

# UCD-5XX



## User Manual

UCD Console SW Version 3.7



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## Edition

UCD-5XX UCD Console 3.7 User Manual, rev 7

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UCD-5XX products meet the essential health and safety requirements, are 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.

## Table of Contents

	Copyright .....	2
	Notice .....	2
	Edition.....	2
	Company Information.....	2
	Trademarks.....	3
	Limited Warranty.....	3
	CE Mark .....	3
	Table of Contents.....	4
1.	About This Manual .....	7
	Purpose .....	7
	Product and Software Version .....	7
	Notes .....	7
2.	Introduction .....	8
	Product Description.....	8
	Safety and Operational Precautions.....	11
3.	Installation.....	12
	Installation Package.....	12
	Software Installation .....	12
	Firmware Update Procedures.....	14
	Firmware Downgrading.....	18
	License Manager .....	19
	UCD Console.....	21
	Options.....	22
	Detaching and Cloning Tabs .....	23
4.	Analyzer Operation .....	24
	Functionality Tabs.....	24
	Link Tab .....	24
	HDCP Tab.....	31
	Video Tab.....	32
	Capture Tab.....	36
	Link Analyzer Tab .....	37
	Audio Tab.....	41
	EDID/DisplayID Tab .....	43
	DPCD Tab.....	45
	SDP Tab.....	46
	DSC Tab.....	48
	Panel Replay Tab .....	50
	FEC Tab .....	52
	Source DUT Testing Tab .....	53
	Cable Info Tab .....	55
	PDC Tab.....	56
	Status List .....	57
	Capabilities .....	59
	DP Alt Mode .....	60
	Power Source.....	61
	Power Sink.....	62
	Controls.....	62
	Bottom Panel .....	64
5.	Generator Operation .....	65
	Functionality Tabs.....	65
	Link Tab .....	65
	Pattern Generator Tab .....	73
	Playback Tab.....	80
	Audio Generator Tab.....	87
	HDCP Tab.....	89
	EDID/DisplayID Tab .....	91
	DPCD Tab.....	93
	SDP Tab.....	94



	FEC Tab .....	95
	Panel Replay Tab .....	97
	ALPM Tab .....	99
	Sink DUT Testing Tab .....	100
	Adaptive-Sync Tab .....	103
	Cable Info Tab .....	104
	PDC Tab .....	105
6.	Link Timeline Viewer .....	106
	Wave Form and Symbol View Settings .....	108
	FrameView Tab .....	112
	Event Selector View .....	113
	Event Details View .....	118
	Wave Forms View .....	121
	Symbols View .....	129
	Images Tab .....	133
	Frame Image View .....	135
7.	Event Timeline Viewer .....	136
8.	Event Log .....	140
	Selecting Logged Events .....	141
	Event Transaction List .....	143
	Customizing Transaction List .....	144
	Event Details .....	146
9.	EDIDDisplayID Editor .....	151
	EDID Editor Features .....	153
	Editing Tips .....	153
10.	Packet Editor .....	155
11.	Pattern Editor .....	156
12.	Image Converter .....	158
	Appendix A: Product Specification .....	159
	UCD-500 .....	159
	UCD-500 Gen2 .....	159
	Appendix B: Product Features .....	161
	UCD-5XX Product Options .....	165
	Appendix C: Predefined Timings .....	166
	Appendix D: Predefined Patterns .....	171
	Appendix E: Sink, Source and Repeater Tests .....	176
	Compliance Tests .....	179
	Running CTS Tests .....	182
	Evaluating CTS Test Results .....	184
	Test Report .....	185
	Audio Test Set .....	186
	CRC Based Video Test Set .....	187
	Link Config Tests .....	190
	Pixel Level Video Tests .....	191
	Appendix F: VTP Pattern Language .....	193
	General .....	193
	Commands .....	194
	Variables .....	200
	Appendix G: Firmware Recovery .....	202
	Downloading Tools .....	202
	Step 1 .....	203
	Step 2 .....	203
	Appendix H: Playlists and Scenarios .....	204
	Playlists .....	205
	Scenarios .....	206
	Parameters .....	206
	Example .....	210

Sample Content in Playback Tab.....	212
Playlist: Basic Video & Audio Example.....	213
Playlist: Frame Rate Example.....	214
Playlist: Audio-Video Latency.....	215
Playlist: HDR & Metadata Example.....	216
Playlist: Grayscale.....	217
Playlist: HDR10+ SSTM Example.....	218
Playlist: PSR1 .....	219

# 1. ABOUT THIS MANUAL

## Purpose

This guide is a User Manual of UCD-5XX products. UCD-5XX are USB-connected video interface test units for use with a computer.

The purpose of this guide is to

- Provide an overview of the product and its features.
- Provide instructions for the user on how to install the software and the drivers.
- Provide instructions for the user on how to update the FW of the unit.
- Introduce the HW features of UCD-5XX 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 **3.7**. 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.

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**Note:** This version of the User Manual describes features in UCD Console software based on the functionality in Microsoft Windows, macOS and Linux operating systems.

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## Notes

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

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**Note:** This text is an important note

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**Warning:** This is a warning about a direct risk for the functionality of the device

---

## 2. INTRODUCTION

### Product Description

UCD-5XX products are high speed, USB 3.0 connected video interface test units.

*UCD Console* is a common graphical user interface (GUI) for Unigraf UCD-5XX, UCD-4XX and UCD-3XX units. The outlook and details of UCD Console will vary depending on the capabilities of the connected unit and will reflect the features enabled.

The software package for UCD-5XX features 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.

### Product Features

- **UCD-500:** DP 2.1 capable Reference Sink and Reference Source for verifying DP and USB-C connected devices with link rates up to 20 Gbps (UHBR20) using USB-C interface and 10 Gbps (UHBR10) using DP interface.
- **UCD-500 Gen2:** DP 2.1 capable Reference Sink and Reference Source for verifying DP and USB-C connected devices with link rates up to 20 Gbps (UHBR20)
- High resolution video up to 8K @60Hz, 16K @60Hz with DSC and audio
- Generate HDR formats such as Dolby Vision™, HDR10 and HDR10+
- 16 GB video frame buffer
- High speed USB 3.0 host PC interface

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

### Available Interface Roles

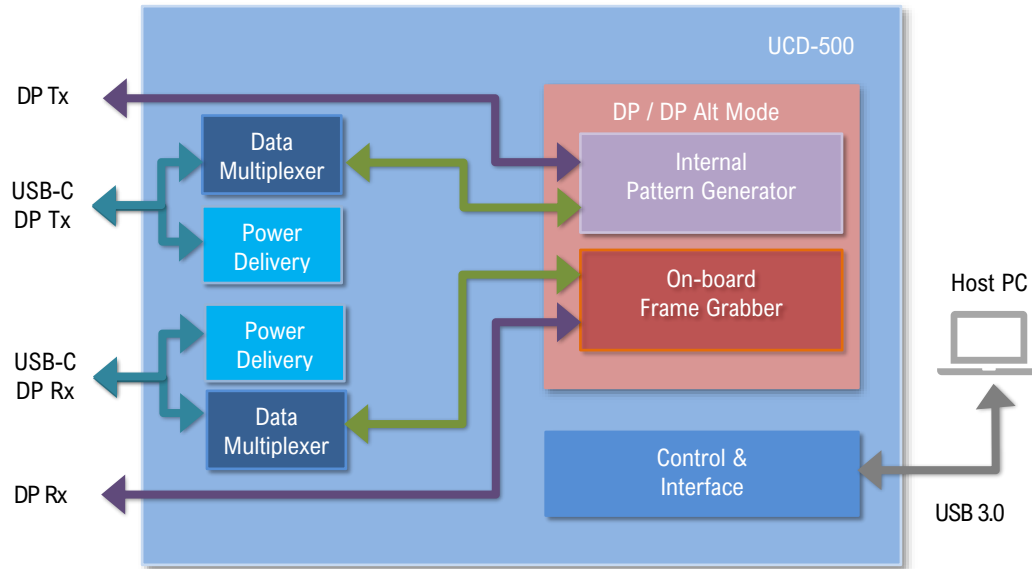
UCD-500 products can operate in various interface role combinations. The used role is selected when UCD Console is launched.

Selection	UCD-500	UCD-500 Gen2
DisplayPort Sink and Source	•	•
USB-C DP Alt-Mode Sink and Source	•	•
DisplayPort Source and USB-C DP Alt-Mode Sink	•	•
USB-C DP Alt-Mode Source and DisplayPort Sink	•	•

## Functional Description

UCD-5XX 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-5XX Functional Diagram



## Delivery Content

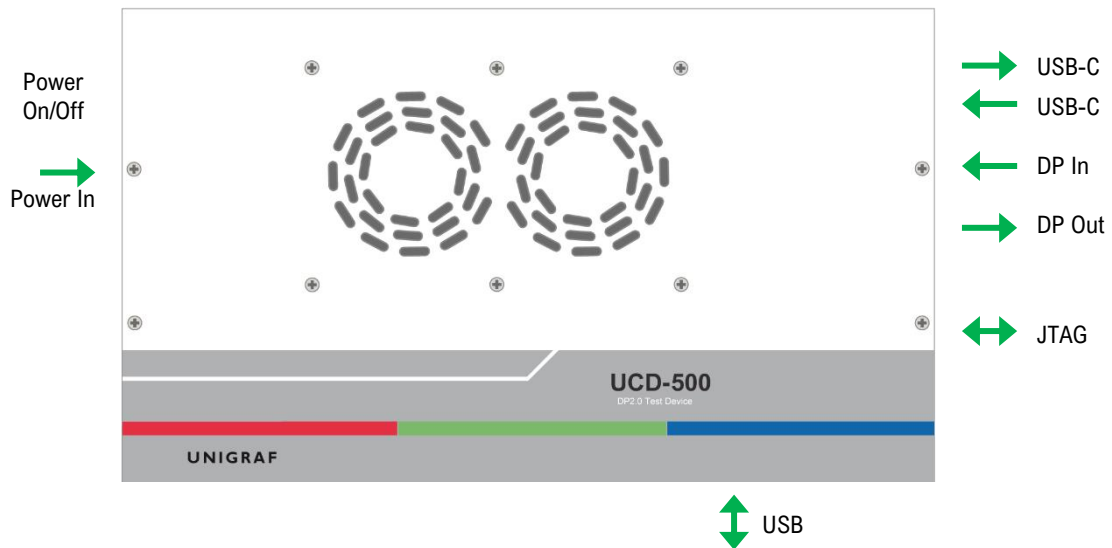
Please find below an image of the items included in UCD-5XX unit delivery



1. UCD-5XX Unit
2. AC/DC Power Supply (100 to 240 Vac 50/60Hz input, +12 Vdc output)
3. DisplayPort cable 0.5 meters length
4. Micro USB cable for FW update
5. Passive TBT4 cables, 0.5 and 1.0 meters length
6. USB 3.0 compliant cable for host PC connection

## Connections

The image below indicates the connections in **UCD-500** and **UCD-500 Gen2** unit and their description.



Name	Description
DP in	DisplayPort™ 2.1 capable input*
DP out	DisplayPort™ 2.1 capable output*
USB-C in	USB-C PD 3.0 DP Alt-Mode input (20 Gbps)
USB-C out	USB-C PD 3.0 DP Alt-mode output (20 Gbps)
Power in	+12 Vdc Power Supply Input
Power On/Off	Rocker power switch
USB	USB 3.0 connection to the host PC
JTAG	JTAG interface for maintenance purposes (micro USB)

(\* In UCD-500 10 Gbps link rate maximum, in UCD-500 Gen2 20 Gbps link rate maximum)

**Note** Capturing and sourcing high resolution video modes and high frame rates set stringent requirements on the video cables and connectors. If in doubt, please contact Unigraf Support.

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

- Use only Unigraf provided AC/DC Power Adapter. Please make sure that connectors and cabling to the Power Adapter are intact. In case there are any doubts about 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.
- 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.

## 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, macOS and Linux.

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

- Drivers (installed during set up)
- UCD Console software (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, the firmware of the unit also needs to be updated. If in doubt, please contact Unigraf.

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

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**Note:** System administrator's privileges are required for performing installations.

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### Software Installation

#### Windows

Install \*.exe file from the package.

Start installation by running application SoftwareBundle\_X.X.XXXX.exe.

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

The user is also asked if they want 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 your 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, enter '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.Applmage* for example).

## Firmware Update Procedures

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.

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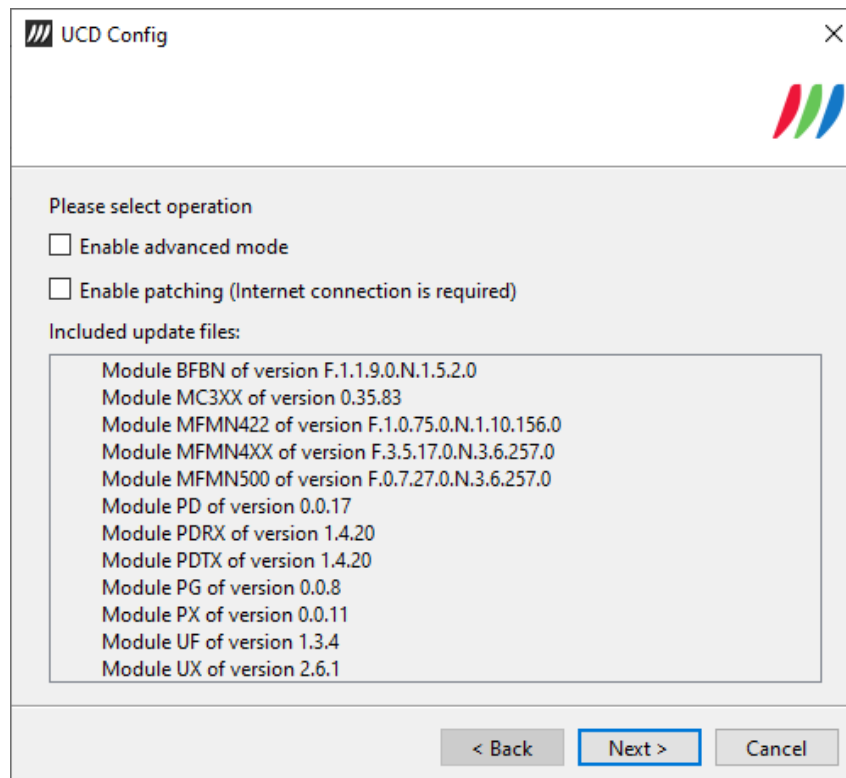
To update the firmware or create a new configuration on a UCD-5XX device, perform the following steps:

- ▶ 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

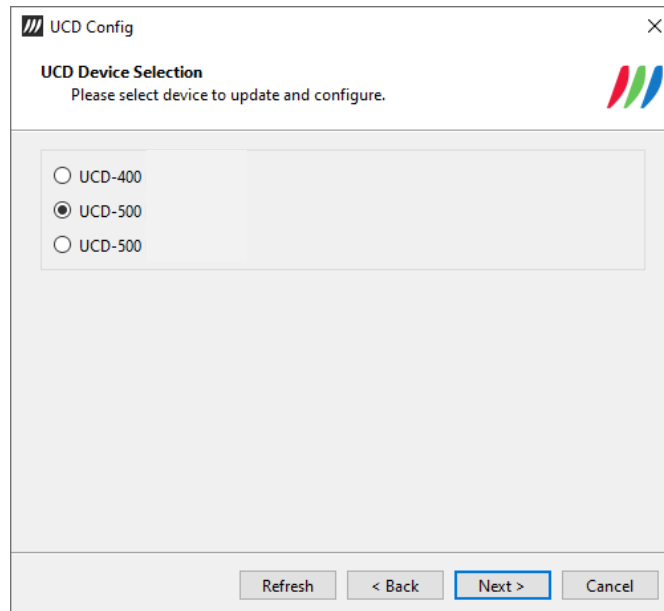
The first page of the utility indicates the firmware component versions present in the package. Select **Enable advanced mode** checkbox if you want to customize the installation (possibly to downgrade firmware for example). **Enable patching (Internet connection is required)** check box is not relevant for UCD-5XX devices.

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:

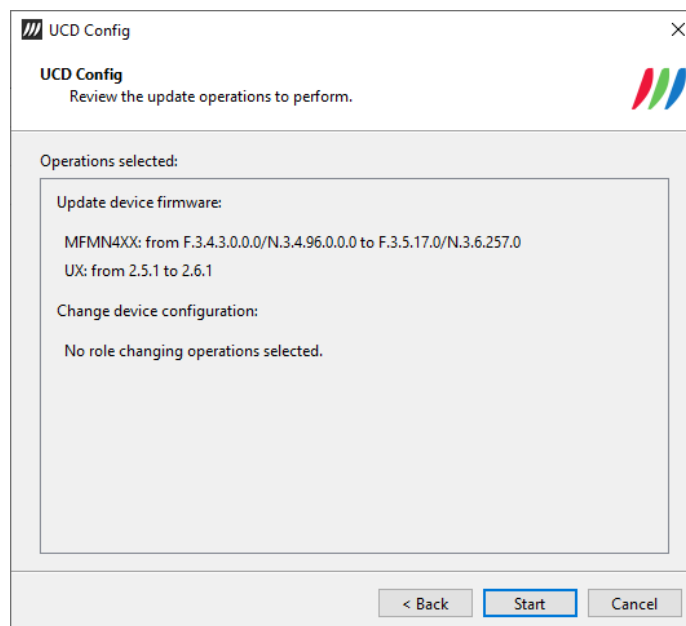
- ▶ FW components available in the UCD device
- ▶ Current FW version (from)
- ▶ FW to be installed (to)

---

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

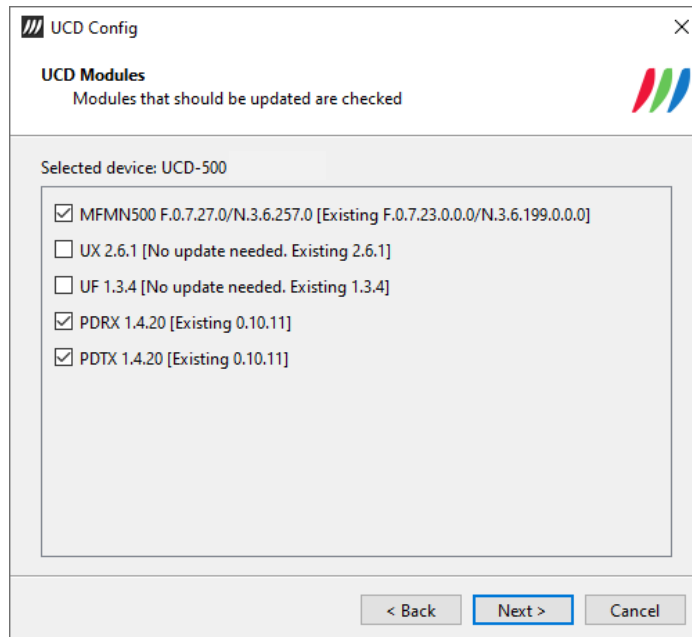
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Click **Start** to start the FW update procedure.

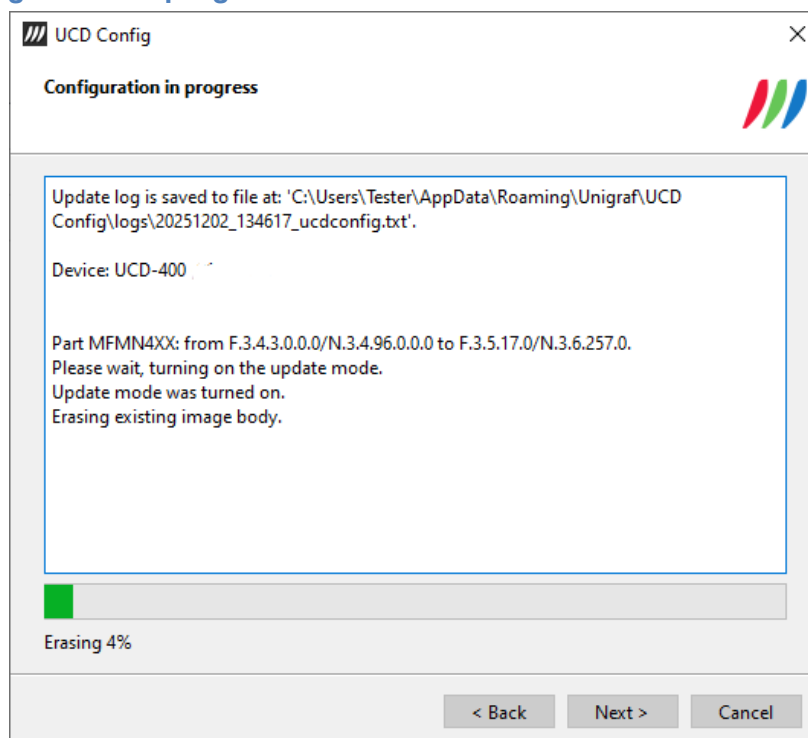


### Advanced Mode

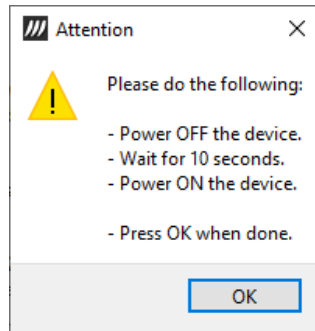
Advanced mode allows users to select individual components to update. Click **Next** to review the components and start the update procedure.



### 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 procedure 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*.

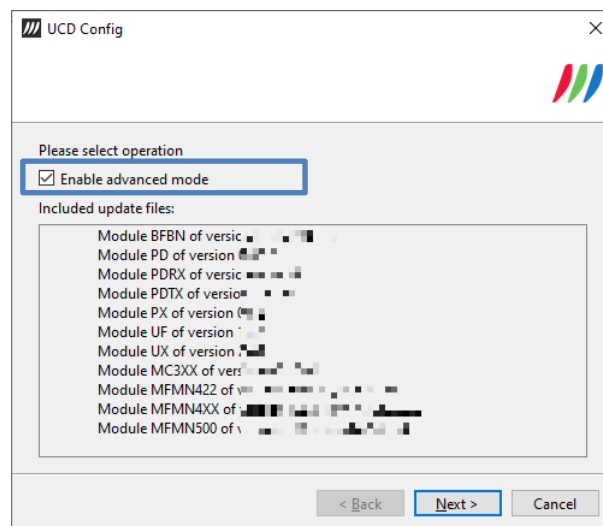
Once FW Recovery procedure has been done and a Firmware version supporting UCD Firmware Configuration tool has been installed, all future updates can be done using this tool.

## 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](http://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 MFMN500 F.X.X.X/N.X.X.X
10. Click **Next**. Click **Start** to start programming FW to the connected UCD Device

## 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 **the 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 on a sticker attached to the bottom of the device.

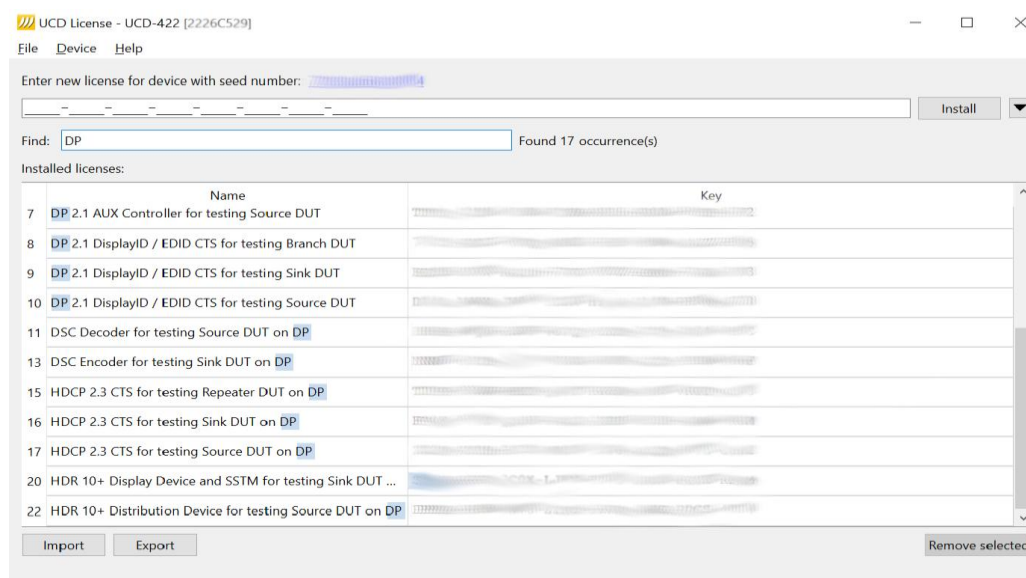
The **Rescan...** button will re-detect connected UCD devices.

### 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 cursor 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 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 note, 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.

<i>Import:</i>	Install licenses from an INI file for the currently selected device.
<i>Export:</i>	<p>Save installed licenses for the currently selected device into an INI file for backup and distribution to other PCs.</p> <p>To export license(s), select the license(s) to be exported and then click the Export button. Please note that licenses from multiple devices can be exported into the same INI file.</p>
<i>Remove Selected:</i>	Uninstall selected licenses. To uninstall a license, click on the license and then click the Remove Selected button



## UCD Console

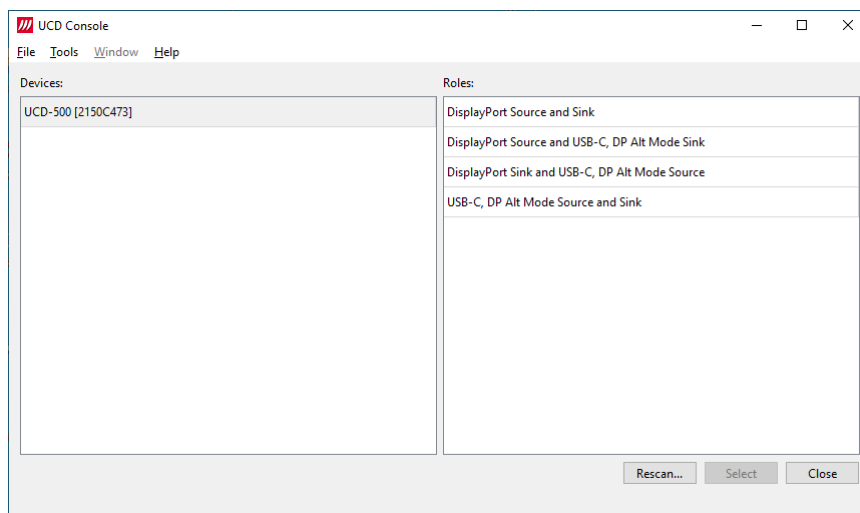
UCD Console is graphical user interface (GUI) for UCD family test equipment for desktop use. UCD Console provides the user access to all features of the unit. UCD Console also includes powerful debugging and analysis tools enabling the user to monitor the status of the display interfaces and assist in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

### 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 double clicking on the appropriate row. If your device cannot be found in the list, please confirm the power and USB connection to the device and click the **Rescan ...** button.

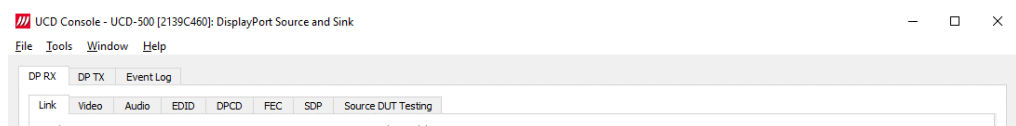


### Role Selection

UCD-5XX features two alternative Sink interfaces (DP and USB-C), and in a similar way two alternative Source Interfaces. One Sink role and one Source role can be active at one time. Sink / Source role selection is done by selecting one of the four combinations during launch of UCD Console.

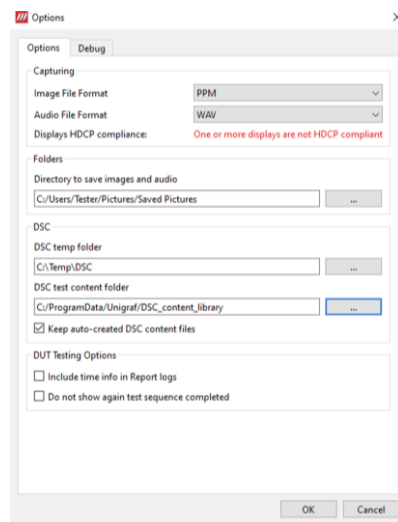
### Analyzer and Generator Operation

Most UCD devices can be used with UCD Console as Analyzer (a Sink device) and as Generator (a Source device). The functionalities of the two operation modes can be found in separate tabs. This User Manual will explain both roles and all role functionalities.



## Options

Options can be found in *Tools > 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

Information if controlling PC is HDCP compliant, i.e. if preview of HDCP encrypted content can be enabled. If the display is non-HDCP compliant or when connected to the PC using RDP (Remote Desktop Protocol) then users will be presented with a blue background with a banner stating 'HDCP unauthorized'. HDCP is currently only supported on Windows OS and not supported on MacOS and Linux.

### Folders

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

### DSC

<i>DSC temp folder</i>	Folder for DSC Work files.
<i>DSC test content folder:</i>	Folder where DSC source bitmap files, related configuration files and DSC conversion tools are stored.
<i>Keep auto-created DSC content files:</i>	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

Configure DUT Testing reports.

<i>Include time info in Report logs:</i>	Include system date and time at the beginning of each event line in generated reports.
--	--

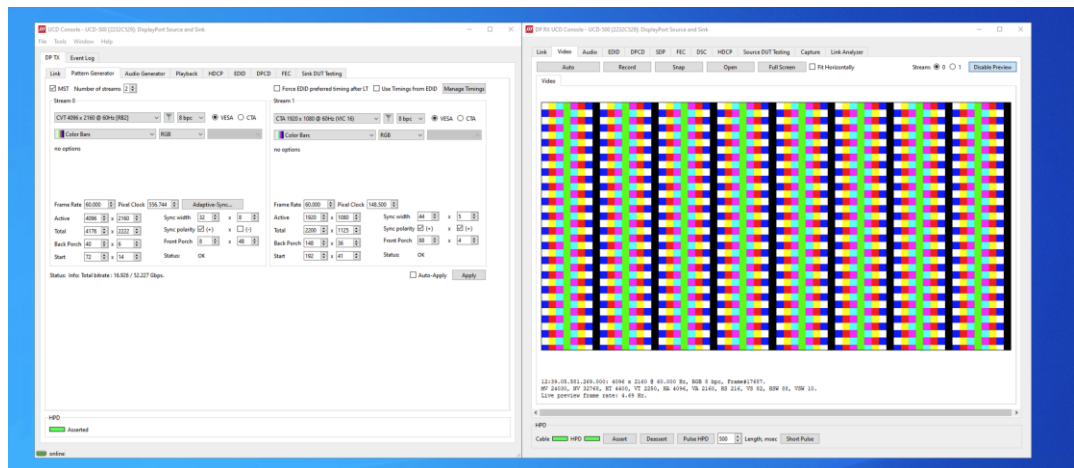
*Do not show again test sequence completed:*

Include system date and time in the beginning of each event line in generated reports.

## 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 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*, the UCD-5XX device acts as DisplayPort or USB-C DisplayPort Alt Mode Sink or Receiver device.

Analyzer functionality related controls and dialogs can be used by selecting *DP RX* tab.

Please note that in UCD-5XX, *Generator* functionality is available simultaneously with Analyzer. Please find the description of Generator functionality later in this manual.

## Functionality Tabs

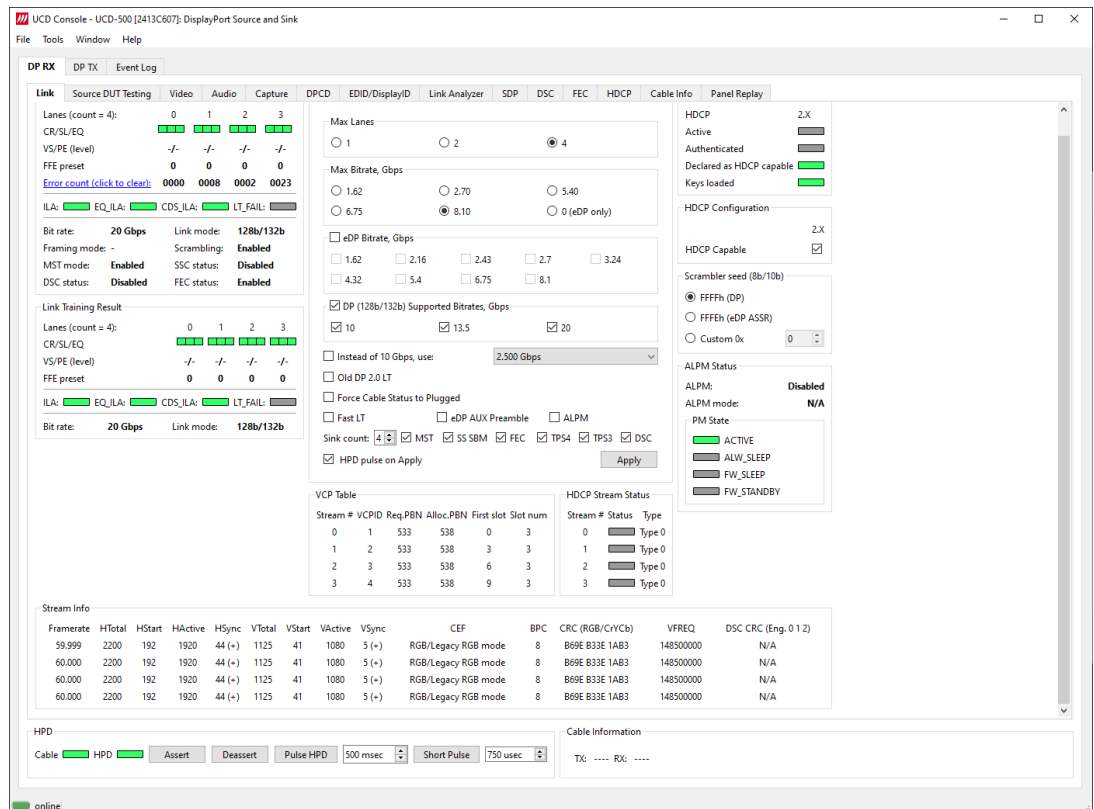
UCD Console features are presented in tabs. Some of the tabs are enabled by default, some only when an applicable license is included.

**Note:**

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

## Link Tab

The Link tab contains the following panels: *Link Status*, *Link Training Result*, *Link Capabilities*, *VCP Table*, *Stream Info*, *HDCP Status*, *HDCP Configuration*, *Scrambler seed* and *HPD*.



## 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 the status of other link modes. The data is retrieved from the DPCD status registers of the UCD Sink. The status is updated automatically.

Link Status				
Lanes (count = 4):	0	1	2	3
CR/SL/EQ				
VS/PE (level)	-/-	-/-	-/-	-/-
FFE preset	0	0	0	0
<a href="#">Error count (click to clear):</a>	0000	0000	0000	0000
ILA:	EQ_ILA:	CDS_ILA:	LT_FAIL:	
Bit rate:	20 Gbps	Link mode:	128b/132b	
Framing mode:	-	Scrambling:	Enabled	
MST mode:	Enabled	SSC status:	Disabled	
DSC status:	Disabled	FEC status:	Enabled	

<i>Lanes:</i>	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
<i>CR/SL/EQ:</i>	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization for each of the four lanes
<i>VS/PE (level):</i>	Voltage Swing / Pre-emphasis level
<i>FFE Preset:</i>	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)
<i>Error count:</i>	Content of DPCD Error Count registers
<i>ILA:</i>	Status LED for Inter-Lane Alignment
<i>EQ_ILA</i>	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding)
<i>CDS_ILA</i>	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding)
<i>LT_FAIL</i>	Status LED for Link Training failure (only with 128b/132b channel coding)
<i>Bit rate:</i>	Currently enabled link bit rate
<i>Link mode:</i>	Currently enabled channel coding (128b/132b or 8b/10b)
<i>Framing mode:</i>	Currently enabled Framing Mode (Normal or Enhanced) (only with 8b/10b channel coding)
<i>Scrambling:</i>	Status of link data scrambling (Enabled or Disabled)
<i>MST mode:</i>	Status of Multi-stream transport (Enabled or Disabled)
<i>SSC Status:</i>	Status of Spread-Spectrum Clock (Enabled or Disabled)
<i>DSC Status:</i>	Status of Display Stream Compression (Enabled or Disabled)
<i>FEC status:</i>	Status of Forward Error Correction function (Enabled or Disabled)

## Link Training Result

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

Link Training Result				
Lanes (count = 4):	0	1	2	3
CR/SL/EQ				
VS/PE (level)	-/-	-/-	-/-	-/-
FFE preset	0	0	0	0
ILA:  EQ_ILA:  CDS_ILA:  LT_FAIL: 				
Bit rate:	20 Gbps			
Link mode:	128b/132b			

<i>Lanes:</i>	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
<i>CR/SL/EQ:</i>	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization for each of the four lanes
<i>VS/PE (level):</i>	Voltage Swing / Pre-emphasis level
<i>FFE preset:</i>	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)
<i>ILA:</i>	Status LED for Inter-Lane Alignment
<i>EQ_ILA</i>	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding)
<i>CDS_ILA</i>	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding)
<i>LT_FAIL</i>	Status LED for Link Training failure (only with 128b/132b channel coding)
<i>Bit rate:</i>	Currently enabled link bit rate
<i>Link mode:</i>	Currently enabled channel coding (128b/132b or 8b/10b)

## Link Capabilities

The Link capabilities panel allows the user to change the way the Sink capabilities are announced in the DPCD capability registers of the UCD Sink. To enable the change, please click *Apply*.

Link Capabilities

Max Lanes  
☐ 1    ☐ 2    ☒ 4

Max Bitrate, Gbps  
☐ 1.62    ☐ 2.70    ☐ 5.40  
☐ 6.75    ☒ 8.10    ☐ 0 (eDP only)

☐ eDP Bitrate, Gbps  
☐ 1.62    ☐ 2.16    ☐ 2.43    ☐ 2.7    ☐ 3.24  
☐ 4.32    ☐ 5.4    ☐ 6.75    ☐ 8.1

☐ DP (128b/132b) Supported Bitrates, Gbps  
☒ 10    ☒ 13.5    ☒ 20

☐ Instead of 10 Gbps, use: 2.500 Gbps

☐ Old DP 2.0 LT

☐ Force Cable Status to Plugged

☐ Enable Fast LT

☐ eDP AUX Preamble

Sink count: 2 ☒ MST ☒ SS SBM ☒ FEC ☒ TPS4 ☒ TPS3 ☒ DSC

☒ HPD pulse on Apply Apply

<i>Max Lanes:</i>	Maximum lane count used
<i>Max Bitrate, Gbps</i>	Maximum link rate used when 8b/10b link coding is selected in LT.
<i>eDP Bitrate, Gbps</i>	Available eDP bitrates. eDP support is limited to eDP 1.5 (i.e. 8b/10b link coding)
<i>DP (128b/132b) Supported Bitrates, Gbps</i>	When checkbox is selected, 128b/132b link coding is supported. Link rates used when 128b/132b link coding is selected in LT. <b>Please observe the Note about the long HPD pulse below.</b>
<i>Instead of 10 Gbps, use:</i>	For supporting low link rate Source devices, the user can make UCD-5XX sink PHY use a selectable lower link rate when performing “10 Gbps” link training in protocol level. Link rates are: 2.5 Gbps, 2.7 Gbps, 5.0 Gbps and 5.4 Gbps
<i>Old DP 2.0 LT</i>	When checked LT will follow initial DP 2.0 spec description. Otherwise, LT as per DP 2.1 specification
<i>Force cable status to plugged:</i>	UCD-400 RX device supports source device detection via AUX by default. Checking this on DPRX disables this behavior.
<i>Enable Fast LT:</i>	Indicates support for link training without AUX transactions.
<i>eDP AUX Preamble</i>	Use <i>eDP AUX Preamble</i> protocol.
<i>Sink count</i>	Selects the number of sinks capable of to transmitter.
<i>MST:</i>	When 8b/10b link coding enabled, indicate support for MST mode and Sideband MSG handling. When 128b/132b link coding enabled, indicate support for multi-stream transport and Sideband MSG.
<i>SS SBM:</i>	When selected, indicate support Sideband MSG while not supporting multi-stream transport. Valid only with 128b/132b channel coding and when “MST” is unchecked.
<i>FEC (8b/10b):</i>	Indicated support for Forward Error Correction feature when 8b/10b link coding is enabled
<i>TPS4, TPS3:</i>	Indicate support for Link Training Pattern Sequence 4 and 3.
<i>DSC (8b/10b)</i>	Select to enable Display Stream Compression (DSC) feature when 8b/10b link coding is enabled
<i>HPD pulse on Apply:</i>	Select to apply a Hot-Plug Detect (HPD) pulse automatically after updating the status. HPD pulse duration will be defined in the <i>Pulse HPD</i> field in <i>HPD</i> dialog in the bottom of the tab.

---

**Note:** Please note that deviating from the rules set in DP 2.1 Specification, UCD-5XX allows selection of maximum link rate for 8b/10b coding also when support for 128b/132b link coding is enabled.

---

**Note:** When changing link coding capability of the Sink device (8b/10b vs 128b/132b), please make sure to issue a Long HPD Pulse after applying new setting or make sure that "HPD pulse on Apply" is selected before applying the change

---

## Scrambler Seed

Scrambler seed (8b/10b)

☒ FFFFh (DP)

☐ FFFEh (eDP ASSR)

☐ Custom 0x

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

Used only when 8b/10b link coding is enabled.

## HDPC Status & Configuration

HDPC Status

HDPC 2.X

Active ☐

Authenticated ☐

Declared as HDPC capable ☒

Keys loaded ☒

HDPC Configuration

HDPC Capable ☒

Copy of HDPC status and controls on HDPC tab.

---

**Note:** Please note that HDCP 1.3 is not supported in 3.7 release.

---

## HDCP Stream Status

HDCP Stream Status

Stream #	Status	Type
0	<input checked="" type="checkbox"/>	Type 0
1	<input checked="" type="checkbox"/>	Type 0
2	<input checked="" type="checkbox"/>	Type 0
3	<input checked="" type="checkbox"/>	Type 0

Shows HDPC status for each stream.

## ALPM Status

ALPM Status

ALPM: Disabled

ALPM mode: N/A

PM State

☒ ACTIVE

☐ ALW\_SLEEP

☐ FW\_SLEEP

☐ FW\_STANDBY

<i>ALPM:</i>	Disabled / Enabled
<i>ALPM mode:</i>	ALPM mode / N/A
<i>Active:</i>	Green light indicates PM is active
<i>ALW_Sleep</i>	AUX-less mode SLEEP state
<i>FW_Sleep</i>	AUX-wake mode SLEEP state
<i>FW_Standby</i>	AUX-wake mode STANDBY state



## Stream Info

Stream Info is achieved from the Main-Stream Attributes (MSA) of the monitored stream. Frame rate is measured by UCD Local Sink

Stream Info													
Framerate	HTotal	HStart	HActive	HSync	VTotat	VStart	VActive	VSync	CEF	BPC	CRC (RGB/CrYCb)	VFREQ	DSC CRC (Eng. 0 1 2)
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A

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

<b>Framerate:</b>	Vertical refresh rate
<b>HTotal:</b>	Horizontal total of transmitted main video stream, measured in pixel count.
<b>HStart:</b>	Horizontal active start from leading edge of HSync, measured in pixel count.
<b>HActive:</b>	Horizontal active, number of active pixels in video line
<b>HSync:</b>	HSync width, measured in pixel count. (+)/(-) positive / negative sync.
<b>VTotat:</b>	Vertical total of transmitted main video stream, measured in line count.
<b>VStart:</b>	Vertical active start from leading edge of VSync, measured in line count.
<b>VActive:</b>	Vertical active, number of active lines in video frame
<b>VSyn:</b>	VSync width, measured in line count. (+)/(-) positive v.s. negative sync.
<b>CEF:</b>	Used color mode: Color format + subsampling / colorimetry
<b>BPC:</b>	Color depth in bits per color (BPC)
<b>CRC (RGB/CrYCb):</b>	16-bit Cyclic redundancy check (CRC) value per color component calculated from active pixels. Value order in YCbCr color format: Cr, Y, Cb.
<b>VFREQ:</b>	Video Frequency (128b/132b channel coding only)
<b>MVID/NVID:</b>	Mvid and Nvid video time stamp values (8b/10b channel coding only)
<b>DSC CRC:</b>	16-bit Cyclic redundancy check (CRC) calculated from compressed pixel stream. Value order: Engine 0, 1, 2.

## VCP Table

VCP Table shows allocation of Virtual Channel Payload for active virtual channels.

The contents of *VCP Table* can be copied by right-clicking on the table and selecting *Copy*.

VCP Table					
Stream #	VCPID	Req.PBN	Alloc.PBN	First slot	Slot num
0	1	533	538	0	3
1	2	533	538	3	3
2	3	533	538	6	3
3	4	533	538	9	3

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

**SID:** Stream identification number of the virtual channel

**Req.PBN:** Requested PBN (payload bandwidth number) value for the virtual channel



**Alloc.PBN:** PBN value allocated for the virtual channel

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

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

## HPD

HPD

Cable 
HPD 
Assert Deassert Pulse HPD 500 msec Short Pulse 750 usec

**Cable:** LED indicates that the hardware has detected an upstream cable.

**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.

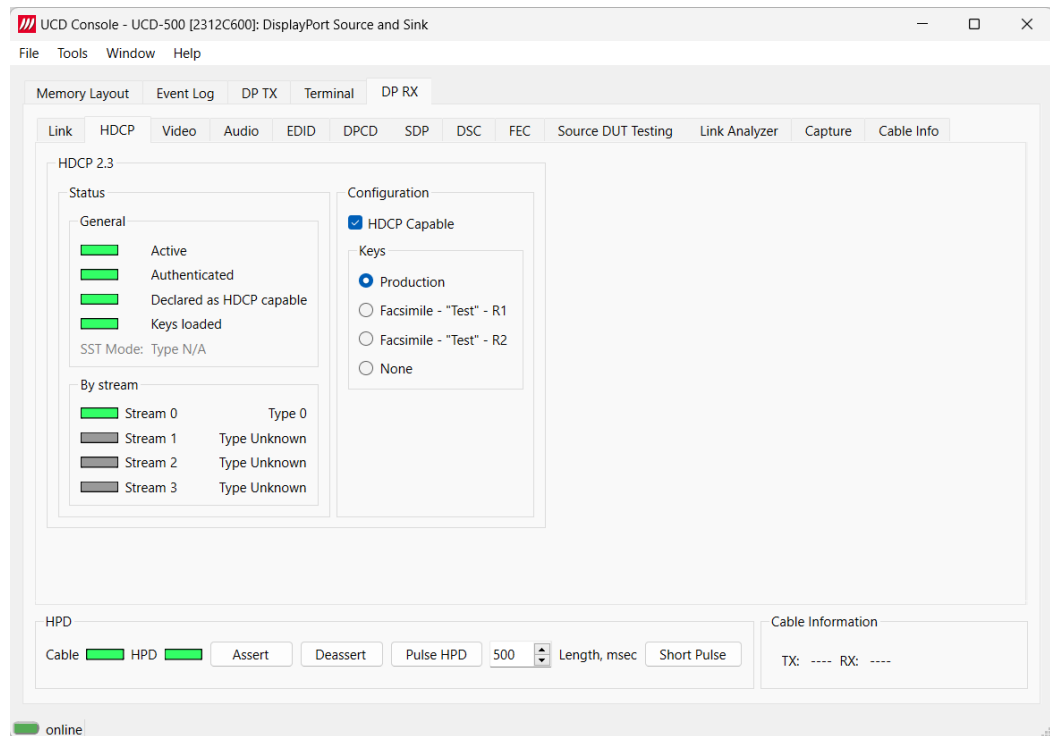
**Pulse HPD:** Click to apply an HPD Pulse with programmable duration. Duration will be defined in the provided field.

**Short Pulse:** Click to apply a short pulse with programmable duration. Duration will be defined in the provided field.

## HDPC Tab

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

**Note:** Please note that HDPC 1.3 is not supported in 3.7 release.



### Status

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

<i>Active:</i>	The link between UCD and the upstream source has been encrypted.
<i>Authenticated:</i>	The HDPC handshake between the UCD and the sink unit has been completed successfully.
<i>Declared as HDPC capable:</i>	The UCD unit recognizes HDPC handshake messages.
<i>Keys loaded:</i>	The HDPC keys are loaded to the UCD unit.
<i>SST Mode Type</i>	Type when in SST mode and in Link mode 8b/10b.
<i>Stream status</i>	Shows HDPC status on each stream.

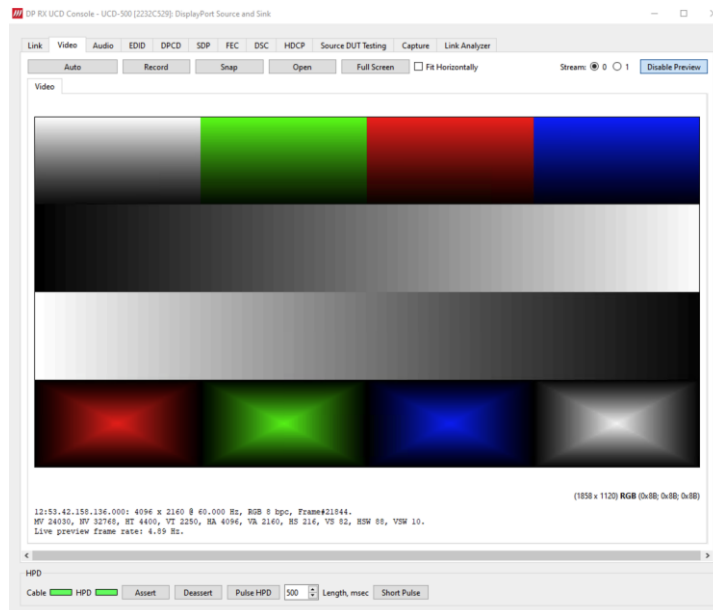
### Configuration

*HDPC Capable:* To disable HDPC, uncheck the box.

### Keys

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

## Video Tab



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

### Disable / Enable Preview

Click the button to start or stop capturing video frames.

### Stream

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

Stream: ☒ 0 ☐ 1

### Video Status

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

```
(1638 x 1410) YCbCr (0x9B; 0x80; 0x80) RGB (0x9B; 0x9B; 0x9B)
11:33.16.830.100.000: 4096 x 2160 @ 60.000 Hz, YCbCr4:2:2 8 bpc (Colorimetry: ITU-R BT.601), Frame#30671.
MV 35, NV 6797440, HT 4400, VT 2250, HA 4096, VA 2160, HS 216, VS 82, HSW 88, VSW 10.
Live preview frame rate: 6.12 Hz.
```

<i>First row:</i>	Cursor location, pixel value at cursor location in YCbCr and RGB
<i>Second row:</i>	Time stamp, Color mode, color depth, frame counter.
<i>Third row:</i>	Mvid, Nvid, Horiz Total, Vert Total, Horiz Active, Vert Active, Horiz Start, Vert Start, Hor Sync Width, Vert Sync Width.
<i>Fourth row:</i>	Live preview frame rate.

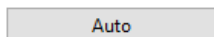
#### Note:

HDCP preview is only available on UCD Console for Windows operating system.

Please note that UCD test equipment are able to capture video at full frame rate.

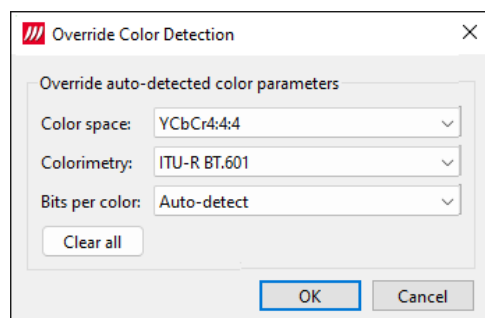
*Live preview frame rate* indicates the rate of updating captured video on UCD Console preview screen. Live preview frame rate is limited e.g., by the USB communication between UCD test equipment and the PC.

## Override Color Detection



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.



<i>Color space:</i>	Define as which format captured data will be interpreted. (Auto-detect, RGB, YCbCr4:4:4, YCbCr4:2:2, YCbCr4:2:0)
---------------------	---

<i>Colorimetry:</i>	Define as which colorimetry captured data will be interpreted. (ITU-R BT.601, ITU-R BT.709, ITU-R BT.2020)
---------------------	---

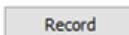
<i>Bits per color</i>	Define as which color depth captured data will be interpreted. (Auto-detect, 6, 8, 10, 12, 16)
-----------------------	---

---

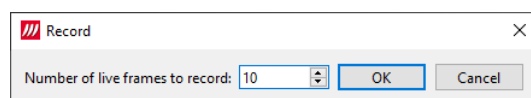
**Note:** Please note that the color mode selection applies to the preview window only. All internal functions use the raw image data as captured from the input channel.

---

## Frame recording

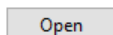


Clicking the button opens a dialog for definition of number of frames recorded.



Recorded frames are stored by default in C:/Users/<Current user>/Pictures. Please refer to Tools > Options where the location of this folder can be customized.

