



M41h 48G Video Analyzer/Generator

for HDMI® 8K Testing

User Guide

Rev: A13



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1 About the M41h 48G Video Analyzer/Generator

This chapter provides an overview of the M41h 48G Video Analyzer/Generator and the ATP Manager features. The M41h 48G Video Analyzer/Generator is an analyzer and generator for testing HDMI 2.1 source and sink devices operating up to 600MHz TMDS character rate and up to 1485MHz pixel rate in FRL mode. It provides visibility into the HDMI protocol to help resolve common interoperability problems in HDMI® systems. The M41h 48G Video Analyzer/Generator parses HDMI streams from source devices with an FRL data rate of 48Gb/s.

NEW! The M41h now supports new configurations with Video Analyzer only and Video Generator-only. Therefore, please note that some of the functions described in this User Guide may not apply to your specific M41h Configuration.

The M41h 48G Video Analyzer/Generator enables you to specify the type of data that you want to capture. This could be:

- Data Analysis (Audio, Video, Data Island) - The M41h will capture all the audio packets, video data and the data islands, timing data and auxiliary data and show them encapsulated into the Fixed Rate Link (FRL) packets.
- Fixed Rate Link (FRL) Data Analysis - The M41h will capture the Fixed Rate Link (FRL) data and show the underlying TMDS data elements.
- TMDS Data Analysis - The M41h will only capture the data islands and video frames.
- Protocol Analysis – The M41h will capture the TMDS and Fixed Rate Link (FRL) protocol data such as the preamble and guard band data.

The ATP Manager is a GUI used to manage the M41h 48G Video Analyzer/Generator.



1.1 What Makes the M41h 48G Video Analyzer/Generator Unique?

The M41h 48G Video Analyzer/Generator analyzer provides visibility into the HDMI FRL and TMDS protocol, timing, control, and auxiliary data of incoming video stream from an HDMI 2.1 source device. It captures and decodes encrypted or unencrypted metadata (audio sample, InfoFrames, and other data packets) as well as HDMI DDC transactions.

1.2 Scope of this User Guide – What is Not Covered in this User Guide

This User Guide documents the operation of the M41h 48G Video Analyzer/Generator. It is intended to be used with the M41h Quick Start Guide.

The User Guide describes the features and functions of the M41h 48G Video Analyzer/Generator as operated through the ATP Manager. The screen shots used are usually from the most current release of the ATP Manager. In some cases, there are functions of the external ATP Manager that will be covered in detail as well. These include: 1) provisioning the IP address of the M41h; 2) viewing the incoming video content from a source device; 3) viewing the incoming HDMI video metadata and DDC transactions in real time.

This User Guide does not cover procedures for **Compliance Testing**, one of the features of the M41h. The procedures for HDMI compliance testing are covered in the HDMI Forum MOIs.

1.3 What Options are Available with the M41h 48G Video Analyzer/Generator?

There are several options available with the M41h 48G Video Analyzer/Generator. You can purchase the M41h as a base level system with both video analysis and video generation function or you can purchase the M41h with only the video analysis function or only the video generation function. You can upgrade the video analysis-only or the video generator-only configurations to the full M41h base functionality using the available upgrades:

- Upgrade to add Video Analysis (“Real Time”) function
- Upgrade to add Video Generator function
- Enhanced source functional testing (includes deep capture analysis, DSC functional testing Cable ID, HDR10+ CT, CEC, UHDA & Gaming compliance testing)
- Enhanced sink functional testing (includes DSC functional, Cable ID, CEC, Gaming compliance testing)
- Aux Channel Analyzer passive monitoring function for DDC channel
- eARC functional testing for Tx
- eARC functional testing for Rx
- eARC compliance testing for Tx
- eARC compliance testing for Rx
- TMDS source compliance testing
- TMDS sink compliance testing
- FRL, FEC, DSC source compliance testing
- FRL, FEC, DSC sink compliance testing
- HDR function for sink display testing (includes HDR10+ compliance testing for displays).

Procedures for using these options are provided herein except for the FRL compliance tests which are described in the MOIs and available through the HDMI Forum.

1.4 Changes to this User Guide

The M41h now supports new configurations with Video Analyzer only and Video Generator-only. Therefore, please note that some of the functions described in this User Guide may not apply to your specific M41h Configuration.

Other changes include updates to the links to the Teledyne LeCroy website instead of the quantumdata website.

