



# M42d DisplayPort 80G Video Analyzer/Generator

## User Guide

Ver. A3



The specifications and information regarding the products in this manual are subject to change without notice. All information, examples and recommendations in this manual are believed to be accurate but are represented without warranty of any kind, express or implied. Users are fully responsible for their application of any products.

See the product page at <https://www.quantumdata.com/m42d.html> for the most up-to-date User Guide.

## Support

For further support on your M42d Instrument, contact Teledyne LeCroy support via <https://www.quantumdata.com/support.html>.

Please provide the following information in your message to the support team:

- Your location
- VPS Software Version (if applicable)
- Device Model Number
- Device Serial Number
- Firmware Version Installed
- Instrument Information Report .txt file (if available)

**Note:** All of the device information can be found within the Instrument Information Report .txt file, so these can be substituted with the full Information Report. Instructions for accessing and saving the Instrument Information Report can be found in **Section 2.2**

<b>1</b>	<b>Getting Started with the M42d</b>	<b>8</b>
1.1	About the M42d DisplayPort 80Gbps Video Analyzer/Generator	8
	Key Features of the M42d 80G Video Analyzer/Generator	8
1.2	What makes the M42d 80Gbps Video Analyzer/Generator unique?	9
1.3	Scope of this User Guide	10
	High-level tasks described in this chapter	10
	What is not covered in this user guide	10
1.4	Revisions to this user guide	10
1.5	What kinds of data does the M42d 80 Gbps Video Analyzer/Generator allow you to view?	11
1.6	What is in the M42d shipping box?	12
	Positioning/Orientation	12
1.7	Getting the M42d up and running	13
	Adjusting M42d Internal Fan Speed	16
	Connecting a DisplayPort Source Device Under Test	17
	Connecting a DisplayPort Sink Device Under Test	18
	Important Notes Using External Monitor for VPS GUI	19
	Connecting a DisplayPort Source and Sink Device for Passive Monitoring	20
1.8	Connectors and Controls	21
	eDP Pin Configurations	22
<b>2</b>	<b>Video Protocol Suite (VPS) GUI Application</b>	<b>23</b>
2.1	Operating the embedded VPS GUI from an external display	23
2.2	Operating VPS on a host PC	24
	Installing and Connecting the M42d VPS GUI Application	24
	Accessing and Saving the Instrument Information Report	30
	Remote Host PC Startup	32
2.3	Profiles	35
	Creating/Choosing a Profile to Start	35
	Switching Profiles within VPS Dashboard	39
	Accessing the Directory Folders for Profiles	41
2.4	Accessing Device Settings and Information	44
	Applying Licenses	44
	Setting the Instrument date and time	48
2.5	Upgrading VPS GUI (Embedded and Remote PC Application)	50
	Upgrading VPS Application on Remote PC	51
	Upgrading Instrument Firmware/Embedded VPS GUI	52
2.6	VNC Remote Connection	55
	Installing TightVNC Viewer and Connecting to the Device	57
<b>3</b>	<b>VPS GUI Dashboard</b>	<b>59</b>
3.1	Status Panel	59
	Status Panel- Left (TX)	60

	Status Panel- Right (RX)	62
3.2	Dashboard Toolbar	64
3.3	Dashboard Main Panel	66
	Dashboard Home	66
3.4	Dashboard Taskbar	67
<b>4</b>	<b>Signal Generator</b>	<b>68</b>
	Overview	68
4.1	Selecting DisplayPort Video Format	70
	Format Window	70
	Selecting format using CTA smart filtering	73
	Selecting format using VESA Smart Filtering	78
	Selecting format using My List (custom lists)	84
	Configuring the format Settings	86
4.2	Pattern	89
	Pattern Window	89
	Selecting a Test Pattern from the Standard List	90
	Selecting a Test Pattern from a Custom List (My List)	93
	Configuring Test Patterns Settings	94
4.3	Testing audio on an audio rendering device	96
	Configuring a Channel	98
	Linking Channels for Simultaneous Configuration	98
4.4	Link Train	102
	Accessing the Link Training Control application	102
	Adaptive Link Train	103
	Non-Adaptive Link Training	105
4.5	Viewing and Comparing the EDID of a connected display	107
	EDID Decode (Viewing the EDID of a connected display):	107
	EDID Comp	111
4.6	Image Shift	112
4.7	HDCP Testing	116
4.8	DSC (Display Stream Compression)	118
	Importing a DPX	121
4.9	DPCD Viewer	122
4.10	Topology and MST (Multi-Stream)	127
	Reading the EDID or DPCD of a downstream Multi-Stream Transport node	129
	Returning to Single-Stream Transport (SST) Mode	131
<b>5</b>	<b>Source Verification with Basic (Real-time) Analyzer</b>	<b>133</b>
5.1	Accessing Basic Analyzer Features	133
	Basic Analyzer Dashboard	135
	Display Window Toolbar	137
	Analyzer Control Panel	138

5.2	Controlling the Basic Analyzer	139
	Viewing the Color values	139
	Setting the video image size and aspect ratio	140
	Setting the EDID for the Rx port	142
	Setting the DPCD for the Rx port	144
	Generating a Hot-plug	145
	Enabling/Disabling HDCP	146
	Reading Error Info	148
5.3	DSC Analysis	149
	DSC Real-time (Snapshot) Analysis	149
	DSC Test CRC Verification	150
5.4	Emulating a Multi-Stream-capable Rx	151
	Returning Emulated Rx to SST mode	<b>Error! Bookmark not defined.</b>
<b>6</b>	<b>Protocol Analyzer with Capture Control</b>	<b>152</b>
6.1	Getting started with the Protocol Analyzer	153
	Configuring the M42d DP Protocol Analyzer with an EDID	153
	Verifying source video	155
6.2	Capture Control Panel	156
	Capturing DisplayPort source data	161
	Opening an Existing Capture	164
6.3	Capture Viewer Panels	165
	Capture Viewer Overview	165
	Capture Viewer Toolbar	167
	Event Plot Panel	174
	Event Detail Panels	179
	Link Symbol Panel	181
	UHBR/Multi-Stream Transport Captures	183
6.4	Searching and Filtering for Specific Data Elements	185
	Event Search	185
	Filtering Specific Data Elements	190
6.5	Importing, Exporting, and Transferring Capture Files	194
	Transferring a Capture File Between Instrument and Remote PC.	195
	Exporting a Capture File	200
	Importing a Capture File	202
<b>7</b>	<b>Auxiliary Channel Analyzer (ACA)</b>	<b>204</b>
7.1	Accessing the Auxiliary Channel Analyzer (ACA)	205
7.2	Monitoring Auxiliary Channels with Aux Channel Analyzer Utilities	207
7.3	ACA Window and Panel Description	213
7.4	ACA Data Viewer	217
	ACA Data Viewer – Panel Description	217
	Exporting ACA Data as Text or HTML File	220

7.5	Using the ACA Filter and Find Features	221
	ACA Filter	221
	ACA Find Feature	227
7.6	Importing, Exporting, and Transferring ACA Data	235
	Transferring an ACA Data File Between Instrument and Remote PC.	236
	Exporting an ACA Data File	241
	Importing ACA Data File	242
<b>8</b>	<b>Passive Monitoring</b>	<b>244</b>
8.1	Connecting a DisplayPort Source and Sink Device Under Test	244
	Enable Passive Probing	246
8.2	Passively Viewing Video Data in Real Time	247
	Accessing Basic Analyzer Features	247
8.3	Passively Monitoring ACA Transactions	251
	Passively Monitoring the Auxiliary Channel Transactions	251
	ACA Window and Panel Description	257
8.4	Passively Analyzing Video Data using Capture Control	261
	Verifying Source Video	261
	Capture Control Panel	263
	Capturing Passed-through DisplayPort source data	268
<b>9</b>	<b>LTTPR Testing</b>	<b>271</b>
9.1	Overview	271
9.2	LTTPR Emulation for Testing Source Devices	272
9.3	Modifying LTTPR Capability Registers	276
	Saving and Opening/Reapplying Saved LTTPR Configurations	282
9.4	Testing LTTPR Devices with M42d as DPTX	287
	Monitoring Link Training Negotiations with LTTPR(s)	287
	Reading DPCD Registers with LTTPR(s) Present	291
<b>10</b>	<b>Panel Replay Testing</b>	<b>292</b>
10.1	Overview	292
10.2	Emulation through the DPCD	292
10.3	Viewing Panel Replay VSCs in Basic Analyzer window	293
10.4	Capturing Panel Replay VSC Packets	297
10.5	Viewing Panel Replay Auxiliary transactions	299
<b>11</b>	<b>eDP</b>	<b>300</b>
	eDP Pin Configurations	300
11.1	eDP Testing Connections	301
11.2	Fast Link Training	302
	Fast Link Training – Source Tests	302
	Fast Link Training – Sink Tests	302

Monitoring the Fast Link Training Transactions on the Aux Channel	305
11.3 Advanced Link Power Management (ALPM)	306
ALPM – Source Tests	306
ALPM – Sink Tests	306
Monitoring the ALPM Transactions on the Aux Channel	306
11.4 Alternate Scrambler Seed	307
11.5 Backlight Control	310
Backlight Control Test Connections	310
Backlight Control – Sink Tests	311
<b>12 Command Reference</b>	<b>312</b>
12.1 Accessing the Command Line	312
12.2 Command Line Conventions	314
Discovering Commands	316
12.3 List of Commands	318
Video-Related commands	318
Audio Generation-Related commands	321
Analyzer-Related commands	322
<b>13 Editors</b>	<b>324</b>
13.1 DPCD Editor	325
Reading/Writing DPCD from/to M42d Emulated Rx	329
Saving and Opening/Reapplying Saved DPCD Configurations	330
13.2 EDID Editor	333
13.3 Format Editor	333
<b>Appendices</b>	<b>334</b>
Appendix A. Licenses	334
Applying Licenses	334
License Listing	340
Appendix B. Configurable LTTTPR Capability Registers	342

# 1 Getting Started with the M42d

---

## 1.1 About the M42d DisplayPort 80Gbps Video Analyzer/Generator

This chapter provides an overview of features of the M42d DisplayPort 80Gbps Video Analyzer/Generator. The M42d is a compact, versatile test instrument offering entry level functional testing that can be extended through software licenses to full compliance testers with sophisticated analysis and diagnostic capabilities.

The M42d supports video pattern testing and audio testing of DP 2.0 capable displays with 1, 2, or 4 lanes at 20 Gb/s link rates per lane, for an 80 Gbps max link rate. It is also backward compatible with DP 1.4 and includes all functionality of the M42d. It is equipped with two (2) Tx ports and two (2) Rx ports—one each for standard DisplayPort and USB-C with DP alt mode support. Only one of the Tx ports and one of the Rx ports can be active at any one time.

The M42d is operated through the Video Protocol Suite (VPS). VPS is a GUI application that can run either on a Windows host PC or an external display connected to the HDMI or DisplayPort port on the back of the M42d. **Chapter 2 is dedicated entirely to the VPS GUI Manager.**



### Key Features of the M42d 80G Video Analyzer/Generator

**Note:** Certain features and functions of the M42d require licensing. More information on licensing can be found in **Chapter 2 (Applying Licenses)** or **Appendix A: Licenses**.

- Equipped with both DP standard and USB-C ports for Tx and Rx functions
- Test DP sources 10Gb/s, 13.5Gb/s, and 20Gb/s lane rates at the new 128b/132b line coding
- View incoming video and metadata—including DSC compressed—from a source device
- Capture and decode incoming video, protocol, and control packets including Display Stream Compression (DSC)
- Run functional tests on displays and monitors at UHBR lane rates with large format and test pattern library
- Configure link training parameters to test display's handling of link training
- Generate Display Stream Compression (DSC), select patterns and configure slices and video parameters



- View and edit EDID and DPCD registers
- Monitor Aux Channel transactions while emulating a DP 1.4 or DP 2.0 source or sink
- Passively monitor the Main Link and Aux Channel between a source & display at UHBR lane rates
- Panel Replay testing for sources and sinks
- LTTTPR device emulation in Transparent mode for testing LTTTPR-capable source devices at 8b/10b line code for lane rates up to HBR3 (support for LTTTPR in non-transparent mode for 128b/132b at UHBR rates is coming soon)
- View Power Delivery (PD) negotiations for USB-C DP Alt Mode
- DP 2.0 Link Layer compliance tests on source devices up to 13.5Gb/s per lane
- 1.4 Link Layer compliance tests on sources and sinks up to 8.1Gb/s per lane
- Run DP 1.4 Forward Error Correction (FEC) and Display Stream Compression (DSC) compliance tests for sources and sinks
- Run HDCP 2.3 compliance tests on DisplayPort sources, sinks and branch devices
- Run audio tests using programmable LPCM sine wave audio tones
- Run tests on embedded DisplayPort (eDP) 1.4b sources and panels using fast link training, ALPM & backlight control

## 1.2 What makes the M42d 80Gbps Video Analyzer/Generator unique?

The Teledyne LeCroy quantumdata M42d Video Analyzer/Generator provides an unprecedented combination of functional and compliance testing for video, audio and protocol of DisplayPort 2.0 and DisplayPort 1.4. The M42d supports legacy DisplayPort lane rates of 1.62, 2.7, 5.4, 8.1 Gb/s and the new DP 2.0 higher speed lane rates and new line coding— 128b/132b—of 10.0, 13.5, and 20.0Gb/s data rates up to 4 lanes.

The protocol analyzer provides a snapshot status view and deep analysis using captures of incoming DisplayPort 2.0 (and DP 1.4) streams from source devices including DSC/FEC compressed streams.

The M42d's video generator can be used for testing displays, USB-C adapters, extenders, etc. The video generator offers a large library of standard video timings and test patterns necessary for testing next generation high resolution displays.

The M42d supports a full suite of DP 1.4 link layer, forward error correction (FEC) and Display Stream Compression (DSC) compliance tests for both sources and sinks. Support for Compliance Tests for DP 2.0 are being added on a rolling basis. See the **compliance** tab on the M42d product page (<https://www.quantumdata.com/m42d.html>) for currently supported compliance tests.

The Passive Probe feature, based on Teledyne LeCroy's cutting-edge T.A.P.4™ technology, enables full monitoring of the DisplayPort Main Link and the Aux Channel between two DisplayPort devices up to 20 Gb/s.

### 1.3 Scope of this User Guide

This user guide documents the operation of the M42d 80 Gbps Video Analyzer/Generator. It is intended to be used with the M42d Quick Start Guide.

The user guide describes the features and functions of the M42d 80 Gbps Video Analyzer/Generator as operated either through the standalone Video Protocol Suite (VPS) PC application or with the Video Protocol Suite running on the M42d itself and displayed on an external monitor connected to the HDMI port on the back of the M42d. The screen shots used are usually from the most current release of the VPS GUI running on a host PC.

#### High-level tasks described in this chapter

- Getting started procedures
- Provisioning the IP address of the M42d
- Installing the M42d VPS GUI on a PC
- Establishing an IP session between an M42d and the host PC running the VPS GUI
- Connecting the DisplayPort source or sink devices under test to the M42d

#### What is not covered in this user guide

The M42d supports a full suite of DP 1.4 and 2.0 link layer, Forward Error Correction (FEC) and Display Stream Compression (DSC) compliance tests for both sources and sinks. Support for compliance tests for DP 2.0 are being added on a rolling bases; however, please refer to the M42d product page for updates on these functionalities. **Note:** These compliance tests are not covered in this user guide.

### 1.4 Revisions to this user guide

Version A3 of the M42d 80G Video Analyzer/Generator User Guide contains the following updates/revisions:

- Full support and instruction throughout the User Guide for the new GUI of the M42d: Video Protocol Suite (VPS)
- Revised screenshots and graphics

**Note:** please be sure to check the quantumdata website and M42d product page for updates to this User Guide <https://www.quantumdata.com/m42d.html>.

## 1.5 What kinds of data does the M42d 80 Gbps Video Analyzer/Generator allow you to view?

By providing visibility into the DisplayPort protocol, and the underlying protocol, video and secondary data packets blocs, as well as DPCD data during link training, the M42d Video Analyzer/Generator enables you to detect changes and identify anomalies in either the DP 1.4 or 2.0 signal. The following is a list of the data types you can view (currently):

- Main Link
  - K Character
  - Control data
  - Video data
  - Audio data
  - Secondary Data Packets
- Aux Channel Read/Write transactions, including:
  - Native DisplayPort aux transactions for capabilities discovery
  - Link Training transactions
  - Multi-Stream Transport Sideband Messages
  - Other DPCD
  - EDID
  - HDCP authentication transactions
- Error data
- Markers

## 1.6 What is in the M42d shipping box?

When a Teledyne LeCroy quantumdata M42d 80G Video Analyzer/Generator is shipped, it will contain the following additional items:

- AC power line cord
- CE mark declaration
- DisplayPort to DisplayPort cable
- USB-C cable (unmarked)
- USB-C cable (marked)
- CATC Micro-D cable assembly
- Ethernet cable
- Mouse
- Quick Start Guide

### Positioning/Orientation

The M42d can be positioned either flat or upright, pictured here:



## 1.7 Getting the M42d up and running

Use the following procedures to get your M42d up and running.

1. Remove the M42d from the shipping box and lay it flat or upright on your desktop or benchtop.
2. Connect the M42d power cable (provided) to a suitable outlet (110-240V 50/60Hz). The power socket is on the back of the M42d as shown below.



3. Connect an external HDMI monitor to the HDMI connector on the back of the M42d; labeled "External Monitor" at the location indicated below.



The setup is depicted below.



4. Connect a mouse to one of the USB ports on the front or back of the M42d as shown below.
5. Connect a keyboard to one of the other USB ports on the front or the back of the M42d.



Power up the M42d via the power button on the front of the M42d.



**Notes:** Regarding Power Button color:

- Solid Red = Powered down/standby
- Solid Green = Booted without network connectivity
- Solid Blue = Booted with network connectivity
- Solid Yellow = The front button is being actively pressed in
- Flashing Yellow = Instrument is powering up
- Flashing Green = Instrument is nearly done powering up (FPGA is ready, firmware still loading)
- Flashing Red = Error

The VPS GUI application will appear on the external display as shown below.



## Adjusting M42d Internal Fan Speed

Once the hardware is set up with an external display connected directly, you may optionally adjust the internal fan on the M42d unit from its default Full Speed setting to the Standard Speed.

**Full Speed** is enabled by default in order to meet the specification of maximum operating ambient temperature of 40°C. Full Speed is necessary for operating at ambient temperature between 30°C and 40°C. If you will be operating the unit at **less than 30°C** (86°F), you may safely change the fan to Standard Speed, which is quieter than the Full Speed setting.

**Note:** This procedure needs to be done on the M42d instrument itself using a display connected to the M42d with a keyboard connected to the USB-A port of the instrument.

The procedure for adjusting fan speed is as follows:

1. If not already off, power down the unit by pressing the power button once.
2. Once completely shut down (power button light is red), power the unit on by pressing the power button again.
3. While booting up, press the DEL key repeatedly to place into BIOS mode.
4. Once in BIOS mode, use the right arrow to select **Advanced** tab.
5. Use the down arrow to select **NCT6106D HW Monitor** and press Enter.
6. Press Enter again to select **Fan Speed Control Mode**
7. Use up/down arrow keys to select **Standard** and press Enter
8. Press F4 key to prompt the **Save & Exit Setup** dialog box.
9. Press Enter to save configuration and exit.

The device will automatically reboot normally with the lower fan speed setting.



### Connecting a DisplayPort Source Device Under Test

#### To connect your source DUT to the M42d:

Connect the source device under test to the M42d DisplayPort In/Rx port as shown below. Note that you can connect either through the full-size standard DP port or the USB-C DP Alt Mode port depending on the lane rate (USB-C port shown in the example below).



The full test setup up is shown below with the VPS GUI Application running on the M42d being viewed on the external display. The sample screen show shows a DisplayPort analysis screen.



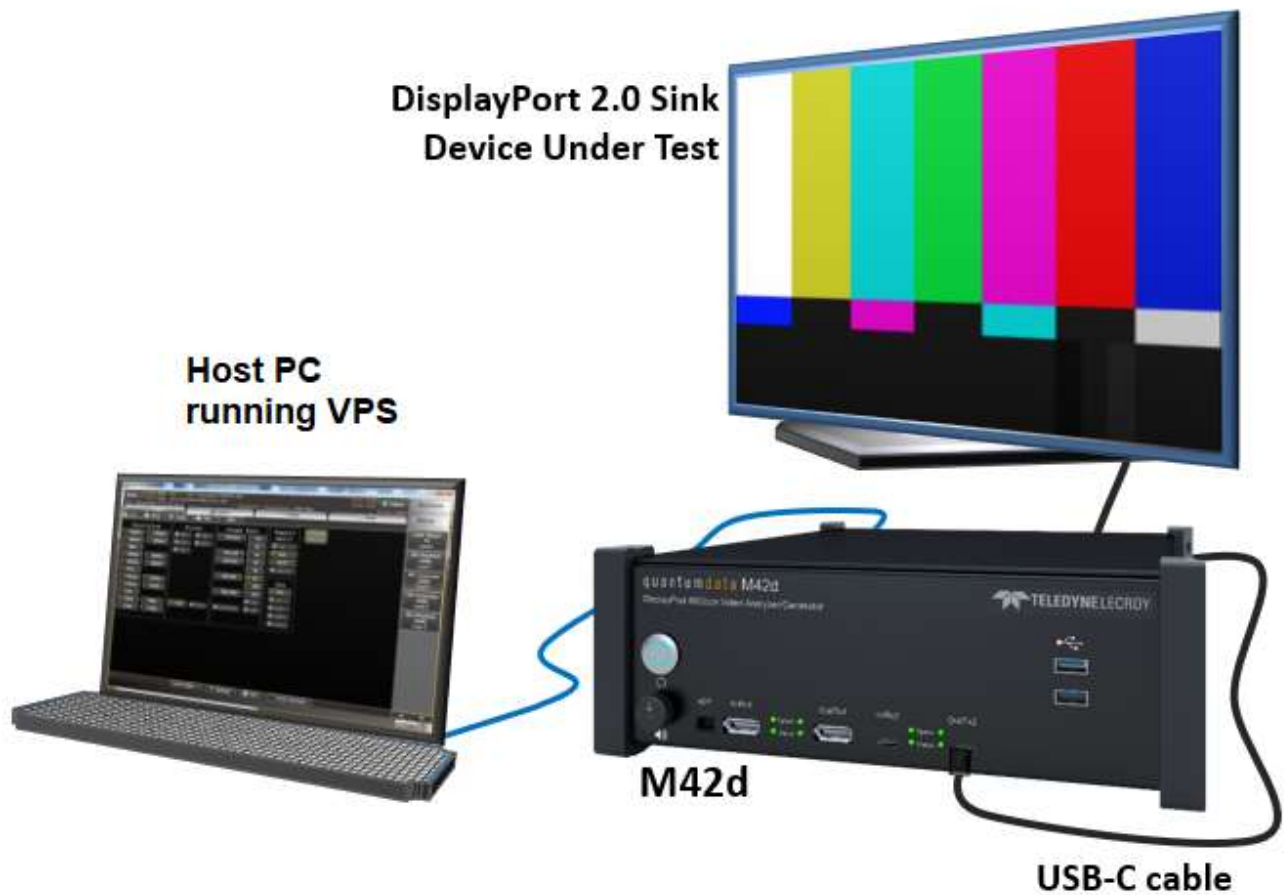
### Connecting a DisplayPort Sink Device Under Test

To connect your sink DUT to the M42d:

Connect the sink device under test to the M42d DisplayPort Out/Tx port as shown below. Note that you can connect either through the full size standard DP port or the USB-C DP Alt Mode port depending on the lane rate (example shows connection to USB-C port).



The full test setup is shown below. This example uses the VPS GUI installed on a host PC.



## Important Notes Using External Monitor for VPS GUI

### Note 1: Selection of external monitor

Due to HDCP content protection requirements, you will have to use an HDCP 2.2 or 2.3-enabled external monitor to view HDCP protected content in the VPS GUI. We have qualified the following displays:

- Dell UltraSharp 27 inch Monitor Model U2718Q.
- Dell UltraSharp 27 inch 4K Monitor Model U2720Q.
- ASUS 28" 4K UHD Monitor Model VP28U.
- ViewSonic 27" 4K UHD Monitor Model VX2776-4K-MHD.
- Other 4K HDCP 2.3 displays may work as well. (for most up-to-date list, refer to the latest revision of the User Guide on the M42d product page <https://www.quantumdata.com/m42d.html>).

### Note 2: Changing the VPS GUI Display Resolution

You can change the resolution that the VPS GUI is displayed at on the connected monitor using the Mint Linux utilities. Follow these steps:

**Step 1:** Minimize the VPS GUI using the minimize button at the top right of the window.

**Step 2:** Once the VPS GUI is minimized, click on the Mint icon (green M) on the lower left corner of the monitor to access the Mint Linux Controls.

**Step 3:** Select the **Settings** primary menu on the left and then on the right select **Display Configuration** secondary menu. The Display Configuration menu appears.


**Step 4:** Set the resolution to 1080p using the **Resolution** pull-down menu. The resolution should change and persist through a reboot.

## Connecting a DisplayPort Source and Sink Device for Passive Monitoring

Passive Monitoring or Passive Probing is a licensed feature of the M42d as well. Full instructions for the connections and Passive Monitoring itself are provided in **Chapter 7 Passive Monitoring**

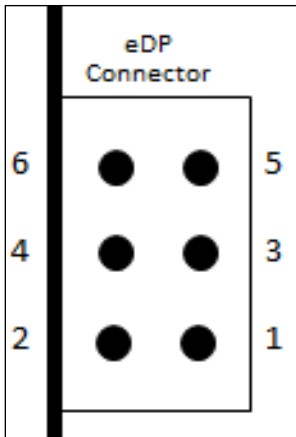
## 1.8 Connectors and Controls

The table below describes the M42d connectors and controls.

M42d Configurations	Information / Function
<p><b>Protocol Analyzer in M42d</b></p> 	<p><b>Front panel:</b></p> <ul style="list-style-type: none"> <li>▪ A – USB-C Out/Tx port for all HBR and UHBR data rates up to 20 Gbps.</li> <li>▪ B – USB-C In/Rx port for all HBR and UHBR data rates up to 20 Gbps.</li> <li>▪ C – DP Out/Tx port for RBR, HBR, HBR3, and UHBR10 (10G data rates)</li> <li>▪ D – DP In/Rx port for RBR, HBR, HBR3, and UHBR10 (10G data rates)</li> <li>▪ E – USB ports (2) used for connecting a mouse and keyboard.</li> <li>▪ F – Knob for turning up or down the volume for the internal speaker.</li> <li>▪ G – Power button; press and release.</li> <li>▪ H – eDP block for Backlight Control (See Note Below).</li> </ul> <p><b>Back panel:</b></p> <ul style="list-style-type: none"> <li>▪ I – Power plug (110-220VAC 50/60Hz)</li> <li>▪ J - HDMI – Admin port for connecting external HDMI UHD display for M42d VPS GUI.</li> <li>▪ K - DisplayPort – Not recommended for use currently.</li> <li>▪ L - USB/USB-C (2 ea.) – For mouse &amp; keyboard.</li> <li>▪ M - RJ45 (2) - E1 Network for connecting host PC running VPS Remote GUI. E2 Aux – Future.</li> <li>▪ N - DVI – Possible future use.</li> <li>▪ O - RS-232 (2) – Possible future use.</li> <li>▪ P - Audio (2) – Possible future use.</li> <li>▪ Q – CrossSync™ for TRIG IN/OUT – Future.</li> <li>▪ R - RCA SPDIF In/Out</li> </ul>

**Note:** The eDP header block provides PWM signal used for controlling the backlight of some eDP displays. The pinout and functions are shown on the next page.

## eDP Pin Configurations



1. BL\_Enable (Possible Future Rx input)
2. BL\_Enable (Tx Output)
3. BL\_PWM\_DIM (Possible Future RX input)
4. BL\_PWM\_DIM (TX Output)
5. Ground
6. Ground

eDP is covered in [Chapter 10 Embedded DisplayPort](#).

## 2 Video Protocol Suite (VPS) GUI Application

### 2.1 Operating the embedded VPS GUI from an external display

The M42d is operated through the Video Protocol Suite (VPS). VPS is a GUI application that can run either on a **Windows host PC** or on an **external display** connected to the HDMI or DisplayPort port on the back of the M42d.

When operating from an external display, a mouse (provided) is required and a keyboard is optional but recommended. In this case of the external display, VPS is running on the M42d itself, but the VPS GUI is displayed on the external monitor. This operational scenario is shown below.



*VPS GUI Running on External Display (Source Test Example)*

## 2.2 Operating VPS on a host PC

You can operate the M42d from the Video Protocol Suite application installed on a host PC. The connection can either be direct, or over a LAN. (It is suggested that you consult with your local IT or network administrator for address assignment policies if using your local area network)

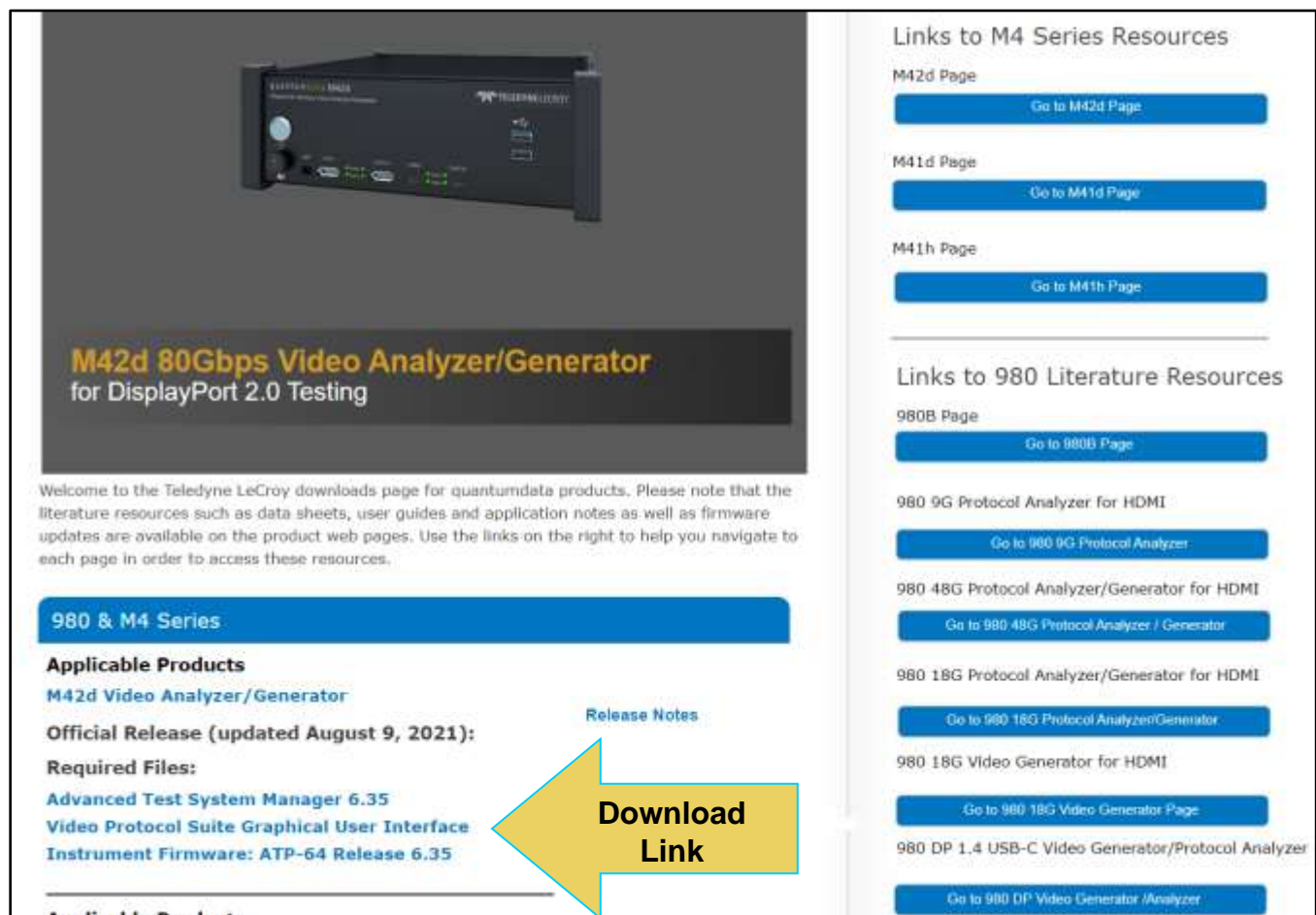
You will have to first download and install the VPS GUI application on your Windows PC. You will then need to connect your PC to the M42d over an Ethernet IP connection. These procedures are provided below.

**Please note:** You will have to have completed the procedures in the section above (**1.7 Getting the M42d Up and Running**) in order to complete the following steps.

### Installing and Connecting the M42d VPS GUI Application

This procedure describes how to setup the VPS application on your host PC and connect to the M42d.

1. Download the VPS GUI application from the quantumdata downloads page:  
<http://www.quantumdata.com/downloads.html>.



The screenshot shows the Teledyne LeCroy quantumdata website. On the left, there is a product image of the M42d 80Gbps Video Analyzer/Generator with the text "M42d 80Gbps Video Analyzer/Generator for DisplayPort 2.0 Testing". Below the image, a welcome message states: "Welcome to the Teledyne LeCroy downloads page for quantumdata products. Please note that the literature resources such as data sheets, user guides and application notes as well as firmware updates are available on the product web pages. Use the links on the right to help you navigate to each page in order to access these resources." A blue button labeled "980 & M4 Series" is visible. Underneath, the "Applicable Products" section lists "M42d Video Analyzer/Generator" with an "Official Release (updated August 9, 2021)" and "Required Files" including "Advanced Test System Manager 6.35", "Video Protocol Suite Graphical User Interface", and "Instrument Firmware: ATP-64 Release 6.35". A yellow arrow labeled "Download Link" points to the "Video Protocol Suite Graphical User Interface" link. On the right side of the page, there are two sections of navigation buttons: "Links to M4 Series Resources" with buttons for "M42d Page", "M41d Page", and "M41h Page"; and "Links to 980 Literature Resources" with buttons for "980B Page", "980 9G Protocol Analyzer for HDMI", "980 48G Protocol Analyzer/Generator for HDMI", "980 18G Protocol Analyzer/Generator for HDMI", "980 18G Video Generator for HDMI", and "980 DP 1.4 USB-C Video Generator/Protocol Analyzer".

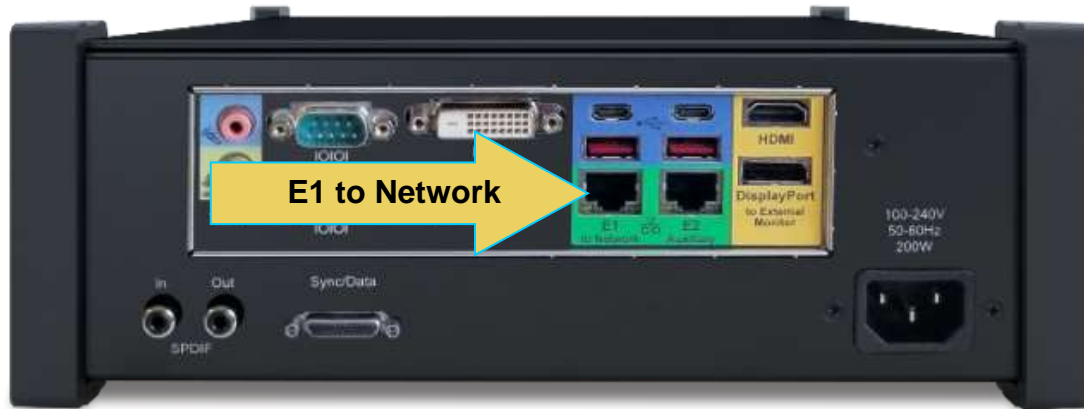
Click the Video Protocol Suite GUI link and follow the installation prompts to install the VPS Remote Application on your Windows PC.



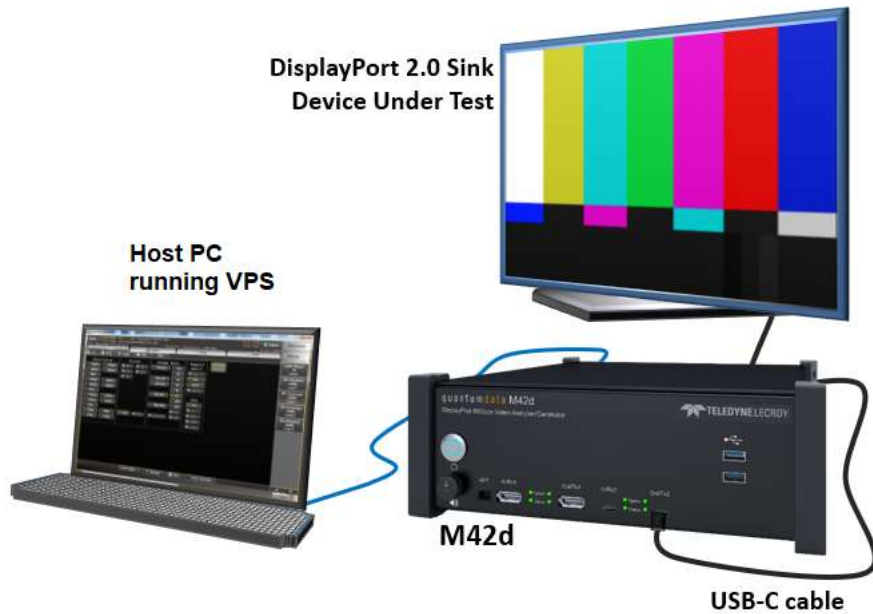
- After installation completes, run the new VPS application. It should be available in the Start Menu under All Programs → VideoProtocolSuite, and also from an icon on your host PC Desktop.

**Note:** Verify that the version number in the title bar matches the version on the website.

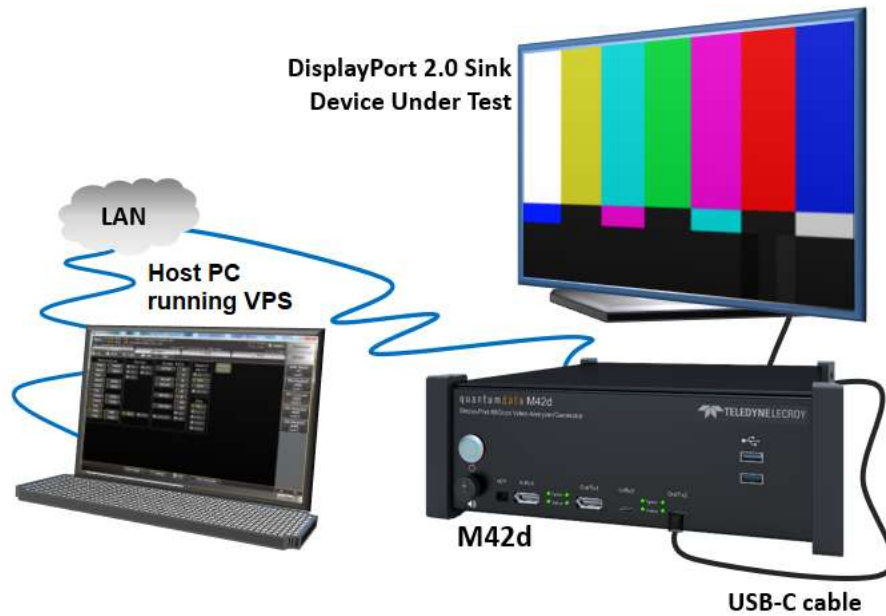
- Connect your PC to the M42d using an Ethernet cable. The connection is made to the Rj45 jack on the back of the M42d labeled E1 to Network as shown below.



The Ethernet IP connection from the host PC to the M42d can be accomplished through your corporate network or you can connect directly. Both scenarios are depicted below.

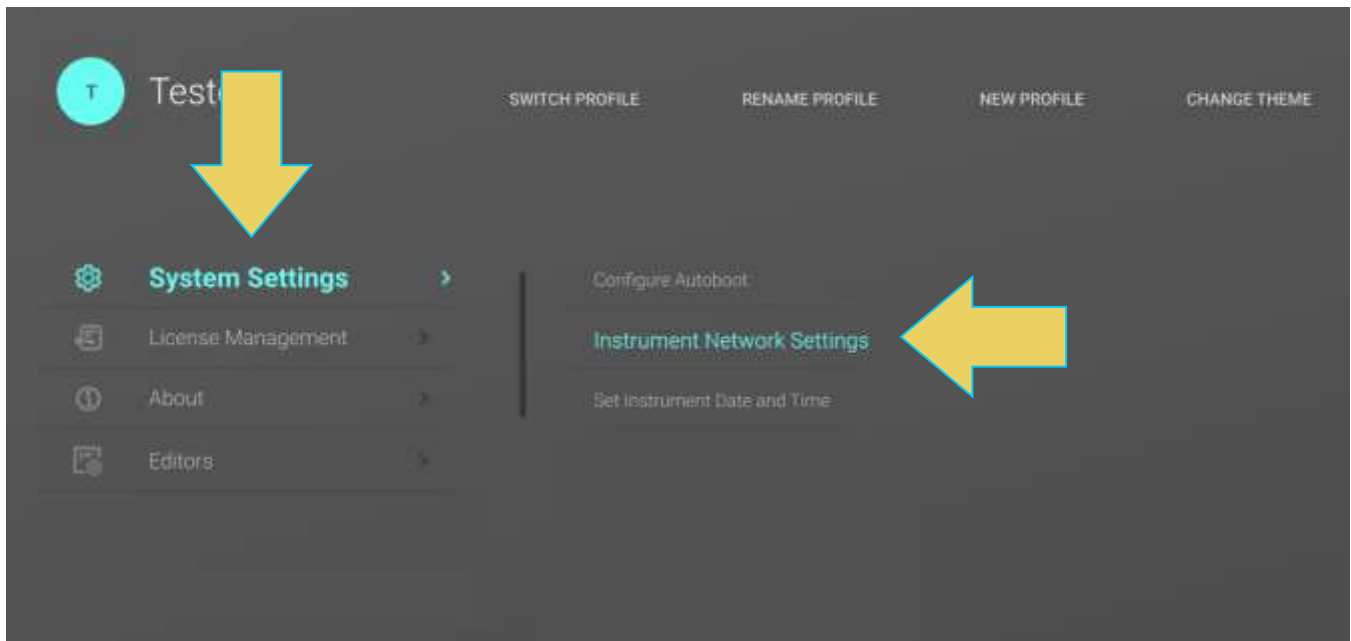


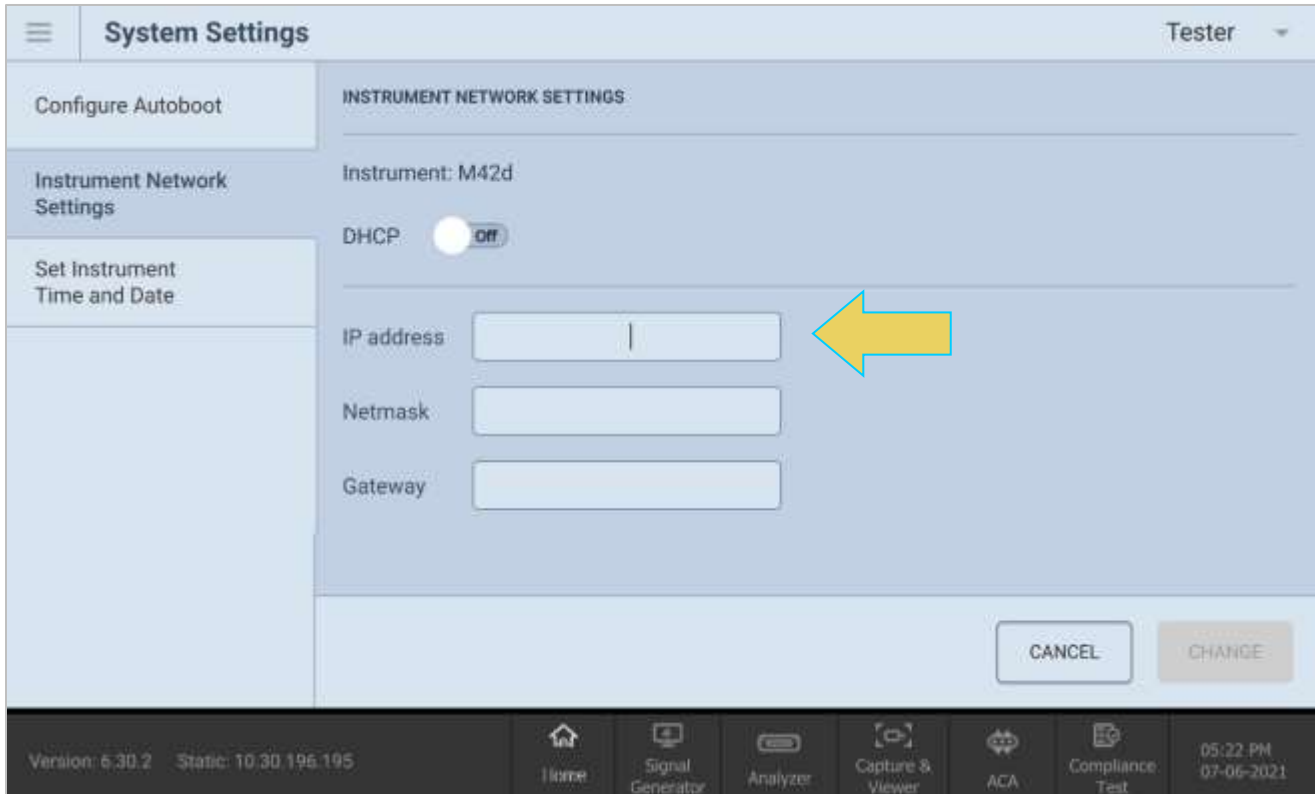
**PC Running VPS Application with Ethernet Direct Connection**



**PC Running VPS Application w/ Ethernet Connection thru Corporate LAN**

- Set the IP address of the M42d **Instrument Network Settings** of the *embedded* VPS GUI. Select the **System Settings** icon and select Instrument Network Settings. A dialog box appears enabling you to set DHCP or specify an IP address, and also make sure the Netmask and Gateway are properly configured. Sample screen shots of these windows are shown below.

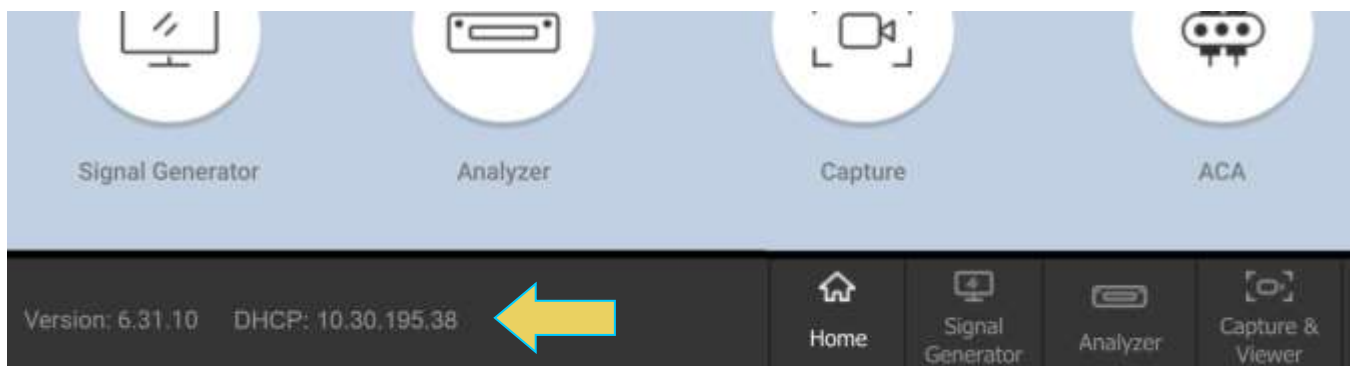




**Note:** Be sure to use an IP address that is compatible with your corporate LAN or your PC if you are connecting directly.

- 5. The instrument will automatically power cycle upon applying changes to the Network Settings.

**Note:** If using DHCP for IP address assignment, check for the resulting IP address at the bottom left of the embedded GUI after rebooting, as shown below.

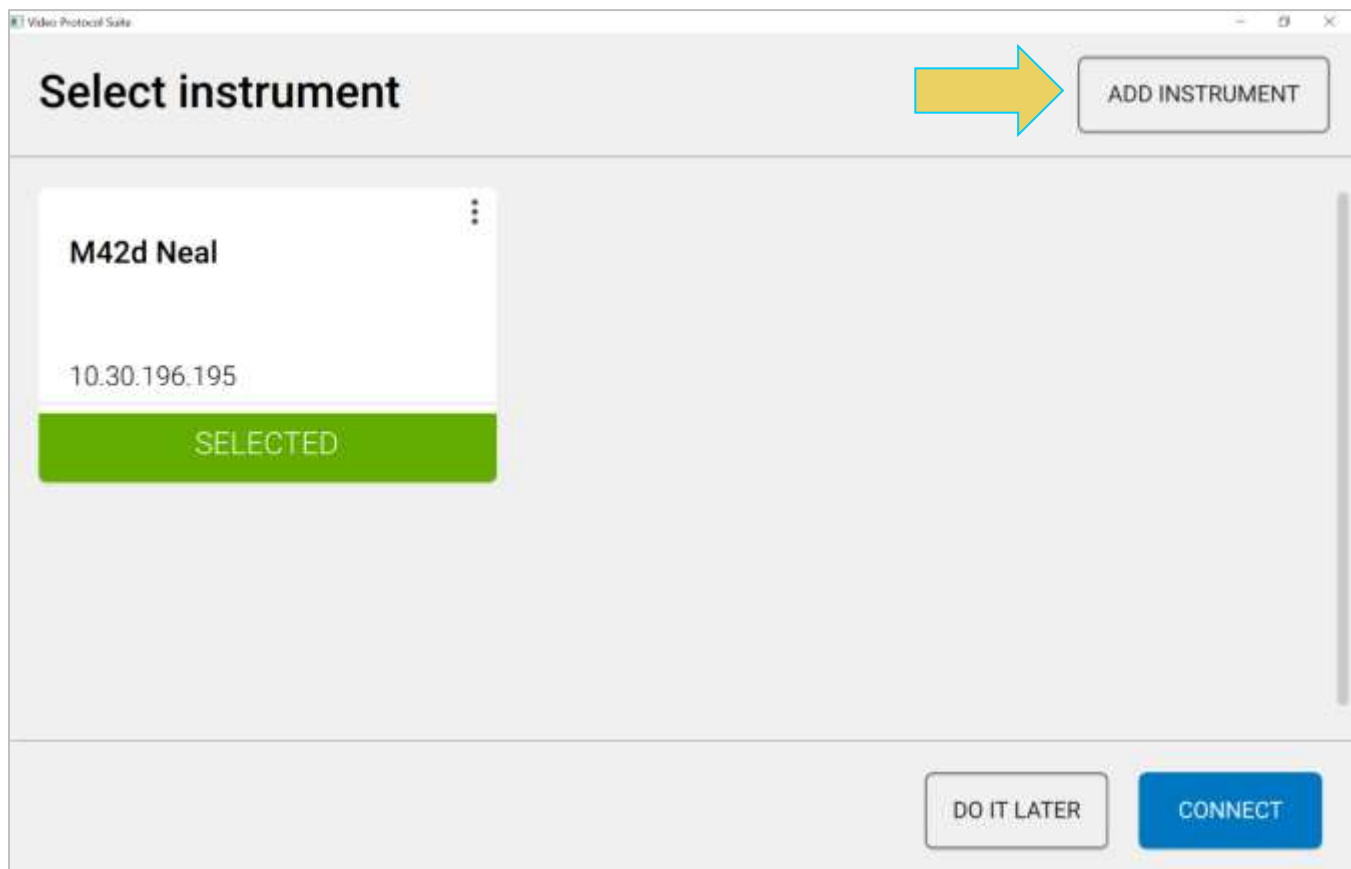


6. To add your M42d to the VPS Application, begin by clicking **Device Selection** on the system menu.

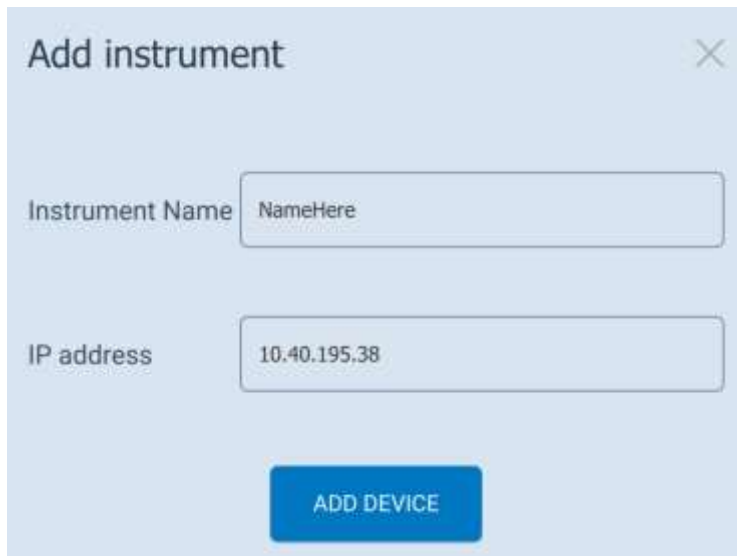


The **Select instrument** window appears, as shown below.

7. Click the **ADD INSTRUMENT** button in the top right corner.

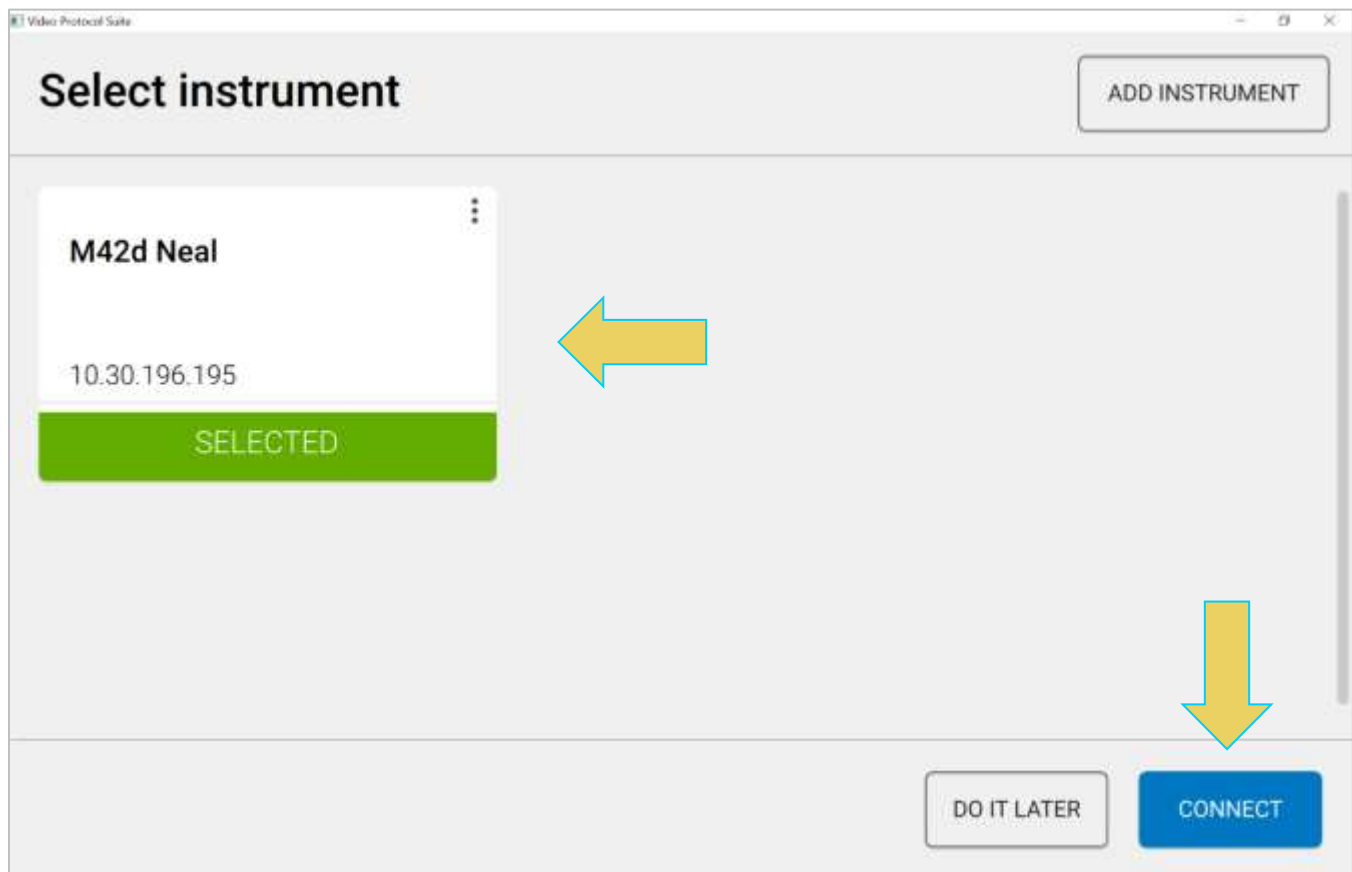


- You will be prompted to enter a name (any suitable name) and IP address (*obtained in step 4*) of the M42d that you want to connect to in the **Add Instrument** dialog box and click on the **ADD DEVICE** activation button.



The screenshot shows a dialog box titled "Add instrument" with a close button (X) in the top right corner. It contains two input fields: "Instrument Name" with the placeholder text "NameHere" and "IP address" with the value "10.40.195.38". At the bottom center is a blue button labeled "ADD DEVICE".

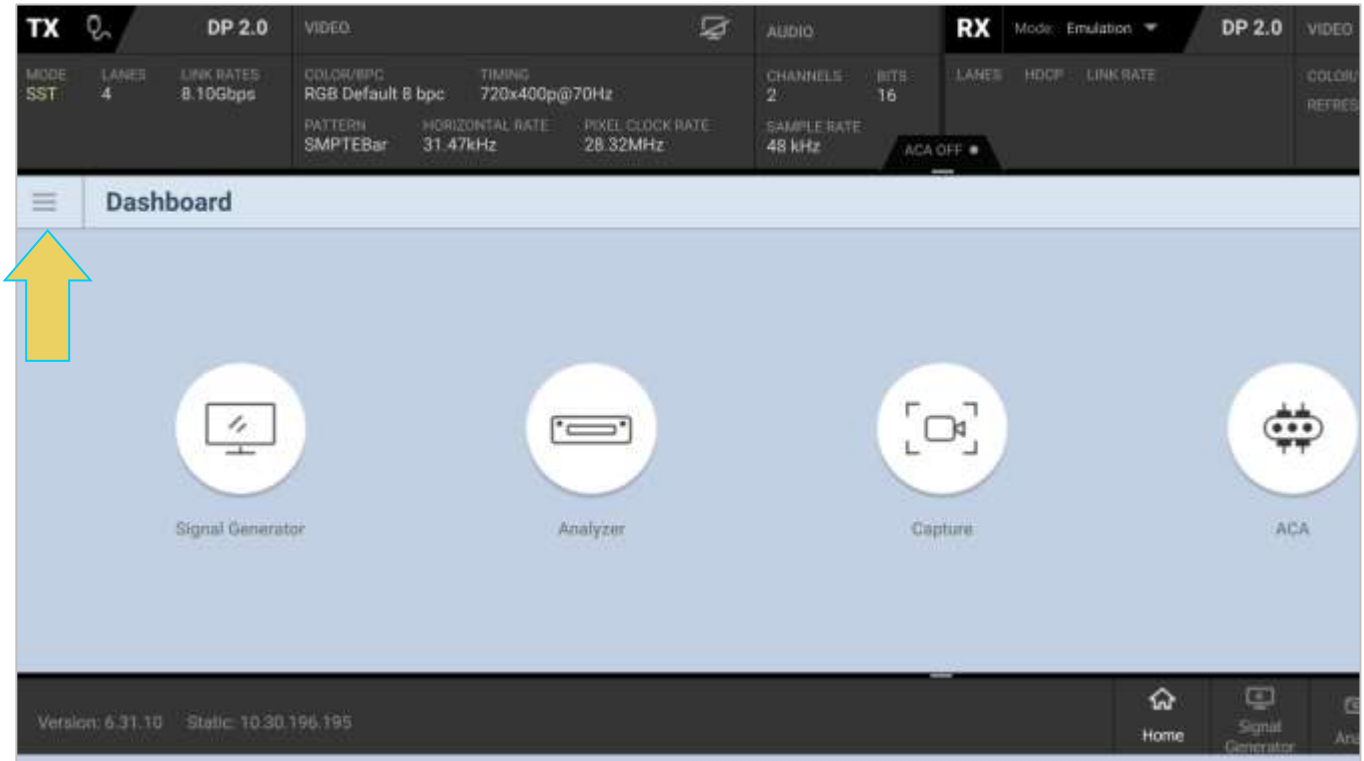
- At this point, you should be taken to the Instrument **Dashboard** of the VPS GUI. If not, select the **CONNECT** button at the bottom right of the **Select instrument** screen.



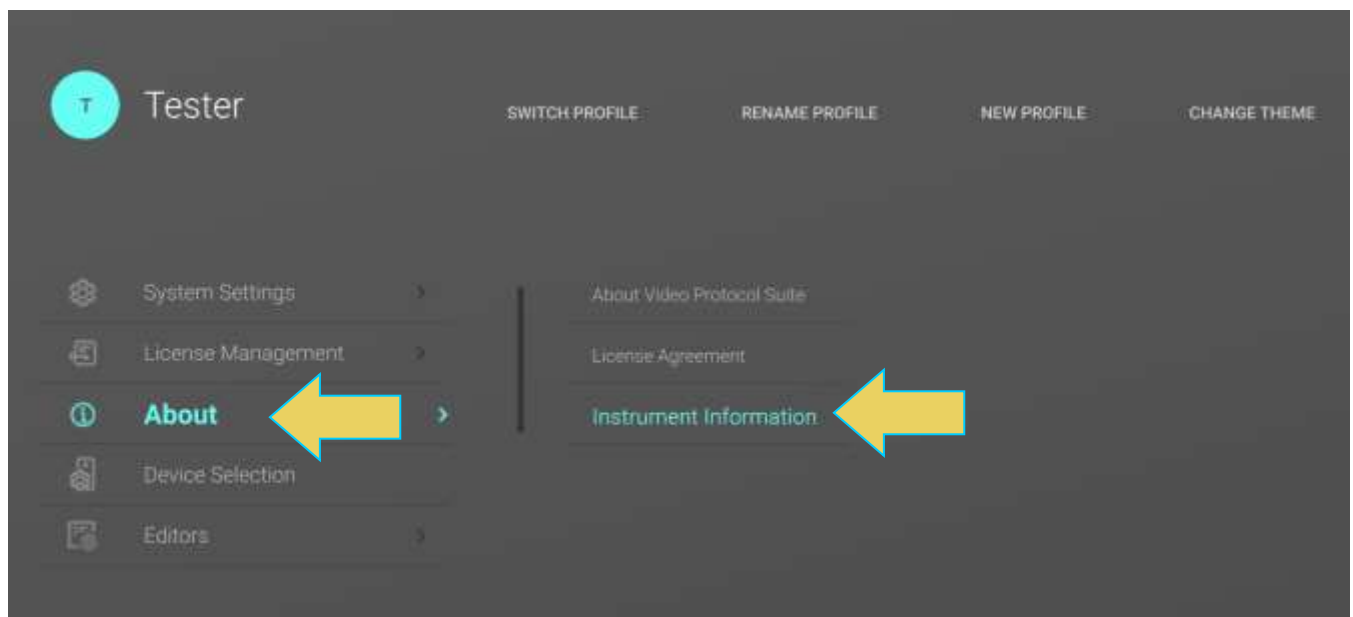
### Accessing and Saving the Instrument Information Report

Once the connection is made, the information report about the connected M42d is available via the **About** menu.

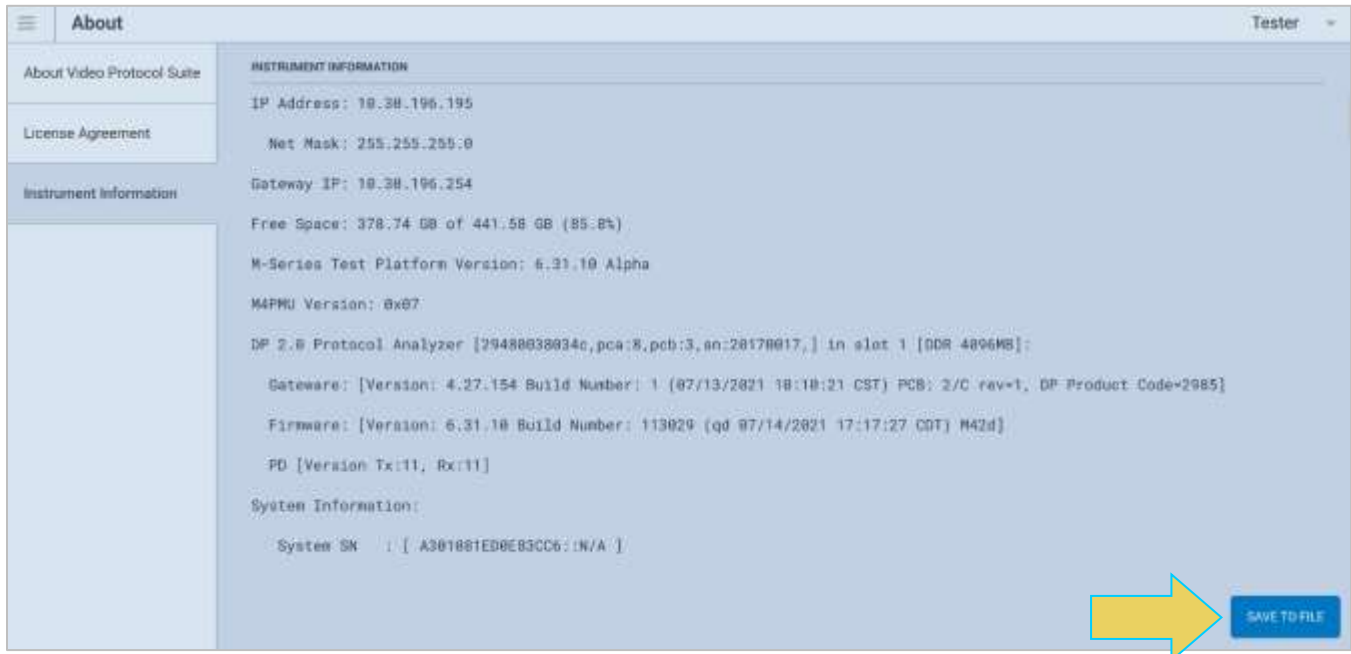
To access the **Instrument Information**, first return to the system menu by clicking the three vertical bar menu icon at the top left of the dashboard, as shown below.



Within the system menu, open the **About** menu and select **Instrument Information**, as shown below.



The **Instrument Information** is then displayed. The information on the Instrument Information window tells you the firmware and hardware release and version information as well as what options you have.



The screenshot shows a software window titled "About" with a user name "Tester" in the top right corner. On the left is a sidebar with three menu items: "About Video Protocol Suite", "License Agreement", and "Instrument Information". The main area displays the following text:

```
INSTRUMENT INFORMATION
IP Address: 10.30.196.195
Net Mask: 255.255.255.0
Gateway IP: 10.30.196.254
Free Space: 378.74 GB of 441.58 GB (85.8%)
M-Series Test Platform Version: 6.31.10 Alpha
M4PMU Version: 0x07
DP 2.0 Protocol Analyzer [29488038034e,pcv:8,pcb:3,sn:20170017,] in slot 1 [DDR 4096MB]:
Gateway: [Version: 4.27.154 Build Number: 1 (07/13/2021 10:10:21 CST) PCB: 2/C rev=1, DP Product Code=2985]
Firmware: [Version: 6.31.10 Build Number: 113029 (qd 07/14/2021 17:17:27 CDT) M42d]
PD [Version Tx:11, Rx:11]
System Information:
System SN : [ A301001ED0E83CC6: (N/A) ]
```

A yellow arrow points to a blue button labeled "SAVE TO FILE" located at the bottom right of the window.

You can save this instrument information report as a .txt file. **This is necessary when contacting Teledyne PSG Support**, as a current version of the report is needed for general support purposes.

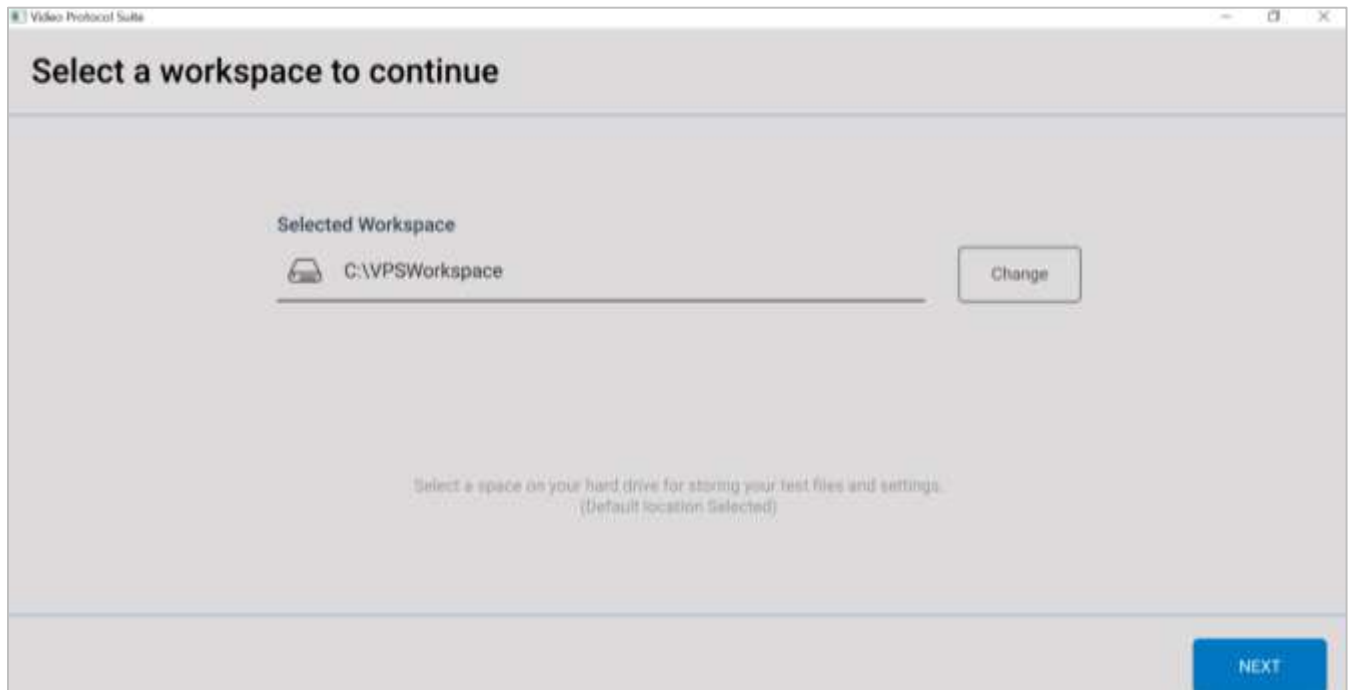
Save the Instrument Information Report by selecting the **SAVE TO FILE** button at the bottom right of the report window, as shown in the previous screenshot.

Enter the desired file name and folder directory, and the information report will be saved as a .txt file.

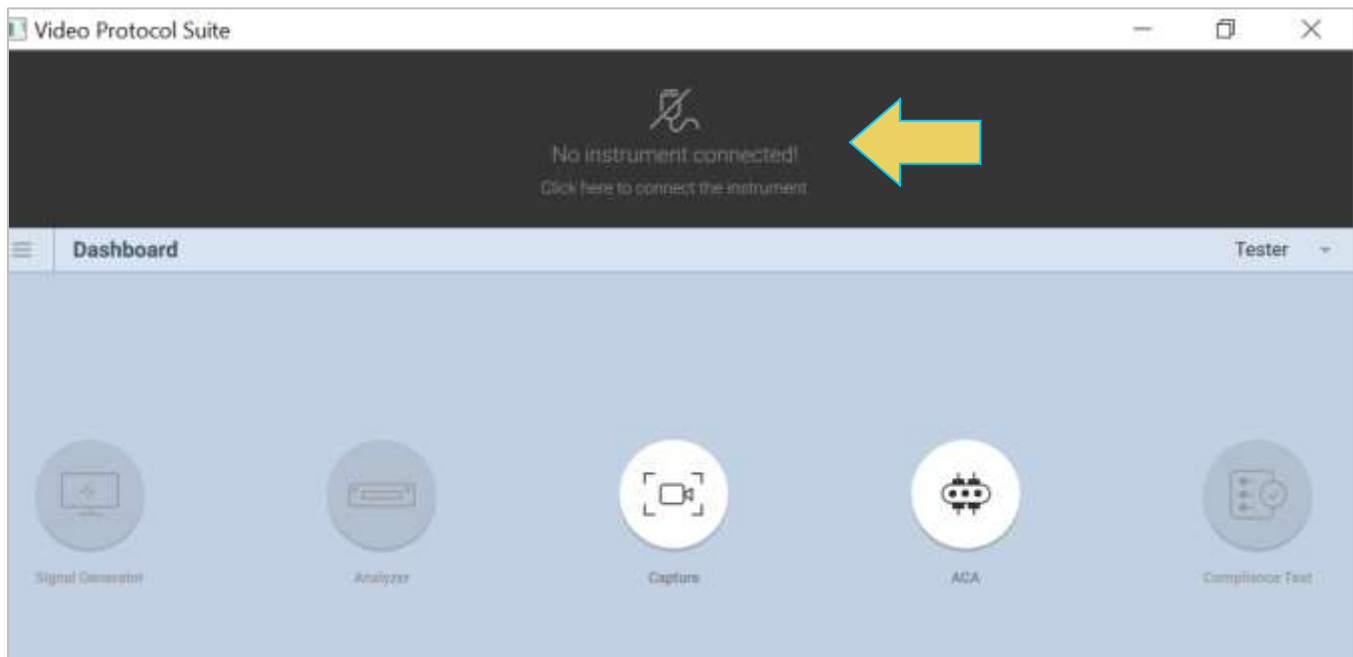
## Remote Host PC Startup

When first opening the VPS Application remotely, you may be prompted to select a Workspace directory, as shown below. The Workspace contains all of the files related to the M42d, including Compliance Test results, DPCDs, ACA and Capture files, and much more.

C:\VPSWorkspace is the default directory, and will be referred to a few times throughout this User Guide. However, you can select any desired directory for the VPS Workspace.



Once you have designated the workspace, you will be prompted to connect to an instrument.

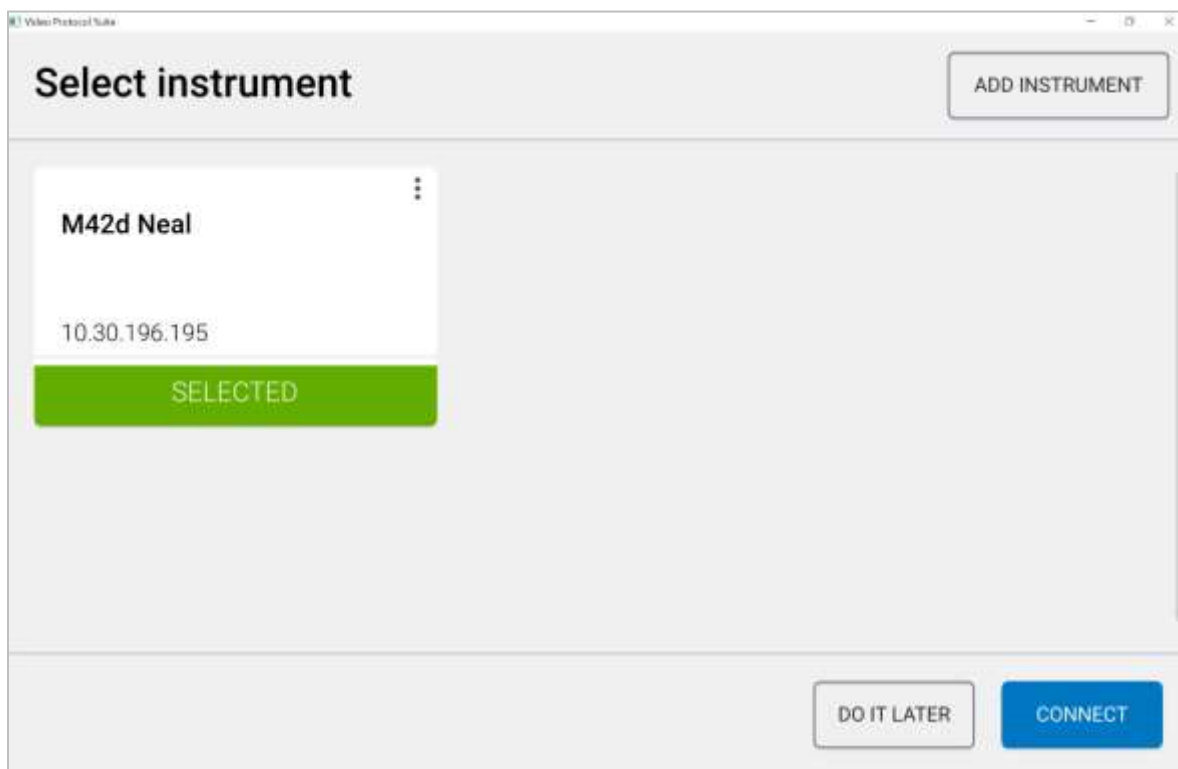




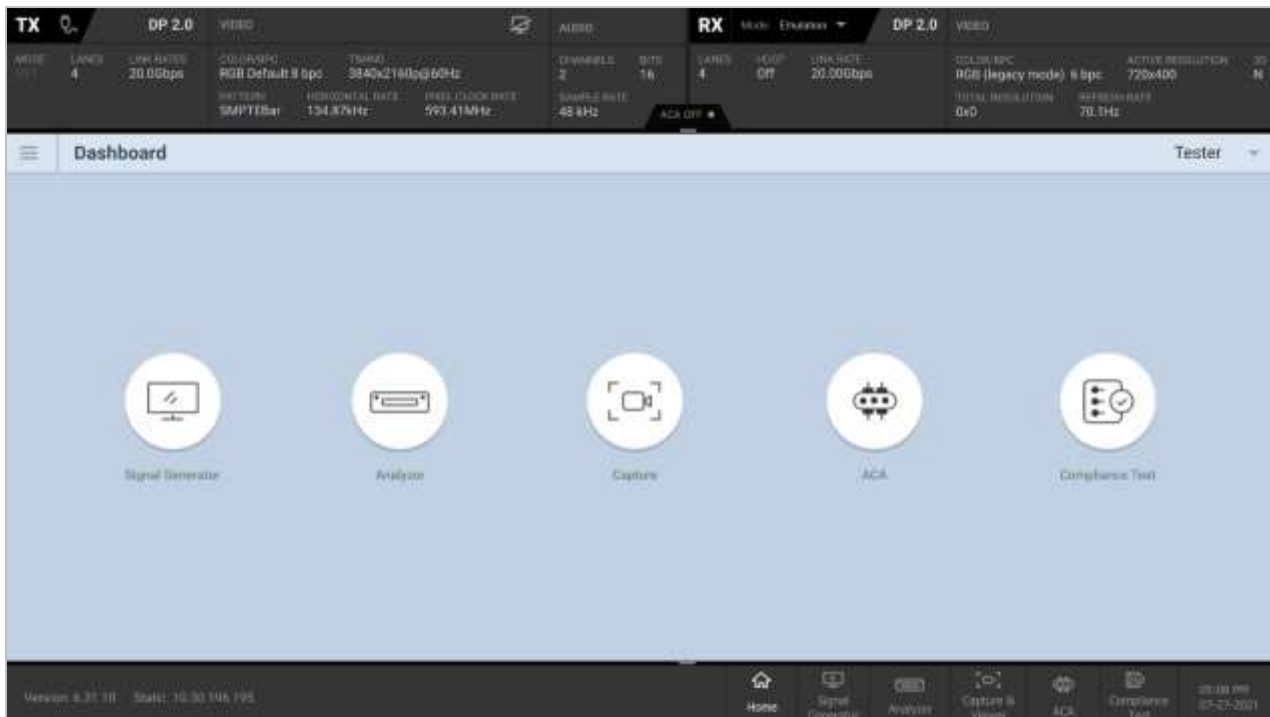
If you get a connection error message (shown below), ensure that all connections are made to the instrument, as demonstrated in the previous section.



**Note:** If you were previously remotely connected to the instrument, the application may skip this step and have you **Select Instrument** or take you straight to the **Dashboard** (following two screenshots).



Once connected to the instrument, VPS will display the home **Dashboard**, shown below.



Details of the dashboard are covered in the next chapter.

## 2.3 Profiles

The Video Protocol Suite (VPS) Application offers a new way of managing saved testing specifications across different users of the M42d Instrument and VPS Application. Users can create profiles to keep track of their Capture files and Compliance Tests, custom lists, saved DPCDs, ACA Data files, and more.

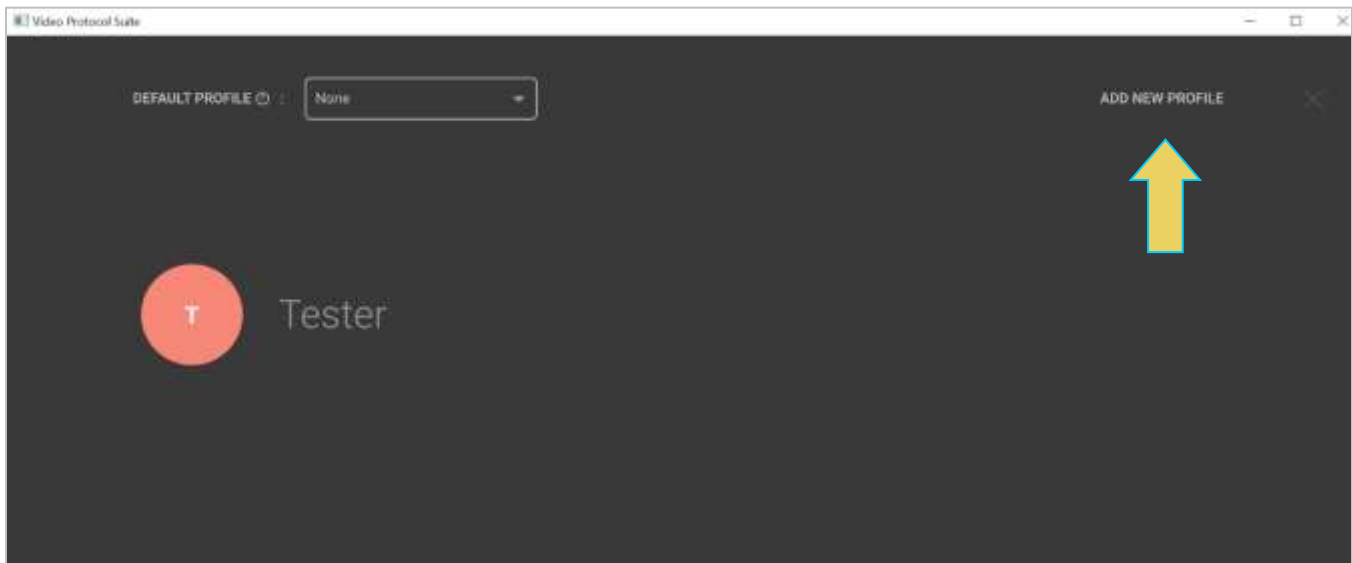
With the Profiles feature, each individual user of the M42d will have their own workspace subfolder in VPS. Any work or tests done under a specific profile will only be available when using the VPS application under that user's profile.

This subsection will go over this new feature in detail.

### Creating/Choosing a Profile to Start

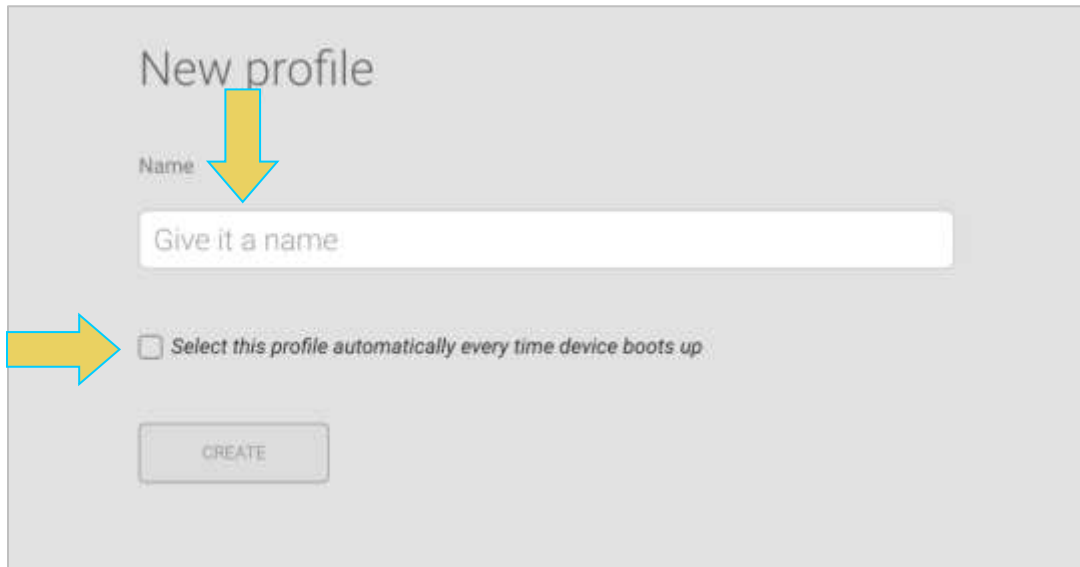
Upon startup, the VPS Application will prompt the user to select a profile.

Add a new profile by clicking the associated button at the top right of this window



**Note:** If you have already created a profile, select it and continue. If you wish to bypass the Profiles feature, click the Tester profile and continue.

Enter a name for the profile, and optionally set this new profile as the default by checking the respective box before clicking **CREATE**.



New profile

Name

Give it a name

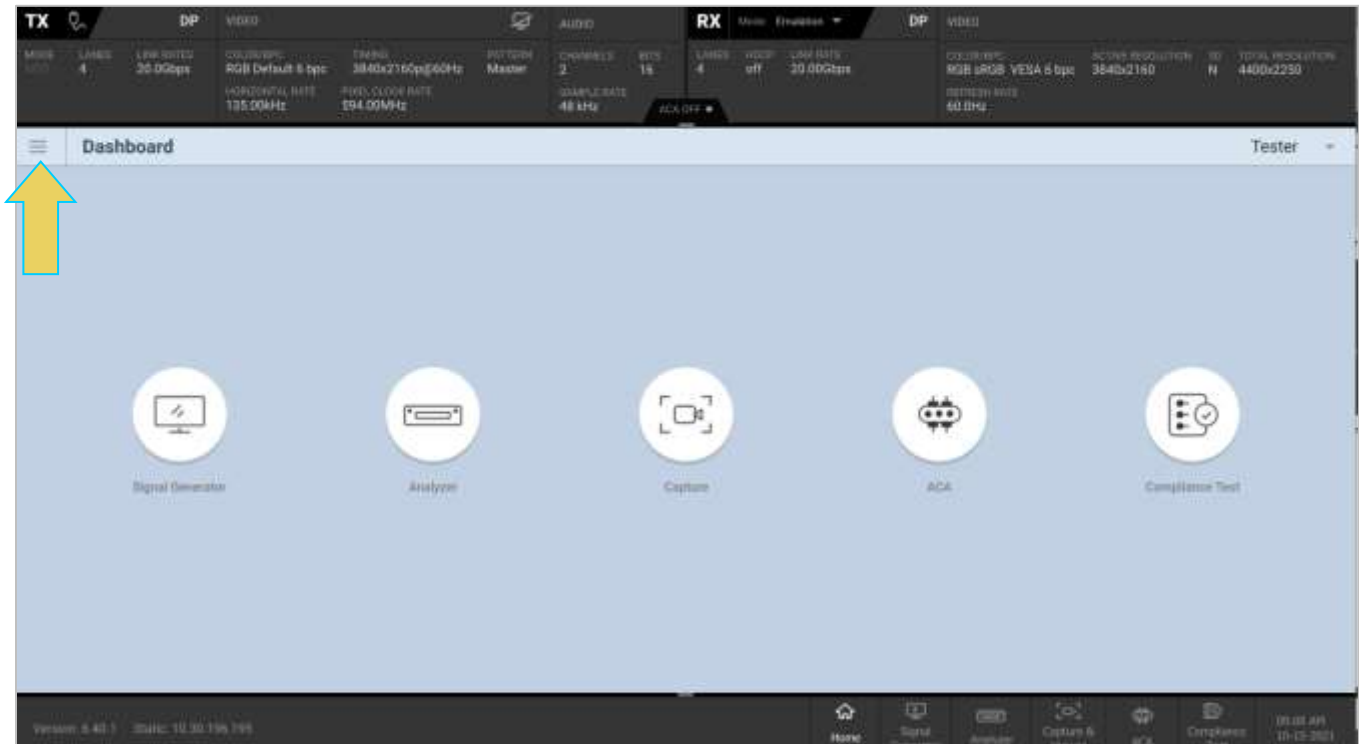
Select this profile automatically every time device boots up

CREATE

You can also change the default profile at any time in the startup profile selection screen, as shown below.



Anytime you wish to switch, rename, or create a new profile, navigate to the System Menu using the hamburger menu icon at the top left of the Dashboard window.

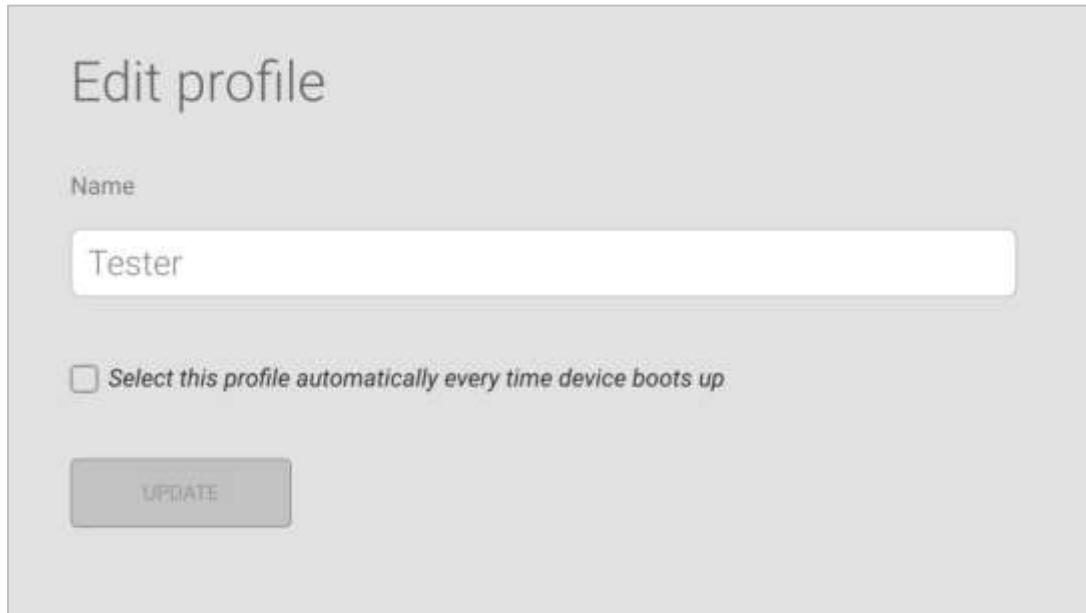


Select the desired Profile tool from the top of the System Menu



In the following example, the user selected **RENAME PROFILE**, and the resulting screen is displayed below.

Accessing the **SWITCH PROFILE** and **NEW PROFILE** utilities from the System Menu are the same as seen previously in this section.



The screenshot shows a web interface for editing a profile. The title is "Edit profile". Below the title is a "Name" label and a text input field containing the text "Tester". Below the input field is a checkbox with the label "Select this profile automatically every time device boots up". At the bottom of the form is a button labeled "UPDATE".

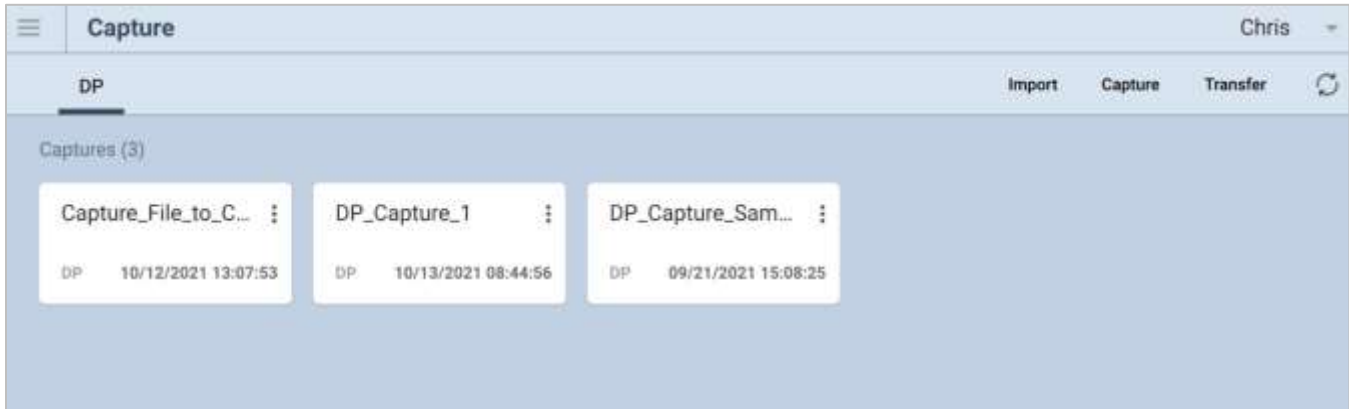
Simply replace the previous name in the **Name** field and optionally check to make this the default profile, and click **UPDATE**.

## Switching Profiles within VPS Dashboard

Once you have selected or updated a profile, you will be taken to the VPS Dashboard.

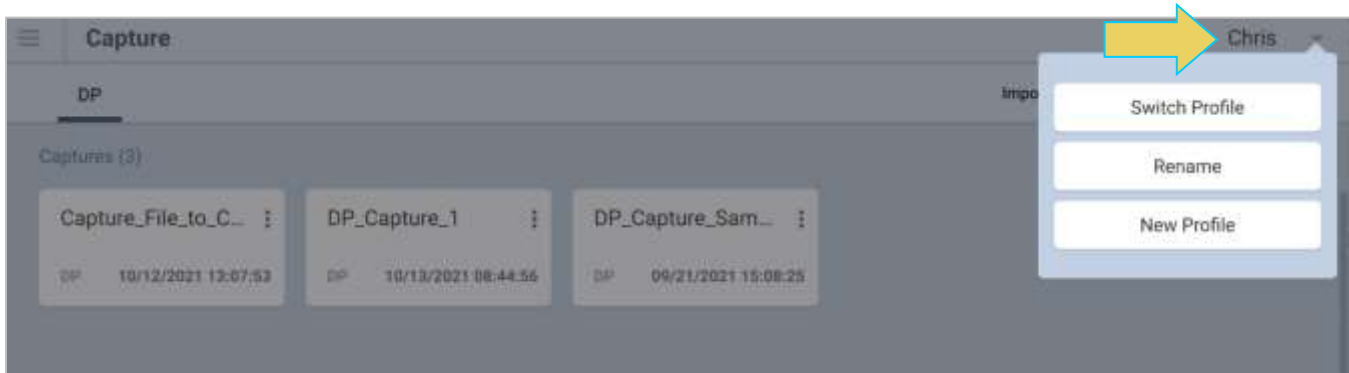
Operate the VPS Application as normal, and any testing or saved configurations will save within your profile's workspace.

In the example below, the Profile "Chris" is selected, and the **Capture Viewer** utility is open.



This profile has three saved Capture files, but there are several saved under other profiles.

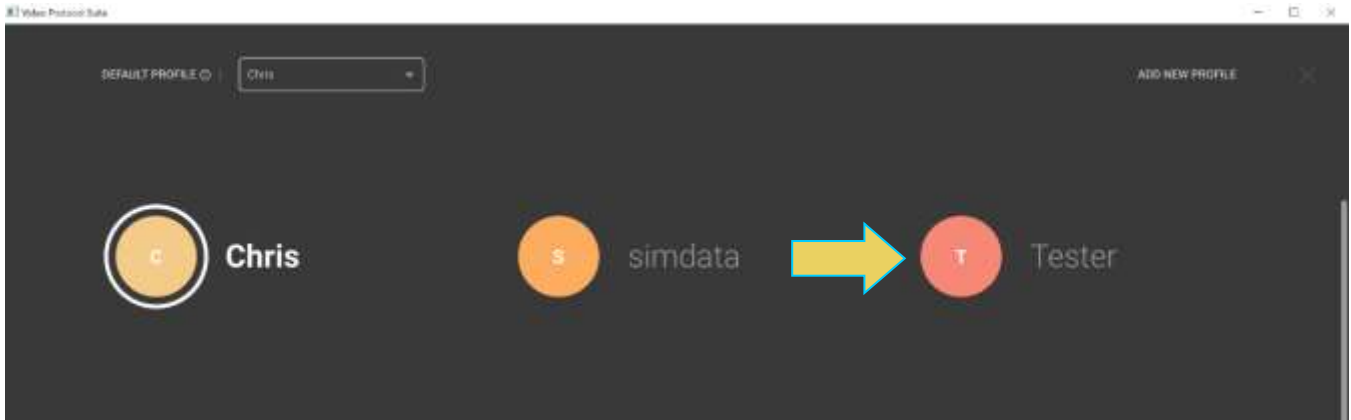
To change profiles quickly while in the VPS dashboard, simply click the Profile name in the top right of the window.



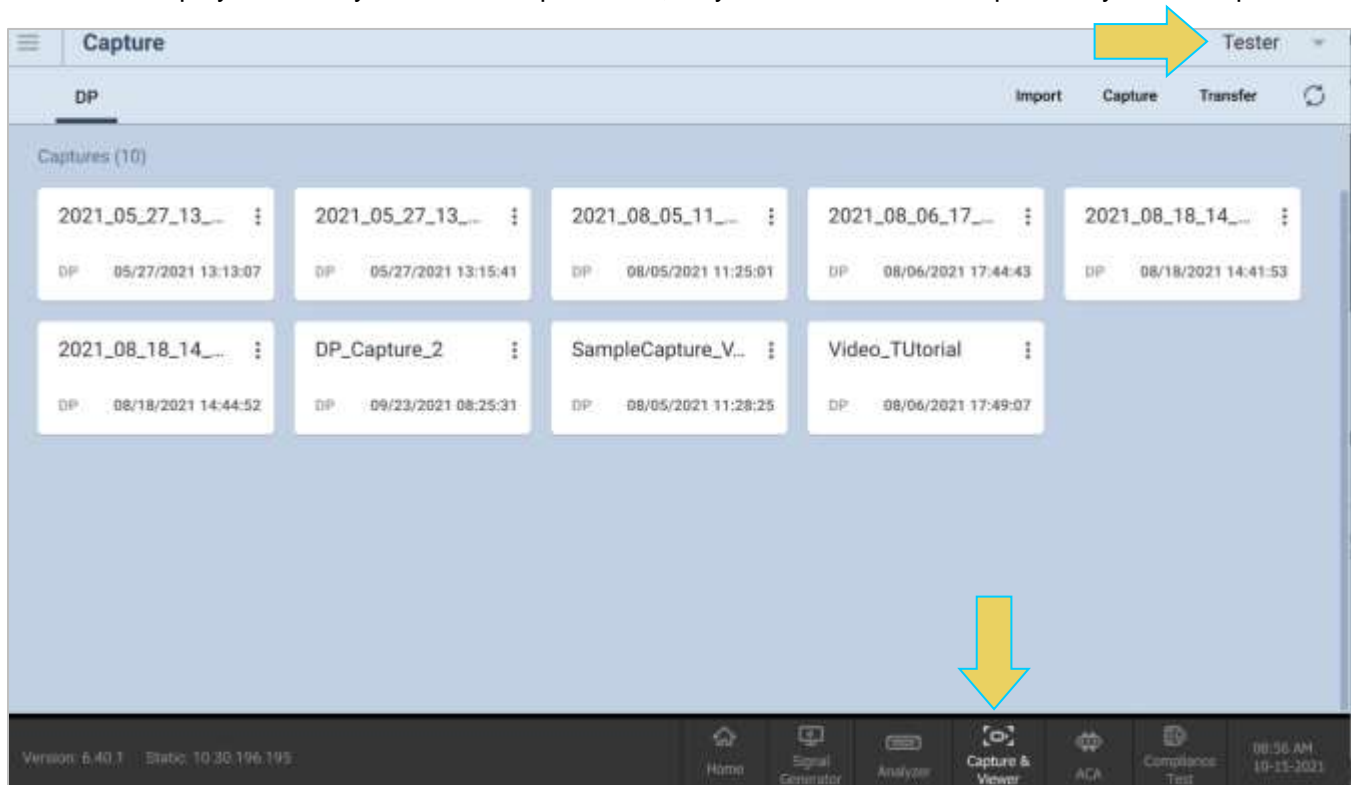
In this pop-out tool, you can **Switch** to another profile, **Rename** the current profile, or create an entirely **New Profile**.

Clicking **Switch Profile** will bring you to the default Profile Selection screen, as shown below.

Choose the profile you'd like to switch to by clicking on it.



In this example, the **Tester** profile is selected, and navigating back to the **Capture Viewer** file selection screen will display an entirely new set of capture files, only available under the specifically selected profile.

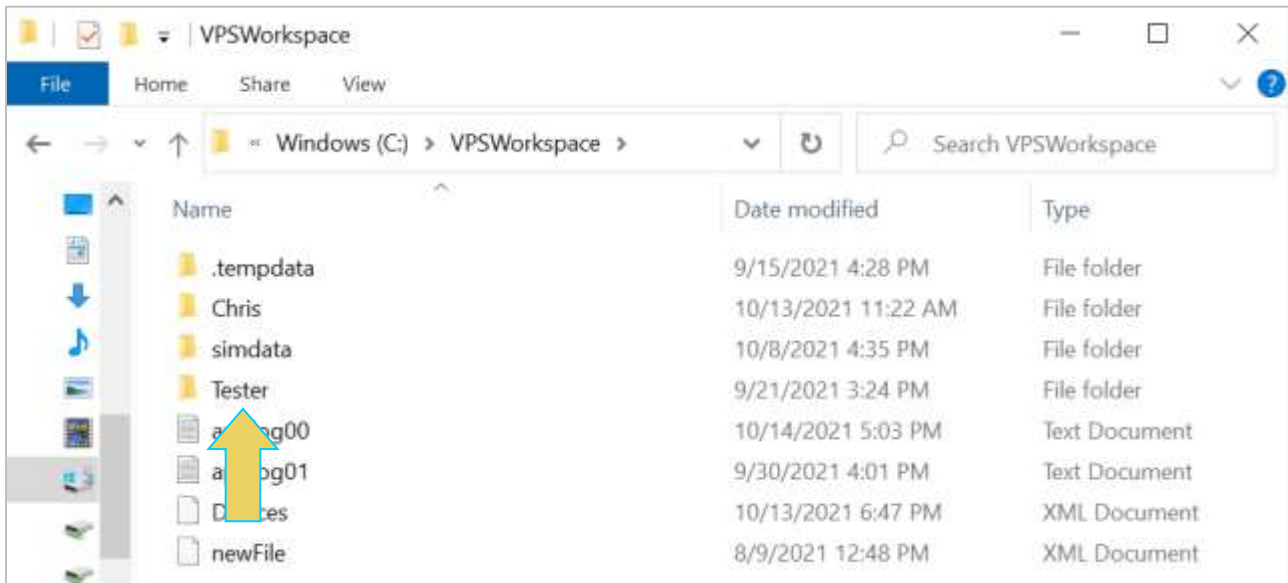




## Accessing the Directory Folders for Profiles

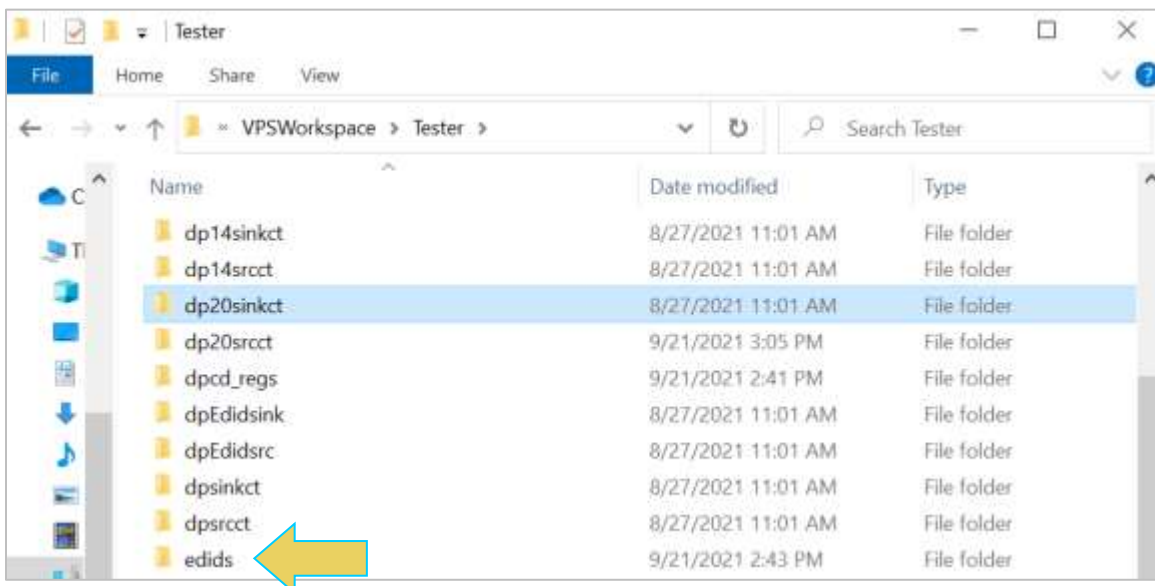
As previously mentioned, the Profiles feature saves all files to individual folders within the VPS Workspace directory on the remote PC or M42d instrument itself. If necessary, you may access these files using a File explorer and navigating to the VPS Workspace directory.

Having previously selected the directory C:\VPSWorkspace for the VPS-related files, navigating to this folder within a file explorer will show folders for each individual profile (Chris, simdata, and Tester), as shown below.



The screen below shows the Tester folder, and its contents. There are individual folders for each type of save file on the M42d. There are also folders for each suite of Compliance Tests available on the M42d.

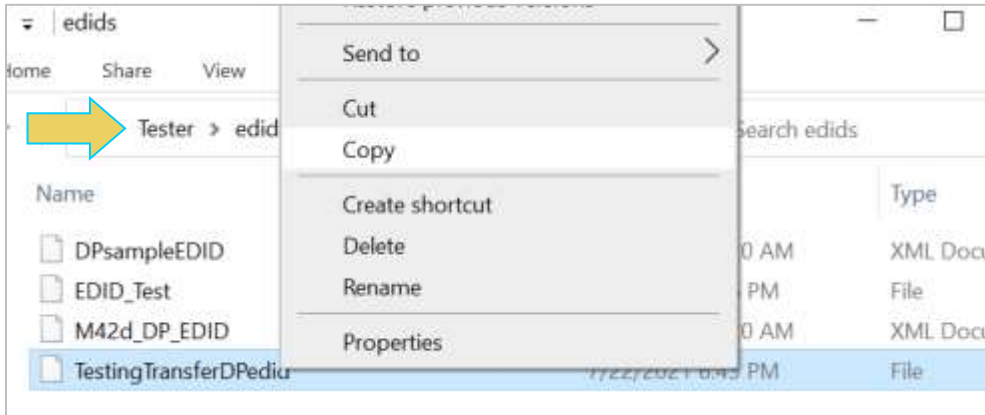
Below you can see the dp20sinkct (DP 2.0 Sink Compliance Tests) folder highlighted. The edids (saved EDIDs) folder is also shown in this screenshot.



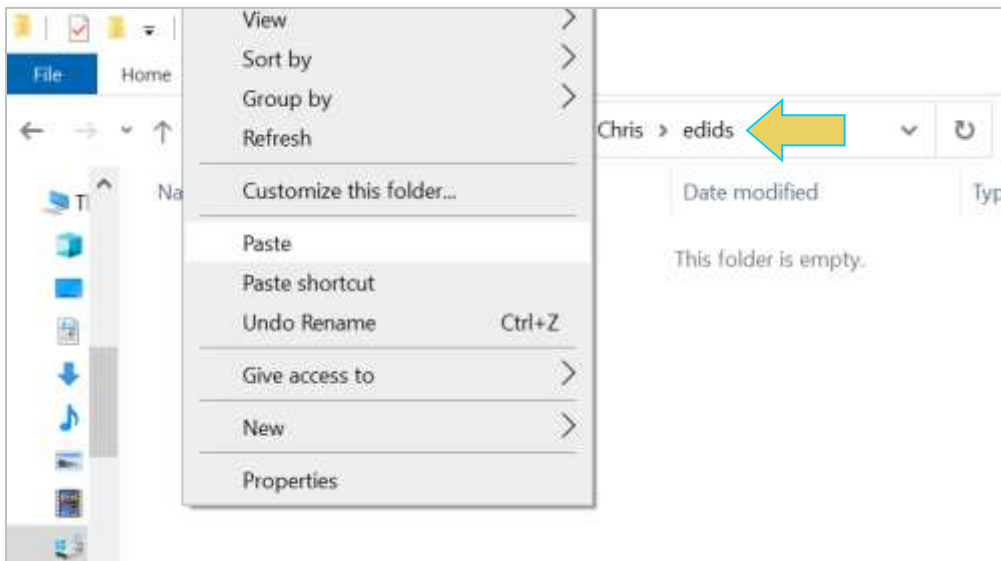
In the event that you would like to transfer a file between profiles, simply copy and paste the file from the origin profile's directory to the target profile's respective folder. An example is shown below

You may wish to do this if a colleague has configured an EDID or DPCD that is appropriate for your testing specifications. Means of transferring **Capture**, **ACA**, and Compliance Test files can be found in their respective chapters.

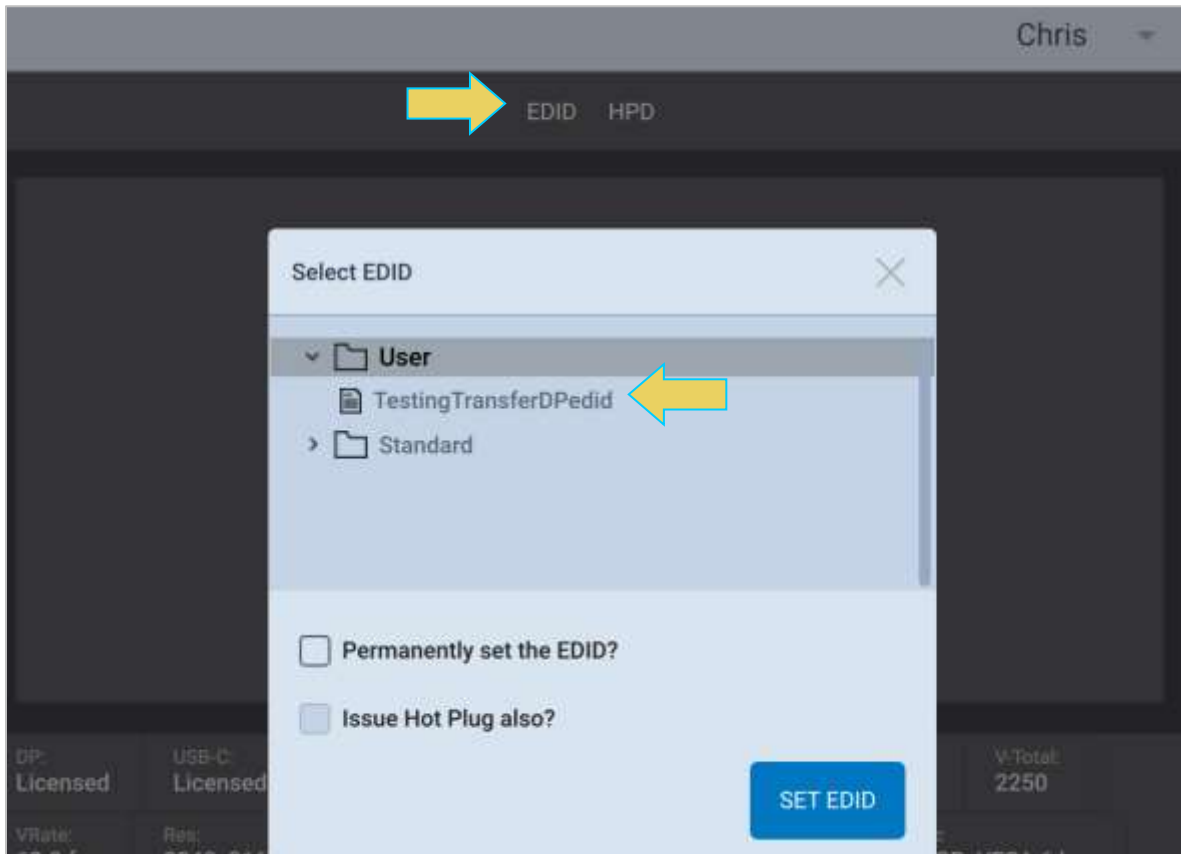
Copy the file from the origin Profile's folder



Paste in the target Profile's respective folder



After this transfer, now the user under the profile Chris can select the newly received EDID for emulation within the M42d's DP Rx Analyzer, as demonstrated below.



## 2.4 Accessing Device Settings and Information

**Note:** Any selections in the **Other** panel not explained here will be covered later on in this User Guide.

### Applying Licenses

Many of the features of the M42d require a specific license to operate. This subsection will demonstrate applying a license.

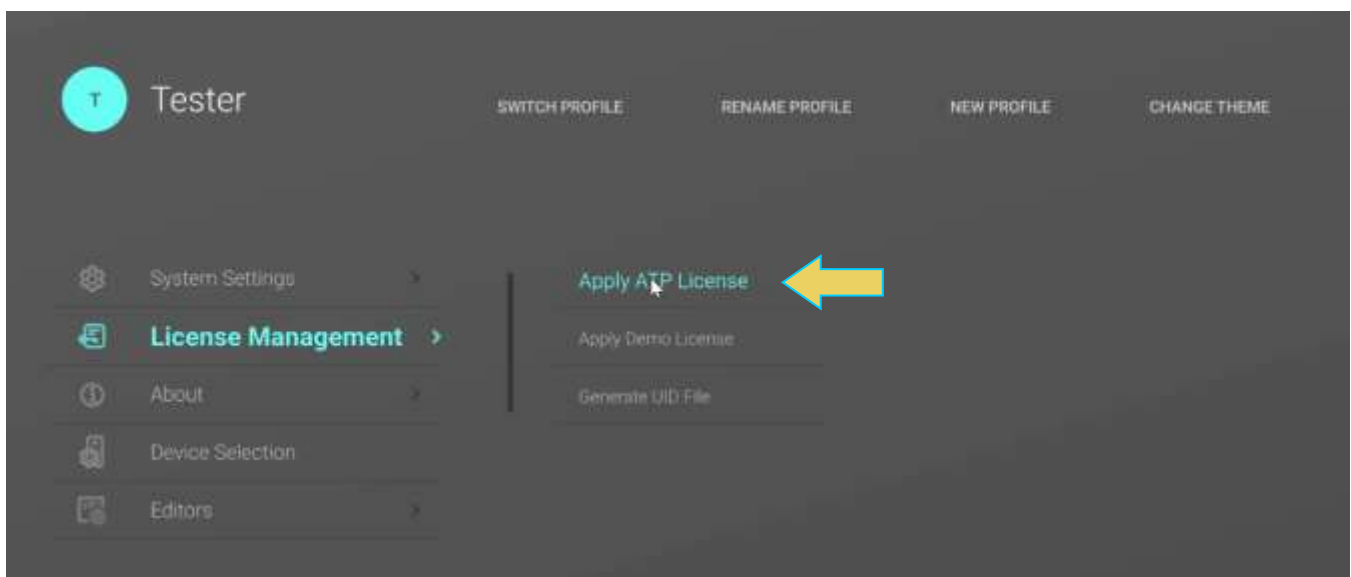
A list of all available licenses is located in **Appendix A: Licenses**.

**Note:** To obtain a license for the M42d, contact Teledyne LeCroy Support, accessible at <http://quantumdata.com/support.html>

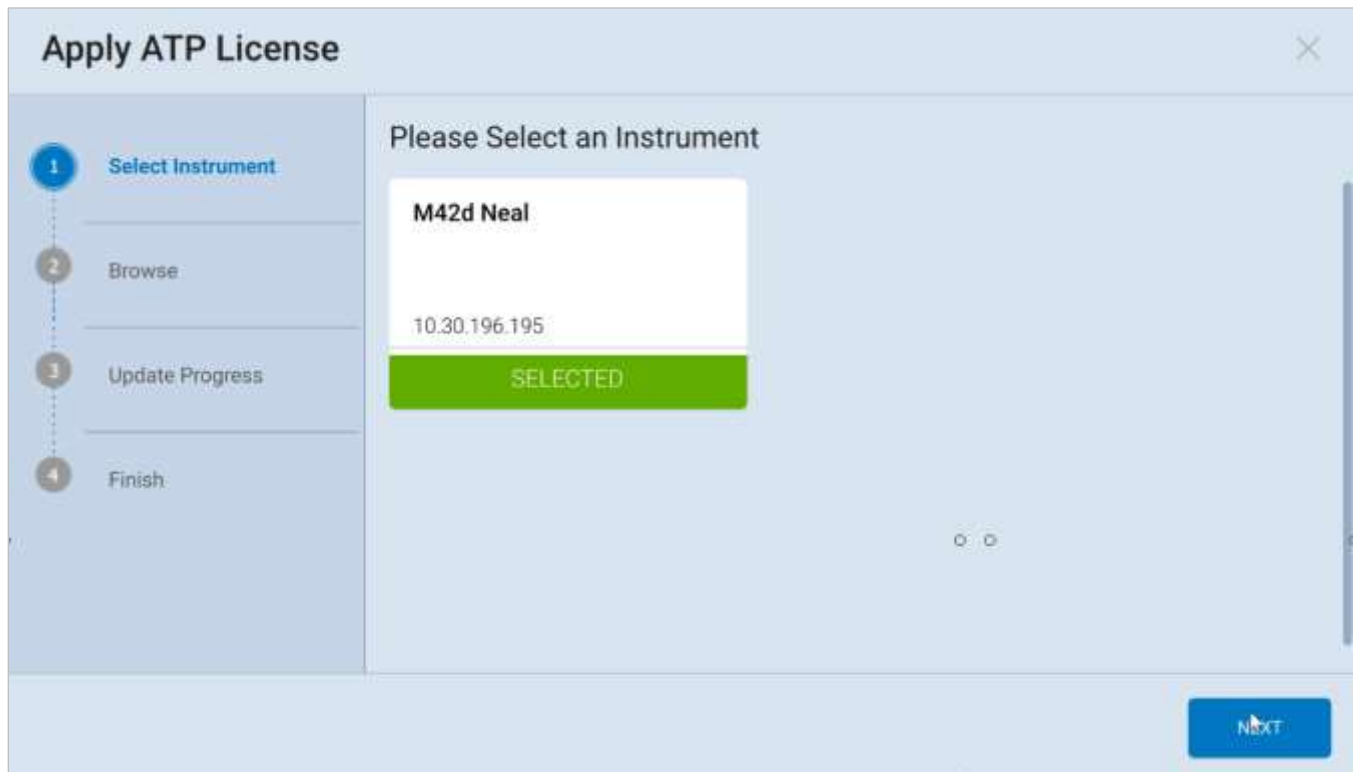
To apply a license:

1. Upload the license file (.lic) using the Navigator by clicking navigating to the System menu, selecting **License Management**, and clicking **Apply ATP License**.

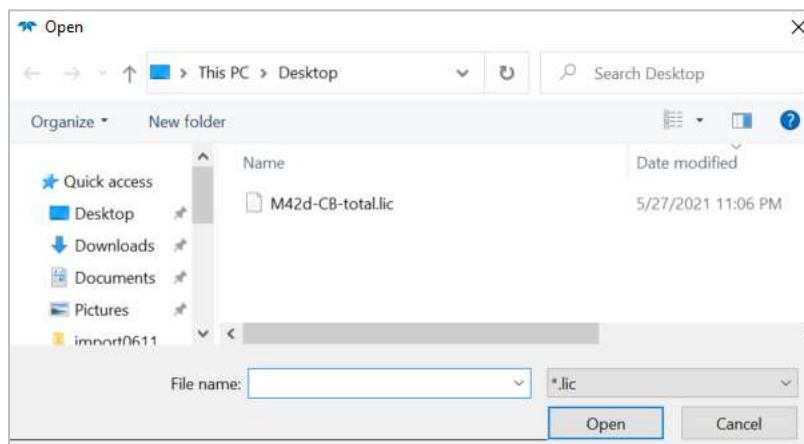
**Note:** As the license file will likely be saved to your PC, it is recommended to use the remote host VPS Application for this function. All screenshots are based on this GUI, though they are both similar.



2. Select the instrument to apply the license to, and click **NEXT**.



3. A file explorer will appear, as shown below. Navigate to the correct directory of the previously downloaded license, select the .lic file, and click **Open**.



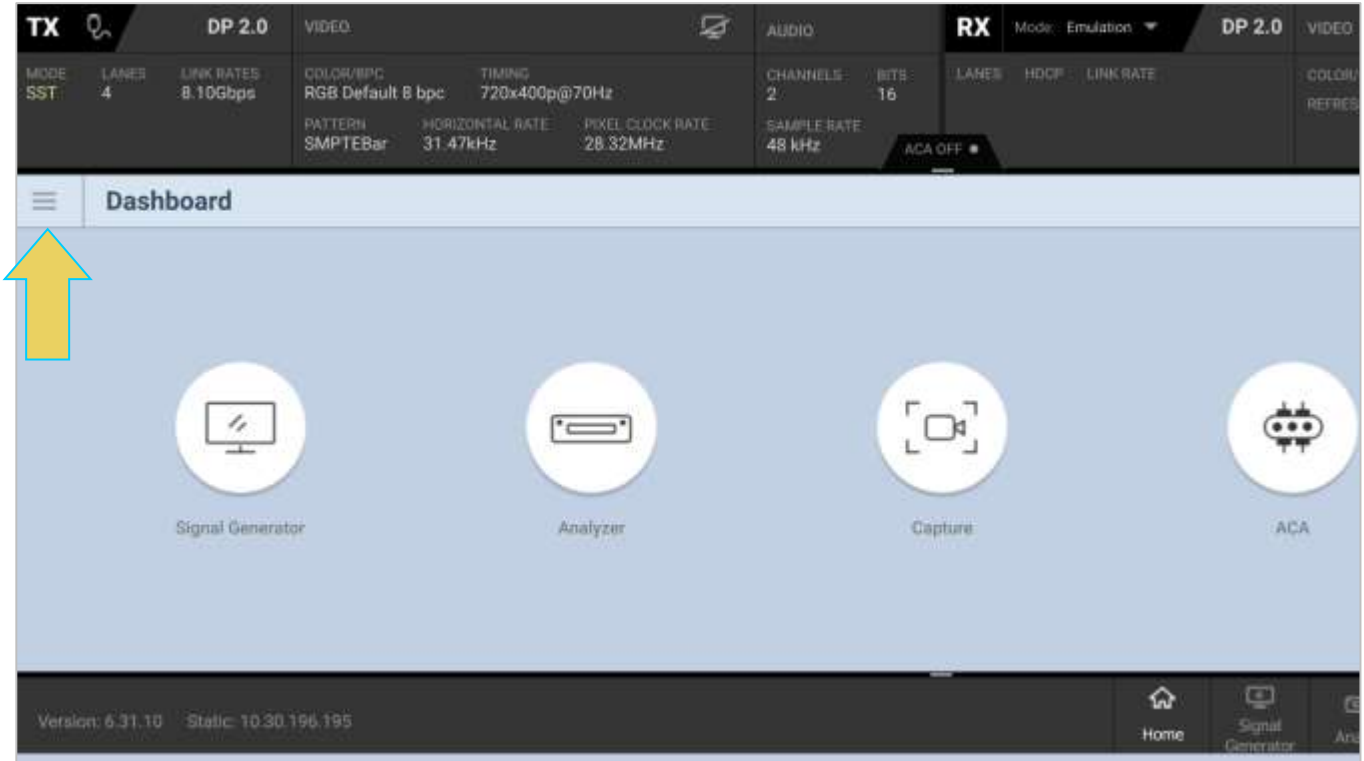
4. A confirmation will appear, and **you must reboot the device** for the changes to take effect.



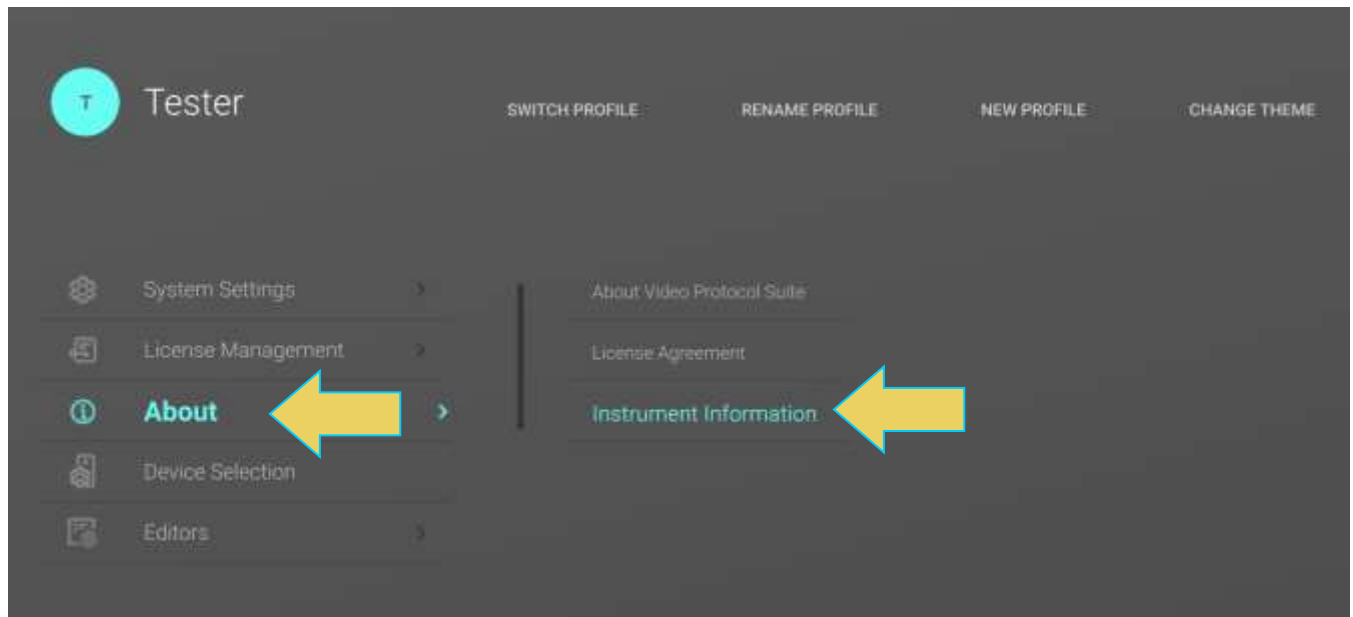
### Verifying Current Licenses

Upon reboot, you may wish to confirm that the correct license was applied. Use the following procedure to check the licenses that are currently applied to your M42d instrument.

To access the **Instrument Information**, first return to the system menu by clicking the three vertical bar menu icon at the top left of the dashboard, as shown below.



Within the system menu, open the **About** menu and select **Instrument Information**, as shown below.



The **About** window will appear, which has various information about the device, and has the **Licensed Features** listed toward the bottom of the report, as demonstrated below.

Instructions for saving the Instrument Information Report can be found in [Section 2.2](#). This saved Information Report is necessary when contacting Teledyne LeCroy PSG Support, as a current version of the report is needed for creating licenses.



The screenshot displays the 'About' window interface. On the left, a sidebar contains three menu items: 'About Video Protocol Suite', 'License Agreement', and 'Instrument Information'. A yellow arrow points to the 'Instrument Information' item. The main content area is titled 'INSTRUMENT INFORMATION' and lists 12 licensed features, each with a license ID and a description in brackets.

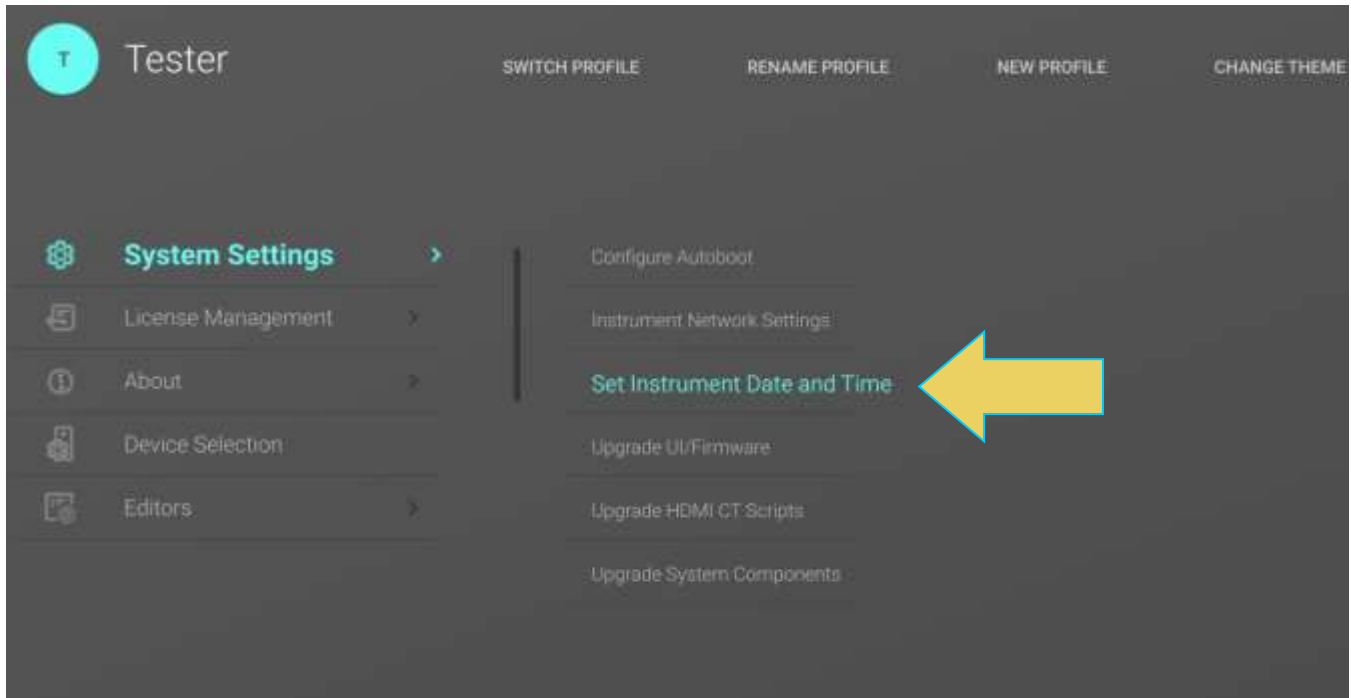
License ID	Description
107	[Part of 95-00225 DP 2.0 Sink Test LTTPR, M42]
108	[Part of 95-00226 DP 2.0 Source Test LTTPR, M42]
109	[Part of 00-00259 DP 2.0 Capture/Analysis, M42]
110	[Part of 00-00259 DP 2.0 Basic Analysis, M42]
111	[Part of 00-00259 DP 2.0 Video Generation, M42]
112	[Part of 95-00225 LTTPR 1.4 Sink Device Testing, M42]
113	[Part of 95-00226 LTTPR 1.4 Source Testing, M42]
115	[95-00232 M42d DP 2.0 Link Layer Source Compliance Test, M42]
116	[95-00233 M42d DP 2.0 Link Layer Sink Compliance Test, M42]
117	[95-00234 M42d DP Adaptive Sync Source Compliance Test, M42]
118	[95-00235 M42d DP Adaptive Sync Sink Compliance Test, M42]
119	[95-00236 M42d DP 2.0 DSC Source Compliance Test, M42]
120	[95-00237 M42d DP 2.0 DSC Sink Compliance Test, M42]

## Setting the Instrument date and time

This procedure describes how to set a M42d's data and time. The procedure assumes that you have connected to an M42d through the external VPS Application.