## Open

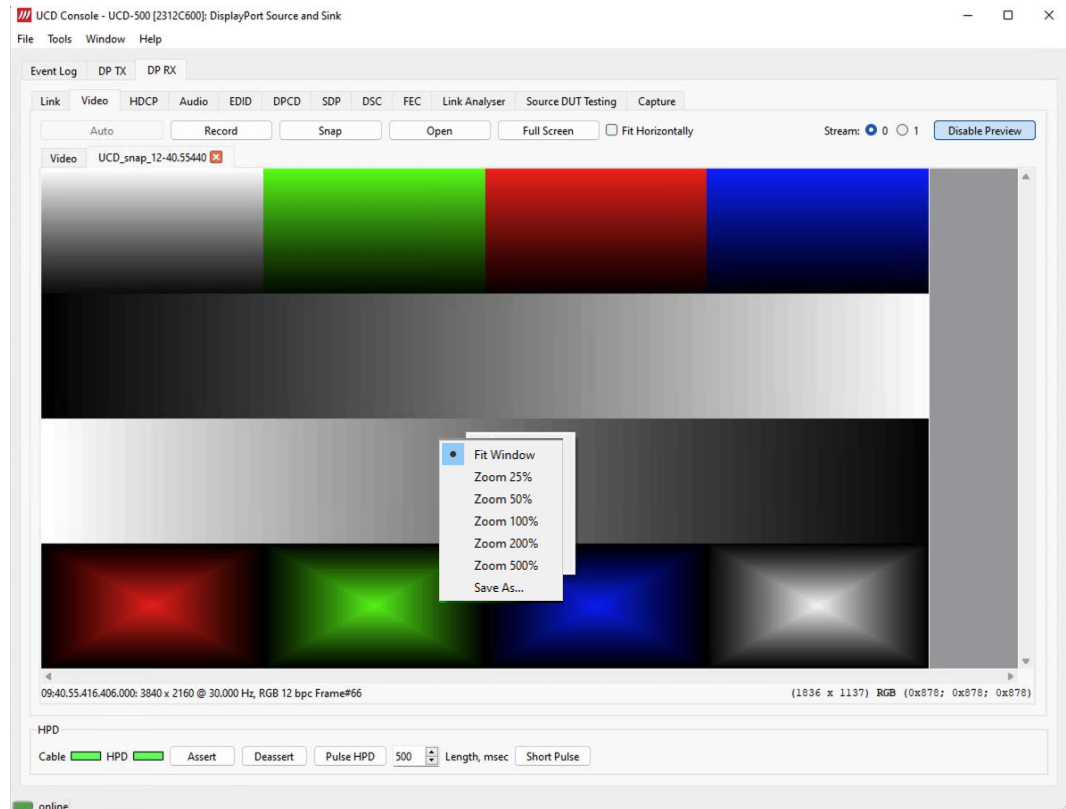


Open folder where captured frames are stored. Please refer to Tools > Options where the location of this folder can be customized.

## 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 RGB and YCbCr components of the pixel on the cursor location in hexadecimal values

## 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%, 50%, 100%, 200%, and 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.

## Full Screen

Full Screen

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

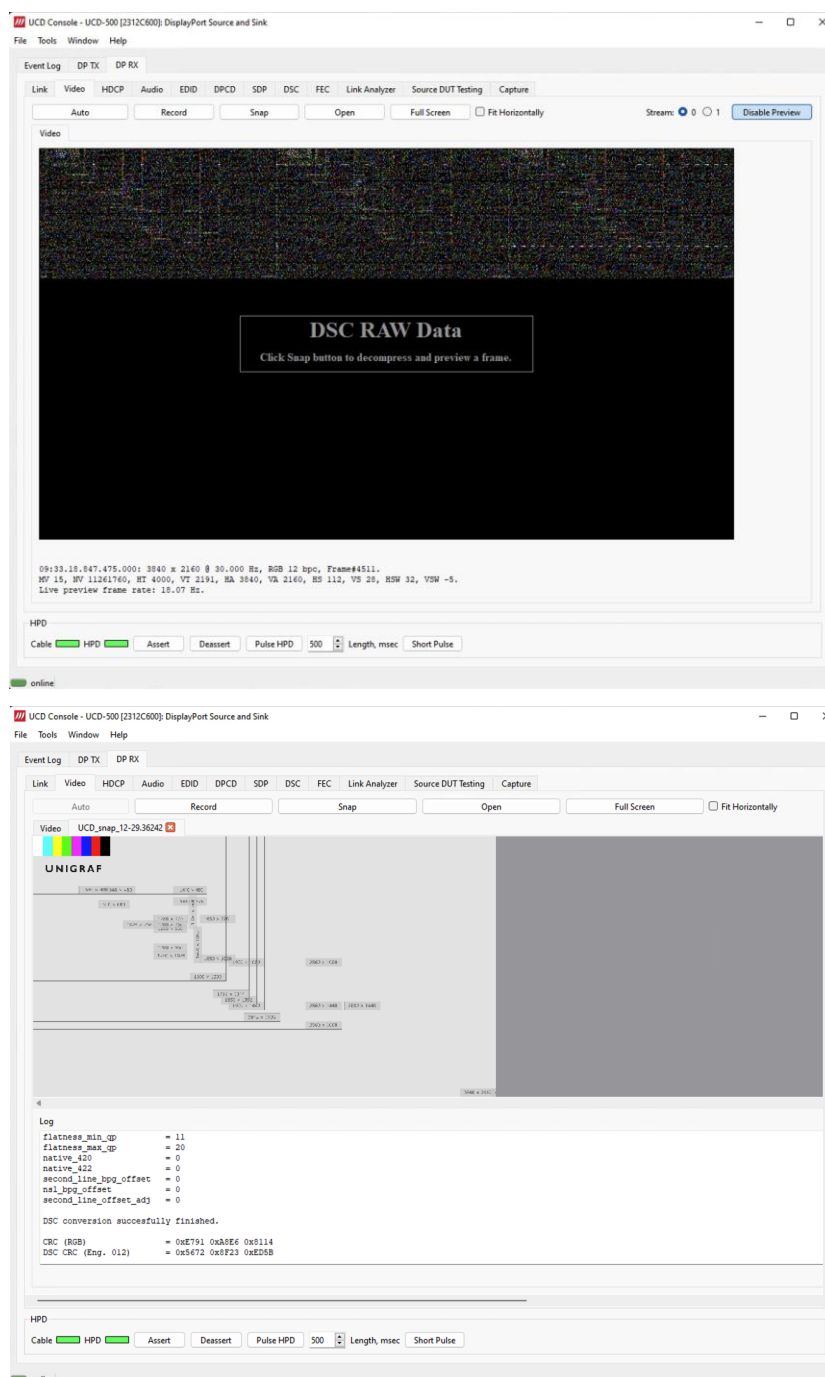
Double-click on the screen or press <Esc> to exit full screen mode.

## Preview DSC Decompressed Stream

In order to capture and preview DSC compressed video DSC must be enabled in *Link Capabilities* dialog in Link tab.

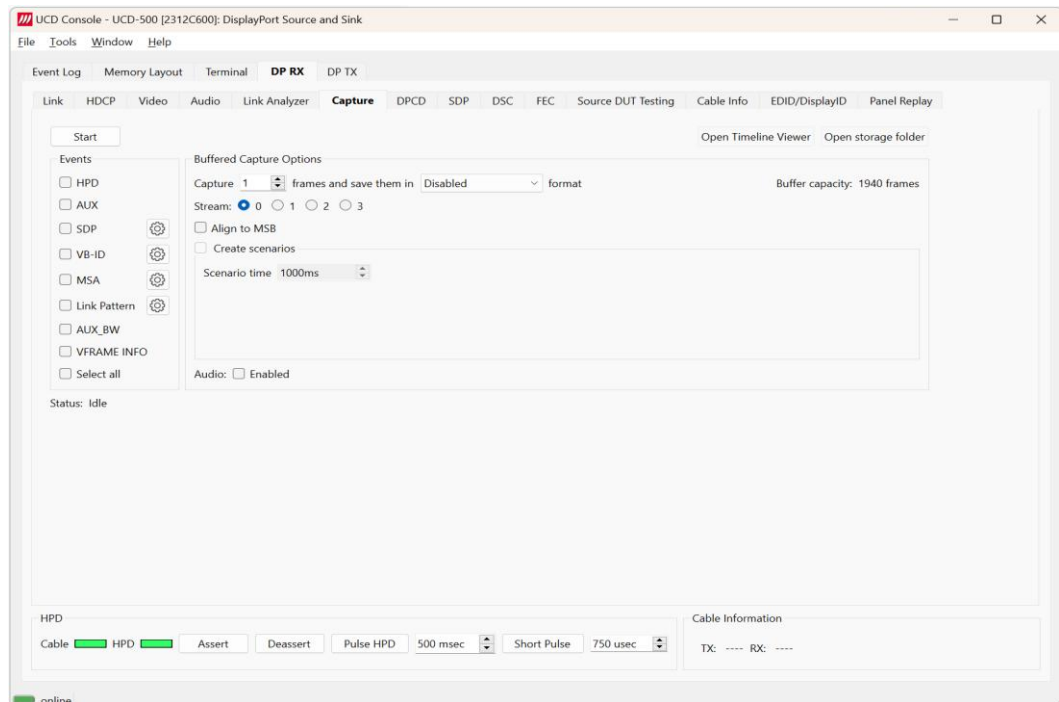
Select **Enable Preview** to verify that DSC compressed stream is received.

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



## 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.



<b>Start / Stop:</b>	Start or Stop capturing
<b>Capture N frames ...:</b>	The number of video frames captured.
<b>Format:</b>	Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PPM, BIN + BMP.
<b>Capacity of buffer:</b>	The number of video frames that can be stored to UCD frame buffer using current video signal format.
<b>Align to MSB</b>	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).
<b>Events:</b>	Please refer to chapter <i>Event Log</i> for details of the captured events.
<b>Status:</b>	Status of the capture.
<b>Open Timeline Viewer</b>	Open Event Timeline Viewer to view the captured data. Refer to chapter seven of this manual for detailed instructions.
<b>Open storage folder:</b>	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:**

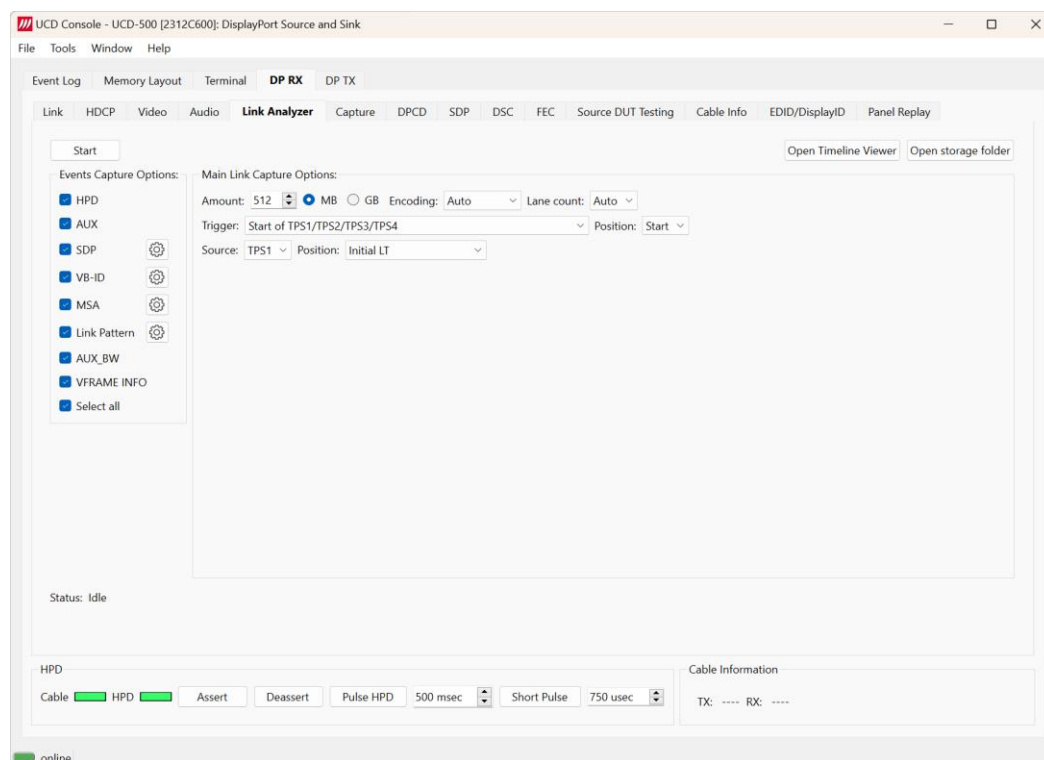
Video Preview needs to be disabled to use Data Capture functionality.

---



## Link Analyzer Tab

Capture of Main-link Data Events and AUX Transactions for evaluation with Link Timeline Viewer. Please refer for details to chapter [Link Timeline Viewer](#) later in this manual for more details.



<b>Start</b>	Start capturing main link data defined by <i>Main Link Capture Options</i>
<b>Open Timeline Viewer</b>	Open Link Timeline Viewer. For detailed description of Link Timeline Viewer, please refer to chapter six of this manual.
<b>Open storage folder</b>	Open folder in the PC where capture data is stored. Folder is the video storage folder defined in <i>Tools &gt; Options</i> . Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "capture_yyyymmdd_hhmmss". (e.g. capture_20210215_093351).

### Main Link Capture Options

<b>Amount:</b>	The amount of data logged to buffer. Buffer size 4 GBytes maximum.
<b>Encoding:</b>	Auto, 8b/10b or 128b/132b
<b>Lane count:</b>	Auto, 1, 2 or 4

## Trigger Point Options

Trigger: Start of TPS1/TPS2/TPS3/TPS4 Position: Start

Source: TPS1 Position: Initial LT

Start  
25%  
50%  
75%  
End

Start of data capture can occur without defined trigger or triggered by a predefined signal combination.

The *Position* drop-down list at the upper right shows where in the trigger event it will start capture.

First select the event block from the *Trigger* drop-down list and use context sub-menus to select detail.

Trigger	Source	Position
No active trigger	—	—
Start of TPS1 / TPS2 / TPS3 / TPS4	TPS1, TPS2, TPS3, TPS4	Initial LT, After ALPM, Initial LT or After ALPM
Exit of TPS1 / TPS2 / TPS3 / TPS4	TPS1, TPS2, TPS3, TPS4	Initial LT, After ALPM, Initial LT or After ALPM
Trigger	Source	Mask (hex)
VB-ID with the MASK – any change, match, selected bit transition	Any VB-ID change VB-ID match with VB-ID Mask Change of any bit in VB-ID that is set in VB-ID mask	Set Mask value in hex format.
VB-ID on TYPE – BS/SR/CPBS/CPSR	BS, SR, CPBS, CPSR	—
Trigger	Options	HB0 (hex), HB1 (hex)
SDP Type received – HB0 and/or HB1 match	Match on HB0, HB1 can be any value Match on HB1, HB0 can be any value Match on HB0 and HB1	Set HB0/HB1 values in hex format.
Trigger	Source	Options
MSA – any change, change by mask, match by mask	Any MSA change Change of any MSA attribute set in mask Match of any MSA attribute set in mask	MVid, NVid, HTotal, VTotal, HActive, VActive, HSyncW, VSyncW, HSyncP, VSyncP, HSyncS, VSyncS, MISC0, MISC1
Any AUX transition	—	Initial LT, After ALPM, Initial LT or After ALPM
Trigger	Type	Address (hex)
AUX read or write of specific address	AUX native write AUX native read	Set address in hex format.
Trigger		
ACT (Allocation Change Trigger)		

**Note:**

If you want to capture during link training and you have set the trigger accordingly, you can initiate link training by clicking *Pulse HPD* at the bottom of the window.

## Events

The following events can be included in the captured data.


### HPD

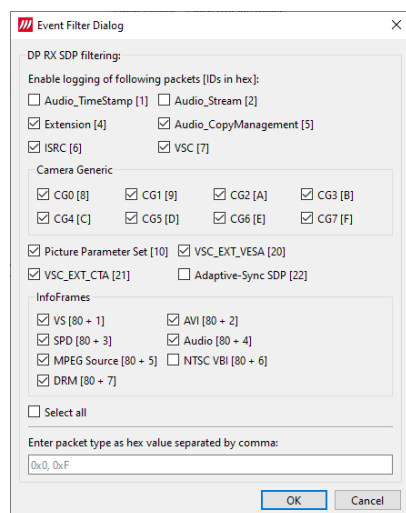
Status and status changes of Hot Plug Detect (HPD) signal

### AUX


AUX Channel transactions.

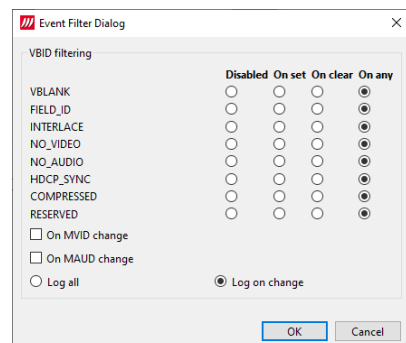
### SDP

Secondary-data Packets received in the 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 “[ ]”.




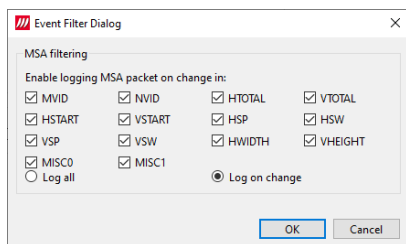
### VB-ID

Vertical Blanking ID packets. Click the  button to open the *Event Filter Dialog*. The dialog enables definition of which bit changes will be logged.




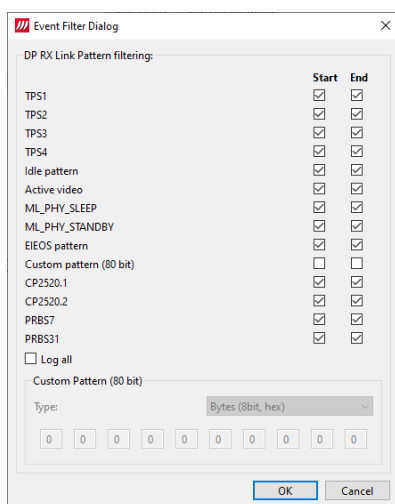
## MSA

Log Main Stream Attributes. Click the  button to open the *Event Filter Dialog*. The dialog enables definition of which events will be logged.



## Link Pattern:

Detect link patterns. Click the  button to open the *Event Filter Dialog*. The dialog enables definition of which patterns will be logged.



## AUX BW:

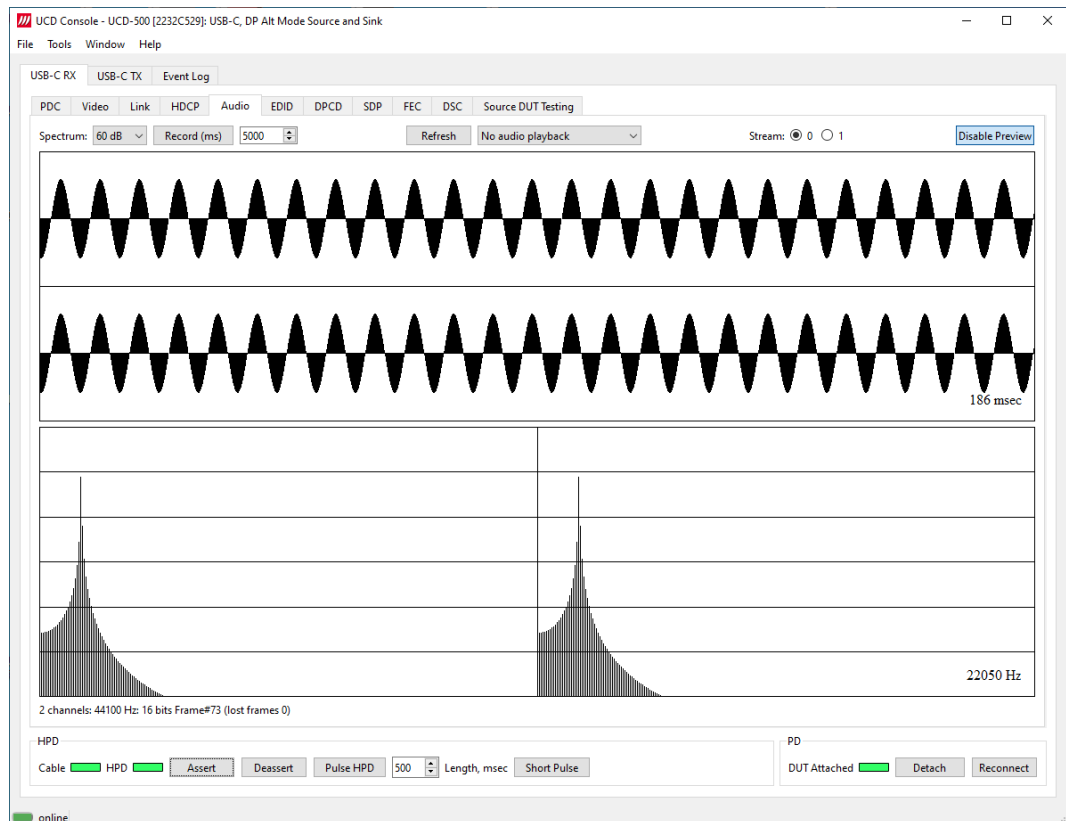
Capture AUX Channel signal details.

## VFRAME INFO

Dimensions of the captured frame measured by the Sink

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

### 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

No audio playback ▾

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 device EDID. Since UCD devices are 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

Refresh

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

## Start Audio Recording

Record (ms) 5000 ▴ ▾

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.

## EDID/DisplayID Tab

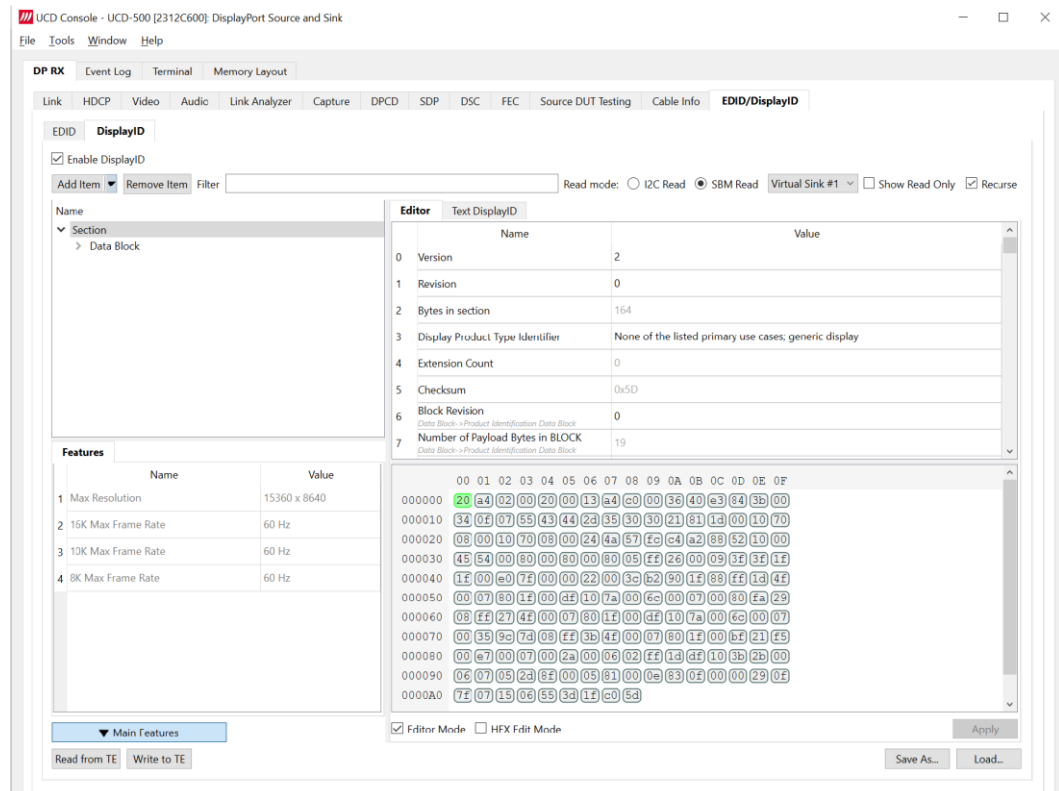
EDID/DisplayID Tab provides tools for accessing the EDID/DisplayID data presented to the connected Source Device. There are three basic functions:

- Load and save data files on the host PC.
- Edit contents in *Editor Mode* or *Hex Edit Mode*.
- Read and write to EDID/DisplayID memory for up to 4 virtual ports.

### EDID/DisplayID Files

The screenshot shows the UCD Console interface with the EDID/DisplayID tab selected. The interface includes a menu bar (File, Tools, Window, Help), a toolbar (DP RX, Event Log, Terminal, Memory Layout), and a main workspace divided into several sections:

- Left Panel:** A tree view showing the structure of the EDID/DisplayID data. It includes sections for VESA (Vendor & Product ID, EDID Structure Version and Revision Numbers, Basic Display Parameters / Features, Color Characteristics, Established Timings I, Established Timings II, Manufacturer's Timings, Standard Timings: Identification, Preferred Timing Block, 18 byte descriptor 2, 18 byte descriptor 3, 18 byte descriptor 4) and CTA (Info, Data block collection, Detailed Timings).
- Top Right:** A section for reading and writing data. It includes a "Read mode" dropdown (I2C Read, SBM Read), a "Virtual Sink #1" dropdown, and checkboxes for "Show Read Only" and "Recurse".
- Center:** A table showing the EDID/DisplayID data. The table has columns for "Name" and "Value". The data is organized into blocks, with the first block being the Header (0x00FFFFFFF000).
- Bottom Left:** A section for features. It includes a "Features" table with columns for "Name" and "Value". The table lists various features such as Max Resolution, Max Frame Rate, and HDR Static.
- Bottom Right:** A section for editing data. It includes a "Hex Edit" mode, a "Save As..." button, and a "Load..." button.



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

**Note:** Four blocks (512 bytes) of EDID code are read. If the device does not support all four blocks, the non-supported data is zeroed.

The *Enable DisplayID* checkbox, when checked, informs generator devices that DisplayID data is available.

The *Text EDID* and *Text DisplayID* tabs allow viewing data in tree form.

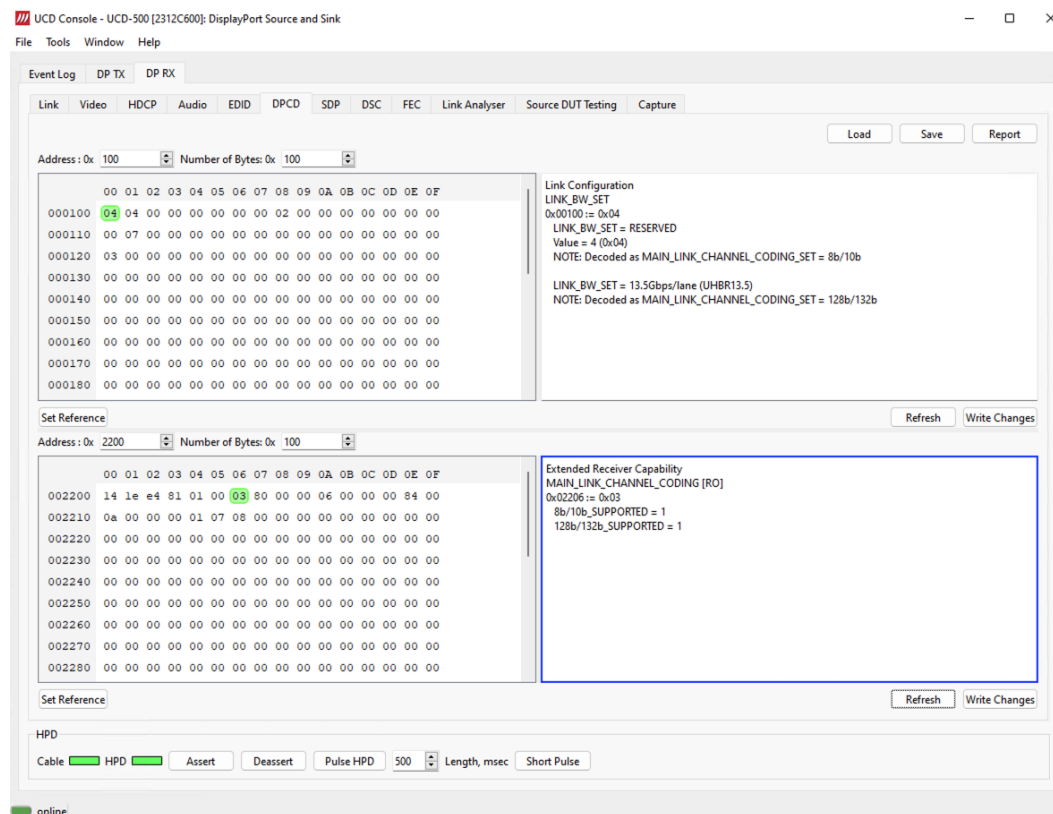
## EDID/SDisplayID Editor

Please see the description in Chapter [EDID/DisplayID Editor](#) later in this document.



## DPCD Tab

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

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

### Note:

- User control like Link Training or mode changes will modify the content of the DPCD registers
- During a reboot of the UCD device the DPCD registers will be returned to their default values

## SDP Tab

In SDP Tab shows the *Secondary-Data Packets* sent by the Source device. Click *Refresh* to update the data. Show/hide the SDP data by clicking *Packet Info* button. The divider line can be dragged to adjust the pane size.

### SDP CRC16 error counters (128b/132b)

**SDP CRC16:** Shows if connected DP Source device supports SDP CRC16. Green light indicates that the source supports SDP CRC 16.

**Streams:** Streams from 0 to 3.

**Error count (click to clear):** Shows error counter values on each lane. Click the row to clear the error counters.

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)

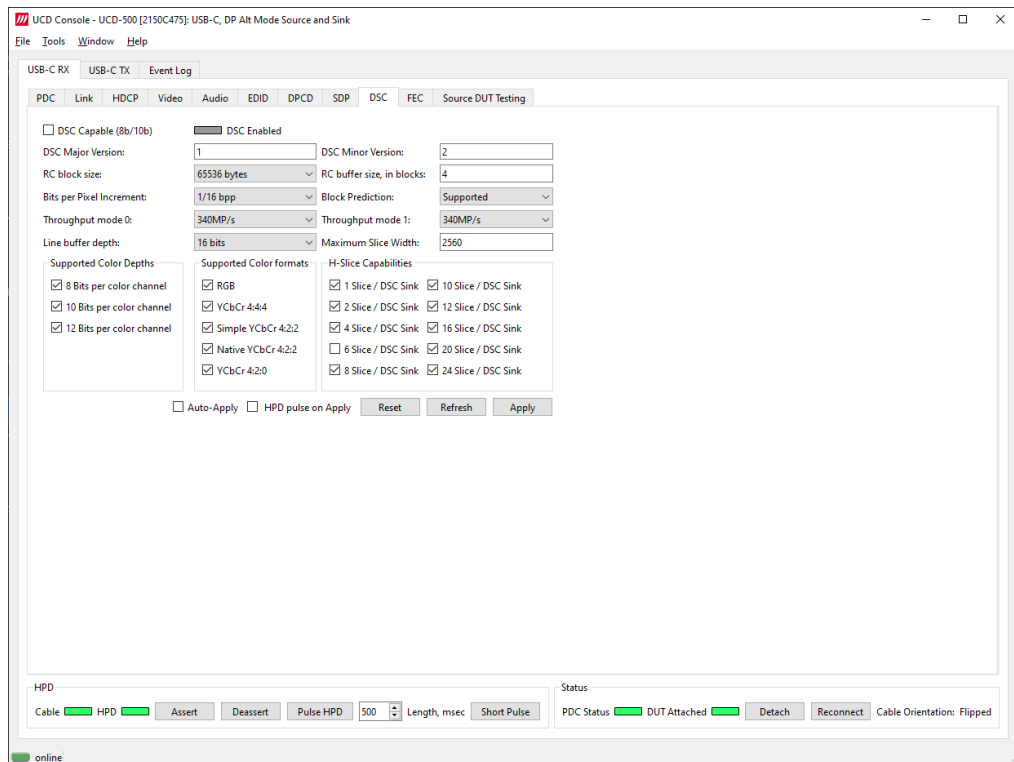
### Saving SDP Packets

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

## DSC Tab

DSC tab contains status of the Display Stream Compression (DSC) feature, and definition of DSC support capabilities that UCD-5XX defines in its DPCD register.



### Enabling DSC

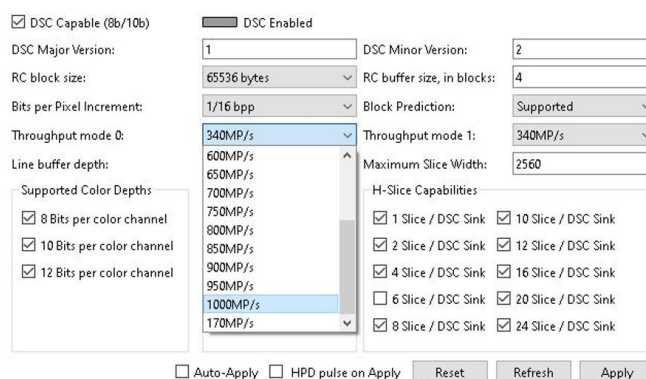
Enabling DSC feature is controlled by the connected source device. When connected, a source verifies corresponding registers in DPCD of UCD-5XX sink to find out if DSC capability is declared.

*DSC Capable* UCD-5XX sink is declared as DSC capable. Control is only in use with 8b/10b link coding.

*DSC Enabled* Connected source has enabled DSC

### Enabling 16K capability for DSC

UCD-5XX sink can support throughputs other than the default value (340 MP/s). To do so, users need to select required 'Throughput mode 0' for 4:4:4 and Simple 4:2:2 modes or 'Throughput mode 1' for Native 4:2:2 and Native 4:2:0 modes. The DP DSC Source device may then use this information to identify possible supported configurations. In order to give an opportunity to the DP DSC Source to enable DSC with 16K resolution, it is necessary to increase the declared DSC throughput at the sink. It should be set to 1000 MP/s.



### DSC Support Capabilities

The various controls in this tab change the content of UCD-5XX sink DPCD register address range (0x00061 through 0x0006F) related to DSC. Please click **Apply** to enable the change.

<i>Apply:</i>	Write changes to the DPCD registers of UCD Sink
<i>Refresh:</i>	Re-read the content of UCD Sink DPCD and update the control status.
<i>Reset:</i>	Reset the content of DSC related DPCD registers in UCD Sink (0x00060 through 0x0006F) to the default values as defined in UCD firmware.

## Panel Replay Tab

*Panel Replay* consists of two main panels: **Panel Replay** and **Panel Self Refresh**.

The *Status* panels show if *Panel Replay* and *Panel Self Refresh* are enabled, and if so, the statuses are reflected in the color widgets below them.

*Panel Replay* and *Panel Self Refresh Capabilities* can be modified in the *Capabilities* panels and applied by clicking the *Apply* buttons (when enabled),

The screenshot shows the DP RX UCD Console interface for UCD-500 [2312C600]. The 'Panel Replay' tab is active, displaying two main sections: 'Panel Replay' and 'Panel Self Refresh'.

**Panel Replay Section:**

- Status:**
  - Self refresh status: Disabled
  - Active frame CRC error: [Color widget]
  - RFB storage error: [Color widget]
  - PSR VSC SDP uncorrectable error: [Color widget]
  - AS SDP missing and not disabled: [Color widget]
- Capabilities:**
  - ☒ Panel Replay
  - ☐ Selective Update Granularity Needed
  - ☐ DSC decode in PR
  - ☒ Selective Update
  - ☒ SU Y Granularity Extended Caps
  - ☐ Asynch Video Timing
  - ☒ Early Transport
  - ☐ DSC CRC of multiple SU regions
  - ☐ Link OFF
  - PR selective update X granularity: One-line address
  - PR selective update Y granularity: One-line address
  - SU Y granularity extended capability:
    - ☐ 8 ☐ 15 ☐ 24 ☐ 40
    - ☐ 10 ☐ 16 ☐ 30 ☐ 48
    - ☐ 12 ☐ 18 ☐ 32 ☐ 54
    - ☐ 14 ☐ 20 ☐ 36 ☐ 64

**Panel Self Refresh Section:**

- Status:**
  - Self refresh status: Disabled
  - Link CRC error: [Color widget]
  - RFB storage error: [Color widget]
  - PSR2 VSC SDP uncorrectable error: [Color widget]
  - SU PSR capability change: [Color widget]
- Capabilities:**
  - PSR supports: PSR 1 is not supported
  - PSR Setup Time (us): 330
  - PR selective update X granularity: One-line address
  - PR selective update Y granularity: One-line address
  - ☐ Link Training Requirement of Sink
  - ☐ Y-coordinate for PSR2 SU
  - ☐ SU coordinates shall adhere
  - ☐ Do not update AUX FRAME SYNC

### Panel Replay

Panel Replay panel consists of *Status* and *Capabilities* panels.

The **Statuses** shown are

- Self refresh status: Disabled, Inactive, Active
- Active frame CRC error: Colored for error
- RFB storage error: Colored for error
- PSR VSC SDP uncorrectable error: Colored for error
- AS SDP missing and not disabled: Colored for condition

The **Capabilities** panel has:

Checkboxes for:

- Panel Replay
- Selective Update
- Early Transport
- Selective Update Granularity Needed
- SU Y Granularity Extended Caps
- DSC CRC of multiple SU regions
- DSC decode in PR
- Asynch Video Timing
- Link OFF

Combo boxes for:

- PR selective update X granularity
- PR selective update Y granularity.
- These can have values: One-line address, Two-line address, Four-line address, Eight-line address, 16-line address.

Grouping for A SU Y granularity extended capability: checkboxes for selections

Press *Apply* to configure and check the *HDP pulse on Apply* if desired.

## Panel Self Refresh

Panel Self Refresh consists of *Status* and *Capabilities* panels.

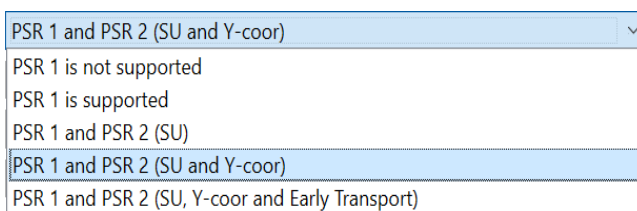
The **Statuses** shown are

- Self refresh status: Disabled, Inactive, Active
- Link CRC error: Colored for error
- RFB storage error: Colored for error
- PSR VSC SDP uncorrectable error: Colored for error
- SU PSR capability change: Colored for change

The **Capabilities** panel has:

Combo boxes for:

- PSR supports:



PSR 1 and PSR 2 (SU and Y-coor)	▼
PSR 1 is not supported	
PSR 1 is supported	
PSR 1 and PSR 2 (SU)	
PSR 1 and PSR 2 (SU and Y-coor)	
PSR 1 and PSR 2 (SU, Y-coor and Early Transport)	

- PSR Setup Time (us): 330, 275, 220, 165, 110, 55, 0
- PR selective update X granularity
- PR selective update Y granularity.

*These can have values: One-line address, Two-line address, Four-line address, Eight-line address, 16-line address.*

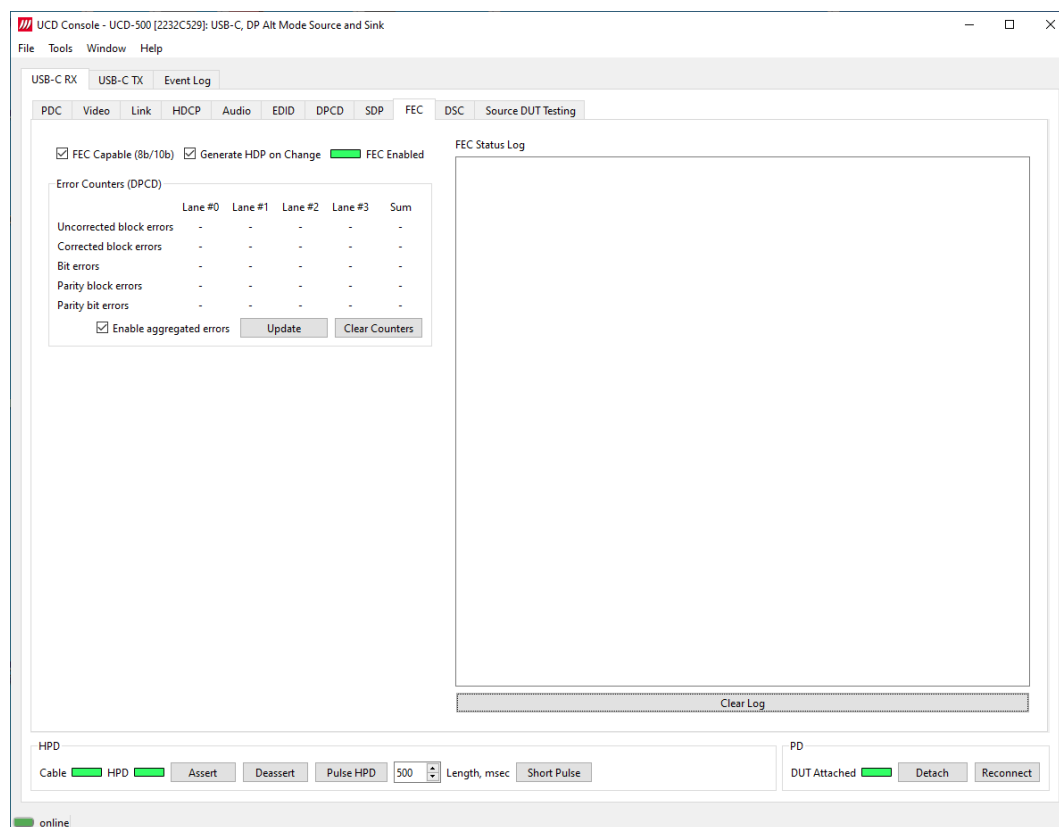
Checkboxes for:

- Link Training Requirement of Sink
- Y-coordinate for PSR22 SU
- SU coordinates shall adhere
- Do not update AUX FRAME SYNC

Press *Apply* to configure.

## FEC Tab

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



### Enabling FEC

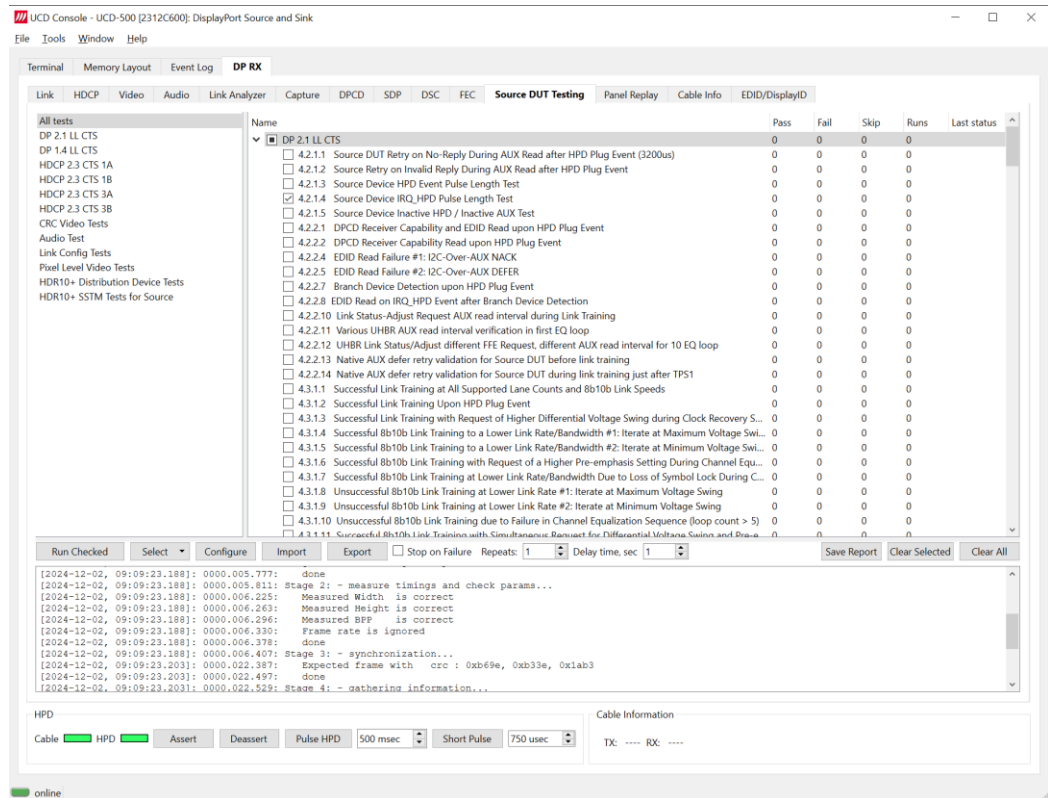
Enabling FEC feature is controlled by the source device. When connected, Source verifies corresponding registers in Sink DPCD to find out if sink is FEC capable. *FEC Status Log* lists FEC events

<i>FEC Capable:</i>	UCD-5XX Sink is declared as FEC capable. Control is only in use with 8b/10b link coding.
<i>Generate HPD on change:</i>	When selected, UCD-5XX Sink generates an HPD to establish a new connection after the change to make sure that connected Source re-reads the FEC capability status
<i>FEC Enabled:</i>	LED to indicate if the source has enabled FEC
<i>Enable aggregated errors</i>	Declare that UCD-5XX Sink is able to indicate aggregated errors in counters
<i>Update:</i>	Read FEC Error Counters from DPCD
<i>Clear Counters:</i>	Clear FEC Error Counters in DPCD.



## Source DUT Testing Tab

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



Select the tests for execution by checking checkboxes or by clicking the test name. *All tests* item on the left-hand side is really just for viewing all tests available. Select the desired test category (ex. *DP 1.4 LLCTS*) when running tests.

**Run/Run Checked:**

Select to start selected/checked tests. Once tests are running the *Run Checked* button is relabeled *Abort* to stop the test sequence if desired.

**Select:**

Includes three sets of options: *Select All*, *Clear All*, *Invert All* for changing the tests current selections; *Save* (checked items), *Load* (and check relevant items), *Remove* (named tests list) for handling named templates; *Import* (check all items contained in file) and *Export* (save all checked items to file) for loading and saving file-based templates. Do not confuse *Import and Export* with those below: These are for setting and saving tests to run.

**Configure:**

Opens a test parameters dialog for the selected test set. Make sure a test category other than *All tests* is selected. Refer to *Test Parameters* below for details.

**Import:**

Load saved test parameter files (\*.td or \*.json) for into UCD Console. Select *Configure* to see current parameters. Loading \*.td files to UCD Console is currently unreliable.

**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 tests if one fails.

**Repeats:**

Number of times to repeat the selected test sequence.

**Delay time:**

Delay in seconds between individual tests.

On completion of each test the result of the test is displayed in the table columns on the right. For each test the table lists the number *Pass*, *Fail*, *Skips*, *Runs* and *Last Status* (status of last run).

<i>Save Report:</i>	Select to generate a HTML report file. This will also open a tab in the default browser and display the results.
<i>Clear Selected:</i>	Clear the test results of the <b>selected</b> (not checked) tests results. A subsequently saved report will not include these test results.
<i>Clear All:</i>	Clear the test log view and the outstanding results.

## Test Parameters

Each test suite has a dedicated set of test parameters. Select *Configure* to launch the parameters dialog for the selected tests.

See Appendix E for parameter descriptions for each test category.

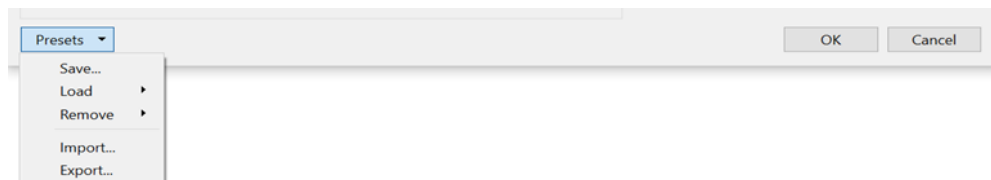
## Saving Test Parameters

Test parameters can be saved in various ways.

- Export parameters in *Source DUT Testing* tab to a \*.td file for later use in UCD Console or with TSI scripting or sharing.
- Export parameters in *Source 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. See description below.

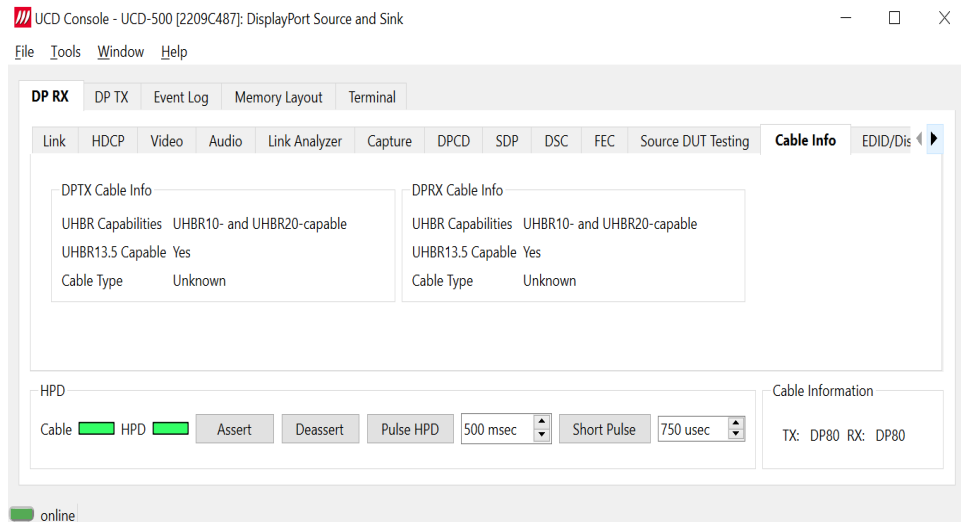
### Presets

All *Configure* dialogs selected parameters can be saved and loaded via *Presets* dropdown menu. Select *Save* or *Load* for named internal configuration parameter sets. Select *Remove* to delete a named internal set. Select *Import* and *Export* for loading and saving parameter sets from and to external files. Note that *Importing* and *Exporting* \*.json files here have a different format than importing those described above

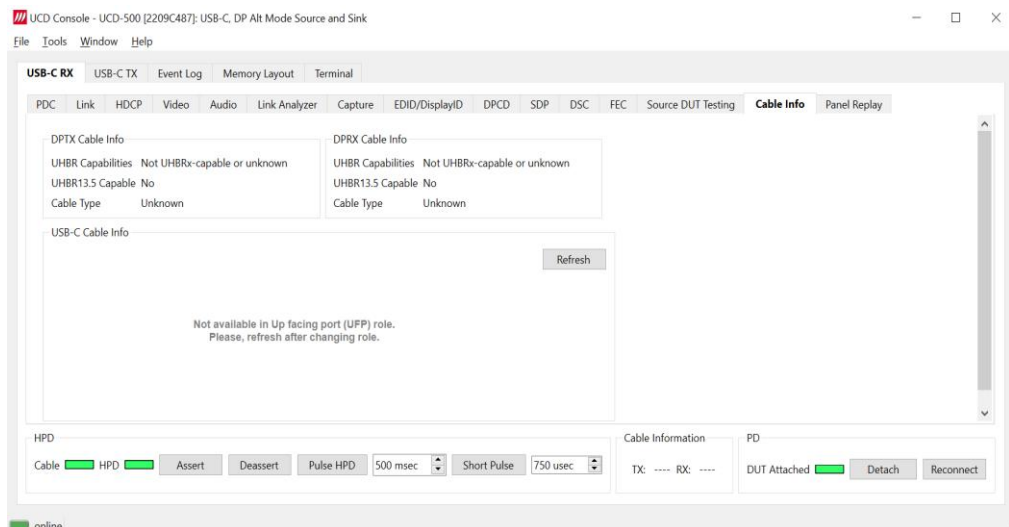


## Cable Info Tab

Cable properties for DP RX and USB-C RX are shown below



Devices with older *Front Ends* may not display DP cable properties correctly.



### DPTX / DPRX Cable Info

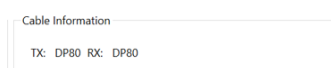
<i>UHBR Capabilities:</i>	Shows DP UHBR capabilities of connected cable.
<i>UHBR 13.5 Capable:</i>	For DP, shows if the connected cable is UHBR 13.5 capable.
<i>Cable Type</i>	For DP, shows type of the cable connected.

### USB-C Cable Info

Data received from cable in response to *Discover Identity* command sent to SOP'.

### DP Cable Information

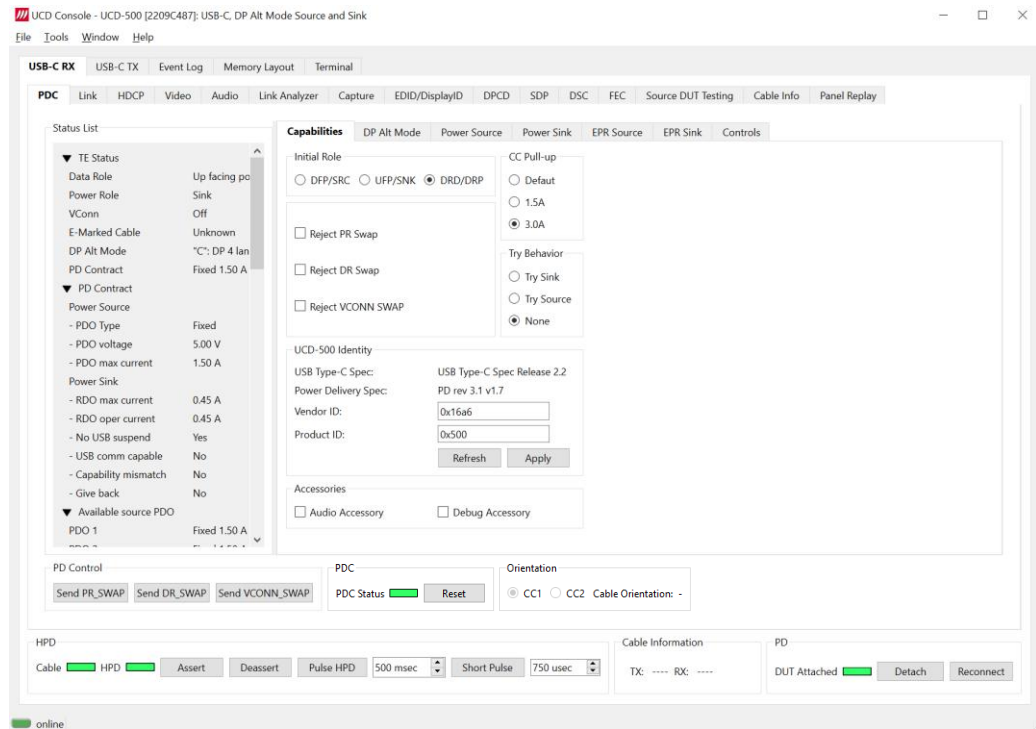
DP Cable information panel shows if the connected cables are DP56 / DP80 capable.