1.5 M41h ATP Manager GUI

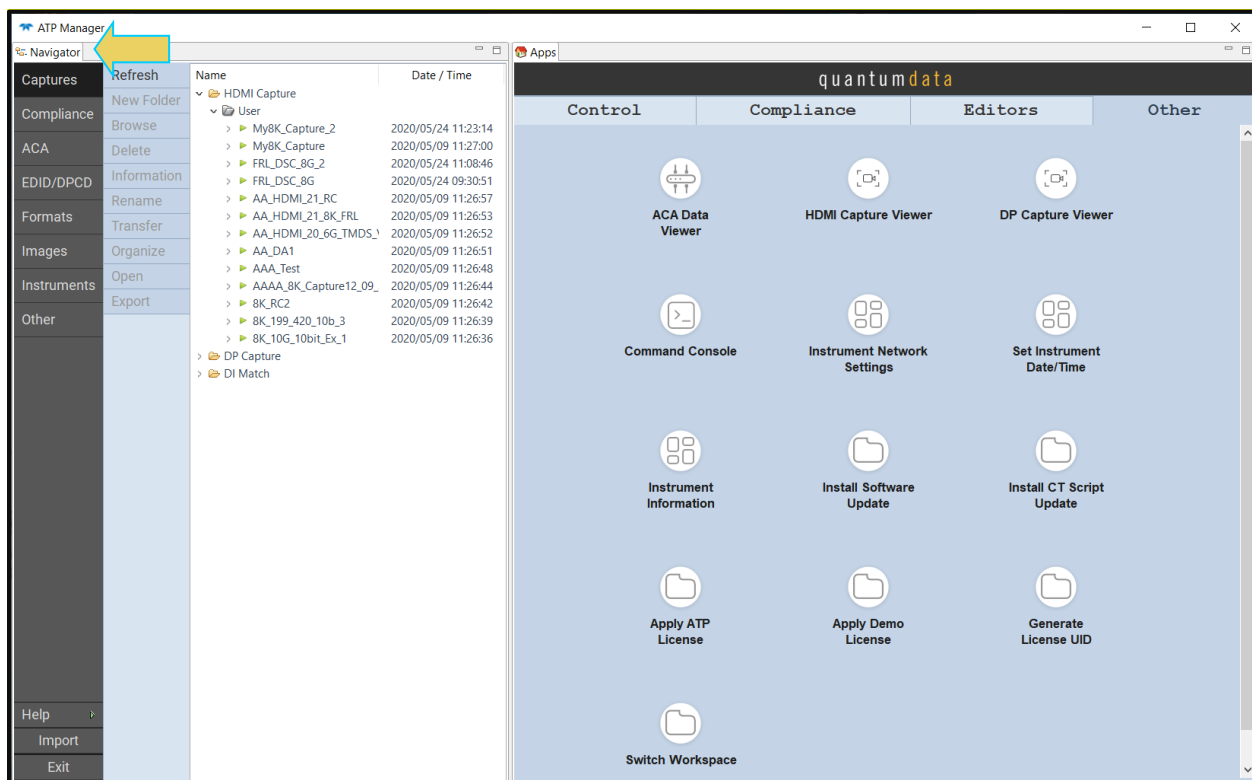
The M41h provides a graphical user-interface, ATP Manager, for operation. This GUI can run both on the M41h instrument itself (embedded ATP Manager) through external display or as a standalone application running on a PC (external ATP Manager). The look, feel, and functions are similar but not identical. The ATP Manager GUI is covered in detail in **Chapter 3**. The following provides the basic differences between the embedded and external screen layouts.

1.5.1 ATP Manager

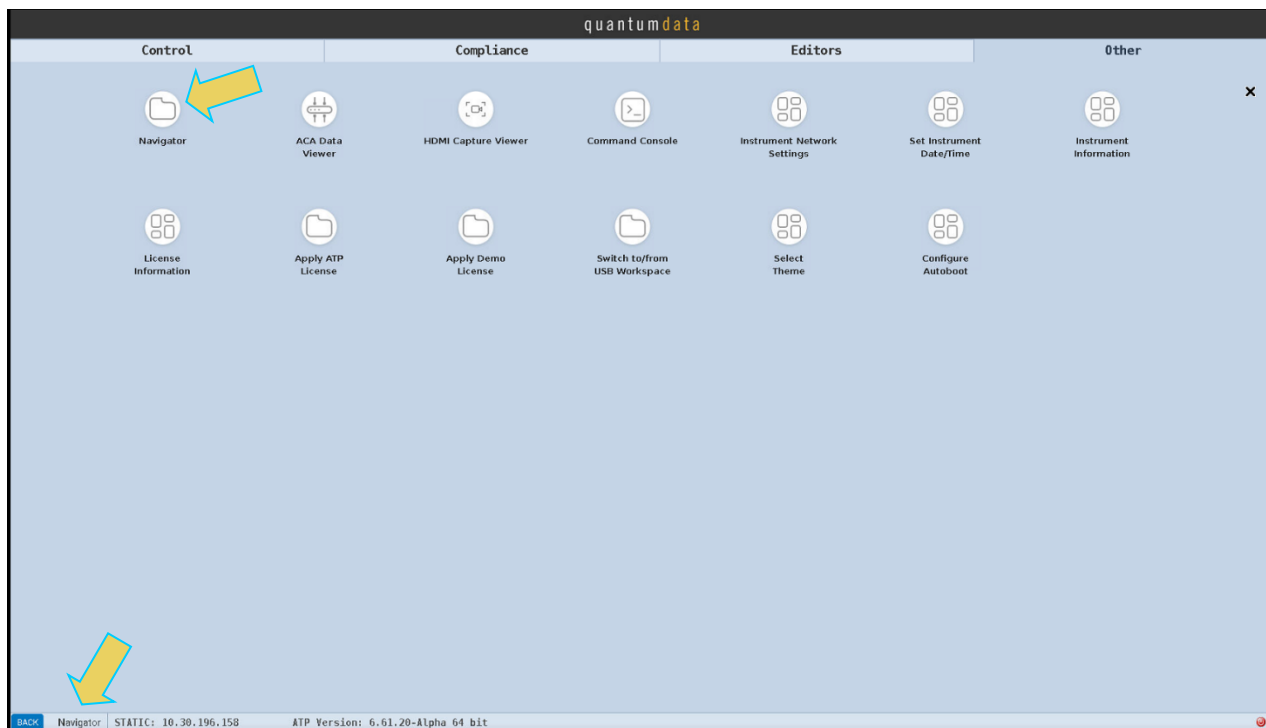
The external ATP Manager provides easy access to the captured data on your PC for sharing with others. It enables you to operate the M41h through a larger interface which allows you to use multiple panels at the same time.

