



# **User Manual** UCD Console SW Version 3.5

# /// UNIGRAF

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# Edition

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### Purpose

This guide is a User Manual of UCD-4XX test devices, that are USB-connected video interface test units for use with a computer.

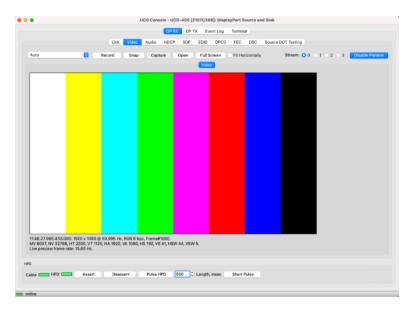
The purpose of this guide is to

- 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 the UCD-4XX units.
- Provide instructions for the user on how to use UCD Console SW.

# **Product and Software Version**

This manual explains features found in UCD Console SW Bundle **3.5**. Please consult Unigraf for differences or upgrades of previous versions.

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



# Notes

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

Note:	This text is an important note
Warning:	This is a warning about a direct risk for the functionality of the device



# **Product Description**

### **USB-Connected Test Equipment**

UCD-4XX devices are high speed, USB 3.0 connected video interface test units. UCD-4XX units include the following models:

- UCD-400 DisplayPort 1.4a Analyzer and Generator
- UCD-411 DisplayPort 1.4a Generator
- UCD-412 HDMI 2.1 Generator
- UCD-422 HDMI 2.1 Analyzer and Generator
  - UCD-424 USB-C DisplayPort Alt mode Analyzer and Generator

*UCD Console SW* is a common graphical user interface (GUI) for Unigraf's UCD test devices. The outlook and details of UCD Console SW will vary depending on the capabilities of the connected unit and will reflect the features enabled.

UCD-4XX units feature a high-level Software Development Kit (SDK) called Test Software Interface (TSI) for use in automated testing. TSI allows for an easy integration of Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation found in additional Unigraf manuals for more details.

### **Stand-Alone Test Equipment**

In stand-alone UCD models the test equipment is built inside a PC and the control interface is a PCI bus instead of a USB connection. Please find below a list of available units:

- UCD-451 Stand-alone DisplayPort 1.4a Generator
- UCD-452 Stand-alone HDMI 2.1 Generator

# UCD-400 and UCD-411

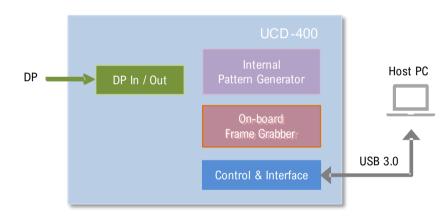
### **Product Features**

- UCD-400: Reference Sink and Source for verifying DP connected devices.
- UCD-411: Reference Source for verifying DP connected sinks.
- DisplayPort 1.4a compliant with HBR3 support
- High resolution video up to 8K 30 Hz, 4K / UHD 120 Hz uncompressed and audio.
- Supports MST (4 streams), Adaptive-Sync, Forward Error Correction (FEC), Display Stream Compression (DSC) and Link Training Tunable PHY Repeater (LTTPR)
- Compatible with HDCP versions 1.3 and 2.3
- 2 GB on-board high-speed video frame buffer
- High speed USB 3.0 host PC interface

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

### **Functional Description**

UCD-400 units consist of a multimedia signal input stage with on-board frame buffer, an internal pattern generator, a control stage, 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.



### **Delivery Content**

Product shipment contains:

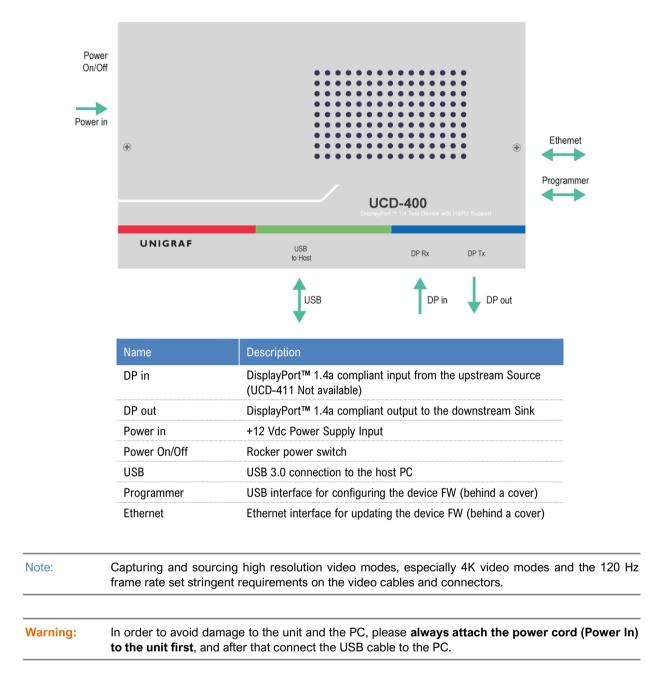
- The UCD-400 or UCD-411 unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
- USB 3.0 compliant cable for host PC connection
- Micro-USB type B compatible cable for FW programming
- USB-C to DP Bi-directional Cable for testing USB-C sinks or sources

### **USB Type-C Interface**

UCD-400 and UCD-411 delivery package includes a "C to DP Bi-directional Cable" to enable testing of Sink or Source devices with USB-C interface.

### Connections

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



# UCD-412 and UCD-422

### **Product Features**

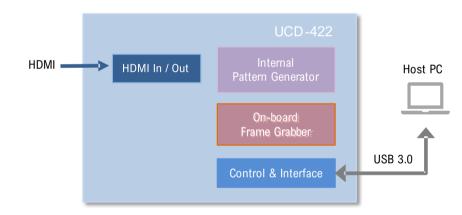
- UCD-422: Reference Sink and Source for verifying HDMI connected devices.
- UCD-412: Reference Source for verifying HDMI connected sinks.
- HDMI 2.1 compatible. Supports FRL and TMDS signaling.
- Supports HDMI video and audio up to 10K@30 Hz, 8K@60 Hz (YCbCr 4:2:0), 4K@120 Hz (YCbCr 4:2:0)
- Supports Display Stream Compression (DSC), and Enhanced Audio Return Channel (eARC)
- Compatible with HDCP versions 1.4 and 2.3
- 2 GB on-board high-speed video frame buffer
- High speed USB 3.0 host PC interface

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

### **Functional Description**

UCD-422 units consist of a multimedia signal input stage with on-board frame buffer, an internal pattern generator, a control stage, and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format. The Interface and Control stages are either passing the captured data directly to the USB interface or storing it to the frame buffer. The internal pattern generator is able to source a signal for testing sink and branch units. The Interface & Control stages are receiving instructions from the host PC to configure and control the functionality of the unit.

Please find below logical diagram of UCD-422 unit

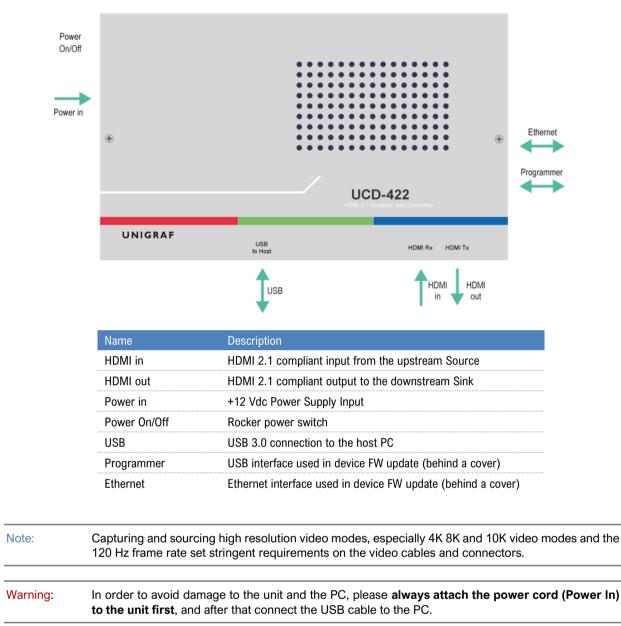


### **Delivery Content**

- Product shipment contains:
- The UCD-422 or UCD-412 unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
- USB 3.0 compliant cable for host PC connection
- HDMI 2.1 grade HDMI cable
- Micro-USB type B compatible cable needed for FW programming.
- Ethernet cable needed for FW programming.

### Connections

The image below indicates the connections in **UCD-422** unit and their description.



# UCD-424

### **Product Features**

- Reference Sink and Source for verifying DisplayPort™ Alt Mode over USB-C
- USB-C v1.3 input and output with Power Delivery 3.0
- DisplayPort 1.4a compliant with HBR3 support
- High resolution video up to 8K 30 Hz, 4K / UHD 120 Hz uncompressed and audio
- Supports MST (4 streams), Adaptive-Sync, Forward Error Correction (FEC), Display Stream Compression (DSC), and Link-Training Tunable PHY Repeater (LTTPR)
- Compatible with HDCP versions 1.3 and 2.3
- 2 GB on-board high-speed video buffer
- High speed USB 3.0 host PC interface

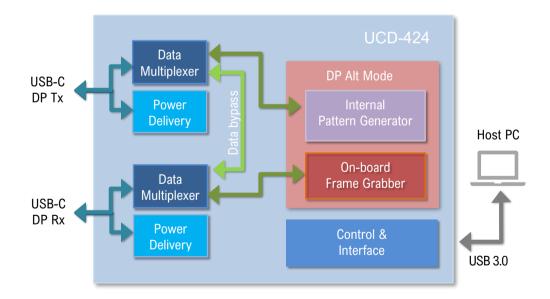
Please refer to Product Specifications in the appendix of this document for details.

### **Functional Description**

UCD-424 units consist of a multimedia signal input stage with on-board frame buffer, an internal pattern generator, a control stage, 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.

USB Data bypass can be enabled between the USB-C connector attached to the DUT to an external device connected to the vacant USB-C connector.

The Interface & Control stages are receiving instructions from the host PC to configure and control the functionality of the unit.



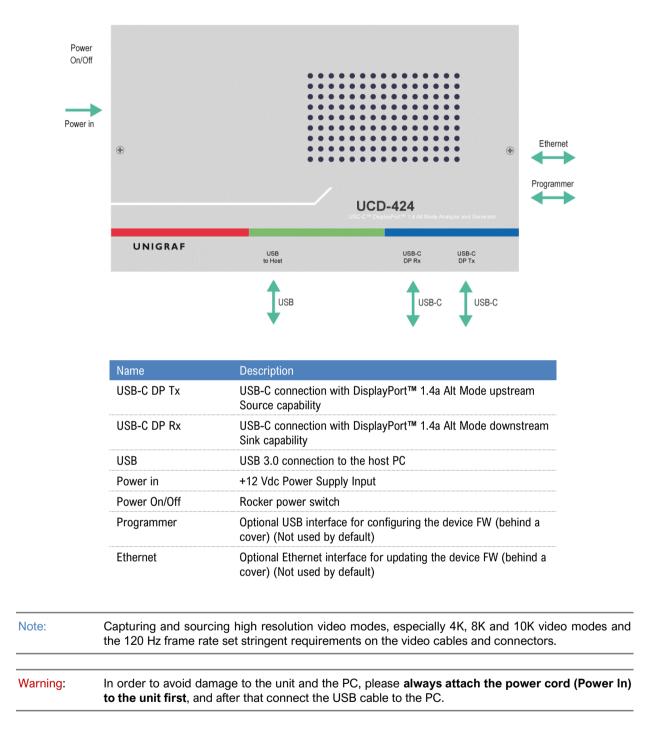
### **Delivery Content**

Product shipment contains:

- The UCD-424 unit
- AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 Vdc output)
- USB 3.0 compliant cable for host PC connection
- USB-C to USB-C USB 3.2 Gen2 e-marked cable
- USB-C to DP Bi-directional Cable for testing DP sinks or sources.

### Connections

The image below indicates the connections in **UCD-424** unit and their description.



# UCD-451

UCD-451 is a stand-alone DisplayPort interface test unit with full featured Generator functionality. UCD-451 contains a built-in PC, a DisplayPort reference source, and software for configuring the test interface and running tests.

UCD-451 is designed to specially facilitate Dolby Vision™ testing in DisplayPort interface.

### **Product Features**

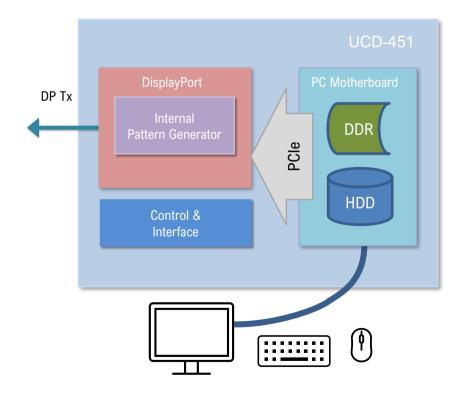
- DisplayPort 1.4a compliant with HBR3 support
- 8K Dolby Vision™ Test Tool
- High resolution video up to 8K 30 Hz, 4K / UHD 120 Hz uncompressed and audio.
- Supports MST (4 streams), Adaptive-Sync, Forward Error Correction (FEC), Display Stream Compression (DSC) and Link Training Tunable PHY Repeater (LTTPR)
- Compatible with HDCP versions 1.3 and 2.3
- Extended video memory up to 32 GBytes
- Embedded Windows PC

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

### **Functional Description**

Part of the DDR memory in the PC motherboard is locked and reserved for storing the playback content. During playback, content is first loaded from hard disk (HDD) to the RAM memory of the PC (DDR). Video frames are then sequentially transferred from PC RAM to pattern generator's internal playback memory via PCIe bus. Pattern Generator firmware triggers a PCIe transfer to request content when needed.

Please find below logical diagram of UCD-451 unit.



# UCD-452

UCD-452 is a stand-alone HDMI interface test unit with full featured Generator functionality. UCD-452 contains a built-in PC, a HDMI reference source, and software for configuring the test interface and running tests.

UCD-452 is designed to specially facilitate Dolby Vision™ testing in HDMI interface.

### **Product Features**

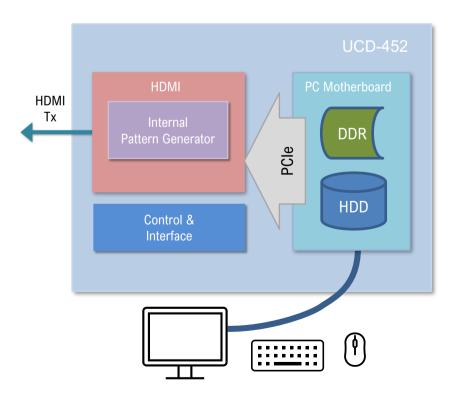
- HDMI 2.1 compatible Test Equipment. Supports FRL and TMDS signaling.
- 8K Dolby Vision™ Test Tool
- Supports HDMI video and audio up to 10K@30 Hz, 8K@60 Hz (YCbCr 4:2:0), 4K@120 Hz (YCbCr 4:2:0)
- Supports Display Stream Compression (DSC), and Enhanced Audio Return Channel (eARC)
- Compatible with HDCP versions 1.4 and 2.3
- Extended video memory up to 32 GBytes
- Embedded Windows PC

Note: Due to HW limitations, only 2 GBytes of video memory can be used with uncompressed deep color video at 3840x2160 p144 video timing. This allows for playing sequences containing up to 40 frames.

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

### **Functional Description**

Part of the DDR memory in the PC motherboard is locked and reserved for storing the playback content. During playback, content is first loaded from hard disk (HDD) to the RAM memory of the PC (DDR). Video frames are then sequentially transferred from PC RAM to pattern generator's internal playback memory via PCIe bus. Pattern Generator firmware triggers a PCIe transfer to request content when needed.



Please find below a logical diagram of UCD-452 unit.

# 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.
- 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 <u>https://www.unigraf.fi/downloads/</u>. Please, note that there are separate packages for Windows and macOS.

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

Drivers (installed during set up) UCD Console SW (installed during set up) License Manager (installed during set up) Device configuration utility (installed during set up) Packet Editor (installed during set up) TSI SDK User Manuals including this document.

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

Note:	The software should be installed before connecting the UCD unit to the computer.
Note:	System administrator's privileges are required for performing installations.

# Software Installation

### Windows

Install \*.exe file from the package.

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

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

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

Create a desktop shortcut

Install the Visual C++ redistributable (needs to be present on Windows)

Install Unigraf USB drivers

Confirm by selecting Next dialog button. Select Install to start the installation.

Select Finish to exit the installation dialog.

#### macOS

Install \*.pkg file from the package. This is a universal binary for ARM and Intel x86.

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

Confirm by selecting Next dialog button. Select Install to start the installation.

Select Finish to exit the installation dialog.

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

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

#### Linux

Linux extract the \*.tar.gz file. You will find two install scripts (install-libfuse.sh and install.sh).

In the Files app select each script in turn, right click and select *Properties* to open the *Properties dialog*. Toggle the *Executable as Program* button.

In the Files app open a terminal window by unselecting any selected files and right clicking and selecting *Open in Terminal* to run the scripts (order is important).

In the terminal type: sudo ./install-libfuse.sh

You will be prompted for you password.

Type: sudo ./install.sh

You will be prompted with:

Please proceed to 'Software & updates' application to tab 'Other Software' and uncheck checkboxes or remove 'cdrom' entry from /etc/apt/sources.list file. Otherwise you will have problems during UCD Console package installation. If you are already done, enter the key 'y'. If not - 'n'

For Ubuntu just enter y. For debian follow instruction.

You will then be prompted again with:

Please proceed to 'Software & updates' application to the first tab and set check box 'Officially supported (main)'. Otherwise you will have problems during UCD Console package installation. If you are already done, enter the key 'y'. If not - 'n'

For Ubuntu just enter y. For debian follow instruction

Answer y for additional prompts.

The Ucd Tool Installer Setup app should now be running.

Select Next>

Select radio button for Install for all users or Install just for me.

You are asked to Choose Installation Directory. Do NOT choose the default (/root/Unigraf/Unigraf UCD Tools at time of writing). Select a directory that is easy to access and remember.

Note the warning: Installing in existing directory. It will be wiped on uninstallation.

Select Next> Install and Finnish.

Navigate to the *Unigraf UCD Tools* directory under the installation directory and double click the app you want to run (*UCDConsole.AppImage* for example).

# **Firmware Update Procedures**

UCD Configuration Utility is used to load firmware to a UCD device. Optionally, the UCD Configuration Utility can be used to select firmware for specific operations. Contact Unigraf for details.

#### **Updating from Earlier FW Versions**

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

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

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

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

Open UCD Console.

Select Tools > Firmware Update.

W UCD Config			$\times$
			///
Please select operation			
🗹 Enable advanced mode			
Enable patching (Internet connection is required)			
Included update files:			
Module BFBN of version F.1.1.9.0.N.1.5.2.0 Module MC3XX of version 0.35.22 Module MFMN422 of version F.1.0.63.N.1.10.128 Module MFMN4XX of version F.3.5.11.0.N.3.6.86.0 Module MFMN500 of version F.0.7.14.0.N.3.6.84.0 Module PD of version 0.0.17 Module PD for version 1.4.6 Module PDTX of version 1.4.6 Module PG of version 0.0.8 Module PX of version 0.0.11 Module UF of version 1.3.4 Module UX of version 2.6.1			
	< Back	Next >	Cancel

The first page of the utility shows the firmware component versions present in the bundle package (or possible installed separately). Select *Enable advanced mode* checkbox if you want to custom install (possibly to downgrade firmware for ex.). Select *Next* to proceed.

The Enable patching (Internet connection is required) check box is not relevant for UCD-4XX devices.

You are presented with a list of connected UCD devices. Select the device to update and Next.

### **Update UCD Modules**

A dialog lists the FW components available in the UCD device, the currently programmed FW version, and the FW to be installed. Select *Next*.

	UCD Config UCD Modules Modules that should be updated are checked Current FW	FW to be installed
FW Module	Selected device: UCD-500 [2312C600]	0.01
	UX 2.6.1 [No update needed. Existing 2.6.1]	
	UF 1.3.4 [No update needed. Existing 1.3.4]	
	PDRX 1.4.6 [Existing 1.4.5]	
	☑ PDTX 1.4.6 [Existing 1.4.5]	
	< <u>B</u> ac	k Next > Cancel

You will be presented with a summary for the update procedure. Select Start.

UCD Config UCD Config Review the update operations to perform.	×
Operations selected:	
Update device firmware:	
MFMN500: from F.0.7.14.0.0.0/N.3.5.192.0.0.0 to F.0.7.14.0/N.3.6.84.0	
PDRX: from 1.4.5 to 1.4.6	
PDTX: from 1.4.5 to 1.4.6	
Change device configuration:	
No role changing operations selected.	
< Back Star	t Cancel
< <u>B</u> ack Star	Cancel

During the install 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 finished select *Next* to see a summary and select *Finish* to complete.

The update proceedure may take several minutes.

### **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 FW version supporting UCD Firmware Configuration tool has been installed, all future updates can be done using this tool.

# **Firmware Downgrading**

Sometimes you may need an older bundle for which the firmware is a separate download.

Follow the procedure below:

- 1. Download the latest *Console 2 SW Bundle (2.4.XX)* from Unigraf download page at unigraf.fi/downloads.
- Run the application SoftwareBundle\_2.4.XX.exe to install the package. Do not launch UCD Console application yet.
- 3. Download Console 2: FW Package 2.3.38 from the same download page.
- 4. Run the executable *FirmwarePackage\_2.3.38.exe* to copy UCD device FW to the proper folder on your PC.
- 5. Launch UCD Console.
- 6. Select Tools > Firmware Update to start the UCD Config utility.
- 7. In UCD Config select Enable advanced mode (see above).
- 8. Select Next to proceed as described in Update UCD Modules above.
- 9. Select the modules to be updated (see image below).
- 10. Select Next to proceed as described above.

UCD Config	×
UCD Modules Modules that should be updated are checked	///
Selected device: UCD-400 [2252C553]	
UX 2.4.0 [No update needed. Existing 2.6.1]	
UF 1.3.4 [No update needed. Existing 1.3.4]	
MFMN4XX F.3.0.45.0/N.1.10.92.0 [No update needed. Existing F.3.5.11/N.3.	6.71]
< <u>B</u> ack <u>N</u> ext > C	ancel

# License Manager

### Licensing

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

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

License keys are managed with **UCD License Manager**. The License Manager can be found in the **Tools** menu of UCD Console SW.

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

#### License Manager GUI

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

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

#### Managing Licenses

### Seed Number

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

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

### Adding New License Keys

-	er new lecense for device with seed number : 706 K and	<u>1990.28</u>		
-			Instal	l
Ins	alled licenses:			
1	Name Link Training Tunable PHY Repeaters	Key ZA50-3D() (()()-2803		Î
2	DSC Encoder for DP Source	Q3ZN-AS, A. MARY MARKALISTY OF STATISTIC-EIRS		
3	DSC Decoder for DP Sink	0TRV-475% 50000 101 58. 3. 3. 3. 10. 4. 10. 4. 10. 4. 10. 4. 10. 4. 10. 4. 10. 4. 10. 10. 10. 10. 10. 10. 10. 10. 10. 10		
4	DP LL CTS 1.4 for testing Branch DUT	KARC-P2 of the state of the state of the state		
5	DP LL CTS 1.4 for testing Sink DUT	SUOU-SQLAR CARLES AND		
6	DP LL CTS 1.4 for testing Source DUT	93Z4-OHAQUARE STOCK STOCKSON STOCKSON		
7	Type-C DisplayPort Source	KAYR-7Fin and the second standard of second -DSTS		
8	Type-C DisplayPort Sink	UKCT-M3%5 Stole Astron Harris Steller Harris - K2LX		
9	DP HDCP 2.3 CTS for testing Sink DUT	SHXS-ACCO STRUCTURES HOLD CLARK STOLENEV		
10	DP HDCP 2.3 CTS for testing Source DUT	WY43-J616 ADDA AND ADDA ADDA STORE SPUP		
11	HDCP 2.3 Support	HN3F-TJ (2. SSIGK SAME AND A SIGNAL AND -VEJU		
12	TSI Electrical Test Software Set	6205-PROCHEND AND SHARE SHE WERE VEXU		

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

Once the license key is fully entered, click 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.

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.

Import:	Install licenses from an INI file for the currently selected device.		
Export:	Save installed licenses for the currently selected device into an INI file for backup and distribution to other PCs. 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.		
Remove Selected:	Uninstall selected licenses. To uninstall a license, click on the license and then click the Remove Selected button		

### **UCD** Console

UCD Console SW 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.

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 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.

UCD Console		-		×
<u>File Tools Window H</u> elp				
Devices:	Roles:			
UCD-400 [1845C291]	DisplayPort Source and Sink			
		_		
	Rescan Se	lect	Clos	e

#### **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.

UCD Co	nsole - U	CD-400 [	1924C312	]: Display	Port Sour	ce and Si	ink						-		×
<u>F</u> ile <u>T</u> ools	<u>H</u> elp														
DP RX	DP TX	Event Lo	og												
Link	HDCP	Video	Audio	EDID	DPCD	SDP	FEC	Source DU	T Testing						
A. 40				Dered		Same		Cashira	0000	E II Corean	it harisaatsl	I	Dicable	Draviau	

# **Options**

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

Detons Debug Capturing Image File Format PPM WAW Audio File Format WAW Compliance Directory to save images and audio Co/Uvers/Tester/Pictures/Saved Pictures Use Ctemp folder Cc/CenternJoSC DSC temp folder Cc/ProgramData/Unigraf/DSC_content, library SC DT Testing Options DIT testing Opt	Options			
Image File Format PPM  Audio File Format WAV  Upplays HDCP compliance One or more displays are not HDCP compliance Folders Eucloy to save images and audio Cr/Users/Tester/Fictures/Saved Pictures USC temp folder Cc/TempOSC UCTURED/SDCC_content_library Keep auto-created DSC content files UDT Testing Options I Include time info in Report logs	Options [	Debug		
Audio File Format WWV Displays HDCP compliance One or more displays are not HDCP compliant Filders Directry to save images and audio Cr/Users/Tester/Fictures/Saved Pictures USC DSC DSC temp folder Cr/TempIDSC USC temp folder Cr/ProgramData/Unigr/IDSC_content_library Cr/ProgramData/Unigr/IDSC_content_library MSK esp auto-created DSC content files DUT Testing Options I Include time info in Report logs	Capturing			
Displays HDCP compliance: One or more displays are not HDCP compliant Folders Directory to save images and audio Cu/User/Tester/Pictures/Saved Pictures Cu/Testry folder Cu/Testry folder Cu/Testry folder Cu/PergramData/Unig/toSc_centent_library Cu/PergramData/Unigred DSC content files DUT Testing Options Include time info in Report logs	Image File F	ormat	PPM ~	
Folders Directory to save images and audio C/Uters/Tester/Pictures/Saved Pictures USC DSC temp folder CC1TempLDSC UC/Program/Data/Unigraf/DSC_content_library Keap usto-created DSC content files UT Tasting Option I include time info in Report logs	Audio File F	ormat	WAV ~	
Directory to save images and audio Cr/Users/Tester/Fictures/Saved Pictures BSC Cr/DepuBSC Cr/Program Cr/ProgramData/Unigraf/DSC_content_Library Cr/ProgramData/Unigraf/DSC_content files DDT Testing Options I Include time info in Report logs	Displays HD	CP compliance:	One or more displays are not HDCP compliant	
C/Ubers/Tester/Pictures/Saved Pictures DSC DSC temp folder C(Nemp)DSC DSC test content folder C(ProgramData/Unigraf/DSC_content, Ibrany @ Meap usto-created DSC content files DUT festing Options @ Include time info in Report logs	Folders			
DSC DSC USC USC USC USC USC USC USC USC USC U	Directory to	save images and a	audio	
DSC temp folder C(Yemp DSC DSC test content folder C(Program Data/Unigraf/OSC_content_library C(Program Data/Unigraf/OSC_content files DUT festing Options Include time info in Report logs	C:/Users/Te	ster/Pictures/Save	ed Pictures	
DSC temp folder C(Yemp DSC DSC test content folder C(Program Data/Unigraf/OSC_content_library C(Program Data/Unigraf/OSC_content files DUT festing Options Include time info in Report logs	DSC			
CxTemp1DSC		older		
DSC test content folder C/ProgramData/Unigraf/DSC_content_library  Ckep auto-created DSC content files DUT Testing Options  Include time info in Report logs				
CL/ProgramData/Unigrat/DSC_content_library  CL/ProgramData/Unigrat/DSC_content_files  DUT Testing Options  Include time info in Report logs	· · ·			
Keep sub-created DSC content files  UT fresting Options  Include time info in Report logs			content library	
DUT Testing Options				
Include time info in Report logs				
	-			
Do not show again test sequence completed			-	
	Do not s	how again test see	quence completed	

### 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.

	<u>DSC</u>	
	DSC temp folder:	Folder for DSC Work files.
	DSC test content folder:	Folder where DSC source bitmap files, related configuration files and DSC conversion tools are stored.
	Keep auto-created DSC content files:	By default, the DSC compressed content is deleted after use. If selected, the content is not deleted.
Warning	Keeping the automatically the DSC compliance test	y created DSC compressed content will shorten the time needed for running is.
	Please note, that the spa	ce needed for storing the full library can be very large (appr. 400 GBytes).

### **DUT Testing Options**

Configure DUT Testing reports.

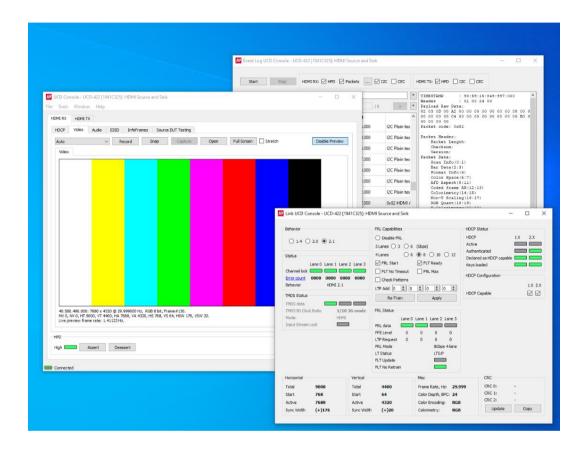
Include time info in Report logs:	Include system date and time in the beginning of each event line in created reports.
Do not show again test sequence completed:	Include system date and time in the beginning of each event line in created reports.

Please make sure that the content will be stored in a medium that has the required space available.

# **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 device acts as DisplayPort, HDMI or USB-C DisplayPort Alt Mode Sink or Receiver device.

Analyzer functionality related controls and dialogs can be used by selecting DP RX or HDMI RX tabs.

Please note that in most UCD-4XX Series units, *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. Standard tabs are similar in all functional roles, Interface Specific tabs present features and controls that are only available for a particular interface.

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

### **Standard Tabs**

Analyzer role features six standard tabs:

- Video preview and saving (Video)
- Audio monitoring and saving (Audio)
- EDID editor (EDID)
- HDCP status monitor and control (HDCP)
- Source DUT Testing tab
- Event Log

### **Interface Specific Tabs**

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

UCD-400 and UCD-424: DP and USB-C DP Alt Mode Reference Sink

- Status information and control of the upstream link (Link)
- DPCD editor (DPCD)
- SDP sent by the Source device (SDP)
- Status and capabilities of the DSC feature (DSC)
- Forward Error Correction (FEC)

UCD-422: HDMI Reference Sink

- Status information and control of the upstream link (Link)
- Received InfoFrame packets (InfoFrame).

### UCD-424: USB-C Reference Sink

USB-C Monitoring (PDC)

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

# **Standard Tabs**

# **HDCP** Tab

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

OP RX	DP TX	Event Lo	og Termin	ai	Memory La	iyout						
Link	Video	Audio	HDCP	EDID	DPCD	Link Analyzer	SDP	FEC	Capture	Source DUT Testing	DSC	
HDC	CP 2.3											
Sta	atus				Config	uration						
-0	General				🗹 HD	CP Capable						
		Active			Keys							
		Authentic	ated		OP	roduction						
[			as HDCP capa	ble	O Fa	acsimile - "Test" -	R1					
1	CCT Mardan	Keys load			⊖ Fa	acsimile - "Test" -	R2					
	SST Mode:	Type N/A			O None							
E	By stream											
[		eam 0	Тур									
		eam 1 eam 2	Type Unkno	e 0								
		eam 3	Type Unkno									
		cumb	type officie									
HPD												

#### **Status**

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

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

### Configuration

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

### **Keys**

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

### HDCP 1.3 / 1.4 vs. HDCP 2.3

Currently, UCD-4XX DP and USB-C DP Alt Mode devices support only HDCP 2.3 standard. Currently, UCD-4XX HDMI devices do not support HDCP.

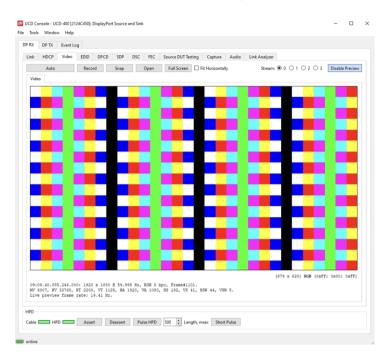
# Capture Tab

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.

Note: Wedge:	W UCD Console - UCD-422 [2201C508]: HDMI Sou	irce and Sink	-	$\times$
We they have the they have the the the the the the the the the th				
Set of the s				
Billered Caduer Options       Capacity of buffer:         Cadeer The The mean and use them is the semal       Capacity of buffer:         Conter remains       Cancer         Start / Stop       Start or stop capturing.         Capacity of buffer:       The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PBM, BIN + BMP.         Capacity of buffer:       The number of video frames that can be stored to UCD frame buffer using current video signal format         Align to MSB       Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).         Create scenarios       Define the length of the scenario         Events:       Please refer to chapter Event Log for details of the captured events         Audio:       Enable audio.         Status:       Status of the capture.         Open Timeline Viewer       Open Event Timeline Viewer to view the captured data. For detailed instructions refer to chapter seven of this manual.         Open storage folder:       Data save folder is defined in menu Tools > Options. Captured video, audio audio addat is saved in a subfolder of this folder. The name of the subfolder is "buffered_capture_yyymmdd_hthmmss" (e.g.,	Link Video HDCP Audio EDID	InfoFrames Source DUT Testing Capture		
Capacity of Define the length of the scenario         Capacity of buffer:         The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PMP, BIN + BMP.         Capacity of buffer:       The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PMP, BIN + BMP.         Capacity of buffer:       The number of video frames that can be stored to UCD frame buffer using current video signal format         Align to MSB       Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).         Create scenarios       Define the length of the scenario         Events:       Please refer to chapter Event Log for details of the captured events         Audio:       Enable audio.         Status:       Status of the capture.         Open Timeline Viewer       Open Event Timeline Viewer to view the captured data. For detailed instructions refer to chapter seven of this manual.         Open storage folder:       Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "buffered capture_capture_vyyymmdd_hthmmss" (e.g.,		Open Timeline Viewer Open storage folder		
Adjusto M8         Index convertions         Events       INPO         Addie       Index         Indie       Indie         Indie       Indie<		RIN v format Canacity of huffer: 258 frame		
Image: Control transmission of the second	Capture 10 • numes and save them in	r una romai. Capacity or ounen: 250 maries		
Start / Stop       Start or stop capturing.         Capture N frames:       The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PPM, BIN + BMP.         Capacity of buffer:       The number of video frames that can be stored to UCD frame buffer using current video signal format         Align to MSB       Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).         Create scenarios       Define the length of the scenario         Events:       Please refer to chapter Event Log for details of the captured events         Audio:       Enable audio.         Status:       Status of the capture.         Open Timeline Viewer       Open Event Timeline Viewer to view the captured data. For detailed instructions refer to chapter seven of this manual.         Open storage folder:       Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "buffered_capture_yyyymmdd_hhmmss" (e.g.,				
Audio:       Exaded         State:       Centure stopped         Info       Interference         Cable       Interference         Start / Stop       Start or stop capturing.         Capture N frames:       The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PPM, BIN + BMP.         Capacity of buffer:       The number of video frames that can be stored to UCD frame buffer using current video signal format         Align to MSB       Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).         Create scenarios       Define the length of the scenario         Events:       Please refer to chapter Event Log for details of the captured events         Audio:       Enable audio.         Status:       Status of the capture.         Open Timeline Viewer       Open Event Timeline Viewer to view the captured data. For detailed instructions refer to chapter seven of this manual.         Open storage folder:       Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "buffered_capture_yyyymmdd_hhmmss" (e.g.,				
Audio:       Exaded         State:       Centure stopped         Info       Interference         Cable       Interference         Start / Stop       Start or stop capturing.         Capture N frames:       The number of video frames captured.         Format:       Selection of the format of the saved video frame bitmaps. BIN, PPM, BMP, BIN + PPM, BIN + BMP.         Capacity of buffer:       The number of video frames that can be stored to UCD frame buffer using current video signal format         Align to MSB       Store binary data aligned to the Most Significant Bit (MSB). When this is left unchecked the binary data is aligned to the Least Significant Bit (LSB).         Create scenarios       Define the length of the scenario         Events:       Please refer to chapter Event Log for details of the captured events         Audio:       Enable audio.         Status:       Status of the capture.         Open Timeline Viewer       Open Event Timeline Viewer to view the captured data. For detailed instructions refer to chapter seven of this manual.         Open storage folder:       Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "buffered_capture_yyyymmdd_hhmmss" (e.g.,				
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# 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.

### Current Stream (UCD-400, UCD-424)

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

### **Video Status**

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

		(1427 x 915) RGB (0x00; 0x00; 0xFF)						
		0: 1920 x 1080 @ 59.995 Hz, RGB 8 bpc, Frame∳12404. HT 2200, VT 1125, HA 1920, VA 1080, HS 192, VS 41, HSW 44, VSW 5. rate: 19.55 Hz.						
	First row:	Cursor location, pixel value at cursor location in YCbCr and RGB						
	Second row:	Time stamp, Color mode, color depth, frame counter.						
	Third row:	Mvid, Nvid, Horiz Total, Vert Total, Horiz Active, Vert Active, Horiz Start, Vert Start, Hor Sync Width, Vert Sync Width.						
	Fourth row:	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. <i>Live preview frame rate</i> indicates the rate of updating captured video on UCD Console preview screen. The rate is limited e.g by the USB communication between UCD test equipment and the PC							

### **Override Color Detection**

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

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

/// Override Cold	or Detection	×
Override auto-	detected color parameters	
Color space:	YCbCr4:4:4	~
Colorimetry:	ITU-R BT.601	~
Bits per color:	Auto-detect	~
Clear all		
	ОК	Cancel

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

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

### **Frame recording**

Record

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

/// Record		?	×
Number of Frames to record 1 💼 🗆 Buffered Capacity of the buffer: 36 frames	OK	Can	cel

Buffered	When checked, all input frames are captured non-drop until the on-board frame buffer will be full.
	When not checked, only one input frame is buffered at a time. Frames will be skipped if the transfer of the data to the PC is slower than the input data rate.
Capacity of the buffer	Capacity of the on board frame buffer with the selected video and color mode.

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

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

Open folder where captured frames are stored. Double click or click **Open** to select a frame file for viewing. Please refer to Tools > Options where the location of this folder can be customized.

### **Full Screen**

Full Screen

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

Double-click on the screen to exit full screen mode.

### **Snap Frame**

Snap

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.

RX	DP TX	Event Lo	9														
ink	HDCP	Video	EDID	DPCD	SDP	DSC	FEC	Source D	JT Testing	Capture	Audio	Link Analyzer					
	Auto		Record		Snap		Open	Full Sc	reen	Fit Horizonta	lly	Stream	• • • •	1 () 2	03 [	Disable Prev	iew
Vide	UCD	_snap_12-2	2.54522 🗵	UC	D_snap_1	2-22.48	977 🔝										
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		0.7															
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	4.493.394.	000: 1920 x	1080 @ 59.9	995 Hz,	RGB 8 bp	c Frame	#16300						(1250 x	550) RG	B (0x00;	OxFF; Ox	t00)
D																	

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 Red, Green and Blue components of the pixel on the cursor location in decimal values
- The HTML HEX color code of the pixel on cursor location
- In case of YCbCr color mode the intensity of the Y, Cb and Cr components of the pixel on the cursor location in decimal 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.

### Previewing DSC Decompressed Stream (UCD-400, UCD-422, UCD-424)

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.

	DP TX	Event Lo	9											
Link	HDCP	Video	EDID C	PCD	SDP DS	C FEC	Source DUT Testing	Capture	Audio	Link An	alyzer			
	Auto		Record		Snap	Open	Full Screen	Fit Horizon	itally		Stream	 1 0 2 0 3	Disable	Preview
Vide	:0													
1	20.51		Sec. 200	1. 1. A.C.	Sec. 16	1912 Secto			STATE X 6 TO	38325				
								1						
							1 provestion							
			(Contractor		A Com				14. M					
		10.34					The second							
				n	SC I		D-4-							
				D	SCI	<b><i>(AW</i></b>	Data							
			Clink 6											
			Check S	nap but	tton to de	compress	s and preview a fr	ame.						
09:	47.49.91	2.077.000	): 3840 x	2160 0	29.999 H	z, RGB 12	bpc, Frame#2619	3.			-			
MV	10636, NT	V 32768,	HT 4000,	VT 2191	29.999 H 1, HA 384	z, RGB 12 0, VA 216	bpc, Frame#2619	3. , ESW 32, V	SW -5.		-			
MV	10636, NT	V 32768,	): 3840 x HI 4000, sate: 18.5	VT 2191	29.999 H 1, HA 384	z, RGB 12 0, VA 216	2 bpc, Frame#2619 50, HS 112, VS 28	3. , HSW 32, V	SW -5.		-			
MV	10636, NT	V 32768,	HT 4000,	VT 2191	29.999 H 1, HA 384	z, RGB 12 0, VA 216	2 bpc, Frame∳2619 0, HS 112, VS 28	3. , HSW 32, V	SW -5.					
MV	10636, NT	V 32768,	HT 4000,	VT 2191	29.999 H 1, HA 384	z, RGB 12 0, VA 216	2 bpc, Frame∳2619 0, HS 112, VS 28	3. , HSW 32, V.	SW -5.					

Click **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. A snapped DSC image can be saved as a DSC-file.

Vide UCD_snap_12-55.31570  Vide UCD_snap_12-55.3	Video UCD_map_12-55.31570	Video UCD_smap_12-55.31570
Log Taking snapshot (NOTE: DSC snapshots may take a while to decompress!) DSC Version = 1.2 ppg_identifier = 0x00 (0) Dits_ppg_competing = 0 linebuf_depth = 9 Dicopped_enable = 0 convert_rupD = 1 timple_122 = 0 vbg_enable = 0	Image: State of the state o	Log Taking snapshot (NOTE: DSC snapshots may take a while to decompress!) SSC Version = 1.2 ppg_identifier = 0x00 (0) bits_ppg_concent = 0 linebuf_depth = 9 block_pred_enable = 0 convert_rupp = 1 timple_022 = 0
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Aking snapshot (NOTE: DSC snapshots may take a while to decompress!)         A           DSC Version         = 1.2           pps_identifier         = 0000 (0)           bits_per_compont         = 6           linebut_depth         = 9           block_pred_enable         = 0           convert_rupb         = 1           simple_422         = 0           vbr_enable         = 0           tbits_per_compile         = 0	Taking snapshot (NOTE: DSC snapshots may take a while to decompress!)         A           DSC Version         = 1.2           pps_identifier         = 0000 (0)           linebuf_idepth         = 9           linebuf_idepth         = 9           lock pred_enable         = 0           convert_rpf         = 1           simple_422         = 0	Aking snapshot (NOTE: DSC snapshots may take a while to decompress!)  DSC Version = 1.2 pps_identifier = 0x00 (0) bits_per_compont = 6 linebut_depth = 9 block_pred_enable = 0 convert_rgb = 1 simple.422 = 0
Aking snapshot (NOTE: DSC snapshots may take a while to decompress!)         A           DSC Version         = 1.2           pps_identifier         = 0000 (0)           bits_per_compont         = 6           linebut_depth         = 9           block_pred_enable         = 0           convert_rupb         = 1           simple_422         = 0           vbr_enable         = 0           tbits_per_compile         = 0	Taking snapshot (NOTE: DSC snapshots may take a while to decompress!)         A           DSC Version         = 1.2           pps_identifier         = 0000 (0)           linebuf_idepth         = 9           linebuf_idepth         = 9           lock pred_enable         = 0           convert_rpf         = 1           simple_422         = 0	Aking snapshot (NOTE: DSC snapshots may take a while to decompress!)  DSC Version = 1.2 pps_identifier = 0x00 (0) bits_per_compont = 6 linebut_depth = 9 block_pred_enable = 0 convert_rgb = 1 simple.422 = 0
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DSC Version       = 1.2         ppg_identifier       = 0 (0)         bits_per_component       = 0         block_pred_emable       = 0         converg_typb       = 1         simple_422       = 0         vbt_mable       = 0         bits_per_project       = 0         bits_per_project       = 0         bits_per_project       = 0         vbt_mable       = 0	DSC Version = 1.2 pps_identifier = 0x00 (0) bits_per_component = 8 linebuf_depth = 9 block_pred_enable = 0 converc_ptp = 1 simple_422 = 0 Vb_renable = 0	DSC Version = 1.2 ppg_identifier = 0x00 (0) bits_per_component = 0 linebuf_depth = 9 block_pred_enable = 0 conver_rypb = 1 simple_422 = 0
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ppg_identifier         = 0x00         (0)           bita_per_concent         = 6           linebuf_depth         = 9           block_pref_enable         = 0           conver_rysb         = 1           simple_422         = 0           vbr_enable         = 0           tsta_per_concel         = 0	ppg_identifier         = 0x00 (0)           bits_per_component         = 8           linebur_depth         = 9           block_pred_enable         = 0           convert_ryb         = 1           simple_422         = 0           vbr_enable         = 0	ppg_identifier         = 0 (0)           bits_per_component         = 0           block_pred_enable         = 0           converg_rgb         = 1           simple_422         = 0
bits_per_component     0       linebuf_depth     9       block_pred_enable     0       convert_ryb     1       simple_422     0       vbr_enable     0       bits_per_pixel     0x60 (6)	bits_per_component         8           linebuf_dept         9           block_pred_enable         0           convert_ryb         1           simple_422         0           byb_enable         0	bits_per_component     0       linebuf_depth     9       block_pred_enable     0       convert_rpb     1       simple_422     0
bits_per_component       0         linebuf_depth       9         block_pred_enable       0         convert_spb       =1         simple_422       0         vbr_enable       =0         convert_spixel       =0	bits_per_component     0       linebuf_depth     9       block_pred_enable     0       conver_typ     1       simple_422     0       vbx_enable     0	bits_per_component         0           linebuf_depth         9           block_pred_enable         0           conver_rpb         1           simple_422         0
linebuf_depth       = 9         block_pred_emable       = 0         converg_rpb       = 1         simple_422       = 0         vhz_emable       = 0         bits_perg_pixel       = 0	1inebuf_depth       9         block_pred_enable       0         convert_tgb       1         simple_422       0         vbr_enable       0	lineburg_depth = 9 block_pred_mable = 0 converg_rgb = 1 simple_422 = 0
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simple_422 = 0 vbr_enable = 0 bits_per_pixel = 0x60 (6)	simple_422 = 0 vbr_enable = 0	simple_422 = 0
vbr_enable = 0 bits_per_pixel = 0x60 (6)	vbr_enable = 0	
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bits_per_pixel = 0x60 (6)		
pic_height = 2160		
programme and	nic beight = 2160	- 2160
	pic_height = 2160 v	pic height = 2160
	pic_height = 2160 v	pic height = 2160
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PD		ptc_height = 2160 v
	bits per pixel $= 0x60$ (6)	bits per pixel $= 0x60$ (6)
pic height = 2160		
	bits per pixel = 0x60 (6)	bits per pixel = $0 \times 60$ (6)
	bits per pixel $= 0x60$ (6)	bits per pixel $= 0x60$ (6)
	hite ner nivel = 0x60 (6)	hite per nivel = 0x60 (6)
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bits_per_pixel = 0x60 (6)		ANT_GUODYG = 0
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bits_per_pixel = 0x60 (6)		VDr_enable = 0
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dp_enable = 0 bits_per_pixel = 0x60 (6)	/br_enable = 0	
dp_enable = 0 bits_per_pixel = 0x60 (6)	/br_enable = 0	
vbr_enable = 0 bits_per_pixel = 0x60 (6)	vbr_enable = 0	
$simple_422 = 0$ $vbr_enable = 0$ $list_per_jixel = 0x60$ (6)	simple_422 = 0 vbr_enable = 0	simple_422 = 0
impla 422 = 0 br_enable = 0 its_per_pixel = 0x60 (6)	imple_422 = 0 br_enable = 0	imple_422 = 0
le_422 = 0 enable = 0 per_pixel = 0x60 (6)	enable = 0	ple_422 = 0
verit_rob = 1 pic_422 = 0 _enable = 0 _enable = 0 (6)	vert_rdb = 1 ple_422 = 0 _enable = 0	vvert_rgb = 1 mple_422 = 0
nvver_spb = 1 mple_422 = 0 x_enable = 0 ts_per_pixel = 0x60 (6)	nvert.ppb = 1 mple_422 = 0 z_enhble = 0	nvert_rgb = 1 mple_422 = 0
nverc_rpb = 1 pple_422 = 0 r_enable = 0 t_pencpire1 = 0x60 (6)	nver_gpb = 1 mpl_422 = 0 = 0	nvert_rgb = 1 mple_422 = 0
nvert_rpb = 1 mple_422 = 0 r_enable = 0 ts_pert_pixel = 0 cx60 (6)	nvert_spb = 1 mple_422 = 0 r_enble = 0	nvert_rgb = 1 mple_422 = 0
nverc_rpb = 1 pple_422 = 0 r_enable = 0 t_pencpire1 = 0x60 (6)	nver_gpb = 1 mpl_422 = 0 = 0	nvert_rgb = 1 mple_422 = 0
onvert_prb = 1 impl_422 = 0 or_enable = 0 tr_per_pixel = 0x60 (6)	nvvert_spb = 1 impl_422 = 0 c_enable = 0	onvert_rgb = 1 imple_422 = 0
onvert_prb = 1 impl_422 = 0 or_enable = 0 tr_per_pixel = 0x60 (6)	nvvert_spb = 1 impl_422 = 0 c_enable = 0	onvert_rgb = 1 imple_422 = 0
onvert_prb = 1 impl_422 = 0 or_enable = 0 tr_per_pixel = 0x60 (6)	nvvert_spb = 1 impl_422 = 0 c_enable = 0	onvert_rgb = 1 imple_422 = 0
nvert_ryb = 1 pic_422 = 0 r_enable = 0 t_pert_pixel = 0x60 (6)	nvert_rpb = 1 mpi422 = 0 = 0	nvert_rgb = 1 mple_422 = 0
verit_rob = 1 ple_422 = 0 _enable = 0 _enable = 0.650 (6)	vert_rqb = 1 ple_422 = 0 _enable = 0	wert_rgb = 1 ple_422 = 0
$erc_ryb$ = 1 $erc_422$ = 0 $erc_5b26$ = 0 $erc_5b26$ = 0(6)	ert_tpb = 1 le_422 = 0 enable = 0	ert_rgb = 1 1e_422 = 0
vercr.rob = 1 ple_422 = 0 enable = 0 per_pixel = 0x60 (6)	vert_rob = 1 ple_422 = 0 enable = 0	vert_rgb = 1 ple_422 = 0
ck_pred_enable = 0 vert_rqb = 1 pt_e122 = 0 _enable = 0 _enable = 0 (6)	ck_pred_enable = 0 pt_ef_22 = 0 	ck_pred_enable = 0 vert_rdb = 1 ple_422 = 0
lock_pred_enable = 0 nwert_rob = 1 mple_422 = 0 r_enable = 0 tr_per_pixel = 0x60 (6)	lock_pred_enable = 0 mpte_422 = 0 y_enable = 0	lock_pred_enable = 0 nvver_gvb = 1 mple_422 = 0
convet; rgb = 1 imple 422 = 0 vb_renable = 0 tis_per_jutel = 0x60 (6)	convert.rpb = 1 simple_422 = 0 brc_enable = 0	convert_rgb = 1 simple_422 = 0
onvert_rgb = 1 imple_422 = 0 b_enable = 0 its_pert_stel = 0x60 (6)	onvert_spb = 1 impl=_422 = 0 c_enable = 0	onvert_rgb = 1 imple_422 = 0
vert.rob = 1 ple_422 = 0 enable = 0 per_tixel = 0x60 (6)	vert.rbb = 1 ple_422 = 0 enale = 0	vert_rgb = 1 ple_422 = 0

# HDMI Link Analyser Tab

Capture Data Events for analysis with *Link Timeline Viewer*. See chapter <u>Link Timeline Viewer</u> for details.

Tools Windo MIRX Ever	w <u>H</u> elp nt Log									
ink HDCP	Video	Audio	EDID	InfoFrames	Source DUT Testi	ng Capture	CEC	Link Analyz	er	
Start								Open 1	Timeline Viewer	Open storage fol
- Main Link Ca	oture Optic	ons:								
Amount: 25	5 🗘 🖲	MB 🔾 GI	В							
Events Captur	re Options:									
Events Captu	re Options:		Pack	ets		12C			CEC	

### Link Analyser buttons

Start	Start capturing main link data using Main Link Capture Options.
Open Timeline Viewer	Open Link Timeline Viewer. See Link Timeline Viewer.
Open storage folder	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**

Amount: The amount of data logged to buffer. Buffer size 2 GBytes maximum.

### **Trigger Point Options**

Data capture start can occur with or without defined trigger criteria.

*Trigger* criteria dropdown has four options: No active trigger, HDP assert, HDP deassert, I2C transaction, *CEC transaction, Main Link* video lock and *Packet data*.

Start		
Main Lin	k Capture Options:	
Amount:	1 🗘 🔿 MB 🖲 GB	
Trigger:	No active trigger 🛛 🗸 Po	osition: Start 🖂
	No active trigger	
	HPD assert	
	HPD deassert	
	I2C transaction	
	CEC transaction	
	Main Link video lock	
	Packet data	

When *I2C transaction* is selected, a drop down list box is enabled and visible with options: *Write*, *Read* and *Any*. Two spinboxs are enabled for *I2C Device Address* and *I2C Register Address*.

 Start

 Main Link Capture Options:

 Amount:
 1

 Image:
 C transaction

 Virite
 ✓

 I2C Device Address:
 71

 I2C Register Address:
 17

When CEC transaction trigger is selected, available trigger options are shown below.

Select trigger options via checkboxes OVERDATA\_ERROR, START\_TIMING\_ERROR and/or by filling in the CEC Template Data (hex) values.

Start
Main Link Capture Options:
Amount: 1 😧 🔿 MB 🖲 GB
Trigger: CEC transaction $\checkmark$ Position: Start $\checkmark$
CEC Template Data (hex):
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
Reset

When the Main Link video lock trigger is selected, available checkboxes are GXB\_LOCK\_RISE, VID\_LOCK\_RISE, and VID\_LOCK\_FALL.

Start								
Main Link Capture Options:								
Amount: 1 🖨 🔿 MB 💿 GB								
Trigger: Main Link video lock $\checkmark$ Position: Start $\checkmark$								
GXB_LOCK_RISE								
VID_LOCK_FALL								

When *Packet data* is selected: Checkbox *BCH\_ERROR*, when checked, will start capture when a *BCH\_ERROR* error has occured (and only when one has occurred). Fill out *packet Template Data* (*hex*) to as needed to filter for events to start capture. Shown below is a trigger for *AVI Infoframes* in general.

Start			Ор	en Timeline Viewer
Main Link Capture Options:				
Amount: 200 🖨 🖲 MB	⊖ gb			
Trigger: Packet data	✓ Position: Start ∨			
BCH_ERROR				
Packet Template Data (hex):				
HBO HB1 HB2	PBO PB1 PB2 PB3	PB4 PB5 PB6 PB7	PB8 PB9 PB10 PB11	
82 02 0D				
PB12 PB13 PB14 PB15	PB16 PB17 PB18 PB19	PB20 PB21 PB22 PB23	PB24 PB25 PB26 PB27	
				Reset

#### **Position**

Triggered capture timepoints available are: Start, 25%, 50%, 75%, End.

#### **Events**

The following events can be selected:

### <u>HPD</u>

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

#### **Packets**

HDMI infoframes. Click the ---- button to open the Event Filter Dialog.

Packet events without checkboxes can be added via the Enter packet type edit control (0x2 for audio sample for example).

Enable logging of foll	wing packets [IDs in	hex]:	
✓ VS [81]	AVI [82]		
SPD [83]	Audio [84]		
MPEG Source [85]	NTSC VBI [86]		
DRM [87]			
Select all			
Enter packet type as h	ex value separated b	y comma:	
0x0, 0x3, 0x4, 0x5, 0x6	i, 0x7, 0x8, 0x9, 0xa, 0	xb, 0xc, 0xd, 0xe, 0xf,	0x7f,

### <u>12C</u>

Capture I2C communication.

### <u>CEC</u>

Capture CEC communication.

# **DP Link Analyzer Tab**

Capture Main-Link Data Events and AUX Transactions for analysis with Link Timeline Viewer. See chapter Link Timeline Viewer for details.

202 UCD Console - UCD-400 [2124C450]: DisplayPort Source and Sink	-	×
File Tools Window Help		
DPTX DPRX Eventlog		
Link HDCP Video EDID DPCD SDP DSC FEC Source DUTTesting Capture Audio Link Analyzer		
Start Open Timeline Viewer Open storage folder		
sant open interior even open storage route Main Link Capture Options:		
Amounti 2 S ONB @ GB		
Trigger Start of TPS1/TPS2/TPS3/TPS4 V Position: Start V		
Source TPS1 V Position: Initial LT V		
Events Capture Options:		
HPD AUX SDP VB-ID MSA Link Pattern AUX_BW VFRAME INFO		
Status: Idie		
HPD		
Cable HPD Assert Deassert Pulse HPD 500 C Length, msec Short Pulse		

Start

Start capturing main link data defined by Main Link Capture Options

Open Timeline Viewer	Open Link Timeline Viewer. For detailed description of Link Timeline Viewer, please refer to chapter six of this manual.
Open storage folder	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**

Amount:

The amount of data logged to buffer. Buffer size 2 GBytes maximum.

### **Trigger Point Options**

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

In the dialog, first select the event block from the upper drop-down list and from the appearing submenus select the detailed trigger.

