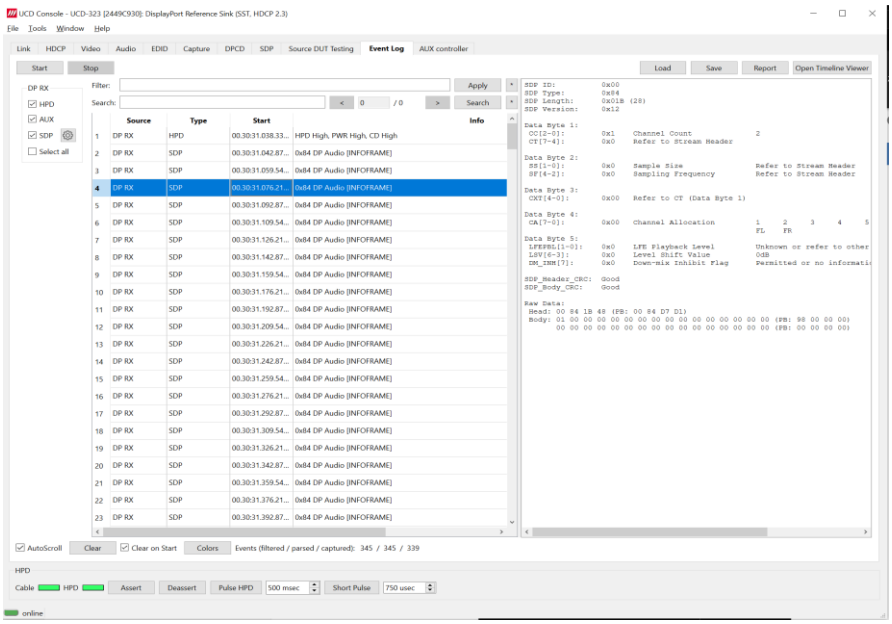
Details tab shows details of the selected event. When the selected event is a frame, the image tab shows the captured frame.



7. EVENT LOG

Event Logger (Event Log) collects time stamped information from the display interface. The type of data items logged is dependent on the display interface used and the role selected.

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



Role	Logged Events
DP Sink	HPD, SDP, AUX Transactions
HDMI Sink	HPD, Packets, I2C, CEC
DP Source	HPD, AUX Transactions
HDMI Source	HPD, I2C, CEC
DP Alt Mode Sink	PD, LSE

Start:	Starts event logging and stop it by clicking *Stop*.
Save:	Save transactions as Event Log data.
Load:	Load saved Event Log data.
Report:	Store event logs as html reports to be shared and viewed with any web browser.
Open Timeline Viewer	Open captured data for viewing in timeline viewer.
AutoScroll:	When selected, transaction list is scrolled vertically, and the latest transaction is shown as the last item of the list. When not selected, the items shown before clicking Start will be shown.
Events	Number of events detected.
Clear:	Click to clear transaction list. When *Clear on Start* is selected, the list is cleared when clicking Start.

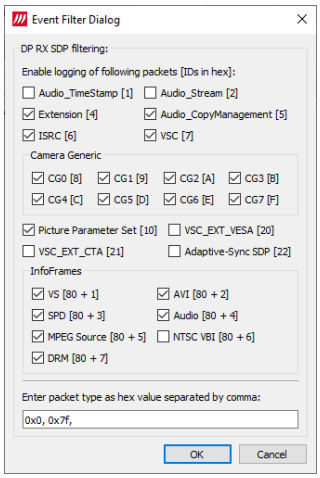
Logged Events

HPD

Status and status changes of Hot Plug Detect (HPD) signal.

SDP

Secondary-data Packets received in DP Main-Link. Click the button to open the *Event Filter Dialog.* The dialog enables filtering of SDP packets. In the dialog, the reference to Packet Type Value is indicated in square brackets "[ ]".

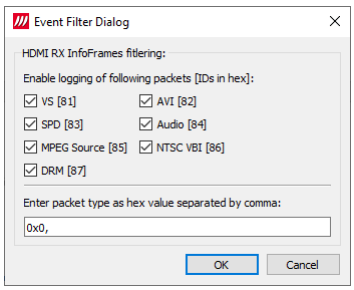


AUX

DP AUX Channel transactions.

Packets

Log metadata sent by Source device in HDMI lanes.



I2C

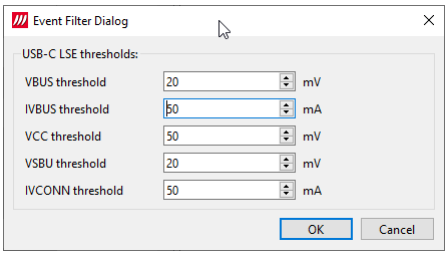
Log data sent over I2C communication lines of HDMI interface.

PD

Log USB-C PD communication messages.

LSE

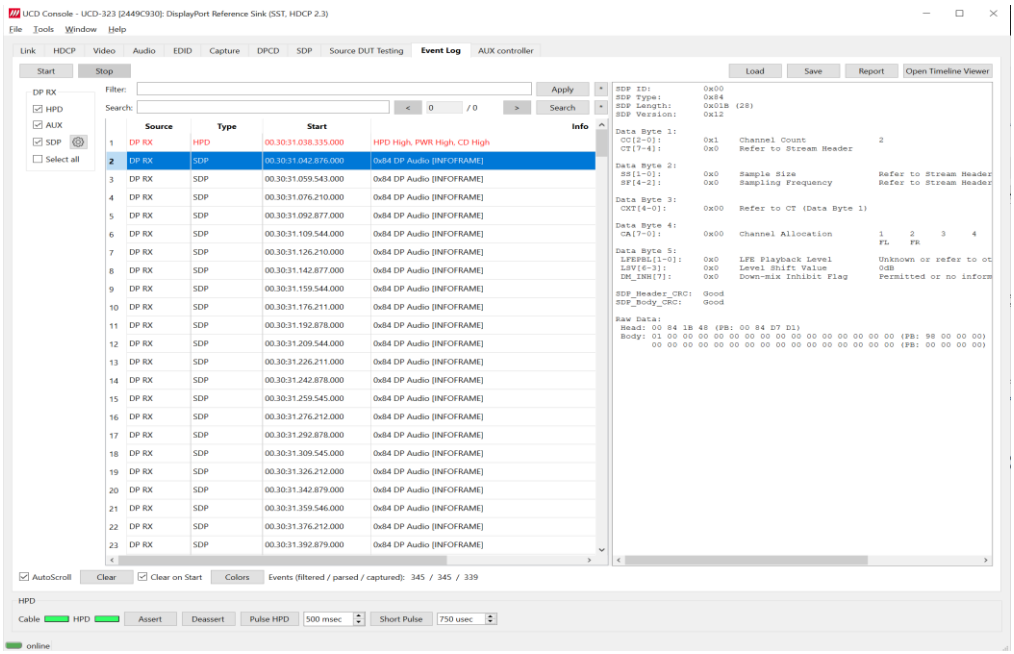
Low Speed Electrical logger captures the Voltage and Current on the low-speed lanes of the USB-C connector including CC, VBUS, VCONN, and SBU.



In Event Filter Dialog the user can set the noise threshold values. Only measurement exceeding the corresponding threshold will be logged.

Event Transaction List

Transaction data in Transaction List is ordered in columns. Each column provides additional information about the data line, facilitating its viewing and interpretation.

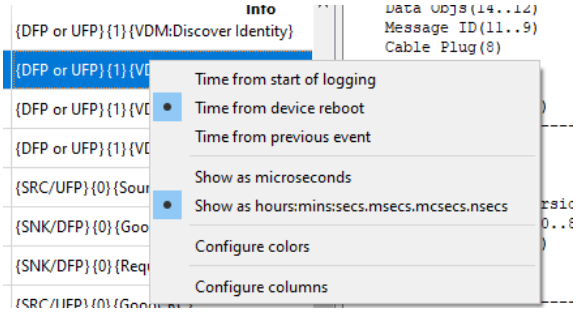


Start:	Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started. The timestamp can be displayed as a time delay from the start of the acquisition (absolute) or from the previous line (relative). The timestamp can be displayed in milliseconds or in minutes, seconds, and microseconds.
Source and Type	The communication port: DP RX to DP TX
Type	The logged item: HPD, SDP, AUX, MSA Change or VB-ID change
Info	This column provides a short description of the message content

Customizing Transaction List

User Can change what data is shown in the transaction list by adding and removing columns or limiting the transaction types in the list. User can also color highlight various types of transactions for better readability.

Right-click on the list to open the menu.



Configure Start

The time indicated in column *Start* can be either:

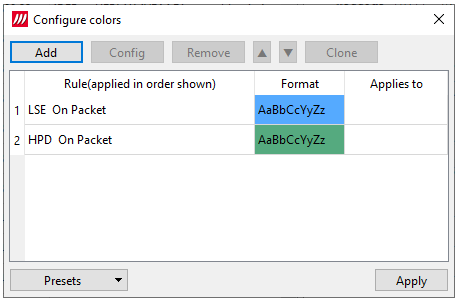
- Time from start of logging
- Time from device reboot
- Time from previous event

The time can be expressed either:

- In microseconds (1/1 000 000 Second)
- Hours : minutes : seconds : milliseconds : nanoseconds

Configure Colors

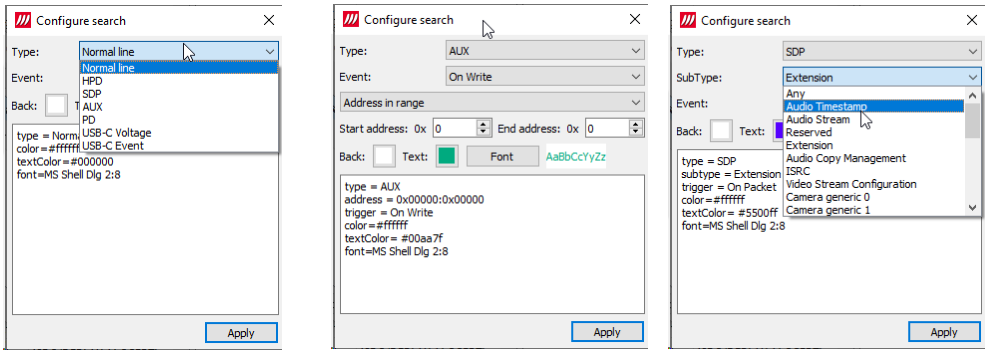
Configure colors dialog allows the user to highlight various types of transactions in the list by changing character color and background color of the transaction line.



Add:	Add a new color highlight rule
Config:	Modify the selected rule
Remove:	Delete the selected rule
Clone:	Duplicate the selected rule
▲▼:	Change order where rules are applied. The rules are applied from the bottom to the top of the list.

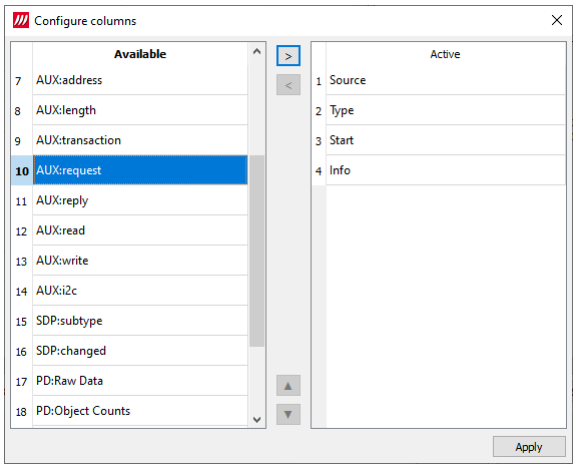
Adding Rules

The color highlight rules are set by transaction type. The content of *Add rules* dialog is dependent on the type of item selected.



Configure Columns

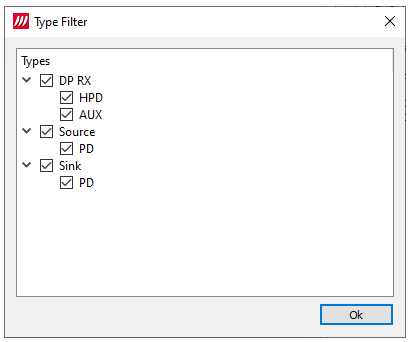
In the dialog there are two columns: *Available* and *Active*. An item from Available list can be included in Active columns by selecting it and clicking on the right arrow [>] in the middle of the two columns.



The order of Active items can be changed by selecting an item and moving its position in the list with up ▲and down ▼ arrows.

Type Filter

Type filter dialog lists the types of transactions found in the list and allows the user to select which transaction lines are currently shown.



Quick Filter

By entering a DPCD address in the Quick Filter field on top of the transaction line, the user can limit the list to show only the reads or writes to this DPCD address.

Parsed Transactions

HPD

Status and status changes of Hot Plug Detect (HPD) signal.

```
Device ID             = 01 [DP RX]
Hot-Plug-Detect Level = HIGH
PWD Level             = HIGH (DP Tx is connected to Rx and has power applied to AUX pu
Cable Detect Level    = HIGH
```

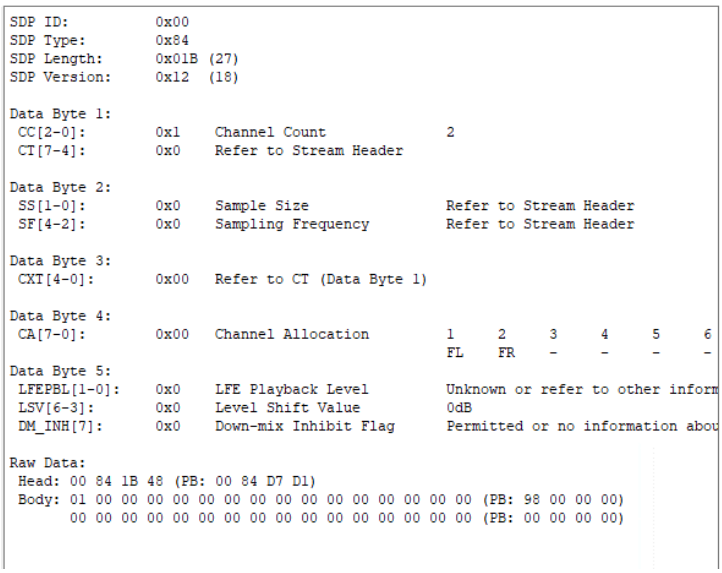
AUX (UCD-301, UCD-323, UCD-323 Gen2)

DP AUX Channel transactions.

```
Direction             = Source to Sink
Native AUX Request    = Write
Length                = 4
Data                  = 0A 0A 0A 0A
Address               = 0x00103

Link Configuration
TRAINING_LANE0_SET
0x00103 := 0x0A
   VOLTAGE_SWING_SET = level 2
   MAX_SWING_REACHED = level 0
   PRE_EMPHASIS_SET = level 1
   MAX_PRE-EMPHASIS_REACHED = 0

   NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b

Link Configuration
TRAINING_LANE1_SET
0x00104 := 0x0A
   VOLTAGE_SWING_SET = level 2
   MAX_SWING_REACHED = level 0
   PRE_EMPHASIS_SET = level 1
   MAX_PRE-EMPHASIS_REACHED = 0

   NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b

Link Configuration
TRAINING_LANE2_SET
0x00105 := 0x0A
   VOLTAGE_SWING_SET = level 2
   MAX_SWING_REACHED = level 0
   PRE_EMPHASIS_SET = level 1
   MAX_PRE-EMPHASIS_REACHED = 0

   NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b

Link Configuration
TRAINING_LANE3_SET
0x00106 := 0x0A
   VOLTAGE_SWING_SET = level 2
   MAX_SWING_REACHED = level 0
   PRE_EMPHASIS_SET = level 1
   MAX_PRE-EMPHASIS_REACHED = 0

   NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b
```

SDP (UCD-301, UCD-323, UCD-323 Gen2)

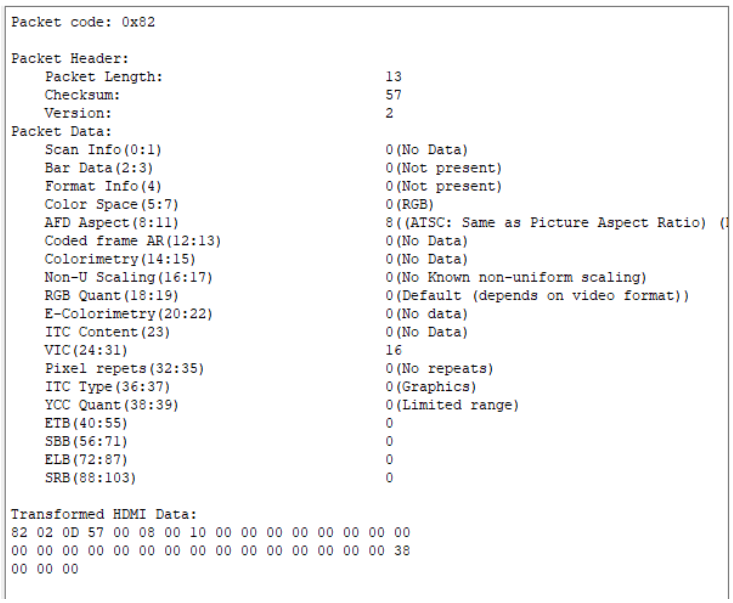
DP Secondary-data Packets.



```
SDP ID:          0x00
SDP Type:        0x84
SDP Length:      0x01B (27)
SDP Version:     0x12  (18)

Data Byte 1:
 CC[2-0]:        0x1    Channel Count             2
 CT[7-4]:        0x0    Refer to Stream Header

Data Byte 2:
 SS[1-0]:        0x0    Sample Size               Refer to Stream Header
 SF[4-2]:        0x0    Sampling Frequency        Refer to Stream Header

Data Byte 3:
 CXT[4-0]:       0x00   Refer to CT (Data Byte 1)

Data Byte 4:
 CA[7-0]:        0x00   Channel Allocation        1     2     3     4     5     6
                                                  FL    FR    -     -     -     -
Data Byte 5:
 LFEPBL[1-0]:    0x0    LFE Playback Level        Unknown or refer to other inform
 LSV[6-3]:       0x0    Level Shift Value         0dB
 DM_INH[7]:      0x0    Down-mix Inhibit Flag     Permitted or no information abou

Raw Data:
 Head: 00 84 1B 48 (PB: 00 84 D7 D1)
 Body: 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 (PB: 98 00 00 00)
       00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 (PB: 00 00 00 00)
```

Packets (UCD-301, UCD-323, UCD-323 Gen2)