1.5.2 External ATP Manager and Embedded ATP Manager Screen Layout Differences

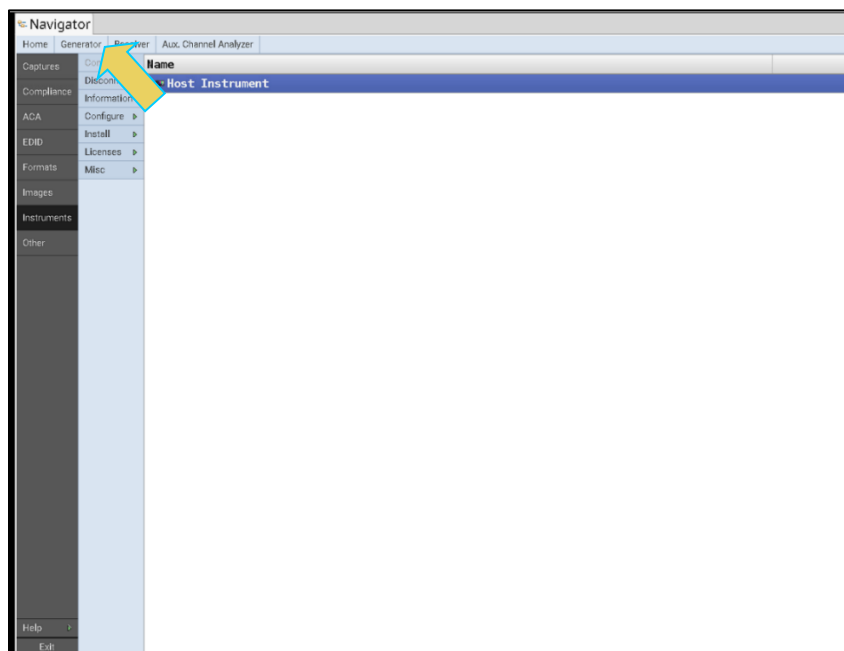
There are a few differences in the layouts between the *embedded* ATP Manager running on an external display and the *external* ATP Manager running on a host PC. The primary difference is the **Navigators** panel which enables you to access the data elements and test results from an instrument. On the PC-installed (external) ATP Manager, the **Navigators** panel is always present on the left side of the **ATP Manager** home screen as shown below.



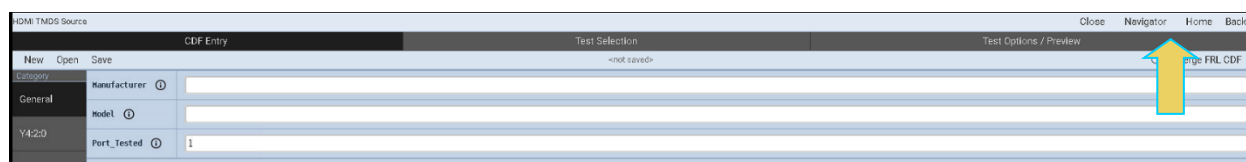
In the embedded ATP Manager (displayed on an external monitor), the **Navigator** screen must be opened from the **Apps** (Home) screen. The **Navigator** application can be accessed either from the **Navigator** icon on the **Other** page of the **Apps** screen, or from the **Navigator** button located in the lower left corner of any screen. See the below image of the embedded ATP Manager home screen.



From the **Navigator** screen, return to the Apps (home) screen by clicking the **Home** button in the upper left corner. See the below image.



Within the numerous embedded ATP Manager screens, the **Navigator** and **Home** buttons typically appear in the upper right corner. See the below image.