### To set the date and time of the M42d:

Within the **System Settings** menu, select **Set Instrument Date and Time**.





The **Set Instrument Date and Time** window appears as shown below:

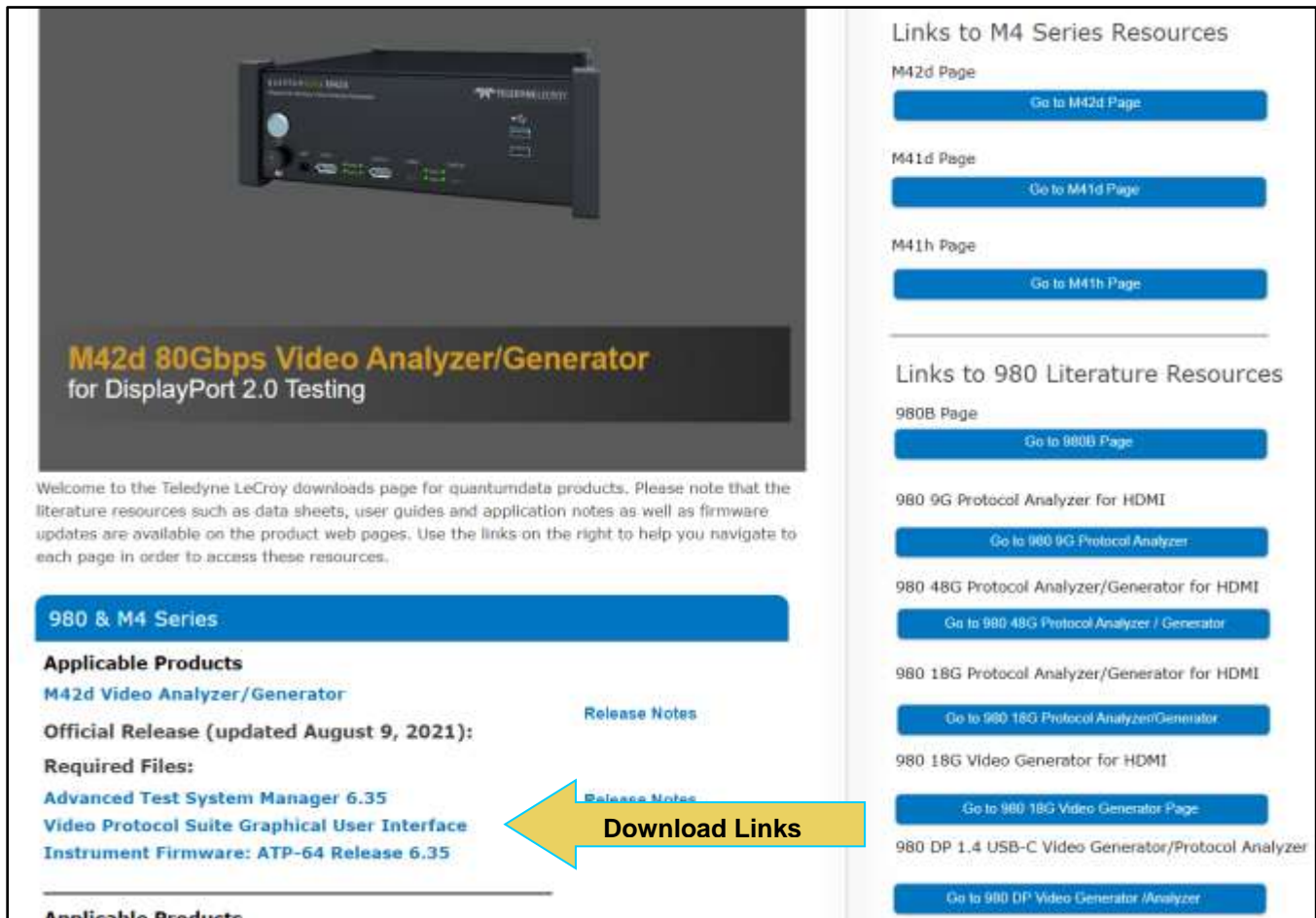
The screenshot shows the 'System Settings' window with the 'Set Instrument Time and Date' section selected. The window title is 'System Settings' and the user is 'Tester'. The main content area is titled 'SET INSTRUMENT DATE AND TIME'. It displays the current date and time as 'FRI, SEPTEMBER 03, 2021' and '10:35 AM'. Below this, there are input fields for 'MM / DD / YYYY' (09 / 03 / 2021) and 'Hrs Min' (10 35 AM). There are also buttons for 'DATE FORMAT' (D/M/Y, M/D/Y, Y/M/D) and 'TIME FORMAT' (12, 24). A 'Time Zone' dropdown menu is set to 'America/Chicago'. At the bottom right, there are 'CANCEL' and 'APPLY' buttons.

Set the month and date and time by selecting from the Calendar and time dials and click **APPLY**.

## 2.5 Upgrading VPS GUI (Embedded and Remote PC Application)

This section provides information about upgrading your M42d VPS GUI, both embedded and on remote host PC. Detailed procedures are not provided in this document. **Please be sure to refer to the Release Notes for a specific release for detailed upgrade instructions.**

Teledyne LeCroy periodically provides maintenance release of software and firmware. The most recent versions are available on the quantumdata downloads page <http://www.quantumdata.com/downloads.html>.



The screenshot shows the Teledyne LeCroy quantumdata website. On the left, there is a product image of the M42d 80Gbps Video Analyzer/Generator. Below the image, the text reads: "M42d 80Gbps Video Analyzer/Generator for DisplayPort 2.0 Testing". To the right of the image, there are two columns of links. The first column, titled "Links to M4 Series Resources", contains links for M42d Page, M41d Page, and M41h Page. The second column, titled "Links to 980 Literature Resources", contains links for 980B Page, 980 9G Protocol Analyzer for HDMI, 980 48G Protocol Analyzer/Generator for HDMI, 980 18G Protocol Analyzer/Generator for HDMI, 980 18G Video Generator for HDMI, and 980 DP 1.4 USB-C Video Generator/Protocol Analyzer. Below the product image, there is a welcome message and a section titled "980 & M4 Series" with a sub-section "Applicable Products". Under "Applicable Products", it lists "M42d Video Analyzer/Generator" with an "Official Release (updated August 9, 2021):" and "Required Files:" including "Advanced Test System Manager 6.35", "Video Protocol Suite Graphical User Interface", and "Instrument Firmware: ATP-64 Release 6.35". A yellow arrow points to the "Download Links" section, which is highlighted in blue.

Two software packages are available for upgrading the M42d VPS GUI:

- The firmware and gateway package for the M42d instrument. This is a Debian software package for installation in the Linux-based instrument. (The file extension is .deb.) This package includes the embedded GUI that will be installed.
 

**Note:** This package also includes the previous GUI (ATP Manager) and will update both embedded applications with this install.
- Windows-based VPS Application. This is the VPS (Video Protocol Suite) GUI that can be used to control the M42d instrument from a Windows PC. This download is discussed in a previous section.

**Notes:** You must upgrade the Windows-based VPS Application every time you upgrade the firmware/software on the unit. **Upgrade the remote VPS Application first**, and then upgrade the M42d firmware as indicated in the release notes.

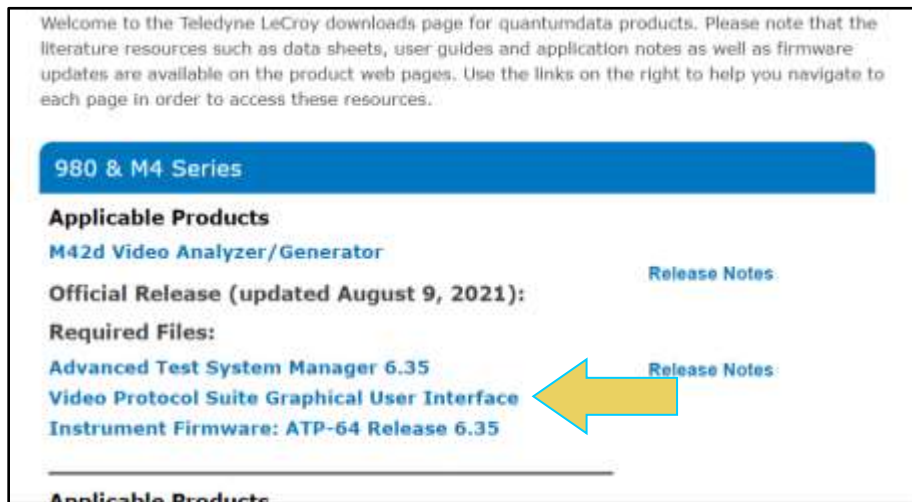
Use the following procedures to update your remote VPS GUI and instrument firmware/embedded VPS GUI:

**Important note:** When upgrading the M42d system firmware, please be sure to disconnect any video cables that are connected to the instrument modules. Failure to do so may result in issues during upgrade.

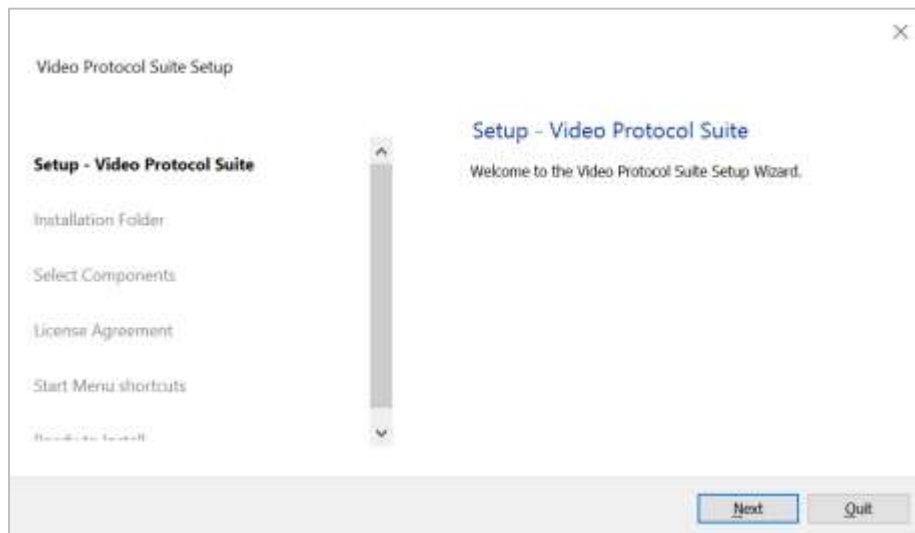
## Upgrading VPS Application on Remote PC

1. Always begin by installing the Windows External Manager software on your remote PC:

Download the VPS GUI Application from the Teledyne LeCroy quantumdata downloads page o



2. Run/open the downloaded file on your PC.

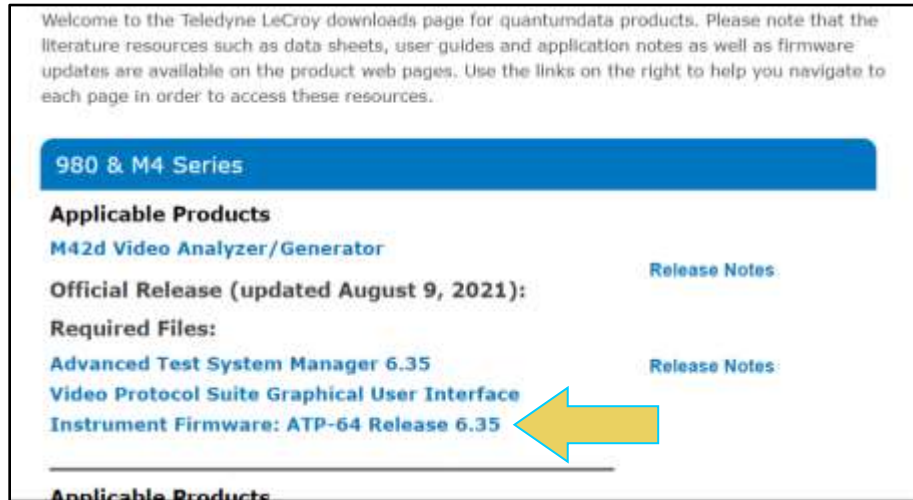


3. Follow the steps to install the VPS GUI Application

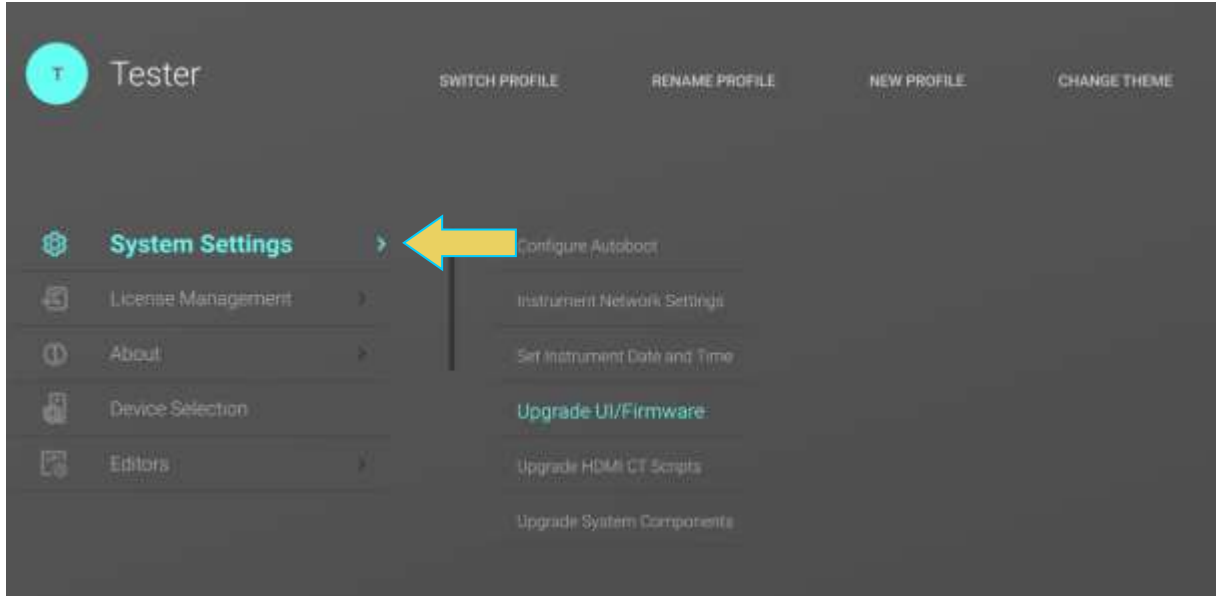
## Upgrading Instrument Firmware/Embedded VPS GUI

1. Download the Instrument firmware for the M42d.

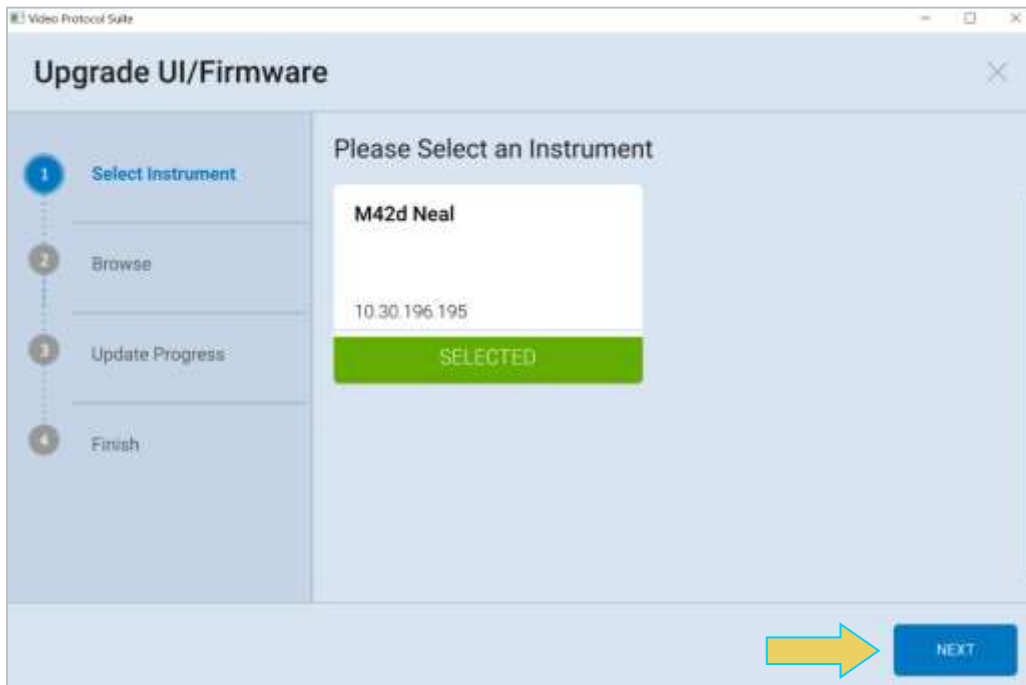
**Note:** For the M41d/h/M42d series, there is only one Debian file beginning with m4series. This Debian file is for all M41d/h/M42d series devices. It will also contain an upgraded ATP Manager application for the instrument.



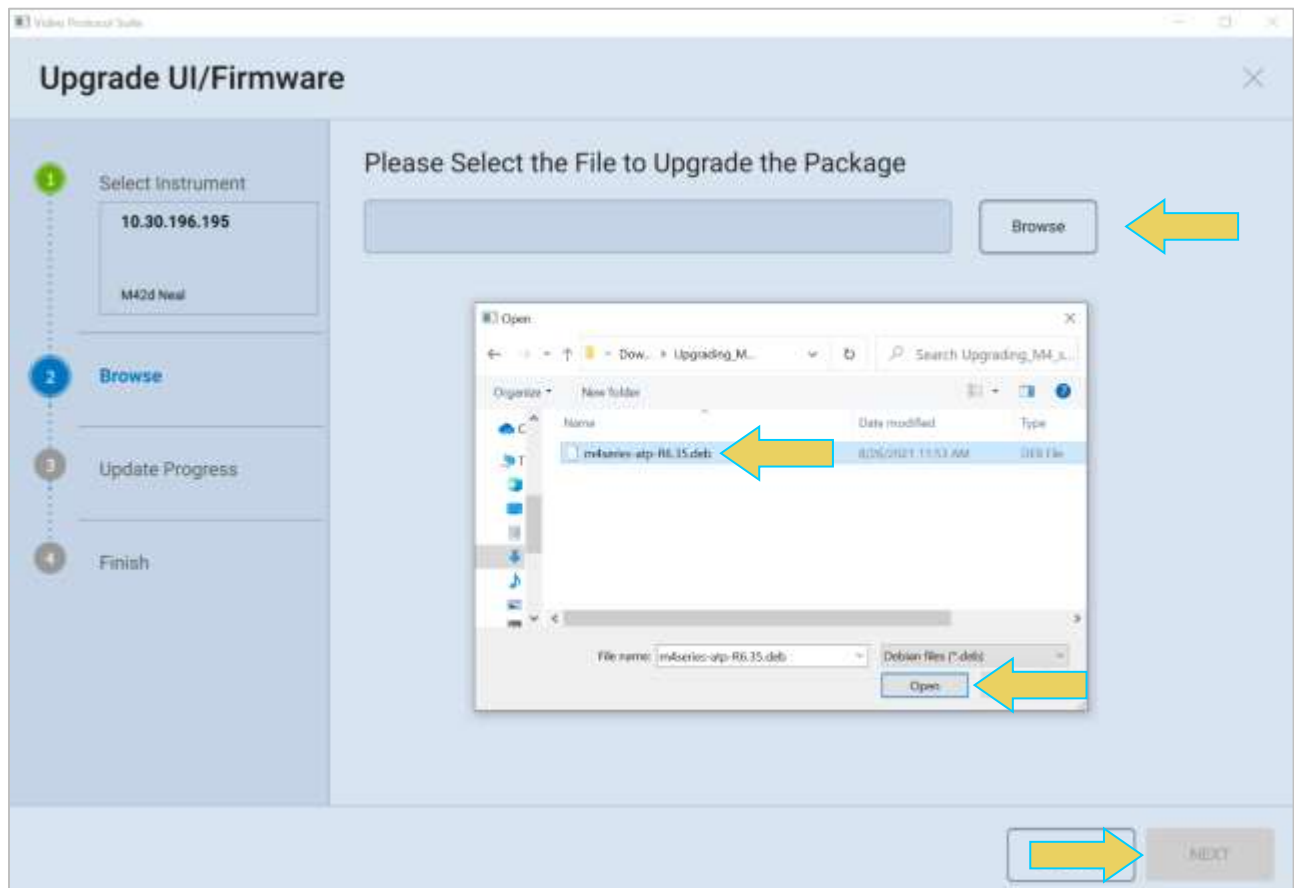
2. Within the Windows VPS Application on your remote PC, navigate to the **System Settings** menu and select **Upgrade UI/Firmware**.



3. Select the target instrument and click **NEXT**



4. Browse for the previously downloaded .deb file and select **NEXT**.



5. Accept the End-User License Agreement, and the upgrade will begin.



6. The device will reboot once the upgrade has completed.

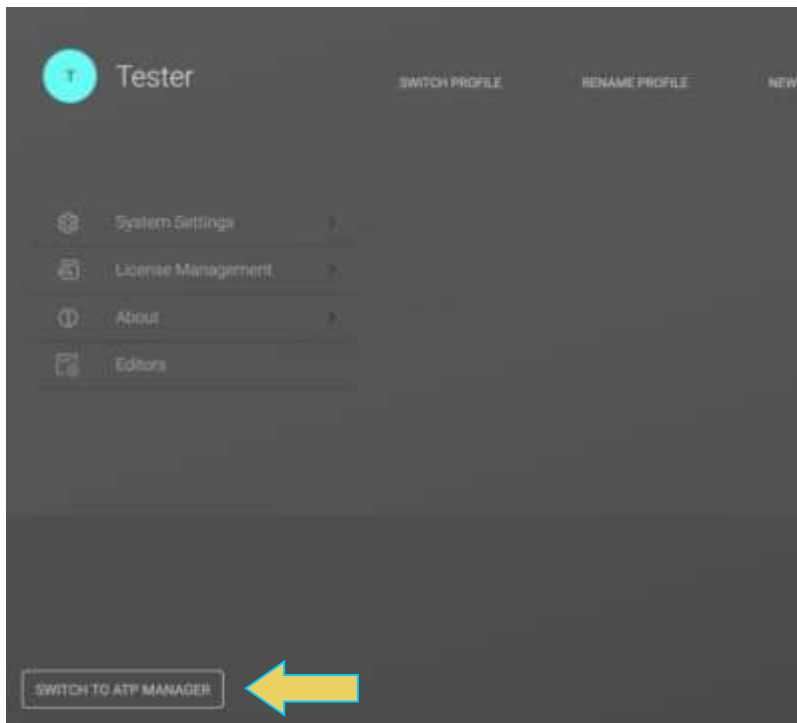
## 2.6 Switching Between VPS and ATP GUI

You may easily switch between the VPS GUI and the legacy ATP Manager GUI. Please note that support for the ATP Manager GUI will be deprecated in the future. Use the following procedures to switch interfaces.

To access the system menu from the Dashboard, click the three-bar menu icon at the top left.



Within the system menu, select the **SWITCH TO ATP MANAGER** button at the bottom left.



This will bring up the legacy ATP Manager GUI. You may revert back to the VPS GUI from here by clicking the **Switch to VPS GUI** button at the bottom right of the card control screen, as shown below.



Please once again note that support for the ATP Manager GUI will eventually be discontinued.



## 2.7 VNC Remote Connection

Sections 2.1 and 2.2 discussed controlling the M42d device either directly using an external monitor, or remotely using the VPS application on a remote host PC. However, the M42d 80G Video Analyzer/Generator does come with another built-in option for controlling the device remotely.

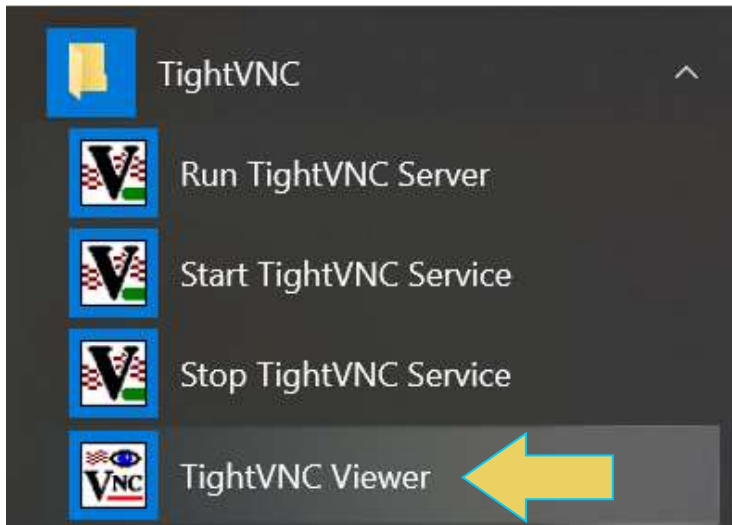
The instruments come with a **VNC Server** installed and enable the user to access the embedded GUI of the instrument remotely as an alternative to using the Remote Windows VPS Application. The main advantage of this is to utilize features that are modified or inaccessible while using a remote host VPS Application as well.

### Installing TightVNC Viewer and Connecting to the Device

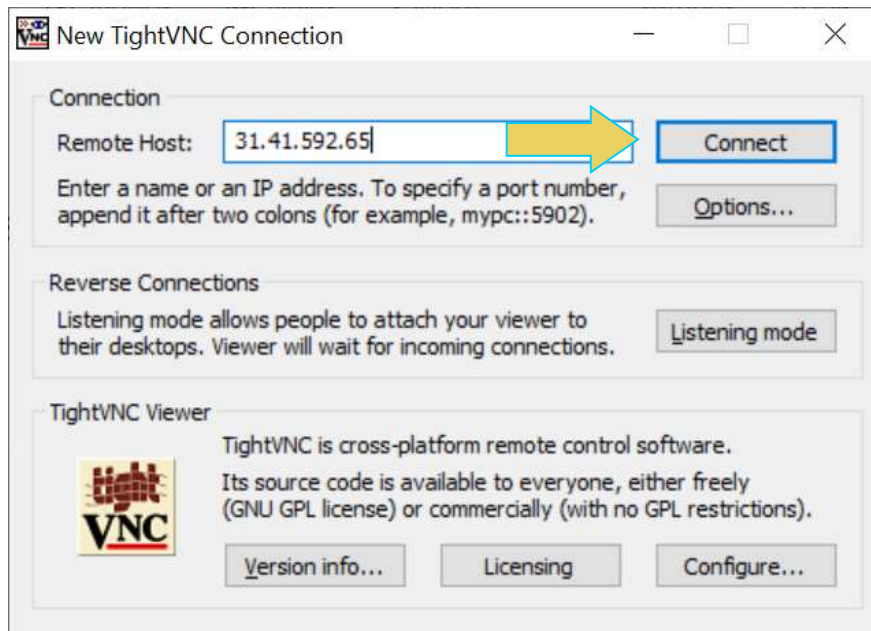
TightVNC Viewer for windows is available for free download at <https://tightvnc.com/download.php>. Navigate to this page on the remote PC that you would like to control the M42d device from, and install the compatible software package.

**Note:** TightVNC comes pre-installed on the M42d device and the server runs automatically on startup, so nothing further needs to be done on the instrument other than powering the device on.

Once TightVNC is installed on the remote computer, open the **TightVNC Viewer** application from the installation directory folder.



Enter the device's IP address in the **Remote Host** field, and click **Connect**. Instructions for locating the device's IP address are in **2.2 Operating the VPS Application on a Host PC**.



The default password for the instrument is ***elocution***, though this can be modified on the **TightVNC Server** application on the M42d device itself.

With the VNC Viewer, you can operate the instrument's embedded GUI to access certain features unavailable on a remote host PC VPS Application GUI.

### 3 VPS GUI Dashboard

The previous sections briefly introduced the VPS GUI, but this section will cover the basics of the Interface in more detail, specifically the Dashboard.

Upon opening the Dashboard, you will see the following:

- A collapsible dashboard panel at the top
- A toolbar featuring the system menu button and profile drop-down
- A home page featuring clickable icons for each application of the M42d 80G Video Analyzer/Generator
- A bottom taskbar with small icons to quickly switch to another application

#### 3.1 Status Panel

The Status Panel at the top of the dashboard contains video information that pertains to the M42d's Signal Generator and Analyzer. This panel is static, meaning it remains pinned at the top of the GUI regardless of the application currently in use.

A screenshot of the status panel is below.



The panel is split into a TX information panel, and an RX information panel, which are discussed in detail within the next two subsections.

Centered at the bottom of the status panel is a tab that indicates whether the ACA Utility (Covered in [Chapter 7](#)) is currently monitoring AUX transactions.

When the ACA is not running, the tab will say **ACA OFF** in grey text.

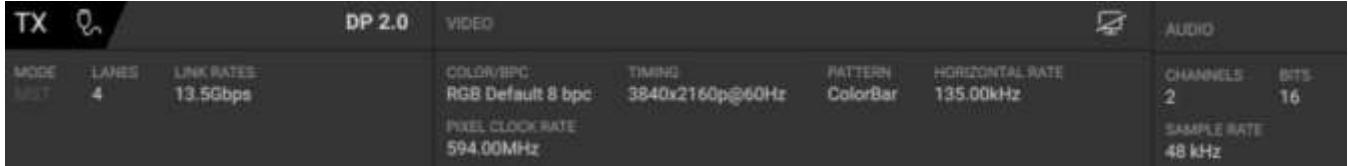


When the ACA is monitoring transactions, the tab will read **ACA ON** with a green light. Click on the tab to expand and show the number of transactions currently recorded.















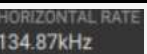
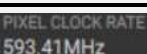


### Status Panel- Left (TX)

The left side of the status panel displays information about the video currently being transmitted with the M42d's **Signal Generator** utility. This information is relevant when testing a sink device and using the M42d to generate and transmit video signal to the sink DUT.



Refer to the table below for a description of the TX dashboard components.

**Note:** Keep in mind that this left-hand (TX) status panel shows settings configured in the M42d's Signal Generator, used in testing a sink device.

Status Panel- TX Side	
Field	Description
<b>Mode</b>  or 	Transport mode: SST or Multi-Stream <b>Note:</b> When trained at a non-UHBR link rate, click the mode to switch between SST and Multi-Stream. 
<b>Lanes</b>  4	Number of lanes used during link training
<b>Link Rates</b>  20.0Gbps	Link rate (per lane)
Video	
<b>Generate Video</b>  or 	Toggle icon to start or stop generation  - indicates signal generation is <b>currently on</b> ; click to turn off.  - indicates signal generation is <b>currently off</b> ; click to turn on.
<b>Color/BPC</b>  RGB Default 8 bpc	Colorimetry type and bit depth
<b>Timing</b>  3840x2160p@60Hz	Currently-selected format: video resolution and frame rate
<b>Pattern</b>  ColorBar	Currently-selected test pattern
<b>Horizontal Rate</b>  134.87kHz	Horizontal refresh rate of the selected format/timing
<b>Pixel Clock Rate</b>  593.41MHz	How often pixels occur (frame rate x pixels per frame)
Audio	
<b>Channels</b>  2	Number of channels for audio generation
<b>Bits</b>  16	Audio bit depth

Status Panel- TX Side	
Field	Description
Sample Rate	Audio sampling frequency

The following are a few examples of the status panel displaying various TX port information.

Generating 4K video signal in Multi-Stream at 13.5 Gbps:

TX		DP 2.0	VIDEO	AUDIO
MODE MST	LANES 4	LINK RATES 13.5Gbps	COLOR/BPC RGB Default 8 bpc TIMING 3840x2160p@60Hz PATTERN ColorBar HORIZONTAL RATE 135.00kHz	CHANNELS 2 BITS 16 SAMPLE RATE 48 kHz

Generating 8K video signal at 20Gbps with 5.1 channel audio:

TX		DP 2.0	VIDEO	AUDIO
MODE MST	LANES 4	LINK RATES 20.0Gbps	COLOR/BPC RGB Default 8 bpc TIMING 7680x4320p@24Hz PATTERN ColorBar HORIZONTAL RATE 108.00kHz	CHANNELS 6 BITS 24 SAMPLE RATE 48 kHz

Generating 1080p video signal in SST at 8.1 Gbps (Legacy Mode):

TX		DP 2.0	VIDEO	AUDIO
MODE SST	LANES 4	LINK RATES 8.10Gbps	COLOR/BPC RGB Default 8 bpc TIMING 1920x1080p@60Hz PATTERN ColorBar HORIZONTAL RATE 67.50kHz	CHANNELS 2 BITS 16 SAMPLE RATE 48 kHz

Video Generation off (**Note:** the settings configured in the Signal Generator are still displayed, but no signal is being transmitted to a sink DUT):

TX		DP 2.0	VIDEO	AUDIO
MODE SST	LANES 4	LINK RATES 8.10Gbps	COLOR/BPC RGB Default 8 bpc TIMING 1920x1080p@60Hz PATTERN ColorBar HORIZONTAL RATE 67.50kHz	CHANNELS 2 BITS 16 SAMPLE RATE 48 kHz

## Status Panel- Right (RX)

The right side of the dashboard displays information about the video currently being received by the Basic Analyzer's emulated receiver. This information is relevant when testing a source device and using the M42d to emulate an RX receiving video signal from the source DUT.

RX			Mode: Emulation	DP 2.0	VIDEO		
LANES	HDCP	LINK RATE	COLOR/BPC	ACTIVE RESOLUTION	3D	TOTAL RESOLUTION	REFRESH RATE
4	Off	8.10Gbps	RGB sRGB VESA 8 bpc	1920x1080	N	2200x1125	60.0Hz

Refer to the table below for a description of the RX status panel components.

**Note:** Keep in mind that this right-hand (**RX**) panel displays information of a video signal being received by the M42d's emulated receiver, used in analyzing a source device.

Dashboard- RX Side	
Field	Description
<b>Mode</b> Mode: Emulation or Mode: Passive	Mode of Basic Analyzer; more information in <b>Chapter 8 Passive Monitoring</b>
<b>Lanes</b> <small>LANES</small> 4	Number of lanes used during Link Training
<b>HDCP</b> <small>HDCP</small> Off	Indicates whether HDCP encryption is enabled
<b>Link Rate</b> <small>LINK RATE</small> 8.10Gbps	Link rate (per lane)
<b>Video</b>	
<b>Color/BPC</b> <small>COLOR/BPC</small> RGB sRGB VESA 8 bpc	Colorimetry/Bit depth
<b>Active Resolution</b> <small>ACTIVE RESOLUTION</small> 1920x1080	Measured video resolution
<b>3D</b> <small>3D</small> N	Status flag of 3D audio
<b>Total Resolution</b> <small>TOTAL RESOLUTION</small> 2200x1125	The total video resolution in horizontal pixels and vertical lines
<b>Refresh Rate</b> <small>REFRESH RATE</small> 60.0Hz	Vertical frame rate

The following are a few examples of the status panel displaying information from different video signals being received by the M42d Analyzer.

Receiving 4K video at UHBR with YCbCr 4:2:2 Colorimetry

RX			Mode: Emulation	DP 2.0	VIDEO		
LANES	HDCP	LINK RATE		COLOR/BPC	ACTIVE RESOLUTION	3D	TOTAL RESOLUTION
4	Off	20.00Gbps	→	YCbCr422 ITU-R BT.709 CEA 8 bpc	3840x2160	N	4400x2250
				REFRESH RATE			
				60.0Hz			

Receiving 1080p video at 8.1 Gbps Link Rate

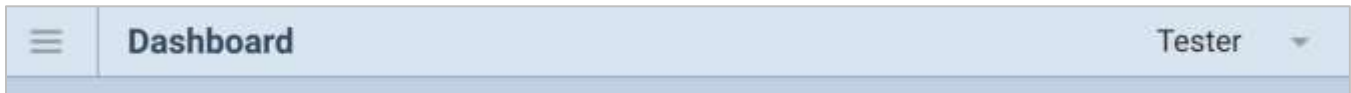
RX			Mode: Emulation	DP 2.0	VIDEO			
LANES	HDCP	LINK RATE		COLOR/BPC	ACTIVE RESOLUTION	3D	TOTAL RESOLUTION	REFRESH RATE
4	Off	8.10Gbps	←	RGB sRGB VESA 8 bpc	1920x1080	N	2200x1125	60.0Hz

Receiving 2160p120 video at 13.5 Gbps Link Rate

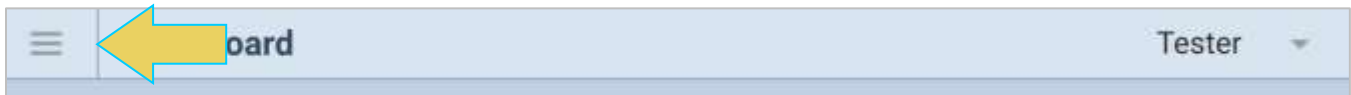
RX			Mode: Emulation	DP 2.0	VIDEO		
LANES	HDCP	LINK RATE		COLOR/BPC	ACTIVE RESOLUTION	3D	TOTAL RESOLUTION
4	Off	13.50Gbps		RGB 6 bpc	3840x2160	N	4400x2250
				REFRESH RATE			
				120.0Hz			

### 3.2 Dashboard Toolbar

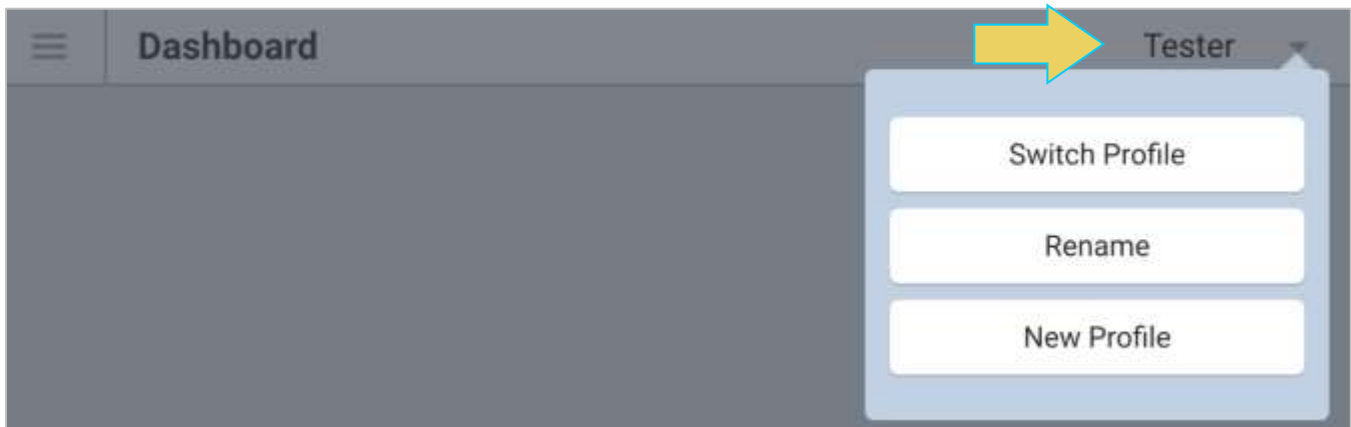
Directly beneath the status panel is a toolbar.



The left-most menu icon will take you to the System Menu (covered in [Chapter 2](#)).



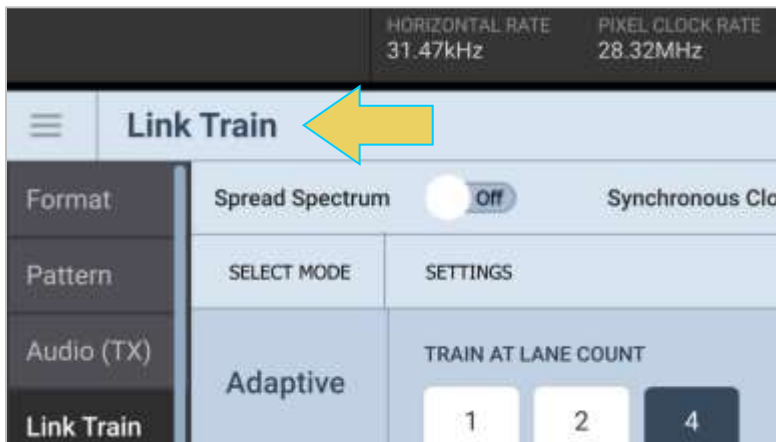
The drop-down menu on the right-hand side of the toolbar allows you to switch between user profiles. Click the current profile name to enable the options to **Switch Profile**, **Rename** (current profile), or create a **New Profile**. Profiles are covered in detail in [2.3 Profiles](#).



The toolbar is static, so it will remain visible regardless of the current application being utilized.

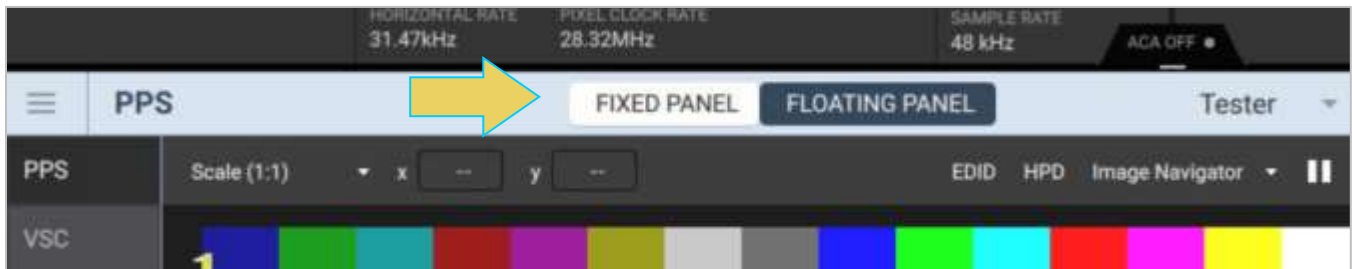
The toolbar will display the name of the current application/utility open. **“Dashboard”** is displayed when on the home page, as shown above.

The next example shows a user in the **Link Train** utility of the **Signal Generator** application. (Full Link Training procedures covered in a later chapter)





The toolbar does have a few more options depending on the application/utility a user is in. In the next example, the user is in the Realtime Analyzer, which features the **Fixed Panel** and **Floating Panel** options now within the toolbar (The Analyzer is covered in detail in **Chapter 5**).

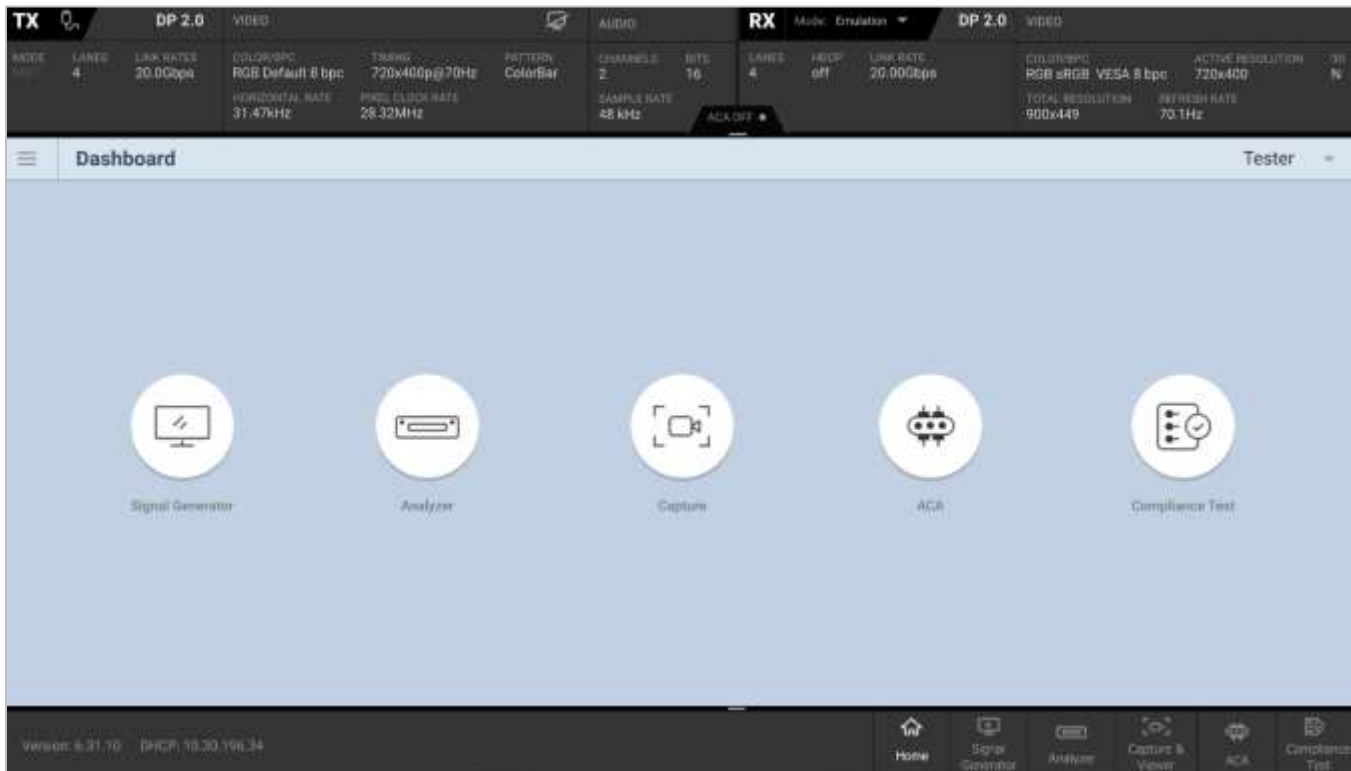


### 3.3 Dashboard Main Panel

The main panel of the Dashboard will display the application/utility currently in use.

#### Dashboard Home

The home page is shown within the dashboard by default. As seen below, the home page has icons that allow you to navigate to any of the M42d's applications.



Each of the applications featured on the landing page of the Dashboard are covered in detail within their own chapter, with the exception of the Compliance Tests.

Chapter Links:

- [Signal Generator](#)
- [Analyzer](#)
- [Capture & Viewer](#)
- [ACA](#)
- [Compliance Test](#)

### 3.4 Dashboard Taskbar

The taskbar, located at the bottom of the Dashboard window, is also static; it remains visible regardless of application currently in use on the GUI.



Click the thin grey bar at the top of the taskbar to expand or collapse application names.



Refer to the following table for a description of the taskbar elements:

Taskbar	
Field/Icon	Description
Version	Firmware Version
IP Address	Indicates whether address is Static or DHCP and lists IP address
Home	Opens the Home page of the VPS Dashboard
Signal Generator	Opens the M42d Signal Generator utility
Analyzer	Opens the M42d Realtime Analyzer
Capture & Viewer	Opens the Protocol Capture Utility and Viewer
ACA	Opens the Auxiliary Channel Analyzer Utility
Compliance Test	Opens the Compliance Testing Suite
Date & Time	Displays the instrument's set date and time.

## 4 Signal Generator

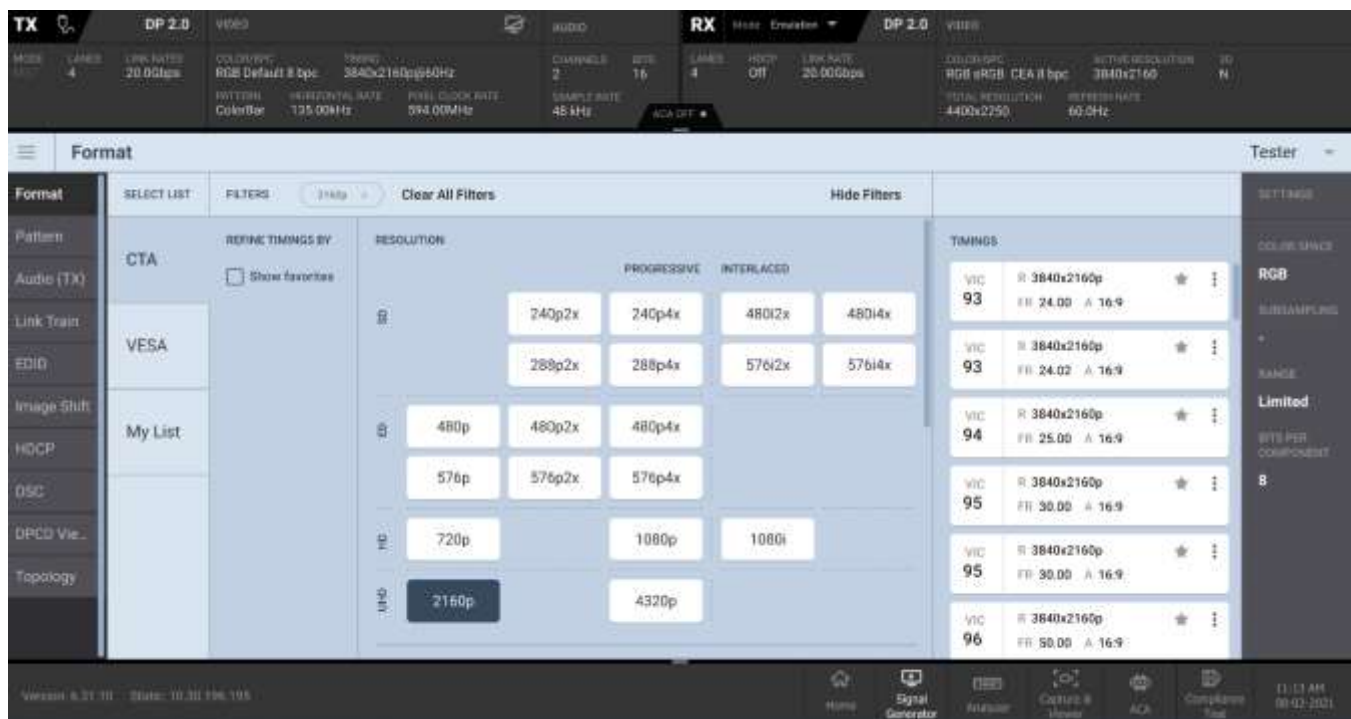
Note that portions of this chapter require specific licenses for the M42d to utilize the features therein, including enabling UHBR rates, and DSC functional tests. More Information and a list of available licenses can be found in [Appendix A. Licenses](#).

### Overview

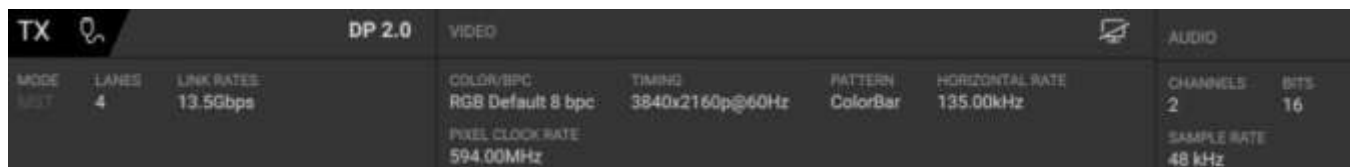
This section provides information for using the M42d signal generator function. To access this, select the **Signal Generator** application icon from the dashboard home page.



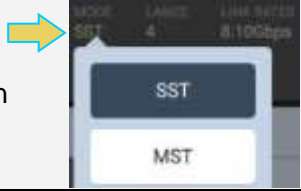
The Signal Generator application appears, as shown below. By default, the window will display either the **Format** tab or the last utility used within the generator



There is a status panel at the top of the window. When using the Signal Generator for testing Sink devices, the **TX** (left) side of the status panel will display information pertaining to the generated video signal.



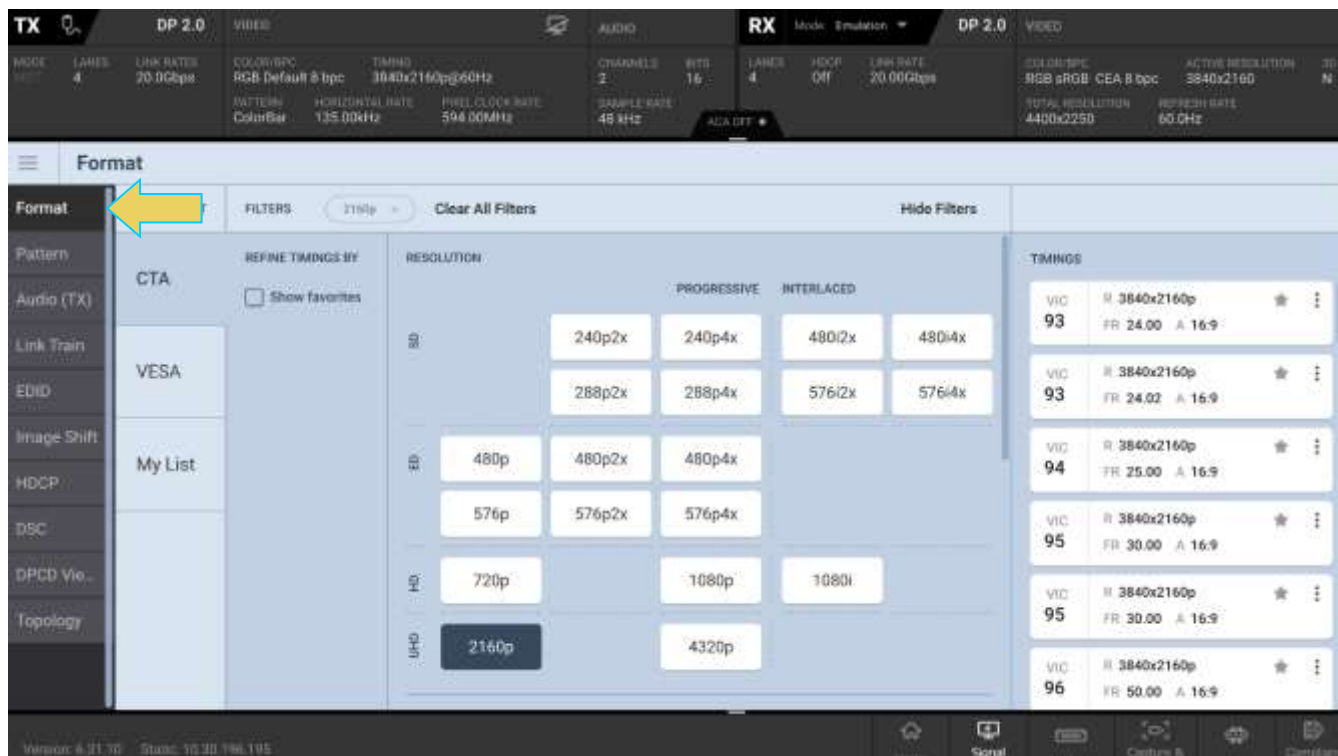
Refer to the below table for information on this status panel.

Signal Generator TX Status Panel	
Field	Description
<b>Mode</b> <span>MODE</span> <input type="checkbox"/> or <span>MODE</span> <input checked="" type="checkbox"/> <b>SST</b>	Transport mode: SST or Multi-Stream <b>Note:</b> When trained at a non-UHBR link rate, click the mode to switch between SST and Multi-Stream. 
<b>Lanes</b> <span>LANES</span> <input type="text" value="4"/>	Number of lanes used during link training
<b>Link Rates</b> <span>LINK RATES</span> <input type="text" value="20.0Gbps"/>	Link rate (per lane)
Video	
<b>Generate Video</b> <input checked="" type="checkbox"/> or <input type="checkbox"/>	Toggle icon to start or stop generation <input checked="" type="checkbox"/> - indicates signal generation is <b>currently on</b> ; click to turn off. <input type="checkbox"/> - indicates signal generation is <b>currently off</b> ; click to turn on.
<b>Color/BPC</b> <span>COLOR/BPC</span> <input type="text" value="RGB Default 8 bpc"/>	Colorimetry type and bit depth
<b>Timing</b> <span>TIMING</span> <input type="text" value="3840x2160p@60Hz"/>	Currently-selected format: video resolution and frame rate
<b>Pattern</b> <span>PATTERN</span> <input type="text" value="ColorBar"/>	Currently-selected test pattern
<b>Horizontal Rate</b> <span>HORIZONTAL RATE</span> <input type="text" value="134.87kHz"/>	Horizontal refresh rate of the selected format/timing
<b>Pixel Clock Rate</b> <span>PIXEL CLOCK RATE</span> <input type="text" value="593.41MHz"/>	How often pixels occur (frame rate x pixels per frame)
Audio	
<b>Channels</b> <span>CHANNELS</span> <input type="text" value="2"/>	Number of channels for audio generation
<b>Bits</b> <span>BITS</span> <input type="text" value="16"/>	Audio bit depth
<b>Sample Rate</b> <span>SAMPLE RATE</span> <input type="text" value="48 kHz"/>	Audio sampling frequency

The information displayed in the status panel will update as you modify the signal generator to your testing specifications.

### 4.1 Selecting DisplayPort Video Format

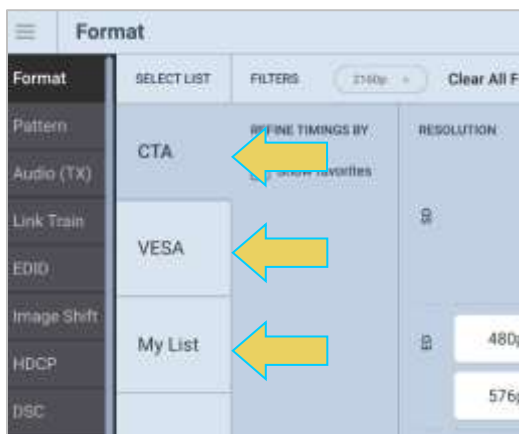
Use the following procedures to select a video resolution (format). To access the formats menu, select the Format tab on the left-hand sidebar within the Signal Generator.



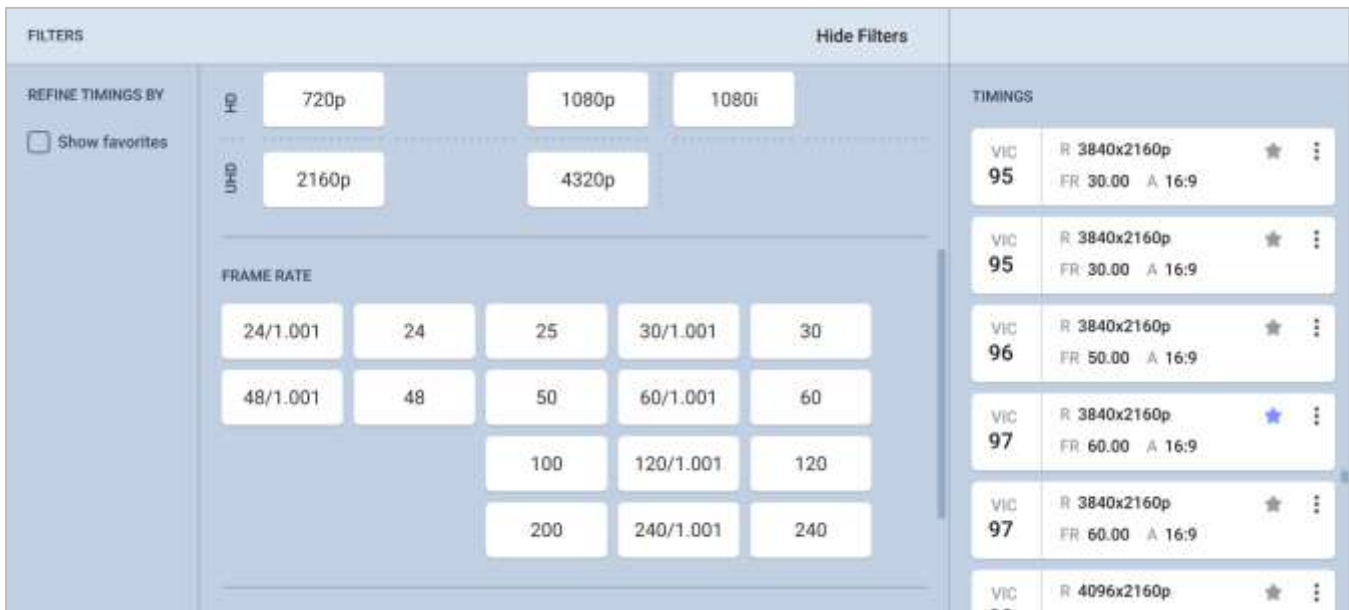
### Format Window

You can select formats (timings) for the M42d 80G Video Analyzer/Generator’s from the format library in one of three ways, which are all covered in this section. Navigate to these options using the **SELECT LIST** sidebar.

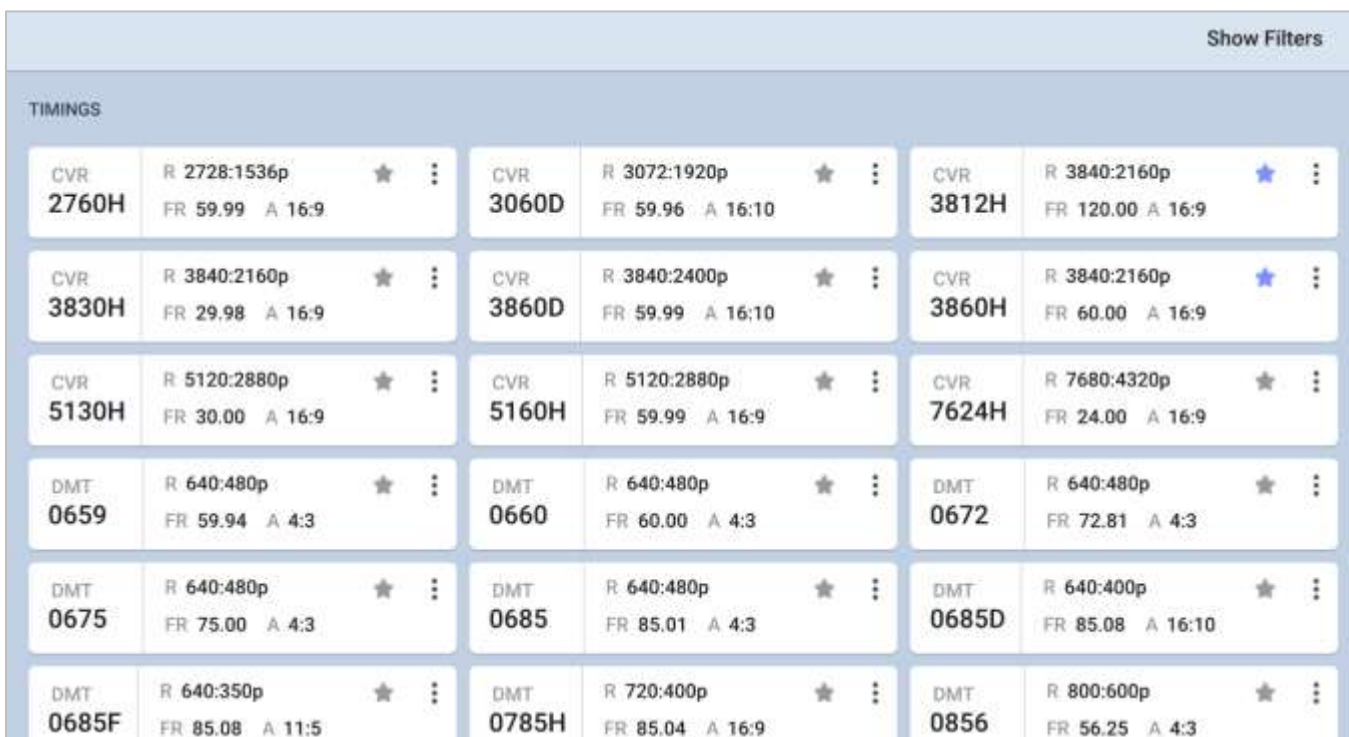
- Select **CTA** format from entire library or using smart filters
- Select **VESA** format from the entire library or using smart filters
- Select from a custom list of formats (**My List**)



The main panel of the format window is where you will select the timing for your testing specifications. Depending which method you are using to select a timing, the main panel will either show a set of filter parameters (first screenshot below), or simply a list of available formats (second screenshot below).



**Format window main panel with filtering enabled**



**Format window main panel with filters hidden**

The right panel of the format window displays the **Format Settings**.



Once you've selected the desired format, you can adjust the settings of this format, which is covered **at the end of this section**.



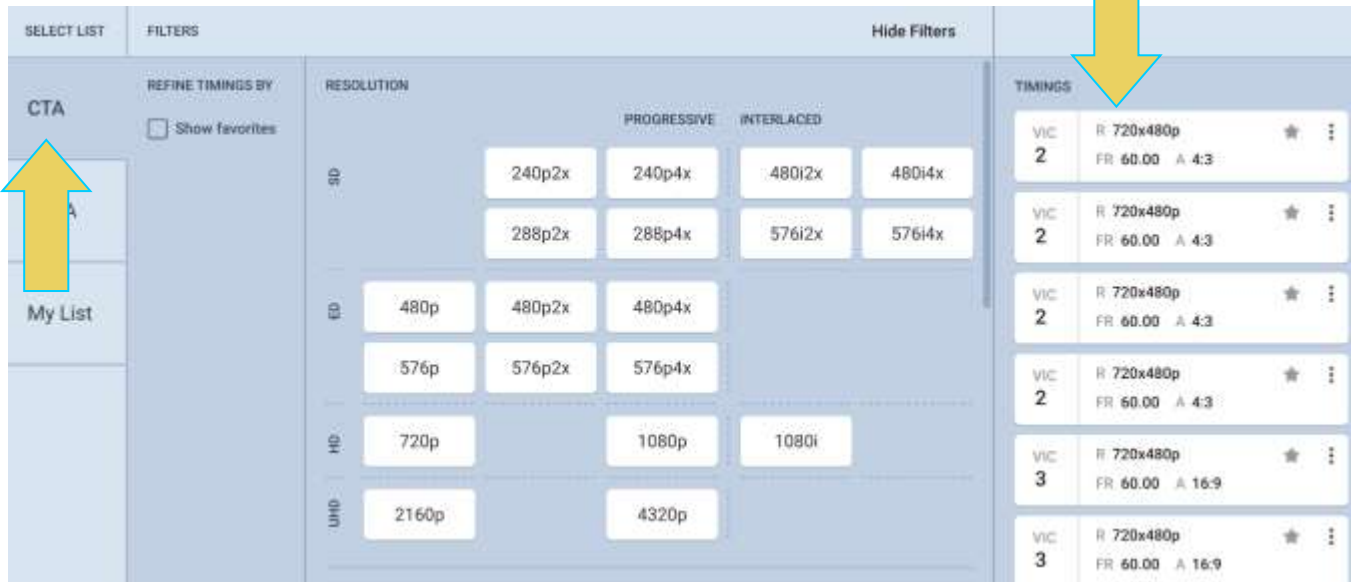
### Selecting format using CTA smart filtering

From the Generator, click the **Format** tab.

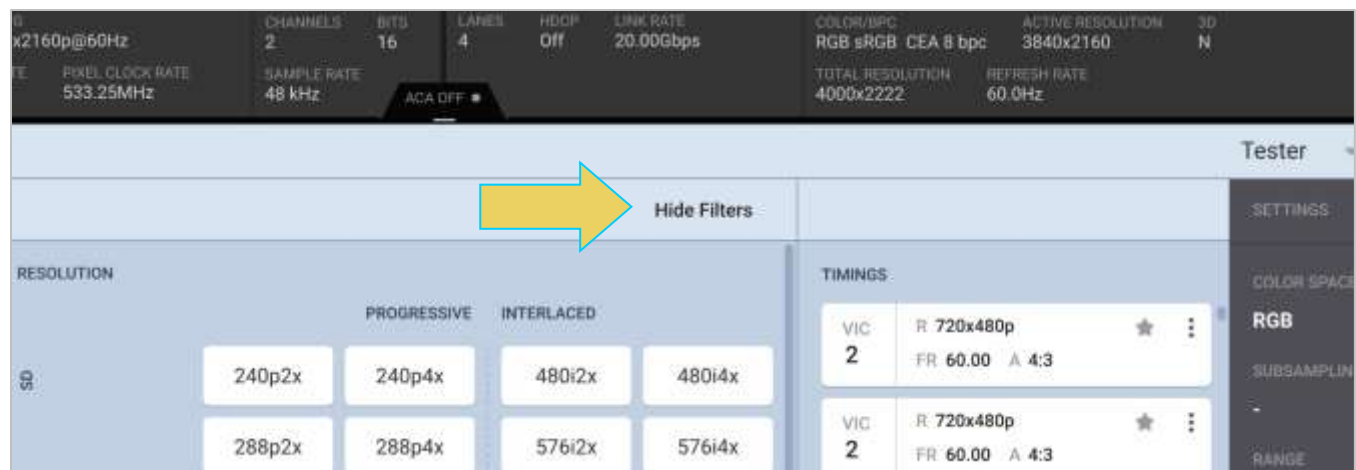
Select the **CTA** tab under the **SELECT LIST** column on the left.

The smart filtering screen enables you to select CTA formats through filtering of various video parameters such as Resolution, Frame Rate, and Aspect Ratio.

The available timings are shown in the right column. This list is narrowed down as you filter the formats according to your testing specifications



You may prefer to simply browse all available formats within a list. In this case, click **Hide Filters** at the top of the window.



The filters will be hidden, allowing you to easily browse through all available timings, as shown below. Click **Show Filters** at the top right to re-enable smart filtering.



Within the **FILTERS** panel, specify any or all of the following parameters, in any order:

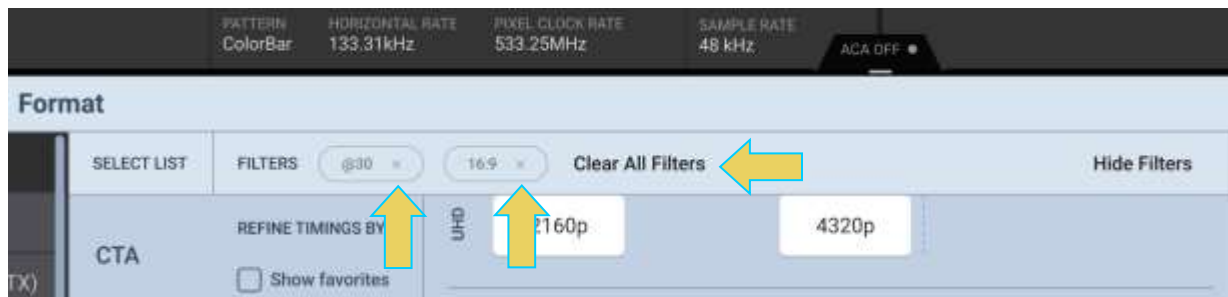
1. Resolution
2. Frame Rate
3. Aspect Ratio
4. Box

This will show available formats (on the right) that meet the filtering criteria specified.

In this example, we are selecting a Frame Rate of 30 Hz and a 16:9 Aspect Ratio. A list of formats on the righthand side of the screen shows the formats that match these first two criteria selected. You may select one of these formats now or continue filtering by Resolution and Box.



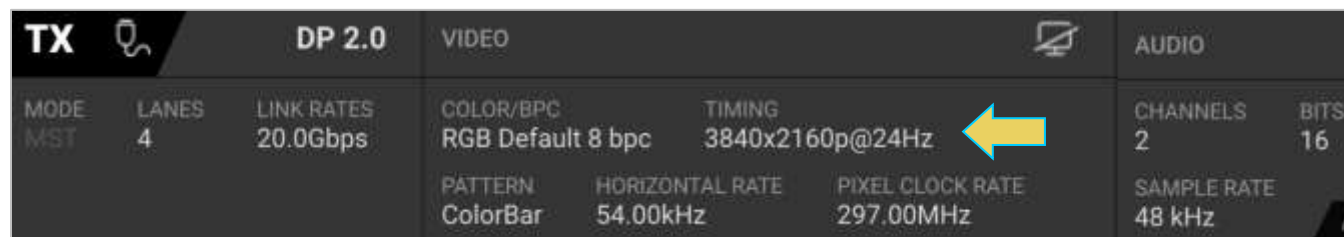
Additionally, you may remove a filtering criterion or **Clear All Filters** using the buttons at the top of the panel:



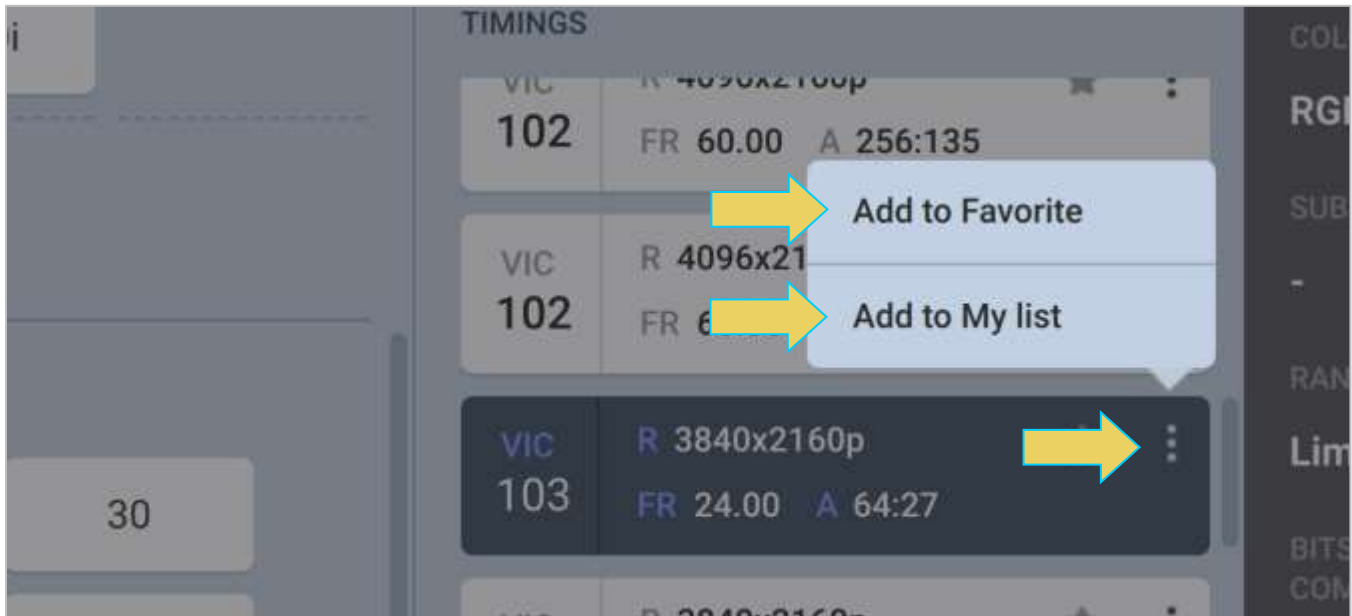
Select a format by clicking on it. Note that you can browse for a format using the scroll bar on the right.



Once a timing format is selected, the status panel at the top of the screen will update, as shown per this example:



At any point, you can click on the three-dot menu at the right of any of the timings boxes to either mark it as a **Favorite** or add to **My List** (**more on My List later in this section**):



Each format has a small gray star on the right, next to the three-dot menu. Favorited formats will appear with this star colored purple, as shown below. A shortcut to marking a timing as a favorite, or removing from favorites, is to simply click the star itself.



**Two formats that have been marked as favorites**

Lastly, you may refine the list of timings in any list by checking the **Show favorites** box next to the list tab on the left.

This example shows only the favorites within the CTA List of formats that are 4k resolution.



This example shows all favorites within the CTA List of formats.



**Note:** You have to check the **Show favorites** box before clicking **Hide Filters** to get to this view.

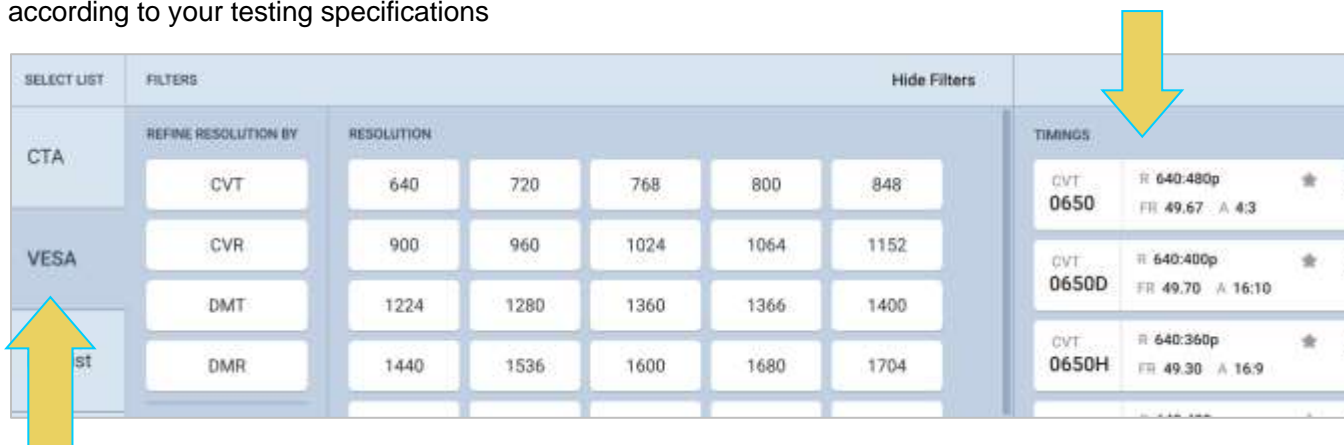
### Selecting format using VESA Smart Filtering

From the Generator, click the **Format** tab.

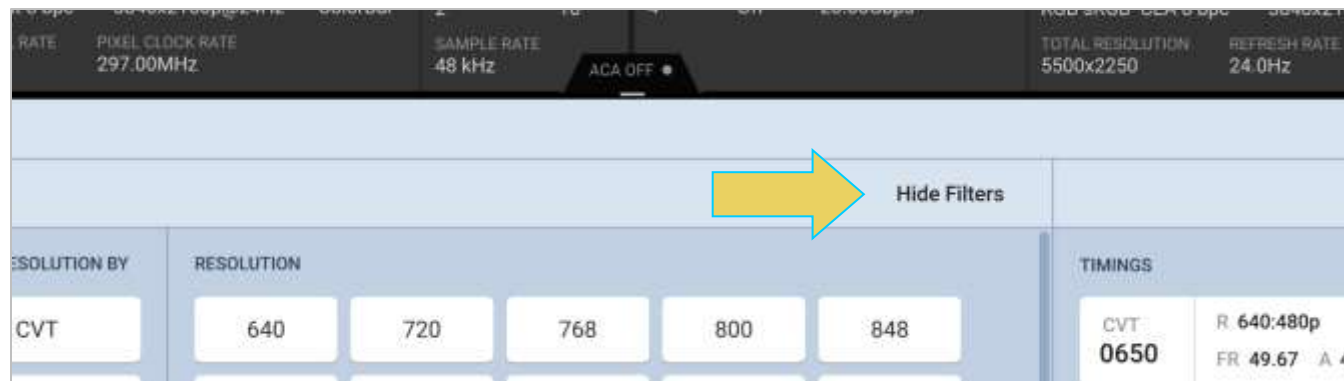
Select the **VESA** tab under the **SELECT LIST** column on the left.

The smart filtering screen enables you to select VESA timings through filtering of various video parameters such as Resolution, Frame Rate, and Aspect Ratio.

The available timings are shown in the right column. This list is narrowed down as you filter the formats according to your testing specifications

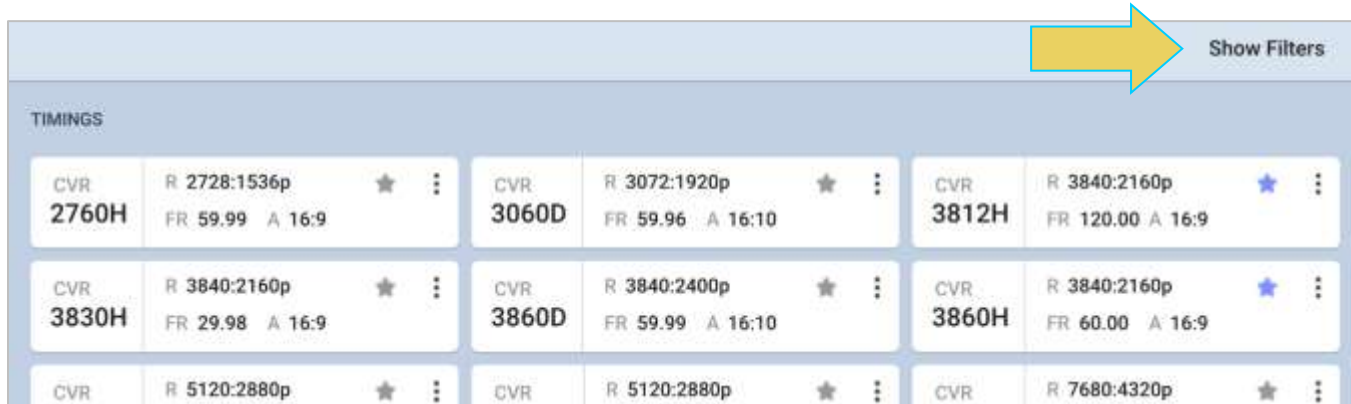


You may prefer to simply browse all available formats within a list. In this case, click **Hide Filters** at the top of the window.



The filters will be hidden, allowing you to easily browse through all available timings, as shown below.

Click **Show Filters** at the top right to re-enable smart filtering.



Within the **FILTERS** panel, specify any or all of the following parameters, in any order:

1. Resolution
2. Frame Rate
3. Aspect Ratio

You can further narrow down resolution choices by selecting an option in the **REFINE RESOLUTION** panel on the left:



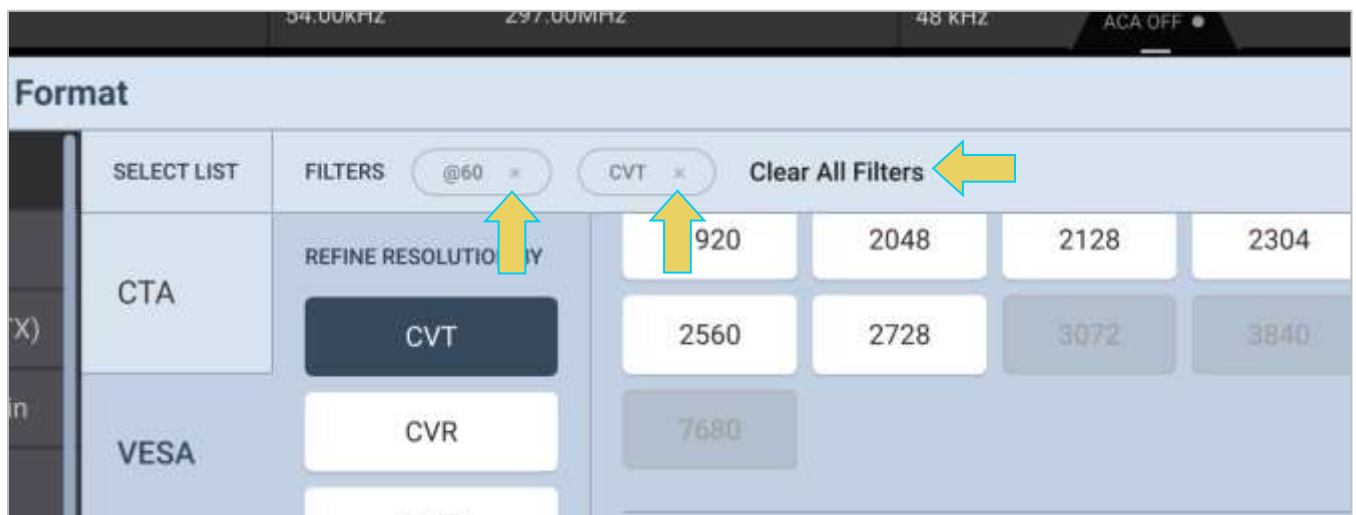
**Note:** CVT stands for CVT-Reduced blanking, and DMR stands for DMT-Reduced blanking.

This will show available formats (on the right) that meet the filtering criteria specified.

In this example, we are selecting a Frame Rate of 60 Hz and have refined the resolution options to CVT only. A list of formats on the righthand side of the screen shows the formats that match these first two criteria selected. You may select one of these formats now or continue filtering by Resolution and Aspect Ratio.

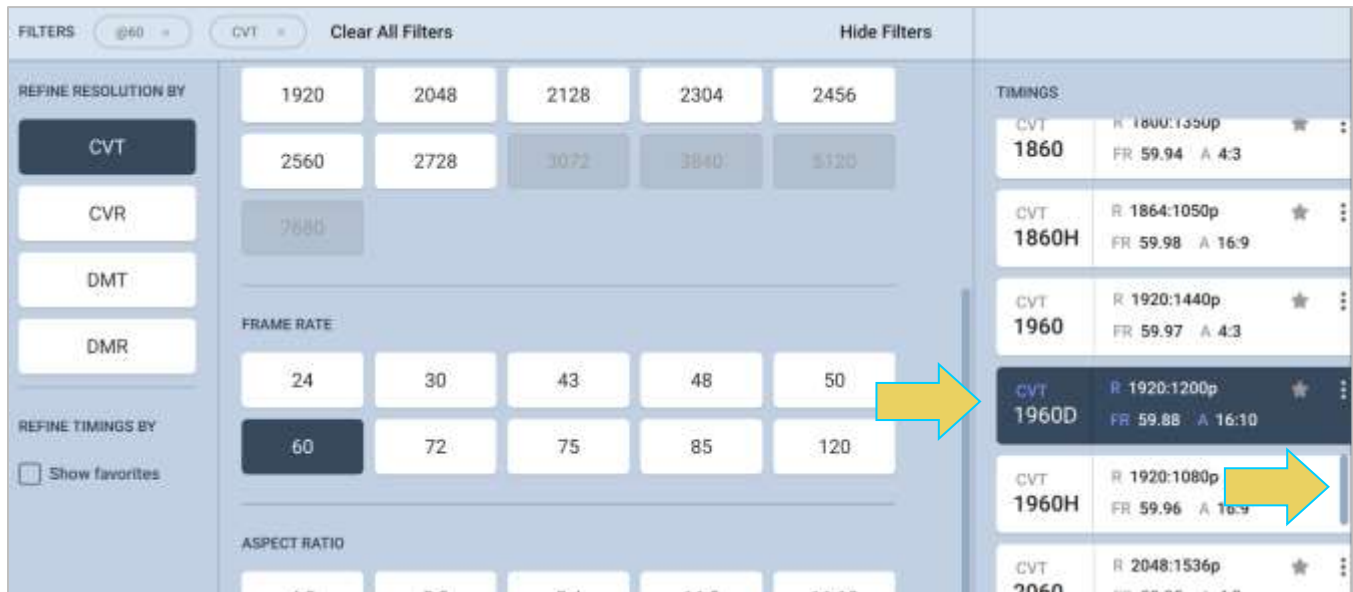


Additionally, you may remove a filtering criterion or **Clear All Filters** using the buttons at the top of the panel:

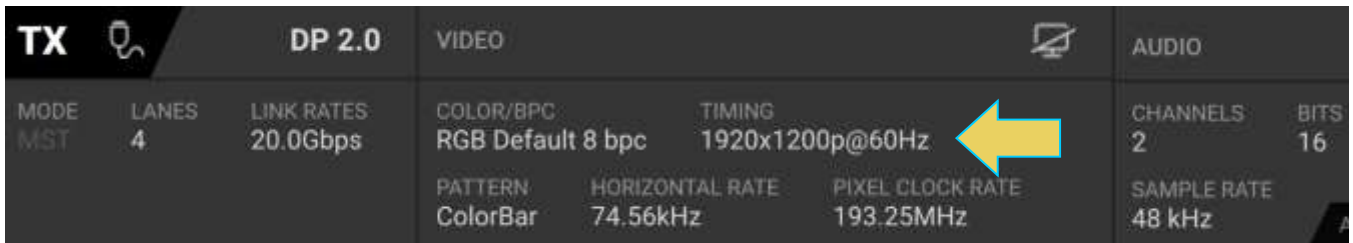




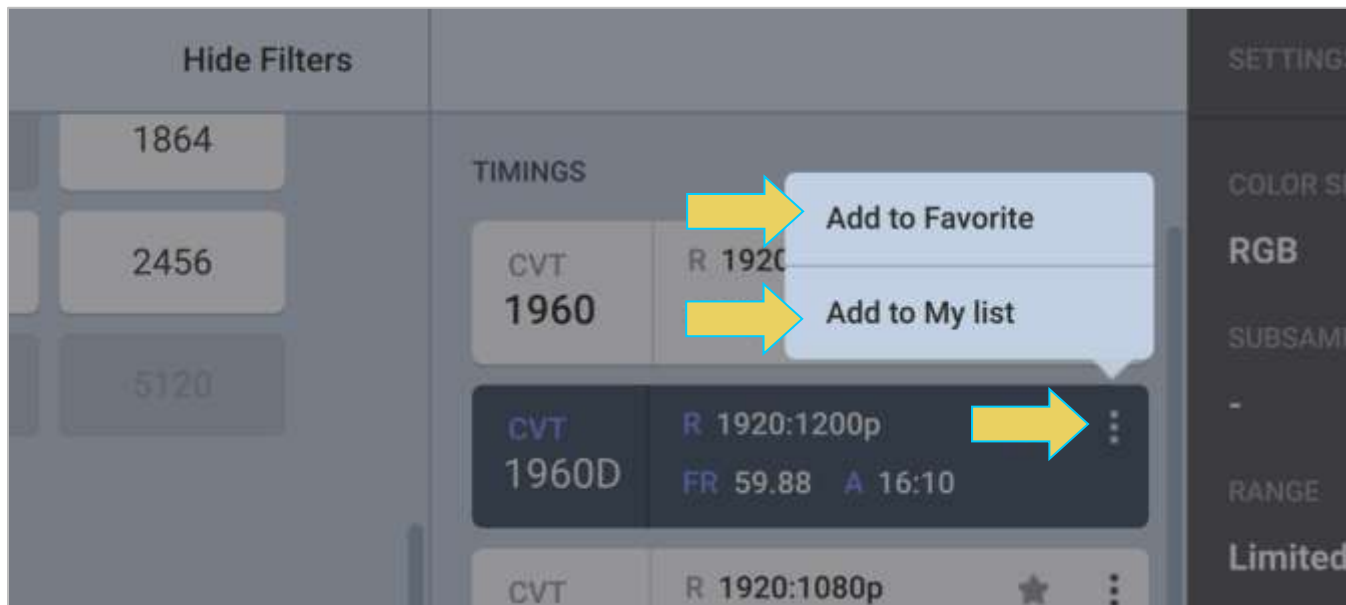
Select a format by clicking on it. Note that you can browse for a format using the scroll bar on the right.



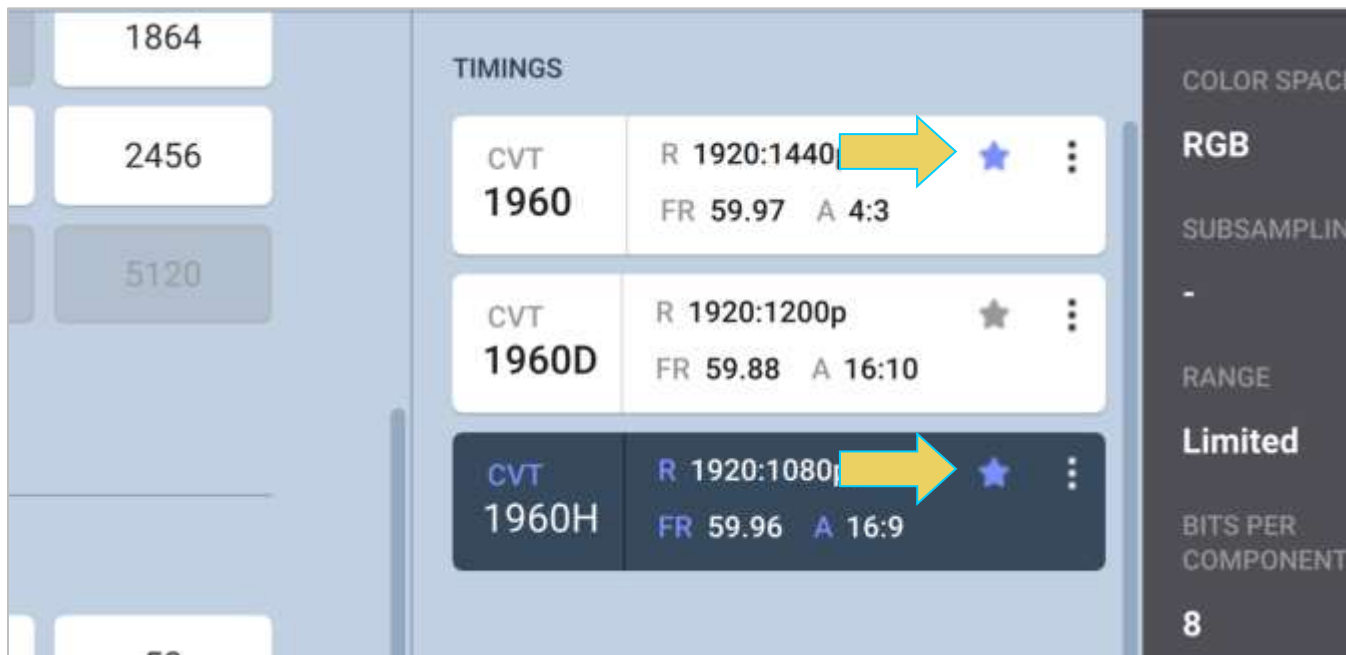
Once a timing format is selected, the status panel at the top of the screen will update, as shown per this example:



At any point, you can click on the three-dot menu at the right of any of the timing boxes to either mark it as a **Favorite** or add to **My List** (**more on My List later in this section**):



Each format has a small gray star on the right, next to the three-dot menu. Favorited formats will appear with this star colored purple, as shown below. A shortcut to marking a timing as a favorite, or removing from favorites, is to simply click the star itself.



**Two formats that have been marked as favorites**

Lastly, you may refine the list of timings in any list by checking the **Show favorites** box next to the list tab on the left.

This example shows only the CVT resolution favorites within the VESA List of formats that are.



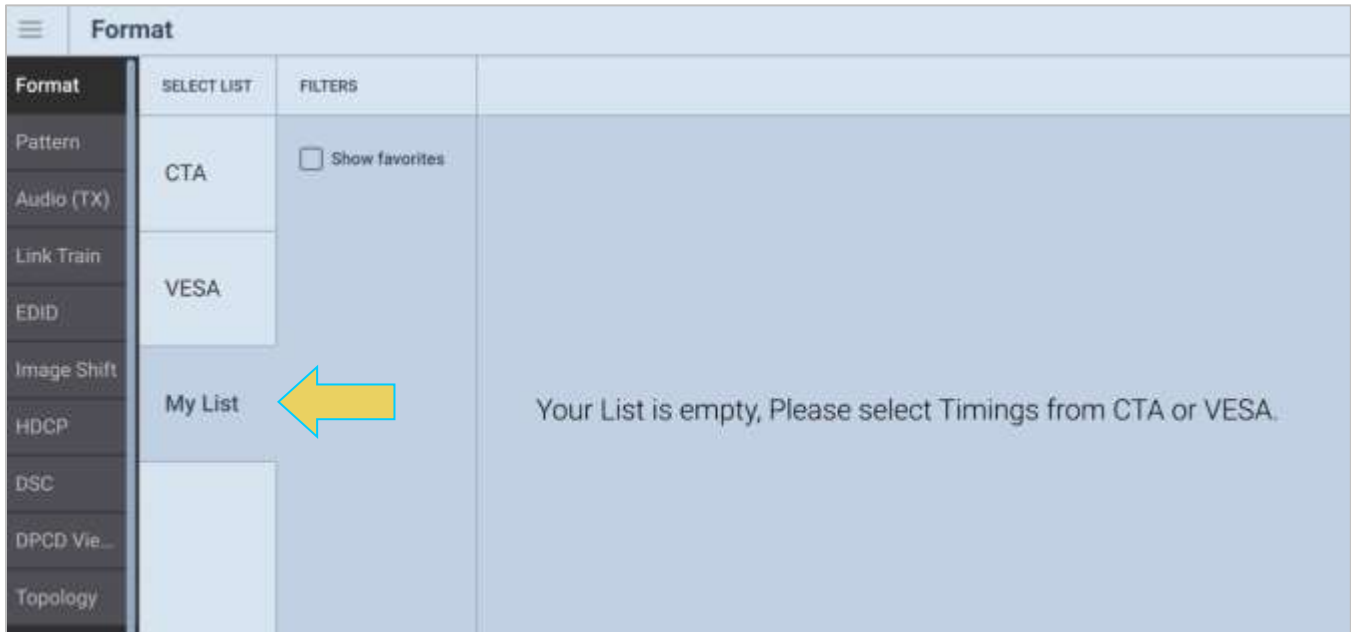
This example shows all favorites within the VESA List of formats.



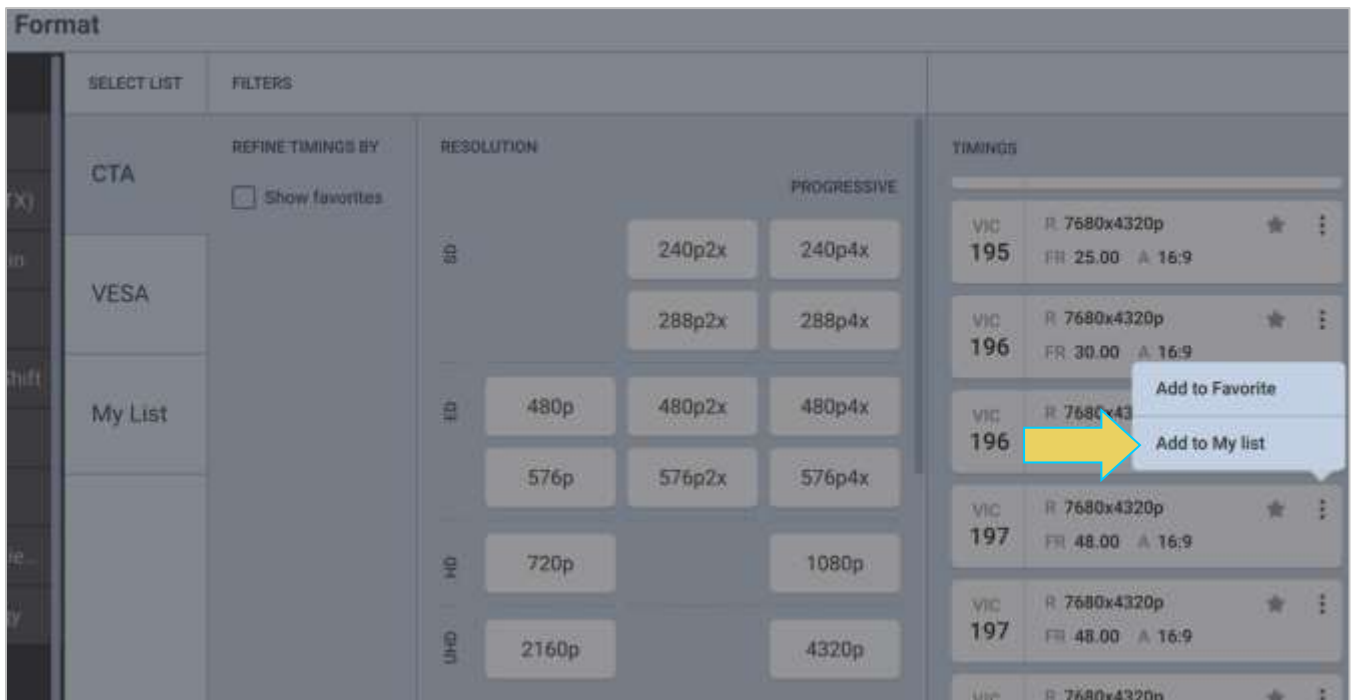
**Note:** You have to check the **Show favorites** box before clicking **Hide Filters** to get to this view.

### Selecting format using My List (custom lists)

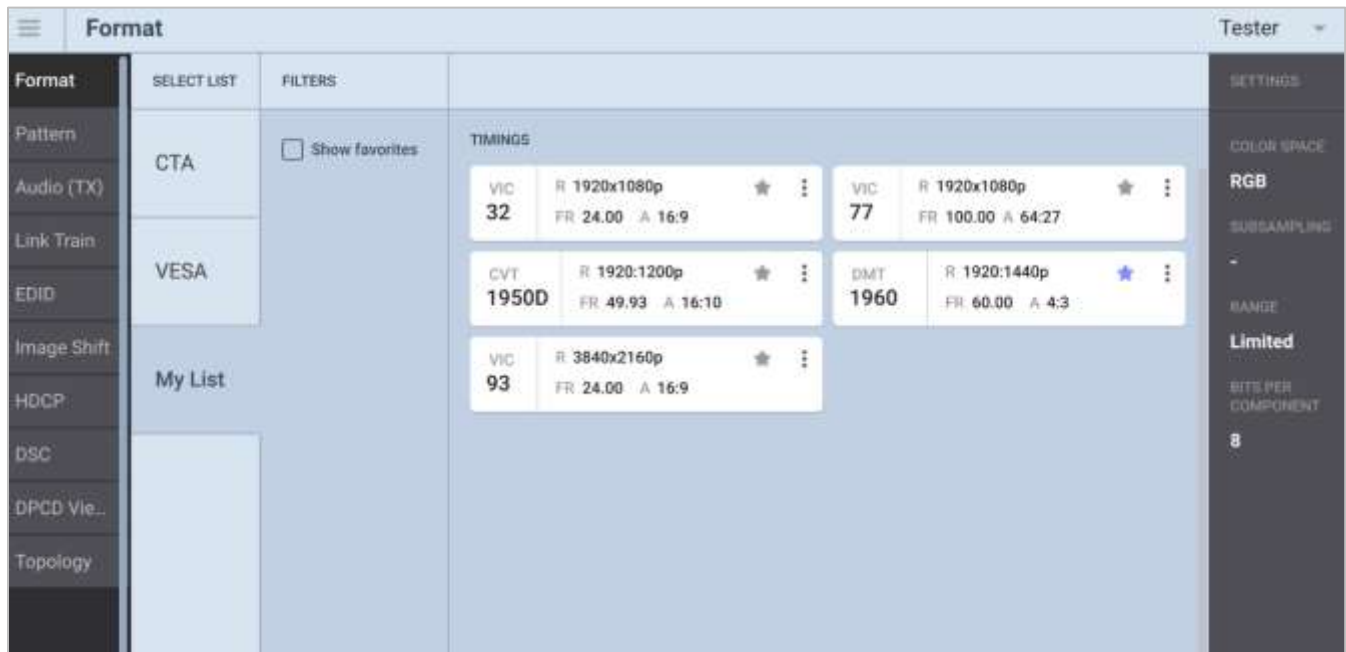
You can create a custom list of formats, called **My List**. This allows you to quickly select from an abbreviated list of your preferred formats. To access your list, Click the **My List** tab in the **SELECT LIST** column. The screen below is what you will see; notice that before adding formats to your list, you'll get a blank screen telling you to fill the list.



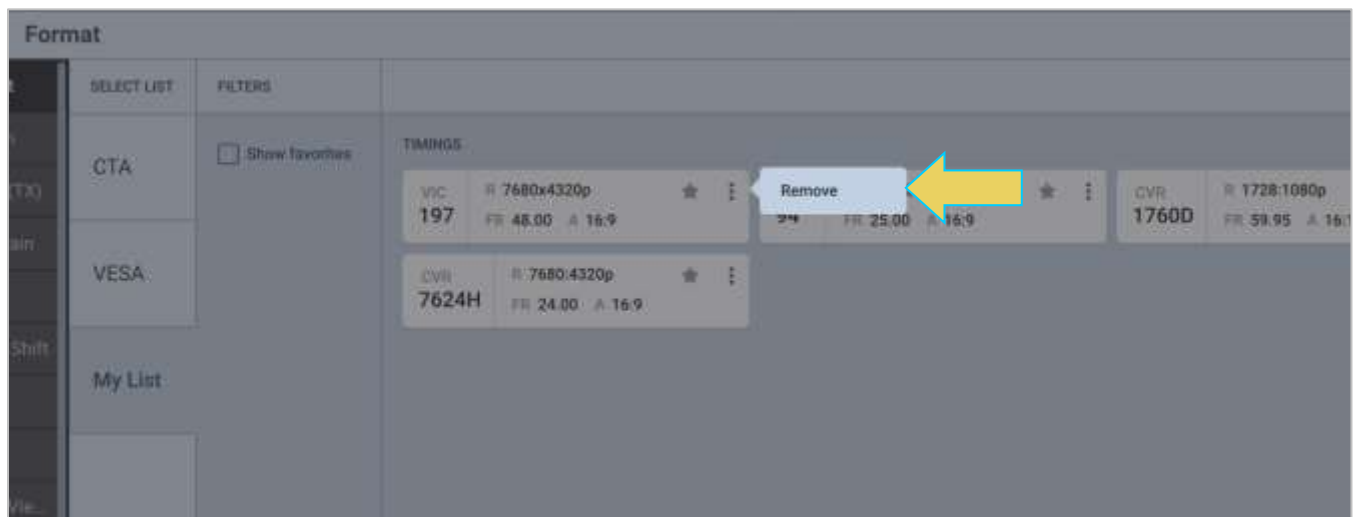
Add formats to the list by clicking the three-dot menu icon within the list's details box and select **Add to My List**.



The screenshot below shows a populated **My List**.



Remove a format from your list by clicking the three-dot menu within the format's details box and click **Remove**.



### Configuring the format Settings

Use the following procedures to configure the format settings. The **Format Settings** dialog box enables you to configure the Color Space, Subsampling, Range, and Bits per Component.

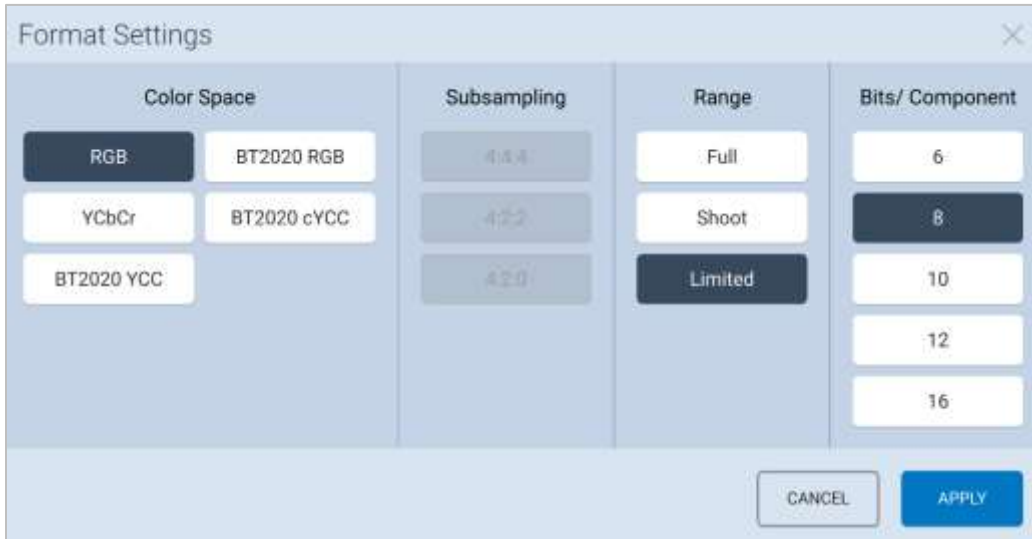
Specify the format settings by clicking anywhere within the **Settings** panel at the right side of the window.

The screenshot displays the software interface for configuring video format settings. At the top, there are tabs for AUDIO, RX (selected), and VIDEO. The RX tab shows Mode: Emulation and DP 2.0. Below this, various parameters are listed: VIDEO MODE (1920x1080p@60Hz), PATTERN (ColorBar), CHANNELS (2), BITS (16), LANES (4), HDCP (Off), LINK RATE (20.00Gbps), COLOR/BPC (RGB sRGB CEA 8 bpc), ACTIVE RESOLUTION (1920x1080), 3D (N), LOCK RATE (30MHz), SAMPLE RATE (48 kHz), TOTAL RESOLUTION (2576x1120), and REFRESH RATE (60.0Hz).

The main area is titled 'TIMINGS' and contains a grid of video format options. Each option includes a VIC or CVT number, resolution (R), refresh rate (FR), and aspect ratio (A). For example, the first row includes VIC 32 (R 1920x1080p, FR 24.00, A 16:9), VIC 56 (R 720x480p, FR 240.00, A 4:3), and VIC 56 (R 720x480p, FR 240.00, A 16:9). Other options include VIC 62, 69, 97, 196, 201, 1250H, 1360H, 1650, 1985H, and CVR 2560:1440p.

On the right side, there is a 'Tester' dropdown menu and a 'Settings' panel. The 'Settings' panel is currently expanded, showing options for COLOR SPACE (set to RGB), SUBSAMPLING, RANGE (set to Limited), and BITS PER COMPONENT (set to 8). A yellow arrow points to the 'Settings' panel.

The Settings dialog box appears as shown below. Select the Color Space, Subsampling (if necessary), Range, and Bits per Component from the **Format Settings** dialog box in accordance with your testing requirements.



Refer to the following table for information on each parameter.

Format Settings		
Parameter	Description	Options
Color Space	Colorimetry and video pixel encoding settings.	<ul style="list-style-type: none"> <li>• RGB – Uses 4:4:4 sampling.</li> <li>• YCbCr – Uses either 4:4:4, 4:2:2 sampling.</li> <li>• BT2020RGB</li> <li>• BT2020 cYCC</li> <li>• BT2020 YCC</li> </ul>
Quantization Range	These values are described in CEA-861E. They pertain to the number of levels for RGB and YCbCr mode.	<ul style="list-style-type: none"> <li>• Limited – Use for CEA formats. Please refer to the specification section on Video Quantization Ranges for more details.</li> <li>• Shoot – SMTPE legal range</li> <li>• Full - Use for PC formats. Please refer to the specification section on Video Quantization Ranges for more details.</li> </ul>
Bits per Component	Color depth per component.	<ul style="list-style-type: none"> <li>• 6 – Six (6) bit per component (24 bit per pixel) color depth.</li> <li>• 8 – Eight (8) bit per component (24 bit per pixel) color depth.</li> </ul>

Format Settings		
Parameter	Description	Options
		<ul style="list-style-type: none"> <li>10 – Ten (10) bit per component (30 bit per pixel) color depth; deep color.</li> <li>12 – Twelve (12) bit per component (36 bit per pixel) color depth; deep color.</li> <li>16 – Sixteen (16) bit per component (48 bit per pixel) color depth; deep color.</li> </ul>

After adjusting the settings to your testing requirements, click **APPLY** to use the selected format and configured settings.

Alternatively, click **CANCEL** to undo any changes to the settings made within the Format Settings dialog box.





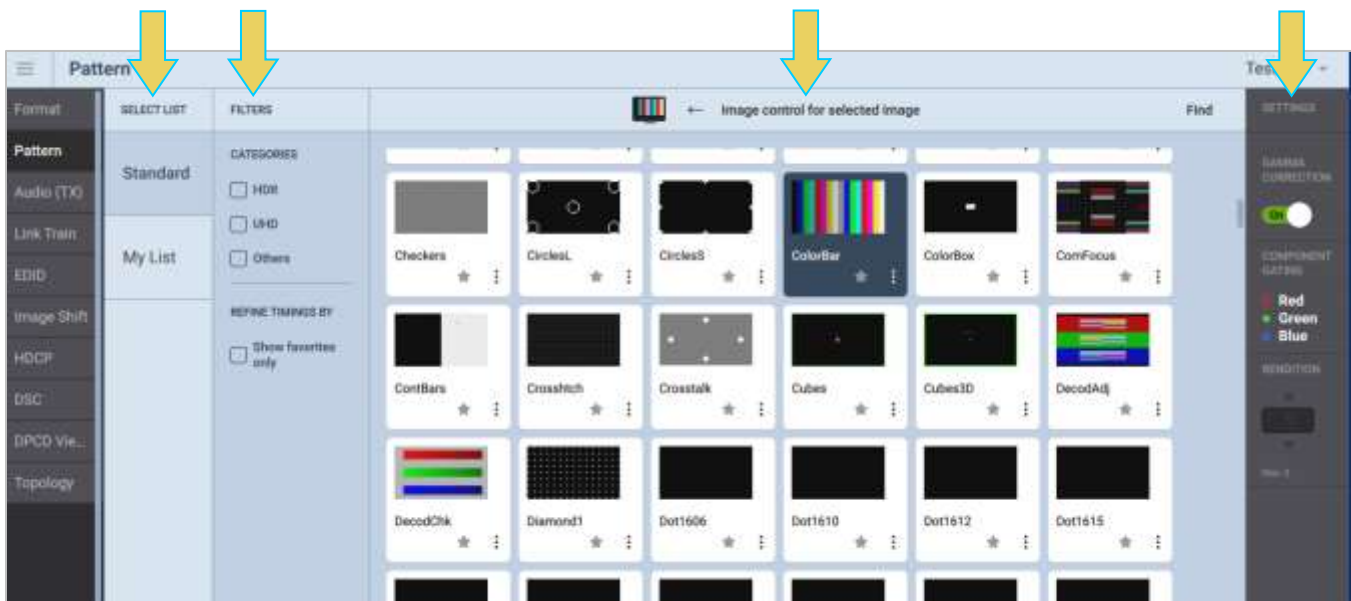
## 4.2 Pattern

Use these procedures to select a test pattern and configure its settings. Click on the **Pattern** tab on the left-hand side of the Signal Generator to access the list of test patterns. You can select a pattern either from the Standard list or a custom list that you create (My List).

### Pattern Window

Upon clicking the Pattern tab, a window will appear with a few panels: Select List, Filters, Images, and Settings.

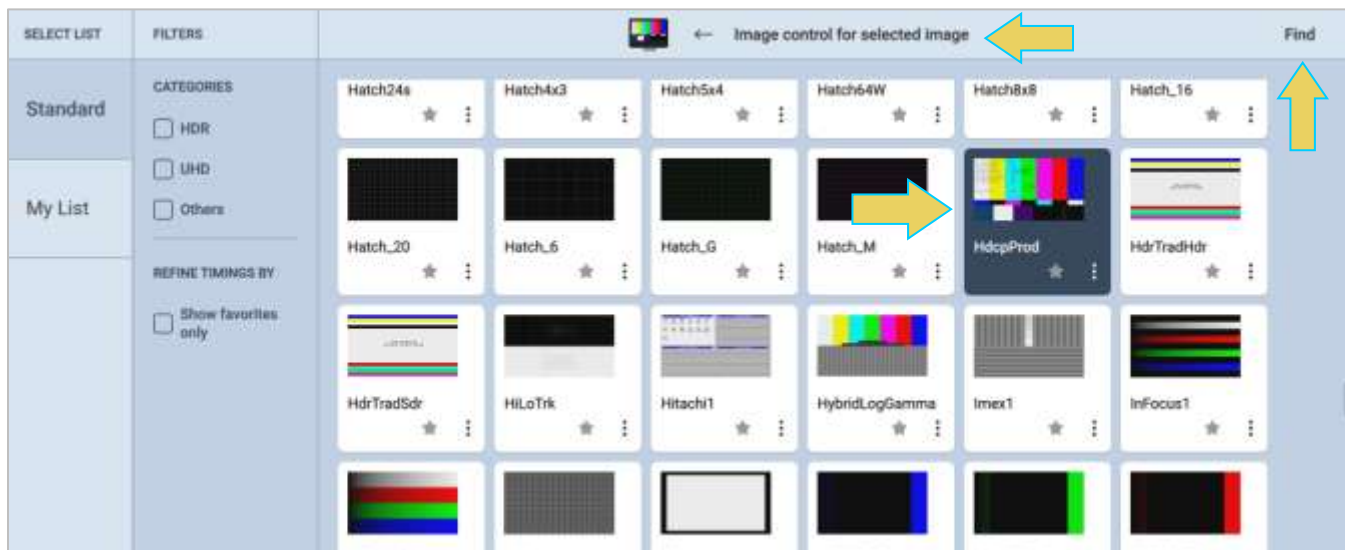
Each of these panels is covered in detail within this section.



### Selecting a Test Pattern from the Standard List

By default, the **Standard** list of patterns will appear. There is a scroll bar on the right to allow access to the entire list by browsing.

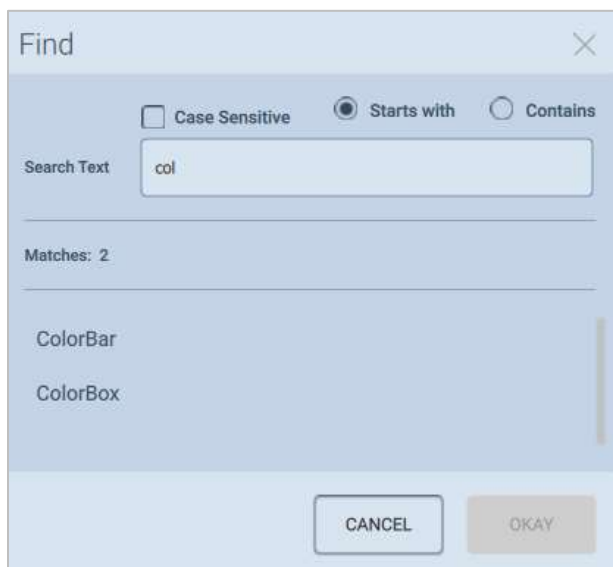
Select a pattern from the list by clicking it. The currently in-use pattern will be highlighted blue, and a thumbnail of the pattern will be displayed at the top of the window, as shown below.



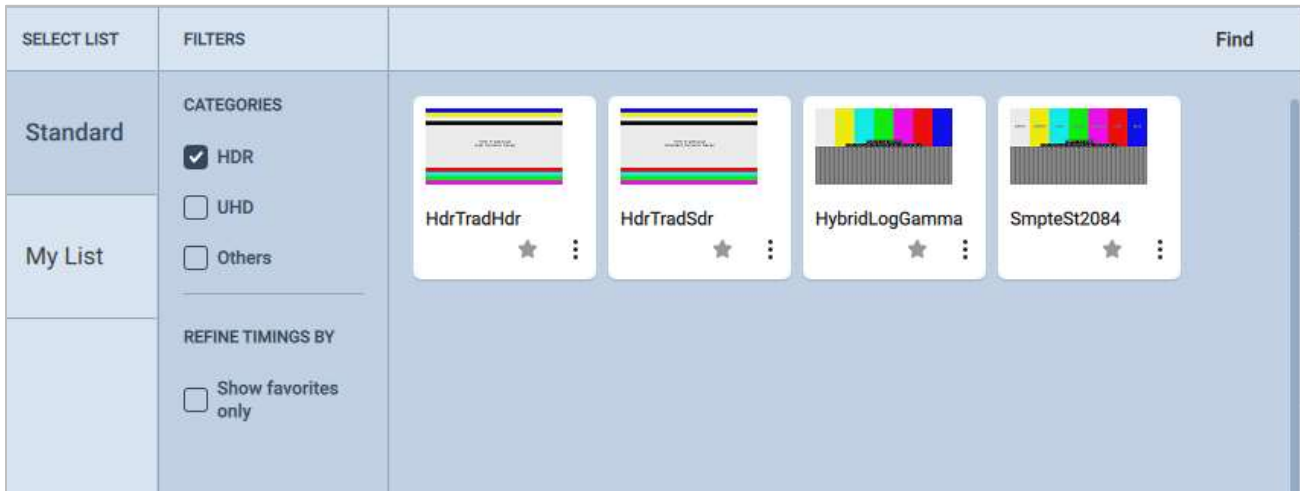
You can optionally use the **Find** feature to search for patterns, or **Filter** for specific pattern types or favorites.

When you press the Find activation button (located at the top right of the window, as seen above), you are presented with a dialog window where you can search for a pattern by name using initial and mid-string partial searches.

The following example shows a search for patterns starting with “col” and returns two results: ColorBar and ColorBox.

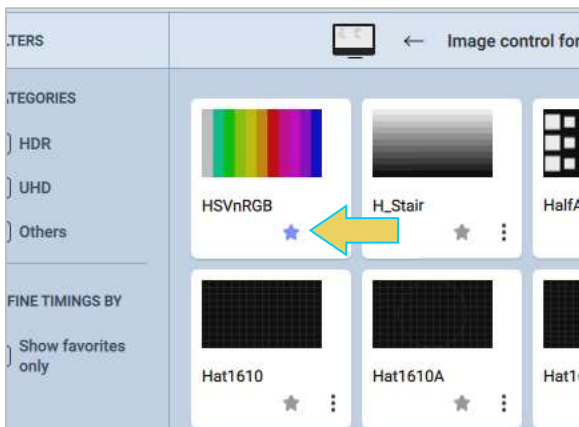
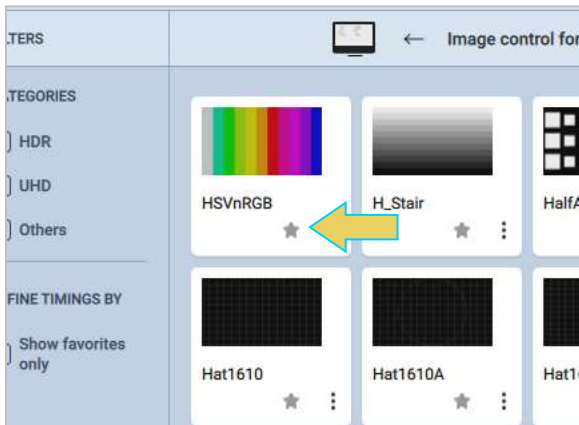


You may also **filter** to narrow down your choices. Filter to a specific category of pattern by checking the box next to the filtering option. This example filters specifically for HDR images.

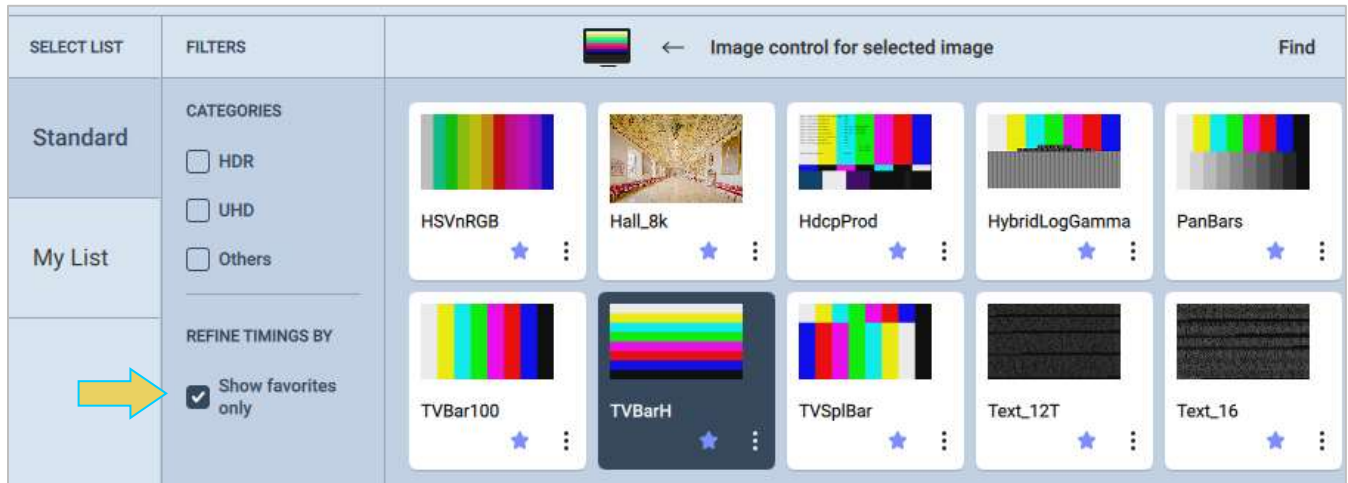


Within the filtering panel, you can select to **Show favorites only**. This easily lets you select certain test patterns that you use often in order to easily locate those images when choosing a pattern.

To mark a pattern as a favorite, simply click the star icon within the pattern's box in the image selection panel, as shown below. The star will appear purple if a pattern has been marked as a favorite.



Once you have selected some favorites, you can refine the selection of patterns shown by checking the box next to **Show favorites only**.

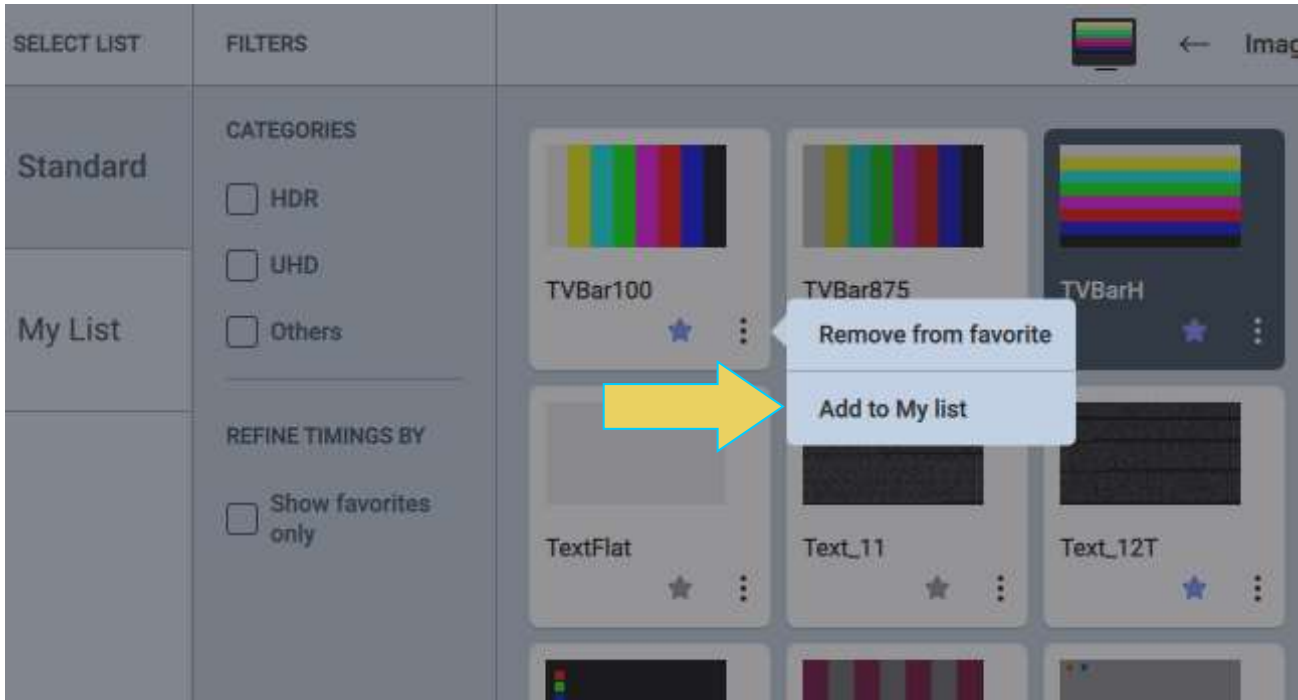


Return to normal view by unchecking the box. The panel displaying images will once again show all images within the standard list for selection.

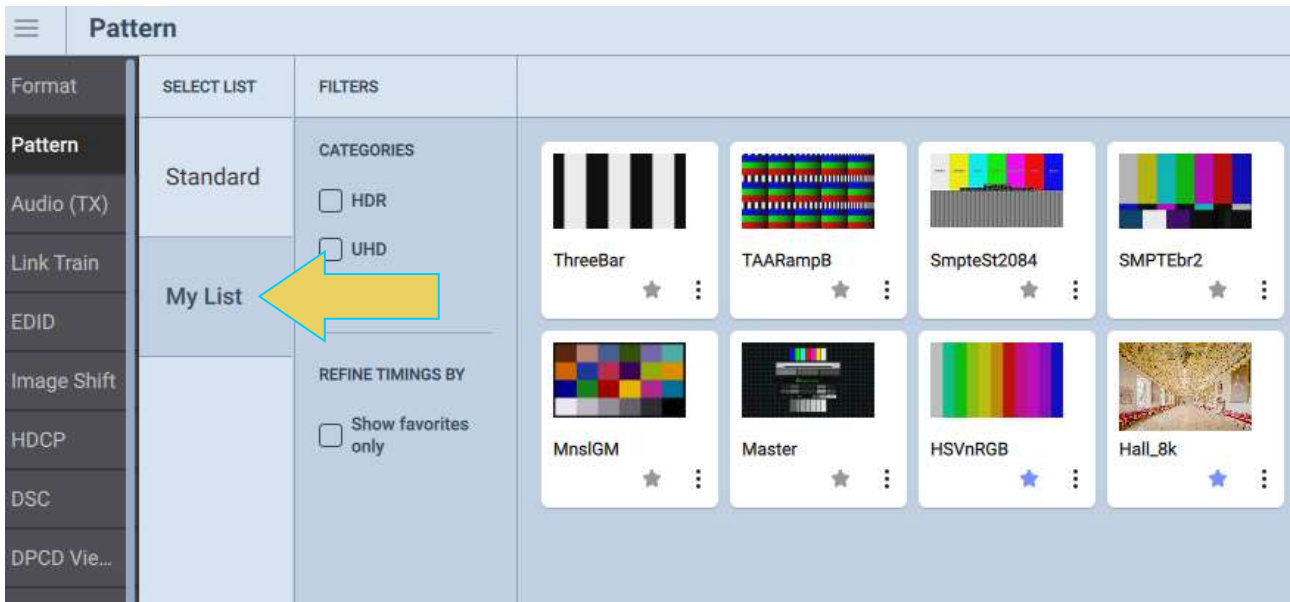
### Selecting a Test Pattern from a Custom List (My List)

You may optionally use the **My List** feature to create a list of patterns to easily display and locate your preferred patterns for testing requirements.

