M42d DisplayPort 80G Video Analyzer/Generator

User Guide

Ver. A1

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
- ATP 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**

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 M41d. 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 Advanced Test Platform (ATP) Manager. The ATP Manager is a GUI application that can run either on a Windows host PC or an external display connected to the HDMI port on the back of the M42d. **Chapter 2 is dedicated entirely to the ATP 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
- LTTPR device emulation in Transparent mode for testing LTTPR-capable source devices at 8b/10b line code for lane rates up to HBR3 (support for LTTPR 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 PC application (i.e. the ATP GUI Manager) or with the ATP GUI Manager 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 ATP GUI Manager 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 ATP GUI Manager on a PC
- Establishing an IP session between an M42d and the host PC running the ATP GUI Manager
- 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

This is the first version of this user guide. Any additions or changes in future versions will be noted in this section.

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:

Flat positioning

Upright positioning

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.

External display for ATP Manager

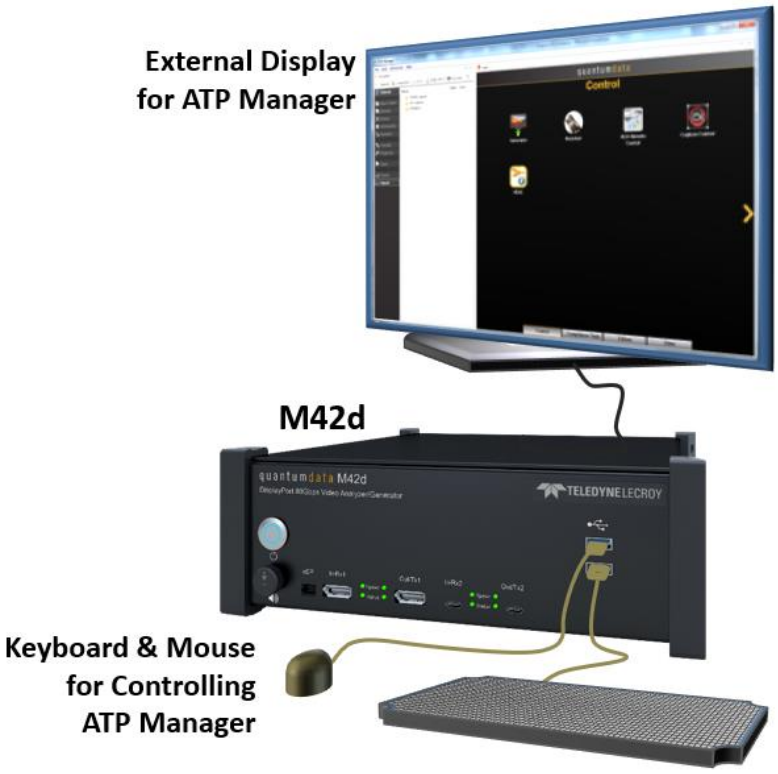
4. Connect a mouse to one of the USB ports on the front or back of the M42d as shown below.
5. Optionally connect a keyboard to one of the other USB ports on the front or the back of the M42d. You can also use the virtual keyboards that present themselves in the ATP Manager.

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 ATP Manager 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:

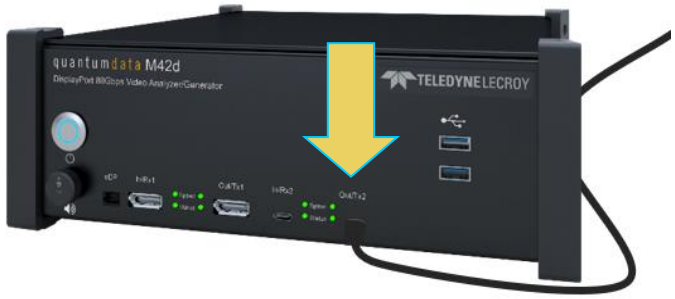
Connect the source device under test to the M42d DisplayPort In/Rx port as shown below. Note that you can connect either through the full-size standard DP port or the USB-C DP Alt Mode port depending on the lane rate (USB-C port shown in the example below).

The full test setup up is shown below with the ATP Manager running on the M42d with the ATP Manager GUI on the external display. The sample screen show shows an DisplayPort analysis screen.

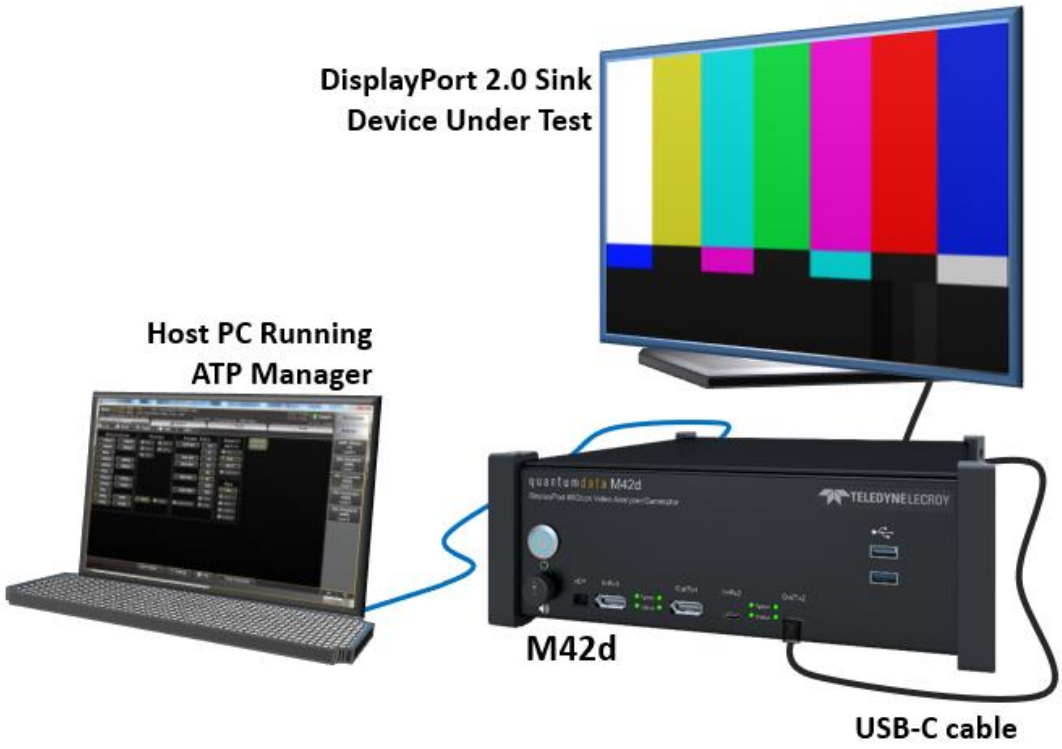
Connecting a DisplayPort Sink Device Under Test

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 up is shown below. This example uses the ATP Manager installed on a host PC.

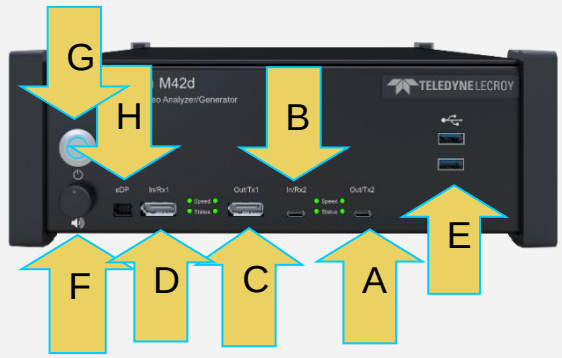


Connecting a DisplayPort Source and Sink Device for Passive Monitoring

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**

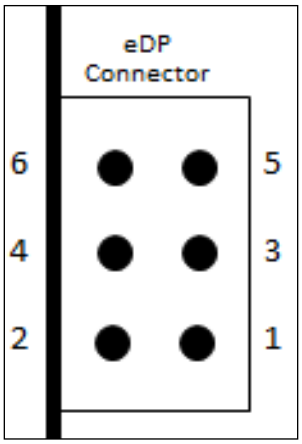
1.8 Connectors and Controls

The table below describes the M42d connectors and controls.

M42d Configurations	Information / Function
Protocol Analyzer in M42d  	**Front panel:** ▪ A – USB-C Out/Tx port for all HBR and UHBR data rates up to 20 Gbps. ▪ B – USB-C In/Rx port for all HBR and UHBR data rates up to 20 Gbps. ▪ C – DP Out/Tx port for RBR, HBR, HBR3, and UHBR10 (10G data rates) ▪ D – DP In/Rx port for RBR, HBR, HBR3, and UHBR10 (10G data rates) ▪ E – USB ports (2) used for connecting a mouse and keyboard. ▪ F – Knob for turning up or down the volume for the internal speaker. ▪ G – Power button; press and release. ▪ H – eDP block for Backlight Control (See Note Below). **Back panel:** ▪ I – Power plug (110-220VAC 50/60Hz) ▪ J - HDMI – Admin port for connecting external HDMI UHD display for M42d ATP Manager. ▪ K - DisplayPort – Not recommended for use currently. ▪ L - USB/USB-C (2 ea.) – For mouse & keyboard. ▪ M - RJ45 (2) - E1 Network for connecting host PC running ATP Mgr. E2 Aux – Future. ▪ N - DVI – Possible future use. ▪ O - RS-232 (2) – Possible future use. ▪ P - Audio (2) – Possible future use. ▪ Q – CrossSync™ for TRIG IN/OUT – Future. ▪ R - RCA SPDIF In/Out

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**.

Important Notes Using External Monitor for ATP Manager

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 ATP Manager 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 ATP Manager GUI Display Resolution

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

Step 1: Click on the lower right corner icon to access **Shutdown** menu. Under GUI Application click on the Close button. The ATP Manager GUI will close.

Step 2: Once the ATP Manager is shutdown, 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.

2 ATP Manager GUI Application

2.1 Operating the ATP Manager from an external display

The M42d is operated through the Advanced Test Platform (ATP) Manager. The ATP Manager is a GUI application that can run either on a **Windows host PC** or on an **external display** connected to the HDMI 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, the ATP Manager is running on the M42d itself, but the ATP Manager GUI is displayed on the external monitor. This operational scenario is shown below.

ATP Manager Running on External Display (Source Test Example)

2.2 Operating the ATP Manager on a host PC

You can operate the M42d from the ATP Manager 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.

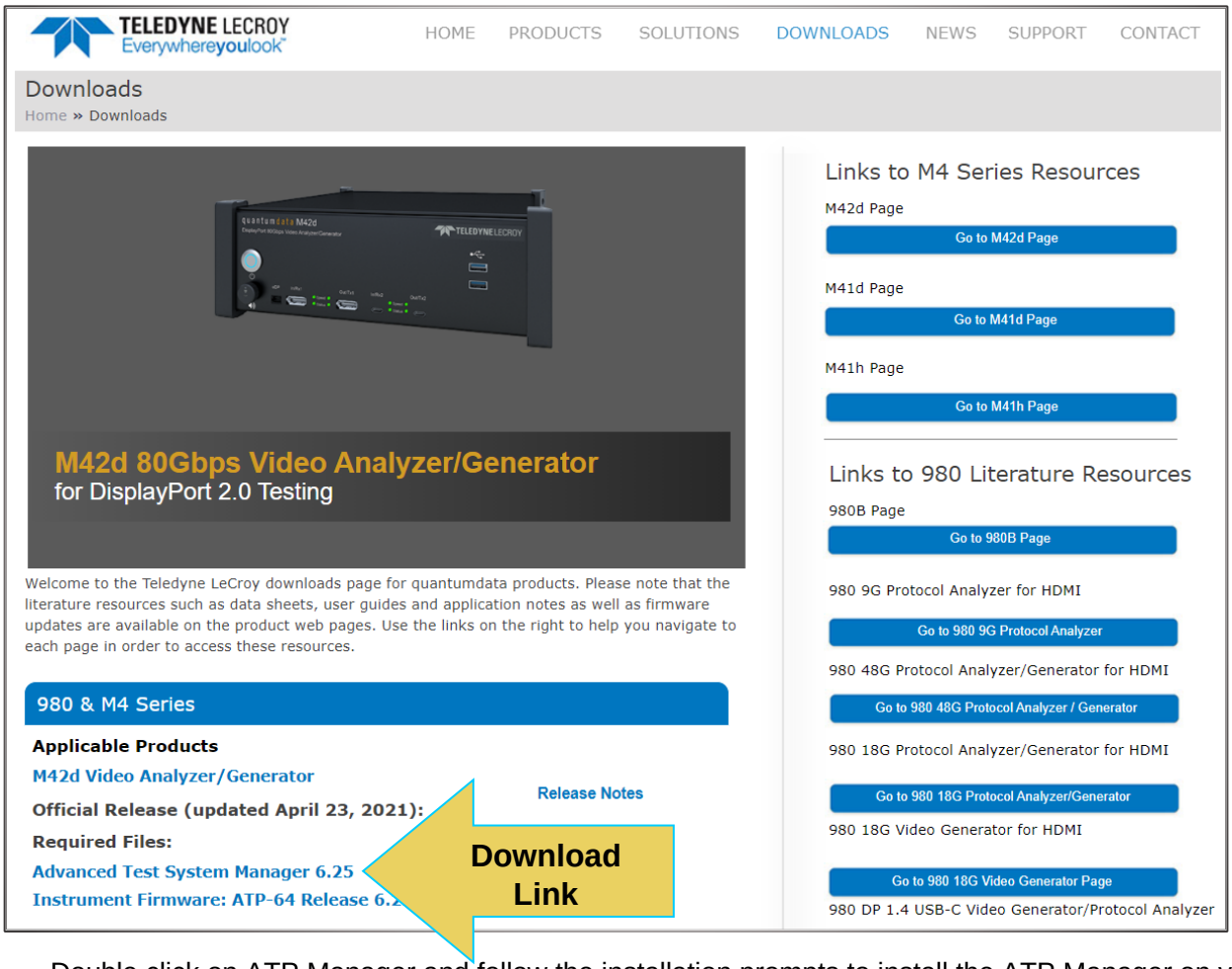
You will have to first download and install the ATP Manager GUI application on your Windows PC. You will then need to connect your PC to the M42d over an Ethernet IP connection. These procedures are provided below.

Please note: You will have to have completed the procedures in the section above **(1.8 Getting the M42d Up and Running)** in order to complete the following steps.

Installing and Connecting the M42d ATP Manager GUI Application

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

1. Download the ATP Manager GUI application from the quantumdata downloads page: **http://www.quantumdata.com/downloads.html**.

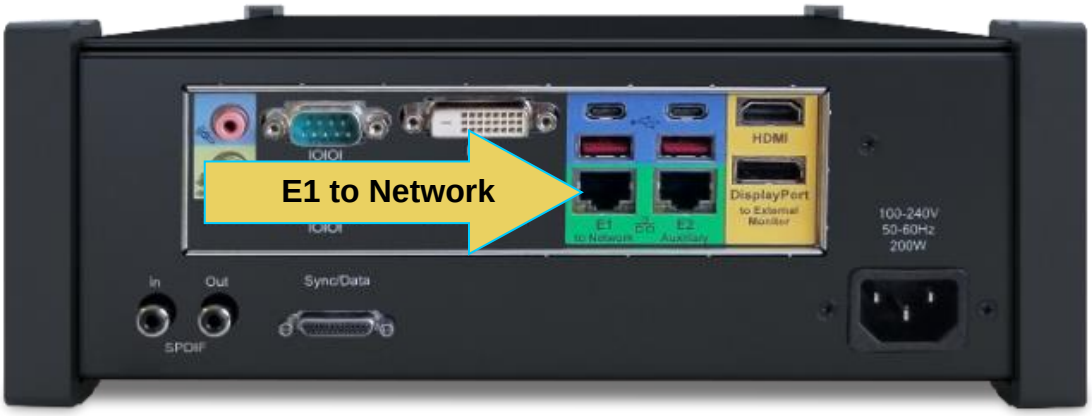


   Double click on ATP Manager and follow the installation prompts to install the ATP Manager on your Windows PC.

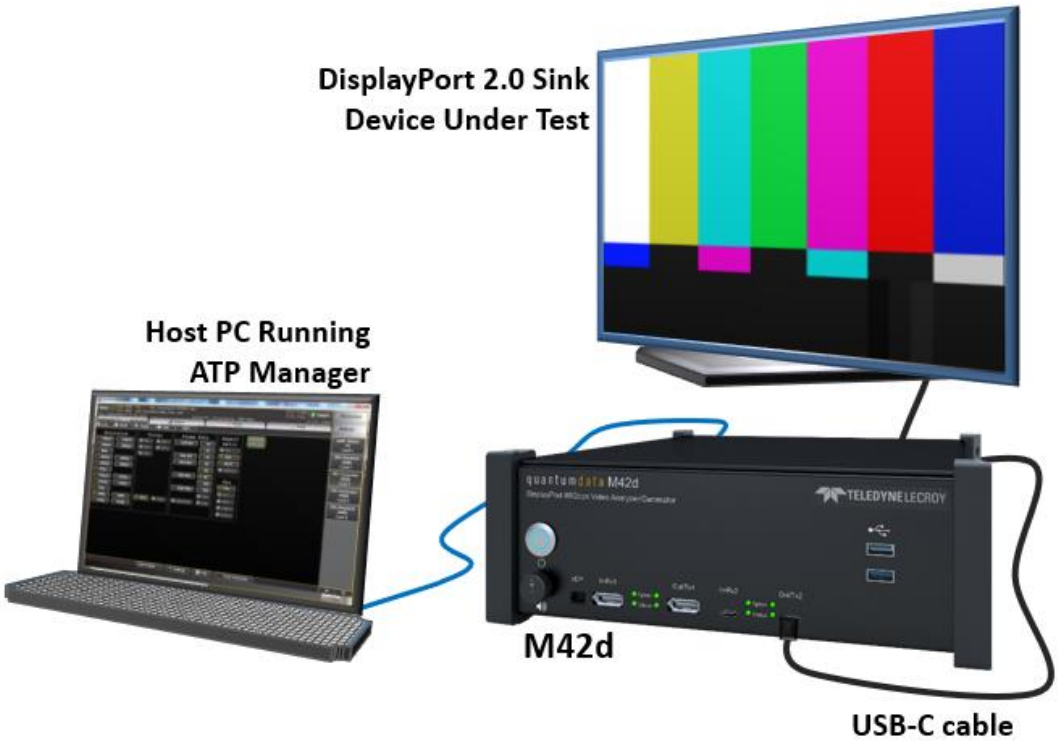
2. After installation completes, run the new ATP Manager. It should be available in the Start Menu under All Programs → Quantum Data, and also from an icon on your host PC Desktop.

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

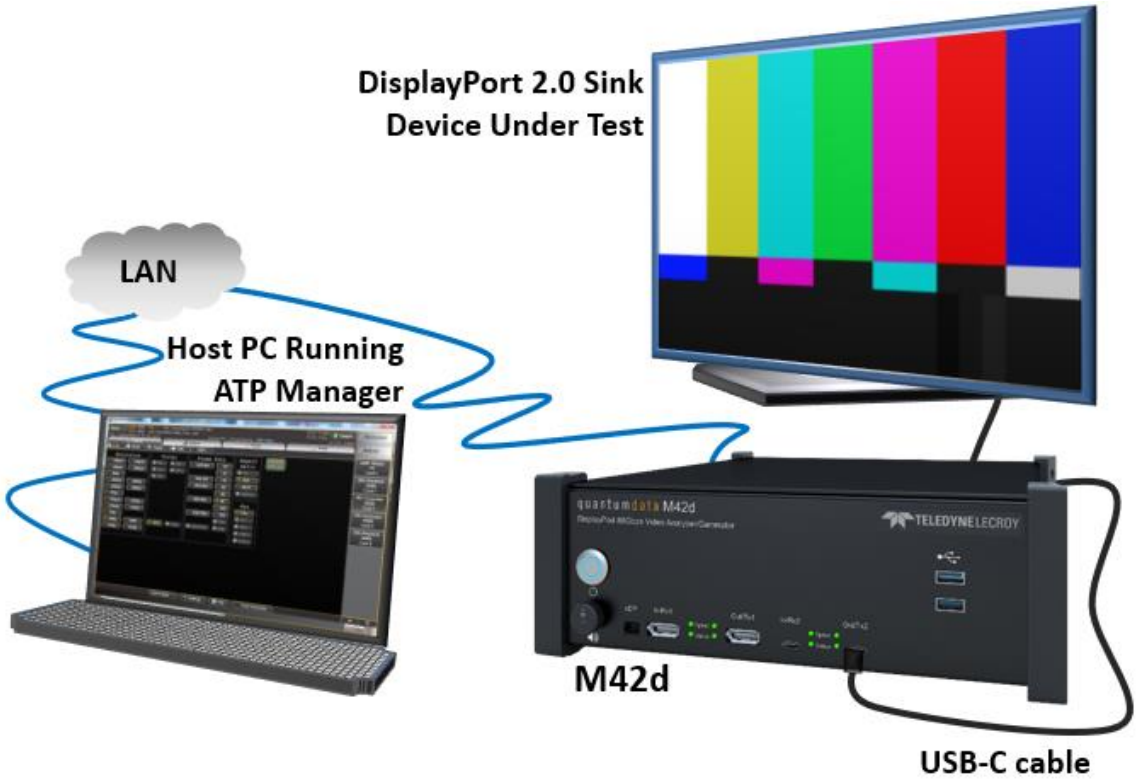
3. Connect your PC to the M42d using an Ethernet cable. The connection is made to the Rj45 jack on the back of the M42d labeled E1 to Network as shown below.



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.

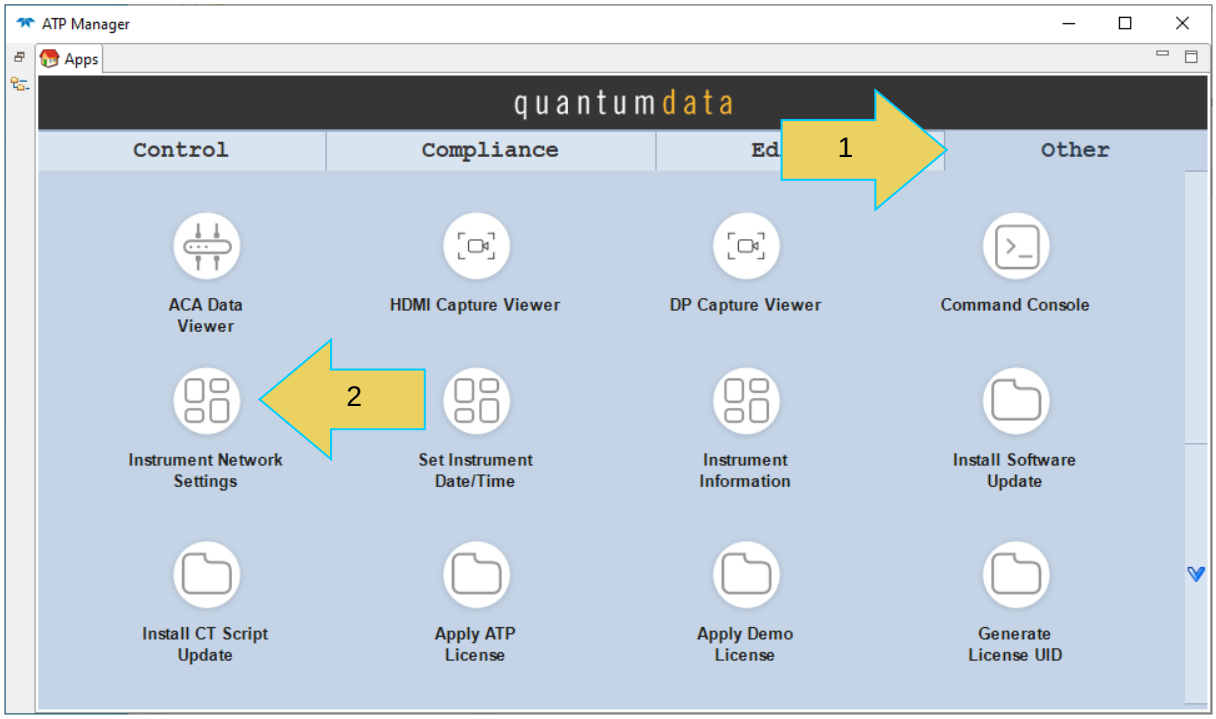


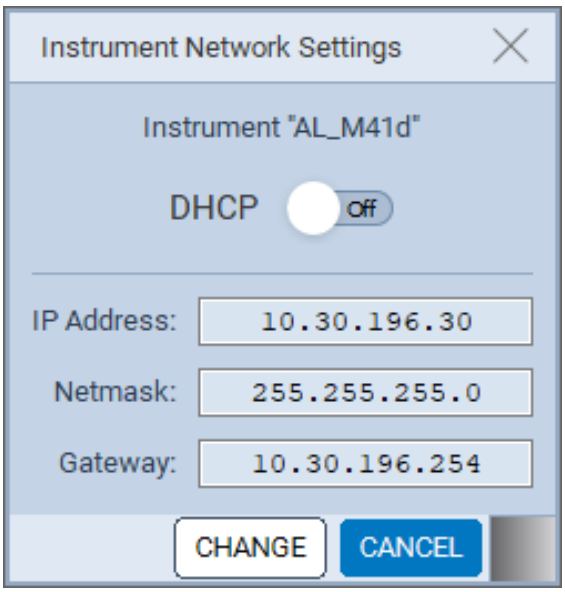
PC Running ATP Manager with Ethernet Direct Connection



PC Running ATP Manager w/ Ethernet Connection thru Corporate LAN

4. Set the IP address of the M42d from the **Other** page under the Control window of the ATP Manager GUI. Select the **Instrument Network Settings** icon. A dialog box appears enabling you to set DHCP or specify an IP address. Sample screen shots of these windows are shown below.



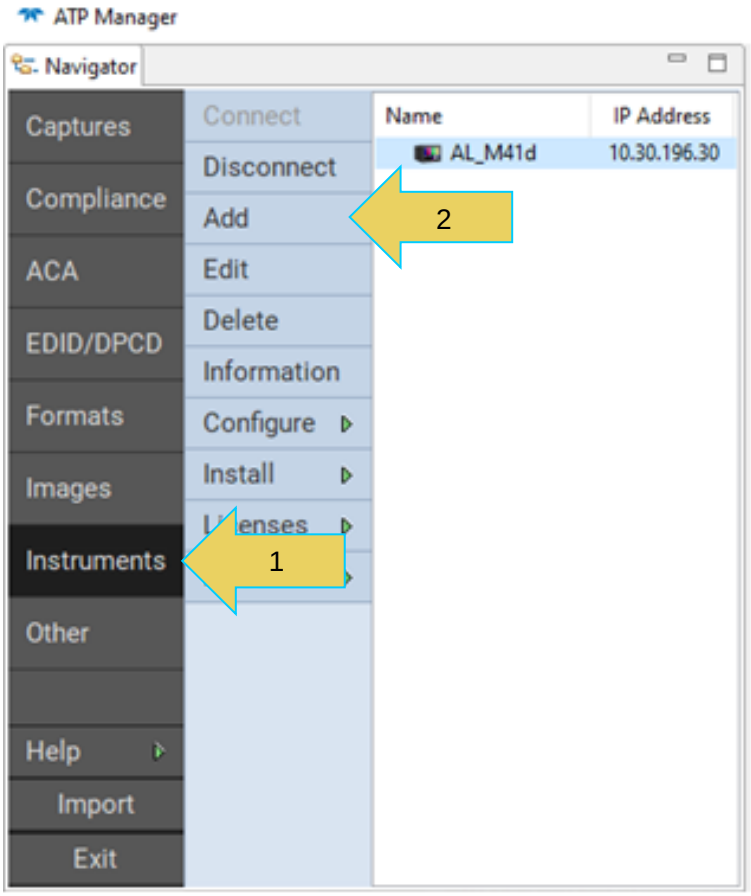


Note: Be sure to use an IP address that is compatible with your corporate LAN or your PC if you are connecting directly.

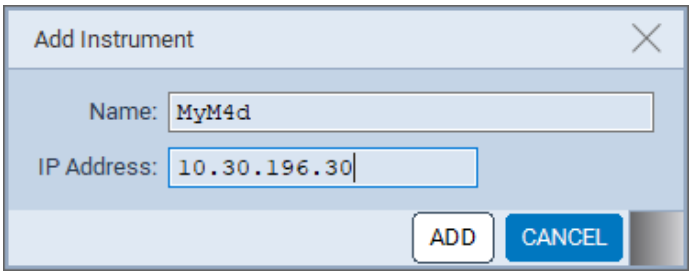
5. The instrument will automatically power cycle upon applying changes to the Network Settings.

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. Add your M42d to the ATP Manager application using the green + Add icon or the + Add item on the Instrument pull-down menu within the Navigator, identified below.

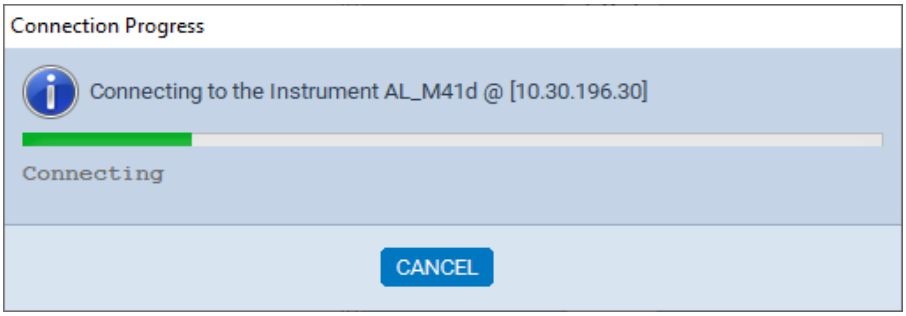


The **Add Instrument** dialog appears enabling you to enter the name and IP information for the M42d that you are trying to connect to (below).



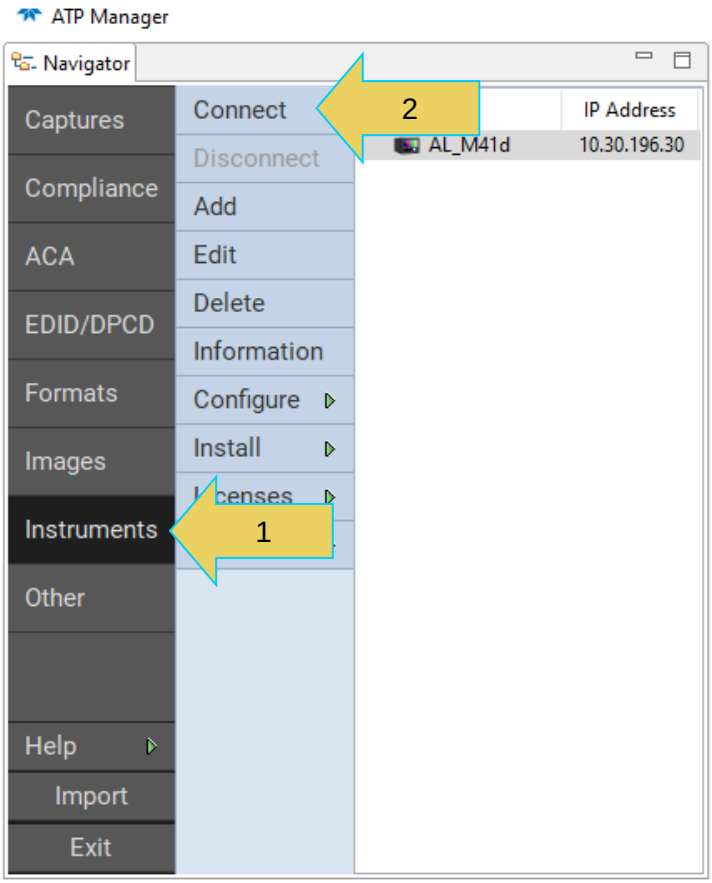
7. Enter the name (any suitable name) and IP address (*obtained in step 4*) of the M42d that you want to connect to in the **Add Instrument** dialog box (above) and click on the **Add** activation button.

You will see a series of messages on a dialog boxes describing the progress. One example is shown below:



The M42d with the IP address you entered appears on the list in the **ATP Navigator** panel (below). The ATP Manager application will automatically connect to the M42d once you add the M42d to the application.

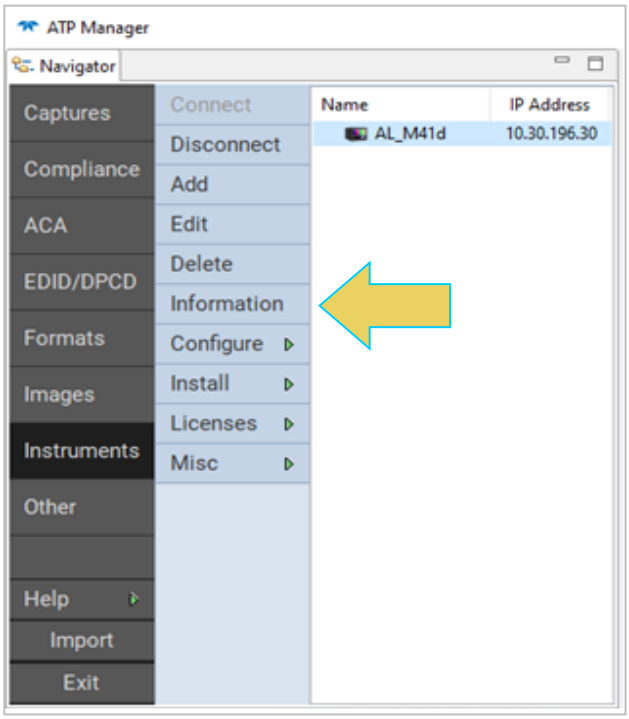
8. (If not already connected) Connect to the M42d using the **Connect** button or the **Connect** item on the right click menu as shown in the screen below.



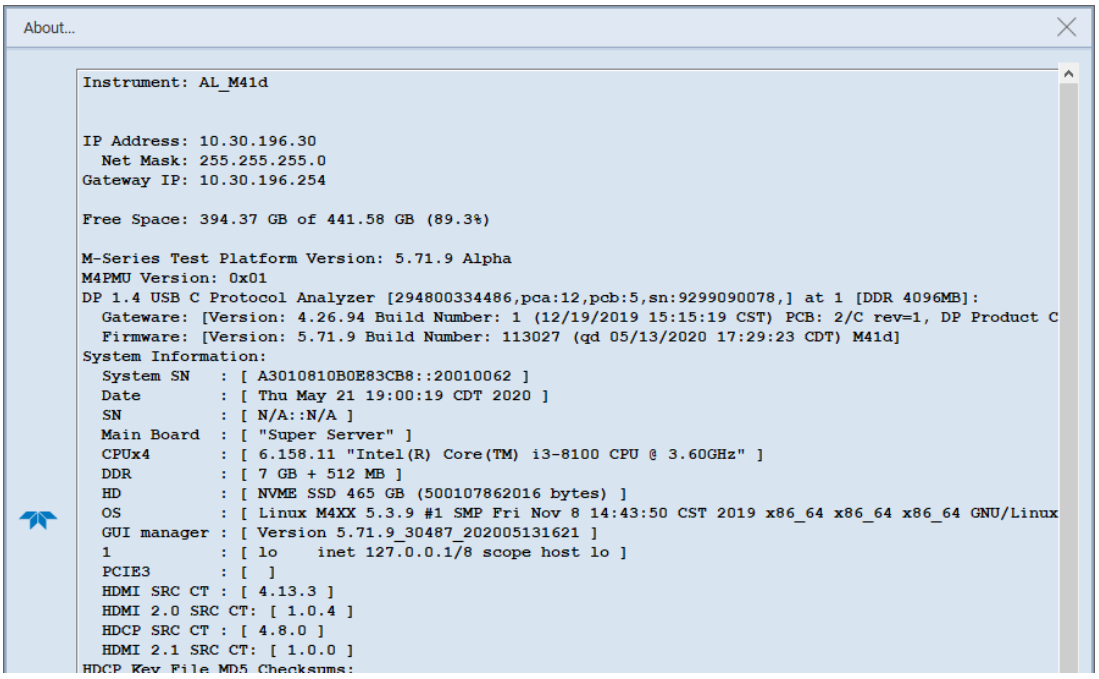
A dialog box appears indicating that a connection is in progress.

Saving the Instrument Information Report

Once the connection is made the information about the connected M42d is available via the Information button as shown below.

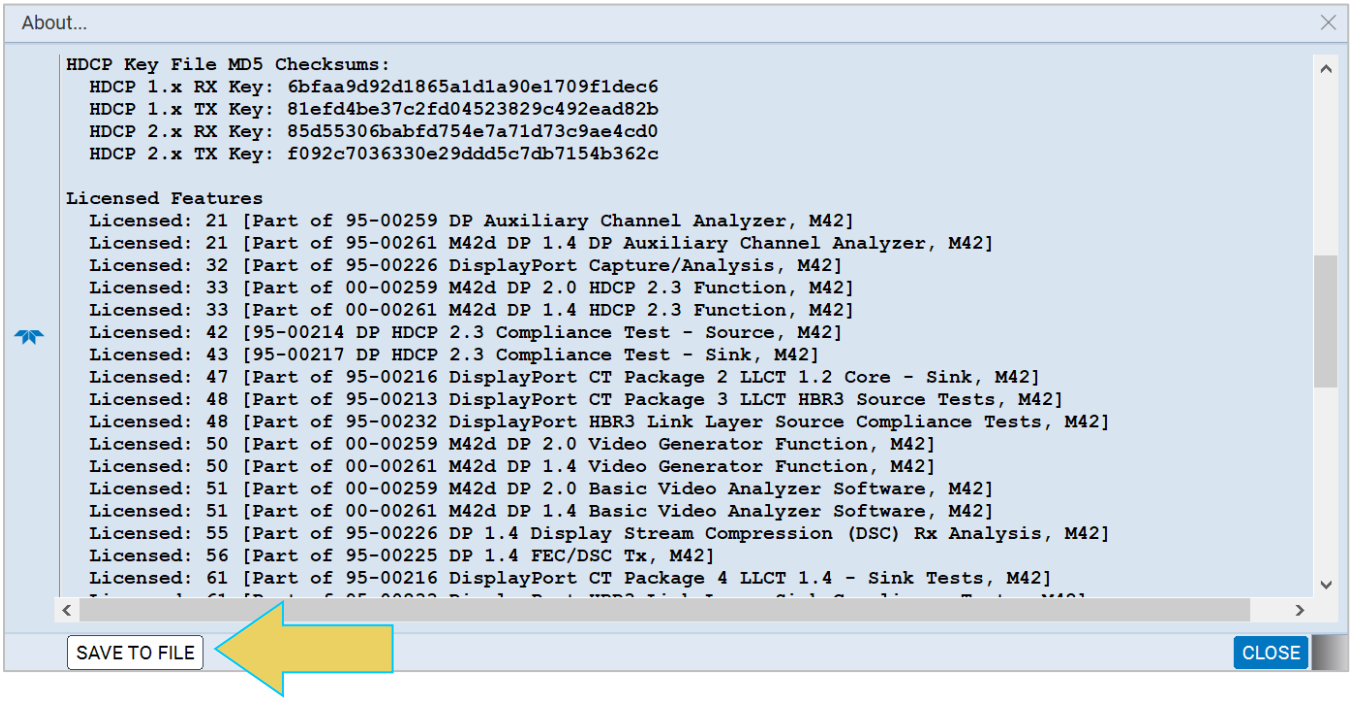


The information is then displayed in a separate window. The information on the Instrument Information window tells you the firmware and hardware release and version information as well as what options you have. This report will be needed if you contact Teledyne LeCroy technical support for any operational questions or issues. The procedure for saving the information report is described on the next page.



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 left of the report window, as shown below.



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

2.3 ATP Manager Home Screen and Navigator

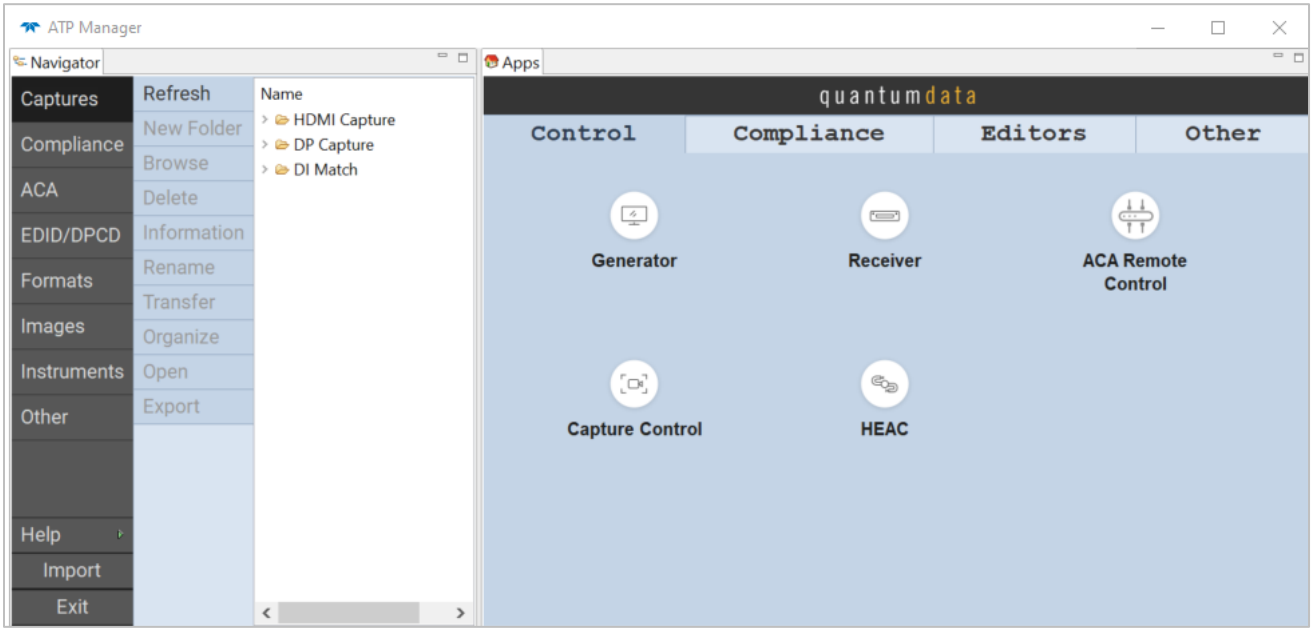
The previous sections briefly showed the ATP Manager GUI, but this section will cover the basics of the Interface in more detail, specifically the Home Screen and **Navigator**.

Home

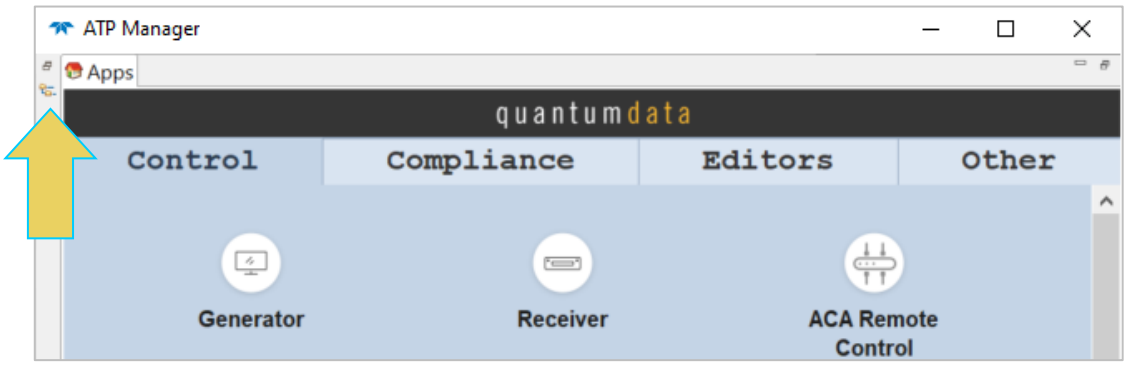
When first opening the ATP Manager, you will see the **Home** screen. This interface has 4 tabs:

- Control
- Compliance
- Editors
- Other

Each of these tabs has its own apps within them. Aside from Compliance, these will all be covered in detail throughout this User Guide. An example of the home screen on a remote PC ATP Manager GUI is shown below.

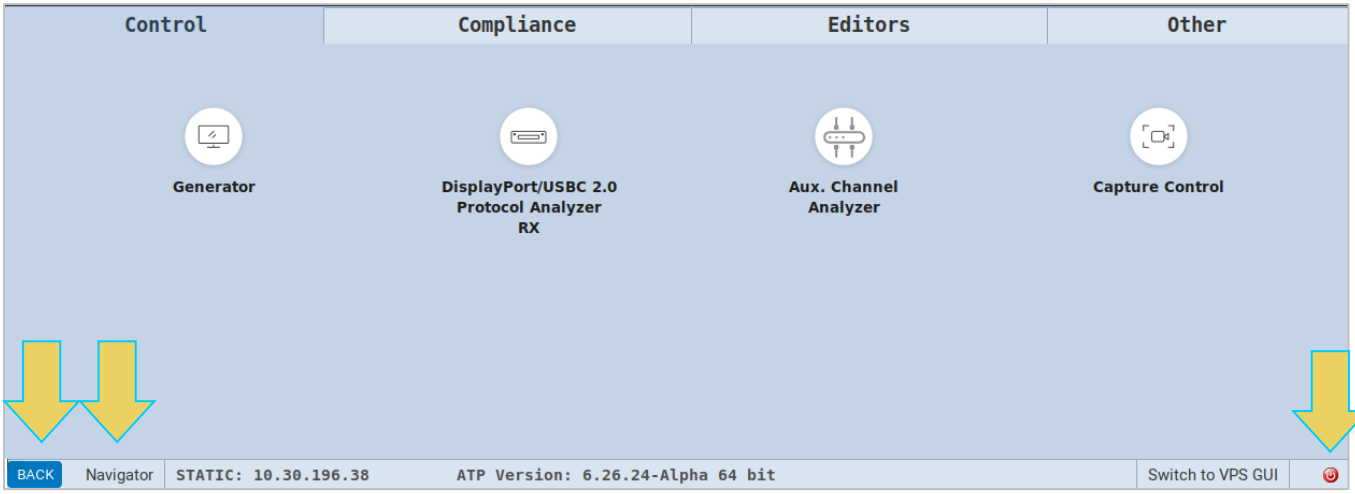


Notice the **Navigator** panel is side by side with the home screen (labeled **Apps**). Either can be minimized or restored using the buttons at the top right of the respective panel. The example below has the Navigator minimized.



The screenshot below is of the embedded GUI on the M42d instrument itself. Note the main difference being that the Navigator and Home are separated in this GUI.

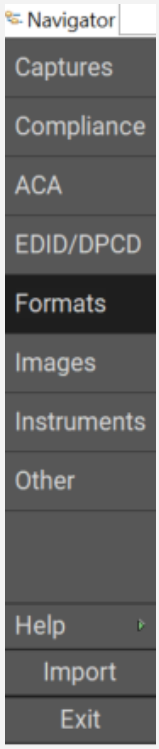
In order to access the Navigator, click the **Navigator** icon at the bottom left of the screen. Additionally, you can use the **BACK** button to navigate back to previous utilities, or click the power button in the bottom right to shut down or reboot the device.



Navigator

The Navigator is a feature-rich utility in the ATP Manager that allows for data portability and customization with the M42d 80G Video Analyzer/Generator.

The Navigator has a sidebar, as seen in the table below, with several options. This subsection will cover a few of these options now, while others are detailed in later chapters.

Navigator Sidebar		
Sidebar	**Button**	**Description**
	**Captures**	Access the directory containing Captures on the device or remote PC.
	Compliance	Access the directory containing Compliance Test selections and results
	ACA	Access the directory containing Aux Channel Analysis data and Filters
	EDID/DPCD	Access the directory containing saved EDID configurations and DPCD registers
	Formats	Access the directory containing saved Formats and Format Lists
	Images	Access the directory containing Image Patterns and Image Lists
	Instruments	List of connected devices. Covered in **Section 2.2 Installing and Connecting the M42d**
	Other	Access Saved Reports
	Help	Access the help/about menu
	Import	Import a file onto a remote PC ATP Manager (remote manager only)
	Exit	Quit the ATP Manager Application

The Navigator allows you to **Import** and **Export** files onto the M42d instrument itself or the remote PC running the ATP Manager GUI. These features enable you to disseminate or receive data and files to/from colleagues, subject matter experts, or Teledyne LeCroy technical support.

The **Transfer** tool within certain tabs is only available on the Remote ATP Manager GUI. The transfer tool allows you to transfer data and files between the remote PC and the M42d instrument. This can be useful for backing up files to both devices or for remote access of tests or analyses run using the embedded GUI ATP Manager on the M42d device.

Examples of file import and export as well as transfer are covered in **6.6 Importing, Exporting, and Transferring Capture Files** as well as **7.5 Importing, Exporting, and Transferring ACA Data**

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.**

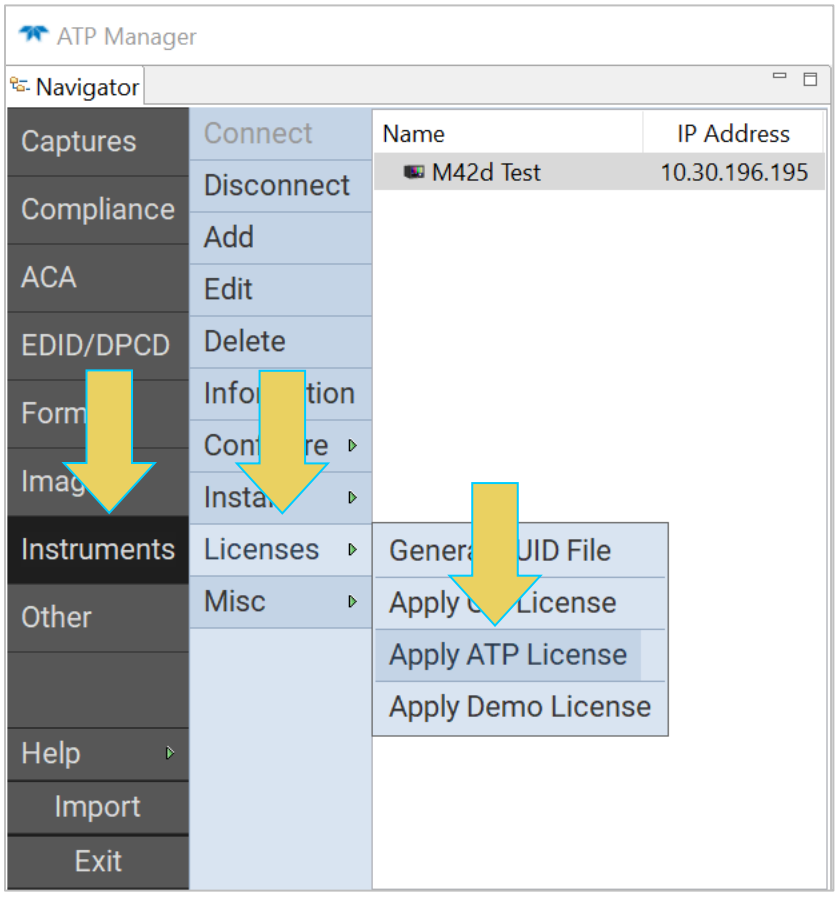
Note: To obtain a license for the M42d, contact Teledyne Support, accessible at **http://quantumdata.com/support.html**

To apply a license:

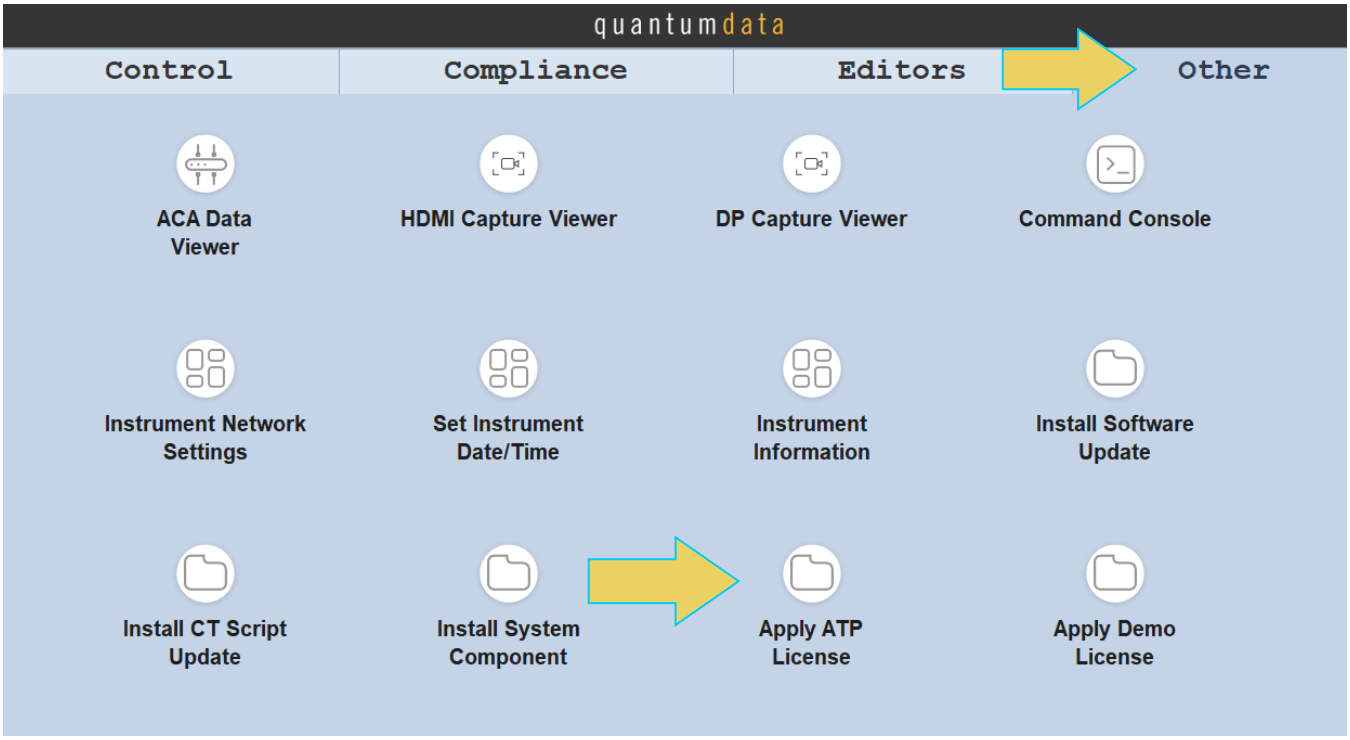
1. Upload the license file (.lic) using the Navigator by clicking **Instruments,** then selecting **Licenses** and clicking **Apply ATP License.** Alternatively, you can access this by selecting the **Other** tab on the GUI home screen and selecting **Apply ATP License**. Both are shown below.

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

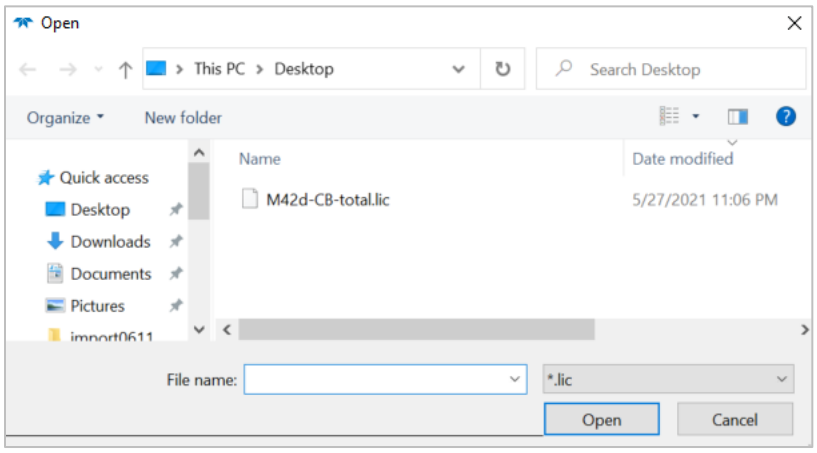
   Using the Navigator:



Using the GUI:



2. 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**.



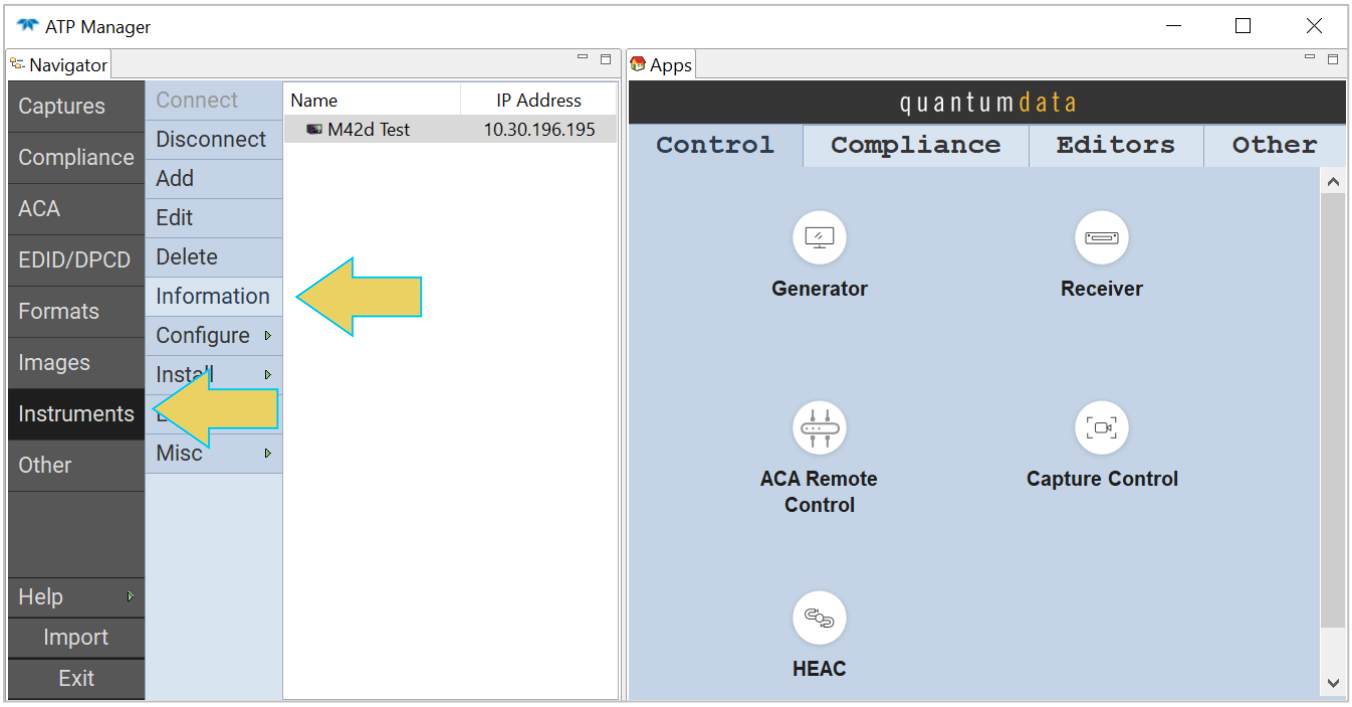
3. A confirmation will appear, and you must reboot the device for the changes to take effect.

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.

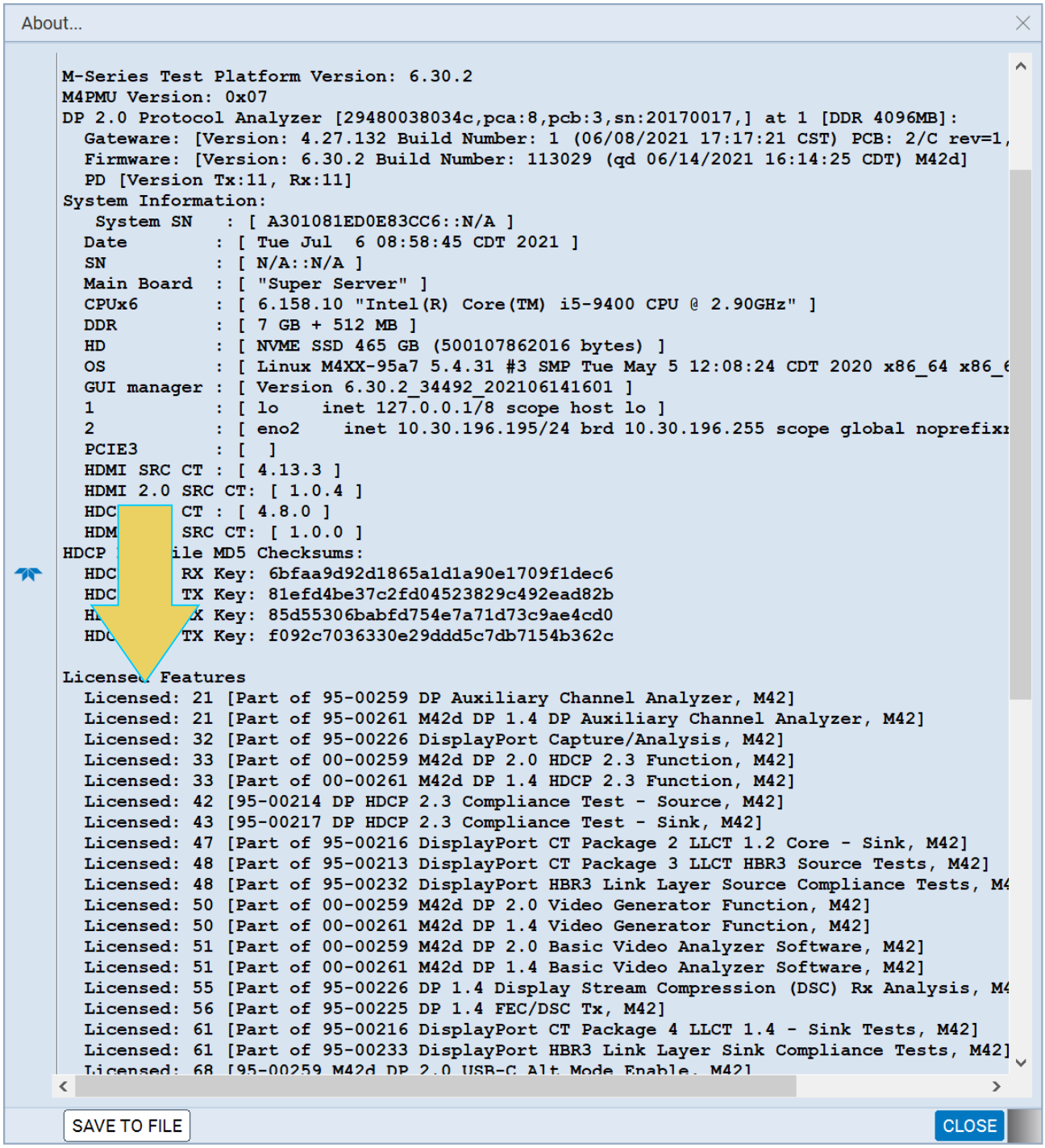
1. Using either the embedded M42d GUI or Remote Host PC ATP Manager, open the **Navigator.**
2. Select the **Instruments** tab.
3. Choose the instrument that you are looking up and select **Information** on the left-hand side bar.

   The Remote ATP Manager will automatically connect to the specified device, if not already connected.



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.

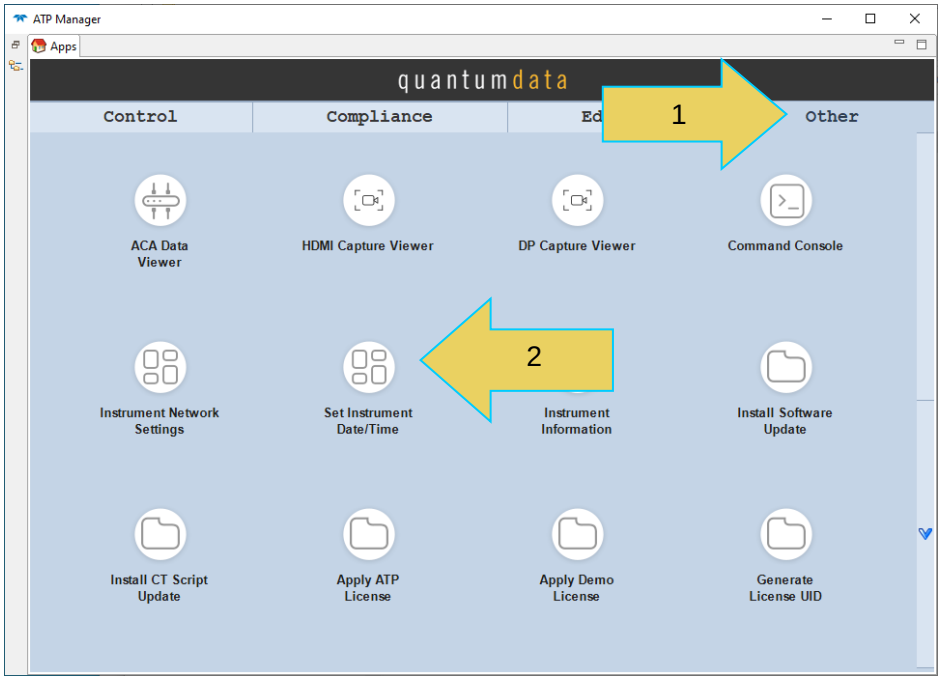


Setting the Instrument date and time

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 ATP Manager.

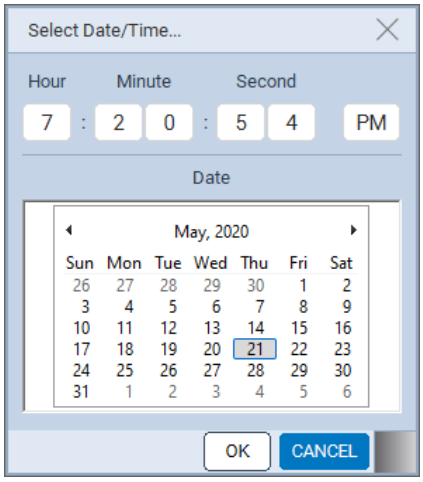
To set the date and time of the M42d:

From the **Other** page (Page 4) of the Apps Window select **Set Instrument Date/Time**.



The **Select Date/Time** dialog box appears as shown below:

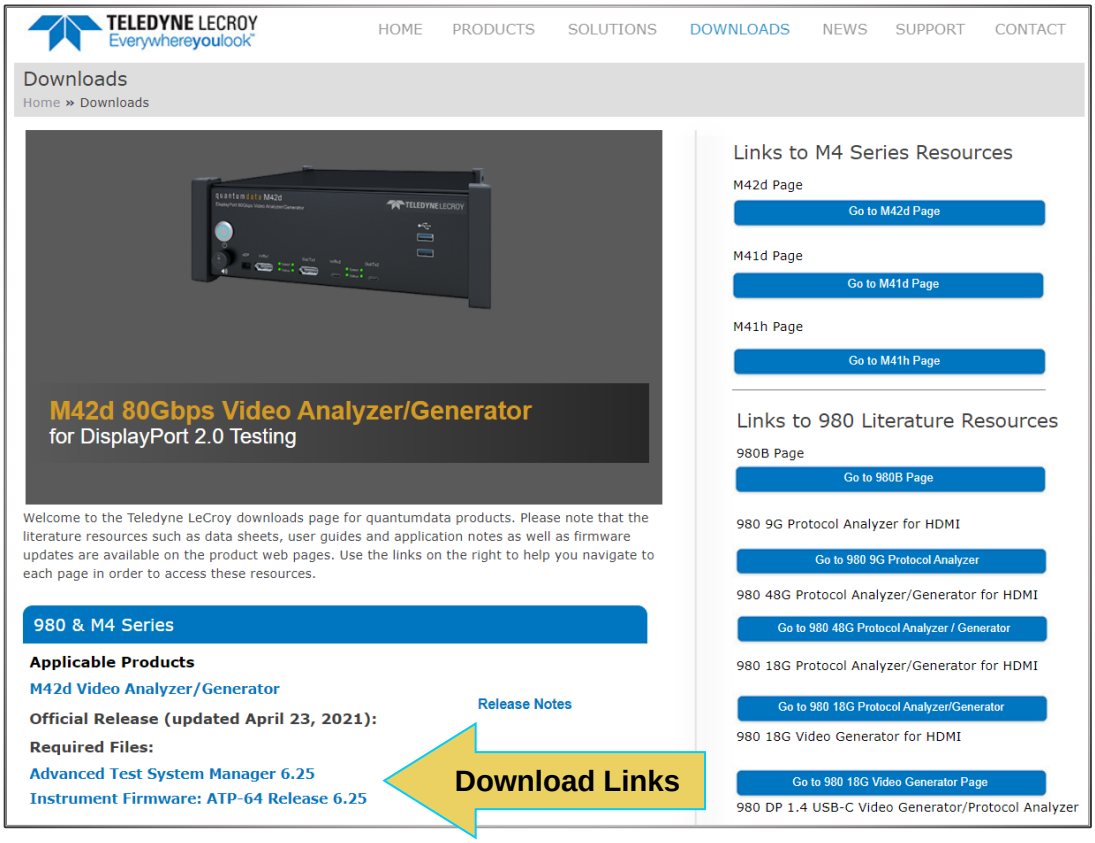
Set the month and date and time by selecting from the Calendar and time dials.



2.5 Upgrading ATP Manager

This section provides information about upgrading your M42d and M42d ATP Manager. 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**.



Two software packages are available for upgrading the M42d:

The firmware and gateware 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 also includes the embedded ATP Manager that will be installed.

Windows-based ATP Manager. This is the ATP Manager GUI that can be used to control the M42d instrument from a Windows PC. This download is discussed previously in **Section 2.2 – Operating the ATP Manager on a host PC**

Notes:

You must upgrade the Windows-based ATP manger every time you upgrade the firmware/software on the unit. **Upgrade the ATP Manager first,** and then upgrade the M42d application firmware as indicated in the release notes.

Please be sure to refer to the Release Notes for the specific release for detailed upgrade instructions.

2.6 VNC Remote Connection

Sections 2.1 and 2.2 discussed controlling the M42d device either directly using an external monitor, or remotely using the ATP Manager 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.

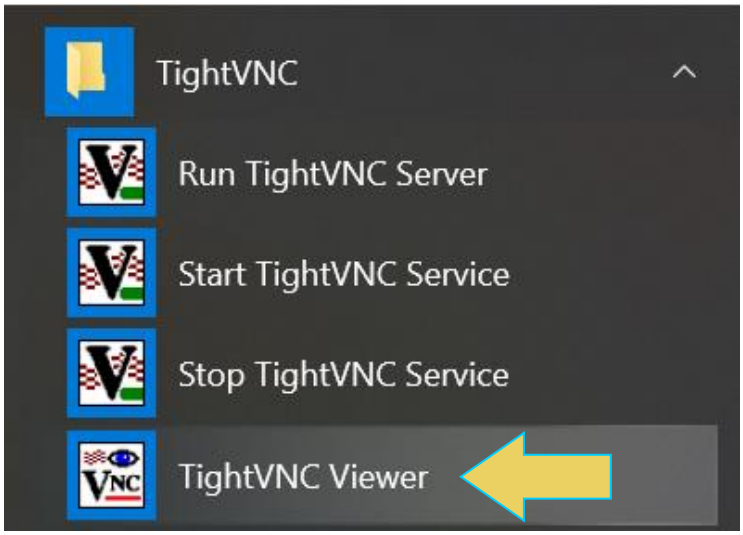
The instruments come with **TightVNC Server** installed and enable the user to access the embedded GUI of the instrument remotely as an alternative to using the ATP Remote Manager. The main advantage of this is to utilize features that are modified or inaccessible while using a remote host ATP Manager.

Installing TightVNC Viewer and Connecting to the Device

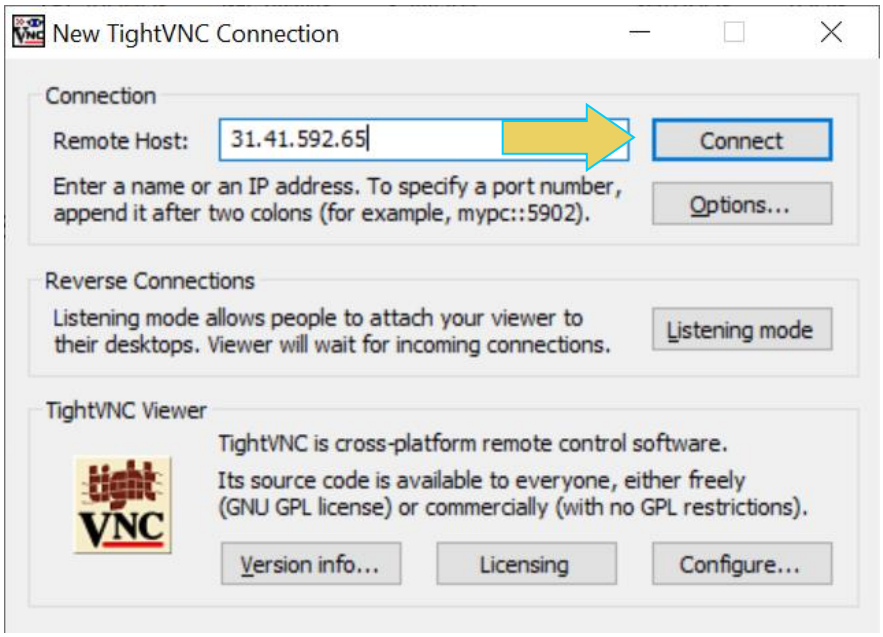
TightVNC Viewer for windows is available for free download at **https://tightvnc.com/download.php**. Navigate to this page on the remote PC that you would like to control the M42d device from, and install the compatible software package.

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 ATP Manager 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.

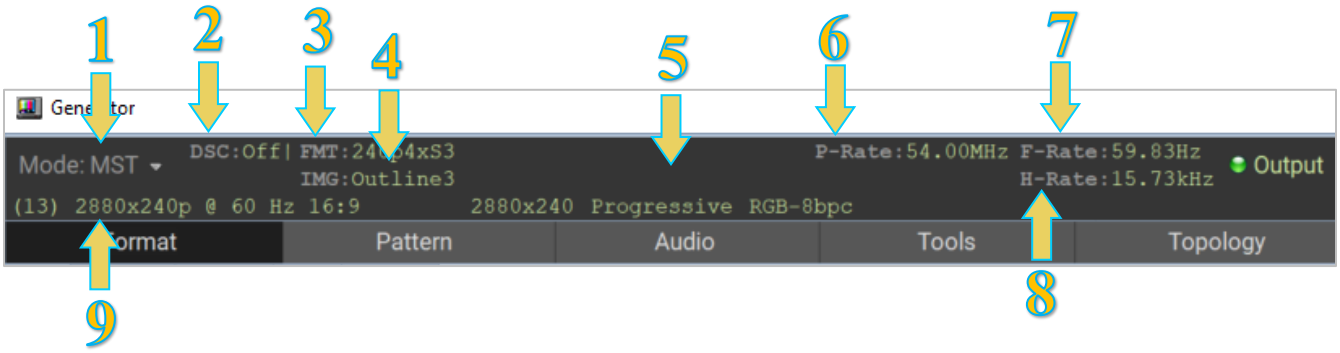
With the VNC Viewer, you can operate the instrument's embedded GUI to access certain features unavailable on a remote host PC ATP Manager GUI.

3 Generator

3.1 Overview

This section provides information for using the M42d video generator function. To access this, select the Generator application icon from the home screen.

The Generator screen has a status area on the top of its panel, pictured below.

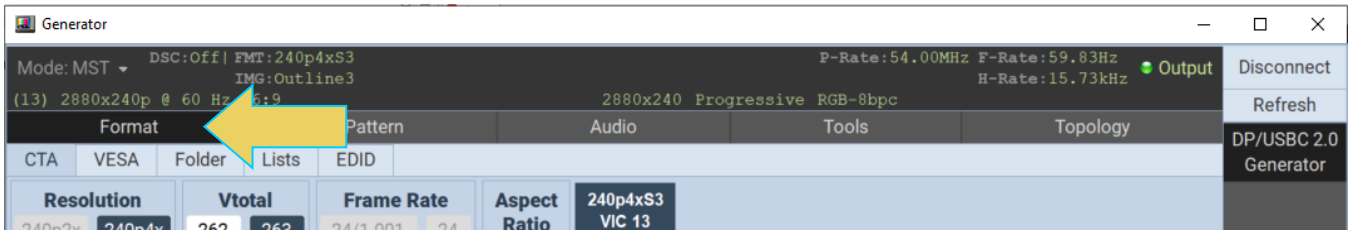


The status area provides the following information:

Generator Status Area (Top)		
Number	**Item**	**Description**
1	Mode	Multi-stream (Multi-Stream Transport) or Single-stream (SST) Transport
2	DSC	Indicates whether Display Stream Compression is currently on or off
3	FMT	The currently active format (selected resolution)
4	IMG	The currently active image (selected test pattern)
5	Resolution, scan, and color	Resolution, scan type, and colorimetry type of active format.
6	P-Rate	The pixel clock rate of the selected timing.
7	F-Rate	The frame or vertical refresh rate of the selected timing.
8	H-Rate	The horizontal refresh rate of the selected timing.
9	Video Identification Code (VIC)	The VIC code is shown in parentheses, followed by the resolution, frame rate, and aspect ratio of the active format.

3.2 Selecting DisplayPort Video Format

Use the following procedures to select a video resolution (format). To access the formats menu, select the Format tab at the top of the Generator application in the M42d GUI Manager.



You can select formats (timings) from either the M42d 80G Video Analyzer/Generator's format library, from the CTA or VESA parameter filters, or from a reduced subset of formats. You can select a format in one of four ways, which are all covered in this section.

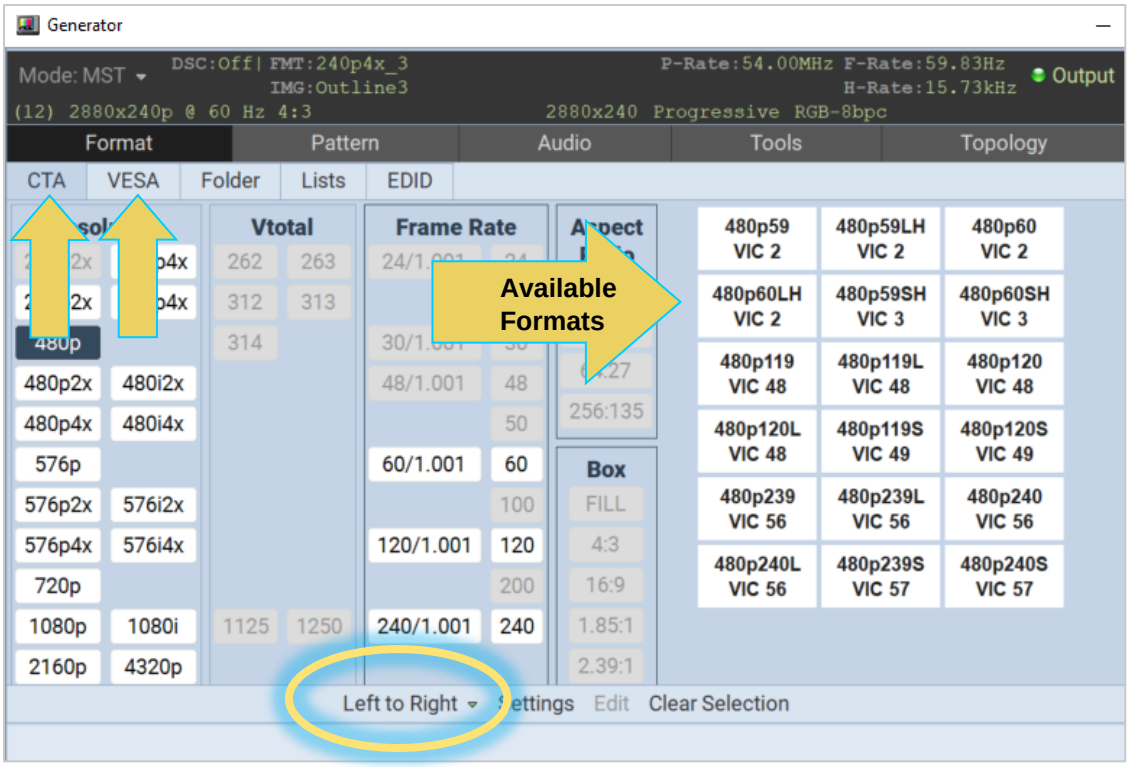
- Select using CTA or VESA smart filters
- Select from the entire library list of formats
- Select from a custom list you have created using the Format List Editor
- Select from a list of formats configured from the EDID of the connected display

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 the CTA or VESA Smart Filtering button

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

Select either the **CTA** or **VESA** subtab underneath the Format tab. The smart filtering screen enables you to select CTA or VESA formats through filtering of various video parameters such as Resolution, Vtotal, Frame Rate, and Aspect Ratio.

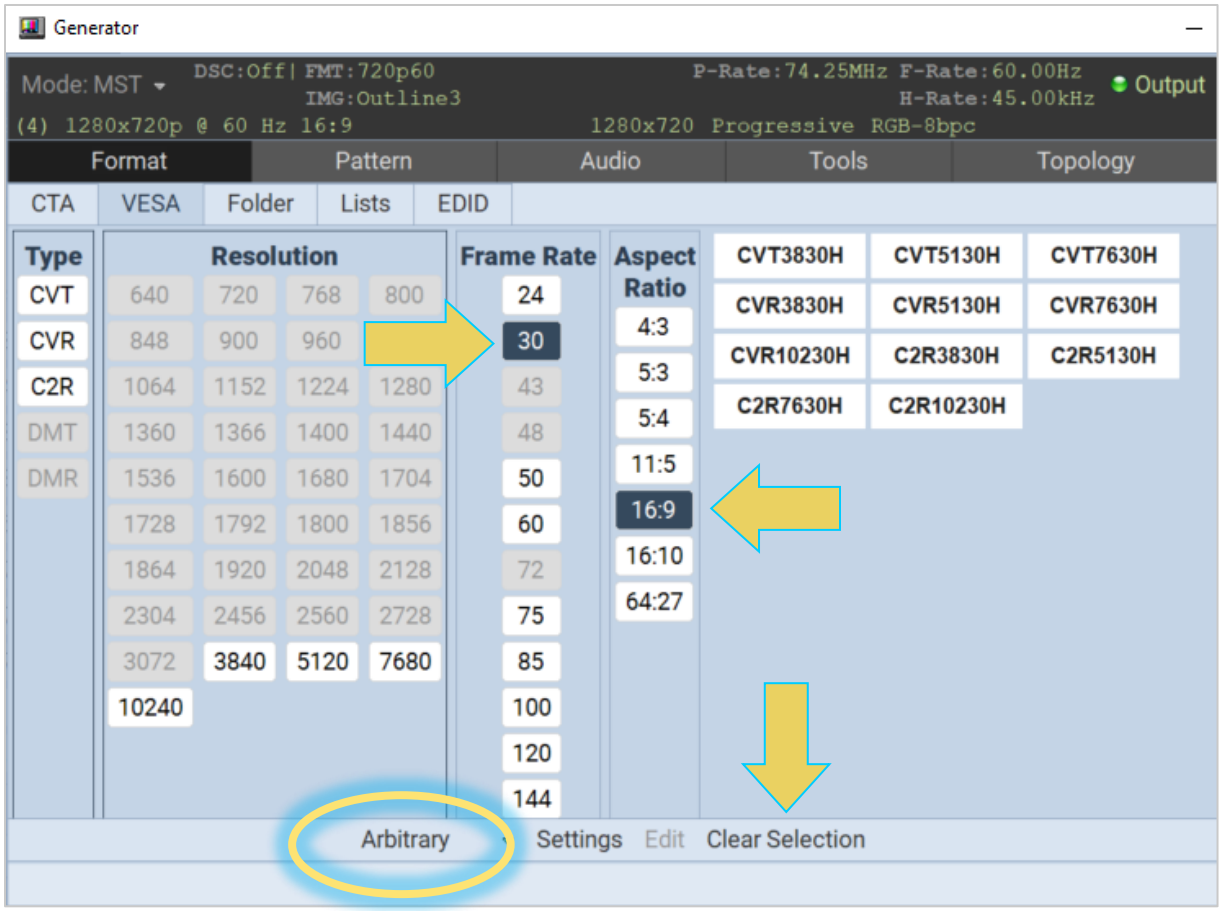


In the previous screenshot, **Left to Right** selection is enabled (circled at bottom of screen). This will show available formats (on the right) that meet the filtering criteria as you narrow down the specified parameters in the following order:

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

Instead of Left to Right, you can also select **Arbitrary**, which enables you to specify filtering criteria in any order. Refer to the example below.

In this example, we are using the VESA smart filter and 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 Type.



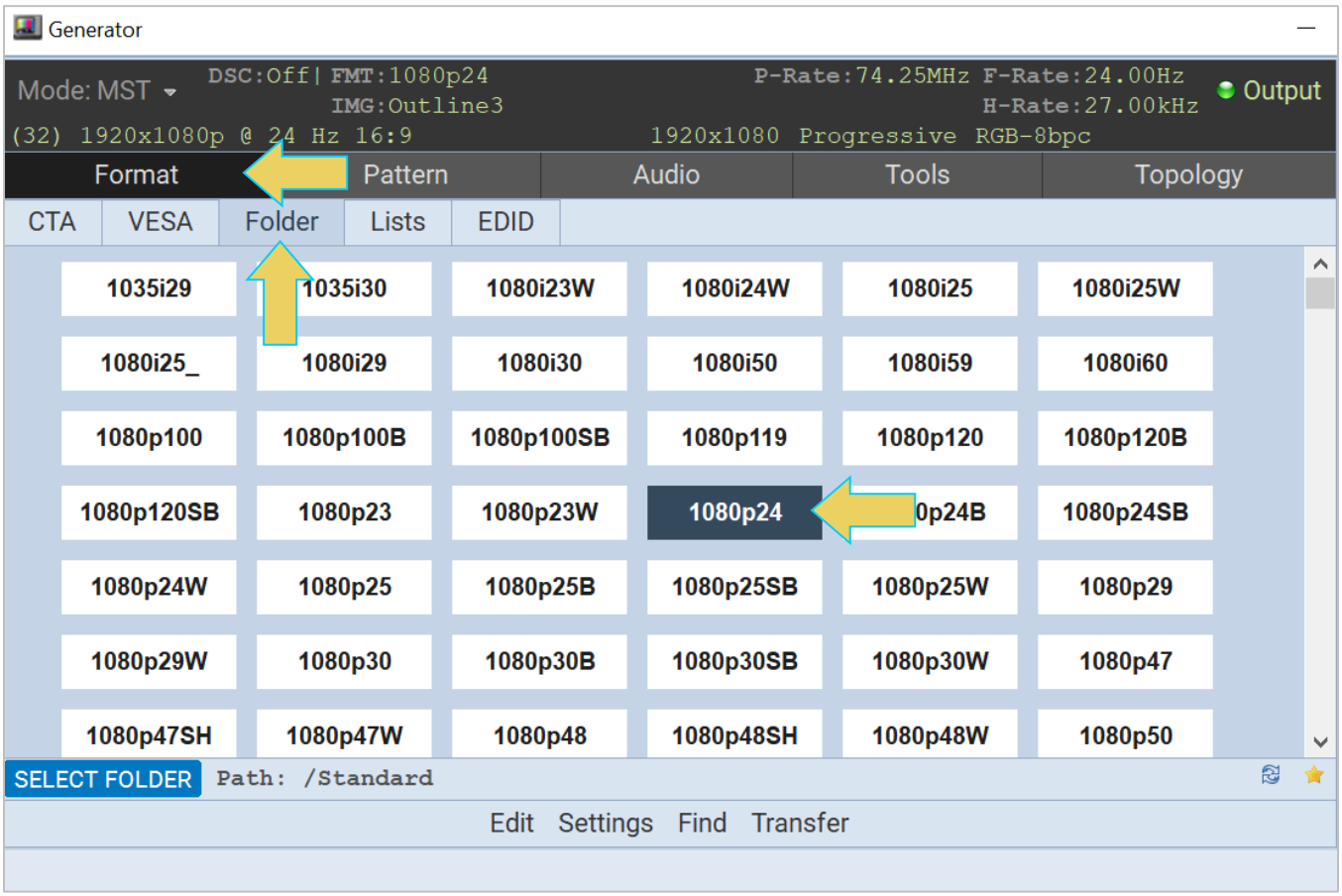
Note: To unselect any of the selected filtering criteria, click **Clear Selection** at the bottom of the window

Selecting format from Library List

Use the following procedures to select a video resolution (format) using the Library List method.

From the Format tab of the Generator app, click the **Folder** subtab. The directory whose formats are being displayed is listed in the lower panel. Typically, SELECT FOLDER Path: /Standard this would be the Standard directory where the M42d's format list is stored. The default path is the Standard path.

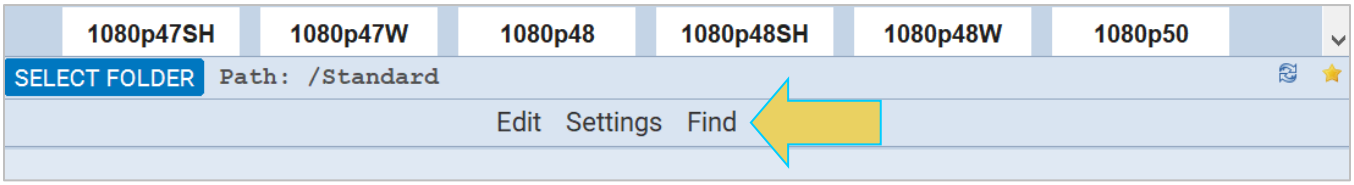
A list of DP, HDMI, or DVI formats will appear as shown in the example below.



The highlighted format is the format that is active. You can also determine this from the status information at the top of the panel. Alternatively, you can click on the Star icon in the bottom right of the panel, and the window will scroll to the currently selected format.

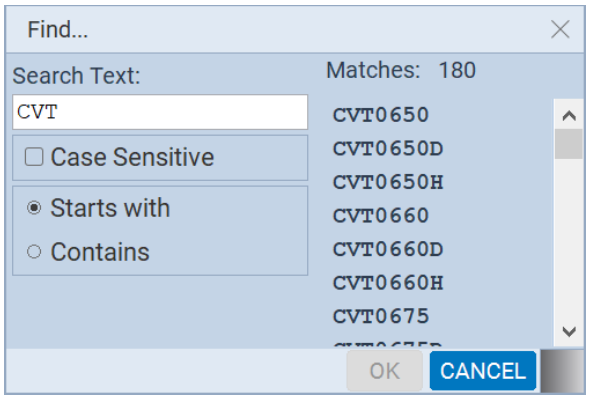
Select a format by clicking on it. Note that you can browse for a format using the scroll bar on the right. You can also search for a format using a test strings on the Find Format dialog box.

Click on the **Find** button on the lower portion of the Format panel.



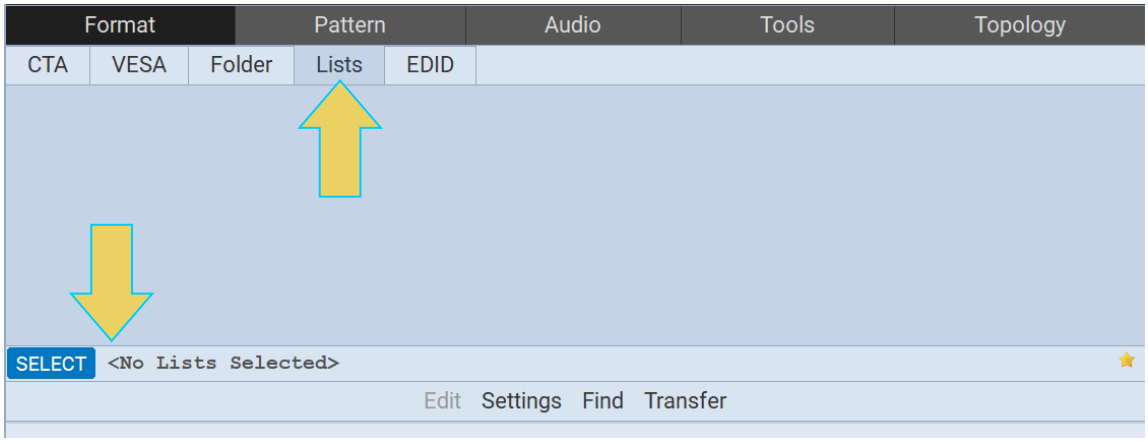
The **Find Format** dialog box appears as shown below. Enter a string in the Search Text field to find a format. You can specify either Starts with or Contains using the radio buttons and you select the Case Sensitive check box to indicate case sensitivity in your text. Click on the **OK** button when you have located the format.

In this screenshot example, the text “CVT” has returned 180 possible matches.

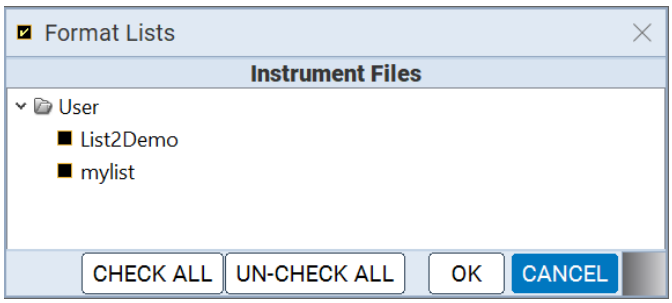


Selecting format using custom Lists

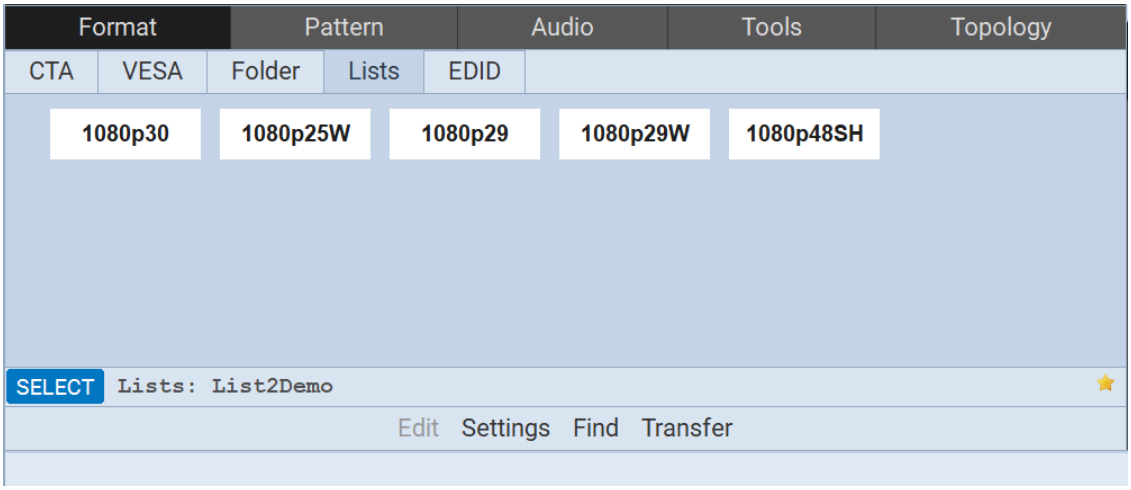
You can create a custom list of formats using the Format Editor (**covered in section 4.5, under the Tools tab**). This allows you to quickly select from an abbreviated list of your preferred formats. To access your list(s), Click the **Lists** subtab underneath the Format tab. The screen below is what you will see; notice that before selecting your list, you’ll get a blank screen and the bottom taskbar will read “<No Lists Selected>”



You can open up and activate any custom Format Lists you have previously defined using the **SELECT** icon (arrow above). A dialog box will appear enabling you to select a custom format list or lists.

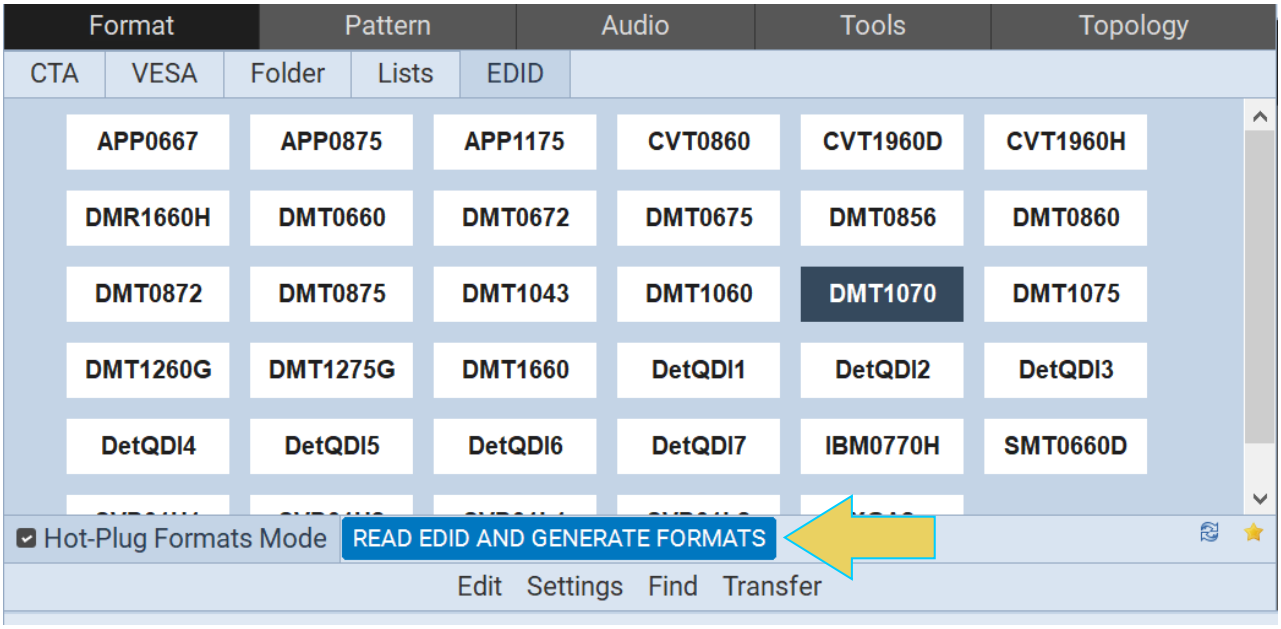


You can select any or all of the custom Format Lists. The example above shows two custom lists, but you can make as many as you'd like. Note that selecting multiple Lists will display all of them in the Format selection window. The screenshot below shows a single list selected. The name of the list or lists will appear in the bottom taskbar.



Generating format from EDID

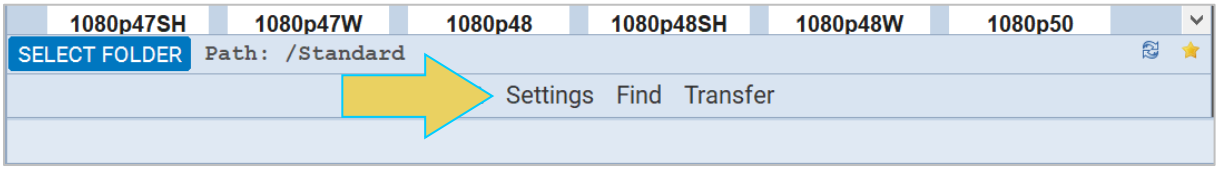
The final subtab under Format is the **EDID** smart activation panel. Click on this button to configure the list of formats in accordance with the EDID for the connected display. The screenshot below shows the EDID panel and the **READ EDID AND GENERATE FORMATS** button, which will present a listing of the preferred formats for the connected DUT.



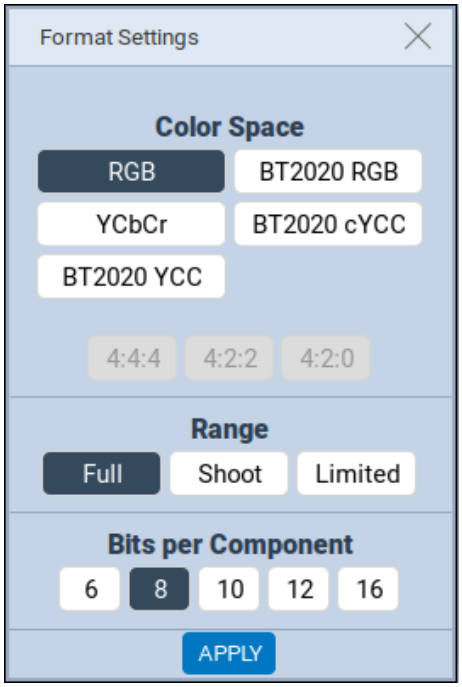
Configuring the format Settings

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

Specify the format settings by clicking on the **Settings** button on the lower center of the panel.



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



Format Settings		
Parameter	Description	Options
Color Space	Colorimetry and video pixel encoding settings.	• RGB – Uses 4:4:4 sampling. • YCbCr – Uses either 4:4:4, 4:2:2 sampling. • BT2020RGB • BT2020 cYCC • BT2020 YCC

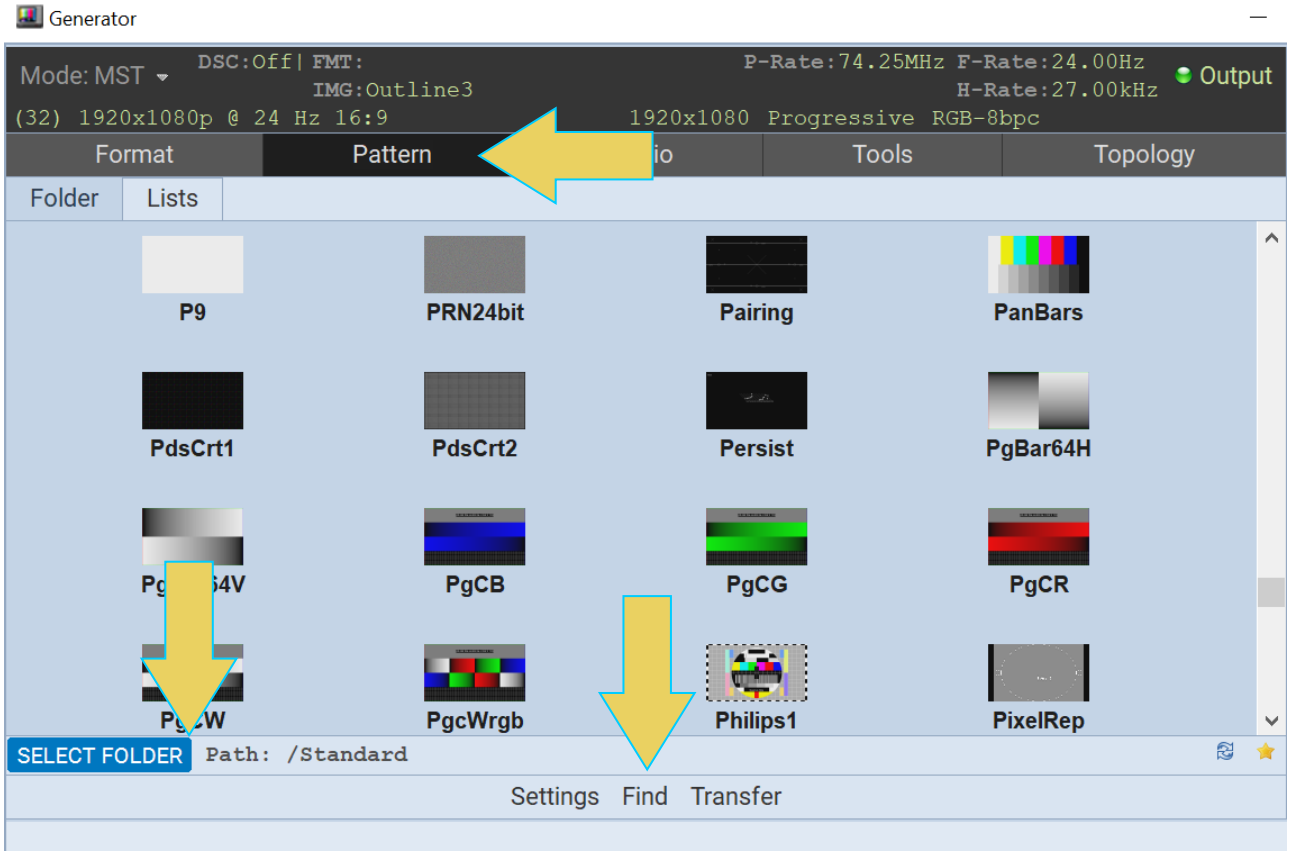
Format Settings		
Parameter	Description	Options
Quantization Range	These values are described in CEA-861E. They pertain to the number of levels for RGB and YCbCr mode.	• Limited – Use for CEA formats. Please refer to the specification section on Video Quantization Ranges for more details. • Shoot – for testing the undershoot/overshoot signal code margins. • Full - Use for PC formats. Please refer to the specification section on Video Quantization Ranges for more details.
Bits per Component	Color depth per component.	• 6 – Six (6) bit per component (24 bit per pixel) color depth. • 8 – Eight (8) bit per component (24 bit per pixel) color depth. • 10 – Ten (10) bit per component (30 bit per pixel) color depth; deep color. • 12 – Twelve (12) bit per component (36 bit per pixel) color depth; deep color. • 16 – Sixteen (16) bit per component (48 bit per pixel) color depth; deep color.

3.3 Pattern

Use these procedures to select a test pattern and configure its settings. Click on the **Pattern** tab at the top of the Generator app to access the list of test patterns. You can select a pattern either from the Library List (Folder subtab) or a custom list that you create.

Selecting a test Pattern from the Library List Folder

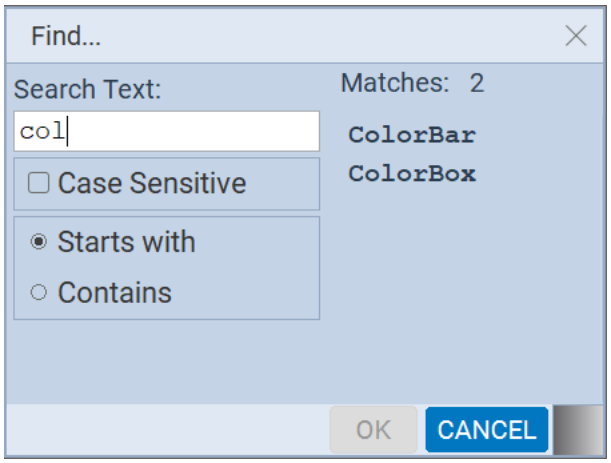
Upon clicking the Pattern tab, a list of patterns will appear. The directory of this Library List is located at the bottom of the window, as shown below. By default, the path is set to Standard, which will display the entire test pattern library.



Select a pattern from the list by clicking it. There is a scroll bar on the right to allow access to the entire list by browsing.

You can either scroll through the list of test patterns or use the **Find** feature to search for patterns. When you press the Find activation button (located at the bottom 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.

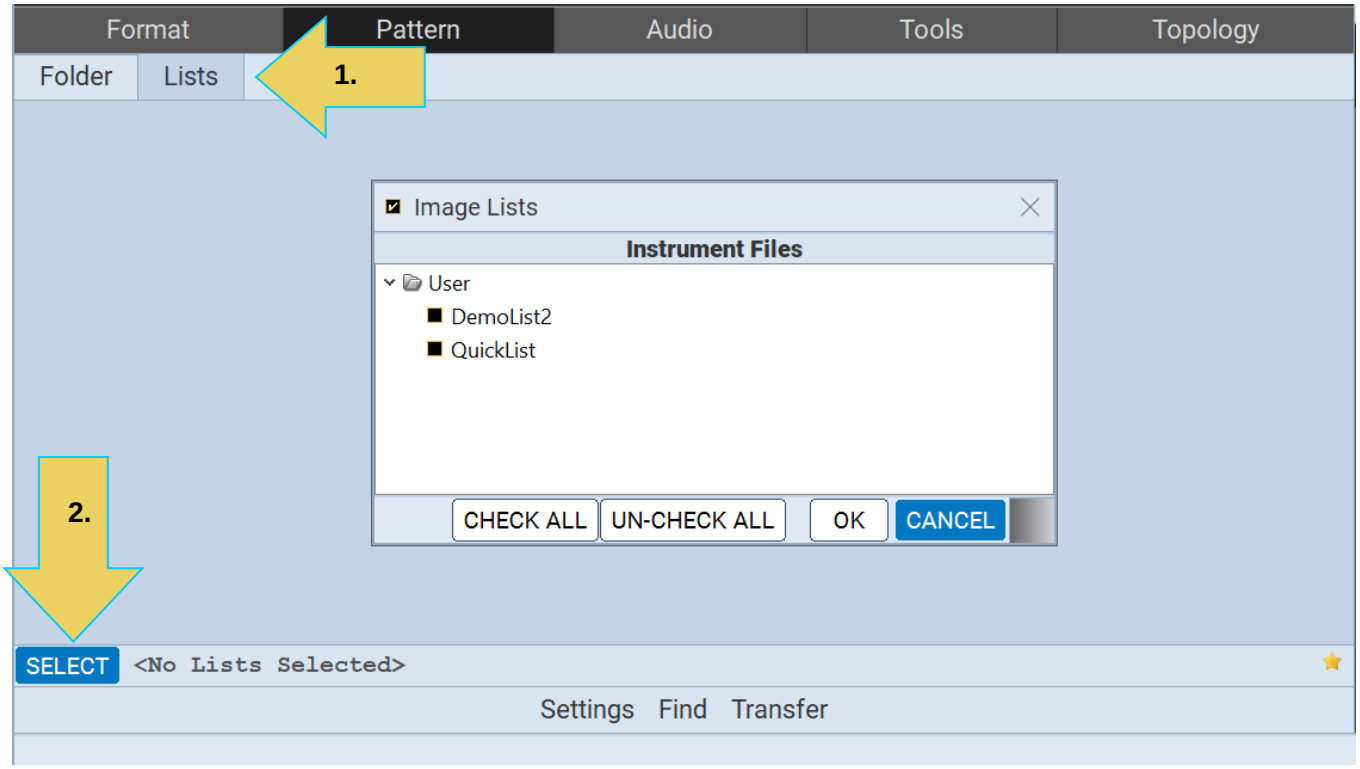
The following example shows a search for patterns starting with “col” and returns two results: ColorBar and ColorBox.