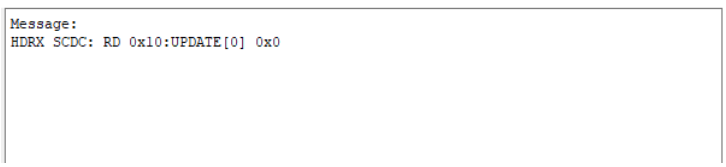
Log metadata sent by Source device in HDMI stream



```
Packet code: 0x82

Packet Header:
    Packet Length:                  13
    Checksum:                       57
    Version:                        2
Packet Data:
    Scan Info(0:1)                  0(No Data)
    Bar Data(2:3)                   0(Not present)
    Format Info(4)                  0(Not present)
    Color Space(5:7)                0(RGB)
    AFD Aspect(8:11)                8((ATSC: Same as Picture Aspect Ratio) (1
    Coded frame AR(12:13)           0(No Data)
    Colorimetry(14:15)              0(No Data)
    Non-U Scaling(16:17)            0(No Known non-uniform scaling)
    RGB Quant(18:19)                0(Default (depends on video format))
    E-Colorimetry(20:22)            0(No data)
    ITC Content(23)                 0(No Data)
    VIC(24:31)                      16
    Pixel repets(32:35)             0(No repeats)
    ITC Type(36:37)                 0(Graphics)
    YCC Quant(38:39)                0(Limited range)
    ETB(40:55)                      0
    SBB(56:71)                      0
    ELB(72:87)                      0
    SRB(88:103)                     0

Transformed HDMI Data:
82 02 0D 57 00 08 00 10 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 38
00 00 00
```

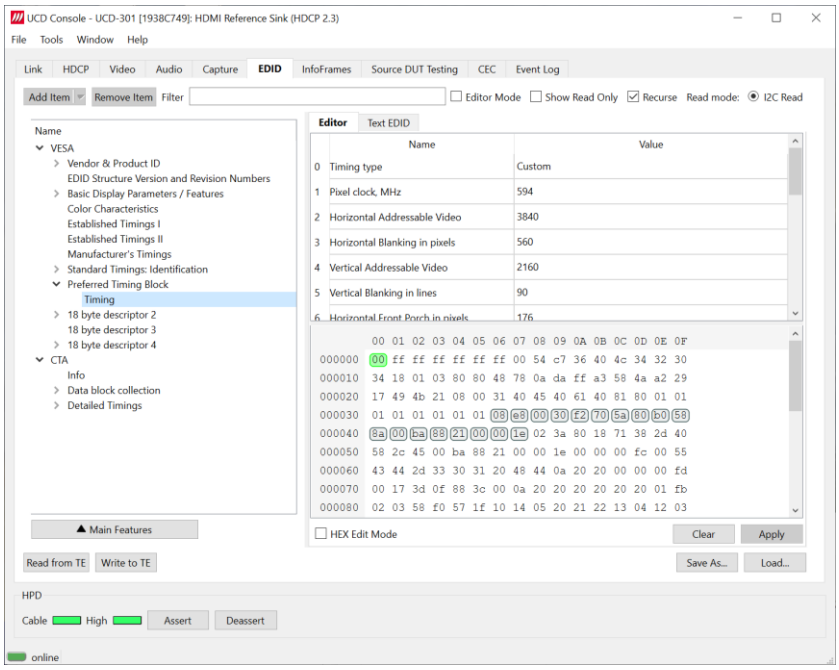
I2C (UCD-301, UCD-323, UCD-323 Gen2)

Log data sent over I2C communication lines of HDMI interface



```
Message:
HDRX SCDC: RD 0x10:UPDATE[0] 0x0
```

8. EDID EDITOR



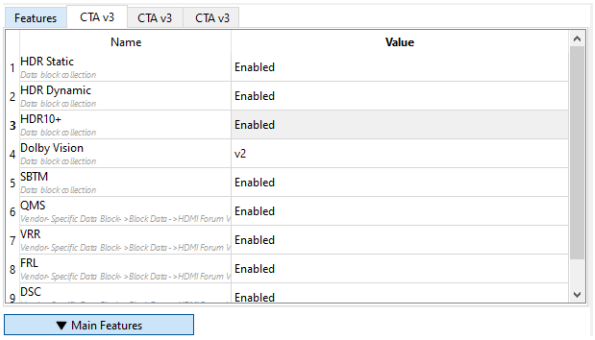
The *EDID/DisplayID Editor* main window is divided into three views. Command buttons are Additionally located in the bottom. The top left *Navigation View* selection focuses and highlights the *Editor View* (top-right) and *Hex Editor View* (bottom-right). The *Editor View* values may be edited when the *Editor Mode* checkbox is checked. *Hex Editor View* presents blocks as hex values and can be edited when the *HEX Edit Mode* checkbox is checked.

Controls

Add Item	Add a new EDID or DisplayID block. Available when in *Editor Mode* exclusively.
Remove Item	Delete the selected EDID or DisplayID block. Available when in *Editor Mode* exclusively.
Filter	Show only items having the filter string in their field name.
Editor Mode	Enable editor mode
Read mode	Select EDID data reading mode: I2C (using I2C protocol) or SBM (MST mode only): virtual channels read via SBM protocol.
Show Read Only	Automatically generated non-editable fields are additionally shown.
Recurse	All subitems of the selected item are presented in *Editor View.*

The buttons in the bottom of the dialog differ based on the role selected, i.e., is the subject the local EDID or EDID of a connected device.

Main Features:	The Main features panel gives an overview of items of common interest. For example, whether the sink is capable of HDR, or Dolby Vision. The small grey italic text shows corresponding location in EDID. If you click on the Value cell, the corresponding address in the HEX mode table is shown.



Read from TE (Analyzer):	Read UCD-3XX local EDID.
Write to TE (Analyzer):	Program UCD-3XX local EDID. Please see the Note below.
Read from TE (Generator):	Read EDID of a connected sink device.
Write to TE (Generator):	Program EDID of a connected sink device.
Editor Mode:	Enable editing EDID content in parsed logical fields. When disabled, all the controls are in read-only mode. For example, for testing purposes it's possible to load invalid EDID and write it to TE without modifications. Once editor mode is enabled, EDID validator corrects errors such as invalid checksums. Modifications are possible in the upper panel with Name – Value pairs.
HEX Edit Mode:	Enable editing EDID content in HEX mode table. When enabled, modifications are possible in the lower panel with HEX values. Click the Apply button to validate the changes and copy them to the upper panel.
Save As…:	Save the current block collection to a disk file.
Load …:	Load an EDID block collection file from disk.

EDID Editor Features

A 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/DisplayID blocks contain a structure that is very similar to a tree structure. The Editor decodes each block into a tree view of the block. The tree view then contains all values within the data block. Contents can be browsed. The Editor has a support for automatic variables, such as the block checksum. When a value in a block is modified, the checksum will be updated. Automatic variables are read only. A log print will be made when an automatic variable is updated by the editor.

Editing Tips

Editing is straightforward:

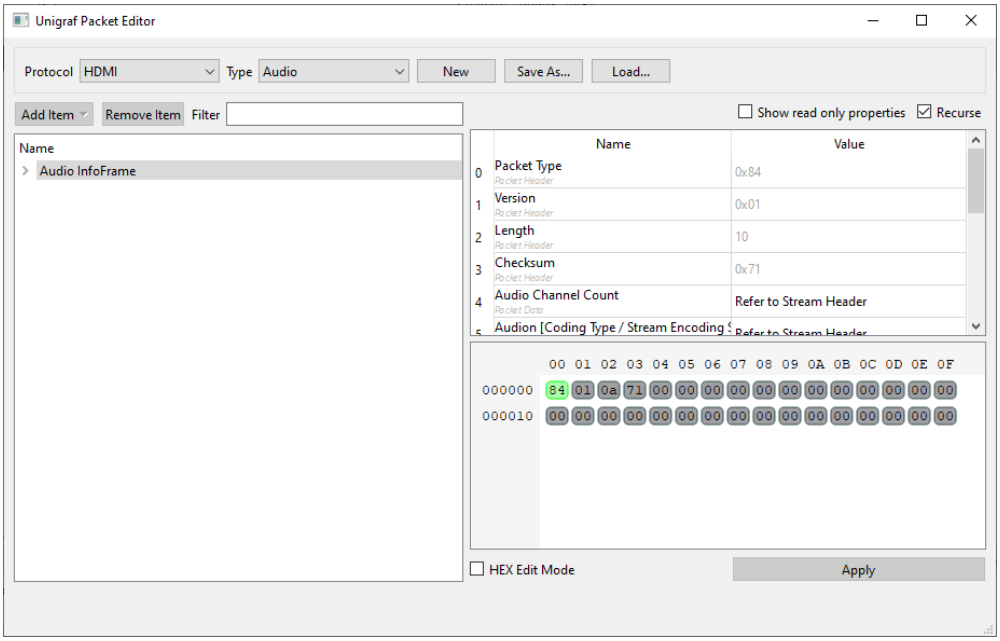
Select property fields to edit.
Red values in *HEX View* show that values have been modified.

Press *Enter* to apply edit values and combo box selections.
In CTA-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”.
Enter hex values with prefixes “**0x**” or “**$**”. No prefix represents a decimal value.
Values may be entered as hexadecimal or decimal regardless of presentation.
Floating point values must have a period “**.**” decimal separator.
Click *Set* after changing a bit-value presented as a single checkbox if you want the new value applied.

Note: EDID Editor does not have an *Undo* function. Therefore, it is highly recommended that you back up un-edited EDID contents to a file before editing it.

9. PACKET EDITOR

Introduction



Packet Editor enables creation and editing metadata packets to be included Scenarios played with Playback function. Open packet editor from UCD Console's menu **Tools > Packet Editor.**

The types of packets are:

- Audio InfoFrame (Audio)
- AVI InfoFrame (AVI)
- Custom InfoFrame (Custom) (HDMI)
- Custom Packet (custom) (DP)
- DR&M InfoFrame (DR&M) (HDMI)
- DR&M Packet (DR&M) (DP)
- EMP-VRR (EMP-VRR)
- GCP InfoFrame (GCP)
- SBTM InfoFrame (SBTM) (HDMI)
- SPD InfoFrame (SPD)
- Vendor-Specific InfoFrame (VS) (HDMI)*
- Vendor-Specific SDP (VS) (DP)*

*) Please select from available VS packet types in field "4: Type" in the packet editor.

10. PATTERN EDITOR

Introduction

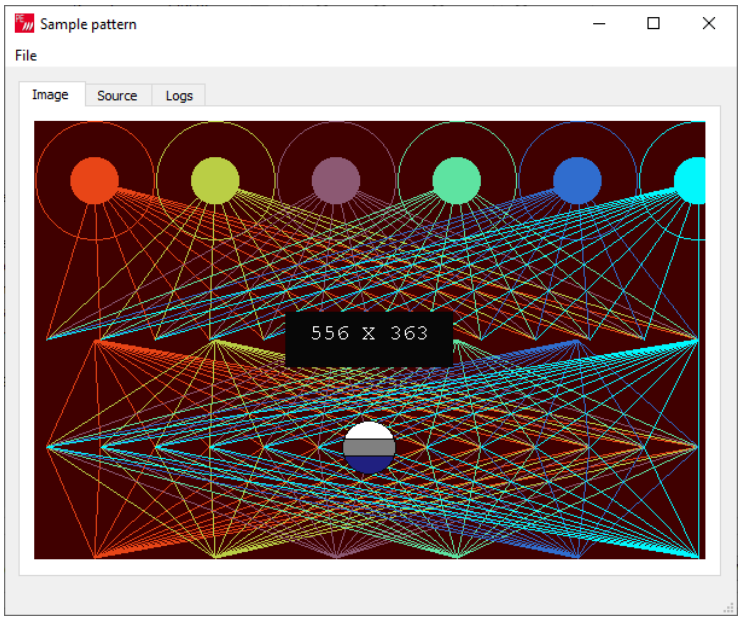
Pattern Editor is a tool for editing and debugging Unigraf Custom VTP Pattern scripts. Open packet editor from UCD Console's menu **Tools > Pattern Editor.**

Please refer to APPENDIX F: VTP PATTERN LANGUAGE later in this document for description of the VTP Pattern Language syntax.

Pattern Editor consists of three tabs:

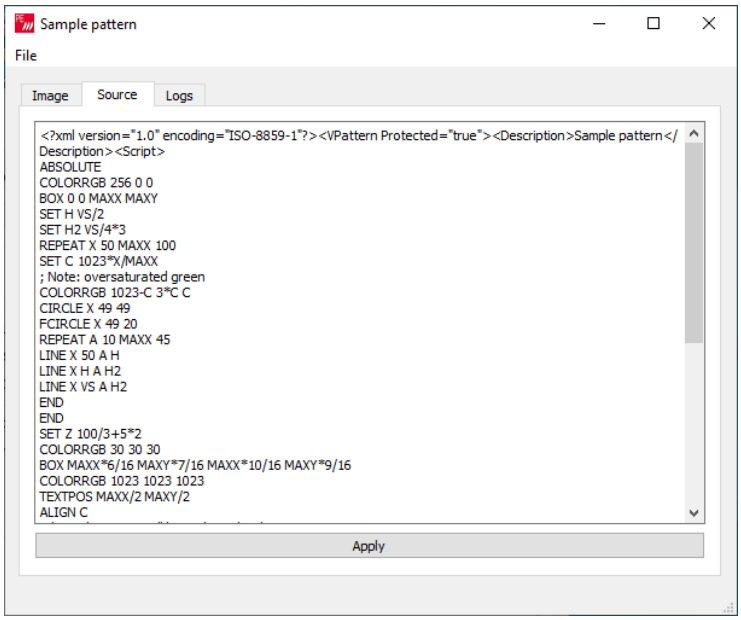
Image Tab

Monitoring the rendering of the VTP pattern script.



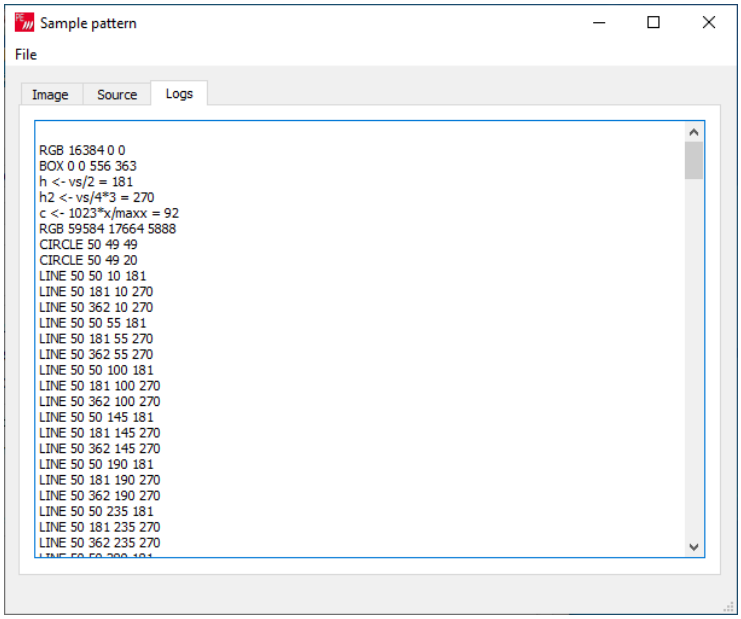
Source Tab

Tool for editing VTP Pattern Language script. Click Apply to render the code in the resolution of the preview image in *Image* tab.



Logs Tab

Log of the pattern code parsing indicating the values assigned to logical variables and the actual parameter values used for render instructions.



Saving and Recalling the Script

In File pull-down menu the user can save his work.

Open: Open a VTP language script from PC

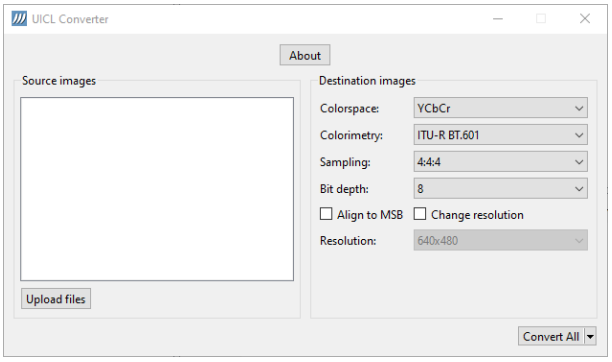
Save Script: Save the script currently in Source tab to PC

Save Image: Save a rendered pattern in PNG, BMP, JPG or PPM format

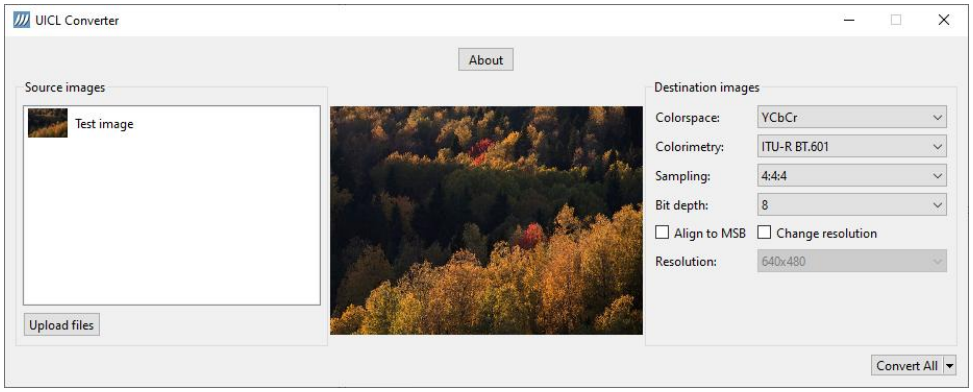
Select Save Resolution: Select from six common resolutions the size in which the pattern script will be rendered when saved.

11. IMAGE CONVERTER

Image Converter is a tool for converting images from one color format to another. This kind of conversion is typically needed when creating YCbCr test images from RGB bitmaps. Open the image converter from UCD Console's menu **Tools > Image Converter.**



Click **Upload files** to load the Source image.



Colorspace	YCbCr, RGB
Colorimetry	ITU-R BT.601, ITU-R BT.709, ITU-R BT2020
Sampling	4:4:4, 4:2:2, 4:2:0
Bit depth	8, 10, 12, 16
Align to MSB	Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).
Change resolution	Select a resolution for the destination image from the pre-defined list
Covert All	Convert all uploaded images to destination format and save them in the same folder as the source images.
Covert All and save to the custom folder	Convert all uploaded images to destination format and save to the selected folder.

