



User Manual UCD Console SW Version 3.4

/// UNIGRAF

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Edition

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UCD-5XX products meet the essential health and safety requirements, are in conformity with and the CE marking has been applied according to the relevant EU Directives using the relevant section of the corresponding standards and other normative documents.

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1. ABOUT THIS MANUAL

Purpose

This guide is a User Manual of UCD-5XX products. UCD-5XX are USB-connected video interface test units for use with a PC with Windows[®] 11, Windows[®] 10, Windows[®] 8 or macOS operating system.

The purpose of this guide is to

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

Product and Software Version

This manual explains features found in UCD Console Software Bundle **3.4**. 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.

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

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

2. INTRODUCTION

Product Description

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

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

The software package for UCD-5XX features a high-level Software Development Kit (SDK) called Test Software Interface (TSI) for use in automated testing. TSI allows for an easy integration of Production and R&D testing routines into an automated test system environment. Please refer to TSI documentation found in additional Unigraf manuals for more details.

Product Features

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

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

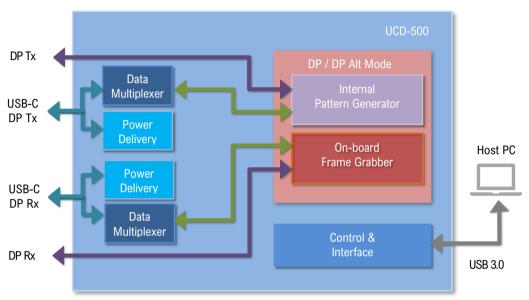
Available Interface Roles

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

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

Functional Description

UCD-5XX units consist of a multimedia signal input stage, an internal pattern generator, a control stage with on-board frame buffer and a PC interface stage. In the Input Stage the signal is conditioned and converted to desired format. The Interface and Control stages are either passing the captured data directly to the USB interface or storing it to the frame buffer. The internal pattern generator is able to source a signal for testing sink and branch units. The Interface & Control stages are receiving instructions from the host PC to configure and control the functionality of the unit.



UCD-5XX Functional Diagram

Delivery Content

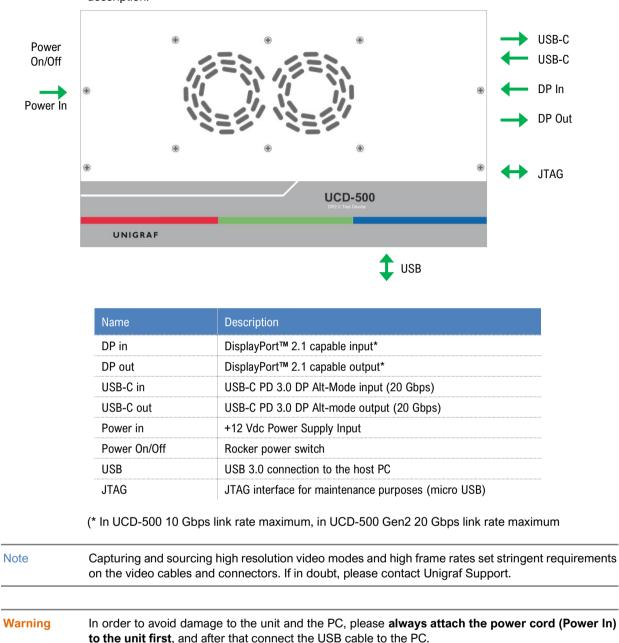
Please find below an image of the items included in UCD-5XX unit delivery



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

Connections

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



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 and for TSI SDK. The bundle contains the following items:

- Windows/macOS drivers (installed during set up)
- UCD Console software (installed during set up)
- License Manager (installed during set up)
- Device configuration utility (installed during set up)
- Packet Editor (installed during set up)
- TSI SDK
- User Manuals including this document.

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

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

Software Installation

- For Windows users, install .exe file from the package.
- For MacOS users, install .pkg file from the package. MacOS is universal for ARM and Intel x86
- Start the installation by running application SoftwareBundle_X.X.XXXX (X.X.XXXX denotes the installed software version)

The welcome page of the installer displays the software package release version.

The user is asked to confirm.

- Creating a desktop shortcut
- Installation of Visual C++ redistributable (needs to be present in Windows)
- Installation of Unigraf USB drivers

Next dialog confirms the selections made. If you are ready, click **Install** to start the installation. Click **Finish** to exit the installation dialog.

Firmware Update Procedure

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

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-5XX device, please perform the following steps:

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

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

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

Updated Modules

The tool lists the FW components available in the UCD device, the currently programmed FW version, and the FW installed in the PC for programming.

	III UCD Config		×
	UCD Config Review the update operations to perform.		///
FW component	Operations selected: Update device firmware: MFMN500 F.0.1.33/N.2.3.7 -> F.0.1.33.0/N.2 PDRX 0.10.4 -> 0.10.6 PDTX 0.10.4 -> 0.10.6	.3.15.0	FW available for programming
	Change device configuration: No role changing operations selected.		med in UCD
		< <u>B</u> ack	Start Cancel

Click Start to start programming.

Power Cycle

When re-initiating the firmware of a UCD device the whole process cannot be done during one session. Therefore, on certain point, user is asked to power cycle the device (switch off power from UCD device > wait for 10 seconds > re-apply power to UCD device).

Click the OK button on the dialog.

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

Recovering Failures in FW Update Procedure

If FW Update procedure fails and cannot be re-initiated, please refer to Appendix I of this manual for instructions on *Firmware Recovery*.

Firmware Downgrading

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

Please follow the procedure below.

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

UCD Config	×
	///
Please select operation	
Enable advanced mode	
Included update files:	
Module BFBN of versic	
< <u>B</u> ack <u>N</u> ext >	Cancel

- 8. Click Next to proceed according to chapter Updated Modules above.
- 9. In UCD Modules select the module titled MFMN500 F.X.X.X/N.X.X.X
- 10. Click Next and Start to start programming FW to the connected UCD Device

License Manager

Licensing

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

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

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

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

License Manager GUI

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

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

Managing Licenses

Seed Number

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

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

stalled licenses:	
Name	Key
DP 2.0 LL CTS for testing Sink DUT	Q85C-
DP 2.0 LL CTS for testing Source DUT	OIEA- " " " I B B B P P B P P P B B B B B B B B B B
DisplayID CTS for testing Source DUT	1586- 5789
DisplayID CTS for testing Sink DUT	Q4MK-
DP 1.4 DSC CTS Sink DUT	VDSV-10 M MINI M I AND A MINI AND A AND A MINI AND A MI
DP 1.4 DSC CTS Source DUT	MSQF-MP M M M M M M M M M M M M M M M M M M
DP LL CTS 1.4 for testing Sink DUT	LM4T-W
DP LL CTS 1.4 for testing Source DUT	2L97-

Adding New License Keys

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

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

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

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

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

Device Selection

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

Once UCD Console GUI is launched, the dialog provides a list of Unigraf UCD devices connected in the PC. Please select the target device by 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 W</u> indow <u>H</u> elp				
Devices:	Roles:			
UCD-500 [2150C473]	DisplayPort Source and Sink			
	DisplayPort Source and USB-C, DP Alt Mode Sink			
	DisplayPort Sink and USB-C, DP Alt Mode Source			
	USB-C, DP Alt Mode Source and Sink			
	Rescan Selec	t	Close	

Role Selection

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

Analyzer and Generator Operation

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

	Console - ols <u>W</u> in)]: Display	Port Sou	irce and	Sink										-		×
DP RX	DP TX	Eventl	.og																
Link	Video	Audio	EDID	DPCD	FEC	SDP	Source DUT Testing												
1.00	k Status						Link Canabilitio	ion											

Options

Options can be found in Tools > Options.

/// Options		>
Options Debug		
Capturing		
Image File Format	PPM	~
Audio File Format	WAV	
Displays HDCP compliance:	One or more displays are not HDCP complia	nt
Folders		
Directory to save images and audio		
C:/Users/Tester/Pictures/Saved Pictu	ires	
DSC		
DSC temp folder		
C:\Temp\DSC		
DSC test content folder		
C:/ProgramData/Unigraf/DSC_conte	nt_library	
Keep auto-created DSC content fi	les	
DUT Testing Options		
Include time info in Report logs		
Do not show again test sequence	completed	
	OK Can	cel

Image File Format

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

Audio File Format

Audio files are stored in WAV format.

Displays HDCP Compliance

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

Folders

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

DSC

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

Warning:

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

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

DUT Testing Options

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.

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.

bels Window Help		Link Video Audio EDID DPCD SDP FEC DSC HDCP Source/DUTTesting Capture	Link Analyzer
EventLog		Auto Record Snap Open Full Screen F	
k Pattern Generator Audio Generator Playback HDCP EDID DPC		Video	
MST Number of streams 2 .	Force EDD preferred tirring after LT Use Tirrings from EDD Manage Tirrings Stream 1		
CVT 4396 x 2160 @ 60Hz [R82] - 🛛 🝸 8 bpc - 👻 @ VESA 🔘 CTA	CTA 1920 x 1080 @ 60Hz (VIC 16) ~ ▼ 8 bpc ~ ⊕ VESA ○ CTA		
Color Bans 🗸 KOB 🗸 🗸	Color Bars 🗸 RGB 🗸 🗸		
e sprime anna Bata (6000 B) Pool Circle (100.140 B) <u>Adaptive Sprime</u> data (6000 B) * (1000 B) (100 B) (100 B) (100 B) (1000 B) (1000 B) (100 B) (100 B) (100 B) (1000 B) (100 B) (100 B) (100 B) (100 B) (100 B) (100 B) (100 B)	Farmer Regn (50.00) (50.00) (60.00)		
has the ThatTillene (1622/1629)	☐ Ann-Appi		

4. ANALYZER OPERATION

When used as an *Analyzer*, the UCD-5XX device acts as DisplayPort or USB-C DisplayPort Alt Mode Sink or Receiver device.

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

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

Functionality Tabs

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

Note:

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

Link Tab

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

ink HDCP Video	Audio Link Analyzer Captur	re EDID DPCD SDP DS	C FEC Source DUT Testing		
Link Status		Link Capabilities		HDCP Status	
Lanes (count = 4):	0 1 2 3	Max Lanes		HDCP 2.X	
CR/SL/EQ		O 1 O 2	• 4	Active	
/S/PE (level) FE preset	-///- 0 0 0 0	Max Bitrate, Gbps		Authenticated Declared as HDCP capable	
Fror count (click to clear		0 1.62 0 2	70 0 5.40	Keys loaded	
LA: EQ_ILA:		0 6.75 @ 8.		HDCP Configuration	
				2.X	
Bit rate: 13.5 Gbp iraming mode: -	ps Link mode: 128b/132b Scrambling: Enabled	DP (128b/132b) Supported Bi		HDCP Capable	
AST mode: Enabled	-	10 11	3.5 🗹 20		
SC status: Disabled	d FEC status: Enabled	Instead of 10 Gbps, use:	2.500 Gbps ~	Scrambler seed (8b/10b)	
ink Training Result		OId DP 2.0 LT		FFFFh (DP)	
anes (count = 4):	0 1 2 3	Force Cable Status to Plugged		O FFFEh (eDP ASSR)	
CR/SL/EQ		Enable Fast LT		O Custom 0x 0 🌻	
/S/PE (level)	-////-	MST SS SBM FEC (8	(b/10b) 🗹 TPS4 🗹 TPS3 🗹 DSC (8b/10b)		
FE preset	0 0 0 0	HPD pulse on Apply	Apply		
la: Eq. Ila: Eq. Ila:	CDS_ILA: LT_FAIL:	VCP Table	HDCP Stream Status		
Bit rate: 13.5 Gbp	os Link mode: 128b/132b	Stream # VCPID Reg.PBN Alloc.P			
		0 1 532 604			
		1 2 532 604	5 5 1 🗔		
tream Info					
Framerate HTotal H	HStart HActive HSync VTotal V	VStart VActive VSync	CEF BPC CRC (RGB/CrYCb)	VFREQ DSC CRC (Eng. 0 1 2)	
				148500000 N/A	
60.000 2200	192 1920 44 (+) 1125	41 1080 5 (+) RGB/Lega	cy RGB mode 8 B69E B33E 1AB3	148500000 N/A	

Link Status

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

Lanes (count :	= 4):	0	1	2	3
CR/SL/EQ					
VS/PE (level)		-/-	-/-	-/-	-/-
FFE preset		0	0	0	0
Error count (c	Calves also A.	0000	0000	0000	0000
Enor count (c	lick to clear):	0000	0000	0000	0000
	Q_ILA:				
ILA: E	Q_ILA:	CDS_ILA:	ode:	LT_FAIL:	I32b
ILA: E	Q_ILA:	CDS_ILA:	ode: ling:	LT_FAIL: 128b/1	132b 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 for each of the four lanes
VS/PE (level):	Voltage Swing / Pre-emphasis level
FFE Preset:	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)
Error count:	Content of DPCD Error Count registers
ILA:	Status LED for Inter-Lane Alignment
EQ_ILA	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding)
CDS_ILA	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding)
LT_FAIL	Status LED for Link Training failure (only with 128b/132b channel coding)
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (128b/132b or 8b/10b)
Framing mode:	Currently enabled Framing Mode (Normal or Enhanced) (only with 8b/10b channel coding)
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 (Enabled or Disabled)
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.

-Link Training R	esult				
Lanes (count = CR/SL/EQ	: 4):	0	1	2	3
VS/PE (level)		-/-	-/-	-/-	-/-
FFE preset		0	0	0	0
ILA: EC		CDS_ILA:		T_FAIL:	
Bit rate:	20 Gbps	Link mo	de:	128b/1	32b

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
FFE preset:	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)
ILA:	Status LED for Inter-Lane Alignment
EQ_ILA	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding)
CDS_ILA	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding)
LT_FAIL	Status LED for Link Training failure (only with 128b/132b channel coding)
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (128b/132b or 8b/10b)

Link Capabilities

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

Link Capabilities				
Max Lanes				
O 1	○ 2		4	
Max Bitrate, Gbps				
0 1.62	0 2.70		0 5.40)
0 6.75	8.10			
DP (128b/132b) Su	pported Bitrates,	Gbps		
☑ 10	13.5		20	
Instead of 10 Gbps,	use:	2.500 Gbp	DS	~
Old DP 2.0 LT				
Force Cable Status	to Plugged			
✓ Enable Fast LT				
MST SS SBM	FEC (8b/10b)	☑ TPS4	☑ TPS3	DSC (8b/10b)
HPD pulse on Appl	у			Apply

Max Lanes:	Maximum lane count used
Max Bitrate, Gbps	Maximum link rate used when 8b/10b link coding is selected in LT.
DP (128b/132b) Supported Bitrates, Gbps	When checkbox is selected, 128b/132b link coding is supported. Link rates used when 128b/132b link coding is selected in LT. Please observe the Note about the long HPD pulse below.
Instead of 10 Gbps, use:	For supporting low link rate Source devices, the user can make UCD- 5XX sink PHY use a selectable lower link rate when performing "10 Gbps" link training in protocol level. Link rates are: 2.5 Gbps, 2.7 Gbps, 5.0 Gbps and 5.4 Gbps
Old DP 2.0 LT	When checked LT will follow initial DP 2.0 spec description. Otherwise, LT as per DP 2.1 specification
Force cable status to plugged:	When checked, sink functionality is active regardless of a failure of upstream device detection e.g., due to incorrect AUX Channel electrica termination.
Enable Fast LT:	Indicates support for link training without AUX transactions.
MST:	When 8b/10b link coding enabled, indicate support for MST mode and Sideband MSG handling. When 128b/132b link coding enabled, indicat support for multi-stream transport and Sideband MSG.
SS SBM:	When selected, indicate support Sideband MSG while not supporting multi-stream transport. Valid only with 128b/132b channel coding and when "MST" is unchecked.
FEC (8b/10b):	Indicated support for Forward Error Correction feature when 8b/10b lir coding is enabled
TPS4, TPS3:	Indicate support for Link Training Pattern Sequence 4 and 3.
DSC (8b/10b)	Select to enable Display Stream Compression (DSC) feature when 8b/10b link coding is enabled
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.
	om to the rules set in DP 2.1 Specification, UCD-5XX allows selection ocoding also when support for 128b/132b link coding is enabled.

UCD-5XX User Manual • UCD Console 3.4

before applying the change

Note:

Note:

Scrambler Seed

Scrambler seed (8b/10b) FFFFh (DP) FFFFh (eDP ASSR) Custom 0x 0

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

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

Copy of HDCP status and controls on HDCP tab.

HDCP Stream Status

HDCP Stream Status Stream # Status 0 1 1

Shows HDPC status for each stream.

Stream Info

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

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

Framerate	HTotal	HStart	HActive	HSync	VTotal	VStart	VActive	VSync	CEF	BPC	CRC (RGB/CrYCb)	VFREQ	DSC CRC (Eng. 012
30.000	9000	768	7680	176 (+)	4400	64	4320	20 (+)	RGB/Legacy RGB mode	6	8789 4AAD ED47	1188000000	N/A
59.996	4000	112	3840	32 (+)	2222	59	2160	5 (-)	RGB/Legacy RGB mode	8	0304 B31A 5E17	533250000	N/A
		Fra	merate	:	Ņ	Vertica	al refre	sh rat	е				
		HT	otal:		l	Horizo	ntal to	tal of t	ransmitted main v	video	stream, meası	ured in pixe	l count.
		HS	tart:		I	Horizo	ntal ac	tive st	art from leading e	dge	of HSync, mea	sured in pi	el count.
		HA	ctive:		I	Horizo	ntal ac	tive, n	umber of active p	ixels	in video line		
		HS	ync:		I	HSync	width,	meas	sured in pixel cour	nt. (+))/(-) positive / ı	negative sy	nc.
		VT	otal:		١	Vertica	al total	of trai	nsmitted main vide	eo sti	ream, measure	d in line co	unt.
		VS	tart:		١	Vertica	al activ	e start	from leading edg	e of '	VSync, measur	ed in line o	ount.
		VA	ctive:		١	Vertica	al activ	e, nun	nber of active line:	s in v	ideo frame		
		VS	ync:		١	/Sync	width,	meas	sured in line count	. (+)/	(-) positive v.s	. negative s	sync.
		CE	F:		I	Jsed o	color m	node: (Color format + sub	osam	pling / colorime	etry	
		BP	C:		(Color	depth i	n bits	per color (BPC)				
		CR	C (RGB	/CrYCŁ	·				dancy check (CRC Value order in YC	'		•	alculated

VFREQ:	Video Frequency (128b/132b channel coding only)
MVID/NVID:	Mvid and Nvid video time stamp values (8b/10b channel coding only)
DSC CRC:	16-bit Cyclic redundancy check (CRC) calculated from compressed pixel stream. Value order: Engine 0, 1, 2.

VCP Table

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

VCP Table

 Port # SID Req.PBN Alloc.PBN First slot Slot num

 0
 1
 532
 604
 0
 5

 1
 2
 532
 604
 5
 5

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

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

HPD

HPD	
Cable HPD	Assert Deassert Pulse HPD 500 💽 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").
Assert:	Click to re-activate the HPD line (set to logical "high").
Deassert:	Click button to set HPD line to logical "low" (de-asserted) and hence no HPD pulse can be generated.
Pulse HPD:	Click to apply an HPD Pulse with programmable duration. Duration will be defined in the provided field.
Short Pulse:	Click to apply a short pulse. Pulse duration is 1 ms.

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.

Ink HDCP Video Audio EDID HDCP 2.3 Status General Active Authenticated Declared as HDCP capable Keys loaded SST Mode: Type N/A	DPCD SDP DSC FEC Configuration PhDCP Capable Keys Production Facsimile - "Test" - R1 Facsimile - "Test" - R2 None	Source DUT Testing	Link Analyzer Capture Ca	able Info	
By stream Stream 0 Type 0 Stream 1 Type Unknown Stream 2 Type Unknown Stream 3 Type Unknown					
IPD Cable HPD Assert Du	eassert Pulse HPD 500	Length, msec Short P	Cable Information Tulse TX: RX:		

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 and in Link mode 8b/10b.
Stream status	Shows HDPC status on each stream

Configuration

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

Keys

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

Video Tab

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



Disable / Enable Preview

Click the button to start or stop capturing video frames.

Stream

Note:

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

Stream: 🖲 0 🔿 1

Video Status

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

	2, HT 2200, VT 1125, HA 1920, VA 1080, HS 192, VS 41, HSW 44, VSW 5. me rate: 19.58 Hz.
Second row:	Time stamp, Timing, 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.

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

Override Color Detection

Auto

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.

III 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.

/// Record					×
Number of live frames to record:	10	-	OK	Cancel	

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

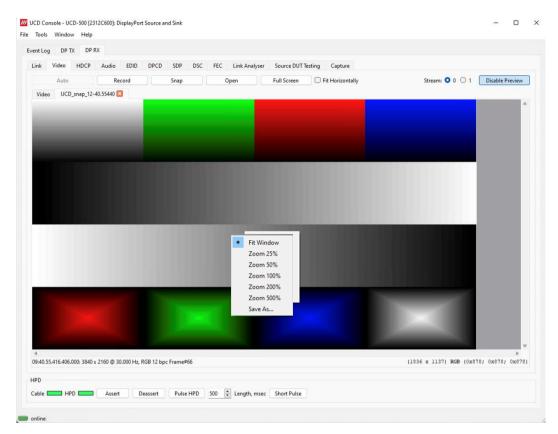
Open

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

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.



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

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

- Location of the cross cursor on the bitmap stating from the upper left corner
- The intensity of the RGB and YCbCr components of the pixel on the cursor location in hexadecimal values

Zoom

Zoom level of the captured frame can be altered by right clicking on top of the preview image and selecting between

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

Save Frame

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

Note: In PPM format the files are stored with the captured color depth, with other formats the color depth is truncated to 8 bits per color.

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

Full Screen

Full Screen

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

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

Preview DSC Decompressed Stream

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

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

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

fools Window Help			
t Log DP TX DP RX			
nk Video HDCP Audio EDID DPCI	D SDP DSC FEC Link Analyzer Sou	urce DUT Testing Capture	
Auto	Snap Open Full	Screen 🗌 Fit Horizontally	Stream: O 0 O 1 Disable Preview
Video			
		The second second second	an a
Compared and the second second			
		California California	
	DSC RAW I	Data	
	Click Snap button to decompress an	ad proving a frame	
	Citck Shap button to necompress an	iu preview a name.	
09:33.18.847.475.000: 3840 x 2160 @ 30.6 MV 15, NV 11261760, HT 4000, VT 2191, HJ Live preview frame rate: 18.07 Hz.	00 Hz, RGB 12 bpc, Frame#4511. 1 3840, VA 2160, H5 112, VS 28, H5W 32.	VSW -5.	
Live preview frame rate: 18.07 Hz.			
D			
ble HPD Assert Deassert	Pulse HPD 500 😨 Length, msec Sho	ort Pulse	
line			
line D Console - UCD-500 (2312C600): DisplayPort Source	e and Sink		- 0
	and Sink		- 0
D Console - UCD-500 [2312C600]: DisplayPort Source	and Sink		- 0
D Console - UCD-500 [2312C600]: DisplayPort Source Tools Window Help		urce DUT Testing Capture	- 0
D Console - UCD-500 [2312C600]: DisplayPort Source fools Window Help nt Log DP TX DP RX nk Video HDCP Audio EDID DPC	D SDP DSC FEC Link Analyzer So		
D Console - UCD-500 [2312C600]: DisplayPort Source fools Window Help ht Log DP TX DP RX ht Video HDCP Audio EDID DPC Auto Record	D SDP DSC FEC Link Analyzer So		Full Screen
D Console - UCD-500 [2312(2600); DisplayPort Source D Console - WCD-500 [2312(2600); DisplayPort Source Middow Help tLog DP TX k Video HOCP Audio EDID DP CC Audio EBID Video HCCP Video EBIC Video UCD_snap; 12-28:38242	D SDP DSC FEC Link Analyzer So		
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D Console - UCD-500 [2312C600] DisplayPort Source Tools Window Help at Log DP TX DP RX ak Video HDCP Audio EDID DPC Auto Record VIGEO UCD, may, 12-233242 VIGEO RECORD	D SDP DSC FEC Link Analyzer So		
D Console - UCD-500 (2312 C600): DisplayPert Source fools Window Help titleg DP TX DP RX k Video HOCP Audio EDD DPC Auto Record Video UCD, snap, 12-28, 3624 2 UNI G RAF	D SDP DSC FEC Link Analyzer So		
D Console - UCD-500 [2312C8005 DisplayPert Source Tel Lg DP Tx DP Rx nk Video HDCP Audio EDD DPC Auto Record Video UCD_snep_12-253622 2 VIDI IG RAF Statistics Source Record Video UCD_snep_12-253622 2 VIDI IG RAF	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 (2312 C600): DisplayPert Source fools Window Help titleg DP TX DP RX k Video HOCP Audio EDD DPC Auto Record Video UCD, snap, 12-28, 3624 2 UNI G RAF	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C8005 DisplayPert Source Tel Lg DP Tx DP Rx nk Video HDCP Audio EDD DPC Auto Record Video UCD_snep_12-253622 2 VIDI IG RAF Statistics Source Record Video UCD_snep_12-253622 2 VIDI IG RAF	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C8005 DisplayPert Source Tel Lg DP Tx DP Rx nk Video HDCP Audio EDD DPC Auto Record Video UCD_snep_12-253622 2 VIDI IG RAF Statistics Source Record Video UCD_snep_12-253622 2 VIDI IG RAF	D SDP DSC FEC Link Analyzer So Snap		
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D Console - UCD-500 [2312C800]: DisplayPed Source foods Window Help at Log OP Tr. DP RX Nr. Video HDCP Audio EDD DPC Auto Record Video UCD_anip: [1:2-23:3022] UNI GRAF	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C8005 DisplayPert Source Tele D P R Hep at Log DP R DP R Auto P R CONTRACT Video UCD_snep_12-23-35322 C UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF Tele D P R HER Tele D P R	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C8005 DisplayPert Source Tele D P R Hep at Log DP R DP R Auto P R CONTRACT Video UCD_snep_12-23-35322 C UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF UNI G RAF Tele D P R HER Tele D P R	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C800]: DisplayPed Source Tools Window Help at Log DP TX DP RX Nk Video HDCP Audio EDD DPC Auto Record Video UCD_anep.12-23.8042 C UT I G RA F UT I G RA F UT I G RA F UT I G RA F I I I I I I I I I I I I I I I I I I I	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2112C000] DisplayPort Source Solo Window Help at Log DP TX DP R w Video HDCP Audio EDID DPC Audio EDID DPC Audio EDID DPC UNICRAF	D SDP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C800]: DisplayPed Source Tools Window Help at Log OP TX DP RX w Video HDCP Audio EDD DPC Auto Record Video UCD_snep.[1:2-338042] UNI GRAF Faitness_Hall, QD faitness_Hall, QD for each subscription = 0 accord_line, video = 0 accord_line,	D SOP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C800]: DisplayPed Source Tools Window Help at Log OP TX DP RX w Video HDCP Audio EDD DPC Auto Record Video UCD_snep.[1:2-338042] UNI GRAF Faitness_Hall, QD faitness_Hall, QD for each subscription = 0 accord_line, video = 0 accord_line,	D SOP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2112C000] DisplayPort Source Solo Window Help at Log DP TX DP R w Video HDCP Audio EDID DPC Audio EDID DPC Audio EDID DPC UNICRAF	D SOP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C800]: DisplayPed Source Tools Window Help at Log OP TX DP RX w Video HDCP Audio EDD DPC Auto Record Video UCD_snep.[1:2-338042] UNI GRAF Faitness_Hall, QD faitness_Hall, QD for each subscription = 0 accord_line, video = 0 accord_line,	D SOP DSC FEC Link Analyzer So Snap		
D Console - UCD-500 [2312C800]: DisplayPed Source Tools Window Help at Log OP TX DP RX w Video HDCP Audio EDD DPC Auto Record Video UCD_snep.[1:2-338042] UNI GRAF Faitness_Hall, QD faitness_Hall, QD for each subscription = 0 accord_line, video = 0 accord_line,	D SOP DSC FEC Link Analyzer So Snap		

Capture Tab

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

	DSC FEC Source DUT Testing Cable Info	
HDCP Video Capture Audio Link-Analyzer EDID DPCD SDP 1	DSC FEC Source DUT Testing Cable Info	
	Open Timeline Viewer Open storage folder	
uffered Capture Options		
apture 5 🛟 frames and save them in BMP → format ream: 0 0 • 1 0 2 0 3	Capacity of buffer: 2071 frames	
ream: 0 0 0 1 0 2 0 3] Align to MSB		
Create scenarious		
Scenario time 1000ms 🗘		
vents: HPD AUX SDP VB-ID MSA Link Patt	tern AUX_BW VFRAME INFO	
udio: Enabled		
us: Idle		
	Cable Information	
HPD Assert Deassert Pulse HPD 500 🗘 Length, msec		
HPD Assert Deassert Pulse HPD 500 + Length, msec		

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 lenghts of the created scenario in milliseconds
Events:	Please refer to chapter Event Log for details of the captured events
Status:	Status of the capture.
Open Timeline Viewer	Open Event Timeline Viewer to view the captured data. Refer to chapter seven of this manual for detailed instructions.
Open storage folder:	Data save folder is defined in menu Tools > Options. Captured video, audio and data is saved in a subfolder of this folder. The name of the subfolder is "buffered_capture_yyyymmdd_hhmmss" (e.g., buffered_capture_20210301_130532).

Note:

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

Link Analyzer Tab

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

		v Help										
TX	DP RX	Event Lo	g									
ink	HDCP	Video	Audio EDI	D DPCD	Capture	SDP	FEC DSC	Source DUT Testing	J Link Analyzer			
S	tart								Open Timeline Viewer	Open storage folder		
Mair	n Link Cap	oture Optio	ons:									
Amo	ount: 2	• 0	MB 🖲 GB									
Trigg	ger: Start	of TPS1/T	PS2/TPS3/TPS4			~	Position: St	tart 🗸				
Sour	rce: TPS1	I 🗸 Posi	tion: Initial LT		\sim							
Even	its Captur	e Options:										
H	HPD	AU>	SDP		VB-ID		🗌 MSA	Link Patte	m 🗆 AUX_BW	VFRAME INFO		
tatus	: Idle											
catus	iule											
PD												
			Aura	Durant	Durley LID	500		Chan the design of the second s	1			
PD able [HP	D	Assert	Deassert	Pulse HPI	500	Eength, r	msec Short Pulse	1			
	HP	D	Assert	Deassert	Pulse HPI	500	🔹 Length, r	msec Short Pulse	1			
	HP	D	Assert	Deassert	Pulse HPI	0 500	€ Length, r	msec Short Pulse	1			

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 > 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 4 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.

SDP

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

III Event Filter Dialo	og			×
DP RX SDP filtering	9:			
Enable logging of	following packet	s [IDs in hex]:		
Audio_TimeSta	imp [1] 🗌 Audi	io_Stream [2]		
Extension [4]	🗹 Audi	io_CopyManagem	ent [5]	
✓ ISRC [6]	✓ VSC	[7]		
Camera Generic				
🗹 CG0 [8]	🗹 CG1 [9]	🗹 CG2 [A]	🗹 CG3 [B]	
🗹 CG4 [C]	🗹 CG5 [D]	CG6 [E]	🗹 CG7 [F]	
Picture Parame	eter Set [10] 🗹	VSC_EXT_VESA [20	1	
VSC_EXT_CTA	[21]	Adaptive-Sync SDI	P [22]	
InfoFrames				
VS [80 + 1]	AV	1 [80 + 2]		
	🗹 Au			
	e [80 + 5] 🗌 NT	SC VBI [80 + 6]		
DRM [80 + 7				
Select all				
Enter packet type	as hex value sepa	rated by comma:		
0x0, 0xF				
		_	OK Cano	ol

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.

VBID filtering				
	Disabled	On se	t On cle	ar 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	0	0	0	۲
On MVID change				
On MAUD change				
🔿 Log all	Elegen	change	2	

<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.

III 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	VHEIGHT	
MISC0 O Log all	MISC1	Log on char	nge	
			OK Cance	el -

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		\square	\checkmark	
TPS2		\square	\checkmark	
TPS3		\square	\checkmark	
TPS4		\square	\checkmark	
Idle pattern		\square	\checkmark	
Active video		\square	\square	
ML_PHY_SLEEP		\square	\checkmark	
ML_PHY_STANDBY		\square	\square	
EIEOS pattern		\square	\checkmark	
Custom pattern (80 bit)				
CP2520.1		\square	\checkmark	
CP2520.2		\square	\square	
PRBS7		\square	\checkmark	
PRBS31		\square	\checkmark	
Log all				
Custom Pattern (80 bit)				
Type:	Bytes (8bit, hex)			
0 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.

fools Window I										
-C RX USB-C TX		-i	0000 00	D 550 D0						
OC Video Lir ectrum: 60 dB v		dio EDID	DPCD SD	P FEC DSG	Source DUT Tes		Ster	eam: 🖲 0 🔾 1		Disable Previ
	necora (ma)	5000		nerest	no udulo piajo	un -				o bable rier
									A A	
			\mathbf{V}							
			VV							
• •	• •	• •	• •	• •	* * *		* * *		• •	V
↓↓↓									4,4,	
						▲ _₩ ▲ _₩ ▲	Å ↓Å√	▲ ↓ ▲ ↓ ▲ ↓		
						A _y A _y A	┍┻┯┻┯╵	▲ ↓ ▲ ↓ ▲ ↓	≜ _V ≜ _V	186 mse
						▲	┢╋╋┥	▲ _↓ ▲ _↓ ▲ _↓	▲ ↓▲	186 mse
		Å √Å				▲ ╻▲╻▲		▲ ↓ ▲ ↓ ▲	▲ ↓ ▲ _♥	186 mse
		, , , ,				▲	▶ ▲ ↓ ▲↓	▲ _↓ ▲ _↓ ▲ _↓	▲ _↓ ▲ _↓	186 mse
						▲╻▲╻	┢╋╋┥	▲ _↓ ▲ _↓ ▲ _↓	▲	186 mse
		, , , , , ,				▲ 	┢╋╋┥	▲ _↓ ▲ _↓ ▲ _↓	▲₩₩	186 mse
		^					/ / / /	▲ ↓ ▲ ↓▲√	▲	186 mse
	`	^					, , , , , , , , , , , , , , , , , , ,	▲ ₩₩₩₩	▲	186 mse
	₩	^					/ / /	▲	▲ ↓ ▲ ↓	186 mse
		^					////	▲	▲ ↓ ▲ ↓	186 mse
		^					////	▲	▲ ↓ ▲ ↓	186 mse
		^							▲ ↓ ▲ ↓	
							/ / /		▲ ↓ ▲ ↓	
	lo bits Frame≢73 (Ir	Ist frames ()					, , , , , ,		▲ ↓ ▲ ↓	
hannels: 44100 Hz	16 bits Frame#73 (h	ist frames 0)						PD	▲ ↓ ▲ ↓	186 mse 22050 H

The audio signal format is shown in three ways.

- The 'oscilloscope' panel displays the waveforms of the received audio channels.
- The frequency spectrum of the audio is shown in the lower panel. The range of the spectrum display is from 0 to 1/2 of the input sampling rate. The amplitude scale of the spectrum display can be selected between 'Linear' to 100 dB.
- The input audio mode field (in the bottom of the dialog) indicates detected audio mode in the input stream and the number of audio packets captured.

Enable Preview / Disable Preview

This button controls capturing the audio data.

Select Monitored Stream

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

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

Playback Device Selection

No audio playback 🗸 🗸

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

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

Refresh Audio Device List

Refresh

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

Start Audio Recording

Record (ms) 5000 ≑

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

EDID Tab

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

- Load and save EDID data files in the host PC.
- Edit the EDID contents either in EDID Editor or in hex format.
- Program and read the contents of the EDID memory for all virtual channels.