Add patterns to your My List by navigating to the Standard list, clicking the three-dot menu within the pattern box, and clicking **Add to My List**, as shown below.

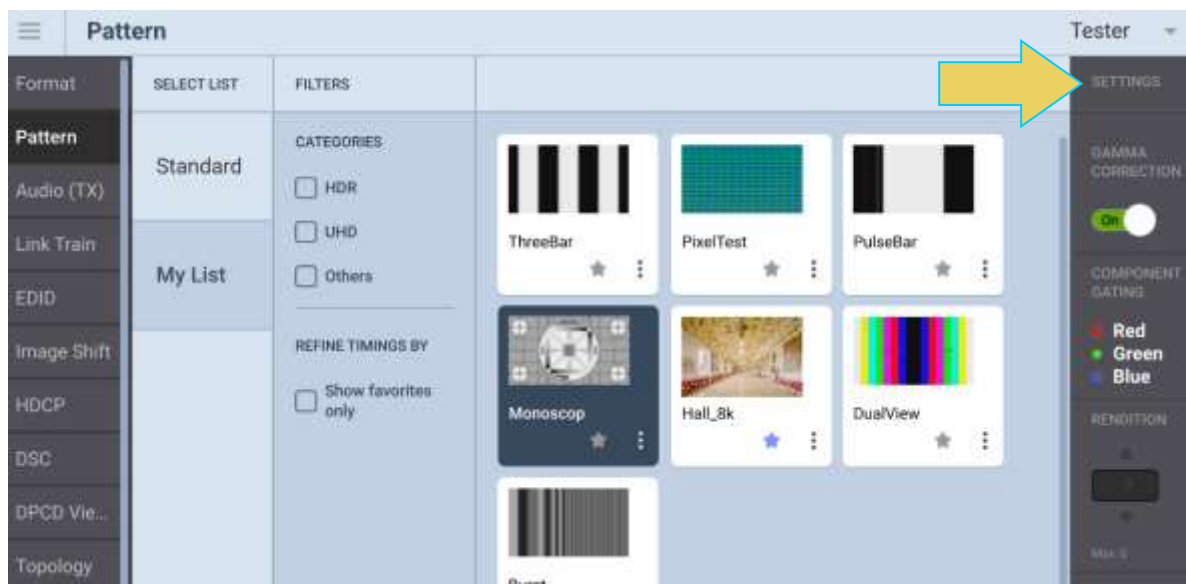


Once you have added patterns to your My List, quickly access them by clicking the **My List** tab on the left-hand side of the window. You will see your preferred patterns within the images panel.



### Configuring Test Patterns Settings

You will find the **SETTINGS** panel on the right-hand side of the Pattern window. From here, you can specify test pattern settings to your testing requirements.



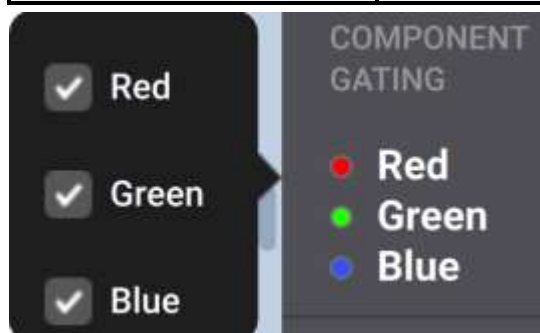
**To specify test pattern settings:**

1. Once you have selected a test pattern, navigate to the Settings side bar.
2. Enable and disable Gamma correction as desired. Refer to the table below for details on this setting.

<b>Gamma Correction</b>	Enables or disables gamma correction which compensate for properties of human vision, to maximize the use of the bits or bandwidth relative to how humans perceive light and color.	<ul style="list-style-type: none"> <li>• On</li> <li>• Off</li> </ul>
-------------------------	---	---

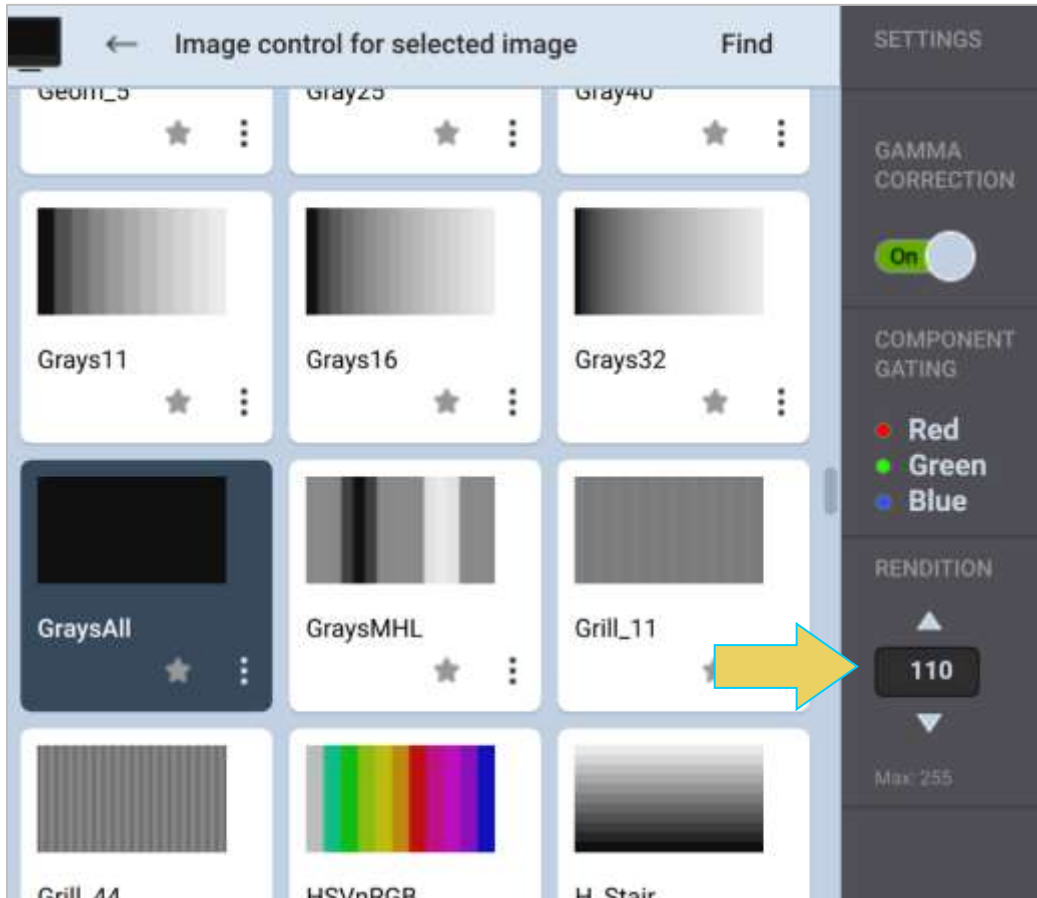
3. Adjust the component gating according to your testing specifications by checking the box next to the associated color component.

<b>Component Gating</b>	Turns on or off the three primary color components.	<ul style="list-style-type: none"> <li>• Red</li> <li>• Green</li> <li>• Blue</li> </ul>
-------------------------	---	--



- 4. Select the rendition where applicable using the Rendition button. The associated dialog box is shown further below.

Some test patterns—such as GraysAll—have multiple versions. These multiple versions can be applied using the Rendition button and associated dialog box as shown below. There is a default that is iteration 0. In the example below iteration 110 is currently being rendered on the sink DUT.



### 4.3 Testing audio on an audio rendering device

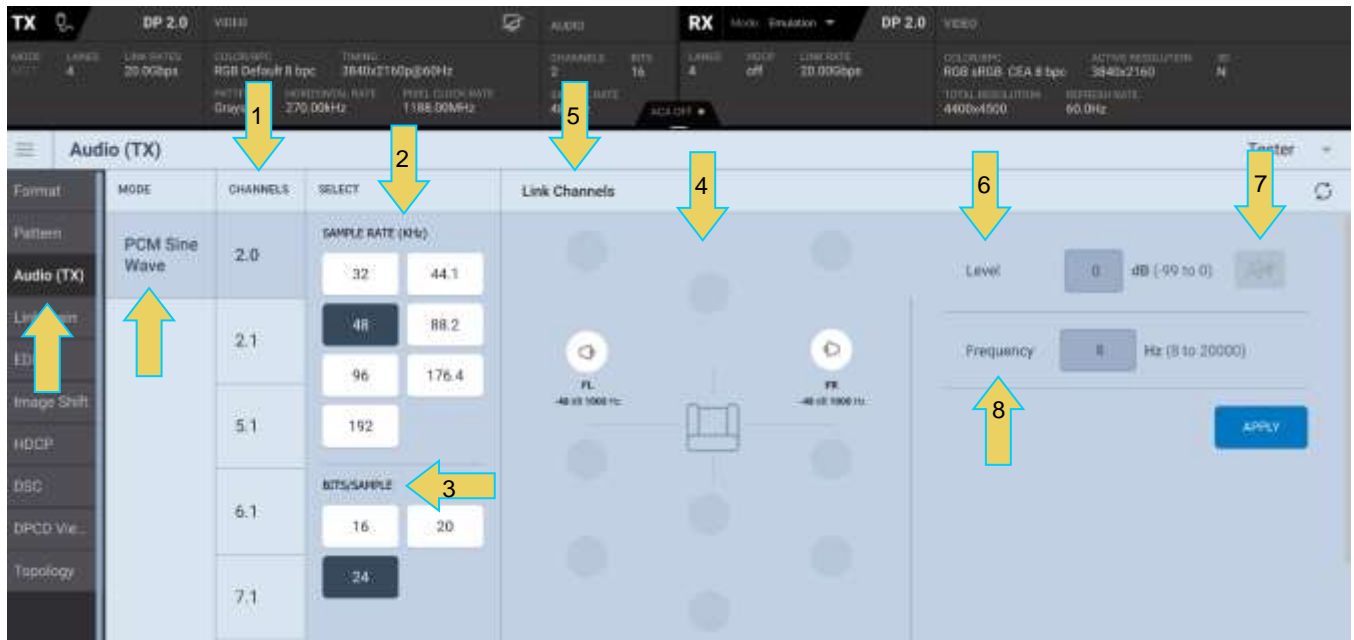
The M42d supports audio testing for sink audio rendering devices. You can output LPCM audio over up to 8 channels at user selectable sampling rates and bits per sample. The audio signal is a sine wave. You can specify the amplitude and the frequency of the sine wave. You can also specify the amplitude and frequency of each channel separately. Use the following procedures to test a DP audio rendering device.

**Note:** When generating DisplayPort Multistream, the audio signal that you specify will be transmitted on all virtual channels.

**To test an audio rendering device:**

Within the Signal Generator, select the **Audio (TX)** tab. If not already selected, click the **PCM Sine Wave** tab on the left side of the window under **MODE**. Both are shown below, as well as the full audio tab interface.



The numbered arrows are used in reference to the table below the image.



The table below summarizes the panels within the Audio (TX) utility.

LPCM Programmable Sine Wave options		
Parameter	Description	Options
1. Channels	This is the number of channels in the audio sine wave test tone.	<ul style="list-style-type: none"> <li>• 2.0</li> <li>• 2.1</li> <li>• 5.1</li> <li>• 6.1</li> <li>• 7.1</li> <li>• 7.1A</li> </ul>



LPCM Programmable Sine Wave options		
Parameter	Description	Options
<b>2. Sample Rate</b>	This is the sampling rate of the audio sine wave test tone.	<ul style="list-style-type: none"> <li>• 32kHz</li> <li>• 44.1kHz</li> <li>• 48kHz</li> <li>• 88.2kHz</li> <li>• 96kHz</li> <li>• 176.4kHz</li> <li>• 192kHz</li> </ul>
<b>3. Bits/Sample</b>	This is the number of bits per channel of the audio sine wave test tone.	<ul style="list-style-type: none"> <li>• 16</li> <li>• 20</li> <li>• 24</li> </ul>
<b>4. Link Channels Channel Selection</b>	Indicates the channel or linked channels that are active. The active channel(s) will be configured for the Level, Mute and Frequency Parameters.	<ol style="list-style-type: none"> <li>1. FL – Front Left</li> <li>2. FR – Front Right (2.0+)</li> <li>3. LFE – Low Frequency Effects (2.1+)</li> <li>4. FC – Front Center (5.1+)</li> <li>5. RL – Rear Left (5.1+)</li> <li>6. RR – Rear Right (5.1+)</li> <li>7. RC – Rear Center (6.1)</li> <li>8. FLC – Front Left Center (7.1)</li> <li>9. FRC – Front Right Center (7.1)</li> <li>10. RLC – Rear Left Center (7.1A)</li> <li>11. RRC – Rear Right Center (7.1A)</li> </ol>
<b>5. Link Channels</b>	Dialog box to link channels to easily configurate multiple channels at once (more on this after the table).	
<b>6. Level (dB)</b>	This is the amplitude of the audio sine wave test tone.	<ul style="list-style-type: none"> <li>• Increments in 3dB throughout a range of – 0dB to -99dB (per channel).</li> </ul>
<b>7. Mute</b>	Mutes or unmutes the audio for a particular channel.	<ul style="list-style-type: none"> <li>• Mute On (no sound) </li> <li>• Mute Off </li> </ul>
<b>8. Frequency (Hz)</b>	The frequency of the audio sine wave test tone.	Programmable throughout a range of 8 Hz to 20kHz (per channel)

### Configuring a Channel

Select a channel for configuration by clicking on the speaker icon above the associated channel, as shown below. Note that the configured level and frequency are shown just below the channel name.

The below example has FR (Front Right) channel selected, and has been configured independently of the other channels because it is the only channel selected.



Once you have configured the channel per your testing specifications, click **APPLY** to save these changes. Multiple channels can be configured at once using the **Link Channels** dialog box (discussed below).

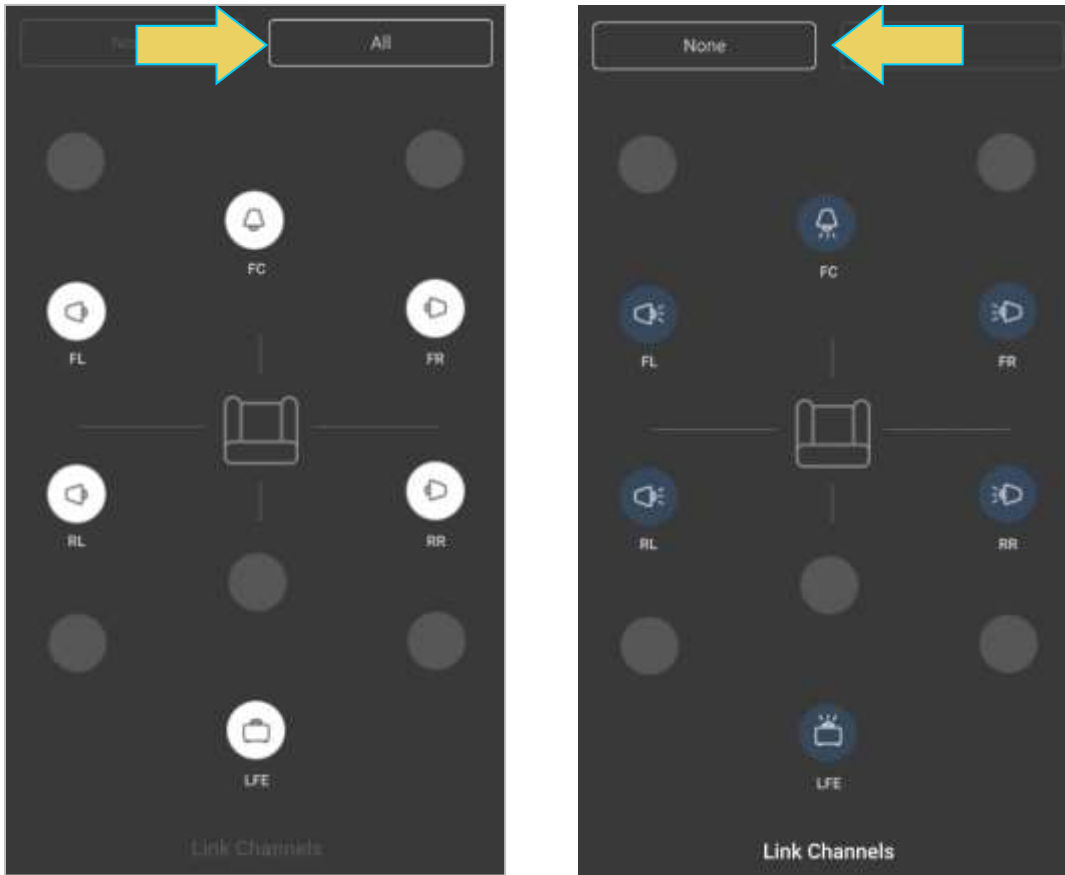
### Linking Channels for Simultaneous Configuration

As mentioned earlier in the section, you can link channels to easily configure all or some channels at once.

To link channels, click the **Link Channels** icon at the top of the window, as shown below.

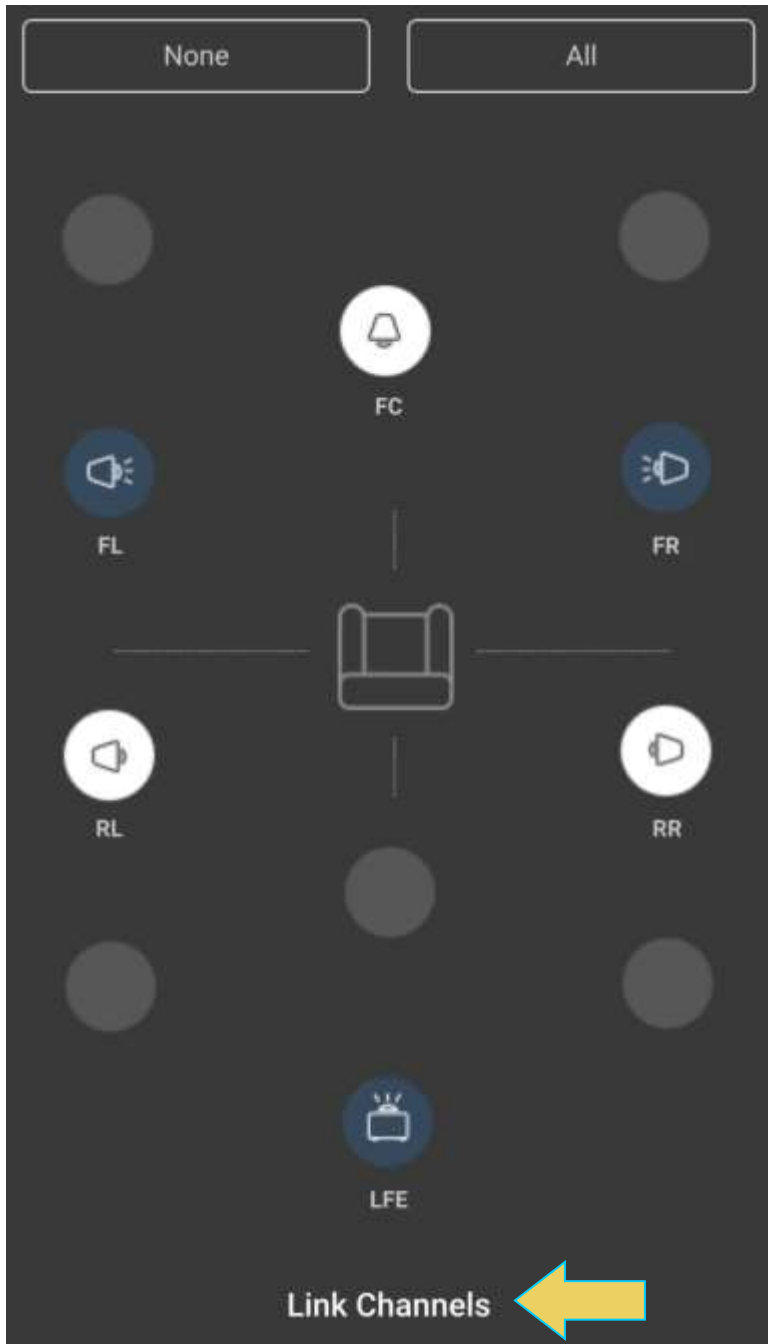


The Link Channels dialog box will appear, as shown below. Easily select all channels by clicking the **ALL** button at the top of the window, as shown below. Deselect all channels by clicking the **NONE** button (only selectable if channels are highlighted below).



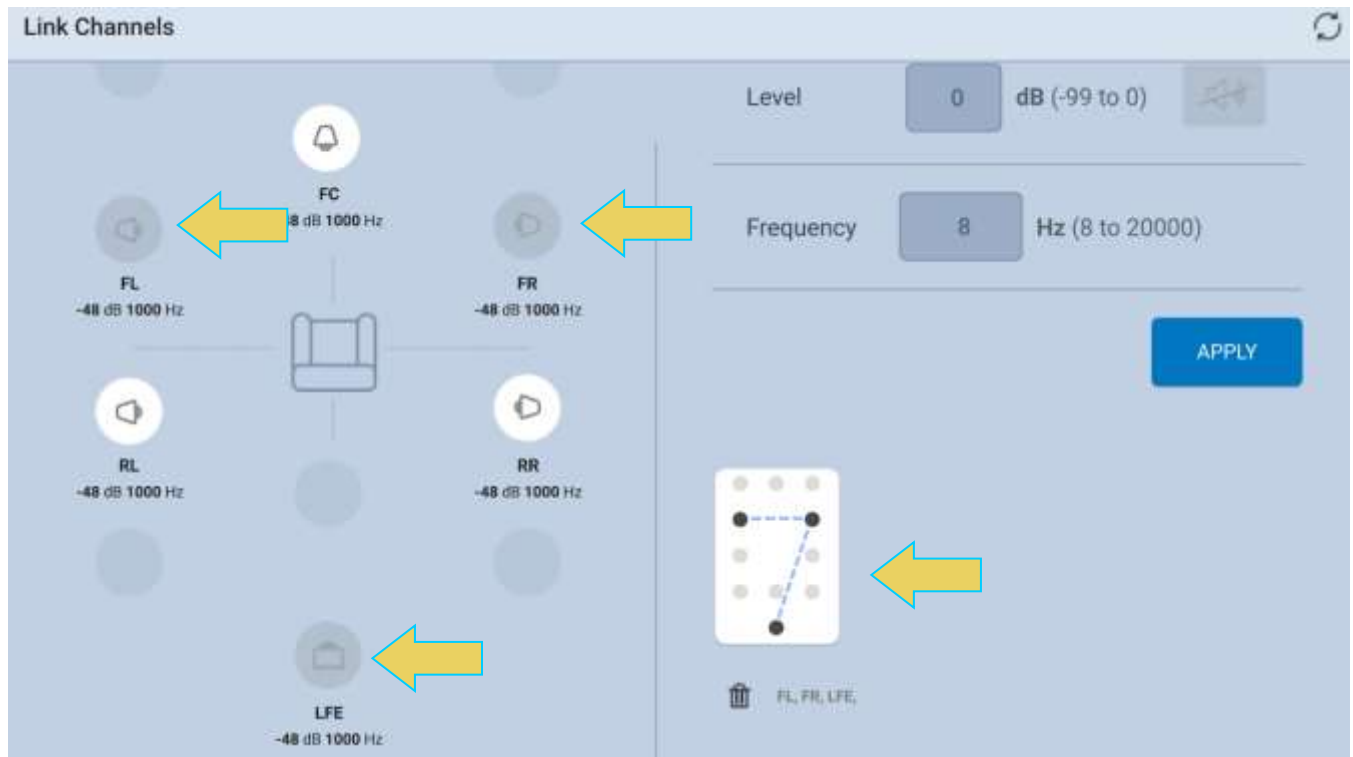
You can also individually select any number of channels you wish to link.

Once you have the channels selected that you wish to link, click the **Link Channels** button at the bottom of the dialog box. The following example has channels 1-3 selected and ready to link.




After clicking **Link Channels**, you will return to the Audio (TX) window.

The linked channels will now appear gray, and there is a diagram on the right side of the window that shows the linked channels.



To modify the linked channels, select the link diagram and make modifications based on the previous steps. Notice that when selected editing, the link diagram will be highlighted.



Easily disable the linking by clicking the trash can icon  next to the linked channels diagram.

## 4.4 Link Train

The M42d 80G Video Analyzer/Generator enables you to control the link training with a DisplayPort sink device. There are three modes:

- Adaptive Training
- Non-Adaptive Training.
- Fast Training

Adaptive and Non-Adaptive are covered in this section, and Fast Training will be covered in **Chapter 10 Embedded DisplayPort (eDP)**

Adaptive Training enables you to train based on Lane Count and Link Rates capabilities that you define in the application.

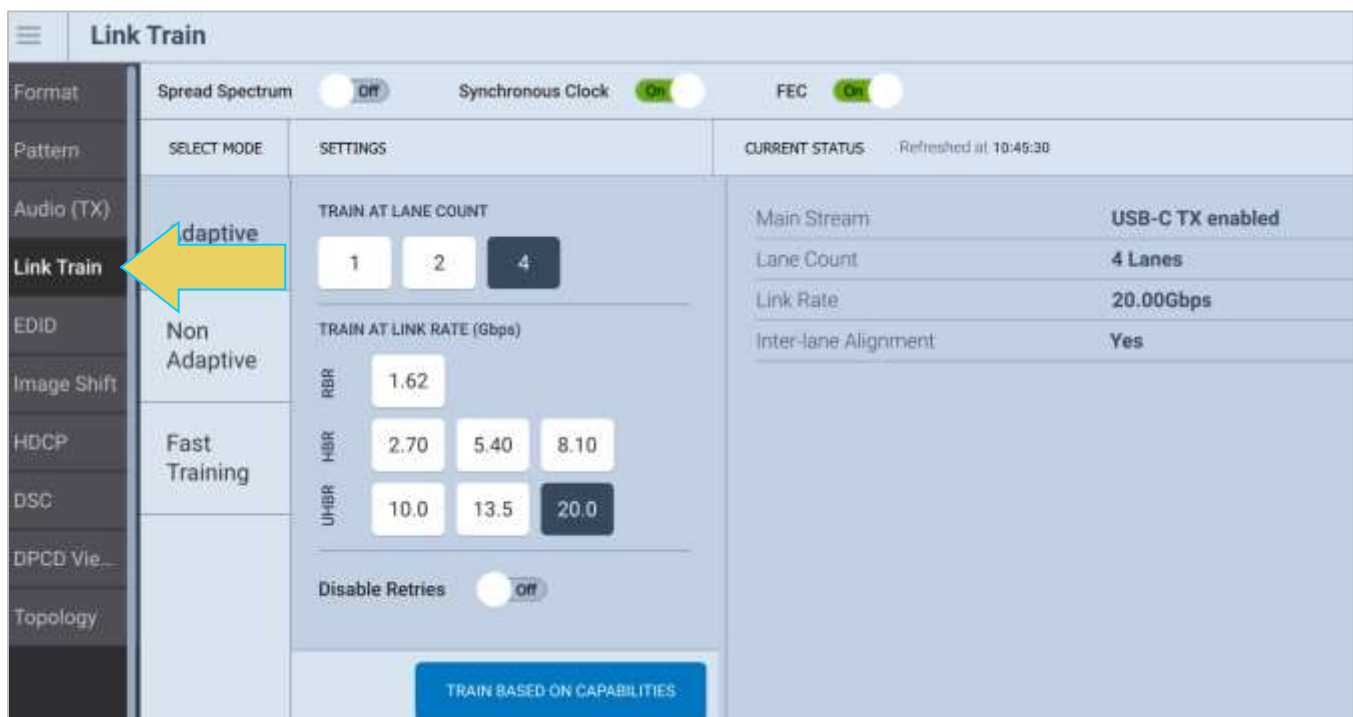
When you set the Lane Count and Link Rate in the Adaptive training mode you are emulating a DP source with those capabilities. The link will be established with the appropriate voltage swing level and pre-emphasis necessary to establish a proper link.

In the Non-Adaptive mode, you are forcing the Lane Count and Link Rate as well as the voltage swing level and pre-emphasis and bypassing the typical link training function.

### Accessing the Link Training Control application

Use the following procedure to test link training with your DP display device. This procedure assumes that you have already selected a DP VESA format and a test pattern to meet your test application requirements (Instructions for this found in sections **4.1** and **4.2**).

1. Access the **Link Train** control application through the **Tools** tab in the Generator interface as shown below.



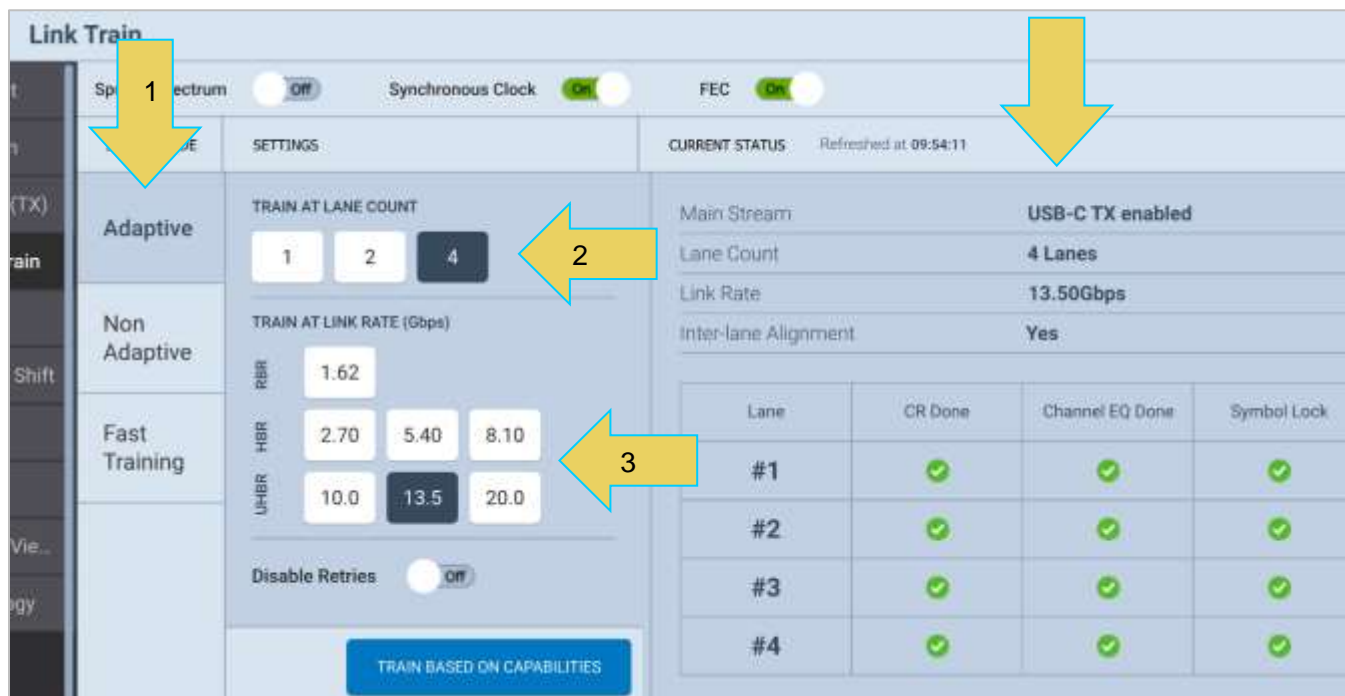
- 2. Select the link training mode tab (Adaptive or Non-Adaptive) in accordance with your requirements.

Steps 3 and 4 on the following pages will cover **Adaptive Training**. For **Non-Adaptive Training**, skip to step 5.

### Adaptive Link Train

- 3. Select the **Train at Lane Count** and **Train at Link Rate** parameters using the labeled icons provided (4 lanes and 13.5 Gbps UHBR link rate shown in the example below).

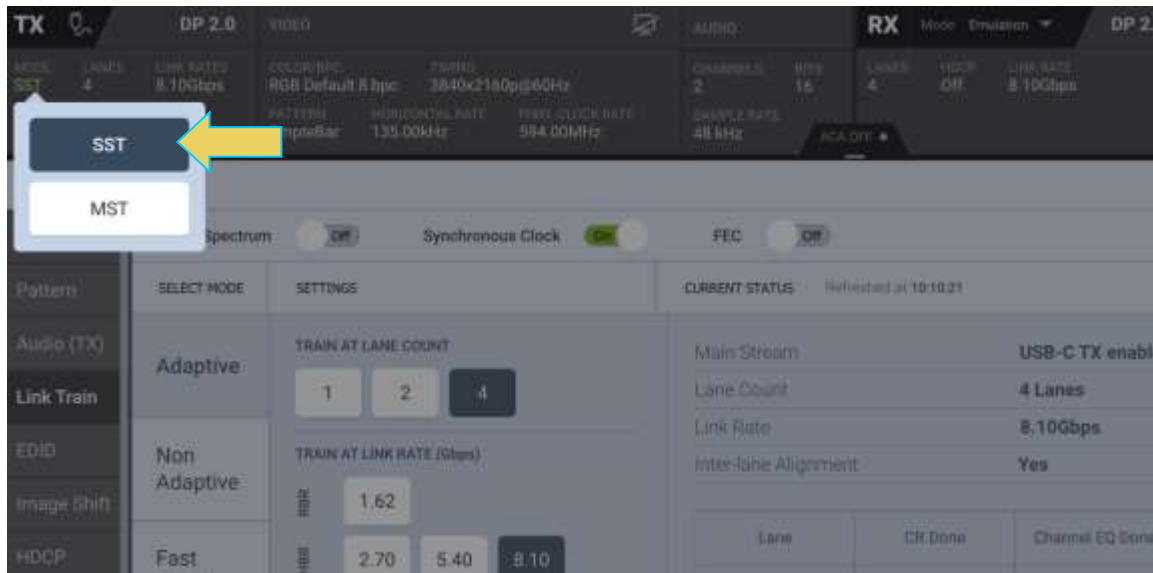
The link training will occur after each selection is made; note the Current Status panel on the right-hand side of the window.



The second example is with a sink DUT only capable of HBR link rates, and the signal generator has trained at 8.10 Gbps

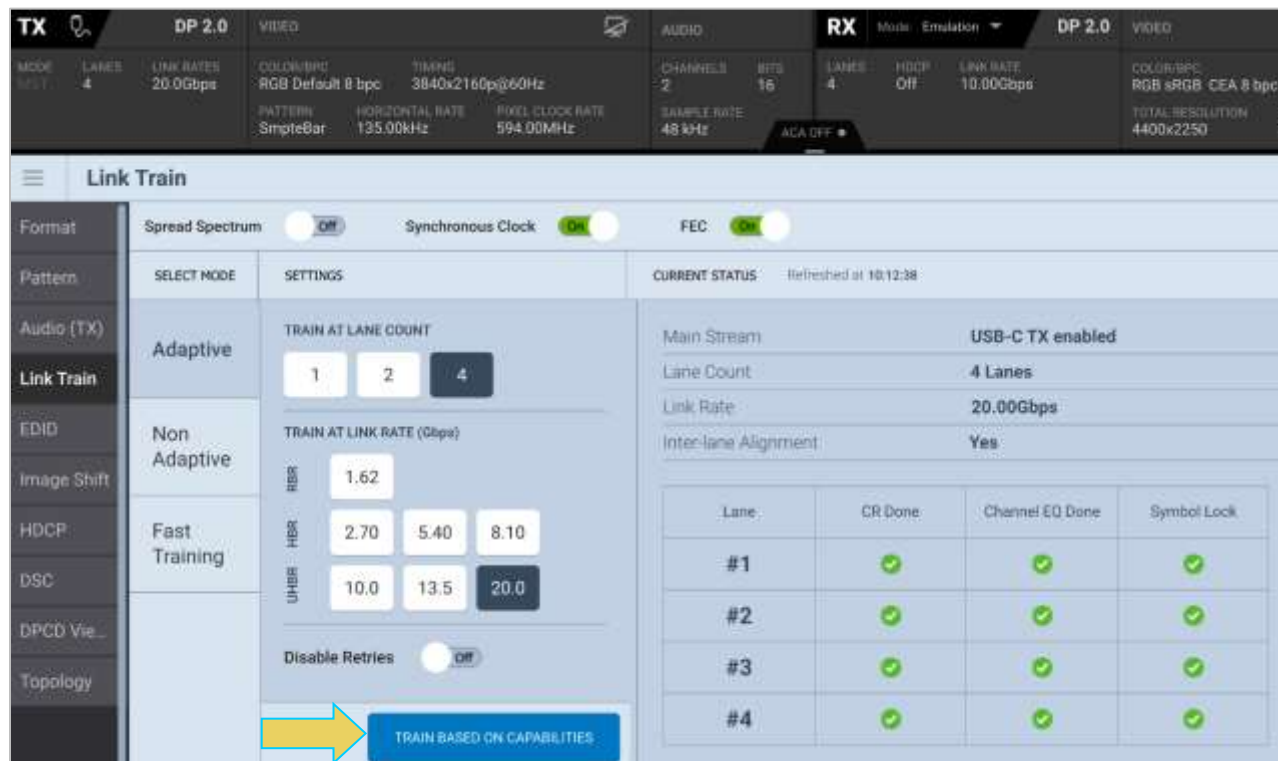


Note that in the top left of the screen, the **Mode** drop-down selection is enabled when link training is done at HBR link rates or lower. Shown below, this allows you to select either Single-Stream (SST) or Multi-Stream Transport (MST) mode for testing.



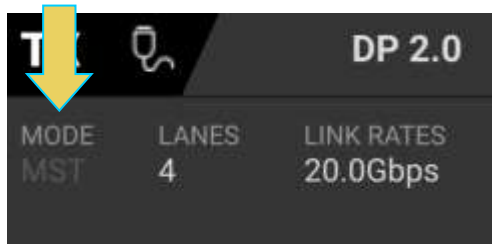
4. Click on the **Train Based on Capabilities** activation button to initiate link training that automatically trains at the highest capabilities of the sink DUT.

The results and status of the link training will be shown on the Link Train application screen as demonstrated below. The DUT in this example trained at 4 Lanes and 20.00 Gbps.





Note that the **Mode** drop-down menu is disabled (grayed out) because the Link Rate is above 10.0 Gbps. Multi-Stream Transport is selected as it is the only option given these settings.



This guide will expand on Multi-Stream Transport in the **Topology section** of this chapter.

## Non-Adaptive Link Training

Optionally, select the **Non-Adaptive** link training mode using the tab provided.

- Specify the **Lane Count**, **Link Rate**, **Voltage Swing Level** and **Pre-emphasis level** parameters. (Note that the link training does *not* automatically occur with each selection, unlike with Adaptive Training)
- Click on the **Force Train** activation button to initiate the link establishment using the parameters you have specified.

**Note:** It is common that many combinations of link parameters will not establish a successful link, because the link training process is not occurring.

The example below shows Non-Adaptive Link Training where the M42d force training at a Link Rate of 8.10 Gbps with a Lane Count of 2, Voltage Swing Level of 1, and Pre-emphasis Level of 2.

Verify successful link training in the **CURRENT STATUS** panel to the right.

Lane	CR Done	Channel EQ Done	Symbol Lock	Voltage Swing	Pre-emphasis Level
#1	✓	✓	✓	1	2
#2	✓	✓	✓	1	2

**Note:** You can monitor the link training transactions with the **Auxiliary Channel Analyzer (ACA)** if desired.

The second example below shows Non-Adaptive Link Training where the M42d forces training at a Link Rate of 13.5 Gbps at 4 lanes. UHBR requires Multi-Stream Transport and requires an **FFE Preset Value** rather than Voltage Swing level and Pre-emphasis level. This difference is shown below as well as the resulting status of the force train.

Spread Spectrum  Off Synchronous Clock  On FEC  On

SELECT MODE	SETTINGS	CURRENT STATUS
Adaptive	TRAIN AT LINK RATE (Gbps) HBR 1.62	Main Stream USB-C TX enabled
Non Adaptive	HBR 2.70 5.40 8.10	Lane Count 4 Lanes
	UHBR 10.0 13.5 20.0	Link Rate 20.00Gbps
Fast Training	FFE Preset Value 0 1 2 3	Inter-lane Alignment Yes
	4 5 6 7	
	8 9 10 11	
	FORCE TRAIN	

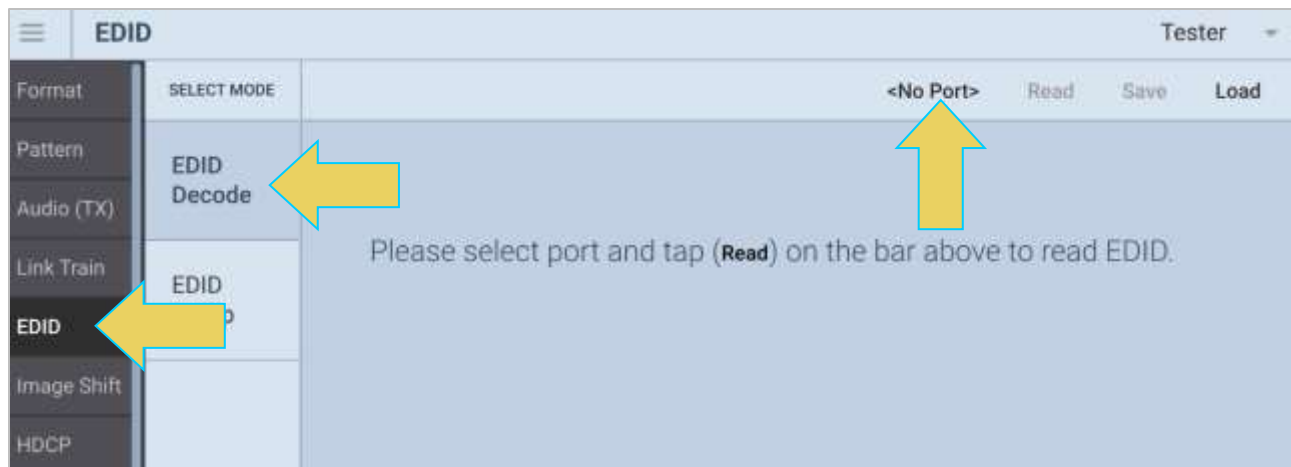
Lane	CR Done	Channel EQ Done	Symbol Lock
#1	✓	✓	✓
#2	✓	✓	✓

## 4.5 Viewing and Comparing the EDID of a connected display

**Note:** You can read the EDID of any specific downstream node. Procedures for this are within this subsection, with more details on Multi-Stream Transport mode covered in **Topology and Multi-Stream Transport**.


### EDID Decode (Viewing the EDID of a connected display):

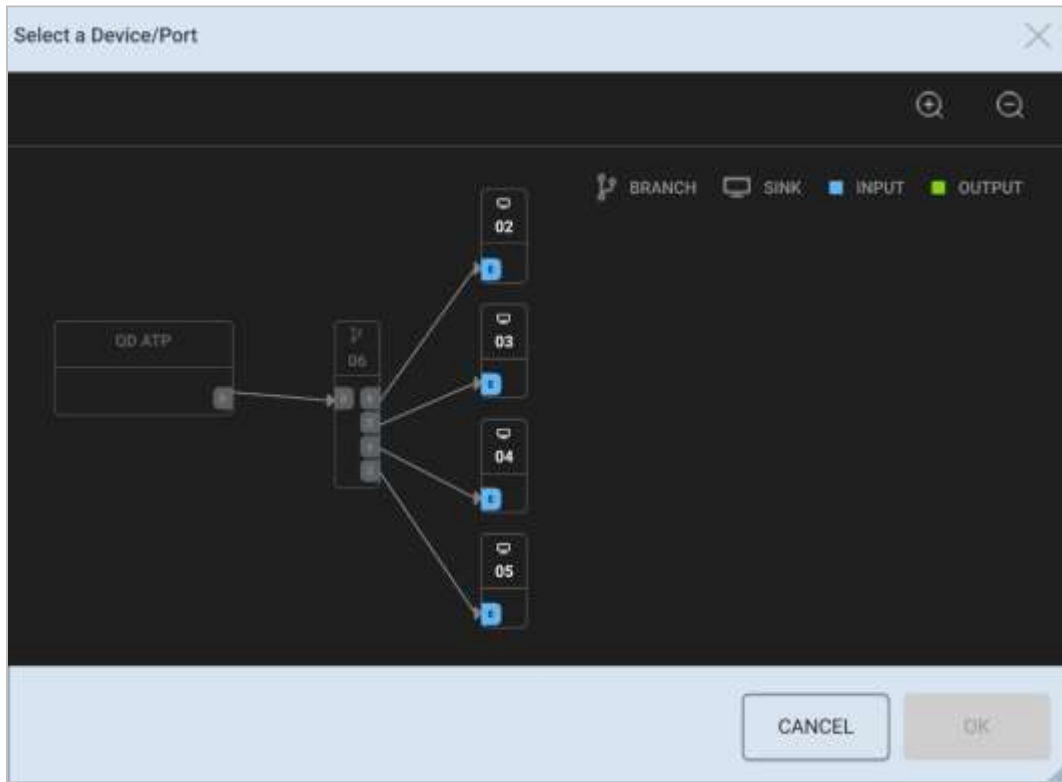
1. From the Signal Generator app of the M42d VPS GUI, select the **EDID** tab.
2. If not already selected, click the **EDID Decode** sub-tab on the left.



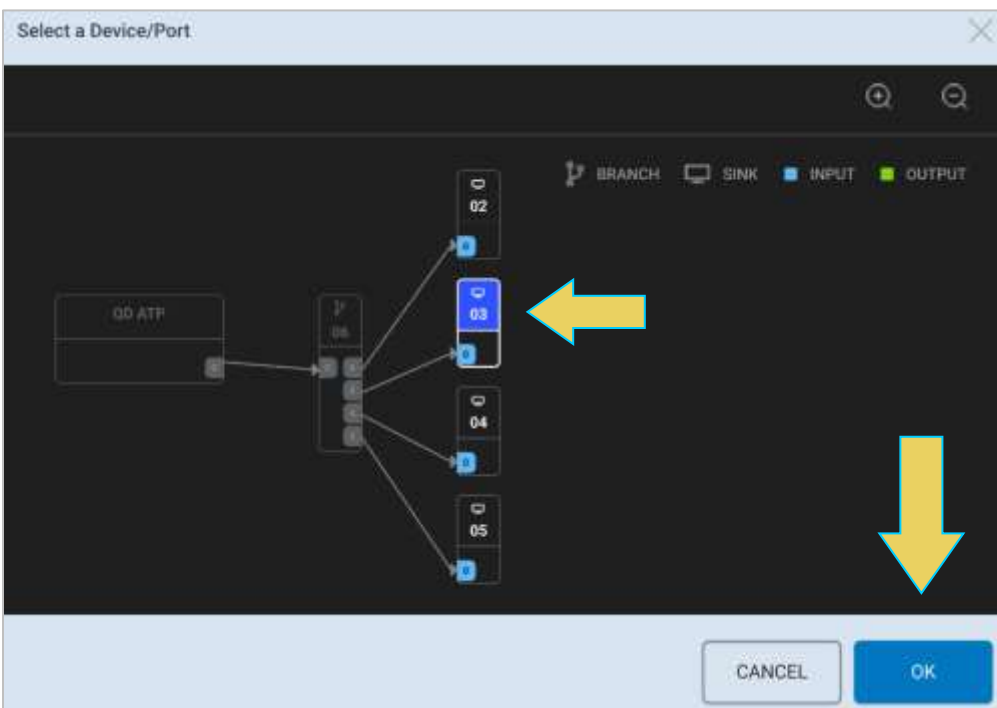
3. **Multi-Stream Transport** mode requires you to select a downstream device. *If you are in **SST** mode, skip the following page and move to **step 6**.*

If you are in Multi-Stream mode and a port has not already been selected, you must select a port to read by clicking the dropdown that will read **<No Port>**, as demonstrated in the previous screenshot.

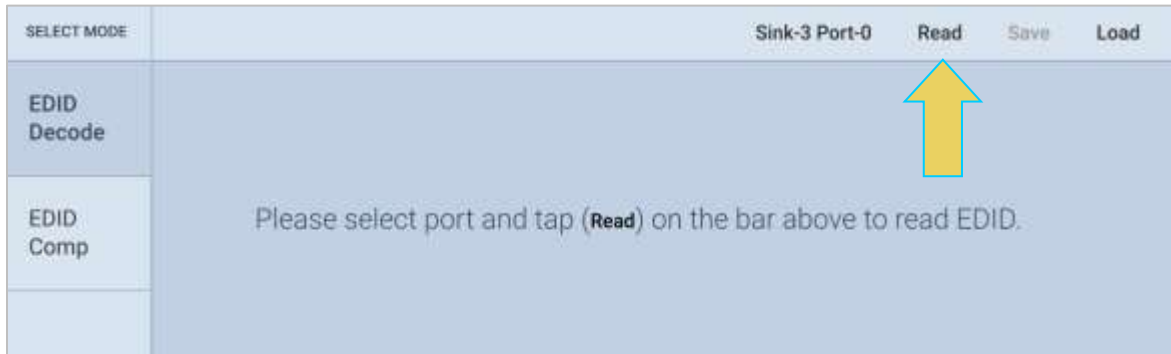
- 4. The **Select a Device/Port** window will open, as shown below. You may need to resize or zoom in/out  to best see the topographical layout.



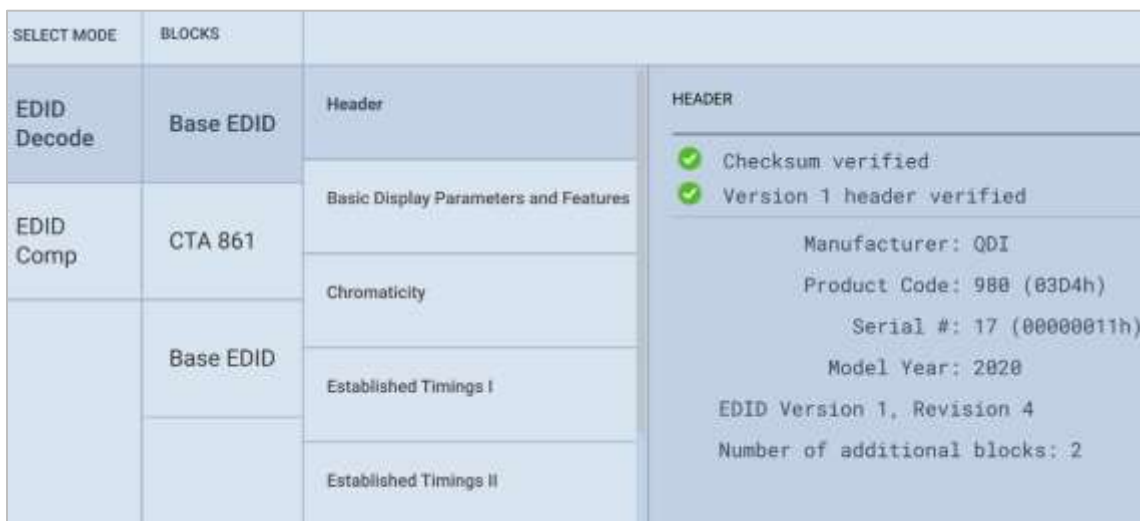
You can select any downstream sink. In the following example, Sink 03 has been selected. Click **OK** once you have selected the appropriate downstream device.



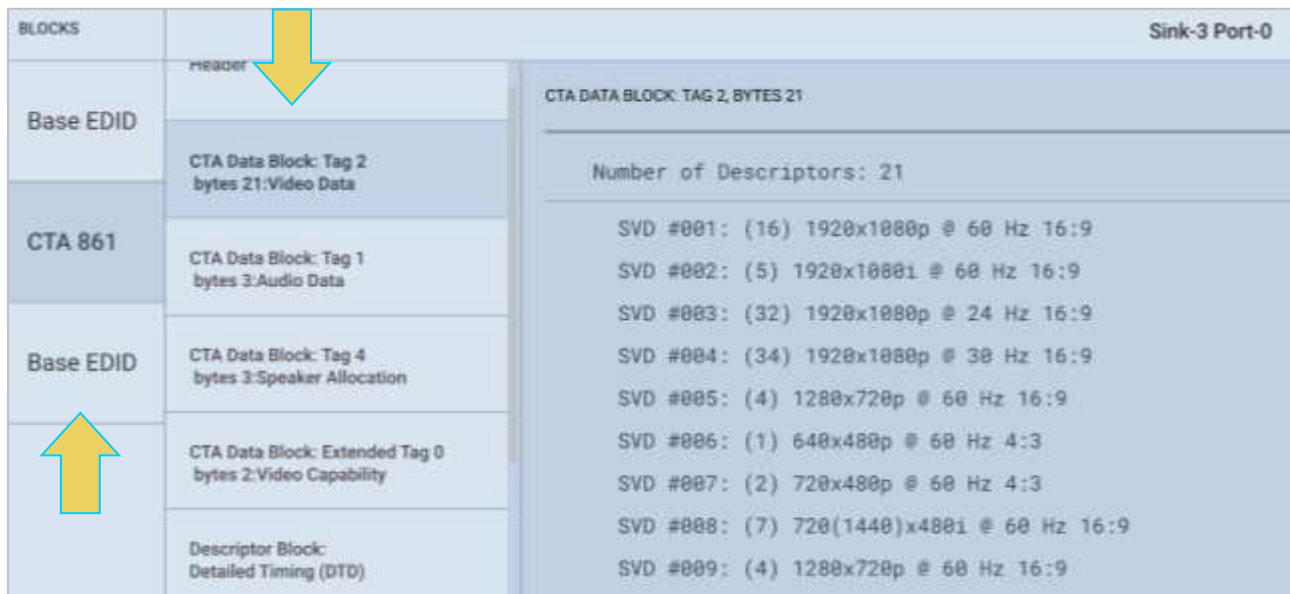
5. Click the **Read** button at the top right of the window.



The EDID will be read and displayed as in the example below



6. Navigate through the blocks and pages of the EDID using the sidebars, as shown below.



Examples of the **EDID** blocks/pages are shown below.

BLOCKS		DESCRIPTOR BLOCK
Base EDID	CTA Data Block: Tag 1 bytes 3:Audio Data	<hr/> Pixel clock: 262.750 MHz Refresh Rate: 29.981 Hz (approx.) Scan type: Progressive Horz Active: 3840 Vert Active: 2160 Horz Blank: 160 Vert Blank: 31 HSync Delay: 48 HSync Width: 32 VSync Delay: 3 VSync Width: 5
CTA 861	CTA Data Block: Tag 4 bytes 3:Speaker Allocation	
Base EDID	CTA Data Block: Extended Tag 0 bytes 2:Video Capability	
	Descriptor Block: Detailed Timing (DTD)	
	Descriptor Block: Detailed Timing (DTD)	
	Descriptor Block: Detailed Timing (DTD)	

BLOCKS		DESCRIPTOR BLOCK
Base EDID	Chromaticity:	<hr/> 800 x 600 @ 72Hz 800 x 600 @ 75Hz 832 x 624 @ 75Hz 1024 x 768 @ 87Hz 1024 x 768 @ 60Hz 1024 x 768 @ 70Hz 1024 x 768 @ 75Hz 1280 x 1024 @ 75Hz  Manufacturer's Timings: 1152 x 870 @ 75Hz
CTA 861	Established Timings I:	
	Established Timings II:	
Base EDID	Standard Timings:	
	Descriptor Block: Detailed Timing (DTD)	
	Descriptor Block: Detailed Timing (DTD)	

## EDID Comp

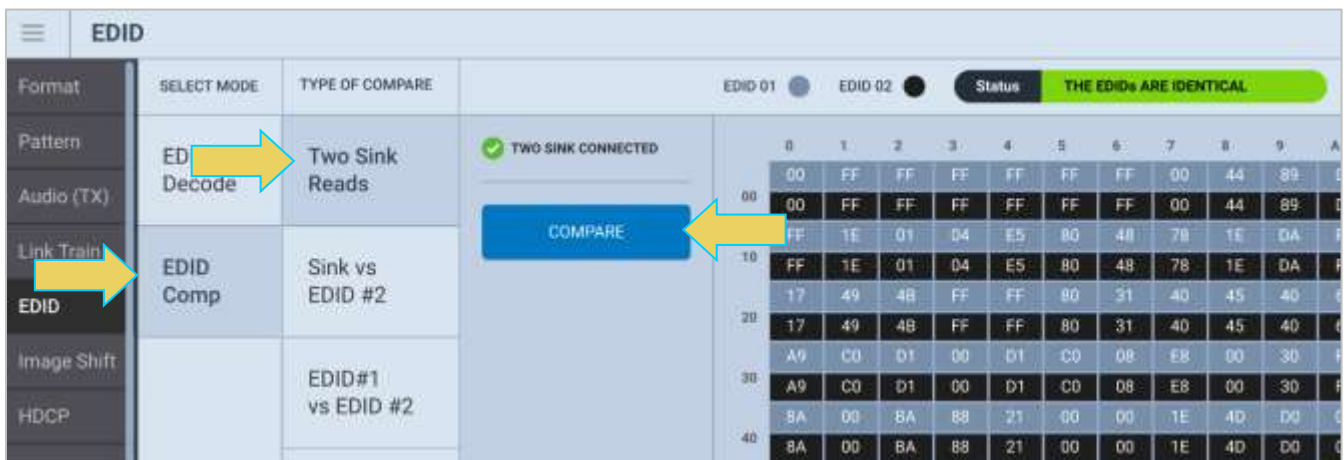
The **EDID Comp** tool allows you to compare EDIDs:

- The EDIDS of two sink devices,
- The EDID of a sink device vs an imported EDID
- Two imported EDIDs vs one another.

Select the **EDID Comp** utility from the **EDID** tab within the Signal Generator.

From here you can select which EDIDs to compare.

The following example shows the comparison of two connected sink devices and the result after clicking the **COMPARE** button.



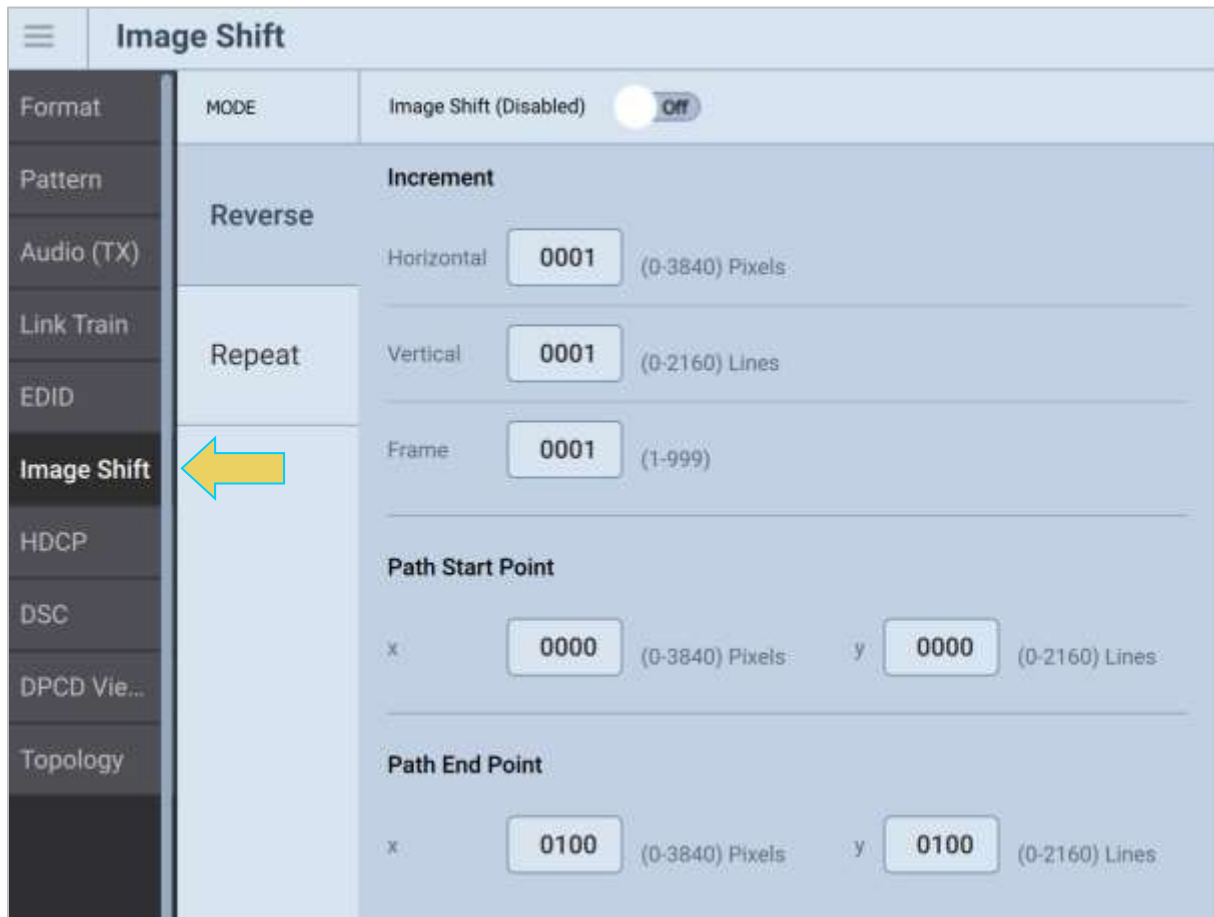
If you are comparing imported EDIDs, click the **Select** button to import. The following example would be comparing a sink device vs an imported EDID.



## 4.6 Image Shift

The M42d Signal Generator allows you to configure image shift settings.

Open the **Image Shift** tool by clicking the respective button on the left-hand sidebar within the Signal Generator.



Configure the **Path Start** and **End Points**, as well as the Increment in pixels by which the image will shift by.

A path start point of 0,0 indicates that the generated image begins in its normal location on the sink DUT (eg. Pixel 0,0 is at the top left of the monitor).

The end point indicates which pixel will be moved to the top left corner of the monitor during the shift. A higher Path End Point will cause the image to shift further.

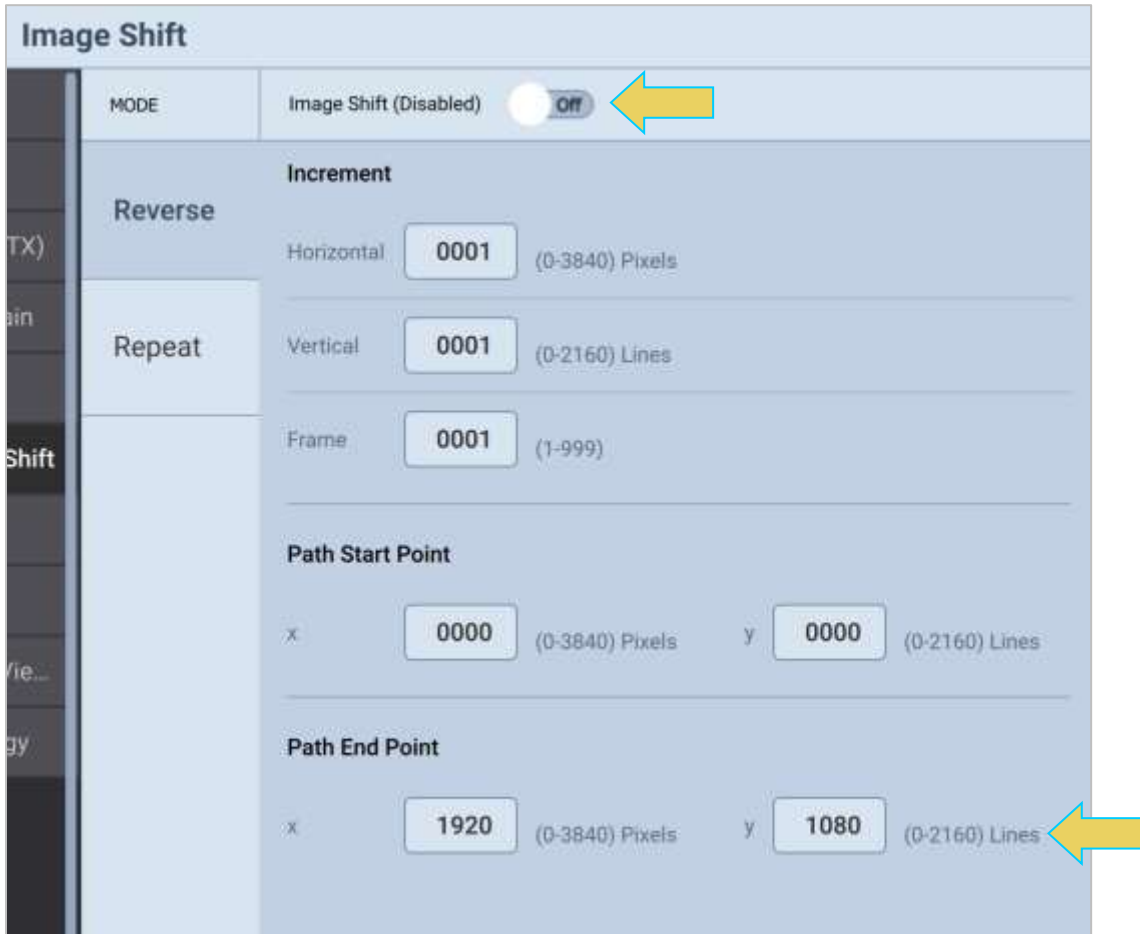
Adjust the increment settings to determine how many pixels the image is shifted per period. A higher number here means that the image will shift more quickly.



The example below consists of several screenshots. The path start point remains 0,0 but the path end point has been increased, per the configured settings below. The **Increment** fields have also been left unchanged from their default 0001.

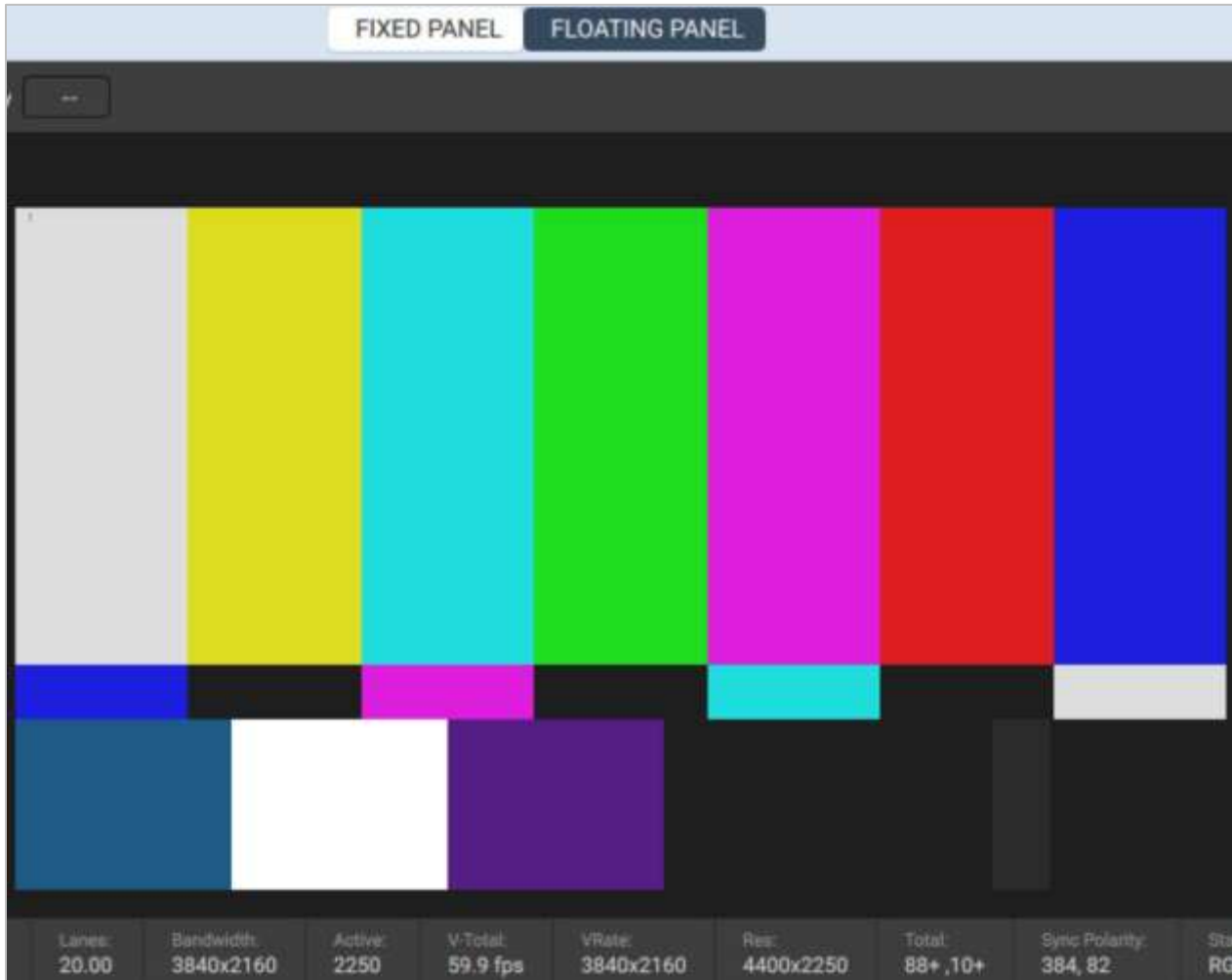
To enable Image Shift:

Toggle the switch from **Off** Image Shift (Disabled)  Off to **On** Image Shift (Enabled)  On

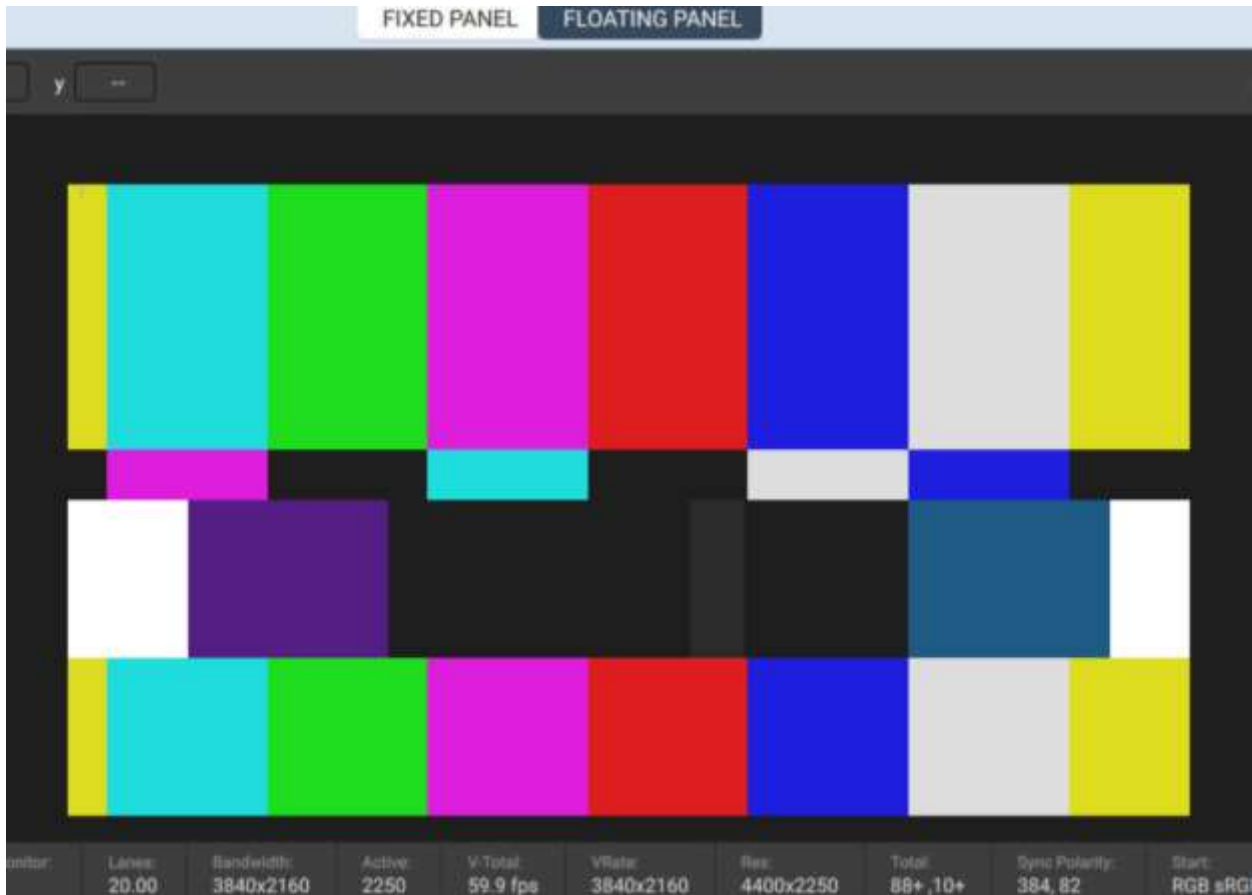


Once **Image Shift** has been enabled, the image will move to the path end point and back to the path start point on a continuous loop.

The screenshot below shows the M42d on loopback mode, so the **Analyzer/Receiver** acts as our sink DUT. The first image shows the video pattern (SMPTEbar image) in its original position without shifting. The second image shows the image shifted once Image Shift was enabled.



**Loopback Mode with Image Shift off**



**Loopback Mode with Image Shift on configured to previously-shown settings.**

As stated, the **Increment** fields will determine the speed at which the Image is shifted.

For perspective, with the Image shifting 1920 x 1080 pixels at an increment of 0001, this process took about 20 seconds to shift and return to its original position. With a Horizontal and Vertical increment of 0100, the process took less than 2 seconds.

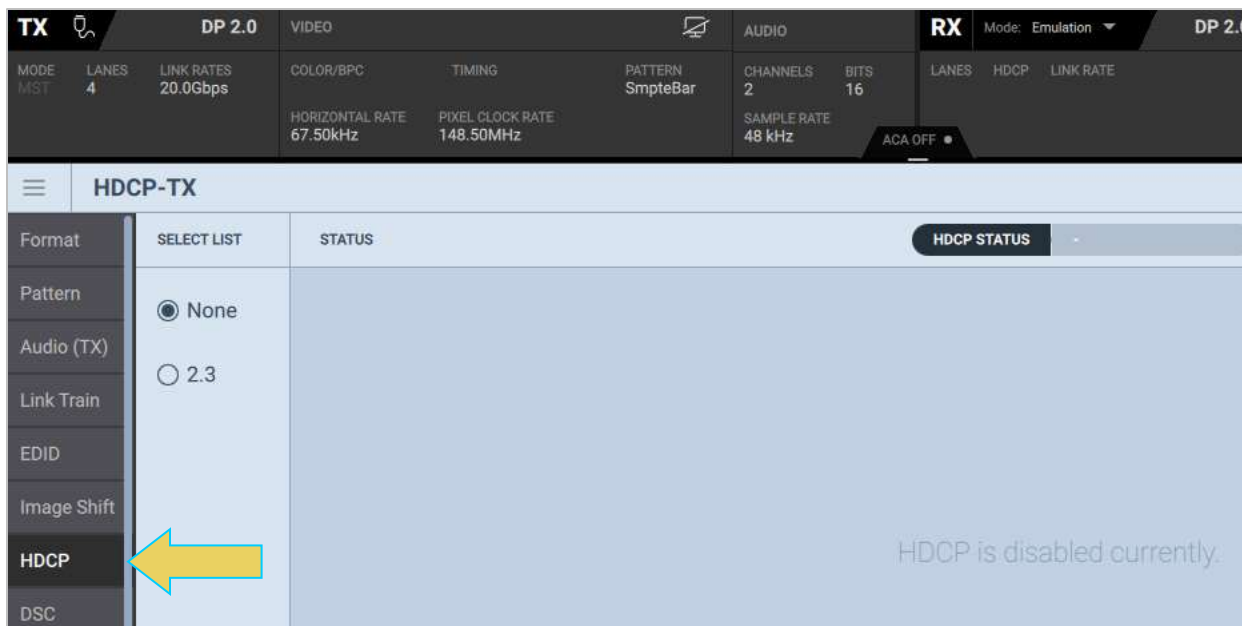


When configuring the **Increment** and **Path Points** while Image Shift is enabled, simply modify the desired field and press **Enter** to apply the changes. There is no need to disable the toggle.

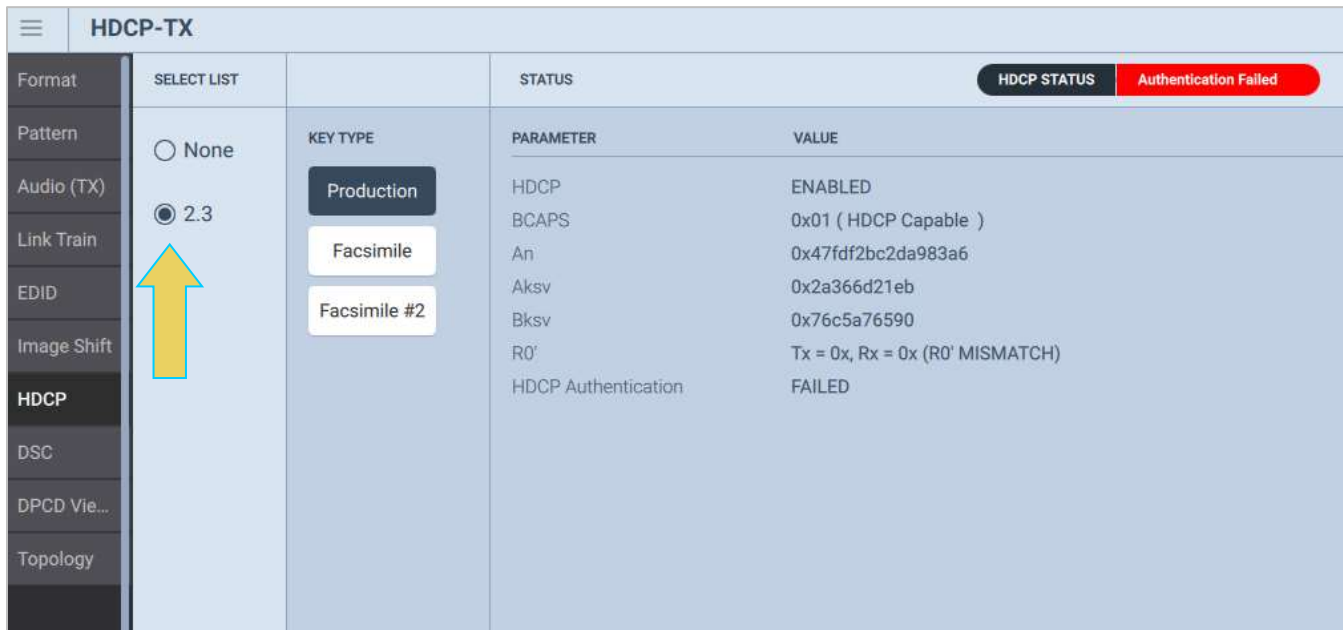
### 4.7 HDCP Testing

To test HDCP on a connected display:

1. Access the **HDCP** tab on the left-hand sidebar of the Signal Generator. The HDCP tool will appear, as shown below.



2. Enable HDCP by selecting the **2.3** radio button. The Status section will update automatically. View the results and status of the test through the HDCP Test screen as shown below.



**Note:** Due to HDCP content protection requirements, you will have to use an HDCP 2.2 or 2.3-enabled external monitor to view HDCP protected content in the VPS GUI. We have qualified the following displays:

- Dell UltraSharp 27 inch Monitor Model U2718Q.
- Dell UltraSharp 27 inch 4K Monitor Model U2720Q.
- ASUS 28" 4K UHD Monitor Model VP28U.
- ViewSonic 27" 4K UHD Monitor Model VX2776-4K-MHD.

Other 4K HDCP 2.3 displays may work as well. (for most up-to-date list, refer to the latest revision of the User Guide on the M42d product page <https://www.quantumdata.com/m42d.html>).

3. Optionally change the **Key Type**. Choose from production key or a facsimile key.

The screenshot shows the 'HDCP-TX' configuration window. On the left is a sidebar with menu items: Format, Pattern, Audio (TX), Link Train, EDID, Image Shift, **HDCP**, DSC, DPCD Vie..., and Topology. The main area is divided into three sections: 'SELECT LIST', 'KEY TYPE', and 'STATUS'. In the 'SELECT LIST' section, '2.3' is selected with a radio button. The 'KEY TYPE' section contains three buttons: 'Production', 'Facsimile' (highlighted with a yellow arrow), and 'Facsimile #2'. The 'STATUS' section contains a table with parameters and their values.

PARAMETER	VALUE
HDCP	ENABLED
BCAPS	0x01 ( HDCP Capable )
Aksv	0x7a5515c489273cb2
Bksv	0xb70361f714
R0'	Tx = 0x, Rx = 0x (R0' MISMATCH)
HDCP Authentication	FAILED

## 4.8 DSC (Display Stream Compression)

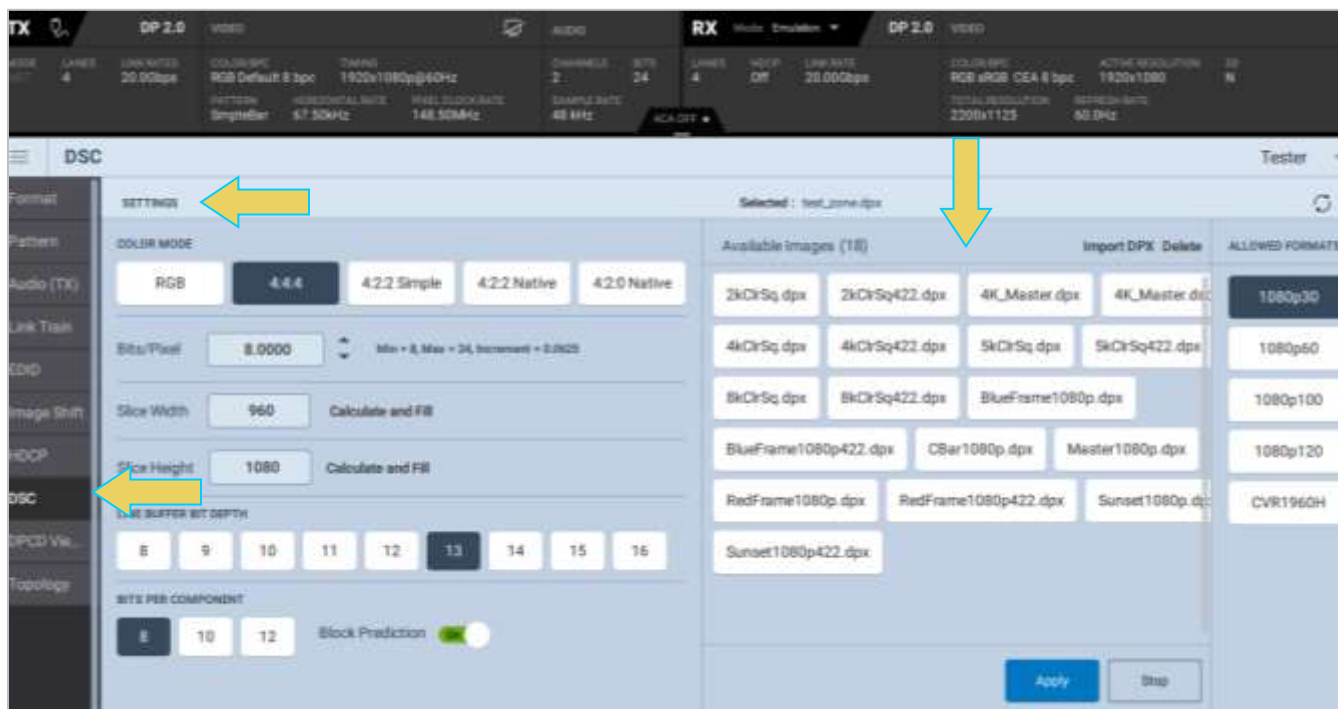
The M42d 80G Video Analyzer/Generator supports a DSC/FEC video generator function. You can output DSC/FEC streams with a user selectable slice configuration, various compression settings, bit depths, colorimetry, etc. You can import your own configuration parameters from a Picture Parameter Set (PPS) of values. You can select from a set of provided DSC images or import your own DPX images.

Display Stream Compression display testing is supported through the standard DP Tx port or the USB-C DP alt mode port.

### To test a DSC/FEC-capable display device:

From the **Tools** tab of the Generator app, select the **DSC** button in the left-hand sidebar. The DSC tools panel appears as shown below.

A list of **Available Images** will appear in the right panel, with optional settings within the left panel.



There are many DPX images by default on the M42d instrument itself, otherwise you can add your own using the **Import DPX** button at the top right. This will be covered in the next subsection.

Select a file from **Available Images** by clicking on it. Timing options will appear in the **Allowed Formats** panel to the right, as shown in the following example.



The **Settings** panel is shown on the left side of the window, as shown below.

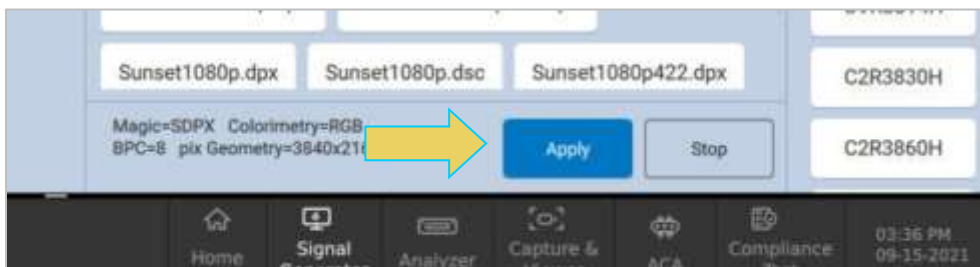
You can set the video parameters here. The Selections for the dialog box are described on the table that follows.



The **Settings** panel parameters are described below:

DSC Video Generator Settings Dialog Box		
Item	Parameters	Comments
Color Mode	Selections are: - RGB - 4:4:4 - 4:2:2 Simple - 4:2:2 Native - 4:2:0	
Bits Per Component	The color depth per component. Options are: - 8 - 10 - 12	These selections would be 24, 30 or 36 respectively for color depth per pixel.
Bits/Pixel	This is the compression, i.e. the number of bits per pixels desired in the compressed output. Select throughout a range of 8 to 15.	The compression ratio can be calculated as Bits per Component x 3 / Bits per Pixel. Example: 8 bit color depth: $8 \times 3 = 24 / 8 = 3:1$ compression ratio.
Slice Width (pixels)	The Width in number of pixels across a slice.	All slices have to be the same size and they are all rectangular.
Slice Height (lines)	The Height in number of lines in a slice.	
Block Prediction	This selection indicates if the video generator will use Block Prediction.	Block prediction is an optional prediction method for the sink. You must be sure that the display you are testing supports Block Prediction.
Line Buffer Bit Depth	This is a Picture Parameter Set (PPS) parameter. It is used to generate the bitstream.	

Click **APPLY** once you have the desired image and format.



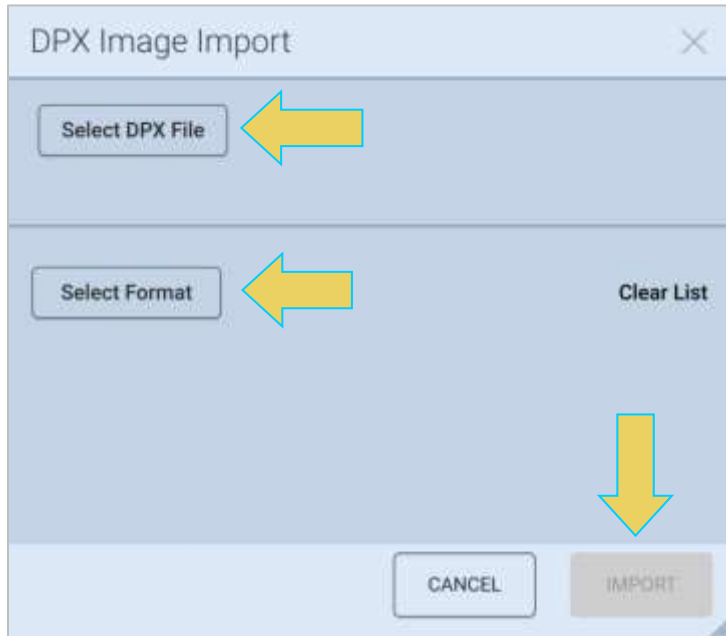


### Importing a DPX

Import your own DPX by clicking the **Import DPX** button in the top right of the **DSC** window, shown below. You may also **Delete** a file from the Available Images panel or **Refresh** this listing to show current available files.



From the **DPX Image Import** dialog box, select the DPX File for Import by clicking the **Browse** button. Add or Remove any supported formats, and click the **IMPORT** button to add to the list of Available Images.



**Note:** You may need to click the **Refresh** button in the top right for the newly imported DPX Image to display in the list of Available Images.

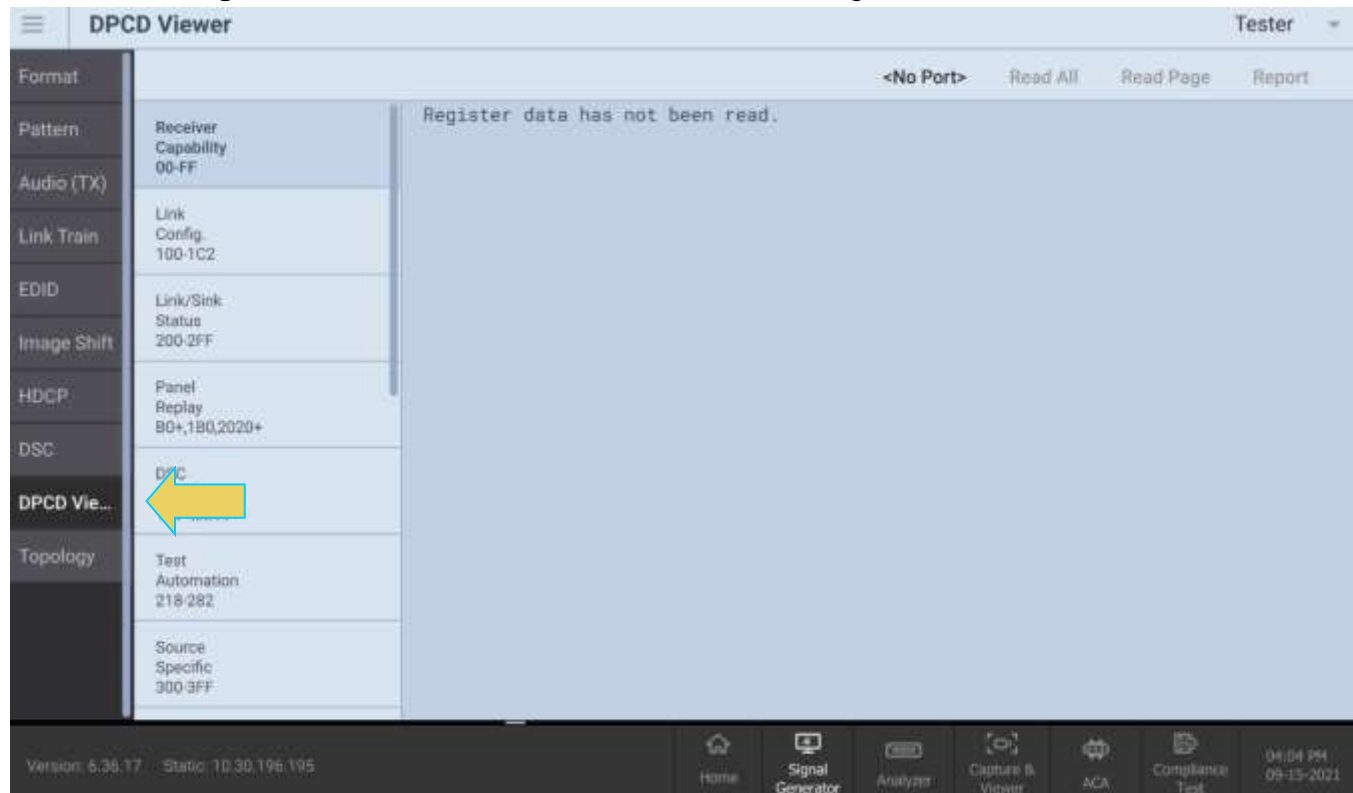
## 4.9 DPCD Viewer

Use the following procedures to view a display's DPCD registers.

**Note:** When the generator is configured for Multi-Stream, you can read the DPCD of any configured downstream sink. This is covered here, with more details on Multi-Stream Transport mode in [section 4.5 Topology and Multi-Stream Transport](#). You can also produce an HTML report of the DPCD registers, which is detailed at the end of this subsection.

### To view the DPCD of a connected display:

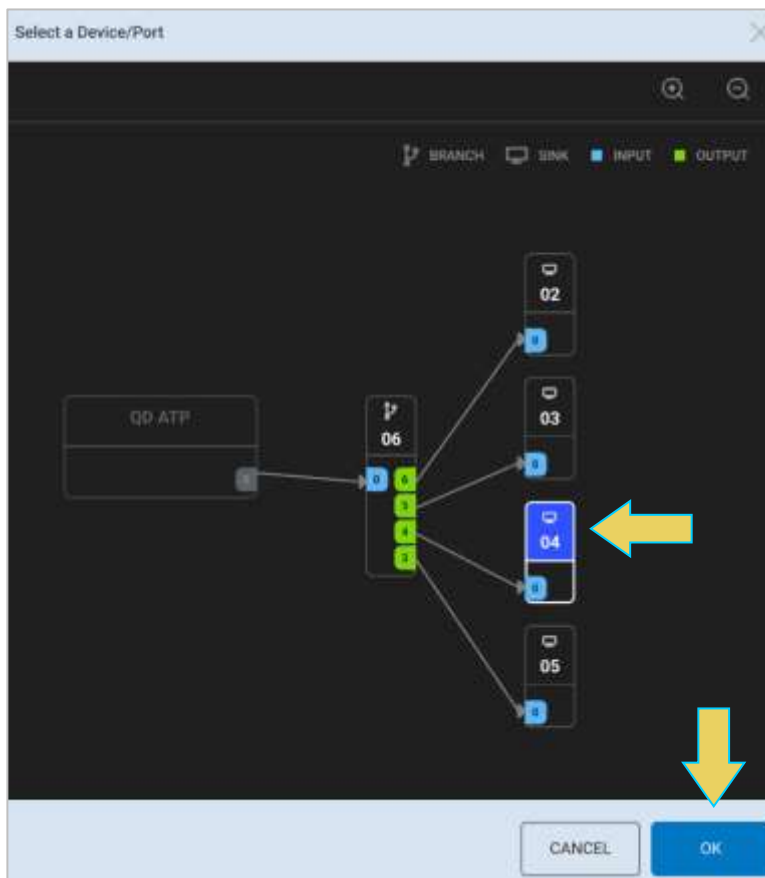
1. Within the **Signal Generator**, select the **DPCD Viewer** tool using the button on the left-hand sidebar.



2. **Multi-Stream Transport** mode requires you to select a downstream device. *If you are in **SST** mode, skip this page and move to step 3.*
- a. If you are in Multi-Stream Transport Mode (indicated at the top left of the screen) and a port has not already been selected, you must select a port to read by clicking the **<NO PORT>** icon in the upper right.



- b. The **Select a Device/Port** dialog box will pop up. You can select any downstream sink or branch device. In the following example, **Sink-04** has been selected. Click **OK** once you have selected the appropriate downstream device.



**Note:** You may need to resize the window or zoom out to see the full device diagram.

3. Select a Register page to read, and click **Read Page** to retrieve the DPCD report for that page. The register pages are listed on the left-hand side of the window in a new sidebar, as shown below.

An example is shown below, with the first page of the Receiver Capability DPCD register displayed in the main panel.

The screenshot shows the 'DPCD Viewer' application window. At the top right, there is a 'Tester' dropdown menu. Below it are four buttons: 'Sink-4 Port-0', 'Read All', 'Read Page', and 'Report'. The 'Read Page' button is highlighted with a yellow arrow. On the left side, there is a sidebar with a list of register pages. The 'Receiver Capability 00-FF' page is selected and highlighted, with a yellow arrow pointing to it. The main panel displays the details for this register, including a table of bit fields and their values.

Bit	Name	Value	Description
7-4	MAJOR_REV	1	
3-0	MINOR_REV	4	
00001: MAX_LINK_RATE			
Bit	Name	Value	Description
7-0	MAX_LINK_RATE	1Eh	8.1 Gbps/lane
00002: MAX_LANE_COUNT			
Bit	Name	Value	Description
4-0	MAX_LANE_COUNT	4	4 lanes
5	POST_LT_ADJ_REQ_SUP	N(0)	
6	TPS3_SUPPORTED	Y(1)	
7	ENHANCED_FRAME_CAP	Y(1)	
00003: MAX_DOWNSPREAD			
Bit	Name	Value	Description
0	MAX_DOWNSPREAD	1	Up to 0.5%
1	STREAM_REGEN_STATUS_CAP	N(0)	
2		0	Reserved
3		0	Reserved
4		0	Reserved

Alternatively, you can click **Read All** without selecting any specific register, and the DPCD report will be generated for all registers.

- Click on a different register to view its DPCD. The example below displays the DSC register on the main panel after the **Read All** option was selected.

The screenshot shows the 'DPCD Viewer' window with the following elements:

- Buttons: Sink-4 Port-0, Read All (highlighted with a yellow arrow), Read Page.
- Register List (Left): Receiver Capability (00-FF), Link Config (100-1G2), Link/Sink Status (200-2FF), Panel Replay (80+,180,2020+), DSC (60+,A0+,160+,2260+), Test Automation (218-282), Source Specific (300-3FF), Sink Specific (400-4FF), Branch Specific.
- Register Details (Right):
  - 00060: DSC SUPPORT**

Bit	Name	Value	Description
0	DSC Support	Y(1)	
1	DSC Pass-through	N(0)	
2	Dynamic PPS Update Cmp->Cmp	N(0)	
3	Dynamic PPS Update UnCmp->Cmp	N(0)	
4		0	Reserved
5		0	Reserved
6		0	Reserved
7		0	Reserved
  - 00061: DSC ALGORITHM REVISION**

Bit	Name	Value	Description
3-8	Version Major	1	
7-4	Version Minor	2	
  - 00062: DSC RC BUFFER BLOCK SIZE**

Bit	Name	Value	Description
1-0	Block-Size	3	64KB
2		0	Reserved
3		0	Reserved
4		0	Reserved
5		0	Reserved
6		0	Reserved
7		0	Reserved

- Scroll down to view all blocks/pages of each register.

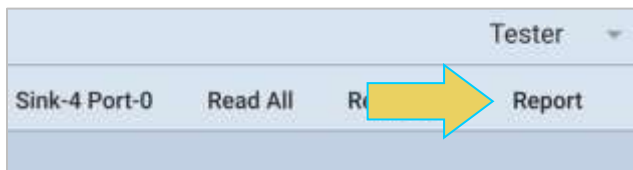
The screenshot shows the 'DPCD Viewer' window with the following elements:

- Buttons: Sink-4 Port-0, Read All, Read Page.
- Register List (Left): Specific (400-4FF), Branch Specific (500-5FF), Sink Control (600), eDP Backlight (700-74F), ESI (2002-2011), Ext Rev. Capability (2200-2273), Protocol Converter (3000-30FF), LTTTPR (F000-F02CF).
- Register Details (Right):
  - 02214: FEATURE\_ENUMERATION\_LIST\_CONT**

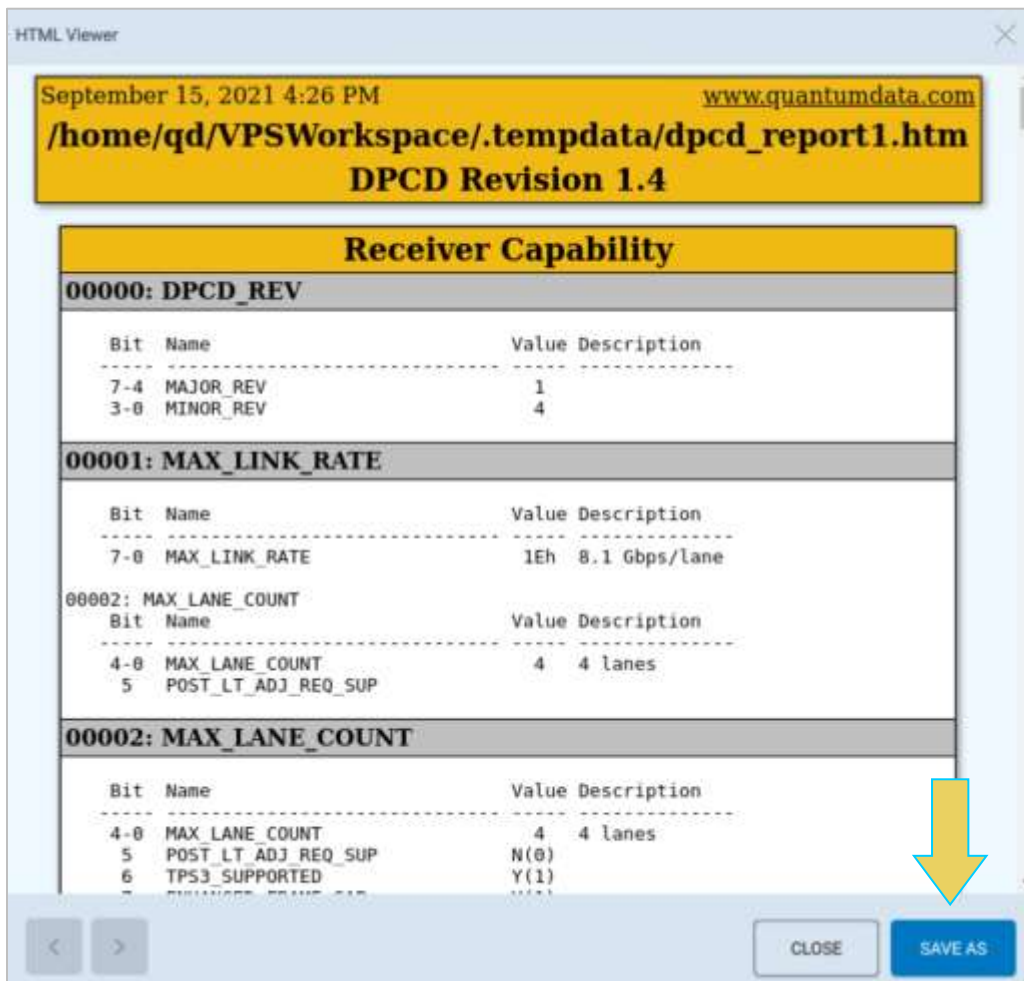
Bit	Name	Value	Description
0	ADAPTIVE_SYNC_SDP_SUPPORTED	N(0)	
1	ADAPTIVE_SYNC_SDP_VERSION_SUPPORTED	N(0)	
2		0	Reserved
3		0	Reserved
4	VSC_EXT_SDP_FRW_VER_1_SUPPORT	N(0)	
5		0	Reserved
6		0	Reserved
7		0	Reserved
  - 02215: 128b/132b\_SUPPORTED\_LINK\_RATES**

Bit	Name	Value	Description
0	10Gbps/lane Support	Y(1)	
1	20Gbps/lane Support	Y(1)	
2	13.5Gbps/lane Support	Y(1)	
3		0	Reserved
4		0	Reserved
5		0	Reserved
6		0	Reserved
7		0	Reserved

6. To view and save the DPCD of a connected display as an .html file, select **REPORT** at the top right:



The HTML report will be generated, allowing you to save to your desktop, as demonstrated below.



**Note:** The HTML DPCD Register Report will only include registers of the sink device that were retrieved using steps 1 – 5. To ensure a full report of all registers, click the **Read All** button in the main DPCD viewer interface, as described in step 4.

## 4.10 Topology and MST (Multi-Stream)

The M42d 80G Video Analyzer/Generator emulates a Multi-Stream source for testing a Multi-Stream branch device or Multi-Stream-capable monitor. Up to four (4) streams are supported depending on bandwidth (resolutions) with a depth of one. You can configure the Multi-Stream topology using a graphical interface. The optional Auxiliary Channel Analyzer (ACA) utility depicts the Multi-Stream Transport negotiations with the connected Multi-Stream Rx device.

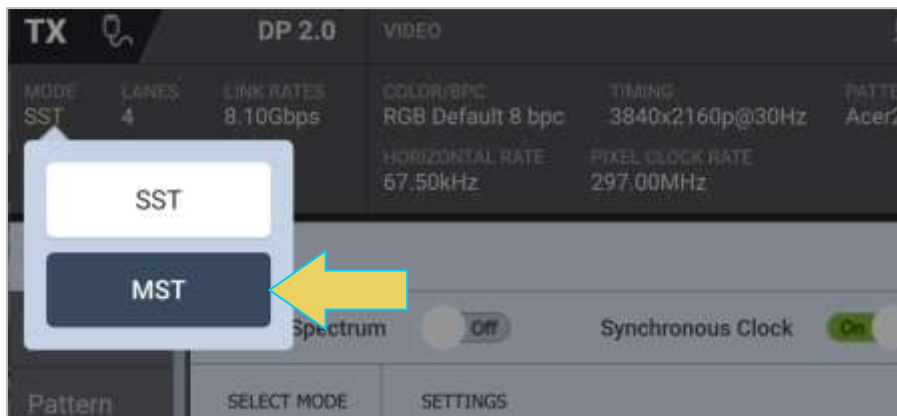
When Multi-Stream Transport is configured, the same video pattern and audio signal is transmitted to all downstream nodes. There is a number indicator that appears on the upper left screen of the downstream Multi-Stream-capable sink that identifies which stream is being delivered.

**Note:** Multi-Stream testing is supported through both the standard DP port and the USB-C DP alt mode port.

Accessing the Multi-Stream Transport Topology window

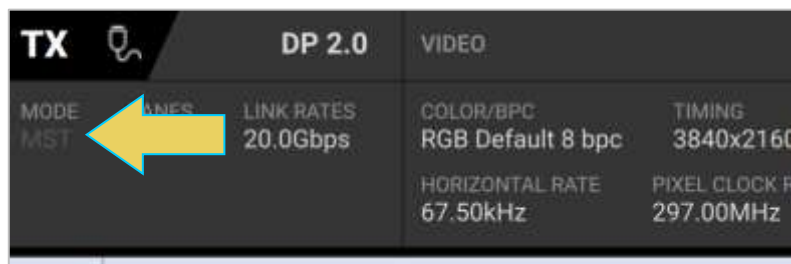
Use the following procedure to test Multi-Stream Transport on a connected Multi-Stream-Capable sink device.

1. At the Generator dialog box, select MST from the Interface drop down menu. Refer to the screen example below.

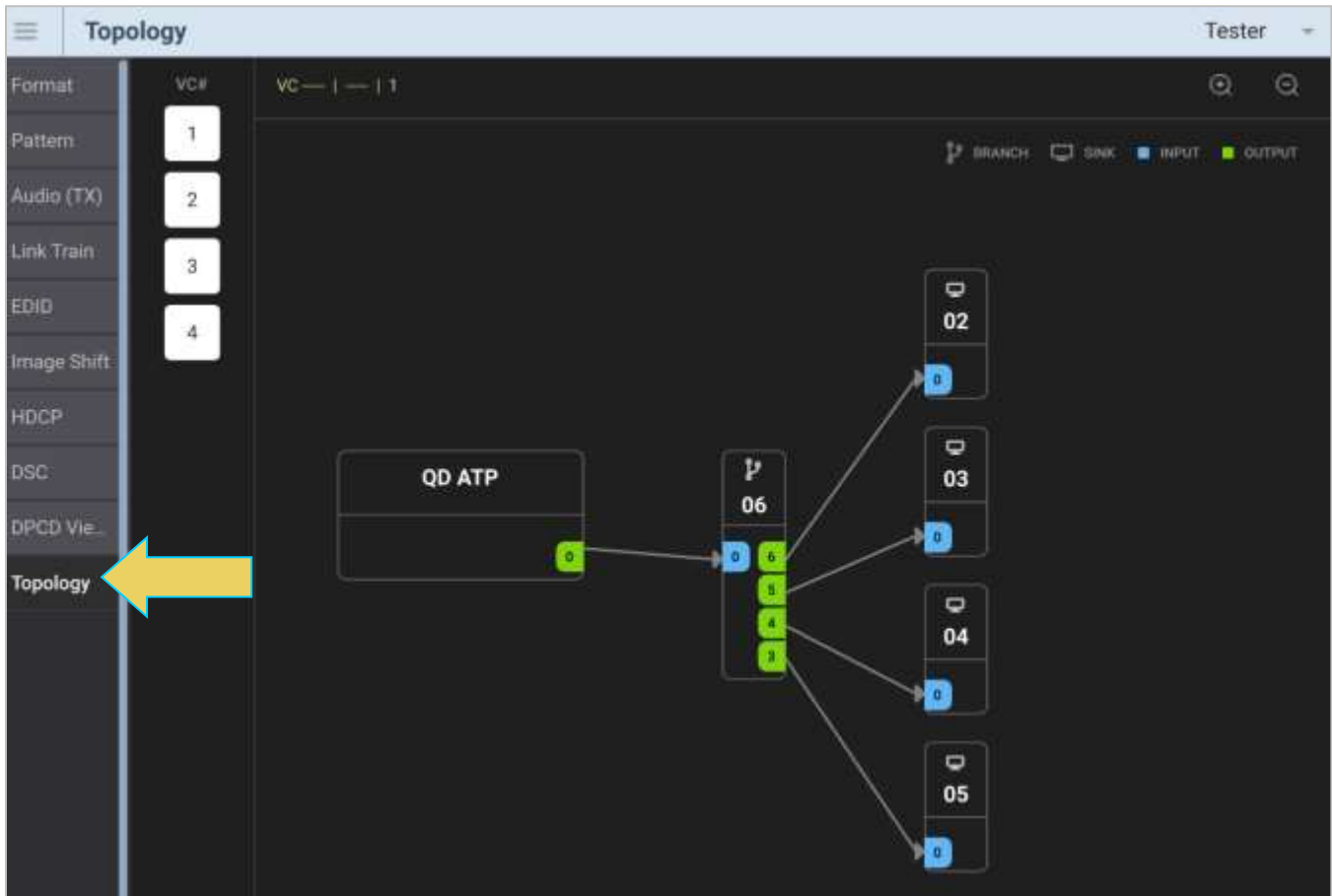


Click **OK** when the confirmation dialog box appears.

**Note** If the **Mode** dropdown is disabled (grayed out, as shown below), then the sink DUT has trained at a UHBR link rate, which requires Multi-Stream. If this is the case, and you would like the option to select **Mode: SST**, refer to the subsection of this chapter titled **Returning to SST Mode**.



- 2. From the Signal Generator, access the **Topology** tab to control the Multi-Stream Transport application as shown below.

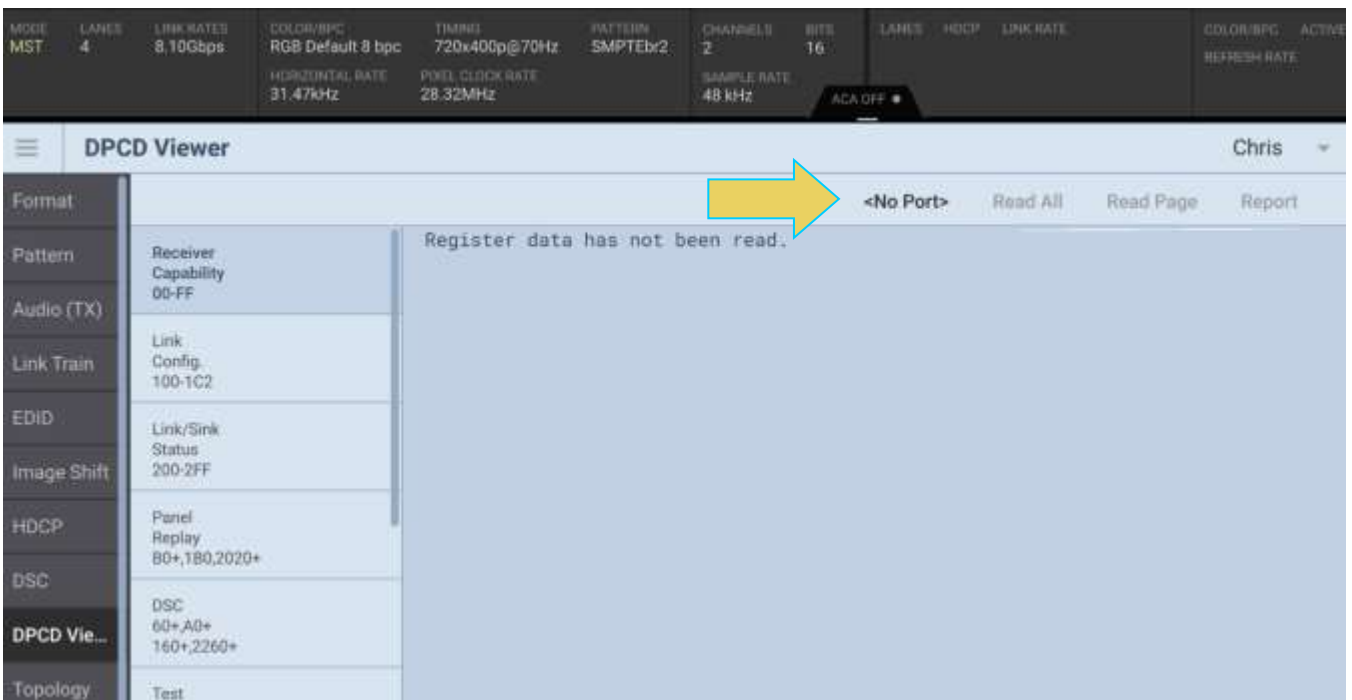
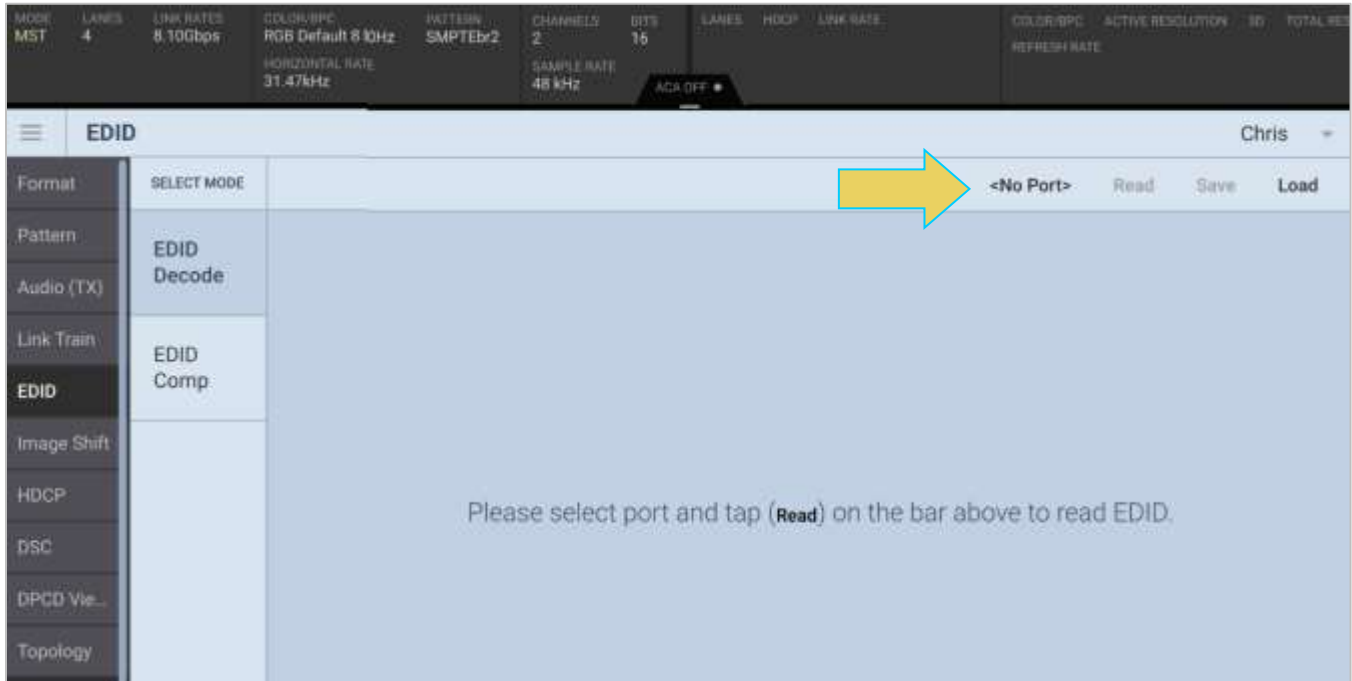




### Reading the EDID or DPCD of a downstream Multi-Stream Transport node

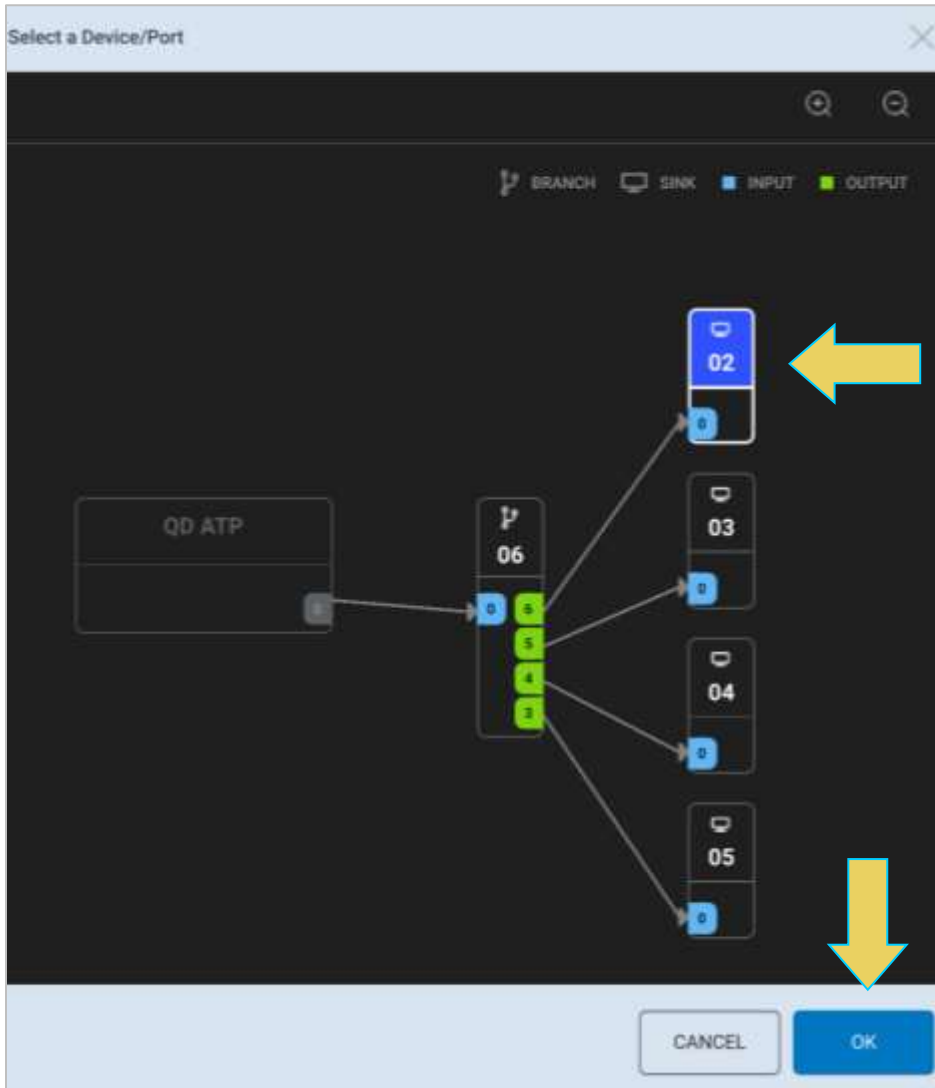
EDID Decode and DPCD Viewer are covered in section 4.5 Tools. The difference with Multi-Stream mode is that you must select the desired downstream device to read the DPCD or EDID from.

Select a device/port by clicking the **<No Port>** button within either tool

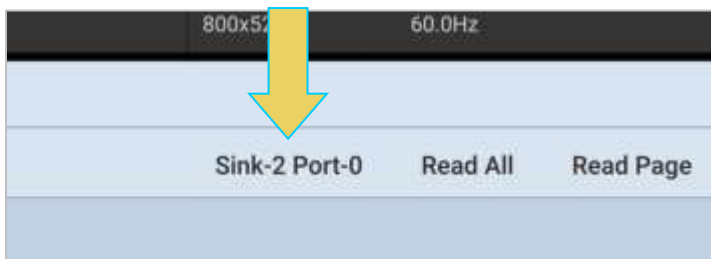


The **Select a Device/Port** window will appear.

Select a node by clicking on it, and selecting **OK**, as demonstrated below.



Once a port has been selected, it will be displayed at the top right of the window, and you may continue as normal.



## Returning to Single-Stream Transport (SST) Mode

If your device is trained at a link rate of 8.1 Gbps or lower, returning to SST mode is as simple as clicking the **Mode** drop down in the top left of the TX status panel and selecting **MST** as depicted below.

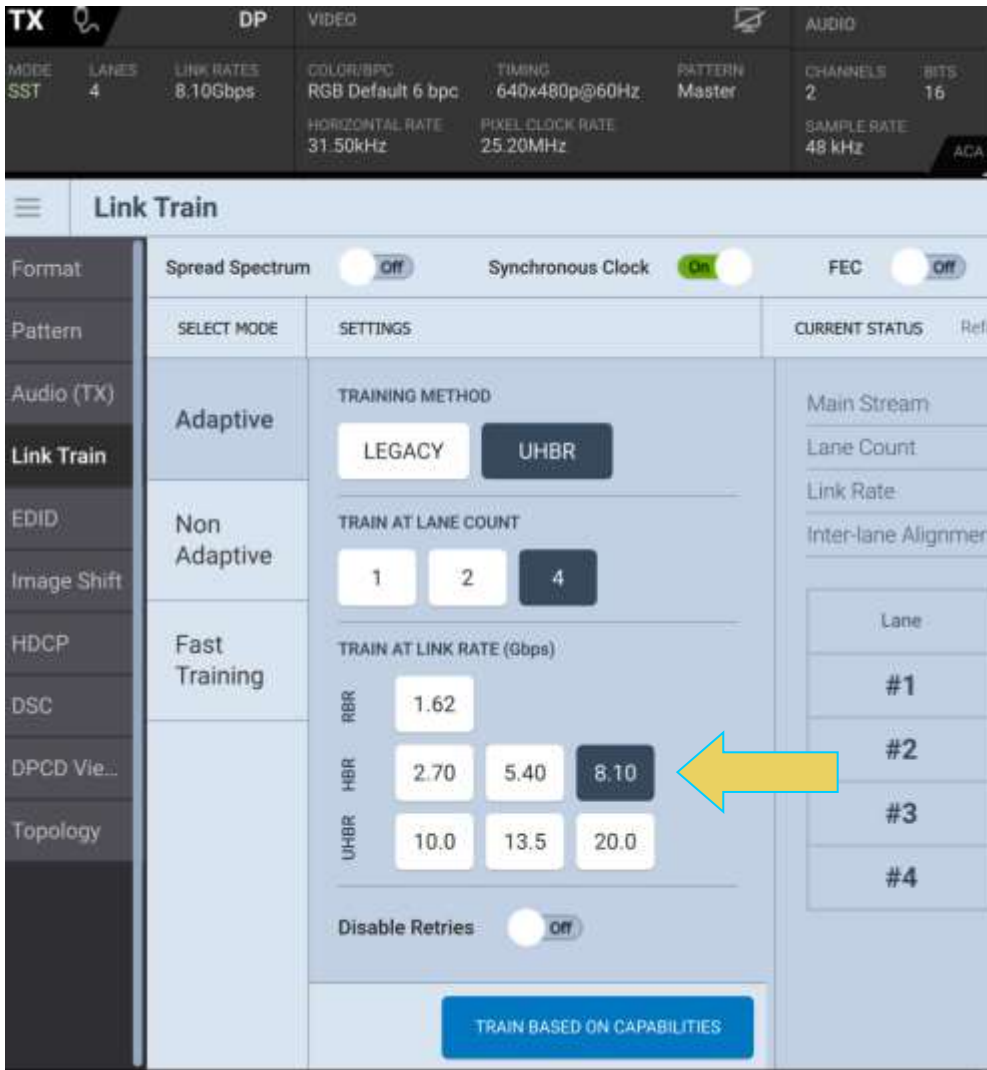


If the **Mode: Multi-Stream Transport** drop down is disabled (not selectable), your sink DUT is likely trained at a UHBR link rate (10.0 Gbps or higher), which requires Multi-Stream Transport mode. SST Mode will require a DUT to train with the M42d at an HBR3 link rate or lower.

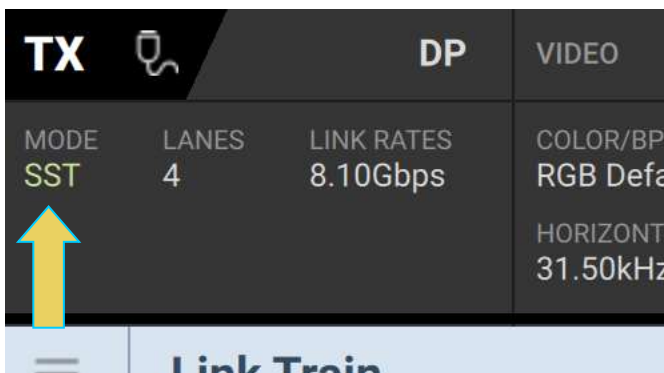
Use the **Link Train** utility in the **Tools** tab to train at a link rate of 8.1 Gbps or lower.

**Note:** Do not click on **TRAIN BASED ON CAPABILITIES** as this will likely train your sink DUT at a link rate higher than desired for SST if it is capable of UHBR.

An example of HBR3 Link training is demonstrated on the next page. More on link training can be found in the [Link Train subsection of this chapter](#).



SST mode will be selected by default after this link training, as shown below.



## 5 Source Verification with Basic (Real-time) Analyzer

Note that portions of this chapter require specific licenses for the M42d to utilize the features therein, including enabling UHBR rates, Aux Channel Analysis utility, and DSC functional tests. More Information and a list of available licenses can be found in [Appendix A. Licenses](#).

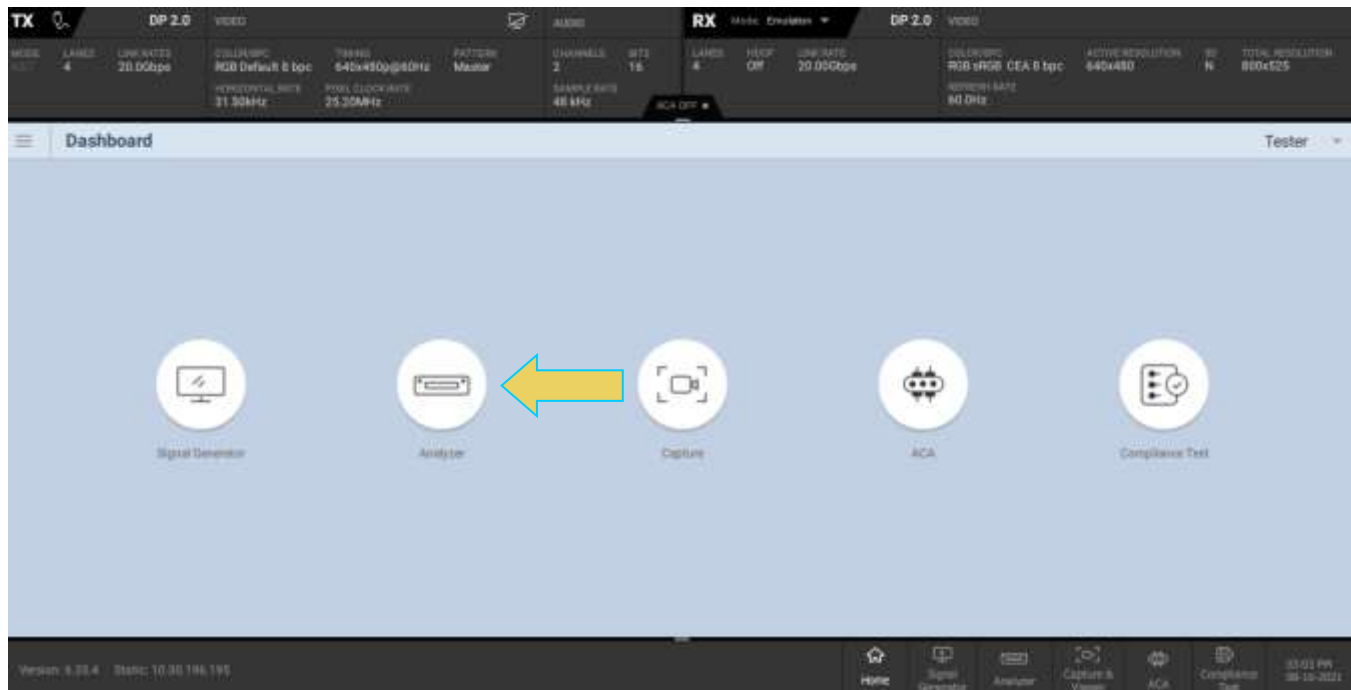
### Basic Analyzer Description

- Emulates an DP 1.4 or DP 2.0 sink device including EDID, DPCD, Multi-Stream Transport, Link Training emulation.
- Provides real time view of the incoming source video and metadata including status of mainstream attributes, secondary data packets, link training, Multi-Stream, HDCP.
- Provides support for viewing the Aux Channel transactions using the quantumdata Auxiliary Channel Analyzer (ACA) application when testing a DP source.

**Note:** The Analyzer panel is *not* transmitted to a **Remote PC VPS Application**. When selecting the **Receiver** on a remote desktop VPS, only the **Tools** dialog box (discussed later in this chapter) will appear. The Analyzer panel is accessible remotely using a VNC. This is discussed in [2.5 VNC Remote Connection](#).