**Note:** USB-C cable info can only be read when in *Down Facing Port* role. Select *Refresh* after changing roles.

## PDC Tab

When UCD-5XX device is in USB-C DP Alt-Mode Sink or Source role, the following interface specific tabs are available.



*USB-C Power Delivery Controller Tab* is for *Power Delivery Contract* behavior control.

The *PDC* tab itself consists of tabs: *DP Alt Mode*, *Power Source*, *Power Sink*, *EPR Source*, *EPR Sink*, *Controls*.

*Status List*, *PD Control* and *Orientation* groups are always visible when any of the above-mentioned tabs are selected.

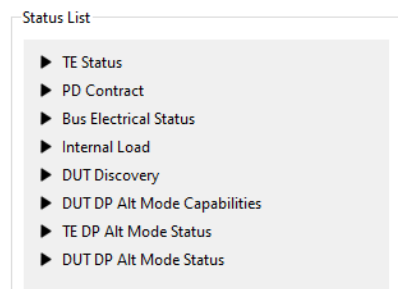
View the current PDC status for both contract partners in the *Status List*.

Select power and data roles and VCONN using the *PD Control* group buttons: *Send PR\_SWAP*, *Send DR\_SWAP*, *Send VCONN\_SWAP*.

*Cable Orientation* can be seen via the *Orientation* group radio buttons.

## Status List

*Status List* information is presented as collapsible sections. Each section contains information related to PDC contract status and available features. See [DP Alt Mode](#) for pin assignments.



### TE Status

<i>Data Role</i>	Up facing port (UFP) or Down facing port (DFP).
<i>Power Role</i>	Sink or Source.
<i>VConn</i>	Off or On.
<i>E-Marked Cable</i>	Cable details.
<i>DP Alt Mode</i>	Alt Mode configuration pin assignment details.
<i>PD Contract</i>	PDO type, current and voltage.

### PD Contract (Power Source)

<i>-PDO Type</i>	Type of PDO.
<i>-PDO voltage</i>	Voltage supplied by source.
<i>-PDO max current</i>	Maximum current supplied by source.

### PD Contract (Power Sink)

<i>-RDO max current</i>	RDO maximum current (A).
<i>-RDO oper current</i>	RDO operating current (A).
<i>-No USB suspend</i>	No USB suspend, Yes or No.
<i>-USB comm capable</i>	USB comm capable, Yes or No.
<i>-Capability mismatch</i>	Capability mismatch, Yes or No.
<i>-Give back</i>	Give back flag, Yes or No.

### Bus Electrical Status

Voltage and current statuses in volts and amps

- Vbus voltage
- Vbus current
- CC1 voltage
- CC2 voltage
- VCONN voltage
- VCONN current
- SBU-1 voltage
- SBU-2 voltage.

### Internal load

- Internal load (Ohm) status: Enabled or Disabled.
- Overcurrent protection status: Triggered or Not triggered.

### DUT Discovery

<i>Data Capable as host</i>	<i>(yes/no)</i>
<i>Data Capable as Device</i>	<i>(yes/no)</i>
<i>Product Type</i>	<i>Product type</i>
<i>USB Vendor ID</i>	<i>Value (hex)</i>
<i>USB-IF Product ID</i>	<i>Value (hex)</i>
<i>BCD Device</i>	<i>Value (hex)</i>
<i>SVID0 and SVID1</i>	<i>Values (hex)</i>

### DUT DP Alt Mode Capabilities

<i>DP Capable</i>	
<i>Receptacle Indication</i>	
<i>USB 2.0 Signaling</i>	
<i>Pin Assignment supported</i>	
	<i>DFP_D Down Facing Port pin assignment</i>
	<i>UFP_D Up Facing Port pin assignment</i>
<i>DPAM Version</i>	<i>Version</i>

### TE DP Alt Mode Status

<i>Status</i>	<i>Active or Not Active</i>
<i>Multi-function preferred</i>	<i>Yes, no or not relevant</i>
<i>HDP state</i>	<i>asserted or not asserted</i>
<i>DP Capable</i>	<i>Bandwidth e.g. HBR3</i>
<i>Pin Assignment</i>	<i>Pin assignment with description</i>
<i>Cable UHBR 13.5 Support</i>	<i>Description</i>
<i>Cable Active Component</i>	<i>Description</i>
<i>DPAM Version</i>	<i>Version</i>

### DUT DP Alt Mode Status

<i>Status</i>	<i>Port and connection status</i>
<i>Multi-function preferred</i>	<i>Yes, no or not relevant</i>
<i>HDP state</i>	<i>asserted or not asserted</i>
<i>Power low</i>	<i>Power low indicator</i>
<i>DPAM Version</i>	<i>Version</i>

## Capabilities

Capabilities

DP Alt Mode

Power Source

Power Sink

Controls

Initial Role

☐ DFP/SRC
 ☐ UFP/SNK
 ☒ DRD/DRP

☐ Reject PR Swap

☐ Reject DR Swap

☐ Reject VCONN SWAP

CC Pull-up

☐ Default
 ☐ 1.5A
 ☒ 3.0A

Try Behavior

☐ Try Sink
 ☐ Try Source
 ☒ None

UCD-500 Identity

USB Type-C Spec:

USB Type-C Spec Release 2.2

Power Delivery Spec:

PD rev 3.1 v1.7

Vendor ID:

0x16a6

Product ID:

0x500

Refresh

Apply

Accessories

☐ Audio Accessory
 ☐ Debug Accessory

<i>Initial Role</i>	Power contract negotiation initial role for TE (UCD-5XX) (power and data).
<i>Reject Swaps</i>	Allow or reject role swap requests.
<i>CC Pull-up</i>	Rp resistance used to advertise current capability.
<i>Try Behavior</i>	Power contract negotiation initial power role.
<i>UCD-500 Identity</i>	Status information provided by TE. <i>Vendor ID</i> and <i>Product ID</i> can be modified by entering new values and selecting <i>Apply</i> . Select <i>Refresh</i> to see that changes have been applied.

## Accessories

<i>Audio Accessory:</i>	Enable simulation of Audio Accessory support.
<i>Debug Accessory</i>	Enable simulation of Debug Accessory support.

Enabling *Audio Accessory* and *Debug Accessory* extends USB Type-C Connection State Machine with \*.Accessory states. (Please refer to USB Type-C specification for details).

**Note:** Note that UCD-500 does not support physical connections for the Accessory functions. The selections are behavioral simulations.

# DP Alt Mode

Controls and capability settings for DisplayPort Alternate Mode.

Capabilities

DP Alt Mode

Power Source

Power Sink

Cable Info

Controls

Enter 2 lane mode (D)

Enter 4 lane mode (C,E)

Exit DP Alt Mode

Disable DP Alt Mode

☒ Auto enter on connect

☐ Multi-function preferred

☒ Align DP and USB Data Roles

DPAM 2.1 Control

Enable

Disable

Status: Enabled

DP Alt Mode Capabilities

UFP\_D

☒ C: 4 DP lanes

☒ D: 2 DP lanes + USB SS

☒ E: 4 DP lanes

Enter 2 lane mode (D):	Restart mode discovery and advertise support for mode D (2 DP lanes + USB SS).
Enter 2 lane mode (C,E):	Restart mode discovery and advertise support for modes C and D (4 DP lanes).
Exit DP Alt Mode:	Exit DP Alternate mode.
Disable DP Alt Mode:	Exit DP Alternate mode and advertise no DP Alternate mode support.
Auto enter on connect:	Start mode discovery after connection and enter DP Alternate mode if suitable configuration is found.
Multi-function preferred:	When entering DP Alternate Mode, select mode D.
Align DP and USB Data Roles	When selected, before entering to DP Alternate Mode, DP role and USB Data role will be aligned to match the role selected for the UCD device, i.e. DFP in Generator role and UFP in Analyzer role.
DPAM 2.1 Control	Enable or Disable.

## DP Alt Mode Capabilities

Supported Pin Assignments declared in DisplayPort Capabilities discover message. Separate for UFP\_D (DisplayPort sink) and DFP\_D (DisplayPort source)



Power Source

Definition of Power Data Objects (PDO) for UCD-5XX when acting as *Power Source Port*.

CapabilitiesDP Alt Mode**Power Source**Power SinkControls

SPR PDOs

Source PDOs	PDO Type	Max Current, mA	Voltage, mV	Peak Current, %	Max Power, mW	Max Voltage, mV	Min Voltage, mV
PDO1	Mandatory	1500	5000	Default			
PDO2	Fixed	1500	9000	Default	0	0	0

Refresh

Apply

Send PDO

Load PDO

Save PDO

*PDO Type*: Definition of power source type (Disabled, Fixed, Variable or Battery)

**Note:** The requirement is that Sources shall supply at least one fixed supply capable of supplying vSafe5V

**Note:** Note that UCD-5XX devices are not able to simulate electrical behavior of *Variable* or *Battery* source types.

<i>Refresh</i>	Re-read status from UCD-5XX
<i>Apply</i>	Program new values to UCD-5XX
<i>Send PDO</i>	Send a Source Capabilities message
<i>Load PDO</i>	Load a stored Power Source PDO configuration from file.
<i>Save PDO</i>	Store current Power Source PDO configuration to a file

## Power Sink

Controls and Definition of Power Data Objects (PDO) for UCD-5XX when acting as *Power Sink Port*.

<i>Give back flag:</i>	UCD-5XX sets <i>GiveBack</i> flag in its <i>Request Data Object</i>
<i>No USB suspend:</i>	UCD-5XX sets No USB Suspend flag in its Request Data Object
<i>PDO type priority:</i>	Setting of the policy used for automatic selection from available PDOs advertised by Source Device. (Prefer higher current / Prefer higher voltage / Prefer higher power)
<i>Max Operation Current</i>	Setting the highest current UCD-5XX will ever require when operating as a Power Sink.

*PDO Type:* Definition of power source type (Disabled, Fixed, Variable or Battery)

**Note:** The requirement is that Sinkss shall supply at least one fixed supply capable of supplying vSafe5V

<i>Refresh</i>	Re-read status from UCD-5XX
<i>Apply</i>	Program new values to UCD-5XX
<i>Load PDO</i>	Load a stored Power Source PDO configuration from file.
<i>Save PDO</i>	Store current Power Source PDO configuration to a file

## Controls

Control tab includes miscellaneous controls related to UCD behavior as a USB-C PD Port Partner.

### [PD Contract Settings](#)

*Automatically negotiate power contract:* When selected UCD will start power contract negotiation if suitable configuration is found.

### [USB Internal Load](#)

Current Load feature that only applicable when UCD-5XX is operating as Power Sink role. Only fixed current value in around 900mA is able to be sinked by UCD-5XX.

## Bottom Panel

### HPD

HPD

Cable  HPD  Assert Deassert Pulse HPD 500 msec Short Pulse 750 usec

<i>Cable</i>	Cable status
<i>HPD:</i>	HPD status
<i>Assert / Deassert:</i>	Manually Assert or Deassert.
<i>Pulse HPD:</i>	Manually pulse HPD. Set the length in milliseconds.
<i>Short pulse:</i>	Manually perform a short pulse. Set the length in milliseconds.

**Note:** Please note that UCD-5XX is not automatically Attached to the connected port partner even if the cable is connected physically. The user needs to click the Attach button manually to make the connection.

### PD Control

PD Control

Send PR\_SWAP Send DR\_SWAP Send VCONN\_SWAP

<i>Send PR_SWAP:</i>	Send <i>PR_Swap</i> message to request an exchange of power roles.
<i>Send DR_SWAP:</i>	Send <i>DR_Swap</i> message to request an exchange DFP and UFP operation between Port Partners while maintaining the direction of power flow over Vbus.
<i>Send VCONN_SWAP:</i>	Send <i>VCONN_Swap</i> message to request an exchange of Vconn Source.

### PD

PD

DUT Attached  Detach Reconnect

<i>DUT Attached:</i>	Indication that <i>Attach</i> event is detected by the Source port in one of its CC lines. Type of USB-C cable detected.
<i>Detach:</i>	Manually <i>Detach</i> USB-C port partners.
<i>Reconnect:</i>	Restart USB-C Source-to-Sink attach procedure.

### PDC and Orientation

PDC

PDC Status  Reset

Orientation

☒ CC1 ☐ CC2 Cable Orientation: -

<i>PDC Status:</i>	UCD-500 PD Controller Status
<i>Reset:</i>	Reset the PD Controller in UCD-500 to overcome abnormal situations.
<i>Reconnect:</i>	Restart USB-C Source-to-Sink attach procedure.
<i>Orientation:</i>	CC1 / CC2 and Cable orientation

## 5. GENERATOR OPERATION

When used as a *Generator*, the UCD device acts as DisplayPort or USB-C DisplayPort Alt Mode Source or Transmitter device. Generator functionality related controls and dialogs can be used by selecting *DP TX* tab.

Please note that in most UCD-5XX Series units *Analyzer* functionality is available simultaneously with Generator functionality. Please find description of Analyzer functionality earlier in this manual.

## 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.

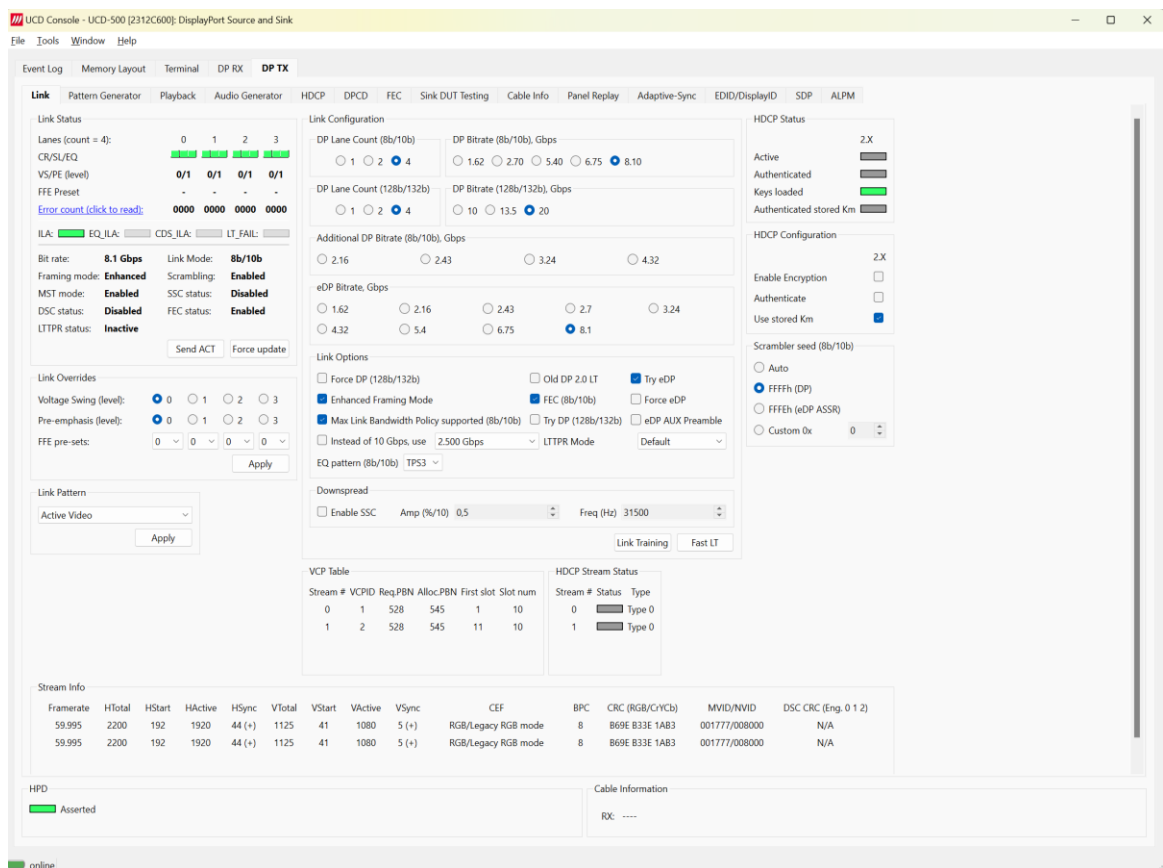
Some of the tabs are enabled by default, some only when an applicable license is included.

### 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









## Link Tab

The 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 UCD Source. It also lists the status of other link modes. The data is retrieved from the DPCD status registers of the connected Sink. The status is updated automatically, but in case it seems that the update is delayed, please click on the *Force update* button.

Link Status	
Lanes (count = 4):	0    1    2    3
CR/SL/EQ	   
VS/PE (level)	-/-   -/-   -/-   -/-
FFE Preset	0    0    0    0
<a href="#">Error count (click to read):</a>	-    -    -    -
ILA: 	EQ_ILA:  CDS_ILA:  LT_FAIL: 
Bit rate: <b>20 Gbps</b>	Link Mode: <b>128b/132b</b>
Framing mode: -	Scrambling: <b>Enabled</b>
MST mode: <b>Enabled</b>	SSC status: <b>Disabled</b>
DSC status: <b>Disabled</b>	FEC status: <b>Enabled</b>
LTPR status: <b>Inactive</b>	
<input type="button" value="Send ACT"/> <input type="button" value="Force update"/>	

<i>Lanes:</i>	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
<i>CR/SL/EQ:</i>	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization.
<i>VS/PE (level):</i>	Voltage Swing / Pre-emphasis level.
<i>FFE preset:</i>	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding).
<i>Error count:</i>	Content of DPCD Error Count registers.
<i>ILA:</i>	Status LED for Inter-Lane Alignment.
<i>EQ_ILA</i>	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding).
<i>CDS_ILA</i>	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding).
<i>LT_FAIL</i>	Status LED for Link Training failure (only with 128b/132b channel coding).
<i>Bit rate:</i>	Currently enabled link bit rate.
<i>Link mode:</i>	Currently enabled channel coding (128b/132b or 8b/10b).
<i>Framing mode:</i>	Status of Enhanced Framing symbol sequence (only with 8b/10b).
<i>Scrambling:</i>	Status of link Data Scrambling (Enabled or Disabled).
<i>MST mode:</i>	Status of the Multistreaming (MST) mode.
<i>SSC status:</i>	Status of Spread-Spectrum Clock (SSC) function.
<i>DSC Status:</i>	Status of Display Stream Compression (DSC) function.
<i>FEC status:</i>	Status of Forward Error Correction (FEC) function.
<i>LTPR Status:</i>	Status of Link Training-tunable PHY Repeater (LTPR) function..
<i>Send ACT:</i>	Force sending Allocation Change Trigger (ACT) sequence over the Main-Link.
<i>Force update:</i>	Re-read statuses to update the panel.

## Link Configuration

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

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

<i>DP Lane Count (8b/10b):</i>	Lane count used when 8b/10b link coding is selected in LT.
<i>DP Bitrate (8b/10b), Gbps:</i>	Link rate used when 8b/10b link coding is selected in LT.
<i>DP Lane Count (128b/132b):</i>	Lane count used when 128b/132b link coding is selected in LT.
<i>DP Bitrate (128b/132b), Gbps:</i>	Link rate used when 128b/132b link coding is selected in LT.
<i>Additional DP Bitrate (8b/10b), Gbps</i>	Additional bit rates available.
<i>eDP Bitrate, Gbps</i>	Bitrates available for eDP .eDP support is limited to eDP 1.5 (i.e. 8b/10b link coding)
<i>Force DP (128b/132b):</i>	UCD-5XX Source uses only 128b/132b link layer protocol, no fall back to 8b/10b link layer.
<i>Enhanced Framing Mode:</i>	Enable Enhanced Framing Mode.
<i>Max Link Bandwidth Policy supported (8b/10b):</i>	When checked, UCD supports Link Training Flow with Maximum Link Data Bandwidth Policy (only in 8b/10b coding).
<i>FEC (8b/10b):</i>	Enable Forward Error Correction feature (only in 8b/10b coding).
<i>LTTTPR:</i>	Select to enable Link Training Tunable PHY Repeater (LTTTPR) protocol support.
<i>Old DP 2.0 LT:</i>	When checked LT will follow initial DP 2.0 specification, otherwise, LT is per DP 2.1 specification.
<i>FEC (8/10b)</i>	Enable Forward Error Correction feature (only for 8b/10b coding).
<i>Try DP (128b/132b):</i>	UCD-5XX Source checks capabilities of the connected Sink and, if it supports 128b/132b link layer protocol, it starts Link Training with 128b/132b link layer. If LT fails it falls back to 8b/10b link layer protocol.
<i>Try eDP</i>	Try to link with eDP.
<i>Force eDP</i>	Force eDP linking.
<i>eDP AUX Preamble</i>	Use eDP AUX Preamble protocol when linking.

<i>Instead of 10 Gbps, use:</i>	For supporting low link rate Sink devices, the user can make UCD-5XX source PHY to use a selectable lower link rate when performing '10 Gbps' link training in protocol level. Link rates are: 2.5 Gbps, 2.7 Gbps, 5.0 Gbps and 5.4 Gbps
<i>LTPR Mode</i>	Select LTPR mode: <i>Default, Ignore, Transparent, Non-Transparent.</i>
<i>EQ pattern (8b/10b)</i>	Pattern (8b/10b) to be used for equalization: auto, TPS2, TPS3 or TPS4.
<i>Enable SSC:</i>	Enable down spreading of link frequency (SSC).
<i>Amp (‰):</i>	SSC Spreading Amplitude (0.1% to 2.5% in 0.01% steps).
<i>Freq (Hz):</i>	SSC Modulation frequency (30 to 33 kHz).



## Link Overrides

Link Overrides

Voltage Swing (level):
☒ 0
☐ 1
☐ 2
☐ 3

Pre-emphasis (level):
☒ 0
☐ 1
☐ 2
☐ 3

FFE pre-sets:

0

0

0

0

Apply

*Voltage Swing (level):* Override Voltage Swing level selected during link training.

*Pre-emphasis (level):* Override Pre-emphasis levels selected during link training.

*FFE pre-sets:* TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding).

Click **Apply** to validate changes. VS/PPE or FFE 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

Link Pattern

Active Video

Active Video

Idle Pattern

Training Pattern 1

Training Pattern 2

Training Pattern 3

Training Pattern 4

PRBS7

HBR2 (CP2520 1)

SER (Symbol Error Rate)

Force Video

Force Idle

HBR2 (CP2520 2)

PRBS9

PRBS11

PRBS15

PRBS23

PRBS31

Link square 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 same as D10.2).

*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 same as CP2520 3).

*PRBS7* Send PRBS7 Link Quality Test Pattern.

*HBR2 (CP2520 1)* Send HBR2 Compliance pattern CP2520 1.

<i>SER (Symbol Error Rate)</i>	Send Symbol Error Rate Measurement pattern.
<i>Force Video</i>	Reference Source will continue Video pattern transmission on the previously established link configuration regardless of the link status.
<i>Force Idle</i>	Reference Source will continue Idle pattern transmission on the previously established link configuration regardless of the link status.
<i>HBR2 (CP2520 2)</i>	Send HBR2 Compliance pattern <i>CP2520 2</i> .
<i>PRBS9</i>	Send PRBS9 Link Quality Test Pattern.
<i>PRBS11</i>	Send PRBS11 Link Quality Test Pattern.
<i>PRBS15</i>	Send PRBS15 Link Quality Test Pattern.
<i>PRBS23</i>	Send PRBS23 Link Quality Test Pattern.
<i>PRBS31</i>	Send PRBS31 Link Quality Test Pattern.
<i>Link square pattern</i>	Send Square Sequence Pattern. The number of continuous 1s followed by continuous 0s is given as a parameter. 0x00 represents one set of 1s and 0s, 0xFF represents 256 1s and 0s.

Click *Apply* to validate the selection.

**Note:**

Please note that except for *Active Video* and *Idle Pattern*, Link Training will NOT be initiated on such events as cable re-plug, Long HPD pulse and IRQ\_HPDP pulse due to link loss.

After using the special bit patterns, in order to return to the default operation mode, please select *Active Video* and click *Apply*.

### Scrambler Seed

Selection of the value to which the Linear Feedback Shift Register (LFSR) is reset during scrambler reset. Used only when 8b/10b link coding is enabled.

### HDCP Status & Configuration





Copy of HDCP status and controls on HDCP tab.

**Note:**

Please note that HDCP 1.3 is not supported in 3.7 release.

## HDCP Stream Status

Shows HDCP stream status for each stream.

HDCP Stream Status		
Stream #	Status	Type
0		Type 0
1		Type 0
2		Type 0
3		Type 0

## SDP Configuration

### SDP Configuration

☐ Split SDP

Enable SDP Splitting.

### Note

Selecting this configuration option does not guarantee that SDP splitting will occur for a given configuration of the Video and Audio pattern generators. SDP splitting will take place when it makes sense and required for SDP splitting conditions are met.

## Stream Info

Stream Info													
Framerate	HTotal	HStart	HActive	HSync	VTotat	VStart	VActive	VSynC	CEF	BPC	CRC (RGB/CbYCr)	VFREQ	DSC CRC (Eng. 0 1 2)
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A

Stream Info is achieved from the Main-Stream Attributes (MSA) 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**.

<i>Framerate</i>	Vertical refresh rate
<i>HTotal</i>	Horizontal total of transmitted main video stream, measured in pixel count.
<i>HStart</i>	Horizontal active start from leading edge of HSync, measured in pixel count.
<i>HActive</i>	Horizontal active, number of active pixels in video line
<i>HSync</i>	HSync width, measured in pixel count. (+)/(-) positive / negative sync.
<i>VTotat</i>	Vertical total of transmitted main video stream, measured in line count.
<i>VStart</i>	Vertical active start from leading edge of VSync, measured in line count.
<i>VActive</i>	Vertical active, number of active lines in video frame
<i>VSync</i>	VSync width, measured in line count. (+)/(-) positive v.s. negative sync.
<i>CEF</i>	Used color mode: Color format + subsampling / colorimetry
<i>BPC</i>	Color depth in bits per color (BPC)
<i>CRC (RGB/CrYCb)</i>	16-bit Cyclic redundancy check (CRC) value per color component calculated from active pixels. Value order in YCbCr color format: Cr, Y, Cb.
<i>VFREQ:</i>	Video Frequency (128b/132b channel coding only)
<i>MVID/NVID:</i>	Mvid and Nvid video time stamp values (8b/10b channel coding only)
<i>DSC CRC</i>	16-bit Cyclic redundancy check (CRC) calculated from compressed pixel stream. Value order Engine 0, 1, 2.

## VCP Table

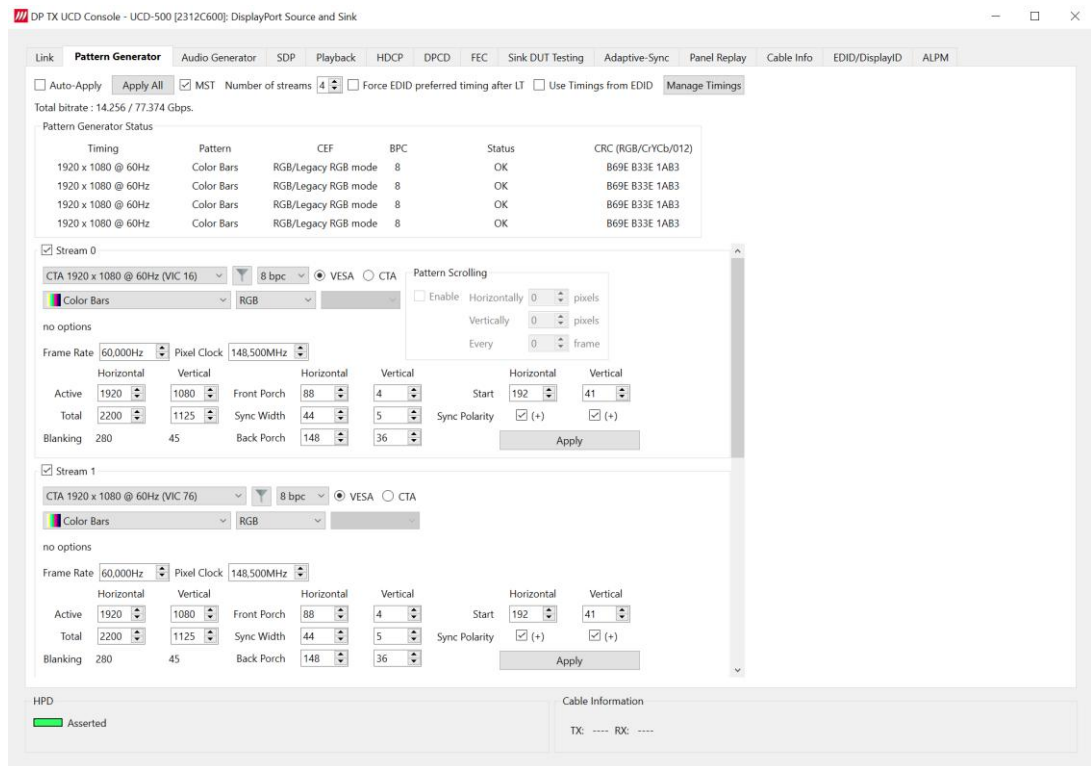
VCP Table					
Stream #	VCPID	Req.PBN	Alloc.PBN	First slot	Slot num
0	1	532	532	0	5
1	2	532	532	5	5
2	3	532	532	10	5
3	4	532	532	15	5

VCP table shows allocation of Virtual Channel Payload for active virtual channels.

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

<i>Port#:</i>	Port number where the virtual channel is directed.
<i>SID:</i>	Stream identification number of the virtual channel
<i>Req.PBN:</i>	Requested PBN (payload bandwidth number) value for the virtual channel
<i>Alloc.PBN:</i>	PBN value allocated for the virtual channel
<i>First slot:</i>	Time slot where the first VC Payload for the virtual channel is stored
<i>Slot num:</i>	Number of VC Payload slots reserved for the virtual channel.

## Pattern Generator Tab



**Note:**

The actual number of streams sent will be negotiated between the source and the sink during link training.

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

**Auto-Apply:**

New settings are being validated when the user is clicks *Apply*. Automatic validation is applied when *Auto-Apply* is checked. When *Select DSC Image* pattern is being streamed and an incompatible *Horizontal and Vertical Active* timings are set, the user is presented with a dialog: *H-Active and V-Active don't match with DSC data. Do you want to upload image?* See [Sourcing DSC Compressed Patterns](#).

**Apply All:**

Apply recent changes to all streams. When *Select DSC Image* pattern is being streamed and an incompatible *Horizontal and Vertical Active* timings are set, the user is presented with a dialog: *H-Active and V-Active don't match with DSC data. Do you want to upload image?* See [Sourcing DSC Compressed Patterns](#).

**MST**

Enable multi-stream transport mode. In 8b/10b link mode, select between SST and MST transport modes. In 128b/132b link coding mode, enable single stream output if checkbox is cleared.

**Number of streams**

Set number of streams via combo box.

**Force EDID preferred timing after LT**

UCD reads the EDID of the connected Sink and after next LT enables to Stream 0 the timing listed in 18 byte descriptor 1 in VESA block of the sink's EDID.

**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

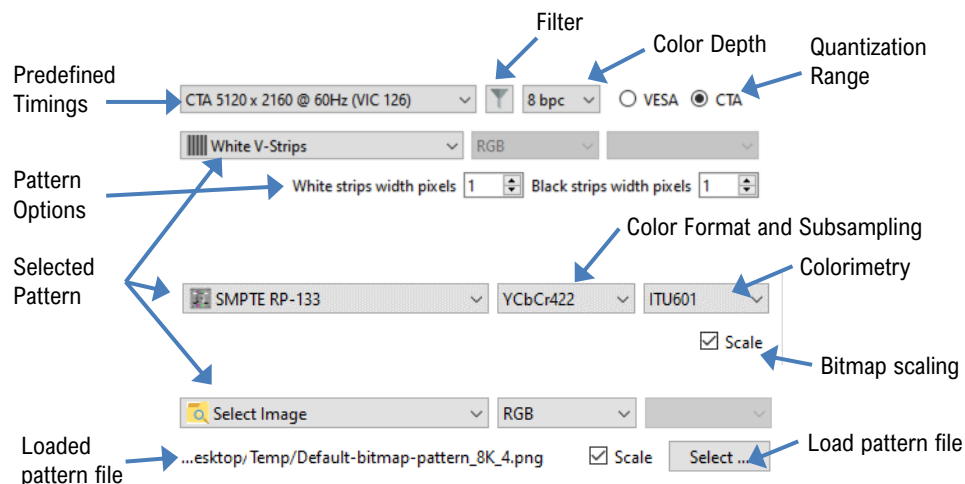
**Total bitrate:**

Used link payload / Total link capability in Gbps

*Pattern Generator Status* panel shows the *Timing*, *Pattern* (Name), *CEF* (color format and subsampling and colorimetry), *BPC* (bits per color), *Status*, and *CRC* value, for each active stream.

## Pattern

Configuration of the video sent in the corresponding stream  
(Controls vary between selected pattern type)



### 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 the *Manage Timings* function the user can add timings to the list and select which timings are shown in the selection.

### Color Format, Subsampling and Color Depth

The table below lists the available color modes and related available color depths.

Selection	Color Format	Subsampling	Available Color Depths
<i>RGB:</i>	RGB	4:4:4	6, 8, 10, 12 and 16 bpc
<i>YCbCr444:</i>	YCbCr	4:4:4	8, 10, 12 and 16 bpc
<i>YCbCr422:</i>	YCbCr	4:2:2	8, 10, 12 and 16 bpc
<i>YCbCr420:</i>	YCbCr	4:2:0	8, 10, 12 and 16 bpc
<i>Y-Only:</i>	Y	4:0:0	6, 7, 8, 10, 12, 14 and 16 bpc
<i>RAW:</i>	RAW	N/A	6, 7, 8, 10, 12, 14 and 16 bpc

### Quantization Range

*VESA:* Patterns are sent with Full Range color values (0 to 255 with 8 bpc)

*CTA:* Patterns are sent with Limited Range color values (16 to 235 with 8 bpc)

Quantization range selection is enabled based on the type of pattern selected.

### 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.

---

**Note:** When MST mode is selected, full selection of test patterns is available only in virtual channel 0

---

## Filter

Filter timings by specific vendors and resolutions. Timings can be sorted by Vendor ID or width.

## Custom Image Patterns

BMP, PNG, JPG and SVG files can be loaded from the PC to be used as custom images.

Please refer to *Link Pattern* in description of Generator role *Link tab* earlier in this manual for sending special binary patterns in the link instead of video.

## Bitmap Scaling

When bitmap patterns are used, they can be used either in their original resolution, aligned to top left corner (=un-check *Scale*), or upscaled or downscaled to match the selected video resolution (=check *Scale*).

## 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.

## Pattern Scrolling

When Pattern Scrolling is enabled, the pattern is moved horizontally and vertically between display scans. The function is available for all patterns except the following: Color Bars, Chessboard, Solid Color, Solid colors (white, red, green, blue), White V-Strips, Motion Pattern, DSC Pattern.

<b>Enable:</b>	Enable or disable pattern scrolling
<b>Horizontally X pixels:</b>	Horizontal step of the pattern movement in pixels (values in range -127...0...128, for YCbCr 4:2:2 even values). 0 = no movement, positive values = pattern moves to the right.
<b>Vertically Y pixels:</b>	Vertical step of the pattern movement in pixels (even values in range -127...0...128, for YCbCr 4:2:0 even values). 0 = no movement, positive values = pattern moves up.
<b>Every N frame:</b>	Delay of pattern movement in display frames (values in range 0... 255). 0 = no movement, 1 = move every frame, n = move every n:th frame.

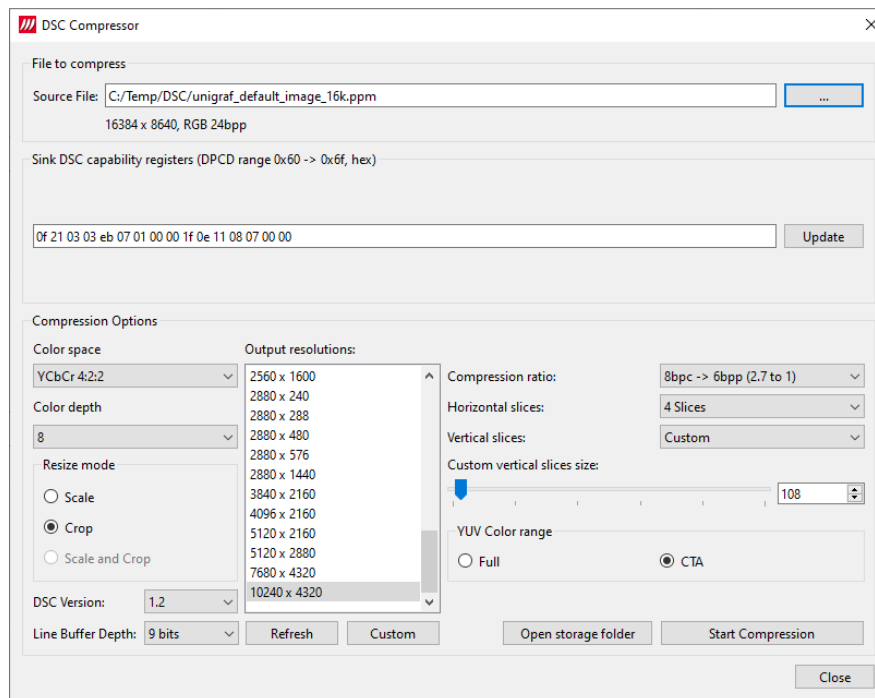
---

**Note:** Please click *Apply* to enable changes or check *Auto-Apply*.

---

## Sourcing DSC Compressed Patterns

UCD Pattern Generator function is able to source DSC content originating from pre-created DSC compressed files. DSC compressed pattern files can be created with a separate tool called *DSC Compressor*. It can be launched from Tools > DSC Compressor.



Select the source bitmap file in Source File field. Define the Output Resolution, the color depth, compression ratio and number of horizontal and vertical slices in the frame.

<i>Source File:</i>	Source bitmap file to be compressed (JPG, PNG, PPM)
<i>Sink DSC capability registers:</i>	Click <i>Update</i> to read DPCD registers 0x60 to 0x6f from the connected Sink device
<i>Color Space:</i>	Color space of the output compressed file (RGB, YCbCr 4:4:4, 4:2:2, 4:2:0, Simple 4:2:2)
<i>Color depth:</i>	Color space of the output compressed file (8, 10, 12, 16)
<i>Output resolution:</i>	Resolution of the output compressed file
<i>Resize mode:</i>	The way the DSC image is created from the Source file
<i>Compression ratio:</i>	Used compression ratio
<i>Horizontal slices:</i>	Nr. of slices horizontally (1 to 24 Slices)
<i>Vertical slices:</i>	Vertical slices (1 to 24 Slices, Custom) Custom vertical slices size: minimum 1, recommended 108
<i>YUV Color range:</i>	Selection of color range between Full range (Full) (0 to 255 at 8 bpc) and Limited Range (CTA) (16 to 235 at 8 bpc)
<i>Refresh:</i>	Refresh the list after adding a custom resolution
<i>Custom:</i>	Create a custom output resolution
<i>DSC Version:</i>	DSC version used (1.1, 1.2)
<i>Line Buffer Depth:</i>	Line buffer bit depth used to generate the bitstream. (8 to 16 bits, default 9 bits)
<i>Open storage folder:</i>	Open DSC temp folder defined in Tools > Options
<i>Start Compression:</i>	Start the compression process



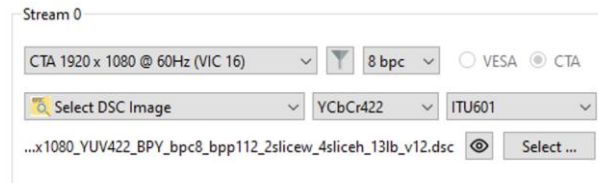
The result of the compression process is saved in the same folder as the source file. The start of the file name is the same as the source bitmap file; resolution and color format are added to the end of the file name.

Example:

```
unigraf_default_image_16k.ppm >>
```

```
unigraf_default_image_16k_1920x1080_YUV422_FULL_bpc8_bpp6.dsc
```

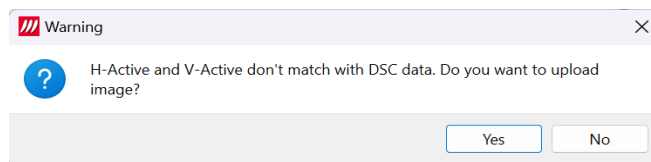
To use the created DSC file in Pattern Generator, select pattern:



Select *DSC Image* and click *Select ...* to open file selection dialog.

When a DSC image is selected as the pattern, UCD Console will automatically enable the resolution and the color mode matching the DSC image. If the connected Sink device declares support for DSC in its DPCD, UCD Console enables DSC.

When *Select DSC Image* pattern is being transmitted and incompatible *Horizontal and Vertical Active* timings are set (Via *Apply* or *Apply All*), the user is presented with a dialog: *H-Active and V-Active don't match with DSC data. Do you want to upload image?*



Above, “*Do you want to upload image?*” is misleading and will be changed to “*Continue to transmit image?*”.

If you select *No*, the new settings will not be applied.

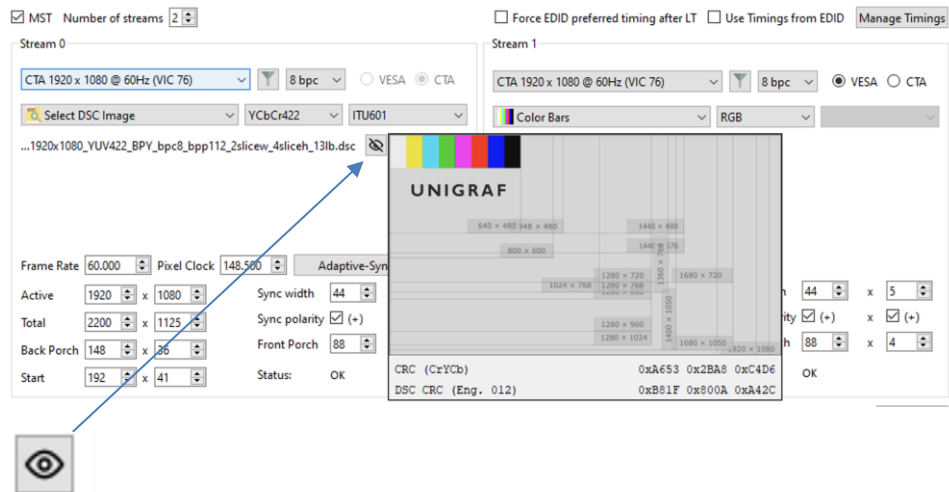
If you select *Yes*, the Pattern will continue to be transmitted. DSC data is transferred in the active window. To transfer all DSC data without loss, active video should be large enough for DSC compressed data ( $\text{DSC\_pic\_height} * \text{DSC\_pic\_length} / \text{compression\_ratio}$ ). MSA H-active should also not be less than DSC pic\_height.

MSA V-active parameters can be reduced without DSC corruption until active video area is no longer large enough to pass all DSC data.

MSA V-active and H-active can be increased until HW limitation (pixel clock limit) and link bandwidth are reached.

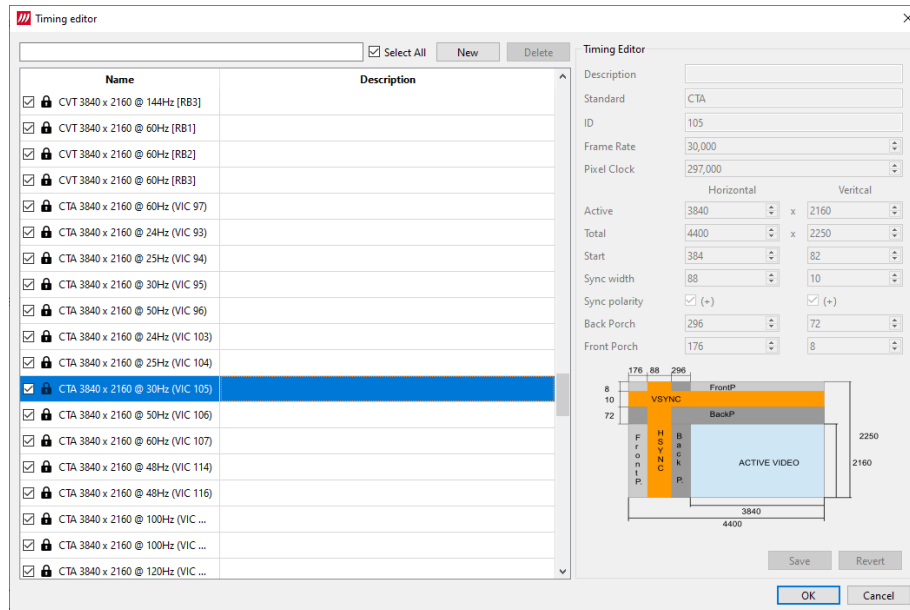
### [Preview DSC image](#)

To preview an DSC image before it is applied to the pattern generator, select the eye icon. CRC and DSC CRC values are indicated in the preview image.



## 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 checkbox 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.

**Delete:** Delete the selected custom timing

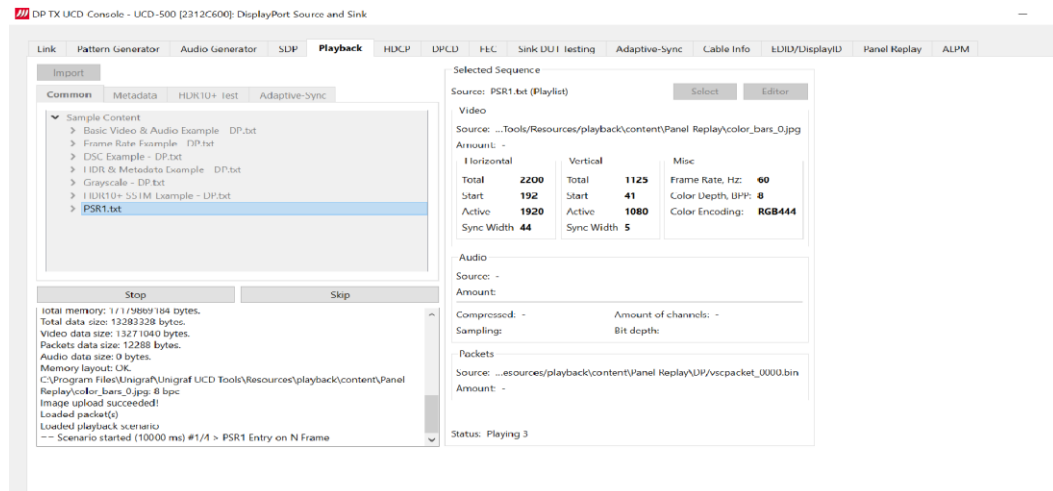
**Save:** Save changes in the selected custom timing.

**Revert:** Undo all changes

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

## Playback Tab

*Playback* Tab is for running *Playlist* and *scenario* files. *Playlists* have *scenarios* which specify timing, video patterns, audio content, related metadata packets and duration for transmission.



Term	Functionality
Playlist	<i>Playlists</i> (text files) specify the UCD devices and output protocol for transmission. It lists <i>scenarios</i> 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:

Note that Playlists and Scenarios are protocol dependent. Provided examples for HDMI and DisplayPort are somewhat different.

## Common Tab

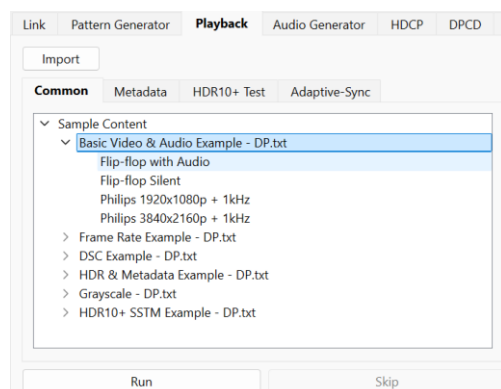
The *Import* button is for importing \*.json files into the *common* tab treeview. Sample content on windows can be found at C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\basic\_library.json. Be **warned** that once imported, items cannot at present be removed. Actually you can but it 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

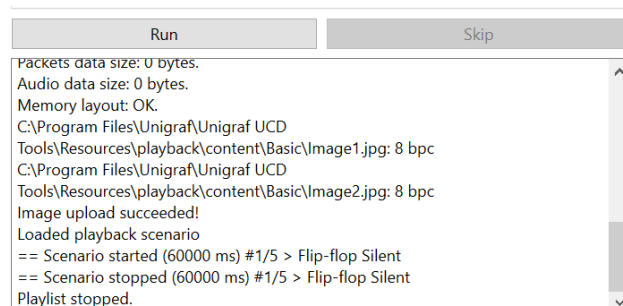
Sample playlists are included in UCD Console. Select a sequence (a playlist or scenario) from the *Sample Content treeview* and press *Run* (or double click it) to play.

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.

Selected Sequence

Source: Philips FHD.txt (Scenario)

SelectEditor

Video

Source: ...Unigraf UCD Tools/Resources/playback/content\Basic\Philips.svg

Amount: -

Horizontal

Total

2200

Start

192

Active

1920

Sync Width

44

Vertical

Total

1125

Start

41

Active

1080

Sync Width

5

Misc

Frame Rate, Hz:

60

Color Depth, BPP:

8

Color Encoding:

RGB444

VRR Frame Rate, Hz:

-

MVRR:

-

Audio

Source: ...f/Unigraf UCD Tools/Resources/playback/content\Basic\1kHz.wav

Amount: 1

Compressed:

No

Amount of channels:

2

Sampling:

44100

Bit depth:

16

Packets

Source: -

Amount: -

Status: Playing 1

## 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 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.

**Scenario Editor**

**Video**

Path: ...goldenGate0.jpg Select

4 files found

☒ Align raw 10/12bit data to 16bit

☐ Show frame numbers during playback

CTA 3840 x 2160 @ 30Hz (VIC 95) RGB 10 bpc

DSC: HCAActive:  HCBlank:

VTotal:  VStart:

VActive:  VSync:

Frame rate:

**Packets**

Path: ...frames\_0000.bin Select

4 files found

**Audio**

Path: ... Select

...

☐ Compress ☐ Little Endian 44100 Hz 2 channels 16 bits

**Playing order**

3:180:0,2:512;

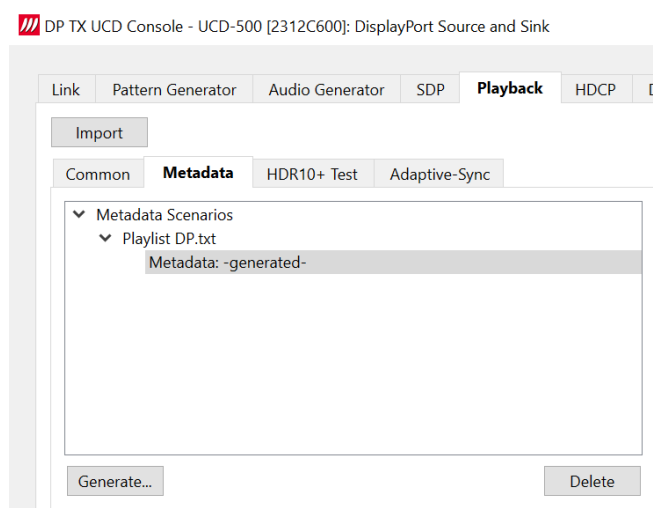
**General**

☐ Enable scrambler Loading color (R,G,B): 52,127,150 HDCP: None

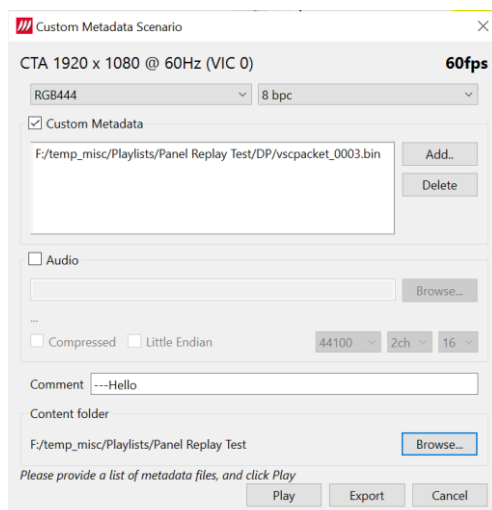
OK Cancel

## 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

Common	Metadata	HDR10+ Test	Adaptive-Sync
Generate...		Delete	

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

Custom Scenario Generator

CTA 1920 x 1080 @ 60Hz (VIC 0) **60fps**

EDID [Not available]

RGB444 8 bpc

Adaptive-Sync

Transition

Min frame rate, fps: 48

Max frame rate, fps: 20

Transition type: Fixed frame rate

Scenario duration

Step duration, sec: 1.00

Step duration, cycles: 2

Frame repetition: 1

☒ Duration in seconds

Adaptive-Sync block not found.

Video

☒ Spinner Fast Frames: 10 ☐ Custom Select...

<Spinners>

Available memory: 16911433728 bytes; 1274 frames

Content folder

C:/Users/Tester/AppData/Local/Unigraf/UCD Console/Playback

Browse...

Sequence of 159 frames

Play Export Cancel

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

Content folder

A folder for generated content must be selected. Press the Browse button to select.

OK

Click *Browse...* to select the folder.

<Spinners>

Available memory: 1879048192 bytes; 141 frames

Content folder

C:/Users/Tester/AppData/Local/Unigraf/UCD Console/Playback

Browse...

Sequence of 17 frames

Play Export Cancel

## 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.

The screenshot shows the 'Adaptive-Sync' settings window. Under the 'Transition' section, 'Min frame rate, fps' is set to 48, 'Max frame rate, fps' is set to 60, and 'Transition type' is set to 'Fixed frame rate'. Under the 'Scenario duration' section, 'Step duration, sec' is 1.00, 'Step duration, cycles' is 2, 'Frame repetition' is 1, and the 'Duration in seconds' checkbox is checked.

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.

The screenshot shows the 'Adaptive-Sync' settings window. Under the 'Transition' section, 'Min frame rate, fps' is 48, 'Max frame rate, fps' is 60, and 'Transition type' is 'Min and max'. Under the 'Scenario duration' section, 'Step duration, sec' is 1.00, 'Step duration, cycles' is 2, 'Frame repetition' is 1, and the 'Duration in seconds' checkbox is checked.