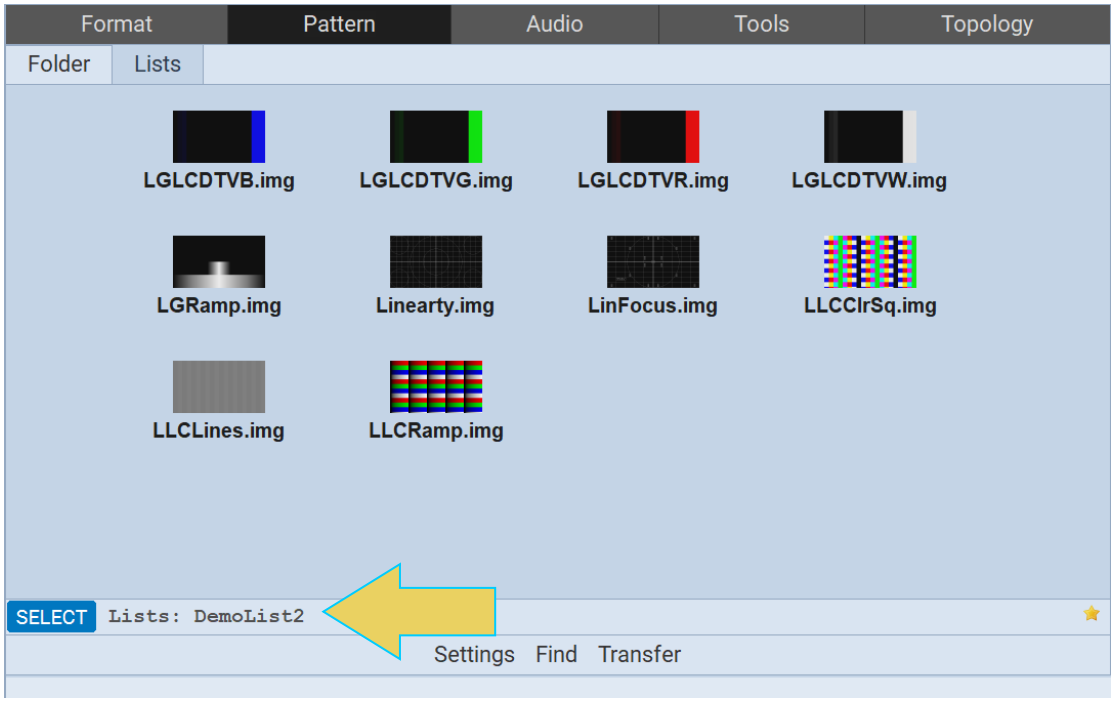
Using Custom List to select a Test Pattern

The subtab **Lists** at the top of the window allows you to pick from a pre-defined list of patterns that you can compile using the Pattern Editor (**covered in section 4.5, under Tools**).

Once again, this list will initially be empty, as shown in the following screenshot. Click the **SELECT** icon at the bottom of the panel to choose a list or set of lists. This is depicted below with two custom lists as options in the Select dialog box.



You can select any or all of the custom pattern lists you have defined. The **Check All** and **Un-Check All** buttons allow convenient selection where you have many Pattern Lists to choose from. The result of selecting one custom Pattern List is shown in the following example. A limited set of patterns area displayed. The **Path** icon at bottom status panel will display that new list's name (DemoList2).

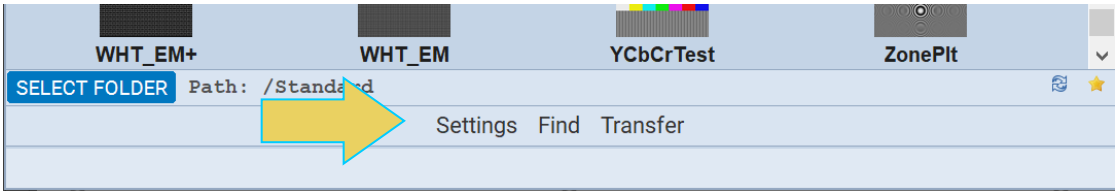


Configuring Test Patterns Settings

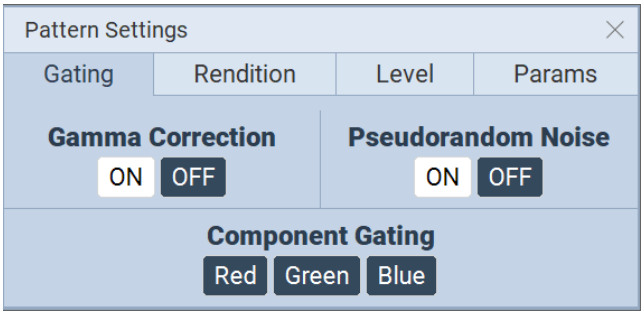
Use the following procedures to select a test pattern.

To specify test pattern settings:

1. From the Pattern tab, click the **Settings** button on the lower center of the panel.



The **Settings** dialog box appears as shown in the following screenshot:

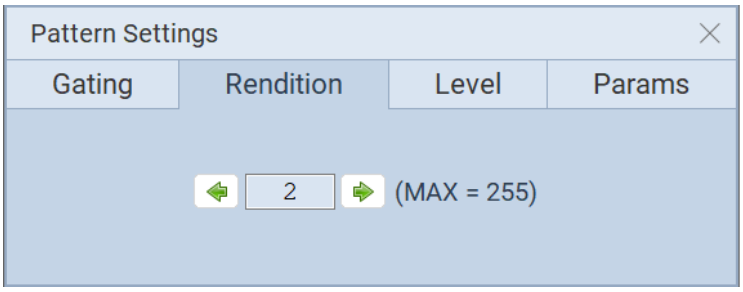


2. Enable and disable Gamma and Pseudo-random noise and set the gating as desired. Refer to the table below for details on these optional settings.

Pattern Settings - Gating	Description	Options
Gamma Correction	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.	• On • Off
Pseudo-Random Noise	Renders a test pattern with high level of volatility between adjacent pixels.	• On • Off
Component Gating	Turns on or off the three primary color components.	• Red • Green • Blue

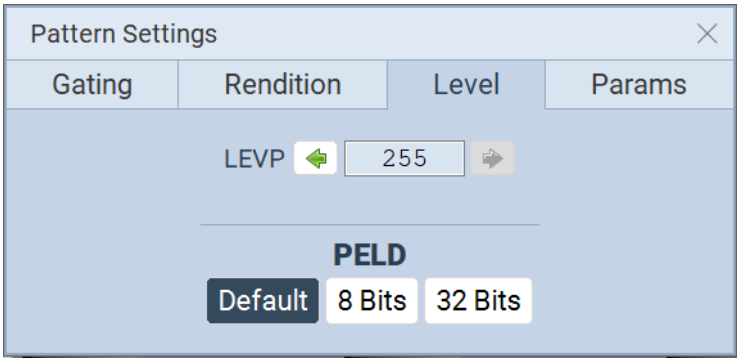
3. Select the rendition where applicable using the Rendition button. The associated dialog box is shown further below.

   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 2 is currently being rendered on the sink DUT.



4. Set the luminance level of the image with the Level button. The associated dialog box is shown further below.

   You can increment the color component values or can decrement the color component values for all pixels of any image through the front panel or the command line. This feature enables you to increment or decrement the values in increments (or decrements) of 1 throughout a range of 0 to 255. The LEVP feature increments or decrements all color component values (R,G,B) for each action by the use.

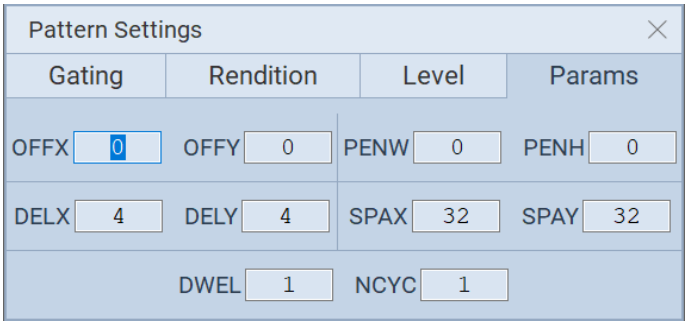


5. Set the pixel depth (PELD) if necessary through the Level button and associated dialog box in the previous screenshot.

   PELD establishes the number of data bits that represent each active pixel in video memory (frame buffer). Parameter. The default setting and setting of 8 allows 256 colors on an image (test pattern) to be rendered. This is suitable for the majority of test patterns. However, some test patterns contain more colors and either require PELD 32 or look optimal only when PELD is set to 32. The test pattern will indicate when PELD 32 setting is required.

   - Default - uses the M42d video generator default
   - 8 - 8 bits-per-pixel (256 colors)
   - 32 - 24 bits-per-pixel (16,777,216 colors).

6. Set the pattern parameters, if necessary, through the **Params** button and associated dialog box shown below. The following table describes each parameter.



Pattern Settings - Parameters	Description
OFFX	Set horizontal offset for large patch of Regulate image
OFFY	Set vertical offset for large patch of Regulate image
DELX	Set horizontal shift for each step of SlideG/SlideRGB image
DELY	Set vertical shift for each step of SlideG/SlideRGB image
DWEL	Set number of frames for each step of SlideG/SlideRGB image
PENW	Set width variable for line thickness in EeRise, NAWC, and Slider images
PENH	Set height variable for line thickness in EeRise, NAWC, and Slider images
SPAX	Set horizontal spacing
SPAY	Set vertical spacing
NCYC	Internal use

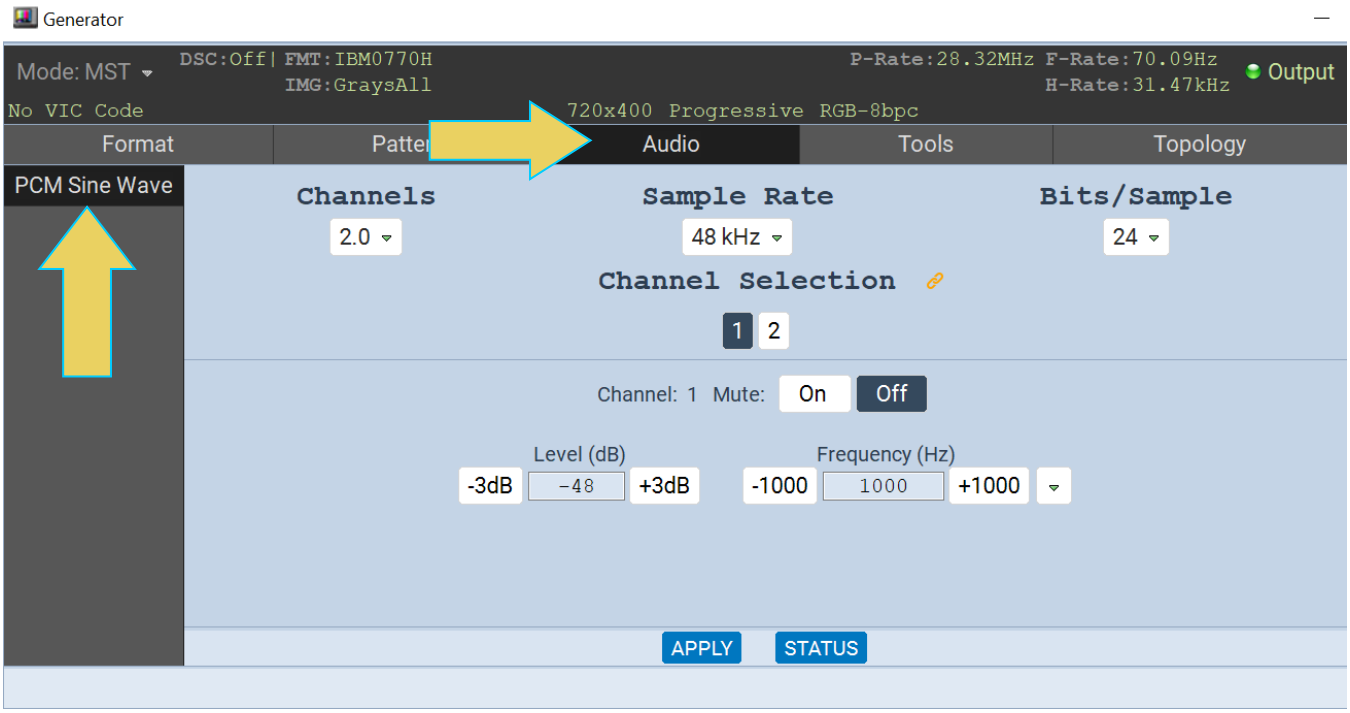
3.4 Testing audio on an audio rendering device

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 also 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:

From the Generator app of the M42d ATP Manager interface, select the **Audio** tab. If not already selected, click the PCM Sine Wave icon on the left side of the window. Both are shown below, as well as the full audio tab interface.

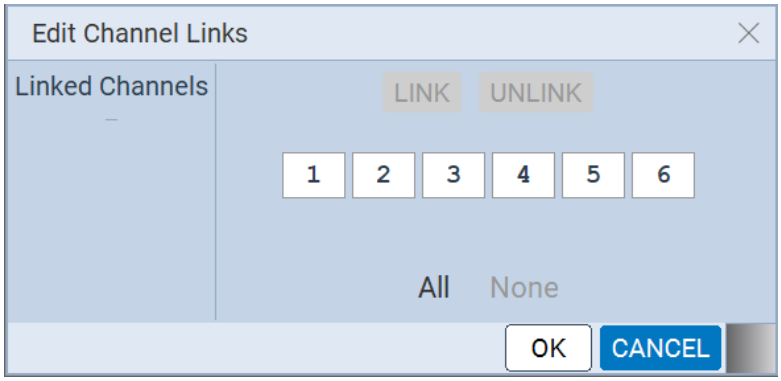


The table below summarizes the M42d 80G Video Analyzer/Generator uncompressed LPCM programmable audio test tones.

LPCM Programmable Sine Wave options		
Parameter	**Description**	**Options**
Channels	This is the number of channels in the audio sine wave test tone.	• 2.0 • 2.1 • 5.1 • 6.1 • 7.1

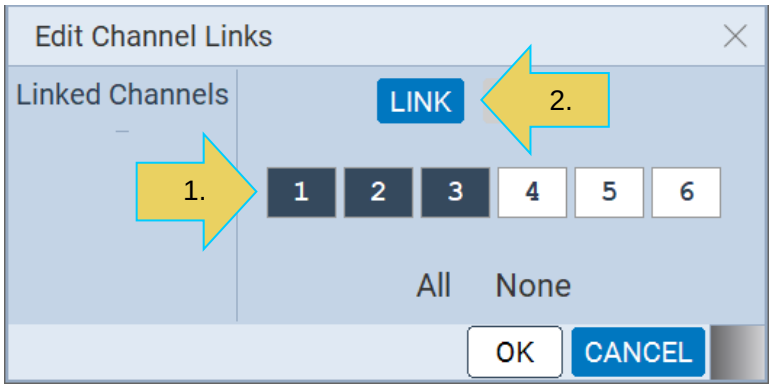
LPCM Programmable Sine Wave options		
Parameter	**Description**	**Options**
Sampling Rate	This is the sampling rate of the audio sine wave test tone.	• 32kHz • 44.1kHz • 48kHz • 88.2kHz • 96kHz • 176.4kHz • 192kHz
Bits per Sample	This is the number of bits per channel of the audio sine wave test tone.	• 16 • 20 • 24
Channel Selection	Indicates the channels that are active. Also indicates the channel that is configured for the Level, Mute and Frequency Parameters.	1. FL – Front Left 2. FR – Front Right 3. LFE – Low Frequency Effects 4. FC – Front Center 5. RL – Rear Left 6. RR – Rear Right 7. RLC – Rear Left Center 8. RRC – Rear Right Center
Level (dB)	This is the amplitude of the audio sine wave test tone.	• Increments in 3dB throughout a range of – 0dB to -99dB (per channel).
Mute	Mutes or unmwutes the audio for a particular channel.	• On • Off
Frequency (Hz)	The frequency of the audio sine wave test tone.	Programmable throughout a range of .008 kHz to 20kHz (per channel) in increments of: • 1Hz • 10Hz • 100Hz • 1kHz

Next to **Channel Selection** is a clickable icon  which allows you to link channels together so that you can adjust settings for all of them at once. Click this icon and the **Edit Channel Links** dialog box appears, as shown in the following screenshot (Note: if you have 2.0 Channels selected, clicking this icon will simply link these two channels, and no dialog box will appear).

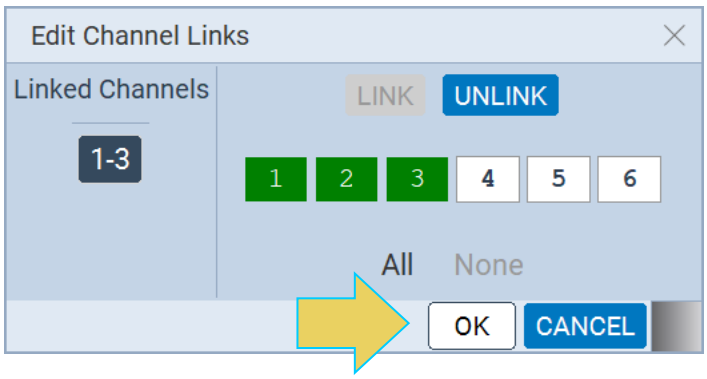


In this dialog box, you can select any number of channels you wish to link. Easily select **All** or **None** of the channels using the respective button.

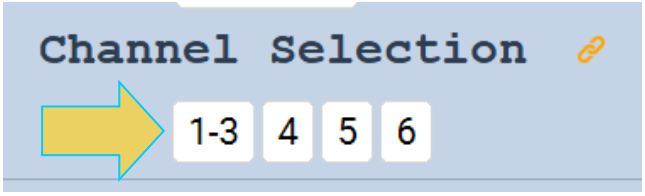
Once you have the channels selected that you wish to link, click the **LINK** button at the top of the dialog box. The following example has channels 1-3 selected and ready to link.



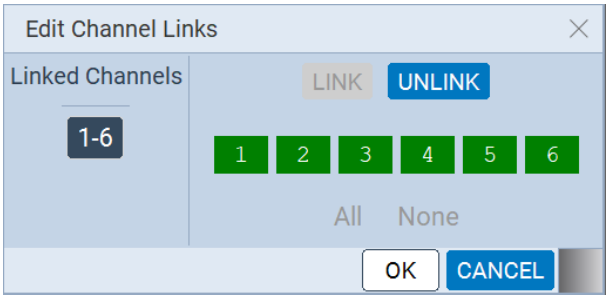
After clicking LINK, the numbered boxes that you selected for linking will turn green. Click **OK** to be taken back to the main Audio testing interface.

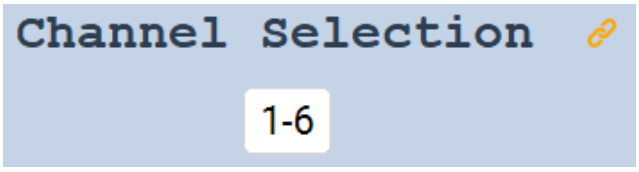


Notice that in the example below, Channels 1-3 are now only one clickable icon, and 4, 5, and 6 remain separate.

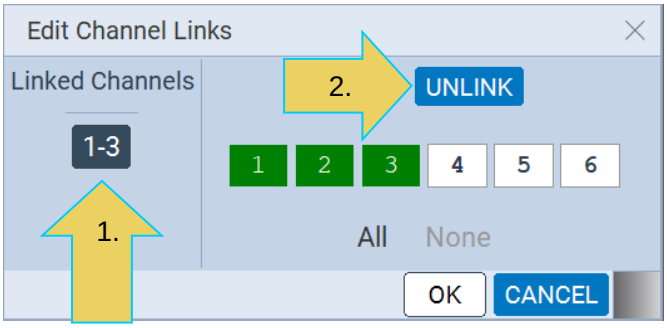


In this next example, all of the channels are linked:





To change or unlink the channels, click the icon again to return to the Edit Channel Links dialog box. You must select the group of linked channels in the left column, as shown below. In this case there is only one grouping of linked channels. Click **UNLINK** at the top of the dialog box and then ok. The Channel Selection area will return to its previous form.

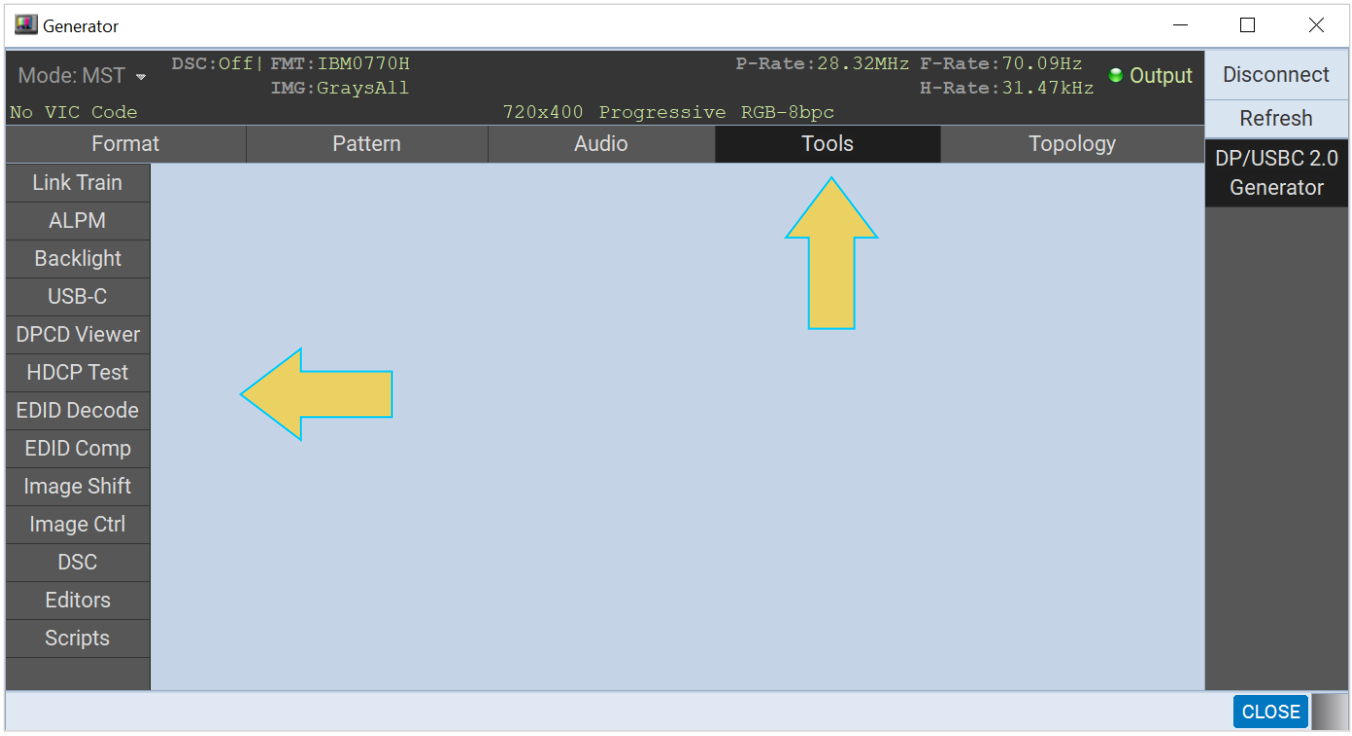


Once you have entered your desired settings for audio testing, click APPLY at the bottom of the window.

Click STATUS to see testing settings before or after applying changes.

3.5 Tools

The **Tools** tab has several utilities, located on the left sidebar. To access these, click on the **Tools** tab in the Generator app on the M42d ATP Manager. This section will review these tools in detail.



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.

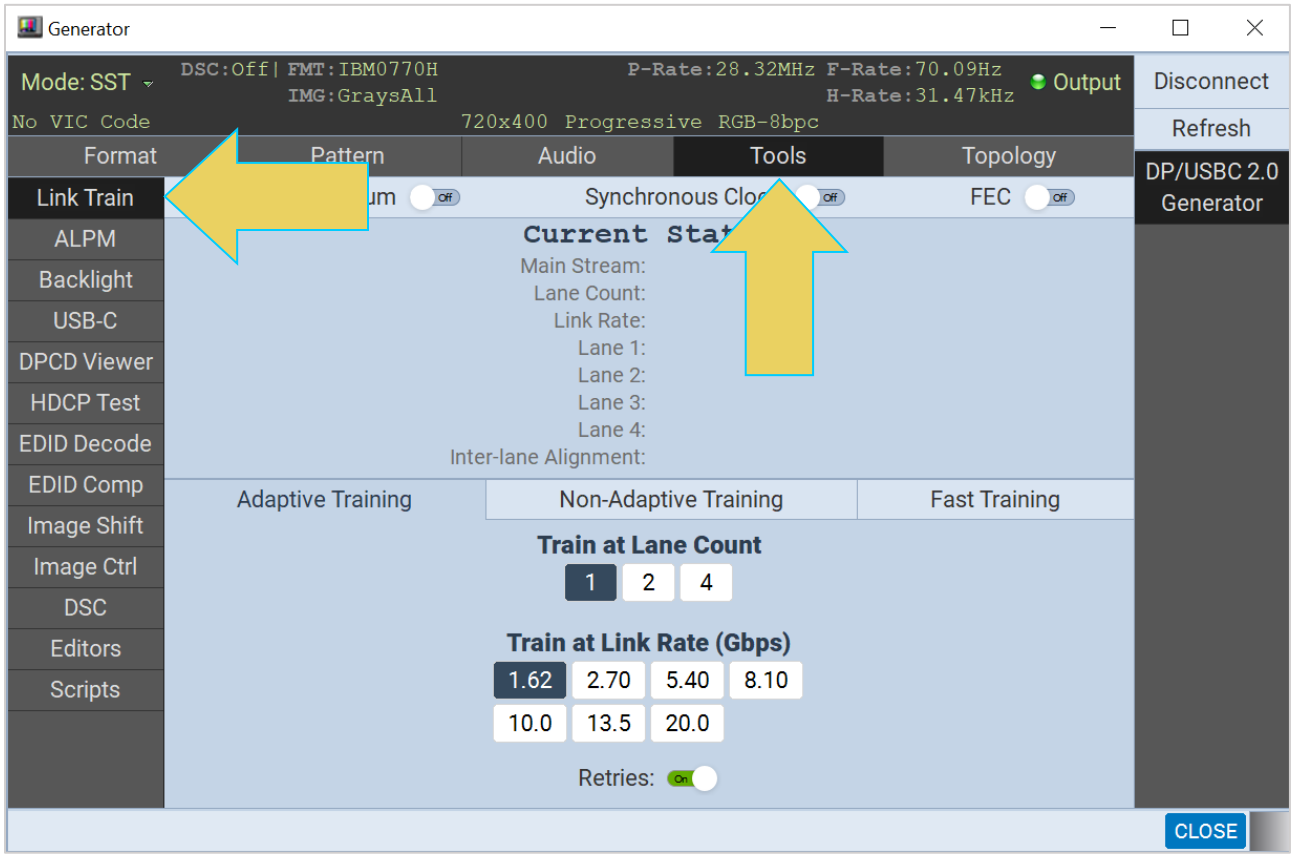
In the Non-Adaptive mode, you are forcing the Lane Count and Link Rate as well as the voltage swing level and pre-emphasis and bypassing the typical link training function.

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

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.

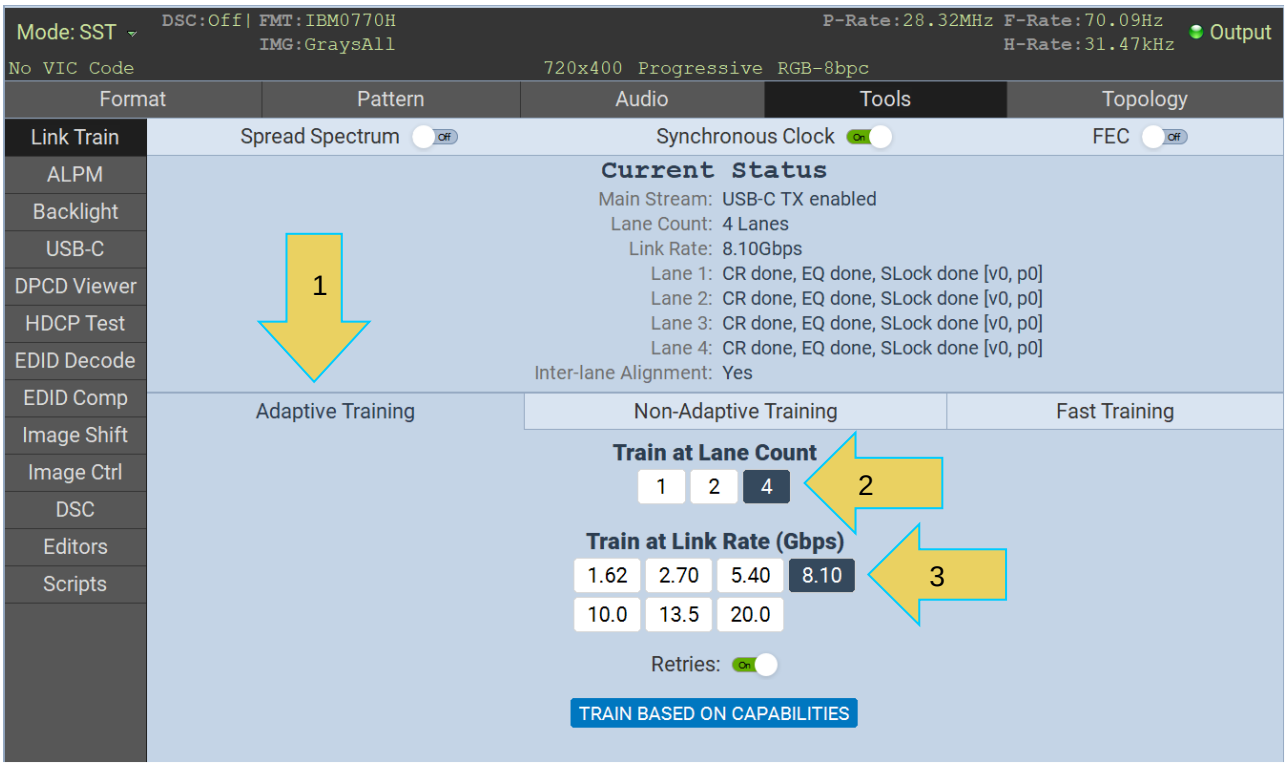


2. Select the link training mode tab (Adaptive or Non-Adapative) in accordance with your requirements.

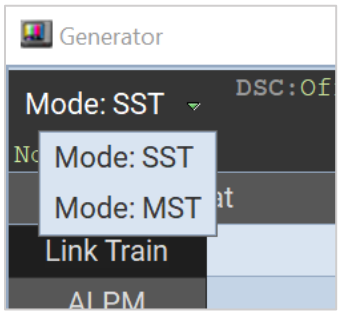
   The first example on the following page will cover **Adaptive Training**. For **Non-Adaptive Training**, skip to step 5

3. Select the **Train at Lane Count** and **Train at Link Rate** parameters using the labeled icons provided (4 lanes and 8.1Gbps link rate shown in the example below).

   The link training will occur after each selection is made; note the Current Status panel at the top of the screen.



Note that in the top left of the screen, the **Mode** drop-down selection is still enabled, as shown below, allowing you to select either Single-Stream (SST) or Multi-Stream Transport (Multi-Stream Transport) mode for testing.

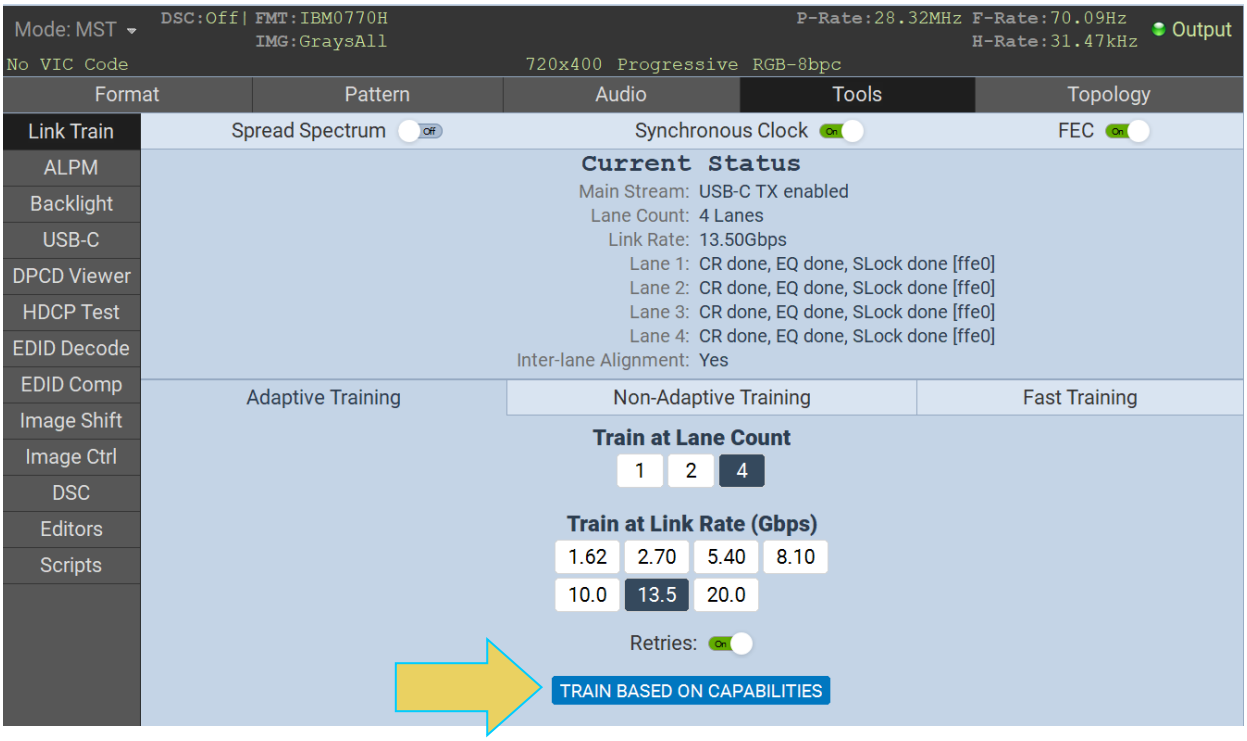


Training at any rate 10.0 Gbps or above forces Mult-Stream Transport mode (Multi-Stream Transport). This will be demonstrated on the following pages.

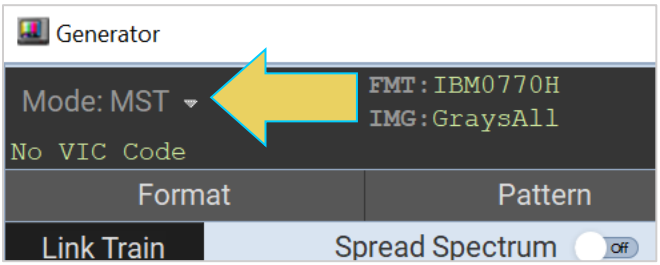
4. Click on the **Train Based on Capabilities** activation button to initiate link training that automatically trains at the highest capabilites of the DUT.

   The results and status of the link training will be shown on the Link Train application screen as shown below. The DUT in this example trained at 4 Lanes and 13.5 Gbps.

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



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.

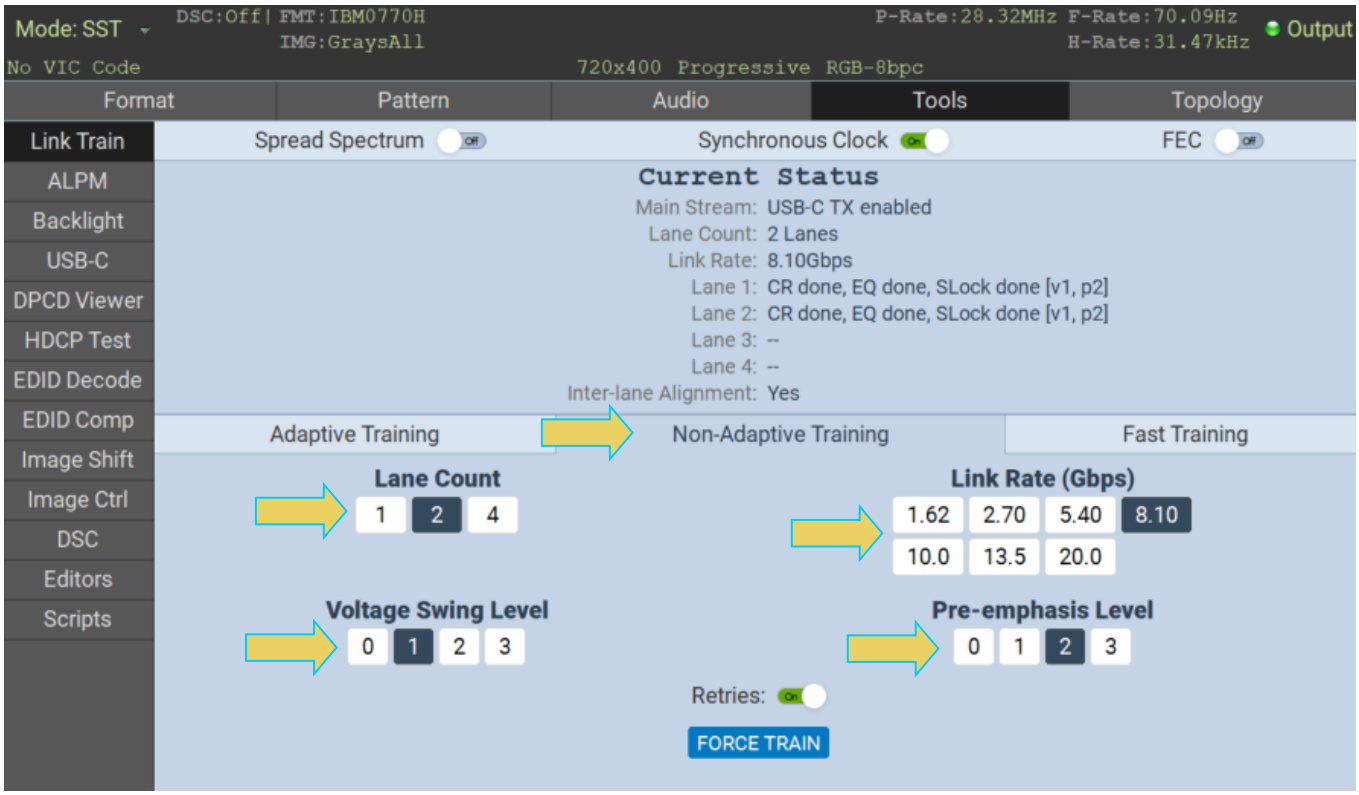


This guide will expand on Multi-Stream Transport in section **4.6 Topology**.

5. Optionally, select the **Non-Adapative** link training mode using the tab provided.
6. 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)
7. Click on the **Force Train** activation button to initiate the link establishment using the parameters you have specified.

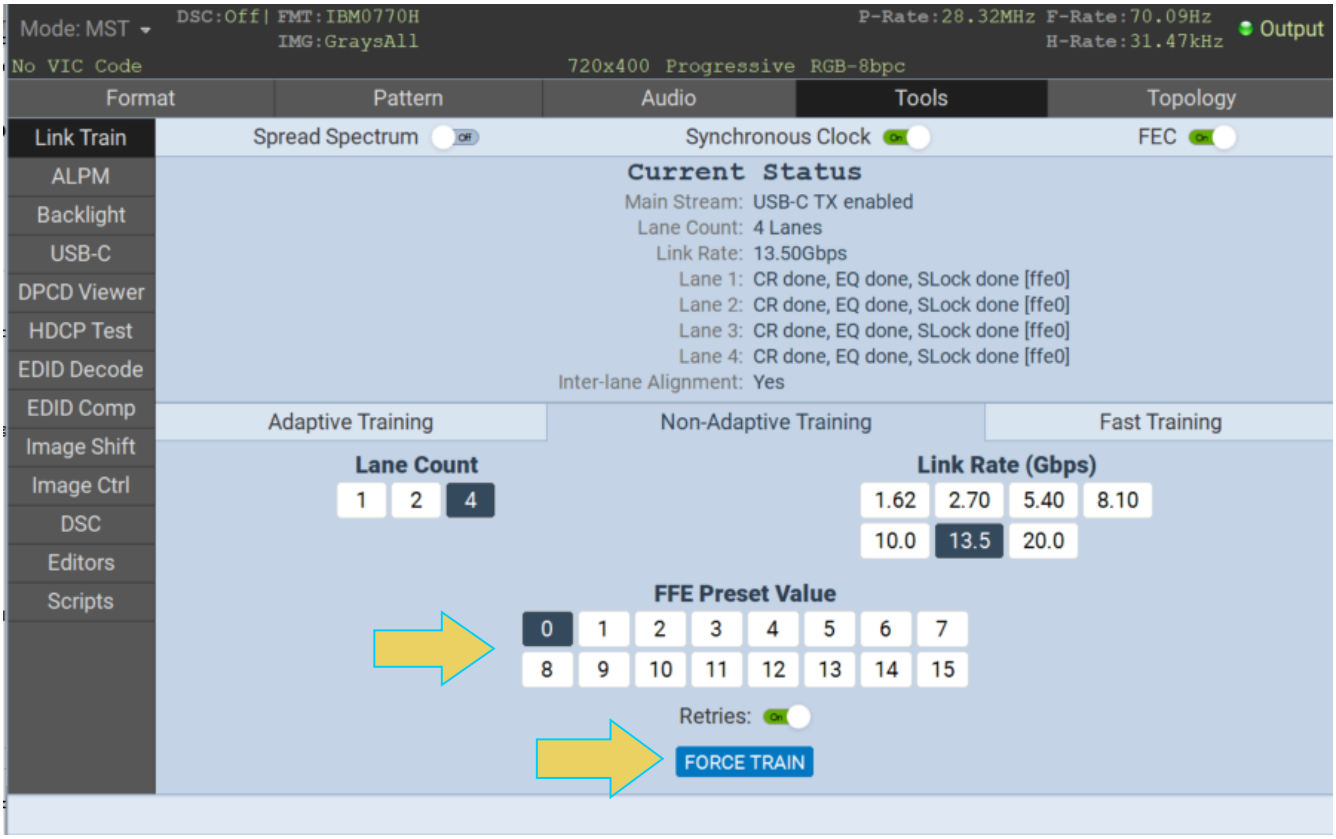
   Note: It is common that many combinations of link parameters will not establish a successful link, because the link training process is not occurring.

   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.



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. UHD 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.



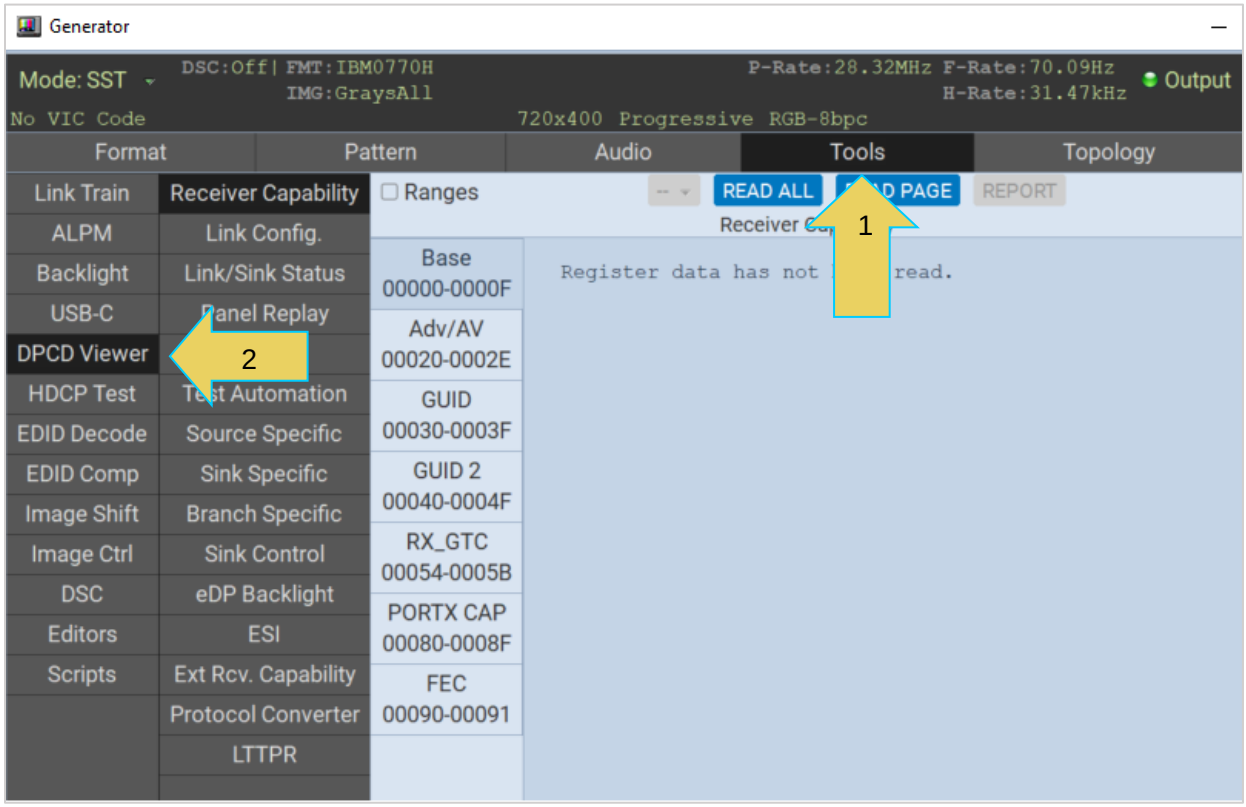
DPCD Viewer

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

Note: When the generator is configured for MultiStream, 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.

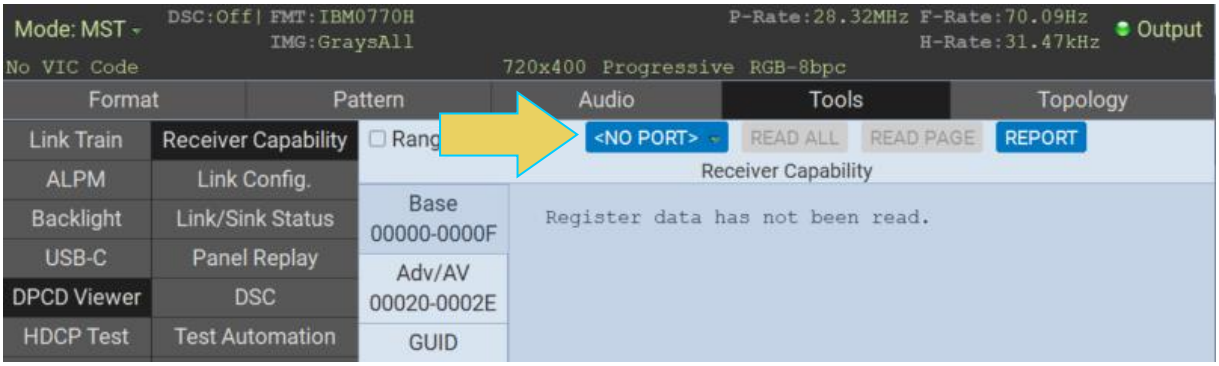
To view the DPCD of a connected display:

1. From the main window of the M42d 80G Generator application, select the **Tools** tab and navigate to the **DPCD Viewer** interface using the button on the left-hand sidebar.

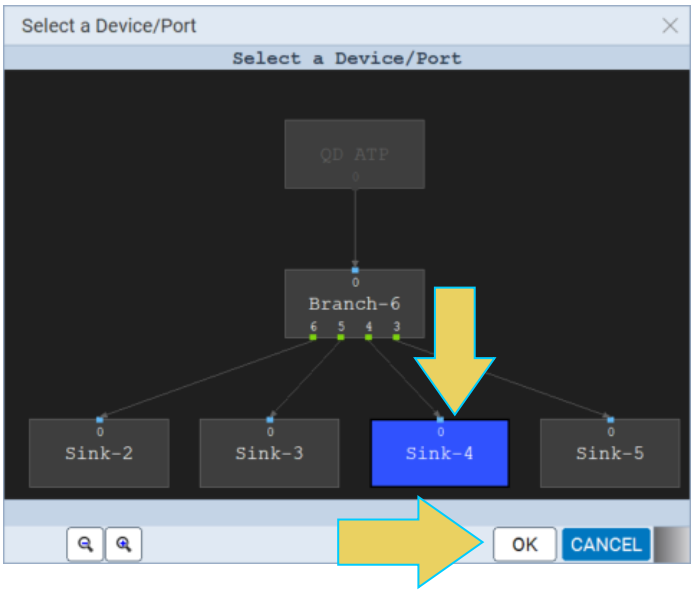


2. **Multi-Stream Transport** mode requires you to select a downstream device. *If you are in **SST** mode, skip this page and move to step 3.*
    a. If you are in Multi-Stream Transport Mode (indicated at the top left of the screen as shown below) and a port has not already been selected, you must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

    The following screenshot shows the interface with a DUT using Multi-Stream Transport:

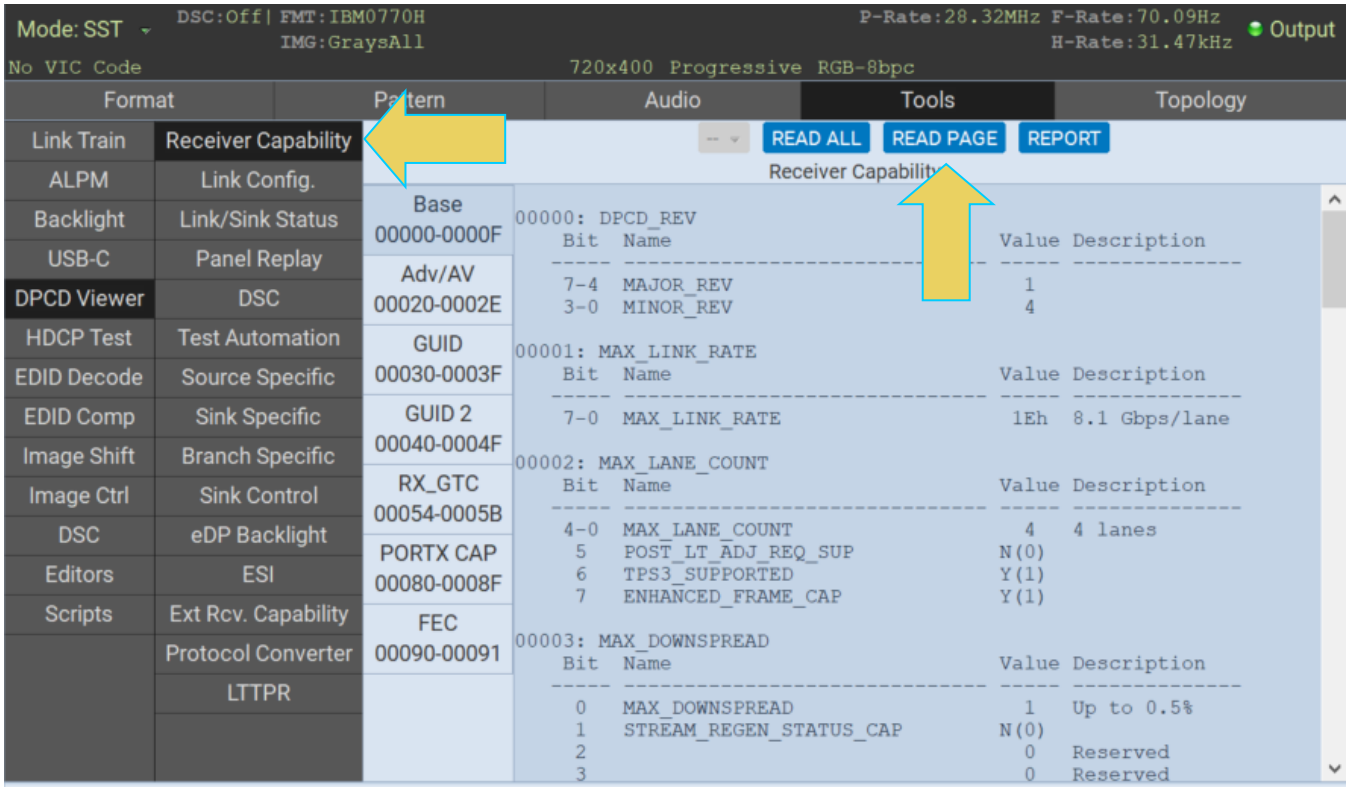


    b. The **Select a Device/Port** dialog box will pop up. You can select any downstream sink or branch device. In the following example, **Sink-4** has been selected. Click **OK** once you have selected the appropriate downstream device.



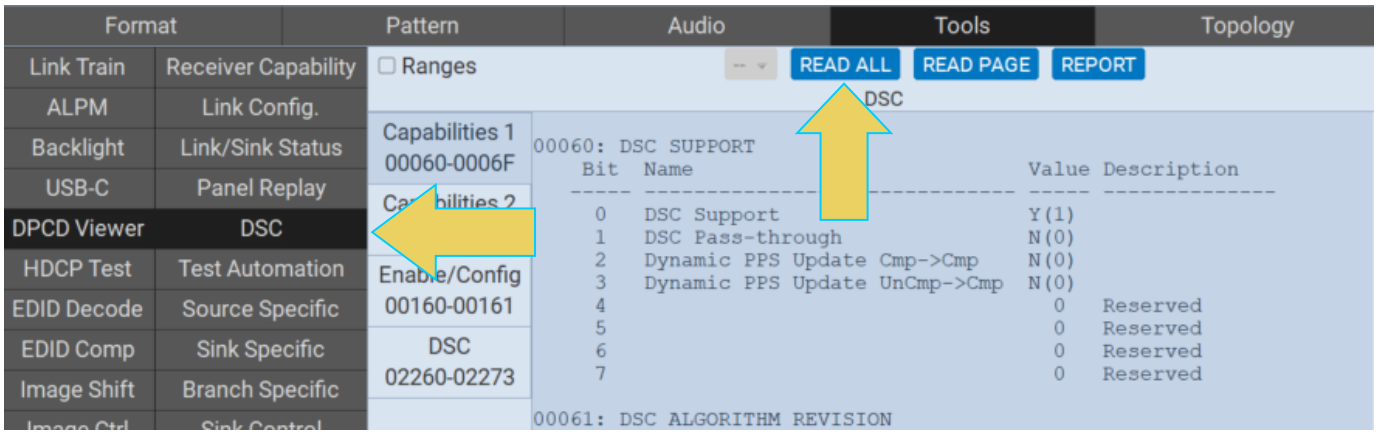
3. Select a Register page to read, and click **READ PAGE** to retrieve the DPCD report for that page. The register pages are listed on the left-hand side of the window in a new sidebar, as shown below.

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

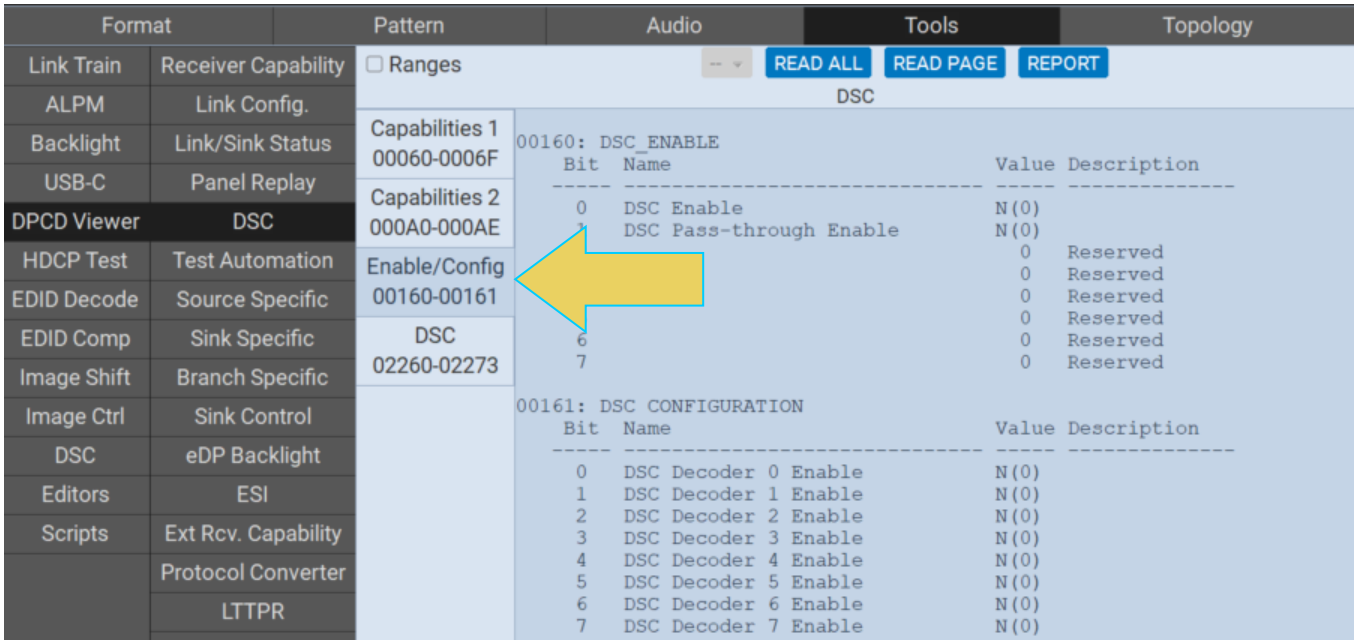


   Alternatively, you can click **READ ALL** without selecting a register, and the DPCD report will be generated for all registers.

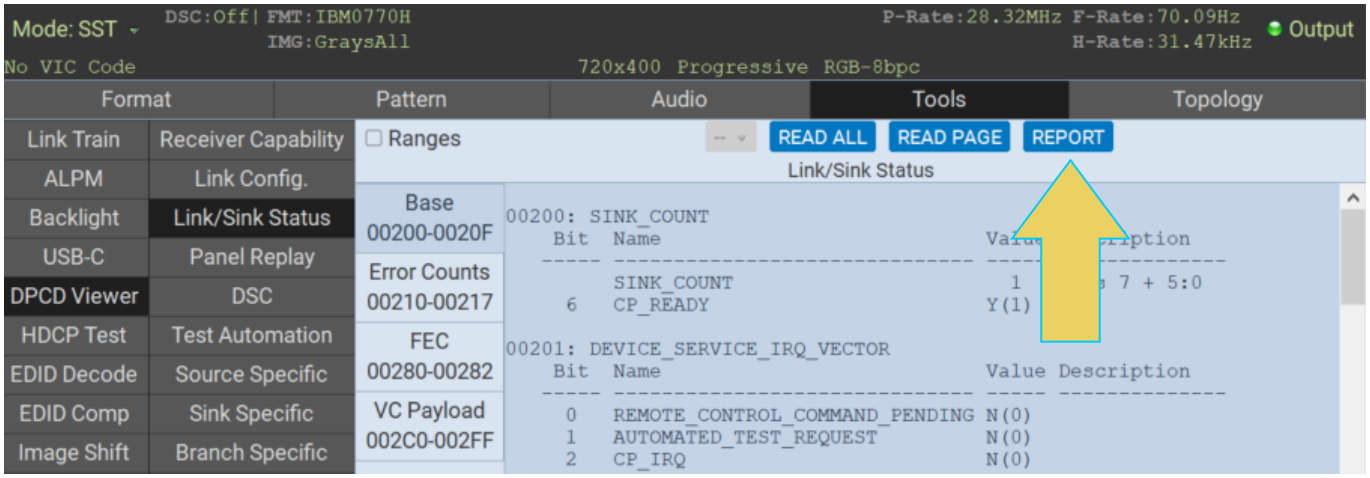
4. Click on a different register to view its DPCD. The example below displays the DSC register on the main panel.



5. View additional blocks/pages of each register by navigating to them using the sidebar to the left of the main panel. The example below displays the **Enable/Config** page of the DSC register set.

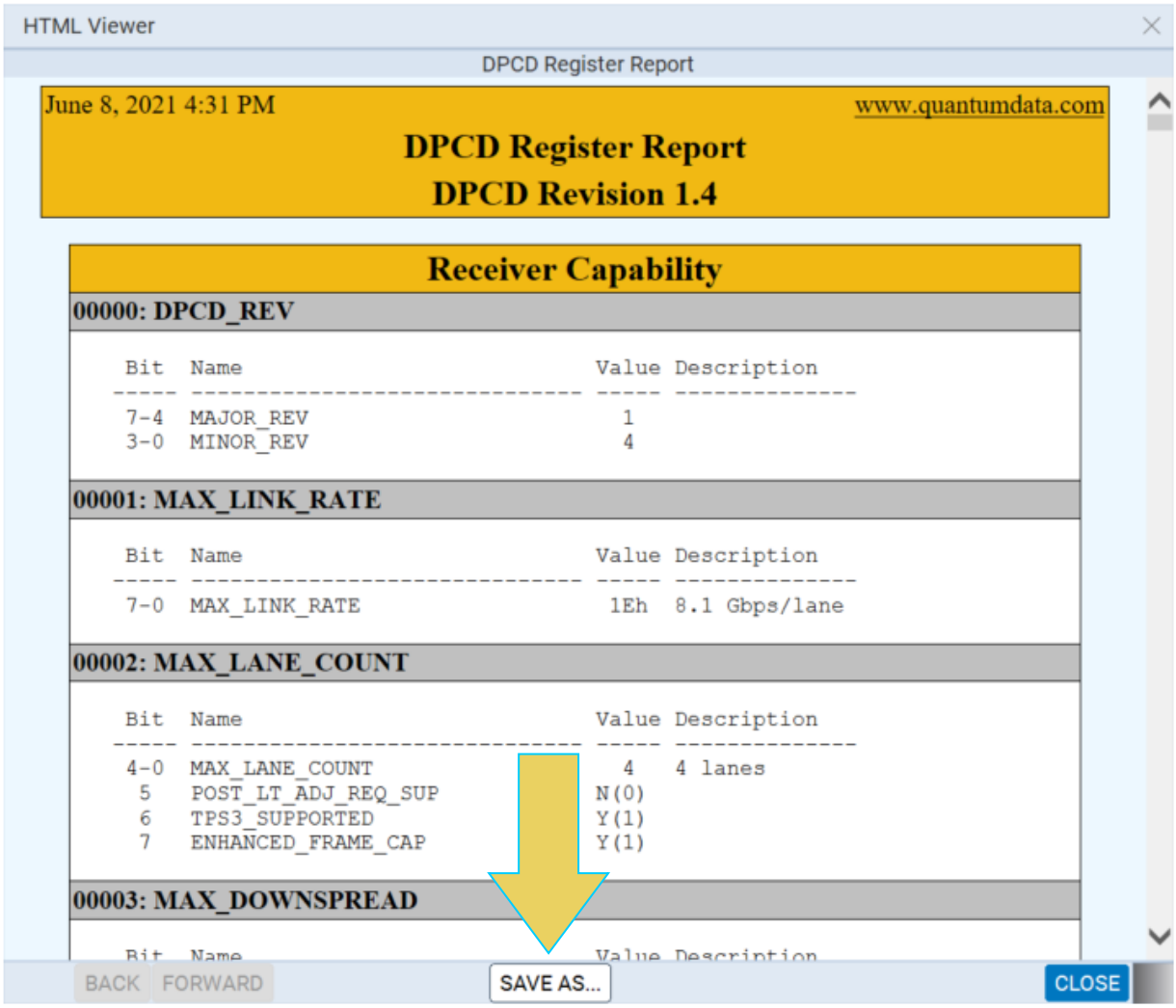


6. To view and save the DPCD of a connected display as an .html file, select **REPORT** at the top of the window:



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

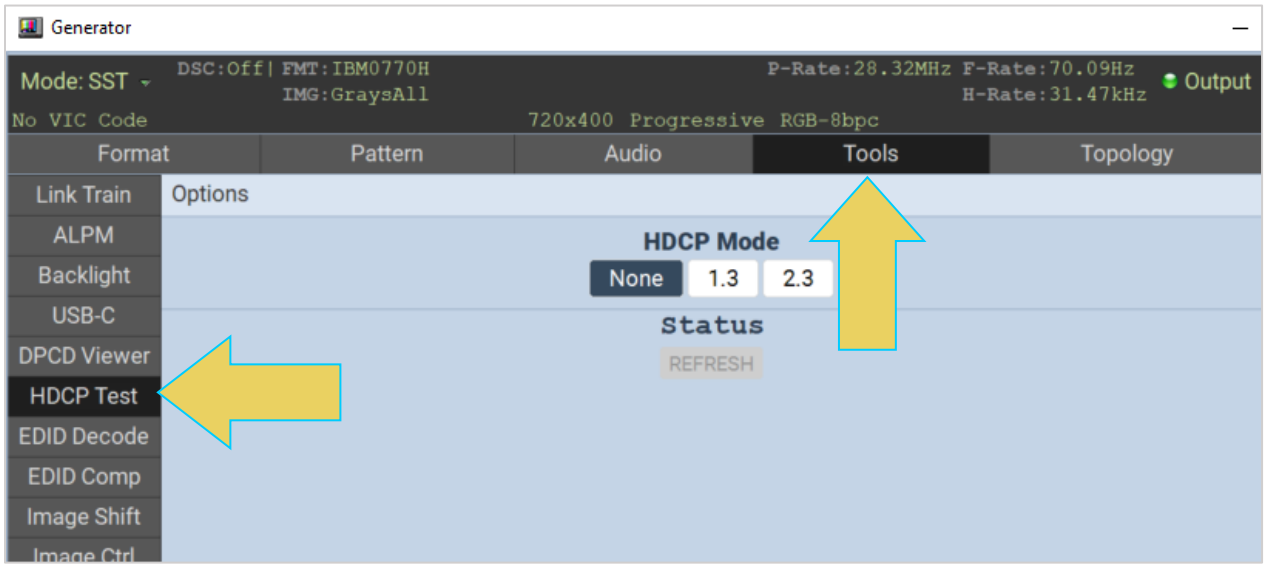
Note: The HTML DPCD Register Report will only include registers of the sink device that were retrieved using steps 1 – 5. To ensure a full report of all registers, click the **READ ALL** button in the main DPCD viewer interface, as described in step 4.



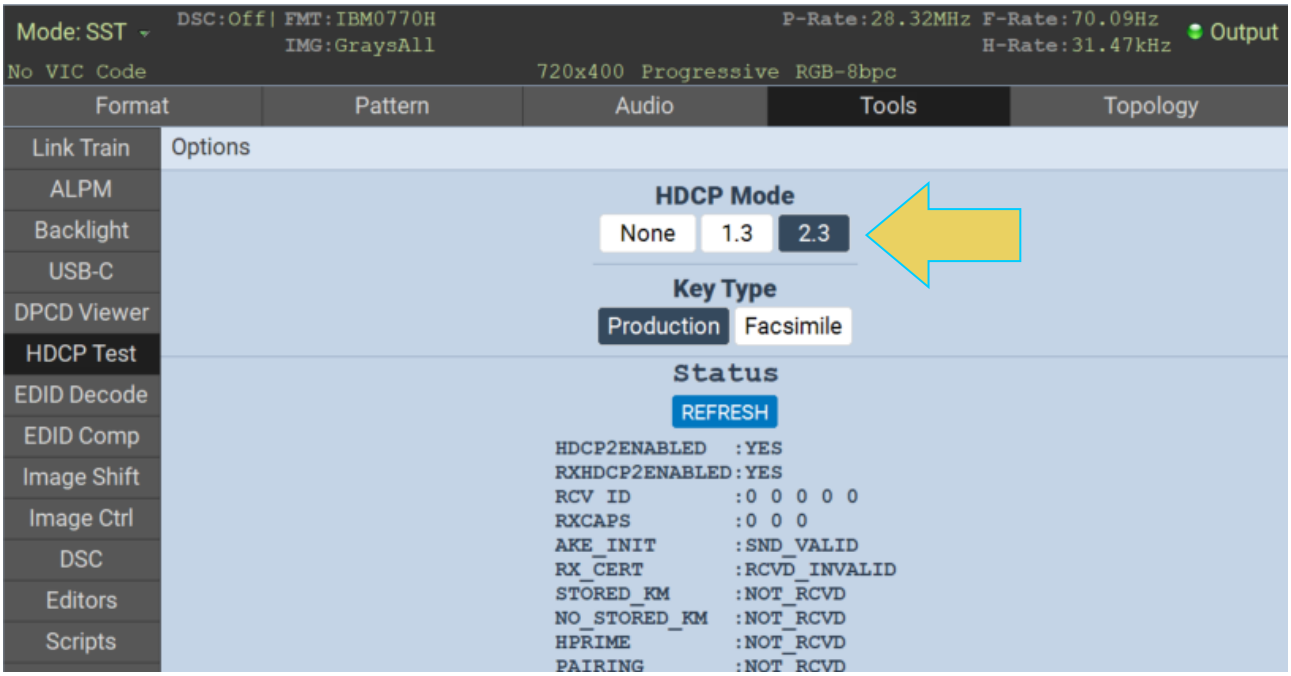
HDCP Testing

To test HDCP on a connected display using the Tools HDCP utility:

1. Access the **HDCP Test** through the **Tools** tab in the Generator app as shown below.



2. Enable HDCP by selecting either **1.3** or **2.3**. The Status section will update automatically. View the results and status of the test through the HDCP Test screen as shown below.

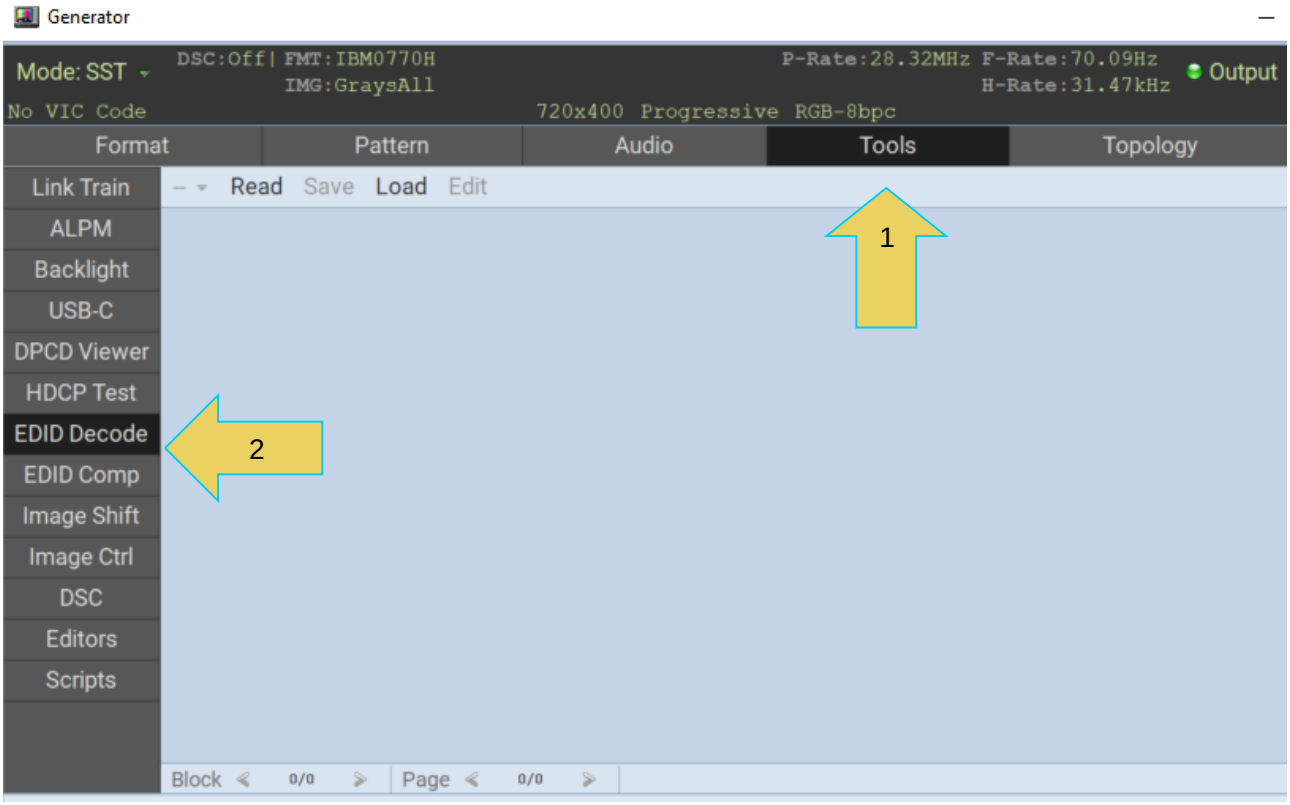


Viewing the EDID of a connected display

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 **section 4.6 Topology and Multi-Stream Transport.**

To view the EDID of a connected display:

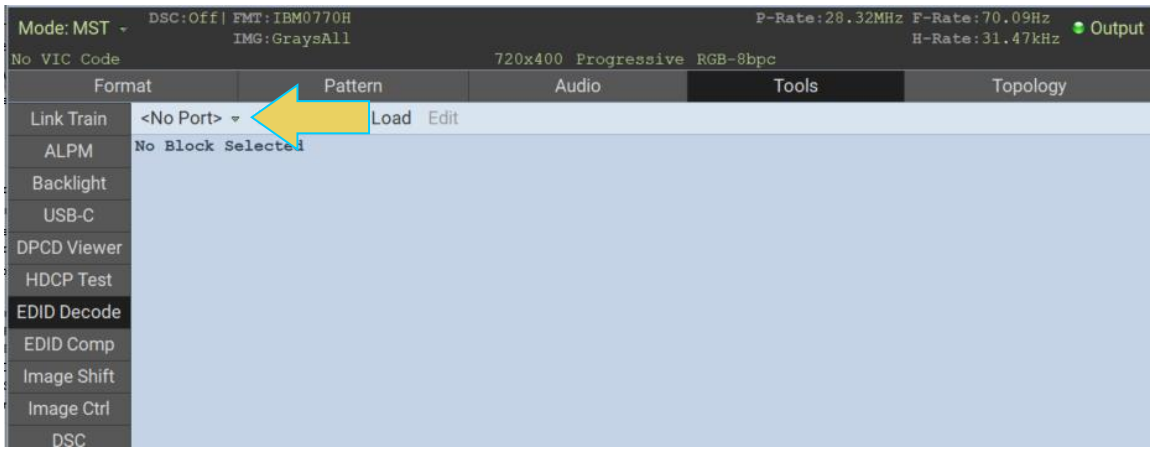
1. From the Generator app of the M42d GUI Interface, select the **Tools** tab.
2. Activate the **EDID Decode** button on the left-hand sidebar (indicated below).



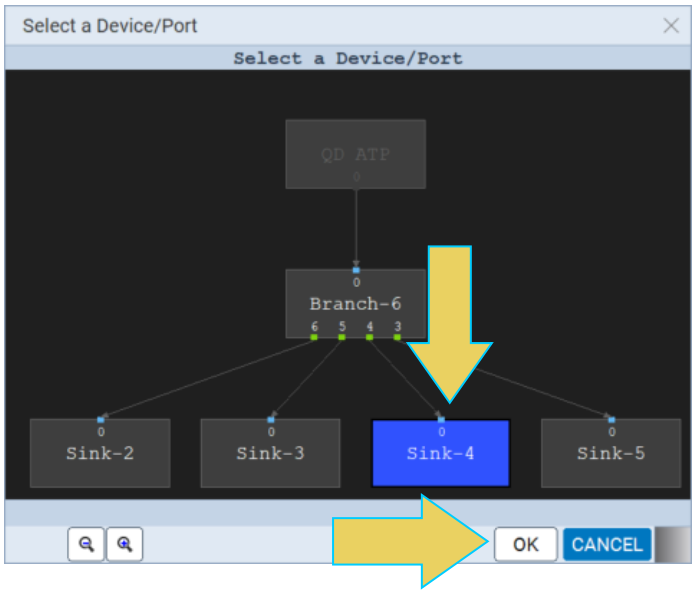
3. **Multi-Stream Transport** mode requires you to select a downstream device. *If you are in **SST** mode, skip this page and move to **step 4**.*

   If you are in Multi-Stream Transport Mode (indicated at the top left of the screen as shown below) and a port has not already been selected, you must select a port to read by clicking the dropdown that will read **<NO PORT>**.

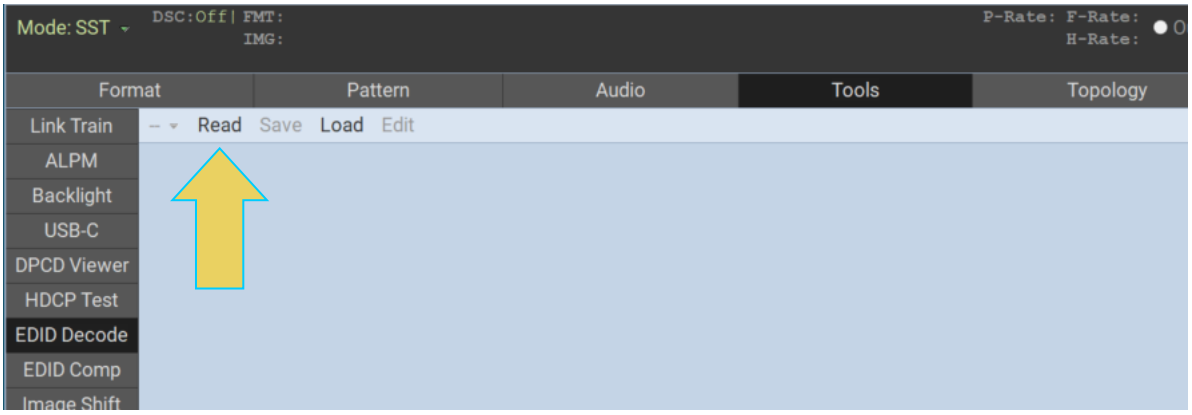
   The following screenshot shows the interface with a DUT using Multi-Stream Transport:



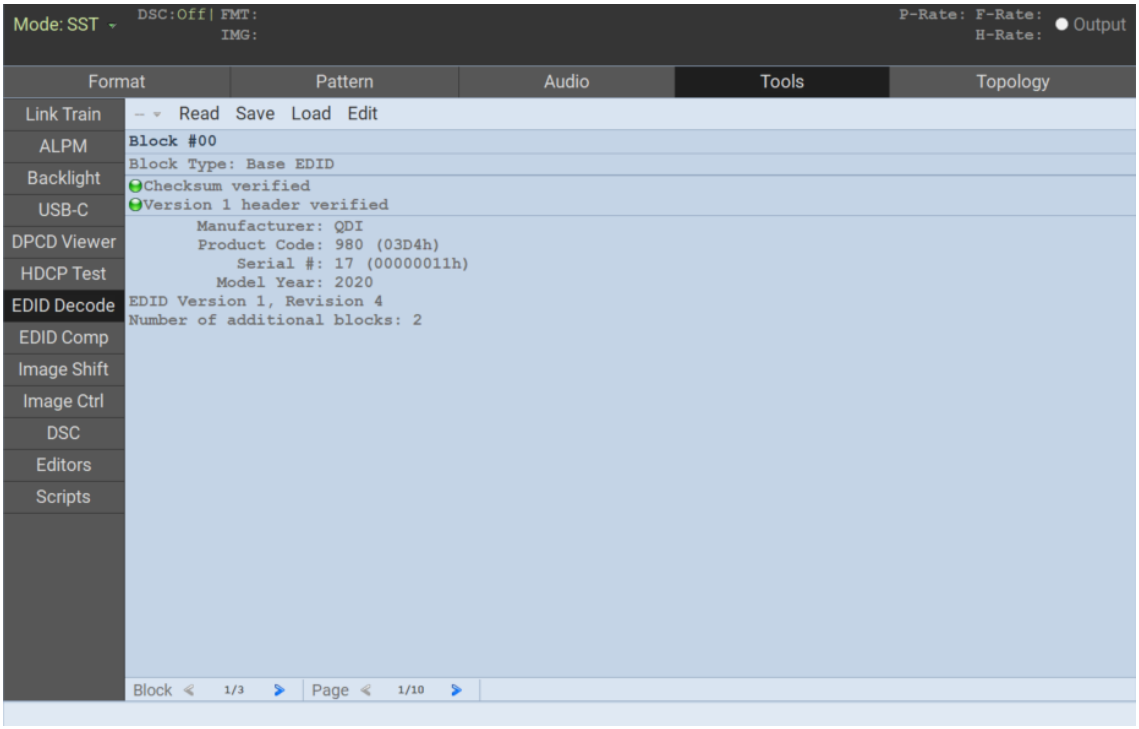
   The **Select a Device/Port** dialog box will pop up. You can select any downstream sink. In the following example, **Sink-4** has been selected. Click **OK** once you have selected the appropriate downstream device.



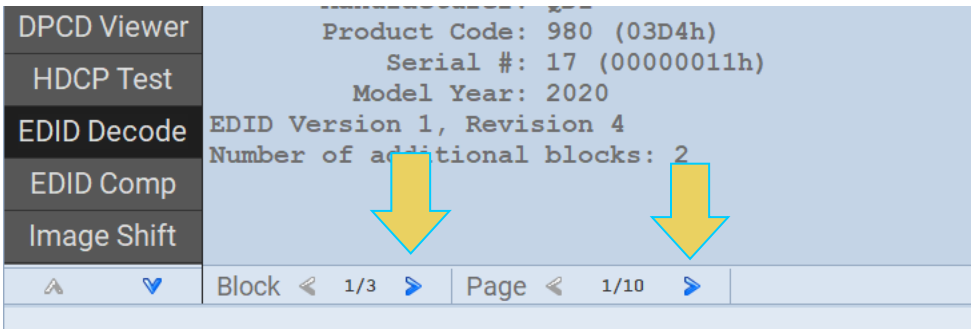
4. Click the **Read** button at the top left of the window.



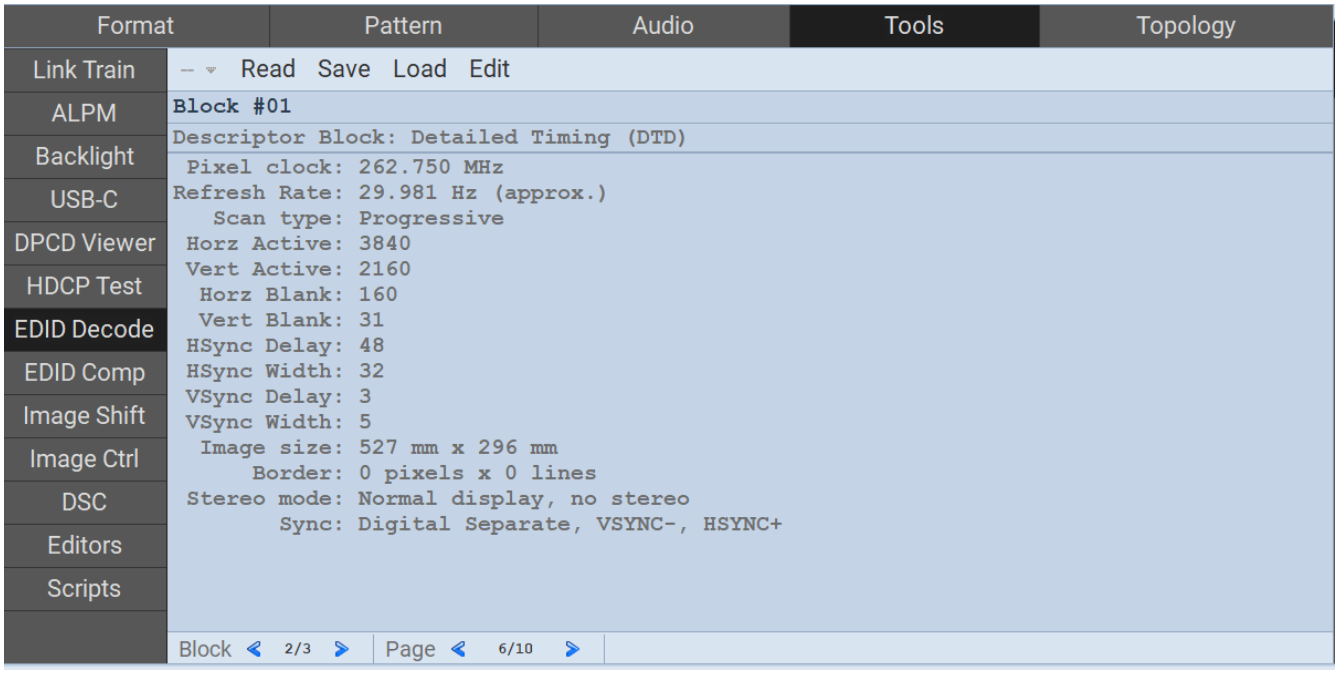
The EDID Decode content will be shown as in the example below

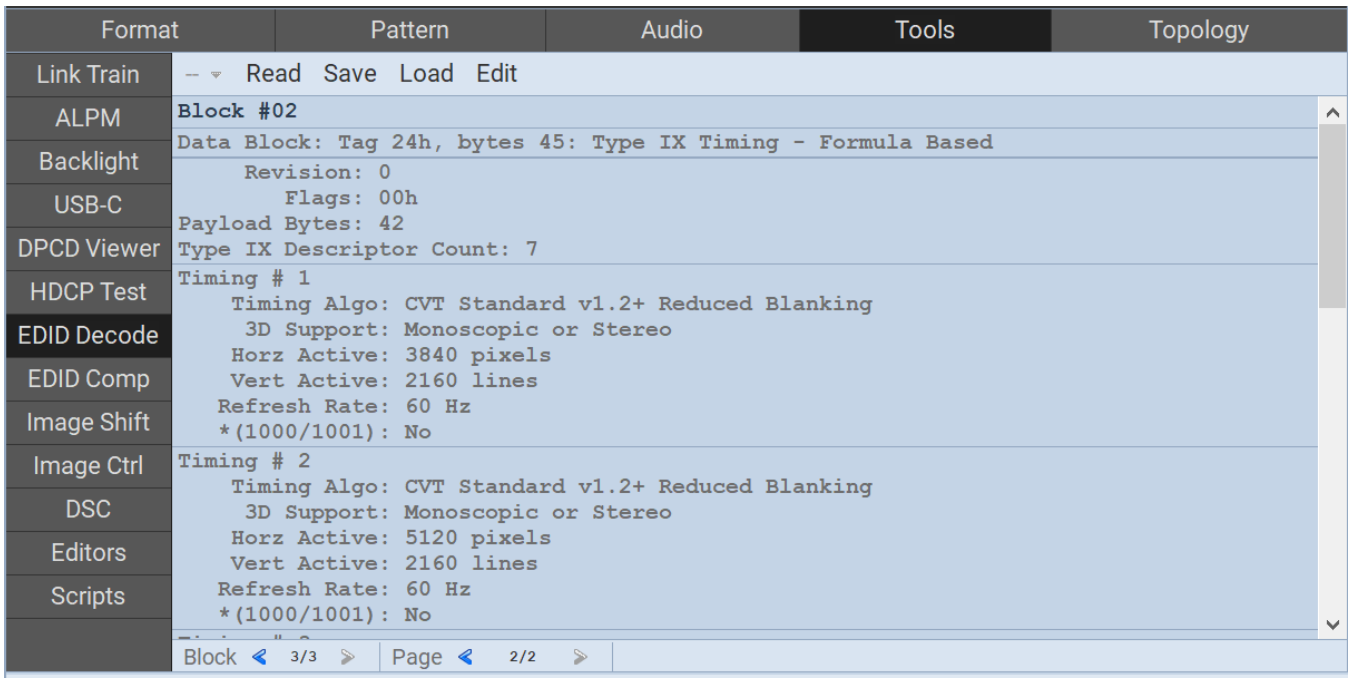


5. Navigate through the blocks and pages of the EDID using the arrow buttons on the lower panel (indicated below).



Examples of the **EDID Decode** second and third blocks are shown below.





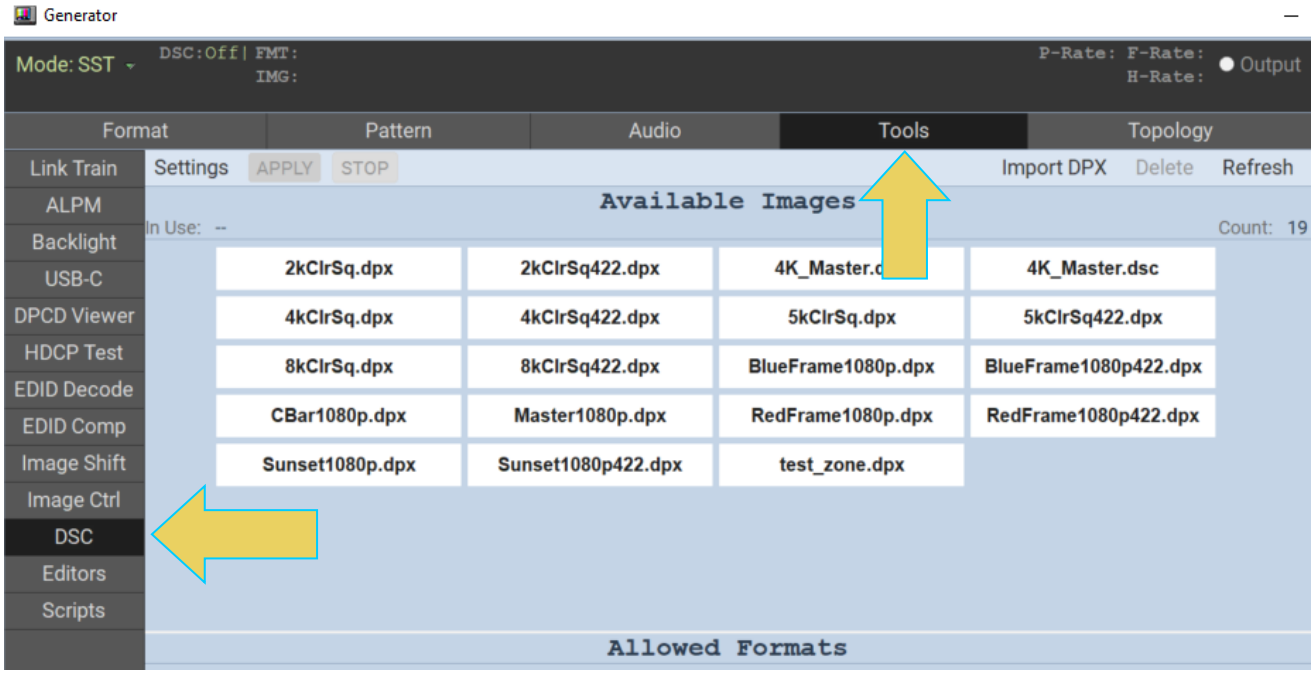
DSC (Display Stream Compression)

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.

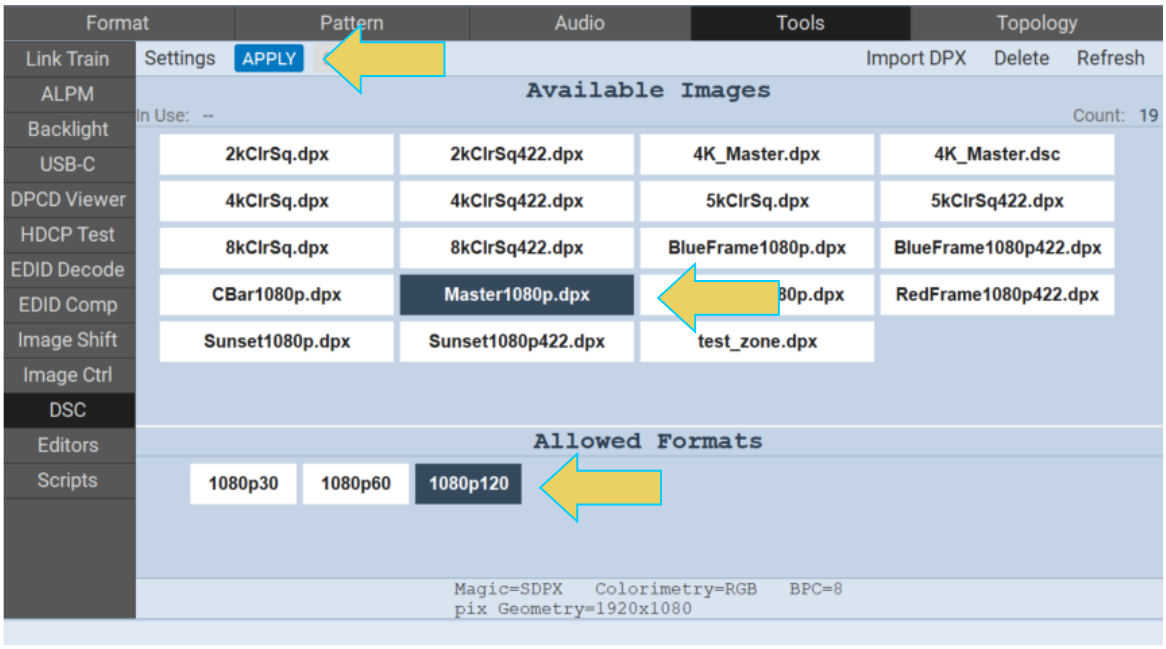
To test a DSC/FEC-capable display device:

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.



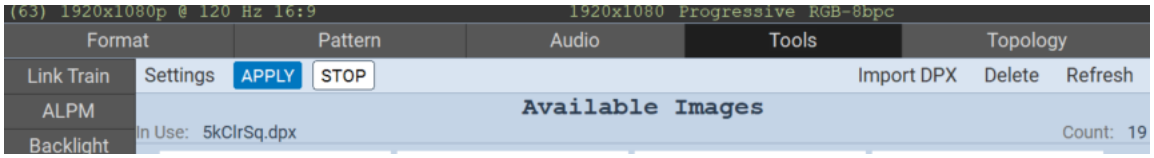
A list of **Available Images** will appear in the top panel. There are many by default on the M42d itself, otherwise you can add your own using the **Import DPX** button at the top right. This will be covered in the next subsection.

Select a file from **Available Images** by clicking on it. Options will appear in the **Allowed Formats** panel below, as shown in the following example. The first format is selected by default. Click **APPLY** once you have the desired image and format.

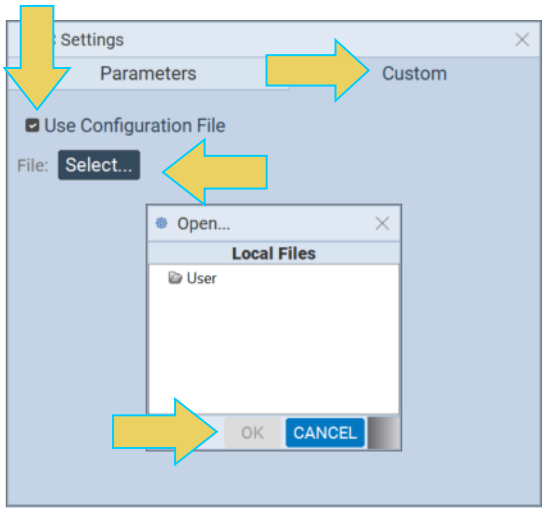


Once a file is selected, the lower information panel shows the parameters of the selected video frame file and the **In Use** area at the top left shows the selected file name.

The **Settings** dialog box is accessed using the Settings button at the top left of the window.



The Settings dialog box is shown below. You can set the video parameters, compression, slice configuration, etc. here, or import a custom set of PPS parameters from a text file. The Selections for the dialog box are described on the table that follows.



The **Settings** dialog box parameters are described below:

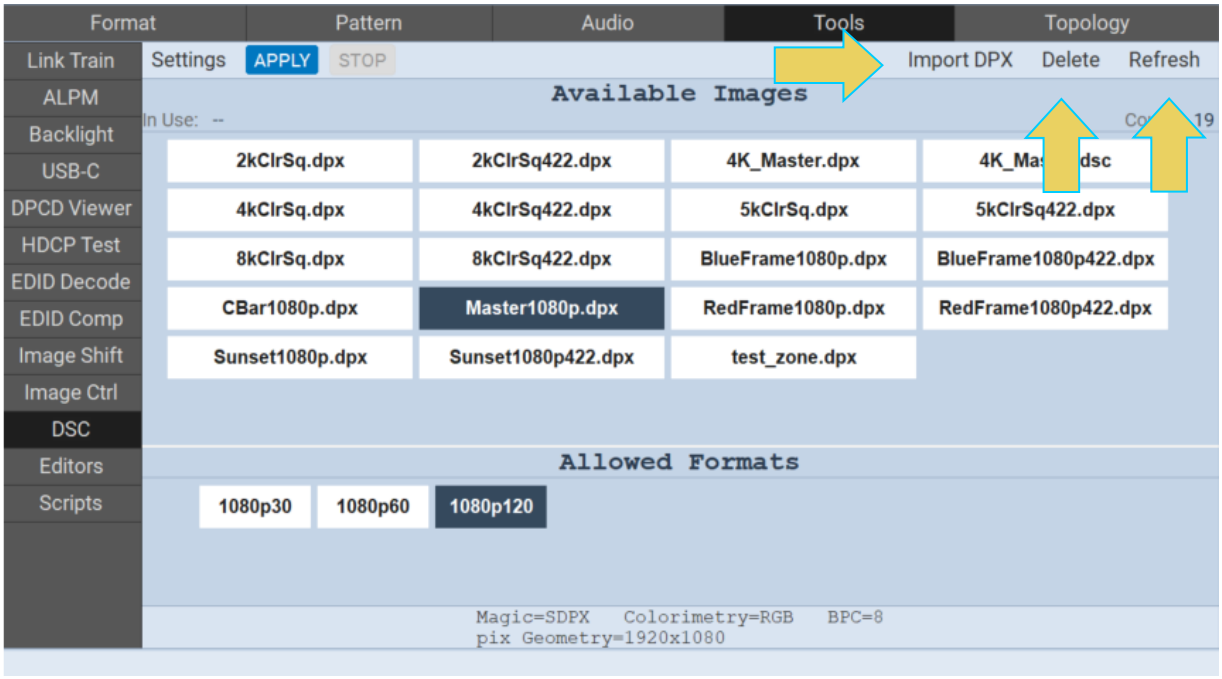
DSC Video Generator Settings Dialog Box		
Item	**Parameters**	**Comments**
Color Mode	Selections are: - RGB - 4:4:4 - 4:2:2 Simple - 4:2:2 Native - 4:2:0	
Bits Per Component	The color depth per component. Options are: - 8 - 10 - 12	These selections would be 24, 30 or 36 respectively for color depth per 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 x 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. You can set this value or import this value as part of a Configuration File using the Custom tab.	You can import a text file to use.

Here is a sample of a .txt Configuration File that you can import:

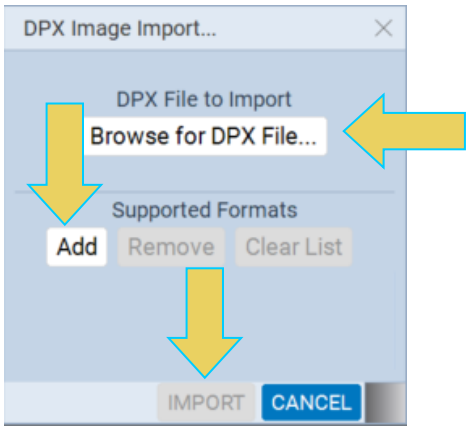
```
   SRC_LIST /qd/dsc_images/cache/src_list.txt
   FUNCTION 1
   OUT_DIR /qd/dsc_images
   DSC_VERSION_MINOR 32628
   SLICE_WIDTH 3840
   SLICE_HEIGHT 1080
   INCLUDE    /qd/dsc_images/cfg/rc_8bpc_8bpp.cfg
   DPX_FILE_OUTPUT 0
   BLOCK_PRED_ENABLE 1
   LINE_BUFFER_BPC 16
   //  DPX read options (the following work well for most modes for GM/IM, some
   anomalies are autodetected)
   DPXR_PAD_ENDS      1   // Pad to 32-bit boundaries
   DPXR_DATUM_ORDER  1
   DPXR_FORCE_BE      0
   SWAP_R_AND_B  1
   //  DPX write options (the following work well for most modes for GM/IM)
   DPXW_PAD_ENDS      1   // Required to output RGB to XNView 1.99 (but not
   YUV!)
   DPXW_DATUM_ORDER   1
   DPXW_FORCE_PACKING 1   // Method to use for 10 & 12-bit data
   SWAP_R_AND_B_OUT   1
PPM_FILE_OUTPUT 0       // Output PPM files
```

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.

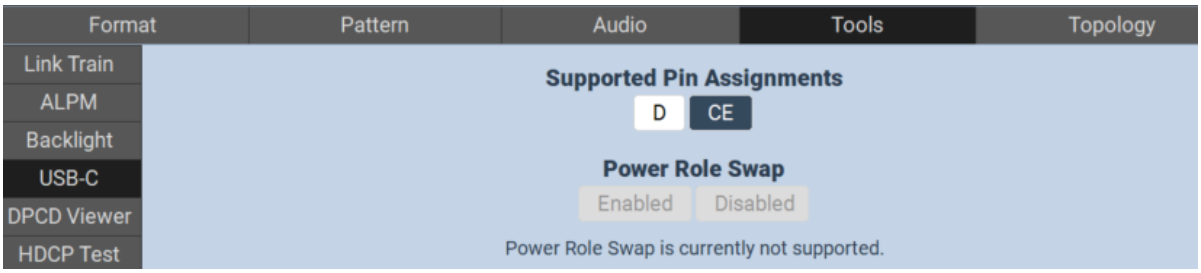


Note: You may need to click the **Refresh** button in the top right for the newly imported DPX Image to display in the list of Available Images.

Other Tools

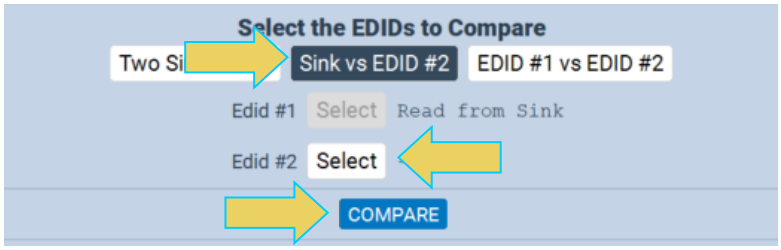
The tools tab has several other utilities:

- ALPM (Advanced Link Power Management) – A utility for embedded DisplayPort (eDP). This will be discussed in **Chapter 10 eDP**.
- Backlight – Also for eDP, discussed in **Chapter 10 eDP**.
- USB-C – Change **Supported Pin Assignments**. Power Role Swap is not currently supported on the M42d.

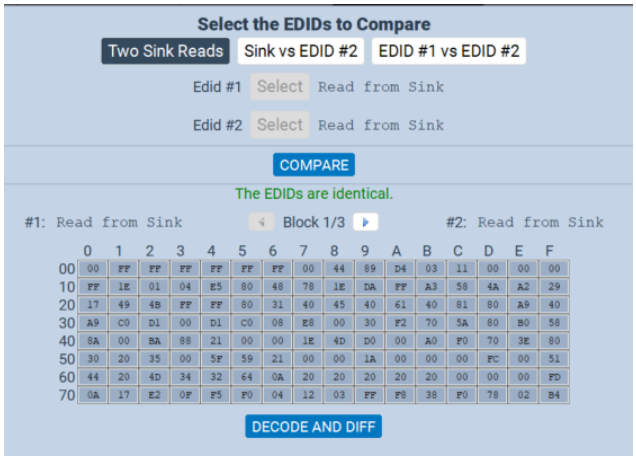


- EDID Comp – Compare the EDIDS of two sink devices, a sink device vs an imported EDID, or two imported EDIDs vs one another.
  - Select the **EDID Comp** utility from the **Tools** tab.

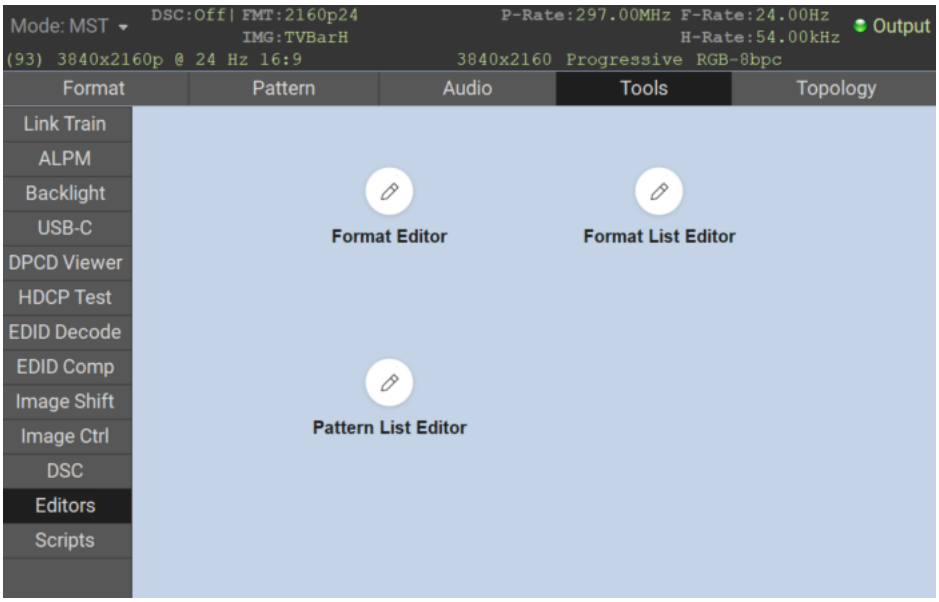
    From here you can select which EDIDs to compare. If you are comparing imported EDIDs, click the **Select** button to import. The following example is comparing a sink device vs an imported EDID.



    The next example shows two sink devices and the result after clicking the **COMPARE** button.

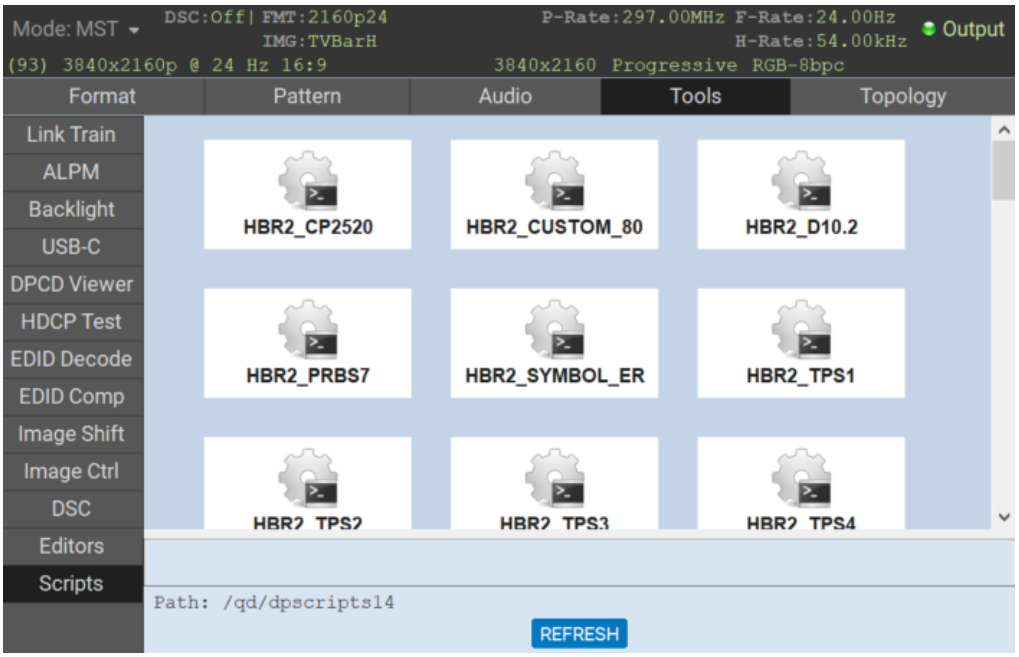


- Editors – Create a custom format or custom lists of patterns and formats. Screenshot example below.



- Scripts – Allows user to implement custom functionality based on low level instrument commands by loading a batch shell script into the directory folder.

Note: A batch shell script must be loaded into the folder path using an external file explorer.