Link HDCP Video Audio EDID DPCD SI	DP DSC FEC Source DUT Testing							
Add Item 🔻 Remove Item Filter	Read mode: O) I2C Read ● SBM Read Virtual Sink #1 ∨ □ Show Read Only ☑ Recurse						
Name	Name	Value						
✓ VESA	0 Pixel clock, MHz 533.25							
> Vendor & Product ID EDID Structure Version and Revision Numbers	1 Horizontal Addressable Video 3840							
> Basic Display Parameters / Features								
Color Characteristics	2 Horizontal Blanking in pixels 160							
 Established Timings I Established Timings II 	3 Vertical Addressable Video 2160							
 Manufacturer's Timings 	4 Vertical Blanking in lines 62							
> Standard Timings: Identification	5 Horizontal Front Porch in pixels 48							
Preferred Timing Block 18 byte descriptor 2								
 > 18 byte descriptor 2 > 18 byte descriptor 3 	6 Horizontal Sync Pulse Width in pixels 32							
18 byte descriptor 4	7 Vertical Front Porch in Lines 3							
✓ CTA Info								
> Data block collection	00 01 02 03 04 05 06 07 08 0	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F						
Detailed Timings	0000000 00 ff ff ff ff ff ff 00 54 c	7 36 40 ff 71 3b 00						
DisplayID Data Block	0000010 34 18 01 04 e5 3d 23 78 3a 5	if bl a2 57 4f a2 28						
> Data block	000020 Of 50 54 bf ef 80 71 4f 81 0	00 81 c0 81 80 a9 c0						
Name Value	000030 b3 00 95 00 d1 c0 4d d0 00 a	a0 f0 70 3e 80 30 20						
1 Max Resolution 15360 x 8640	000040 35005f592100001a 56 5	5e 00 a0 a0 a0 29 50						
2 HDR Static	000050 30 20 35 00 5f 59 21 00 00 1	La 00 00 00 fd 00 38						
	0000060 4b le 86 36 00 0a 20 20 20 2	20 20 20 00 00 00 fc						
	0000070 00 55 43 44 2d 35 30 30 20 4	44 50 31 0a 20 02 13						
4 HDR10+ CTA -> CEA Extension_V3->Data block collection->Data block	000080 02 03 12 71 83 4f 00 00 29 0	of 7f 07 15 06 55 3d						
5 Dolby Vision CTA -> CEA Extension, V3-> Data block collection -> Data	000090 lf c0 00 00 00 00 00 00 00 0	00 00 00 00 00 00						
		v 00 00 00 00 00 00 v						
 Main Features 	Editor Mode HEX Edit Mode	Apply						
Read from TE Write to TE		Save As Load						

EDID Files

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

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

EDID Editor

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

DPCD Tab

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

nk Vid	leo	HDO	P	Aut	lio	EC	DID	C	DPCI	D	SD	P	DS	с	FE	2	Link	Analy	ser	Sou	rce DUT Te	sting	C	opture									
dress: 0x 000100 000110 000120 000130 000140	00 04 00 03 00 00 00	04 07 00 00 00 00	D2 0 D0 0 D0 0 D0 0 D0 0 D0 0			5 0 0 0 0 0 0 0 0 0		07 00 00 00 00 00	08 02 00 00 00 00 00	09 00 00 00 00 00	00 00 00 00 00	00 00 00 00 00									LINK_BV	SET 0x04 SET = (0x04 codec	= RES I) d as N = 13.5	1AIN_L Gbps/I	ane (l	HANNEL_ JHBR13.5) HANNEL_(-	= 8b/1		Save	2		Report
000160 000170 000180 et Referen	00	00	00 0	0 0	0 0	0 0	00 0	00 (00	00	00	00	00	00	00	00	D												C	Refresh	1	Write	e Chan
ldress : 0x	2200)	-	Nu	mbe	of	Byter	s: Ox	10	0		\$																					
002200 002210 002220 002230 002240 002250 002250 002260 002270 002280	14 0a 00 00 00 00 00	1e 00 00 00 00 00 00	00 0 00 0 00 0 00 0 00 0 00 0		1 0 1 0 0 0 0 0 0 0 0 0 0 0	0 (0 7 0 0 0 0 0 0 0 0 0	3 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		00 00 00 00 00 00 00	00 00 00 00 00 00	06 00 00 00 00 00	00 00 00 00 00 00	000000000000000000000000000000000000000) 84) 00) 00) 00) 00) 00) 00						Extended MAIN_LIN 0x02206 :: 8b/10b_ 128b/13	K_CH/ 0x03 UPPO	ANNE	i_cod = 1	ING [RO]							
t Referen	ce																												C	Refresh		Write	e Chan

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

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

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

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

SDP Tab

In SDP Tab shows the *Secondary-Data Packets* sent by the Source device. Click **Refresh** to re-read the data. Show / hide the parsed data by selecting **Packet Info**.

k HDCP	Event Log					
	Video Capture I	Jirk Analyzer Audio	EDID DPCD SC	JP DSC FEC Sou	rce DUT Testing Cable Info	
SDP CRC16 em	or counters (128b/132b)					
SDP CRC16	Streams (count = 4		3			
Name Head		04 05 04 07 08 09 10		10 19 20 21 22 23 24 2	15 24 27 28 29 20 31	Packets mto
						a nie
Refresh	Save					
Refresh	Save				Cable Information	

SDP CRC16 error counters (128b/132b)

SDP CRC16 error counters (128b/132b)									
SDP CRC16	Streams (count = 4):	0	1	2	3				
SDP CKCT0	Error count (click to clear):	00	00	00	00				

SDP CRC16:	Shows if connected DP Source device supports SDP CRC16. Green light indicates that the source supports SDP CRC 16.
Streams:	Streams from 0 to 3.
Error count (click to clear):	Shows error counter values on each lane. Click the row to clear the error counters.

The following packets are recognized:

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

Saving SDP Packets

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



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

DSC Tab

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

e <u>T</u> ools <u>W</u> indow <u>H</u> elp		rce and Sink				
ISB-C RX USB-C TX Event L	Log					
PDC Link HDCP Video	o Audio EDID DI	PCD SDP DSC FEC	Source DUT Testing			
DSC Capable (8b/10b)	DSC Enabled					
DSC Major Version:	1	DSC Minor Version:	2]		
RC block size:	65536 bytes	 RC buffer size, in blocks: 	4]		
Bits per Pixel Increment:	1/16 bpp	V Block Prediction:	Supported ~			
Throughput mode 0:	340MP/s	Throughput mode 1:	340MP/s ~			
Line buffer depth:	16 bits	✓ Maximum Slice Width:	2560]		
Supported Color Depths	Supported Color form	ats H-Slice Capabilities				
🗹 8 Bits per color channel	RGB	I Slice / DSC Sink	10 Slice / DSC Sink			
10 Bits per color channel	VCbCr 4:4:4	2 Slice / DSC Sink	12 Slice / DSC Sink			
☑ 12 Bits per color channel	Simple YCbCr 4:2:2	4 Slice / DSC Sink	16 Slice / DSC Sink			
	Native YCbCr 4:2:2					
	VCbCr 4:2:0	8 Slice / DSC Sink	24 Slice / DSC Sink			
Г	Auto-Apply HPD pu	lse on Apply Reset	Refresh Apply	1		
E	Auto-Apply 🗌 HPD pu	lse on Apply Reset	Refresh Apply			
C	Auto-Apply 🗌 HPD pu	lse on Apply Reset	Refresh Apply			
C	Auto-Apply 🗌 HPD pu	lse on Apply Reset	Refresh Apply]		
E] Auto-Apply 🗌 HPD pu	lse on Apply Reset	Refresh Apply]		
E] Auto-Apply ☐ HPD pu	lse on Apply Reset	Refresh Apply]		
C] Auto-Apply ☐ HPD pu	lse on Apply Reset	Refresh Apply]		
C] Auto-Apply ☐ HPD pu	Ise on Apply Reset	Refresh Apply]		
C] Auto-Apply [] HPD pu	Ise on Apply Reset	Refresh Apply			
C] Auto-Apply HPD pu	tse on Apply Reset	Refresh Apply			
C] Auto-Apply ☐ HPD pu	ise on Apply Reset	Refresh Apply			
C] Auto-Apply [] HPD pu	tee on Apply Reset	Refresh Apply			
C] Auto-Apply [] HPD pu	tee on Apply Reset	Refresh Apply			
] Auto-Apply □ HPD pu	te on Apply Reset	Refresh Apply			
нро		Pulse HPD 500 C Lengt		Status PPC Status DUT Attached	Detach Reconnect Cable	

Enabling DSC

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

DSC Capable	UCD-5XX sink is declared as DSC capable. Control is only in use with 8b/10b link coding.
DSC Enabled	Connected source has enabled DSC

Enabling 16K capability for DSC

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

🗹 DSC Capable (8b/10b)	DSC Enabled	ł			
DSC Major Version:	1		DSC Minor Version:	2	
RC block size:	65536 bytes	~	RC buffer size, in blocks:	4	
Bits per Pixel Increment:	1/16 bpp	~	Block Prediction:	Supported	~
Throughput mode 0:	340MP/s	~	Throughput mode 1:	340MP/s	~
Line buffer depth: Supported Color Depths B Bits per color channel 10 Bits per color channel 12 Bits per color channel	600MP/s 650MP/s 700MP/s 750MP/s 800MP/s 800MP/s 900MP/s 900MP/s 1000MP/s 170MP/s	~	Maximum Slice Width: H-Slice Capabilities 2 I Slice / DSC Sink 2 Slice / DSC Sink 4 Slice / DSC Sink 6 Slice / DSC Sink 8 Slice / DSC Sink 2 8 Slice / DSC Sink 2 8 Slice / DSC Sink 2 8 Slice / DSC Sink 3 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1] 12 Slice / DS] 16 Slice / DS] 20 Slice / DS	IC Sink IC Sink IC Sink
	Auto-Apply 🗌 HPI	D pulse o	n Apply Reset	Refresh	Apply

DSC Support Capabilities

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

Apply:	Write changes to the DPCD registers of UCD Sink
Refresh:	Re-read the content of UCD Sink DPCD and update the control status.
Reset:	Reset the content of DSC related DPCD registers in UCD Sink (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.

		Help							
B-C RX	USB-C		vent Log						
DC \	/ideo I	Link	HDCP	Audio	EDID	DPCD SI	DP FEC	DSC Source DUT Testing	
			_					FEC Status Log	
✓ FEC	C Capable	(8b/10b) 🗹 Gen	erate HDP	on Chang	e 💻 F	EC Enabled	-	
Error C	Counters (l	DPCD)							
			Lane #0	Lane #1	Lane #2	2 Lane #3	Sum		
	rected blo		s -	-	-	-	-		
	ted block	errors		1.1	-	-			
Bit erro			-	-	-	-	-		
	block erro bit errors	rs	-	-	-	-	-		
Parity									
	🗹 Enab	ole aggre	egated erro	ors	Update	Clear	Counters		
								ClearLog	
PD	HPD		Assert		assert	Pulse HPI	500	Clear Log Length, msec Short Pulse DuT Attached Detac	

Enabling FEC

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

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

Source DUT Testing Tab

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

All tests CRC Video Tests Audio Test DP 1.4 LL CTS Link Config Tests DP 2.1 LL CTS HDCP 2.3 CTS 1A HDCP 2.3 CTS 1B HDCP 2.3 CTS 3A	HDCP 2.3	CTS 3B	Pixel Lev	el Video Tests	HDR10+
Name	Pass	Fail	Skip	Runs	Last status
✓ □ CRC Video Tests	0	0	0	0	
CRC based single reference frame video test	0	0	0	0	
CRC based single frame video stability test	0	0	0	0	
CRC based sequence of reference frames video test	0	0	0	0	
CRC based continuous sequence of reference frames video test	0	0	0	0	
✓ □ Audio Test	0	0	0	0	
Validate audio signal frequency and glitch-free audio reproduction	0	0	0	0	
	0	0	0	0	
4.2.1.1 Source DUT Retry on No-Reply During AUX Read after HPD Plug Event (3200us) 4.2.1.2 Source Retry on Invalid Reply During AUX Read after HPD Plug Event	0	0	0	0	
4.2.1.2 Source Ketry on Invalid Keply Duning AUX Kead after HPD Plug Event 4.2.1.3 Source Device HPD Event Pulse Length Test	0	0	0	0	
4.2.1.3 Source Device HPD Event Pulse Length Test	0	0	0	0	
4.1.1.5 Source Device Inactive HPD / Inactive AUX Test	ő	ő	ő	ő	
4.2.1.1 DPCD Receiver Capability and EDID Read upon HPD Plug Event	ő	ŏ	ŏ	ŏ	
4.2.2.2 DPCD Receiver Capability Read upon HPD Plug Event	0	0	0	0	
		_			
Run Selected Select Configure Import Export Stop on Failure Repeats: 1 Delay time, sec 1		Sav	re Report	Clear Selecte	d Clear A

Select the tests for execution by selecting corresponding checkboxes or by highlighting them by left-clicking on the test name.

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 the selected test set. Please refer to <i>Test Parameters</i> below for details.
Import:	Load saved test parameter files (*.td or *.json).
Export:	Save test parameters for later use or for use in test automation. For saving parameters for later use in UCD Console, either format can be used. For saving parameters for TSI scripting, please use *.td files. For use with Python applications, please use *.json files.
Stop on Failure:	Stops execution of the selected tests if one of the tests fail
Repeats:	Repeat the selected test several times
Delay time:	Delay in seconds between individual tests.

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

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

Test Parameters

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

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

Saving Test Parameters

Test parameters can be saved in various ways.

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

Presets 🔻		
Save		-
Load	•	
Remove	÷	
Import		
Export		

DUT Testing Options

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

Cable Info Tab

PDC Link HCCP Visio Audo LinkAnalyzer Capter DID DPCD SDP DSC HCC Source DUT Teeting, Cable Info DPTX Cable Info LIHRIR Capabilies Not LIHRIN-capable or unknown LIHRIR Capabilies Not LIHRIN-capable or unknown UHRISS Capable No Cable Type Unknown USB-C Cable Info Not available in Up facing port (UPP) rele. Please, refresh differ changing relo.	Event Log USB-C RX		
UHBR Capabilities Not UHBR-capabile or unknown UHBRS Capabilities Not UHBR-capabilities Not Cable Hype UHBR-capabilities Not Cable Hype UHBR-capabilities Not Cable Hype Not	HDCP Video Audio Link Ar	vnalyzer Capture EDID DPCD SDP DSC FEC Source DUT Testing Cable Info	
USB-C Cable Info Refresh Not available in Uo facine port (UPP) role.	pabilities Not UHBRx-capable or unknown 5 Capable No	n UHBR Capabilities Not UHBR-capable or unknown UHBR13.5 Capable No	
Refresh Not available in Up facine port (UPP) role.		Caule type Officion	
Not avaitable in Ug nacing port (UPP) role. Please, refresh after changing role.		Refresh	
	Not available in Up Piease, refresh	facing port (UFP) role. after changing role.	
PD Cable Information PD			

DPTX / DPRX Cable Info

UHBR Capabilities:	Shows the UHBR capabilities of the connected cable.
UHBR 13.5 Capable:	Shows if the connected cable is UHBR 13.5 capable.
Cable Type	Type of the cable connected.

USB-C Cable Info

USB-C cable information is not available in UFP role.

Cable Information

Cable information panel shows if the connected cables are D80 / DP40 capable.

```
Cable Information
TX: DP80 RX: DP80
```

Note: Please note that cable info can only be read when in Down Facing Port role. Please click *Refresh* after changing roles.

USB-C Monitoring

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

Console - UCD-500 [2232C	531]: USB-C, DP Alt Mode Source	and Sink					-	
C RX USB-C TX Even	t Log							
C HDCP Audio E	DID DPCD SDP FEC	DSC Source DUT Testir	ng Capture Link Ana	lyzer Link Vi	deo			
	0.0 0.00 001 100	bio boarceborriesta	ig coptaite clinicitie	yeer enne m	0.0			
Status List		Capabilities DF	P Alt Mode Power Source	e Power Sink	Cable Info Controls			
▼ TE Status Data Role Power Role	Up facing port (UFP) Sink	Initial Role O DFP/SRC C) UFP/SNK () DRD/DRP	CC Pull-up O Defaut O 1.5A				
VConn E-Marked Cable DP Alt Mode	Off Unknown "C": DP v1.4a 4 Ianes	Reject PR Swa	3p	3.0A				
PD Contract PD Contract PO Contract Power Source	Fixed 3.00 A / 5.00 V	Reject DR Sw. Reject VCON		Try Behavior Try Sink Try Source				
- PDO Type	Fixed			None				
- PDO voltage	5.00 V	UCD-500 Identity	/					
 PDO max current Power Sink 	3.00 A	USB Type-C Spec	:: USB Type-C S	Spec Release 2.2				
Power Sink - RDO max current	0.45 A	Power Delivery S	pec: PD rev 3.1 v1	.7				
- RDO max current	0.45 A	Vendor ID:	0x16A6					
- No USB suspend	Yes	Product ID:	0x 500					
- USB comm capable	No	Accessories						
- Capability mismatch	No	Audio Access	sory 🗌 Debug Ad	cessory				
- Give back	No							
 Available source PDO 								
PDO 1	Fixed 3.00 A / 5.00 V							
PDO 2	Fixed 3.00 A / 9.00 V							
 Bus Electrical Status 	6 10 11							
Vbus voltage Vbus current	5.42 V 0.08 A							
CC1 voltage	0.08 A	~						
PD Control	0.00 1	Orientation						
	SWAP Send VCONN_SWAP	CC1 CC2 Cable C	Drientation: Flipped					
1						PD		
le 💶 HPD 💶 🗌	Assert Deassert Pul	Ise HPD 500 🗘 Length	n, msec Short Pulse			DUT Attached	Detach R	Reconn

In *USB-C Power Delivery* tab () 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 PD Contract roles for the UCD-5XX device and the optional USB-C PD Contract capabilities. Controls allow the 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-5XX device, and the connected DUT.

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

The two bottom panels indicate status of the cable connection and PD Control controls for role swaps.

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.

▼ TE Status	
Data Role	Up facing port (UFP)
Power Role	Sink
VConn	Off
E-Marked Cable	Unknown
DP Alt Mode	"C": DP v1.4a 4 lanes
PD Contract	Fixed 3.00 A / 5.00 V
▼ PD Contract	
Power Source	
- PDO Type	Fixed
- PDO voltage	5.00 V
- PDO max current	3.00 A
Power Sink	
- RDO max current	0.80 A
- RDO oper current	0.80 A
- No USB suspend	Yes
- USB comm capable	No
- Capability mismatch	No
- Give back	No

TE Status:

UCD-5XX 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)

▼ Available source PDO		1
PDO 1	Fixed 3.00 A / 5.00 V	
PDO 2	Fixed 3.00 A / 9.00 V	
 Bus Electical Status 		
Vbus voltage	5.45 V	
Vbus current	0.06 A	
CC1 voltage	0.03 V	
CC2 voltage	1.67 V	
VCONN voltage	0.00 V	
VCONN current	0.00 A	
SBU-1 voltage	0.26 V	
SBU-2 voltage	2.61 V	
▼ Internal Load		
10 Ohm	Disabled	
Overcurrent protection		
- 10 Ohm OCP	Triggered	

Available source PDO:	Available source PDO offered by UCD-5XX (PDO 1, PDO 2)
Bus Electrical Status:	(Vbus voltage, Vbus current, CC1 voltage, CC2 voltage, VCONN voltage, VCONN current, SBU-1 voltage, SBU-2 voltage)
Internal load:	UCD-5XX internal load feature enabling status and over current protection status indicator (10 Ohm, Overcurrent protection)

DUT Discovery	DUT information (data capable as host, data capable as device, product type, USB vendor ID, USB product ID, BCD device, SVID0, SVID1)
DUT DP Alt Mode Capabilities:	DP Alt Mode Capabilities of the DUT (DP capability, receptacle indication, USB 2.0 Signaling, Pin assignments supported)
TE DP Alt Mode Status:	UCD-5XX internal DP Alternate mode status (Status, Multi- function preferred, HPD state, DP capable, pin assignment, cable UBHR 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)
▼ DUT Discovery	
Data Capable as Host	N/A
Data Capable as Device	N/A
Product Type	N/A
USB Vendor ID	N/A
USB Product ID	N/A
BCD Device	N/A
SVID0	N/A
SVID1	N/A
 DUT DP Alt Mode Capabilities 	
DP Capable	HBR3
Receptacle Indication	USB-C receptacle
USB 2.0 Signaling	May be required
Pin Assignment supported	
- DFP_D	no
- UFP_D	C, D, E
- DPAM Version	Version 2.1 or higher
▼ TE DP Alt Mode Status	
Status	N/A
Multi-function prefered	N/A
HPD state	N/A
DP Capable	HBR3
Pin Assignment	N/A
Cable UHBR 13.5 Support	N/A
Cable Active Component	N/A
DPAM Version	N/A
▼ DUT DP Alt Mode Status	
Status	N/A
Multi-function prefered	N/A
HPD state	N/A
Power low	N/A
No DPAM Suspend	N/A

Capabilities

1.11.10.1		e Power Sink	EPR Source	EPR Sink	Cable Info	Controls
Initial Role		CC Pull-up				
○ DFP/SRC ○ U	IFP/SNK	O Defaut				
		O 1.5A				
Reject PR Swap		3.0A				
Reject DR Swap Reject VCONN SWAP		Try Behavior				
		O Try Sink				
		O Try Source				
		None				
UCD-500 Identity						
Power Delivery Spe	c: PD rev 3.0 v1	.2				
Vendor ID:	0x16A6					
Product ID:	0x500					
Product Type:	unspecified					
Accessories						
Audio Accessor	y Debug A	ccessory				
	Defines the	role which LICE	-5XX prese		the start o	f PD
Initial Role:		ion (both powe	r and data r	016).		
Initial Role: Reject Swaps:	communicat			,	ected port p	oartner.
	communicat Allow or reje Control of Rp	ion (both powe	quests from ses to adve	n the connertise the cu	urrent sourc	
Reject Swaps:	communicat Allow or reje Control of R in initial USB	ion (both powe oct role swap re o that Source u	quests from ses to adve ion and in P	n the conne rtise the cu 2D Rev 2.0	urrent source operation.	ce capability
Reject Swaps: CC Pull-up:	communicat Allow or reje Control of R in initial USB Control the U handshake.	ion (both powe oct role swap re o that Source u s Type-C operat	quests from ses to adve ion and in P that UCD-5X	n the connection rtise the cu 2D Rev 2.0 (X initially	urrent source operation.	ce capability
Reject Swaps: CC Pull-up: Try Behavior: UCD-500 Identity:	communicat Allow or reje Control of R in initial USB Control the U handshake.	ion (both powe ot role swap re o that Source u Type-C operat JSB-C PD role	quests from ses to adve ion and in P that UCD-5X	n the connection rtise the cu 2D Rev 2.0 (X initially	urrent source operation.	ce capability
Reject Swaps: CC Pull-up: Try Behavior:	communicat Allow or reje Control of R in initial USB Control the U handshake.	ion (both powe ot role swap re o that Source u Type-C operat JSB-C PD role	quests from ses to adve ion and in P that UCD-5X	n the connection rtise the cu 2D Rev 2.0 (X initially	urrent source operation.	ce capability
Reject Swaps: CC Pull-up: Try Behavior: UCD-500 Identity:	communicat Allow or reje Control of Rţ in initial USB Control the U handshake. Status inform	ion (both powe ot role swap re o that Source u Type-C operat JSB-C PD role	quests from ses to adve ion and in P that UCD-5X I by UCD-5X	n the connective the curve of the connective the curve of	urrent source operation.	ce capability

with *.Accessory states. (Please refer to USB Type-C specification for details).

Note: Please note that UCD-500 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.

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

DP Alt Mode Capabilities

Supported Pin Assignments declared in DisplayPort Capabilities discover message. Separate for UFP_D (DisplayPort sink) and DFP_D (DisplayPort source)

Power Source

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

					Cable Ir		EPR S	Source	LFIN	er Sink	FOW	Sourc	Power	OP Alt Mode	Capabilities D
															SPR PDOs
t,	Min Voltage, mV	ŧ,	ax Voltage, mV	Ma	e Power, mW		Current, %	Peak	tage, nV		Current, mA		De	PDO Typ	Source PDOs
							~	100	E	5000	•	3000	~	Mandatory	PDO1
- A - V	0	*)	\$ 0		0	~	100	-	9000	•	3000	~	Fixed	PDO2
	0	×)	÷ 0		_	-	100		9000	L		~		

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

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

Note: Please note that UCD-5XX devices are not able to simulate as Source the electrical behavior of Variable and Battery source types.

Refresh	Re-read status from UCD-5XX
Apply	Program new values to UCD-5XX
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-5XX when acting as Power Sink Port.

Capabilities	DP Alt Mode	Power Source	Power Sink	EPR Source	EPR Sink	Cable Info	Controls	
Controls	SPR PDOs							
Flags								
Give b	back flag							
No US	SB suspend							
PDO type	e priority	Max Operation	Current					
Prefer hi	igher voltage \vee	450	-					
							. ,	
Prefer hi Give back				Back flag in	its Reque	est Data Ol	oject	
	a flag:	UCD-5XX	sets GiveE	<i>Back</i> flag in SB Suspen	•			ect
Give back	a flag: suspend:	UCD-5XX UCD-5XX Setting of advertised	sets <i>GiveE</i> sets No U the policy	SB Suspend used for an e Device. (F	d flag in it utomatic s	ts Request selection fi	Data Obj rom availa	able PDOs

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

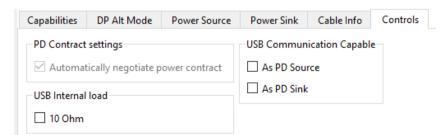
Capabilities	DP Alt Mode	Power	Source	Powe	r Sink	EPR So	ource	EPR S	ink	Cable In	fo	Controls	5
Controls	SPR PDOs												
Sink PDOs	PDO Typ	e		Current, nA	Voltag mV		Max Po mV			Voltage, mV	Min	n Voltage, mV	
PDO1	Mandatory	~	450	-	5000	•							
PDO2	Disabled	~	0	*	0	* *	0	-	0		0		*
Refresh	Apply	Load	PDO	Save P	DO								

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

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

Controls

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



PD Contract Settings

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

USB Internal Load

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

Bottom Panel

HPD	
Cable HPD	Assert Deassert Pulse HPD 500 🗭 Length, msec Short Puls
Cable	Cable status
HPD:	HPD status
Assert / Deassert:	Manually Assert or Deassert.
Pulse HPD:	Manually pulse HPD. Set the lenght in milliseconds.

Note:

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

PD Control

PD Control Send PR_SWAP Send DR_SW	AP Send VCONN_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.

<u>PD</u>



	lines. Type of USB-C cable detected.
Detach:	Manually Detach USB-C port partners.
Reconnect:	Restart USB-C Source-to-Sink attach procedure.

5. GENERATOR OPERATION

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

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

Functionality Tabs

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

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

Note:

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

Link Tab

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

722 UCD Console - UCD-500 [2304C560]: DisplayPort Source and Sink File Tools Window Help	-	×
DP RX DP TX Event Log		
Link Pattern Generator Playback Audio Generator HDCP EDID DPCD FEC Sink DUT Testing		
Link Status Link Configuration HDCP Status Lanes (count = 4): 0 1 2 VS/FE (level) - - - VS/FE (level) - - - LA C EQ.LA: CDS_JLA: LT_FAL: Bit rate: 13.5 Gbps - - LA C EQ.LA: CDS_JLA: LT_FAL: Bit rate: 13.5 Gbps - - Link Options - - - DS ctatus: Disabled SSC status: Disabled DS ctatus: Disabled SSC attus: Enabled ILTPR status: Inactor Force up (128/132b) Dy D (128/132b) Old D 2.0 IT Max Link Bandwidth Policy supported (8b/10b) Tyrp (D2B/132b) Old D 2.0 IT Authenticated Authenticate Unk Overrides - - - - - - Unk Overrides - - - - - - Unk Overrides - - - - - - Unk Overrides -		
Apply Jober 10 10 332 332 53 0 1 332 53 0 1 332 53 0 1 1 2 332 53 0 1 1 1 2 332 53 5 1 <		

Link Status

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

Link Status						
Lanes (count =	4):	0	1	2	3	
CR/SL/EQ						
VS/PE (level)		-/-	-/-	-/-	-/-	
FFE Preset		0	0	0	0	
Error count (cl	ick to read):	-	-	-	-	
ILA: EC	Q_ILA: 💶 (CDS_ILA:		LT_FAIL:		
Bit rate:	20 Gbps	Link Mo	de:	128b/1	132b	
Framing mode	s -	Scramb	ling:	Enable	d	
MST mode: Enabled		SSC status:		Disabled		
DSC status:	Disabled	FEC stat	us:	Enable	d	
LTTPR status:	Inactive					

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
FFE preset:	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)
Error count:	Content of DPCD Error Count registers
ILA:	Status LED for Inter-Lane Alignment
EQ_ILA	Status LED for Inter-Lane Alignment on Equalization stage (only with 128b/132b channel coding)
CDS_ILA	Status LED for Inter-Lane Alignment on Clock and Data Switch stage (only with 128b/132b channel coding)
LT_FAIL	Status LED for Link Training failure (only with 128b/132b channel coding)
Bit rate:	Currently enabled link bit rate
Link mode:	Currently enabled channel coding (128b/132b or 8b/10b)
Framing mode:	Status of Enhanced Framing symbol sequence (only with 8b/10b)
Scrambling:	Status of link Data Scrambling (Enabled or Disabled)
MST mode:	Status of the Multistreaming (MST) mode
SSC status:	Status of Spread-Spectrum Clock (SSC) function
DSC Status:	Status of Display Stream Compression (DSC) function
FEC status:	Status of Forward Error Correction (FEC) function.
LTTPR Status:	Status of Link Training-tunable PHY Repeater (LTTPR) function

Send ACT:	Force sending an Allocation Change Trigger (ACT) sequence over the Main-Link
Force update:	Re-read statuses to update the panel

Link Configuration

ink Configuration						
DP Lane Count (8b/10b)	DP Bitrate (8b/1	l0b), Gbp	s			
○ 1 ○ 2 ● 4	○ 1.62 ○ 2.7	70 🔿 5.	40 🔿 6.75 🔘	8.10		
DP Lane Count (128b/132b)	DP Bitrate (128b	o/132b), (Sbps			
○ 1 ○ 2 ● 4	○ 10 ○ 13.5					
Link Options						
Force DP (128b/132b)		E F	Try eDP			
Enhanced Framing Mode		FEC (8b/10b)				
Max Link Bandwidth Policy	supported (8b/10	b) 🗹 Tr	y DP (128b/132b)	Old DP 2.0 LT		
Instead of 10 Gbps, use		2.500 Gbj	ps	~		
Downspread						
Enable SSC Amp (%)	0.5	•	Freq (Hz) 3000	0 🗘		
				Link Trainin		

Set target capabilities for the link training. Click Link Training to with changed features.

DP Lane Count (8b/10b):Lane count used when 8b/10b link coding is selected in LTDP Bitrate (8b/10b), Gbps:Link rate used when 8b/10b link coding is selected in LTDP Lane Count (128b/132b):Lane count used when 128b/132b link coding is selected inDP Bitrate (128b/132b), Gbps:Link rate used when 128b/132b link coding is selected inForce DP (128b/132b):UCD-5XX Source uses only 128b/132b link layer protocol to 8b/10b link layer.Enhanced Framing Mode:Enable Enhanced Framing ModeMax Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b coding)LTTPR:Select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer protocol, it starts Link Training Supports 128b/132b link layer p	
DP Lane Count (128b/132b):Lane count used when 128b/132b link coding is selectedDP Bitrate (128b/132b), Gbps:Link rate used when 128b/132b link coding is selected inForce DP (128b/132b):UCD-5XX Source uses only 128b/132b link layer protocol to 8b/10b link layer.Enhanced Framing Mode:Enable Enhanced Framing ModeMax Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b c protocol supportLTTPR:Select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	.T
DP Bitrate (128b/132b), Gbps:Link rate used when 128b/132b link coding is selected inForce DP (128b/132b):UCD-5XX Source uses only 128b/132b link layer protocol to 8b/10b link layer.Enhanced Framing Mode:Enable Enhanced Framing ModeMax Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b c select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	
Force DP (128b/132b):UCD-5XX Source uses only 128b/132b link layer protocol to 8b/10b link layer.Enhanced Framing Mode:Enable Enhanced Framing ModeMax Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b c gelect to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	in LT
to 8b/10b link layer.Enhanced Framing Mode:Enable Enhanced Framing ModeMax Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b coding)LTTPR:Select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	LT
Max Link Bandwidth Policy supported (8b/10b):When checked, UCD supports Link Training Flow with Ma Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b c Enable Forward Error Correction feature (only in 8b/10b c Select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	, no fall back
supported (8b/10b):Data Bandwidth Policy (only in 8b/10b coding)FEC (8b/10b):Enable Forward Error Correction feature (only in 8b/10b coding)LTTPR:Select to enable Link Training Tunable PHY Repeater (LTT protocol supportTry DP (128b/132b):UCD-5XX Source checks capabilities of the connected Sir	
LTTPR: Select to enable Link Training Tunable PHY Repeater (LTT protocol support Try DP (128b/132b): UCD-5XX Source checks capabilities of the connected Sir	ximum Link
Try DP (128b/132b): UCD-5XX Source checks capabilities of the connected Sir	oding)
	íPR)
128b/132b link layer. If LT fails it falls back to 8b/10b link protocol	ning with
Old DP 2.0 LT:When checked LT will follow initial DP 2.0 spec descriptionOtherwise, LT as per DP 2.1 specification	n.
Instead of 10 Gbps, use: For supporting low link rate Sink devices, the user can ma 5XX source PHY to use a selectable lower link rate when '10 Gbps' link training in protocol level. Link rates are: 2.5 Gbps, 2.7 Gbps, 5.0 Gbps and 5.4 Gbp	performing
Enable SSC: Enable down spreading of link frequency (SSC).	
Amp (‰): SSC Spreading Amplitude.	
Freq (Hz): SSC Modulation frequency.	

Link Overrides

			4	Apply
FFE pre-sets:	0 ~	0 ~	0 ~	0 ~
Pre-emphasis (level):	٥ (01	O 2	03
Voltage Swing (level):	0	01	O 2	03
Link Overrides				

Voltage Swing (level):	Override Voltage Swing level selected during link training				
Pre-emphasis (level):	Override Pre-emphasis levels selected during link training				
FFE pre-sets:	TX Feed Forward Equalization (FFE) preset value (only with 128b/132b channel coding)				

Click **Apply** to validate changes.

Link Pattern

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

Active Video	Transmit Video Pattern, Audio and Metadata
Idle Pattern	Link is active but no stream data is being transmitted
Training Pattern 1	Send Link Training Pattern Sequence 1 (TPS1)
Training Pattern 2	Send Link Training Pattern Sequence 2 (TPS2)
Training Pattern 3	Send Link Training Pattern Sequence 3 (TPS3)
Training Pattern 4	Send Link Training Pattern Sequence 4 (TPS4)
PRBS7	Send PRBS7 Link Quality Test Pattern
HBR2 Compliance EYE pattern	Send HBR2 Compliance EYE pattern
SER (Symbol Error Rate)	Send Symbol Error Rate Measurement pattern
Force Video	Reference Source will continue Video pattern transmission on the previously established link configuration regardless of the link status.
Force Idle	Reference Source will continue Idle pattern transmission on the previously established link configuration regardless of the link status.
PRBS9	Send PRBS9 Link Quality Test Pattern
PRBS11	Send PRBS11 Link Quality Test Pattern
PRBS15	Send PRBS15 Link Quality Test Pattern
PRBS23	Send PRBS23 Link Quality Test Pattern
PRBS31	Send PRBS31 Link Quality Test Pattern
Link square pattern	Send Square Sequence Pattern. The number of continuous 1s followed by continuous 0s is given as a parameter. 0x00 represents one set of 1s and 0s, 0xFF represents 256 1s and 0s.

Click **Apply** to validate the selection.

Note: Please note that except for *Active Video* and *Idle Pattern*, Link Training will NOT be initiated on such events as cable re-plug, Long HPD pulse and IRQ_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*.

Scrambler Seed

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

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.

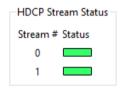
HDCP Status & Configuration

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

Copy of HDCP status and controls on HDCP tab.

HDCP Stream Status

Shows HDCP stream status for each stream.



SDP Configuration

SDP Configuration	
Split SDP	

Enable SDP Splitting.