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.

The screenshot shows the 'Adaptive-Sync' settings window. Under the 'Transition' section, 'Min frame rate, fps' is 48, 'Max frame rate, fps' is 60, and 'Transition type' is 'Gradual'. Under the 'Scenario duration' section, 'Step duration, sec' is 1.00, 'Step duration, cycles' is 2, 'Frame repetition' is 1, and the 'Duration in seconds' checkbox is checked.

## Video

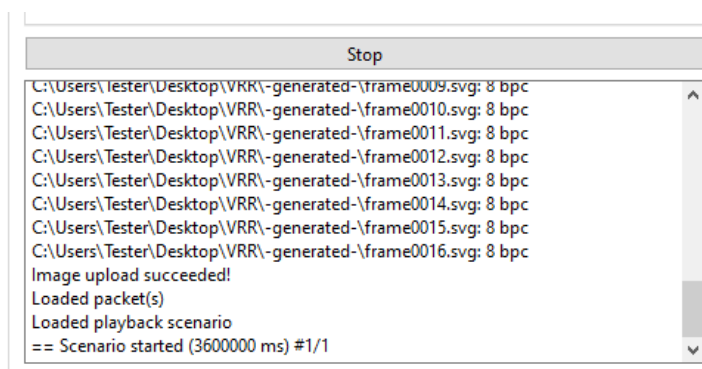
The screenshot shows the 'Video' settings window. At the top, 'Spinner' is selected with a speed of 'Fast' and 'Frames' set to 10. Below this is a preview of the spinner pattern. At the bottom, it shows 'Available memory: 1879048192 bytes; 141 frames', 'Content folder: C:/Users/Tester/Desktop', and 'Sequence of 17 frames'. Buttons for 'Play', 'Export', and 'Cancel' are at the bottom right.

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.

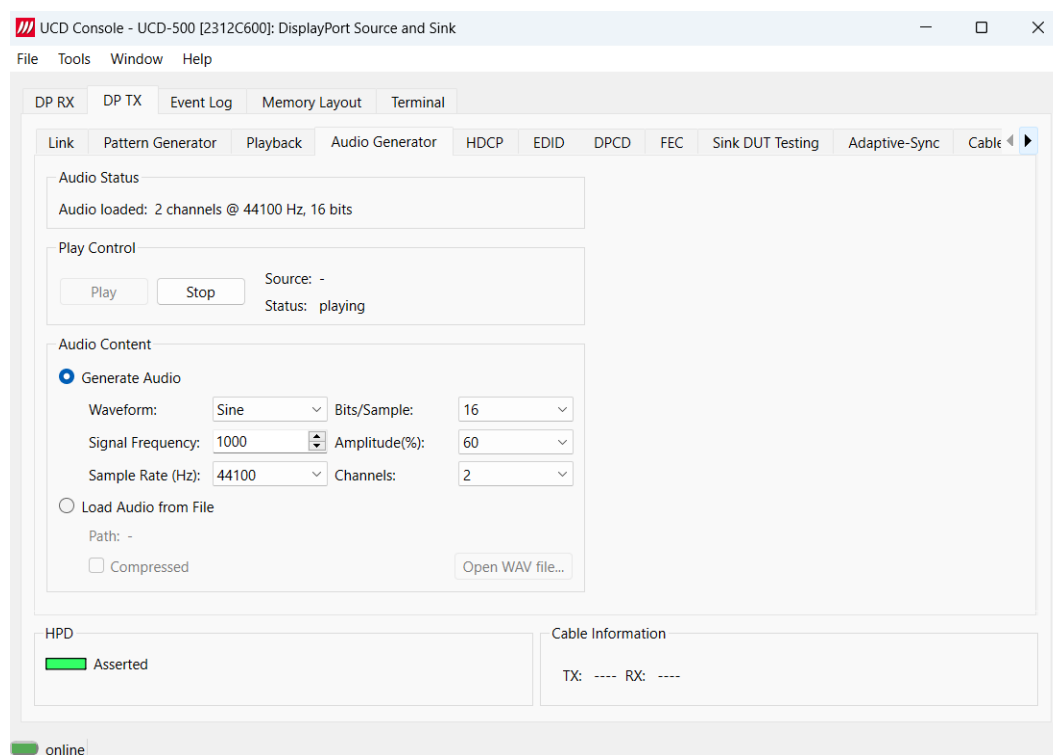
You can play the scenario by clicking *Play*. When the scenario starts playing, the scenario generator window will close. You can now inspect the progress in the log in the playback tab as shown below.



## 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 the *Play* button.

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

*Audio Status* displays current audio content status.

### Audio Content

Audio transmission can be internally generated or loaded from a \*.wav file.

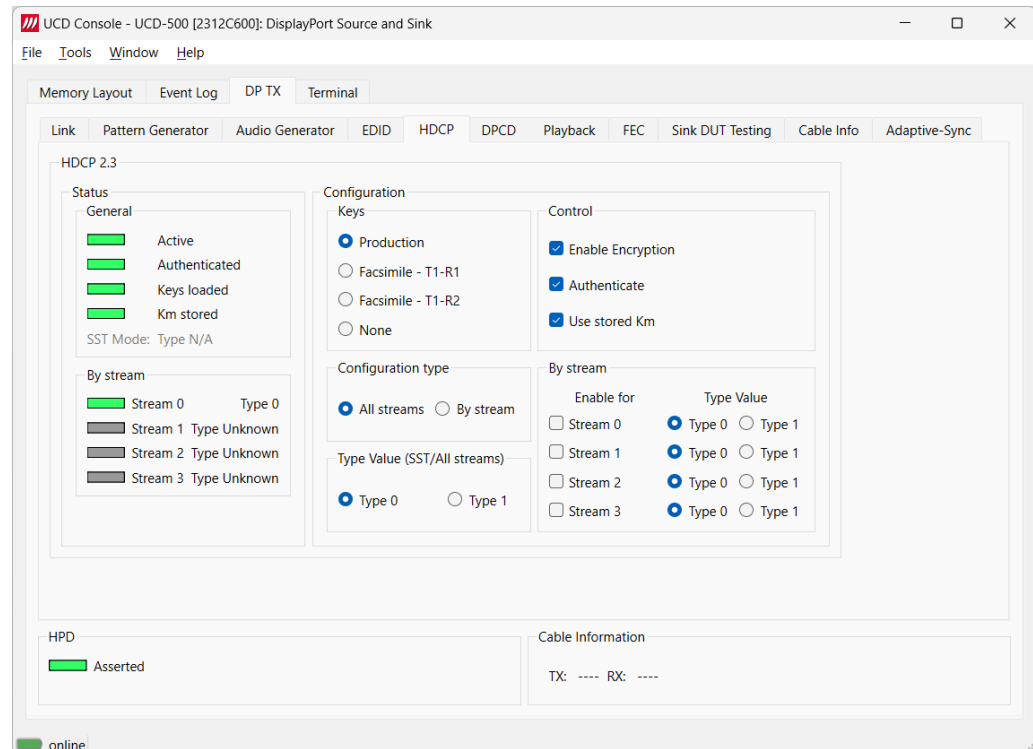
For \*.wav files, file parameters will be used. When generating audio internally, set the details of the LPCM Audio signal:

<i>Waveform</i>	Selection of audio waveform: Sine, Sawtooth, Square, or Incremental.
<i>Signal Frequency</i>	Audio signal frequency in Hz.
<i>Sample Rate (Hz)</i>	Audio sampling rate: 32000, 44100 (default), 48000, 88200, 96000, 176400, 192000.
<i>Bits/Sample</i>	Sample bit depth: 16, 20, 24.
<i>Amplitude(%)</i>	Audio amplitude: 10%, 20%, ..., 90%, 100%.
<i>Channels</i>	Audio channels: 1, 2, ..., 7, 8. LPCM (uncompressed) audio is used.

## HDCC Tab

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

**Note:** Please note that HDCC 1.3 is not supported in 3.7 release.



### Status General

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

<i>Active:</i>	The stream between UCD and the downstream sink has been encrypted.
<i>Authenticated:</i>	HDCC handshake between the UCD and the sink unit has been completed successfully.
<i>Keys loaded:</i>	HDCC keys are loaded to the UCD unit.
<i>Km is stored:</i>	Master Key (Km) is stored.
<i>SST Mode Type</i>	Type when in SST mode and in Link mode 8b/10b.

### Status By stream

Stream status shows HDCC status on each stream.

### Configuration Control

<i>Enable encryption:</i>	Check to enable the encryption of the stream between UCD and the downstream sink.
<i>Authenticate:</i>	Perform the HDCC initiation handshake between the UCD and the sink unit.
<i>Use stored Km:</i>	Use stored Master key (Km)

### Configuration type

Select to configure HDCC for All streams at once or By stream.

**By stream**

Select and configure streams.

**Type Value (All streams)**

Select Type 0 or Type 1. Type 1 ensures that content encryption is done with HDCP version 2.2 or higher.

**Configuration Keys**

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

## EDID/DisplayID Tab

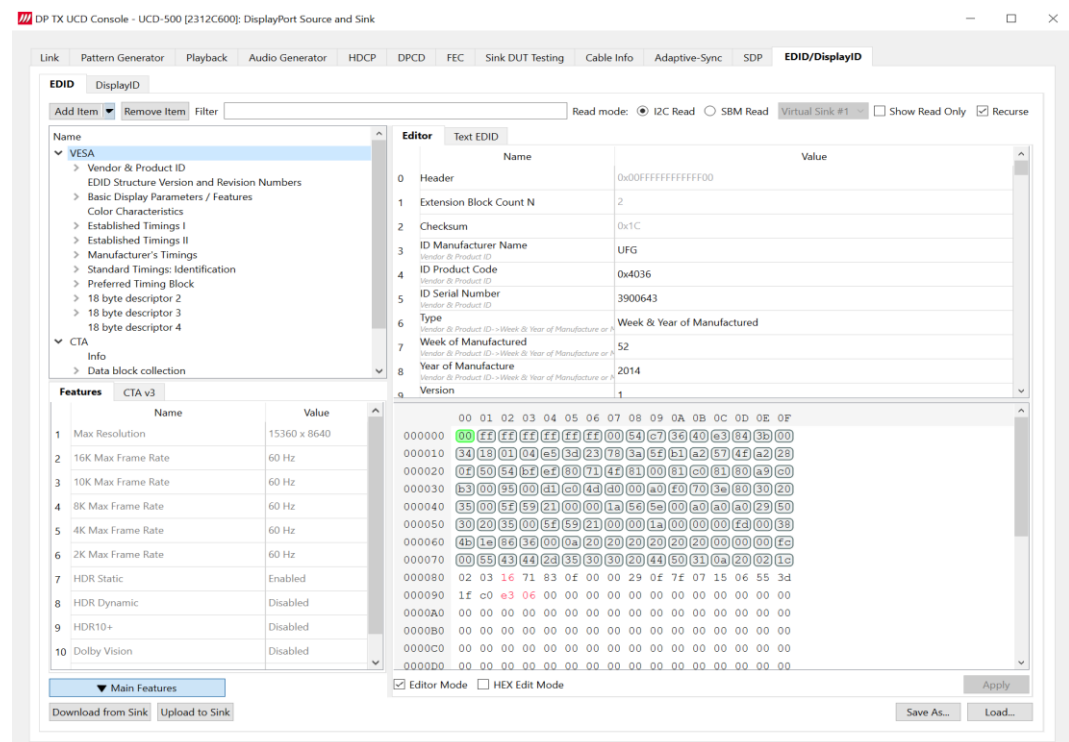
The EDID/DisplayID Tab provides tools for accessing the EDID/DisplayID data of the connected sink device.

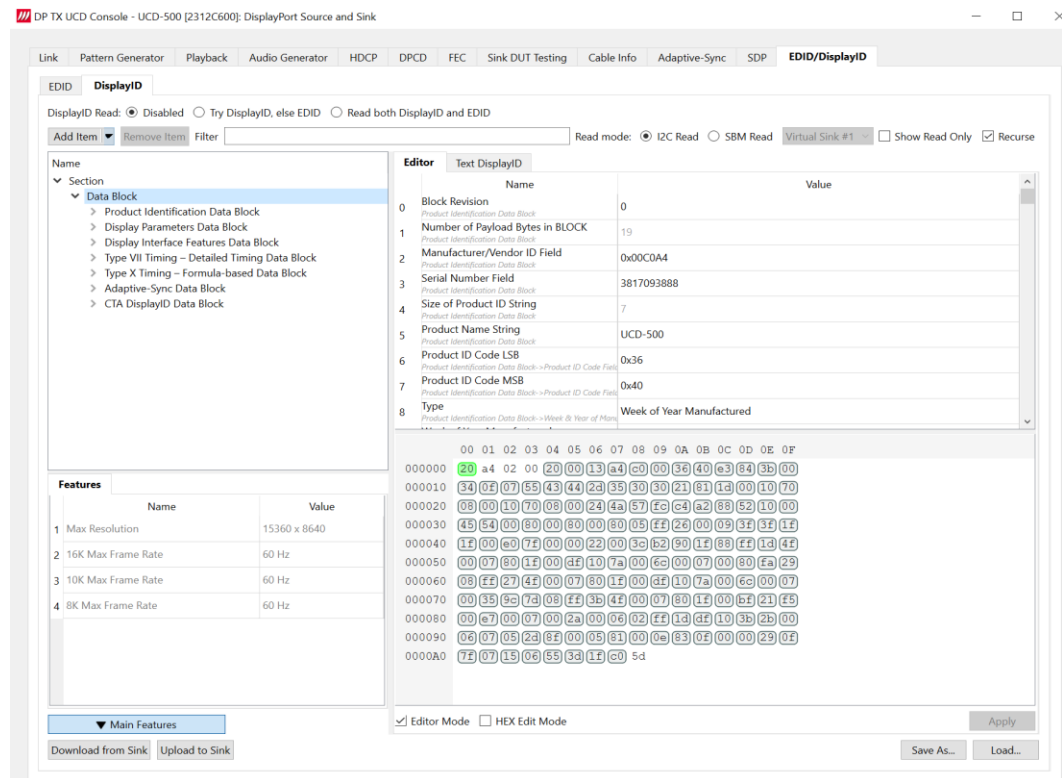
There are three basic functions:

- Load and save the data files on the host PC.
- Edit data contents either in *Editor Mode* or in *Hex Edit Mode*.
- Read and write data to the connected sink. Up to 4 virtual channels can be accessed.

### EDID/DisplayID Files

With *Load...* and *Save As...* a file can be read into the editor or written to a file from the PC.





At the top the *DisplayID* tab dialog are radio buttons to control how DisplayID data is read: *Disabled*, *Try DisplayID, else EDID*, and *Read both DisplayID and EDID*. These have no effect when downloading from the sink unless the sink supports DisplayID protocol.

The contents of the device EDID/DisplayID file are not modified, or their integrity checked during load and save operations.

---

**Note:** Four blocks (512 bytes) of EDID code are read. If the device does not support all four blocks, the non-supported data values are set to zero.

---

In the Editor Panes (upper right pane), the *Text EDID* and *Text DisplayID* tabs allow viewing data in tree form.

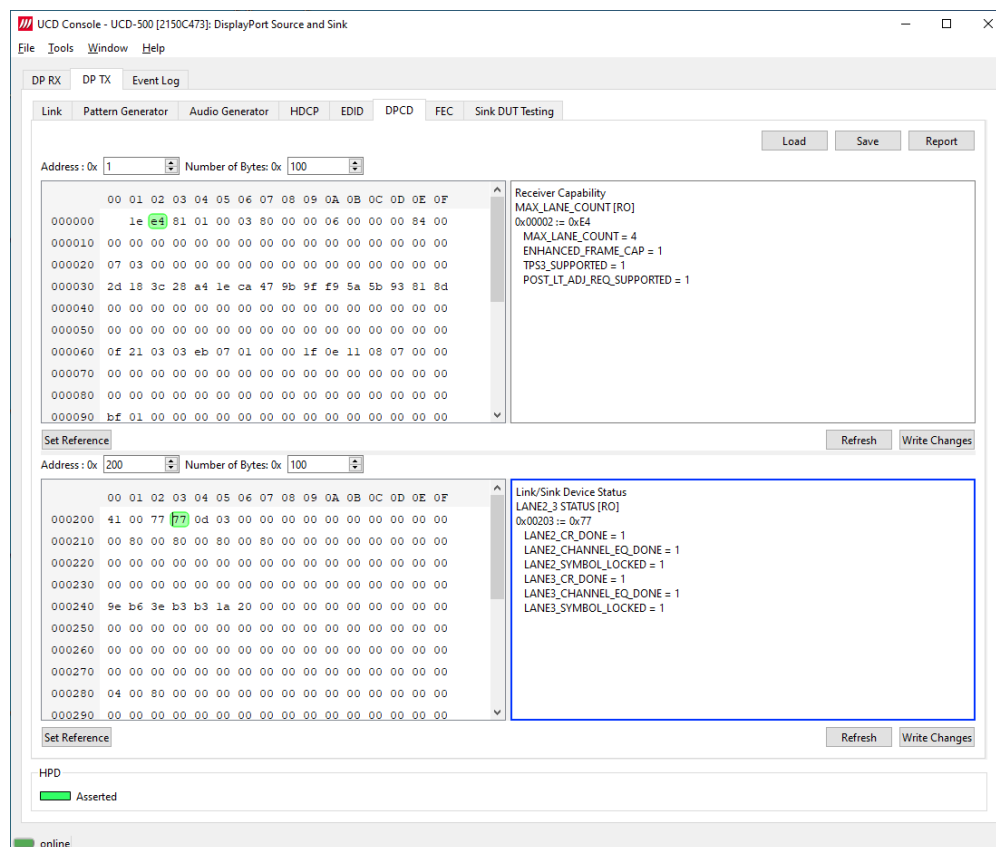
## EDID/DisplayID Editor

Please see the description of the EDID editor in Chapter [EDID/DisplayID Editor](#) later in this document.



## 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.

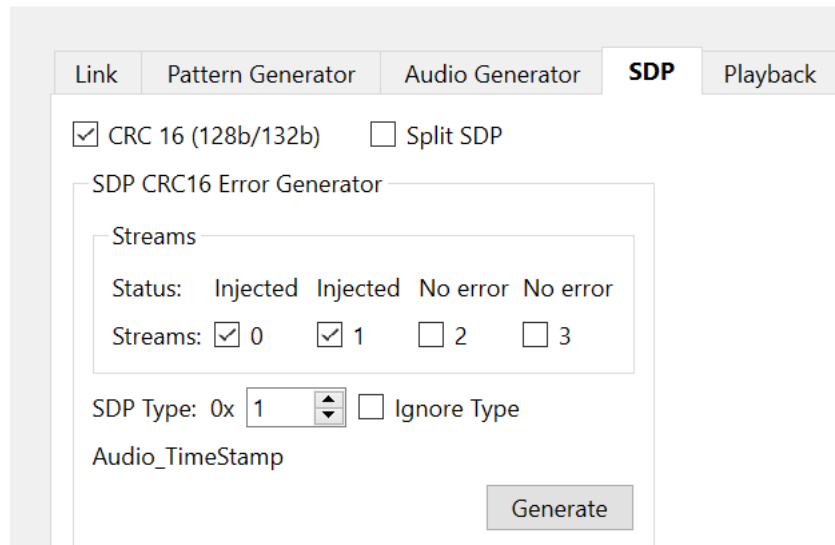
<i>Save:</i>	Select DPCD content to a binary <i>DPCD Data</i> file (*.DPD).
<i>Load:</i>	Select previously saved binary <i>DPCD Data</i> file (*.DPD).
<i>Report:</i>	Save parsed content of selected DPCD register ranges as HTML file
<i>Refresh:</i>	Re-read the data from the DPCD registers to the window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

## SDP Tab

SDP CRC16 signature generation is an optional feature in the standard. A 128b/132b DP-capable DP Source device that supports SDP CRC16 shall generate an SDP CRC16 signature and place it in the SDP.

 DP TX UCD Console - UCD-500 [2312C600]: DisplayPort Source and Sink



Link Pattern Generator Audio Generator **SDP** Playback

☒ CRC 16 (128b/132b) ☐ Split SDP

SDP CRC16 Error Generator

Streams

Status:	Injected	Injected	No error	No error
Streams:	<input checked="" type="checkbox"/> 0	<input checked="" type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3

SDP Type: 0x   ☐ Ignore Type

Audio\_TimeStamp

The *CRC 16 (128b/132b)* checkbox enables SDP CRC16.

The *SDP CRC16 Error Generator* groupbox is for selecting streams and type for injection.

The *SDP Type* edit control determines the type of SDP that gets the signature.

The *IgnoreType* checkbox is for any type.

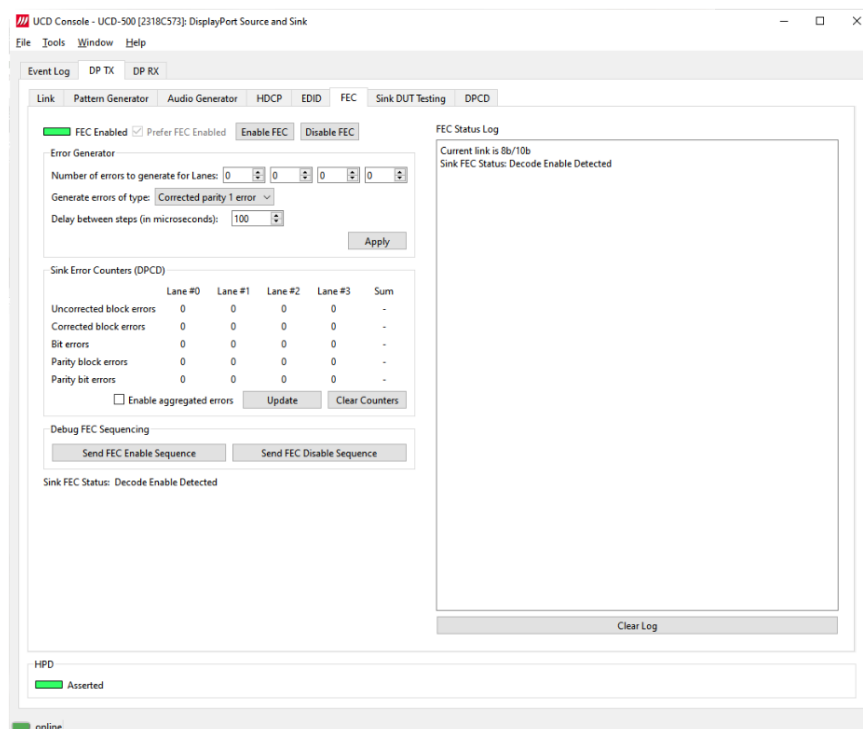
Selecting *Generate* will inject the signature into the next SDP of the selected type.

The *Split SDP* checkbox allows SDP to be split into non-contiguous data packets.

## FEC Tab

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

<i>Enable FEC</i>	UCD will verify if connected sink supports FEC and begins the handshake for enabling FEC. Only available with 8b/10b link coding.
<i>Disable FEC</i>	UCD will start the FEC disable handshake. Only available with 8b/10b link coding.
<i>Prefer FEC Enabled</i>	If selected, and the connected sink supports FEC, UCD will start the FEC Enable Sequence after a successful connection. Only available with 8b/10b link coding.



### Error Generator 8b/10b Link Coding

Selections will set how many errors will be inserted into one FEC block, and to which link symbols. There are five options:

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

#### Note:

FEC must be enabled and running before errors can be added. Link training will reset sink FEC error counters.

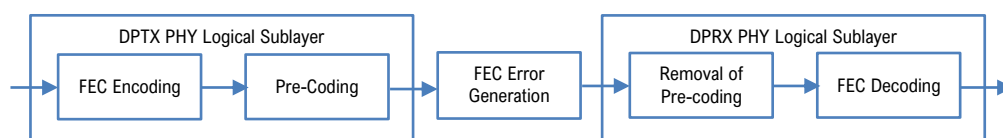
### Error Generator 128b/132b Link Coding

Selections will set how many errors will be inserted into one FEC block, and to which link symbols. There are five options:

Uncorrected block	3 symbol errors with 3 error bits together
Corrected block 4 errors	2 symbol errors with 4 error bits together
Corrected block 2 errors	1 symbol errors with 2 error bits together

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

<i>Apply</i>	Start error injection
<i>Enable aggregated errors</i>	Enables FPGA logic that can calculate FEC errors sum across all active lanes.
<i>Update</i>	Read sink DPCD FEC error counter registers
<i>Clear counters</i>	Clear sink DPCD FEC error counter registers



**Note:**

When using 128b/132b link coding the errors are inserted to Pre-coded RS block right after PHY Sync symbol (Pls see the illustration above). Because of this, on the RX side the number of bit errors will differ from the errors that are inserted on TX side, since pre-coding removal is XOR of the previous bit with the current bit.

## Panel Replay Tab

The screenshot shows the UNIGRAF DP TX UCD Console interface. The top navigation bar includes tabs: Link, Pattern Generator, Audio Generator, SDP, Playback, HDCP, DPCD, FEC, Sink DUT Testing, Adaptive-Sync, Cable Info, EDID/DisplayID, **Panel Replay**, and ALPM. The **Panel Replay** tab is active.

**Current Pattern Capabilities:**

- Panel Replay: Supported
- PSR/PSR2 support: PSR2
- Full frame CRC: Supported
- Selective Update: Supported
- Selective Update CRC: Supported
- Early Transport: Supported

*If the current pattern does not support early transport or selective update CRC, please select another one)*

**Command:**

- Disable
- Inactive mode
- Active mode
- Full-screen update
- Selective update

**Status:**

Command Status: No command  
Status: Active mode  
Error: Y gran limit is violated

**Configuration:**

Mode: PR

☒ Early transport  
☒ HPD\_IRQ on missing AS SDP  
☐ HPD\_IRQ on uncorrectable VSC SDP error  
☒ Frame Capture

☒ Enable CRC check  
☐ HPD\_IRQ on RFB storage error  
☐ HPD\_IRQ on active frame CRC error  
☐ SU: Region scan line capture

☐ Main-link remains ON during PSR1/PSR2  
☐ Self refresh rate unlock  
☐ SU extended Y granularity

**Frame 1** **Frame 2**

**Region 1**

X coordinate: 0  
Y coordinate: 0  
Width: 100  
Height: 100

**Region 2**

X coordinate: 300  
Y coordinate: 300  
Width: 100  
Height: 100

**History:**

```
SU region index in frame: 0
Frame index during SU: 0
CRC R: 0x0000
CRC G: 0x0000
CRC B: 0x0000
CRC Valid: No

Block 2:
Upper left corner X: 200
Upper left corner Y: 200
Width: 100
Height: 100
SU region index in frame: 1
Frame index during SU: 0
CRC R: 0xb07e
CRC G: 0x9fef
CRC B: 0xe945
CRC Valid: Yes

Block 3:
Upper left corner X: 0
Upper left corner Y: 0
Width: 100
Height: 100
SU region index in frame: 0
Frame index during SU: 1
CRC R: 0x0000
CRC G: 0x0000
CRC B: 0x0000
CRC Valid: No

Block 4:
Upper left corner X: 300
Upper left corner Y: 300
Width: 100
Height: 100
SU region index in frame: 1
Frame index during SU: 1
CRC R: 0xa3a8
CRC G: 0x4634
CRC B: 0x0039
CRC Valid: Yes
```

Clear

### Current Pattern Capabilities

*Current Pattern Capabilities* panel displays what features are supported. Selecting different patterns in the *Pattern Generator* will affect supported features shown here. For example *Pattern Generator* pattern *Color Bars* will disable *Early Transport* capability whereas *Color Squares* will enable it.

### Command

*Command* panel has the following functions (reflected in the *Status* panel below it):

<i>Disable</i>	Disable Panel Replay.
<i>Inactive mode</i>	Set mode to inactive.
<i>Active mode</i>	Set mode to active.
<i>Full-screen update</i>	Transmit Full-screen update.
<i>Selective update</i>	Transmit selective update (shown in Command Status and History).

### Status

*Status* panel reflects the *Command Status*, *Status* and *Error*.

*Command Status* will show *Selective update* when *Active mode* and *Selective update* buttons have been selected (see above); otherwise it will display *No command*.

*Status* will show state: *Disable*, *Inactive mode* or *Active mode*.

*Error* will show *No error*, *Incorrect command* or an error message.

## History

*History* panel displays results from applying commands in the *command* panel (see above).

## Configuration

*Configuration* panel allows users to configure *Panel Replay* behavior.

The *Mode* combo box allows mode selection: *PR*, *PSR1*, *PSR2*.

*Configuration* checkboxes available are:

- Early transport: can be set when supported in Current Pattern Capabilities
- HPD\_IRQ on missing AS SDP
- HPD\_IRQ on uncorrectable VSC SDP error
- Enable CRC check
- HPD\_IRQ on RFB storage error
- HPD\_IRQ on active frame CRC error
- Main-link remains ON during PSR1/PSR2
- Self refresh unlock
- SU extended Y granularity
- Frame Capture
- SU:Region scan line capture

The available parameters for *Frame1* and *Frame 2* for *Region 1* and *Region 2* are:

<i>X coordinate</i>	X coordinate of region
<i>Y coordinate</i>	Y coordinate of region
<i>Width</i>	Width of region
<i>Height</i>	Height of region

These are the transmitted blocks sent when *command Selective update* is pressed (see above).

*Apply* button is used to set the *Configuration* panel state.

## ALPM Tab

UCD Console - UCD-500 [2312C600]: DisplayPort Source and Sink

File Tools Window Help

Terminal Memory Layout **DP TX** Event Log

Link Pattern Generator Playback Audio Generator HDCP DPCD FEC Sink DUT Testing EDID/DisplayID **ALPM**

Link Status

☒ ACTIVE

☐ ALW\_SLEEP

☐ FW\_SLEEP

☐ FW\_STANDBY

Link Control

☒ Enable ALPM

☒ Power-on

☐ Power-off

☐ Automatic Power-off during each vertical blanking

Errors

☐ AUX\_PHY\_WAKE\_ACK not received

[Click to clear](#)

Power-off entering

☒ ML\_PHY\_SLEEP ☐ ML\_PHY\_STANDBY

Additional sequences

PHY hold pattern length, symbols

Power-off exiting

☒ AUX-less

☐ AUX-wake

☐ Check AUX\_PHY\_WAKE\_ACK

AUX\_PHY\_WAKE retries

tLFPS\_Cycle, ns

LFPS\_Cycle Count

tSilence, ns

ML\_PHY\_LOCK\_1 time, us

ML\_PHY\_LOCK\_2 time, us

☐ TPS1 ☐ TPS2 ☐ TPS3 ☒ TPS4

☐ TPS2 ☐ TPS3 ☒ TPS4

Default

*Link Status* panel shows current ALPM status.

*Link Control* panel is for enabling ALPM and for setting ALPM state. Note that ALPM is only available in 8b/10b SST mode.

*Power-off entering* offers two modes via radio buttons *ML\_PHY\_SLEEP* and *ML\_PHY\_STANDBY*. *Additional sequences* and *PHY hold pattern length, symbols* can be set via the combo boxes.

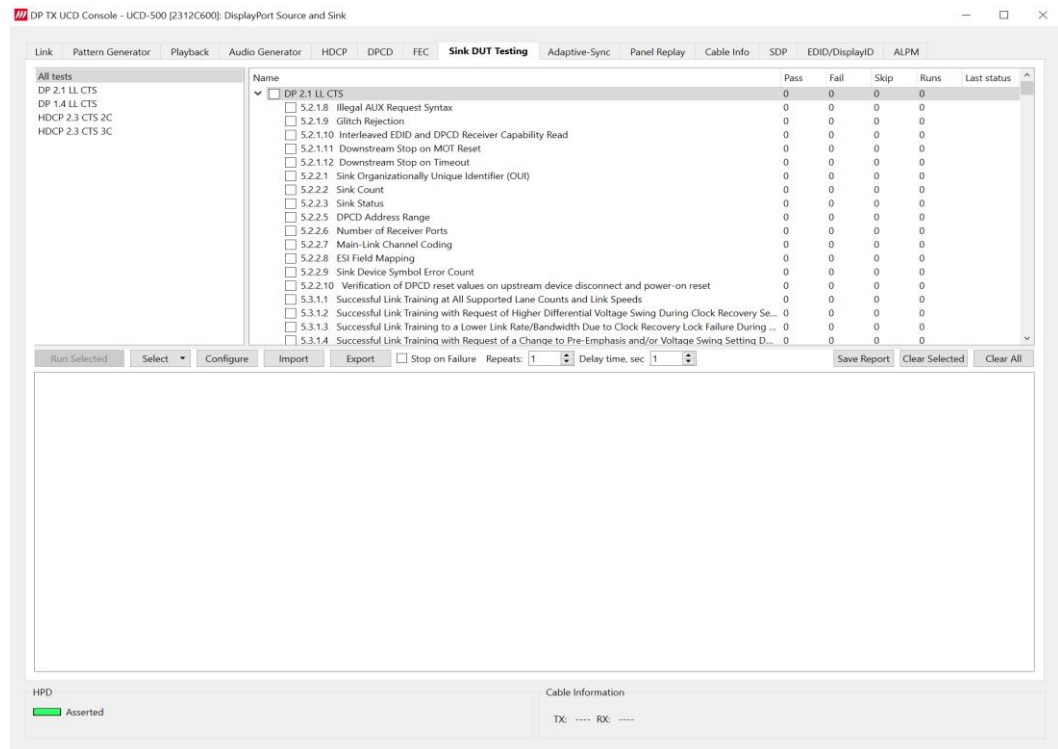
*Power-off exiting* offers two methods via the *AUX-less* and *AUX\_wake* radio buttons. Parameters for each can be set via the widgets in the respective groups.

If the *AUX\_wake* method is selected and *AUX\_PHY\_WAKE\_ACK* is checked and the sink does not respond with *AUX\_PHY\_WAKE\_ACK*, the *Errors* group *AUX\_PHY\_WAKE\_ACK not received* indicator will be lit.

*ML\_PHY\_LOCK\_1* and *ML\_PHY\_LOCK\_2* times may be set along with their patterns: TPS1 – TPS4. *ML\_PHY\_LOCK\_2* is available if TPS1 is selected for *ML\_PHY\_LOCK\_1*.

## Sink DUT Testing Tab

Refer to *Appendix E* for descriptions of the tests available. The tests are presented in a split view, the left being test categories and the right being the tests within.



Select the tests for execution by checking checkboxes or by clicking the test name. *All tests* item on the left hand side is really just for viewing all tests available. Select the desired test category (ex. *DP 1.4 LL CTS*) when running tests.

<b>Run/Run Checked:</b>	Select to start selected/checked tests. Once tests are running the <i>Run Checked</i> button is relabeled <i>Abort</i> to stop the test sequence if desired.
<b>Select:</b>	Includes three sets of options: <i>Select All</i> , <i>Clear All</i> , <i>Invert All</i> for changing the tests current selections; <i>Save</i> (checked items), <i>Load</i> (and check relevant items), <i>Remove</i> (named tests list) for handling named templates; <i>Import</i> (check all items contained in file) and <i>Export</i> (save all checked items to file) for loading and saving file-based templates. Do not confuse <i>Import</i> and <i>Export</i> with those below: These are for setting and saving tests to run.
<b>Configure:</b>	Opens a test parameters dialog for the selected test set. Make sure a test category other than <i>All tests</i> is selected. Refer to <i>Test Parameters</i> below for details.
<b>Import:</b>	Load saved test parameter files (*.td or *.json) for into UCD Console. Select <i>Configure</i> to see current parameters. Loading *.td files to UCD Console is currently unreliable.
<b>Export:</b>	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, use *.json files.
<b>Stop on Failure:</b>	Stops execution of tests if one fails.
<b>Repeats:</b>	Number of times to repeat the selected test sequence.
<b>Delay time:</b>	Delay in seconds between individual tests.



On completion of each test the result of the test is displayed in the table columns on the right. For each test the table lists the number *Pass*, *Fail*, *Skips*, *Runs* and *Last Status* (status of last run).

<i>Save Report:</i>	Select to generate a HTML report file. This will also open a tab in the default browser and display the results.
<i>Clear Selected</i>	Clear the test results of the <i>selected</i> (not <i>checked</i> ) tests results. A subsequently saved report will not include these test results.
<i>Clear All:</i>	Clear the test log view and the outstanding results.

## 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.

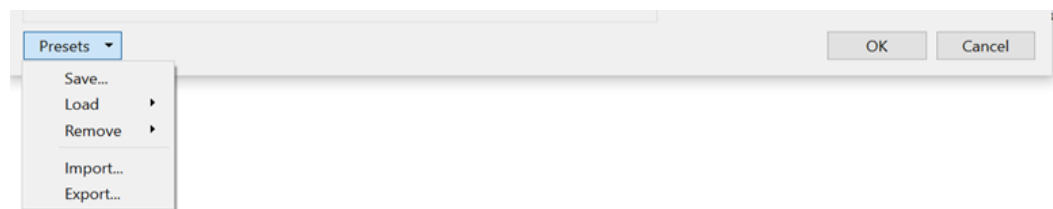
## Saving Test Parameters

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, to run TSI scripts, or to share test parameters with someone. Presently importing \*.td files into UCD Console is unreliable.
- Export parameters in *Sink DUT Testing* tab to a \*.json file for later use in UCD Console, to run Python scripts, or to load test parameters into UCD Console.
- Save parameters in *Configure* dialog as Presets later to be used in UCD Console. See description below.

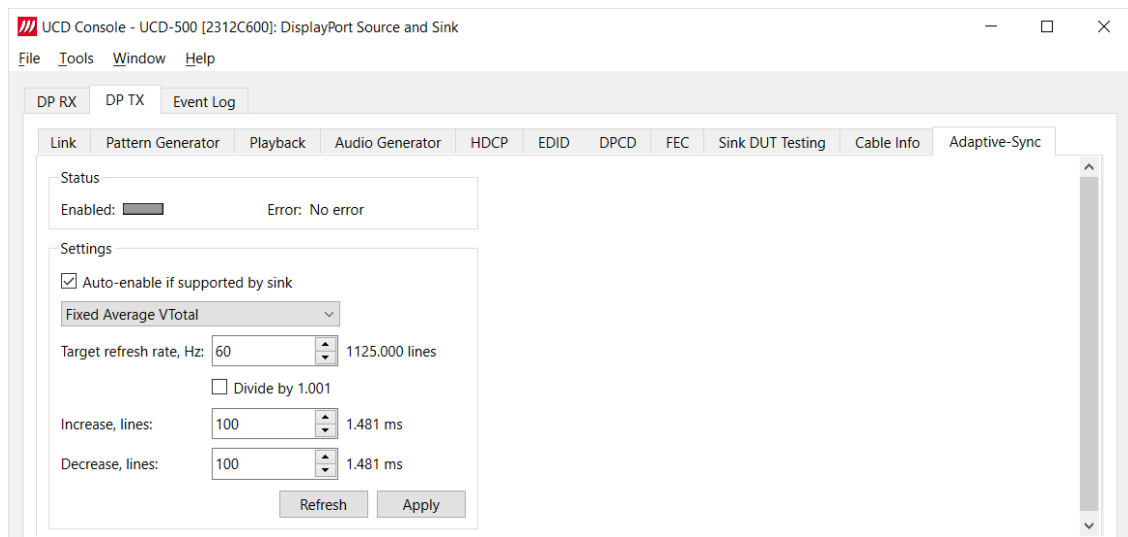
## Presets

All *Configure* dialogs selected parameters can be saved and loaded via *Presets* dropdown menu. Select *Save* or *Load* for named internal configuration parameter sets. Select *Remove* to delete a named internal set. Select *Import* and *Export* for loading and saving parameter sets from and to external files. Note that *importing* and *Exporting* \*.json files here have a different format than importing those described above.



## Adaptive-Sync Tab

Adaptive-Sync feature is available for Stream 0.



<i>Auto enabled if supported by Sink:</i>	The feature is enabled based on connected Sink status
<i>Disabled:</i>	Feature is disabled unless <i>Auto Enabled ... box is checked. Please see the note below.</i>
<i>Adaptive Total, constant refresh rate:</i>	Added blank lines
<i>Adaptive Total, Square pattern:</i>	Added blank lines, min; Added blank lines, max; Period, frames.
<i>Adaptive VTotal, Zigzag pattern:</i>	Added blank lines, min; Added blank lines, max; Increase, lines; Decrease, lines.
<i>Fixed Average VTotal:</i>	Target refresh rate, Hz; Increase, lines; Decrease, lines

**Note:** Please note that in case *Auto enabled if supported by Sink* is selected and the connected Sink device supports Adaptive-Sync, but the selected mode is *Disabled*, then Adaptive-Sync is enabled in mode "*Adaptive Total, constant refresh rate*" with 0 (zero) added blank lines. Control dialog will be updated to indicate the status.

## Cable Info Tab

Cable properties for DP TX and USB-C TX are shown below.

Some information may not be available for older front ends.

UCD Console - UCD-500 [2209C487]: DisplayPort Source and Sink

File Tools Window Help

DP RX **DP TX** Event Log Memory Layout Terminal

Link Pattern Generator Playback Audio Generator HDCP DPCD FEC **Cable Info**

DPRX Cable Info

UHBR Capabilities UHBR10- and UHBR20-capable

UHBR13.5 Capable Yes

Cable Type Unknown

UCD Console - UCD-500 [2209C487]: USB-C, DP Alt Mode Source and Sink

File Tools Window Help

USB-C RX **USB-C TX** Event Log Memory Layout Terminal

PDC Link SDP Pattern Generator Adaptive-Sync Panel Replay ALPM Playback Audio Generator HDCP EDID/DisplayID DPCD FEC **Cable Info**

DPRX Cable Info

UHBR Capabilities Not UHBRx-capable or unknown

UHBR13.5 Capable No

Cable Type Unknown

USB-C Cable Info Refresh

C2 20 00 1C 00 00 00 00 10 03 0F 0A 43 20 08 45 00 00 00 00 00 00

USB Vendor ID	20C2	XID Assigned by USB-IF	0x00000000
Modal operation supported	Yes		
Product Type	Passive Cable		
USB Communications Capable as USB Device	No	bcdDevice	0x0310
USB Communications Capable as USB Host	No	USB product ID	0x0A0F

USB Highest Speed	USB 4 Gen3
VBUS Current Handling Capability	5A
Maximum Vbus Voltage	20V
Cable Termination Type	VCONN not required
Cable Latency	<10ns (~1m)
EPR Capable	No
Type-C plug to Type-A/B/C/Captive	USB Type-C
Firmware Version	5
Hardware Version	4

Thunderbolt Capable Yes

### DPTX / DPRX Cable Info

**UHBR Capabilities:** DP UHBR capabilities of the connected cable.

**UHBR 13.5 Capable:** DP UHBR 13.5 capable.

**Cable Type** Type of the cable.

### USB-C Cable Info

Displays the information received from cable in response to *Discover Identity* command sent to SOP'.

### Cable Information

For DP connection, Cable information panel shows if the connected cables are D80 / DP40 capable.

Cable Information

RX: DP80

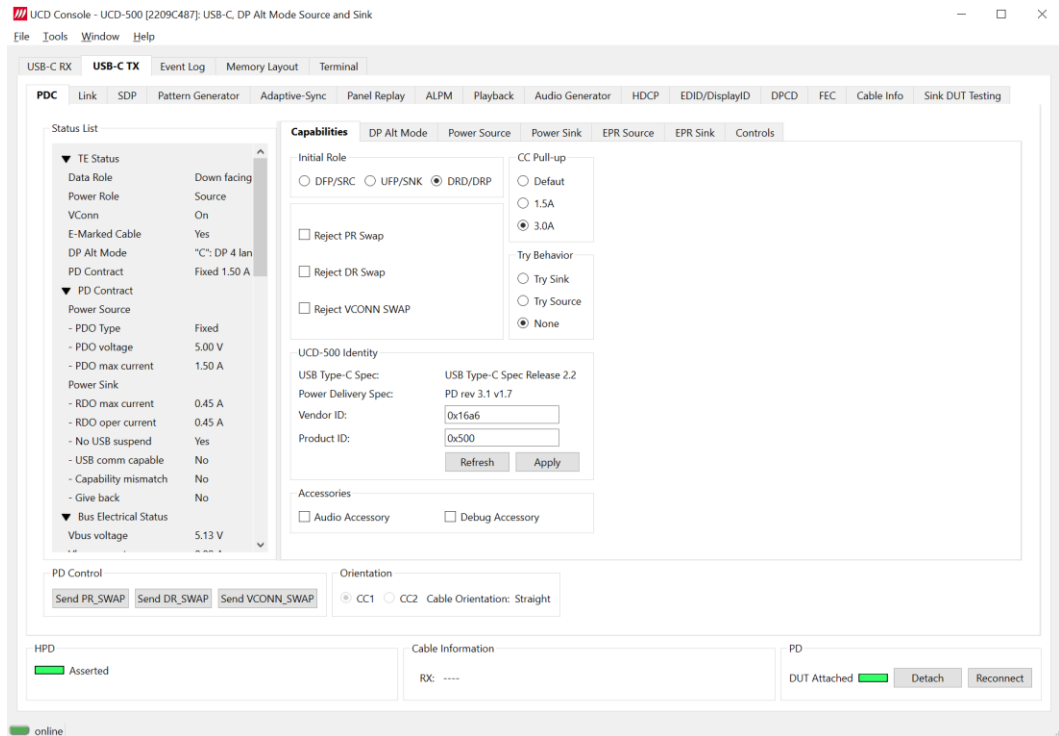
#### Note:

For USC-C, Cable info can only be read when in *Down Facing Port* role.  
Select *Refresh* after changing roles

## PDC Tab

When *USB-C DP Alt Mode Reference Source* role is in use, the following interface specific tabs are available.

The *PDC Tab* for TX is almost identical to *PDC Tab* for RX (see [PDC Tab](#)).

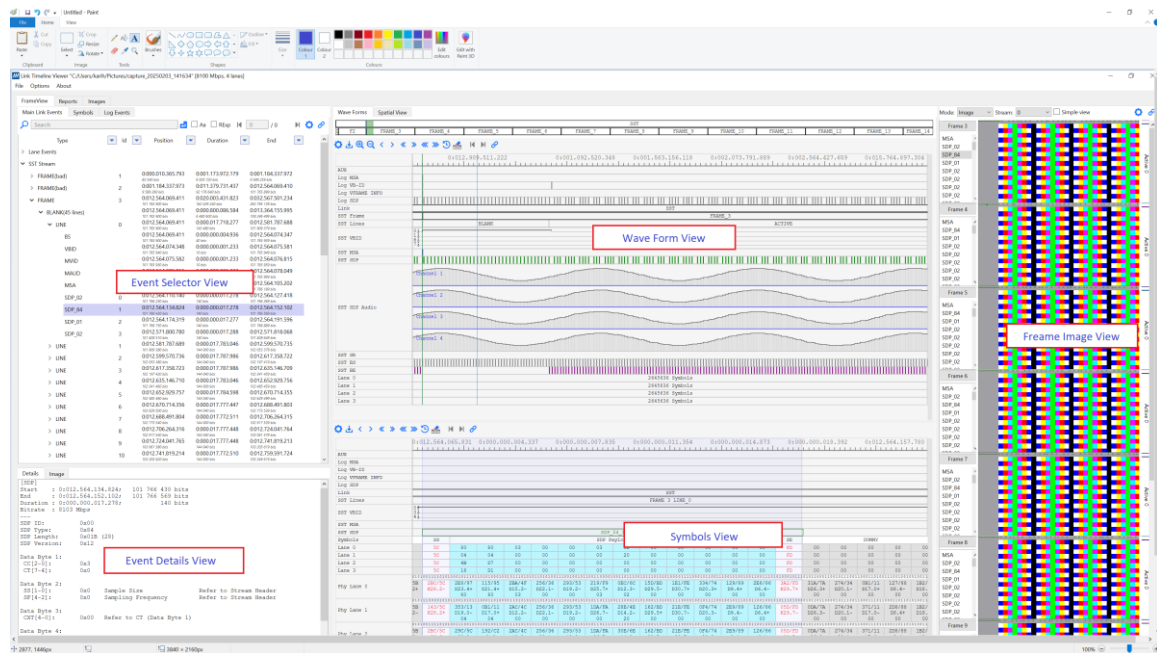


## 6. LINK TIMELINE VIEWER

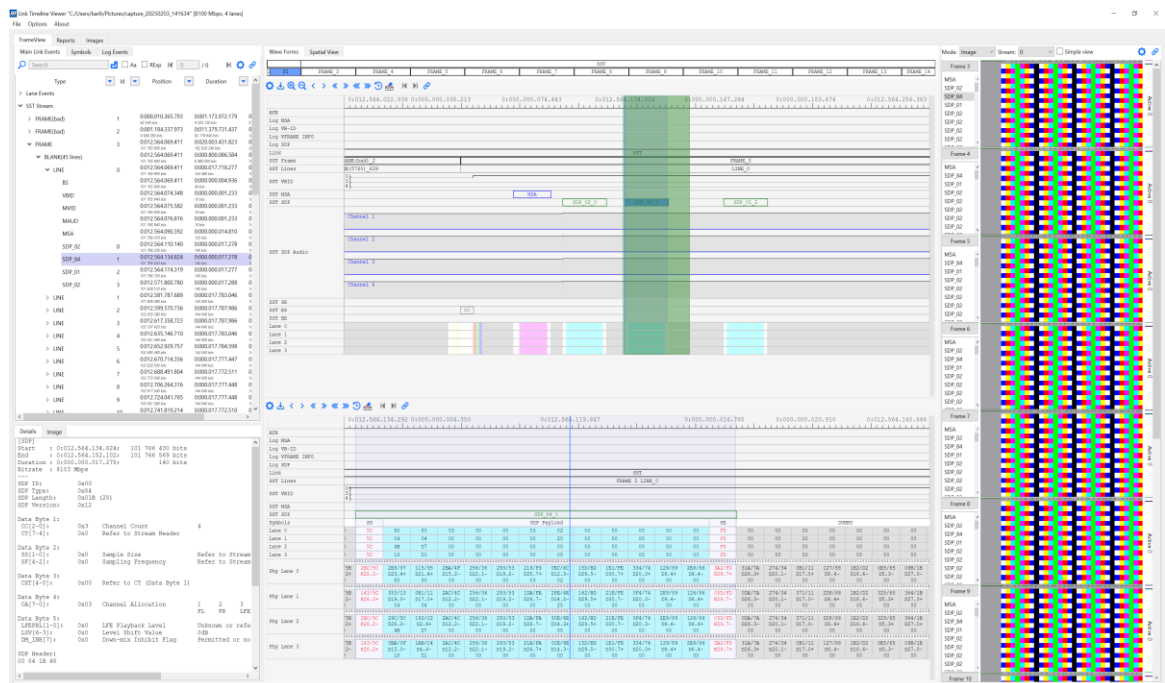
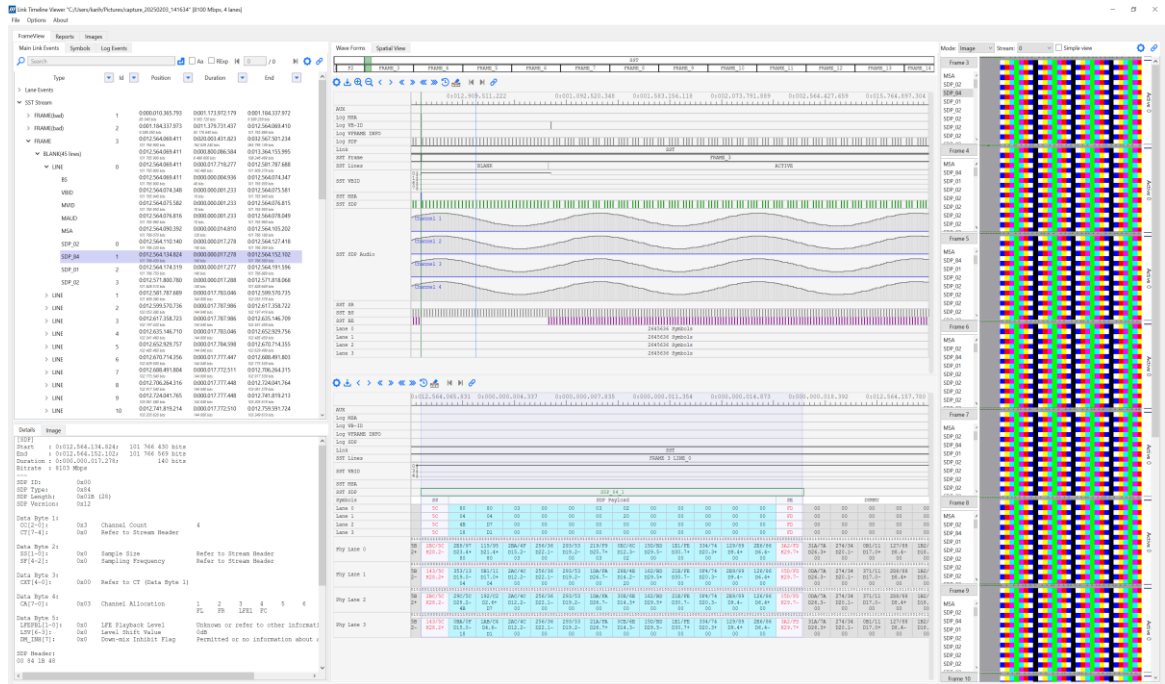
*Link Timeline Viewer* is a tool for studying streamed data and timing for data captured with *Link Analyzer*.

- Link Timeline Viewer main panel contains three tabs (for three modes):
- FrameView tab is the primary tab for analyzing captured events on the timeline.
- Reports tab can be used to summarize events (AUX at present).
- Images tab lets the user view captured video frame images.