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 value 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	Туре	Address (hex)
AUX read or write of specific address	AUX native, AUX natve read	Set address in hex format

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.

#### <u>HPD</u>

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

### <u>AUX</u>

AUX Channel transactions.

### <u>SDP</u>

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 "[]".

Event Filter Dialog				×
DP RX SDP filtering:				
Enable logging of followi	ng packets	[IDs in hex]:		
Audio_TimeStamp [1]	Audio	_Stream [2]		
Extension [4]	Audio	_CopyManagemer	nt [5]	
ISRC [6]	🗹 VSC [7	1		
Camera Generic				
🗹 CG0 [8] 🛛 🗹 C	G1 [9]	🗹 CG2 [A]	🗹 CG3 [B]	
☑ CG4[C] ☑ C	G5 [D]	CG6 [E]	CG7 [F]	
Picture Parameter Set	[10] 🗹 VS	C_EXT_VESA [20]		
VSC_EXT_CTA [21]		daptive-Sync SDP	[22]	
InfoFrames				
VS [80 + 1]	🗹 AVI	80 + 2]		
SPD [80 + 3]		io [80 + 4]		
MPEG Source [80 + DRM [80 + 7]	5] 🗌 NTS	C VBI [80 + 6]		
[♥] DKM[00 + 7]				
Select all				
Enter packet type as hex v	/alue separa	ted by comma:		
0x0, 0xF				
		C	)K Cancel	

### 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.

Disabled         On set         On cetar         On any           VBLANK         O <td< th=""><th>VBID filtering</th><th></th></td<>	VBID filtering	
FIELD_ID         O         O         Immediate           INTERLACE         O         O         Immediate           NO_VIDEO         O         O         Immediate           NO_AUDIO         O         O         Immediate           HDCP_SYNC         O         O         Immediate           COMPRESSED         O         Immediate         Immediate           On MVID change         O         Immediate         Immediate		Disabled On set On clear On any
INTERLACE 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	VBLANK	
NQ_VIDEO         ○         ○         ●           NQ_AUDIO         ○         ○         ●           HDCP_SYNC         ○         ○         ●           COMPRESED         ○         ○         ●           □ On M/UD change         □         ○         ●	FIELD_ID	
NO_AUDIO         O         •<	INTERLACE	
HDCP_SYNC O O O O COMPRESED O O O O RESERVED O O O O O n MVID change	NO_VIDEO	
COMPRESSED O O O RESERVED O O O O O O O O O O O O O O O O O O O	NO_AUDIO	
RESERVED O O O		
On MVID change On MAUD change	COMPRESSED	
On MAUD change	RESERVED	$\circ$ $\circ$ $\circ$
	On MVID change	
○ Log all	On MAUD change	
	🔿 Log all	Log on change

### <u>MSA</u>

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

📶 Event Filter D	ialog		×
MSA filtering			
Enable logging	MSA packet on ch	ange in:	
MVID	NVID	HTOTAL	VTOTAL
HSTART	VSTART	HSP HSP	HSW
VSP	VSW	HWIDTH	
MISC0	MISC1		
O Log all		Log on char	nge
			OK Cancel

### Link Pattern:

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

💯 Event Filter Dialog			>	×
DP RX Link Pattern filtering:				
		Start	End	
TPS1		$\checkmark$	$\checkmark$	
TPS2		$\checkmark$	$\checkmark$	
TPS3		$\square$	$\checkmark$	
TPS4		$\checkmark$	$\checkmark$	
Idle pattern		$\checkmark$	$\square$	
Active video		$\square$		
ML_PHY_SLEEP		$\checkmark$	$\square$	
ML_PHY_STANDBY		$\checkmark$	$\checkmark$	
EIEOS pattern		$\checkmark$		
Custom pattern (80 bit)				
CP2520.1		$\checkmark$	$\checkmark$	
CP2520.2		$\checkmark$		
PRBS7		$\checkmark$		
PRBS31		$\checkmark$	$\checkmark$	
Log all				
Custom Pattern (80 bit)				
Type:	Bytes (8bit, hex)		$\sim$	
0 0 0 0	0 0 0	0	0	
	ОК		Cancel	

### AUX\_BW:

Capture AUX Channel signal details.

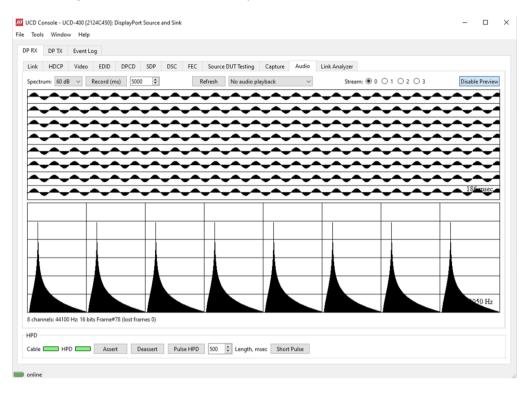
### VFRAME INFO

Dimensions of the catured 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 span of the oscilloscope preview window is defined with Playback buffer found in Tools >
   Options dialog. The value is given in ksamples (1024 samples). The relation between the preview
   window span in milliseconds (msec) and the value given in *Playback buffer* depends on the
   sampling frequency. Please do not exceed the *Main buffer* set in the same dialog. Please refer
   to description of the *Video Audio and Misc Options* earlier in this document.

#### **Enable Preview / Disable Preview**

This button controls capturing the audio data.

#### **Select Monitored Stream**

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

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

### **Playback device selection**

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

UCD C		D-400 [21 w Help		DisplayPor	t Source	and Sink						-		×
DP RX	DP TX HDCP	Event L Video	og EDID	DPCD	SDP	DSC	FEC	Source DUT Testing	Capture	Audio	Link Analyzer			
Spectr	rum: 60 dE	3 ~	Record (m	ns) 5000			_	Refresh No audio p		~	Stream:	Disabl	e Preview	]

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-4XX EDID. Since UCD-4XX is not performing any audio format conversion, it might occur that the source provides an audio format that the selected playback device is not supporting. In case a conflict occurs, please change manually the EDID content or disable audio playback to monitor the waveforms in UCD Console.

#### **Refresh audio device list**

Refresh

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

#### **Audio Buffer Size**

The amount of buffering used in the data transfer between the UCD-4XX unit and the PC in Audio buffer size in Tools > Options dialog, Main buffer. Increased buffer size will ensure a smooth audio output but will also increase the delay between the capture of the audio stream and its playback.

#### Start audio recording

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.

#### Input audio mode

2 channels: 44100 Hz: 16 bits Frame #413 (lost frames 0)

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

# EDID/DisplayID Tab

EDID/DisplayID Tab provides tools for accessing the EDID/DisplayID data of the UCD Sink 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 the *Hex Edit Mode*.
- Read and write to EDID/DisplayID memory for up to 4 virtual ports.

### **EDID/DisplayID Files**

	DisplayID d Item  Remove Item Filter	_		Read mode: 0 I2C F	Read 🔘 SBM Read Virtual Sink #1 🗸 🗌	Show Read Only	Recur	se
Nar	me VESA		Editor	Text EDID	1 Million Co.			
~	VESA V Vendor & Product ID			Name	Value			
	<ul> <li>Week &amp; Year of Manufacture</li> <li>Week &amp; Year of Manufact</li> </ul>		0 Hea		0x00FFFFFFFFFFF00			
	EDID Structure Version and Revis		1 Exte	nsion Block Count N	2			
	> Basic Display Parameters / Featu Color Characteristics	ires	2 Cher	cksum	0x18			
	<ul> <li>Established Timings I</li> </ul>			lanufacturer Name ar & Product ID	UFG			
	> Established Timings II			roduct Code ar & Product ID	0x4036			
	Manufacturer's Timings     Standard Timings Identification		5 ID S	erial Number	22415942			
Fe	eatures CTA v3		Two	er & Product ID				
	Name	Value		00 01 02 03 04 05 06	07 08 09 0A 0B 0C 0D 0E 0F			
1	Max Resolution	10240 x 4320	00000		0054c73640460a5601			
2	10K Max Frame Rate	60 Hz	00001		783a5fb1a2574fa228			
3	8K Max Frame Rate	60 Hz	00002		4f810081c08180a9c0 d000a0f0703e803020			
4	4K Max Frame Rate	145 Hz	00004		(1a)56)5e)00)a0)a0)a0)29)50			
5	2K Max Frame Rate	145 Hz	00005		0001a0000fd0038			
	HDR Static	Disabled	00006		20202020200000fc			
0	TIDA SIGUC	Disabled	00007		30204450310a200218			
_	▼ Main Features			Mode HEX Edit Mode	00 74 DT /T D/ 15 D6 55 34		Apply	
_								
Rea	d from TE Write to TE					Save As	Load	

Enable DisplayID		
Add Item V Remove Item Filter	Read mode: • I2C Read SBM Read Virtual Sink #1 ~	🗌 Show Read Only 🛛 Recurse
Name	Editor Text DisplayID	
Section     Data Block	Name Value	
<ul> <li>Product Identification Data Block</li> </ul>	0 Week of Year Manufactured 52	
Product ID Code Field V Week & Year of Manufacture or Model Year	1 Gregorian Year 2015	
Week of Year Manufacture of Moder real		
> Display Parameters Data Block		
Display Interface Features Data Block		
<ul> <li>Type VII Timing – Detailed Timing Data Block</li> <li>Type X Timing – Formula-based Data Block</li> </ul>		
> Adaptive-Sync Data Block		
> CTA DisplayID Data Block		
	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	1
	000000 20 90 02 00 20 00 13 a4 c0 00 36 40 46 0a 56 01 000010 34 00 55 43 44 2d 34 30 30 21 81 1d 00 10 70	
	000010 34 01 07 55 45 44 2d 54 50 50 21 81 1d 00 10 70 000020 08 00 10 70 08 00 24 4a 57 fc c4 a2 88 52 10 00	
	000030 45 54 00 80 00 80 00 80 05 ff 26 00 09 3f 3f 1f	
	000040 1f 00 e0 7f 00 00 22 00 28 b2 90 1f 88 ff 1d 4f	I
	000050 00 07 80 1f 00 df 10 7a 00 6c 00 07 00 80 fa 29	
	000060 88 ff 27 4f 00 07 80 1f 00 df 10 7a 00 6c 00 07	
	000070 00 2a 00 06 02 ff 1d df 10 3b 2b 00 06 07 05 2d	
▲ Main Features	Editor Mode 🗌 HEX Edit Mode	Apply
- Main reactives		Save As Load
Read from TE Write to TE		

With *Load...* and *Save As...* a file can be read or written to from a 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) are read. If the device does not support all four blocks, the non-supported data is replaced with zeros.

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/DisplayID Editor**

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

# Source DUT Testing Tab

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

<u>⊥</u> ools <u>W</u> indow <u>H</u> elp															
RX Event Log Memory Layout Termi	nal														
Link HDCP Video Audio Link Anal	yzer Capture	EDID/DisplayID	DPCD	SDP	DSC	FEC	Source DUT	Testing	Panel Replay						
All tests	Name									Pass	Fail	Skip	Runs	Last statu	IS
DP 1.4 LL CTS	✓ ■ DP 1.4 LL 0	TS								0	0	0	0		
HDCP 2.3 CTS 1A HDCP 2.3 CTS 1B		Source DUT Retry						(3200us)		0	0	0	0		
HDCP 2.3 CTS 3A		Source Retry on In Source Device HPI				after HP	D Plug Event			0	0	0	0		
HDCP 2.3 CTS 3B		Source Device HPI								0	0	0	0		
CRC Video Tests		Source Device Ina								0	0	0	0		
Audio Test	4.2.2.1	DPCD Receiver Ca	pability and	d EDID Re	ad upon	HPD Plu	g Event			0	0	0	0		
Link Config Tests Pixel Level Video Tests		DPCD Receiver Ca	pability Rea	ad upon H	HPD Plug	Event				0	0	0	0		
HDR10+ Distribution Device Tests		EDID Read EDID Read Failure								0	0	0	0		
HDR10+ SSTM Tests for Source		EDID Read Failure								0	0	0	0		
		EDID Corruption E		er non b						0	0	0	0		
		Branch Device Det		n HPD Pl	ug Event					0	0	0	0		
		EDID Read on IRQ			nch Devi	ce Detect	ion			0	0	0	0		
		E-DDC Four Block			20					0	0	0	0		
		Link Status-Adjus Successful LT at Al								0	0	0	0		
		Successful Link Tra				renk spe	eus			0	0	0	0		
		Successful LT with				al Voltage	Swing During	Clock Rec	overy Sequence	0	0	0	0		
		Successful LT to a								0	0	0	0		
		Successful LT to a							20 of 2007 1111	0	0	0	0		
		Successful LT with Successful LT at Lo									0	0	0	Pass	
		Unsuccessful LT at LC						annei Equ	alization sequenci	0	0	0	0	Pass	
		Unsuccessful LT at						ng		0	0	0	0		
		Unsuccessful LT d								0	0	0	0		
		Successful LT with				ifferentia	Voltage Swing	g and Pre-	emphasis during		0	0	0		
		Source Device Lin Source Device Lin								0	0	0	0		
		Successful Link Re				Due to I	ose of Symbol	Lock		0	0	0	0		
		Successful Link Re							ock	0	0	0	0		
		Successful Link Re					oss of Inter-la	ne Alignm	ent Lock	0	0	0	0		
		Handling of IRQ H		vith No Er	ror Statu:	s Bits Set				0	0	0	0		
		Lane Count Reduct Video Time Stamp								0	0	0	0		
		Data Packing and								0	0	0	0		
		Main Stream Data		nd Stuffing	g - Least	Packed T	U			0	0	0	0		
		Main Stream Data				Packed T	U			0	0	0	0		
		Main Video Stream		hange Ha	ndling					0	0	0	0		
		Power Managemen Audio Stream Hea								0	0	0	0		
		Audio Stream Hea								0	0	0	0		
		Audio InfoFrame F		656						0	0	0	0		
		Audio Stream Tran								0	0	0	0		
		Audio Start Seque			31		10000			0	0	0	0		
	4.5.1.1	FEC enable verifica	ation for all	supporte	d Lane o	ount and	Link Speed			0	0	0	0		
Run Checked Select  Configure	Import	Export S	stop on Fail	ure Rep	eats: 1	٢	Delay time, sec	1	•		Save	Report	Clear Selected	d Clear	r All
[2024-11-21, 13:00:15.007]; 0000.99( 2024-11-21, 13:00:15.007]; 0000.99( 2024-11-21, 13:00:15.007]; 0000.997 [2024-11-21, 13:00:15.007]; 0000.997 [2024-11-21, 13:00:15.007]; 0000.997 [2024-11-21, 13:00:15.007]; 0000.497 [2024-11-21, 13:00:15.007]; 0000.497 [2024-11-21, 13:00:15.007]; 0000.407 [2024-11-21, 13:00:15.007]; 0000.407 [2024-11-21, 13:00:15.007]; 0000.407	.036: AUX .094: Source 1 .160: Link Tra .449: AUX .706: AUX .075: Test PA:	WR: 00102h: DUT writes TRAI wining OK RD: 00107h: WR: 00107h: SED: "4.3.1.7	1 00 NING_FAT 1 00 1 00 Succes				ik Rate Due	to Loss	s of Symbol Lo	ck Duri	ng Chan	nel Equ	alization S	equence	-
Tests execution finished.															
4PD															
				ort Pulse	750 u	sec 🗘									
Cable HPD Assert Dea	sert Pulse H	PD 500 msec													

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 <i>Run Checked</i> button is relabeled <i>Abort</i> to stop the test sequence if desired.
Select:	Includes three sets of options: <i>Select All, Clear All, 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 and Export</i> 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 <i>All</i> tests is selected. Refer to <i>Test Parameters</i> below for details.
Import:	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.
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, 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).

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

#### **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 to be later 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 *Import*ing and *Export*ing \*.json files here have a different format than importing those described above.

		ОК	(
	•		
e 🕨	e 🕨		

# DP and DP Alt Mode Reference Sink

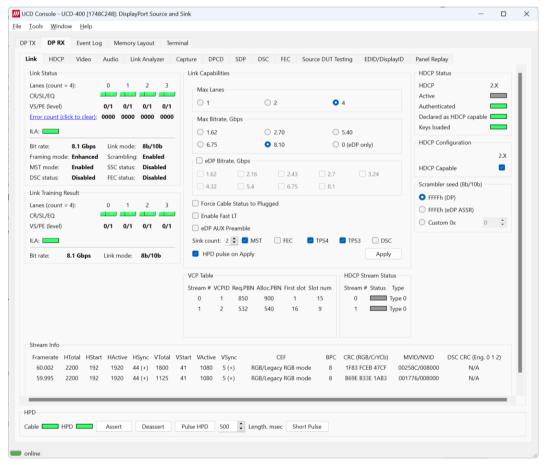
Role:	Product:	
DP Reference Sink (DP RX)	UCD-400	_
USB-C DP Alt Mode Reference Sink (DP RX)	UCD-424	_

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

- Status information and control of the upstream link (Link)
- DPCD editor (DPCD)
- Analyze Secondary-data Packets received (SDP)
- Display Stream Compression status and configuration (DSC)
- Forward Error Correction (FEC)

## Link Tab

Link tab contains four panels: Cable / HPD, Link Status, Link Capabilities HDCP Status and Configuration, Video Status 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 status of other link modes. The data is retrieved from the DPCD status registers of the UCD Sink. The status is updated automatically.

Lanes (count =	4):	0	1	2	3
CR/SL/EQ					
VS/PE (level)		0/1	0/1	0/1	0/1
Error count (clic	:k to clear):	0000	0000	0000	0000
ILA:					
	0.4.51			0.44	
Bit rate:	8.1 Gbps	_	mode:		
	•	_		8b/10	
Bit rate:	•	Scra			ed

Lanes:	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
CR/SL/EQ:	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization for each of the four lanes
VS/PE (level):	Voltage Swing / Pre-emphasis level
Error count:	Content of DPCD Error Count registers
ILA:	LED indicator for 'Inter lane Alignment Done'
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (8b/10b only)
Framing mode:	Currently enabled Framing Mode (Normal or Enhanced)
Scrambling:	Status of link data scrambling (Enabled or Disabled)
MST mode:	Status of Multi-stream transport (Enabled or Disabled)
SSC Status:	Status of Spread-Spectrum Clock (Enabled or Disabled)
DSC Status:	Status of Display Stream Compression
FEC status:	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.

Lanes (count = 4):	0 1 2 3
CR/SL/EQ	
VS/PE (level)	0/1 0/1 0/1 0/1
ILA:	
Bit rate: 8.1 Gbps	Link mode: 8b/10b
Lanes:	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
CR/SL/EQ:	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization for each of the four lanes
CR/SL/EQ: VS/PE (level):	
VS/PE (level):	Equalization for each of the four lanes
	Equalization for each of the four lanes Voltage Swing / Pre-emphasis level

#### **Link Capabilities**

Link capabilities allows the user to change the way the Sink capabilities are announced in the DPCD capability registers of the UCD Sink. To update the new status to the DPCD registers click *Apply*.

O 2	•	4
0 2.70	(	5.40
• 8.10	$\langle$	0 (eDP only)
ps		
2.16 2	43 2.7	3.24
5.4 6	75 🗌 8.1	
us to Plugged		
ble		
MST 🗌 FEC	C 🔽 TPS4	TPS3 DSC
oply		Apply
	2.70 8.10 ps 2.16 2. 5.4 6. us to Plugged ble	<ul> <li>2.70 (</li> <li>2.70 (</li> <li>8.10 (</li> <li>ps</li> <li>2.16 2.43 2.7</li> <li>5.4 6.75 8.1</li> <li>us to Plugged</li> <li>ole</li> <li>MST □ FEC &lt; TPS4</li> </ul>

Max lanes:	Maximum lane count used
Max Bitrate, Gbps	Maximum link rate used in LT
eDP Bitrate,Gbps	Available eDP bitrates.
Force Cable Status to Plugged:	UCD-400 RX device supports source device detection via AUX by default. Checking this on DPRX disables this behavior.
Enable Fast LT:	Indicate support for link training without AUX transactions.
eDP AUX Preamble,Gbps	Use eDP AUX Preamble protocol.
Sink count:	Selects the number of sinks capable of to transmitter.
MST:	Indicate support for MST mode and Sideband MSG handling.
FEC (8b/10b):	Indicate support for Forward Error Correction (FEC) feature.
TPS4, TPS3:	Indicate support for Link Training Pattern Sequence 4 and 3 correspondingly.
DSC (8b/10b):	Indicate support for Display Stream Compression (DSC) feature
HPD pulse on Apply:	Select to apply a Hot-Plug Detect (HPD) pulse automatically after updating the status. HPD pulse duration will be defined in the <i>Pulse HPD</i> field in <i>HPD</i> dialog in the bottom of the tab.

### **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.

Scrambler seed (8b/10b)	
⊖ Auto	
FFFFh (DP)	
O FFFEh (eDP ASSR)	
O Custom 0x	0 +

#### **HDCP Status**

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

HDCP Status	
HDCP	2.X
Active	
Authenticated	
Declared as HDCP capable	
Keys loaded	
Keys loaded HDCP Configuration	
	2.X

### **HDCP Configuration**

Enable and disable HDCP capability of UCD Sink. Duplicates of the controls found in HDCP tab. Currently, UCD-4XX devices support only HDCP 2.3 standard.

#### **Stream Info**

Framerate         HTotal         HStart         HActive         HSync         VTotal         VStart         VActive         VSync         CEF         BPC         CRC (RGB/CrYCb)         MVID/NVID         DSC CRC (Eng.           59.995         2200         192         1920         44 (+)         1125         41         1080         5 (+)         YCbCr4:2:2/ITU-R BT.601         8         E18E 0815 5A14         001777/008000         N/A	Streamin	n Info													
59.995 2200 192 1920 44 (+) 1125 41 1080 5 (+) YCbCr4:2:2/ITU-R BT.601 8 E18E 0815 5A14 001777/008000 N/A	Framera	erate HTo	Total	HStart	HActive	HSync	VTotal	VStart	VActive	VSync	CEF	BPC	CRC (RGB/CrYCb)	MVID/NVID	DSC CRC (Eng. 0 1 2)
	59.995	95 220	200	192	1920	44 (+)	1125	41	1080	5 (+)	YCbCr4:2:2/ITU-R BT.601	8	E18E 0815 5A14	001777/008000	N/A
59.995 2200 192 1920 44 (+) 1125 41 1080 5 (+) RGB/Legacy RGB mode 8 B69E B33E 1AB3 001777/008000 N/A	59.995	95 220	200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	001777/008000	N/A
59.995 2200 192 1920 44 (+) 1125 41 1080 5 (+) RGB/Legacy RGB mode 8 B69E B33E 1AB3 001777/008000 N/A	59.995	95 220	200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	001777/008000	N/A
59.985 2200 192 1920 44 (+) 1125 41 1080 5 (+) RGB/Legacy RGB mode 8 B69E B33E 1AB3 001776/008000 N/A	59.985	85 220	200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	001776/008000	N/A

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

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

Note that the MSA information used for Video Timing Details is provided by the Upstream Source. It is not measured by the UCD Local Sink.

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

### **VCP** Table

VCP Table	9					
Stream #	VCPID	Req.PBN	Alloc.PBN	First slot	Slot num	
0	1	532	540	1	9	
1	2	532	540	10	9	
2	3	532	540	19	9	
3	4	532	540	28	9	

VCP table shows allocation of Virtual Channel Payload for active virtual MST channels. The content of *VCP Table* can be copied by right-clicking on the table and selecting **Copy**.

Strem #:	Port number where the virtual channel is directed.
VCPID:	Stream identification number of the virtual channel
Req.PBN:	Requested PBN (payload bandwidth) 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.

### **HDCP Stream Status**

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

Shows the MST HDCP Stream, Status and Type.

### HPD

HPD	
Cable HPD	Assert Deassert Pulse HPD 500 🖨 Length, msec Short Pulse
Cable LED:	Indicates that the hardware has detected an upstream cable.
HPD LED:	Indicates that the HPD signal is Asserted (logical "high").
Deassert:	Click button to set HPD line to logical "low" (de-asserted) and hence no HPD pulse can be generated.
Assert:	Click to re-activate the HPD line (set to logical "high").
Pulse HPD:	Click to apply an HPD Pulse with programmable duration. Duration will be defined in the provided field.
Short Pulse:	Click to apply a short pulse. Pulse duration is 1 ms.

### **Multistreaming**

When Multistreaming (MST) is enabled, the details of the received virtual channels is shown in Stream Info table and VCP Table .

Link HDCP Video Audio Link Analyzer	Capture DPCD SDP DSC FEC Source DUT Testing EDID/DisplayID	Panel Replay
Link Status	Link Capabilities	HDCP Status
Lanes (count = 4): 0 1 2 3		HDCP 2.X
CR/SL/EQ	Max Lanes	Active
VS/PE (level) 0/1 0/1 0/1 0/1	○ 1 ○ 2 <b>○</b> 4	Authenticated
Error count (click to clear); 0000 0000 0000 0000	Max Bitrate, Gbps	Declared as HDCP capable
ILA:	0 1.62 0 2.70 0 5.40	Keys loaded
Bit rate: 8.1 Gbps Link mode: 8b/10b	○ 6.75	HDCP Configuration
Framing mode: Enhanced Scrambling: Enabled	eDP Bitrate, Gbps	2.X
MST mode: Enabled SSC status: Disabled DSC status: Disabled FEC status: Disabled	1.62 2.16 2.43 2.7 3.24	HDCP Capable
	4.32 5.4 6.75 8.1	Scrambler seed (8b/10b)
Link Training Result	Force Cable Status to Plugged	• FFFFh (DP)
Lanes (count = 4): 0 1 2 3 CR/SL/EQ	Force cable status to Progged     Fable Fast LT	O FFFEh (eDP ASSR)
VS/PE (level) 0/1 0/1 0/1 0/1		🔿 Custom 0x 🛛 0
ILA:	Sink count: 4 🗣 🗹 MST 💿 FEC 🕑 TPS4 🕑 TPS3 💿 DSC	
	HPD pulse on Apply Apply	
Bit rate: 8.1 Gbps Link mode: 8b/10b	The pulse on Apply	
	VCP Table HDCP Stream Status	
	VCP Table HDCP Stream Status Stream # VCPID Req.PBN Alloc.PBN First slot Slot num Stream # Status Type	
	Stream # VCPID Req.PBN Alloc.PBN First slot: Slot num         Stream # Status         Type           0         1         532         540         1         9         0         Type 0	
	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type           0         1         532         540         1         9         0         Type 0           1         2         532         540         10         9         1         Type 0	
	Stream # VCPID         Req.PBN         Alloc-PBN First slot Slot num         Stream # Status         Type 0           0         1         532         540         1         9         0         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0	
	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type           0         1         532         540         1         9         0         Type 0           1         2         532         540         10         9         1         Type 0	
Stream Info	Stream # VCPID         Req.PBN         Alloc.PBN First slot Slot num         Stream # Status         Type 0           0         1         532         540         1         9         0         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           3         4         532         540         28         9         3         Type 0	
Framerate HTotal HStart HActive HSync VTotal	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type 0           0         1         532         540         1         9         1         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           3         4         532         540         28         9         3         Type 0	/ID/NVID DSC CRC (Eng. 0 1 2)
Framerate         HTotal         HStart         HActive         HSync         VTotal           59.995         2200         192         1920         44 (+)         1125	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type           0         1         532         540         1         9         0         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           3         4         532         540         28         9         3         Type 0           VStart         VActive         VSync         CEF         BPC         CRC (RGB/CrYCb)         MM           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017	77/008000 N/A
Framerate HTotal HStart HActive HSync VTotal	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type           0         1         532         540         1         9         1         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           3         4         532         540         28         9         3         Type 0           VStart         VActive         VSync         CEF         BPC         CRC (RGB/CryCb)         MM           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017	
Framerate         HTotal         HStart         HActive         HSync         VTotal           59.995         2200         192         1920         44 (+)         1125           59.995         2200         192         1920         44 (+)         1125	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type 0           0         1         532         540         1         9         1         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           2         3         532         540         19         9         2         Type 0           2         3         4         532         540         28         9         2         Type 0           VStart         VActive         VSync         CEF         BPC         CRC (RGB/CrYCb)         MW           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017	77/008000 N/A 77/008000 N/A
Framerate         HTotal         HStart         HActive         HSync         VTotal           59.995         2200         192         1920         44 (+)         1125           59.995         2200         192         1920         44 (+)         1125           59.995         2200         192         1920         44 (+)         1125	Stream # VCPID Req.PBN Alloc.PBN First slot Slot num         Stream # Status Type 0           0         1         532         540         1         9         1         Type 0           1         2         532         540         10         9         1         Type 0           2         3         532         540         19         9         2         Type 0           2         3         532         540         19         9         2         Type 0           2         3         4         532         540         28         9         2         Type 0           VStart         VActive         VSync         CEF         BPC         CRC (RGB/CrYCb)         MW           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017           41         1080         5 (+)         RGB/Legacy RGB mode         8         B69E B33E 1AB3         0017	77/008000 N/A 77/008000 N/A 77/008000 N/A

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# **DPCD** Tab

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

	TX	Eve	nt L	g																	
ink HD	СР	Vie	leo	E	DID		DPCD	)	SDP		DSC	F	EC	S	ourc	e DUI	l Test	ng Capture Audio Link Analyzer			
																		Load	Save	F	Report
Address : 0x	0		E	•	lum	ber	of Byt	tes: (	h [1	00		-									
	00	01	02	03	04	05	5 06	07	08	09	AO	0B	oc	OD	0E	OF	^	Receiver Capability			
000000	14	le	e4	81	01	00	0 01	80	00	00	06	00	00	00	84	00		MAX_LANE_COUNT [RO] 0x00002 := 0xE4			
000010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		MAX_LANE_COUNT = 4			
000020	07	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00		ENHANCED_FRAME_CAP = 1 TPS3_SUPPORTED = 1			
000030	2d	18	3c	28	a4	le	e ca	47	9b	9f	f9	5a	5b	93	81	8d		POST_LT_ADJ_REQ_SUPPORTED = 1			
000040	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00					
000050	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00					
ddress : 0x	220	)	6	•	lum	ber	of By	tes: (	x 10	00	_	٦									
	00	01	02	03	04	05	5 06	07	08	09	0A	0B	0C	OD	0E	OF	^	Extended Receiver Capability MAX_LINK_RATE [RO]			
002200	14	le	e4	81	01	00	0 01	80	00	00	06	00	00	00	84	00		0x02201 := 0x1E			
002210	0a	00	00	00	01	00	08	00	00	00	00	00	00	00	00	00		MAX_LINK_RATE = 8.1Gpbs(HBR3)			
	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00					
002220	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00					
002220 002230	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00					
	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	~				
002230																			Refresh	Write	Change
002230 002240	00																				

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

Save:	Select DPCD content to the PC (please see below).
Load:	Retrieve previously saved DPCD data (please see below).
Report:	Save parsed content of selected DPCD register ranges as HTML file
Refresh:	Re-read the data from the DPCD registers to the window in question
Write Changes:	To program the data into the DPCD registers of UCD Local Sink
Set Reference:	Store currently shown data as a reference for comparison

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

#### Saving and Loading DPCD Content

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

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

Note:	- User controls like Link Training or mode changes will modify the content of the DPCD registers
	- During a reboot of UCD-4XX 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 re-read the data. Show / hide the parsed data by clicking **Packets Info** in the divider bar.

The following packets are recognized:

in	k H	IDCP Video	EDID	DPCD	SDP	DSC	FEC	Source DUT	Testing	Capture	Audio	Lin	k Analyzer				
1	Name ATS	Header 00 01 02 03 00 01 17 48							8-channe	L L-PCM	audio						1 Manada III A
	ASP	00 02 00 01 00 10 7F 00	12 00 00 18 00 08 22 3C 27	9 90 00 70 0 89 10 60 E F0 03 01 A 7A 2A 71 0 00 00 00	0 08 7 D 20 0 A 32 7	29 A. CH[0]: 0x50257000 S: 0x257000 V: 0 U: 0 08 7. CH[1]: 0xA0257000 S: 0x257000 V: 0 U: 0 20 0. 23 7. S: Audio sample word	C: ( C: (	0 P: 0 0 P: 0	SF1 SF2	SP: SP:	CA: CA:						
						PR: P S S R SP: S CA: C SDP H 00 02 SDP D	FS - St F1 - St F2 - St SV - Ri ample I hannel eader: 00 01 ata:	Sit © Code and i ub-frame 1 s ub-frame 1 ub-frame 2 ESERVED. Present Bit Allocation: 00 70 29 AC	and start	of the	audio b: ne!	Lock			).		
PC		h Save	Asse		eassert		lse HPD	500 🔶 L	.ength, mse		t Pulse						

- Audio\_TimeStamp
- Audio\_Stream
- Extension
- Audio\_CopyManagement
- ISRC (International Standard Recording Code)
- Video Stream Configuration (VSC)
- Camera Generic 0 ... 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 defines in its DPCD register.

File Tools Window Help DP RX DP TX Event Log Link HDCP Video EDID CDSC Capable (8b/10b) DSC Major Version: RC block size: Bits per Pixel Increment: Throughput mode 0: Line buffer depth: Supported Color Depths Sis per color Channel 10 Bits per color channel 10 Bits per color channel 12 Bits per color channel	DPCD     SDP     DSC     FEC     Source DUT Testing     Capture     Audio     Link Analyzer       DSC Enabled     1     DSC Minor Version:     2       1     DSC Minor Version:     2       65536 bytes     R Couffer size, in blocks:     4       1/16 bpp     Block Prediction:     Supported       340MP/s     Throughput mode 1:     340MP/s       18 bits     Maximum Slice Width:     2560       Supported Color formatt     H-Slice Apsbillities     Y CSbCr 4:44       Ø YCSbCr 4:44     Ø 2 Slice / DSC Sink     10 Slice / DSC Sink       Ø Simple VCbCr 4:22     Ø 4 Slice / DSC Sink     16 Slice / DSC Sink       Ø Native YCbCr 4:22     6 Slice / DSC Sink     20 Slice / DSC Sink	
HPD Cable HPD Asse	VCbCr 4:20     ✓ S Slice / DSC Sink    ✓ 24 Slice / DSC Sink     uuto-Apply	

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

DSC Capable (8b/10b):	UCD is declared as DSC capable. Capability can be enabled or disabled in DP RX Link tab.
DSC Enabled:	LED indicating that the connected source has enabled DSC
Apply:	Write changes to UCD sink DPCD registers
Refresh:	Re-read the content of UCD sink DPCD and update the control status.
Reset:	Reset the content of UCD DSC related DPCD registers (0x00060 through 0x0006F) to the default values as defined in UCD firmware.

# **FEC** Tab

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

	DP TX	Event Log							
Link	HDCP	Video	EDID	DPCD	SDP DS	C FEC	Source D	UT Testing Capture Audio Link Analyzer	
	FEC Canal	ble (8b/10b)	Gener	ate HDP o	n Change	EF(	• Enabled	FEC Status Log	
			E oana		in chunge		e enablea	Current link is 8b/10b	
Err	ror Counter	rs (DPCD)						FEC Status: Decode Disable Detected / Sequence NOT detected FEC Status: Decode Enable Detected	
				Lane #1	Lane #2	Lane #3	Sum	FEC Status: Decode Disable Detected / Sequence NOT detected	
	ncorrected lo	block errors	-		-	-	-	FEC Status: Decode Enable Detected FEC Status: Decode Disable Detected / Sequence NOT detected	
	t errors	OCK errors	-			-		FEC Status: Decode Enable Detected	
	arity block e	errors	-	-	-	-	-	FEC Status: Decode Disable Detected / Sequence NOT detected FEC Status: Decode Enable Detected	
	arity bit erro				-	-	-		
	E E	nable aggre	gated error:	s U	pdate	Clear Co	ounters		
	E E	inable aggre	gated error:	s U	pdate	Clear Cr	punters		
	₩ E	nable aggre	gated error	s U	pdate	Clear Cr	ounters	Clear Log	
	₩ E	nable aggre	gated error	s U	pdate	Clear Cr	ounters	Clear Log	

#### **Enabling FEC**

Enabling FEC feature is controlled by the source device. When connected, source verifies corresponding registers in sink DPCD to find out if sink is FEC capable. This register in UCD-4XX sink can be controlled by **FEC Capable** checkbox.

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

 Update:
 Read FEC Error Counters from DPCD

 Clear Counters:
 Clear FEC Error Counters in DPCD.

FEC Status Log lists FEC events.

# **HDMI Reference Sink**

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-422

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

- Status information and control of the upstream link (Link)
- Received InfoFrame packets (InfoFrames).

# Link Tab

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

Behavior ○ 1.4 ○ 2.0 ④ 2.1	foFrames         Source DUT Testing         Capture           FRL Capabilities	CEC Link Analyzer HDCP Status HDCP Active	1.X 2.X
Status         Lane 0         Lane 1         Lane 2         Lane 3           Channel lock         0001         0000         0003         0003           Auto Adjustment         4117         3a35         3cc0         0011	4 Lanes 6 6 8 0 10 € 12 ✓ FRL Start ✓ FLT Ready ☐ FLT No Timeout ☐ FRL Max ☐ Check Patterns	Authenticated Declared as HDCP capable Keys loaded HDCP Configuration	
Behavior         HDMI 2.1           TMDS Status            Mode:         HDMI           TMDS Bit Clock Ratio         1/10 36 mode           Input Stream Lock	LTP Add 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	HDCP Capable	1X 2X
Horizontal	FRL Mode 12Gbps 4-lane LT Status LTS:P FLT Update FLT No Retrain Misc	<b>676</b>	
Horizontal         Vertical           Total         2200         Total           Start         192         Start           Active         1920         Active           Sync Width         (-)44         Sync Width	Misc           1125         Frame Rate, Hz: 59.97           41         Color Depth, BPC: 8           1080         Color Encoding: RGB           (+)5         Colorimetry: Unkn	CRC 1: - CRC 2: -	Сору

#### **Behavior**

Selection of HDMI operation mode: HDMI 1.4, HDMI 2.0 or HDMI 2.1.

Please perform HPD Deassert - Assert after change of mode.

#### **Status**

Channel lock:	Status of Channel Lock in the four lanes and currently selected HDMI mode
Error count:	Contents of the SCDC Error counter registers of the UCD-422 Sink.
Auto Adjustment	Adjustment errors on lanes.
Behavior:	Assigned HDMI mode

### TMDS Status (Only in TMDS Mode)

TMDS Status	
Mode:	HDMI
TMDS Bit Clock Ratio	1/10 3G mode
Input Stream Lock	

 Mode:
 Indication of HDMI / DVI mode

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

Input Stream Lock: Indication of TMDS character lock

### FRL Capabilities (Only in FRL Mode)

FRL Capabilities allows the user to change the way the Sink capabilities are announced in the SCDC capability registers of the UCD-422 Sink.

FRL Capabilities	
O Disable FRL	
3 Lanes () 3 () 6 (0	Gbps)
4Lanes 🔾 6 🤇	8 🖲 10 🔿 12
FRL Start	FLT Ready
FLT No Timeout	FRL Max
Check Patterns	
LTP Add 0 🖨 0	• 0 • 0 •
Re-Train	Apply

Disable FRL:	Disable FRL mode
Capability Radio Buttons:	Selection of the maximum link count and link rate capability of UCD-422 sink. Written to FLR_Rate configuration register of UCD_422 Sink. Please click <b>Re-train</b> to apply
FRL Start:	Control of the HDMI sink's FRL_start bit (1/0)
FLT Ready:	Control of the HDMI sink's FLT_ready bit (1/0).
FLT No Timeout:	Status of the HDMI sink's FLT_no_timeout bit (1/0)
FRL Max:	Status of the HDMI sink's FRL_Max bit (1/0)
Check Patterns:	If Check Patterns in unselected then there's no pattern verification during link training
LTP Add:	Additional Requested Link Training pattern in HDMI sink's LnX_LTP_req (X=0-3) register.
Re-Train:	Request a new link training
Apply:	Store new settings

### FRL Status (Only in FRL Mode)

FRL Status displays the status of the link training and the link parameters negotiated between UCD-422 Sink and the Upstream Source. The status is updated automatically.

FRL Status				
	Lane 0	Lane 1	Lane 2	Lane 3
FRL data				
FFE Level	0	0	0	0
LTP Request	0	0	0	0
FRL Mode			10Gbp	s 4-lane
LT Status			LTS:P	
FLT Update				]
FLT No Retrain	n			)

FRL Data 0/1/2/3:	Indication of data flow in FRL links 0 to 3
FFE Level:	Status of Feed Forward Equalizer Level that HDMI transmitter is using (only in FRL mode)
LTP Request:	Currently requested FRL link training pattern.
FRL Mode:	Lane count and link rate configuration used in FRL mode
LT Status:	Status of the FRL Link Training State
FLT Update:	Status of the UCD-422 sink's FLT_update bit (1/0) (only in FRL mode)
FLT No Retrain:	Status of UCD-422 Sink's FLT_no_retrain bit (1/0) (only in FRL mode)

### **HDCP Status**

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

HDCP Status		
HDCP	1.X	2.X
Active		
Authenticated		
Declared as HDCP capable		
Keys loaded		
HDCP Configuration		
		1.X 2.X
HDCP Capable		$\bowtie$

### **HDCP Configuration**

Enable and disable HDCP 1.4 or HDCP 2.3 capability of UCD-422 Sink. Duplicates of the controls found in HDCP tab.

Note: HDCP is not supported in 3.5 release	
--	--

#### **Video Status**

Video Timing and Color Details as retrieved from stream metadata. Frame rate is measured by UCD-422 Local Sink.

Horizontal		Vertical		Misc		CRC	
Total	9000	Total	4400	Frame Rate, Hz:	30.0	CRC 0:	0x3A65
Start	768	Start	64	Color Depth, BPC:	24	CRC 1:	0xF27C
Active	7680	Active	4320	Color Encoding:	RGB	CRC 2:	0x832F
Sync Width	(+)176	Sync Width	(+)20	Colorimetry:	RGB	Update	Сору

### CRC

The 16-bit **CRC** (checksum, cyclic redundancy check) values of the three color components calculated by the Sink hardware. To re-calculate, click **Update**. Click **Copy** to store the information to the clipboard.

### HPD

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

# InfoFrame Tab

InfoFrame Tab displays received InfoFrames. Click **Refresh** to update the list. Show / hide the parsed data by selecting **Packet Info**.

ink Video Audio EDID InfoFrames Source DUT Testing Capture HDCP		
Name         Head         Dot           00 <td< th=""><th>Packet code: bed2 Packet Resder: Packet Resder: Packet Resder: Version: Packet Last Packet Last Packet</th><th>13 13 14 15 16 16 17 17 17 17 17 17 17 17 17 17</th></td<>	Packet code: bed2 Packet Resder: Packet Resder: Packet Resder: Version: Packet Last Packet	13 13 14 15 16 16 17 17 17 17 17 17 17 17 17 17
Refresh Save		

#### **Received InfoFrames**

InfoFrames tab displays in hexadecimal format the following received InfoFrames:

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

#### **Saving Infoframes**

Infoframe packets can be saved in a file in binary format. Click *Save* and in the dialog select the packet types of choise. File name will be of format *EMP\_2022-07-28T15\_54\_24.bin*, where *EMP* is the packet type and *2022-07-28T15\_54\_24* the time stamp.

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

### **Infoframe Features**

Observe features found in infoframes by selecting Features.

	RX	HDMI TX	Event Log	Memory Lay	out Terminal						
in	v	ideo Au	dio EDID	InfoFrames	Source DUT Testing	Capture	HDCP				
1	Name GCP EMP AVI	03 00 00 7F C0 00	10 04 00 0 84 00 01 0	0 00 00 00 10 0 01 00 04 01	08 09 10 11 12 13 3 04 00 00 00 00 00 3 01 00 32 00 00 00 0	10 04 00 00 00 00 00 00	00 00 00 1 00 00 00 0	.0 04 00 00 0 00 00 00 00 0	0 00 00 0 00 00	Gaming VRR	
										QFT (FVA)	
.0	Refrest	n Sa	ve								

# **USB-C** Monitoring

Role:	Product:
USB-C DP Alt Mode Reference Source (USB-C TX) or	UCD-424
USB-C DP Alt Mode Reference Sink (USB-C RX)	060-424

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

• USB-C Power Delivery (PDC)

In USB-C Power Delivery tab (PDC) operator can evaluate the status of the USB-C connection and USB Power Delivery Contract, the various roles adopted, and the configuration of the DP Alternate Mode. The user can set the initial roles for the UCD-424 test equipment and the optional capabilities for UCD-424 in the USB-C PD Contract. Controls allow user also to swap Power and Data roles.

USB-C Monitoring dialog is divided into four panels. The upper left panel is a Status List indicating statuses of both port partners, UCD-424 and the connected DUT.

The tabs on the right panel configuration dialogs of various USB-C interface functions.

The bottom panel indicates status of the cable connection and PD Control controls for role swaps

B-C RX USB-C TX Event	-	P EDID DPCD FEC SDP	DSC Source DUT Testin	0		
	alo Link Analysei Pibo	F EDID DECD FEC SDE	DSC Source DOT lestin	g		
Status List		Capabilities DP Alt Mode	Power Source Power Sink	Cable Info Controls		
▼ TE Status Data Role Power Role VConn E-Marked Cable DP Alt Mode PD Contract P DP CONT P DP C	Up facing port (UFP) Sink Off Unknown "C": DP 1.3 4 lanes Fixed 3.00 A / 9.00 V Fixed 3.00 A / 9.00 V 3.00 A 3.00 A 3.00 A 3.00 A Yes		CC Pull-up DRD/DRP Defaut 1.5A 3.0A Try Behavior Try Sink Try Sink Try Sink Try Source None PD rev 3.0 V1.0 0x16A6 0x24 unspecified			
- USB comm capable Yes - Capability mismatch No - Give back No	Accessories	Debug Accessory				
	9.28 V 1.04 A 0.02 V 1.62 V					
PD Control		PDC	Orienta	tion		
Send PR_SWAP Send DR_	SWAP Send VCONN_SWAP	Send FR_SWAP PDC Status	Reset O CC	CC2 Cable Orientation: Flipped		
IPD					PD	
Cable 💶 HPD 💶	Assert Deassert	Pulse HPD 500 🗘 Length, msec				Reconnec

# **Status List**

In Status List the information is presented in foldable sections. Each section contains information related to one feature of USB-C interface or PD protocol. The user can fold out the sections needed for the task in question.

<ul> <li>▼ TE Status</li> <li>Data Role</li> <li>Down facing port (DFP)</li> <li>Power Role</li> <li>Source</li> <li>VConn</li> <li>On</li> <li>E-Marked Cable</li> <li>Yes</li> <li>DP Alt Mode</li> <li>"C": DP v1.4a 4 lanes</li> <li>PD Contract</li> <li>Fixed 3.00 A / 9.00 V</li> <li>▼ PD Contract</li> <li>Power Source</li> <li>PDO Type</li> <li>Fixed</li> <li>PDO voltage</li> <li>9.00 V</li> <li>PDO max current</li> <li>3.00 A</li> <li>POWer Sink</li> <li>RDO max current</li> <li>3.00 A</li> <li>No USB suspend</li> <li>Yes</li> <li>USB comm capable</li> <li>Yes</li> <li>Capability mismatch</li> <li>No</li> </ul>	Status List		
Power Role     Source       VConn     On       E-Marked Cable     Yes       DP Alt Mode     "C": DP v1.4a 4 lanes       PD Contract     Fixed 3.00 A / 9.00 V       ▼ PD Contract     Power Source       - PDO Type     Fixed       - PDO voltage     9.00 V       - PDO max current     3.00 A       - RDO max current     3.00 A       - RDO oper current     3.00 A       - No USB suspend     Yes       - USB comm capable     Yes	▼ TE Status		^
VCon On E-Marked Cable Yes DP Alt Mode "C": DP v1.4a 4 Ianes PD Contract Fixed 3.00 A / 9.00 V ▼ PD Contract Power Source - PDO Type Fixed - PDO voltage 9.00 V - PDO max current 3.00 A Power Sink - RDO max current 3.00 A - RDO oper current 3.00 A - RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	Data Role	Down facing port (DFP)	
E-Marked Cable Ves DP Alt Mode "C": DP v1.4a 4 lanes PD Contract Fixed 3.00 A / 9.00 V ▼ PD Contract Power Source - PDO Type Fixed - PDO voltage 9.00 V - PDO max current 3.00 A Power Sink - RDO max current 3.00 A - RDO oper current 3.00 A - RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	Power Role	Source	
DP Alt Mode "C": DP v1.4a 4 lanes PD Contract Fixed 3.00 A / 9.00 V ▼ PD Contract Power Source - PDO Type Fixed - PDO voltage 9.00 V - PDO max current 3.00 A Power Sink - RDO max current 3.00 A - RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	VConn	On	
PD Contract Fixed 3.00 A / 9.00 V ▼ PD Contract Power Source - PDO Type Fixed - PDO voltage 9.00 V - PDO max current 3.00 A Power Sink - RDO max current 3.00 A - RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	E-Marked Cable	Yes	
<ul> <li>▼ PD Contract</li> <li>Power Source</li> <li>- PDO Type</li> <li>Fixed</li> <li>- PDO voltage</li> <li>9.00 V</li> <li>- PDO max current</li> <li>3.00 A</li> <li>Power Sink</li> <li>- RDO max current</li> <li>3.00 A</li> <li>- RDO oper current</li> <li>3.00 A</li> <li>- No USB suspend</li> <li>Yes</li> <li>- USB comm capable</li> <li>Yes</li> </ul>	DP Alt Mode	"C": DP v1.4a 4 lanes	
Power Source         - PDO Type       Fixed         - PDO voltage       9.00 V         - PDO max current       3.00 A         Power Sink       -         - RDO max current       3.00 A         - RDO oper current       3.00 A         - No USB suspend       Yes         - USB comm capable       Yes	PD Contract	Fixed 3.00 A / 9.00 V	
- PDO Type     Fixed       - PDO voltage     9.00 V       - PDO max current     3.00 A       Power Sink     -       - RDO max current     3.00 A       - RDO oper current     3.00 A       - No USB suspend     Yes       - USB comm capable     Yes	▼ PD Contract		
PDO voltage 9.00 V     PDO max current 3.00 A     Power Sink     RDO max current 3.00 A     RDO oper current 3.00 A     No USB suspend Yes     USB comm capable Yes	Power Source		
PDO max current 3.00 A     Power Sink     RDO max current 3.00 A     RDO oper current 3.00 A     No USB suspend Yes     USB comm capable Yes	- PDO Type	Fixed	
Power Sink - RDO max current 3.00 A - RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	- PDO voltage	9.00 V	
- RDO max current 3.00 A     - RDO oper current 3.00 A     - No USB suspend Yes     - USB comm capable Yes	- PDO max current	3.00 A	
- RDO oper current 3.00 A - No USB suspend Yes - USB comm capable Yes	Power Sink		
- No USB suspend Yes     - USB comm capable Yes	- RDO max current	3.00 A	
- USB comm capable Yes	- RDO oper current	3.00 A	
	- No USB suspend	Yes	
- Capability mismatch No	- USB comm capable	Yes	
	- Capability mismatch	No	
- Give back No	- Give back	No	

#### TE Status:

UCD-424 internal status (Data role, Power Role, VConn, E-marked cable, DP Alt Mode, PD Contract status)

#### PD Contract:

Details of the PD Contract (Power Source: PDO Type, PDO Voltage, PDO max current; Power Sink: RDO max current, RDO operating current, USB statuses)

PDO 1         Fixed 3.00 A / 5.00 V           PDO 2         Fixed 3.00 A / 9.00 V           ▼ Bus Electical Status         Vbus voltage           Vbus voltage         9.38 V           Vbus current         1.07 A           CC1 voltage         1.67 V           CC2 voltage         0.00 V
<ul> <li>▼ Bus Electical Status</li> <li>Vbus voltage</li> <li>9.38 V</li> <li>Vbus current</li> <li>1.07 A</li> <li>CC1 voltage</li> <li>1.67 V</li> </ul>
Vbus voltage9.38 VVbus current1.07 ACC1 voltage1.67 V
Vbus current 1.07 A CC1 voltage 1.67 V
CC1 voltage 1.67 V
CC2
CC2 voltage 0.00 V
VCONN voltage 0.00 V
VCONN current 0.00 A
SBU-1 voltage 0.27 V
SBU-2 voltage 2.70 V

Available source PDO:	(PDO 1, PDO 2)
BUS Electrical Status:	(Vbus voltage, Vbus current, CC1 voltage, CC2 voltage, VCONN voltage, VCONN voltage, VCONN current, SBU-1 voltage, SBU-2 voltage)

<ul> <li>DUT Discovery</li> </ul>	
Data Capable as Host	yes
Data Capable as Device	yes
Product Type	N/A
USB Vendor ID	0x16A6
USB Product ID	0x424
BCD Device	0x710
SVID0	0xFF01
SVID1	0x00
<ul> <li>DP Alt Mode support</li> </ul>	
Supports DP v1.3	yes
Supports USB gen2	no
Pin Assignment supported	
- DFP_D	yes
- UFP_D	no
- DPAM Version	Version 2.0 or earlier

#### DUT Discovery:

DUT information (data capable as host, data capable as device, product type, USB vendor ID, USB product ID, BCD device, SVID0, SVID1)

DP Alt Mode support:

Supported DisplayPort Alt Mode features (Supports DP v 1.3, Supports USB gen2, Pin Assignments supported as DFP\_D, UFP\_D, and DPAM Version)

<ul> <li>TE DP Alt Mode Status</li> </ul>		
Status	Active	
Multi-function prefered	no	
HPD state	asserted	
Select DP v1.3	yes	
Select USB gen2	no	
Pin Assignment	"C": DP v1.4a 4 lanes	
Cable UHBR 13.5 Support	Not Supported	
Cable Active Component	Passive -or- cable type is unknown	
DPAM Version	Version 2.0 or earlier	
DUT DP Alt Mode Status		
Status	DFP_D is connected.	
Multi-function prefered	not relevant	
HPD state	asserted	
Power low	Normal operation.	
No DPAM Suspend	$UFP\_U/DP$ Sink device has no preference for entry into low power state	

TE DP Alt Mode Status:	UCD-424 internal DP Alternate mode status (Status, Multi-function preferred, HPD state, Select DP v1.3, Select USB gen2, Pin Assignment, Cable UHBR 13.5 Support, Cable Active Component, DPAM Version)
DUT Alt Mode Status:	Status of the connected USB-C port partner gained from status update messages (Status, Multi-function preferred, HPD State, Power low, No DPAM Suspend)

# Capabilities

Capabilities DP Alt Mode	Power Source	Power Sink	Cable Info	Controls	
Initial Role DFP/SRC UFP/SNK Reject PR Swap Reject DR Swap Reject VCONN SWAP Reject FR Swap	DRD/DRP	CC Pull-up Defaut 1.5A 3.0A Try Behavior Try Sink Try Source None			
Vendor ID: Product ID:	PD rev 3.0 v1.0 0x16A6 0x424 unspecified				
Audio Accessory	Debug Acco	essory			

Initial Role:	Defines the role which UCD-424 presents itself in the start PD communication (both power and data role).
Reject Swaps:	Allow or reject mode swap requests from the connected port partner.
CC Pull-up:	Control of Rp that Source uses to advertise the initial current source capability using USB-C Current method.
Try Behavior:	Control the USB-C PD role that UCD-424 initially takes in the connection handshake.
UCD-424 Identity:	Status information provided by UCD-424.

Accessories	
Audio Accessory	Debug Accessory

### Accessories

Audio Accessory:	Enable simulation of Audio Accessory support
Debug Accessory:	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:	Please note that UCD-424 does not support any physical connections for the Accessory functions.
	The selections enable only behavioral simulation.

# **DP Alt Mode**

Controls and capability settings for DisplayPort Alternate Mode.

apabilities DP Alt Mode Power	r Source Power Sink Cable Info Controls
Enter 2 Iane mode (D) Enter 4 Iane mode (C,E) Exit DP Alt Mode Disable DP Alt Mode Auto enter on connect "DP to Type-C Cable Adapter" mode Multi-function prefered	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.
"DP to Type-C Cable Adapter" mode:	Perform an automated procedure for connecting a DP to USB-C bidirectional cable. Please find an abstract of the issue below.
Multi-function preferred:	When entering DP Alternate Mode, select mode D.

### DP to Type-C Cable Adapter

USB-C to DP Bi-directional Cable contains an active converter microchip that needs to be powered from USB-C interface. Therefore UCD-424 must be initially configured in power source role for USB Default Operation where it applies vSafe5V on Vbus to power up the microchip in the cable.

USB-C to DP Bi-directional Cable uses pin assignment E when acting as a source. In order to provide the "cable" a possibility to request the configuration it needs, UCD-424 has to initiate a Data Role Swap to be in UFP, Device, data mode.

#### **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-424 when acting as *Power Source Port*.

SPR PDOs							
Source PDOs	PDO Type	Max Current, mA	Voltage, mV	Peak Current, %	Max Power, mW	Max Voltage, mV	Min Voltage, mV
PDO1	Mandatory ~	3000 🗘	5000	125 ~			
PDO2	Fixed ~	3000 🗘	9000	110 ~	0	÷ 0	÷ 0
Refresh	Apply Send	PDO Load I	PDO Save I	00			

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

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

Note: Please note that UCD-424 is not able to simulate as Source the electrical behavior of Variable and Battery source types.

Refresh	Re-read status from UCD-424
Apply	Program new values to UCD-424
Send PDO	Send a Source Capabilities message
Load PDO	Load a stored Power Source PDO configuration from file.
Save PDO	Store current Power Source PDO configuration to a file

# **Power Sink**

Controls and Definition of Power Data Objects (PDO) for UCD-424 when acting as Power Sink Port.