File name for the destination image is of form:

Test image[1920x1080_yuv444_8bpc_BT601_Packed_YCbCr_LSB]

APPENDIX A: PRODUCT SPECIFICATION

UCD-301

Inputs	DisplayPort™ 1.4a compliant with HBR2 max bit rate HDMI 2.0 compliant
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	Debian 11.0 or higher. Ubuntu 20.04.4 LTS or higher. MacOS Big Sur 11.7.10 or higher. Windows 10 10.0.19045 or higher.
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output) System input: 12Vdc, 3A
Environmental	Operating temperature: 15 to 40 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	281 × 128 × 62 mm
Weight	0.9 kg w/o power supply

UCD-323

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
Capture memory	4 GBytes
Computer interface	USB 3.0 and USB 2.0
Software	Debian 11.0 or higher. Ubuntu 20.04.4 LTS or higher. MacOS Big Sur 11.7.10 or higher. Windows 10 10.0.19045 or higher.
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output) System input: 12Vdc, 3A
Environmental	Operating temperature: 15 to 40 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	281 × 128 × 62 mm
Weight	0.9 kg w/o power supply

UCD-323 Gen2

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
Capture memory	4 GBytes
Computer interface	USB 3.0 and USB 2.0
Software	Debian 11.0 or higher. Ubuntu 20.04.4 LTS or higher. MacOS Big Sur 11.7.10 or higher. Windows 10 10.0.19045 or higher.
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output) System input: 12Vdc, 3A
Environmental	Operating temperature: 15 to 40 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	281 × 128 × 62 mm
Weight	0.9 kg w/o power supply

APPENDIX B: PRODUCT FEATURES

UCD-301, UCD-323 & UCD-323 Gen2

Interface Role / Product Option	Default	Console Pro	HDCP 2.3 support (Console Pro)	HDCP 2.3 CTS Sink / Source DUT	DP 2.1 AUX Controller	TSI Basic	TSI Advanced	Electrical Test	HDCP 2.3 support
HDMI Reference Sink									
Video status, preview and saving	●					▲			
Audio monitoring, graphical preview and saving	●					▲			
Link status	●					▲			
Link control		●					▲		
HPD status and control	●					▲			
EDID read and write		●					▲		
EDID Editor		●							
HDCP 1.4 status and control		●					▲		
HDCP 2.3 status and control			●						▲
Event Log		●							
Infoframe status		●					▲		
Source DUT Testing		●					▲	▲	
Electrical Test (UCD-301)		●						▲	
eARC (UCD-323 Gen2)		●							
DP Reference Sink									
Video status, preview and saving	●					▲			
Buffered capture		●							
Audio monitoring, graphical preview and saving	●					▲			
Link status	●					▲			
Link control		●					▲		
HPD status and control	●					▲			
DPCD editor		●							
Monitor InfoFrame Status (SDP)		●					▲		
EDID read and write		●					▲		
EDID / DisplayID Editor		●							
HDCP 1.3 status and control**		●							
HDCP 2.3 status and control			●						▲
Event Log, AUX Analyzer		●							
AUX Controller					●				
Source DUT Testing (Link and CRC test)		●					▲		
Electrical Test UCD-301		●						▲	
HDCP 2.3 CTS for testing DP Source DUT				●					

*) Separate licenses for testing Sink and Source DUT

**) HDCP 1.3 is not supported for 3.9 release

UCD-301, UCD-323 & UCD-323 Gen2 (cont.)

Input /Output Role	Default	Console Pro	HDCP 2.3 support (Console Pro)	HDCP 2.3 CTS Sink / Source DUT	DP 2.1 AUX Controller	TSI Basic	TSI Advanced	HDCP 2.3 support
HDMI Reference Source (UCD-323 only)								
Video pattern generator (fixed patterns and timings)	●						▲	
Custom video patterns and timings		●						▲
Playback		●						▲
Audio Generator	●							
Link status	●							▲
Link control		●						▲
EDID read and write		●						▲
EDID Editor		●						
SCDC Editor		●						▲
Event Log		●						
Sink DUT Testing		●						
HDCP 1.4 status and control		●						▲
HDCP 2.3 status and control			●					
DP Reference Source (UCD-323 only)								
Video pattern generator (fixed patterns and timings)	●					▲		
Custom video patterns and timings		●					▲	
Audio generator	●							
Playback		●					▲	
Link status	●					▲		
Link control		●						
HPD status	●						▲	
EDID read and write		●					▲	
EDID / DisplayID Editor		●						
MST Feature (up to 2 streams)	●					●		
DPCD editor		●						
HDCP 1.3 status and control**		●					▲	
HDCP 2.3 status and control			●					
Event Log, AUX Analyzer		●						
AUX Controller					●			
Sink DUT Testing		●						
HDCP 2.3 CTS for testing DP Sink DUT				●				

**) HDCP 1.3 is not supported for 3.9 release

UCD-301, UCD-323 & UCD-323 Gen2 Product Options

Product	P/N
UCD-300 Series SW Options	
UCD Console Pro for HDMI Reference Sink	MT6610
UCD Console Pro for DP Reference Sink	MT6611
UCD Console Pro for HDMI Reference Source	MT6613
UCD Console Pro for DP Reference Source	MT6614
HDCP 2.3 support	MT6504
HDCP 2.3 CTS Options for UCD-301, UCD-323	
HDCP 2.3 CTS for testing Source DUT on DP	MT6634
HDCP 2.3 CTS for testing Sink DUT on DP	MT6636
SDK Options for UCD-301, UCD-323, UCD-323 Gen2	
TSI SDK Advanced Test Set	MT6501
TSI SDK Adv. Test Set with HDCP 2.3 support	MT6516
TSI Electrical Test Set	MT6502
HDR10+ Options for UCD-323	
HDR 10+ Display Device and SSTM for testing Sink DUT on HDMI	MT6675
HDR 10+ Display Device and SSTM for testing Sink DUT on DP	MT6676
HDR 10+ Distribution Device for testing Source DUT on HDMI	MT6677
HDR 10+ Distribution Device for testing Source DUT on DP	MT6678
PHY CTS Options for UCD-323 Gen2	
DP 2.1 Reference Sink AUX Controller for testing Source DUT	065060
DP 2.1 Reference Source AUX Controller for testing Sink DUT	065061

APPENDIX C: PREDEFINED TIMINGS

Description	TSI*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CVT 640x480 @60Hz	0	640	480	800	525	144	35	96	2	60	25.20
CTA 640x480 @60Hz (VIC 1)	1	640	480	800	525	144	35	96	2	60	25.17
CTA 720x480 @60Hz (VIC 2)	2	720	480	858	525	122	36	62	6	60	27.00
CTA 720x480 @60Hz (VIC 3)	3	720	480	858	525	122	36	62	6	60	27.00
CTA 720x576 @50Hz (VIC 17)	4	720	576	864	625	132	44	64	5	50	27.00
CTA 720x576 @50Hz (VIC 18)	5	720	576	864	625	132	44	64	5	50	27.00
CTA 720x576 @100Hz (VIC 42)	6	720	576	864	625	132	44	64	5	100	54.00
CTA 720x576 @100Hz (VIC 43)	7	720	576	864	625	132	44	64	5	100	54.00
CTA 720x480 @120Hz (VIC 49)	8	720	480	858	525	122	36	62	6	120	54.00
CTA 720x480 @120Hz (VIC 48)	9	720	480	858	525	122	36	62	6	120	54.05
CTA 720x576 @200Hz (VIC 52)	10	720	576	864	625	132	44	64	5	200	108.00
CTA 720x576 @200Hz (VIC 53)	11	720	576	864	625	132	44	64	5	200	108.00
CTA 720x480 @240Hz (VIC 56)	12	720	480	858	525	122	36	62	6	240	108.00
CTA 720x480 @240Hz (VIC 57)	13	720	480	858	525	122	36	62	6	240	108.00
CVT 768x480 @85Hz	14	768	480	992	507	184	24	72	6	85	42.50
OVT 768x480 @85Hz	15	768	480	928	741	64	242	32	8	85	58.45
DMT 800x600 @60Hz (DMT 0x09)	16	800	600	1056	628	216	27	128	4	60	40.00
DMT 848x480 @60Hz (DMT 0x0E)	17	848	480	1088	517	224	31	112	8	60	33.75
CVT 1024x640 @60Hz	18	1024	640	1312	665	248	22	104	6	60	52.25
DMT 1024x768 @60Hz (DMT 0x10)	19	1024	768	1344	806	296	35	136	6	60	65.00
OVT 1024x640 @60Hz	20	1024	640	1240	660	64	16	32	8	60	49.10
CVT 1152x720 @75Hz	21	1152	720	1520	755	304	32	120	6	75	85.75
OVT 1152x720 @75Hz	22	1152	720	1280	1224	64	496	32	8	75	117.50
CTA 1280x720 @50Hz (VIC 19)	23	1280	720	1980	750	260	25	40	5	50	74.25
CTA 1280x720 @100Hz (VIC 41)	24	1280	720	1980	750	260	25	40	5	100	148.50
CTA 1280x720 @24Hz (VIC 60)	25	1280	720	3300	750	260	25	40	5	24	59.40
CTA 1280x720 @25Hz (VIC 61)	26	1280	720	3960	750	260	25	40	5	25	74.25
CTA 1280x720 @30Hz (VIC 62)	27	1280	720	3300	750	260	25	40	5	30	74.25
CTA 1280x720 @24Hz (VIC 65)	28	1280	720	3300	750	260	25	40	5	24	59.40
CTA 1280x720 @25Hz (VIC 66)	29	1280	720	3960	750	260	25	40	5	25	74.25
CTA 1280x720 @30Hz (VIC 67)	30	1280	720	3300	750	260	25	40	5	30	74.25
CTA 1280x720 @50Hz (VIC 68)	31	1280	720	1980	750	260	25	40	5	50	74.25
CTA 1280x720 @60Hz (VIC 69)	32	1280	720	1650	750	260	25	40	5	60	74.25
CTA 1280x720 @100Hz (VIC 70)	33	1280	720	1980	750	260	25	40	5	100	148.50
CTA 1280x720 @120Hz (VIC 71)	34	1280	720	1650	750	260	25	40	5	120	148.50
CTA 1280x720 @48Hz (VIC 108)	35	1280	720	2500	750	260	25	40	5	48	90.00
CTA 1280x720 @48Hz (VIC 109)	36	1280	720	2500	750	260	25	40	5	48	90.00
CTA 1280x720 @60Hz (VIC 4)	37	1280	720	1650	750	260	25	40	5	60	74.25
CTA 1280x720 @120Hz (VIC 47)	38	1280	720	1650	750	260	25	40	5	120	148.50
OVT 1280x720 @24Hz	39	1280	720	1600	925	64	194	32	8	24	35.52
OVT 1280x720 @120Hz	40	1280	720	1408	775	64	38	32	8	120	130.94

CVT 1280x768 @60Hz	41	1280	768	1440	790	112	19	32	7	60	68.26
DMT 1280x768 @60Hz (DMT 0x17)	42	1280	768	1664	798	320	27	128	7	60	79.67
OVT 1280x768 @60Hz	43	1280	768	1472	800	64	20	32	8	60	70.66
DMT 1280x800 @60Hz (DMT 0x1B)	44	1280	800	1440	823	112	20	32	6	60	71.11
DMT 1280x800 @60Hz (DMT 0x1C)	45	1280	800	1680	831	328	28	128	6	60	83.76
OVT 1280x960 @60Hz	46	1280	960	1440	1000	64	24	32	8	60	86.40
DMT 1280x960 @60Hz (DMT 0x20)	47	1280	960	1800	1000	424	39	112	3	60	108.00
CVT 1280x960 @60Hz	48	1280	960	1696	996	336	33	128	4	60	101.25
DMT 1280x1024 @60Hz (DMT 0x23)	49	1280	1024	1688	1066	360	41	112	3	60	107.96
DMT 1360x768 @60Hz (DMT 0x27)	50	1360	768	1792	795	368	24	112	6	60	85.48
DMT 1400x1050 @60Hz (DMT 0x29)	51	1400	1050	1560	1080	112	27	32	4	60	101.09
DMT 1400x1050 @60Hz (DMT 0x2A)	52	1400	1050	1864	1089	376	36	144	4	60	121.79
CTA 1440x480 @60Hz (VIC 6)	53	1440	480	1716	525	238	18	124	3	60	54.00
CTA 1440x480 @60Hz (VIC 7)	54	1440	480	1716	525	238	18	124	3	60	54.00
OVT 1440x240 @60Hz	55	1440	240	1920	260	64	14	32	8	60	29.95
CTA 1440x240 @60Hz (VIC 8)	56	1440	240	1716	263	238	18	124	3	60	27.00
CTA 1440x240 @60Hz (VIC 9)	57	1440	240	1716	262	238	18	124	3	60	27.00
CVT 1440x240 @60Hz	58	1440	240	1716	262	238	18	124	3	60	27.00
OVT 1440x480 @60Hz	59	1440	480	1696	500	64	12	32	8	60	50.88
CTA 1440x480 @60Hz (VIC 14)	60	1440	480	1716	525	244	36	124	6	60	54.00
CTA 1440x480 @60Hz (VIC 15)	61	1440	480	1716	525	244	36	124	6	60	54.00
CTA 1440x576 @50Hz (VIC 21)	62	1440	576	1728	625	264	22	126	3	50	54.00
CTA 1440x576 @50Hz (VIC 22)	63	1440	576	1728	625	264	22	126	3	50	54.00
CTA 1440x288 @50Hz (VIC 23)	64	1440	288	1728	314	264	22	126	3	50	27.00
CTA 1440x288 @50Hz (VIC 24)	65	1440	288	1728	314	264	22	126	3	50	27.00
CTA 1440x576 @50Hz (VIC 29)	66	1440	576	1728	625	264	44	128	5	50	54.00
CTA 1440x576 @50Hz (VIC 30)	67	1440	576	1728	625	264	44	128	5	50	54.00
CTA 1440x576 @100Hz (VIC 44)	68	1440	576	1728	625	264	22	126	3	100	108.00
CTA 1440x576 @100Hz (VIC 45)	69	1440	576	1728	625	264	22	126	3	100	108.00
CTA 1440x480 @120Hz (VIC 50)	70	1440	480	1716	525	238	18	124	3	120	108.00
CTA 1440x480 @120Hz (VIC 51)	71	1440	480	1716	525	238	18	124	3	120	108.00
CTA 1440x576 @200Hz (VIC 54)	72	1440	576	1728	625	264	22	126	3	200	216.00
CTA 1440x576 @200Hz (VIC 55)	73	1440	576	1728	625	264	22	126	3	200	216.00
CTA 1440x480 @240Hz (VIC 58)	74	1440	480	1716	525	238	18	124	3	240	216.00
CTA 1440x480 @240Hz (VIC 59)	75	1440	480	1716	525	238	18	124	3	240	216.00
OVT 1440x900 @60Hz	76	1440	900	1600	940	64	23	32	8	60	90.24
DMT 1440x900 @60Hz (DMT 0x2F)	77	1440	900	1904	934	384	31	152	6	60	106.50
OVT 1536x960 @85Hz	78	1536	960	1640	1440	64	469	32	8	85	200.74
CVT 1536x960 @85Hz	79	1536	960	2080	1011	432	48	160	6	85	178.50
CVT 1600x1200 @60Hz	80	1600	1200	1760	1235	112	32	32	4	60	130.42
DMT 1600x1200 @60Hz (DMT 0x33)	81	1600	1200	2160	1250	496	49	192	3	60	162.00
CTA 1680x720 @24Hz (VIC 79)	82	1680	720	3300	750	260	25	40	5	24	59.40
CTA 1680x720 @25Hz (VIC 80)	83	1680	720	3168	750	260	25	40	5	25	59.40
CTA 1680x720 @30Hz (VIC 81)	84	1680	720	2640	750	260	25	40	5	30	59.40

CTA 1680x720 @50Hz (VIC 82)	85	1680	720	2200	750	260	25	40	5	50	82.50
CTA 1680x720 @100Hz (VIC 84)	86	1680	720	2000	825	260	100	40	5	100	165.00
CTA 1680x720 @48Hz (VIC 110)	87	1680	720	2750	750	260	25	40	5	48	99.00
CTA 1680x720 @60Hz (VIC 83)	88	1680	720	2200	750	260	25	40	5	60	99.00
CTA 1680x720 @120Hz (VIC 85)	89	1680	720	2000	825	260	100	40	5	120	198.00
DMT 1680x1050 @60Hz (DMT 0x39)	90	1680	1050	1840	1080	112	27	32	6	60	119.23
DMT 1680x1050 @60Hz (DMT 0x3A)	91	1680	1050	2240	1089	456	36	176	6	60	146.36
DMT 1792x1344 @60Hz (DMT 0x3E)	92	1792	1344	2448	1394	528	49	200	3	60	204.75
DMT 1856x1392 @60Hz (DMT 0x41)	93	1856	1392	2528	1439	576	46	224	3	60	218.27
CTA 1920x1080 @60Hz (VIC 5)	94	1920	1080	2200	1125	192	20	44	5	60	148.50
CTA 1920x1080 @50Hz (VIC 20)	95	1920	1080	2640	1125	192	20	44	5	50	148.50
CTA 1920x1080 @50Hz (VIC 31)	96	1920	1080	2640	1125	192	41	44	5	50	148.50
CTA 1920x1080 @24Hz (VIC 32)	97	1920	1080	2750	1125	192	41	44	5	24	74.25
CTA 1920x1080 @25Hz (VIC 33)	98	1920	1080	2640	1125	192	41	44	5	25	74.25
CTA 1920x1080 @50Hz (VIC 39)	99	1920	1080	2304	1250	352	62	168	5	50	144.00
CTA 1920x1080 @100Hz (VIC 40)	100	1920	1080	2640	1125	192	20	44	5	100	297.00
CTA 1920x1080 @120Hz (VIC 46)	101	1920	1080	2200	1125	192	20	44	5	120	297.00
OVT 1920x1080 @30Hz	102	1920	1080	2144	1100	64	14	32	8	30	70.75
OVT 1920x1080 @60Hz	103	1920	1080	2080	1120	64	27	32	8	60	139.78
OVT 1920x1080 @85Hz	104	1920	1080	2016	1623	64	529	32	8	85	278.12
OVT 1920x1080 @100Hz	105	1920	1080	2016	1380	64	286	32	8	100	278.21
OVT 1920x1080 @120Hz	106	1920	1080	2016	1150	64	56	32	8	120	278.21
OVT 1920x1080 @144Hz	107	1920	1080	2040	1175	64	68	32	8	144	345.17
OVT 1920x1080 @240Hz	108	1920	1080	2000	1215	64	117	32	8	240	583.20
CTA 1920x1080 @100Hz (VIC 64)	109	1920	1080	2640	1125	192	41	44	5	100	297.00
CTA 1920x1080 @24Hz (VIC 72)	110	1920	1080	2750	1125	192	41	44	5	24	74.25
CTA 1920x1080 @25Hz (VIC 73)	111	1920	1080	2640	1125	192	41	44	5	25	74.25
CTA 1920x1080 @30Hz (VIC 74)	112	1920	1080	2200	1125	192	41	44	5	30	74.25
CTA 1920x1080 @50Hz (VIC 75)	113	1920	1080	2640	1125	192	41	44	5	50	148.50
CTA 1920x1080 @60Hz (VIC 76)	114	1920	1080	2200	1125	192	41	44	5	60	148.50
CTA 1920x1080 @100Hz (VIC 77)	115	1920	1080	2640	1125	192	41	44	5	100	297.00
CTA 1920x1080 @120Hz (VIC 78)	116	1920	1080	2200	1125	192	41	44	5	120	297.00
CVT 1920x1080 @30Hz	117	1920	1080	2080	1096	112	13	32	5	30	68.39
CVT 1920x1080 @30Hz	118	1920	1080	2000	1096	72	14	32	8	30	65.76
CVT 1920x1080 @144Hz	119	1920	1080	2080	1157	112	74	32	5	144	346.66
CVT 1920x1080 @144Hz	120	1920	1080	2000	1157	72	14	32	8	144	333.33
CVT 1920x1080 @144Hz	121	1920	1080	2080	1157	152	14	32	8	144	346.66
CVT 1920x1080 @200Hz	122	1920	1080	2080	1190	152	14	32	8	200	495.21
CVT 1920x1080 @240Hz	123	1920	1080	2080	1215	112	132	32	5	240	606.27
CVT 1920x1080 @240Hz	124	1920	1080	2000	1215	72	14	32	8	240	582.95
CVT 1920x1080 @240Hz	125	1920	1080	2080	1215	152	14	32	8	240	606.27
CTA 1920x1080 @30Hz (VIC 34)	126	1920	1080	2200	1125	192	41	44	5	30	74.25
CVT 1920x1080 @60Hz	127	1920	1080	2080	1111	112	28	32	5	60	138.65
CVT 1920x1080 @60Hz	128	1920	1080	2000	1111	72	14	32	8	60	133.32