Note

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

Stream Info

Stream Info													
Framerate	HTotal	HStart	HActive	HSync	VTotal	VStart	VActive	VSync	CEF	BPC	CRC (RGB/CrYCb)	VFREQ	DSC CRC (Eng. 012)
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	YCbCr4:2:0/ITU-R BT.601	8	F311 0815 EAB3	148500000	N/A
60.000	2200	192	1920	44 (+)	1125	41	1080	5 (+)	RGB/Legacy RGB mode	8	B69E B33E 1AB3	148500000	N/A

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

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

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.
VFREQ:	Video Frequency (128b/132b channel coding only)
MVID/NVID:	Mvid and Nvid video time stamp values (8b/10b channel coding only)
DSC CRC	16-bit Cyclic redundancy check (CRC) calculated from compressed pixel stream. Value order Engine 0, 1, 2.

VCP Table

- VCP Та	ble					
Port #	SID	Req.PBN	Alloc.PBN	First slot	Slot num	
0	1	2125	2149	0	12	
1	2	2125	2149	12	12	

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

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

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

Pattern Generator Tab

Link	Pattern Generator	Audio Generator	Playback	HDCP EDID	DPCD FEC	Sink DUT Testing				
	T Number of stream		Physick			EDID preferred timing after			Tinzinga	
Strea		2 -			Stream 1	EDID preferred timing after		rom EDID Manage	limings	
CVT	4096 x 2160 @ 60Hz [F	B2] ~ "	₹ 8 bpc ∨	⊖ vesa . ⊛ ct	A CTA 1920	x 1080 @ 60Hz (VIC 16)	~ 🝸 8 bpc	✓ ● VESA ○	СТА	
	Color Squares	~ YC	bCr420 V	ITU601	~ Colo	Bars	∽ RGB	~	- ~	
Pat	ptions ttern Scrolling				no optior	5				
		Horizontally 0 Vertically 0 ixel Clock 556.744	pixels	very 0 🗘 fran ve-Sync		e 60.000 🗘 Pixel Cloc	k 148.500 💲			
Activ	/e 4096 € x 2	160 🖨 S	ync width 32		Active	1920 文 x 1080 🗘	Sync width	44 🔹 x 5	•	
Total			ync polarity 🗹 (·		Total	2200 🗘 x 1125 🕏	Sync polarity			
Back	Porch 40 🕏 x 🗄			★ x 48		Land Land	Front Porch		.	
	72 🕏 x	4 🔹 Si	tatus: OK		Start	192 🗘 x 41 🗘	Status:	ОК		
Start	(1000 and 000000 and	245 / 52.227 Gbps.						Auto-Apply A	Apply	
	Info: Total bitrate : 10									
	Info: Total bitrate : 10									
	Info: Total bitrate : 10									
	Info: Total bitrate : 10									

Note:

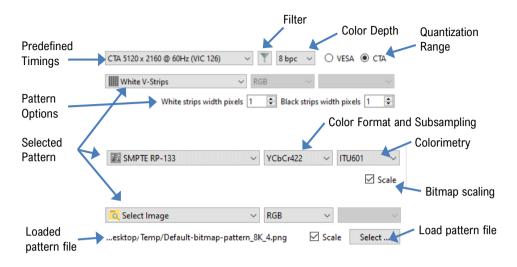
Please note that the actual number of streams sent will be negotiated between the source and the sink during link training.

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

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
Status Info:	Used link payload / Total link capability in Gbps
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

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



Predefined Timings

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

Color Format, Subsampling and Color Depth

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

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

Quantization Range

VESA:Patterns are sent with Full Range color values (0 to 255 with 8 bpc)CTA:Patterns are sent with Limited Range color values (16 to 235 with 8 bpc)

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

Video Pattern

The selection includes a set of predefined patterns and a possibility to load user defined custom patterns. Please find a description of the available predefined patterns in <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 virtual channel 0

Filter

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

/// Form	×
Timing Filtering	
Enable	
Filter by vendor	
Unigraf Other	
Filter by resolution	
2k and less 4k 8k and more	e
Sort timings by: Vendor ID \vee	
Cancel App	ly

Custom Image Patterns

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

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

Bitmap Scaling

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

Pattern Options

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

Pattern Scrolling

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

	izontally 0 pixels every 0 frame ically 0 pixels
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.



Please click Apply to enable changes or check Auto-Apply.

Adaptive-Sync Control

Adaptive-Sync feature is available for Stream 0. Adaptive-Sync control dialog opens by clicking button *Adaptive-Sync....*

Note:	Adaptive-Sync is currently limited to	Stream 0.					
	Stream 0		Z Adaptive-Sync X				
	CTA 1920 x 1080 @ 60Hz (VIC 16) V 🛛 8 bpc V	● VESA ○ CTA	Auto-enable if supported by sink				
	Motion Pattern V RGB V	\sim	Fixed Average VTotal \checkmark				
	Fra	ime count 10 😫	Target refresh rate, Hz: 60 ▲ 1125.000 lines				
			Divide by 1.001				
			Increase, lines: 100 🔹 1.481 ms				
	Frame Rate 60.000 🗢 Pixel Clock 148.500 🗢 Adaptiv	re-Sync	Decrease, lines: 100 🔦 1.481 ms				
	Auto enabled if supported by Sink:	The feature is enabled based on connected Sink status Feature is disabled unless <i>Auto Enabled box is</i> <i>checked. Please see the note below.</i> Added blank lines Added blank lines, min; Added blank lines, max; Period, frames.					
	Disabled:						
	Adaptive Total, constant refresh rate:						
	Adaptive Total, Square pattern:						
	Adaptive VTotal, Zigzag pattern:	Added blank lines, min; Added blank lines, max; Increase, lines; Decrease, lines. Target refresh rate, Hz; Increase, lines; Decrease, lines					
	Fixed Average VTotal:						
Note:	supports Adaptive-Sync, but the sele	ected mode is	by Sink is selected and the connected Sink d Disabled, then Adaptive-Sync is enabled in to added blank lines. Control dialog will be up				

Info

The Info row indicates how much link capacity is being used by the streams and what is the total available link capacity.

Status: Info: Total bitrate : 20.246 / 54.000 Gbps.

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.

DSC Compressor			
ile to compress			
Source File: C:/Temp/DS	C/unigraf_default_image_16	k.ppm	
16384 x 8640), RGB 24bpp		
Sink DSC capability regist	ters (DPCD range 0x60 -> 0x6	f, hex)	
0f 21 03 03 eb 07 01 00 00) 1f 0e 11 08 07 00 00		Update
Compression Options			
Color space	Output resolution	ns:	
YCbCr 4:2:2	~ 2560 x 1600	 Compression ratio 	atio: 8bpc -> 6bpp (2.7 to 1)
Color depth	2880 x 240 2880 x 288	Horizontal slice	4 Slices
8	✓ 2880 x 480	Vertical slices:	Custom
Resize mode	2880 x 576	Custom vertical	I slices size:
○ Scale	2880 x 1440 3840 x 2160		108
	4096 x 2160		
-			
Crop	5120 x 2160	YUV Color ran	nge
	5120 x 2880	VUV Color ran	● CTA
Crop Scale and Crop	5120 x 2880 7680 x 4320 10240 x 4320	O Full	-
Crop Cscale and Crop DSC Version: 1.2	5120 x 2880 7680 x 4320 10240 x 4320	⊖ Full	I CTA
Crop Scale and Crop	5120 x 2880 7680 x 4320 10240 x 4320	⊖ Full	-

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

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

Example: unigraf_default_image_16k.ppm >> unigraf_default_image_16k_1920x1080_YUV422_FULL_bpc8_bpp6.dsc

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

CTA 1920 x 1080 @ 60Hz (VIC 16)	~	8 bpc	~	O VESA	A 🖲 CTA
🯹 Select DSC Image →	YCbC	r422	~	ITU601	`

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

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

Preview DSC image

MST Number of streams 2 🗢		Force EDID prefe	erred timing after	LT 🗌 Use Timir	ngs from EDID	Manage Timings
Stream 0		Stream 1				
CTA 1920 x 1080 @ 60Hz (VIC 76) VES	ia 🖲 cta	CTA 1920 x 1080 @	60Hz (VIC 76)	~ ¥ 81	opc v 🖲	VESA 🔿 CTA
Select DSC Image ∨ YCbCr422 ∨ ITU601	~	Color Bars		∼ RGB	~	\sim
1920x1080_YUV422_BPY_bpc8_bpp112_2slicew_4sliceh_13lb.dsc					1	
	UNIGR	AF				
	6	40 × 480 348 × 480	1440 × 480			
Frame Rate 60.000 🐑 Pixel Clock 148.500 🐑 Adaptive-Syn		800 × 600 1024 × 768		680 × 720		
Active 1920 🗣 x 1080 🗣 Sync width 44 🜩		1024 × 768	1280 × 768		44 🕏	x 5 🜩
Total 2200 🛊 x 1125 ✗ Sync polarity ☑ (+)			1280 × 960 0		ity 🗹 (+)	x 🗹 (+)
Back Porch 148 🗢 x 35 🗢 Front Porch 88 🗢			1280 × 1024	680 × 1050 1920 × 1080	h 88 🗘	x 4 🗢
Start 192 - 141 - Status: OK	CRC (CrYCb)		0xA653	0x2BA8 0xC4D6	ок	
	DSC CRC (Eng.	012)	0xB81F	0x800A 0xA420	;	
0						
\sim						

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.

Note:	Please note that the selected video mode has to match the used compressed DSC file.	
-------	---	--

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					
🛾 🔒 CVT 3840 x 2160 @ 144Hz [RB3]			Standard	CTA				
🛾 🔒 CVT 3840 x 2160 @ 60Hz [RB1]			ID	105				
🛾 🔒 CVT 3840 x 2160 @ 60Hz [RB2]			Frame Rate	30,000				
] 🔒 CVT 3840 x 2160 @ 60Hz [RB3]			Pixel Clock	297,000 Horizon			Veri	
]			Active	3840	ital 🌲	×	2160 Ven	tcal
GTA 3840 x 2160 @ 24Hz (VIC 93)			Total	4400	\$	x	2250	
GTA 3840 x 2160 @ 25Hz (VIC 94)			Start	384	-		82	
CTA 3840 x 2160 @ 30Hz (VIC 95)			Sync width	88	*		10	
GTA 3840 × 2160 @ 50Hz (VIC 96)			Sync polarity	(+)			(+)	
CTA 3840 x 2160 @ 24Hz (VIC 103)			Back Porch	296	*		72	
CTA 3840 x 2160 @ 25Hz (VIC 104)			Front Porch	176	÷		8	
🔒 CTA 3840 x 2160 @ 30Hz (VIC 105)			8	296 FrontP				
CTA 3840 x 2160 @ 50Hz (VIC 106)			10 VSY 72	NC BackP				
CTA 3840 x 2160 @ 60Hz (VIC 107)			F H	Ba				2250
CTA 3840 × 2160 @ 48Hz (VIC 114)			Front P.	c	CTIVE VI	DEO		2160
CTA 3840 x 2160 @ 48Hz (VIC 116)			P.	Р.				
CTA 3840 x 2160 @ 100Hz (VIC				4400	3840	_		
CTA 3840 x 2160 @ 100Hz (VIC				4400				
G CTA 3840 x 2160 @ 120Hz (VIC						Sav	/e	Revert

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 \mathbf{a} indicates that a timing is a fixed timing which cannot be edited or deleted. Custom timings are indicated with a head icon $\mathbf{1}$.

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.

MST Operation

The functionality of MST selection is different in 8b/10b and 128b/132b link modes. The difference is, however, transparent for the user.

_		
UCD Console - UCD-500 [2304C560]: DisplayPort Source and Sink File Tools Window Help		- 🗆 ×
Link Pattern Generator Playback Audio Generator EDID HDCP DPC	5 17	
☑ MST Number of streams 4 ÷	Force EDID preferred timing after LT Use Timings from EDID Manage Timings	
Stream 0	Stream 1	
CTA 1920 x 1080 @ 60Hz (VIC 76) VESA O CTA	CTA 1920 x 1080 @ 60Hz (VIC 76) Y 8 bpc VESA O CTA	
Color Bars V RGB V	Color Bars V RGB V	
no options	no options	
Frame Rate 60.000 Pixel Clock 148.500 Adaptive-Sync	Frame Rate 60.000 + Pixel Clock 148.500 +	
Active 1920 🗘 x 1080 🗘 Sync width 44 🗘 x 5 🗘	Active 1920 x 1080 x Sync width 44 x 5 : Total 2200 x 1125 Sync polarity ∑ (+) x ∠ (+)	
Total 2200 • x 1125 • Sync polarity ∅ (+) x ∅ (+) Back Porch 148 • 26 • Front Porch 88 • x 4 •		
	back Polchi 146 • X 50 •	
Start 192 : x 41 : Status: OK	Start 192 : x 41 : Status: OK	
Stream 2	Stream 3	
CTA 1920 x 1080 @ 60Hz (VIC 76) VESA O CTA	CTA 1920 x 1080 @ 60Hz (VIC 76) VESA O CTA	
Color Bars V RGB V	Color Bars	
no options	no options	
Frame Rate 60.000 + Pixel Clock 148.500 +	Frame Rate 60.000 ÷ Pixel Clock 148.500 ÷	
Active 1920 • x 1080 • Sync width 44 • x 5 •	Active 1920 : x 1080 : Sync width 44 : x 5 :	
Total 2200 ÷ x x I125 ÷ Sync polarity ☑ (+) x ☑ (+)	Total 2200 ÷ x 1125 ÷ Sync polarity ∅ (+)	
Back Porch 148 😨 x 36 😨 Front Porch 88 😨 x 4 😨	Back Porch 148 ÷ x 36 ÷ Front Porch 88 ÷ x 4 ÷	
Start 192 : x 41 : Status: OK	Start 192 : x 41 : Status: OK	
Status: Info: Total bitrate : 14.256 / 52.227 Gbps.	Auto-Apply Apply	
HPD	Cable Information	
Asserted		
	TX: RX:	
online		

MST:

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. Perform stream(s) allocation based on connected Sink Device capabilities if checkbox is set.

Number of streams: When MST is enabled, select number of streams sourced

Playback Tab

Playback allows for running predefined *Playlist* files. A 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*.

UCD Console - UCD-500 [2150C471]: DisplayPort Source and Sink File Tools Window Help				—	×
DP RX DP TX Event Log					
Link Pattern Generator Playback Audio Generator HDCP EDID	DPCD FEC Sink D	OUT Testing			
Import	Selected Sequence				
Common Metadata HDR10+ Test Adaptive-Sync	Source:		Select Editor		
 Sample Content > Basic Video & Audio Example - DP.txt 	Video Source: -				
 Frame Rate Example - DP.txt DSC Example - DP.txt 	Amount: -				
> HDR & Metadata Example - DP.txt	Horizontal	Vertical	Misc		
 > Grayscale - DP.txt > HDR10+ SSTM Example - DP.txt 	Total - Start -	Total - Start -	Frame Rate, Hz: - Color Depth, BPP: -		
	Active - Sync Width -	Active - Sync Width -	Color Encoding: -		
		-,			
	Audio				
	Source: - Amount: -				
Run					
	Compressed: - Sampling: -	Amount of c Bit depth:	hannels: -		
	Packets	bit depon			
	Source: -				
	Amount: -				
	Status: Idle				
	Status, fore				
HPD					
Asserted					
online					

Term	Functionality
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 humar 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	
	/ision DEMO /list HDMI.txt			^
	Dolby Vision [DEMO		
✓ Sample	Content			
✓ Bas	ic Video & Aud	dio Example - HD	MI.txt	
	Flip-flop with	Audio		
	Flip-flop Silent	t		
	Philips 1920x1	080p + 1kHz		
	Philips 3840x2	160p + 1kHz		
> VRF	R Example - HD	0MI.txt		
> QM	S-VRR Exampl	e - HDMI.txt		
> ALL	M.txt			~
				•
		Run		

Click Stop to stop playing the scenario.

Selected Sequence

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

Selected Se	equence				
Source: 192	20x1080.txt	Select	Editor		
Video					
Source:	nigraf UCD	Tools/Resou	urces/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, BPF	P: 8
Active	1920	Active	1080	Color Encoding:	RGB444
Sync Wid	th 44	Sync Wid	lth 5		

Status Log

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

Stop	
lotal 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

// Scer	nario Editor	
Video		
Dath	goldenGate0.jpg	Select
Path:		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	ts	
Path:	frames_0000.bin	Select
	4 files found	
Audio		
Path:		Select
	Compresse Little Endia 44100 Hz V 2 ch	annels 🗸 16 bits 🗸
Plavir	ng order	
):0,2:512;	
0.100		
Gener	ral	
🗌 Er	hable scrambler Loading color (R,G,B): 52,127,150	HDCP: None ~
		OK Cancel

Metadata Tab

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

First you are asked to select the folder 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.
	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.

Metadata			
			Add
			Delete

Comment

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

.

HDR10+ Test Tab

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

Adaptive-Sync tab

Common	Metadata	HDR10+ Test	Adaptive-Sync	
Generate.				Delete

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

		Scenario duration		
	*	Step duration, sec	1.00	*
	*	Step duration, cycles	2	* *
rame rate	\sim	Frame repetition	1	÷.
		Duration in secon	ds	
ames: 10 🗘			O Custom	Select
			O Custom	Select
ames: 10 🜩			O Custom	Select
			O Custom	Select
			Custom	Select
	rame rate	rame rate \checkmark	Step duration, cycles rame rate Frame repetition Duration in second	Step duration, cycles 2 rame rate Frame repetition 1 Duration in seconds Duration in seconds 1

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.
	ОК

Click Browse... to select the folder.

Available memory: 1879048192 bytes; 141 frames			
Content folder			
C:/Users/Tester/AppData/Local/Unigraf/UCD Console\Playback			Browse
equence 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).

💯 Custom Scenario Generator	×
CTA 1920 x 1080 @ 60Hz (VIC 76)	60fps
EDID [HDMI Forum VSDB; HDR Static MDB; HDR10+ VSVDB; Dolby Vision VSVDB] RGB444 V 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	\sim	Frame repetition	1	-
			Duration in second	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		
Min frame rate, fps	48	•	Step duration, sec	1,00	4
Max frame rate, fps	60	•	Step duration, cycles	2	\$
Transition type	Min and max	\sim	Frame repetition	1	\$

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	* *
Max frame rate, fps	60	-	Step duration, cycles	2	Ť
Transition type	Gradual	~	Frame repetition	1	\$

<u>Video</u>

Video	
● Spinner Fast ∨ Frames: 10 ‡	O Custom Select
⊕ 	20
<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\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-\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	

Audio Generator Tab

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

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

<u>T</u> ools <u>W</u> indow <u>H</u> elş	0					
P RX DP TX Event	Log					
Link Pattern Generato	or Audio Generat	tor HDCP	EDID I	DPCD I	FEC	Sink DUT Testing
Audio Status						
Audio loaded: 2 chann	els @ 44100 Hz, 16 b	its				
Play Control						
Play Sto	p Source: - Status: ste	opped				
Audio Content						
Generate Audio						
Waveform:	Sine ~	Bits/Sample:	16	~		
Signal Frequency:	1000 🗘	Amplitude(%):	60	~		
Sample Rate (Hz):	44100 ~	Channels:	2	~		
O Load Audio from Fil	e					
Path: -						
			Open \	VAV file		
HPD						
Asserted						

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

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

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

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

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.

Memory Layout Event Log DP TX Link Pattern Generator Audio Gen HDCP 2.3	Terminal HDCP DPCD	Playback FEC	Sink DUT Testing Cable I	nfo Adapti	ive-Sync	
Status General Active Authenticated Km stored SST Mode: Type N/A By stream Stream 0 Type 0 Stream 1 Type Unknown Stream 2 Type Unknown Stream 3 Type Unknown	Configuration Keys Production Facsimile - T1-R1 Facsimile - T1-R2 None Configuration type All streams By stream Type Value (SST/All streams) Type 0 Type 1	Control Control Authenticate Use stored Kn By stream Enable for Stream 0 Stream 1 Stream 2 Stream 3				
HPD Asserted		Cable Information TX: RX:				

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 and in Link mode 8b/10b.

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.

EDID Tab

EDID Tab provides tools for accessing the EDID including DisplayID extension of the connected sink device.

There are three basic functions:

- Load and save EDID data files in the host PC.
- Edit the EDID contents either in EDID Editor or in hex format.

DC Link Pattern Generator Playback Audio Generator	HDCP EDID DPCD FEC Sink DUT Testing	
dd Item 👻 Remove Item Filter	Read mode: O I2C Read () SBM Read	Virtual Sink #1 🗸 🗌 Show Read Only 🗹 Recurse
ame VESA Vetada & Product ID EDID Structure Version and Revision Numbers Basic Display Parameters / Features Color Characteristics Stabilished Timings I Stabilished Timings II Manufacture's Timings Standard Timings IBock IByte descriptor 2 IB byte descriptor 2 IB byte descriptor 3 IB byte descriptor 4 CTA Info Data block collection Detailed Timings DisplayID V Data block	Name Name 0 Pixel clock, MHz 533.25 1 Horizontal Addressable Video 3840 2 Horizontal Addressable Video 160 3 Vertical Addressable Video 2160 4 Vertical Addressable Video 2160 4 Vertical Blanking in pixels 62 5 Horizontal Front Porch in pixels 48 6 Horizontal Sync Pulse Width in pixels 32 7 Vertical Front Porch in Lines 3 00 01 02 03 04 05 06 07 08 09 0A 0B 0C DD 00 01 02 03 04 05 06 07 08 09 0A 0B 0C DD 00 00 00 03 04 05 06 07 08 09 0A 0B 0C DD 00 00 00 03 04 05 06 07 08 <	2 28
Name Value Max Resolution 15360 x 8640 HDR Static Disabled DRO Dynamic Disabled Chi - Chi formany (3- Date abort collection - Date (DRO Dynamic) Disabled Chi - Chi formany (3- Date abort collection - Date (DRO Dynamic) Disabled Disabled Disabled Disabled Disabled	000030 b3 00 95 00 11 cf 43 df 00 03 07 98 65 56 0 a0 a0 22 25 0005 35 05 10 00 1 a5 58 00 a0 a0 22 22 000050 30 20 35 00 55 58 10 00 1 a0 a0 a0 22 20 20 20 20 00 <	50 38 fc 219 534 00 00
Main Features Read EDID Write to Sink D Asserted	Editor Mode HEX Edit Mode	Apply Save As Load PD DUT Attached Detach Reconnect

• Program and read the contents of the EDID of the sink devices connected.

EDID Files

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

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

EDID Editor

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

Note:	Please note that a Source device is always able to read EDID of the connected Sink device. However,
	it is dependent on the design of the connected Sink device if modifying its EDID content is enabled.

DPCD Tab

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

Address : 0x		Audio Generator	HDCP	EDID	DPCD	FEC Sink	DUT Testing		
		Number of Bytes: 0x	100	÷				Load Save	Report
auress . ox		3 04 05 06 07			OC OD OE	OF	Receiver Capability MAX LANE COUNT [RO]		
000000	1e e4 8	1 01 00 03 80	00 00	06 00	00 00 84	00	0x00002 := 0xE4		
000010	00 00 00 0	0 00 00 00 00	00 00	00 00	00 00 00	00	MAX_LANE_COUNT = 4 ENHANCED_FRAME_CAP = 1		
000020	07 03 00 0	0 00 00 00 00	00 00	00 00	00 00 00	00	TPS3_SUPPORTED = 1 POST_LT_ADJ_REQ_SUPPORTED = 1		
		8 a4 le ca 47					POST_ET_AD_REQ_SOPPORTED = 1		
		0 00 00 00 00							
		0 00 00 00 00							
		3 eb 07 01 00 0 00 00 00 00							
		0 00 00 00 00 00							
		0 00 00 00 00 00							
Set Referen	_							Refresh	Write Change
Address : 0x		Number of Bytes: 0x	100	\$				Nerresit	write changes
touress . ox	200	Number of bytes. or				1			
	00 01 02 0	3 04 05 06 07	08 09	OA OB	OC OD OE	OF	Link/Sink Device Status LANE2_3 STATUS [RO]		
		7 0d 03 00 00					0x00203 := 0x77 LANE2_CR_DONE = 1		
		0 00 80 00 80					LANE2_CHANNEL_EQ_DONE = 1		
000220		0 00 00 00 00					LANE2_SYMBOL_LOCKED = 1 LANE3_CR_DONE = 1		
		0 00 00 00 00					LANE3_CHANNEL_EQ_DONE = 1		
	se pe se p	3 b3 1a 20 00					LANE3_SYMBOL_LOCKED = 1		
000240	00.00.00.0								
000240 000250	00 00 00 0	0 00 00 00 00	00 00						
000240 000250 000260	00 00 00 0	0 00 00 00 00 00	00 00	00 00					
000240 000250 000260 000270	00 00 00 0	0 00 00 00 00 00 0 00 00 00 00 0 00 00 0				00			
000240 000250 000260 000270 000280	00 00 00 00 00 00 00 00 04 00 80 0	0 00 00 00 00	00 00	00 00	00 00 00				
000240 000250 000260 000270 000280	00 00 00 0 00 00 00 0 04 00 80 0 00 00 00 0	o oo oo oo oo o oo oo oo oo	00 00	00 00	00 00 00			Refresh	Write Changes

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

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

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

FEC Tab

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

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

UCD Console - UCD-500 [2318C573]: DisplayPort Source and Sink _ × <u>File Tools Window H</u>elp Event Log DP TX DP RX Link Pattern Generator Audio Generator HDCP EDID FEC Sink DUT Testing DPCD FEC Enabled Prefer FEC Enabled Enable FEC Disable FEC FEC Status Log Current link is 8b/10b Sink FEC Status: Decode Enable Detected Error Generator Number of errors to generate for Lanes: 0 😨 0 💿 0 💿 Generate errors of type: Corrected parity 1 error ~ 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

 Corrected block errors
 0
 0
 0
 Bit errors 0 0 0 0 Parity block errors 0 0 0 Parity bit errors Enable aggregated errors Update Clear Counters Debug FEC Sequencing Send FEC Enable Sequence Send FEC Disable Sequence Sink FEC Status: Decode Enable Detected Clear Log HPD Asserted

Error Generator 8b/10b Link Coding

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

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

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

Error Generator 128b/132b Link Coding

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

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

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

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



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

Panel Replay Tab

Current pattern capabilities panel shows if panel replay, selective update and early transport are supported for the selected pattern on Pattern Generator tab. *Status* panel shows the status of the command, the current state of the module, the error, in case something goes wrong when executing the command.

Command panel has the following functions:

Disable	Disable PR module
Active mode	Enter PR Active mode, can be used directly from Disabled state
Inactive mode	Enter PR Inactive mode, can be used from Disabled or Active mode states
Selective update	Enable update of RX internal frame buffer

In *Configuration panel* user can configure Selective update of the internal RX frame buffer. The user can select which frame regions of the internal RX frame buffer the TX will ask to update. If necessary, Early transport feature can be used. Currently design is limited with 2 regions for 2 frames. In case the user has not selected regions to update the TX will ask to update 2 full frames, otherwise TX will ask to update non-zero regions from *Configuration panel*.

The available parameters for Regions 1 and 2 in both frames are:

X coordinate	Update Region Upper-left Corner X-coordinate (Pixel Count)
Y coordinate	Update Region First Scan Line Y-coordinate
Width	Update Region Rectangle Width (Pixel Count)
Height	Update Region Rectangle Height (Line Count)

Tools Window Help 58-C TX Event Log USB-C PDC Link Pattern Generat		HDCP Playback	EDID FEC	Sink DUT Testing	DPCD	Panel Replay	Cable Info			
Current Pattern Capabilities Panel Replay: Selective Update: Early Transport: (If the current pattern does please select another one) Status Command Status: Status	Supported Supported Not Supported	Configuration Early bangot Frame 1 Region 1 Xecordinate Work Height Frame 2 Region 1 Xecordinate Work Height Height	0 0 0 0 0 0 0 0 0	Region 2 X.condinate V.condinate V.condinate Width Height X.condinate V.condinate V.condinate Width Height	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	С С С С С С С С С С С С С С С С С С С				
HPD Asserted			formation				PD DUT Attached	Detach R	leconnect	

Cable Info Tab

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

ools Window Help CTX Event Log USB-C RX					
C Link Pattern Generator Playback Audio Gener	ator HDCP EDID DPCD FEC	Sink DUT Testing Panel Repla	ay Cable Info		
UHBR Capabilities Not UHBRx-capable or unknown UHBR13.5 Capable No Cable Type Unknown	UHBR Capabilities Not UHBRx-capable or UHBR13.5 Capable No Cable Type Unknown	unknown			
USB-C Cable Info					
A6 19 00 1C 00 00 00 00 00 54 85 32 20 08 00 00 00 00 00	00 00 00 00 00	Refresh			
USB Vendor ID 19A6 Modal operation supported Yes Product Type Passive Cable	XID Assigned by USB-IF 0x00000000				
USB Communications Capable as USB Device No USB Communications Capable as USB Host No	bcdDevice 0x0000 USB product ID 0x8554				
USB Highest Speed USB 3.2/USB 4 Gen2 VBUS Current Handling Capability 3A Maximum VBus Voltage 20V					
Cable Termination Type VCONN not required Cable Latency <10ns (~1m)					
EPR Capable No Type-C plug to Type-A/B/C/Captive USB Type-C					
Firmware Version 0					
Hardware Version 0					
Thunderbolt Capable No					
D	Cable Information		PD		
Asserted	TX: RX:		DUT Attached	Detach Re	econne

DPTX / DPRX Cable Info

UHBR Capabilities:	Shows the UHBR capabilities of the connected cable.
UHBR 13.5 Capable:	Shows if the connected cable is UHBR 13.5 capable.
Cable Type	Type of the cable connected.

USB-C Cable Info

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

Cable Information

Cable information panel shows if the connected cables are D80 / DP40 capable.

Cable	Inform	atior	1	
TX:	DP80	RX:	DP80	

Note: Please note that cable info can only be read when in Down Facing Port role. Please click *Refresh* after changing roles.

Link	Pattern Generator	Audio Generator	HDCP	EDID	DPCD	FEC	Sink DUT Testing							
All te	ests DP 1.4 LL CTS	5 DP 2.1 LL CTS												
Name	2								Pass	Fail	Skip	Runs	Last status	1
~ [DP 1.4 LL CTS													
_		e Byte from Valid DF	CD Address						0	0	0	0		
	5.2.1.2 DPCD R	eceiver Capability Re	ad (Read 12 E	ytes from	Valid DP	CD Addres	is)		0	0	0	0		
		ne Byte to Valid DPC							0	0	0	0		
		ne Bytes to Valid DP							0	0	0	0		
		ID Offset (One Byte							0	0	0	0		
		e EDID Byte (One By							0	0	0	0		
		ad (1 Byte I2C-Over-	AUX Segment	Write, 11	Byte I2C-(Over-AUX	Offset Write, 128 B	Syte I2C-Ov		0	0	0		
	5.2.1.8 Illegal A								0	0	0	0		
	5.2.1.9 Glitch Re	ejection ived EDID and DPCD	Receiver Con	ability Po	ad				0	0	0	0		
		tream Stop on MOT		oomity Ne					0	0	0	0		
		tream Stop on Time							ő	ŏ	ŏ	õ		
		anizationally Unique		UD					0	0	0	0		
	5.2.2.2 Sink Cou								0	0	0	0		
	5.2.2.3 Sink Stat	us							0	0	0	0		•
Run Se	elected Select	Configure	Import	Expo	rt 🗌	Stop on F	ailure Repeats	1 🗘	Delav ti	ime, sec 1	\$	Save Repo	ort Clear	AII

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

Select the tests for execution by selecting corresponding checkboxes or by highlighting them by left-clicking on the test name.

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 the selected test set. Please refer to <i>Test Parameters</i> below for details.
Import:	Load saved test parameter files (*.td or *.json).
Export:	Save test parameters for later use or for use in test automation. For saving parameters for later use in UCD Console, either format can be used. For saving parameters for TSI scripting, please use *.td files. For use with Python applications, please use *.json files.
Stop on Failure:	Stops execution of the selected tests if one of the tests fail
Repeats:	Repeat the selected test several times
Delay time:	Delay in seconds between individual tests.

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

Save Report:	Click to generate a 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

Test Parameters

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

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

Saving Test Parameters

Test parameters can be saved in various ways.

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

Presets

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

P	resets 🔻	
	Save	
	Load	Þ
	Remove	Þ
	Import	
	Export	

DUT Testing Options

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

USB-C Monitoring

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

• USB-C Power Delivery (PDC)

When UCD-5XX is used in *DP Alt Mode Reference Source* role, *USB-C Power Delivery* (PDC) tab is available. The content of *USB-C Power Delivery* tab is similar to the tab available when in UCD-5XX 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.

D Console - UCD-500 [2232C5 Tools Window Help	31]: USB-C, DP Alt Mode S	ource and Sink		- 0
-C RX USB-C TX Event	Log			
DC Link Pattern Gener		Playback HDCP EDID D	CD FEC Sink DUT Testing	
C Link Pattern Genera	ator Audio Generator	Playback HDCP EDID D	CD FEC Sink DOT lesting	
Status List		Capabilities DP Alt Mode	ower Source Power Sink Cable Info Controls	
▼ TE Status	^	Initial Role	CC Pull-up	
Data Role	Down facing port (I	○ DFP/SRC ○ UFP/SNK ●	DRD/DRP O Defaut	
Power Role	Source		O 1.5A	
VConn	On		 3.0A 	
E-Marked Cable	Yes	Reject PR Swap		
DP Alt Mode PD Contract	"C": DP v1.4a 4 lane Fixed 3.00 A / 5.00 \	Reject DR Swap	Try Behavior	
▼ PD Contract	1 MCG 5100 M/ 5100 1	L reject on swap	O Try Sink	
Power Source		Reject VCONN SWAP	O Try Source	
- PDO Type	Fixed		None	
- PDO voltage	5.00 V	UCD-500 Identity		
- PDO max current	3.00 A		ISB Type-C Spec Release 2.2	
Power Sink - RDO max current	0.45 A	Power Delivery Spec:	D rev 3.1 v1.7	
- RDO max current - RDO oper current	0.45 A		x16A6	
- No USB suspend	Yes	Product ID:	x 500	
- USB comm capable	No	Accessories		
- Capability mismatch	No	Audio Accessory	Debug Accessory	
- Give back	No			
Available source PDO				
PDO 1 PDO 2	N/A N/A			
Bus Electrical Status	1974			
Vbus voltage	5.48 V			
Vbus current	0.09 A			
CC1 voltage	1.64 V 🗸			
PD Control		Orientation		
Send PR_SWAP Send DR_	SWAP Send VCONN_SWA	P CC1 CC2 Cable Orie	ntation: Straight	
D				PD
Asserted				DUT Attached Detach Reconnec

6. LINK TIMELINE VIEWER

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

Link Timline Viewer main panel contains two tabs:

- *FrameView* provides the user ability to evaluate events within the captured data and their occurrence in time scale.
- *Images* lets the user view video frame images decoded from the captured data.