Controls	SPR PDOs			
Flags				
Give ba	-			
-PDO type p	priority	R_SWAP required curre	rrent – Max Operation Current –	
Prefer high	her current $$	Disable	✓ 500 ÷	
Give bac	k flag:	UCD-424	24 sets GiveBack flag in its Request Data Object	
No USB	suspend:		24 sets No USB Suspend flag in its Request Data Object	
PDO typ	e priority:	advertise	of the policy used for automatic selection from available PDC sed by Source Device. (Prefer higher current / Prefer higher / Prefer higher power)	)s
	eration	Setting t	the highest current UCD-424 will ever require when operatin	g a
Max Ope Current	, autom	a Power	a Shik.	
			a Shik.	
Current	DP Alt Mode	a Power	Power Sink Cable Info Controls	
Current		a Power		
Current	DP Alt Mode SPR PDOs	a Power	Power Sink Cable Info Controls	
Current apabilities Controls	DP Alt Mode SPR PDOs	a Power Power Source P Oper Currer	Power Sink Cable Info Controls rent, Voltage, Max Power, Max Voltage, Min Voltage,	



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

Refresh	Re-read status from UCD-424
Apply	Program new values to UCD-424
Load PDO	Load a stored Power Source PDO configuration from file.
Save PDO	Store current Power Source PDO configuration to a file

# Cable Info

Cable Info tab displays the information received from the cable as a response to *Discover Identity* command sent to SOP'.

Capabilities	DP Alt Mode Power Sour	rce Power Sink	Cable Info	Controls					
A6 16 00 1C 00	0 00 00 00 00 00 54 85 52 20 08 0	0 00 00 00 00 00 00 00	00 00	Refre	sh				
USB Vendor	ID ation supported	16A6	····						
		yes Passive Cable							
Product Typ	e unications Capable as USB Devi		bcdDevice	0x0000					
			USB product						
USB Commi	unications Capable as USB Host	t no	USB product	0000004					
USB SuperSp	eed Signalling Support	USB 3.1 Gen1 an	id Gen2						
VBUS throug	jh cable	Yes							
VBUS Currer	nt Handling Capability	5A	5A						
SSRX2 Direct	tionality Support	Fixed							
SSRX1 Direct	tionality Support	Fixed							
SSTX2 Direct	ionality Support	Fixed							
SSTX1 Direct	ionality Support	Fixed	Fixed						
Cable Termi	nation Type	VCONN not req	VCONN not required						
Cable Laten	cy	<10ns (~1m)							
USB Type-C	plug to USB Type-A/B/C/Capti	ve USB Type-C							
Firmware Ve	rsion	0							
Hardware Ve	ersion	0							

Note:

Please note that cable info can only be read when in DFP Data Role.

# Controls

Control tab includes miscellaneous controls related to UCD-424 behavior as a USB-C PD Port Partner.

### PD Contract Settings

Automatically negotiate power contract: When selected UCD-424 will start power contract negotiation if suitable configuration is found.

Capabilities	DP Alt Mode	Power Source	Power Sink	Cable Info	Cont
PD Contrac	<b>ct settings</b> atically negotiate	power contract	USB Commu As PD So		ble
ET Cable U One	SB 2.0 diferential	pairs wo			

### ET cable USB2.0 differential pairs

There are two versions for Unigraf Electrical Test Cable. The difference is the number of USB D+/pairs included in the cable. The reasoning is that if an unused pair is not terminated, it is a receiver of EMI and disturbs the electrical circuitry.

Cable with P/N 546117 has two USB2.0 pairs (A6, A7 and B6, B7), while P/N 546114 has only one pair (A6, A7). Please update the control accordingly.

If DUT has shorted USB2.0 pins A6 to B6 and A7 to B7 at the receptacle then choose cable One: In order to minimize in-cable signal coupling only one USB D+/- pair is included in the cable

If DUT has shorted USB2.0 pins routed to mux or similar, then choose cable Two: In order to enable electrical cable flip in cases where USB D+ lines and USB D- lines correspondingly have not been shorted together on Device side, both USB D+/- pairs are included in the cable. This cable marked with a label "2xUSB 2.0 PAIRS".

#### **USB** Communication Capable

You can control the USB Communication Capable bit in its Request Data Object.

Note: Please click *Apply* to enable changes.

# **Bottom Panel**

Bottom panel includes statuses and controls for the USB-C connection

**Status** 

PDC	Orientation	PD
PDC Status Reset	• CC1 · CC2 Cable Orientation: Straight	DUT Attached Reconnect

PDC Status	LED for USB-C Power Delivery Control	

Reset:	Reset the PD Controller in UCD-424 to overcome abnormal situations.
Orientation:	Straight (CC1 terminated) or Flipped (CC2 terminated).
DUT Attached:	Indication that Attach is detected by the Source port in one of its CC lines.
Reconnect:	Restart USB-C Source-to-Sink attach procedure.

PD Control

PD Control

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

Send PR_SWAP:	Send PR_Swap message to request an exchange of power roles.
Send DR_SWAP:	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.
Send VCONN_SWAP:	Send VCONN_Swap message to request an exchange of Vconn Source.
Send FR_SWAP:	Send FR_Swap message to request a Fast Role Swap.

# 5. GENERATOR OPERATION

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

Please note that in most UCD-4XX 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.

### **Standard Tabs**

Analyzer role features six standard tabs:

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

### **Interface Specific Tabs**

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

UCD-400, UCD-411, UCD-451 and UCD-424: DP and USB-C DP Alt Mode Reference Source

- Status information and control of the downstream link (Link).
- DPCD monitor (DPCD)
- Forward Error Correction (FEC)

### UCD-422, UCD-452 and UCD-412: HDMI Reference Source

- Status information and control of the downstream link (Link).
- SCDC monitor (SCDC)

### UCD-424: USB-C Reference Source

• USB-C Monitoring (PDC)

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

# **Standard Tabs**

# Pattern Generator Tab

<u>I</u> ools <u>W</u> indow <u>H</u> elp												
TX DP RX Event	Log Memory Lay	out Terminal										
Link Pattern Generat	or Playback A	udio Generator	HDCP [	OPCD	FEC Sink DU	JT Testing	Adaptive-Syne	C ALPM	Panel Replay	EDID/DisplayID	SDP	
Auto-Apply Apply	All 🛛 MST Num	ber of streams 2	Force	EDID pr	eferred timing af	ter LT 🗌 Use	Timings from	EDID Mana	ge Timings			
fotal bitrate : 7.128 / 25.5	15 Gbps.											
Pattern Generator Statu	5											
Timing	Pattern	CE		BPC	Sta			GB/CrYCb/012)				
1920 x 1080 @ 60Hz 1920 x 1080 @ 60Hz	Color Bars Color Bars	RGB/Legacy		8 8	c			B33E 1AB3 B33E 1AB3				
1920 x 1080 @ 60Hz 1920 x 1080 @ 60Hz		RGB/Legacy RGB/Legacy		8	0		Rear	0000				
1920 x 1080 @ 60Hz	Color Bars	RGB/Legacy		8	C			0000				
▼ Stream 0												
CTA 1920 x 1080 @ 60	tz (VIC 76) V	R hnc V	• VESA	CTA	Pattern Scrollin	a			- I			
	~ R		VESA (	CIA	Enable Ho		2 nivels					
Color Bars	~ R	GB V					pixels					
no options					Ev		frame					
Frame Rate 60,000Hz	Pixel Clock 148	- Contract of the second se				,						
Horizontal	Vertical	Horizo		ertical		Horizontal	Vertical					
Active 1920 ÷		ont Porch 88	÷ 4	÷	Start	192 🗘	41 韋					
Total 2200 🗢		nc Width 44	<ul> <li>         5     </li> <li>         36     </li> </ul>	•	Sync Polarity	(+)	(+)					
Blanking 280	45 Ba	ick Porch 148	\$ 36	•		A	pply					
▼ Stream 1									- L			
CTA 1920 x 1080 @ 60	Hz (VIC 76) V	🝸 8 bpc 🗠	• VESA	) CTA								
Color Bars	~ R	GB ~										
no options												
Frame Rate 60,000Hz	Pixel Clock 148	3 500kHz										
Horizontal	Vertical	Horizo	ontal V	ertical		Horizontal	Vertical					
Active 1920 🗘	1080 🗘 Fro	ont Porch 88	• 4	٩	Start	192 🗘	41 0					
Total 2200 🗘	1125 🗘 Sy	nc Width 44	\$ 5	٢	Sync Polarity	(+)	🛃 (+)					
Blanking 280	45 Ba	ick Porch 148	\$ 36	۰.		A	pply					
▼ Stream 2												
<ul> <li>Sueam 2</li> </ul>												
IPD												

Link Pat	tern Generator	Playback	Audio Gen	erator	HDCP	EDID	SCDC	Sink D	OUT Testing	Cable I	nfo CEC		
Auto-App	ply						Π.	Jse Timing	gs from EDID	Manag	e Timings		
	: 4.010 / 48.000	Gbps.											
	nerator Status — Fiming	Patterr	n	CEF		BPC		Sta	tus				
1920 x	1080 @ 60Hz	Color Ba	ars RGB	/Legacy F	GB mod	le 8		0	к				
							Timing Ge	norator					
	x 1080 @ 60Hz		8 bpc	✓ ○ \	/esa C		<ul> <li>CTA</li> </ul>		Generate				
Color		~	RGB	~					Generate				
no options		_					VIC U	•					
Frame Rate		Pixel Clock	148.500kHz										
	Horizontal	Vertical	5 . D . I	Horizor		Vertica		0	Horizontal		rtical		
Active Total	1920 <b>‡</b> 2200 <b>‡</b>	1080 🗘	Front Porch Sync Width	88 44	•		Sync	Start Polarity	192 🗘	41	(+)		
Blanking	280	45	Back Porch		•		• Sync	Polarity			(+)		
Dianking	200	45	back forch	140	•	50	•		A	pply			
HPD													

Note:	The video modes that can be used in MST streams are limited by the overall capability of the DisplayPort link and the capability of the connected DisplayPort Sink or Branch device.										
	Auto-Apply:	New settings are being validated when the user is clicks <i>Apply</i> . Automatic validation is applied when <i>Auto-Apply</i> is checked. When <i>Select DSC Image</i> 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 <u>Sourcing DSC Compressed Patterns</u> .									
	Apply All:	Apply recent changes to all streams. When <i>Select DSC Image</i> pattern is being streamed and an incompatible <i>Horizontal and Vertical Active</i> timings are set, the user is presented with a dialog: <i>H-Active and V-Active don't match with DSC data. Do you</i> <i>want to upload image?</i> See <u>Sourcing DSC Compressed Patterns</u> .									
	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 without stream allocation using Sideband messages if checkbox is cleared.									
	Number of streams	Set number of steams 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 (PIs see Note below)									
	Auto-Apply	In order to avoid sourcing invalid video mode combinations new settings are being validated when the user is clicking Apply. Automatic validation will be applied when <i>Auto-Apply</i> is checked.									
	Apply         Apply recent changes           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.										
Note:	A full description of Mi available. Please contact	inimum link configuration combinations for UCD standard video modes t Unigraf for details.									

### Pattern

(Controls vary between selected pattern type) Filter Color Depth Quantization Predefined Range CTA 5120 x 2160 @ 60Hz (VIC 126) Timings 8 bpc 🗸 Y White V-Strips Pattern Black strips width pixels 1 + White strips width pixels Option Color Format and Subsampling Selected Colorimetry Pattern SMPTE RP-133 ITU601 YCbCr422 Scal Bitmap scaling ~ RGB 🔍 Select Image Load pattern file Loaded ...esktop/Temp/Default-bitmap-pattern\_8K\_4.png Scale Select pattern file

Configuration of the video sent in the corresponding stream

### Predefined Timings

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

### Color Depth

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

### 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 <u>Appendix D</u> 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 stream 0

### **Filter**

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

III Form		×
Timing Filterin	-	
		🗆 сүт
Filter by res		8k and more
Sort timings t	y: Vendor IE	) ~
	Cance	el Apply

### Custom Image Patterns

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

Please refer to *Link Pattern* in description of *DP and DP Alt Mode Reference Source Link tab* later in this manual for sending special DisplayPort 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 left top 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 <u>Appendix D</u> of this document.

Note:

### **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.

✓ Enable Horizontally 10 ↓ Vertically 10 ↓ Every 1 ↓	pixels pixels frame
Enable:	Enable or disable pattern scrolling
Horizontally X pixels:	Horizontal step of the pattern movement in pixels (values in range -1270128, for YCbCr 4:2:2 even values). 0 = no movement, positive values = pattern moves to the right.
Vertically Y pixels:	Vertical step of the pattern movement in pixels (even values in range –1270128, for YCbCr 4:2:0 even values). 0 = no movement, positive values = pattern moves up.
Every N frame:	Delay of pattern movement in display frames (values in range $0255$ ). 0 = no movement, $1 =$ move every frame, $n =$ move every n:th frame.

### **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.

File to compress				
Source File: C:/Temp/DSC/ur	nigraf_default_image_16k.ppm			
16384 x 8640, RGE	3 24bpp			
Sink DSC capability registers (I	DPCD range 0x60 -> 0x6f, hex)			
01 21 03 03 eb 07 01 00 00 1f 0	e 11 08 07 00 00			Update
Compression Options				
Color space	Output resolutions:			
· · · ·	✓ 2560 x 1600	▲ Compression	on ratio:	8bpc -> 6bpp (2.7 to 1)
YCbCr 4:2:2	✓ 2560 x 1600 2880 x 240	<ul> <li>Compression</li> <li>Horizontal s</li> </ul>		
YCbCr 4:2:2 Color depth	✓ 2560 x 1600		slices:	
YCbCr 4:2:2 Color depth	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 288</li> <li>2880 x 480</li> <li>2880 x 480</li> <li>2880 x 576</li> </ul>	Horizontal s Vertical slice	slices:	4 Slices
YCbCr 4:2:2 Color depth 8 Resize mode	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 288</li> <li>2880 x 288</li> <li>2880 x 576</li> <li>2880 x 1440</li> </ul>	Horizontal s Vertical slice	slices: es:	4 Slices Custom
YCbCr 4:2:2 Color depth 8	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 288</li> <li>2880 x 480</li> <li>2880 x 576</li> <li>2880 x 1440</li> <li>3840 x 2160</li> </ul>	Horizontal s Vertical slice Custom ver	slices: es:	4 Slices
	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 288</li> <li>2880 x 288</li> <li>2880 x 576</li> <li>2880 x 1440</li> </ul>	Horizontal s Vertical slice Custom ver	slices: es: tical slices size:	4 Slices Custom
YCbCr 4:2:2 Color depth 8 Resize mode O Scale © Crop	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 288</li> <li>2880 x 480</li> <li>2880 x 576</li> <li>2880 x 1440</li> <li>3840 x 2160</li> <li>4096 x 2160</li> </ul>	Horizontal sice Custom ver	slices: es: tical slices size:	4 Slices Custom
YCbCr 4:2:2 Color depth 8 Resize mode O Scale	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 280</li> <li>2880 x 480</li> <li>2880 x 480</li> <li>2880 x 1440</li> <li>3840 x 2160</li> <li>4096 x 2160</li> <li>5120 x 2160</li> <li>5120 x 2160</li> <li>7680 x 4320</li> </ul>	Horizontal s Vertical slice Custom ver	slices: es: tical slices size:	4 Slices Custom
YCbCr 4:2:2 Color depth 8 Resize mode O Scale © Crop	<ul> <li>2560 x 1600</li> <li>2880 x 240</li> <li>2880 x 280</li> <li>2880 x 288</li> <li>2880 x 480</li> <li>2880 x 576</li> <li>2880 x 1440</li> <li>3840 x 2160</li> <li>4096 x 2160</li> <li>5120 x 2160</li> <li>5120 x 2880</li> </ul>	Horizontal sice Custom ver	slices: es: tical slices size:	4 Slices Custom

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.

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

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.

CVT 3840 >	2160 @	30Hz [R	B1]	~	Y 8 bpc	~	VES	A O CT	A
🙇 Select	DSC Imag	ge		~ R	GB	~			2
3840x216	0_RGB444	BPY_b	pc8_bpp	128_2slice	w_sliceh_1	3lb.dsc	0	Select	
							_		
Frame Rate	30.000	•	ixel Cloc	k 262.92	0 🗣	Adaptiv	/e-Sync.		
	30.000	1-	ixel Cloc		0 🔹	Adaptiv 32	ve-Sync.	_	*
Active	3840	* x 2				32	• •	5	4
Frame Rate Active Total Back Porce	3840 4000	* x 2	160 🔹	:	Sync width	32 y ☑ (+	• •	< 5 ( ) (-)	•

When a DSC image is selected as the pattern, UCD Console will automatically enable DSC, provided that the connected Sink device declares support for DSC in its DPCD.

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?

/// Warr	ning	×
?	H-Active and V-Active don't match with DSC data. Do you want to upload image?	
	Yes No	

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 (DSC\_pic\_height \* DSC\_pic\_lenght / 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 will be indicated in the preview image.

MST Number of streams 2 💭		Force EDID prefe	erred timing after		se Timings	from EDID	Manage Timings
Stream 0		Stream 1					
CTA 1920 x 1080 @ 60Hz (VIC 76) V 8 bpc V	⊖ vesa  ⊚ cta	CTA 1920 x 1080 @	60Hz (VIC 76)	~	₹ 8 bpc	~	vesa 🔿 cta
🔁 Select DSC Image v YCbCr422 v IT	U601 ~	Color Bars		∼ RG	В	~	$\sim$
1920x1080_YUV422_BPY_bpc8_bpp112_2slicew_4sliceh_13lb.dsc	W UNIGR	AF					
	6	40 × 480 348 × 480	1440 × 480				
Total 2200 🕏 x 1125 🗢 Sync polarity 🗹 (+)	•	800 × 600 1024 × 768	1280 × 768 1280 × 868 1280 × 960 1280 × 960	1680 × 720	n it: 220 × 1080 h	44 ♥ y ☑ (+) 88 ♥	x 5 🔹 x 🗹 (+) x 4 🕏
Start 192 🗲 x 41 🔹 Status: OK	CRC (CrYCb)			0x2BA8		ОК	
	DSC CRC (Eng.	012)	0xB01F	0x800A	0xA42C		

### **Manage Timings**

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

	Select All New	Delete	Timing Editor					
Name	Description	^	Description					
CTA 3840 x 2160 @ 30Hz (VIC 95)			Standard	CVT				
I GTA 3840 x 2160 @ 50Hz (VIC 96)			ID	0				
🗋 🔒 CTA 3840 x 2160 @ 24Hz (VIC 103)			Frame Rate	60.000				\$
□ 🔒 CTA 3840 × 2160 @ 25Hz (VIC 104)			Pixel Clock	556.744 Horizo			Veritcal	\$
□ 🔒 CTA 3840 × 2160 @ 30Hz (VIC 105)			Active	4096	antal 🌩	x 2	160	\$
□ 🔒 CTA 3840 × 2160 @ 50Hz (VIC 106)			Total	4176	4 ¥	x 2	222	\$
□ 🔒 CTA 3840 × 2160 @ 60Hz (VIC 107)			Start	72	<b>\$</b>	14	4	\$
GTA 3840 x 2160 @ 48Hz (VIC 114)			Sync width	32	÷	8		¢
☐ CTA 3840 × 2160 @ 48Hz (VIC 116)			Sync polarity	✓ (+)			(-)	
☐ CTA 3840 × 2160 @ 100Hz (VIC			Back Porch	40	\$	6		¢
☐ CTA 3840 × 2160 @ 100Hz (VIC			Front Porch	8	*	4	5	Ŧ
☐ CTA 3840 × 2160 @ 120Hz (VIC			48	40 FrontP				
🗹 🔒 CVT 4096 x 2160 @ 60Hz [RB2]			8 VS 6	YNC BackP				
☐			Fron	Ba			223	22
🗹 🔒 CVT 4096 x 2160 @ 60Hz [RB3]			r on t P.		ACTIVE VIE	DEO	2160	,
🗹 🔒 CVT 4096 x 2160 @ 144Hz [RB3]			Р.	Р.				
☑ 🔒 CTA 4096 x 2160 @ 60Hz (VIC 102)				4176	4096		1	
🗋 🔒 CTA 4096 x 2160 @ 120Hz (VIC								
GTA 4096 x 2160 @ 100Hz (VIC		~				Save	Rev	rert

### **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
 Indicates that a timing is a fixed timing 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.

HDMI Timing Generator (UCD-422,UCD-412)

HDMI Timings can be generated and applied via the Timing Generator group.

Timing Generator CTA OVT Generate RID 3: 1680 x 720 (64x27) ~ FR 5: 30Hz ~

● CTA ○ OVT Generate	Timing Generator	
VIC 77 🖨	$\odot$ cta $\bigcirc$ ovt	Generate
	VIC 77 🖨	

To do this select CTA or OVT timings radio button. Select desire RID and FR or VIC in combo boxes and then click the *Generate* button.

The generated values will be reflected in the Frame parameters. Click Apply to set timing.

Frame Rate	e 30.000Hz	Pixel Clock	44.400kHz	×				
	Horizontal	Vertical		Horizontal	Vertical		Horizontal	Vertical
Active	1680 韋	720	Front Porch	256 🗘	6	Start	64	14
Total	2000 🗘	740 🔶	Sync Width	32	8	Sync Polarity	✓ (+)	✓ (+)
Blanking	320	20	Back Porch	32	6		Арр	ly

# **Playback Tab**

Role:	Product:
DP Reference Source (DP TX)	UCD-424, UCD-400, UCD-411
HDMI Reference Source (HDMI RX)	UCD-422, UCD-412

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

Playlist	Playlist defines the UCD device and the output where the content is played. It lists the played Scenarios and their duration.
Scenario	Scenario is an operating structure that allows user to determine a specific sequence of video frames, metadata packets and audio that are going to be played in the defined order. Playlists and Scenarios are stored as human readable text files. The files can be edited using any text-editor software.
Advanced Playlists	Unigraf UCD devices can also be used as a compatibility test tool for dedicated standards like Dolby Vision™ and HDR10+. Please contact Unigraf for details.

The provided examples are also somewhat different for HDMI and DisplayPort.

Note:

### **Common Tab**

Sample playlists are included in UCD Console by default. Select a sequence (a scenario) from the playlists and press *Run* to play the sequence.

Common	Metadata	HDR10+ Test	VRR/QMS	
✓ Play	/ision DEMO /list HDMI.txt Dolby Vision E	DEMO		^
✓ Sample ✓ Bas		dio Example - HDI Audio	MI.txt	
	Flip-flop Silent Philips 1920x1	t		
> VRF	Philips 3840x2 R Example - HE			
	IS-VRR Exampl .M.txt	e - HDMI.txt		~
	<b></b>	Run	•	

Click Stop to stop playing the scenario.

### Selected Sequence

Currently run sequence and its details are indicated in Selected Sequence.

Selected Sequence							
Source: 192	Source: 1920x1080.txt (Scenario) Select Editor						
Video							
Source:r	nigraf UCD	Tools/Resou	irces/playb	ack\content/Basic\I	mage1.jpg		
Amount: -							
Horizont	al	Vertical		Misc			
Total	2200	Total	1125	Frame Rate, Hz:	60		
Start	192	Start	41	Color Depth, BPP	P: 8		
Active	1920	Active	1080	Color Encoding:	RGB444		
Sync Wid	th <b>44</b>	Sync Wid	th 5				

### Status Log

The executed steps of the scenario are listed in the Status Log.

Stop	
Iotal data size: 43352064 bytes. Video data size: 39813120 bytes. Packets data size: 0 bytes. Audio data size: 3538944 bytes. Memory layout: OK. C:\Program Files\Unigraf\Unigraf UCD Tools\Resources\playback\content\Basic\Image1.jpg: 8 bpc C:\Program Files\Unigraf\Unigraf UCD	^
Tools/Resources/playback/content/Basic\Image2.jpg: 8 bpc Image upload succeeded! Loaded playback scenario == Scenario started (3600000 ms) #1/1	~

#### **Scenario Editor**

Details of a Scenario can be edited with *Scenario Editor*. Please refer to *Appendix H: Scenarios and Playlists* later in this manual for details of Scenarios.

// Scer	nario Editor	×
Video	D	
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:	HCActive: HCBlank:	
	VTotal: VStart:	
	VActive: VSync:	
	Frame rate:	
Packe	ets	
Path:	:frames_0000.bin	Select
	4 files found	
Audio	0	
Path:	:	Select
	Compresse 🗌 Little Endia 44100 Hz 🗸 2 channe	els $\vee$ 16 bits $\vee$
Playir	ng order	
3:180	0:0,2:512;	
Gener	ral	
	nable scrambler Loading color (R,G,B): 52,127,150	HDCP: None ~

### Metadata Tab

Dialog	×
CTA 1920 x 1080 @ 60Hz (VIC 0)	60fps
RGB444 ~ 8 bpc	~
Metadata	
	Add Delete
Comment	
Content folder	
C:/Users/juha.eskola/AppData/Local/Unigraf/UCD Console\Playback	Browse
Please select a content folder	Play Export Cancel

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

/// Con	tent folder X
İ	A folder for generated content must be selected. Press the Browse button to select.
	ОК

#### Click Browse... to select the folder.

Content folder			
C:/Users/juha.eskola/AppData/Local/Unigraf/UCD Console\Playback			Browse
Please select a content folder			
	Play	Export	Cancel

### Timing details

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

CTA 1920 x 1080 @ 60Hz (VIC 0)		60fps
RGB444	✓ 8 bpc	~

### Metadata

In metadata section you can add and delete metadata packets.

etadata		
		Add
		Delete

#### **Comment**

You can add comments after there dashes in the comment field.

Comment	

### HDR10+ Test Tab

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

### **VRR/QMS** tab

Common	HDR10+ Test	VRR/QMS	
Generate			Delete

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

/// Custom Scenario Gene	rator				×
CTA 1920 x 1080 @ EDID (HDMI Forum VSDB;		0+ VSVD	B; Dolby Vision VSVDB]		60fps
RGB444		~	8 bpc		~
VRR QMS					
Transition			Scenario duration		
Min frame rate, fps	20	4 ¥	Step duration, sec	1.00	*
Max frame rate, fps		\$	Step duration, cycles	2	4 ¥
Transition type	Fixed frame rate	$\sim$	Frame repetition	1	
			Duration in secon	ids	
Video Spinner Fast	✓ Frames: 10 ♀			O Custom	Select
	* ®		* 8 * 4	2 6	
<spinners></spinners>					
Available memory: 187904 Content folder	8192 bytes; 141 frames				
					Browse
C:/Users/Tester/AppData	/Local/Unigraf/UCD Co	onsole\P	аураск		Browse
Sequence of 17 frames				-	
			Play	Export	Cancel

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

/// Cont	tent folder	×	
	A folder for generated content must be select Press the Browse button to select.	ed.	
	OK		
Click	Browse to select the	e f	older
<spir< th=""><th>nners&gt;</th><th></th><th></th></spir<>	nners>		

<spinners></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

### **Timing details**

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

Ustom Scenario Generator	×
CTA 1920 x 1080 @ 60Hz (VIC 76) EDID (HDMI Forum VSDB; HDR Static MDB; HDR10+ VSVD	60fps B; Dolby Vision VSVDB]
RGB444 ~	8 bpc 🗸 🗸

#### **VRR** settings

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

Min f	rame rate, fps	20	•	Step duration, sec	1.00	
Max	frame rate, fps	60	*	Step duration, cycles	2	- 
Trans	ition type	Fixed frame rate	$\sim$	Frame repetition	1	A V
				Duration in second	ds	

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

Mi	n frame rate, fps	20	-	Step duration, sec	1.00	
Ma	ax frame rate, fps	60	*	Step duration, cycles	2	4
Tra	nsition type	Min and max	$\sim$	Frame repetition	1	
				Duration in second	ds	

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.

		20			4.00	
Mir	n frame rate, fps	20	-	Step duration, sec	1.00	*
Ma	x frame rate, fps	60	•	Step duration, cycles	2	*
Trai	nsition type	Gradual	$\sim$	Frame repetition	1	-
				Duration in second	ds	

### **QMS** settings

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

VRR QMS			
Next_TFR			
QMS-VRR is not active	30/1.001	50	120/1.001
24/1.001	30	60/1.001	120
24	48/1.001	60	None
25	48	100	All
		Step	duration, cycles 2 🔹
SCDC: QMS: 1; QMS-TFRmin: 1	; QMS-TFRmax: 1		
/ideo			
Video			
● Spinner Fast ∨ Fr	ames: 10 🜲	C	Custom Select
⊕ 		* * * 1	* 0
<			,
<spinners></spinners>			
vailable memory: 1879048192 by	tes; 141 frames		
Content folder			
Cullicore/Tester/Desiston			Province

Sequence of 17 frames

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

Play Export Cancel

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

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

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

### **Adaptive-Sync tab**

Common	Metadata	HDR10+ Test	Adaptive-Sync	
Generate				Delete

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

GB444		~	8 bpc		
daptive-Sync					
Transition			Scenario duration		
Min frame rate, fps	48	*	Step duration, sec	1.00	*
Max frame rate, fps	20	4 ¥	Step duration, cycles	2	÷.
Transition type	Fixed frame rate	$\sim$	Frame repetition	1	\$
lideo	vt found.		Duration in secon	O Custom	Select
/ideo Spinner Fast	✓ Frames: 10 ♀		Duration in secon		Select
daptive-Sync block nc fideo Spinner Fast	✓ Frames: 10 ♀	€	Duration in secon		Select
fideo © Spinner Fast	✓ Frames: 10 ♀		Duration in secon		Select

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

/// Con	tent folder X
1	A folder for generated content must be selected. Press the Browse button to select.
	OK

#### Click Browse ... to select the folder.

<spinners></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

### **Timing details**

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

Ustom Scenario Generator		×
CTA 1920 x 1080 @ 60Hz (VIC 7 EDID [HDMI Forum VSDB; HDR Static MDB;	·	60fps
RGB444	∨ 8 bpc	~

### 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.

Adaptive-Sync			
Transition		Scenario duration	
Min frame rate, fps	48	Step duration, sec	1,00
Max frame rate, fps	60	Step duration, cycles	2
Transition type	Fixed frame rate $\qquad \qquad	Frame repetition	1
		Duration in secon	ds

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.

Transition			Scenario duration	
Transition			Scenario duration	
Min frame rate, fps	48		Step duration, sec	1,00
Max frame rate, fps	60	•	Step duration, cycles	2
Transition type	Min and max	$\sim$	Frame repetition	1
			✓ Duration in seco	nds

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.

Transition			Scenario duration		
Min frame rate, fps	48	-	Step duration, sec	1,00	4
Max frame rate, fps	60	-	Step duration, cycles	2	
Transition type	Gradual	~	Frame repetition	1	4

### <u>Video</u>

Video		
● Spinner Fast v Frames: 10 🜲	○ Custom	Select
	200	
<		>
<spinners></spinners>		
Available memory: 1879048192 bytes; 141 frames		
Content folder		
C:/Users/Tester/Desktop		Browse
Sequence of 17 frames		
	Play Export	Cancel

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

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

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

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

Stop	
C:\Users\lester\Uesktop\VKK\-generated-\frameUUU9.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0010.svg: 8 bpc	^
C:\Users\Tester\Desktop\VRR\-generated-\frame0011.svg: 8 bpc	
C:\Users\Tester\Desktop\VRR\-generated-\frame0012.svg: 8 bpc	
C:\Users\Tester\Desktop\VRR\-generated-\frame0013.svg: 8 bpc	
C:\Users\Tester\Desktop\VRR\-generated-\frame0014.svg: 8 bpc	
C:\Users\Tester\Desktop\VRR\-generated-\frame0015.svg: 8 bpc	
C:\Users\Tester\Desktop\VRR\-generated-\frame0016.svg: 8 bpc	
Image upload succeeded!	
Loaded packet(s)	
Loaded playback scenario	
== Scenario started (3600000 ms) #1/1	

Stop	
C:\Users\Tester\Desktop\VRR\-generated-\frame0009.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0010.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0011.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0012.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0013.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0015.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0015.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0015.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0015.svg: 8 bpc C:\Users\Tester\Desktop\VRR\-generated-\frame0016.svg: 8 bpc	^
Loaded packet(s) Loaded playback scenario	
== Scenario started (3600000 ms) #1/1	~

## Audio Generator Tab

Audio generator allows the user to play LPCM audio generated internally or from files in WAV format. Audio is played to all active ports.

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

#### III HDMI TX UCD Console - UCD-422 [2201C508]: HDMI Source and Sink

ink Pattern Generato	or Playback	Audio Generator	HDCP	EDID	SCDC	Sink DUT Testing	Cable In
Audio Status							
Audio loaded: 2 channe	els @ 44100 Hz	, 16 bits					
Diau Control							
Play Control	_						
Play Sto	p	e: audio generator					
	Status	: playing					
Audio Content							
_							
_	Sine	V Bits/Sample:	16	~			
Generate Audio	Sine 1000	<ul> <li>Bits/Sample:</li> <li>Amplitude(%):</li> </ul>	16 60	~			
Generate Audio Waveform:							
Generate Audio Waveform: Signal Frequency:	1000 44100	Amplitude(%):	60	~			
Waveform: Signal Frequency: Sample Rate (Hz):	1000 44100	Amplitude(%):	60	~			

#### audio format.

To load an audio file from your PC, select Load audio from file, click the Open WAV file... button, browse and select the file and click **Open**.

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 looped until the Stop button is clicked.

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

### **Audio Content**

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

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

Waveform	Selection of audio waveform: Sine, Sawtooth, Square, or Incremental
Signal Frequency	Setting audio signal frequency in Hz
Sample Rate (Hz)	Selection of audio sampling rate: 32000, 44100 (default), 48000, 88200, 96000, 176400, 192000
Bits/Sample	Selection of sample bit depth: 16, 24
Amplitude(%)	Selection of audio amplitude: 10%, 20%,, 90%, 100%
Channels	Selection of sent audio channels: 1, 2,, 7, 8. When selecting 1 or 2 audio channels '1 and 2 channel LPCM Audio mode' is used and when 3 and more channels '3- to 8-channel LPCM Audio mode' is used.

## **HDCP** Tab

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

Playback     HDCP     EDID       Configuration     Keys     Production       Image: Production     Facsimile - T1-R1       Image: Facsimile - T1-R2     None       Configuration type     All streams       Image: All streams     By stream       Type Value (SST/All streams)     Type 1	DPCD     FEC     Sink DUT Testing     Ac       Control     Enable Encryption       Enable Encryption       Authenticate       Use stored Km       By stream       Enable for       Type 0       Stream 1       Stream 2       Stream 3       Type 0       Type 1	Japtive-Sync		
	Configuration Keys Production Facsimile - T1-R1 Facsimile - T1-R2 None Configuration type All streams By stream Type Value (SST/All streams)	Configuration       Keys       Control         Production       Enable Encryption         Facsimile - T1-R1       Authenticate         Facsimile - T1-R2       Vue stored Km         None       Use stored Km         Configuration type       By stream         All streams       By stream         Type Value (SST/All streams)       Stream 1       Type 0         Type 0       Type 1	Configuration       Control         Production       Enable Encryption         Facsimile - T1-R1       Authenticate         Facsimile - T1-R2       Use stored Km         None       By stream         Configuration type       By stream         All streams       By stream         Type Value (SST/All streams)       Stream 1         Type 0       Type 1         Stream 2       Type 0	Configuration       Control         Production       Enable Encryption         Facsimile - T1-R1       Authenticate         Facsimile - T1-R2       Use stored Km         None       By stream         Configuration type       By stream         All streams       By stream         Type Value (SST/All streams)       Stream 1         Type 0       Type 1

#### **Status General**

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

Active:	The stream between UCD and the downstream sink has been encrypted.
Authenticated:	HDCP handshake between the UCD and the sink unit has been completed successfully.
Keys loaded:	HDCP keys are loaded to the UCD unit.
Km is stored:	Master Key (Km) is stored
SST Mode Type	Type when in SST mode.

### **Status By stream**

Stream status shows HDCP status on each stream.

### **Configuration Control**

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

### **Configuration type**

Select to configure HDCP 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.

### HDCP 1.3 / 1.4 vs. HDCP 2.3

Currently, UCD-4XX DP and USB-C DP Alt Mode devices support only HDCP 2.3 standard. Currently, UCD-4XX HDMI devices do not support HDCP.

# EDID/DisplayID Tab

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 in the host PC.
- Edit the 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.

DI					de: ● I2C Read ○ SBM Read Virtual Sink #1 ~		
	ld Item 💌 Remove Item Filter			tor Text EDID	de: Virtual Sink #1	Show Read Only	Recurse
	VESA		Ea				
	> Vendor & Product ID EDID Structure Version and Revi		0	Name Header	Value 0x00FFFFFFFFFFF00		1
	> Basic Display Parameters / Featu Color Characteristics	ires	1	Extension Block Count N	2		
	> Established Timings I		2	Checksum	0x18		
Established Timings II     Manufacturer's Timings		3	3 ID Manufacturer Name Verder & Product ID				
	> Standard Timings: Identification		4	ID Product Code Vendor 8: Product ID	0x4036		
	<ul> <li>Preferred Timing Block</li> <li>18 byte descriptor 2</li> <li>18 byte descriptor 3</li> </ul>		5	ID Serial Number Vendor & Product ID	22415942		
F	eatures CTA v3		6	Type Vendor & Product ID->Week & Year of Manufacture	week & Year of Manufactured		
	Name	Value		00 01 02 03 04 05 05	07 08 09 0A 0B 0C 0D 0E 0F		
1	Max Resolution	10240 x 4320	00		00(54)c7(36)40(46)0a(56)01		
2	10K Max Frame Rate	60 Hz	00	0010 34180104e53d23	783a5fb1a2574fa228		- 1
3	8K Max Frame Rate	60 Hz			4f 81 00 81 c0 81 80 a9 c0 d0 00 a0 f0 70 3e 80 30 20		
4	4K Max Frame Rate	145 Hz			1a 56 5e 00 a0 a0 a0 29 50		
5	2K Max Frame Rate	145 Hz		0050 302035005f5921	00001a00000fd0038		
6	HDR Static	Disabled			20202020200000fc		
2					30204450310a200218 00 29 0f 7f 07 15 06 55 3d		
7	HDR Dynamic	Disabled			00 29 01 /1 07 15 06 55 3d		
	▼ Main Features			ditor Mode 🔲 HEX Edit Mode			Apply
						Courses 1	Land
Do	wnload from Sink Upload to Sink					Save As	Load

	layID			
	Remove Item Filter	DisplayID, else EDID 🔍 Re	ead both DisplayID and EDID Read mode: • 12C Read SBM Read Virtual Sink #1 V Show Read Only	Recurs
Name			Editor Text DisplayID	
✓ Section			Name Value	
✓ Data B	Block oduct Identification Dat	a Block	0 Week of Year Manufactured 48	
	Product ID Code Field		1 Gregorian Year 2015	
~	Week & Year of Manu Week of Year Man			
✓ Di	splay Parameters Data E			
	Feature Support Flags			
		icity (Primary Color 1 Ch icity (Primary Color 2 Ch		
	Native Color Chromat	icity (Primary Color 3 Ch		
	Native Color Chromati Native Luminance-rela	icity (White Point Chro ated Fields		
	Native Color Donth on			
Features				
	Name	Value	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F	
1 Max Resol		10240 x 4320	000000 20 90 02 00 20 00 13 a4 c0 00 36 40 46 0a 56 01	
2 10K Max F	rame Rate	60 Hz	000010 30 0f 07 55 43 44 2d 34 30 30 21 81 1d 00 10 70 000020 08 00 10 70 08 00 24 4a 57 fc c4 a2 88 52 10 00	
3 8K Max Fra	ame Rate	60 Hz	000030 45 54 00 80 00 80 00 80 05 ff 26 00 09 3f 3f 1f	
			000040 1f 00 e0 7f 00 00 22 00 28 b2 90 1f 88 ff 1d 4f	
			000050 00 07 80 1f 00 df 10 7a 00 6c 00 07 00 80 fa 29	
			000060 88 ff 27 4f 00 07 80 1f 00 df 10 7a 00 6c 00 07	
			000070 00 2a 00 06 02 ff 1d df 10 3b 2b 00 06 07 05 2d	
			000080 8f 00 05 81 00 0e 83 0f 00 00 29 0f 7f 07 15 06 000090 55 3d 1f c0 4d	
			000030 22 2d TI CO 4d	
<b>T</b> N	Aain Features		Editor Mode HEX Edit Mode	Apply
	m Sink Upload to Sin		Save As	Load

At 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.

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

Note: Four blocks (512 bytes) of EDID/DisplayID 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.

# Panel Replay Tab

Init in the Generation     Audio Generation     Diversition     Audio Generation     Diversition       Parel Replay:     Separated Selective Update:     Separated Biological Selection     Applied Biological Selection     Applied Biological Selection     Applied Biological Selection       Parel Replay:     Separated Selective Update:     Separated Biological Selection     Applied Biological Selection     Applied Biological Selection     Applied Biological Selection       File Selective Update:     Selective:     S	Pattern Generator	Audio Generator SDP						
head Regins Separated PSPSR apported PSPSR apported Separated Selective Update CRC Supported Selective Update CRC Support			and the second se	D FEC. Sink DUT testing	Adaptive-Sync	Cable Info EDID/DisplayID	Panel Replay ADM	
PSI/PSI/PSI/PSI/PSI/PSI/PSI/PSI/PSI/PSI/								
Luff fame CDC:       Supported         Selective Update: CDC:       Supported         Selective Update: CDC:       Supported         Luff fame CDC:       Supported         Supported       Luff fame CDC:         S			Mode: PR ~				Ap	phy
biechter Update:       Supported subcher Update:       Die UPD, RO on statistick SS OP enrol Die UPD, RO on statistick SS OP enrol SS OP enrol SS OP enrol Notice SS OP enrol SS OP enrol Die UPD, RO on statistick SS OP enrol SS OP			Early transport		F	Enable CRC check	Main-link remains C	N during PSR1/PS
<pre>memory based in the out of some of any formation if the out of any /pre>			HPD_IRQ on missing AS SE	e .	E	HPD_IRQ on RFB storage error	Self refresh rate uni	lock
ery branch Support Sup								
The outer update and randy ra								
iomad Active mode Active mode Selective update total momad Status: No contraid Status: Active mode no: ' ' gran think is addeed Height 100 E Height 100 Height 100 E Height 100 Height 100 E Height 100 Height 100 Height 100 Free status arising strate : 0 C C C R 1 & C C C C C C C C C C C C C C C C C C	the current pattern does	not support early transport				2 30 Mg/m scan me capture		
Ivactive mode     Active mode     Image: Selective update     Image: Selective	ommand		Region 1			Region 2		
tactor mode     X coordinate     0     X coordinate     x coordinate       Selective mode     V coordinate     0     X coordinate     x coordinate       Selective mode     0     X     V coordinate     x coordinate     x coordinate       Selective mode     0     X     V coordinate     x coordinate     x coordinate     x coordinate       Width     0     X     V coordinate     0     X     x coordinate     x coordinate       Width     00     X     V coordinate     0     X     V coordinate     x coordinate       Width     00     X     V coordinate     0     X     V coordinate     x coordinate       Width     00     X     V coordinate     0     X     V coordinate     x coordinate       Width     V00     X     V coordinate     V coordinate     V coordinate     V coordinate       Width     V00     X     V coordinate     V coordinate     V coordinate     V coordinate       Height     V00     X     V coordinate     V coordinate     V coordinate     V coordinate       Vision     V coordinate     V coordinate     V coordinate     V coordinate     V coordinate       Vision     V coordinate     V coordinate	Dis	able						
Active mode       Image: Selective update       Image: Uncontinue       Image: Uncontinities       Image: Uncontinities								
Full scene update         Selective update         Selective update         With         emmend Status:         Active mode         roc:       Y gen limit is voldated         With       100         Height       100         Height       100         Height       100         Selective update       100         With       100         Height       100         Height       100         Selective update       100         Sel			X coordinate	0	2	X coordinate	300	\$
Solective update     V coordinate     Image: Coordinate     Monoclassical and								
atter ammand Status: No command status: V gran find is violated width 100 B Width 100 Height 100 Height 100 B Width 100 B Wi								
menand state: No constand state: V guan limit is volded With 100 C Height 100 Height 100 C Height 100 Height 100 C Height 100 Filter 2: Filter 100 Height 100 C Height 100 Filter 2: Filter 100 Height 100 Filter 2: Filter 100 Height 100 Filter 2: Filter 100 Height 100 Filter 2: Filter 100 Height 100 Height 100 Filter 2: Filter 100 Height	Selectiv	re update	Y coordinate	0	•	Y coordinate	300	0
Active mode root: Y gan limit is volded Width 100 C Width 100 Height 100 C Height 100 Finite C Height 100 Finit C Height 100 Finite C Height 100 Finit C Height 100 Finit	atus							
and Actor Mapor Transformer is soluted Height Heig	mmand Status:	No command			1000			
Height 100 Height 100 Height 100 Height 100 Height 100 Height 100 Height 100 Height 100 Height 100			Width	100	•	Width	100	0
Henory  Finance  Prome index define 16 frame: 0  Prome index define 300 0  CC 20 0 00000  CC 20 0 00000  Refer 11  Prome index define 300  Prome index	IOF:	Y gran limit is violated						
Factory Factory Factory Factory Final State Later Control (Later C								
00 devine locate in finance 0 rives instant units (1977) 0 dotted in the second seco			Height	100	۵.	Height	100	٥.
Freme index daring for 0 control of control of the format			History					
Control Validi No Bilevice Control Vi 300 Oper 1445 Control VI 300 Oper 1445 Control VI 300 Heritari 100 14 fitamin 1 Provide 160 14 fitamin 1 Oper 160 14 fitamin 1 Cot Al Control 40 (1901)								
				Frame Links string file of the second string f	RUI 0 RI 200 FI 200 FI 200 FI 200 FI 200 FI 200 RI 0 FI 200 FI 200			

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

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

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

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

The *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 actaive 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:

X coordinate	X coordinate of region
Y coordinate	Y coordinate of region
Width	Width of region
Height	Height of region

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

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

# 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.

ink SDP	Pattern Gen	erator	Adaptive-S	Sync	Panel Repla	y ALPN	Playback	Audio Generat	or HDCF	EDID/Displayl	D DPCD	FEC	Sink DU	T Testing				
All tests				Name									Pass	Fail	Skip	Runs	Last status	
OP 1.4 LL CT	s			Y 🔳	OP 1.4 LL CT								0	0	0	0		
HDCP 2.3 CT	S 2C						rte from Valid D	PCD Address					1	0	0	1	Pass	
IDCP 2.3 CT	S 3C							ead (Read 12 Byte	s from Valid	DPCD Address)			0	0	0	0		
							yte to Valid DP						0	0	0	0		
								PCD Addresses					0	0	0	0		
								e I2C-Over-AUX V	/rite)				0	0	0	0		
								yte I2C-Over-AU)					0	0	0	0		
										C-Over-AUX Offse	t Write, 128 B	yte I2C-0	D 0	0	0	0		
							Request Syntax						0	0	0	0		
					5.2.1.9								0	0	0	0		
								Receiver Capabi	ity Read				0	0	0	0		
							n Stop on MOT						0	0	0	0		
							n Stop on Time						0	0	0	0		
								e Identifier (OUI)					0	0	0	0		
					5.2.2.2								0	0	0	0		
				i	5.2.2.3	ink Status							0	0	0	0		
				Ì	5.2.2.5 C	PCD Addre	ss Range						0	0	0	0		
				i	5.2.2.6	Jumber of F	Receiver Ports						0	0	0	0		
				ĺ	5.2.2.7 N	Aain Link Cl	nannel Coding						0	0	0	0		
				i	5.2.2.8 E	SI Field Ma	pping						0	0	0	0		
				[	5.2.2.9	ink Device	Symbol Error Co	ount					0	0	0	0		
				[	5.3.1.1 5	uccessful L	nk Training at A	All Supported Lan	Counts and	Link Speeds			0	0	0	0		
				[	5.3.1.2 5	uccessful L	nk Training wit	h Request of High	er Differenti	I Voltage Swing D	uring Clock Re	covery S	e 0	0	0	0		
				[	5.3.1.3 9	uccessful L	nk Training to a	Lower Link Rate	Due to Clock	Recovery Lock Fai	lure During C	lock Reco	ov 0	0	0	0		
				[	5.3.1.4 9	uccessful L	nk Training wit	h Request of a Ch	ange to Pre-	Emphasis and or Vo	oltage Swing S	Setting D	u 0	0	0	0		
				[	5.3.1.5 \$	uccessful L	nk Training at L	ower Link Rate D	ue to Loss of	Symbol Lock Durin	ng Channel Eq	ualizatio	n 0	0	0	0		
				[	5.3.1.6 L	ane Count	Reduction						0	0	0	0		
				[	5.3.1.7 L	ane Count	ncrease						0	0	0	0		
Run Chec	ked Selee	ct 💌	Configure	In	nport	Export	Stop on Fa	ilure Repeats:	I 🗘 D	elay time, sec 1	-			Save	Report	Clear Selected	d	AI
2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11- 2024-11-	22, 09:35:59 22, 09:35:59	.796]: .796]: .797]: .797]: .887]: .887]: .887]: .887]: .887]: .887]: PASSED	0000.081 0000.082 0000.082 0000.082 0000.082 0000.082 0000.082 0000.084 0000.084 0000.084	260: 329: 053: 116: 914: 958: 015: 102: 163:	Setting 1 Set Defer Reference AUX R AUX_ACK Defer Ret AUX data Reference Read byte	s timeout Retry Co Source : D: 0x000 ry Counto : 14 source o R0 match	counter = 0 ceads 1 byte 000: 1 er = 0 checks reply ces first by		that real s that real	d bytes R0 ma ver Capabilit:		JT's Re	aceiver C	apabilit	y Fiel	d		
acte ava	oution finie	hed																_

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.

Run/Run Checked:	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.
Select:	Includes three sets of options: <i>Select All, Clear All, 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 and Export</i> 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 <i>All</i> tests is selected. Refer to <i>Test Parameters</i> below for details.
Import:	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.
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, 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).

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

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#### **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 *import*ing and *Export*ing \*.json files here have a different format than importing those described above.

OK
 ÖK

# Adaptive-Sync Tab

Adaptive-Sync feature is available for Stream 0.

UCD Console - UCD-400	[1748C248]: DisplayPort Source and Sir	nk						
File Tools Window Hel	lp							
DP RX DP TX Even	t Log							
Link Pattern Generat	or Playback Audio Generator	HDCP	EDID	DPCD	FEC	Sink DUT Testing	Adaptive-Sync	
Status Enabled:	Error: No error							
Settings	ported by sink							
Fixed Average VTotal	~							
Target refresh rate, Hz:	60 • 1125.000 lines							
	Divide by 1.001							
Increase, lines:	100 1.481 ms							
Decrease, lines:	100 1.481 ms							
	Refresh Apply							

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

lote: 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.

# DP and DP Alt Mode Reference Source

Role:	Product:
DP Reference Source (DP TX)	UCD-400, UCD-411, UCD-451
USB-C DP Alt Mode Reference Source (DP TX)	UCD-424

When roles *DP Reference Source* or *DP Alt Mode Reference Source* are in use, the following interface specific tabs are available.

- Status information and control of the downstream link (Link).
- DPCD monitor (DPCD)
- Forward Error Correction (FEC)

### Link Tab

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

nk Pattern Generator Playback Audio Generator H Link Status	HDCP DPCD FEC Sink DUT Testing Adaptive-S Link Configuration	Sync ALPM EDID/Dis	playID SDP HDCP Status	
Lanes (count = 4): 0 1 2 3	DP Lane Count (8b/10b) DP Bitrate (8b/10b), Gbp	s	2.X	
CR/SL/EQ         1/0         1/	○ 1 ○ 2 ○ 4 ○ 1.62 ○ 2.70 ○ 5			
Error count (click to read):	Additional DP Bitrate (8b/10b), Gbps		Keys loaded	
	○ 2.16 ○ 2.43 ○ 3.24	0 4.32	Authenticated stored Km	
Bit rate: 8.1 Gbps Link Mode: 8b/10b	eDP Bitrate, Gbps		HDCP Configuration	
Framing mode: Enhanced Scrambling: Enabled	0 1.62 0 2.16 0 2.43 0 2.7	3.24		2.X
MST mode: Disabled SSC status: Disabled	○ 1.32 ○ 2.10 ○ 2.43 ○ 2.1 ○ 4.32 ○ 5.4 ○ 6.75 ● 8.1	0 5.24		
DSC status: Disabled FEC status: Disabled	○ 4.52 ○ 5.4 ○ 0.75 <b>○</b> 8.1			
Send ACT	Link Options			
		Try eDP		
Link Overrides	Enhanced Framing Mode 🗌 FEC (8b/10b)	Force eDP	Scrambler seed (8b/10b)	
Voltage Swing (level): 🗿 0 🛛 1 🔷 2 🔷 3		eDP AUX Preamble	<ul> <li>Auto</li> </ul>	
Pre-emphasis (level): O O 1 O 2 O 3	LTTPR Mode Default ~		FFFFh (DP)	
Apply	Downspread		FFFEh (eDP ASSR)	
Link Pattern		eq (Hz) 31500 🗘	O Custom 0x 0	÷
Active Video ~	Link	Training Fast LT		
Apply	VCP Table	HDCP Stream Status		
	Stream # VCPID Reg.PBN Alloc.PBN First slot Slot num	Stream # Status Type		
Stream Info				
Framerate HTotal HStart HActive HSync VTotal VSta	rt VActive VSync CEF BPC CRC	C (RGB/CrYCb) MVID/	VVID DSC CRC (Eng. 0 1 2)	
59.985 2200 192 1920 44 (+) 1125 41	,	83 FCEB 47CF 001776/0	, ,	

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

Lanes (count =	4):	0	1	2	3
CR/SL/EQ					
VS/PE (level)		1/0	1/0	1/0	1/0
Error count (clic	k to read):	-	-	-	-
ILA: EQ		CDS_ILA: [		LT_FAIL:	
		CDS_ILA: [ Link Mo		LT_FAIL: 86/10	
ila: 🗾 Eq	ILA:	_	ode:		)
ILA: EQ Bit rate:	ILA:	Link Mo	ode: ling:	8b/10ł	o d

Lanes:	Indicates the number of lanes used for DisplayPort or DisplayPort Alt Mode.
CR/SL/EQ:	LED indicators for status of Clock Recovery / Symbol Lock / Channel Equalization
VS/PE (level):	Voltage Swing / Pre-emphasis level
Error count:	Content of DPCD Error Count registers
ILA:	Status LED for Inter-Lane Alignment
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (8b/10b only)
Framing mode:	Status of Enhanced Framing symbol sequence
Scrambling:	Status of link data scrambling (Enabled or Disabled)
MST mode:	Status of the Multistreaming (MST) mode
SSC status:	Status of down spreading of link frequency (SSC) function
DSC Status:	Status of Display Stream Compression (DSC) function
FEC status:	Status of Forward Error Correction (FEC) function.

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

#### HPD

HPD	
Asserted	

Asserted:

LED indicates status of Hot Plug Detect (HPD) signal

#### Link configuration

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

Link Configura	ation						
DP Lane Cou	unt (8b/10b)	DP Bitrate (8b/10b), Gbps					
010	2 0 4	○ 1.62 ○ 2.70 ○ 5.40 ○ 6.75 • 8.10					
Additional D	P Bitrate (8b/10b)	, Gbps					
0 2.16	2.43	$\bigcirc$	3.24	0 4.32			
eDP Bitrate,	Gbps						
0 1.62	2.16	2.43	0 2.7	3.24			
0 4.32	5.4	6.75	0 8.1				
Link Options	5						
				Try eDP			
🔄 Enhanced	d Framing Mode	FEC (8b/10	b)	Force eDP			
				eDP AUX Preamble			
LTTPR Mode	Default	$\sim$					
Downspread	1						
Enable S	SC Amp (%/	10) 0,5	÷ Free	q (Hz) 31500 🗘			
			Link	Training Fast LT			

Number of Lanes	Lane count used when 8b/10b link coding is selected in LT
Bitrate, Gbps	Link rate used when 8b/10b link coding is selected in LT
Additional DP Bitrate (8b/10b), Gbps	Additional bit rates available.
eDP Bitrate, Gbps	Bitrates available for eDP.
Enhanced Framing Mode	Enable Enhanced Framing Mode
FEC (8/10b)	Enable Forward Error Correction feature (only in 8b/10b coding)
Try eDP	Try to link with eDP.
Force eDP	Force eDP linking.
eDP AUX Preamble	Use eDP AUX Preamble protocol when linking.
LTTPR Mode	Select LTTPR mode; Default, Ignore, Transparent, Non-Transparent.
Enable SSC	Enable Downspread of link frequency (SSC).
Amp (‰)	SSC Spreading Amplitude (0.1% to 2.5% in 0.01% steps).
Freq (Hz)	SSC Modulation frequency (30 to 33 kHz).

#### **Link Overrides**

Override Voltage Swing and Pre-emphasis levels selected during link training. Click **Apply** to validate changes.

Link Overrides			
Voltage Swing (level): 🔘 0	1	0 2	03
Pre-emphasis (level): 🔘 0	1	0 2	03
			Apply

#### **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)	

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

Active Video	Transmit Video Pattern, Audio and Metadata.
Idle Pattern	Link is active but no stream data is being transmitted.
Training Pattern 1	Send Link Training Pattern Sequence 1 (TPS1).
Training Pattern 2	Send Link Training Pattern Sequence 2 (TPS2).
Training Pattern 3	Send Link Training Pattern Sequence 3 (TPS3).
Training Pattern 4	Send Link Training Pattern Sequence 4 (TPS4).
PRBS7	Send PRBS7 Link Quality Test Pattern.
HBR2 (CP2520 1)	Send HBR2 Compliance pattern CP2520 1.
SER (Symbol Error Rate)	Send Symbol Error Rate Measurement pattern
Force Video	Character error messages from sink will not interrupt video transmission.
Force Idle	Link Training and Active Video will not be initiated even after a re-plug.
HBR2 (CP2520 2)	Send HBR2 Compliance pattern CP2520 2.

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\_HPD 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*.

#### **Stream Info**

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

- F	stream Info													
	Framerate	HTotal	HStart	HActive	HSync	VTotal	VStart	VActive	VSync	CEF	BPC	CRC (RGB/CrYCb)	MVID/NVID	DSC CRC (Eng. 0 1 2)
	59.985	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	001776/008000	N/A
	59.995	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	001777/008000	N/A

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

Framerate	Vertical refresh rate
HTotal	Horizontal total of transmitted main video stream, measured in pixel count.
HStart	Horizontal active start from leading edge of HSync, measured in pixel count.
HActive	Horizontal active, number of active pixels in video line
HSync	HSync width, measured in pixel count. (+)/(-) positive / negative sync.
VTotal	Vertical total of transmitted main video stream, measured in line count.
VStart	Vertical active start from leading edge of VSync, measured in line count.
VActive	Vertical active, number of active lines in video frame
VSync	VSync width, measured in line count. (+)/(-) positive v.s. negative sync.
CEF	Used color mode: Color format + subsampling / colorimetry

BPC	Color depth in bits per color (BPC)
CRC (RGB/CrYCb)	16-bit Cyclic redundancy check (CRC) value per color component calculated from active pixels. Value order in YCbCr color format: Cr, Y, Cb.
MVID/NVID	Mvid and Nvid video time stamp values
DSC CRC	16-bit Cyclic redundancy check (CRC) calculated from compressed pixel stream. Value order Engine 0, 1, 2.