DMT 1920x1080 @60Hz (DMT 0x52)	129	1920	1080	2200	1125	192	41	44	5	60	148.50
CTA 1920x1080 @60Hz (VIC 16)	130	1920	1080	2200	1125	192	41	44	5	60	148.50
CVT 1920x1080 @120Hz	131	1920	1080	2080	1144	112	61	32	5	120	285.54
CVT 1920x1080 @120Hz	132	1920	1080	2000	1144	72	14	32	8	120	274.56
CTA 1920x1080 @120Hz (VIC 63)	133	1920	1080	2200	1125	192	41	44	5	120	297.00
CTA 1920x1080 @48Hz (VIC 111)	134	1920	1080	2750	1125	192	41	44	5	48	148.50
CTA 1920x1080 @48Hz (VIC 112)	135	1920	1080	2750	1125	192	41	44	5	48	148.50
CVT 1920x1080 @85Hz	136	1920	1080	2624	1137	560	54	208	5	85	253.25
DMT 1920x1200 @60Hz (DMT 0x45)	137	1920	1200	2592	1245	536	42	200	6	60	193.62
OVT 1920x1440 @60Hz	138	1920	1440	2048	1500	64	36	32	8	60	184.32
DMT 1920x1440 @60Hz (DMT 0x49)	139	1920	1440	2600	1500	552	59	208	3	60	234.00
CVT 1920x1440 @60Hz	140	1920	1440	2080	1481	112	38	32	4	60	184.75
CVT 2048x1280 @60Hz	141	2048	1280	2208	1317	112	34	32	6	60	174.25
OVT 2048x1280 @60Hz	142	2048	1280	2200	1320	64	32	32	8	60	174.24
OVT 2048x1536 @60Hz	143	2048	1536	2200	1580	64	38	32	8	60	208.56
CVT 2048x1536 @60Hz	144	2048	1536	2208	1580	112	41	32	4	60	209.32
CVT 2128x1200 @60Hz	145	2128	1200	2864	1245	592	42	224	10	60	213.75
OVT 2128x1200 @60Hz	146	2128	1200	2280	1240	64	30	32	8	60	169.63
OVT 2456x1536 @50Hz	147	2456	1536	2600	1896	64	354	32	8	50	246.48
OVT 2456x1536 @75Hz	148	2456	1536	2560	2608	64	1057	32	8	75	500.74
CVT 2456x1536 @50Hz	149	2456	1536	3320	1583	696	44	264	10	50	262.78
CVT 2456x1536 @75Hz	150	2456	1536	3384	1606	728	67	264	10	75	407.25
CTA 2560x1080 @24Hz (VIC 86)	151	2560	1080	3750	1100	192	16	44	5	24	99.00
CTA 2560x1080 @25Hz (VIC 87)	152	2560	1080	3200	1125	192	41	44	5	25	90.00
CTA 2560x1080 @30Hz (VIC 88)	153	2560	1080	3520	1125	192	41	44	5	30	118.80
CTA 2560x1080 @50Hz (VIC 89)	154	2560	1080	3300	1125	192	41	44	5	50	185.62
CTA 2560x1080 @100Hz (VIC 91)	155	2560	1080	2970	1250	192	166	44	5	100	371.25
OVT 2560x1080 @30Hz	156	2560	1080	2784	1100	64	14	32	8	30	91.87
OVT 2560x1080 @60Hz	157	2560	1080	2720	1120	64	27	32	8	60	182.78
OVT 2560x1080 @120Hz	158	2560	1080	2656	1150	64	56	32	8	120	366.53
CVT 2560x1440 @60Hz	159	2560	1440	2640	1481	72	14	32	8	60	234.59
CVT 2560x1440 @60Hz	160	2560	1440	2720	1481	112	38	32	5	60	241.70
CVT 2560x1440 @144Hz	161	2560	1440	2720	1543	152	14	32	8	144	604.57
CVT 2560x1440 @200Hz	162	2560	1440	2720	1586	152	14	32	8	200	863.09
CTA 2560x1080 @48Hz (VIC 113)	163	2560	1080	3750	1100	192	16	44	5	48	198.00
CVT 2560x1080 @60Hz	164	2560	1080	3424	1120	704	37	272	10	60	230.09
CVT 2560x1080 @60Hz	165	2560	1080	2720	1111	112	28	32	10	60	181.32
CVT 2560x1080 @144Hz	166	2560	1080	2720	1157	152	14	32	8	144	453.33
CVT 2560x1080 @200Hz	167	2560	1080	2720	1190	152	14	32	8	200	647.59
CTA 2560x1080 @60Hz (VIC 90)	168	2560	1080	3000	1100	192	16	44	5	60	198.00
CTA 2560x1080 @120Hz (VIC 92)	169	2560	1080	3300	1250	192	166	44	5	120	495.00
DMT 2560x1600 @60Hz (DMT 0x4D)	170	2560	1600	3504	1658	752	55	280	6	60	348.58
DMT 2560x1600 @60Hz (DMT 0x4C)	171	2560	1600	2720	1646	112	43	32	6	60	268.63

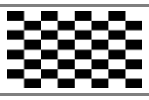
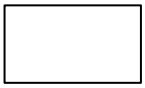
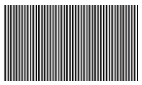
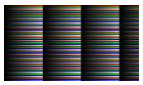
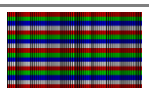
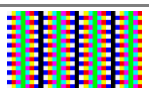
OVT 2560x1600 @60Hz	172	2560	1600	2680	1660	64	40	32	8	60	266.93
CVT 2560x1920 @75Hz	173	2560	1920	3552	2006	776	83	280	4	75	534.25
OVT 2560x1920 @75Hz	174	2560	1920	2688	3280	64	1329	32	8	75	661.25
OVT 2728x1536 @60Hz	175	2728	1536	2880	1580	64	38	32	8	60	273.02
CVT 2728x1536 @60Hz	176	2728	1536	3720	1592	792	53	296	10	60	355.00
CTA 2880x240 @60Hz (VIC 12)	177	2880	240	3432	263	476	18	248	3	60	54.00
CTA 2880x240 @60Hz (VIC 13)	178	2880	240	3432	263	476	18	248	3	60	54.00
CTA 2880x288 @50Hz (VIC 27)	179	2880	288	3456	314	528	22	252	3	50	54.00
CTA 2880x288 @50Hz (VIC 28)	180	2880	288	3456	314	528	22	252	3	50	54.00
CTA 2880x480 @60Hz (VIC 10)	181	2880	480	3432	525	476	18	248	3	60	108.00
CTA 2880x480 @60Hz (VIC 11)	182	2880	480	3432	525	476	18	248	3	60	108.00
CTA 2880x480 @60Hz (VIC 35)	183	2880	480	3432	525	488	36	248	6	60	108.00
CTA 2880x480 @60Hz (VIC 36)	184	2880	480	3432	525	488	36	248	6	60	108.00
CTA 2880x576 @50Hz (VIC 37)	185	2880	576	3456	625	528	44	256	5	50	108.00
CTA 2880x576 @50Hz (VIC 38)	186	2880	576	3456	625	528	44	256	5	50	108.00
CTA 2880x576 @50Hz (VIC 25)	187	2880	576	3456	625	528	22	252	3	50	108.00
CTA 2880x576 @50Hz (VIC 26)	188	2880	576	3456	625	528	22	252	3	50	108.00
2880x1440 @60Hz	189	2880	1440	2976	1456	48	8	8	1	60	259.98
CVT 3440x1440 @60Hz	190	3440	1440	4688	1493	992	50	368	10	60	419.95
CVT 3440x1440 @60Hz	191	3440	1440	3600	1481	112	38	32	10	60	319.90
CVT 3440x1440 @60Hz	192	3440	1440	3520	1481	72	14	32	8	60	312.79
CVT 3440x1440 @120Hz	193	3440	1440	4800	1545	1064	102	384	10	120	889.92
CVT 3440x1440 @120Hz	194	3440	1440	3600	1525	112	82	32	10	120	658.80
CVT 3440x1440 @120Hz	195	3440	1440	3520	1525	72	14	32	8	120	644.16
CVT 3440x1440 @165Hz	196	3440	1440	4832	1588	1080	145	384	10	165	1266.08
CVT 3440x1440 @165Hz	197	3440	1440	3600	1559	112	116	32	10	165	926.05
CVT 3440x1440 @165Hz	198	3440	1440	3520	1559	72	14	32	8	165	905.47
CVT 3440x1440 @200Hz	199	3440	1440	4848	1622	1088	179	384	10	200	1572.69
CVT 3440x1440 @200Hz	200	3440	1440	3600	1586	112	143	32	10	200	1141.92
CVT 3440x1440 @200Hz	201	3440	1440	3520	1586	72	14	32	8	200	1116.54
CVT 3440x1440 @240Hz	202	3440	1440	4848	1663	1088	220	384	10	240	1934.93
CVT 3440x1440 @240Hz	203	3440	1440	3600	1619	112	176	32	10	240	1398.82
CVT 3440x1440 @240Hz	204	3440	1440	3520	1619	72	14	32	8	240	1367.73
CVT 3840x2160 @30Hz	205	3840	2160	4000	2191	112	28	32	5	30	262.92
CVT 3840x2160 @30Hz	206	3840	2160	3920	2191	72	14	32	8	30	257.66
CVT 3840x2160 @60Hz	207	3840	2160	4000	2222	112	59	32	5	60	533.28
CVT 3840x2160 @60Hz	208	3840	2160	3920	2222	72	14	32	8	60	522.61
CVT 3840x2160 @60Hz	209	3840	2160	4000	2222	152	14	32	8	60	533.47
CTA 3840x2160 @60Hz (VIC 97)	210	3840	2160	4400	2250	384	82	88	10	60	594.00
CTA 3840x2160 @24Hz (VIC 93)	211	3840	2160	5500	2250	384	82	88	10	24	297.00
CTA 3840x2160 @25Hz (VIC 94)	212	3840	2160	5280	2250	384	82	88	10	25	297.00
CTA 3840x2160 @30Hz (VIC 95)	213	3840	2160	4400	2250	384	82	88	10	30	297.00
CTA 3840x2160 @50Hz (VIC 96)	214	3840	2160	5280	2250	384	82	88	10	50	594.00
CTA 3840x2160 @24Hz (VIC 103)	215	3840	2160	5500	2250	384	82	88	10	24	297.00
CTA 3840x2160 @25Hz (VIC 104)	216	3840	2160	5280	2250	384	82	88	10	25	297.00
CTA 3840x2160 @30Hz (VIC 105)	217	3840	2160	4400	2250	384	82	88	10	30	297.00

CTA 3840x2160 @50Hz (VIC 106)	218	3840	2160	5280	2250	384	82	88	10	50	594.00
CTA 3840x2160 @60Hz (VIC 107)	219	3840	2160	4400	2250	384	82	88	10	60	594.00
CTA 3840x2160 @48Hz (VIC 114)	220	3840	2160	5500	2250	384	82	88	10	48	594.00
CTA 3840x2160 @48Hz (VIC 116)	221	3840	2160	5500	2250	384	82	88	10	48	594.00
CTA 3840x2160 @100Hz (VIC 117)	222	3840	2160	5280	2250	384	82	88	10	100	1188.00
CTA 3840x2160 @100Hz (VIC 119)	223	3840	2160	5280	2250	384	82	88	10	100	1188.00
CTA 3840x2160 @120Hz (VIC 120)	224	3840	2160	4400	2250	384	82	88	10	120	1188.00
OVT 3840x2160 @30Hz	225	3840	2160	3968	2200	64	27	32	8	30	261.89
OVT 3840x2160 @60Hz	226	3840	2160	3960	2240	64	54	32	8	60	532.22
OVT 3840x2160 @120Hz	227	3840	2160	3968	2300	64	111	32	8	120	1095.17
OVT 3840x2160 @144Hz	228	3840	2160	4000	2314	64	134	32	8	144	1332.86
OVT 3840x2400 @60Hz	229	3840	2400	3960	2480	64	60	32	8	60	589.25
OVT 4096x2160 @30Hz	230	4096	2160	4224	2200	64	27	32	8	30	278.78
CVT 4096x2160 @60Hz	231	4096	2160	4176	2222	72	14	32	8	60	556.74
CVT 4096x2160 @60Hz	232	4096	2160	4256	2222	112	59	32	10	60	567.41
CVT 4096x2160 @60Hz	233	4096	2160	4256	2222	152	14	32	8	60	567.61
CVT 4096x2160 @144Hz	234	4096	2160	4256	2314	152	14	32	8	144	1418.66
CTA 4096x2160 @60Hz (VIC 102)	235	4096	2160	4400	2250	216	82	88	10	60	594.00
CTA 4096x2160 @120Hz (VIC 219)	236	4096	2160	4400	2250	216	82	88	10	120	1188.00
CTA 4096x2160 @100Hz (VIC 218)	237	4096	2160	5280	2250	384	82	88	10	100	1188.00
CTA 4096x2160 @50Hz (VIC 101)	238	4096	2160	5280	2250	216	82	88	10	50	594.00
CTA 4096x2160 @48Hz (VIC 115)	239	4096	2160	5500	2250	384	82	88	10	48	594.00
CTA 4096x2160 @24Hz (VIC 98)	240	4096	2160	5500	2250	384	82	88	10	24	297.00
CTA 4096x2160 @25Hz (VIC 99)	241	4096	2160	5280	2250	216	82	88	10	25	297.00
CTA 4096x2160 @30Hz (VIC 100)	242	4096	2160	4400	2250	216	82	88	10	30	297.00

*) TSI Timing ID
CVT: Coordinated Video Timings (CVT; VESA-2013-3 v1. 2); *DMT*: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings; *CTA*: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H); *UG*: Unigraf proprietary timing

APPENDIX D: PREDEFINED PATTERNS

Fixed Patterns

Selection	Pattern	Description
Disabled		The links are activated but no video data transferred
Color Bar		100% intensity color bars of all primaries and mixed combinations.
Chessboard		8 by 8 chessboard with black (0%) and 100% intensity white
Solid Black		0% luminance
Solid White		100% white
Solid Red		100% red
Solid Green		100% green
Solid Blue		100% blue
White V-Strips		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 1 to 1000.
Gradient RGB Stripes		16 pixels high horizontal red, green, blue and white stripes. Intensity is increased from 0 to 100% with steps defined by the given parameter (Color Step = cs) and selected color. (step = cs*color_depth/256). “n” range 0 to 5000 (default 100).
Color Ramp		Color Ramp test pattern defined by VESA DisplayPort Link Layer Compliance Test Specification.
Color Square		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)
Motion Pattern		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)
Square Window		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).

Extended Patterns

Selection	Icon	Description
Select Image		Custom image uploaded by the user. Click on Select … to browse.
Unigraf PM5544		Vpattern vector pattern based on PM5544
Color Web		Vpattern vector pattern.
Chinese Town Full HD		JPG Bitmap image (1920 x 1080 px)
UG-2111 HLG Narrow		Software generated pattern. HLG Narrow dynamic range.
UG-2111 PQ Narrow		Software generated pattern. PQ Narrow dynamic range.
UG-2111 PQ Full		Software generated pattern. PQ Full dynamic range.
Multi		Vpattern vector pattern. Multi-purpose pattern w square grid, cross-grids, 1x1 cross-hatches, circles, and color bars
SMPTE RP-133		Vpattern vector pattern based on SMTPE RP-133
SMPTE 303M		Vpattern vector pattern. SMPTE 303M; Full Range; RGB values before gamma correction based on D65 and PAL primaries
Blue		Vpattern vector pattern. 100% Blue
CirclesW		Vpattern vector pattern. Concentric circles
Complex		Vpattern vector pattern. Complex Pattern w 64 steps
Green		Vpattern vector pattern. 100% Green
Hor1W-Even		Vpattern vector pattern. Horizontal 1 px wide White bars in even rows
Hor1W-Odd		Vpattern vector pattern. Horizontal 1 px wide White bars in odd rows
Hor4W		Vpattern vector pattern. Horizontal 4 px high White bars
Hor10W		Vpattern vector pattern. Horizontal 10 px high White bars
Hor-10xB		Vpattern vector pattern. 10 pcs horizontal Blue bars
Hor-10G		Vpattern vector pattern. 10 pcs horizontal Green bars

Extended Patterns (contd.)