1.6 Types of Data the M41h Allows You to View

By providing visibility into the HDMI FRL protocol, and the underlying protocol, video and data island blocks as well as SCDC data during FRL link training data, the M41h 48G Video Analyzer/Generator enables you to detect changes and identify anomalies in the HDMI 2.1 signal. The following is a list of the data types you can view:

- Fixed Rate Link (FRL)
 - Fixed Rate Link packets
 - Character blocks
 - Super blocks
 - FEC blocks
- Active Video
 - Guard bands
 - Preambles
- Data Islands
 - Guard bands

- Preambles
- DDC transactions
 - EDID
 - SCDC
- Control data (Vsync, Hsync, encryption enable)

2 Getting Started

The following sections provide instructions to get your M41h 48G Video Analyzer/Generator up and running. This User Guide should be used in conjunction with the Quick Start Guide.

2.1 What is Shipped with the M41h 48G Video Analyzer/Generator?

When a Teledyne LeCroy quantumdata M41h is shipped, it contains the following additional items:

- AC Power Line Cord
- CE mark declaration
- High Speed/high quality HDMI® Cable
Note: Use of the high-quality HDMI cable is noted within the procedures of this User Guide.
- Ethernet Cable
- Mouse
- Quick Start Guide

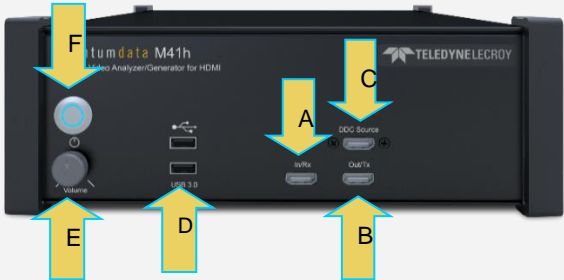
2.2 Getting the M41h Up and Running

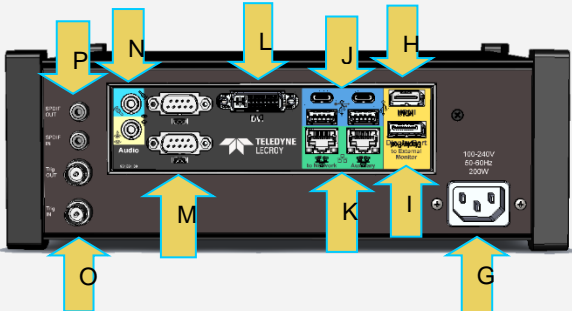
This section includes the following topics for interconnecting applicable components and making preliminary adjustments to optional operating modes.

- **Connector Description**
- **Set Up** (includes information regarding monitor selection)
- **Adjusting M41h Internal Fan Speed**
- **Changing the ATP Manager GUI Display Resolution**

2.2.1 Connector Description

The following table provides images and descriptions of the front and rear panel features of the M41h 48G Video Analyzer/Generator.

M41h Configurations	Information / Function
Protocol Analyzer in M41h  <p>The image shows the front panel of the M41h 48G Video Analyzer/Generator. It is a black device with a silver faceplate. Labels A through F point to various features: A points to the HDMI In/Rx port, B points to the HDMI Out/Tx port, C points to the DDC Source port, D points to the USB ports, E points to the Volume knob, and F points to the Power button.</p>	M41h 48G Video Analyzer/Generator front panel: A – In/Rx: HDMI 2.1 receive port for testing HDMI 2.1 sources. B – Out/Tx: HDMI 2.1 transmit port for analyzing HDMI 2.1 sinks. C – DDC Source: HDMI 2.1 receive port used for reading the EDID over the DDC channel (applies to eARC Tx test). D – USB ports (2 ea) used for connecting a mouse and keyboard. E – Volume knob for adjusting the internal speaker level. Used for eARC Rx audio only.

M41h Configurations	Information / Function
	<p>F – Power button; press and release to select on/off. Power button color modes:</p> <ul style="list-style-type: none"> • Solid Red = Powered down/standby. • Solid Green = Booted without network connectivity. • Solid Blue = Booted with network connectivity. • Solid Yellow = Instrument power on, hardware not initialized. • Flashing Yellow = Instrument hardware initializing in progress. • Flashing Green = Instrument boot is in process. • Flashing Red = Error. <p>M41h 48G Video Analyzer/Generator rear panel:</p> <p>G – Power cable connection (100-240VAC 50-60Hz; 200 watts).</p> <p>H – HDMI port (Admin) for connecting ext HDMI UHD display.</p> <p>I – DisplayPort for possible future use.</p> <p>J – USB & USB-C ports (2 ea) for mouse & keyboard.</p> <p>K – RJ45 ports (2 ea); E1 Network for connecting host PC running ATP Manager (E2 Auxiliary not used).</p> <p>L – DVI for possible future use.</p> <p>M – RS-232 (2 ea) for possible future use.</p> <p>N – Audio (2 ea) for possible future use.</p> <p>O – TRIG IN/OUT for possible future use.</p> <p>P - RCA ports: SPDIF OUT monitors eARC audio; SPDIF IN for possible use.</p>

Note: The M41h 48G Video Analyzer/Generator contains an internal speaker for audio monitoring. The speaker level is controlled by the front panel Volume knob. Audio monitoring and the volume control are specifically for eARC Rx audio.