#### **VCP** Table

-VCP lable	è					
Stream #	VCPID	Req.PBN	Alloc.PBN	First slot	Slot num	
0	1	532	540	1	9	
1	2	532	540	10	9	
2	3	532	540	19	9	
3	4	532	540	28	9	

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

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

Stream #:	Stream number where the virtual channel is directed.	
VCPID:	VCPID: Stream identification number of the virtual channel.	
Req.PBN: Requested PBN (payload bandwidth) value for the virtual channel		
Alloc.PBN: PBN value allocated for the virtual channel		
First slot:	<i>First slot</i> : 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.	

#### **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**

2.X
2.X

Copy of HDCP status and controls on HDCP tab.

#### **HDCP Stream Status**

Shows HDCP stream status for each stream.

HDCP Stream Status			
Status	Type		
	Type 0		
	Status		

#### **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.

# **DPCD** Tab

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

20 UCD Console - UCD-400 (1750C250): DisplayPort Source and Sink le _ Tools _ Help	-		;
DP RX DP TX Event Log			
Link Pattern Generator Playback Audio Generator HDCP EDID DPCD FEC Sink DUT Testing			
Address : 0x 2200 🔄 Number of Bytes: 0x 100 🗣		Report	
00         01         02         03         04         05         06         07         08         09         0A         0B         0C         0D         0E         C         D         Extended flexions: Capability Mod221: Index         Extended flexions: Capability Mod221:			
Set Reference Reference	Wr	rite Chang	es
Address : 0x 100 Vumber of Bytes: 0x 100 V		ine energy	
00         01         02         03         04         05         06         07         08         09         0A         0B         0C         0D         0E         0E         DE         DE<		its choose	
Set Reference Refresh	Wr	rite Chang	25
HPD Asserted			

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

Save:	Select DPCD content to the PC (please see below).	
Load:	Retrieve previously saved DPCD data (please see below).	
Report:	Save parsed content of selected DPCD register ranges as HTML file	
Refresh:	Re-read the data from the DPCD registers to the window in question	
Write Changes: To program the data into the DPCD registers of the connected Sink		
Set Reference:	Store currently shown data as a reference for comparison	

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

#### **Saving and Loading DPCD Content**

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

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

# **FEC** Tab

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

UCD Console - UCD-400 [1918C307]: DisplayPort Source and Sink	-	×
Eile Jools Window Help		
DP TX Event Log DP RX		
Pattern Generator Audio Generator EDID HDCP FEC Playback Sink DUT Testing Link DPCD		
FEC Enabled 🗹 Prefer FEC Enabled Enable FEC Disable FEC FEC Status Log		
Error Generator		
Number of errors to generate for Lanes: 0 0 0 0 0 0 0 0		
Generate errors of type: Corrected parity 1 error $\vee$		
Delay between steps (in microseconds): 100		
Apply		
Sink Error Counters (DPCD)		
Lane #0 Lane #1 Lane #2 Lane #3 Sum Uncorrected block errors 0 0 0 0 0		
Corrected block errors 0 0 0 0 0 0 0		
Bit errors 0 0 0 0 0		
Parity block errors 0 0 0 0 0		
Parity bit errors 0 0 0 0		
Enable aggregated errors     Update     Clear Counters		
Debug FEC Sequencing		
Send FEC Enable Sequence Send FEC Disable Sequence		
Sink FEC Status: Decode Enable Detected		
SINK FEC Status: Decode Enable Detected		
ClearLog		
Clear Log		
HPD		
Asserted		
online		

Enable FEC	UCD will verify if connected sink supports FEC and begins the handshake for enabling FEC.	
Disable FEC	UCD will start the FEC disable handshake.	
Prefer FEC Enabled	If selected, and the connected sink supports FEC, UCD will start the FEC Enable Sequence after a successful connection.	

#### **Error Generator**

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
	1 symbol error with 1 error bit together
Corrected parity 1 error	1 parity byte error with 1 error bit together

Link training will reset sink FEC error counters.

Each lane can have its individual error amount. When only one lane is enabled, errors can be injected to even and odd decoders by using **lane #0** and **lane #1** counters.

Apply	Start error injection
Update	Read sink DPCD FEC error counter registers

Note:

Clear counters	Clear sink DPCD FEC error counter registers
Send FEC Enable Sequence	UCD-4XX will start adding FEC Enable Sequence in its main link data.
Send FEC Disable Sequence	UCD-4XX will start adding FEC Disable Sequence in its main link data.

## ALPM Tab

Event Log Terminal DP RX DP TX Memory L	ayout	
Link     Pattern Generator     Playback     Audio Generator       Link Status     Link Control       ACTIVE     Enable ALPM       ALW_SLEEP     Power-on       FW_SLEEP     Power-off       FW_STANDBY     Automatic Power-off du		Sink DUT Testing Adaptive-Sync ALP
Power-off entering       ML_PHY_SLEEP     ML_PHY_STANDBY       Additional sequences     0       PHY hold pattern length, symbols     50	LFPS_Cycle Count 16	<ul> <li>AUX-wake</li> <li>Check AUX_PHY_WAKE_ACK</li> <li>AUX_PHY_WAKE retries 0 \$</li> </ul>
		<ul> <li>TPS1 O TPS2 O TPS3 O TPS4</li> <li>TPS2 O TPS3 O TPS4</li> <li>TPS2 O TPS3 O TPS4</li> </ul>

Link Status panel shows current ALPM status.

Link Control panel is for enabling ALPM and for setting ALPM state.

*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*.

# **HDMI Reference Source**

Role:	Product:
HDMI Reference Source (HDMI TX)	UCD-422, UCD-412, UCD-452

When roles HDMI Reference Source is in use, the following interface specific tabs are available.

- Status information and control of the downstream link (Link)
- SCDC monitor (SCDC)

# Link Tab

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

0       1.4       0.20       0.21       O Disable FRL         3 Lane 0       0.20       0.20       0.20       0.20         3 Lane 0       1.20       0.20       0.20       0.20         4 Lane 2       0.20       0.20       0.20       0.20         5 hannel lock 0       0.000       0.000       0.000       0.000       0.20         2 behavior HDMI 2.1       LTI meout (ms):       2       2       2         Wold 0       HDMI       FRL Status       TRado (ms):       2       2         MDS Status       FRL Status       FRL Status       10Gbps 4-lane       1         MDS Control       FRL Status       FTR Ready       1       2       2         MDS Control       FRL Statu       FRL Status       1       1       2       2       2         MDS Control       FRL Status       10Gbps 4-lane       1       2<	nk Pattern Generator Playback Au	dio Generator HDCP EDID SCDC Sink I	DUT Testing HDCP Status		 	_
Lance 0 Lance 1 Lance 2 Lance 3         4 Lances         6         0	○ 1.4 ○ 2.0 ● 2.1		The Status	1.X 2.X		
Lane U Lane L Lane Z Lane 3         FFE Max:         Q Q <th< td=""><td>Status</td><td>3 Lanes 🔿 3 🔿 6 (Gbps)</td><td>Active</td><td></td><td></td><td></td></th<>	Status	3 Lanes 🔿 3 🔿 6 (Gbps)	Active			
Landel lock       Int Induct (mg):       Int	Lane 0 Lane 1 Lane 2 Lane 3					
If mercault (ms):     200     5       If mercault (ms):     2     6       Wideo     If Poll Timeout (ms):     2       If Poll Timeout (ms):     2     6       Image: Ima	Channel lock 💶 💶 💷		· · · · · · · · · · · · · · · · · · ·			
Video         Link Training         I         Link Training         I         LX 2X           MD5 Status         FRL Status         IIX 2M         IIX 2X         IIX 2X           MD5 Status //10 3G mode         FRL Status         IISP/3         IIX 2X         IIX 2X           MD5 Status //10 3G mode         FRL Mode         105bps 4-lane         III         IIII 2X           MD5 Scottol         FRL Mode         III Polo         IIII 2X         IIIII 2X         IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII			Additional Called Stored Kill			
MDS Satus         FRL Status         Int Value         <			HDCP Configuration			
Mode         HDMI         FRL Status         IndDs Bit Clock Ratio         1/10 3G mode         ITS P/3           MOS Centrol         FRL Status         ITS P/3         Authenticate         IC           MOS Centrol         FRL Status         ITS P/3         Use stored Km         IC           Mode         O U1         HDMI         FRL Status         ITS P/3         Use stored Km         IC           Mode         O G         0         G         IS         IS         IS         IS           Intelle Scrambler         FRL Status         Issee         Issee <td< td=""><td></td><td>Link Training</td><td></td><td>1.X 2.X</td><td></td><td></td></td<>		Link Training		1.X 2.X		
MDS Bit Clock Ratio 1/10 3G mode     FRL Mode     10Gipps 4-lane     Authenticate     I       Scrambling     FIL Yoptat     FIL Status     TSP/200       MDS Control     FRL Status     FIL Yoptat     FIL Status     FIL Yoptat       Mode     6 G     3 G     FIL To Timeout     FIL Status     FIL Yoptat       Ink Mode     6 G     3 G     FIL To Timeout     FIL Name     FIL Name       Inhelie Scrambler     LUP     0     0     0       Pattern 0     0     0     0		FRL Status	Enable Encryption			
Strambling     FLT Update     FLT Update     Use stored Km     Image: Comparison of the comparison of	TMDS Bit Clock Ratio 1/10 3G mode		Authenticate			
MDS Control         FLT Ready           Vade         DVI          HDMI         FRL Shart           ink Mode               6G              3 G              FIT Normation              Fit Name           Enable Scrambler              FRL Max               Lane 1              Lane 2               Lane 2               Lane 2               Lane 2            Phyter              0               0               0               0	Scrambling		Use stored Km			
Inable Scrambler     FIT No Timeout       Enable Scrambler     FRL Max       Lane 0     Lane 1       Lane 0     0       Pattern     0     0	TMDS Control					
InnuMode         0         0         0         0           Enable Strambler         FRL Max         Lane 0         Lane 1         Lane 2           LTP         0         0         0         0           Pattern         0         0         0         0	Mode: O DVI 💿 HDMI	FRL Start				
Enable Scrambler         Lane 0         Lane 1         Lane 2         Lane 3           LTP         0	Link Mode: 🔘 6G 🛛 💿 3G					
LTP 0 0 0 0 Pattern 0 0 0 0	Enable Scrambler					
FFE level 0 0 0 0						
		FFE level 0 0 0 0				

#### **HDMI Behavior**

Selection of the HDMI version to be used (HDMI 1.4 / HDMI 2.0 / HDMI 2.1).

#### **Status**

Channel lock:	Status of Channel Lock in the four lanes
Error count:	Contents of the SCDC Error counter registers of the connected Sink.
Behavior:	Assigned HDMI mode
Video	Video signal status

#### TMDS Status (only in TMDS mode)

TMDS Status			
Mode		HDMI	
TMDS Bit Cloc	k Ratio	1/10	3G mode
Scrar	mbling		
TMDS Control			
Mode:		/I	HDMI
Link Mode:	0 60	6	🔘 3G
Enable Sc	rambler		

#### Mada

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

#### TMDS Control (only in TMDS mode)

Mode:	Selection of the HDMI/TMDS mode (HDMI/DVI)
Link Mode:	Selection of TMDS Bit Period / TMDS Clock Period ratio (1/10 or 1/40) (3G / 6G)
Enable Scrambler:	Control of Scrambling_Enable bit

#### **FRL Control**

FRL Control				
O Disable FRL				
3 Lanes 🔿 3	06	(Gbps)		
4 Lanes	06	08	10	0 12
FFE Max: 0 🖨	0 🗘	0 🗘 0	÷ 0 :	0 🗘
LT Timeout (ms):		200		
LT Poll Timeout (ms):				
	Link 1	Fraining		

Disable FRL:	Disable FRL mode
Capability Radio Buttons:	Selection of the link mode used for FRL link training.
FFE Max:	Set the maximum FFE level (0 to 4) supported for each FRL rate
LT Timeout:	The time used for FLT Timer (default = 200 ms)
LT Poll Timeout:	Poll interval for FLT_update flag (default = 2 ms)

Please click Link Training to apply

#### **FRL Status**

FRL Statu	s			
FRL Mode			100	Sbps 4-lane
LT Status			LTS	:P/3
FLT Upda	te			
FLT Read	у			
FRL Start				
FLT No Ti	meout			
FRL Max				
	Lane 0	Lane 1	Lane 2	Lane 3
LTP	0	0	0	0
Pattern	0	0	0	0
FFE level	0	0	0	0

FRL Mode:	FRL Mode used by UCD-4XX HDMI source
LT Status:	FRL link training status of UCD-4XX HDMI source
FLT Update:	Status of FLT_update flag in SCDC Update Flags register of the connected HDMI sink.
FLT Ready:	Status of FLT_ready flag in SCDC Status Flags register of the connected HDMI sink.
FRL Start:	Status of FLT_start flag in SCDC Update Flags register of the connected HDMI sink.
FLT No Timeout:	Status of FLT_no_timeout flag in SCDC Source Test Configuration register of the connected HDMI sink.
FRL Max:	Status of FRL_Max flag in SCDC Source Test Configuration register of the connected HDMI sink.

#### **Lane Status Matrix**

LTP:	Status of Lnx_LTP_req (x = 0 to 3) fields in SCDC Status Flags register of the connected HDMI sink
Pattern:	Link Training Pattern used (0 to 8)
FFE Level:	FFE level used (0 to 3)

#### **HDCP Status**

HDCP Status	
	1.X 2.X
Active	
Authenticated	
Keys loaded	
Authenticated stored R	im 🗖
HDCP Configuration	
	1.X 2.X
Enable Encryption	
Authenticate	
Use stored Km	

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

#### **HDCP Configuration**

Enable and disable HDCP 1.4 or HDCP 2.3 capability of UCD-422 and UCD-412 Sink. Duplicates of the controls found in HDCP tab.

Note:	Currently HDCP is not supported
-------	---------------------------------

#### HPD (Bottom panel)

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

# **SCDC Monitor**

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

The SCDC Monitor panel on the right hand side shows the interpretation of the SCDC byte selected

nk Pat	ttern G	enera	tor	Play	back	A	Audio	Gen	erato	or	HD	СР	E	DID	SC	DC	Sink D	UT Te	sting								
ddress : 0x	0	-	¢ N	umbe	r of By	/tes: (	0x [1	00	¢	S	CDC	Deco	oder:										Load	ł	Save	Repor	t
000050	00 00 00 5e 00 00 00 00 00 00 00 00 00	01 ( 00 ( 00 ( 00 ( 00 ( 00 ( 00 ( 00 (	31       0         30       0	0 00 0 00 0 00 0 00 0 00 0 00 0 00 0 0	00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 80 00 00 00 00 00 00 00 00 0	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 80 00 00 00 00 00 00 00 00	00 00 00 00 80 00 00 00 00 00 00 00 00	00 00 00 00 80 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00						Status ar 0x00000 : <canno< th=""><th>= 0x</th><th>00</th><th>ata Ch</th><th>annel</th><th></th><th></th></canno<>	= 0x	00	ata Ch	annel		
Set Refer	ence															Refr	esh	Writ	e Chang	es							

on the monitoring windows. The selected byte is shown with a green outline.

Save:	Select SCDC content to the PC (please see below).
Load:	Retrieve previously saved SCDC data (please see below).
Report:	Save parsed content of selected SCDC register ranges as HTML file
Refresh:	Re-read the data from the SCDC registers to the window in question
Write Changes:	To program the data into the SCDC registers of the connected Sink
Set Reference:	Store currently shown data as a reference for comparison

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

#### Saving and Loading SCDC Content

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

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

# Cable Info Tab

The Cable Info tab displays cable specifications.

Tools Window Help							
vent Log Terminal Memory L	ayout HDMI	TX					
Pattern Generator Audio Genera	ator HDCP	EDID	Playback	Sink DUT Testing	Link	SCDC	Cable Inf
Cable ID Data Category 1: Category 2: Category 3: HEAC:	Supported Supported Supported Supported	Manuf Manuf	acturer OUI – acturer OUI 1 acturer OUI 2 acturer OUI 3	: 0xCD			
Cable Need PCA: Only Mono Direction: Mono Direction Error: Cable in PCA mode: Daisy Chained Cable Detection:	Required PCA Supported Happened Yes 4660		1.0774 1.1774 - 46774 14	DDCCBBAA202020			

# **USB-C** Monitoring

Role:	Product:
USB-C DP Alt Mode Reference Source (USB-C TX) or	UCD-424

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

• USB-C Power Delivery (PDC)

# **USB-C** Power Delivery Tab

When UCD-424 is used in *DP Alt Mode Reference Source* role, *USB-C Power Delivery* tab is available. The content of *USB-C Power Delivery* tab is similar to the tab available when in UCD-424 is used in *DP Alt Mode Reference Sink* role.

Please refer to chapter USB-C Monitoring in section 4. Analyzer Operation earlier in this document.

C RX USB-C TX Event	Log									
C Link Pattern Gener	ator Playback	Audio Generator HDC	P EDID D	PCD FEC	Sink DUT Testing					
Status List			Capabilities	DP Alt Mode	Power Source	Power Sink	Cable Info	Controls		
TE Status     Data Role     Power Role     VConn     E-Marked Cable     DP Alt Mode     PD Contract     PD Contract     PD Contract     PO Voltage     -PDO Type     PDO voltage     PDO Onac current     RDO max current     RDO oper current     No US8 suppend	Up facing port (U Sink Off Unknown "C": DP v1.4a 4 la Fixed 3.00 A / 9.0 Fixed 9.00 V 3.00 A 3.00 A 3.00 A Yes	ines	Reject P Reject D	R Swap R Swap CONN SWAP R Swap entity Spec:	PD rev 3.0 v1 0x16A6 0x424	CC Pull-up Defaut 1.5A 3.0A Try Behavior Try Sink Try Source None				
- USB comm capable - Capability mismatch	Yes No		Accessories		Debug Ac	cessory				
- Give back ▼ Available source PDO PDO 1 PDO 2 ▼ Bus Electical Status Vbus voltage Vbus current	No Fixed 3.00 A / 5.0 Fixed 3.00 A / 9.0 9.37 V 1.06 A				-	-				
PD Control			PDC		Orienta	tion				
Send PR_SWAP Send DR_	SWAP Send VCON	IN_SWAP Send FR_SWAP	PDC Status	Res	et O CC	1   CC2 Cable	Orientation: F	lipped		
0									PD	

# 6. HDMI LINK TIMELINE VIEWER

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-422

HDMI Link Timeline Viewer is a tool for evaluating the content and timing of data captured via HDMI Link Analyzer functionality of UCD Console.

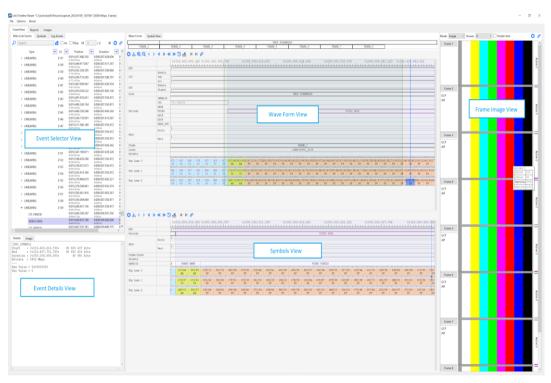
HDMI Link Timeline Viewer has three tabs (for three modes):

*FrameView* tab is the **primary** tab for analyzing captured events on the timeline.

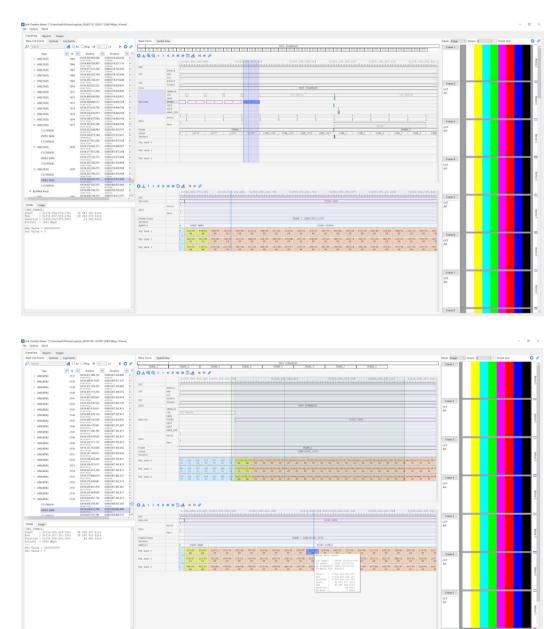
Reports tab can be used to summarize events (AUX at present).

Images tab lets the user view captured video frame images.

The FrameView tab and its views are shown below.



*FrameView tab* zoomed out and zoomed in views of the timeline 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) as shown below. 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.



# Wave Form and Symbols View Settings

Shown below are the WaveForms View and Symbols Views settings widgets.

								CRAMBLED								
FRAME_1		FRAME_2		FRAME_3	FRAME_4		FRAME_5		FRAME_6	FRA	ME_7	17	RAME_8			
•±€€<	. « » «	« »» 🕤 🔺	H H 🔗	1												
		0:016.666.8	28.267 0	:000.000.293	.274 0:	:000.000.5	53.032	0:000.00	0.832.789	0:000.00	01.102.546		:000.001.	372.304	0:016	.668.794.0
HPD		8														
	Events															
12C	sda	3														
	scl	9														
CEC	Events Signal	1														
Link	STAURT	•						75	DS SCRAMBLED							
22115	INVALID															
	CTL			C							CTL PERIC	D				
eriods VI	DATA		D	D												
	VIDEO															
	SSCP	S														
	HDCP								E							
	KEEP_OUT									KEEP_OUT						
	Horiz	8	HSYNC	-												
Sync		1														
	Vert	•								VSYNC						
Frane										FRAME 2						
Lines										LINE 0						
Packets			GCP	AVI												
Phy Lane 0																
Phy Lane 1																
and many 1																
Phy Lane 2																

			16 667	982 220			48			420 0.	016 66	.997.765				022 36/				36	0.016	.668.017	26
PD		3-																					-
riods		-										CTL	PERIOD										-
		à																					-
	Horiz																						
ync		1																					
	Vert	0																					
rame/Lines												FRAME	2 LINE_0										
ackets																							
ymbols				TL										H	DCP								
		11111	11000011:		0010001111	1000011110	0111100011	11100001100	0111010000	0001111001	100011011	110111100000	101110000	0000110111	10001111000	110000111	1001111001	11001110000	0001111000	0111100011	100111000	0110000111	a a
hy Lane 0		1	387	03C	352	050	318	0C3	017	33C	3D8	018	01D	3D8	078	3C3	33C	039	078	31E	039	3C3	
			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	
		01110	01100111:	1110000110	0000111011:	1110011000	1101100000	001001111	027	0011000111	100011110	063	011110001	1111000100	0000101111	001111000	0000110111	11000011100	078	1111000011	3D8	1110011000	
hy Lane 1		C	3CC 00	0C3	388	033	018	324	027	306	378	063	318	047	358	03C	3D8 01	0E1	078	30F 01	306	033	
		0.0.0.0			1110001100		1110000111	1100011000		1111001000	011100100	00010001111	011020111	1111000100	011100000100			11110100000			221111201	1101110000	
hy Lane 2		7	01D	3D8	063	352	387	063	315	027	027	362	306	047	087	381	300	017	3C3	087	33C	010	
cuy hours a			00	00	00	00	00	00		00	00	00	00	00	0.0	00			00	0.0		00	

#### **Gear Icon**



Select the *Gear* icon to select events to be displayed (+) or hidden (-). When *Gear* icon is selected, you can drag a row to reorder rows.



#### **Save Icon**



Select the Save icon to Save, Load or Remove named internal settings sets. You can also Import or Export named \*.json files containing settings or Reset to default.

¢ ₹	€, €, < >	<b>«</b> :
3	Save	þ.
AU	Load	· -
Li Fr	Remove	
Li	Import	
VB	Export	_
MS.	Reset to default	
SDP		

#### Zooming



Select *Zoom* + or – icons to zoom in and out or use the mouse wheel. The zooming in/out option applies to *Wave Form View* only.

#### Scrolling

Use the arrow keys to navigate the timeline. One arrow moves the timeline one page, two arrows 10 pages and three 100 pages.

You can also scroll by dragging ( click and hold while dragging).

#### **Clock icon**



Move to a time point. Enter values and press OK.

Move to time poir	nt ×
Enter bit offset:	
1 376 340,937	
[-0:000.503.315.999	: 0:002.516.579.823 ]
Enter time:	
169 917 890,804	
[-0:062.137.505.894	: 0:310.687.507.793 ]
	Cancel
OK	Cancel

#### **Eraser**



Removes all measurements on the timeline.

#### **Move to Previous or Next Frame**

Move back or forward to the same relative location in the previous or next frame.

#### Sync Data

Not synchronized. Synchronized.

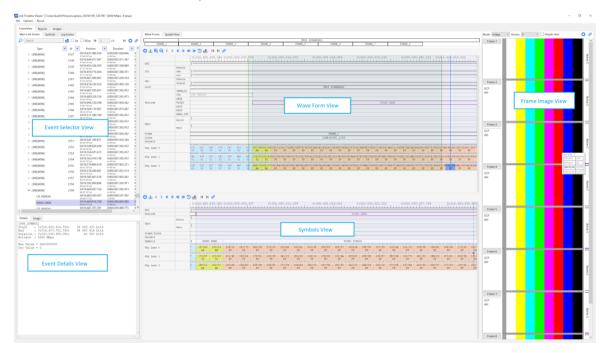
# FrameView Tab

Frame View tab has three tabs: *Main Link Events, Symbols,* and *Log Events.* The *Main Link Events* tab is the **primary** tab for analysis and is presented first.

# Main Link Events Tab

*Main Link Events* tab consists of five panels: Event Selector View, Event Details View, Wave Form View, Symbols View and Frame Image View.

Each of these views are synchronized and actions in one will be reflected in others.



#### **Event Selector View**

*Event Selector View* events are presented as a folding list of *FRAMEs*. Each *FRAME* contains a set of *BLANK LINEs* followed by a set of *ACTIVE* LINEs and finally by another short set of *BLANK LINEs*. *BLANK* LINEs contain items such as *CTR* periods and *DATA ISLAND* periods. *DATA ISLANDs* contain *HDMI data packets* such as *GCP* and *AVI* packets. *ACTIVE* LINESs contain *CTRL* and *VIDEO DATA* items.

Main Link Events Symbols Log	Events				
Search		2	Aa 🗌 RExp 🚺 🛛	/0	00
Туре	Id	Position	Duration	End	
FRAME	1	0:020.239.117.146 30 055 212 bits	0:016.666.598.436	0:036.905.715.582	
<ul> <li>BLANK(41 lines)</li> </ul>		0:020.239.117.146	0:000.607.404.920	0:020.846.522.066	
✓ LINE	0	0:020.239.117.146 30 055 212 bits	0:000.014.814.753	0:020.253.931.899 30 077 211 bits	
CTL PERIOD		0:020.179.265.539 29 966 332 bits	0:000.060.107.497 89 260 bits	0:020.239.373.036 30 055 591 bits	
✓ DATA ISLAND PERIOD		0:020.239.373.037 30 055 592 bits	0:000.000.242.422 360 bits	0:020.239.615.459 30 055 951 bits	
GCP		0:020.239.386.505 30 055 612 bits	0:000.000.215.486 320 bits	0:020.239.601.991 30 055 931 bits	
CTL PERIOD		0:020.239.615.460 30 055 952 bits	0:000.000.134.679 200 bits	0:020.239.750.139 30 056 151 bits	
✓ DATA ISLAND PERIOD		0:020.239.750.140	0:000.000.242.422	0:020.239.992.562	
AVI		0:020.239.763.608	0:000.000.215.486	0:020.239.979.094	
CTL PERIOD		0:020.239.992.563	0:000.607.808.959	0:020.847.801.522	
> LINE	1	0:020.253.931.900	0:000.014.814.753	0:020.268.746.653 30 099 211 bits	
> LINE	2	0:020.268.746.654	0:000.014.814.753	0:020.283.561.407	
> LINE	3	30 099 212 bits 0:020.283.561.408 30 121 212 bits	22 000 bits 0:000.014.814.753 22 000 bits	30 121 211 bits 0:020.298.376.161 30 143 211 bits	

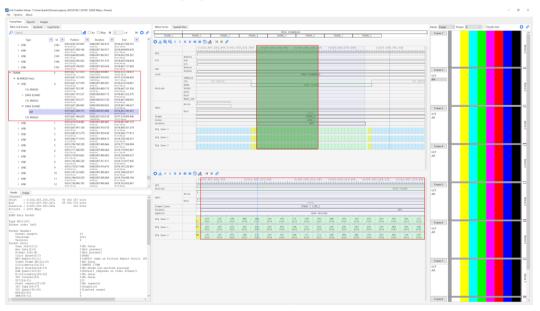
The timing format used in Link Timeline Viewer consists of two timings based on time and bits.

The time format is as follows:

seconds:milliseconds.microseconds.nanoseconds.picoseconds

In the image above you can see the time format on top and the bit format underneath (smaller grey font).

When clicking on a *Main Link Event*, both *Wave Form View* and *Symbol View* are focused, and the time stamp block of the item is highlighted as shown below.



Event timing details are shown in the columns are the following:

Туре:	Type of item.
ld:	Items 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

#### Search

You can search events by typing its name in the Search bar and pressing *enter* or by clicking the *enter* icon. The events are highlighted and shown in *Wave Form View* and *Symbol View*.

		× 🖬 🗆	Aa 🗌 RExp 🔀 🛛 2	. / 77 🕨	0
Туре	Id	Position	Duration	End	^
✓ FRAME	2	0:036.905.715.583	0:016.666.598.437 24 750 000 bits	0:053.572.314.020 79 555 211 bits	
✓ BLANK(41 lines)		0:036.905.715.583 54 805 212 bits	0:000.607.404.920 902 000 bits	0:037.513.120.503 55 707 211 bits	
✓ LINE	0	0:036.905.715.583 54 805 212 bits	0:000.014.814.753 22 000 bits	0:036.920.530.336 54 827 211 bits	
CTL PERIOD		0:036.845.863.976 54 716 332 bits	0:000.060.107.497 89 260 bits	0:036.905.971.473 54 805 591 bits	
> DATA ISLAND PERIOD		0:036.905.971.474 54 805 592 bits	0:000.000.242.423 360 bits	0:036.906.213.897 54 805 951 bits	
CTL PERIOD		0:036.906.213.898 54 805 952 bits	0:000.000.134.678 200 bits	0:036.906.348.576 54 806 151 bits	
✓ DATA ISLAND PERIOD		0:036.906.348.577 54 806 152 bits	0:000.000.242.423 360 bits	0:036.906.591.000 54 806 511 bits	_
AVI		0:036.906.362.045 54 806 172 bits	0:000.000.215.487 320 bits	0:036.906.577.532 54 806 491 bits	
CTL PERIOD		0:036.906.591.001 54 806 512 bits	0:000.607.808.958 902 600 bits	0:037.514.399.959 55 709 111 bits	
> LINE	1	0:036.920.530.337 54 827 212 bits	0:000.014.814.754 22 000 bits	0:036.935.345.091 54 849 211 bits	
> LINE	2	0:036.935.345.092 54 849 212 bits	0:000.014.814.753 22 000 bits	0:036.950.159.845 54 871 211 bits	

Aa:	Makes search function case sensitive.
RExp:	Use regular expressions.
2	Click the enter icon to apply filters.

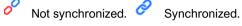


Click *Find Prev* and *Find Next* icons to navigate. Also shown is the instance (here instance 2 out of 77).

#### 0

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

Configure search	$\times$
Case Sensitive	
Use regular expression	
Columns:	
🗹 Туре	
🗹 Id	
Position	
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Ap	ply
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Click icons to synchronize data for view.

# Symbols Tab

Symbols View lists all PERIODS.

Search			🛃 🗌 Aa 🗌 RExp 🚺 🛛 🛛 / 0 🛛 🗎 🔅	Ø
Туре	Position	Li 🔻	Value	· ^
VIDEO DATA PERIOD	0:020.077.434.306 29 815 112 bits	0	0000000	
CTL PERIOD	0:020.090.377.014 29 834 332 bits	0	0000000	
VIDEO DATA PERIOD	0:020.092.249.060 29 837 112 bits	0	0000000	
CTL PERIOD	0:020.105.191.768 29 856 332 bits	0	0000000	
VIDEO DATA PERIOD	0:020.107.063.814 29 859 112 bits	0	0000000	
CTL PERIOD	0:020.120.006.522 29 878 332 bits	0	0000000	
VIDEO DATA PERIOD	0:020.121.878.568	0	0000000	
CTL PERIOD	0:020.134.821.276	0	0000000	
VIDEO DATA PERIOD	0:020.136.693.323	0	0000000	
CTL PERIOD	0:020.149.636.031	0	0000000	
VIDEO DATA PERIOD	0:020.151.508.077	0	0000000	
CTL PERIOD	0:020.164.450.785 29 944 332 bits	0	0000000	
VIDEO DATA PERIOD	0:020.166.322.831 29 947 112 bits	0	0000000	
CTL PERIOD	0:020.179.265.539 29 966 332 bits	0	0000000	
DATA ISLAND PERIOD	0:020.239.373.037 30 055 592 bits	0	0000000	

Selection and multiview highlighting behavior is as for Main Link Events above.

Search criteria are the same as for Main Link Events above.

Each column has a sort and filter icon. Shown below is for the *Type* sort and filter icon.

Type 🔽 Po	osition 🔽	Li 🔽	
Sort Ascending	6	0	0000000
Sort Descending	4	0	0000000
1 Clear Sort	0	0	0000000
Clear Filter		-	
Search:		0	0000000
Select all	4	0	00000000
🗹 CTL PERIOD	2	0	0000000
	8	0	0000000
VIDEO DATA PERIOD	6	0	0000000
	3	0	0000000
	1	0	0000000
Apply Ca	ncel 7	0	0000000
29 944 332	bits 5	0	0000000

# **Event Details View**

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

#### **Details Tab**

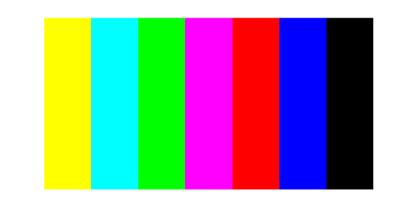
The information shown in the *Details* tab depends on the selected item. A *FRAME* item is shown below.

[FRAME]		
Start : 0:020.239.117.146;	30 055 212 bits	
End : 0:036.905.715.582;		
Duration : 0:016.666.598.436;	24 750 000 bits	
HTotal : 2200		
VTotal : 1125		
HActive : 1920		
VActive : 1080		
HSyncWidth : 44		
VSyncWidth : 5		
HBackPorch : 148		
VBackPorch : 36		
HFrontPorch: 88		
VFrontPorch: 4		
HStart : 192		
VStart : 41		
BPP : 24		
Colorspace: RGB		
Sampling : 4:4:4		

#### **Images Tab**

Image for currently selected FRAME can be viewed (only when FRAME is selected).





# Wave Forms View

Wave Form View consists of two tabs: Wave Forms and Spatial View.

#### **Wave Forms**

Wave Form View looks different depending on zoom level. Images below show the views in zoomed out and zoomed in states.

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.

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by Lane 1		027	3D8 00 01 0	33 30E 01 01	017	17F Data Islar	d Leading GuardGuar	d 2C3 1 0000 0	13C 2CC 001 0000	163 2C6 0000 0000	18E 0000	271 2C3 0000 0000	29C 0000
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#### Columns are:

HPD	Hot Plug Detect signal.
<i>12C</i>	I2C Events and signals sda and scl
CEC:	CEC Events and Signal
Link	Link type (TMDS SCRAMBLED for ex.)
Periods	INVALID, CTL, DATA, VIDEO, SSCP, HDCP, KEEP_OUT
Sync	HSYNC and VSYNC periods and signals
Frame	Frame number.
Lines	ACTIVE and BLANK lines
Packets	GCP and AVI packets
PHY Lane 0	Lane 0 data
PHY Lane 1	Lane 1 data
PHY Lane 2	Lane 2 data

The scroll bar at the top shows all captured frames. Select a frame by double-clicking.

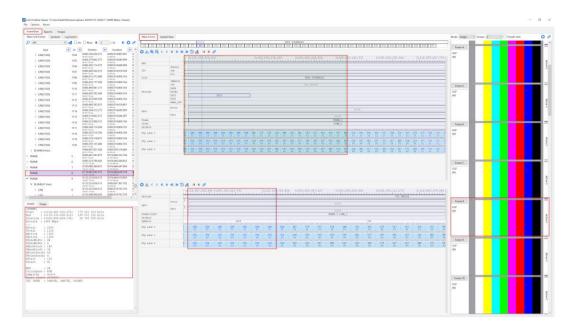


21 22 23 24 25 26 27 28 23 33 43 53 36 37 38 59 40 41 42 43 44 45 46 47 48 49 50

As you hover over the timeline, a timestamp for that position is displayed on the timeline at the cursor horizontal location.

Popups show details of events as you hover over them in Wave Form View.

Below illustrates how the different views align when you double click in the *Wave Form View* or the *Symbols View*.



#### Measuring

The ruler tool allows users to measure the time 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. Use the eraser tool to remove measures.

															_
F1 F2 F3	F4 F5	F6	F7	F8	F9	F10	F11	F12	F13	F1	4 F1	5 F1	6 F	17 F	18
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#### **Spatial View Tab**

Frame pixel images are shown in Spatial View.

Drag to scroll Frames.

Double-clicking the timeline when Spatial View Tab is active will select the event in Event Selector View.

A popup showing details will be shown when hovering over a *Frame* or HDMI data packets such as *GCP* and *AVI*.

Hover over an event to see event details in a popup window. Double-click an event will to select it in and see details in *Event Details View*.

neView Reports Images							
in Link Events Symbols	Log Events					Wave Forms Spatial View	
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Type	Id	Position	Duration	End	^	< > « » « »	
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<ul> <li>BLANK(41 lines)</li> </ul>		0.336.904.487.458	0:000.607.404.920	0.337.511.892.378	-		
✓ UNE	0	0:336.904.487.458	0:000.014.814.753	0.336.919.302.211		mouse hover	
CTL PERIOD		0:336.844.635.851	0:000.060.107.497	0.336.904.743.348		HTotal : 2200 WTotal : 1125	
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AVI		0:336.905.133-920 508 206 172 km	0:000.000.215.487	0:336.905.349.407 581 205 497 km		VStart : 41	
CTL PERIOD		0:336.905.362.876 502.205.512 kin	0:000.607.808.958 822.600 km	0:337.513.171.834 501.209 111 bits		BTP 1 24 Colorspace: R5B	
> LINE	1	0.336.919.302.212	0:000.014.814.754	0.336.934.116.966		Sampling : 4:4:4	
> LINE	2	0.336.934.116.967	0:000.014.814.753	0.336.948.921.720			
> LINE	1	0:336.948.931.721	22 000 Mix 0:000.014.814.753	500 277 217 Mite 0.336.963.746.474	_		
> LINE	4	0:336.963.746.475	22 000 MIN 0:000.014.814.753	0.336.978.561.228			
	-	0:336.978.561.229	22 007 No 0:000.014.814.753	0136.993.375.982			
> LINE	5	500 d15 212 kin	22 000 bits	500-027-211-bits			
> LINE	6	0:336.993.375.983 301 437 212 km	0:000.014.814.753 27 000 Mis	0:337.008.190.736 301.439.211 http:		double click GCP here sets mouse hover will show focus to event and updates	
> LINE	7	0:337.008.190.737 501-459.212 htt	0:000.014.814.754 27 000 bits	0:337.023.005.491		focus to event and updates popup with details	
> LINE	8	0:337.023.005.492	0:000.014.814.753	0.337.037.820.245			
> LINE	9	0.337.037.820.246	0.000.014.814.753	0.337.052.634.999		Rink (47	_
> UNE	10	0.337.052.635.000	0:000.014.814.753	0.337.067.449.753			
> LINE	11	00 525 212 http: 0:337.067.449.754	0:000.014.814.753	0.337.082.264.507			
		0:337.082.264.508	22 002 Min 0:000.014.814.753	500 569 217 ain. 0:337.097.079.261			
> LINE	12	0:337.097.079.262	0:000.014.814.754	0.337.091.009.201 0.337.111.894.016			
> LINE	13	500 591 212 km	22 000 bits	500-512 217 bits			
> LINE	14	0:337.111.894.017 500 612 212 hit	0:000.014.814.753	0:337.126.708.770 501-525.211 kits		ketswo	
> LINE	15	0:337.126.708.771	0:000.014.814.753 22 007 Min	0.337.141.523.524	/		
N LINE	16	0.337.141.523.525	0:000.014.814.753	0.337.156.338.278	~		
ills Image							
(ME)					1		
ct : 0:336.904.487 : 0:353.571.085	458; 5	500 305 212 bits 525 055 211 bits					
tion : 0:016.666.598		24 750 000 bits				15443	
al : 2200							
al : 1125							
ive : 1920 ive : 1080							
nowidth : 44							
ncWidth : 5 skPorch : 148							
skPorch : 36 ontForch: 88							
ontPorch: 4							
art : 192 art : 41							
i 24 orspace: RGB							
pling : 4:4:4							

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# Symbols View

Like *Wave Form View*, *Symbol View* presents HDMI transmission data and periods. As with *Wave Form View*, drag to scroll horizontally or use the *settings* ribbon arrow keys.

		0:	116.667	.029.5	46 0:000.0	000.023.7	80		0	:116.66	.084.860				0:0	000.000	089.400		0:000.0	00.111.2	73	0:116	.667.170	.994
Periods																					PERIOD			_
	Horiz	8								_					HSYN	12								_
Sync	Vert	8-													110.114	-								-
	verc																							
Trame/Lines														FRA	ME 8 I	LINE_0								
ackets																								
ymbols							SCP											CTL						
hy Lane 0		7	2AB 11	2AB 11	2AB 11	2AB	2AB 11	2AB 11	2AB 11	2AB	3E1 11	078	033	31		3E4 11	03C 11	3E1 11	033	027	3CC 11	3C6 11	047	
hy Lane 1		100	00101010 354	10010101 354	01100101010 354	1001010101 354	354	1001010101 354	354	354	CTL Symbo					000111100 0F0	1000011111 3E1	017	39C	39C	027	001111000) 03C	010001111 3E2	1000
		-	00	00	00	00	00	00	00	00	10b symbo					00	00	00	00	00	00	00	00	
hy Lane 2		8	354 00	354 00	354 00	354 00	354 00	354 00	354 00		2b symbol Start	: 11	.667.079.		8	047	3CC 00	3D8 00	078 00	027 00	387 00	388 00	078	
											End Duration Start End Duration Bitrate	0:000 173 173	667.086. 000.006. 51 223 E 51 232 E 10 E 1 E	729 its its its										

Periods	Transmission PERIODs
Sync	Horiz and Vert periods
Frame/Lines	Frame and Line number
Packets	HTML GCP and AVI packet identifiers
Symbols	HDMI transmission symbols.
Phy Lane 0	TMDS Channel 0 data.
Phy Lane 1	TMDS Channel 1 data.
Phy Lane 2	TMDS Channel 2 data.

Illustrated below are the TMDS channel values for *PIXEL*s for the color white. Note from the tool tip that the value has been scrambled.

00011101110	0110001101	000100110:	1011111010	110100000101
1DC	2C6	2C8	17D	20B
FF	FF	FF	FF	FF
11110000010	0000111011	000000011	1101110011	00001001111
107	10b sym	ool : 0	x1DC (01	11011100)
FF		e index:		
10000100100				
090	Start	: 0:0	20.847.8	82.330
FF	End	: 0:0	20.847.8	89.064
000000000000	Duration	n : 0:0	00.000.0	06.734
000	Start	: 3	0 959 23	2 bits
000	End	: 3	0 959 24	1 bits
INE (1920	Duration	n :	1	0 bits

Illustrated below are the values for a SSCP period. Note from the tooptip that this is not scrambled.

			SS	CP				
				CTL				
01101010101	1101010101	1101010101	110101010	1101010101	11010	10101	1101010101	11010101011
2AB	2AB	2AB	2AB	2AB	27	AB	2AB	2AB
11	11	11	11	11	1	1	11	11
00010101011	0010101011	0010101011	001010101	0010101011	00101	01011	0010101011	00101010110
354 00	354 00	354 00	354 00	10b sym	001	: 0:	x2AB (10)	10101011)
10010101011	0010101011	0010101011	001010101	Value2				
354 00	354 00	354 00	354 00	Start	:		20.239.13	
11111111111	1000000000	0000000000	011111111		h :		00.000.00	
3FF	001	000	3FE	Start	:	3		2 bits
				Duration	n :		1(	) bits

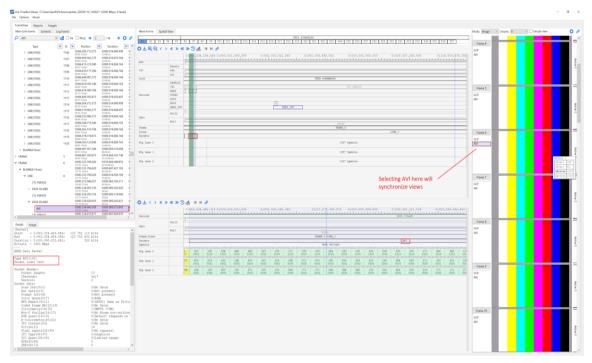
Each individual block contains the following information (tooltiup also shown).

First row	10b/8b symbol in HEX format
Second row	Descrambled value.

# Frame Image View

Frame Image View can be used to select *Frames* and GCP or AVI periods and synchronizing with other views.

As shown below, selecting the AVI event in Frame Image View also selects it in Event Selector View and synchronizes the other views. Hovering over the Active0 area will show the frame geometry details.



Mode can be Image or Rect (shows just a green rectangle to save processing time).

Stream combobox and Simple view checkbox do not work at present.

# 7. DP LINK TIMELINE VIEWER

Role:	Product:
DP Reference Sink (DP RX)	UCD-400
USB-C DP Alt Mode Reference Sink (DP RX)	UCD-424

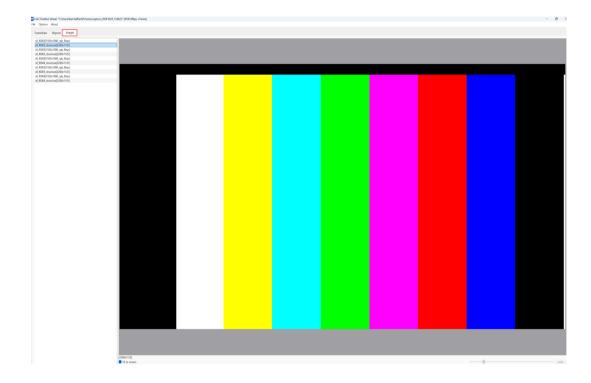
*Link Timeline Viewer* is a tool for evaluating the content and timing of data captured with *Link Analyzer* function of UCD Console.

Link Timeline Viewer main panel contains two tabs:

- *FrameView* provides the user ability to evaluate events within the captured data and their occurrence in time scale.
- *Reports* shows AUX channel activity at present.
- Images lets the user view frame images from the captured data.



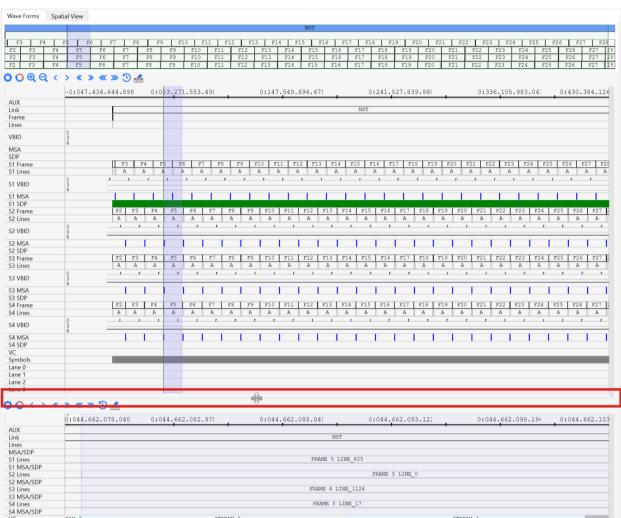
eView Reports Images	
Report	79E-DHIMADIS_LANE1 = level 1
	NOTE: Decoded as MAIM_LINK_CMANNEL_COLINO_SET = 00/10b
	TK_TTK_TRANST_TALIN_LAARS) = 4
	TX_FFE_PRESET_VALUE_LANE1 = 4
	NOTE: Decoded as MAIN_LINE_CHARMEL_CODIN0_SET = 128b/132b
	Link/Tink Device Status
	ADJUST_SEQUEST_LANE2_3 (FO)
	0x00207 := 0x44
	WOLTANE_SWINS_LANE2 = level 0
	<pre>JFE-ENSWARIS_LANE2 = level 1</pre>
	VOLTAGE_INING_LANE3 = level 0
	FRE-EMFHAGIS_LANES = level 1
	NOTE: Decoded as MAIN_LINK_COMANNEL_CODING_NET = %b/10b
	TX_TTE_FHESTE_TALKE_LANE2 - 4
	TX_TTE_PRESET_VALUE_LANE) = 4
	NOTE: Decoded as NAIM_LINK_CHANNEL_COULNO_SET = 128b/132b
	Transaction Data 00 44 44
	Manchaster II codes: preasblat 5.0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
	command: 0 0 0 0 1 [bu0] (0 0 0 0 [bu0]) data: 0 1 0 0 1 0 0 1 0 0 [0044] 0 1 0 0 0 1 0 0 [0044]
	bostample: H H F F
	19 Packet content type = 0x00 [Data message]



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Note:

When using Link Timeline Viewer with MST, it's possible that all information for all streams are not visible. Different streams are shown below in the *Wave Form View* and the *Symbols View*. The view handle may be use to adjust visibility. Remove rows via the gear icon optimize screen real estate. (See the next chapter for instructions.)



54 MISA/SUP																					
VC	EAM 2						STREAM 3									STREAM 4					
Symbols		BS																			
	011100	0011110100	0100111011	0100110001	0111010001	0011100110	0010110101	0011011010	1001101100	0111000110	1011011001	0010010111	0010010111	1100001010	0011110011	1100001001	1101101000	0111101000	0011110100	0111101000	010110111
	A/6A	0BC/1C	372/12	232/F2	22E/E1	19C/DC	2B4/54	16C/AC	0D9/79	18E/CE	26D/22	3A4/FB	3A4/FB	143/5C	33C/7C	243/DC	05B/FB	05E/FE	0BC/1C	05E/FE	1DA/FA
Phy Lane 0	0.3-	K28.0-	D18.0-	D18.7+	D1.7-	D28.6-	D20.2-	D12.5-	D25.3-	D14.6-	D2.1-	K27.7+	K27.7+	K28.2+	K28.3-	K28.6+	K27.7-	K30.7-	K28.0-	K30.7-	D26.7-
	00		00	00	00	00	00	00	00	00	00										00
	010011	1100001011	0100110100	0100110111	1000101110	0011100110	0010110101	0011011010	1001100011	0111000110	0100101001	1101101000	1101101000	0011110101	1100001100	0011110110	0010010111	1000010111	1100001011	1000010111	010110000
	A/6A	343/1C	0B2/12	3B2/F2	1D1/E1	19C/DC	2B4/54	16C/AC	319/79	18E/CE	252/22	05B/FB	05B/FB	2BC/5C	0C3/7C	1BC/DC	3A4/FB	3A1/FE	343/1C	3A1/FE	21A/FA
Phy Lane 1	0.3+	K28.0+	D18.0+	D18.7-	D1.7+	D28.6-	D20.2-	D12.5-	D25.3+	D14.6-	D2.1+	K27.7-	K27.7-	K28.2-	K28.3+	K28.6-	K27.7+	K30.7+	K28.0+	K30.7+	D26.7+
	00		00	00	00	00	00	00	00	00	00										00
	010011	110 000 101 1	0100110100	0100110111	1000101110	0011100110	0010110101	0011011010	1001100011	0111000110	0100101001	1101101000	1101101000	0011110101	1100001100	0011110110	0010010111	1000010111	1100001011	1000010111	010110000
	A/6A	343/1C	0B2/12	3B2/F2	1D1/E1	19C/DC	2B4/54	16C/AC	319/79	18E/CE	252/22	05B/FB	05B/FB	2BC/5C	0C3/7C	1BC/DC	3A4/FB	3A1/FE	343/1C	3A1/FE	21A/FA
Phy Lane 2	0.3+	K28.0+	D18.0+	D18.7-	D1.7+	D28.6-	D20.2-	D12.5-	D25.3+	D14.6-	D2.1+	K27.7-	K27.7-	K28.2-	K28.3+	K28.6-	K27.7+	K30.7+	K28.0+	K30.7+	D26.7+
	00		00	00	00	00	00	00	00	00	00										00
	010011	110 000 101 1	0100110100	0100110111	1000101110	0011100110	0010110101	0011011010	1001100011	0111000110	0100101001	1101101000	1101101000	0011110101	1100001100	0011110110	0010010111	1000010111	110 000 101 1	1000010111	010110000
	A/6A	343/1C	0B2/12	3B2/F2	1D1/E1	19C/DC	2B4/54	16C/AC	319/79	18E/CE	252/22	05B/FB	05B/FB	2BC/5C	0C3/7C	1BC/DC	3A4/FB	3A1/FE	343/1C	3A1/FE	21A/FA
Phy Lane 3	0.3+	K28.0+	D18.0+	D18.7-	D1.7+	D28.6-	D20.2-	D12.5-	D25.3+	D14.6-	D2.1+	K27.7-	K27.7-	K28.2-	K28.3+	K28.6-	K27.7+	K30.7+	K28.0+	K30.7+	D26.7+
	00		00	00	00	00	00	00	00	00	00										00

# Wave Form and Symbols View Settings

7254													5					
								BS-IDL8	6_1				_		11		FR	AME_3
₽Ŧ€d<>																		
	0:1:	37.005.	361.54:	3		49.407.				0:161	.809.90	1.959			0:174.	212.17	2.167	
JX																		
og AUX																		
og MSA																		
g VB-ID																		
og Link																		
g VFRAME INFO																		
nk														_				
T Frame		BS-IDL									AME_2						FRAME_	
BT Lines		BLAN	к				1	в		7	CTIVE			В			ACTIV	E
ST VBID	034						_							-				
ST MSA							-											
ST SDP																		
T SR	1							1										
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ine 0																		
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·平〈〉《》					0.11	2 240 /	505 073			0-153	240.60	1.020			0.152	240 60	5 001	
	0:1	) 🛃   53.349.	679.114	4		53.349.6 + I + +	685.073				1.349.69				0:153.	.349.69		
xu	0:1	53.349.	679.114	4														
JX pg AUX	0:1	53.349.	679.114	4														
xt	0:1	53.349.	679.114	4														
IX og AUX og MSA og VB-ID og Link	0:1	53.349.	679.114	4														
NX NG AUX NG MSA NG VB-ID NG Link NG VFRAME INFO	0:1	53.349.	679.114	4														
IX IQ AUX IQ HEA IQ VE-ID II IN IN VERAME INFO INFO	0:1	53.349.	679.114	4									551					
IX IQ AUX IQ HEA IQ VE-ID II IN IN VERAME INFO INFO	0:1	53.349.	679.114	4									55T					
X og AUX og MSA og VB-LD og VB-LD og VFRAME INFO nk TT Lines	0:1	53.349.	679.114	4									551					
XX Jg AUX Jg MSA Jg VB-ID Jg UInk Jg VFAMME INFO Ink TT Lines TT VBID	0:1	53.349.	679.114	4														
X yg AUX yg MSA yg VE-LD g Link y VFRAME INFO ink T Lines YF VBID YF MSA	0:1	53.349.	679.114	4									53T					
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IX IX IQ MEA IQ VE-ID IQ ULIAK IQ VELAME INFO INF II Lines IT VBID IT MSD IT SDP mbols me 0	0:1	BC	679.114 + + + 1 =	s 70	BC	VBID	MVID 76	MAUD	00	00	00	D05	MY	50 00	RAME 2 L	.INE_0	55 5C	SC
X Sg AUX Sg VB-LD Sg VB-LD Sg VB-LD Sg VFDAME INFO INK T LINES TT MSA TT MSA TT MSA TT MSA TT MSA TT SDP mbols nne 0 nne 1	0:1	BC BC	679.114 + + + 1 = = = = = = = = = = = = = = = = = = =	4 4 7 7 7 7 7 7 7	BC	VBID 11	NVID 76 76	MAUD 00 00	00	00	00	D00 00	MY 00 00	8 00 00	RAME 2 L	INE_0	53 50 50	SC SC
XX XY 29 AUX 29 MaA 29 VB-LD 29 VEAME INFO 17 VIALD 17 VIALD 17 VIALD 17 SDP mbols mbols 19 0 0 11 000 11 000 1	0:1	BC BC BC BC	679.114 + + +   + + +   B 70 70 70 70	s 70 70 70	BC BC BC	VBID 11 11	MVID 76 76	MAUD 00 00	00 00 00	00	00 00 00	D00 00 00	MY 00 00 00	87 00 00 00	RAME 2 L:	INE_0	58 50 50 50	SC SC SC
XX XY 29 AUX 29 MaA 29 VB-LD 29 VEAME INFO 17 VIALD 17 VIALD 17 VIALD 17 SDP mbols mbols 19 0 0 11 000 11 000 1	0:11	BC B	679.111 	S 7C 7C 7C	BC BC BC BC	VBID 11 11 11	NVID 76 76 76	MAUD 00 00 00	00 00 00	00	00 00 00	D00 00 00 00	MY 00 00 00	81 00 00 00	RAME 2 L	INE_0	58 50 50 50 50	50 50 50 50
X ga ADX ga ADX ga Max ga Waha ga Weande ga Weande ga Weande Link TF Lines TF VBID TF SDP mbols menols m		BC BC BC BC	679.114 + + +   B 7C 7C 7C 7C	S 7C 7C 7C 7C	BC BC BC BC BC	VBID 11 11 11 11	NVID 76 76 76 76	MAUD 00 00 00	00 00 00 00	00 00 00 00	00 00 00 00 00	D08	MY 00 00 00	00 00 00 00	RAME 2 L	INE_0	53 50 50 50 50 50 50	5C 5C 5C 5C
XX AUX po MBA		BC BC BC BC BC BC BC BC BC	679.111	S 7C 7C 7C 7C	BC BC BC BC BC	VBID 11 11 11 12 229/90 D16.4+	NVID 76 76 76 76 76	MAUD 00 00 00 220/50 D29.2-	00 00 00 131/91 17.7.4+	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	000 000 000 000 000 000 000 000 000 00	MY 00 00 00 10101001 32B/64 D4.3-	00 00 00 00 00 00 00 00 00 00 00 00 00	RAME 2 L	INE_0	55 50 50 50 50 50 50 143/50	5C 5C 5C 5C
X ga ADX ga ADX ga Max ga Waha ga Weande ga Weande ga Weande Link TF Lines TF VBID TF SDP mbols menols m		BC BC BC BC BC BC BC BC BC BC BC BC	B 70 70 70 70 70 70 70 70 70 70 70 70 70	S 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C	BC BC BC BC BC BC BC BC BC BC BC BC BC B	VBID 11 11 11 11 2259/90 D16.4+ 11	MVID 76 76 76 76 081/78 D30.3+ 76	MAUD 00 00 00 00 29D/5D 28D/5D 282,2- 00	00 00 00 131/91 131/91 127.4+	00 00 00 00 00 10001110 10001110	00 00 00 00 00 00 00 00 00 00 00 00 00	D00 00 00 00 00 00 00 00 00 00 00 00 00	MY 00 00 00 11010101 32B/64 D4.3- 00	00 00 00 00 00 00 00 00 00 00 00 00 00	RAME 2 L:	.INE_0 00 00 00 00 2A3/43 D3.2- 00	38 50 50 50 50 50 142/50 K28.2+	5C 5C 5C 5C 2BC/5C 828.2-
XX Y2 AVX Y2 MAA Y2 WS-TD Y2 WS-TD Y2 WS-TD Y2 WS-TA Y2 WS-		BC BC BC BC BC BC BC BC	679.114 	S 7C 7C 7C 7C 7C 7C 828.3+ 10300110	BC BC BC BC 31C/BC K25.5-	VBID 11 11 11 120001001 200/90 01001001	NVID 76 76 76 76 76 76 76 76 76 76 76 76 76	MAUD 00 00 00 22bJ/5D 225.2- 00	00 00 00 131/91 137.4+ 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 01 00 01 00 01 00 00 00 0	00 00 00 00 00 00 00 00 00 00 00 00 00	MY 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	TINE_0	53 50 50 50 50 110000111 110000111	5C 5C 5C 2BC/5C K28.2-
IX og ANX og ANX og ANA og San AVX og Verande INFO Ink Tr Lines Tr Lines Tr Lines Tr SDP og De		BC BC BC BC BC BC BC BC BC BC BC BC BC B	B 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C 7C	S 7C 7C 7C 7C 7C 7C 7C 828.3+	BC BC BC BC BC BC BC BC BC BC BC BC BC B	VBID 11 11 11 12 229/90 D16.4+ 11 100000101 2229/90	NVID 76 76 76 76 081/78 081/78 081/78	MAUD 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 01 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 01/91 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 159/89 D9.7- 0.7- 0.7- 155/89	00 00 00 116/76 522.3+ 00	DUR 00 00 00 00 00 00 00 00 04D/ED D13.7+ 04D/ED	MY 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 099/19 D25.0+ 009/19 099/19	00 00 00 00 00 00 00 00 00 00 00 00 00	.INE_0 00 00 00 00 00 00 00 00 00 00 00 00 0	38 50 50 50 50 50 142/50 K28.2+	5C 5C 5C 2BC/5C K28.2-

#### Gear



The gear icon under the scroll bar allows users to select which events are shown in *Wave Form and Symbol Views*. Click the red circle to remove events. You can select which VBID events are shown by clicking the pen tool.