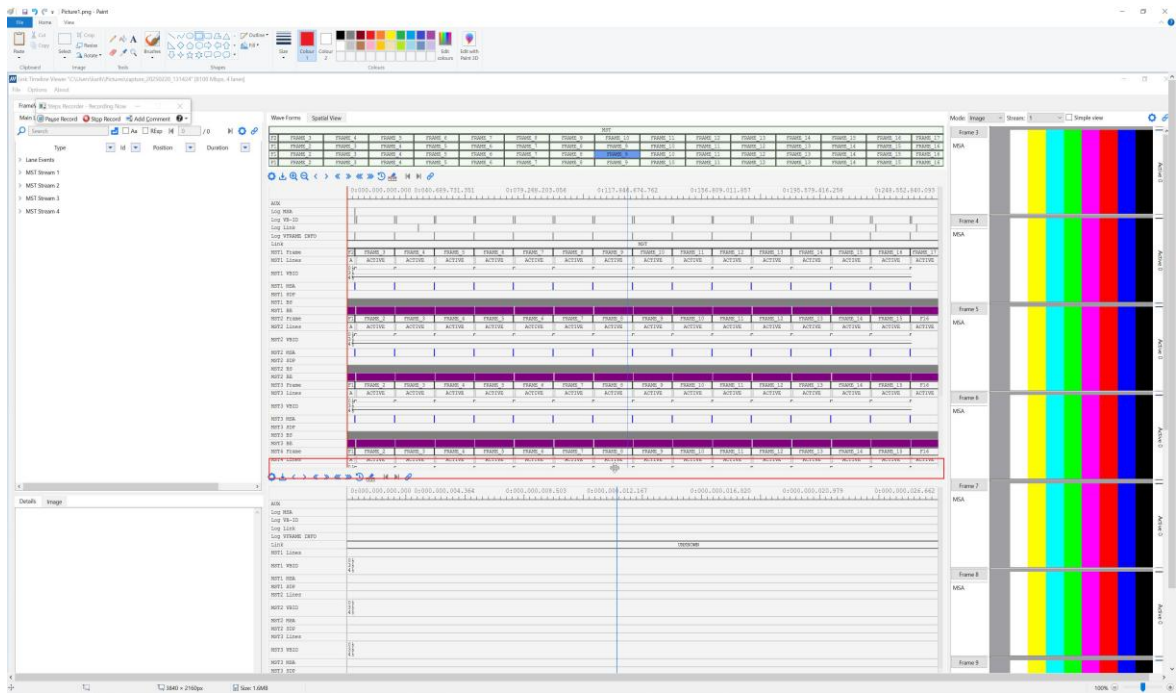
The *FrameView* tab and its views are shown below.



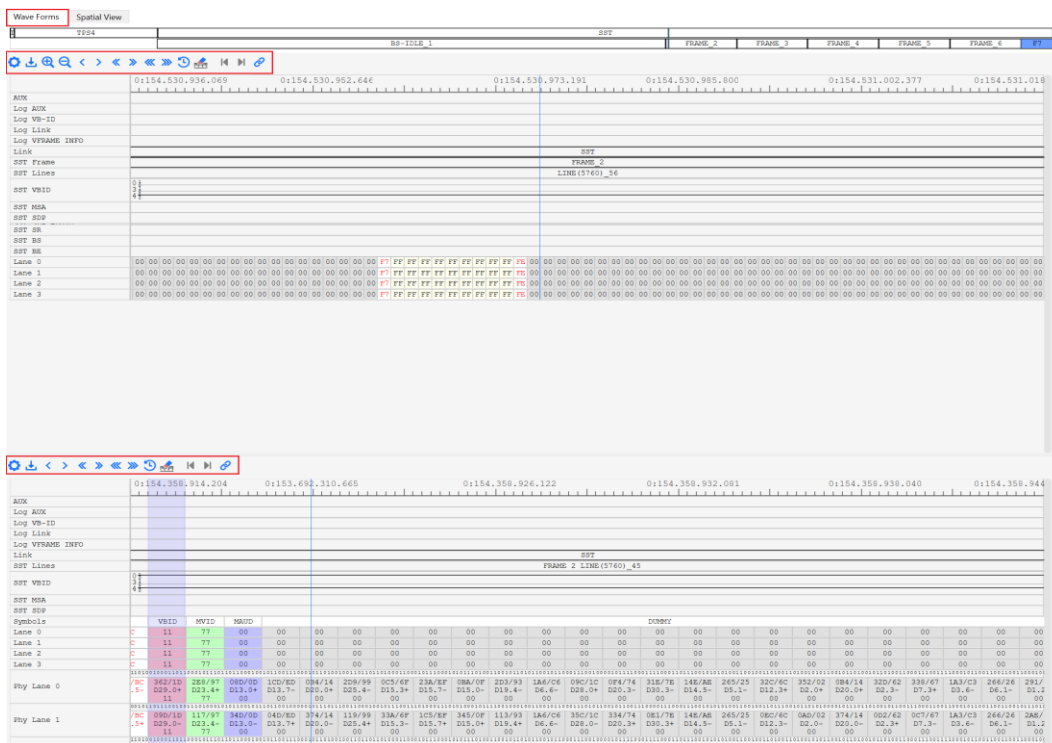
Wave Form View zoomed out and zoomed in views are shown below. Event periods are shown under the timeline (at the top) in their proper row as period rectangles with text descriptions (or abbreviations or no text, space permitting). Double-clicking a period rectangle will highlight the timeline portion of the rectangle and the row header(s). To zoom the Wave Form View, position the cursor and use the mouse wheel to zoom in or out with respect to the cursor location. Drag to scroll the Wave Form View and the Symbols View horizontally.



A splitter cursor appears when hovering between the *Wave Form View* and the *Symbols View* when all content cannot be displayed (typical with MST streams). Drag the splitter cursor to view hidden rows (see image below). Removing rows via the *gear* icon may also help.



## Wave Form and Symbol View Settings

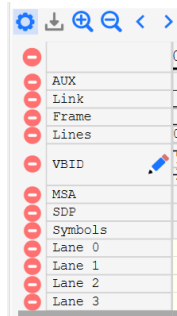




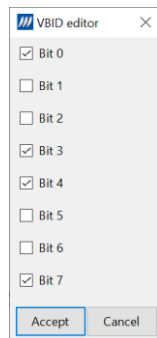
## Gear Icon



The gear icon under the scroll bar allows users to select which events are shown in **Wave Form and Symbol View**. Click the red circle to remove events.



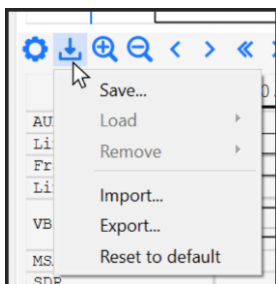
You can select which VBI bits are shown by clicking the pen tool.



## Save Icon



By clicking the Save icon you can save, load and remove settings selected with the gear icon. You can also import and export .json files and reset settings to default.



## Zooming



You can zoom in/out with the magnifying glass icons. The zooming in/out option applies to **Wave Form View** only.

## Scrolling



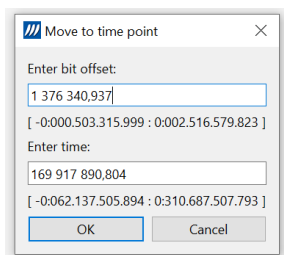
You can use the arrow keys to move in the timeline. One arrow moves the timeline one interval, two arrows move it 10 intervals and three arrows move it 100 intervals.

Alternatively, you can scroll by clicking, holding and dragging.

## Clock icon



With the clock icon you can move to a time point. Enter the values and press OK.



## Eraser



The eraser icon deletes all made measurements on the timeline.

## Move to Previous or Next Interval

Move back interval and Move next interval



## Sync Data

Sync data for views.



Not synchronized.



Synchronized.

# FrameView Tab

FrameView tab consists of five areas (views) shown below.

*Event Selector View*

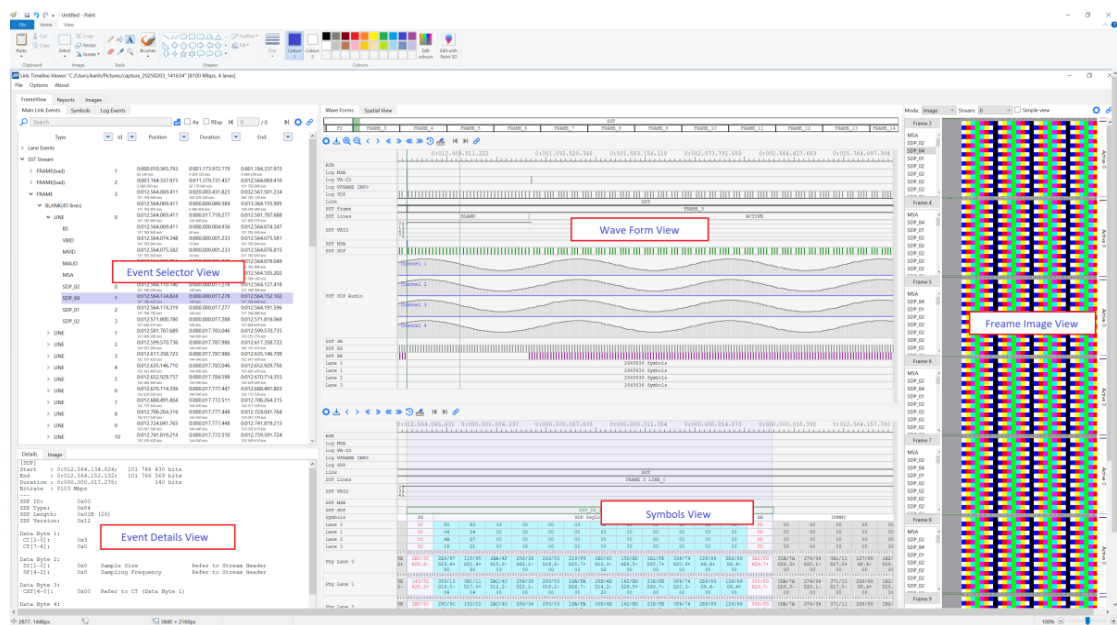
*Event Details View*

*Wave Form View*

*Symbols View*

*Frame Image View*

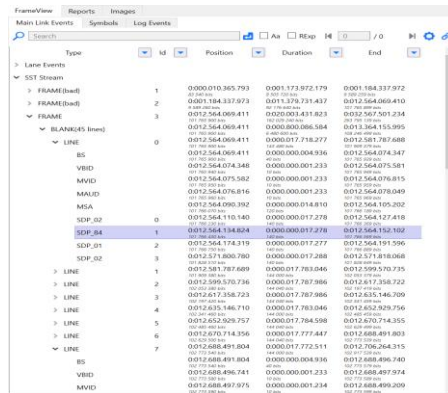
Each of these areas will be described in detail. These views are synchronized and actions in one view will affect presentations in others.



## Event Selector View

### Main Link Events Tab

*Event Selector View* events are presented as a folding list of *Lane Events* and *FRAMEs*. Each *FRAME* contains a set of *BLANK LINES* followed by a set of *ACTIVE LINES*. Select items in *Main Link Events tab* to locate items of interest and focus the *Wave Form View* and the *Symbol View*.



The timing format used in Timeline Viewer consists of two timings based on *time* and *bits*.

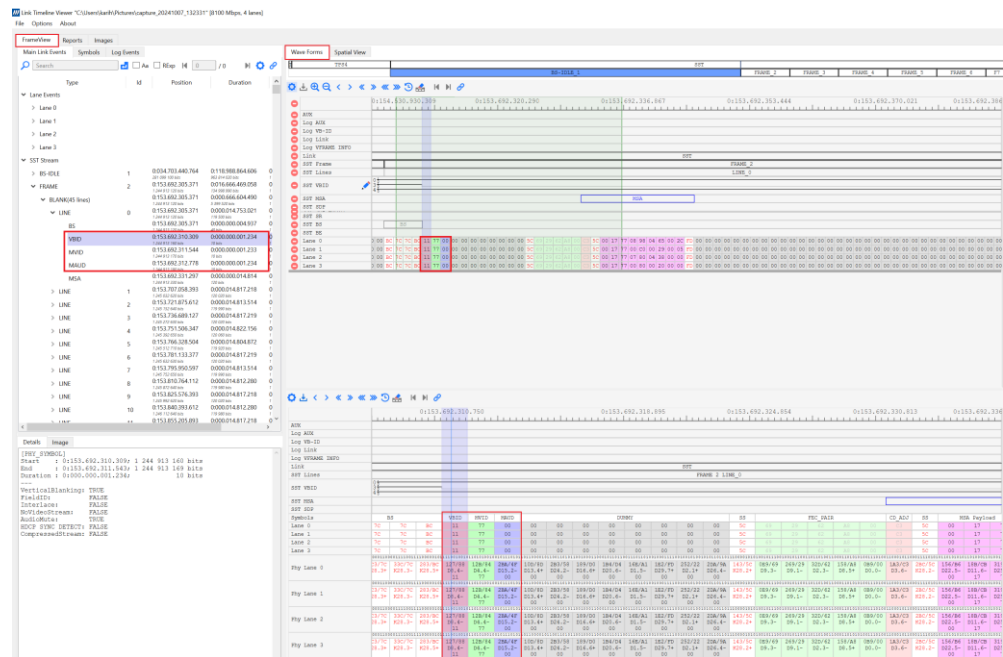
The time format is shown as follows:

*seconds:milliseconds.microseconds.nanoseconds.picoseconds*

The timing format is demonstrated in the image below where you can see the time format on top and the bit format under it with a smaller grey font.

Type	Id	Position	Duration	End
> BS-IDLE	1	0:034.619.841.130 280 421 940 bits	0:118.983.568.333 963 771 120 bits	0:153.603.409.463 1 244 193 059 bits
> FRAME	2	0:153.603.409.464 1 244 193 060 bits	0:016.667.883.866 135 010 450 bits	0:170.271.293.330 1 379 203 509 bits
- - - - -	-	0:170.271.293.331	0:016.667.883.867	0:186.939.183.371

When selecting a Frame, a Line, an Event, or a Symbol, both *Wave Form View* and *Symbols View* are focused, and the time stamp of the item is highlighted as shown below.



Event Selector timing column details are:

**Type:** Type of item. FRAME, LINE, or name of Event

**Id:** Event's occurrence number

**Position:** Start of the event from start of the captured data

**Duration:** Duration of the event

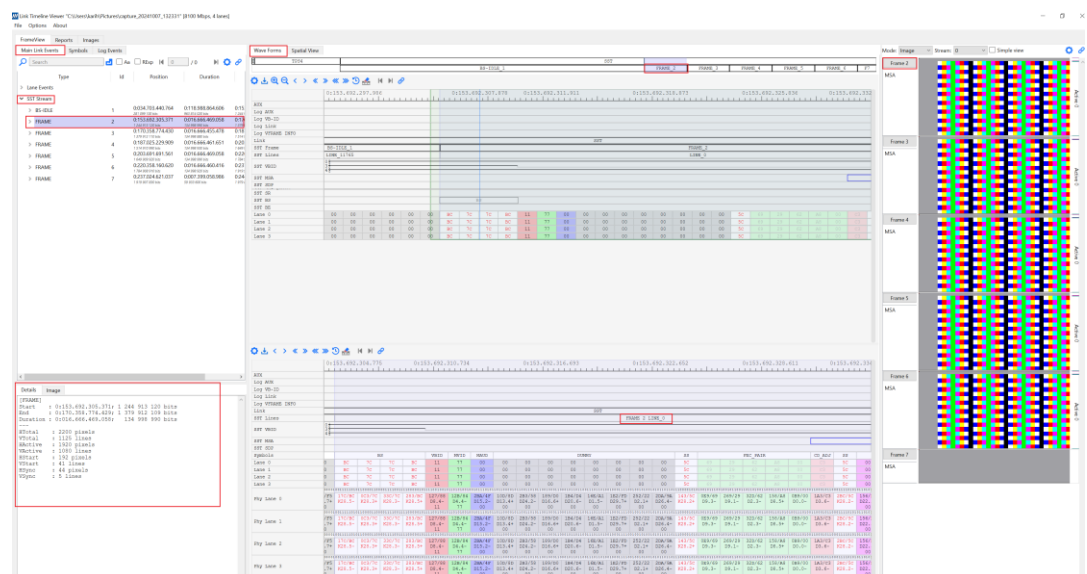
**End:** End of the event from start of the captured data

Under *Main Link Events*, there are two types of event categories (for an SST link): *Lane events* and *SST/MST Stream(s)*.

Type	Id	Position	Duration	End
▼ Lane Events				
> Lane 0				
> Lane 1				
> Lane 2				
> Lane 3				
▼ SST Stream				
> FRAME(bad)	1	0:000.004.514.795	0:007.348.683.898	0:007.35
> FRAME	2	0:007.353.198.694	0:016.667.892.509	0:024.02
> FRAME	3	0:024.021.091.204	0:016.667.887.570	0:040.68
> FRAME	4	0:040.688.978.775	0:016.667.887.571	0:057.35
> FRAME	5	0:057.356.866.347	0:016.667.887.570	0:074.02
> FRAME	6	0:074.024.753.918	0:016.667.892.509	0:090.69
> FRAME	7	0:090.692.646.428	0:016.667.887.570	0:107.36
> FRAME	8	0:107.360.533.999	0:016.667.887.571	0:124.02
> FRAME	9	0:124.028.421.571	0:016.667.887.570	0:140.69
> FRAME	10	0:140.696.309.142	0:016.667.892.509	0:157.36

Lane events shows events such as SST, TPS1, TPS3 and TPS4 for each lane.

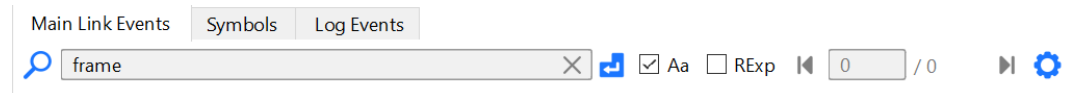
Find all the captured frames under *SST Stream* (or *MST Streams*). Selecting a *Frame* in the *Event Selector*, highlights it and focuses the *Wave Form View* and the *Symbols View* as seen below. Event details are shown in *Event Details View* in the lower left corner.



You can search events by typing in the Search bar and pressing enter. Events are highlighted and selected in the *Wave Form View* and the *Symbols View*.

Type	Id	Position	Duration	End
Lane Events				
SST Stream				
FRAME(bad)	1	0:000.009.259.063 <small>75 000 bits</small>	0:002.207.395.066 <small>17 880 280 bits</small>	0:002.216.654.129 <small>17 955 279 bits</small>
FRAME(bad)	2	0:002.216.654.130 <small>17 955 280 bits</small>	0:014.399.524.866 <small>116 638 630 bits</small>	0:016.616.178.996 <small>134 593 909 bits</small>
ACTIVE(972 lines)		0:002.216.654.130 <small>17 955 280 bits</small>	0:014.399.524.866 <small>116 638 630 bits</small>	0:016.616.178.996 <small>134 593 909 bits</small>
LINE(5760)	0	0:002.216.654.130 <small>17 955 280 bits</small>	0:000.014.812.030 <small>119 980 bits</small>	0:002.231.466.160 <small>18 075 259 bits</small>
SR		0:002.216.654.130 <small>17 955 280 bits</small>	0:000.000.004.937 <small>40 bits</small>	0:002.216.659.067 <small>17 955 319 bits</small>
VBID		0:002.216.659.068 <small>17 955 320 bits</small>	0:000.000.001.233 <small>10 bits</small>	0:002.216.660.301 <small>17 955 329 bits</small>
MVID		0:002.216.660.302 <small>17 955 330 bits</small>	0:000.000.001.234 <small>10 bits</small>	0:002.216.661.536 <small>17 955 339 bits</small>
MAUD		0:002.216.661.537 <small>17 955 340 bits</small>	0:000.000.001.233 <small>10 bits</small>	0:002.216.662.770 <small>17 955 349 bits</small>
SDP_02	0	0:002.216.675.117 <small>17 955 450 bits</small>	0:000.000.014.813 <small>120 bits</small>	0:002.216.689.930 <small>17 955 569 bits</small>
BE		0:002.218.582.484 <small>17 970 900 bits</small>	0:000.000.001.233 <small>10 bits</small>	0:002.218.583.717 <small>17 970 909 bits</small>
LINE(5760)	1	0:002.231.466.161 <small>18 075 260 bits</small>	0:000.014.823.140 <small>120 070 bits</small>	0:002.246.289.301 <small>18 195 329 bits</small>
LINE(5760)	2	0:002.246.289.302 <small>18 195 330 bits</small>	0:000.014.804.623 <small>119 920 bits</small>	0:002.261.093.925 <small>18 315 249 bits</small>
		0:002.261.093.926 <small>119 920 bits</small>	0:000.014.816.968 <small>119 920 bits</small>	0:002.275.910.894 <small>119 920 bits</small>





**Aa** Toogle case sensitive or not.

**RExp** Use regular expressions.



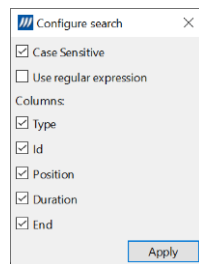
Click the enter icon to apply filters.



Click *Find Prev* and *Find Next* icons to navigate. Instance 2 out of 77 is selected.



The gear icon opens *Configure search* window. In addition to settings described above, you can select which columns are shown in *Main Link Events* window.



## Symbols Tab

*Symbols* view lists all the PHY level events found in the capture made. Where *Main Link Events* is structured as a tree, *Symbols* view is presented as a list of symbols. Search and filter as explained above.

Main Link Events

Symbols

Log Events

Filter

**Type:** Type of item.

**Id:** Event's occurrence number

**Position:** Start of the event from start of captured data

**Lane:** The main link lane for Symbol

**Value:**

## Event Details View

The event details are shown in the window in the lower left corner. The event details consists of two tabs: *Details* tab and *Image* tab.

### Details Tab

The information shown in the *Details* tab is context dependant.

Frame details are shown below.

For example, in the image below we can see that the line is part of blanking as the value for

Details	Image
[FRAME]	
Start	: 0:203.253.553.972; 1 646 360 990 bits
End	: 0:219.921.436.604; 1 781 371 429 bits
Duration	: 0:016.667.882.632; 135 010 440 bits
---	
HTotal	: 2200 pixels
VTotals	: 1125 lines
HActive	: 1920 pixels
VActive	: 1080 lines
HStart	: 192 pixels
VStart	: 41 lines
HSync	: 44 pixels
VSynC	: 5 lines
Total pixel count 6220800	

*VerticalBlanking* details are shown below. *VerticalBlanking* is set as *TRUE*. *AudioMute* is set as *FALSE* so audio is being transferred.

Details	Image
[LINE]	
Start	: 0:153.249.911.010; 1 241 329 710 bits
End	: 0:153.264.671.438; 1 241 449 269 bits
Duration	: 0:000.014.760.428; 119 560 bits
---	
VBID	1 0x1
VerticalBlanking: TRUE	
FieldID: FALSE	
Interlace: FALSE	
NoVideoStream: FALSE	
AudioMute: FALSE	
HDCP SYNC DETECT: FALSE	
CompressedStream: FALSE	
MVID	119 0x77
MAUD	44 0x2c
META	1 0x1
Pixel Count = 0	

MSA frame data is shown below.

Details	Image
<pre> [MSA] Start   : 0:153.249.931.998; 1 241 329 880 bits End     : 0:153.249.943.108; 1 241 329 969 bits Duration : 0:000.000.011.110;          90 bits ----- FIELD   DEC      HEX      BITS ----- MVID    6007      0x1777 NVID    32768     0x8000 HActive 1920      0x780 VActive 1080      0x438 HTotal  2200      0x898 VTotal  1125      0x465 HStart  192       0xC0 VStart  41        0x29 VSynWidth 5      0x5 HSynWidth 44     0x2C MISC0   32       0x20      00100000 MISC1   0        0x0       00000000  MISC0.Synchronous Clock: Link clock and main video stream clock are asynchronous. MISC1.Interlaced Vertical Total Even: Number of lines per interlaced frame (consisting of two fields) is an odd number MISC1.Stereo Video Attribute: No 3D stereo video in-band signaling  MISC.Colorimetry Format Value: 1          0x1          00000001 MISC.Colorimetry Format: RGB unspecified color space (Legacy RGB mode), 8 bpc, 8bpc ----- 00 00 00 00 17 17 17 17 77 77 77 77 08 00 07 00 98 C0 80 80 04 00 04 00 65 29 38 20 00 00 00 00 2C 05 00 00 </pre>	

SDP events contain several different kinds of events all with individual details. An audio stamp event is shown below.

Details	Image
<pre> [SDP] Start   : 0:034.894.928.816;   282 650 160 bits End     : 0:034.894.943.629;   282 650 279 bits Duration : 0:000.000.014.813;         120 bits ----- Secondary-data Packet HB0 (ID)  0x00 HB1 (Type) 0x01 Audio_TimeStamp HB2       0x17 HB3       0x48 PB0       0x00 PB1       0x67 PB2       0x35 PB3       0xD1 Header checksum OK  Data checksum OK  Maud      0x0000012C 300 Naud      0x00008000 32768  PB4       0xB4 PB5       0xB4 PB6       0xB4 PB7       0xB4 PB8       0x7F PB9       0x7F PB10      0x7F PB11      0x7F </pre>	

Events such as *BS*, *VBID* and *MVID* will be shown under [PHY\_SYMBOL] title. A *VBID* event is shown below.

Details	Image
[PHY_SYMBOL]	
Start	: 0:170.271.298.270; 1 379 203 550 bits
End	: 0:170.271.299.503; 1 379 203 559 bits
Duration	: 0:000.000.001.233; 10 bits
---	
VerticalBlanking: TRUE	
FieldID: FALSE	
Interlace: FALSE	
NoVideoStream: FALSE	
AudioMute: FALSE	
HDCP SYNC DETECT: FALSE	
CompressedStream: FALSE	

PHY Area events shows *TPS* events. In the image below you can see a *TPS1* event and its start, end and duration.

Details	Image
[PHY_AREA]	
Start	: 0:000.000.000.000; 0 bits
End	: 0:000.854.703.667; 6 923 129 bits
Duration	: 0:000.854.703.667; 6 923 130 bits
---	
TPS1	

## Image Tab

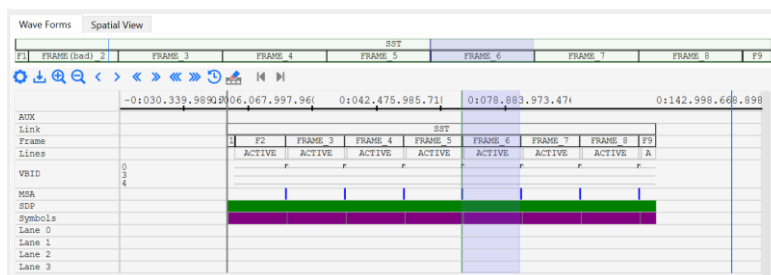
Image tab shows the frame captured with active area. Please note that Images are shown only shown when a frame is selected.

Lane Events			
▼ SST Stream			
> FRAME(bad)	1	00001009.259.063	0002207.395.066 0002216.654.129
> FRAME(bad)	2	0002216.654.130	0014399.524.866 0016616.178.996
> FRAME	3	0016616.178.997	0016666.123.615 0033282.302.612
> FRAME	4	0033282.302.613	0016666.111.268 0049948.413.881
> FRAME	5	0049948.413.882	0016666.119.911 0066614.533.793
> FRAME	6	0066614.533.794	0016666.122.379 0083280.656.173
> FRAME	7	0083280.656.174	0016666.114.973 0099946.771.147
> FRAME	8	0099946.771.148	0016666.117.441 0116612.888.589
> FRAME(bad)	9	0116612.888.590	0204740.585.679 0121353.474.269
Details Image			
			

## Wave Forms View

Wave Forms View consists of two tabs: *Wave Forms* and *Spatial View*. Image for SST mode.

### Wave Forms Tab



**AUX:** Events of the AUX channel.

**Link:** Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)

**Lines:** Frame and line number

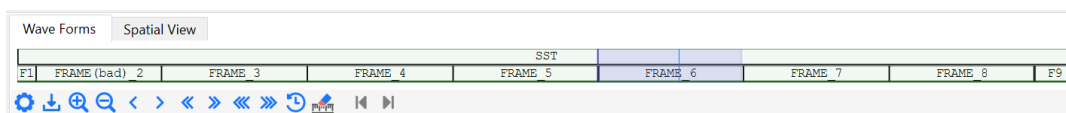
**VBI:** Location of VBI events

**MSA/SDP:** Location of MSA and SDP events

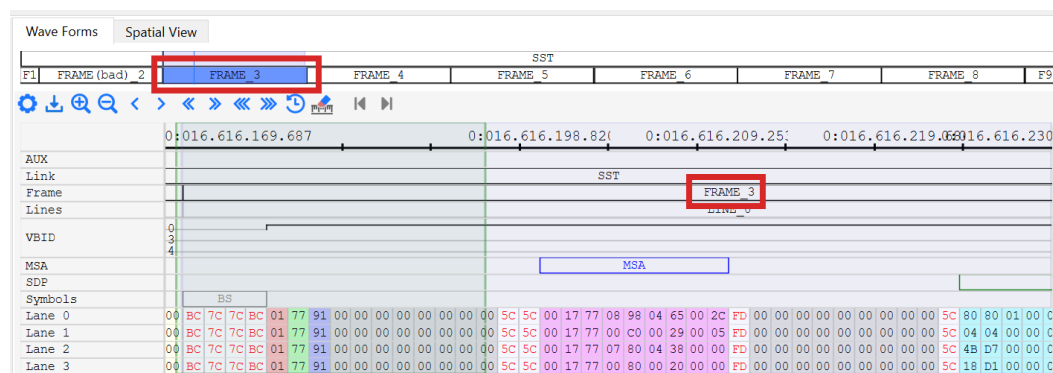
**Symbols:** Control and special symbols

**Lanes (0-3):** Decoded data and control symbols

The scroll bar on the top of the panels shows all captured frames of the bulk. As no triggers were set on the example capture shown in the image below, the first frame is not captured fully. Please, note that this view cannot be zoomed in.



You can select a frame by double-clicking on it. After a frame is selected, it turns into light purple (shown in SST mode) and *Wave Form View* will be focused to view this frame.



The screenshot displays the Wireshark interface with the following details:

- Packet List Pane:** Shows a single packet, Frame 3, selected. The packet is of type "Hypertext Transfer Protocol".
- Packet Details Pane:** Shows the structure of the selected packet. The expanded sections are:
  - Ethernet II:** Shows the source and destination MAC addresses.
  - Internet Protocol Version 4:** Shows the source and destination IP addresses. The source IP is highlighted with a red box.
  - Hypertext Transfer Protocol:** Shows the request method (GET) and the requested URI.
- Packet Bytes Pane:** Shows the raw data of the packet. A red box highlights the IP address field (0.0.0.0).

The screenshot displays the TimeLineViewer application interface. The top section shows the main timeline with a seek bar and various playback controls. Below this, a list of tracks is visible, including SST System, RS, VBS, MVD, MAUD, MGA, SEI, SP, and J4. The selected track, SP, J4, is expanded to show a detailed view of its frames. This view includes a table with columns for frame number, timestamp, and duration. The table shows a sequence of frames with timestamps ranging from 00:00:00.000 to 00:00:00.000. The interface also includes a 'Wave Forms' section on the right, which displays a waveform for the selected track.

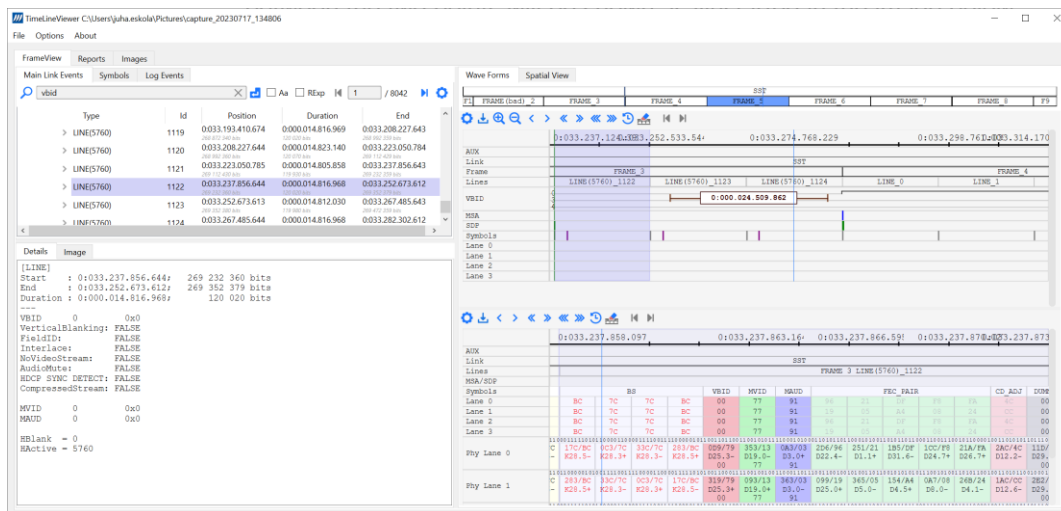
When double-clicking on timeline or within the perimeters of *Wave Forms View*, *Symbol View* is focused, and the event is selected in *Event Selector View* as shown below. The green vertical line in *Wave Form View* positions the event.

The screenshot displays the UNIGRAF Link Timeline Viewer interface. The main window is divided into several panes. On the left, the 'Main Link Events' pane shows a list of events. The 'Event Selector View' is active, showing details for a selected event (ID: 358, Position: 0:021:919:709:505). The 'Wave Form View' is also visible, showing a timeline with a green vertical line indicating the selected event. The 'Symbol View' is focused, showing a detailed view of the event's data, including a table of symbols and their values.

Double clicking on a frame in *Wave Form View* focuses areas as seen below.

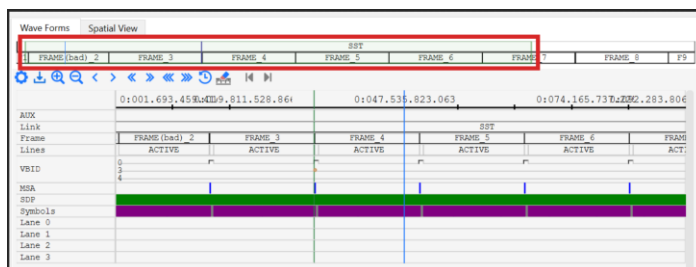
The screenshot displays the UNIGRAF Link Timeline Viewer interface. The main window is divided into several panes. The 'Wave Form View' is active, showing a timeline with a green vertical line indicating the selected event. The 'Symbol View' is focused, showing a detailed view of the event's data, including a table of symbols and their values. The 'Event Selector View' is also visible, showing details for the selected event (ID: 5, Position: 0:049:948:413:882).

The ruler tool allows users to measure the distance between two points on the timeline. When you right click on the timeline, a point will appear. Right click again on the timeline and the distance between the two points will be shown as illustrated below.

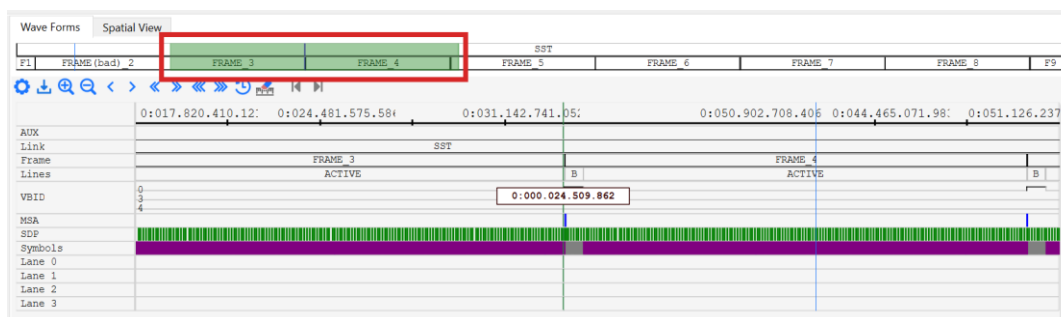


Various zoom levels are described:

Zoom in a bit and the area shown in *Wave Form View* is highlighted with light green color.

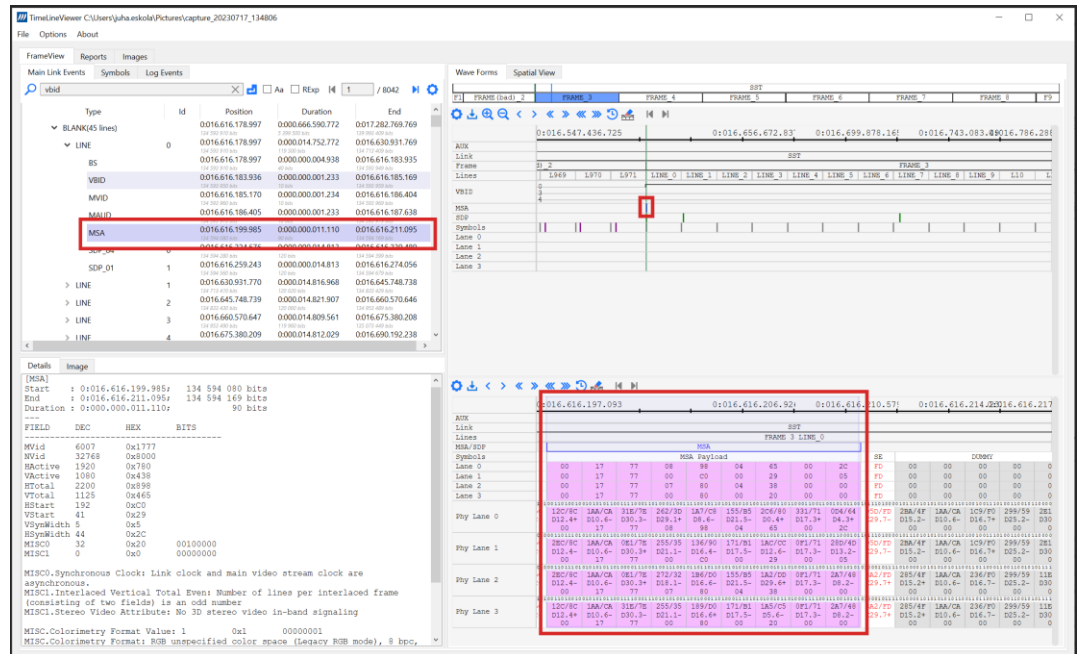


Zoom in more and the frames shown in *Wave Form View*, are highlighted in green in the scroll bar.

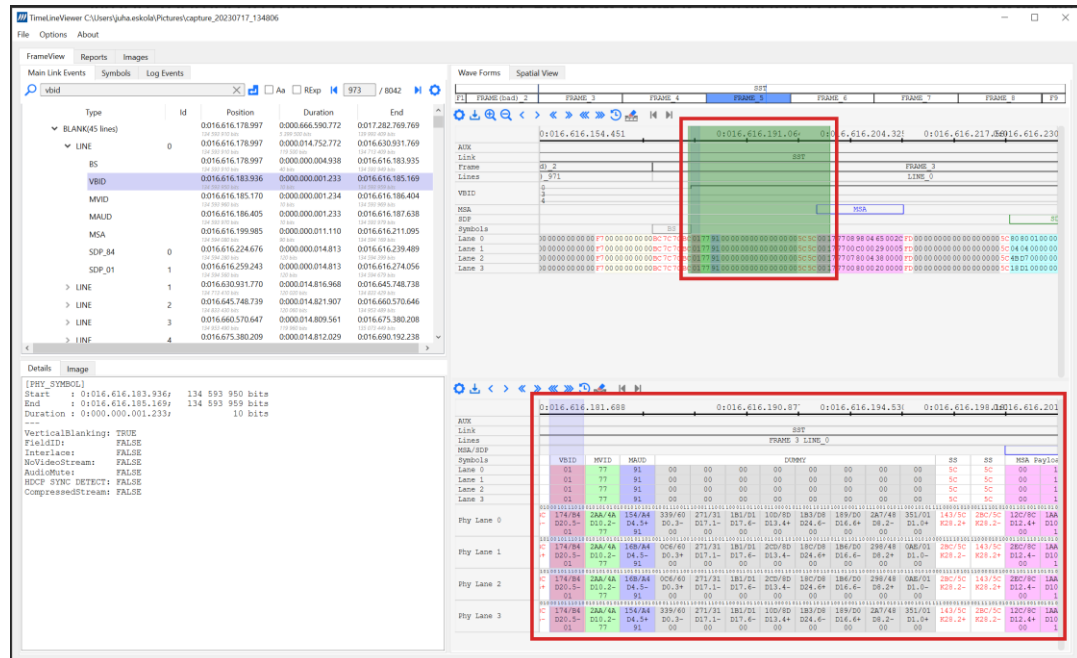




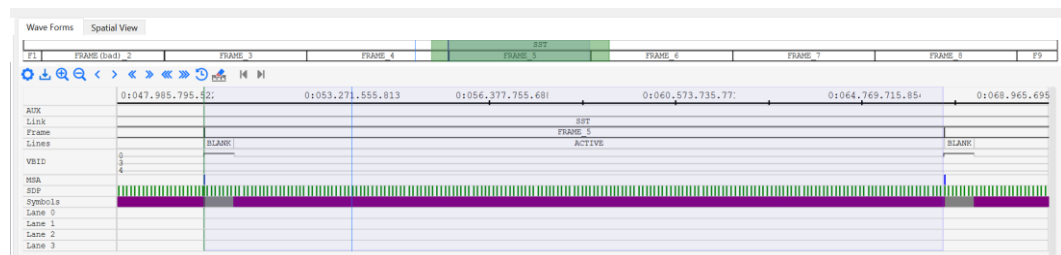
Zooming in further, *Wave Form View* shows the events as small vertical lines. When zooming in on a certain event, make sure to keep the cursor on top of the event you are interested in.



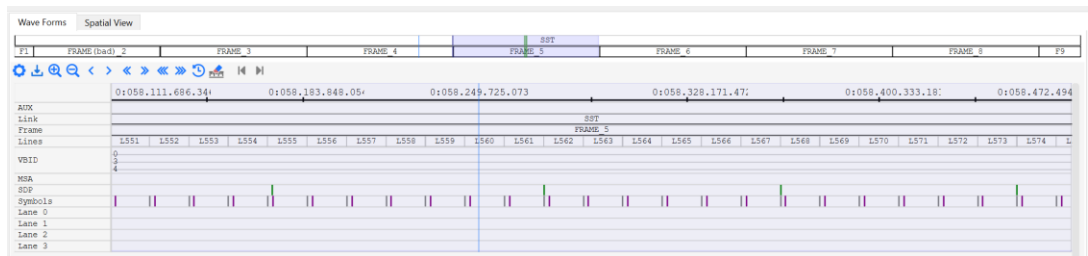
Zooming in further, the area shown in *Symbols View* is highlighted in *Wave Form View* with green color.



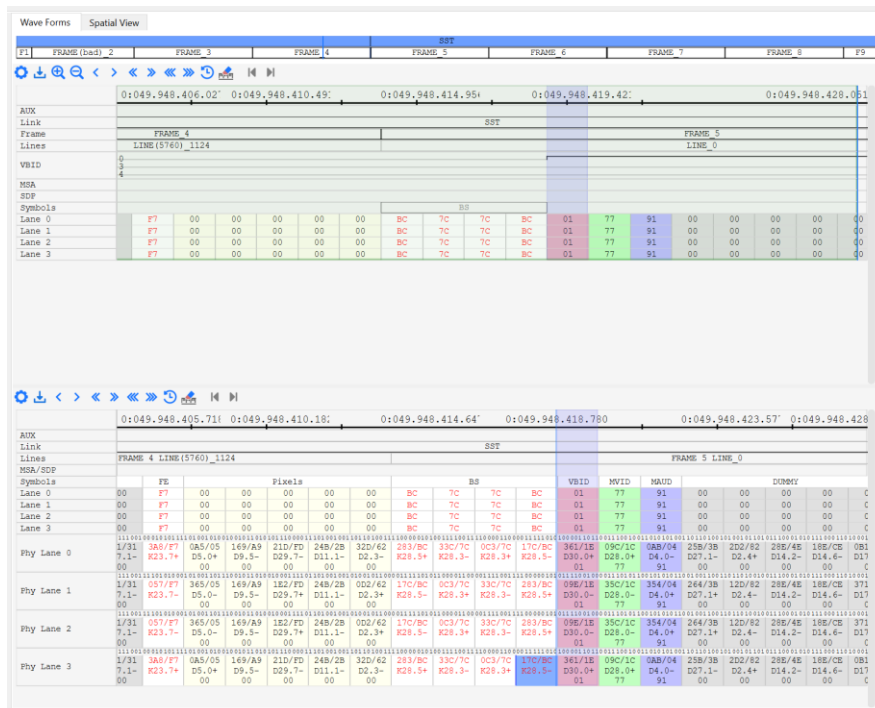
The image below shows a view of one frame in *Wave Form View* when zoomed in on a frame level. You can see the blank area and active in this view.



Zooming in closer, you begin to see the *Frame* line numbers (L560 for ex.) in the *Lines* row.

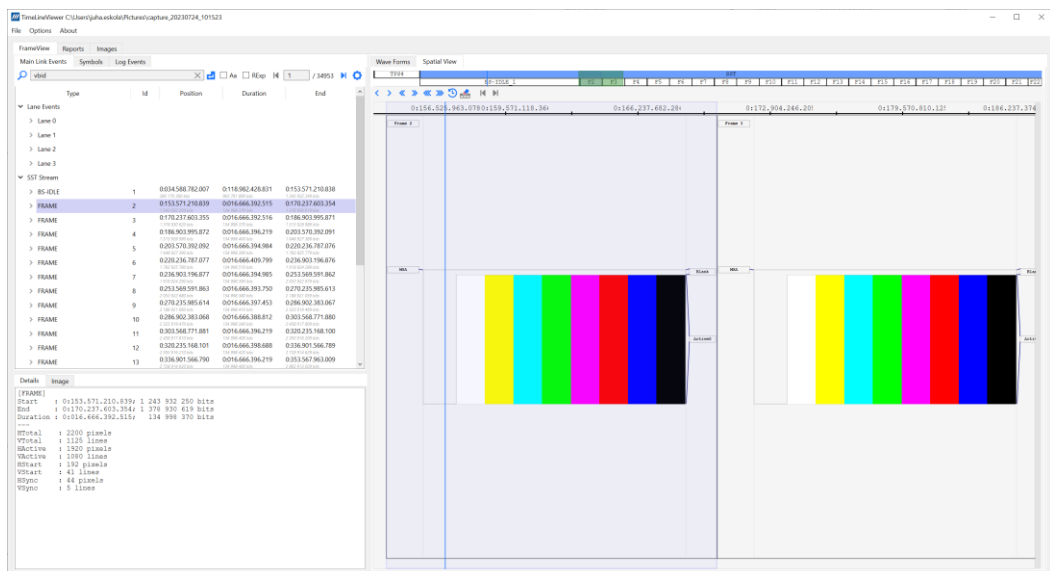


The lines shown in *Wave Form View* are symbols that match those shown in *Symbols View*. When you zoom in close enough, you can see the symbols in both views as shown below.

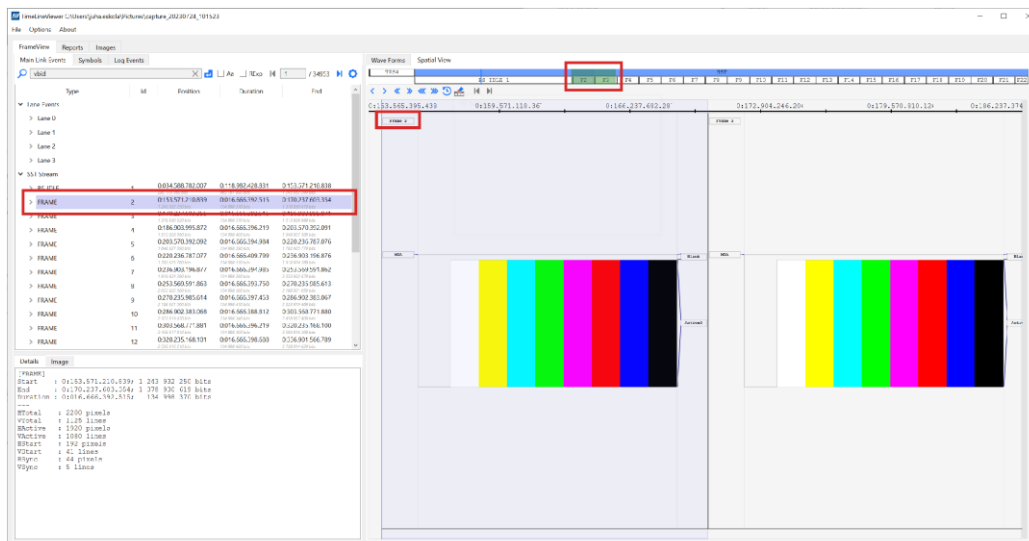


## Spatial View Tab

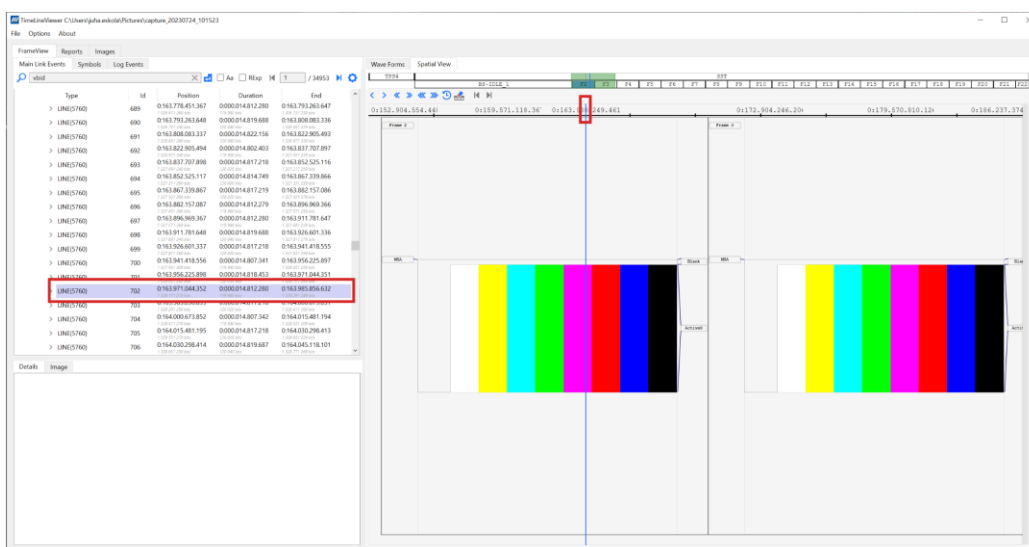
Spatial view shows the geometry of the frame.



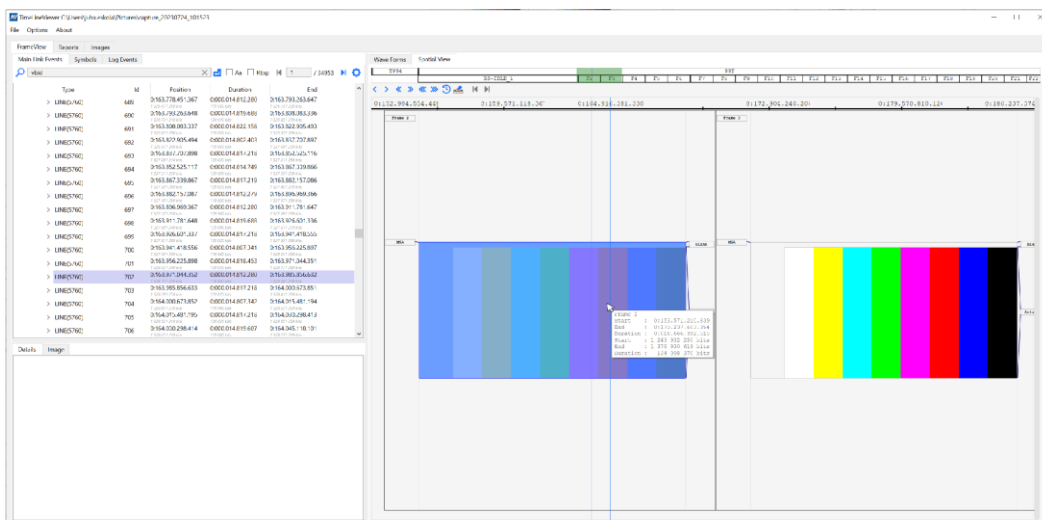
If you select a frame in *Event Selector* the frame will be shown in *Spatial View* as shown in the image below.



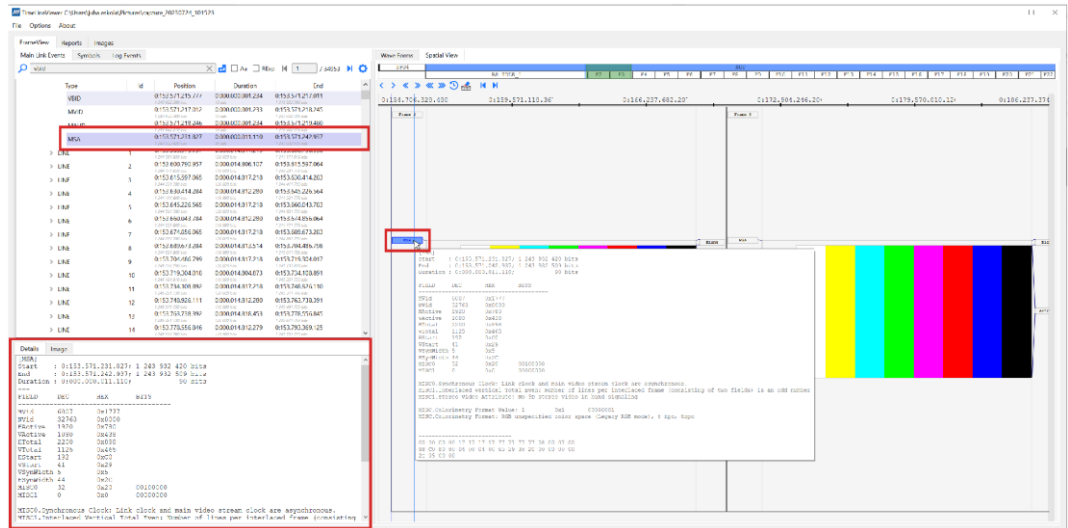
If you double-click on the timeline, the line on that time stamp will be selected in the *Event Selector View* as illustrated in the image below.