2.2.2 Set Up and Power On

The following procedure describes how to interconnect the applicable components to get your M41h 48G Video Analyzer/Generator up and running in the embedded ATP Manager configuration.

1. Remove the M41h from the shipping box and lay it flat or upright on your desktop or benchtop.



2. Connect the provided power cable to the M41h rear panel and to a suitable outlet (110-240V 50/60Hz) (see **G** in the previous **Connector Description** table).
3. Connect an external HDMI monitor to the **HDMI** connector on the M41h rear panel labeled: **to External Monitor** (see **H** in the previous **Connector Description** table).

Important Note: You can connect a wide variety of displays to the HDMI admin port on the back of the M41h. However, if the incoming video from the source device under test is content protected with HDCP 2.3, then you must connect a display that supports HDCP 2.3 in order to see the incoming video in the Real Time window. You will receive a notification informing you of this.

Selection of External Monitor:

Due to HDCP content protection requirements, you will have to use an HDCP 2.2 or 2.3-enabled monitor to view HDCP protected content in the external ATP Manager. The following displays comply:

- Dell UltraSharp 27" Monitor Model U2718Q.
- Dell UltraSharp 27" 4K Monitor Model U2720Q.
- ViewSonic 27" 4K UHD Monitor Model VX2776-4K-MHD.
- Acer 27" Monitor Model KW272U

For an up-to-date list, refer to the latest revision of the Quick Start Guide on the M41h product page <https://teledynelecroy.com/protocolanalyzer/quantumdata-m41h.aspx>.

The monitor setup is depicted below.



4. Connect a mouse to one of the USB ports on the front or rear panel of the M41h.
5. Optionally connect a keyboard to one of the other USB ports on the front or rear panel of the M41h. You can also use the virtual keyboards that present themselves in the ATP Manager.

You can fully operate the M41h through the *embedded* ATP Manager using this connection scenario with a keyboard, mouse, and external monitor. However, there is an alternative way with the *external* ATP Manager application running on a host Windows PC. You can operate the M41h from the external ATP Manager installed on a host PC as described in **Section 2.3**.



6. Power up the M41h via the power button on the front of the M41h.



The ATP Manager application will appear on the external display as shown below.

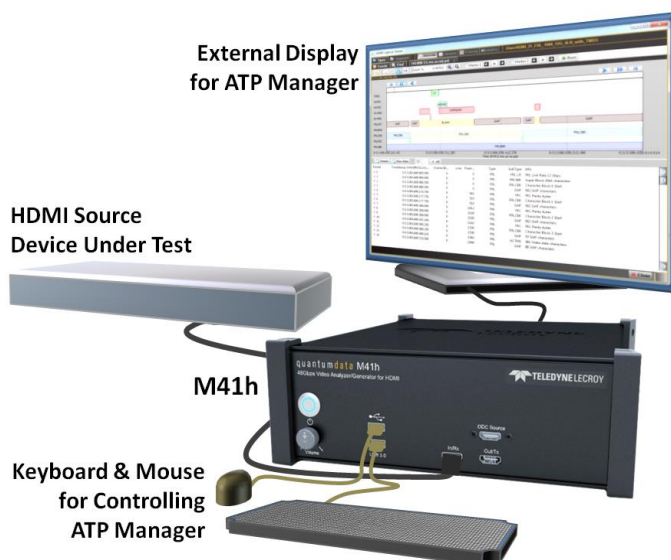


M41h Video Analyzer/Generator Analysis Configuration:

The M41h 48G Video Analyzer/Generator uses sink emulation with its HDMI Rx port connected directly to the source device under test. In the sink emulation mode, you monitor the HDMI transactions between the source device under test and the M41h 48G Video Analyzer/Generator's Rx port.

Note: Use the high-quality HDMI cable provided with the M41h to interconnect the HDMI source or sink device under test.

Connect your HDMI source or sink device under test to the appropriate In/Rx or Out/Tx port on the front of the M41h. The connection for an HDMI source DUT is shown below.



2.2.3 Adjusting M41h Internal Fan Speed

Once the hardware is set up with an external display connected directly, you may optionally adjust the internal fan on the M41h unit from its full speed setting (default) to the standard speed.

Full Speed mode is enabled by default 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 mode, which is quieter than the Full Speed setting.

Note: This procedure needs to be done on the M41h instrument itself using a display connected to the M41h 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.

2.2.4 Changing the ATP Manager GUI Display Resolution

You can change the resolution that the ATP Manager GUI is displayed on the connected monitor using the Mint Linux utilities by following these steps:

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.
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.
3. Select the **Settings** primary menu on the left; on the right select **Display Configuration** secondary menu. The **Display Configuration** menu appears.
4. Set the resolution to **1080p** using the **Resolution** pull-down menu.

The resolution should change and persist through a reboot.