Selection	Icon	Description
Hor-10xR		Vpattern vector pattern. 10 pcs horizontal Red bars
Hor-10xW		Vpattern vector pattern. 10 pcs horizontal White bars
HorRainbow-1024		Vpattern vector pattern. Horizontal Rainbow Ramps 1024 steps
HorRGBW-1024		Vpattern vector pattern. Horizontal RGBW Ramps 1024 steps
HorScale9		Vpattern vector pattern. Nine Horizontal Color Ramps
HorScaleW-64		Vpattern vector pattern. Horizontal White ramp 64 steps
HorScaleW-128		Vpattern vector pattern. Horizontal White ramp 128 steps
HorScaleW-X2		Vpattern vector pattern. Horizontal White ramp w edges 128 steps
InnerBox-BKtoB		Vpattern vector pattern. InnerBox pattern from Black to Blue
InnerBox-BKtoG		Vpattern vector pattern. InnerBox pattern from Black to Green
InnerBox-BKtoR		Vpattern vector pattern. InnerBox pattern from Black to Red
InnerBox-BKtoW		Vpattern vector pattern. InnerBox pattern from Black to White
InnerBoxMIX		Vpattern vector pattern. InnerBox pattern mixed hues.
InnerBox-RtoB		Vpattern vector pattern. InnerBox pattern from Red to Blue
Red		Vpattern vector pattern. 100% Red
Ver1W-Even		Vpattern vector pattern. Vertical 1 px wide White bars in even columns
Ver1W-Odd		Vpattern vector pattern. Vertical 1 px wide White bars in odd columns
Ver4W		Vpattern vector pattern. Vertical 4 px wide White bars
Ver10W		Vpattern vector pattern. Vertical 10 px wide White bars
Ver-10xG		Vpattern vector pattern. 10 pcs Vertical Blue bars
Ver-10xR		Vpattern vector pattern. 10 pcs Vertical Blue bars
Ver-10xB		Vpattern vector pattern. 10 pcs Vertical Blue bars
Ver-10xW		Vpattern vector pattern. 10 pcs Vertical Blue bars

Extended Patterns (contd.)

Selection	Icon	Description
VerBars75%		Vpattern vector pattern. Vertical 75% intensity Color bars
VerBars100%		Vpattern vector pattern. Vertical 100% intensity Color bars
VerRGBW-1024		Vpattern vector pattern. Vertical RGBW Ramps 1024 steps
X-HatchBK-C		Vpattern vector pattern. Black 16 x12 Grid w Circle on White background
X-HatchW		White 16 x12 Grid on Black background
X-HatchW-C		White 16 x12 Grid w Circle on Black background
X-HatchW-CC		Vpattern vector pattern. White 16 x12 Grid w Ellipses, Circle and 100% color bars
Gray Box 10		China 5.6 White Window 10%
Gray Box 20		China 5.6 White Window 20%
Gray Box 30		China 5.6 White Window 30%
Gray Box 40		China 5.6 White Window 40%
Gray Box 50		China 5.6 White Window 50%
Gray Box 60		China 5.6 White Window 60%
Gray Box 70		China 5.6 White Window 70%
Gray Box 80		China 5.6 White Window 80%
Gray Box 90		China 5.6 White Window 90%
Gray Box 100		China 5.6 White Window 100%
8 Level Gray		China 5.5 Ultimate 8 Level Grayscale

Extended Patterns (contd.)

Selection	Icon	Description
Black'n'White Window HDTV		China 5.8 Black and White Window(FOR HDTV)
Black'n'White Window SDTV		China 5.8 Black and White Window(FOR SDTV)
Black Line HDTV		China 5.10 Black Line
Black Line SDTV		China 5.10 Black Line SDTV
Black Window		China 5.7 Black Window
Check Board		China 5.9 Check Board
Line'n'Window		China 5.11 Line and Window
Narrow White Window		China 5.19 Narrow White Window
Single Dot		China Single Dot
White Line HDTV		5.10 White Line for HDTV
White Line SDTV		5.10 White Line for SDTV

More test patterns can be downloaded e.g. from www.icdm-sid.org/ downloads/testpatterns.html.

APPENDIX E: SINK AND SOURCE DUT TESTS

Source DUT Testing		Pro License	DP HDCP 2.3 CTS*	Electrical Testing
HDCP 2.3 CTS 1A Test Set DP RX (UCD-301, UCD-323)	HCDP2.3 CTS 1A-01 – HCDP2.3 CTS 1A-12		•	
HDCP 2.3 CTS 1B Test Set DP RX (UCD-301, UCD-323)	HCDP2.3 CTS 1B-01 – HCDP2.3 CTS 1B-10		•	
Audio Test Set (UCD-301, UCD-323)	Validate audio signal frequency and glitch-free audio reproduction	•		
CEC functional Test Set HDMI RX (UCD-301, UCD-323)	CEC functional test, CEC PHY Addr test, CEC Complete test, CEC Wake up test, CEC Standby test	•		
CRC based Video Test Set (UCD-301, UCD-323)	CRC based single frame reference video test; CRC based single frame stability test; CRC based sequence of frames reference video test	•		
Timings Video Tests	Timings: single reference frame video test	•		
Electrical Test Set HDMI RX (UCD-301)	Power test; TMDS test; HPD test; DDC and CEC test			•
Electrical Test Set DP RX (UCD-301)	HPD test; Main Link test; AUX test			•
Link Config Tests (UCD-301, UCD-323)	Link Training at All Supported Lane Counts and Link Rates	•		
Pixel Level Video Tests (UCD-301, UCD-323)	Compare a defined number of captured frames to a single reference frame	•		
VRR Source DUT Tests (HDMI RX) (UCD-323, UCD-301)	VRR static test; QMS Test; VRR Dynamic test	•		

*) Separate licenses for testing Sink and Source DUT

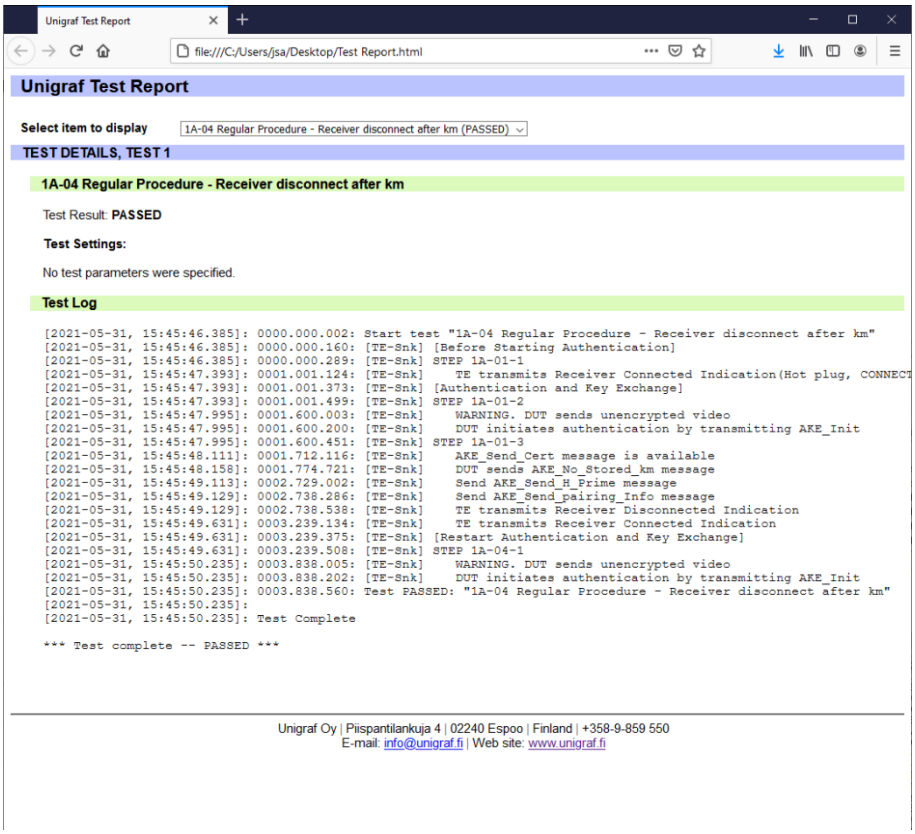
Sink DUT Testing		Pro License	DP HDCP 2.3 CTS*	Electrical Testing
HDCP 2.3 CTS 2C Test Set DP TX (UCD-323)	HCDP2.3 CTS 2C-01 – HCDP2.3 CTS 2C-06		•	
VRR Sink DUT Tests (HDMI TX) (UCD-323)	VRR static test; QMS Test; VRR Dynamic test	•		

*) Separate licenses for testing Sink and Source DUT

Test Report

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

The user can add details of the DUT, test situation and other remarks to the report.



Audio Test Set – DP Rx, HDMI Rx

Role:	Product:
DP Reference Sink (DP RX)	UCD-301, UCD-323, UCD-323 Gen2
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323, UCD-323 Gen2

Validate audio signal frequency and glitch-free audio reproduction

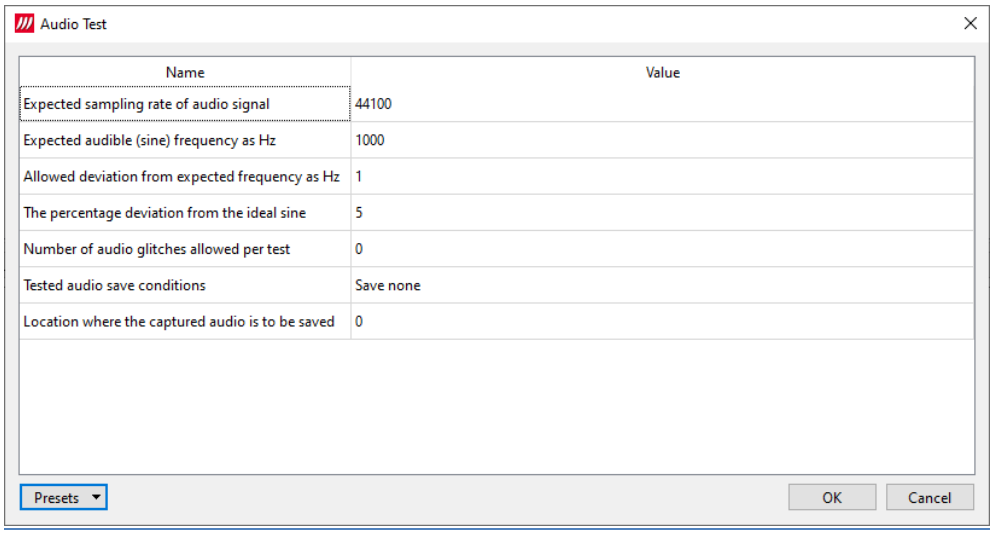
Perform frequency check on the digital audio content and verify the content to be glitch-free. This test assumes that a pure sine-wave audio signal content is being transmitted to the test equipment.

The test will first capture minimum of one second of audio content. The audio is then analyzed in two stages.

First, the power spectrum is calculated, and the highest peak must be within the defined window. Resolution of the peak frequency check is better than ±1 Hz.

In the second stage, received audio is checked for random glitches, such as dropped or duplicated samples.

The test is considered passed if power of audio content spectrum has its maximum within the defined window, and the number of detected audio glitches does not exceed programmed limit.



Parameters in use

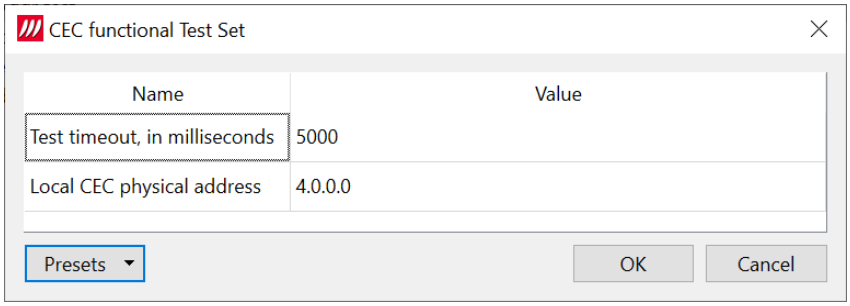
- Expected sampling rate of audio signal (default 44 100 s/sec)
- Expected audible (sine) frequency in Hz (default 1000 Hz)
- Allowed deviation from expected frequency in Hz (default 1 Hz)
- The percentage deviation from the ideal sine (default 5)
- Number of audio glitches allowed per test (default 0)
- Tested audio save conditions: save none, save failed, save all (default Save none)
- Location where the captured audio is to be saved. Double click the select folder. (default 0)

CEC Functional Test Set – HDMI Rx

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323

Parameters in use

- Test timeout, in milliseconds
- Local CEC physical address
-



CEC Functional Test

Test is intended to check that DUT does CEC initialization correctly after HPD. TE initialize EDID with configured address. Apply HPD and expected that Logical Physical addresses that presented in EDID will be applied with Report Physical Address message to inform TE about the mapping Logical and Physical addresses. That is expectation of CEC behavior.

CEC Phy Address test.

Test is intended to check that CEC line is working properly, and DUT can receive CEC Report Physical Address or customized OP Code. TE checks that HPD is high and CEC line available and send Report Physical Address (or customized OP Code) message in broadcast mode (or with specific destination).

CEC Wake Up test

Test is intended to check that CEC line is working properly, and DUT can send CEC Wake Up command. TE checks that HPD is high and CEC line available and wait for Wake Up message.

CEC Stand By test

Test is intended to check that CEC line is working properly, and DUT can send CEC Stand By command. TE checks that HPD is high and CEC line available and wait for Stand By message.

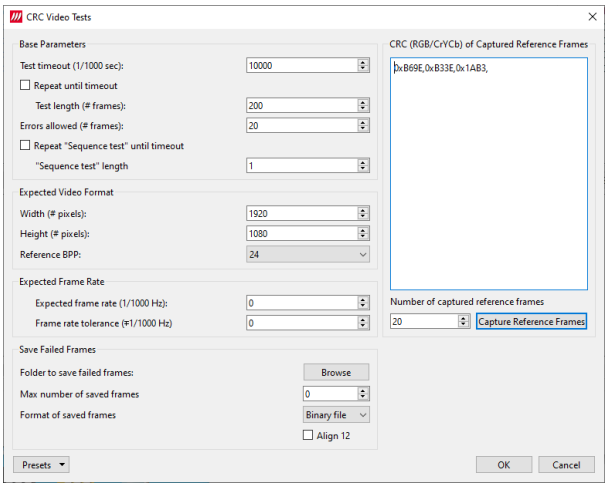
CEC Complete test

Test is intended to check that CEC line is working properly, and DUT can send sequence of commands from Stand By mode. TE checks that HPD is high and CEC line available. TE waiting for sequence of commands from DUT Wake UP and then again Stand By.

Note:	The default physical address in UCD 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.

CRC Video Tests – HDMI Rx, DP Rx



Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323, UCD-323 Gen2
DP Reference Sink (DP RX)	UCD-301, UCD-323, UCD-323 Gen2
Test timeout:	If enabled test will abort when the time has elapsed
Repeat until timeout:	Enable “Test timeout”
Test length (# frames):	Number of captured frames to test
Errors allowed (# frames):	Number of failing frames allowed before test is Fails
Repeat “Sequence test” until timeout:	Repeat test sequence until the timeout set
“Sequence test” lenght (# of repeats):	Repeat the sequence
Expected video format	Format of the signal expected. Width, heiht and reference BPP.
Expected frame rate	Expected frame rate and frame rate tolerance.
Number of captured reference	Number of frames stored as reference
Capture Reference Frames	Capture reference frames for the test
Folder to save failed frames:	PC folder where failed frames are stored.
Maximum number of save frames:	Maximum number of failed frames stored to PC
Format of saved frames	Select the format of saved frames
Presets:	Store and recall settings

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 10 000 ms)
- Test lengths (default 200 frames)
- Errors allowed (default 20)
- Sequence test length (default 1)
- Expected video format
    - Width (default 1920)
    - Height (default 1080)
    - Reference BPP (default 24)
- Expected frame rate
- Frame rate tolerance

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 10 000 ms)
- Test lengths (default 200 frames)
- Errors allowed (default 20)

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 10 000 ms)
- Test lengths (default 200 frames)
- Expected video format
    - Width (default 1920)
    - Height (default 1080)
    - Reference BPP (default 24)
- Expected frame rate
- Frame rate tolerance

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.

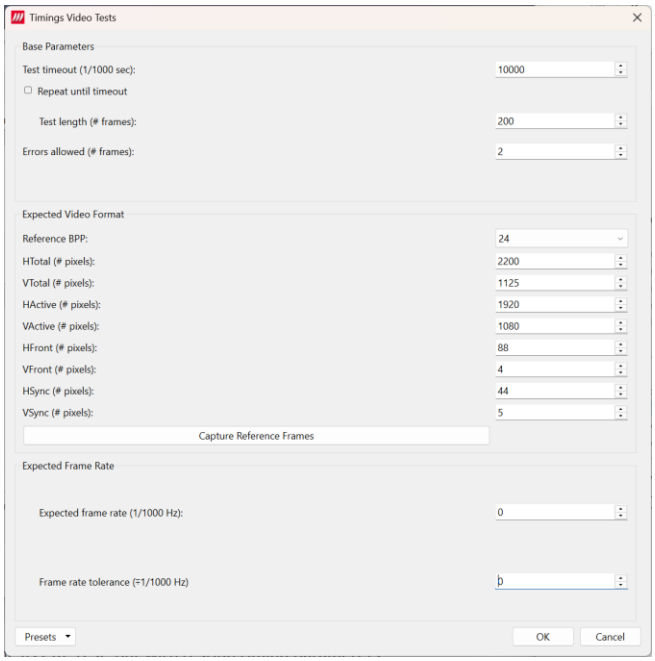
The test optionally captures the failed frames as bitmap images and stores them into the hard disc.