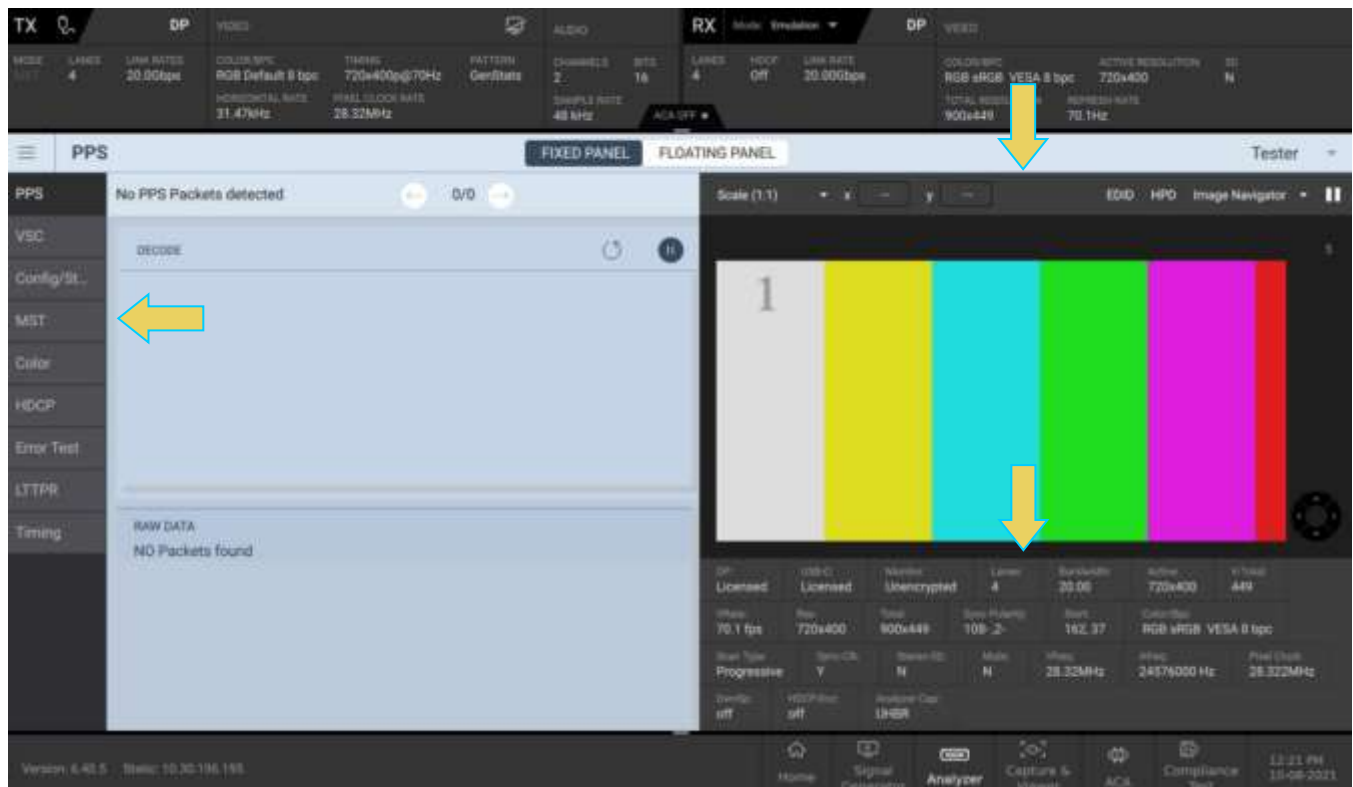
### 5.1 Accessing Basic Analyzer Features

From the Dashboard Home of the M42d VPS GUI Application, select the **Analyzer**, as shown below.

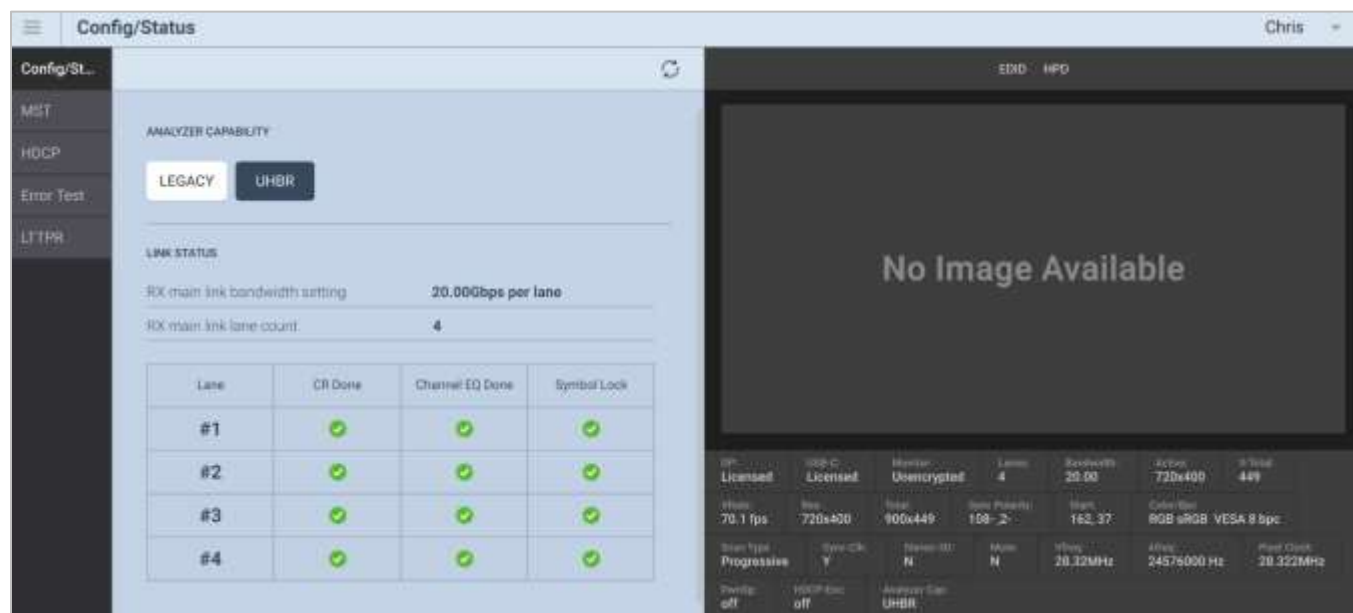


The Analyzer panel appears showing the incoming video image. The M42d's Rx analyzer port provides periodic video frame captures enabling you to view frames of video. This feature provides a basic confidence test to verify that the incoming video is essentially correct.

There is a dashboard underneath the incoming video display, indicating the essential video characteristics, and there is a set of controls both above the toolbar, and a left sidebar with tabs for the various tools of the Receiver.



**Note:** The Analyzer panel is *not* transmitted to a Remote PC VPS Application. When selecting the Receiver on the desktop VPS Application, only portions of the Tools dialog box (discussed later in this chapter) will appear, as shown below. The Analyzer panel is accessible remotely using a VNC. This is discussed in [2.6 VNC Remote Connection](#).



For this reason, most instructions and screenshots in the next two chapters are from the embedded VPS GUI on the M42d device itself.

### Basic Analyzer Dashboard

This subsection describes the dashboard components on the top of the Basic Analyzer panel. Refer to the table below for a description of these components.

Basic Analyzer – Dashboard Items						
Example dashboard of DisplayPort 2.0 Protocol Analyzer Rx						
DP: Licensed	USB-C: Licensed	Monitor: Unencrypted	Lanes: 4	Bandwidth: 20.00	Active: 7680x4320	V-Total: 4400
VRate: 60.0 fps	Res: 7680x4320	Total: 9000x4400	Sync Polarity: 176+ ,20+	Start: 768, 64	Color/Bpc RGB sRGB CEA 8 bpc	
Scan Type Progressive	Sync-Clk: Y	Stereo-3D: N	Mute: N	Mvid: 0	Nvid: 0	Maud: 0
Pixel Clock: 2376MHz	DwnSp: off	HDCP-Enc: off	Analyzer Cap: UHBR			
Example with DSC enabled						
DP: Licensed	USB-C: Licensed	Monitor: Unencrypted	Lanes: 4	Bandwidth: 20.00	Active: DSCxEnabled	V-Total: 1125
VRate: 60.0 fps	Res: 1920x1080	Total: 2200x1125	Sync Polarity: 44+ ,5+	Start: 192, 41	Color/Bpc na CEA 8 bpc	
Scan Type Progressive	Sync-Clk: Y	Stereo-3D: N	Mute: N	Vfreq: 148.50MHz	Afreq: 24576000 Hz	Pixel Clock: 148.5MHz
DwnSp: off	HDCP-Enc: off	Analyzer Cap: UHBR				

Monitor: <b>Unencrypted</b>	<p><b>Top Row Items:</b></p> <ul style="list-style-type: none"> <li>▪ <b>Monitor</b> - Indicates the HDCP encryption status of the received video. <b>Note:</b> If unencrypted, the <b>Unencrypted</b> indicator will show.</li> <li>▪ <b>Lanes</b> - The number of lanes used during link training.</li> <li>▪ <b>Bandwidth</b> - The link rate (per lane, Gbps).</li> <li>▪ <b>Active (video resolution)</b> - This is the measured video resolution. <b>Note:</b> If DSC is active, it will be indicated in this field.</li> <li>▪ <b>V-Total</b> - This is the measured total vertical video lines per frame.</li> </ul> <p><b>Second Row Items:</b></p> <ul style="list-style-type: none"> <li>▪ <b>VRate</b> - This is the measured vertical frame rate</li> <li>▪ <b>Res</b> - The active video resolution in horizontal pixels and vertical lines determined from the main stream attributes.</li> <li>▪ <b>Total</b> - The total video in horizontal pixels and vertical lines determined from the main stream attributes.</li> </ul>
Monitor: <b>HDCP 1.3</b>	
Bandwidth: <b>20.00</b>	
VRate: <b>60.0 fps</b>	
Res: <b>7680x4320</b>	

### Basic Analyzer – Dashboard Items

Sync Polarity:  
88+,10+

Color/Bpc:  
RGB sRGB CEA 8 bpc

Color/Bpc:  
YCbCr422 ITU-R BT.709

Vfreq:  
593.41MHz

Afreq:  
24576000 Hz

Analyzer Cap:  
UHBR

Analyzer Cap:  
Legacy

- **Sync Polarity** - Horizontal sync pulse width (in pixels) and polarity, followed by vertical sync pulse width (in lines) and polarity. (e.g. Hsync 88 pixels, positive; Vsync 10 lines, positive)
- **Start** - The starting pixel and line in the active video.
- **Colorimetry and bit depth** - The colorimetry and bit depth.

#### Third Row Items:

- **Scan** - The scan type used, progressive (e.g. Prog) or interlaced (Inter).
- **Sync-Clk** - Indicates if the Link Clock and Main Video Stream clock are asynchronous or synchronous. A value of N means async; a value of Y means synchronous.
- **Stereo-3D** - The status of 3D audio.
- **Mute** - The AudioMute flag status.
- **Vfreq** - Video pixel frequency.
- **Afreq** - Audio sampling frequency.

#### Fourth Row Items:

- **Pixel Clock** - How often pixels occur (frame rate x pixels per frame)
- **DwnSp** - DownSpread indicates whether Spread Spectrum Clocking (SSC) is enabled
- **HDCP-Enc** - Indicates if HDCP encryption is currently active
- **Analyzer Cap:** - Indicates Rx link rate capability: Legacy (8.1 Gbps or lower) or UHBR




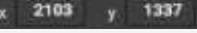






### Display Window Toolbar

There is a toolbar at the top of the Analyzer window (shown below) with a few controls.

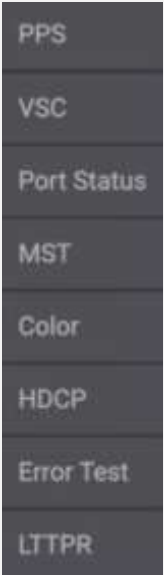


Refer to the following table for a description of the toolbar controls:

Analyzer Toolbar Controls	Description
Fixed Panel  Floating Panel 	<ul style="list-style-type: none"> <li>• Toggle whether the Analyzer tools (covered in next subsection) appear in a floating window or are anchored to the left side of the Analyzer panel.</li> </ul>
Scale 	<ul style="list-style-type: none"> <li>• Allows you to set the size, quality, and aspect ratio of the incoming video image</li> </ul>
Pixel Selection 	<ul style="list-style-type: none"> <li>• Displays location of selected pixel</li> <li>• Allows you to specify desired pixel for selection</li> </ul>
EDID Selection 	<ul style="list-style-type: none"> <li>• Select an EDID to load into emulated receiver.</li> </ul>
Hot Plug Generator 	<ul style="list-style-type: none"> <li>• Generate a hot-plug pulse of duration between .1 – 4000 milliseconds.</li> </ul>
Image Navigator 	<ul style="list-style-type: none"> <li>• Depending on scale, change visible portion of the received video</li> <li>• Red outlined box is visible portion within the receiver.</li> </ul>
Start/Pause 	<ul style="list-style-type: none"> <li>• Enable or disable the showing of the incoming video image.</li> </ul>

## Analyzer Control Panel

This subsection describes the main control panel for the Basic Analyzer. Refer to the table below for a description of these controls. This chapter expands on many of the tools presented in this table in later sections.

Basic Analyzer – Control Panel	Control Button Descriptions
<p><b>Main Control Panel</b></p> 	<p>The following controls are provided in the main control panel on the left-hand side of the Real Time mode interface. The purpose of each button and their basic control functions are described below:</p> <ul style="list-style-type: none"> <li>▪ PPS – The PPS button brings up the Picture Parameter Set panel. Used with DSC Analysis.</li> <li>▪ VSC – The VSC button displays Video Stream Configuration data</li> <li>▪ Port Status – Displays information on the Rx Main Link lanes and link rate</li> <li>▪ MST – Provides for Multi-Stream Transport configuration.</li> <li>▪ Color – The Color button and associated dialog box enables you to identify the color of any particular pixel.</li> <li>▪ HDCP – Allows you to enable and configure HDCP within the receiver.</li> <li>▪ Error Test – Access error testing analysis tools.</li> <li>▪ LTTPR – Access tools for LTTPR Emulation (license required). This feature is covered in <b>Chapter 9 LTTPR Testing</b></li> </ul>

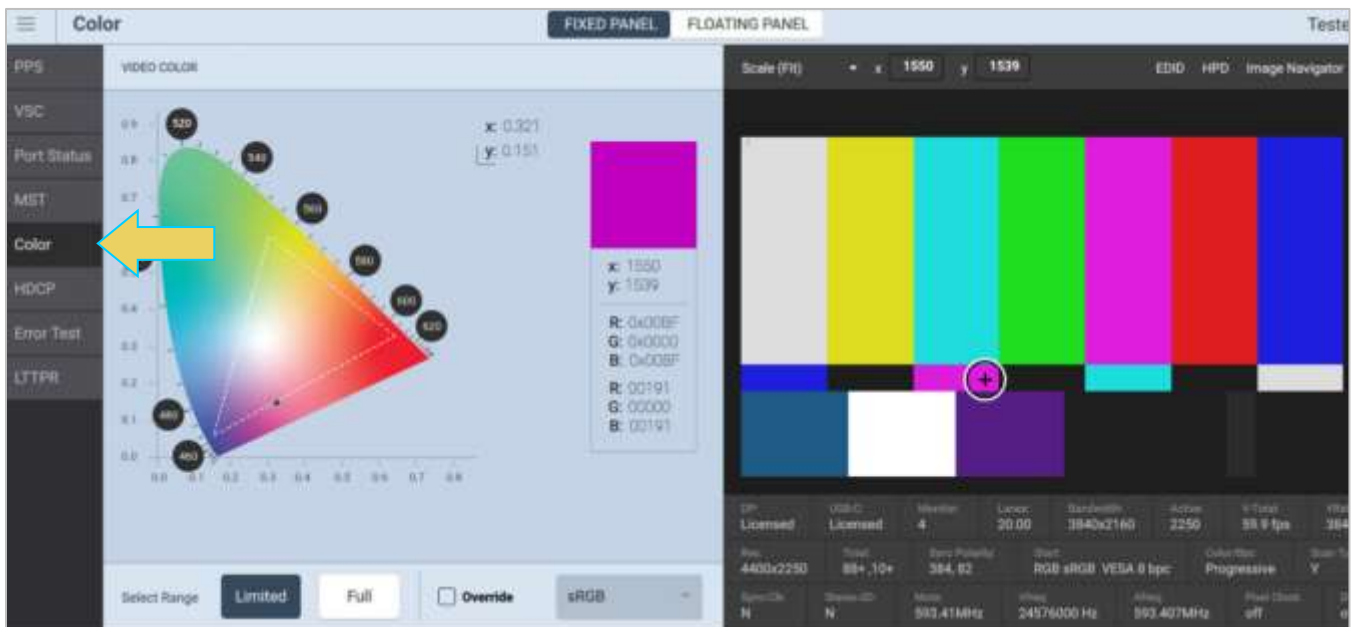
## 5.2 Controlling the Basic Analyzer

This subsection provides procedures on how to control the Basic Analyzer features.

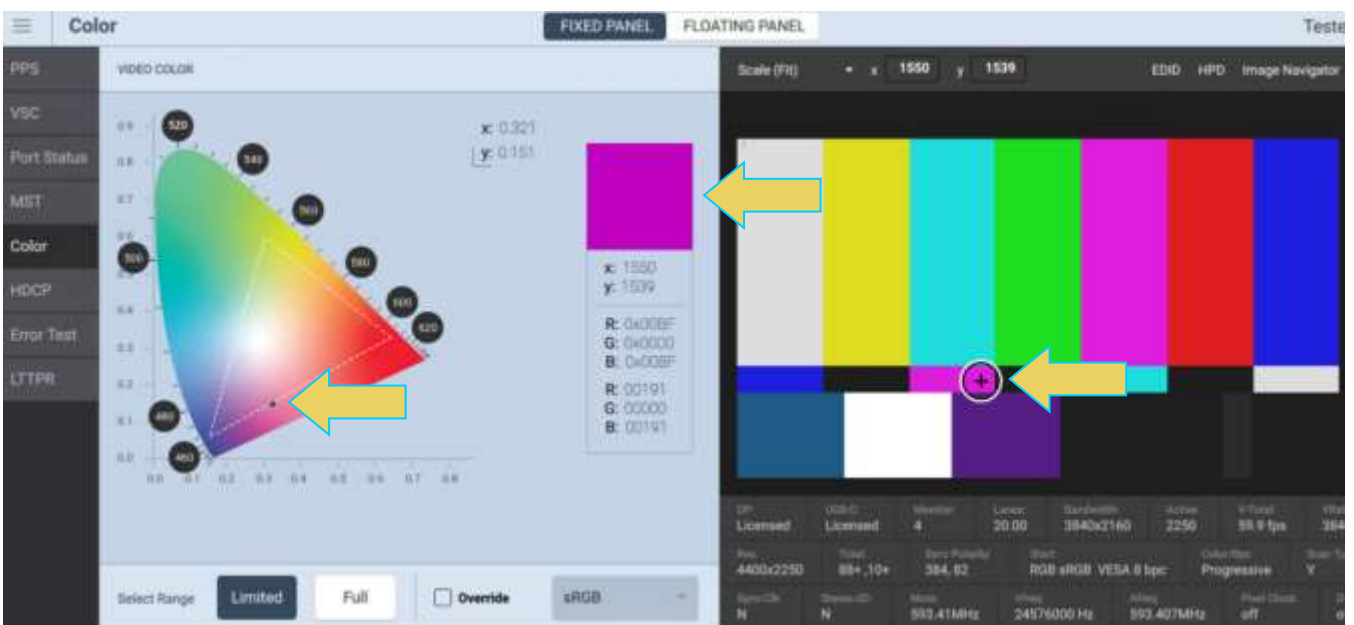
### Viewing the Color values

The M42d enables you to determine the color values of any individual pixel.

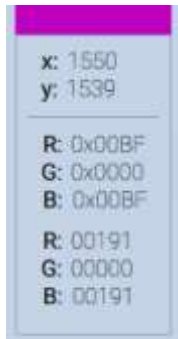
1. Access the Color dialog box by clicking the icon on the left-hand side bar, as shown below.



2. Click on any location within the video frame to read its pixel color.



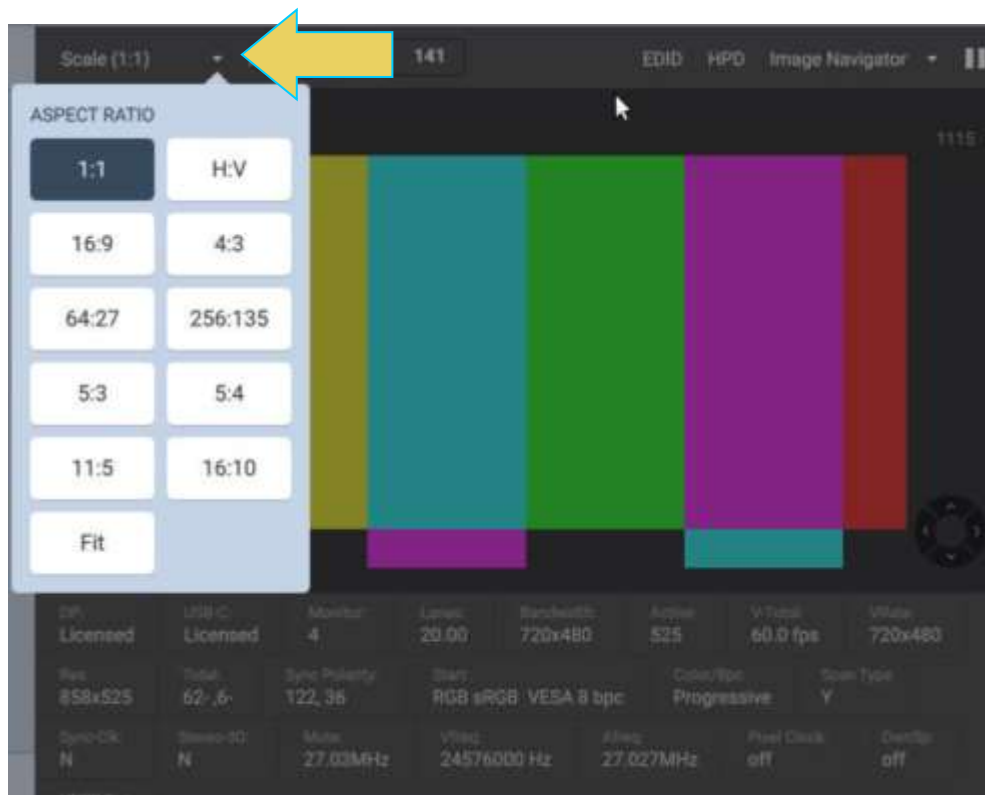
- Read the pixel values on the dialog box provided. The pixel values (X for the horizontal – Y for the vertical) are provided in both hex and decimal.



### Setting the video image size and aspect ratio

The M42d enables you to set the size and aspect ratio of the displayed video image.

Access the **Image Scale** dialog box by clicking the **Scale** icon above the receiver video frame, as shown below.

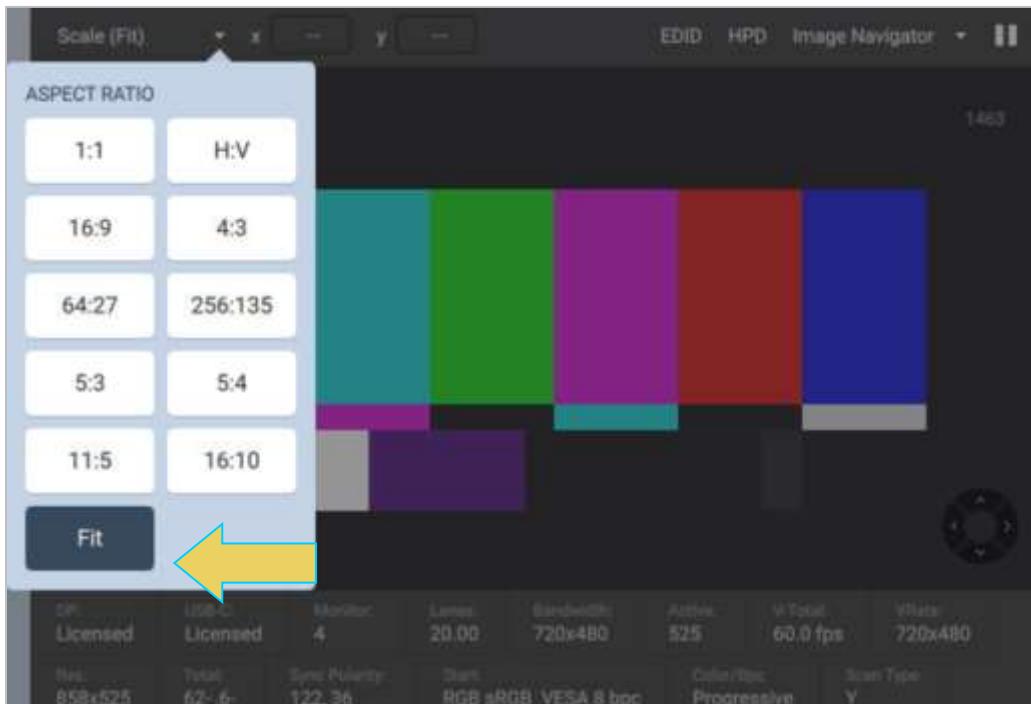


Set the size to either 1:1 or any of the scaling options.

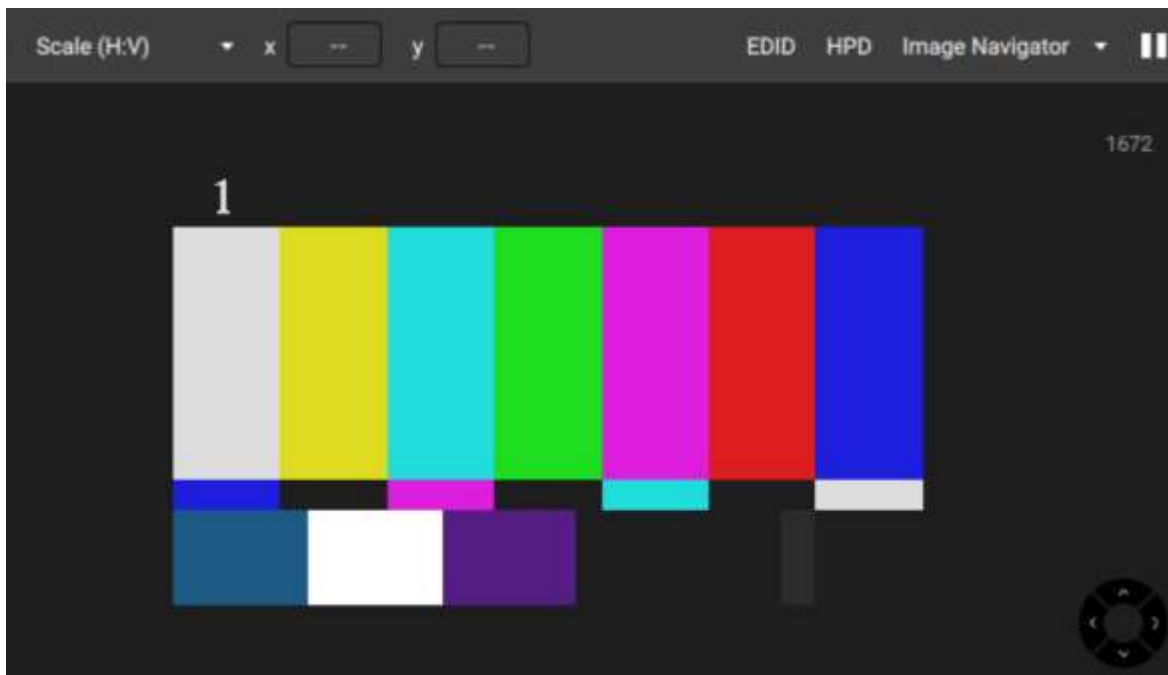
- The 1:1 setting means that the image appears in its true size. In this mode, if the image is too large for the viewing panel, it can be moved by using the Image Navigator drop-down or clicking and dragging to view all areas of the image.

- Scaling the image will fit it within the viewing area of the M42d's VPS display, or within the Aspect Ratio defined.

The example below shows Image Scale set to Scaled with an Aspect Ratio set to Fit the viewing panel.



This final example below is in Scaled mode with an Aspect Ratio of 4:3.



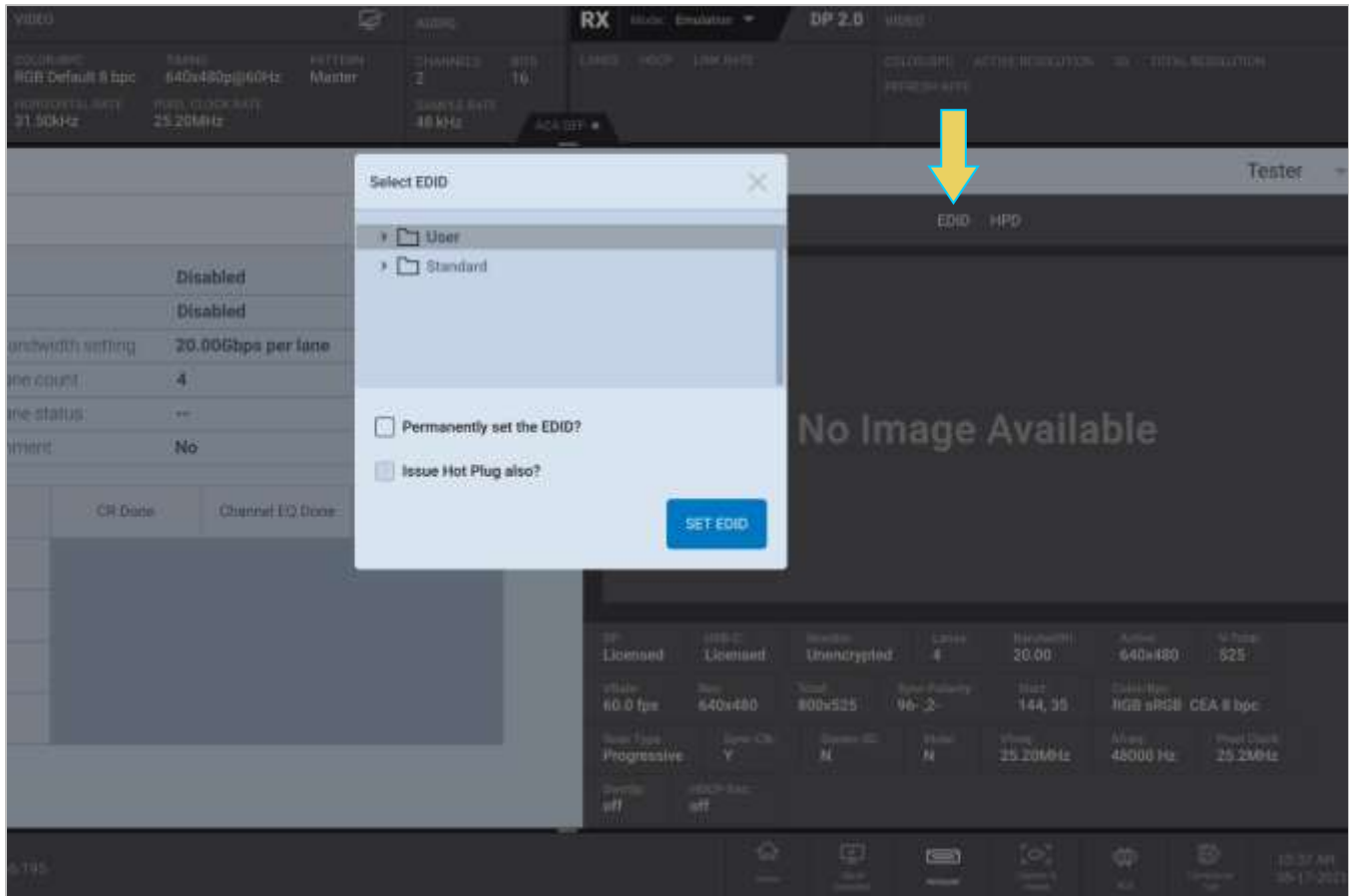
**Note:** Scaling uses simple decimation, so some fine image details may be inaccurate or lost.

## Setting the EDID for the Rx port

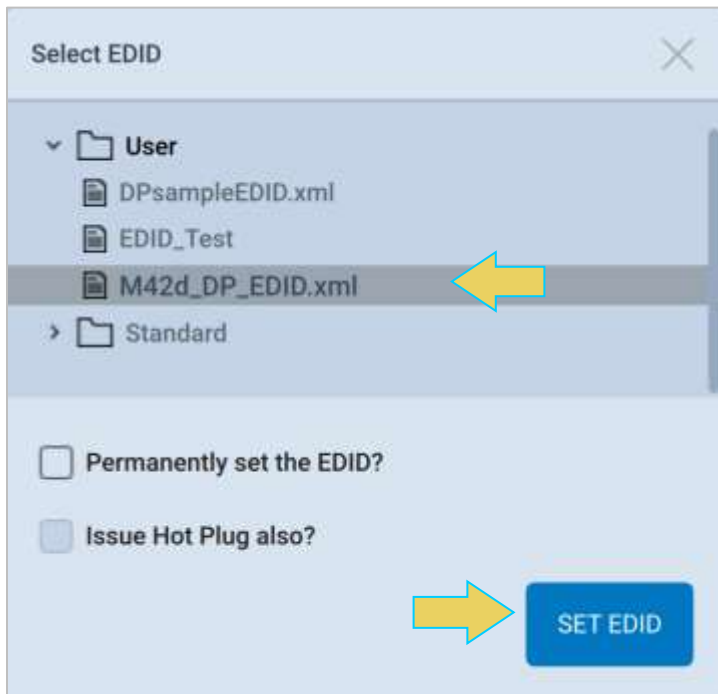
**Note:** By default, the M42d emulates an EDID that is compatible with DP 2.0. You can permanently change the EDID (until explicitly changed) using the procedures provided in this section, otherwise it resets to the default EDID each time the instrument is booted.

Use the procedures below to provision the M42d Rx port with an EDID to emulate a sink device.

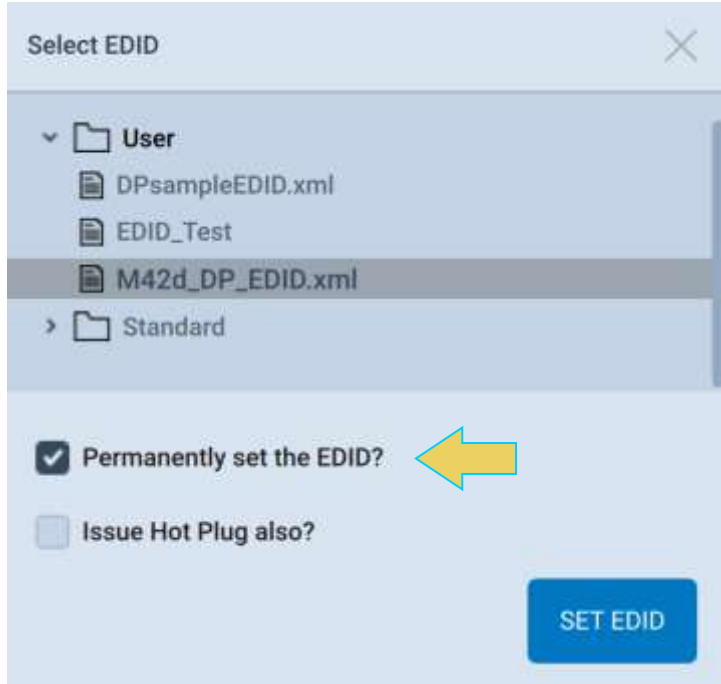
1. Open the **Analyzer** from the Home Dashboard.
2. Access the Select EDID dialog box by clicking the **EDID** button on the top toolbar, as shown below.



3. Select the EDID that you wish to emulate on the module's Rx port and then click **SET EDID**.



4. You may also wish to set the EDID permanently. You can do so by checking the respective box within the Select EDID window.



The M42d's Rx port will emulate the EDID you selected.

## Setting the DPCD for the Rx port

The M42d enables you to set the emulated Receiver's DPCD. However, the **Set DPCD** feature within the Analyzer is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

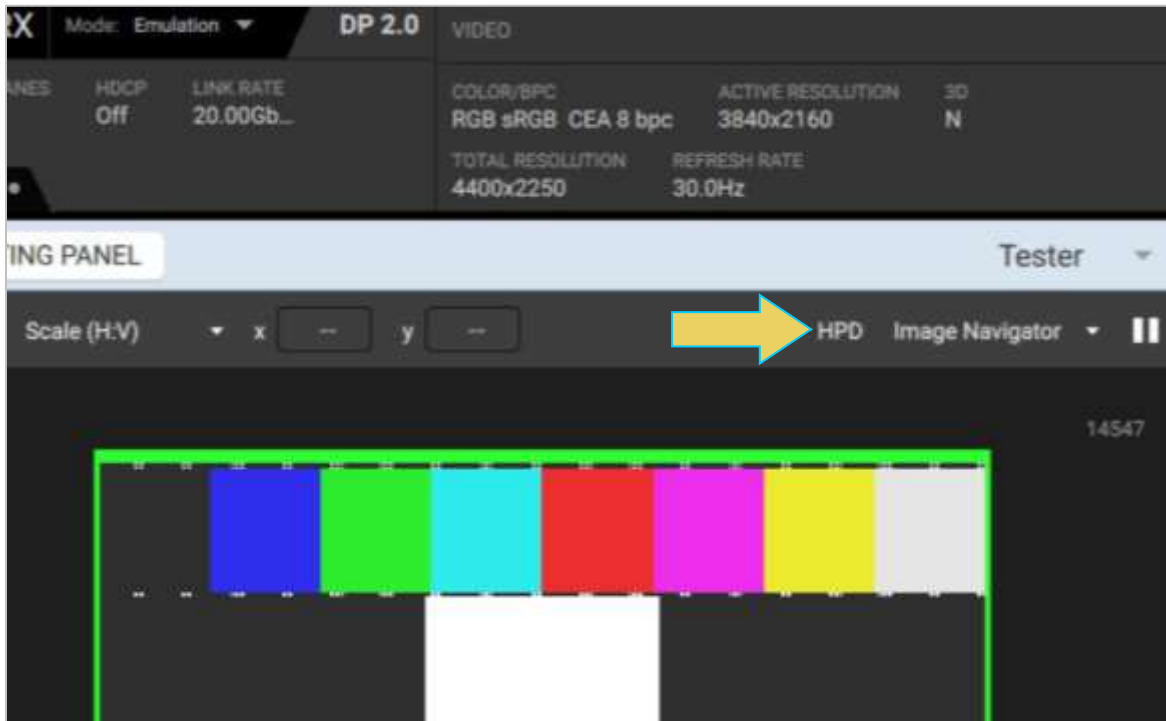
You may also refer to **13.1 DPCD Editor** for procedures to configure, save, load, and ultimately set a DPCD for the Analyzer. Functionally, setting the DPCD within the DPCD Editor is the same as using the **Set DPCD** feature within the Analyzer, though it requires a couple of extra steps.



### Generating a Hot-plug

The M42d Signal receiver allows you to generate a hot-plug pulse of duration between .1 – 4000 milliseconds using the Hot-plug tool within the real-time analyzer.

Access the Hot-plug tool by clicking the **HPD** icon at the top of the receiver display panel



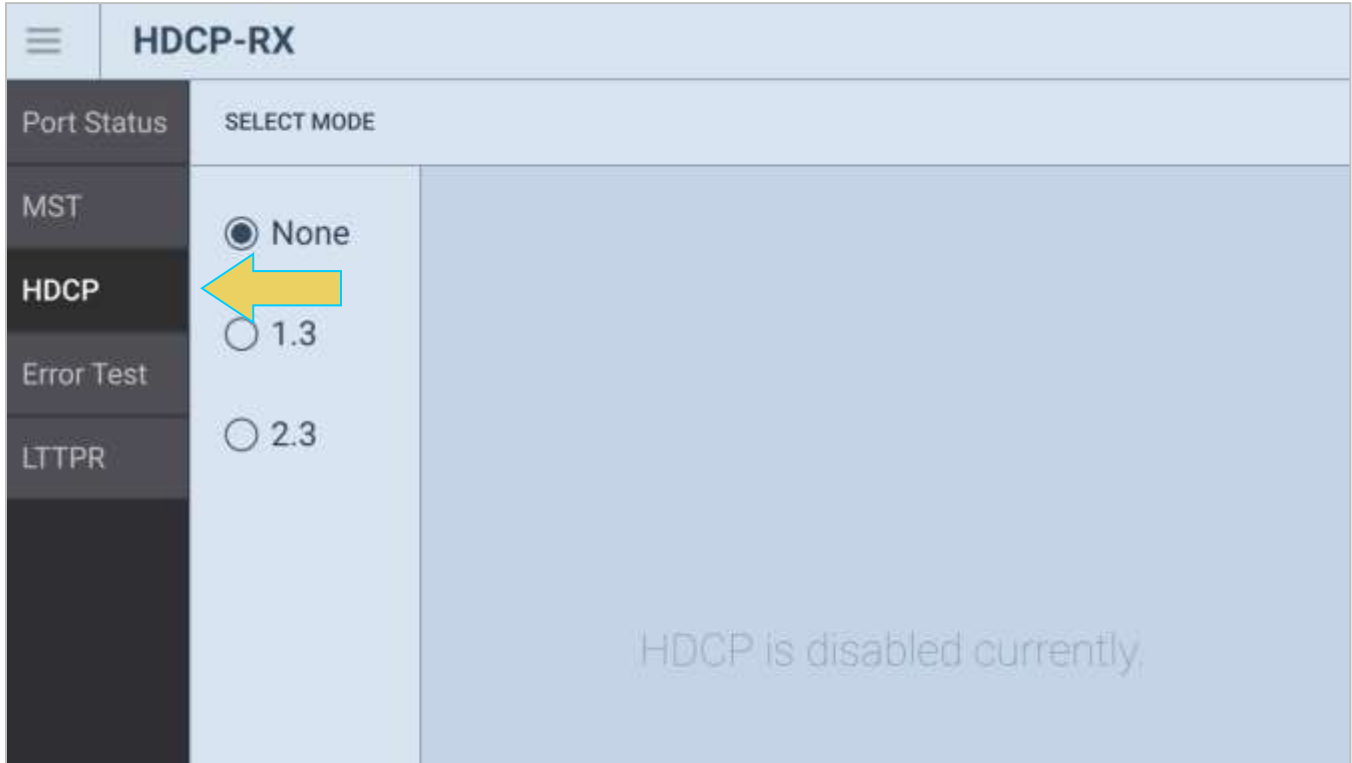
Enter the desired length for the hot-plug pulse and click **GENERATE HOT PLUG**, as shown below.



### Enabling/Disabling HDCP

You can enable HDCP on the M42d's emulated Rx port within the Analyzer.

On the left side-bar, click **HDCP** to be taken to the HDCP tool.



Enable HDCP 1.3 or 2.3 using the radio buttons. The example below shows HDCP 2.3 enabled.



Once HDCP is enabled, select the Key type, toggle on or off repeaters, and configure depth and device count.

The status of received HDCP signal will be displayed in the right-most panel.

☰
**HDCP-RX**

Port Status	SELECT MODE		STATUS																																			
MST	<input type="radio"/> None  <input type="radio"/> 1.3  <input checked="" type="radio"/> 2.3	<b>KEY TYPE</b> <div style="margin-bottom: 5px; background-color: #333; color: white; padding: 2px 5px; text-align: center;">Production</div> <div style="margin-bottom: 5px; background-color: #eee; padding: 2px 5px; text-align: center;">Facsimile</div> <div style="margin-bottom: 5px; background-color: #eee; padding: 2px 5px; text-align: center;">Facsimile #2</div> <hr/> <b>REPEATER</b> <div style="display: flex; align-items: center;"> <input type="checkbox"/> <span style="margin-left: 5px;">Off</span> </div> <hr/> <b>Depth</b> <div style="background-color: #eee; padding: 2px 5px; text-align: center;">0</div> <hr/> <b>Device Count</b> <div style="background-color: #eee; padding: 2px 5px; text-align: center;">0</div>	<div style="text-align: right; font-size: 20px; color: #ccc;">↻</div> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr style="border-bottom: 1px solid #ccc;"> <th style="width: 60%;">PARAMETER</th> <th>VALUE</th> </tr> </thead> <tbody> <tr><td>HDCP2ENABLED</td><td>YES</td></tr> <tr><td>RTX</td><td>NA</td></tr> <tr><td>TXCAPS</td><td>NA</td></tr> <tr><td>AKE_INIT</td><td>NOT_RCVD</td></tr> <tr><td>RX_CERT</td><td>NOT_RCVD</td></tr> <tr><td>STORED_KM</td><td>NOT_RCVD</td></tr> <tr><td>NO_STORED_KM</td><td>NOT_RCVD</td></tr> <tr><td>HPRIME</td><td>NOT_RCVD</td></tr> <tr><td>PAIRING</td><td>NOT_RCVD</td></tr> <tr><td>LC_INIT</td><td>NOT_RCVD</td></tr> <tr><td>LPRIME</td><td>NOT_RCVD</td></tr> <tr><td>SKE</td><td>NOT_RCVD</td></tr> <tr><td>AUTHENTICATED</td><td>NO</td></tr> <tr><td>REPAUTH_RCVIDLST</td><td>MSG_NOT_SND</td></tr> <tr><td>RCVIDLST_ACK</td><td>NOT_RCVD</td></tr> <tr><td>STRM_MGMT</td><td>NOT_RCVD</td></tr> </tbody> </table>	PARAMETER	VALUE	HDCP2ENABLED	YES	RTX	NA	TXCAPS	NA	AKE_INIT	NOT_RCVD	RX_CERT	NOT_RCVD	STORED_KM	NOT_RCVD	NO_STORED_KM	NOT_RCVD	HPRIME	NOT_RCVD	PAIRING	NOT_RCVD	LC_INIT	NOT_RCVD	LPRIME	NOT_RCVD	SKE	NOT_RCVD	AUTHENTICATED	NO	REPAUTH_RCVIDLST	MSG_NOT_SND	RCVIDLST_ACK	NOT_RCVD	STRM_MGMT	NOT_RCVD	
PARAMETER		VALUE																																				
HDCP2ENABLED		YES																																				
RTX		NA																																				
TXCAPS	NA																																					
AKE_INIT	NOT_RCVD																																					
RX_CERT	NOT_RCVD																																					
STORED_KM	NOT_RCVD																																					
NO_STORED_KM	NOT_RCVD																																					
HPRIME	NOT_RCVD																																					
PAIRING	NOT_RCVD																																					
LC_INIT	NOT_RCVD																																					
LPRIME	NOT_RCVD																																					
SKE	NOT_RCVD																																					
AUTHENTICATED	NO																																					
REPAUTH_RCVIDLST	MSG_NOT_SND																																					
RCVIDLST_ACK	NOT_RCVD																																					
STRM_MGMT	NOT_RCVD																																					
HDCP																																						
Error Test																																						
LTPR																																						

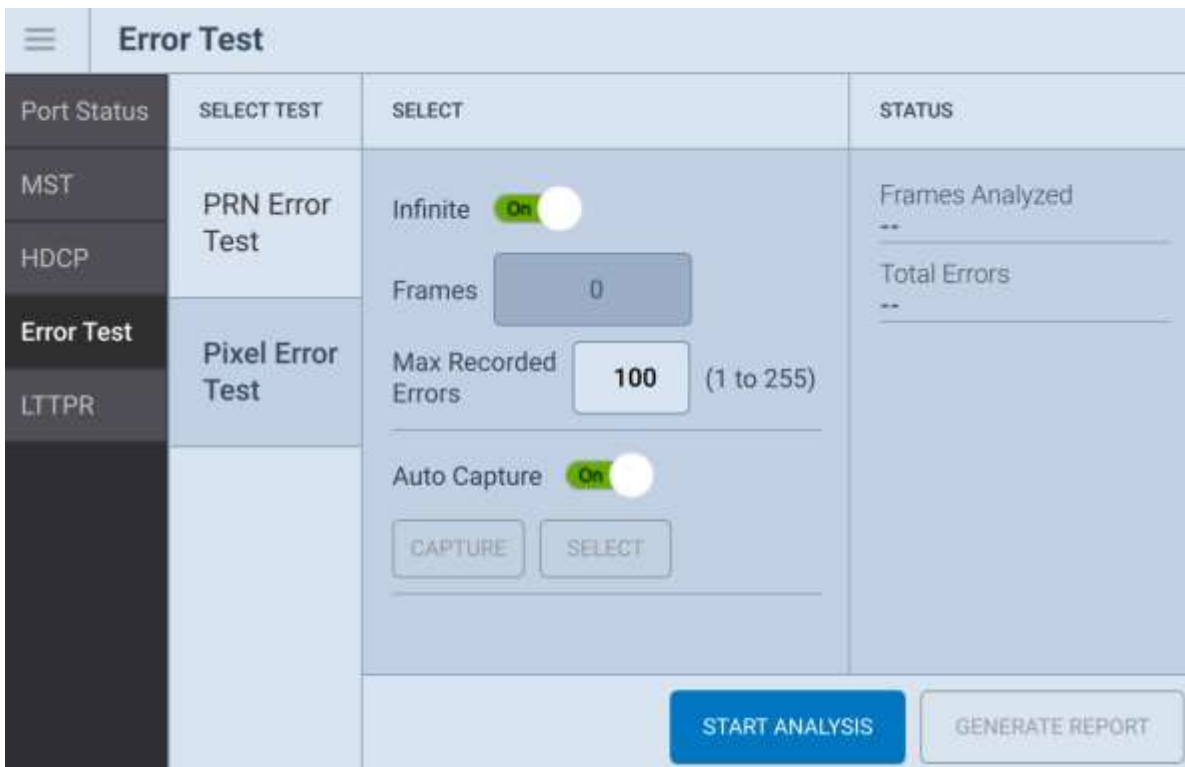
### Reading Error Info

Access the Error Test tool within the left-hand sidebar, as demonstrated below.

Select from **PRN Error Test** and **Pixel Error Test**. Configure desired settings and click **START ANALYSIS**. As shown in the two screenshots below.



**PRN Error Test configuration**



**Pixel Error Test configuration**

### 5.3 DSC Analysis

This section covers Display Stream Compression features within the Analyzer.

#### DSC Real-time (Snapshot) Analysis

The DSC Analysis feature allows you to view the incoming DSC decompressed frame. The DSC video is presented as a series of snapshots (not “real time”). You will be able to see the DSC metadata in the Picture Parameter Set (PPS).

To access the Picture Parameter Set panel in the Analyzer interface, select the **PPS** button from the left-hand side controls. The PPS panel is shown below.

The screenshot shows the M42d Video Analyzer interface. The top section displays TX and RX parameters for DP 2.0 VIDEO and AUDIO. The PPS panel is visible on the left, with a yellow arrow pointing to the 'PPS' button. The PPS panel shows various parameters including VSC, Part Status, MST, Color, HDCP, Error Test, and LTTPR. A yellow arrow points to the 'DSCxEnabled' status in the bottom right corner of the PPS panel.

Parameter	Value
bits_per_pixel	128 (8.000000 bits)
pic_height	1080
pic_width	1920
slice_height	1080
slice_width	960
chunk_size	960
initial_smil_delay	512
initial_dec_delay	856
initial_scale_value	32

Parameter	Value
DSCxEnabled	DSCxEnabled
Active Resolution	1125
Color Space	CEA 8 bpc
Refresh Rate	30.0 fps

**Note:** If DSC is not enabled on the source DUT, the PPS panel will be empty. Ensure that the analyzer status panel displays **DSCxEnabled**, as shown above.

Scroll down within the **DECODE** and **RAW DATA** panels to see all of the information.

## DSC Test CRC Verification

You can also verify the Test CRC of the incoming DSC decompressed frame to support test automation on Display Stream Compressed (DSC) frames.

The DisplayPort specification requires registers in a DSC-capable sink device for exposing calculated CRCs on the decompressed (“reconstructed”) pixel values. This enables a DSC source developer to acquire an objective verification that their compression engine is working properly.

Prior to this, a developer would have to view the compressed image frames received by the M42d and subjectively assess the compression through a visual inspection.

The source DUT transmits a DSC compressed frame to the DSC sink. The Test CRC registers in the sink (in this case the M42d analyzer emulating a sink) now expose the calculated values to be read by the source, thus enabling the verification. Developers of a DSC-capable source can read these registers over the Aux Channel.

Accessing and reading the DPCD register is covered in the [Chapter 4 section titled DPCD viewer](#). To access the CRC Test readouts, select the Test Automation register and scroll down to registers 240-246, as shown below.

The screenshot shows the DPCD Viewer interface with the following content:

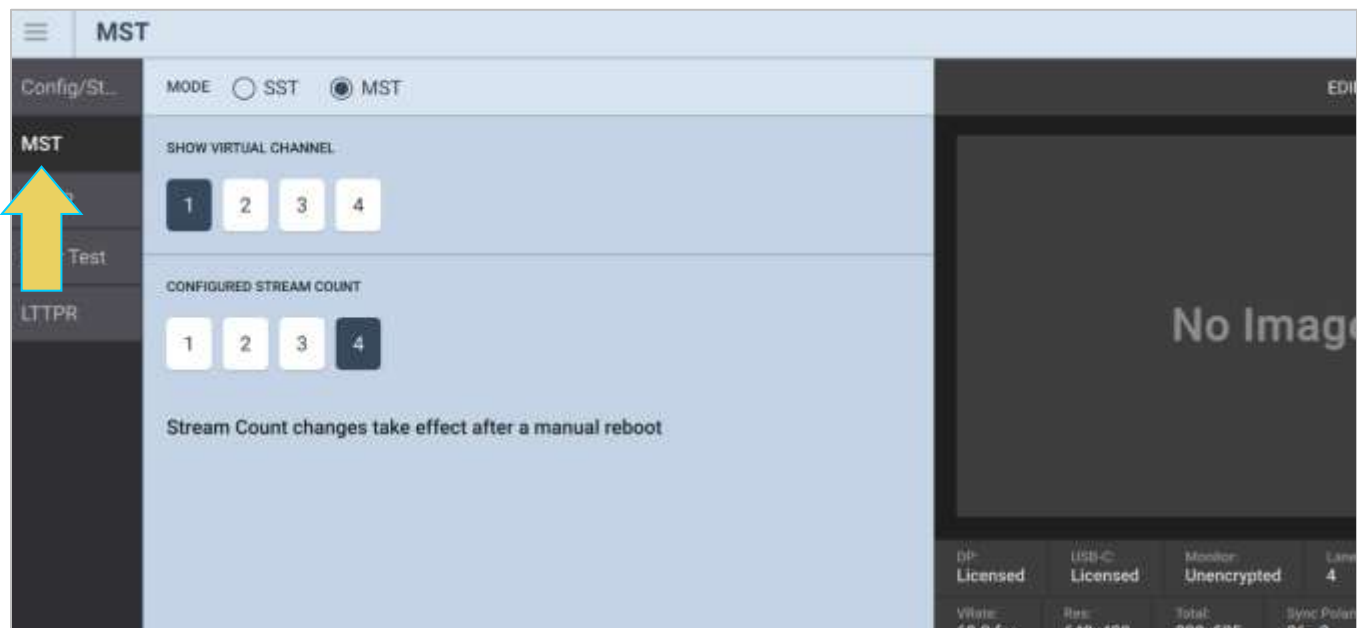
Format	Sink-4 Port-0	Read All	Read Page	Report																				
Pattern	6	0	Reserved																					
Audio (TX)	7	0	Reserved																					
Link Train	00234: TEST_REFRESH_RATE_NUMERATOR Value = 00h (0)																							
EDID	00240: TEST_CRC_R_CR CRC: 0000h (0)																							
Image Shift	00242: TEST_CRC_G_Y CRC: 0000h (0)																							
Test Automation	00244: TEST_CRC_B_CB CRC: 0000h (0)																							
Source Specific	00246: TEST_SINK_MISC																							
Topology	<table border="1"> <thead> <tr> <th>Bit</th> <th>Name</th> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>3-0</td> <td>TEST_CRC_COUNT</td> <td>0</td> <td></td> </tr> <tr> <td>4</td> <td></td> <td>0</td> <td>Reserved</td> </tr> <tr> <td>5</td> <td>TEST_CRC_SUPPORTED</td> <td>N(0)</td> <td></td> </tr> <tr> <td>6</td> <td></td> <td>0</td> <td>Reserved</td> </tr> </tbody> </table>				Bit	Name	Value	Description	3-0	TEST_CRC_COUNT	0		4		0	Reserved	5	TEST_CRC_SUPPORTED	N(0)		6		0	Reserved
Bit	Name	Value	Description																					
3-0	TEST_CRC_COUNT	0																						
4		0	Reserved																					
5	TEST_CRC_SUPPORTED	N(0)																						
6		0	Reserved																					

## 5.4 Emulating a Multi-Stream Rx Port

The M41d's Basic Analyzer option can emulate a DisplayPort Multi-Stream Transport (MST) branch device and MST sinks nodes. The emulation capability includes the ability to present EDIDs from downstream MST sink devices and to provide a response to DPCD reads. The M41d analyzer port will respond to MST negotiation requests from MST-capable DP source devices. Currently the EDID presented will be the same for all downstream MST sink nodes.

### To access the Multi-Stream Transport dialog box:

Navigate to the **Analyzer** tool within the VPS Dashboard, and click the **MST** tab on the left sidebar, as shown below.



The panel has three fields:

- **Mode:** Select between SST and Multi-Stream Transport
- **Virtual Channel to Show:** Select which virtual channel to display within the Protocol Analyzer/Receiver.
- **Configured Stream Count:** Change the number of streams between transmitted by the Generator.

This dialog box enables the user to add or remove a downstream node. Select the desired number of nodes in the **Configured Stream Count** field. The following example has selected two streams.

**Note:** After selecting a stream count, you must reboot the M42d for the changes to apply. You will also need to retrain to the desired link rate after the reboot, if applicable.

## 6 Protocol Analyzer with Capture Control

---

Note that this chapter requires specific licenses for the M42d to utilize the features therein, including licenses for enhanced source/sink functional tests, ACA utility, and enabling UHBR rates. More Information and a list of available licenses can be found in [Appendix A. Licenses](#).

### Protocol Analyzer Description:

- Requires the Basic Analyzer license to be installed as well.
- Provides capture and store of the main link protocol, video and metadata including main stream attributes and secondary data from an incoming DP source device.

### Operational workflow for capturing data with your M42d DP Protocol Analyzer

This subsection describes how to use the M42d analyzer function to capture and analyze from DisplayPort source devices. Testing an DP source device involves the following high-level steps:

1. Configure the M42d analyzer with the proper EDID.
2. Connecting the DP source device.
3. View the incoming video in Real Time Analyzer to check the status of the device under test.
4. Specify a trigger method.
5. Initiate the capturing of the data.
6. Examine the test data through the VPS GUI Application at the high-level view on the **Event Plot** panel or the Video Analysis panel.
7. Drill down to examine the data at the lower level through the details of the **Data Decode** panel view.
8. (Optional) You may wish to capture and view the raw hex data.



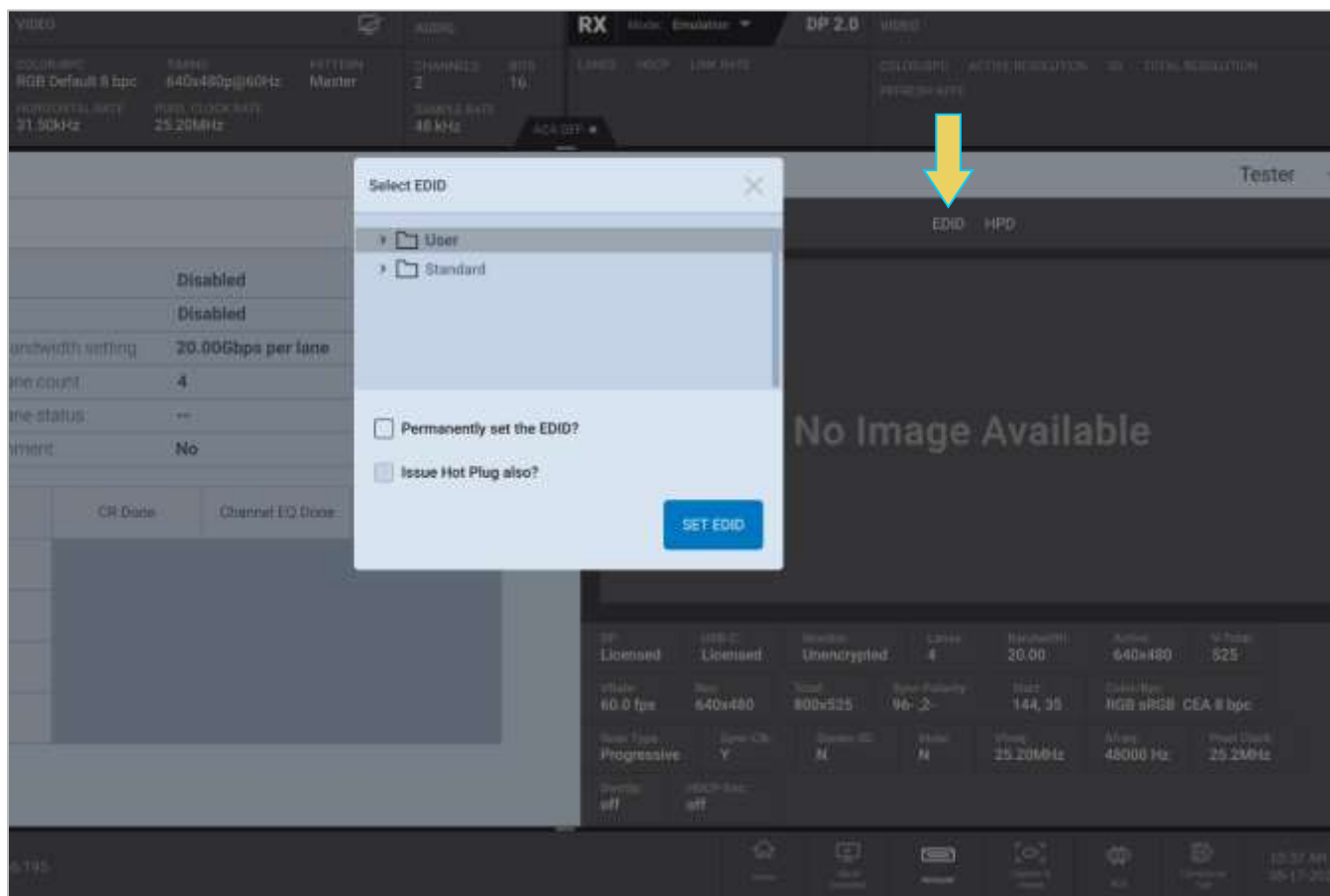
## 6.1 Getting started with the Protocol Analyzer

### Configuring the M42d DP Protocol Analyzer with an EDID

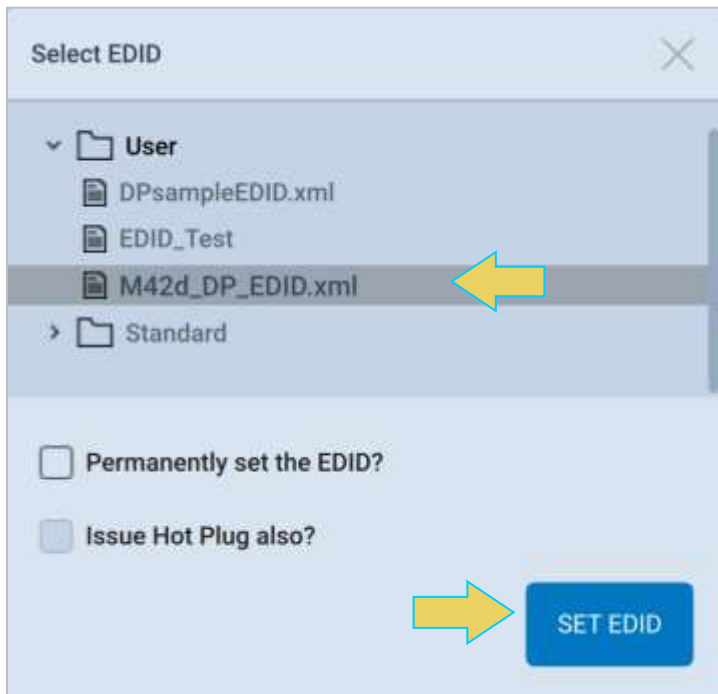
**Note:** By default, the M42d emulates an EDID that is compatible with DP 2.0. You can permanently change the EDID (until explicitly changed) using the procedures provided in this section, otherwise it resets to the default EDID each time the instrument is booted.

Use the procedures below to provision the M42d Rx port with an EDID to emulate a sink device.

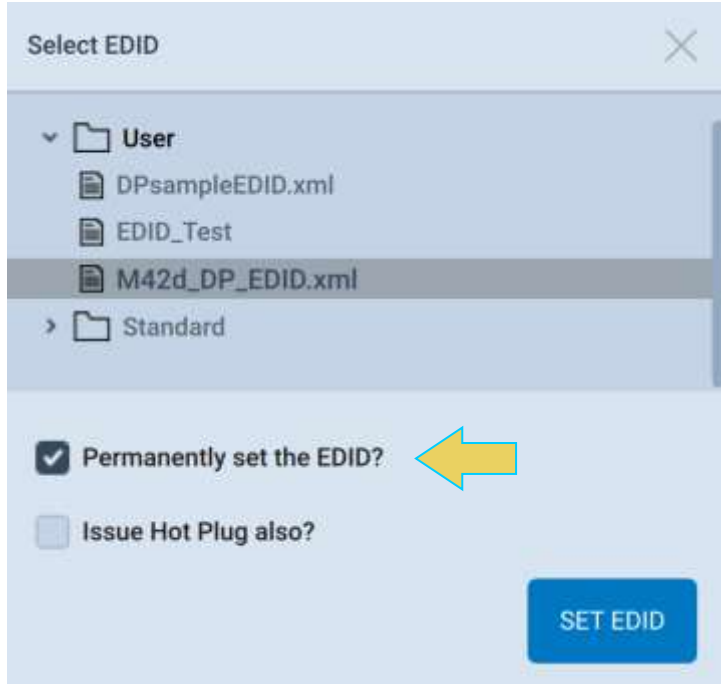
5. Open the **Analyzer** from the Home Dashboard.
6. Access the Select EDID dialog box by clicking the **EDID** button on the top toolbar, as shown below.



7. Select the EDID that you wish to emulate on the module's Rx port and then click **SET EDID**.



8. You may also wish to set the EDID permanently. You can do so by checking the respective box within the Select EDID window.

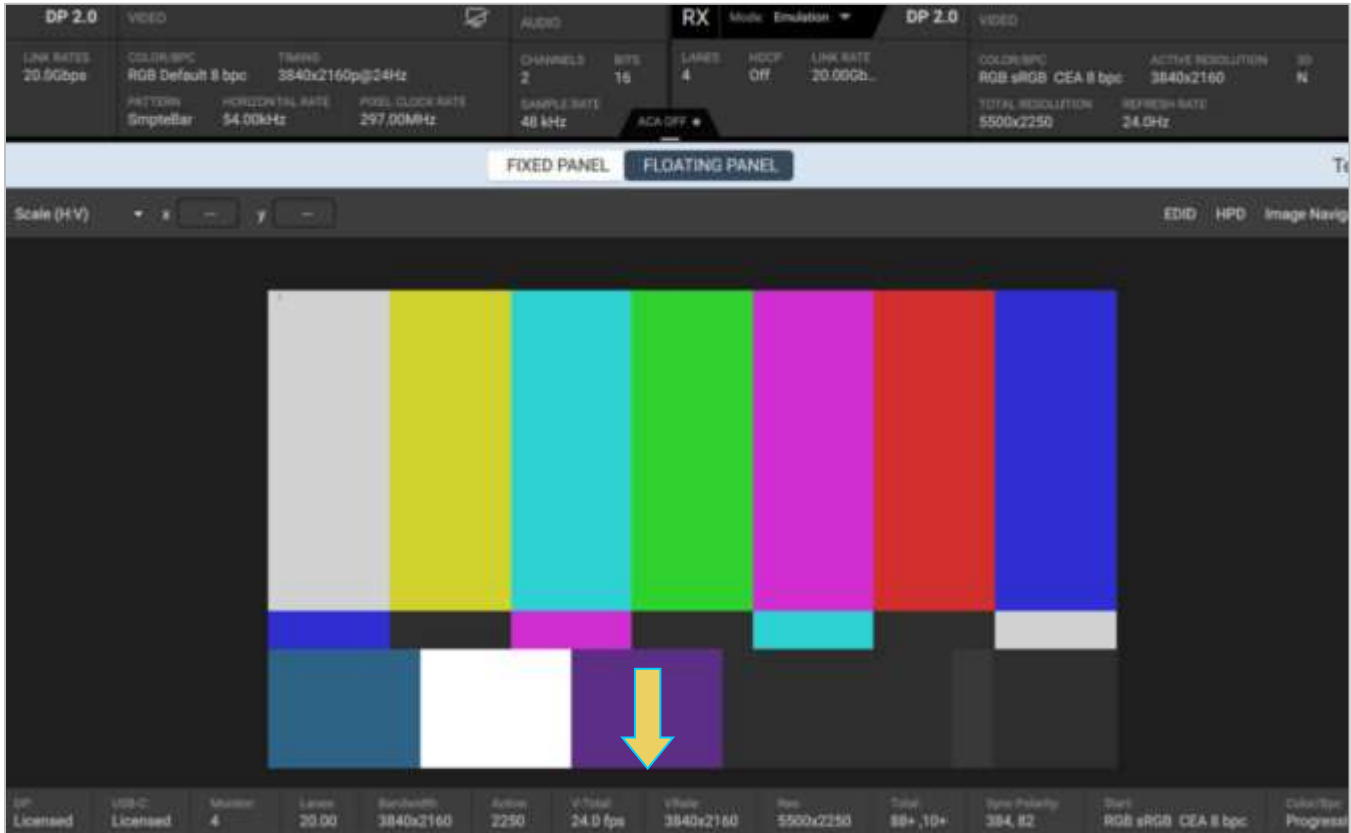


The M42d's Rx port will emulate the EDID you selected.

### Verifying source video

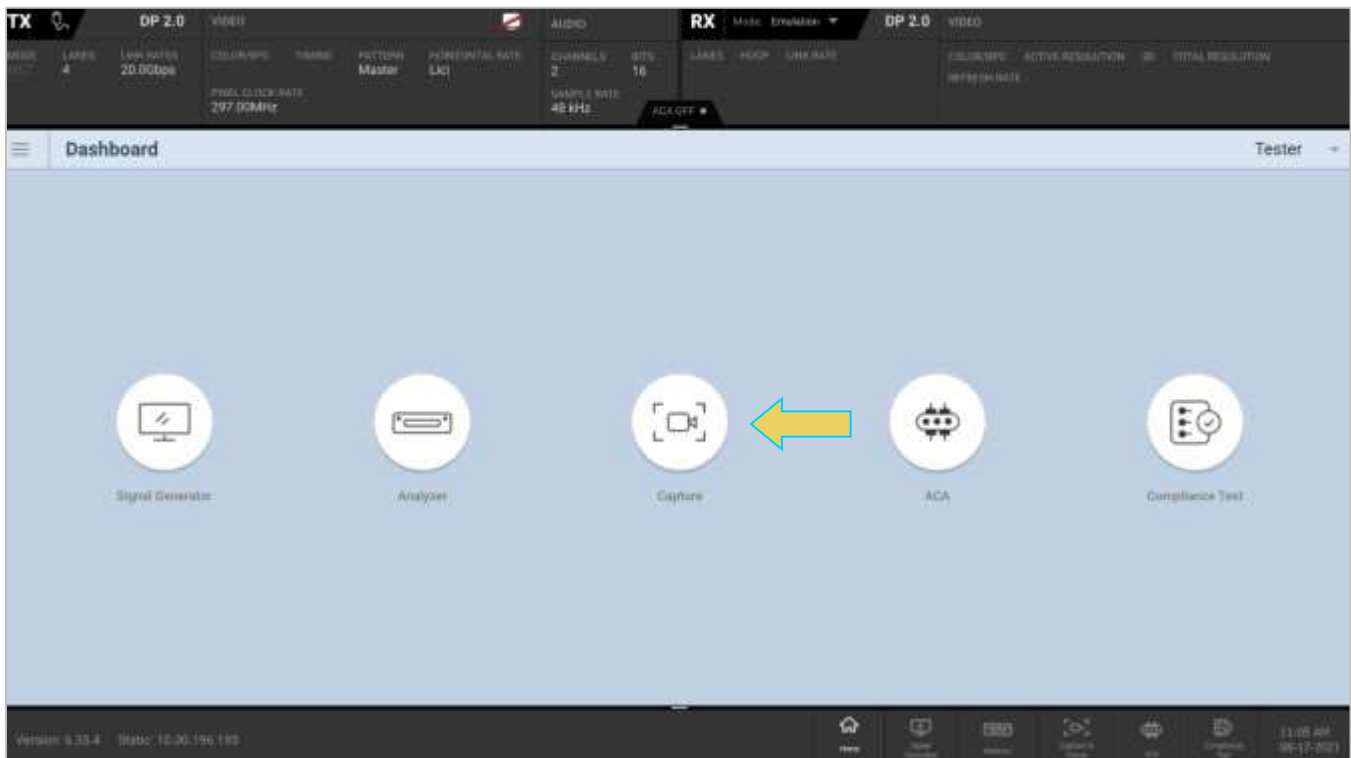
Before you capture data, you should verify that you are receiving DisplayPort video from the source.

Verify the incoming video of the DisplayPort source to ensure that the source is outputting the proper video. In the screen example below the video shown is a test pattern. Typically, the video you will see will be from a PC or some other source. Verify the information in the bottom status panel.

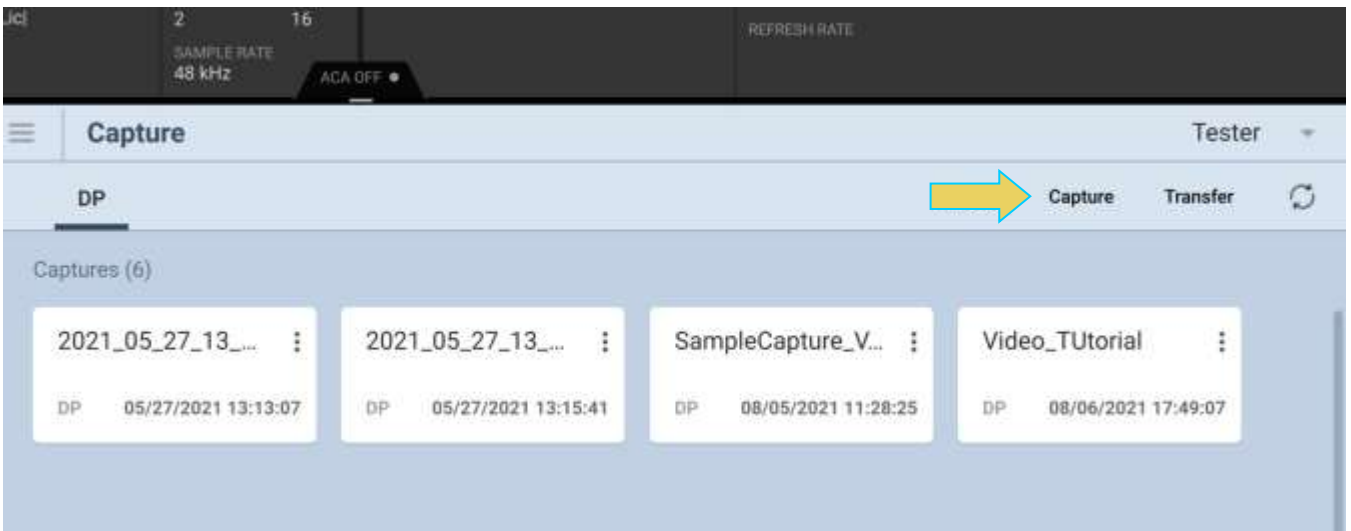


## 6.2 Capture Control Panel

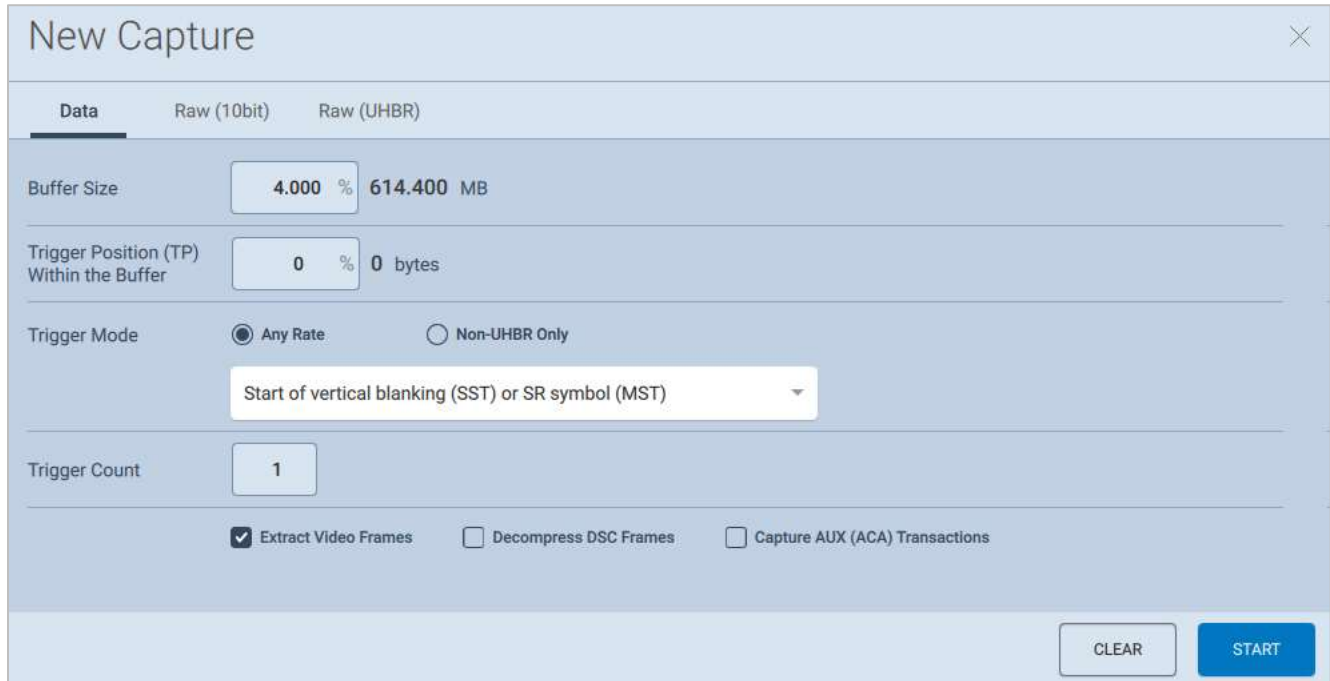
Access the **Capture & Viewer** from the Home Dashboard of the M42d VPS GUI.



By default, a list of saved captures is displayed, as shown below. Click the **Capture** button at the top right to begin a new capture.



You initiate a new capture through the Capture Control panel. The Capture Control panel enables you to setup the capture parameters. The figure below shows the Capture Control panel and its control and selection items.



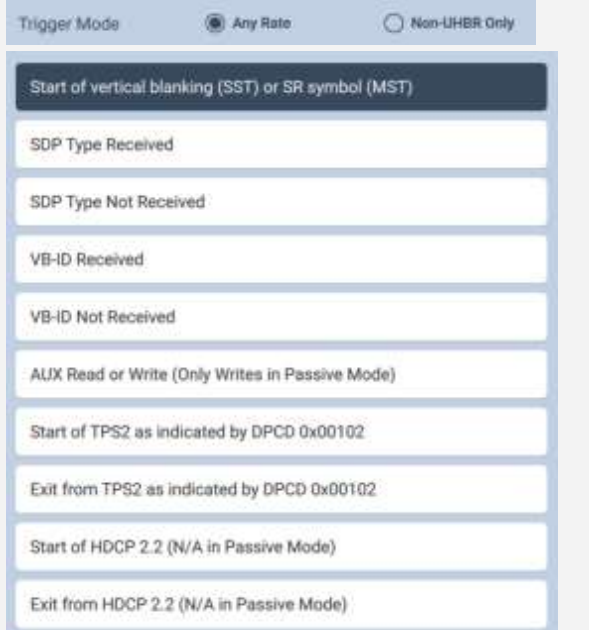
The following table describes the functions of the **Capture Control** panel, specifically the **Data** tab:

Capture Control Panel - Function	Item - Description
Buffer Size	<ul style="list-style-type: none"> <li>Enables you to set the size of the captured data in percent of the 8 GB buffer.</li> <li>This is a sliderbar that provides an indication (on the left) of the percent of the total possible size to be captured. A lower value will require less time for the captured data to accumulate.</li> </ul>
Trigger Position within Buffer	<ul style="list-style-type: none"> <li>Enables you to set the position of the trigger event within the captured data.</li> <li>This sliderbar determines how much of the data that has accumulated in the capture buffer has occurred before the trigger event. The sliderbar has an indication (on the left) of the location of the trigger event within the captured data. The value is expressed as a percent.</li> <li>A value of 0% indicates that the trigger event occurs at the beginning of the resulting captured data and 100% indicates that the trigger event occurs at the end of the resulting captured data.</li> <li>A value of 50% indicates that the trigger event is in the middle of the captured data.</li> </ul>


Capture Control Panel - Function	Item - Description
	<ul style="list-style-type: none"> <li>• <b>Note:</b> The Buffer Position Slidebar is not applicable when you select Vsync as the trigger condition.</li> </ul>
Trigger Mode	<ul style="list-style-type: none"> <li>• Enables you to specify the type of data that you want to capture.</li> <li>• <b>Note:</b> <i>This is covered in greater detail after this table.</i></li> </ul>
Trigger Count	<ul style="list-style-type: none"> <li>• Option to specify which occurrence of the selected trigger event will initiate capture</li> <li>• eg. a Trigger Count of 5 will start capture at the 5<sup>th</sup> occurrence of the trigger event</li> </ul>
Extract Video Frames	<ul style="list-style-type: none"> <li>• Enables you to view the video frames that were captured.</li> </ul>
Decompress DSC Frames	<ul style="list-style-type: none"> <li>• Makes video frames viewable if DSC mode is enabled</li> <li>• Extract Video Frames toggle must be enabled for this option to be active</li> </ul>
Capture AUX (ACA) Transactions	<ul style="list-style-type: none"> <li>• Enables you to capture the Aux Channel transactions</li> </ul>
Start Capture (Capture Tab)	<ul style="list-style-type: none"> <li>• Initiates a capture using the criteria defined in the <b>Trigger Mode</b> and <b>Trigger Symbol</b>.</li> </ul>

The **Trigger Mode** drop down selection allows you to pick the specific event occurrence that will initiate the capture. You may use the radio buttons to select a trigger at **Any Rate** or **Non-UHBR Only**

With the **Any Rate** radio button selected, a set of options is selectable from the drop-down menu beneath it, as shown below and described in the following table:

Any Rate Trigger Mode Drop Down Menu	Trigger Options
	<ul style="list-style-type: none"> <li>• Start of vertical blanking (SST) or SR/LLCPM symbol (Multi-Stream Transport)</li> <li>• SDP Type Received</li> <li>• SDP Type Not Received</li> <li>• VB-ID Received</li> <li>• VB-ID Not Received</li> <li>• AUX Read or Write (Only Writes in Passive Mode)</li> <li>• Start of TPS2 as indicated by DPCD 0x00102</li> <li>• Exit from TPS2 as indicated by DPCD 0x00102</li> <li>• Start of HDCP 2.2/2.3 (N/A in Passive Mode)</li> <li>• Exit from HDCP 2.2/2.3 (N/A in Passive Mode)</li> </ul>

When selecting **Non-UHBR Only** Trigger, another set of options is selectable from the drop-down menu beneath it. A few of these triggers require you to select the lane for the trigger to occur on, as shown and described in the table below. You may need to scroll down within the list to see all options.

Non-UHBR Only Trigger Mode Drop Down	Trigger Options
	<ul style="list-style-type: none"> <li>• Specified Symbol (more on next page)</li> <li>• Data Byte Value</li> <li>• 8B10B Symbol Error</li> <li>• 8B10B Disparity Error</li> <li>• Start of TPS3 as indicated by DPCD 0x00102</li> <li>• Exit from TPS3 as indicated by DPCD 0x00102</li> <li>• Start of TPS4 as indicated by DPCD 0x00102</li> <li>• Exit from TPS4 as indicated by DPCD 0x00102</li> <li>• Start of HDCP 1.3 (N/A in Passive Mode)</li> <li>• Exit from HDCP 1.3 (N/A in Passive Mode)</li> <li>• FEC Decode Enable Sequence</li> <li>• FEC Decode Disable Sequence</li> <li>• ML_PHY_STANDBY detected on main link</li> <li>• ML_PHY_SLEEP detected on main link</li> <li>• AUX_PHY_WAKE detected on AUX channel</li> </ul>

AVF	BE	BF
BS	C0	C1
C2	C3	C4
C5	C6	C7
CP	CPF	EOC
FE	FS	LLCPM
PM	R2	SE
SF	SR	SS

If **Specified Symbol** is selected, then select one of:

- BS=Blanking Start
- BE=Blanking End
- BF=Blanking Fill
- C0-C7=VC Payload Fill Control code sequence
- CP=Content Protection
- FE=Fill End, FS=Fill Start
- R2
- SE=Secondary Data End
- SR=Scrambler Reset,
- SS=Secondary Data Start
- Other

**Note:** You may need to scroll down to see all options

The next subsection will describe the procedures for capturing and viewing data using **Capture Control**.



## Capturing DisplayPort source data

The procedures for running a capture of the DisplayPort source are described in this subsection. You can operate the Protocol Analyzer either through the M42d embedded VPS GUI or via a PC through the external VPS GUI Application. Most of the examples in this section are taken from the embedded M42d VPS GUI but the look and feel are quite similar between the two.


### Capturing DisplayPort source data

1. Access the **Capture Control** application from the VPS Dashboard home screen.

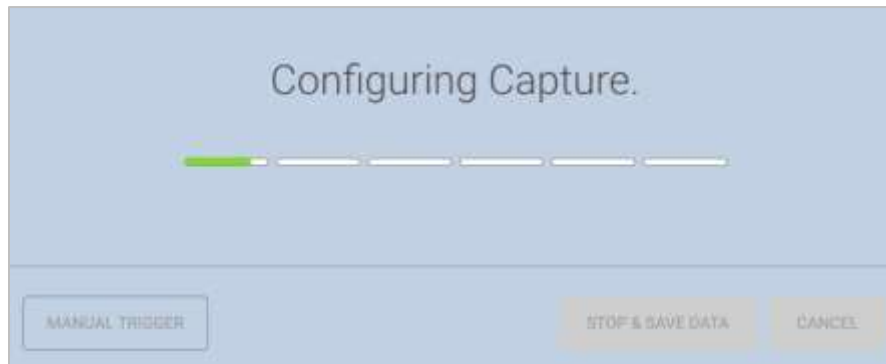
The **Capture Control** window opens as shown below.

The screenshot shows the 'New Capture' dialog box with the following configuration:

- Buffer Size: 4.000 % (614.400 MB)
- Trigger Position (TP) Within the Buffer: 0 % (0 bytes)
- Trigger Mode: Any Rate (selected), Non-UHBR Only
- Trigger Mode Dropdown: Start of vertical blanking (SST) or SR symbol (MST)
- Trigger Count: 1
- Extract Video Frames:
- Decompress DSC Frames:
- Capture AUX (ACA) Transactions:
- Buttons: CLEAR, START

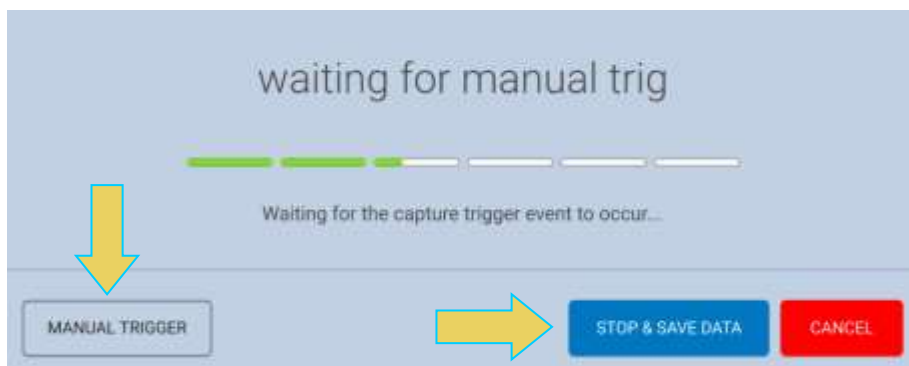
2. Specify the **Buffer Size** and **Trigger Position, Mode,** and **Count** in accordance with the information provided earlier in this chapter.
3. Toggle on or off the options to **Extract Video Frames, Decompress DSC** (if applicable), and **Capture AUX (ACA) Transactions.**
4. Initiate the capture by clicking on the **Start** activation button 

A progress bar will appear, as shown below.

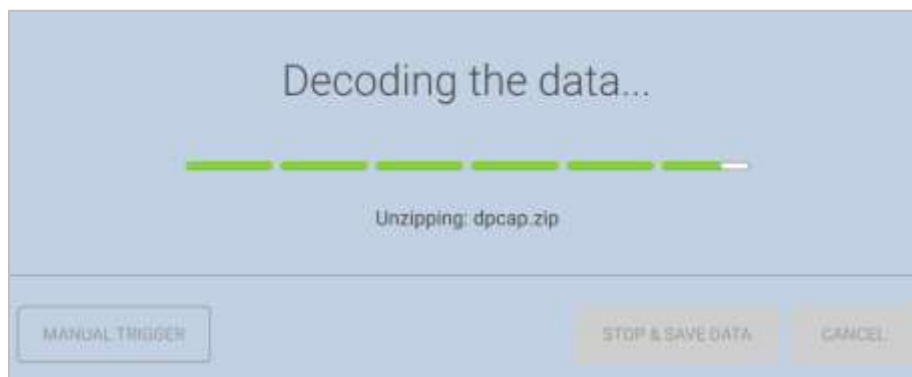


If the capture trigger event does not occur, you may click the **MANUAL TRIGGER** or **STOP AND SAVE DATA** buttons. They are described below. You can also **CANCEL** the capture at any time.

- Manual Trigger – If the trigger event does not occur as expected, or if you are viewing the video display in real time and you notice an occurrence that you would like to capture the data of, manually initiate a capture with the previously set specifications at this point.
- Stop and Save Data – If the capture is not triggered as expected, you can essentially cancel the capture and keep the raw data for later analysis.



Once the capture trigger event has occurred, the data will be decoded and saved for viewing. An example of the progress bar while this occurs is below.



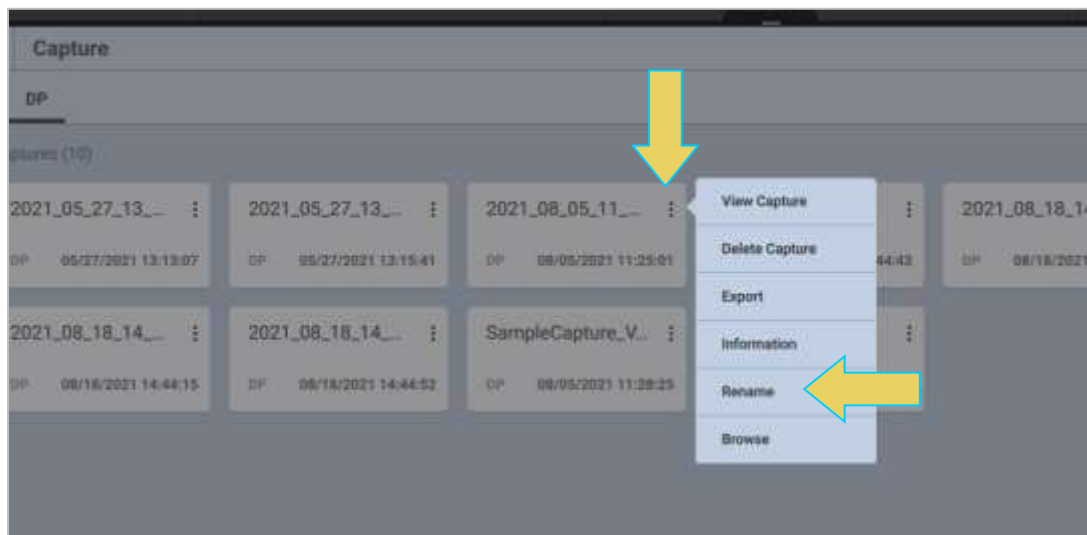
When the capture is complete, the data is presented in the **DP Capture Viewer**. An example of the captured data is shown in the screen shot example below.



The **Capture Viewer** and its features/functionality is covered in much detail in the next two sections of this chapter. **6.3 Capture Viewer Panels** covers the Event Plot, Data Decode/Details, and Link Symbol panels, while **6.4 Searching and Filtering** for Specific Data Elements covers searching for events or symbols, and filtering using the functions within the Capture Viewer.

The Capture file name will initially be the date/time it was performed, as pictured in bold at the top of the above screenshot.

To change the Capture file name, exit the Capture Viewer, click the three-dot menu icon of the capture you wish to change, then click **Rename**, as shown below.

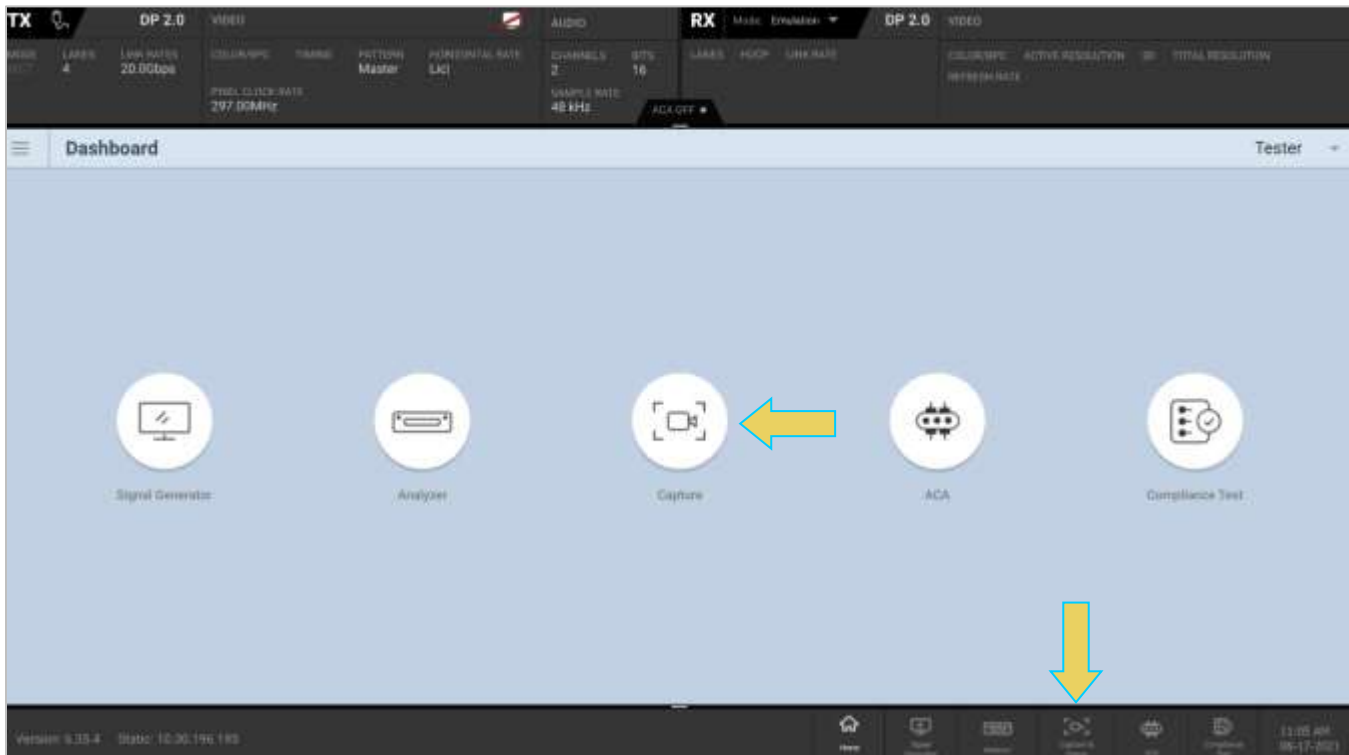


## Opening an Existing Capture

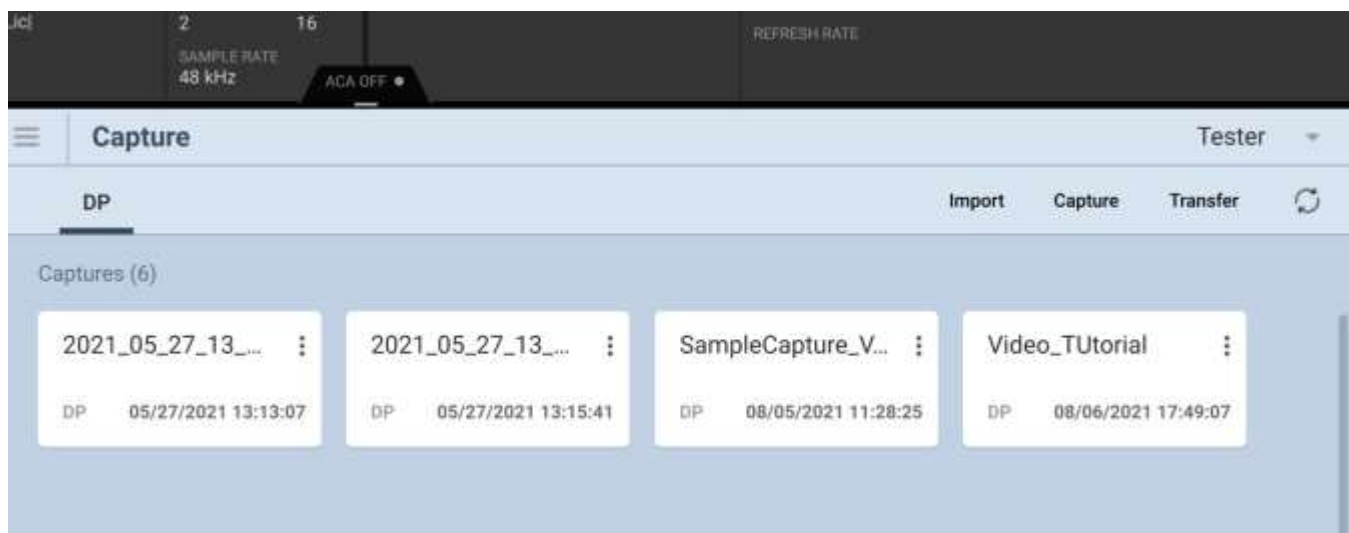
This section provides the procedure for opening a capture within the **Capture Viewer**.

Before covering the DP Capture Viewer in detail in the following sections, this subsection will go over opening a previously saved capture within the Capture Viewer.

Open the **Capture & Viewer** from the Home Dashboard or the icon at the bottom of the window.



A list of previously executed captures is available. Simply click the file you wish to open, and it will be displayed in the DP Capture Viewer.



## 6.3 Capture Viewer Panels

### Capture Viewer Overview

The **Capture Viewer** enables you to locate data by searching for specific data types, panning, scrolling and zooming using various techniques. You can filter the data by type to limit the amount of data to sift through.

There are three (3) panels in the Capture Viewer:

- **Event Plot Panel** – Visual presentation of the audio, video, metadata, protocol and control elements.
- **Event Table** (Transactions panel and Details panel) – Tabular chronology of audio, video, metadata, protocol and control elements with precise timestamps assigned. Enable searching and filtering.
- **Link Symbol Panel (RAW DATA)** – Table of link symbol values in hex for all lanes.

The panels are synchronized with one another. When a datum is selected, it automatically selects the corresponding information in the other two panels. Refer to the screen capture and information below.

The screenshot displays the Capture Viewer interface for the file 2021\_08\_05\_11\_23\_33. The interface is divided into three main panels:

- Event Plot Panel:** Located at the top, it shows a timeline with markers and data points. A yellow arrow points to this panel.
- Event Table Panel:** Located at the bottom left, it displays a table of events with columns for Link Clock, Time Stamp, and Type. A yellow arrow points to this panel.
- RAW DATA Panel:** Located on the right, it shows a hex dump of data with columns for Offset, L0, L1, L2, and L3. A yellow arrow points to this panel.

The Event Table panel shows the following data:

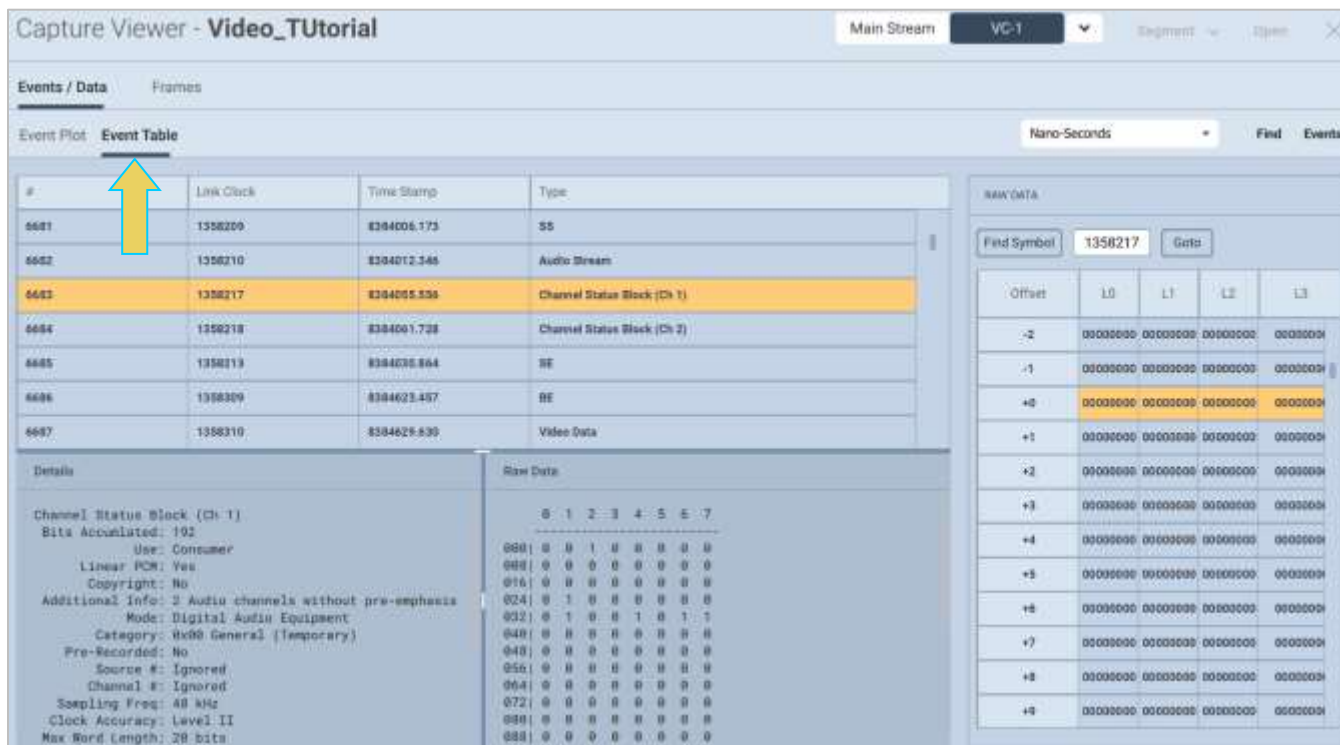
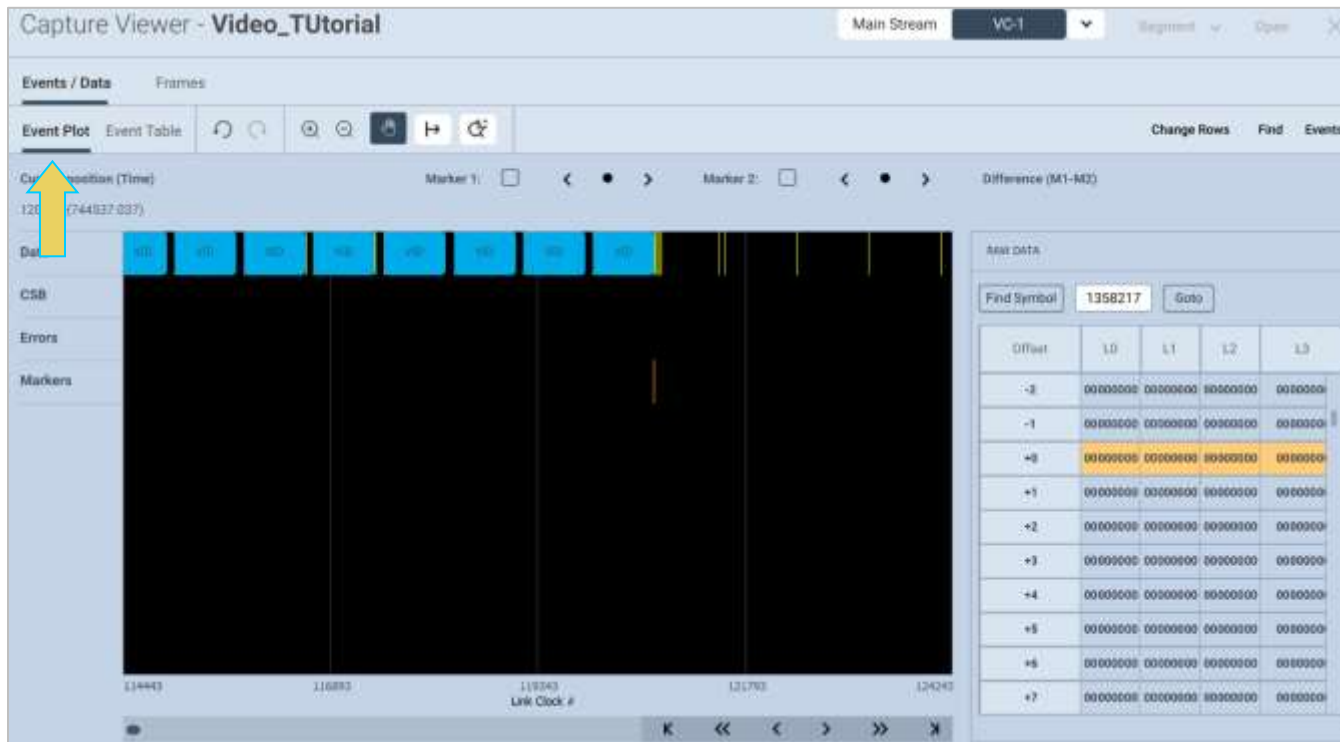
#	Link Clock	Time Stamp	Type
2500	471383	0:0:0.001.745.862.863	BF
2500	471384	0:0:0.001.745.866.667	BS
2507	471385	0:0:0.001.745.870.370	BS Data
2508	471405	0:0:0.001.745.944.444	SS
2509	471406	0:0:0.001.745.948.148	Audio Stream
2510	471416	0:0:0.001.745.992.893	SE
2511	473149	0:0:0.001.752.482.863	SE
2512	473148	0:0:0.001.752.488.667	Video Data
2513	473149	0:0:0.001.752.477.778	FW

The RAW DATA panel shows the following hex dump:

Offset	L0	L1	L2	L3
-2	60	00	00	00
-1	55	55	55	55
+0	00	02	00	01
+1	01	0E	60	07
+2	35	99	44	01
+3	1E	16	50	85
+4	00	00	00	00
+5	A0	98	A0	90
+6	21	8D	35	98
+7	38	02	5A	87
+8	FC	F4	8B	E3
+9	FF	FF	FF	FF
+10	A0	98	A0	90
+11	F2	BF	77	22
+12	9E	9E	9E	9E
+13	00	00	00	00

Before looking at the Capture Viewer panels, the following subsection will cover the toolbar at the top of the Capture Viewer interface.

**Note:** Depending on your display’s resolution and scaling, the **Event Plot Panel** and **Event Table** will be shown in separate tabs, as shown below.

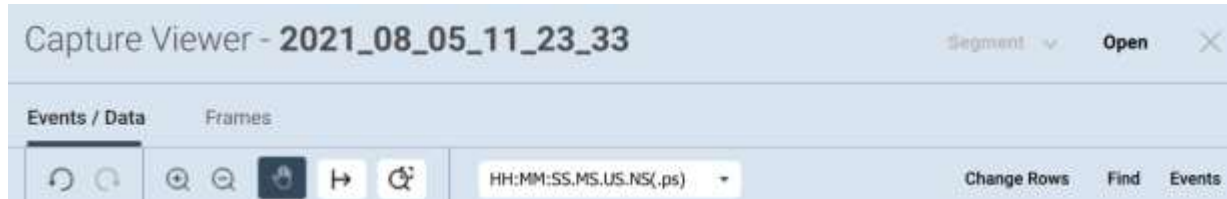


## Capture Viewer Toolbar

The toolbar at the top of the Capture Viewer interface enables you to view, find, or filter for specific data types, as well as customize the format that the time is displayed in. You can also open or simply view the different virtual channels captured.

Additionally, certain utilities on the toolbar are accessible if the option was enabled when executing the capture in the previous steps, specifically the **Frames** tab.

A screenshot of the toolbar is below. Note that the **Open** toolbar button at the top right is utilized during UHBR/Multi-Stream transport captures. This is covered **later in this section**.



## Segment

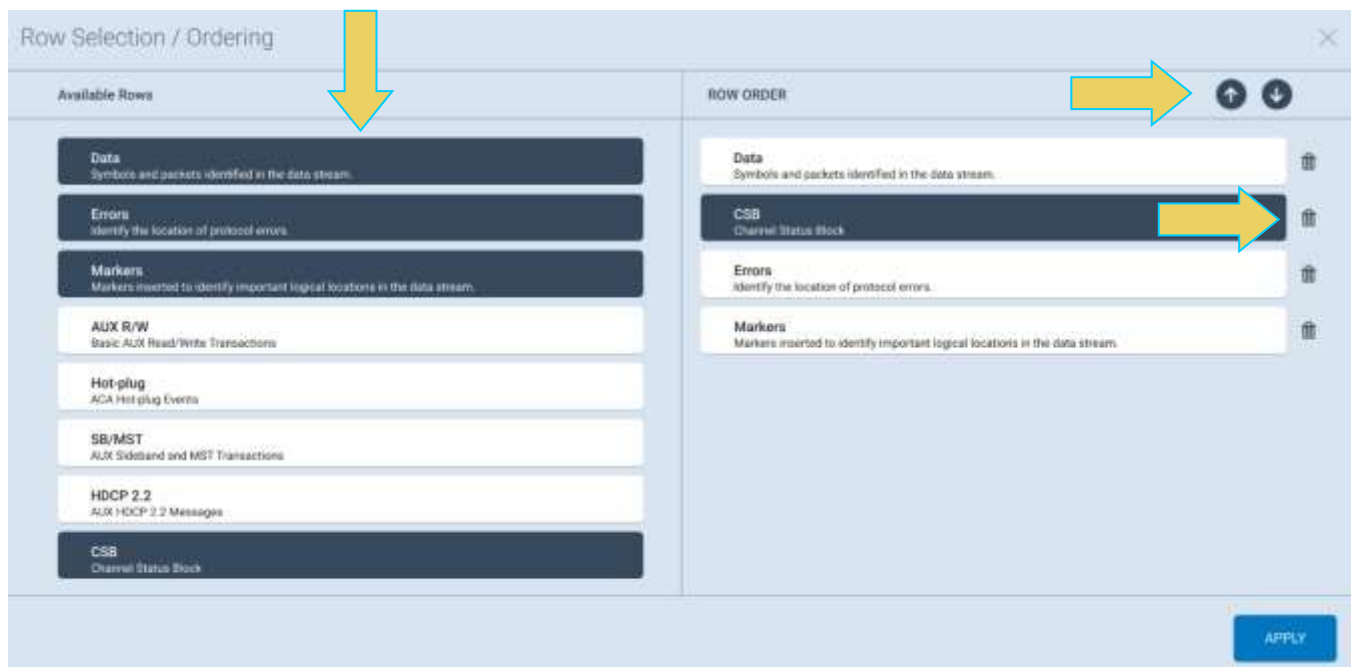
The Open Segment button  is enabled when performing a large capture. The capture is broken up into segments within the Capture Viewer, and you can click **Segment** to view the segment in its entirety.

## Change Rows

The Change Rows **Change Rows** button brings up the **Row Selection/Ordering** dialog box, as shown below. The following example has **Data**, **Errors**, **Markers**, and **CSB** (Channel Status Block) rows selected and ordered.

Make a row visible in the Event Plot Panel by clicking on it in the **Available Rows** (left-hand) column. Remove a row by clicking it again in the Available Rows column or selecting it in the Row Order column and clicking the trash can to the right of the row, as shown below.

Re-order by selecting the row in the **Row Order** and using the up/down arrows above the column.



Click the **APPLY** button at the bottom right.



The Capture Viewer window with these settings will display as follows, with the selected rows in the Event Plot Panel.



The **Events** **Events** and **Find** **Find** buttons are covered in **Section 6.4 Searching and Filtering for Specific Data Elements.**

### Time Format

The Time Format drop down selection enables you to specify the format of the **Time Stamp** column in the Data Decode panel. The screenshot below shows the **Time** dropdown menu. In this example, the format selected is HH:MM:SS.ms.us.ns(.ps) which shows demicals down to the picoseconds.

The screenshot displays the software interface with the 'Time Format' dropdown menu set to 'HH:MM:SS.ms.us.ns(.ps)'. A yellow arrow points to this dropdown. Below the menu is an 'Event Plot' showing a timeline with markers at 114443, 116893, and 119343. A second yellow arrow points from the plot area down to the 'Event Table' below.

#	Link Clock	Time Stamp	Type
6681	1358209	0:0:0.008.384.006.173	SS
6682	1358210	0:0:0.008.384.012.346	Audio Stream
6683	1358217	0:0:0.008.384.055.556	Channel Status BI
6684	1358218	0:0:0.008.384.061.728	Channel Status BI

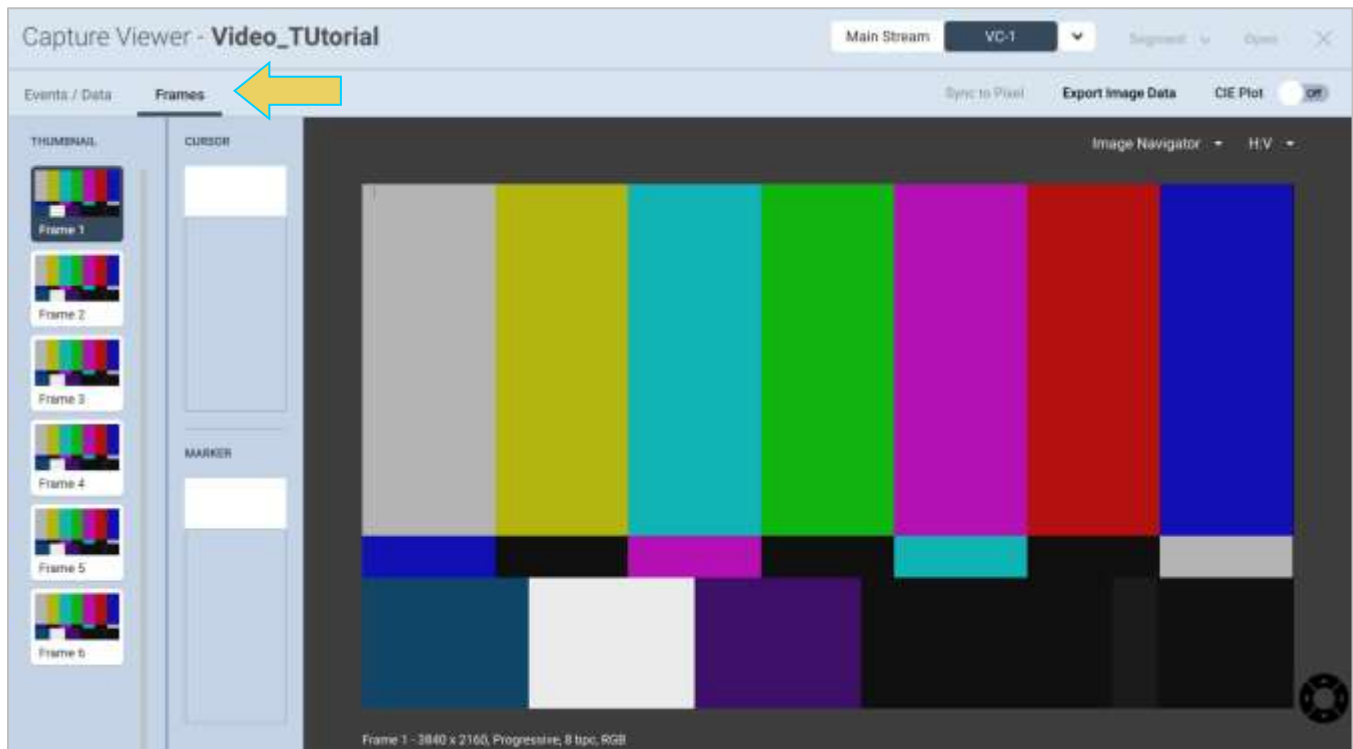
This next example shows the TimeStamp shown in Nano-Seconds.

The screenshot shows the 'Capture Viewer - Video\_Tutorial' interface. At the top right, it says 'Main Stream'. Below that, there are navigation icons and a 'SELECT FORMAT' dropdown menu. The dropdown menu is open, showing options: 'Pico-Seconds', 'Nano-Seconds' (highlighted with a yellow arrow), 'Micro-Seconds', 'Milli-Seconds', and 'HH:MM:SS.ms.us.ns(ps)'. Below the dropdown, there is an 'Event Plot' section with a 'Current position (Time)' of 122932 (0:0:0.000.758.839.506). The plot shows a timeline with blue bars and vertical markers. A yellow arrow points from the 'Nano-Seconds' option in the dropdown to the 'Event Table' below. The 'Event Table' has columns for '#', 'Link Clock', 'Time Stamp', 'Type', and 'Details'. The table contains four rows of event data.

#	Link Clock	Time Stamp	Type	Details
6679	1358204	8382975.309	BS	Channel Status Block (Ch 1) Bits Accumulated: 192 Raw Data 0 1 2 3 4 5 6 7 000: 0 0 1 0 0 0 0 0
6680	1358205	8383981.481	BS Data	
6681	1358209	8384006.173	SS	
6682	1358210	8384012.346	Audio Stream	

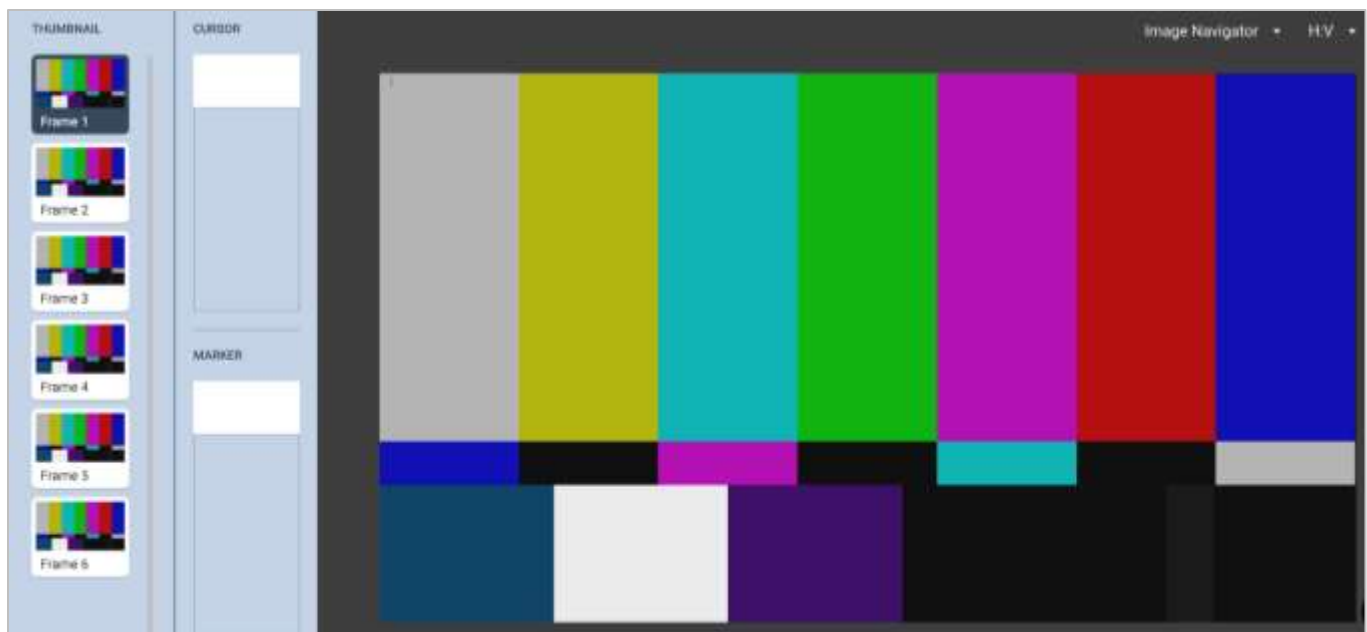
## Frames

If you selected to **Extract Video Frames** when running the capture, you can access the video frames by clicking the Frames tab at the top left.



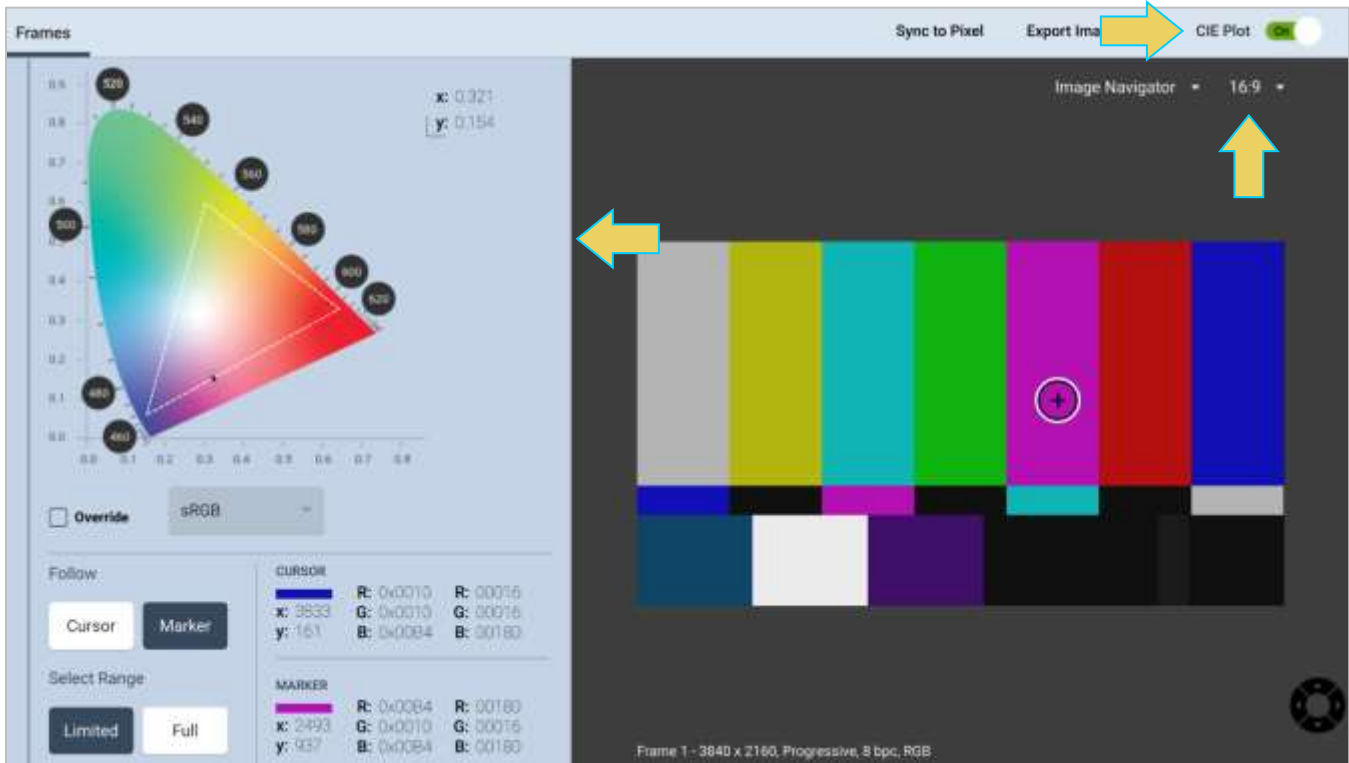
The video image viewer panel is on the right, and you can select a Frame from the thumbnail list on the left.

Depending on the **Buffer Size** specified, there will be more or less frames to view. The example below extracted six video frames.



Within the Video Image Viewer panel, you can scale the image, toggle on or off the colorimetry panel (CIE Plot), or export the image data.

The following example is scaled 16:9. The colorimetry panel is also enabled on the left-hand side of the window.



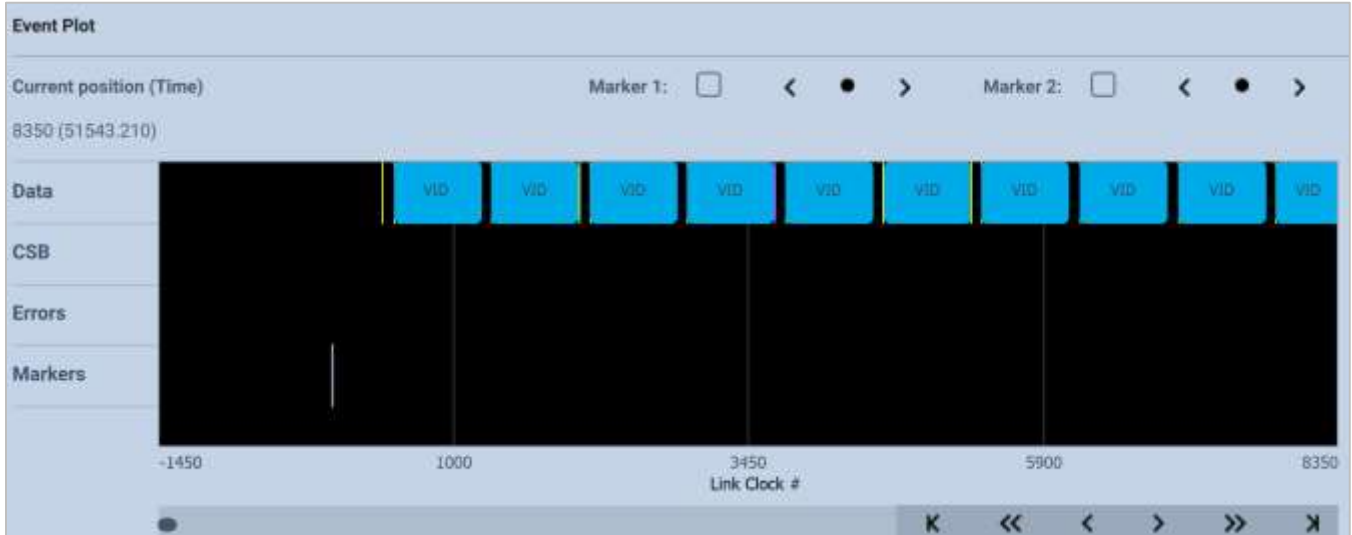
Click anywhere within the Image Viewer and the pixel information will be displayed in the colorimetry panel.

Click **Export Image Data** to save one or all frames as a Bitmap, Text, or DSC data file, as shown below.

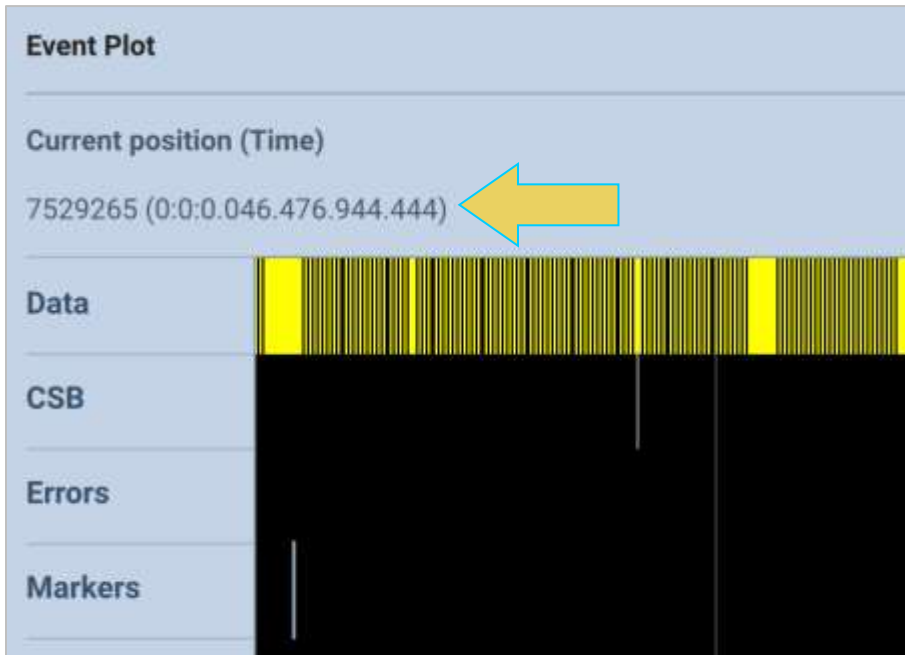


### Event Plot Panel

The **Event Plot** is shown below. The **Event Plot** provides a graphical view of the captured data symbols. The vertical axis is the data types. In this example the Data, CSB, Errors, and Markers rows are enabled. The scale along the bottom shows the Link Clock number.