W Unk Timeline Viewer "E:/YuriDonskoy/ucd_data/capture_202402	05_120415* [81	100 Mbps, 4 lanes]															
File Options About																	
FrameView Reports Images																	
Main Link Events Symbols Log Events		Wave Forms Spatial \	liew														
🔎 msa 🛛 🛃 🗆 Aa 🗆 RExp. 4 1 / 2	NO N									MST							
		1 82	1.3	24	F5		16		F7	10	P	9		F10	F11	F12	F13 F14
Type Id Positi	n ^	81	FRAME (HDCP)_2	2	RAME (HDCP)	_3	2	RAME (HDC	(P)_4	FRAME (B	DCR)_5	Ŷ	FRAME ((HDCP)_6		FRAME (HDCP) 7	FRAME (HDCP) 8
> Lane Events		○ ±€€<>	« » « ») 🖪 🛃 II	€ 14												
 MST Stream 1 			0:004.4	72.779.827	0:	011.18	7.139.	641	0:015.0	78.835.251	0	:020.38	81.86	2,963	0	:025.684.890.	675 0:030.987.918
> FRAME(HDCP) 1 0.000.044.54				mhum	u u u i i		1111	Luuu	uuuli		Luuni	uu lu		mult			
260 790 bits	.898 0.0	AUX Link					-				Mar						
 FRAME(HDCP) 2 0:001.301.52 10:542.000 attr 	4598 000	MST1 Frame	PRAME	(HDCP) 2			-			RAME (HDCP) 3	Rot		-			FRAME (HDCP) 4	
 ENCRYPTED(525 lines) 0.001.301.52 10.542 002 min 	.898 0.0	MST1 Lines		AND TED			-			ENCRYPTED			-			ENCRYPTED	
✓ LINE 0 0001.301.522 10542 600 bit		MST1 VBID	03														
pc 0.001.301.52	.898 0.0	MST1 MSA	4														
10 542 600 kits	132 0.0	MST1 SDP															
10 542 610 885	12-6	MST1 BS															
MVID 0:001.301.60	.908 0:0	MST1 BE															
MAUD 0:001.301.60		MST2 Frame	TRAME (HDCP								FRAME (H						
10 543 250 bits	10 à	MST2 Lines	ENCRYPTE	D							ENCRY	DIED					
MSA 0.001.301.84	.878 0.0	MST2 VBID	3														
SDP 78 0 0:001.302.41	.237 0.0		4				-										
SDP 90 1 0:001.303.301	5.36 341 0:0	MST2 MSA MST2 SDP															
3DF_90 10 557 030 am	5.26	MST2 BS															
SDP_71 2 0:001.304.11	.497 0:0	MST2 BE															
LINE 1 0.001.319.892	.939 0:0	Link Frame/MTP															
> LINE 2 0.001.339.07	.544 0.0	WC .															
10.846 710 bits	486 0:0	○ ± < > « »	« » 🕑 🛃	6 M M -													
> LINE 3 0:001.358.08	.486 0:0 ~			01.848.110	0.001 3	01.05	0.740		0.001.3/	.857.767		:001.30			0	.001 201 055	633 0:001.301.871
¢	>		0:001.3	11040.110	01001.3	11111	2.740	hana			Luuu	1001.30	01.00			1001.301.866.	633 01001.301.871
Details Image		AUX															
[MSA]	A	Link									57						
Start : 0:001.301.848.878; 10 545 200		MST1 Lines								FRAME (HDCI) 2 LINE	0					
End : 0:001.302.263.683; 10 548 559 Duration : 0:000.000.414.805; 3 360		MST1 VBID	034														
		M9T1 MSA															
FIELD DEC HEX BITS		MST1 SDP															
MVid 11623524 0xB15C64		MST2 Lines								ERAME (HDCP) 1	LINE (5760)_85					
NVid 15987304 0xF3F268 HActive 54945 0xD6A1		MST2 VBID	34														
VActive 1715 0x683		MST2 MSA															
HTotal 36360 0x8E08		MST2 SDP															
VTotal 3830 0xEF6 HStart 60729 0xED39		Link Frame/MTP											32	19			
VStart 57886 0xE21E		WC .	STREAM		STREAM						REAM 2						NO STREAM
VSynWidth 29750 0x7436		Symbols Lane 0		NTPN	MSA Pay. Bl	load 5C	28		90	1A E9	ixels OA	BF		14 18	EC		
HSynWidth 48994 0xBF62 MISC0 99 0x63 01100011		Lane 0		00			28		9C 15	E0 6A	EB	19		14 1A 14 5C	35		
MISC0 99 0x63 01100011 MISC1 139 0x8B 10001011		Lane 2		00			80	08		2D E1	08						
AND 10001011	~	Lane 3		00			34			1D C1				10 38			
¢	>																

Unk Timeline Viewer *E:/YuriDonsi	:oy/ucd_data	/capture_20240205_1	20415" [81	00 Mbps, 4 lanes]																
le Options About																				
FrameView Reports Image	5																			
Main Link Events Symbols	Log Events			Wave Forms Spatial	View															
🔎 msa 🛛 🔀 🗆 Aa	BEER H	1 / 20	N O		_						M	87								
				1 72	83	F4		F5	16		27	2.0		F9		r10	F11	F12	F13	
Туре	Id	Position	^	F1	FRAME (HDCP)			E(HDCP)_3	TRA	ME (HDCP)	4	FRAM	S(HDCP)_5		FRAME (HDCP)_6		FRAME (HDCP) 7	FRAME ()	(HDCP)_8
> Lane Events			- 11	$\bigcirc \mp \oplus \odot < >$	« » «	» 🕑 🚣	- 14 - 1	Ы												
 MST Stream 1 						.301.726.3	82 0	:001.301.9	04.116		:001.302	.081.85		0:001.	302.25	9.584	0:001.	302.418.002	0:001.	.302.61
> FRAME(HDCP)	1	0.000.044.541.029		AUX					uuuu lu		lii				1111			111111		
FRAME(HDCP)	2	360 790 bits 0:001.301.527.898	10 7 0:0	Link			-						MST							
	2	10 542 600 bin 0:001.301.527.898	810	MST1 Frame								FRAME	(HDCP)_2							
 ENCRYPTED(525 lines) 		10 542 600 bits	aro	MST1 Lines								L	INE_0							
~ LINE	0	0:001.301.527.898	0:0	MST1 VBID	3															
BS		0.001.301.527.898	0:0	MST1 MSA	4						ASA				-					
VBID		10 542 600 bits 0:001.301.529.132	0:0	MST1 SDP											_					
		10 542 610 am 0:001.301.606.908	70 A	MST1 BS																
MVID		10 543 240 bits	10.6	MST1 BE																
MAUD		0:001.301.608.143	0:0	MST2 Frame MST2 Lines			-						ME(MDCP)_1 E(5760) 85							
MSA		0.001.301.848.878	0:0		0															
		10 545 200 Mits 0:001.302.419.237	2.36 0:0	MST2 VBID	3															
SDP_7B	0	10 549 820 bits	5.26	MST2 MSA																
SDP_90	1	0:001.303.309.341 10 557 000 bits	5.26	MST2 SDP MST2 BS																
SDP_71	2	0:001.304.115.497	0:0	NST2 BE																
> UNE	1	0:001.319.892.939	0:0	Link Frame/MTP	327	328		329	330	3	331	332		333	33	1	335	336	337	
> LINE	2	10 691 360 bin 0:001.339.071.544	755 0:0	vc			_	NO SIREAM	NO SIRES	M	SIREAM	NO STR	EAM NO	STREAM	NO :	STREAM	NO STRE	NO STREAD	NO STREAM	4 11 1
		10 846 710 bits	154	$O \pm < > < >$	• « » 🕉	🔏 н н	1													
< LINE	3	0.001.358.083.486	0:0			301 848 1		:001.301.8	52 740		:001.301	857 37		0:001.	301 86				0:001.301.	870 39
			,		1111			111111			111111			11111						1 1 1 1 1
Details Image				AUX Link									MST							_
				MST1 Lines								ERAME (I	DCP) 2 LI	NE 0						_
				MST1 VBID	0									-						
					4															
				MST1 MSA MST1 SDP			_	_		_	_		_	_	MSA	_	_			_
				MST2 Lines							11	AME (HDCP) 1 LINE (5	5760) R5						
					0															_
				MST2 VBID	34															
				HST2 MSA																
				MST2 SDP Link Frame/MTP											32	0				_
				VC	STREAM			STREAM 1					STREAM 2			-			NO STREAM	
				Symbols		MTP	H N	ISA Payload					Pixels							
				Lane 0		00			2B								A EC			
				Lane 1		00		85 48 FD 94					6A E						_	_
				Lane 2		00			80	08			81 D							
				Lane 3					34		86									

Note:

When using Link Timeline Viewer with MST, it's possible that all information for all streams are not fitted in the default window size. Below you can see how different streams are presented in *Wave Form View* and *Symbol View*. To make room for either of the view areas, please scale the areas from the area shown with the red box. You can also remove lines from both views to accommodate necessary information from all streams. Please refer to next chapter for detailed instructions.

Link Timeline Viewer "E\YuriDonskoy\ucd_data\capture_20240207_152902" e Options About									
FrameView Reports Images									
Main Link Events Symbols Log Events	Wave Forms	Spatial View							
O Search 🛃 🗆 Aa 🗆 RExp 14 0 / 0	н 🔿 📃 🔤				DATA				
	FRA	ME (bad)_1		ERAM	E_2			FRAME_3	
Type Id Position		ME (bad)_1		ERAM				FRAME_3	
Lane Events	FRA	ME (bad) 1 FRAME (bad) 1		FRAM	E_2 FRAME 2			FRAME_3 FRAME_3	
MST Stream 1					ENARS_2			FRANL_3	
	○ ∓ € ∈	(< >	» 🕑 🚣 H N						
MST Stream 2		0:000.000.	.000.000	0:011.8	10.905.621	0:021.844.2	48.183	0:029.125.664.244 0:0	036.407.0
MST Stream 3	AUX			1	••••••				
MST Stream 4	Link					DATA			
	MST1 Frame	FRAM	E(bad) 1		FRAME 2			FRAME 3	
	MST1 Lines	A	CTIVE B		ACTIVE	В		ACTIVE	
	MST1 VBID	0				_			
		4							
	NUT1 MUA MST1 SDP								
	MST1 BS								
	MST1 BE								
	MST2 Frame		E (bad)_1		FRAME_2			FRAME_3	
	MST2 Lines	N	CTIVE B		ACTIVE	В		ACTIVE	
	MST2 VBID	3							
	MST2 MSA								
	MST2 SDP MST2 BS								
	MST2 BS MST2 BE								
	MST3 Frame	FRAM	E (bad)_1		FRAME_2			FRAME 3	_
	MST3 Lines	N	CTIVE B		ACTIVE	В		ACTIVE	
	MST3 VBID	0	_						
	NST3 MSA	4							
	MST3 MSA MST3 SDP								
	MST3 BS								
	> MST3 BE								
Details Image	MST4 Frame		FRAME(bad)_1		FRAME_2			FRAME_3	
indge	MST4 Lines		ACTIVE	2	ACTIVE		В	ACTIVE	
	MST4 VBID	3		_					
	\bigcirc \bigcirc \leftrightarrow $<$ >	« » « » 🖲 ,	<u>s</u> i pi						
		0:000.000.	.000.000 0:000	.000.003.597	0:000.000	.008.609 0:000.000.0	10.793	0:000.000.014.391 0:0	000.000.
	AUX								
	Link								
	MST1 Lines								
	MST1 VBID	0							
	MST1 MSA								
	MST1 SDP								
	MST2 Lines								
	MST2 VBID	034							
	MST2 MSA								
	MST2 MSA MST2 SDP								

Wave Form and Symbol View Settings

	DATA
	и м <u>ж</u> С « » « »
a made i	
	0:000.000.000 0:011.538.232.644 0:021.844.226.850 0:029.125.635.800 0:036.407.04
AUX	
Link	DATA
L-Frames	δ 5000 10000 15000 20000 25000 30000 35000
LLCP	
SR/Phy Sync	
VC	
Lane 0	
Lane 1	
Lane 2	
Lane 3	
	ж ж»Э
	» « » Э 🛃 И И
	» ≪ » 3 ﷺ M M 1000.000.000.000.000.003.05€ 0:000.000.003.05€ 0:000.000.005.170 0:000.000.012.227 0:000.000.01
)∓<>«	
)∓<>≪	
) ± < > « NUX Link	
AUX AUX Link -Frames CC Symbols	
AUX AUX Link -Frames CC Symbols	
) ± < > « AUX Link L-Frames CC	
MUX AUX AUX AUX AUX AUX AUX AUX A	
UX ink -Frames rc ymbols ane 0 ane 1 ane 2	
UX dink -Frames rc yubbla .ane 0 .ane 1	

Gear Icon



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

0	± € €< >
0	0
0	AUX
Ó	Link
0	Frame
0	Frame Lines 0
0	VBID
0	MSA
0	SDP
Õ	Symbols
Ō	Lane 0
Õ	Lane 1
0	Lane 2
0	Lane 3

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

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

Save Icon

Ŧ.

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

0.4	€, Q, < >	"
5	Save	b
AU	Load	•
Li Fr	Remove	
Li	Import	
VB	Export	
MS.	Reset to default	

Zooming



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

Scrolling

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

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

Clock icon



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

Move to time poi	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



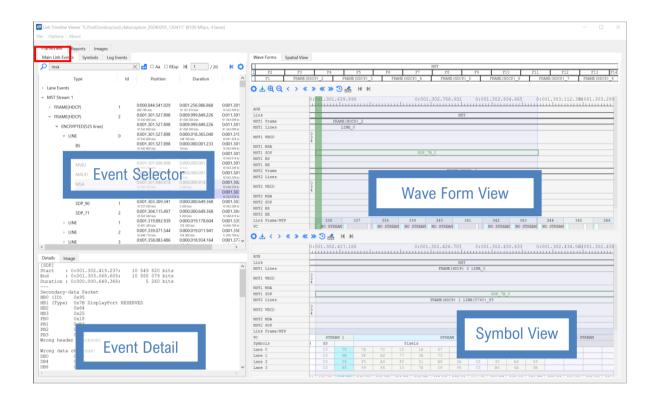
The eraser icon deletes all made measurements on the timeline.

FrameView Tab

FrameView tab consists of four areas shown in the image below.

- Event Selector
- Event Detail
- Wave Form View
- Symbol View

Each of these areas will be described in detail in the upcoming chapters. However, it is worth noting that all these areas are interconnected and actions in one area will affect the information shown in other areas.



Event Selector

Main Link Events

Main Link Events lists events, packets and symbols occurring during the time span of the captured data. By selecting items in Main Link Events, the user can easily locate the items of interest and get the **Wave Form View** and **Symbol View** panels focused for evaluating the item. In Event Selector the events are presented as a folding list of detected items. When opened, each frame lists video lines detected, and further the events detected during each of the lines.

Search			🛃 🗌 Aa 🗌 R	Exp 📢 0 /0	ы
Type	Id	Position	Duration	End	^
✓ 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	
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 in Timeline Viewer consists of two timings based on time and bits.

The time format is shown as follows:

seconds:milliseconds.microseconds.nanoseconds.picoseconds

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

Туре		Id	Position	Duration	End
>	BS-IDLE	1	0:034.619.841.130 280 421 940 bits	0:118.983.568.333 963 771 120 bits	0:153.603.409.463 1 244 193 059 bits
>	FRAME	2	0:153.603.409.464 1 244 193 060 bits	0:016.667.883.866 135 010 450 bits	0:170.271.293.330 1 379 203 509 bits
+		-	0.170 271 202 221	0.016 667 800 040	M-196 020 192 271

When clicking on a Frame, a Line, an Event, or a Symbol, both *Wave Form View* and *Symbol View* are focused on the item, and the time stamp of the item is indicated with light blue color highlighting as shown in the image below.

Unk Timeline Viewer "E/YuriDonsk Options About	:oy/ucd_data,	/capture_20240205_120	0415" [8100 Mbps, 4 k	ines]															
ameView Reports Images	5																		
Nain Link Events Symbols	Log Events				Wave Forms Spatial V	View													
vbid		🗙 🛃 🗆 Aa 🗆 RE:	xp 🕅 1 / 1-	1889 🕨 🙆								IST							
					1 F2 F				16		F7	2.0		153		F10	F11		F13
Туре	Id	Position	Duration	^		ME (HDCP)_2	FRAME ()		190	AME (HDC	8)_4	FRAM	E(HDCP)	5	1245	E (EDCP) 6		FRAME (HDCP) 7	FRAME (HDCP
Lane Events					○ ±€€< < >	« » « >	ا 🕹 🕑 ٧	M M											
MST Stream 1						0:000.00	4.539.708					44.550	.005	0:0	100.04	4.553.93	5 0	:000.044.55	7.865000.044.
 FRAME(HDCP) 	1	0:000.044.541.029	0:001.256.986.868	0:001.301	AUX								mlu		ulu		huu		
 ENCRYPTED(66 lines) 		0:000.044.541.029	0:001.256.986.868	10.542.599 M 0:001.301	Link								MST					-	
		0:000,044,541,029	10 181 810 885	10 542 599 M 0:000.063	MST1 Frame			_		-		_			B (HDCP)				
 LINE(960) 	0	360 790 bits	0:000.019.011.940 154 000 bits	514 789 bits	MST1 Lines									LIN	8 (960)	0			
BS		0:000.044.541.029	0:000.000.001.233	0:000.044	MST1 VBID	3													
VBID		0:000.044.542.263	0:000.000.001.234	0:000.044	MST1 MSA	4													
MYE	_	360 800 bits	12.635	362 809 685	MST1 SDP														
		0:000.044.621.274	0:000.000.001.234	361 439 Nm 0:000.044	MST1 BS	1													
MAUD		361 440 bits	10 bits	361 449 bits	MST1 BE MST2 Frame								AME (HDC	1 (0)					
BE		0:000.048.510.080	0:000.000.001.234	0:000.045	MST2 Lines			_					INE (5760						
> LINE(960)	1	0.000.063.552.970	0:000.018.934.165	0:000.082	MST2 VBID	9													
> LINE(960)	2	0:000.082.487.136	0:000.019.010.706	0:000.101		4													
	3	0:000.101.497.843	152 990 Mill 0:000.019.179.838	822 149 Mis 0:000.120	MST2 MSA MST2 SDP														
> LINE(960)	-	0:000.120.677.682	0:000.019.010.707	977 509 Mil	MST2 BS														
> LINE(960)	4	977 510 bits	152 990 bits	7 137 499 Alts	MST2 BE														
> LINE(960)	5	0:000.139.688.390 1 131 500 bits	0:000.019.011.940 154 000 bib	0:000.158 1 285 499 bits	Link Frame/MTP WC	SAM 1					STREAM			149				NO 57	DEAM
> LINE(960)	6	0:000.158.700.331	0:000.019.177.370	0:000.177	Lane 0	17	1A						E4					00 01	
> LINE(960)	7	1.285 500 bits 0:000.177.877.702	0:000.019.013.175	0:000.19€ 🗸	Lane 1					FA				A4	6A				
> DIAE(300)				>	Lane 2					94 cc			88	λλ 5.2	90	41			
tails Image					Lane 3	08	62	:3 1	82 C	oc	09	11	28	53	85	CE			
tails Image				^	$O \pm < > < >$	« » 3 s	8 N N												
								044.541			0:000.0					4.549.61			3.542000.044.
					AUX														
					Link					_			MST	_					
					MST1 Lines	0			-						TR	AME (HDCP)	1 LINE(9	60)_0	
					MST1 WBID	34													
					MST1 MSA														
					MST1 SDP														
					MST2 Lines	0		-			T	FAME (ND)	CP) 1 L3	INE (576)	0)_0				
					MST2 WBID	34													
					M972 MSA	,		-											
					MST2 SDP														
					Link Frame/MTP											149			
				~	WC Symbols	TREAM	NTPH	82	VBID	line"	VCPF				STREAM	2 Pixels			NO S
					olumora		ni ra	- 33	.310	- 40.1						* * AGTO			

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

Туре:	Type of item. FRAME, LINE, or name of Event
ld:	Event's occurrence number
Position:	Start of the event from start of the captured data
Duration:	Duration of the event
End:	End of the event from start of the captured data

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

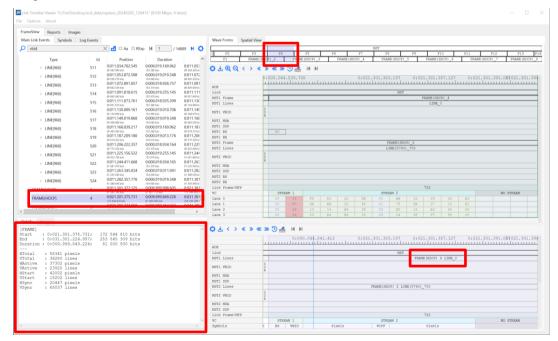
Main Link Events Symb	ols Log Event	s		
Cos: frame		🗌 🛃 🗌 Aa 🗌 RE	xp 🛛 0 /0	ÞI 🗘
Туре	Id	Position	Duration	End
✓ Lane Events				
> Lane 0				
> Lane 1				
> Lane 2				
> Lane 3				
✓ SST Stream				
> FRAME(bad)	1	0:000.004.514.795	0:007.348.683.898	0:007.35
> FRAME	2	0:007.353.198.694	0:016.667.892.509	0:024.02
> FRAME	3	0:024.021.091.204	0:016.667.887.570	0:040.68
> FRAME	4	0:040.688.978.775	0:016.667.887.571	329 582 169 0:057.35
> FRAME	5	329 582 170 bits 0:057.356.866.347	135 010 480 bits 0:016.667.887.570	464 592 645 0:074.02
> FRAME	6	464 592 650 bits 0:074.024.753.918	135 010 480 bits 0:016.667.892.509	599 603 125 0:090.65
> FRAME	7	599 603 130 bits 0:090.692.646.428	135 010 520 bits 0:016.667.887.570	734 613 645 0:107.3€
> FRAME	8	734 613 650 bits 0:107.360.533.999	135 010 480 bits 0:016.667.887.571	869 624 125 0:124.02
> FRAME	9	869 624 130 bits 0:124.028.421.571	135 010 480 bits 0:016.667.887.570	1 004 634 6 0:140.65
> FRAME	10	1 004 634 610 bits 0:140.696.309.142 1 139 645 090 bits	135 010 480 bits 0:016.667.892.509 135 010 520 bits	1 139 645 0 0:157.36 1 274 655 6
<		0 457 354 304 653	0.045 553 003 534	>

Lane Events

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

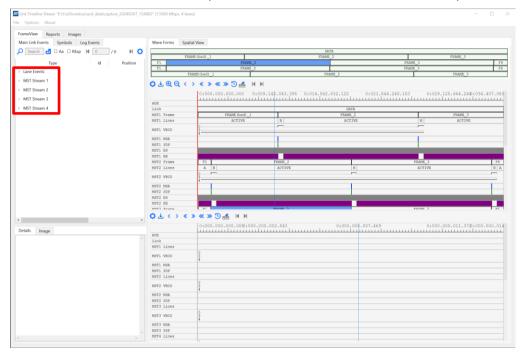
SST Stream

You can find all the captured frames under "SST Stream". When clicking on a frame in the Event selector, the frame is highlighted and shown in *Wave Form View* and *Symbol View* as shown in the image below. Event details are shown in *Event Details* in the lower left corner.



MST Stream

When using Link Timeline Viewer in MST mode, the streams are shown in the event selector as in the image below. Click on each stream to inspect its events. All aspects of the events found under different streams include the same aspects as in the SST mode described in the chapter above.



Search

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

) frame		× 🛃 🗆	🛛 Aa 🗌 RExp 🛛 🖊	1 /9 🕨
Туре	Id	Position	Duration	End
Lane Events				
SST Stream				
> FRAME(bad)	1	0:000.009.259.063 75 000 bits	0:002.207.395.066	0:002.216.654.129
✓ FRAME(bad)	2	0:002.216.654.130	0:014.399.524.866 116 638 630 bits	0:016.616.178.996 134 593 909 bits
✓ ACTIVE(972 lines)		0:002.216.654.130 17 955 280 bits	0:014.399.524.866	0:016.616.178.996 134 593 909 bits
✓ LINE(5760)	0	0:002.216.654.130 17 955 280 bits	0:000.014.812.030	0:002.231.466.160 18 075 259 bits
SR		0:002.216.654.130 17 955 280 bits	0:000.000.004.937 40 bits	0:002.216.659.067
VBID		0:002.216.659.068 17 955 320 bits	0:000.000.001.233	0:002.216.660.301 17 955 329 bits
MVID		0:002.216.660.302 17 955 330 bits	0:000.000.001.234	0:002.216.661.536 17 955 339 bits
MAUD		0:002.216.661.537 17 955 340 bits	0:000.000.001.233	0:002.216.662.770 17 955 349 bits
SDP_02	0	0:002.216.675.117 17 955 450 bits	0:000.000.014.813 120 bits	0:002.216.689.930 17 955 569 bits
BE		0:002.218.582.484 17 970 900 bits	0:000.000.001.233	0:002.218.583.717 17 970 909 bits
> LINE(5760)	1	0:002.231.466.161 18 075 260 bits	0:000.014.823.140	0:002.246.289.301 18 195 329 bits
> LINE(5760)	2	0:002.246.289.302 18 195 330 bits 0:002 261 093 926	0:000.014.804.623 119 920 bits 0:000 014 816 968	0:002.261.093.925 18 315 249 bits 0:002 275 910 894
				>

Main Link Events	Symbols Log Events
🔎 frame	🗙 🛃 🖓 Aa 🗌 RExp 🚺 0 🛛 / 0 🛛 🗎 🔅
Aa:	Makes search function case sensitive.
RExp:	Use regular expressions.

r - I

Click the enter icon to apply filters.

0

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

Configure search	×
Case Sensitive	
Use regular expression	
Columns:	
🗹 Туре	
🗹 Id	
Position	
Duration	
🗹 End	
Apply	-

Symbols

Symbols view lists all the PHY level events found in the capture made. Wheres *Main Link Events* is structured in a tree format, *Symbols* view is presented in a list format containing all symbols from the capture.

Filter					🛃 🗌 Aa 🗌 RExp	0
Search				🛃 🗌 Aa 🗌 RExp	I 0 /0 N	0
Type	Id	Position	Lane		Value	^
BE		2 159 324 484 bits 17 490 900 bits	0	00000000		
BS		2 172 208 161 bits 17 595 260 bits	0	00000000		
MVID		2 172 214 333 bits 17 595 310 bits	0	0x00		
MAUD		2 172 215 568 bits 17 595 320 bits	0	0x00		
BE		2 174 136 515 bits	0	00000000		
BS		2 187 025 130 bits	0	00000000		
MVID		2 187 031 302 bits	0	0x00		
MAUD		2 187 032 537 bits	0	0x00		
BE		2 188 953 484 bits	0	00000000		
BS		2 201 837 161 bits	0	00000000		
MVID		2 201 843 333 bits	0	0x00		
MAUD		2 201 844 568 bits	0	0x00		
RF		2 203 765 515 bits	0	00000000		~

<i>Type:</i> Type of item. FRAME, LINE, or name of Event	
<i>Id:</i> Event's occurrence number	
Position: Start of the event from start of the captured data	
Lane: The main link lane where the Symbol was found	

Value:

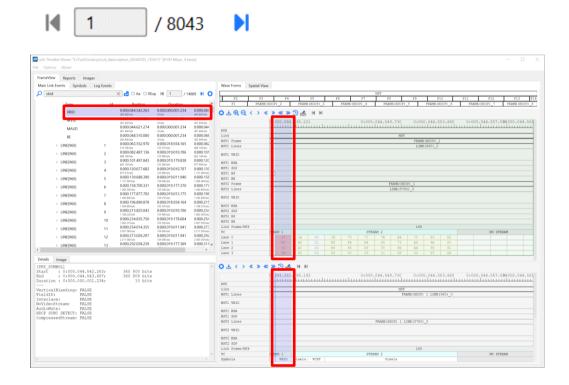
Filter

You can filter symbols by typing the event name in the Filter bar. The screenshot below shows an example of VBID event search.

Main Link Events	Symbols	Log Events				
Vb Vb					🗙 🛃 🗌 Aa 🗌 RExp	0
Search				🛃 🗌 Aa 🗌 RExp	0 / 0 ▶	0
Туре	Id	Position	Lane		Value	^
VBID		11 357 095 694 bits 91 994 430 bits	0	060000000		
VBID		11 371 907 725 bits 92 114 410 bits	0	060000000		
VBID		11 386 733 335 bits 92 234 500 bits	0	060000000		
VBID		11 401 550 305 bits 92 354 520 bits	0	0Ь0000000		
VBID		11 416 352 459 bits 92 474 420 bits	0	060000000		
VBID		11 431 169 428 bits 92 594 440 bits	0	0b0000000		
VBID		11 445 981 459 bits 92 714 420 bits	0	0b0000000		
VBID		11 460 794 725 bits	0	0Ь0000000		

Search

Whereas filtering simply lists all the symbols matching the search word, **Search** will find all searched symbols and when selected, shows them on *Wave Form View* and *Symbol View*. You can browse through the found symbols by using the arrow keys:



Event Details

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

Details tab

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

<u>Frame</u>

Details Imag	je
[FRAME] Start : ():203.253.553.972; 1 646 360 990 bits
End : (0:219.921.436.604; 1 781 371 429 bits
Duration : (0:016.667.882.632; 135 010 440 bits
VTotal : HActive : VActive : HStart : VStart : HSync : VSync :	192 pixels 41 lines 44 pixels

For frames the details include the following parameters:

- Start, End and duration
- HTotal and VTotal
- HActive and VActive
- HStart and VStart
- HSync and VSync
- Total pixel count

The above mentioned parameters can be set for the transferred pattern in the pattern generator tab. For detailed information, please refer to UCD-4XX/UCD-5XX user manual.

Line

For example, in the image below we can see that the line is part of blanking as the value for VerticalBlanking is set as TRUE. Also, AudioMute is set as FALSE so audio is being transferred.

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

MSA

Details	Image					
[MSA] Start End Duration	: 0:153	.249.931.998; .249.943.108; .000.011.110;	1 241 329 96			
FIELD		HEX	BITS			
MVid NVid HActive VActive HTotal VTotal	6007 32768 1920 1080 2200 1125 192 41 ch 5 ch 44 32	0x8000 0x780 0x438 0x898 0x465 0xC0 0x29 0x5 0x22	00100000 00000000			
MISC1.In	nterlaced			in video stream clock are asynchronous. er of lines per interlaced frame (consisting of two fields) is an		
odd numk MISC1.St		eo Attribute:	No 3D stered	video in-band signaling		
MISC.Colorimetry Format Value: 1 0x1 00000001 MISC.Colorimetry Format: RGB unspecified color space (Legacy RGB mode), 8 bpc, 8bpc						
00 00 00 17 17 17 17 77 77 77 78 00 07 00 98 C0 80 80 04 00 04 00 65 29 38 20 00 00 00 2C 05 00 00						
L						

<u>SDP</u>

SDP events contain several different kinds of events all with individual details shown. The image below shows an audio stamp event.

```
Details Image
[SDP]

        Start
        : 0:034.894.928.816;
        282 650 160 bits

        End
        : 0:034.894.943.629;
        282 650 279 bits

        Duration
        : 0:000.000.014.813;
        120 bits

Secondary-data Packet
HBO (ID) 0x00
HB1 (Type) 0x01 Audio_TimeStamp
HB2 0x17
нв3
                        0x48
                       0x00
0x67
PB0
PB1
PB2
                        0x35
PB3
                       0xD1
Header checksum OK
Data checksum OK
                      0x0000012C 300
0x00008000 32768
Maud
Naud
                       0xB4
0xB4
PB4
PB5
PB6
                        0xB4
PB7
PB8
                       0xB4
0x7F
                       0x7F
0x7F
0x7F
0x7F
PB9
PB10
PB11
```

PHY Symbol

Events such as BS, VBID and MVID will be shown under [PHY _SYMBOL] title. For example, in the image below we see the event details for VBID event.

Details	Image					
End	: 0:170. : 0:170.	271.298.270; 271.299.503;	_	 	559	bits
	n : 0:000. lBlanking:	000.001.233; TRUE			10	bits
FieldID: Interla	ce:	FALSE FALSE				

PHY Area

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

Details	Image						
[PHY AR	EA]						
Start	: 0:	000.000.000.000	;		0	bits	
End	: 0:	000.854.703.667	; 6	923	129	bits	
Duratio	n : 0:	000.854.703.667	; 6	923	130	bits	
TPS1							

Image tab

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

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	0:014.399.524.866 116 638 630 bits	0:016.616.178.996 134 593 509 hits
> FRAME	3	0:016.616.178.997	0:016.666.123.615	0:033.282.302.612 269 592 379 Min
> 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
tails Image				
tails Image				

Wave Forms View

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

Wave Forms

			DATA			
	FRAME (bad)_1		FRAME_2			FRAME_3
• ₹ € € € €	× * * * * * * * №					
	0:000.000.000.000 0:007.28	613.748		4.076.843	01029.126	454.995 0:036.408.04
			and the second second	and a second concerned concerned and a		
AUX						
Link			DAT			
MST1 Frame	FRAME (bad) _1			FRAME_2		FRAME_3
MST1 Lines	ACTIVE		В	ACTIVE	8	ACTIVE
MST1 VBID	2				_	
MST1 MSA	4				_	
NST1 SOP						
MRT1 BR						
NST1 BE						
L-Frames	0 5000	10000	15000 20	000 25000	30000	35000
LLCP					30000	
58/Phy Sync						
storing spine						
Lane 0						
Lane 1						

AUX:	Events of the AUX channel.
Link:	Link state (TPS1, TPS2, TPS3, TPS4, SST, MST etc.)
Lines:	Frame and line number
VBID:	Location of VBID events
MSA/SDP:	Location of MSA and SDP events
Symbols:	Control and special symbols
Lanes (0-3):	Decoded data and control symbols

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

Wave Forms Spatial View		
	DATA	
FRAME (bad) _1	FRAME_2	FRAME_3
ੑ ੵ ± ⊕ ⊖ < > < > < > ③ ♣ । ।		

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

			DATA		
	FRAME (bad) 1		FRAME 2		FRAME 3
¢±€€<	> « » « » 🕑 🏄	H H			
	0:009.102.017.186	0:020.65	5.308.311	0:030.946.858.432	0:038.228.472.181 0:045.510.085
AUX					
Link		DATA			
MST1 Frame		FRAME		FRAME_3	1
MST1 Lines	В	ACTIV	Е	D RUITUD	
MST1 VBID	3				
MST1 MSA					
MST1 SDP					
MST1 BS					
MST1 BE					
L-Frames	000 1500	0 20000	25000 30	35000	
LLCP					
SR/Phy Sync					
VC					
Lane 0					
Lane 1					
Lane 2					
Lane 3					

When you hover the cursor over the timeline, the timestamp of that position on the timeline is shown as illustrated in the image below.

			DATA			
	FRAME (bad) 1		FRAME_2			FRAME_3
1 A A A	> 🕷 🐭 🕲 💒 🛛 🕯	N				
	0:009.102.017.186 0:016	.383.630.934 0:024.26	5.711.788	0:030.9	46.858.432	0:038.228.472.181 0:045.510.08
AUX						
Link		DATA				
MST1 Frame		FRAME_2			FRAME_3	
1ST1 Lines	В	ACTIVE		В	ACTIVE	
IST1 VBID	3			_		
MOII VEID	4					
MST1 MSA						
MST1 SDP						
MST1 BS						
MST1 BE						
L-Frames	0000 15000	20000 25000	300	00	35000	
LLCP						
SR/Phy Sync						
VC						
Lane 0						
ane 1						
Lane 2						
Lane 3						

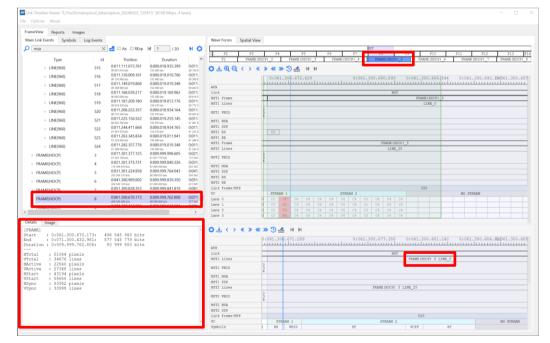
When you hover mouse cursor over an event in *Wave Form View*, a popup windows shows details of the event.