0	±⊕(Q <	>
0		0
0	AUX	
Ō	Link	
Ō	Frame	
0	Lines	0
0	VBID	Mad OI
0	MSA	
Ŏ	SDP	
Ō	Symbols	
Ō	Lane 0	
0	Lane 1	
Ō	Lane 2	
0	Lane 3	

You can select which VBID bits are shown using the pen tool.

III VBID edit	tor X
Bit 0	
🗌 Bit 1	
Bit 2	
Bit 3	
🗹 Bit 4	
Bit 5	
🗌 Bit 6	
Bit 7	
Accept	Cancel

Save

#### ÷

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

0 Ŧ	€€€ < >	<b>«</b>
k	Save	þ
AU	Load	> [
Li	Remove	
Li	Import	
VB	Export	
MS.	Reset to default	
CDD		

#### Zoom

### €Q

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

#### Scroll

You can use the arrow keys to move in the timeline. A single arrow shifts the timeline one interval, two arrows by 10 intervals and three arrows by 100 intervals.

Alternatively, you can scroll via mouse drag (clicki and hold).

#### Clock

### Э

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

Move to time poir	nt ×
Enter bit offset:	
1 376 340,937	
[-0:000.503.315.999 :	0:002.516.579.823 ]
Enter time:	
169 917 890,804	
[-0:062.137.505.894 :	0:310.687.507.793 ]
ОК	Cancel

#### **Eraser**



The eraser icon deletes all made measurements on the timeline.

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#### **Move to Previous or Next Interval**

Move back interval and Move next interval.

#### Sync Data

Sync data for views.

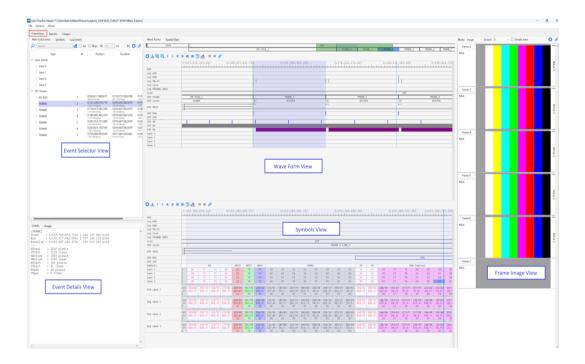


# FrameView Tab

Frame View tab consists of four areas shown below.

- Event Selector View •
- Event Details View •
- Wave Form View .
- Symbols View •
- Frame Image View •

These will be described in detail. Note that all these views are synchronized (when the synchronize icons are blue).



## **Event Selector View**

### **Main Link Events Tab**

Main Link Events lists captured data: events, packets and symbols. Selecting items in Main Link Events, you can easily locate the items of interest and focus get the Wave Form View and Symbols View for items. Event Selector events are presented via a tree control. When expanded, each FRAME lists video LINES and their events.

Main Link Ev	ents Symbols	Log Events				
Search				🔜 🛃 🗌 Aa 🗌 R	Exp 14 0 / 0	ы
	Type	Id	Position	Duration	End	1
~	LINE	0	0:016.616.178.997	0:000.014.752.772	0:016.630.931.769	
	BS		0:016.616.178.997	0:000.000.004.938	0:016.616.183.935	- 1
	VBID		0:016.616.183.936	0:000.000.001.233	0:016.616.185.169	
	MVID		0:016.616.185.170	0:000.000.001.234	0:016.616.186.404	
	MAUD		0:016.616.186.405	0:000.000.001.233	0:016.616.187.638	
	MSA		0:016.616.199.985	0:000.000.011.110	0:016.616.211.095	
	SDP_84	0	0:016.616.224.676	0:000.000.014.813	0:016.616.239.489	
	SDP_01	1	0:016.616.259.243	0:000.000.014.813	0:016.616.274.056	
>	LINE	1	0:016.630.931.770	0:000.014.816.968	0:016.645.748.738	
>	LINE	2	0:016.645.748.739	0:000.014.821.907	0:016.660.570.646	
>	LINE	3	0:016.660.570.647	0:000.014.809.561	0.016.675.380.208	
>	LINE	4	0:016.675.380.209	0:000.014.812.029	0:016.690.192.238	
>	LINE	5	0:016.690.192.239	0:000.014.816.969	0:016.705.009.208	
>	LINE	6	0:016.705.009.209	0:000.014.813.264	0:016.719.822.473	
>	LINE	7	0:016.719.822.474	0:000.014.816.968	0.016.734.639.442	

The timing format used is text and bits formats.

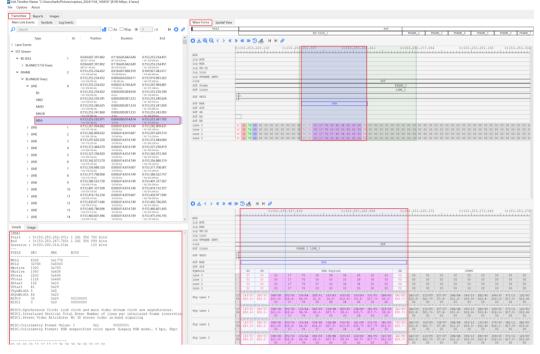
The text time format is as follows:

seconds:milliseconds.microseconds.nanoseconds.picoseconds

The timing format is shown below. You can see the text format on top and the bit format below (small grey font).

Туре		Id	Position	Duration	End
>	BS-IDLE	1		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
-	· · ·-	-	0.170 271 202 221	0.016 667 800 0/0	<b>N-186 030 183 371</b>

Selecting a *Frame*, *Line*, *Event*, or *Symbol* will focus the *Wave Form View* and *the Symbols View*. The time stamp of the item is highlighted in light blue.



Event Selector View timing details columns are:

Туре:	Type of item. FRAME, LINE, or name of Event
ld:	Identification number
Position:	Start of the event from start of data capture
Duration:	Duration of the event
End:	End of the event from start of data capture

Main Link Events Symbo	ls Log Events			
Cs: frame		🗌 🛃 🗌 Aa 🗌 RE	xp 14 0 / 0	N O
Туре	Id	Position	Duration	End ^
✓ Lane Events				
> Lane 0				
> Lane 1				
> Lane 2				
> Lane 3				
<ul> <li>SST Stream</li> </ul>				
> 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	0:090.65
> 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	0:140.65
> FRAME	10	0:140.696.309.142 1 139 645 090 bits	0:016.667.892.509	0:157.3€ 1 274 655 6
<				>

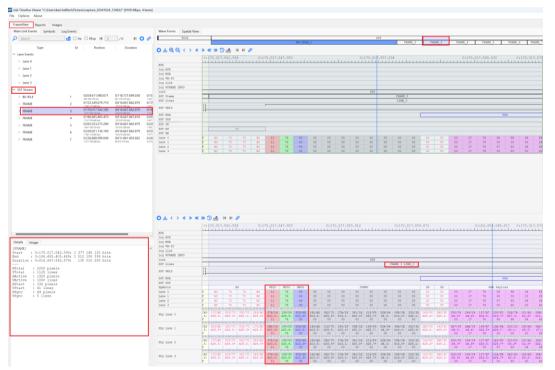
Under Main Link Events, there are two types of event categories: Lane events and SST/MST Stream.

### Lane Events

These are events occuring for each lane (such as SST, TPS1, TPS3 and TPS4).

#### SST Stream

You can find all captured frames under *SST Stream*. When selecting a frame in the *Event Selector View*, it is highlighted and also focused in the *Wave Form View* and the *Symbols View* as shown below. Event details are shown in *Event Details View* in the lower left corner.



### **MST Stream**

When using *Link Timeline Viewer* in *MST* mode, streams are displayed in the *Event Selector View* as shown below. Select a stream to inspect its events. All stream events and their handling are as for *SST* mode described previously.

le Options About																					
rameView Reports Images																					
Main Link Events Symbols Log Events	Wave Forms Spatial V	iew																			
🖸 Searth 🛃 🛛 Aa 🗆 RExp. Ht. 0 / 0 🛛 H 🔇										MST											
	F1 FRAME 2 F1 FRAME 2	FRAME_3	TRAVE 4			FRAME 6	11633		TRAVE 0	19330		FRAME_10		BAME_11 BAME_11		ME_12 ME_12	1920		TRAME 14		AME_15 AME_15
Type Id Position Duration	F1 F3ARE 2 F1 F3ARE 2 F1 F3ARE 2	FRAME_3 FRAME_3	FILAME 4	1745	5 5	HUARE 6	1100	<b>3</b> 7	FTARE 8	1500	5.9	FRAME 10	. T	TAME 11 TAME 11	77A	ME 12 ME 12	1745	15 13	TUME 14		AME_15 AME_15 AME_15
MST Stream 1											-										
MST Stream 2	O∓@G <>	« » « »	9 🛃 H	PI 🔗																	
MST Stream 3	MST1 Frame									_	TUANE 2			_							
	MST1 Lines			LINE_43				INS_44			LIN	B(5760)_4				LINS (					ENE(5760)_47
MST Stream 4	MST1 VBID																				
	MET1 MSA																				
	MAT1 SDP MST1 B5	-								-				_							
	MST1 BE					-													_		
	MST2 Frame																				
	MHT2 Lines			LINE_43				LINS_44		_		RE(5760)_(				1138	\$157603_4				LINE(5760)_4
	NFT2 VEID	1												_							
	MST2 SDP																				
	NST2 B5 NST2 BE																				
	MST2 BE MST3 Frame									_	FRAME 2										
	MST3 Lines	0.0		LINE_43		1		LINE_44			1	INE (5760)	45	_		115	NE (5760)	46			LINE(5760)
	NFT3 VRID NST3 MSA												_	_	_	_		_			
	NST3 SDP																				
	MOTO BO																				
	MST3 BE MST4 Frame									_	TRAVE 2			_							
	MST4 Lines	LINE_43			LINE	_44			LINE (	(5760)_45				NE (5760)	46			LINE	1(5760)_47		
	MST4 VBID	31																			
	NUT4 HDA	**																			
	MST4 SDP																				
	0 ± < > « »	Channel 1																			
	MST2 VBID	1014																			
Details Image	MST2 M5A																				
LINE	<ul> <li>MST2 SDP</li> <li>MST3 Lines</li> </ul>									59.0	ME 2 LINE	44									
tart : 0:007.571.394.036; 61 328 560 bits nd : 0:007.586.329.772; 61 449 539 bits	MIT) VALD	28								1.795											
uration : 0:000.014.935.736; 120 980 bits		41																			
 BID 1 0x1	MST3 MSA																				
erticalBlanking; TRUE	MST4 Lines									I'RAMI	2 LINE(51	60)_45									
ieldID: FALSE nterlace: FALSE	MST4 VBID	31																			
oVideoStream: FALSE sdioMute: FALSE	NUT4 MIA	41																			
DCP SIDE DETECT: FALSE	MST4 SDP																				
empressedStream: FALSE	Link Frame/HTP	an				STREAM 1							803	STREAM 2						879.8	IN 3
				ST	3.5	VBID	NVID	NAUD		sr	VCPF						51				
VID 0 0x0	Symbols	201						91													
AUD 0 0x0	Lane 0	0																			
AUD 0 0x0 Blank = 0																	04				
AUD 0 0x0 Blank = 0	Lane 0 Lane 1	0	C4 C4 C4 C4	04 04					C4 0	04 04											
NUD 0 0x0 Slank = 0	Lane 1 Lane 2	0			C4 C0	01 227/28 28.7-	103/23 019.7-	91 174/84 020.5-					343/1C #28.0+	382/FD 829.7+	3A2/ED #29.7+	003/70 828.3+			18C/DC 24 \$28.4- \$2	i/pc 658.	88 330/10 7- 828.3-
UD 0 0x0	Lane 0 Lane 1 Lane 2 Lane 3	7a/2r 126 15.1- 06. 00	C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C	C4 C4 C4 3A2/FD 00 829.7* K2	C4 C3 C4 C3 3/7c 056/8 8.3+ K30.7	227/28 08.7- 01	103/F3 019.7- 76	174/84 020.5- 91	243/pc 050 #28.6+ #23	D/ED 28C/50 9.7- x28.2-	348/27 23.7+	388/27 23.7+	343/1C #28.0+	382/FD 829.7+	3A2/ED 829.7+	003/70 828.3+	065/85 829.7-	05s/rs x30.7-	18C/DC 24 828.4- 82	1.6+ \$27	88 330/10 7- 828.3-
AUD 0 0x0	Lans 0 Lans 1 Lans 2 Lans 3 Fby Lans 0	45/27 286, 0 0	C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C	C4 C4 C4 3A2/FD 00 829,7+ K2 05D/FD 23 829,7+ K2	C4 C3 S4 C3 S4 C3 S4 S3/7C 055/5 S3/7C 055/5 S3/7C 055/5 S30.7 S	227/28 - 08.7- 01 : 109/29 - 08.7+ 01	103/83 019.7- 76 212/82 019.7+ 76	174/84 020.5- 91 174/84 020.5- 91	243/DC 050 828.6+ 829 180/DC 3A0 828.6- 829	2/FD 28C/50 9.7- 828.2- 2/FD 142/50 9.7+ 828.2-	: 385/27 - 823.7+ : 058/88 : 827.7-	588/87 823.7+ 057/87 823.7-	343/10 #28.0+ GBC/10 #28.0+	382/FD 829,7+ 050/FD 829,7-	3A2/ED 829.7+ 05D/ED 829.7-	003/10 828.3+ 220/70 828.3-	065/FD 829,7- 3A2/FD 829,7+	056/78 830.7- 281/78 830.7+	180/00 24 828.6- 82 243/00 18 828.6+ 82	1/DC 058 1.6+ #27 2/DC 384 1.6- #27	98 330/10 7- 828.3- 98 002/10 74 828.3+
NUD 0 0x0 Blank = 0	Lans 0 Lans 1 Lans 2 Lans 3 Fby Lans 0	0 0 0 7a/2r 126 15,1- 06 0 45/27 28 5,1+ 06 5,1+ 06	C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C4 C	C4 C4 C4 3A2/FD 00 829,7+ K2 05D/FD 23 829,7+ K2	C6 C3 C4 C3 3/7C 055/5 8.3+ K30.7 C/7C 241/5 8.3- K30.7	227/203 - D8.7- 01 : 100/203 : D8.7+ 01	103/F3 019.7- 76 212/F2 019.7+ 76	174/84 020.5- 91 174/84 020.5- 91	243/DC 050 828.6+ 823 180/DC 3A3 828.6- 823	2/FD 28C/50 9.7- 828.2- 2/FD 142/50 9.7+ 828.2-	: 385/27 - 823.7+ : 058/28 + 827.7-	588/27 223.7+ 057/27 223.7-	343/10 #28.0+ 080/10 #28.0+	382/FD 829.7+ 050/FD 829.7-	3A2/FD #29.74 05D/FD #29.74	003/10 828.3+ 220/70 828.3-	065)/FD 829,7- 3A2/FD 829,7+	056/78 830.7- 2AL/78 830.7+	180/00 24 828.6- 82 243/00 18 828.6+ 82	5/DC 058 1.6+ 827 5/DC 384 1.6- 827	85 330/10 7- 828,3- 98 003/10 7+ 828,3+
NUD 0 0x0 Blank = 0	Lane 0 Lane 1 Lane 2 Lane 3 Eby Lane 0 Eby Lane 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	C4           C28.6+           C28.6+           C28.6+           C4           C4	C6 C6 342/70 00 829,7+ 82 655/70 33 829,7+ 82 342/90 00 829,7+ 82	C4         C3           C4         C3           C4         C3           S3/7C         O55/2           8.3+         K30.7           C/7C         3A2/6           8.3-         K30.7           S3/7C         O56/8           8.3+         K30.7           S4/7C         O56/8           8.3+         K30.7	2 227/23 D8.7- 01 100/20 28.7+ 01 5 227/29 D9.7- 01	103/F3 019.7- 76 212/F2 019.7+ 76 103/F3 019.7- 76	174/84 020.5- 91 174/84 020.5- 91 174/84 020.5- 91	243/DC 05c #29.64 #29 196/DC 282 #28.64 #29 #28.64 #29 243/DC 055 #29.64 #29	D/FD 28C/50 9.7- x28.2- 2/FD 142/50 9.7+ x28.2- 9.7+ x28.2- 0/FD 28C/50 9.7- x28.2-	2 358/97 823.7+ 2 058/98 827.7- 011000000 5 343/10 828.0+	548/97 923.7+ 057/97 923.7- 823.7- 348/97 923.7+	343/10 #28.0+ #28.0- 343/10 #28.0+	382/FD 829.7+ 05D/FD 829.7- 382/FD 829.7+	3A2/ED 829,7+ 05D/ED 829,7- 3A2/ED 829,7+	003/70 K29.3+ 230/70 K28.3- 003/70 K29.2+	05D/FD 829.7- 2A2/FD 829.7+ 05D/FD 829.7-	055/FE 830.7- 2A1/FE 830.7+ 056/FB 830.7-	180/DC 24 829.4- 82 242/DC 18 829.4+ 82 81113114114 180/DC 24 829.4- 82	5/DC 058 8.6+ 827 5/DC 284 1.6- 827 5/DC 058 1.64 827	PB 33C/10 7- 828.3- FB 002/10 7+ 828.3+ FB 33C/10 7- 828.3-
NUD 0 0x0 Blank = 0	Lane 0 Lane 1 Lane 2 Lane 3 Eby Lane 0 Eby Lane 1	0 0 0 0 0 0 0 0 0 0 0 0 0 0	C4           C4           C4           C4           C4           C4           BC/DC           C4           X28.6-           C4           X28.6-           C4           X28.6-           C4           X28.6-           C4           X28.6-           C4           X28.6-           C4           C4           X28.6-           C4           X28.6-           C4           X28.6-           C4           X28.6-	C6 C6 C6 362/TD 055/TD 055/TD 352/TD 36	C4         C3           C4         C3           C4         C3           C4         C3           C4         C3           C4         C3           S,3+         S30,7           C4         C3           C5         C4           C4         C3           C4         C3           C5         C4           C4         C3           C5         C4           C4         C4           C5	2 227/28 28.7- 01 2 158/28 2 8.7- 01 2 158/28 01 01 01 01 01 01 01 01 01 01	103/F3 019.7- 78 212/F3 019.7+ 76 103/F3 019.7- 76 203/F3 019.7- 76	174/24 020.5- 91 174/24 020.5- 91 174/84 020.5- 91 174/84 020.5- 91	243/DC 050 828.6+ 823 186/DC 363 828.6- 823 243/DC 050 828.6+ 823	2/FD 28C/5C 9,7- 928.2- 2/FD 142/5C 9,7+ 928.2- 1000000000000000000000000000000000000	2 388/27 2 358/27 2 058/28 5 27.7- 011000000 0 343/10 829.0+ 011000000 2 343/20 6 282.0+	S88/27 #23.7+ 057/27 #23.7- 1000000000000000000000000000000000000	343/10 #28.0+ GBC/10 #28.0- 343/10 #28.0+ GBC/10 #28.0-	382/FD 829.7+ 055/FD 829.7- 382/FD 829.7+ 055/FD 829.7-	3A2/ED 829.7+ 05D/ED 829.7- 3A2/ED 829.7- 05D/ED 829.7-	003/70 828.3+ 330/70 828.3- 003/70 828.3+ 003/70 828.3+ 330/70	050/FD 829.7- 3A2/FD 829.7+ 050/FD 829.7- 3A2/FD 829.7-	055/75 K30.7- 200101111 2A1/7E K30.7+ 056/YB K30.7- 056/YB K30.7- 056/YB K30.7- 056/YB K30.7-	180/DC 24 928.6- 92 243/DC 18 943/DC 18 943/DC 18 180/DC 24 829.6- 82 191000111 243/DC 18 243/DC 18	5/bc 058 1.64 827 5/bc 284 1.6- 827 5/bc 058 1.64 827 5/bc 284 1.64 827	PB 33c/1c 7- #28.3- PB 0c3/1c 7+ #28.3+ PB 33c/1c 7- #28.3+ PB 0c3/1c PB 0c3/1c

### Search

Search for events in *Event Selector View* by typing the event name in the search bar and pressing enter. The events found are highlighted and shown in the *Wave Form View* and the *Symbol View*.

Link Timeline Viewer "C:\Users\karih\Pictures\capture\_20241104\_145850" [8100 Mbps, 4 lanes]

File Options About				
FrameView Reports Images				
Main Link Events Symbols Log E	vents			
<b>V</b> BID		] 🛃 🗙	🗌 Aa 🗌 RExp 🔀	3 / 18154 🕨 🙆 🤗
Туре	Id	Position	Duration	End ^
✓ LINE	1	0:034.617.505.338	0:000.010.113.535 81 920 bits	0:034.627.618.873
BS		0:034.617.505.338 280 403 020 bits	0:000.000.004.937 40 bits	0:034.617.510.275 280 403 059 bits
VBID		0:034.617.510.276 280 403 060 bits	0:000.000.001.234	0:034.617.511.510 280 403 069 bits
MVID		0:034.617.511.511 280 403 070 bits	0:000.000.001.233	0:034.617.512.744 280 403 079 bits
MAUD		0:034.617.512.745	0:000.000.001.234	0:034.617.513.979 280 403 089 bits
✓ LINE	2	0:034.627.618.874	0:000.010.113.535	0:034.637.732.409
BS		0:034.627.618.874 280 484 940 bits	0:000.000.004.937 40 bits	0:034.627.623.811 280 484 979 bits
VBID		0:034.627.623.812	0:000.000.001.234	0:034.627.625.046
MVID		0:034.627.625.047	0:000.000.001.233	0:034.627.626.280 280 484 999 bits
MAUD		0:034.627.626.281	0:000.000.001.234	0:034.627.627.515 280 485 009 bits
> LINE	3	0:034.637.732.410 280 566 860 bits	0:000.010.113.535	0:034.647.845.945 280 648 779 bits
> LINE	4	0:034.647.845.946	0:000.010.113.535	0:034.657.959.481
> LINE	5	0:034.657.959.482 280 730 700 bits	0:000.010.113.535 81 920 bits	0:034.668.073.017 280 812 619 bits
> LINE	6	0:034.668.073.018	0:000.010.113.535	0:034.678.186.553



Click the enter icon to search.



Use Case Sensitive and/or Use regular expressions.

3 / 18154

Arrows navigate to next or previous filtered event.

0

The gear icon opens the *Configure search* dialog. Select which columns are used for searching and what criteria (*Case Sensitive* or *Use regular expression*) are used. Click the *Apply* to refresh.

$\frac{1}{2}$ Configure search $\times$	
Case Sensitive	
Use regular expression	
Columns:	
🗹 Туре	
✓ Id	
Position	
Duration	
🗹 End	
Apply	]

Ò

Click to synchronize views.

#### **Symbols Tab**

Symbols tab lists PHY level events found.

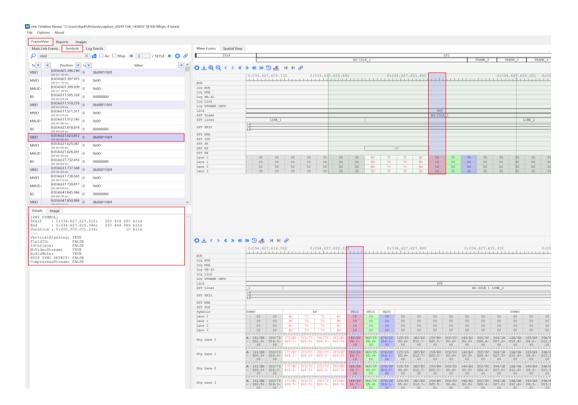
Link Timeline Viewer "C/Users\k e Options About	karih\Pictures\capture_20241104_145850" [81	() Mfops, 4 lanes)	
FrameView Reports Ima	ages		
Main Link Events Symbols	Log Events		
D vbid	X 🛃 🗌 Aa 🗌 R5p H 1	(1854 N O O	
Ty Position •			
BID 0:034.607.396.740 280.227 (40.5m)			
MID 0:034.607.397.975			
MUD 0:034.607.399.209			
IS 0:034.617.505.338	0 00000000		
BID 0.034.617.510.276	0 0600011001		
AVID 0.034.617.511.511	0 0x00		
4AUD 0:034.617.512.745	0 0x00		
s 0:034.627.618.874			
BID 0.034.627.623.812			
MD 0:034.627.625.047	0 0x00		
MUD 0:034.627.626.281	0 0x00		
s 0.034.637.732.410	0 00000000		
BID 0:034.637.737.348	0 0600011001		
MD 0:034.637.738.583	0 0x00		
MUD 0:034.637.739.817	0 0x00		
s 0.034.647.845.946	0 00000000		
BID 0.034.647.850.884	0 0600011001		
Туре:	Type of it	em: FRAME, LINE or Event name	
d:	Idontifica	tion number	
u.	IUEIIIIII.a		
Position:	Timestan	np from start of the capture	
Lane:	The main	link Symbol lane	
	0	-1	
Value:	Symbol v	alue	

### Search

Search and filter symbols as described above for the *Main Link Events Tab*. Each column additionally has a drop down filter dialog (down arrow icon): Use these to sort and select events. The screenshots below show a *VBID* event search and a column filter dialog.

Frame	View Reports	Ima	ges		
Main L	ink Events Sy	ymbols	Lo	g Events	
PV	BID		×	Aa 🗌 RExp 🛿 1 / 276 🕨	0
Ту	Positi	ion 💌	4-	Value	1
VBID	0:153.253.2		0	0600010001	
VBID	0:153.267.9		0	0600010001	
VBID	0:153.282.8	314.570	0	0600010001	
VBID	0:153.297.6	534.258	0	0600010001	
VBID	0:153.312.4	49.008	0	0600010001	
VBID	0:153.327.2	63.758	0	0600010001	
VBID	0:153.342.0	78.508	0	0600010001	
VBID	0:153.356.8	393.258	0	0600010001	
VBID	0:153.371.7	712.946	0	0600010001	
VBID	0:153.386.5	527.696	0	0600010001	
	lue Sort Ascen				
1	llue Sort Ascen	ding	_		
1	lue	ding	)		
<b>↑</b>	llue Sort Ascen Sort Desce Clear Sort	ding nding	)		
↑ ↑ ↑ ↑ ~	ilue Sort Ascen Sort Desce	ding nding	9		
↑ ↓ ↑ ↑ ▼	lue Sort Ascen Sort Desce Clear Sort Clear Filter Search:	ding nding	3		
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	Ilue Sort Ascen Sort Desce Clear Sort Clear Filter Search: Select all	iding Inding	3		
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	Sort Ascen Sort Desce Clear Sort Clear Filter Search: Select all	iding inding	3		
↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑	Sort Ascen Sort Desce Clear Sort Clear Filter Search: Select all © 00000 © 00000	iding Inding			
	Sort Ascen Sort Desce Clear Sort Clear Filter Search: Select all O00000 O00000 O00000	iding inding	0		
	Ilue Sort Ascen Sort Desce Clear Sort Clear Filter Select all O 00000 O 00000 O 00000 O 00000 O 00000	iding inding 0000 02c 01000	0		
	Sort Ascen Sort Desce Clear Sort Clear Filter Select all O 00000 O 00000 O 00000 O 00000	iding inding 0000 02c 01000	0		
	lue Sort Ascen Sort Desce Clear Sort Clear Filter Search: 00000 0 00000 0 00000 0 00000 0 00000 0 00000	iding inding 0000 02c 01000	0		

Searching will highlight all found event symbols. When selected, it will also be selected in the *Wave Form View*, the *Symbols View* and the *Event Details View*. You can browse through symbols using the next or previous arrow buttons.



## **Event Details**

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

#### **Details tab**

The information shown in the Details tab depends on the event selected.

#### Frame

Details Image	
[FRAME] Start : 0:203.253.553.972; End : 0:219.921.436.604; Duration : 0:016.667.882.632;  HTOtal : 2200 pixels VTotal : 1125 lines HActive : 1920 pixels VActive : 1080 lines HStart : 192 pixels VStart : 41 lines HSync : 44 pixels VSync : 5 lines Total pixel count 6220800	1 781 371 429 bits

Details shown above are FRAME details.

#### Line

Details	Image							
End Duration  VBID Vertica FieldID Interlad NoVideoS AudioMut HDCP SYN	: 0:153. n : 0:000. 1 lBlanking: ce: Stream:	FALSE FALSE FALSE FALSE FALSE	1	241	449	269	bits	
MAUD	119 44 1 punt = 0	0x77 0x2c 0x1						

In the image above the selected *Line* is part of blanking (*VerticalBlanking* is *TRUE*). Audio is not being streamed (*AudioMute* is *FALSE*).

#### MSA

Details In	nage					
[MSA]						
Start :	: 0:153.249	9.931.998;	1 241	329	880	bits
End :	: 0:153.249	9.943.108;	1 241	329	969	bits
Duration :	: 0:000.000	0.011.110;			90	bits
FIELD	DEC	HEX	BITS			
MVid	6007	0x1777				
NVid	32768	0008x0				
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	001000	000		
MISC1	0	0x0	000000	000		

MISCO.Synchronous Clock: Link clock and main video stream clock are asynchronous. MISCI.Interlaced Vertical Total Even: Number of lines per interlaced frame (consisting of two fields) is an odd number MISCI.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

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### SDP

Details	Image
End	: 0:034.894.928.816; 282 650 160 bits : 0:034.894.943.629; 282 650 279 bits : 0:000.000.014.813; 120 bits
Secondar HBO (ID) HB1 (Typ HB2 HB3 PB0 PB1 PB2 PB3	y-data Packet 0x00 0x01 Audio_TimeStamp 0x17 0x48 0x00 0x67 0x35 0xD1 necksum OK
Data che	cksum OK
Maud Naud	0x0000012C 300 0x00008000 32768
PB4 PB5 PB6 PB7 PB8 PB9 PB10 PB11	0xB4 0xB4 0xB4 0xF4 0x7F 0x7F 0x7F 0x7F

Different SDP events have individual details. An audio stamp event is shown above.

### **PHY Symbol**

Details	Image				
End	: 0:1 : 0:1	70.271.298.270; 70.271.299.503; 00.000.001.233;		559	
	: ce: Stream: te: NC DETE	ng: TRUE FALSE FALSE FALSE FALSE CT: FALSE am: FALSE			

Events such as BS, VBID and MVID are shown as [PHY\_SYMBOL]. A VBID event is shown above.

### PHY Area

Details	Image					
[PHY AR	EA]					
Start	: 0:	000.000.000.00	0;		0	bits
End	: 0:	000.854.703.66	7; 6	923	129	bits
Duratio	n : 0:	000.854.703.66	7 <b>;</b> 6	923	130	bits
TPS1						

[PHY Area] events are TPS events. A TPS1 event is shown.

### Image tab

Image tab shows the captured *FRAME* active area. Images are shown only shown when a *FRAME* is selected.

SST Stream		0.000.009.259.063	0:002.207.395.066	0:002.216.654.129
> FRAME(bad)	1	75 000 bits	17 880 280 bits	17 955 279 bits
> FRAME(bad)	2	0:002.216.654.130 17 955 280 bits	0:014.399.524.866	0:016.616.178.996 134 593 909 bits
> FRAME	3	0:016.616.178.997	0:016.666.123.615	0:033.282.302.612
> FRAME	4	0.033.282.302.613	0.016.666.111.268	0:049.948.413.881
> FRAME	5	0.049.948.413.882	0.016.666.119.911	0:066.614.533.793
> FRAME	6	0.066.614.533.794	0.016.666.122.379	0:083.280.656.173
> FRAME	7	0.083.280.656.174	0:016.666.114.973	0:099.946.771.147
> FRAME	8	0:099.946.771.148	0:016.666.117.441	0:116.612.888.589
> FRAME(bad)	9	0:116.612.888.590	0:004.740.585.679	0:121.353.474.269
Details Image				
Image				

# Wave Forms View

Wave Forms View consists of two tabs: Wave Forms and Spatial View.

### **Wave Forms**

TPS4					SST						
		BS-IDLE_1				FRAME_2	FRAME_3	FRAME_4	FRAME_5	FRAME_6	FRJ
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	0:153.253.211.208 0:153.253.224	.300		0:153.23	8.243.48	1 0:153.253.2	50.484		.253.263.57		3.253
							1111111				
AUX											
Log AUX											
Log MSA											
Log VB-ID											
Log Link											
Log VERAME INFO											
Link					SST						
SST Frame	BS-IDLE_1							FRAME_2			
SST Lines	LINE_11731							LINE_0			
SST VBID	0			-							
SST MSA	11				-			MSA			
SST SDP											
SST SR											
SST BS			BS	1							
SST BE											
Lane 0	00 00 00 00 00 00 00 00 00 00 00 00 00		0 BC 7C 7C BC	11 76 00	00 00 00	00 00 00 00 00	5c 5c 00 1	7 76 08 98 04	65 00 2C ED	00 00 00 00	00 00
Lane 1	00 00 00 00 00 00 00 00 00 00 00 00 00										
Lane 2	00 00 00 00 00 00 00 00 00 00 00 00 00										
Lane 3	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00	0 BC 7C 7C BC	11 76 00	00 00 00	00 00 00 00 00	5C 5C 00 1	7 76 00 80 00	20 00 00 FD	00 00 00 00	00 00
JX:	AUX channe	l events									
ng Aux	Log packets	for ALIX									

Log MSALog packets for MSALog VB-IDLog packets for VB-IDLog LinkLog packets for Link (TPS1, TPS2, TPS3, TPS4 detection)Log VFRAME INFOLog video frame dataLink:Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)SST FrameSST frame numberSST LinesSST Line numberSST VBIDSST vertical blankSST SDPSST SDP periodSST SST SRSST SST SST SST SST SST SST SST SST SST	Log Aux	Log packets for AUX
Log LinkLog packets for Link (TPS1, TPS2, TPS3, TPS4 detection)Log VFRAME INFOLog video frame dataLink:Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)SST FrameSST frame numberSST LinesSST Line numberSST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	Log MSA	Log packets for MSA
Log VFRAME INFOLog video frame dataLink:Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)SST FrameSST frame numberSST LinesSST Line numberSST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	Log VB-ID	Log packets for VB-ID
Link:Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)SST FrameSST frame numberSST LinesSST Line numberSST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	Log Link	Log packets for Link (TPS1, TPS2, TPS3, TPS4 detection)
SST FrameSST frame numberSST LinesSST Line numberSST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	Log VFRAME INFO	Log video frame data
SST LinesSST Line numberSST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	Link:	Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)
SST VBIDSST vertical blankSST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	SST Frame	SST frame number
SST MSASST MSA periodSST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	SST Lines	SST Line number
SST SDPSST SDP periodSST SRSST SR symbol periodSST BSSST BS symbol periodSST BESST BE symbol period	SST VBID	SST vertical blank
SST SR     SST SR symbol period       SST BS     SST BS symbol period       SST BE     SST BE symbol period	SST MSA	SST MSA period
SST BS     SST BS symbol period       SST BE     SST BE symbol period	SST SDP	SST SDP period
SST BE     SST BE symbol period	SST SR	SST SR symbol period
	SST BS	SST BS symbol period
	SST BE	SST BE symbol period
Lanes (0-3): Data and control symbols	Lanes (0-3):	Data and control symbols

Captuared FRAMEs are shown at the top. As no triggers were set on the example below, the first *FRAME* is not fully captured.

Wave Forms Spatial	View							
			SST					
F1 FRAME (bad) 2	FRAME_3	FRAME 4	FRAME 5	FRAME	6	FRAME 7	FRAME 8	F9
$\mathbf{O} \pm \mathbf{Q} \mathbf{Q} \langle \rangle$	« » « » 🖱	<u>na I</u>						

Select a frame by double-clicking it: It turns light purple and the Wave Form View will be focused.

Wave Forms Spat		
	SST	
F1 FRAME (bad) 2	FRAME_3 FRAME_4 FRAME_5 FRAME_6 FRAME_7	FRAME_8 F9
<b>○</b> ± €	» « » 🕲 🏤 🔟 🕨	
	16.616.169.687 0:016.616.198.82( 0:016.616.209.25; 0:01	6.616.219.068016.616.230
AUX		
Link	SST	
Frame	FRAME_3	
Lines		
VBID		
MSA	MSA	
SDP		
Symbols	BS	
Lane 0	C 7C 7C 8C 01 77 91 00 00 00 00 00 00 00 00 5C 5C 00 17 77 08 98 04 65 00 2C FD 00 00 00 00 00 00	00 00 00 00 5C 80 80 01 00 C
Lane 1	C 7C 7C 8C 01 77 91 00 00 00 00 00 00 00 00 5C 5C 00 17 77 00 C0 00 29 00 05 FD 00 00 00 00 00	00 00 00 00 5C 04 04 00 00 C
Lane 2	C 7C 7C 8C 01 77 91 00 00 00 00 00 00 00 00 5C 5C 00 17 77 07 80 04 38 00 00 FD 00 00 00 00 00 00	
Lane 3	C 7C 7C 8C 01 77 91 00 00 00 00 00 00 00 00 5C 5C 00 17 77 00 80 00 20 00 00 FD 00 00 00 00 00	00 00 00 00 5C 18 D1 00 00 C

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#### As the cursor moves over the view, the timestamp is displayed.

																		SS	т																								
F1 FRAME (bad) 2		E	RAM	E_3				1	FRA	ME	4					F	RAM	IE_5	;				FF	AME	E_6					FR	AME	_7					F	RAM	E_8	3		L	F
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Lines																										I	IN	E_0															
VBID	034				_	_	_	_									_	_																	_	_	_	_	_	_	_	_	
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Symbols																																											1
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Lane 1	00	BC 7	C 70	C BC	01	77	91	00	00	00	00	00	00	0	p d	0 5	ic 5	ic (	00 1	7 7	7 0	00 0	:0 0	00	29	00	05	FD	00	0 00	0 0	0 0	00	00	00	00	00	5C	04	04	00	00	j
Lane 2	00	BC 7	C 70	C BC	01	77	91	00	00	00	00	00	00	0	p	0 5	ic 5	ic (	00 1	7 7	7 0	07 8	0 0	)4 3	38	00	00	FD	00	0 00	0 0	0 0	00	00	00	00	00	5C	4B	B D7	00	00	j
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Move the mouse over an event period in Wave Form View to see details via a popover.

FrameView Reports Imag Main Link Events Symbols					Wave Forms Spatie	d Minus								
Q void	tog trens			RExp H 1 /8042 H Q						887				
Type	ld	Position	Duration	End	F1 FRAME (bad) 2		FRAME 3		25 4	FRAME_5	FRAME	6 1	FRAME_7	FRAME_8 P
v SST Stream	60	Position	Daration	Eng	O T O O < :	• <b>« »</b>								
> FRAME/bad)	12	0.000.009.259.063	0:002.207.395.066	0.002.216.654.129	2175	-	0:016.6	16.204.860		01016.616.213.	0:016	.616.220.934	0:016,616.2	28.0101016.616.23
	- S	0.002,216,654,110	0.014.399.524.866	0.016.616.178.996	Link	1					207			
> FRAME(bacl)	2	0.016.616.178.997	0.016.666.123.615	0.033.282.302.612	Fraze	0			FRAME_3					
✓ FRAME	3				VBID	17			eans_v					
✓ BLANK(45 lines)		0.016.616.178.997	0.000.666.590.772	0.017.282.769.769	NIA NIA	ć	_	-	-					
✓ LINE	0	0.016.616.178.997	0.000.014.752.772	0.016.630.931.769	80P 9		_							500 B4 0
BS		0.016.616.178.997	0:000.000.004.938	0.016.616.183.935	symbols Lane 0	I AND IN A	7 77 08		016.616.199.98					
VEID		0.016.616.183.936	0:000.000.001.233	0016.616.185.169	Lane 1	00 11	7 77 00	Duration / 0	016.614.211.09	5; 134 594 169 0/ 90				
MVID		0.016.616.185.170	0:000.000.001.234	0.016.616.186.404	Lane 2 Lane 3		7 77 01		HEX	SITS				
MAUD		0.016.616.186.405	0.000.000.001.233	0016.616.187.638				swid 60	7 0x1777					
		0.016.616.199.985	0.000.000.011.110	0.016.616.211.095				NVid 32 EActive 18	0008x6000					
MSA			92.00					VActive 10	0:0:430					
SDP_84	0	0.016.616.224.676	0.000.000.014.813	0.016.616.239.489				HTOLAL 22 VTotal 11	15 0x465					
Details Image								NUCEARE 41	0x29					
(FRAME)								VSynWidth 5 ESynWidth 44	0x5 0x20					
Start : 0:016.616.1	78.997;	134 593 910 bits			0 Ŧ < > « >		-	MINCO 32	0x20					
End : 0:033.292.30 Duration : 0:016.666.13		069 592 379 bits 134 998 470 bits				0:016.61	16.179.57	3			video stream cl			
					AON Link			MIDC1.Interl	aced Vertical T	otal Even: Mumbe	of lines per in	terlaced frame (	consisting of two	fields) is as odd musi
BTotal : 2200 pixel: VTotal : 1125 lines					Lines						ideo in-band sig	naling		
HActive : 1920 pixel:					MEA/SDF Symbols			MIDC.Colorim	stry Format Val	set 1 Ox B unspecified co	or space (Legacy	ROB model . 8 br	ic. Shot	
VActive : 1080 lines EStart : 192 pixels					Lane 0	38	70							
VStart : 41 lines					Lane 1 Lane 2	10								
HSync : 44 pixels VSync : 5 lines					Lane 3	1				17 77 77 08 58 0 29 38 20 00 00 0				
VSync : 5 lines						and the set	THO AT THE MENT	11 20 05 00 00	re ou ve ou er.	28.35 20 00 00 0				
					Hty Lane 0	H 828.5	H 828.3-		01 31	31 00	00 00	00. 00	00 00	01.0+ 829.2+ 829 00
						2 17C/m		33c/7c 283/80	174/84 234/	4A 188/A4 006/	0 271/31 1B1/5	12 2CD/8D 18C/	D0 186/D0 298/48	0AE/01 28C/5C 143 D1.0- #25.2- #25
					Phy Lane 1	1.12.6			01 77	91 00	00 00	00 00	00 00	00
					thy Lane 2	100 00 110 2 170/8 + 825.5	101111001110 RC 002/10 I- 928-3+	33C/1C 283/80 #28.3- #25.5-	01 77 174/84 233/ D20.5- D10.	91 00 4A 165/A4 006/ 2- D4.5- D0.3	00 D0 0 271/31 181/5 + D17.1- D17.6	00 00 1 205/80 180/ - D13.4- D24.	00 00 D8 186/D6 298/48 6+ D16.6- D8.2+	00 0AE/01 2BC/5C 143 D1.5- #29.2- #29
					thy Lane 2	1900000000000 2 150780 9 826.5	10110000000 10 003/10 1- 928.3+	33C/1C 283/80 925.3- 825.54	01 77 174/84 233/ 020.5- 810. 01 77	91 00 4A 165/A4 006/ 2- 04.5- 00.1 91 00	00 D0 0 271/31 181/5 + D17.1- D17.6 00 D0	00 00 1 200/80 180/ - D13.4- D24. 00 00	00 00 D6 186/D0 298/48 6+ D16.6- D8.2+ 00 00	00 OAE/01 2BC/5C 14

Double-clicking anywhere in the *Wave Forms View* synchronizes the *Symbols View* and the event is selected in *Event Selector* when as shown below. The green vertical area in *Wave Form View* shows the position within an event.

Nucle         Specify         Specify <thspecify< th=""> <thspecify< th=""> <thspe< th=""><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></thspe<></thspecify<></thspecify<>																							
Mode	ameView Reports Imag					Law a law																	
$\frac{1}{2} \frac{1}{10001} \frac{1}{2001} \frac{1}{200000} \frac{1}{200000000000000000000000000000000000$		Log Events					patial view							25	87								
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0       0	Type	Id				^ O±QQ <	) <u>«</u>	<b>»</b> «	x 🔉 🕑	🛃 H	M												
> (M605W0       350       00214523459       00214420671       0021452355         > (M605W0       350       00214809336       00204420671       00219379304         > (M605W0       350       00219879355       002044558       00219379304         > (M605W0       350       00219877540       002044558       002193755877         > (M605W0       002193757460       002044558       002193758677       002044588       002193758677         > (M605W0       002193757460       0020459757687       002004597576877       00201937576877       00201937576877         > (M605W0       002193757687       0020048977       00219375844897       0021937584587       0021937584587         > (M605W0       002193757687       0000049877       0021937584587       0021937584587       0021937584587         > (M605W0       0021937584237       0000049877       002193875847       0021937584587       0021937584587         > (M605W0       002193758421729       0000049877       002193874847       002193874847       00219375844877         > (M605W0       0021937874687       00219387484877       0011938448877       0011938448877       0011939748448877         > (M605W0       0021938748747       0020948787       00219387484877       001199779979799799797997997	> LINE(5760)	354			0:021.875.258.597		- Ib	1,919	9,648,55		920,258	.061	0:02	1.920.	867.57!	0	:021.92	21.477.0	084		0:0	21.937.	181.495
→       InterConstruction       316       000014481320       000014481330       000014882305         →       InterConstruction       316       000014882305       000014882307       000014883007       00001483007       0000148230	> LINE(5760)	355				AUX	-#*		-					-		-							
LINE 100         101         001/19/19/00/10         0000/19/19/00/00           LINE 100         101         101/19/10/10/10         101/19/10/10/10         101/19/10/10/10         101/19/10/10/10/10         101/19/10/10/10/10/10/10/10/10/10/10/10/10/10/	1 UNE/57670	156	0.021.890.079.270	0.000.014.813.265	0:021.904.892.535		- #									70							
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The image below shows you how the different areas of the Link Timeline Viewer synchronize when you double-click a *FRAME* in *Wave Form View*.

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### Measuring

The ruler tool allows users to measure distance between two points on the timeline. Two right-clicks on the timeline (or on the same row) will display the distance between the two points as shown below.

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#### Zooming

Zoom happens via the mouse wheel. When zooming it is important to keep the cursor centered on your point of interest. Various events appear as vertical lines or solid areas when zoomed out. As you zooming in, spans begin to appear and finally text begins to appear. Images at various stages of zoom are shown below.

Original view.

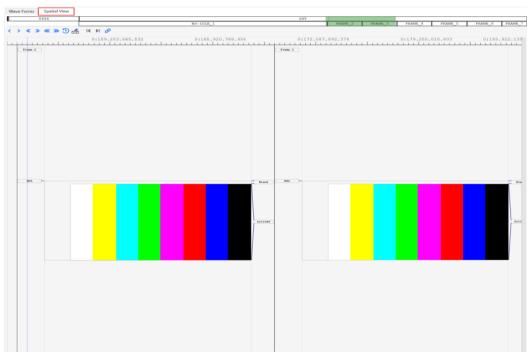
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> LINE(5760)	54	0:154.053.290.211	0.000.014.814.749	0.154.068.104.960	507 35 507 35					36													
> LINE(5760)	55	0:154,068,104,961	0:000.014.819.688	0.154,082,924,649	Lane 0 Lane 1	00 00 00 00			00 00		rr rr	TT TT FF FF	rr r	r rr	rr rs	00 0	00 0	00 00	00 0	0 00	00 00	00 00	
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> LINE(\$760)	57	0:154.097.739.400	0:000.014.814.749	0:154.112.554.149	Lane 3	00 00 00 00 00	0 00 00	00 00	00 00	00 FB	11 11	11 11	77 7	7 77	11 11	00 0	00 0	00 00	00 0	00 0	00 00	00 00	00 0
> LINE(\$250)	58	0:154.112.554.150	0:000.014.814.749	0.154.127.368.899																			
> LINE(5760)	59	0:154.127.368.900	0.000.014.819.687	0:154.142.188.587																			
> LINE(\$760)	60	0:154.142.188.588	0.000.014.814.749	0.154.157.003.337																			
		0:154.157.003.338	0:000.014.814.749	0:154.171.818.087																			
> LINE(5760)	60 61 62	0:154.157.003.338 1.00077199.66 0:154.171.818.088	0:000.014.814.749 107:007 Noi 0:000.014.814.749	0:154.171.818.087 1.041.707.818.087 1.041.707.709.66 0:154.186.632.837																			
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> LINE(5760) > LINE(5760) ✓ LINE(5760) BS VBID MAUD	61 62	0:154.157.003.338 1.8697179346 0:154.771.318.008 1.8697179346 0:154.165.62.2838 1.8697179346 0:154.165.62.2838 1.8697179346 0:154.165.632.838 1.8697179346 0:154.165.632.839 0:154.165.632.839 0:154.165.632.839 0:154.165.640.859 0:154.165.640.859	0.000.014.814.749 10707 Ab 10707 A	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	v ANX Log ANX Log NEA	0:154.100.557.730	0:15	4.100.563	.004	0	154.10	10.540.2	83		0:154.3	108.574	.043	1	0:15	1.100.5	78.034	013	54.10
> LINE(5760) > LINE(5760) = LINE(5760) BS VBD MVID MVID BE LINE(5760) MVID MVID BE LINE(5760) MVID	61 62 63	0.154.157.003.338 1.080071996 0.154.171.018.080 0.154.105.052.039 0.154.105.052.039 0.154.105.052.039 0.154.105.052.039 0.154.105.053.031 1.08072046 0.154.105.053.031 1.08072046 0.154.105.053.031 1.08072046 0.154.105.053.031 1.08072046 0.154.105.052.039 1.0804205 1.0804505 1.08050505 1.080505 1.08050505 1.08050505 1.08050505 1.080505050505050505050505050505050505050	0:000.014.814.749 0:000.014.814.749 0:000.014.814.749 0:000.014.814.749 0:000.014.814.749 0:000.000.001.234 0:000.000.001.233 0:000.000.001.233 0:000.000.001.233 0:000.000.001.233 0:000.000.001.233	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AUX Log AUX Log AUX Log SUA     Log VB-ID Log Link	0:154.100.557.730	0:15	4,100.563	.004	•	1154.10	10.560.2	83		0:154.	100.574	.043	1	0:15	1.100.5	78.034	011	54,10
<ul> <li>LINE(5760)</li> <li>LINE(5760)</li> <li>LINE(5760)</li> <li>MNID</li> <li>MNID</li> <li>MNID</li> <li>MNID</li> <li>Image</li> <li>(_5798001)</li> <li>I 01154,188.56</li> </ul>	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AUX     Log MIX     Log MIX     Log MIX     Log VD-ID     Log Link     Log VFIAME INFO	0:154.100.557.730	0:15	4,100,563	.004	0	154.10	10.540.2	13		0:154.1	100.574	.043	1	0:15	1.100.5	78.836	013	54.10
> LINE(5760) > LINE(5760) UNE(5760) BS VHD MAUD MUD BC (53700L) (5350L) (5354,188,56 t : 0:154,188,56 t : 0:	61 62 63	0.154.157.003.338 1.800071995 0.154.177.018.008 0.154.170.018 0.154.105.018 1.800071995 0.154.105.018 1.800071995 1.800071995 0.154.105.018 0.154.	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AUX Log AUX Log AUX Log SUA     Log VB-ID Log Link	0:154.100.557.730	0:15	4,100,563	.004		1:154.10		83 			100.574	.043	1	0:15	1.100.5	78.834	012	54.10
> INE(5760) > INE(5760) = INE(5760) = INE(5760) = INE(5760) = S = S = S = S = S = S = S = S	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AUX Log MIX Log MIA Log VSA Log VSA Log VSA Log VSA Log VSAME INFO Link Log VSAME INFO Link	0:154.100.557.730	0:15	4.100.563	.004		1154.10		887			100.574	.043	1	0:15	1.100.5	78.034	012	54.11
> LINE(5760) > LINE(5760) = LINE(5760) = B = VHD MAUD = MAUD = 0.134,180.56 = 0.134,180.56 = 10.134,180.56 = 10.134,180.56	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	ADX Log SDA Log SDA Log VD-ID Log VD-ID Log VTNAME INFO Link SD7 Lines	0:154.100.557.730	0:15	4,100,563	.004		154.10		887			100.574	.043	1	0:15	1.100.5	78.034		54.10
> LINE(5760) > LINE(5760) = LINE(5760) = BS VBD MAID MAID = BE = C = C = C = C = C = C = C = C	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AIX Log NDA Log NDA Log NDA Log VD-LD Log Link Log VDAMS INFO LIDK SFT VBLD SFT NDA SFT NDA SFT NDA	01156.100.557.730	0115	4,100,563	.004				887			100.574	.043	1	0:15		78.034	012	54,10
> INE(5760) > INE(5760) = INE(5760) = INE(5760) = INE(5760) = S = S = S = S = S = S = S = S	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AIR           Log NRK           NOT NOR           Log NRK           Log NRK           SUP NOR           ANT NOR           ANT NOR           SUP NOR           ANT	0134.186.557.732	DZ	111111	7   17	P1x	:els 77	TIAN	887 61 2 LINE	(5763)_6	13	0	00	00	00	FILL	00	00	00
→ LINE(5760)     → LINE(5760)     → LINE(5760)     w LINE(5760)     w LINE(5760)     w MAD     web     MAUD     web     mage     mage     formanol.1     t    instat.188.56     tiom : 0 + 154.188.56	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	ADK           Log KDK           Log KDK           Log KDK           Log KDK           Log KDK           LOT           LOT           LOT           SPT LION           SPT VEID           SPT FED           SPT KDE           Lone 0           Lane 1	01364.388.557.730	0:15	FF 1	7 77 77	71× 17 17		11111 1100	SST 61 2 LINE FF FF	(5760)_6 IT IT	13 17 17 17	60 00	00	00	00	FILL 00 00	00	00	00
> INE(5760) > INE(5760) = INE(5760) = INE(5760) = INE(5760) = S = S = S = S = S = S = S = S	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	AIR         Log NRK           Log NRK         Log NRK           Log NRK         Log NRK           Log Ves-10         Log Ves-10           Log Ves-10         Log NRK           Log Ves-10         Log Ves-10           Mark	01364.386.557.730 01364.386.557.730 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.386.557.930 0144.586.557.930 0144.586.557.930 0144.586.577.930 0144.586.577.930 0144.586.577.930 0144.586.577.930 0144.586.577.930 0144.586.577.930 0144.586.577.930 0145.577.9300 0145.577.9300 0145.577.9300 0145.577.9300 0145.577.9300000000000000000000000000000000000	0:11 		T IT T IT T IT T IT	21x	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	77AM	SST 6 2 LINE FF FF FF	(5760)_6 (5760)_6		0	00	00	00	FILL	00	00	00
> LINE(5760) > LINE(5760) = LINE(5760) = LINE(5760) = S = S = S = S = S = S = S = S	61 62 63	0.554.457.00.318 1.44477.00.100 0.554.777.0.110.00 0.554.770.010.00 0.554.106.672.00 0.554.106.672.00 0.554.106.673.706 1.24477.0100 0.554.106.673.706 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.673.707 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 0.554.106.012.000 1.24477.0100 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.00000 1.24477.000000 1.24477.00000000 1.24477.000000000000000000000000000000000	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	ADX           Log KIX           Link           AFF Hole           AFF Hole           Link	C01967 C01967	0115 FB FB FB FB FB FB FB FB FB FB FB FB FB	FF 1 FF 1 FT 1 FT 1 FT 1 FT 1 FT 1 FT 1	T IT T IT T IT T IT VIII 2009.2	71x 77 77 77 77 77 77 77 77	els FT TT TT TT TT TT TT TT	77 77 77 77 77 77 77 77 77 77	77 66 2 LINE 77 77 77 77 77 77 77	(\$760)_6 17 17 17 17 17 17 15 15 15 15 15 15 15 15 15 15	F9 F8 F8 F8 F8 F8 F8 F8 F8 F8 F8 F8 F8 F8	60 60 60 60 60 60 60 60	00 00 00 194/04	00 00 00 00	00 00 00 00 00	FILL 00 00 00 00	00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00
> LINE(5760) > LINE(5760) = LINE(5760) = LINE(5760) = S = S = S = S = S = S = S = S	61 62 63	0.554.457.00.318 1.444 er Weis 0.554.77.0.318.06 0.554.77.0.318.06 0.554.166.67.02.00 0.554.166.67.07.07 1.244.07.07.08 0.554.166.67.07.07 1.244.07.07.08 0.554.166.67.07.07 1.244.07.07.08 0.554.166.67.07 0.554.166.97.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.67.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.166.57.07 0.554.167.07 0.554.17	00000174,8114,749 U01004-0 0000014,8114,749 U01004-0 0000014,8114,749 U010040 0000,000,0014,8114,749 U01000,000,0014,813 U0100,000,000,014,233 U000,000,0014,233 U000	12467709360 20154.771.818.0807 126771.818.0807 1267709360 20154.786.632.837 1260709360 20154.786.632.775 1267702360 20154.786.6339.700 12687723960 20154.786.6339.700 12687723960 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.786.6339.700 20154.787 20154.775 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20154.787 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.7777 20155.77777 20155.7777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.77777 20155.777777 20155.7777777 20155.777777 20155.77777	ADX           Log KIX           Log KIX           Log KIX           Log KIX           Log KIX           LOG TO-U           LOG           LOG           KIX           LOG	01 3 4 1 3 8 5 7 7 2 5 7 7 2 5 7 7 2 5 7 7 7 2 5 7 7 7 2 5 7 7 7 2 5 7 7 7 2 5 7 7 7 2 5 7 7 7 2 5 7 7 7 7	0:15 FB FB FB FB FB FB FB FB FB FB FB FB FB	FF 1 FF 1 FF 1 FF 1 FF 1 FF 1 FF 1 FF 1	T TT T TT T TT T TT T TT T TT T TT T T	71x 177 177 177 177 177 177 177 177 177	1 + + + + + + + + + + + + + + + + + + +	779AM	ST ST ST ST ST ST ST ST ST ST	(5760)_6 FF FF FF FF FF FF FF FF FF F	FS FS FE FE SAL/FE SO, 7+ SOUTHER SO, 7+	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 194/Ce D4.6+ 00	00 00 00 263/58 00 363/58	00 00 00 00 00 00 00 00 00 00 00 00 00	FILL 00 00 00 00 224/38 D27.44 00 224/38 D27.44	00 00 00 235/47 27.3+ 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00
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#### Zooming in so spans with text can be seen. Note that views are synchronized.