2.3 Managing the M41h with ATP Manager From a PC.

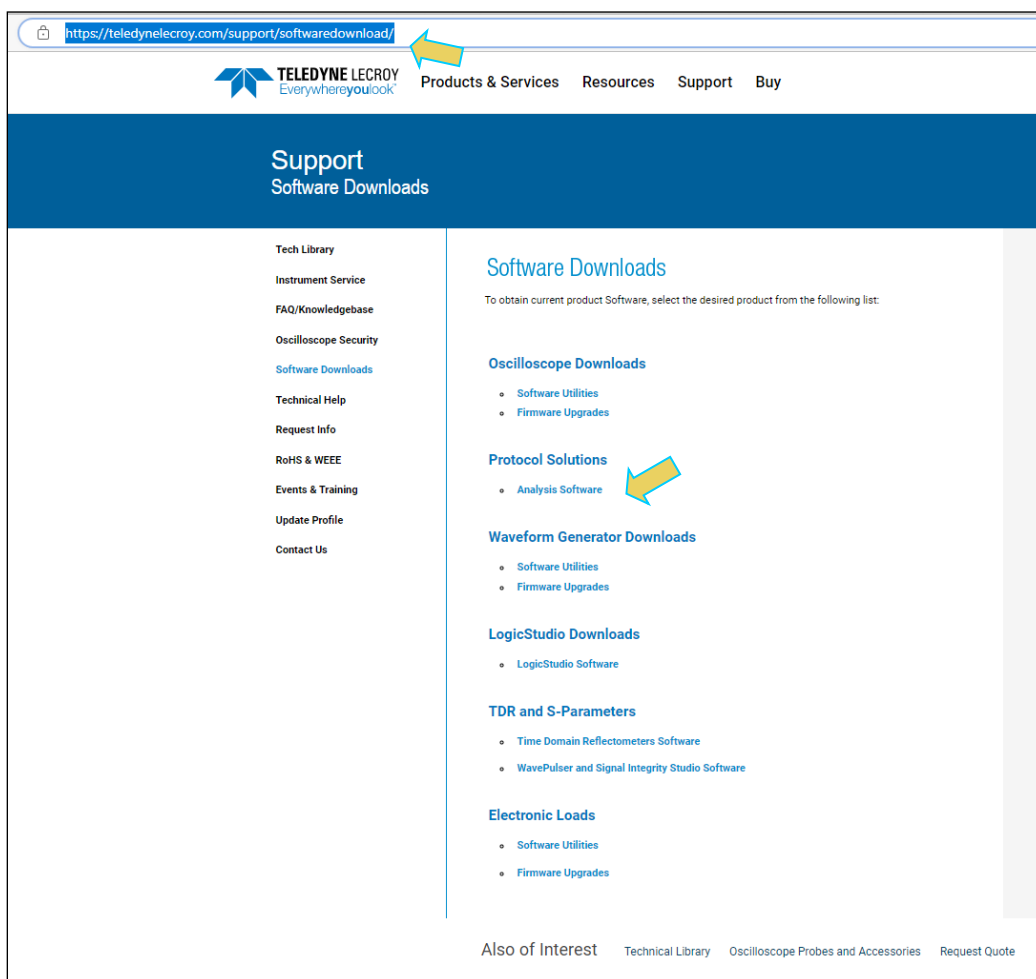
You can operate the M41h from the ATP Manager application installed on a host PC. You will have to first download and install the ATP Manager GUI application on your Windows PC. You will then need to connect your PC to the M41h over an Ethernet IP connection. These procedures are provided below.

2.3.1 Install the M41h ATP Manager GUI Application

Note: You must complete the procedures in **Section 2.2.2** before performing the following steps.

This procedure describes how to install the ATP Manager application on your host PC and connect to the M41h.

1. Download the ATP Manager GUI application from the quantumdata downloads page:
<https://teledynelecroy.com/support/softwaredownload/>. Double click on **ATP Manager 5.50** (or the latest release) and follow the installation prompts to install the ATP Manager on your Windows PC.



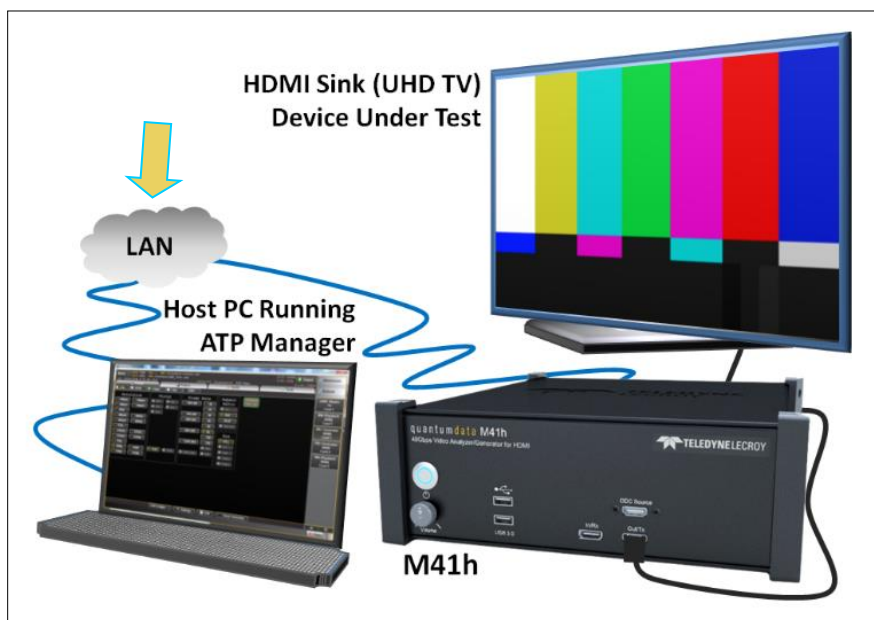
2. After installation completes, run the new ATP Manager. It should be available in the **Start** menu under **All Programs** → **Quantum Data**, and from an icon on your Desktop.