Wave Forms Spatia	al View															
								MST								
F1 FRAME (HDCP) 2	FRAME (HDCP) 3						FRAME (HDCP) 7			DCP) 9		FRAME (H		FRAME (HDCP) 12		
FRAME (HDCP)_1	FRAME (HDC)	P)_2	FR	AME (HDCP)	3	FR	AME (HDCP) 4	FRAME (HDCP	_5		FRAME (HDCP)_6		FRAME	(HDCP)_7	FRAME (HD	CP)_8
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	0:001.30	01.850.351	. 0:	001.301.	854.130		0:001.301	859.776	0:	001.30	1.865.421		0:001.3	801.871.067	0:001.	301.87
AUX																
Link								MST								
MST1 Frame								FRAME (HDCP)	2							
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MST1 BS		[MSA] Start	. 0.001 30	01.848.878;	10.5	45 200 bit										
MST1 BE				02.263.683;		48 559 bit	5									
MST2 Frame			: 0:000.00	00.414.805		3 360 bit	5									
MST2 Lines		FIELD	DEC	HEX	BITS											
	0	F 1660	DEC		D115											
MST2 VBID	34	MVid		0xB15C64												
MST2 MSA		NVid HActive	15987304 54945	0xF3F268 0xD6A1												
MST2 SDP		VActive	1715	0x6B3												
MST2 BS		HTotal	36360	0x8E08												
MST2 BE		VTotal HStart	3830 60729	0xEF6 0xED39												
Link Frame/MTP		VStart	57886	0xE21E												
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Lane 0		HSynWidth MISCO	99	0xBF62 0x63		1										
Lane 1		MISC1	139	0x8B												
Lane 2		1														
Lane 3		MISCO.Syn	chronous (Clock: Link	c clock a	nd main vi Number of	deo stream clock a lines per interla	re synchronous. The ced frame (consisti	value Mv	fieldel	is an even numb	gardless o or	of whether	link clock dow	m spread is er	sabled.
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)	» « » 🧿 🛃	MISC.Colo	rimetry Fo	ormat Value	: 163	0xA3	10100011									
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AUX		1														
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MST1 Lines		- 08 39 A1 62 36 43		UG 68 F6 11	S B3 63 E	15 74 EC 8B										
	0	-L														

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

ameView Reports Images																		
fain Link Events Symbols I					Wave Forms Spatial	View												
msa		🛃 🗆 Aa 🗆 RExp	M 1 / 20	N O							MST							
		· - ·		^	1 F2 F:	3 F4 ME(HDCP) 2	FRAME (H)		F6	F7 AME (HDCP) 4	F8 FRAME (H	89	IRANE	F10	F11	RAME (HDC)	F12	F13 RAME (HDCP)
Type	Id	Position 0:001.149.179.283	Duration 0:000.019.011.941	0:001.					FRI	AME (HDCP)_4	FRAME (H	DCP)_5	FRAME	(HDCP)_6	E	RAME (HDC)	<u>57</u> B	RAME (HDCP)
> LINE(960)	58	9 308 550 Mit	154 000 bits	9.452.54	$\circ \mp \otimes \odot < \rightarrow$	« » « »	> 🕑 🚣	м м 🖕	_									
 LINE(960) 	59	0:001.168.191.225 9.462.550 pm	0:000.019.178.604 755.350 bits	9.677.89			1.843.197				.301.859.7						.871.0670	
> LINE(960)	60	0:001.187.369.830	0:000.019.010.706	0:001.	AUX								uuluu					
> UNE(960)	61	0:001.206.380.537	0:000.019.011.940	0:001.	Link							MST		_				
		9771890 Mb 0:001.225.392.478	0:000.019.178.604	9 825 88 0:001.	MST1 Frame							s (HDCP)_2						
> LINE(960)	62	9 925 890 Mits	755 350 bits	10.087.2	MST1 Lines	0					I	INE_0						
> LINE(960)	63	0:001.244.571.083	0:000.019.011.941 /54.000 bits	0:001.	MST1 VBID	3												
> LINE(960)	64	0:001.263.583.025	0:000.018.934.164 153 370 bits	0:001.	MST1 MSA								MS	A	-	-		
> LINE(960)	65	0:001.282.517.190	0:000.019.010.707	0:001.	MST1 SDP													
FRAME(HDCP)	2	10.388 610 bits 0:001.301.527.898	753 880 bits 0:009.999.849.226	0:011.	MST1 BS MST1 BE													
	2	10 542 600 min 0:001.301.527.898	81 000 300 bin 0:009.999.849.226	97.542.0 0:011.	MST1 BE MST2 Frame						FRAM	E(HDCP)_1		-			_	
 ENCRYPTED(525 lines) 		10 542 600 665	81 000 500 bits	91 543 0	MST2 Lines						LINE	(5760)_85						
✓ LINE	0	0:001.301.527.898	0:000.018.365.040 /48 750 bits	0:001.	MST2 VBID	0 3												
BS		0:001.301.527.898	0:000.000.001.233	0:001.	MST2 MSA	4												
VBID		0:001.301.529.132	0:000.000.001.234	0:001.	MST2 SDP													
MVID		10 542 610 km 0:001.301.606.908	10 bits 0:000.000.001.234	10.542.6 0:001.	MST2 BS													
		10 543 240 bits 0:001.301.608.143	70 duits	0:001	MST2 BE Link Frame/MTP									329				
MAUD					VC VC	LEAM	STREAM	1		91	REAM 2			343		NO ST	REAM	
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					MST1 WBID	3												
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					MST1 SDP													
					MST2 Lines						FRAME (HDCP)	1 LINE(576	0)_85					
					MST2 VBID	34												
					MST2 MSA													
					MST2 SDP													
					Link Frame/MTP									329				

The image below further shows you how the different areas of the Timeline Viewer align when you double click on a frame in *Wave Form View*.



Measuring

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

ameView Reports Imag	25								
ain Link Events Symbols	Log Events		Wave Forms Se	oatial View					
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		0.000.046.002.096	M7K						
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> FRAME	2	0.011.542.113.800	MST1 Frame				NAME_3		
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85		0.028.208.495.384	N971 83						
		0.028.208.497.754	N971 84				LF 30021		
VBID		300 820 670 Ahr	L-Franes LLCP				LF 30021		
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SDP 01	0	0.028.208.962.339	WC UNIT OF INC	1					
5DP_01	0	300 825 942 oht	Lane 0			06 1551			
SDP_84	1	0.028.209.125.003	Lane 1			106 [35]			
LINE		0.028.223.394.040	Lane 2			108 [33]			
> LINE		367 627 773 6ht	Lane 3	0000011 25	13041 [48] 304130	106 [22] 304			
> LINE	2	0:028.238.142:031							
> LINE	3	0.028,252,884,912							
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> UNE	4		07<>	0:028.208.495.083	0:028.208.498.089	0:028.208.501.05	6 0:028.208.5	01.102 01028.208	.506.914 0:028.208
	4	0.028.267.635.200		0:028.208.495.083		0:028.208.501.09	6 0:028.208.5	04.102 0:028.208	.506.914 0:028.208
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	4	0.028.267.635.200		0:028.208.495.083	0:028.208.498.089	0:028.208.501.09	6 0:028.208.5		.506.914 0:028.208
	4	0.028.267.635.200	MUE Link MSTI Lines	0:028.208.495.083	0:028.208.498.089	0:028.208,501.05	DATA		.506.914 0:028.208
	4	0.028.267.635.200	M7E Link	0:028.208.495.083	0:028.208.498.089	0:028.208.501.05	DATA		.506.914 0:028.208
	4	0.028.267.635.200	MUE Link MSTI Lines	0:028.208.495.083	0:028.208.498.089	0:028.208.501.05	DATA		.506.914 0:028.208
	4	0.028.267.635.200	AUX Link MSTI Lines NFTI VBID	0:028.208.495.083	0:028.208.498.089	0:028.208.501.05	DATA		.596.914 0:028.209
	4	0.028.267.635.200	AUX Link MSTI Lines NSTI VBID MSTI MSA	0:028.208.495.083	0:028.208.498.089	0:028.208.501.05	DATA		.506.914 0:028.208
	4	0.028.267.635.200	AUX Link MSTI Lines NSTI VBID MSTI MSA NSTI SDP	0:028.208.495.083	01028.208.498.089	01028.200,501.05	EACA FRUME 3 LIN		.506.914 0:028.200
	4	0.028.267.635.200	AUX Link MSTI Lines MSTI VBID MSTI MSA MSTI SOP L-Frames	0:028.208.495.083	0:028.208.498.089	1 53	DATA PROME 3 LIN LF 30021 1 23		.506.914 0:028.200
	4	0.028.267.635.200	AUX Link MOTI Lines MOTI VBID MOTI MOA MOTI SOP L-Frames VC	0:028,208,495,083	01028.208.498.089	1 53 19045914 [83]	IF STORE 2 LIN		.506.914 0:028.200
	4	0.028.267.635.200	A/R LLDk NDTI LINES NDTI VBID NDTI SDA NDTI SDA NDTI SDA VC Dymbols Lame 0 Lame 1	01028.208.495.083	01028.208.498.089	1 5 5 1606996 [80]	EF 30021 23 29 29 29 29 29 29 29 29 29 29 29 29 29		.506.514 0:028.204
	4	0.028.267.635.200	AUX Link MUTI Lines NUTI VUID MUTI VUID L-Frums VC Dymois Late 0 Late 0 Late 1 Late 2	0:028.208.455.083	0-028.208.498.089	1 55 55 19045940 19045940 19045940 19045940 19045940 19045940	EF 30021 15 3021 15 5021 15 503 15960546 (88) 15960546 (88)		596,914 0:028.201
	4	0.028.267.635.200	A/R LLDk NDTI LINES NDTI VBID NDTI SDA NDTI SDA NDTI SDA VC Dymbols Lame 0 Lame 1	0 020.208.455.003	01028.208.499.089	1 53 79947946 (88) 79947946 (88) 79947946 (88)	EF 30021 190452 3 LIN 2015	<u>z_0</u>	
	4	0.028.267.635.200	A/M Link MUTI Lines MUTI MUA MUTI LINES MUTI AMA MUTI MUA MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI	0 028.208.455.052	01028.208.498.089	1 55 55 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1944596 1945 1945 1945 1945 1945 1945 1945 1945	EF 30021 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2_0	
	4	0.028.267.635.200	AUX Link MUTI Lines NUTI VUID MUTI VUID L-Frums VC Dymois Late 0 Late 0 Late 1 Late 2	0 029.00.455.003	01028.208,499.089	1 50 79945946 (as) 79945946 (as) 79945946 (as) 79945946 (as)	EF 3/021 EF 3/021 1 2 1 2 1 2 1 2 2 2 2 2 2 2 2 2 2 2 2 2	2_0 2_1	11
	4	0.028.267.635.200	A/M Link MUTI Lines MUTI MUA MUTI LINES MUTI AMA MUTI MUA MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI MUTI	0 028.208.455.052	1 91028.208.498.085 1 9025 1 9000011 9000011 9000011 9000011 9000011 9000011 9000011 9000011 9000011	1 55 195(1964 (88) 195(1964 (88) 195(1964 (88) 195(1964 (88) 195(1964 (88) 195(1964 (88) 195(1964 (88)	EF 3001 1 PRASS 3 LIN EF 3001 2 S3 1 PRASS 4 101 1 PRASS 4 10	santi menerenciata ta Statilite Zartuski Neccion	

Zooming In

When you zoom in a little, the area shown in *Wave Form View* is highlighted with light green color as illustrated in the image below.

Wave Forms Spatial View							
			DATA				
FRAME (bad) 1	RAME_2	FRAME_3	ERAME_4	FRAME_5	FRAME	6 FRAME_7	FRAME_8
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When you zoom in more, the frames shown in *Wave Form View*, are highlighted in green in the scroll bar as shown in the image below.

				DATA	k								
FRAME (bad) 1	FRAME_2	FRAME_3	FR	ME_4	FRAME_5	FRAME_6	FRAME_7	FRAME_8					
〕 ± € € < :	> « » « » 🕑 🚣	I I											
	0:038.319.454.909	0:041.893.705.2	200 0:044.82	.508.540	0:04	9.042.205.782	0:052.616.456.073	0:056.190.70					
AUX													
Link					DATA								
MST1 Frame	FR	AME_3											
MST1 Lines		ACTIVE				в							
MST1 VBID	3												
MST1 MSA													
MST1 SDP													
MST1 BS													
MST1 BE													
L-Frames	300 43200	45600		8000	50400	52800	55200 5760	0					
LLCP		11111111111111		111111111	1111111111111111111		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	11111111111					
SR/Phy Sync													
VC													
Lane 0													
Lane 1													
Lane 2													
Lane 3													

When zoomed in more, *Wave Form View* shows the events in small vertical lines as shown in the image below. When you want to zoom into a certain event, make sure to keep the cursor on top of the event you want to inspect more in detail.

formations and a														
FrameView Reports Images														
Main Link Events Symbols Lo					Wave Forms Spatia	d View								
🔎 msa	×	🛃 🗆 Aa 🗆 RExp	3 / 20	NO	1 72	r3 F4	1 5		r6 r 7	MST TB	79	F10	F11 F12	F13
Type	Id	Position	Duration	^		AME (HDCP) 2	FRAME (H		FRAME (HDCP) 4	FRAME (HI		FRAME (HDCP) 6	FRAME (HDCP) 7	FRAME (HDCP
> LINE(960)	517	0:021.148.869.096	0:000.019.169.962	0:021.	OLQQ (> « » « »	3.4	H H						
> LINE(960)	518	0:021.168.039.059	0:000.019.019.347	0:021.				021.128.84	44.035 0.00	1.249.495.5	01.0.001	ack aca 701	0:021.490.797.9	5001 (11
> LINE(960)	519	0:021.187.058.407	0:000.018.934.165	0:021.		0:021.0	11111111	w21.128.8	44.275 0102	1.249.495.5			01021.490.797.9	
	520	0:021,205.992,573	0:000.019.010.706	0:021.	AUX Link						M87			
> LINE(960)		171 772 190 His 0:021.225.003.280	0:000.019.172.431	171 926	MST1 Frame		RAME (HDCP)						FRAME (HDC	
> LINE(960)	521	171 926 180 bits	155 300 bits	172 081	MST1 Lines	9 510 511	512 513 51	4 515 516 51	17 518 519 520 52	1 522 523 524	L0 L1 L2	2 13 14 15 16	L7 L8 L9 L10 L11 L1	2 L13 L14 L
> LINE(960)	522	0:021.244.175.712 172 081 480 bits	0:000.019.018.114 154 050 bits	0:021.	MST1 VBID	34								
> LINE(960)	523	0:021.263.193.827 172.235.530 bits	0:000.019.011.940 154 000 bits	0:021.	MST1 MSA									
> LINE(960)	524	0:021.282.205.768	0:000.019.169.962	0:021.	MST1 SDP MST1 BS					1 1 1				1 1 1
 FRAME(HDCP) 	4	0:021.301.375.731	0:009.999.849.226 #1 000.500 http	0:031.	MST1 BE	111	ΓĽΈ	ትትት	1111	111				
 ENCRYPTED(525 lines) 		0:021.301.375.731	0:009.999.849.226	0:031.	MST2 Frame MST2 Lines		684			TRAM	(HDCP)_2			
✓ LINE	0	0:021.301.375.731	0:000.018.366.276	0:021		0	004							
BS		0:021.301.375.731	148.770 http: 0:000.000.001.234	0:021.	MBT2 VBID	34								
		0:021.301.376.966	0:000.000.001.233	0:021.	MST2 MSA MST2 SDP							-		
VBID		0:021,301,462,149	0:000.000.001.234	172 544 0:021	MST2 BS									
MVID		172 545 510 His 0-021 301 463 384	17 6b 0:000.000.001.233	172.545	MST2 BE Link Frame/MTP	L254		FRAME 255	LINK FRAME 256	LINK FRAME	257 LINK	FRAME 258 LINK	FRAME 259 LINK FRAM	05 260 L
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d : 0:021.302.111.		72 550 769 bits 3 360 bits				0:021.3	01.696.30	021.301.7	00.115 0:02	1.301.703.8	97 0:021	.301.707.651	0:021.301.711.4	06D21.301
-					AUX									
ELD DEC HEX	BIT	'S			Link MST1 Lines						MST CP) 4 LINE	0		
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Active 37302 0x91B	5													
ctive 23920 0x5D7(otal 58341 0xE3E					MST1 MSA MST1 SDP							MSA		
otal 36280 0x8DB	3				MST2 Lines					FRAME (HDCP)	2 LINE(5760	0)_700		
tart 42002 0xA412 tart 15202 0x3B62					MST2 VBID	03								
ynWidth 65037 0xFE0 ynWidth 20447 0x4FD					MST2 MSA	4								
3C0 92 0x5C	010	11100			MST2 SDP									
SC1 179 0xB3	101	10011			Link Frame/MTP VC	SAM		STREAM 1				737 STREAM 2		,
				>	Symbols		MTPH	MSA Faylos	ed .	Pixels	W	CEE .	Pixels	14

When zoomed in more, the area shown in *Symbol View* is highlighted in *Wave Form View* with green color as shown in the image below.

ink Timeline Viewer *E:/YuriDonsko	/ucd_data/ca	pture_20240205_120	M15" [8100 Mbps, 4 la	ines]						
Options About										
ameView Reports Images										
fain Link Events Symbols Lo	g Events				Wave Forms Spatial Vie	w				
msa	×	🛃 🗆 Aa 🗆 RExp	3 / 20	N O				MST		
Type	Id	Position	Duration	^	1 F2 F3 F1 FRAME	F4 (HDCP) 2 E	F5 RAME (EDCP) 3	F6 F7 F8 FRAME (HDCP) 4 FRAME (HDCP) 5		F12 F13 P) 7 FRAME (HDCP)
> LINE(960)	517	0:021.148.869.096	0:000.019.169.962	0:021.	O L Q Q < >		A 14 M			
> LINE(960)	518	0:021.168.039.059	0:000.019.019.347	277.454 0:021.	G adary		1.686.836	0:021.301.706.636	0:021.301.720.603 0:021.301	.734.569021.301.7
> LINE(960)	E10	171 464 760 bits 0:021.187.058.407	0:000.018.934.165	0:021.						
> LINE(960)		171 618 820 Min 0:021.205.992.573	753 370 bits 0:000.019.010.706	0:021.	AUX			MST		
	320	171 772 190 ых 0:021.225.003.280	757 990 bits 0:000.019.172.431	0:021	MST1 Frame			FRAME (HDC	4	
> LINE(960)	136	171 926 180 bits	755.300 bits	172 061	MST1 Lines			LINE_0		
> LINE(960)		0:021.244.175.712 172.081.480 bits	0:000.019.018.114 /54 050 bits	0:021.	MST1 VBID	3				
> LINE(960)	522	0:021.263.193.827	0:000.019.011.940	0:021.	MS71 MSA	9			ИЗА	
> LINE(960)	524	0:021.282.205.768	0:000.019.169.962	0:021.	MST1 SDP					
		772 389 530 bits 0:021.301.375.731	755 280 bits 0:009.999.849.226	172 544 0:031.	MS71 BS MS71 BE					
 FRAME(HDCP) 	4	172 544 810 bits	87 000 500 MN 0:009.999.849.226	253 545 0:031.	MST1 BE MST2 Frame			FRAME (RDC)	2	
 ENCRYPTED(525 lines) 		0:021.301.375.731 172 544 810 bits	81 000 500 bits	253 545	MST2 Lines			LINE (5760)	00	
✓ LINE		0:021.301.375.731	0:000.018.366.276	0:021. 172.688	MST2 VBID	03				
BS		0:021.301.375.731	0:000.000.001.234	0:021.	MST2 MSA	ā.				
VBID		0:021.301.376.966	0:000.000.001.233	0:021.	MST2 SDP					
		172 544 820 bits 0:021.301.462.149	70 bits 0:000.000.001.234	772 544 0:021.	MST2 BS					
MVID		172 545 510 bits	10 bits	172 545	MST2 BE					
MAUD		0:021.301.463.384	0:000.000.001.233	0:021.	Link Frame/MTP	NO	STREAM		NO STREAM	737
MSA		0:021.301.696.712	0:000.000.414.805	0:021.	Lane 0		o sources	00EABDDC8904A6c00F47427235	NO DIMINI	
SDP 26		172 547 410 bits 0:021.302.267.070	3 360 Mes 0:000.000.649.368	0:021.	Lane 1					
307 20				>	Lane 2					
etails Image					Lane 3			00 6214 37E51EF5C3F712C8A5D8		
SA]				^	O ± < > « »	× >> •	Id bi		_	
art : 0:021.301.696. d : 0:021.302.111.		547 410 bits				b:021.301.6	0.0.051	0.031 301 303 003	0.001 201 202 526 0.001 201	211 00001 001 2
ration : 0:000.000.414.		3 360 bits						01021.301.703.897	0:021.301.707.679 0:021.301	
ELD DEC HEX	BITS				AUX					
ELD DEC HEX	BITS				MST1 Lines			MIT FRAME (HDCP) 4	LINE 0	
id 15371715 0xEA8 id 13331761 0xCB6					MST1 VBID	8		100000007		
ctive 37302 0x91B	5					4				
ctive 23920 0x5D7 otal 58341 0xE3E					MST1 MSA MST1 SDP				MSA	
otal 58341 UXE3E otal 36280 0x8DB					MST1 SDF MST2 Lines			FRAME(HDCP) 2 LIN	E(5760) 700	
tart 42002 0xA41 tart 15202 0x386	2				MST2 VBID	0		Lives (nect) + sta		
vnWidth 65037 0xFE0)				MST2 MSA	4				
ynWidth 20447 0x4FD SC0 92 0x5C		100			MST2 MSA MST2 SDP					
SC0 92 0x5C	01011				Link Frame/MTP				737	
SC1 179 0xB3	10110									

If you zoom in closer, into a line level view, you begin to see the lines the frame consists of.

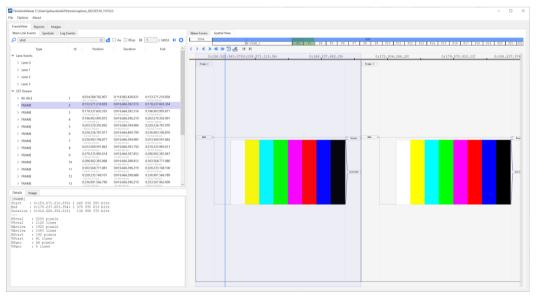
1 F2 F3	F4	F5	20 20						
		2.5	F6 F7	F8	F9	F10	F11	F12	F13
F1 FRAM	IE (HDCP) 2	FRAME (HDCP) 3	FRAME (HDCP)	4 FRAME (HDCP))5 F	RAME (HDCP) 6	FRAME	(HDCP) 7	FRAME (HDCP)
	0:053.385.			75.121.513					069053.628.20
AUX									

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

				4			MST									_
	F3 F4		F5	F6		F7	F8		F9	F10		F11	F12		F13	
F1 FR	AME (HDCP)_2	FRAM	E (HDCP)	3	FRAME (HD	CP)_4	FRAM	E (HDCP)	5 1	FRAME (HD	CP)_6	FRAM	E (HDCP)	7 FR	AME (HDCI	2)
} ± ⊕ ⊖ < ⇒	• « » « :	» 🗩 🚽	. II I	M												
	0:053.4		_			0.053	441.56	1 318	0.053	.441.56	7 548	0.05	8.441.5	73 703-909	3 441	51
					mhn											
AUX																_
Link								MST								-
MST1 Frame MST1 Lines								RAME (HDC) INE (960)								-
ASTI LINES	0						L.	INE(900)	_112							-
IST1 VBID	3															
IST1 MSA																
IST1 SDP																
IST1 BS																
IST1 BE																
IST2 Frame							E	RAME (HDCI	P)_4							Ē
ST2 Lines							LI	NE (5760)	619							Ĩ
ST2 VBID	9															
	4															
IST2 MSA																
IST2 SDP																
IST2 BS																
ST2 BE																
ink Frame/MTP		663 NO STREAM NO ST														
c		NO STR	EAM									NO STI	EAM			
ane O																
ane 1																
ane 2																
ane 3					54	43 6	5 A8	AA 05								
• • < > « >																l
ux ▶ ± < > ≪ >	0:053.4	41.552.	873				441.56	uulu	0:053	.441.56			3.441.5			
JUX Jink	0:053.4	41.552.	873					MST								
UX ink	0:053.4	41.552.	873					MST								
UX ink ST1 Lines	0:053.4	41.552.	873					MST								
UX ink ST1 Lines ST1 VBID	0:053.4	41.552.	873					MST								
UX ink ST1 Lines ST1 VBID C	0:053.4	41.552.	873				FRAME (HD	MST								
UX ink IST1 Lines IST1 VBID C ymbols	0:053.4	41.552.	873	84	76		FRAME (HD	MST	NE (960)_1							
UX ink IST1 Lines IST1 VBID C ymbols ane 0 ane 1	0:053.4	41.552.	873				FRAME (HD	MST CP) 7 LIN	NE (960)_1 CD_ADJ							
UX ink IST1 Lines IST1 VBID C ymbols ane 0 ane 1 ane 2	0:053.4	41.552.	873	84 FF CF	76 53 65	FEC_PAIR 9F 64 F9	FRAME (HD	MST CP) 7 LIN 7D 05 FE	NE (960)_1 CD_ADJ A5 85 85							
UX ink IST1 Lines IST1 VBID C ymbols ane 0 ane 1	0:053.4	41.552.	873	84 FF	76 53	FEC_PAIR 9E 64	FRAME (HD)	MST CP) 7 LIN 7D 05	NE (960)_1 CD_ADJ A5 85							
UX ink IST1 Lines IST1 VBID C ymbols ane 0 ane 1 ane 2	0:053.4	41.552.	873	84 FF CF	76 53 65 43	FEC_PAIR 9F 64 F9 65	FRAME (HD	MST CP) 7 LIN 7D 05 FE	NE (960)_1 CD_ADJ A5 85 85 85 05				NO STREA	M		5
UX ink STI Lines STI Lines C ymbols C ymbols ane 0 ane 1 ane 2 ane 3 hy Lane 0	0:053.4	M 1A9/C9 D9.6- BE	873	84 87 CF 54 2D4/84	76 53 65 43 316/76	FEC_PAIR 9F 64 F9 65 2CA/9F	FRAME (HD 68 80 80 80 80 80 80 80 80 80 80 80 80 80	MST CE) 7 LII 7D 05 FB AA 31D/7D	NE (960)_1 CD_ADJ A5 85 85 85 05 165/A5	0E8/77 D23.3+	247/27 D7.1-	1E3/E3 D3.7-	NO STREA	M 262/3D D29.1+	195/DS D21.6-	5
UX ink ST1 Lines ST1 VBID C ymbols ane 0 ane 1 ane 2 ane 3	0:053.4	M 1A9/C9 D9.6- BE 1B2/D2 D18.6-	25E/3E D30.1- 30.1- 30.7 7.4+	84 EF CF 54 2D4/84 D4.4+ 235/FF	76 53 65 43 316/76 D22.3+ 293/53	FEC_PAIR 97 64 79 65 2CA/9F D31.4+ 32B/64	68 68 80 80 80 80 80 80 83 80 83 8 98.3 8 149/80	MST CP) 7 LII 05 FE AA 31D/7D D29.3- 365/05	NE (960)_1 CD_ADJ A5 85 05 165/A5 D5.5- 125/85	0E8/77 D23.3+ 7A 2A3/43 D3.2-	247/27 D7.1- 32D/62 D2.3-	1E3/E3 D3.7- DF 0AC/0C D12.0+	NO STREA 332/72 D18.3+ CA 255/35 D21.1-	M 262/3D D29.1+ 44 1A5/C5 D5.6-	195/D2 D21.6- 0C 253/33 D19.1-	3

Spatial View

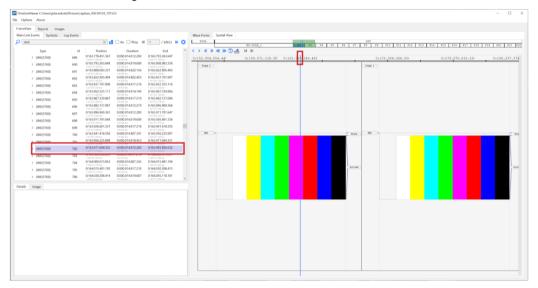
Spatial view shows the geometry of the frame.



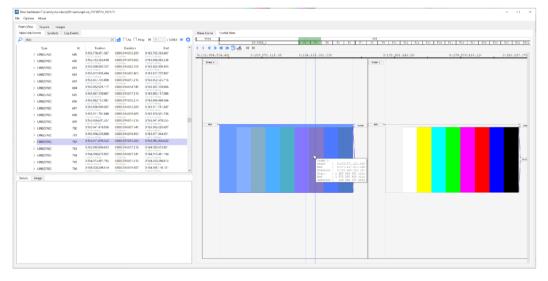
If you select a frame in *Event Selector* the frame will be shown in *Spatial View* as shown in the image below.

Innetineviewer Chlosen/juh le Options About	eskol#9/ictore/,capture_20230/24	101528							- 0
FrameView Reports In									
Main Link Events Symbol				Wave Forms Spatial View					
vbid 🔍	×	🛃 🗌 Aa 🔄 NDop 🕅	1 / 34853 🕨 🔇	7154	10 IDLS 1	72 72 74 75 76	847 17 70 79 710 711 712	F12 F14 F15 F16 F17 F18	#10 #20 #21
Тура	Id Position	Duration	End ^	<>< > < > < > < > < > < > < > < > < > <	🚓 нін 🕨				
✓ Lane Events				C:153.565.395.439	0:159.571.118.36	0:166.237.692.28	0:172.904.246.204	0:179.570.810.124	0:186.237.3
> Lane 0				Atlant 2			Finite 2		
> Lane 1									
> Lane 2									
> Lane 3									
¥ SSI Stream									
> BC IFIE	4 0.034.588.782.	07 0.118.982.428.831	0.153.571.210.838						
> FRAME	2 0:153.571.2103	839 0:016.565.392.515	0:170.237.603.354						
7 75538	3 1 20 50 50 50	104 994 340 800	152874914						
> FRAME	4 0:186.903.9953								
> FRAME	5 0.203.570.392.0		0220236767.076						
> FRAME	6 0220236787		0236.903 196.876	NO			lank Mile		
> FRAME	7 0.236.903.1963	CRE.NEE.666.61010 VVI	0253.569.591.862						
> FRAME	u 0.253.560.591.0	163 0:016.565.393.750	0270235565.613						
> FRAME	9 0.270.235.905.0		0.286.902.383.067						
> FRAME	10 0.286.902.383.0	068 0:016.565.388.812	0303.553.771.880						
> FRAME	0.303.568.771.8	81 0:016.565.396.219	0.320.235.168.100			24	sivel		24
> FRAME	12 0.320.235.168.1	001 0.016.565.398.503	2 202 201 202 kits 0 336-901 566 789						
7 1990	12 2 50 1 N 2 10 km		272839-62914s						
Details Image									
[FRAME] Start + 0+153,571	.210.839/ 1 243 932 250 b	ite							
End : 0:170,237	.603.354/ 1 378 930 619 h .392.515/ 134 998 370 h	i.to							
		11.124							
NTotal : 2200 pim VYotal : 1125 lin	15								
EActive : 1920 pix VActive : 1080 lin									
HStart : 192 pixe. VStart : 41 lines	Lo								
RSync : 44 pixel									
VSync : 5 lincs									

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



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



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

M Timel IndViewer CAlibard	Apiha eskolat/Picture/Jcz	schure_28230724_101	523							11 ->
File Options About										
FrameWaw Haports										
Main Link Events Sym	whols log Events					ns Spatial View				
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Type	ld	Position	Duration	[rd ^	< > «	(»«(»Э) 🔏 ин				
VEID		0.1535/1215///	0.000.000.001.234	0(153.5/1.217.011	0:154.7	0:159.571.110.36	0:166.237.602.201	0:172.504.246.20	0:179.570.010.12*	0:106.237.376
MVD		0.153.571,217.012	0.990.000.991.233	0.153.571.218.245	Trans			Fran 1		
		0.1535/1.218.246	0.000.000.001.234	0.153.5/1.219.480						
MSA		0.153.571.231.827	0.000.000.011.110	0.153.571.242.957						
> LNL		L NET THE REPORT	DE OPTING	120 IN						
> LINE	2	0.153 600.790 957		0:153.515.597.064						
> INF	3	0153.615.597.065	0.000.014.817.218	0:153.630.414.203						
> LINE	4	0.153.630.414.284	0.000.014.812.290	0.153.645.226.564						
> LINE		0:153.645.226.565	0:000.014.017.213	0:153.560.043.763						
> UNE		0.153.660.043.784	0-000.014.812.290	0:153.5/4.855.064						
> 104	-	0.153.674.056.065	0:000.014.017.218	0:153.509.673.203						
> UNE		0.152.68367.6.284	0:000014.012.514	0:15.0.704.486.758	-			RIAN MALE -		111
> LINE		0.153.704.486.299				start : 0:150.571.201.027/ 1 243 902 420	bits			
> UNE	10	0153719,004.016	0:000.014.004.073	0:153.734.100.891		Ful : 0:153.571.242.987) 1 243 987 507 Duration : 0:000.000.011.110/ 00	bit.s			
	11	0153734308.892		0153746826110		FIGLD DEC NEX SETS				
> UNE	12	0152740.926.111	0000.014.012.200	0:153.763.738.391		291d 6007 0x1277				
		0153763738392	0:000.014.818.453	0.153.778.556.845		swid 52760 0x0000 Bhotive 1920 0xVED				A47.0
> UNE	13	0.153.770.556.046		0:153,793,369,125		WACTIVE 1000 00433 MDeLa1 3200 04998				
> UNE	14	CARLESS MEAN	01/01/56	INTERNA V		wrotal 1125 0x065 RELevit 102 0x06				
Details Image						VStart 41 0x29 VSYMMidth 5 0x5				
[HIA] Start : 0:153.1	571.231.027/ 1 2	43 932 420 51-		^		WTy+06 mL+ 44 0x2C 00200 0000000				
End : 0:153.5 Duration : 0:000.0	571.242.937; 1 2	43 932 509 bit 90 pit				what e out southing				
			3			MIDCO.Synchronous Clock: Link clock and mai MISCI.interlaced vertical Total system surple	r of lines per interlaced frame (consisting	of two fields) is an odd number		
FIELD DEC	HEX BIJ					MISCL.STORCE VIGOO ATTRIBUTO: NO SD STORCE				
wwid 6027 Wid 32760	0×1777 0×0000					MIDC.Colorimetry Format Value: 1 Do MIDC.Colorimetry Format: 365 unspecified of	1 CODECCI Nor space (Legary Hill mode), i kpc, Napo			
EActive 1970	0x780									
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VSiari 41 VSynWigth 5	0x29									
ESynaticth 44	0x20									
MISU0 32 MIDC1 0	0x20 001 0x0 000	00000								
MIGCO. Synchronous	Clock: Link clo	ck and main vie	deo stream clock	are asynchronous.						
MISCL.Interlaged 1	Vertical Total 7	went Thinker of	lines per inter	laced frame (consisting Y						

Symbol View

In addition to *Wave Form View*, *Symbol View* shows symbols from the PHY lanes. Identically to *Wave Form View* you can scroll the *Symbol View* by clicking it, holding and dragging or by using the arrow keys.