### **Spatial View**

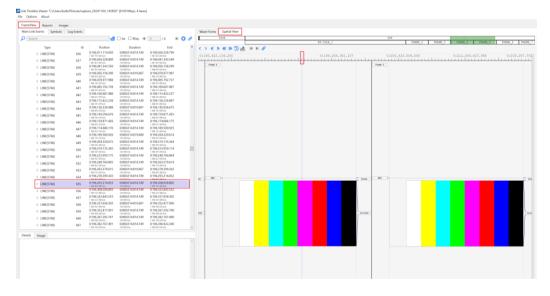
Spatial view shows the geometry of the frame.



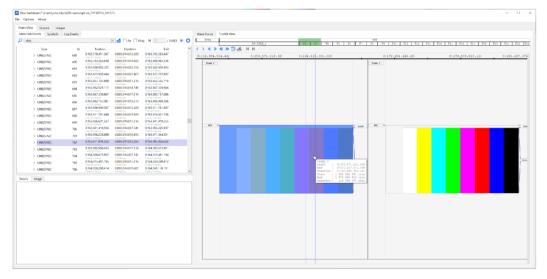
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> FI	LAME	2	0:153.253.234.452	0:016.667.808.559	0:169.521.043.011														
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Selecting a FRAME in Event Selector View will display it in Spatial View.

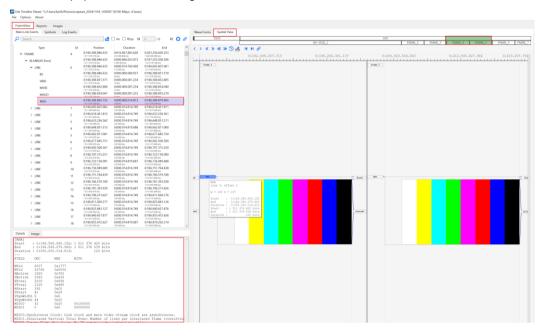
Double-clicking on the timeline, will select the LINE in the Event Selector View as shown below.



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



If you double-click an event label in the *Spatial View* (*MSA* label shown here), it is selected in the *Event Selector View* and details are shown in the *Event Details View*. Details of the event will also be shown in a popover when hovering over the label.



# Symbols View

*Symbol View* shows symbols from the *PHY* lanes in addition to those shown in *Wave Form View*. Scroll *Symbols View* via drag or by using the arrow keys.

			:170.01	7.545.0	0 770	:170.0	017.54	7.953			0:170	0.017.5	53.912			0:170.	017.559	.871			0:170.0	17.565.	830	0	:170.017.
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ane 2	F	BC			BC		11	76	00	00	00	00	00	00	00	00	00	5C	SC	00	17	76	07	80	04
ane 3	F 01010	BC 001111101	7C	7C	BC	01010010	11	76	00	00	00	00	00	00	00	00	00	5C 1100001010	5C 0011110101	00	17	76	00	80	00
hy Lane 0	/AD	17C/BC K28.5-	0C3/7C K28.3+	33C/7C K28.3-	283/ K28.			199/D9		14D/AD D13.5-	0E2/7D D29.3+	27A/2F D15.1-	361/1E D30.0+	219/F9 D25.7+	32B/64 D4.3-	08E/0E D14.0+	25D/3D D29.1-	143/5C K28.2+	2BC/5C K28,2-	358/08 D8.0+	194/C4 D4.6+	157/B7 D23.5-	232/F2 D18.7+	31B/7B D27.3-	151/A1 2 D1.5+ 1
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hy Lane 1	/AD	283/BC K28.5+		0C3/7C K28.3+		BC 0B	4/14	199/D9	OCD/6D	14D/AD D13.5-	31D/7D D29.3-	245/28	09E/1E D30.0-	1D9/F9 D25.7-	0D4/64 D4.3+	34E/0E	262/3D D29.1+	2BC/5C K28.2-	143/5C K28.2+	0A7/08 D8.0-	1AB/C4 D4.6-	168/B7 D23.5+	1DA/FA D26.7-	263/23 D3.1-	165/A5 0 D5.5-
	F						11	76		00	00	00	00	00	00	00	00			00	17	76	00	CO	00
hy Lane 2	/AD	17C/BC K28.5-	0C3/7C K28.3+	33C/7C	283/ K28.	BC 37/	4/14 :		30D/6D		0E2/7D	272/28	361/1E			08E/0E D14.0+		143/5C	28C/5C 828.2-	358/08 D8.0+	194/C4 D4.6+	157/B7 D23.5-		323/63 D3.3+	151/A1 1 D1.5+ 1
	F		8110000110	R20.3-				76	00		00	00	00	00	00		00	N20.27		00	17	76	07	80	04
hy Lane 3	/AD		0C3/7C K28.3+	33C/7C	283/ K28.	BC 374	4/14	199/D9 025.6-	30D/6D	14D/AD			361/1E D30.0+					143/5C K28.2+	2BC/5C #28.2-		194/C4 D4.6*		21A/FA D26.7*		165/A5 D5.5-
	F	K20.3-	K20.3*	F20.3-	R20.	Del	0.0-	76	00	00	00	00	00	00	00	00	00	N20.24	820.2-	00	17	76	00	80	00
				-																					
AUX:				Εv	ent	IS O	of th	ne A	٩UX	cha	nnel														
ink:				1 1.	ak i	otat	~ (	тр	21 -	rDQ4	о те	202	TPS		ет	MC.	T ot	<b>~</b> )							
_111K.				LII	IK 3	รเสเ	.е (	15	<b>э</b> т,	1504	∠, ור	- აა,	IFC	94, C	<b>о</b> т,	IVIS	i eu	<i>.</i> )							
og Aux				10			kati	n fo	r Al	1															
.og Aux				LO	γP	Jaci	Kels	SIL	r Al	J															
				•				~		~															
.og MSA				Lo	ng p	Daci	kets	s to	r M	S															
-																									
.og VB-ID				Lo	a r	baci	kets	s fo	r VI	3-ID															
- J					51																				
.og Link				10	na r	naci	ket	s fo	rli	nk (	TPS	1 T	PS2,	TP.	3.3 7	TPS4	1)								
-og 2					9 1							.,	02,		, .		·/								
.og VFRAM	IE I	NFC	)	Lo	og v	vide	eo f	ran	ne d	ata															
ink:				Lir	nk :	stat	:e (	TPS	S1, <sup>-</sup>	TPS2	2, TF	PS3,	TPS	S4, S	ST,	MS	T ete	c.)							
ines:				Fr	am	e a	nd	line	nu	mbe	r														
											•														
/BID				Ve	ertic	cal	blaı	nkir	ng																
NSA				M	SA	per	rioc	1																	
SDP				SE	)P	(se	cor	nda	rv d	ata p	hack	ets)													
-									-	•															
Symbols:				UC	ontr	01 8	and	sp	ecia	I SY	mbo	is p	erio	IS											
anes (0-3).	):			De	eco	dec	d da	ata	and	con	trol	sym	bols	;											
PHY Lanes	(0-	3):		Bi	nar	y b	it s	trea	am,	10b	/8b :	scra	mble	ed sy	/mb	ols,	sym	bol	cod	e an	d				

### **Link Symbols**

	1/31	3A8/F7	0A5/05	169/A9	21D/FD	24B/2B	32D/62	283	/BC 33C/7C	0C3/7C	17C/BC	361/	1E	09C/1C	0AB/04	25B/3B	2D2/82
hy Lane 0	7.1-	K23.7+	D5.0+	D9.5-	D29.7-	D11.1-	D2.3-	<b>K28</b>	.5+ K28.3-	K28.3+	K28.5-	D30.	0+	D28.0+	D4.0-	D27.1-	D2.4+
	00		00	00	00	00	00		1.0h static 1	0.000	110100/	0.1		77	91	00	00
	111001	1110101000	10100110111	001011010	0100011110	1101001001	0100101100		10b symbol			)0011)	100	0011101011	0010101011	0010011001	101101001
	1/31	057/E7	365/05	169/A9	1E2/FD	24B/2B							E	35C/1C	354/04	264/3B	12D/82
hy Lane 1	7.1-	K23.7-	D5.0-	D9.5-	D29.7+	D11.1-	D2.3+	K28	Symbol code	: K28.	5+		0-	D28.0-	D4.0+	D27.1+	D2.4-
	00		00	00	00	00	00		Descramble	index :	53874 (	xD272		77	91	00	00
	111001	1110101000	10100110111	001011010	0100011110	1101001001	0100101100	00111					100	0011101011	0010101011	0010011001	101101001
	1/31	057/F7	365/05	169/A9	1E2/FD	24B/2B	0D2/62	170	Start :	0:049.5	948.413.8	382	E	35C/1C	354/04	264/3B	12D/82
hy Lane 2	7.1-	K23.7-	D5.0-	D9.5-	D29.7+	D11.1-	D2.3+	K28	End :	0:049.9	948.415.1	117	)-	D28.0-	D4.0+	D27.1+	D2.4-
	00		00	00	00	00	00		Duration :	0:000.0	000.001.2	235		77	91	00	00
	111001	0001010111	10100101001	001011010	1011100001	1101001001	1011010011	11000	Start :	404 59	90 750 bi	ts	011	0011100100	1101010100	1101101001	010010110
	1/31	3A8/F7	0A5/05	169/A9	21D/FD	24B/2B	32D/62	283	End :	404 54	90 759 bi	ts	E	09C/1C	0AB/04	25B/3B	2D2/82
hy Lane 3	7.1-	K23.7+	D5.0+	D9.5-	D29.7-	D11.1-	D2.3-	K28			10 bi		1+	D28.0+	D4.0-	D27.1-	D2.4+
	00		00	00	00	00	00		source and the s		20.00	h he of		77	91	00	00

The lower part of the *Symbols View* displays the values of link symbols on the physical link lanes. You can see the individual bits above the symbol blocks. When you hover your mouse over a symbol, a popover shows details of the symbol:

10b symbol:	Link symbol as sent (in this case 8b/10b link coding)
8b symbol:	Link symbol after conversion to 8 bits
Symbol code:	Link symbol K or D code
Descrambled:	Link symbol value after de-scrambling
Start:	Start of the item from start of the captured data

End:	End of the item from start of the captured data
Duration:	Length of the symbols

A ink symbols is shown below.

Each block contains the following information

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

### Scrambling

The result of scrambling can be seen in *Symbols View.* The first row of each block below shows different 10b/8b link symbols.

	010 010 00	1101001101	0001011100	0111101010	1011001010	0101001010	1010110101
	)4B/EB	2CB/8B	0E8/77	15E/BE	14D/AD	14A/BF	2B5/5F
Phy Lane 0	)11.7+	D11.4-	D23.3+	D30.5-	D13.5-	D31.5+	D31.2-
	00	00	00	00	00	00	00
	01001000	1101001101	0001011100	0111101010	1011001010	0101001010	1010110101
	)4B/EB	2CB/8B	0E8/77	15E/BE	14D/AD	14A/BF	2B5/5F
Phy Lane 1	)11.7+	D11.4-	D23.3+	D30.5-	D13.5-	D31.5+	D31.2-
	00	00	00	00	00	00	00
	01001000	1101001101	0001011100	0111101010	1011001010	0101001010	1010110101
	)4B/EB	2CB/8B	0E8/77	15E/BE	14D/AD	14A/BF	2B5/5F
Phy Lane 2	)11.7+	D11.4-	D23.3+	D30.5-	D13.5-	D31.5+	D31.2-
	00	00	00	00	00	00	00
	01001110	1101000010	1110100011	1000011010	1011001010	1010111010	0101000101
	.CB/EB	10B/8B	317/77	161/BE	14D/AD	175/BF	28A/5F
Phy Lane 3	011.7-	D11.4+	D23.3-	D30.5+	D13.5-	D31.5-	D31.2+
	00	00	00	00	00	00	00

### **Forward Error Correction (FEC)**

FEC parity codes are highlighted in *Symbols View* in light green. CD\_ADJ symbols are highlighted in light red.

В9				В2		
B1				бA		
94	42		A0	2A		
94	42		A0	2A		
1001101010	1110001100	1001011101	1001001101	0100111010	1100010001	10
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+	
1000111010	0011101001	1100010010	0110110010	0101011100	1110010011	01
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-	
0010110010	1011010101	0011001110	0110001010	0101011001	1010011011	01
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-	
0010110010	1011010101	0011001110	0110001010	0101011001	1010011011	01
134/94 D20.4+	2AD/42 D2.2-	1CC/F8 D24.7+	146/A0 D0.5+	26A/2A D10.1-	365/05 D5.0-	2
	B1 94 94 1001101010 159/B9 D25.5- 10000111010 171/B1 D17.5- 0010110010 134/94 D20.4+ 0010110010 134/94	B1         3C           94         42           94         42           1001101010110001100         110001100           159/B9         0C7/67           D25.5-         D7.3-           1000011101000000000000000000000000000	B1         3C         83           94         42         F8           94         42         F8           100110101011000110010010011011         001011010011100010010110101           159/B9         0C7/67         2E9/89           D25.5-         D7.3-         D9.4-           1000011101000000000000000000000000000	B1         3C         83         90           94         42         F8         A0           94         42         F8         A0           100110101010010010010010010010010010010	B1         3C         83         90         6A           94         42         F8         A0         2A           94         42         F8         A0         2A           100110101010100100100100100100100100100	B1         3C         83         90         6A         68           94         42         F8         A0         2A         05           94         42         F8         A0         2A         05           1001101011100011001001010101001001010100100101

### SDP

SDPs are highlighted in turquoise. You can see the start of the SDP event marked as SS and the end of the SDP event marked as SE.

_										SST							
									BS-IDI	E 1 LINE	_3						
							SDP	01_7									
	SS													SE			
	5C	00	60	00	01	2C	00	В4	00	80	00	00	7F	FD			
	5C	01	01 07 00 01 2C 00 B4 00 80 00 00 7F 47 D5 00 01 2C 00 B4 00 80 00 00 7F														
	5C	47	D5	00	01	2C	00	В4	00	80	00	00	7 F	FD			
	5C	18	31	00	01	2C	00	В4	00	80	00	00	7F	FD			
. 0			0101101101	0101100101	0011100110	0100101110			1101100101				0101101010	01000101110			
	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			
	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+			
		00	60	00	01	2C	00	B4	00	80	00	00	7F				
. 0														01000101110			
	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			
	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+			
		01	07	00	01	2C	00	В4	00	80	00	00	7 F				
. 0														10111010001			
	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			
	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-			
		47	D5	00	01	2C	00	В4	00	80	00	00	7 F				
. 0														10111010001			
	2BC/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			
	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-			
		18	31	00	01	2C	00	В4	00	80	00	00	7F				

### **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.

		FE					Pixels					FS	
	00	F7	00	00	00	00	00	00	00	00	00	FE	00
	00	F7	00	00	00	00	00	00	00	00	00	FE	00
	00	F7	00	00	00	00	00	00	00	00	00	FE	00
	00	F7	00	00	00	00	00	00	00	00	00	FE	00
.0010	1011011	0001010111	1100010001	0011101001	0110100101	1001011001	1100011010	1110001100	0110110100	0111001110	1100010101	1000010111	01000110100
3	6A/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
D	10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+
	00		00	00	00	00	00	00	00	00	00		00
0010	1010100	1110101000	1100011110	0011101001	0110100101	1001011001	1100011010	0001110011	1001001011	0111001000	1100010101	0111101000	10111010100
0	AA/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
D	10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	K30.7-	D29.5-
	00		00	00	00	00	00	00	00	00	00		00
.0010	1010100	1110101000	1100011110	0011101001	0110100101	1001011001	1100011010	0001110011	1001001011	0111001000	1100010101	0111101000	10111010100
0	AO/AA	057/F7	1E3/E3	25C/3C	296/56	269/29	163/A3	338/67	349/10	04E/EE	2A3/43	05E/FE	15D/BD
D	10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	к30.7-	D29.5-
	00		00	00	00	00	00	00	00	00	00		00
0010	1011011	0001010111	1100010001	0011101001	0110100101	1001011001	1100011010	1110001100	0110110100	0111001110	1100010101	1000010111	01000110100
3	6A/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
D	10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+
	00		00	00	00	00	00	00	00	00	00		00

#### **MSA**

MSA symbols are highlighted in purple color.

							SST						
	FRAME	4 LINE_0											
							MSA						
	SS	SS										SE	
00	5C	5C	00	17	77	08	98	04	65	00	2C	FD	00
00	5C	5C	00	17	77	00	C0	00	29	00	05	FD	00
00	5C	5C	00	17	77	07	80	04	38	00	00	FD	00
00	5C	5C	00	17	77	00	80	00	20	00	00	FD	00
110001010	0011110101	1100001010	1010110001	0011100110	1110100100	0110110110	1000111010	0010111001	0101010110	0011100101	1001101001	0100010111	0110100110
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	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+	D22.6-
00			00	17	77	08	98	04	65	00	2C		00
	1100001010			0011100110	0001011011	0011000110	1001011110	1001001001		0011100101			0110100110
178/A7	143/5C	2BC/5C	1CA/FF	19C/DC	368/17	18C/D8	1E9/E9	249/30	2E6/86	29C/5C	349/10	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+	D22.6-
00			00	17	77	00	C0	00	29	00	05		00
	1100001010		0101001110	0011100110	0001011011	0101000110	1001011010	0010111001	1110100010	0011100101			0110100110
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	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+	D22.6-
00			00	17	77	07	80	04	38	00	00		00
	1100001010				0001011011	0011000110	1001011010	0110111001	1010001101	0011100101			0110100110
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	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-	D22.6-
00			00	17	77	00	80	00	20	00	00		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.

	es																		
in Link Events Symbols	Log Events				Wave Forms	Spatial View													
vbid		×	🛃 🗌 Aa 🗌 RExp	l4 1 / 34953 🕨 🔇	TP34	85-7	IDLE 1		72 73	T4 T5	<b>F6 F</b> 7	887 71 73	F10 F1	1 712 7	13 F14	715 7	16 117	F10 F11	720 7
Туре	Id	Position	Duration	End	0±@Q			34											
Lane Events							588.738.			d	034.588.	787.73	0:03	4.588.81	5.891	0.0	34.588.	844.006	134.588
SST Stream					AUX					+ 1					-				
BS-IDLE	1	0.034.588.782.007	0:118.982.428.831	0:153.571.210.838	Link Frame	UND	NOWN			_	_					8	SST 18-IDLE 1		
<ul> <li>BLANK(512 lines)</li> </ul>		0.034.588.782.007	0.005.178.151.418	0.039.766.933.425	Lines												LINE_0		
✓ LINE	0	0.034.588.782.007	0.000.010.113.535	0.034.598.895.542	VBID	34													
SR		0.034.588.782.007	0.000.000.004.937	0.034.588.786.944	MSA SDP					_									
VBID		0.034.588.786.945	0.000.000.001.234	0.034.588.788.179	Symbols Lane 0						5R								
MVID		0.034.588.788.180	0.000.000.001.233	0.034.588.789.413	Lane 1						- 10								
MAUD		0.034.588.789.414	0.000.000.001.234	0.034.588.790.648	Lane 2 Lane 3					_									
> LINE	1	0.034.598.895.543	0.000.010.113.535	0.034.609.009.078															
> LINE	2	0.034.609.009.079	0.000.010.113.535	0.034.619.122.614															
> UNE	3	0:034.619.122.615	0.000.010.113.535	0.034.629.236.150															
> LINE	4	0.034.629.236.151	0.000.010.113.535	0.034.639.349.686															
> LINE	5	0.034.639.349.687	0.000.010.113.535	0.034.649.463.222															
> LINE	5	0.034.649.463.223	0.000.010.113.535	0.034,659,576,758															
> LINE		280 661 880 bits		282 742 798 kin															
			0.000.010.113.535																
	7	0.034.659.576.759 200740 200 Mill 0.034.669.690.295	0.000.010.113.535 81 925 Min 0.000.010.113.535	0.034.669.690.294															
> LINE	8	0.034.669.690.295	81 900 Min 0.000.010.113.535 81 900 Min	0.034.669.690.294 201327 70 bits 0.034.679.803.830 201107 607 609 bits	<b>○</b> ∓ < →					_	_								
> LINE > LINE	8	200 Tel 800 Mil 0.034.669.690.295 200 605 720 Mil 0.034.679.803.831 200 907 640 Mil	81 520 Min 0.000.010.113.535 81 520 Min 0.000.010.113.535 81 520 Min	0.034.669.690.294 200.625 7/3 km 0.034.679.803.830 200.607 608 km 0.034.689.917.366 200.607 508 km			38.781.			0:	034 588.	788.47	0:03	4.588.79	2.29	0:0	34.588.	796.111	034.588
> LINE	8	0.034.669.690.295 0.034.679.803.831	0.000.010.113.535 0.000.010.113.535 0.000.010.113.535	0.034.669.690.294 306.827 279.860 0.034.679.803.830 306.87.669.803.830 0.034.689.917.366	AUX Link					. 0:	034 588.	788.47	0:03	83	1		34.588.	796.10	034.588
> LINE > LINE > LINE	8	280 742 800 km 0.034,669,690,295 260 405 720 km 0.034,679,260 803,831 260 907 649 km 0.034,689,917,367	81 525 min 0:000.010.113.535 81 505 min 0:000.010.113.535 81 505 min 0:000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lines					• 0:	034 588.	788.47	0:03		1		34.588.	796.111	034.588
> LINE > LINE > LINE ails Image Y SYMBOL)	8 9 10	00034.669.690.295 0034.679.803.831 0034.679.803.831 0034.689.917.367 0034.689.917.367	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lines MMA/SDP Symbols	0:034.1	588.781.			VBI	D MVID	HAND		SS BS-IDLE 1	1 LINE_(	0	MMY		
> LINE > LINE > LINE > LINE alls Image Y_SYMBOL] rt : 0:034.588.78 : 0:034.588.78	8 9 10 6.945; 2 8,179; 2	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lines MSA/SDP Symbols Lane 0 Lane 1	0:034.1	10 10	.113 .99 70 10	7C 7C	VB1 1C 13 1C 14	D MVID	MAUD 00 00	00	85-IDLE 1	00 00	0 DOP 00 00	00 00	00	00
> LINE > LINE > LINE alls Image Y_SYMBOL] rt : 0:1034.588.78 : 0:1034.588.78 ation : 0:000.000.00	8 9 10 6.945; 2 8,179; 2	0003466996295 00346699690295 0034679,8003831 0034679,8003831 00346899917.367 20180100100	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lines MMA/SDP Symbols Lane 0	0:034.1	10 10 10 10	.113 55 70 70 70 70 70	70 70 70 70	VB1 10 15 10 15 10 15	D MVID 00 00 00	MAUD 00 00 00	00 00 00	88 BS-IDLE 1 00 00 00 00	87 1 LINE_0 00 00 00	0 00 00 00 00	00 00 00 00	00 00 00	00 00 00
> LINE > LINE > LINE alls Image Y_SYMBOL] rt : 0:034.598.78 : 0:034.598.78 ation : 0:000.000.00	8 9 10 6.945; 2 8,179; 2	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lins MEA/SDP Symbols Lane 0 Lane 1 Lane 2 Lane 3	0:034.	10 10 10 10 10	.113 85 70 70 70 70 70 70 70 70	7C 7C 7C 7C 7C	V81 10 11 10 11 10 11 11 11 11	D MVID 00 00 00 00 00	HAUD 00 00 00 00 7 186/cD	00 00 00 374/14	89-IDL5 1 00 00 00 00 00 172/82 1	00 00 00 00 238/£7	0 00 00 00 00 00 00 00	12D/82	00 00 00 02/72	00 00 00 00 00
> LINE > LINE > LINE > UNE Image 7_SYMPOL] TT : 01034.588.78 : 01034.588.78 ation : 01004.080.00 ation : 01000.000.00 TRUE Solution : TRUE	8 9 10 6.945; 2 8.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lines MSA/SDP Symbols Lane 0 Lane 1 Lane 2	00034.1	10 10 10 10 10 10 10 828.0-	.113 55 70 70 70 70 70 70 70 70 70 70 70 70 70	70 70 70 70 70 70 8003/70 828.3+ 82	V21 10 13 10 13 10 13 10 13 10 14 10 br>10 14 10 10 10 10 10 10 10 10 10 10 10 10 10	D MVID 00 00 00 00 00 00 00 00 00 00 00 00 00	MAUD 00 00 00 00 00 7 186/c0 + D0.6+	00 00 00 374/14 D20.0-	88 85-IDL5 1 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00	00 00 00 00 072/72 D18.3-	00 00 00 00 00 00 00 00 00 00 00
> LINE > LINE > LINE > UNE Image r SYMEDL] r SYMEDL] r or 0.034,589,78 r or 0.004,589,78 r or 0.004,588,78 r or 0.004,588,788,788 r or 0.004,788,788,788,788 r or 0.004,788,788,788,788,788,788,788,788,788,78	8 9 10 6.945; 2 8.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	AUX Link Lins MEA/SDP Symbols Lane 0 Lane 1 Lane 2 Lane 3	00 00 00 00 00 00 00 00 00 00 00 00 00	10 10 10 10 10 10 10 10 10 10 10 10 10 1	.113 55 70 70 70 70 70 70 70 70 70 70 70 70 70	70 70 70 70 803/70 828.3+ 82 80001100011 903/70 90	V80 1C 15 1C 11 1C 1 1C 11 1C	D MVID 00 00 00 00 00 00 00 00 00 00 00 00 00	HAUD 00 00 00 7 186/CD 7 186/CD 7 186/CD	00 00 00 374/14 520.0- 00 375/14	88-IDLE 1 00 00 00 00 00 00 172/82 18.5- 00 00 172/82 172/82	00 00 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00 00 00 00 0	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 092/72 D18.3- 00 092/72	00 00 00 0022/62 D14.3- 00
> LINE > LINE > LINE   Image (_SYMBOL] to 1034.500.70 to 0034.500.70 to 0034.500.70 to 0034.500.70 to 0034.500 to 0034.5000 to 0034.500 to 0034.5000 to 0034.5000	8 9 10 6.945; 2 9.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	ADX Link Lines MMA/SDB Symbols Lane 0 Lane 1 Lane 2 Lane 3 Fby Lane 0	00 00 00 00 00 00 00 00 00 00 00 00 00	10 10 10 10 10 822/10 828/0-	.113 89 70 70 70 70 70 70 70 70 70 70 70 70 70	7C 7C 7C 7C 8C3/7C 08 828.3+ 82 9C3/7C 08 828.3+ 82 9C3/7C 08 828.3+ 82	V80 10 11 10 1	D MVID 00 00 00 00 00 00 00 00 00 00 00 00 00	HAUD 00 00 00 1286/C0 + D0.6+ 00 7 186/C0 + D0.6+ 00	00 00 00 00 00 00 00 00 00 00 00 00 00	88-IDLE 1 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 238/E7 07.7+ 00 00 238/E7 00 00 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00 00 00 00 0	122/82 D2.4- 00 122/82 D2.4- 00	00 00 00 02/72 D18.3- 00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00
> LINE > LINE > LINE - UNE III Image (_SYMBOL] - CO34.500.70 - CO34.500 - C - C - C - C - C - C - C - C	8 9 10 6.945; 2 9.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	ADX Link Lines MMA/SDB Symbols Lane 0 Lane 1 Lane 2 Lane 3 Fby Lane 0	00 00 00 00 00 00 00 00 00 00 00 00 00	10 10 10 10 10 10 10 10 10 10 10 10 10 1	.113 113 	70 70 70 70 803/70 828.3+ 82 80001100011 903/70 90	VE 1C 11 1C 11	D MVID 00 00 00 00 00 00 00 00 00 00 00 00 00	HAUD 00 00 00 00 7 186/C0 7 186/C0 7 186/C0 7 186/C0	00 00 00 00 00 00 00 00 00 00 00 00 00	88-1016 1 00 00 00 00 172/82 1 00 172/82 1 00 172/82 1 00 172/82 1 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00 00 00 00 00 00 00	12D/82 D2.4- 00 12D/82 D2.4- 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00
> LINE > LINE > LINE alls Image Y SYMBOL] T : 01034.560.76 : 01034.560.76 : 01034.560.76 : 01034.560.76 : 01034.560.76 : 01034.560.76 : 0104.560.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76 : 0104.76	8 9 10 6.945; 2 9.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	ADM Link Lines HEAK/BDP Symbols Lane 0 Lane 1 Lane 1 Lane 3 Fhy Lane 0 Fhy Lane 1	0:034.1 00 00 00 00 00 00 00 00 00 00 00 00 00	10 10 10 10 10 10 10 10 10 10 10 10 10 1	.113 70 70 70 70 70 70 70 70 70 70	7C 7C 7C 7C 0C3/7C 08 828.3+ 82 0C3/7C 08 828.3+ 82 0C3/7C 08 828.3+ 82	Ver 1C 11 1C 11 1C 12 1C 11 1C 1	D MWID 00 00 00 00 00 00 00 00 00 00 00 00 00	HAUD 00 00 00 7 186/C0 4 D0.6+ 00 7 186/C0 4 D0.6+ 00 100.6+ 00	00 00 00 00 00 00 00 00 00 00 00 00 00	88 88-IDLE 1 00 00 00 00 00 00 00 00 00 0	00 00 00 00 238/E7 238/E7 00 238/E7 238/E7 07.7+ 00 238/E7 00 238/F7 00	0 D00 00 00 00 00 00 00 00 00	12D/82 00 00 00 12D/82 00 12D/82 00 12D/82 00 12D/82 00	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00
> LINE > LINE > LINE alls image y SYMDOL] t: 01034,588,78 : 0104,78 : 0104,78 :	8 9 10 6.945; 2 9.179; 2 1.234;	200 200 200 200 200 200 200 200 200 200	41 000 ho 0.000010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535 41 000 ho 0.000.010.113.535	0.034.669.690.294 200.657 19 test 0.034.679.803.830 201 607 50 test 0.034.689.917.366 200 500 201 test 0.034.700.030.902	ADM Link Lines HEAK/BDP Symbols Lane 0 Lane 1 Lane 1 Lane 3 Fhy Lane 0 Fhy Lane 1	0:034.1 00 00 00 00 00 00 00 00 00 00 00 00 00	10 10 10 10 10 10 10 10 10 10 10 10 10 1	.113 55 70 70 70 70 70 70 70 70 70 70	7C 7C 7C 7C 0C3/7C 0B K28.3+ K2 0C3/7C 0B K28.3+ K2 0C3/7C 0B K28.3+ K2	Ver 1C 13 1C 1	D MWID 00 00 00 00 00 00 00 00 00 00 00 00 00	HAUD 00 00 7 186/C0 4 D0.6+ 00 7 186/C0 7 186/C0 7 186/C0	00 00 00 374/14 D20.0- 00 374/14 374/14 374/14 374/14 374/14 374/14	88 88-IDLE 1 00 00 00 00 00 00 00 00 00 0	00 00 00 00 00 00 00 00 00 00 00 00 00	0 DOB 00 00 00 00 00 00 00 00 00 0	120/82 00 00 00 120/82 02.4- 00 120/82 02.4- 00 120/82 02.4- 00 00 120/82 02.4-	00 00 00 00 00 00 00 00 00 00 00 00 00	00 00 00 00 00 00 00 00 00 00 00 00 00

#### **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.

meVew Reports Images																						
ain Link Events Symbols Log Eve	ents			Wave Forms S	patial View																	
vbid	×	An Rop H	E 1 / 34953 🕨 🕻	7934		RP-TICK			2 1 12 1	24 1 25	1 24 1 3	391	F9 F10	TRUE	12 1 212	1.04.1	251		7 1 218	1 212 1	220	F21
Type	ld Position	Duration	End	o tee	() < >									1						1.00		
Lane Events					-0:000.00			00,000,026	571	010	00.000.05	4.73		:000,000	082.881		0.1	200.000	.111.04	1 0	2000.0	
✓ Lane 0				AUX					•													_
UNION COM	0.000.000.000.000	0.000.000.001.234	0.000.000.001.234	Link	C.									TF01								-
TPS1	0.000.000.001.235	0:000.943.085.996	0.000.943.087.231	Lines																		
1234	0.000010.007.000	0.033.611.233.666	0.021.001.21.2.020	VBID	3																	
UNKNOWN	0.034.584.317.829	0.000.004.464.177		202A																		
SST	0.034.588.782.007	0.462.511.480.206		Symbols																		
Lane 1	200 170 300 Ma	3 740 300 340 sea	4 121 537 133 133	Lane 0 Lane 1																		
Lane 2				Lane 2 Lane 3																		
Lane 3																						
Stream																						
	0-034 588 782 007		0153 571 210 838																			
		INCOME AND ADDRESS OF	0:153.571.210.838																			
✓ BLANK(512 lines)	040 100 000 Add 04034 588 782 007 200 100 000 Add	0.005.178.151.418	0:039.766.933.425																			
✓ BLANK(512 lines) ✓ LINE	0-034.588.782.007	0:005.178.151.418	0.039.766.933.425 0.039.766.933.425 0.034.598.095.542 00.034.598.095.542																			
✓ BLANK(512 lines) ✓ LINE 0 SR	0-034-588,782,007 0-034-588,782,007 0-034-588,782,007 0-034-588,782,007 0-034-588,782,007	0:005.178.151.418 d1 507.55 htt 0:000.010.113.535 d1 507 htt 0:000.000.004.937 d2 htt	1.00 002.00 min 0.039.766.933.425 502.103.900 min 0.034.598.095.542 200.252.00 min 0.034.588.786.944 200.173.00 min																			
V BLANK(512 lines) V LINE 0 SR VIED	0.034.588.782.007 0.034.588.782.007 0.034.588.782.007 0.034.588.782.007	0:005.178.151.418 0:005.178.151.418 0:000.010.113.535 df 500 bio 0:000.000.004.937 df 500 0:000.000.001.234 df 500	1.001382.001395 00039.766.933.425 027.117.987345 00034.598.095.542 201.07.075445 00034.588.786.944 201.177.09546 00034.588.786.736.179 00034.588.738.179																			
V BLANK(512 line) V LINE 0 SR VBIO MVID	0.034 588 782,007 0.034 588 782,007 0.034 588 782,007 0.034 588 782,007 0.034 588 796,945 0.034 588 796,945	0:005.178.151.418 0:000.010.113.535 0:000.010.113.535 0:000.000.004.937 0:00 0:000.000.001.234 0:000 0:000.000.001.233 0:00	1.521 802 309 400 0.0393 7565 933 8.425 502 113 905 905 0.034 598 795 5542 00134 598 795 5542 00134 598 795 5544 00134 598 795 554 00134 598 795 514 00134 598 795 514 00145 514 51	0.4 < > <	( ) <u> « » (</u>	9. <b>4</b> 10	H															
V ELANK(512 lines) V LINE 0 SR VIED MVID MAUD	001 1030 540 0034 5582 752.2007 003 1030 549 0034 5582 752.2007 0034 5582 752.2007 0034 5582 7582.2007 0034 5582 7582 7597 0034 5582 7584 759 0034 5582 7584 759 0034 5582 7594 754 0034 5582 7594 754	00100000000000000000000000000000000000	1 A31 582 249 449 0 0339 2765 033 A425 262 113 249 249 0 034 568 2495 542 0 034 568 2495 544 0 034 568 2496 544 0 034 568 2496 179 0 034 568 249 443 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 034 568 2496 445 0 035 568 2496 44568 2496 44568 2496 44568 44568 44568 44568 44568 44	0 + ( ) (				00.000.006	.05+	010	00.000.03	1.25!		1000,000.	016.46;		01	200.000	.021.66	1_0	01000.0	200
V BLANK(512 lines) V LINE 0 SR VBIO MVID	0.034 588 782,007 0.034 588 782,007 0.034 588 782,007 0.034 588 782,007 0.034 588 796,945 0.034 588 796,945	0:005.178.151.418 0:000.010.113.535 0:000.010.113.535 0:000.000.004.937 0:00 0:000.000.001.234 0:000 0:000.000.001.233 0:00	1.521 802 309 400 0.0393 7565 933 8.425 502 113 905 905 0.034 598 795 5542 00134 598 795 5542 00134 598 795 5544 00134 598 795 554 00134 598 795 514 00134 598 795 514 00145 514 51	ATTK				00.000.006	.051	010	00.000.03	1.25!		_	016.46;		01	200,000	.021.66	1.0	22000.0	201
V BLANK(512 lines) V LINE 0 SR VIED MAVED MAUD	0014 588 782 207 0014 588 786 345 0014 588 786 345 0014 588 789 414 0014 588 789 414	00000000000000000000000000000000000000	1241 0020100 00392.050313.425 20111190190 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0504.0590.078	- Allx Link Lines				00.000.000	.05+	010	00.000.03	1.25!		1000.000. TP81	016.46;	•	01	000.000	.021.66	1.0	2:000.0	200
	0014580782.007 0014580782.007 0014588782.007 00145887782.007 0014587787787787787787787787787787777777777	00000000000000000000000000000000000000	1241 0020100 00392.050313.425 20111190190 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0504.0590.078	<ul> <li>Altx Link Lines MSA/3DP Symbols</li> </ul>				00.000.006	.05+	010	00.000.03	1.25!		_	016.46		01	200.000	.021.66	1 0	0:000.0	201
V BLANK(S12 Ines) V LINE 0 SR WBD MVID MMUD > LINE 1	0014 588 782 207 0014 588 786 345 0014 588 786 345 0014 588 789 414 0014 588 789 414	00000000000000000000000000000000000000	1241 0020100 00392.050313.425 20111190190 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0504.0590.078	<ul> <li>ATTX</li> <li>Link</li> <li>Lines</li> <li>MSA/3DP</li> <li>Symbols</li> <li>Lame 0</li> </ul>				100.000.006	051	010	00,000.03	4.	0. 0	_	016.46;		011	000000	.021.66	1 0	01000.0	200
	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 0020100 00392.050313.425 20111190190 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0504.0590.078	<ul> <li>ATE Link Lines MSA/JDP</li> <li>Symbols Lane 0 Lane 1</li> <li>Lane 2</li> </ul>				00.000.006	054 4A 4A 4A	010 (A 4A (A 4A (A 4A	60.000.03	11.25! 4A 4A 4A	4.1. 6. 6.3. 6. 6.3. 6.	_	016.46:	44 44 44	011 65 65	000,000 64. 64.	6.021.66	1 0 60 60 60	40. 40. 40.	200
✓ REANUG12 Integ     ✓ LINE 0     SR     VIDI     MAUD     MAUD     JUNE 1     Integ     1     10000,000,001,2315     101000,000,001,2315     101000,000,001,2315     101000,000,001,2315	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 0020100 00392.050313.425 20111190190 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0502.0504 00345.0504.0590.078	<ul> <li>ATEL</li> <li>Lines</li> <li>MAX/3DP</li> <li>Symbols</li> <li>Lane 0</li> <li>Lane 1</li> <li>Lane 2</li> <li>Lane 3</li> </ul>	010 1 4 4 4 4 4 4	00.000.00	3.243 010 63. 63. 63.	ιλ (Λ) ιλ (Λ) ιλ (Λ) ιλ (Λ)	4A 4A 4A 4A 4A	4Λ 4Α 4Λ 4Α 4Λ 4Α 4Λ 4Λ 4Λ 4Λ	44 44 44 44	4A 4A 4A	43, 4 43, 4 43, 4 43, 4 43, 4	1931 0. 0. 0.	43 43 43 43		43 43 43 43		4.5. 4.5. 4.5. 4.5.		40 45 40 40	
✓ ELANE(512 Inve)     ✓ ELANE(512 Inve)     ✓ ELNE     ✓ ELNE     ✓ MAUD     MAUD     MAUD     ✓ UNE     1     Maa     7     7     1     10000,000,001,2015,2017     1     00000,000,001,2015	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 00240 00 00392.050 0313.425 00139.200 0134.55 00134.590 0134.590 0034.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.754540 00134.5902.750540 00134.5902.750540 00134.5902.750540 00134.5902.750540	<ul> <li>ATE Link Lines MSA/JDP</li> <li>Symbols Lane 0 Lane 1</li> <li>Lane 2</li> </ul>	0100 1 44 45 45 45 538/46 500.2-	00.000.00	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0	14 (4 14 (4 14 (4 14 (4 15) (4) (4) (4) (4) (4) (4) (4) (4) (4) (4	6/5 6/5 0/5 28/8/48, 21 250.2- 2	6A 6	4A 4A 4A 4A 4A 2- D10.2-	4A 4A 4A 2AA/4A D10.2-	63. 6 63. 6 75. 6 75. 6 75. 6 75. 6 75. 6 75. 75. 75. 75. 75. 75. 75. 75. 75. 75.	1981 4. 64. 4. 64. 4. 64. 4. 64. 4. 64. 4. 64. 4. 64. 64. 2. 010.2	44, 44, 44, 2243/44, D10.2-	2AA/4A D10.2-	64, 64, 63, 1010-2-	6. 6. 6. 234/44 D10.2-	6A 6A 6A 238A/4A D10.2-	4A 4A 4A 23A/4A D10.2-	0, 6, 6, 0, 254/43, 250.2-	
✓ ELANE(512 Inve)     ✓ ELANE(512 Inve)     ✓ ELNE     ✓ ELNE     ✓ MAUD     MAUD     MAUD     ✓ UNE     1     Maa     7     7     1     10000,000,001,2015,2017     1     00000,000,001,2015	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 00240 00 00392.050 0313.425 00139.200 0134.55 00134.590 0134.590 0034.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.754540 00134.5902.750540 00134.5902.750540 00134.5902.750540 00134.5902.750540	<ul> <li>ADX Link Link HMA/JDP</li> <li>Symbols</li> <li>Lane 0</li> <li>Lane 1</li> <li>Lane 3</li> <li>Fby Lane 0</li> </ul>	0100 T 01 01 01 01 01 01 01 01 01 01 01 01 01	238./4A	40	15. (A 15. (A 16. (A 16. (A 17. (A) 17. (A) 17	4A 4A 4A 28A/4A 200.2- D	6. 6. 6. 7. 6. 7. 6. 7. 6. 7. 7.	4A 4A 4A 4A 2AA/4A 010.2-	4A 4A 4A 4A 010.2- 2AJ/4A	63. 6 63. 6 7 7 80. 6 7 80. 6 80. 60	1981 4. 4. 4. 4. 4. 4. 4. 4. 4. 2. 5. 101.2. 4. 2. 5. 101.2.	65. 65. 65. 238/48. D10.2-	288/48 D10.2-	65 65 65 288/48 D10.2-	44. 45. 46. 234/44. 234/44.	6A 6A 6A 28A/4A D10.2-	4A 4A 4A 238A/4A D10.2-	0/ 0/ 0/ 1284/48 1200.2- 1284/48	
✓ ELANE(512 Inve)     ✓ ELANE(512 Inve)     ✓ ELNE     ✓ ELNE     ✓ MAUD     MAUD     MAUD     ✓ UNE     1     Maa     7     7     1     10000,000,001,2015,2017     1     00000,000,001,2015	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 00240 00 00392.050 0313.425 00139.200 0134.55 00134.590 0134.590 0034.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.754540 00134.5902.750540 00134.5902.750540 00134.5902.750540 00134.5902.750540	<ul> <li>ATEL</li> <li>Lines</li> <li>MAX/3DP</li> <li>Symbols</li> <li>Lane 0</li> <li>Lane 1</li> <li>Lane 2</li> <li>Lane 3</li> </ul>	0100 1 234/44 234/44 234/44 234/44	20.000.00 0 0 284/44 000.2-	40. 40. 40. 40. 40. 40. 40. 40.	0. 0	4A 4A 4A 2BA/4A 2DD-2- 2DA/4A 2DD-2- 2DA/4A 2DD-2- 2DD-2DD-	(A (A (A (A (A (A (A (A (A (A (A (A) (A (A))))))))))	4A 4A 4A 2AA/4A 2- D10.2- 4A 23A/4A 2- D10.2-	4A 4A 4A 010.2- 238/48 010.2-	64. 6 63. 6 64. 6 7 7 7 84. 6 84. 7 84. 7	1931 43. 43. 43. 43. 44. 27. 44. 27. 44. 27. 44. 27. 45. 45. 45. 45. 45. 45. 45. 45	0. 0. 0. 288/68 010.2- 288/68 010.2-	288/48 D10.2- 288/48 D10.2-	65 65 65 284/44 200.2- 000.2-	64. 64. 63. 234/44. 010.2- 234/44. 010.2-	65 65 65 284/44 200.2- 284/44 200.2-	6A 6A 6A 23A/4A 200.2- 28A/4A 510.2-	0), 6), 6), 28A/4A, 200.2- 28A/4A, 200.2-	
V ELANE(512 Inve)     V ELANE(512 Inve)     V ELNE     SR     VED     MAUD     MAUD     VENE     1     MAUD     1     MAU     1     MAU     1	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 00240 00 00392.050 0313.425 00139.200 0134.55 00134.590 0134.590 0034.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.754540 00134.5902.750540 00134.5902.750540 00134.5902.750540 00134.5902.750540	<ul> <li>ANX Link Lines MSA/JOP Symbols Lans 1 Lans 1 Lans 2 Lans 3 Fby Lans 0</li> <li>Fby Lans 0</li> </ul>	0100 1 224/4A 224/4A 224/4A	00.000.00 00.000.00 00.000 00.00 00.00 00.00 00.00 00.000 00.000 00.000 00.000 00.000 00.000 00.000 00.000 00.000 00.000	3.243 010 4. 5. 5. 5. 5. 5. 5. 5. 5. 5. 5	15. 64 15. 64	4/A 4/A 4/A 2020-2- 2020-	(A (A (A (A (A (A (A (A (A (A (A (A))))))))))	4A 4A 4A 2AA/4A 2- D10.2- 4A 23A/4A 2- D10.2- 4A 23A/4A	4A 4A 4A 10.22A/4A 10.2- 22A/4A 10.2-	63. 6 63. 6 75. 75. 75. 75. 75. 75. 75. 75. 75. 75.	TPRI 4. 4. 4. 4. 4. 22. 4. 4. 4. 4.	40 40 40 2244/46 D10.2- 2244/46 D10.2-	288/48 D10.2- 288/48 D10.2- 100.2-	45 65 65 100.2- 100.2- 100.2- 100.2-	64. 63. 64. 63. 63. 64. 65. 284./44. 610.2- 101.1111 284./44.	63 63 63 020,2- 234/4A 020,2- 234/4A	40 40 40 500.2- 2340/40 210.2-	66. 66. 67. 284/48. 200.2- 284/48. 200.2-	
✓ ELANE(512 Inve)     ✓ ELANE(512 Inve)     ✓ ELNE     ✓ ELNE     ✓ MAUD     MAUD     MAUD     ✓ UNE     1     Maa     7     7     1     10000,000,001,2015,2017     1     00000,000,001,2015	10 1000000 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 782.007 0014588 786.008 0014588 786.583 0014588 786.583 0014588 895.543 0014588 895.543 0014588 895.543 0014589 395.543	00000000000000000000000000000000000000	1241 00240 00 00392.050 0313.425 00139.200 0134.55 00134.590 0134.590 0034.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.7542 00134.5902.754540 00134.5902.750540 00134.5902.750540 00134.5902.750540 00134.5902.750540	<ul> <li>ADX Link Link HMA/JDP</li> <li>Symbols</li> <li>Lane 0</li> <li>Lane 1</li> <li>Lane 3</li> <li>Fby Lane 0</li> </ul>	0100 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	00.000.00 00.000.00 00.00 00.00 00.00 00.00 00.00 00.00 00.00 00.000.00 00.000.00 00.000.00 00.000.00 00.000.000	3.243 010 4. 4. 4. 4. 4. 4. 4. 4. 4. 4.	0. 0	(h (h) (h) (h) 204/44, 21 204/44, 21 200.2- 0 204/44, 21 200.2- 0	0. 0A 0.	4A 2AA/4A 2- D10.2- 4A 2AA/4A 2- D10.2- 4A 2AA/4A 2- D10.2-	6A 6A 6A 6A 6A 6A 6A 74A 74A 74A 74A 74A 74A 74A 74A 74A 74	64. 6 63. 6 70. 7 70. 70	1981 44. 24. 45. 46. 24. 46. 24. 46. 24. 46. 24. 46. 24. 46. 24. 46. 24. 46. 24. 46. 24. 46. 20. 47. 48. 24. 48. 24. 49. 49. 20. 49. 40. 49. 40. 40. 49. 40. 40. 40. 40. 40. 40. 40. 40. 40. 40	63 65 63 64 64 64 64 64 64 64 70 10.2- 10.2- 10.2- 10.2- 10.0 204/48 10.0 2- 204/48	2AA/4A D10.2- 2AA/4A D10.2- 2AA/4A D10.2-	40. 40. 284/44 200.2- 101111111 284/44 200.2-	64. 64. 64. 65. 63. 63. 63. 64. 64. 65. 65. 64. 64. 65. 65. 65. 65. 65. 65. 65. 65. 65. 65	40. 40. 40. 284/44 200.2- 284/44 200.2- 284/44 200.2-	6A 6A 6A 6A 238A/4A 200.2- 238A/4A 200.2- 238A/4A 200.2-	6A 6A 28A/4A 2100.2- 28A/4A 200.2- 28A/4A 200.2-	

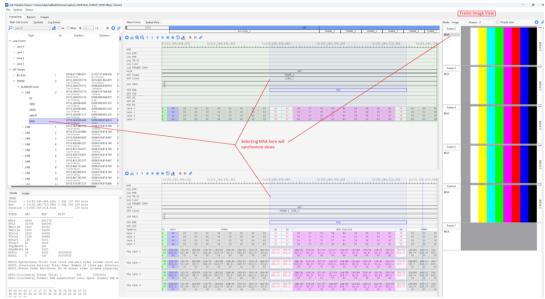
#### The image below illustrates the transition from TPS1 to TPS4.

		0	:000.85	4.696.3	25		0:000	.854.7	01.43:	0	.000.8	54.705.8	841	0:00	0.854.7	10.25(	0:000.8	854.714
AUX															-			
Link			TPS1													TPS4		
Lines																		
MSA/SDP																		
Symbols																		
Lane 0										10	BC	BC	1C	00	00	00	00	00
Lane 1										10	BC	BC	10	00	00	00	00	00
Lane 2										10	BC	BC	1C	00	00	00	00	00
Lane 3										10	BC	BC	10	00	00	00	00	00
Phy Lane 0	2AA/4A D10.2-	0BC/1C K28.0-	17C/BC K28.5-	283/BC K28.5+	0BC/1C K28.0-	235/FF D31.7- 00	097/17 D23.0- 00	189/C0 D0.6- 00	0B4/14 D20.0+ 00	010011101 172/B2 D18.5- 00								
Phy Lane 1	2AA/4A D10.2-	0BC/1C K28.0-	17C/BC K28.5-	283/BC K28.5+	0BC/1C K28.0-	235/FF D31.7- 00	097/17 D23.0- 00	1B9/C0 D0.6- 00	0B4/14 D20.0+ 00	172/B2 D18.5- 00								
Phy Lane 2	2AA/4A D10.2-	0BC/1C K28.0-	17C/BC K28.5-	283/BC K28.5+	0BC/1C K28.0-	235/FF D31.7- 00	097/17 D23.0- 00	1B9/C0 D0.6- 00	0B4/14 D20.0+ 00	172/B2 D18.5- 00								
Phy Lane 3	2AA/4A D10.2-	0BC/1C K28.0-	17C/BC K28.5-	283/BC K28.5+	0BC/1C K28.0-	235/FF D31.7- 00	097/17 D23.0- 00	189/C0 D0.6- 00	0B4/14 D20.0+ 00	01001110 172/B2 D18.5- 00								

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# Frame Image View

Frame Image View can be used to select frames and GCP or AVI periods in related views.



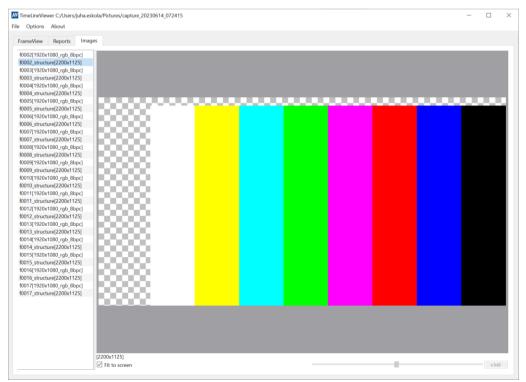
As shown below selecting the *MSA* event in *Frame Image View* also selects it in *Event Selector View* and synchronizes the other views. Hovering over the Active0 area will show the frame geometry details.

# **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.





Event Timeline Viewer is an application for inspecting data captured in capture tab.

Event Timeline Viewer consists of four areas.