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

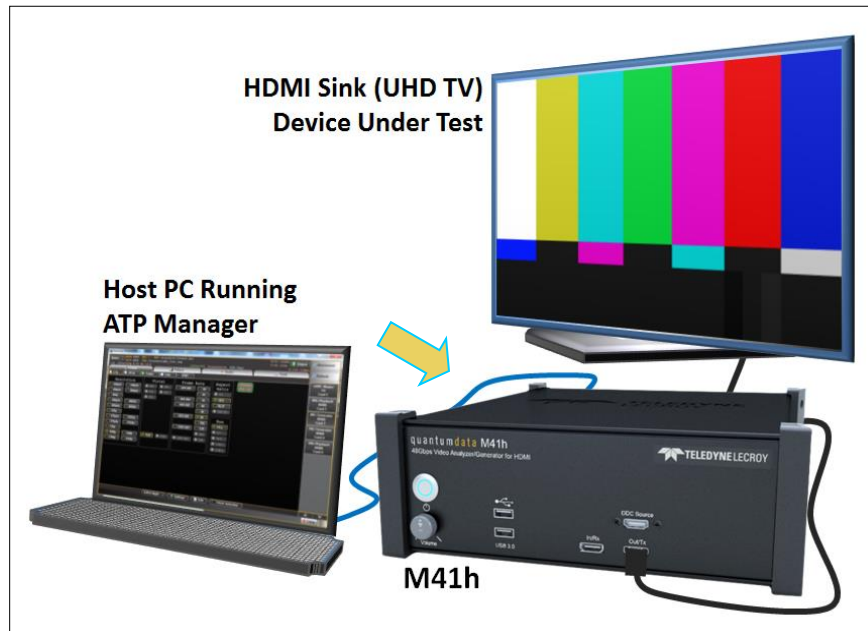
3. Connect your PC to the M41h using an Ethernet cable. The connection is made to the Rj45 jack on the back of the M41h labeled E1 to Network as shown below.



The Ethernet IP connection from the host PC to the M41h can be accomplished through your corporate network or you can connect directly. Both scenarios are depicted in the images below.