When you hover a cursor on top of the frame, frame details will be shown. Frame details include the start, end and duration of the frame.



When you hover your mouse over an event shown next the frame, details of that event will be shown in a popup window. If you double-click on the event, it will be selected in the *Event Selector* and its details will be shown in the *Event Details*.



In addition to *Wave Form View*, *Symbols View* (shown in SST mode) shows symbols from the PHY lanes. Identically to *Wave Form View* you can scroll the *Symbols View* by clicking it, holding and dragging or by using the arrow keys.

<i>AUX:</i>	Events of the AUX channel.
<i>Link:</i>	Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)
<i>Lines:</i>	Frame and line number
<i>MSA/SDP:</i>	Location of MSA and SDP events
<i>Symbols:</i>	Control and special symbols
<i>Lanes (0-3):</i>	Decoded data and control symbols
<i>PHY Lanes (0-3):</i>	Binary bit stream, 10b/8b scrambled symbols, symbol code and descrambled values

[illegible]

The lower part of the *Symbol View* (shown in SST mode) describes the distribution of link symbols in the physical link lanes. You can see the individual bits above the symbol blocks. When you mouse hover over a symbol, a popup shows details of the selected symbol. Details include:

129

001 01 010 100 1  
0AA/0A  
D10.0+  
00

First row:	10b/8b link symbol in HEX format
Second row:	Link symbol K or D code. K symbols are highlighted with red color.
Third row:	Descrambled value if available

You can see the result of scrambling in *Symbols View (shown in SST mode)*. As you can see in the image below, all blocks have value of 00. However, the first row of each block reads a different 10b/8b link symbols.

Phy Lane 0	01001000110100110100010111000111101010101100101001010010101010101010101010
	04B/EB    2CB/8B    0E8/77    15E/BE    14D/AD    14A/BF    2B5/5F
	D11.7+    D11.4-    D23.3+    D30.5-    D13.5-    D31.5+    D31.2-
	00                  00                  00                  00                  00                  00                  00
Phy Lane 1	01001000110100110100010111000111101010101100101001010010101010101010101010
	04B/EB    2CB/8B    0E8/77    15E/BE    14D/AD    14A/BF    2B5/5F
	D11.7+    D11.4-    D23.3+    D30.5-    D13.5-    D31.5+    D31.2-
	00                  00                  00                  00                  00                  00                  00
Phy Lane 2	01001000110100110100010111000111101010101100101001010010101010101010101010
	04B/EB    2CB/8B    0E8/77    15E/BE    14D/AD    14A/BF    2B5/5F
	D11.7+    D11.4-    D23.3+    D30.5-    D13.5-    D31.5+    D31.2-
	00                  00                  00                  00                  00                  00                  00
Phy Lane 3	010011101101000001011101000111000011010101100101010101011010010100010101010
	_CB/EB    10B/8B    317/77    161/BE    14D/AD    175/BF    28A/5F
	D11.7-    D11.4+    D23.3-    D30.5+    D13.5-    D31.5-    D31.2+
	00                  00                  00                  00                  00                  00                  00

FEC parity codes are highlighted in *Symbols View* with a light green color. CD\_ADJ symbols are highlighted with light red color. Image for SST mode.

	B9	67	89	90	B2	E3	
	B1	3C	83	90	6A	68	
	94	42	F8	A0	2A	05	
	94	42	F8	A0	2A	05	
0110011010101111000110010010111011001001010100111010110001000110	159/B9	0C7/67	2E9/89	2C9/90	172/B2	223/E3	2
-	D25.5-	D7.3-	D9.4-	D16.4+	D18.5-	D3.7+	
1010001110100011110010010011010110110010010101011100111001001101	171/B1	25C/3C	123/83	136/90	0EA/6A	327/68	2
+	D17.5-	D28.1-	D3.4+	D16.4-	D10.3-	D8.3-	
100010110010101101010101001100111001100010100101011001101001101101	134/94	2AD/42	1CC/F8	146/A0	26A/2A	365/05	2
+	D20.4+	D2.2-	D24.7+	D0.5+	D10.1-	D5.0-	
100010110010101101010101001100111001100010100101011001101001101101	134/94	2AD/42	1CC/F8	146/A0	26A/2A	365/05	2
+	D20.4+	D2.2-	D24.7+	D0.5+	D10.1-	D5.0-	



## SDP

SDPs are highlighted with turquoise color. You can see the start of the SDP event marked as SS and the end of the SDP event marked as SE. Image for SST mode.

SST															
BS-IDLE 1 LINE_3															
SDP_01_7															
SS															SE
5C	00	60	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
5C	01	07	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
5C	47	D5	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
5C	18	31	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
143/5C	0E3/63	2DA/9A	29A/5A	19C/DC	1D2/E2	2E2/9D	231/F1	29B/5B	1A3/C3	34A/1F	165/A5	15A/BA	3A2/FD	3A2/FD	
K28.2+	D3.3-	D26.4-	D26.2-	D28.6-	D2.7+	D29.4+	D17.7+	D27.2-	D3.6-	D31.0+	D5.5-	D26.5-	K29.7+	K29.7+	
	00	60	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
143/5C	32D/62	1E2/FD	29A/5A	19C/DC	1D2/E2	2E2/9D	231/F1	29B/5B	1A3/C3	34A/1F	165/A5	15A/BA	3A2/FD	3A2/FD	
K28.2+	D2.3-	D29.7+	D26.2-	D28.6-	D2.7+	D29.4+	D17.7+	D27.2-	D3.6-	D31.0+	D5.5-	D26.5-	K29.7+	K29.7+	
	01	07	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
143/5C	26B/24	245/2F	29A/5A	19C/DC	22D/E2	11D/9D	3B1/F1	2A4/5B	1A3/C3	0B5/1F	165/A5	15A/BA	05D/FD	05D/FD	
K28.2+	D4.1-	D15.1+	D26.2-	D28.6-	D2.7-	D29.4-	D17.7-	D27.2+	D3.6-	D31.0-	D5.5-	D26.5-	K29.7-	K29.7-	
	47	D5	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	
28C/5C	0E4/7B	18B/CB	29A/5A	19C/DC	22D/E2	11D/9D	3B1/F1	2A4/5B	1A3/C3	0B5/1F	165/A5	15A/BA	05D/FD	05D/FD	
K28.2-	D27.3+	D11.6-	D26.2-	D28.6-	D2.7-	D29.4-	D17.7-	D27.2+	D3.6-	D31.0-	D5.5-	D26.5-	K29.7-	K29.7-	
	18	31	00	01	2C	00	B4	00	80	00	00	7F	FD	FD	

## Pixel data

Grey area is fill symbols (scrambled 00). Light yellow area is actual pixels (surrounded by fill end symbol and fill start symbol). K30.7 is fill start and K23.7 is fill end. Image for SST mode.

Pixels															
FE															FS
00	F7	00	00	00	00	00	00	00	00	00	00	FE	00	00	
00	F7	00	00	00	00	00	00	00	00	00	00	FE	00	00	
00	F7	00	00	00	00	00	00	00	00	00	00	FE	00	00	
00	F7	00	00	00	00	00	00	00	00	00	00	FE	00	00	
36A/0A	3A8/F7	223/E3	25C/3C	296/56	269/29	163/A3	0C7/67	0B6/10	1CE/EE	2A3/43	3A1/FE	162/BD	162/BD	162/BD	
D10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+	D29.5+	D29.5+	
00		00	00	00	00	00	00	00	00	00	00	00	00	00	
0AA/0A	057/F7	1E3/E3	25C/3C	296/56	269/29	163/A3	338/67	349/10	04E/EE	2A3/43	05E/FE	15D/BD	15D/BD	15D/BD	
D10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	K30.7-	D29.5-	D29.5-	D29.5-	
00		00	00	00	00	00	00	00	00	00	00	00	00	00	
0AA/0A	057/F7	1E3/E3	25C/3C	296/56	269/29	163/A3	338/67	349/10	04E/EE	2A3/43	05E/FE	15D/BD	15D/BD	15D/BD	
D10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	K30.7-	D29.5-	D29.5-	D29.5-	
00		00	00	00	00	00	00	00	00	00	00	00	00	00	
36A/0A	3A8/F7	223/E3	25C/3C	296/56	269/29	163/A3	0C7/67	0B6/10	1CE/EE	2A3/43	3A1/FE	162/BD	162/BD	162/BD	
D10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+	D29.5+	D29.5+	
00		00	00	00	00	00	00	00	00	00	00	00	00	00	

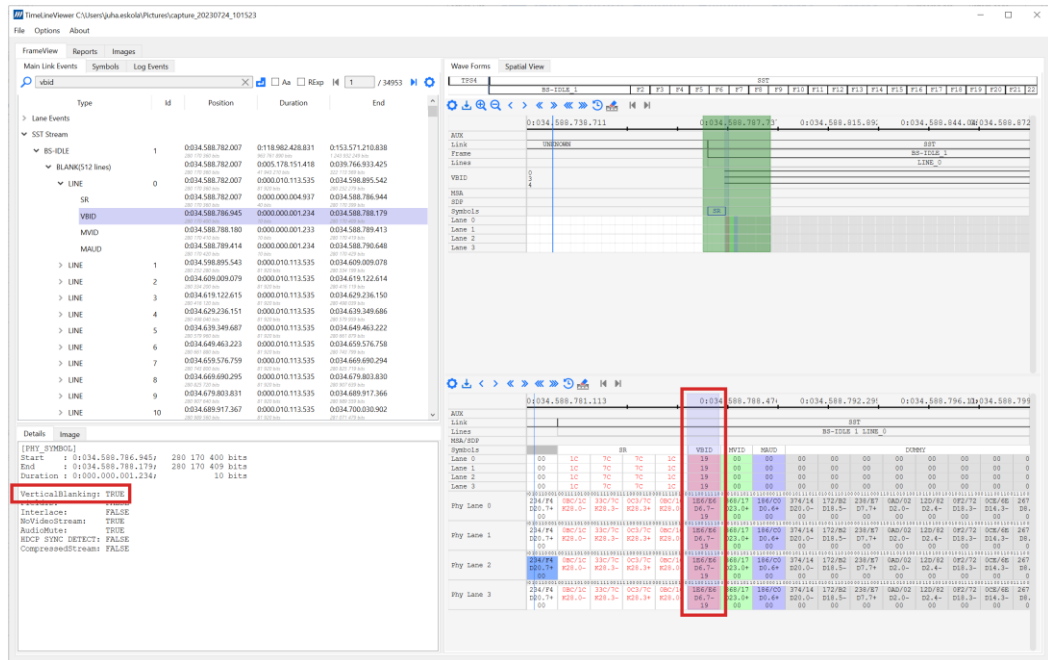
## MSA

MSA symbols are highlighted in purple color. Image for SST mode.

SST															
FRAME 4 LINE_0															
MSA															
SS	SS													SE	
00	5C	5C	00	17	77	08	98	04	65	00	2C	FD	FD	00	
00	5C	5C	00	17	77	00	C0	00	29	00	05	FD	FD	00	
00	5C	5C	00	17	77	07	80	04	38	00	00	FD	FD	00	
00	5C	5C	00	17	77	00	80	00	20	00	00	FD	FD	00	
147/A7	2BC/5C	143/5C	235/FF	19C/DC	097/17	1B6/D0	171/B1	274/34	1AA/CA	29C/5C	259/39	3A2/FD	3A2/FD	196/D6	
D7.5-	K28.2-	K28.2+	D31.7-	D28.6-	D23.0-	D16.6-	D17.5-	D20.1-	D10.6-	D28.2-	D25.1-	K29.7+	K29.7+	D22.6-	
00			00	17	77	08	98	04	65	00	2C	FD	FD	00	
178/A7	143/5C	2BC/5C	1CA/FF	19C/DC	368/17	18C/D8	1E9/B9	249/30	2E6/86	29C/5C	349/10	3A2/FD	3A2/FD	196/D6	
D7.5+	K28.2+	K28.2-	D31.7+	D28.6-	D23.0+	D24.6+	D9.7-	D16.1+	D6.4-	D28.2-	D16.0+	K29.7+	K29.7+	D22.6-	
00			00	17	77	00	C0	00	29	00	05	FD	FD	00	
178/A7	143/5C	2BC/5C	1CA/FF	19C/DC	368/17	18A/DF	169/A9	274/34	117/97	29C/5C	355/15	3A2/FD	3A2/FD	196/D6	
D7.5+	K28.2+	K28.2-	D31.7+	D28.6-	D23.0+	D31.6+	D9.5-	D20.1-	D23.4-	D28.2-	D21.0-	K29.7+	K29.7+	D22.6-	
00			00	17	77	07	80	04	38	00	00	FD	FD	00	
178/A7	143/5C	2BC/5C	1CA/FF	19C/DC	368/17	18C/D8	169/A9	276/30	2C5/8F	29C/5C	095/15	05D/FD	05D/FD	196/D6	
D7.5+	K28.2+	K28.2-	D31.7+	D28.6-	D23.0+	D24.6+	D9.5-	D16.1-	D15.4+	D28.2-	D21.0+	K29.7-	K29.7-	D22.6-	
00			00	17	77	00	80	00	20	00	00	FD	FD	00	

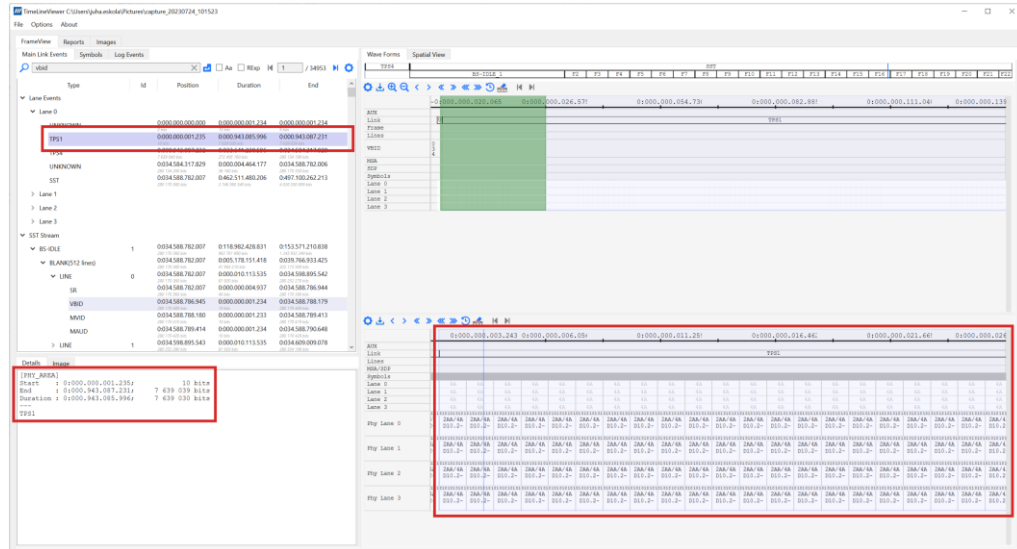
## VBID

The *Event Details* will show information of what the line will contain. In the image below you can see that the line is vertical blanking without pixel data. Image for SST mode.

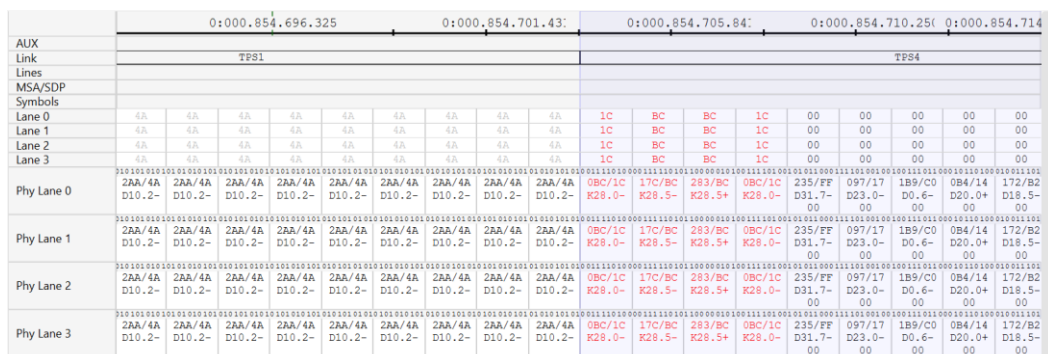


## TPS Events

The image below shows how the events are shown for each lane in *Event Selector*, *Symbol View* and *Event details*. The image below shows a TPS1 event. Image for SST mode.



The image below illustrates the transition from TPS1 to TPS4. Image for SST mode.



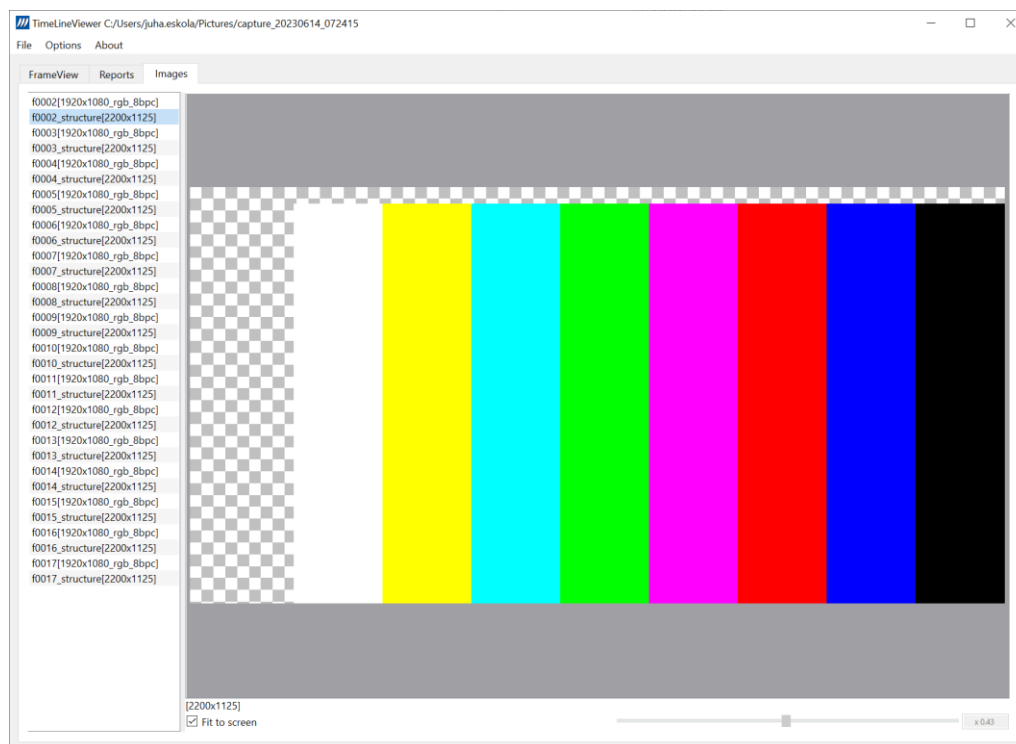


## Images Tab

Video frames decoded from Main Link Data Capture can be previewed in Images tab. Frames are listed on the left-hand side of the window. Each frame has two lines. The first line shows the frame with its active area only.



The second line is a structure frame, which shows total and active area.





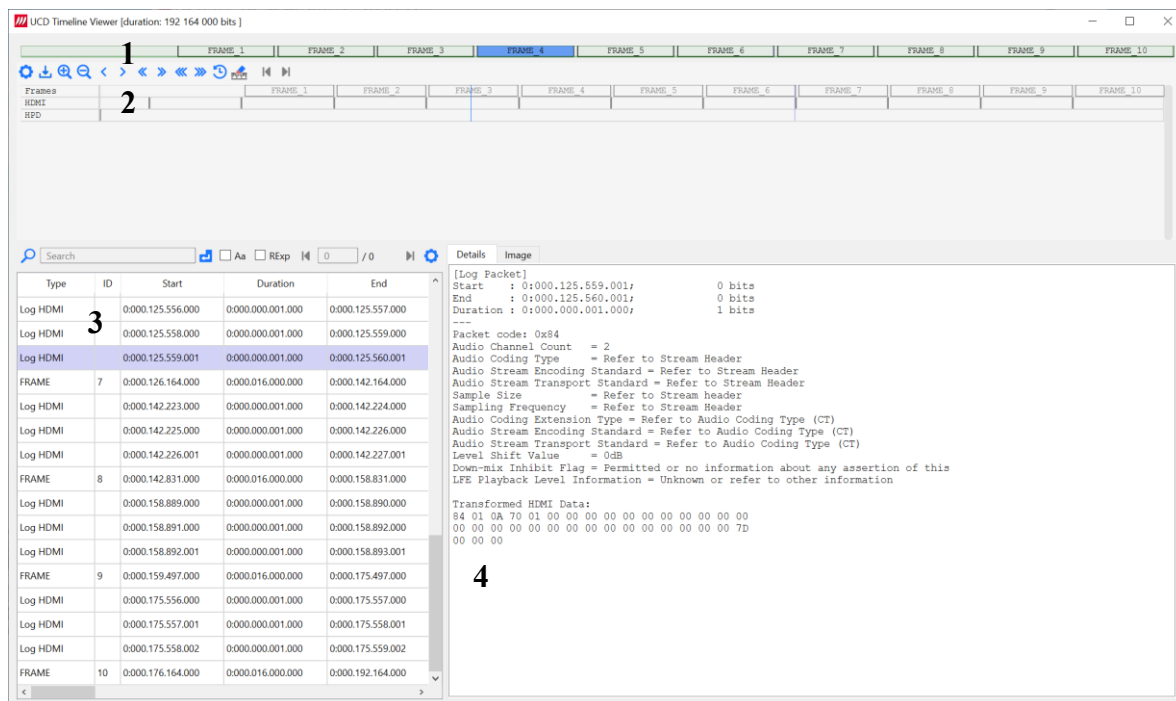


## 7. EVENT TIMELINE VIEWER

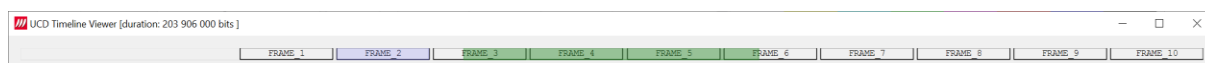
*Event Timeline Viewer* is an application for inspecting data captured in capture and event log tabs.

Event Timeline Viewer consists of four areas.

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

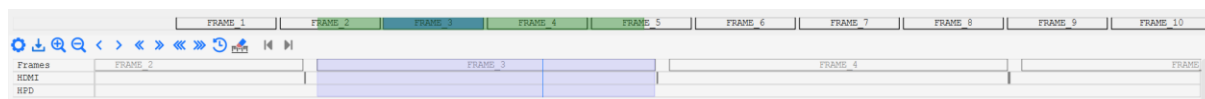


### Frame View









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

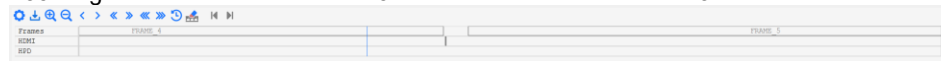


The view below shows all frames and events selected in the capture tab. The area highlighted in green in frame view indicates the area shown in events view.

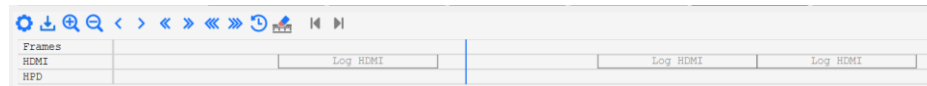
## Tools

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 on the timeline.
 Move to a time point	Move to a certain time point on the timeline by double clickin 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.

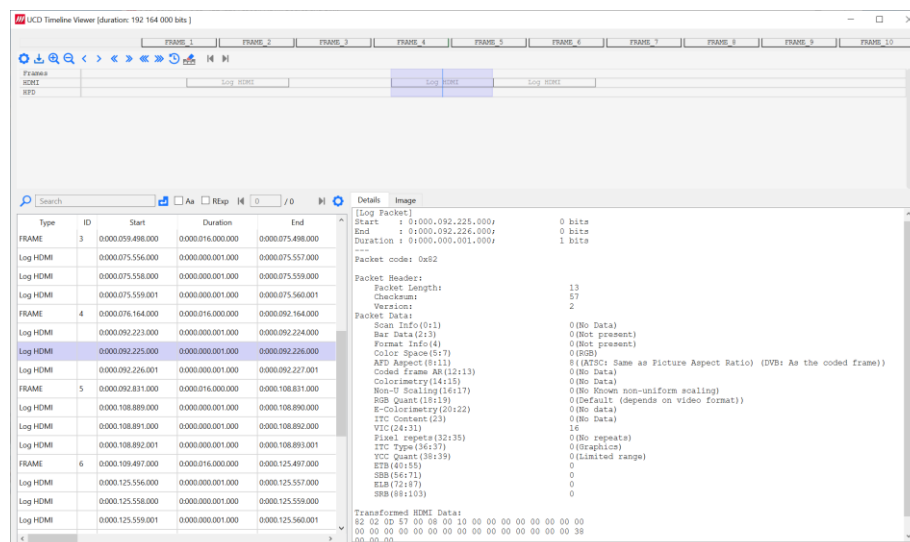
Zooming on the timeline



When 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
FRAME	3	0:000.059.498.000	0:000.016.000.000	0:000.075.498.000	
Log HDMI		0:000.075.556.000	0:000.000.001.000	0:000.075.557.000	0x03 HDMI GCP
Log HDMI		0:000.075.558.000	0:000.000.001.000	0:000.075.559.000	0x82 HDMI AVI [INFOFRAME]
Log HDMI		0:000.075.559.001	0:000.000.001.000	0:000.075.560.001	0x84 HDMI Audio [INFOFRAME]
FRAME	4	0:000.076.164.000	0:000.016.000.000	0:000.092.164.000	
Log HDMI		0:000.092.223.000	0:000.000.001.000	0:000.092.224.000	0x03 HDMI GCP
Log HDMI		0:000.092.225.000	0:000.000.001.000	0:000.092.226.000	0x82 HDMI AVI [INFOFRAME]
Log HDMI		0:000.092.226.001	0:000.000.001.000	0:000.092.227.001	0x84 HDMI Audio [INFOFRAME]
FRAME	5	0:000.092.831.000	0:000.016.000.000	0:000.108.831.000	
Log HDMI		0:000.108.889.000	0:000.000.001.000	0:000.108.890.000	0x03 HDMI GCP
Log HDMI		0:000.108.891.000	0:000.000.001.000	0:000.108.892.000	0x82 HDMI AVI [INFOFRAME]
Log HDMI		0:000.108.892.001	0:000.000.001.000	0:000.108.893.001	0x84 HDMI Audio [INFOFRAME]
FRAME	6	0:000.109.497.000	0:000.016.000.000	0:000.125.497.000	
Log HDMI		0:000.125.556.000	0:000.000.001.000	0:000.125.557.000	0x03 HDMI GCP
Log HDMI		0:000.125.558.000	0:000.000.001.000	0:000.125.559.000	0x82 HDMI AVI [INFOFRAME]
Log HDMI		0:000.125.559.001	0:000.000.001.000	0:000.125.560.001	0x84 HDMI Audio [INFOFRAME]
FRAME	7	0:000.126.164.000	0:000.016.000.000	0:000.142.164.000	

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.

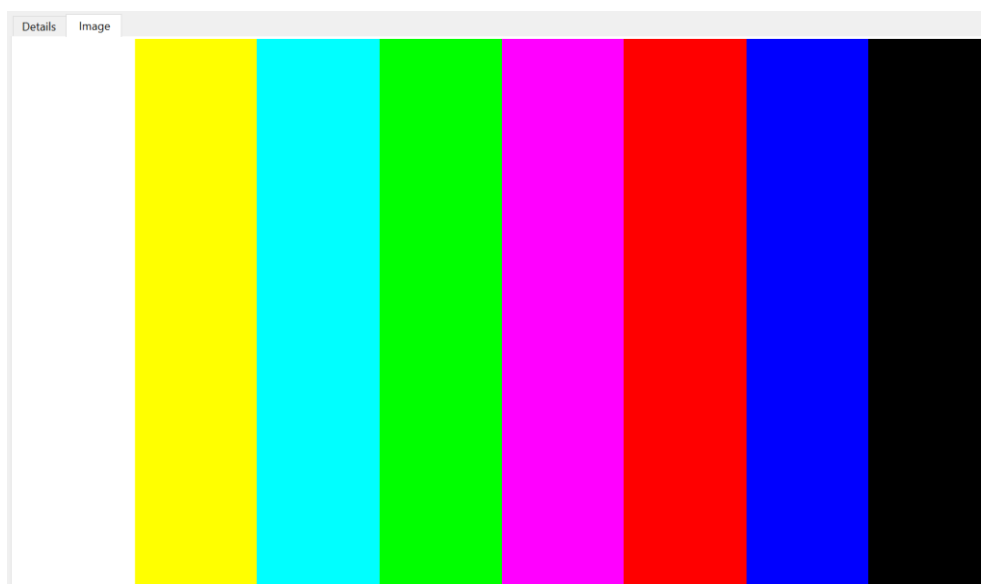
## Event Log Tools

 Search	Search events from the event log. Search results are highlighted in purple.
 Apply search filters	Apply filters.
<input type="checkbox"/> Aa <input type="checkbox"/> 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

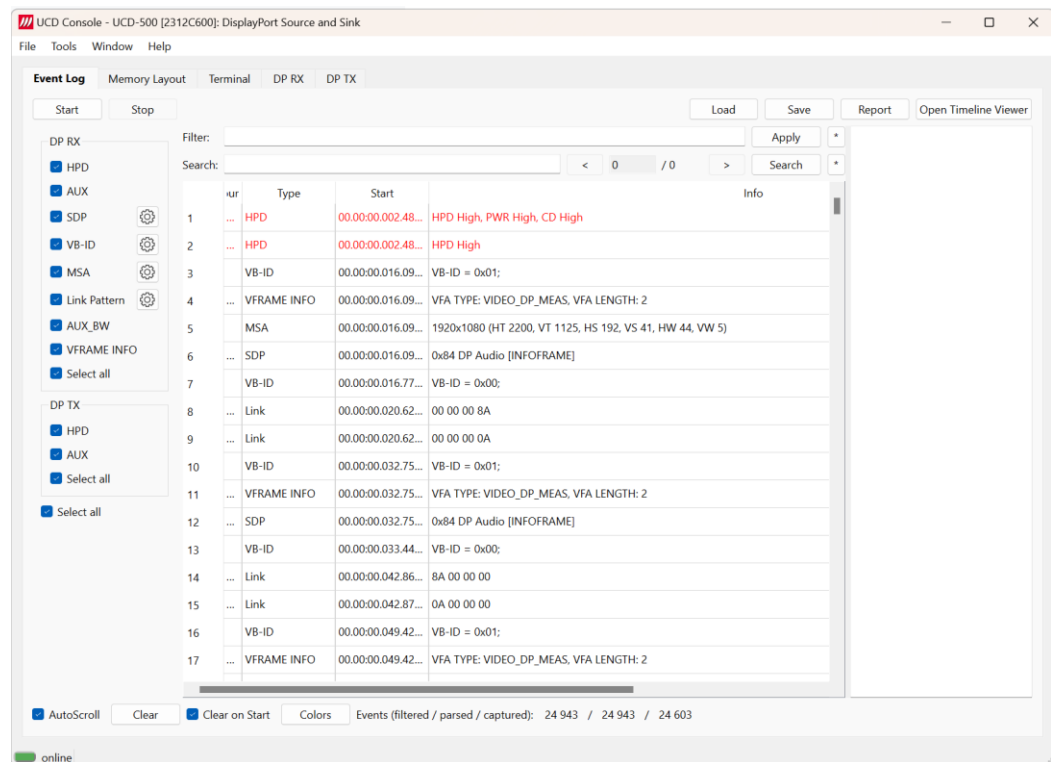
Details	Image
[Log Packet]	
Start : 0:000.092.225.000;	0 bits
End : 0:000.092.226.000;	0 bits
Duration : 0:000.000.001.000;	1 bits
--	
Packet code: 0x82	
Packet Header:	
Packet Length:	13
Checksum:	57
Version:	2
Packet Data:	
Scan Info(0:1)	0 (No Data)
Bar Data(2:3)	0 (Not present)
Format Info(4)	0 (Not present)
Color Space(5:7)	0 (RGB)
AFD Aspect(8:11)	8 ((ATSC: Same as Picture Aspect Ratio) (DVB: As the coded frame))
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 repeats(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 38	
00 00 00	

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



## 8. EVENT LOG

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 DP Alt Mode Sink	HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW
DP Source DP Alt Mode Source	HPD, AUX
DP Alt Mode Sink DP Alt Mode Source	PD, LSE
<i>Start:</i>	Starts event logging and stop it by clicking <i>Stop</i> .
<i>Save:</i>	Save transactions as Event Log data as binary or as CSV
<i>Load:</i>	Load saved Event Log data
<i>Report:</i>	Store event logs as reports in HTML format to be shared and viewed with any web browser.
<i>Open Timeline Viewer</i>	Open Event Timeline Viewer to inspect the captured data. Refer to chapter seven of this manual for detailed instructions.
<i>AutoScroll:</i>	When selected, the transaction list is automatically 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.
<i>Events:</i>	Number of events detected
<i>Colors:</i>	Open configure colors dialog
<i>Clear:</i>	Click to clear transaction list. When <i>Clear on Start</i> is selected, the list is cleared when clicking Start.



## Selecting Logged Events


### HPD

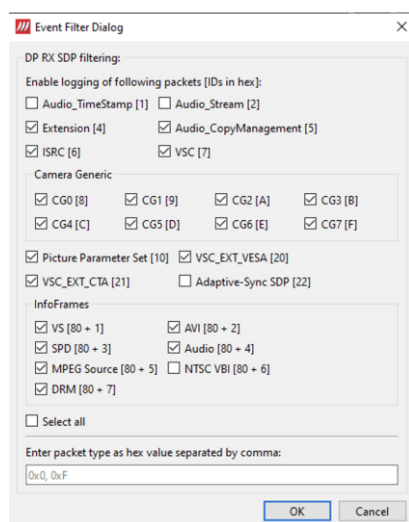
Status and status changes of Hot Plug Detect (HPD) signal, power detection status and cable connection status. HPD Trace, HPD De-assert to HPD Assert interval.

### AUX


Log DP AUX Channel transactions and Sideband Messaging.

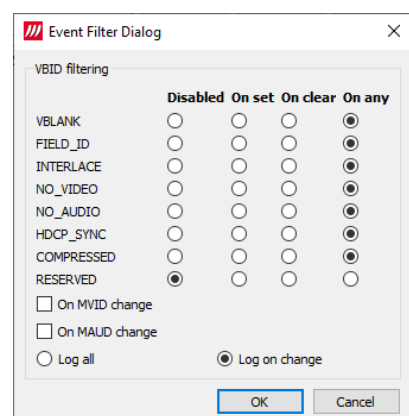
### SDP

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




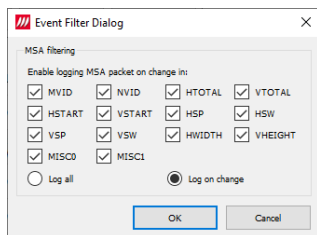
### VB-ID

Log Vertical Blanking ID packets sent in DP stream. Click the  button to open the *Event Filter Dialog*. The dialog enables definition of which events will be logged.



## MSA

Log Main Stream Attributes sent in DP stream. Click the  button to open the *Event Filter Dialog*. The dialog enables logging of all MSA packets and the changes on the selected parameter.



## VFRAME INFO

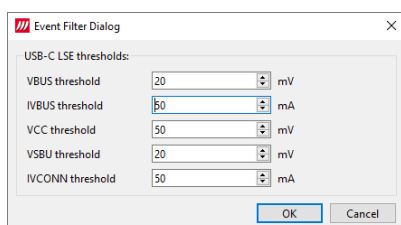
Dimensions of the captured frame measured by the Sink

## 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.



Event Filter Dialog sets the threshold values for capturing the changes. Parsed transaction data shows the captured data with indication of the changed values.

## AUX\_BW

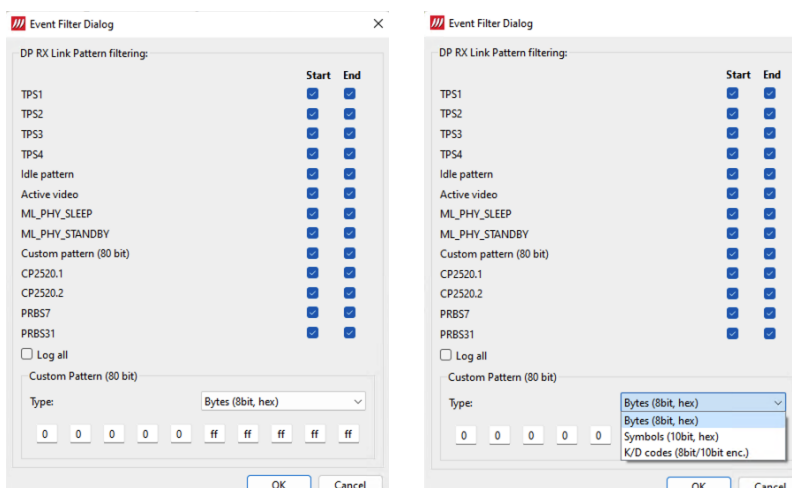
Log AUX\_Bitwise transactions as a series of Manchester II codes.

## Link Pattern

Click the  button to open the *Event Filter Dialog*.

Log link patterns. Event filter dialog sets the type of link patterns that will be captured.

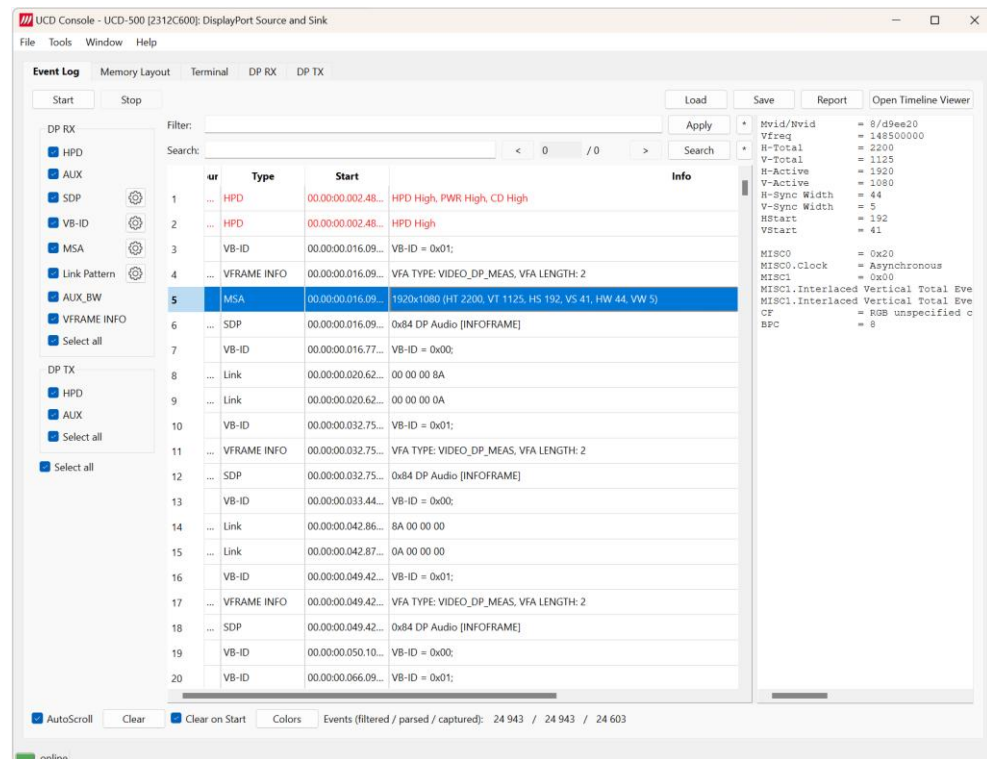
Custom Pattern (80 bit) is a sequence that either splits into 10 bytes or 8b/10b encoded symbols. For 10b symbols, either K/D codes or hex values must be provided. For bytes, hex values must be provided.



## Event Transaction List

Transaction data in Transaction List is ordered in columns. Each column provides additional Information.

You can search events by typing its name in the Search bar and pressing enter or selecting the *Search* button. Pressing F3 (Ctrl+G on macos) takes you to the next found and Shift+F3 (Shift+Ctrl+G on macOS) takes you to the previous found.



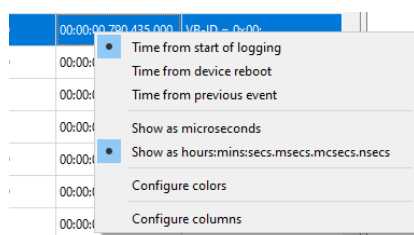
<i>Source:</i>	The communication port: DP RX to DP TX
<i>Type</i>	The logged item: HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW, VFRAME INFO
<i>Start:</i>	Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started. The 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.
<i>Info</i>	This column provides a short description of the message content

When hovering the mouse over the transaction list, a mouse-over window will open. It provides a brief list of the content in the transaction under the mouse.

## 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. Users 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:

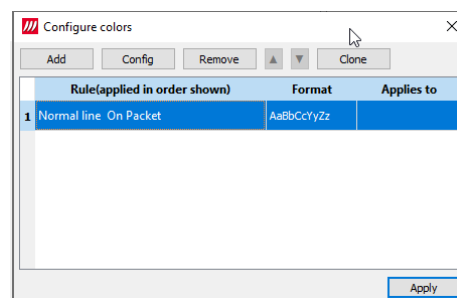
- Time from start of logging.
- Time from previous reboot.
- Time from previous event.

The time can be expressed either:

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

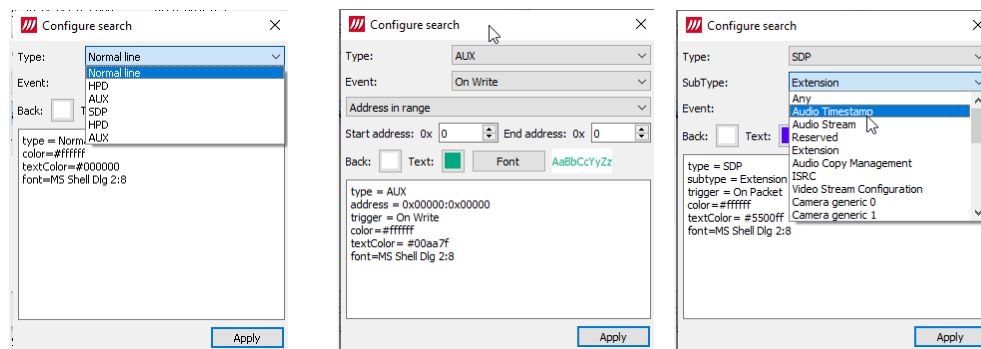
*Remove:* Delete the selected rule

*Clone:* Duplicate the selected rule

▲ ▼: Change the order where rules are applied.  
The rules are applied from the bottom to the top of the list.

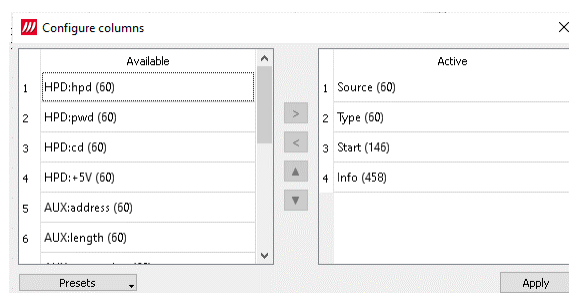
## Adding Rules

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

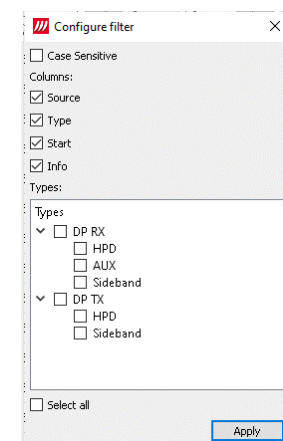
In the dialog there are two columns: *Available* and *Active*. An item from the Available list can be included in the Active column by selecting it and clicking on the right arrow [>] in the middle of the two columns.



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.

## Event Details

### HPD

HPD transactions include the following statuses:

<i>HPD Level:</i>	Status of HPD signal: HIGH (Asserted), LOW (De-asserted)
<i>Power Level: (in DP RX)</i>	Status of source device detection: High (DP Tx detected), LOW (DP Tx not detected)
<i>Cable Detect Level: (in DP RX):</i>	Status of cable detection HIGH (Cable connection detected) LOW (Cable connection not detected)

```
Device ID      = 01 [DP RX]
HPD Level      = HIGH
Power Level    = LOW (DP Tx is connected to Rx and has power applied to AUX pull-up resist
Cable Detect Level = HIGH
```

### HPD Trace

HPD De-assert to HPD Assert interval.

```
Interval: 501.525 ms [HPD Assert]
```

### AUX

Transaction list includes the following DP AUX Channel transactions. The parsed transactions panel provides details for each transaction.

<i>RD:</i>	Native AUX Request Transaction for read
<i>WR:</i>	Native AUX Request Transaction for write
<i>I2C RD:</i>	I2C-over-AUX Request Transaction for read
<i>I2C WR:</i>	I2C-over-AUX Request Transaction for write
<i>AUX_ACK:</i>	AUX Reply Transaction (Request accepted)
<i>AUX_NACK:</i>	AUX Reply Transaction (Request not accepted)
<i>AUX_DEFER:</i>	AUX Reply Transaction (Delayed, new request needed)
<i>Sideband REQ:</i>	Sideband down request message (DOWN_REQ_MSG)
<i>Sideband REP:</i>	Sideband down reply message (DOWN_REP_MSG)
<i>EDID Trace:</i>	Accumulated EDID content from I2C or sideband down messages
<i>DisplayID:</i>	Accumulated DisplayID content from I2C or sideband down messages
<i>HDCP Trace 1.X or HDCP Trace 2.3:</i>	HDCP Transmitter and HDCP Receiver communicate DPCD values over AUX Channel. Transactions are listed as DPCD Address Range Traces where HDCP Port name is indicated.

### Native AUX Transaction Example

```

Direction          = Source to Sink
Native AUX Request  = Read
Length              = 6
Address             = 0x00200

```

```

Link/Sink Device Status
SINK_COUNT [RO]
0x00200

```

```

Link/Sink Device Status
DEVICE_SERVICE_IRQ_VECTOR
0x00201

```

```

Link/Sink Device Status
LANE0_1_STATUS [RO]
0x00202

```

```

Link/Sink Device Status
LANE2_3 STATUS [RO]
0x00203

```

```

Link/Sink Device Status
LANE_ALIGN_STATUS_UPDATED [RO]
0x00204

```

```

Link/Sink Device Status
SINK_STATUS [RO]
0x00205

```

```

Direction          = Sink to Source
Native AUX Reply    = AUX_ACK
I2C-over-AUX Reply  = AUX_ACK

```

```

Link/Sink Device Status
SINK_COUNT [RO]
0x00200 := 0x01
SINK_COUNT = 1
CP_READY = 0

```

```

Link/Sink Device Status
DEVICE_SERVICE_IRQ_VECTOR
0x00201 := 0x10
REMOTE_CONTROL_COMMAND_PENDING = 0
AUTOMATED_TEST_REQUEST = 0
CP_IRQ = 0
MCCS_IRQ = 0
DOWN_REP_MSG_RDY = 1
UP_REQ_MSG_RDY = 0
SINK_SPECIFIC_IRQ = 0

```

```

Link/Sink Device Status
LANE0_1_STATUS [RO]
0x00202 := 0x77
LANE0_CR_DONE = 1
LANE0_CHANNEL_EQ_DONE = 1
LANE0_SYMBOL_LOCKED = 1
LANE1_CR_DONE = 1
LANE1_CHANNEL_EQ_DONE = 1
LANE1_SYMBOL_LOCKED = 1

```

```

Link/Sink Device Status

```

### Sideband Message Example

```

Sideband message header
Link_Count_Total          1
Link_Count_Remaining      0
Broadcast_Message         0
Path_Message              1
MSG_Body_Length           3
Start_Of_MT               1
End_Of_MT                 1
Message_Sequence_No       0

Sideband message validity check
MSG_Header_CRC            7[Good]
MSG_Body_CRC              95[Good]
Header Reserved (Zero) fields [Good]

Message Transaction decode
Request_Identifier         0x10[ENUM_PATH]
Port_Number               8

```

```

Sideband message header
Link_Count_Total          1
Link_Count_Remaining      0
Broadcast_Message         0
Path_Message              1
MSG_Body_Length           7
Start_Of_MT               1
End_Of_MT                 1
Message_Sequence_No       0

Sideband message validity check
MSG_Header_CRC            0[Good]
MSG_Body_CRC              20[Good]
Header Reserved (Zero) fields [Good]

Message Transaction decode
Reply_Type                 ACK
Request_Identifier         0x10[ENUM_PATH]
Port_Number               8
Full_Payload_Bandwidth_Number_Available 7737
Payload_Bandwidth_Number  7737

```

### HDCEP Trace Example

```

E(kpub)_k(m)- DPCD Address range trace
0x69220 - 0x6929F
No extended trace decoding available.
Block dump:
CD C7 90 67 D8 D9 9A BD 43 56 64 18 52 A5 73 BB
41 56 E1 FD 82 F8 3A 24 9A BB 0C FD 42 98 3B 17
D8 E6 07 14 D6 E9 CA 25 19 10 3D 26 38 F6 15 B7
5E 4F BE 8B 25 B3 CC 62 0E 1D 00 21 41 E2 DD 09
50 A2 26 E5 8F 9D A0 2F F2 18 AA 98 48 C6 6D 49
AB D8 92 7E B3 A7 F2 CC 85 55 F7 51 53 31 41 FC
68 C2 6D BF 06 5A 8B D7 B9 17 87 53 8E 16 DE 74
00 E3 96 1C 4E A8 81 30 BA 68 B8 3D D6 EE C9 F7

```

DP Secondary-data Packets.

Vertical Blanking ID packets sent in DP stream.

Main Stream Attributes sent in DP stream.

148



## VFRAME INFO

Measured dimensions of the captured video frame

```
Stream ID          = 0
VFRECORD 1
VFA TYPE           VIDEO_DP_MEAS
VFA LENGTH         2
Vtotal             1125
Hactive            1920
Vactive            1080
```

## PD

USB-C PD communication messages

```
Start of packet: SOP (S1 S1 S1 S2)
-----
Header                                0x21A1                                Data Message
Extended(15)                          0
Data Objs(14..12)                      2
Message ID(11..9)                      0
Port Power Role(8)                     Source(0x1)
Spec Rev(7..6)                         v3.0(0x2)
Port Data Role(5)                      DFP(0x1)
Message Type(4..0)                     Source_Capabilities(0x01)
-----
Fixed PDO - Source                     0x2A01912C
Fixed supply(31..30)                   0x0
Dual-Role Power(29)                    True(0x1)
USB Suspend Supported(28)              False(0x0)
Unconstrained Power(27)                True(0x1)
USB Comm Capable(26)                   False(0x0)
Dual-Role Data(25)                     True(0x1)
Unchunked Ext Messages Sup(24)         False(0x0)
EPR Mode Capable(23)                   False(0x0)
Reserved(22)                           0x0
Peak Current(21..20)                   Peak current equals Ioc(0x0)
Voltage(19..10)                        5000mV(0x064)
Maximum Current(9..0)                  3000mA(0x12C)
-----
Fixed PDO - Source                     0x2A02D12C
Fixed supply(31..30)                   0x0
Dual-Role Power(29)                    True(0x1)
USB Suspend Supported(28)              False(0x0)
Unconstrained Power(27)                True(0x1)
USB Comm Capable(26)                   False(0x0)
Dual-Role Data(25)                     True(0x1)
Unchunked Ext Messages Sup(24)         False(0x0)
EPR Mode Capable(23)                   False(0x0)
Reserved(22)                           0x0
Peak Current(21..20)                   Peak current equals Ioc(0x0)
Voltage(19..10)                        9000mV(0x0B4)
Maximum Current(9..0)                  3000mA(0x12C)
-----
CRC                                    0x18F3953D
-----
End of packet
-----
```

## LSE

Status of USB-C Low Speed Electrical signals

```
Device ID          = 01
Packet size        = 40 [bytes]
Data length        = 40
Vbus TimeStamp     = 02:53:20.750.932.000

Vbus voltage       = 5420 mV [updated]
Vbus currents      = 88 mA
Vcc 1              = 5337 mV [updated]
Vcc 2              = 1680 mV [updated]
Vsbu 1             = 234 mV
Vsbu 2             = 2865 mV
Ivconn             = 5337 mA [updated]
```

Status of link pattern detected in which lane.