3.6 Topology and Multi-Stream Transport (Multi-Stream Transport)

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

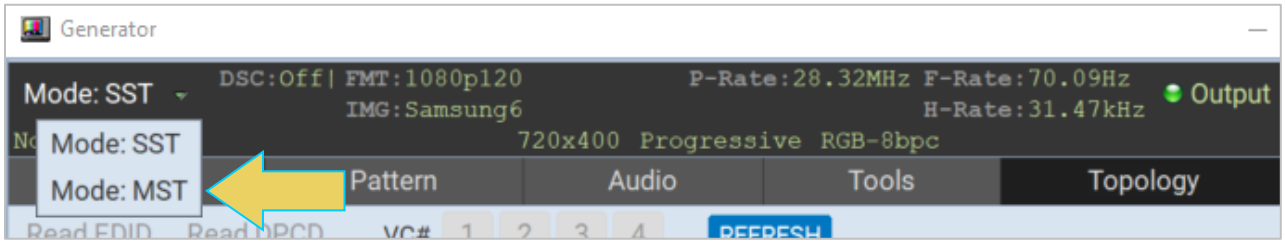
When Multi-Stream Transport is configured, the same video pattern and audio signal is transmitted to all downstream nodes. There is a number indicator that appears on the upper left screen of the downstream Multi-Stream Transport sink that identifies which stream is being delivered.

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

Accessing the Multi-Stream Transport Topology window

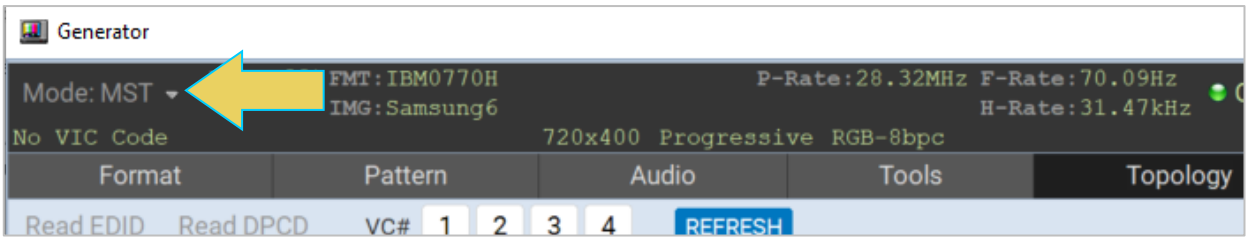
Use the following procedure to test Multi-Stream Transport on a connected Multi-Stream Transport-Capable sink device.

1. At the Generator dialog box, select Multi-Stream Transport from the Interface drop down menu. Refer to the screen example below.

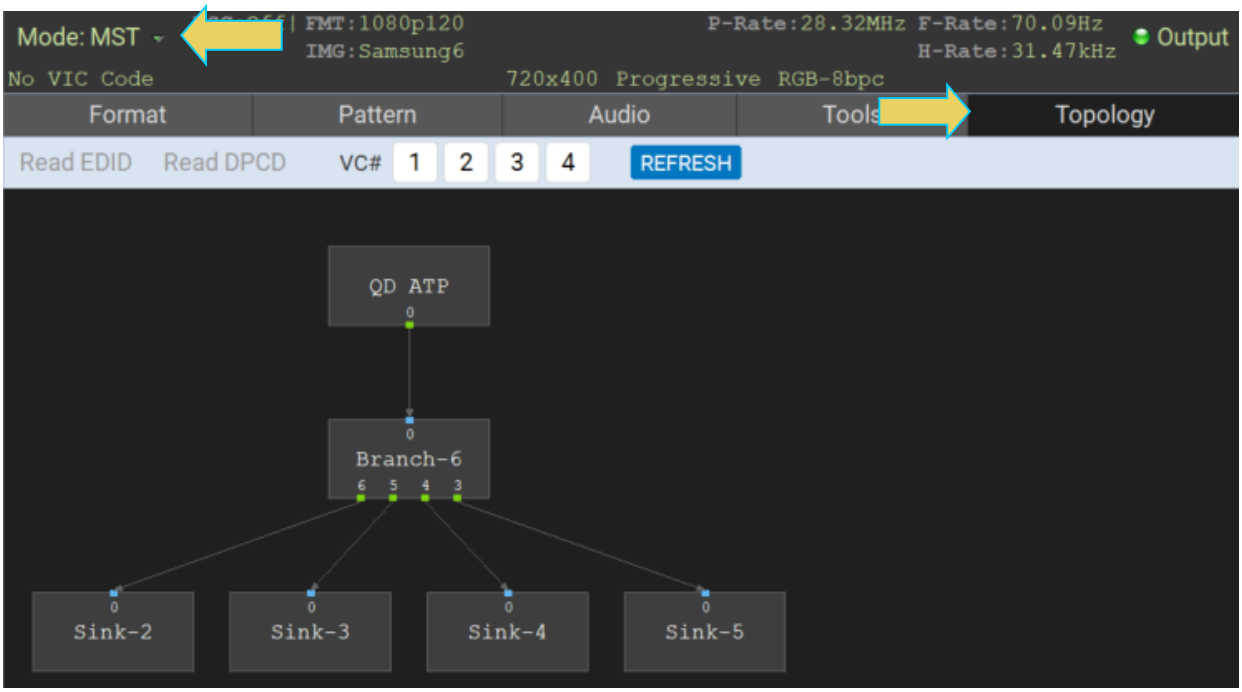


Click **OK** when the confirmation dialog box appears.

Note If the **Mode** dropdown is unselectable (grayed out, as shown below), then the Sink device has been trained at a UHD link rate, which requires Multi-Stream Transport. 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 Generator window, access the **Topology** tab to control the Multi-Stream Transport application as shown below. Notice the **Mode** has been switched to Multi-Stream Transport after the previous step.



The table below summarizes the graphical controls of the Multi-Stream Transport Topology window.

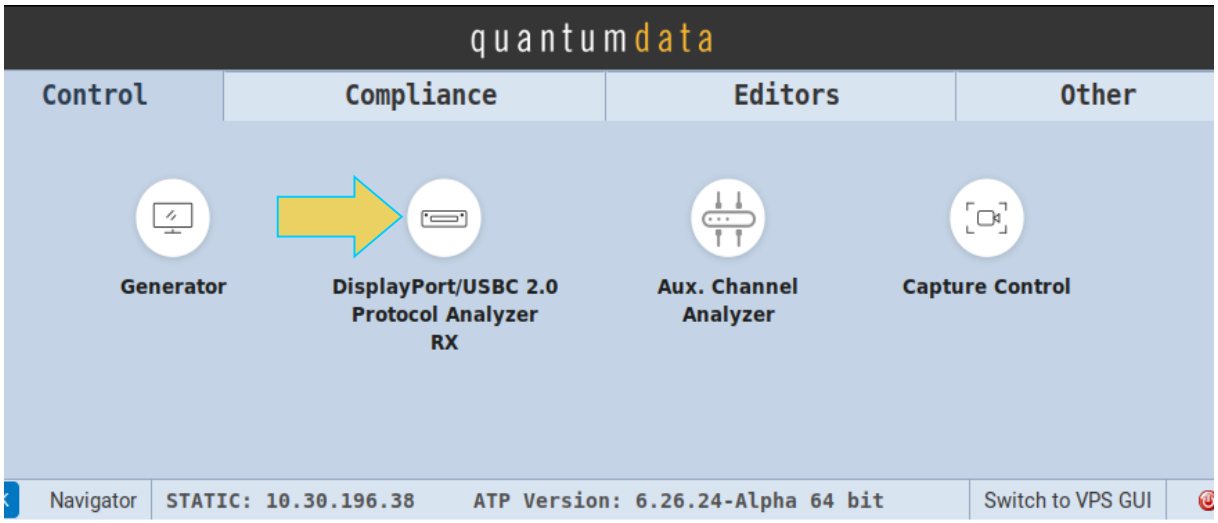
Multi-Stream Transport Topology Window	
Button	**Description**
Read EDID	Enables you to read the EDID of the selected downstream Multi-Stream Transport Rx node.
Read DPCD	Enables you to read the DPCD of the selected downstream Multi-Stream Transport Rx node.
Virtual Channels VC #1…VC #4	Select the virtual channel to analyze
Refresh	Refreshes the view.

Configuring the number of downstream Multi-Stream Transport nodes.

Use the following procedure to configure the number of downstream Multi-Stream Transport nodes.

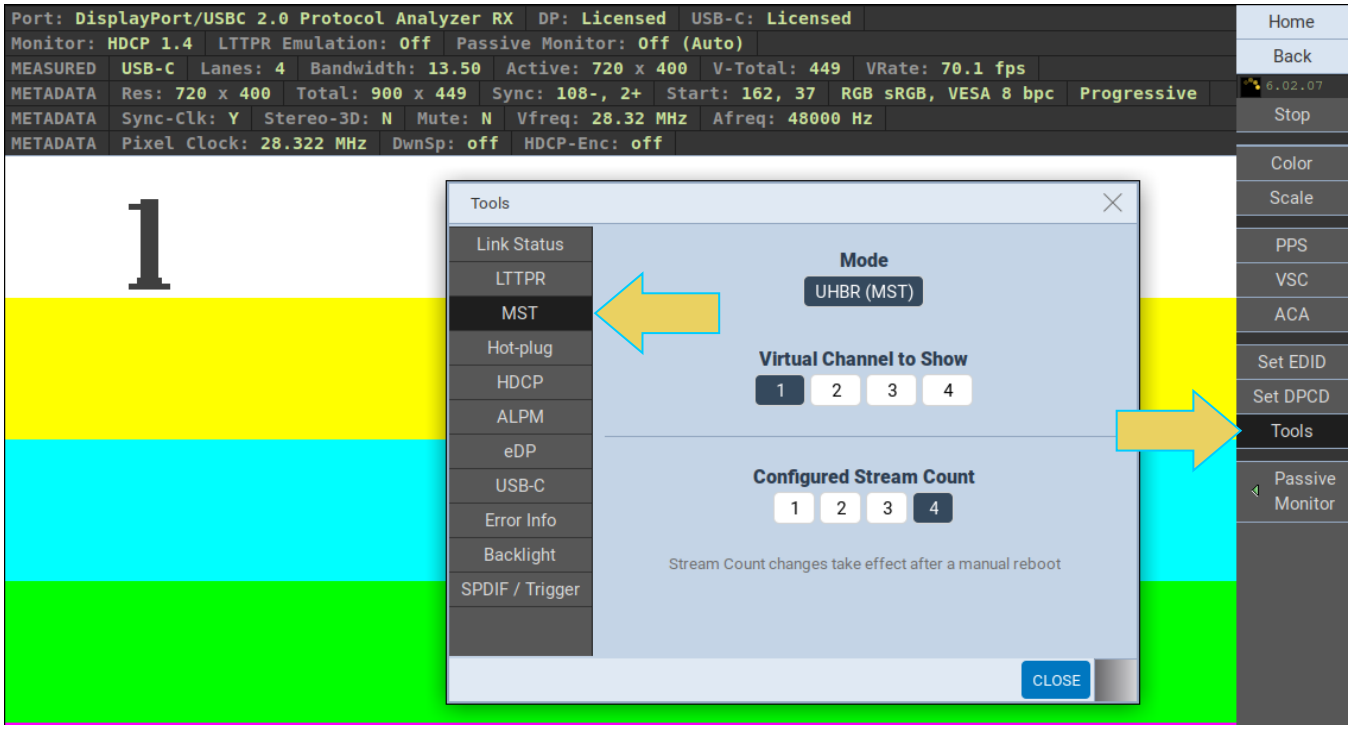
To access the Multi-Stream Transport dialog box:

1. Using the embedded ATP Manager GUI on the M42d, navigate to the **DisplayPort/USBC 2.0 Protocol Analyzer RX** interface, or the **Receiver** interface on a remote PC ATP Manager.



Note: This application is covered in detail in **Chapter 4 Source Verification with Basic Analyzer**

2. Click the **Tools** button on the right sidebar.
3. The **Tools** dialog box will appear. Select the **Multi-Stream Transport** tab within this dialog box, as shown below.

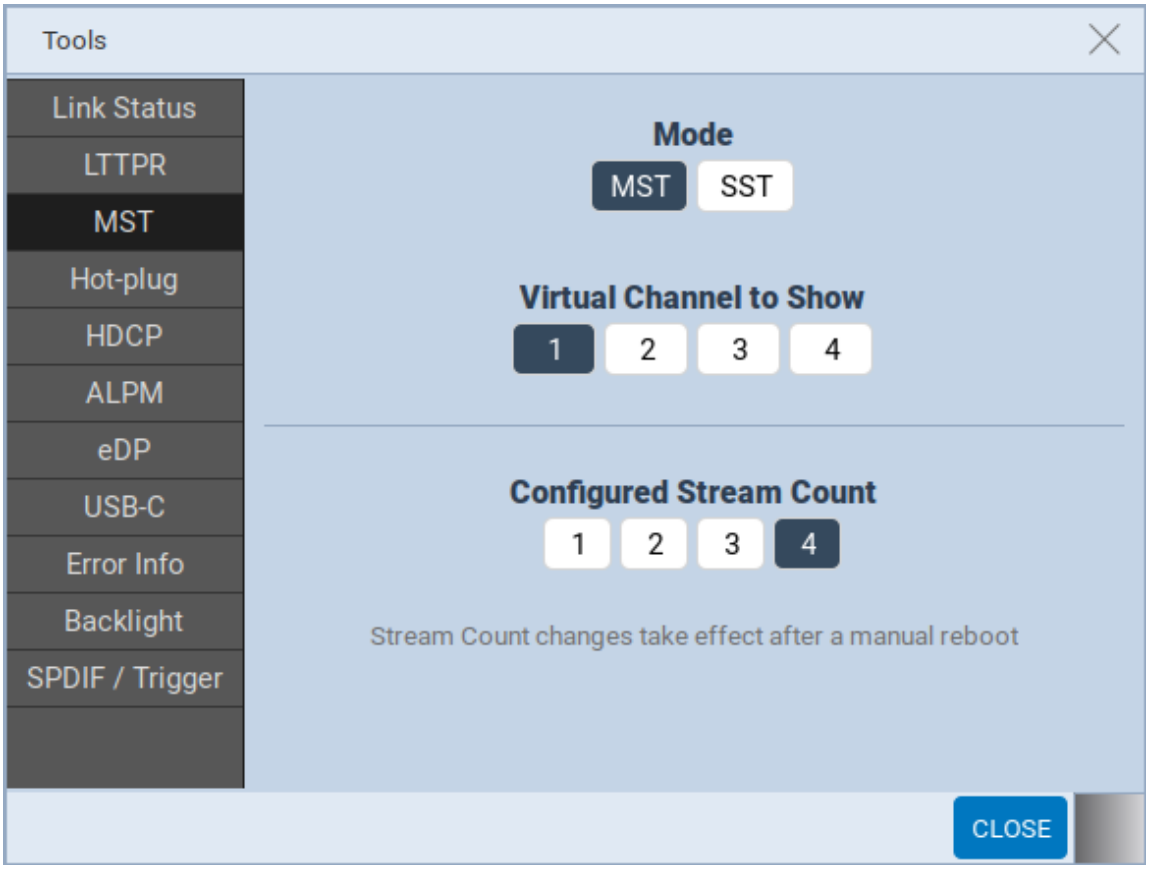


The previous screenshot shows the dialog box with a device that has link trained at 10.0, 13.5, or 20.0 Gb/s. These rates are UHBR which require Multi-Stream Transport, and SST is not an option under **Mode**.

The next example of the dialog box below shows a device link trained at 8.1 Gb/s or lower.

The dialog box has three fields:

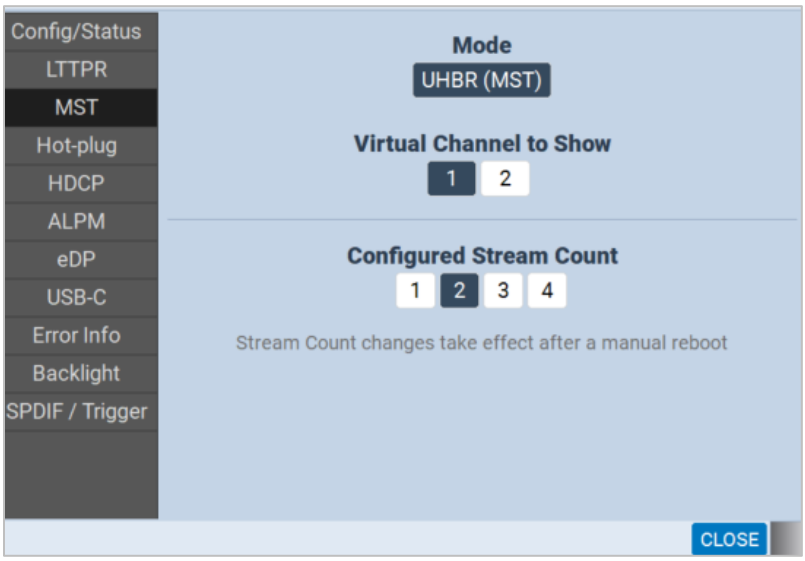
- **Mode**: Select between SST and Multi-Stream Transport
- **Virtual Channel to Show**: Select which virtual channel to display within the Protocol Analyzer/Receiver.
- **Configured Stream Count**: Change the number of streams between transmitted by the Generator.


Tools
Link Status
LTTPR
MST
Hot-plug
HDCP
ALPM
eDP
USB-C
Error Info
Backlight
SPDIF / Trigger
Mode
MST
SST
Virtual Channel to Show
1
2
3
4
Configured Stream Count
1
2
3
4
Stream Count changes take effect after a manual reboot
CLOSE

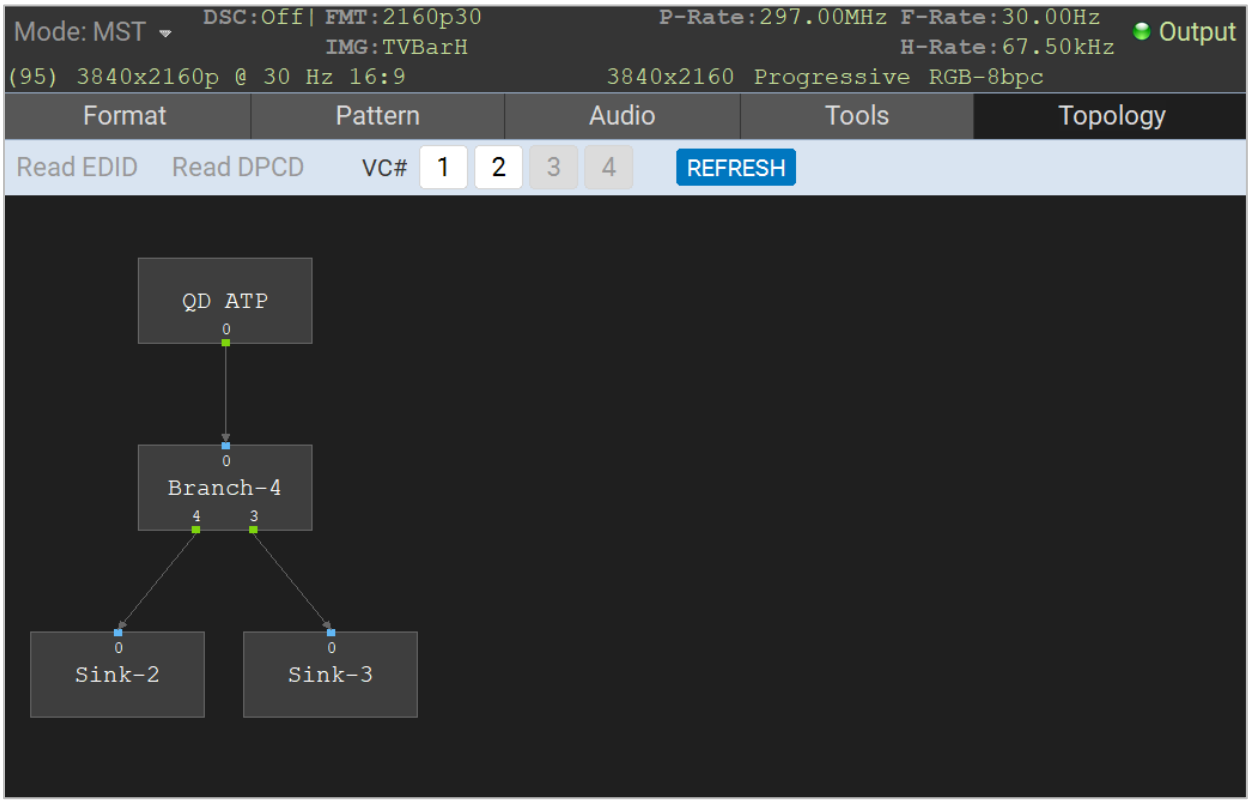
To add/remove a downstream node:

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.



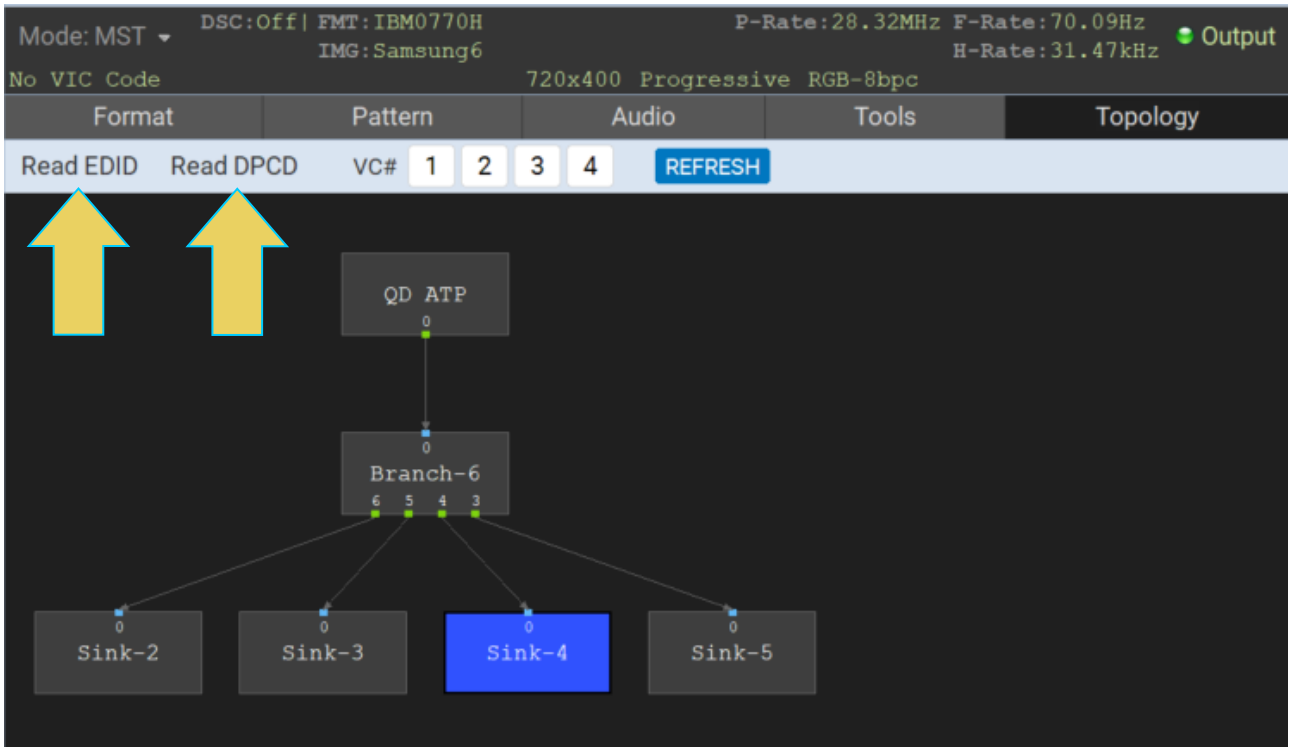
After rebooting, navigate to the **Topology** tab to verify the number of downstream nodes. Continuing from the previous example, the topology now displays a branch device and two sinks, as shown below.



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

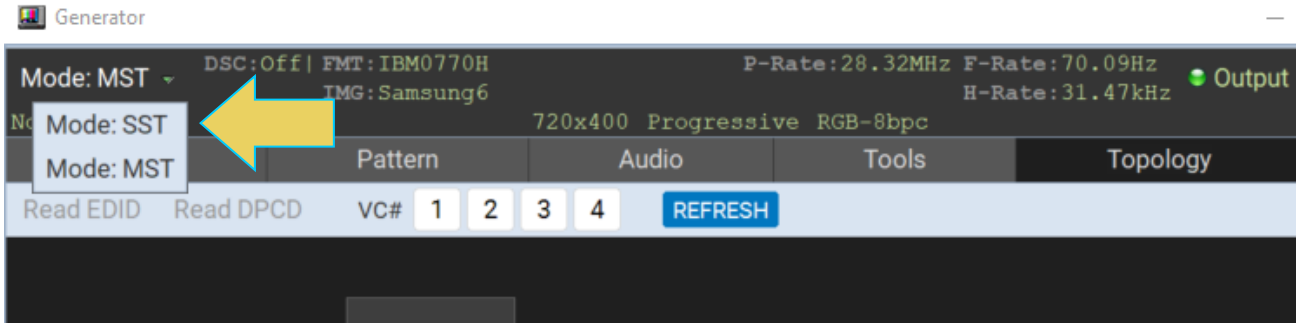
EDID Decode and DPCD Viewer are covered in section **4.5 Tools**, but there is another way to access these utilities while in Multi-Stream Transport mode from the Topology tab.

The **Read EDID** and **Read DPCD** buttons are located at the top left of the window in the Topology tab (shown below). Clicking either of these will take you to the respective utility in the Tools tab. The example below has Sink-4 selected.



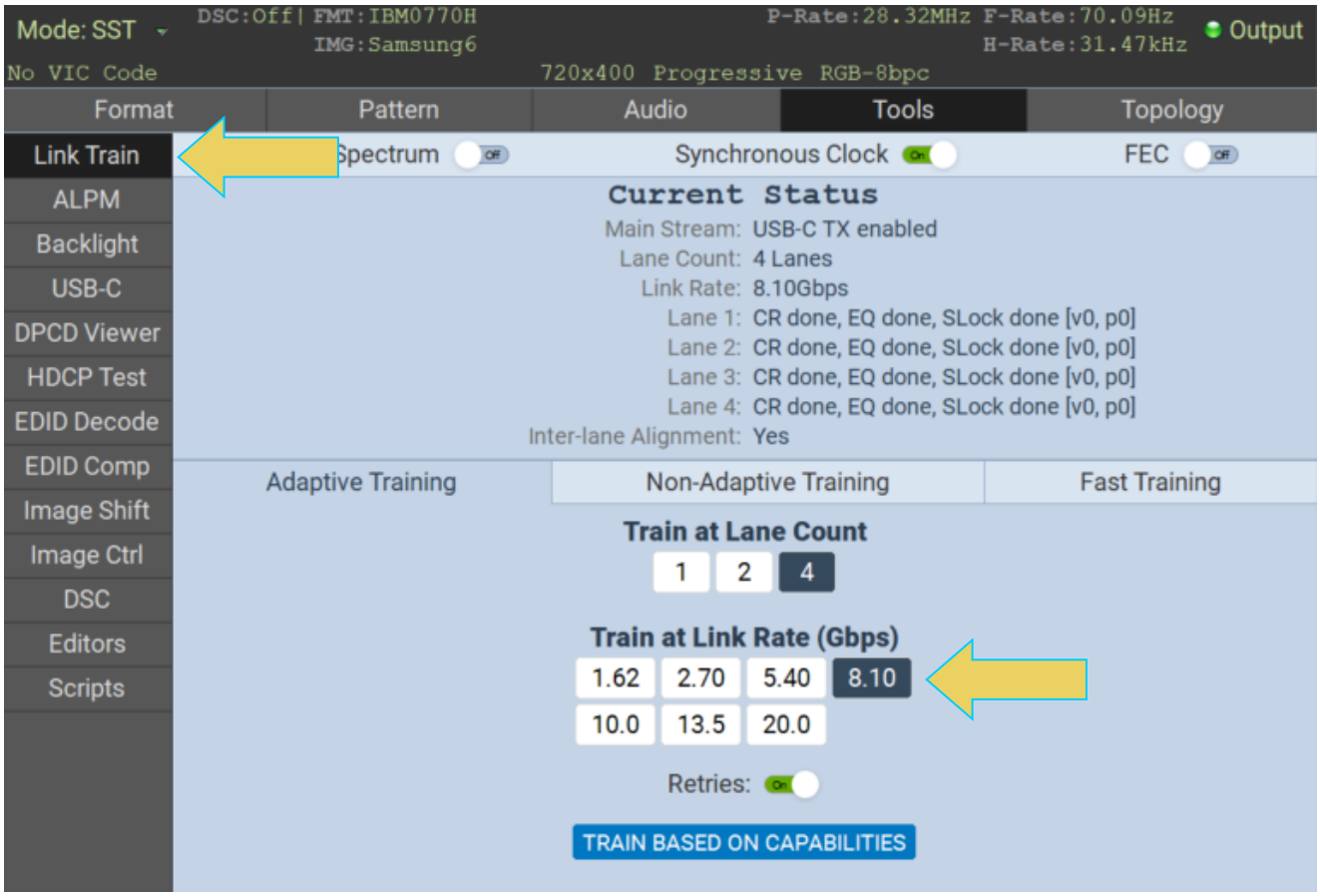
Returning to Single-Stream Transport (SST) Mode

If your device previously 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 and selecting **Mode: SST** as depicted below.



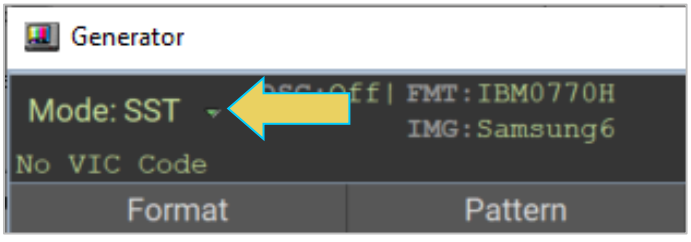
If the **Mode: Multi-Stream Transport** drop down is not clickable, your sink device is likely trained at a UHD link rate (10.0 Gbps or higher), which requires Multi-Stream Transport mode. You must use the **Link Train** utility in the **Tools** tab to train at a link rate of 8.1 Gbps or lower.

An example of this is depicted below. More on link training can be found in the **Link Train subsection of this chapter**.



Note: Do not click on **TRAIN BASED ON CAPABILITIES** as this will likely train at a link rate higher than desired for SST.

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



4 Source Verification with Basic (Real-time) Analyzer

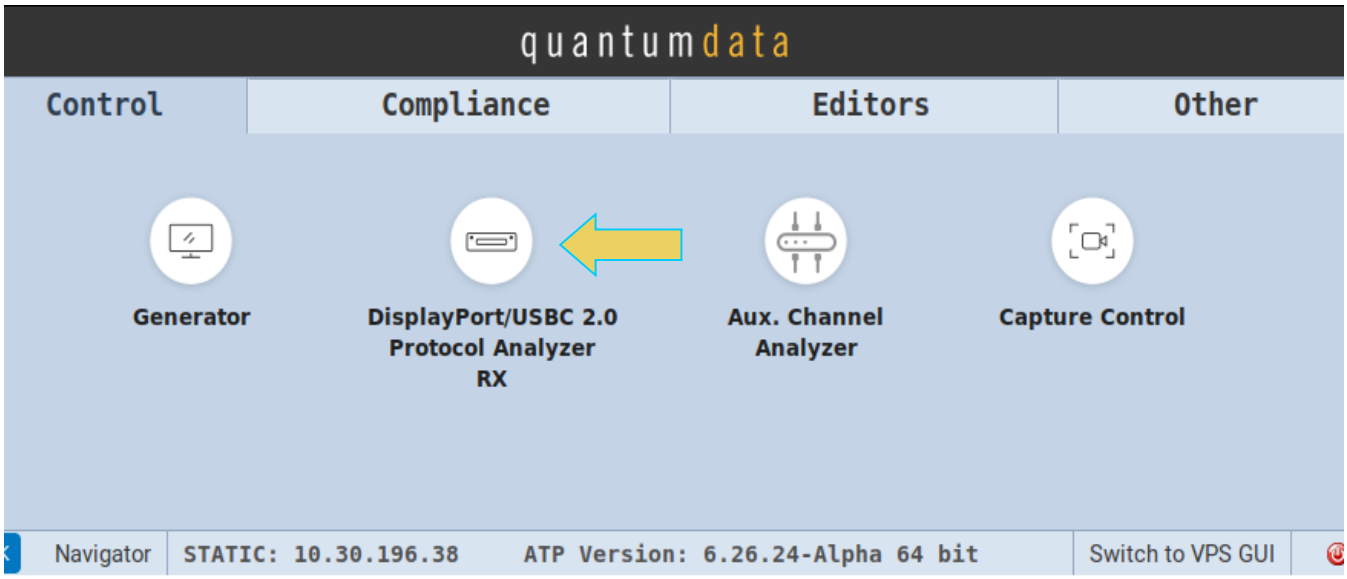
Basic Analyzer Description

- 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 Transport, HDCP.
- Provides support for viewing the Aux Channel transactions using the quantumdata Auxiliary Channel Analyzer (ACA) application when testing a DP source.

Note: **Chapter 5** will cover the Protocol Analyzer/Capture Control function of the M42d.

4.1 Accessing Basic Analyzer Features

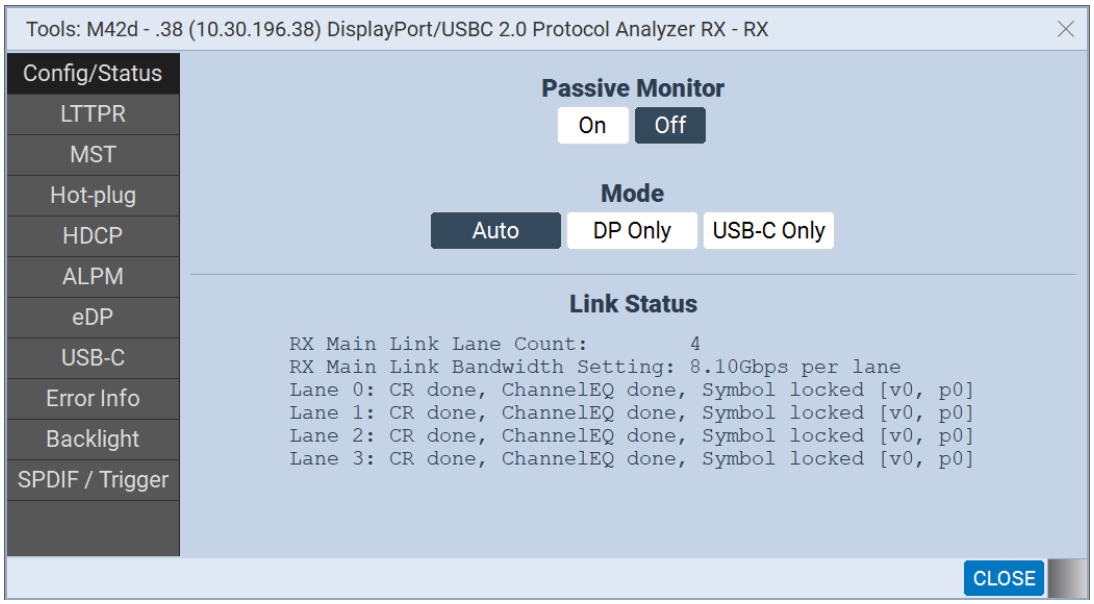
From the Home screen of the M42d ATP Manager, select the **DisplayPort/USBC 2.0 Protocol Analyzer Rx** app, as shown below.



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 on the top of the panel indicating the essential video characteristics, and there is a set of controls on the right-hand side, as shown below.

Note: The Analyzer panel is ***not*** transmitted to a **Remote PC ATP Manager.** When selecting the **Receiver** on a desktop ATP Manager, only 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 **2.5 VNC Remote Connection**.



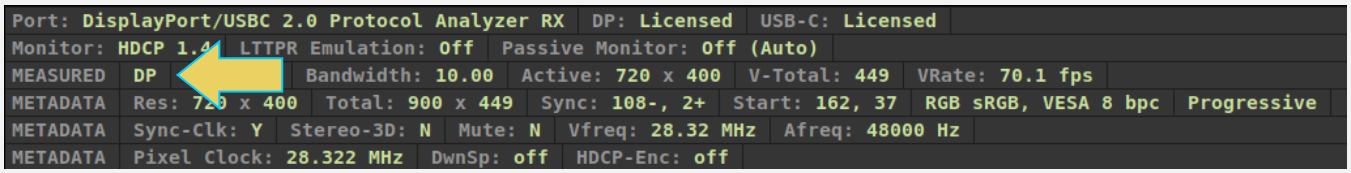
For this reason, most instructions and screenshots in the next two chapters are from the embedded ATP Manager GUI on the M42d device itself.

Basic Analyzer Dashboard

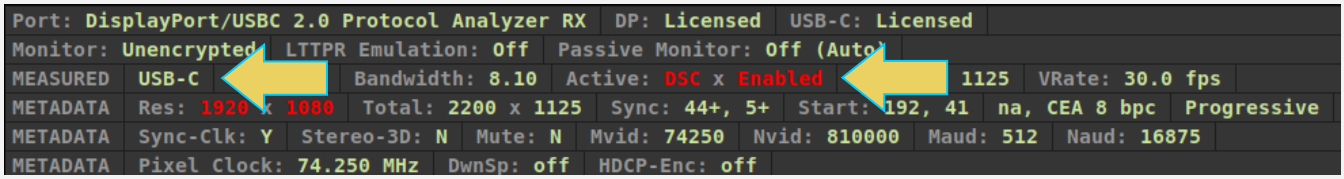
This subsection describes the dashboard components on the top of the Basic Analyzer panel. Refer to the table below for a description of these components.

Basic Analyzer – Dashboard Items

Example dashboard of DisplayPort 2.0 Protocol Analyzer Rx



Example using USB-C DP-alt mode with DSC enabled and active



The following items are on the Real Time dashboard:

Top Row Items – Module and Port:

- **Port** `Port: DisplayPort/USBC 2.0 Protocol Analyzer RX` - The Port area shows the current Rx port that is being displayed on the Basic Analyzer.

Second Row Items:

- **Monitor** `Monitor: HDCP 1.4` - Indicates the HDCP encryption status of the received video.
  Note: If unencrypted, this will be the indicator: `Monitor: Unencrypted`
- **LTTPR Emulation** `LTTPR Emulation: Off` - Indicates whether LTTPR emulation is active
- **Passive Monitor** `Passive Monitor: Off (Auto)` – Indicates whether passive monitoring is enabled.

Third Row Items:

- **Measured** `MEASURED DP` or `MEASURED USB-C` - Indicates whether USB-C or DP (DisplayPort) is currently connected.
- **Lanes** `Lanes: 4` - The number of lanes used during link training.
- **Bandwidth** `Bandwidth: 13.50` - The link rate (per lane).
- **Active (video resolution)** `Active: 3840 x 2160` - This is the measured video resolution.
  Note: If DSC is active this will be indicated `Active: DSC x Enabled`.
- **V-Total** `V-Total: 2250` - This is the measured total vertical video lines per frame.
- **VRate** `VRate: 60.0 fps` - This is the measured vertical frame rate

Fourth Row Items:

- **Res** `Res: 3840 x 2160` - The active video resolution in horizontal pixels and vertical lines determined from the main stream attributes.
- **Total** `Total: 4400 x 2250` - The total video in horizontal pixels and vertical lines determined from the main stream attributes.

Basic Analyzer – Dashboard Items

- **Sync** `Sync: 88+, 10+` **-** 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** `Start: 384, 82` **-** The starting pixel and line in the active video determined from the main stream attributes.
- **Colorimetry and bit depth** `RGB sRGB, CEA 8 bpc` **-** The colorimetry and bit depth determined from the main stream attributes.
- **Scan** `Progressive` **-** The scan type used, progressive (e.g. Prog) or interlaced (Inter) determined from the main stream attributes.

Fifth Row Items:

- **Sync-Clk** `Sync-Clk: Y` **-** 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. This value is determined by the main stream attributes.
- **Stereo-3D** `Stereo-3D: N` **-** The status of 3D audio determined from the main stream attributes.
- **Mute** `Mute: N` **-** The AudioMute flag status determined from the main stream attributes.
- **Vfreq** `Vfreq: 594.00 MHz` - Video pixel frequency determined from the main stream attributes.
- **Afreq** `Afreq: 48000 Hz` - Audio sampling frequency determined from the main stream attributes.

Sixth Row Items:

- **Pixel Clock** `Pixel Clock: 594.000 MHz` - How often pixels occur (frame rate x pixels per frame)
- **DwnSp** `DwnSp: off` - DownSpread indicates whether Spread Spectrum Clocking (SSC) is enabled
- **HDCP-Enc** `HDCP-Enc: off` – Indicates if HDCP encryption is currently active

Main 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
Main Control Panel 	The following controls are provided in the main control panel on the right edge of the Real Time mode interface. Each of the buttons have a pull-down menu associated with them. The purpose of each button and their basic control functions are described below: ▪ Home – The Home button Home is a navigation button that when pressed takes you back to the home screen **Apps** Panel. ▪ Back – The Back button Back is a navigation button that when pressed takes you back to the previously viewed screen. ▪ Start/Stop –The Start / Stop button Stop / Start is used to enable and disable the showing of the incoming video image. ▪ Color – The Color button Color and associated dialog box enables you to identify the color of any particular pixel. ▪ Scale – The Scale button Scale and associated dialog box enables you to set the size, quality and aspect ratio of the incoming video image. ▪ PPS – The PPS button PPS brings up the Picture Parameter Set panel. Used with DSC Analysis. ▪ VSC – The VSC button VSC displays Video Stream Configuration data ▪ ACA – The ACA button ACA is used to bring up the ACA utility. ▪ Set EDID – The Set EDID button Set EDID is used to set the EDID ▪ Set DPCD – The Set DPCD button Set DPCD is used to set the DPCD ▪ Tools – The Tools button Tools brings up the Tools dialog box, which will be discussed in detail later in this chapter. ▪ Passive Monitor – The Passive Monitor button Passive Monitor allows you to toggle Passive Monitor mode. **Note:** More details on **Passive Monitoring** are found in **Chapter 7 Passive Monitoring**.

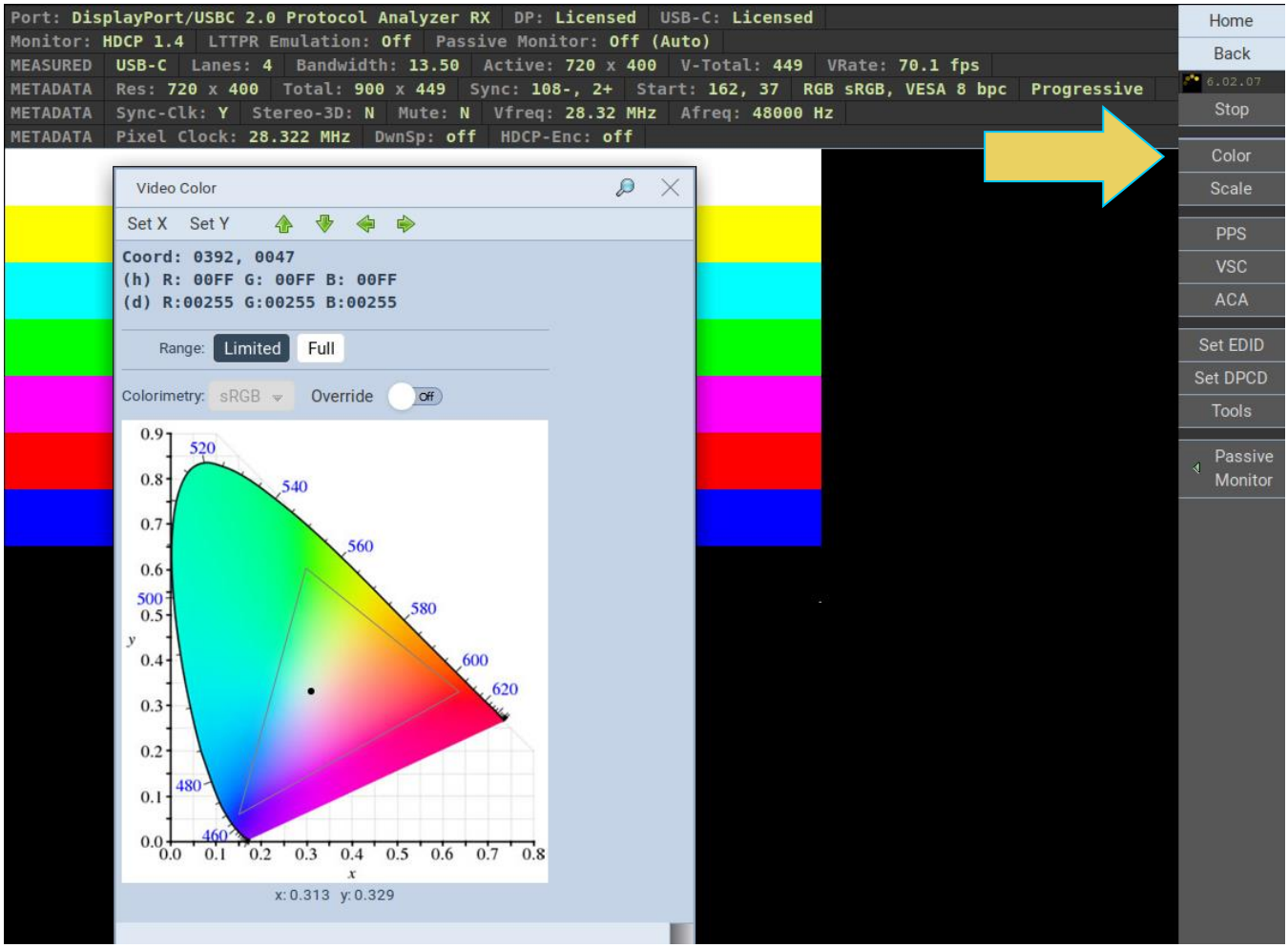
4.2 Controlling the Basic Analyzer

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

Viewing the Color values

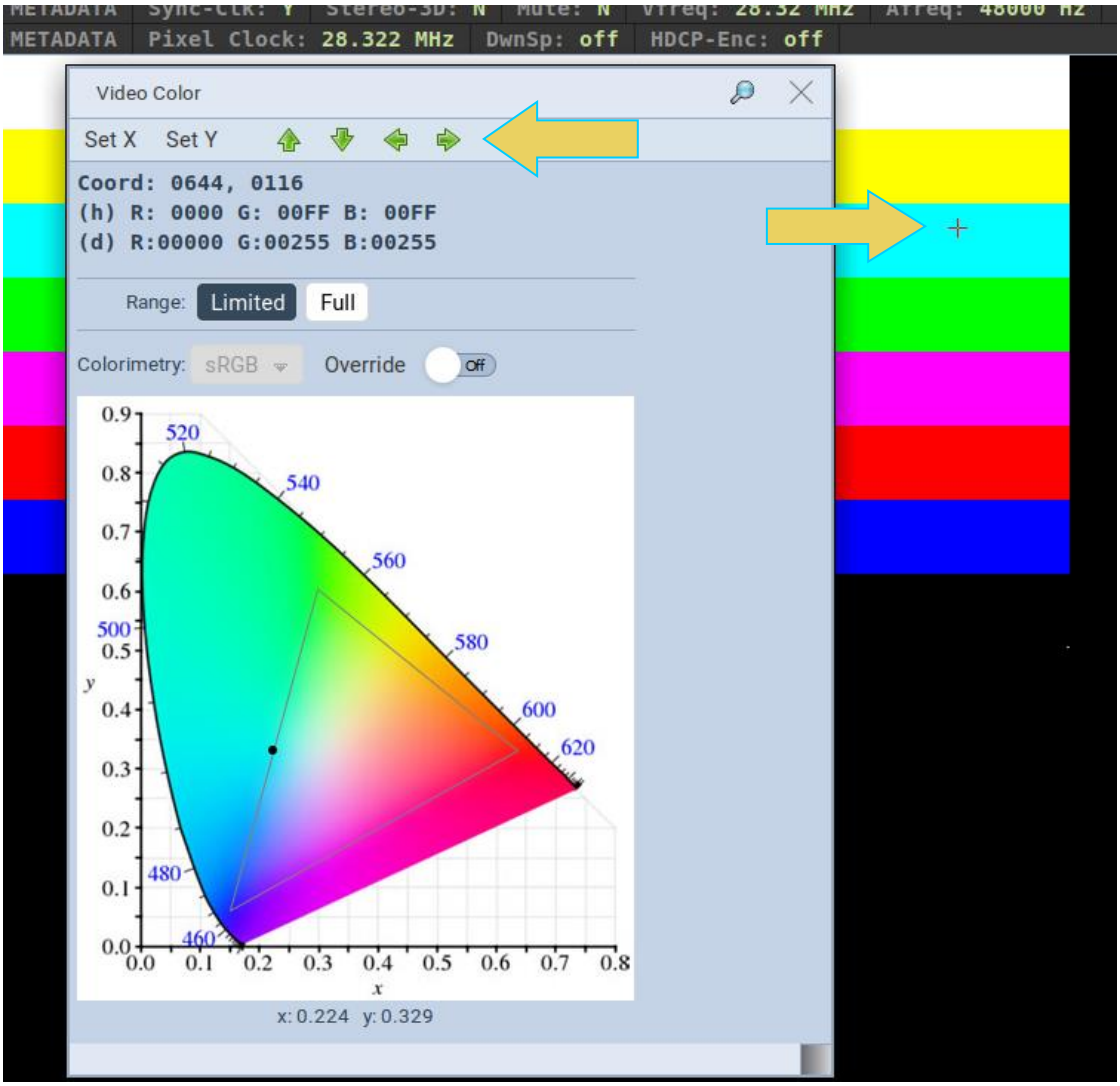
The M42d enables you to determine the color values of any individual pixel.

1. Access the Color dialog box by clicking the icon on the right-hand side control panel, as shown below.



The **Video Color** dialog box will open.

2. Click on any location within the video frame to read its pixel color. You can also move to the adjacent pixels with the green arrow buttons provided in the dialog box, as shown below.

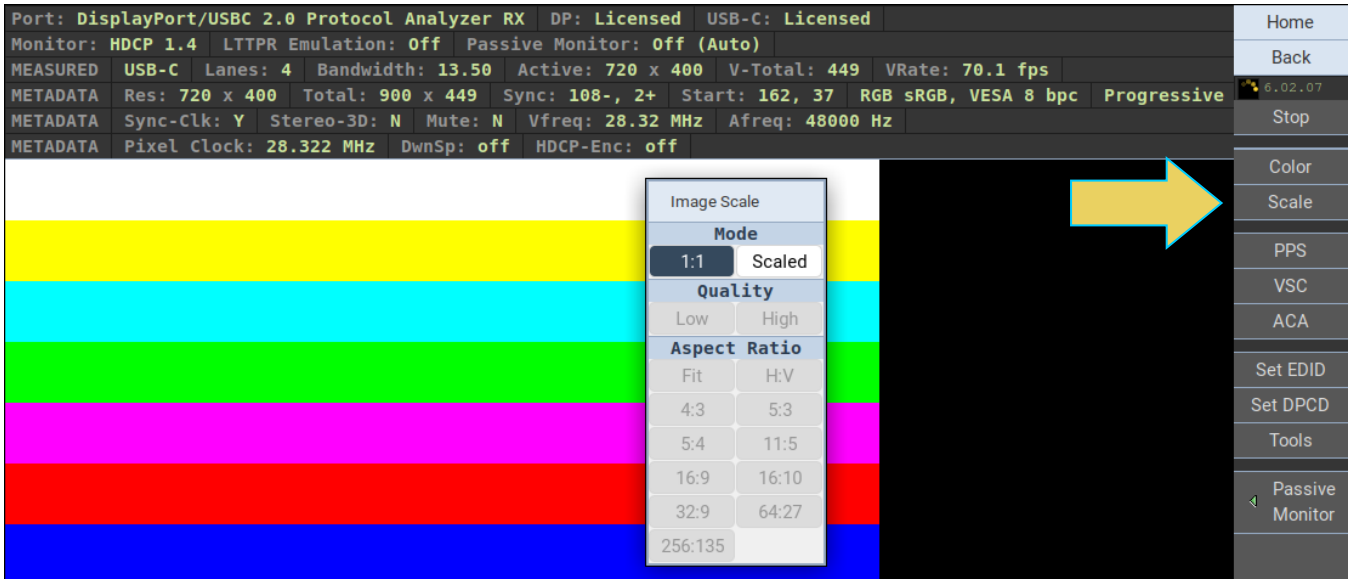


3. Read the pixel values on the dialog box provided. The pixel values (X for the horizontal – Y for the vertical) are provided in both hex and decimal.

Setting the video image size and aspect ratio

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

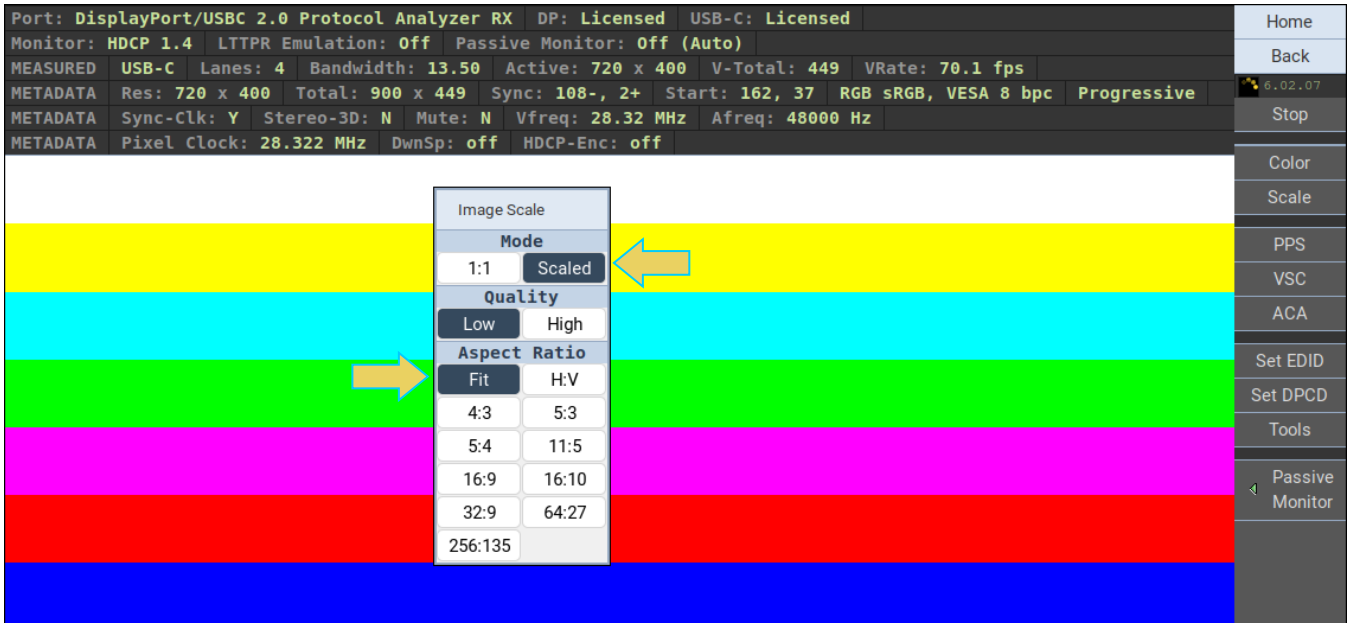
Access the **Image Scale** dialog box by clicking the **Scale** icon on the right-hand side control panel, as shown below.



Set the size to either 1:1 or Scaled.

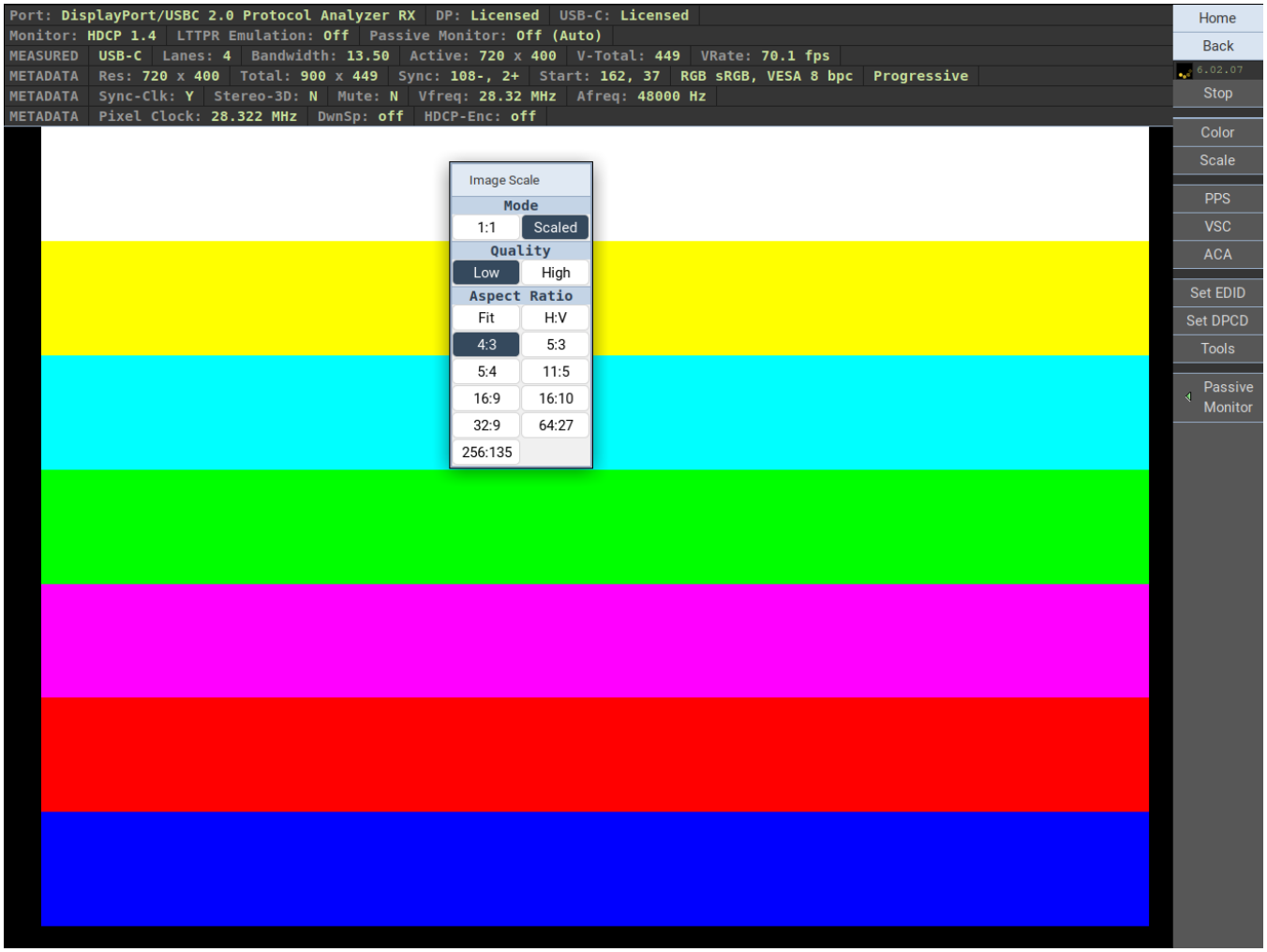
- The 1:1 setting means that the image appears in its true size. In this mode, if the image is too large for the viewing panel, it can be moved by clicking and dragging to view all areas of the image.
- The Scaled setting means that the image appears scaled to fit within the viewing area of the M42d's ATP GUI display, or within the Aspect Ratio defined.

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



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

Note: In order to set the Quality and the Aspect Ratio you must set the Mode to Scaled.

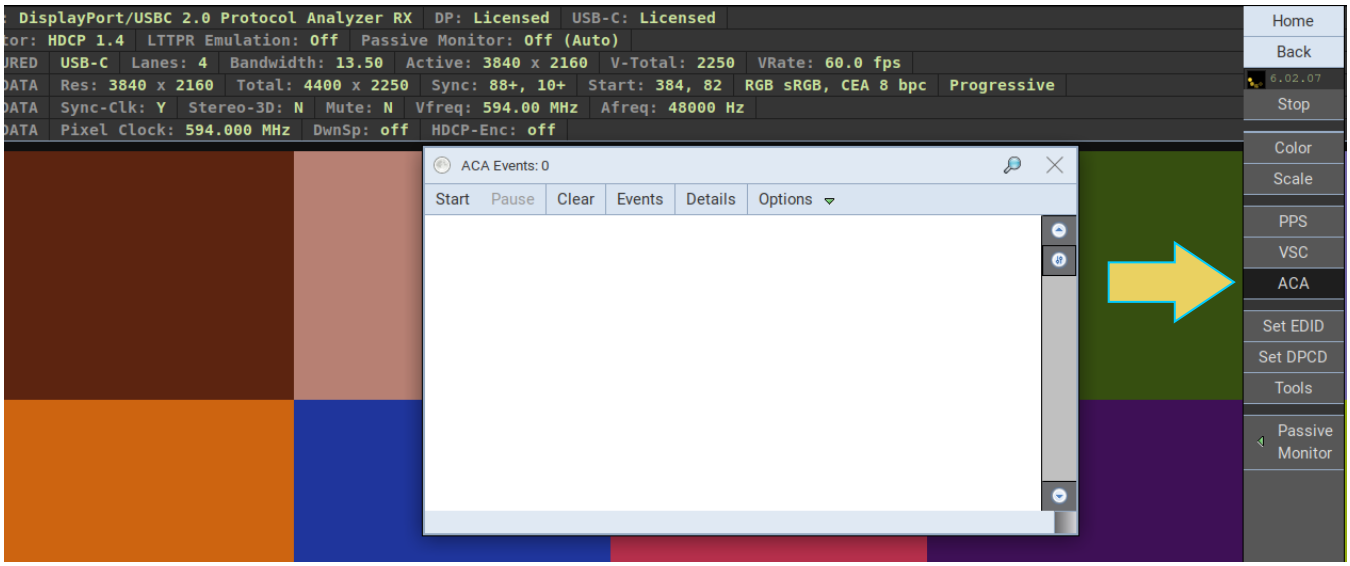


Note: Scaling uses simple decimation, so some fine image details may be inaccurate or lost.

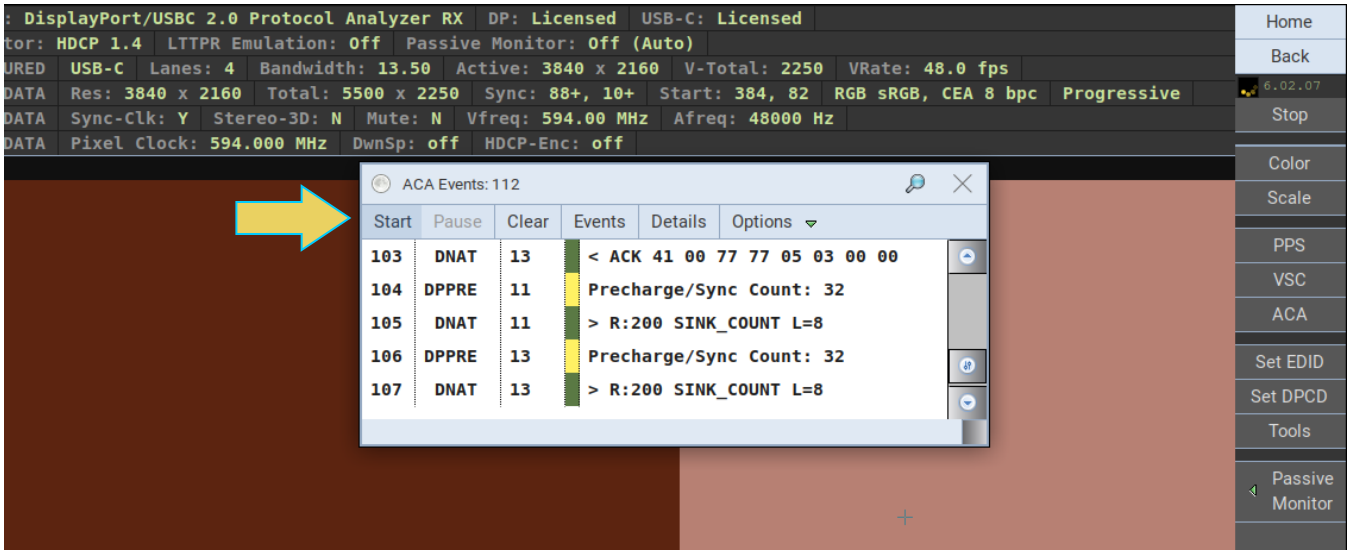
Monitoring transactions using the ACA Utility

You can monitor the Aux channel transactions from the ACA Utility, as well. The Aux Channel Analyzer is covered in detail in **Chapter 6**. The tool is discussed briefly here, but you can refer to Chapter 6 for a more in-depth look at the ACA utility.

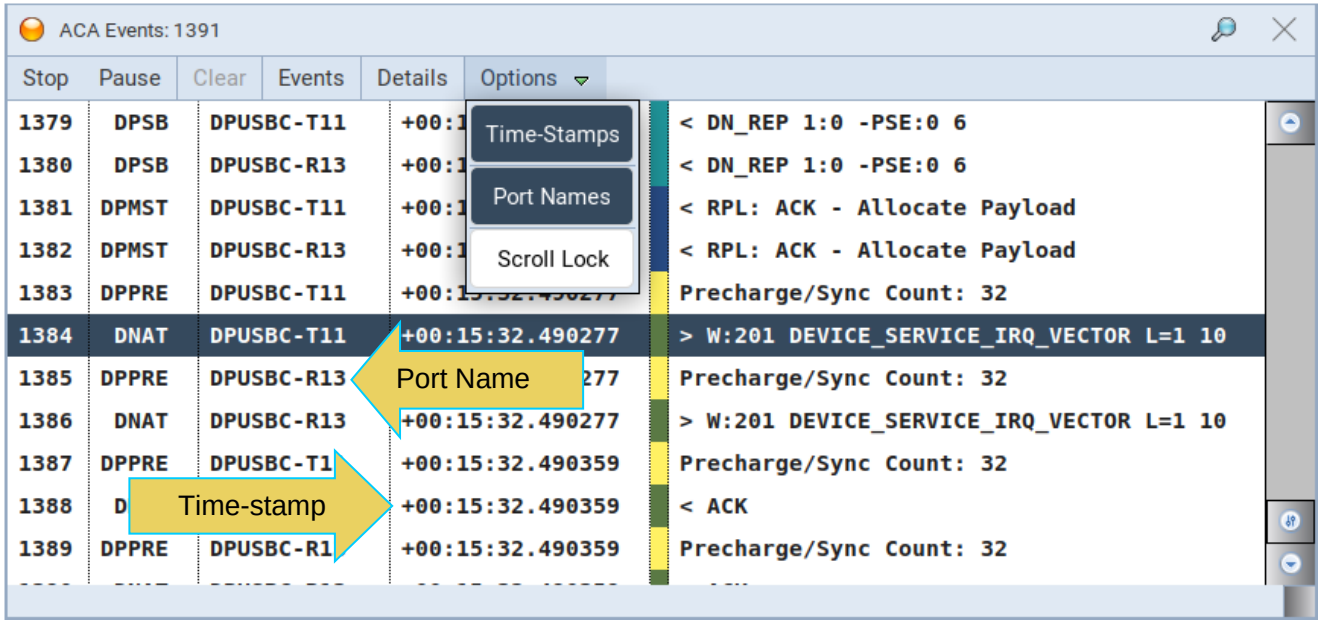
Access the ACA Utility by clicking the **ACA** button on the right-hand sidebar, as shown below.



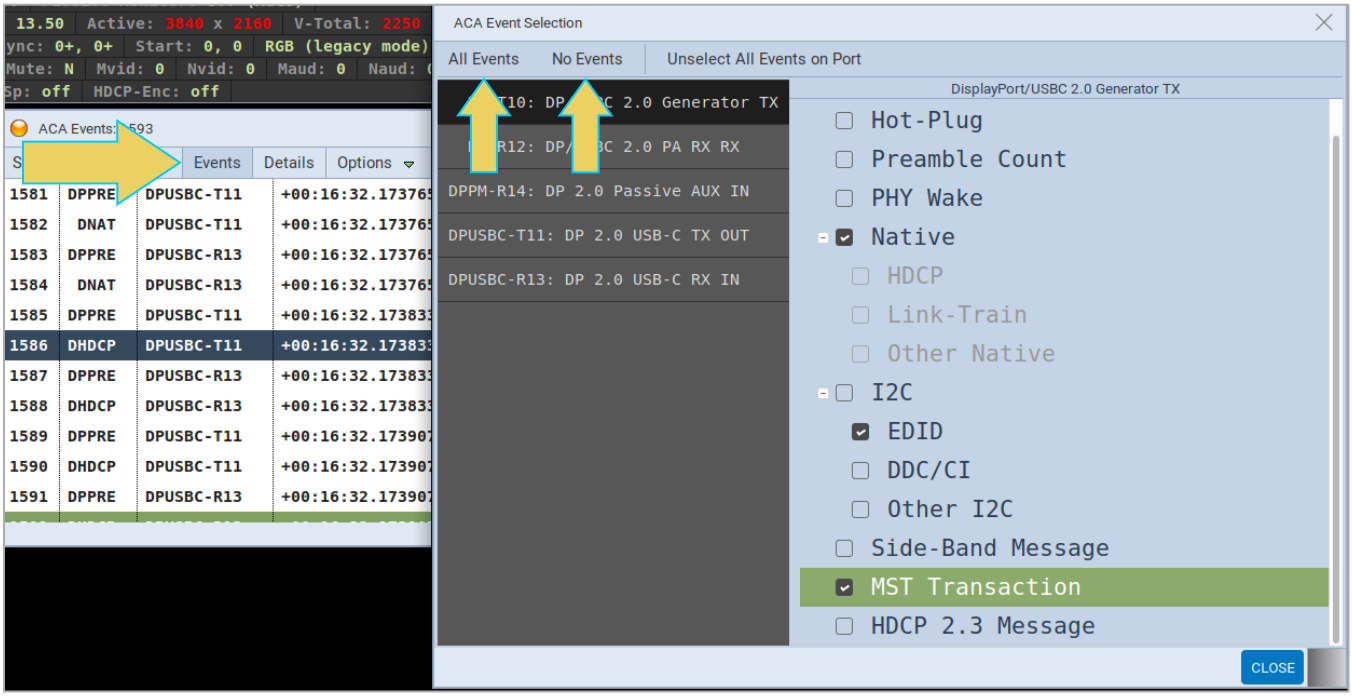
Click **Start** to begin monitoring the Aux Channel transactions. The ACA Utility will begin monitoring for Aux transactions and display them, as shown below.



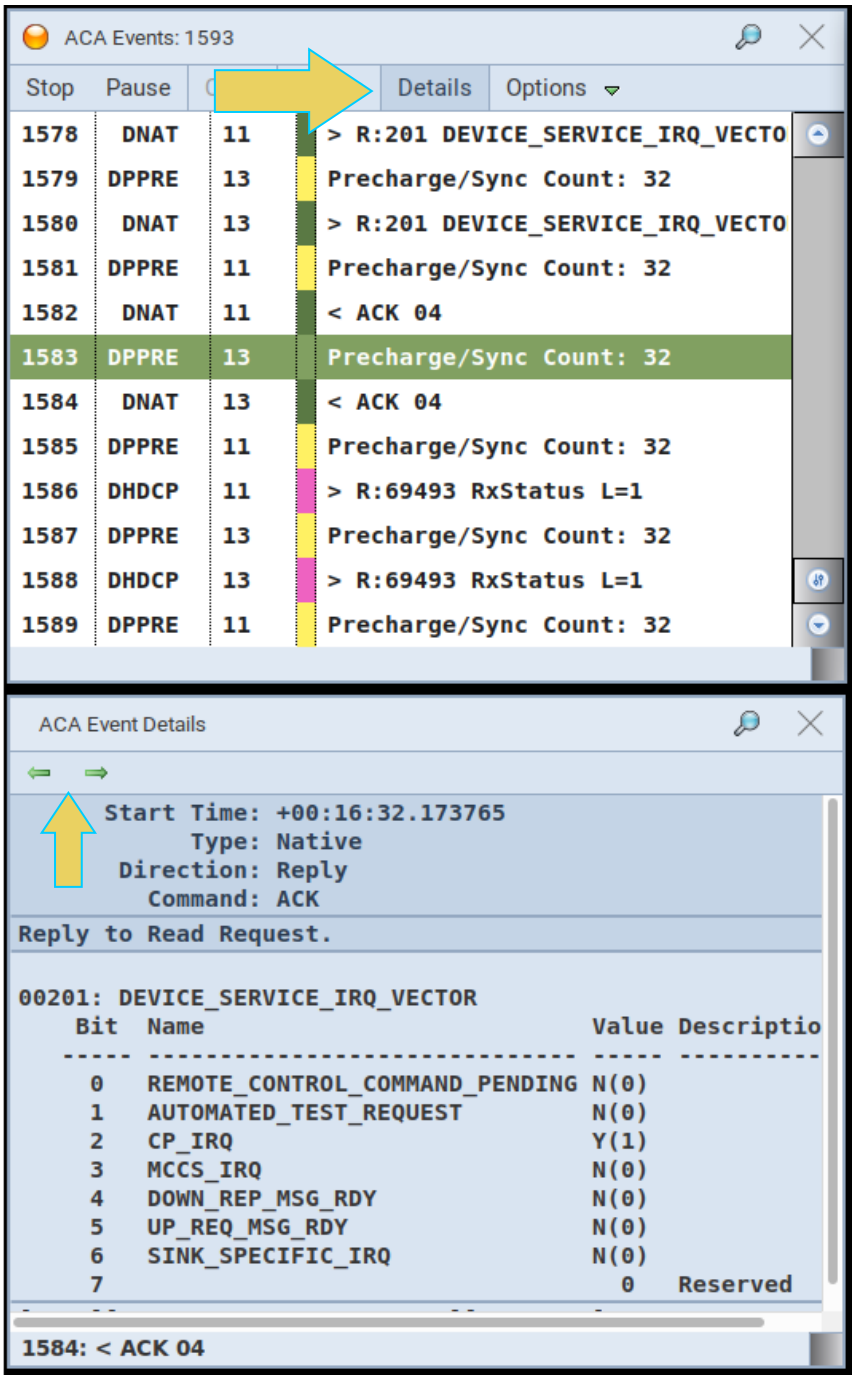
Click the **Options** flyout menu to toggle certain viewing settings. In the example below, the Time-Stamps and Port Names for each event are displayed.



In the ACA Utility, you can click the **Events** button for a dialog box that enables you to select which events you would like the Analyzer to display. Easily select All or No events, or check the specific events you would like to monitor. In the example below, all DP Native, EDID, and Multi-Stream Transport Transaction events are selected.



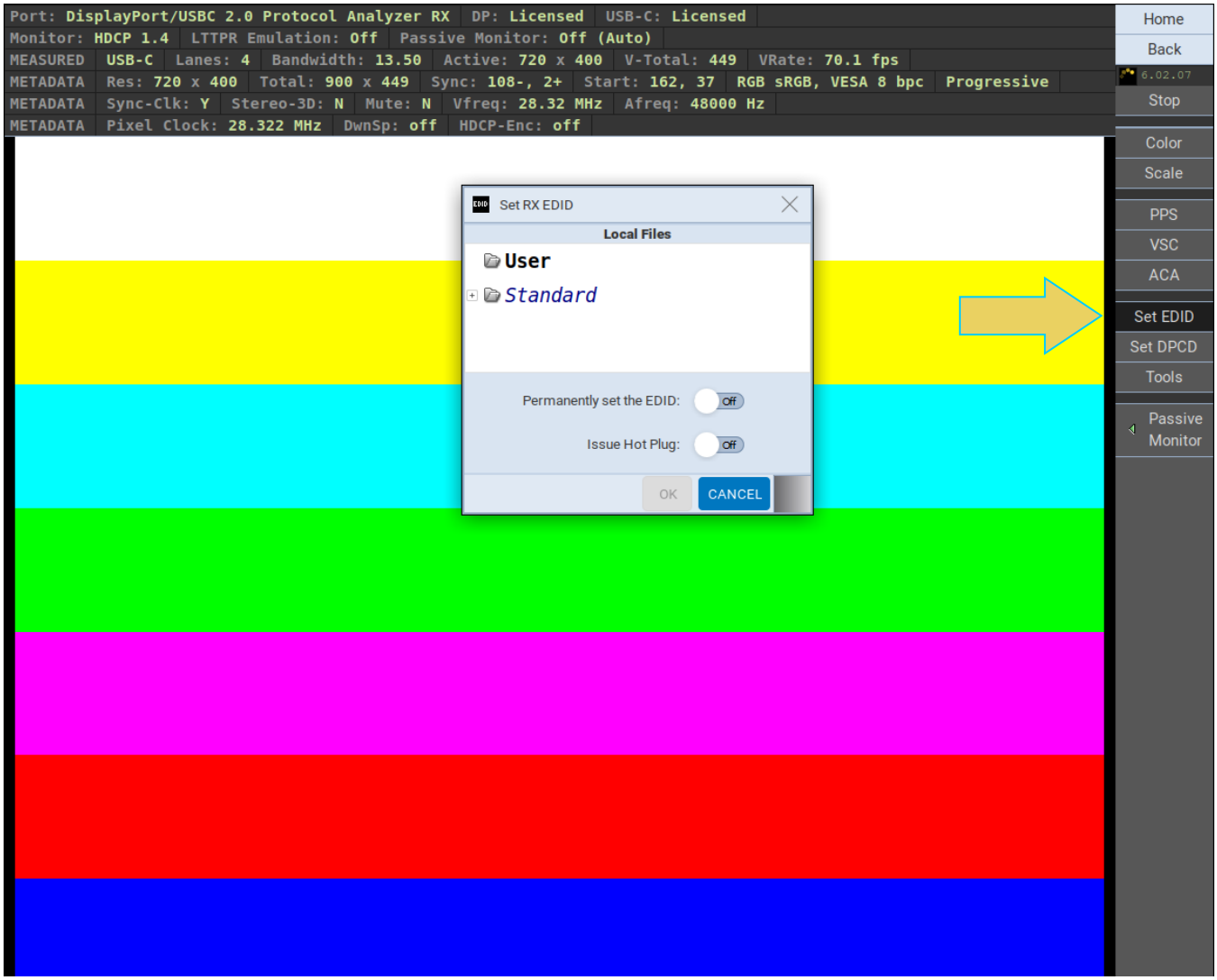
Click the **Events** button for a dialog box displaying the details of the selected event. Easily navigate to the previous or next event inside this box using the arrows at the top, as shown in the two dialog boxes below.



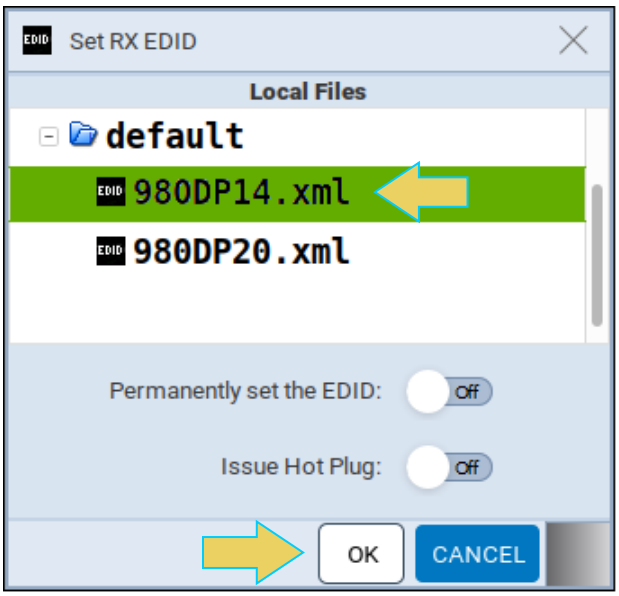
Setting the EDID for the Rx port

The M42d enables you to set Rx ports EDID for emulation. The ATP GUI provides an EDID Editor enabling you to create your own custom EDIDs. You can also capture EDIDs from the M42d's Tx ports and save them for testing on the Rx port.

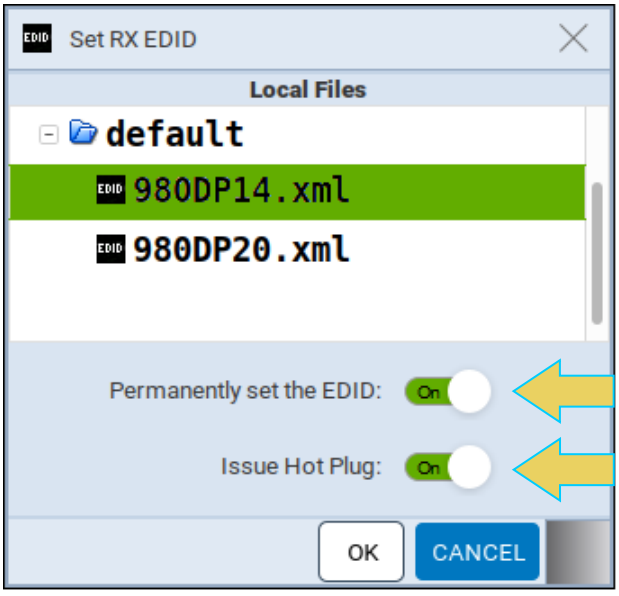
1. Access the Set EDID dialog box by clicking the **Set EDID** button on the right-hand sidebar, as shown below.



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



3. You may also wish to generate a hot plug while setting EDID or set the EDID permanently. You can do these by toggling either setting in the Set RX EDID dialog box, as shown below.



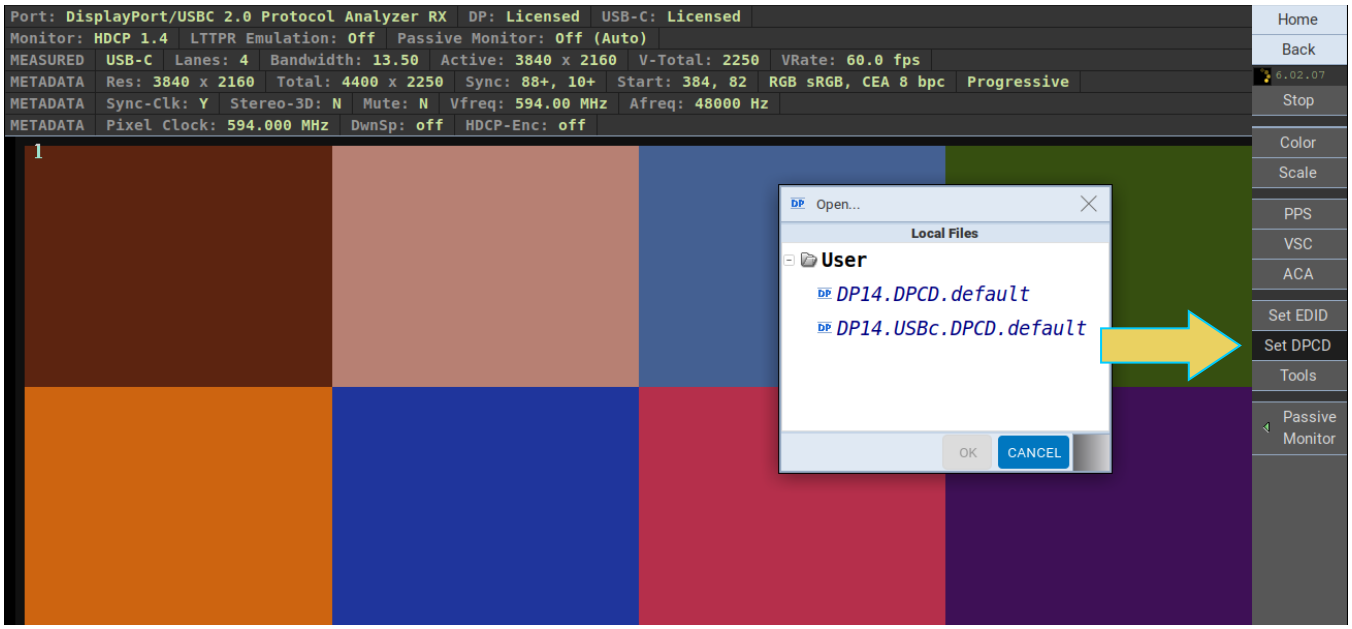
The M42d's Rx port will emulate the EDID you selected.

Refer to the section of Chapter 3 titled **Viewing EDIDs of a Connected Display** for instructions on how to capture EDIDs from HDTVs.

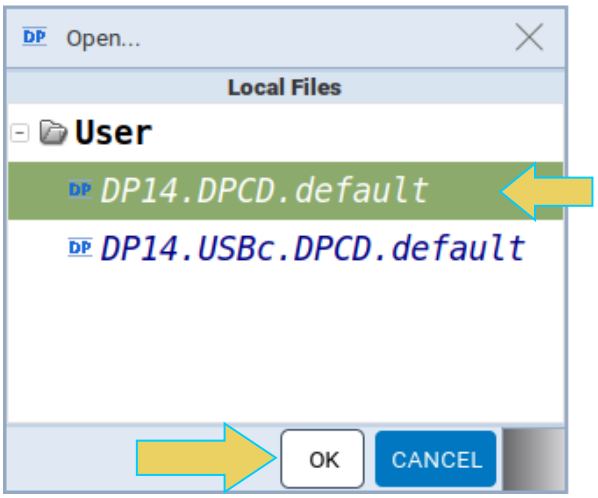
Setting the DPCD for the Rx port

The M42d enables you to set the DPCD. The ATP GUI provides an DPCD Editor enabling you to create your own custom DPCDs, as well.

1. Access the Set DPCD dialog box by clicking the **Set DPCD** button on the right-hand sidebar, as shown below.



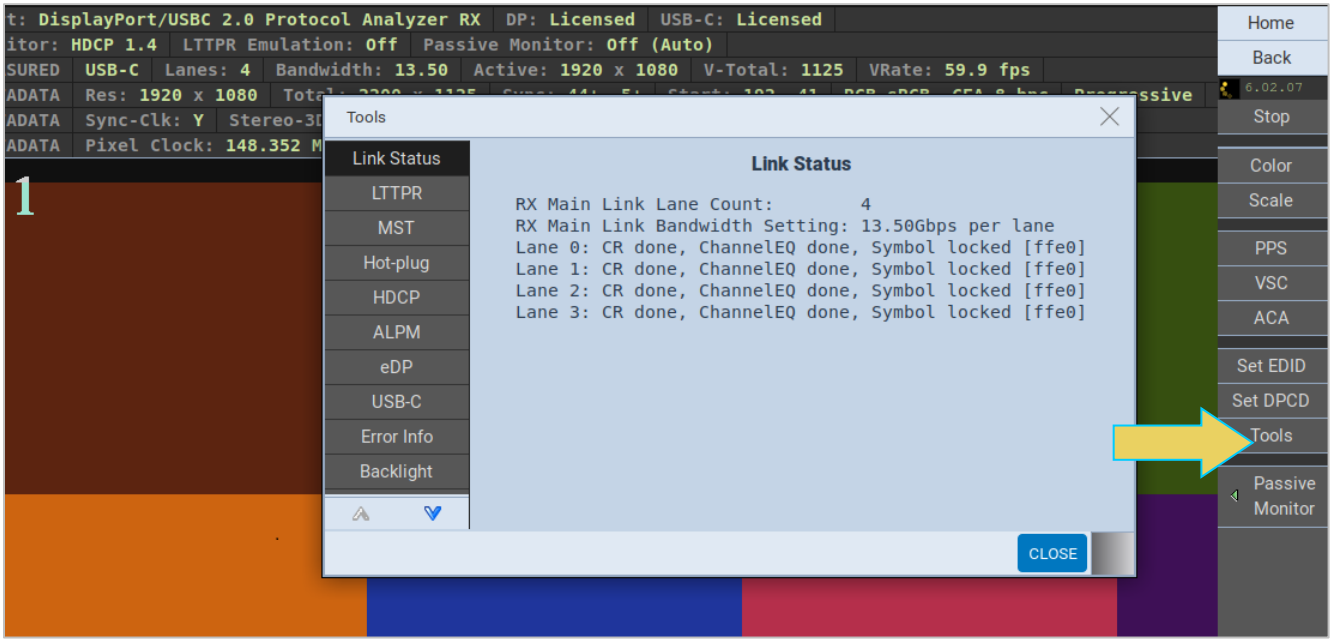
2. Select the desired DPCD and then click **OK.**



Refer to the section of Chapter 3 titled **DPCD Viewer** for instructions on how to view a display's DPCD registers.

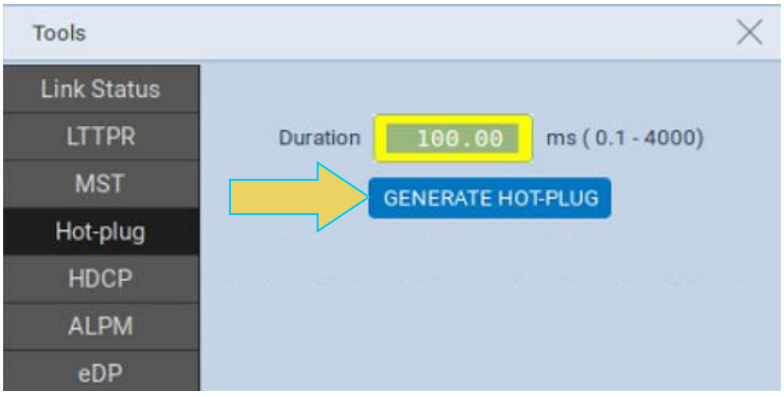
4.3 Tools Dialog Box

The **Tools** dialog box offers additional features, options, and statuses within it. This section will cover these in varying detail. Access the Tools dialog box by clicking the **Tools** button on the right-hand side control menu, as shown below.

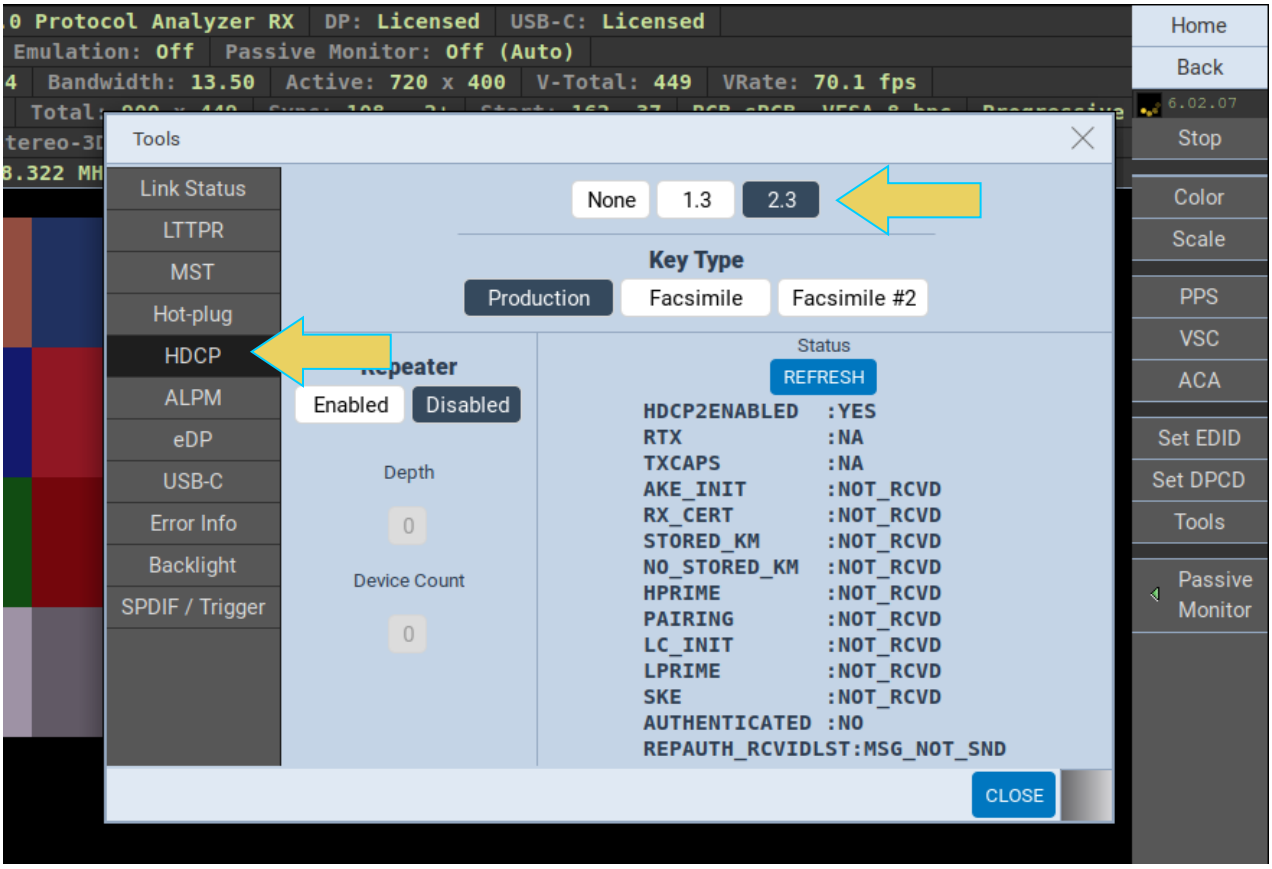


Overview of Tools dialog box selections:

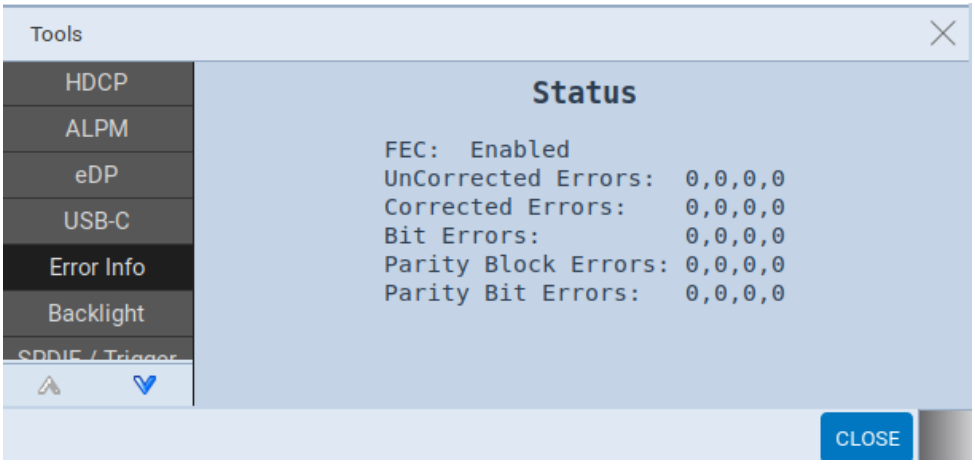
- **Link Status**- Provides information on the Rx Main Link lanes and link rate
- **LTTPR**- Access tools for LTTPR Emulation (license required). This feature is covered in **Chapter 8 LTTPR Testing**
- **Multi-Stream Transport**- Provides for Multi-Stream Transport configuration. This feature is covered in detail in **4.6 Topology and Multi-Stream Transport**.
- **Hot-plug**- Generate a hot-plug pulse of duration between .1 – 4000 milliseconds. Example shown below



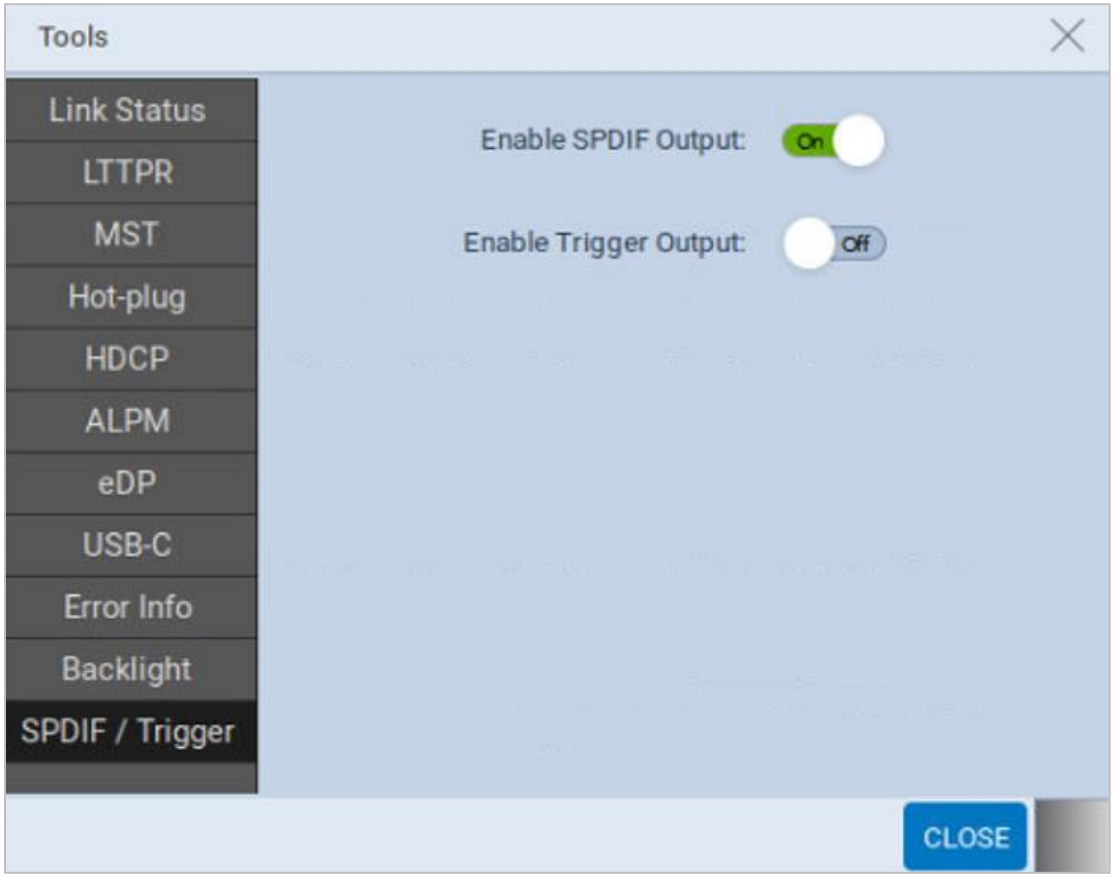
- **HDCP**- Enable/Disable HDCP or select version. You may also edit the Key Type or Bcaps from this screen.
  In the exampled shown below, HDCP 2.3 is enabled.



- **ALPM**- Advanced Link Power Management: Provides information on ALPM States
- **eDP**- Enable or Disable embedded DisplayPort. This feature is covered in **Chapter 10 eDP**.
- **USB-C**- Select from supported USB-C Pin Assignments
- **Error Info**- Displays status of Forward Error Correction (FEC). FEC is enabled in the example shown below.



- **Backlight**- Displays backlight intensity percentage.
- **SPDIF / Trigger**- Allows you to Toggle SPDIF and/or Trigger output.



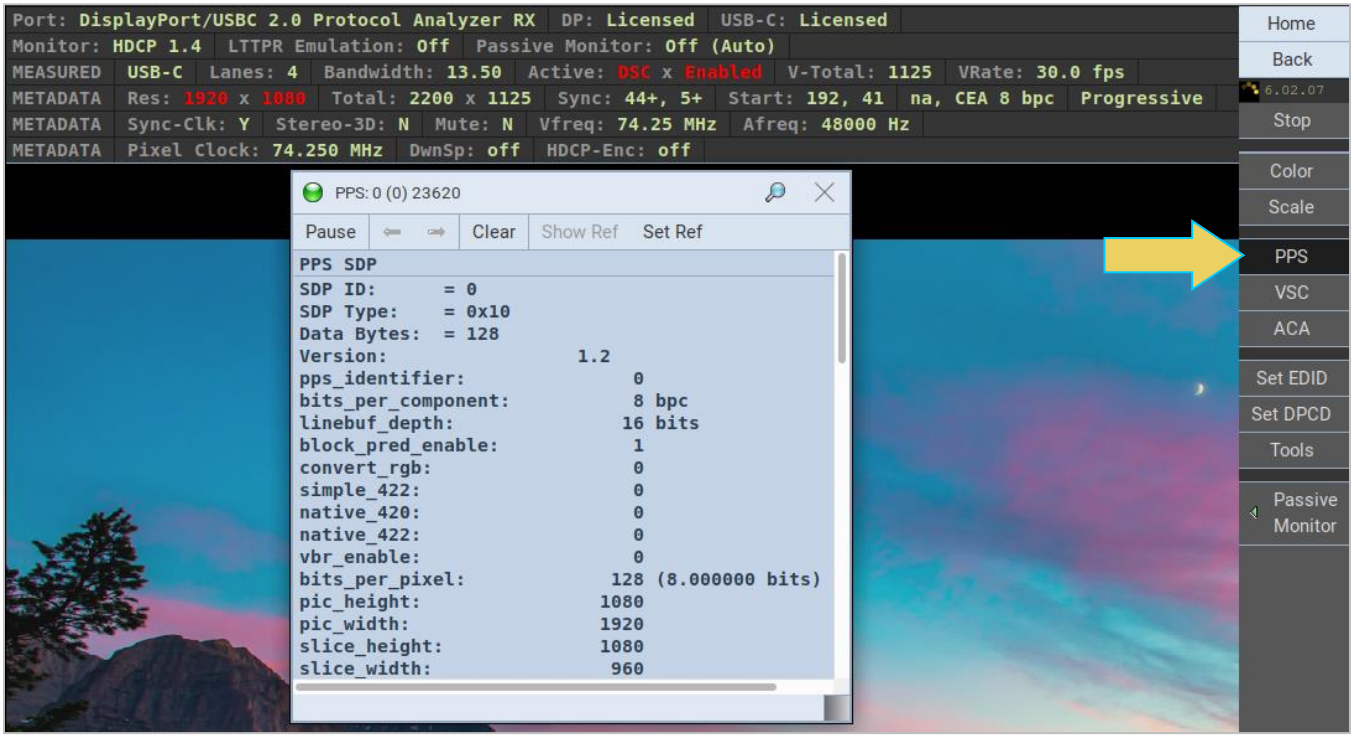
4.4 DSC Analysis

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 right-hand side controls. The PPS panel is shown below.



DSC Test CRC Verification

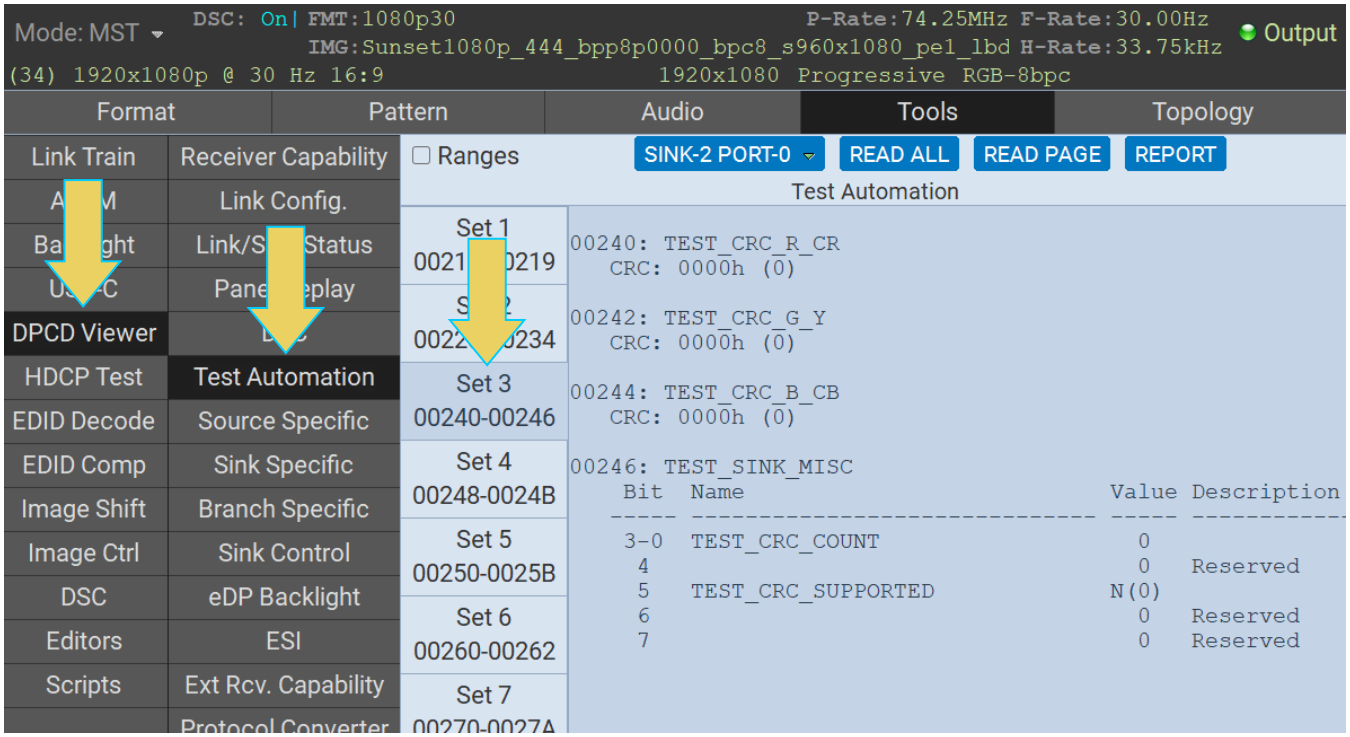
You can also verify the Test CRC of the incoming DSC decompressed frame to support test automation on Display Stream Compressed (DSC) frames.

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 3 section titled DPCD viewer**. To access the CRC Test readouts, select the Test Automation register and click Set 3, as shown in the example below.



5 Protocol Analyzer with Capture Control

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 DisplayPort source devices. Testing an DP source device involves the following high-level steps:

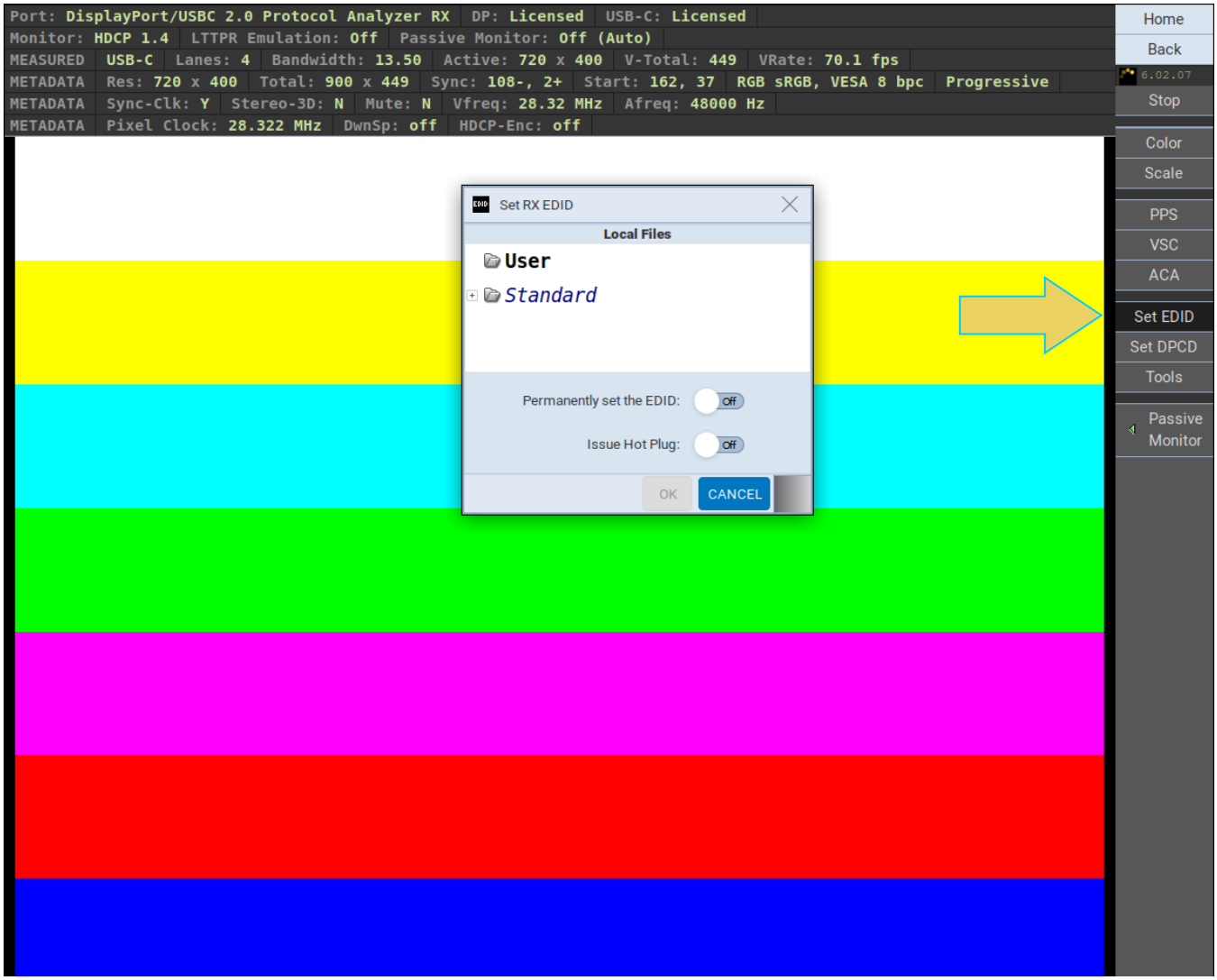
1. Configure the M42d analyzer with the proper EDID.
2. Connecting the DP source device. (see **Chapter 3 Connecting DUT**)
3. View the incoming video in real time to check the status of the device under test.
4. Specify a trigger method.
5. Initiate the capturing of the data.
6. Examine the test data through the ATP GUI Manager 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.