Parameters in use

- Test Timeout (default 10 000 ms)
- Test lengths (default 200 frames)
- Errors allowed (default 20)
- Sequence test length (default 1)
- Expected video format
    - Width (default 1920)
    - Height (default 1080)
    - Reference BPP (default 24)
- Expected frame rate
- Frame rate tolerance

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

Timings Video Tests – HDMI Rx

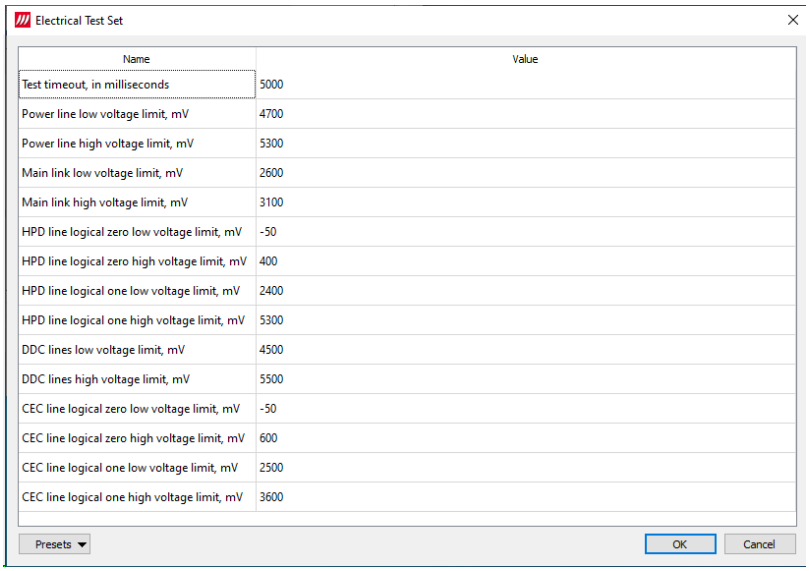


Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323, UCD-323 Gen2
Test timeout:	If enabled test will abort when the time has elapsed
Repeat until timeout:	Enable “Test timeout”
Test length (# frames):	Number of captured frames to test
Errors allowed (# frames):	Number of failing frames allowed before test is Fails
Expected video format	Format of the signal expected: Reference BPP, HTotal, VTotal, HACtive, VActive, HFront, VFront, HSync, VSync
Capture Reference Frames	Capture reference frames for the test
Expected frame rate	Expected frame rate and frame rate tolerance.
Folder to save failed frames:	PC folder where failed frames are stored.
Presets:	Store and recall settings

Electrical Test Set – HDMI Rx

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301

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 15) 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 parameter limits, the test result is FAIL.

Parameters in use

- 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

Role:	Product:
DP Reference Sink (DP RX)	UCD-301

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 into power or ground lines.

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 lie 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.

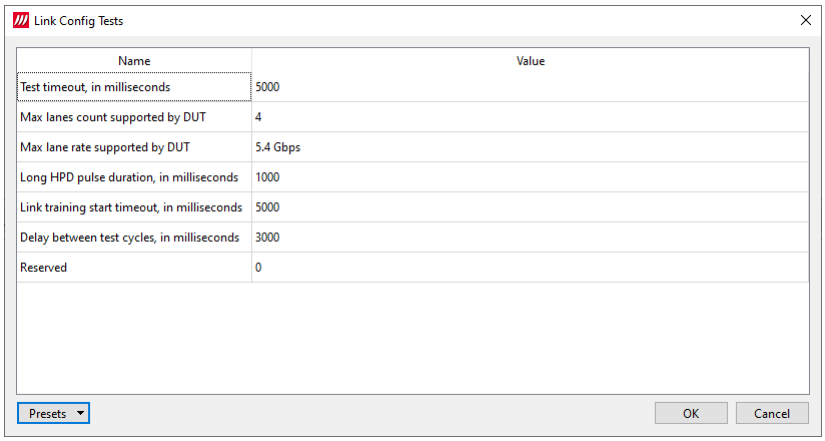
The test is first done to AUX- line and then to AUX+ line.

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)

Link Config Tests – DP Rx

Role:	Product:
DP Reference Sink (DP RX)	UCD-301, UCD-323



Link Training at All Supported Lane Counts and Link Rates

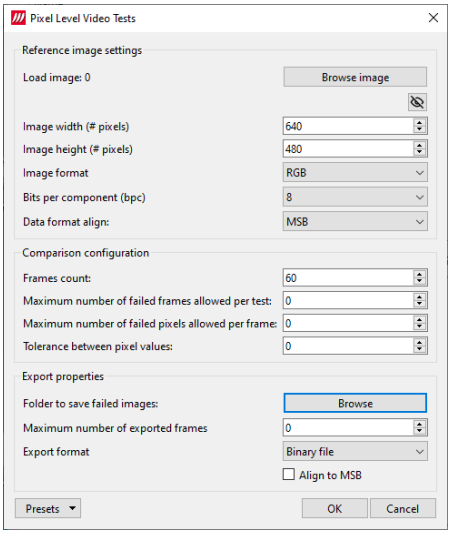
Test requests link training on all supported lane counts and link rates. Each link training must be successfully completed in order to pass the test.

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)

Pixel Level Video Tests – DP Rx, HDMI Rx

Role:	Product:
DP Reference Sink (DP RX)	UCD-301, UCD-323
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323



Compare a defined number of captured frames to a single reference frame.

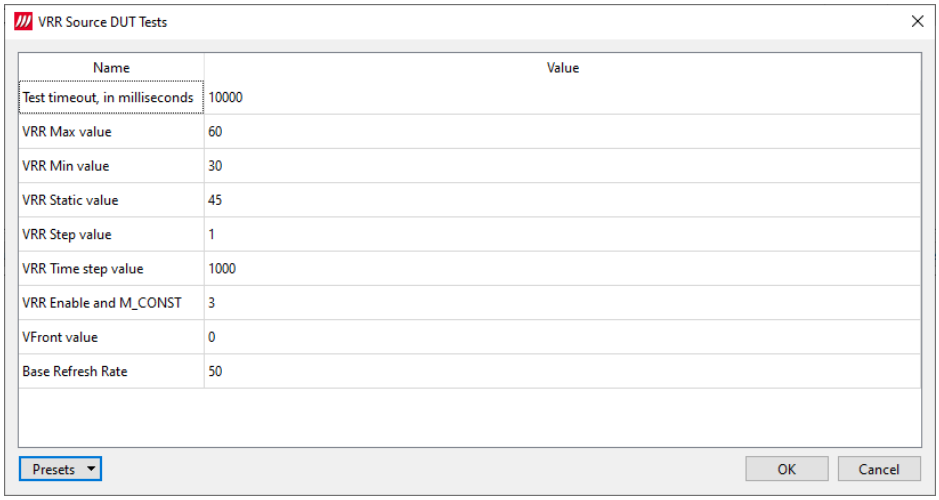
The test will capture the required number of consecutive frames into system RAM and then perform analysis between each frame and reference frame. Test is considered passed if the number of failed frames does not exceed the programmed value.

Parameters in use

Load image:	Load the reference image
Image resolution (#pixels): width and height	Video resolution expected
Image format:	Image format expected
Bits per component:	Bits per component expected
Data format align:	Video data format expected (MSB, LSB)
Frames count:	Number of frames buffered for testing
Maximum number of failed frames allowed per test:	Number of failed frames allowed totally
Maximum number of failed pixels allowed per frame:	Number of failed pixels allowed per buffered frame
Tolerance between pixel values:	The allowed difference between a color component of pixel in the captured frame to the reference bitmap.
Folder to save failed images:	PC folder where failed frames are stored.
Maximum number of exported frames:	Maximum number of failed frames stored to PC
Export format	Binary file, PPM image or BMP image
Presets:	Store and recall settings

VRR Source DUT Tests – HDMI Rx

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-301, UCD-323, UCD-323 Gen2



Parameters in use

- Test timeout, in milliseconds
- VRR Max value – maximum VRR frame rate value;
- VRR Min value – minimum VRR frame rate value;
- VRR Static value – static VRR frame rate value;
- VRR Step value – value to change current VRR value during a test;
- VRR Time step value – value to change current VRR value during a test;
- VRR Enable and M_CONST
- VFront and RB
- Base Refresh Rate

Static VRR Test

Test verifies that DUT Source applies expected static VRR value.

After configuring the parameters operator starts the test. Test waits until DUT Source starts VRR mode. When VRR mode is detected, test verifies that received timing matches the VRR Value parameter and the data in received EMP packets match the timing.

Quick Media Switching (QMS) Test

Verify that VRR is set correctly when frame rate is changing with a set time interval. For example, change VRR from 30 to 60 Hz with step 1 each 1 second.

After configuring the parameters operator starts the test. Test waits until DUT Source starts VRR mode. When VRR mode is detected, test verifies that VRR is changed after each time interval set by VRR Time parameter, and the applied VRR change is as set in the parameter. Test also verifies that data in received EMP packets match with applied VRR.

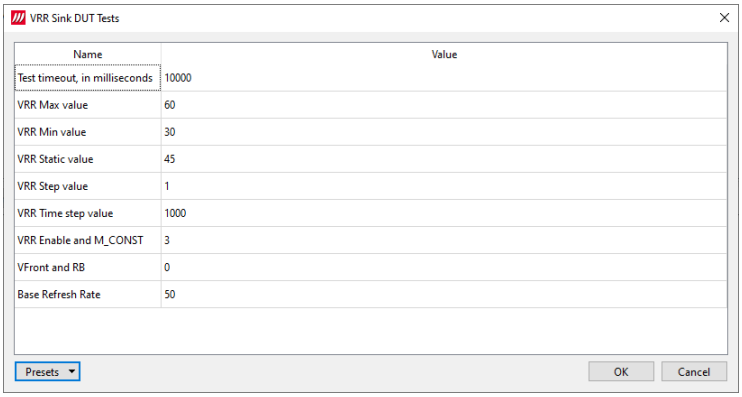
VRR Dynamic Test

Verify that VRR is set correctly when frame rate is changing with each frame. For example, change VRR from 60 to 120 Hz with step 1 each frame.

After configuring the parameters operator starts the test. Test waits until DUT Source starts VRR mode. When VRR mode is detected, test verifies that VRR is changed between each frame. Test also verifies that data in received EMP packets match with applied VRR.

VRR Sink DUT Tests – HDMI Tx

Role:	Product:
HDMI Reference Source (HDMI TX)	UCD-323



Parameters in use

- Test timeout, in milliseconds
- VRR Max value – maximum VRR frame rate value;
- VRR Min value – minimum VRR frame rate value;
- VRR Static value – static VRR frame rate value;
- VRR Step value – value to change current VRR value during a test;
- VRR Time step value – value to change current VRR value during a test;
- VRR Enable and M_CONST
- VFront and RB
- Base Refresh Rate

Static VRR Test

Test verifies that DUT Sink correctly applies a static VRR value.

After configuring the parameters operator starts the test. Operator verifies that DUT Sink has applied VRR correctly and provides the information in the dialog of the test.

Quick Media Switching (QMS) Test

Verify that VRR is set correctly when frame rate is changing with a set time interval. For example, change VRR from 30 to 60 Hz with step 1 each 1 second.

After configuring the parameters operator starts the test. Operator verifies that DUT Sink has applied VRR correctly and frame rate is changing as expected. Operator provides the information in the dialog of the test.

Dynamic Test

Verify that VRR is set correctly when frame rate is changing with each frame. For example, change VRR from 60 to 120 Hz with step 1 each frame.

After configuring the parameters operator starts the test. Operator verifies that DUT Sink has applied VRR correctly and frame rate is changing as expected. Operator provides the information in the dialog of the test.

APPENDIX F: VPATTERN LANGUAGE

General

The Vpattern definition language (in the following simply “VTP”) is a straightforward yet flexible way of describing test patterns for UCD Generators. This description is providing an introduction and examples of the most usable instructions and parameters.

The VTP language uses text command syntax. Each row represents one drawing instruction. The coordinate system can be either absolute or scaled. In the absolute mode the actual pixel position is referred while in the scaled mode the coordinates refer to the “Drawing resolution” used while drawing. For both absolute and scaling coordinates the origin is the upper left hand corner of the screen.

Terminology

The following terms are used in this document:

Coordinate system: two numerical ranges of integer, positive numbers. E.g. {0,799},{0,599} or {0,10000},{0,10000}.

Coordinates: a tuple of integer, positive numbers used to address a position on an image, e.g. (100,250). The first number is the horizontal position, the second one the vertical position. The actual position is always related to the coordinate system currently in use

Drawing resolution: the width and height of the space that can be used for drawing, expressed in pixels. E.g., 2560 by 1600.

Drawing area: a 2-dimensional area spanning all of the drawing resolution, expressed in the current coordinate system notation. E.g., if the drawing resolution is 800 x 600 pixels, the drawing area includes all points (x,y) where x = 0 to 799 and y = 0 to 599 in ABSOLUTE mode or x = 0 to 10000 and y = 0 to 10000 in SCALED mode.

Notation

The following notation is used in this document:

- A token is enclosed by characters ‘<’ and ‘>’. For instance, <variable> represents a generic variable.
- Different legal choices for a command parameter are separated by character ‘|’. For instance, <variable> | <number> means that either variable or number can be used as parameters.
- Items that can be repeated 0, 1 or more times are preceded by ‘{‘ and followed by ‘}*’. For instance {<number>}* means zero, one or more occurrences of a number.

Syntax rules

The following general syntax rules apply to VTP language files:

- The VTP is a text-based, interpreted language
- Commands, variables, and constant names are not case-sensitive.
- All text at the right of a semicolon (‘;’) is treated as comment.
- All strings are delimited by quotation marks (“a string”). Quote and backslash characters must be prefixed by the backslash symbols (“ a quote \” and a backslash \\”).
- Filenames cannot contain pathnames.

Commands

Scaling commands

All drawing commands using coordinates can refer either to absolute or scaled coordinates. The absolute coordinate system starts at 0 and its measurement unit is the pixel (vertically the line). It extends up to the maximum drawing resolution in use minus one, expressed in pixels too.

Conversely, the scaled coordinate system ranges from 0 to 10000, independently from the drawing resolution. Its measurement unit is thus a flexible, virtual pixel.

Absolute coordinates provide the fastest drawing speed, but they are resolution specific. Scaled coordinates are resolution independent while introducing a slight speed penalization.

For both systems, the origin (0,0) refers to the upper left hand corner of the screen.

ABSOLUTE

```
Syntax: ABSOLUTE
```

This command is normally used in the beginning of the VTP file. All drawing commands issued after ABSOLUTE will have absolute coordinate values, i.e., their coordinates will be interpreted as pixels and lines.

The allowed coordinate values are from 0 to the maximum drawing resolution minus one. For instance, for a drawing resolution of 2560 x 1600 pixels, the allowed coordinate range (x,y) for x is 0 to 2559 and for y 0 to 1599.

Constants MAXX and MAXY can be used in place of the numeric values to achieve basic scaling capabilities.

SCALED

```
Syntax: SCALED
```

All drawing commands issued after the SCALED command will have their coordinates interpreted as within a range from 0 to 10000 (10001 possible coordinate values), regardless of the current drawing resolution. Positioning can be calculated as percentages. If you wanted to address a point at 50% of the drawing resolution, then you would use the number 5000. If you wanted 75% you would simply use the 7500.

Graphics Drawing Commands

All of the following graphics drawing commands use the currently selected foreground color for shape perimeter and filling.

LINE

```
Syntax: LINE x1 y1 x2 y2
```

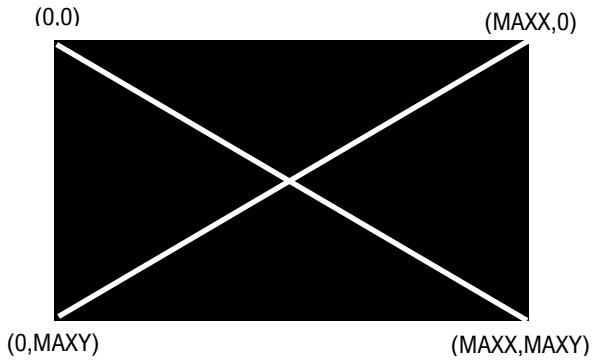
Draws a line from point (x1,y1) to point (x2,y2).

Example:

You can draw a white diagonal cross using either ABSOLUTE and SCALED coordinate mode and get the same result.

ABSOLUTE ; Set scaling mode to absolute
COLORDEPTH 8 ; 8 bits per color
COLORRGB 255 255 255 ; white
LINE 0 0 MAXX MAXY ; Draw a line from upper left to lower right corner
LINE 0 MAXY MAXX 0 ; Draw a line from lower left to upper right corner
Or if you want a fixed size for 640 x 480 resolution
LINE 0 0 639 479
LINE 0 479 639 0

The pattern will look like this:



Using SCALED instead of ABSOLUTE.

SCALED
COLORDEPTH 8
COLORRGB 255 255 255
LINE 0 0 10000 10000
LINE 0 10000 10000 0

BOX

```
Syntax: BOX x1 y1 x2 y2
```

Draws a filled rectangle with upper left corner (x1,y1) and lower right corner (x2,y2).

Example:

This code will create a full white screen with all resolutions.

SCALED
COLORDEPTH 8
COLORRGB 255 255 255
BOX 0 0 10000 10000

DOT

```
Syntax: DOT x y
```

Draws a single dot at location (x,y).

FILL

```
Syntax FILL x y
```

Initiates a flood fill (or seed fill) with foreground color starting from position (x,y).

CIRCLE

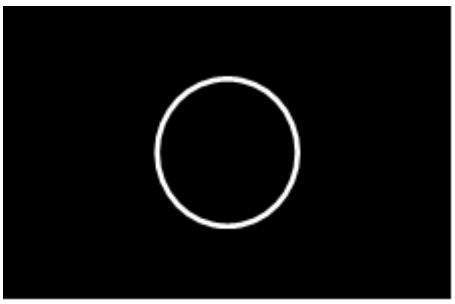
```
Syntax: CIRCLE x y r
```

Draws a circle with center point at (x,y) and radius r. Please, note that when using SCALED coordinates radius r is expressed as a vertical measure.

Example:

SCALED
COLORDEPTH 8
COLORRGB 255 255 255
CIRCLE 5000 5000 50

The pattern will look like this:

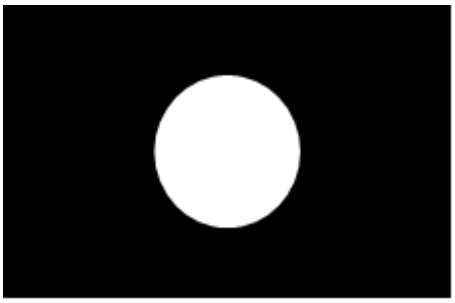


FCIRCLE

Syntax: FCIRCLE x y r

Draws a circle with center point at (x,y) and radius r. Filled with foreground color. Please, note that when using SCALED coordinates radius r is expressed as a vertical measure.

The pattern will look like this:



ELLIPSE

```
Syntax: ELLIPSE x y hr vr
```

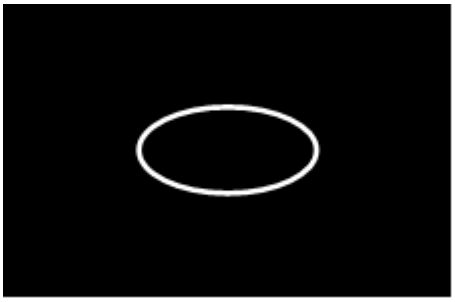
Draws an ellipse with center point at (x,y), horizontal radius hr and vertical radius vr.

You can use ELLIPSE instead of CIRCLE for example when the displayed pixel is not square for compensating the stretching.

Example:

SCALED
COLORDEPTH 8
COLORRGB 255 255 255
ELLIPSE 5000 5000 3000 4000

The pattern will look like this:



Text Drawing Commands

All of the following commands use the currently selected foreground color for the "foreground" pixels of the font and the currently selected background color for "background" pixels.