## AUX\_BW

```
Packet content type      = 0x00 [Data message]
Packet size             = 24 [bytes]
Direction              = Source to Sink
Native AXI Request     = Write
Length                 = 2
Data                   = 08 08
Address                = 0x001093

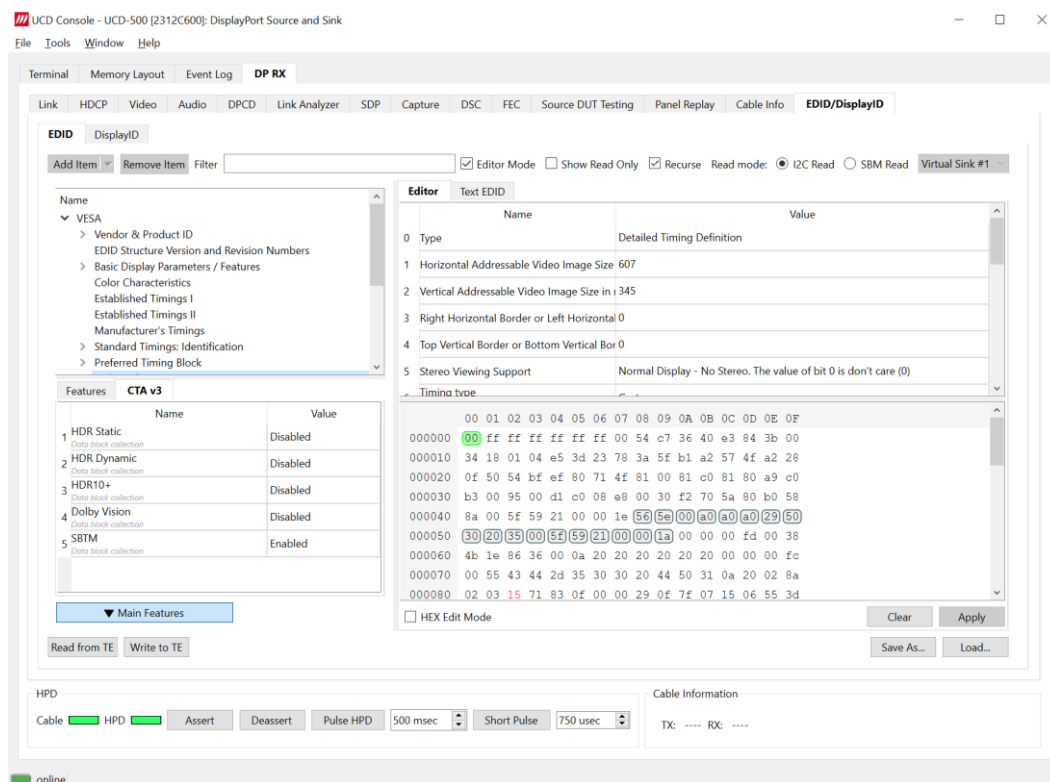
Link Configuration
TRAINING_LANE0_SET
0x001093 = 0x08
    VOLTAGE_SWING_SET = level 0
    MAX_SWING_REACHED = level 0
    PRE_EMPHASIS_SET = level 1
    PRE_EMPHASIS_REACHED = 0
NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b
TX_FFE_PRESET_VALUE = 8
NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 128b/132b

Link Configuration
TRAINING_LANE1_SET
0x001094 = 0x08
    VOLTAGE_SWING_SET = level 0
    MAX_SWING_REACHED = level 0
    PRE_EMPHASIS_SET = level 1
    PRE_EMPHASIS_REACHED = 0
NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 8b/10b
TX_FFE_PRESET_VALUE = 8
NOTE: Decoded as MAIN_LINK_CHANNEL_CODING_SET = 128b/132b

Transaction Data
80 01 03 01 08 08

Manchester II codes:
preamble: 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 H N L L
control:   1 0 0 0 [0x01]
address:   0 0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 1 1 [0x001093]
length:    0 0 0 0 0 0 0 0 1 [0x001]
data:      0 0 0 0 1 0 0 0 [0x08]
           0 0 0 0 1 0 0 0 [0x08]
postamble: H N L L
```

## 9. EDIDDISPLAYID 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.

<i>Add Item</i>	Add a new EDID or DisplayID block. Available when in <i>Editor Mode</i> exclusively.
<i>Remove Item</i>	Delete the selected EDID or DisplayID block. Available when in <i>Editor Mode</i> exclusively.
<i>Filter</i>	Show only items having the filter string in their field name.
<i>Read mode</i>	Select EDID data reading mode: I2C (using I2C protocol) or SBM (MST mode only): virtual channels read via SBM protocol.
<i>Show Read Only</i>	Automatically generated non-editable fields are additionally shown.
<i>Recurse</i>	All subitems of the selected item are presented in <i>Editor View</i> .
<i>Virtual Sink #1</i>	Dropdown labled with the currently selected virtual sink (MST).

The buttons at the bottom of the dialog differ based on role: *Analyser (Read from TE and Write to TE)* or *Generator (Download from Sink and Upload to Sink)*.

▼ Main Features

☐ HEX Edit Mode

Read from TE Write to TE

Clear Apply

Save As... Load...

<i>Read from TE (Analyzer):</i>	Read device local EDID/DisplayID blocks into editor.
<i>Write to TE (Analyzer):</i>	Write editor data to device local EDID/DisplayID blocks.
<i>Download from Sink (Generator):</i>	Read EDID/DisplayID blocks from connected sink device into editor.
<i>Upload to Sink (Generator):</i>	Write editor EDID/DisplayID blocks to connected sink device. See note below.
<i>Editor Mode:</i>	Enable editing EDID/DisplayID content in top right view. For example, for testing purposes, it's possible to load invalid EDID/DisplayID data and write it to TE without modifications. Once <i>Editor Mode</i> is enabled, the validator corrects errors such as invalid checksums. Top right view name-value pairs can be edited.
<i>HEX Edit Mode:</i>	Enable editing EDID/DisplayID content in bottom right HEX view. When enabled, HEX values may be edited. Click <i>Apply</i> to validate changes and update other views.
<i>Save As...:</i>	Save the current editor data to disk in various formats: binary, hex, ecd, txt and xml.
<i>Load ...:</i>	Load EDID/DisplayID data from disk. Same formats as above available.

**Note:** A source device is always able to read EDID data of the connected Sink device. A source device can read the DisplayID data of the sink device if the sink device permits. The connected sink device may or may not allow its EDID/DisplayID content to be modified.

Select the *Main Features* button to view items of common interest. For example, whether the sink is capable of HDR, or Dolby Vision, etc.

Features		CTA v3
	Name	Value
1	Max Resolution	10240 x 4320
2	10K Max Frame Rate	60 Hz
3	8K Max Frame Rate	60 Hz
4	4K Max Frame Rate	145 Hz
5	2K Max Frame Rate	145 Hz
6	HDR Static	Disabled
7	HDR Dynamic	Disabled
8	HDR10+	Disabled
9	Dolby Vision	Disabled
10	SBTM	Disabled

The *Main Features* view *CTA v3* tab (available only in EDID tab not DisplayID tab) allows enabling/disabling features. You enable/disable a feature by selecting the *Value* field with *Editor Mode* enabled (AND HEX Edit Mode disabled). When a value is disabled and you want to enable it, the *Editor View* will be blank as focus has been set on the values to be enabled (and are zero when disabled). New highlighted hex values will be added and highlighted in the lower right *Hex View*. New node data will also appear under the CTA node in the top left tree view.

Features		CTA v3
	Name	Value
1	HDR Static <small>Data block collection</small>	Disabled
2	HDR Dynamic <small>Data block collection</small>	Disabled
3	HDR10+ <small>Data block collection</small>	Disabled
4	Dolby Vision <small>Data block collection</small>	Disabled
5	SBTM <small>Data block collection</small>	Enabled ▾
		Disabled
		Enabled

## 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:**

The Editor does not have an *Undo* function. Therefore, it is recommended that you back up unedited data to a file before editing.

---



# 11. PATTERN EDITOR

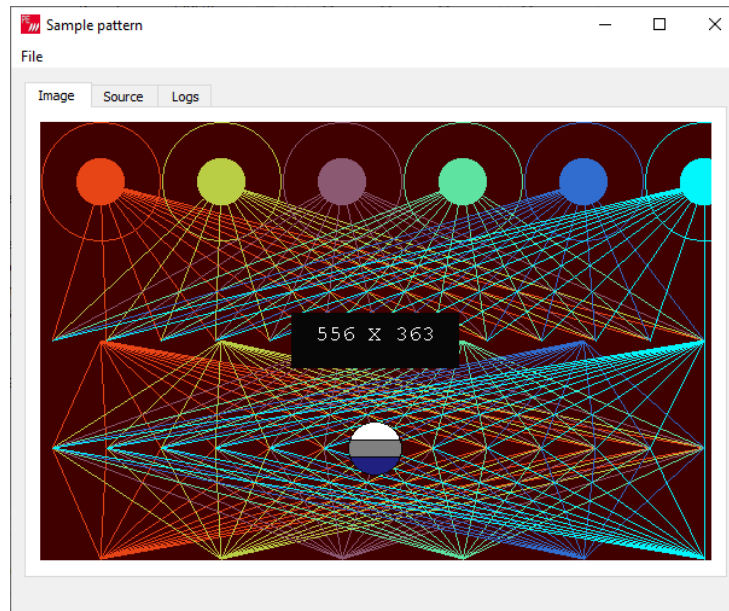
Pattern Editor is a tool for editing and debugging Unigraf Custom VTP Pattern scripts.

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:

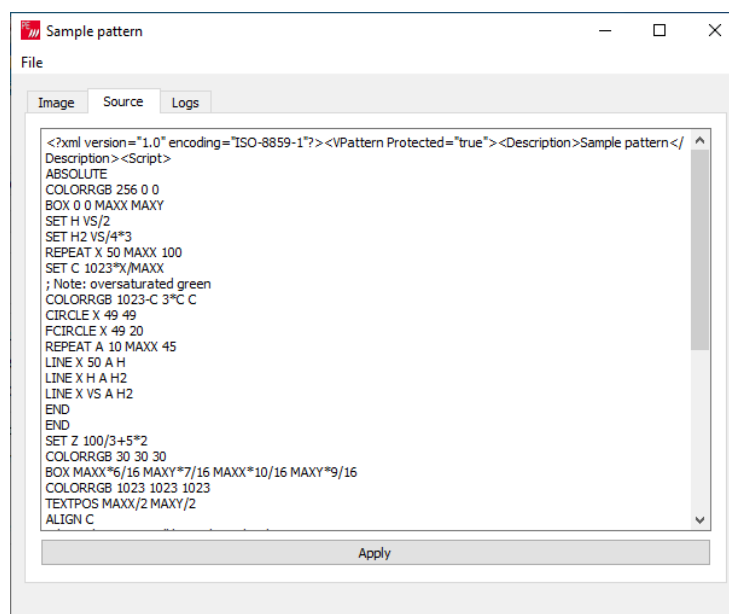
## Image Tab

Monitoring the rendering of the VTP pattern script.



## Source Tab

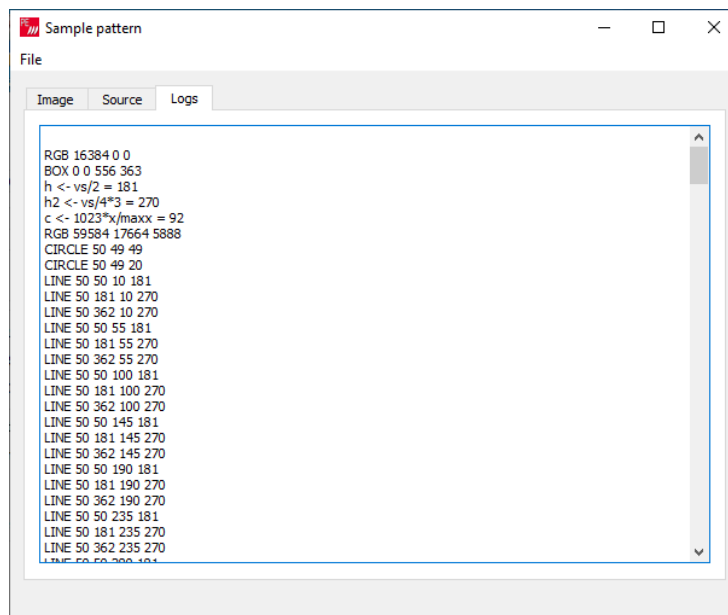
Tool for editing VTP Pattern Language script. Click Apply to render the code in the resolution of the preview image in *Image* tab.





## Logs Tab

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



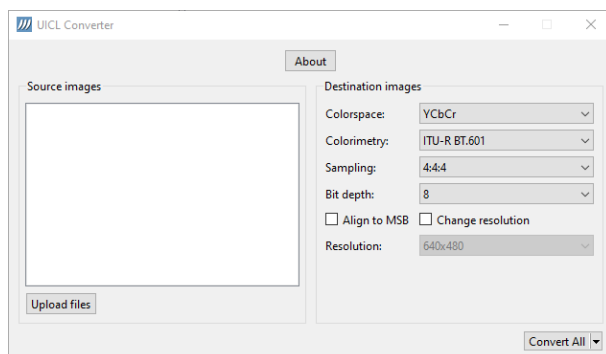
## Saving and Recalling the Script

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

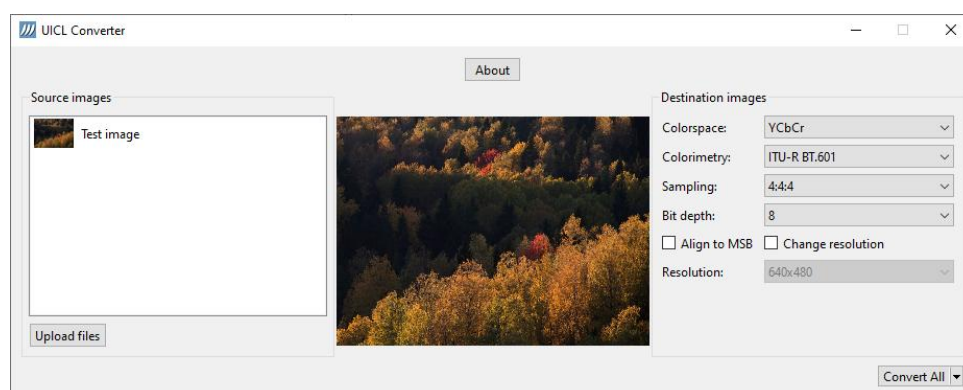
<i>Open:</i>	Open a VTP language script from PC
<i>Save Script:</i>	Save the script currently in Source tab to PC
<i>Save Image:</i>	Save a rendered pattern in PNG, BMP, JPG or PPM format
<i>Select Save Resolution:</i>	Select from six common resolutions the size in which the pattern script will be rendered when saved.

## 12. 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.



<i>Colorspace</i>	YCbCr, RGB
<i>Colorimetry</i>	ITU-R BT.601, ITU-R BT.709, ITU-R BT2020
<i>Sampling</i>	4:4:4, 4:2:2, 4:2:0
<i>Bit depth</i>	8, 10, 12, 16
<i>Align to MSB</i>	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).
<i>Change resolution</i>	Select a resolution for the destination image from the pre-defined list
<i>Covert All</i>	Convert all uploaded images to destination format and save them in the same folder as the source images.
<i>Covert All and save to the custom folder</i>	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-500

Input	DisplayPort: DP 2.0/2.1 capable (DP In) (10 Gbps link rate maximum) USB-C: PD 3.0 compliant (USB-C In) (20 Gbps link rate maximum)
Output	DisplayPort: DP 2.1 compliant (DP Out) (10 Gbps link rate maximum) USB-C: PD 3.0 compliant (USB-C Out) (20 Gbps link rate maximum)
Max video mode	7680 × 4320 p60 input and output. 15360 × 8640 p60 input and output with DSC.
Audio	Source and receive LPCM, 2 – 8 channels, 44.1 to 192 kHz. Source compressed formats using TSI
Content Protection	HDCP 2.3 supported
DSC Capability	DSC sink, with off-line decompression DSC source using pre-compressed content
Additional features	Playback function
Computer interface	USB 3.0
Operating System	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, +24 Vdc output)
Environmental	Operating temperature: 15 to 35 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	331 mm x 197 mm x 66 mm
Weight	1.9kg

### UCD-500 Gen2

Input	DisplayPort: DP 2.1 compliant (DP In) (20 Gbps link rate) USB-C: PD 3.0 compliant (USB-C In) (20 Gbps link rate)
Output	DisplayPort: DP 2.1 compliant (DP Out) (20 Gbps link rate) USB-C: PD 3.0 compliant (USB-C Out) (20 Gbps link rate)
Max video mode	7680 × 4320 p60 input and output. 15360 × 8640 p60 input and output with DSC
Audio	Source and receive LPCM, 2 – 8 channels, 44.1 to 192 kHz. Source compressed formats using TSI
Content Protection	HDCP 2.3 supported
DSC Capability	DSC sink, with off-line decompression DSC source using pre-compressed content
Additional features	Playback function
Computer interface	USB 3.0
Operating System	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, +24 Vdc output)
Environmental	Operating temperature: 15 to 35 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	331 mm x 197 mm x 66 mm

Weight	1.9kg
--------	-------

## APPENDIX B: PRODUCT FEATURES

Input / Output Role	UCD-5XX Default	DP Link Analyzer	Panel Replay	eDP Support**	DP 1.4a LL CTS	DP 2.1 LL CTS	DP 1.4a DSC CTS	DP 2.1 DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Source DUT	HDCP 2.3 CTS Sink, Source & Repeater DUT	DP 2.1 LTTPR CTS for Source DUT	TSI Basic
DP Reference Sink														
Video status, preview and saving	•													▲
Buffered capture	•													
Audio monitoring, graphical preview and saving	•													▲
Link status	•													▲
Link control	•													▲
HPD status and control	•													▲
Fast Link Training (Link Training without AUX Transaction)	•													
MST Feature (up to 4 streams)	•													▲
FEC Feature	•													▲
DSC Decoder, DSC Control	•													▲
Adaptive-Sync Feature**	•													▲
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	•													▲
Source DUT Testing (Link and CRC test)	•													▲
DP Link Analyzer		•												
eDP Reference Sink														
eDP Link Training & Link Rate Support**				•										
Alternate Scrambler Seed Reset (ASSR)	•													
Ability to Ignore Certain MSA Data Fields	•													
OUI Support	•													
GUID Register Support	•													
Source Device Detection by way of the AUX_CH	•													

\*) HDCP 1.3 is not supported in 3.7

\*\*) eDP support is limited to eDP 1.5 (i.e. 8b/10b link coding)

Input / Output Role	Panel Replay	eDP Support	DP 1.4a LL CTS	DP 2.1 LL CTS	DP 1.4a DSC CTS	DP 2.1 DSC CTS	DP 2.1 MST CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Source DUT	HDCP 2.3 CTS Sink, Source & Repeater DUT	DP 2.1 LTTPR CTS for Source DUT	DP 2.1 MST CTS
DP Reference Sink													
Panel Replay	•												
PSR1		•											
PSR2		•											
Early Transport	•	•											
Selective Update	•	•											
AUX-less ALPM	•	•											
AUX-wake ALPM		•											
DP 1.4 / 2.1 CTS for testing Source DUT													
DP 1.4 LL, Audio, FEC CTS for testing Source DUT			•										
DP 2.1 LL CTS for testing Source DUT				•									
DP 1.4a DSC CTS for testing Source DUT					•								
DP 2.1 DSC CTS for testing Source DUT						•							
DP 2.1 MST CTS for testing Source DUT							•						
DisplayID-EDID CTS for testing Source DUT								•					
Adaptive-Sync CTS for testing Source DUT									•				
HDCP 2.3 CTS for testing DP Source DUT										•	•		
HDCP 2.3 CTS for testing DP Repeater DUT											•		
DP 2.1 LTTPR CTS for testing Source DUT												•	
DP 2.1 MST CTS for testing Source DUT													•

Input / Output Role	UCD-5XX Default	Panel Replay	eDP Support	DP 1.4a LL CTS	DP 2.1 LL CTS	DP 1.4a DSC CTS	DP 2.1 DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Sink DUT	HDCP 2.3 CTS Sink Source and Repeater DUT	DP 2.1 LTTTPR CTS for Sink DUT	TSI Basic
DP Reference Source													
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	•												
Fast Link Training (Link Training without AUX Transaction)	•												
MST Feature (up to 4 streams)	•												▲
FEC Feature	•												▲
DSC Encoder	•												
Adaptive-Sync Feature	•												▲
DPCD editor	•												
LTTTPR Feature	•												▲
HDCP 1.3 status and control*	•												▲
HDCP 2.3 status and control	•												▲
Event Log, AUX Analyzer	•												
Playback	•												
eDP Reference Source													
eDP Link Training & Link Rate Support**			•										
Alternate Scrambler Seed Reset (ASSR)	•												
OUI Support	•												
GUID Register Support	•												
Live Frame Mode	•												
Panel Replay, PSR, ALPM													
Panel Replay		•											
PSR1			•										
PSR2			•										
Early Transport		•	•										
Selective Update		•	•										
AUX-less ALPM		•	•										
AUX-wake ALPM			•										

\*) HDCP 1.3 is not supported in 3.7

\*\*) eDP support is limited to eDP 1.5 (i.e. 8b/10b link coding)

Input / Output Role	UCD-5XX Default	Panel Replay	eDP Support	DP 1.4a LL CTS	DP 2.1 LL CTS	DP 1.4a DSC CTS	DP 2.1 DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Sink DUT	HDCP 2.3 CTS Sink Source and Repeater DUT	DP 2.1 LTTTPR CTS for Sink DUT
DP 1.4 / 2.1 Link Layer CTS for testing Sink DUT												
DP 1.4a LL, Audio and FEC CTS for testing Sink DUT				•								
DP 2.1 LL CTS for testing Sink DUT					•							
DP 1.4a DSC CTS for testing Sink DUT						•						
DP 2.1 DSC CTS for testing Sink DUT							•					
DisplayID / EDID CTS for testing Sink DUT								•				
Adaptive-Sync CTS for testing Sink DUT									•			
HDCP 2.3 CTS for testing DP Sink DUT										•	•	
HDCP 2.3 CTS for testing DP Repeater DUT											•	
DP 2.1 LTTTPR CTS for testing Sink DUT												•



## UCD-5XX Product Options

Hardware Test Tool	P/N
UCD-500 Gen2	066710
UCD-500 Upgrade to UCD-500 Gen2	066705
HDCP 2.3 CTS Testing	
HDCP 2.3 CTS for testing Source DUT on DP	MT6634
HDCP 2.3 CTS for testing Sink DUT on DP	MT6636
HDCP 2.3 CTS for testing Repeater DUT on DP	MT6638
DP 2.1 CTS Testing	
DP 2.1 LL CTS for testing Source DUT	MT6662
DP 2.1 LL CTS for testing Sink DUT	MT6660
DP 2.1 DSC CTS for testing Source DUT	MT6656
DP 2.1 DSC CTS for testing Sink DUT	MT6657
DP 2.1 MST CTS for testing Source DUT	MT6663
DP 1.4a CTS Testing	
DP 1.4a LL CTS for testing Source DUT	MT6637
DP 1.4a LL CTS for testing Sink DUT	MT6635
DP 1.4a DSC CTS for testing Source DUT	MT6642
DP 1.4a DSC CTS for testing Sink DUT	MT6643
DisplayID / EDID CTS testing	
DP 2.1 DisplayID / EDID CTS for testing Source DUT	MT6646
DP 2.1 DisplayID / EDID CTS for testing Sink DUT	MT6647
Adaptive Sync CTS Testing	
DP 2.1 Adaptive-Sync CTS for testing Source DUT	MT6648
DP 2.1 Adaptive-Sync CTS for testing Sink DUT	MT6649
LTTTPR CTS Testing	
DP 2.1 LTTTPR CTS for testing Source DUT	MT6680
DP 2.1 LTTTPR CTS for testing Sink DUT	MT6679
DP 2.1 LTTTPR CTS for testing LTTTPR DUT	MT6682
Link Analyzer	
DP 2.1 Link Analyzer	MT6682
Panel Replay and eDP support	
DP 2.1 Panel Replay support for testing Sink & Source DUT	MT6683
eDP support for testing Sink & Source DUT**	MT6684
HDR10+ CTS	
HDR 10+ Distribution Device for testing Source DUT on DP	MT6678
HDR 10+ Display Device and SSTM for testing Sink DUT on DP	MT6676

\*\* ) eDP support is limited to eDP 1.5 (i.e. 8b/10b link coding)

## APPENDIX C: PREDEFINED TIMINGS

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CVT 640 × 480 @ 60 Hz	640	480	800	525	144	35	96	2	60	25,20
CTA 640 × 480 @ 60 Hz (VIC 1)	640	480	800	525	144	35	96	2	60	25,17
CTA 720 × 480 @ 60 Hz (VIC 2)	720	480	858	525	122	36	62	6	60	27,03
CTA 720 × 480 @ 60 Hz (VIC 3)	720	480	858	525	122	36	62	6	60	27,00
CTA 720 × 576 @ 50 Hz (VIC 17)	720	576	864	625	132	44	64	5	50	27,00
CTA 720 × 576 @ 50 Hz (VIC 18)	720	576	864	625	132	44	64	5	50	27,00
CTA 720 × 576 @ 100 Hz (VIC 42)	720	576	864	625	132	44	64	5	100	54,00
CTA 720 × 576 @ 100 Hz (VIC 43)	720	576	864	625	132	44	64	5	100	54,00
CTA 720 × 480 @ 120 Hz (VIC 49)	720	480	858	525	122	36	62	6	120	54,00
CTA 720 × 480 @ 120 Hz (VIC 48)	720	480	858	525	122	36	62	6	120	54,05
CTA 720 × 576 @ 200 Hz (VIC 52)	720	576	864	625	132	44	64	5	200	108,00
CTA 720 × 576 @ 200 Hz (VIC 53)	720	576	864	625	132	44	64	5	200	108,00
CTA 720 × 480 @ 240 Hz (VIC 56)	720	480	858	525	122	36	62	6	240	108,00
CTA 720 × 480 @ 240 Hz (VIC 57)	720	480	858	525	122	36	62	6	240	108,00
DMT 800 × 600 @ 60 Hz (ID 9)	800	600	1056	628	216	27	128	4	60	39,79
DMT 848 × 480 @ 60 Hz (ID 14)	848	480	1088	517	224	31	112	8	60	33,75
DMT 1024 × 768 @ 60 Hz (ID 16)	1024	768	1344	806	296	35	136	6	60	65,00
CTA 1280 × 720 @ 50 Hz (VIC 19)	1280	720	1980	750	260	25	40	5	50	74,25
CTA 1280 × 720 @ 100 Hz (VIC 41)	1280	720	1980	750	260	25	40	5	100	148,50
CTA 1280 × 720 @ 24 Hz (VIC 60)	1280	720	3300	750	260	25	40	5	24	59,40
CTA 1280 × 720 @ 25 Hz (VIC 61)	1280	720	3960	750	260	25	40	5	25	74,25
CTA 1280 × 720 @ 30 Hz (VIC 62)	1280	720	3300	750	260	25	40	5	30	74,25
CTA 1280 × 720 @ 24 Hz (VIC 65)	1280	720	3300	750	260	25	40	5	24	59,40
CTA 1280 × 720 @ 25 Hz (VIC 66)	1280	720	3960	750	260	25	40	5	25	74,25
CTA 1280 × 720 @ 30 Hz (VIC 67)	1280	720	3300	750	260	25	40	5	30	74,25
CTA 1280 × 720 @ 50 Hz (VIC 68)	1280	720	1980	750	260	25	40	5	50	74,25
CTA 1280 × 720 @ 60 Hz (VIC 69)	1280	720	1650	750	260	25	40	5	60	74,25
CTA 1280 × 720 @ 100 Hz (VIC 70)	1280	720	1980	750	260	25	40	5	100	148,50
CTA 1280 × 720 @ 120 Hz (VIC 71)	1280	720	1650	750	260	25	40	5	120	148,50
CTA 1280 × 720 @ 48 Hz (VIC 108)	1280	720	2500	750	260	25	40	5	48	90,00
CTA 1280 × 720 @ 48 Hz (VIC 109)	1280	720	2500	750	260	25	40	5	48	90,00
CTA 1280 × 720 @ 60 Hz (VIC 4)	1280	720	1650	750	260	25	40	5	60	74,25
CTA 1280 × 720 @ 120 Hz (VIC 47)	1280	720	1650	750	260	25	40	5	120	148,50
CVT 1280 × 768 @ 60 Hz [RB1]	1280	768	1440	790	112	19	32	7	60	68,26
DMT 1280 × 768 @ 60 Hz (ID 23)	1280	768	1664	798	320	27	128	7	60	79,67
DMT 1280 × 800 @ 60 Hz (ID 27)	1280	800	1440	823	112	20	32	6	60	71,11
DMT 1280 × 800 @ 60 Hz (ID 28)	1280	800	1680	831	328	28	128	6	60	83,76
DMT 1280 × 960 @ 60 Hz (ID 32)	1280	960	1800	1000	424	39	112	3	60	108,00
DMT 1280 × 1024 @ 60 Hz (ID 35)	1280	1024	1688	1066	360	41	112	3	60	107,96
DMT 1360 × 768 @ 60 Hz (ID 39)	1360	768	1792	795	368	24	112	6	60	85,48
DMT 1400 × 1050 @ 60 Hz (ID 41)	1400	1050	1560	1080	112	27	32	4	60	101,09
DMT 1400 × 1050 @ 60 Hz (ID 42)	1400	1050	1864	1089	376	36	144	4	60	121,79

\*) CVT: Coordinated Video Timings (CVT v2.0)

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)

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CTA 1440 × 240 @ 60 Hz (VIC 8)	1440	240	1716	263	238	18	124	3	60	27,00
CTA 1440 × 240 @ 60 Hz (VIC 9)	1440	240	1716	263	238	18	124	3	60	27,00
CTA 1440 × 480 @ 60 Hz (VIC 14)	1440	480	1716	525	244	36	124	6	60	54,00
CTA 1440 × 480 @ 60 Hz (VIC 15)	1440	480	1716	525	244	36	124	6	60	54,00
CTA 1440 × 576 @ 50 Hz (VIC 22)	1440	576	1728	625	264	22	126	3	50	54,00
CTA 1440 × 288 @ 50 Hz (VIC 23)	1440	288	1728	314	264	22	126	3	50	27,00
CTA 1440 × 288 @ 50 Hz (VIC 24)	1440	288	1728	314	264	22	126	3	50	27,00
CTA 1440 × 576 @ 50 Hz (VIC 29)	1440	576	1728	625	264	44	128	5	50	54,00
CTA 1440 × 576 @ 50 Hz (VIC 30)	1440	576	1728	625	264	44	128	5	50	54,00
CVT 1600 × 1200 @ 60 Hz [RB1]	1600	1200	1760	1235	112	32	32	4	60	130,42
DMT 1600 × 1200 @ 60 Hz (ID 51)	1600	1200	2160	1250	496	49	192	3	60	162,00
CTA 1680 × 720 @ 24 Hz (VIC 79)	1680	720	3300	750	260	25	40	5	24	59,40
CTA 1680 × 720 @ 25 Hz (VIC 80)	1680	720	3168	750	260	25	40	5	25	59,40
CTA 1680 × 720 @ 30 Hz (VIC 81)	1680	720	2640	750	260	25	40	5	30	59,40
CTA 1680 × 720 @ 50 Hz (VIC 82)	1680	720	2200	750	260	25	40	5	50	82,50
CTA 1680 × 720 @ 100 Hz (VIC 84)	1680	720	2000	825	260	100	40	5	100	165,00
CTA 1680 × 720 @ 48 Hz (VIC 110)	1680	720	2750	750	260	25	40	5	48	99,00
CTA 1680 × 720 @ 60 Hz (VIC 83)	1680	720	2200	750	260	25	40	5	60	99,00
CTA 1680 × 720 @ 120 Hz (VIC 85)	1680	720	2000	825	260	100	40	5	120	198,00
DMT 1680 × 1050 @ 60 Hz (ID 57)	1680	1050	1840	1080	112	27	32	6	60	119,23
DMT 1680 × 1050 @ 60 Hz (ID 58)	1680	1050	2240	1089	456	36	176	6	60	146,36
DMT 1792 × 1344 @ 60 Hz (ID 62)	1792	1344	2448	1394	528	49	200	3	60	204,75
DMT 1856 × 1392 @ 60 Hz (ID 65)	1856	1392	2528	1439	576	46	224	3	60	218,27
CTA 1920 × 1080 @ 50 Hz (VIC 31)	1920	1080	2640	1125	192	41	44	5	50	148,50
CTA 1920 × 1080 @ 24 Hz (VIC 32)	1920	1080	2750	1125	192	41	44	5	24	74,25
CTA 1920 × 1080 @ 25 Hz (VIC 33)	1920	1080	2640	1125	192	41	44	5	25	74,25
CTA 1920 × 1080 @ 100 Hz (VIC 64)	1920	1080	2640	1125	192	41	44	5	100	297,00
CTA 1920 × 1080 @ 24 Hz (VIC 72)	1920	1080	2750	1125	192	41	44	5	24	74,25
CTA 1920 × 1080 @ 25 Hz (VIC 73)	1920	1080	2640	1125	192	41	44	5	25	74,25
CTA 1920 × 1080 @ 30 Hz (VIC 74)	1920	1080	2200	1125	192	41	44	5	30	74,25
CTA 1920 × 1080 @ 50 Hz (VIC 75)	1920	1080	2640	1125	192	41	44	5	50	148,50
CTA 1920 × 1080 @ 60 Hz (VIC 76)	1920	1080	2200	1125	192	41	44	5	60	148,50
CTA 1920 × 1080 @ 100 Hz (VIC 77)	1920	1080	2640	1125	192	41	44	5	100	297,00
CTA 1920 × 1080 @ 120 Hz (VIC 78)	1920	1080	2200	1125	192	41	44	5	120	297,00
CVT 1920 × 1080 @ 30 Hz [RB1]	1920	1080	2080	1096	112	13	32	5	30	68,39
CVT 1920 × 1080 @ 30 Hz [RB2]	1920	1080	2000	1096	72	14	32	8	30	65,76
CVT 1920 × 1080 @ 144 Hz [RB3]	1920	1080	2080	1157	152	14	32	8	144	346,66
CVT 1920 × 1080 @ 200 Hz [RB3]	1920	1080	2080	1190	152	14	32	8	200	495,21
CTA 1920 × 1080 @ 30 Hz (VIC 34)	1920	1080	2200	1125	192	41	44	5	30	74,25
CVT 1920 × 1080 @ 60 Hz [RB1]	1920	1080	2080	1111	112	28	32	5	60	138,65
CVT 1920 × 1080 @ 60 Hz	1920	1080	2000	1111	72	14	32	8	60	133,32
DMT 1920 × 1080 @ 60 Hz (ID 82)	1920	1080	2200	1125	192	41	44	5	60	148,50
CTA 1920 × 1080 @ 60 Hz (VIC 16)	1920	1080	2200	1125	192	41	44	5	60	148,50
CVT 1920 × 1080 @ 120 Hz [RB1]	1920	1080	2080	1144	112	61	32	5	120	285,54
CVT 1920 × 1080 @ 120 Hz [RB2]	1920	1080	2000	1144	72	14	32	8	120	274,56
CTA 1920 × 1080 @ 120 Hz (VIC 63)	1920	1080	2200	1125	192	41	44	5	120	297,00

\*) CVT: Coordinated Video Timings (CVT v2.0)

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)

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CTA 1920 × 1080 @ 48 Hz (VIC 111)	1920	1080	2750	1125	192	41	44	5	48	148,50
CTA 1920 × 1080 @ 48 Hz (VIC 112)	1920	1080	2750	1125	192	41	44	5	48	148,50
DMT 1920 × 1200 @ 60 Hz (ID 69)	1920	1200	2592	1245	536	42	200	6	60	193,62
DMT 1920 × 1440 @ 60 Hz (ID 73)	1920	1440	2600	1500	552	59	208	3	60	234,00
CVT 2048 × 1536 @ 60 Hz [RB1]	2048	1536	2208	1580	112	41	32	4	60	209,32
CTA 2560 × 1080 @ 24 Hz (VIC 86)	2560	1080	3750	1100	192	16	44	5	24	99,00
CTA 2560 × 1080 @ 25 Hz (VIC 87)	2560	1080	3200	1125	192	41	44	5	25	90,00
CTA 2560 × 1080 @ 30 Hz (VIC 88)	2560	1080	3520	1125	192	41	44	5	30	118,80
CTA 2560 × 1080 @ 50 Hz (VIC 89)	2560	1080	3300	1125	192	41	44	5	50	185,63
CTA 2560 × 1080 @ 100 Hz (VIC 91)	2560	1080	2970	1250	192	166	44	5	100	371,25
CVT 2560 × 1440 @ 60 Hz [RB2]	2560	1440	2640	1481	72	14	32	8	60	234,59
CVT 2560 × 1440 @ 60 Hz [RB1]	2560	1440	2720	1481	112	38	32	5	60	241,70
CVT 2560 × 1440 @ 144 Hz [RB3]	2560	1440	2720	1543	152	14	32	8	144	604,57
CVT 2560 × 1440 @ 200 Hz [RB3]	2560	1440	2720	1586	152	14	32	8	200	863,09
CTA 2560 × 1080 @ 48 Hz (VIC 113)	2560	1080	3750	1100	192	16	44	5	48	198,00
CVT 2560 × 1080 @ 60 Hz	2560	1080	3424	1120	704	37	272	10	60	230,09
CVT 2560 × 1080 @ 60 Hz [RB1]	2560	1080	2720	1111	112	28	32	10	60	181,32
CVT 2560 × 1080 @ 144 Hz [RB3]	2560	1080	2720	1157	152	14	32	8	144	453,33
CVT 2560 × 1080 @ 200 Hz [RB3]	2560	1080	2720	1190	152	14	32	8	200	647,59
CTA 2560 × 1080 @ 60 Hz (VIC 90)	2560	1080	3000	1100	192	16	44	5	60	198,00
CTA 2560 × 1080 @ 120 Hz (VIC 92)	2560	1080	3300	1250	192	16	44	5	120	495,00
DMT 2560 × 1600 @ 60 Hz (ID 77)	2560	1600	3504	1658	752	55	280	6	60	348,58
DMT 2560 × 1600 @ 60 Hz (ID 76)	2560	1600	2720	1646	112	43	32	6	60	268,63
CTA 2880 × 240 @ 60 Hz (VIC 12)	2880	240	3432	263	476	18	248	3	60	54,00
CTA 2880 × 240 @ 60 Hz (VIC 13)	2880	240	3432	263	476	18	248	3	60	54,00
CTA 2880 × 288 @ 50 Hz (VIC 27)	2880	288	3456	314	528	22	252	3	50	54,00
CTA 2880 × 288 @ 50 Hz (VIC 28)	2880	288	3456	314	528	22	252	3	50	54,00
CTA 2880 × 480 @ 60 Hz (VIC 35)	2880	480	3432	525	488	36	248	6	60	108,00
CTA 2880 × 480 @ 60 Hz (VIC 36)	2880	480	3432	525	488	36	248	6	60	108,00
CTA 2880 × 576 @ 50 Hz (VIC 37)	2880	576	3456	625	528	44	256	5	50	108,00
CTA 2880 × 576 @ 50 Hz (VIC 38)	2880	576	3456	625	528	44	256	5	50	108,00
2880 × 1440 @ 60 Hz	2880	1440	2976	1456	48	8	8	1	60	259,98
CVT 3840 × 2160 @ 30 Hz [RB1]	3840	2160	4000	2191	112	28	32	5	30	262,92
CVT 3840 × 2160 @ 30 Hz [RB2]	3840	2160	3920	2191	72	14	32	8	30	257,66
CVT 3840 × 2160 @ 144 Hz [RB3]	3840	2160	4000	2314	152	14	32	8	144	1333,33
CVT 3840 × 2160 @ 60 Hz [RB1]	3840	2160	4000	2222	112	59	32	5	60	533,28
CVT 3840 × 2160 @ 60 Hz [RB2]	3840	2160	3920	2222	72	14	32	8	60	522,61
CVT 3840 × 2160 @ 60 Hz [RB3]	3840	2160	4000	2222	152	14	32	8	60	533,47
CTA 3840 × 2160 @ 60 Hz (VIC 97)	3840	2160	4400	2250	384	82	88	10	60	594,00
CTA 3840 × 2160 @ 24 Hz (VIC 93)	3840	2160	5500	2250	384	82	88	10	24	297,00
CTA 3840 × 2160 @ 25 Hz (VIC 94)	3840	2160	5280	2250	384	82	88	10	25	297,00
CTA 3840 × 2160 @ 30 Hz (VIC 95)	3840	2160	4400	2250	384	82	88	10	30	297,00
CTA 3840 × 2160 @ 50 Hz (VIC 96)	3840	2160	5280	2250	384	82	88	10	50	594,00
CTA 3840 × 2160 @ 24 Hz (VIC 103)	3840	2160	5500	2250	384	82	88	10	24	297,00
CTA 3840 × 2160 @ 25 Hz (VIC 104)	3840	2160	5280	2250	384	82	88	10	25	297,00
CTA 3840 × 2160 @ 30 Hz (VIC 105)	3840	2160	4400	2250	384	82	88	10	30	297,00

\*) CVT: Coordinated Video Timings (CVT v2.0)

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)

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CTA 3840 × 2160 @ 50 Hz (VIC 106)	3840	2160	5280	2250	384	82	88	10	50	594,00
CTA 3840 × 2160 @ 60 Hz (VIC 107)	3840	2160	4400	2250	384	82	88	10	60	594,00
CTA 3840 × 2160 @ 48 Hz (VIC 114)	3840	2160	5500	2250	384	82	88	10	48	594,00
CTA 3840 × 2160 @ 48 Hz (VIC 116)	3840	2160	5500	2250	384	82	88	10	48	594,00
CTA 3840 × 2160 @ 100 Hz (VIC 117)	3840	2160	5280	2250	384	82	88	10	100	1188,00
CTA 3840 × 2160 @ 100 Hz (VIC 119)	3840	2160	5280	2250	384	82	88	10	100	1188,00
CTA 3840 × 2160 @ 120 Hz (VIC 120)	3840	2160	4400	2250	384	82	88	10	120	1188,00
CVT 4096 × 2160 @ 60 Hz [RB2]	4096	2160	4176	2222	72	14	32	8	60	556,74
CVT 4096 × 2160 @ 60 Hz [RB1]	4096	2160	4256	2222	112	59	32	10	60	567,41
CVT 4096 × 2160 @ 60 Hz [RB3]	4096	2160	4256	2222	152	14	32	8	60	567,61
CVT 4096 × 2160 @ 144 Hz [RB3]	4096	2160	4256	2314	152	14	32	8	144	1418,66
CTA 4096 × 2160 @ 60 Hz (VIC 102)	4096	2160	4400	2250	216	82	88	10	60	594,00
CTA 4096 × 2160 @ 120 Hz (VIC 219)	4096	2160	4400	2250	216	82	88	10	120	1188,00
CTA 4096 × 2160 @ 100 Hz (VIC 218)	4096	2160	5280	2250	384	82	88	10	100	1188,00
CTA 4096 × 2160 @ 50 Hz (VIC 101)	4096	2160	5280	2250	216	82	88	10	50	594,00
CTA 4096 × 2160 @ 48 Hz (VIC 115)	4096	2160	5500	2250	384	82	88	10	48	594,00
CTA 4096 × 2160 @ 24 Hz (VIC 98)	4096	2160	5500	2250	384	82	88	10	24	297,00
CTA 4096 × 2160 @ 25 Hz (VIC 99)	4096	2160	5280	2250	216	82	88	10	25	297,00
CTA 4096 × 2160 @ 30 Hz (VIC 100)	4096	2160	4400	2250	216	82	88	10	30	297,00
CVT 3840 × 2160 @ 120 Hz [RB1]	3840	2160	4000	2287	112	124	32	5	120	1097,76
CVT 3840 × 2160 @ 120 Hz [RB2]	3840	2160	3920	2287	72	14	32	8	120	1075,80
CTA 3840 × 2160 @ 120 Hz (VIC 118)	3840	2160	4400	2250	384	82	88	10	120	1188,00
CVT 5120 × 2160 @ 30 Hz [RB1]	5120	2160	5280	2191	112	28	32	10	30	347,05
CVT 5120 × 2160 @ 30 Hz [RB2]	5120	2160	5200	2191	72	14	32	8	30	341,80
CTA 5120 × 2160 @ 30 Hz (VIC 123)	5120	2160	6000	2200	216	32	88	10	30	396,00
CVT 5120 × 2160 @ 60 Hz [RB1]	5120	2160	5280	2222	112	59	32	10	60	703,93
CVT 5120 × 2160 @ 60 Hz [RB2]	5120	2160	5200	2222	72	14	32	6	60	693,26
CTA 5120 × 2160 @ 60 Hz (VIC 126)	5120	2160	5500	2250	216	82	88	10	60	742,50
CVT 5120 × 2160 @ 120 Hz [RB1]	5120	2160	5280	2287	112	124	32	10	120	1449,04
CVT 5120 × 2160 @ 120 Hz [RB3]	5120	2160	5280	2287	152	14	32	8	120	1449,55
CVT 5120 × 2160 @ 120 Hz [RB2]	5120	2160	5200	2287	72	14	32	8	120	1427,09
CTA 5120 × 2160 @ 120 Hz (VIC 193)	5120	2160	5500	2250	216	82	88	10	120	1485,00
5120 × 2880 @ 60 Hz	5120	2880	5280	2962	112	79	32	5	60	938,36
5120 × 2880 @ 60 Hz	5120	2880	5200	2962	72	14	32	8	60	924,14
5120 × 2880 @ 60 Hz	5120	2880	5280	2962	152	14	32	8	60	938,69
CTA 5120 × 2160 @ 48 Hz (VIC 124)	5120	2160	6250	2475	384	307	88	10	48	742,50
CTA 5120 × 2160 @ 50 Hz (VIC 125)	5120	2160	6600	2250	384	82	88	10	50	742,50
CTA 5120 × 2160 @ 100 Hz (VIC 127)	5120	2160	6600	2250	384	82	88	10	100	1485,00
CTA 5120 × 2160 @ 25 Hz (VIC 122)	5120	2160	7200	2200	384	32	88	10	25	396,00
CTA 5120 × 2160 @ 24 Hz (VIC 121)	5120	2160	7500	2200	384	32	88	10	24	396,00
CVT 7680 × 4320 @ 30 Hz [RB1]	7680	4320	7760	4381	72	14	32	8	30	1019,90
CVT 7680 × 4320 @ 30 Hz [RB1]	7680	4320	7840	4381	112	58	32	5	30	1030,41
CVT 7680 × 4320 @ 60 Hz [RB1]	7680	4320	7760	4443	72	14	32	8	60	2068,66
CVT 7680 × 4320 @ 100 Hz [RB1]	7680	4320	7760	4529	72	14	32	8	100	3514,50
CVT 7680 × 4320 @ 60 Hz	7680	4320	7840	4443	112	120	32	5	60	2089,99
CVT 7680 × 4320 @ 100 Hz [RB1]	7680	4320	7840	4529	112	206	32	5	100	3550,74

\*) CVT: Coordinated Video Timings (CVT v2.0)

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)

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
CTA 7680 × 4320 @ 120 Hz (VIC 201)	7680	4320	8800	4500	768	164	176	20	120	4752,00
CTA 7680 × 4320 @ 120 Hz (VIC 209)	7680	4320	8800	4500	768	164	176	20	120	4752,00
CTA 7680 × 4320 @ 30 Hz (VIC 204)	7680	4320	9000	4400	768	64	176	20	30	1188,00
CTA 7680 × 4320 @ 30 Hz (VIC 196)	7680	4320	9000	4400	768	64	176	20	30	1188,00
CTA 7680 × 4320 @ 60 Hz (VIC 207)	7680	4320	9000	4400	768	64	176	20	60	2376,00
CTA 7680 × 4320 @ 60 Hz (VIC 199)	7680	4320	9000	4400	768	64	176	20	60	2376,00
CTA 7680 × 4320 @ 100 Hz (VIC 208)	7680	4320	10560	4500	768	164	176	20	100	4752,00
CTA 7680 × 4320 @ 100 Hz (VIC 200)	7680	4320	10560	4500	768	164	176	20	100	4752,00
CTA 7680 × 4320 @ 25 Hz (VIC 203)	7680	4320	10800	4400	768	64	176	20	25	1188,00
CTA 7680 × 4320 @ 25 Hz (VIC 195)	7680	4320	10800	4400	768	64	176	20	25	1188,00
CTA 7680 × 4320 @ 50 Hz (VIC 198)	7680	4320	10800	4400	768	64	176	20	50	2376,00
CTA 7680 × 4320 @ 50 Hz (VIC 206)	7680	4320	10800	4400	768	64	176	20	50	2376,00
CTA 7680 × 4320 @ 24 Hz (VIC 194)	7680	4320	11000	4500	768	164	176	20	24	1188,00
CTA 7680 × 4320 @ 48 Hz (VIC 197)	7680	4320	11000	4500	768	164	176	20	48	2376,00
CTA 7680 × 4320 @ 24 Hz (VIC 202)	7680	4320	11000	4500	768	164	176	20	24	1188,00
CTA 7680 × 4320 @ 48 Hz (VIC 205)	7680	4320	11000	4500	768	164	176	20	48	2376,00
CTA 10240 × 4320 @ 24 Hz (VIC 210)	10240	4320	12500	4950	768	614	176	20	24	1485,00
CTA 10240 × 4320 @ 25 Hz (VIC 211)	10240	4320	13500	4400	768	64	176	20	25	1485,00
CTA 10240 × 4320 @ 30 Hz (VIC 212)	10240	4320	11000	4500	472	164	176	20	30	1485,00
CTA 10240 × 4320 @ 48 Hz (VIC 213)	10240	4320	12500	4950	768	614	176	20	48	2970,00
CTA 10240 × 4320 @ 50 Hz (VIC 214)	10240	4320	13500	4400	768	64	176	20	50	2970,00
CTA 10240 × 4320 @ 60 Hz (VIC 215)	10240	4320	11000	4500	472	164	176	20	60	2970,00
CTA 10240 × 4320 @ 100 Hz (VIC 216)	10240	4320	13200	4500	768	164	176	20	100	5940,00
CTA 10240 × 4320 @ 120 Hz (VIC 217)	10240	4320	11000	4500	472	164	176	20	120	5940,00
CTA 15360 × 8640 @ 30Hz [RB1]	15360	8640	15520	8761	112	118	32	5	30	4079,00
CTA 15360 × 8640 @ 30Hz [RB2]	15360	8640	15440	8761	72	14	32	8	30	4058,10
CTA 15360 × 8640 @ 30Hz [RB3]	15360	8640	15520	8761	152	14	32	8	30	4080,55










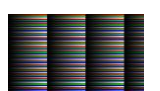
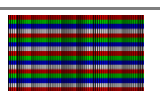
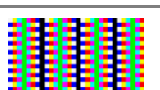


\*) CVT: Coordinated Video Timings (CVT v2.0)

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)






















## 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 Color		Solid color. User selected RGB values
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.
RGB Wide Strips		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.
Select DSC Image		Custom DSC compressed image file 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 crosshatches, circles, and color bars
SMPTE RP-133		Vpattern vector pattern based on SMPTE 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 (cont.)

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 (cont.)

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		Vpattern vector pattern. White 16 x12 Grid on Black background
X-HatchW-C		Vpattern vector pattern. 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		Vpattern vector pattern. China 5.6 White Window 10%
Gray Box 20		Vpattern vector pattern. China 5.6 White Window 20%
Gray Box 30		Vpattern vector pattern. China 5.6 White Window 30%
Gray Box 40		Vpattern vector pattern. China 5.6 White Window 40%
Gray Box 50		Vpattern vector pattern. China 5.6 White Window 50%
Gray Box 60		Vpattern vector pattern. China 5.6 White Window 60%
Gray Box 70		Vpattern vector pattern. China 5.6 White Window 70%
Gray Box 80		Vpattern vector pattern. China 5.6 White Window 80%
Gray Box 90		Vpattern vector pattern. China 5.6 White Window 90%
Gray Box 100		Vpattern vector pattern. China 5.6 White Window 100%
8 Level Gray		Vpattern vector pattern. China 5.5 Ultimate 8 Level Grayscale

## Extended Patterns (cont.)

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

More test patterns can be downloaded e.g. from [www.icdm-sid.org/](http://www.icdm-sid.org/)

## APPENDIX E: SINK, SOURCE AND REPEATER TESTS

Source DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS*	DP 2.1 LL CTS*	DP 2.1 DSC CTS	DP 2.1 MST CTS	DP 2.1 DisplayID & EDID CTS*	DP 2.1 Adaptive-Sync CTS DUT*	DP 2.1 LTTPR CTS	HDCP 2.3 CTS*
Audio Test	Validate audio signal frequency and glitch-free audio reproduction	●									
CRC Video Tests	CRC based single frame reference video test, CRC based single frame stability test, CRC based sequence of frames reference video test, CRC based continuous sequence of frames reference video test	●									
DP 1.4a Link Layer CTS	4.2.1.1 – 4.2.1.5, 4.2.2.1 – 4.2.2.10, 4.3.1.1 – 4.3.1.13, 4.3.2.1 – 4.3.2.5, 4.3.3.1, 4.4.1.1 – 4.4.1.3, 4.4.2, 4.4.3, 4.4.4.2 – 4.4.4.6, 4.5.1.1 – 4.5.1.2		●								
DP 1.4a DSC CTS	4.6.1.1 – 4.6.1.9			●							
DP 2.1 Link Layer CTS	4.2.1.1 – 4.2.1.5, 4.2.2.1 – 4.2.2.2, 4.2.2.4 – 4.2.2.5, 4.2.2.7 – 4.2.2.8, 4.2.2.10 – 4.2.2.14, 4.3.1.1 – 4.3.1.24, 4.3.2.1 – 4.3.2.4, 4.3.3.1 – 4.3.3.2, 4.4.1.1-4.4.1.6, 4.4.2.1 – 4.4.2.2, 4.4.3, 4.4.4.2 – 4.4.4.13, 4.5.1.1-4.5.1.2				●						
DP 2.1 DSC CTS	4.6.1.1 – 4.6.1.9					●					
DP 2.1 MST CTS	4.10.1.1 – 4.10.1.21						●				
DisplayID-EDID CTS***	4.7.1.1 – 4.7.1.4, 4.7.2.1 – 4.7.2.2, 4.7.3.1 – 4.7.3.3, 4.7.4.1, 4.7.4.4, 4.7.5.1, 4.7.6.1 - 4.7.6.4, 4.7.7.1 - 4.7.7.2							●			
Adaptive-Sync CTS	4.8.1.1 – 4.8.1.2, 4.8.2.1 – 4.8.2.3								●		
DP 2.1 LTTPR CTS	4.9.1.1 – 4.9.1.22									●	
HDCP 2.3 CTS 1A Test Set	HDCP2.3 CTS 1A-01 – HDCP2.3 CTS 1A-12										●
HDCP 2.3 CTS 1B Test Set	HDCP2.3 CTS 1B-01 – HDCP2.3 CTS 1B-10										●
Link Config Tests	Link Training at All Supported Lane Counts and Link Rates	●									
Pixel Level Video Tests	Compare video frame sequence with a single reference	●									

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

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

Sink DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS*	DP 2.1 LL CTS*	DP 2.1 DSC CTS	DP 2.1 DisplayID & EDID CTS*	DP 2.1 Adaptive-Sync CTS DUT*	DP 2.1 LTTTPR CTS*	HDCP 2.3 CTS*
DP 1.4 Link Layer CTS	5.2.1.1 – 5.2.1.12, 5.2.2.1 – 5.2.2.9, 5.3.1.1 – 5.3.1.9, 5.3.2.1 – 5.3.2.2, 5.4.1.1 – 5.4.1.4, 5.4.2, 5.4.3.1 – 5.4.3.2, 5.4.4.1 – 5.4.4.6, 5.5.1.1 – 5.5.1.7		●							
DP 1.4 DSC CTS	5.6.1.1 – 5.6.1.26, 5.6.2.1 – 5.6.2.14			●						
DP 2.1 Link Layer CTS	5.2.1.8 – 5.2.1.12, 5.2.2.1 – 5.2.2.10, 5.3.1.1 – 5.3.1.5, 5.3.1.8 – 5.3.1.15, 5.3.2.1 – 5.3.2.2, 5.4.1.1 – 5.4.1.8, 5.4.2.1 – 5.4.2.2, 5.4.3.1 – 5.4.3.4, 5.4.4.1 – 5.4.4.10, 5.4.5.1 – 5.4.5.5, 5.5.1.1 – 5.5.1.12				●					
DP 2.1 DSC CTS	5.6.1.1 – 5.6.1.26, 5.6.2.1 – 5.6.2.16, 5.6.3.1 – 5.6.3.7					●				
DisplayID-EDID CTS***	5.7.1.1 – 5.7.1.2, 5.7.1.3.1 – 5.7.1.3.4, 5.7.1.4.1 – 5.7.1.4.9, 5.7.1.5 – 5.7.1.6, 5.7.2.1 – 5.7.2.2, 5.7.2.3.1 – 5.7.2.3.5, 5.7.2.4.1 – 5.7.2.4.2, 5.7.2.5.1 – 5.7.2.5.2, 5.7.2.6.1 – 5.7.2.6.2, 5.7.2.7.1, 5.7.2.8, 5.7.3.1 – 5.7.3.5, 5.7.4.1 – 5.7.4.3, 5.7.4.5, 5.7.5.1, 5.7.6.1 – 5.7.6.5, 5.7.7.1 – 5.7.7.6, 5.7.8.1 – 5.7.8.6, 5.7.9.1 – 5.7.9.3, 5.7.10.1 – 5.7.10.3, 5.7.11.1 – 5.7.11.5, 5.7.12.1 – 5.7.12.4, 5.7.13.1 – 5.7.13.2, 5.7.14.1 – 5.7.14.8, 5.7.15.1 – 5.7.15.11, 5.7.16.1 – 5.7.16.7, 5.7.16.9 – 5.7.16.10, 5.7.17.1 – 5.7.17.5, 5.7.18.1, 5.7.19.1 – 5.7.19.6, 5.7.20.1 – 5.7.20.3, 5.7.21.1 – 5.7.21.5, 5.7.22.1 – 5.7.22.7						●			
Adaptive-Sync CTS****	5.8.1.1 – 5.8.1.3							●		
DP 2.1 LTTTPR CTS	5.9.1.1 – 5.9.1.15								●	
HDCP 2.3 CTS 2C Test Set	HDCP2.3 CTS 2C-01 – HDCP2.3 CTS 2C-05									●

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

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

\*\*\*\*) Adaptive-Sync CTS is currently limited to 8b/10b link coding and SST mode. Unigraf UCD-400 was used by VESA for TE correlation of the tests.