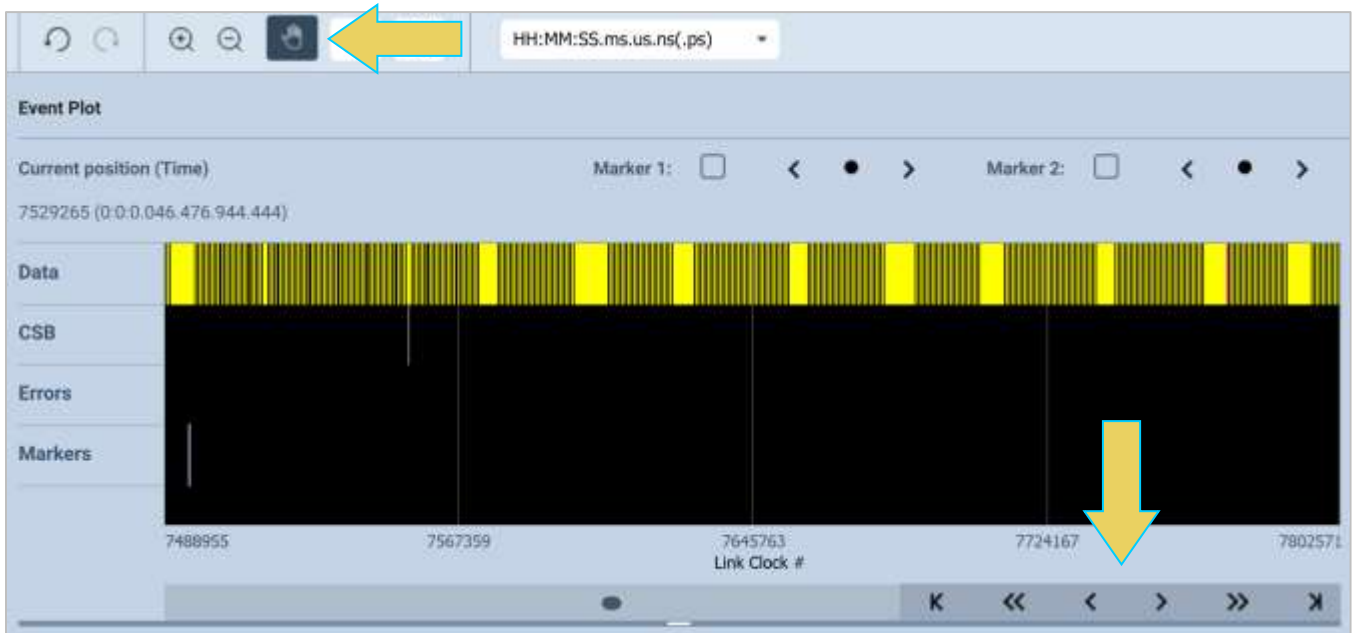
The timestamp of the cursor is shown near the top of the panel. As you move the pointer tool throughout the **Event Plot** panel the timestamp of the pointer's location is provided on the top of the panel as indicated below:



### Scrolling in the Event Plot Panel




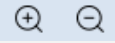
A scroll bar is provided to enable you to quickly browse through the data. The scroll bar is under the set of function icons just above the data panel where the data is displayed. You can also scroll to the end, scroll by page or scroll incrementally in either direction using the **K** **«** **<** backward and forward activation **>** **»** **⌘** buttons located to the right of the scroll bar.

You can also click and drag the panel in either direction if **Pan Mode** is enabled. Click the hand icon  at the top left of the Event Plot Panel to enable click and drag in Pan Mode.




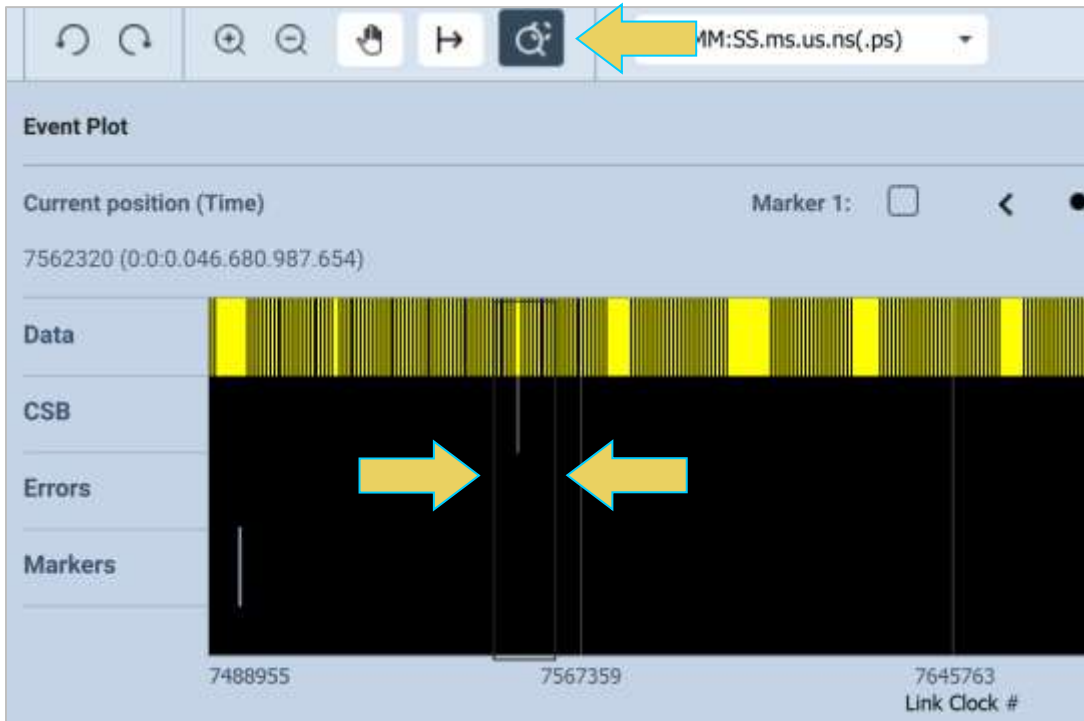
### Zooming in the Event Plot Panel

You can zoom in and zoom out and pan across the data using the slide bars provided. You can also zoom by surrounding a specific section of the captured data. These functions are described in the following table.

Even Plot Zoom Icons	Function
<p><b>Zoom Icons</b></p> 	<p>Previous  – This icon reverts the Event Plot Panel to the previous view. This will effectively “undo” a zoom or scroll.</p> <p>Range Zoom  – This function zooms in on a selected range within the Event Plot. Details below.</p> <p>Zoom In/Out icons  – The Zoom In/Out function buttons enables you to zoom in and zoom out by clicking on the activation button. The centered point will remain the same.</p>

### Surrounding and Zooming

The **Event Plot** provides a Range Zoom tool . You can select an area of the **Event Plot** by clicking and dragging across. When you do this the new view will be limited to the horizontal range that you selected. The midpoint of the selection will become the new center of the data displayed. The following screen shows an example of the Range Zoom Mode. The rectangle indicates the resultant section that is surrounded.




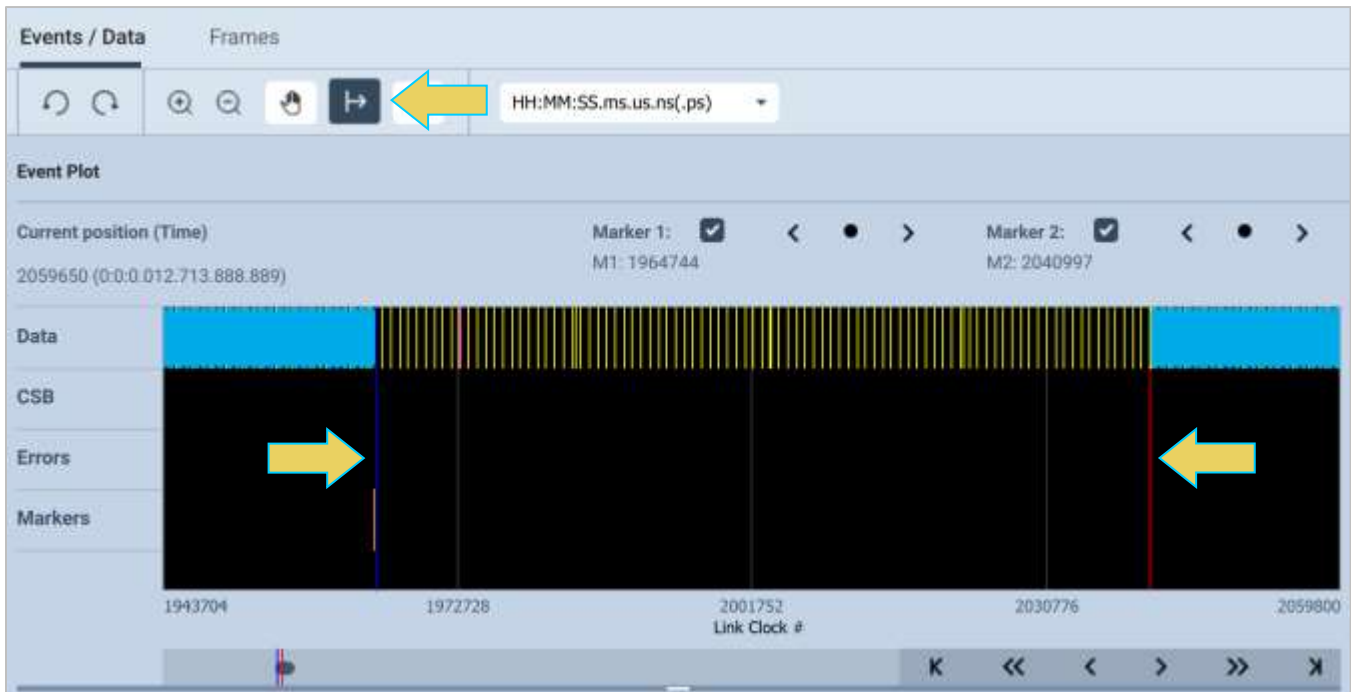
The resulting screen is as follows:

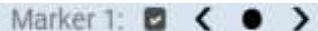





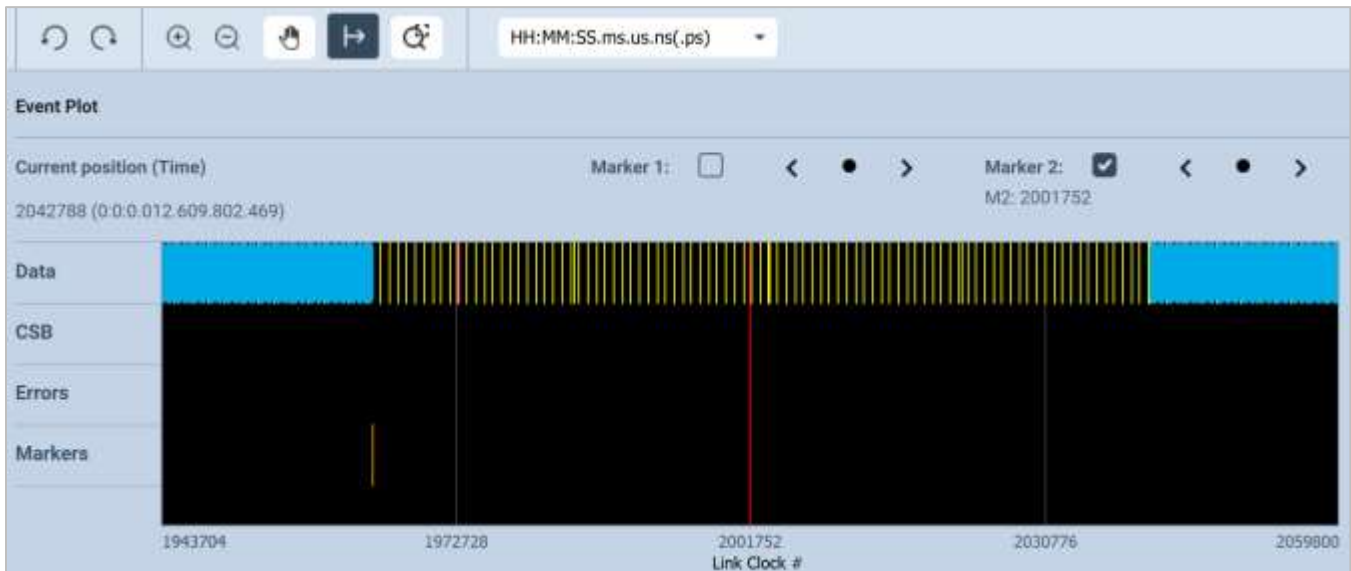
## Working with Markers

The **Event Plot** panel enables you to view the data at a high level and identify points of interest for further analysis. You can set two cursors or "markers" at particular points of interest using the Markers activation button . The **Event Plot** will show you the time difference between the two cursors. Note the example below.

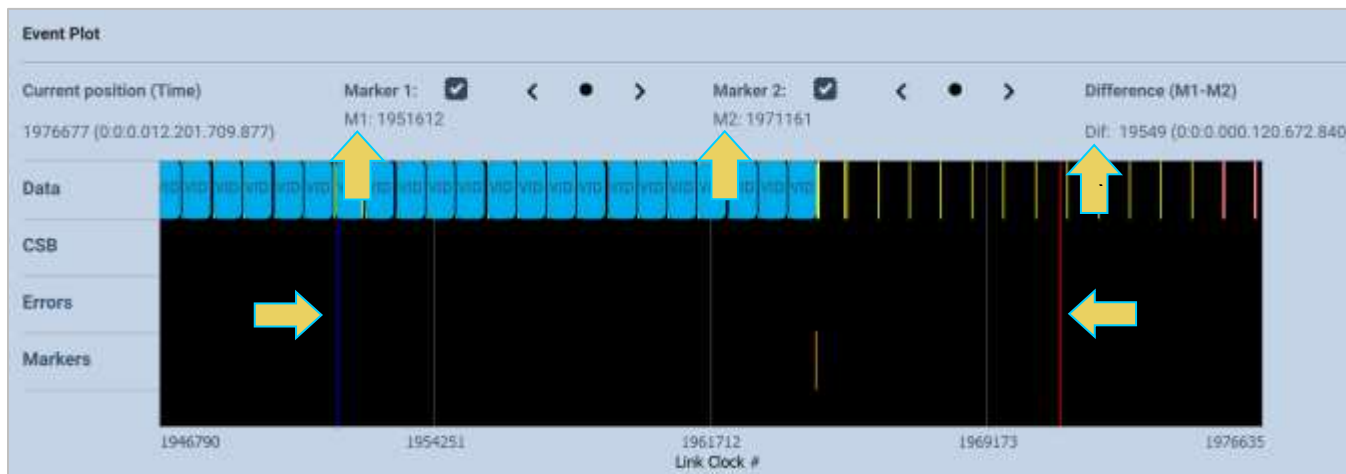


You can fine tune the position of the markers with the left and right arrows associated with each marker: . You can also deselect and remove a marker by unchecking its respective box.

The center  icon allows you to center the particular marker on the center of the **Event Plot** window. The example below shows Marker 2 deselected/removed and the Event Plot centered on Marker 1.



You can see the timestamp associated with each marker which are color coded (blue and red) just above the area where the data is shown. The dark text to the right labeled **Dif** shows the difference between the two markers in pixels and time.



### Link Clock timeline.

The Link clock symbol times are shown at the bottom of the **Event Plot** panel as indicated below.



### Event Detail Panels

The **Event Table Panel** is shown below. The Event Table provides a tabular or transactional view of the captured data symbols. When you highlight a transaction the information in the transaction appear in the Details panel to the right. The information in the Details panel is decoded in human readable text.

The example below shows an Audio Stream data type highlighted.

The screenshot displays the software interface with the following components:

- Events / Data** and **Frames** tabs at the top.
- Event Plot** and **Event Table** tabs below.
- Event Table** with the following data:

#	Link Clock	Time Stamp	Type
150	29823	0:0:0.000.184.092.593	BS Da
151	29827	0:0:0.000.184.117.284	SS
152	29828	0:0:0.000.184.123.457	Audio Stream
153	29831	0:0:0.000.184.141.975	SE
154	29925	0:0:0.000.184.722.222	BE
155	29926	0:0:0.000.184.728.395	Video Data
156	30646	0:0:0.000.189.172.840	BS
157	30647	0:0:0.000.189.179.012	BS Data

**Details** panel (highlighted for transaction 152):

```
Audio Stream  
Packet ID: 0  
Coding: 0 (2-8 Ch LPCM, IEC 61937 <= 6.144Mbps)  
Layout: 2 Channel Layout  
Sample 0  
  ch01=900083b0 ch02=a00083b0  
Sample 1  
  ch01=90009fde ch02=a0009fde  
Sample 2  
  ch01=9000b94f ch02=a000b94f  
Sample 3  
  ch01=9800cf94 ch02=a800cf94
```

**Raw Data** panel:

```
Lane 3: 01 00 de 9f 00 a0 00 94 cf 00 a8 00  
Lane 2: 00 00 de 9f 00 90 00 94 cf 00 98 00  
Lane 1: 02 00 b0 83 00 a0 00 4f b9 00 a0 00  
Lane 0: 00 00 b0 83 00 90 00 4f b9 00 90 00
```

**Note:** Depending on screen resolution and scaling, the Event Table may appear underneath the Event Plot, as shown in the example below, with the details panel of an MSA data type highlighted.

**Event Plot**

Current position (Time): 4124405 (0:0:0.025.459.290.123)

Marker 1:  M1: 1951612

Marker 2:  M2: 1971161

Data, CSB, Errors, Markers

-8297839 -4086560 120720 4330000 8539200

Link Clock #

K << < > >> X


**Event Table**

#	Link Clock	Time Stamp	Type	Details
607	119994	0:0:0.000.740.703.704	Video Data	MSA VFREQ: 1188000000 Hz Htotal: 4400 pixels Vtotal: 2250 lines Hwidth: 3840 pixels Vheight: 2160 lines Hstart: 384 Hsync: (+) 88 pixels Vstart: 82 lines Raw Data: Lane 3: 00 00 46 cf 71 00 29 41 00 00 00 00 Lane 2: 00 00 00 0f 00 00 70 00 00 00 00 00 Lane 1: 00 00 00 01 00 00 52 00 0a 00 00 00 Lane 0: 00 00 00 11 30 00 ca 00 50 00 00 00
608	120714	0:0:0.000.745.148.148	BS	
609	120715	0:0:0.000.745.154.321	BS Data	
610	120715	0:0:0.000.745.154.321	Start of Frame	
611	120718	0:0:0.000.745.172.840	SS	
612	120719	0:0:0.000.745.179.012	SS	
613	120720	0:0:0.000.745.185.185	MSA	
614	120723	0:0:0.000.745.203.704	SE	
615	120749	0:0:0.000.745.364.198	SS	
616	120750	0:0:0.000.745.370.370	Audio TimeStamp	
617	120753	0:0:0.000.745.388.889	SE	

### Link Symbol Panel


The **Link Symbol Panel** is shown below. The **Link Symbol Panel** provides an event list of all the raw link symbols in the capture for each lane. The data for each lane is presented in a separate column.

When you double click on a link symbol, the offset is reset to zero at that link symbol and the other two panels are then synchronized to that that point in the capture. The Link Symbol that is synchronized to is presented at the top of the panel as indicated below. The same occurs when a data type is selected in either of the other two panels.

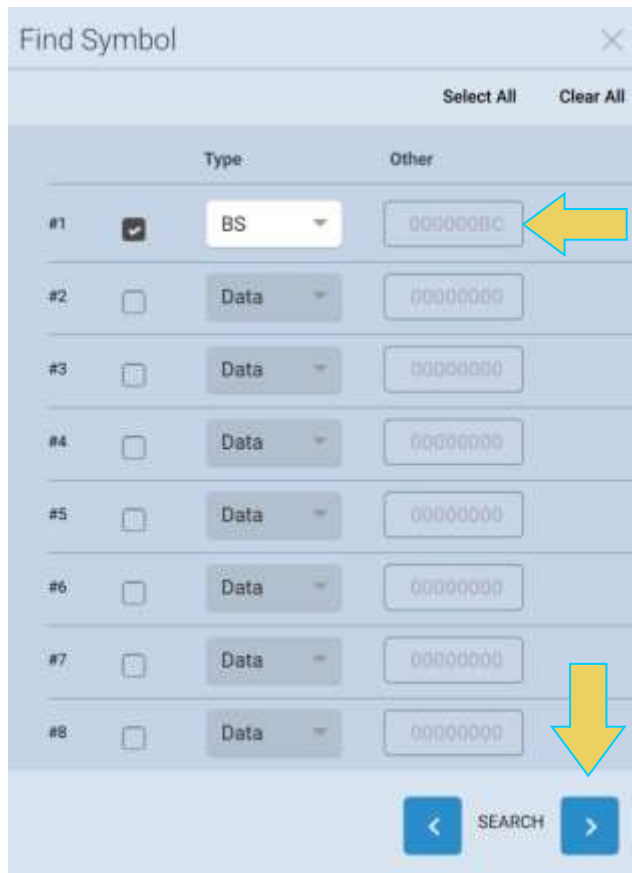
RAW DATA 

Find Symbol  Goto

Offset	L0	L1	L2	L3
-8	10101010	10101010	10101010	10101010
-7	10101010	10101010	10101010	10101010
-6	BS	BS	BS	BS
-5	00000001	00000001	00000001	00000001
-4	00000000	00000000	00000000	00000000
-3	00000000	00000000	00000000	00000000
-2	SS	SS	SS	SS
-1	SS	SS	SS	SS
+0	11000000	01000000	0F000000	CF460000
+1	00CA0830	00520080	00700800	41290070
+2	00000058	0000000A	00000000	00000000
+3	SE	SE	SE	SE
+4	00000000	00000000	00000000	00000000
+5	00000000	00000000	00000000	00000000



The **Find** button enables you to search for any type of control element. The Find dialog box is shown below with the Blanking Start (BS) control element selected. You can then search through the Link Symbol panel for all occurrences of that symbol or any other using the **PREVIOUS** and **NEXT** buttons within the Symbol Search box.



You can select up to 8 symbols to search for.

The **Goto** button enables you to snap to a specific Symbol number. When **Absolute** is selected, you will enter the exact Link Symbol number to find.



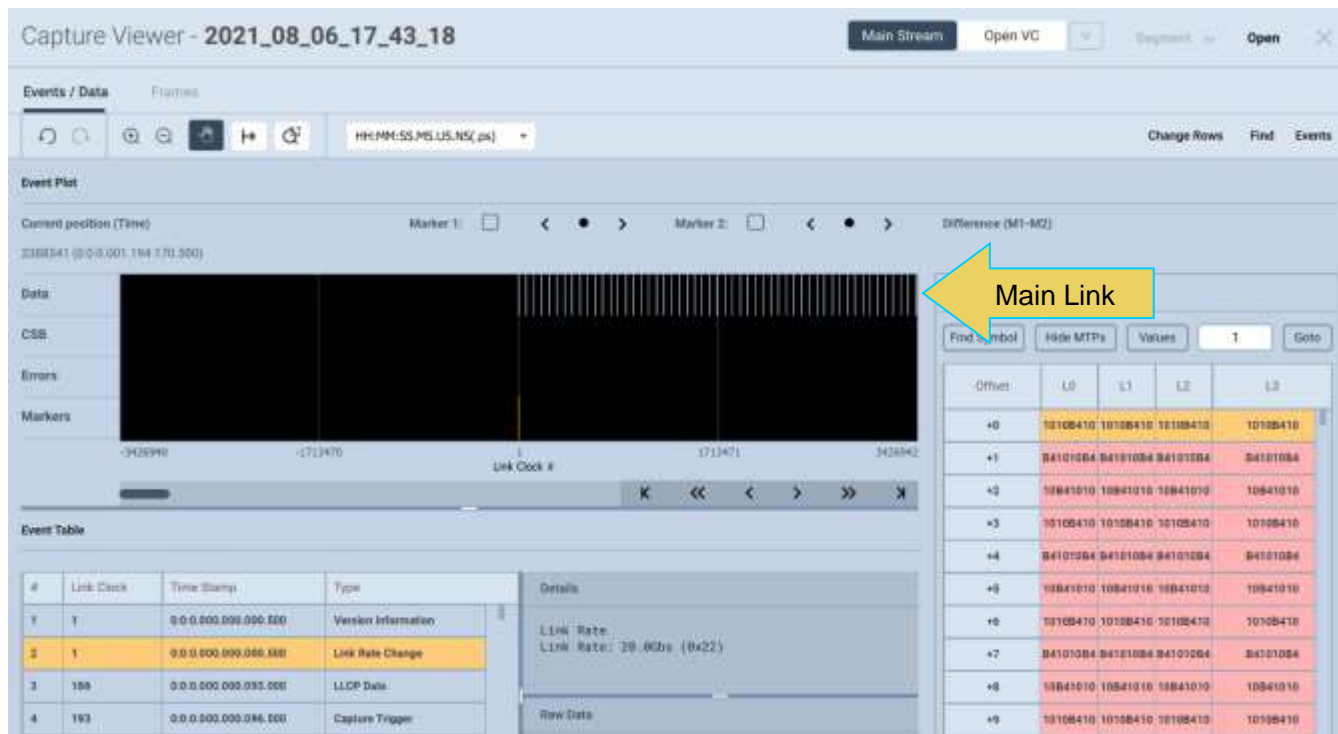
When **Relative to Zero** is selected, the function finds the Link Symbol relative to the Link Symbol with **Offset** of +0. Negative and Positive numbers are both accepted in this mode.

**Note:** If the Symbol # entered (either Absolute or Relative to Zero) is out of bounds, the **GOTO** button will be grayed out and unclickable.

### UHBR/Multi-Stream Transport Captures

When performing a capture in Multi-Stream Transport mode, the **Capture Viewer** will display the main link capture data within the Event Plot Panel, as shown below.

**Note:** For information on Multi-Stream Transport modes, see [3.6 Topology and Multi-Stream Transport](#).



To access the desired virtual channel and its captured data, use the **Open VC** button enabled in the top right of the window, as shown below.



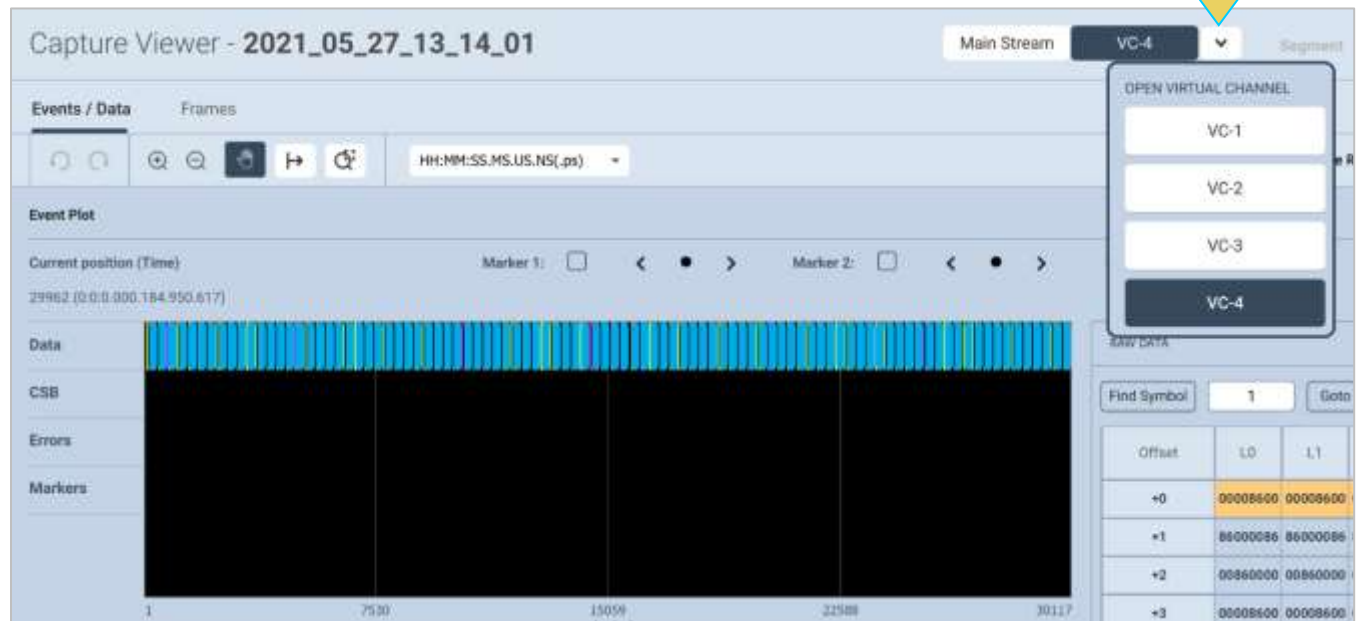
The **Open a Virtual Channel** dialog box will appear. Select the desired virtual channel you wish to view, as demonstrated below.



Upon selecting a virtual channel, the **Capture Viewer** will present the specified virtual channel and the data will be available for viewing, as described previously in this section.

You can easily return to the Main Link capture viewer by clicking the **Main Stream** button, or open a different virtual channel by clicking the drop-down to the right of the current VC, both in the top right of the window (pictured below).

The example shown below has virtual channel 4 selected.



The screenshot displays the 'Capture Viewer - 2021\_05\_27\_13\_14\_01' interface. At the top right, there are buttons for 'Main Stream' and 'VC-4', with a dropdown arrow next to 'VC-4'. A yellow arrow points to this dropdown menu, which is open, showing a list of virtual channels: 'VC-1', 'VC-2', 'VC-3', and 'VC-4'. The 'VC-4' option is highlighted in dark blue. Below the dropdown, the interface shows an 'Event Plot' with a current position of 29962 (00:0:000.184.950.617). The plot area is divided into sections for 'Data', 'CSB', 'Errors', and 'Markers'. The 'Data' section shows a dense bar of blue and green vertical lines. The 'CSB' section is black. The 'Errors' and 'Markers' sections are also black. At the bottom of the plot, there are time markers: 1, 7530, 15059, 22588, and 30117. On the right side, there is a 'RAW DATA' section with a 'Find Symbol' input field containing '1' and a 'Goto' button. Below this is a table with columns 'Offset', 'L0', and 'L1'.

Offset	L0	L1
+0	00008600	00008600
+1	86000086	86000086
+2	00860000	00860000
+3	00008600	00008600

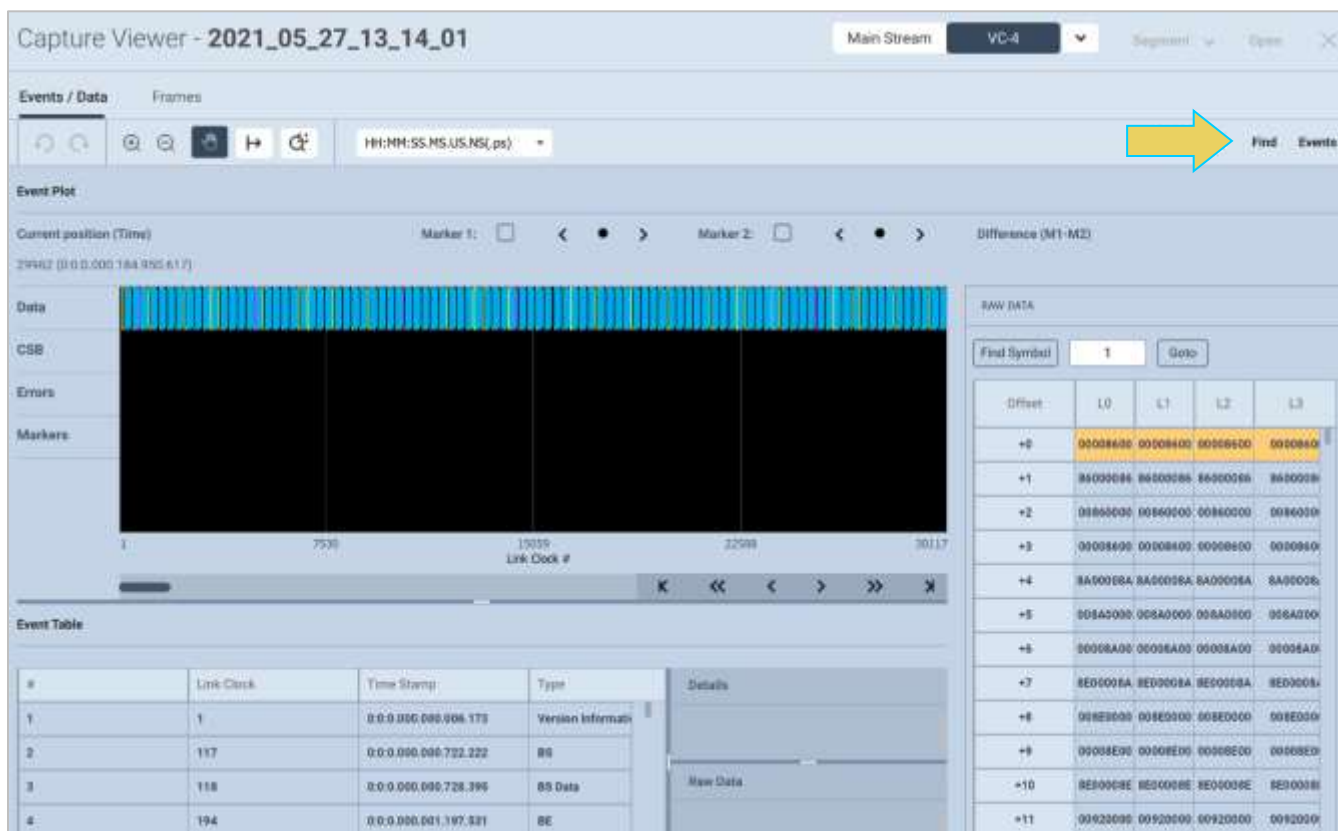


### 6.4 Searching and Filtering for Specific Data Elements

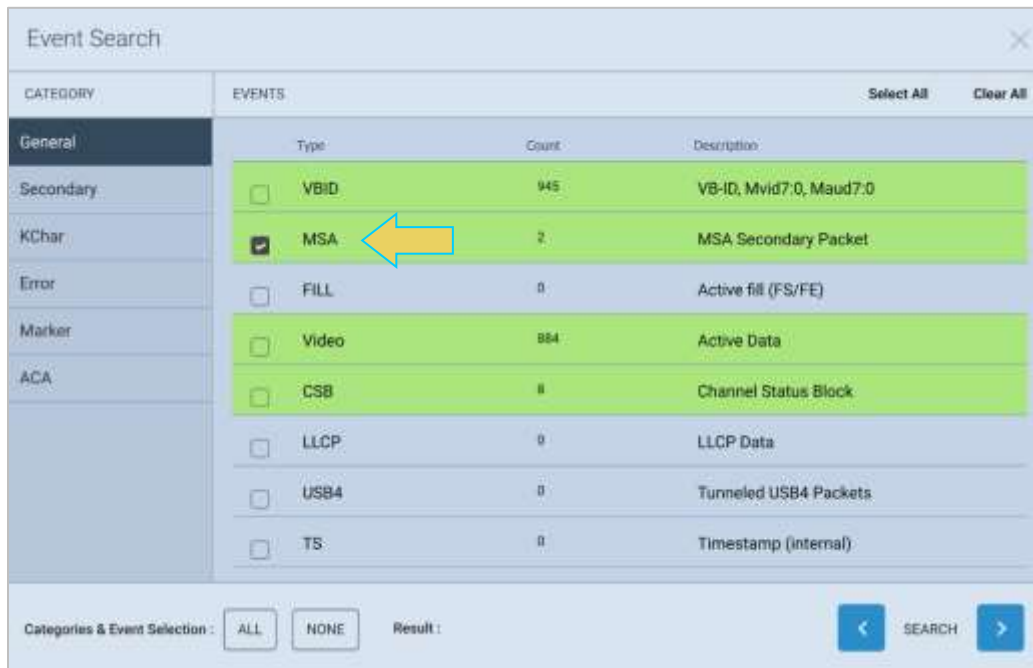
You can locate data items by browsing either through the **Event Plot** view of the **Event Data** table. The two windows (**Event Plot** and **Event Table**) are in sync as you browse, search or select an item.

#### Event Search

You can locate specific data types using the **Event Search** feature in either the Event Plot or the Event Table. The following screen shot is a typical example of captured data. The Event Search dialog box is accessible from the **Find** activation button **Find** on the top of the Capture Viewer window as shown below.

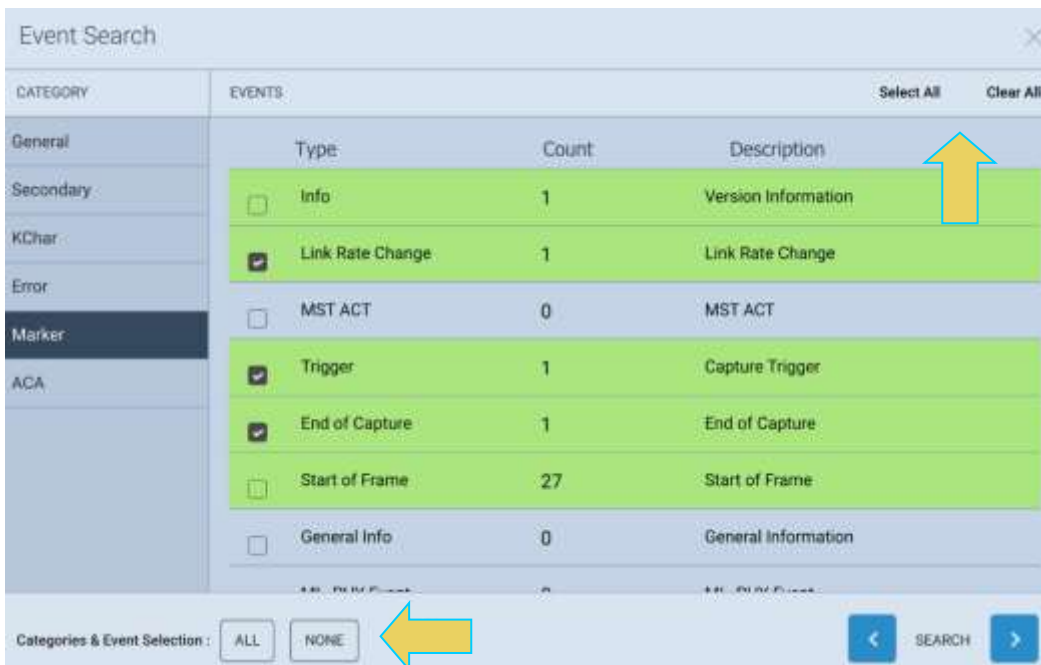


The **Event Search** dialog box is shown below. You can search for specific data types using the tabs and the check boxes within each tab. This example has MSA Secondary Packet data type selected for search.



The dialog box enables you to select all or none of the data element types per category using the **Select All** or **Clear All** buttons on the top of the dialog box, as shown below.

There are several tabs on the sidebar. Each tab enables you to select from a category of data types. You can click also select **ALL** or **NONE** to check/uncheck all data types in every tab.



Select as many or few data types as you need to find.

Once you have selected your desired data types, click the right or left **SEARCH** button to move to the next/previous result. The results of a search are shown at the bottom of the dialog box, next to **Results**, as shown below.

This example searches for the VSC data type. Note that the **Count** is an indication of the number of that data element that appears in the captured data.

The screenshot shows the 'Event Search' dialog box with a table of search results. The table has columns for 'Type', 'Count', and 'Description'. The 'MSA' row is selected, and its count is 27. The 'SEARCH' button is highlighted with a yellow arrow.

Category	Type	Count	Description
General	<input type="checkbox"/> VBID	13952	VB-ID, Mvid7:0, Maud7:0
Secondary	<input checked="" type="checkbox"/> MSA	27	MSA Secondary Packet
KChar	<input type="checkbox"/> FILL	1358560	Active fill (FS/FE)
Error	<input type="checkbox"/> Video	1371296	Active Data
Marker	<input type="checkbox"/> CSB	220	Channel Status Block
ACA	<input type="checkbox"/> LLCPC	0	LLCP Data
	<input type="checkbox"/> USB4	0	Tunneled USB4 Packets

Categories & Event Selection:   Result: Found MSA @ 9000032, #213219

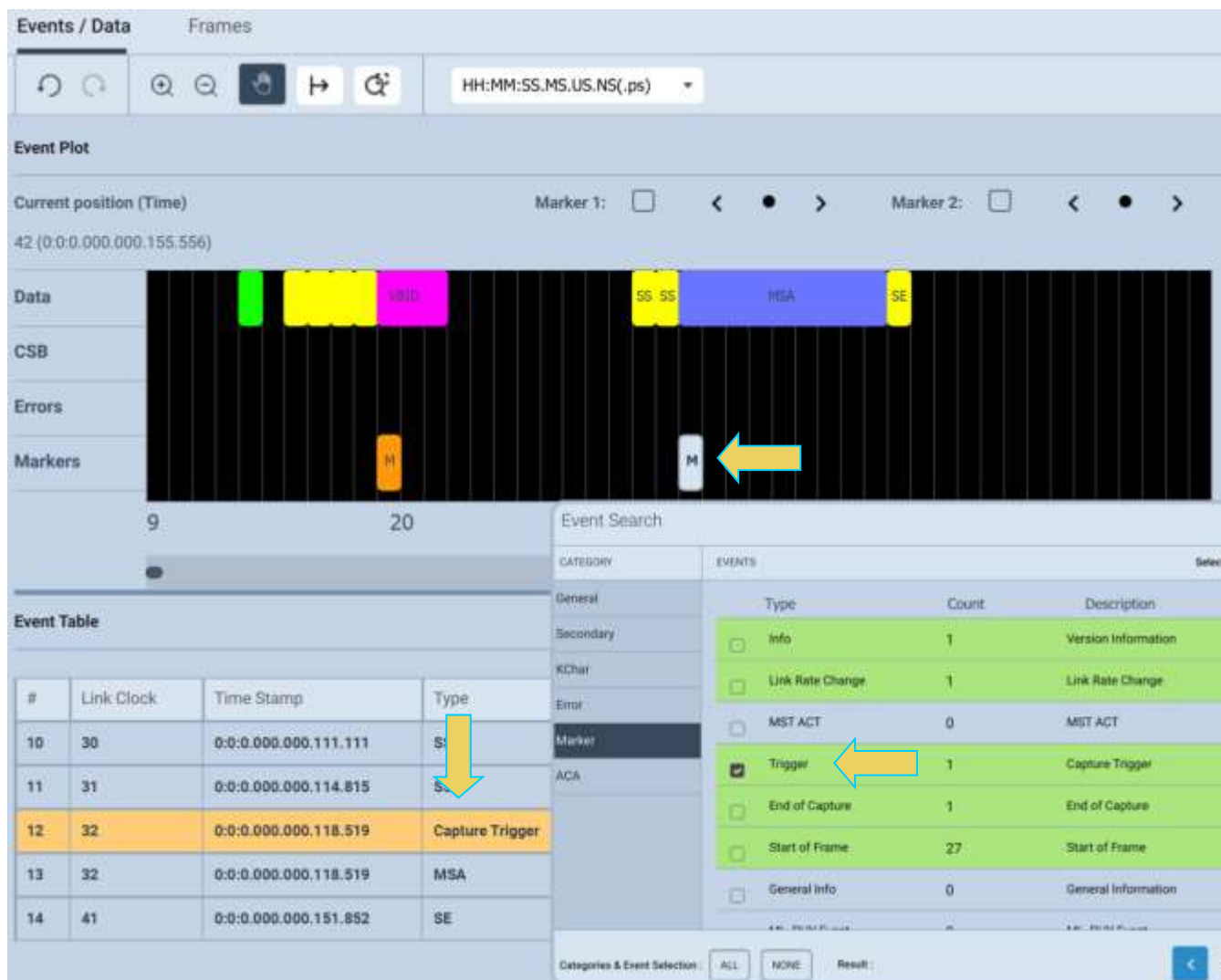
This next screenshot is the same search, after pressing the **NEXT** button one more time and proceeding to the next occurrence of the VSC data type.

The screenshot shows the 'Event Search' dialog box with the same table of search results. The 'SEARCH' button is highlighted with a yellow arrow.

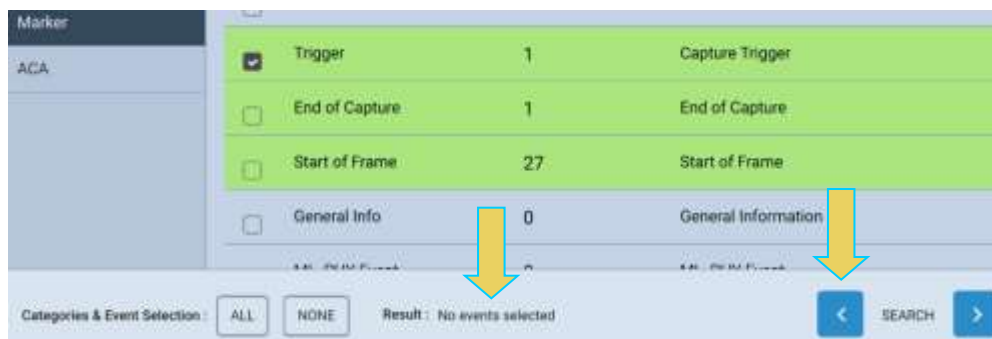
Category	Type	Count	Description
General	<input type="checkbox"/> VBID	13952	VB-ID, Mvid7:0, Maud7:0
Secondary	<input checked="" type="checkbox"/> MSA	27	MSA Secondary Packet
KChar	<input type="checkbox"/> FILL	1358560	Active fill (FS/FE)
Error	<input type="checkbox"/> Video	1371296	Active Data
Marker	<input type="checkbox"/> CSB	220	Channel Status Block
ACA	<input type="checkbox"/> LLCPC	0	LLCP Data
	<input type="checkbox"/> USB4	0	Tunneled USB4 Packets

Categories & Event Selection:   Result: Found MSA @ 22500032, #533033

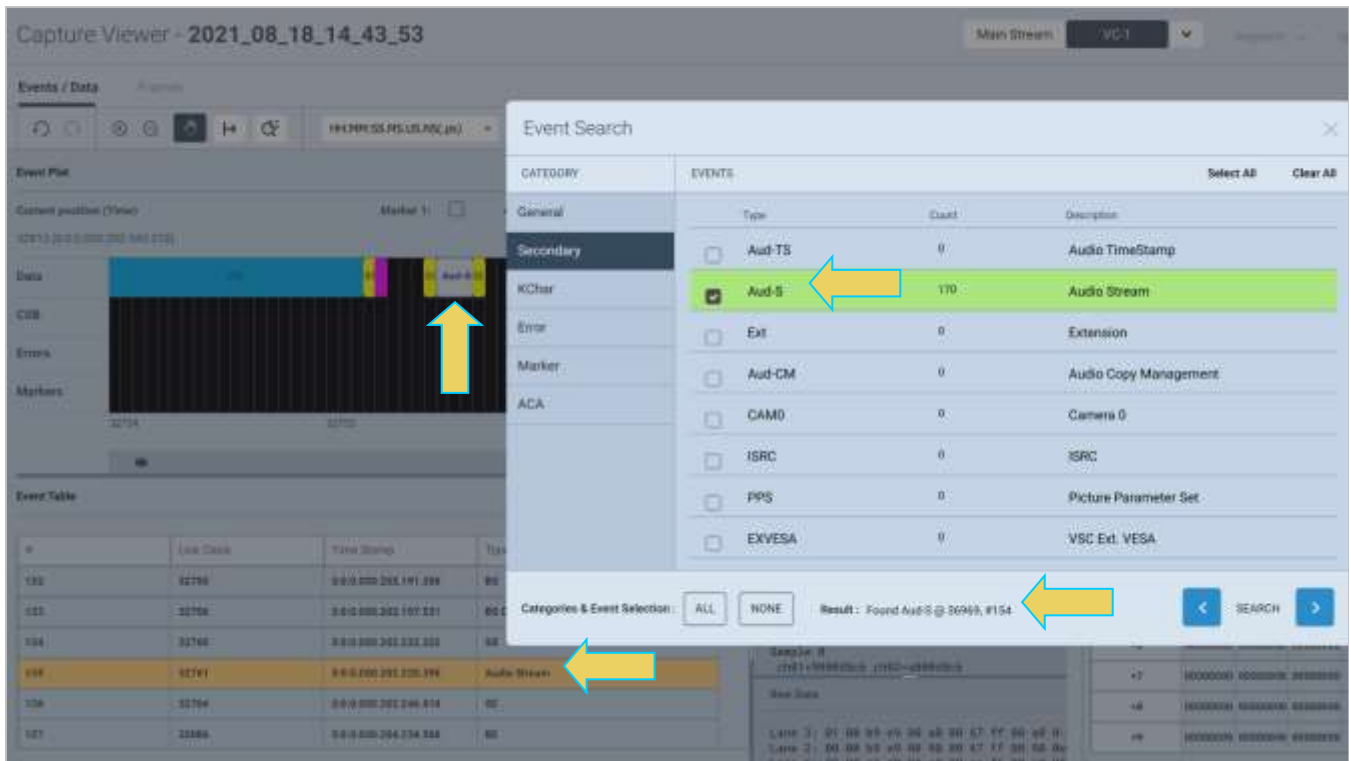
In the following example, the **Trigger** condition **Marker** is searched for. The search function centered the trigger condition marker on the **Event Plot**. Since the panels are synchronous, the trigger marker is also selected in the **Data Decode** and **Link Symbol** panels.



**Note:** If the **Count** column shows a count of greater than zero for a selected event type, but clicking the next arrow yields the message **No Events Selected** (example below), you may be ahead of that occurrence on the timeline, and need to click the previous arrow button instead.

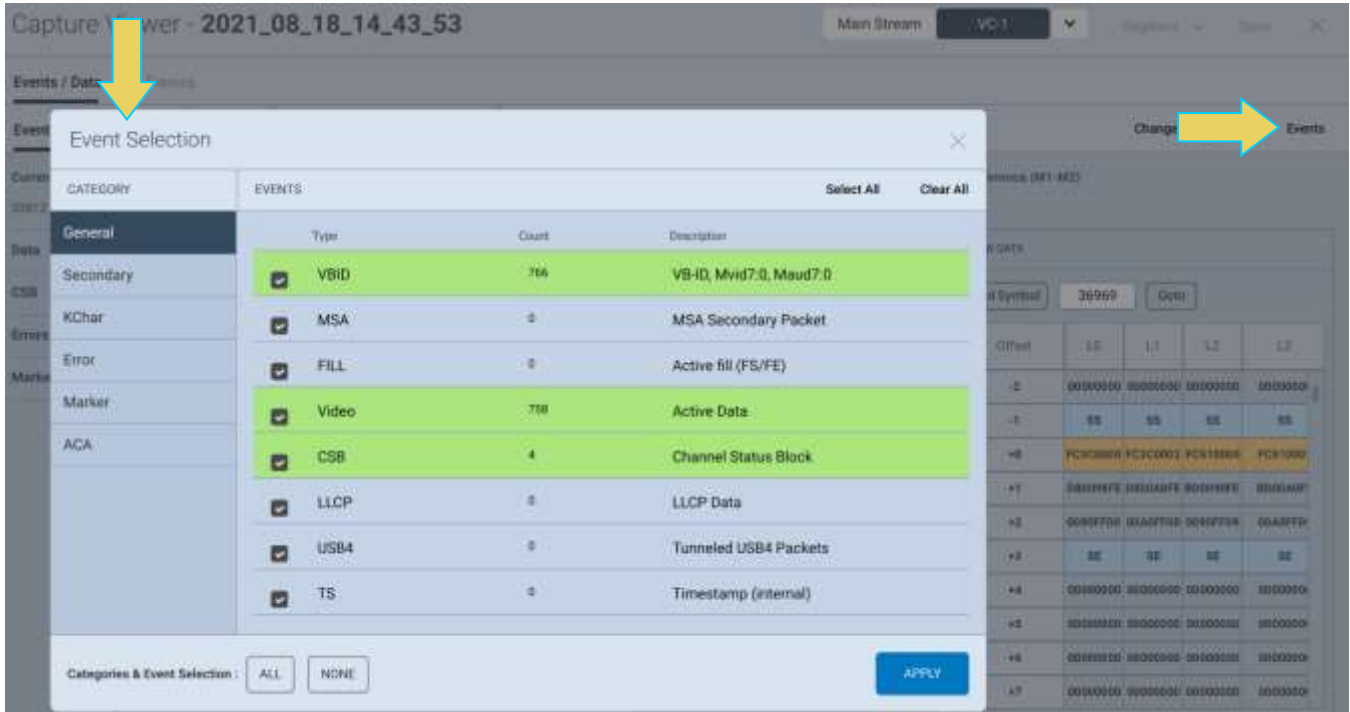


The following example shows a search of audio packets.

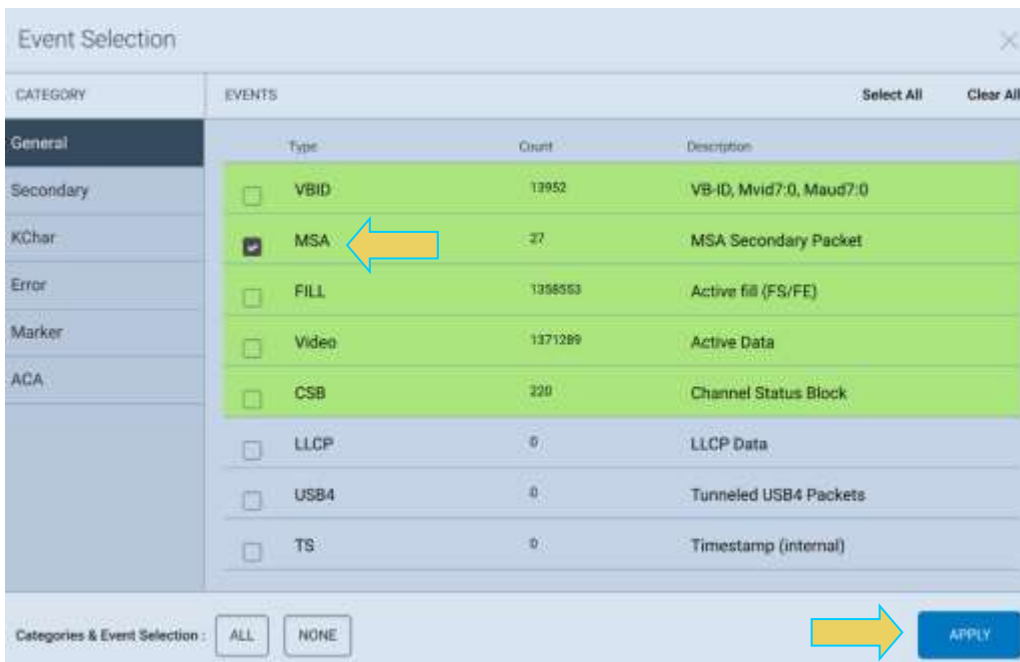


### Filtering Specific Data Elements

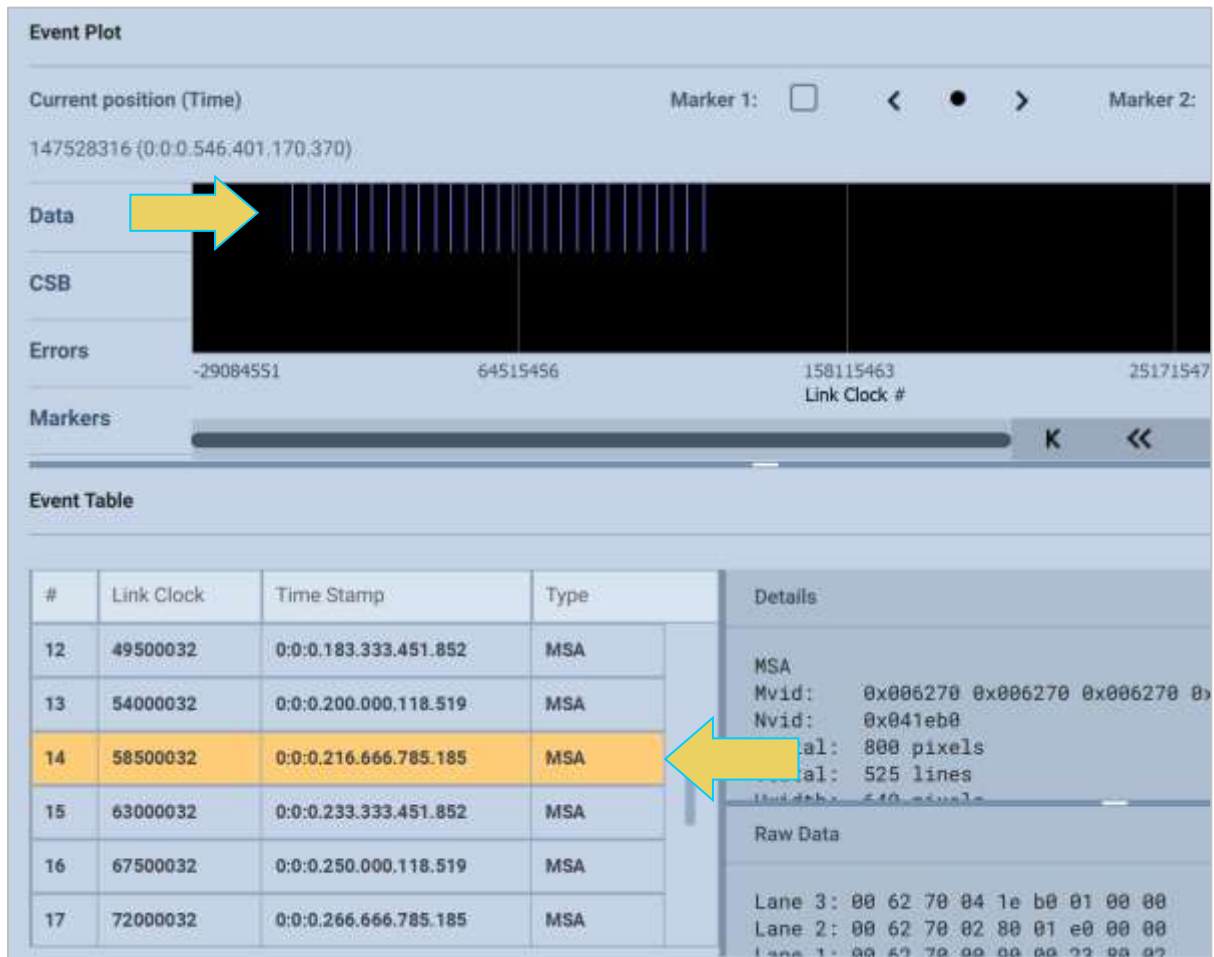
You can filter the captured data to show only specific data types using the **Event Selection** feature. The **Event Selection** dialog box is accessible from the **Events** activation button **Events** at the top right of the **Capture Viewer** window as shown below, with the **Event Selection** window on the left.



The following screen shows an example of filtering for an MSA Secondary Packet. Check the box next to the data type you wish to filter and click **APPLY**. The results of the filter apply to both the **Event Plot** and the **Event Data** panels.



The results of the filter for MSA data elements on the **Event Plot** and **Event Table** panels are shown below.



Similarly to the **Find** dialog box, the categories in Event Selection are listed in the left-hand column. You can select or deselect all categories with the **ALL** or **NONE** button at the top of the dialog box. You can also **Select All** or **Clear All** within an individual category. The example below has opted to Select All within the **KChar** category.

The screenshot shows the 'Event Selection' dialog box. On the left, a list of categories includes General, Secondary, KChar, Error, Marker, and ACA. The 'KChar' category is selected. The main area displays a table of events with columns for Type, Count, and Description. All events in the KChar category are checked. At the bottom, there are buttons for 'ALL', 'NONE', and 'APPLY'. A yellow arrow points to the 'ALL' button.

CATEGORY	EVENTS			Select All	Clear All
General	Type	Count	Description		
Secondary	<input checked="" type="checkbox"/> SR	54	Scrambler Reset		
<b>KChar</b>	<input checked="" type="checkbox"/> SS	5423	Secondary-data Start		
Error	<input checked="" type="checkbox"/> CPF	0	CP Symbol (FEC)		
Marker	<input checked="" type="checkbox"/> BS	27850	Blanking Start		
ACA	<input checked="" type="checkbox"/> EOC	0	End of Chunk		
	<input checked="" type="checkbox"/> R2	0	Reserved 2		
	<input checked="" type="checkbox"/> BE	12737	Blanking End		
	<input checked="" type="checkbox"/> SE	5396	Secondary-data End		

Categories & Event Selection :



The following screen shows the results of the filter.

Capture Viewer - 2021\_08\_05\_11\_23\_33

Events / Data Frames

HH:MM:SS.MS.US.NS(.ps)

Current position (Time): 452870 (0.0.0.001.677.296.296)

Marker 1: [ ] < ● > Marker 2: [ ] < ● > Difference (M1-M2):

Data

CSB

Errors

Markers: -25000 -433022 870000 Link Clock: # 1750000 1800079

Event Table

#	Link Clock	Time Stamp	Type
1	15	0.0.0.000.000.065.566	BS
2	16	0.0.0.000.000.059.259	BF
3	17	0.0.0.000.000.062.968	BF
4	18	0.0.0.000.000.066.667	BS
5	20	0.0.0.000.000.111.111	BS

Raw Data

Offset	L0	L1	L2	L3
-2	FE	FE	FE	FE
-1	FF	FF	FF	FF
+0	BS	BS	BS	BS
+1	BF	BF	BF	BF
+2	BF	BF	BF	BF
+3	BS	BS	BS	BS
+4	01	01	01	01
+5	70	70	70	70
+6	00	00	00	00
+7	00	00	00	00

## 6.5 Importing, Exporting, and Transferring Capture Files

You have the ability to **Import**, **Export**, and **Transfer** Capture Files from captures performed using the M42d embedded or remote VPS application GUI.

This section will describe the following processes in detail:

- **Export** of a Capture file to a file folder or USB storage
- **Import** of a Capture file from a local file folder or USB storage
- **Transfer** of a Capture from an M42d instrument to a remote host PC or vice versa.

The **Import** and **Export** features allow you to exchange capture files between your PC or a USB Drive and the VPS Application of the M42d.

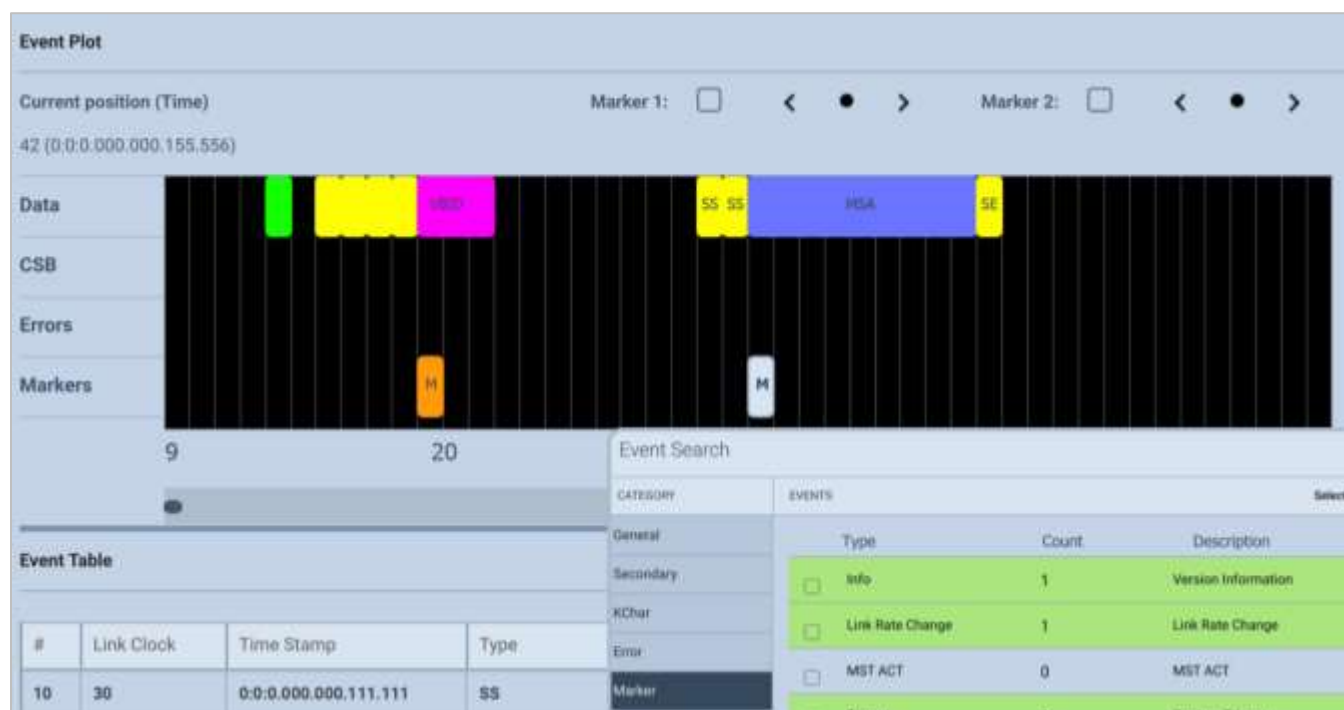
You may Export a capture file to disseminate to colleagues or other subject matter experts. You may need to import a file when you want to examine a capture file taken by a colleague or transferred from USB storage. The **Export** and **Import** function zips or unzips a capture file to enable you to post it on an FTP server or disseminate through email if the file is not too large.

Captures executed on the M42d instrument's embedded VPS GUI need to be transferred to the remote host PC before being able to **Export**.

The **Transfer** feature enables you to simply transfer a capture file executed on the M42d embedded GUI onto your PC's VPS Application for viewing/analysis, or vice versa. The Transfer feature is only accessible from the Remote VPS Application on a PC since a remote PC is needed to execute the transfer.

You may Transfer a capture file to back up your captures to your PC from your instrument and vice versa. You also need to transfer a capture in this manner in order to view it remotely if you originally ran the capture on the M42d embedded VPS GUI.

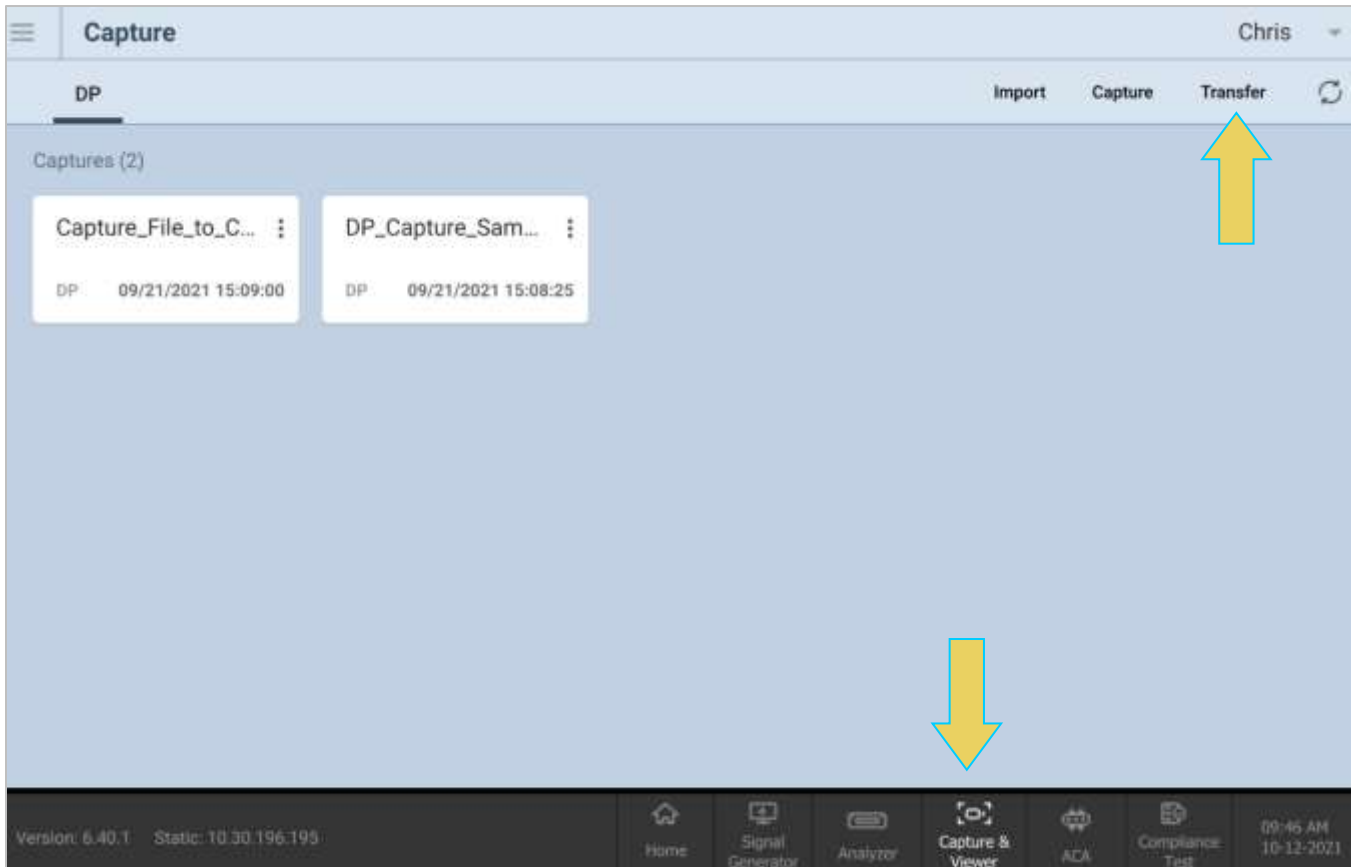
All of these features are accessible through the **VPS Application** interface on a remote PC.



## Transferring a Capture File Between Instrument and Remote PC.

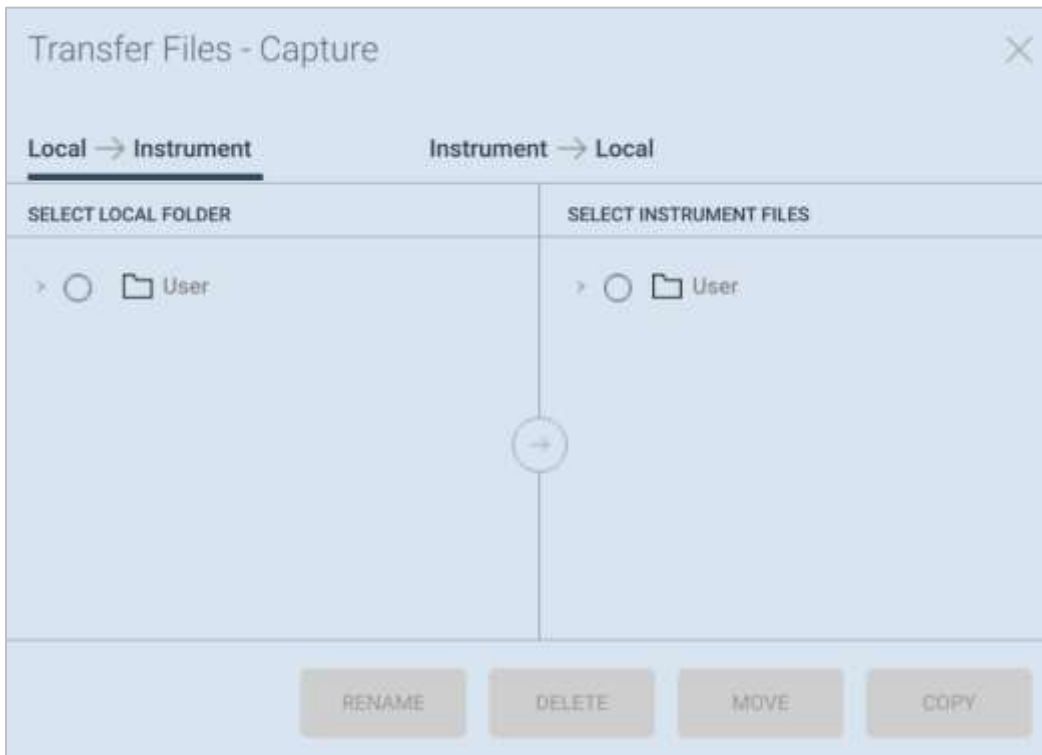
Transferring a capture file between the M42d instrument and remote PC may be necessary prior to exporting a file, so those procedures are described in this first subsection. Exporting and Importing are in following subsections.

To Transfer a file, Navigate to the **Capture & Viewer** tool from the VPS Dashboard. Select the **Transfer** button at the top right of the window, as shown below.

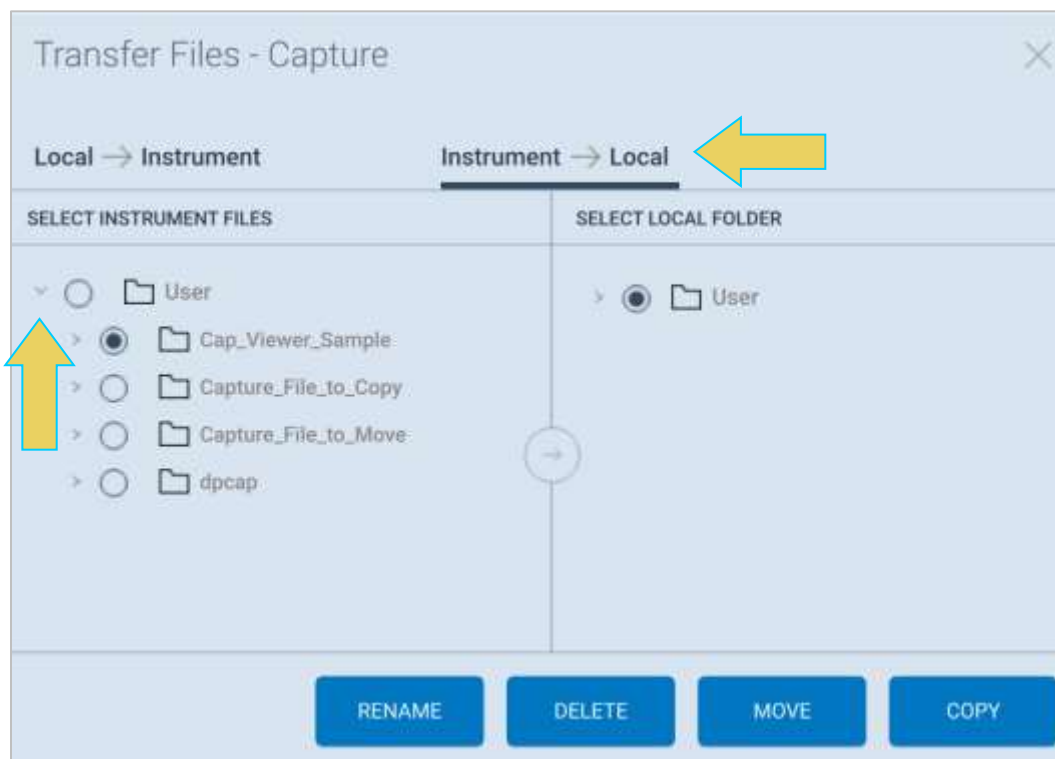


**Note:** The VPS Application must be running on the M42d instrument's embedded GUI in order for this tool to function properly.

The Capture file transfer window will appear, as shown below.

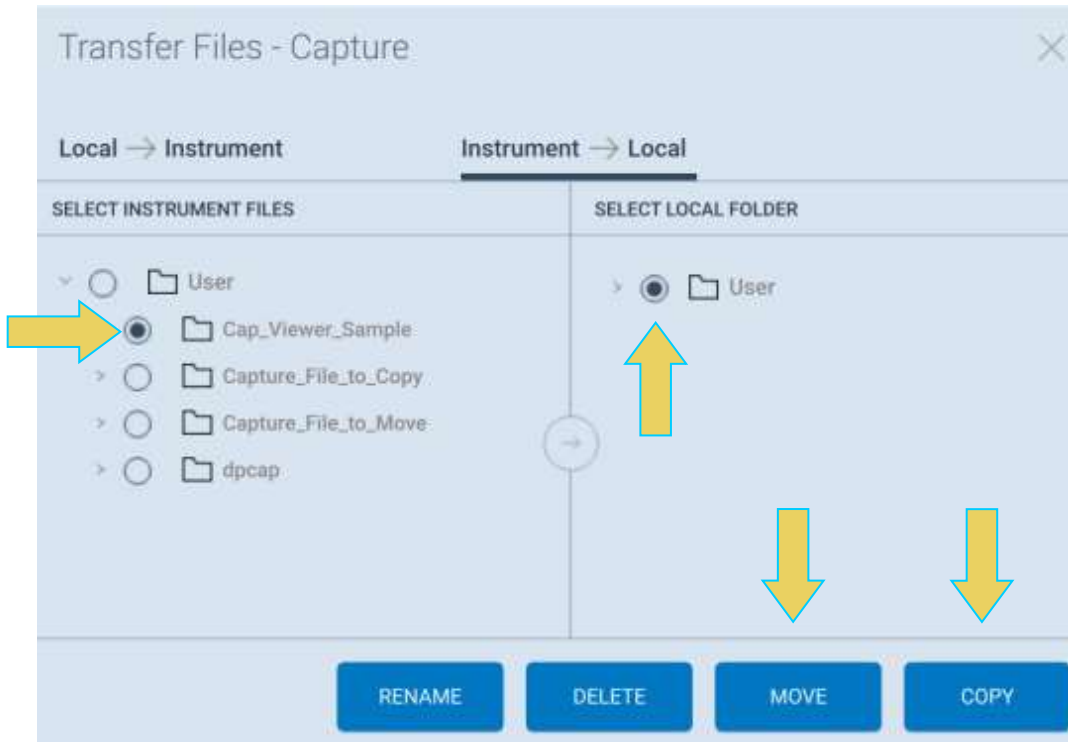


To transfer a capture file from the M42d instrument to the PC, select the **Instrument -> Local** tab at the top. Click the arrow > icon next to the **User** folder to expand it and view the files eligible for transfer.

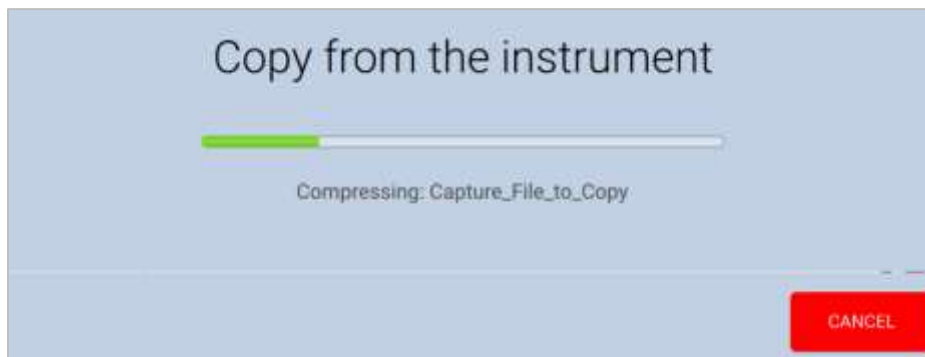


Select the desired file for transfer in the left-hand column labeled **Instrument Files**. Next, click on a target folder in the righthand column labeled **Select Local Folder**.

At this point you may either **Copy** the file to the instrument or **Move** it—which removes the file from the local storage on either the M42d instrument or PC after copying to the other device.

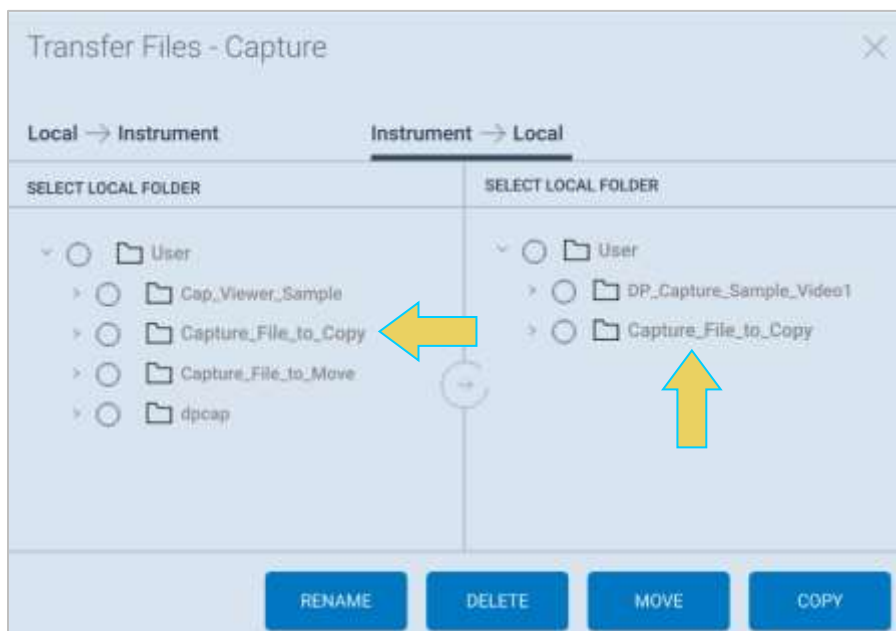


The example below shows copying a capture file from the Instrument to the PC VPS Workspace's **User** folder.



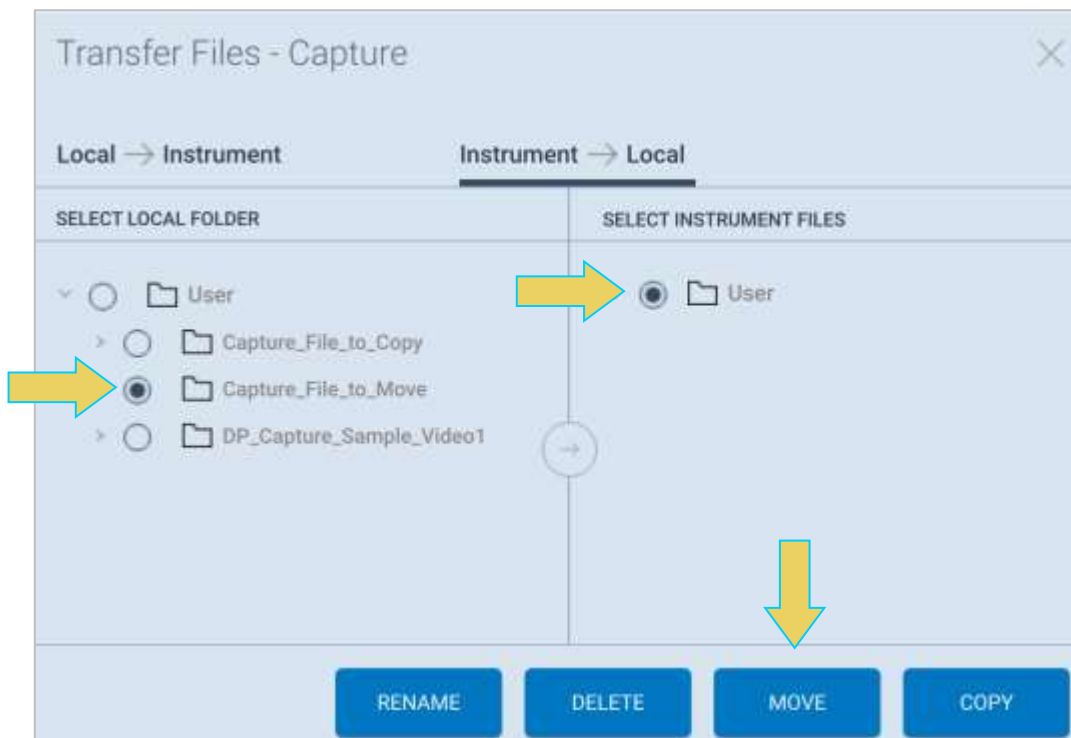
The result is the file now appearing in the **Instrument Files** column as well, as shown below.

**Note:** If the **Move** transfer option is used, the file will not appear in both directories, only the target folder on the device, as mentioned earlier.

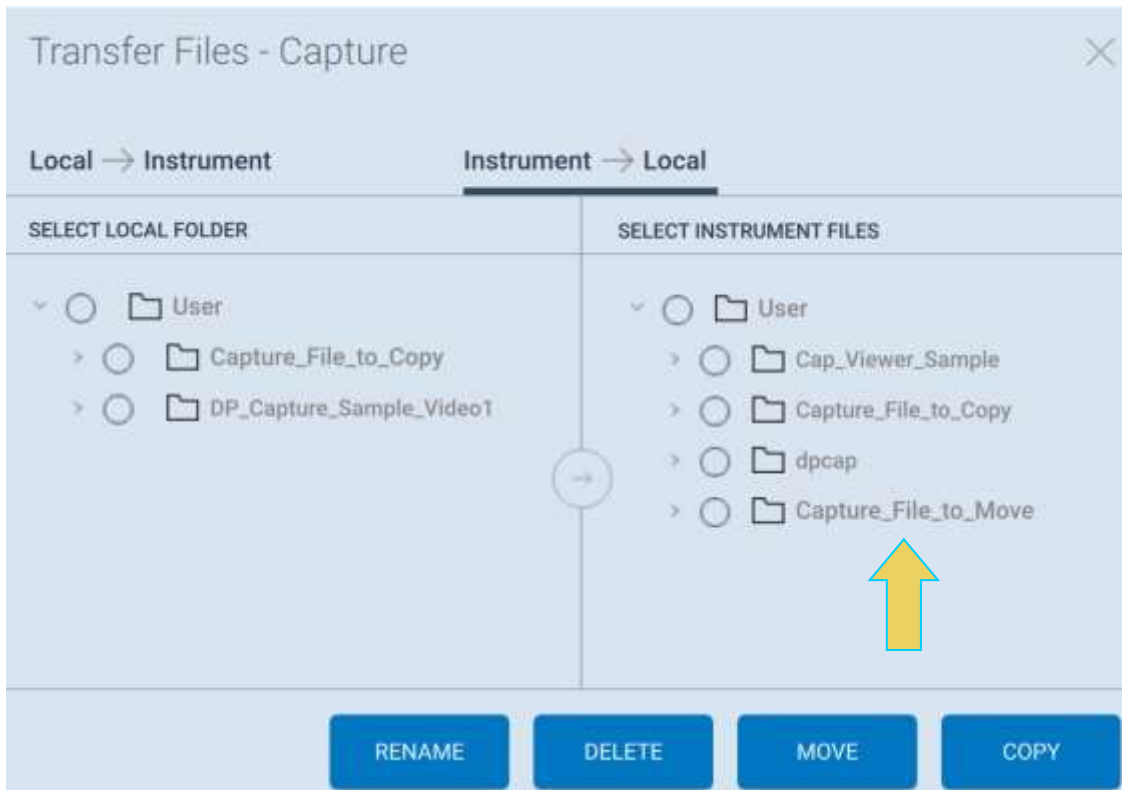


To transfer a file from a PC to the M42d instrument, select a file from the **Instrument Files** column, and a target folder from the **Local Files** column, and click **Copy** or **Move** to transfer.

The following example shows a capture file being moved from the PC to the instrument.



The result is shown below. Notice the file is no longer contained within the **User** folder of the **Local Files**.

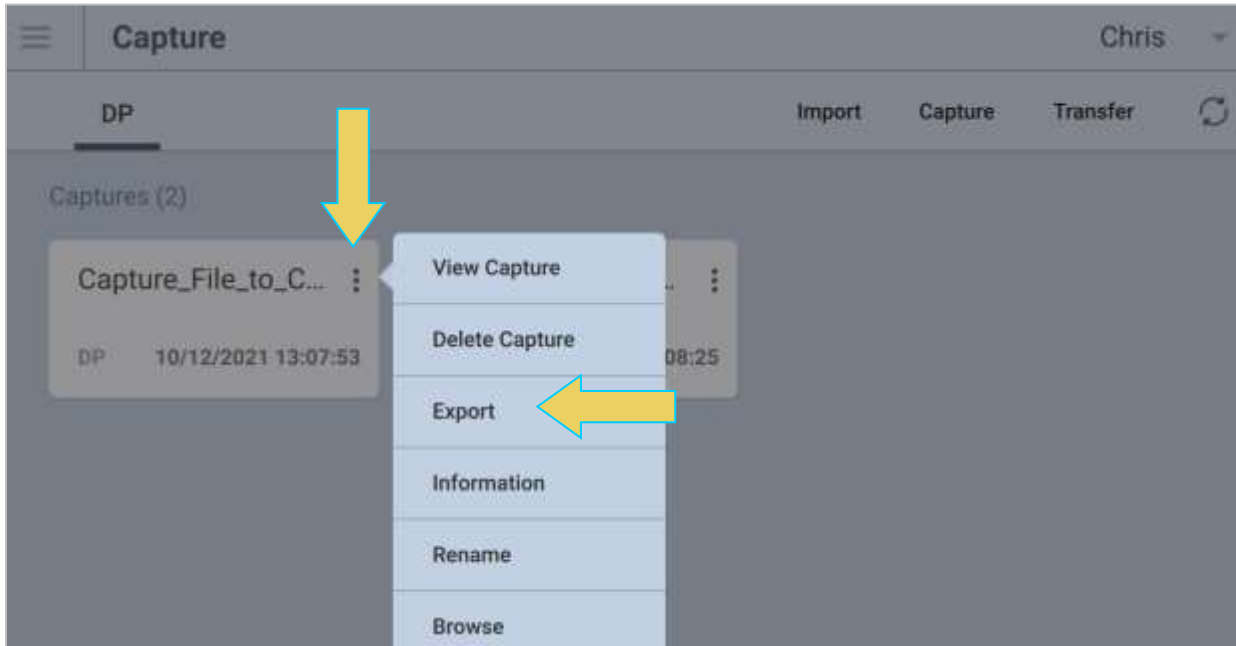


**Note:** If a file in the target folder already has the same name as the file you are attempting to transfer, the **Copy** and **Move** buttons will not be enabled. You will need to rename the capture first using the **Rename** button at the bottom of the dialog box.

## Exporting a Capture File

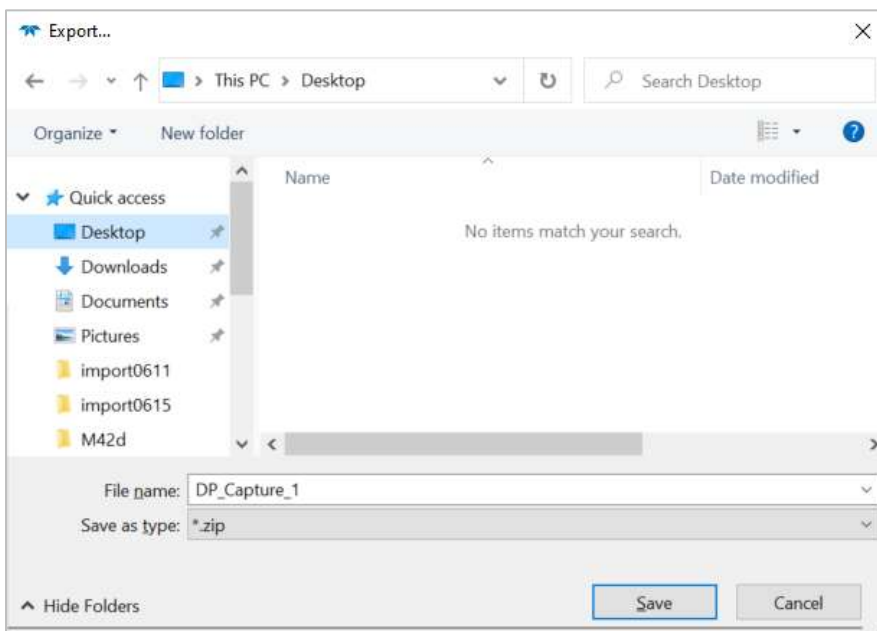
To export a capture file, navigate to the **Capture & Viewer** from the VPS Dashboard

Click on the three-button menu icon of the desired capture file, and select **Export**, shown below.



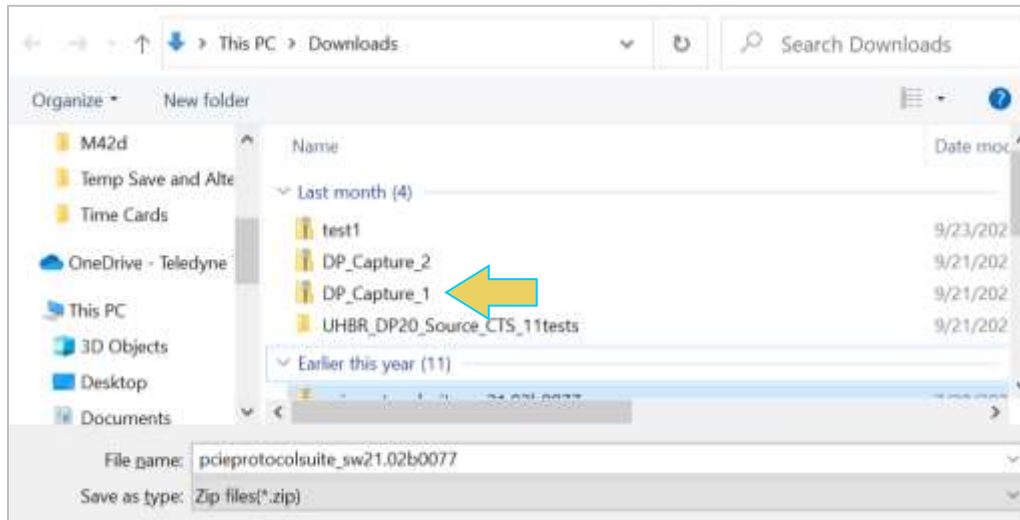
When you select **Export**, a File Explorer window will show up enabling you to save the capture as a zip file in a directory and name of your choosing. Refer to the screen example below.

**Note:** If you are on the M42d instrument itself, the file explorer window will be Linux-based.



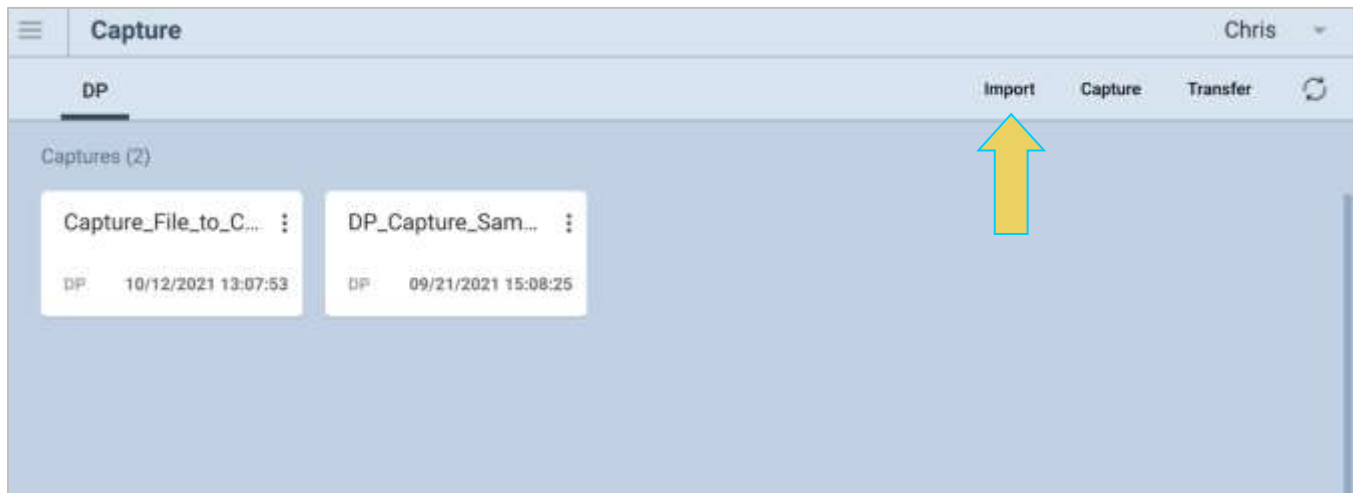


Choose a desired directory and filename, and click **Save**. This capture file will then be accessible in a file explorer as a compressed zip file, as shown below.

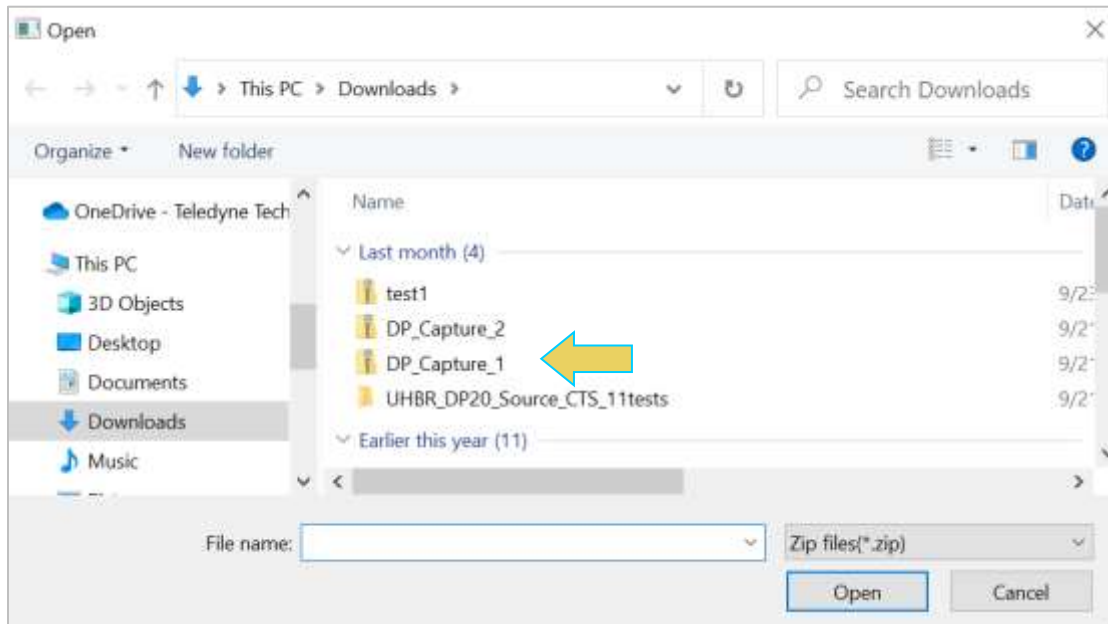


## Importing a Capture File

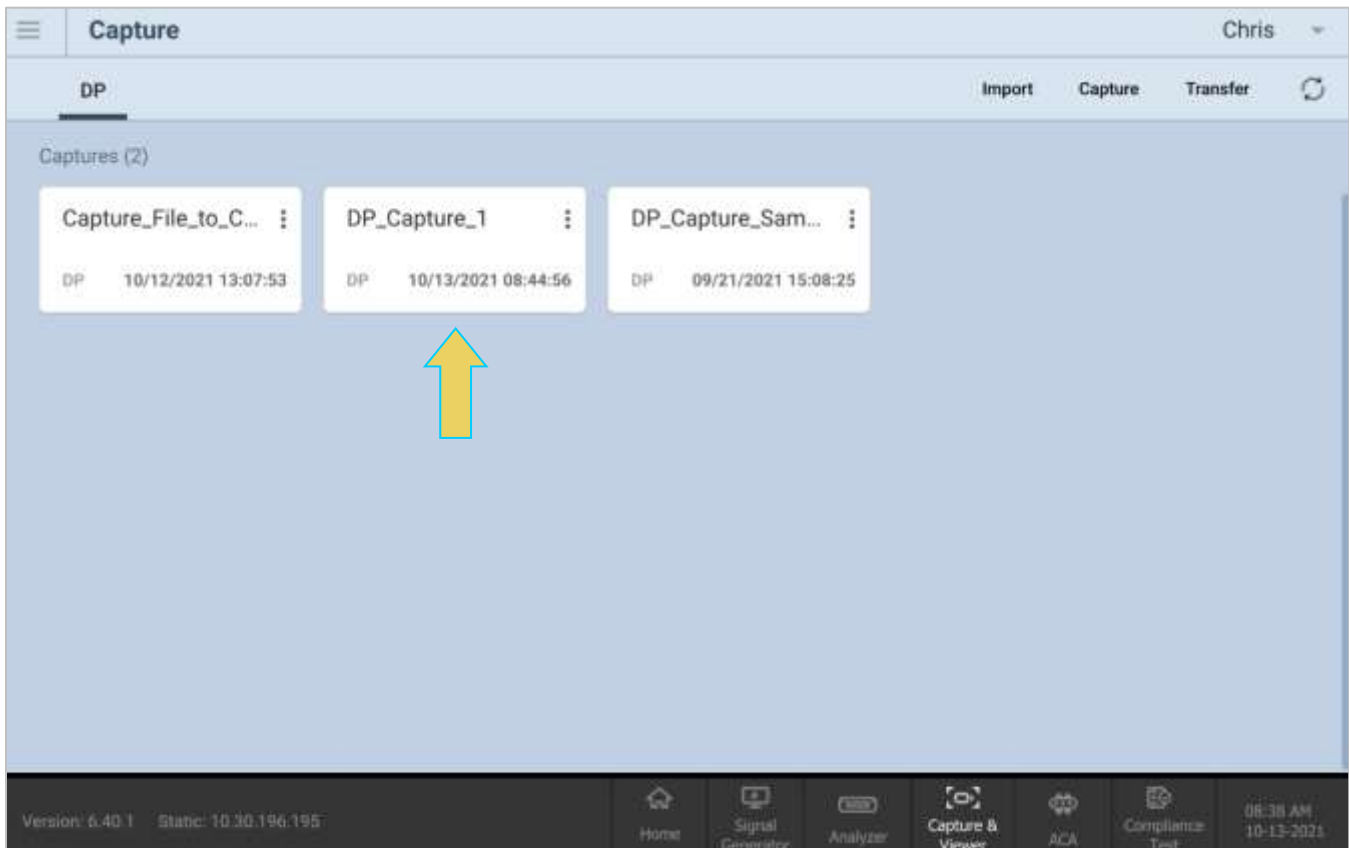
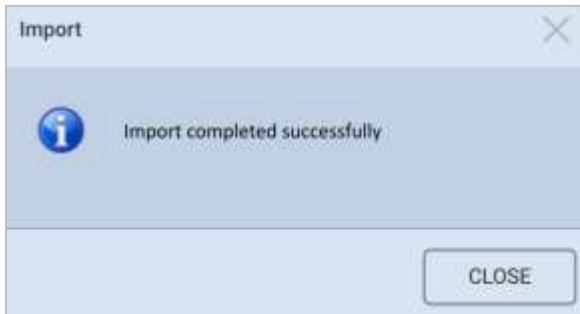
To import a file, within the **Capture & Viewer** tool, click the **Import** button at the top right.



A File Explorer window will appear enabling you to navigate to the directory where you have stored your zipped capture file. Select the file and click **Open** as shown below.



You will see a confirmation dialog box and you the new capture will appear in the list of captures in the **Navigator** panel as shown below.



## 7 Auxiliary Channel Analyzer (ACA)

---

Note that this chapter requires specific licenses for the M42d to utilize the features therein, including enabling UHBR rates, and DSC functional tests. More Information and a list of available licenses can be found in **Appendix A. Licenses**.

The Auxiliary Channel Analyzer (**ACA**) utilities enable you to view the AUX channel traffic for DisplayPort streams in real time or from stored real time log files. For DisplayPort, you can view the HDCP authentication transactions, EDID exchanges, Link Training transactions, side band messages, Multi-Stream Transport negotiations, etc. in real time with the ACA either through the embedded VPS GUI or the external VPS GUI application running on a host PC.

You can view the transactions between the M42d 80G Video Analyzer/Generator, generator ports and a connected DP display device and you can monitor the transactions between the M42d's analyzer port and a connected DP source device.

There are two (2) Auxiliary Channel Analyzer utilities:

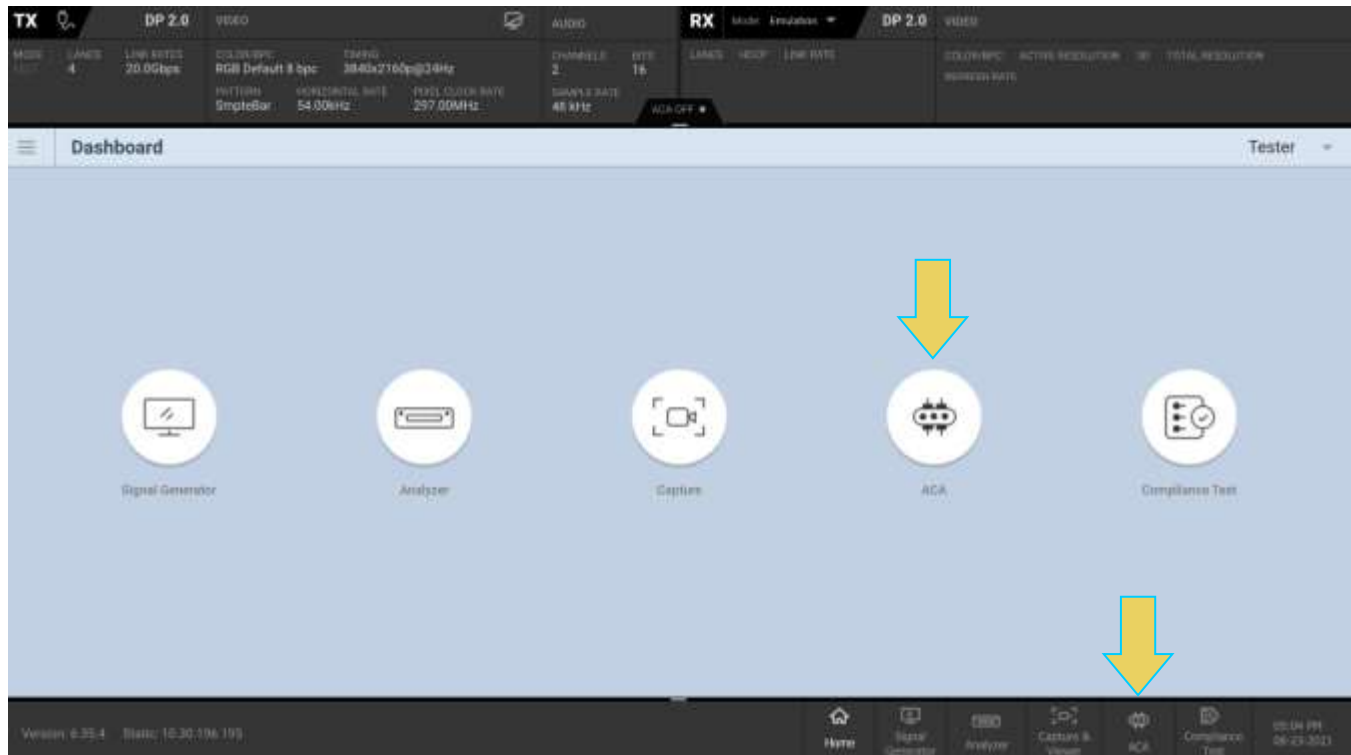
- **Auxiliary Channel Analyzer (“ACA”)** – Used for real time viewing auxiliary channel DisplayPort Aux Chan data through the VPS GUI Application. You can also open existing ACA trace files stored on the M42d Instrument.
- **ACA Data Viewer** - Used for viewing previously captured auxiliary channel data. You can view these saved ACA traces and disseminate them to colleagues at other locations. These colleagues can then use the ACA Data Viewer utility off-line without a M42d test instrument to view these transactions.

The following sections in this chapter detail procedures for both of these utilities.

## 7.1 Accessing the Auxiliary Channel Analyzer (ACA)

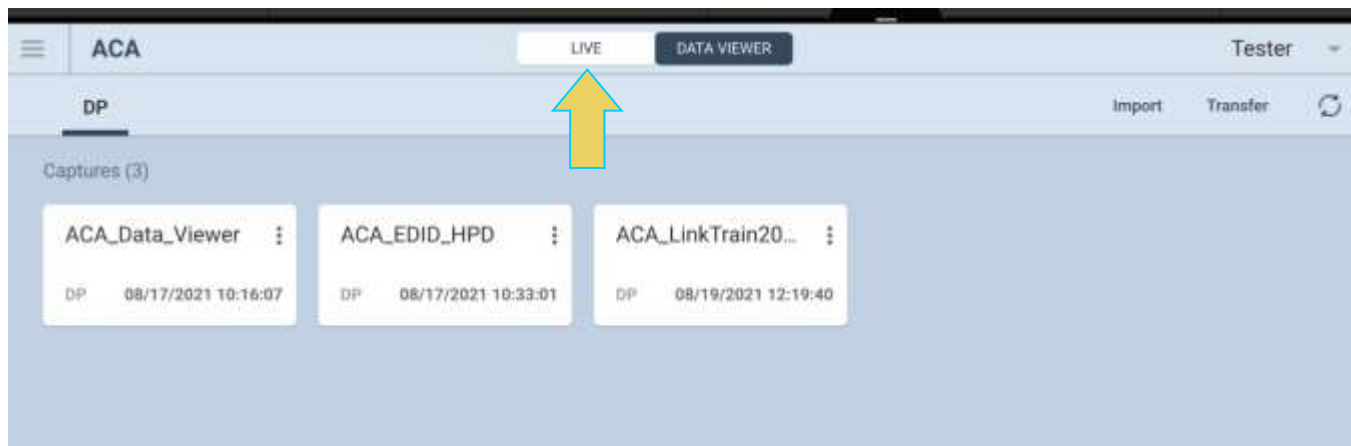
Use the following procedures to monitor the DisplayPort Aux Chan transactions with a DisplayPort device in real time. The procedures assume that the DP device under test is powered up and connected to one of the M42d ports. The operation of the ACA is the same when testing a source or a sink.

For the ACA utility, Select the **Aux. Channel Analyzer** app from the Dashboard Home or the bottom toolbar.

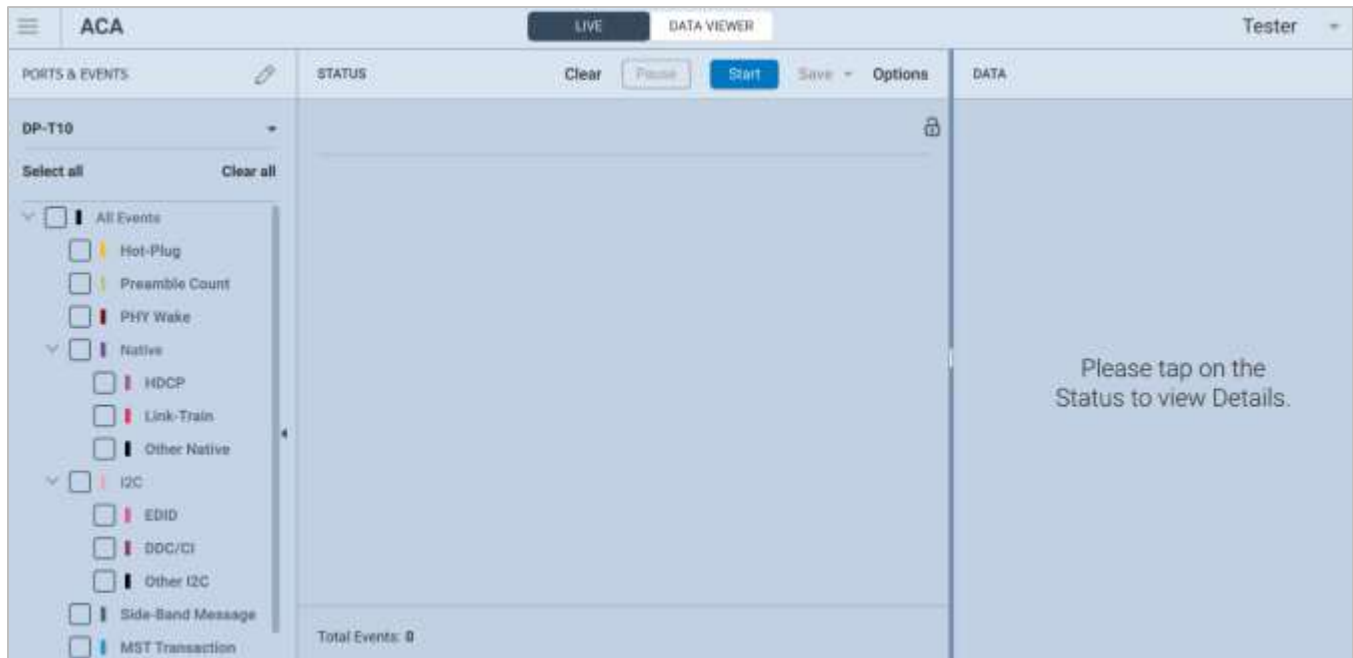


The **ACA** window appears as shown below. Previously saved ACA captures are available to select for viewing within the **ACA Data Viewer**, which is described in a later subsection.



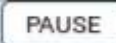
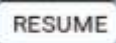
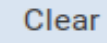




Click on the **LIVE** tab at the top of the window to be taken to the **ACA Utility**



The ACA Utility will appear, as shown below.



The following table describes the ACA Control menu, located at the top of the window in the above screenshot. This is just a brief overview, as detailed instructions on certain features here will be described in following sections.

 / 	Starts and Stops the collection of ACA data
 / 	Halts the updates of the data to the ACA panel to view traces and allows you to resume.
	Clears the ACA Trace Panel.
	Opens up the <b>Options</b> dialog box. Described in detail later in this section.
Scroll Lock  or 	<p>Pauses the Trace Panel on the selected event. With <b>Scroll Lock</b> off (open lock), the Trace Panel will continue to move in order to display the most recent event.</p> <p>With Scroll lock on (closed lock), the Trace Panel will anchor at its current position.</p>
	<b>Save</b> – Save current trace locally for analysis in the <b>ACA Data Viewer</b>

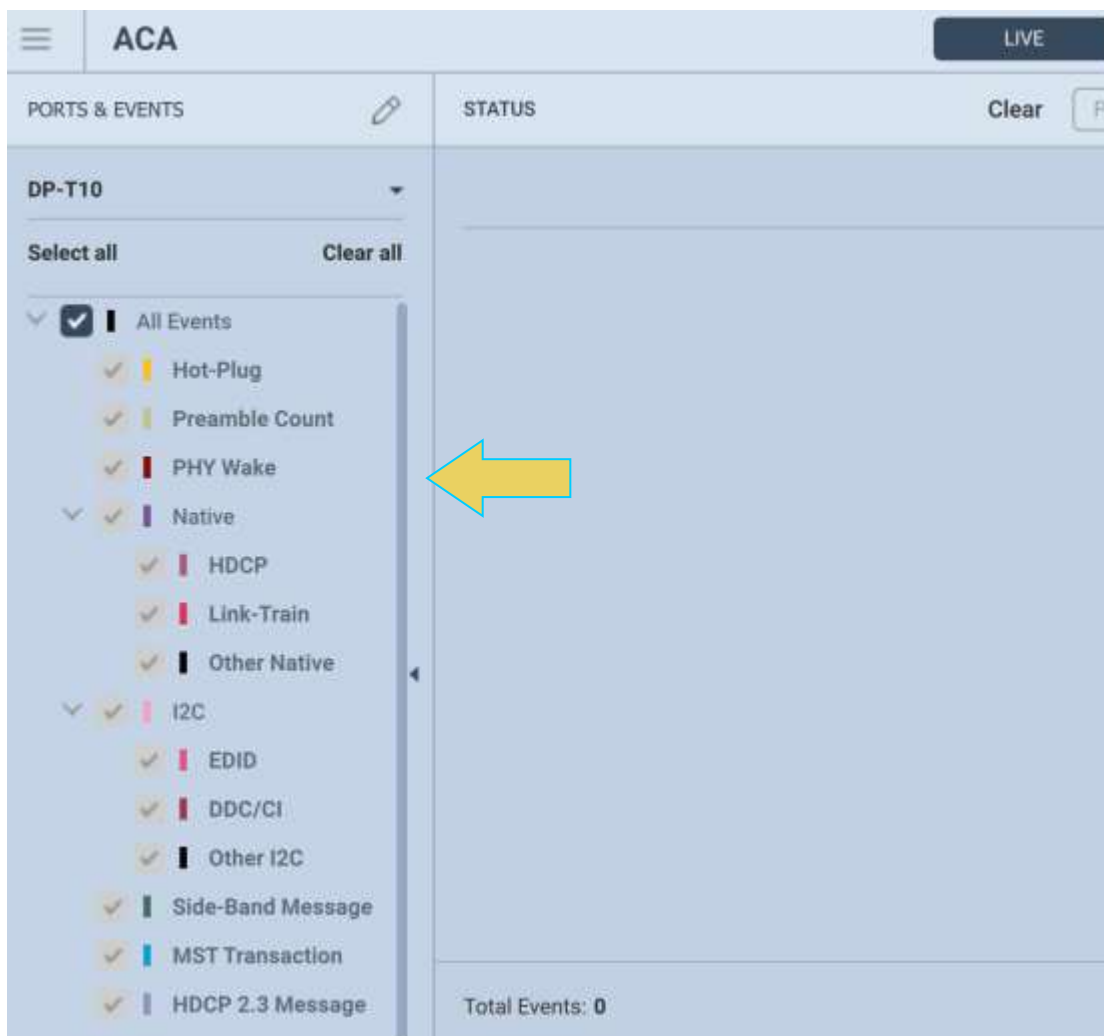
## 7.2 Monitoring Auxiliary Channels with Aux Channel Analyzer Utilities

This section describes the procedures for monitoring the auxiliary channel data through the VPS GUI using the Aux Channel Analyzer real time utility. You can monitor the DisplayPort transactions in real time when a module is emulating a DisplayPort source device. If you have the M42d Rx Analyzer port you can emulate a DisplayPort sink device to test a DisplayPort source device.


Use the following procedures to monitor the DisplayPort Aux Chan transactions with a DisplayPort device in real time. The procedures assume that the DP device under test is powered up and connected to one of the

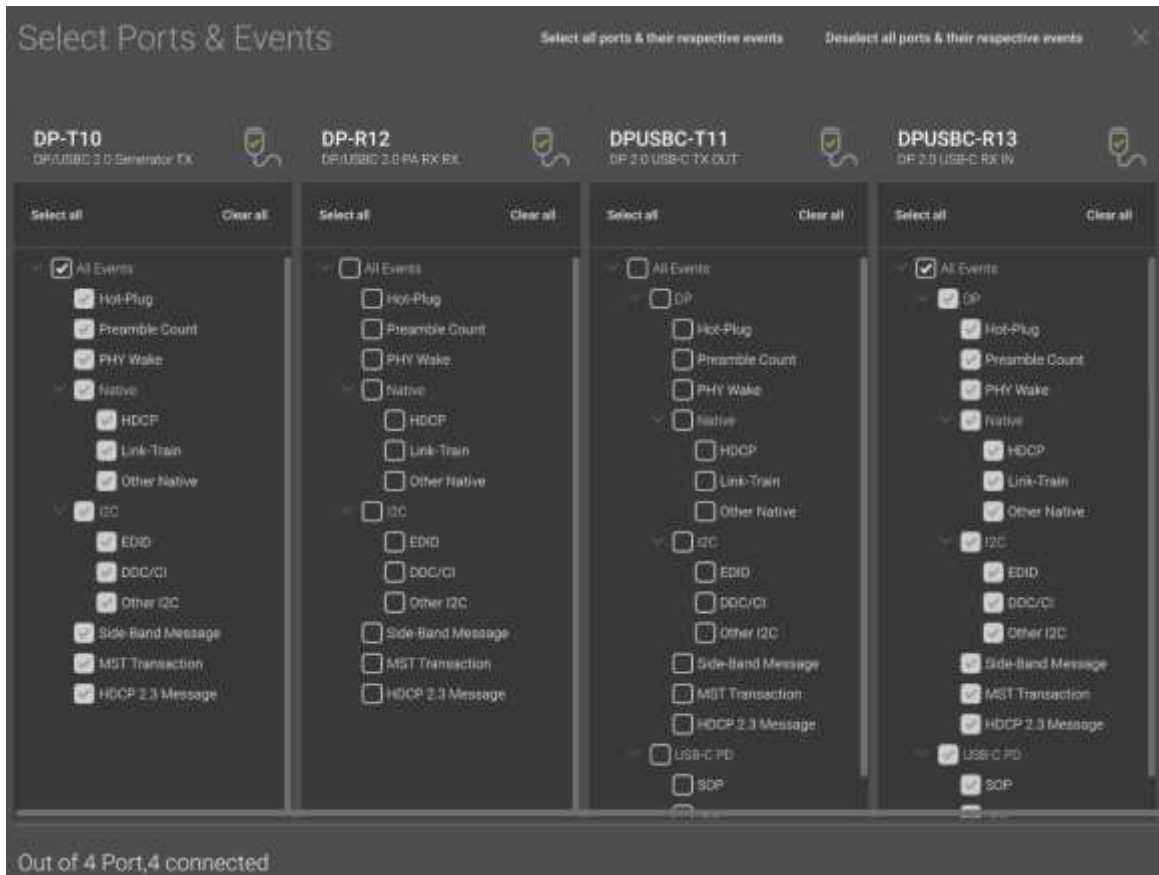
### To monitor the DisplayPort transactions:

1. Access the **Aux Channel Analyzer**, as demonstrated in the previous section.
2. Specify which DP events you wish to monitor using the **PORTS & EVENTS** panel on the left side of the window.

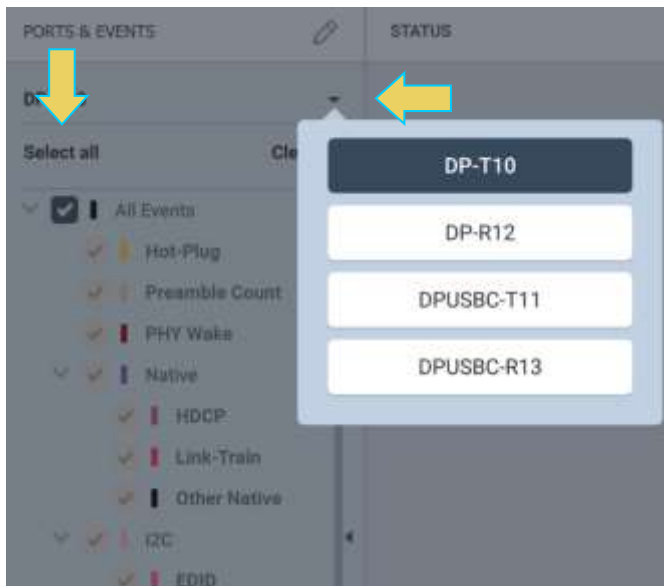


You can configure the monitored ports and events in one of two ways:

- Click the pencil icon  to open up the **Select Ports & Events** dialog box:



- Select the drop-down next to the port name to choose a port and select/deselect any or all events on the selected port:





- Select the ports and events you wish to monitor. Refer to the table below for options. The icons with dark backgrounds are within the **Select Ports & Events** dialog box, while the light backgrounds are in the left-hand panel within the ACA window.

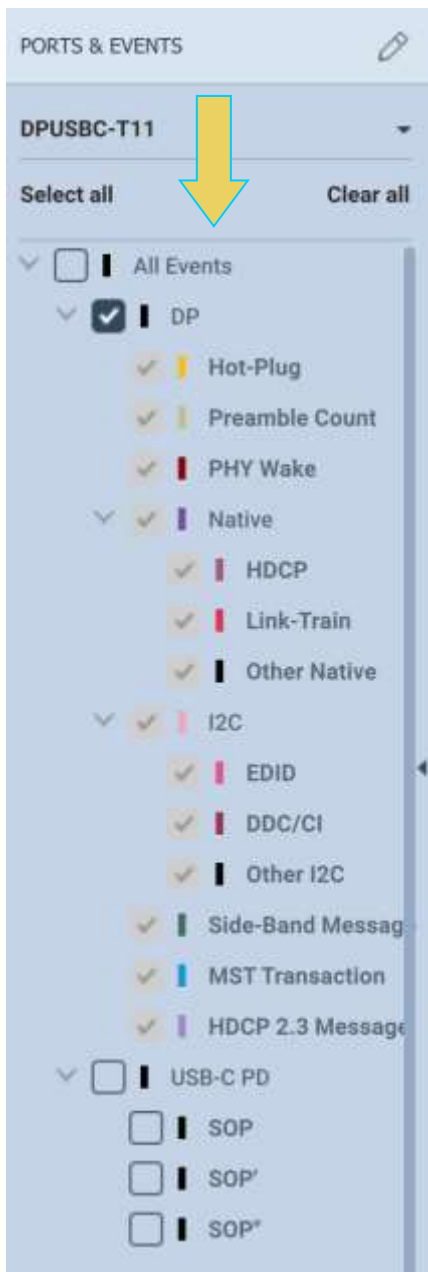
Select all ports & their respective events	Select all events on all ports
Deselect all ports & their respective events	Deselect all events on all ports
DP-T10 / DP-T10: DP/USB-C 2.0 Generator TX	Select events on the M42d's Generator simulated Tx port
DP-R12 / DP-R12: DP/USB-C 2.0 PA RX RX	Select events on the M42d's Protocol Analyzer simulated Rx port
DPUSBC-T11 / DPUSBC-T11: DP 2.0 USB-C TX OUT	Select events on the connected DP or USB-C Tx port
DPUSBC-R13 / DPUSBC-R13: DP 2.0 USB-C RX IN	Select events on the connected DP or USB-C Rx port
Select all / Select all	Select all events only on the specified port
Clear all / Clear all	

- Specify which DP events you wish to monitor. You can select **All Events** or any set of individual events. In the following example, the user has selected All Events (on all connected ports), which is the default selection.

**Important Note:** You can filter and search through the ACA traces after the data collection has completed, as well. Procedures for searching and sorting are provided in a separate subsection further below.

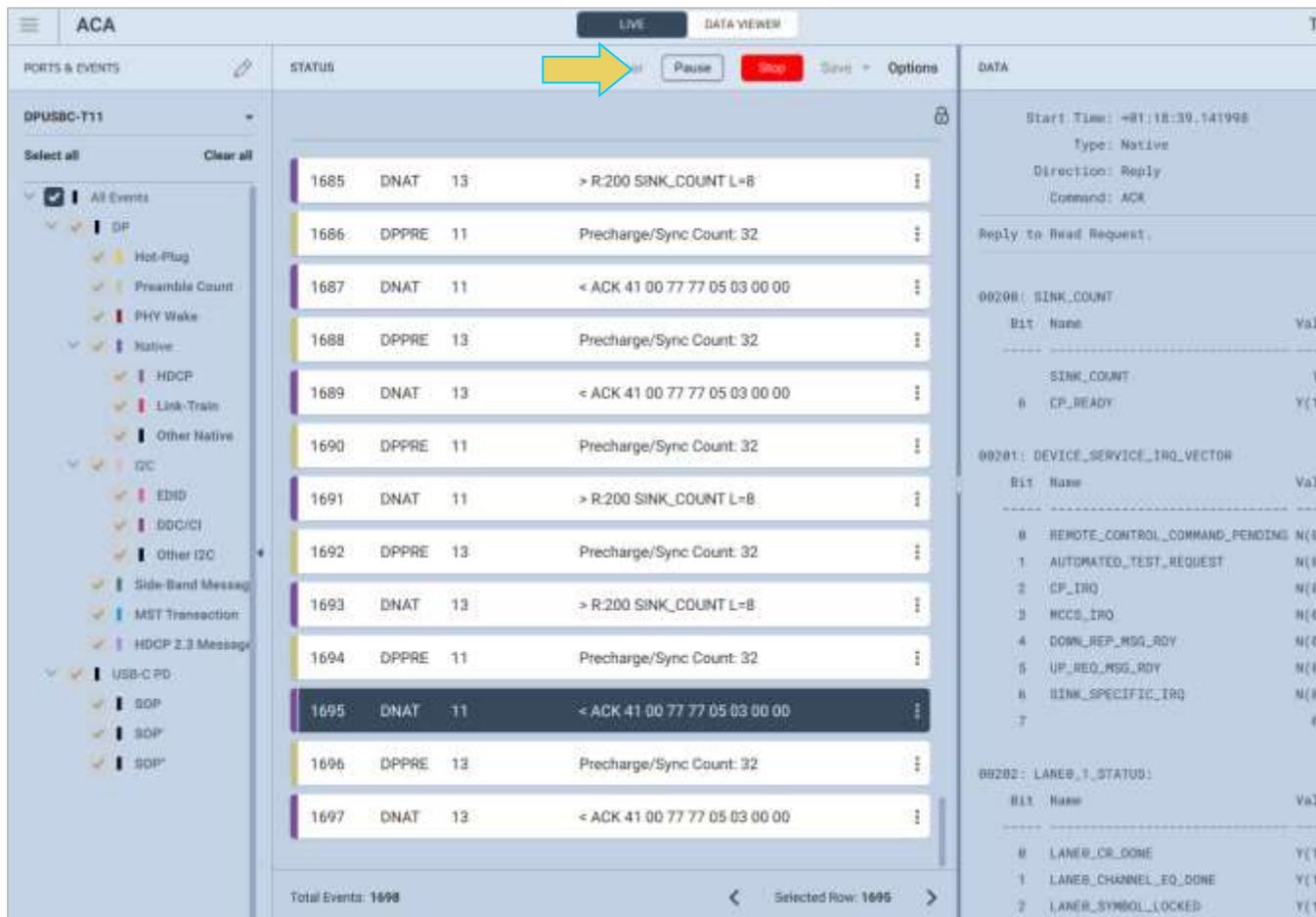


In the next example, the user has selected to monitor only DP events on the DP/USB-C Tx Out port.



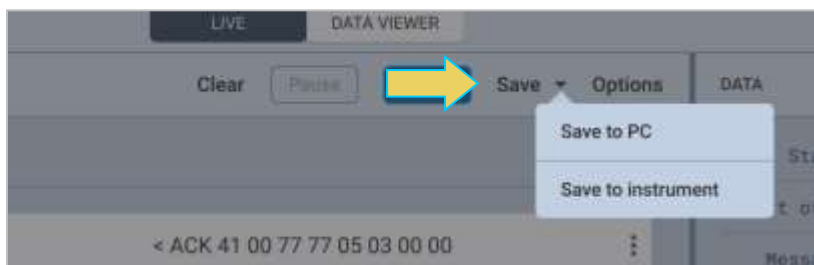
5. Select the **Start** button on the ACA Control Menu at the top to initiate the monitoring/viewing of the DP Aux Chan transactions.
6. Take the necessary action—such as a hot plug—to initiate EDID, HDCP or Link Training transactions.

An example showing monitored data is shown below. You can stop or pause the collection at any time using the buttons on the ACA Control Menu.



The next subsection will break down the ACA Window in more detail. It is very similar to the ACA Data viewer utility, which will also be covered.

7. Once you have finished running the trace, click the **Save** dropdown and select **Save to Instrument** or **Save to PC** depending on whether you are working with the remote ACA utility or the embedded Aux Channel Analyzer.