5.1 Getting started with the Protocol Analyzer

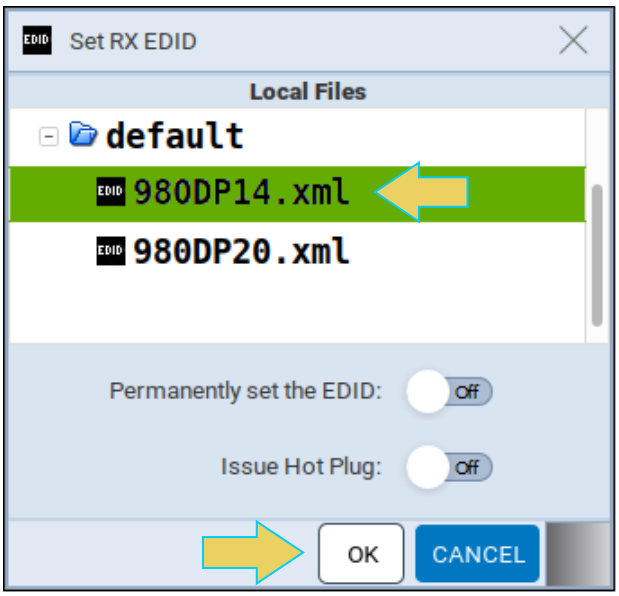
Configuring the M42d DP Protocol Analyzer with an EDID

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

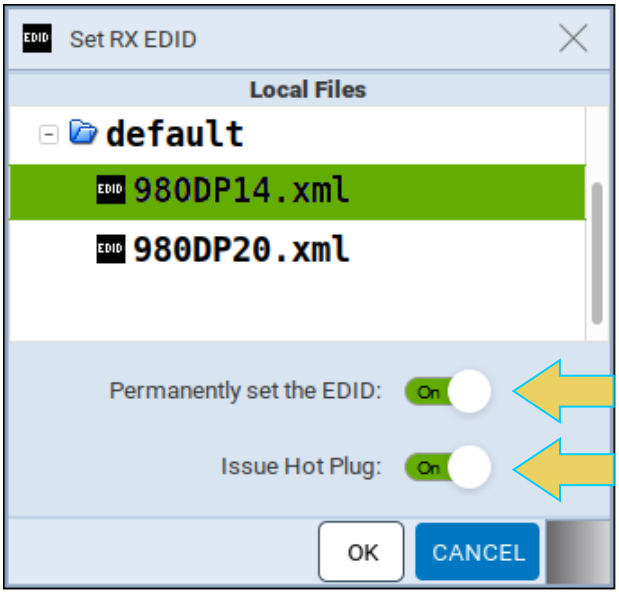
4. Open the **DisplayPort/USBC 2.0 Protocol Analyzer** from the home screen.
5. Access the Set EDID dialog box by clicking the **Set EDID** button on the right-hand sidebar, as shown below.



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



7. You may also wish to generate a hot plug while setting EDID or set the EDID permanently. You can do these by toggling either setting in the Set RX EDID dialog box, as shown below.

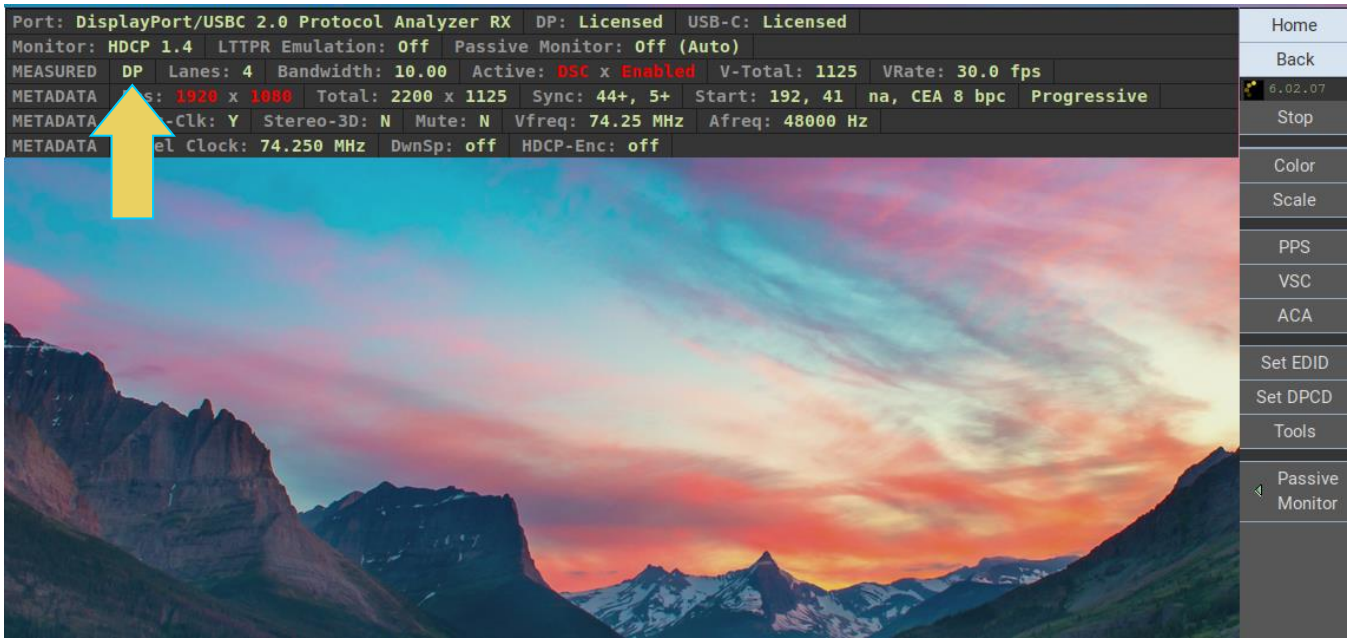


The M42d's Rx port will emulate the EDID you selected.

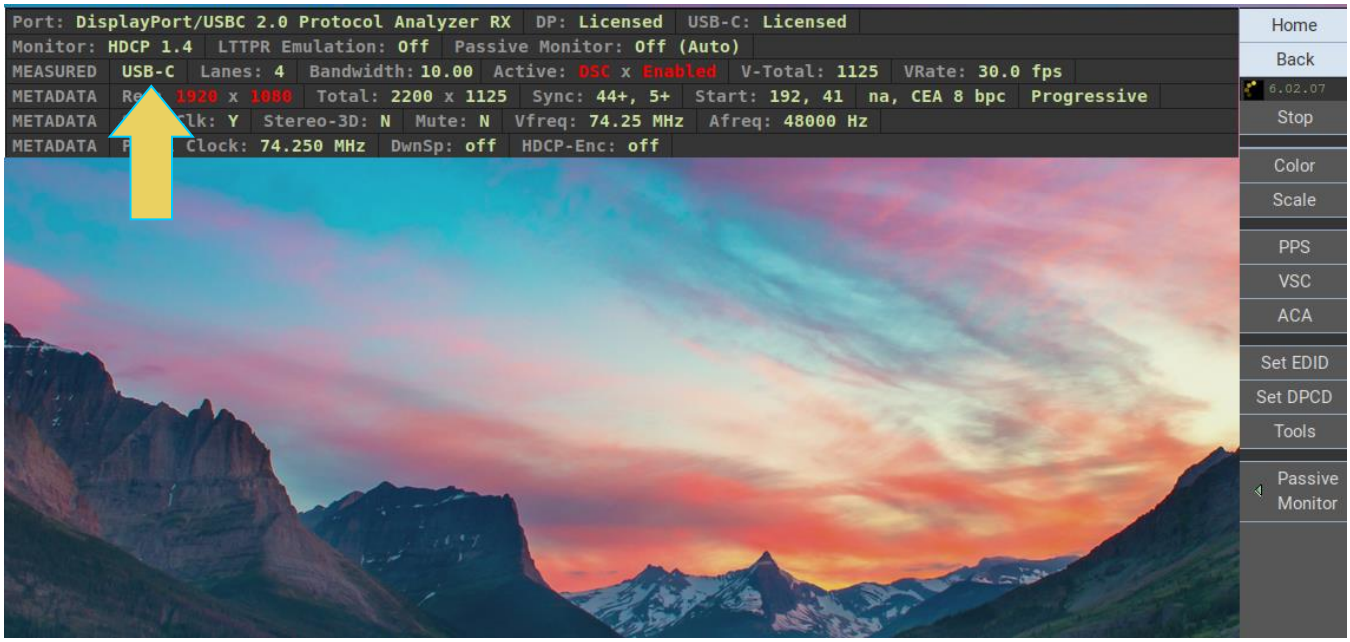
Verifying source video

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 top status bar.



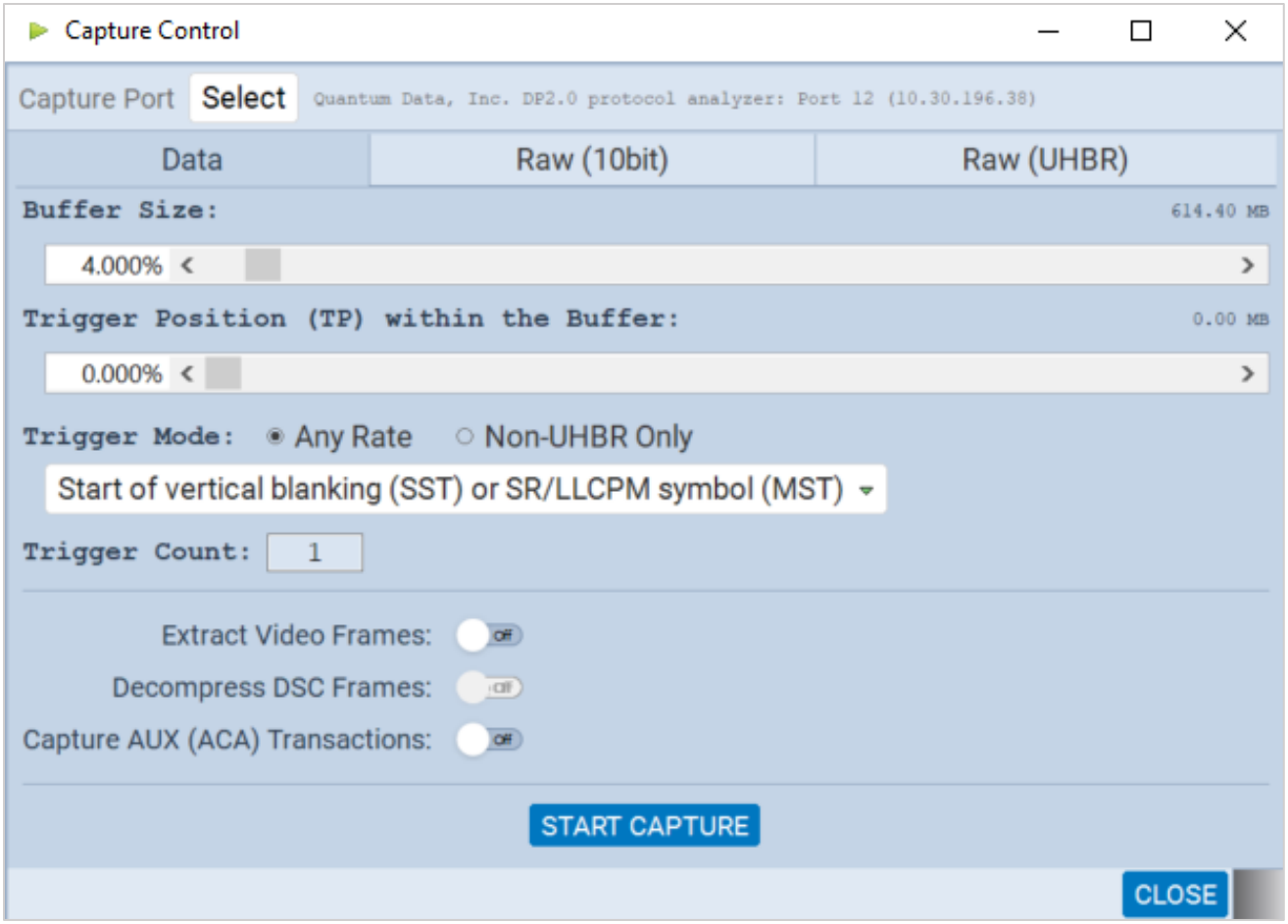
The following is an example of a Real Time view with USB-C source



5.2 Capture Control Panel

Access the **Capture Control** app from the Home Screen of the ATP Manager interface.

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.



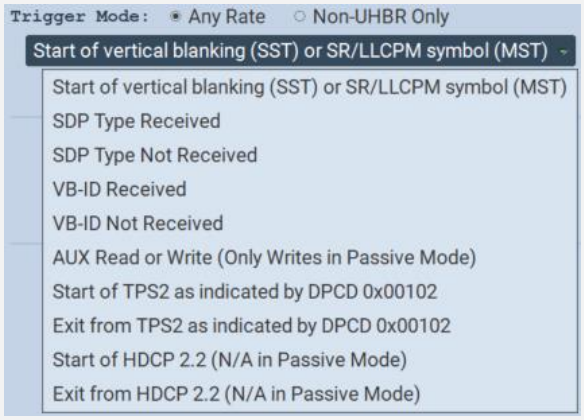
The following table describes the functions of the **Capture Control** panel, specifically the **Data** tab:

Capture Control Panel - Function	Item - Description
Buffer Size	• Enables you to set the size of the captured data in percent. • This is a slidebar 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.
Trigger Position within Buffer	• Enables you to set the position of the trigger event within the captured data. • This slidebar determines how much of the data that has accumulated in the capture buffer has occurred before the trigger

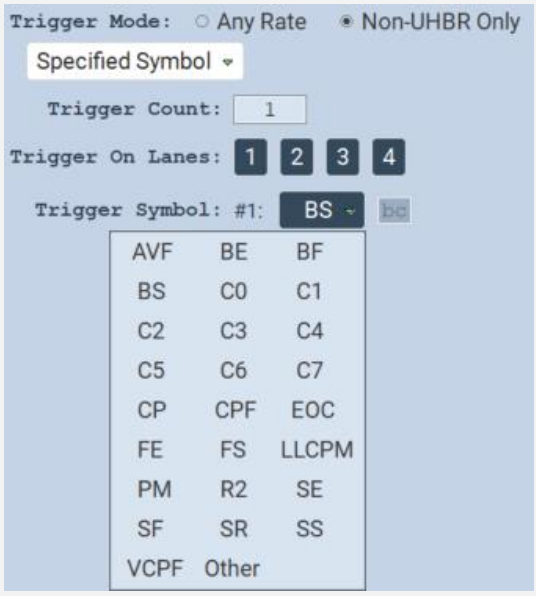
Capture Control Panel - Function	Item - Description
	event. The slidebar has an indication (on the left) of the location of the trigger event within the captured data. The value is expressed as a percent. • A value of 0% indicates that the trigger event occurs at the beginning of the resulting captured data and 100% indicates that the trigger event occurs at the end of the resulting captured data. • A value of 50% indicates that the trigger event is in the middle of the captured data. • **Note**: The Buffer Position Slidebar is not applicable when you select Vsync as the trigger condition.
Trigger Mode	• Enables you to specify the type of data that you want to capture. • ***Note:*** *This is covered in greater detail after this table.*
Trigger Count	• Option to specify which occurrence of the selected trigger event will initiate capture • eg. a Trigger Count of 5 will start capture at the 5th occurrence of the trigger event
Extract Video Frames	• Enables you to view the video frames that were captured.
Decompress DSC Frames	• Makes video frames viewable if DSC mode is enabled • Extract Video Frames toggle must be enabled for this option to be active
Capture AUX (ACA) Transactions	• Enables you to capture the Aux Channel transactions
Start Capture (Capture Tab)	• Initiates a capture using the criteria defined in the **Trigger Mode** and **Trigger Symbol**.

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
	• Start of vertical blanking (SST) or SR/LLCPM symbol (Multi-Stream Transport) • SDP Type Received • SDP Type Not Received • VB-ID Received • VB-ID Not Received • AUX Read or Write (Only Writes in Passive Mode) • Start of TPS2 as indicated by DPCD 0x00102 • Exit from TPS2 as indicated by DPCD 0x00102 • Start of HDCP 2.2 (N/A in Passive Mode) • Exit from HDCP 2.2 (N/A in Passive Mode)

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.

Non-UHBR Only Trigger Mode Drop Down	Trigger Options
	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 • R0-2 • SE=Secondary Data End • SR=Scrambler Reset, • SS=Secondary Data Start • Other

Specified Symbol Data Byte Value 8B10B Symbol Error 8B10B Disparity Error Start of TPS3 as indicated by DPCD 0x00102 Exit from TPS3 as indicated by DPCD 0x00102 Start of TPS4 as indicated by DPCD 0x00102 Exit from TPS4 as indicated by DPCD 0x00102 Start of HDCP 1.3 (N/A in Passive Mode) Exit from HDCP 1.3 (N/A in Passive Mode) FEC Decode Enable Sequence FEC Decode Disable Sequence ML_PHY_STANDBY sequence detected on the main link ML_PHY_SLEEP sequence detected on the main link AUX_PHY_WAKE sequence detected on the AUX channel	• Data Byte Value • 8B10B Symbol Error • 8B10B Disparity Error • Start of TPS3 as indicated by DPCD 0x00102 • Exit from TPS3 as indicated by DPCD 0x00102 • Start of TPS4 as indicated by DPCD 0x00102 • Exit from TPS4 as indicated by DPCD 0x00102 • Start of HDCP 1.3 (N/A in Passive Mode) • Exit from HDCP 1.3 (N/A in Passive Mode) • FEC Decode Enable Sequence • FEC Decode Disable Sequence • ML_PHY_STANDBY detected on main link • ML_PHY_SLEEP detected on main link • AUX_PHY_WAKE detected on AUX channel

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

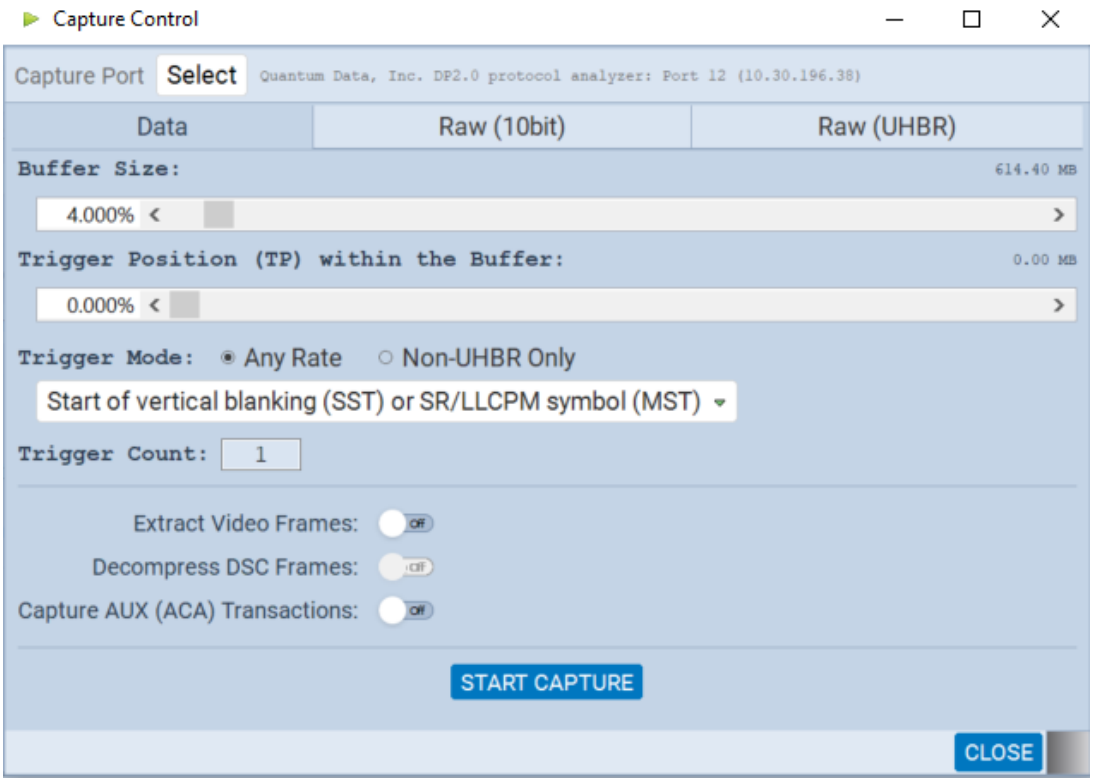
Capturing Displayport source data

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 ATP GUI or via a PC through the external ATP GUI Manager. Most of the examples in this section are taken from the embedded ATP GUI Manager but the look and feel are quite similar between the two.

Capturing DisplayPort source data

1. Access the **Capture Control** application from the ATP Manager home screen.

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



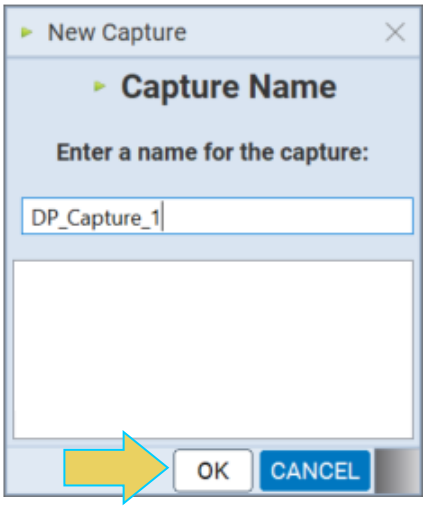
2. Select the port using the **Select**  activation button at the top of the window.

3. Specify the **Buffer Size** and **Trigger Position, Mode,** and **Count** in accordance with the information provided earlier in this chapter.

4. Toggle on or off the options to **Extract Video Frames**, **Decompress DSC** (if applicable), and **Capture AUX (ACA) Transactions**.

5. Initiate the capture by clicking on the **Start Capture** activation button
   

   You will be prompted with a **New Capture** dialog box (below) given you an opportunity to assign a name to the capture file.

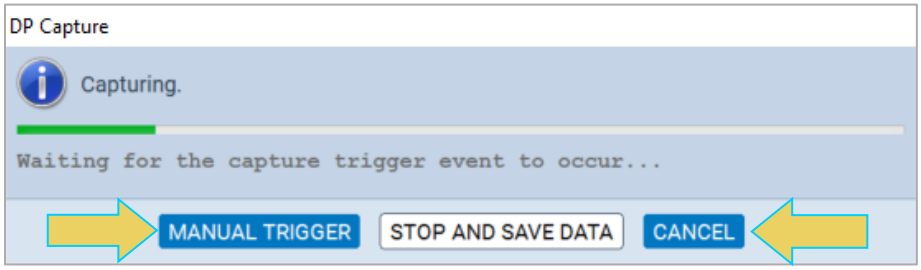


6. Enter a name in the space provided in the **New Capture** dialog box.

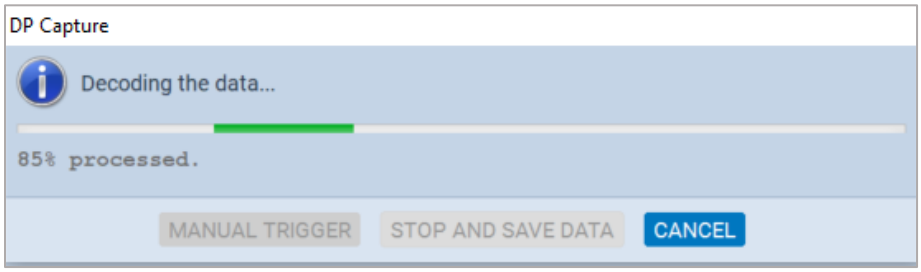
   Click **OK** to begin the capture process. A progress bar will appear, as shown below.

   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.

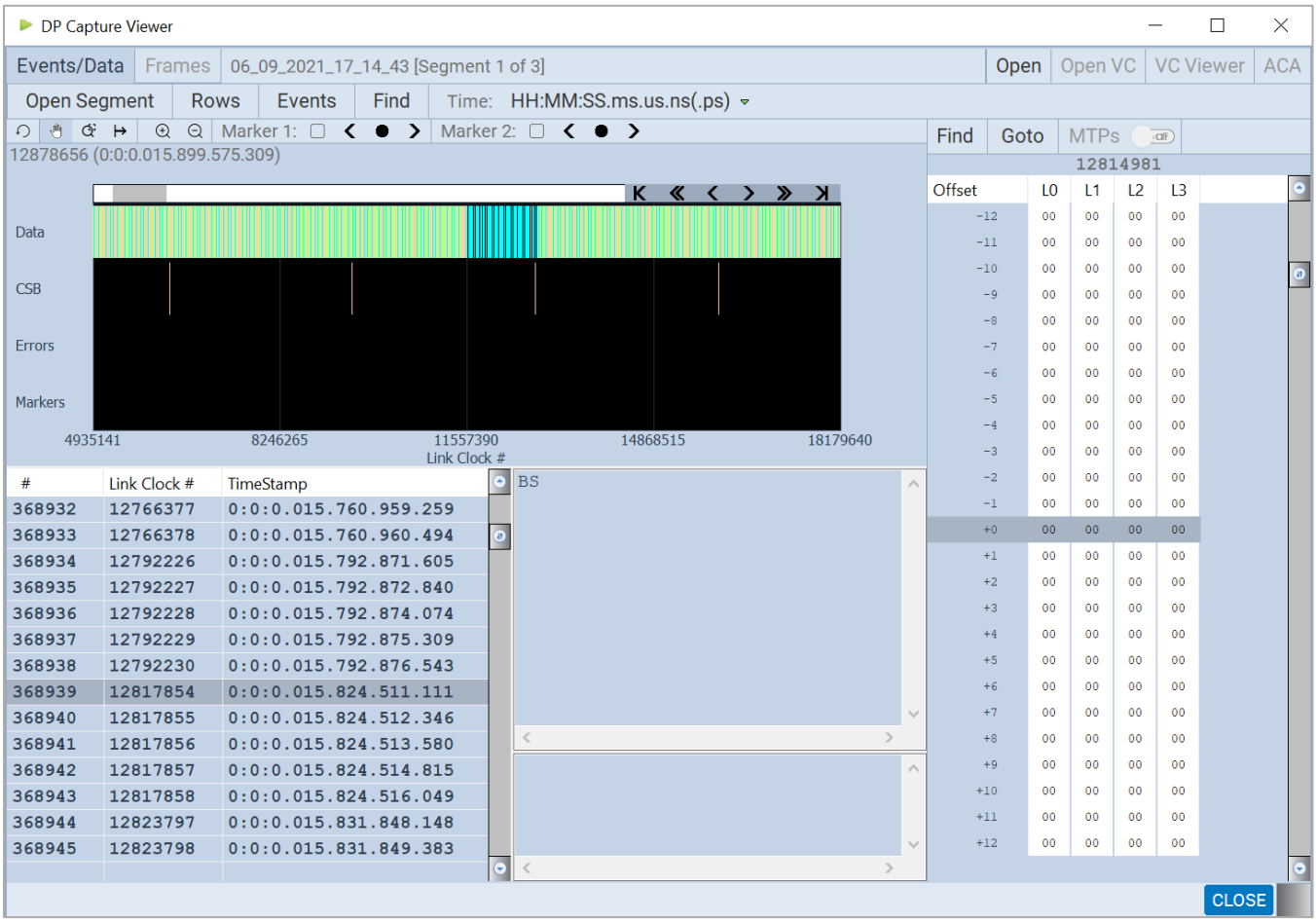
   - Manual Trigger – If the trigger event does not occur as expected, or if you are viewing the video display in real time and you notice an occurrence that you would like to capture the data of, manually initiate a capture with the previously set specifications at this point.
   - Stop and Save Data –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

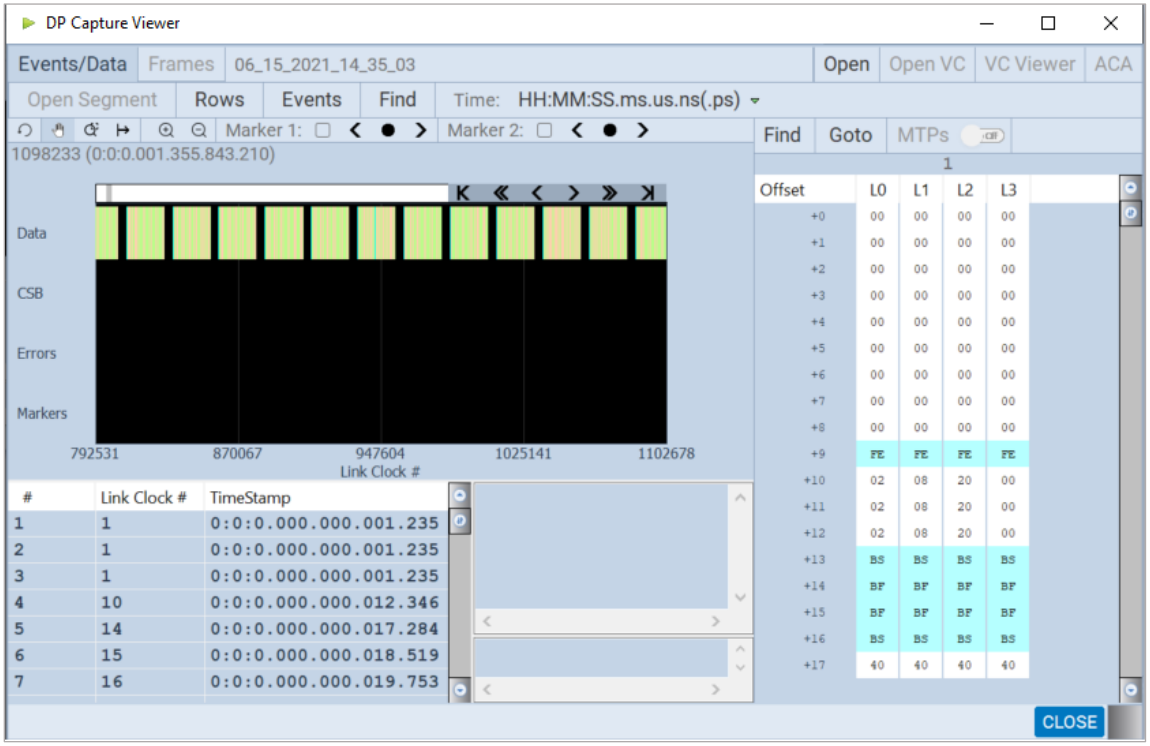


The **Capture Viewer** and its features/functionality is covered in much detail in the next two sections of this chapter. **5.4 Capture Viewer Panels** covers the Event Plot, Data Decode/Details, and Link Symbol panels, while **5.5 Searching and Filtering** for Specific Data Elements covers searching for events or symbols, and filtering using the functions within the Capture Viewer.

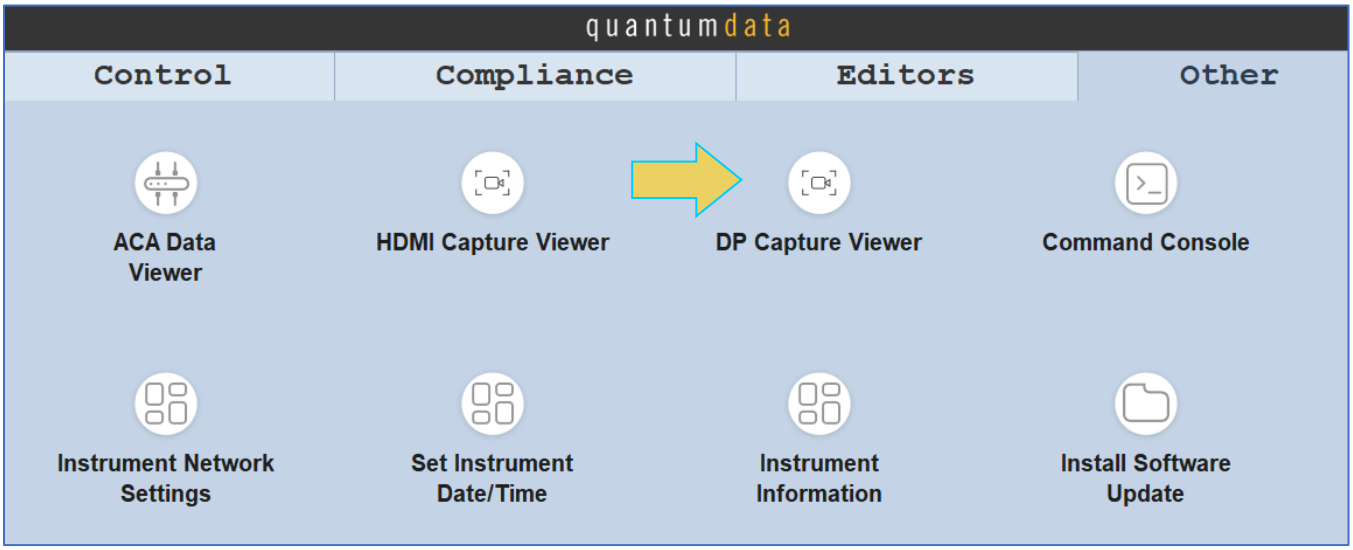
Opening an Existing Capture

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.

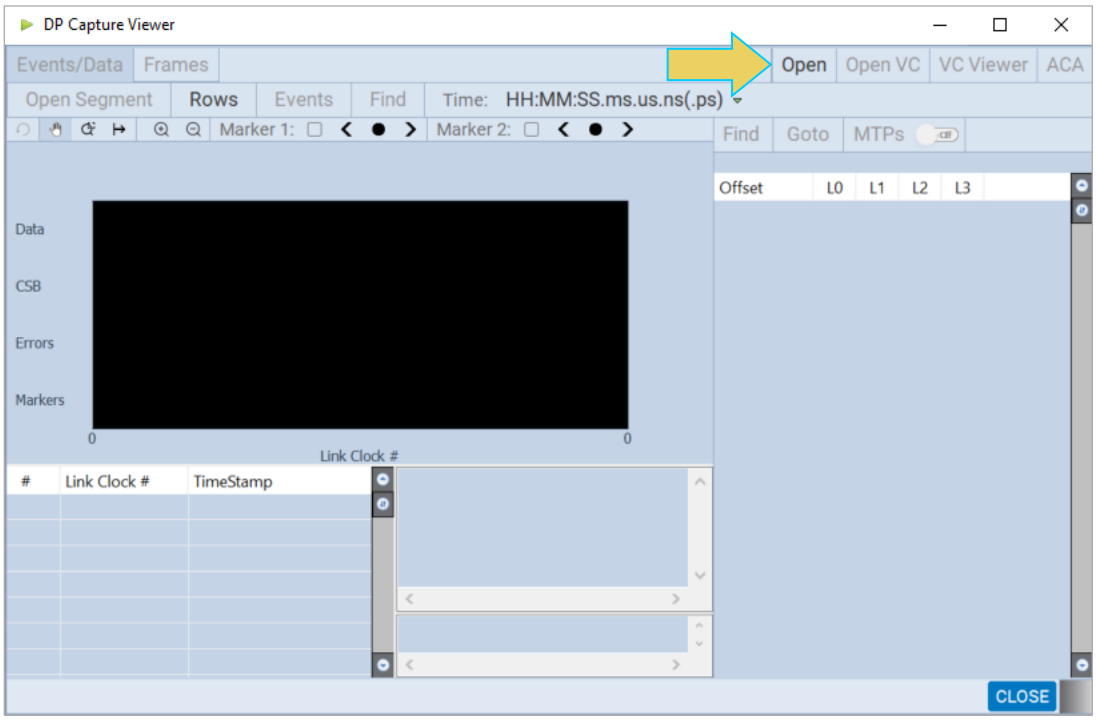
After running a capture, the DP Capture Viewer opens to display the resulting data, as shown below.



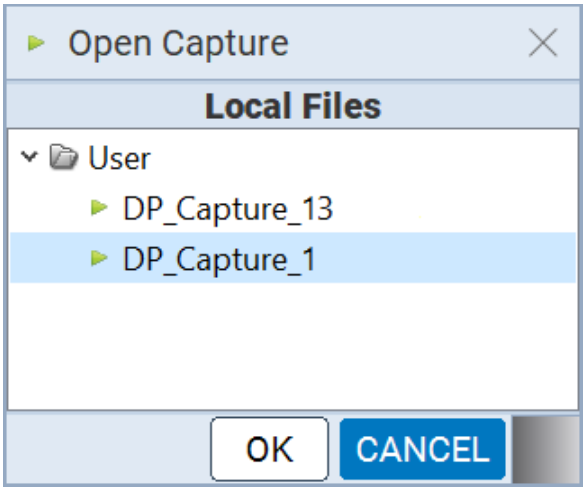
The Capture Viewer can also be opened from the Home screen of the ATP Manager. Click the **Other** tab, and select the **DP Capture Viewer** icon, as shown below.



Once in the Capture Viewer, click the **Open** button at the top right of the window, as shown below.



A dialog box will open up, prompting you to select a capture file, as shown below. Select the capture you wish to open and click **OK**.



5.3 Capture Viewer Panels

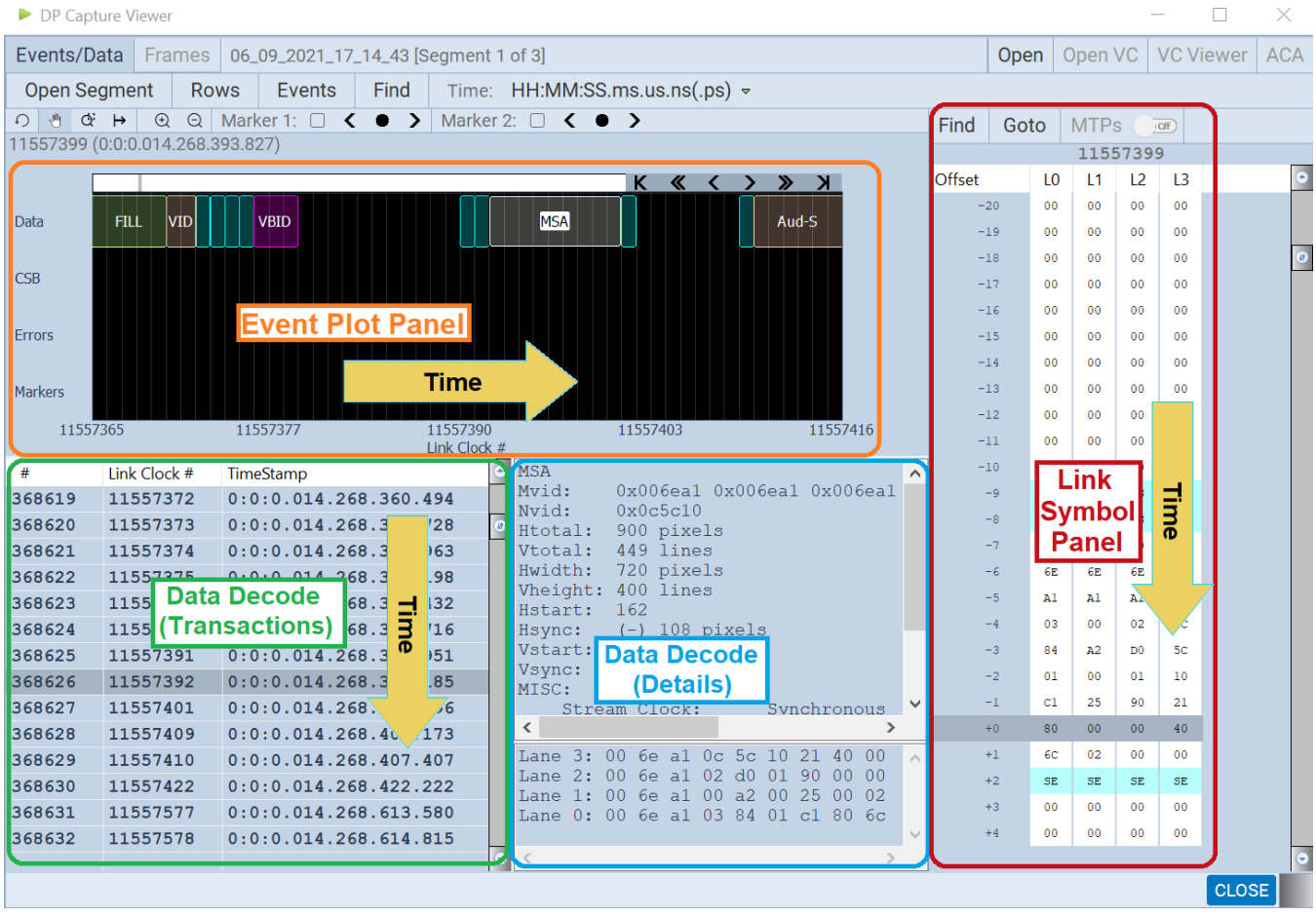
Capture Viewer Overview

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.
- **Data Decode** (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** – 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.



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

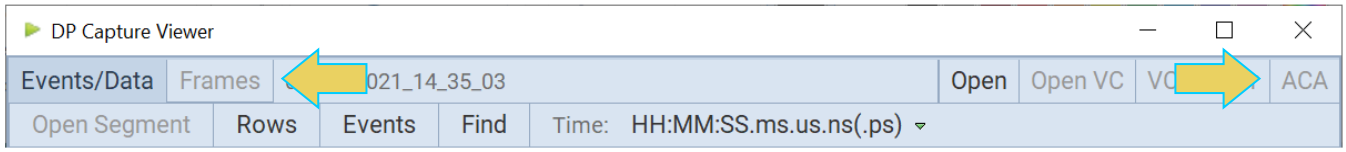
Capture Viewer Toolbar

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 and **ACA Data Viewer**.

A screenshot of the toolbar is below. Note that the **Open VC** and **VC Viewer** toolbar buttons at the top right are utilized during UHD/Multi-Stream Transport transport captures. This is covered **later in this section**.

If the **Extract Video Frames** and/or **Capture AUX (ACA) Transactions** options were toggled off when starting the capture, those buttons will be greyed out, as shown below.

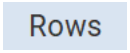


Open Segment

The Open Segment button 

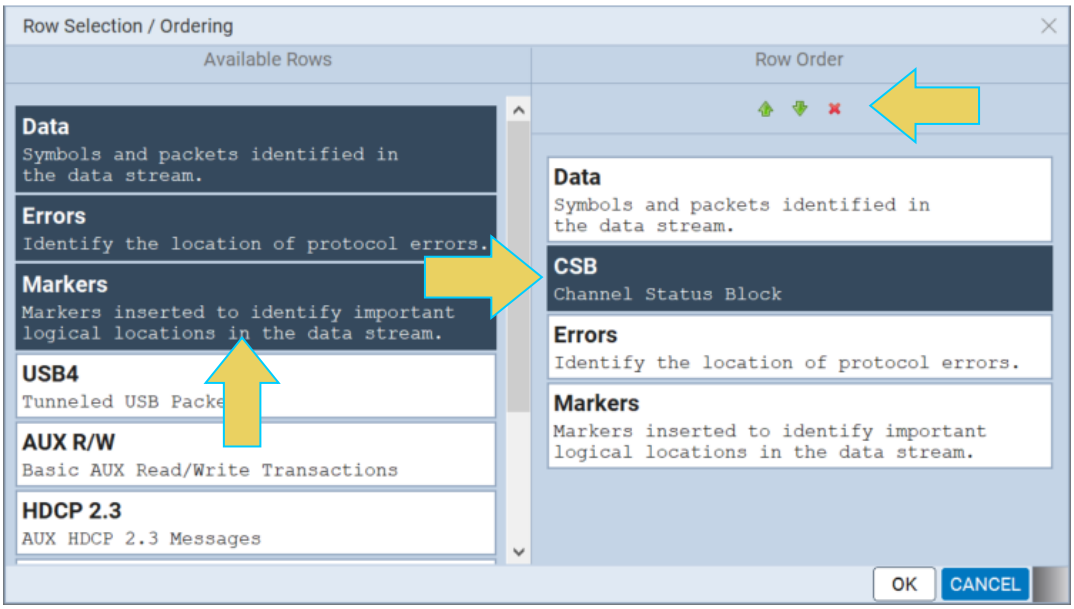
is enabled when performing a large capture. The capture is broken up into segments within the Capture Viewer, and you can click **Open Segment** to view the segment in its entirety.

Rows

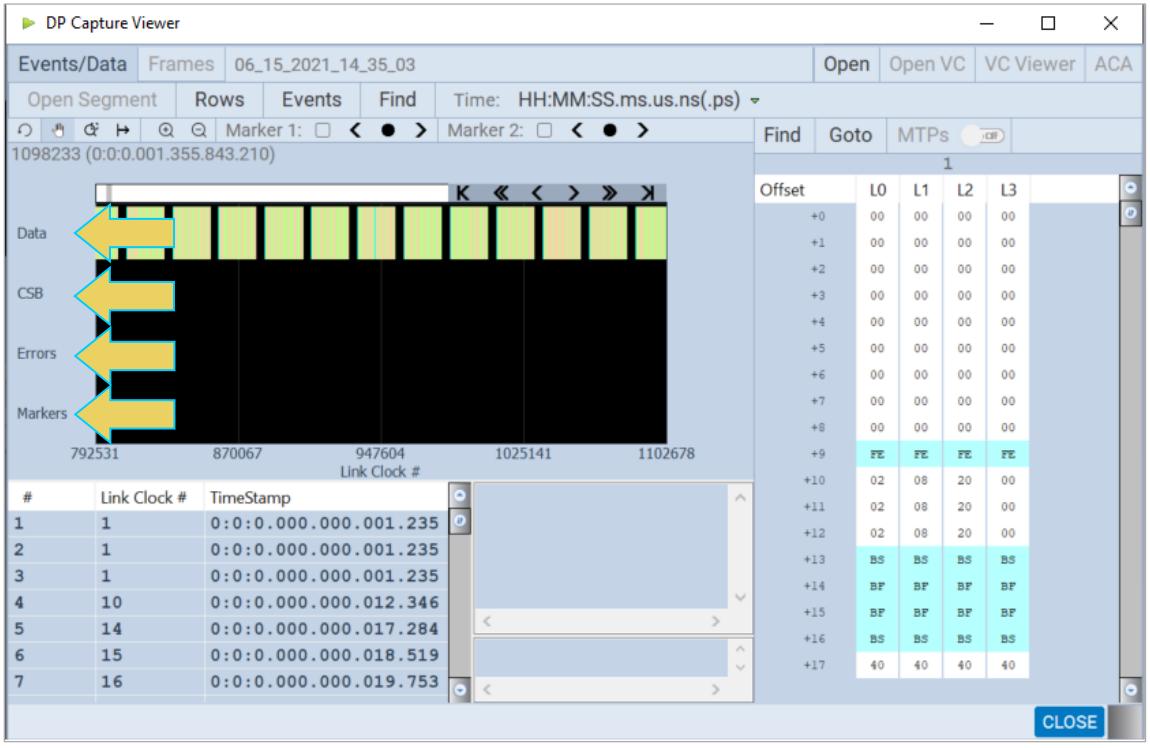
The Rows button 

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. Re-order using the arrows in the **Row Order** (right-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 red **X** at the top of the column, as shown below.



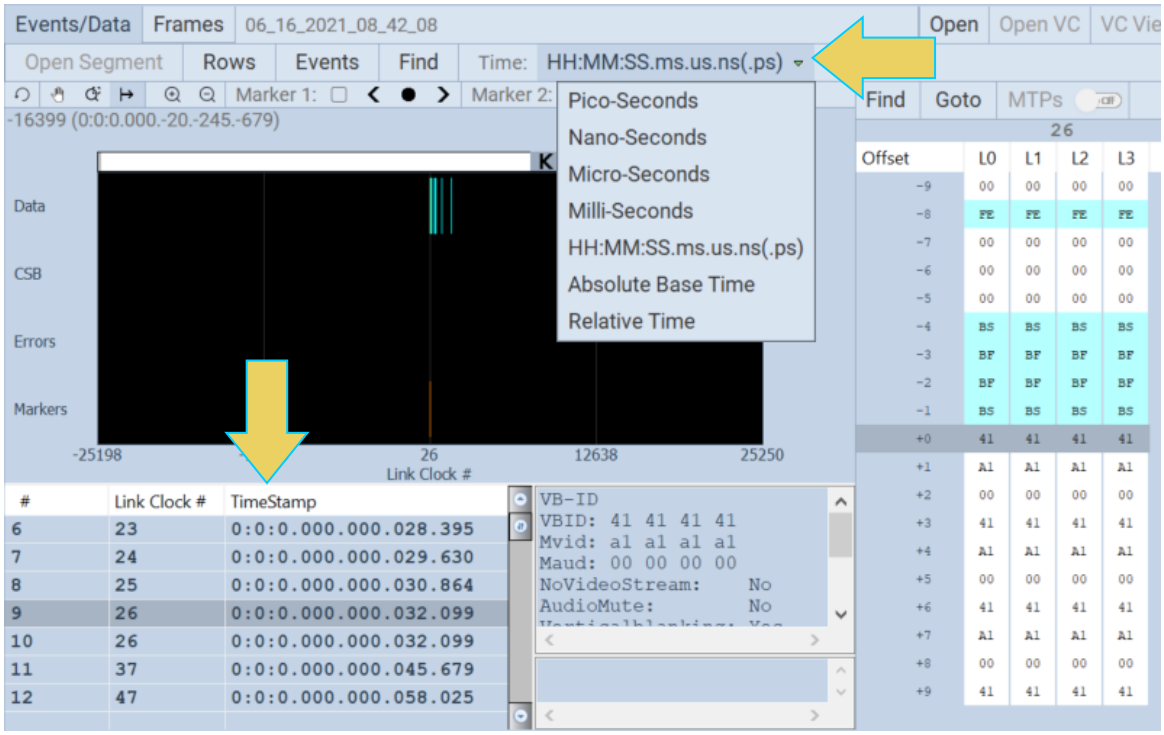
The Capture Viewer window with these settings will display as follows, with the selected rows in the Event Plot Panel.



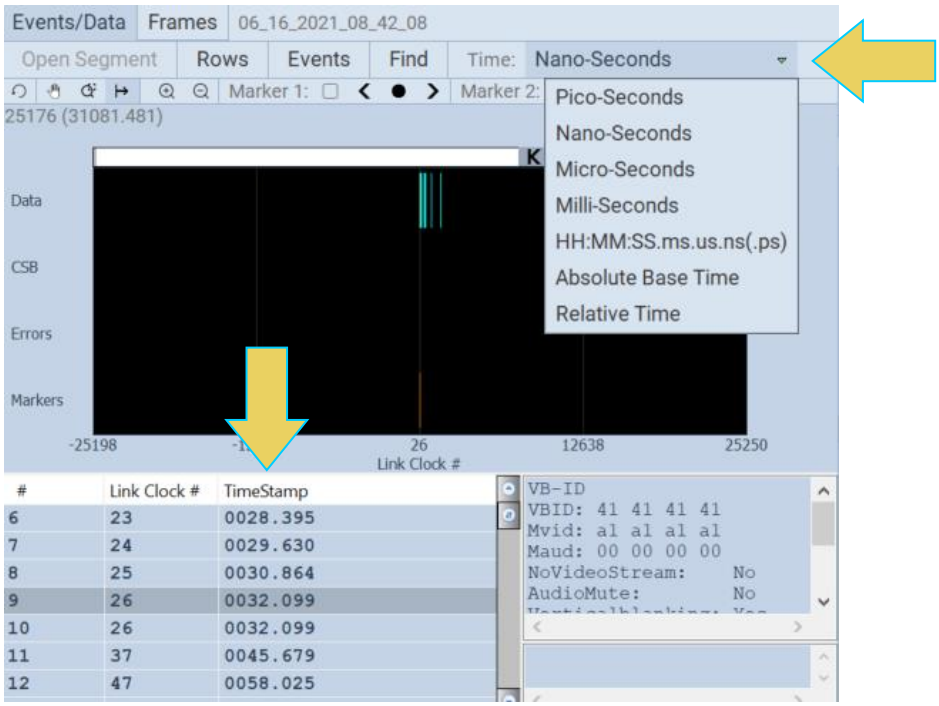
The **Events** Events and **Find** Find buttons will be covered in **Section 6.5 Searching and Filtering for Specific Data Elements.**

Time:

The Time drop down selection Time: enables you to specify the format of the **TimeStamp** 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.

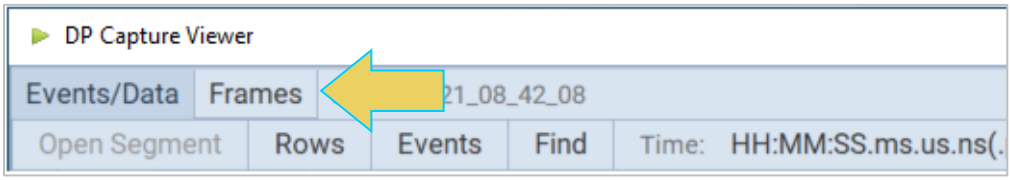


This next example shows the TimeStamp shown in Nano-Seconds.

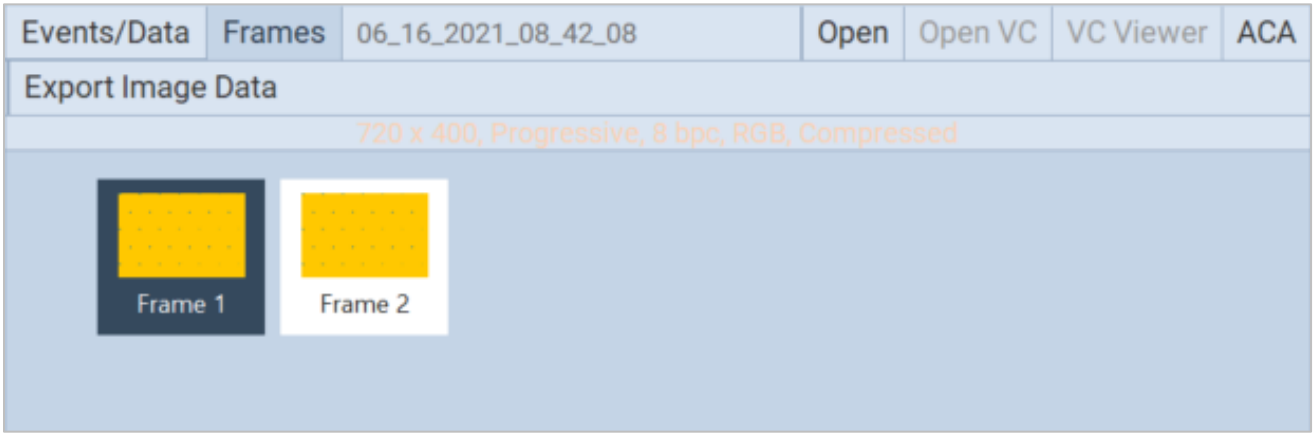


Frames

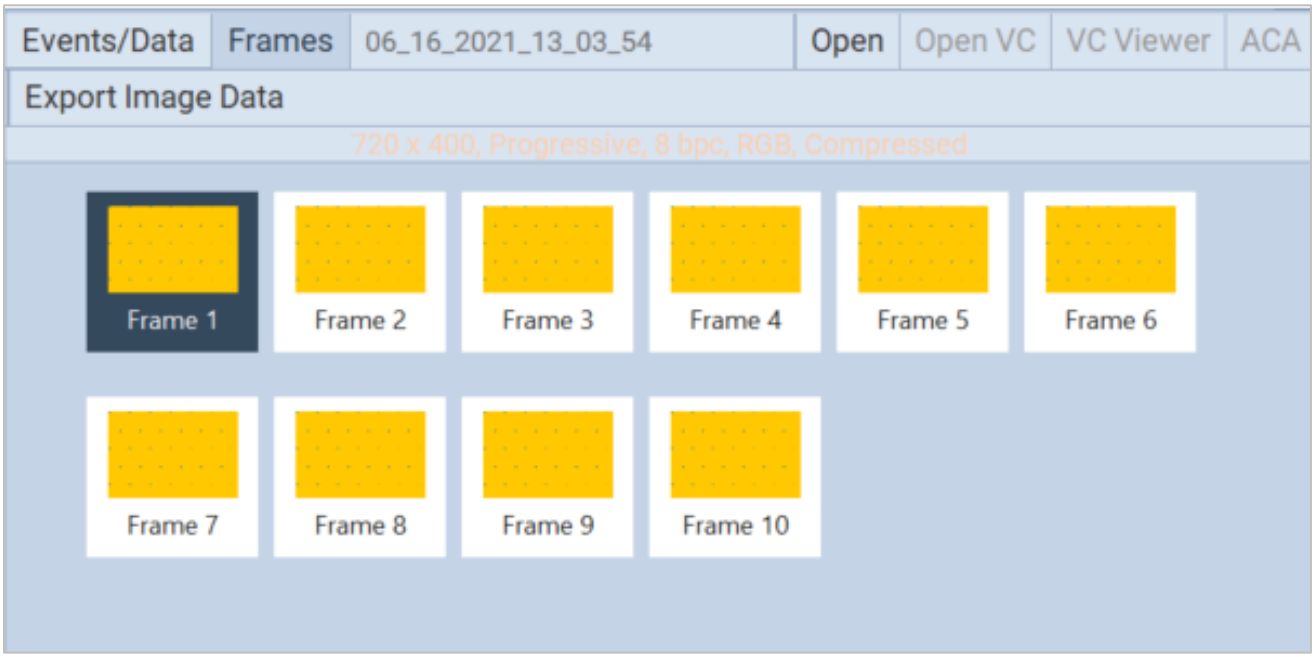
If you selected to **Extract Video Frames** when running the capture, the button to access the **Frames** tab will be enabled, as shown below.



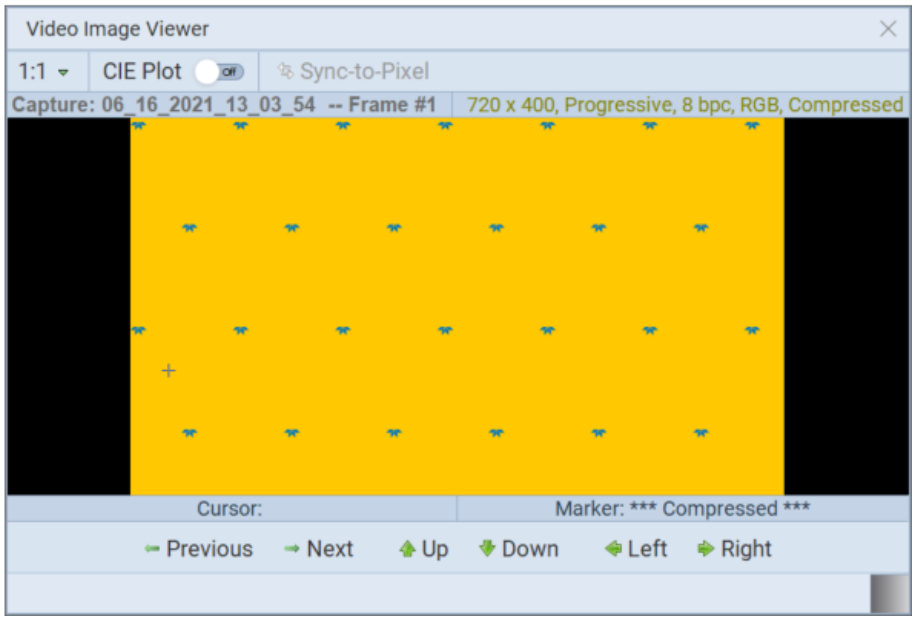
Click this to access the **Frames** tab, which is shown below. Depending on the **Buffer Size** specified, there will be more or less frames to view. The example below is a 1.000% buffer size, which extracted two video frames in this case.



This next example is a 4.000% buffer size, which extracted 10 video frames.

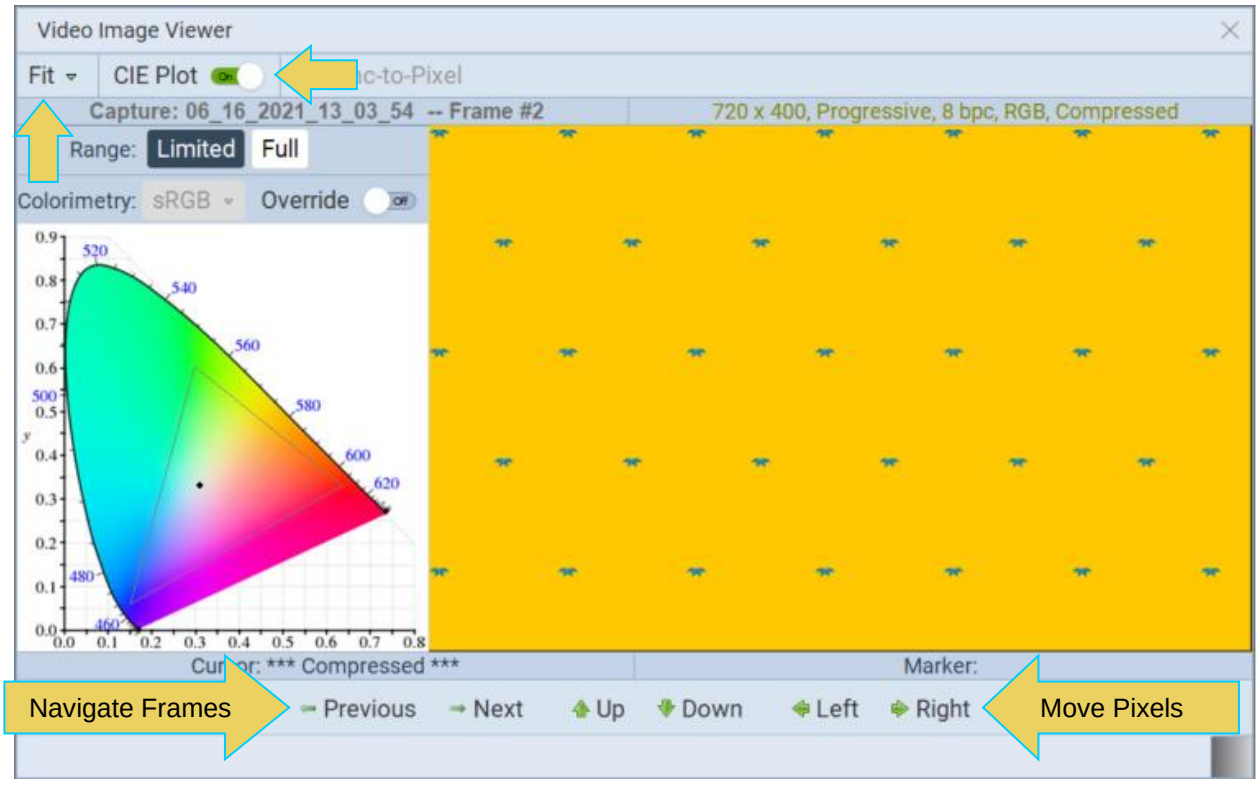


From this tab you can open the **Video Image Viewer** by double clicking any frame. This pop out panel is shown below.



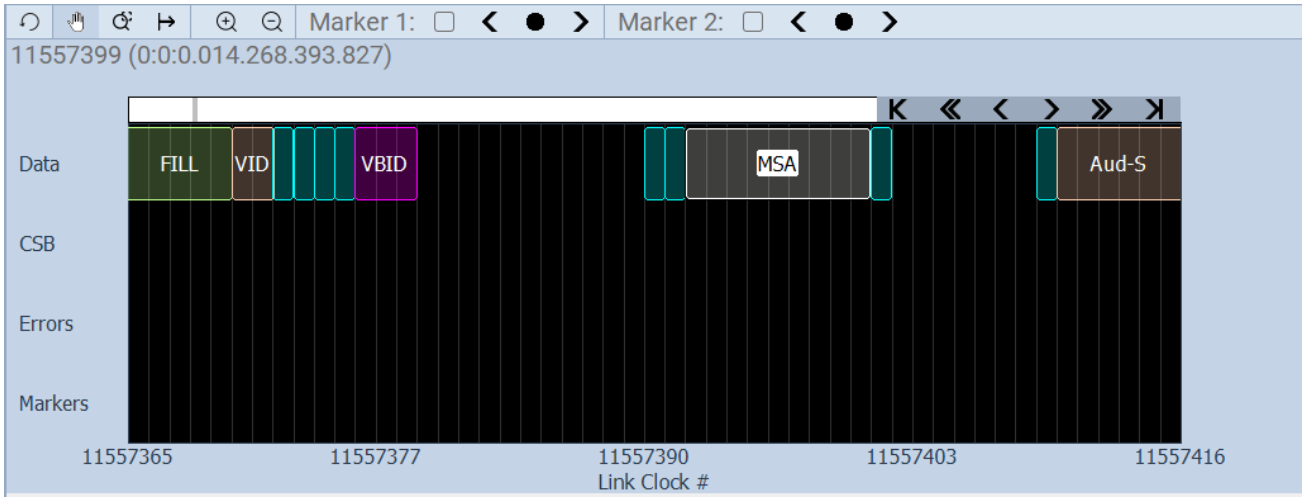
Once in the Video Image Viewer, you can scale the image and toggle on or off the colorimetry panel (CIE Plot). The previous image was scaled to 1:1, and the following example is scaled to fit. The colorimetry panel is also enabled on the left-hand side of the panel.

You can also navigate to the **Previous** or **Next** image frame, or move to an adjacent pixel using the arrows at the bottom of the panel.

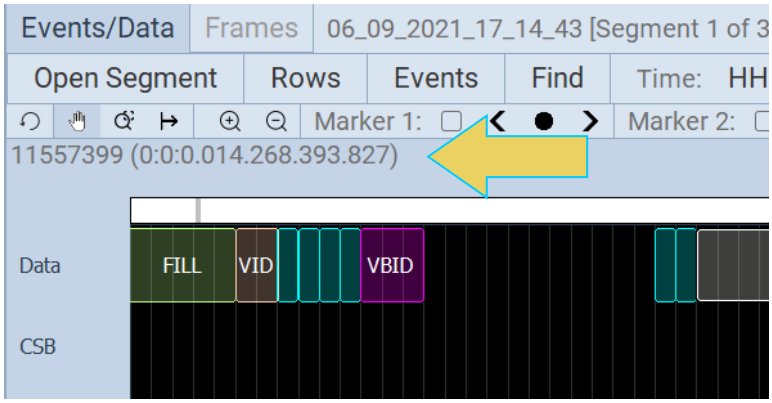


Event Plot Panel

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.



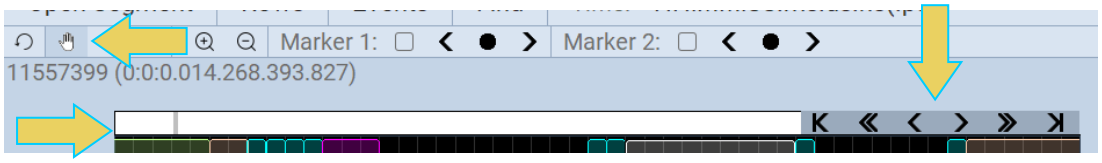
The timestamp of the cursor is shown near the top of the panel. As you move the pointer tool throughout the **Event Plot** panel the timestamp of the pointer's location is provided on the top of the panel as indicated below:



Scrolling in the Event Plot Panel

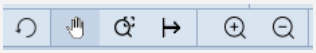
A scroll bar is provided to enable you to quickly browse through the data. The scroll bar is under the set of function icons just above the data panel where the data is displayed. You can also scroll to the end, scroll by page or scroll incrementally in either direction using the backward and forward 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.



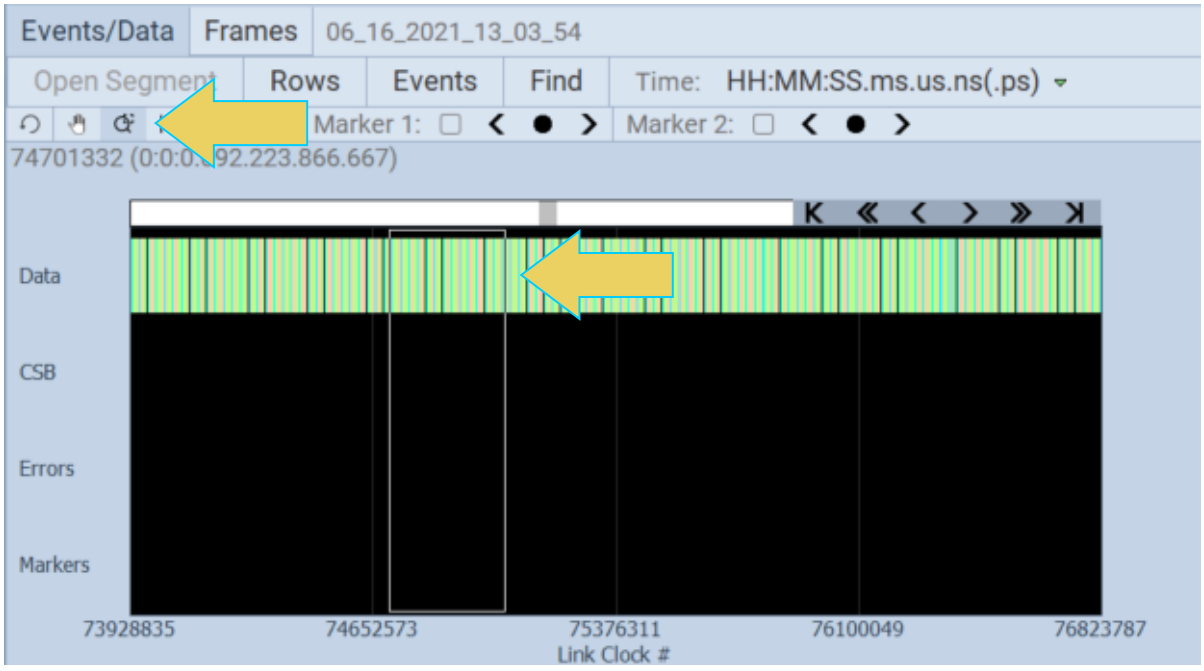
Zooming in the Event Plot Panel

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.

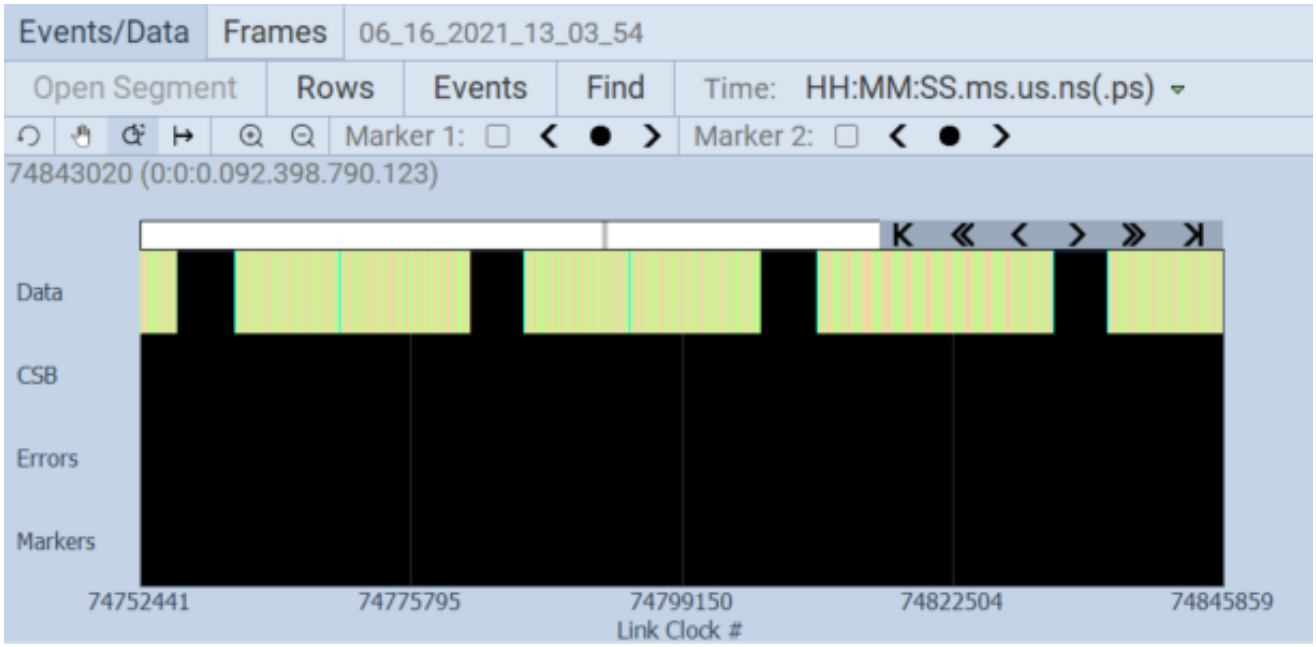
Even Plot Zoom Icons	Function
Zoom Icons 	Previous – This icon reverts the Event Plot Panel to the previous view. This will effectively “undo” a zoom or scroll. Range Zoom – This function zooms in on a selected range within the Event Plot. Details below. Zoom In/Out icons – The Zoom In/Out function buttons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

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.

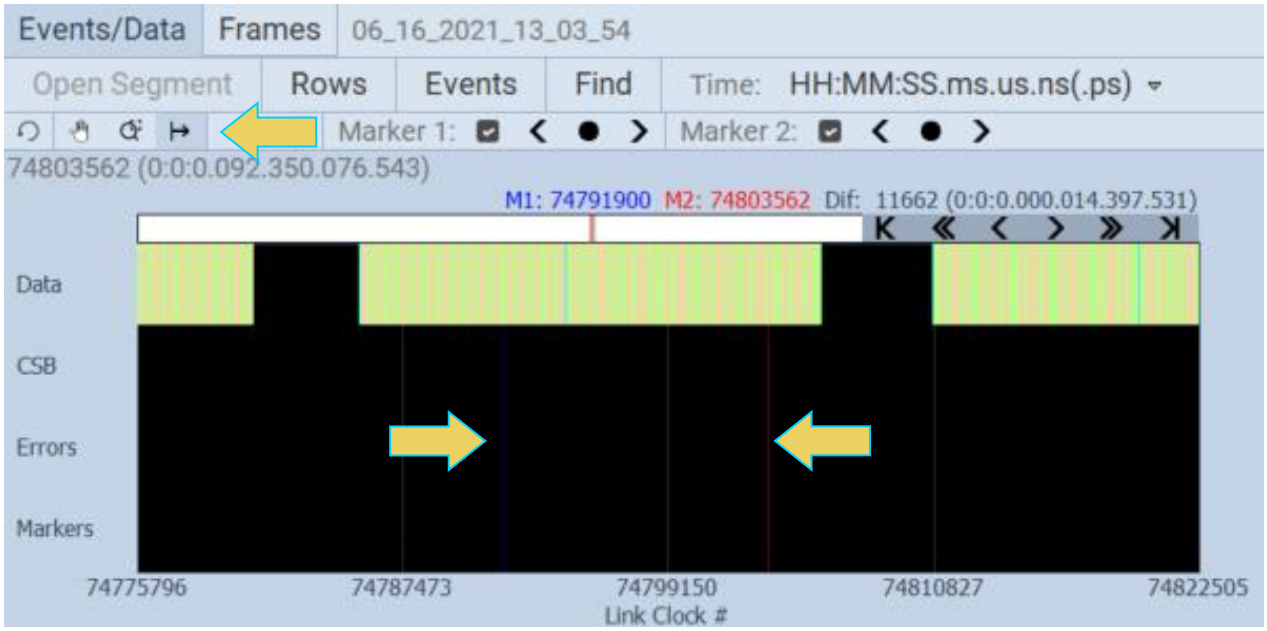


The resulting screen is as follows:

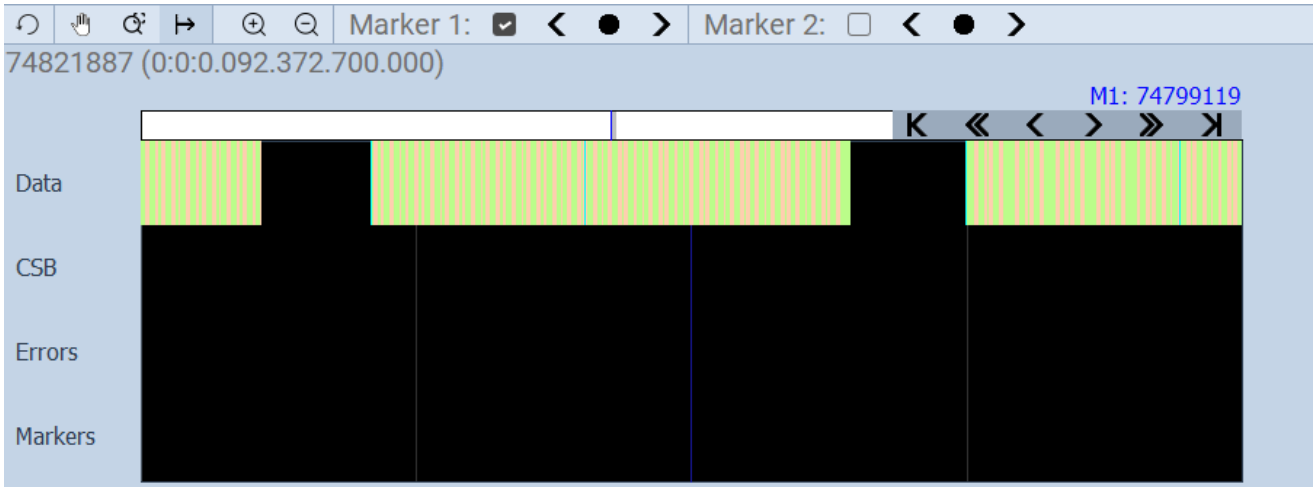


Working with Markers

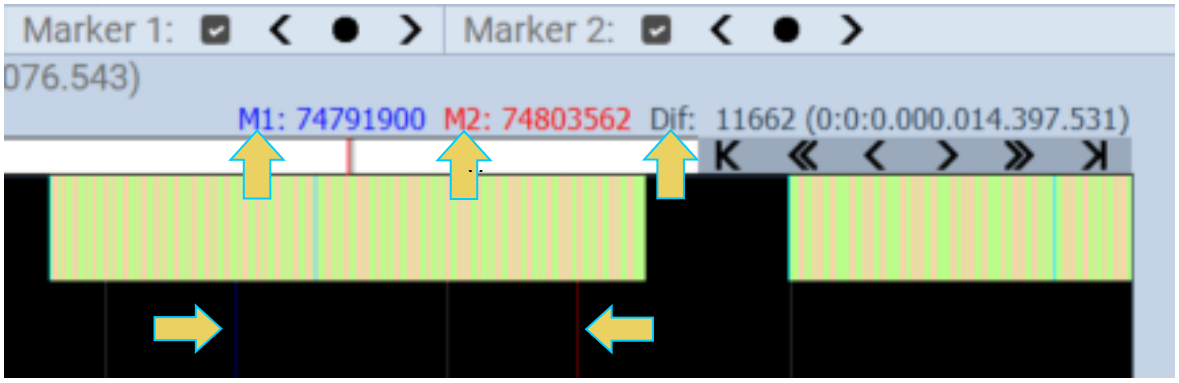
The **Event Plot** panel enables you to view the data at a high level and identify points of interest for further analysis. You can set two cursors or "markers" at particular points of interest using the Markers activation button . The **Event Plot** will show you the time difference between the two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



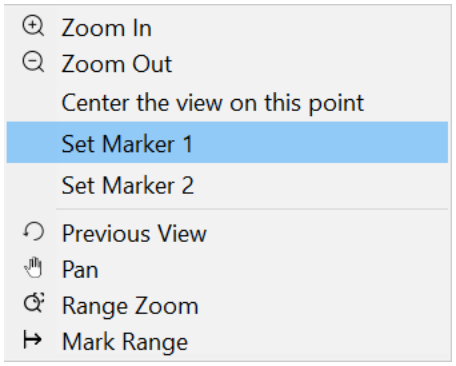
You can fine tune the position of the markers with the left and right arrows associated with each marker:  You can also deselect and remove a marker by unchecking its respective box. The  center icon allows you to center the particular marker on the center of the **Event Plot** window. The example below 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.

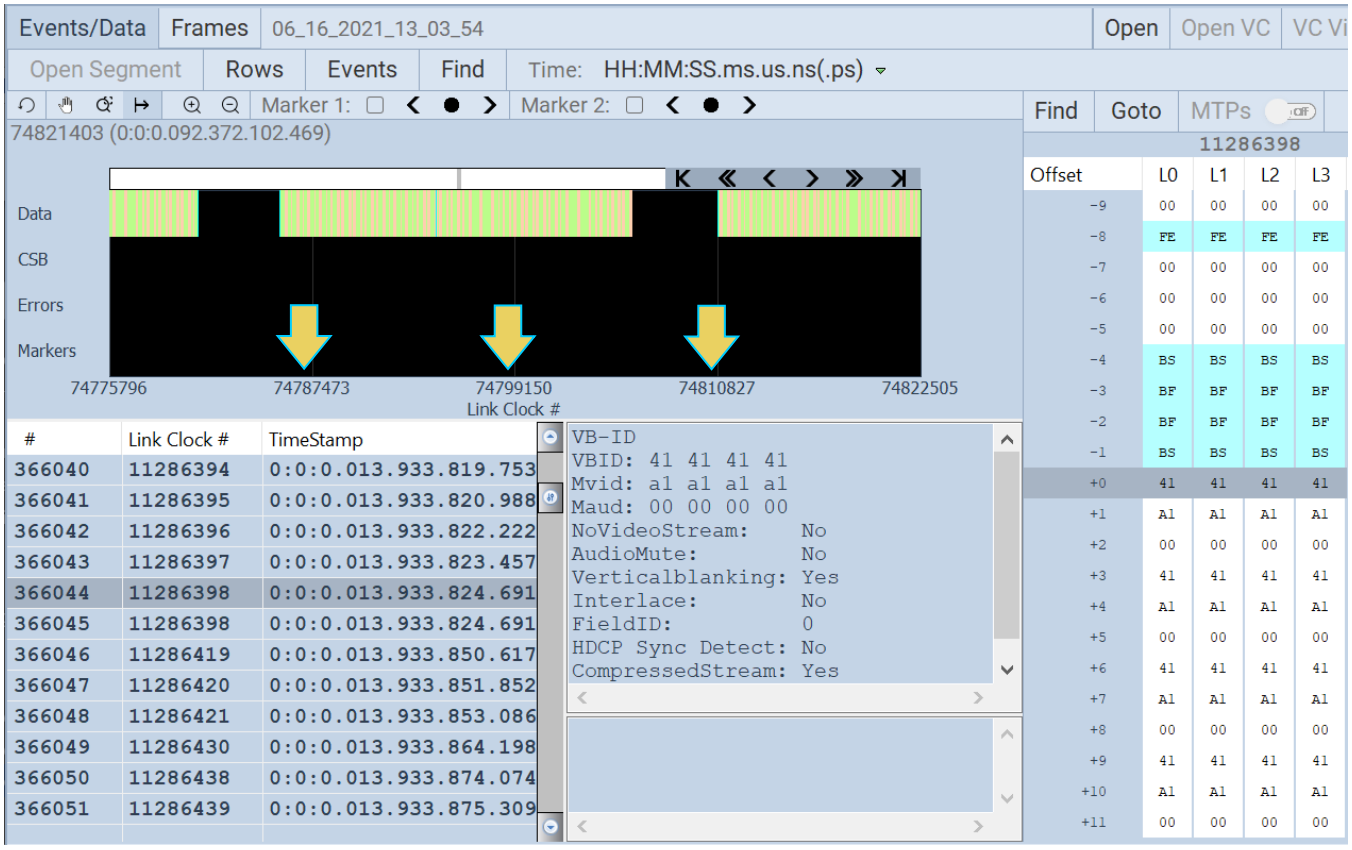


Note: You can also set an individual marker using the right click menu shown below.



Link Clock timeline.

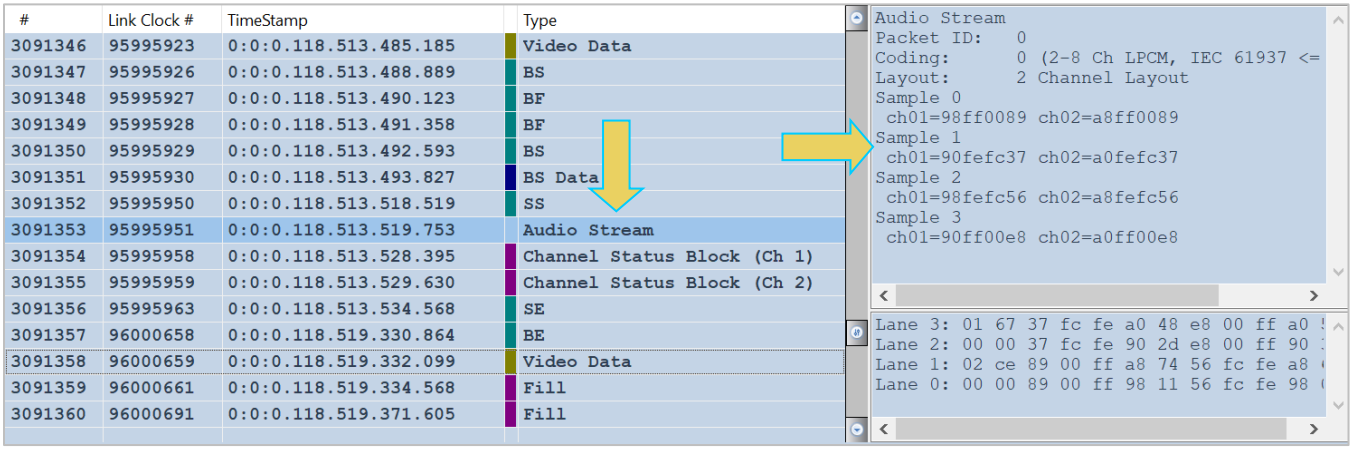
The Link clock symbol times are shown at the bottom of the **Event Plot** panel as indicated below.



Data Decode Panels

The **Data Decode Panel** is shown below. The **Data Decode panel** 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.



#	Link Clock #	TimeStamp	Type
3091346	95995923	0:0:0.118.513.485.185	Video Data
3091347	95995926	0:0:0.118.513.488.889	BS
3091348	95995927	0:0:0.118.513.490.123	BF
3091349	95995928	0:0:0.118.513.491.358	BF
3091350	95995929	0:0:0.118.513.492.593	BS
3091351	95995930	0:0:0.118.513.493.827	BS Data
3091352	95995950	0:0:0.118.513.518.519	SS
3091353	95995951	0:0:0.118.513.519.753	Audio Stream
3091354	95995958	0:0:0.118.513.528.395	Channel Status Block (Ch 1)
3091355	95995959	0:0:0.118.513.529.630	Channel Status Block (Ch 2)
3091356	95995963	0:0:0.118.513.534.568	SE
3091357	96000658	0:0:0.118.519.330.864	BE
3091358	96000659	0:0:0.118.519.332.099	Video Data
3091359	96000661	0:0:0.118.519.334.568	Fill
3091360	96000691	0:0:0.118.519.371.605	Fill

```
Audio Stream
Packet ID:   0
Coding:      0 (2-8 Ch LPCM, IEC 61937 <=
Layout:      2 Channel Layout
Sample 0
 ch01=98ff0089 ch02=a8ff0089
Sample 1
 ch01=90fefc37 ch02=a0fefc37
Sample 2
 ch01=98fefc56 ch02=a8fefc56
Sample 3
 ch01=90ff00e8 ch02=a0ff00e8
```

```
Lane 3: 01 67 37 fc fe a0 48 e8 00 ff a0
Lane 2: 00 00 37 fc fe 90 2d e8 00 ff 90
Lane 1: 02 ce 89 00 ff a8 74 56 fc fe a8
Lane 0: 00 00 89 00 ff 98 11 56 fc fe 98
```

The next example below shows the details panel of an MSA data type highlighted.

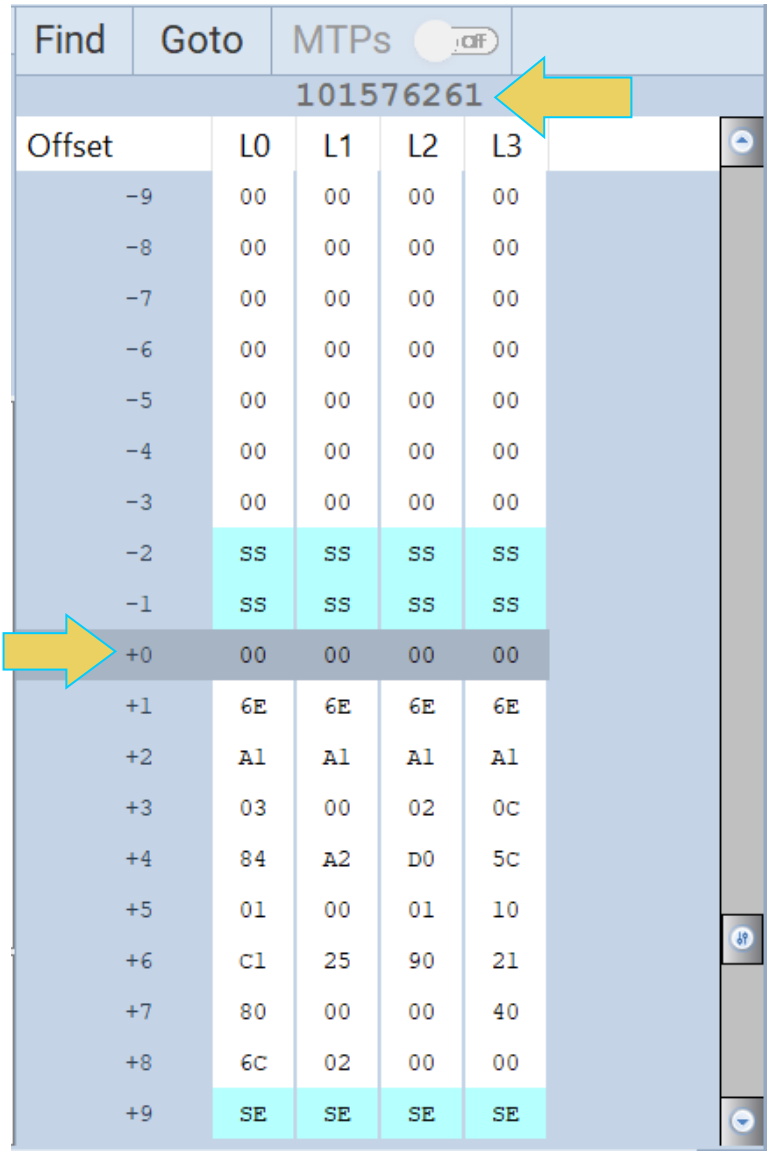
```
MSA
Mvid:    0x006ea1 0x006ea1 0x006ea1 0x006ea1
Nvid:    0x0c5c10
Htotal:  900 pixels
Vtotal:  449 lines
Hwidth:  720 pixels
Vheight: 400 lines
Hstart:  162
Hsync:   (-) 108 pixels
Vstart:  37 lines
Vsync:   (+) 2 lines
MISC:
    Stream Clock:      Synchronous
    Interlaced v-even: Vtotal Odd
    3D Signaling:      No in-band signaling
  * Refer to the VSC SDP for the Pixel Encoding/Colorimetry Format.
```

```
Lane 3: 00 6e a1 0c 5c 10 21 40 00
Lane 2: 00 6e a1 02 d0 01 90 00 00
Lane 1: 00 6e a1 00 a2 00 25 00 02
Lane 0: 00 6e a1 03 84 01 c1 80 6c
```

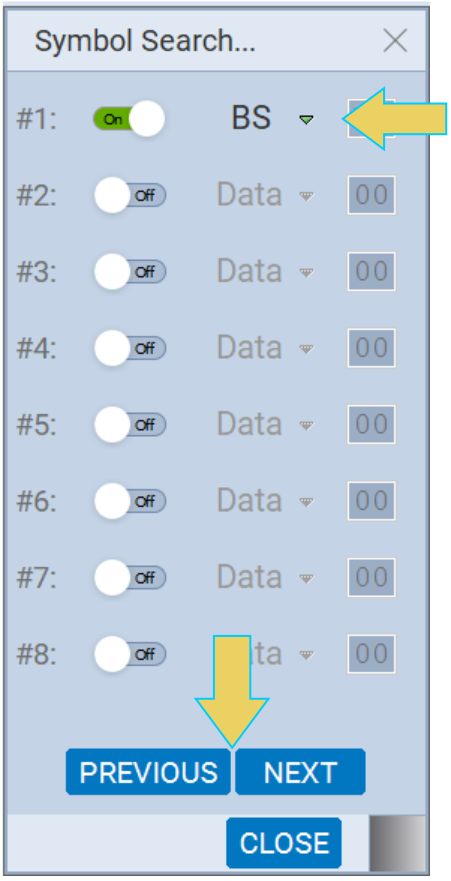
Link Symbol Panel

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.

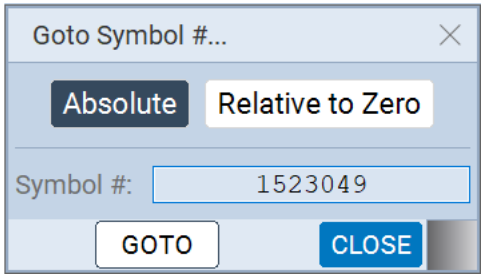


The **Find** button enables you to search for any type of control element. The Find dialog box is shown below with the Blanking Start (BS) control element selected. You can then search through the Link Symbol panel for all occurrences of that symbol or any other using the **PREVIOUS** and **NEXT** buttons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



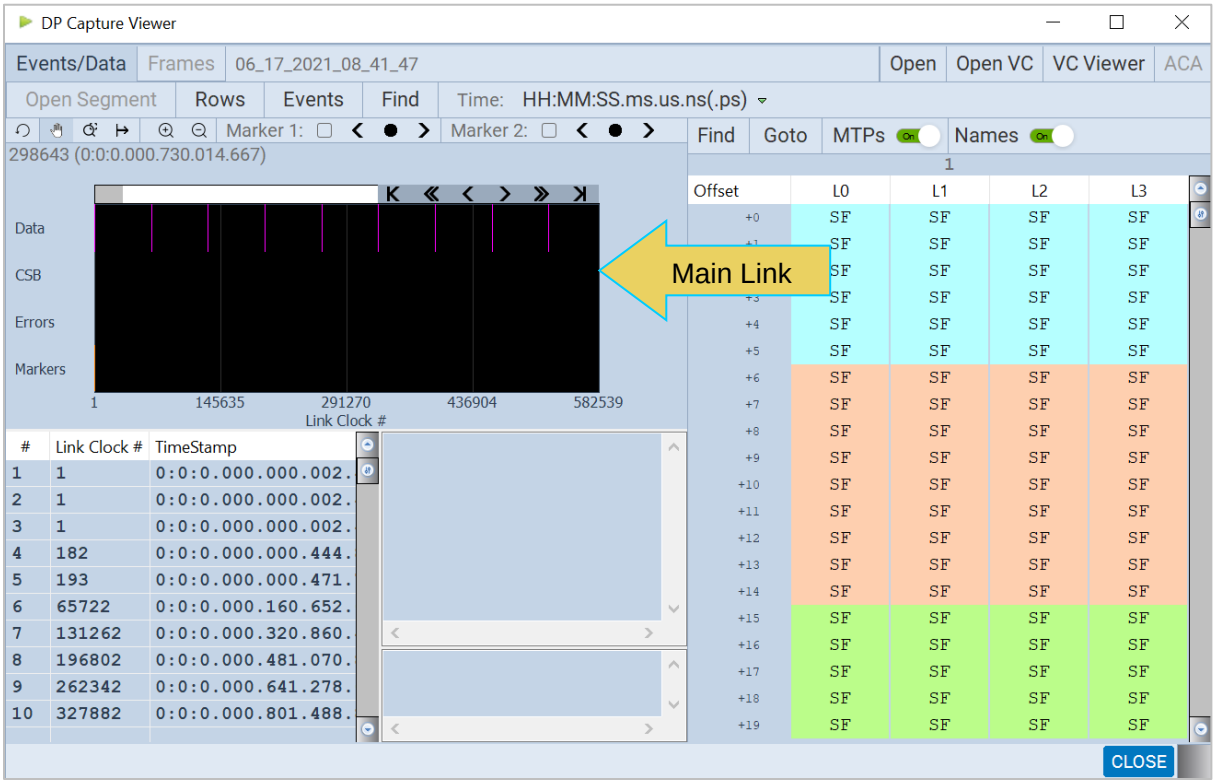
When **Relative to Zero** is selected, the function finds the Link Symbol relative to the Link Symbol with **Offset** of +0. Negative and Positive numbers are both accepted in this mode.

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

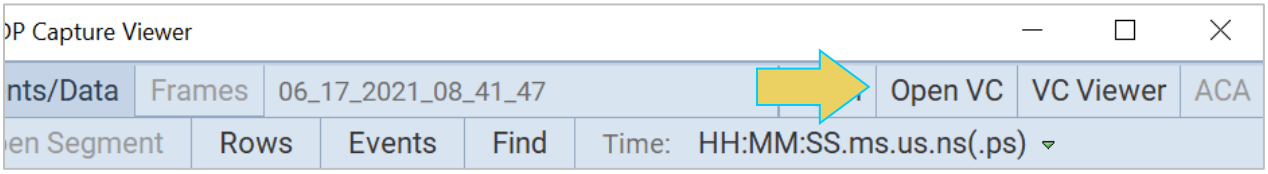
UHD/Multi-Stream Transport Captures

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.

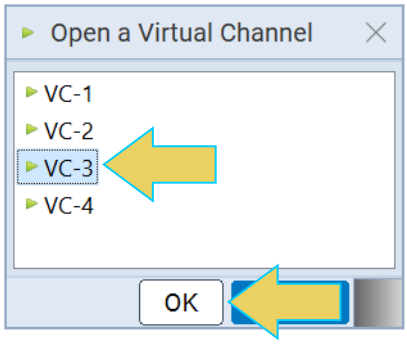
Note: For information on Multi-Stream Transport modes, see **3.6 Topology and Multi-Stream Transport**.



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.



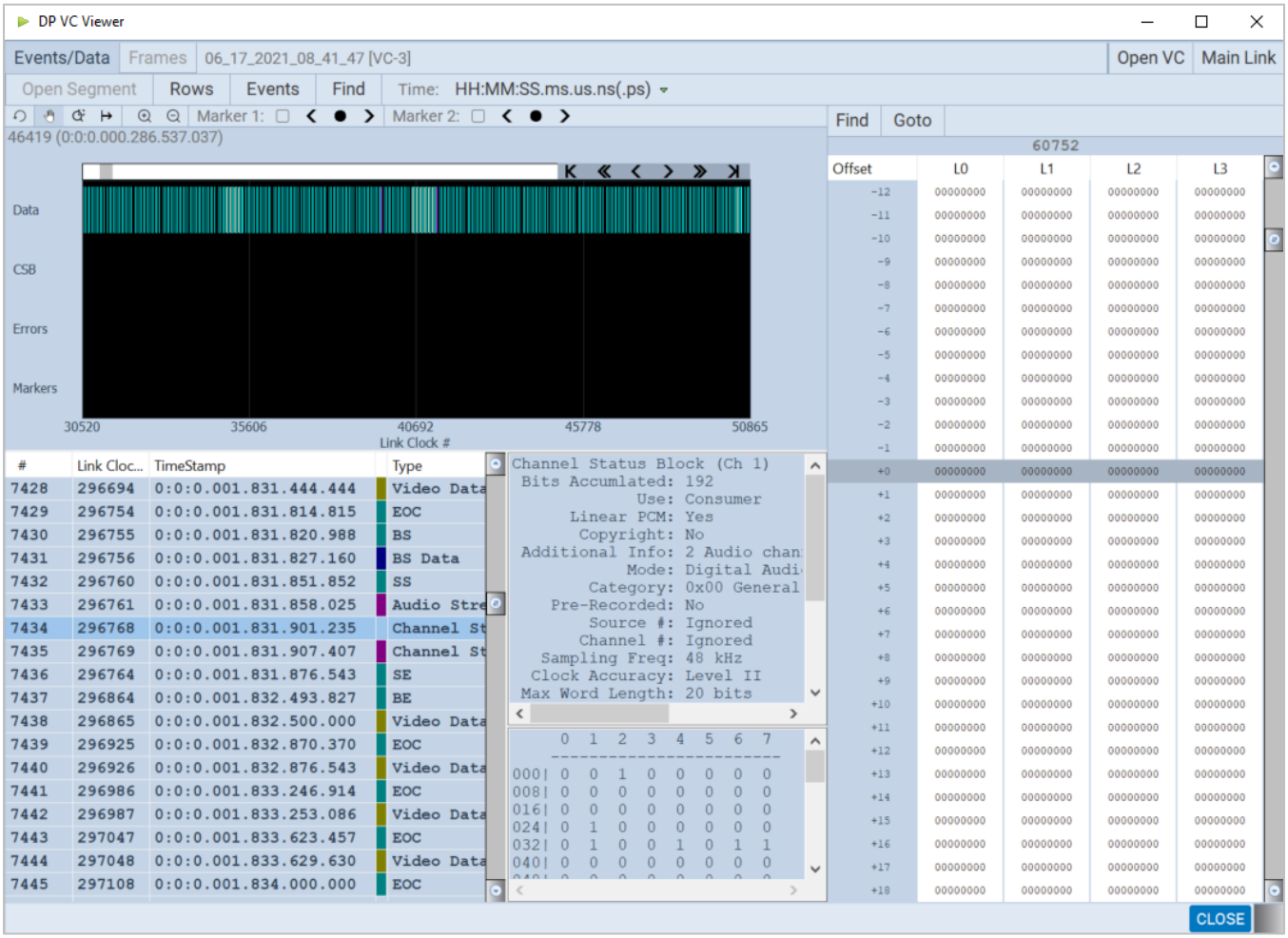
The **Open a Virtual Channel** dialog box will appear. Select the desired virtual channel you wish to view, and click **OK**, as demonstrated below.



Upon selecting a virtual channel, the **DP VC 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 Link** button, or open a different virtual channel by clicking the **Open VC** button as well, both in the top right of the window (pictured below)

The example shown below has virtual channel 3 selected.

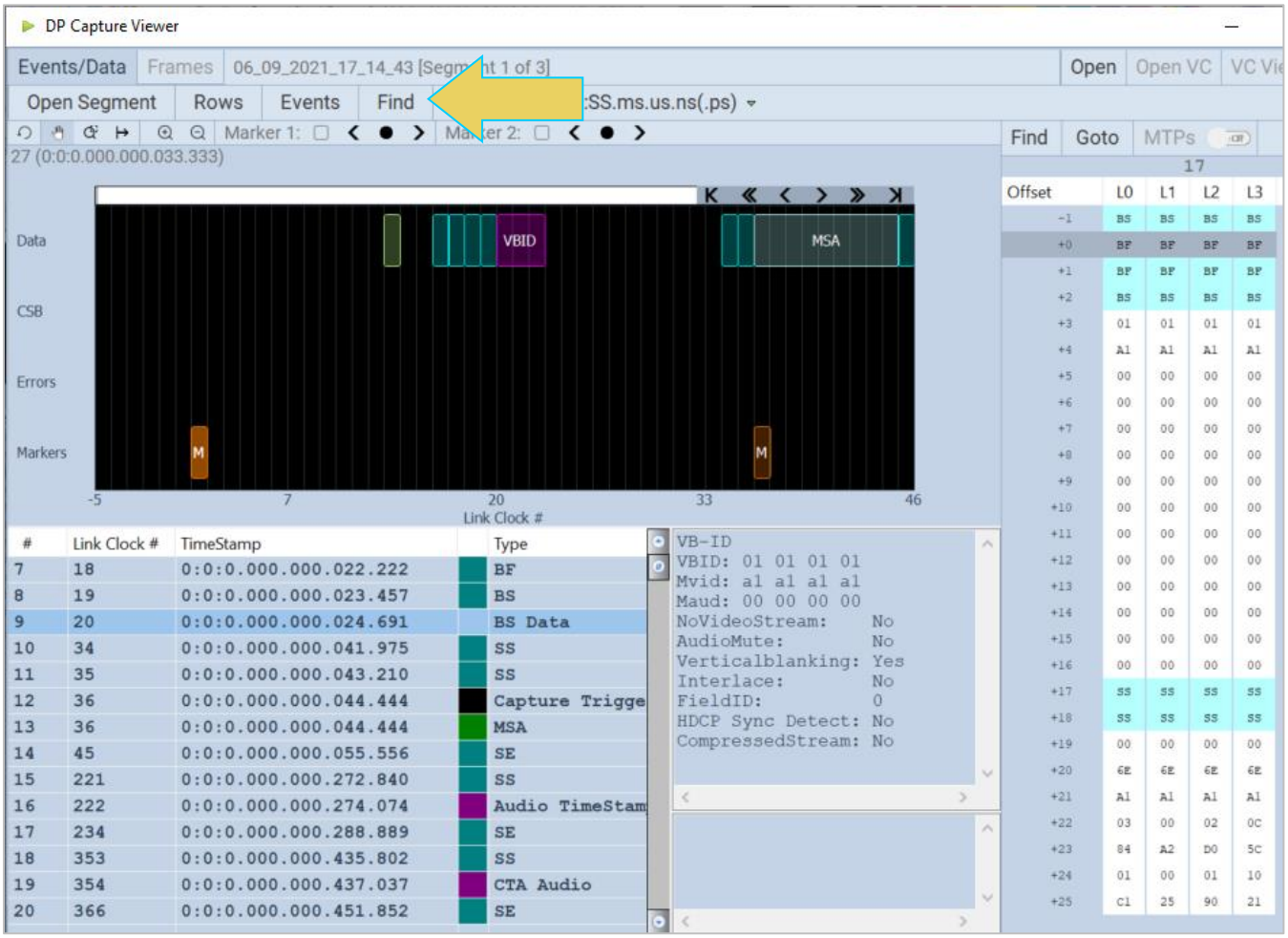


5.4 Searching and Filtering for Specific Data Elements

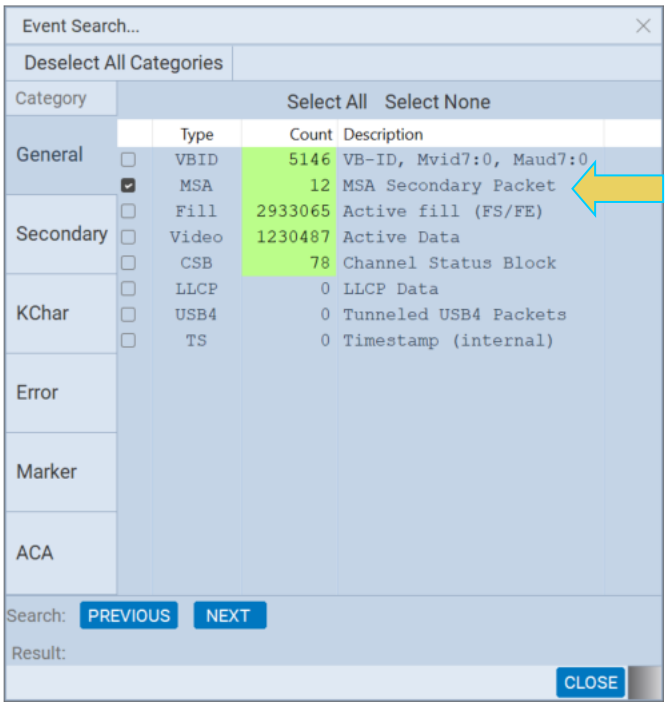
You can locate data items by browsing either through the **Event Plot** view of the **Event Data** table. The two windows (**Event Plot** and **Event Table**) are in sync as you browse, search or select an item.

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 **DP Capture Viewer** window as shown below.

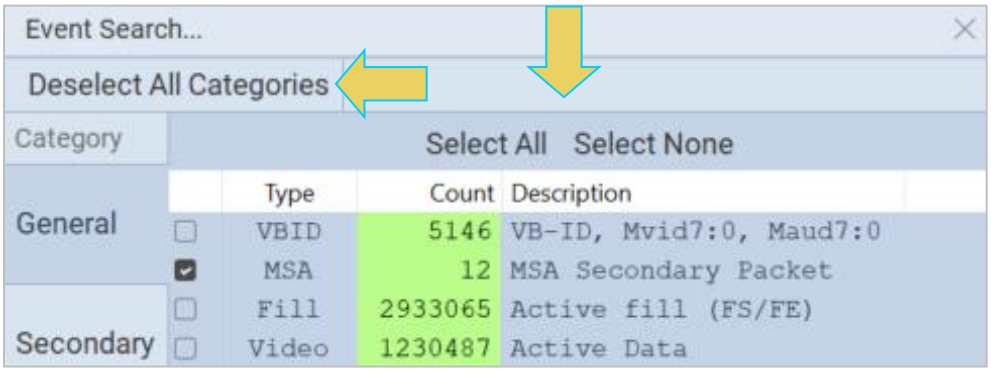


The **Event Search** dialog box is shown below. You can search for specific data types using the tabs and the check boxes within each tab. This example has MSA Secondary Packet data type selected for search.