LTPR and DP Tunnel Device Testing		Default	DP 2.1 LTPR CTS for testing LTPR Device
DP 2.1 LTPR CTS for testing LTPR Device	7.1.1.1 – 7.1.1.9, 7.1.2.1 – 7.1.2.9, 7.1.3.1-7.1.3.8, 7.1.4.1-7.1.4.10, 7.1.5.1-7.1.5.6, 7.1.6.1-7.1.6.7, 7.1.7.1-7.1.7.7, 7.1.8.1, 7.1.9.1, 7.1.10.1		●

Repeater DUT Testing		Default	HDCP 2.3 CTS*
HDCP 2.3 CTS 3A Test Set	HDCP2.3 CTS 3A-01 – HDCP2.3 CTS 3A-06		●
HDCP 2.3 CTS 3B Test Set	HDCP2.3 CTS 3B-01 – HDCP2.3 CTS 3B-07		●
HDCP 2.3 CTS 3C Test Set	HDCP2.3 CTS 3C-01 – HDCP2.3 CTS 3C-25		●

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

## Compliance Tests

Compliance test capability is a license enabled add-on to UCD Console. The tests are included in the GUI software, license codes enable the tests for use.

Please refer to *Appendix B Licensing* for details. The list of compliance tests that UCD Console supports, please refer to document *DP CTS Tool Options for Unigraf UCD-500.pdf*. It can be downloaded in Unigraf Document Center at <https://www.unigraf.fi/documents/>. If you have any additional questions, please contact Unigraf or your local representative.

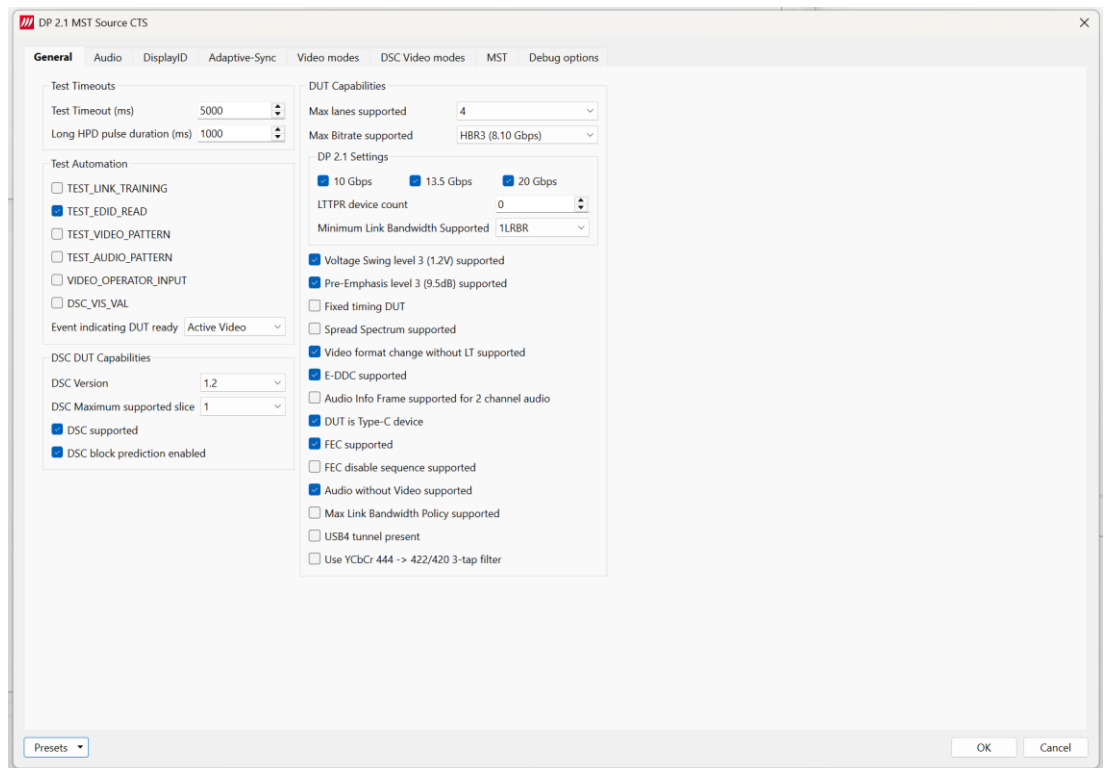
Compliance tests (CTS Tests) are part of tests included in **Source DUT Testing** tab of **DP RX** and **Sink DUT Testing** tab of **DP TX**.

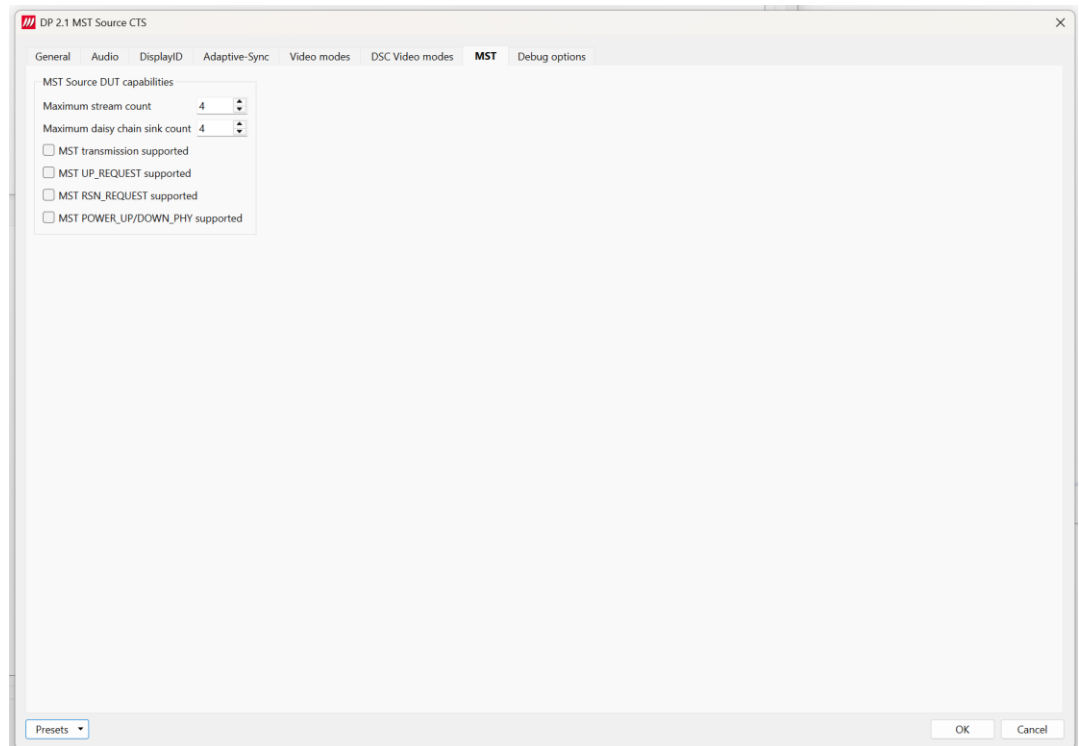
The tests cases are divided into test categories as described in *Appendix E* of this document. Test categories are placed in sub-tabs. Test category tabs are enabled based on licenses present. Please refer to chapter 3 *License Manager* earlier in this document.

### Test Parameters

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

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

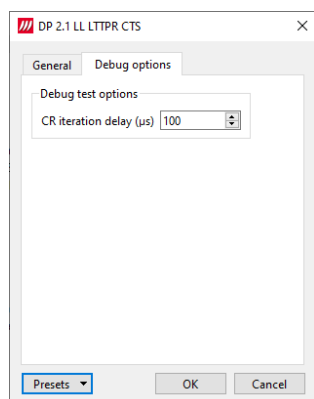






### DP 2.1 LL LTTTPR CTS CR iteration delay

Debug options allows users to manually set the CR iteration delay. To access debug options to set the CR iteration delay, select a test from DP 2.1 LL LTTTPR CTS test set and click **Configure**.




---

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

---

### DSC Test Content

When running DSC Compliance Tests, Console needs to have access to DSC content used as test patterns. This content will be automatically created during test execution. Creation of the test content takes time and considerably slows down the execution of the test. To avoid this after the first test run, users are able to save the created DSC content by selecting the option *Keep auto-created DSC content files* described below.

---

**Warning** 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.

---

### Options

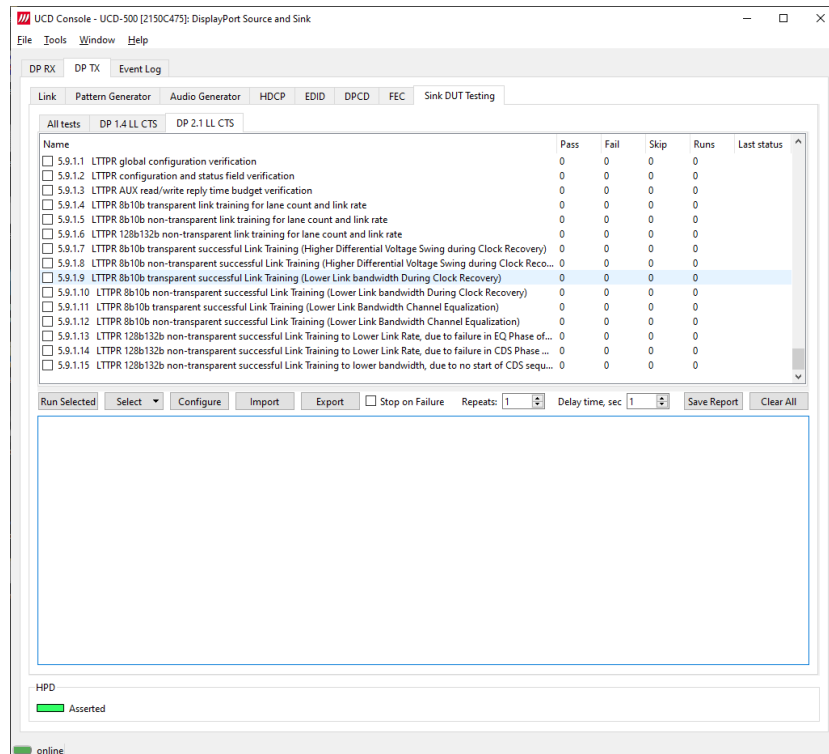
In Tools > Options menu you can define DSC Work folder and DSC test content directory.

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

## Running CTS Tests

*Source DUT Testing* and *Sink DUT Testing* tabs include the tests enabled with the set of licenses present in UCD Console grouped in test set tabs. In tabs the tests are listed by the test name and reference number as in applicable compliance test specification. UCD-5XX firmware implements the test according to the test specification.

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



Select the tests for execution by clicking the corresponding row. For selecting multiple consecutive tests in the list hold down the Shift key of your keyboard while selecting the tests. For selecting multiple individual tests hold down the Ctrl key in your keyboard while selecting.

<i>Run Selected</i>	Click to start selected tests. By clicking <i>Abort</i> the sequence is stopped.
<i>Select:</i>	Includes the following options for creating templates for tests execution: Select All, Clear All, Invert All, Save, Import and Export
<i>Configure</i>	Clicking opens a dialog for defining the test parameters for that set. Please refer to <i>Test Parameters</i> below for description.
<i>Import:</i>	Load saved test parameter files (*.td or *.json).
<i>Export:</i>	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.
<i>Stop on Failure:</i>	Stops execution of the selected tests if one of the tests fail
<i>Repeats:</i>	Repeat the selected test several times. When repeating a sequence of tests, all selected tests are performed in each repetition. E.g., when you repeat tests 1, 2 and 3 two times, the sequence is: 1, 2, 3, 1, 2, 3.
<i>Delay time</i>	Delay in seconds between individual tests.
<i>Save Report:</i>	Click to generate a report file in HTML format for sharing the results with other parties for <i>viewing</i> without UCD Console.
<i>Clear All</i>	Clear the test log and the results matrix

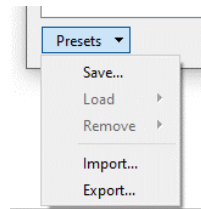
## Saving Test Parameters

Test parameters can be saved in various ways.

- Export parameters in *Sink/Source DUT Testing* tab to a \*.td file for later use in UCD Console or with TSI scripting or sharing.
- Export parameters in *Sink/Source 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

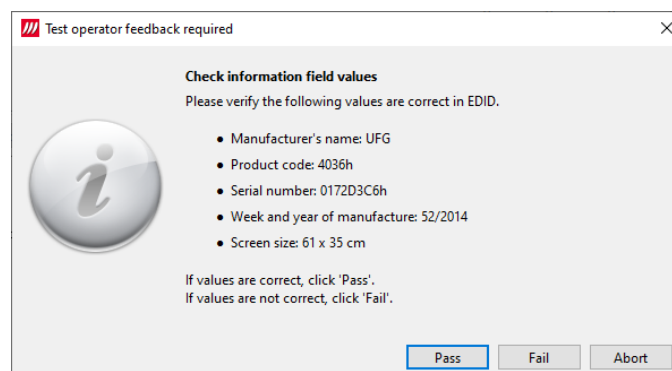
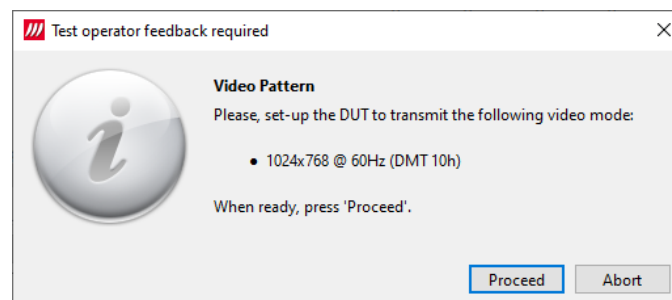
In all *Configure* dialogs the selected parameters can be saved as Presets. Please click **Presets...** to save or recall a configuration. Click Save first to assign the configuration a name, and after that you can e.g. Export it to a file.



## Operator Feedback

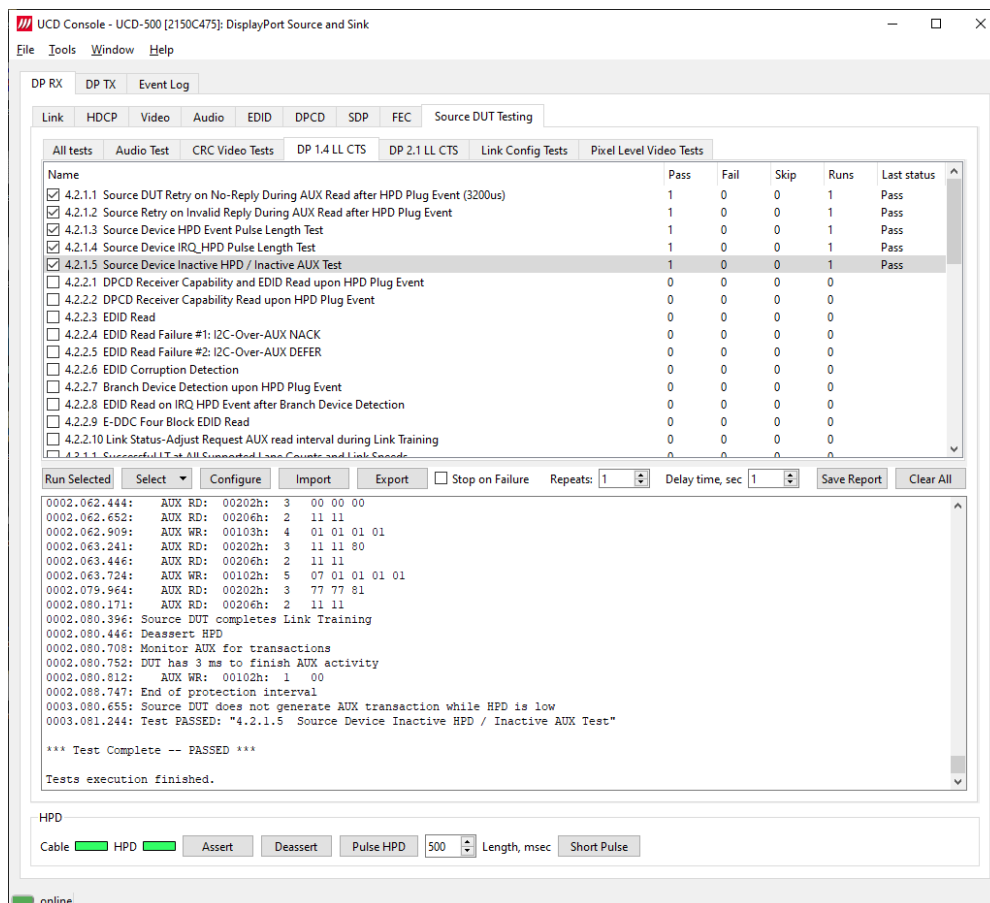
In some compliance tests operator action or feedback is required for items that the test itself cannot perform or confirm. In these cases test opens a pop-up dialog. In the dialog the operator is instructed about items to do or to be verified and buttons for providing the “Proceed” instruction or “Pass” and “Fail” feedback.

Clicking “Abort” stops execution of the test.



## Evaluating CTS Test Results

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



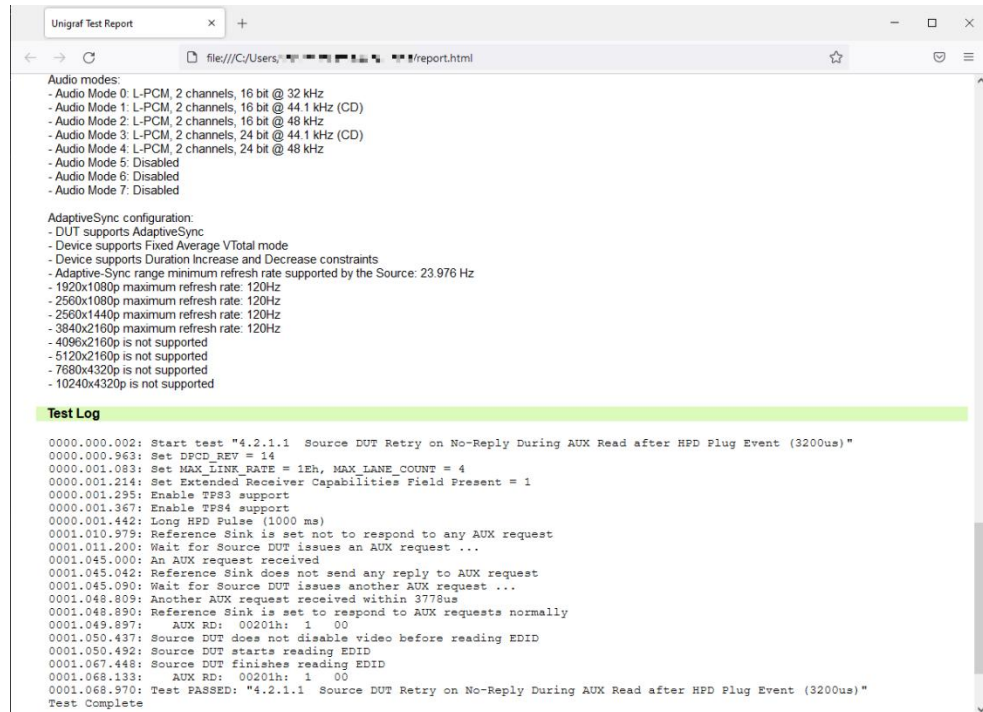
At the completion of each test the result of the test is indicated in the matrix on the right hand side of the test panel. For each test the matrix lists the number of occurrences of each result and the number of tries performed.

## Test Report

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

### Viewing the CTS Test Report

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



### DUT Testing Options

Please refer to Tools > Options earlier in this manual for control on including system date and time in the beginning of each event line in created reports.

## Audio Test Set

### 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 a 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  $\pm 1$  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.

Name	Value
Expected sampling rate of audio signal	44100
Expected audible (sine) frequency as Hz	1000
Allowed deviation from expected frequency as Hz	1
Number of audio glitches allowed per test	0
Tested audio save conditions	Save none
Location where the captured audio is to be saved	C:/Users/Tester/Documents/Test Reports

Presets ▼ OK Cancel

### 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)
- Number of audio glitches allowed per test (default 0)
- Tested audio save conditions (Save none / Save failed / Save all)

Click **Location where the captured audio is to be saved** to browse for the folder to store tests.

## CRC Based Video Test Set

Role:

DP Reference Sink (DP RX)

Product:

UCD-500 and Gen 2

### Configuration

*Test timeout:* If enabled test will abort when the time has elapsed

*Repeat until timeout:* Omit "Test length" parameter

*Test length (# frames):* Number of captured frames to test

*Errors allowed (# frames):* Number of failing frames allowed before test Fails

*Repeat "Sequence Test" until timeout:* Repeat test sequence until the timeout set (length parameter below omitted)

*"Sequence Test" length* Repeat count of the "Sequence Test"

*Expected Video Format* Format of the signal expected

*Expected Frame Rate:* Verify stability of the video signal. Verification disabled if Expected Frame Rate is set to "0"

*Number of captured reference frames:* 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.

*Max number of saved frames:* Maximum number of failed frames stored to PC

*Format of saved frames:* Select saved image format (Binary file, PPM image, BMP image)

*Align 12* 12bpc values are be shifted to MSB of a 16bits container. If not checked, 12 LSB are used to store colour component values.

*Presets:* Store and recall settings

### CRC Based Single Reference Frame Video Test

The test compares captured frames to a captured reference. In Configure dialog, please select 1 to *CRC Capture length* and click *Capture Now*.

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)
- Total number of frames (default 2 00 ms)
- Number of bad frames allowed (default 20)
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz, 1/1000 Hz)
- Frame rate tolerance (mHz, 1/1000 Hz)
- Reference CRCs (R, G, B)

### CRC Based Single Frame Video Stability Test

The test verifies that the captured video is stable.

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

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

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

#### Parameters in use

- Test Timeout (default 100 00 ms)
- Total number of frames (default 200 ms)
- Number of bad frames 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)
- Number of frames to be tested (default 20)
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz, 1/1000 Hz)
- Frame rate tolerance (mHz, 1/1000 Hz)
- Reference CRCs (R, G, B)

---

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

---

### CRC Based Continuous Sequence of Reference Frames Test

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

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

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

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

#### Parameters in use

- Test Timeout (default 10 000 ms)
- Number of frames to be tested (default 20)
- Number of iterations
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz, 1/1000 Hz)
- Frame rate tolerance (mHz, 1/1000 Hz)
- Expected color format
- Reference CRCs (R, G, B)

---

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

---

## Link Config Tests

### 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.

In Configure, please define the parameters for the test.

Name	Value
Test timeout, in milliseconds	5000
Max lanes count supported by DUT	4
Max lane rate supported by DUT	5.4 Gbps
Long HPD pulse duration, in milliseconds	1000
Link training start timeout, in milliseconds	5000
Delay between test cycles, in milliseconds	3000
Reserved	0

Presets

OK Cancel

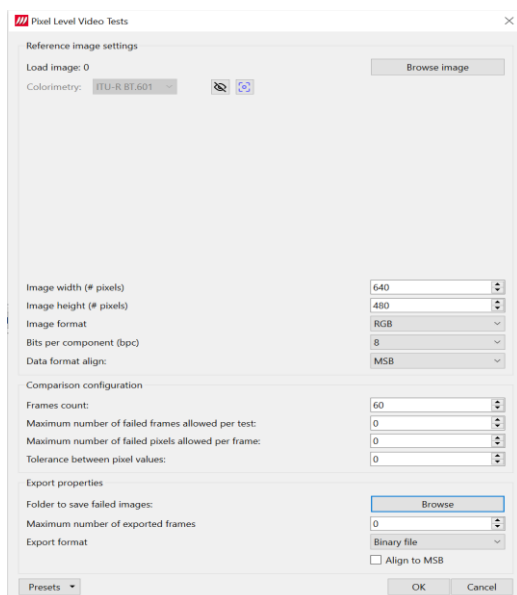
### Parameters in use

- Test Timeout (default 5 000 ms)
- Max lane count supported by DUT (default 4)
- Max lane rate supported by DUT.
- 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

### Compare Video Frame Sequence with a Single Reference

The test compares captured frames to the provided reference image on pixel level by buffering the indicated number of captured frames first in the local UCD device frame buffer and after that



downloads them to the PC for evaluation.

The test compares the captured frames to a provided reference image on pixel level.

- The color component values of each pixel in the captured frame is compared to the corresponding pixels in the reference image.
- If the difference is larger than the provided tolerance, the pixel is considered failed.
- If the number of failed pixels in a frame is larger than the provided tolerance, the frame is considered failed.
- If the number of failed frames in the test is larger than the provided tolerance, the test is considered failed.
- Failed frames can be stored for evaluation.



<i>Load image:</i>	Load the reference image
<i>Image resolution:</i>	Video resolution expected
<i>Image format:</i>	Image format expected
<i>Bits per component:</i>	Bits per component expected
<i>Data format:</i>	Video data format expected
<i>Frames count:</i>	Number of frames buffered for testing
<i>Maximum number of failed frames allowed per test:</i>	Number of failed frames allowed totally
<i>Maximum number of failed frames allowed per test:</i>	Number of failed pixels allowed per buffered frame
<i>Tolerance between pixel values:</i>	The allowed difference between a color component of pixel in the captured frame to the reference bitmap.
<i>Folder to save failed images:</i>	PC folder where failed frames are stored.
<i>Maximum number of exported frames:</i>	Maximum number of failed frames saved to PC
<i>Export format:</i>	Format of saved failed frames: Binary file, PPM image, BMP image

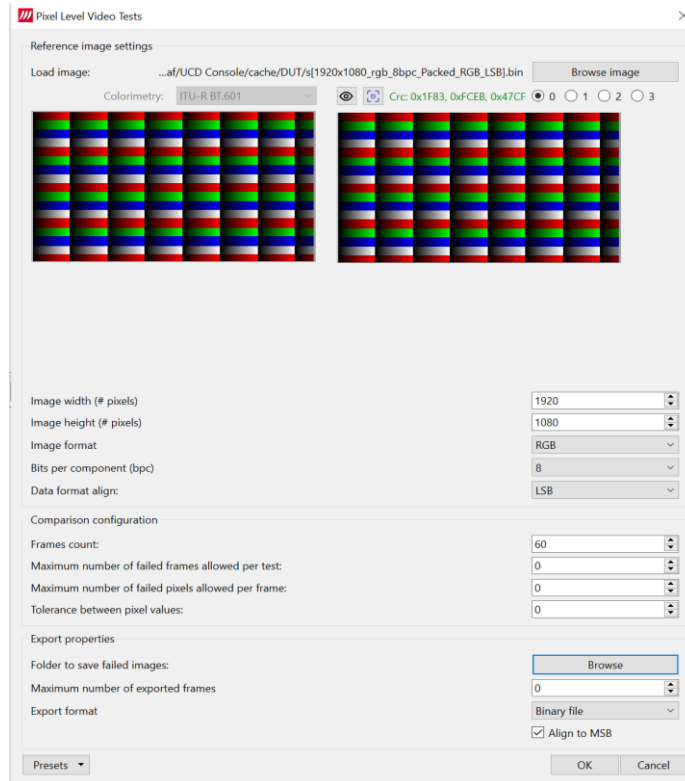
*Presets:*

Store and recall settings

### Capturing Reference Image

Users can use the received video as reference. Make sure you are receiving video first.

1. In *Settings* dialog click the enable preview icon .
2. When the preview has been enabled click the *Capture reference* icon  to store a frame and use it as reference. Before accepting the frame, the stability of the video is verified with a CRC stability check. Captured CRC can also be verified by the user.



## APPENDIX F: VTP PATTERN 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 provides 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:

- 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 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 or 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.*

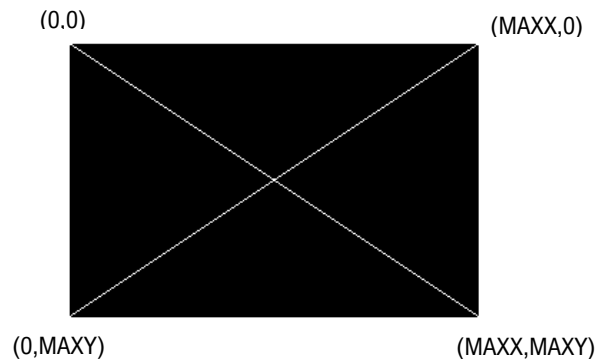
*LINE 0 MAXY MAXX 0 ; Draw a line from lower left to upper right corner.*

*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

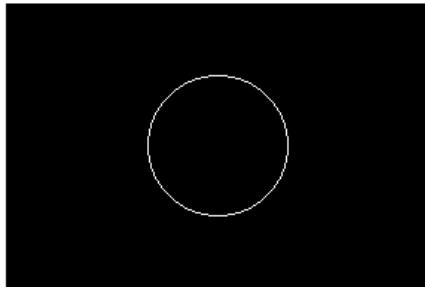
```
Syntax: CIRCLE x y r
```

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

Example:

```
SCALED  
COLORDEPTH 8  
COLORRGB 255 255 255  
CIRCLE 5000 5000 2500
```

The pattern will look like this:

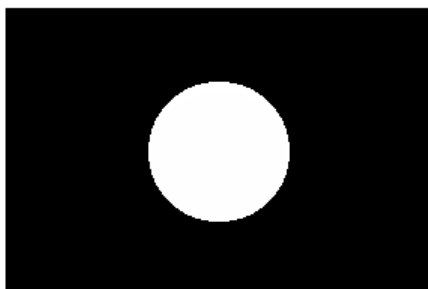


### FCIRCLE

```
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 using reference to vertical maximum.

The pattern will look like this:





## ELLIPSE

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

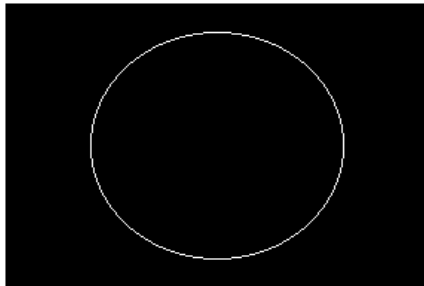
Draws an ellipse with center point at (x,y), horizontal radius hr and vertical radius vr.

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

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.

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 value of variable HR
                           ; 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

### 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 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 always have positive integers or zero value. When an expression is evaluated 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

<i>Coordinate system:</i>	ABSOLUTE
<i>Foreground color:</i>	1023 1023 1023
<i>Background color:</i>	0 0 0
<i>Image:</i>	Output image is cleared (all black)
<i>Variables:</i>	All variables are initialized to zero
<i>Color depth:</i>	COLORDEPTH 10

## APPENDIX G: FIRMWARE RECOVERY

The chapter below describes a procedure for recovering Firmware of UCD-5XX unit in a case when e.g., the normal FW Update procedure failed because of a critical error.

### Note

The firmware recovery procedure is only available for Windows operating system.

## Downloading Tools

The Recovery patch is programmed to UCD Device with a separate tool called **Intel® Quartus® Prime Pro Edition Programmer and Tools**. The tool can be downloaded from **Intel® FPGA** website:

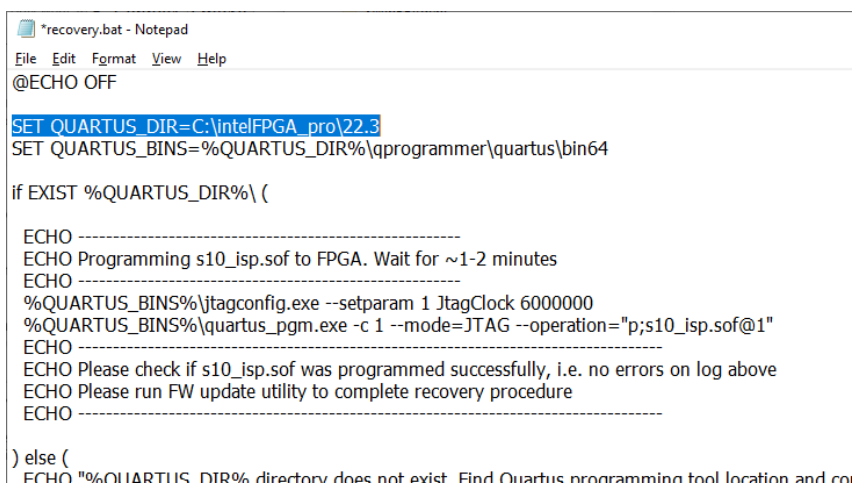
<https://www.intel.com/content/www/us/en/software-kit/746667/intel-quartus-prime-pro-edition-design-software-version-22-3-for-windows.html>

1. On the download page, please select section “**Additional Software**”. Please download the software under “**Intel® Quartus® Prime Pro Edition Programmer and Tools**”.
2. Please download and install the tool using default option in the PC.

The screenshot displays the Intel Quartus Prime Pro Edition Design Software Version 22.3 for Windows download page. The 'Downloads' section is visible, with the 'Additional Software' tab selected and highlighted by a red box. Under this tab, the 'Intel® Quartus® Prime Pro Edition Programmer and Tools' download is highlighted by another red box. The download link is 'QuartusProProgrammerSetup-22.3.0.104-windows.exe', with a size of 1.2 GB and a SHA1 hash of 46fa1732c9aac991e85bdebb3cdac94298c0954d. The installation size is 3.46 GB.

## Step 1

1. Connect the UCD device to the power supply and switch on power.
2. Connect the UCD device with a USB cable to the PC through USB connector (Please refer to chapter **Product Description > Connections** earlier in this document)
3. Please locate the *UCD-5xx\_recovery.zip* file. By default the file is stored in C:\Program Files\Unigraf\Unigraf UCD Tools\recovery
4. Extract the content of the ZIP file in a folder in your PC, e.g., C:\Temp
5. Open Windows **Command Prompt** application
6. Change current directory to where the ZIP file was extracted (e.g. *cd \Temp*)
7. Connect a micro-USB cable to **JTAG** connector in the UCD device (Please refer to chapter **Product Description > Connections** earlier in this document).
8. In the directory where the ZIP file was extracted (e.g. c:\Temp) please edit file **recovery.bat**
9. On line three (3) parameter "QUARTUS\_DIR" is set to point to the folder where the Quartus Programmer was installed (by default **C:\intelFPGA\_pro\22.3**). If needed, please edit line three to match. Please save the file.



```
*recovery.bat - Notepad
File Edit Format View Help
@ECHO OFF

SET QUARTUS_DIR=C:\intelFPGA_pro\22.3
SET QUARTUS_BINS=%QUARTUS_DIR%\qprogrammer\quartus\bin64

if EXIST %QUARTUS_DIR% (

    ECHO -----
    ECHO Programming s10_isp.sof to FPGA. Wait for ~1-2 minutes
    ECHO -----
    %QUARTUS_BINS%\jtagconfig.exe --setparam 1 JtagClock 6000000
    %QUARTUS_BINS%\quartus_pgm.exe -c 1 --mode=JTAG --operation="p;s10_isp.sof@1"
    ECHO -----
    ECHO Please check if s10_isp.sof was programmed successfully, i.e. no errors on log above
    ECHO Please run FW update utility to complete recovery procedure
    ECHO -----

) else (
    ECHO "%QUARTUS_DIR%" directory does not exist. Find Quartus programming tool location and co
```

10. In Windows **Command Prompt** application please make sure that current directory is still the same (e.g. C:\temp)
11. Launch batch **recovery.bat**
12. Please wait until the batch file has been completed (may take up to several minutes).

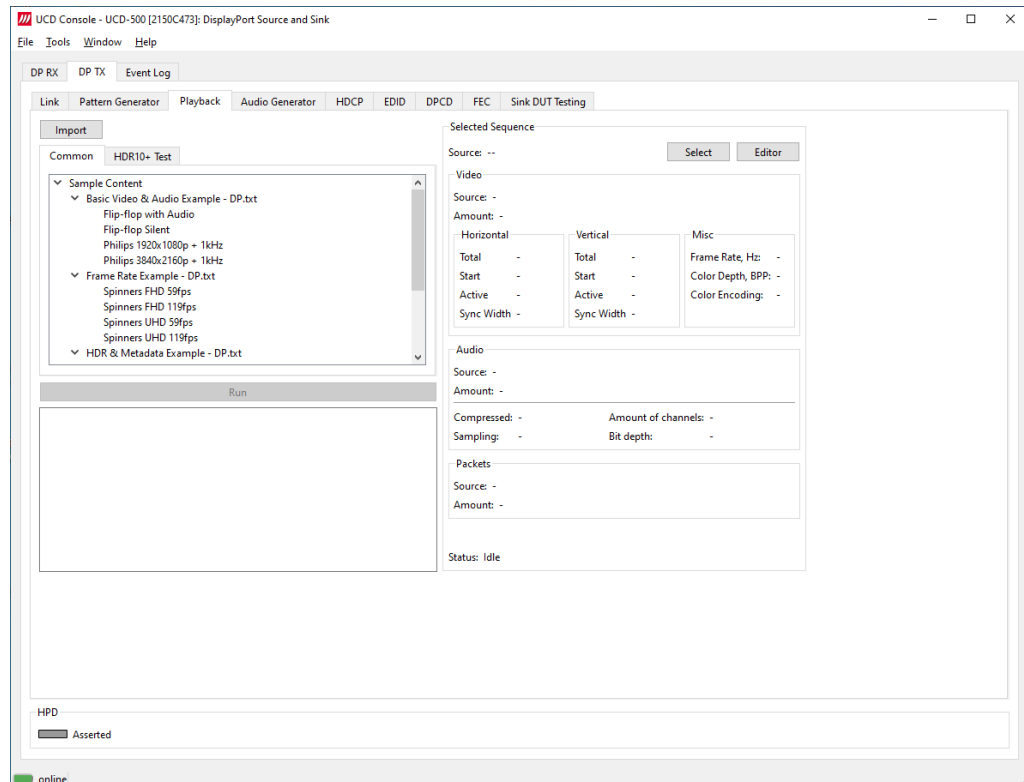
## Step 2

Perform FW update procedure as described in section **Installation > Firmware Update Procedure** earlier in this manual.

After Recovery procedure has been completed, you can delete the files stored in e.g., C:\Temp.

## APPENDIX H: PLAYLISTS AND SCENARIOS

UCD Console's Playback enables you to run scripts called playlists. Use playlists to stream video, audio and metadata. See the Unigraf UCD Console Playback Tutorial at [www.unigraf.fi/resource/tutorial-run-edit-and-create-sdr-and-hdr-scenarios-with-unigraf-s-playback-tool/](http://www.unigraf.fi/resource/tutorial-run-edit-and-create-sdr-and-hdr-scenarios-with-unigraf-s-playback-tool/)



### 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

Before transmission content is loaded to frame memory buffer of the UCD device. Frame buffer memory limits content (number of frames) that can be played. UCD-5XX devices by default feature 16 gigabytes of memory. This enables loading up to 320 4K or 80 8K video frames. Contact Unigraf for information for larger frame buffer sizes.

### Sample Content

You can use sample content as a basis for creating custom test sequences: see UCD Console *Playback* tab. Sample content is stored by default (on Windows) at *C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\content*. See [Sample Content in Playback](#) Tab 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 block

*Device* block describes the device and output connector type.

Key	Description	Possible values
[ <i>Device</i> ]	Required. Start of the <i>Device</i> block.	
<i>serialnumber</i>	Required. Serial number of the UCD device. The '*' wildcard can be used if only one UCD source device is connected to the PC.	'*' '1722C333'
<i>connectortype</i>	Required. Output connector type to be used. Playlists shall not contain scenarios for different connector types.	'HDMI Out' 'DisplayPort Out' 'USBC Out'
<i>reset</i>	Only applies to UCD-323.	

### Scenario block

*Scenario* block describes a scenario and its playback parameters. Playlists run scenarios in the order they are listed.

Key	Description	Possible values
[ <i>Scenario</i> ]	Required. Start of a <i>Scenario</i> block. <i>Playlists</i> can have multiple <i>Scenario</i> blocks.	
<i>caption</i>	Optional. Title. Any character string accepted.	'Scenario 1' 'SDR - HDR'
<i>path</i>	Required. Specifies relative path to <i>scenario</i> file.	Any valid path
<i>period</i>	Required. Duration of <i>scenario</i> transmission in milliseconds. 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 item	Description
<i>video</i>	Relative path of (first numbered or only) video frame file
<i>audio</i>	Relative path of audio file
<i>packets</i>	Relative path of (first numbered or only) metadata packet file
<i>porder</i>	Play order. See <i>Content Playing Order</i> below.
<i>align12</i>	Alignment of 12-bit binary pixel data. '1' aligned to LSB; '0' aligned to MSB.
<i>audioswap</i>	'1' for Little Endian audio samples
<i>audiocompressed</i>	'1' compressed audio; '0' uncompressed audio
<i>audiosampling</i>	Audio sampling rate (e.g., 44100)
<i>audiochannels</i>	Number of audio channels
<i>audiobits</i>	Audio bits per sample (usually 16 or 24)
<i>scrambler</i>	'1' scrambling enabled; '0' scrambling disabled
<i>audiosync</i>	Audio sync
<i>colorspace</i>	Video color space: RGB; YUV444; YUV422; YUV420
<i>bitspercolor</i>	Video color depth (bits per color)
<i>timing.hactive</i>	Timing: horizontal active
<i>timing.vactive</i>	Timing: vertical active
<i>timing.htotal</i>	Timing: horizontal total
<i>timing.vtotal</i>	Timing: vertical total
<i>timing.hstart</i>	Timing: horizontal start
<i>timing.vstart</i>	Timing: vertical start
<i>timing.hsync</i>	Timing: horizontal sync width
<i>timing.vsync</i>	Timing: vertical sync width
<i>timing.frate</i>	Timing: framerate in milliseconds
<i>hdcp</i>	HDCP version used (can be 1.4 2.3 or 'none')
<i>loadingRGB</i>	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)
<i>linkRate</i>	Default link rate. HDMI: 0 = TMDS; 1 – 5 = FRL with 3, 6, 8, 10 and 12 Gbps link rate. DP: Link rate = Value × 0.27 Gbps. (E.g., 20 = 5.4 Gbps/lane (HBR2)).
<i>linkRateMin</i>	Minimum link rate desired. <i>Scenario</i> will fail if not achieved
<i>DSC timing parameters</i>	Parameters are different for DP and HDMI. See below.

DSC Timing parameters for HDMI

dscFrameRate	DSC Timing: Frame rate [fps] × 1000
dscHcactive	DSC Timing: Horizontal active
dscHcblank	DSC Timing: Horizontal blank
dscVtotal	DSC Timing: Vertical total
dscVsync	DSC Timing: Vertical sync
dscVstart	DSC Timing: Vertical start
dscVactive	DSC Timing: Vertical active

DSC Timing parameters for DP

dscFrameRate	DSC Timing: Frame rate [fps] × 1000
dscVtotal	DSC Timing: Vertical total
dscVsync	DSC Timing: Vertical sync
dscVstart	DSC Timing: Vertical start
dscVactive	DSC Timing: Vertical active
dscHtota	DSC Timing: Horizontal total
dscHsyn	DSC Timing: Horizontal sync
dscHstart	DSC Timing: Horizontal start
dscHactive	DSC Timing: Horizontal active

## 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 of the form:

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

## Parameters

Char	Description	Possible values	Examples
:	Separator between step parameters.	':'	See below
;	Step delimiter.	','	See below
p	Not used with UCD-5XX.	'p'	
V	Required. Video frame indices (zero based). Parameters are applied to all frames in the step. Images (possibly numbered) are loaded from the <i>video</i> file path.	'1' '1,2,5' '0-59'	'1:60:16:256;' '1,2,5:60:16:256;' '0-59:60:16:256;'
R	Required. Repetitions of current step. For example, '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 <i>packets</i> 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 <a href="#">Color Format</a> below.	'256' '513'	'1:30:0:256;' '1:30:0:513;'
vXX	Optional. Frame rate when VRR/Adaptive-Sync is enabled. The parameter is in the form 'vXX', where 'XX' is the frame rate.	'v60' 'v30'	'1:30:0:256v60;' '1:30:0:256v30;'

### Color Format

Color format is a two-byte decimal value. The lower byte provides an index to used color space and the higher byte an index to the color depth. Please find the indexes in the table 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 parameter value is encoded as follows:

$[\text{Color Depth}] \times 256 + [\text{Color Space}]$ ,

where  $[\text{Color Depth}]$  and  $[\text{Color Space}]$  are indices from the table above.

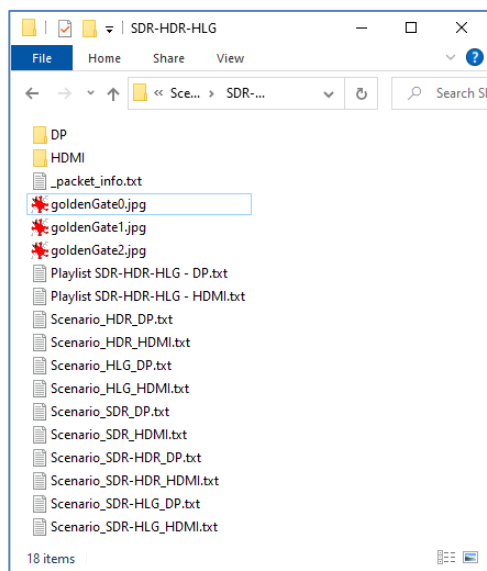
For example, parameter for YCbCr 4:4:4, 10 bits is  $(2 \times 256 + 1) = 513$ .

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

Below is a playlist example: SDR-HDR-HLG – DP.



### Playlist file (Playlist SDR-HDR-HLG - DP.txt)

Playlist item and example content	Description
[Device]	Start of device section
Serialnumber = *	Only one UCD device present.
Connectortype = DisplayPort Out	DisplayPort output
[Scenario]	Start of Scenario 1
caption = SDR	Scenario title "SDR"
period = 10000	Duration 10 sec
path = Scenario_SDR_DP.txt	Scenario file: Scenario_SDR_DP.txt in current folder
[Scenario]	Start of Scenario 2
caption = HDR	Scenario title "HDR"
period = 10000	Duration 10 sec
path = Scenario_HDR_DP.txt	Scenario file: Scenario_HDR_DP.txt in current folder
[Scenario]	Start of Scenario 3
caption = HLG	Scenario title "HLG"
period = 10000	Duration 10 sec
path = Scenario_HLG_DP.txt	Scenario file: Scenario_HLG_DP.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_DP.txt	Scenario file: Scenario_SDR-HDR_DP.txt in current folder
[Scenario]	Start of Scenario 5
caption = SDR – HLG	Scenario title "SDR – HLG"
period = 10000	Duration 10 sec
path = Scenario_HDR_DP.txt	Scenario file: Scenario_SDR-HLG_DP.txt in current folder

## Scenario File (Scenario\_SDR-HDR-DP.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=DP\Infoframes_0000.bin	Packet files in folder DP\, 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, Packet 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
hdcg=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.
linkRate=0	
linkRateMin=	Not specified
dscFrameRate=60	DSC Timing: Frame rate [fps] × 1000
dscHcactive=7840	DSC Timing: Horizontal active
dscHcblank=100	DSC Timing: Horizontal blank
dscVtotal=2250	DSC Timing: Vertical total
dscVsync=10	DSC Timing: Vertical sync
dscVstart=82	DSC Timing: Vertical start
dscVactive=2160	DSC Timing: Vertical active

## Sample Content in Playback Tab

Use UCD Console's Playback examples to create custom test content. On Windows, examples can typically be found at C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\content.

Provided examples include:

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 through 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 transmits video and audio as described below.

### Video

Frames used for Scenario 1 and Scenario 2 (Image1.jpg, Image2.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: Frame Rate Example

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: Audio-Video Latency

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

Description of Scenarios

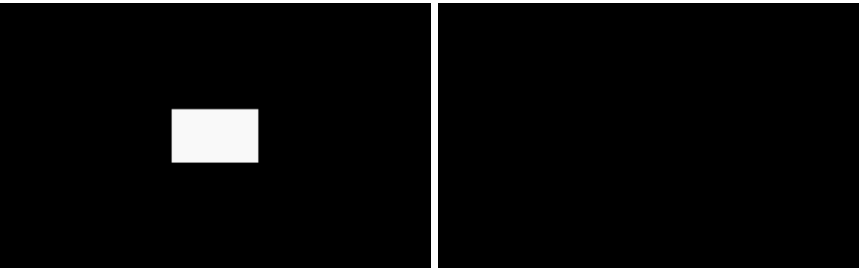
These scenarios can be used to estimate audio-video synchronization using external tools like Sync-One2 or similar. Video latency measuring requires the Unigraf ULT-01 tool.

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.

Video

	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

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 DP 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

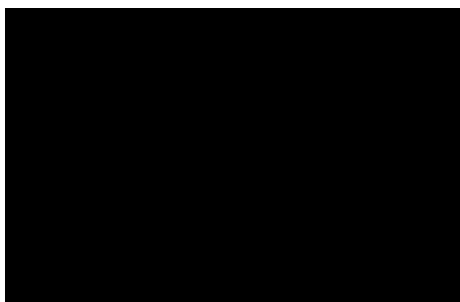
The scenarios show smooth transition though shades of gray from black to white.

	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.

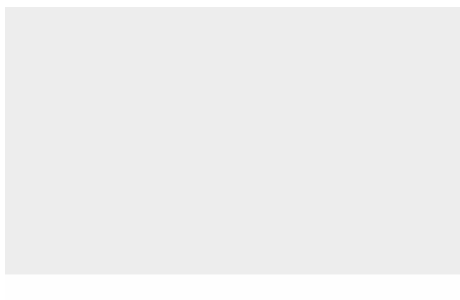
Gray0.vpattern



Gray60.vpattern



Gray119.vpattern



Playlist: HDR10+ SSTM Example

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

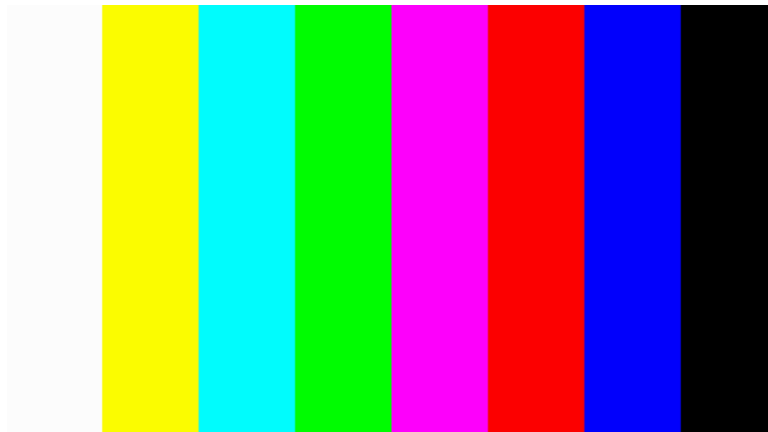


## Playlist: PSR1

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