TEXTPOS

```
Syntax: TEXTPOS x y
```

Sets the text drawing position to point (x,y).

TEXT

```
Syntax: TEXT <string> | <var> | <const> { <string> | <var> | <const> }*
```

The command executes a CR and LF (carriage return and line feed) and then draws a text string <string>, a variable <var>, a constant <const> or a combination of them starting from the current text position.

<string> parameter is a quoted sequence of characters. If the string contains a quote character (") or a backslash character (\) then it must be preceded with a back slash character (\).

<var> is a parameter variable (A – Z, MAXX, MAXY) defined by SET command.

<const> one of the Timing Variables. Timing variables are defined by currently loaded timing parameters. Please refer to Chapter 3.

Note: Please note that when using the timing parameters in a pattern the display will be redrawn every time the timing is changed. Normally the VTG does not have to redraw the picture when only e.g., the horizontal sync is changed, but if the HS variable is used in the pattern it needs to be updated to display the new value.

Example:

ABSOLUTE
COLORDEPTH 8
COLORRGB 255 255 255
TEXTPOS 100 100 ; Text starting point 100 pixels from left edge and 100 display lines down from top
TEXT "HRES=" HR " PIXELS ; This will draw the text HRES then the variable HR value and PIXELS
TEXT "Quote character \" and backslash \\"

Program Flow Commands

REPEAT

```
Syntax: REPEAT <variable> a b s
```

All commands after between REPEAT and END command are repeated the number of times defined by <variable>. <variable> is set to value a before starting the first iteration loop. At the end of each iteration, variable is incremented by s (variable = variable + s). The REPEAT is terminated when variable reaches or exceeds value b, and the execution continues from the command following the END command. For example:

SCALED
COLORDEPTH 8
COLORRGB 255 255 255
REPEAT W 0 10000 200
LINE W 0 W 10000
END

A maximum of 2 REPEAT loops can be nested (placed inside each other).

END

Syntax: END

This command follows a REPEAT command and defines a group of instructions to be repeated.

Color Commands

The user can assign the used colors in two basic ways: either by giving the actual Red, Green and Blue (or R, G and B) color component values or using pre-defined color palettes. The first method is referred as True Color Mode and the latter as Palette Mode.

In True Color Mode the numerical values given for R, G and B will be the actual output signal intensity values for the pixel in question. The numerical color value in Palette Mode will act as an address (or index) to a pre-defined color in a 256 color table. The output signal intensity will be the R, G and B value entry in the cell where the address points to.

Palette mode can only be used with True Color Mode is .

COLORDEPTH

```
Syntax: COLORDEPTH n
```

The command is used in True Color Mode (COLORMODE 2), to define the number of bits used for each color component (R, G and B) of the data to be displayed. Possible values for the parameter n are 6, 8, 10 and 12. If COLORDEPTH command is not used, 10 bits per color is used.

Example: To display a bitmap that uses 8 bits for r, g and b (24-bit colors) you have to use COLORDEPTH 8.

Command	Nr of color bits	Range of values for R, G and B
COLORDEPTH 6	18	0 to 63
COLORDEPTH 8	24	0 to 255
COLORDEPTH 10	30	0 to 1023
COLORDEPTH 12	36	0 to 4095

COLORDEPTH can be used only once in a VTP file, and it has to be placed before all drawing instructions it is supposed to affect.

COLORRGB

```
Syntax: COLORRGB r g b
```

The command defines the foreground color used for the following drawing commands. The command is used in True Color Mode only.

The range of values for r, g and b depends on the bits per color used. If not changed with COLORDEPTH command, 10 bits per color is used. Please refer to COLORDEPTH command for range of values.

Various Commands

SET

```
Syntax: SET <variable> n
```

Assigns value n to programming variable called variable. n must be a positive number or zero.

Variables

Timing Variables

Timing Variable	Value name
HF	Drawing resolution horizontal size minus one
HP	Drawing resolution vertical size minus one
HR	Current timing horizontal frequency (MHz?)
HA	Current timing horizontal period (pixels)
HS	Current timing horizontal resolution (pixels)
HBP	Current timing horizontal active time (pixels)
HFP	Current timing horizontal sync length (pixels)
VF	Current timing horizontal back porch length (pixels)
VP	Current timing horizontal front porch length (pixels)
VR	Current timing vertical frequency (MHz?)
VA	Current timing vertical period (lines)
VS	Current timing vertical resolution (lines)
VBP	Current timing vertical active time (lines)
VFP	Current timing vertical sync length (lines)
PF	Current timing vertical back porch length (lines)
HLB	Current timing vertical front porch length (lines)
HRB	Pixel frequency (Mpps?)
VTB	Drawing resolution horizontal size minus one
VBB	Drawing resolution vertical size minus one

Expressions

Any command numeric parameter can be replaced by an expression, according to the syntax below:

<term> ::= <variable> | <constant> | <number>

<expression> ::= <term> { '+' | '-' | '*' | '/' | '%' } <term>

<parameter> ::= <term> | <expression>

Some example of legal parameter values:

B
MAXX
342
B + MAXX
B / 2
*B * C*

Expressions have always positive integers or zero value. When an expression evaluates to a negative value, it is set automatically to zero. Number values are also always positive integers or zero.

Assignments

A variable can be assigned a numerical value by using the SET command.

The second parameter of the SET command can be replaced by an expression thus allowing commands like those here below:

SET C B+MAXX

SET K K+1

SET K A+B

Default state at VTP execution startup

Coordinate system: ABSOLUTE

Foreground color: 1023 1023 1023

Background color: 0 0 0

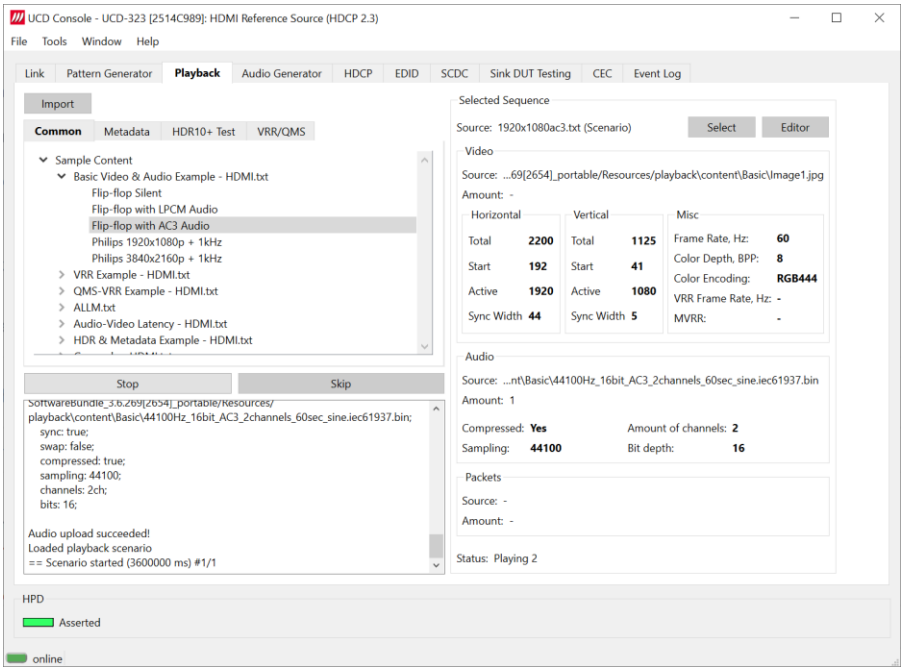
Output image is cleared (all black)

All variables are initialized to zero

COLORDEPTH 10

APPENDIX H: PLAYLISTS AND SCENARIOS

UCD Console's Playback enables you to run scripts called playlists. Use playlists to stream video, audio and metadata.



Playlist

A *Playlist* is a text script consisting of a *[Device]* block and *[Scenario]* block(s). *A [Device]* block lists the serial number of the device and *connectortype* (such as a displayport transmitter). *[Scenarios]* blocks have a *caption* (which are used to display sample content), a period (*Scenario* duration in milliseconds) and a relative path to a script text file (ex. Scenario_PSR1_Entry_N.txt). Scenarios are played in sequence.

Scenario

A *scenario* is a script text file to specify a sequence of video frames, metadata packets and audio to be transmitted.

Frame Memory

When played, all content is first loaded to the frame memory buffer of the UCD device. This enables smooth transition between content items during execution of the Scenario.

The size of frame buffer memory sets a limit for content that can be played. In their default configuration UCD devices feature a 2 GBytes frame buffer memory. This frame buffer enables loading up to 40 pcs 4K video frames or 10 pcs 8K video frames.

Also available is UCD-323 HDDP 4G (P/N 066520) with 4 gigabytes of frame buffer memory.

Sample Content

UCD Console's Playback tab features a set of sample content. These examples can be used as a basis for creating custom test sequences. The sample content is stored as files by default in *C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\content*. It is advisable to create copy of the installed original files and edit the copies.

See Sample Content later in this Appendix.

Playlists

A *playlist* defines the UCD device to be used and the output destination for transmission. It lists *scenarios* the played (video and audio sequences including metadata) to be transmitted and their duration.

Note: *Playlists* and *Scenarios* are technology dependent. Metadata (or packets) differ for HDMI and DisplayPort Device section

Device block

Device block describes the device and output connector type.

Key	Description	Possible values
[Device]	Required. Start of the Device block.	
serialnumber	Required. Specifies serial number of the UCD device. The '*' wildcard can be used if only one UCD source device is connected to the PC.	'*' *'1722C333'*
connectortype	Required. Specifies output connector to be used. Playlist cannot contain scenarios for different connector types.	*'HDMI Out'* *'DisplayPort Out'* *'USBC Out'*
reset	Optional. '1' = UCD device is restarted after playlist completion Device restart takes approximately up to 5 seconds. Only for use with UCD-323.	*'0' or '1'* *Default '0'*

Scenario block

Section describes selected scenario and its playback parameters. Playlist runs scenarios in the order they are listed.

Key	Description	Possible values
[Scenario]	Required. Start of a Scenario section. Playlist can have multiple Scenario sections.	
caption	Optional. Title of the Scenario. Any character string accepted.	*'Scenario 1'* *'Playlist completed'*
path	Required. Specifies relative path to scenario file.	*Any path*
period	Required. Duration of Scenario in msec. The duration is ignored if close-after-upload is set to '1'.	*'60000'* *'5000'*
close-after-upload	Optional. When set to '1', command line version of the Playback tool will exit after loading scenario content and starting playback.	*'0' or '1'* Default '0'
execute-after-upload	Optional. Executes provided command in cmd.exe or bash and waits for its completion. Calculation of 'period' starts after the command is executed.	*'script.bat && dir'* *'rmdir /home/user/test/'*

Scenarios

A Scenario is text file for specifying a specific sequence of video frames, events (packets) and audio to be played in order. *Scenarios* also set up the device state for transmission.

Parameters

Scenario parameters are defined below.

Scenario ite	Description
video	Relative path format of video frame files
audio	Relative path of the audio file
packets	Relative path of metadata packet files
porder	Play order. See *Content Playing Order* below.
align12	Alignment of 12-bit binary pixel data. '1' aligned to LSB; '0' aligned to MSB.
audioswap	'1' for Little Endian audio samples
audiocompressed	1 compressed audio; 0 uncompressed audio
audiosampling	Audio sampling rate (e.g. 44100)
audiochannels	Number of audio channels
audiobits	Audio bits per sample (usually 16 or 24)
scramble	1 scrambling enabled; 0 scrambling disabled
colorspace	Video color space: RGB; YUV444; YUV422; YUV420
bitspercolor	Video color depth (bits per color)
timing.hactiv	Timing: horizontal active
timing.vactiv	Timing: vertical active
timing.htota	Timing: horizontal total
timing.vtotal	Timing: vertical total
timing.hstart	Timing: horizontal start
timing.vstart	Timing: vertical start
timing.hsync	Timing: horizontal sync width
timing.vsyn	Timing: vertical sync width
timing.frate	Timing: framerate in milliseconds
hdcp	HDCP version used (can be 1.4 2.3 or 'none')
loadingRGB	The R, G and B color components of uniform color pattern shown when content is being uploaded to the device before playback (e.g.0,0,0)

Content Play Order

Play order is a sequence of steps. Steps are delimited with semicolons (;).

Each step has:

Range (possibly numbered e.g. allm_000.jpg, allm_001.jpg, …) of video frame(s)
How many times the frame(s) are played
Packet(s) (possibly numbered e.g. allm_0.bin, allm_1.bin, …) indices to be sent during the video frame(s) transmission
Color format
Optional frame rate when VRR/Adaptive-Sync is enabled

Format

Each scenario step is described in the form:

```
pV:R:E:FvXX;
```

Parameters

Char	Description	Possible values	Examples
:	Required. Separator between general step parameters.	*':'*	*See any below*
;	Required. Indication of step description end.	*';'*	*See any below*
p	Optional. Indicates assertion of a HPD pulse on HDMI RX connector of UCD device during current step. Preceding video frame index. Only for HDMI playback.	*'p'*	*'p1:60:1:256;'* *'p0-59:60:1:256;'*
V	Required. Index (zero based) of video frame. Images are loaded from the *video* file path. Specifies a range of image(s). The order in which images are called in a *scenario* is optional. Specified parameters are applied to all frames in the step	*'1'* *'0-59'*	*'1:60:16:256;'* *'0-59:60:16:256;'*
R	Required. Repetitions of current step. E.g., stating '1' with 60 FPS frame rate means that current step will be played only for 1/60 of a second.	*'30'* *'1'*	*'1:30:16:256;'* *'1:1:16:256;'*
E	Optional. Metadata packet indices (zero based): A single packet or a comma separated list of packets. The index may be of the form 3l15 (lower case 'l'). At which vertical line do we want to put our packet in. 3l15 means insert packet 3 at line 15. Packets are loaded from the *packets* path.	*'0'* *'4,1,29'* *none* 3l15	*'1:30:0:256;'* *'1:30:4,1,29:256;'* *'1:30::256;'* 0:10000:3l15:256;
F	Required. Color Format and color depth. See Color Format below.	*'256'* *'513'*	*'1:30:0:256;'* *'1:30:0:513;'*
vXX	Optional. Control of frame rate when VRR/Adaptive-Sync is enabled. In order to enable VRR/Adaptive-Sync, the corresponding event must be included in this step. The parameter is always in format of 'vXX', where 'XX' states frame rate. The parameter is provided after color format value, separated with 'v'.	*'v60'* *'v30'*	*'1:30:0:256v60;'* *'1:30:0:256v30;'*

Color Format

Color format is a two-byte decimal value: The lower byte is the index to the color space and the higher byte the index to the color depth. See below.

Index	Color Depth (bits/color)	Color Space
0	6	RGB
1	8	YCbCr 4:4:4
2	10	YCbCr 4:2:2
3	12	YCbCr 4:2:0
4	16	–

The encoded parameter value is encoded as follows:

[Color Depth] × *256* + *[Color Space],*

where *[Color Depth]* and *[Color Space]* are indices from the table above.

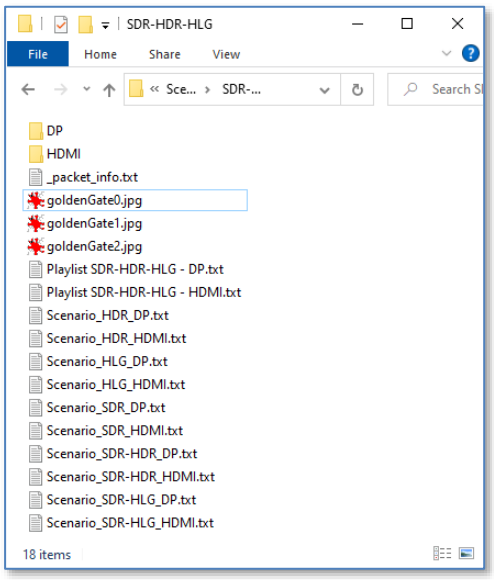
For example, parameter for YCbCr 4:4:4, 10 bits is (2 × 256 + 1) = 513.

Pre-calculated values for available color formats are shown below:

	6 BPC	8 BPC	10 BPC	12 BPC	16 BPC
RGB	0	256	512	768	1024
YCbCr 4:4:4	N/A	257	513	769	1025
YCbCr 4:2:2	N/A	258	514	770	1026
YCbCr 4:2:0	N/A	259	515	771	1027

Example

Please find below description of Playlist SDR-HDR-HLG – HDMI.



Playlist file (Playlist SDR-HDR-HLG - HDMI.txt)

Playlist item and example content	Description
[Device]	Start of device section
serialnumber=*	Only one UCD device present.
connectortype=HDMI Out	HDMI output
[Scenario]	Start of Scenario 1
caption = SDR	Scenario title “SDR”
period = 10000	Duration 10 sec
path = Scenario_SDR_HDMI.txt	Scenario file: Scenario_SDR_HDMI.txt in current folder
[Scenario]	Start of Scenario 2
caption = HDR	Scenario title “HDR”
period = 10000	Duration 10 sec
path = Scenario_HDR_HDMI.txt	Scenario file: Scenario_HDR_HDMI.txt in current folder
[Scenario]	Start of Scenario 3
caption = HLG	Scenario title “HLG”
period = 10000	Duration 10 sec
path = Scenario_HLG_HDMI.txt	Scenario file: Scenario_HLG_HDMI.txt in current folder
[Scenario]	Start of Scenario 4
caption = SDR – HDR	Scenario title “SDR – HDR”
period = 10000	Duration 10 sec
path = Scenario_SDR-HDR_HDMI.txt	Scenario file: Scenario_SDR-HDR_HDMI.txt in current folder
[Scenario]	Start of Scenario 5
caption = SDR – HLG	Scenario title “SDR – HLG”
period = 10000	Duration 10 sec
path = Scenario_HDR_HDMI.txt	Scenario file: Scenario_SDR-HLG_HDMI.txt in current folder

Scenario File (Scenario_SDR-HDR-HDMI.txt)

Scenario item and example content	Description
video=goldenGate0.jpg	Video files in current folder, file name format goldenGate0.jpg (0…)
audio=<Audio not selected>	Audio not selected
packets=HDMI\Infoframes_0000.bin	Packet files in folder HDMI\, file name format Infoframes_0000.bin (0…)
porder=0:180:2:256;1:180:2,0:256;	180 frames of image index 0, Packet index 2, RGB 8 bpc 180 frames of image index 1, Packets index 2 and 0, RGB 8 bpc
align12=1	Pixel data is aligned to LSB
audioswap=0	-
audiocompressed=0	-
audiosampling=0	-
audiochannels=0	-
audiobits=0	-
scrambler=0	scrambling disabled
colorspace=RGB444	Video color space: RGB 4:4:4
bitspercolor=8	Video color depth: 8 (bpc)
timing.hactive=1920	Timing: Horizontal active
timing.vactive=1080	Timing: Vertical active
timing.htotal=2200	Timing: Horizontal total
timing.vtotal=1125	Timing: Vertical total
timing.hstart=192	Timing: Horizontal start
timing.vstart=41	Timing: Vertical start
timing.hsync=44	Timing: Horizontal sync width
timing.vsync=5	Timing: Vertical sync width
timing.frate=60000	Timing: Frame rate 60 fps
hdcp=none	HDCP not enabled
loadingRGB=52,127,150	Solid color pattern shown when content is being uploaded to the device before playback is R=52, G=127, B=150. (Sample: )

Sample Content in Playback Tab

UCD Console's Playback tab features a set of examples for the user to create custom test content. This content is stored by default in *C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content*. It is advisable to create copy of the installed files and edit the copies.