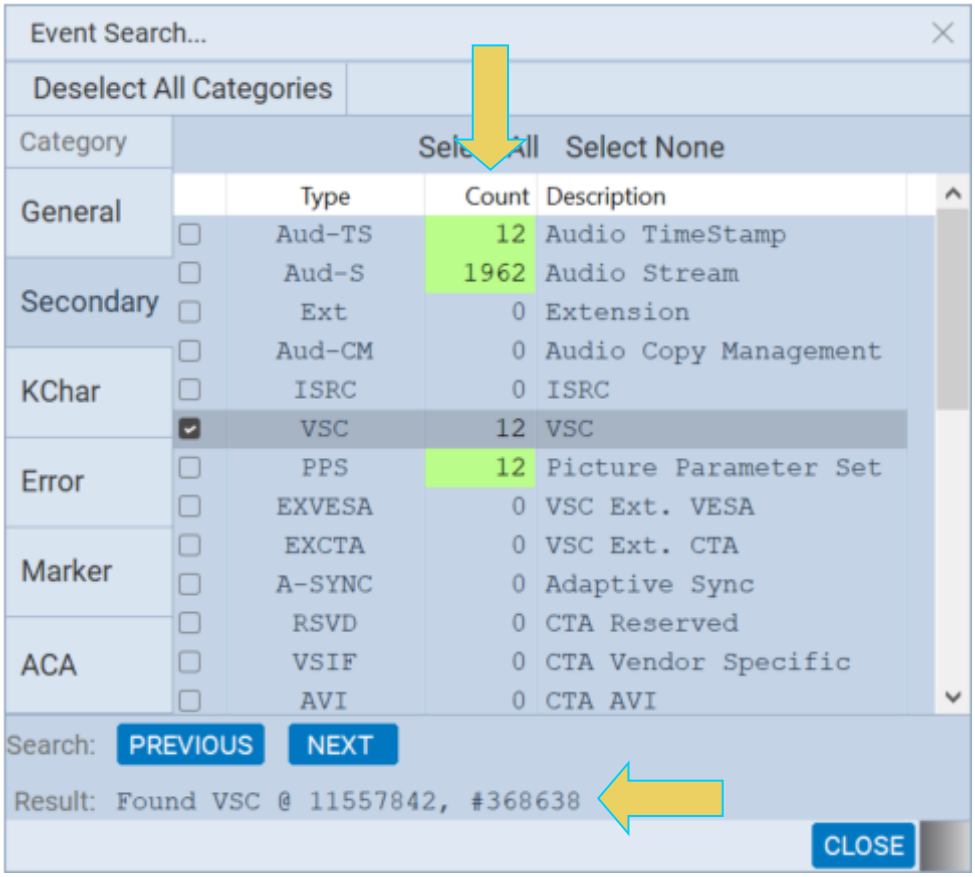
The dialog box enables you to select all or none of the data element types per category using the **Select All** or **Select None** buttons on the top of the dialog box, as shown below.

There are several tabs on the sidebar. Each tab enables you to select from a category of data types. You can click **Deselect All Categories** to uncheck all data types in every tab.

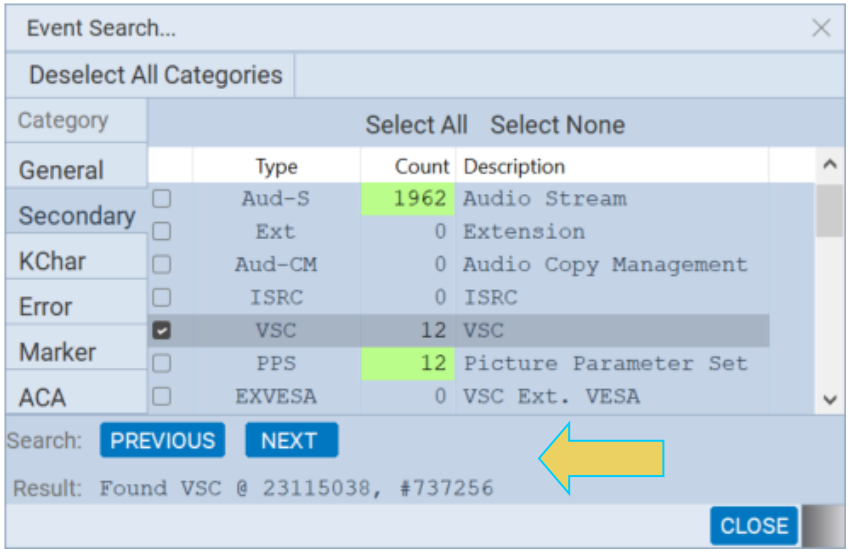


Select as many or few data types as you need to find.

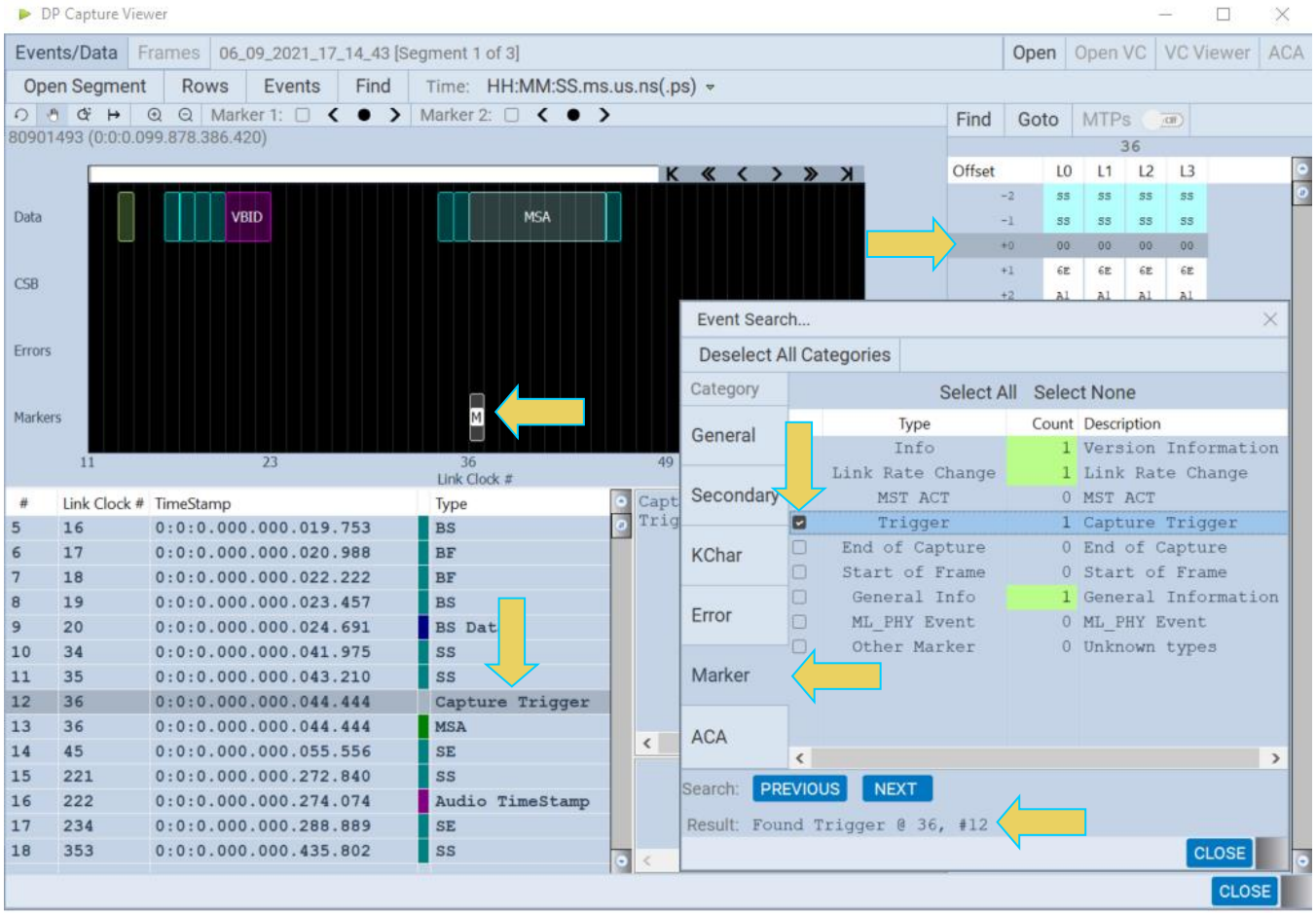
Once you have selected your desired data types, click the **NEXT** button to move to the first result. The results of a search are shown at the bottom of the dialog box, under **Results**, as shown below. This example searches for the VSC data type. Note that the **Count** is an indication of the number of that data element that appears in the captured data.



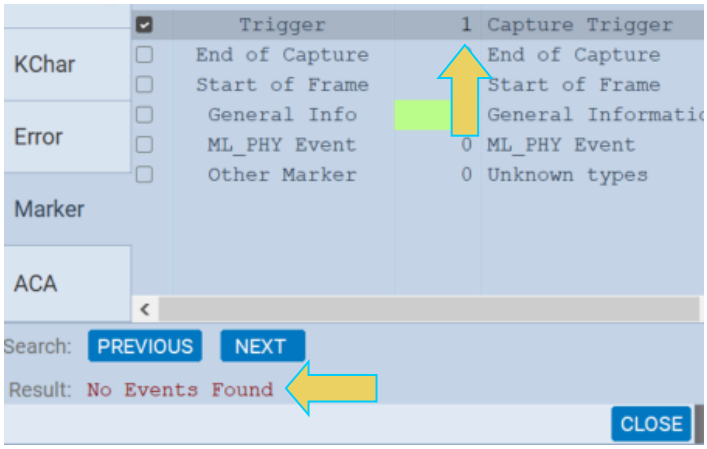
This next screenshot is the same search, after pressing the **NEXT** button one more time and proceeding to the next occurrence of the VSC data type.



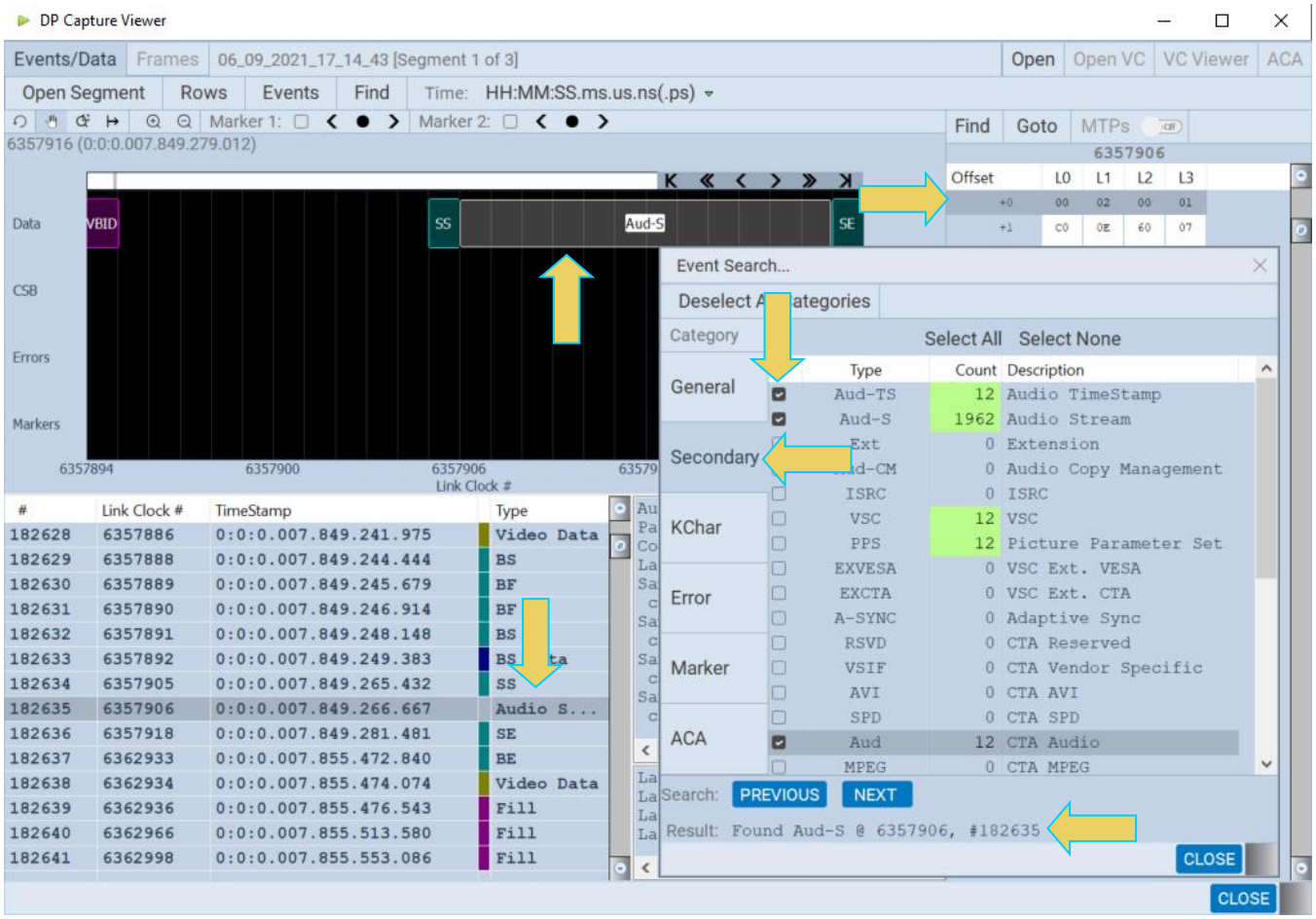
In the following example, the **Trigger** condition **Marker** is searched for. Note that the status of the search is shown on the bottom of the dialog box. The search function centered the trigger condition marker on the **Event Plot** which you can partially see behind the dialog box. Since the panels 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, but clicking **NEXT** yields the message **No Events Found** (example below), you may be ahead of that occurrence, and need to click the **PREVIOUS** button instead.

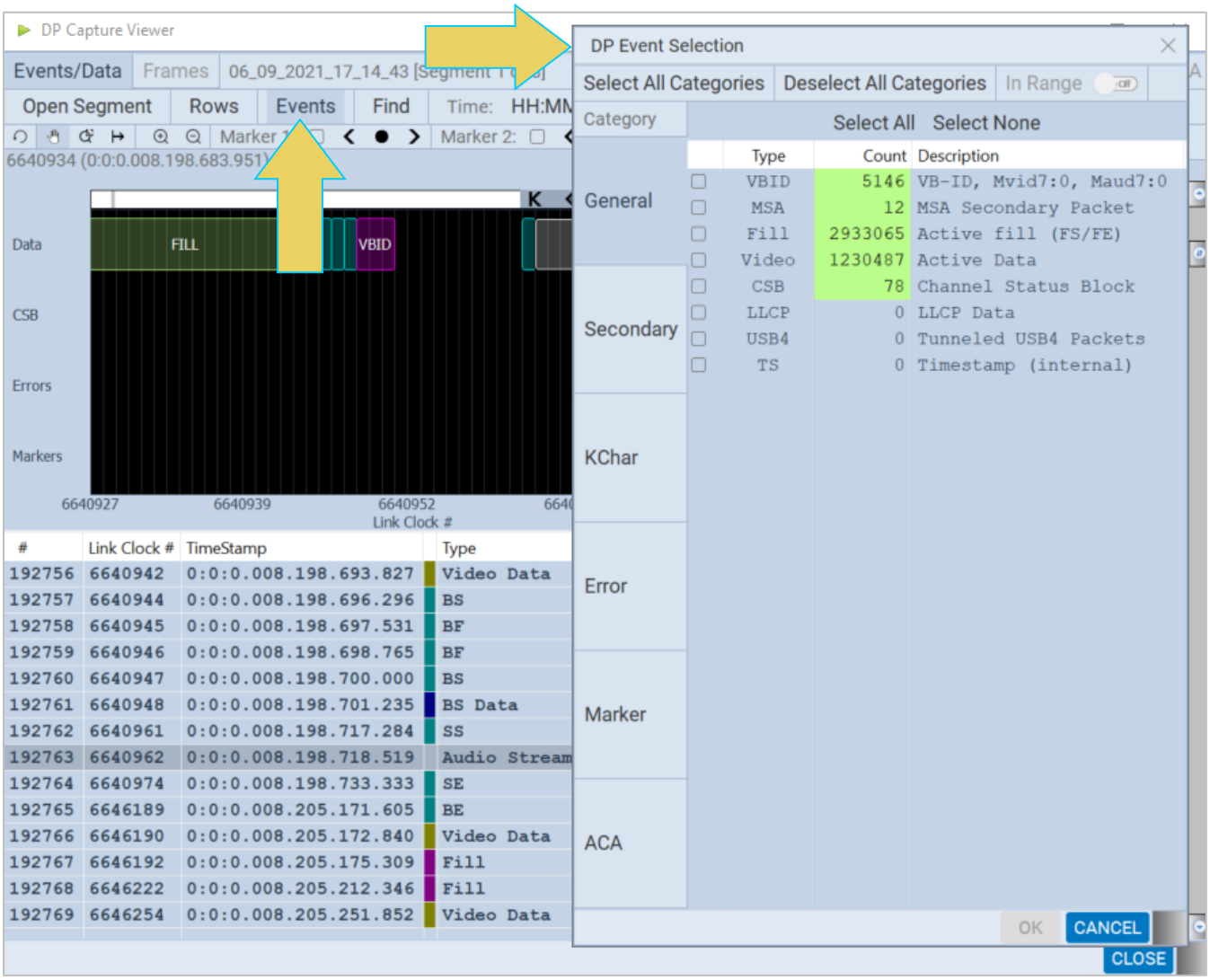


The following example shows a search of audio packets.

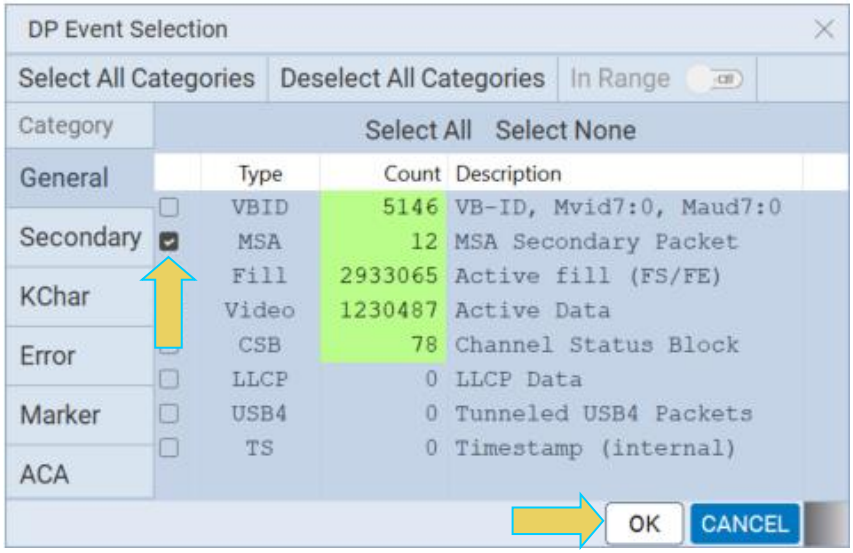


Filtering Specific Data Elements

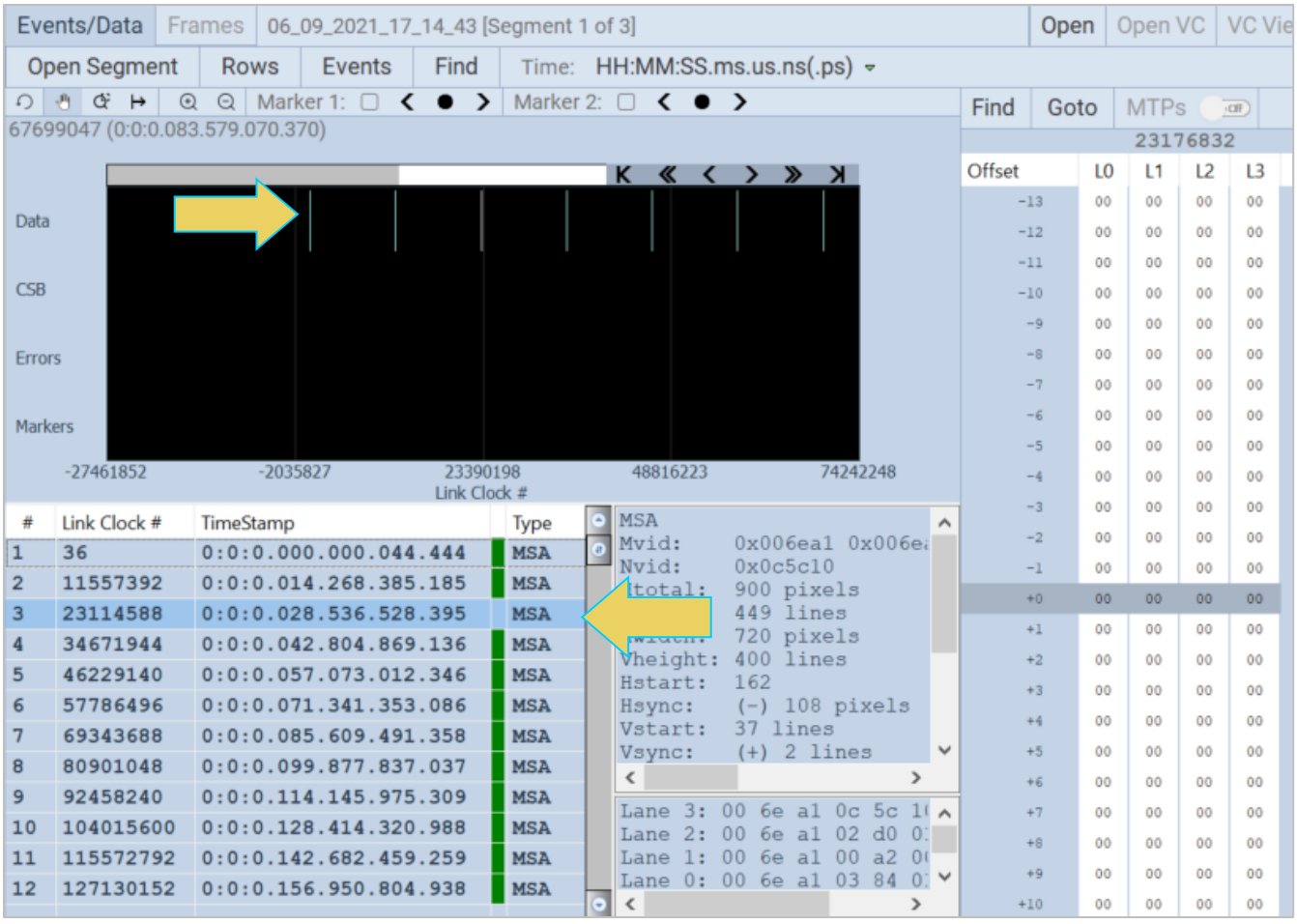
You can filter the captured data to show only specific data types using the **Event Selection** feature. The **Event Selection** dialog box is accessible from the **Events** activation button Events on the top of the **DP Capture Viewer** window as shown below, with the **DP Event Selection** window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



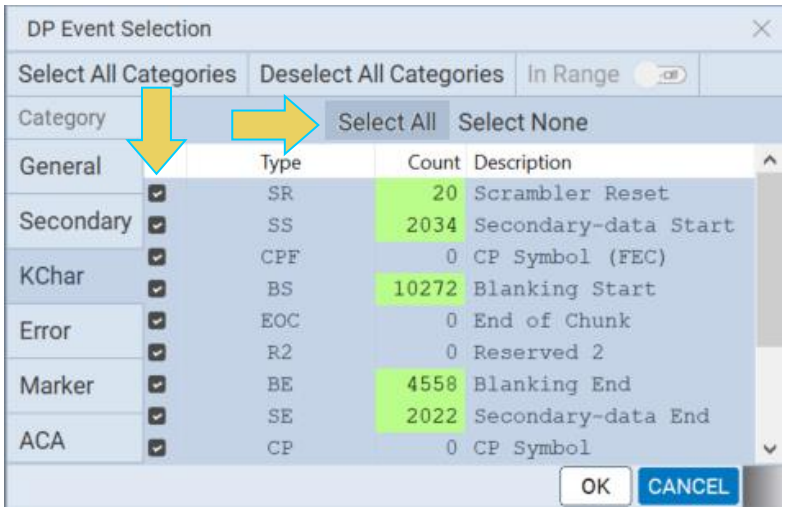
The following screen shows an example of filtering for an MSA Secondary Packet. Check the box next to the data type you wish to filter, and click **OK**. The results of the filter apply to both the **Event Plot** and the **Event Data** panels.



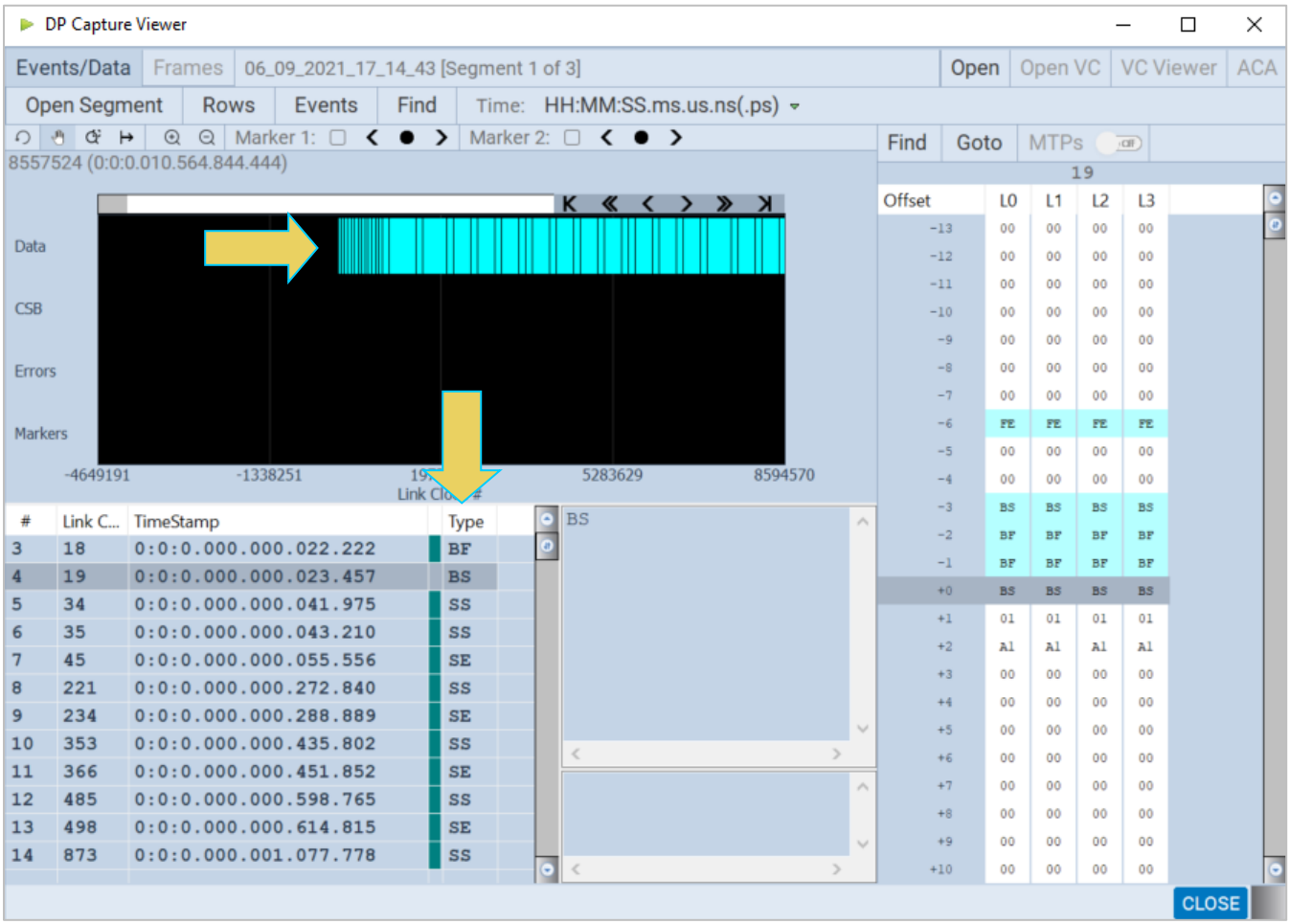
The results of the filter for MSA data elements on the **Event Plot** and **Event Table** panels are shown below.



Similarly to the **Find** dialog box, you can **Select** or **Deselect All Categories** with the buttons at the top of the dialog box. The categories are listed in the left-hand column. You can also **Select All** or **Select None** within an individual category. The example below has opted to Select All within the **KChar** category.



The following screen shows the results of the filter.



5.5 Importing, Exporting, and Transferring Capture Files

This section describes the **Import**, **Export**, and **Transfer** features of the M42d.

The **Import** and **Export** options on the right-click menu and the **Navigator** sidebar allow you to exchange capture files between your PC or a USB Drive and the ATP GUI Manager application.

You may Export a capture file to disseminate to colleagues or other subject matter experts. You 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 of the file is not too large.

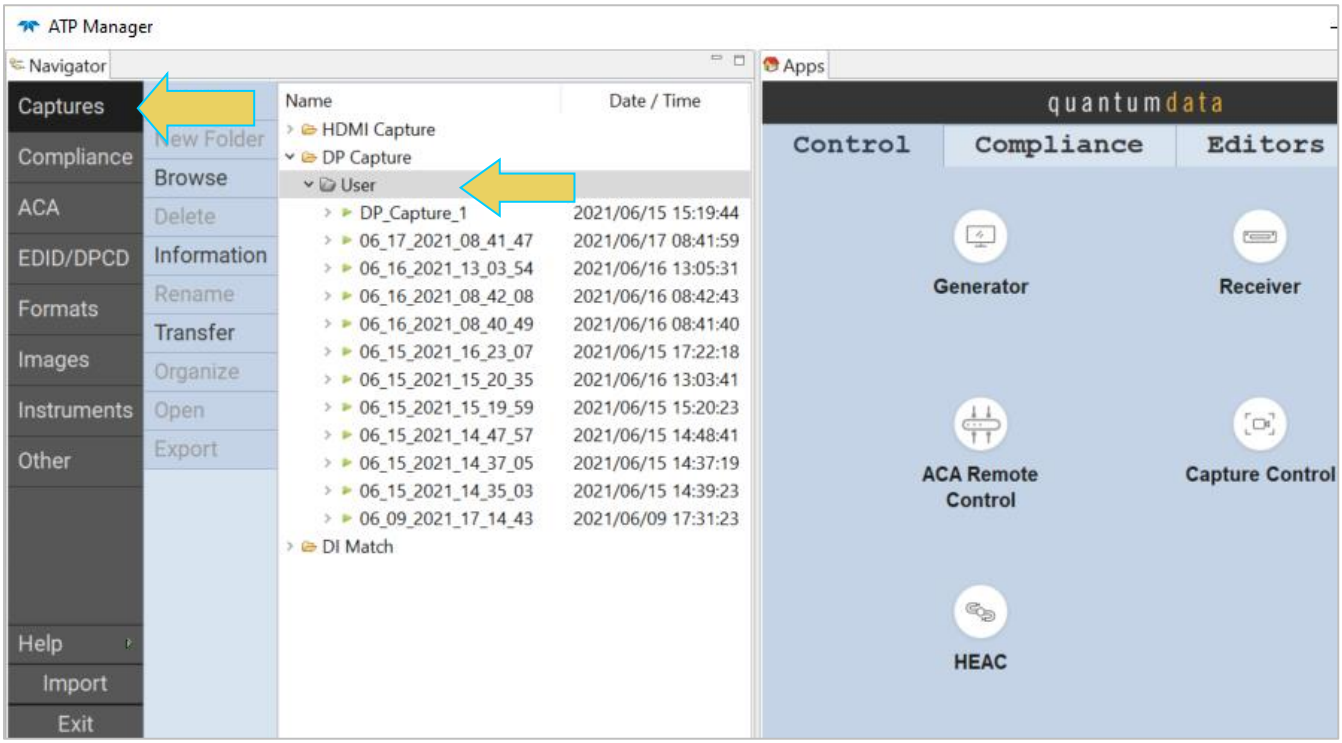
The **Transfer** feature enables you to simply transfer a capture file executed on the M42d embedded GUI onto your PC's ATP Manager for viewing/analysis, or vice versa. The Transfer feature is only accessible from the Remote ATP Manager on a PC since you need a remote PC to execute the transfer.

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 ATP Manager.

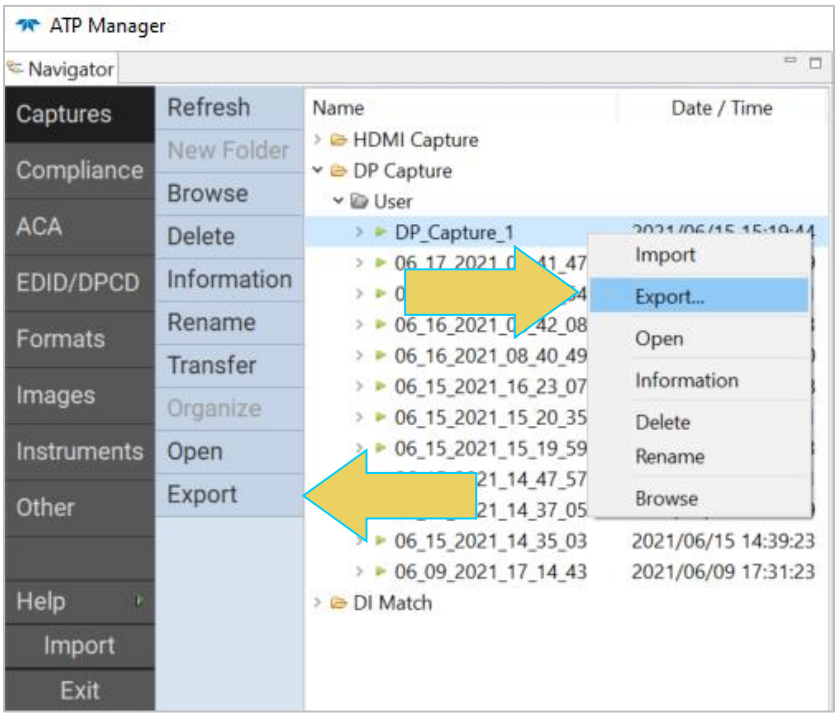
All of these features are accessible through the **Navigator** interface on the instrument or the remote manager.

Exporting a Capture File

To export a capture file, navigate to its folder in the ATP Manager Navigator interface by clicking **Captures** and expanding the folder(s) that it is contained in. An example below shows capture files stored in the **User** folder on a PC running the remote ATP Manager.

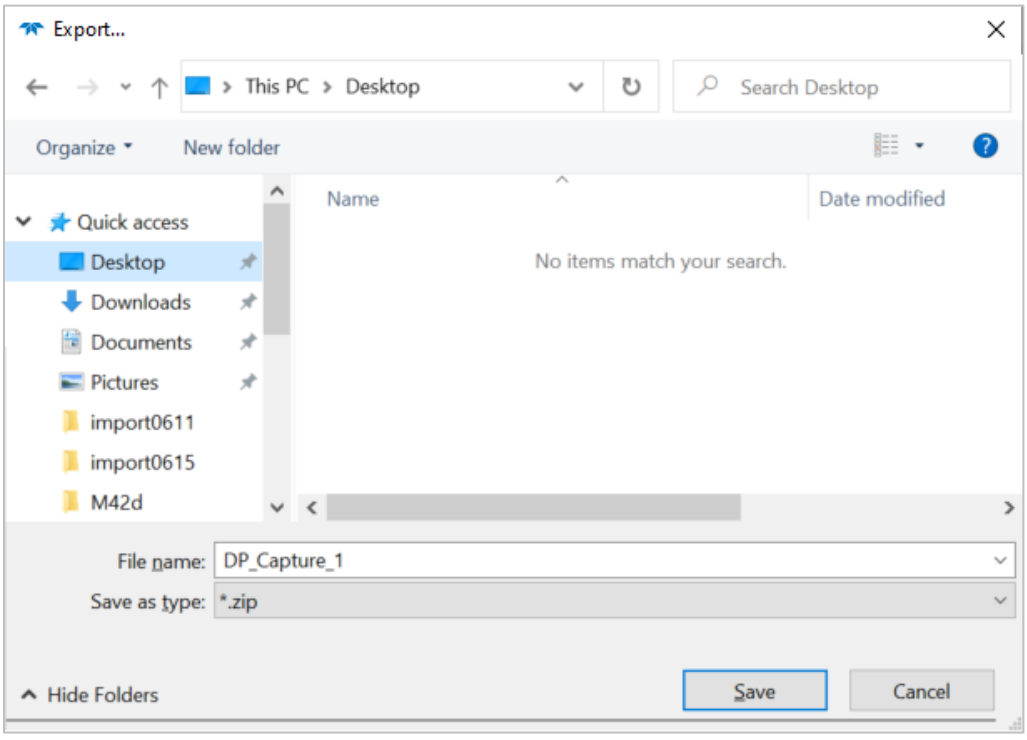


Click on a capture file, and export by selecting the **Export** button on the left sidebar, or right-clicking and selecting **Export**, both shown below.

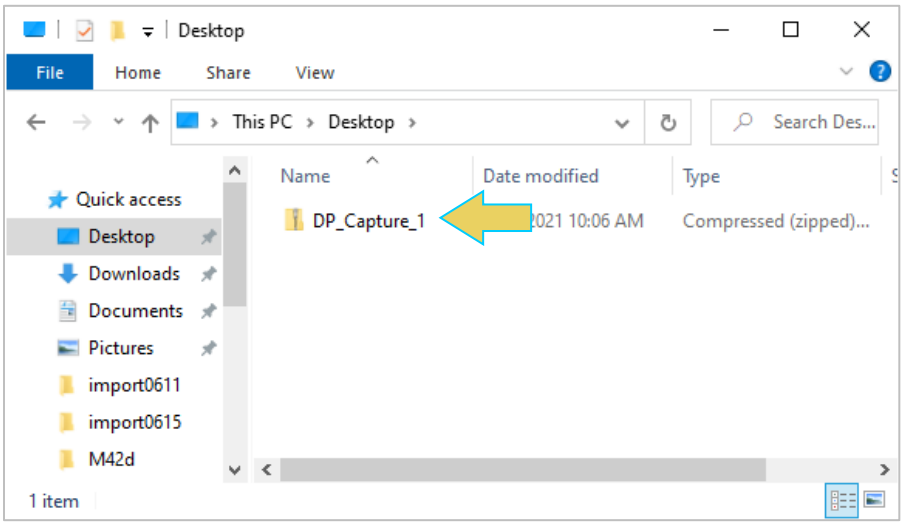


When you select **Export**, a File Explorer window will show up enabling you to save the capture as a zip file in a directory and name of your choosing. Refer to the screen example below.

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

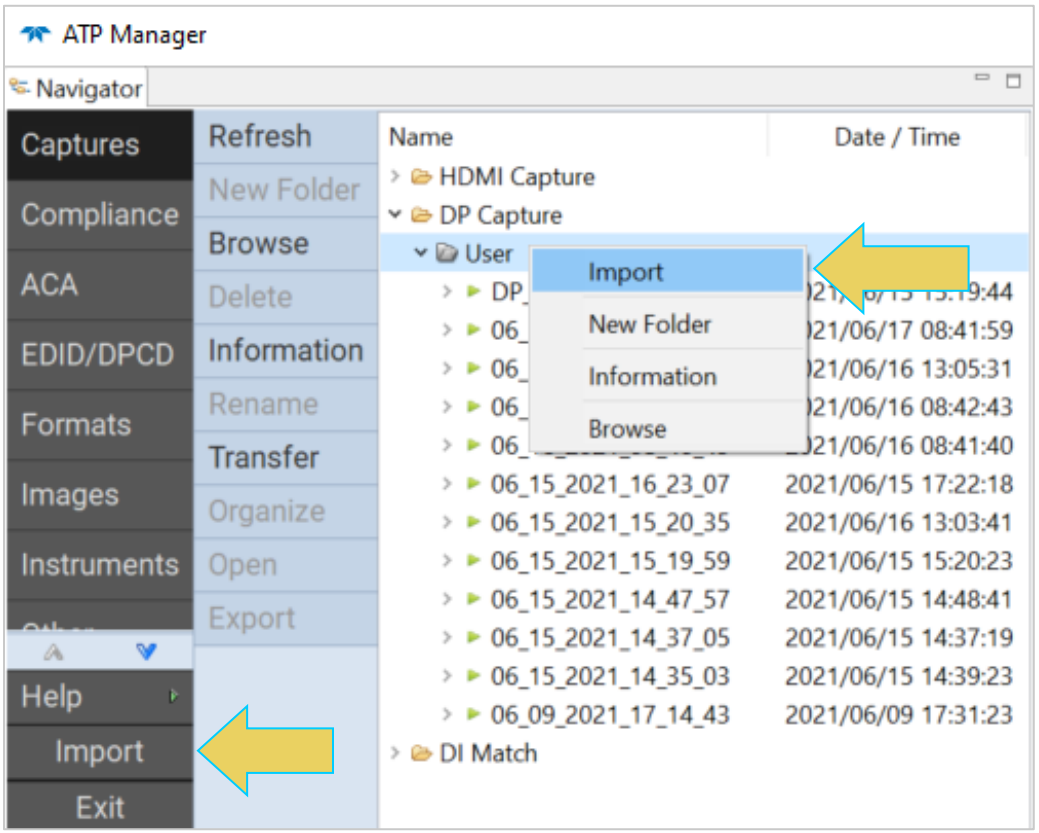


Choose a desired directory and filename, and click **Save**. This capture file will then be accessible in a file explorer as a compressed zip file, as shown below.

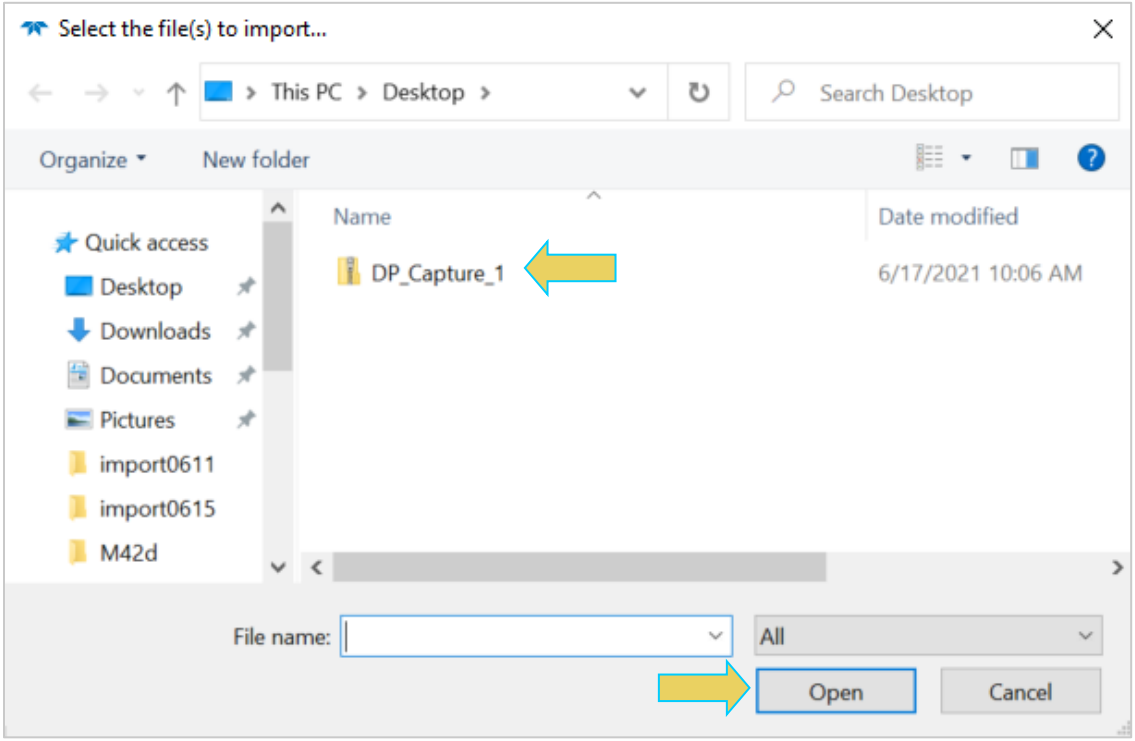


Importing a Capture File

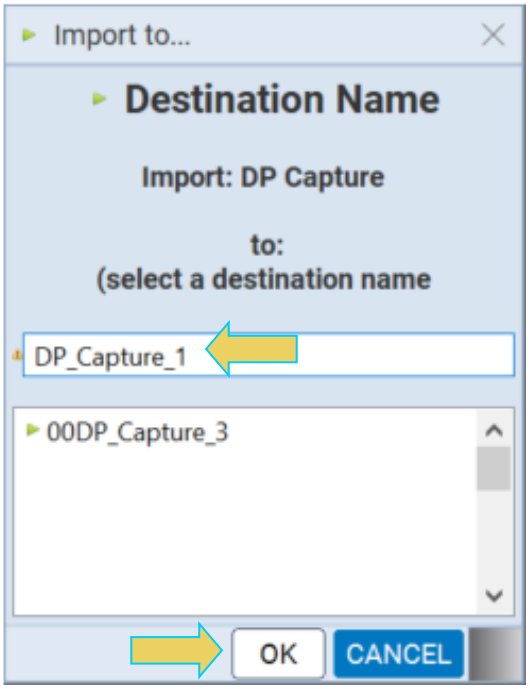
Similarly, to import a file, in the Navigator either right click on the desired target folder, or select the folder and click the **Import** button at the bottom left of the window. The example below demonstrates importing a capture file into the **User** folder.



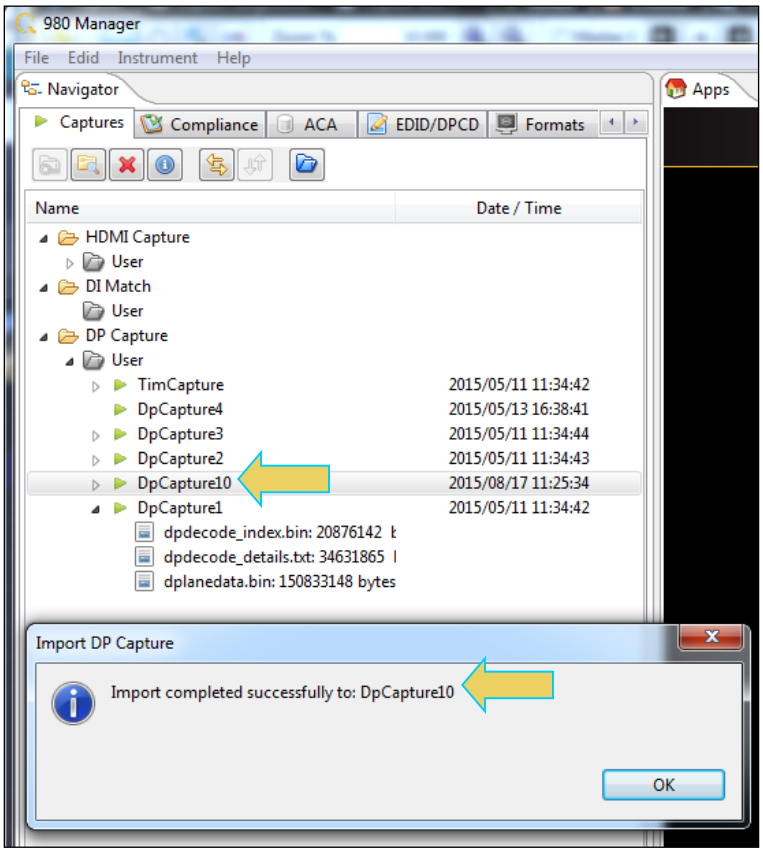
A File Explorer window will appear enabling you to navigate to the directory where you have stored your zipped capture file. Select the file and click **Open** as shown below.



You will then be given an opportunity to rename the file with the **Import DP Capture** dialog box as shown below. Click **OK** once you have the desired name for the import.

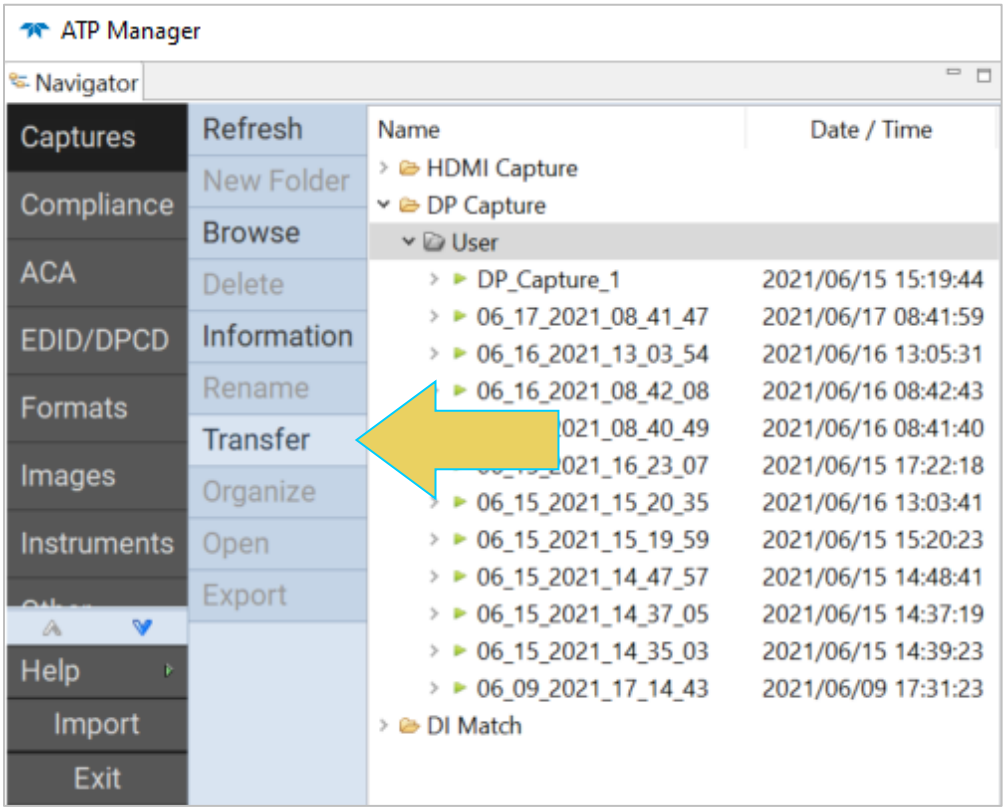


You will see a confirmation dialog box and you the new capture will appear in the list of captures in the **Navigator** panel as shown below.

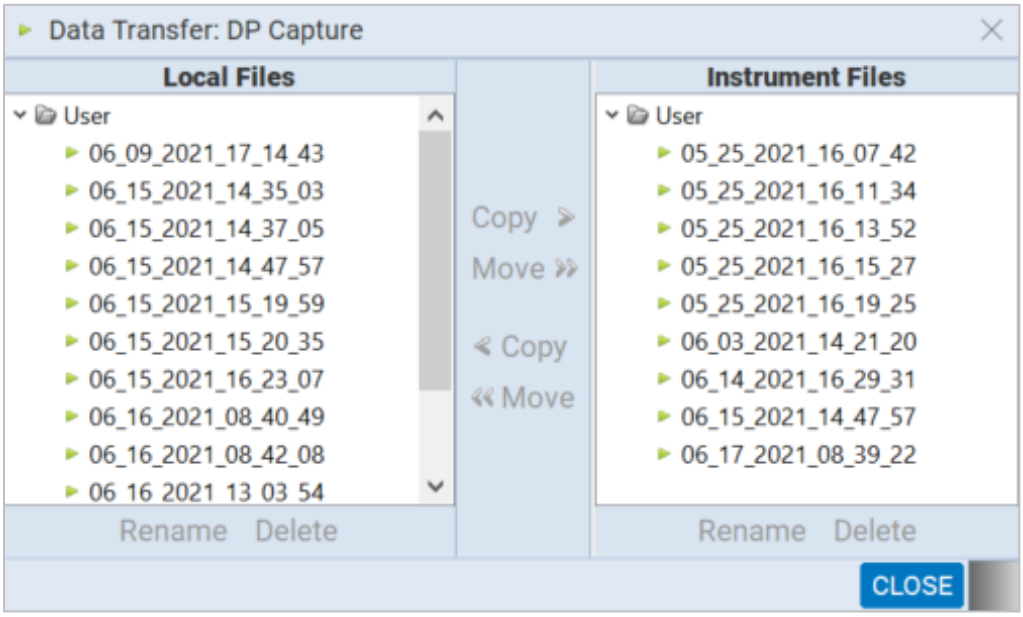


Transferring a Capture File Between Instrument and Remote PC.

To Transfer a file, use the Navigator interface to select the folder on the remote PC that you wish to transfer to/from. Click the **Transfer** button on the left sidebar. An example below shows a Transfer with the **User** folder selected.

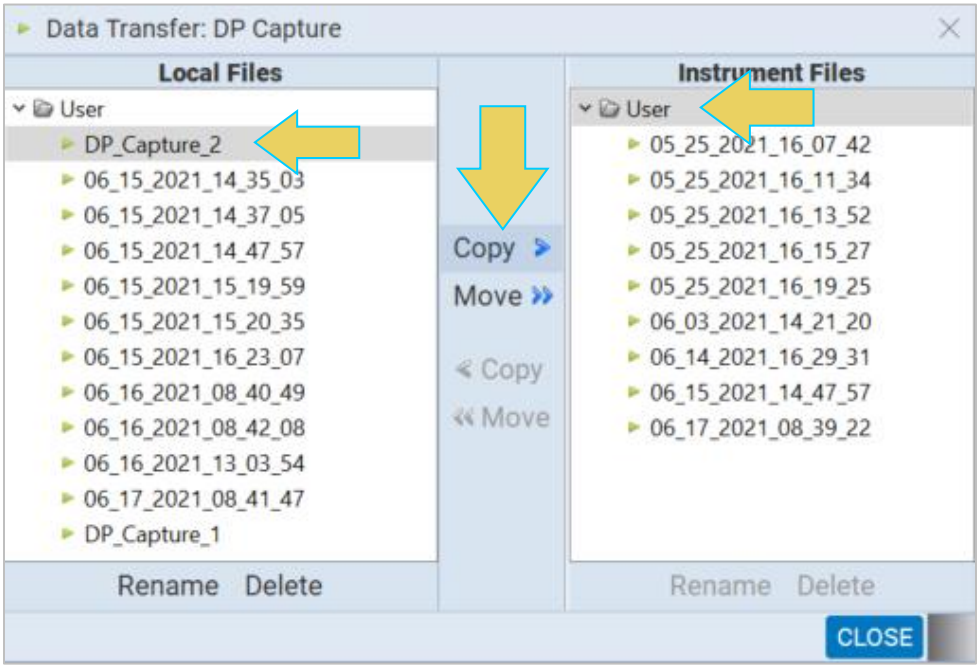


The **Data Transfer: DP Capture** dialog box will appear, as shown below.



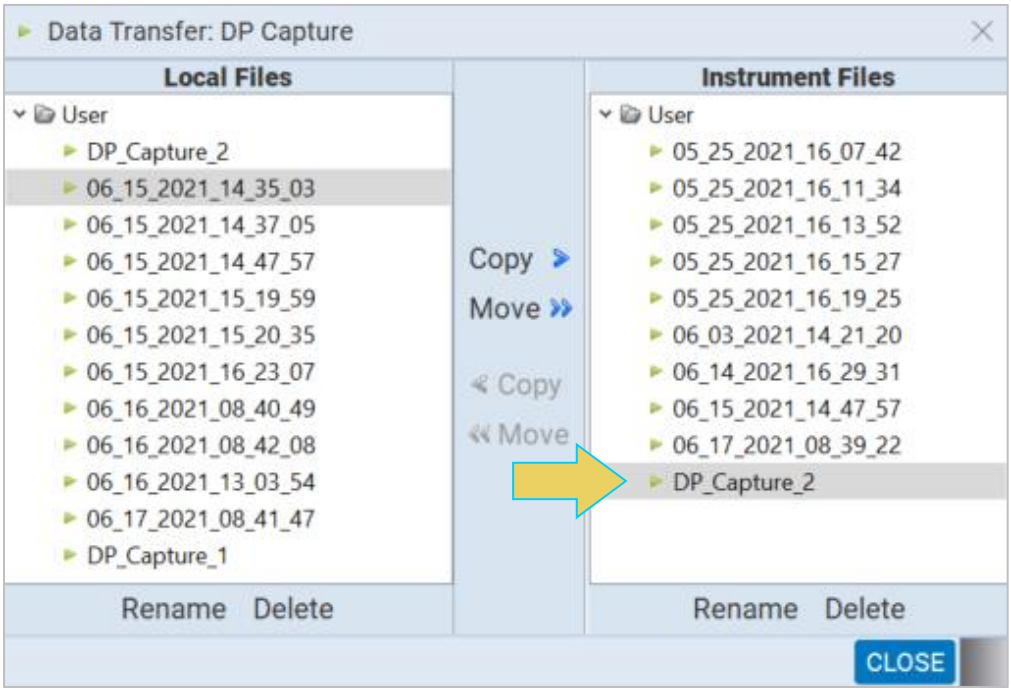
To transfer a capture file from the PC to the Instrument, select the file in the left-hand column labeled **Local Files.** Next, click on a target folder in the righthand column labeled **Instrument Files.** At this point you may either **Copy** the file to the instrument or **Move** it—which removes the file from the local storage on the PC.

The example below shows copying the file DP_Capture_2 from the PC onto the Instrument's **User** folder.

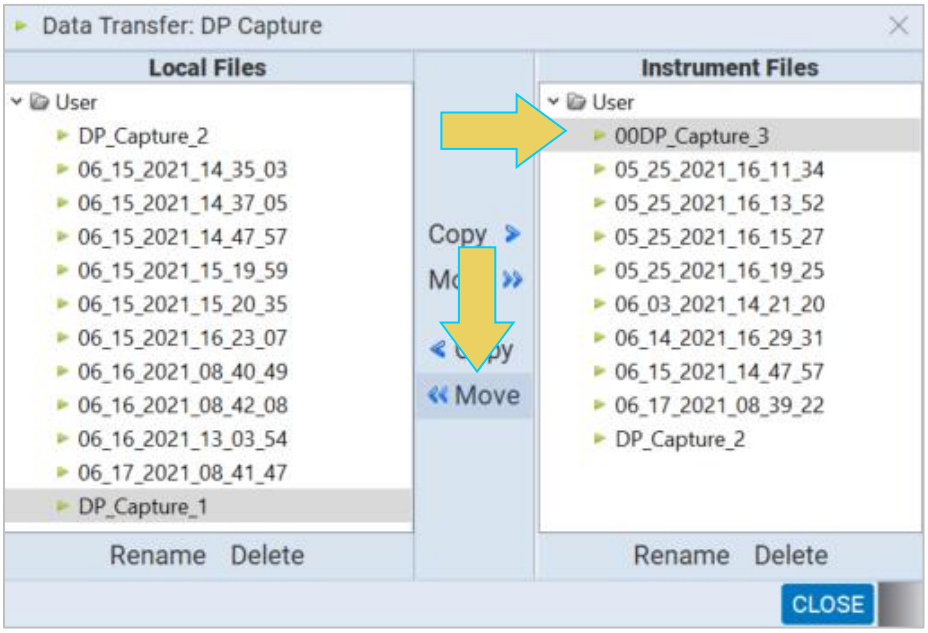


The result is the DP_Capture_2 file now appearing in the **Instrument Files** column as well, as shown below.

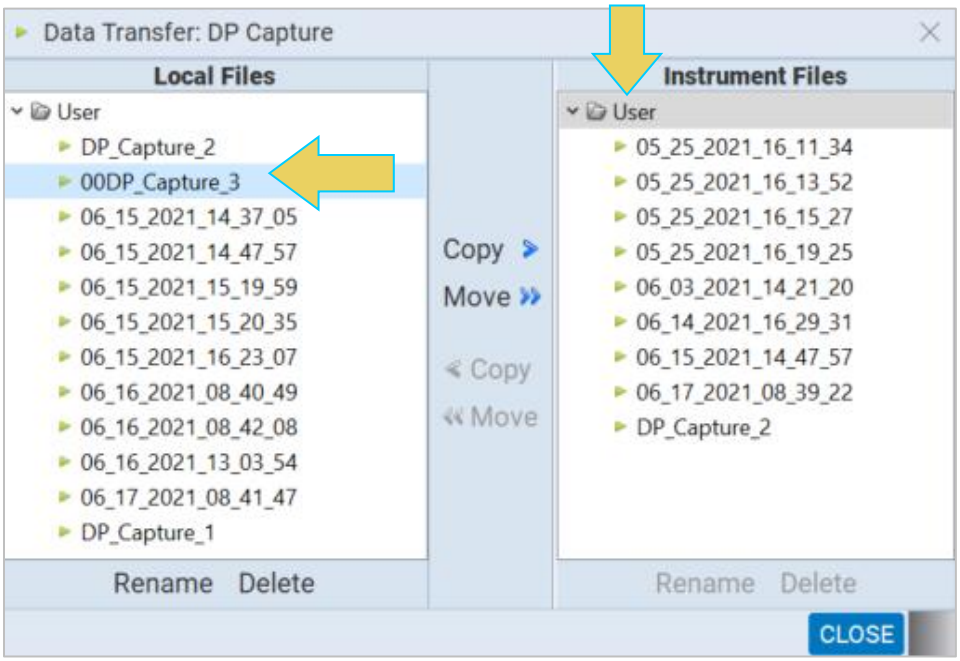
Note: If the **Move>>** transfer option is utilized, the file will not appear in both directories, only the target folder on the instrument, as mentioned earlier.



To transfer a file from the Instrument to the Local Host, 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 the file 00DP_Capture_3 being moved from the Instrument to the PC.



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

6 Auxiliary Channel Analyzer (ACA)

The Auxiliary Channel Analyzer **(ACA)** utilities enable you to view the DDC and 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 ATP GUI Manager or the external ATP GUI Manager 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 three (3) Auxiliary Channel Analyzer utilities:

- **Auxiliary Channel Analyzer ("ACA")** – Used for real time viewing auxiliary channel DisplayPort Aux Chan data through the ATP GUI Manager. You can also open existing ACA trace files stored on the M42d Instrument.
- **ACA Remote Control** - Used for viewing auxiliary channel DisplayPort data through the ATP GUI Manager. This application operates in sync with the Aux Channel Analyzer on the embedded display.
- **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.

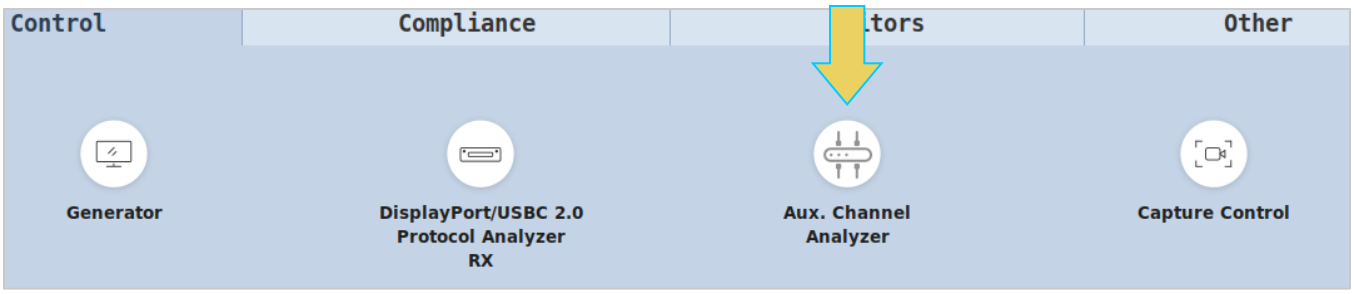
6.1 Accessing the Auxiliary Channel Analyzer (ACA)

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 M41d ports. The operation of the ACA is the same when testing a source or a sink.

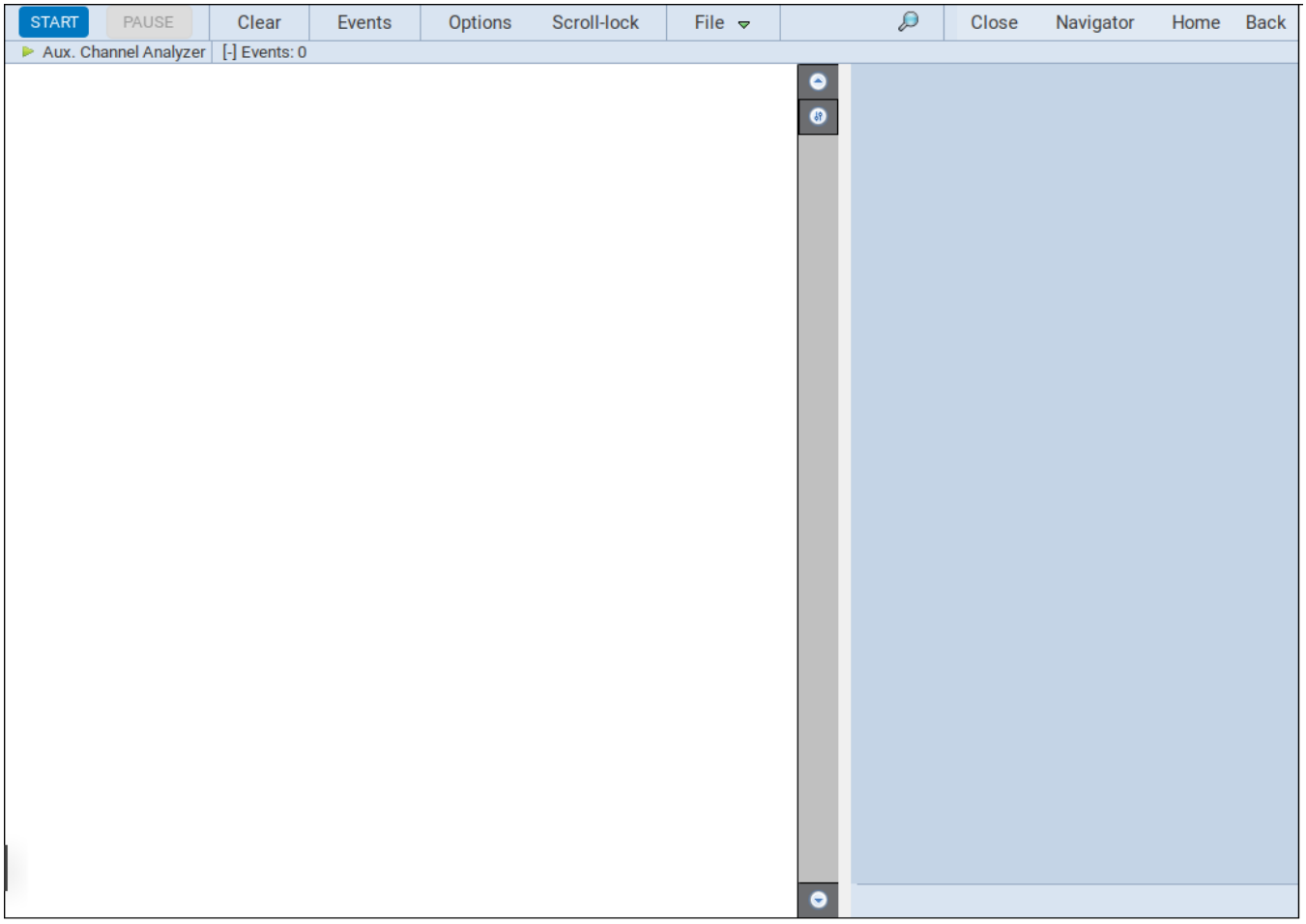
The operation of the two ACA real time utilities—**Aux Channel Analyzer** on the connected external HDMI display and the **ACA Remote Control** on the ATP GUI Manager running on the host PC is similar, though both are covered in this section.

Accessing the Auxiliary Channel Analyzer on the embedded M42d GUI

For the ACA utility, Select the **Aux. Channel Analyzer** app.



The **Aux Channel Analyzer** panel appears 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.

There is a menu associated with the ACA Info panel. It is location on the right side of the panel. The ACA pull-down menu provides the following functions:	
START / STOP	Starts and Stops the collection of DDC data
PAUSE / RESUME	Halts the updates of the data to the ACA panel to view traces and allows you to resume.
Clear	Clears the ACA Trace Panel.
Events	Opens up the **ACA Event Selection** window. This feature is described in detail later in this section.

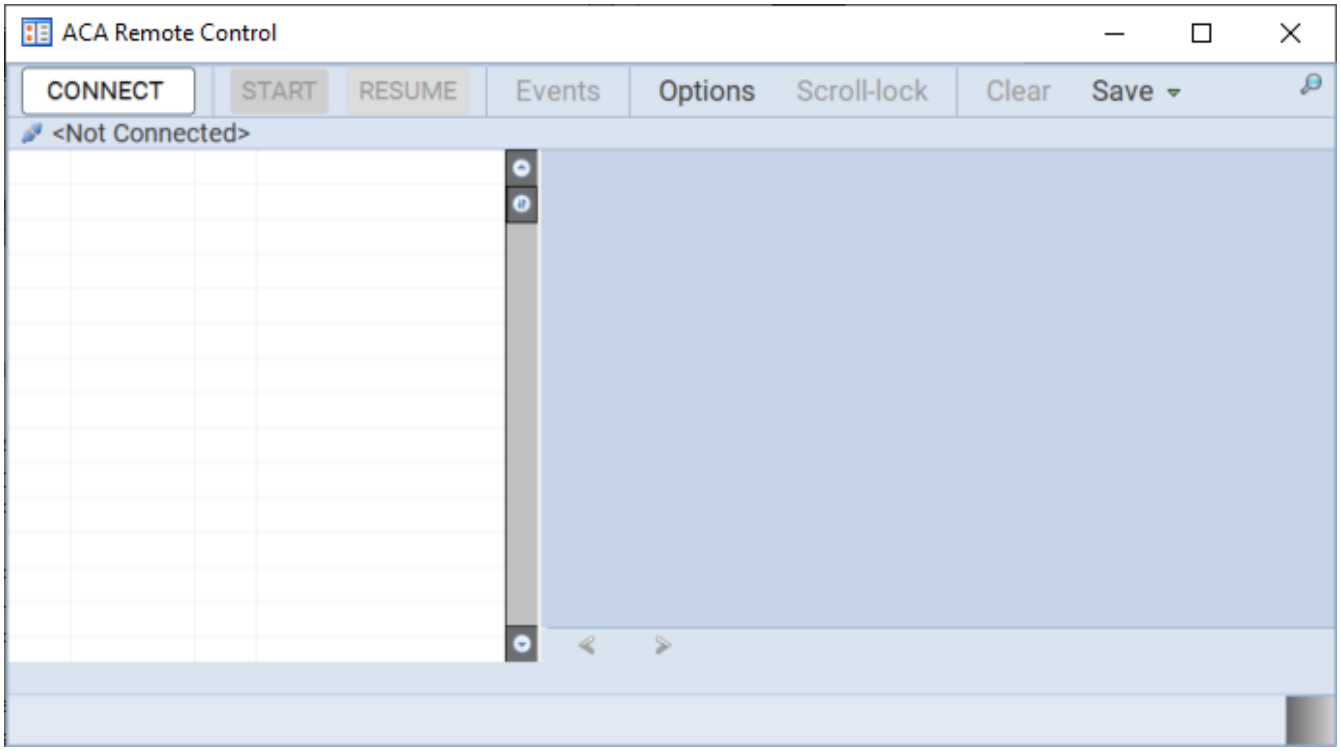
Options	Opens up the **Options** dialog box. Described in detail later in this section.
Scroll-lock	Pauses the Trace Panel on the selected event. With **Scroll Lock** off, the Trace Panel will continue to move in order to display the most recent event.
	▪ **File** – Opens flyout menu with Open and Save options ▪ **Open** – Open a previously saved ACA file **Save** – Save current trace locally
Home	Navigates you back to the Home menu screen of the M42d ATP GUI Manager.
Back	Navigates back to the previous screen in the Real Time mode.
Navigator	Takes you to the Navigator interface
Close	Closes out the ACA application.

Accessing the Auxiliary Channel Analyzer Remote Control on a PC

This subsection describes the **ACA Remote Control** utility used for viewing the real time DisplayPort Aux Channel transactions through the ATP GUI Manager.

ACA Remote Control – Panel Description

The **ACA Remote Control** panel application is available only on the ATP GUI Manager. It enables you to collect and view the ACA transactions in real time from a remotely connected PC with the ATP GUI Manager application. A screenshot of the Remote Control window is below. Notice there are a few slight differences from the embedded GUI, which are detailed in the table below.



There are a few differences between the ACA window on the embedded M42d GUI and the ACA Remote Control on a PC. These changes are outlined below.	
CONNECT	Connect to your test instrument. Will either connect automatically (if you have just one instrument in ATP Manager), or offer you to select a device to connect to.
Save Save to Instrument Save to PC	▪ **Save** – drops down Save flyout menu ▪ **Save to Instrument** – allows you to save the current ACA Trace to the M42d itself ▪ **Save to PC** – allows you to save the current ACA Trace to the host PC

	Drop-down menu allowing you to change text size of the window

6.2 Monitoring Auxiliary Channels with Aux Channel Analyzer Utilities

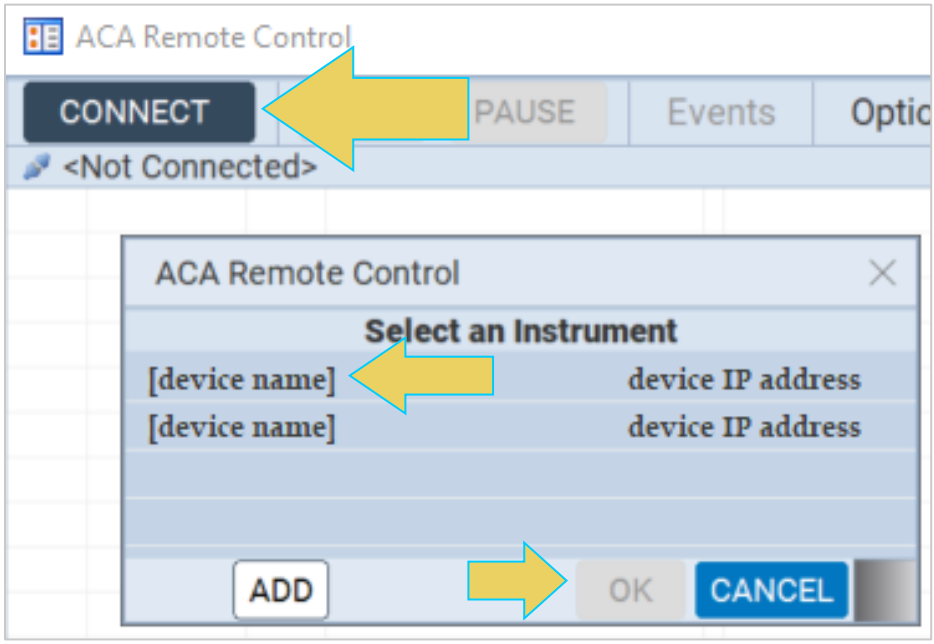
This section describes the procedures for monitoring the auxiliary channel data through the ATP GUI Manager using the Aux Channel Analyzer real time utilities—both the Aux Channel Analyzer utility available through the M42d ATP GUI Manager or the ACA Remote Control utility available through the external ATP GUI Manager running on a PC. You can monitor the DisplayPort transactions in real time when 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 M41d ports. The operation of the ACA is the same when testing a source or a sink.

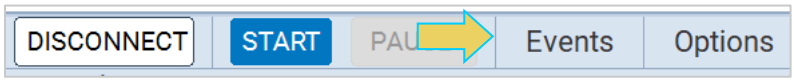
The operation of the two ACA real time utilities—**Aux Channel Analyzer** on the connected external HDMI display and the **ACA Remote Control** on the ATP GUI Manager running on the host PC is similar. The screen examples used in this subsection are from the **ACA Remote Control** utility on the ATP GUI Manager exceptions related to the operation of the ACA on the ATP GUI Manager running on the connected external HDMI display are noted.

To monitor the DisplayPort transactions:

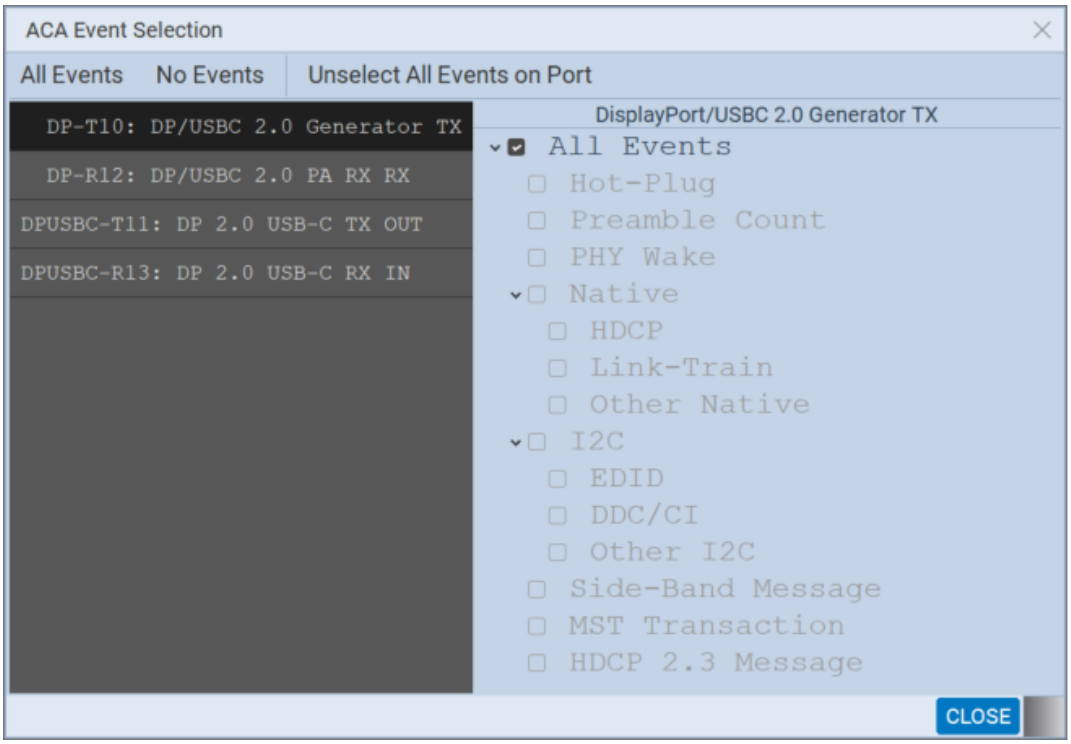
1. Access the **Aux Channel Analyzer** / **ACA Remote Control** (depending on the display method for the ATP Manager GUI).
2. If you are using the **ACA Remote Control** on a host PC, first connect to the desired instrument, as shown below.



3. Specify which DP events you wish to monitor using the **EVENTS** button in the control menu, as shown below.



The **ACA Event Selection** dialog box will appear, as shown below.



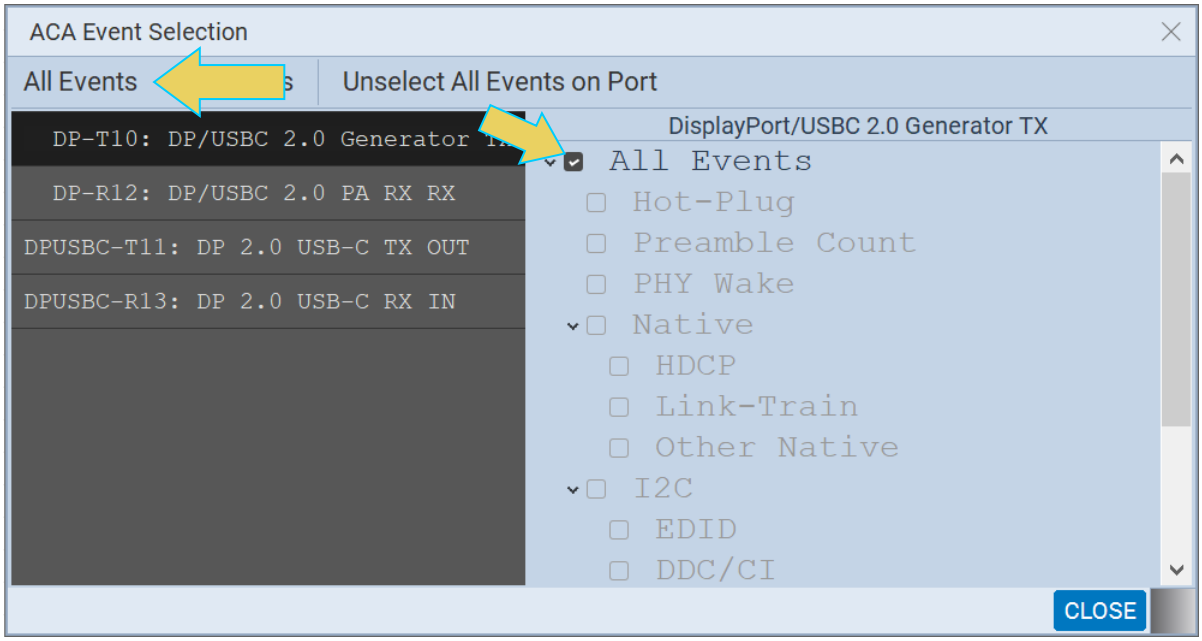
4. Select the ports and events you wish to monitor. Refer to the table below for options.

All Events	Select all events on all ports
No Events	Deselect all events on all ports
Unselect All Events on Port	Deselect all events only on the selected port
DP-T10: DP/USBC 2.0 Generator TX	Select events on the M42d's Generator simulated Tx port
DP-R12: DP/USBC 2.0 PA RX RX	Select events on the M42d's Protocol Analyzer simulated Rx port
DPUSBC-T11: DP 2.0 USB-C TX OUT	Select events on the connected DP or USB-C Tx port

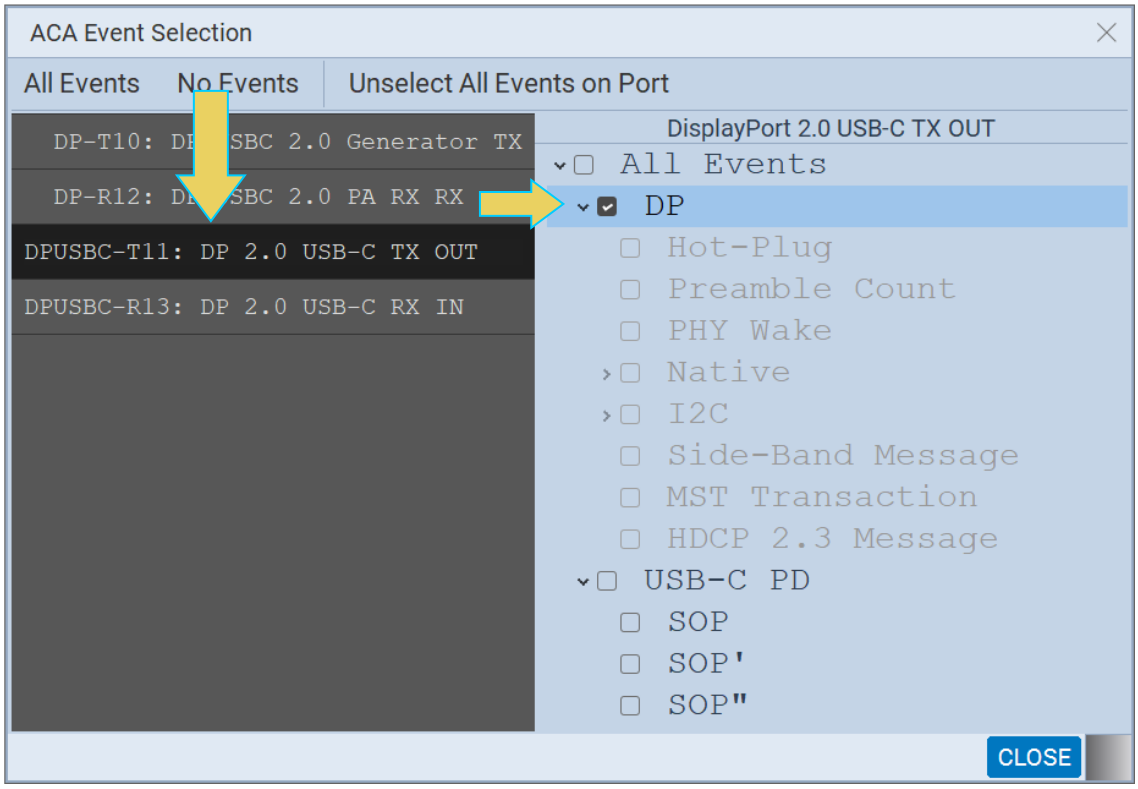
DPUSBC-R13: DP 2.0 USB-C RX IN	Select events on the connected DP or USB-C Rx port

5. Specify which DP events you wish to monitor. You can select **All Events** of any set of individual events. In the following example, the user has selected All Events (on all 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.

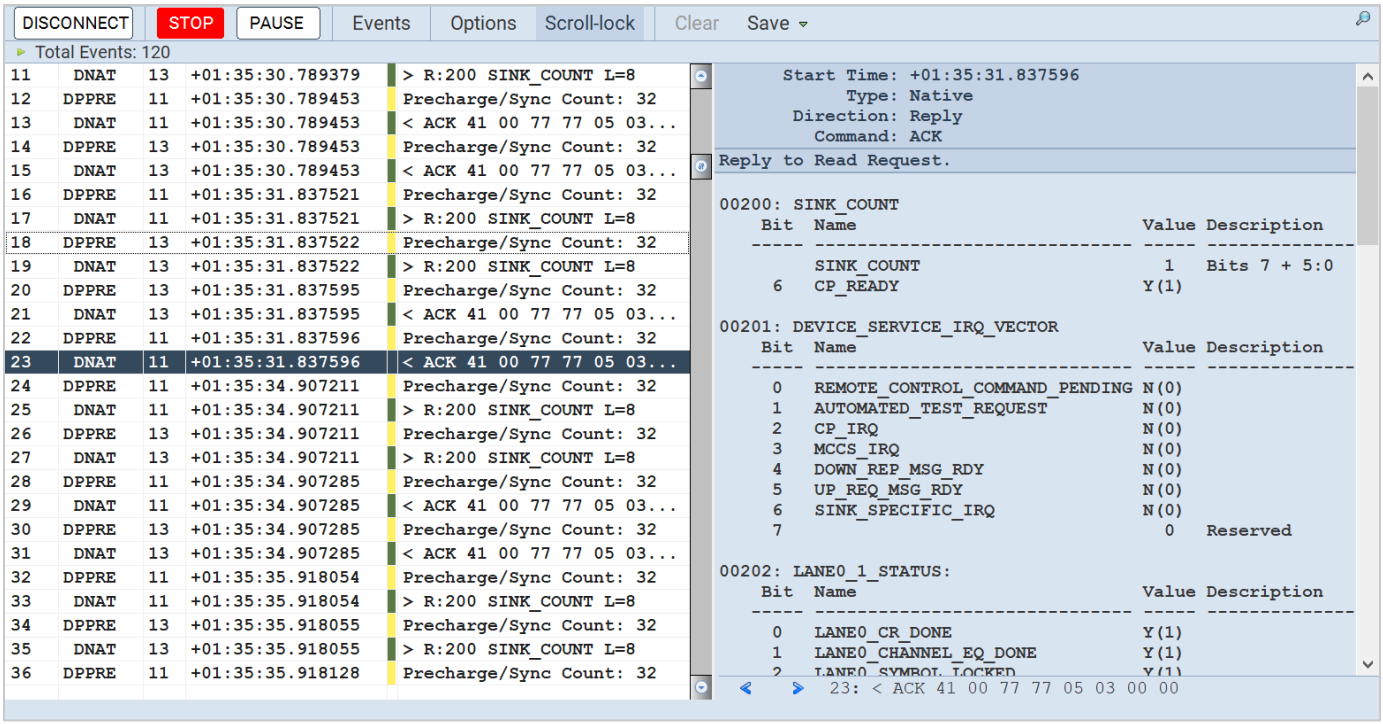


In the next example, the user has selected to monitor only DP events on the DP/USB-C Tx Out port.



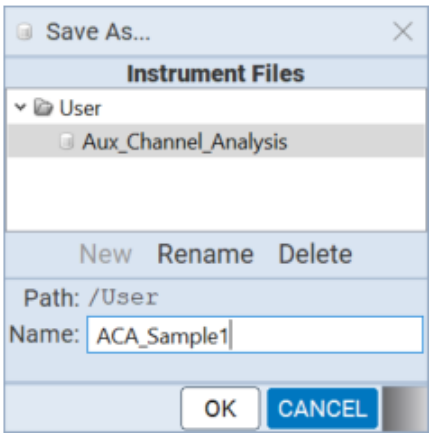
6. Touch select the **Start** button on the ACA Control Menu at the top to initiate the viewing of the DP Aux Chan transactions.
7. Take the necessary action—such as a hot plug—to initiate EDID, HDCP or Link Training transactions. You will see the Aux Chan transactions in the ACA panel as shown below.

   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.

8. Once you have finished running the trace, click on **Save to Instrument** or **Save to PC** depending on whether you are working with the external ACA Remote Control utility or the embedded Aux Channel Analyzer. A dialog box appears (below). Enter a name and then click on **OK**.



Please note:

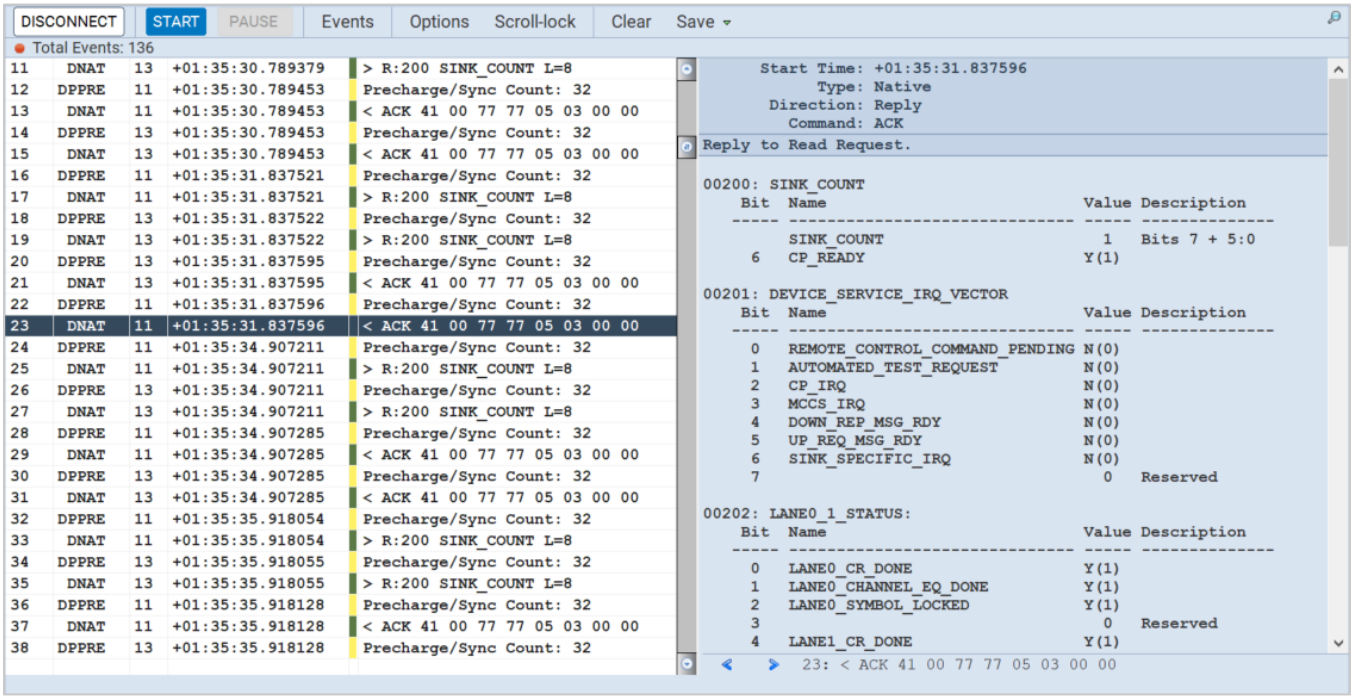
- In order to use the **ACA Data Viewer** utility (**Section 6.4**) on your PC to view the traces or the ACA viewer on the ATP GUI Manager running on the external display with the powerful searching and filtering features, you must save the file, as shown in the previous step.
- If you are working on the **Aux Channel Analyzer** viewer but prefer to use **ACA Data Viewer** on the external ATP GUI Manager, you will have to transfer the saved file to your PC using the ATP GUI

Manager running on the external display. This is covered in **6.5 Importing, Exporting, and Transferring ACA Data**.

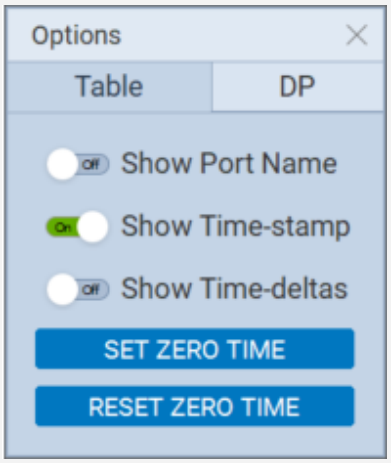
- You can also passively monitor ACA transactions while testing both a source and sink device. Instructions for this procedure are in **Chapter 7 Passive Monitoring**.

6.3 ACA Window and Panel Description

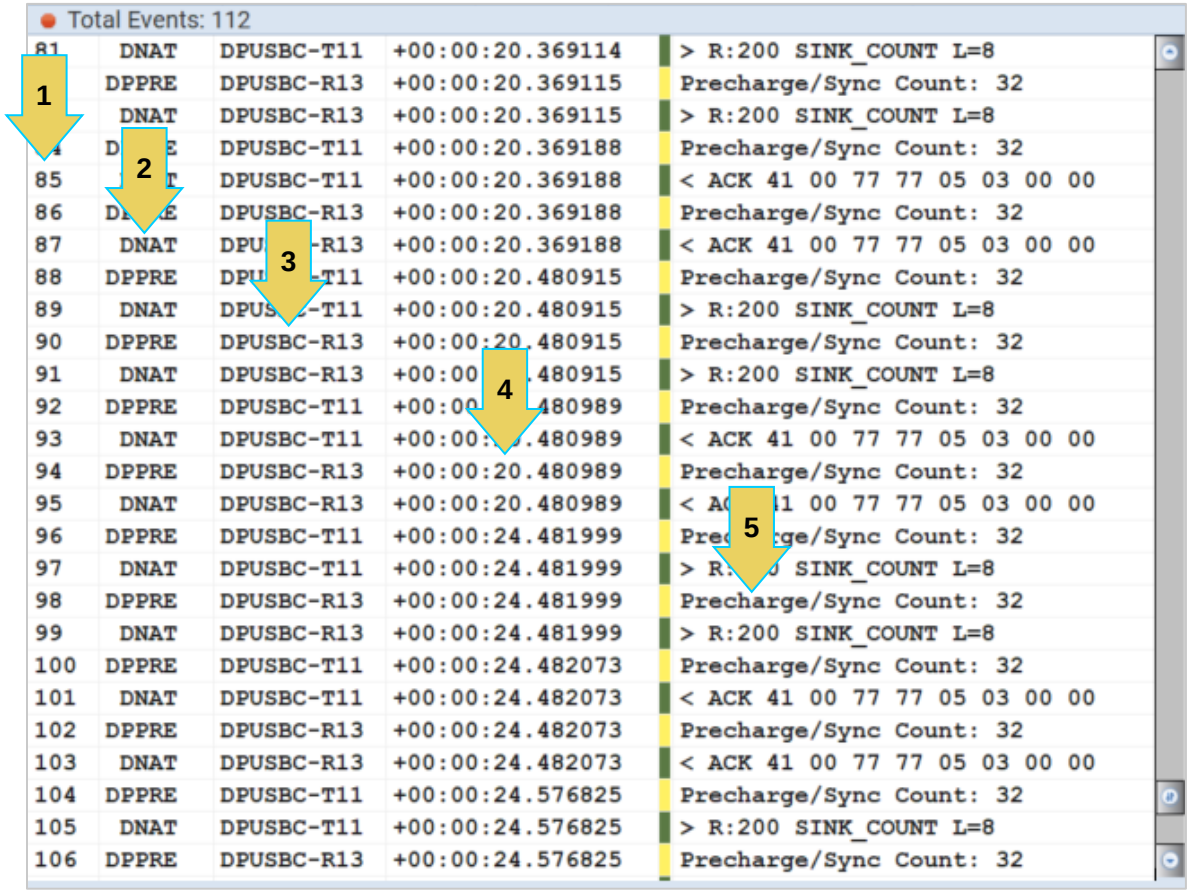
The ACA Window will display the trace details from the data collection executed in the previous section. An example of a populated ACA window is below. Note the top toolbar remains unchanged from when first opening the Aux Channel Analyzer.



You can access the **Options** dialog box using the top Control menu. Options menu items are described in the following table:

Options Dialog Box	
	▪ **Scroll Lock** – Locks the left-hand trace panel to the selected event. When this is off, the panel will continuously scroll with the most recent event. ▪ **Show Port Name** – Enables you to display or not display the Port name (the Port number is always shown). ▪ **Show Time-stamp** – Enables you to show or not show 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 **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. The numbered arrows correspond to the descriptions immediately following the screenshot.

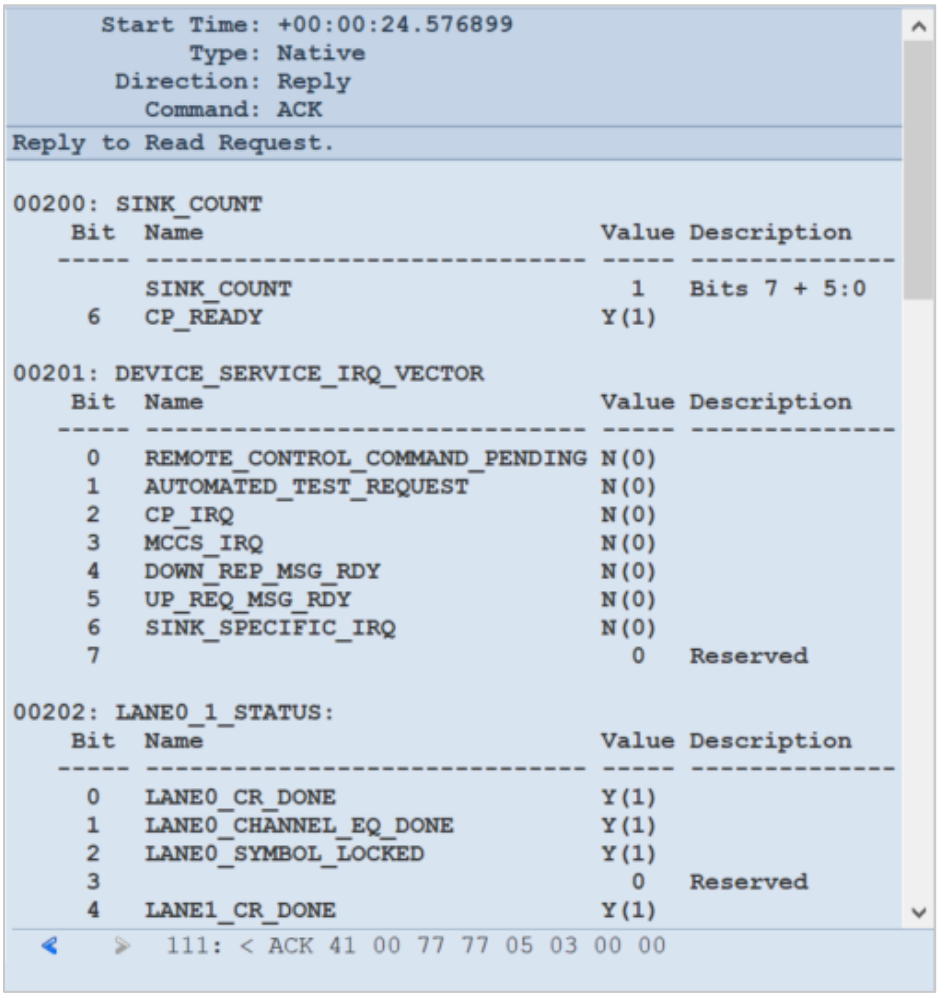


Total Events: 112

81	DNAT	DPUSBC-T11	+00:00:20.369114	> R:200 SINK_COUNT L=8
	DPPRE	DPUSBC-R13	+00:00:20.369115	Precharge/Sync Count: 32
	DNAT	DPUSBC-R13	+00:00:20.369115	> R:200 SINK_COUNT L=8
	D E	DPUSBC-T11	+00:00:20.369188	Precharge/Sync Count: 32
85	T	DPUSBC-T11	+00:00:20.369188	< ACK 41 00 77 77 05 03 00 00
86	D E	DPUSBC-R13	+00:00:20.369188	Precharge/Sync Count: 32
87	DNAT	DPU -R13	+00:00:20.369188	< ACK 41 00 77 77 05 03 00 00
88	DPPRE	DPU -T11	+00:00:20.480915	Precharge/Sync Count: 32
89	DNAT	DPUS -T11	+00:00:20.480915	> R:200 SINK_COUNT L=8
90	DPPRE	DPUSBC-R13	+00:00:20.480915	Precharge/Sync Count: 32
91	DNAT	DPUSBC-R13	+00:00 .480915	> R:200 SINK_COUNT L=8
92	DPPRE	DPUSBC-T11	+00:00 .480989	Precharge/Sync Count: 32
93	DNAT	DPUSBC-T11	+00:00: .480989	< ACK 41 00 77 77 05 03 00 00
94	DPPRE	DPUSBC-R13	+00:00:20.480989	Precharge/Sync Count: 32
95	DNAT	DPUSBC-R13	+00:00:20.480989	< A 1 00 77 77 05 03 00 00
96	DPPRE	DPUSBC-T11	+00:00:24.481999	Prec ge/Sync Count: 32
97	DNAT	DPUSBC-T11	+00:00:24.481999	> R: SINK_COUNT L=8
98	DPPRE	DPUSBC-R13	+00:00:24.481999	Precharge/Sync Count: 32
99	DNAT	DPUSBC-R13	+00:00:24.481999	> R:200 SINK_COUNT L=8
100	DPPRE	DPUSBC-T11	+00:00:24.482073	Precharge/Sync Count: 32
101	DNAT	DPUSBC-T11	+00:00:24.482073	< ACK 41 00 77 77 05 03 00 00
102	DPPRE	DPUSBC-R13	+00:00:24.482073	Precharge/Sync Count: 32
103	DNAT	DPUSBC-R13	+00:00:24.482073	< ACK 41 00 77 77 05 03 00 00
104	DPPRE	DPUSBC-T11	+00:00:24.576825	Precharge/Sync Count: 32
105	DNAT	DPUSBC-T11	+00:00:24.576825	> R:200 SINK_COUNT L=8
106	DPPRE	DPUSBC-R13	+00:00:24.576825	Precharge/Sync Count: 32

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 M41d 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.



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.

There are some control arrows and a status panel on the bottom of the ACA Event Details panel, as shown below.

The left and right arrows allow you to navigate to the immediately previous or following transaction.

The **Status Field** to the right shows the sequence number and the description of the selected transaction.

6.4 ACA Data Viewer

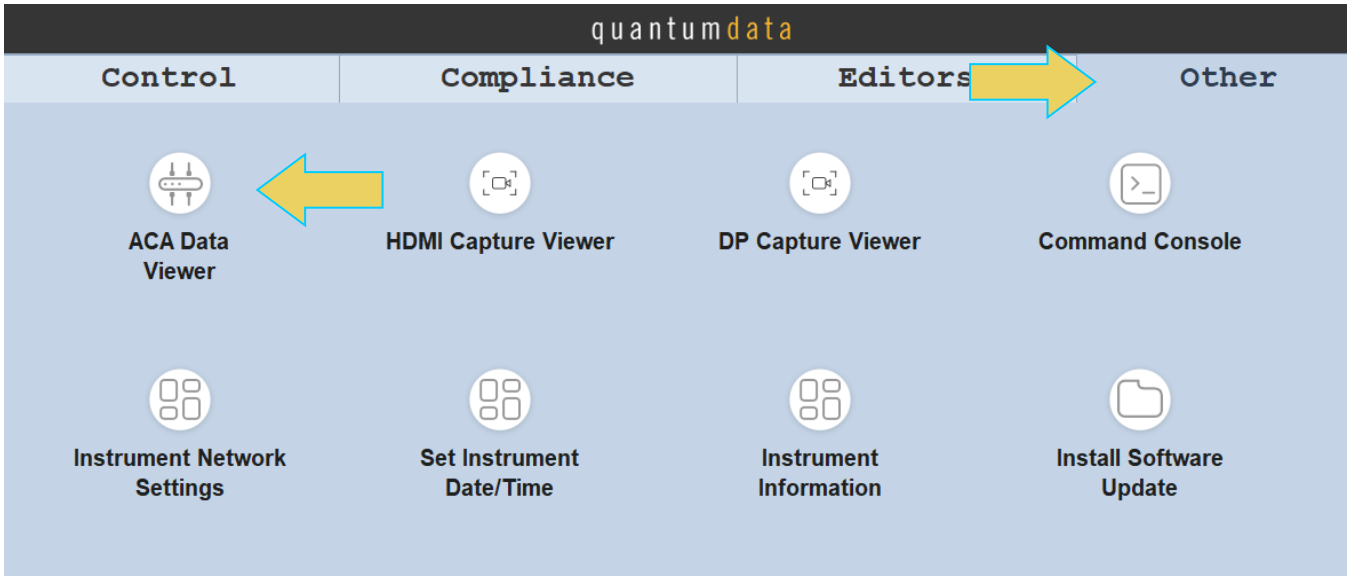
This subsection describes the **ACA Data Viewer** utility used for viewing DisplayPort Aux Channel transactions that have been stored on the PC hosting the ATP GUI Manager. You can use the **ACA** utility on the ATP GUI Manager to view ACA trace files stored on the M41d itself. The operation of the two ACA utilities is similar. The screen examples used in this subsection are from the **ACA Data Viewer** utility but the general operation is similar to the embedded version.

Please note that in order to use the **ACA Data Viewer** utility on your remote PC to view the traces or the ACA viewer on the M42d ATP GUI Manager display with the powerful searching and filtering features, you must save the file.

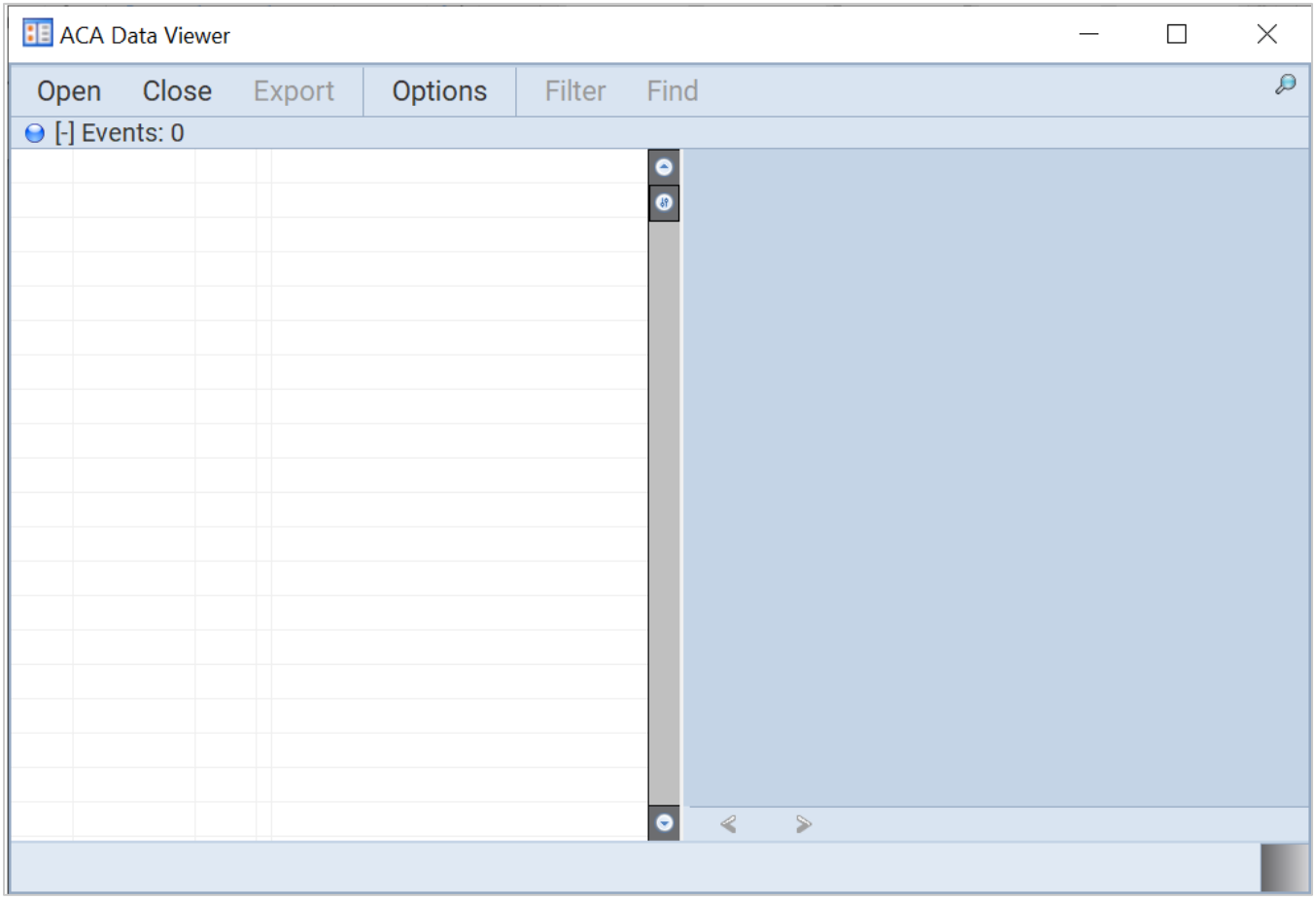
If you are working on the embedded **Aux Channel Analyzer** viewer but prefer to use **ACA Data Viewer** on the external ATP GUI Manager, you will have to transfer the saved file to your PC using the external ATP GUI Manager. Instructions for transferring are detailed in the next section.