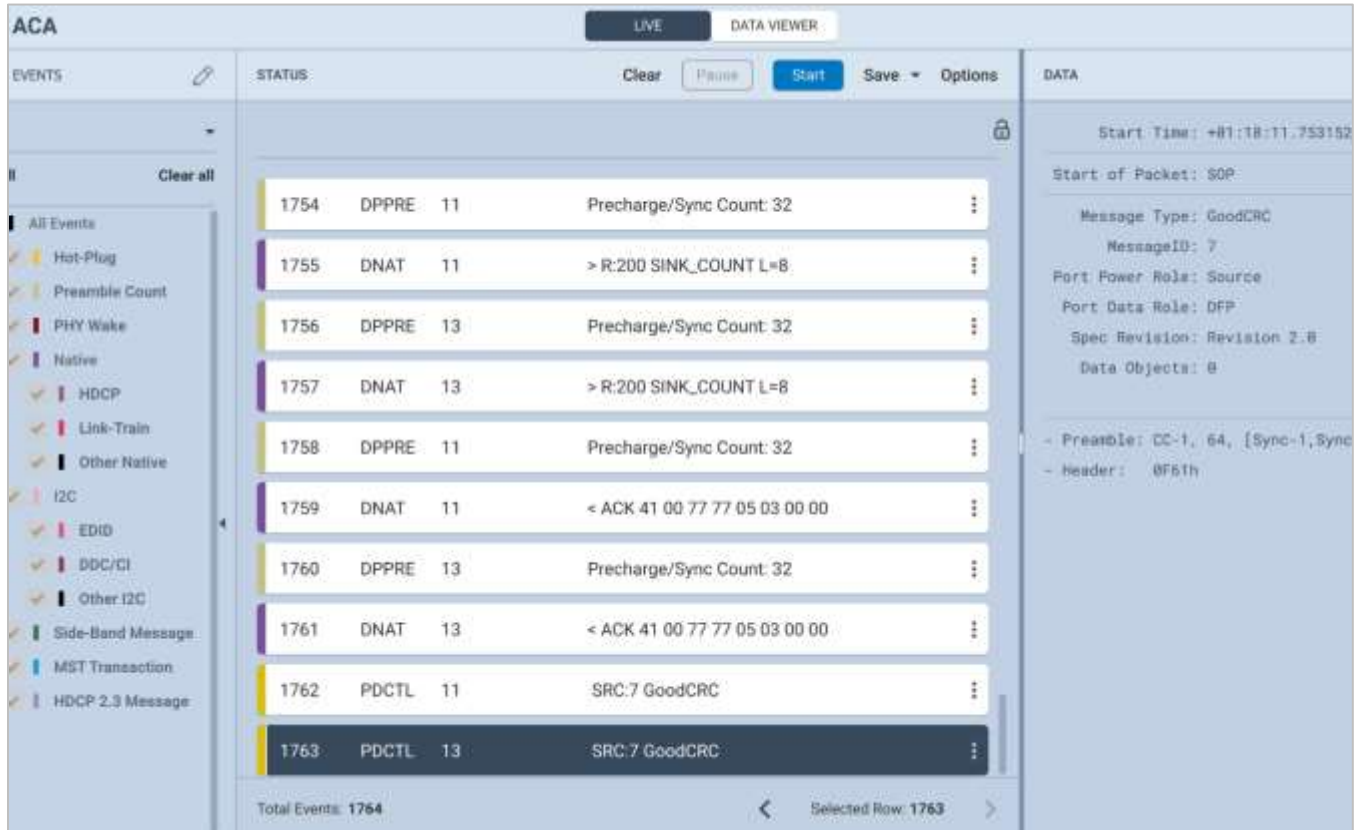


**Please note:**

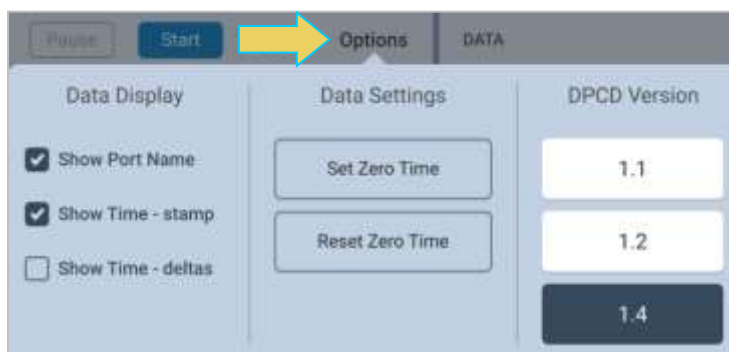
- In order to use the **ACA Data Viewer** utility (**Section 7.4**) on your PC to view the traces or the ACA viewer on the VPS GUI running on the external display with the powerful searching and filtering features, you must save the file, as shown in the previous step.
- If you are working on the **Aux Channel Analyzer** viewer on the instrument's embedded GUI but prefer to use **ACA Data Viewer** on the remote VPS GUI Application, you will have to transfer the saved file to your PC using the VPS Application running on the remote PC. This is covered in **7.5 Importing, Exporting, and Transferring ACA Data**.
- You can also passively monitor ACA transactions while testing both a source and sink device. Instructions for this procedure are in **Chapter 8 Passive Monitoring**.

### 7.3 ACA Window and Panel Description

The ACA Window will display the trace details from the data collection executed in the previous section. An example of a populated ACA window is below. Note the top toolbar remains unchanged from when first opening the Aux Channel Analyzer **LIVE** window.



You can access the **Options** dialog box using the top Control menu.



Options menu items are described in the following table:

Options Dialog Box	
	<ul style="list-style-type: none"> <li>▪ <b>Show Port Name</b> – Enables you to display or hide the Port name (the Port number is always shown).</li> <li>▪ <b>Show Time-stamp</b> – Enables you to show or hide the time stamps for each transaction.</li> </ul>

- **Show Time-deltas** – Enables you to show the time stamps relative to the previous transaction. Only available when Time-Stamps are shown (see above).
- **Set Zero Time** – Enables you to set a log record to zero. Subsequent log records are relative to this new zero time record.
- **Reset to Zero Time** – Resets the initial record in the active log in the ACA Trace window to zero.

The **STATUS**/ACA Trace Panel displays each event in a row with some information. This information is expanded in the ACA Event Details panel which will be covered next.

An example of the ACA Trace Panel is below. This example has the Port Name and Time-stamp selected from the options menu.

The numbered arrows correspond to the descriptions immediately following the screenshot.



1. **Item number** – This is a unique sequence number of the transaction.
2. **Type** – The type of Aux Chan transaction; either EDID, HDCP DPLT (Link Training), DNAT (DP native Aux transactions), etc.
3. **Port Name and Number** – Port Name is an optional viewing field. Port Number will always be displayed.
4. **Time stamp** (optional viewing field) – Shows the timestamp of each transaction. Can either be absolute time based (shown) on the M42d system clock or relative time (Time-deltas) referenced from the initial transaction in the trace.
5. **Transaction Description** – A brief description of the transaction.

The **ACA Event Details Panel** will display the details of the selected transaction within the trace panel, as shown below. This screenshot is of details for a Link Training transaction.

**Note:** You may need to scroll down to see all data.

```

DATA

Start Time: +01:20:10.421899
Type: Native
Direction: Reply
Command: ACK

Reply to Read Request.

00200: SINK_COUNT
  Bit Name          Value Description
  -----
  SINK_COUNT        1 Bits 7 + 5:0
  6 CP_READY        Y(1)

00201: DEVICE_SERVICE_IRQ_VECTOR
  Bit Name          Value Description
  -----
  0 REMOTE_CONTROL_COMMAND_PENDING N(0)
  1 AUTOMATED_TEST_REQUEST          N(0)
  2 CP_IRQ                          N(0)
  3 MCCS_IRQ                         N(0)
  4 DOWN_REP_MSG_RDY                 N(0)
  5 UP_REQ_MSG_RDY                    N(0)
  6 SINK_SPECIFIC_IRQ                 N(0)

```

The following list describes the information that is provided in the **ACA Event Details** dialog box.

**Note:** The information in the Details panel will vary depending on the type of log record that is selected.

- **Start Time** – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.

- **Type** – There are various types of data that can be monitored on the DisplayPort interfaces: EDID, HDCP and DP specific data types related to Link Training, side band messaging, Multi-Stream Transport transactions, native transactions, etc.
- **Direction** – The direction of the transaction either a request or a reply.
- **Command** – The type of Command being issued
- **Address** – The register address of the transaction
- **Details (text)** – The contents of the transaction in human readable text.  
**Details (hex)** – The contents of the transaction in hex data.



## 7.4 ACA Data Viewer

This section describes the **ACA Data Viewer** utility used for viewing DisplayPort Aux Channel transaction data that have been stored on the PC hosting VPS GUI Application. You can also use the ACA Data Viewer on the embedded VPS GUI to view ACA trace files stored on the M42d itself.

**Please note** that in order to use the **ACA Data Viewer** utility on your remote PC to view the traces or the ACA Data viewer on the embedded M42d GUI with the powerful searching and filtering features, you must save the file. This procedure is covered in a previous section.

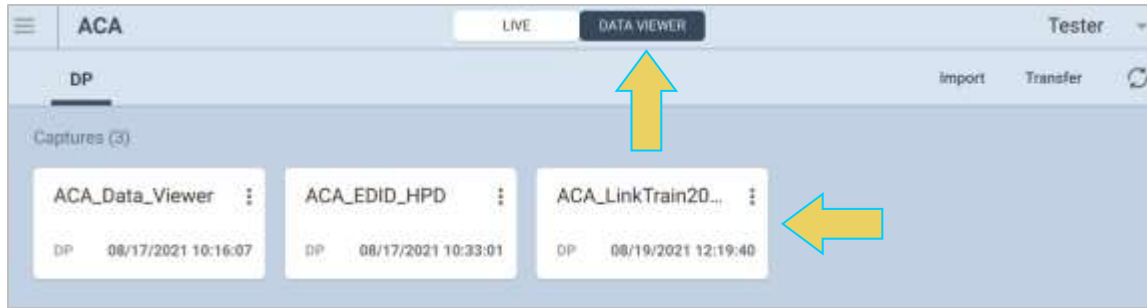
If you are working on the embedded **Aux Channel Analyzer** viewer but prefer to use **ACA Data Viewer** on the external remote VPS Application, you will have to transfer the saved file to your PC using the external VPS GUI. Instructions for transferring are detailed in the next section.

### ACA Data Viewer – Panel Description

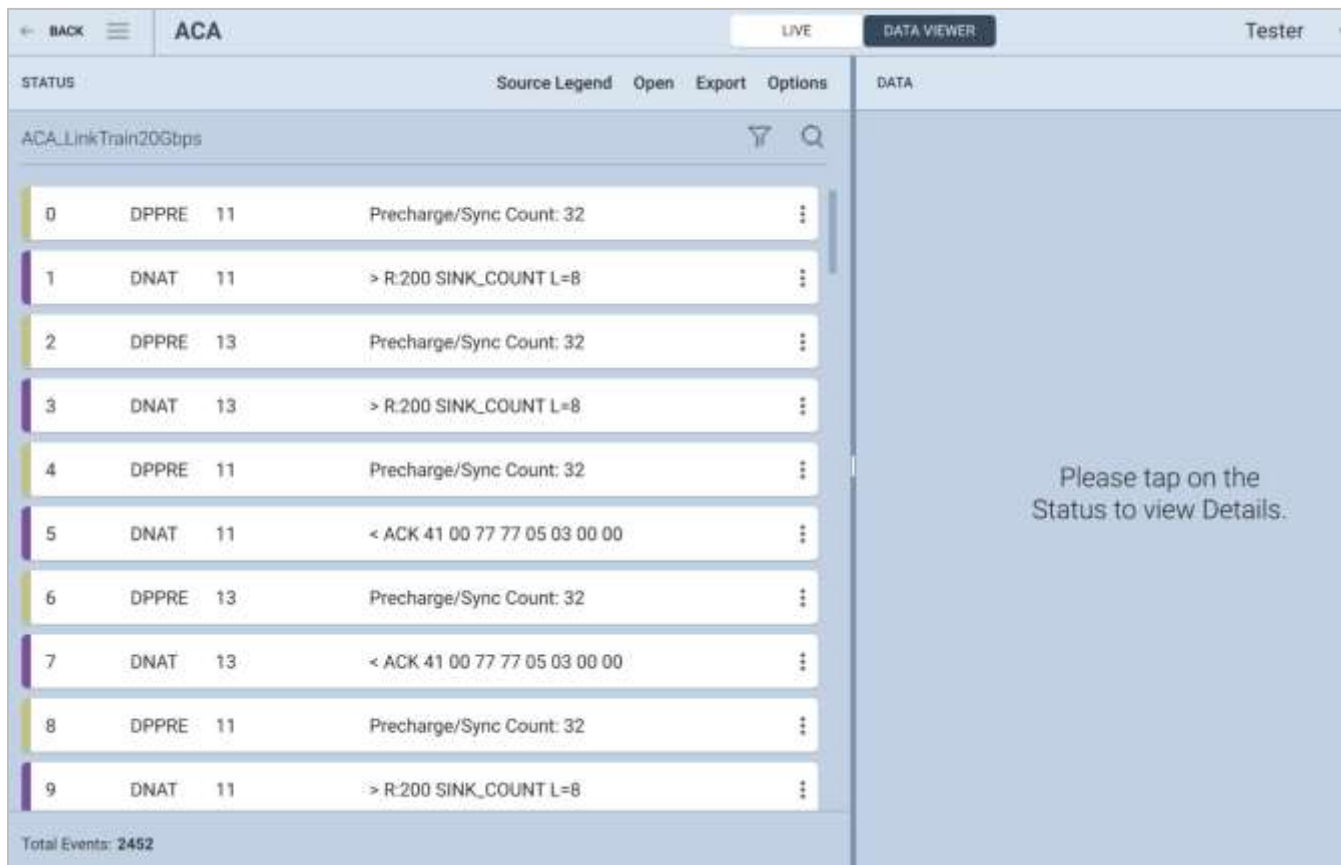
Access the ACA Data Viewer by selecting **ACA** on the home dashboard or from the quick access toolbar shown below.





If not already selected, click the **DATA VIEWER** tab at the top of the window. Otherwise, select an ACA Data file to open from the **Captures** panel, as shown below.



You'll notice the window looks similar to the ACA Utility, though there are a few distinct and very useful additions. A screenshot of the populated **ACA Data Viewer** is below. Notice the Trace Panel (**STATUS**) and Event Details Panel (**DATA**) are the same as described in **7.3 ACA Window and Panel Description**.



The main difference is in the Control Menu at the top of the window. The following are features not found in the ACA Utility while performing a trace:

- **Source Legend** – Reference for Port numbers and names
- **Open** – Open a file saved locally, whether on the instrument or host PC
- **Export** – Export results as text or html file
- **Filter**  – Filter results shown in the Trace Panel
- **Find**  – Find a specific data type in the Trace Panel



## Exporting ACA Data as Text or HTML File

The **Export** feature allows you to export the current ACA Data Set as either a text or HTML file and save it locally to the hard disk.

The following table features a screenshot of the **Export as...** dialog box. In this example, **All** events have been selected.

Export Dialog Box	
Field	Description
<b>Events</b>	Enables you to select all recorded events, or a specified range
<b>Start</b>	Field available only when Range radio button is active to specify the first record of the range of records to include in the export operation
<b>End</b>	Field available only when Range radio button is active to specify the last record of the range of records to include in the export operation.
<b>Show Time Delta</b>	Toggle enabling you to export the data with the time showing as relative to the previous event
<b>Show Details</b>	Toggle enabling you to export the data and include the human-readable information in the Event Details Panel
<b>Show Raw Data</b>	Toggle enabling you to export the data and include the raw data
<b>File Format</b>	Enables you to select between Text or HTML file export

Once you have selected the desired options, choose a folder to save the file in, and click **Save**.

This data will then be accessible in any program that is capable of reading .txt or .htm files.

## 7.5 Using the ACA Filter and Find Features

### ACA Filter

The **ACA Filter** dialog box is accessible using the Filter button. The **ACA Filter** function enables you to filter an ACA trace file to view a subset of the log records in a particular data set.

The ACA Filter feature is only available within the **ACA Data Viewer**. If you wish to use the Filter feature on ACA traces that you have captured using the **ACA Remote Control** (remote PC) or **Aux Channel Analyzer** (embedded GUI), you have to save the ACA data and reload it through the **ACA Data Viewer** utility.

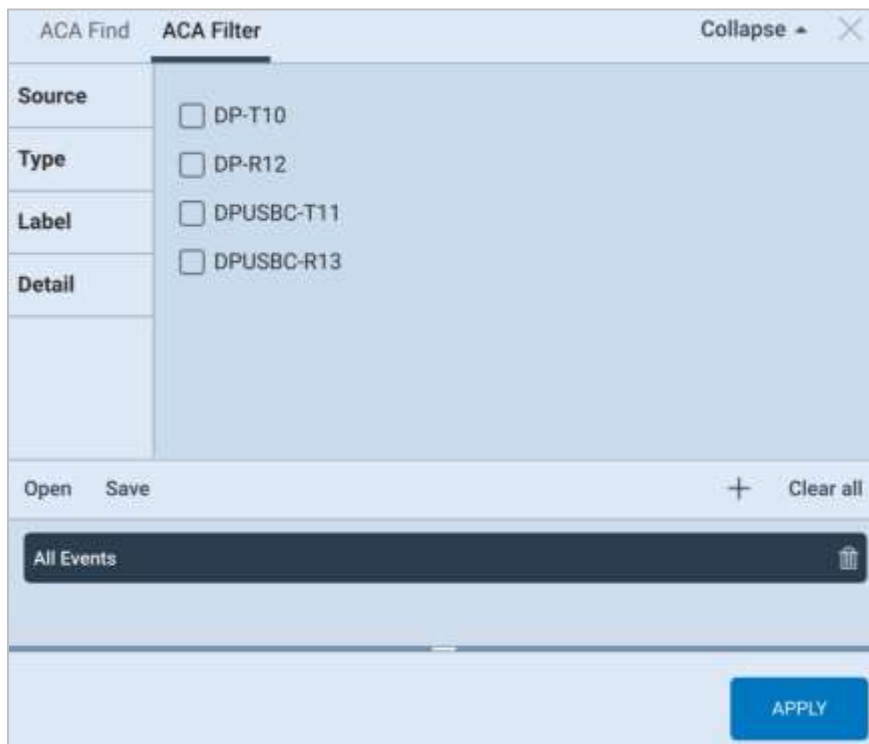
See **7.2 Monitoring Auxiliary Channels with ACA Utility** for instructions on saving an ACA Data set.

### Filtering Data

You access the ACA Filter function using the **Filter**  button on the control menu at the top of the **ACA Data Viewer** window.



The **ACA Filter** dialog box appears, as shown below.

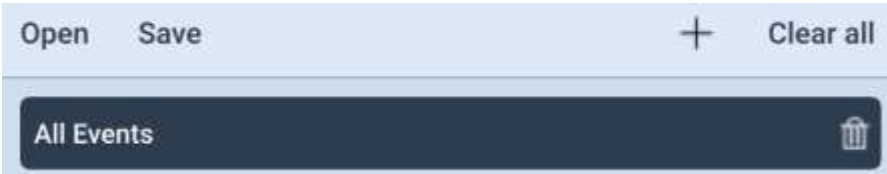




By default, all events are selected, as displayed in the bottom panel of the dialog box.

There are four tabs within the dialog box, as well as a control toolbar at the top of the bottom panel. Each tab will be covered in detail within this subsection, along with examples.

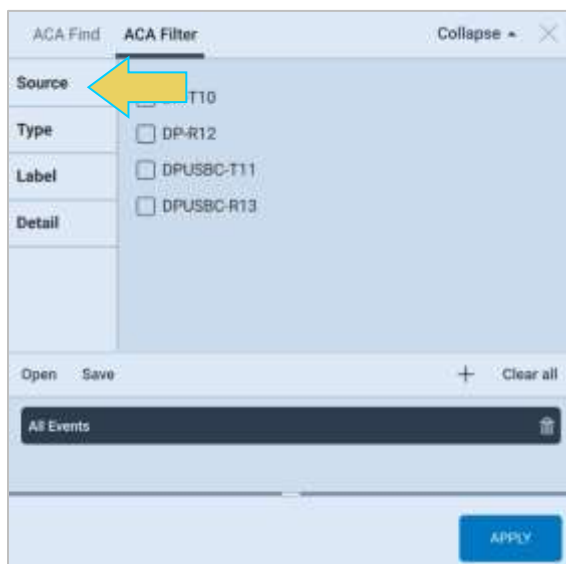
Note that criteria may be selected and combined amongst all four filtering options if so desired.

The following table gives an overview of the Control Menu:

ACA Filter – Control Menu		
		
Button	Function	Description
<b>Open</b>	Opens a stored user-created Filter configuration.	You can store commonly used filter configurations using the Save function and recall them for quick access using the Open button.
<b>Save</b>	Saves the current user-created Filter configuration.	
<b>Clear</b>	Clear the existing Filter criteria.	You can build up complex filter configurations by combining multiple filter criteria. When you add multiple configurations, they behave as a logical OR function whereby if either of the criteria is True, the filter function will filter an entry.  When you are assembling filter configurations you can clear individual configurations by highlighting them in the panel provided and then use the Clear button. You can add through the Add button. You can remove an individual configuration using the Remove button. Example screen shots are shown below.
<b>Add</b> 	Sets the currently defined Filter criteria defined in either the Source, Type, Label or Details sub-panels and adds another row for a new filter criterion.	
<b>Remove</b> 	Removes a highlighted filter criterion of an existing filter configuration.	

### Filter by Source

The following screenshot demonstrates the **Source** tab within the **ACA Filter** dialog box. A description is following the image.



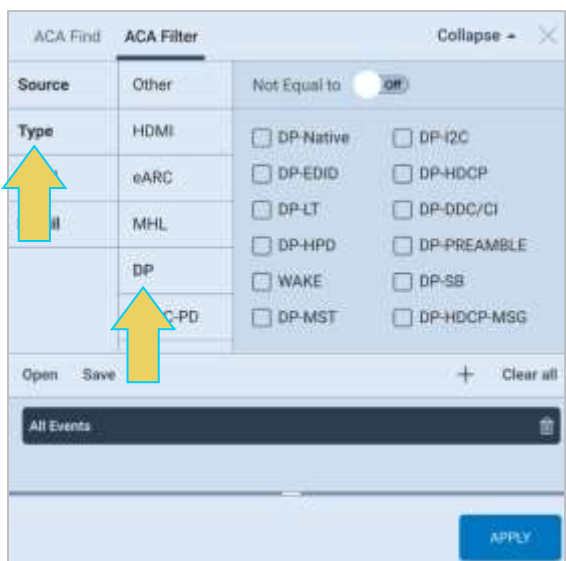
The **Source** tab features checkboxes to select the port on a particular module that you want to filter. Please note that you can collect data in the ACA Trace window from multiple ports.

When you select multiple Source ports they behave as a logical OR function.

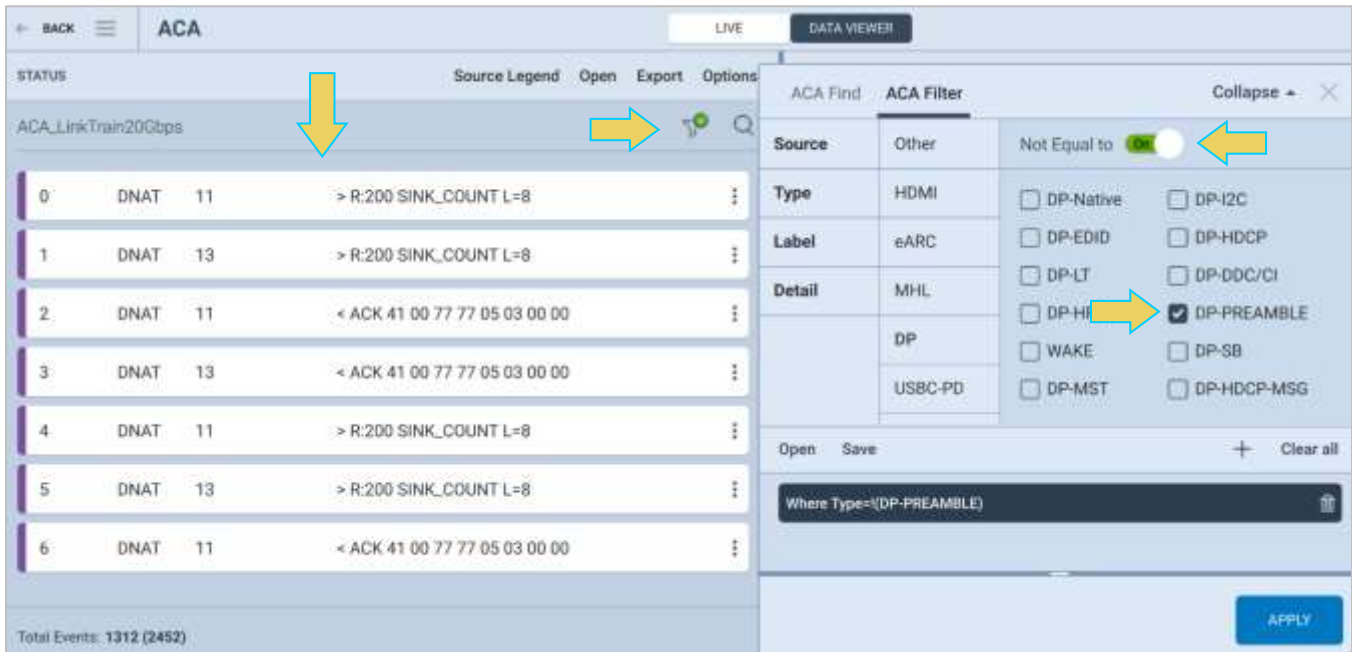
When you initiate a search, the Filter function will locate all records matching the criteria. If only the Source (port) is specified, all records from or to that source will be highlighted.

### Filter by Type

The following screenshot demonstrates the **Type** tab within the **ACA Filter** dialog box. The **Type** tab consists of check boxes enabling you to specify which data types you wish to filter for. When you select multiple data types they behave as a logical OR function.

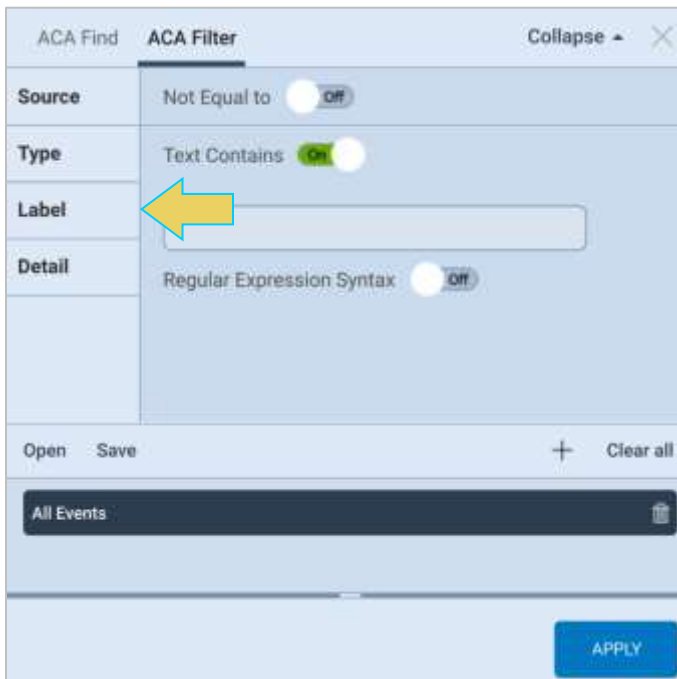


The following example filters out all **DP-PREAMBLE** data types using the **NOT** operator. Notice that when a filtering criteria is active, there is a green checkmark on the filter icon within the ACA Data Viewer.



### Filtering by Label

The following screenshot demonstrates the **Label** tab within the **ACA Filter** dialog box. A description is following the image.



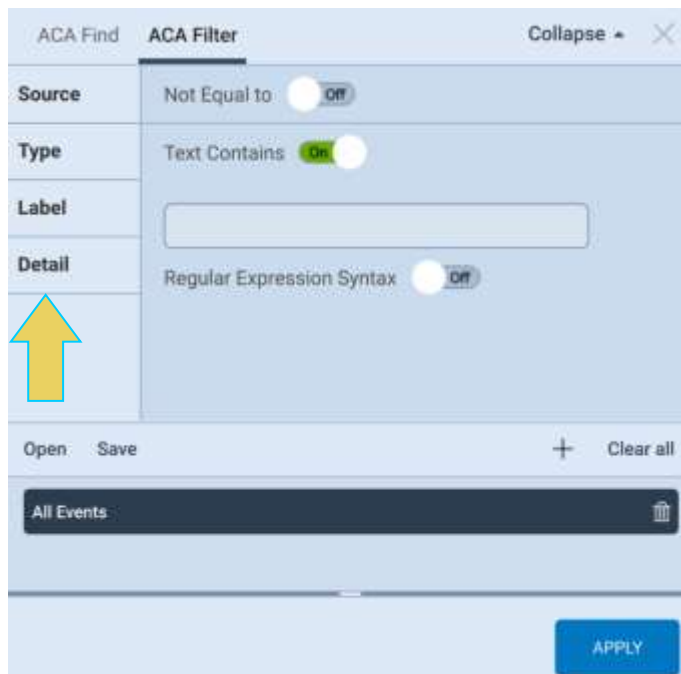


The **Label** tab is used for specifying criteria for text that appears in the Label field of the event log. When you enter a criterion in the Label field, it will automatically be added to the set of criteria in the panel above it.

- Text Contains – A toggle to activate the Label criteria.
- Not Equal to – A toggle which when activated will filter for records that *do not* meet the criteria in the field beneath it.
- Text Field – A text field to enter a string that will be matched (or not matched). **NOTE:** This text field is case sensitive.
- Regular Expression Syntax – A toggle to specify whether the text in the Text Field will be treated as plain text or a regular expression. Regular expression syntax is a commonly used set of operators for filtering the text. You can find detailed examples on the web including Wikipedia. If Regular Expression checkbox is checked, you can enter in any regular expression into the text field for a string match.

### Filtering by Detail

The following screenshot demonstrates the **Detail** tab within the **ACA Filter** dialog box. A description is following the image.

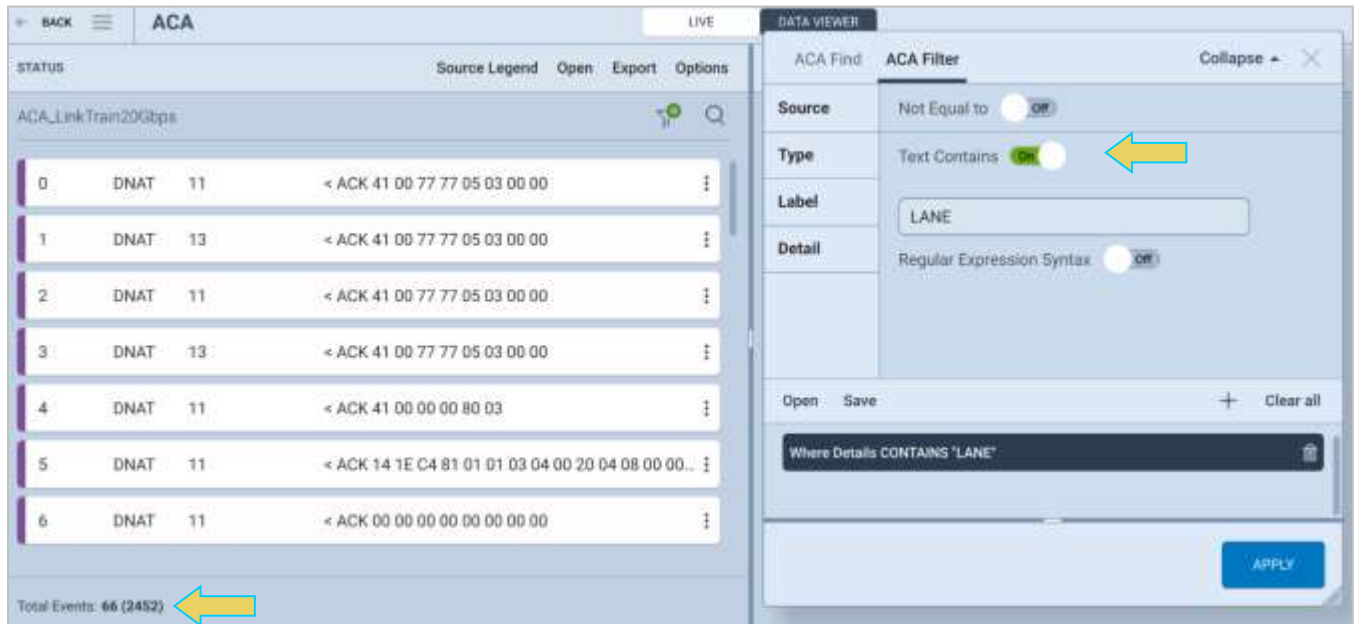


The **Detail** tab is used for specifying criteria for text that appears in the Details field of the event log. When you enter a criterion in the Detail field, it will automatically be added to the set of criteria in the panel above it.

The fields and functionality in this panel are the same as the **Label** tab (see above).

The following example filters for events that contain the word “LANE” in their transaction details (the field is case-sensitive). The results are on the left-hand side within the ACA Data Viewer Trace Panel.

Note that the Event counter beneath the Trace Panel shows how many events are within the filter, followed by the total number of events in the unfiltered trace in parentheses.



## ACA Find Feature

The **ACA Find** dialog box is accessible using the Find  button. The **ACA Find** function enables you to quickly locate different types of events.

The ACA Find feature is only available within the **ACA Data Viewer**. If you wish to use the Find feature on ACA traces that you have captured using the **ACA Remote Control** (remote PC) or **Aux Channel Analyzer** (embedded GUI), you have to save the ACA data and reload it through the **ACA Data Viewer** utility.

See [7.2 Monitoring Auxiliary Channels with ACA Utility](#) for instructions on saving an ACA Data set.

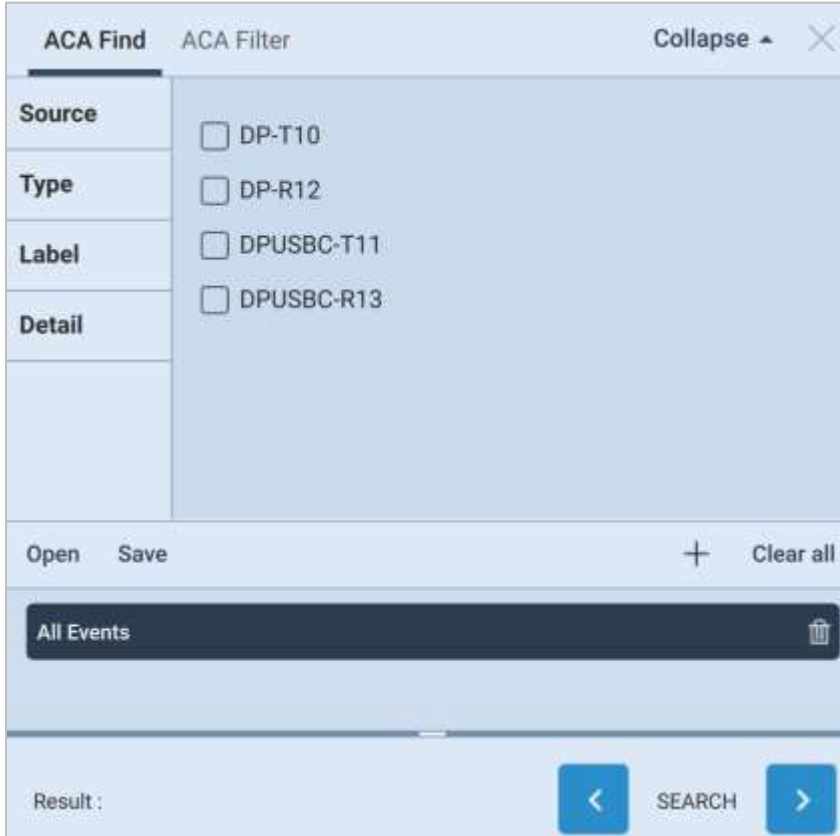
A screenshot of the **ACA Find** dialog box is below. Note that the Find dialog box is identical in appearance to the Filter dialog box.

### Finding Specific Data

You access the ACA Find function using the **Find** button on the control menu at the top of the **ACA Data Viewer** window.



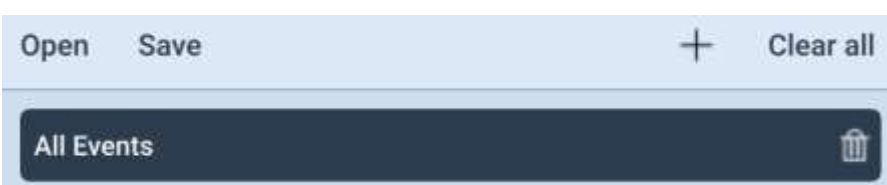
The **ACA Find** dialog box appears, as shown below.



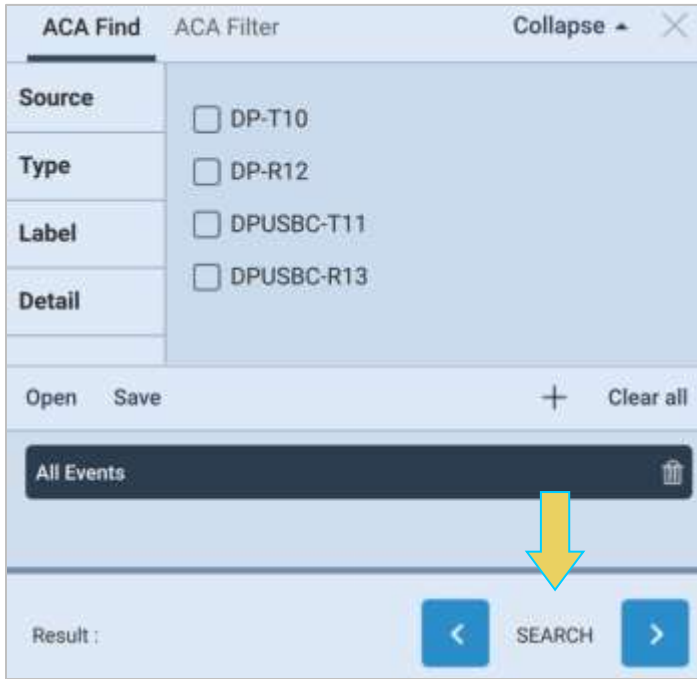
There are four tabs within the dialog box, as well as a control toolbar at the top of the bottom panel. Each tab will be covered in detail within this subsection, along with examples.

Note that criteria may be selected and combined amongst all four finding options if so desired.

The following table gives an overview of the Control Menu:

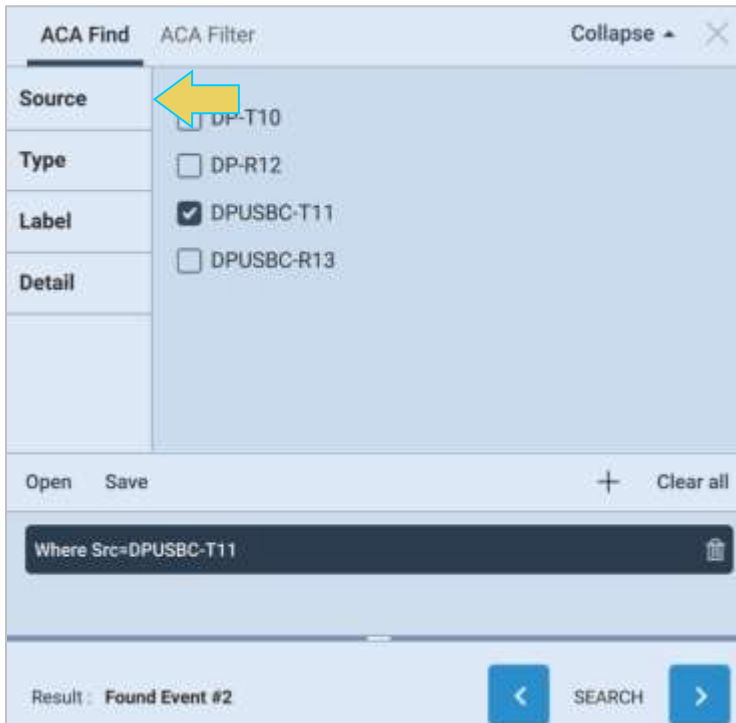
ACA Find – Control Menu		
		
Button	Function	Description
<b>Open</b>	Opens a stored user-created Find configuration.	You can store commonly used Find configurations using the Save function and recall them for quick access using the Open button.
<b>Save</b>	Saves the current user-created Find configuration.	
<b>Clear all</b>	Clear the existing Find criteria.	You can build up complex Find configurations by combining multiple find criteria. When you add multiple configurations, they behave as a logical OR function whereby if either of the criteria is True, the find function will find an entry.  When you are assembling find configurations you can clear individual configurations by highlighting them in the panel provided and then use the Clear button. You can add through the Add button. You can remove an individual configuration using the Remove button.  Example screen shots are shown below.
<b>Add</b> +	Sets the currently defined Find criteria defined in either the Source, Type, Label or Details sub-panels and adds another row for a new find criterion.	
<b>Remove</b> 🗑️	Removes a highlighted find criterion of an existing find configuration.	

The bottom of the dialog box features **PREVIOUS** and **NEXT** arrow buttons. These will take you to the next or previous match of the find criteria within the Trace Panel. Use these to navigate the events that were found matching the desired criteria.



### Find by Source

The following screenshot demonstrates the **Source** tab within the **ACA Find** dialog box. A description is following the image.



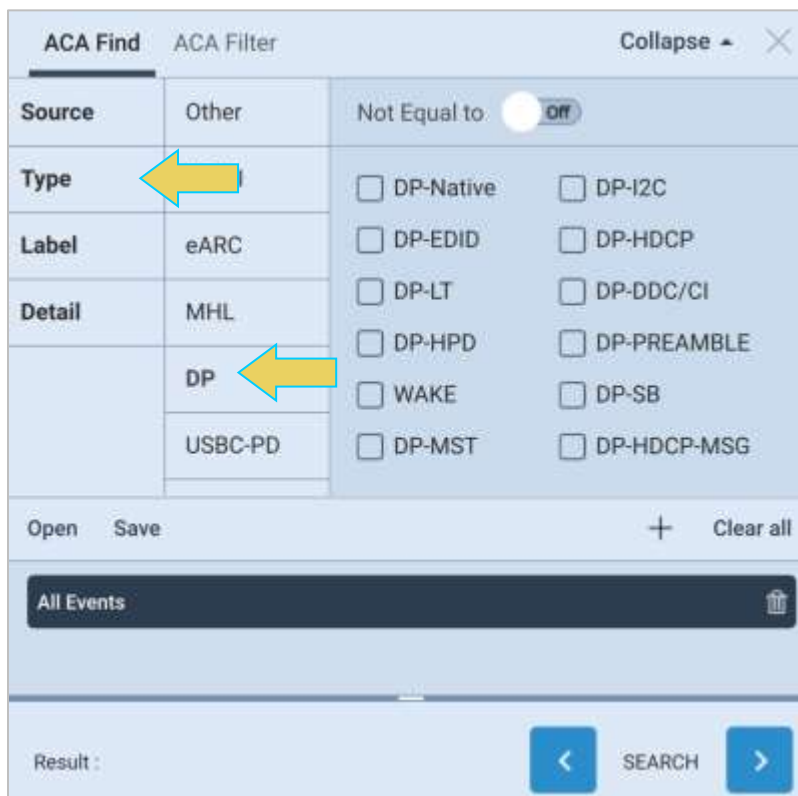
The **Source** tab features checkboxes to select the port on a particular module that you want to find. Please note that you can collect data in the ACA Trace window from multiple ports.

When you select multiple Source ports they behave as a logical OR function.

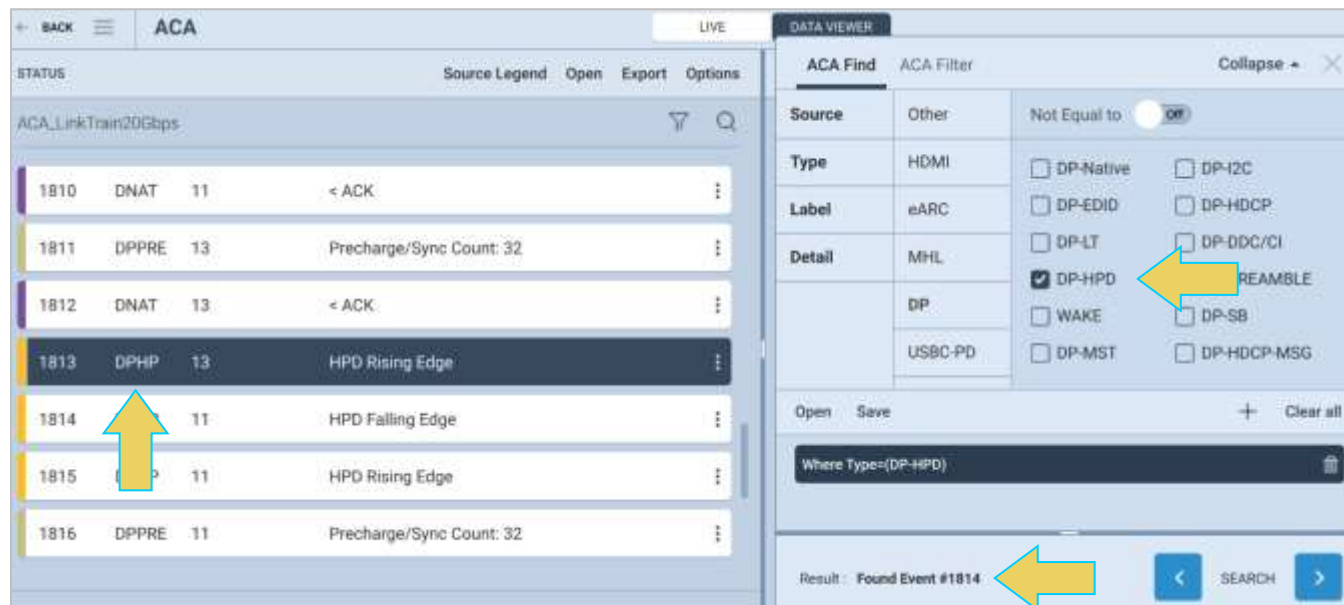
When you initiate a search, by clicking on the Next or Previous button, the Find function will locate a record matching the criteria. If only the Source (port) is specified, the next or previous record from or to that source will be highlighted.

### Find by Type

The following screenshot demonstrates the **Type** tab within the **ACA Find** dialog box. The **Type** tab consists of check boxes enabling you to specify which data types you wish to find. When you select multiple data Types they behave as a logical OR function.



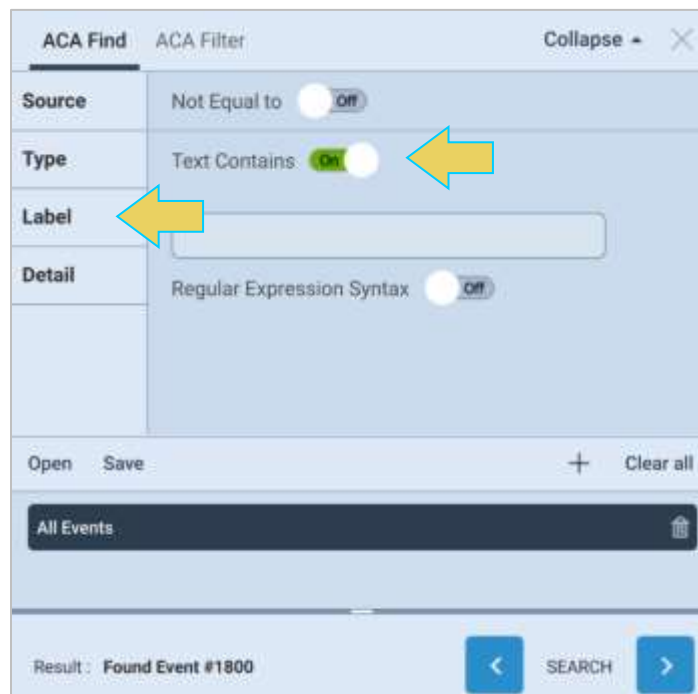
The following example demonstrates a search for all events of type DP-Native. The result of clicking **NEXT** once DP-Native has been checked appears on the left-hand side within the ACA Trace Panel.



Clicking the **NEXT** arrow again would take the Trace Panel to the next DPHP data type on line 1814.

### Finding by Label

The following screenshot demonstrates the **Label** tab within the **ACA Find** dialog box. A description is following the image.



The **Label** tab is used for specifying criteria for text that appears in the Label field of the event log. When you enter a criterion in the Label field, it will automatically be added to the set of criteria in the panel above it.

- Text Contains – A toggle to activate the Label criteria.
- NOT – A checkbox which when checked will find records that *do not* meet the criteria in the field beneath it.
- Text Field – A text field to enter a string that will be matched (or not matched). **NOTE:** This text field is case sensitive.
- Regular Expression Syntax – A check box to specify whether the text in the Text Field will be treated as plain text or a regular expression. Regular expression syntax is a commonly used set of operators for finding the text. You can find detailed examples on the web including Wikipedia. If Regular Expression checkbox is checked, you can enter in any regular expression into the text field for a string match.

The following example searches for DP-Native type events, but narrows the search by finding labels with text containing “ACK.” Note the bottom panel which lists all criteria for the search as a logical AND function.

The screenshot displays the ACA interface with a search filter dialog box open. The dialog box is titled "ACA Find" and has tabs for "ACA Find" and "ACA Filter". The "ACA Find" tab is active. It shows a "Source" field set to "Not Equal to" (off), a "Type" field set to "Text Contains" (on), a "Label" field containing "ACK", and a "Detail" field set to "Regular Expression Syntax" (off). Below the dialog box, a search criteria bar shows "Where Type=(DP-Native) AND Label CONTAINS 'ACK'". The background shows a list of events with columns for ID, Type, and Label. Event 521 is highlighted with a yellow arrow pointing to its label field containing "< ACK 41 80 00 00 80 83".



## Finding by Detail

The following screenshot demonstrates the **Detail** tab within the **ACA Find** dialog box. A description is following the image.

The **Detail** tab is used for specifying criteria for text that appears in the Details field of the event log. When you enter a criterion in the Detail field, it will automatically be added to the set of criteria in the panel above it.

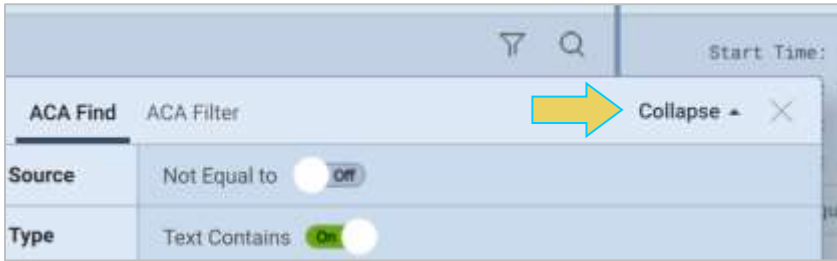
The fields and functionality in this panel are the same as the **Label** tab (see above).

The following example retains the previous two criteria (DP-Native data type and “ACK” in the label), but searches for events that contain the text “DPCD” (the field is case-sensitive).

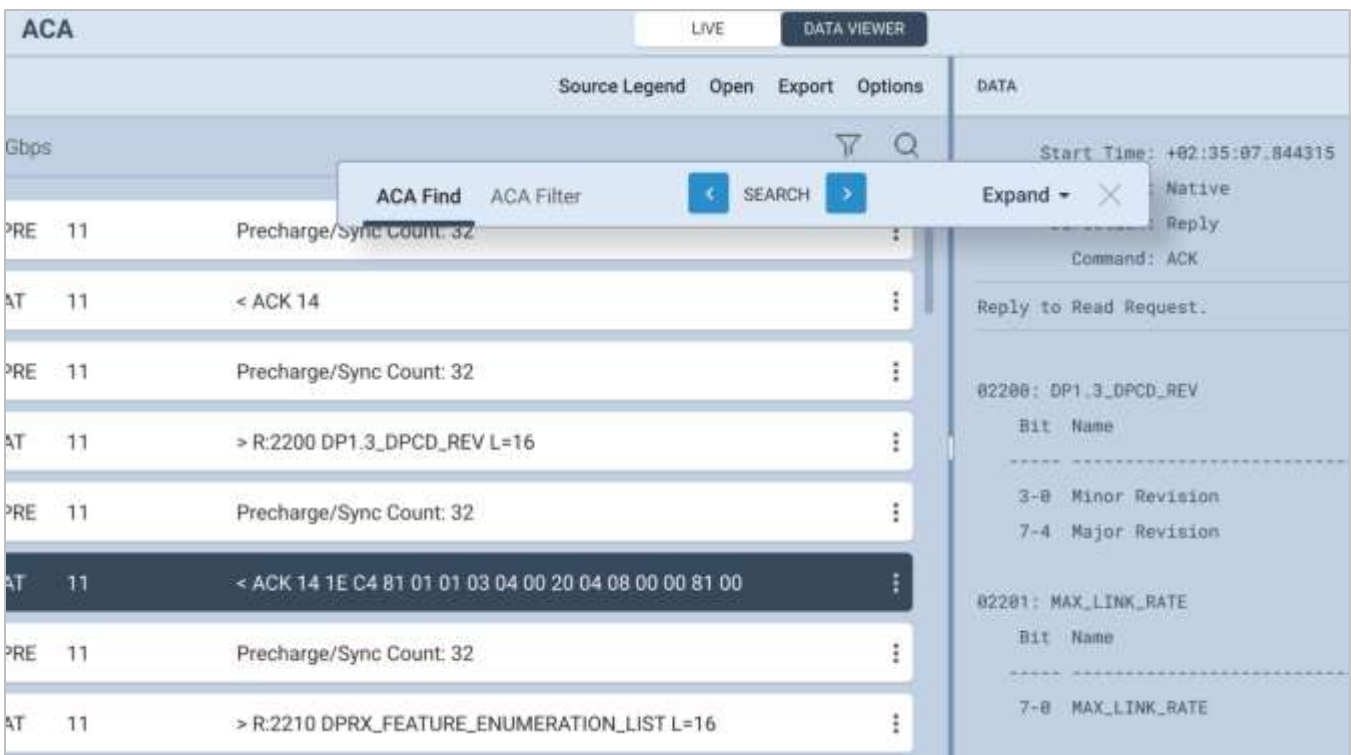
The **ACA Find** dialog box is below and the result of the search in the **ACA Data Viewer** window follows. Note the bottom panel which lists all the criteria for the search.

The screenshot shows the **ACA Find** dialog box with the **ACA Filter** tab selected. The dialog has a **Collapse** button and a close button (X) in the top right corner. The main area is divided into a left sidebar and a right main panel. The sidebar has four tabs: **Source**, **Type**, **Label**, and **Detail**. The **Detail** tab is selected, indicated by a yellow arrow pointing up. The main panel shows the following settings: **Source** is set to **Not Equal to** with a toggle switch set to **off**; **Type** is set to **Text Contains** with a green **On** toggle switch and a yellow arrow pointing left; **Label** is set to **ACK** in a text input field; **Detail** is set to **Regular Expression Syntax** with a toggle switch set to **off**. Below the main panel are buttons for **Open**, **Save**, a plus sign (+), and **Clear all**. A dark blue bar at the bottom of the main panel displays the search criteria: **Where Type=(DP-Native) AND Label CONTAINS "ACK" AND Details CONTAINS "DPCD"**, with a yellow arrow pointing left. At the bottom of the dialog, it shows **Result : Found Event #98** and a **SEARCH** button with left and right navigation arrows.

You can **Collapse** the Find dialog box to better view the ACA Data Viewer main window without exiting the find tool altogether.



This would be the resulting screen within the ACA Data Viewer after collapsing the dialog box following the previous example.



Click **Expand** to make the ACA Find tool visible again.

## 7.6 Importing, Exporting, and Transferring ACA Data

You have the ability to **Import**, **Export**, and **Transfer** ACA Data Files from captures performed using the M42d embedded or remote VPS application GUI.

This section will describe the following processes in detail:

- **Export** of an ACA Data file to a file folder or USB storage
- **Import** of an ACA Data file from a local file folder or USB storage
- **Transfer** of an ACA Data file from an M42d instrument to a remote host PC or vice versa.

The **Import** and **Export** features allow you to exchange ACA Data files between your PC or a USB Drive and the VPS Application of the M42d.

You may Export an ACA Data file to disseminate to colleagues or other subject matter experts. You may need to import a file when you want to examine ACA trace taken by a colleague or transferred from USB storage. The **Export** and **Import** function zips or unzips a capture file to enable you to post it on an FTP server or disseminate through email if the file is not too large.

ACA data files recorded on the M42d instrument's embedded VPS GUI need to be transferred to the remote host PC before being able to **Export** for dissemination.

The **Transfer** feature enables you to simply transfer an ACA data file executed on the M42d embedded GUI onto your PC's VPS Application for viewing/analysis, or vice versa. The Transfer feature is only accessible from the Remote VPS Application on a PC since a remote PC is needed to execute the transfer.

You may Transfer an ACA Data file to back them up to your PC from your instrument and vice versa. You also need to transfer a capture in this manner in order to view it remotely if you originally ran the capture on the M42d embedded VPS GUI.

All of these features are accessible through the **VPS Application** interface on a remote PC.

The screenshot displays the ACA Data Viewer interface. The top bar includes 'LIVE' and 'DATA VIEWER' tabs. Below the tabs are buttons for 'Clear', 'Pause', 'Start', 'Save', and 'Options'. The main area is divided into three sections: 'EVENTS', 'STATUS', and 'DATA'.

The 'EVENTS' section on the left shows a list of event types: All Events, Hot-Plug, Preamble Count, PHY Wake, Native, HDCP, Link-Train, Other Native, I2C, EDID, DDC/CI, Other I2C, and Side-Band Message. A 'Clear all' button is visible above the list.

The 'STATUS' section in the center displays a table of events:

Event ID	Type	Count	Description
1754	DPPRE	11	Precharge/Sync Count: 32
1755	DNAT	11	> R:200 SINK_COUNT L=8
1756	DPPRE	13	Precharge/Sync Count: 32
1757	DNAT	13	> R:200 SINK_COUNT L=8
1758	DPPRE	11	Precharge/Sync Count: 32
1759	DNAT	11	< ACK 41 00 77 77 05 03 00 00
1760	DPPRE	13	Precharge/Sync Count: 32
1761	DNAT	13	< ACK 41 00 77 77 05 03 00 00

The 'DATA' section on the right shows detailed packet information:

```

Start Time: +01:18:11.753152
Start of Packet: SOP
Message Type: GoodCRC
MessageID: 7
Port Power Role: Source
Port Data Role: DFP
Spec Revision: Revision 2.0
Data Objects: 0

- Preamble: CC-1, 64, [Sync-1, Sync
- Header: #F61h
  
```

## Transferring an ACA Data File Between Instrument and Remote PC.

Transferring a capture file between the M42d instrument and remote PC may be necessary prior to exporting a file, so those procedures are described in this first subsection. Exporting and Importing are in following subsections.

You can view ACA traces using the ACA viewer off-line on your PC with the **ACA Data Viewer** utility. In order to view the ACA files on your PC with the VPS GUI application you will first have to transfer them to the PC using the **Data Transfer** utility.

The ability to save ACA traces enables you to disseminate them to other subject matter experts for analysis or to Teledyne customer support. You can view the ACA traces without a M42d test instrument once you have transferred the files to your PC.

**Note:** Transferring files must be done on a host PC that is connected remotely to an M42d instrument.

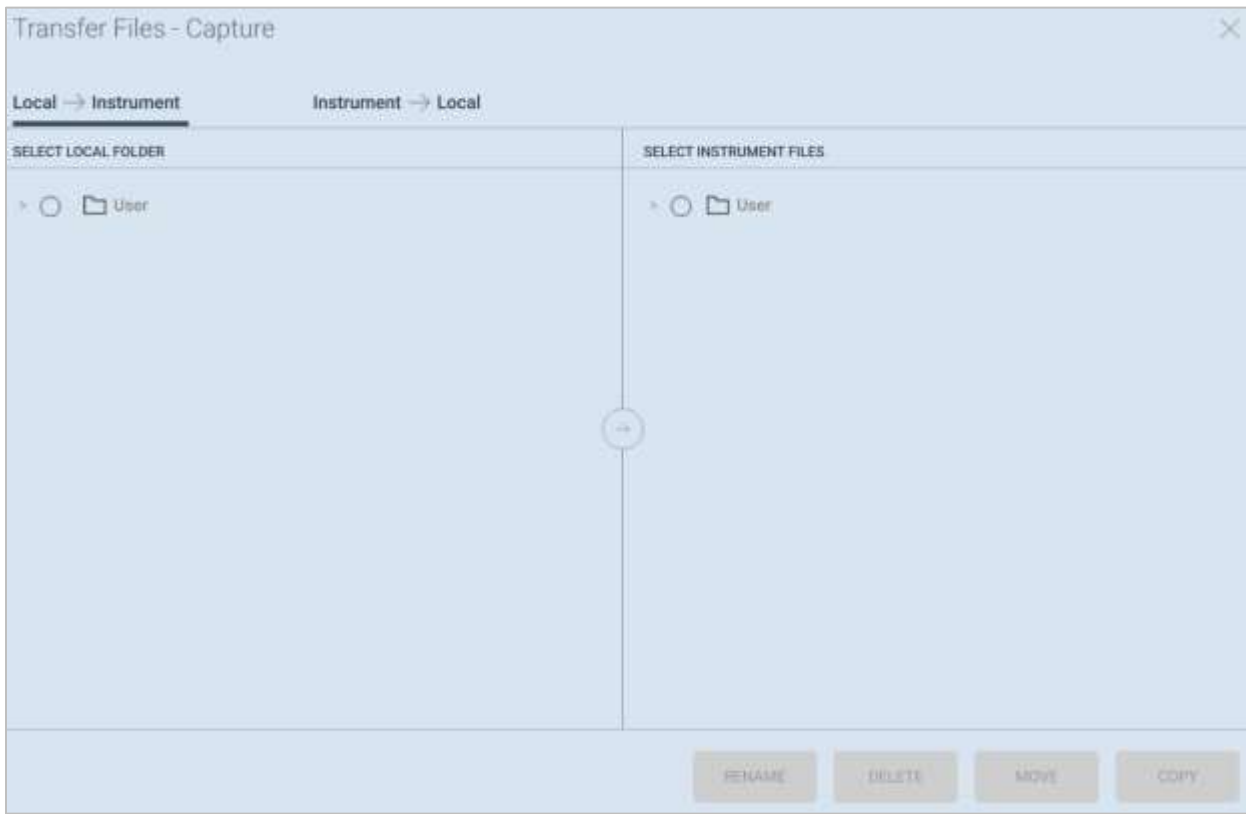
### Transferring ACA Data Files


To Transfer a file, navigate to the **ACA** tool from the VPS Dashboard. Select the **Transfer** button at the top right of the window, as shown below.

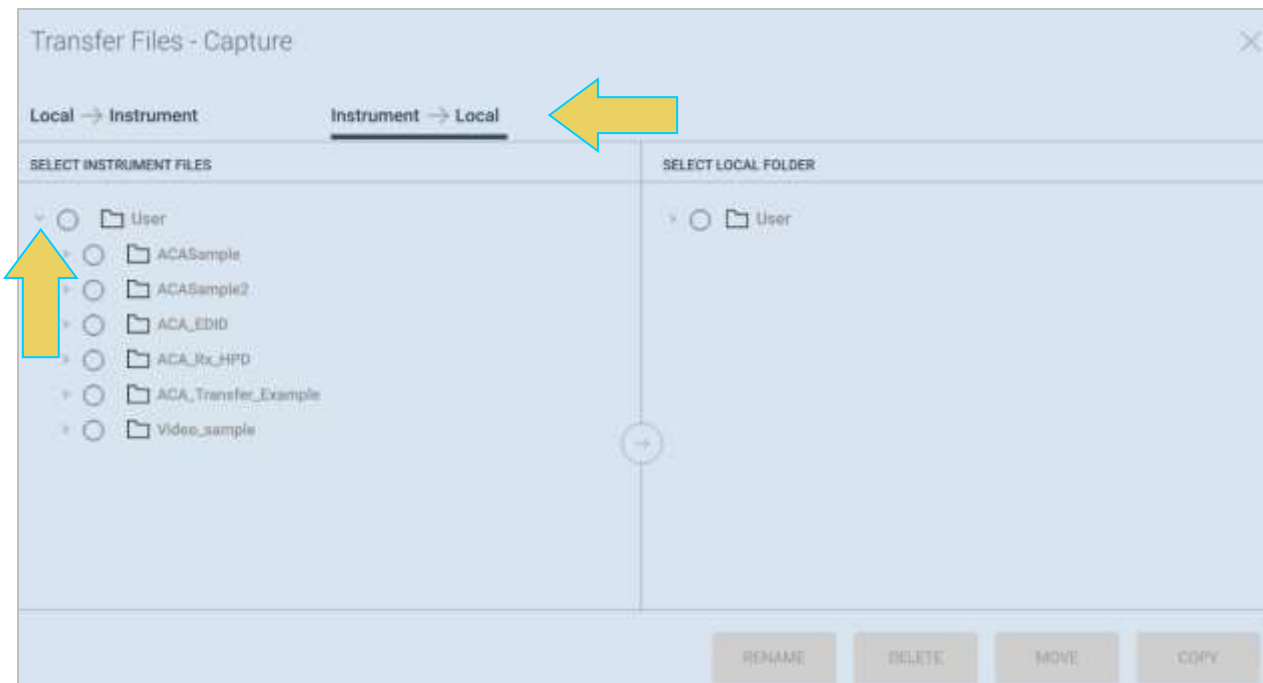


**Note:** The VPS Application must be running on the M42d instrument's embedded GUI in order for this tool to function properly.

The **Transfer** utility will appear, as shown below.



To transfer an ACA Data file from the M42d Instrument to a remote PC, select the **Instrument -> Local** tab at the top. Click the arrow  icon next to the **User** folder to expand it and view the files eligible for transfer.

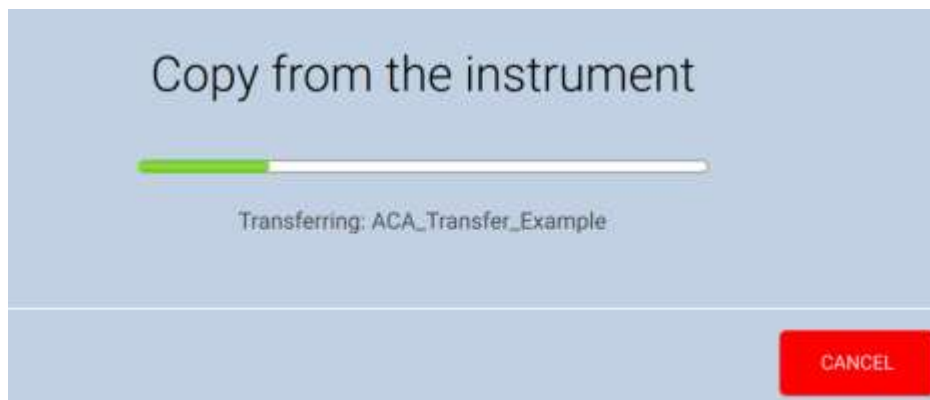


Select the desired file for transfer in the left-hand column labeled **Instrument Files**. Next, click on a target folder in the righthand column labeled **Select Local Folder**.

At this point you may either **Copy** the file to the instrument or **Move** it—which removes the file from the local storage on either the M42d instrument or PC after copying to the other device.



The example below shows **copying** a file from the Instrument to the remote PC's **User** folder.



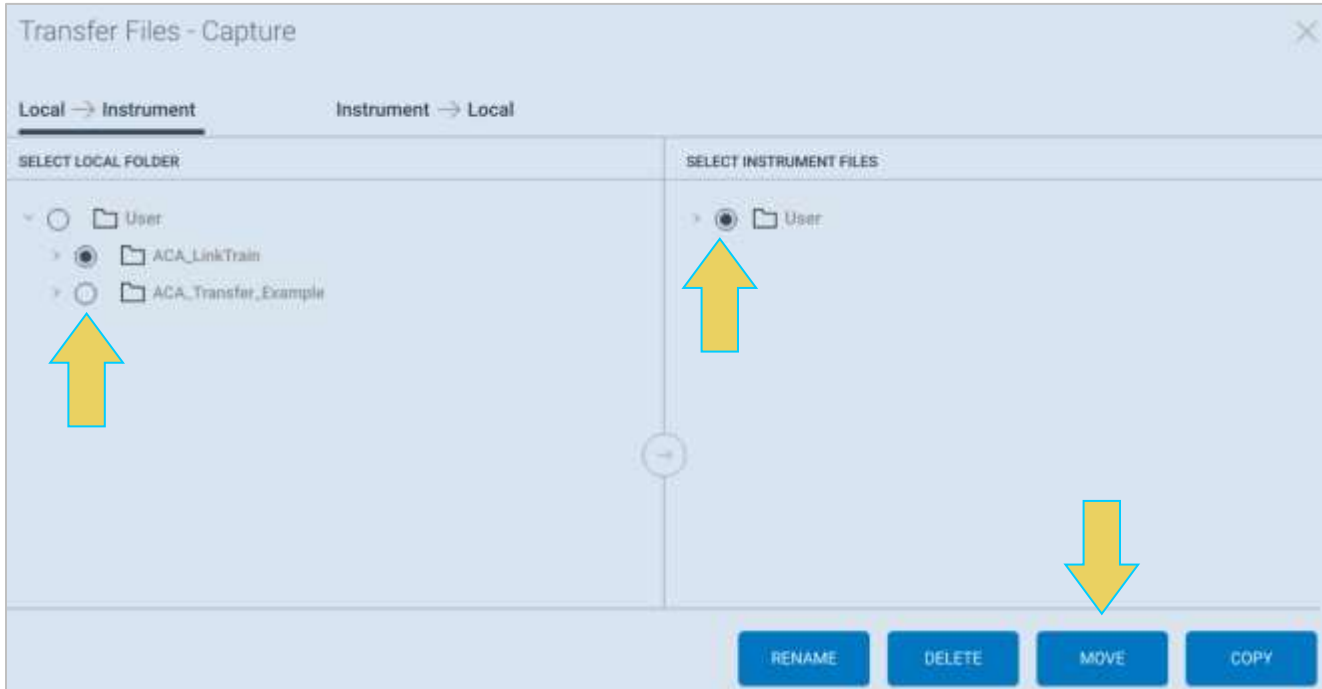
The result is the ACA data file now appearing in the **Instrument Files** column as well, as shown below.

**Note:** If the **Move>>** transfer option is utilized, the file will not appear in both directories, only the target folder on the instrument, as mentioned earlier, and shown in the next example.

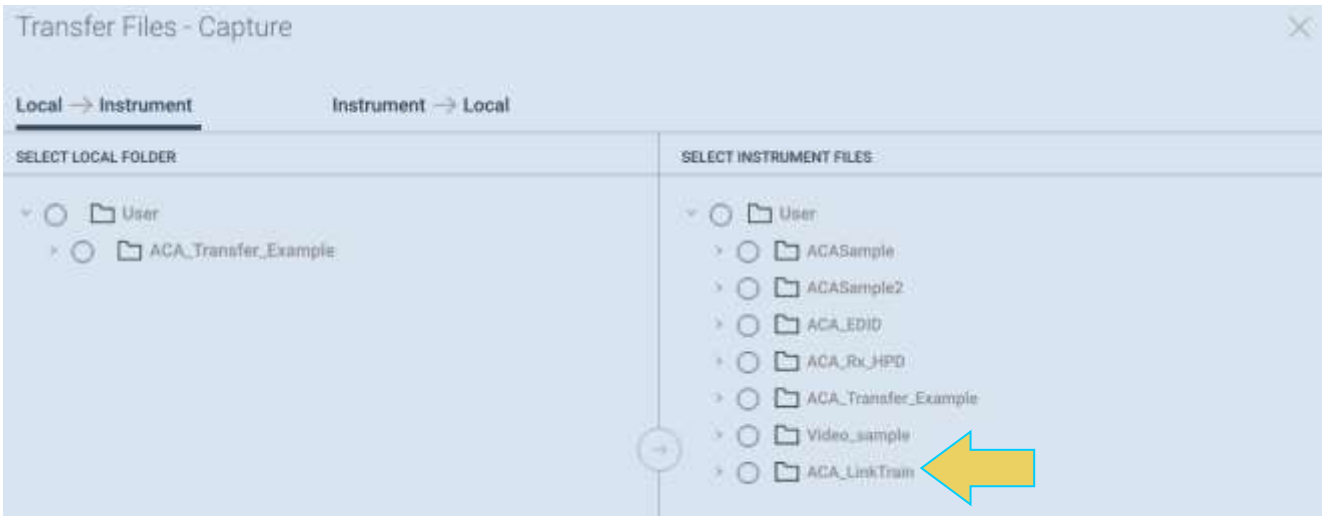


To transfer a file from a PC to the M42d instrument, select a file from the **Instrument Files** column, and a target folder from the **Local Files** column, and click **Copy** or **Move** to transfer.

The following example shows an ACA Data file being moved from the PC to the instrument.



The result is shown below. Notice the file is no longer contained within the **User** folder of the **Local Folder**.



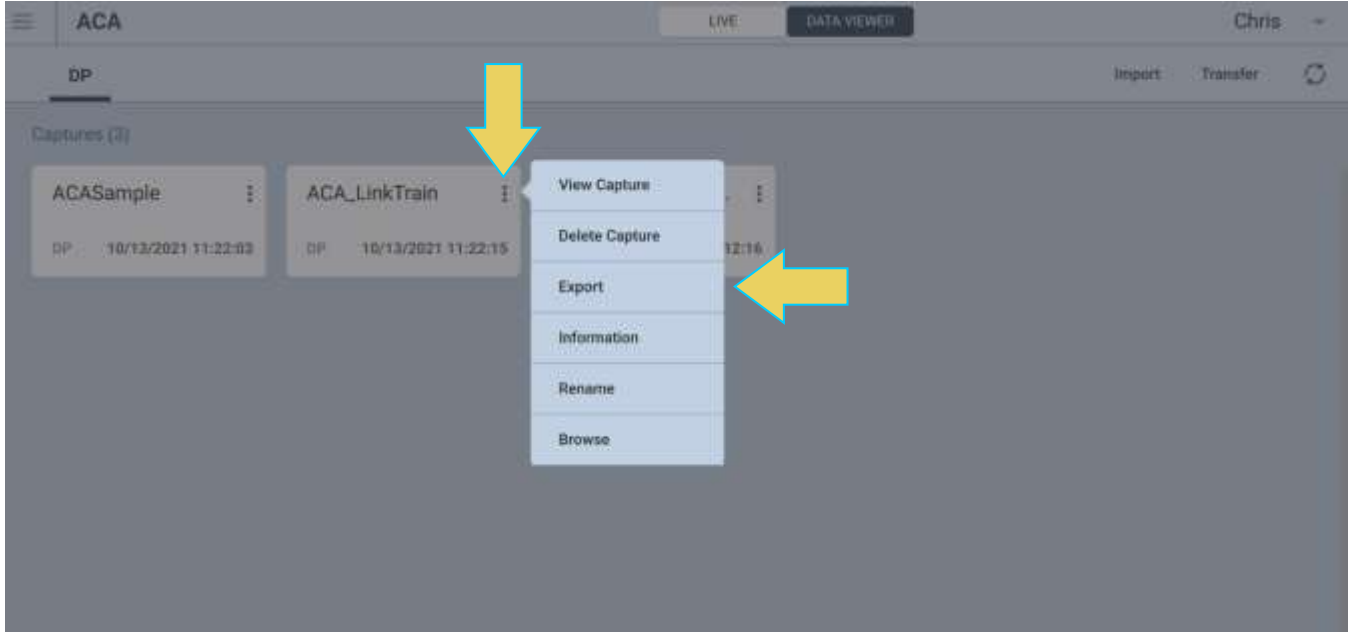
**Note:** If a file in the target folder already has the same name as the file you are attempting to transfer, the **Copy** and **Move** buttons will not be enabled. You will need to rename the capture first using the **Rename** button at the bottom of the dialog box.



### Exporting an ACA Data File

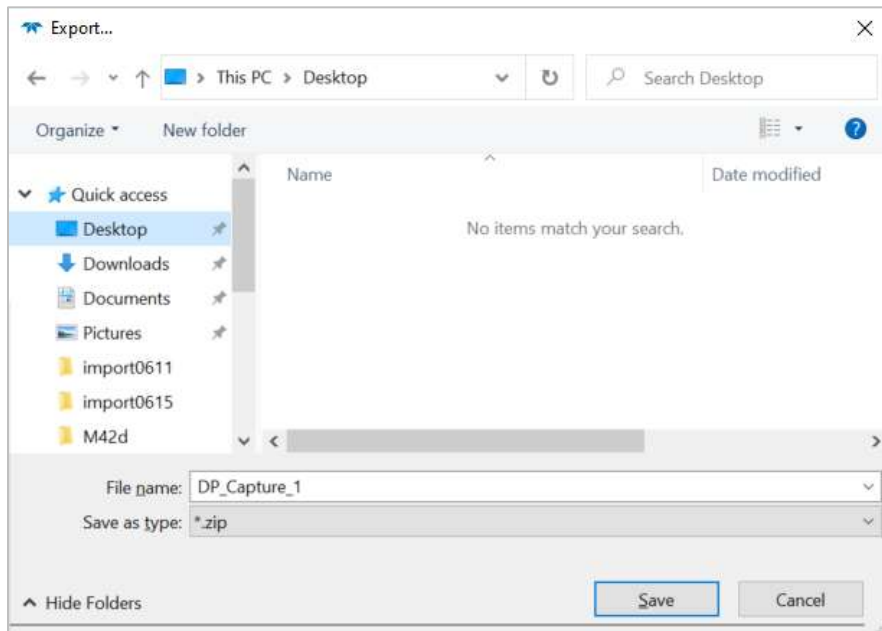
To export an ACA Data file, navigate to the **ACA** utility from the VPS Dashboard

Click on the three-button menu icon of the desired file, and select **Export**, shown below.

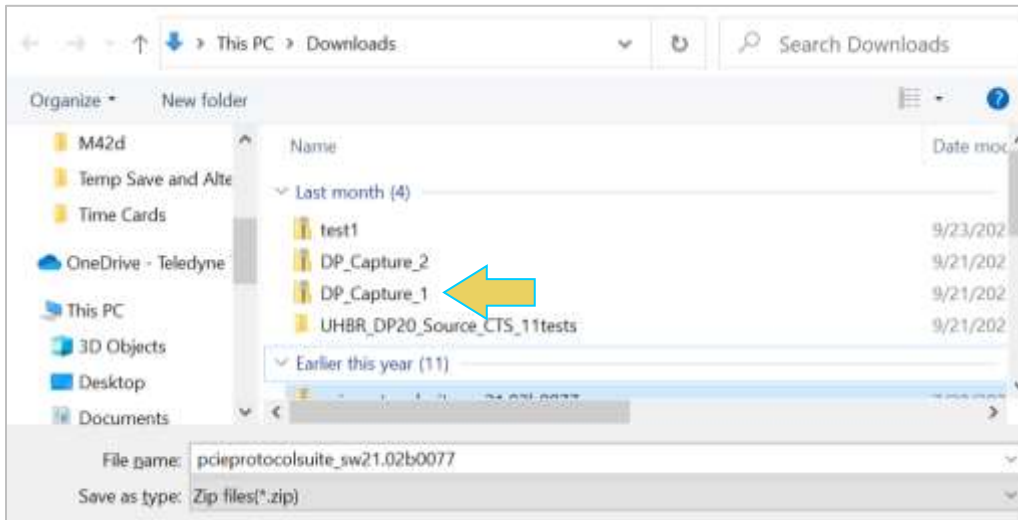


When you select **Export**, a File Explorer window will show up enabling you to save the capture as a zip file in a directory and name of your choosing. Refer to the screen example below.

**Note:** If you are on the M42d instrument itself, the file explorer window will be Linux-based.

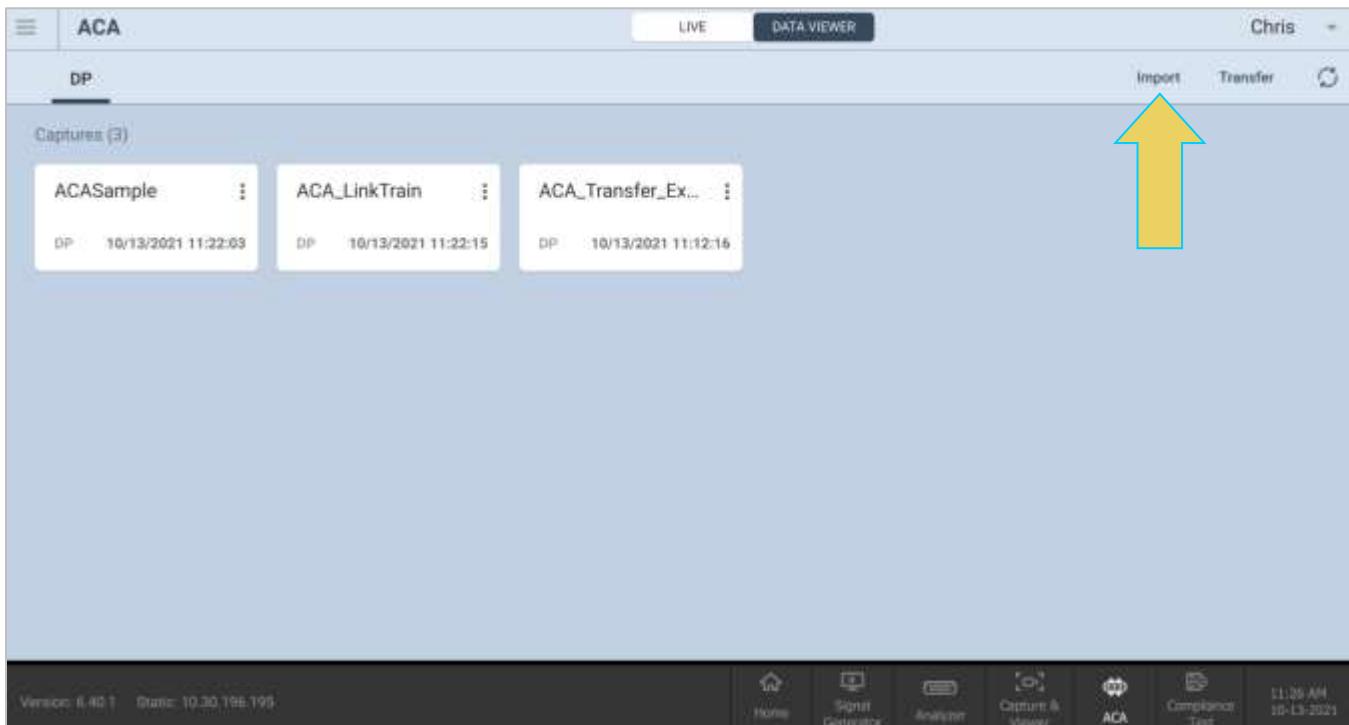


Choose a desired directory and filename, and click **Save**. This capture file will then be accessible in a file explorer as a compressed zip file, as shown below.

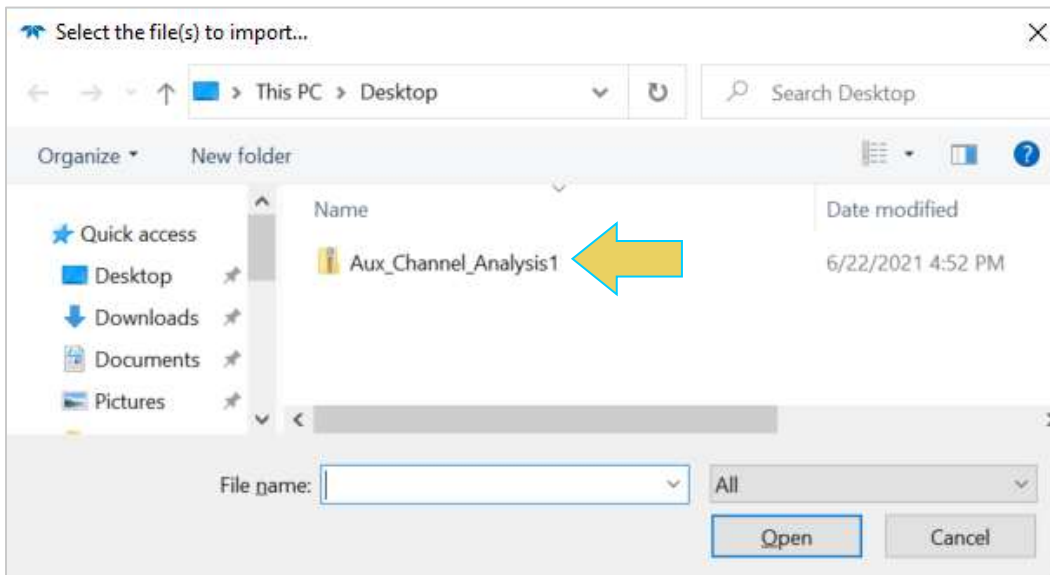


### Importing ACA Data File

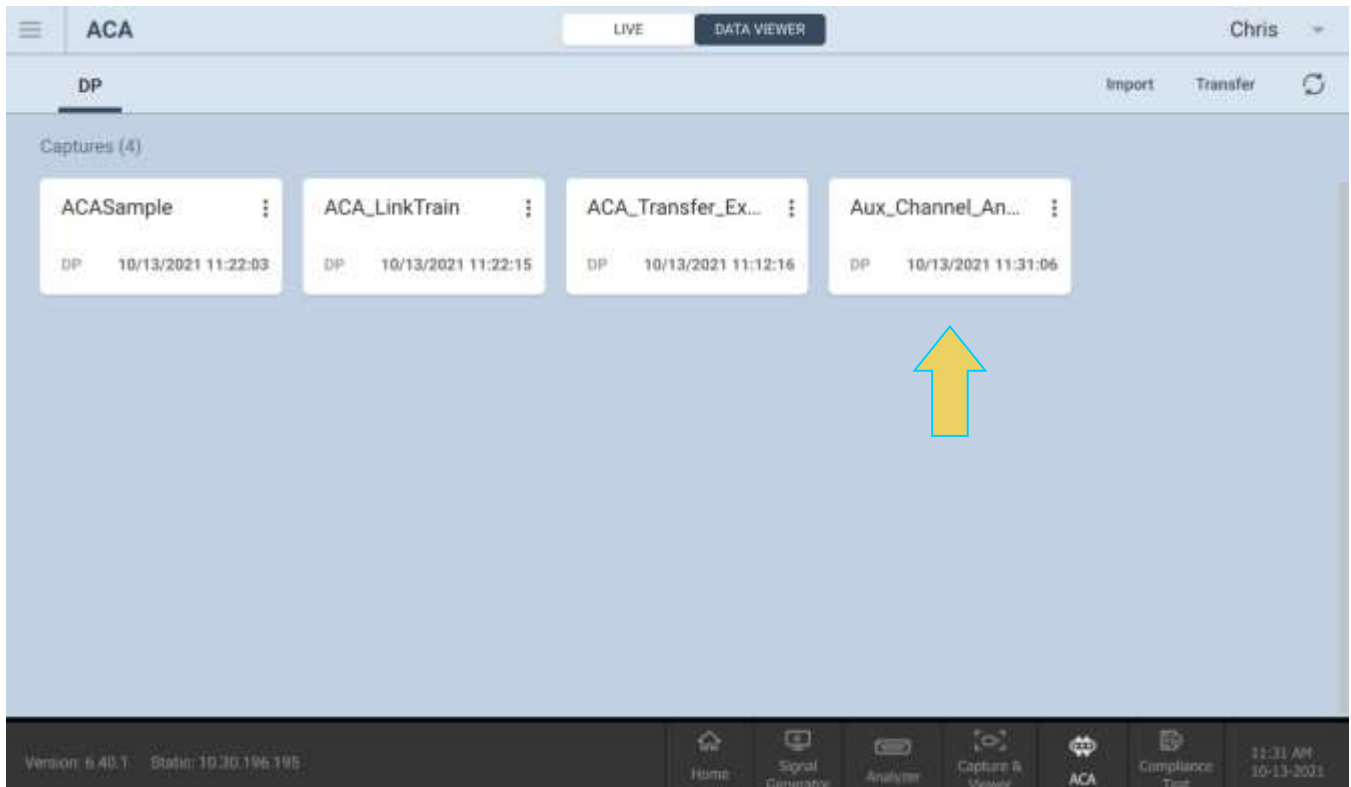
To import a file, within the **ACA** tool, click the **Import** button at the top right.



A File Explorer window will appear enabling you to navigate to the directory where you have stored your ACA Data file. This can be a local file on the PC/Instrument itself or a USB storage drive. Select the file and click **Open** as shown below.



You will see a confirmation dialog box and the new ACA Data file will appear in the list of Captures within the **Data Viewer**.



## 8 Passive Monitoring

Passive Monitoring, or Passive Probing, is a licensed feature of the M42d. The M42d allows the user to place the instrument between a DP1.4/2.0 source and a DP1.4/2.0 Sink and monitor the video information passing through the unit using the Protocol Analyzer as well as performing regular and ACA captures. Note that HDCP video content cannot be displayed or captured.

Passive Monitoring enables the user to perform the following functionality:

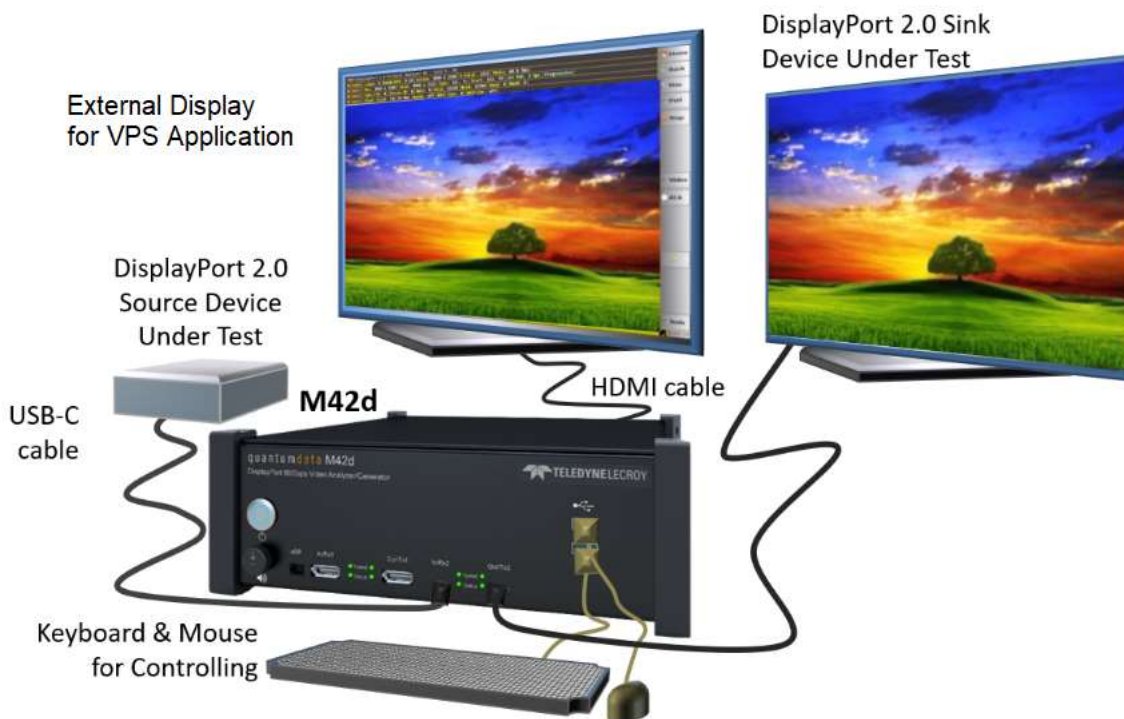
- Use the Basic Analyzer dashboard to view all the video data passing through in real time
- Use the ACA to perform capture of Aux Channel data
- Perform regular data capture of the data passing through using the Capture Control Protocol Analyzer.

### 8.1 Connecting a DisplayPort Source and Sink Device Under Test

This procedure describes how to connect a source and a sink device to the M42d for Passive Monitoring.

**Note: Passive Monitoring connections can only be made to the M42d via native high quality 8K DP cables (one meter or less) or the USB-C cables provided.**

The following procedure will provide for a stable connection. Use the diagram below as a guideline. Note that this diagram shows connections only to the USB-C ports. Alternatively, you can use the DisplayPort connectors up to 10G lane rates. But you must use the same type ports (DP or USB-C) on each side.



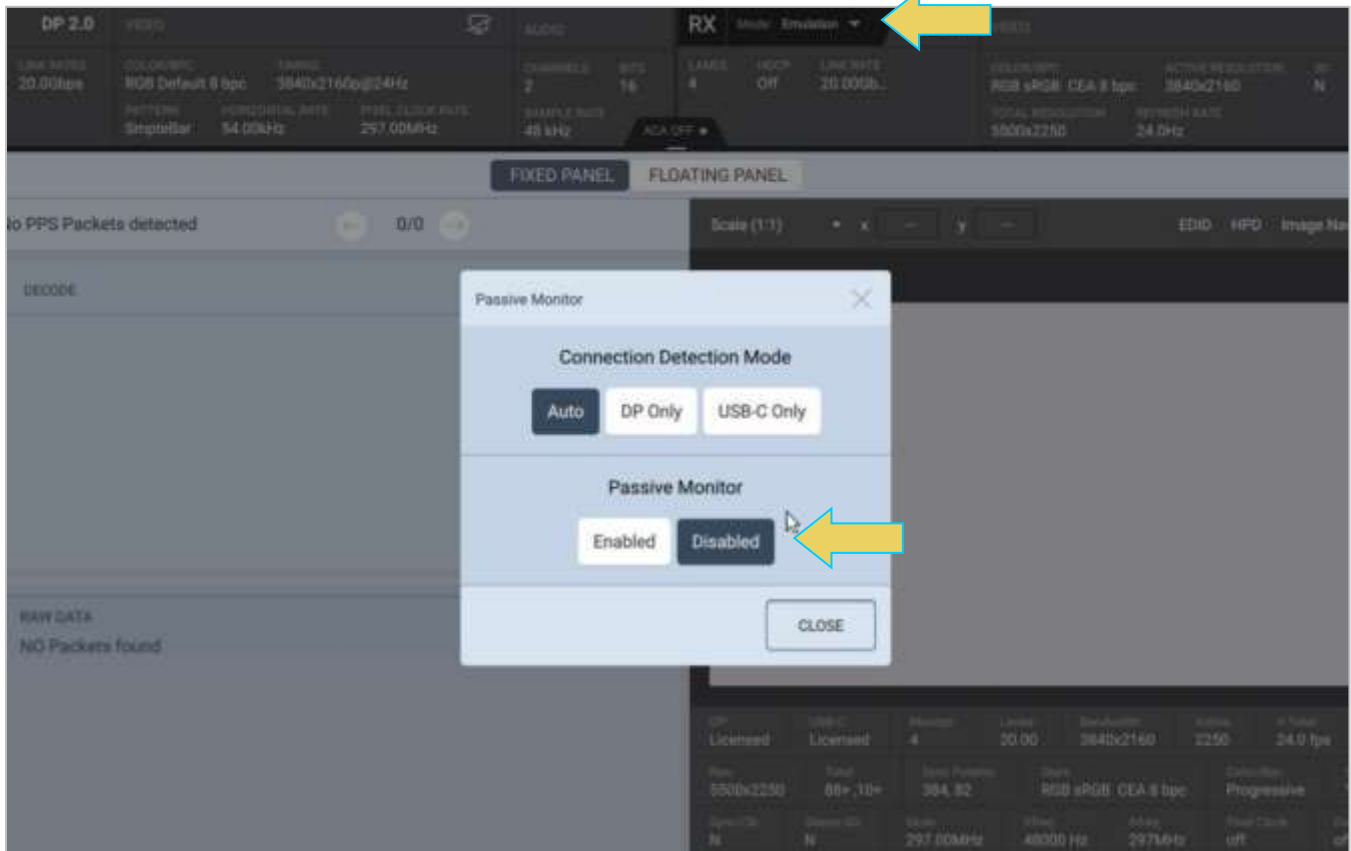
**Note:** During passive monitoring of HDCP protected content, only the external source and sink devices participate in the encryption. The Passive-mode Analyzer does not have access to the encryption key and therefore cannot display the transported video.

### To connect your source and sink DUT to the M42d:

1. Open the “Real Time” Receiver (Basic Analyzer) window of the embedded VPS (running on the externally connected display connected to the HDMI admin port in back).

2. Click on the **Mode** button at the top of the screen and ensure Passive Monitor is **Disabled**.

**Note:** You *cannot* do this step from the External VPS Application running on a remote host PC.

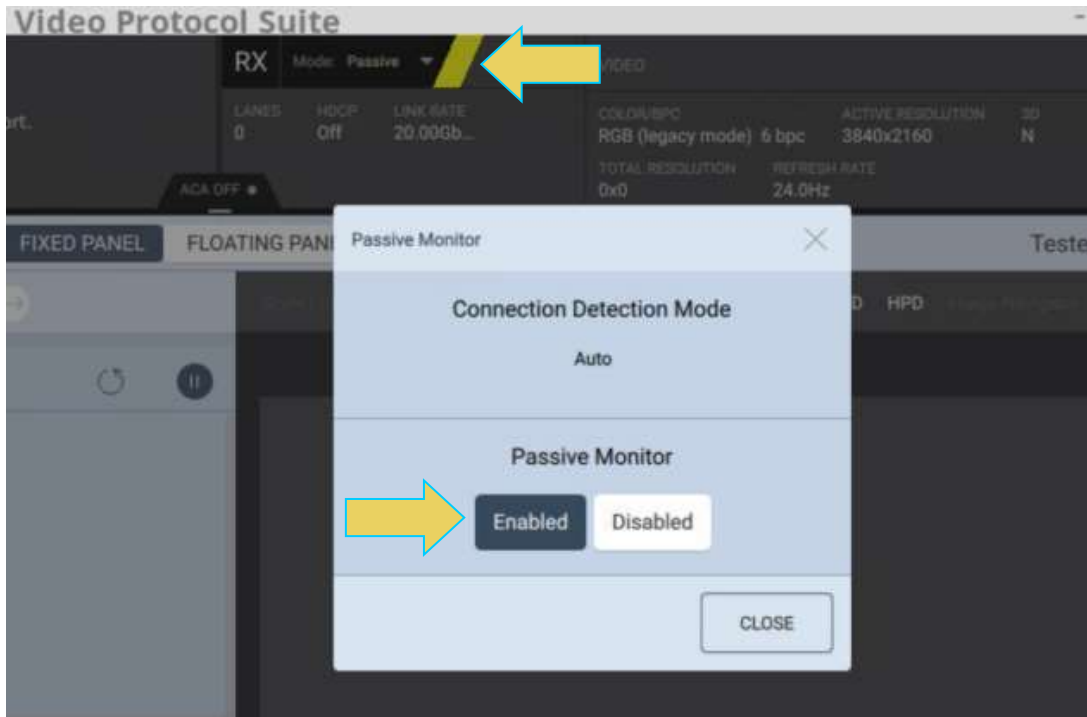


3. Connect your source to the M42d Rx port of your choice (either USB-C or DisplayPort) with the appropriate cable to your source device.
4. Configure your source device to output a DisplayPort video stream.
5. In the case of USB-C cable connections, verify that the cable connections are correct. The port status LED should be **Green** and you should see the video on the external display connected to the M42d HDMI admin port. Flip the USB-C cable at the M42d if the status LED is **Red**.
6. Connect a cable to the M42d Tx port with the appropriate cable (DisplayPort or USB-C that you used to connect from your source device) to the display device.
7. Configure the M42d to generate a DisplayPort signal.
8. In the case of USB-C cable connections, verify that the cable connections are correct. The port status LED should be **Green** and you should see the generated video on your Sink display device. Flip the USB-C cable at the M42d if the status LED is **Red**.

9. Verify that the status LED's on the ports are **Green**

### Enable Passive Probing

You can now enable Passive Probing by turning On Passive Monitoring through the Basic Analyzer window as shown below.



**Important Note:** In the passive-probing mode, you may need to generate a hot plug by physically disconnecting/connecting only the cable between **Source** and the **M42d Rx port**.

***The cable between M42d Tx port and Sink must remain connected.***

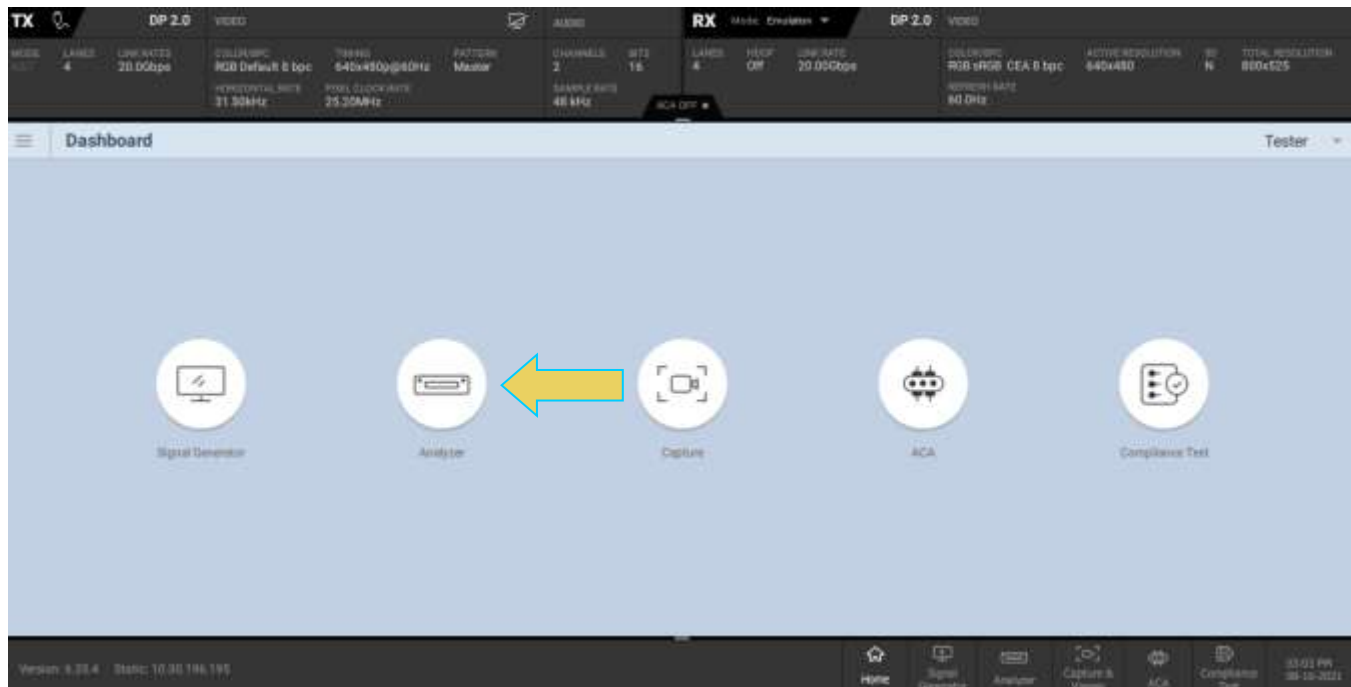
## 8.2 Passively Viewing Video Data in Real Time

The Basic Analyzer provides real time view of the monitored source video and metadata including status of mainstream attributes, secondary data attributes, link training, Multi-Stream Transport, and HDCP.

Passive Monitoring using the Rx Analyzer real-time viewer is similar to the procedures outlined in [Chapter 4 Source Verification with Basic \(Real-time\) Analyzer](#). Refer to that chapter if necessary for more in-depth coverage of this process.

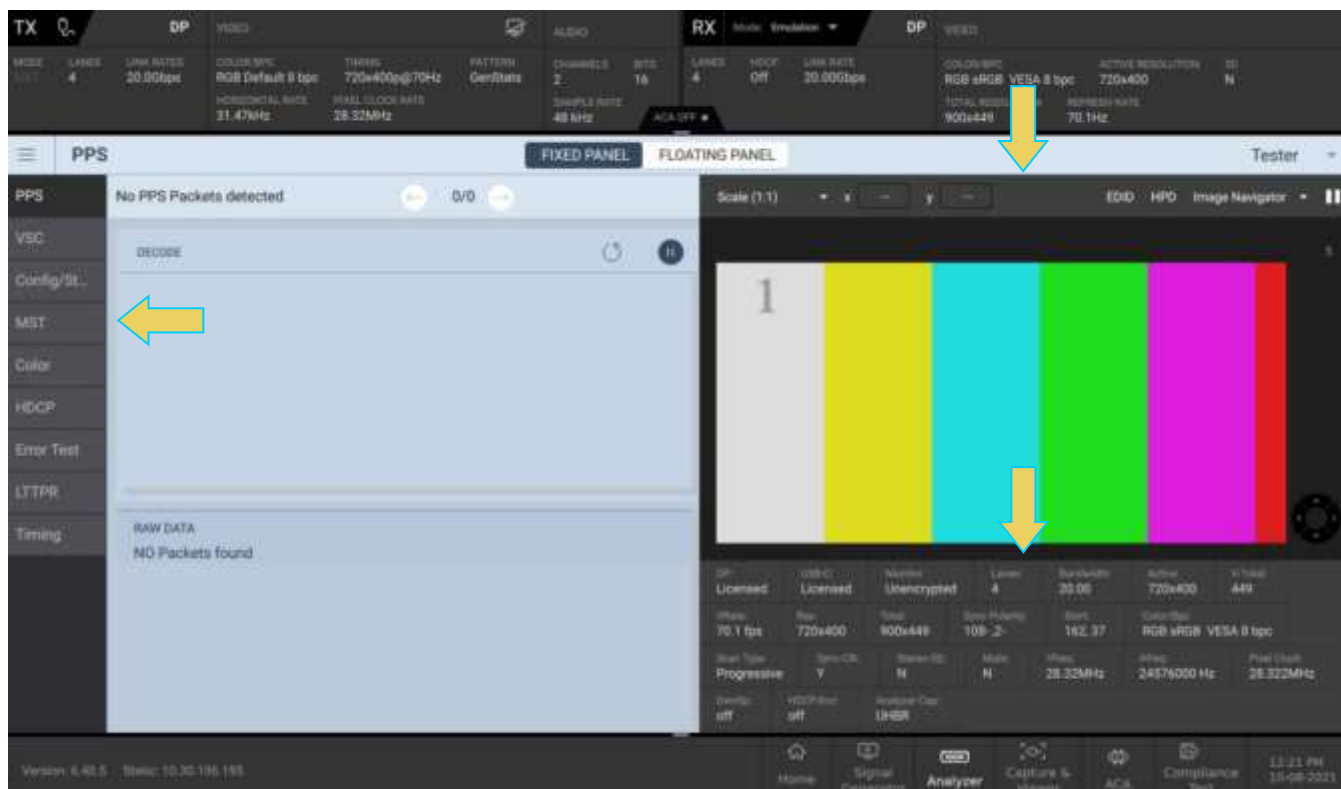
### Accessing Basic Analyzer Features

From the Dashboard Home of the M42d VPS GUI Application, select the **Analyzer**, as shown below.

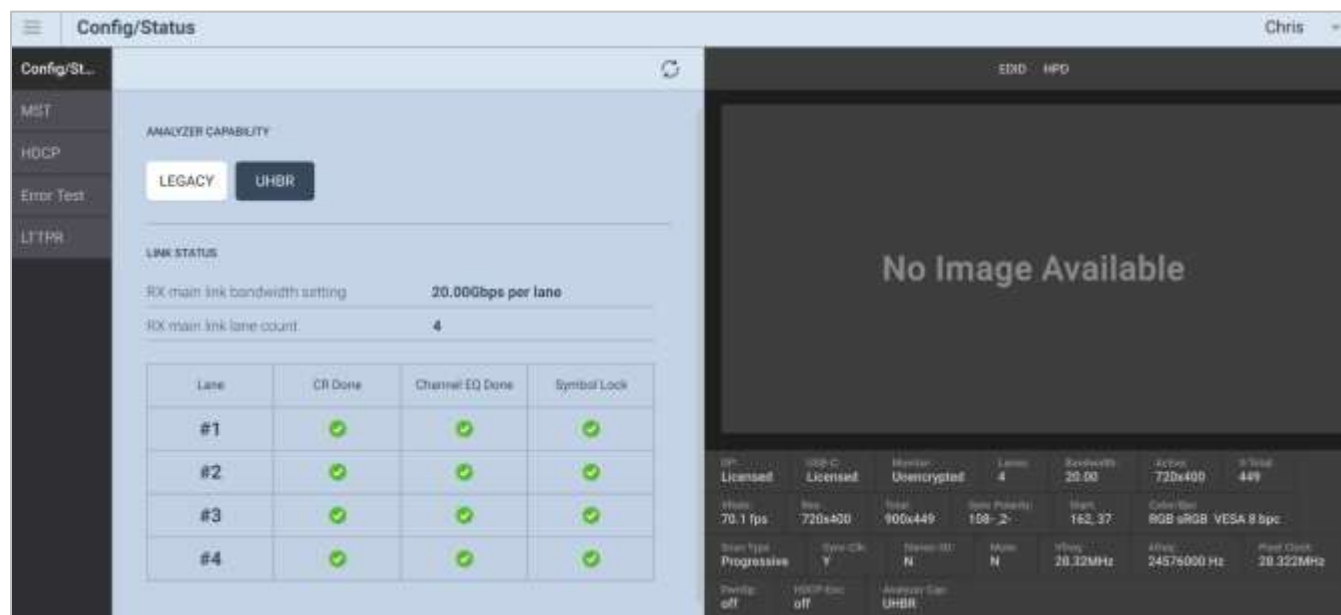


The Analyzer panel appears showing the passed-through video image. The M42d's Rx analyzer port provides periodic video frame captures enabling you to view frames of video. This feature provides a basic confidence test to verify that the passed-through video is essentially correct.

There is a dashboard underneath the monitored video display, indicating the essential video characteristics, and there is a set of controls both above the toolbar, and a left sidebar with tabs for the various tools of the Receiver.



**Note:** The Analyzer image panel is *not* transmitted to a **Remote PC VPS Application**. When selecting the **Receiver** on the desktop VPS Application, only portions of the **Tools** dialog box (discussed later in this chapter) will appear, as shown below. The Analyzer panel is accessible remotely using a VNC. This is discussed in **2.6 VNC Remote Connection**.





### Basic Analyzer Dashboard

This subsection describes the dashboard components on the top of the Basic Analyzer panel. Refer to the table below for a description of these components.

#### Basic Analyzer – Dashboard Items

Example dashboard of DisplayPort 2.0 Protocol Analyzer Rx

DP: Licensed	USB-C: Licensed	Monitor: Unencrypted	Lanes: 4	Bandwidth: 20.00	Active: 7680x4320	V-Total: 4400
VRate: 60.0 fps	Res: 7680x4320	Total: 9000x4400	Sync Polarity: 176+ ,20+	Start: 768, 64	Color/Bpc RGB sRGB CEA 8 bpc	
Scan Type Progressive	Sync-Clk: Y	Stereo-3D: N	Mute: N	Mvid: 0	Nvid: 0	Maud: 0
Pixel Clock: 2376MHz	DwnSp: off	HDCP-Enc: off	Analyzer Cap: UHBR			

Example with DSC enabled

DP: Licensed	USB-C: Licensed	Monitor: Unencrypted	Lanes: 4	Bandwidth: 20.00	Active: DSCxEnabled	V-Total: 1125
VRate: 60.0 fps	Res: 1920x1080	Total: 2200x1125	Sync Polarity: 44+ ,5+	Start: 192, 41	Color/Bpc na CEA 8 bpc	
Scan Type Progressive	Sync-Clk: Y	Stereo-3D: N	Mute: N	Vfreq: 148.50MHz	Afreq: 24576000 Hz	Pixel Clock: 148.5MHz
DwnSp: off	HDCP-Enc: off	Analyzer Cap: UHBR				



Monitor: Unencrypted
Monitor: HDCP 1.3
Bandwidth: 20.00
VRate: 60.0 fps
Res: 7680x4320

#### Top Row Items:

- **Monitor** - Indicates the HDCP encryption status of the passed-through video.  
**Note:** If unencrypted, the **Unencrypted** indicator will show.
- **Lanes** - The number of lanes used during link training.
- **Bandwidth** - The link rate (per lane, Gbps).
- **Active (video resolution)** - This is the measured video resolution.  
**Note:** If DSC is active, it will be indicated in this field.
- **V-Total** - This is the measured total vertical video lines per frame.

#### Second Row Items:

- **VRate** - This is the measured vertical frame rate
- **Res** - The active video resolution in horizontal pixels and vertical lines.
- **Total** - The total video in horizontal pixels and vertical lines.
- **Sync Polarity** - Horizontal sync pulse width (in pixels) and polarity, followed by vertical sync pulse width (in lines) and polarity. (e.g. Hsync 88 pixels, positive; Vsync 10 lines, positive)
- **Start** - The starting pixel and line in the active video.
- **Colorimetry and bit depth** - The colorimetry and bit depth.

#### Third Row Items:

- **Scan** - The scan type used, progressive (e.g. Prog) or interlaced (Inter).

### Basic Analyzer – Dashboard Items

<div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Vfreq: 593.41MHz</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Afreq: 24576000 Hz</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 2px;">Analyzer Cap: UHBR</div> <div style="border: 1px solid black; padding: 2px;">Analyzer Cap: Legacy</div>	<ul style="list-style-type: none"> <li>▪ <b>Sync-Clk</b> - Indicates if the Link Clock and Main Video Stream clock are asynchronous or synchronous. A value of N means async; a value of Y means synchronous.</li> <li>▪ <b>Stereo-3D</b> - The status of 3D audio.</li> <li>▪ <b>Mute</b> - The AudioMute flag status.</li> <li>▪ <b>Vfreq</b> - Video pixel frequency.</li> <li>▪ <b>Afreq</b> - Audio sampling frequency.</li> </ul> <p><b>Fourth Row Items:</b></p> <ul style="list-style-type: none"> <li>▪ <b>Pixel Clock</b> - How often pixels occur (frame rate x pixels per frame)</li> <li>▪ <b>DwnSp</b> - DownSpread indicates whether Spread Spectrum Clocking (SSC) is enabled</li> <li>▪ <b>HDCP-Enc</b> - Indicates if HDCP encryption is currently active</li> <li>▪ <b>Analyzer Cap:</b> - Indicates Rx link rate capability: <i>(not applicable to Passive Monitoring)</i></li> </ul>
---	---

For a more in-depth look at the Rx Analyzer, see section **Chapter 4 Source Verification with Basic (Real-time) Analyzer**. Real-time analysis with the Basic Analyzer is functionally similar to these procedures while in Passive mode.

### 8.3 Passively Monitoring ACA Transactions

**Note:** These are procedures used during passive monitoring as configured in previous sections.

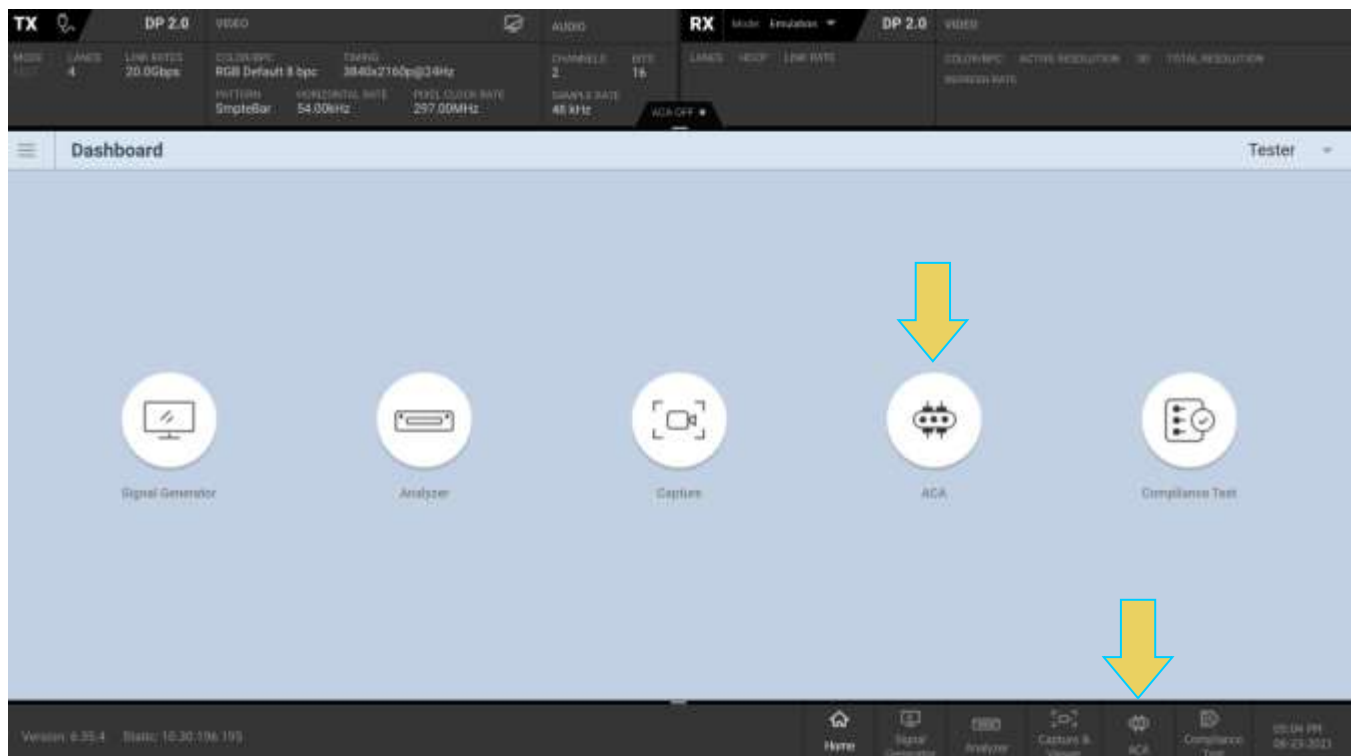
The Auxiliary Channel Analyzer (**ACA**) utilities enable you to view the AUX channel traffic for passively monitored DisplayPort streams in real time. For DisplayPort, you can view the HDCP authentication transactions, EDID exchanges, Link Training transactions, side band messages, Multi-Stream Transport negotiations, etc. in real time with the ACA utility.

In **Passive Monitor** mode, you can view the transactions between the connected DP source device and a connected DP display device.

#### Passively Monitoring the Auxiliary Channel Transactions

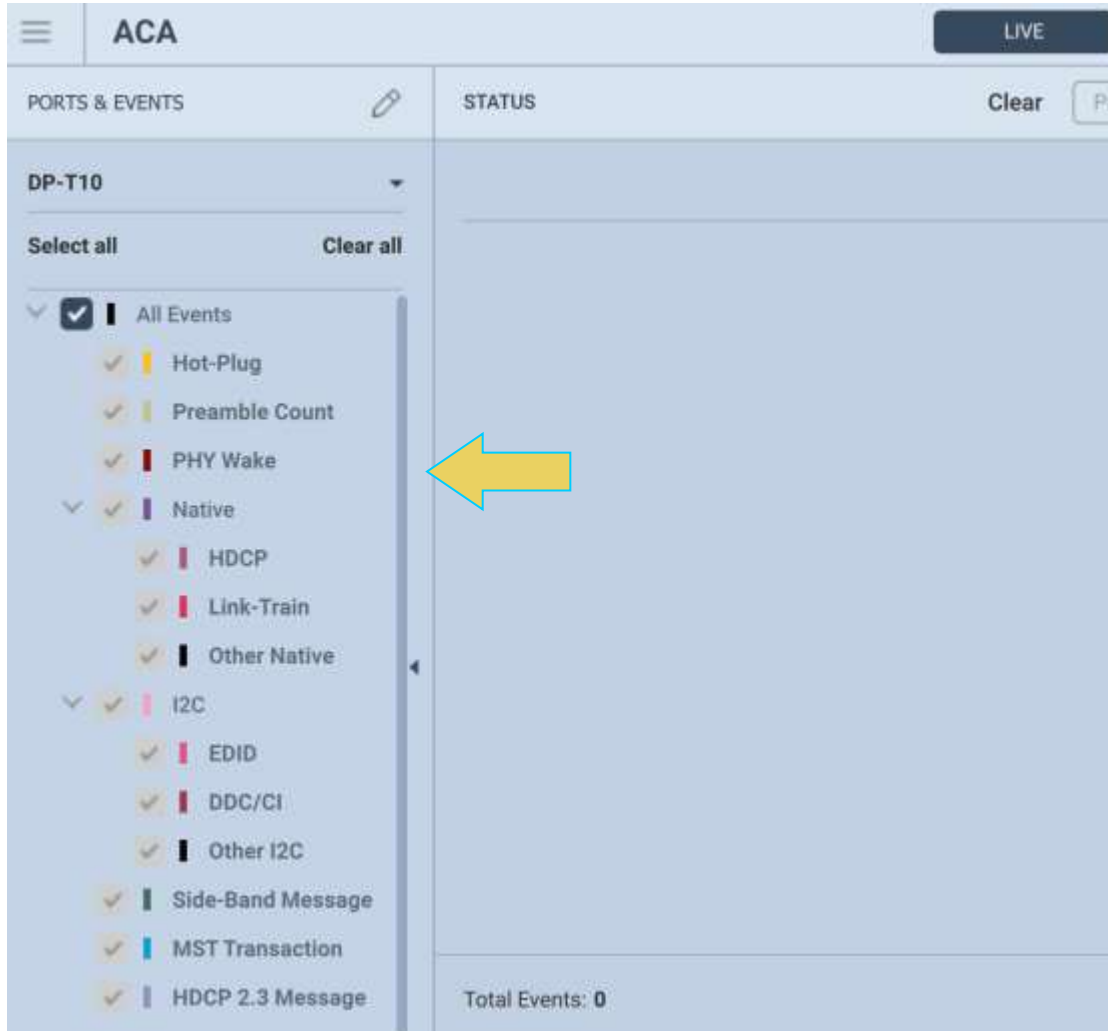
To passively monitor the Aux Channel transactions:

1. Select the **Aux. Channel Analyzer** app from the Dashboard Home or the bottom toolbar.




- 2. Specify which DP events you wish to passively monitor using the **PORTS & EVENTS** panel on the left side of the window.

**Note:** In Passive Monitoring, you will only want to monitor transactions on the DP 2.0/USB-C Tx Out and Rx In (bottom two ports listed), *not* the Generator or PA Rx (top two ports listed).

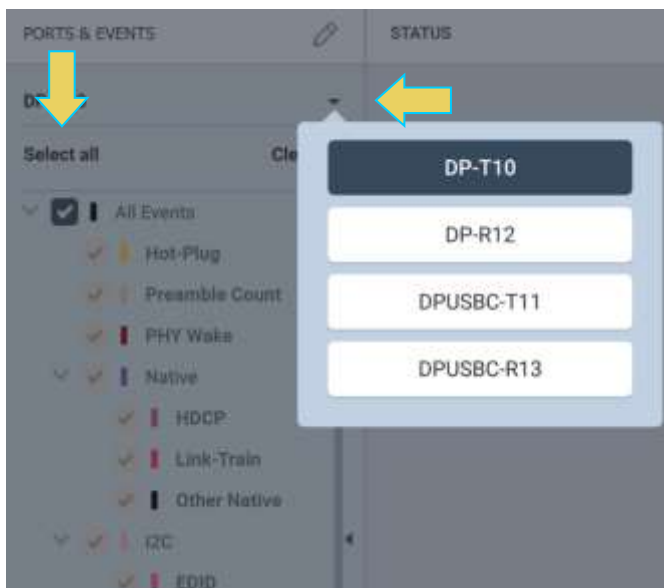


You can configure the monitored ports and events in one of two ways:

- Click the pencil icon  to open up the **Select Ports & Events** dialog box:



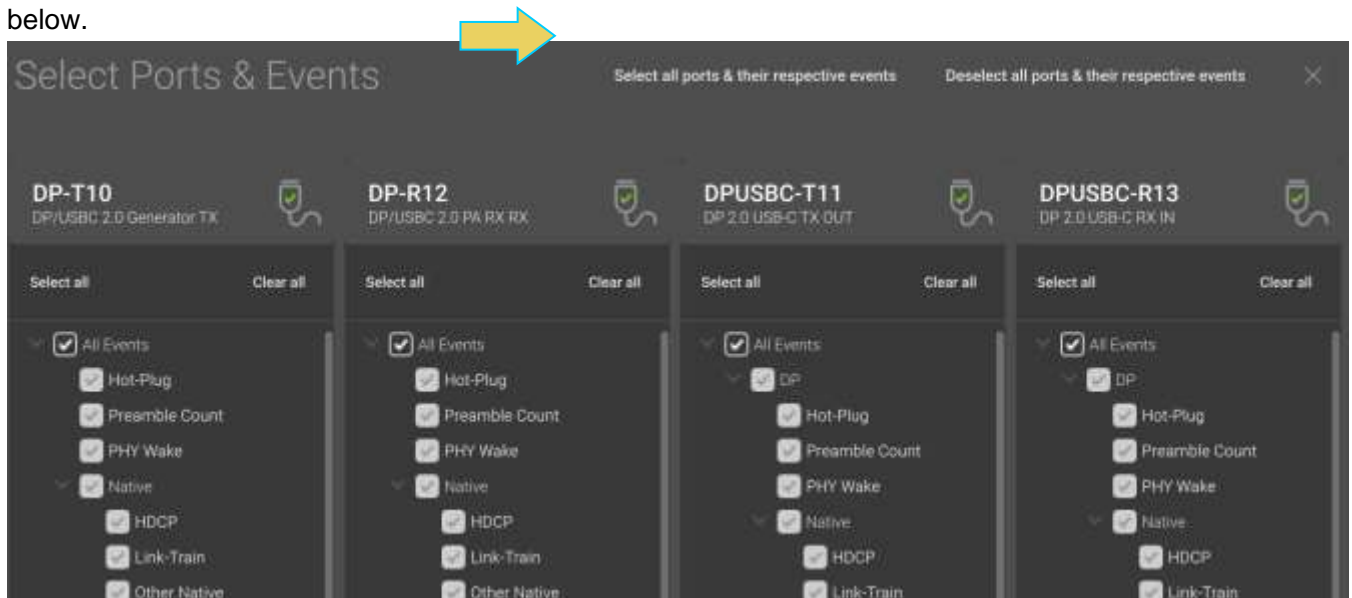
- Select the drop-down next to the port name to choose a port and select/deselect any or all events on the selected port:



- Select the ports and events you wish to passively monitor. Refer to the table below for options. The icons with dark backgrounds are within the **Select Ports & Events** dialog box, while the light backgrounds are in the left-hand panel within the ACA window.

Select all ports & their respective events	Select all events on all ports
Deselect all ports & their respective events	Deselect all events on all ports
DP-T10 / DP-T10: DP/USBC 2.0 Generator TX	Select events on the M42d's Generator simulated Tx port
DP-R12 / DP-R12: DP/USBC 2.0 PA RX RX	Select events on the M42d's Protocol Analyzer simulated Rx port
DPUSBC-T11 / DPUSBC-T11: DP 2.0 USB-C TX OUT	Select events on the connected DP or USB-C Tx port
DPUSBC-R13 / DPUSBC-R13: DP 2.0 USB-C RX IN	Select events on the connected DP or USB-C Rx port
Select all / Select all	Select all events only on the specified port
Clear all / Clear all	

- Note:** In Passive Monitoring, you will only want to monitor transactions on the DP 2.0/USB-C Tx Out and Rx In (bottom two ports listed), **not** the Generator or PA Rx (top two ports listed). Specify which DP events you wish to monitor. You can select **All Events** or any set of individual events. In the following example, the user has selected All Events (on all connected ports), which is the default selection.
- Important Note:** You can filter and search through the ACA traces after the data collection has completed, as well. Procedures for searching and sorting are provided in a separate subsection further below.



Select the **Start** button on the ACA Control Menu at the top to initiate the monitoring/viewing of the DP Aux Chan transactions.

- Take the necessary action—such as a hot plug—to initiate EDID, HDCP or Link Training transactions.

An example showing passively monitored data is shown below. You can stop or pause the collection at any time using the buttons on the ACA Control Menu.

The screenshot displays the ACA interface with the following components:

- Top Bar:** Includes 'LIVE' and 'DATA VIEWER' tabs, and buttons for 'Pause' (highlighted with a yellow arrow), 'Stop', 'Save', and 'Options'.
- Left Panel (PORTS & EVENTS):** Shows a tree view for 'DPUSBC-T11' with various event categories like DP, Native, I2C, and USB-C PD.
- Center Panel (STATUS):** A table of transactions with columns for time, type, and data. The selected row (1695) is highlighted in dark blue.
 

Time	Type	Data
1685	DNAT	13 > R:200 SINK_COUNT L=8
1686	DPPRE	11 Precharge/Sync Count: 32
1687	DNAT	11 < ACK 41 00 77 77 05 03 00 00
1688	DPPRE	13 Precharge/Sync Count: 32
1689	DNAT	13 < ACK 41 00 77 77 05 03 00 00
1690	DPPRE	11 Precharge/Sync Count: 32
1691	DNAT	11 > R:200 SINK_COUNT L=8
1692	DPPRE	13 Precharge/Sync Count: 32
1693	DNAT	13 > R:200 SINK_COUNT L=8
1694	DPPRE	11 Precharge/Sync Count: 32
1695	DNAT	11 < ACK 41 00 77 77 05 03 00 00
1696	DPPRE	13 Precharge/Sync Count: 32
1697	DNAT	13 < ACK 41 00 77 77 05 03 00 00
- Right Panel (DATA):** Shows a detailed view of the selected transaction (1695), including fields like 'Start Time', 'Type', 'Direction', and 'Command'. It also displays a list of registers (e.g., SINK\_COUNT, DEVICE\_SERVICE\_IRQ\_VECTOR) with their values.

The next subsection will break down the ACA Window in more detail. It is very similar to the ACA Data viewer utility, which will also be covered.

- Once you have finished running the trace, click the **Save** dropdown and select **Save to Instrument** or **Save to PC** depending on whether you are working with the remote ACA utility or the embedded Aux Channel Analyzer.

This close-up screenshot shows the 'Save' dropdown menu with two options: 'Save to PC' and 'Save to instrument'. A yellow arrow points to the 'Save to PC' option.