Note: Playlists and Scenarios are interface technology dependent.
The provided examples are different for HDMI and DisplayPort.

Provided examples for each interface are shown below:

HDMI

The following playlists are available for HDMI interface.

Playlist Name	Description	Location
Basic Video & Audio Example	Example playlist for demonstrating the use of video and audio files.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Basic*
VRR Example	Playlist for demonstrating Variable Refresh Rate (VRR) capability of a DUT monitor. Utilizes extensively frame sequencing capability in scenario, and the use of metadata packets.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\VRR*
QMS-VRR Example	Playlist for demonstrating Quick Media Switching - Variable Refresh Rate (QMS-VRR) capability of a DUT monitor. Utilizes extensively frame sequencing capability in scenario, and the use of metadata packets.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\VRR*
ALLM	Playlist for demonstrating Auto Low-latency Mode (ALLM) capability of a DUT monitor.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\ALLM*
Audio-Video Latency	These scenarios can be used to estimate audio-video synchronization using external tools like Sync-One2 or similar.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\AV Latency*
HDR & Metadata Example	Example playlist that demonstrates the use of video files and metadata packets in testing a DUT monitor	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\HDR GoldenGate*
Grayscale	The scenarios show smooth transition though shades of gray from black to white.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Grayscale*
HDR10+ SSTM & SBTM Example	Playlist demonstrates using HDR10+ SSTM VSIF for Source-Side Tone Mapping, and HDMI Forum SBTM VSIF for Source-Based Tone Mapping.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\SBTM-SSTM*
Dolby Vision DEMO – Playlist	A set of static images transmitted with matching Dolby Vision metadata.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Dolby Vision*

DP

The following playlists are available for DisplayPort interface.

Playlist Name	Description	Location
Basic Video & Audio Example	Example playlist for demonstrating the use of video and audio files.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Basic*
Frame Rate Example	Playlist for demonstrating use of multiple frame rates with FHD and UHD resolution.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\VRR*
Audio-Video Latency	These scenarios can be used to estimate audio-video synchronization using external tools like Sync-One2 or similar.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\AV Latency*
HDR & Metadata Example	Example playlist that demonstrates the use of video files and metadata packets in testing a DUT monitor	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\HDR Golden Gate*
Grayscale	The scenarios show smooth transition though shades of gray from black to white.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Grayscale*
HDR10+ SSTM Example	Playlist demonstrates using HDR10+ SSTM VSIF for Source-Side Tone Mapping.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\SBTM-SSTM*
PSR1	A set of static images transmitted with matching Dolby Vision metadata.	*C:\Program Files\Unigraf\Unigraf UCD Tools \data\playback\content\Panel Replay*

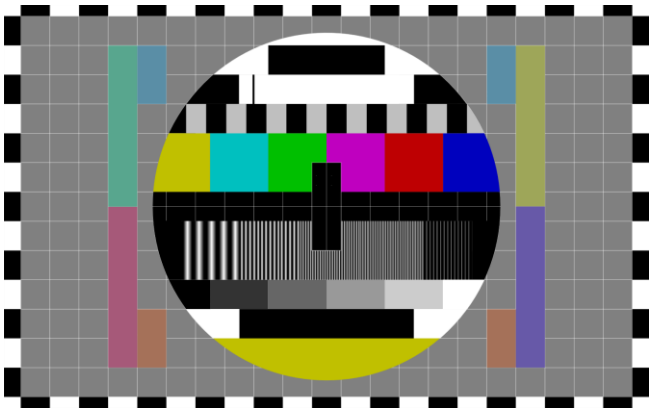
Playlist: Basic Video & Audio Example

The playlist sequences video files and audio according to the description below.

Video

Frames used for Scenario 1 and Scenario 2 (Image1.jpg, Image 2.jpg)

Frame used for Scenario 3 and Scenario 4 (Philips.svg)



Description of Scenarios

	Name	Duration	Repeated sequence
1	Flip-flop with LPCM Audio	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 60 frames Image1.jpg, 60 frames Image2.jpg, Audio: Rhythm.wav
2	Flip-flop with AC3 Audio	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 60 frames Image1.jpg, 60 frames Image2.jpg, Audio: 44100Hz_16bit_AC3_2channels_60sec_sine.iec61937.bin
3	Flip-flop Silent	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 60 frames Image1.jpg, 60 frames Image2.jpg, No Audio.
4	Philips 1920x1080p + 1kHz	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 60 Frames Philips.svg, Audio: 1 kHz sine wave (1kHz.wav)
5	Philips 3840x2160p + 1kHz	60 s	CTA 3840 x 2160 @ 60Hz (VIC 97), RGB 8 BPC 60 Frames Philips.svg, Audio: 1 kHz sine wave (1kHz.wav)

Playlist: Audio-Video Latency

Note: To measure video latency, ULT-01 test tool is needed.

Description of Scenarios

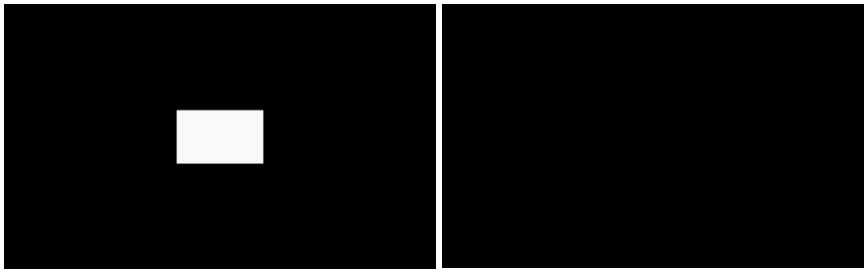
These scenarios can be used to estimate audio-video synchronization using external tools like Sync-One2 or similar. Video latency measuring requires the Unigraf ULT-01 tool.

The pattern with a white patch is shown for 15 frames, and then the black screen is shown for 45 frames. The audio beep is transmitted during the first frame of a white patch pattern.

	Name	Duration	Repeated sequence
1	vic16	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 15 frames frame1.vpattern, 45 frame0.vpattern, Audio: beep.wav
2	vic97	60 s	CTA 3840×2160 60 Hz (VIC 97), RGB 8 BPC, 45 frames frame1.vpattern, 15 frame0.vpattern, Audio: beep.wav

Video

Frames used for the scenario (frame1.vpattern frame0.vpattern)



Playlist: HDR & Metadata Example

Example demonstrates the use of metadata packets.

Video:

The Scenarios use four versions of the same image: GoldenGate0.jpg, GoldenGate1.jpg, GoldenGate2.jpg and GoldenGate3.jpg.

All four images use the same dynamic range in pixel data but contain a text label indicating pixel dynamic range applied in the metadata. If DUT behaves correctly, applying different metadata changes the appearance of the image on DUT screen.

Scenarios for HDMI Output

Video mode in all steps: CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, No audio.

Name	Duration	Repeated sequence
SDR	10 sec	180 frames GoldenGate0.jpg, Packet: Infoframes_0002;
HDR	10 sec	180 frames GoldenGate1.jpg, Packets: Infoframes_0002, Infoframes_0000
HLG	10 sec	180 frames GoldenGate2.jpg, Packets: Infoframes_0001, Infoframes_0002
HDR10+	10 sec	180 frames GoldenGate3.jpg, Packets: Infoframes_0002, Infoframes_0003, Infoframes_0000
SDR – HDR	10 sec	180 frames GoldenGate0.jpg, Packets: Infoframes_0002; 180 frames GoldenGate1.jpg, Packets: Infoframes_0002, Infoframes_0000
SDR – HLG	10 sec	180 frames GoldenGate0.jpg, Packet: – ; 180 frames GoldenGate2.jpg, Packets: Packets: Infoframes_0001, Infoframes_0002
SDR – HDR10+	10 sec	180 frames GoldenGate0.jpg, Packet: Infoframes_0002; 180 frames GoldenGate3.jpg, Packets: Infoframes_0002, Infoframes_0003, Infoframes_0000

Playlist: Grayscale

Description of Scenarios

The scenarios show smooth transition though shades of gray from black to white.

	Name	Duration	Repeated sequence
1	GrayFHD_60	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 12 BPC, 120 frames: gray0.vpattern - gray119.vpattern, Audio: No audio
2	GrayUHD_119	60 s	CTA 3840×2160 119,88 Hz, RGB 12 BPC, 120 frames: gray0.vpattern - gray119.vpattern, Audio: No audio

Video

Below you can see three example frames from the video.

Gray0.vpattern

Gray60.vpattern

Gray119.vpattern

Playlist: Dolby Vision DEMO (HDMI)

Description of Scenarios

A set of static images transmitted with matching Dolby Vision metadata.

	Name	Duration	Repeated sequence
1	playFiles_scenario	30 s	1920×1080 60Hz, RGB 8 BPC, 4 frames: Video_0000.bin – Video_0003.bin, Infoframes: Infoframe0000.bin – InfoFrame0033.bin Audio: No audio

Playlist: VRR Example (HDMI)

Playlist demonstrates controlling VRR (Variable Refresh Rate) in Scenarios when using HDMI output.

Video

The image used for the test contains a combination of color bars, gray scales, and rotating items. The test uses a sequence of images creating a full rotation in 60 frames.

Scenario with Video Mode 1920.1080 60 Hz

The scenario uses 1920×1080 59.94/60 Hz video timing (VIC 16). No audio.

	Name	Duration	Repeated sequence
1	FHD VRR 48..59 switch	60 s	VRR enabled. RGB 8 BPC. Packets: infoframe_00, infoframe_01 300 frames with 48 Hz frame rate, 300 frames with 59 Hz frame rate.

Scenario with Video Mode 3840.2160 60 Hz

The scenario uses 3840×2160 59.94/60 video timing (VIC 97). No audio.

	Name	Duration	Repeated sequence
1	UHD VRR48..59 switch	60 s	VRR enabled. RGB 8 BPC. Packets: infoframe_00, infoframe_02 300 frames with 48 Hz frame rate, 300 frames with 59 Hz frame rate.

Scenario with Video Mode 3840.2160 60 Hz

The scenario uses 3840×2160 59.94/60 video timing (VIC 97). No audio.

	Name	Duration	Repeated sequence
1	UHD VRR48..59 switch	60 s	VRR enabled. RGB 8 BPC. Packets: infoframe_00, infoframe_02 300 frames with 48 Hz frame rate, 300 frames with 59 Hz frame rate.

Playlist: QMS-VRR Example (HDMI)

Playlist demonstrates Quick Media Switching QMS by sending Video Timing Extended Metadata (VTEM) with TFR changing between 48/1.001 and 60.

Video

The same as in VRR Example above.

Playlist: ALLM (HDMI)

Playlist for demonstrating Auto Low-latency Mode (ALLM) capability of a DUT monitor.

Video:

The Scenarios use a series of images: allm_on_off_000.jpg to allm_on_off_0011.jpg. Text panel on the images indicate if ALLM is enabled or not. The first scenario is presented with ALLM enabled and the second by switching ALLM on and off sequentially.

Scenarios for HDMI Output

Video mode in all steps: CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, No audio.

Name	Duration	Repeated sequence
ALLM Static	60 sec	10 frames allm_on_off_000.jpg, Packet: allm_0.bin; 10 frames allm_on_off_001.jpg, Packet: allm_0.bin; 10 frames allm_on_off_002.jpg, Packet: allm_0.bin; 10 frames allm_on_off_003.jpg, Packet: allm_0.bin; 10 frames allm_on_off_004.jpg, Packet: allm_0.bin; 10 frames allm_on_off_005.jpg, Packet: allm_0.bin
ALLM Toggle	60 sec	10 frames allm_on_off_000.jpg, Packet: allm_0.bin; 10 frames allm_on_off_001.jpg, Packet: allm_0.bin; 10 frames allm_on_off_002.jpg, Packet: allm_0.bin; 10 frames allm_on_off_003.jpg, Packet: allm_0.bin; 10 frames allm_on_off_004.jpg, Packet: allm_0.bin; 10 frames allm_on_off_005.jpg, Packet: allm_0.bin; 10 frames allm_on_off_006.jpg, Packet: allm_1.bin; 10 frames allm_on_off_007.jpg, Packet: allm_1.bin; 10 frames allm_on_off_008.jpg, Packet: allm_1.bin; 10 frames allm_on_off_009.jpg, Packet: allm_1.bin; 10 frames allm_on_off_0010.jpg, Packet: allm_1.bin; 10 frames allm_on_off_0011.jpg, Packet: allm_1.bin

Playlist: HDR10+ SSTM & SBTM Example (HDMI)

Description of Scenarios

Playlist demonstrates using HDR10+ SSTM VSIF for Source-Side Tone Mapping, and HDMI Forum SBTM VSIF for Source-Based Tone Mapping.

	Name	Duration	Repeated sequence
1	SDR	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Channel1.jpg, repeated 180 times Packets: Infoframes_0005.bin, Audio: No audio
2	HDR10+ SSTM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Channel0.jpg, repeated 180 times Packets: Infoframes_0000.bin, _0005.bin, _0006.bin Audio: No audio
3	SBTM G-RDM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Channel0.jpg, repeated 180 times, Packets: Infoframes_0000.bin, _0005.bin, _0007.bin Audio: No audio
4	SDR – SBTM G-RDM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Step1: Channel1.jpg, repeated 150 times, Packets: Infoframes_0005.bin Step2: Channel0.jpg, repeated 180 times, Packets: 0000.bin, _0005.bin, _0007.bin Audio: No audio
5	SBTM D-RDM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Channel0.jpg, repeated 180 times Packets: Infoframes_0000.bin, _0005.bin, _0008.bin Audio: No audio
6	SDR – SBTM D-RDM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Step1: Channel1.jpg, repeated 150 times, Packets: Infoframes_0005.bin Step2: Channel0.jpg, repeated 150 times, Packets: 0000.bin, _0005.bin, _0008.bin Audio: No audio

Video

Channel0.jpg

Channel1.jpg

Playlist: HDR10+ SSTM Example (DP)

Playlist demonstrates using HDR10+ SSTM VSIF for Source-Side Tone Mapping.

	Name	Duration	Repeated sequence
1	HDR10+ SSTM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Channel0.jpg, repeated 180 times Packets: Infoframes_0000.bin, _0003.bin Audio: No audio
2	SDR – HDR10+ SSTM	10 s	3840×2160 30 Hz, RGB 10 BPC, Video: Step1: Channel0.jpg, repeated 150 times Packets: Infoframes_0000.bin, _0003.bin Step2: Channel1.jpg, repeated 150 times Packets: None Audio: No audio

Video

Channel0.jpg

Channel1.jpg

Playlist: Frame Rate Example (DP)

Playlist for demonstrating use of multiple frame rates with FHD and UHD resolution when using DisplayPort output.

Video

The image used for the test contains a combination of color bars, gray scales, and rotating items. The test uses a sequence of images creating a full rotation in 60 frames

Executed Scenarios

The test is using four scenarios (RGB 8 BPC, No audio)

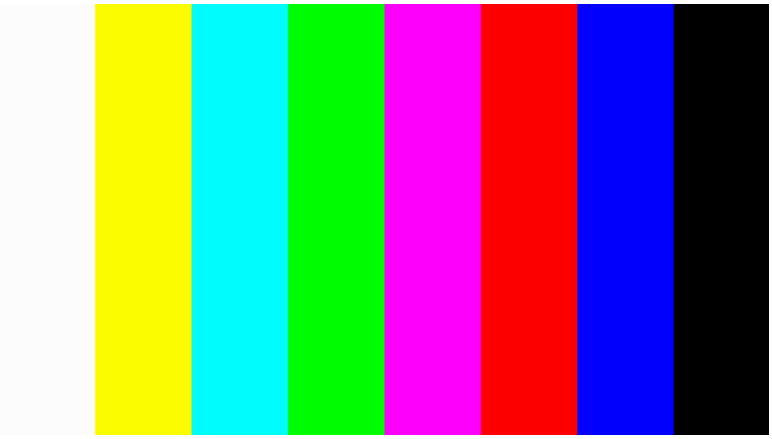
	Name	Duration	Repeated sequence
1	Spinners FHD 59fps	60 s	1920×1080 59.94/60 Hz video timing (VIC 16), 60 frames 'colorBarsSpinning-X.svg' X= 0 to 59
2	Spinners FHD 119fps	60 s	1920×1080 119.88/120 Hz video timing (VIC 63), 60 frames 'colorBarsSpinning-X.svg' X= 0 to 59
3	Spinners UHD 59fps	60 s	3840×2160 59.94/60 Hz video timing (VIC 97) 60 frames 'colorBarsSpinning-X.svg' X= 0 to 59
4	Spinners UHD 119fps	60 s	3840×2160 119.88/120 Hz Hz video timing (VIC 120) 60 frames 'colorBarsSpinning-X.svg' X= 0 to 59

Playlist: PSR1 (DP)

Playlist for demonstrating Panel Replay functionality.

Video:

The Scenarios use color_bars_0.jpg image.



Scenarios

Video mode in all steps: CTA 1920×1080 60 Hz (VIC 16), RGB 8 bpc, No audio.

Name	Duration	Repeated sequence
PSR1 Entry N	10 sec	color_bars_0.jpg.jpg, Packets: DP/vscpacket_0000.bin on line 0; color_bars_0.jpg.jpg, Packets: DP/vscpacket_0001.bin on line 1; color_bars_0.jpg.jpg, Packets: DP/vscpacket_0003.bin on line 15;
PSR1 Entry N p 1	10 sec	color_bars_0.jpg.jpg, Packets: DP/vscpacket_0000.bin
PSR1 Abort N p 1	10 sec	color_bars_0.jpg.jpg, Packets: DP/vscpacket_0000.bin
PSR1 Abort N p 2	10 sec	color_bars_0.jpg.jpg, Packets: DP/vscpacket_0000.bin