ACA Data Viewer – Panel Description

Access the ACA Data Viewer by selecting the **Other** tab on the home screen and clicking the ACA Data Viewer icon, as shown below.

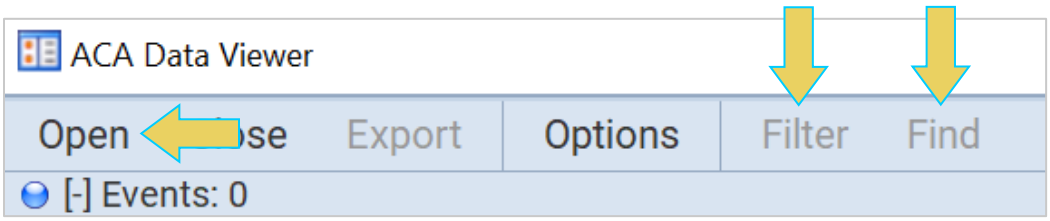


You'll notice the window looks similar to the ACA Utility, though there are a few distinct and very useful additions. A screenshot of the populated **ACA Data Viewer** is below. Notice the **Trace Panel** and **Event Details Panel** are the same as described in **7.3 ACA Window and Panel Description**.



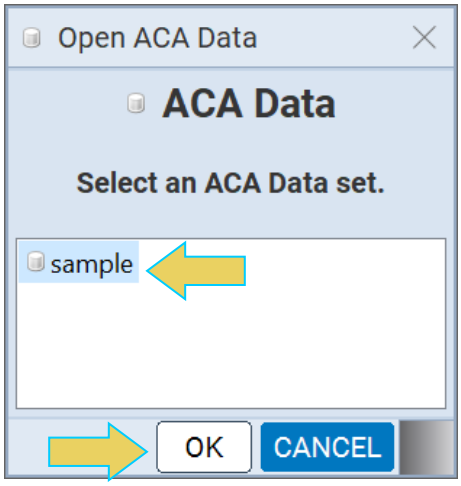
The main difference is in the Control Menu at the top of the window. The following are features not found in the ACA Utility:

- **Open** – Open a file saved locally, whether on the instrument or host PC
- **Filter** – Filter results shown in the Trace Panel
- **Find** – Find a specific data type in the Trace Panel
- **Export** – Export results as text or html file

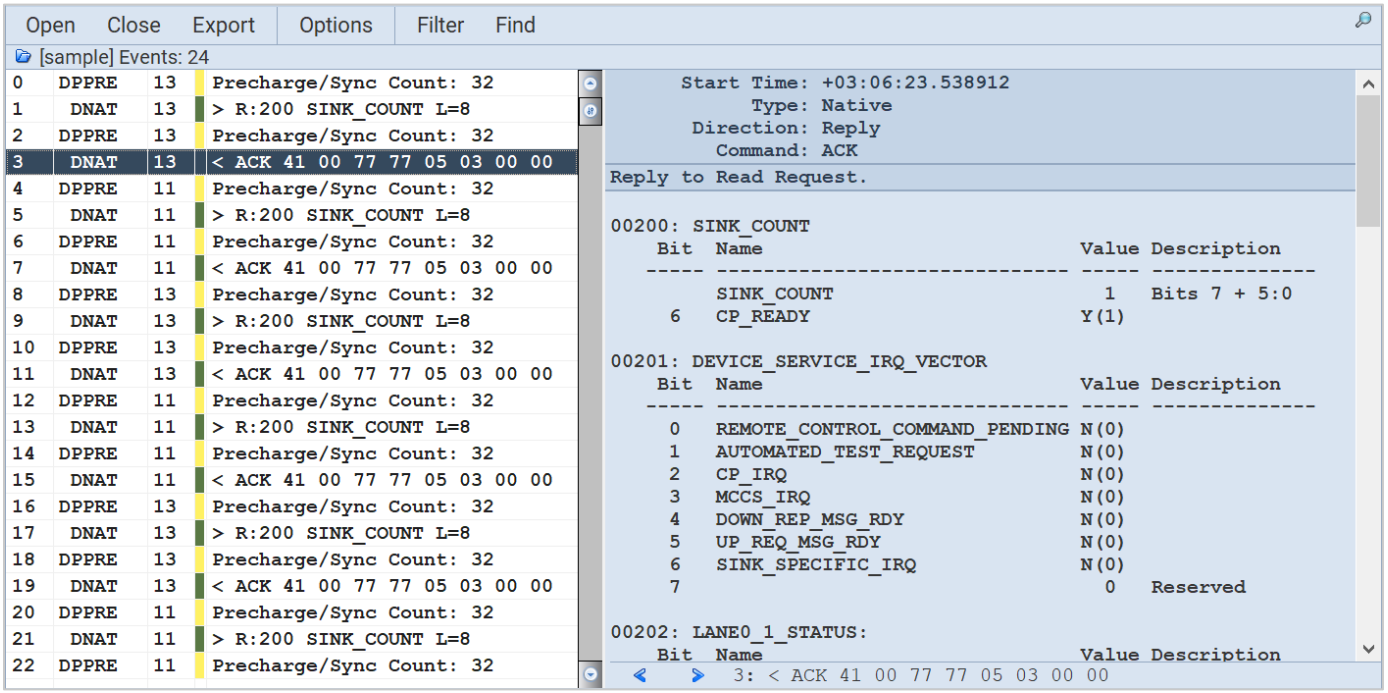


To load an ACA Data set, click the **Open** button in the control menu. The **Open ACA Data** dialog box will appear, as shown below.

Select the data set you would like to open, and then click **OK**.



The resulting populated ACA Data Viewer is shown in the example below. Notice the Trace Panel and Event Detail Panel are identical to the view while monitoring in the ACA Utility itself.

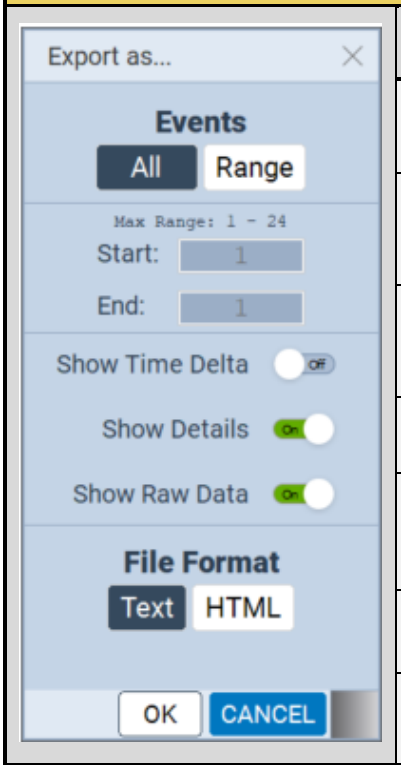


Exporting ACA Data as Text or HTML File

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
Events	Enables you to select all recorded events, or a specified range
Start	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
End	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.
Show Time Delta	Toggle enabling you to export the data with the time showing as relative to the previous event
Show Details	Toggle enabling you to export the data and include the human-readable information in the Event Details Panel
Show Raw Data	Toggle enabling you to export the data and include the raw data
File Format	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.

Using the ACA Filter Feature

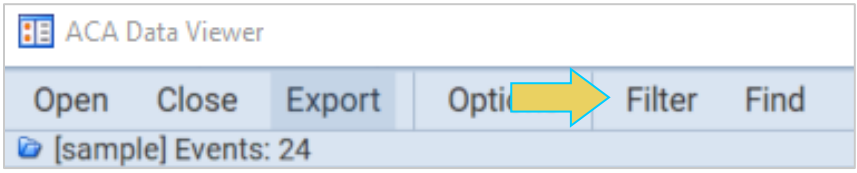
The **ACA Filter** dialog box is accessible using the Filter button. The **ACA Filter** function enables you to filter an ACA trace file to view a subset of the log records in a particular data set.

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.

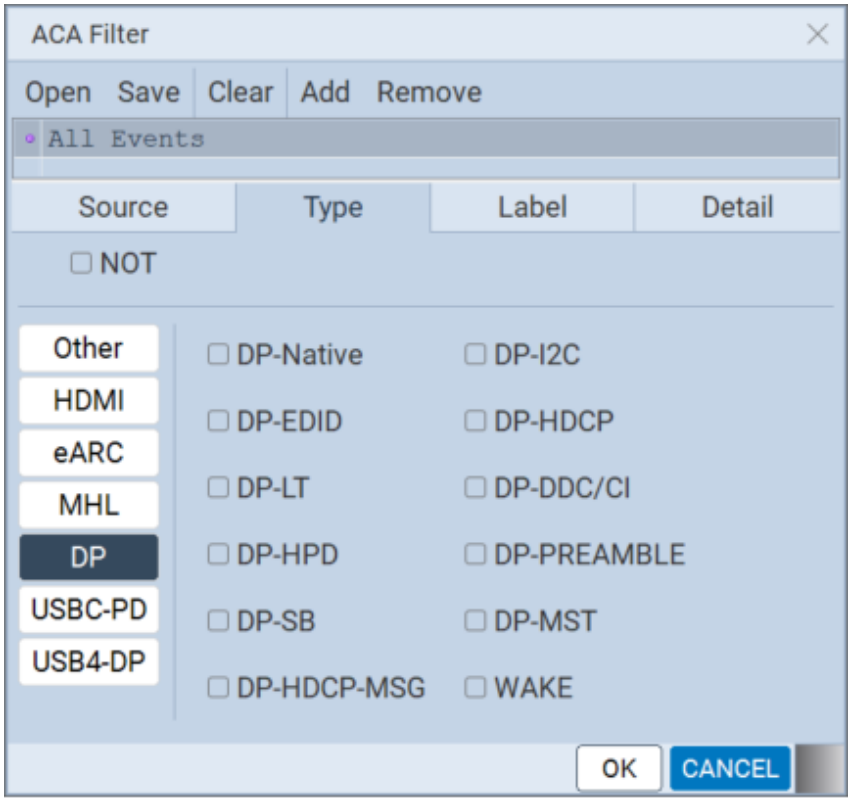
See **7.2 Monitoring Auxiliary Channels with ACA Utility** for instructions on saving an ACA Data set.

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.

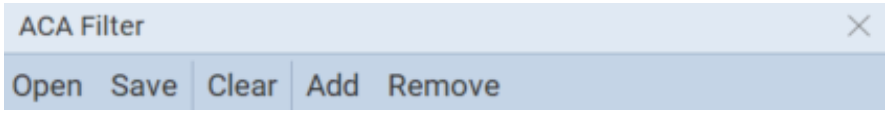


There are four tabs within the dialog box, as well as a control toolbar at the top. Each tab will be covered in detail within this subsection, along with examples.

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 at the top of the dialog box:

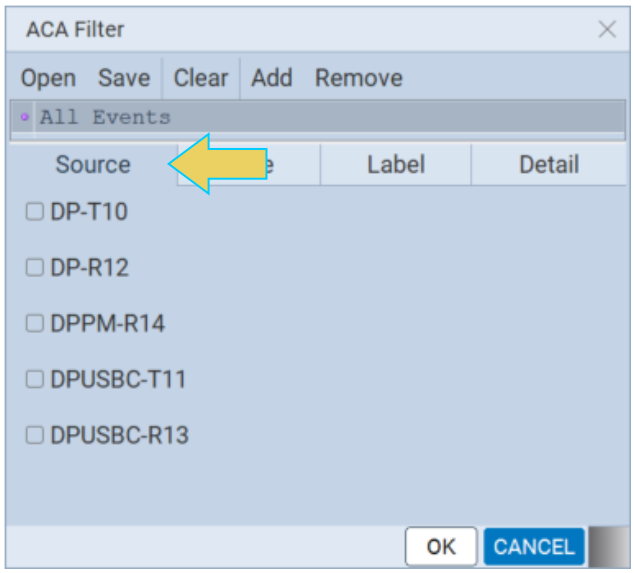
ACA Filter – Control Menu



Button	Function	Description
Open	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.
Save	Saves the current user-created Filter configuration.	
Clear	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. You enter criteria through the embedded touch screen with a pop-up keypad in the ACA real time utility or simply by typing on the external ATP GUI Manager interface. 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.
Add	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.	
Remove	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.



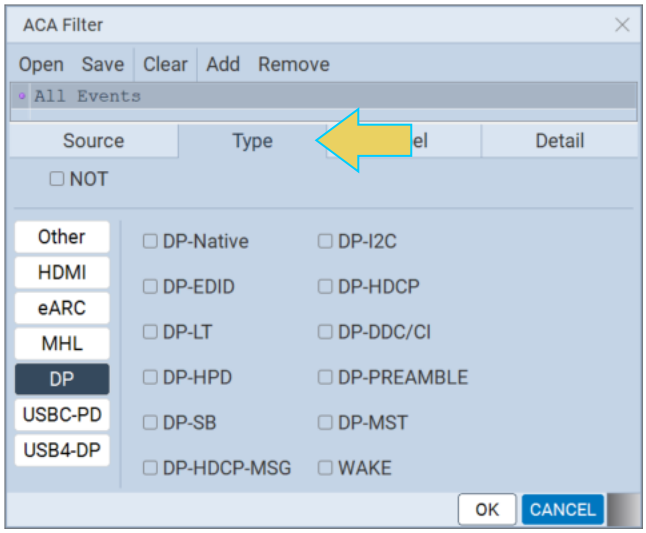
The **Source** tab features checkboxes to select the port on a particular module that you want to filter. Please note that you can collect data in the ACA Trace window from multiple ports.

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.

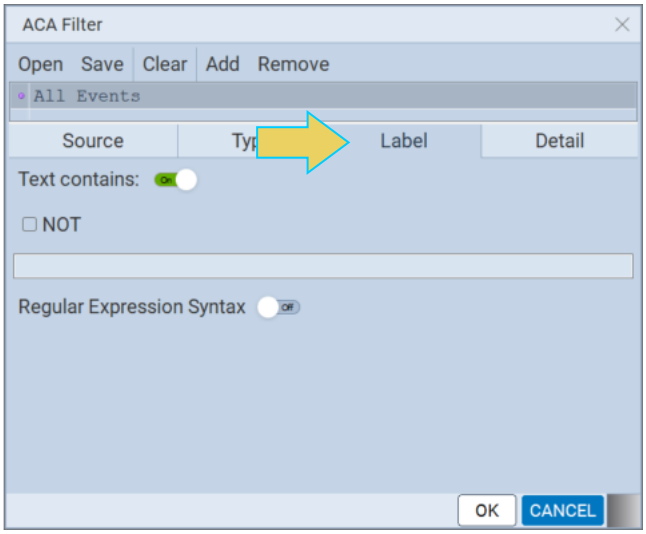
Filter by Type

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.



Filtering by Label

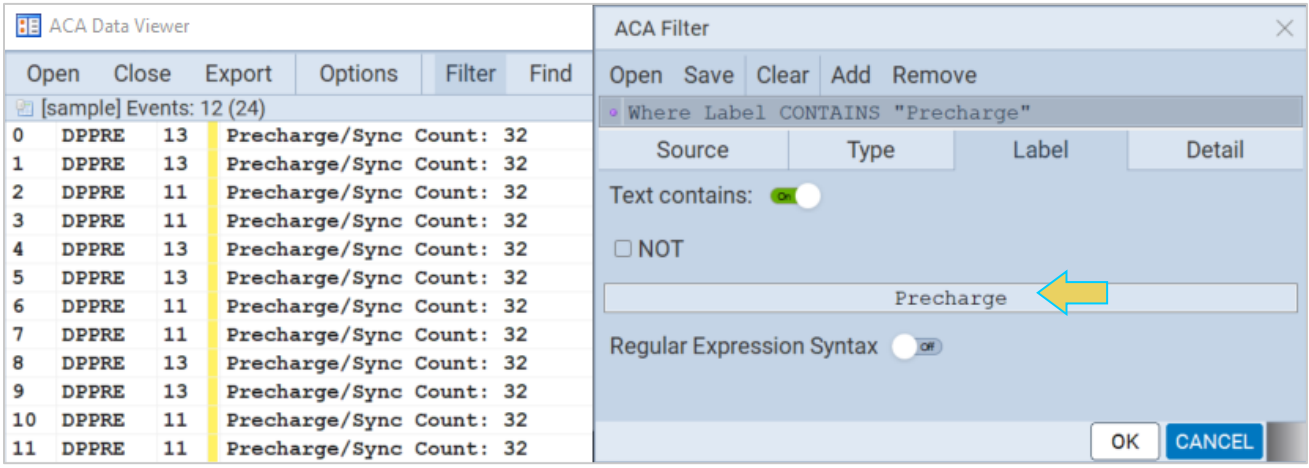
The following screenshot demonstrates the **Label** tab within the **ACA Filter** dialog box. A description is following the image.



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.

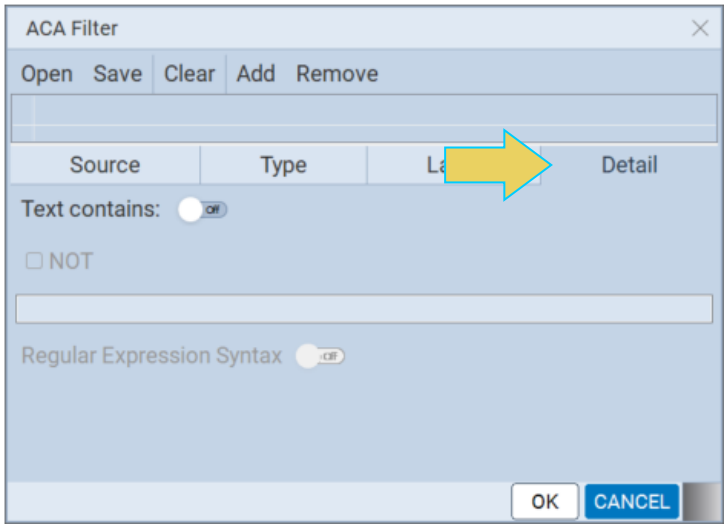
- Text Contains – A toggle to activate the Label criteria.
- NOT – A checkbox which when checked will filter for records that *do not* meet the criteria in the field beneath it.
- Text Field – A text field to enter a string that will be matched (or not matched). **NOTE:** This text field is case sensitive.
- Regular Expression Syntax – A 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 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.

The following example filters for an event with “Precharge” in its label (result on the left):



Filtering by Detail

The following screenshot demonstrates the **Detail** tab within the **ACA Filter** dialog box. A description is following the image.

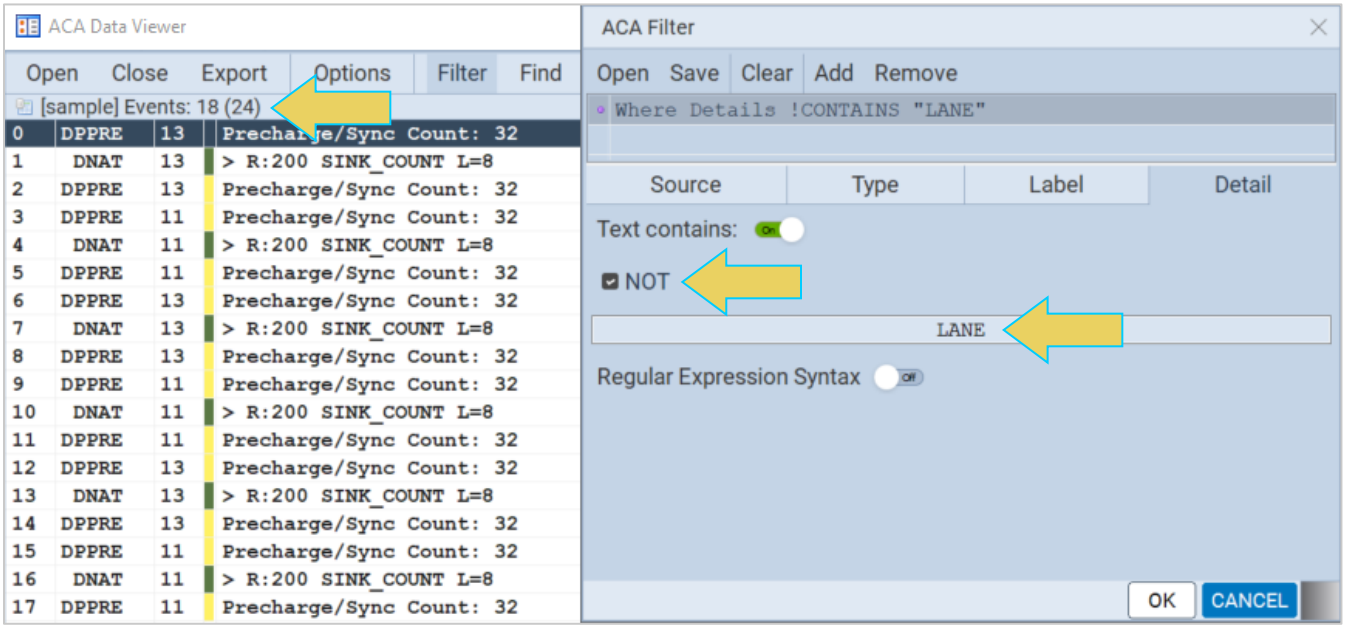


The **Detail** tab is used for specifying criteria for text that appears in the Details field of the event log. When you enter a criterion in the Detail field, it will automatically be added to the set of criteria in the panel above it.

The fields and functionality in this panel are the same as the **Label** tab (see above).

The following example filters for events that do **NOT** contain the word “LANE” (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 above the Trace Panel shows how many events are within the filter, followed by the total number of events in the unfiltered trace in parentheses.



Using the 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.

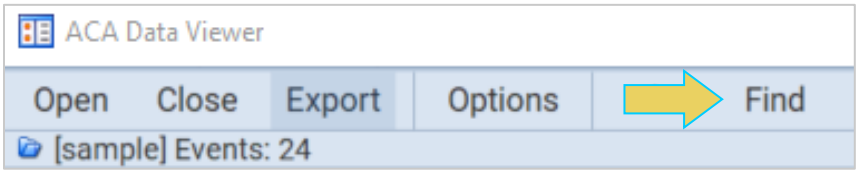
The ACA Filter feature is only available within the **ACA Data Viewer**. If you wish to use the Filter feature on ACA traces that you have captured using the **ACA Remote Control** (remote PC) or **Aux Channel Analyzer** (embedded GUI), you have to save the ACA data and reload it through the **ACA Data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

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

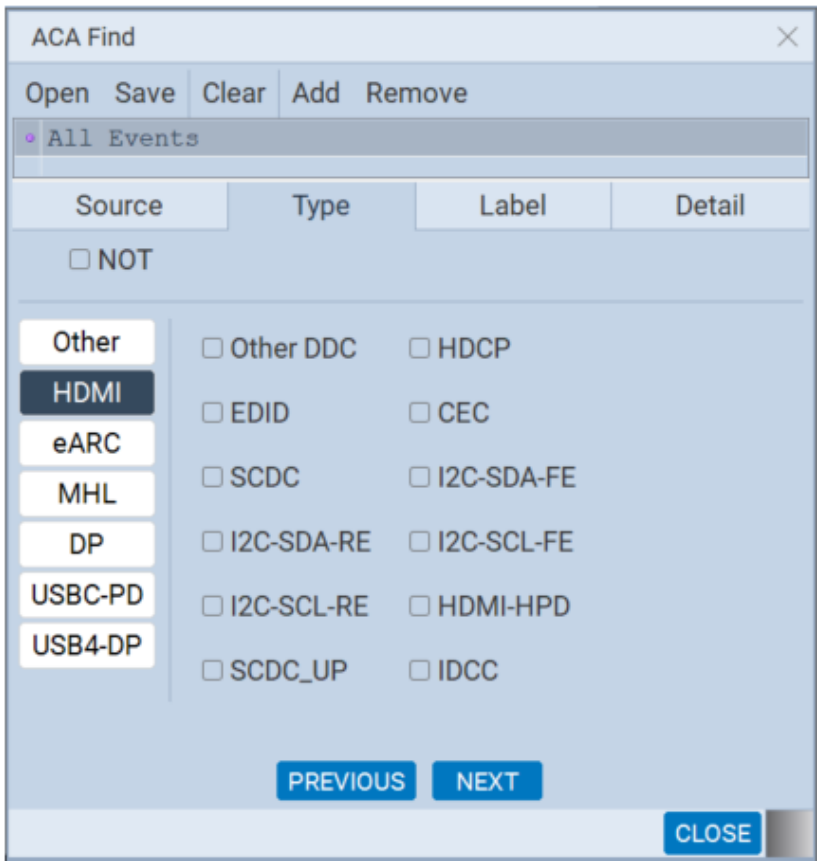
A screenshot of the **ACA Find** dialog box is below. Note that the Find dialog box is similar in appearance to the Filter dialog box.

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.

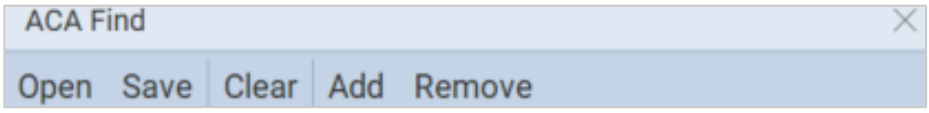


There are four tabs within the Find dialog box, as well as a control toolbar at the top. Each tab will be covered in detail within this subsection, along with examples.

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

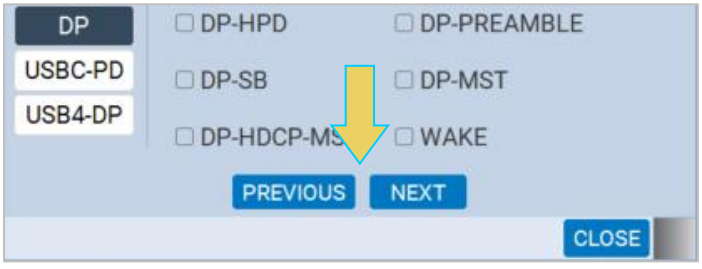
The following table gives an overview of the Control Menu at the top of the dialog box:

ACA Filter – Control Menu



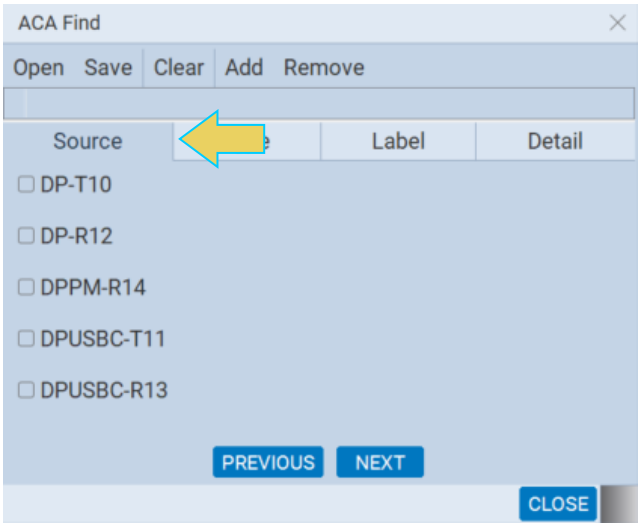
Button	Function	Description
Open	Opens a stored user-created Find configuration.	You can store commonly used find configurations using the Save function and recall them for quick access using the Open button.
Save	Saves the current user-created Find configuration.	
Clear	Clear the existing Find criteria.	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 search will find an entry. You enter criteria through the embedded touch screen with a pop-up keypad in the ACA real time utility or simply by typing on the external ATP GUI Manager interface. 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.
Add	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.	
Remove	Removes a highlighted find criterion of an existing find configuration.	

The bottom of the dialog box features a **PREVIOUS** and **NEXT** button. 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.



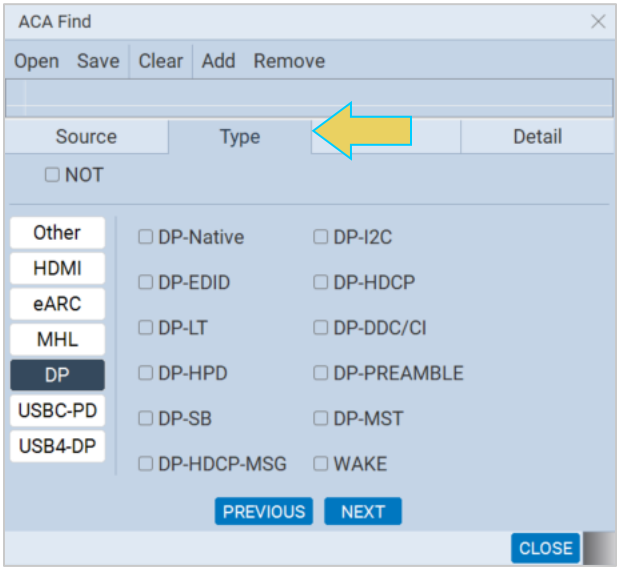
The **Source** tab features checkboxes to select the port on a particular module that you want to find. Please note that you can collect data in the ACA Trace window from multiple ports.

When you select multiple Source ports they behave as a logical OR function.

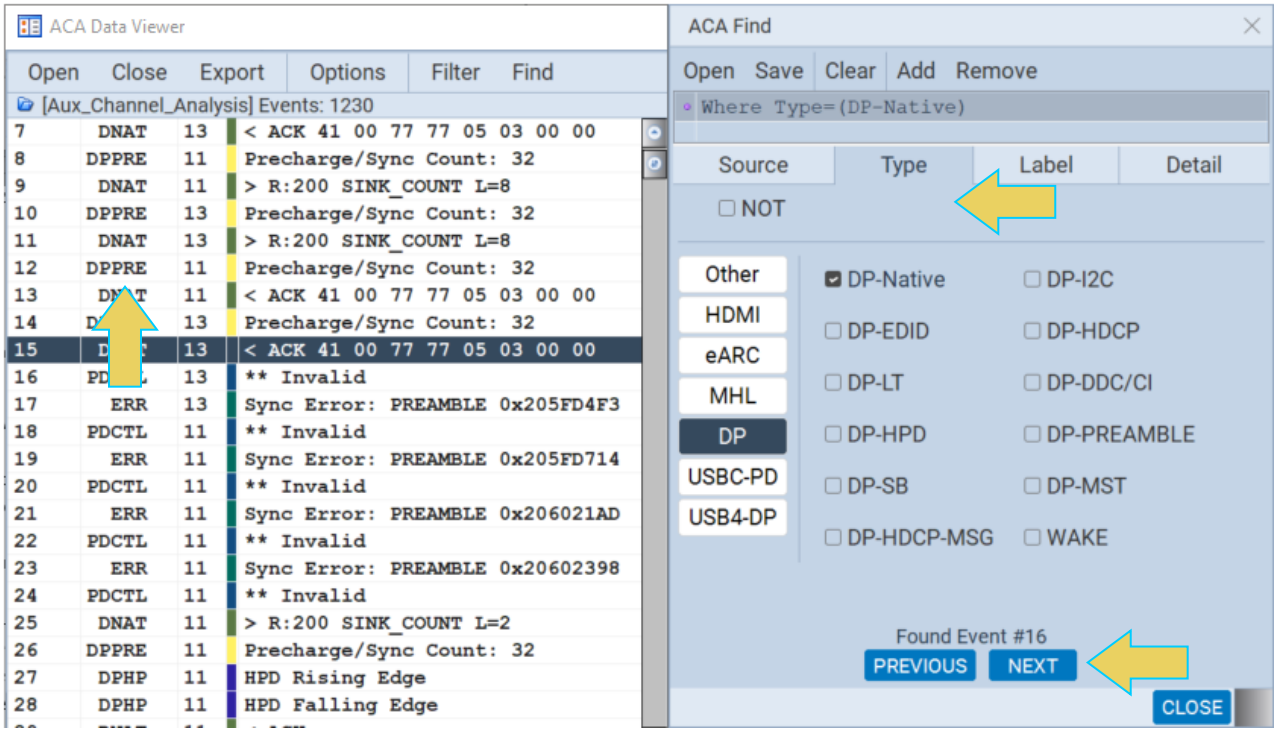
When you initiate a search, by clicking on the Next or Previous button, the Find function will locate a record matching the criteria. If only the Source (port) is specified, the next or previous record from or to that source will be highlighted.

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.



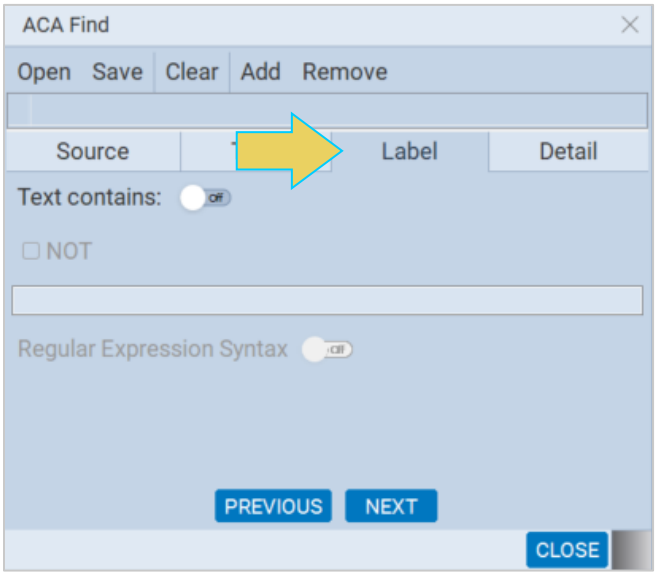
The following example demonstrates a search for all events of type DP-Native. The result of clicking **NEXT** once DP-Native has been checked appears on the left-hand side within the ACA Trace Panel.



Clicking **NEXT** again would take the Trace Panel to the next DNAT data type on line 25.

Finding by Label

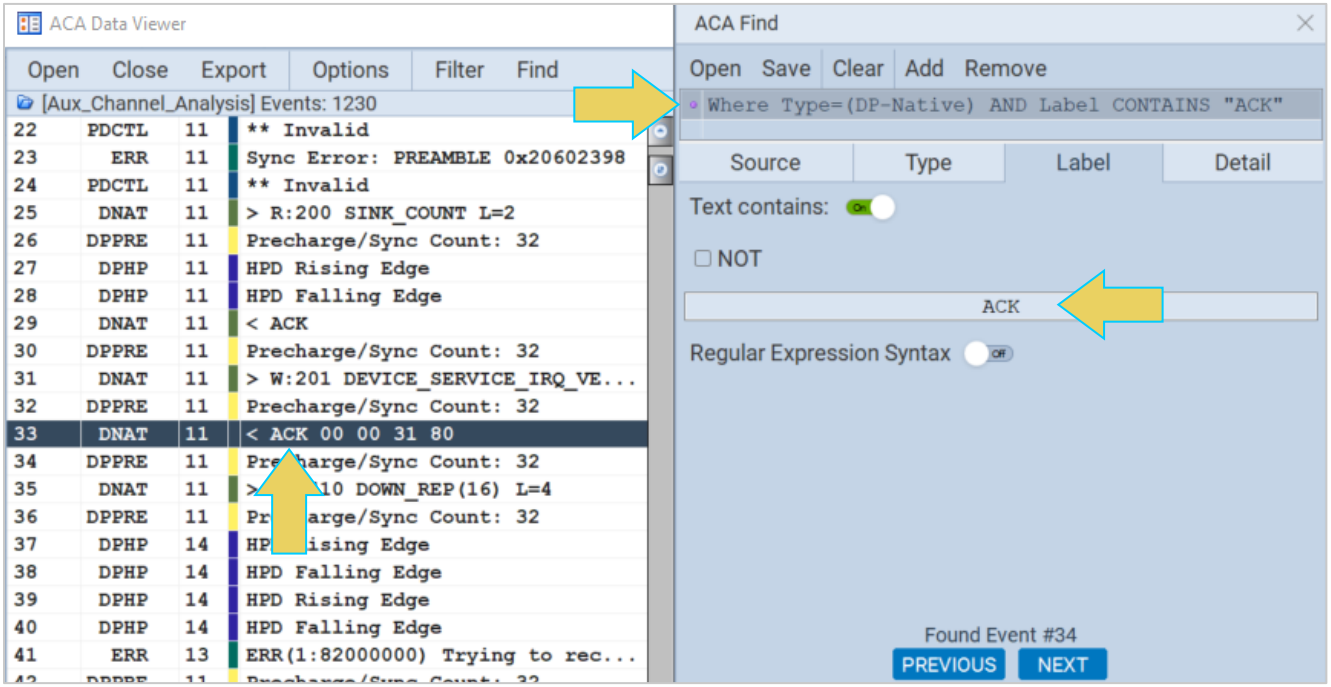
The following screenshot demonstrates the **Label** tab within the **ACA Find** dialog box. A description is following the image.



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.

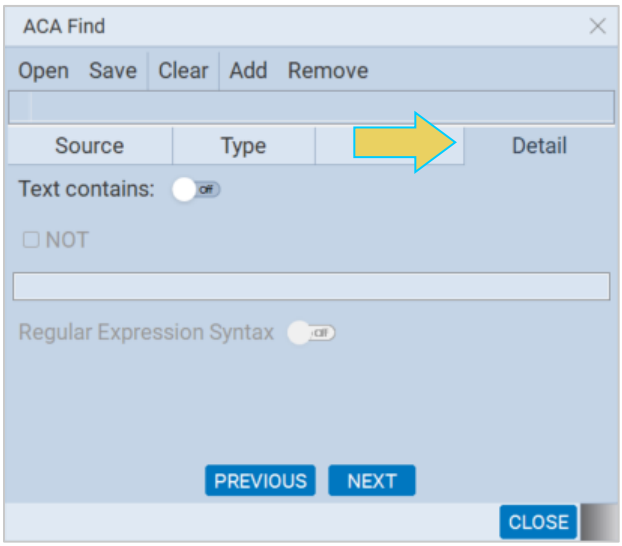
- Text Contains – A toggle to activate the Label criteria.
- NOT – A checkbox which when checked will find records that *do not* meet the criteria in the field beneath it.
- Text Field – A text field to enter a string that will be matched (or not matched). **NOTE:** This text field is case sensitive.
- 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 retains the previous criterion (type DP-Native), but searches for a label with text containing “ACK.” Note the top right panel which lists all criteria for the search.



Finding by Detail

The following screenshot demonstrates the **Detail** tab within the **ACA Find** dialog box. A description is following the image.

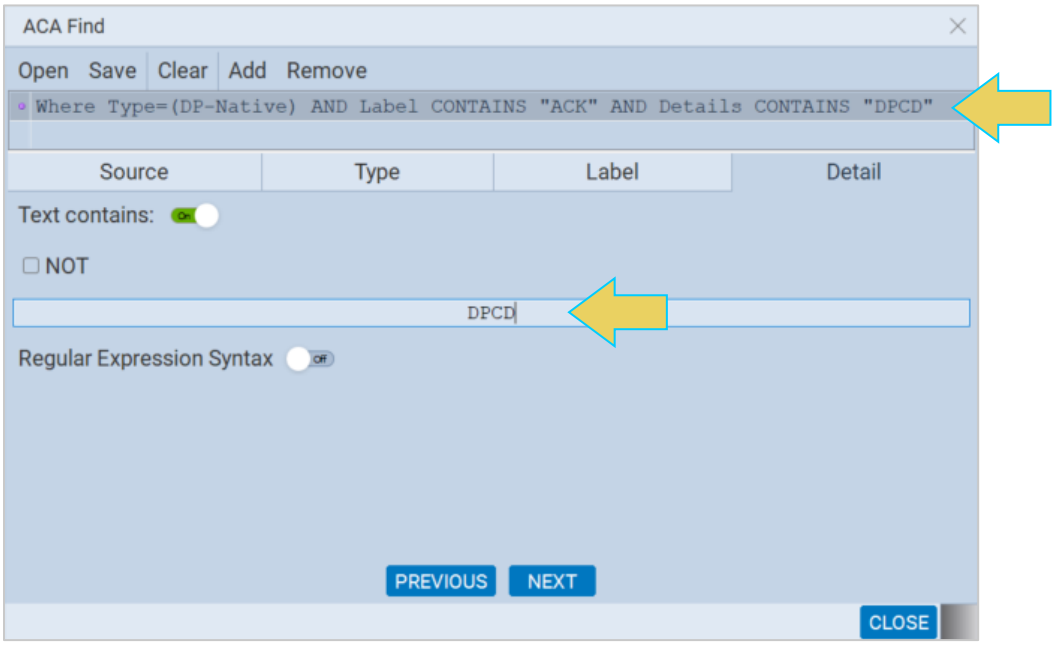


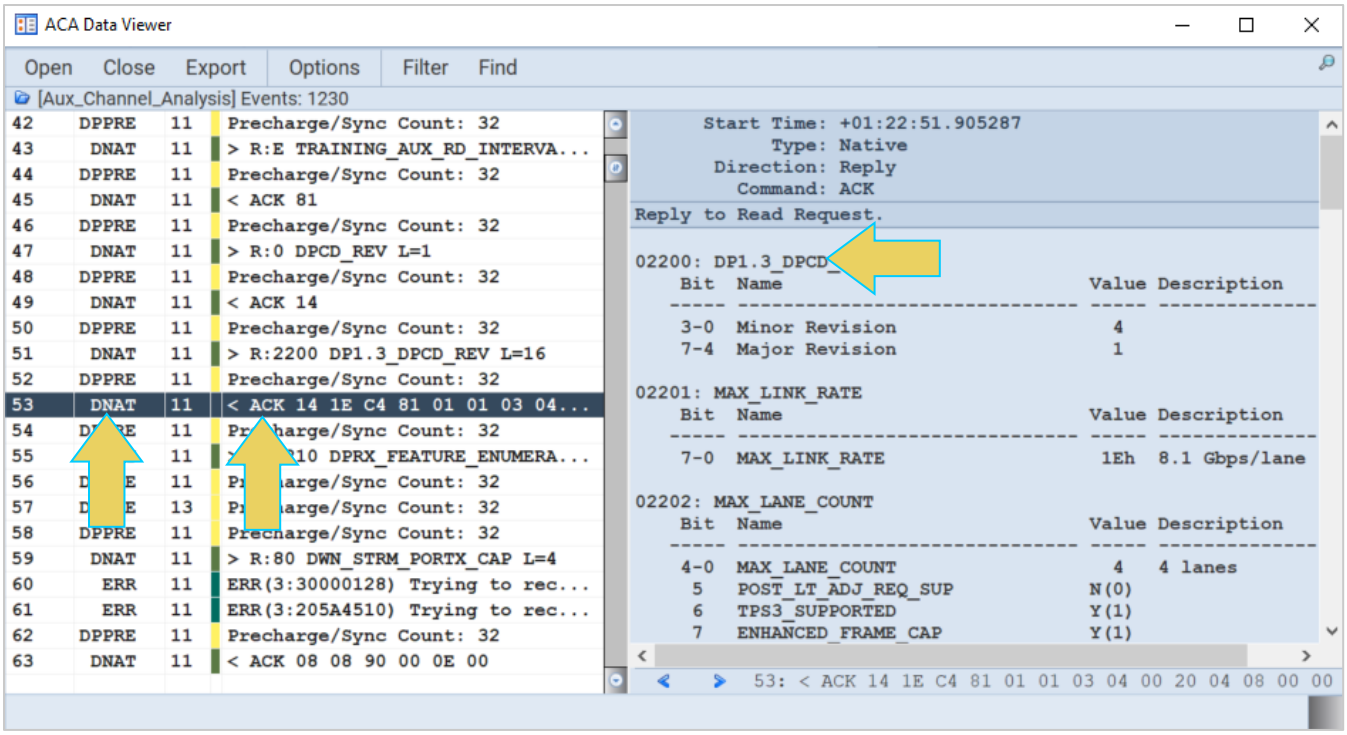
The **Detail** tab is used for specifying criteria for text that appears in the Details field of the event log. When you enter a criterion in the Detail field, it will automatically be added to the set of criteria in the panel above it.

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 top right panel which lists all the criteria for the search.




ACA Data Viewer
Open
Close
Export
Options
Filter
Find
[Aux_Channel_Analysis] Events: 1230
42 DPPRE 11 Precharge/Sync Count: 32
43 DNAT 11 > R:E TRAINING_AUX_RD_INTERVA...
44 DPPRE 11 Precharge/Sync Count: 32
45 DNAT 11 < ACK 81
46 DPPRE 11 Precharge/Sync Count: 32
47 DNAT 11 > R:0 DPCD_REV L=1
48 DPPRE 11 Precharge/Sync Count: 32
49 DNAT 11 < ACK 14
50 DPPRE 11 Precharge/Sync Count: 32
51 DNAT 11 > R:2200 DP1.3_DPCD_REV L=16
52 DPPRE 11 Precharge/Sync Count: 32
53 DNAT 11 < ACK 14 1E C4 81 01 01 03 04...
59 DNAT 11 > R:80 DWN_STRM_PORTX_CAP L=4
60 ERR 11 ERR(3:30000128) Trying to rec...
61 ERR 11 ERR(3:205A4510) Trying to rec...
62 DPPRE 11 Precharge/Sync Count: 32
63 DNAT 11 < ACK 08 08 90 00 0E 00
Start Time: +01:22:51.905287
Type: Native
Direction: Reply
Command: ACK
Reply to Read Request.
02200: DP1.3_DPCD
Bit Name Value Description
3-0 Minor Revision 4
7-4 Major Revision 1
02201: MAX_LINK_RATE
Bit Name Value Description
7-0 MAX_LINK_RATE 1Eh 8.1 Gbps/lane
02202: 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)
53: < ACK 14 1E C4 81 01 01 03 04 00 20 04 08 00 00

6.5 Importing, Exporting, and Transferring ACA Data

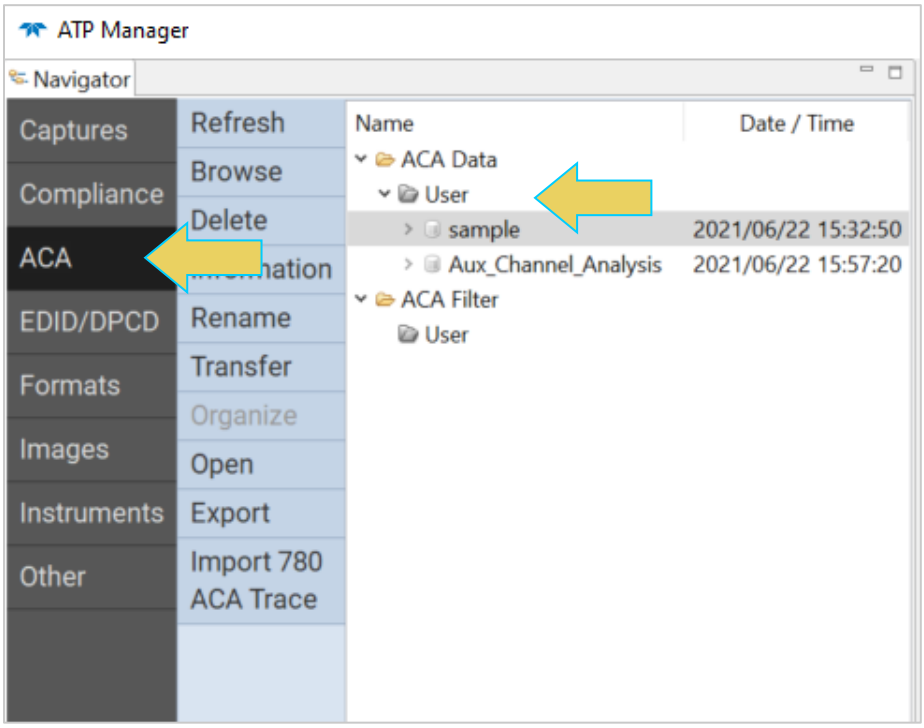
This subsection will describe the following processes in detail:

- **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 set from an M42d instrument to a remote host PC or vice versa.

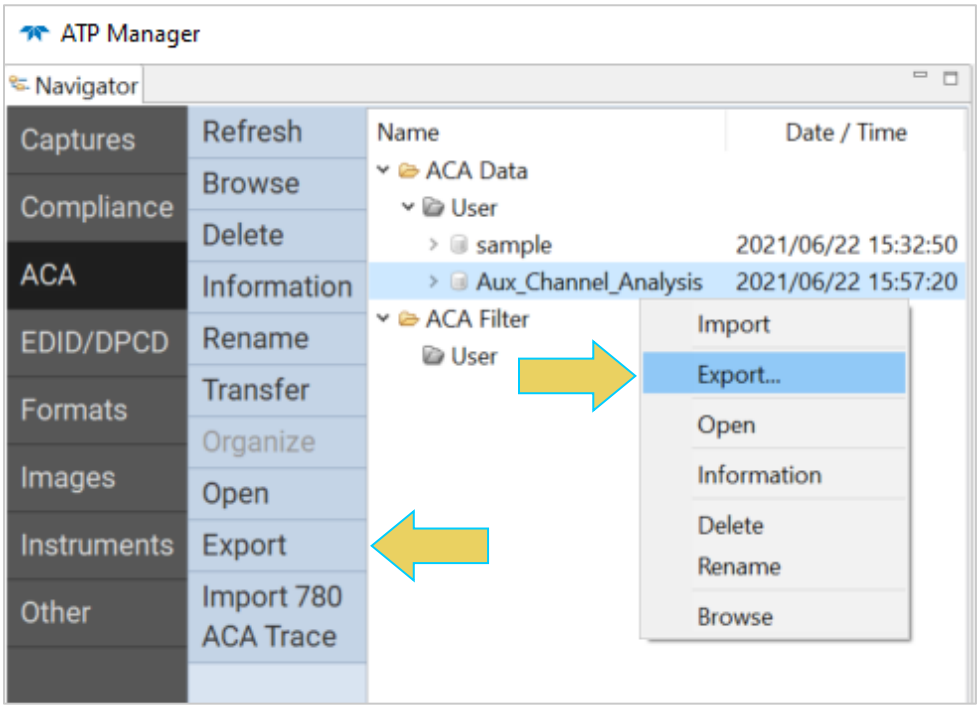
All of these features are accessible through the **Navigator** interface either on the instrument itself or through the remote ATP Manager.

Exporting an ACA Data File

To export an ACA data file, navigate to its folder in the ATP Manager Navigator interface by clicking **ACA** and expanding the folder(s) that it is contained in. An example below shows ACA data files stored in the **User** folder on a PC running the remote ATP Manager

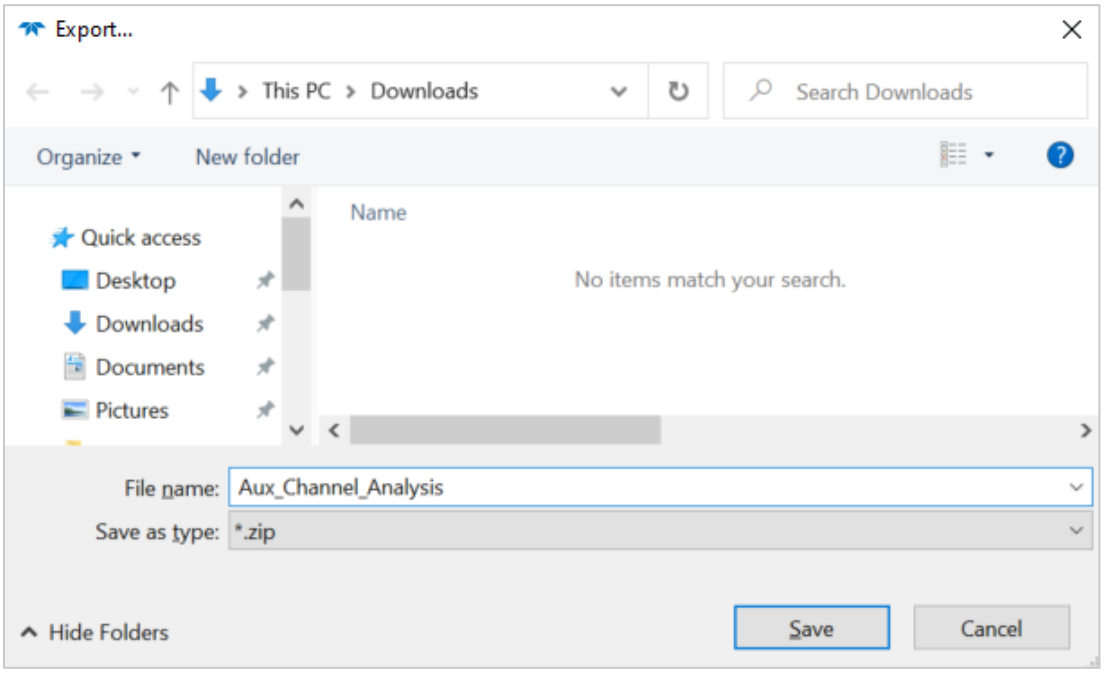


Click on an ACA data file, and export by selecting the **Export** button on the left sidebar, or right-clicking and selecting **Export.** Both shown below.

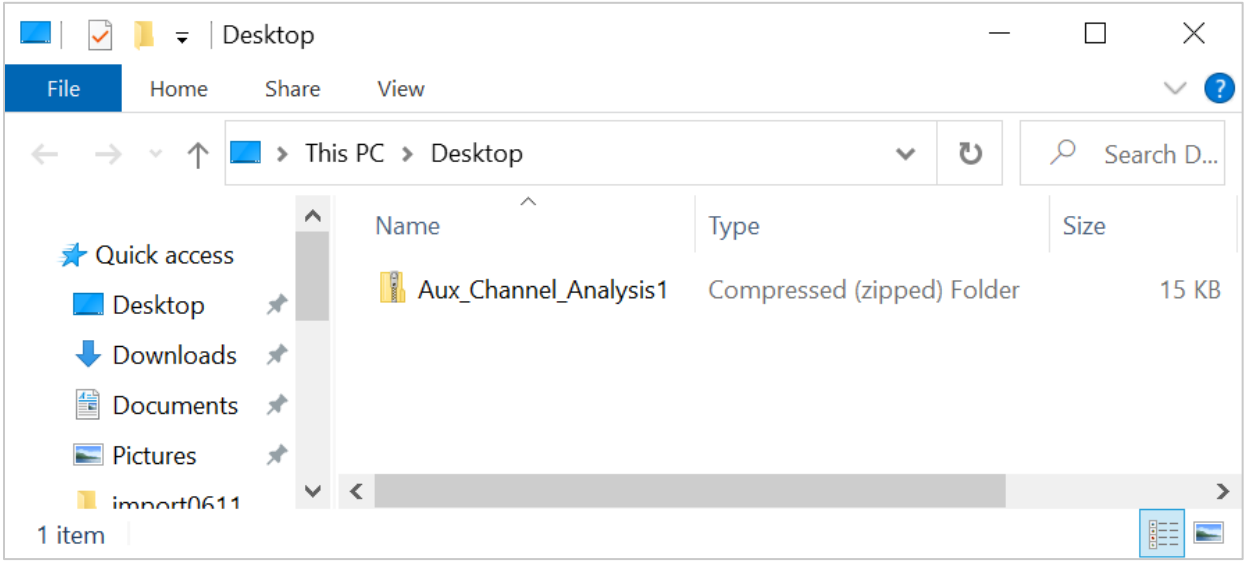


When you select **Export**, a File Explorer window will show up enabling you to save the capture as a zip file in a directory and name of your choosing. Refer to the screen example below.

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

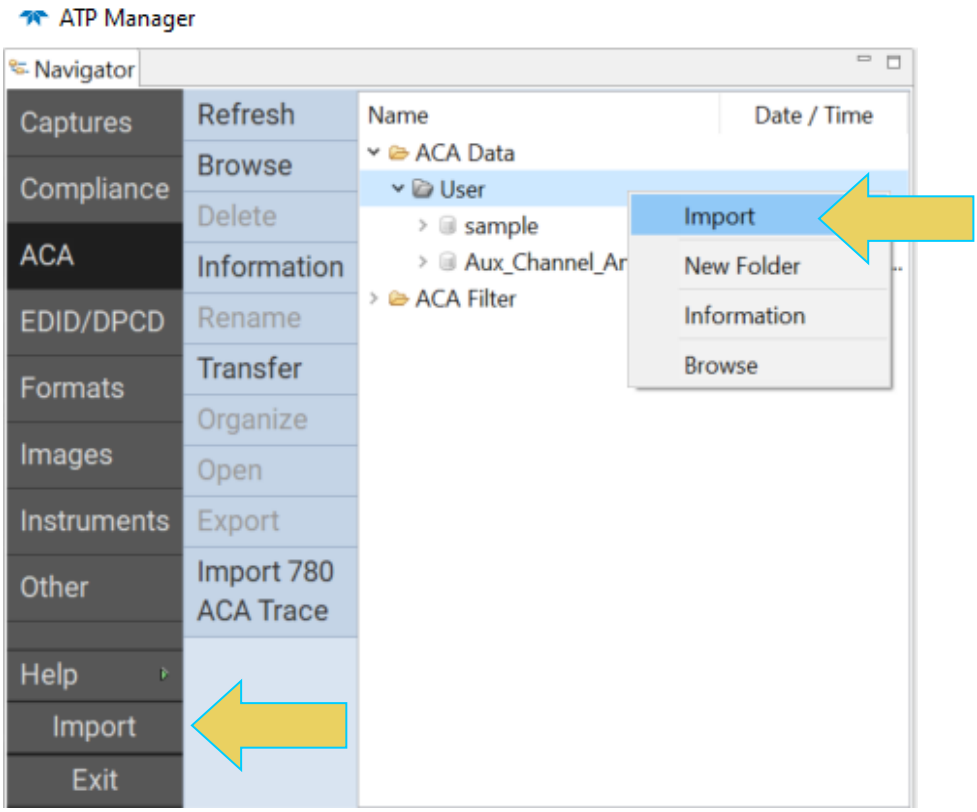


Choose a desired directory and filename, and click **Save**. This capture file will then be accessible in a file explorer as a compressed zip file, as shown below.

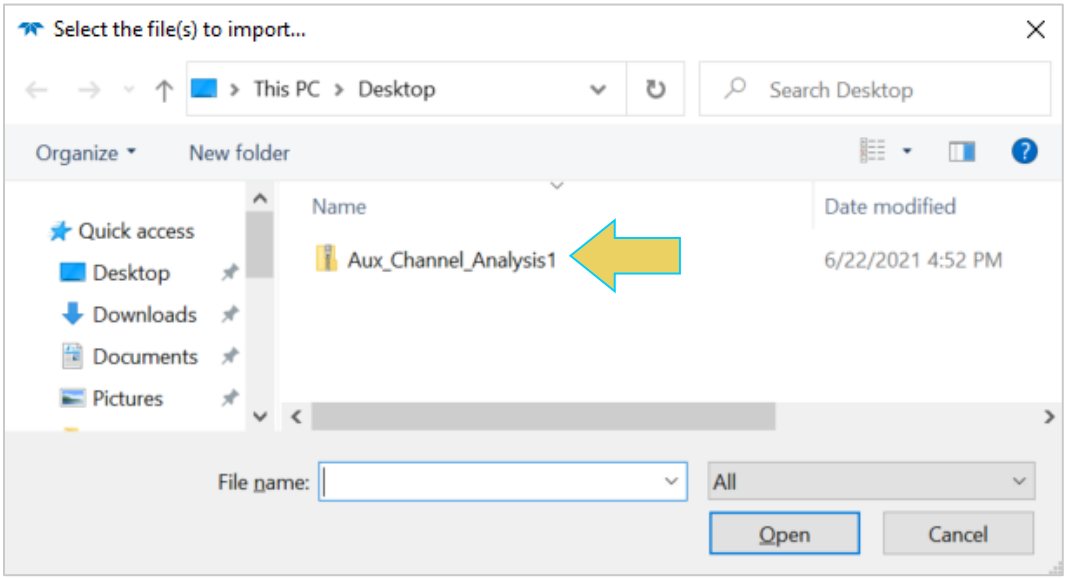


Importing a Capture File

Similarly, to import a file, in the Navigator either right click on the desired target folder, or select the folder and click the **Import** button at the bottom left of the window. The example below demonstrates importing an ACA Data file into the **User** folder.

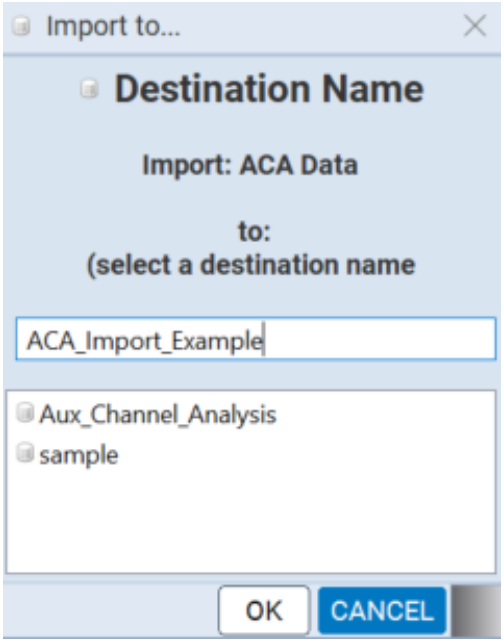


A File Explorer window will appear enabling you to navigate to the directory where you have stored your zipped capture file. This can be a local file on the PC/Instrument itself or a USB storage drive. Select the file and click **Open** as shown below.



A dialog box will appear, instructing you to choose a destination name. The contents of the zipped folder will be unzipped to a new folder with this name. This is the same as naming an ACA Trace file when saving in the ACA Remote Control (PC) or Aux Channel Analyzer Utility (M42d)

Choose the default, or type in a destination name for the ACA Data, then click **OK**.



The ACA Data file folder will now appear in the folder that you imported into.

Transferring and ACA Data File Between Instrument and Remote PC.

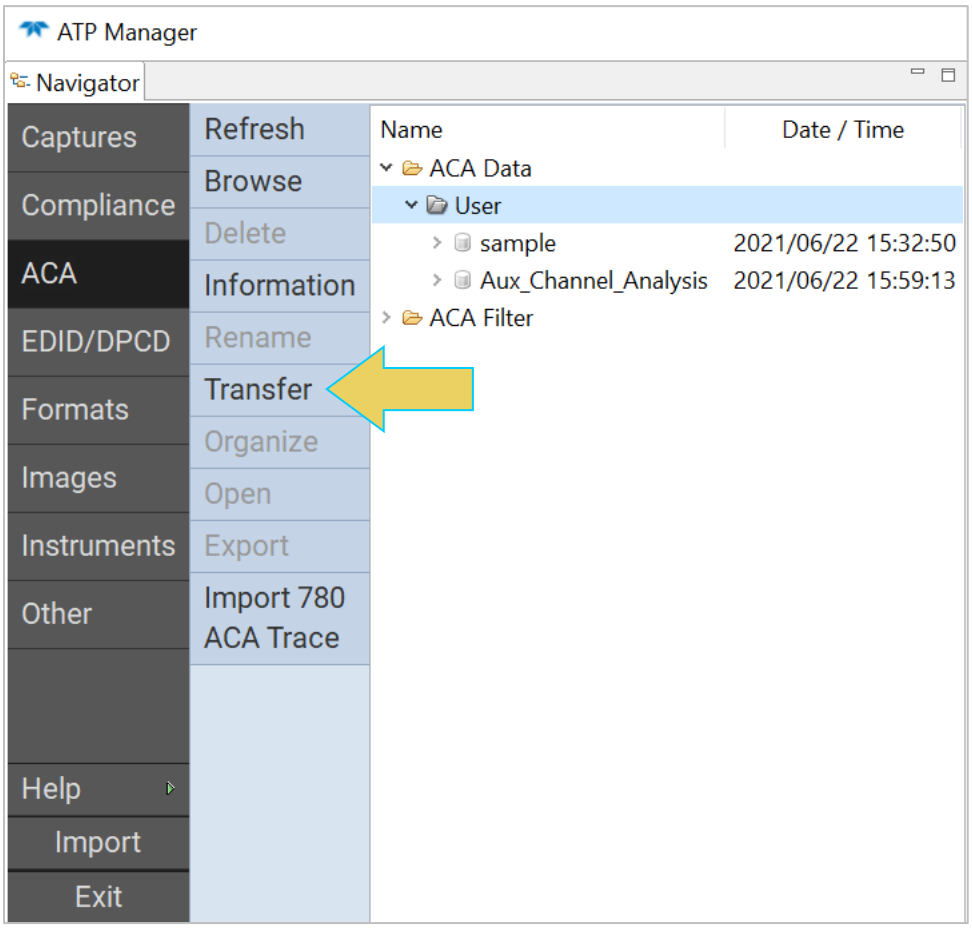
You can view ACA traces using the ACA viewer off-line on your PC with the **ACA Data Viewer** utility. In order to view the ACA files on your PC with the ATP GUI Manager application you will first have to transfer them to the PC using the **Data Transfer** utility.

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 M41d test instrument once you have transferred the files to your PC.

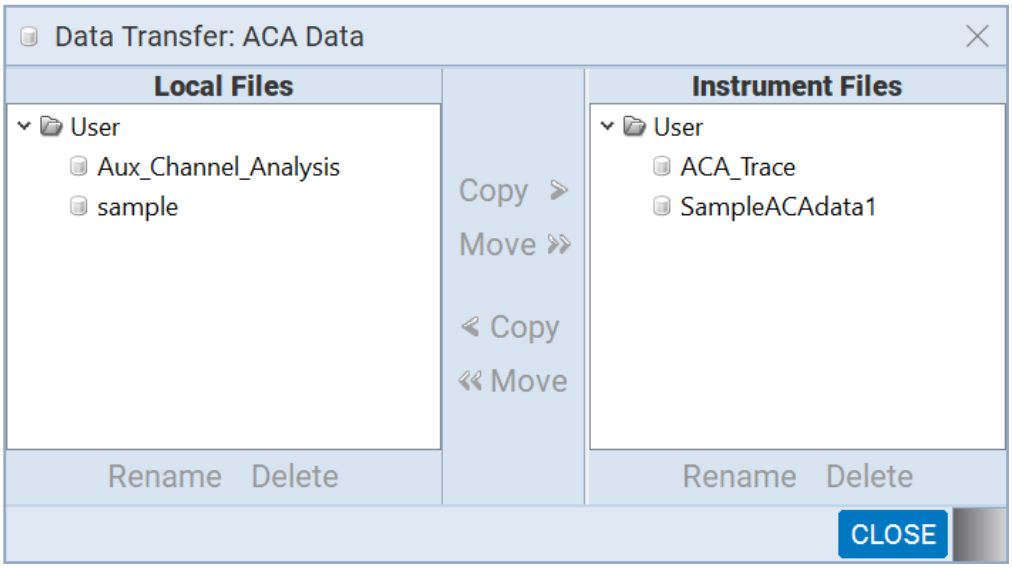
Note: Transferring files must be done on a host PC that is connected remotely to an M42d instrument.

Transferring ACA Data Files

To Transfer a file, use the Navigator interface to select the folder on the remote PC that you wish to transfer to/from. Click the **Transfer** button on the left sidebar. An example below shows a Transfer with the **User** folder selected.

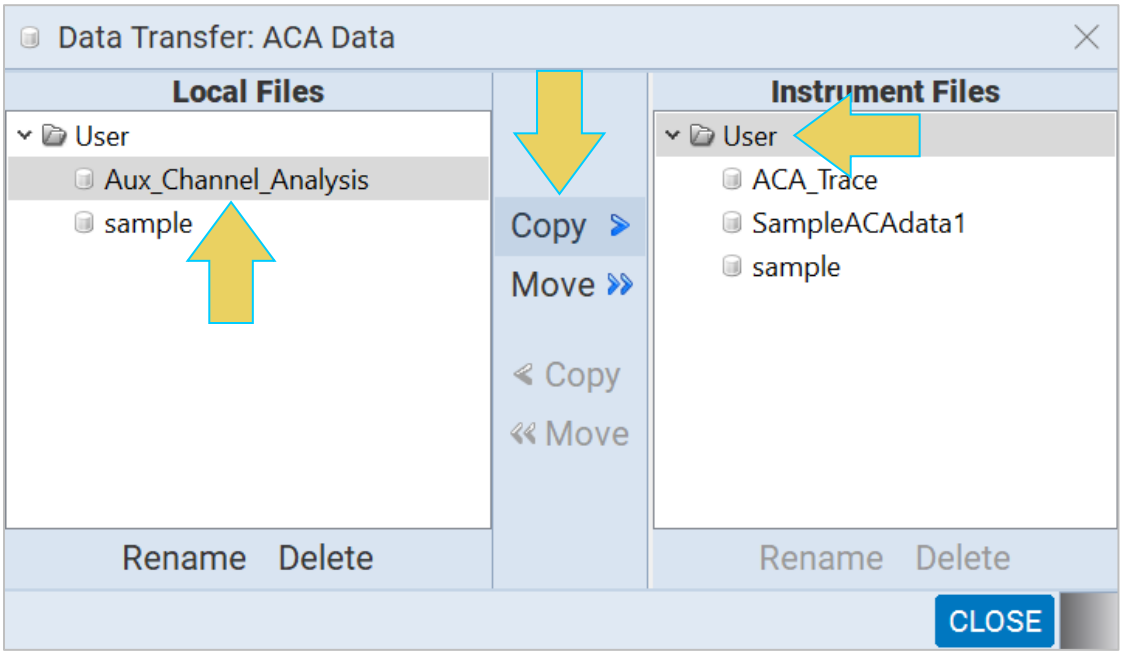


The **Data Transfer: ACA Data** dialog box will appear, as shown below.



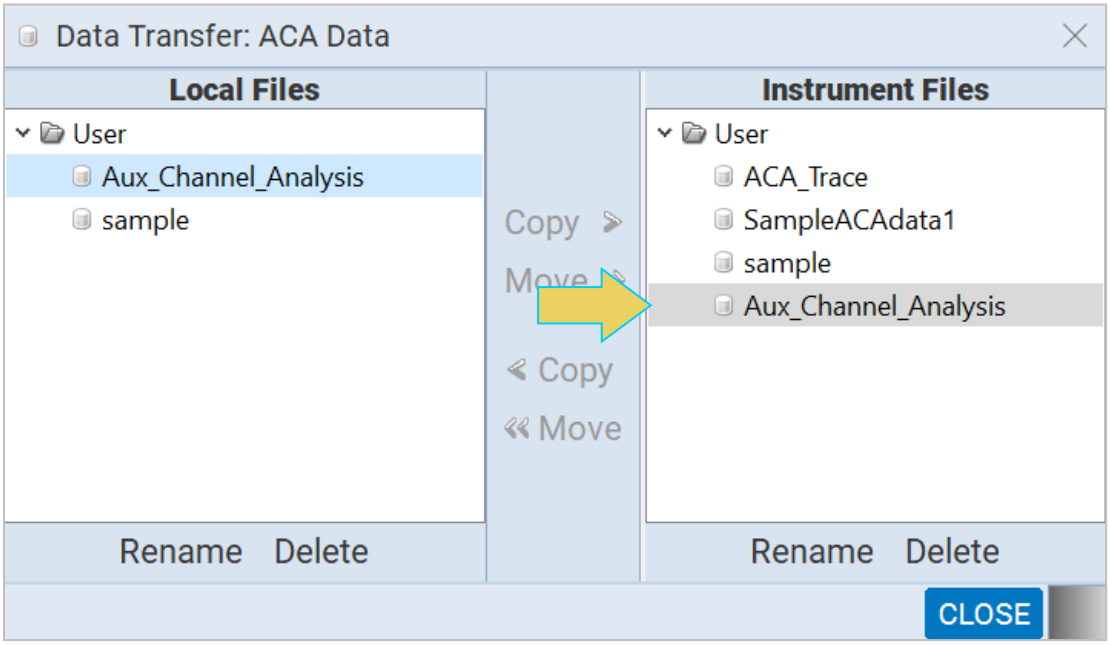
To transfer a capture file from the PC to the Instrument, select the file in the left-hand column labeled **Local Files.** Next, click on a target folder in the righthand column labeled **Instrument Files.** At this point you may either **Copy** the file to the instrument or **Move** it—which removes the file from the local storage on the PC.

The example below shows **copying** the file Aux_Channel_Analysis from the PC onto the Instrument's **User** folder.

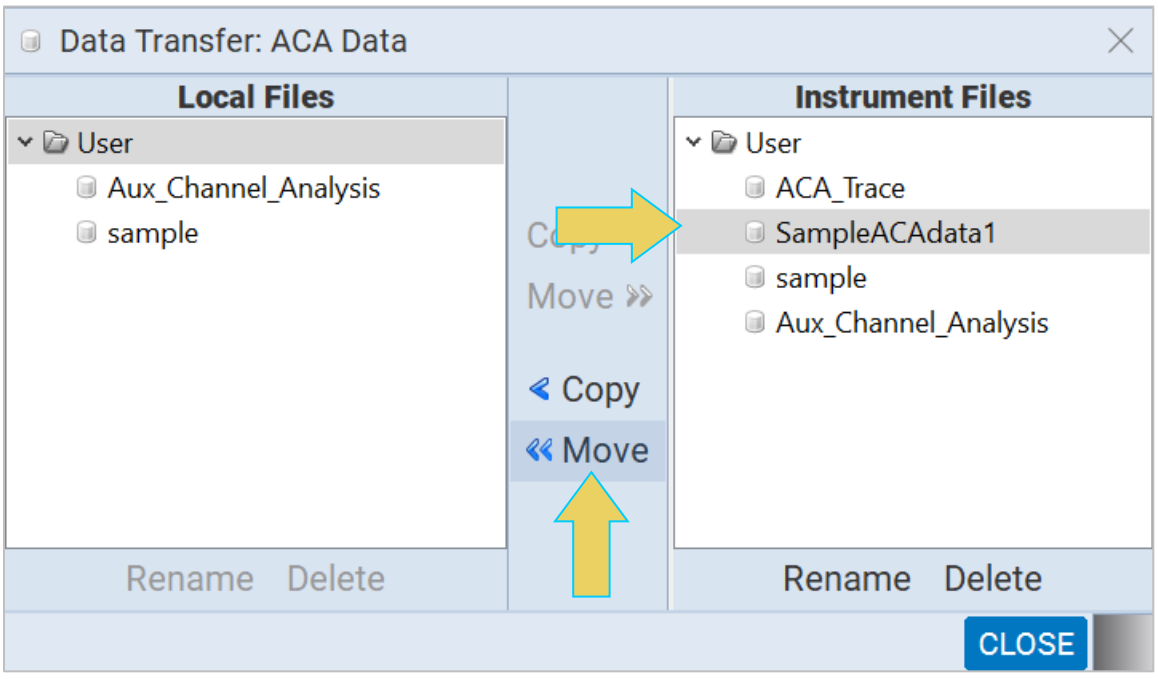


The result is the Aux_Channel_Analysis file now appearing in the **Instrument Files** column as well, as shown below.

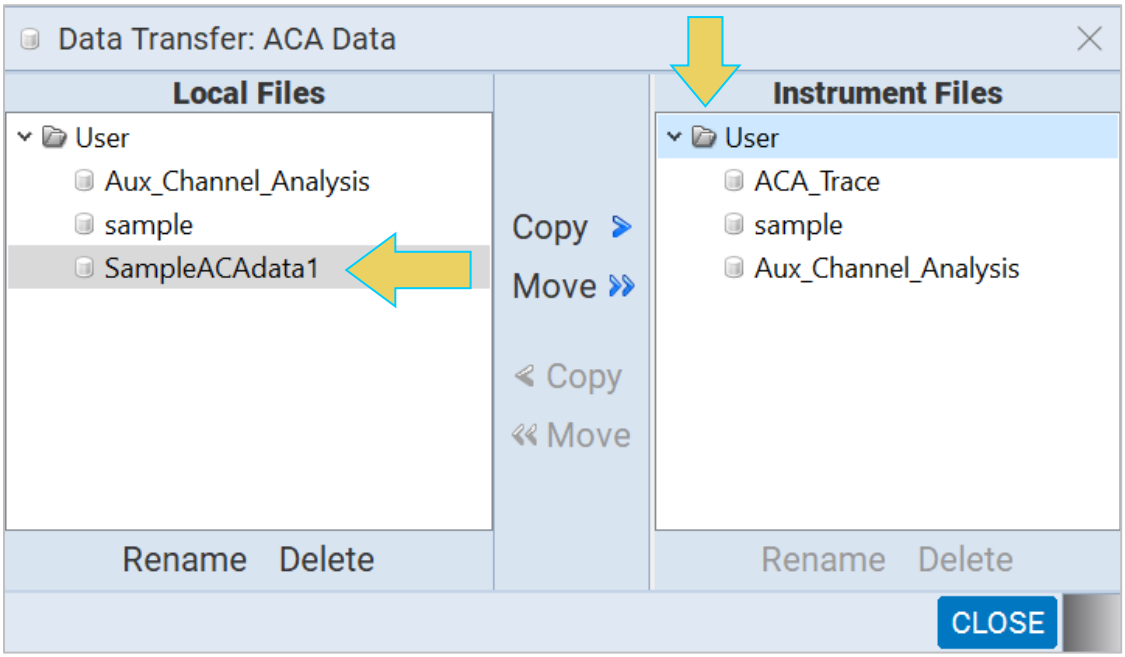
Note: If the **Move>>** transfer option is utilized, the file will not appear in both directories, only the target folder on the instrument, as mentioned earlier, and shown in the next example.



To transfer a file from the Instrument to the Local Host, 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 the file SampleACAdata1 being **moved** from the Instrument to the PC's user folder.



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

7 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.

7.1 Connecting a DisplayPort Source and Sink Device Under Test

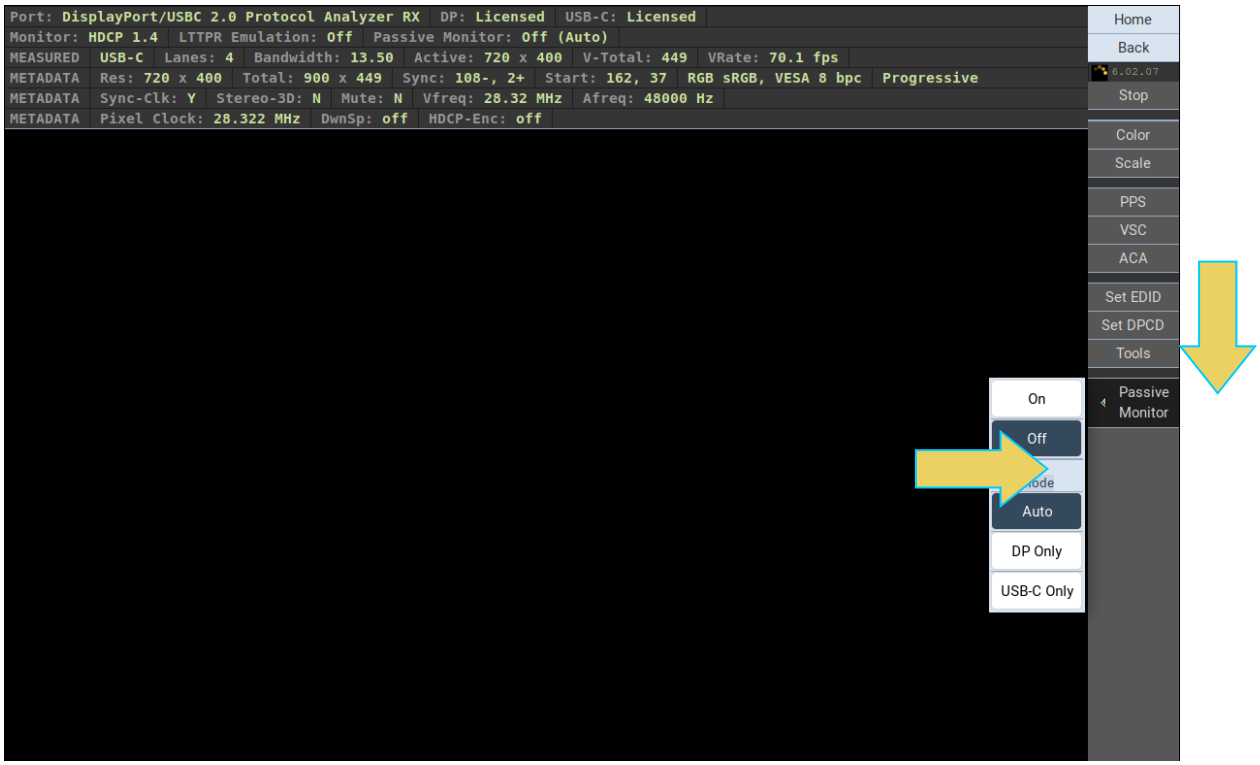
This procedure describes how to connect a source and a sink device to the M42d for Passive Monitoring. Connections can be made to the M42d via native high quality 8K DP cables (one meter or less) or the USB-C cables provided.

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:

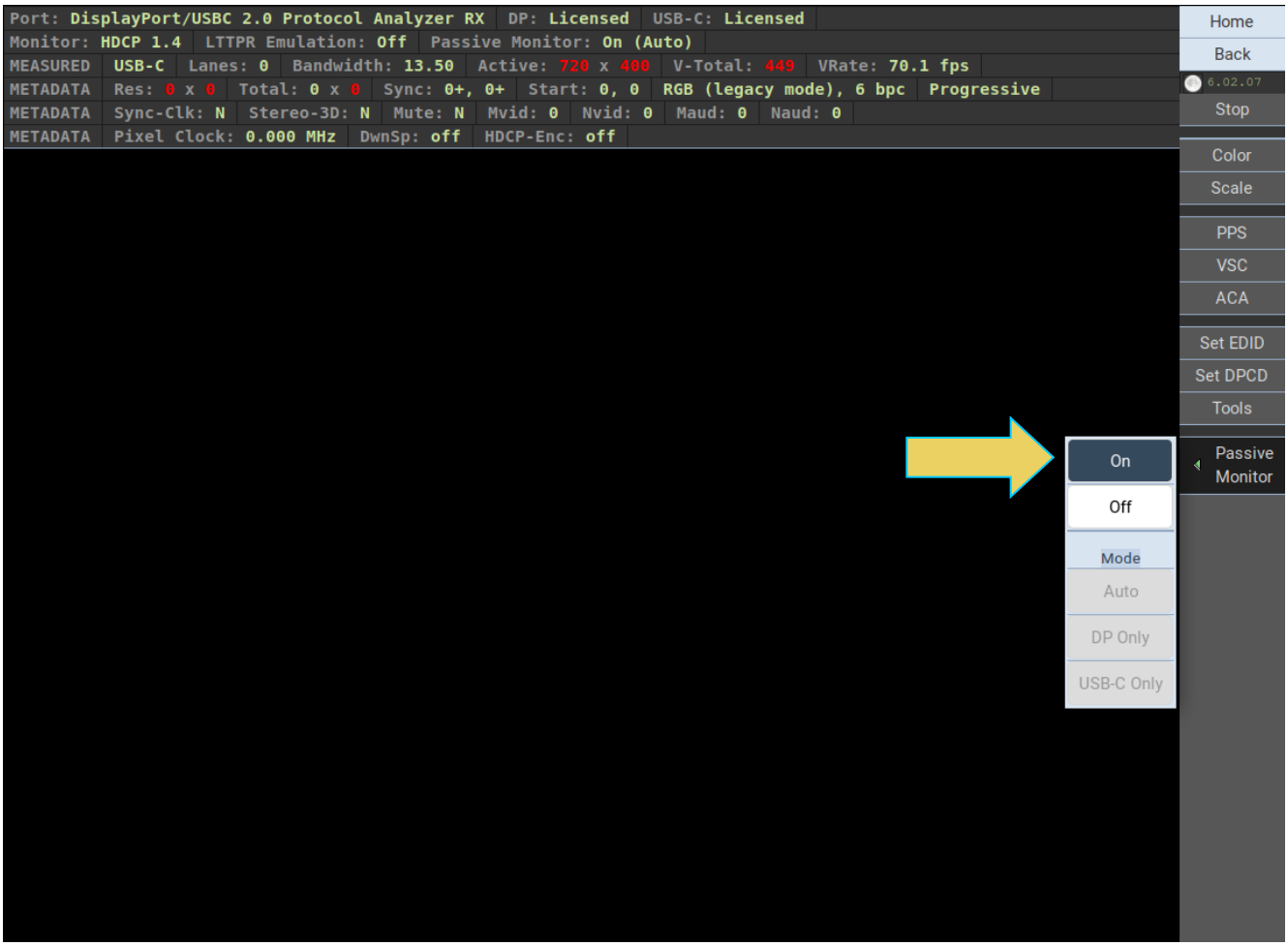
1. Open the “Real Time” Receiver (Basic Analyzer) window of the embedded ATP (running on the externally connected display connected to the HDMI admin port in back).
2. Click on the Passive Monitoring button and ensure it is **Off**.
   Note: You *cannot* do this step from the External ATP Manager running on a 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, make sure 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. Once you have verified that the status LED’s on the ports are **Green** (Note this LED does not indicate the orientation during Passive Probing)

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.

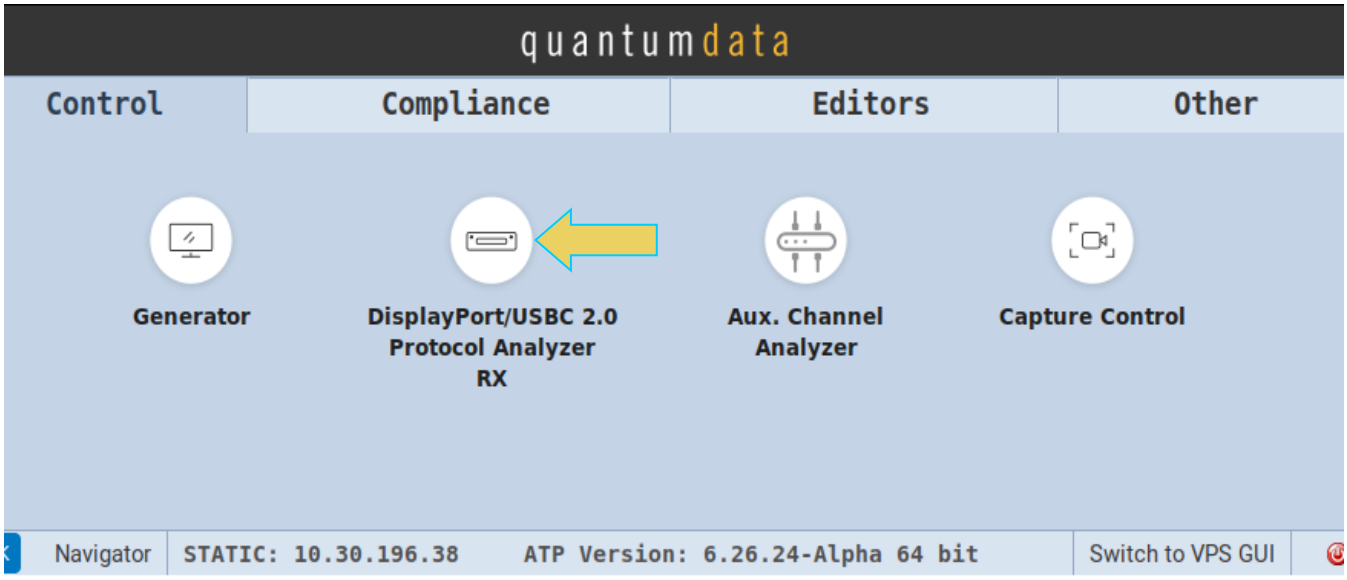
7.2 Passively Viewing Video Data in Real Time

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.

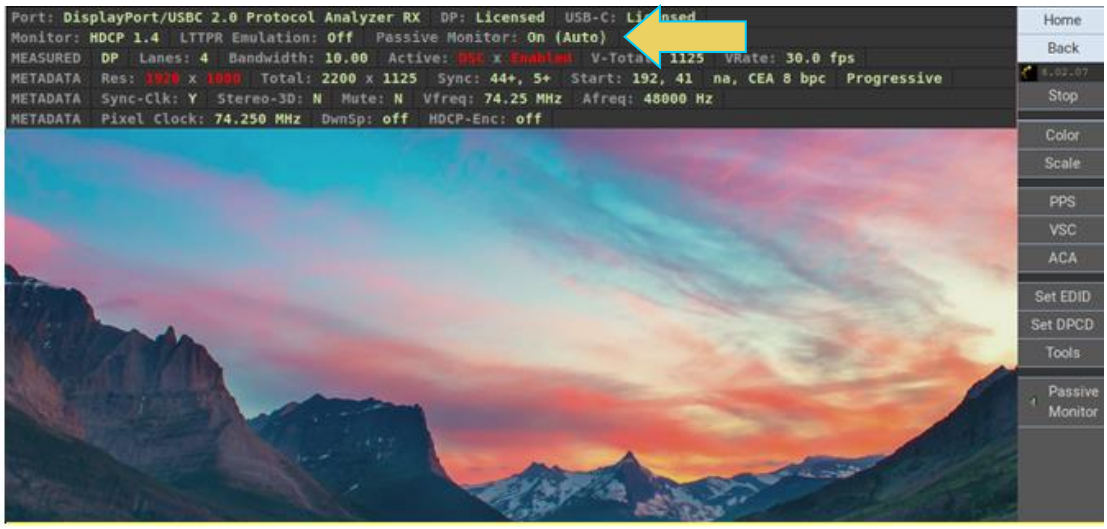
Passive Monitoring using the Rx Analyzer real-time viewer is similar to the procedures outlined in **Chapter 4 Source Verification with Basic (Real-time) Analyzer**. Refer to that chapter if necessary for more in-depth coverage of this process.

Accessing Basic Analyzer Features

From the Home screen of the M42d ATP Manager, select the **DisplayPort/USBC 2.0 Protocol Analyzer Rx** app, as shown below.



The Analyzer panel appears showing the passed-through video image. The M42d's Basic Analyzer provides periodic video frame captures of the source video, enabling you to view frames of video. This feature provides a basic confidence test to verify that the passed-through video is essentially correct.

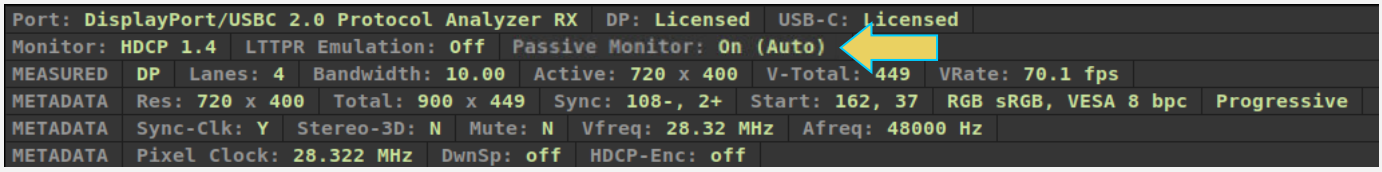


Basic Analyzer Dashboard

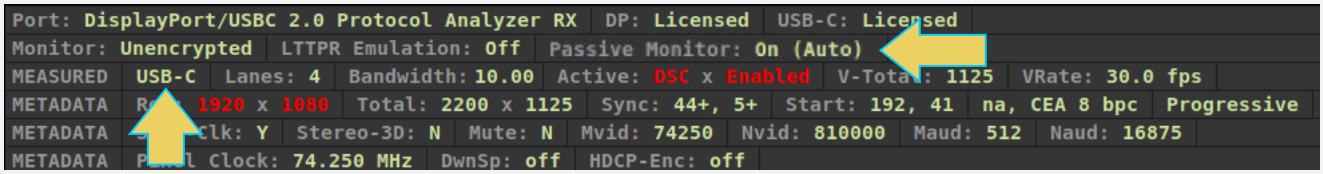
This subsection describes the dashboard components on the top of the Basic Analyzer panel. Refer to the table below for a description of these components.

Basic Analyzer – Dashboard Items

Example dashboard of DisplayPort 2.0 Protocol Analyzer Rx in Passive Monitoring mode.



Example using USB-C DP-alt mode in Passive Monitoring mode with DSC enabled and active.



Note: The Source and Sink devices must both be connected to the same type of port (USB-C or DP) for Passive Monitoring to work.

The following items are on the Real Time dashboard:

Top Row Items – Module and Port:

- **Port** `Port: DisplayPort/USBC 2.0 Protocol Analyzer RX` - The Port area shows the current Rx port that is being displayed on the Basic Analyzer. Currently the only analyzer port is the Video Generator port.

Second Row Items:

- **Monitor** `Monitor: HDCP 1.4` - Indicates the HDCP encryption of the monitor.
  Note: If unencrypted, this will be the indicator: `Monitor: Unencrypted`
- **LTTPR Emulation** `LTTPR Emulation: Off` - Indicates whether LTTPR emulation is active
- **Passive Monitor** `Passive Monitor: On (Auto)` – Indicates that passive monitoring is enabled.

Third Row Items:

- **Measured** `MEASURED | DP` or `MEASURED | USB-C` - Indicates whether USB-C or DP (DisplayPort) is currently connected.
- **Lanes** `Lanes: 4` - The number of lanes used during link training.
- **Bandwidth** `Bandwidth: 13.50` - The link rate (per lane).
- **Active (video resolution)** `Active: 3840 x 2160` - This is the measured video resolution.
  Note: If DSC is active this will be indicated `Active: DSC x Enabled`.
- **V-Total** `V-Total: 2250` - This is the measured total vertical video lines per frame.
- **VRate** `VRate: 60.0 fps` - This is the measured vertical frame rate

Fourth Row Items:

- **Res** `Res: 3840 x 2160` - The active video resolution in horizontal pixels and vertical lines determined from the main stream attributes.
- **Total** `Total: 4400 x 2250` - The total video in horizontal pixels and vertical lines determined from the main stream attributes.

Basic Analyzer – Dashboard Items

- **Sync** `Sync: 88+, 10+` **-** 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** `Start: 384, 82` **-** The starting pixel and line in the active video determined from the main stream attributes.
- **Colorimetry and bit depth** `RGB sRGB, CEA 8 bpc` **-** The colorimetry and bit depth determined from the main stream attributes.
- **Scan** `Progressive` **-** The scan type used, progressive (e.g. Prog) or interlaced (Inter) determined from the main stream attributes.

Fifth Row Items:

- **Sync-Clk** `Sync-Clk: Y` **-** 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. This value is determined by the main stream attributes.
- **Stereo-3D** `Stereo-3D: N` **-** The status of 3D audio determined from the main stream attributes.
- **Mute** `Mute: N` **-** The AudioMute flag status determined from the main stream attributes.
- **Vfreq** `Vfreq: 594.00 MHz` - Video frequency determined from the main stream attributes.
- **Afreq** `Afreq: 48000 Hz` - Audio frequency determined from the main stream attributes.

Sixth Row Items:

- **Pixel Clock** `Pixel Clock: 594.000 MHz` - How often pixels occur (frame rate x pixels per frame)
- **DwnSp** `DwnSp: off` - DownSpread indicates whether Spread Spectrum Clocking (SSC) is enabled
- **HDCP-Enc** `HDCP-Enc: off` – Indicates if HDCP encryption is currently active

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.

7.3 Passively Monitoring ACA Transactions

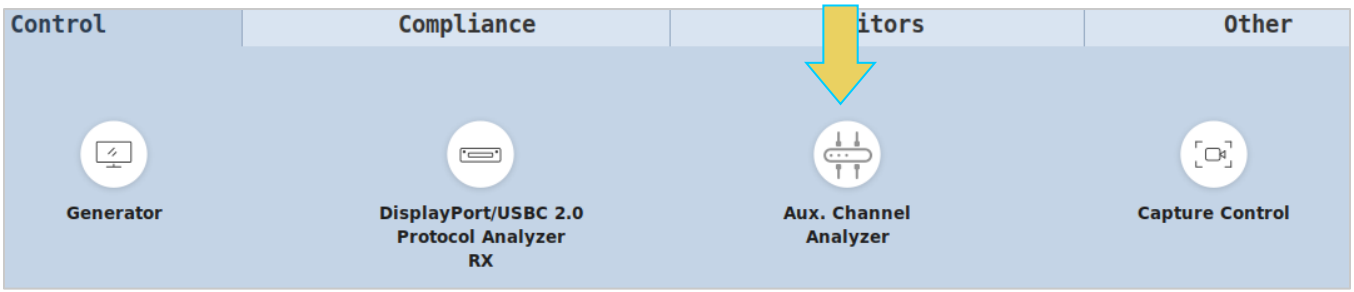
The Auxiliary Channel Analyzer **(ACA)** utilities enable you to view the DDC and aux channel traffic for passively monitored DisplayPort streams in real time. For DisplayPort, you can view the HDCP authentication transactions, EDID exchanges, Link Training transactions, side band messages, Multi-Stream 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.

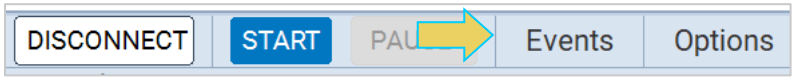
Passively Monitoring the Auxiliary Channel Transactions

To passively monitor the Aux Channel transactions:

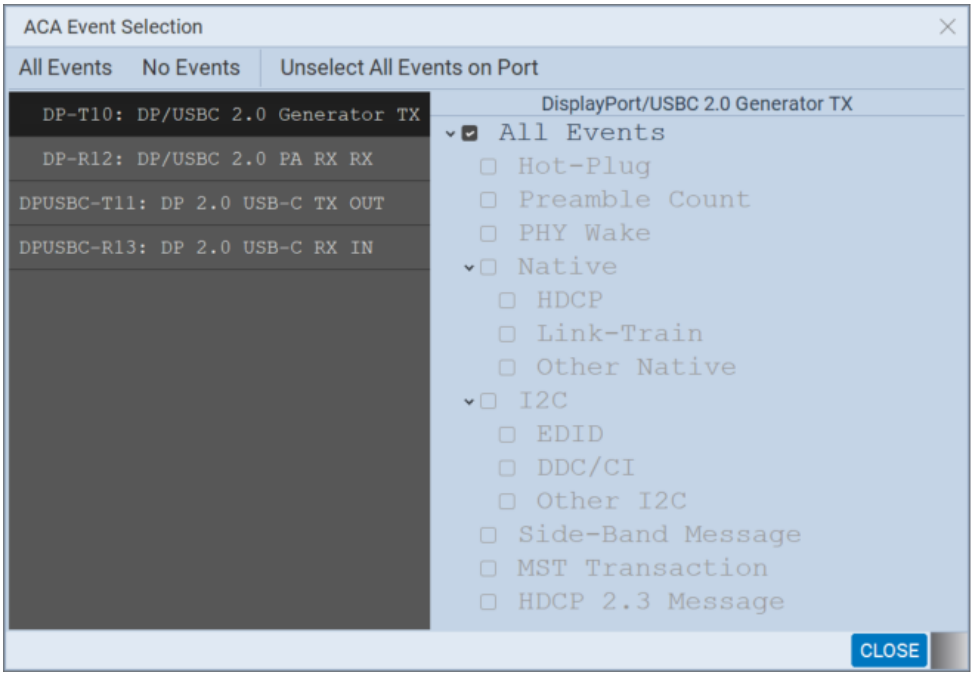
1. Access the **Aux Channel Analyzer**, as demonstrated below.



2. Specify which DP events you wish to passively monitor using the **EVENTS** button in the control menu, as shown below.



The **ACA Event Selection** dialog box will appear, as shown below.



3. Select the ports and events you wish to monitor. Refer to the table below for options.

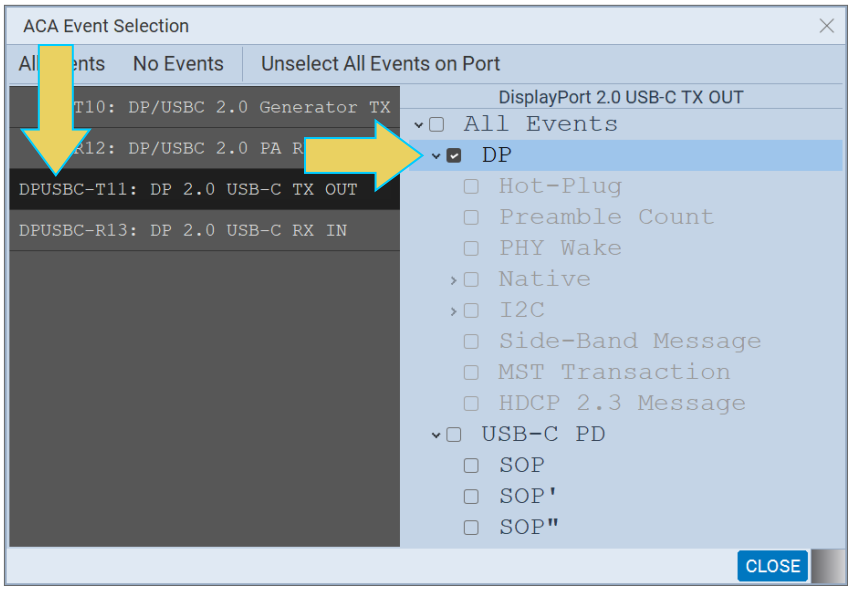
   Note: In Passive Monitoring, you will only want to monitor transactions on the DP 2.0/USB-C Tx Out and Rx In (bottom two ports listed), ***not*** the Generator or PA Rx (top two ports listed).

All Events	Select all events on all ports
No Events	Deselect all events on all ports
Unselect All Events on Port	Deselect all events only on the selected port
DP-T10: DP/USBC 2.0 Generator TX	Select events on the M42d's Generator simulated Tx port (not used in Passive Monitoring)
DP-R12: DP/USBC 2.0 PA RX RX	Select events on the M42d's Protocol Analyzer simulated Rx port (not used in Passive Monitoring)
DPUSBC-T11: DP 2.0 USB-C TX OUT	Select events on the connected DP or USB-C Tx port
DPUSBC-R13: DP 2.0 USB-C RX IN	Select events on the connected DP or USB-C Rx port

4. Specify which DP events you wish to passively monitor. You can select **All Events** of any set of individual events. In the following example, the user has selected All Events (on all 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 **6.4 ACA Data Viewer**.

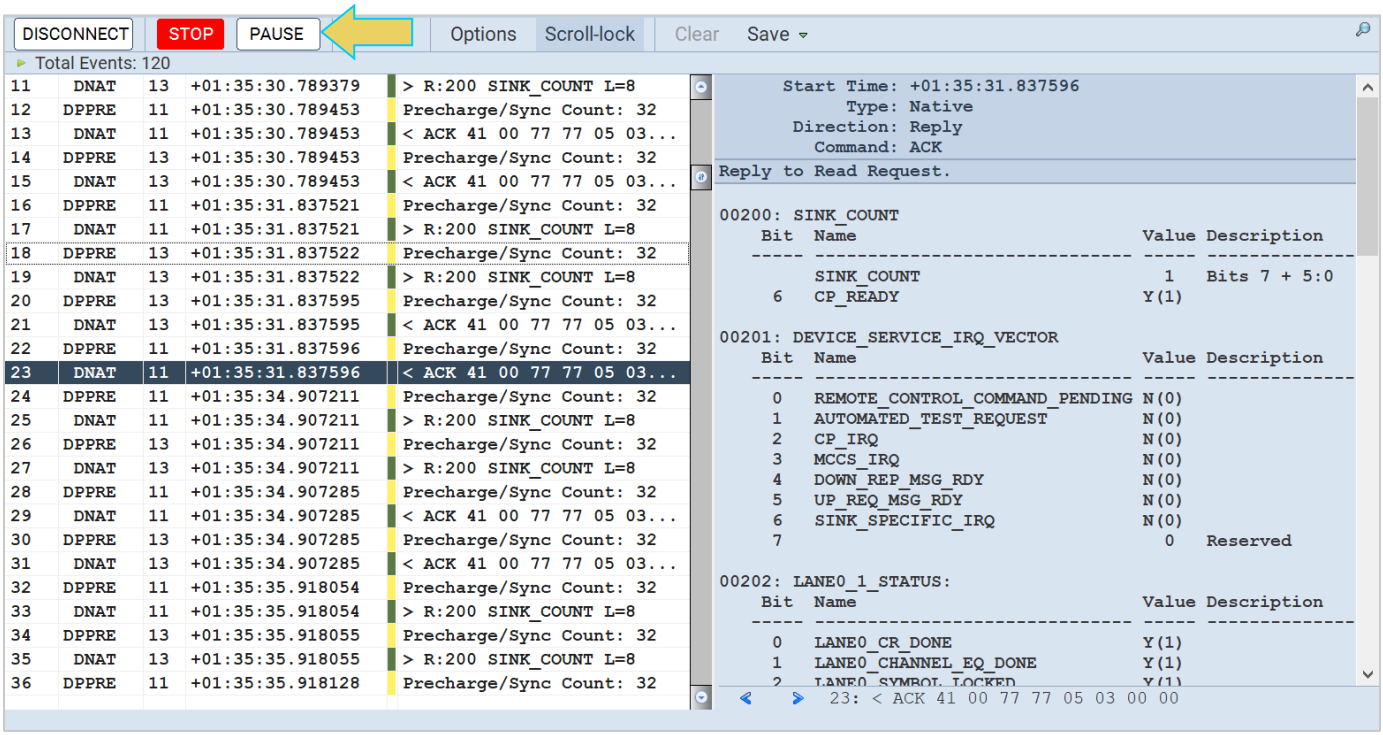
   In this example, the user has selected to passively monitor only DP events on the DP/USB-C Tx Out port.



5. Select the **Start** button on the ACA Control Menu at the top to initiate passive monitoring of the passed-through Aux Chan transactions.

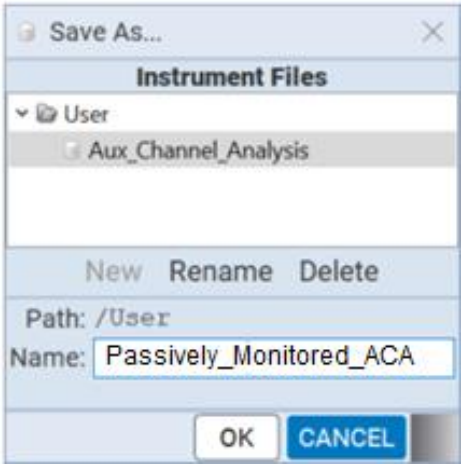
6. Take the necessary action—such as a hot plug—to initiate EDID, HDCP or Link Training transactions between the connected source and sink devices. You will see the passed-through Aux Chan transactions in the ACA panel as shown below.

   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.



   Section 6.3 breaks down the ACA Window in more detail. It is very similar to the ACA Data viewer utility, which is also be covered.

7. Once you have finished running the trace, click on **Save to Instrument**. A dialog box appears (below). Enter a name and then click on **OK**.