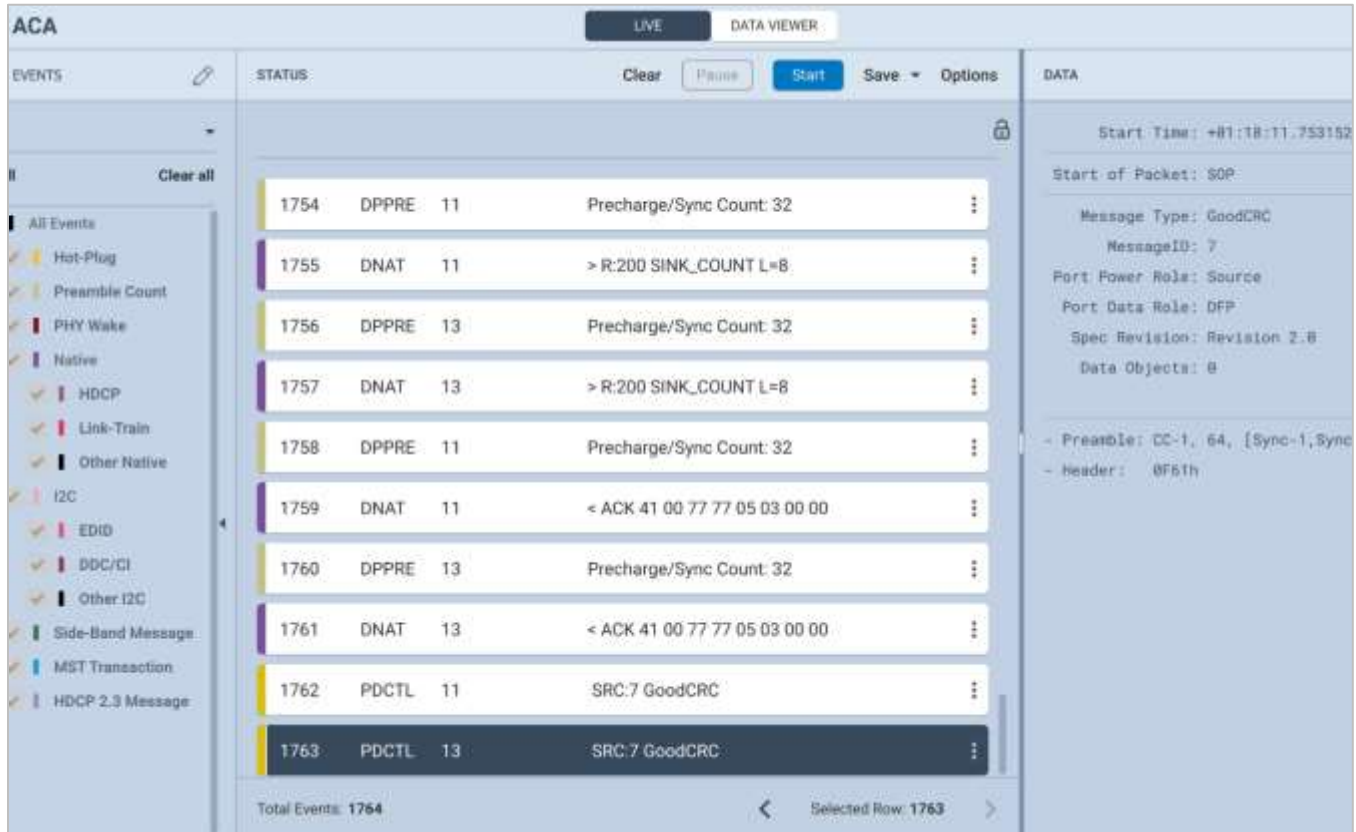
**Please note:**

- In order to use the **ACA Data Viewer** utility ([Section 7.4](#)) on your PC to view the traces or the ACA viewer on the VPS GUI running on the external display with the powerful searching and filtering features, you must save the file, as shown in the previous step.
- If you are working on the **Aux Channel Analyzer** viewer on the instrument's embedded GUI but prefer to use **ACA Data Viewer** on the remote VPS GUI Application, you will have to transfer the saved file to your PC using the VPS Application running on the remote PC. This is covered in [7.6 Importing, Exporting, and Transferring ACA Data](#).

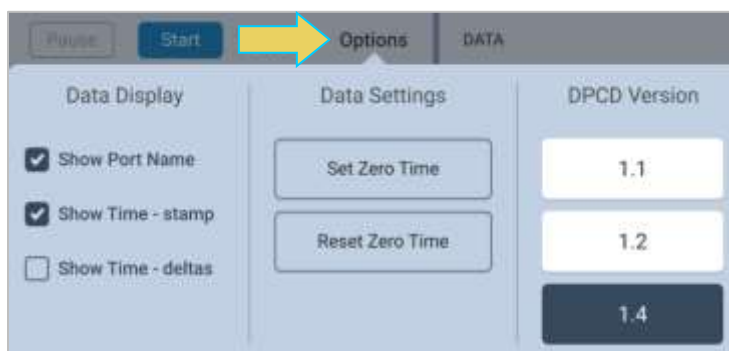


### ACA Window and Panel Description

The ACA Window will display the trace details from the data collection executed in the previous section. An example of a populated ACA window is below. Note the top toolbar remains unchanged from when first opening the Aux Channel Analyzer **LIVE** window.



You can access the **Options** dialog box using the top Control menu.



Options menu items are described in the following table:

Options Dialog Box	Description
<b>Show Port Name</b>	Enables you to display or hide the Port name (the Port number is always shown).
<b>Show Time-stamp</b>	Enables you to show or hide the time stamps for each transaction.

- **Show Time-deltas** – Enables you to show the time stamps relative to the previous transaction. Only available when Time-Stamps are shown (see above).
- **Set Zero Time** – Enables you to set a log record to zero. Subsequent log records are relative to this new zero time record.
- **Reset to Zero Time** – Resets the initial record in the active log in the ACA Trace window to zero.

The **STATUS**/ACA Trace Panel displays each event in a row with some information. This information is expanded in the ACA Event Details panel which will be covered next.

An example of the ACA Trace Panel is below. This example has the Port Name and Time-stamp selected from the options menu.

The numbered arrows correspond to the descriptions immediately following the screenshot.



6. **Item number** – This is a unique sequence number of the transaction.
7. **Type** – The type of Aux Chan transaction; either EDID, HDCP DPLT (Link Training), DNAT (DP native Aux transactions), etc.
8. **Port Name and Number** – Port Name is an optional viewing field. Port Number will always be displayed.
9. **Time stamp** (optional viewing field) – Shows the timestamp of each transaction. Can either be absolute time based (shown) on the M42d system clock or relative time (Time-deltas) referenced from the initial transaction in the trace.
10. **Transaction Description** – A brief description of the transaction.

The **ACA Event Details Panel** will display the details of the selected transaction within the trace panel, as shown below. This screenshot is of details for a Link Training transaction.

**Note:** You may need to scroll down to see all data.

```

DATA

Start Time: +01:20:10.421899
Type: Native
Direction: Reply
Command: ACK

Reply to Read Request.

00200: SINK_COUNT
  Bit Name          Value Description
  -----
  SINK_COUNT        1 Bits 7 + 5:0
  6 CP_READY        Y(1)

00201: DEVICE_SERVICE_IRQ_VECTOR
  Bit Name          Value Description
  -----
  0 REMOTE_CONTROL_COMMAND_PENDING N(0)
  1 AUTOMATED_TEST_REQUEST          N(0)
  2 CP_IRQ                          N(0)
  3 MCCS_IRQ                         N(0)
  4 DOWN_REP_MSG_RDY                 N(0)
  5 UP_REQ_MSG_RDY                    N(0)
  6 SINK_SPECIFIC_IRQ                 N(0)

```

The following list describes the information that is provided in the **ACA Event Details** dialog box.

**Note:** The information in the Details panel will vary depending on the type of log record that is selected.

- **Start Time** – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.

- **Type** – There are various types of data that can be monitored on the DisplayPort interfaces: EDID, HDCP and DP specific data types related to Link Training, side band messaging, Multi-Stream Transport transactions, native transactions, etc.
  - **Direction** – The direction of the transaction either a request or a reply.
  - **Command** – The type of Command being issued
  - **Address** – The register address of the transaction
  - **Details (text)** – The contents of the transaction in human readable text.
- Details (hex)** – The contents of the transaction in hex data.

## 8.4 Passively Analyzing Video Data using Capture Control

**Note:** These are procedures used during passive monitoring as configured in previous sections.

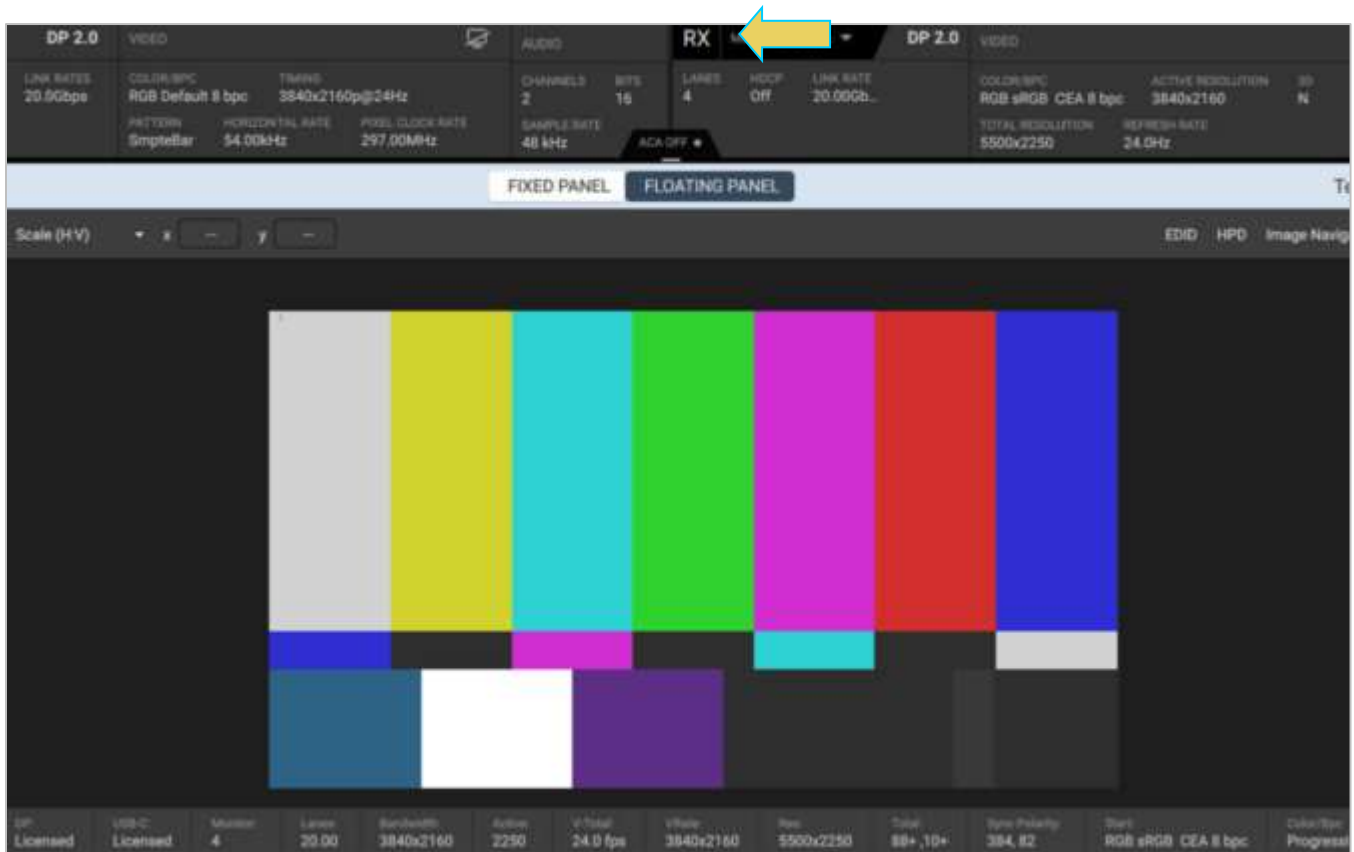
The Capture Control utility allows the user to capture and store passed-through data of the main link protocol, video, and metadata—including main stream attributes and secondary data—from a passively monitored DP connection.

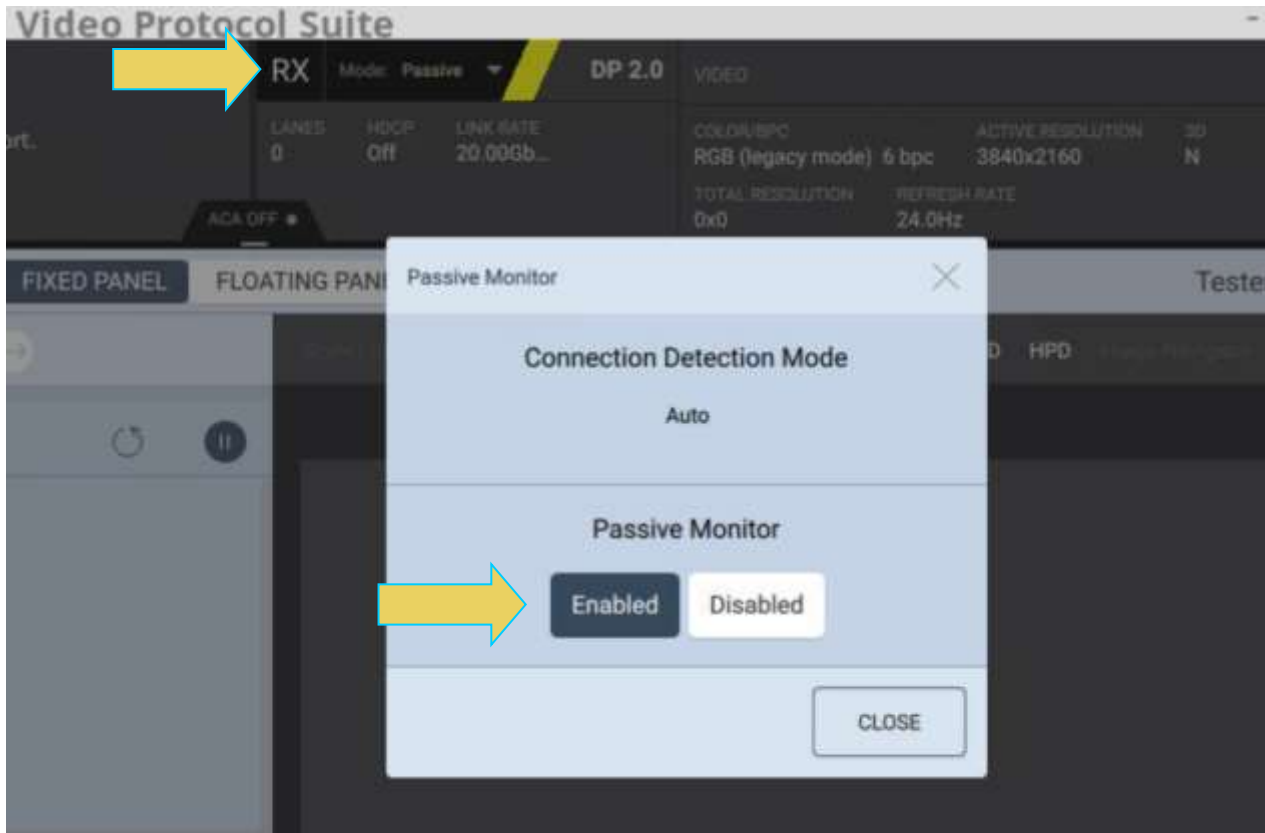
Use the following procedure to capture passively monitored video data using the Capture Control utility.

### Verifying Source Video

Before you capture passively monitored video data, you should verify that you are properly receiving the passed-through DisplayPort video from the source.

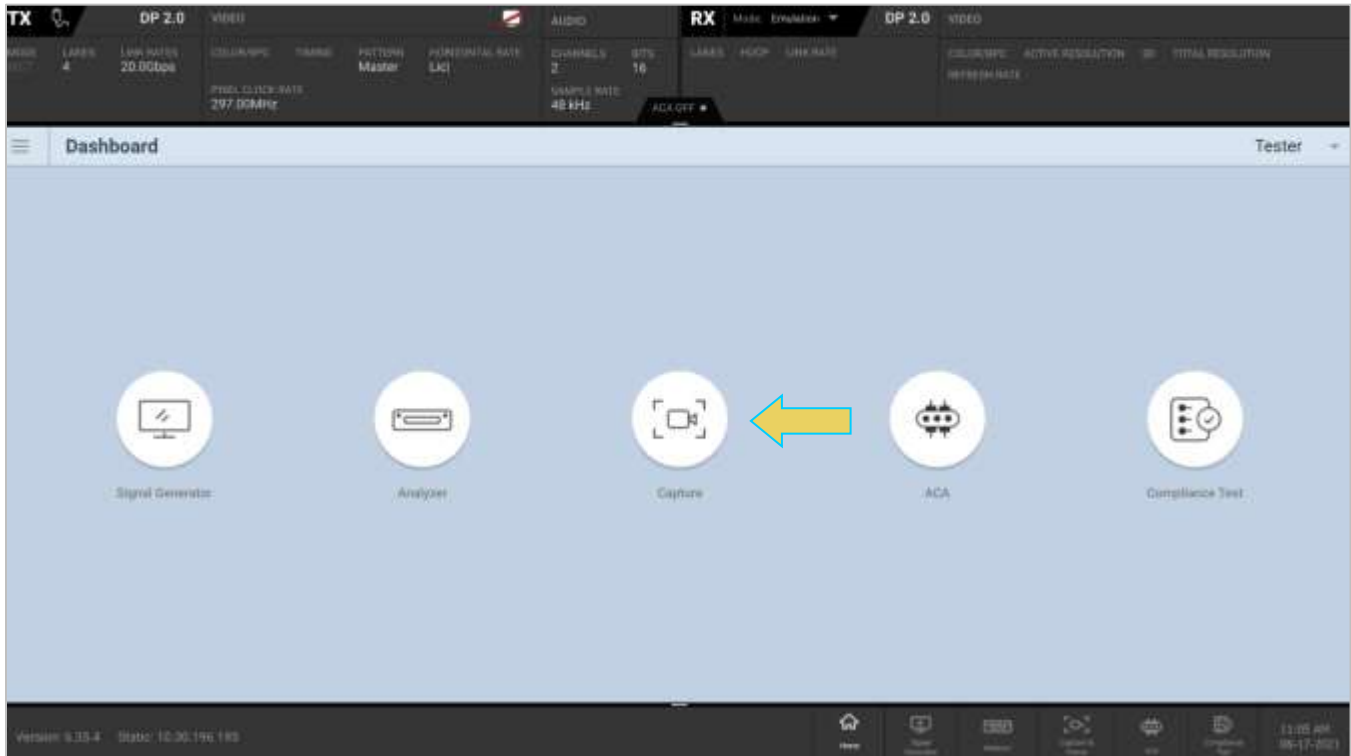
Verify the incoming video of the DisplayPort source to ensure that the source is outputting the proper video. In the screen example below the video shown is a test pattern. Typically, the video you will see will be from a PC or some other source device. Verify the information in the top status bar, and that **Passive Monitor** is on, as shown below.



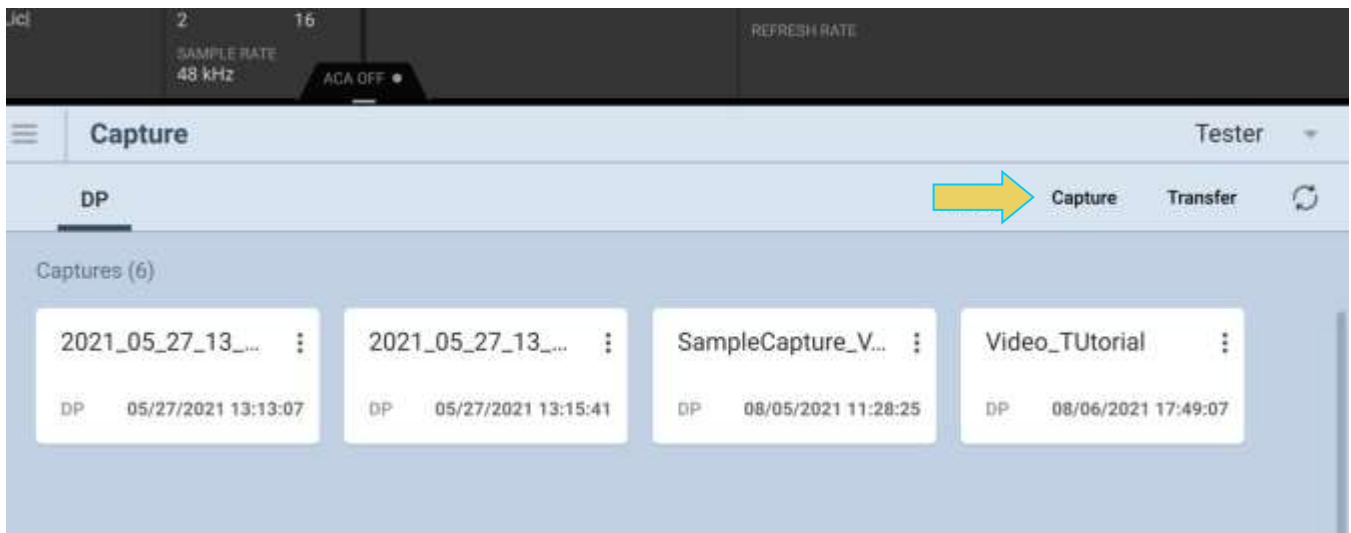


### Capture Control Panel

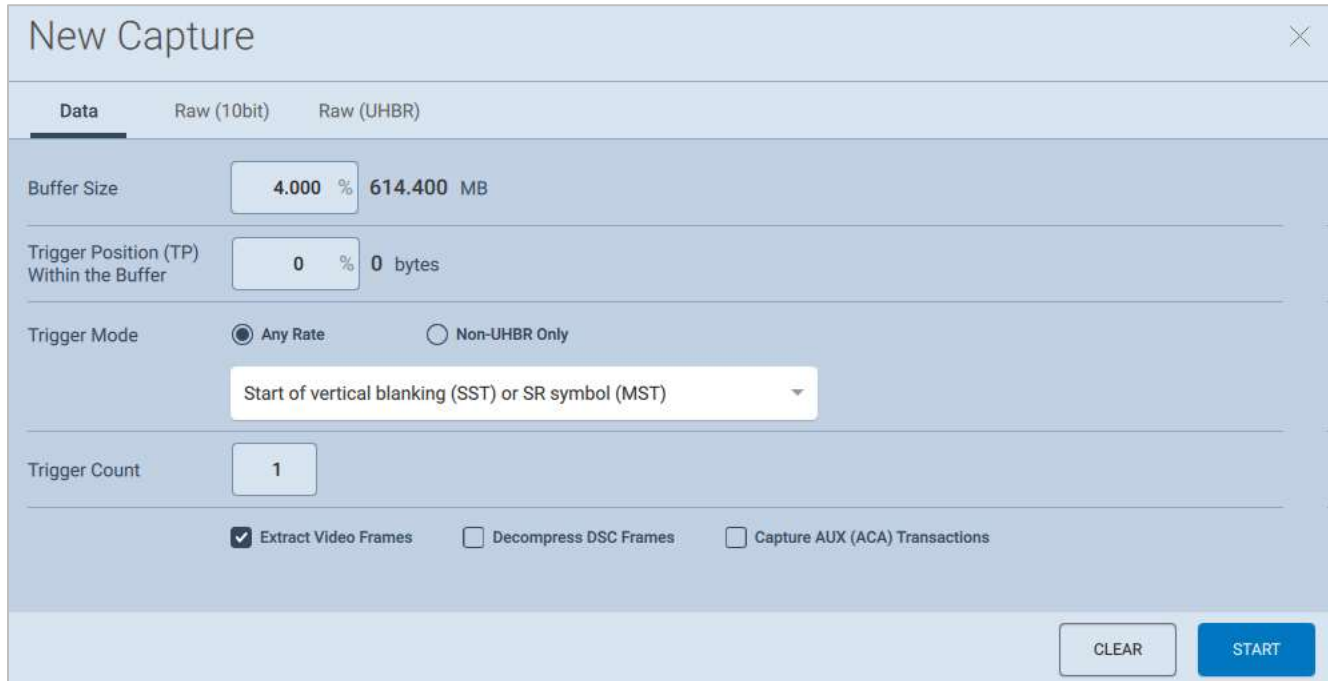
To analyze captured passively monitored DisplayPort data, access the **Capture & Viewer** from the Home Dashboard of the M42d VPS GUI.



By default, a list of saved captures is displayed, as shown below. Click the **Capture** button at the top right to begin a new capture in passive monitoring mode.



You initiate a new capture of passively monitored data through the Capture Control panel. The Capture Control panel enables you to setup the capture parameters. The figure below shows the Capture Control panel and its control and selection items.



The following table describes the functions of the **Capture Control** panel, specifically the **Data** tab:

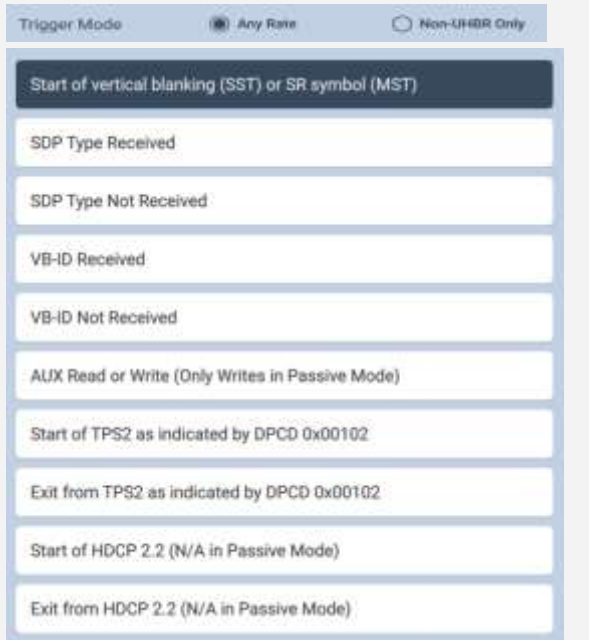
Capture Control Panel - Function	Item - Description
Buffer Size	<ul style="list-style-type: none"> <li>Enables you to set the size of the captured data in percent of the 8 GB buffer.</li> <li>This is a sliderbar that provides an indication (on the left) of the percent of the total possible size to be captured. A lower value will require less time for the captured data to accumulate.</li> </ul>
Trigger Position within Buffer	<ul style="list-style-type: none"> <li>Enables you to set the position of the trigger event within the captured data.</li> <li>This sliderbar determines how much of the data that has accumulated in the capture buffer has occurred before the trigger event. The sliderbar has an indication (on the left) of the location of the trigger event within the captured data. The value is expressed as a percent.</li> <li>A value of 0% indicates that the trigger event occurs at the beginning of the resulting captured data and 100% indicates that the trigger event occurs at the end of the resulting captured data.</li> <li>A value of 50% indicates that the trigger event is in the middle of the captured data.</li> </ul>




Capture Control Panel - Function	Item - Description
	<ul style="list-style-type: none"> <li>• <b>Note:</b> The Buffer Position Slidebar is not applicable when you select Vsync as the trigger condition.</li> </ul>
Trigger Mode	<ul style="list-style-type: none"> <li>• Enables you to specify the type of data that you want to capture.</li> <li>• <b>Note:</b> <i>This is covered in greater detail after this table.</i></li> </ul>
Trigger Count	<ul style="list-style-type: none"> <li>• Option to specify which occurrence of the selected trigger event will initiate capture</li> <li>• eg. a Trigger Count of 5 will start capture at the 5<sup>th</sup> occurrence of the trigger event</li> </ul>
Extract Video Frames	<ul style="list-style-type: none"> <li>• Enables you to view the video frames that were captured.</li> </ul>
Decompress DSC Frames	<ul style="list-style-type: none"> <li>• Makes video frames viewable if DSC mode is enabled</li> <li>• Extract Video Frames toggle must be enabled for this option to be active</li> </ul>
Capture AUX (ACA) Transactions	<ul style="list-style-type: none"> <li>• Enables you to capture the Aux Channel transactions</li> </ul>
Start Capture (Capture Tab)	<ul style="list-style-type: none"> <li>• Initiates a capture using the criteria defined in the <b>Trigger Mode</b> and <b>Trigger Symbol</b>.</li> </ul>

The **Trigger Mode** drop down selection allows you to pick the specific event occurrence that will initiate the capture in passive monitoring mode. You may use the radio buttons to select a trigger at **Any Rate** or **Non-UHBR Only**

With the **Any Rate** radio button selected, a set of options is selectable from the drop-down menu beneath it, as shown below and described in the following table:

Any Rate Trigger Mode Drop Down Menu	Trigger Options
	<ul style="list-style-type: none"> <li>• Start of vertical blanking (SST) or SR/LLCPM symbol (Multi-Stream Transport)</li> <li>• SDP Type Received</li> <li>• SDP Type Not Received</li> <li>• VB-ID Received</li> <li>• VB-ID Not Received</li> <li>• AUX Read or Write (Only Writes in Passive Mode)</li> <li>• Start of TPS2 as indicated by DPCD 0x00102</li> <li>• Exit from TPS2 as indicated by DPCD 0x00102</li> <li>• Start of HDCP 2.2/2.3 (N/A in Passive Mode)</li> <li>• Exit from HDCP 2.2/2.3 (N/A in Passive Mode)</li> </ul>

When selecting **Non-UHBR Only** Trigger, another set of options is selectable from the drop-down menu beneath it. A few of these triggers require you to select the lane for the trigger to occur on, as shown and described in the table below. You may need to scroll down within the list to see all options.

Non-UHBR Only Trigger Mode Drop Down	Trigger Options
	<ul style="list-style-type: none"> <li>• Specified Symbol (more on next page)</li> <li>• Data Byte Value</li> <li>• 8B10B Symbol Error</li> <li>• 8B10B Disparity Error</li> <li>• Start of TPS3 as indicated by DPCD 0x00102</li> <li>• Exit from TPS3 as indicated by DPCD 0x00102</li> <li>• Start of TPS4 as indicated by DPCD 0x00102</li> <li>• Exit from TPS4 as indicated by DPCD 0x00102</li> <li>• Start of HDCP 1.3 (N/A in Passive Mode)</li> <li>• Exit from HDCP 1.3 (N/A in Passive Mode)</li> <li>• FEC Decode Enable Sequence</li> <li>• FEC Decode Disable Sequence</li> <li>• ML_PHY_STANDBY detected on main link</li> <li>• ML_PHY_SLEEP detected on main link</li> <li>• AUX_PHY_WAKE detected on AUX channel</li> </ul>

AVF	BE	BF
BS	C0	C1
C2	C3	C4
C5	C6	C7
CP	CPF	EOC
FE	FS	LLCPM
PM	R2	SE
SF	SR	SS

If **Specified Symbol** is selected, then select one of:

- BS=Blanking Start
- BE=Blanking End
- BF=Blanking Fill
- C0-C7=VC Payload Fill Control code sequence
- CP=Content Protection
- FE=Fill End, FS=Fill Start
- R2
- SE=Secondary Data End
- SR=Scrambler Reset,
- SS=Secondary Data Start
- Other

**Note:** You may need to scroll down to see all options

The next subsection will describe the procedures for capturing and viewing data using **Capture Control**.

## Capturing Passed-through DisplayPort source data

The procedures for running a capture of the DisplayPort source are described in this subsection. You can operate the Protocol Analyzer either through the M42d embedded VPS GUI or via a PC through the external VPS GUI Application. Most of the examples in this section are taken from the embedded VPS GUI but the look and feel are quite similar between the two.


### Capturing DisplayPort source data

5. Access the **Capture Control** application from the VPS Dashboard home screen.

The **Capture Control** window opens as shown below.

The screenshot shows the 'New Capture' dialog box with the following configuration:

- Buffer Size: 4,000 % (614.400 MB)
- Trigger Position (TP) Within the Buffer: 0 % (0 bytes)
- Trigger Mode: Any Rate (selected), Non-UHBR Only (unselected)
- Trigger Mode Dropdown: Start of vertical blanking (SST) or SR symbol (MST)
- Trigger Count: 1
- Extract Video Frames:
- Decompress DSC Frames:
- Capture AUX (ACA) Transactions:
- Buttons: CLEAR, START

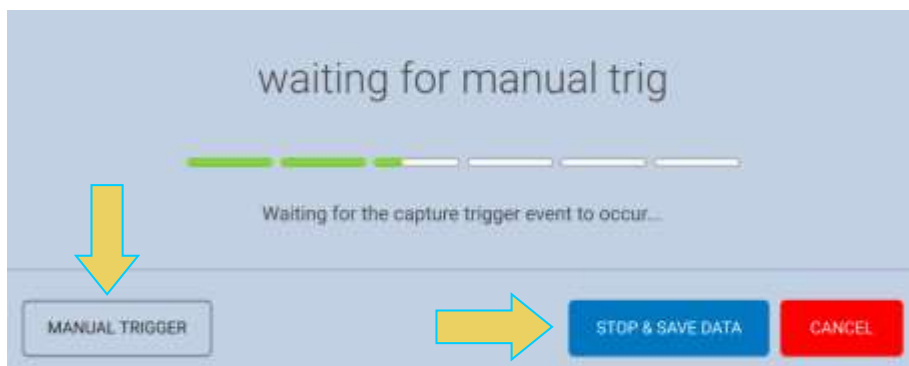
6. Specify the **Buffer Size** and **Trigger Position, Mode,** and **Count** in accordance with the information provided earlier in this chapter.
7. Toggle on or off the options to **Extract Video Frames, Decompress DSC** (if applicable), and **Capture AUX (ACA) Transactions**.
8. Initiate the capture by clicking on the **Start** activation button 

A progress bar will appear, as shown below.

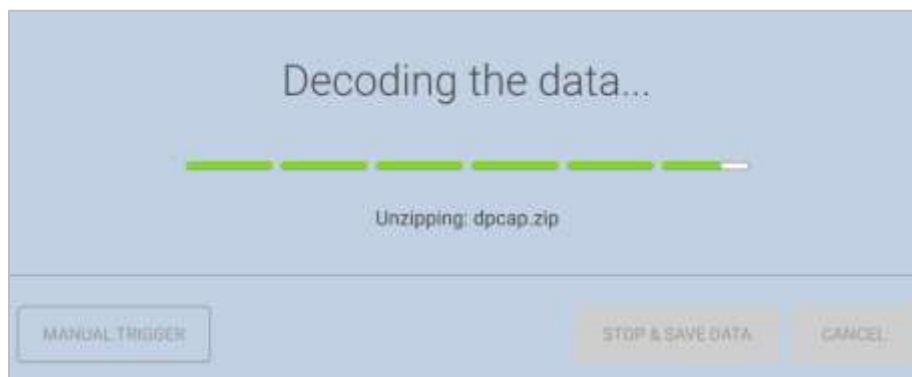


If the capture trigger event does not occur, you may click the **MANUAL TRIGGER** or **STOP AND SAVE DATA** buttons. They are described below. You can also **CANCEL** the capture at any time.

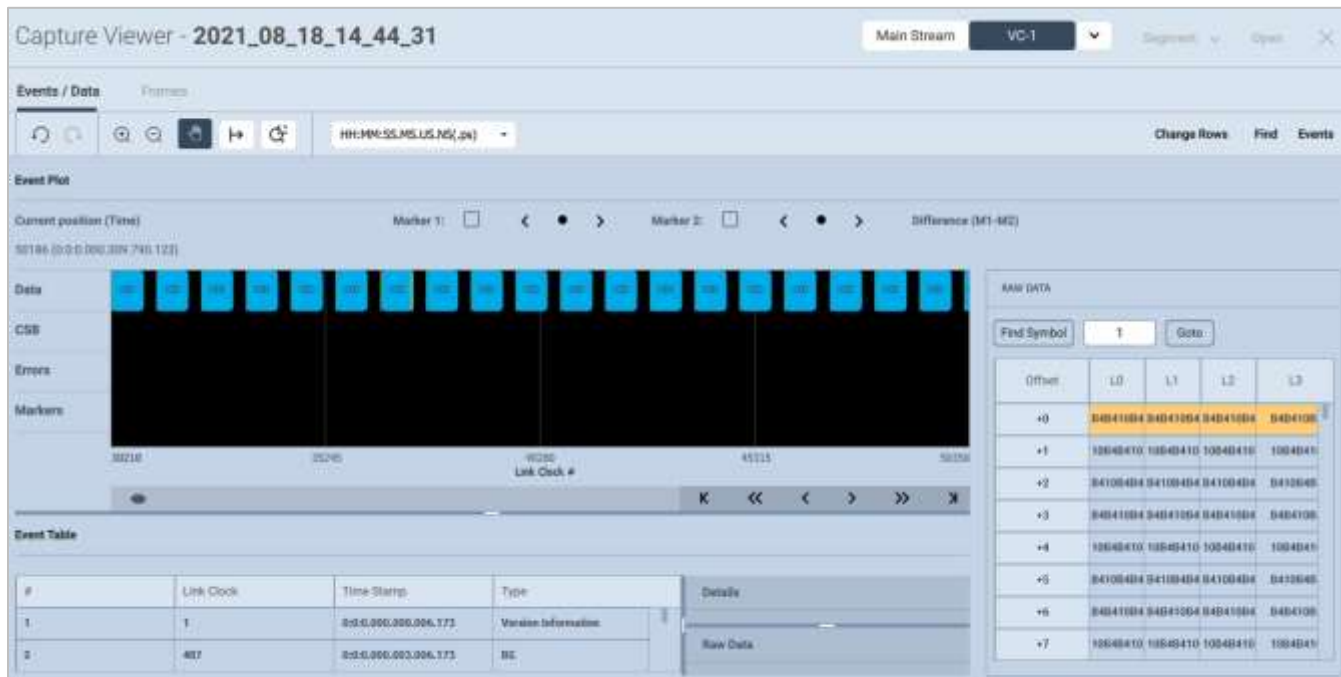
- Manual Trigger – If the trigger event does not occur as expected, or if you are viewing the video display in real time and you notice an occurrence that you would like to capture the data of, manually initiate a capture with the previously set specifications at this point.
- Stop and Save Data – If the capture is not triggered as expected, you can essentially cancel the capture and keep the raw data for later analysis.



Once the capture trigger event has occurred, the data will be decoded and saved for viewing. An example of the progress bar while this occurs is below.



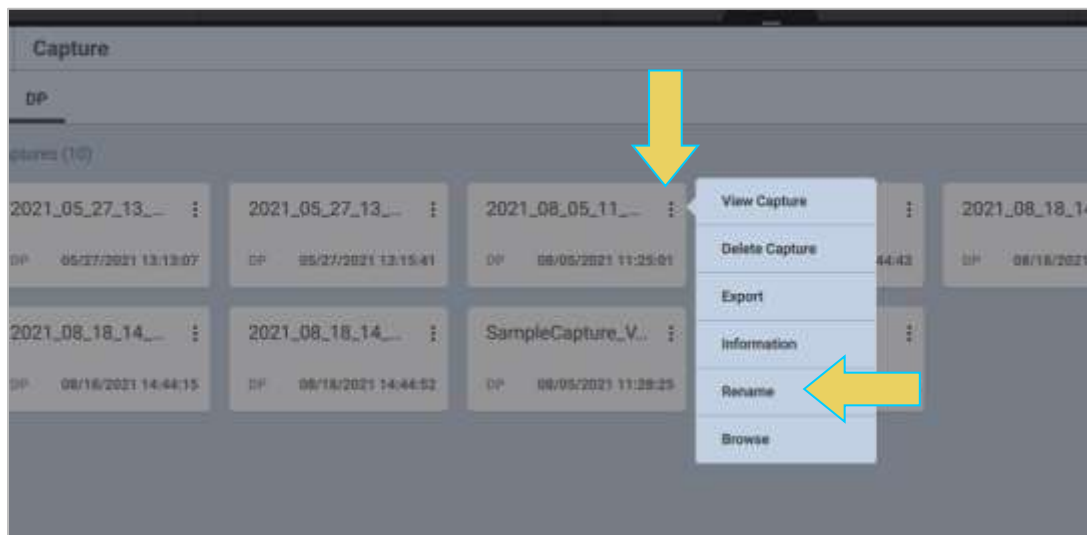
When the capture is complete, the data is presented in the **DP Capture Viewer**. An example of the captured data is shown in the screen shot example below.



The **Capture Viewer** and its features/functionality is covered in much detail in the next two sections of this chapter. **6.3 Capture Viewer Panels** covers the Event Plot, Data Decode/Details, and Link Symbol panels, while **6.4 Searching and Filtering** for Specific Data Elements covers searching for events or symbols, and filtering using the functions within the Capture Viewer.

The Capture file name will initially be the date/time it was performed, as pictured in bold at the top of the above screenshot.

To change the Capture file name, exit the Capture Viewer, click the three-dot menu icon of the capture you wish to change, then click **Rename**, as shown below.



## 9 LTTPR Testing

---

All LTTPR testing features are licensed. More information about licenses can be found in [Appendix A. Licenses](#).

### 9.1 Overview

The M42d supports the testing of LTTPR-capable source devices and also provides link layer transaction data for LTTPR devices and a DPRx sink.

Two revisions of LTTPR are supported, revisions 14h and 20h. Revision 14h is for non-transparent mode or transparent mode for LTTPR in an 8b/10b network. Revision 20h is used when testing LTTPRs in non-transparent mode in UHBR networks.

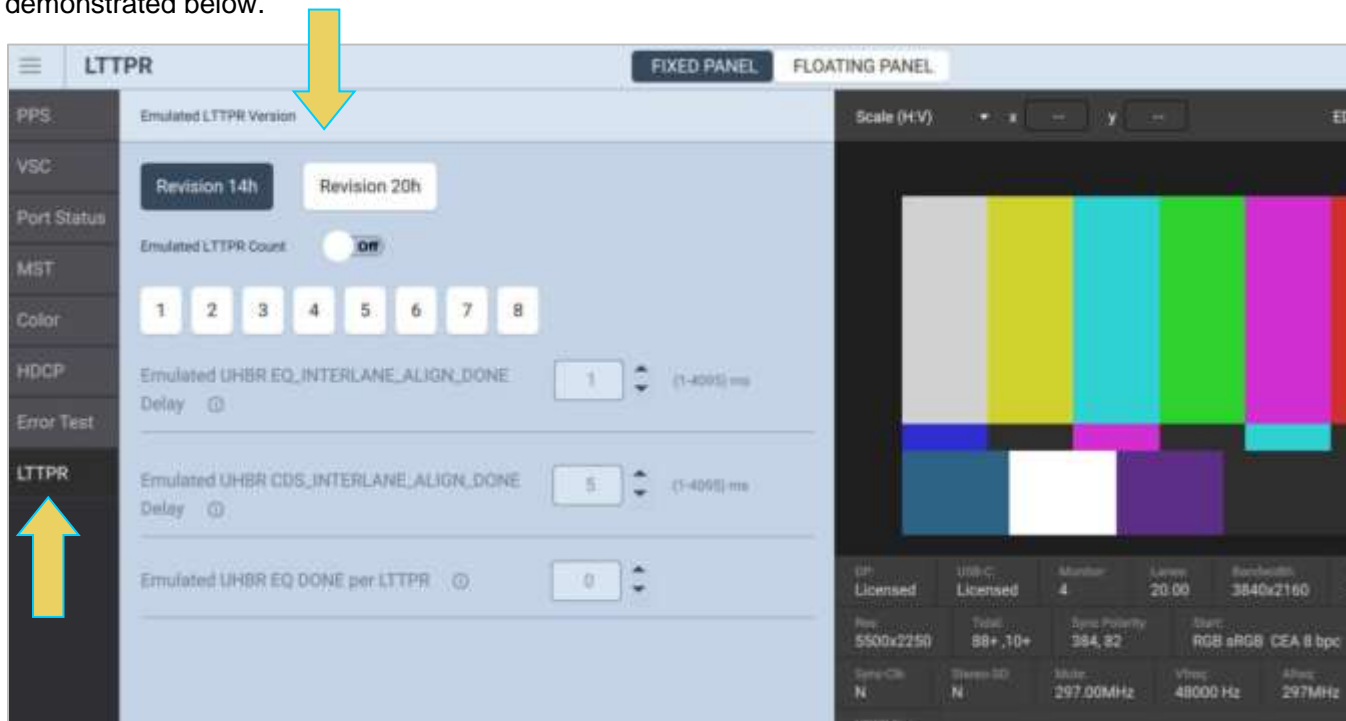
While testing a source device in the non-transparent mode, each LTTPR is trained in the link. This ensures better signal quality to the end-to-end link. When testing an LTTPR-capable source device, the M42d can emulate a network of up to 8 LTTPR devices and a DPRx (sink).

The M42d can also generate video to LTTPR device(s) as a DPTx (source).

## 9.2 LTTPR Emulation for Testing Source Devices

The tool you will use for LTTPR emulation is located within the **Analyzer Rx** interface, accessible from the Dashboard home screen of the M42d's embedded VPS GUI.

To access the LTTPR utility, click the **LTTPR** icon in the control menu on the left-hand side of the Receiver. This will display the **Tools** dialog box. Click the **LTTPR** tab on the left sidebar to access the utility, as demonstrated below.



The LTTPR emulation tool appears as shown above. Using this tool, you can emulate up to eight LTTPR devices. This tool offers options for configuring the emulated LTTPR, and more configurations are available within the DPCD Editor, which is covered in the next section.



To emulate LTTPR for testing a source device, first select the version of LTTPR according to your testing specification, as shown below.



Notice that with version 14h selected, the adjustable UHBR options within the LTTPR tool for do not apply to non-UHBR emulation. These are enabled with version 20h in UHBR mode, as shown below.



If emulating LTTPR version 20h (non-transparent LTTPR), modify the values of the adjustable fields in accordance with your testing specifications.

For example, in the screenshot below, the source device will read that the emulated LTPPR8 is not set due to the user-configured override value of 7F in the bottom-most field.

The screenshot shows the 'Emulated LTPPR Version' configuration panel. At the top, there are two buttons: 'Revision 14h' (light blue) and 'Revision 20h' (dark blue). Below this is a toggle for 'Emulated LTPPR Count' which is currently set to 'Off'. A row of eight numbered buttons (1-8) is visible. The main settings area contains three rows of delay controls, each with a text label, a numeric input field, a vertical slider, and a unit '(1-4095) ms':

- Emulated UHBR EQ\_INTERLANE\_ALIGN\_DONE Delay: Input field shows '1'.
- Emulated UHBR CDS\_INTERLANE\_ALIGN\_DONE Delay: Input field shows '5'.
- Emulated UHBR EQ DONE per LTPPR: Input field shows '7F'. A yellow arrow points to this field from the right.

**Note:** Any adjustments to these settings must be done with the **Emulated LTPPR Count** set to **Off**. Once an LTPPR count has been set, the M42d begins emulating LTPPR and the settings cannot be changed without again turning emulation off.

Once you have adjusted these fields per your testing requirements, select the number of LTTPR devices you wish to emulate. The **Emulated LTTPR Count** toggle automatically turns on when a number is selected.

The following example has selected an LTTPR count of 4.



As mentioned previously, notice that the adjustable fields are now disabled, as emulation has begun.

In order to re-enable adjustment of these fields and re-activate LTTPR:

1. Toggle emulation off.

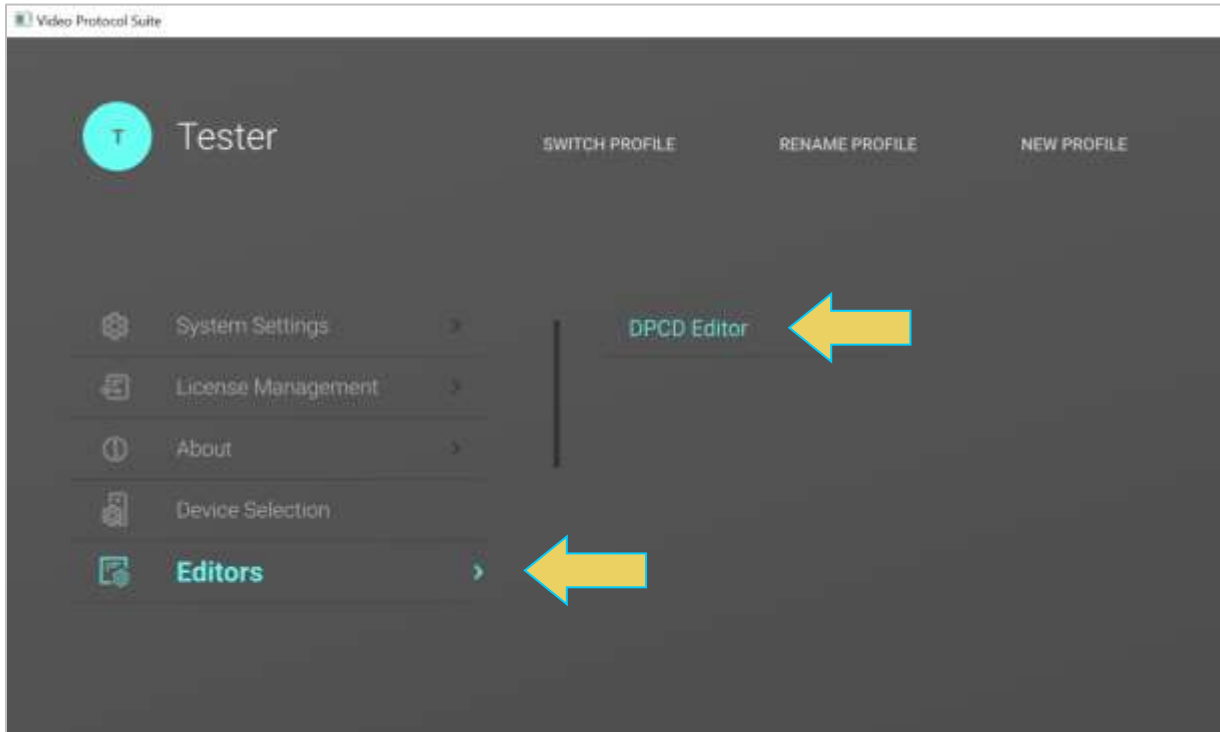


2. Make adjustments to desired fields in LTTPR Tool
3. Re-enable LTTPR emulation by selecting desired LTTPR Count.



### 9.3 Modifying LTTPR Capability Registers

Once the M42d has begun LTTPR emulation, you can modify the DPCD of the emulated Rx LTTPR device to further meet your testing specifications. To do this, access the **DPCD Editor** utility within the **Editors** tab of the system menu, as shown below.



This takes you to the **DPCD Editor**.

Full instructions for the DPCD Editor are found in [section 13.1](#).

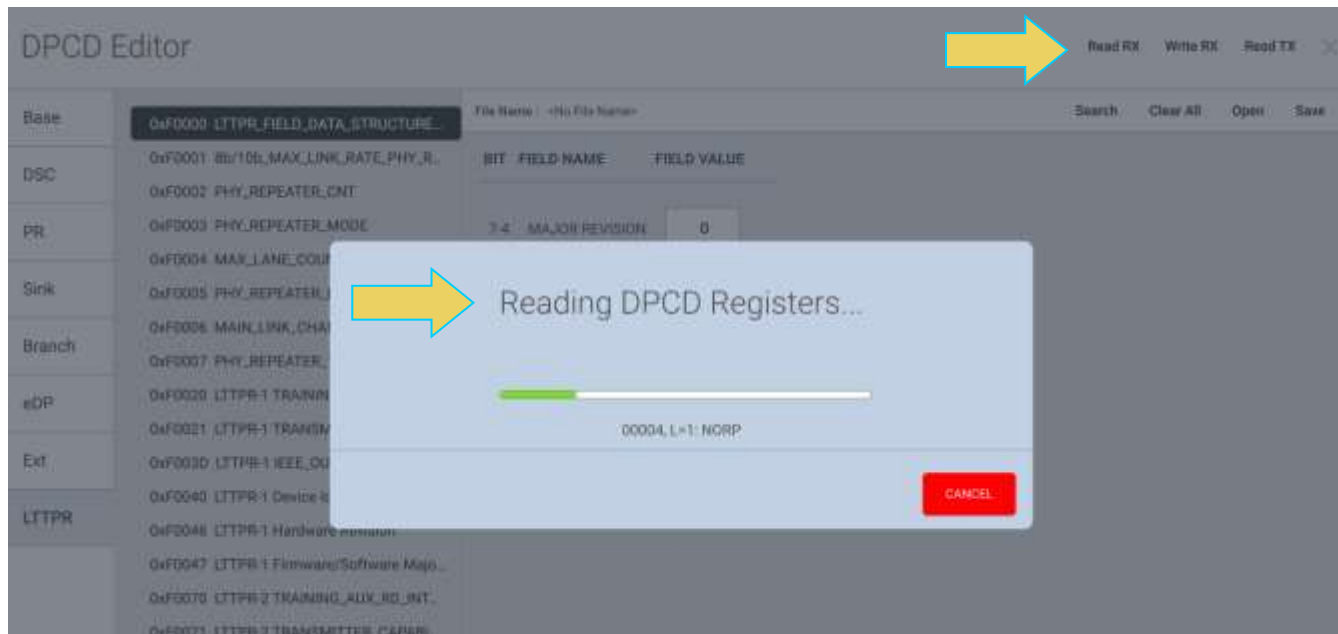
Navigate to the **LTTTPR** tab on the left-hand sidebar, as demonstrated below.

The screenshot shows the DPCD Editor interface. On the left is a sidebar with a tree view of categories: Base, DSC, PR, Sink, Branch, eDP, Ext, and LTTTPR. The LTTTPR category is selected and highlighted in blue. A yellow arrow points to the LTTTPR category in the sidebar. The main area displays a table of bit fields with names and values. The table has two columns: BIT and FIELD VALUE. The fields are: 7-4 MAJOR REVISION (0) and 3-0 MINOR REVISION (0). At the bottom of the main area, there is a section for BYTES (00) and buttons for Read page and Write page.

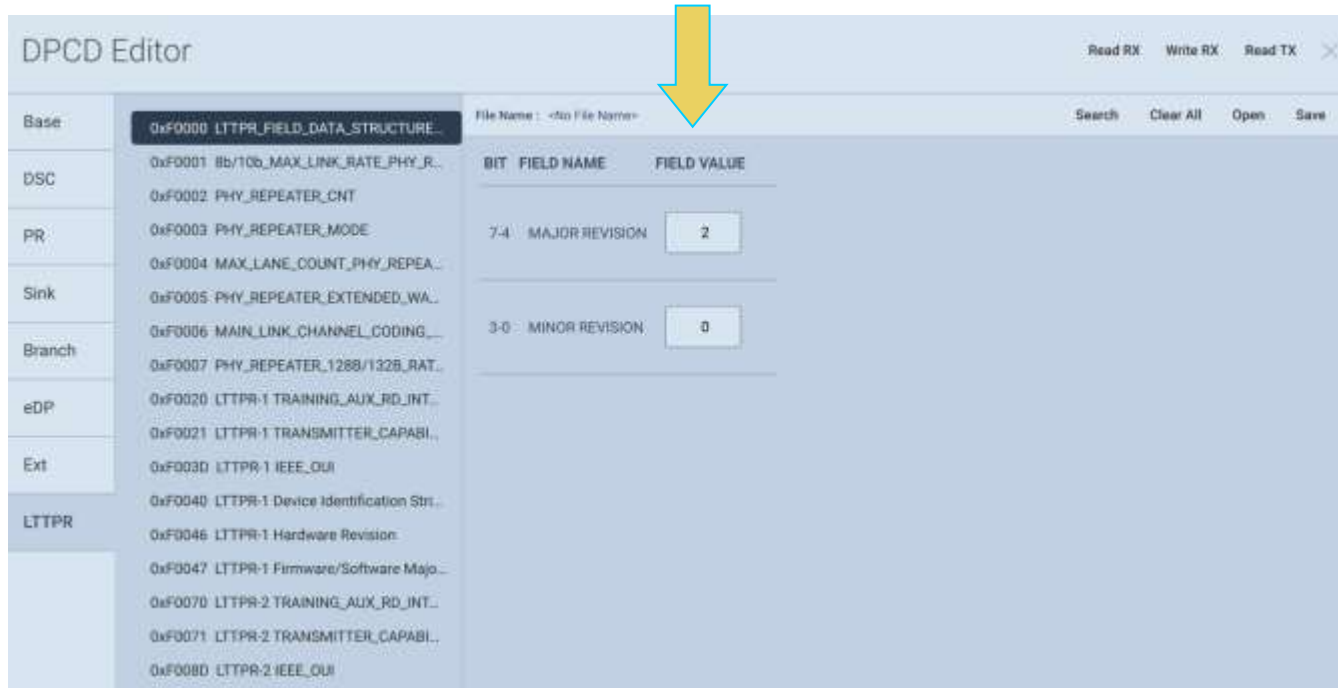
BIT	FIELD NAME	FIELD VALUE
7-4	MAJOR REVISION	0
3-0	MINOR REVISION	0

The window displays tabs for each LTTTPR Capability Register that can be changed. To display the registers for the current Rx being emulated by the M42d, click **Read Rx** in the top right corner of the window. A loading bar will appear while the Rx DPCD is read, as shown below.

**Note:** The LTTTPR emulation demonstrated in the previous section **must be enabled** for the registers to correctly populate field values other than zero. With LTTTPR off, the editor will display zero for all field values.

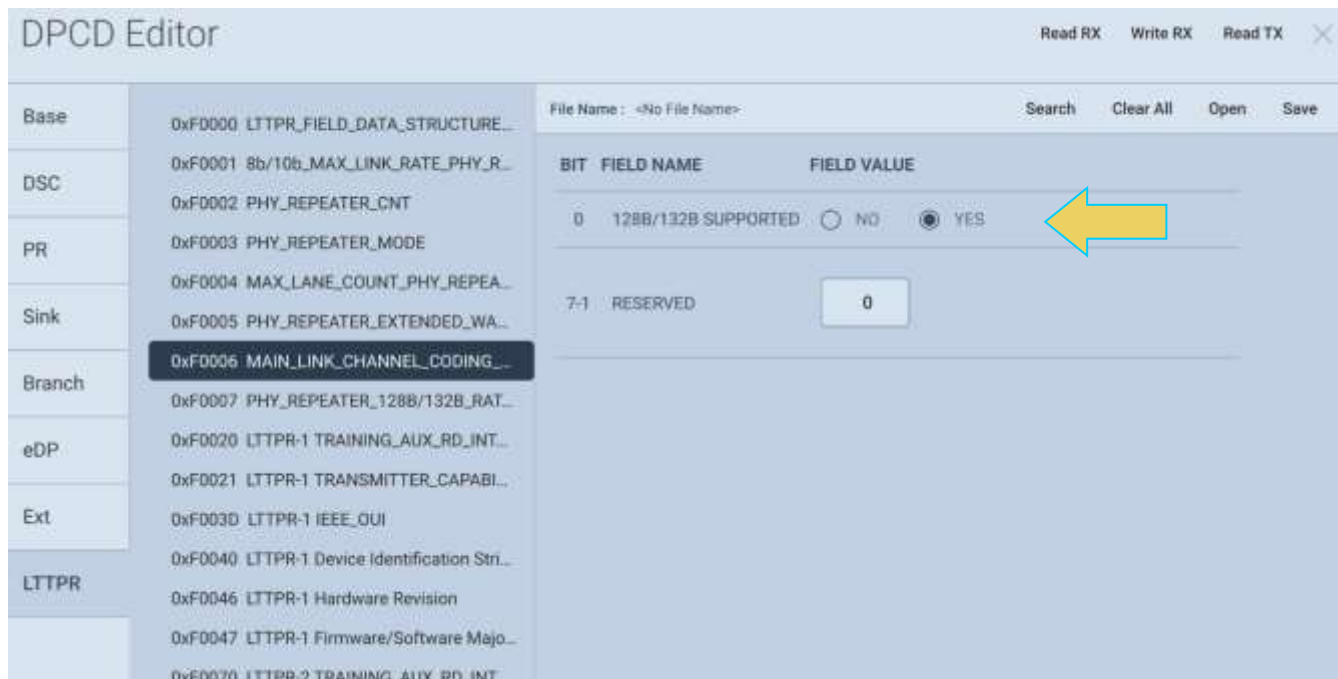


The DPCD Editor will now display the LTTTPR Capability Registers with their current field values. The example below is emulating LTTTPR 2.0 (20h). Major Revision value is 2, Minor Revision value is 0.

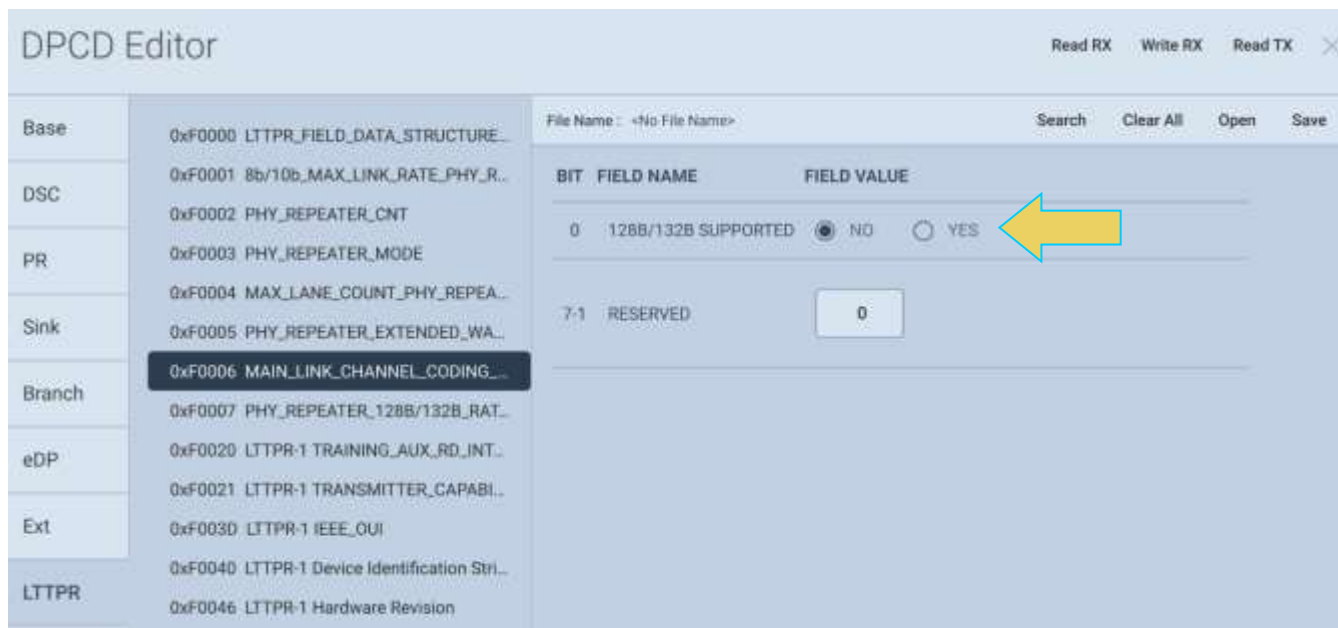


These capability registers are configurable to be able to emulate different LTTTPR configurations. A full list of the registers is listed in **Appendix B. Configurable LTTTPR Capability Registers.**

To modify the configuration, select the LTTTPR register you wish to change, as shown below. This example has selected the F0006h MAIN\_LINK\_CHANNEL\_CODING\_PHY\_REPEATER register. The currently emulated configuration supports 128b/132b coding.



Edit the fields that you wish to re-configure according to your testing specifications. Furthering the previous example, the user has disabled support for 128b/132b coding using the respective radio button, shown below.



In the example below, the user selects register F0007h PHY\_REPEATER\_128B/132B\_RATES and disables support for all UHBR rates, as shown in the following sample screenshots.

Base 0xF0000 LTTPR\_FIELD\_DATA\_STRUCTURE...

DSC 0xF0001 8b/10b\_MAX\_LINK\_RATE\_PHY\_R...  
0xF0002 PHY\_REPEATER\_CNT

PR 0xF0003 PHY\_REPEATER\_MODE  
0xF0004 MAX\_LANE\_COUNT\_PHY\_REPEA...

Sink 0xF0005 PHY\_REPEATER\_EXTENDED\_WA...  
0xF0006 MAIN\_LINK\_CHANNEL\_CODING\_...

Branch 0xF0007 PHY\_REPEATER\_128B/132B\_RAT...

eDP 0xF0020 LTTPR-1 TRAINING\_AUX\_RD\_INT...  
0xF0021 LTTPR-1 TRANSMITTER\_CAPABI...

Ext 0xF0030 LTTPR-1 IEEE\_OUI  
0xF0040 LTTPR-1 Device Identification Stri...

LTTPR 0xF0046 LTTPR-1 Hardware Revision

File Name : <No File Name>

BIT	FIELD NAME	FIELD VALUE	
0	10 GBPS/LANE SUPPORT	<input checked="" type="radio"/> NO	<input type="radio"/> YES
1	20 GBPS/LANE SUPPORT	<input checked="" type="radio"/> NO	<input type="radio"/> YES
2	13.5 GBPS/LANE SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
7-3	RESERVED	<input type="text" value="0"/>	

Base 0xF0000 LTTPR\_FIELD\_DATA\_STRUCTURE...

DSC 0xF0001 8b/10b\_MAX\_LINK\_RATE\_PHY\_R...  
0xF0002 PHY\_REPEATER\_CNT

PR 0xF0003 PHY\_REPEATER\_MODE  
0xF0004 MAX\_LANE\_COUNT\_PHY\_REPEA...

Sink 0xF0005 PHY\_REPEATER\_EXTENDED\_WA...  
0xF0006 MAIN\_LINK\_CHANNEL\_CODING\_...

Branch 0xF0007 PHY\_REPEATER\_128B/132B\_RAT...

eDP 0xF0020 LTTPR-1 TRAINING\_AUX\_RD\_INT...  
0xF0021 LTTPR-1 TRANSMITTER\_CAPABI...

Ext 0xF0030 LTTPR-1 IEEE\_OUI  
0xF0040 LTTPR-1 Device Identification Stri...

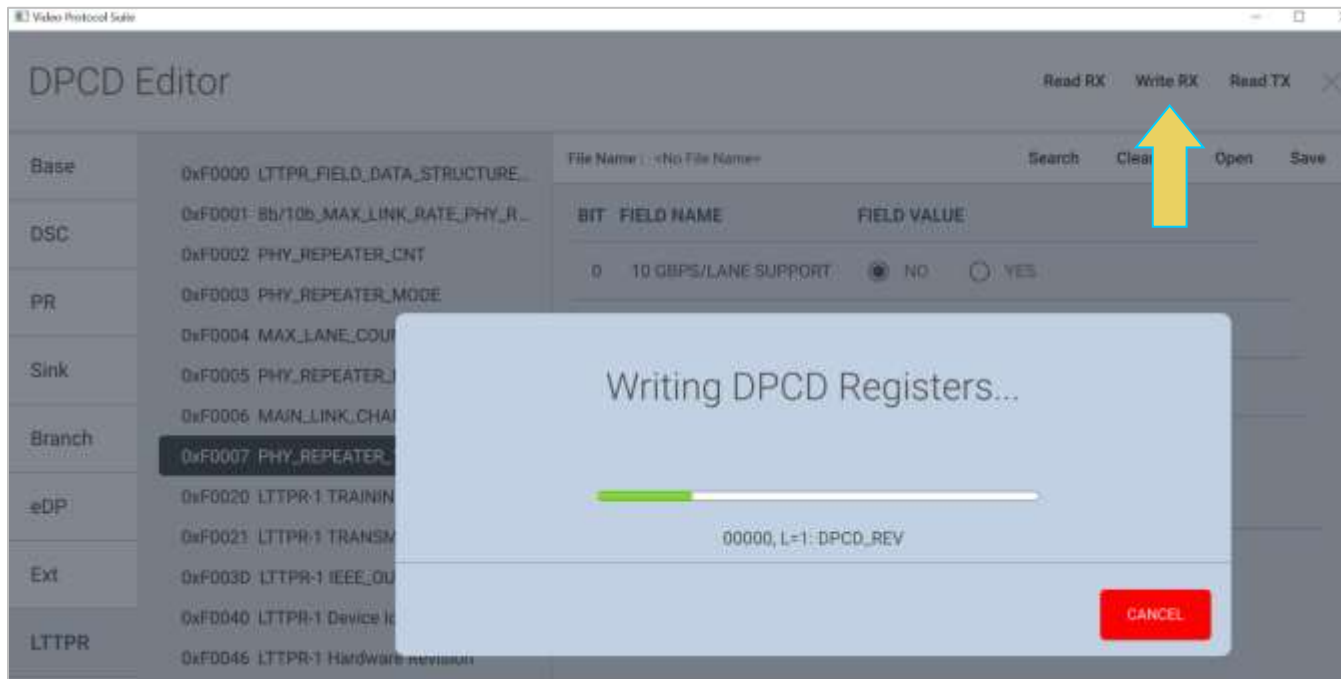
LTTPR 0xF0046 LTTPR-1 Hardware Revision

File Name : <No File Name>

BIT	FIELD NAME	FIELD VALUE	
0	10 GBPS/LANE SUPPORT	<input checked="" type="radio"/> NO	<input type="radio"/> YES
1	20 GBPS/LANE SUPPORT	<input checked="" type="radio"/> NO	<input type="radio"/> YES
2	13.5 GBPS/LANE SUPPORT	<input checked="" type="radio"/> NO	<input type="radio"/> YES
7-3	RESERVED	<input type="text" value="0"/>	



Once you have configured the LTTTPR Capability Registers to your testing specifications, click on **Write Rx** in the top corner, and the M42d's receiver will update its emulated LTTTPR with the modified DPCD.



After modifying the DPCD registers, issue a hotplug in some way (whether through the Basic Analyzer or by unplugging and plugging back in the DP or USB-C cable). The emulated LTTTPR will now reflect the newly configured LTTTPR capabilities.

**Note:** Configured LTTTPR capabilities using the DPCD Editor have to be reapplied anytime the LTTTPR is reset/modified and reenabled from the Rx Analyzer Tools menu. Instructions for saving and quickly reapplying user modified register configurations are in the following subsection.

## Saving and Opening/Reapplying Saved LTTPR Configurations

As stated in the previous section, the DPCD and LTTPR Capability Registers reset to the specifications given in the LTTPR tab of the Tools Menu within the Rx Analyzer. Any manually reconfigured capability registers will be overwritten with DPCD of the newly enabled Rx and emulated LTTPR.

The M42d offers the ability to save and open a modified DPCD (including LTTPR Capability Registers) to quickly reapply these configurations when LTTPR is reset or reenabled from the Rx Analyzer Tools menu.

For example, a user can configure the DPCD according to their test specifications and save the DPCD, then recall the DPCD any time they start or restart a test session.

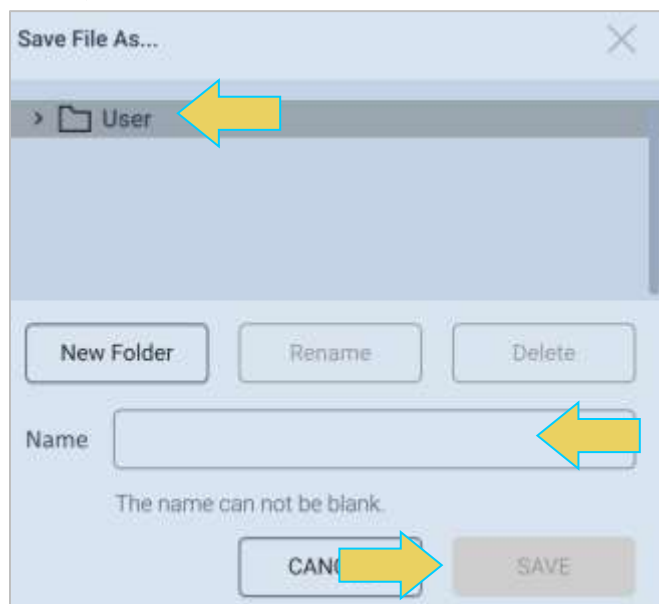
The procedure for this process is as follows:

### Saving DPCD

1. Once you have the configurations you would like to save within the DPCD Editor, click **Save** at the top of the window.



2. A **Save** dialog box will appear. Select the desired path, type in a name for the new DPCD, and click **SAVE**, as shown below.



The DPCD is now saved in the **User** folder.

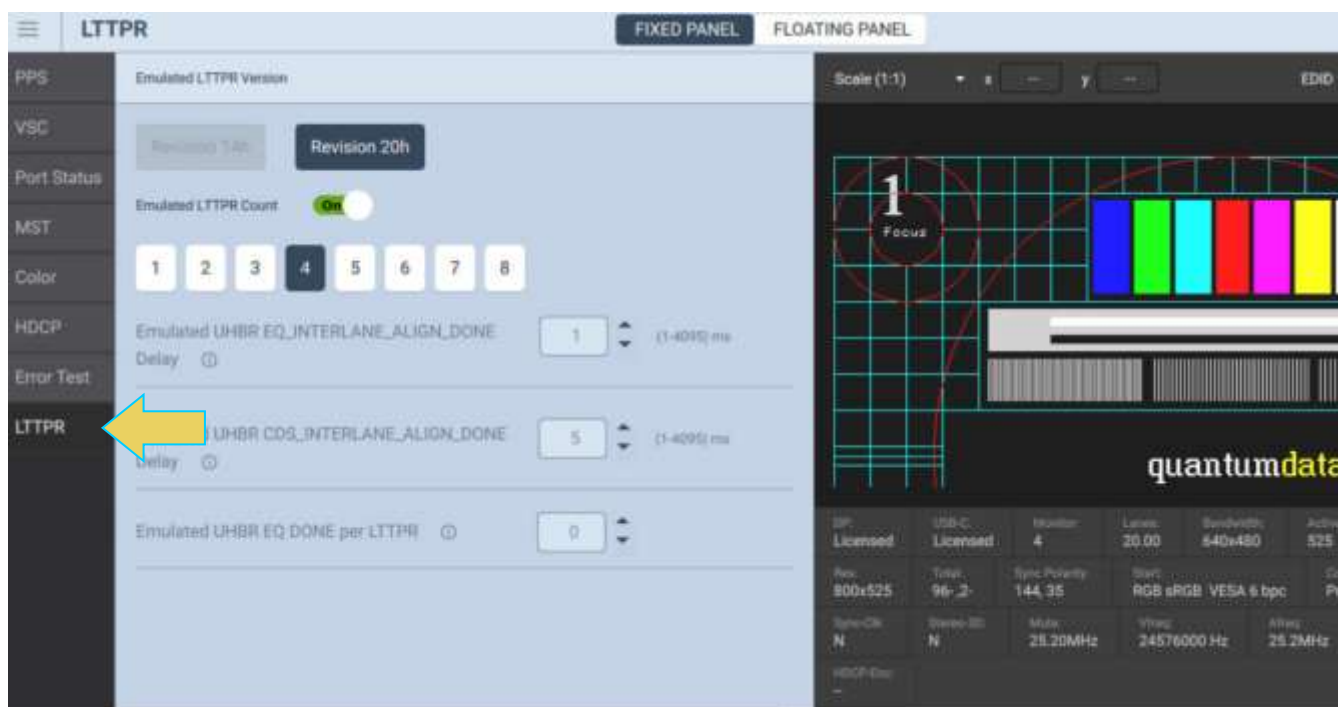
With the configured DPCD now saved, you can open apply this DPCD at any time from the DPCD Editor. In the following example, the user will enable LTTTPR with slightly modified settings using the LTTTPR Tool within the Analyzer Rx, as demonstrated in the first section of this chapter.

**Note:** Keep in mind through the next several steps that when loading a custom DPCD, LTTTPR **must already be emulating**. If you begin LTTTPR emulation after loading the custom DPCD, the DPCD registers will be reset to the default configurations for the given emulation mode.

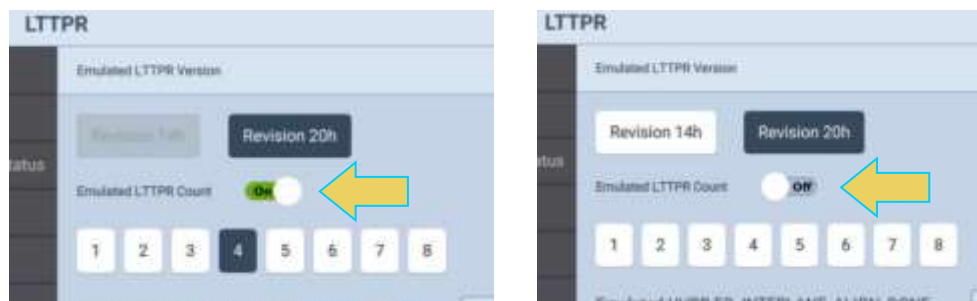
### Reset LTTTPR Emulation

- 3. Navigate to the LTTTPR Tool within the Analyzer Rx.

LTTTPR Emulation should still be active, as shown below.



- 4. Turn off LTTTPR emulation.

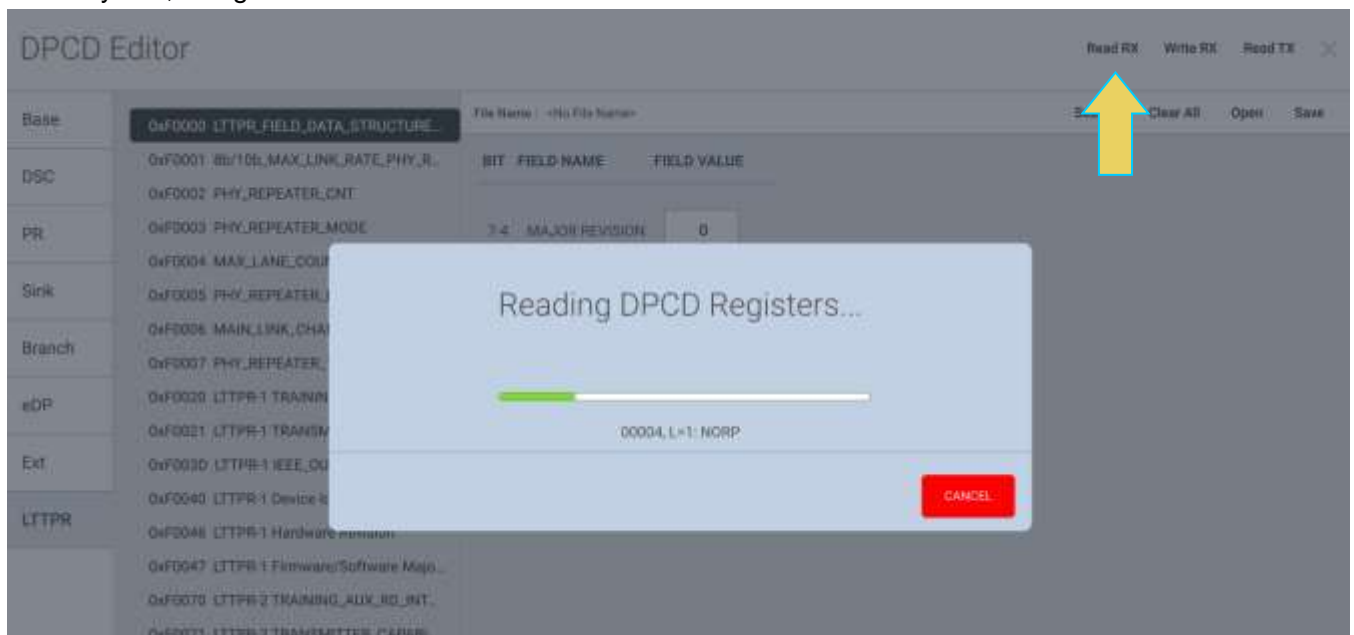


- 5. Make the desired adjustments to the emulated LTTPr within this Tools dialog box, and resume LTTPr emulation. In the following example, the LTTPr version has been switched to 1.4 and there are now 8 emulated LTTPr.

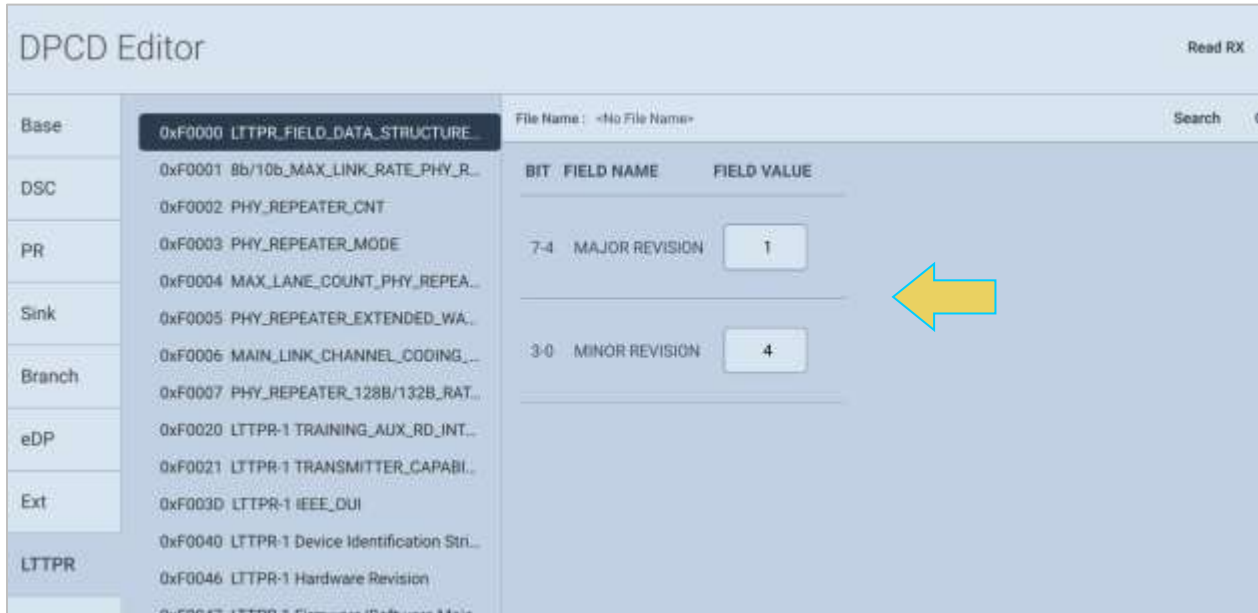


Upon reactivating LTTPr emulation, the DPCD will revert to the settings applied in this step using the Analyzer Rx LTTPr Tool.

- 6. To verify this, navigate to the DPCD Editor and click **Read Rx**.

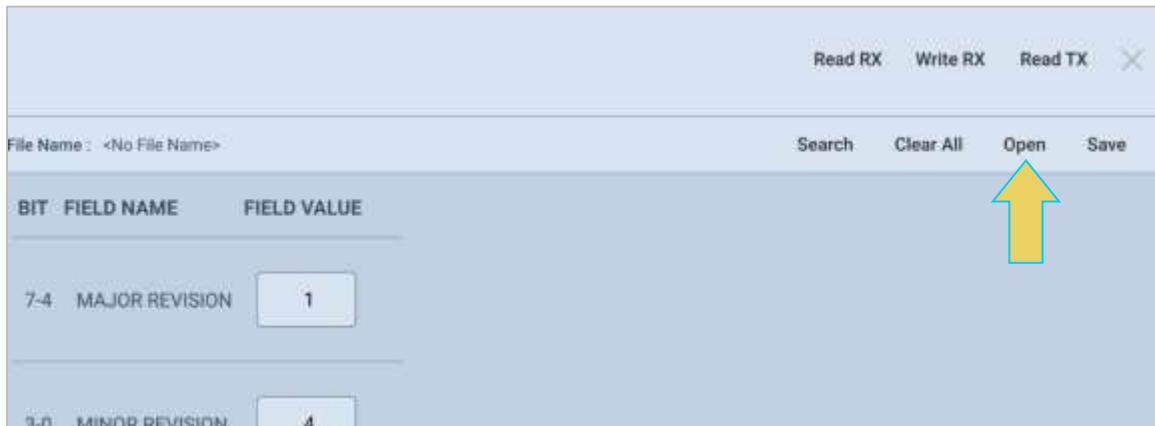


After reading the Rx DPCD, the first LTTTPR Capability register will display version 1.4, as shown below.

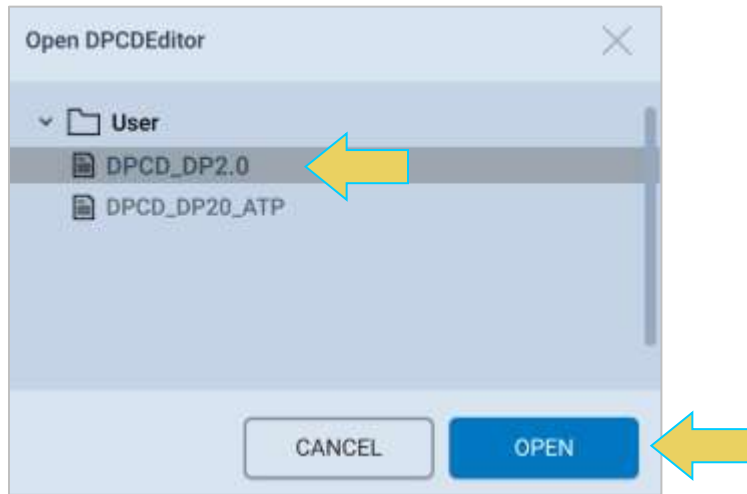


### Open/Reapply Previously Saved DPCD

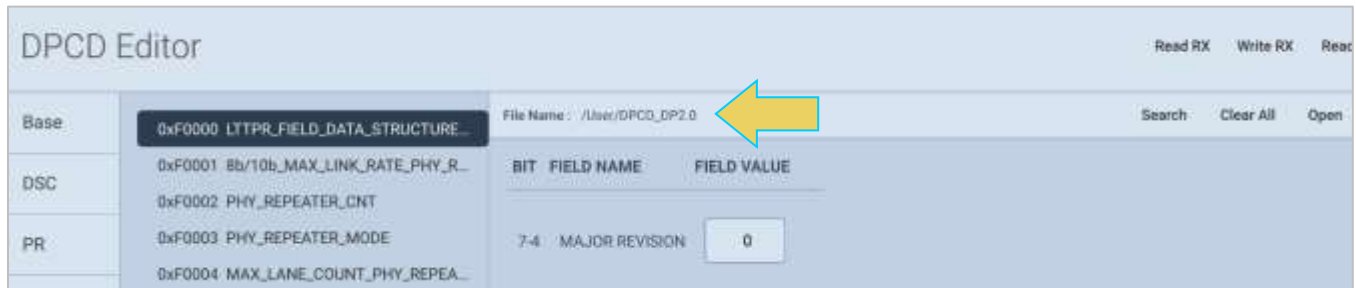
7. To restore the previously set and saved LTTTPR capabilities, open the saved DPCD file by clicking the **Open** button at the top of the DPCD Editor window.



8. An **Open** dialog box will appear. Select the desired DPCD file and click **OK**



Once the DPCD has loaded, the file name will appear at the top of the window, as shown below. Notice as well that the first LTTTPR Capability Register displays the previously configured Field Values for the LTTTPR version number being emulated by the Rx.



The example within this subsection was a rudimentary change to the DPCD’s LTTTPR Register, but demonstrated the capability to save and open custom DPCDs when dealing with LTTTPR. This gives the user the ability to pick up where they left off with previous configurations when beginning a new testing session.

A full list of the configurable LTTTPR Capability Registers within the DPCD Editor can be found in **Appendix B. Configurable LTTTPR Capability Registers.**

## 9.4 Testing LTTTPR Devices with M42d as DPTX

The M42d also has the capability to test and read the ability of one or multiple LTTTPR devices to link train with as a Tx source.

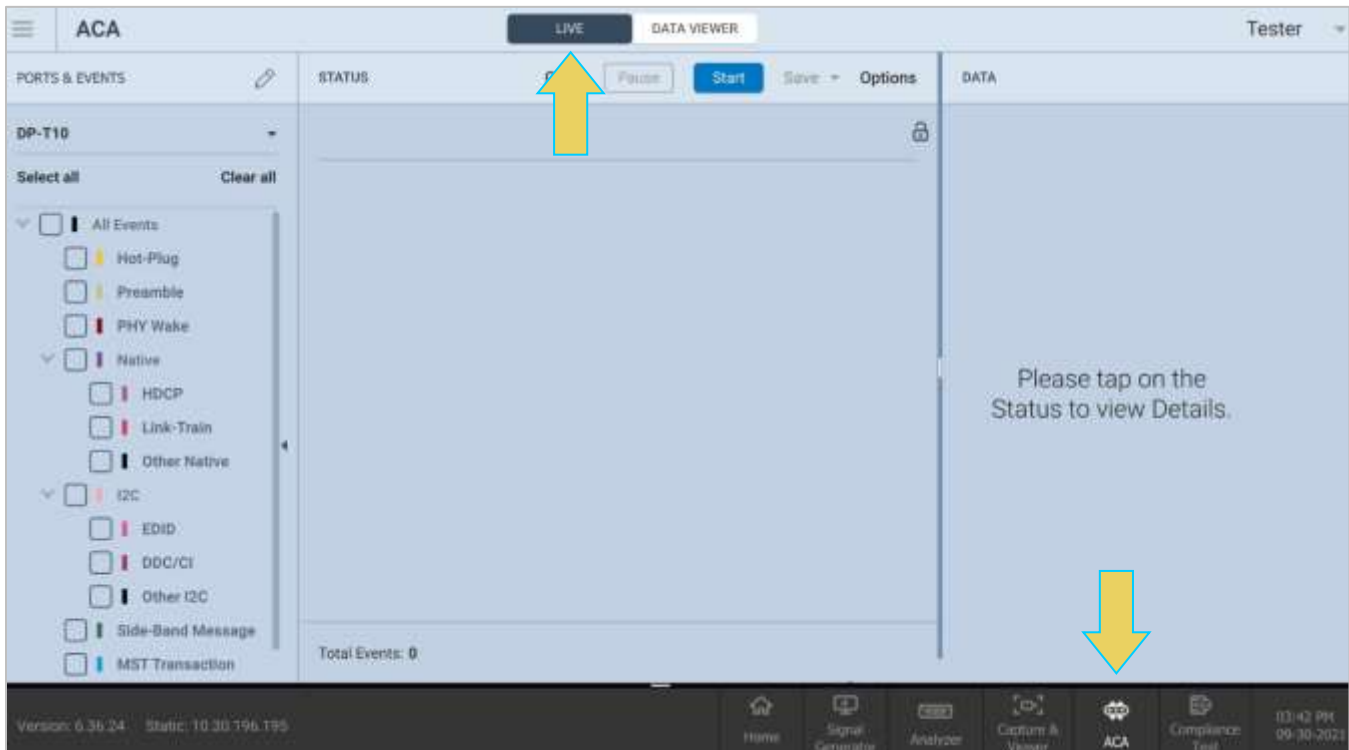
The negotiated transactions can be viewed within the ACA Utility. Detailed instructions for executing an Aux Channel trace are provided in [Chapter 6 Auxiliary Channel Analyzer](#). This section will cover using the ACA utility with one or multiple LTTTPR devices.

**Note:** This is a separately licensed capability. More information on licenses can be found in [Appendix A. Licenses](#).

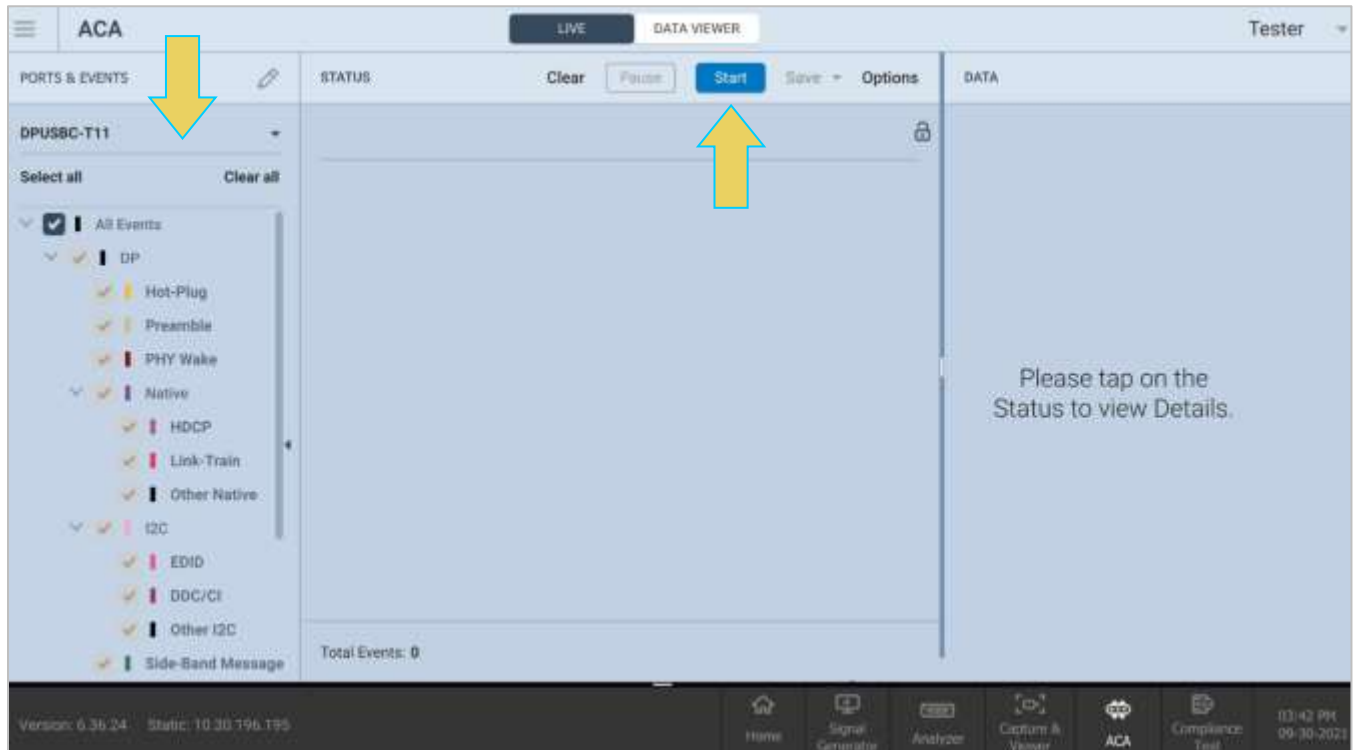
### Monitoring Link Training Negotiations with LTTTPR(s)

This subsection outlines the procedures for monitoring the link training transactions between the M42d instrument acting as a source and up to eight LTTTPRs between source and sink.

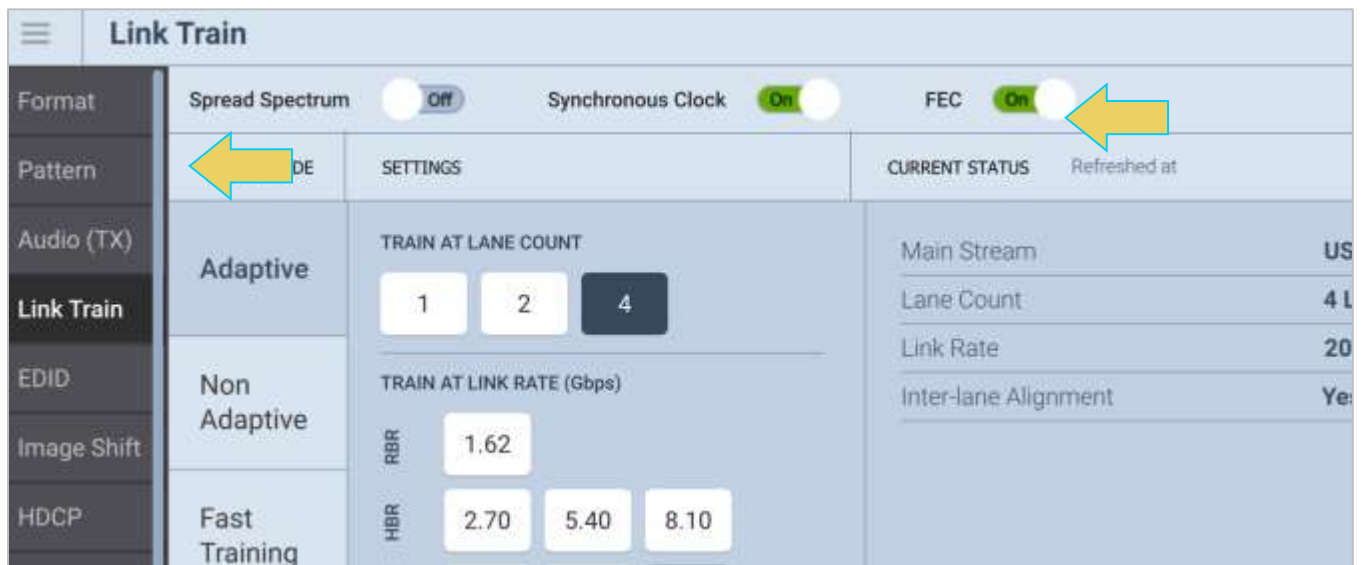
1. With the LTTTPR devices properly connected, open the ACA Utility, and **LIVE** tab if not already opened



2. Ensure that the desired ports and events are selected, and click **Start** to initiate Aux Channel monitoring, as shown below. (Note: for more detailed instructions, see [Chapter 7 Aux Channel Analyzer](#))

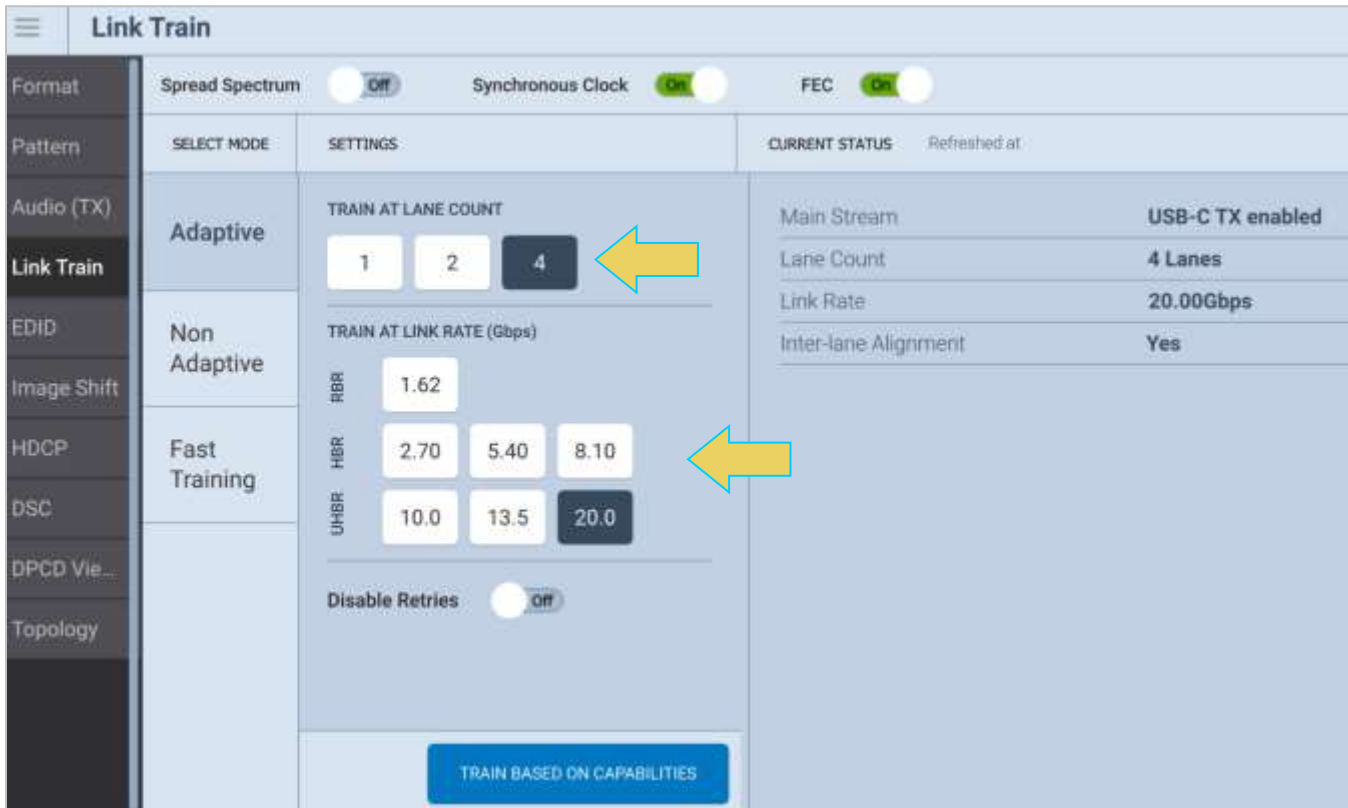


3. Navigate to the **Link Train** utility within the **Signal Generator**.

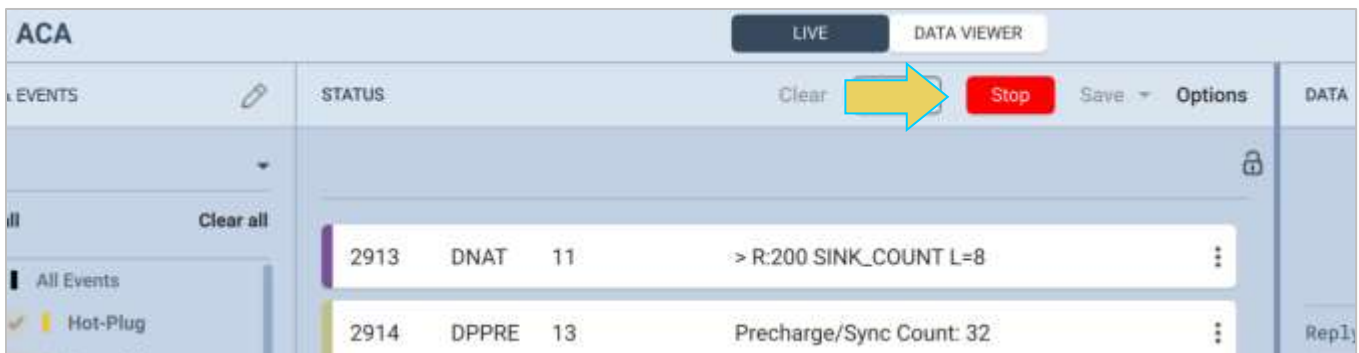




4. Within the **Link Train** tool, select a **Lane Count** and a **Link Rate** according to your desired testing specifications, as shown below. Link training will automatically occur at the selection of a Link Rate.



5. Once link training is complete, return to the ACA Utility or ACA Remote Control and click **STOP** to end the ACA trace.



**Note:** To use the more robust features of the **ACA Data Viewer**, including **finding** and **filtering** for specific event types, see **Chapter 7 Auxiliary Channel Analyzer (ACA)** for detailed instructions on saving trace files and accessing the ACA Data Viewer.

6. Within the Trace Panel, scroll to the appropriate event to view the LTTTPR capabilities read during Link Training. A few of the capabilities demonstrated in the following example are displayed within the Event Details panel as follows:

- LTTTPR version 2.0 (value for Major Revision 2, Minor Revision 0)
- Max Link Rate value is 1Eh (8.1 Gbps per lane)
- LTTTPR Count value is 01h (4 LTTTPRs)
- LTTTPR Mode value is AAh (Non-transparent LTTTPR)

The screenshot displays the 'DATA VIEWER' interface. The left pane shows a list of events, with event 115 selected. The right pane shows the details for event 115, which is a 'Precharge/Sync Count: 32' event. The details panel shows the following data:

Field ID	Field Name	Value	Description
F0000	LTTTPR_FIELD_DATA_STRUCTURE_REV		
3-0	Minor Revision Number	0	
7-4	Major Revision Number	2	
F0001	8b/10b_MAX_LINK_RATE_PHY_REPEATER		
7-0	MAX_LINK_RATE	1Eh	8.1 Gbps/lane
F0002	PHY_REPEATER_CNT		
7-0	LTTTPR Count	01h	0
F0003	PHY_REPEATER_MODE		

### Reading DPCD Registers with LTTTPR(s) Present

As discussed in **Chapter 4 Signal Generator**, you can view the DPCD of a connected sink. The **DPCD Viewer** has the capability of reading connected LTTTPR devices as well.

Navigate to the **DPCD Viewer** tool within the **Generator** application and **Tools** tab.

Select the **LTTTPR** Registers from the left sidebar and click **READ PAGE** or **READ ALL**. From here you will be able to see the capabilities and configurations similar to what was monitored within the ACA Utility in the previous subsection.

A brief example below shows the results of reading the DPCD with the DPCD Viewer.

The screenshot shows the DPCD Viewer interface with a sidebar on the left and a main display area on the right. The sidebar lists various DPCD fields, with 'LTTTPR F0000-F02CF' selected and highlighted by a yellow arrow. The main display area shows the details for the selected register, 'F0000: LTTTPR\_FIELD\_DATA\_STRUCTURE\_REV', with a yellow arrow pointing to it. The details are organized into a table with columns for Bit, Name, Value, and Description.

Bit	Name	Value	Description
<b>F0000: LTTTPR_FIELD_DATA_STRUCTURE_REV</b>			
3-0	Minor Revision Number	0	
7-4	Major Revision Number	2	
<b>F0001: 8b/10b_MAX_LINK_RATE_PHY_REPEATER</b>			
7-0	MAX_LINK_RATE	1Eh	8.1 Gbps/lane
<b>F0002: PHY_REPEATER_CNT</b>			
7-0	LTTTPR Count	01h	8
<b>F0003: PHY_REPEATER_MODE</b>			
7-0	Mode	AAh	Non-transparent
<b>F0004: MAX_LANE_COUNT_PHY_REPEATER</b>			
Bit	Name	Value	Description

## 10 Panel Replay Testing

### 10.1 Overview

The M42d's supports basic testing of Panel Replay-capable source devices. This feature provides the following:

- Basic emulation through the DPCD
- The ability to capture the Panel Replay VSC packets in Capture Control to show the selective updates to frames
- Viewing of the Panel Replay VSCs in the Basic Analyzer window
- Viewing of the Auxiliary transactions for querying the Panel Replay capabilities in the DPCD

**Note:** Panel Replay testing is a licensed feature. Information on specific licenses can be found in [Appendix A. Licenses](#)

### 10.2 Emulation through the DPCD

The following DPCD registers are implemented in support of Panel Replay.

- PANEL REPLAY CAPABILITY SUPPORT registers (DPCD address 00B0h-0B4h)
- PANEL REPLAY ENABLE, AND CONFIGURATION registers (DPCD address 001B0h)
- PANEL REPLAY STATUS registers (DPCD address 002004h – 0020024h)

You can modify the DPCD registers to enable support for Panel Replay in the Receiver/Analyzer, as well as configure settings, shown in the following screenshot example.

**Note:** for detailed instructions on the **DPCD Editor**, see [Chapter 13](#)



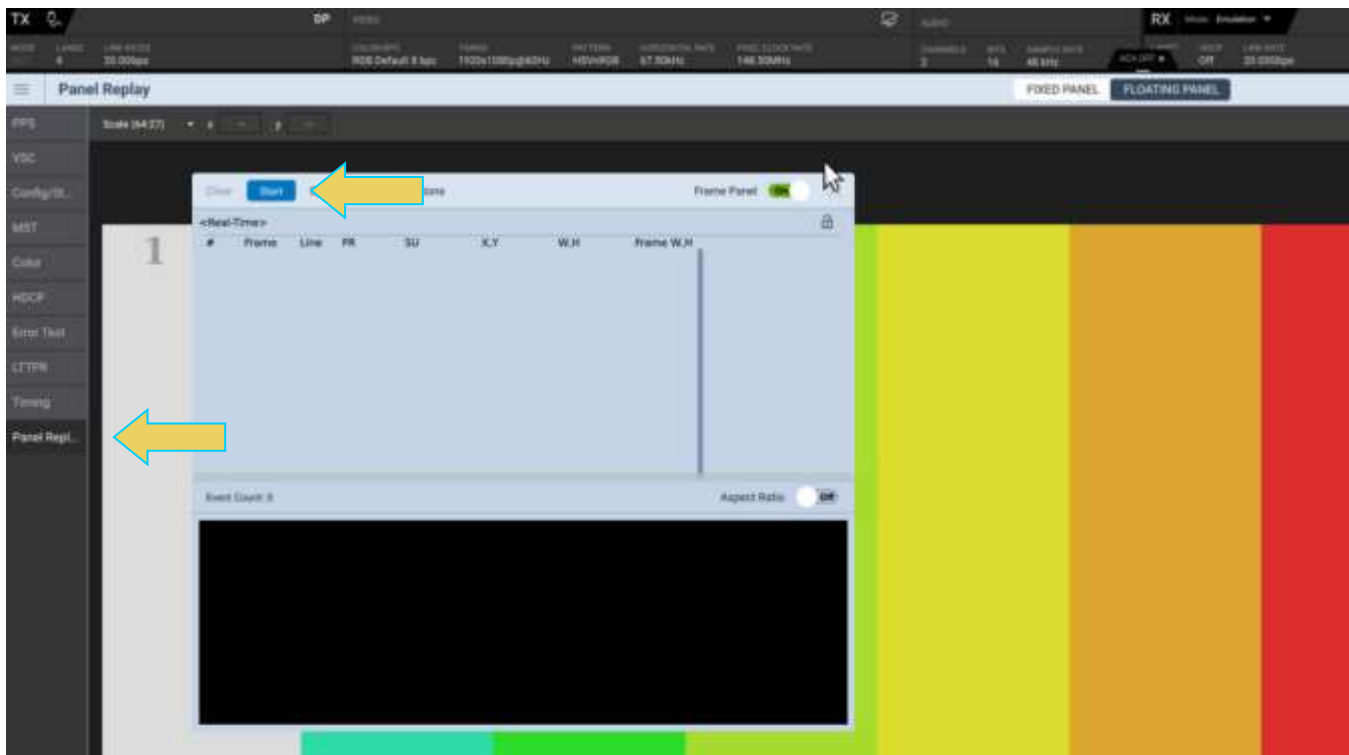
### 10.3 Viewing Panel Replay data in Basic Analyzer window

The M42d offers the ability to view the Panel Replay VSCs within the real time Basic Analyzer.

Use the following procedures to view the Video Stream Configuration data while testing a Panel Replay-capable source DUT.

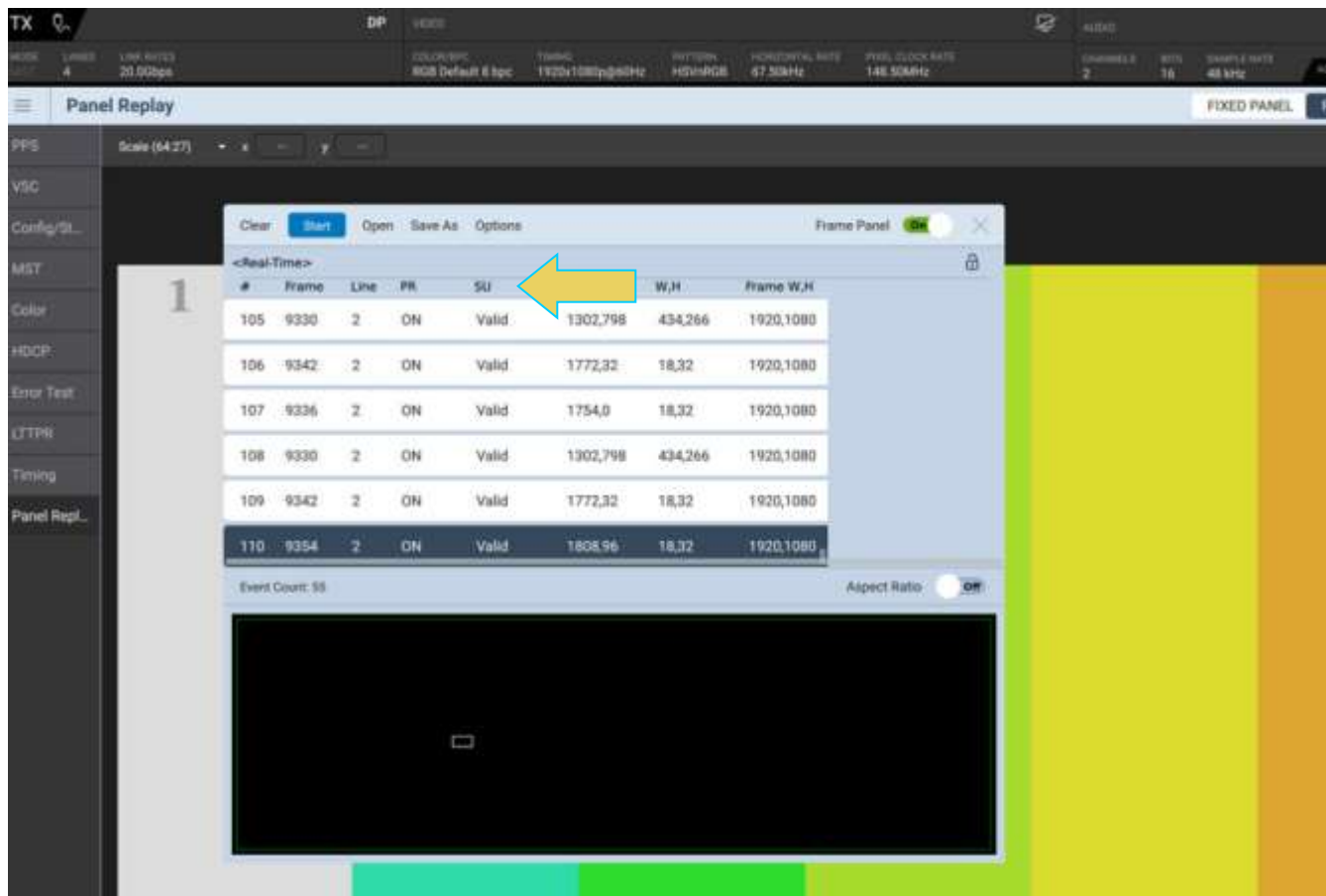
Open the Basic Analyzer from the Home Screen. More information on the Basic Analyzer can be found in [Chapter 5 Source Verification with Basic Analyzer](#).

Access the VSC information window by clicking the **Panel Replay** button in the left-hand control menu within the Analyzer. The Panel Replay tool window will appear within the Analyzer, as demonstrated below.



Click **Start** (pointed out above) to begin monitoring Panel Replay data.

The Panel Replay tool window contains information about Panel Replay. Note the **PR State** column listed as Active and **SU** (selective updates) fields in the packets as shown in the example below.

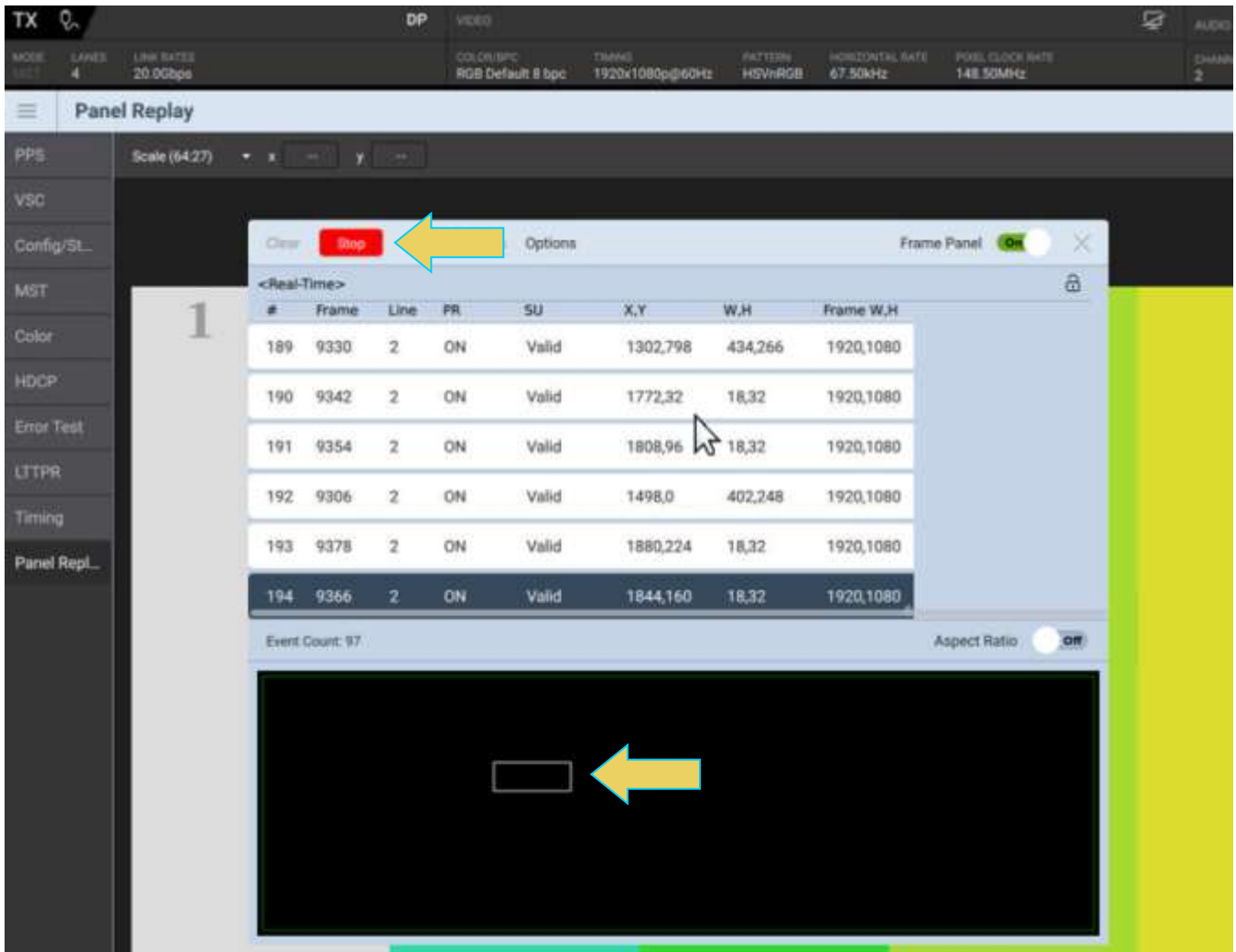


A summary of the columns is listed in the table below:

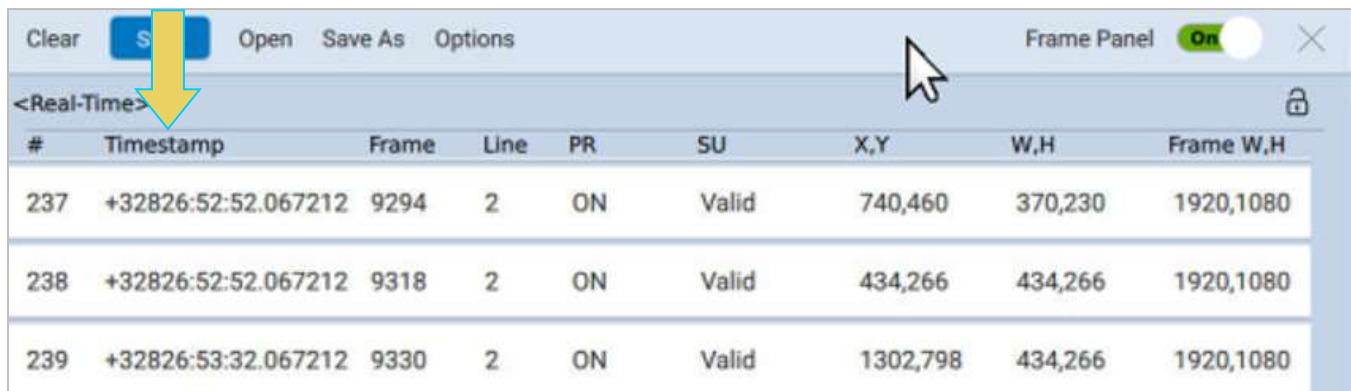
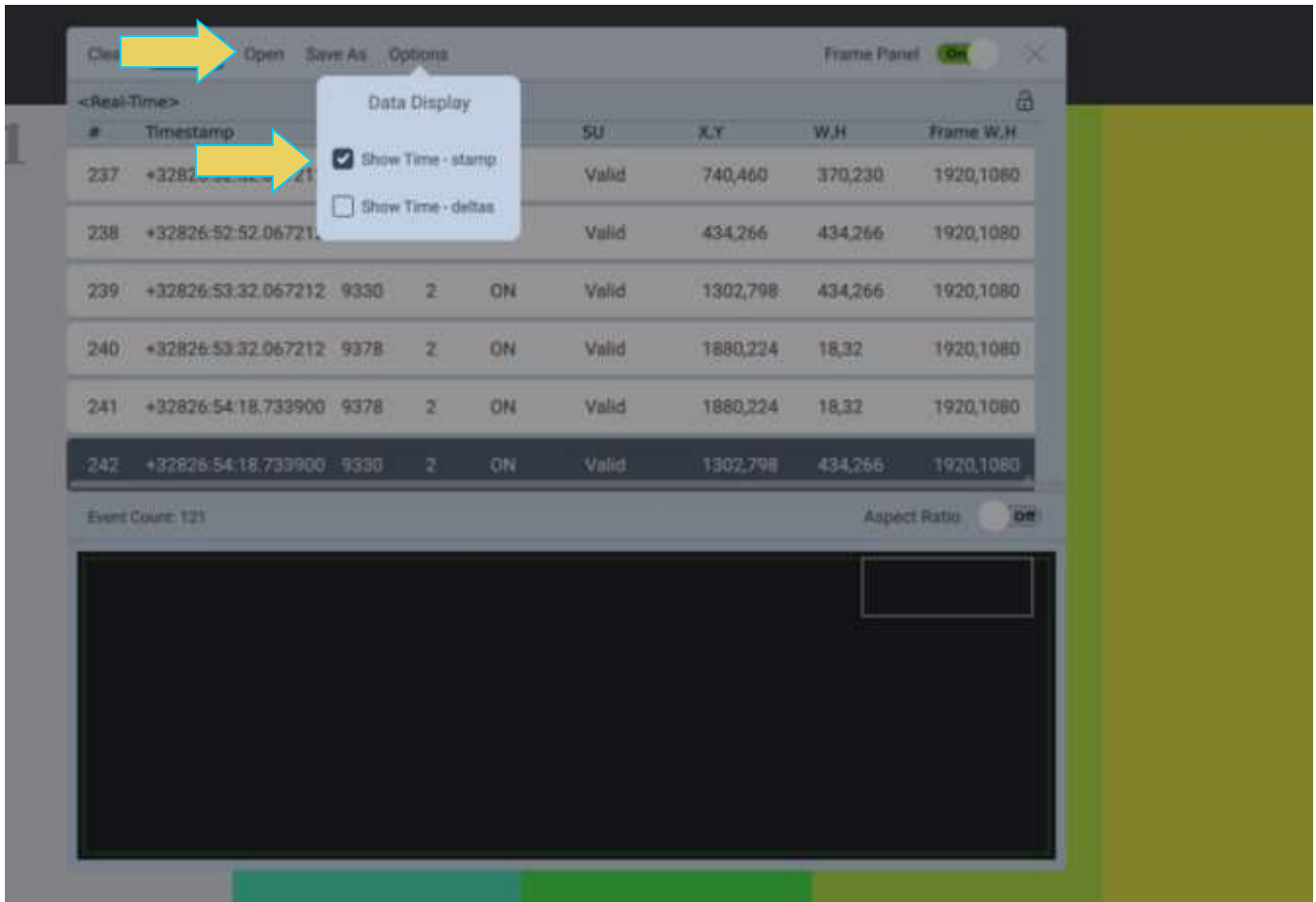
Panel Replay Colum Summary	
Field	Description
#	Line Number
Frame	Frame number captured
Line	Video line captured
PR	Indicates whether Panel Replay is active
SU	Indicates whether Selective Update is valid
X, Y	Pixel location of selective update region
W, H	Dimensions of selective update region
Frame W, H	Dimensions of entire frame

Notice that while the tool is running, the selective update region of the frame is outlined in the lower panel, as indicated below.

Click the red **Stop** button to end Panel Replay monitoring.



Optionally click **Save As** to save a recorded Panel Replay session, or **Open** a previously saved data set. Click the **Options** drop down to show time-stamp and/or time-delta columns, as indicated below.



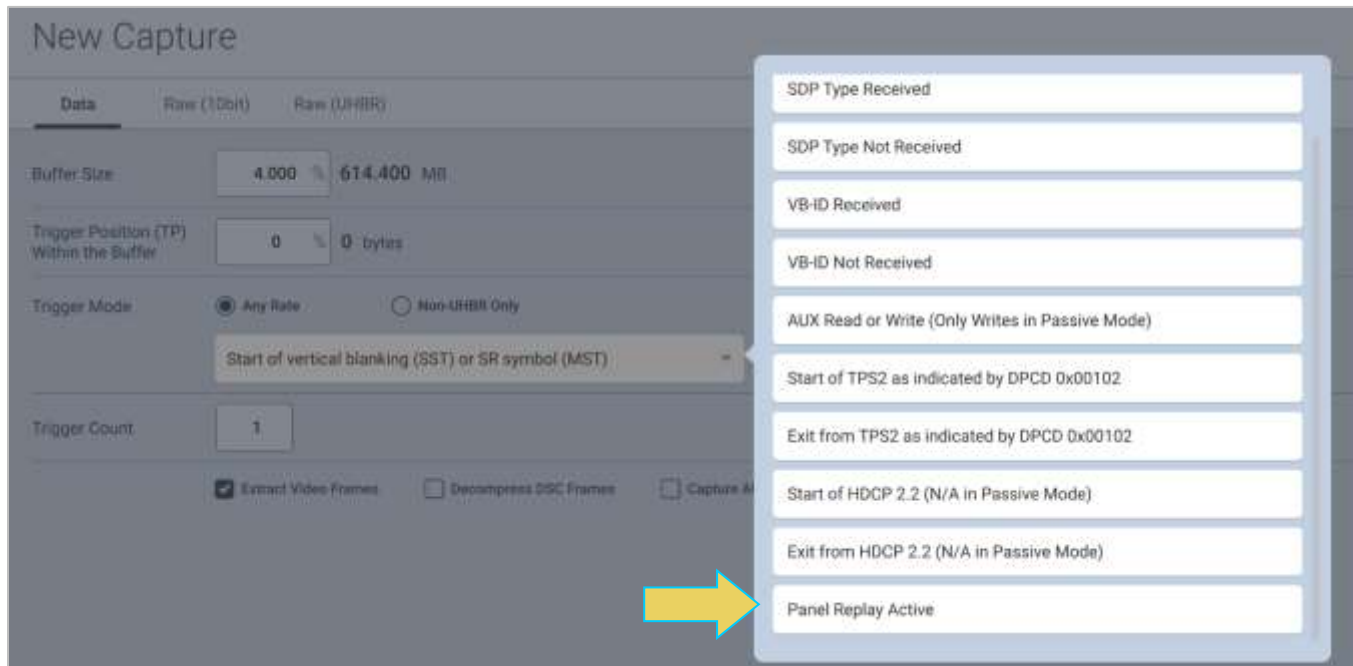


## 10.4 Capturing Panel Replay Packets

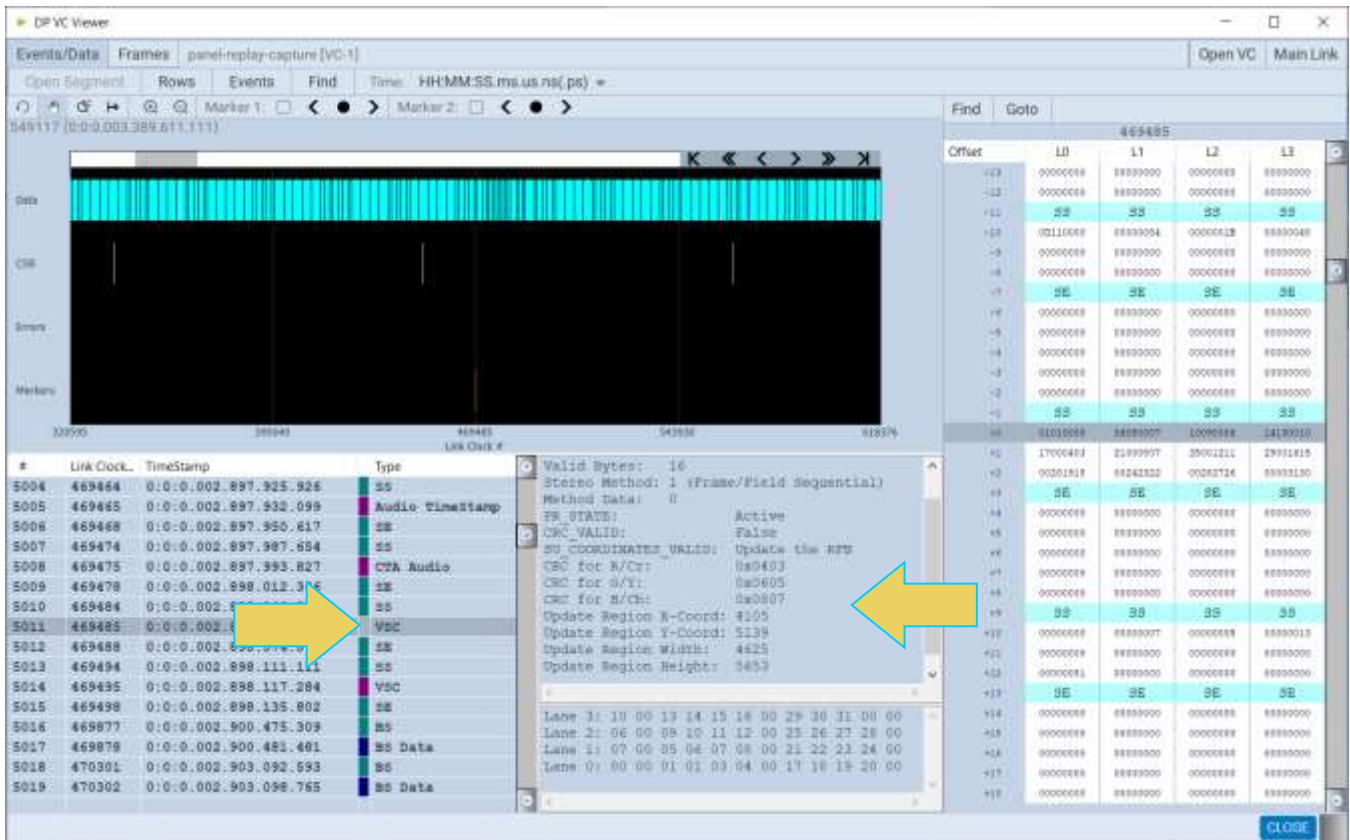
The M42d offers the ability to capture VSC packets in the Protocol Analyzer.

For full instructions on the **Capture & Viewer** utility, see **Chapter 6**.

A **Panel Replay Active** trigger mode is available within the Capture Control utility, as shown below.



After executing the capture, the Virtual Channels within the Capture Viewer show the VSC packets and the selected update regions. Note the selective updates fields in the Event Details panel of the selected VSC packet.

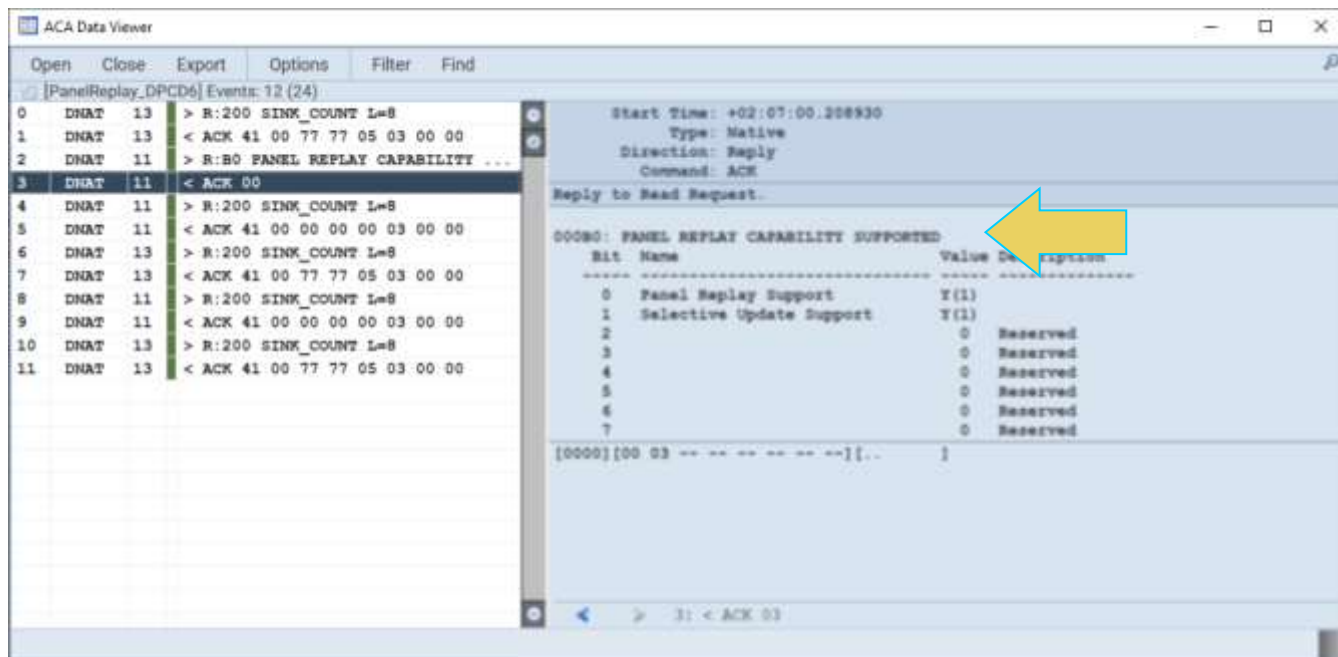


### 10.5 Viewing Panel Replay Auxiliary transactions

ACA decoding has been implemented for all Panel Replay DPCD registers. When a source DUT makes a connection to the M42d, you can monitor the Aux Channel to verify that the source reads the Panel Replay DPCD registers as shown below.