MST2 VB1D	34															
MST2 MSA																
MST2 SDP																
Link Frame/MTP															3	25
VC	S	TREAM			STRE	AM 1					STRE	AM 2				
Symbols				MTPH	BS	VBID	Pix	els	VCPF				Pixels			
Lane 0				00	CO	E1	AE	12	CO	78	CC	B3	7D	70	B2	75
Lane 1				00	CO	C2	9D	2C	C1	DO	72	45	AO	E7	AE	F4
Lane 2				00	CO	94	A5	49	C2	11	DC	FF	7F	D5	1D	2C
Lane 3				00	CO	60	33	86	C3	2F	00	50	70	CE	1D	A8
Phy Lane 0	3	11B/9B D27.4- CC	2AA/4A D10.2- A8	26A/2A D10.1- 00	05E/FE K30.7-	0E5/65 D5.3- E1	347/07 D7.0- AE	332/72 D18.3+ 12	143/5C K28.2+	199/D9 D25.6- 78	2B5/5F D31.2- CC	191/C1 D1.6+ B3	0AE/01 D1.0- 7D	167/A8 D8.5- 70	125/85 D5.4+ B2	2D5/ D21. 75
Phy Lane 1	3	1C6/E0 D0.7+ B7	1A6/C6 D6.6- 24	26A/2A D10.1- 00	3A1/FE K30.7+	2A6/46 D6.2- C2	274/34 D20.1- 9D	2AC/4C D12.2- 2C	343/1C K28.0+	331/71 D17.3+ D0	1D1/E1 D1.7+ 72	268/37 D23.1+ 45	19C/DC D28.6- A0	275/3F D31.1- E7	119/99 D25.4+ AE	374/3 D20.0 F4
Phy Lane 2	7 -	0EC/6C D12.3- 3B	3B4/F4 D20.7- 16	26A/2A D10.1- 00	3A1/FE K30.7+	349/10 D16.0+ 94	0AC/0C D12.0+ A5	269/29 D9.1- 49	05B/FB K27.7-	176/B0 D16.5- 11	285/4F D15.2+ DC	2CD/8D D13.4- FF	0A3/03 D3.0+ 7F	34D/0D D13.0- D5	26A/2A D10.1- 1D	1AC/0 D12.0 2C
Phy Lane 3	3	35A/1A D26.0- 4D	2E8/97 D23.4+ 75	26A/2A D10.1- 00	3A1/FE K30.7+	1D4/E4 D4.7+ 60	11A/9A D26.4+ 33	1E6/E6 D6.7- 86	3A8/F7 K23.7+	10E/8E D14.4+ 2F	135/9F D31.4- 0C	26D/22 D2.1- 50	0AC/0C D12.0+ 70	356/16 D22.0- CE	26A/2A D10.1- 1D	298/4 D8.2 A8

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

Link Symbols

																-	
S	TREAM			STRE	IAM 1						STRE	AM 2					
			MTPH	BS	VBID	Pix	els	VC	/CPF Pixel:								
			00	CO	El	AE	12	C	0	78	CC	B3	7D	70	B2	75	
			00	CO	C2	9D	2C	C	1	DO	72	45	AO	E7	AE	F4	
			00	CO	94	A5	49	C	2	11	DC	FF	7 F	D5	1D	2C	
			00	CO	60	33	86	C	3	2F	00	50	70	CE	1D	AS	
3	11B/9B	2AA/4A	26A/2A	OSE/FE	0E5/65	347/07	332/72		/5C	199/D9	2B5/5F	191/C1	0AE/01	167/A8	125/85	2D5/95	
	D27.4-	D10.2-	D10.1-	K30.7-	D5.3-	D7.0-	D18.3+	K28	.2+	D25.6-	D31.2-	D1.6+	D1.0-	D8.5-	D5.4+	D21.4-	
	CC	AS	00		E1	AE	12			78	CC	B3	70	70	B2	75	
									10b	symbol	: 0x143	(0101000	011)				
3	1C6/E0	1A6/C6	26A/2A	3A1/FE	2A6/46	274/34	2AC/4C	343	8b :	symbol	: 0x5C		DC	275/3F	119/99	374/14	
	D0.7+	D6.6-	D10.1-	K30.7+	D6.2-	D20.1-	D12.2-	K28	Symi	bol code	: K28.2+	-	6-	D31.1-	D25.4+	D20.0-	
	B7	24	00		C2	9D	2C		Des	cramble :	index : 2	0804 0x	5144	E7	AE	F4	
7	OEC/6C	3B4/F4	26A/2A	3A1/FE	349/10	0AC/0C	269/29	051	Sta:	rt :		1.532.83		34D/0D	26A/2A	1AC/CC	
F.	D12.3-	D20.7-	D10.1-	K30.7+	D16.0+	D12.0+	D9.1-	K21	End			1.534.07		D13.0-	D10.1-	D12.6-	
	3B	16	00		94	A5	49			ation :		0.001.23		D5	1D	2C	
									Sta:	rt :		640 bit					
3	35A/1A	2E8/97	26A/2A	3A1/FE	1D4/E4	11A/9A	1E6/E6	3A8	End		10 542	649 bit		356/16	26A/2A	298/48	
F	D26.0-	D23.4+	D10.1-	K30.7+	D4.7+	D26.4+	D6.7-	K23	Dura	ation :		10 bit	s 0+	D22.0-	D10.1-	D8.2+	
	4D	75	00		60	33	86			2F	00	50	70	CE	1D	A8	

The lower part of the **Symbol View** describes the distribution of link symbols in the physical link lanes. You can see the individual bits above the symbol blocks. When you hover your mouse over a symbol, a window appears presenting details of the selected symbol. The details include:

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

For clarity, the position of control symbols and and payload of link events is marked with a gray bar on top of the corresponding link symbols.

010101010100
A0/AA0
D10.0+
00

Each individual block contains the following information

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

Scrambling

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

	01001000	1101001101	0001011100	0111101010	1011001010	0101001010	10101101010
)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	10101101010
)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	10101101010
)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	01010001010
	LCB/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 *Symbol View* with a light green color. CD_ADJ symbols are highlighted with light red color.

	В9						
	B1	3C			бA		
	94	42		AO	2A		
	94	42		AO	2A		
01	1001101010	1110001100	1001011101	1001001101	0100111010	1100010001	10
D	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+	
10	1000111010	0011101001	1100010010	0110110010	0101011100	1110010011	01
C	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-	
10	0010110010	1011010101	0011001110	0110001010	0101011001	1010011011	01
C	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-	
10	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
	220.11	2212	22	20101	220.1	20.0	

SDP

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

										SST				
									BS-IDI	LE 1 LINE	_3			
							SDP	01_7						
	SS													SE
	5C	00	60	00	01	2C	00	В4	00	80	00	00	7F	FD
	5C	01	07	00	01	2C	00	В4	00	80	00	00	7F	FD
	5C	47	D5	00	01	2C	00	В4	00	80	00	00	7F	FD
	5C	18	31	00	01	2C	00	В4	00	80	00	00	7F	FD
.0	1100001010	1100011100												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	В4	00	80	00	00	7 F	
. 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	7F	
. 0					0011100110								0101101010	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	0011110101						1011100010							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
00	101011011	0001010111	1100010001	0011101001	0110100101	1001011001	1100011010	1110001100	0110110100	0111001110	1100010101	1000010111	01000110100
	36A/0A	3A8/F7	223/E3	25C/3C	296/56	269/29	163/A3	0C7/67	0B6/10	1CE/EE	2A3/43	3A1/FE	162/BD
	D10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+
	00		00	00	00	00	00	00	00	00	00		00
00	101010100	1110101000	1100011110	0011101001	0110100101	1001011001	1100011010	0001110011	1001001011	0111001000	1100010101	0111101000	10111010100
	A0/AA0	057/F7	1E3/E3	25C/3C	296/56	269/29	163/A3	338/67	349/10	04E/EE	2A3/43	05E/FE	15D/BD
	D10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	K30.7-	D29.5-
	00		00	00	00	00	00	00	00	00	00		00
00	101010100	1110101000	1100011110	0011101001	0110100101	1001011001	1100011010	0001110011	1001001011	0111001000	1100010101	0111101000	10111010100
	A0/AA0	057/F7	1E3/E3	25C/3C	296/56	269/29	163/A3	338/67	349/10	04E/EE	2A3/43	05E/FE	15D/BD
	D10.0+	K23.7-	D3.7-	D28.1-	D22.2-	D9.1-	D3.5-	D7.3+	D16.0+	D14.7+	D3.2-	K30.7-	D29.5-
	00		00	00	00	00	00	00	00	00	00		00
00	101011011	0001010111	1100010001	0011101001	0110100101	1001011001	1100011010	1110001100	0110110100	0111001110	1100010101	1000010111	01000110100
	36A/0A	3A8/F7	223/E3	25C/3C	296/56	269/29	163/A3	0C7/67	0B6/10	1CE/EE	2A3/43	3A1/FE	162/BD
	D10.0-	K23.7+	D3.7+	D28.1-	D22.2-	D9.1-	D3.5-	D7.3-	D16.0-	D14.7-	D3.2-	K30.7+	D29.5+
	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
		1100001010	1010110001	0011100110	1110100100	0110110110	1000111010	0010111001	0101010110	0011100101	1001101001	0100010111	01101001101
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
001111010	1100001010	0011110101		0011100110	0001011011	0011000110	1001011110	1001001001	0110011101	0011100101			01101001101
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	0011110101	0101001110	0011100110	0001011011	0101000110	1001011010	0010111001	1110100010	0011100101		0100010111	01101001101
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
		0011110101			0001011011	0011000110	1001011010	0110111001	1010001101	0011100101			01101001101
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

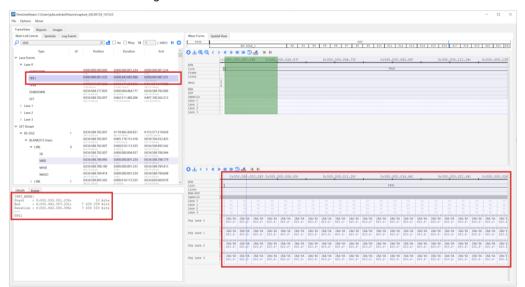
VBID

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.

	s										
ain Link Events Symbols	Log Events				Wave Forms Sp	atial View		887			
vbid		×	🛃 🗌 Aa 🗌 RExp	H 1 / 34953 N 🔇	1984	BS-IDLE_1 F	2 83 84 85		9 F10 F11 F12 F13	F14 F15 F16 F17	F18 F19 F20 F2
Туре	Id	Position	Duration	End	OLQQ	> « » « » 🕄 🛃 🕴	₽I				
Lane Events						0:034.588.738.711	0:01	4.588.787.73	0:034.588.815.	892 0:034.588	.844.000034.588.
SST Stream					AUX Link	UNDICARN				788	
✓ BS-IDLE	1	0:034.588.782.007	0:118.982.428.831	0:153.571.210.838	Frame	UNIONORIE				BS-IDLE	1
 BLANK(512 lines) 		0:034.588.782.007	0.005.178.151.418	0.039.766.933.425	Lines	0		-		LINE_0	
✓ UNE	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			2			
MVID		0:034.588.788.180	0:000.000.001.233	0.034.588.789.413	Lane 1						
MAUD		0:034.588.789.414	0.000.000.001.234	0:034.588.790.648	Lane 2 Lane 3						
> LINE	1	280 170 420 bits 0:034.598.895.543	0.000.010.113.535	0.034.609.009.078							
> UNE	2	0:034.609.009.079	0:000.010.113.535	0:034.619.122.614							
> LINE	2	0:034.619.122.615	0.000.010.113.535	0:034.629.236.150							
		0:034.629.236.151	0:000.010.113.535	0:034.639.349.686							
> LINE	4										
		280-498 040 bits 04024 620 240 687	81 020 hits 0 0000 010 112 525	200 579 999 Mile 0-024 640 462 222							
> LINE	5	0:034.639.349.687	0:000.010.113.535	0:034.649.463.222							
> LINE	6	0:034.639.349.687 200 577 590 Min 0:034.649.463.223 200 601 600 Min	0:000.010.113.535 51 525 http 0:000.010.113.535 51 525 http	0:034.649.463.222 200 501 673 561 0:034.659.576.758 200 747 799 561							
> LINE > LINE	6 7	0:034.639.349.687 200 577 980 bets 0:034.649.463.223 200 601 600 bets 0:034.659.576.759 200 767 600 bets	0.000.010.113.535 d1 025 bits 0.0000.010.113.535 d1 025 bits 0.0000.010.113.535 d1 025 bits 0.0000.010.113.535	0:034.649.463.222 200 001 073 bols 0:034.659.576.758 200 707 799 bols 0:034.669.690.294 200 007 73 bols							
> UNE	6	0:034.639.349.687 200 570 960 860 0:034.649.463.223 200 961 880 866 0:034.659.576.759 200 741 800 866 0:034.669.690.295 200 82 720 866	0:000.010.113.535 d1 205 bits 0:000.010.113.535 d1 205 bits 0:000.010.113.535 d1 205 bits 0:000.010.113.535 d1 205 bits 0:000.010.113.535 d1 205 bits	0.034.649.463.222 200 507 3 km 0.034.659.576.758 200 707 3 km 0.034.669.690.294 200 507 73 3 km 0.034.679.803.830 200 507 737 3 km	0+<>	» « » Э 😤 н н					
> LINE > LINE	6 7	0:034.639.349.687 20:579.900 hm 0:034.649.463.223 20:051.000 hm 0:034.659.576.759 20:024.669.690.295 20:057.700 hm 0:034.669.803.831 20:027.00 hm	0:000.010.113.535 d1 acto bits 0:000.010.113.535 d1 acto bits 0:000.010.113.535 d1 acto bits 0:000.010.113.535 d1 acto bits 0:000.010.113.535 d1 acto bits 0:000.010.113.535 d1 acto bits 0:000.010.113.535	0.034.649.463.222 200 06 77 bio 0.034.659.576.758 200 78 bio 0.034.669.9562.294 200 07 19 bio 0.034.669.9502.294 200 07 19 bio 0.034.669.9173.366 200 087 25 bio 0.034.669.9173.366 200 087 25 bio 200 087 25 bio	0 ∓<>∢	» ≪ ≫ 3 🛃 14 M 0-034.588.781.113	0:01	4 588.788.471	0:034.588.792.	29! 0:034,588	.796.10,034.588.
> LINE > LINE > LINE	6 7 8	0.034.639.349.687 200 579 900 am 0.034.649.463.223 200 501 800 am 0.034.659.576.759 200 501 800 am 0.034.669.690.295 200 507 700 am 0.034.679.803.831	0:000.010.113.535 d1:000.010.113.535 d1:000.010.113.535 d1:000.010.113.535 d1:000.010.113.535 d1:000.010.113.535 d1:000.010.113.535	0.034.649,463.222 203.07 (27) 30 203.07 (27) 30 203.07 (27) 30 203.6659.576,758 203.87 (27) 30 203.87 (2	AUX		0:0:	4 588.788.474		29. 0:034.588	.796.12.034.588.
> LINE > LINE > LINE > LINE > LINE > LINE	6 7 8 9	0:034.639.349.687 20:379.900 km 0:034.649.463.223 20:051 800 km 0:034.659.576.759 20:051 800 km 0:034.669.902.95 20:057 20 km 0:034.669.917.367 0:034.659.917.367	0.000.010.113.535 d1 20 hb 0.000.010.113.535 d1 20 hb 0.000.010.113.535 d1 20 hb 0.000.010.113.535 d1 20 hb 0.000.010.113.535 d1 20 hb 0.000.010.113.535 d1 20 hb 0.000.010.113.535	0.034.649.463.222 0.034.659.576.758 200746 079 350 200746 059.5576.758 200746 059.5690.294 20054 6579.203.830 200746 759.203.830 20054 6579.203.830 20054 659.917.366 20054 639.558 20054 639.258 20054 700.258 20054 700.2	AUX Link Lines		0:01	4 588.788.474	0:034.588.792. 887 85-TOLE 1 1		.796.12,034.588.
> LINE > LINE > LINE > LINE > LINE > LINE alls Image Y. SYMOD.]	6 7 8 9 10	0.034.639.349.687 2015 Sty 100 Jan 20134.649.63.223 201611 400 Jan 0.034.659.576.759 2016 2016 0.034.659.576.759 2016 2016 0.034.659.950.295 2016 2016 0.034.659.917.367 20134.659.917.367 20134.659.917.367	0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0113.535 31 00000 010.113.535 31 00000 010.113.535	0.034.649.463.222 0.034.659.576.758 200746 079 350 200746 059.5576.758 200746 059.5690.294 20054 6579.203.830 200746 759.203.830 20054 6579.203.830 20054 659.917.366 20054 639.558 20054 639.258 20054 700.258 20054 700.2	AUX Link		0:0	4 588.788.47	897		.796.12) 034.588.
> LINE > LINE > LINE > LINE > LINE > LINE > LINE 3/15 Image 7_SYMDDL] TT : 0:034.588.78	6 7 8 9 10	0034.639.349.687 0034.649.463.223 0034.659.576.759 0034.659.576.759 0034.659.902.295 0034.679.003.831 0034.679.003.831 0034.679.003.831 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.659.576.59 0034.679.003.831 0034.679.0034.679.0034 0034.679.0034.679.0034.679.0034 003	0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0000.010.113.535 31 00000 0113.535 31 00000 010.113.535 31 00000 010.113.535	0.034.649.463.222 0.034.659.576.758 200746 079 350 200746 059.5576.758 200746 059.5690.294 20054 6579.203.830 200746 759.203.830 20054 6579.203.830 20054 659.917.366 20054 639.558 20054 639.258 20054 700.258 20054 700.2	AUX Link Lines MSA/SDP Symbols Lane 0	0:034.568.701.113	VBID : 10 19	HVID NAUD	33T B5-IDLE 1 L	INE_0 DUMMY 0 00 00	00 00
> LINE > LINE > LINE > LINE > LINE > LINE 315 Image Y_SYMDOL1 rt : 0:034.580.70 : 0:034.580.71	6 7 8 9 10 5.945; 2 3.179; 2	0.034.639.349.687 2015 Sty 100 Jan 20134.649.63.223 201611 400 Jan 0.034.659.576.759 2016 2016 0.034.659.576.759 2016 2016 0.034.659.950.295 2016 2016 0.034.659.917.367 20134.659.917.367 20134.659.917.367	0000.010.113.535 31.003/0 0000.010.113.535 31.003/0 0000.010.113.535 31.003/0 0000.010.113.535 31.003/0 0000.010.113.535 31.003/0 0.000.010.113.535 31.003/0 0.000.010.113.535	0.034.649.463.222 0.034.659.576.758 200746 079 350 200746 059.5576.758 200746 059.5690.294 20054 6579.203.830 200746 759.203.830 20054 6579.203.830 20054 659.917.366 20054 639.558 20054 639.258 20054 700.258 20054 700.2	AUX Link Lines MSA/SDP Symbols Lane 0 Lane 1 Lane 2	0:034.568.701.113	VBID 2 1C 19 3 1C 19 3 1C 19 3 1C 19	HVID NAUD 00 00 00 00 00 00	88T B5-IDLE 1 L 00 00 0 00 00 0 00 00 0	INE_0 DUMMY 0 00 00 0 00 00	00 00 00 00 00 00
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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.

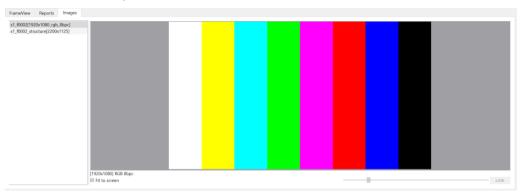


The image below illustrates the transition from TPS1 to TPS4.

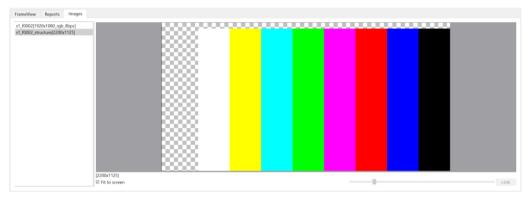
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AUX																		
Link			TPS1													TPS4		
Lines																		
MSA/SDP																		
Symbols																		
Lane 0										10	BC	BC	1C	00	00	00	00	00
Lane 1										1C	BC	BC	1C	00	00	00	00	00
Lane 2										1C	BC	BC	1C	00	00	00	00	00
Lane 3										1C	BC	BC	1C	00	00	00	00	00
Phy Lane 0	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	0101010101 2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	0101010101 2AA/4A D10.2-	2AA/4A D10.2-	0101010101 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	1001110110 1B9/C0 D0.6- 00	0B4/14 D20.0+ 00	172/B2 D18.5- 00
Phy Lane 1	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-		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-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	0BC/1C K28.0-		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
				010101010101				0101010101		0011110100			0011110100	1010110001	1110100100		00010110100	
Phy Lane 3	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	2AA/4A D10.2-	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

Images Tab

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



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

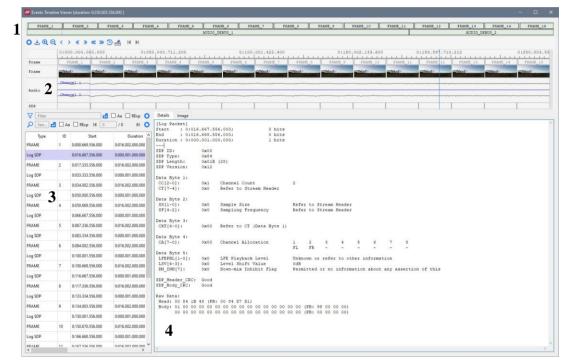


7. EVENT TIMELINE VIEWER

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

Event Timeline Viewer consists of four areas.

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



Frame View

FRAME_1	FRAME_2	FRAME_3	FRAME_4	FRAME_5	FRAME_6	FRAME_7	FRAME_8	FRAME_9	FRAME_10	FRAME_11	FRAME_12	FRAME_13	FRAME_14	FRAME_15
AUDIO_DEBUG_1											AUDIO_DE	BUG_2		
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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

	0:000.000.0	00.000	0:050	.000.711.200		0:100	.001.422.400		0:150.	.002.133.600		0:193.897	.710.212		0:250.003.
rame	FRAME_1	FRAME_2	FRAME_3	FRAME_4	FRAME_S	FRAME_6	FRAME_7	FRAME_0	FRAME_9	FRAME_10	FRAME_11	FRAME	12 FRAME_13	FRAME_14	FRAME_15
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adio	Chennel 2														

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.

timeline

<u>Tools</u>

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Tool		Function
Gear Icon		Hide / add events on the timeline
🛃 Save Icon		Save, load, remove, import, export and remove presets
e Q 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

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

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

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	0.000.075.558.000	0.000.000.001.000	0:000.075.559.000	- Dacket Meaday	
				Packet Length: 13	
4				Version: 2	
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	0.000.125.556.000	0.000.000.001.000	0:000.125.557.000	SBB (56:71) 0 ELB (72:87) 0	
	0:000.125.558.000	0.000.000.001.000	0:000.125.559.000	SRB(88:103) 0	
	4	ID Start 3 0000079.998.000 0000079.998.000 000075.556.000 0000075.556.000 0000075.556.000 4 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.556.000 0000075.256.000 0000075.256.000 0000075.256.000 0000075.256.000 0000075.256.000 000075.256.000 0000075.256.000 000075.256.000	D Start Duration 0 000019-488.000 000016.000000 000019-556.000 0000000101000 0000075-558.000 000000010000 0000075-558.000 00000000000 0000075-558.000 000000000000 0000075-558.000 000016.000000 0000075-558.000 000016.000000 0000075-558.000 000016.000000 0000092-258.001 00001000.001000 0000092-258.001 00001000.001000 00000192-258.000 0000000.001000 0000108-878.000 0000000.001000 0000108-878.000 00000000.001000 0000108-872.000 00000000.001000 0000108-872.000 00000000.001000 0000108-872.000 00000000.001000 0000108-872.000 00000000.001000 00000125-5556.000 00000000.001000	D Start Duration End 3 0000075-9680.000 0000075-9680.000 0000075-9680.000 0000075-9680.000 0000075-5596.000 00000076-000.000 0000075-9590.000 0000075-9590.000 0000075-5596.000 00000076-000.000 0000075-5590.000 0000075-5590.000 0000075-5596.000 0000076-000.000 0000072-5590.000 0000072-2580.000 0000076-1540.000 0000016-000.000 0000072-2240.000 00000072-2240.000 0000078-2225.000 00000000-00.000 00000-002.272.010 0000000-227.011 5 0000078-224.000 000000-001.000 00000-002.272.011 0000000-00.000 00000-002.272.011 6 000000-001.000 00000-001.000 00000-002.272.011 000000-001.000 00000-002.272.011 6 00000-001.000 00000-001.000 00000-001.000 00000-002.000 00000-002.000 000000-001.000 00000-001.000 00000-001.000 00000-002.000 00000-002.000 00000-001.000 0000-004.000.000 00000-002.000 0000-004.0000 0000-004.0000 00000-004.0000 0000-004.00000	Dest Duration File File

Event Log

Type	ID	Start	Duration	End	Info	i.
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

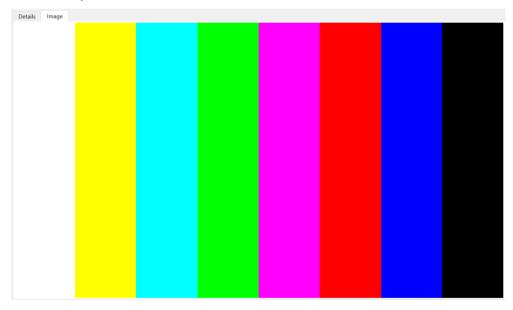
P Search Search	Search events from the event log. Search results are highlighted in purple.
Apply search filters	Apply filters.
Aa RExp Search filters	Aa filter: Make search case sensitive RExp: Use regular expressions in search
K 7 /12 Search results	Shows search results. Move from one search result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

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Details / Image

Details Image		
[Log Packet]		^
Start : 0:000.092.225.000;	0 bits	
End : 0:000.092.226.000;	0 bits	
Duration : 0:000.000.001.000;	1 bits	
Packet code: 0x82		
Packet Header:		
Packet Length:	13	
Checksum:	57	
Version:	2	
Packet Data:		
Scan Info(0:1)	0(No Data)	
Bar Data(2:3)	0(Not present)	
Format Info(4)	0 (Not present)	
Color Space(5:7)	0 (RGB)	
AFD Aspect (8:11)	8((ATSC: Same as Picture Aspect Ratio) (DVB: As the coded frame))	
Coded frame AR(12:13)	0(No Data)	
Colorimetry (14:15)	0(No Data)	
Non-U Scaling(16:17)	0(No Known non-uniform scaling)	
RGB Quant(18:19)	0(Default (depends on video format))	
E-Colorimetry(20:22)	0(No data)	
ITC Content(23)	0(No Data)	
VIC(24:31)	16	
Pixel 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 00 038	
00 00 00		~

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



8. EVENT LOG

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

UCD Console - UCD-500 [2306C	563]: DisplayPort	Source and Sink					– 🗆 X
File Tools Window Help DP TX DP RX Event Log							
DP TX DP RX Event Log Start Stop					Load	Save Report	Open Timeline Viewer
	Filter:				Load	*	Open Inneine viewei
DP RX	Search:				< 0 /0	> *	
	ur Type		Start			Info ^	
SDP							
VB-ID							
□ MSA							
Link Pattern							
AUX_BW							
VFRAME INFO							
Select all							
DP TX							
Select all							
Select all							
	<					~	
AutoScroll Clear	Clear on Start	Colors E	vents (filtered / parsed	/ captured): 0 / 0 / 0		>	
💼 online							.4

Role	Logged Events
DP Sink DP Alt Mode Sink	HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW
DP Source DP Alt Mode Source	HPD, AUX
DP Alt Mode Sink DP Alt Mode Source	PD, LSE

Start:	Starts event logging and stop it by clicking Stop.
Save:	Save transactions as Event Log data as binary or as CSV
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. Refer to chapter seven of this manual for detailed instructions.
AutoScroll:	When selected, the transaction list is automatically scrolled vertically, and the latest transaction is shown as the last item of the list. When not selected, the items shown before clicking Start will be shown.
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. HPD Trace, HPD De-assert to HPD Assert interval.

AUX

Log DP AUX Channel transactions and Sideband Messaging.

SDP

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

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 CopyManagement [5] Copy (1) Copy (1) CopyManagement [5] Copy	
Audio_TimeStamp [1]	
SRC [6] V VSC [7] Camera Generic CG0 [8] CG1 [9] CG2 [A] CG3 [0] V CG4 [C] CG5 [D] CG6 [E] CG7 [F] Picture Parameter Set [10] V VSC_EXT_VESA [20] V VSC_EXT_VESA [21] V SC_EXT_CTA [21] Adaptive-Sync SDP [22]	
Camera Generic If CG0 [8] If CG1 [9] If CG2 [A] If CG3 [E] If CG4 [C] If CG5 [D] If CG6 [E] If CG7 [F] If Picture Parameter Set [10] V VSC_EXT_VESA [20] If VSC_EXT_CTA [21] If Adaptive-Sync SDP [22]	
Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction of Construction Image: Construction Image: Construction of Construct	
Ø CG4 [C] Ø CG5 [D] Ø CG6 [E] Ø CG7 [I Ø Picture Parameter Set [10] Ø VSC_EXT_VESA [20] Ø VSC_EXT_CTA [21] Adaptive-Sync SDP [22]	
Picture Parameter Set [10] VSC_EXT_VESA [20] VSC_EXT_CTA [21] Adaptive-Sync SDP [22]]
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]	
Select all	
Enter packet type as hex value separated by comma:	
0x0, 0xF	

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.

Event Filter Dial	og			>
VBID filtering				
	Disab	led On se	et On cle	ear On any
VBLANK	0	0	0	۲
FIELD_ID	0	0	\odot	۲
INTERLACE	$^{\circ}$	\odot	$^{\circ}$	۲
NO_VIDEO	$^{\circ}$	0	\circ	۲
NO_AUDIO	$^{\circ}$	0	$^{\circ}$	۲
HDCP_SYNC	$^{\circ}$	0	$^{\circ}$	۲
COMPRESSED	$^{\circ}$	0	$^{\circ}$	۲
RESERVED	۲	0	$^{\circ}$	0
On MVID chang	e			
On MAUD chan	ge			
🔿 Log all		Log	on change	2
		Oł	(Cancel

MSA

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

📶 Event Filter	Dialog			\times
MSA filtering				
Enable logging 1	45A packet on ch	ange in:		
MVID	VID NVID	HTOTAL	VTOTAL	
HSTART	VSTART	V HSP	V HSW	
VSP	VSW	HWIDTH	VHEIGHT	
MISCO	MISC1			
🔵 Log all		Log on ch	ange	
	_			_
		ок	Cancel	

VFRAME INFO

Dimensions of the catured frame measured by the Sink

PD

Log USB-C PD communication messages

LSE

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

📶 Event Filter Dialog			×
USB-C LSE thresholds:			
VBUS threshold	20	🔹 mV	
IVBUS threshold	5 0	🗢 mA	
VCC threshold	50	🗢 mV	
VSBU threshold	20	mV	
IVCONN threshold	50	🜩 mA	
		ОК Са	ancel

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

AUX_BW

Log AUX_Bitwise transactions as a series of Manchester II codes.

Link Pattern

Click the button to open the Event Filter Dialog.

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

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

Event Filter Dialog	×	W Event Filter Dialog	
DP RX Link Pattern filtering:		DP RX Link Pattern filtering:	
	Start End		Start End
TPS1		TPS1	
TPS2		TPS2	
TPS3		TPS3	
TPS4		TPS4	
Idle pattern		Idle pattern	
Active video		Active video	
ML_PHY_SLEEP		ML_PHY_SLEEP	
ML_PHY_STANDBY		ML_PHY_STANDBY	
Custom pattern (80 bit)		Custom pattern (80 bit)	
CP2520.1		CP2520.1	
CP2520.2		CP2520.2	
PRBS7		PRBS7	
PRBS31		PRBS31	
🗆 Log all		🗌 Log all	
Custom Pattern (80 bit)		Custom Pattern (80 bit)	
Type: Bytes (8bit, her	c) ~	Type: Bytes (8t	vit, hex) 🗸 🗸
		Bytes (8b	
0 0 0 0 0 ff ff	ff ff ff		(10bit, hex)
		K/D code	es (8bit/10bit enc.)
	OK Cancel		OK Cancel

Event Transaction List

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

P RX DP TX Event Log							
Start Stop							Load Save Report Open Timeline Vie
DP RX	Filter				•	Directio	on = Sink to Source AUX Reply = AUX ACK
HPD HPD	Search:			< 0 /0	> *		r-AUX Reply = AUX_ACK
Z AUX		Source	Туре	Start	^		ent Status Indicator UNT ESI (RO)
□ SDP	1110	DP RX	AUX	00:00:10.129.694.000	RD 0x01400: 1	0x02002	:= 0x41 COUNT = 1
✓ VB-ID	1111	DP RX	AUX	00:00:10.129.824.000	AUX_ACK 10		EADY = 1
MSA	1112	DP RX	Sideband REP	00:00:10.129.824.000	DOWN_REP-R		ent Status Indicator
Link Pattern	1113	DP RX	AUX	00:00:10.130.679.000	RD 0x01410: 1	0x02003	SERVICE_IRQ_VECTOR_ESI0 := 0x00
AUX_BW	1114	DP RX	AUX	00:00:10.130.810.000	AUX_ACK 00	AUTOR	TE_CONTROL_COMMAND_PENDING = 0 MATED_TEST_REQUEST = 0
VFRAME INFO	1115	DP RX	AUX	00:00:10.131.663.000	RD 0x01420: 1	MCCS	RQ = 0 _IRQ = 0
Select all	1116	DP RX	AUX	00:00:10.131.793.000	AUX_ACK 00	UP_R	_REP_MSG_RDY = 0 EQ_MSG_RDY = 0
DP TX	1117	DP RX	AUX	00:00:10.132.650.000	WR 0x02003:	SINK	_SPECIFIC_IRQ = 0
HPD	1118	DP RX	AUX	00:00:10.132.786.000	AUX_ACK		ent Status Indicator
□ AUX	1119	DP RX	AUX	00:00:10.133.510.000	RD 0x00000: 1		SERVICE_IRQ_VECTOR_ESI1 := 0x00
Select all	1120	DP RX	AUX	00:00:10.133.625.000	AUX_ACK 14	LOCK	TC_MSTR_REQ_STATUS_CHANGED = 0 _ACQUISITION_REQUEST = 0
Select all	1121	DP RX	AUX	00:00:10.135.200.000	RD 0x02002: 1		IRQ = 0 L REPLAY_ERROR_STATUS = 0
	1122	DP RX	AUX	00:00:10.135.458.000	AUX, ACK 41	DSC_1	ERROR_STATUS = 0
	1123		VB-ID	00:00:10.157.329.000	VB-ID address =	8194	nt Status Indicator VICE IRQ VECTOR ESIO
	1124		VB-ID	00:00:10.157.935.000	length = 1 VB-ID read = 1	4	= 0x00 P CHANGED = 0
	1125		VB-ID	00:00:10.190.662.000	reply = 1 VB-IC transactio		STATUS_CHANGED = 0 M STATUS CHANGED = 0
	1126		VB-ID	00:00:10.191.268.000	VB-ID value[0x0		LINK_STATUS_CHANGED = 0 CTED OFF ENTRY REQUESTED = 0
	1127		VB-ID	00:00:10.223.995.000	VB-ID value[0x0	2004] = 0 2005] = 0	NNELING_IRQ = 0
	1128		VB-ID	00:00:10.224.601.000	VB-ID value[0x0 value[0x0	20061 - 0	nt Status Indicator R STATUS [CRO]
	1129		VB-ID	00:00:10.257.328.000	VB-ID value[0x0	2008] = 0	= 0x00 CRC ERROR = 0 [No CRC error]
	1130 <		VB-ID	00:00:10.257.934.000	VB-ID value[0x0 value[0x0	200A] = 0	TORAGE_ERROR = 0 [No internal error is detected] VSC SDP INCORRECTABLE FRENE = 0 [No VSC SDP uncorrectable

Source:	The communication port: DP RX to DP TX
Туре	The logged item: HPD, AUX, SDP, VB-ID, MSA, Link Pattern, AUX_BW, VFRAME INFO
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. Users can also color highlight various types of transactions for better readability.

Right-click on the list to open the menu.

00:00:00 7	90.435.000 VR-ID - 0x00+
00:00:(Time from start of logging Time from device reboot
00:00:(Time from previous event
00:00:(Show as microseconds
00:00:(Show as hours:mins:secs.msecs.mcsecs.nsecs
00:00:(Configure colors
00:00:(Configure columns

Configure Start

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

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

The time can be expressed either:

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

Configure Colors

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

Configure colo	rs	1	×
Add	Config Remove	▲ ▼ Clo	
Rule(appl	ied in order shown)	Format	Applies to
1 Normal line On	Packet	AaBbCcYyZz	
			Apply

Add: Add a new color highlight rule

, 1001	
Config:	Modify the selected rule
Remove:	Delete the selected rule
Clone:	Duplicate the selected rule
▲ ♥:	Change the order where rules are applied. The rules are applied from the bottom to the top of the list.

Adding Rules

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

💯 Configure search X	Configure search	X Configure search
Type: Normal Ine Event: Internatione Back: 1 TSDP HPD Property Start Color=#f000000 font=MS Shell Dig 2:8	Type: AUX Event: On Write Address in range Start address: 0x 0 End address: 0x 0	Y Type: SDP SubType: Extension Ary Event: Audo Streatoro Badk: Text Audo Streatoro SubType = Extension SubType = Extension SubType = Extension Sype = Sope Audo Copy Management Audo Copy Management SubType = Extension Stream Configuration Conresgener: 0 Font=MSShell Dig 2:8
Apply	Apply	Apply

Configure Columns

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

	Available	^			Active
	HPD:hpd (60)			1	Source (60)
2	HPD:pwd (60)		>	2	Туре (60)
3	HPD:cd (60)		<	3	Start (146)
ŀ	HPD:+5V (60)			4	Info (458)
	AUX:address (60)				
5	AUX:length (60)				

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.

Type Filter

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

Case Sensitive	
Columns:	
Source	
🗹 Туре	
🗹 Start	
🗹 Info	
fypes:	
Types DP RX DP RX AUX Sideband DP TX HPD Sideband	
Select all	Apply

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:

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

```
Device ID = 01 [DP RX]

HPD Level = HIGH

Power Level = LOW (DP Tx is connected to Rx and has power applied to AUX pull-up resist

Cable Detect Level = HIGH
```

HPD Trace

HPD De-assert to HPD Assert interval.