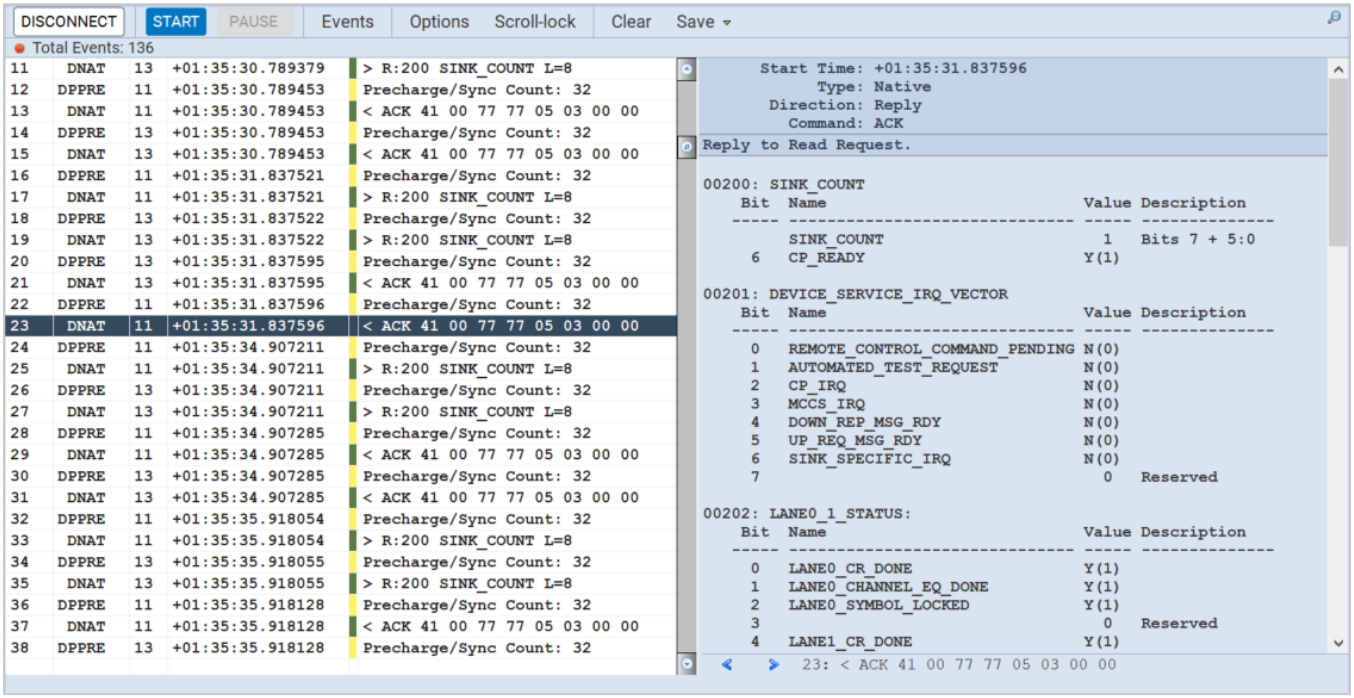


Please note:

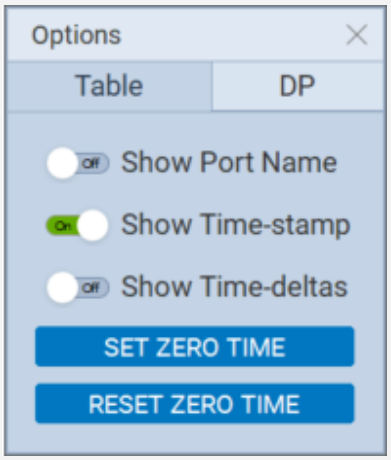
- In order to use the **ACA Data Viewer** utility (**Section 6.4**) on your PC to view the traces or the ACA viewer on the ATP GUI Manager running on the external display with the powerful searching and filtering features, you must save the file, as shown in the previous step.
- If you are working on the **Aux Channel Analyzer** viewer but prefer to use **ACA Data Viewer** on the external ATP GUI Manager, you will have to transfer the saved file to your PC using the ATP GUI Manager running on the external display. This is covered in **6.5 Importing, Exporting, and Transferring ACA Data**.

ACA Window and Panel Description

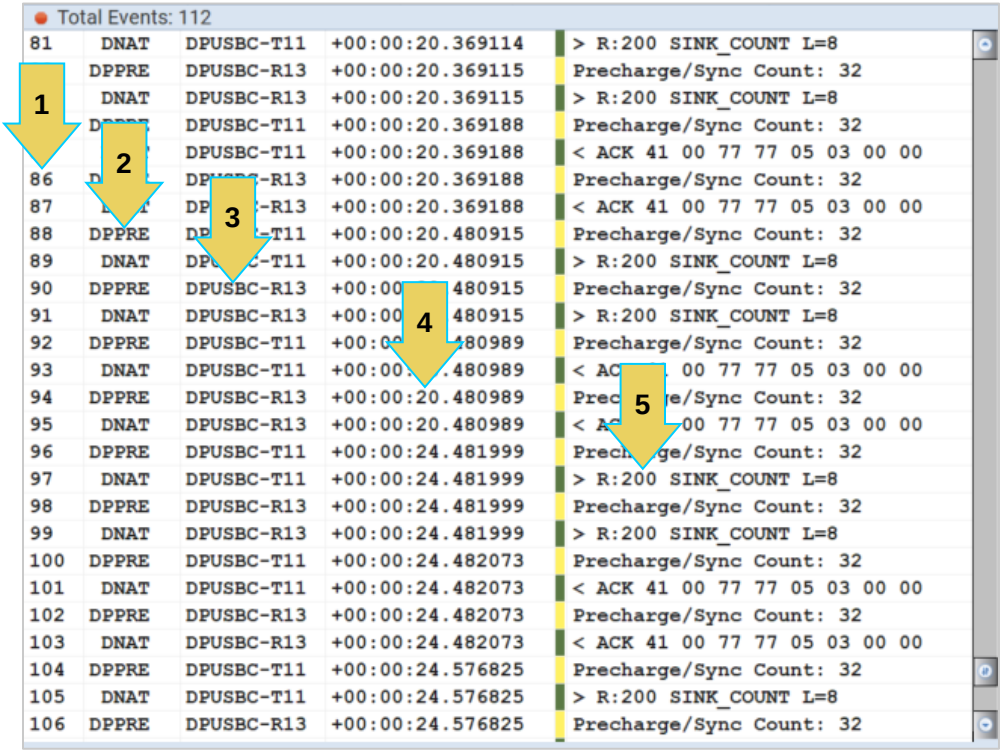
The ACA Window will display the trace details from the data collection executed in the previous section. An example of a populated ACA window is below. Note the top toolbar remains unchanged from when first opening the Aux Channel Analyzer.



You can access the **Options** dialog box using the top Control menu. Options menu items are described in the following table:

Options Dialog Box	
	▪ **Scroll Lock** – Locks the left-hand trace panel to the selected event. When this is off, the panel will continuously scroll with the most recent event. ▪ **Show Port Name** – Enables you to display or not display the Port name (the Port number is always shown). ▪ **Show Time-stamp** – Enables you to show or not show 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.

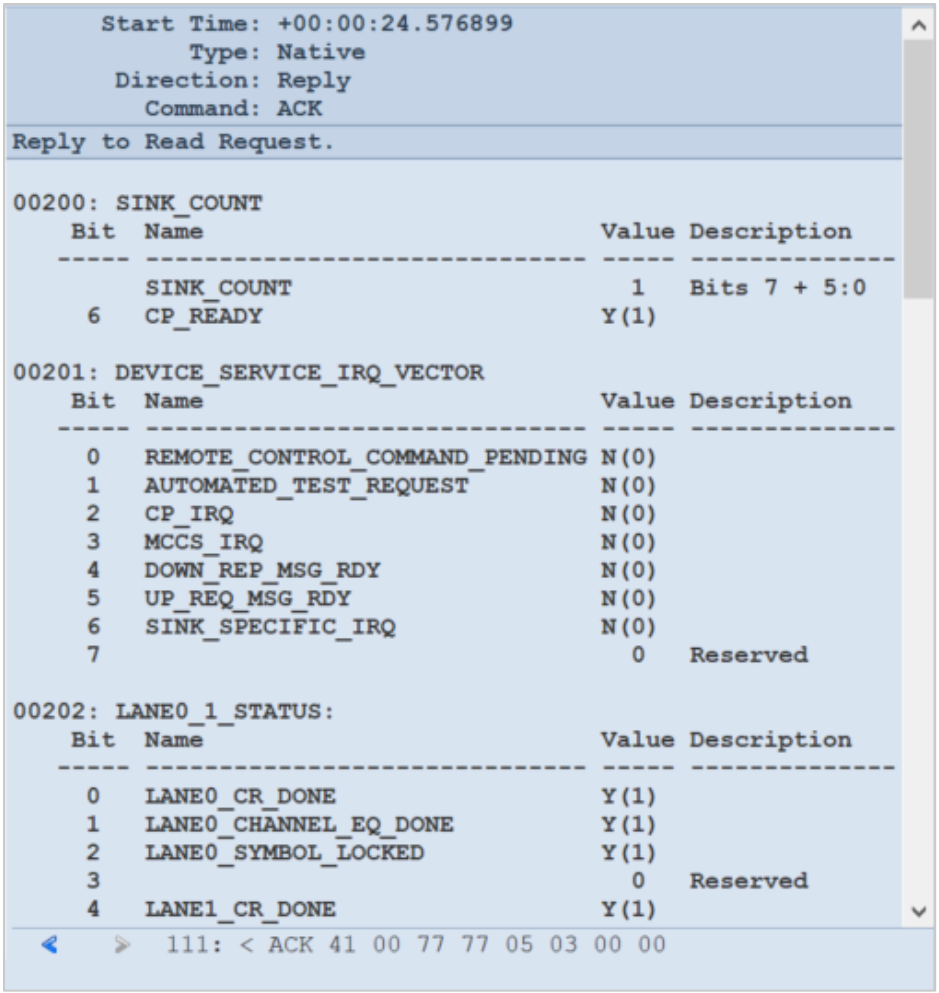
The **ACA Trace Panel** displays each event in a row with some information. This information is expanded in the ACA Event Details panel which will be covered next. An example of the ACA Trace Panel is below. The numbered arrows correspond to the descriptions immediately following the screenshot.



81	DNAT	DPUSBC-T11	+00:00:20.369114	> R:200 SINK_COUNT L=8
	DPPRE	DPUSBC-R13	+00:00:20.369115	Precharge/Sync Count: 32
	DNAT	DPUSBC-R13	+00:00:20.369115	> R:200 SINK_COUNT L=8
		DPUSBC-T11	+00:00:20.369188	Precharge/Sync Count: 32
		DPUSBC-T11	+00:00:20.369188	< ACK 41 00 77 77 05 03 00 00
86		DP -R13	+00:00:20.369188	Precharge/Sync Count: 32
87		DP -R13	+00:00:20.369188	< ACK 41 00 77 77 05 03 00 00
88	DPPRE	DP -T11	+00:00:20.480915	Precharge/Sync Count: 32
89	DNAT	DP -T11	+00:00:20.480915	> R:200 SINK_COUNT L=8
90	DPPRE	DPUSBC-R13	+00:00 480915	Precharge/Sync Count: 32
91	DNAT	DPUSBC-R13	+00:00 480915	> R:200 SINK_COUNT L=8
92	DPPRE	DPUSBC-T11	+00:00 480989	Precharge/Sync Count: 32
93	DNAT	DPUSBC-T11	+00:00 480989	< AC 00 77 77 05 03 00 00
94	DPPRE	DPUSBC-R13	+00:00:20.480989	Prec e/Sync Count: 32
95	DNAT	DPUSBC-R13	+00:00:20.480989	< A 00 77 77 05 03 00 00
96	DPPRE	DPUSBC-T11	+00:00:24.481999	Prec ge/Sync Count: 32
97	DNAT	DPUSBC-T11	+00:00:24.481999	> R:200 SINK_COUNT L=8
98	DPPRE	DPUSBC-R13	+00:00:24.481999	Precharge/Sync Count: 32
99	DNAT	DPUSBC-R13	+00:00:24.481999	> R:200 SINK_COUNT L=8
100	DPPRE	DPUSBC-T11	+00:00:24.482073	Precharge/Sync Count: 32
101	DNAT	DPUSBC-T11	+00:00:24.482073	< ACK 41 00 77 77 05 03 00 00
102	DPPRE	DPUSBC-R13	+00:00:24.482073	Precharge/Sync Count: 32
103	DNAT	DPUSBC-R13	+00:00:24.482073	< ACK 41 00 77 77 05 03 00 00
104	DPPRE	DPUSBC-T11	+00:00:24.576825	Precharge/Sync Count: 32
105	DNAT	DPUSBC-T11	+00:00:24.576825	> R:200 SINK_COUNT L=8
106	DPPRE	DPUSBC-R13	+00:00:24.576825	Precharge/Sync Count: 32

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 M41d 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.



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.

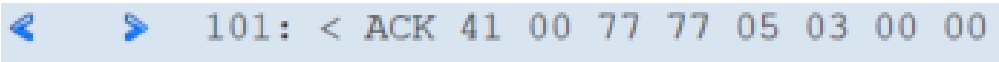
- **Start Time** – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.

- **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.

There are some control arrows and a status panel on the bottom of the ACA Event Details panel, as shown below.

The left and right arrows allow you to navigate to the immediately previous or following transaction.

The **Status Field** to the right shows the sequence number and the description of the selected transaction.



7.4 Passively Analyzing Video Data using Capture Control

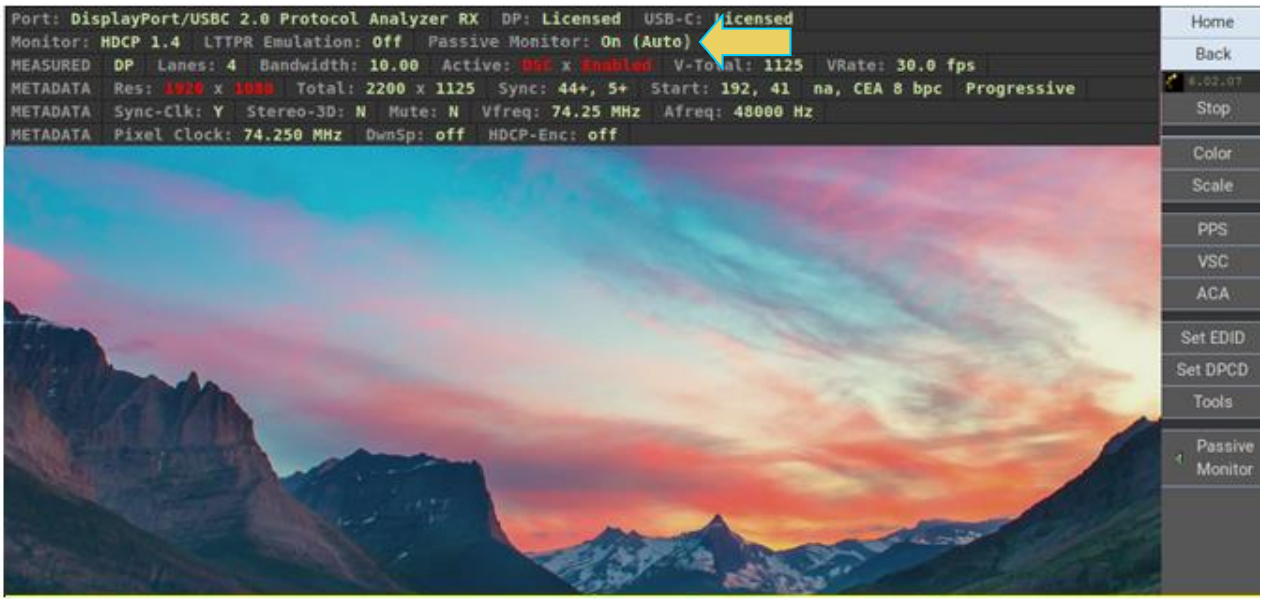
The Capture Control utility allows the user to capture and store passed-through data of the main link protocol, video, and metadata—including main stream attributes and secondary data—from a passively monitored DP connection.

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.

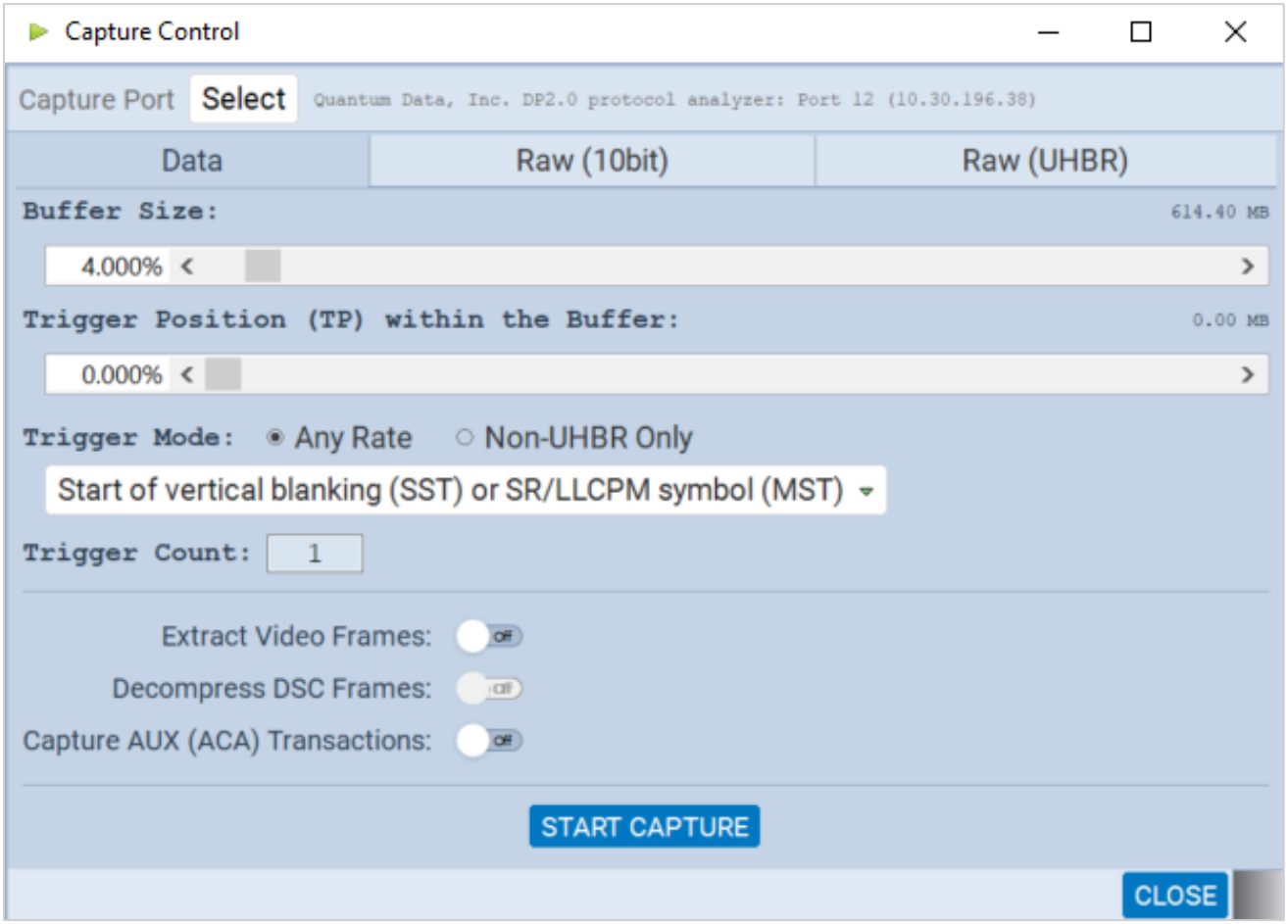
Verify the incoming video of the DisplayPort source to ensure that the source is outputting the proper video. In the screen example below the video shown is a test pattern. Typically, the video you will see will be from a PC or some other source device. Verify the information in the top status bar, and that **Passive Monitor** is on, as shown below.



Capture Control Panel

Access the **Capture Control** app from the Home Screen of the ATP Manager interface.

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.



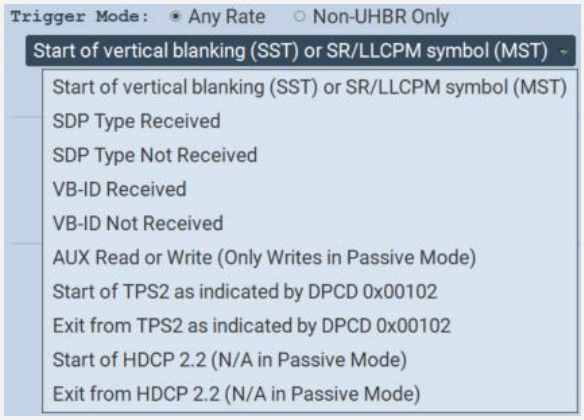
The following table describes the functions of the **Capture Control** panel, specifically the **Data** tab:

Capture Control Panel - Function	Item - Description
Buffer Size	• Enables you to set the size of the captured data in percent. • This is a slidebar 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.
Trigger Position within Buffer	• Enables you to set the position of the trigger event within the captured data. • This slidebar determines how much of the data that has accumulated in the capture buffer has occurred before the trigger

Capture Control Panel - Function	Item - Description
	event. The slidebar has an indication (on the left) of the location of the trigger event within the captured data. The value is expressed as a percent. • 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. • A value of 50% indicates that the trigger event is in the middle of the captured data. • **Note**: The Buffer Position Slidebar is not applicable when you select Vsync as the trigger condition.
Trigger Mode	• Enables you to specify the type of data that you want to capture. • ***Note:*** *This is covered in greater detail later in this section*
Trigger Count	• Option to specify which occurrence of the selected trigger event will initiate capture • eg. a Trigger Count of 5 will start capture at the 5th occurrence of the trigger event
Extract Video Frames	• Enables you to view the video frames that were captured.
Decompress DSC Frames	• Makes video frames viewable if DSC mode is enabled • Extract Video Frames toggle must be enabled for this option to be active
Capture AUX (ACA) Transactions	• Enables you to capture the Aux Channel transactions
Start Capture (Capture Tab)	• Initiates a capture using the criteria defined in the **Trigger Mode** and **Trigger Symbol**.

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
	• Start of vertical blanking (SST) or SR/LLCPM symbol (Multi-Stream Transport) • SDP Type Received • SDP Type Not Received • VB-ID Received • VB-ID Not Received • AUX Read or Write (Only Writes in Passive Mode) • Start of TPS2 as indicated by DPCD 0x00102 • Exit from TPS2 as indicated by DPCD 0x00102 • Start of HDCP 2.2 (N/A in Passive Mode) • Exit from HDCP 2.2 (N/A in Passive Mode)

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.

Non-UHBR Only Trigger Mode Drop Down	Trigger Options
	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 • R0-2 • SE=Secondary Data End • SR=Scrambler Reset, • SS=Secondary Data Start • Other

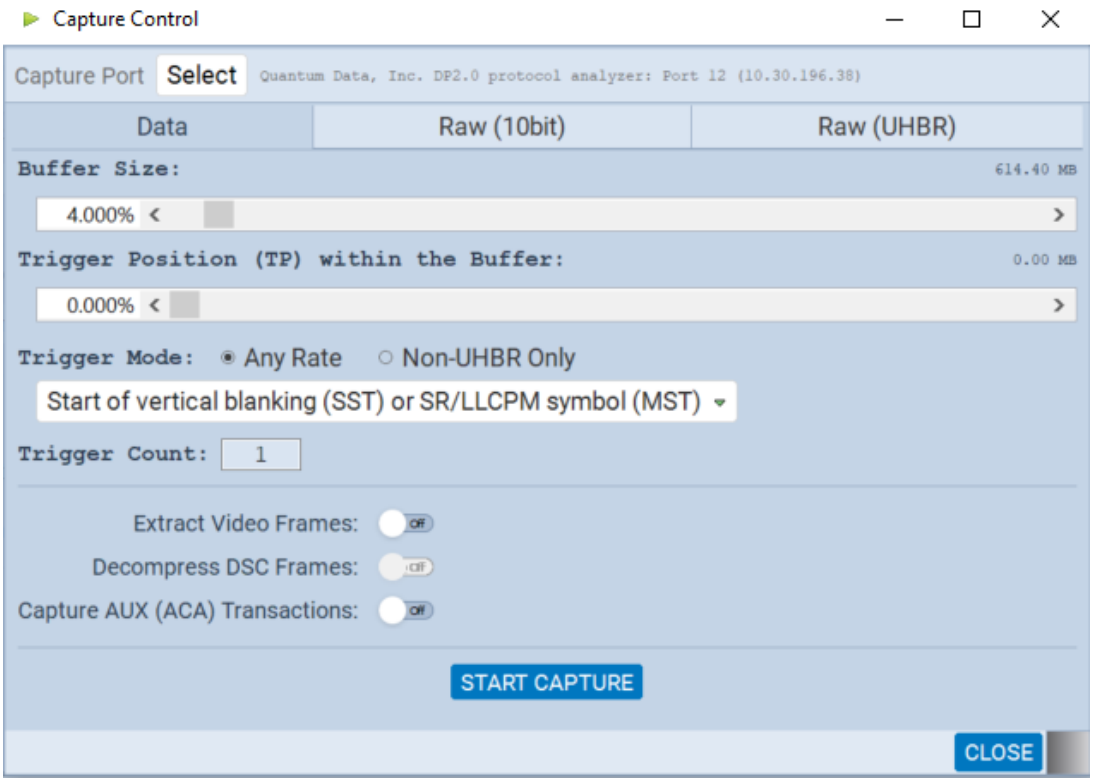
Specified Symbol Data Byte Value 8B10B Symbol Error 8B10B Disparity Error Start of TPS3 as indicated by DPCD 0x00102 Exit from TPS3 as indicated by DPCD 0x00102 Start of TPS4 as indicated by DPCD 0x00102 Exit from TPS4 as indicated by DPCD 0x00102 Start of HDCP 1.3 (N/A in Passive Mode) Exit from HDCP 1.3 (N/A in Passive Mode) FEC Decode Enable Sequence FEC Decode Disable Sequence ML_PHY_STANDBY sequence detected on the main link ML_PHY_SLEEP sequence detected on the main link AUX_PHY_WAKE sequence detected on the AUX channel	• Data Byte Value • 8B10B Symbol Error • 8B10B Disparity Error • Start of TPS3 as indicated by DPCD 0x00102 • Exit from TPS3 as indicated by DPCD 0x00102 • Start of TPS4 as indicated by DPCD 0x00102 • Exit from TPS4 as indicated by DPCD 0x00102 • Start of HDCP 1.3 (N/A in Passive Mode) • Exit from HDCP 1.3 (N/A in Passive Mode) • FEC Decode Enable Sequence • FEC Decode Disable Sequence • ML_PHY_STANDBY detected on main link • ML_PHY_SLEEP detected on main link • AUX_PHY_WAKE detected on AUX channel

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

Capturing Passed-through Displayport Video Data

1. Access the **Capture Control** application from the ATP Manager home screen.

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



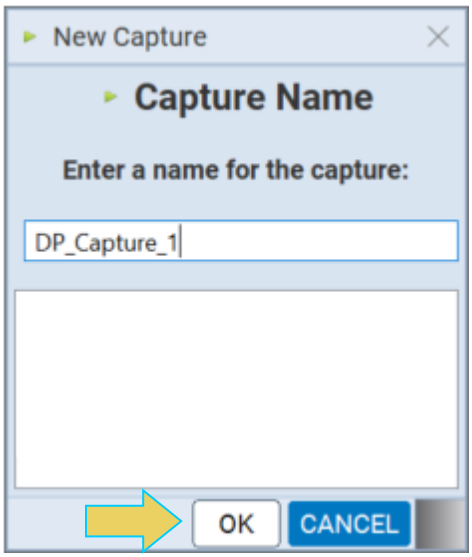
2. Select the port using the **Select**  activation button as shown below.

3. Specify the **Buffer Size** and **Trigger Position, Mode,** and **Count** in accordance with the information provided earlier in this chapter.

4. Toggle on or off the options to **Extract Video Frames**, **Decompress DSC** (if applicable), and **Capture AUX (ACA) Transactions**.

5. Initiate the capture by clicking on the **Start Capture** activation button
   

You will be prompted with a **New Capture** dialog box (below) given you an opportunity to assign a name to the capture file.

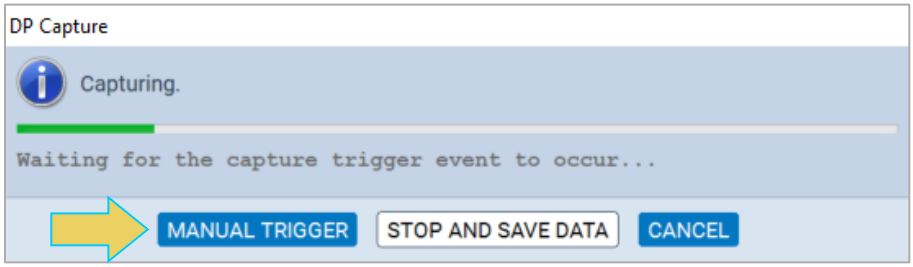


6. Enter a name in the space provided in the **New Capture** dialog box.

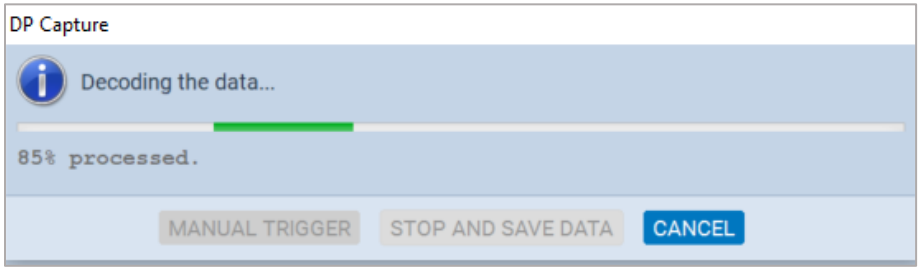
   Click **OK** to begin the capture process. A progress bar will appear, as shown below.

   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.

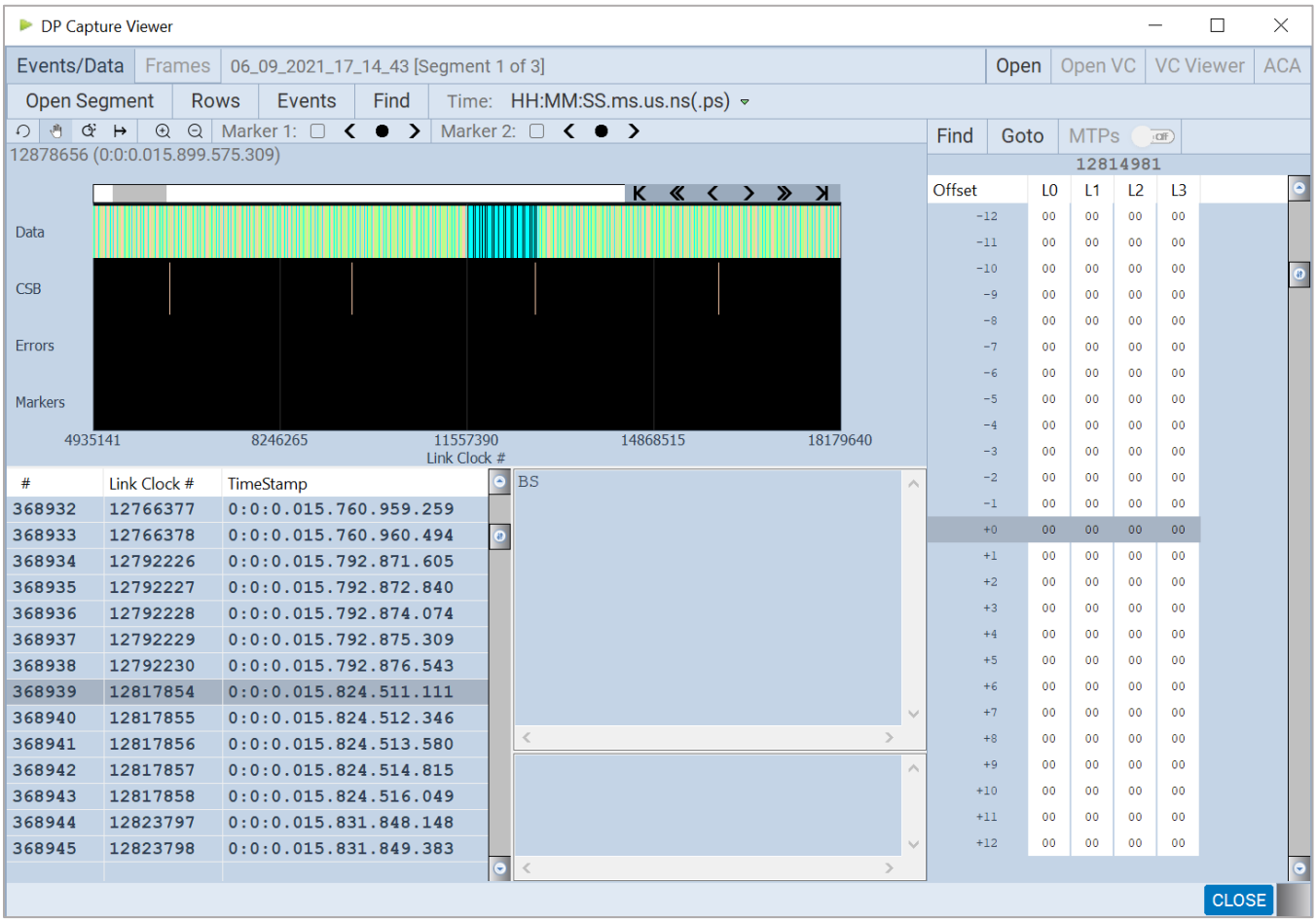
   - Manual Trigger – If the trigger event does not occur as expected, or if you are viewing the video display in real time and you notice an occurrence that you would like to capture the data of, manually initiate a capture with the previously set specifications at this point.
   - Stop and Save Data – 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 are covered in much detail in sections **6.4 Capture Viewer Panels** (covers the Event Plot, Data Decode/Details, and Link Symbol panels) and **6.5 Searching and Filtering for Specific Data Elements** (searching for events or symbols, and filtering using the functions within the Capture Viewer).

8 LTTPR Testing

All LTTPR testing features are licensed. More information about licenses can be found in **Appendix A. Licenses**.

8.1 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.

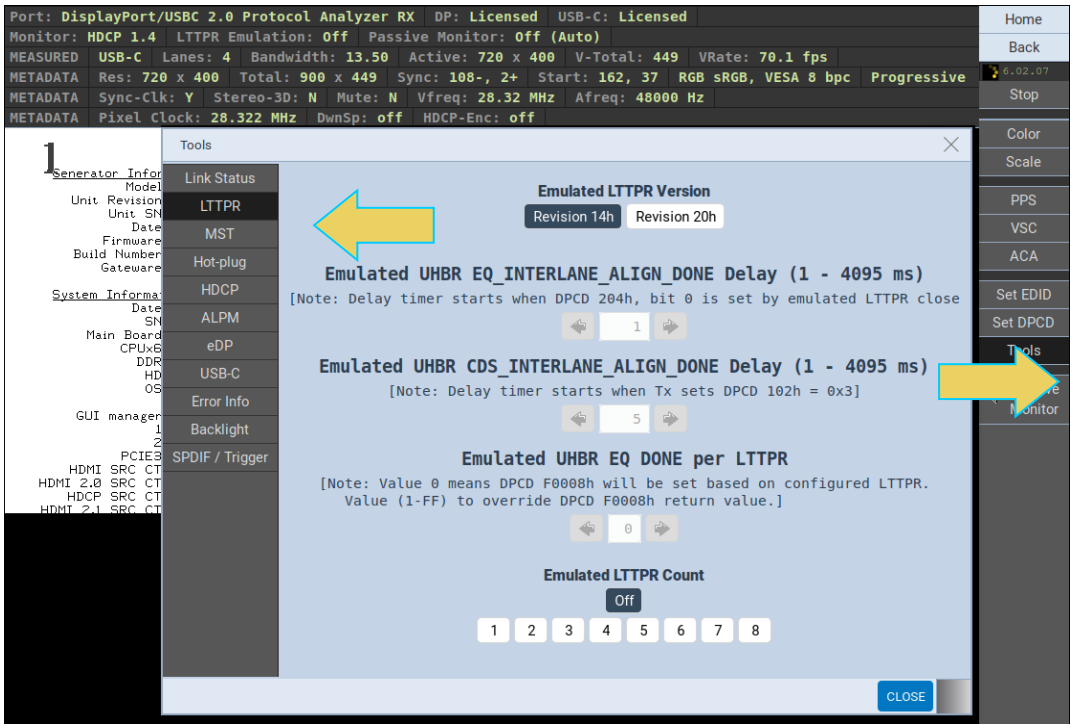
While testing a source device in the non-transparent mode, each LTTPR is trained in the link. This ensures better signal quality to the end-to-end link. When testing an LTTPR-capable source device, the M42d can emulate a network of up to 8 LTTPR devices and a DPRx (sink).

The M42d can also generate video to LTTPR device(s) as a DPTx (source).

8.2 LTTPR Emulation for Testing Source Devices

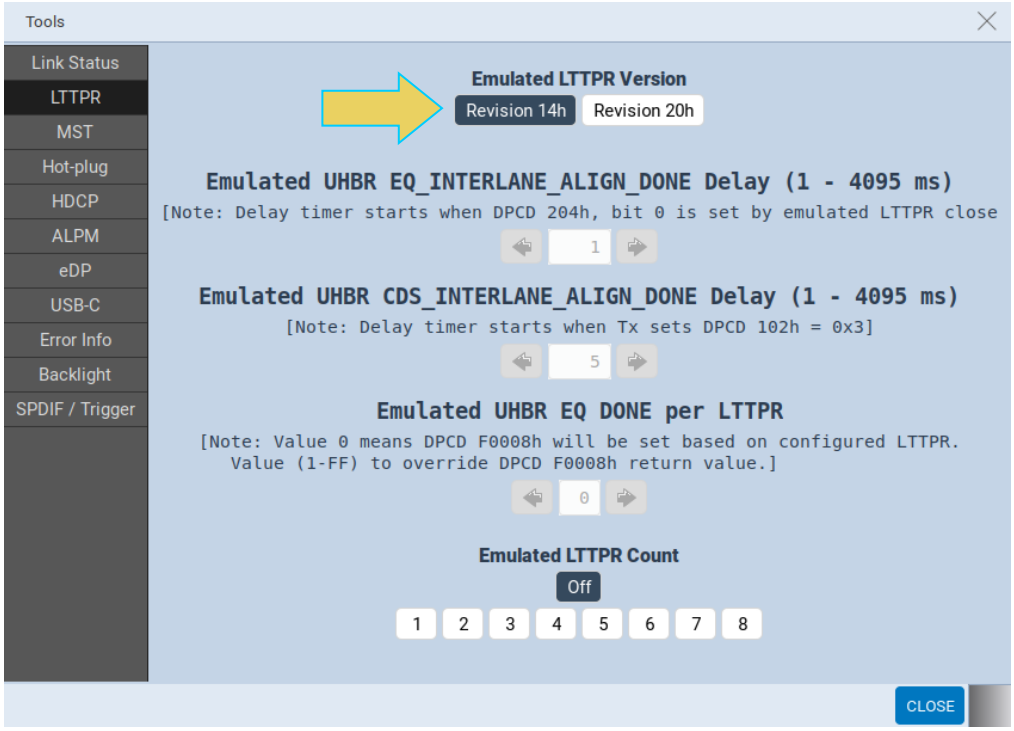
The tool you will use for LTTPR emulation is located within the **Protocol Analyzer Rx** interface, accessible from the Home screen of the M42d's embedded ATP Manager GUI.

To access the LTTPR utility, click the **Tools** icon in the control menu on the right-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.

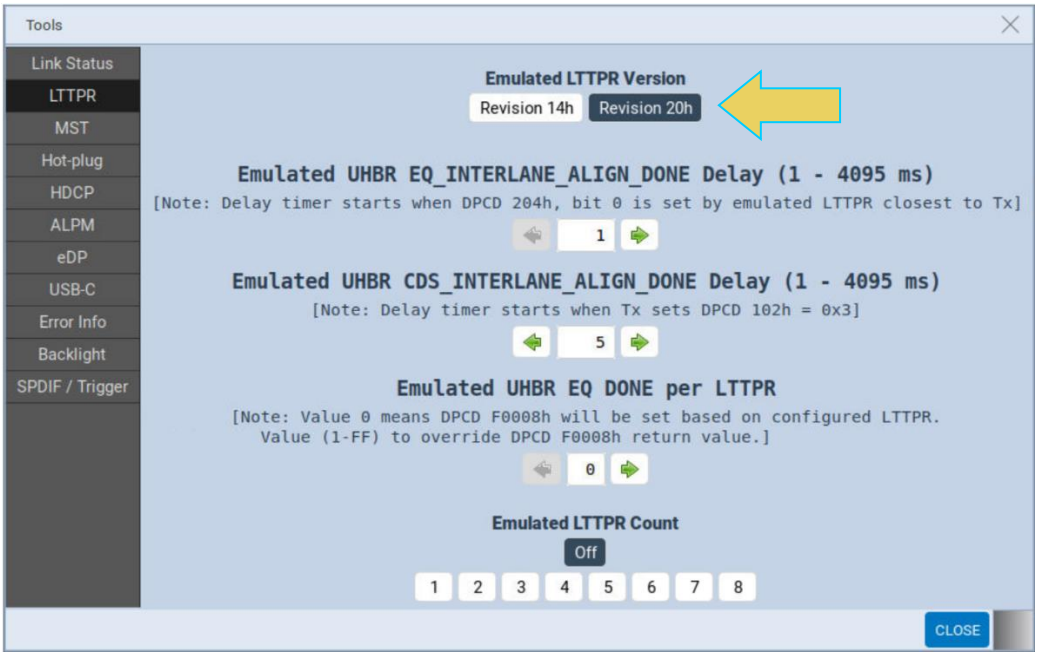


The LTTPR emulation tool appears as shown above. Using this tool, you can emulate up to eight LTTPR devices. This tool offers options for configuring the emulated LTTPR, and more configurations are available within the DPCD Editor, which is covered in the next section.

To emulate LTTPR for testing a source device, first select the version of LTTPR according to your testing specification, as shown below.

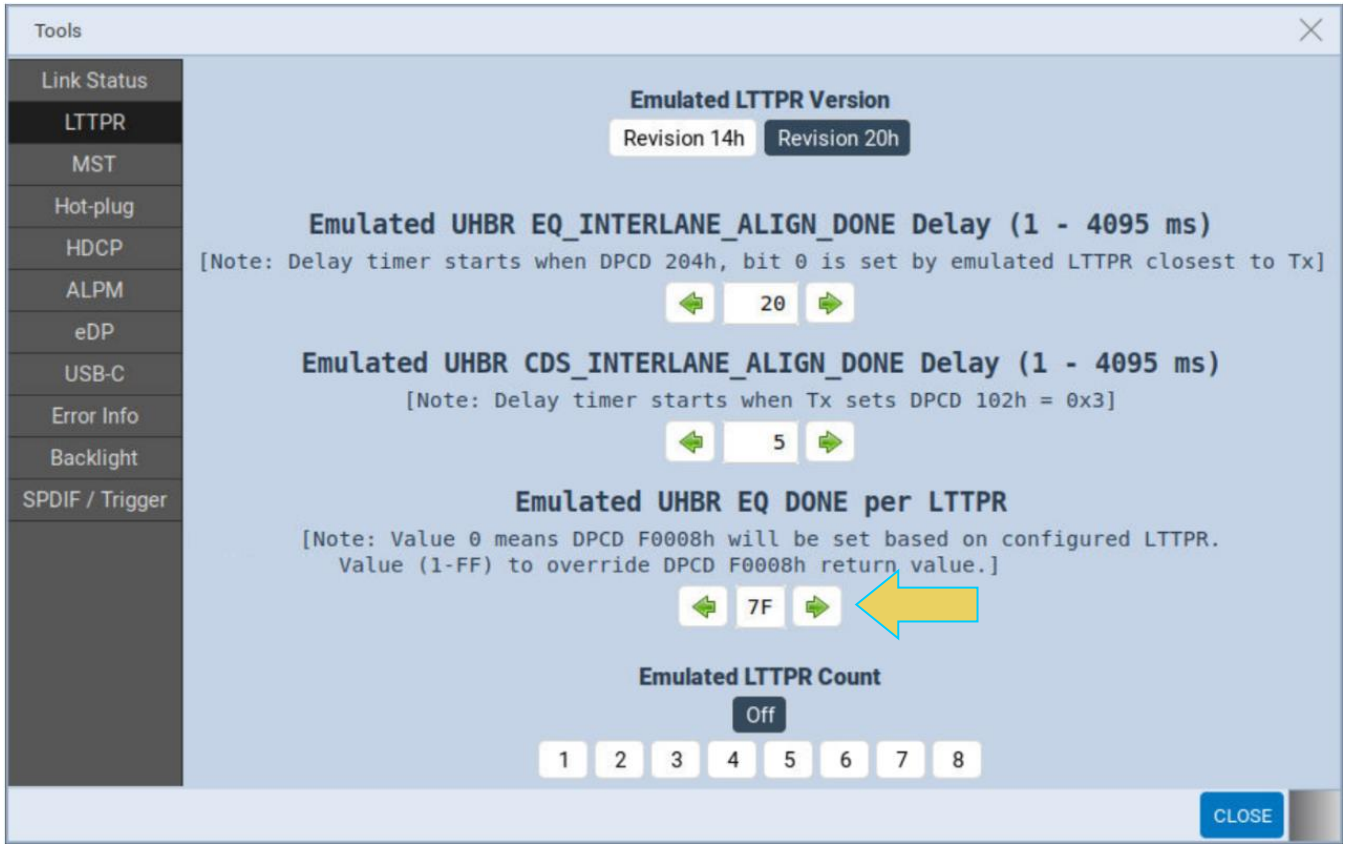


Notice that with version 14h selected, the adjustable UHBR options within the LTTPR tool for do not apply to non-UHBR emulation. These are enabled with version 20h in UHBR mode, as shown below.



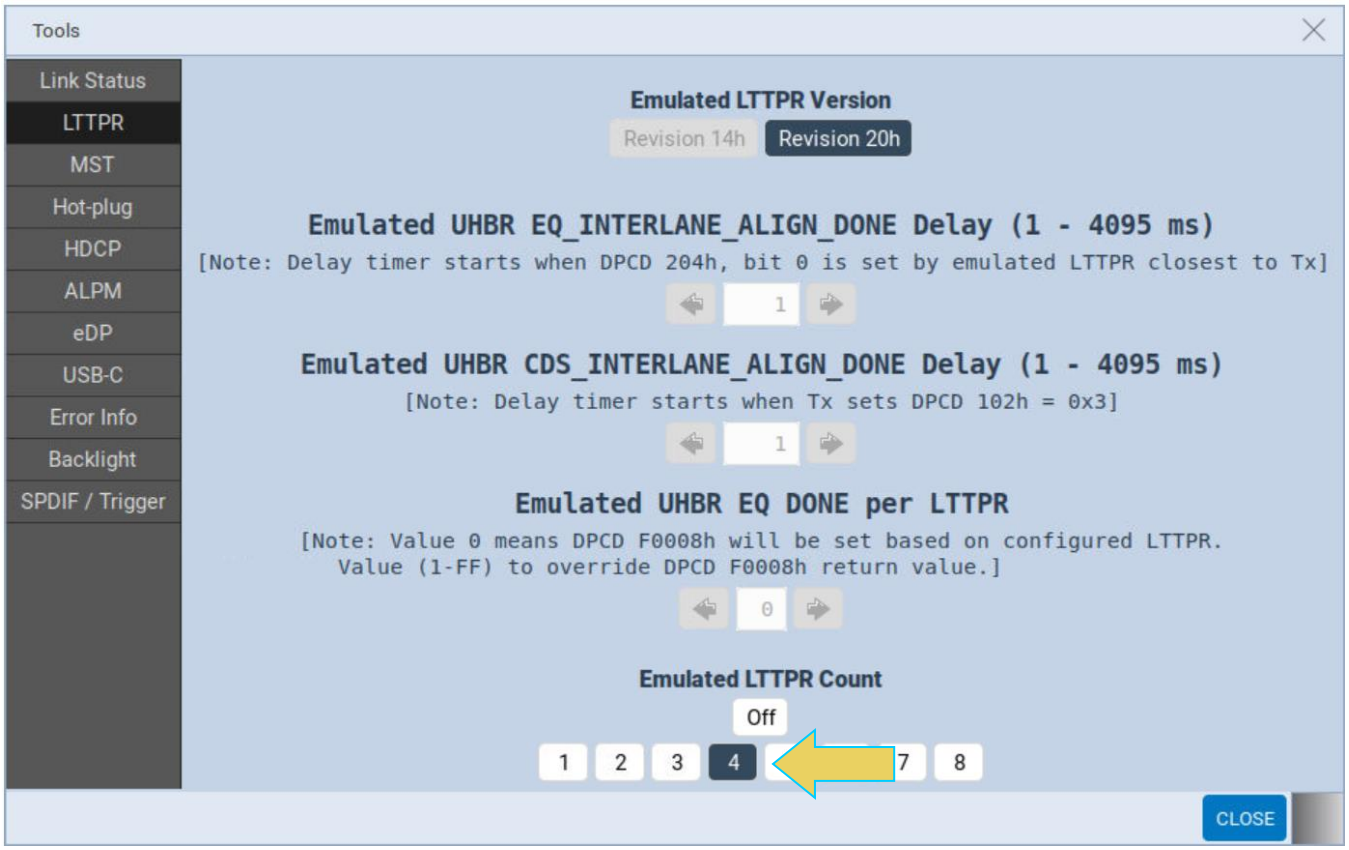
If emulating LTTPR version 20h (non-transparent LTTPR), modify the values of the adjustable fields in accordance with your testing specifications.

For example, in the screenshot below, the source device will read that the emulated LTTPR8 is not set due to the user-configured override value of 7F in the bottom-most field.



Note: Any adjustments to these settings must be done with the **Emulated TPPR Count** set to **Off**. Once an LTTPR count has been set, the M42d begins emulating LTTPR and the settings cannot be changed without again turning emulation off.

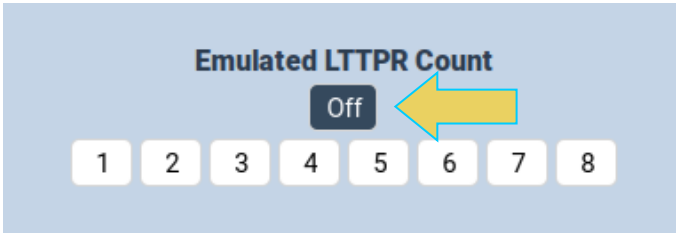
Once you have adjusted these fields per your testing requirements, select the number of LTTPR devices you wish to emulate. The following example has selected an LTTPR count of 4.



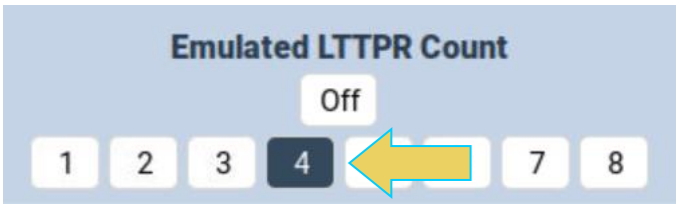
As mentioned previously, notice that the adjustable fields are now disabled, as emulation has begun.

In order to re-enable adjustment of these fields and re-activate LTTPR:

1. Turn off emulation by clicking the **Off** button.

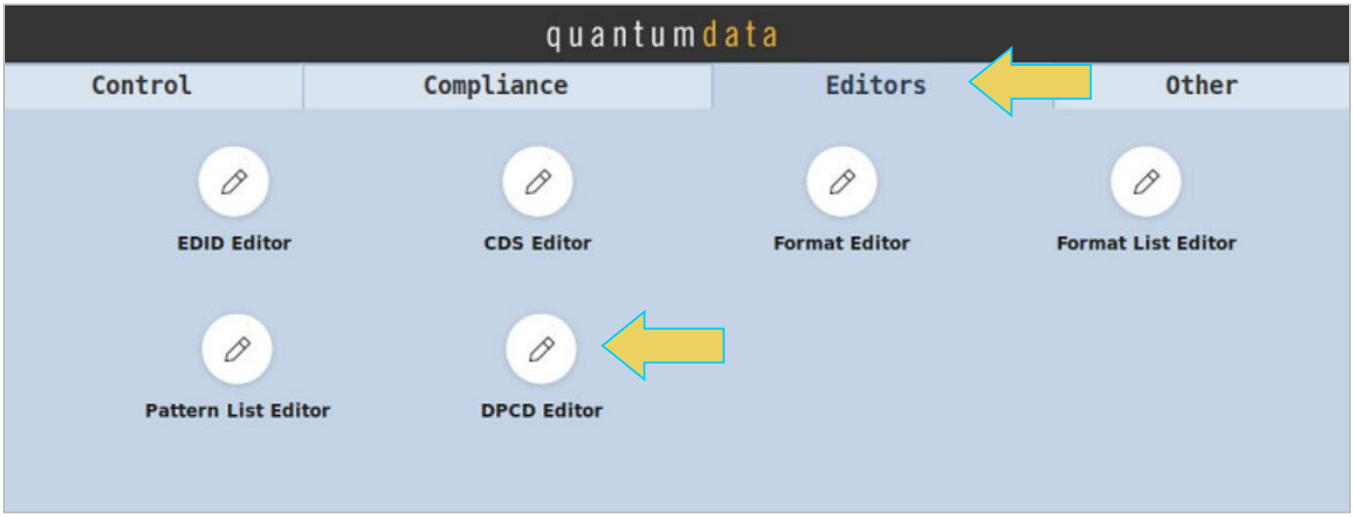


2. Make adjustments to desired fields in LTTPR Tool
3. Re-enable LTTPR emulation by selecting desired LTTPR Count.

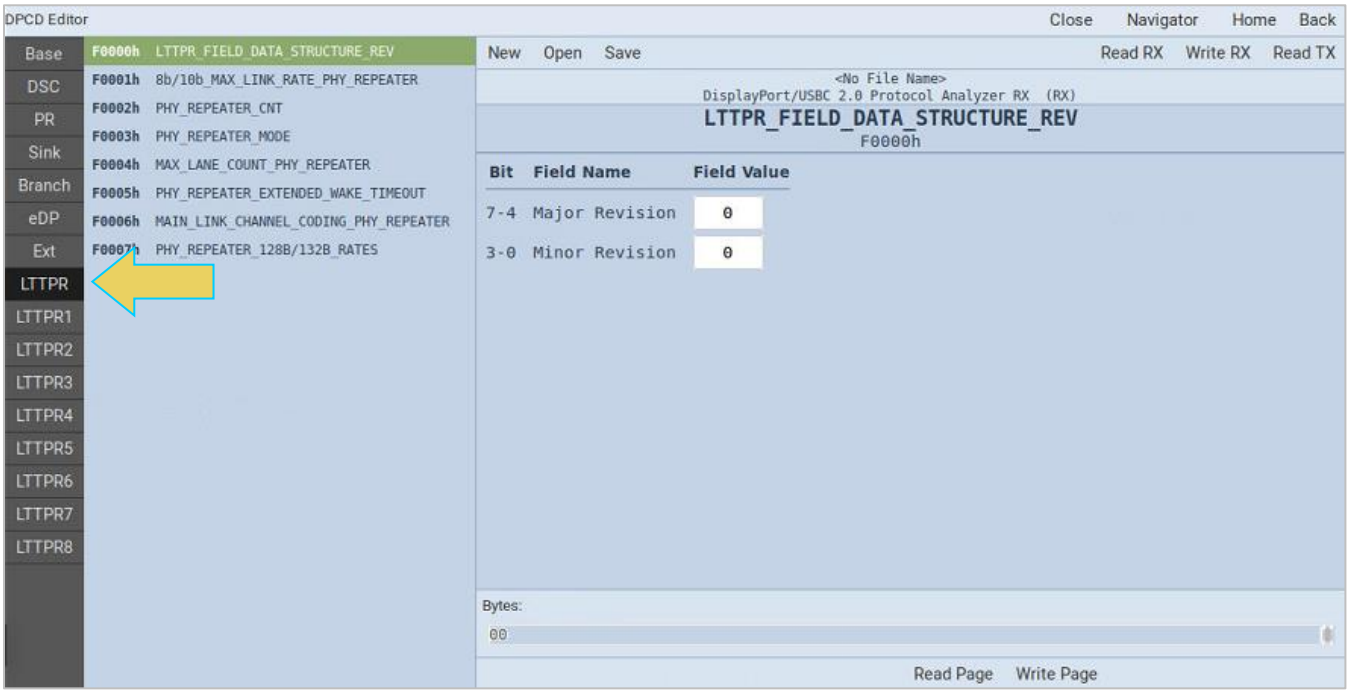


8.3 Modifying LTTPR Capability Registers

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 Home screen, as shown below.

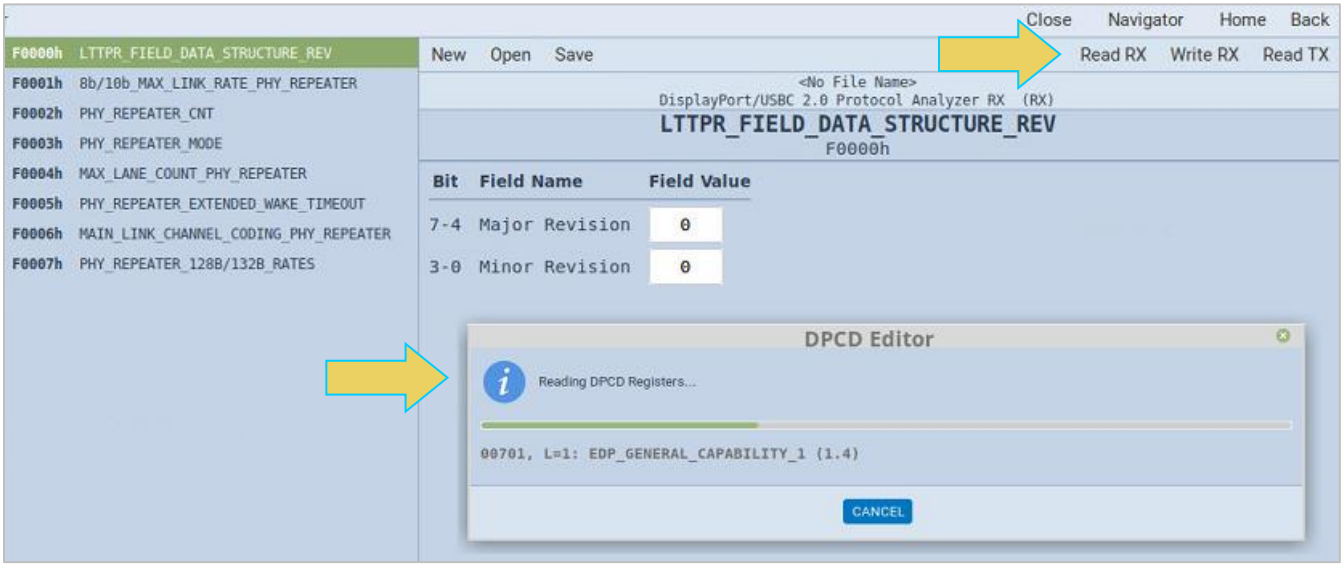


This takes you to the **DPCD Editor**. From there, navigate to the **LTTPR** tab on the left-hand sidebar, as demonstrated below.

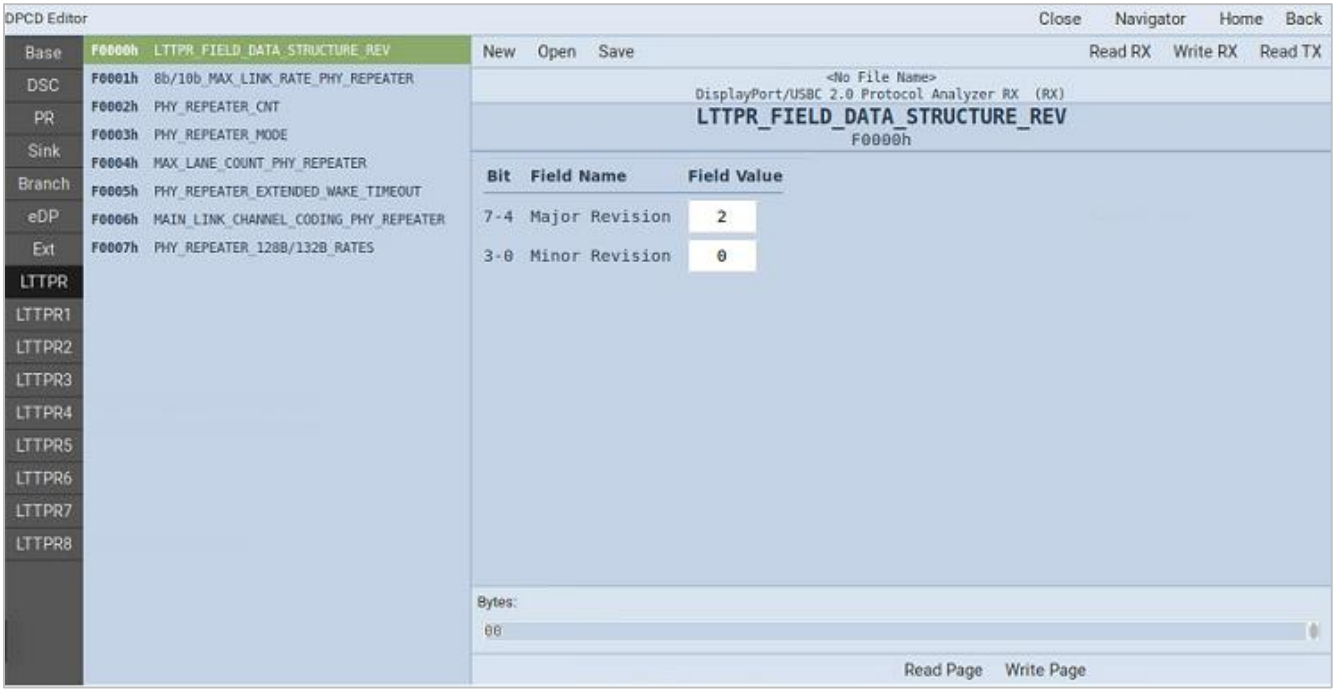


The window displays tabs for each LTTPR Capability Register that can be changed. To display the registers for the current Rx being emulated by the M42d, click **Read Rx** in the top right corner of the window. A loading bar will appear while the Rx DPCD is read, as shown below.

Note: The LTTPR emulation demonstrated in the previous section ***must be enabled*** for the registers to correctly to populate field values other than zero. LTTPR off will display zero for all field values.

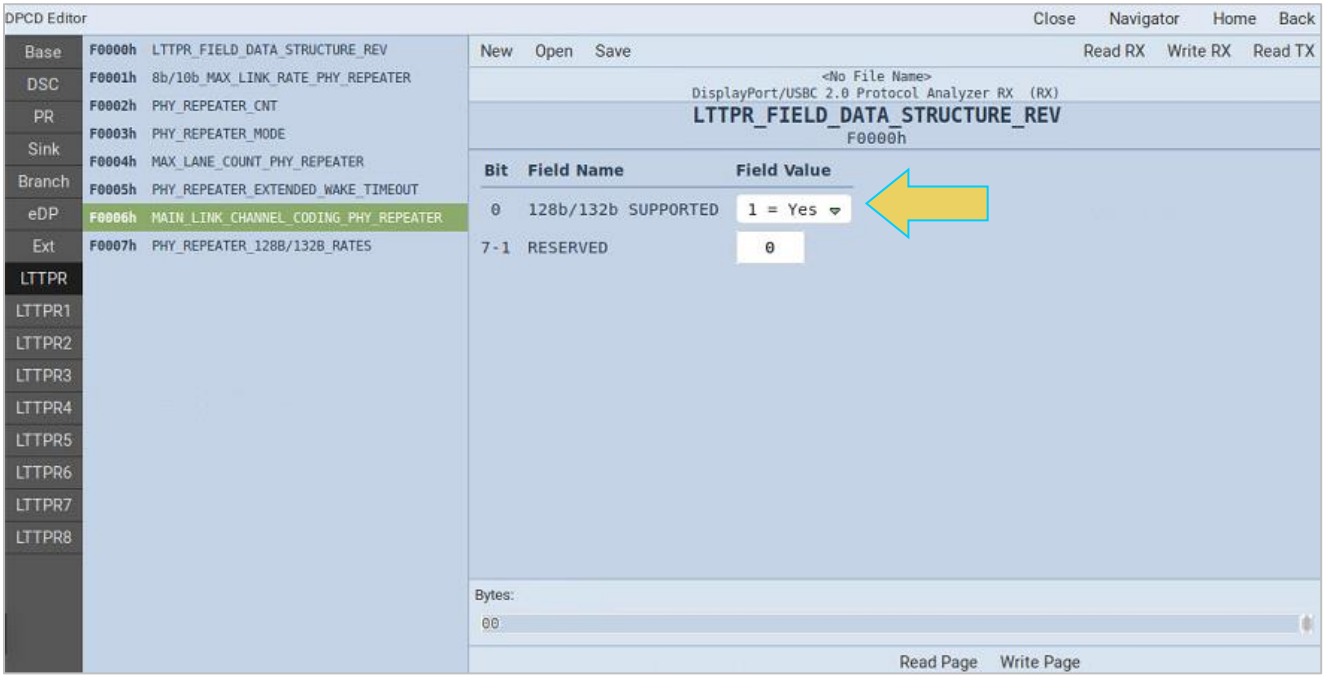


The DPCD Editor will now display the LTTPR Capability Registers with their current field values. The example below is emulating LTTPR 2.0 (20h). Major Revision value is 2, Minor Revision value is 0.

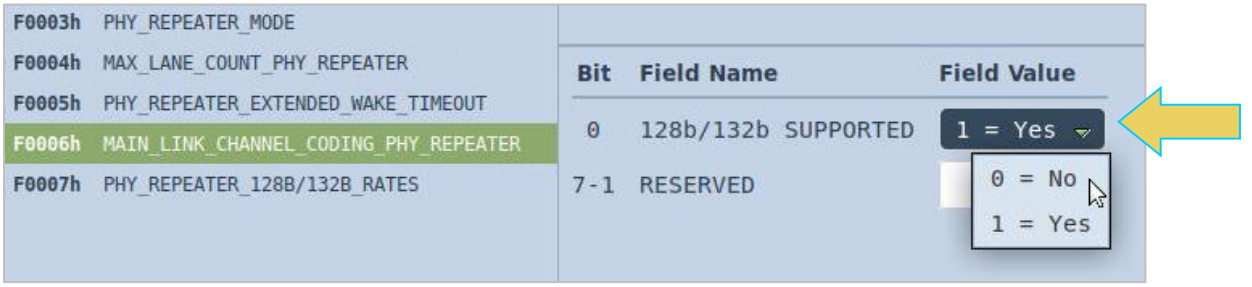


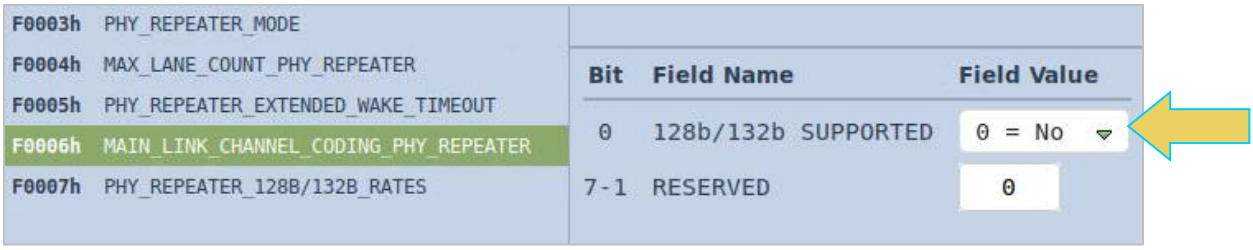
These capability registers are configurable to be able to emulate different LTTPR configurations. A full list of the registers is listed in **Appendix B. Configurable LTTPR Capability Registers**.

To modify the configuration, select the LTTPR 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.

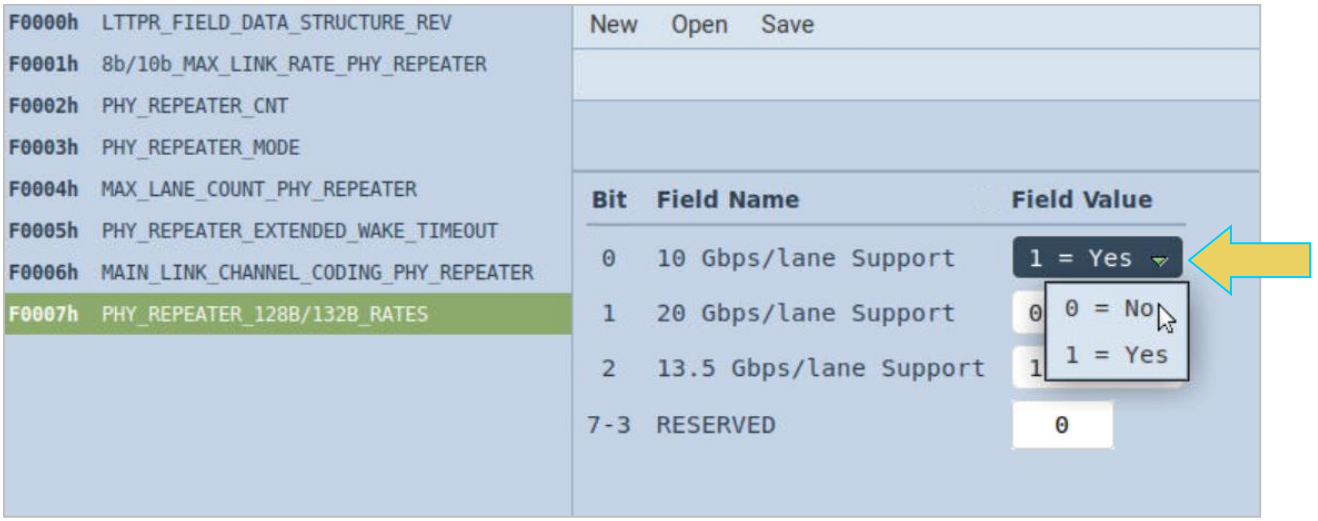


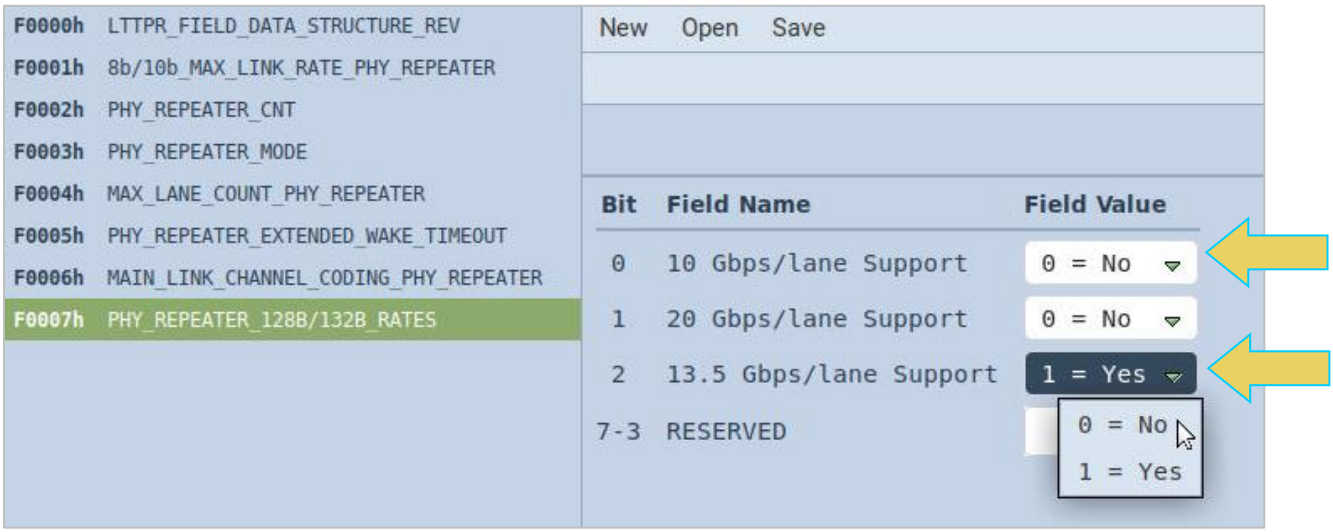
Edit the fields that you wish to re-configure according to your testing specifications. Furthering the previous example, the user has disabled support for 128b/132b coding using the drop-down menu, as demonstrated below.

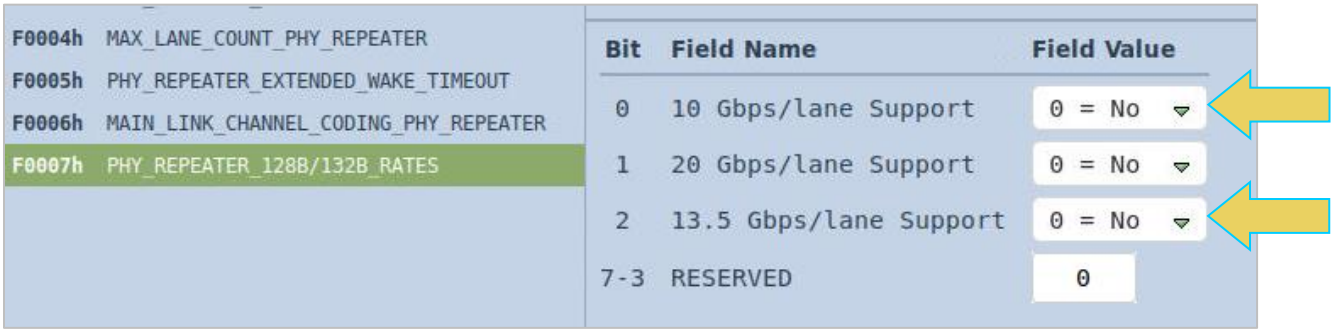




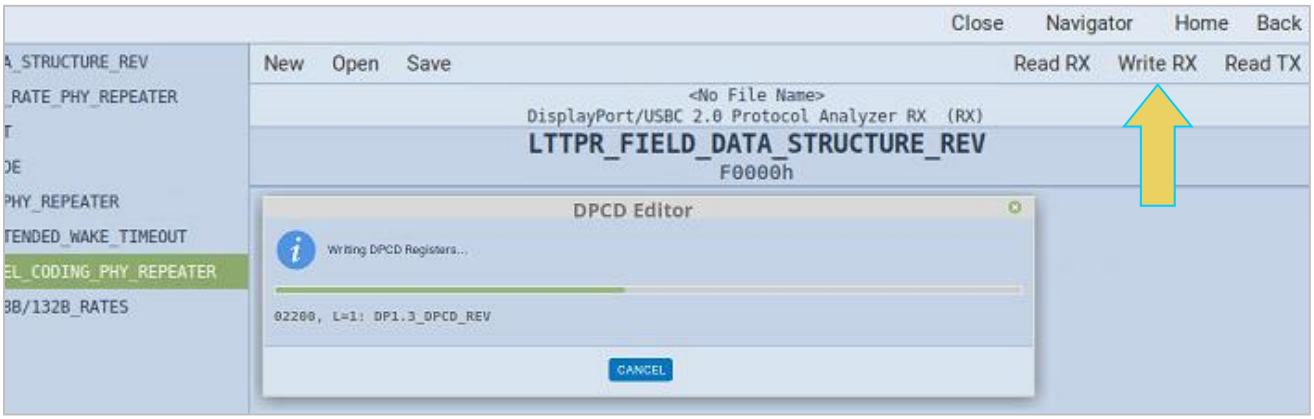
Additionally, continuing with the example, the user would select F0007h PHY_REPEATER_128B/132B_RATES and disable support for all UHBR rates, as shown in the following sample screenshots.



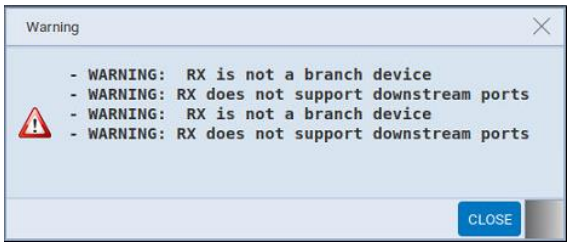




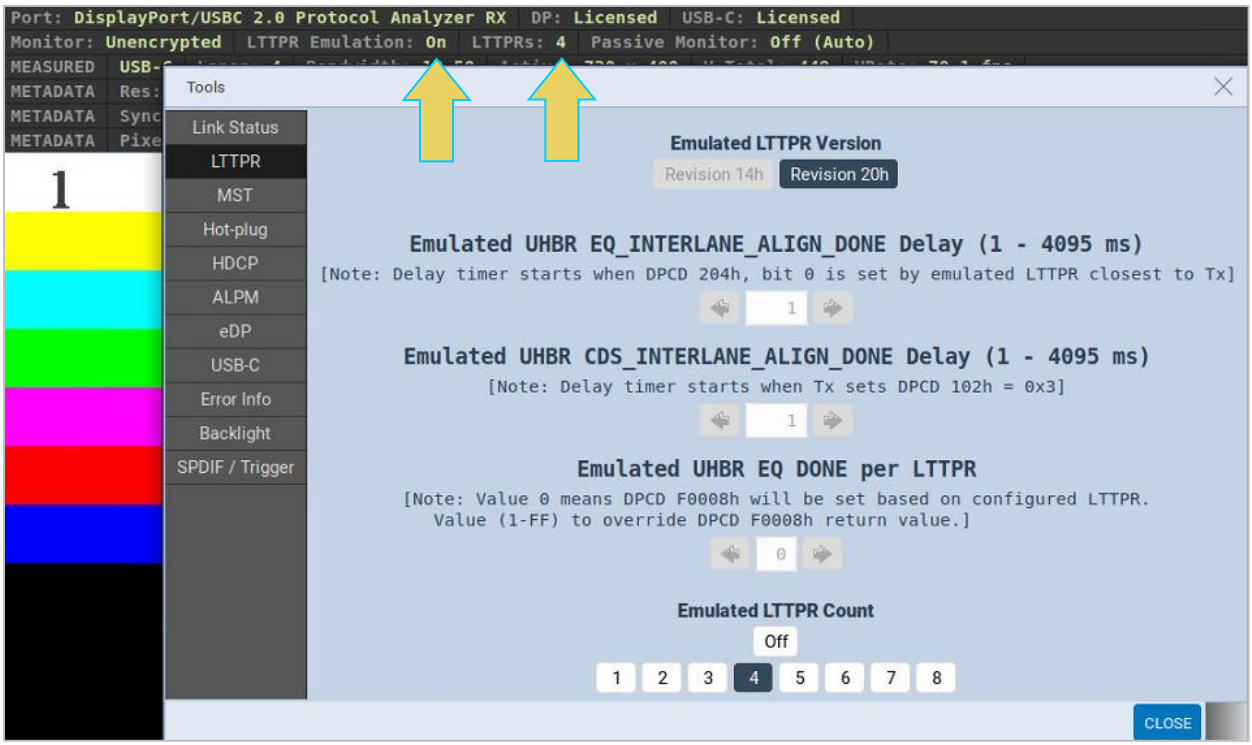
Once you have configured the LTTPR Capability Registers to your testing specifications, click on **Write Rx** in the top corner, and the M42d's receiver will update its emulated LTTPR with the modified DPCD.



A dialog box (example pictured below) may appear with warning messages regarding the M42d's simulated Rx. This can be ignored when testing a source device and writing a configured DPCD to the M42d as an Rx.



The emulated LTTPR will now reflect the newly configured LTTPR capabilities.



In the previous screenshot, the user has navigated back to the M42d Receiver and the dashboard is still reading as 4 LTTPR being emulated.

In this specific example, the M42d Rx still supports LTTPR version 2.0, emulating 4 LTTPR. However, based on the DPCD editing, the emulated LTTPR only supports up to 8.10 Gbps link rate and will not support any UHBR rates or 128b/132b coding. The source is forced into transparent 8b/10b LTTPR link training at a rate of up to 8.10 Gbps.

Note: Configured LTTPR capabilities using the DPCD Editor have to be reapplied anytime the LTTPR 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.

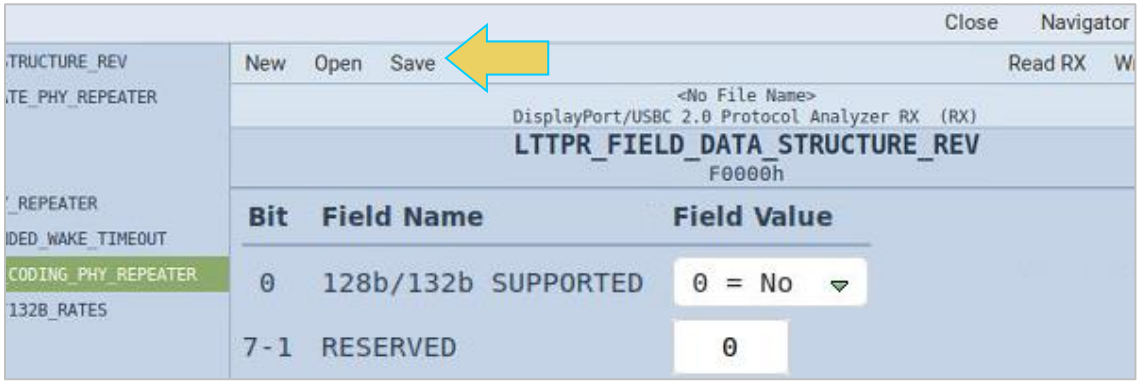
The M42d offers the ability to save and open a modified DPCD (including LTTPR Capability Registers) to quickly reapply these configurations when LTTPR is reset or reenabled from the Rx Analyzer Tools menu.

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.

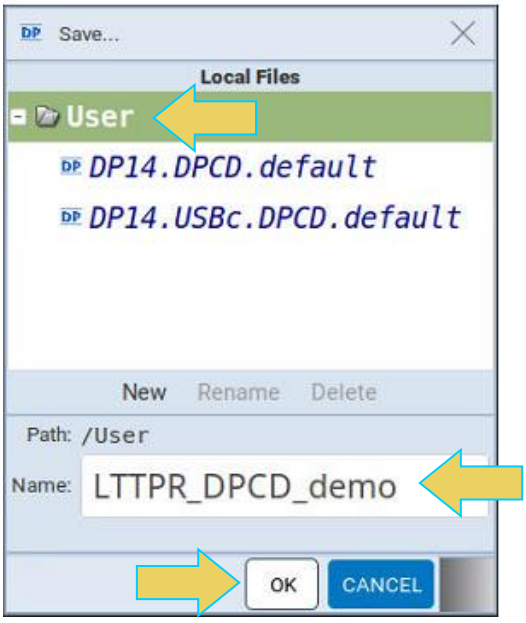
The procedure for this process is as follows:

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 **OK**, as shown below.



The DPCD is now saved in the **User** folder.

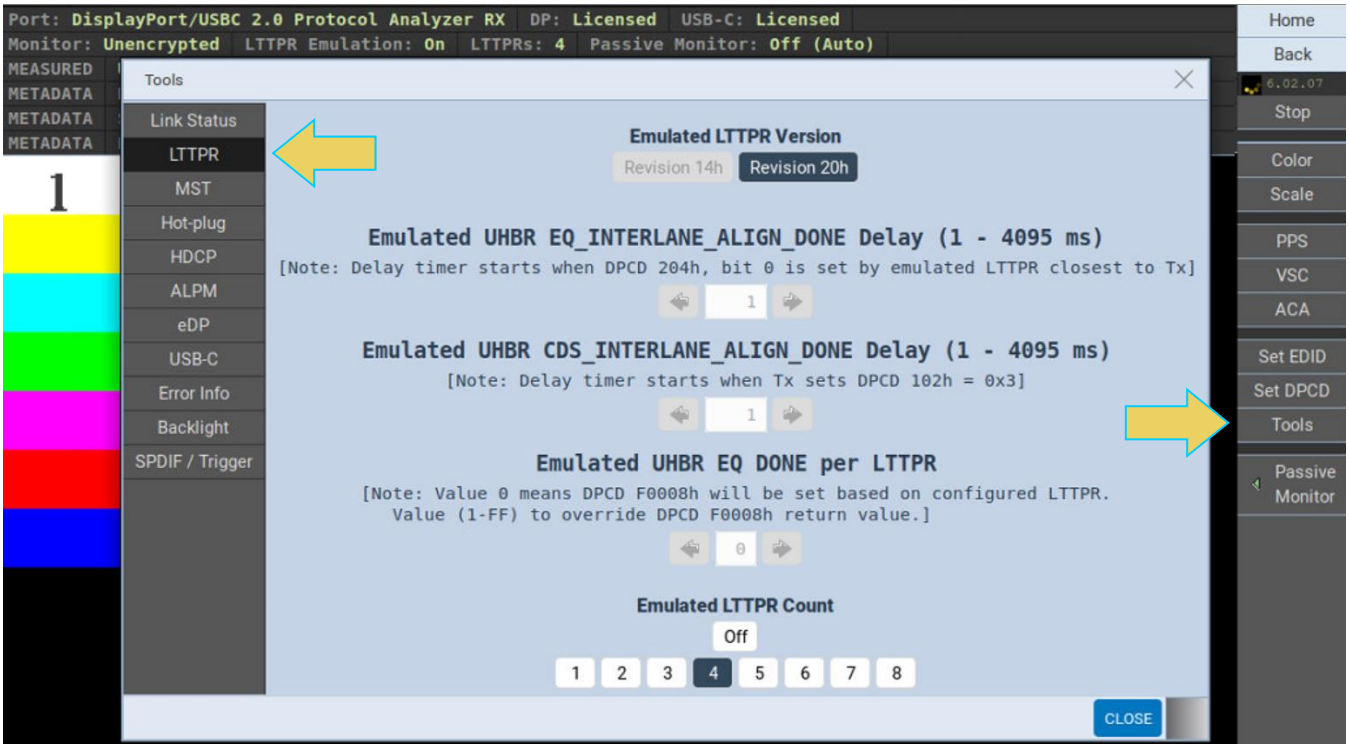
With the configured DPCD now saved, you can open apply this DPCD at any time from the DPCD Editor. In the following example, the user will enable LTTPR with slightly modified settings using the LTTPR Tool within the Analyzer Rx, as demonstrated in the first section of this chapter.

Note: Keep in mind through the next several steps that when loading a custom DPCD, LTTPR ***must already be emulating***. If you begin LTTPR emulation after loading the custom DPCD, the DPCD registers will be reset to the default configurations for the given emulation.

Reset LTTPR Emulation

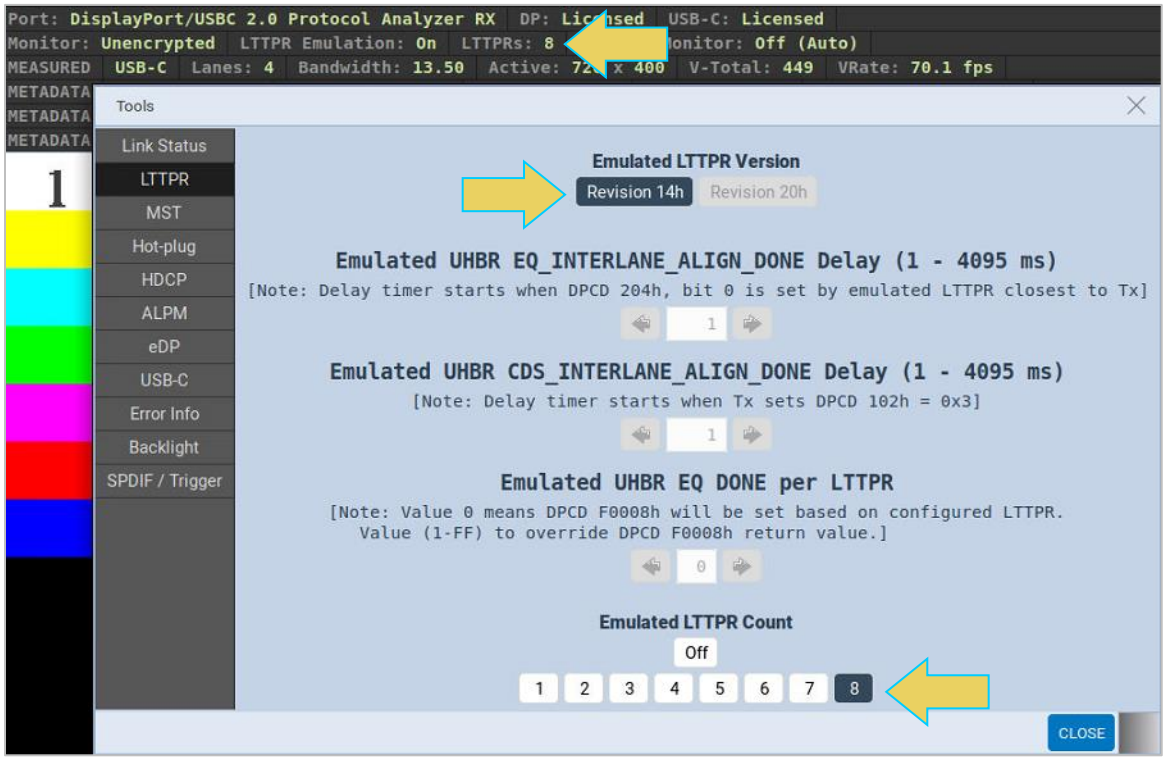
3. Navigate to the LTTPR Tool within the Analyzer Rx.

   LTTPR Emulation should still be active, as shown below.



4. Turn off LTTPR emulation.

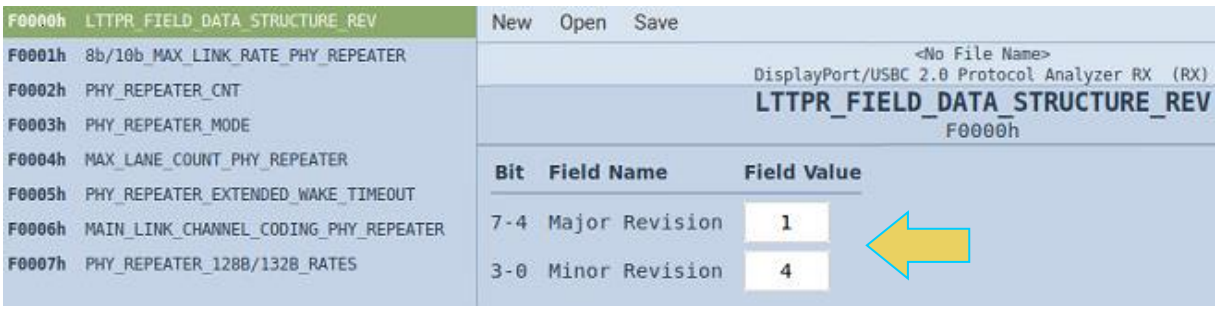
5. Make the desired adjustments to the emulated LTTPR within this Tools dialog box, and resume LTTPR emulation. In the following example, the LTTPR version has been switched to 1.4 and there are now 8 emulated LTTPR.



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**.

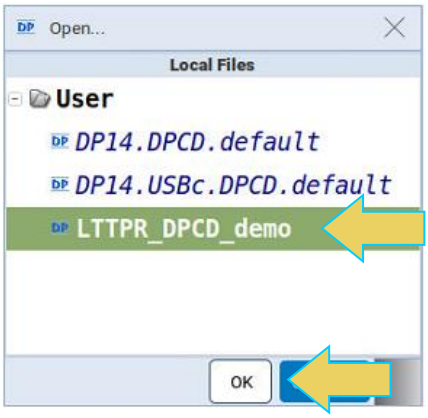
After reading the Rx DPCD, the first LTTPR Capability register will display as version 1.4, as shown below.



Open/Reapply Previously Saved DPCD

7. To restore the previously set and saved LTTPR 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 LTTPR Capability Register displays the previously configured Field Values for the LTTPR version number being emulated by the Rx.

The example within this subsection was a rudimentary change to the DPCD's LTTPR Register, but demonstrated the capability to save and open custom DPCDs when dealing with LTTPR. 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 LTTPR Capability Registers within the DPCD Editor can be found in **Appendix B. Configurable LTTPR Capability Registers**.

8.4 Testing LTTPR Devices with M42d as DPTX

The M42d also has the capability to test and read the ability of one or multiple LTTPR devices to link train with 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 LTTPR devices.

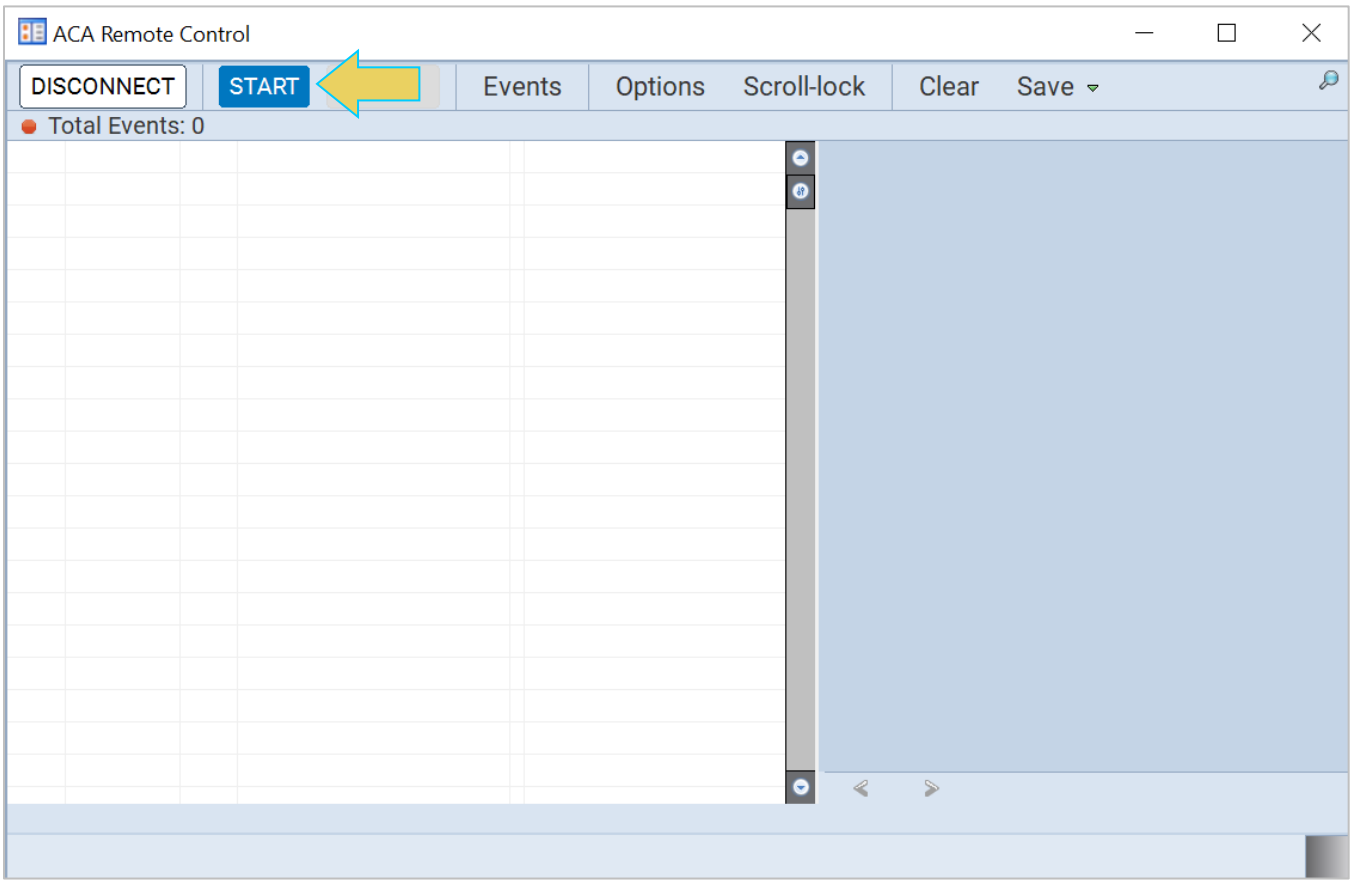
Note: This is a separately licensed capability. More information on licenses can be found in **Appendix A. Licenses**.

Monitoring Link Training Negotiations with LTTPR(s)

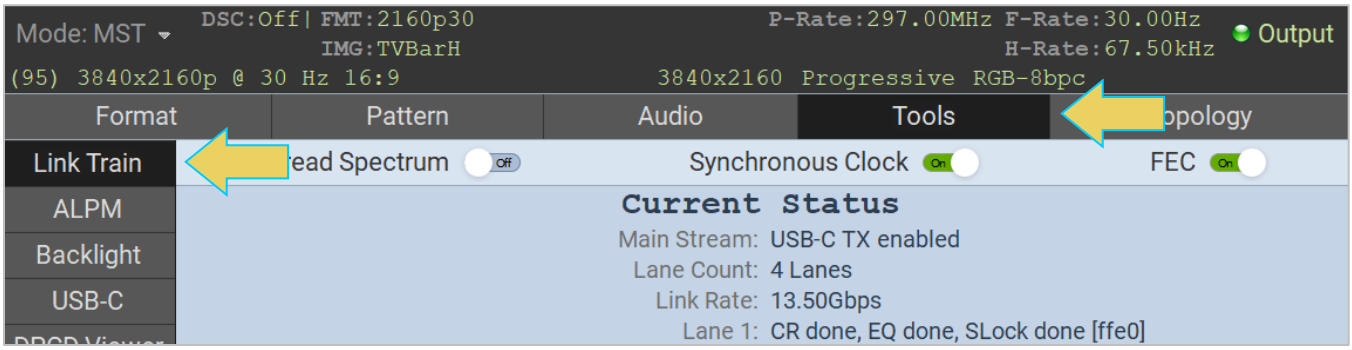
This subsection outlines the procedures for monitoring the link training transactions between the M42d instrument acting as a source and up to eight LTTPRs between source and sink.

With the LTTPR devices properly connected, open the ACA Utility or ACA Remote Control. The screenshot examples in this section are of the ACA Remote Control operating on a remote host PC, though the operation is similar to that of the ACA Utility on the embedded GUI ATP Manager of the M42d.

1. Connect to the correct M42d instrument if using the ACA Remote Control, and click **START** to begin monitoring the aux channel transactions.

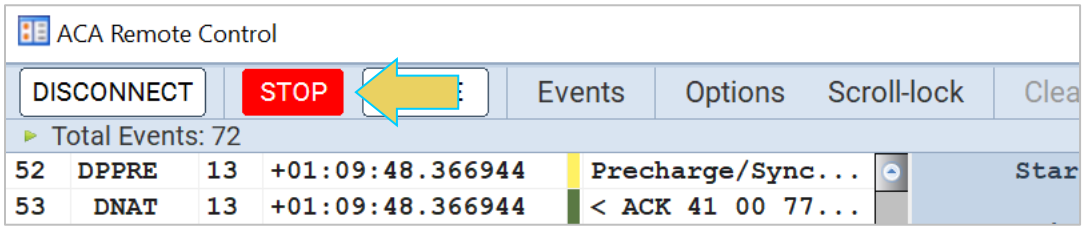


2. Navigate to the **Tools** tab within the **Generator** application. From there, select **Link Train** from the left-hand sidebar.



3. 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.

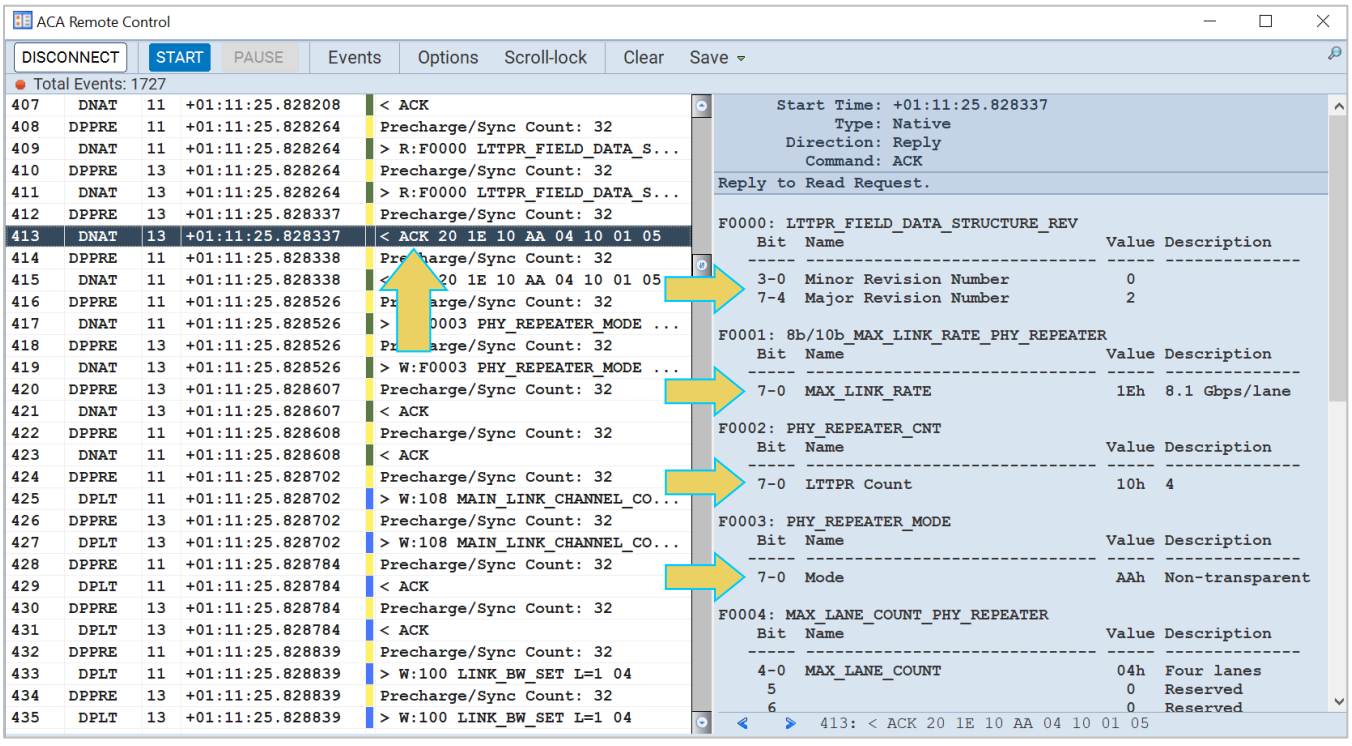
4. Once link training is complete, return to the ACA Utility or ACA Remote Control and click **STOP** to end the ACA trace.



Note: To use the more robust features of the **ACA Data Viewer**, including **finding** and **filtering** for specific event types, see **Chapter 6 Auxiliary Channel Analyzer (ACA)** for detailed instructions on saving trace files and accessing the ACA Data Viewer.

5. Within the Trace Panel, scroll to the appropriate event to view the LTTPR capabilities read during Link Training. A few of the capabilities demonstrated in the following example are displayed within the Event Details panel as follows:

   - LTTPR version 2.0 (value for Major Revision 2, Minor Revision 0)
   - Max Link Rate value is 1Eh (8.1 Gbps per lane)
   - LTTPR Count value is 10h (4 LTTPRs)
   - LTTPR Mode value is AAh (Non-transparent LTTPR)



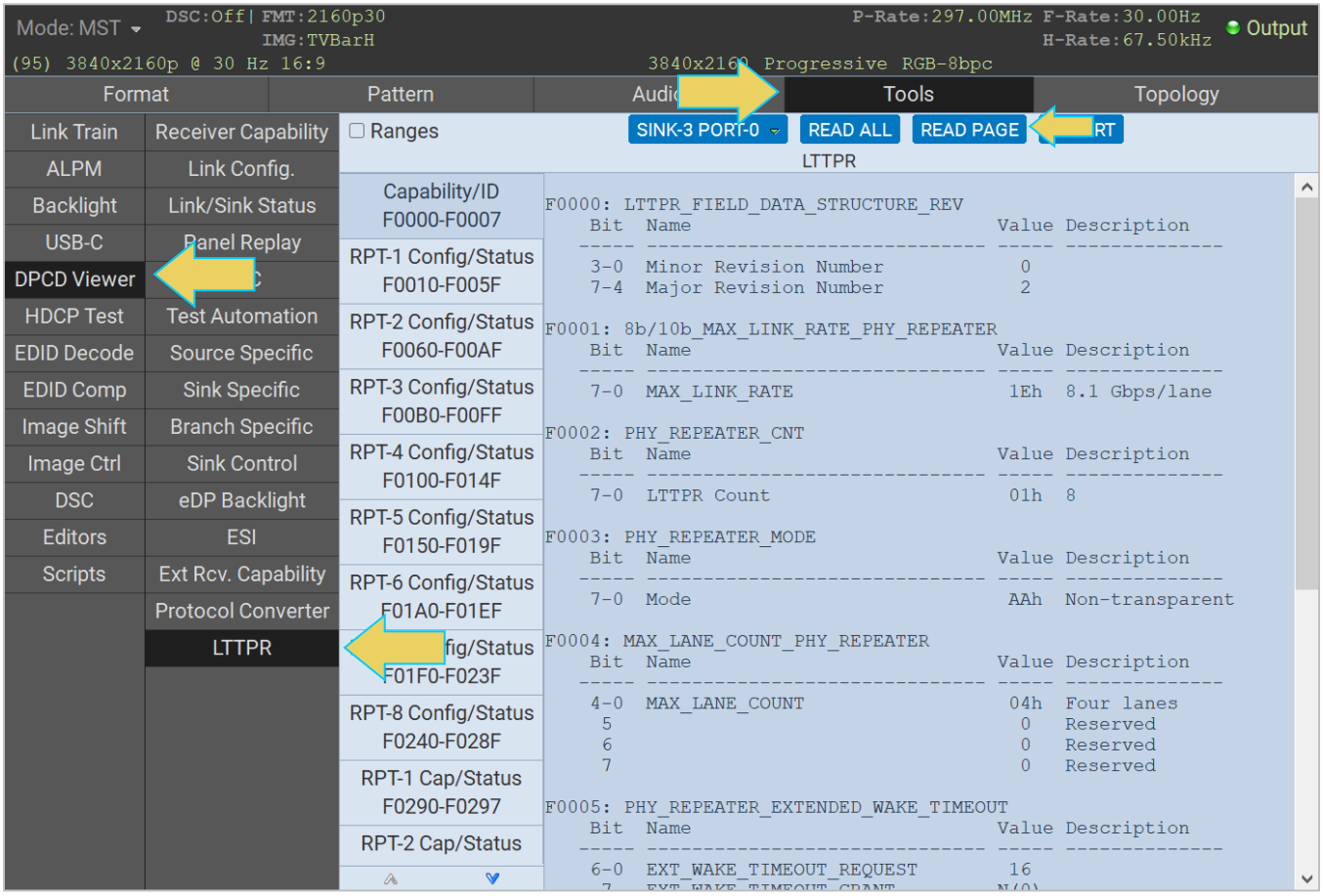
Reading DPCD Registers with LTTPR(s) Present

As discussed in **Chapter 3 Generator**, you can view the DPCD of a connected sink. The **DPCD Viewer** has the capability of reading connected LTTPR devices as well.

Navigate to the **DPCD Viewer** tool within the **Generator** application and **Tools** tab.

Select the **LTTPR** 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.



9 Panel Replay Testing

9.1 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

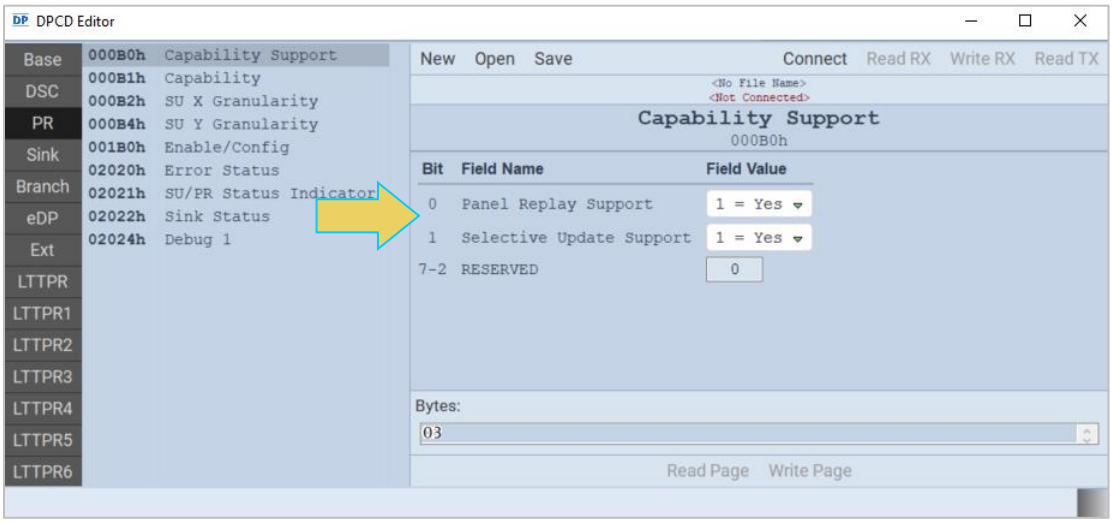
Note: Panel Replay testing is a licensed feature. Information on specific licenses can be found in **Appendix A. Licenses**

9.2 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 configure the DPCD registers to emulate support for Panel Replay, as shown in the following screenshot example.