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

		1 FF	UAME 1 FR	AME 2 FR	FRAME 4	FRAME 5	FRAME 6	FRAME 7	FRAME 8	FRAME 9	FRAME 10
• . <b>↓</b> . ⊕ ∈		> « » « » ;	<u> </u>								
Frames			FRAME_1	FRAME_2	FRAME_3 FRAM	E_4 FRAME_5	FRAME_6	FRAME_7	FRAME_8	FRAME_9	FRAME_10
HDMI HPD		2									
-											
Search			Aa RExp I	0 /0 ▶	Details Image						
Type	ID	Start	Duration	End	[Log Packet] Start : 0:000.12		0 bits				
.og HDMI		0:000.125.556.000	0:000.000.001.000	0:000.125.557.000	End : 0:000.12 Duration : 0:000.00	25.560.001; 00.001.000;	0 bits 1 bits				
og HDMI	3	0:000.125.558.000	0:000.000.001.000	0:000.125.559.000	Packet code: 0x84						
og HDMI		0:000.125.559.001	0:000.000.001.000	0:000.125.560.001	Audio Channel Count Audio Coding Type	= 2 = Refer to Stre	eam Header				
FRAME	7	0:000.126.164.000	0:000.016.000.000	0:000.142.164.000	Audio Stream Encodi Audio Stream Transp	ing Standard = Refe	er to Stream Heade				
	·	0:000.142.223.000	0:000.000.001.000	0:000.142.224.000	Sample Size Sampling Frequency	= Refer to Stre	eam header	AGT.			
					Audio Coding Extens	sion Type = Refer 1	to Audio Coding Ty	/pe (CT)			
Log HDMI		0:000.142.225.000	0:000.000.001.000	0:000.142.226.000	Audio Stream Encodi Audio Stream Transp	oort Standard = Re:					
Log HDMI		0:000.142.226.001	0:000.000.001.000	0:000.142.227.001	Level Shift Value Down-mix Inhibit Fl	= 0dB lag = Permitted or	no information al	out any assert:	ion of this		
FRAME	8	0:000.142.831.000	0:000.016.000.000	0:000.158.831.000	LFE Playback Level	Information = Unk	nown or refer to o	other informatio	on		
Log HDMI		0:000.158.889.000	0:000.000.001.000	0:000.158.890.000	fransformed HDMI Da 34 01 0A 70 01 00 0		00 00 00 00				
Log HDMI		0:000.158.891.000	0:000.000.001.000	0:000.158.892.000							
Log HDMI		0:000.158.892.001	0:000.000.001.000	0:000.158.893.001	0 00 00						
FRAME	9	0:000.159.497.000	0:000.016.000.000	0:000.175.497.000	4						
		0:000.175.556.000	0:000.000.001.000	0:000.175.557.000	-						
Log HDMI		0:000.175.557.001	0:000.000.001.000	0:000.175.558.001							
Log HDMI											
5		0:000.175.558.002	0:000.000.001.000	0:000.175.559.002							

#### **Frame View**

UCD Timeline Viewer [duration: 203 906 000 bits ]										-		×
	FRAME_1	FRAME_2	FRAME_3	FRAME_4	FRAME_5	FRAME_6	FRAME_7	FRAME_8	FRAME_9		FRAME_10	

The uppermost panel shwos the captured frames. The selected frame is highlighted in purple. You can select a frame by double-clickin 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**

	FRAME_1	FRAME_2	2	FRAME_3	F	RAME_4	FRA	E_5	FRAME_6	FRAME_7	FRAME_8	FRAME_9	FRAME_10
	< > < > < > < > < > < > < > < > < > < >												
Frames HDMI	FRAME_2				FRAME_3	-				FRAME_4			FRAME
HPD													

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

#### **Tools**

Tool	Function
Gear Icon	Hide / add events on the timeline
L 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
O ∓ ⊕ ⊖ < > < > < > 3 № 14 №			
Frames FRAME_4			
HEMI			
890			

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

$\mathbf{O} \oplus \mathbf{G}$	< > < » < > 🕲 🏤 🛯 🖬		
Frames			
HDMI	Log HDMI	Log HDMI	Log HDMI
HPD			

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

o±€e			RAME 1 ER	AND 2 1 FRAM	E 3    TEAME 4    TEAME 5    TEAME 6    TEAME 7    TEAME 8    TEAME 9    TEAME 9    TEAME 10
				NGE_2 FINE	<u>5_3 ENAR5_4 ENAR5_5 ENAR5_6 ENAR5_7 ENAR5_8 ENAR5_7 ENAR5_7 ENAR5_7</u>
ranes	< ``				
ICMI					Log HINKI Log HINKI
EPD					
Search			Aa RExp M	0 /0 1	Details Image
Search				0 70 PT	[Log Packet]
Type	ID	Start	Duration	End	Start : 0:000.092.225.000; 0 bits End : 0:000.092.226.000; 0 bits
AME	3	0.000.059.498.000	0.000.016.000.000	0:000.075.498.000	Duration : 0:000.000.001.0000 1 bits
ig HDMI		0:000.075.556.000	0.000.000.001.000	0:000.075.557.000	Packet code: 0x82
g HDMI		0.000.075.558.000	0.000.000.001.000	0:000.075.559.000	Packet Header:
og HDMI		0.000.075.559.001	0.000.000.001.000	0:000.075.560.001	Packet Length: 13 Checksum: 57
RAME	4	0.000.076.164.000	0.000.016.000.000	0:000.092.164.000	Version: 2
					Packet Data: Scan Info(0:1) 0(No Data)
.og HDMI		0.000.092.223.000	0.000.000.001.000	0:000.092.224.000	Bar Data (2:3) 0 (Not present) Format Info(4) 0 (Not present)
.og HDMI		0.000.092.225.000	0.000.000.001.000	0:000.092.226.000	Color Space(5:7) 0(RGB) AFD Ascect(8:1) 8((ATSC: Same as Picture Aspect Ratio) (DVB: As the coded frame))
.og HDMI		0.000.092.226.001	0.000.000.001.000	0:000.092.227.001	Coded frame AR(12:13) 0(No Data)
RAME	5	0.000.092.831.000	0.000.016.000.000	0:000.108.831.000	Colorimetry(14:15) 0 (No Data) Non-U Scaling(16:17) 0 (No Known non-uniform scaling)
og HDMI		0.000.108.889.000	0.000.000.001.000	0:000.108.890.000	RGB Quant(18:19) 0(Default (depends on video format)) E-Colorimetry(20:22) 0(No data)
og HDMI		0.000.108.891.000	0.000.000.001.000	0:000.108.892.000	ITC Content (23) 0(No Data) VIC (24:31) 16
					Pixel repets(32:35) 0(No repeats)
		0:000.108.892.001	0.000.000.001.000	0:000.108.893.001	ITC Type (36:37) 0 (Graphics) VCC Quant (38:39) 0 (Limited range)
		0:000.109.497.000	0.000.016.000.000	0:000.125.497.000	ETB (40:55) 0 SBB (56:71) 0
	6				
og HDMI RAME og HDMI	0	0.000.125.556.000	0.000.000.001.000	0:000.125.557.000	ELB(72:87) 0
RAME	0	0.000.125.556.000	0.000.000.001.000	0:000.125.557.000	ELB(72:87) 0 SRB(0%103) 0 Transformed HEMI Data:

### **Event Log**

Type	ID	Start	Duration	End	Info	1
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:

Туре	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.

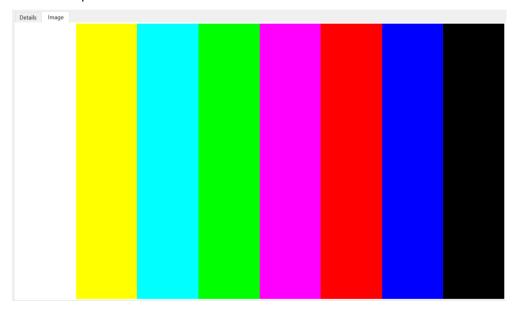
### Event Log Tools

P Search Search	Search events from the event log. Search results are highlighted in purple.
Apply search filters	Apply filters.
Aa RExp Search filters	Aa filter: Make search case sensitive RExp: Use regular expressions in search
K 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	- 14
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 repets(32:35)	0(No repeats)	
ITC Type(36:37)	0(Graphics)	
YCC Quant(38:39)	0(Limited range)	
ETB(40:55)	0	
SBB (56:71)	0	
ELB(72:87)	0	
SRB(88:103)	0	
Transformed HDMI Data:		
82 02 0D 57 00 08 00 10 00 00 00 0		
00 00 00 00 00 00 00 00 00 00 00 00 0	0 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.





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.

TX DP RX Event Log	Memory Layout Terminal					
Start Stop			Load	Save	Report	Open Timeline V
DP RX	Filter:		Apply	•		
HPD	Search: VB-ID	< 0 / 0 >	Search	-		
aux	-ur Type Start	Info		-		
SDP						
VB-ID						
MSA						
Link Pattern						
AUX_BW						
VFRAME INFO Select all						
DP TX						
AUX						
Select all						
Select all						
	4 Colors Events (filtered / parsed / captured):			-		

Role	Logged Events
DP Sink (UCD-400) DP Alt Mode Sink (UCD-424)	HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW, VFRAME INFO
HDMI Sink (UCD-422)	HPD, Packets, I2C, CEC
DP Source (UCD-400, UCD-411, 451) DP Alt Mode Source (UCD-424)	HPD, AUX
HDMI Source (UCD-422, UCD-412, 452)	
DP Alt Mode Sink (UCD-424) DP Alt Mode Source (UCD-424)	PD, LSE

Start:	Starts event logging and stop it by clicking Stop.
Save:	Save transactions as Event Log data.
Load:	Load saved Event Log data
Report:	Store event logs as reports in HTML format to be shared and viewed with any web browser.
Open Timeline Viewer	Open Event timeline Viewer to inspect the captured data. For detailed instructions refer to chapter 7 of this manual.
AutoScroll:	When selected, transaction list is scrolled vertically, and the latest transaction is shown as the last item of the list. When not selected, the items shown before clicking Start will be shown.
Events	Number of events detected
Colors:	Open configure colors dialog
Clear:	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.

#### 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 filtering of SDP packets. In the dialog, the reference to Packet Type Value is indicated in square brackets "[]".

III Event Filter Dialog	×
DP RX SDP filtering:	
Enable logging of following packets [IDs in hex]:	
Audio_TimeStamp [1] Audio_Stream [2]	
Extension [4] Audio_CopyManagement [5]	
✓ ISRC [6] ✓ VSC [7]	
Camera Generic	
🗹 CG0 [8] 🗹 CG1 [9] 🗹 CG2 [A] 🗹 CG3 [8]	
🗹 CG4 [C] 🗹 CG5 [D] 🗹 CG6 [E] 🗹 CG7 [F]	
VSC_EXT_CTA [21] Adaptive-Sync SDP [22]	
✓ VS [80 + 1] ✓ AVI [80 + 2]	
SPD [80 + 3]         Audio [80 + 4]           MPEG Source [80 + 5]         NTSC VBI [80 + 6]           DRM [80 + 7]	
Enter packet type as hex value separated by comma: 0x0, 0xF	
OK Cance	el

#### **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.

VBID filtering				
	Disabled	l On set	On clear	On any
VBLANK	0	0	0	۲
FIELD_ID	0	0	0	۲
INTERLACE	0	0	0	۲
NO_VIDEO	0	0	0	۲
NO_AUDIO	0	0	0	۲
HDCP_SYNC	0	0	0	۲
COMPRESSED	0	0	0	۲
RESERVED	۲	0	0	0
On MVID change				
On MAUD change				
🔾 Log all	(	Log on	change	

#### **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:s of just changes on selected parameter.

W Event Filter	Dialog			×
MSA filtering				
Enable logging I	45A packet on ch	ange in:		
MVID	VID NVID	HTOTAL	VTOTAL	
HSTART	VSTART	HSP	HSW	
VSP	VSW	MWIDTH	VHEIGHT	
MISC0	MISC1			
🔵 Log all		Log on cha	ange	
	_			_
		ОК	Cancel	

#### **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 squence 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 Filter Dialog		>
DP RX Link Pattern filtering:			DP RX Link Pattern filtering:		
	Start	End		Start	End
TPS1	<b>~</b>		TPS1		<b>~</b>
TPS2	<u>~</u>		TPS2		<ul> <li></li> </ul>
TPS3	<b>~</b>		TPS3		<u>~</u>
TPS4	<b>~</b>		TPS4		<ul> <li>Image: A set of the /li></ul>
Idle pattern	<u>~</u>		Idle pattern		<ul> <li>Image: A set of the /li></ul>
Active video	<b>~</b>		Active video		<b>~</b>
ML_PHY_SLEEP	<b>~</b>		ML_PHY_SLEEP		$\sim$
ML_PHY_STANDBY	<u>~</u>		ML_PHY_STANDBY		<b>~</b>
Custom pattern (80 bit)	<b>~</b>		Custom pattern (80 bit)		$\sim$
CP2520.1	$\sim$		CP2520.1		<b>~</b>
CP2520.2	<u>~</u>		CP2520.2		$\sim$
PRBS7	$\sim$		PRBS7		<b>~</b>
PRBS31	<u>~</u>		PRBS31		<u>~</u>
🗌 Log all			Log all		
Custom Pattern (80 bit)			Custom Pattern (80 bit)		
Type: Bytes (8bit, hex	t)	~	Type: Bytes (	(8bit, hex)	$\sim$
				(8bit, hex)	
0 0 0 0 0 ff ff	ff ff	ff		ols (10bit, hex)	- 11
			K/D co	des (8bit/10bit enc.)	_
	ок	ancel		ОК С	ancel

#### AUX\_BW

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

#### **VFRAME INFO**

Dimensions of the catured frame measured by the Sink

#### **Packets**

Log metadata sent by Source device in HDMI stream

SPD [83] Audio [84]	HDMI RX InfoFrames fi	tlering:
SPD [83] Audio [84]	Enable logging of follow	wing packets [IDs in hex]:
	VS [81]	AVI [82]
	SPD [83]	Audio [84]
MPEG Source [85] VISC VBI [86]	MPEG Source [85]	NTSC VBI [86]
🗹 DRM [87]	🗹 DRM [87]	
	0x0,	

#### **I2C**

Log data sent over I2C communication lines of HDMI interface

#### PD

Log USB-C PD communication messages

### CEC

Log CEC communication messages

### LSE

USB-C LSE thresholds:			
VBUS threshold	20	🗢 mV	
IVBUS threshold	<b>5</b> 0	🔹 mA	
VCC threshold	50	mV     m	
VSBU threshold	20	🗢 mV	
IVCONN threshold	50	≑ mA	

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.

## **Event Transaction List**

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

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.

Start	Stop										Load		Save	Report	Open Timeline View
DP RX		Filter	r								Apply		Device Stream		= 01 = 00
HPD		Sear	ch:	VB-ID		< 2 /230 > Se				Search		Data le	ngth	= 3 _Flag = 0[bit 0]	
aux SDP		1	ur	Type HPD	Start	HPD High DWR High CD High	Info HPD High, PWR High, CD High				FieldID_Flag = 0[bit 1] Interlace_Flag = 0[bit 2] NoVideoStream_Flag = 0[bit 3]				
VB-ID 2 HPD				00.00:00.001.52							1	AudioMute_Flag = 0[bit 4] HDCP SYNC DETECT = 0[bit 5]			
MSA	3 VB-ID 00.00:00.004.20 VB-ID =										CompressedStream_Flag = 0[bit 6] Reserved = 0[bit 7] Mvid = 0x76				
		1920x1080 (HT 2200, VT 1125, HS 192, VS 41, HW 44, VW 5)					$\begin{array}{rcl} Mvid &= 0x76\\ Maud &= 0x91 \end{array}$								
AUX_BW		5		VFRAME INFO		VFA TYPE: VIDEO DP MEAS, VFA LEP			"						
VFRAME INFO	)	6		SDP		0x84 DP Audio [INFOFRAME]									
Select all		7	-	VB-ID	00.00:00.004.8							1			
DP TX		8		VB-ID	00.00:00.020.8	Time from start of logging Time from device reboot									
HPD		9		VFRAME INFO	00.00:00.020.8	The formation of the second	GTH: 2								
🖬 AUX		1.5		SDP	00.00:00.020.8	Show as microseconds									
Select all				VB-ID		Show as hours.min:s.ms.us.ns									
Select all		12		VB-ID	00.00:00.037.5	Configure colors									
				VFRAME INFO		Configure columns VFA TYPE: VIDEO_DP_MEAS, VFA LEP	IGTH: 2								
				SDP		0x84 DP Audio [INFOFRAME]									
				VB-ID	00.00:00.038.22										
				VB-ID	00.00:00.054.21										
				VFRAME INFO		VFA TYPE: VIDEO_DP_MEAS, VFA LEP	IGTH: 2								
				SDP		0x84 DP Audio [INFOFRAME]									
		19		VB-ID	00.00:00.054.89										
		20		VB-ID	00.00:00.070.88	VB-ID = 0x01;									
		21		VFRAME INFO	00.00:00.070.88	VFA TYPE: VIDEO_DP_MEAS, VFA LEP	IGTH: 2								
		22		SDP	00.00:00.070.88	0x84 DP Audio [INFOFRAME]									
		23		VB-ID	00.00:00.071.56	VB-ID = 0x00;									
		24		VB-ID	00.00:00.087.54	VB-ID = 0x01;									
		25		VFRAME INFO	00.00:00.087.54	VFA TYPE: VIDEO_DP_MEAS, VFA LEP	IGTH: 2								
			-												

Source:	The communication port: DP RX, DP TX, HDMI RX, HDMI TX or HDCP 1.X, HDCP 2.3
Туре:	The logged item: HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW, VFRAME INFO (DP or DP Alt Mode) HPD, Packets, I2C, CEC (HDMI)
Start:	Each line is identified by its timestamp, marking the instant when an event or error was detected, or when a data transaction got started.
	The timestamp can be displayed as a time delay from the start of the acquisition (absolute) or from the previous line (relative). The timestamp can be displayed in milliseconds or in minutes, seconds, and microseconds.
Info:	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. User can also color highlight various types of transactions for better readability.

Right-click on the list to open the menu.

	Time from device reboot	0005
	Time from previous event	00
	Show as microseconds	D1: 1
•	Show as hours:mins:secs.msecs.mcsecs.nsecs	00
	Configure colors	00: 1
	Configure columns	14

### **Configure Start**

The time indicated in column Start can be either:

- Time from device reboot
- Time from previous event

The time can be expressed either:

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

### **Configure Colors**

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

/// Configure	colors			67
Add	Config	Remove	A V (	Clone
Rule(a	applied in order	shown)	Format	Applies to
1 Normal line	On Packet		AaBbCcYyZz	
				Apply

Add: Add a new color highlight rule

	5 5
Config:	Modify the selected rule
Remove:	Delete the selected rule
Clone:	Duplicate the selected rule
▲ ▼:	Change order where rules are applied.

The rules are applied from the bottom to the top of the list.

### Adding Rules

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

Configure search X	Configure search	X Configure search
With configure search     X       Type:     Normal line       Event:     HPD       Back:     TAUX       PD     Yep       Color = #fffffUse       textColor = #ffffUse       TextColor = #for USB-C Voltage       textColor = #for USB-C Voltage	Zu     Configure search       Type:     AUX       Event:     On Write       Address in range     Start address: 0x       Start address:     0       Back:     Text:       Font     Aa8bCcYy2z       type = AUX       address = 0x00000:0x00000       trigger = On Write       color = #00aa7f       font=MS Shell Dig 2:8	✓         Type:         SDP           ✓         SubType:         Extension           ✓         Event:         Audo Trmestano           Audo Stream         Audo Stream           Badk:         Text:         Reserved           Extension         Extension
Apply	Appl	Ply Apply

### **Configure Columns**

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

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

	Available	^			Active
1	HPD:hpd (60)		>	1	Source (60)
2	HPD:pwd (60)			2	Туре (70)
3	HPD:cd (60)			3	Start (164)
4	HPD:+5V (60)		- -	4	Info (735)
5	AUX:address (60)				
6	AUX-length (60)	¥			

#### **Type Filter**

Type filter dialog lists the types of transactions found in the list and allows the user to select which

Configure filter	×
Case Sensitive	
Columns:	
Source	
🗹 Туре	
Start	
🗹 Info	
Types:	
Types DP RX HPD MSA AUX VB-ID	
Select all	
Apply	

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:

Hot-Plug-Detect Level:	Status of HPD signal: HIGH (Asserted), LOW (De-asserted)
PWD Level:	Status of source device detection: High (DP Tx detected), LOW (DP Tx not detected)
Cable Detect Level:	Status of cable detection HIGH (Cable connection detected) LOW (Cable connection not detected)

```
Device ID = 01 [DP RX]
Hot-Plug-Detect Level = HIGH
FWD Level = HIGH (DP Tx is connected to Rx and has power applied to AUX pull-up resistor)
Cable Detect Level = HIGH
```

#### AUX (UCD-400, UCD-411, UCD-424, UCD-451)

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

RD:	Native AUX Request Transaction for read
WR:	Native AUX Request Transaction for write
I2C RD:	I2C-over-AUX Request Transaction for read
I2C WR:	I2C-over-AUX Request Transaction for write
AUX_ACK:	AUX Reply Transaction (Request accepted)
AUX_NACK:	AUX Reply Transaction (Request not accepted)
AUX_DEFER:	AUX Reply Transaction (Delayed, new request needed)
Sideband REQ:	Sideband down request message (DOWN_REQ_MSG)
Sideband REP:	Sideband down reply message (DOWN_REP_MSG)
HDCP Trace 1.X or HDCP Trace 2.3:	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 Native AUX Request Length	= Source to Sink = Read = 6
Address	= 0x00200
Link/Sink Device Sta SINK_COUNT [RO] 0x00200	atus
Link/Sink Device Sta DEVICE_SERVICE_IRQ_V 0x00201	
Link/Sink Device Sta LANE0_1_STATUS [RO] 0x00202	atus
Link/Sink Device Sta LANE2_3 STATUS [RO] 0x00203	atus
Link/Sink Device Sta LANE_ALIGN_STATUS_U 0x00204	
Link/Sink Device Sta SINK_STATUS [RO] 0x00205	atus

#### Sideband Message Example

Sideband message header		Sideban
Link_Count_Total	1	Link
Link_Count_Remaining	0	Link
Broadcast_Message	0	Broa
Path_Message	1	Path
MSG Body Length	3	MSG
Start_Of_MT	1	Star
End Of MT	1	End
Message_Sequence_No	0	Mess
Sideband message validity check		Sideban
MSG_Header_CRC	7 [Good]	MSG
MSG Body CRC	95[Good]	MSG
Header Reserved (Zero) fields	[Good]	Head
Message Transaction decode		Message
Request_Identifier	0x10[ENUM_PATH	Repl
Port_Number	8	Requ
_		Port

#### 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\_CRANNEL\_EQ\_DONE = 1 LANE1\_CR\_DONE = 1 LANE1\_CRANNEL\_EQ\_DONE = 1

Link/Sink Device Status

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
	Link_Count_Total Link_Count_Remaining Broadcast_Message Path_Message MSG_Body_Length Start Of_MT Message_Sequence_No Sideband message validity check MSG_Beader_CRC MSG_Beader_CRC MsG_Body_CRC Header Reserved (Zero) fields Message Transaction decode Reply_Type Request_Identifier Port_Number Full_Payload_Bandwidth_Number_Available

#### HDCP 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 88 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 88 3D D6 EE C9 F7

#### **SDP (UCD-400, UCD-424)**

DP Secondary-data Packets.

SDP ID:	0x00		
SDP Type:	0x84		
SDP Length:	0x01B	(27)	
SDP Version:	0x12	(18)	
Data Byte 1:			
	0.91	Channel Count	2
		Refer to Stream Header	2
CI[/-4].	UNU	Kelei to Stieam headel	
Data Byte 2:			
SS[1-0]:	0x0	Sample Size	Refer to Stream Header
SF[4-2]:	0x0	Sampling Frequency	Refer to Stream Header
Data Byte 3:			
CXT[4-0]:	0x00	Refer to CT (Data Byte 1)	
Data Byte 4:			
-	0x00	Channel Allocation	1 2 3 4 5 6
			FL FR
Data Byte 5:			
LFEPBL[1-0]:	0x0	LFE Playback Level	Unknown or refer to other inform
LSV[6-3]:	0x0	Level Shift Value	0dB
DM_INH[7]:	0x0	Down-mix Inhibit Flag	Permitted or no information about
Raw Data:			
Head: 00 84 1B	40 (DD.	00 84 07 01)	
		0 00 00 00 00 00 00 00 00 00 00	0 00 (PB: 98 00 00 00)
1 00 00 00	00 00 0		0 00 (12. 00 00 00 00)

#### **VB-ID (UCD-400, UCD-424)**

Vertical Blanking ID packets sent in DP stream.

```
Device ID = 00

Stream ID = 00

Data length = 3

VerticalBlanking_Flag = 1[bit 0]

FieldID_Flag = 0[bit 1]

Interlace_Flag = 0[bit 3]

AudioMute_Flag = 1[bit 4]

HDCP SYNC DETECT = 0[bit 5]

CompressedStream_Flag = 0[bit 6]

Reserved = 0[bit 7]

Mvid = 0x33

Maud = 0x00
```

#### MSA (UCD-400, UCD-424)

Main Stream Attributes sent in DP stream.

Device ID	- 01
Stream ID	
Data length	
Mvid	= 0x2333
Nvid	= 0x8000
H-Total	= 2200
V-Total	= 1125
H-Active	= 1920
V-Active	= 1080
H-Sync Width	= 44
V-Sync Width	= 5
H-Sync Start	= 192
V-Sync Start	= 41
MISC0	= 0x20
MISC0.Clock	= Asynchronous
MISC1	= 0x00
MISC1.Interlac	ed Vertical Total Even: Number of lines per interlaced frame (consist
MISC1.Interlac	ed Vertical Total Even: No 3D stereo video in-band signaling

#### Link Pattern (UCD-400, UCD-424)

Status of link pattern detected in which lane.

Device	ID = 01
Lane 0	0
Lane 1	0
Lane 2	[]
Lane 3	[TPS1; Detected; ]

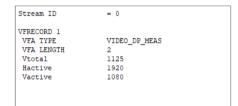
#### AUX\_BW (UCD-400, UCD-424)

Status of captured binary Manchester II codes. The duration of the preamble and postamble will be presented.

Packet conte																			
		e	= 0;	¢00	[Da	ta :	ne a	289	e)										
Packet size			= 2	4 [2	yte	a]													
Direction			= 3	ouro	e t	0 8	ink												
Native AUX R	equest		= 10	rite	£														
Length			= 2																
Data			= 0	8 08	E														
Address			= 0;	¢001	03														
Link Configu	ration																		
TRAINING LAN																			
0x00103 := 0																			
VOLTAGE SI		ET =	10	rel	0														
MAX SWING																			
PRE EMPHA																			
MAX PRE-E																			
NOTE: Dec						ann	EL.	COD	INC	3 2	127	-	8b/	105					
			_		-					-									
TX FFE PR	ESET V.	ALUE	=	8															
NOTE: Dec	oded a	5 MA	IN :	LINS	CH	ANN	EL	cop	INC	3 3	set.	=	128	b/1	32b				
	WING S																		
VOLTAGE_S MAX_SWING PRE_EMPHA MAX_PRE-E NOTE: Dec TX_FFE_PR NOTE: Dec	SIS_SE MPHASI oded a ESET_V	T = S_RE s MA ALUE	lev ACHI IN_	ED * LINE	0 _CH		1												
MAX_SWING PRE_EMPHA MAX_PRE-E NOTE: Dec TX_FFE_PR NOTE: Dec	SIS_SE MPHASI oded a ESET_V oded a	T = S_RE s MA ALUE	lev ACHI IN_	ED * LINE	0 _CH		1												
HAX_SWING PRE_ENPHA HAX_PRE-EN NOTE: Dec TX_PFE_PR NOTE: Dec Transaction	SIS_SE MPHASI oded a ESET_V. oded a Data	T = S_RE s MA ALUE	lev ACHI IN_	ED * LINE	0 _CH		1												
NAX_SWING PRE_ENPHA NAX_PRE-EN NOTE: Dec TX_FFE_PR NOTE: Dec Transaction	SIS_SE MPHASI oded a ESET_V. oded a Data	T = S_RE s MA ALUE	lev ACHI IN_	ED * LINE	0 _CH		1												
HAX_SWING PRE_EMPHA HAX_PRE_E NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01	SIS_SE MPHASI oded a ESET_V oded a Data 08 08	T = 8_RE a MA ALUE a MA	lev ACHI IN_	ED * LINE	0 _CH		1												
MAX_SWING PRE_EMPHA MAX_PRE_E NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01 Manchester I preamble:	SIS_SE MPHASI oded a ESET_V oded a Data 08 08 I code L 0 0	T = S_RE S_NA ALUE S_NA S: 0 0	lev ACH IN_ IN_ 0 0	ED *	сн Ссн	ANN	EL_	COD	ING	a_s	DET	-	128	b/1	32b	2 0		н	L
HAX SWING PRE_ENPEA MAX_PRE_D NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01 preamble: command:	SIS_SE NPHABI oded a ESET_V oded a Data 08 08 I code L 0 0 1 0 0	T = 3_RE 3 MA ALUE 3 MA 3: 0 0 0 [0	1ev ACH IN_ IN_ IN_ 0 0 x8]	ED *	0 (_CH	ann 0 0	el	0 0	IN(	0	o	=	128	b/1 0 0	32b 0 (	2 0	н	н	L
HAX SWING PRE_ENPEA MAX_PRE_D NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01 preamble: command:	SIS_SE NPHABI oded a ESET_V oded a Data 08 08 I code L 0 0 1 0 0	T = 3_RE 3 MA ALUE 3 MA 3: 0 0 0 [0	1ev ACH IN_ IN_ IN_ 0 0 x8]	ED *	0 (_CH	ann 0 0	el	0 0	IN(	0	o	=	128	b/1 0 0	32b 0 (	2 0	н	н	L
HAX_SWING PRE_EMPHA: HAX_PRE_E NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01 Manchester I preamble: command: address: length:	SIS_SE MPHASI oded a ESET_V. oded a Data 08 08 I code L 0 0 1 0 0 0 0 0	T = S_RE	lev ACH IN_ = IN_ 0 0 x8] 0 0 0 0	0 ( 1 )	CH	ANN 0 0 0 1 1]	el	0 0	IN(	0	o	=	128	b/1 0 0	32b 0 (	2 0	н	Я	L
MAX_SWING PRE_EMPHAL MAX_PRE_E NOTE: Dec TX_FFE_PR NOTE: Dec Transaction 80 01 03 01 Manchester I preamble:	SIS_SE MPHASI oded a ESET_V. oded a Data 08 08 I code L 0 0 1 0 0 0 0 0	T = S_RE	lev ACH IN_ = IN_ 0 0 x8] 0 0 0 0	0 ( 1 )	CH	ANN 0 0 0 1 1]	el	0 0	IN(	0	o	=	128	b/1 0 0	32b 0 (	> 0	н	я	L
HAX SWING PRE_MPRA HAX PRE-E NOTE: Bec TX_FFE_PR NOTE: Dec Transaction 10 01 03 01 Manchester I premble: command: address: length: data:	SIS_SE MPHASI oded a ESET_V. oded a Data 08 08 I code L 0 0 1 0 0 0 0 0	T = S_RE	lev. ACH IN IN 0 0 0 0 0 0 0 0	ED	CH CH	ANN 0 0 0 1 1] 8]	el	0 0	IN(	0	o	=	128	b/1 0 0	32b 0 (	2 0	н	н	L

#### VFAME INFO (UCD-400, UCD-424)

Measure dimensions of capture video frame.



#### **PD (UCD-424)**

USB-C PD communication messages

Header	0x21A1	Data Message
Extended (15)	0	
Data Objs(1412)	2	
Message ID(119)	0	
Port Power Role(8)	Source(0x1)	
Spec Rev(76)	v3.0(0x2)	
Port Data Role(5)	DFP(0x1)	
Message Type(40)	Source_Capabil	lities(0x01)
Fixed PDO - Source	0x2A01912C	
Fixed supply(3130)	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(2120)	Peak current e	equals Ioc(0x0)
Voltage (1910)	5000mV(0x064)	
Maximum Current(90)	3000mA(0x12C)	
Fixed PDO - Source	0x2A02D12C	
Fixed supply(3130)	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(2120)	Peak current e	equals Ioc(0x0)
Voltage(1910)	9000mV(0x0B4)	
Maximum Current(90)	3000mA(0x12C)	
CRC	0x18F3953D	
End of packet		

#### **LSE (UCD-424)**

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 currens	= 88 mA
Vcc 1	= 5337 mV [updated]
Vcc 2	= 1680 mV [updated]
Vsbu 1	= 234 mV
Vsbu 2	= 2865 mV
Ivconn	= 5337 mA [updated]

#### Packets (UCD-422, UCD-452)

Log metadata sent by Source device in HDMI stream

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)
Coded frame AR(12:13)	0(No Data)
Colorimetry(14:15)	0(No Data)
Non-U Scaling(16:17)	0(No Known non-uniform scaling)
RGB Quant(18:19)	0(Default (depends on video format))
E-Colorimetry(20:22)	0(No data)
ITC Content(23)	0(No Data)
VIC(24:31)	16
Pixel repets(32:35)	0(No repeats)
ITC Type(36:37)	0(Graphics)
YCC Quant(38:39)	0(Limited range)
ETB(40:55)	0
SBB(56:71)	0
ELB(72:87)	0
SRB(88:103)	0
Transformed HDMI Data:	
82 02 0D 57 00 08 00 10 00 00 00 00 00 00	00 00
00 00 00 00 00 00 00 00 00 00 00 00 00	00 38
00 00 00	

#### I2C (UCD-422, UCD-452)

Log data sent over I2C communication lines of HDMI interface

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

#### **CEC (UCD-422, UCD-452)**

#### **CEC** messages

Flags: 00 Data length: 7 Ackonledges vector: 0x001F	
Header: Initiator address: Destination address:	0x00 0x0F
Opcode Block: Opcode:	<report address="" physical="">(0x84)</report>
[Physical Address] [Device Type]	0.0.0.0 TV(0x00)

# 10. EDID/DISPLAYID EDITOR

The *EDID/DisplayID Editor* main window is divided into three views. The bottom area additionally has command buttons. The top left tree view selection determines the blocks to be edited. The top right view shows data for the currently selected item in the top left view. These values may be edited when the *Editor Mode* checkbox is checked, The bottom right hex view shows that data as hex values. The hex values of the currently selected item in the top left view are highlighted. Values can be edited when the *HEX Edit Mode* checkbox is checked.

RX	DP TX Event Log Memor	y Layout Terminal							
ink	HDCP Video Audio L	ink Analyzer Captu	re D	PCD	SDP DSC FEC Source	EDID/DisplayID			
EDI	DisplayID								
Ad	dd Item 🔻 Remove Item Filter				Read mode: 🧿 I2C Re	ad 🔘 SBM Read Virtual Sink #1 🗸 🗌	Show Read Onl	y 🛃 Recurs	se
Na	ime		Edi	itor	Text EDID				
	VESA				Name	Value			
	✓ Vendor & Product ID		0	Heade		0x00FFFFFFFFFFF00		- P	
	<ul> <li>Week &amp; Year of Manufactur</li> <li>Week &amp; Year of Manufa</li> </ul>								
	EDID Structure Version and Rev	ision Numbers	1		sion Block Count N	2			
	> Basic Display Parameters / Feat Color Characteristics	ures	2	Check		0x18			
	<ul> <li>Established Timings I</li> </ul>		3		nufacturer Name & Product ID	UFG			
	> Established Timings II		4		duct Code & Product ID	0x4036			
	<ul> <li>Manufacturer's Timings</li> <li>Standard Timings Identification</li> </ul>		5	ID Ser	ial Number	22415942			
F	eatures CTA v3			Vendor a	& Product ID				
	Name	Value			00 01 02 03 04 05 06	07 08 09 0A 0B 0C 0D 0E 0F			
1	Max Resolution	10240 x 4320	00	0000	00fffffffffff	0054c73640460a5601			L
2	10K Max Frame Rate	60 Hz				78 3a 5f bl a2 57 4f a2 28			٩.
3	8K Max Frame Rate	60 Hz			0000000	4f810081c08180a9c0			
4	4K Max Frame Rate	145 Hz				d000a0f0703e803020 1a)56)5e)00(a0(a0(a0)29)50			
1						100001a000000fd0038			
5	2K Max Frame Rate	145 Hz				20202020200000fc			
6	HDR Static	Disabled			0000000	30204450310a200218			
						00 29 OF 7F 07 15 06 55 3d			
	Main Features		U E	ditor M	lode 🔲 HEX Edit Mode			Apply	
Rea	ad from TE Write to TE						Save As	Load	
PD									
	HPD Assert	Deassert Pul	se HPD	500	Length, msec Short Puls				

Add Item:	Add a new EDID or DisplayID block. Available when in <i>Editor Mode</i> exclusivly.
Remove Item:	Delete the selected EDID or DisplayID block. Available when in <i>Editor Mode</i> exclusivly.
Filter:	Show only items having indicated string in the field name.
Read mode:	Select data read mode: I2C: local read using I2C protocol SBM (MST mode only): virtual channels read with SBM protocol
Show Read Only:	When selected, automatically created fields are shown.
Recurse:	When selected, the entire tree of the selected item is parsed in the top right hand list.

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

		*
▼ Main Features	Editor Mode HEX Edit Mode	Apply
Read from TE Write to TE	Save As	Load

Read from TE (Analyzer):	Read device local EDID/DisplayID blocks into editor.
Write to TE (Analyzer):	Write editor data to device local EDID/DisplayID blocks.
Download from Sink (Generator):	Read EDID/DisplayID blocks from connected sink device into editor.
Upload to Sink (Generator):	Write editor EDID/DisplayID blocks to connected sink device. See note below.
Editor Mode:	Enable editing EDID/DispslayID 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 paiars can be edited.
HEX Edit Mode:	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.
Save As:	Save the current editor data to disk in various formats: binary, hex, ecd or txt.
Load:	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.

The *Main Features* view *Features* tab view gives an overview of items of common interest. For example, whether the sink is capable of HDR, or Dolby Vision, etc.

		Name	Value
	Max Res	olution	10240 x 4320
	10K Max	Frame Rate	60 Hz
	8K Max	Frame Rate	60 Hz
	4K Max	Frame Rate	145 Hz
	2K Max	Frame Rate	145 Hz
	HDR Sta	tic	Disabled
	HDR Dy	namic	Disabled
	HDR10+		Disabled
	Dolby V	ision	Disabled
5	SBTM		Disabled

The *Main Features* view *CTA v3* tab (avalable only in EDID tab not DisplayID tab) allows enabling/disabling features. You enable/disable a feature by double clicking the Value field with *Editor Mode* enabled. When enabling, 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 right tree view.

I	eatures	CTA v3		
		Nar	ne	Value
1	HDR Stati			Enabled
2	HDR Dyn Data block o			Disabled
3	HDR10+ Data block c	ollection		Disabled
4	Dolby Vis Data block o			Disabled
5	SBTM Data block o	ollection		Disabled

### **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 contained within the data block. The contents can then be easily browsed, using only a few mouse clicks. The Editor supports automatic variables, such as the block checksum. When the user changes a value in a block, the tool will update the checksum. The automatic variables are read only. A log print will be made when an automatic variable is updated by the editor.

### **Editing Tips**

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

Note:	EDID Editor does not have an <i>Undo</i> function. Therefore, it is highly recommended that you back up un-edited EDID contents to a file before editing it.
	<ul> <li>Remember to click Set after changing a bit-value presented as a single checkbox if you want the new value applied.</li> </ul>
	<ul> <li>Floating point values must be given with period "." as decimal separator, even if your localization setting defines decimal separator as comma (or other).</li> </ul>
	<ul> <li>You can always enter HEX or DEC, even if the value is presented as HEX, and/or value range is given in HEX.</li> </ul>
	<ul> <li>Enter hex values with prefix "0x" or "\$", no prefix means a decimal value.</li> </ul>
	<ul> <li>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".</li> </ul>
	Enter key will apply text-edit values and combo-box selection.
	<ul> <li>Red values in the HEX view indicate a changed value.</li> </ul>
	Double-click the property field to edit.

# 11. PACKET EDITOR

#### Packet Editor enables creation and editing metadata packets.

Unigraf Packet Editor																-				×
Protocol Display Port v Type Audio v	New		Save	e As		L	.oad													
Add Item , Remove Item Filter												] She	ow re	ead o	only p	prope	erties	$\checkmark$	Recu	ırse
Name						Nam	e								Valu	e				^
✓ Audio InfoFrame	- 1	0	Audio Ch	ann	el Co	unt					2 ch	ann	els							
Packet Header		1	Audion [(	Cod	ing T	me /	Stre	am F	ncodi	na	Refe	r to	Stree	am H	loade	ar.				
Packet Data     Channel allocation (0 - 49)					ing i	/pc/	Juic		neoui	-										
channel anocation (o 45)		2	Sample Si	ize							Refe	r to	Strea	am H	leade	er				
		3	Sampling	Fre	quen	cy					Refe	er to	Strea	am H	leade	er				
		4	Туре								Cha	nnel	allo	catio	n (0	- 49)				
		5	CA Channel allo	catio	n (0 - 4	9)					0									*
				00	0 01	02	03	04	05	06	07	08	09	AO	0B	oc	OD	0E	OF	
		6	000000	00	84	lb	48	01	00	00	00	00	00	00	00	00	00	00	00	
		0	000010	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
			000020	00	00	00	00													
			HEX Edit	Мо	de										A	pply				
L																				

The types of supported packets are:

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

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



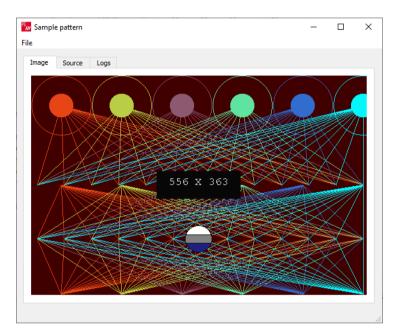
Pattern Editor is a tool for editing and debugging Unigraf Custom VTP Pattern scripts.

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.

le						
Image Source	Logs					
xml version ="1.0<br Description > <scription ABSOLUTE COLORRGB 256 0 0 BOX 0 0 MAXX MAX SET H VS/2 SET H VS/2 SET H 2 VS/4*3 SET C 1023*V/MAX SET C 1023*V/MAX SET C 1023*V/MAX COLORRGB 1023-C CIRCLE X 49 49 FCIRCLE X 49 49 FCIRCLE X 49 40 REPEAT A 10 MAX CIRCLE X 49 40 REPEAT A 10 MAX LINE X NO A H LINE X NO A H LINE X NO A H LINE X NO A H SET Z 100/3+5*2 COLORRGB 1023 10 BOX MAXX*6/16 MA COLORRGB 1023 11 EXTPOS MAX/2 M ALIGN C</scription 	t> 100 X ed green 3*C C 45 0 XY*7/16 MAXX; 23 1023		rue"> <description></description>	Sample pa	attern </th <th>~</th>	~
		Apply				

#### Logs Tab

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

Image         Source         Logs           RGB 163840 0         BOX 0 0 556 363         A           h <- vs/2 = 181         A         A           h <- vs/2 = 181         A         A           h <- vs/2 = 3270         C         C           c <- 1023*x/max = 92         RGB 50584 17664 5888         CIRCLE 50 49 49           CIRCLE 50 49 49         CIRCLE 50 49 49         CIRCLE 50 49 20           LINE 50 50 10 181         LINE 50 55 181         LINE 50 362 10 270           LINE 50 50 100 181         LINE 50 100 181         LINE 50 100 181           LINE 50 50 100 181         LINE 50 50 100 181         LINE 50 50 190 181           LINE 50 50 190 181         LINE 50 50 190 181         LINE 50 50 190 181           LINE 50 50 190 181         LINE 50 50 190 181         LINE 50 50 190 181           LINE 50 50 190 181         LINE 50 362 190 270         LINE 50 362 190 270           LINE 50 50 190 181         LINE 50 362 190 270         LINE 50 362 190 270           LINE 50 181 190 270         LINE 50 181 235 270         LINE 50 50 150 253 181           LINE 50 181 235 270         LINE 50 181 235 270         LINE 50 181 235 270	B 16384 0 0         X 0 0 556 363         < vs/2 = 181         < vs/2 = 181         < vs/2 * 9 = 270         - 1023*x/maxx = 92         B 9584 17664 5888         XCLE 50 49 49         XCLE 50 49 49         XCLE 50 49 49         E 50 30 10 181         E 50 362 10 270         E 50 50 101 181         E 50 181 16 270         E 50 50 103 181         E 50 181 145 270         E 50 50 191 181         E 50 50 191 181         E 50 362 109 270         E 50 362 185 270         E 50 362 109 270         E 50 362 109 270         E 50 362 109 270         E 50 362 235 270	// Sample pattern	_	×
RGB 16384 0 0           BOX 0 0 556 363           h < vs/2 = 181	B 16384 0 0 X 0 0 556 363 < vs/2 = 181 < vs/2 = 181 < vs/2 = 181 < vs/2 = 827 < vs/4*9 = 270 - 1023*x/max = 92 B 9584 1766 4588 SQLE 50 49 49 SQLE 50 49 49 E 50 50 10 181 E 50 181 10 270 E 50 362 100 270 E 50 362 105 270 E 50 362 105 270 E 50 362 105 270 E 50 362 25 270 E 50 50 235 181 E 50 181 1235 270 E 50 362 25 270	ile		
RGB 16384 0 0           BOX 0 0 556 363           h <- vs/2 = 181	B 16384 0 0         X 0 0 556 363         < vs/2 = 181			
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#### Saving and Recalling the Script

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

Open: Open a VTP language script from PC

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

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

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

#### UNIGRAF

#### **IMAGE CONVERTER** 13.

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.

IICL Converter		-		×
Advance mode		Ab	out	
Source image	Destination in	nage		
No image selected	Colorspace:	YCbCr		$\sim$
Select	Colorimetry:	ITU-R BT.	601	$\sim$
	Sampling:	4:4:4		$\sim$
	Bit depth:	8		$\sim$
			Conv	rert

Image Converter has two operating modes: Standard mode and Advanced mode. In Standard mode typical image file formats are used as Source image and the user sets basic color formats for the Destination image. In Advanced mode, the user is able to define the Source and Destination image parameters in detail.

Click Select to load the Source image. Click Convert to store the Destination image. File name for
--

IICL Converter			- 🗆	×
Advance mode			About	
Source image		Destination image		
Colorspace:	RGB ~	Colorspace:	YCbCr	$\sim$
Colorimetry:	ITU-R BT.601 $\sim$	Colorimetry:	ITU-R BT.601	$\sim$
	full range		🗌 full range	
Sampling:	4:4:4 ~	Sampling:	4:4:4	$\sim$
Packing:	Planar v	Packing:	Planar	$\sim$
Component order:	RGB ~	Component order:	YCbCr	] ~
Alignment:	LSB ~	Alignment:	LSB	$\sim$
Bit depth:	8	Bit depth:	8	
Monochrome:		Monochrome:		
Width:	1920			
Height:	1080			
Path:	Select			
Selected file:	C:/Users/Tester/Pictures/capture_20221130_031408/capture_20221130_031408.mainlink.bin			
			Conv	rert

#### the Destination image is of form:

Source\_image\_1920x1080\_8bits\_yuv444\_lsb.bin

Source_image	Name of the image file used as Source image
1920x1080	Resolution of the Source Image
8bits	Bit depth of the Destination image
yuv444	Color space and sampling of the Destination image
lsb	Data alignment of the Destination image

# APPENDIX A: PRODUCT SPECIFICATION

### UCD-400 and UCD-411

Input	DisplayPort™ 1.4a compliant (DP Rx) <i>(UCD-400 only)</i>
Output	DisplayPort™ 1.4a compliant (DP Tx)
Max video mode	7680 × 4320 p30 input and output 3840 × 2160 p120 input and output
Audio	LPCM, 2 – 8 channels, 44.1 to 192 kHz
Content Protection	HDCP 2.3, HDCP 1.3
DSC Capability	DSC Sink with off-line decompression DSC Source using pre-compressed content
Additional features	FEC, LTTPR, DSC DP 1.4a LL CTS, DP DSC CTS HDCP 2.3 CTS
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, +12 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	280 × 200 × 80 mm
Weight	1.2 kg w/o power supply

### UCD-422 and UCD-412

Input	HDMI 2.1 (10K@30Hz) (HDMI Rx) (UCD-422 only)
Output	HDMI 2.1 (10K@30Hz) (HDMI Tx)
HDMI 2.1 Features	FRL, TMDS, ALLM, VRR, QMS-VRR, SBTM
Content Protection	HDCP 2.2, HDCP 2.3
Additional features	eARC, DSC*, FEC*
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, +12 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	272 × 170 × 60 mm
Weight	1.2 kg w/o power supply

\*) Please contact Unigraf for detailed availability

### UCD-424

Input	USB-C DP Alt Mode 1.4a compliant (USB-C Rx)
Output	USB-C DP Alt Mode 1.4a compliant (USB-C Tx)
Max video mode	7680 × 4320 p30 input and output 3840 × 2160 p120 input and output
Audio	LPCM, 2 – 8 channels, 44.1 to 192 kHz
Content Protection	HDCP 2.3, HDCP 1.3
DSC Capability	DSC sink with off-line decompression DSC source using pre-compressed content
Additional features	FEC, LTTPR*, DSC DP 1.4a LL CTS, DP DSC CTS HDCP 2.3 CTS
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, +12 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	280 × 200 × 80 mm
Weight	1.2 kg w/o power supply

### UCD-451

Output	DisplayPort™ 1.4a compliant (DP Tx)
Max video mode	7680 × 4320 p30 3840 × 2160 p120
Content Protection	HDCP 2.3, HDCP 1.3
Additional features	FEC, LTTPR, DSC DP 1.4a LL CTS, DP DSC CTS* HDCP 2.3 CTS*
DSC Capability	DSC source using pre-compressed content
User Interface	Computer with monitor, keyboard and mouse
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.
Video memory	Extended video memory up to 32 GBytes
Connections	6 x USB 3.0, 2 x Ethernet, 1 x HDMI
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 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	329 × 188 × 215 mm
Weight	3.9 kg w/o power supply

\*) Please contact Unigraf for availability

### UCD-452

Output	HDMI 2.1 (HDMI Tx)
Max video mode	10240 x 4320 @ 30Hz 10240 x 4320 @ 60Hz with DSC
HDMI 2.1 Features	FRL, TMDS, ALLM, VRR, QMS-VRR, SBTM DSC 1.2a, FEC, eARC*
Content Protection	HDCP 2.3, 1.4
User Interface	Computer with monitor, keyboard and mouse
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.
Video memory	Extended video memory up to 32 GBytes
Connections	6 x USB 3.0, 2 x Ethernet, 1 x HDMI
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +12 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	329 × 188 × 215 mm
Weight	3.9 kg w/o power supply

\*) Please contact Unigraf for availability

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# **APPENDIX B: PRODUCT FEATURES**

# UCD-400, UCD-411, UCD-424 and UCD-451 Features

Input / Output Role	UCD-4XX Default	DSC Decoder	DP 1,4a Link Analyzer	Panel Replay	eDP Support	DP 1.4a LL CTS	DP 1.4a DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Source DUT	HDCP 2.3 CTS Sink, Source & Repeater DUT	TSI Basic
DP Reference Sink (UCD-400 and UCD-424)												
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)	•											
Main 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	•											
Panel Replay, PSR, ALPM												
Panel Replay				•								
PSR1					•							
PSR2					•							
Early Transport				•	•							

Selective Update		•	•							
AUX-less ALPM		•	•							
AUX-wake ALPM			•							
DP 1.4 / 2.1 Link Layer CTS for testing Source DUT										
DP 1.4a LL, Audio, FEC CTS				•						
DP 1.4a DSC 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									•	

\*) HDCP 1.3 is currently not supported. It will be supported in later 3.X release package.

\*\*) Adaptive-Sync is currently limited to SST mode.