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

AUX

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

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	= Source to Sink	ſ
Native AUX Request		
Length	= 6	
Address	= 0x00200	
Address	= 0x00200	
Link/Sink Device Sta		
	tus	
SINK_COUNT [RO]		
0x00200		
Link/Sink Device Sta	t 110	
DEVICE SERVICE IRQ V		
DEVICE_SERVICE_IRQ_V	ECIOR	
0x00201		
Link/Sink Device Sta	tue	
LANEO 1 STATUS [RO]	cus	
x00202		
1400202		
Link/Sink Device Sta	tus	
ANE2 3 STATUS [RO]		
x00203		
200200		
Link/Sink Device Sta	tus	
LANE ALIGN STATUS UP		
0x00204		
Link/Sink Device Sta	tus	
SINK STATUS [RO]		
0x00205		

Native AUX Reply I2C-over-AUX Reply Link/Sink Device Stat SINK_COUNT [RO] 0x00200 := 0x01 SINK_COUNT = 1	= AUX_ACK
CP_READY = 0 Link/Sink Device Stat DEVICE_SERVICE_IRQ_VF 0x00201 := 0x10 REMOTE_CONTROL_CON AUTOMATED_TEST_REC CP_IRQ = 0 MCCS_IRQ = 0 DOWN_REP_MSG_RDY = UP_REO_MSG_RDY = 0 SINK SPECIFIC IRQ	ECTOR MMAND_PENDING = 0 QUEST = 0 = 1
Link/Sink Device Stat LANEO_1_STATUS [RO] 0X00202 := 0X77 LANEO_CR_DONE = 1 LANEO_CHANNEL EQ_I LANEO_SYMBOL_LOCKH LANE1_CR_DONE = 1 LANE1_CHANNEL EQ_I LANE1_CHANNEL EQ_I LANE1_SYMBOL_LOCKH	DONE = 1 ED = 1 DONE = 1

Link/Sink Device Status

Sideband Message Example

Sideband message header		Sideband message header	
Link_Count_Total	1	Link_Count_Total	1
Link_Count_Remaining	0	Link_Count_Remaining	0
Broadcast_Message	0	Broadcast Message	0
Path_Message	1	Path Message	1
MSG_Body_Length	3	MSG Body Length	7
Start_Of_MT	1	Start Of MT	1
End_Of_MT	1	End Of MT	1
Message_Sequence_No	0	Message_Sequence_No	0
Sideband message validity check		Sideband message validity check	
MSG_Header_CRC	7 [Good]	MSG Header CRC	0[Good]
MSG Body_CRC	95 [Good]	MSG Body CRC	20 [Good]
Header Reserved (Zero) fields	[Good]	Header Reserved (Zero) fields	[Good]
Message Transaction decode		Message Transaction decode	
Request Identifier	0x10[ENUM PATH	Reply Type	ACK
Port Number	8	Request Identifier	0x10[ENUM PATH
-		Port Number	8
		Full Payload Bandwidth Number Available	7737
		Payload Bandwidth Number	7737

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 8B 25 B3 CC 62 0E 1D 00 21 41 E2 DD 09
50 A2 26 E5 8F 9D A0 2F F2 18 AA 98 48 C6 6D 49
AB D8 92 7E B3 A7 F2 CC 85 55 F7 51 53 31 41 FC
68 C2 6D BF 06 5A 8B D7 B9 17 87 53 8E 16 DE 74
00 E3 96 1C 4E A8 81 30 BA 68 B8 3D D6 EE C9 F7

SDP

DP Secondary-data Packets.

SDP ID:			
SDP Type:			
SDP Length:			
SDP Version:	0x12	(18)	
Data Byte 1:	0-1	Change 1 Gauge	2
		Channel Count Refer to Stream Header	2
CI[/-4]:	0x0	Refer to Stream Header	
Data Byte 2:			
	0.40	Sample Size	Refer to Stream Header
SF[4-2]:			
	0.10	Sampring frequency	Nerer 55 Stream Medder
Data Byte 3:			
-	0x00	Refer to CT (Data Bvte 1)	
		,	
Data Byte 4:			
CA[7-0]:	0x00	Channel Allocation	1 2 3 4 5 6
			FL FR
Data Byte 5:			
			Unknown or refer to other inform
			0dB
DM_INH[7]:	0x0	Down-mix Inhibit Flag	Permitted or no information about
Raw Data:			
Head: 00 84 1B			
		0 00 00 00 00 00 00 00 00 0	
00 00 00	00 00 0	0 00 00 00 00 00 00 00 00 0	0 00 (PB: 00 00 00 00)

VB-ID

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]

NoVideoStream_Flag = 0[bit 4]

HDCP SYNC DETECT = 0[bit 5]

CompressedStream_Flag = 0[bit 6]

Reserved = 0[bit 7]

Mvid = 0x33

Maud = 0x00
```

MSA

Main Stream Attributes sent in DP stream.

```
Device ID = 01

Stream ID = 03

Data length = 28

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 = 192

V-Sync Start = 41

MISC0 = 0x20

MISC0 = 0x20

MISC1 = 0x00

MISC1.Interlaced Vertical Total Even: Number of lines per interlaced frame (consist

MISC1.Interlaced Vertical Total Even: No 3D stereo video in-band signaling
```

VFRAME INFO

Measured dimensions of the captured video frame

Stream ID	= 0
VFRECORD 1	
VFA TYPE	VIDEO DP MEAS
VFA LENGTH	2
Vtotal	1125
Hactive	1920
Vactive	1080

PD

USB-C PD communication messages

Header	0x21A1 Data Mess	age
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_Capabilities(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 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 equals Ioc(0x0)	
Voltage(1910)	9000mV(0x0B4)	
Maximum Current(90)	3000mA(0x12C)	
CRC	0x18F3953D	
End of packet		

LSE

Status of USB-C Low Speed Electrical signals

Device ID	= 01
Packet size	= 40 [bytes]
Data length	= 40
Vbus TimeStamp	= 02:53:20.750.932.000
Vbus voltage	= 5420 mV [updated]
Vbus 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]

Link Pattern

Status of link pattern detected in which lane.

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

AUX_BW

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

9. EDID EDITOR

The EDID Editor main window is divided into four data panels and command buttons below them.

The top left panel shows the currently edited E-EDID blocks in a tree form, the top right panel shows parsed content of the currently selected item, and lower right panel a HEX view of the data block.

The lower left panel shows a snapshot of key features of the EDID.

UCD Console - UCD-500 [2150C473]; DisplayPort Source and Sink I Gools Window Help DP RX DP TX Event Log	- 0
Link HDCP Video Audio EDID DPCD SDP DSC Add Item v Remove Item Filter </td <td>FEC Source DUT Testing Read mode: ○ 12C Read ● SBIM Read Virtual Sink #1 ∨ □ Show Read Only ☑ Recurse</td>	FEC Source DUT Testing Read mode: ○ 12C Read ● SBIM Read Virtual Sink #1 ∨ □ Show Read Only ☑ Recurse
Name VESA VESA VESA Structure Version and Revision Numbers Baic Display Parameters / Features Color Characteristics Established Timings I Standard Timings Identification Standard Timing Silentification Betraited Timing Silentification Ibyte descriptor 2 Ibyte descriptor 3 Ibyte descriptor 4 CIA Info Data block collection Detailed Timings V DisplayID Data block	Name Value 0 Pixel clock, MHz 533.25 1 Horizontal Addressable Video 3840 2 Horizontal Addressable Video 3840 3 Vertical Addressable Video 2160 4 Vertical Addressable Video 2160 5 Horizontal Front Porch in pixels 48 6 Horizontal Front Porch in pixels 32 7 Vertical Front Porch in Lines 3 00 01 02 04 05 06 05 0000000 08 05 06 07 08 09 00 02 07 08 00 01 02 37 8 05 00 00 00 00 00 04 6 7 34 05 13 00 00 00 04 45 34 71 35 00 00 00 00 04 45 34 71 35 00 00 00 00
Name Value 1 Max Resolution 15360 x 8640 2 HDR Static Disabled 3 HDR Dynamic Disabled 4 HDR Vial (Static Static Stati	000020 0f 50 54 bF ef 80 71 4f 81 00 81 c0 81 80 a5 c0 000030 b3 00 95 00 41 c0 461 d0 000 a0 f0 70 56 650 50 20 000040 35 00 5f 59 21 00 00 1a 00 00 00 fd 00 38 000060 4b 1e 86 36 00 0a 20 20 20 20 20 20 00 00 0 fc 000070 00 55 43 44 2d 35 30 30 2d 45 53 10 a 20 02 13 000080 1f c0 00 00 00 00 00 00 00 00 00 00 00 00 000050 1f c0 00 00 00 00 00 00 00 00 00 00 00 000050 1f c0 00 00 00 00 00 00 00 00 00 00 00 00 000050 1f c0 00 00 00 00 00 00 00 00 00 00 00 00

Add Item:	Add a new EDID or DisplayID block
Remove Item:	Delete the selected EDID or DisplayID block.
Filter:	Show only items having indicated the string in the field name
Read mode:	Select EDID data reading mode: I2C: local EDID read using I2C protocol SBM (MST mode only): virtual channels read with SBM protocol
Show Read Only:	When selected, also automatically created fields are shown
Recurse:	When selected, the whole logical tree of the selected item is parsed on the right hand side list.

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

▼ Main Features	Editor Mode HEX Edit Mod	le		
d from TE Write to TE			Save As	
Main Features:	common interest HDR, or Dolby Vi corresponding lo	es panel gives an overview of ite t. For example, whether the sink ision, etc. The small grey italic t ocation in EDID. If you click on th ng address in the HEX mode tab	t is capable of ext shows ne Value cell,	
	Features CTA v3 CTA	v3 CTA v3		
	Name 1 HDR Static Data block a llection	Value Enabled	^	
	2 HDR Dynamic Data block a llection	Enabled		
	3 HDR10+ Data block as lection 4 Dolby Vision	Enabled		
	4 Data block to lection 5 SBTM Data block as llection	v2 Enabled		
	Data block a llection GMS GMS	Enabled		
	7 VRR Vendor-Specific Data Block >Block Da VRR	ttz -> HDMI Forum V Enabled		
	8 FRL Vendor- Specific Data Block ->Block Da	nn - >HDMI Forum V		
	9 DSC ▼ Main Features	Enabled	~	
Read from TE (Analyzer):	Read UCD-5XX lo	ocal EDID.		
Write to TE (Analyzer):	Program UCD-5X	Program UCD-5XX local EDID. Please see the Note below.		
Download from Sink (Generator)	Read EDID of a c	Read EDID of a connected sink device.		
Upload to Sink (Generator):	Program EDID of	Program EDID of a connected sink device.		
Editor Mode:	Enable editing EDID content in parsed logical fields. When disabled, all the controls are in read-only mode. For example, for testing purposes it's possible to load invalid EDID and write it to TE without modifications. Once editor mode is enabled, EDID validator corrects errors such as invalid checksums. Modifications are possible in the upper panel with Name – Value pairs.			
HEX Edit Mode:	enabled, modifica HEX values. Click	Enable editing EDID content in HEX mode table. When enabled, modifications are possible in the lower panel with HEX values. Click the Apply button to validate the changes and copy them to the upper panel.		
Save As:	Save the current block collection to a disk file.			

Note:

Please note that a Source device is always able to read EDID of the connected Sink device. However, it is dependent on the design of the connected Sink device if modifying its EDID content is enabled.

EDID Editor Features

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

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.

- Double-click the property field to edit.
- Red values in the HEX view indicate a changed value.
- Enter key will apply text-edit values and combo-box selection.
- In CTA-861 blocks, you can add and remove 18-byte descriptors and CEA data blocks by setting the values "18-byte Descriptors in this block" and "CEA Data block count".
- Enter hex values with prefix "**0x**" or "**\$**", no prefix means a decimal value.
- You can always enter HEX or DEC, even if the value is presented as HEX, and/or value range is given in HEX.
- Floating point values must be given with period "." as decimal separator, even if your localization setting defines decimal separator as comma (or other).
- Remember to click **Set** after changing a bit-value presented as a single checkbox if you want the new value applied.

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

10. PACKET EDITOR

Packet Editor enables creation and editing metadata packets. Launch the packet editor by selecting *Tools > Packet Editor*.

Unigraf Packet Editor		- 🗆 X
Protocol Display Port V Type Audio V	New Save As Load	
Add Item 🔎 Remove Item Filter	Show read only pro	perties 🗹 Recurse
Name	Name Value	^
✓ Audio InfoFrame	0 Audio Channel Count 2 channels	
Packet Header Packet Data	1 Audion [Coding Type / Stream Encoding Stream Header	
Channel allocation (0 - 49)	2 Sample Size Refer to Stream Header	
	3 Sampling Frequency Refer to Stream Header	
	4 Type Channel allocation (0 - 49	9)
	5 CA Channel allocation (0 - 49) 0	*
	00 01 02 03 04 05 06 07 08 09 0A 0B 0	C OD OE OF
	0000000 00 84 1b 48 01 00 00 00 00 00 00 00	0 00 00 00
	000010 00 00 00 00 00 00 00 00 00 00 00	0 00 00 00
	000020 00 00 00 00	
	HEX Edit Mode App!	у

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.

11. PATTERN EDITOR

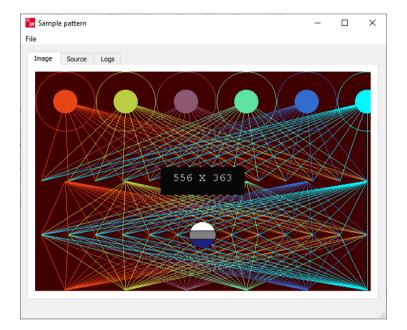
Pattern Editor is a tool for editing and debugging Unigraf Custom VTP Pattern scripts. Launch the packet editor by selecting *Tools > Pattern Editor*.

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

Pattern Editor consists of three tabs:

Image Tab

Monitoring the rendering of the VTP pattern script.



Source Tab

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

5 Sample pattern	-		\times
File			
Image Source Logs			
<pre><?xml version="1.0" encoding="ISO-8859-1"? > <vpattern protected="true"> <description>S Description > <script> ABSOLUTE COLORRGB 256 0 0 BOX 00 MAXX MAXY SET H V S/2 SET H V S/4"3 REPEAT X 50 MAXX 100 SET C 1023*X/MAXX ; Note: oversaturated green COLORRGB 1023-C 3*C C CIRCLE X 49 49 FCIRCLE X 49 40 REPEAT A 10 MAXX 45 LINE X FO A H LINE X H A H2 LINE X VS H2 END SET Z 100/3+5*2 COLORRGB 30 30 30 BOX MAXY*7/16 MAXX*10/16 MAXY*9/16 COLORRGB 1023 1023 TEXTPOS MAXX/2 MAXY/2 ALIGN C</pre></td><td>ample pat</td><td>itern</</td><td>~</td></tr><tr><td>Apply</td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></tbody></table></script></description></vpattern></pre>			

Logs Tab

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

Sample pattern	-	>
:		
Image Source Logs		
		\sim
RGB 16384 0 0		
BOX 0 0 556 363		
h <- vs/2 = 181		
h2 <- vs/4*3 = 270		
c <- 1023*x/maxx = 92		
RGB 59584 17664 5888		
CIRCLE 50 49 49		
CIRCLE 50 49 20		
LINE 50 50 10 181		
LINE 50 181 10 270		
LINE 50 362 10 270		
LINE 50 50 55 181		
LINE 50 181 55 270		
LINE 50 362 55 270		
LINE 50 50 100 181		
LINE 50 181 100 270		
LINE 50 362 100 270		
LINE 50 50 145 181		
LINE 50 181 145 270		
LINE 50 362 145 270		
LINE 50 50 190 181		
LINE 50 181 190 270		
LINE 50 362 190 270		
LINE 50 50 235 181		
LINE 50 181 235 270		
LINE 50 362 235 270		
		\mathbf{v}

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.

12. IMAGE CONVERTER

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

Course impress	About Destination ima		
Source images	Colorspace: Colorimetry: Sampling: Bit depth:	YCbCr TTU-R 8T.601 4:4:4 8 3 Change resolution 640x480	> > > >

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

IICL Converter			3 <u></u>		×
	About				
Source images		Destination image	es		
Test image	and the second	Colorspace:	YCbCr		~
	mark all and the	Colorimetry:	ITU-R BT.601		~
	and the second	Sampling:	4:4:4		~
	the state of the second second	Bit depth:	8		~
	Contraction of the second s	Align to MSB	Change resoluti	ion	
		Resolution:	640x480		
Upload files					
human and h				Conver	All 🔻

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

File name for the destination image is of form:

Test image[1920x1080_yuv444_8bpc_BT601_Packed_YCbCr_LSB]

APPENDIX A: PRODUCT SPECIFICATION

UCD-500

Input	DisplayPort: DP 2.0/2.1 capable (DP In) (10 Gbps link rate maximum) USB-C: PD 3.0 compliant (USB-C In) (20 Gbps link rate maximum)
Output	DisplayPort: DP 2.1 compliant (DP Out) (10 Gbps link rate maximum) USB-C: PD 3.0 compliant (USB-C Out) (20 Gbps link rate maximum)
Max video mode	7680 × 4320 p60 input and output. 15360 × 8640 p60 input and output with DSC.
Audio	Source and receive LPCM, 2 – 8 channels, 44.1 to 192 kHz. Source compressed formats using TSI
Content Protection	HDCP 2.3 supported
DSC Capability	DSC sink, with off-line decompression DSC source using pre-compressed content
Additional features	Playback function
Computer interface	USB 3.0
Software	Windows, MacOS, Linux UCD Console application, TSI SDK.
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +24 Vdc output)
Environmental	Operating temperature: 15 to 35 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	331 mm x 197 mm x 66 mm
Weight	1.9kg

UCD-500 Gen2

Input	DisplayPort: DP 2.1 compliant (DP In) (20 Gbps link rate) USB-C: PD 3.0 compliant (USB-C In) (20 Gbps link rate)
Output	DisplayPort: DP 2.1 compliant (DP Out) (20 Gbps link rate) USB-C: PD 3.0 compliant (USB-C Out) (20 Gbps link rate)
Max video mode	7680 × 4320 p60 input and output. 15360 × 8640 p60 input and output with DSC
Audio	Source and receive LPCM, 2 – 8 channels, 44.1 to 192 kHz. Source compressed formats using TSI
Content Protection	HDCP 2.3 supported
DSC Capability	DSC sink, with off-line decompression DSC source using pre-compressed content
Additional features	Playback function
Computer interface	USB 3.0
Software	Windows, MacOS, Linux UCD Console application, TSI SDK.
Power supply	AC/DC Power supply (100 to 240 Vac 50/60 Hz input, +24 Vdc output)
Environmental	Operating temperature: 15 to 35 deg C Storage temperature: 0 to 50 deg C Humidity 30% to 70% RH, non-condensing
Mechanical Size	331 mm x 197 mm x 66 mm
Weight	1.9kg

Supported clocks

Link\Mode	RGB	YCbCr444	YCbCr422	YCbCr420	DSC
128b	4480MHz	4480MHz	4480MHz	8960MHz	8960MHz*
8b/10b	1520MHz	1520MHz	1520MHz	3040MHz	3040MHz*

*DSC compression ratio must be 2 or higher. For DSC image that does not require pixel rate higher than 4480MHz and 1520MHz there is no limitation on the compression ratio

APPENDIX B: PRODUCT FEATURES

Input / Output Role	UCD-5XX Default	DP 1.4a LL CTS	DP 2.1 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	DP 2.1 LTTPR CTS for Source DUT	TSI Basic
DP Reference Sink	1	1		1				1	1	
Video status, preview and saving	•									
Buffered capture	•									
Audio monitoring, graphical preview and saving	•									
Link status	•									
Link control	•									
HPD status and control	•									
MST Feature	•									
FEC Feature	•									
DSC Decoder, DSC Control	•									
Adaptive-Sync Feature**	•									
DPCD editor	•									
Monitor InfoFrame Status (SDP)	•									
EDID read and write	•									
EDID / DisplayID Editor	•									
HDCP 2.3 status and control	•									
Event Log, AUX Analyzer	•									
Source DUT Testing (Link and CRC test)	•									
DP 1.4 LL, Audio, FEC CTS for testing Source DUT		•								
DP 2.1 LL CTS for testing Source DUT			•							
DP 1.4 DSC CTS for testing Source DUT				•						
DisplayID-EDID CTS for testing Source DUT					٠					
Adaptive-Sync CTS for testing Source DUT**						•				
HDCP 2.3 CTS for testing DP Source DUT							•	•		
HDCP 2.3 CTS for testing DP Repeater DUT								•		
DP 2.1 LTTPR CTS for testing Source DUT									•	

**) Adaptive-Sync feature is currently limited to Stream 0. Adaptive-Sync CTS is currently limited to 8b/10b link coding and SST.

Input /Output Role	UCD-5XX Default	DP 1.4a LL CTS	DP 2.1 LL CTS	DP 1.4a DSC CTS	DisplayID / EDID CTS	Adaptive-Sync CTS	HDCP 2.3 CTS Sink DUT	HDCP 2.3 CTS for Sink, Source & Repeater DUT	DP 2.1 LTTPR CTS for Sink DUT	TSI Basic
DP Reference Source										
Video pattern generator	•									
Audio generator	•									
Link status	•									
Link control	•									
HPD status	•									
EDID read and write	•									
EDID / DisplayID Editor	•									
MST Feature	•									
FEC Feature	•									
DSC Encoder	•									
Adaptive-Sync Feature**	•									
DPCD editor	•									
LTTPR Feature	•									
HDCP 2.3 status and control	•									
Event Log, AUX Analyzer	•									
Sink DUT Testing	•									
DP 1.4 LL, Audio and FEC CTS for testing Sink DUT		•								
DP 2.1 LL CTS for testing Sink DUT			•							
DP 1.4 DSC CTS for testing Sink DUT				•						
DisplayID / EDID CTS for testing Sink DUT					•					
Adaptive-Sync CTS for testing Sink DUT**						•				
HDCP 2.3 CTS for testing DP Sink DUT							•	•		
HDCP 2.3 CTS for testing DP Repeater DUT								•		
DP 2.1 LTTPR CTS for testing Sink DUT									•	

**) Adaptive-Sync feature is currently limited to Stream 0. Adaptive-Sync CTS is currently limited to 8b/10b link coding and SST.

UCD-5XX Product Options

Hardware Test Tool	P/N
UCD-500 Gen2	066710
HDCP 2.3 CTS Testing	
HDCP 2.3 CTS for testing Source DUT on DP	MT6634
HDCP 2.3 CTS for testing Sink DUT on DP	MT6636
HDCP 2.3 CTS for testing Repeater DUT on DP	MT6638
DP 2.1 CTS Testing	
DP 2.1 LL CTS for testing Source DUT	MT6662
DP 2.1 LL CTS for testing Sink DUT	MT6660
DP 2.1 DSC CTS for testing Source DUT	MT6656
DP 2.1 DSC CTS for testing Sink DUT	MT6657
DP 1.4a CTS Testing	
DP 1.4a LL CTS for testing Source DUT	MT6637
DP 1.4a LL CTS for testing Sink DUT	MT6635
DP 1.4a DSC CTS for testing Source DUT	MT6642
DP 1.4a DSC CTS for testing Sink DUT	MT6643
DisplayID / EDID CTS testing	
DP 2.1 DisplayID / EDID CTS for testing Source DUT	MT6646
DP 2.1 DisplayID / EDID CTS for testing Sink DUT	MT6647
Adaptive Sync CTS Testing	
DP 2.1 Adaptive-Sync CTS for testing Source DUT	MT6648
DP 2.1 Adaptive-Sync CTS for testing Sink DUT	MT6649
LTTPR CTS Testing	
DP 2.1 LTTPR CTS for testing Source DUT	MT6680
DP 2.1 LTTPR CTS for testing Sink DUT	MT6679
DP 2.1 LTTPR CTS for testing LTTPR Device	MT6682

APPENDIX C: PREDEFINED TIMINGS

Description*	HA	VA	НТ	VT	HST	VST	HSYN	VSYN	FR	Pixel Clock
Description		VA		VI	1101	V01	113110	VOIN		(MHz)
CVT 640 × 480 @ 60 Hz	640	480	800	525	144	35	96	2	60	25,20
CTA 640 × 480 @ 60 Hz (VIC 1)	640	480	800	525	144	35	96	2	60	25,17
CTA 720 × 480 @ 60 Hz (VIC 2)	720	480	858	525	122	36	62	6	60	27,03
CTA 720 × 480 @ 60 Hz (VIC 3)	720	480	858	525	122	36	62	6	60	27,00
CTA 720 × 576 @ 50 Hz (VIC 17)	720	576	864	625	132	44	64	5	50	27,00
CTA 720 × 576 @ 50 Hz (VIC 18)	720	576	864	625	132	44	64	5	50	27,00
CTA 720 × 576 @ 100 Hz (VIC 42)	720	576	864	625	132	44	64	5	100	54,00
CTA 720 × 576 @ 100 Hz (VIC 43)	720	576	864	625	132	44	64	5	100	54,00
CTA 720 × 480 @ 120 Hz (VIC 49)	720	480	858	525	122	36	62	6	120	54,00
CTA 720 × 480 @ 120 Hz (VIC 48)	720	480	858	525	122	36	62	6	120	54,05
CTA 720 × 576 @ 200 Hz (VIC 52)	720	576	864	625	132	44	64	5	200	108,00
CTA 720 × 576 @ 200 Hz (VIC 53)	720	576	864	625	132	44	64	5	200	108,00
CTA 720 × 480 @ 240 Hz (VIC 56)	720	480	858	525	122	36	62	6	240	108,00
CTA 720 × 480 @ 240 Hz (VIC 57)	720	480	858	525	122	36	62	6	240	108,00
DMT 800 × 600 @ 60 Hz (ID 9)	800	600	1056	628	216	27	128	4	60	39,79
DMT 848 × 480 @ 60 Hz (ID 14)	848	480	1088	517	224	31	112	8	60	33,75
DMT 1024 × 768 @ 60 Hz (ID 16)	1024	768	1344	806	296	35	136	6	60	65,00
CTA 1280 × 720 @ 50 Hz (VIC 19)	1280	720	1980	750	260	25	40	5	50	74,25
CTA 1280 × 720 @ 100 Hz (VIC 41)	1280	720	1980	750	260	25	40	5	100	148,50
CTA 1280 × 720 @ 24 Hz (VIC 60)	1280	720	3300	750	260	25	40	5	24	59,40
CTA 1280 × 720 @ 25 Hz (VIC 61)	1280	720	3960	750	260	25	40	5	25	74,25
CTA 1280 × 720 @ 30 Hz (VIC 62)	1280	720	3300	750	260	25	40	5	30	74,25
CTA 1280 × 720 @ 24 Hz (VIC 65)	1280	720	3300	750	260	25	40	5	24	59,40
CTA 1280 × 720 @ 25 Hz (VIC 66)	1280	720	3960	750	260	25	40	5	25	74,25
CTA 1280 × 720 @ 30 Hz (VIC 67)	1280	720	3300	750	260	25	40	5	30	74,25
CTA 1280 × 720 @ 50 Hz (VIC 68)	1280	720	1980	750	260	25	40	5	50	74,25
CTA 1280 × 720 @ 60 Hz (VIC 69)	1280	720	1650	750	260	25	40	5	60	74,25
CTA 1280 × 720 @ 100 Hz (VIC 70)	1280	720	1980	750	260	25	40	5	100	148,50
CTA 1280 × 720 @ 120 Hz (VIC 71)	1280	720	1650	750	260	25	40	5	120	148,50
CTA 1280 × 720 @ 48 Hz (VIC 108)	1280	720	2500	750	260	25	40	5	48	90,00
CTA 1280 × 720 @ 48 Hz (VIC 109)	1280	720	2500	750	260	25	40	5	48	90,00
CTA 1280 × 720 @ 60 Hz (VIC 4)	1280	720	1650	750	260	25	40	5	60	74,25
CTA 1280 × 720 @ 120 Hz (VIC 47)	1280	720	1650	750	260	25	40	5	120	148,50
CVT 1280 × 768 @ 60 Hz [RB1]	1280	768	1440	790	112	19	32	7	60	68,26
DMT 1280 × 768 @ 60 Hz (ID 23)	1280	768	1664	798	320	27	128	7	60	79,67
DMT 1280 × 800 @ 60 Hz (ID 27)	1280	800	1440	823	112	20	32	6	60	71,11
DMT 1280 × 800 @ 60 Hz (ID 28)	1280	800	1680	831	328	28	128	6	60	83,76
DMT 1280 × 960 @ 60 Hz (ID 32)	1280	960	1800	1000	424	39	112	3	60	108,00
DMT 1280 × 1024 @ 60 Hz (ID 35)	1280	1024	1688	1066	360	41	112	3	60	107,96
DMT 1360 × 768 @ 60 Hz (ID 39)	1360	768	1792	795	368	24	112	6	60	85,48
DMT 1400 × 1050 @ 60 Hz (ID 41)	1400	1050	1560	1080	112	27	32	4	60	101,09
DMT 1400 × 1050 @ 60 Hz (ID 42)	1400	1050	1864	1089	376	36	144	4	60	121,79

*) CVT: Coordinated Video Timings (CVT v2.0) DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

CTA: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H)

Description*	HA	VA	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 51)	1600	1200	2160	1250	496	49	192	3	60	162,00
CTA 1680 × 720 @ 24 Hz (VIC 79)	1680	720	3300	750	260	25	40	5	24	59,40
CTA 1680 × 720 @ 25 Hz (VIC 80)	1680	720	3168	750	260	25	40	5	25	59,40
CTA 1680 × 720 @ 30 Hz (VIC 81)	1680	720	2640	750	260	25	40	5	30	59,40
CTA 1680 × 720 @ 50 Hz (VIC 82)	1680	720	2200	750	260	25	40	5	50	82,50
CTA 1680 × 720 @ 100 Hz (VIC 84)	1680	720	2000	825	260	100	40	5	100	165,00
CTA 1680 × 720 @ 48 Hz (VIC 110)	1680	720	2750	750	260	25	40	5	48	99,00
CTA 1680 × 720 @ 60 Hz (VIC 83)	1680	720	2200	750	260	25	40	5	60	99,00
CTA 1680 × 720 @ 120 Hz (VIC 85)	1680	720	2000	825	260	100	40	5	120	198,00
DMT 1680 × 1050 @ 60 Hz (ID 57)	1680	1050	1840	1080	112	27	32	6	60	119,23
DMT 1680 × 1050 @ 60 Hz (ID 58)	1680	1050	2240	1089	456	36	176	6	60	146,36
DMT 1792 × 1344 @ 60 Hz (ID 62)	1792	1344	2448	1394	528	49	200	3	60	204,75
DMT 1856 × 1392 @ 60 Hz (ID 65)	1856	1392	2528	1439	576	46	224	3	60	218,27
CTA 1920 × 1080 @ 50 Hz (VIC 31)	1920	1080	2640	1125	192	41	44	5	50	148,50
CTA 1920 × 1080 @ 24 Hz (VIC 32)	1920	1080	2750	1125	192	41	44	5	24	74,25
CTA 1920 × 1080 @ 25 Hz (VIC 33)	1920	1080	2640	1125	192	41	44	5	25	74,25
CTA 1920 × 1080 @ 100 Hz (VIC 64)	1920	1080	2640	1125	192	41	44	5	100	297,00
CTA 1920 × 1080 @ 24 Hz (VIC 72)	1920	1080	2750	1125	192	41	44	5	24	74,25
CTA 1920 × 1080 @ 25 Hz (VIC 73)	1920	1080	2640	1125	192	41	44	5	25	74,25
CTA 1920 × 1080 @ 30 Hz (VIC 74)	1920	1080	2200	1125	192	41	44	5	30	74,25
CTA 1920 × 1080 @ 50 Hz (VIC 75)	1920	1080	2640	1125	192	41	44	5	50	148,50
CTA 1920 × 1080 @ 60 Hz (VIC 76)	1920	1080	2200	1125	192	41	44	5	60	148,50
CTA 1920 × 1080 @ 100 Hz (VIC 77)	1920	1080	2640	1125	192	41	44	5	100	297,00
CTA 1920 × 1080 @ 120 Hz (VIC 78)	1920	1080	2200	1125	192	41	44	5	120	297,00
CVT 1920 × 1080 @ 30 Hz [RB1]	1920	1080	2080	1096	112	13	32	5	30	68,39
CVT 1920 × 1080 @ 30 Hz [RB2]	1920	1080	2000	1096	72	14	32	8	30	65,76
CVT 1920 × 1080 @ 144 Hz [RB3]	1920	1080	2080	1157	152	14	32	8	144	346,66
CVT 1920 × 1080 @ 200 Hz [RB3]	1920	1080	2080	1190	152	14	32	8	200	495,21
CTA 1920 × 1080 @ 30 Hz (VIC 34)	1920	1080	2200	1125	192	41	44	5	30	74,25
CVT 1920 × 1080 @ 60 Hz [RB1]	1920	1080	2080	1111	112	28	32	5	60	138,65
CVT 1920 × 1080 @ 60 Hz	1920	1080	2000	1111	72	14	32	8	60	133,32
DMT 1920 × 1080 @ 60 Hz (ID 82)	1920	1080	2200	1125	192	41	44	5	60	148,50
CTA 1920 × 1080 @ 60 Hz (VIC 16)	1920	1080	2200	1125	192	41	44	5	60	148,50
CVT 1920 × 1080 @ 120 Hz [RB1]	1920	1080	2080	1144	112	61	32	5	120	285,54
CVT 1920 × 1080 @ 120 Hz [RB2]	1920	1080	2000	1144	72	14	32	8	120	274,56
CTA 1920 × 1080 @ 120 Hz (VIC 63)	1920	1080	2200	1125	192	41	44	5	120	297,00

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DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

CTA: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H)

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

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DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

CTA: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H)

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

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DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

CTA: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H)

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

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

DMT: VESA and Industry Standards and Guidelines for Computer Display Monitor Timings

CTA: A DTV Profile for Uncompressed High Speed Digital Interfaces (CTA-861-H)

APPENDIX D: PREDEFINED PATTERNS

Fixed Pattern	S	
Selection	Pattern	Description
Disabled	×	The links are activated but no video data transferred
Color Bar		100% intensity color bars of all primaries and mixed combinations.
Chessboard		8 by 8 chessboard with black (0%) and 100% intensity white
Solid Color		Solid color. User selected RGB values
Solid White		100% white
Solid Red		100% red
Solid Green		100% green
Solid Blue		100% blue
White V-Strips		Vertical stripes of black (0%) and white (100%). Parameters set the widths of the black and white stripes in pixels respectively. Default black / white = 20 / 20 pixels. Parameter range 1 to 1000.
RGB Wide Strips		16 pixels high horizontal red, green, blue, and white stripes. Intensity is increased from 0 to 100% with steps defined by the given parameter (Color Step = cs) and selected color. (step = cs*color_depth/256). "n" range 0 to 5000 (default 100).
Color Ramp		Color Ramp test pattern defined by VESA DisplayPort Link Layer Compliance Test Specification.
Color Square		Color Square test pattern defined by VESA DisplayPort Link Layer Compliance Test Specification. Color mode can be selected between RGB, YCbCr 4:4:4, 4:2:2, 4:2:0 (ITU Rec 601 / 709)
Motion Pattern		Horizontally moving color bar pattern. The pattern is shifted to left one pixel in each frame in a sequence. The length of the sequence is defined with parameter. Range 0 to 34 (default is 20)
Square Window		100% intensity white square horizontally and vertically centered. Height and width defined by parameter as the percentage of height and width of the frame (default 30).

Extended Patterns

Selection	Icon	Description
Select Image	Ō	Custom image uploaded by the user. Click on Select to browse.
Select DSC Image	O,	Custom DSC compressed image file uploaded by the user. Click on Select to browse.
Unigraf PM5544	æ	Vpattern vector pattern based on PM5544
Color Web	2	Vpattern vector pattern.
Chinese Town Full HD		JPG Bitmap image (1920 x 1080 px)
UG-2111 HLG Narrow	22	Software generated pattern. HLG Narrow dynamic range.
UG-2111 PQ Narrow		Software generated pattern. PQ Narrow dynamic range.
UG-2111 PQ Full		Software generated pattern. PQ Full dynamic range.
Multi		Vpattern vector pattern. Multi-purpose pattern w square grid, cross-grids, 1x1 crosshatches, circles, and color bars
SMPTE RP-133		Vpattern vector pattern based on 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	Icon	Description
Hor-10xR		Vpattern vector pattern. 10 pcs horizontal Red bars
Hor-10xW		Vpattern vector pattern. 10 pcs horizontal White bars
HorRainbow-1024		Vpattern vector pattern. Horizontal Rainbow Ramps 1024 steps
HorRGBW-1024		Vpattern vector pattern. Horizontal RGBW Ramps 1024 steps
HorScale9		Vpattern vector pattern. Nine Horizontal Color Ramps
HorScaleW-64		Vpattern vector pattern. Horizontal White ramp 64 steps
HorScaleW-128		Vpattern vector pattern. Horizontal White ramp 128 steps
HorScaleW-X2		Vpattern vector pattern. Horizontal White ramp w edges 128 steps
InnerBox-BKtoB		Vpattern vector pattern. InnerBox pattern from Black to Blue
InnerBox-BKtoG	×	Vpattern vector pattern. InnerBox pattern from Black to Green
InnerBox-BKtoR		Vpattern vector pattern. InnerBox pattern from Black to Red
InnerBox-BKtoW	X	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.)
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Selection	Icon	Description
Black'n'White Window HDTV	••	Vpattern vector pattern. China 5.8 Black and White Window(FOR HDTV)
Black'n'White Window SDTV	•	Vpattern vector pattern. China 5.8 Black and White Window(FOR SDTV)
Black Line HDTV		Vpattern vector pattern. China 5.10 Black Line HDTV
Black Line SDTV		Vpattern vector pattern. China 5.10 Black Line SDTV
Black Window		Vpattern vector pattern. China 5.7 Black Window
Check Board	**	Vpattern vector pattern. China 5.9 Check Board
Line'n'Window		Vpattern vector pattern. China 5.11 Line and Window
Narrow White Window		Vpattern vector pattern. China 5.19 Narrow White Window
Single Dot		Vpattern vector pattern. China Single Dot
White Line HDTV		Vpattern vector pattern. China 5.10 White Line for HDTV
White Line SDTV		Vpattern vector pattern. China 5.10 White Line for SDTV

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

APPENDIX E: SINK, SOURCE AND REPEATER TESTS

Source DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS*	DP 2.1 LL CTS*	DP 2.1 DSC CTS	DP 2.1 DisplayID & EDID CTS*	DP 2.1 Adaptive-Sync CTS DUT*	DP 2.1 LTTPR CTS	HDCP 2.3 CTS*
Audio Test	Validate audio signal frequency and glitch-free audio reproduction	•								
CRC Video Tests	CRC based single frame reference video test, CRC based single frame stability test, CRC based sequence of frames reference video test, CRC based continuous sequence of frames reference video test	•								
DP 1.4a Link Layer CTS	4.2.1.1 – 4.2.1.5, 4.2.2.1 – 4.2.2.10, 4.3.1.1 – 4.3.1.13, 4.3.2.1 – 4.3.2.5, 4.3.3.1, 4.4.1.1 – 4.4.1.3, 4.4.2, 4.4.3, 4.4.4.2 – 4.4.4.6, 4.5.1.1 – 4.5.1.2		•							
DP 1.4a DSC CTS	4.6.1.1 – 4.6.1.9			•						\square
DP 2.1 Link Layer CTS	4.2.1.1 – 4.2.1.5, 4.2.2.1 – 4.2.2.2, 4.2.2.4 – 4.2.2.5, 4.2.2.7 – 4.2.2.8, 4.2.2.10, 4.2.2.11 – 4.2.2.12, 4.3.1.1 – 4.3.1.24, 4.3.2.1 – 4.3.2.5, 4.3.3.1 – 4.3.3.2, 4.4.1.1- 4.4.1.6, 4.4.2.1 – 4.4.2.2, 4.4.3, 4.4.4.2 – 4.4.4.6				•					
DP 2.1 DSC CTS	4.6.1.1 – 4.6.1.9					•				\square
DisplayID-EDID CTS***	4.7.1.1 – 4.7.1.4, 4.7.2.1 – 4.7.2.2, 4.7.3.1 – 4.7.3.3, 4.7.4.1, 4.7.5.1						•			\square
Adaptive-Sync CTS****	4.8.1.1 - 4.8.1.2, 4.8.2.1 - 4.8.2.3							•		
DP 2.1 LTTPR CTS	4.9.1.1 – 4.9.1.21								•	
HDCP 2.3 CTS 1A Test Set	HDCP2.3 CTS 1A-01 – HDCP2.3 CTS 1A-12									
HDCP 2.3 CTS 1B Test Set	HDCP2.3 CTS 1B-01 – HDCP2.3 CTS 1B-10									
Link Config Tests	Link Training at All Supported Lane Counts and Link Rates	•								
Pixel Level Video Tests	Compare video frame sequence with a single reference									

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

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

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

Sink DUT Testing		Default	DP 1.4a LL CTS*	DP 1.4a DSC CTS*	DP 2.1 LL CTS*	DP 2.1 DSC CTS	DP 2.1 DisplayID & EDID CTS*	DP 21 Adaptive-Sync CTS DUT*	DP 2.1 LTTPR CTS*	HDCP 2.3 CTS*
DP 1.4 Link Layer CTS	5.2.1.1 – 5.2.1.12, 5.2.2.1 – 5.2.2.9, 5.3.1.1 – 5.3.1.9, 5.3.2.1 – 5.3.2.2, 5.4.1.1 – 5.4.1.4, 5.4.2, 5.4.3.1 – 5.4.3.2, 5.4.4.1 – 5.4.4.6, 5.5.1.1 – 5.5.1.7		•							
DP 1.4 DSC CTS	5.6.1.1 - 5.6.1.26, 5.6.2.1 - 5.6.2.14			•						
DP 2.1 Link Layer CTS	5.2.1.8 - 5.2.1.12, 5.2.2.1 - 5.2.2.3, 5.2.2.5 - 5.2.2.10, 5.3.1.1 - 5.3.1.5, 5.3.1.8 - 5.3.1.15, 5.3.2.1 - 5.3.2.2, 5.4.1.1 - 5.4.1.8, 5.4.2.1 - 5.4.2.2, 5.4.4.1 - 5.4.4.6, 5.4.5.1 - 5.4.5.5, 5.5.1.1 - 5.5.1.12				•					
DP 2.1 DSC CTS	5.6.1.1 – 5.6.1.26, 5.6.2.1 – 5.6.2.16, 5.6.3.1 – 5.6.3.6					•				
DisplayID-EDID CTS***	$\begin{array}{l} 5.7.1.1-5.7.1.2, 5.7.1.3.1-5.7.1.3.4, 5.7.1.4.1-\\ 5.7.1.4.9, 5.7.1.5, 5.7.2.1-5.7.2.2, 5.7.2.3.1-\\ 5.7.2.3.5, 5.7.2.4.1-5.7.2.4.2, 5.7.2.5.1-5.7.2.5.2,\\ 5.7.2.6.1-5.7.2.6.2, 5.7.2.7.1, 5.7.2.8, 5.7.3.1-\\ 5.7.3.5, 5.7.4.1-5.7.4.3, 5.7.4.5, 5.7.5.1, 5.7.6.1-\\ 5.7.6.5, 5.7.7.1-5.7.7.6, 5.7.8.1-5.7.8.6, 5.7.9.1-\\ 5.7.9.3, 5.7.10.1-5.7.10.3, 5.7.11.1-5.7.11.5,\\ 5.7.12.1-5.7.12.4, 5.7.14.1-5.7.14.6, 5.7.15.1-\\ 5.7.15.9, 5.7.16.1-5.7.16.8, 5.7.17.1-5.7.17.5\end{array}$						•			
Adaptive-Sync CTS****	5.8.1.1 – 5.8.1.3							•		
DP 2.1 LTTPR CTS	5.9.1.1 – 5.9.1.15								•	
HDCP 2.3 CTS 2C Test Set	HDCP2.3 CTS 2C-01 – HDCP2.3 CTS 2C-05									•

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

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

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

LTTPR and DP Tunnel Device Testing		Default	DP 2.1 LTTPR CTS for testing LTTPR Device
DP 2.1 LTTPR CTS for testing LTTPR Device	7.1.1.1 – 7.1.1.9, 7.1.2.1 – 7.1.2.9, 7.1.3.1-7.1.3.8, 7.1.4.1-7.1.4.8, 7.1.5.1- 7.1.5.6, 7.1.6.1-7.1.6.7, 7.1.7.1-7.1.7.7, 7.1.8.1, 7.1.9.1, 7.1.10.1 – 7.1.10.2, 7.1.11.1 – 7.1.11.2, 7.1.12.1 – 7.1.12.8		•

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

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

Compliance Tests

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

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

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

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

Test Parameters

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

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

est Timeouts	DUT Capabilities					
est Timeout (ms) 5000	Max lanes supported 4		~			
ong HPD pulse duration (ms) 1000	Max Bitrate supported H	BR3 (8.10 Gbps)	~			
st Automation	DP 2.1 Settings					
TEST_LINK_TRAINING	🗹 10 Gbps 🛛 🗌 13.5 Gbp	s 🗌 20 GI				
TEST_EDID_READ	LTTPR device count	0	\$			
] TEST_VIDEO_PATTERN	Minimum Link Bandwidth Suppo	orted 1LRBR	~			
TEST_AUDIO_PATTERN	✓ Voltage Swing level 3 (1.2V) su	pported				
	Pre-Emphasis level 3 (9.5dB) su					
DSC_VIS_VAL	Fixed timing DUT					
ent indicating DUT ready Always ready ~	Spread Spectrum Supported					
SC Version 12 ~ SC Version 12 ~ C Maximum supported slice 1 ~ DSC supported DSC block prediction enabled	Video format change without I Lane count reduction without FE-DDC supported DUT is Type-C Device FEC supported FEC disable sequence supported Audio without Video supported Max Link Bandwidth Policy sup	.T supported ir 2 channel audi sd d	io j			



DP 2.1 LL LTTPR CTS CR iteration delay

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

DP 2.1 LL LTTPR CTS	×
General Debug options	
Debug test options	
CR iteration delay (µs)	
Presets V Can	cel

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-5XX firmware implements the test according to the test specification.

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

	DP TX	Event Log													
Link	Pattern	Generator	Audio Generator	HDCP	EDID	DPCD	FEC	Sink DUT Testing							
All te	sts D	P 1.4 LL CTS	DP 2.1 LL CTS												
Name										Pass	Fail	Skip	Runs	Last statu	s ^
5.9	.1.1 LTTE	PR global con	figuration verificati	on						0	0	0	0		
			ion and status field							0	0	0	0		
5.9	.1.3 LTTR	PR AUX read/	write reply time bud	lget verifica	tion					0	0	0	0		
			sparent link training							0	0	0	0		
			-transparent link tra							0	0	0	0		
			non-transparent lin							0	0	0	0		
								e Swing during Clock		0	0	0	0		
								oltage Swing during C	lock Reco		0	0	0		
								ring Clock Recovery)		0	0	0	0		
								Ith During Clock Reco	overy)	0	0	0	0		
								hannel Equalization)		0	0	0	0		
								Ith Channel Equalizat e, due to failure in EC		-	0	0	0		
								e, due to failure in EC			0	0	0		
								ith, due to no start of			ō	0	0		
						,									v
Run Se	elected	Select 🔻	Configure	Import	Expo	ort 🗌	Stop on	Failure Repeats:	1 🗘	Delay ti	me, sec 1	٢	Save Repo	rt Clea	r All

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

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 <i>viewing</i> without UCD Console.
Clear All	Clear the test log and the results matrix

Saving Test Parameters

Test parameters can be saved in various ways.

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

Presets

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



Operator Feedback

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

Clicking "Abort" stops execution of the test.

Test operator feedba	ck required	×
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 feedback re	quired	×
	heck information field values lease 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	
i	 Product code: 4036h Serial number: 0172D3C6h Week and year of manufacture: 52/2014 	

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.

UCD Console - UCD-500 [2150C475]: DisplayPort Source and Sink					- 0	
<u>F</u> ile <u>T</u> ools <u>W</u> indow <u>H</u> elp						
DP RX DP TX Event Log						
Link HDCP Video Audio EDID DPCD SDP FEC Source DUT Testing						
All tests Audio Test CRC Video Tests DP 1.4 LL CTS DP 2.1 LL CTS Link Config Tests Pixel Level Vid	deo Tests					
Name	Pass	Fail	Skip	Runs	Last status	^
✓ 4.2.1.1 Source DUT Retry on No-Reply During AUX Read after HPD Plug Event (3200us)	1	0	0	1	Pass	
4.2.1.2 Source Retry on Invalid Reply During AUX Read after HPD Plug Event	1	0	0	1	Pass	
✓ 4.2.1.3 Source Device HPD Event Pulse Length Test	1	0	0	1	Pass	
✓ 4.2.1.4 Source Device IRQ_HPD Pulse Length Test	1	0	0	1	Pass	
✓ 4.2.1.5 Source Device Inactive HPD / Inactive AUX Test	1	0	0	1	Pass	
4.2.2.1 DPCD Receiver Capability and EDID Read upon HPD Plug Event	0	0	0	0	1033	
4.2.2.2 DPCD Receiver Capability Read upon HPD Plug Event	0	0	0	0		
4.2.2.3 EDID Read	0	0	0	0		
4.2.2.4 EDID Read Failure #1: I2C-Over-AUX NACK	0	õ	õ	õ		
4.2.2.5 EDID Read Failure #2: I2C-Over-AUX DEFER	õ	õ	õ	ŏ		
4.2.2.6 EDID Corruption Detection	ŏ	õ	ŏ	ő		
4.2.2.7 Branch Device Detection upon HPD Plug Event	ő	õ	ŏ	ő		
4.2.2.8 EDID Read on IRQ HPD Event after Branch Device Detection	0	0	ő	0		
4.2.2.9 E-DDC Four Block EDID Read	õ	õ	õ	0		
4.2.2.10 Link Status-Adjust Request AUX read interval during Link Training	ŏ	õ	0	ŏ		
4.2.11 Successful IT at All Supported Lang Counts and Link Speeds	0	0	0	0		~
Run Selected Select Configure Import Export Stop on Failure Repeats: 1	Delay tim	ne, sec 1	•	Save Repo	ort Clear A	AII
0002.062.444: AUX RD: 02020h: 3 00 00 00 00 0000.062.652: AUX RD: 02016: 2 11 11 0002.062.969: AUX WR: 00103h: 4 01 01 01 0002.062.241: AUX WR: 00103h: 4 01 01 01 0002.063.241: AUX RD: 02021h: 3 11 18 0 00 <td></td> <td></td> <td></td> <td></td> <td></td> <td>^</td>						^
0002.063.446: AUX RD: 00206h: 2 11 11						
0002.063.724: AUX WR: 00102h: 5 07 01 01 01 01						
0002.079.964: AUX RD: 00202h: 3 77 77 81						
0002.080.171: AUX RD: 00206h: 2 11 11 0002.080.396: Source DUT completes Link Training						
0002.080.446: Deassert HPD						
0002.080.708: Monitor AUX for transactions						
0002.080.752: DUT has 3 ms to finish AUX activity						
0002.080.812: AUX WR: 00102h: 1 00						
0002.088.747: End of protection interval 0003.080.655: Source DUT does not generate AUX transaction while HPD is low						
0003.081.244: Test PASSED: "4.2.1.5 Source Device Inactive HPD / Inactive AUX Test"						
*** Test Complete PASSED ***						
Tests execution finished.						*
- HPD						
Cable HPD Assert Deassert Pulse HPD 500 🔹 Length, msec Short Pulse						
online						

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

Test Report

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

Viewing the CTS Test Report

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

	Jnigraf Test Report	×	+								-		
	\rightarrow C	🗋 file://	/C:/Users/	n maa na hira	/report.html				£	3		${\times}$	
A	udio modes: Audio Mode 0: L-PCM Audio Mode 0: L-PCM Audio Mode 2: L-PCM Audio Mode 2: L-PCM Audio Mode 4: L-PCM Audio Mode 6: Disable Audio Mode 7: Disable daptiveSync configura DUT supports Adaptiv Device supports Fuxe Device supports Fuxe Device supports Fuxe Device supports Fuxe Device supports Fuxe Device supports Fuxe Device may maximu Z560X1080p maximu Z560X1400p maximu Z560X1440p maximu	, 2 channels , 2 channels , 2 channels , 2 channels , 2 channels ed ation: reSync d Average V tion Increas minimum re m refresh ra m refresh ra	 16 bit @ 44.1 k 16 bit @ 48.1 k 24 bit @ 44.1 k 24 bit @ 44.1 k 24 bit @ 48 kH; 24 bit @ 48 kH; 	Hz (CD) z Hz (CD) z constraints	: 23.976 Hz								
	4096x2160p is not sup 5120x2160p is not sup												
T	7680x4320p is not su 10240x4320p is not su est Log	pported upported	"4 2 1 1 go	AFCE DIT DET	v on No-Penl	v During All	Y Dead after	HDD Dlug Pu	ant (3200us				
- - - - - - - - - - - - - - - - - - -	10240x4320p is not si est Log 1000.000.002: Sta 1000.000.963: Set 1000.001.214: Set 1000.001.215: Ena 1000.001.295: Ena	pported upported art test t DPCD_RE t MAX_LIN t Extende able TPS3 able TPS4	V = 14 K_RATE = 1Eh d Receiver C support support	, MAX_LANE_CO apabilities F	UNT = 4	-	X Read afte:	c HPD Plug Ev	ent (3200us) "			
- - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	10240x4320p is not si est Log 1000.000.963: set 1000.001.214: set 1000.001.255: End 1000.001.425: End 1000.001.427: End 1000.001.367: End 1001.010.377: Ref 1001.010.377: Ref 1001.010.255: Ref 1001.045.042: Ref 101.045.042: Ref 101.045.042: Ref	pported upported t DFCD_RE t MAX_LIN t Extende able TPS3 able TPS4 ng HPD Pu ference S AUX requ ference S it for So	<pre>v = 14 K_RATE = 1Eh d Receiver C support lse (1000 ms ink is set n urce DUT iss est received ink does not urce DUT iss</pre>	, MAX LANE CO apabilities F) ot to respond ues an AUX re send any rep ues another A	UNT = 4 ield Present to any AUX quest ly to AUX re UX request .	request	X Read afte;	c HPD Plug Ev	ent (3200us	.) "			
	10240x4320p is not si est Log 000.000.021; sta 000.000.031; sta 000.001.032; sta 000.001.032; sta 000.001.24; set 000.001.24; set 000.001.36; sta 000.001.36; sta 000.001.01; sta 000.001.01; sta 001.045.042; set 001.045.042; set 001.045.095; Mai 001.045.895; Ref	pported upported art test t DFOD RE t MAX_LIN t Extende able TF93 able TF94 able TF94 able TF94 able TF94 able TF94 able TF94 able TF94 ference S ther AUX ference S auX requ ference S auX RD: irce DUT irce DUT	<pre>v = 14 K_RATE = 1eh d Receiver C support lse (1000 ms ink is set n urce DUT iss est received ink does not nuce bUT iss request rec 00201h: 1 does not dis starts readi</pre>	, MAX LANE CO apabilities F) ot to respond ues an AUX re send any rep ues another A eived within o respond to . 00 able video be	UNT = 4 ield Present to any AUX quest ly to AUX re UX request . 3778us AUX requests	request equest	X Read afte	c HPD Plug Ev	ent (3200us	.) =			

DUT Testing Options

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

Audio Test Set

Validate audio signal frequency and glitch-free audio reproduction

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

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

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

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

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

Validate audio signal frequency and glitch-free are	udio reproduction X
Name	Value
Expected sampling rate of audio signal	44100
Expected audible (sine) frequency as Hz	1000
Allowed deviation from expected frequency as Hz	1
Number of audio glitches allowed per test	0
Tested audio save conditions	Save none
Location where the captured audio is to be saved	C:/Users/Tester/Documents/Test Reports
Presets 🔻	OK Cancel

Parameters in use

- Expected sampling rate of audio signal (default 44 100 s/sec)
- Expected audible (sine) frequency in Hz (default 1000 Hz)
- Allowed deviation from expected frequency in Hz (default 1 Hz)
- Number of audio glitches allowed per test (default 0)
- Tested audio save conditions (Save none / Save failed / Save all)

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

CRC Based Video Test Set

Role:	Product:
DP Reference Sink (DP RX)	UCD-500 and Gen 2

Configuration

Base parametrs			CRC (RGB/CrYCb) of Captured Reference Frames
lest timeout (1/1000 sec):	10000	٢	0xB69E,0xB33E,0x1AB3,
Repeat until timeout			
Test length (# frames):	200	\$	
Frors allowed (# frames):	20	•	
Repeat "Sequence Test" until timeout			
"Sequence Test" length	1	٢	
Expected Video Format			
Width (# pixels):	1920	٢	
Height (# pixels):	1080	\$	
Reference BPP:	24	~	
Expected Frame Rate			
Expected frame rate (1/1000 Hz):	0	•	
Expected frame rate (1/1000 Hz): Frame rate tolerance (=1/1000 Hz)	0	•	Number of cantured reference frames
		Next	Number of captured reference frames 20 Capture Reference Frames
Frame rate tolerance (=1/1000 Hz)		Next	
		Next	
Frame rate tolerance (=1/1000 Hz) ave Failed Frames		•	
Frame rate tolerance (=1/1000 Hz) save Failed Frames older to save failed frames:		© Browse	

Test timeout:	If enabled test will abort when the time has elapsed
Repeat until timeout:	Omit "Test length" parameter
Test length (# frames):	Number of captured frames to test
Errors allowed (# frames):	Number of failing frames allowed before test Fails
Repeat "Sequence Test" until timeout:	Repeat test sequence until the timeout set (length parameter below omitted)
"Sequence Test" length	Repeat count of the "Sequence Test"
Expected Video Format	Format of the signal expected
Expected Frame Rate:	Verify stability of the video signal. Verification disabled if Expected Frame Rate is set to "0"
Number of captured reference frames:	Number of frames stored as reference
Capture Reference Frames:	Capture reference frames for the test
Folder to save failed frames:	PC folder where failed frames are stored.
Max number of saved frames:	Maximum number of failed frames stored to PC
Format of saved frames:	Select saved image format (Binary file, PPM image, BMP image)
Align 12	12bpc values are be shifted to MSB of a 16bits container. If not checked, 12 LSB are used to store colour component values.
Presets:	Store and recall settings

CRC Based Single Reference Frame Video Test

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

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

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

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

Parameters in use

- Test Timeout (default 10 000 ms)
- Total number of frames (default 2 00 ms)
- Number of bad frames allowed (default 20)
- Reference width (default 1920)
- Reference height (default 1080)
- Reference BPP (default 24)
- Expected frame rate (mHz, 1/1000 Hz)
- Frame rate tolerance (mHz, 1/1000 Hz)
- Reference CRCs (R, G, B)

CRC Based Single Frame Video Stability Test

The test verifies that the captured video is stable.

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

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

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

Parameters in use

- Test Timeout (default 100 00 ms)
- Total number of frames (default 200 ms)
- Number of bad frames allowed (default 20)

CRC Based Sequence of Reference Frames Test

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

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

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

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

Parameters in use

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

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

CRC Based Continuous Sequence of Reference Frames Test

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

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

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

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

Parameters in use

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

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

Link Config Tests

Link Training at All Supported Lane Counts and Link Rates

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

In Configure, please define the parameters for the test.

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

Parameters in use

- Test Timeout (default 5 000 ms)
- Max lane count supported by DUT (default 4)
- Max lane rate supported by DUT.
- Long HPD pulse duration (default 1 000 ms)
- Link training start timeout (default 5 000 ms)
- Delay between test cycles (default 3 000 ms)

Pixel Level Video Tests

Compare Video Frame Sequence with a Single Reference

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

Reference image settings		
Load image: 0	Browse image	
		Ø
Image resolution(width x height)	640x480	\sim
Image format	RGB	\sim
Bits per component (bpc)	8	~
Data format:	LSB	~
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	¢
	Binary file	~

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.

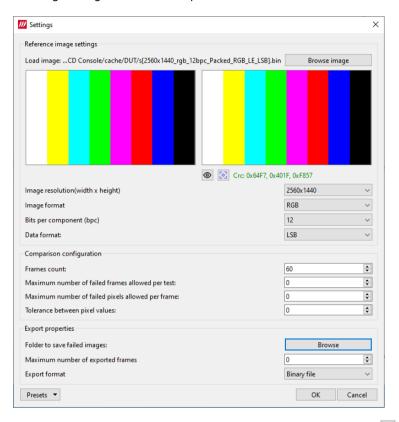
Load image:	Load the reference image
Image resolution:	Video resolution expected
Image format:	Image format expected
Bits per component:	Bits per component expected
Data format:	Video data format expected
Frames count:	Number of frames buffered for testing
Maximum number of failed frames allowed per 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 folder where failed frames are stored.
Maximum number of exported frames:	Maximum number of failed frames saved to PC
Export format:	Format of saved failed frames: Binary file, PPM image, BMP image
Presets:	Store and recall settings

•

Capturing Reference Image

Users can use the received video as reference.

In Settings dialog click the enable preview icon 🔌.



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

APPENDIX F: VTP PATTERN LANGUAGE

General

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

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

Terminology

The following terms are used in this document:

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

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

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

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

Notation

The following notation is used in this document:

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

Syntax rules

The following general syntax rules apply to VTP language files:

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

Commands

Scaling commands

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

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

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

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

ABSOLUTE

Syntax: ABSOLUTE

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

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

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

SCALED

Syntax: SCALED

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

Graphics Drawing Commands

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

LINE

Syntax: LINE x1 y1 x2 y2

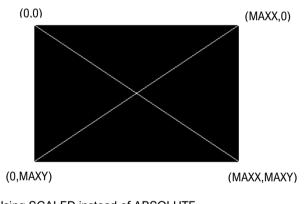
Draws a line from point (x1,y1) to point (x2,y2).

Example:

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

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

The pattern will look like this:



Using SCALED instead of ABSOLUTE.

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

<u>BOX</u>

Syntax: BOX x1 y1 x2 y2

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

Example:

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

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

DOT

Syntax: DOT x y

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

<u>FILL</u>

Syntax FILL x y

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

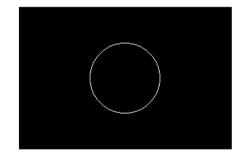
CIRCLE

Syntax: CIRCLE x y r

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

Example:

SCALED COLORDEPTH 8 COLORRGB 255 255 255 CIRCLE 5000 5000 2500 The pattern will look like this:

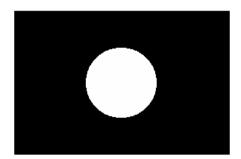


FCIRCLE

Syntax: FCIRCLE x y r

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

The pattern will look like this:



ELLIPSE

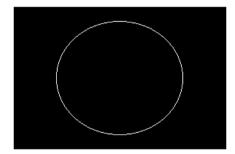
Syntax: ELLIPSE x y hr vr

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

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

Example:

SCALED COLORDEPTH 8 COLORRGB 255 255 255 ELLIPSE 5000 5000 3000 4000 The pattern will look like this:



Text Drawing Commands

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

TEXTPOS

Syntax: TEXTPOS x y

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

<u>TEXT</u>

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 ba	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

COLORDEPTH

Syntax: COLORDEPTH n

The command is used in True Color Mode (COLORMODE 2), to define the number of bits used for each color component (R, G and B) of the data to be displayed. Possible values for parameter "n" are 6, 8, 10 and 12.

If COLORDEPTH command is not used, 10 bits per color is used.

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

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

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

COLORRGB

Syntax: COLORRGB r g b

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

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

Various Commands

<u>SET</u>

Syntax: SET <variable> n

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

Variables

Timing Variables

Timing Variable	Value name
HF	Drawing resolution horizontal size minus one
HP	Drawing resolution vertical size minus one
HR	Current timing horizontal frequency (MHz?)
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 always have positive integers or zero value. When an expression is evaluated to a negative value, it is set automatically to zero. Number values are also always positive integers or zero.

Assignments

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

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

SET C B+MAXX SET K K+1 SET K A+B

Default state at VTP execution startup

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 RECOVERY

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

Note

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

Downloading Tools

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

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

1. On the download page, please select section "Additional Software". Please download the software under "Intel® Quartus® Prime Pro Edition Programmer and Tools".

2. Please download and install the tool using default option in the PC.

intel	PRODUCTS SUPPORT SOLUTIONS DEVELOPERS PARTNERS & PARTNERS Q Search Intel.com	
FPGA	ware Dewnload Center	
	Intel® Quartus® Prime Pro Edition Design Software Version 22.3 for Windows ¹⁰ Date Version 746667 9/25/2022 22.3 (Lates) ×	
	The treat Quarture Prives Pro Edition Design Software, Version 22.3 Includes functional and security updates. Users should promptly install the latest version upon release socurity. Additional security updates are planned and will be provided as they become available. Users should promptly install the latest version upon release obolete. If you would like to receive customer notifications by e-mail, plaze subscribe to our subscribe. Tyou are using floating license server for Intel FPGA software, you need to uggrade to the latest license daemon software (v11.18.2.0). Intel FPGA software, version 22.3, doesn't work with old version of daemon software. You can down and the daemon software from this link. To find software server for Intel FPGA software from this link. Bein to a booker apport tos: Bein to a booker apport tos: Beins and Anavers on specific IP or Products. Bownload B Complete Download Multiple Download Individual Files Multiple Download I Multiple Download Mu	
	ptc-22.3.0.104-windows.exe SHA1: b8adb559957633e99d3b147af7a509f173606b3b ** Installation size: 0.39 GB	
	Intel® Quartus® Prime Pro Edition Programmer and Tools Download Size: 1.2 GB QuartusProProgrammerSetup-22.3.0.104-windows.exe SHA1: 46fa1732c9aac991e85bdebb3cdac94298c0954d ** Installation size: 3.46 GB SHA1: 46fa1732c9aac991e85bdebb3cdac94298c0954d	
	Ashling RiscFree IDE for Intel® FPGAs Download Size: 541.5 MB	

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-5xx_recovery.zip* file. By default the file is stored in C:\Program Files\Unigraf\Unigraf UCD Tools\recovery
- 4. Extract the content of the ZIP file in a folder in your PC, e.g., C:\Temp
- 5. Open Windows **Command Prompt** application
- 6. Change current directory to where the ZIP file was extracted (e.g. cd |Temp)
- Connect a micro-USB cable to JTAG connector in the UCD device (Please refer to chapter Product Description > Connections earlier in this document).
- 8. In the directory where the ZIP file was extrected (e.g. c:\Temp) please edit file recovery.bat
- On line three (3) parameter "QUARTUS_DIR" is set to point to the folder where the Qartus Programmer was installed (by default C:\intelFPGA_pro\22.3). If needed, please edit line three to match. Please save the file.