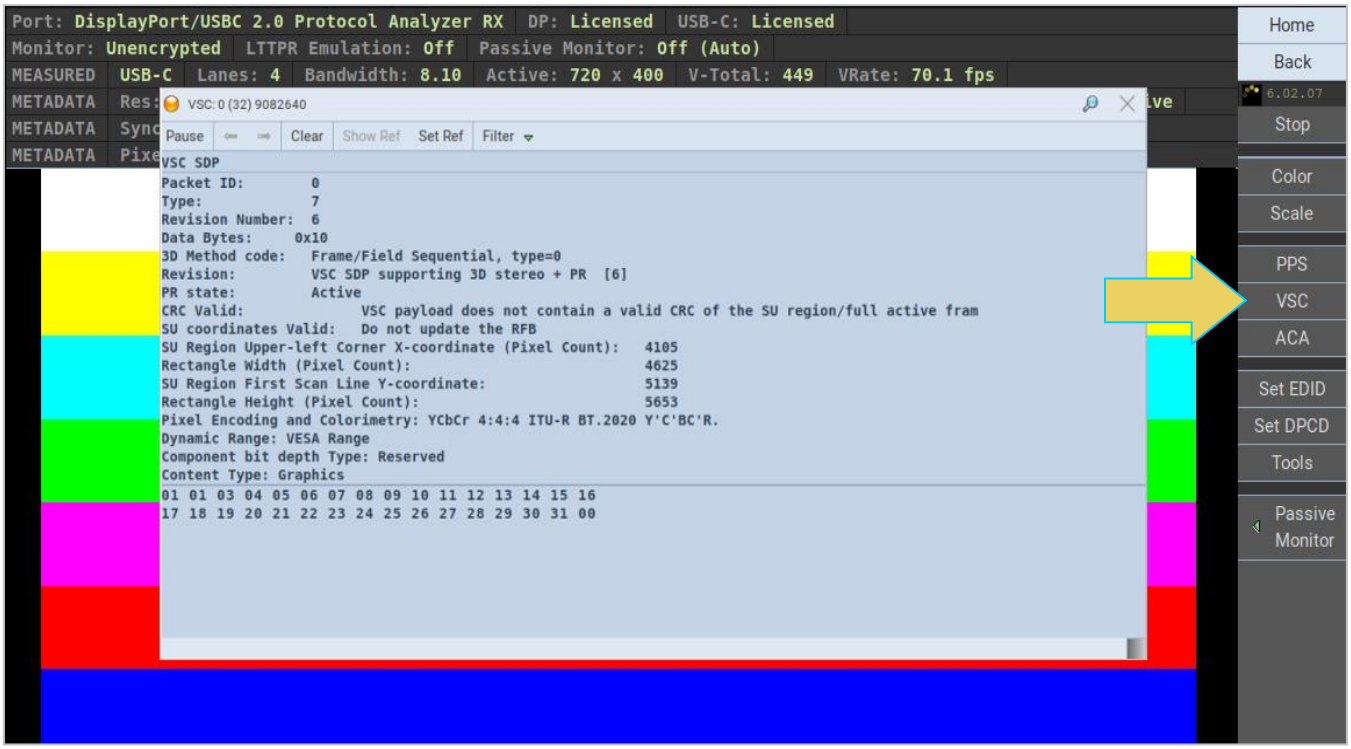
9.3 Viewing Panel Replay VSCs in Basic Analyzer window

The M42d offers the ability to view the Panel Replay VSCs within the real time Basic Analyzer.

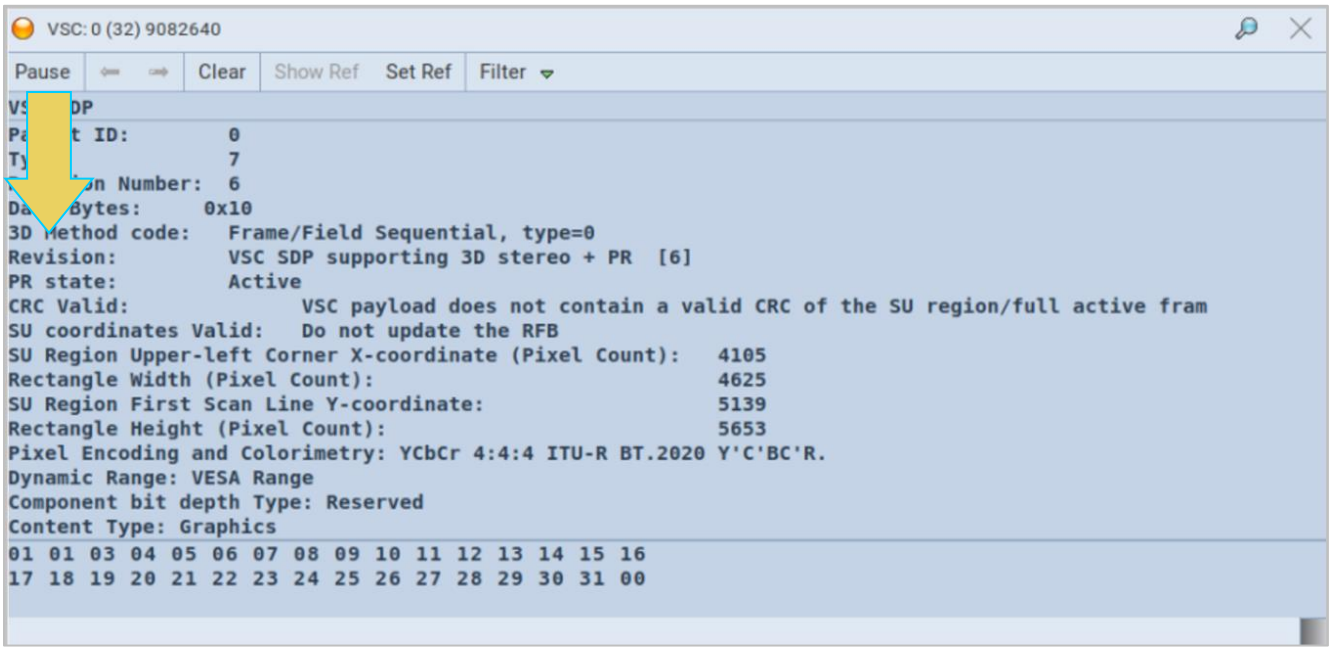
Use the following procedures to view the Video Stream Configuration data while testing a Panel Replay-capable source DUT.

Open the Basic Analyzer from the Home Screen. More information on the Basic Analyzer can be found in **Chapter 4 Source Verification with Basic Analyzer**.

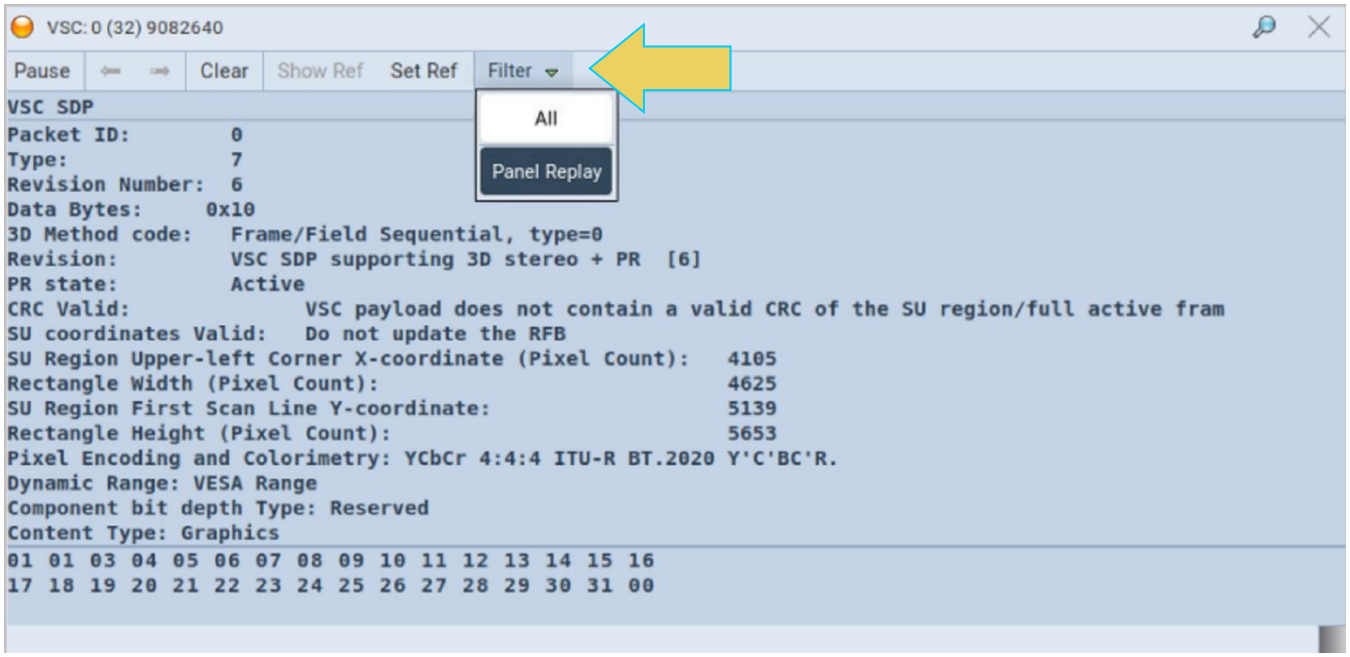
Access the VSC information window by clicking the **VSC** button in the right-hand control menu within the Analyzer. The VSC window will appear within the Analyzer, as demonstrated below.



The VSC window contains information about Panel Replay. Note the **PR State** and selective updates fields in the VSC packet example below.

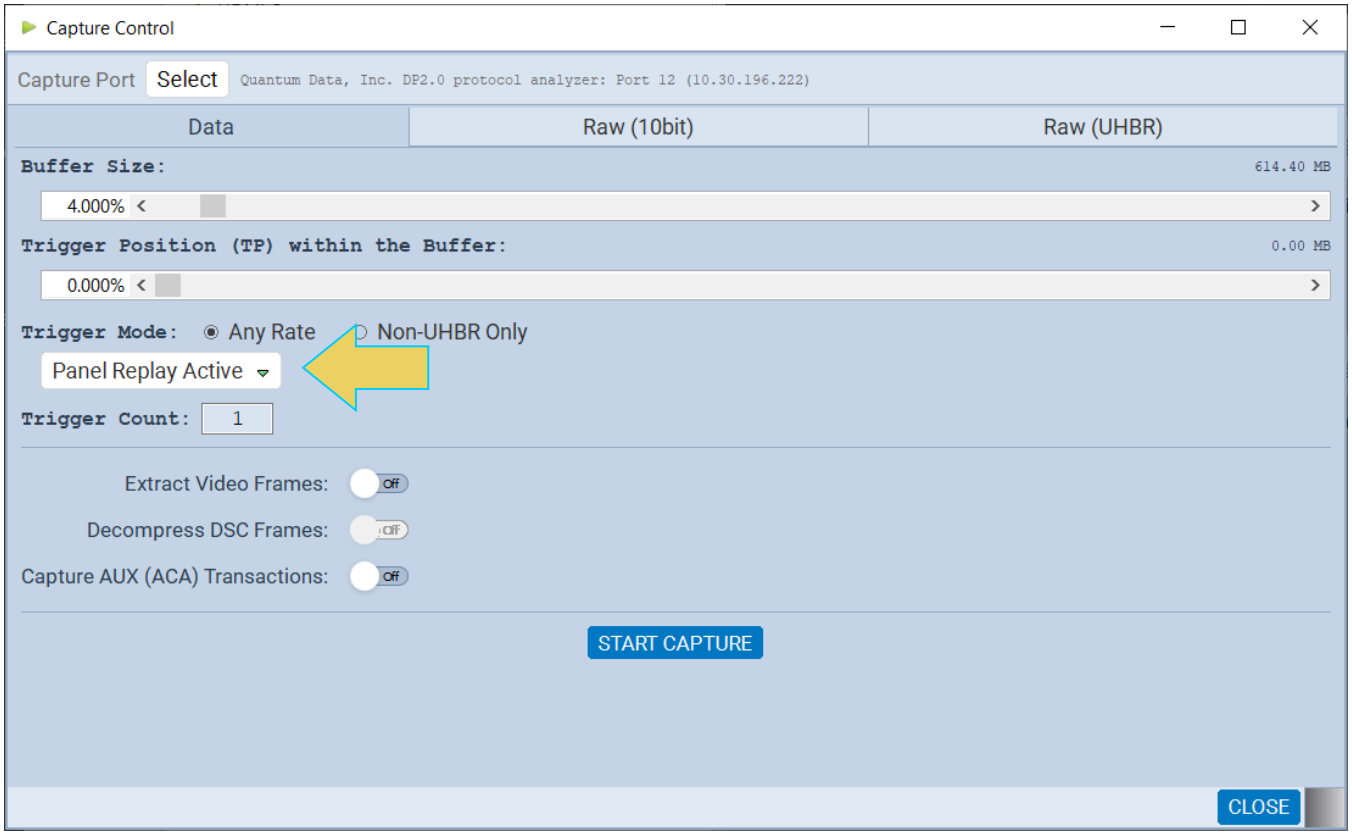


You may also utilize the **Filter** drop-down menu to view the Panel Replay VSC packets in real time, as demonstrated below.

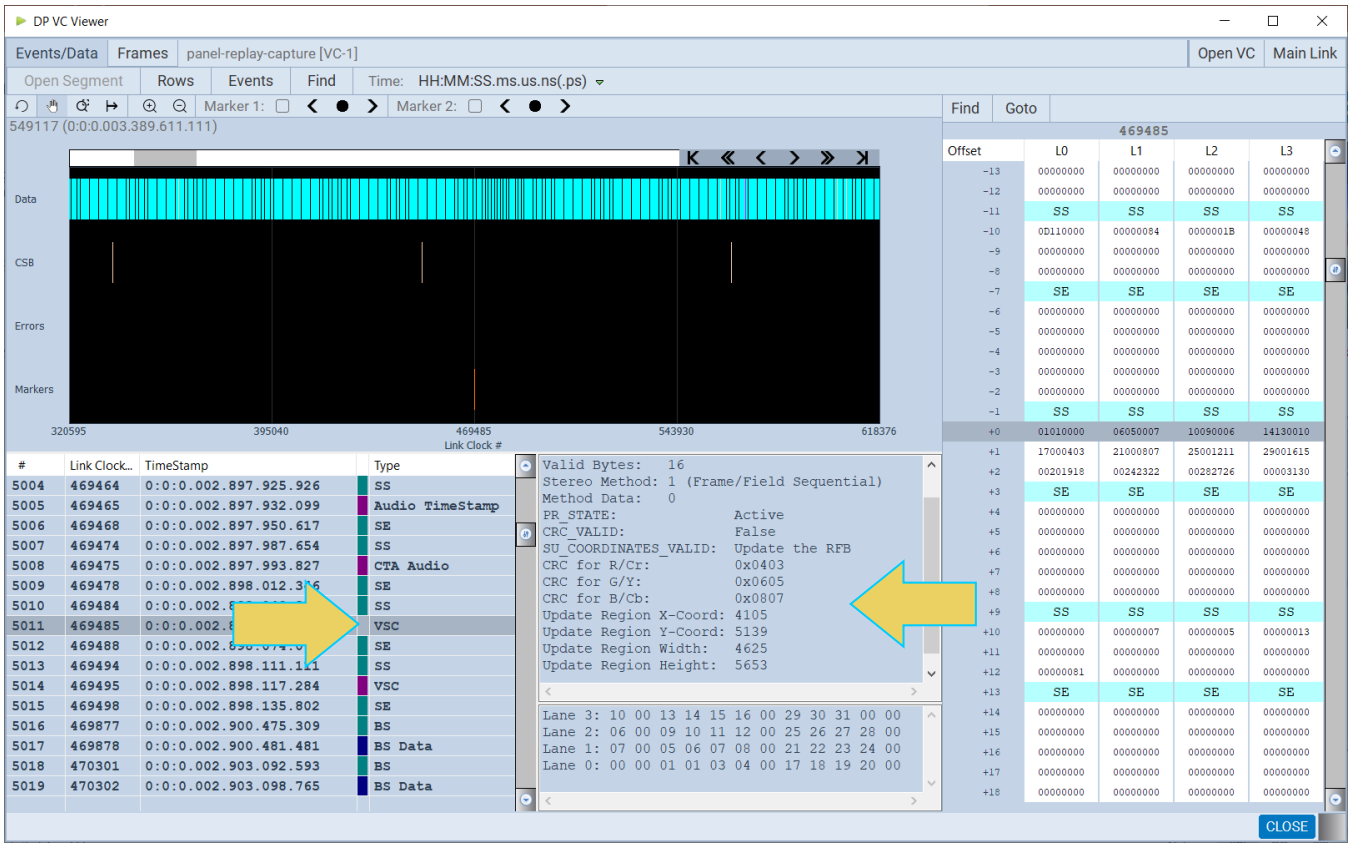


9.4 Capturing Panel Replay VSC Packets

The M42d offers the ability to capture VSC packets in the Protocol Analyzer. 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.

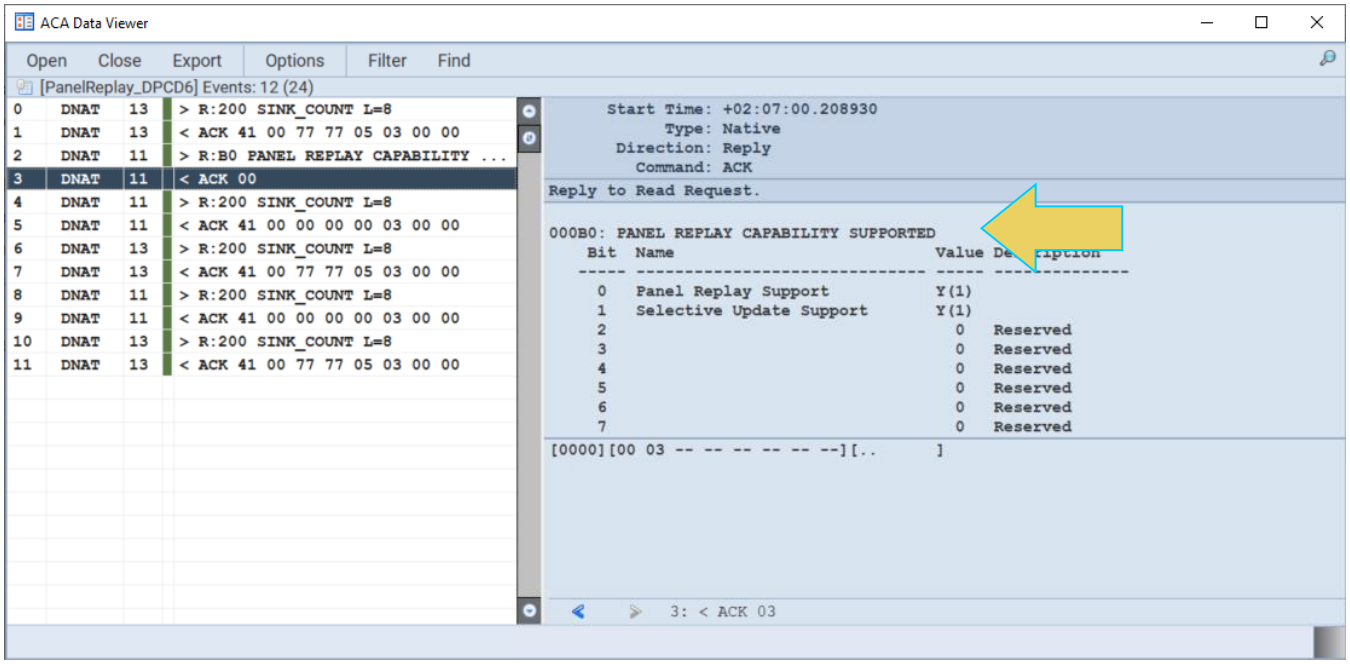


9.5 Viewing Panel Replay Auxiliary transactions

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 6 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.

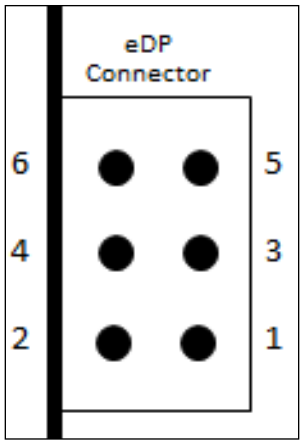


10 eDP

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.

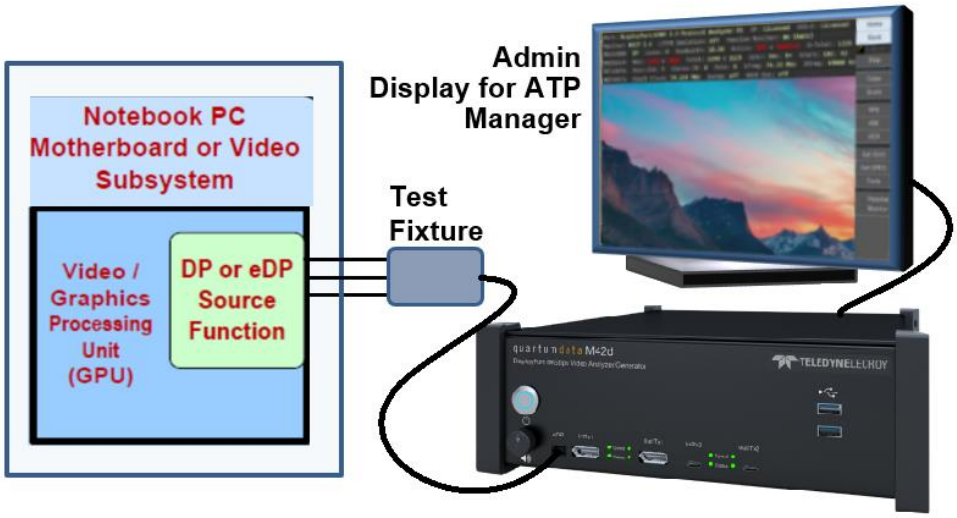
eDP Pin Configurations



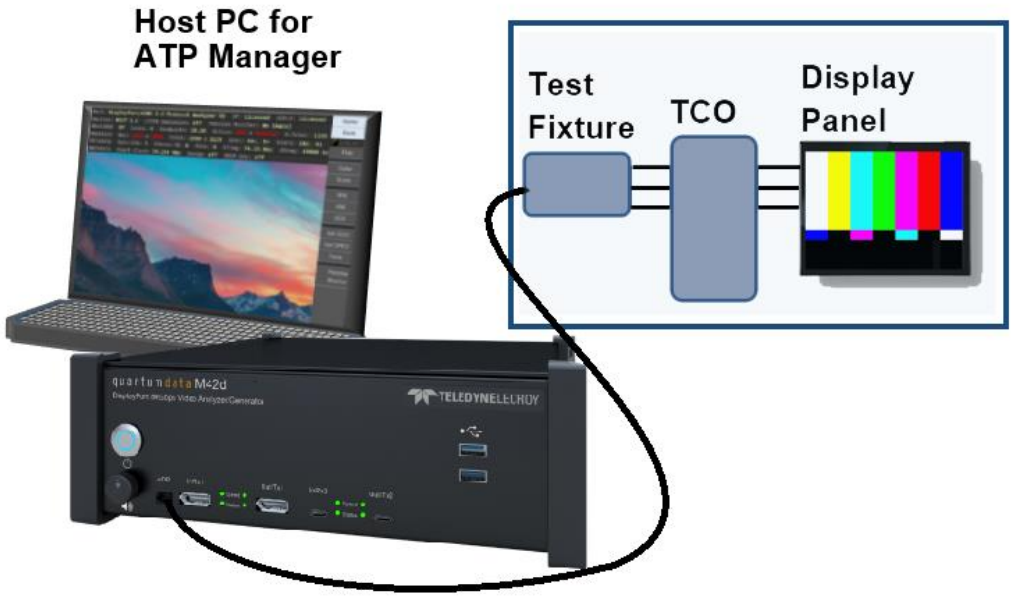
1. BL_Enable (Possible Future Rx input)
2. BL_Enable (Tx Output)
3. BL_PWM_DIM (Possible Future RX input)
4. BL_PWM_DIM (TX Output)
5. Ground
6. Ground

10.1 eDP Testing Connections

This section provides procedures on how to connect your eDP TCON panel or graphics source system to the M41d HBR3 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

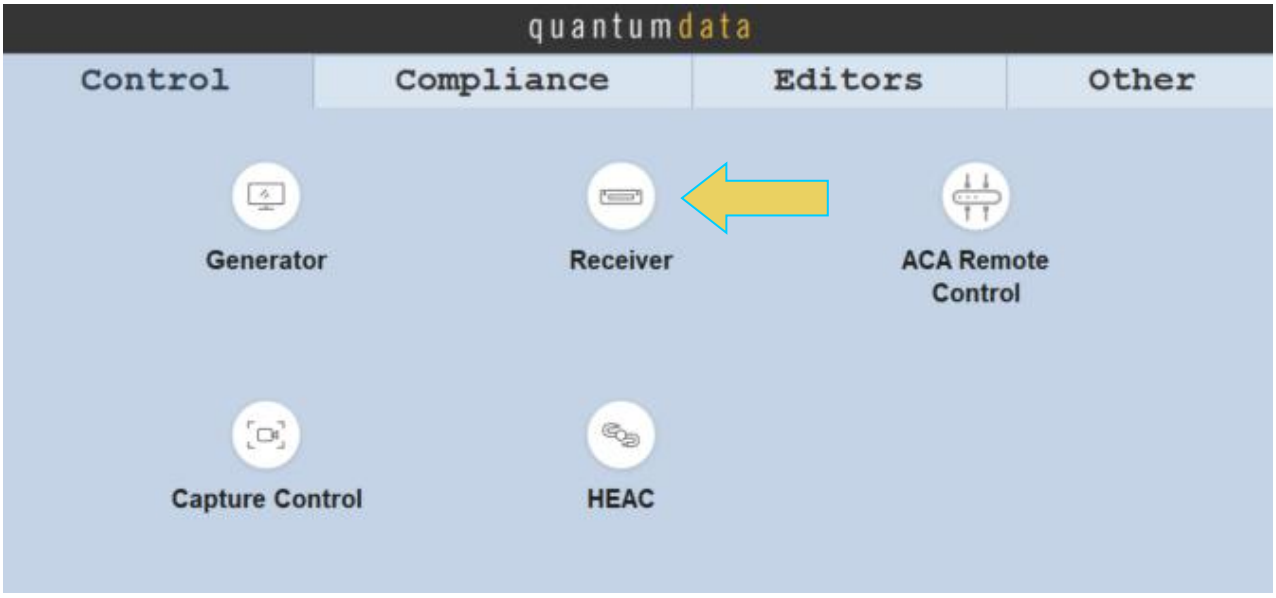
10.2 Fast Link Training

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.

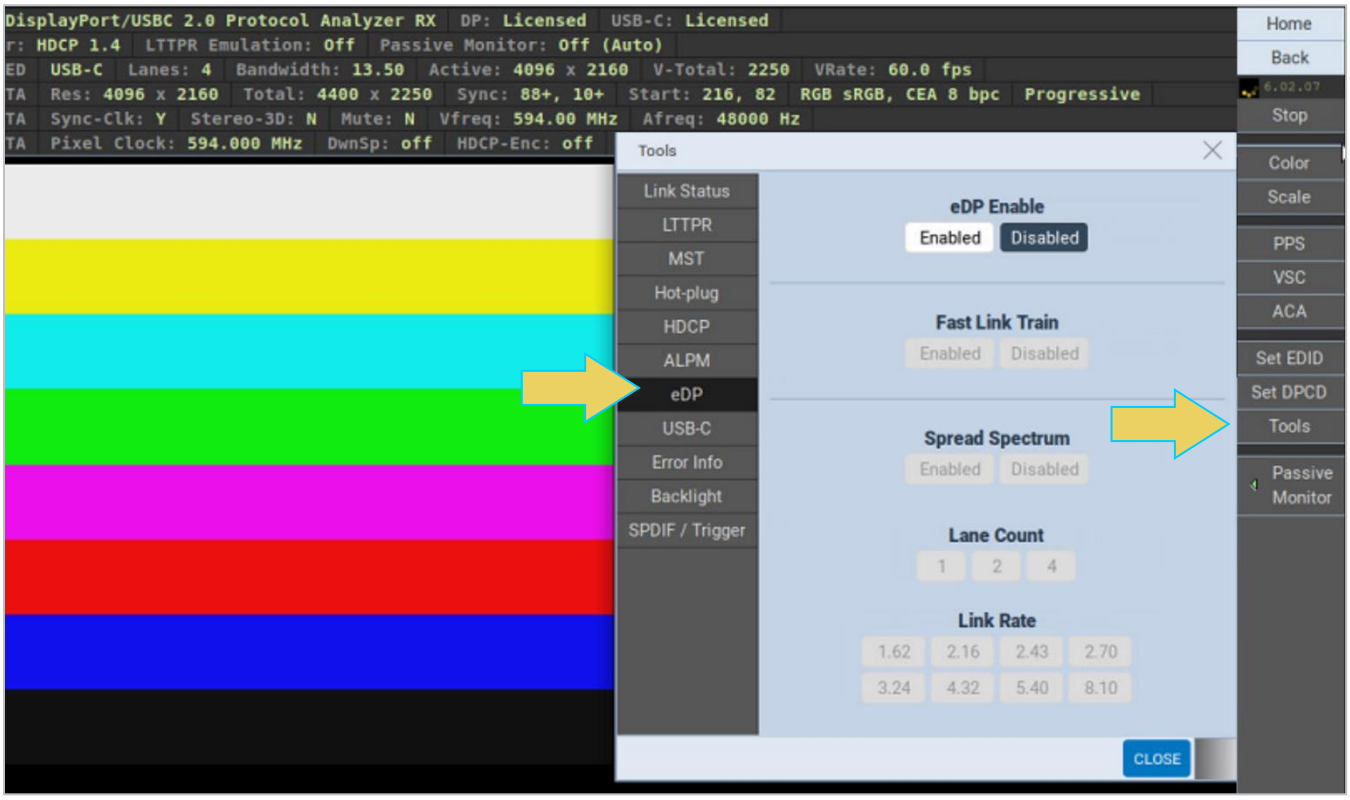
Fast Link Training – Source Tests

Use the following procedure to test eDP fast link training on an eDP source device.

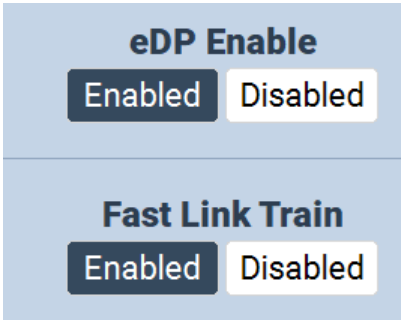
1. Navigate to the **Rx Analyzer/Receiver** from the Home screen of the M42d ATP Manager GUI



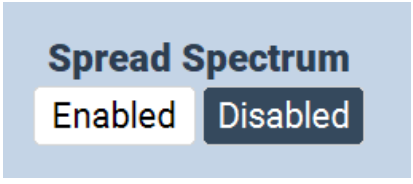
2. Within the Basic Analyzer, select the **Tools** button on the control menu, then select the **eDP** tab on the left-hand side of the Tools dialog box, as shown below.



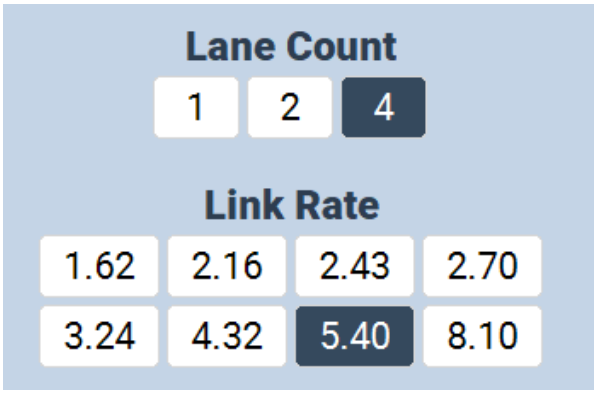
3. Enable eDP and Fast Link Training using the Enabled buttons indicated below:



4. Select to enable or disable **Spread Spectrum** according to your test requirements.



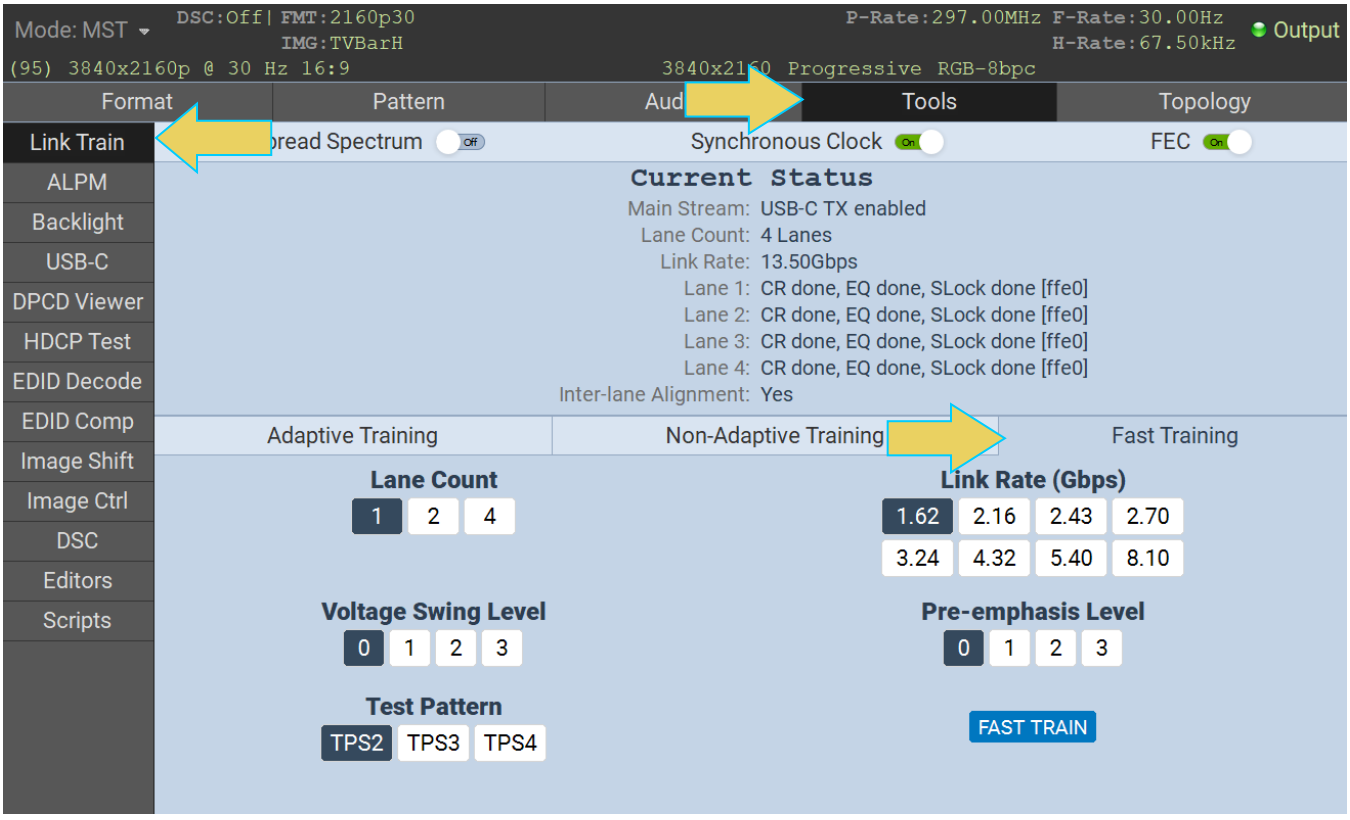
5. Select to Fast Link Training **Lane Count** and **Link Rate** according to your test requirements.



Fast Link Training – Sink Tests

Use the following procedure to test eDP fast link training on an eDP sink device.

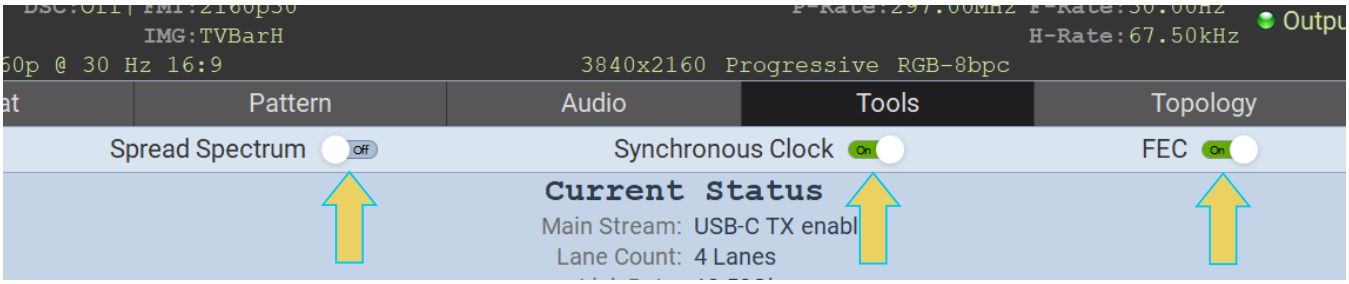
1. Access the Fast Link Training controls from the **Generator** panel and the **Tools** tab.



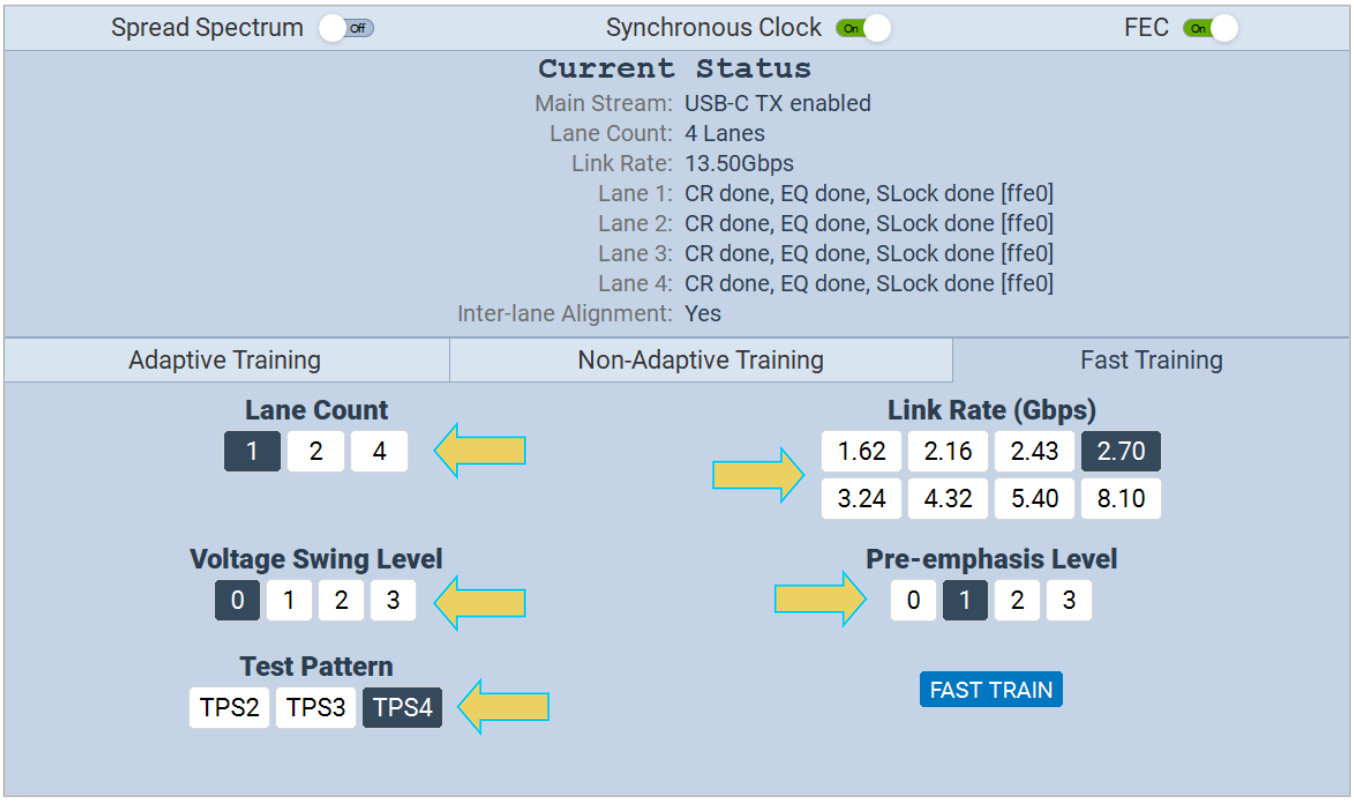
2. Select the Fast Train tab on the right as indicated by the arrow on the above screen shot.

   The Link Train window shows the **Current Status** in the top panel, and the control options within the bottom panel.

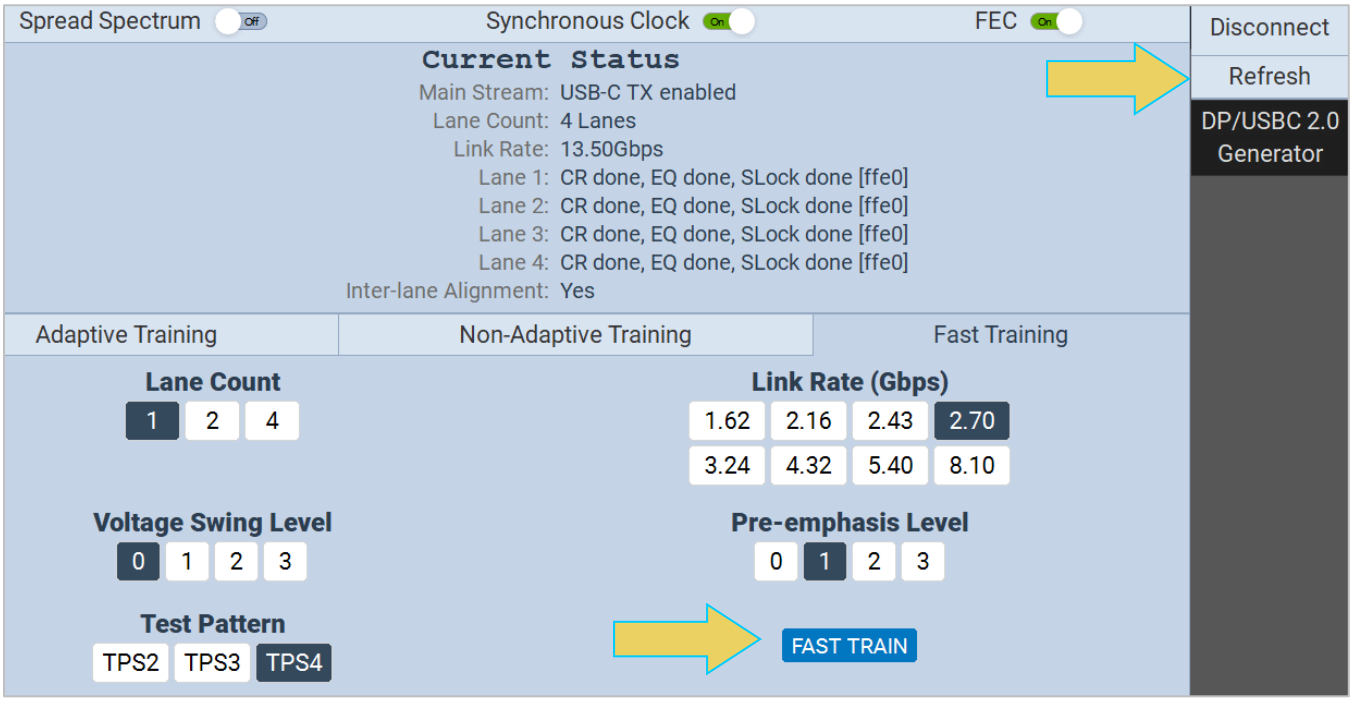
3. Toggle on or off **Spread Spectrum**, **Synchronous Clock**, and **FEC** (Forward Error Correction) at the top of the window according to your test requirements, as demonstrated below



4. Select the Lane Count, Link Rate, Voltage Swing, Pre-Emphasis and the Test Pattern in accordance with your eDP test requirements. See below.

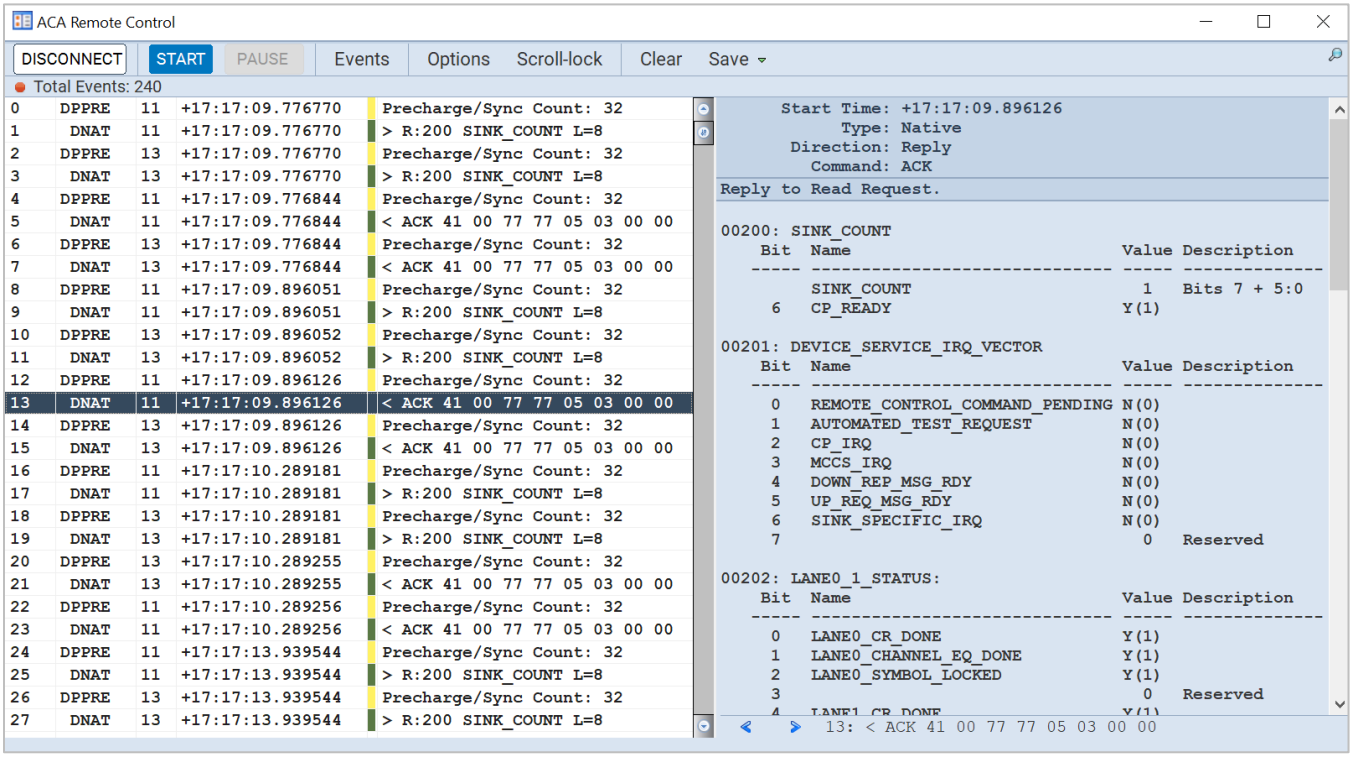


5. Click on the Fast Train button to initiate the link training. Then click on the Refresh button, as shown below



Fast Link Training – 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.



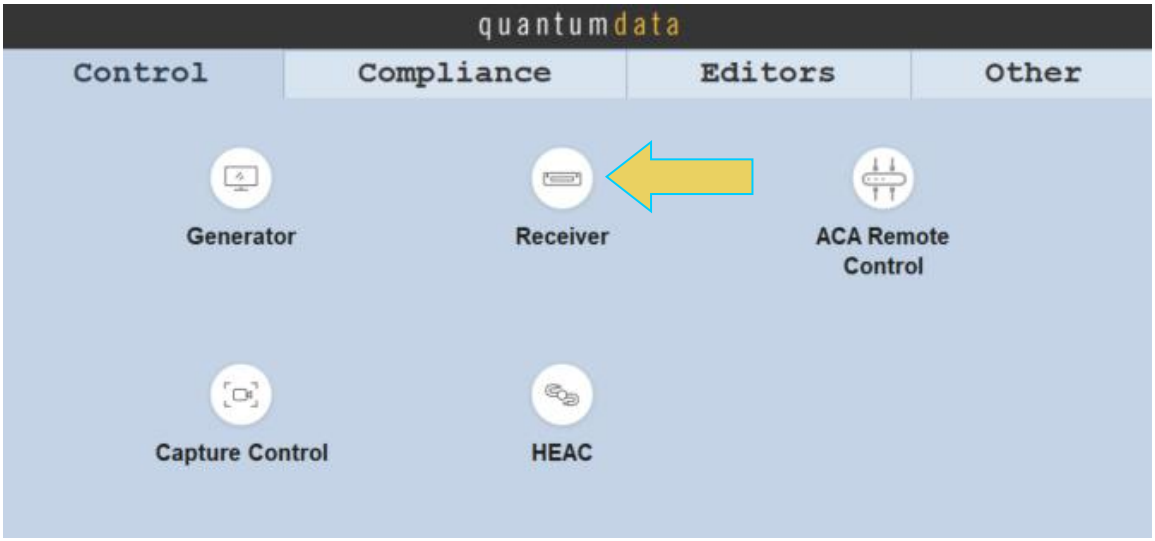
10.3 Advanced Link Power Management (ALPM)

This section provides procedures on testing eDP ALPM on eDP source and sink devices.

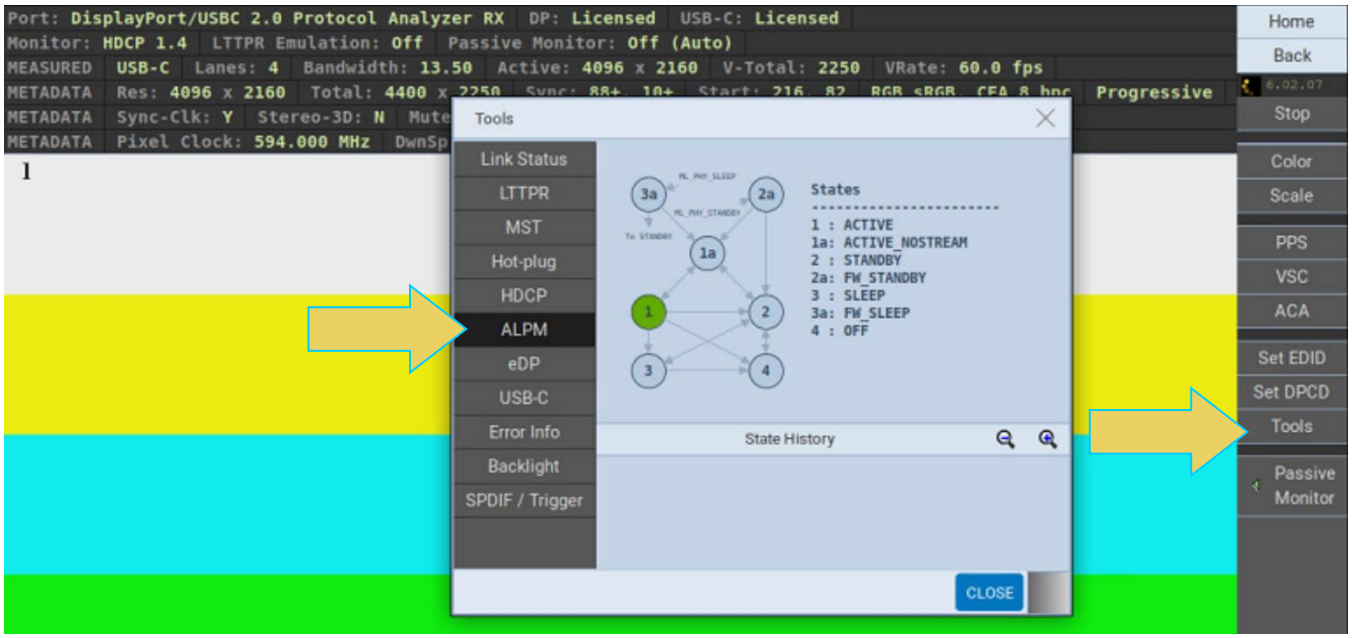
ALPM – Source Tests

Use the following procedure to test eDP ALPM on an eDP source device.

1. Navigate to the Rx Analyzer/Receiver from the Home screen of the M42d ATP Manager GUI.



2. Within the Rx Analyzer, Select the **Tools** button on the control menu, then select the **ALPM** tab on the left-hand side of the Tools dialog box, as shown below.



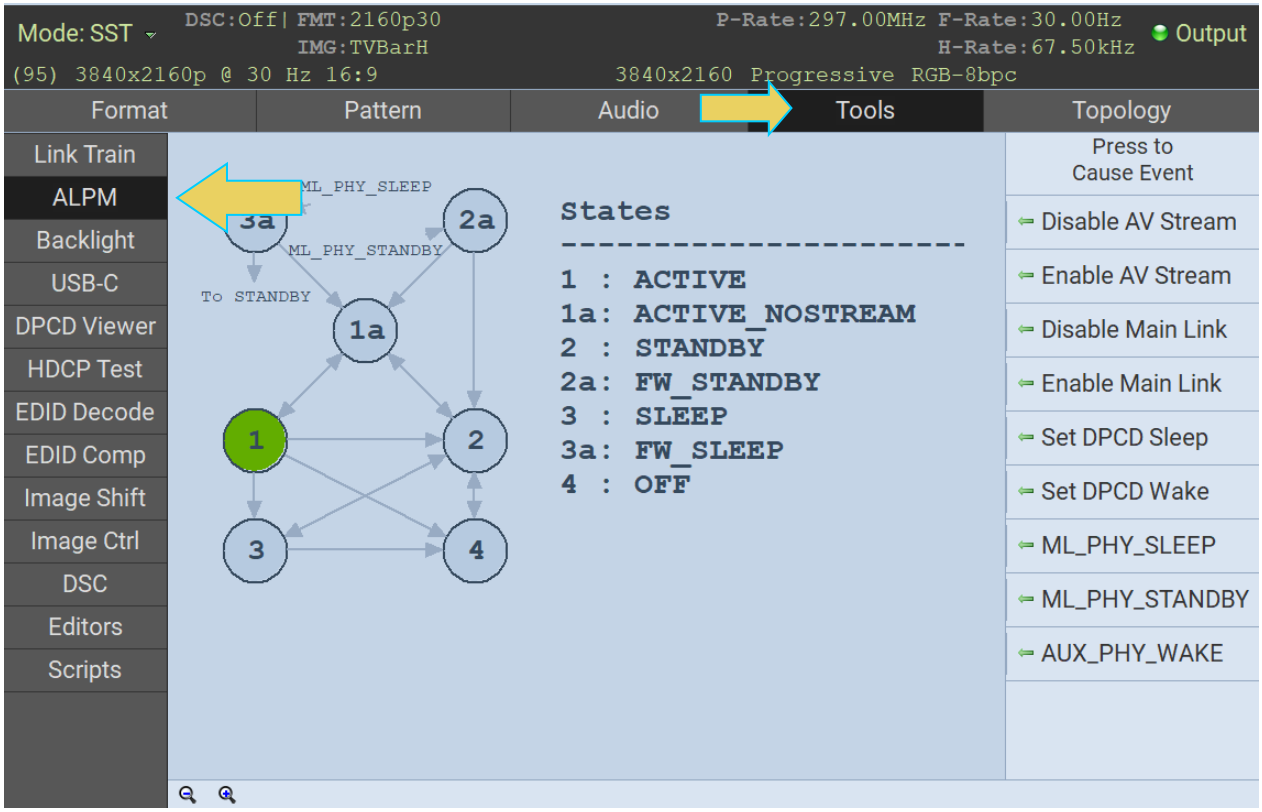
3. Within this window, view the **States** diagram on the top of the **Tools** panel and the **State Transaction History** at the bottom.

   Note: You may need to zoom in or out on the diagram, which can be done using the magnifying glass icons at the bottom right of the panel  as shown above

ALPM – Sink Tests

Use the following procedure to test eDP ALPM on an eDP sink device.

1. Access the **ALPM** controls from the **Generator** panel and the **Tools** tab, as shown below.

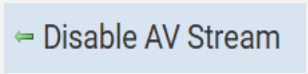
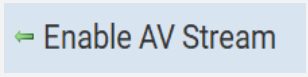
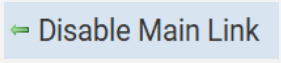
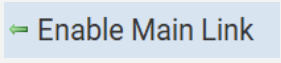
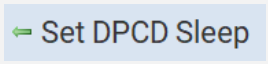
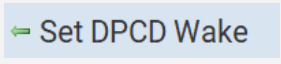
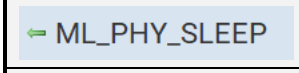
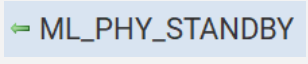
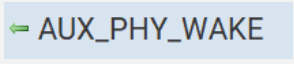


2. Select the ALPM button on the left indicated by the arrow on the above screen shot.

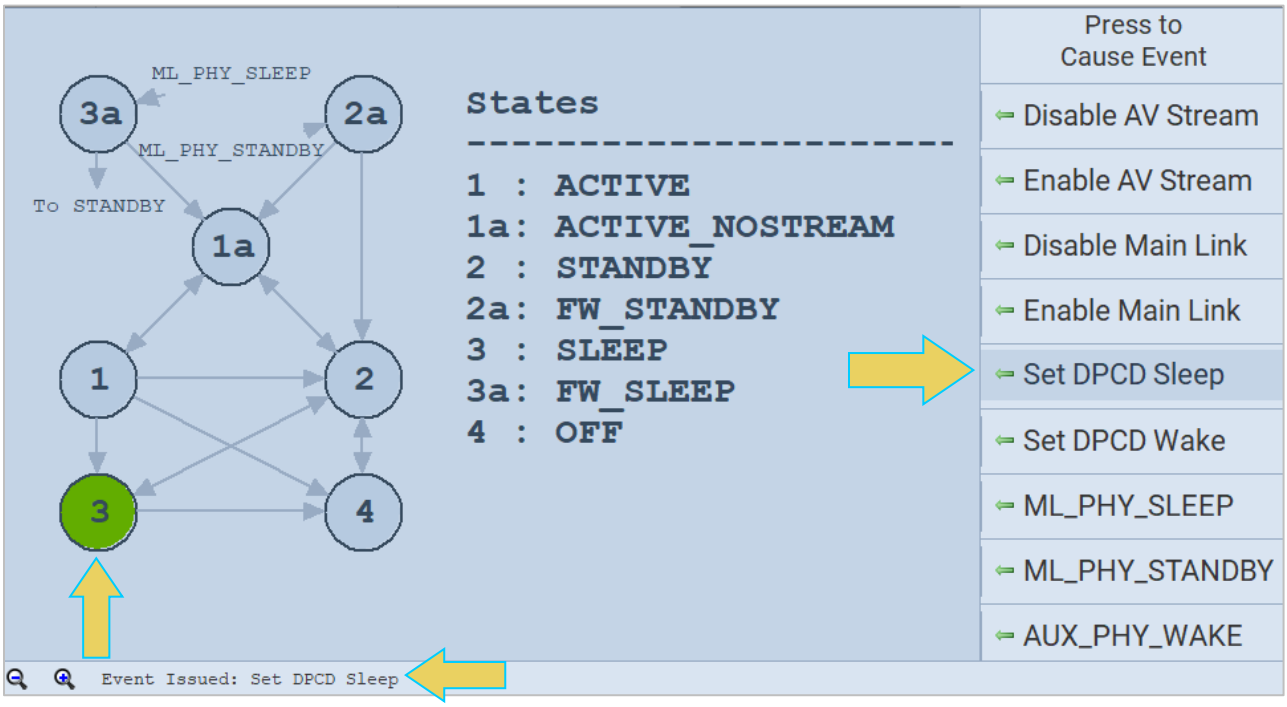
   The ALPM window shows the current state on the left side of the panel.

3. Select the activation buttons on the right side of the window underneath **Press to Cause Event** to cause transitions to the various ALPM states.

The following table describes the ALPM **Activation** function buttons.

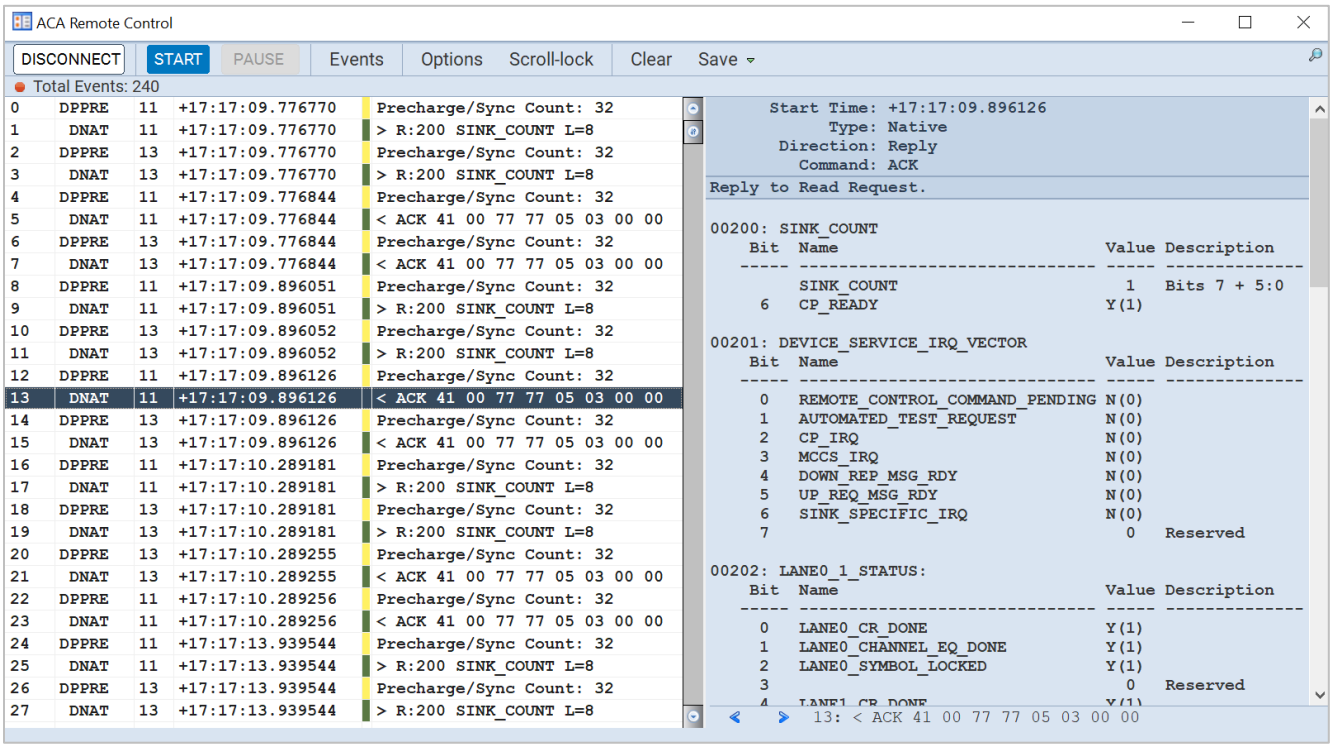
ALPM State Transition Buttons	
Activation Buttons	**Function**
Disable AV Stream 	Disables the streaming of audio and video over the main link. The link is trained and the source is sending either an idle pattern or a ML_PHY_LOCK pattern. Causes a transition to the 1a state: Active NoStream.
Enable AV Stream 	Enables the streaming of audio and video over the main link. The link is trained and the source is sending an AV stream. Causes a transition to the 1 state: Active.
Disable Main Link 	Disables the Main Link.
Enable Main Link 	Enables the Main Link.
Set DPCD Sleep 	Puts the ALPM sink in the Sleep state by writing to DPCD registers over the Aux Channel.
Set DPCD Wake 	Puts the ALPM sink in the Wake state by writing to DPCD registers over the Aux Channel.
ML Phy Sleep 	Puts the ALPM sink in the Sleep state by sending K-character sequence over the Main Link.
ML Phy Standby 	Puts the ALPM sink in the Standby state by sending K-character sequence over the Main Link.
Aux Phy Wake 	Puts the ALPM sink in the Standby state by writing a bit sequence over the Aux Channel.

The example below demonstrates the **Set DPCD Sleep** event being activated



Fast Link Training – Monitoring the ALPM Transactions on the Aux Channel

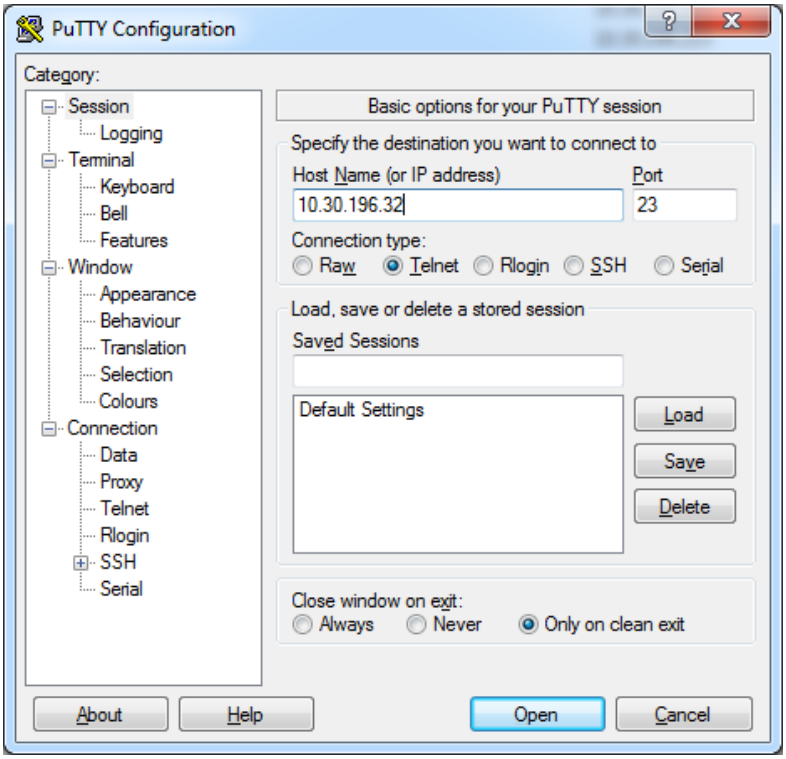
Refer to the ACA section **Monitoring the DisplayPort auxiliary channels with the ACA utilities** for procedures in monitoring the eDP ALPM Aux Channel transactions associated with the eDP negotiations. A sample screen shot is shown below.



10.4 Alternate Scrambler Seed

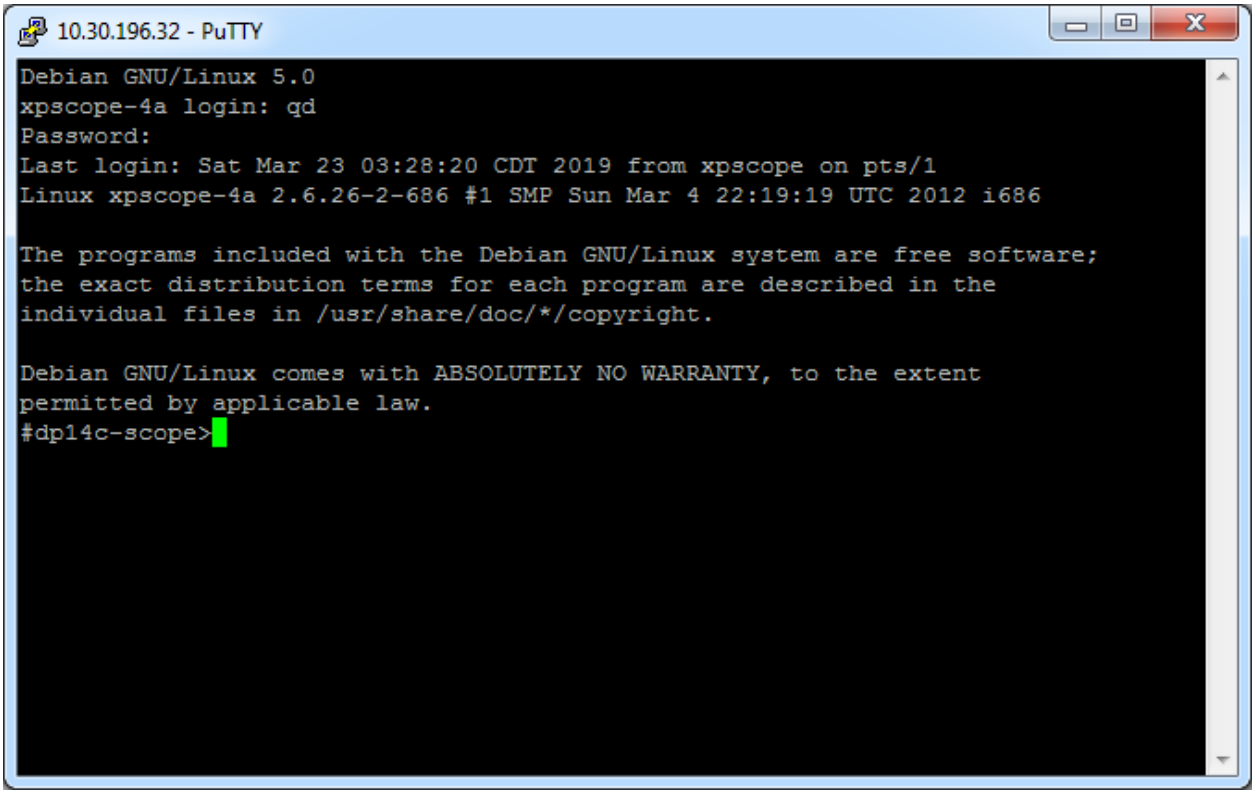
The DP 2.0 eDP-capable module supports the alternate scrambler seed. Currently the feature is supported only through the command line. Use the following procedures to activate the alternate scrambler seed for an eDP source.

1. Access the command line interface through the ATP GUI Manager console or a terminal program such as PUTTY as shown below.

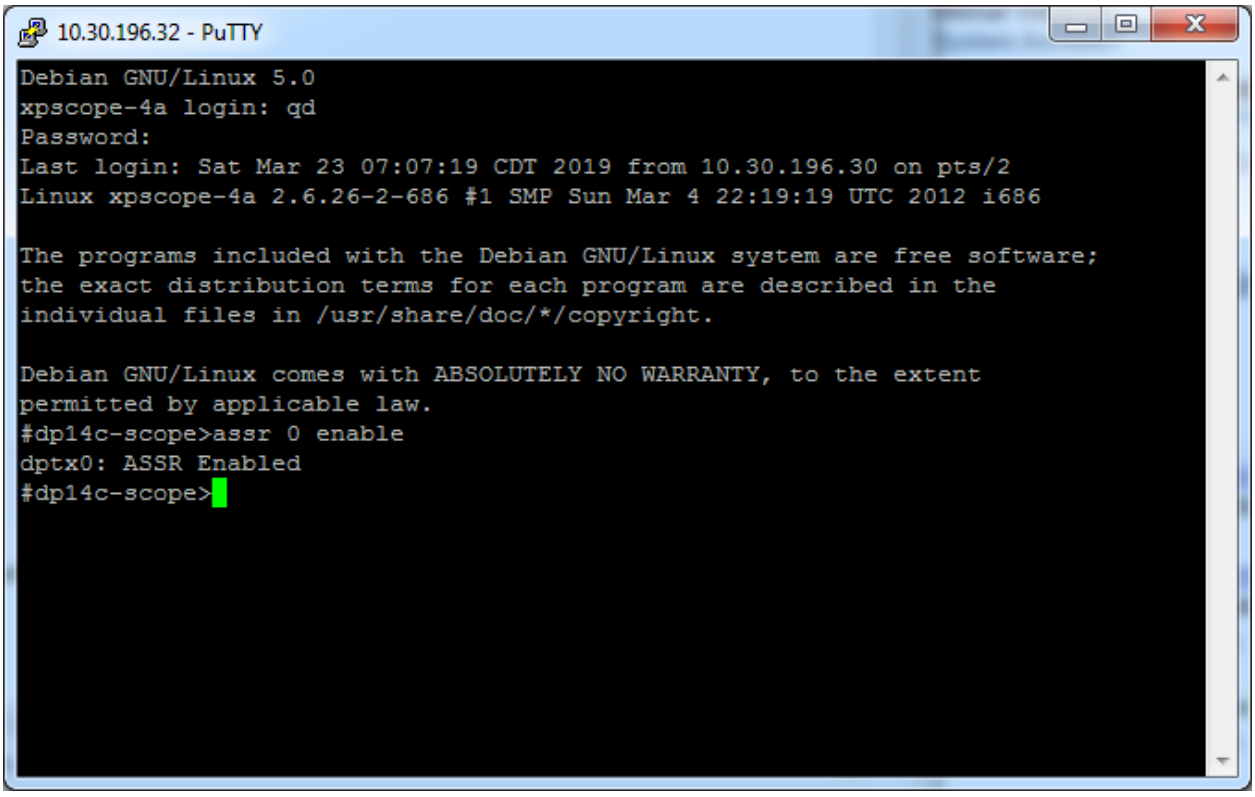


2. Enter qd for the login.
3. Enter qd for the password.

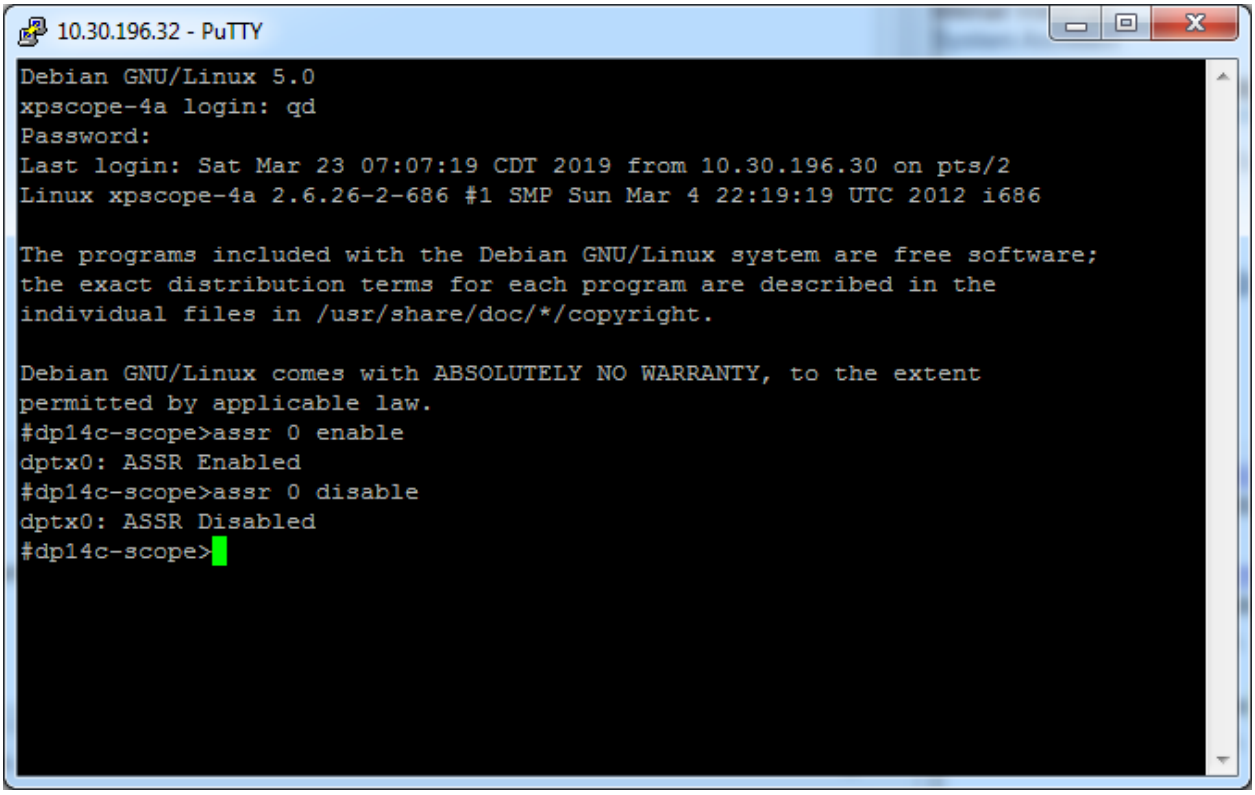
The following screen appears.



4. To enable alternate scrambler, type the following command:



5. To disable alternate scrambler, type the following command:



10.5 Backlight Control

This section describes backlight control and provides procedures for using the M41d 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 thought direct connection leads.

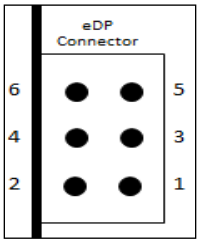
Backlight Control Test Connections

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.

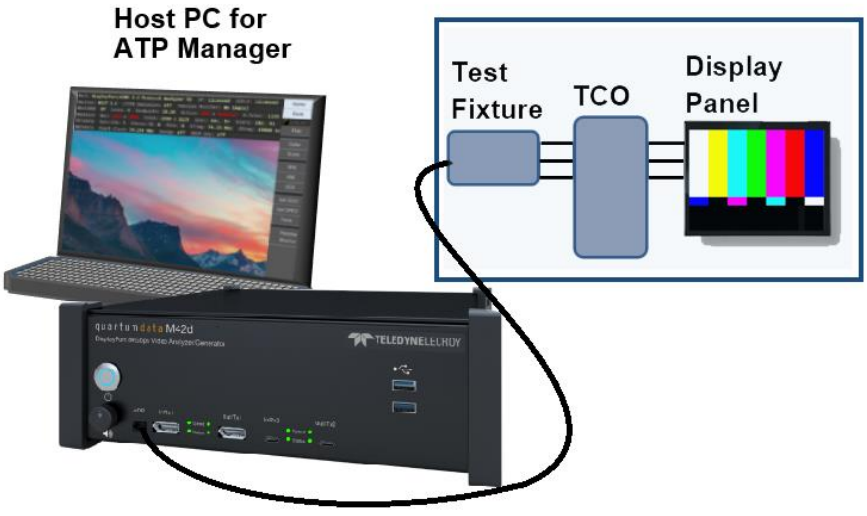
1. Connect the provided cable from the eDP System Panel using the eDP connector.
2. Connect the other end with the standard DP connector and the eDP header block the provided cable to the M42d. Refer to the diagrams below.

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

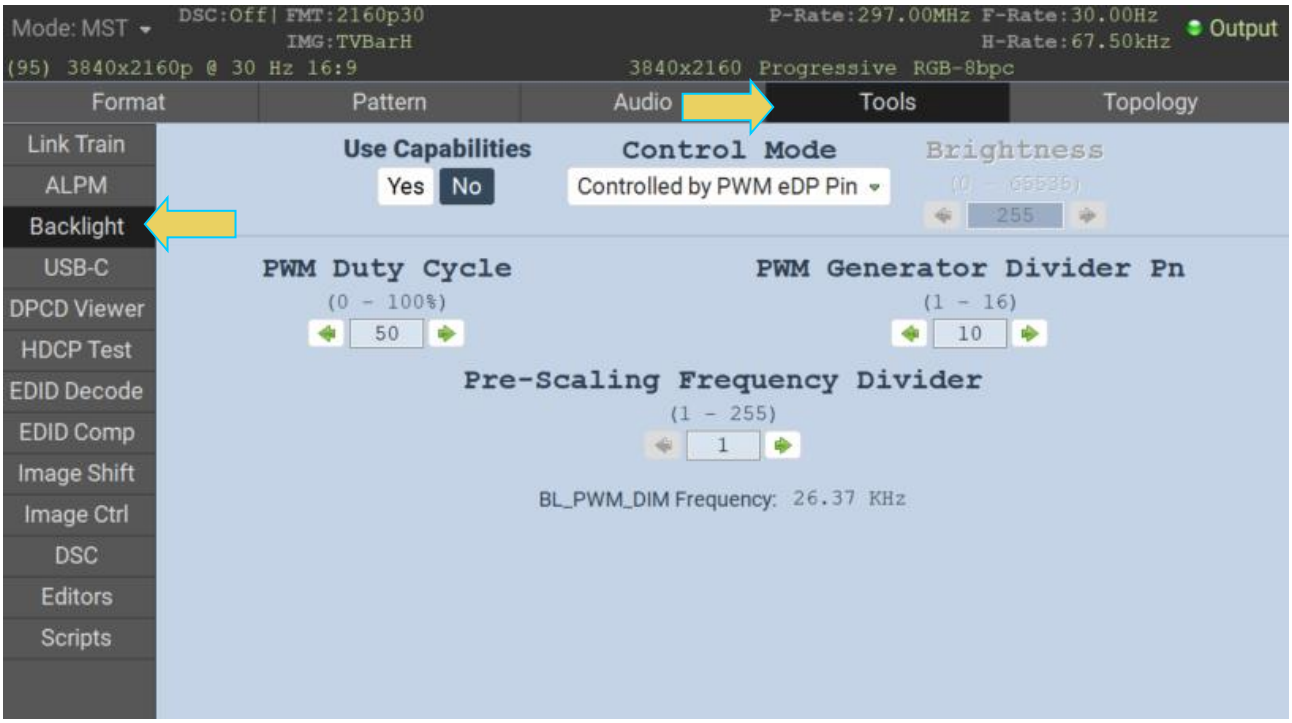


eDP Sink Test Connections

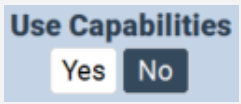
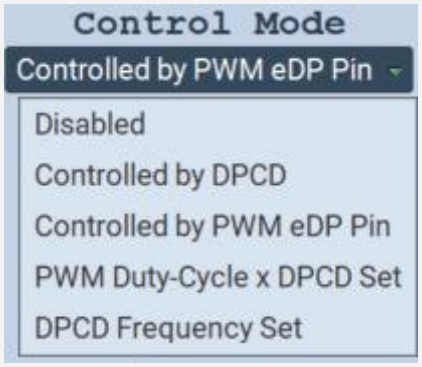
Backlight Control – Sink Tests

Use the following procedure to test eDP backlight on an eDP sink device.

1. Access the **Backlight** controls from the **Generator** panel and the **Tools** tab. Refer to the screen below.



The following table describes the Tx Backlight Controls.

Tx Backlight Control Fields	
	**Use Capabilities** – Enables or disables the Backlight control feature.
	**Control Mode** – Select how the backlight is controlled. Options available are: ▪ Disabled - ▪ Controlled by DPCD ▪ Controlled by PWM eDP Pin ▪ PWM Duty-Cycle x DPCD Set ▪ DPCD Frequency Set
	**Brightness** – Set the brightness of the backlight. **Note:** Must be in **Controlled by DPCD** mode

Tx Backlight Control Fields	
	**PWM Duty Cycle** – The Duty Cycle control can be modified in percentages from 0 to 100%. The percentage of the Duty Cycle controls the percentage of the voltage high period.
	**Pre-Scaling Freq Divider** – The Pre-Scaling Frequency Divider is used to pre-scale the backlight PWM Cycle frequency.
	**PWM Generator Divider Pn** - The PWM Generator Divider is used to create backlight dimming PWM signal.

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**

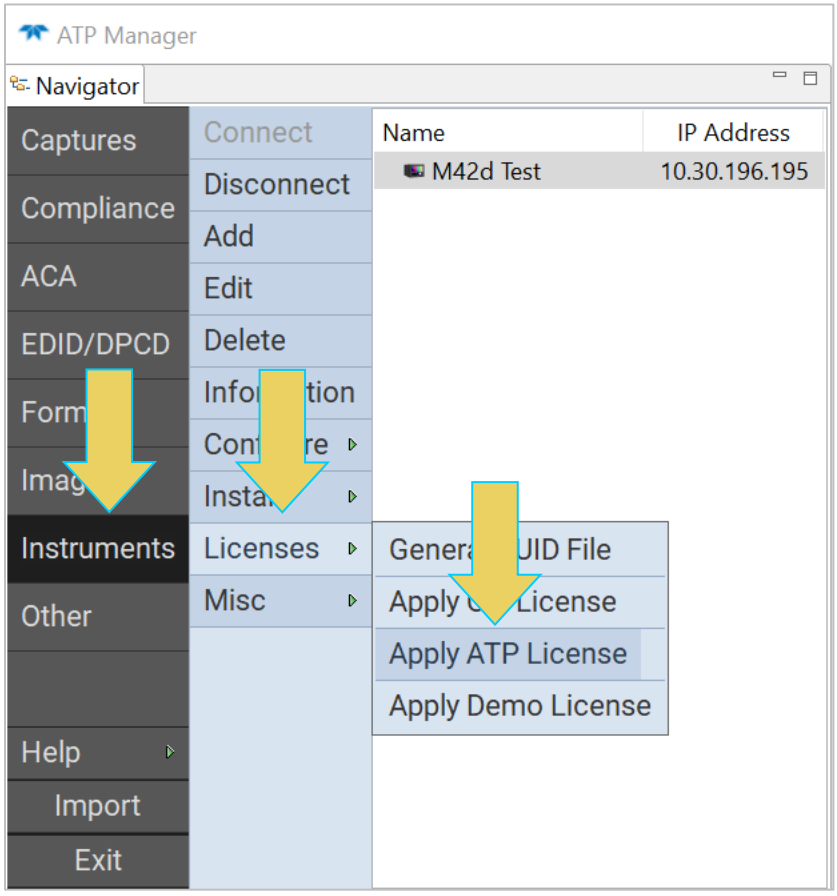
Applying Licenses

To apply a license:

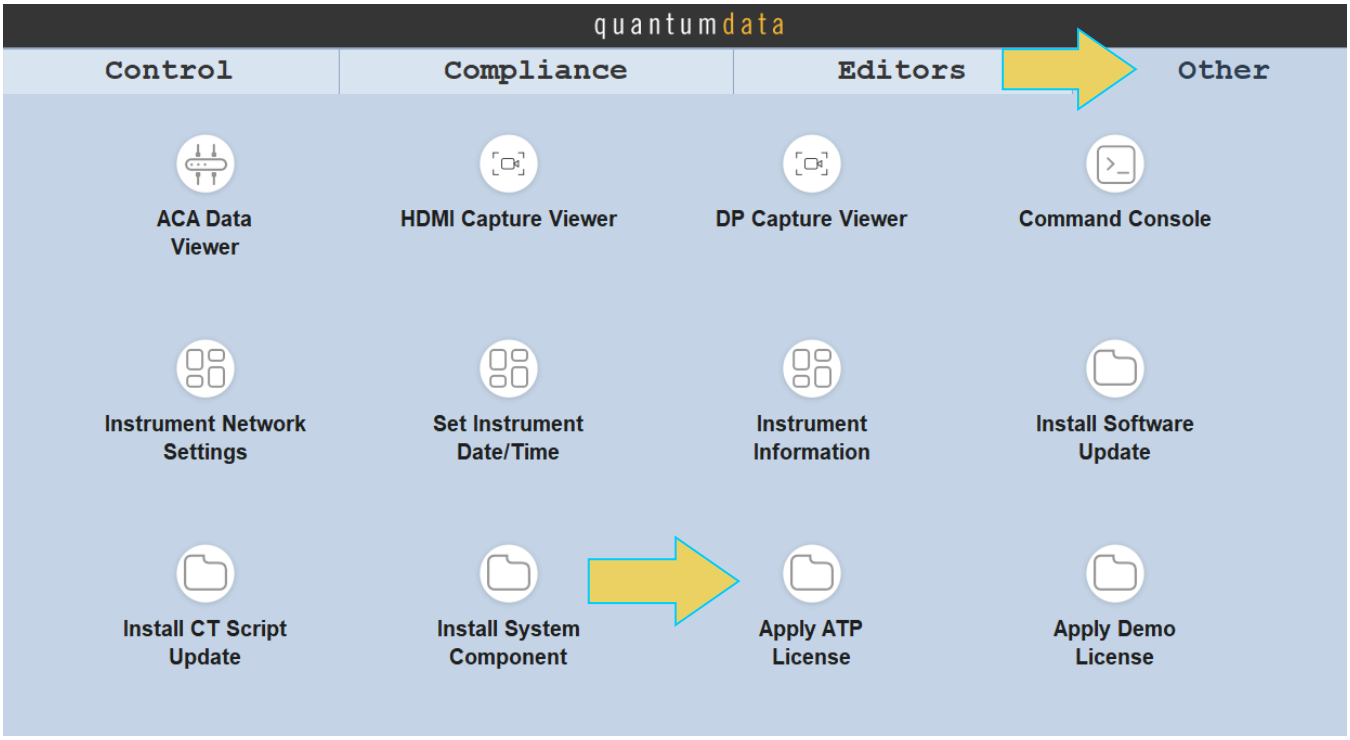
1. Upload the license file (.lic) using the Navigator by clicking **Instruments,** then selecting **Licenses** and clicking **Apply ATP License.** Alternatively, you can access this by selecting the **Other** tab on the GUI home screen and selecting **Apply ATP License**. Both are shown below.

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

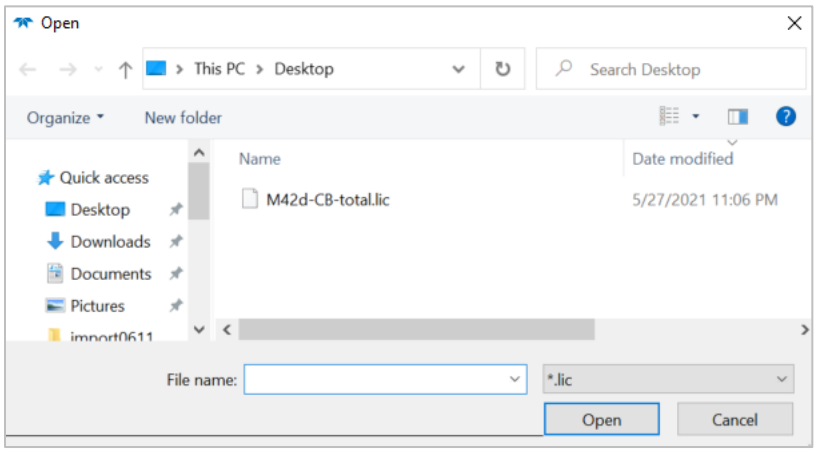
   Using the Navigator:



Using the GUI:



2. 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**.



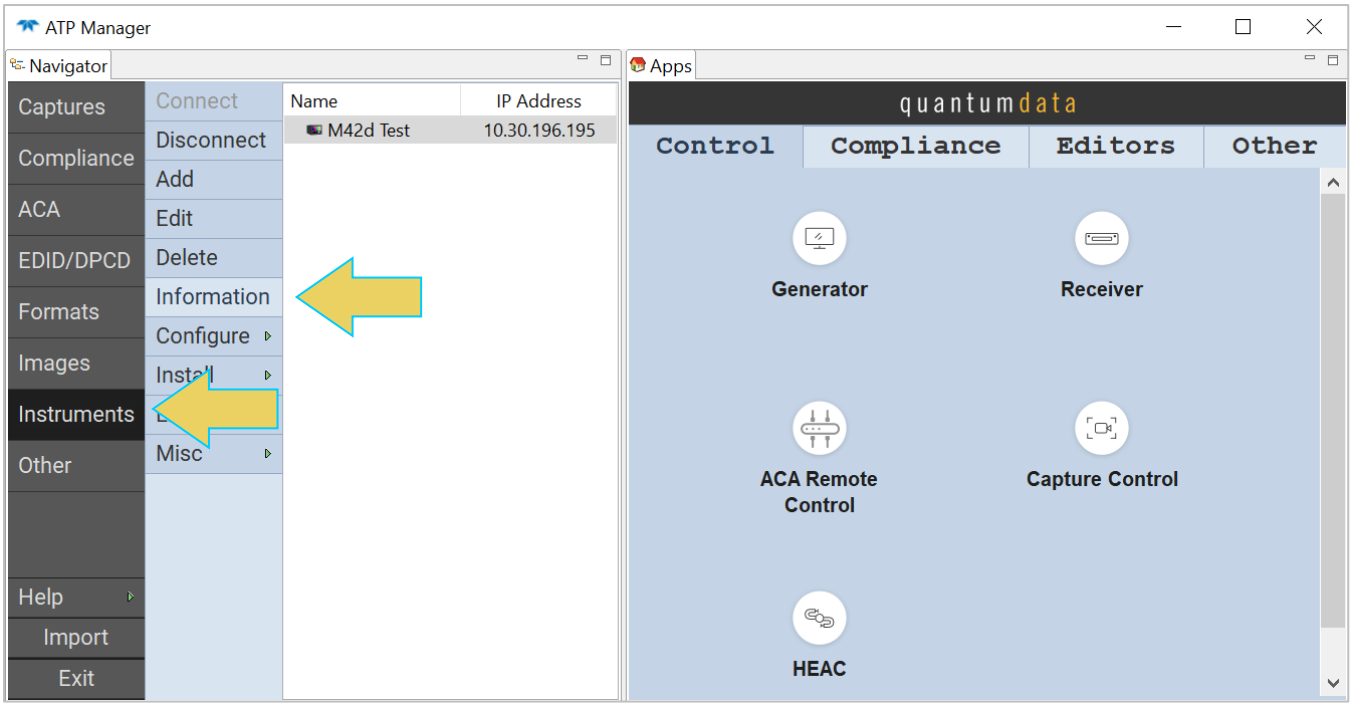
3. A confirmation will appear, and you must **reboot the device** for the changes to take effect.

Verifying Current Licenses

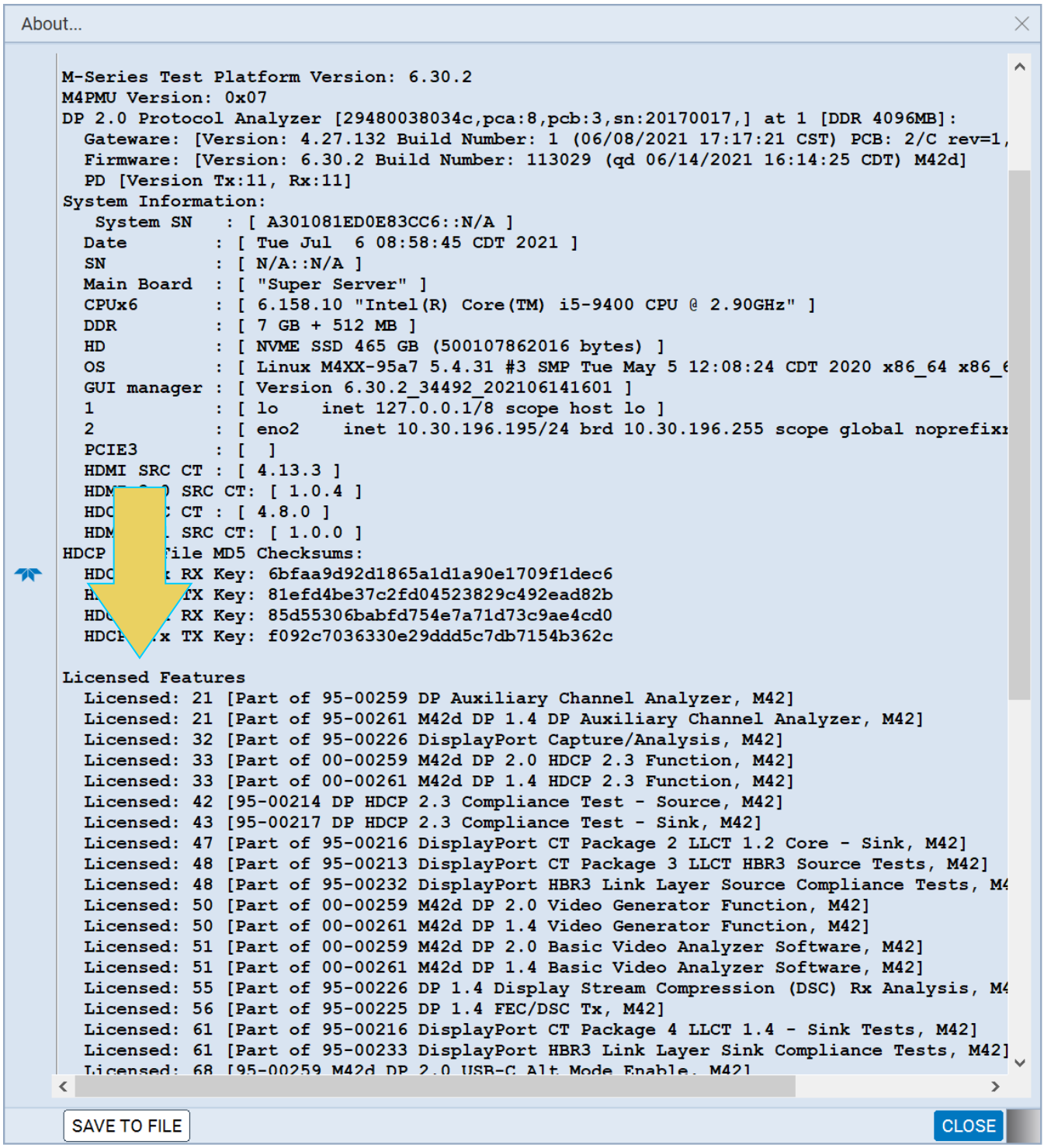
Use the following procedure to check the licenses that are currently applied to your M42d instrument.

4. Using either the embedded M42d GUI or Remote Host PC ATP Manager, open the **Navigator.**
5. Select the **Instruments** tab.
6. Choose the instrument that you are looking up and select **Information** on the left-hand side bar.

   The Remote ATP Manager will automatically connect to the specified device, if not already connected.



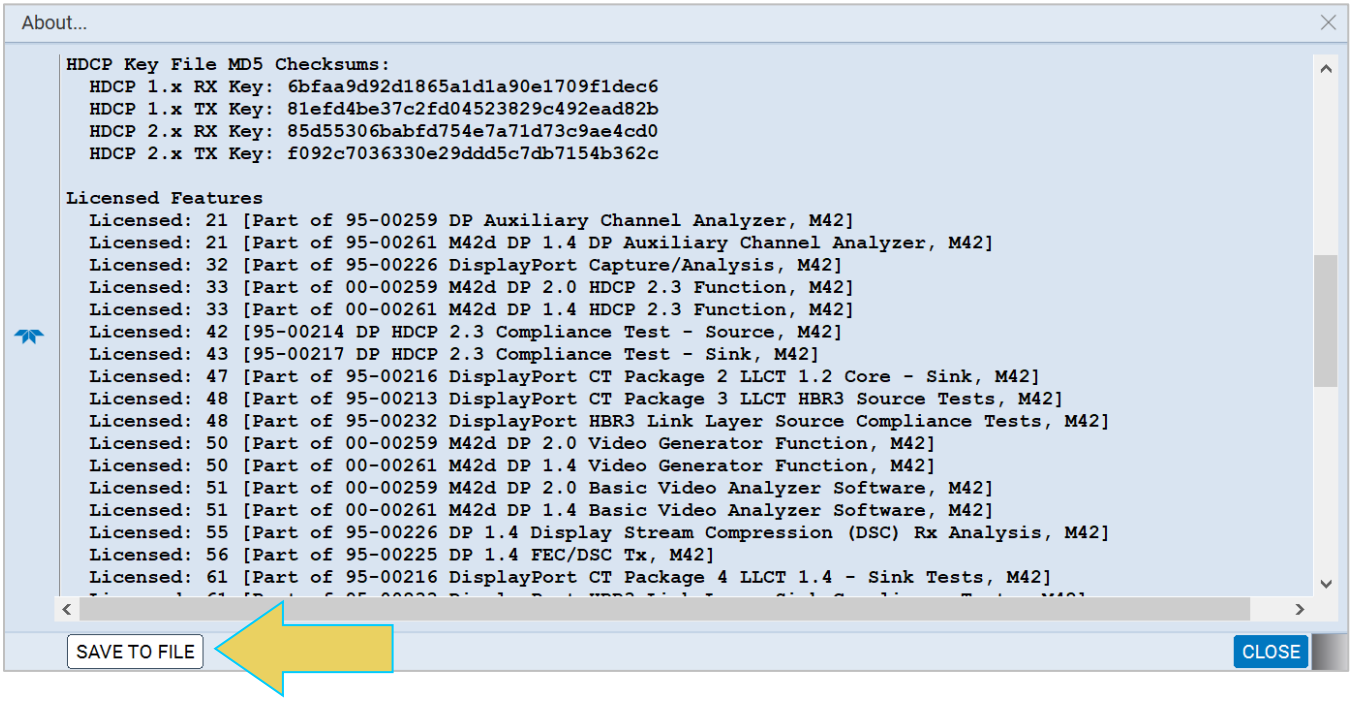
The **About** window will appear, which has various information about the device, and has the **Licensed Features** listed toward the bottom of the report, as demonstrated below.



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 for a number of reasons, including:

- The instrument information report includes the hash codes necessary to write a new license for your specific instrument.
- The new license overwrites the current license; the new license is appended to a list of the current licenses on the instrument, which Teledyne support can obtain from the instrument information report.

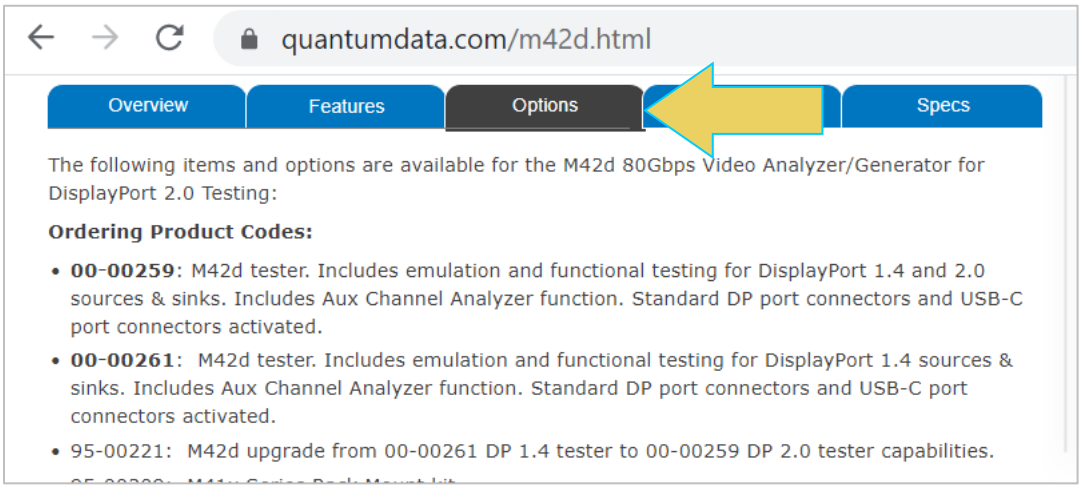
Save the Instrument Information Report by selecting the **SAVE TO FILE** button at the bottom left of the report window, as shown below.



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	**quantumdata M42d DisplayPort 2.0 UHBR-20 Video Analyzer/Generator**	**21:33:50:51:68:69:110:111**
	- Base DP 2.0 functionality includes UHBR video generation, basic analysis and ACA	
	- With both DP and USB-C ports enabled	
00-00261	**quantumdata M42d DisplayPort 2.0 HBR3 Video Analyzer/Generator**	**21:33:50:51:68:69**
	- Base DP 1.4 functionality includes HBR3 video generation, basic analysis and ACA	
	- With both DP and USB-C ports enabled	
Options		
95-00221	**M42d Upgrade 00-00261 to enable UHBR rates**	**103**
	- Requires 00-00261	
95-00222	**M42d Passive Probing Main Link and Aux Channel**	**104**
	- Requires 00-00259 or 00-00261	
95-00225	**M42d DP Enhanced Sink Functional Tests**	**56:101:105:112:107**
	- Includes DSC (for DP 1.4), LTTPR (and Panel Replay if 00-00259 or 95-00221)	
	- LTTPR and Panel Replay will be available in a future release	
95-00226	**M42d DP Enhanced Source Functional Tests**	**32:55:102:106:108:113:109**

	- Includes Capture Analysis, DSC (for DP 1.4), LTTPR (and Panel Replay if 00-00259 or 95-00221)	
	- LTTPR and Panel Replay will be available in a future release	
95-00227	**M41d/M42d DP EDID/DisplayID Sink Compliance Test Suite**	**73**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
95-00228	**M41d/M42d DP EDID/DisplayID Source Compliance Test Suite**	**76**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
95-00209	**M4 Series Rackmount Kit**	**N/A**
	- Requires 00-00258 or 00-00259 or 00-00260 or 00-00261	
95-00212	**M41d/M42d Embedded DisplayPort (eDP) option**	**70**
	- Requires 00-00259 or 00-00261, Or:	
	- Requires 00-00260	
95-00213	**M41d/M42d DP 1.4 Link Layer & FEC Source Compliance Test Suite**	**35:48:93**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
95-00214	**M41d/M42d DP HDCP 2.3 Source Compliance Test Suite**	**33:43**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
95-00215	**M41d/M42d DP 1.4 DSC & FEC Source Compliance Test Suite**	**71**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
95-00216	**M41d/M42d DP 1.4 Link Layer & FEC Sink Compliance Test Suite**	**47:61:94**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
95-00217	**M41d/M42d DP HDCP 2.3 Sink Compliance Test Suite**	**33:43**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
95-00218	**M41d/M42d DP 1.4 DSC & FEC Sink Compliance Test Suite**	**72**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
95-00232	**M41d/M42d DP 2.0 Link Layer Source Compliance Test Suite**	**115**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	
95-00233	**M41d/M42d DP 2.0 Link Layer Sink Compliance Test Suite**	**116**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	
95-00234	**M41d/M42d DP Adaptive Sync Source Compliance Test Suite**	**117**
	- Requires (00-00259 or 00-00261) and 95-00226, Or:	
	- Requires 00-00260 and 95-00219	

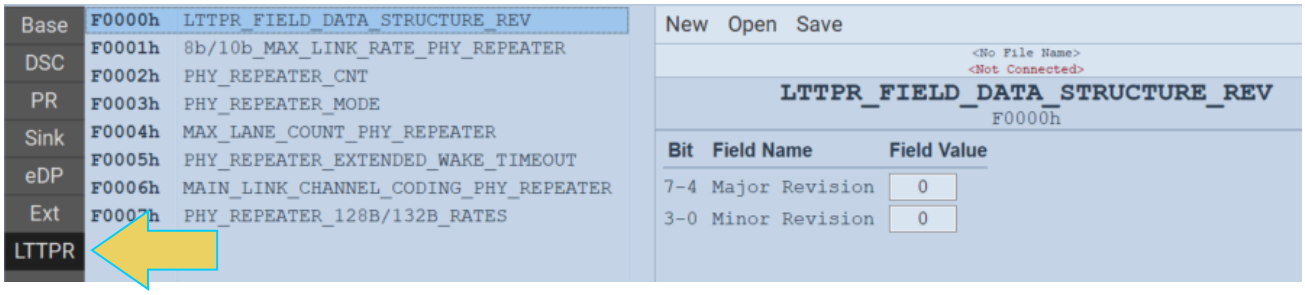
95-00235	**M41d/M42d DP Adaptive Sync Sink Compliance Test Suite**	**118**
	- Requires (00-00259 or 00-00261) and 95-00225, Or:	
	- Requires 00-00260 and 95-00220	

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	▪ Minor Revision Number ▪ Major Revision Number
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	▪ MAX_LANE_COUNT ▪ Reserved
F0005h	PHY_REPEATER_EXTENDED_WAKE_ TIMEOUT	▪ EXTENDED_WAKE_TIMEOUT_ REQUEST ▪ EXTENDED_WAKE_TIMEOUT_GRANT
F0006h	MAIN_LINK_CHANNEL_CODING_PHY_ REPEATER	▪ 128b/132b SUPPORTED ▪ Reserved

DPCD Address	Register	Field(s)
F0007h	PHY_REPEATER_128B/132B_RATES	▪ 10 Gbps/lane Support ▪ 13.5 Gbps/lane Support ▪ 20 Gbps/lane Support ▪ Reserved

The following tables are the configurable registers for each individual LTTPR. The only significant changes among the tables are the register address for each LTTPR.

LTTPR1

DPCD Address	Register	Field(s)
F0020h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F0021h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F003Dh	IEEE_OUI	
F0040h	Device Identification String	
F0046h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0047h-F0048h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR2

DPCD Address	Register	Field(s)
F0070h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER2	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F0071h	TRANSMITTER_CAPABILITY_PHY_ REPEATER2	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED

DPCD Address	Register	Field(s)
		▪ Reserved
F008Dh	IEEE_OUI	
F0090h	Device Identification String	
F0096h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0097h-F0098h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR3

DPCD Address	Register	Field(s)
F00C0h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER3	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F00C1h	TRANSMITTER_CAPABILITY_PHY_ REPEATER3	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F00DDh	IEEE_OUI	
F00E0h	Device Identification String	
F00E6h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F00E7h-F00E8h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR4

DPCD Address	Register	Field(s)
F0110h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT

DPCD Address	Register	Field(s)
F0111h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F012Dh	IEEE_OUI	
F0130h	Device Identification String	
F0136h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0137h-F0138h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR5

DPCD Address	Register	Field(s)
F0160h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F0161h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F017Dh	IEEE_OUI	
F0180h	Device Identification String	
F0186h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0187h-F0188h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR6

DPCD Address	Register	Field(s)
F01B0h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F01B1h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F01CDh	IEEE_OUI	
F01D0h	Device Identification String	
F01D6h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F01D7h-F01D8h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR7

DPCD Address	Register	Field(s)
F0200h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F0201h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F021Dh	IEEE_OUI	
F0220h	Device Identification String	
F0226h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0227h-F0228h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision

LTTPR8

DPCD Address	Register	Field(s)
F0250h	TRAINING_AUX_RD_INTERVAL_PHY_ REPEATER1	▪ Interval ▪ EXT_RX_CAP_FIELD_PRESENT
F0251h	TRANSMITTER_CAPABILITY_PHY_ REPEATER1	▪ VOLTAGE_SWING_LEVEL_3_ SUPPORTED ▪ PRE_EMPHASIS_LEVEL_3_ SUPPORTED ▪ Reserved
F026Dh	IEEE_OUI	
F0270h	Device Identification String	
F0276h	Hardware Revision	▪ Hardware Major Revision ▪ Hardware Minor Revision
F0277h-F0278h	Firmware/Software Revision	▪ Major Revision ▪ Minor Revision