# UCD-400, UCD-411, UCD-424 and UCD-451 Features (cont.)

Input / Output Role	UCD-4XX Default	DSC Encoder	LTTPR	Panel Replay	eDP Support	DP 1.4a LL CTS	DP 1.4a DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Sink DUT	HDCP 2.3 CTS Sink, Source and Repeater DUT	TSI Basic
DP Reference Source			1	1								
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	•											
LTTPR Feature			•									
HDCP 1.3 status and control*	•											
HDCP 2.3 status and control	•											
Event Log, AUX Analyzer	•											
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					•							
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 1.4a 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**								•	

\*) HDCP 1.3 is currently not supported. It will be supported in later 3.X release package

\*\*) Please check availability for UDC-451 from Unigraf

### UCD-422, UCD-412 and UCD-452 Features

Input / Output Role	UCD-4XX Default	HDMI 1.4 Link Analyzer	TSI Basic
HDMI Reference Sink (UCD-422 only)			
Video status, preview and saving	•		
Buffered capture	•		
Audio monitoring, graphical preview and saving	•		
Link status	•		
Link control	•		
HPD status and control	•		
EDID read and write	•		
EDID Editor	•		
HDCP 1.4 status and control*	•		
HDCP 2.3 status and control*	•		
FEC Feature	•		
DSC Decoder, DSC Control	•		
ALLM, VRR	•		
Event Log	•		
InfoFrame status	•		
eARC	•		
Source DUT Testing	•		
HDMI 1.4 Link Analyzer		•	

\*) HDCP is currently not supported. It will be supported in later 3.X release package

HDMI Reference Source		
Video pattern generator (fixed patterns and timings)	•	
Custom video patterns and timings	•	
Playback	•	
Audio Generator	•	
Link status	•	
Link control	•	
EDID read and write	•	
EDID Editor	•	
DSC Encoder	•	
SCDC Editor	•	
Event Log	•	
Sink DUT Testing	•	
HDCP 1.4 status and control*	•	
HDCP 2.3 status and control*	•	

\*) HDCP is currently not supported. It will be supported in later 3.X release package

### UCD-424 USB-C Features

Input / Output Role	UCD-4XX Default	TSI Basic			
USB-C Modes Common					
USB-C Data Role status & control	•				
USB-C Power Role status & control	•				
USB-C Vbus / CC / Vconn voltage / current monitoring	•				
Power Delivery protocol monitoring	•				
Cable Info (E-marker details)	•				
Event Logger	•				
Support for USB-C Power for 5V/3A	•				
Support for USB-C Power for 9V/3A	•				
DP Alt Mode Common					
USB-C DP ALT Mode status	•				
USB-C DP ALT Mode control	•				

## **Product Options**

#### UCD-400, UCD-411 and UCD-424 Product Options

Product	P/N	Product	P/N
HDCP 2.3 CTS for testing Source DUT on DP	MT6634	DSC Decoder for testing Source DUT on DP	MT6670
HDCP 2.3 CTS for testing Sink DUT on DP	MT6636	DSC Encoder for testing Sink DUT on DP	MT6671
HDCP 2.3 CTS for testing Repeater DUT on DP	MT6638	DP 2.1 Adaptive-Sync CTS for testing Source DUT (8b/10b)	MT6648
DP 1.4a LL CTS for testing Sink DUT	MT6635	DP 2.1 Adaptive-Sync CTS for testing Sink DUT (8b/10b)	MT6649
DP 1.4a LL CTS for testing Source DUT	MT6637	HDR 10+ Display Device and SSTM Test for testing Sink DUT on DP	MT6676
DP 1.4a DSC CTS for testing Source DUT	MT6642	HDR 10+ Distribution Device for testing Source DUT on DP	MT6678
DP 1.4a DSC CTS for testing Sink DUT	MT6643	DP 1.4a Link Analyzer	MT6655
DP 2.1 DisplayID / EDID CTS for testing Source DUT (8b/10b)	MT6646	DP 2.1 Panel Replay support for testing Sink & Source DUT	MT6685
DP 2.1 DisplayID / EDID CTS for testing Sink DUT (8b/10b)	MT6647	eDP support for testing Sink & Source DUT	MT6686

#### UCD-412, UCD-422 Product Options

Product	P/N	Product	P/N
DSC Decoder for testing Source DUT on HDMI	MT6672	HDR10+ DD and SSTM Tests for HDMI Sink DUT	MT6675
DSC Encoder for testing Sink DUT on HDMI	MT6673	HDR10+ DD and SSTM Tests for HDMI Source DUT	MT6677
HDMI 1.4 Link Analyzer	MT6658		

# **APPENDIX C: PREDEFINED TIMINGS**

Description*	HA	VA	нт	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 Eh)	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 10h)	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 17h)	1280	768	1664	798	320	27	128	7	60	79,67
DMT 1280 × 800 @ 60 Hz (ID 1Bh) [RB1]	1280	800	1440	823	112	20	32	6	60	71,11
DMT 1280 × 800 @ 60 Hz (ID 1Ch)	1280	800	1680	831	328	28	128	6	60	83,76
DMT 1280 × 960 @ 60 Hz (ID 20h)	1280	960	1800	1000	424	39	112	3	60	108,00
DMT 1280 × 1024 @ 60 Hz (ID 23h)	1280	1024	1688	1066	360	41	112	3	60	107,96
DMT 1360 × 768 @ 60 Hz (ID 27h)	1360	768	1792	795	368	24	112	6	60	85,48
DMT 1400 × 1050 @ 60 Hz (ID 29h) [RB1]	1400	1050	1560	1080	112	27	32	4	60	101,09
DMT 1400 × 1050 @ 60 Hz (ID 2Ah)	1400	1050	1864	1089	376	36	144	4	60	121,79

\*) CVT: Coordinated Video Timings (CVT; VESA-2021-09-27 v2.0)

DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

Description*	HA	VA	НТ	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 33h)	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 39h) [RB1]	1680	1050	1840	1080	112	27	32	6	60	119,23
DMT 1680 × 1050 @ 60 Hz (ID 3Ah)	1680	1050	2240	1089	456	36	176	6	60	146,36
DMT 1792 × 1344 @ 60 Hz (ID 3Eh)	1792	1344	2448	1394	528	49	200	3	60	204,75
DMT 1856 × 1392 @ 60 Hz (ID 41h)	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 1		1080	2000	1111	72	14	32	8	60	133,32
DMT 1920 × 1080 @ 60 Hz (ID 52h)	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; VESA-2021-09-27 v2.0) DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

Description*	HA	VA	нт	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 45h)	1920	1200	2592	1245	536	42	200	6	60	193,62
DMT 1920 × 1440 @ 60 Hz (ID 49h)	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) CTA 2560 × 1080 @ 25 Hz (VIC 87)	2560 2560	1080 1080	3750 3200	1100 1125	192 192	16 41	44 44	5 5	24 25	99,00 90,00
CTA 2560 × 1080 @ 20 Hz (VIC 87)	2560	1080	35200	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 2560	1080	2720	1157 1190	152	14	32	8 8	144	453,33
CVT 2560 × 1080 @ 200 Hz [RB3] CTA 2560 × 1080 @ 60 Hz (VIC 90)	2560	1080 1080	2720 3000	1100	152 192	14 16	32 44	0 5	200 60	647,59 198,00
CTA 2560 × 1080 @ 00 Hz (VIC 92)	2560	1080	3300	1250	192	16	44	5	120	495,00
DMT 2560 × 1600 @ 60 Hz (ID 4Dh)	2560	1600	3504	1658	752	55	280	6	60	348,58
DMT 2560 × 1600 @ 60 Hz (ID 4Ch) [RB1]	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 × 1440 @ 60 Hz	2880	576 1440	3456 2976	625	528 48	44 °	256	5	50 60	108,00
CVT 3840 × 2160 @ 30 Hz [RB1]	2880 3840	2160	4000	1456 2191	40	8 28	8 32	1 5	60 30	259,98 262,92
CVT 3840 × 2160 @ 30 Hz [RB2]	3840	2160	3920	2191	72	14	32	8	30	257,66
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; VESA-2021-09-27 v2.0) DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

Description*	HA	VA	HT	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock
	00.40	0400	5000	0050	004	00	00	40	50	(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
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
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 [RB2]	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 [RB2]	7680	4320	7760	4443	72	14	32	8	60	2068,66
CVT 7680 × 4320 @ 100 Hz [RB2]	7680	4320	7760	4529	72	14	32	8	100	3514,50
CVT 7680 × 4320 @ 60 Hz [RB1]	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
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 @ 60Hz (VIC 199)	7680	4320	9000	4400	768	64	176	20	60	2376,00

\*) CVT: Coordinated Video Timings (CVT; VESA-2021-09-27 v2.0)

DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

Description*	НА	VA	нт	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock (MHz)
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
Unigraf 10240 x 4320 @ 30 Hz [RB1]	10240	4320	11000	4500	112	58	32	5	30	1485,00
Unigraf 10240 x 4320 @ 30 Hz [RB2]	10240	4320	11000	4500	72	14	32	8	30	1485,00
CTA 10240 x 4320 @ 24 Hz (VIC 210)	10240	4320	12500	4950	768	614	176	20	24	1485,00
CTA 10240 x 4320 @ 25 Hz (VIC 211)	10240	4320	13500	4400	768	64	176	20	25	1485,00
CTA 10240 x 4320 @ 30 Hz (VIC 212)	10240	4320	11000	4500	472	164	176	20	30	1485,00
CTA 10240 x 4320 @ 48 Hz (VIC 213)	10240	4320	12500	4950	768	614	176	20	48	2970,00
CTA 10240 x 4320 @ 50 Hz (VIC 214)	10240	4320	13500	4400	768	64	176	20	50	2970,00
CTA 10240 x 4320 @ 60 Hz (VIC 215)	10240	4320	11000	4500	472	164	176	20	60	2970,00
CTA 10240 x 4320 @ 100 Hz (VIC 216)	10240	4320	13200	4500	768	164	176	20	100	5940,00
CTA 10240 x 4320 @ 120 Hz (VIC 217)	10240	4320	11000	4500	472	164	176	20	120	5940,00

\*) CVT: Coordinated Video Timings (CVT; VESA-2021-09-27 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

<b>Fixed Patterns</b>		
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
		Vertical stripes of black (0%) and white (100%).
White V-Strips		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	Ō	Custom image uploaded by the user. Click on Select to browse.
Select DSC Image	<b>O</b>	Custom DSC compressed image file uploaded by the user. Click on Select to browse.
Unigraf PM5544	<b>e</b>	Vpattern vector pattern based on PM5544
Color Web		Vpattern vector pattern.
Chinese Town Full HD		JPG Bitmap image (1920 x 1080 px)
UG-2111 HLG Narrow		Software generated pattern. HLG Narrow dynamic range.
UG-2111 PQ Narrow		Software generated pattern. PQ Narrow dynamic range.
UG-2111 PQ Full		Software generated pattern. PQ Full dynamic range.
Multi		Vpattern vector pattern. Multi-purpose pattern w square grid, cross-grids, 1x1 cross-hatches, circles, and color bars
SMPTE RP-133		Vpattern vector pattern based on SMTPE RP-133
SMPTE 303M		Vpattern vector pattern. SMPTE 303M; Full Range; RGB values before gamma correction based on D65 and PAL primaries
Blue		Vpattern vector pattern. 100% Blue
CirclesW	88	Vpattern vector pattern. Concentric circles
Complex	5	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		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	lcon	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/

# APPENDIX E: SINK, SOURCE AND REPEATER TESTS

Source DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS	DP 2.1 DisplayID / EDID CTS (8b/10b)*	DP 2.1 Adaptive-Sync CTS (8b/10b)*	HDCP 2.3 CTS*	HDR10+ Distribution Device Tests
Audio Test	Validate audio signal frequency and glitch-free audio reproduction	•						
CEC Functional Test Set (HDMI) (UCD-422)	CEC functional test, CEC PHY Addr test, CEC Complete test, CEC Wake up test, CEC Standby test	•						
CRC Video Tests (UCD-400, UCD-422, UCD-424) Will be available in future UCD-4XX versions	CRC based single frame reference video test, CRC based single frame stability test, CRC based sequence of frames reference video test CRC based continuous sequence of frames reference video test	•						
Link Config Tests (DP) (UCD-400, UCD-424)	Link Training at All Supported Lane Counts and Link Rates	•						
Pixel Level Video Tests	Compare video frame sequence with a single reference							
VRR Source DUT Tests (HDMI) (UCD-412, UCD-422)	VRR static test, QMS Test, VRR Dynamic test	•						
DP 1.4a Link Layer CTS (UCD-400, UCD-424)	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, 4.4.4.1 – 4.4.4.6, 4.5.1.1 – 4.5.1.2		•					
DP 1.4 DSC CTS (UCD-400, UCD-424)	4.6.1.1 – 4.6.1.9			•				
DP 1.4 DisplayID-EDID CTS (UCD-400, UCD-424)	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, 4.7.5.1, 4.7.6.1 - 4.7.6.4, 4.7.7.1 - 4.7.7.2				•			
DP Adaptive-Sync CTS (UCD-400, UCD-424)	4.8.1.1 - 4.8.1.2, 4.8.2.1 - 4.8.2.3					•		
DP HDCP 2.3 CTS 1A Test Set (UCD-400, UCD-424)	HDCP2.3 CTS 1A-01 - HDCP2.3 CTS 1A-12						•	
DP HDCP 2.3 CTS 1B Test Set (UCD-400, UCD-424)	HDCP2.3 CTS 1B-01 - HDCP2.3 CTS 1B-10						•	
HDR10+ Distribution Device Tests (HDMI RX / DP RX) (UCD-400, UCD-422, UCD-424)	Tests from: HDR10+ TEST SPECIFICATION, HDR10+ Distribution Device							•
HDR10+ SSTM Tests for Source (HDMI RX / DP RX) (UCD-400, UCD-422, UCD-424)	Tests from: HDR10+ TEST SPECIFICATION, Source Side Tone Mapping for Source Device							•

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

Sink DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS Sink DUT*	DP 2.1 DisplayID / EDID CTS (8b/10b)*	DP 2.1 Adaptive-Sync CTS (8b/10b)*	DP HDCP 2.3 CTS*	HDR10+ DD & SSTM CTS
VRR Sink DUT Tests (HDMI) (UCD-412, UCD-422)	VRR static test, QMS Test, VRR Dynamic test	•						
DP 1.4a Link Layer CTS (UCD-400, UCD-411, UCD-424)**	5.2.1.1 – 5.2.1.12, 5.2.2.1 – 5.2.2.9, 5.3.1.1 – 5.3.1.9, 5.3.2.1 – 5.3.2.2, 5.4.1.1 – 5.4.1.4, 5.4.2, 5.4.3.1 – 5.4.3.2, 5.4.4.1 – 5.4.4.6, 5.5.1.1 – 5.5.1.7		•					
DP 1.4a DSC CTS (UCD-400, UCD-411, UCD-424)**	5.6.1.1 – 5.6.1.26, 5.6.2.1 – 5.6.2.14			•				
DP 1.4a DisplayID-EDID CTS (UCD-400, UCD-411, UCD-424)**	$\begin{array}{l} 5.7.1.1-5.7.1.2,\ 5.7.1.3.1-5.7.1.3.4,\ 5.7.1.4.1-5.7.1.4.9,\ 5.7.1.5-5.7.1.6,\ 5.7.2.1-5.7.2.2,\\ 5.7.2.3.1-5.7.2.3.5,\ 5.7.2.4.1-5.7.2.4.2,\ 5.7.2.5.1-5.7.2.5.2,\ 5.7.2.6.1-5.7.2.6.2,\ 5.7.2.7.1,\ 5.7.2.8,\\ 5.7.3.1-5.7.3.5,\ 5.7.4.1-5.7.4.3,\ 5.7.4.5,\ 5.7.5.1,\\ 5.7.6.1-5.7.6.5,\ 5.7.7.1-5.7.7.6,\ 5.7.8.1-5.7.8.6,\ 5.7.9.1-5.7.9.3,\ 5.7.10.1-5.7.10.3,\\ 5.7.11.1-5.7.11.5,\ 5.7.12.1-5.7.12.4,\ 5.7.14.1-5.7.14.6,\ 5.7.15.1-5.7.15.9,\ 5.7.16.1-5.7.19.6,\\ 5.7.20.1-5.7.20.3,\ 5.7.21.1-5.7.21.5,\ 5.7.22.1-5.7.22.1-5.7.22.1-5.7.22.1-5.7.22.7\\ \end{array}$				•			
DP Adaptive-Sync CTS (UCD-400, UCD-411, UCD-424)**	5.8.1.1 – 5.8.1.3					•		
DP HDCP 2.3 CTS 2C Test Set (UCD-400, UCD-411, UCD-424)**	HDCP2.3 CTS 2C-01 – HDCP2.3 CTS 2C-06						•	
HDR10+ CTS Tests (HDMI & DP)	HDR10+ Display Device and SSTM Tests							•

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

\*\*) Please check availability for UCD-451 from Unigraf

Repeater DUT Testing		Default	DP HDCP 2.3 CTS*
DP HDCP 2.3 CTS 3A Test Set (UCD-400, UCD-411, UCD-424)	HDCP2.3 CTS 3A-01 – HDCP2.3 CTS 3A-06		•
DP HDCP 2.3 CTS 3B Test Set (UCD-400, UCD-411, UCD-424)	HDCP2.3 CTS 3B-01 – HDCP2.3 CTS 3B-07		•
DP HDCP 2.3 CTS 3C Test Set (UCD-400, UCD-411, UCD-424)	HDCP2.3 CTS 3C-01 – HDCP2.3 CTS 3C-25		•

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

# **Compliance Tests**

Role:	Product:
DP Reference Sink (DP RX)	UCD-400, UCD-424
DP Reference Source (DP TX)	UCD-400, UCD-411, UCD-424, UCD-451*

\*) Please check availability for UCD-451 from Unigraf

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-400.pdf*. It can be downloaded in Unigraf Document Center at <a href="https://www.unigraf.fi/documents/">https://www.unigraf.fi/documents/</a>. If you have any additional questions, please contact Unigraf or your local representative.

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

The tests cases are divided to test categories as described in *Appendix E* of this document. 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.

eneral Audio DSC DisplayID Adaptive-S	iync				
Test Timeouts	Colorimetry			Test Automati	on
Test Timeout (ms) 5000 © Long HPD pulse duration (ms) 1000 ©	RGB 6 bpc VESA 8 bpc VESA 10 bpc VESA 6 bpc CTA 8 bpc CTA Select All	10bpc CTA (ITU.601)     1     8bpc CTA (ITU.709)     8	YCbCr 4:4:4 Ibpc CTA (ITU.6 I0bpc CTA (ITU.7 I0bpc CTA (ITU.7 I0bpc CTA (ITU.7	601)  ☐ TEST_EDID 09)  ☐ TEST_VIDE 709)  ☐ TEST_AUD	 _READ O_PATTERN
Max lanes supported 4 ~	Video Modes				
Max Bitrate supported HBR3 (8.10 Gbps) V	Fail-safe video r	node:		640 x 480 @ 60Hz 6 BPC	2
Voltage Swing level 3 (1.2V) supported	Maximum supp	orted video mode:		3840 x 2160 @ 60Hz 8 B	PC
Pre-Emphasis level 3 (9.5dB) supported					
Fixed timing DUT	Most Packed Tir	nings			
Spread Spectrum Supported	1 Lane			DMT 1280 x 768p @ 60	Hz, RB1, 6 bpc
✓ Spread Spectrum Supported ✓ Video format change without LT supported.	2 Lanes			DMT 1400 x 1050p @ 60	Hz, RB1, 8 bpc
Video format change without LT supported. Lane count reduction without LT supported.	4 Lanes			CTA 1920 x 1080p @ 60	Hz, 10 bpc
Earle count reduction without LT supported.	Time-stamp ger	neration			
Audio Info Frame supported for 2 channel audio		1 lane		2 lanes	4 lanes
DUT is Type-C Device	RBR	848 x 480 @ 60Hz 8 BPC 🛛 🗸	1280 x 720 @	60Hz 8 BPC ~	1920 x 1080 @ 60Hz 8 BPC
☐ DOT is type-C Device ✓ FEC supported	HBR	1280 x 720 @ 60Hz 8 BPC ~	1280 x 960 @	60Hz 8 BPC ~	1920 x 1080 @ 60Hz 8 BPC
FEC disable sequence supported	HBR2	1280 x 960 @ 60Hz 8 BPC ~	1920 x 1080	© 60Hz 8 BPC ∨	1920 x 1080 @ 120Hz 8 BPC
Audio without Video supported	HBR3	1920 x 1440 @ 60Hz 8 BPC ~		@ 30Hz 8 BPC V	3840 x 2160 @ 60Hz 8 BPC

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

Note:

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

## **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.

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

# **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-400 firmware implements the test according to the test specification.

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

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

All tests CRC												
lame	Video Tests	Audio Test	IP 1.4 LL CTS	Link Config Tests	HDCP 2.3	CISTA HDC	P 2.3 CTS 1B	HDCP 2.3 CT Pass	-	HDCP 2.3 C Skip	Runs	el Level Vider ◀ Last status
								Pass	Fail 0	5кір 0	Runs	Last status
	Retry on Invalid			HPD Plug Event (3	200us)			0	0	0	0	
	Device HPD Eve			IFD Flug Event				ő	ō	0	0	
4.2.1.4 Source								ŏ	ŏ	ő	ő	
4.2.1.5 Source								ő	ŏ	ŏ	ŏ	
4.2.2.1 DPCD				lug Event				0	ō	0	0	
4.2.2.2 DPCD								0	ō	ō	ō	
4.2.2.3 EDID R			-					0	0	0	0	
4.2.2.4 EDID R	ead Failure #1: 12	C-Over-AUX N	ACK					0	0	0	0	
	ead Failure #2: 12		EFER					0	0	0	0	
	orruption Detec							0	0	0	0	
	Device Detection							0	0	0	0	
4.2.2.8 EDID R			nch Device Dete	ection				0	0	0	0	
	Four Block EDID							0	0	0	0	
	tatus-Adjust Rec							0	0	0	0	
	sful LT at All Sup			peeds				0	0	0	0	
4.3.1.2 Succes				ige Swing During C	la al- Da ana an	· · · · · · · · ·		0	0	0	0	
4.3.1.5 Succes					lock Recovery	sequence		0	0	0	0	
				num Voltage Swing				0	0	0	0	
				Setting During Cha		on Sequence		ő	ő	ő	0	
				ol Lock During Cha				0	0	0	0	
4.3.1.8 Unsuc								0	ō	ō	ō	
				num Voltage Swine	3			0	0	0	0	
4.3.1.10 Unsuc	cessful LT due to	Failure in Char	nel Equalizatio	n Sequence (loop	count > 5]			0	0	0	0	
] 4.3.1.11 Succe	ssful LT with Sim	ultaneous Requ	est for Differen	tial Voltage Swing	and Pre-empha	sis during Clock	Recovery Seque	ence 0	0	0	0	
Run Selected	Select 💌	Configure	Import	Export	Stop on Failu	re Repeats: 1	Delay t	ime sec 1	0		Save Repo	rt Clear Al
Humberetten	beleet	comgure	mport	capore c		ine incpeator [1	- octory c				ourenep	cicarra

Run Selected	Click to start selected tests. By clicking Abort the sequence is stopped.
Select:	Includes the following options for creating templates for tests execution: Select All, Clear All, Invert All, Save, Import and Export
Configure	Clicking opens a dialog for defining the test parameters for that set. Please refer to <i>Test Parameters</i> below for description.
Import:	Load saved test parameter files (*.td or *.json).
Export:	Save test parameters for later use or for use in test automation. For saving parameters for later use in UCD Console, either format can be used. For saving parameters for TSI scripting, please use *.td files. For use with Python applications, please use *.json files.
Stop on Failure:	Stops execution of the selected tests if one of the tests fail
Repeats:	Repeat the selected test several times. 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.
Delay time	Delay in seconds between individual tests.
Save Report:	Click to generate a report file in HTML format for sharing the results with other parties for viewing without UCD Console.
Clear Log	Clear the test log and the results matrix

## **Saving Test Parameters**

Test parameters can be saved in various ways.

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

	Pre	esets 🔻		
6		Save		
		Load	•	
		Remove	•	
		Import		
		Export		

#### **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.

Test operator feedbac	ck required X	
i	Video Pattern Please, set-up the DUT to transmit the following video mode: • 1024x768 @ 60Hz (DMT 10h) When ready, press 'Proceed'.	
	Proceed Abort	
Test operator feedbac	k required	×
i	Check information field values Please verify the following values are correct in EDID. • Manufacturer's name: UFG • Product code: 4036h • Serial number: 0172D3C6h • Week and year of manufacture: 52/2014 • Screen size: 61 x 35 cm If values are correct, click 'Pass', If values are not correct, click 'Fail'.	
	Pass Fail	Abort

## **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.

		vent Log		5010	DPCD	SDP			Source DUT Testing							
Link Hl			Audio	EDID			DSC	FEC								
All tests	Audio	Test	CRC Vide	eo Tests	DP 1.4 L	L CTS	HDCP	2.3 CTS 1	A HDCP 2.3 CTS 1B	HDCP 2.3 CTS 3A		2.3 CTS 3B		onfig Tests	Pixel Lev	
Name											Pass	Fail	Skip	Runs	Last statu	• ^
4.2.1.1	Source D	UT Retry	on No-R	Reply Duri	ing AUX Re	ad after	HPD Plu	g Event (	3200us)		1	0	0	1	Pass	
✓ 4.2.1.2	Source R	letry on Ir	nvalid Re	ply Durin	g AUX Rea	d after H	HPD Plug	Event			1	0	0	1	Pass	
4.2.1.3	Source D	evice HP	D Event	Pulse Len	igth Test						1	0	0	1	Pass	
4.2.1.4	Source D	evice IRC	HPD P	ulse Lengt	th Test						1	0	0	1	Pass	
4.2.1.5	Source D	evice Ina	ctive HP	D / Inacti	ve AUX Tes	ŧ					1	0	0	1	Pass	
4.2.2.1	DPCD Re	ceiver Ca	pability	and EDID	Read upor	HPD P	lug Event				0	0	0	0		
					n HPD Plu						0	0	0	0		
4.2.2.3			,			9 ent					ŏ	ő	ŏ	ő		
4.2.2.4			#1-120-	Over-AU	NACK						0	ő	0	0		
4.2.2.4											0	0	0	0		
					V DEFER						0	0	0	0		
4.2.2.6																
					Plug Even						0	0	0	0		
					Branch Dev	ice Dete	ection				0	0	0	0		
4.2.2.9											0	0	0	0		
4.2.2.1	) Link Sta	tus-Adius	t Reque	st AUX rea	ad interval	durina l	Link Train	ina			0	0	0	0		~
Run Select	ed 🔳 So	elect all	Invert s	election	Configu	re	Import	E	xport 🗌 Stop on Fai	lure Repeats: 1	Contract Dela	y time, sec	1 🗘	Save Rep	ort Clea	r All
0001.045	.226:	AUX F	D: 00	202h:	2 00 0	0										^
0001.045	.476:	AUX F	D: 00	206h:	2 11 1	1										
0001.045		AUX V		103h:		1 01 0	01									
0001.046		AUX F		202h:												
0001.046		AUX F		206h:												
0001.046		AUX W		102h: 202h:		1 01 0	01 01									
0001.047				202n: 204h:		·										
0001.047					2 11 1	1										
					Link Tra											
0001.048				-		-										
0001.048																
					h AUX ac	tivity	1									
0001.048				102h:												
0001.051						MIV			le HPD is low							
									IE HFD 18 IOW D / Inactive AUX Te	et."						
Test Com		CDC PRO			Source	20010	~ indu	ave ne	D / INGOLVE NOA IE							- 10
Tests ex		finish	ed.													~
HPD																

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 by clicking **Save Report**.

## **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

Unigraf T	est Report	×	+					-		Х
$\rightarrow$ C	7	1 file:///C	:/Temp/terst repor	rt.html				ŝ	$\bigtriangledown$	=
- Audio I - Audio I - Audio I - Audio I	Mode 3: L-PCI	M, 2 channel: M, 2 channel: bled bled	s, 16 bit @ 48 kHz s, 24 bit @ 44.1 kl s, 24 bit @ 48 kHz	(Hz (CD)						
- DÚT se - Device - Device - Adaptiv - 1920x1 - 2560x1 - 2560x1 - 3840x2	ve-Sync range 1080p maximu 1080p maximu 1440p maximu 2160p maximu	tiveSync ed Average V ration Increase minimum re um refresh ra um refresh ra um refresh ra um refresh ra	se and Decrease fresh rate suppor te: 120Hz te: 120Hz te: 120Hz	constraints rted by the Source: 23	.976 Hz					
- 5120x2 - 7680x4	2160p is not s 2160p is not s 4320p is not s x4320p is not s	upported upported								
- 5120x2 - 7680x4	2160p is not s 4320p is not s x4320p is not s	upported upported								
- 5120x2 - 7680x4 - 10240x Test Lo	2160p is not s 4320p is not s x4320p is not s v4320p is not s og	upported upported supported		ource DUT Retry o	on No-Reply Duri	ng AUX Read afte	er HPD Plug E	Event (3200)	15) "	
- 5120x2 - 7680x4 - 10240> Test Lo	2160 p is not s 4320 p is not s x4320 p is not y g 000.002: st 000.752: se	upported upported supported	v = 14	-		ng AUX Read afte	er HPD Plug E	Event (3200)	15)"	
- 5120x2 - 7680x4 - 10240> Test Lo	2160 p is not s 4320 p is not s x4320 p is not 99 000.002: st 000.752: se 000.882: se	upported upported supported tart test t DPCD_RE at MAX_LIN	V = 14 IK RATE = 1Eh	ource DUT Retry ( 1, MAX_LANE_COUNT apabilities Fiel	r = 4	ng AUX Read afte	er HPD Plug E	Svent (3200)	18)"	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0	2160p is not s 4320p is not s 4320p is not s 4320p is not s 000.002: st 000.752: se 000.882: se 01.031: se 001.126: Er	upported upported supported tart test t DPCD_RE st MAX_LIN st Extende nable TPS3	CV = 14 NK_RATE = 1Eh d Receiver Ca support	, MAX LANE COUNT	r = 4	ng AUX Read afte	r HPD Plug E	2vent (3200)	15) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0	2160p is not s 4320p is not s 4320p is not 900.002: st 000.752: se 000.882: se 001.026: Er 001.210: Er	upported upported supported supported t DPCD_RE t MAX_LIN et Extende mable TPS3 nable TPS4	V = 14 K_RATE = 1Eh d Receiver C support support	n, MAX_LANE_COUN Capabilities Fiel	r = 4	ng AUX Read afte	er HPD Plug E	2vent (3200)	15) "	
- 5120x2 - 7680x4 - 10240> Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0	2160p is not s 1320p is not s 1320p is not s 1320p is not s 1320p is not s 1300.022: st 100.752: st 100.822: st 100.822: st 101.210: Er 101.296: Lt	upported upported supported supported t DPCD_RE et DAX_IIN et Extende nable TPS3 nable TPS4 nable TPS4	V = 14 K_RATE = 1Eh d Receiver Ca support support dise (1000 ms)	n, MAX_LANE_COUNT Capabilities Fiel	r = 4 ld Present = 1	-	er HPD Plug E	Svent (3200)	15) "	
- 5120x2 - 7680x4 - 10240x <b>Test Lo</b> 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0	2160p is not s 1320p is not s	upported upported supported supported text test text DPCD_RE textende hable TPS3 hable TPS4 ong HPD Pu ofference S	V = 14 K_RATE = 1Eh d Receiver C support support dise (1000 ms dink is set no	a, MAX_LANE_COUNT Sapabilities Fiel a) not to respond to	r = 4 ld Present = 1 o any AUX reques	-	or HPD Plug E	Event (3200)	15)"	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0	2160p is not s 1320p is not s x4320p is not s x4320p is not s 1000.002: st 1000.752: se 100.882: se 101.126: se 101.210: se 101.296: Lo 101.382: Re 101.382: Re 101.505: Wa	upported upported supported supported to DPCD_RE at DPCD_RE at DPCD_RE to DPCD_RE at DPCD_RE to DPC	V = 14 K_RATE = 1Eh d Receiver C support support lise (1000 ms bink is set no surce DUT issuer	A, MAX LANE COUNT Capabilities Fiel () () () () () () () () () () () () ()	r = 4 ld Present = 1 o any AUX reques	-	or HPD Plug E	2vent (3200)	15)"	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0	2160p is not s 1320p is not s	upported upported supported supported text test text DCCD_RE text MAX_LIN text Extende hable TPS3 hable TPS3 h	V = 14 K RATE = 1Eh d Receiver C support support llse (1000 ms Sink is set n ource DUT iss 0000Eh: 1	a, MAX_LANE_COUNT Capabilities Fiel a) not to respond to sues an AUX reque ???	r = 4 ld Present = 1 o any AUX reques	-	r HPD Plug E	2vent (3200)	15) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0	2160p is not s 1320p is not s x4320p is not s x4320p is not 9 000.002: St 000.822: St 001.126: Er 001.226: Lo 001.326: Rt 001.325: Wa 035.311: Ar	upported upported supported supported t DPCD_RE able TPS3 able TPS3 able TPS4 org HPD Pu ofference S ait for Sc AUX RD: AUX requ	V = 14 K_RATE = 1Eh d Receiver C support is support lise (1000 ms bink is set n ource DUT iss 0000Eh: 1 test received	A, MAX_LANE_COUNT Capabilities Fiel of to respond to sues an AUX reque 22?	r = 4 ld Present = 1 o any AUX reques	-	r HPD Plug E	Event (3200)	15) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0	2160p is not s 1320p is not s x4320p is not s x4320p is not 000.002: st 000.882: se 001.031: se 001.206: Lc 001.296: Lc 001.296: Lc 001.205: We 35.214: 35.351: Ar 35.359: Re	upported upported supported supported text test text DPCD_RE text Adv text	V = 14 KRATE = 1Eh d Receiver C: support support lise (1000 ms jink is set no purce DUT iss 0000Eh: 1 uest received sink does not	a, MAX_LANE_COUNT Capabilities Fiel a) not to respond to sues an AUX reque ???	r = 4 Id Present = 1 o any AUX reques sst to AUX request	-	r HPD Plug E	2vent (3200)	13) "	
- 5120x2 - 7680x4 - 10240x <b>Test Lo</b> 0000.0 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 1320p is not s x4320p is not s x4320p is not 000.002: st 000.882: se 001.031: se 001.206: Lc 001.296: Lc 001.296: Lc 001.205: We 35.214: 35.351: Ar 35.359: Re	upported upported supported st DPCD_RE t DPCD_RE t Extende t Extende nable TPS4 ong HPD Pu ofference S ait for Sc AUX RD: h AUX requ ference S it for Sc	V = 14 KRATE = 1Eh d Receiver C: support support lise (1000 ms jink is set no purce DUT iss 0000Eh: 1 uest received sink does not	A, MAX_LANE_COUNT Sapabilities Fiel b) not to respond to sues an AUX reque ??? i: send any reply sues another AUX	r = 4 Id Present = 1 o any AUX reques sst to AUX request	-	or HPD Plug E	2vent (3200)	18) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 4320p is not s 4320p is not s 000.002: st 000.752: se 001.0282: se 001.0282: se 001.021: se 001.205: tr 001.205: tr 001.325: se 001.355: se 001.355	upported upported supported supported to PCD_RE to PCD_P	<pre>W = 14 K_RATE = 1Eh d Receiver C: support is support link is set n. vurce DUT isso 0000Eh: 1 lest received burce DUT isso 0000Eh: 1 is request rec</pre>	A MAX LANE COUNT Capabilities Field () () () () () () () () () () () () ()	<pre>c = 4 ld Present = 1 &gt; any AUX reques est to AUX request request 35us</pre>	e	r HPD Plug E	2vent (3200)	15) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 4320p is not s 4320p is not s 4320p is not s 4320p is not 00.002: st 000.752: s 000.882: se 001.126: Er 001.210: Er 001.235: s 001.255: We 001.255: We 001.555:	upported upported supported supported to DPCD_REX table TPS3 hable TPS3 hable TPS3 hable TPS4 hable	<pre>Y = 14 K_RATE = 16h d Receiver C: i support ils (1000 ms bink is set n uurce DUT iss 0000Eh: 1 ink does not urce DUT iss 0000Eh: 1 C request rec ink is set t</pre>	A MAX LANE COUNT apabilities Fiel )) iot to respond to uses an AUX reque ??? i send any reply uses another AUX ??? seired within 433 or respond to AUD	<pre>c = 4 ld Present = 1 &gt; any AUX reques est to AUX request request 35us</pre>	e	r HPD Plug E	event (3200)	15)"	
- 5120x2 - 7680x4 - 10240x <b>Test Lo</b> 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 4320p	upported upported supported supported supported test MAX_LIN test Extende hable TP83 able TP84 able TP84 able TP84 sint for Sc AUX RD: to for sc AUX RD: to for a c AUX RD: to for a c A	<pre>vy = 14 K RATE = 16h d Receiver C: support support use (1000 ms ink is set n user beceived ink does not uurce DUT iss 00002h: 1 : request rec ink is set t : request rec ink is set t</pre>	A, MAX LANE COUNT Capabilities Fiel () () () () () () () () () ()	<pre>c = 4 ld Present = 1 &gt; any AUX reques est to AUX request request 35us</pre>	e	or HPD Plug E	2vent (3200)	13) "	
- 5120x2 - 7680x4 - 10240x Test Lo 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 4320p is not s 4320p is not s 4320p is not s 4320p is not 00.002: st 000.752: s 000.822: se 001.126: Er 001.210: Er 001.226: L 101.235: s 35.311: A. 35.31: A. 35.31: A. 35.41: We 33.726: Ar 33.726: Ar 33.927: R 33.927: R	upported upported supported supported to DPCD_REX table TPS3 hable TPS4 hable	<pre>vy = 14 K_RATE = 16h d Receiver C: support support is support unce DUT iss 0000Eh: 1 vurce DUT iss 0000Eh: 1 C request rec ink is set t 0000Eh: 1 C request rec ink is set t</pre>	A MAX LANE COUNT apabilities Fiel biot to respond to uses an AUX reque ??? i send any reply uses another AUX ??? seived within 433 or respond to AU2 80 14	<pre>r = 4 Id Present = 1 o any AUX request set to AUX request SSus ( requests norma</pre>	e	r HPD Plug E	2vent (3200)	15)"	
- 5120x2 - 7680x4 - 10240x <b>Test Lo</b> 0000.0 0000.0 0000.0 0000.0 0000.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0 0001.0	2160p is not s 4320p is not s	upported upported supported supported test MAX_LIN test Extended table TP45 able TP45 able TP45 ference S AUX RD: uother AUX ference S AUX RD: aUX RD:	<pre>vy = 14 K_RATE = 16h d Receiver C: support support is support unce DUT iss 0000Eh: 1 vurce DUT iss 0000Eh: 1 C request rec ink is set t 0000Eh: 1 C request rec ink is set t</pre>	, MAX LANE COUNT Dapabilities Fiel () () () () () () () () () ()	<pre>r = 4 Id Present = 1 o any AUX request set to AUX request SSus ( requests norma</pre>	e	or HPD Plug E	2vent (3200)	15) "	

# Audio Test Set

Role:	Product:
DP Reference Sink (DP RX)	UCD-400
HDMI Reference Sink (HDMI RX)	UCD-422
DP Alt Mode Reference Sink (DP RX)	UCD-424

### Validate audio signal frequency and glitch-free audio reproduction

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

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

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

In the second stage, received audio is checked for random glitches, such as dropped or duplicated samples. This is achieved by examining how the RDV ("Relative Distortion Value") changes over time within the sampled audio.

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.

📶 Audio Test			$\times$
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	0		
Presets 🔻		ОК	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)

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

# **CEC Functional Tests Set**

Role:	Product:
HDMI Reference Sink (HDMI RX)	UCD-422

## Parameters in use

- Test timeout, in milliseconds
- Local CEC physical address

CEC functional Test Set	×
Name	Value
Test timeout, in milliseconds	5000
Local CEC physical address	4.0.0.0
Presets 🔻	OK Cancel

#### **CEC Functional Test**

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

#### **CEC Phy Address test.**

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

#### **CEC Wake Up test**

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

#### **CEC Stand By test**

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

### **CEC Complete test**

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

Note:	The default physical address in UCD EDID is 1:0:0:0. In order to simulate a change in the address, please use another address range
Note:	As a side effect, the CEC will also verify functionality of HPD and EDID reading if the test passes.

# **CRC Based Video Test Set**

Role:	Product:	
DP Reference Sink (DP RX)	UCD-400	
HDMI Reference Sink (HDMI RX)	UCD-422	
DP Alt Mode Reference Sink (DP RX)	UCD-424	

## Configuration

CRC Video Tests				
Base parametrs				CRC (RGB/CrYCb) of Captured Reference Frame
Test timeout (1/1000 sec):	10000		\$	0xB69E,0xB33E,0x1AB3,
Repeat until timeout				
Test length (# frames):	200		\$	
Errors allowed (# frames):	20		:	
Repeat "Sequence Test" until timeout				
"Sequence Test" length	1		•	
Expected Video Format				
Width (# pixels):	1920		\$	
Height (# pixels):	1080		\$	
Reference BPP:	24		~	
Expected Frame Rate				
Expected frame rate (1/1000 Hz):	0		•	
Frame rate tolerance (∓1/1000 Hz)	0		\$	Number of captured reference frames
				20 Capture Reference Frame
Save Failed Frames				
Folder to save failed frames:		Browse		
Max number of saved frames		0	:	
ormat of saved frames		Binary file	~	
		🗌 Align 12		
Presets •				OK Cancel

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.

# **Pixel Level Video Tests**

Role:	Product:
DP Reference Sink (DP RX)	UCD-400
HDMI Reference Sink (HDMI RX)	UCD-422
DP Alt Mode Reference Sink (DP RX)	UCD-424

## Compare video frame sequence with a single reference

The test compares captured frames to the provided reference image at the 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.

III Pixel Level Video Tests	×
Reference image settings	
Load image: 0	Browse image
Colorimetry: ITU-R BT.601 V	stense indge
Image width (# pixels)	640
Image height (# pixels)	480
Image format	RGB ~
Bits per component (bpc)	8 ~
Data format align:	MSB ~
Comparison configuration	
Frames count:	60
Maximum number of failed frames allowed per test:	0
Maximum number of failed pixels allowed per frame:	0
Tolerance between pixel values:	0
Export properties	
Folder to save failed images:	Browse
Maximum number of exported frames	0
Export format	Binary file ~
	Align to MSB
Dereste	
Presets 👻	OK Cancel

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.

Browse image:	Load reference image from disk
Image width:	Width expected
Image height:	Height expected
Image format:	Image format expected
Bits per component:	Bits per component expected
Data format align:	Video data alignment expected
Frames count:	Number of frames buffered for testing
Maximum number of failed frames allowed per test:	Number of failed frames allowed totally
Maximum number of failed frames allowed per test:	Number of failed pixels allowed per buffered frame
Tolerance between pixel values:	The allowed difference between a color component of pixel in the captured frame to the reference bitmap.
Folder to save failed images:	PC directory where failed frames are stored.
Maximum number of exported frames:	Maximum number of failed frames stored to PC
Export format:	Format of exported image: Binary file, PPM image, BMP image
Align to MSB	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

## Capturing Reference Image

User can capture received video as reference:

1. In Settings dialog click the enable live preview icon  $\bigotimes$ .

eference image s	ettings									
oad image:	af/L	JCD Console/cache	e/DUT/s[192	 				Browse im	-	
Col	iorimetry: [	TU-R BT.601		Cre: 0x1F83	I, OxFCEB,	0x47CF	0	0102	2 () 3	
nage width (# pix							1920 1080			\$ \$ ~
mage height (# pi mage format its per componer Data format align:	nt (bpc)						RGB 8 LSB			~ ~
mage format iits per componer Data format align:	nt (bpc)						8			
nage format lits per componer Data format align: Comparison config rames count: Maximum number	nt (bpc) guration of failed fran	nes allowed per tes					8			
nage format iits per componer Data format align: comparison config rames count: Maximum number Maximum number	nt (bpc) guration of failed fran	els allowed per fran					8 LSB 60 0			> + + +
mage format its per componen Data format align: comparison config- rames count: Maximum number daximum number olerance betweer	nt (bpc) guration of failed fran of failed pixe a pixel values:	els allowed per fran					8 LSB 60 0	Browse	2	> + + +
mage format itis per componen bata format align: comparison config rames count: Aaximum number Aaximum number olerance betweer xport properties	nt (bpc) guration of failed fran of failed pixe n pixel values: ed images:	els allowed per fran					8 LSB 60 0	Browse	9	> + + +
mage format itis per componen aata format align: icomparison config rames count: Aaximum number Aaximum number olerance betweer xport properties older to save faile	nt (bpc) guration of failed fran of failed pixe n pixel values: ed images:	els allowed per fran					8 LSB 0 0 0 0 0 8 inary		9	> + + + +

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, stability of the video is verified with a CRC stability check. Captured CRC can also be verified by the user.

# Link Config Tests

Role:	Product:
DP Reference Sink (DP RX)	UCD-400
DP Alt Mode Reference Sink (DP RX)	UCD-424

## 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

## 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)

# VRR Source DUT Tests – HDMI Rx

Role:		Product:
HDMI Reference	Sink (HDMI RX)	UCD-422
Configure		
VRR Source DUT Tests	×	
Name	Value	
Test timeout, in milliseconds	10000	
VRR Max value	60	
VRR Min value	30	
VRR Static value	45	
VRR Step value	1	
VRR Time step value	1000	
VRR Enable and M_CONST	3	
VFront value	0	
Base Refresh Rate	50	
Presets 🔻	OK Cancel	
VRR Max value:		Maximum VRR frame rate
VRR Min value:		Minimum VRR frame rate
VRR Static value	:	Static VRR frame rate
VRR Step value:		Change of current VRR value during a test
VRR Time step v	alue:	Change of current VRR value during a test
VRR Enable and	M_Const:	Click to open dialog for enabling <i>VRR Enable</i> and <i>M_CONST</i>
VFront value:		Click to open dialog for enabling Base VFront and RB

## **VRR Static Test**

Test verifies that DUT Source applies expected static VRR value.

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

## **Quick Media Switching (QMS) Test**

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

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

### **VRR Dynamic Test**

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

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

# VRR Sink DUT Tests – HDMI Tx

Role:	Product:

HDMI Reference Source (HDMI TX)

UCD-422, UCD-412, UCD-452

### **Configure**

Name	Value
Test timeout, in milliseconds	10000
/RR Max value	60
/RR Min value	30
/RR Static value	45
/RR Step value	1
/RR Time step value	1000
/RR Enable and M_CONST	3
/Front and RB	0
Base Refresh Rate	50

VRR Max value:	Maximum VRR frame rate
VRR Min value:	Minimum VRR frame rate
VRR Static value:	Static VRR frame rate
VRR Step value:	Change of current VRR value during a test
VRR Time step value:	Change of current VRR value during a test
VRR Enable and M_Const:	Click to open dialog for enabling <i>VRR Enable</i> and <i>M_CONST</i>
VFront value:	Click to open dialog for enabling Base VFront and RB
Base Refresh Rate:	Set Base Refresh Rate

### **Static VRR Test**

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

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

### **Quick Media Switching (QMS) Test**

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

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

#### **Dynamic Test**

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

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

# APPENDIX F: 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 is providing an introduction and examples of the most usable instructions and parameters.

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

### **Terminology**

The following terms are used in this document:

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

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

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

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

### Notation

The following notation is used in this document:

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

## Syntax rules

The following general syntax rules apply to VTP language files:

- The VTP is a text-based, interpreted language.
- Commands, variables, and constant names are not case-sensitive.
- All text to the right of a semicolon (';') is treated as a comment.
- All strings are delimited by quotation marks ("a string").
- Quotation mark and backslash characters must be prefixed by a backslash character (a quotation mark character = \") (a backslash character = \\).
- 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  $2560 \times 1600$  pixels, the allowed coordinate range (x,y) for x is 0 to 2559 and for y 0 to 1599.

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

#### **SCALED**

Syntax: SCALED

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

## **Graphics Drawing Commands**

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

LINE

Syntax: LINE x1 y1 x2 y2

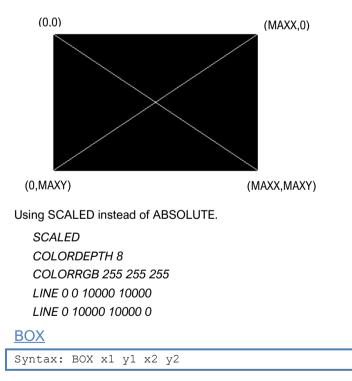
Draws a line from point (x1,y1) to point (x2,y2).

Example:

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

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

The pattern will look like this:



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).

<u>FILL</u>

Syntax FILL x y

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

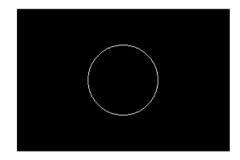
<u>CIRCLE</u>

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:

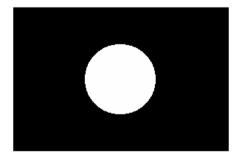


## **FCIRCLE**

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**

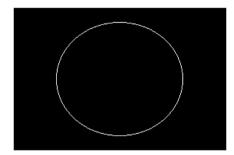
Syntax: ELLIPSE x y hr vr

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 b	ackslash \\"

## **Program Flow Commands**

## REPEAT

Syntax: REPEAT <variable> a b s

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

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

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

## **END**

Syntax: END

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

### **Color Commands**

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

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

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

**COLORDEPTH** 

Syntax: COLORDEPTH n

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

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

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

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

COLORRGB

Syntax: COLORRGB r g b

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

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

### **Various Commands**

<u>SET</u>	
Syntax: SET <variable></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?)
НА	Current timing horizontal period (pixels)
HS	Current timing horizontal resolution (pixels)
HBP	Current timing horizontal active time (pixels)
HFP	Current timing horizontal sync length (pixels)
VF	Current timing horizontal back porch length (pixels)
VP	Current timing horizontal front porch length (pixels)
VR	Current timing vertical frequency (MHz?)
VA	Current timing vertical period (lines)
VS	Current timing vertical resolution (lines)
VBP	Current timing vertical active time (lines)
VFP	Current timing vertical sync length (lines)
PF	Current timing vertical back porch length (lines)
HLB	Current timing vertical front porch length (lines)
HRB	Pixel frequency (Mpps?)
VTB	Drawing resolution horizontal size minus one
VBB	Drawing resolution vertical size minus one

## **Expressions**

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

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

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

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

Some example of legal parameter values:

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

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

## Assignments

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

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

SET C B+MAXX SET K K+1 SET K A+B

## Default state at VTP execution startup

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

# APPENDIX G: FIRMWARE UPDATE WITH QUARTUS

The chapter below describes a procedure for updating UCD-4XX Series Firmware when the normal FW Update procedure fails.

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 Lite Edition Design Software Version 18.1 for Windows. The tool can be downloaded from the Intel® FPGA website: https://www.intel.com/content/www/us/en/software-kit/665990/intel-quartus-prime-lite-edition-design-software-version-18-1-for-windows.html

1. On the download page, please select section "Individual Files". Please download the software under "Intel® Quartus® Prime (includes Nios® II EDS)".

2. Please download and install the tool using defaults on the PC.

www Intel® Quartus® Prime Lit							~ - 🗆 X
← → C △ ■ in		)uartus®		lition Design So		on 18.1 for	* * • • • • • • • • • • • • • • • • • •
	ID 665990	Date 9/23/2018	Software Type FPGA Development	Software Package  Quartus® Prime Lite	Version Version	Operating Systems           V         Windows         V	
	A newer versio	on of this software is	available, which includes fund	tional and security updates. Custo	omers should <u>click here</u> to upda	ate to the latest version.	
Feedback	security updates. contact our support The Intel® Quartu available in a new subscribe to our s Critical Issues and Knowledge Base:	If you must use this ort team. s* Prime Lite Edition ret version, or all de- subscribe to our cus ubscribe to our cus Patches for the Inth Search for Errata. Al sweets on specific IP S	version of software, follow the Design Software, Version 18. rices supported by this version tomer notification mailing list. version of the software of the software of the software of the software of the software so see Critical Issues and Patco or Products.	i Software, Version 18.1. hes.	elp improve security. For critica eb when support for all devices	al support requests, please s in this release are	
		Down	(includes Starter Edition) load 0.625-windows.exe	Size: 1.1 GB SHA1: f4b428584c780016c	d119c0b1fd16c26dee880dcc	v	
		us® Prime (include Down uartusLiteSetup-18.		Size: 1.7 GB SHA1: 70faf36e2c8d69aa52	243de767242a75832fa749e	~	

# Step 1

- 1. Connect the UCD device to the power supply and switch on power.
- 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-4xx\_recovery.zip* file. By default the file is at C:\Program Files\Unigraf\Unigraf UCD Tools\recovery.

- 4. Extract the content of the ZIP file in a folder on your PC (e.g., C:\Temp).
- 5. Open Windows Command Prompt application.
- 6. Navigate to the directory to where the ZIP file was extracted (e.g. cd \Temp).
- 7. Connect a micro-USB cable to the JTAG connector on the UCD device (Please refer to chapter Product Description > Connections earlier in this document).
- 8. In the directory where the ZIP file was extrected (e.g. c:\Temp) please edit file recovery.bat
- 9. On line three, the parameter "QUARTUS\_DIR" is set to point to the folder where the Qartus Programmer was installed (by default C:\intelFPGA\_lite\18.1). Edit and save as needed.

R	BECHO OFF
S	SET QUARTUS DIR=C:\intelFPGA lite\18.1
	SET QUARTUS_BINS=%QUARTUS_DIR%\quartus\bin64
s	setlocal ENABLEDELAYEDEXPANSION
	if EXIST %QUARTUS DIR% (
1	I TELEL STORATOR THE ( (
	ЕСНО
	ECHO Programming all_isp.sof to FPGA. Wait for $\sim$ 1-2 minutes
	call %QUARTUS_BINS%\jtagconfig.exesetparam 1 JtagClock 6000000
	if !ERRORLEVEL! EQU 0 (
	ECHO
	ECHO Set parameter 1 JtagClock 6000000 - SUCCESS
	ECH0
	) else ( ECR0
	ECRO Set parameter 1 JtagClock 6000000 - FAIL
	ECHO
	exit !ERRORLEVEL!
	)
	<pre>%QUARTUS BINS%\quartus pqm.exe -c 1mode=JTAGoperation="p;al0 isp.sof@1"</pre>
	with the second se
	if !ERRORLEVEL! EQU 0 (
	ECHO Please check if all_isp.sof was programmed successfully, i.e. no errors on log above ECHO Please run FW update utility to complete recovery procedure
	ECRO
	) else (
	ECHO
	8CHO Programming operation - FAIL ECHO
	CCHO
	) else (

- **10.** In the **Command Prompt** application make sure that the current directory is still the same (e.g. C:\temp).
- 11. Launch batch recovery.bat by typing "recovery.bat" at the prompt.
- 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 completed, you can delete the files (in e.g., C:\Temp).

# APPENDIX H: PLAYLISTS AND SCENARIOS

UCD Console's Playback tab enables the user to execute playback macros called Playlists. Playlists define the video and audio content and the related metadata streamed in predefined sequences.

Import Cemmon HDR10+ Test VRR/QMS	Selected Sequence Source Select Editor	
Service Content and Services     Service Content Addition     Service Content Addition     Service Content Addition     Obstance     Obstance	Votes Source - Annouet: - Herizontal Ventical Macc Traine Rate, Ho: - Sourt - Start - Sourt - Start - Sourt - Color Enceding - Sync Wolth - Sync Wolth -	
East	Audie Source - Amount -	
	Compresed: - Amount of channels: - Sampling: - Bit depth: - Packets Source -	
	Amount: -	

### **Playlist**

*Playlist* defines the UCD device and the output where the content is played. It lists the played Scenarios and their duration.

### **Scenario**

*Scenario* is an operating structure that allows user to determine a specific sequence of video frames, metadata packets and audio that are going to be played in the defined order.

Playlists and Scenarios are stored as human readable text files. The files can be edited using any text-editor software.

#### **Frame Memory**

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

The size of frame buffer memory sets a limit for content that can be played. In their default configuration UCD devices feature a 2 GBytes frame buffer memory. This frame buffer enables loading up to 40 pcs 4K video frames or 10 pcs 8K video frames. For information about models with larger frame buffer memory, please contact Unigraf.

#### **Sample Content**

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

Please find a description of the sample content later in this Appendix.

# Playlists

Playlist defines the UCD device and the output where the content is played. It lists the played video and audio sequences called Scenarios and their duration.

Playlists are stored as human readable text files. The files can be edited using any text-editor software. It is advisable to create a copy of the installed original files and edit the copies.

Note:

Please note that Playlists and Scenarios are interface technology dependent. Metadata (or packets) are different between for HDMI and DisplayPort

## **Device section**

Section describes what device and what output connector to use.

Кеу	Description	Possible values
[Device]	Required. Start of the Device section.	
serialnumber	Required. Specifies serial number of the UCD device. The '*' wildcard can be used if only one UCD source device is connected to the PC.	'*' '1722C333'
connectortype	Required. Specifies output connector to be used. Playlist cannot contain scenarios for different connector types.	'HDMI Out' 'DisplayPort Out' 'USBC Out'
reset	N/A	'0' or '1' Default '0'

## **Scenario section**

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

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

# **Scenarios**

Scenario is an operating structure that allows user determine a specific sequence of video frames, events and audio that are going to be played in a certain order. In addition, scenario determines environment for sequence to play.

Scenarios are stored as human readable text files. The files can be edited using any text-editor software. It is advisable to create copy of the installed original files and edit the copies.

Note:

Please note that Playlists and Scenarios are interface technology dependent.

# Parameters

Scenario parameters are defined as a list of items. Please find below a description of Scenario items.

Scenario item	Description	
video= :	Path and file name format of video frame files	
audio= :	Path and file name of the audio file	
packets= :	Path and file name format of metadata packet files	
porder= :	Content Playing Order. Please see Content Playing Order below.	
Mapping= :		
align12=1	Alignment of 12-bit binary pixel data. '1' aligned to LSB; '0' aligned to MSB.	
audioswap= :	'1' for Little Endian audio samples	
audiocompressed= :	'1' compressed audio; '0' uncompressed audio	
audiosampling= :	Audio sampling rate. E.g., 44100	
audiochannels= :	Nr. of audio channels	
audiobits= :	Audio bits per sample (usually 16 or 24)	
scrambler= :	'1' scrambling enabled; '0' scrambling disabled	
audiosync= :		
colorspace= :	Video color space: RGB; YUV444; YUV422; YUV420	
bitspercolor= :	Video color depth (bpc)	
timing.hactive= :	Timing: Horizontal active	
timing.vactive= :	Timing: Vertical active	
timing.htotal= :	Timing: Horizontal total	
timing.vtotal= :	Timing: Vertical total	
timing.hstart= :	Timing: Horizontal start	
timing.vstart= :	Timing: Vertical start	
timing.hsync= :	Timing: Horizontal sync width	
timing.vsync= :	Timing: Vertical sync width	
timing.frate= :	Timing: frame rate	
hdcp= :	HDCP version used	
loadingRGB= :	The R, G and B color components of solid color pattern shown when content is being uploaded to the device before playback (e.g., 0,0,0)	
linkRate:	Default link rate. HDMI: 0 = TMDS; 1 – 5 = FRL with 3, 6, 8, 10 and 12 Bbps link rate. DP: Link rate = Value × 0.27 Gbps. (E.g., 20 = 5.4 Gbps/lane (HBR2)).	
linkRateMin= :	Minimum link rate used. If available link rate is lower, scenario will fail.	
DSC timing parameters:	Parameters are different between DP and HDMI. Please 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	
dscHtotal=	DSC Timing: Horizontal total	
dscHsync=	DSC Timing: Horizontal sync	
dscHstart=	DSC Timing: Horizontal start	
dscHactive=	DSC Timing: Horizontal active	

## **Content Playing Order**

Playing order is described in a textual format as a sequence of steps. Steps are separated with ';' symbol.

Each step describes:

- Index of played video frame or a range of video frames,
- How many times the frame(s) are played,
- Index of the packet or the set of packets that will be sent during the video frame(s),
- Color format used for the step.
- Optional frame rate when VRR is enabled.

#### Format structure

Each scenario step is described in following textual format:

pV:R:E:FvXX;

#### Parameters

Please see table below for description of used parameters.

Char	Description	Possible values	Examples
:	Required. Separator between general step parameters.	·.'	See any below
;	Required. Indication of step description end.	"." "	See any below
р	Optional. Indicates assertion of a HPD pulse on HDMI RX connector of UCD device during current step. Preceding video frame index. Only for HDMI playback.	ʻp'	'p1:60:1:256;' 'p0-59:60:1:256;'
V	Required. Index of a video frame. Index is zero based. Images are loaded from the indicated file path. Parameter can state either a single image or a range of images. The order in which images are called in scenario steps is optional. All specified parameters are applied to all frames in the scenario step.	'1' '0-59'	'1:60:16:256;' '0-59:60:16:256;'
R	Required. Repetitions of current step. E.g., stating '1' with 60 FPS frame rate means that current step will be played only for 1/60 of a second.	'30' '1'	'1:30:16:256;' '1:1:16:256;'
E	Optional. Index of metadata packet. Index is zero based. Packets are loaded from the indicated file path. Parameter can indicate either a single packet or a comma separated list of packets. Order of packets is optional.	'0' '4,1,29' none	'1:30:0:256;' '1:30:4,1,29:256;' '1:30::256;'
F	Required. Color format and color depth. PIs see chapter Color Format below.	'256' '513'	'1:30:0:256;' '1:30:0:513;'
vXX	Optional. Control of frame rate when VRR is enabled. In order to enable VRR, corresponding HDMI VSIF event must be included into this step. The parameter is always in format of 'vXX', where 'XX' states frame rate. Parameter is provided after color format value, separated with 'v'.	'v60' 'v30'	'1:30:0:256v60;' '1:30:0:256v30;'

## **Color Format**

Color format is a two-byte value presented in decimal. 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 encoded parameter value is calculated using the following formula:

[Color Depth] × 256 + [Color Space],

where [Color Depth] and [Color Space] are indexes obtained from the table above.

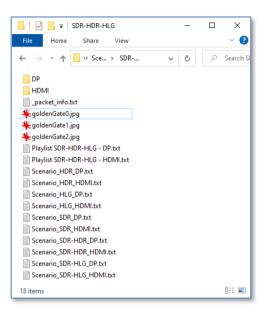
For example, parameter for YCbCr 4:4:4, 10 bits is  $(2 \times 256 + 1) = 513$ .

Pre-calculated values for available color formats:

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

# Example

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



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

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

## Scenario File (Scenario\_SDR-HDR-HDMI.txt)

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

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# Sample Content in Playback Tab

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

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

#### In the table below, please find a list of examples provided.

HDMI		
Playlist Name	Description	
Basic Video & Audio Example	Example playlist for demonstrating the use of video and audio files.	
VRR Example	Playlist for demonstrating Variable Refresh Rate (VRR) capability of a DUT monitor.	
QMS-VRR Example	Playlist for demonstrating Quick Media Switching VRR (QMS-VRR) capability of a DUT monitor.	
ALLM	Playlist for demonstrating Auto Low-latency Mode (ALLM) capability of a DUT monitor	
HDR & Metadata Example	Example playlist that demonstrates the use of video files and metadata packets in testing a DUT monitor	

#### DP

Playlist Name	Description
Basic Video & Audio Example	Example playlist for demonstrating the use of video and audio files.
HDR & Metadata Example	Example playlist that demonstrates the use of video files and metadata packets in testing a DUT monitor
Frame Rate Example	Playlist for demonstrating use of multiple frame rates with FHD and UHD resolution.

# Playlist: Basic Video & Audio Example

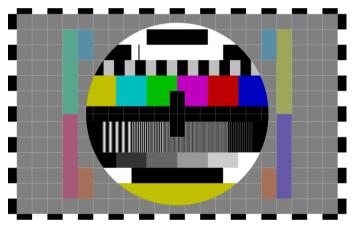
The playlist sequences video files and audio according to the description below.

## Video

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



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



```
Description of Scenarios
```

	Name	Duration	Repeated sequence
1	Flip-flop with 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 Silent	60 s	CTA 1920×1080 60 Hz (VIC 16), RGB 8 BPC, 60 frames Image1.jpg, 60 frames Image2.jpg, No Audio.
3	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)
4	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: HDR & Metadata Example

Example demonstrates the use of metadata packets.

## Video:

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

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



## Scenarios for HDMI Output

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

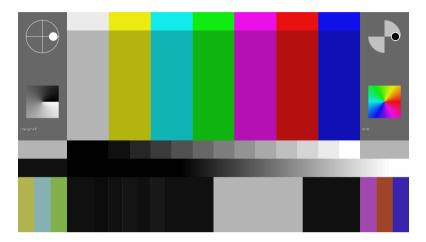
Name	Duration	Repeated sequence	
SDR	10 sec	180 frames GoldenGate0.jpg, Packet: Infoframes_0002;	
HDR	10 sec	180 frames GoldenGate1.jpg, Packets: Infoframes_0002, Infoframes_0000	
HLG	10 sec	180 frames GoldenGate2.jpg, Packets: Infoframes_0001, Infoframes_0002	
HDR10+	10 sec	180 frames GoldenGate3.jpg,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

# Playlist: VRR Example (HDMI)

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

## Video

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



## Scenario with Video Mode 1920×1080 60 Hz

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

	Name	Duration	Repeated sequence
1	FHD VRR 4859 switch	60 s	VRR enabled. RGB 8 BPC. Packets: infoframe_00, infoframe_01 300 frames with 48 Hz frame rate, 300 frames with 59 Hz frame rate.

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## Scenario with Video Mode 3840×2160 60 Hz

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

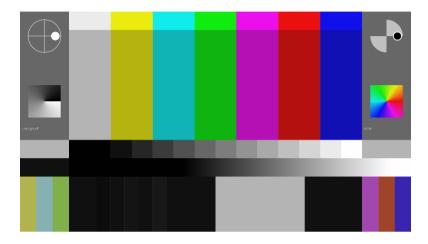
	Name	Duration	Repeated sequence
1	UHD VRR 4859 switch	60 s	VRR enabled. RGB 8 BPC. Packets: infoframe_00, infoframe_02 300 frames with 48 Hz frame rate, 300 frames with 59 Hz frame rate.

# Playlist: Frame Rate Example (DP)

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

## Video

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



## **Executed Scenarios**

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

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

# Playlist: ALLM (HDMI)

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

### Video:

The Scenarios use a series of images: allm\_on\_off\_000.jpg to allm\_on\_off\_0011.jpg. Text panel on the images indicate if ALLM is enabled or not. The first scenario is presented with ALLM enabled and the second by switching ALLM on and off sequentially.





## **Scenarios for HDMI Output**

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

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