**Note:** For procedures for using the M42d’s ACA utility, including running an analysis and finding/filtering for specific events, see **Chapter 7 Auxiliary Channel Analyzer**.

The following example shows an Aux Channel Analysis in which the source DUT confirms that Panel Replay capability is supported by the M42d’s emulated Rx.

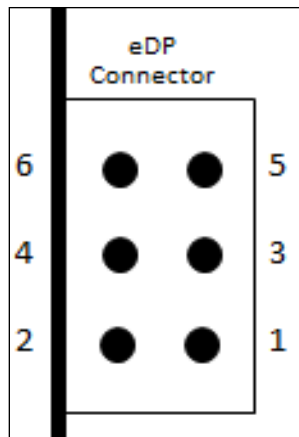


## 11 eDP

The M42d 80G Video Analyzer/Generator supports several eDP features such as fast link training, alternate scrambler seed, Advanced Link Power Management (ALPM) and backlight control through control pins. A pin header is available to provide access to the backlight Tx control test feature. The M42d offers the hardware necessary to support a variety of optional eDP features.

**Note:** The eDP features are optional and require purchase of a license to activate.

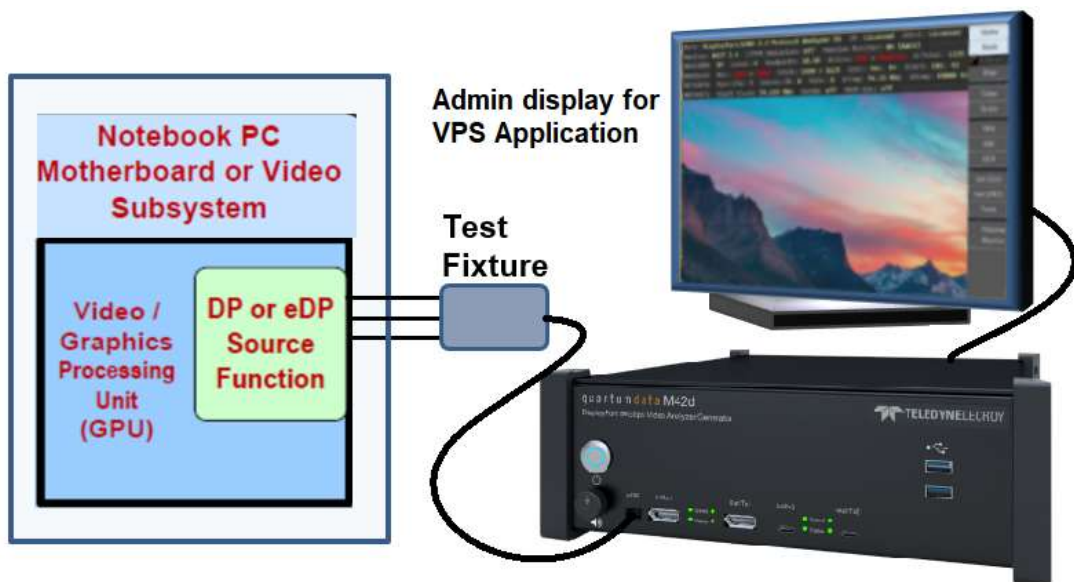
### eDP Pin Configurations



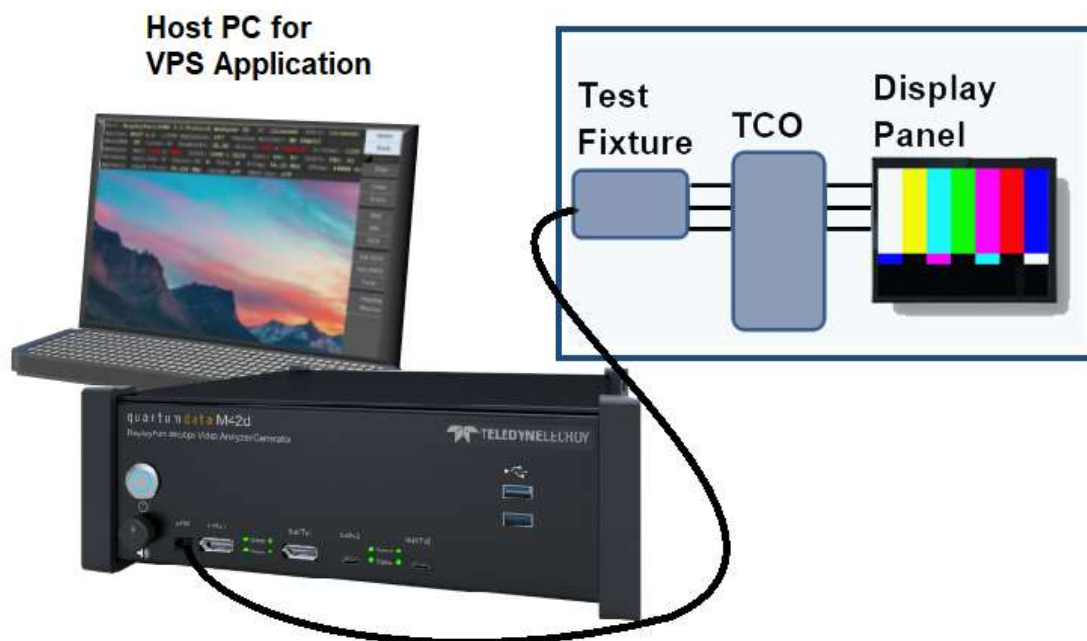
1. BL\_Enable (Possible Future Rx input)
2. BL\_Enable (Tx Output)
3. BL\_PWM\_DIM (Possible Future RX input)
4. BL\_PWM\_DIM (TX Output)
5. Ground
6. Ground

### 11.1 eDP Testing Connections

This section provides procedures on how to connect your eDP TCON panel or graphics source system to the M42d DisplayPort Video Analyzer/Generator. You will use the Standard DisplayPort connectors for testing eDP (not the USB-C connectors). You will need an eDP to DP adapter cable and or an adapter board to make these connections.



#### eDP Source Test Connections



#### eDP Sink Test Connections

## 11.2 Fast Link Training

This section provides procedures on eDP fast link training. Once the fast link training has been achieved the Source or Sink test features supported by the M42d 80G Video Analyzer/Generator can be used.

### Fast Link Training – Source Tests

The eDP fast link training feature to test source DUTs is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

### Fast Link Training – Sink Tests

Use the following procedure to test eDP fast link training on an eDP sink device.

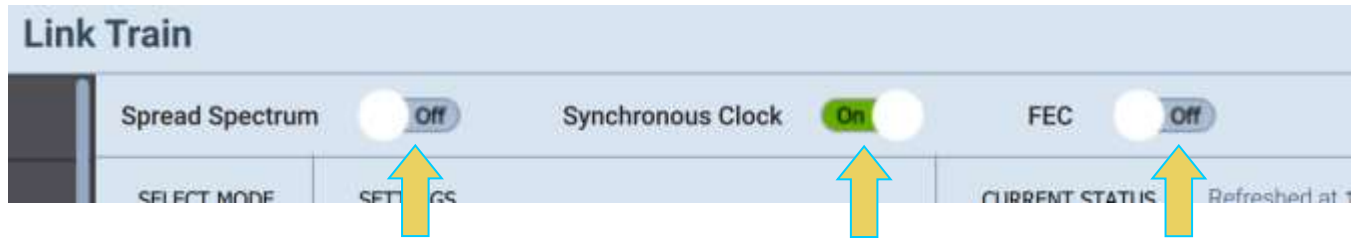
1. Access the Fast Link Training controls from the **Link Train** tool within the **Signal Generator**.

The screenshot displays the Link Train interface. At the top, there are three toggle switches: Spread Spectrum (Off), Synchronous Clock (On), and FEC (Off). Below these are three tabs: SELECT MODE, SETTINGS, and CURRENT STATUS. The SELECT MODE tab is active, showing three options: Adaptive, Non Adaptive, and Fast Training. A yellow arrow points to the 'Fast Training' option. The SETTINGS tab is also visible, showing various parameters: TRAIN AT LANE COUNT (1, 2, 4), TRAIN AT LINK RATE (Gbps) (1.62, 2.70, 5.40, 8.10), eDP (2.16, 2.43, 3.24, 4.32), VOLTAGE SWING LEVEL (0, 1, 2, 3), and PRE-EMPHASIS LEVEL. A blue 'FAST TRAIN' button is located at the bottom of the settings panel. The CURRENT STATUS tab shows a refresh time of 16:43:26 and a table of lane training results.

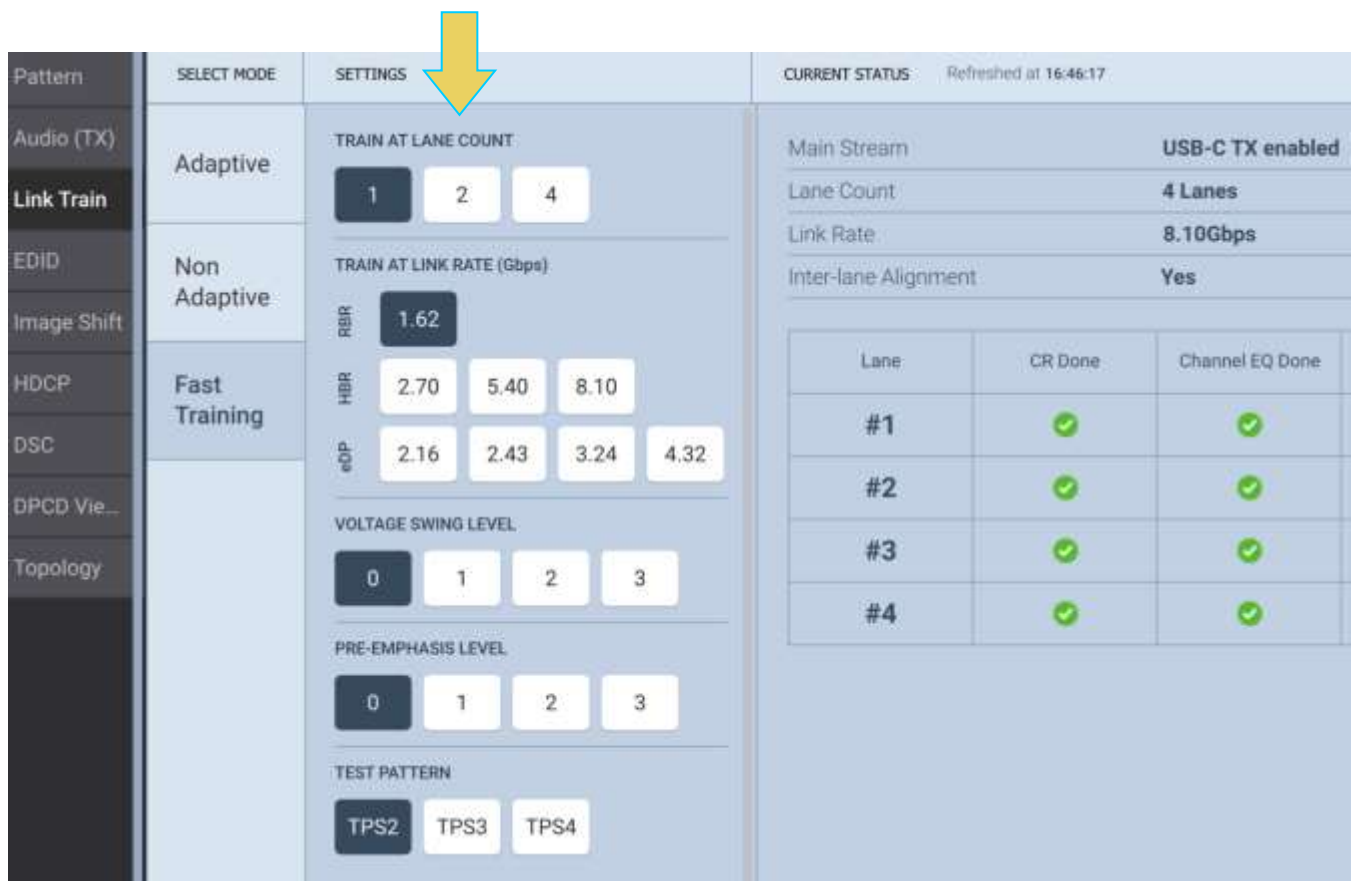
Main Stream	USB-C TX enabled		
Lane-Count	4 Lanes		
Link Rate	8.10Gbps		
Inter-lane Alignment	Yes		
Lane	CR Done	Channel EQ Done	Symbol Lock
#1	✓	✓	✓
#2	✓	✓	✓
#3	✓	✓	✓
#4	✓	✓	✓

The Link Train window shows the **Current Status** in the top panel, and the control options within the bottom panel.

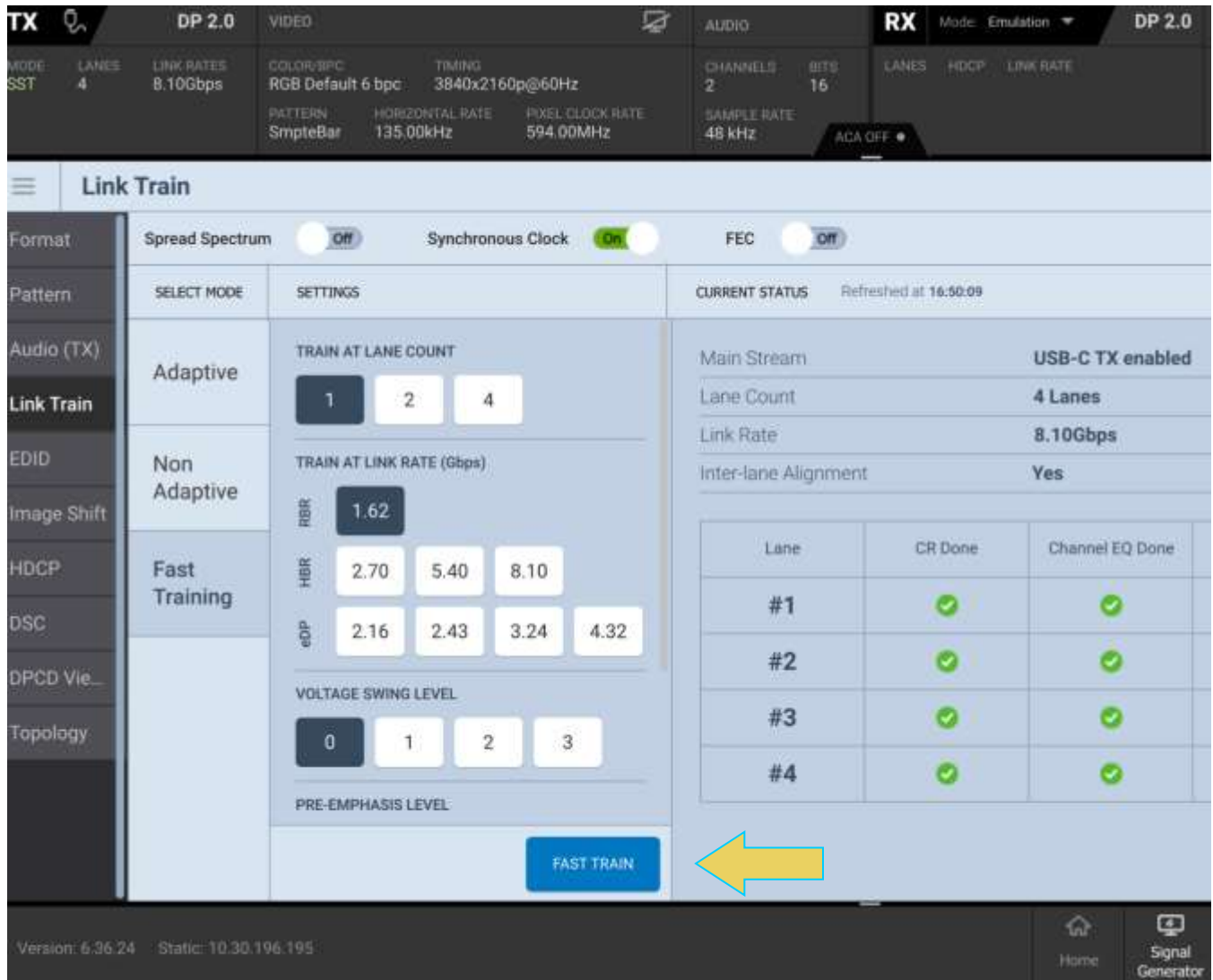
- Toggle on or off **Spread Spectrum**, **Synchronous Clock**, and **FEC** (Forward Error Correction) at the top of the window according to your test requirements, as demonstrated below



- Select the Lane Count, Link Rate, Voltage Swing, Pre-Emphasis and the Test Pattern in accordance with your eDP test requirements. See below.



4. Click on the Fast Train button to initiate the link training, as shown below.





### Monitoring the Fast Link Training Transactions on the Aux Channel

Refer to the ACA section **Monitoring the DisplayPort auxiliary channels with the ACA utilities** for procedures in monitoring the eDP fast link training and ALPM Aux Channel transactions associated with the eDP negotiations. A sample screen shot is shown below.

The screenshot displays the ACA Data Viewer interface. The left pane shows a list of transactions with columns for ID, Type, Length, and Content. Row 62 is selected. The right pane shows details for the selected transaction, including start time, type, direction, and command. Below this, a table lists bit fields for EDP\_GENERAL\_CAPABILITY\_1.

Bit	Name	Value	Description
0	TOON_BACKLIGHT_ADJUST	Y(1)	
1	BACKLIGHT_PIN_ENABLE	Y(1)	
2	BACKLIGHT_AUX_ENABLE	Y(1)	
3	PANEL_SELF_TEST_PIN_ENABLE	N(0)	
4	PANEL_SELF_TEST_AUX_ENABLE	N(0)	
5	FRC_ENABLE	N(0)	
6	COLOR_ENGINE_CAPABLE	N(0)	
7	RET_POWER_CAPABLE	Y(1)	

## 11.3 Advanced Link Power Management (ALPM)

This section provides procedures on testing eDP ALPM on eDP source and sink devices.

### ALPM – Source Tests

The **ALPM** utility to test source DUTs is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

### ALPM – Sink Tests

The **ALPM** utility to test sink DUTs is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

## Monitoring the ALPM Transactions on the Aux Channel

Refer to the ACA section **Monitoring the DisplayPort auxiliary channels with the ACA utilities** for procedures in monitoring the eDP ALPM Aux Channel transactions associated with the eDP negotiations. A sample screen shot is shown below.

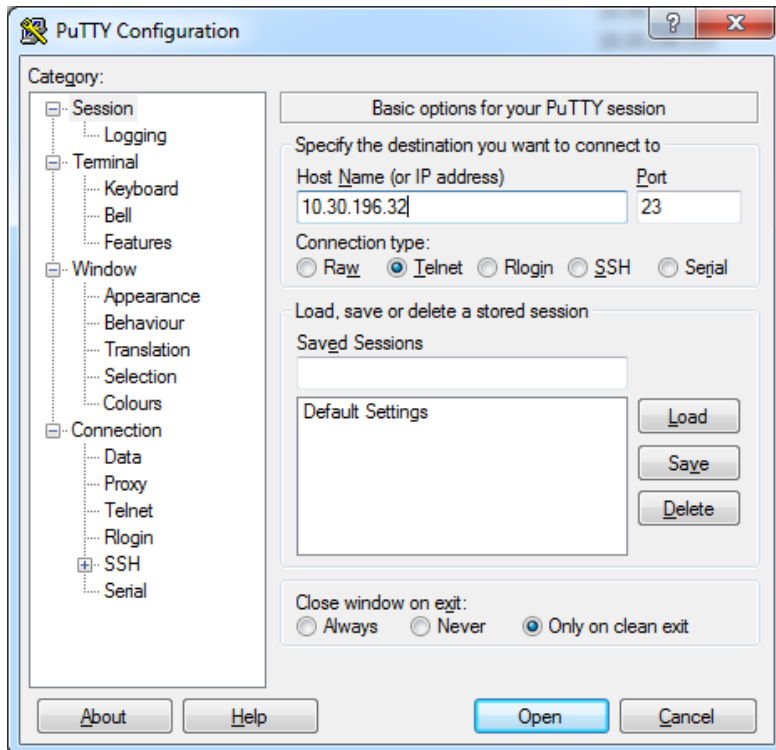
The screenshot displays the ACA Data Viewer interface. The main table shows a list of events with columns for event number, type, status, and data. Event 74 is selected, and its details are shown in the right pane. The details include the start time, type, direction, and command. Below the details, a table shows the bit fields for the RX\_ALPM\_CAPABILITIES command.

Bit	Name	Value	Description
0	ALPM_CAP	Y(1)	
1	PR_State 2a Support	Y(1)	
2		0	Reserved
3		0	Reserved
4		0	Reserved
5		0	Reserved
6		0	Reserved
7		0	Reserved

## 11.4 Alternate Scrambler Seed

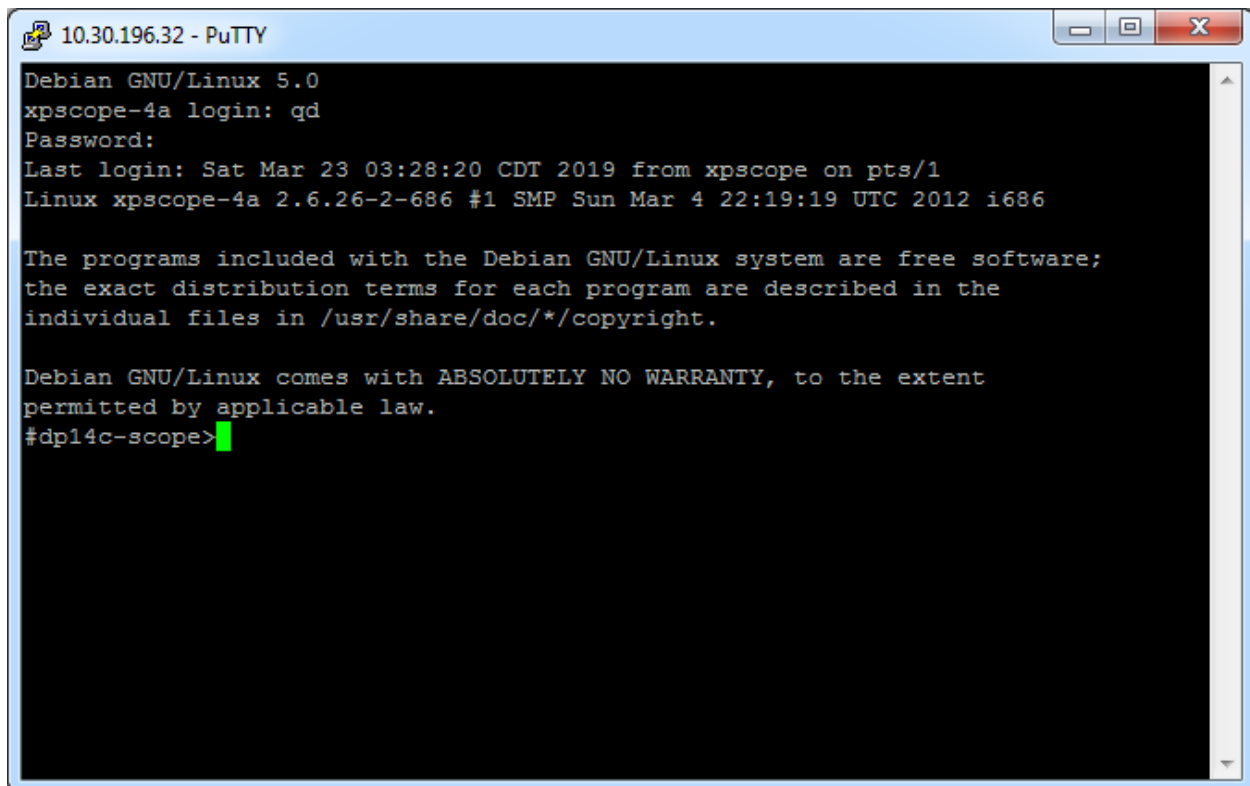
The DP 2.0 eDP-capable module supports the alternate scrambler seed. Currently the feature is supported only through the command line. Use the following procedures to activate the alternate scrambler seed for an eDP source.

1. Access the command line interface through the M42d's embedded console or a terminal program such as PuTTY as shown below.



2. Enter qd for the login.
3. Enter qd for the password.

The following screen appears.

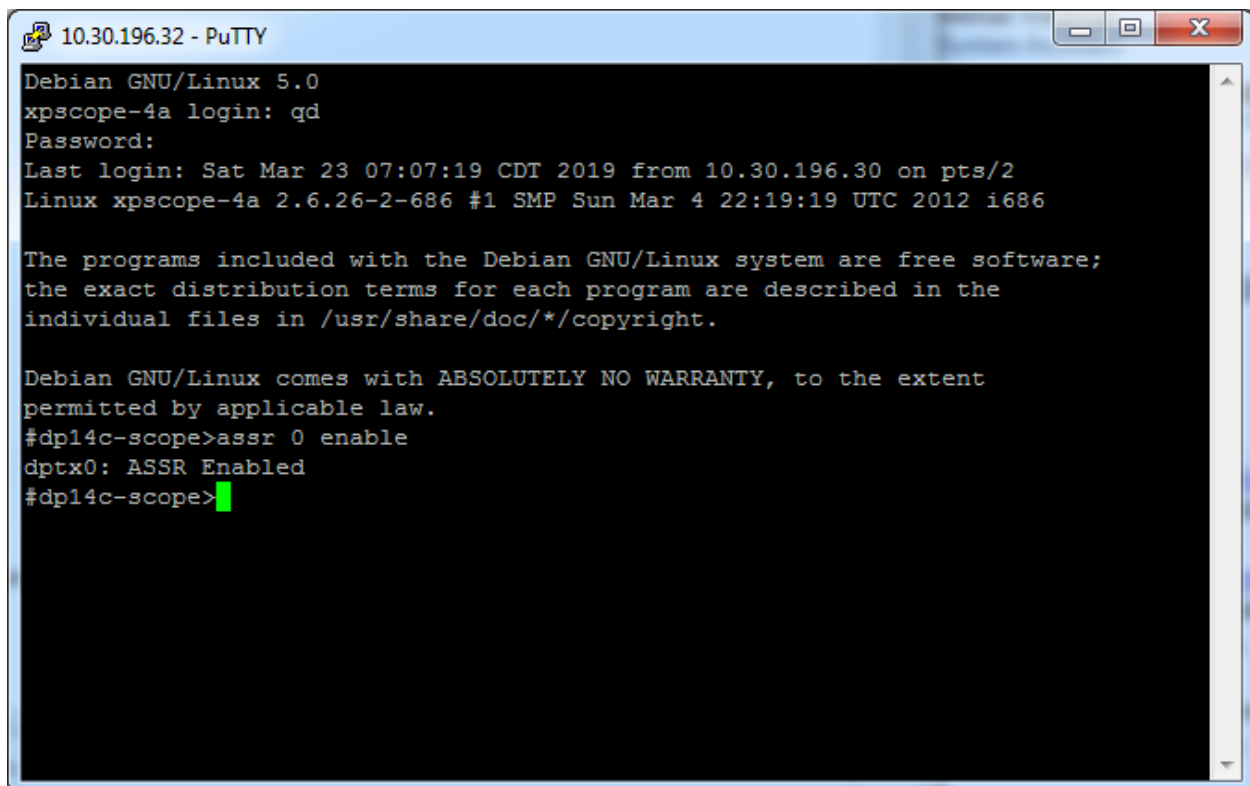


```
10.30.196.32 - PuTTY
Debian GNU/Linux 5.0
xpscope-4a login: qd
Password:
Last login: Sat Mar 23 03:28:20 CDT 2019 from xpscope on pts/1
Linux xpscope-4a 2.6.26-2-686 #1 SMP Sun Mar 4 22:19:19 UTC 2012 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
#dp14c-scope>
```

4. To enable alternate scrambler, type the following command:

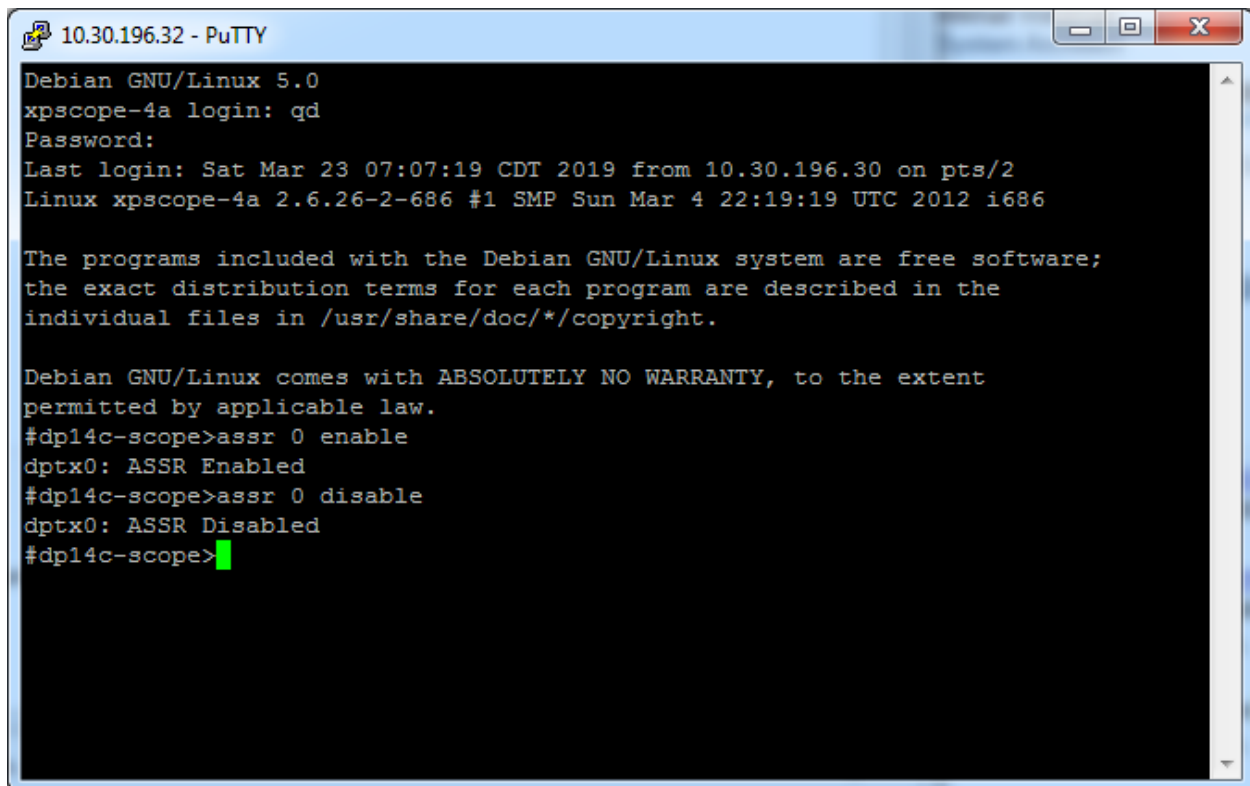


```
10.30.196.32 - PuTTY
Debian GNU/Linux 5.0
xpscope-4a login: qd
Password:
Last login: Sat Mar 23 07:07:19 CDT 2019 from 10.30.196.30 on pts/2
Linux xpscope-4a 2.6.26-2-686 #1 SMP Sun Mar 4 22:19:19 UTC 2012 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
#dp14c-scope>assr 0 enable
dptx0: ASSR Enabled
#dp14c-scope>
```

5. To disable alternate scrambler, type the following command:



```
10.30.196.32 - PuTTY
Debian GNU/Linux 5.0
xpscope-4a login: qd
Password:
Last login: Sat Mar 23 07:07:19 CDT 2019 from 10.30.196.30 on pts/2
Linux xpscope-4a 2.6.26-2-686 #1 SMP Sun Mar 4 22:19:19 UTC 2012 i686

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
#dp14c-scope>assr 0 enable
dptx0: ASSR Enabled
#dp14c-scope>assr 0 disable
dptx0: ASSR Disabled
#dp14c-scope>
```

## 11.5 Backlight Control

This section describes backlight control and provides procedures for using the M42d HBR3 Video Analyzer/Generator to control the backlight of an eDP TCON panel subsystem.

There are two methods of controlling the backlight: 1) Aux control messages, 2) control backlight through direct connection leads.

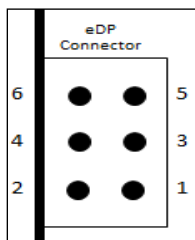
### Backlight Control Test Connections

This subsection provides procedures on how to connect the M42d 80G Video Analyzer/Generator to your eDP display panel for backlight control. You will use the Standard DisplayPort connector and the eDP header pin block and a special Teledyne LeCroy provided cable assembly.

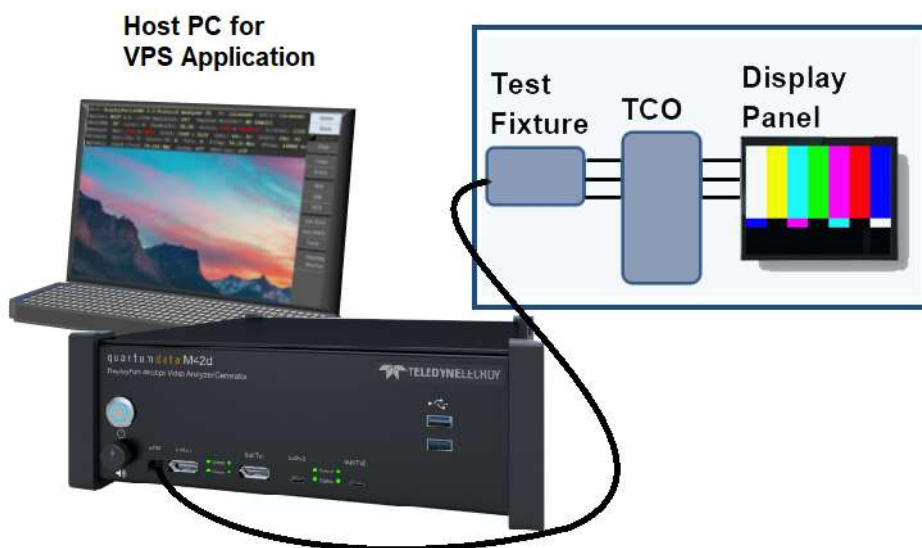
1. Connect the provided cable from the eDP System Panel using the eDP connector.
2. Connect the other end with the standard DP connector and the eDP header block the provided cable to the M42d. Refer to the diagrams below.

**Note:** The eDP header block is used for controlling the backlight of an eDP display. The pinout and functions are shown below.

#### eDP Pin Configurations:



1. BL\_Enable (Possible Future Rx input)
2. BL\_Enable (Tx Output)
3. BL\_PWM\_DIM (Possible Future RX input)
4. BL\_PWM\_DIM (TX Output)
5. Ground
6. Ground



#### eDP Sink Test Connections

## **Backlight Control – Sink Tests**

The **ALPM** utility to test sink DUTs is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

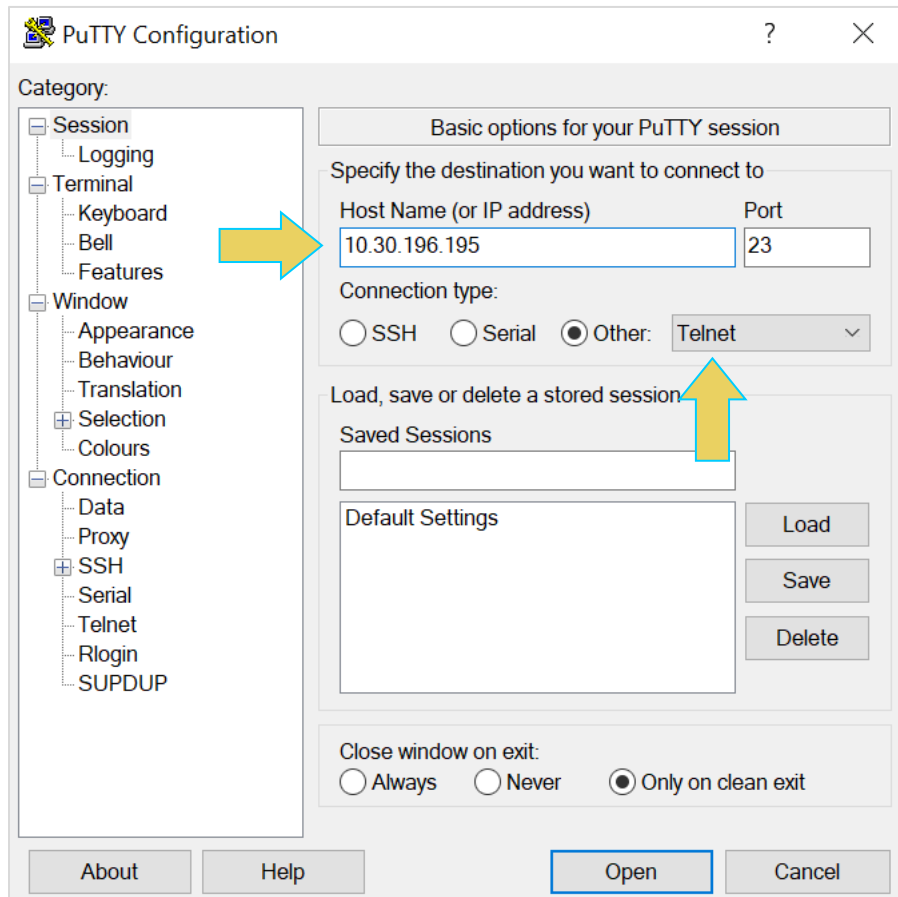
## 12 Command Reference

### 12.1 Accessing the Command Line

This section provides a list of commands available for use with the M42d. You can control the M42d through the command line via a telnet session or from the M42d's Console panel. Typically users will utilize a terminal program such as PuTTY.

#### To establish a command line session through a telnet session:

1. Launch the Command Prompt utility from the Windows Accessories such as PuTTY.

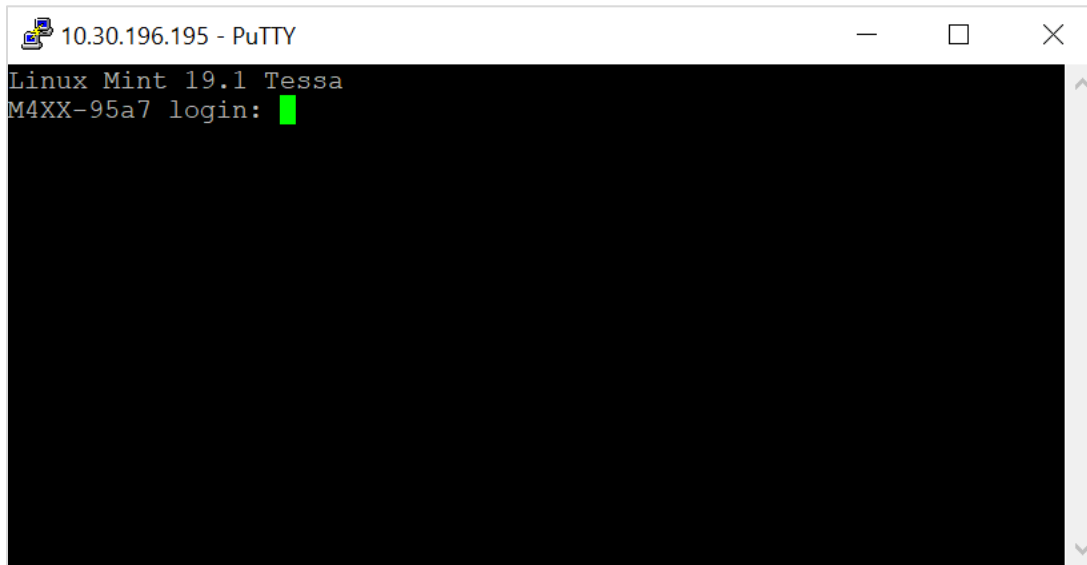


2. Establish a telnet session with the M42d, as shown above. Note you will enter in the IP address of the M42d (10.30.196.195 in example)

Instructions for obtaining or changing the instrument's IP address are found in [Chapter 2](#).



The M42d login prompt will then appear as shown below.

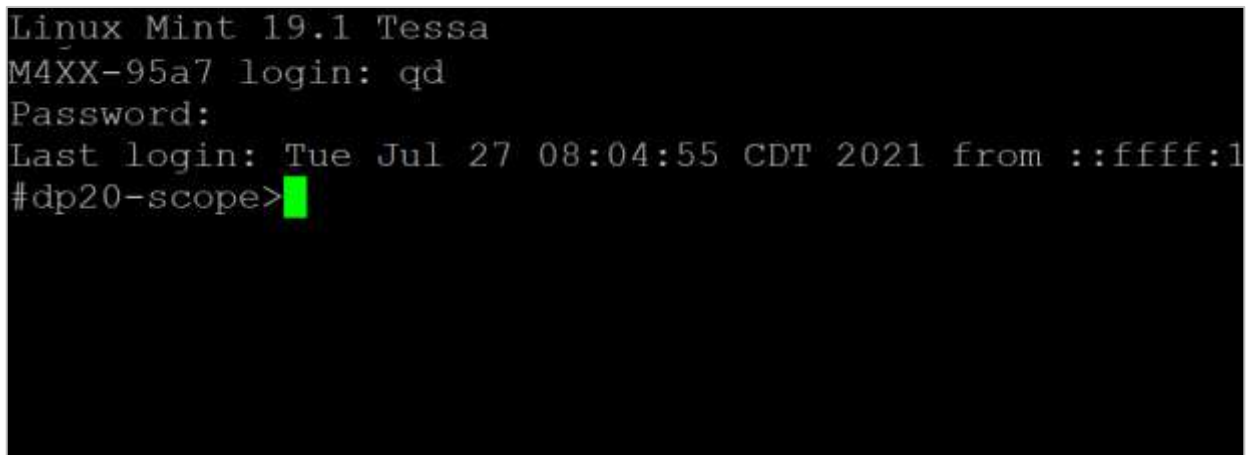
A screenshot of a PuTTY terminal window titled "10.30.196.195 - PuTTY". The terminal output shows "Linux Mint 19.1 Tessa" followed by "M4XX-95a7 login:" and a green cursor. The rest of the terminal area is black.

3. Login at the prompt.

**login:** qd

**Password:** qd // you will not be able to see the entry.

4. The **#dp20-scope>** prompt will appear allowing you to enter commands. Refer to the screen example below.

A screenshot of a PuTTY terminal window showing the login process. The output is: "Linux Mint 19.1 Tessa", "M4XX-95a7 login: qd", "Password:", "Last login: Tue Jul 27 08:04:55 CDT 2021 from ::ffff:1", and "#dp20-scope>" with a green cursor.

- Determine port numbers of the instrument using the `discover` command, seen below.

```
M4XX-95a7 login: qd
Password:
Last login: Tue Jul 27 08:04:55 CDT 2021 from ::ffff:10.30.198.
#dp20-scope>discover
slot:          1
rev:           1
class:         Quantum Data, Inc. DP2.0 protocol analyzer
device:        e015
pci:           00:01:00 speed=7.5GT/s width=x8
qdbus:         SLAVE
port:          0:1:2400: DP TX
port:          1:1:2400: Usb-c TX
port:          2:0:2400: DP RX PA
port:          3:0:2400: Usb-c RX PA

#dp20-scope>
```

## 12.2 Command Line Conventions

Since the M42d can be equipped with multiple modules, there is a convention for addressing commands to specific modules.

The addressing convention is as follows:

```
<IN/OUT><Slot><Port>: command_string
```

**Note:** The slot number for use on the M42d will always be 1.

Example: Load a test pattern for the transmitter port (DP TX port 0) on the M42d 80G Video Analyzer/Generator:

```
OUT10:IMGL SMPTEBar
```

If you are using the second Tx port (USB-C TX):

```
OUT11:IMGL SMPTEBar
```

**Note:** Loading a test pattern into the port will not apply it. Use command `OUT10:IMGU` to use the loaded pattern.

If the Rx port is active the Tx1 port will not be available and you will receive an error (below). In this case you will have to use Tx2.

```
#dp20-scope>out10:fmtu?  
ERROR: Invalid Command: \out10:fmtu?  
rxhprime: DP HDCP2 set hprime in rxstatus  
rxlnkfail: DP HDCP2 set link integrity failure in rxstatus  
rxpair: DP HDCP2 set pair in rxstatus
```

**Note:** Commands are not case sensitive.

## Discovering Commands

You can also use the Command Line to determine commands associated with various actions done in the VPS GUI Application. This may be helpful for users that are more comfortable with operating the instrument via the command line or that need to operate the instrument remotely without the GUI.

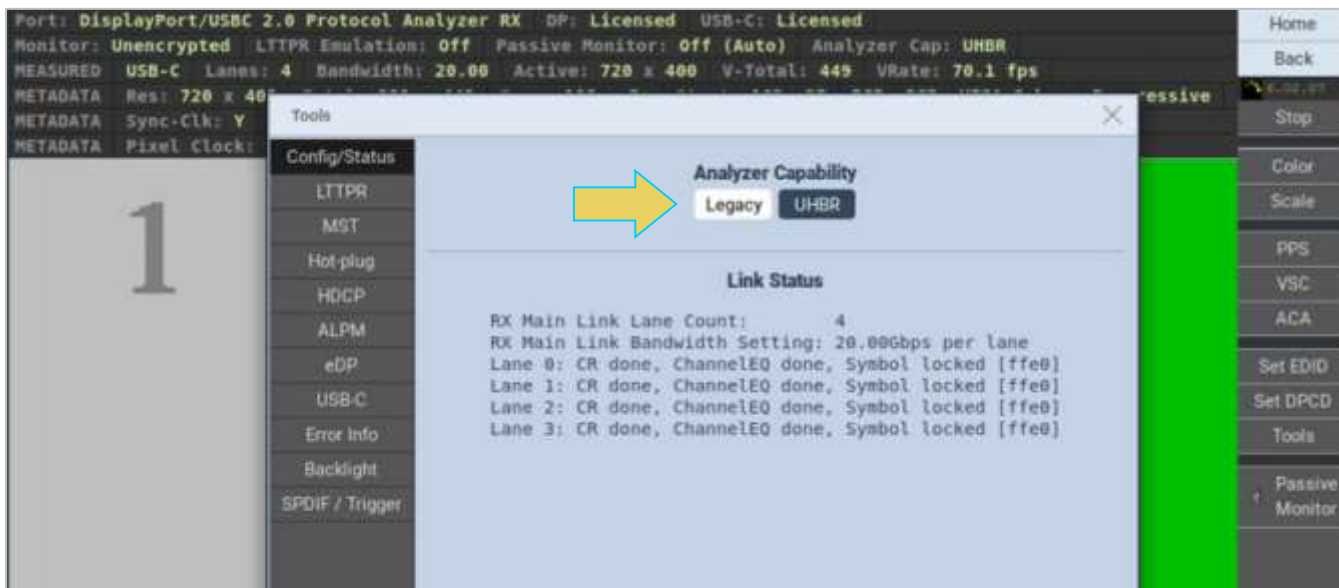
Use the following procedure to determine commands associated with GUI events:

1. Log in to the device using the steps in the previous section
2. Quit the current process with the `q` command
3. Change directory to the `/qd` folder: `cd /qd`
4. Enter the following command to begin monitoring the commands that are currently being executed by the instrument:  

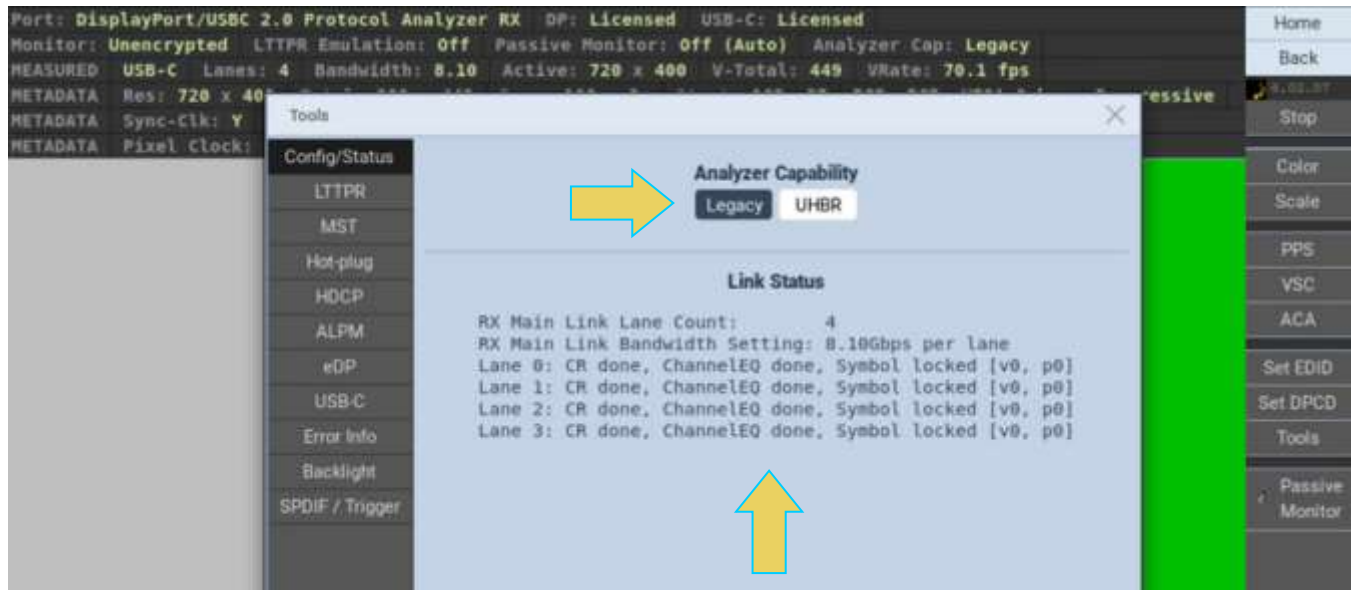
```
tail -f /qd/ptalk.log
```
5. Complete the desired action within the GUI of the M42d.
6. `Ctrl + C` to terminate the process

The following example demonstrates switching the Rx Analyzer Capability from UHBR to Legacy mode and determining its associated command:

Within the Tools dialog box of the Basic Analyzer, select Legacy in the **Analyzer Capability** section.



The analyzer's capabilities will be adjusted, and the **Link Status** section will update accordingly, as shown below.



You can then see what the respective command was for the action executed on the interface. As seen below, the command for switching the Analyzer Capability from UHBR to Legacy is:

```
IN12:uhbr_cap disable
```

```

M4XX-95a7 login: qd
Password:
Last login: Tue Jul 27 09:46:07 CDT 2021 from 10.30.198.9 on pts/4
#dp20-scope>q
qd@M4XX-95a7:~$ cd /qd
qd@M4XX-95a7:/qd$ tail -f /qd/ptalk.log
07/27 09:48:29 pid=2364: > [IN12:dprx msa|]
07/27 09:48:29 pid=2364: < { Clocks, H Total : 0x00000384| Hsync Polarity : 0x
000000| Clocks, V Total : 0x000001c1| Vsync Polarity : 0x00000001| HSync Width
0x0000006c| VSync Width : 0x00000002| Horz Resolution : 0x000002d0| Vert Reso
tion : 0x00000190| Horz Start : 0x000000a2| Vert Start : 0x00000025| Misc0 : 0
0000021| Misc1 : 0x00000040| Vfreq : 28321678| Strm_Clk : 28,322| VB-ID : 0x00
0001| Afreq : 48000|}$#done)
07/27 09:48:29 pid=2364: > [IN12:lttpr|]
07/27 09:48:29 pid=2364: < {0|}$#done)
07/27 09:48:29 pid=2364: > [IN12:passive|]
07/27 09:48:29 pid=2364: < {PASSIVE: disabled|}$#done)
07/27 09:48:29 pid=2364: > [IN12:passive mode|]
07/27 09:48:29 pid=2364: < {PASSIVE MODE: AUTO|}$#done)
07/27 09:48:29 pid=2364: > [IN12:uhbr_cap|]
07/27 09:48:29 pid=2364: < {enable|}$#done)
07/27 09:48:30 pid=2364: > [IN12:uhbr_cap disable|]
07/27 09:48:31 pid=2364: < {Setting UHBR capability: disable|}$#done)
07/27 09:48:31 pid=2364: > [IN12:dprx stat|]
07/27 09:48:31 pid=2364: < {RX Main Link Lane Count: 4|RX Main Link Bandwidth

```

## 12.3 List of Commands

Refer to the following tables for a listing of oft-used commands.

### Video-Related commands

<b>ALLU</b>	
Command supported?: Y	Query supported?: N
Same as the FMTU command. Example: FMTL 720p60 ALLU	
<b>DVQM</b>	
Command supported?: Y	Query supported?: Y
Sets the quantization mode (color range) for the video. Valid values are: 0 = 0-255; 2 = 16-235. Requires FMTU or ALLU to activate. Query returns the current setting of the digital quantization mode. Examples: DVQM 2 // sets the mode or range to 16-235). or DVQM 0 // sets the mode or range to 0-255). DVQM? // returns the current value.	
<b>DVSM</b>	
Command supported?: Y	Query supported?: Y
Sets the sampling mode between 4:4:4 and 4:2:2 in YCbCr mode. Valid values are: 2 = 4:2:2; 4 = 4:4:4. Requires FMTU or ALLU to activate. Query returns the current setting of the digital sampling mode. Examples: DVSM 2 // sets the sampling to 4:2:2. or DVSM 4 // sets the sampling to 4:4:4. DVSM? // returns the current value.	
<b>DVST</b>	
Command supported?: Y	Query supported?: Y
Sets the digital video signal type. Valid values are: RGB = 10; YCbCr = 14. Requires FMTU or ALLU to activate. Query returns the current setting of the digital video signal type. Example: DVST 10 // activates the HDMI/DVI output for RGB video). DVST? // returns the current value.	
<b>FMTL</b>	
Command supported?: Y	Query supported?: Y
Loads a format. Takes a format name as a parameter. Requires FMTU or ALLU to activate. Requires FMTU or ALLU to activate. Query returns the currently loaded format. Examples: FMTL 720p60 // loads the 720p60 format.	

FMTL? // returns the current value.	
<b>FMTU</b>	
Command supported?: Y	Query supported?: Y
<p>Uses the currently loaded format. Takes no parameters.  Query returns the currently used format.  Example:  FMTL 720p60  FMTU</p>	
<b>IMGL</b>	
Command supported?: Y	Query supported?: Y
<p>Loads an image. Takes an image name as a parameter.  Requires IMGU, FMTU or ALLU to activate.  Query returns the currently loaded image.  Example:  IMGL SMPTEBar // loads smptebar image</p>	
<b>IMGU</b>	
Command supported?: Y	Query supported?: Y
<p>Uses (activates) the currently loaded image. Takes no parameters.  Query returns the currently used image.  IMGL SMPTEBar  IMGU</p>	
<b>ISUB</b>	
Command supported?: Y	Query supported?: Y
<p>Enables or disables activation of alternate versions of test images if they have alternate versions. Takes no parameters.  Query returns the current setting.  IMGL graysall // loads the SlideBox image  ISUB 1 // enables alternate versions of the image  IVER 1 // activates the first version of an image  IMGU // invokes the image and image version.  ISUB 0 // disables alternate versions of the image</p>	
<b>IVER</b>	
Command supported?: Y	Query supported?: Y
<p>Enables or disables activation of alternate versions of test images if they have alternate versions. Takes no parameters.  Query returns the current setting.  IMGL graysall // loads the SlideBox image  ISUB 1 // enables alternate versions of the image  IVER 100 // activates the 100th version of the image  IMGU // invokes the image and image version.</p>	
<b>NBPC</b>	
Command supported?: Y	Query supported?: Y
<p>Sets the number of bits per component on HDMI. Valid values are: 8 = 8 bits per component; 10 = 10 bits per component; 12 = 12 bits per component. Only affects output when color space is RGB or YCbCr 4:4:4.  Requires FMTU or ALLU to activate.  Query returns the current setting of the number of bits per component.  Example:  NBPC 12 // sets the component bit depth to 12 bits</p>	

NBPC? // returns the current value.	
<b>OUTG</b>	
Command supported?: Y	Query supported?: Y
Sets the enable gate of video output. (This is defaulted to 1 – only set to 0 to disable video when absolutely necessary.) Requires FMTU or ALLU to activate. Query returns the current setting for the enable gate for the video. Example: OUTG 1 // enables the outputs. OUTG? // returns the current setting.	
<b>REDG/GRNG/BLUG</b>	
Command supported?: Y	Query supported?: Y
Enables red/green/blue, respectively. (Also see XVSG.) Requires FMTU or ALLU to activate. Query returns the current setting for enabling red, green, blue video. Examples: REDG 1 // enables the red output channel. GRNG 0 // disables the green output channel. BLUG 1 // enables the blue output channel. BLUG? // returns the current setting.	
<b>SCAN</b>	
Command supported?: Y	Query supported?: Y
Sets the current format to either progressive (SCAN 1) or interlaced (SCAN 2). Requires FMTU or ALLU to activate. Query returns the current setting for the scan type. Example: SCAN 1 // sets the output to progressive. SCAN? // returns the current setting.	
<b>XVSI</b>	
Command supported?: Y	Query supported?: Y
Sets the video interface of the unit. Requires FMTU or ALLU to activate. Query returns the current interface activation setting. Examples: XVSI 2 // Sets DVI Computer formats XVSI 3 // Sets DVI TV formats XVSI 4 // Sets active interface to HDMI	



## Audio Generation-Related commands

Refer to the following table lists the audio related commands for generation.

<b>DASI</b>	
Command supported?: Y	Query supported?: Y
Sets the digital audio signal interface. Requires FMTU or ALLU to activate. Valid values are: 0 – off (if previously selected audio is not analog) 1 – DP 6 - HDMI Examples: DASI 6 // sets the digital audio signal to DisplayPort. DASI? // returns the current setting.	
<b>ARAT</b>	
Command supported?: Y	Query supported?: Y
Sets the audio sampling rate on HDMI LPCM audio. Requires FMTU or ALLU to activate. Parameter values: - <i>rate</i> = sampling rate; 32000, 44100, 48000, 88200, 96000, 176400, 192000 Examples: ARAT 48000 // sets the sampling rate to 48kHz. ARAT? // returns the current setting of the sampling rate.	
<b>NBPA</b>	
Command supported?: Y	Query supported?: Y
Sets the number of bits per sample in analog and HDMI PCM audio. Requires FMTU or ALLU to activate. Parameter values: - <i>bits</i> = number of bits per sample; 16, 20 or 24 Examples: NBPA 24 // sets the value of audio depth. NBPA? // returns the current setting.	
<b>NDAC</b>	
Command supported?: Y	Query supported?: Y
Sets the number of digital audio channels for an LPCM audio signal. Requires FMTU or ALLU to activate. Parameter values: - <i>ch</i> = channels; 2 - 8 Examples: NDAC 8 // sets the number of channels to 8. NDAC? // returns the current setting.	
<b>SAMP</b>	
Command supported?: Y	Query supported?: Y
Sets the amplitude on either a specific channel or all channels. Requires FMTU or ALLU to activate.	

Syntax: SAMP <amp> <ch>

Possible parameter values:

- *amp* amplitude; min = -99dB, max = 0dB

- *ch* = channel; 0 - 7

Examples:

```
SAMP -12 // sets all channels to -12dB.
```

Or

```
SAMP -3 1 // sets channel #1 to -3dB - valid channels are 0-7.
```

```
SAMP? // returns the current setting.
```

### SRAT

Command supported?: Y

Query supported?: Y

Sets the sine wave frequency on either a specific channel or all channels.

Requires FMTU or ALLU to activate.

Examples:

```
SRAT 1000 // Sets all channels to 1KHz.
```

Or

```
SRAT 440 1 // Sets channel #1 to 440Hz - valid channels are 0-7.
```

```
SRAT? // returns the current value.
```

## Analyzer-Related commands

Refer to the following tables for the supported commands related to the analyzer function for testing DP source devices.

### LINK VSTAT

Command supported?: Y

Queries for the incoming DisplayPort stream attributes.

Example:

```
LINK VSTAT
```

Sample response:

```
Lane count: 4 // lanes used
```

```
Bandwidth: 8.1 // link rate
```

```
Hactive: 1920 // horizontal active video (pixels)
```

```
Htotal: 2200 // horizontal total video including "blanking" (pixels)
```

```
Vactive: 1079 // vertical active video (lines)
```

```
Vtotal: 1125 // vertical total video including "blanking" (lines)
```

```
Scan: Progressive
```

```
BPC: 8 // bits per component
```

```
YCC Color: N/A
```

```
Components: Adobe RGB
```

```
HDCP encryption: off // status of HDCP encryption
```

### DPRX MSA

Command supported?: Y

Queries for the incoming DisplayPort main stream attributes and presents the results in hex format. The main stream attributes are Attributes describing the main video stream format in terms of geometry and color format. They are inserted once per video frame during the video blanking period.

Example:

```
DPRX MSA
```

Sample response:

```
Clocks, H Total: 0x00000898 // horizontal total clock cycles
Hsync Polarity: 0x00000001 // horizontal sync pulse polarity 0 = active high pulse
                          or 1 = active low pulse
Clocks, V Total: 0x00000465 // vertical total clock cycles
Vsync Polarity: 0x00000001 // vertical sync pulse polarity 0 = active high pulse
                          or 1 = active low pulse
HSync Width: 0x0000002c // horizontal sync pulse width
VSync Width: 0x00000005 // vertical sync pulse width
Horz Resolution: 0x00000780 // horizontal active resolution clock cycles
Vert Resolution: 0x00000438 // vertical active resolution clock cycles
Horz Start: 0x000000c0 // starting pixel for active resolution
Vert Start: 0x00000029 // starting line for active resolution
Misc0: 0x00000038
Misc1: 0x00000000
M Vid: 0x00002333 // M value for video
N Vid: 0x00008000 // N value for video
VB-ID: 0x00000010
```

## 13 Editors

---

The M42d offers a number of editors for certain features of the M42d. Currently, the only functional editor in the VPS GUI Application is the DPCD Editor, described in the next section of this chapter.

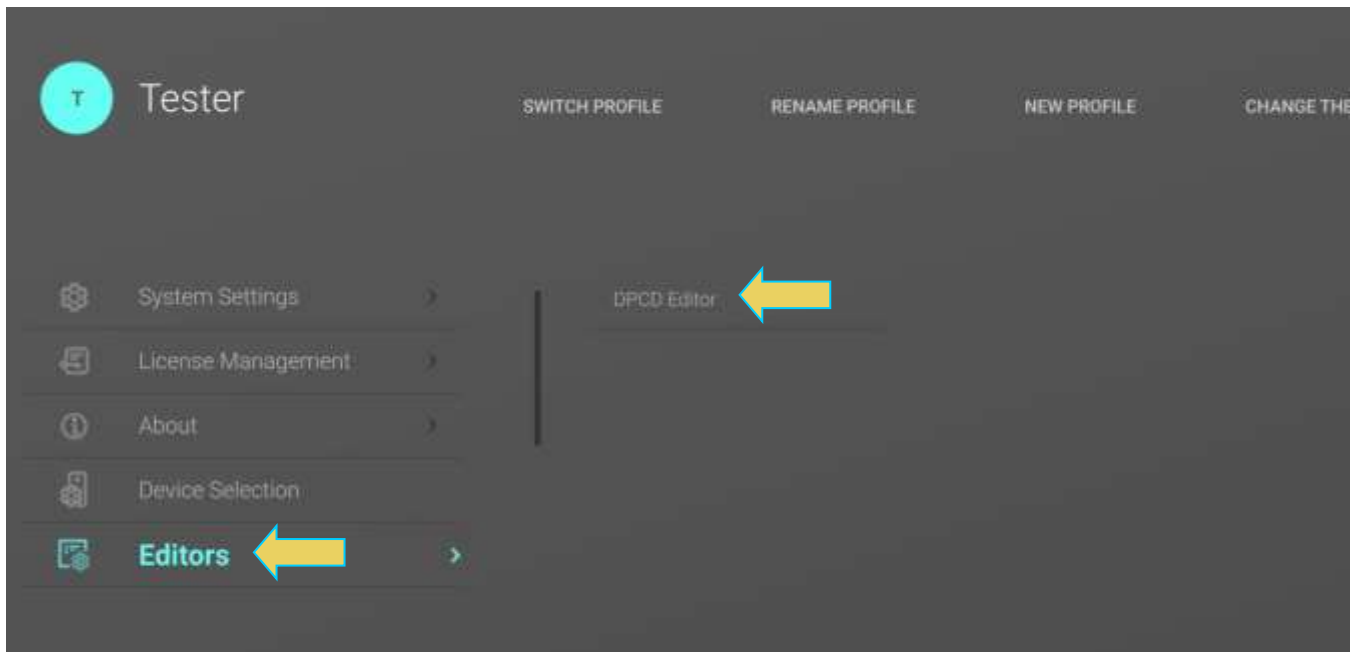
For all other editors, please see the ATP Version of the M42d User Guide.

## 13.1 DPCD Editor

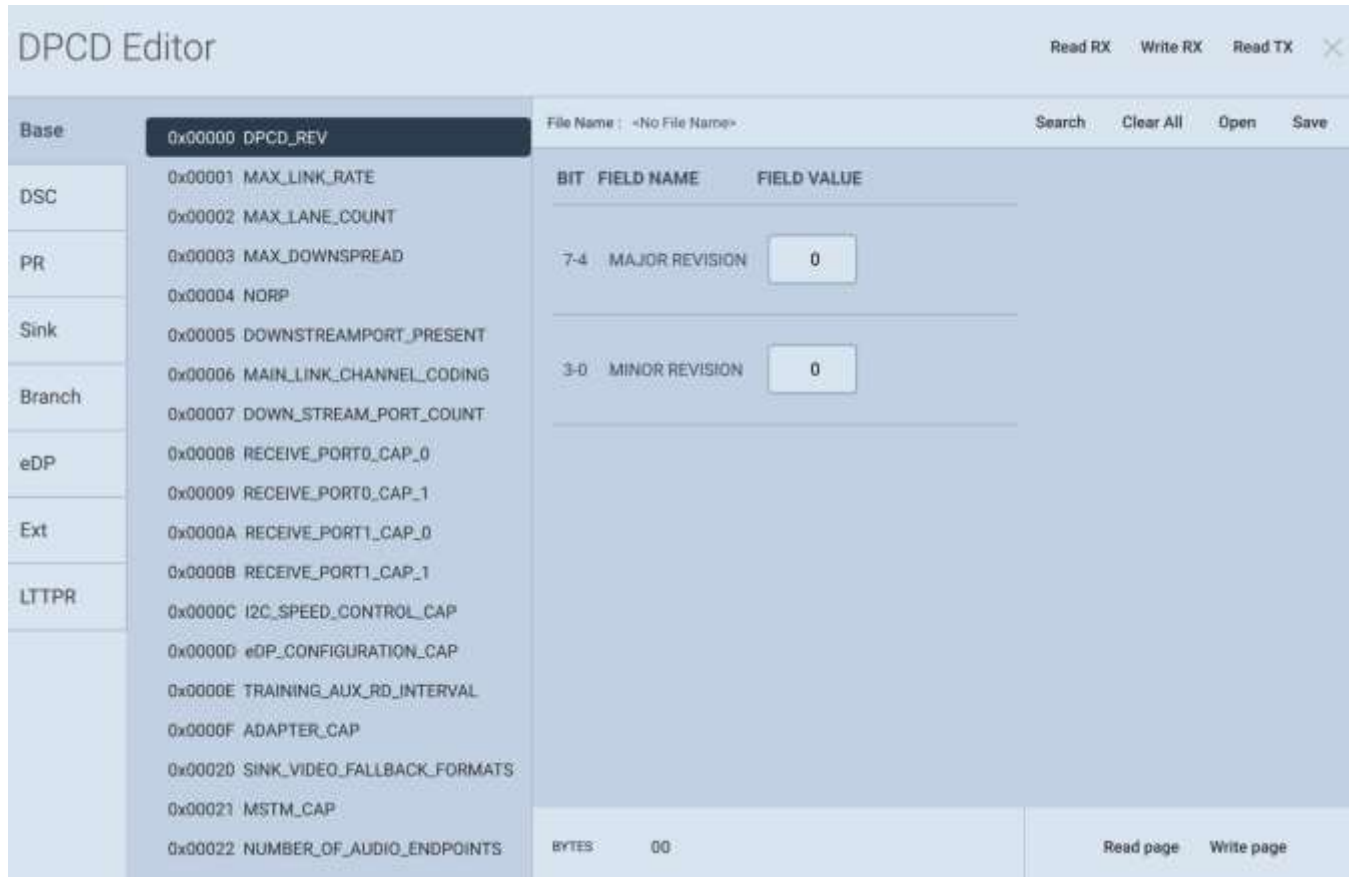
The VPS Application has a GUI DPCD editing feature. The **DPCD Editor** allows you to configure the DPCD of the DPRx that the M42d emulates for source testing.

This section provides procedures on how to edit the M42d analyzer port's DPCD registers. The M42d analyzer provides a set of dialog boxes that enable you to edit the DPCD registers through pull down menus and text fields. You can save these edited configurations for recall when testing DP sources. This enables you to emulate a variety of DPCD register configurations on the Rx port.

Access the DPCD Editor within the System menu by clicking Editors and selecting the DPCD Editor, as shown below.



The following screen shows the DPCD Editor main screen. Note that each register set is selected on the left and the editing tools are available on the main area of the dialog box on the right side.



There are a set of controls available with the DPCD Editor. These are defined in the table below:

DPCD Editor controls	
Item	Description
File Name: File Name : /User/DPCD_DP2.0	Indicates the current directory where the edited DPCD registers will be stored and opened from.
Register Address 0x00001 MAX_LINK_RATE 0x00002 MAX_LANE_COUNT	Shows the various configurable DPCD register blocks and enables selection of them for editing their contents.
Open Open	Enables you to open a previously saved DPCD configuration file for editing.
Save Save	Enables you to save a DPCD configuration file for later reuse. A dialog box will appear enabling you to assign a name to the DPCD file.
Read RX Read RX	Enables you to read the entire current DPCD configuration of the M42d's emulated Rx. This populates the dialog boxes with the current register settings.

DPCD Editor controls	
Item	Description
	<b>Note:</b> This must be done first if you wish to edit the currently emulated Rx DPCD
Write RX <span>Write RX</span>	This writes the entire contents of the edited DPCD file to the M42d Rx port for emulation.
Read TX <span>Read TX</span>	This enables you to read the DPCD of the Rx device that is connected to the test instrument's Tx port.
Read Page <span>Read Page</span>	Enables you to read the DPCD register values of the selected page of the M42d Rx device. This populates dialog boxes with the current register settings.
Write Page <span>Write Page</span>	This writes the contents of the register values on the selected page of the DPCD to the M42d Rx port for emulation.

The following screen examples show several of the DPCD Editor's address blocks (pages).

The screenshot shows the DPCD Editor interface. On the left, a list of address blocks is displayed with categories like Base, DSC, PR, Sink, Branch, eDP, Ext, and LTTPR. The 'Base' category is selected, and the 'MAX\_LANE\_COUNT' entry (0x00002) is highlighted. A yellow arrow points to the 'Base' label, and another points to the highlighted entry. On the right, the 'MAX\_LANE\_COUNT' field is shown with a value of 4. Below it, other fields like POST\_LT\_ADJ\_REQ\_SUPPORTED, TPS3\_SUPPORTED, and ENHANCED\_FRAME\_CAP are shown with radio button options for YES/NO. The file name is /User/DPCD\_DP2.0 and the current page is C4.

### DPCD Editor

File Name : /User/DPCD\_DP2.0

BIT	FIELD NAME	FIELD VALUE	
0	RGB SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
1	YCBCR 4:4:4 SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
2	YCBCR SIMPLE 4:2:2 SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
3	YCBCR NATIVE 4:2:2 SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
4	YCBCR NATIVE 4:2:0 SUPPORT	<input type="radio"/> NO	<input checked="" type="radio"/> YES
7-5	RESERVED	<input type="text" value="0"/>	

**Left Panel:**

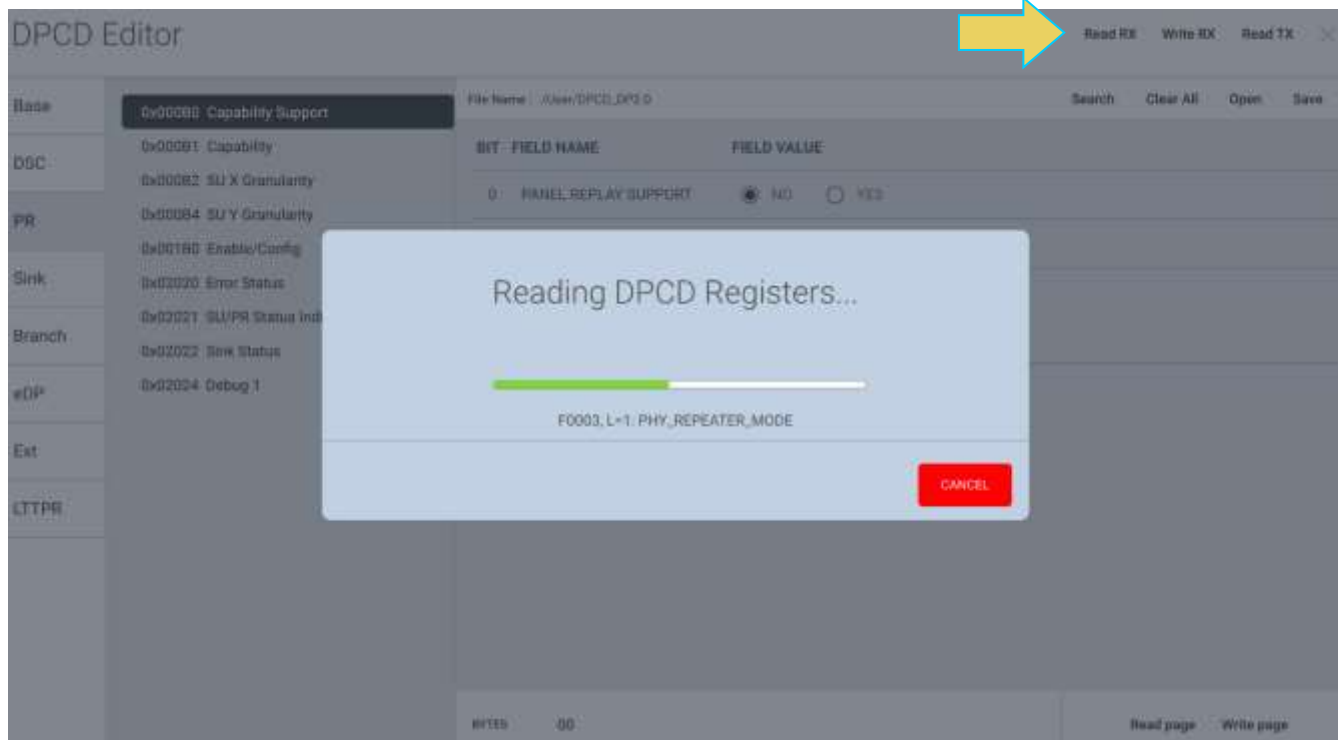
- Base: 0x00060 DSC SUPPORT
- DSC: 0x00061 DSC ALGORITHM REVISION (highlighted with yellow arrow)
- DSC: 0x00062 DSC RC BUFFER BLOCK SIZE
- PR: 0x00063 DSC RC BUFFER SIZE
- Sink: 0x00064 DSC SLICE CAPABILITIES 1
- Branch: 0x00065 DSC LINE BUFFER BIT DEPTH
- Branch: 0x00066 DSC BLOCK PREDICTION SUPPO...
- Branch: 0x00067 DSC MAX Bits per pixel (L)
- eDP: 0x00068 DSC MAX Bits per pixel (H)
- eDP: 0x00069 DSC COLOR FORMAT CAPABILITI... (highlighted with dark blue bar)
- Ext: 0x0006A DSC COLOR DEPTH CAPABILITIES
- Ext: 0x0006B Peak DSC Throughput
- LTTPR: 0x0006C DSC Maximum Slice Width



### Reading/Writing DPCD from/to M42d Emulated Rx

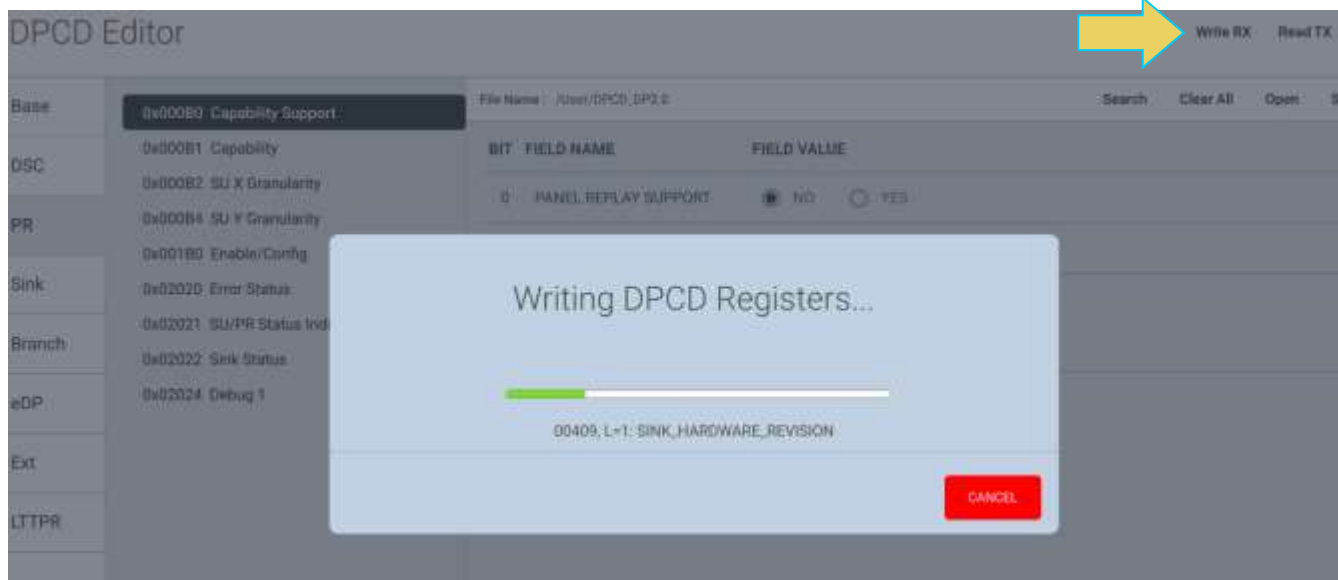
Prior to editing the DPCD that is currently being emulated by the Basic Analyzer, you must read the DPCD so that the DPCD Editor's configurable fields are populated by the current values.

To read the DPCD, click **Read RX** in the top right of the DPCD Editor, as shown below.



Once the DPCD Registers have been read, you can configure them to your testing specifications.

Once fully configured, you can optionally save the DPCD (instructions for this are in the next subsection) and write it to the Analyzer RX for emulation by clicking the **Write RX** button within the DPCD Editor.



## Saving and Opening/Reapplying Saved DPCD Configurations

The DPCD registers are edited by any number of tools within the Basic Analyzer application. At this point, any manually reconfigured capability registers will be overwritten with DPCD of the new specifications of the emulated Rx.

The M42d offers the ability to save and open/apply a custom modified DPCD to quickly reapply these configurations upon instrument reboot or if the configurations are changed at some point during testing. This feature is also beneficial for quickly testing a source with multiple different DPCDs.

For example, a user can configure the DPCD according to their test specifications and save the DPCD, then recall the DPCD any time they start or restart a test session.

The procedure for this process is as follows:

### Saving DPCD

1. Once you have the configurations you would like to save within the DPCD Editor, click **Save** at the top right of the window.



2. A **Save** dialog box will appear. Select the desired path, type in a name for the new DPCD, and click **SAVE**, as shown below.



The DPCD is now saved in the **User** folder.

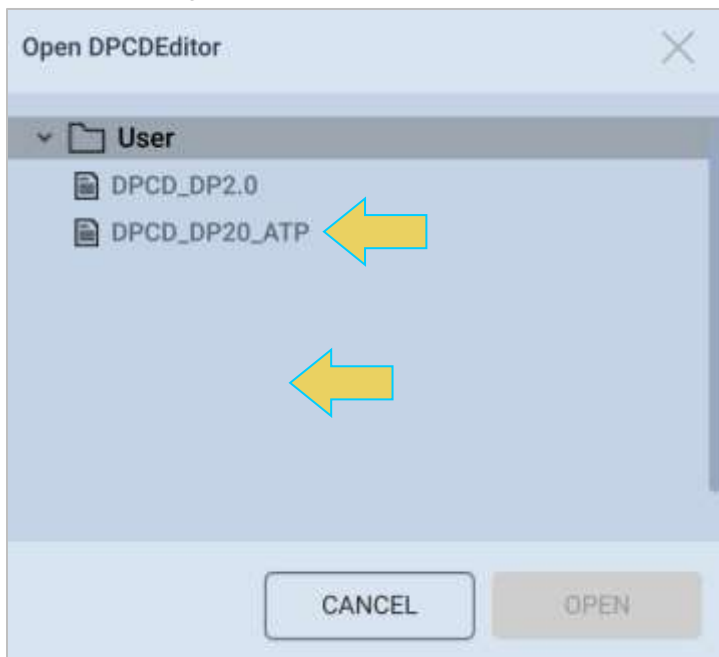
With the configured DPCD now saved, you can open and apply this DPCD at any time from the DPCD Editor.

### Open/Reapply Previously Saved DPCD

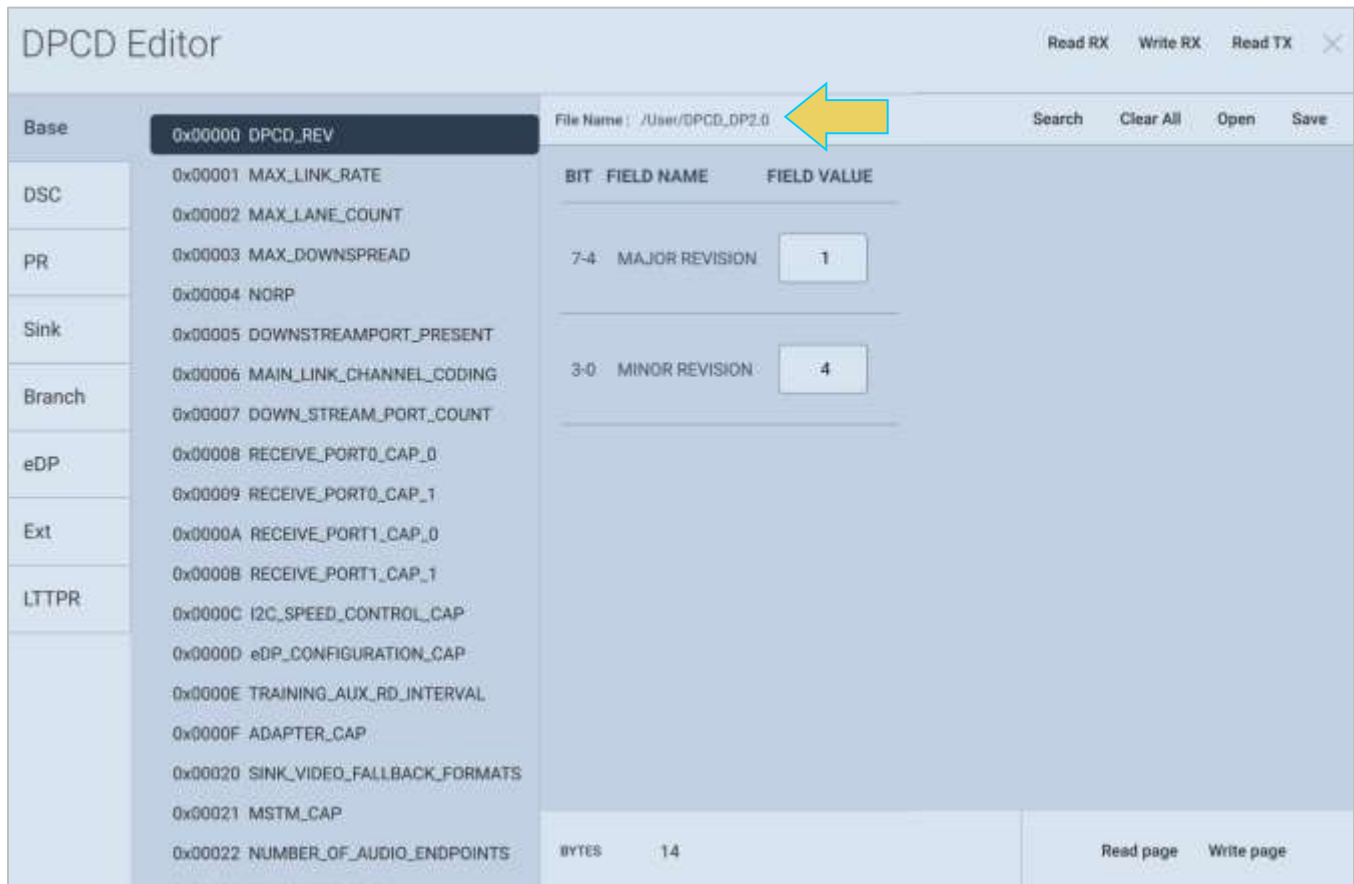
3. To restore the previously saved DPCD, click the **Open** button at the top of the DPCD Editor window.



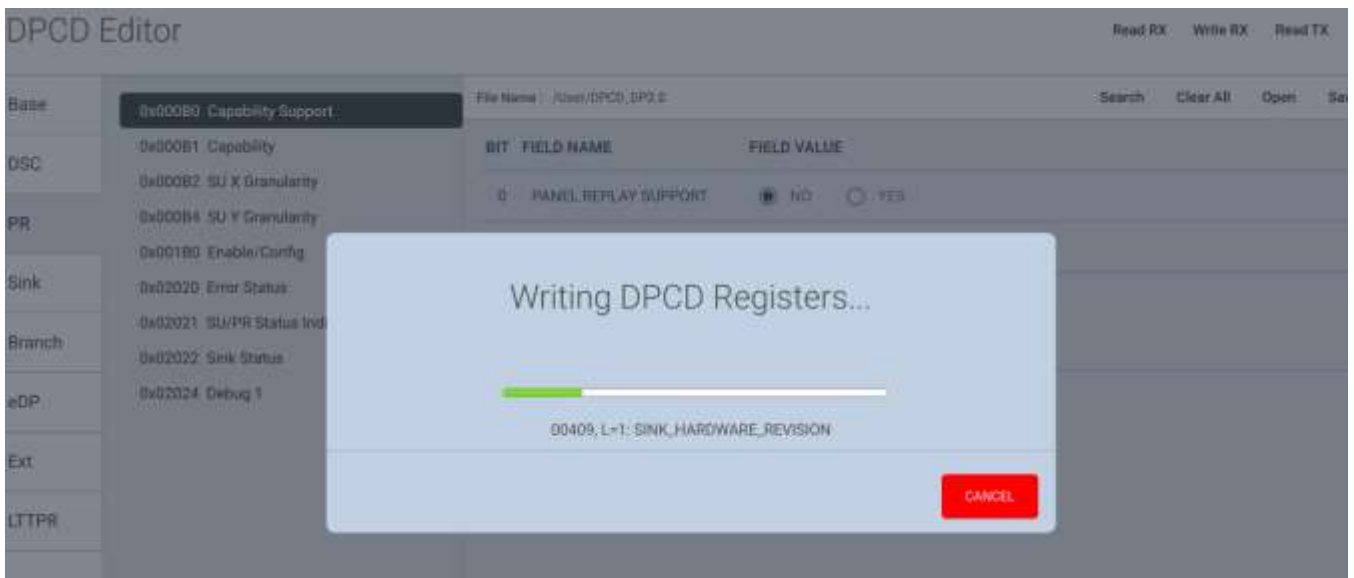
4. An **Open** dialog box will appear. Select the desired DPCD file and click **OK**



Once the DPCD has loaded, the file name will appear at the top of the window, as shown below.



5. Lastly, write the DPCD to the M42d's emulated RX to apply the DPCD to the receiver/analyzer.



## 13.2 EDID Editor

The **EDID Editor** feature is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

## 13.3 Format Editor

The **Format Editor** feature is not currently functional in the Video Protocol Suite (VPS) Application. Please refer to the M42d User Guide for the ATP Manager GUI to utilize this feature.

## Appendices

---

### Appendix A. Licenses

Many of the features of the M42d require a specific license to operate. This appendix will demonstrate how to apply a license, as well as list the available licenses.

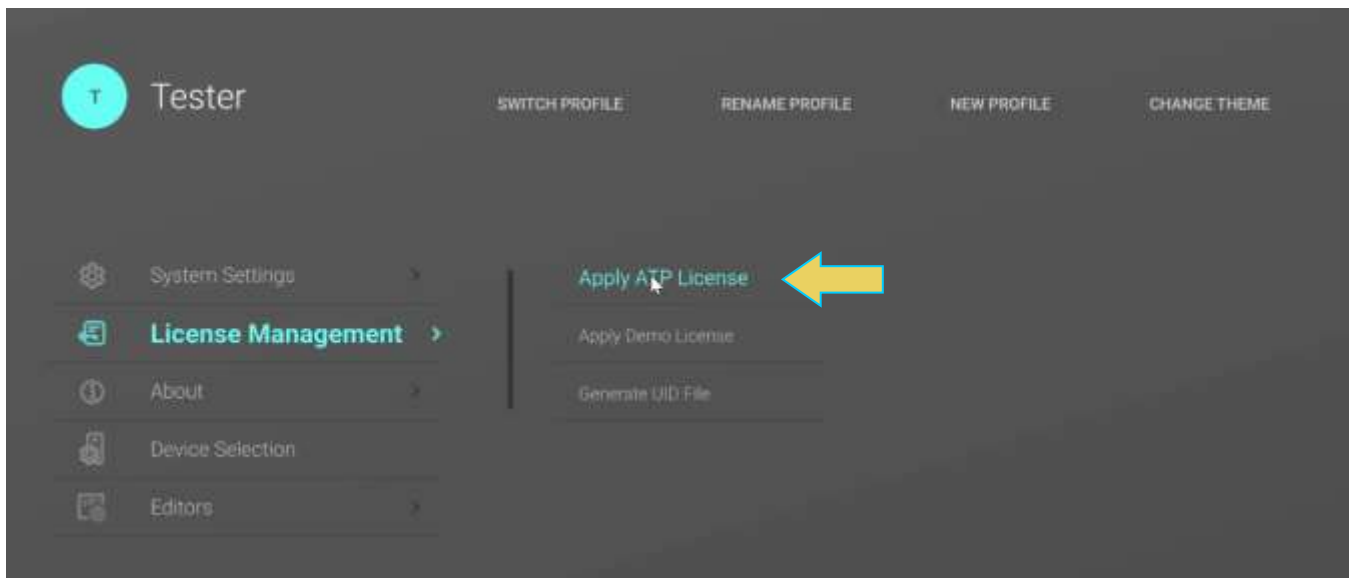
To obtain a license for the M42d, contact Teledyne Support, accessible at <http://quantumdata.com/support.html>

#### Applying Licenses

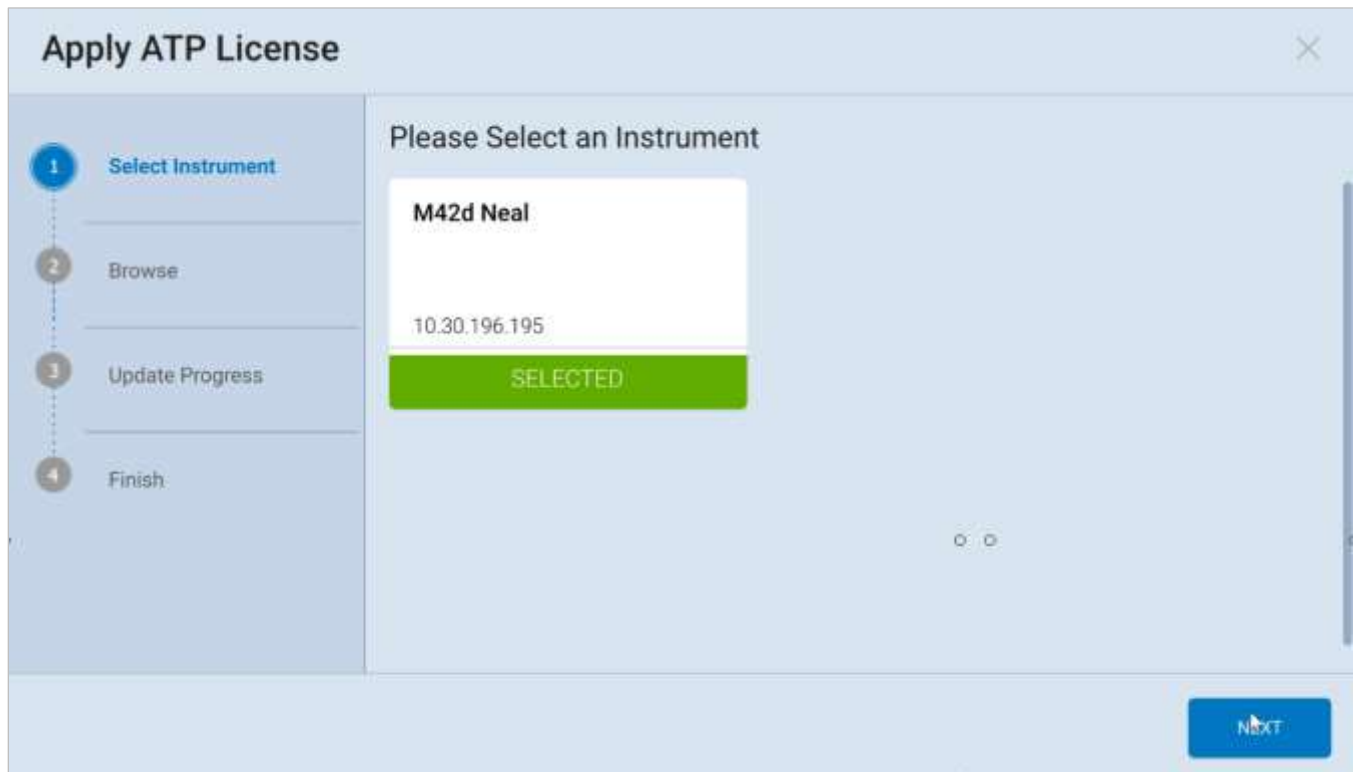
To apply a license:

1. Upload the license file (.lic) using the Navigator by clicking navigating to the System menu, selecting **License Management**, and clicking **Apply ATP License**.

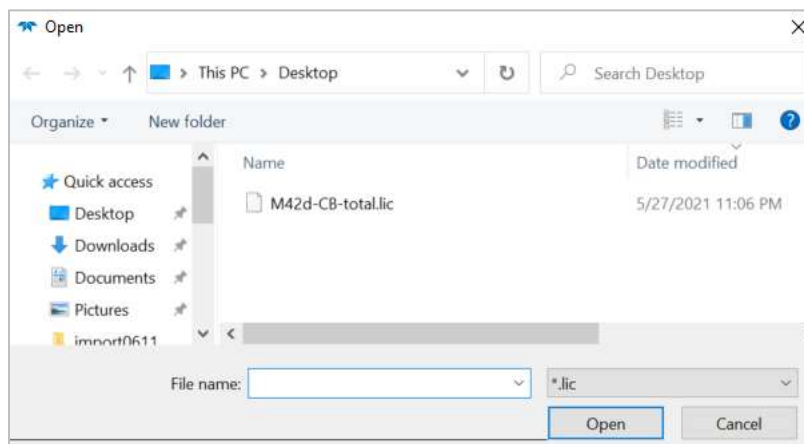
**Note:** As the license file will likely be saved to your PC, it is recommended to use the remote host VPS Application for this function. All screenshots are based on this GUI, though they are both similar.



2. Select the instrument to apply the license to, and click **NEXT**.



3. A file explorer will appear, as shown below. Navigate to the correct directory of the previously downloaded license, select the .lic file, and click **Open**.



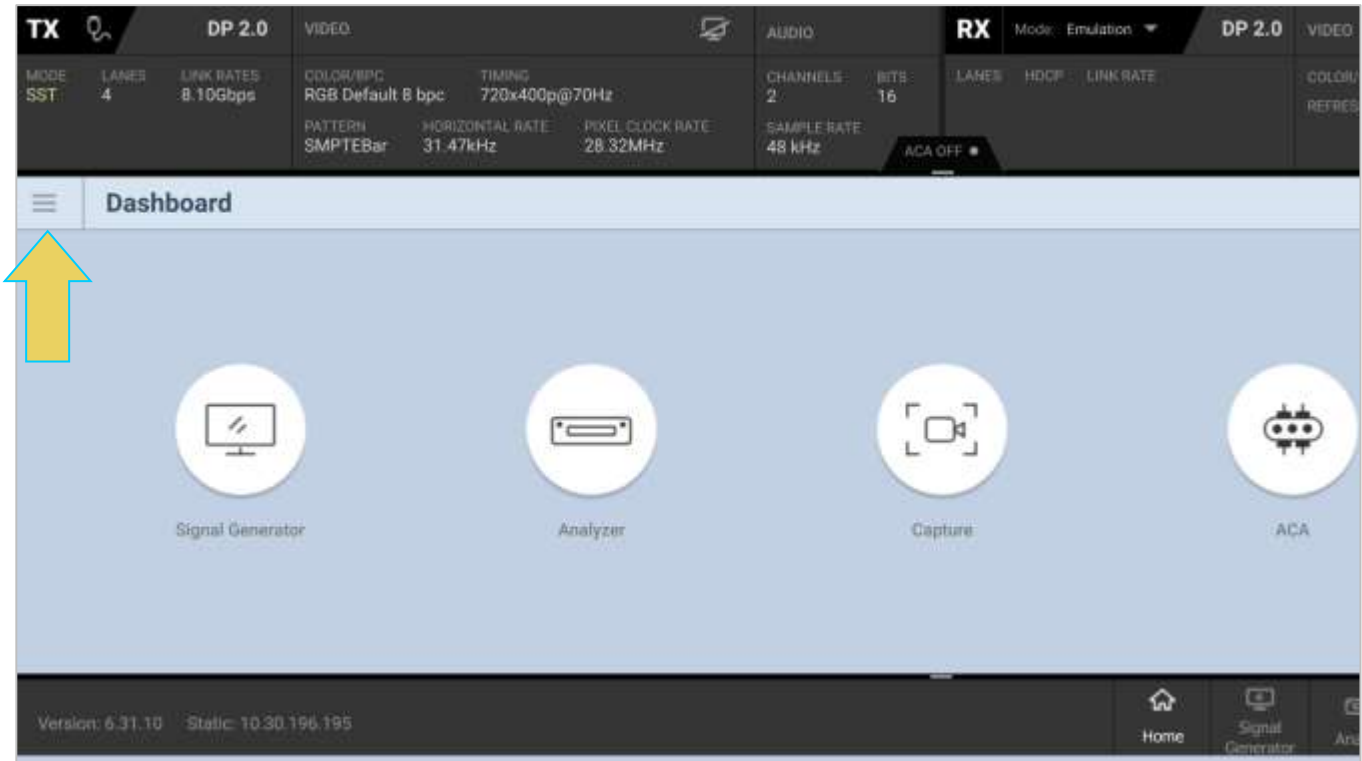
4. A confirmation will appear, and **you must reboot the device** for the changes to take effect.



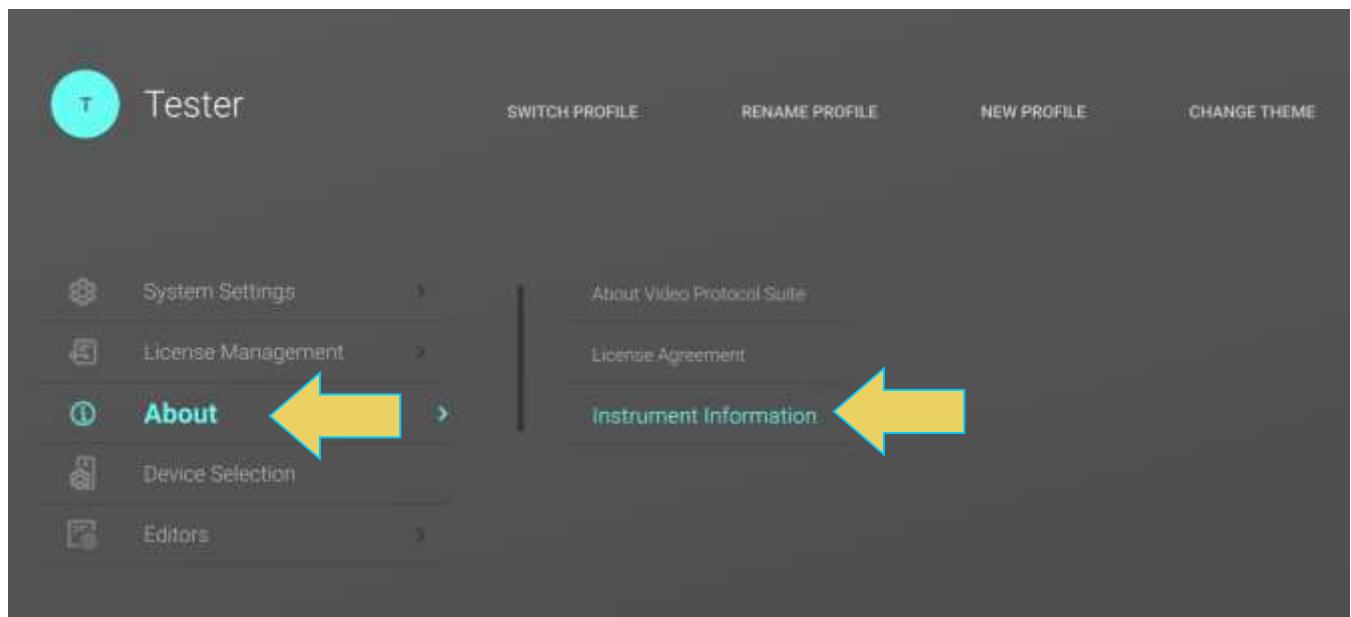
## Verifying Current Licenses

Upon reboot, you may wish to confirm that the correct license was applied. Use the following procedure to check the licenses that are currently applied to your M42d instrument.

To access the **Instrument Information**, first return to the system menu by clicking the three vertical bar menu icon at the top left of the dashboard, as shown below.



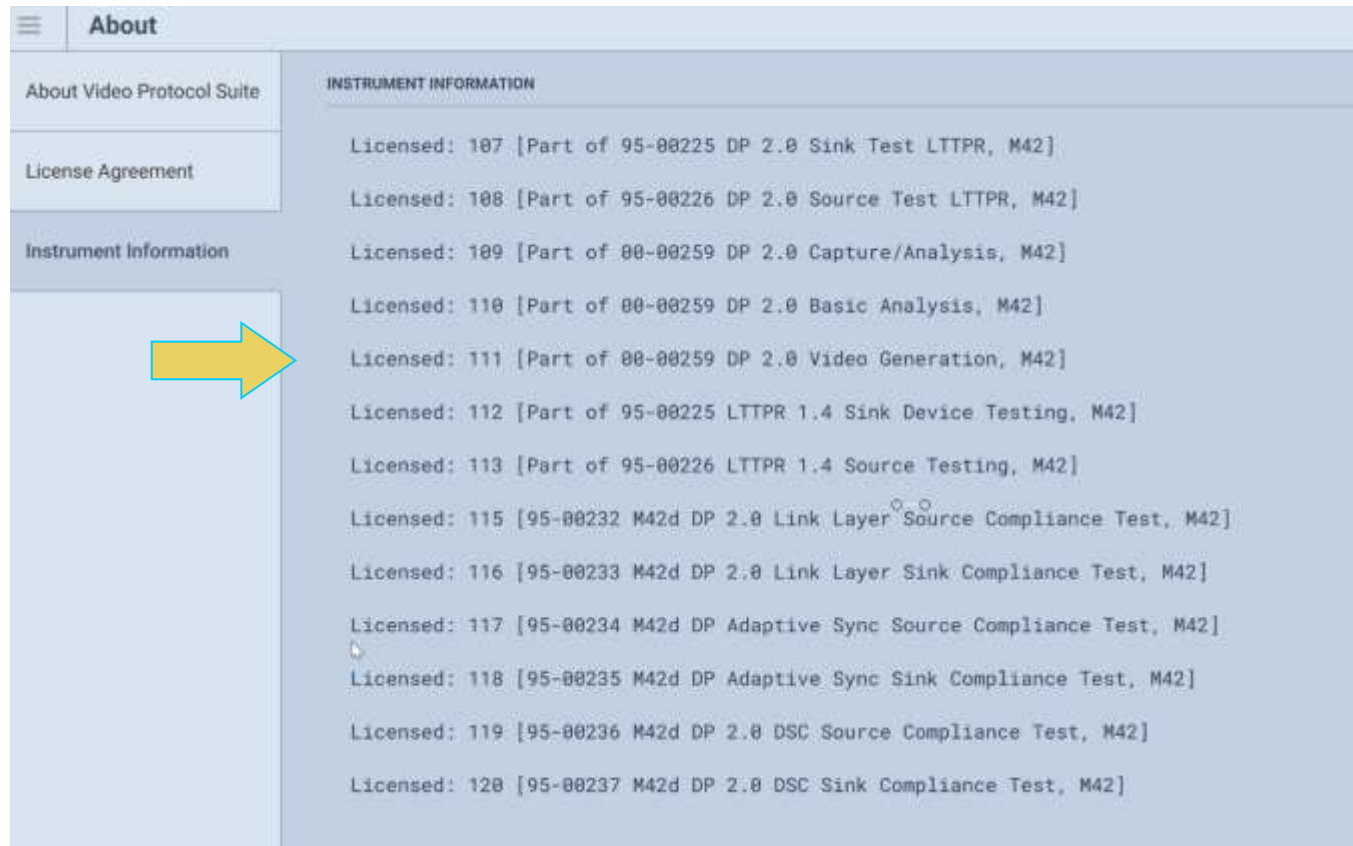
Within the system menu, open the **About** menu and select **Instrument Information**, as shown below.





The **About** window will appear, which has various information about the device, and has the **Licensed Features** listed toward the bottom of the report, as demonstrated below.

Instructions for saving the Instrument Information Report can be found in [Section 2.2](#). This saved Information Report is necessary when contacting Teledyne LeCroy PSG Support, as a current version of the report is needed for creating licenses.

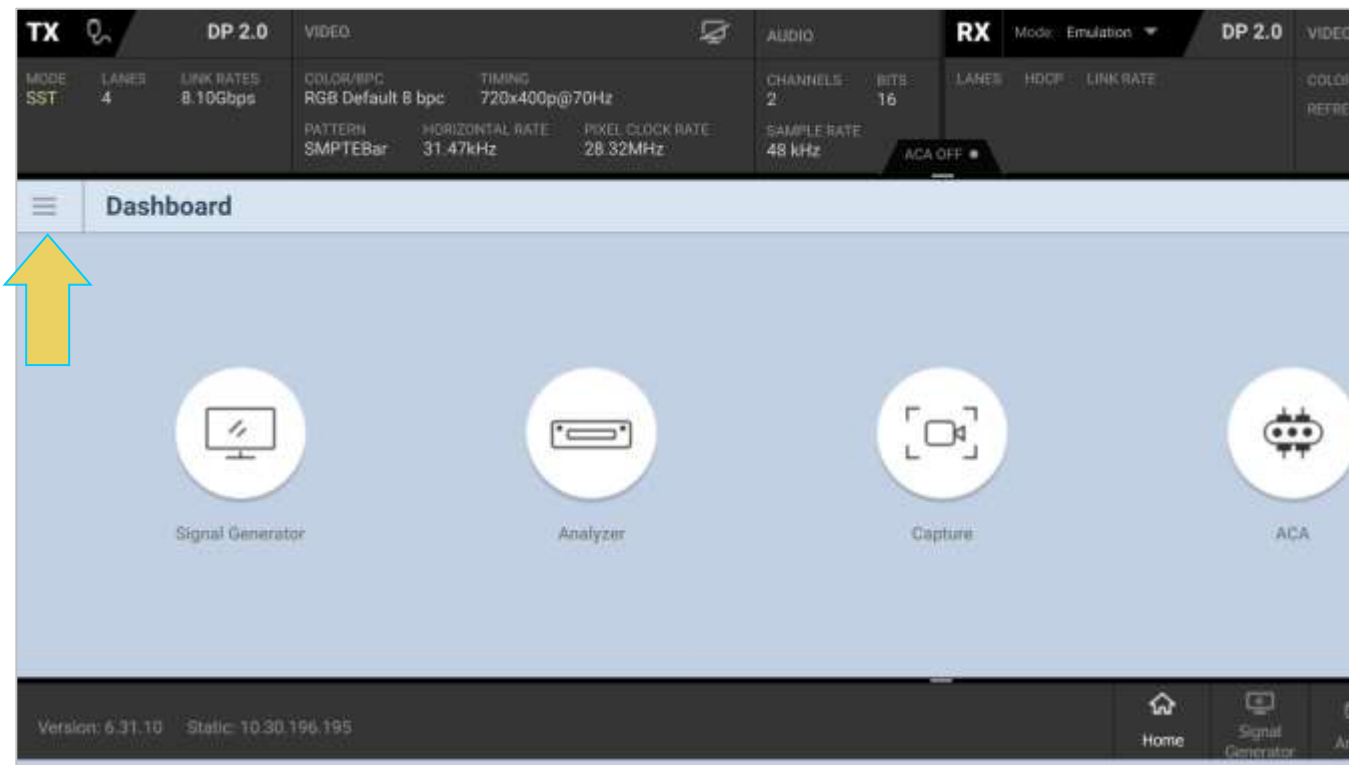


The screenshot displays the 'About' window interface. On the left, a sidebar contains three menu items: 'About Video Protocol Suite', 'License Agreement', and 'Instrument Information'. A yellow arrow points to the 'Instrument Information' item. The main content area is titled 'INSTRUMENT INFORMATION' and lists 12 licensed features, each with a license ID and a description in brackets.

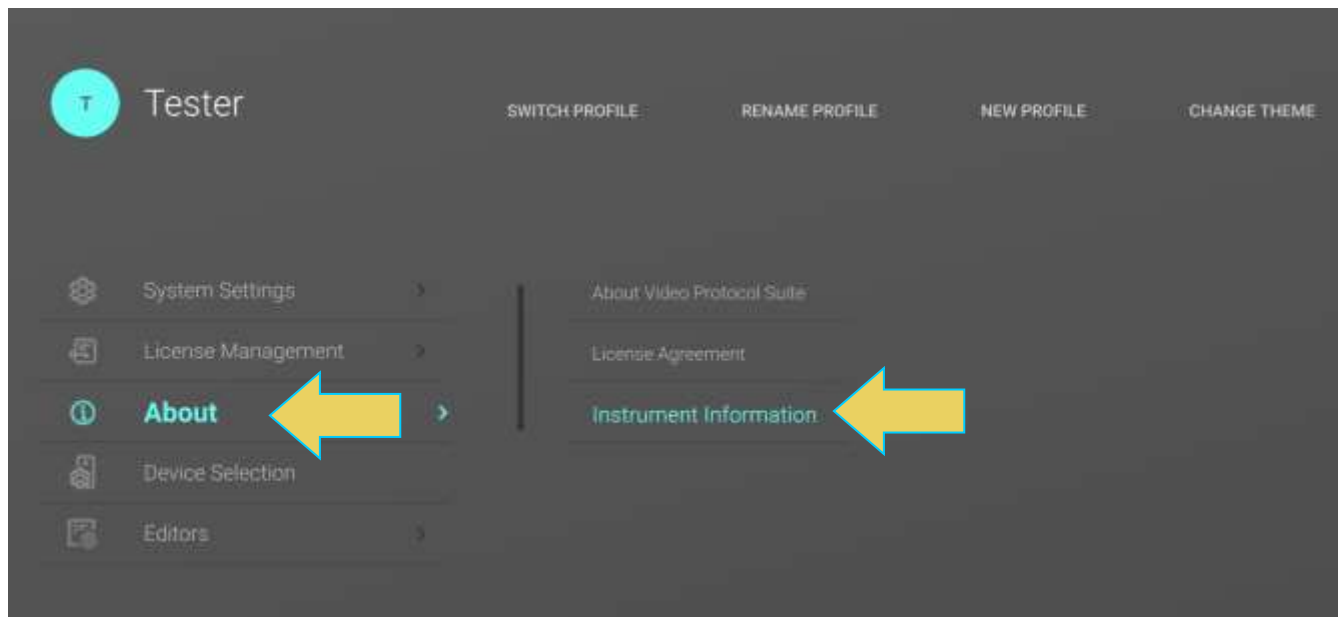
License ID	Description
107	[Part of 95-00225 DP 2.0 Sink Test LTTPR, M42]
108	[Part of 95-00226 DP 2.0 Source Test LTTPR, M42]
109	[Part of 00-00259 DP 2.0 Capture/Analysis, M42]
110	[Part of 00-00259 DP 2.0 Basic Analysis, M42]
111	[Part of 00-00259 DP 2.0 Video Generation, M42]
112	[Part of 95-00225 LTTPR 1.4 Sink Device Testing, M42]
113	[Part of 95-00226 LTTPR 1.4 Source Testing, M42]
115	[95-00232 M42d DP 2.0 Link Layer Source Compliance Test, M42]
116	[95-00233 M42d DP 2.0 Link Layer Sink Compliance Test, M42]
117	[95-00234 M42d DP Adaptive Sync Source Compliance Test, M42]
118	[95-00235 M42d DP Adaptive Sync Sink Compliance Test, M42]
119	[95-00236 M42d DP 2.0 DSC Source Compliance Test, M42]
120	[95-00237 M42d DP 2.0 DSC Sink Compliance Test, M42]

Additionally, you can save this instrument information report as a .txt file. This is necessary when contacting Teledyne support regarding licenses, as they will ask you to send the report so they can determine current licensed features.

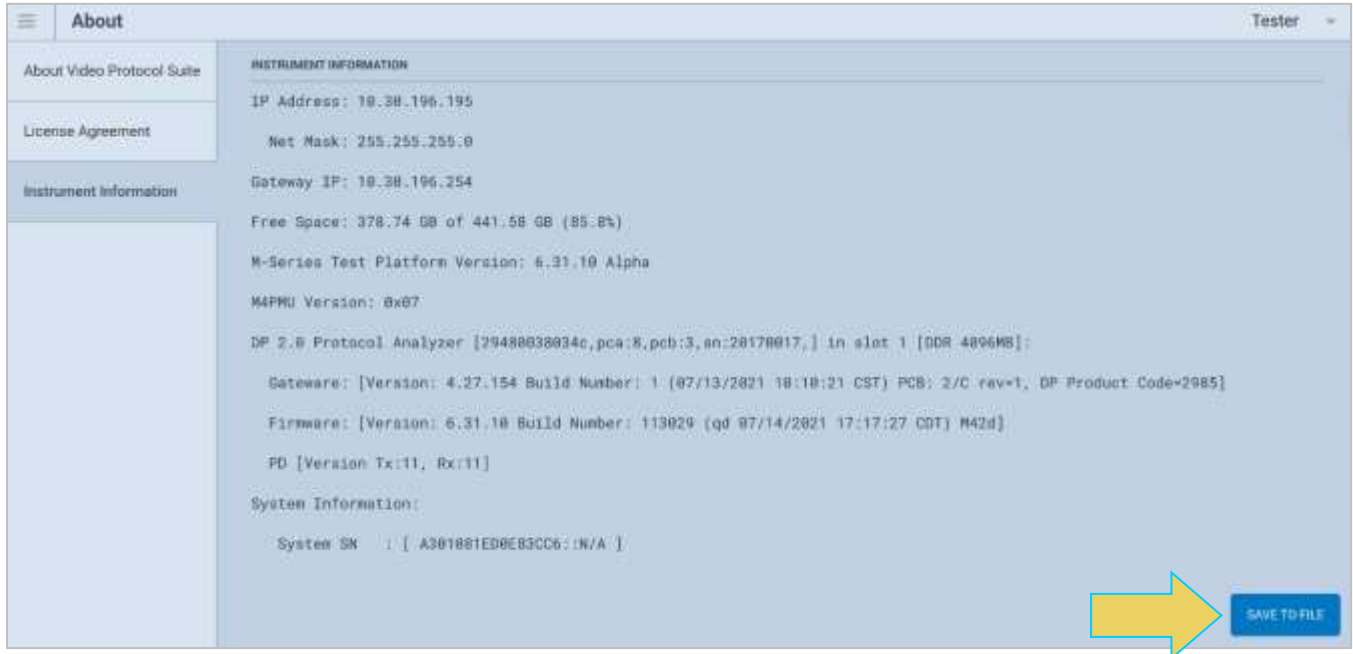
To access the **Instrument Information**, first return to the system menu by clicking the three vertical bar menu icon at the top left of the dashboard, as shown below.



Within the system menu, open the **About** menu and select **Instrument Information**, as shown below.



The **Instrument Information** is then displayed. The information on the Instrument Information window tells you the firmware and hardware release and version information as well as what options you have.



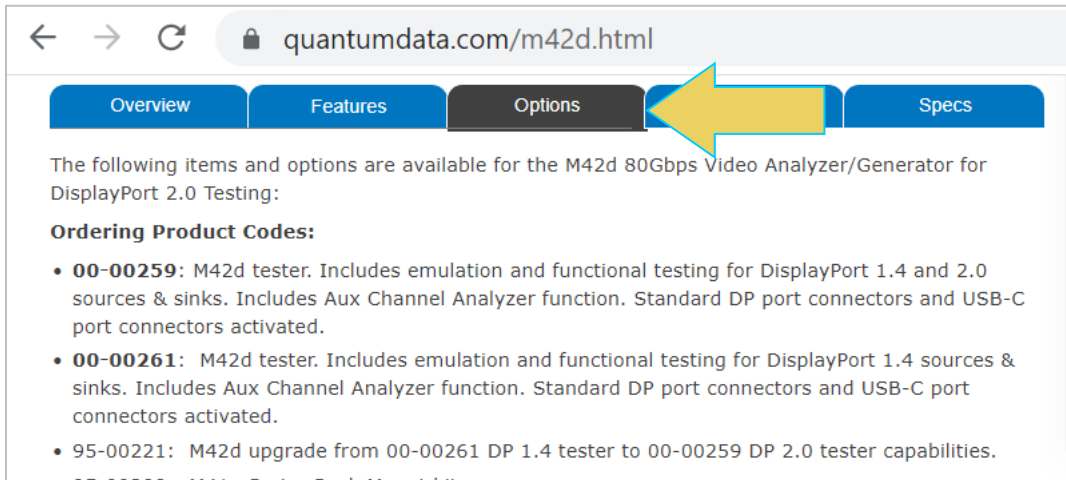
Save the Instrument Information Report by selecting the **SAVE TO FILE** button at the bottom right of the report window, as shown in the previous screenshot.

Enter the desired file name and folder directory, and the information report will be saved as a .txt file.

## License Listing

This appendix provides a listing of all licenses available for the M42d.

The licenses and this listing are subject to revisions. Check current licenses and product ordering codes at <https://www.quantumdata.com/m42d.html> under the **Options** tab, shown below.



To obtain a license, contact Teledyne Support, accessible at <http://quantumdata.com/support.html>.

Part Number (SKU)	Description	License Keys
00-00259	<b>quantumdata M42d DisplayPort 2.0 UHBR-20 Video Analyzer/Generator</b>	<b>21:33:50:51:68:69:110:111</b>
	- Base DP 2.0 functionality includes UHBR video generation, basic analysis and ACA	
	- With both DP and USB-C ports enabled	
00-00261	<b>quantumdata M42d DisplayPort 2.0 HBR3 Video Analyzer/Generator</b>	<b>21:33:50:51:68:69</b>
	- Base DP 1.4 functionality includes HBR3 video generation, basic analysis and ACA	
	- With both DP and USB-C ports enabled	
<b>Options</b>		
95-00221	<b>M42d Upgrade 00-00261 to enable UHBR rates</b>	<b>103</b>
	- Requires 00-00261	
95-00222	<b>M42d Passive Probing Main Link and Aux Channel</b>	<b>104</b>
	- Requires 00-00259 or 00-00261	
95-00225	<b>M42d DP Enhanced Sink Functional Tests</b>	<b>56:101:105:112:107</b>
	- Includes DSC (for DP 1.4), LTTTPR (and Panel Replay if 00-00259 or 95-00221)	
95-00226	<b>M42d DP Enhanced Source Functional Tests</b>	<b>32:55:102:106:108:113:109</b>
	- Includes Capture Analysis, DSC (for DP 1.4), LTTTPR (and Panel Replay if 00-00259 or 95-00221)	

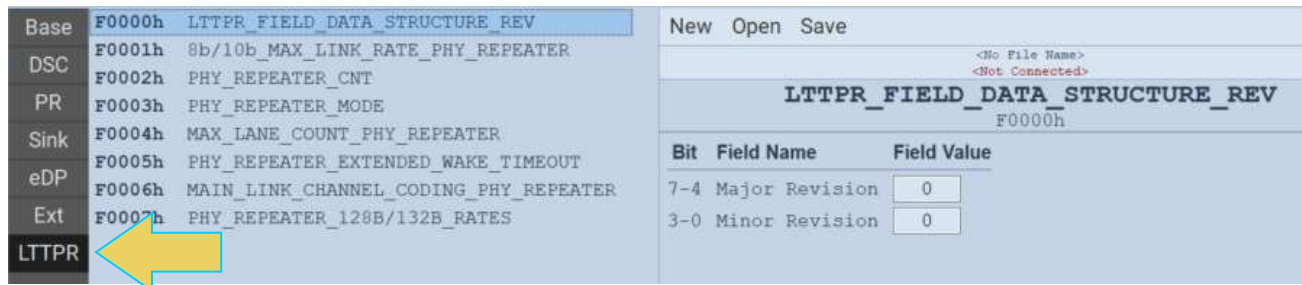
<b>95-00227</b>	<b>M42d/M42d DP EDID/DisplayID Sink Compliance Test Suite</b>	<b>73</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
<b>95-00228</b>	<b>M42d/M42d DP EDID/DisplayID Source Compliance Test Suite</b>	<b>76</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00209</b>	<b>M4 Series Rackmount Kit</b>	<b>N/A</b>
	- Requires 00-00258 or 00-00259 or 00-00260 or 00-00261	
<b>95-00212</b>	<b>M42d/M42d Embedded DisplayPort (eDP) option</b>	<b>70</b>
	- Requires 00-00259 or 00-00261, Or:	
	- Requires 00-00260	
<b>95-00213</b>	<b>M42d/M42d DP 1.4 Link Layer &amp; FEC Source Compliance Test Suite</b>	<b>35:48:93</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00214</b>	<b>M42d/M42d DP HDCP 2.3 Source Compliance Test Suite</b>	<b>33:43</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00215</b>	<b>M42d/M42d DP 1.4 DSC &amp; FEC Source Compliance Test Suite</b>	<b>71</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00216</b>	<b>M42d/M42d DP 1.4 Link Layer &amp; FEC Sink Compliance Test Suite</b>	<b>47:61:94</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
<b>95-00217</b>	<b>M42d/M42d DP HDCP 2.3 Sink Compliance Test Suite</b>	<b>33:43</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
<b>95-00218</b>	<b>M42d/M42d DP 1.4 DSC &amp; FEC Sink Compliance Test Suite</b>	<b>72</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
<b>95-00232</b>	<b>M42d/M42d DP 2.0 Link Layer Source Compliance Test Suite</b>	<b>115</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00233</b>	<b>M42d/M42d DP 2.0 Link Layer Sink Compliance Test Suite</b>	<b>116</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
<b>95-00234</b>	<b>M42d/M42d DP Adaptive Sync Source Compliance Test Suite</b>	<b>117</b>
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
<b>95-00235</b>	<b>M42d/M42d DP Adaptive Sync Sink Compliance Test Suite</b>	<b>118</b>
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	

## Appendix B. Configurable LTTPR Capability Registers

As covered in **Chapter 8 LTTPR Testing**, while emulating LTTPR for testing of a source, many LTTPR capability registers within the DPCD are modifiable. This appendix lists those registers that can be edited.

**Note:** For more information on the registers, including field values, see the *VESA DisplayPort 2.0 Standard* document.

See **8.2 Modifying DPCD of Emulated LTTPR** for specific instructions on accessing the DPCD Editor, saving custom configurations, and opening them upon startup. A screenshot of the LTTPR tab of the DPCD editor is below.



### LTTPR Capability Registers:

See the following table for the configurable registers.

DPCD Address	Register	Field(s)
F0000h	LTTPR_FIELD_DATA_STRUCTURE_REV	<ul style="list-style-type: none"> <li>Minor Revision Number</li> <li>Major Revision Number</li> </ul>
F0001h	8b/10b_MAX_LINK_RATE_PHY_REPEATER	MAX_LINK_RATE (Gbps per lane)
F0002h	PHY_REPEATER_CNT	Count: Indicates the number of LTTPRs that are present. Up to eight LTTPRs are supported.
F0003h	PHY_REPEATER_MODE	Mode: Indicates the mode in which an LTTPR is operating.
F0004h	MAX_LANE_COUNT_PHY_REPEATER	<ul style="list-style-type: none"> <li>MAX_LANE_COUNT</li> <li>Reserved</li> </ul>
F0005h	PHY_REPEATER_EXTENDED_WAKE_TIMEOUT	<ul style="list-style-type: none"> <li>EXTENDED_WAKE_TIMEOUT_REQUEST</li> <li>EXTENDED_WAKE_TIMEOUT_GRANT</li> </ul>
F0006h	MAIN_LINK_CHANNEL_CODING_PHY_REPEATER	<ul style="list-style-type: none"> <li>128b/132b SUPPORTED</li> <li>Reserved</li> </ul>

DPCD Address	Register	Field(s)
F0007h	PHY_REPEATER_128B/132B_RATES	<ul style="list-style-type: none"> <li>▪ 10 Gbps/lane Support</li> <li>▪ 13.5 Gbps/lane Support</li> <li>▪ 20 Gbps/lane Support</li> <li>▪ Reserved</li> </ul>

The following tables are the configurable registers for each individual LTTTPR. The only significant changes among the tables are the register address for each LTTTPR.

#### LTTTPR1

DPCD Address	Register	Field(s)
F0020h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F0021h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F003Dh	IEEE_OUI	
F0040h	Device Identification String	
F0046h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F0047h- F0048h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>

#### LTTTPR2

DPCD Address	Register	Field(s)
F0070h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER2	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F0071h	TRANSMITTER_CAPABILITY_PHY_REPEATER2	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> </ul>

DPCD Address	Register	Field(s)
		<ul style="list-style-type: none"> <li>Reserved</li> </ul>
F008Dh	IEEE_OUI	
F0090h	Device Identification String	
F0096h	Hardware Revision	<ul style="list-style-type: none"> <li>Hardware Major Revision</li> <li>Hardware Minor Revision</li> </ul>
F0097h- F0098h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>Major Revision</li> <li>Minor Revision</li> </ul>

**LTTPR3**

DPCD Address	Register	Field(s)
F00C0h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER3	<ul style="list-style-type: none"> <li>Interval</li> <li>EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F00C1h	TRANSMITTER_CAPABILITY_PHY_REPEATER3	<ul style="list-style-type: none"> <li>VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>Reserved</li> </ul>
F00DDh	IEEE_OUI	
F00E0h	Device Identification String	
F00E6h	Hardware Revision	<ul style="list-style-type: none"> <li>Hardware Major Revision</li> <li>Hardware Minor Revision</li> </ul>
F00E7h- F00E8h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>Major Revision</li> <li>Minor Revision</li> </ul>

**LTTPR4**

DPCD Address	Register	Field(s)
F0110h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>Interval</li> <li>EXT_RX_CAP_FIELD_PRESENT</li> </ul>



DPCD Address	Register	Field(s)
F0111h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F012Dh	IEEE_OUI	
F0130h	Device Identification String	
F0136h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F0137h- F0138h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>

**LTTPR5**

DPCD Address	Register	Field(s)
F0160h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F0161h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F017Dh	IEEE_OUI	
F0180h	Device Identification String	
F0186h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F0187h- F0188h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>

**LTTPR6**

<b>DPCD Address</b>	<b>Register</b>	<b>Field(s)</b>
F01B0h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F01B1h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F01CDh	IEEE_OUI	
F01D0h	Device Identification String	
F01D6h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F01D7h- F01D8h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>

**LTTPR7**

<b>DPCD Address</b>	<b>Register</b>	<b>Field(s)</b>
F0200h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F0201h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F021Dh	IEEE_OUI	
F0220h	Device Identification String	
F0226h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F0227h- F0228h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>

**LTTPR8**

<b>DPCD Address</b>	<b>Register</b>	<b>Field(s)</b>
F0250h	TRAINING_AUX_RD_INTERVAL_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ Interval</li> <li>▪ EXT_RX_CAP_FIELD_PRESENT</li> </ul>
F0251h	TRANSMITTER_CAPABILITY_PHY_REPEATER1	<ul style="list-style-type: none"> <li>▪ VOLTAGE_SWING_LEVEL_3_SUPPORTED</li> <li>▪ PRE_EMPHASIS_LEVEL_3_SUPPORTED</li> <li>▪ Reserved</li> </ul>
F026Dh	IEEE_OUI	
F0270h	Device Identification String	
F0276h	Hardware Revision	<ul style="list-style-type: none"> <li>▪ Hardware Major Revision</li> <li>▪ Hardware Minor Revision</li> </ul>
F0277h- F0278h	Firmware/Software Revision	<ul style="list-style-type: none"> <li>▪ Major Revision</li> <li>▪ Minor Revision</li> </ul>