```
*recovery.bat - Notepad
<u>File Edit Format View H</u>elp
@ECHO OFF
SET OUARTUS_DIR=C:\intelFPGA_pro\22.3
SET QUARTUS_BINS=%QUARTUS_DIR%\qprogrammer\quartus\bin64
if EXIST %OUARTUS DIR%\ (
 FCHO -----
ECHO Programming s10_isp.sof to FPGA. Wait for ~1-2 minutes
 FCHO
 %QUARTUS_BINS%\jtagconfig.exe --setparam 1 JtagClock 6000000
 %QUARTUS_BINS%\quartus_pgm.exe -c 1 --mode=JTAG --operation="p;s10_isp.sof@1"
 ECHO -
 ECHO Please check if s10_isp.sof was programmed successfully, i.e. no errors on log above
 ECHO Please run FW update utility to complete recovery procedure
 ECHO
) else (
```

FCHO "%OLIARTIIS DIR% directory does not exist. Find Quartus programming tool location and cou

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

Step 2

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

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

APPENDIX H: PLAYLISTS AND SCENARIOS

UCD Console's Playback 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.

UCD Console - UCD-500 [2150C473]: DisplayPort Source and Sink Eile Iools <u>W</u> indow <u>H</u> elp		- 🗆 X
DP RX DP TX Event Log		
Link Pattern Generator Playback Audio Generator HDCP EDID DF	PCD FEC Sink DUT Testing	
Import	Selected Sequence	
Common HDR10+ Test	Source: Select Editor	
✓ Sample Content	Video	
 Basic Video & Audio Example - DP.txt 	Source: -	
Flip-flop with Audio Flip-flop Silent	Amount: -	
Philips 1920x1080p + 1kHz	Horizontal Vertical Misc	
Philips 3840x2160p + 1kHz Y Frame Rate Example - DP.txt	Total - Total - Frame Rate, Hz: - Start - Start - Color Depth, BPP: -	
Spinners FHD 59fps	Active - Active - Color Encoding: -	
Spinners FHD 119fps	Sync Width - Sync Width -	
Spinners UHD 59fps Spinners UHD 119fps		
✓ HDR & Metadata Example - DP.txt	Audio	
	Source: -	
Run	Amount: -	
	Compressed: - Amount of channels: -	
	Sampling: - Bit depth: -	
	Packets	
	Source: -	
	Amount: -	
	Status: Idle	
HPD		
Asserted		
nline online		

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 the 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-5XX devices feature a 16 GBytes frame buffer memory. This frame buffer enables loading up to 320 pcs 4K video frames or 80 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 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.

Кеу	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' 'SDR - HDR'
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'

Scenarios

A Scenario is an operating structure that allows the user to determine a specific sequence of video frames, events and audio that are going to be played in a certain order. In addition, scenarios determine the 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 a 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.	
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	
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= :		
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.KRate: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/Adaptive-Sync 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	Not used with UCD-5XX	'p'	ʻp1:60:1:256;' ʻp0-59:60:1:256;'
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/Adaptive-Sync is enabled. In order to enable VRR/Adaptive-Sync, the corresponding event must be included in this step. The parameter is always in format of 'vXX', where 'XX' states frame rate. The parameter is provided after color format value, separated with 'v'.	'v60' 'v30'	'1:30:0:256v60;' '1:30:0:256v30;'

Color Format

Color format is a two-byte 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.

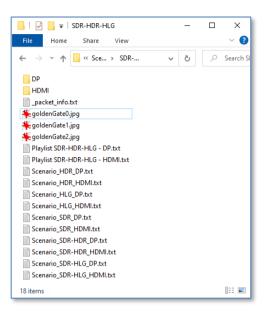
For example, parameter for YCbCr 4:4:4, 10 bits is $(2 \times 256 + 1) = 513$.

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 the description of Playlist SDR-HDR-HLG – DP.



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

	,
Playlist item and example content	Description
[Device]	Start of device section
Serialnumber = *	Only one UCD device present.
Connectortype = DisplayPort Out	DisplayPort output
[Scenario]	Start of Scenario 1
caption = SDR	Scenario title "SDR"
period = 10000	Duration 10 sec
path = Scenario_SDR_DP.txt	Scenario file: Scenario_SDR_DP.txt in current folder
[Scenario]	Start of Scenario 2
caption = HDR	Scenario title "HDR"
period = 10000	Duration 10 sec
path = Scenario_HDR_DP.txt	Scenario file: Scenario_HDR_DP.txt in current folder
[Scenario]	Start of Scenario 3
caption = HLG	Scenario title "HLG"
period = 10000	Duration 10 sec
path = Scenario_HLG_DP.txt	Scenario file: Scenario_HLG_DP.txt in current folder
[Scenario]	Start of Scenario 4
caption = SDR – HDR	Scenario title "SDR – HDR"
period = 10000	Duration 10 sec
path = Scenario_SDR-HDR_DP.txt	Scenario file: Scenario_SDR-HDR_DP.txt in current folder
[Scenario]	Start of Scenario 5
caption = SDR – HLG	Scenario title "SDR – HLG"
period = 10000	Duration 10 sec
path = Scenario_HDR_DP.txt	Scenario file: Scenario_SDR-HLG_DP.txt in current folder

Scenario File (Scenario_SDR-HDR-DP.txt)

Scenario item and example content	Description
video=goldenGate0.jpg	Video files in current folder, file name format goldenGate0.jpg
	(0)
audio= <audio not="" selected=""></audio>	Audio not selected
packets=DP\Infoframes_0000.bin	Packet files in folder DP file name format Infoframes_0000.bin
	(0)
porder=0:180:2:256;1:180:2,0:256;	180 frames of image index 0, Packet index 2, RGB 8 bpc 180 frames of image index 1, 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:
linkRate=0	
linkRateMin=	
dscFrameRate=60	DSC Timing: Frame rate [fps] × 1000
dscHcactive=7840	DSC Timing: Horizontal active
dscHcblank=100	DSC Timing: Horizontal blank
dscVtotal=2250	DSC Timing: Vertical total
dscVsync=10	DSC Timing: Vertical sync
dscVstart=82	DSC Timing: Vertical start
dscVactive=2160	DSC Timing: Vertical active
·	