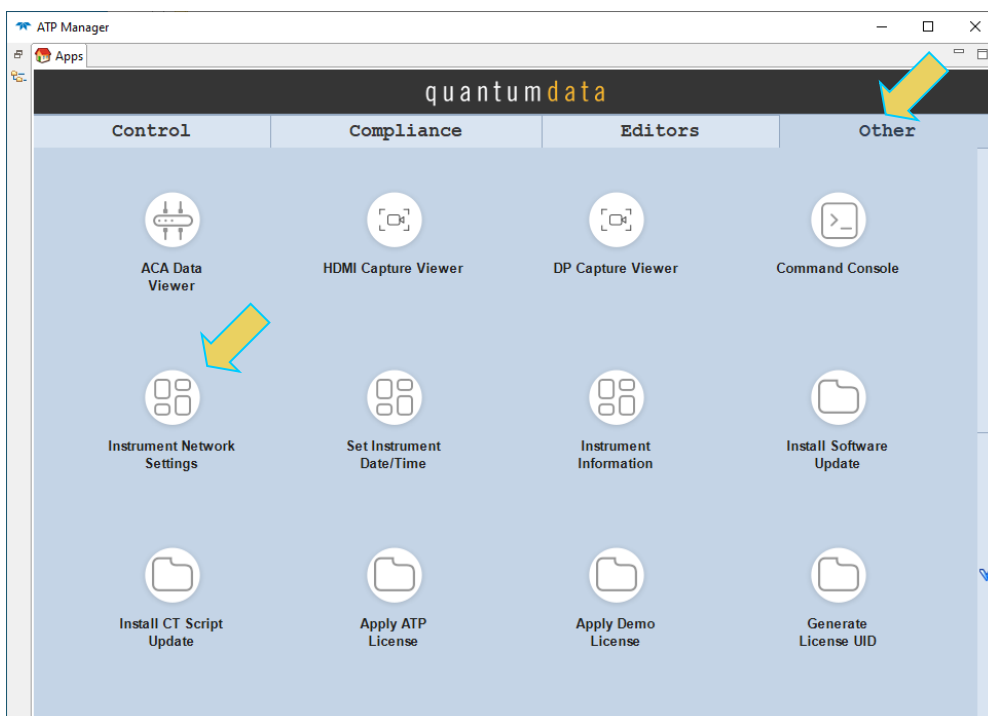


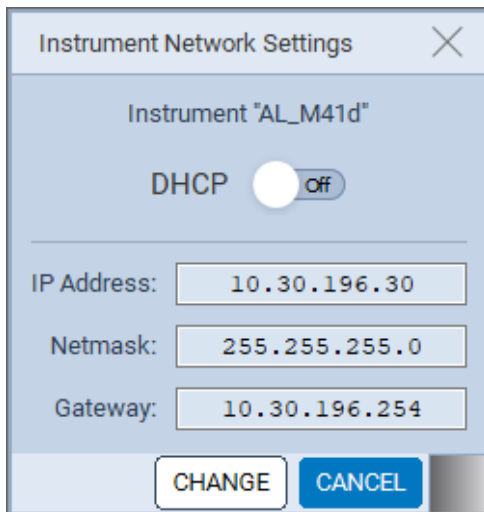
PC Running ATP Manager w/ Ethernet Connection thru Corporate LAN



PC Running ATP Manager with Ethernet Direct Connection

4. From the **Other** page on the **Apps** panel of the **ATP Manager** screen, select the **Instrument Network Settings** application. A dialog box appears enabling you to set DHCP or specify an IP address. Sample screen shots of these windows are shown below.





Instrument Network Settings

Instrument "AL_M41d"

DHCP ☐ Off

IP Address: 10.30.196.30

Netmask: 255.255.255.0

Gateway: 10.30.196.254

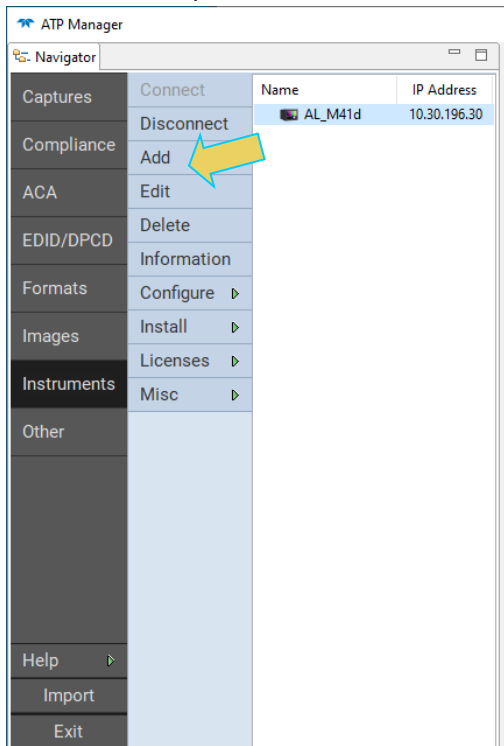
CHANGE CANCEL

5. Ensure **DHCP** is toggled **Off** and enter the IP address. Click the **CHANGE** button.
Note: Be sure to use an IP address that is compatible with your corporate LAN or with your PC if you are connecting directly.
6. Power cycle the M41h with the power button on the front panel.

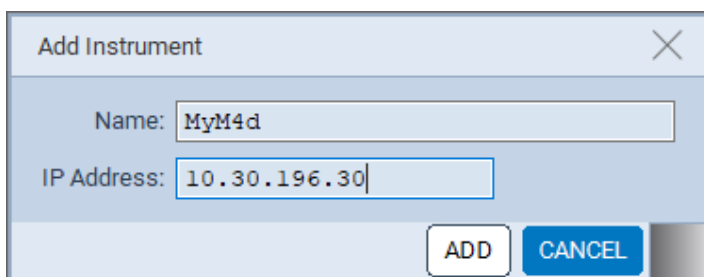


7. A dialog box will appear on the ATP Manager. Select **Shutdown**. Wait five seconds and reapply power.

8. Add your M41h to the ATP Manager application using the green + Add icon or the + Add item on the Instrument pull-down menu identified below.

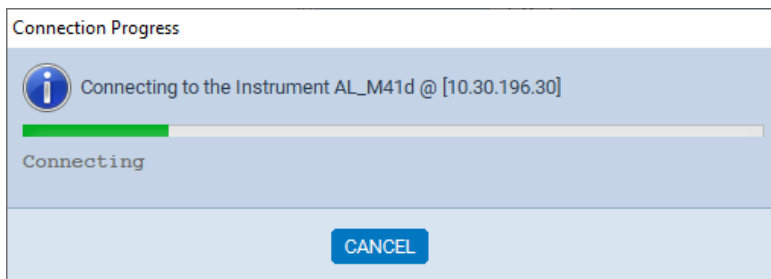


The **Add Instrument** dialog appears enabling you to enter the name and IP information for the M41h that you are trying to connect to (below).



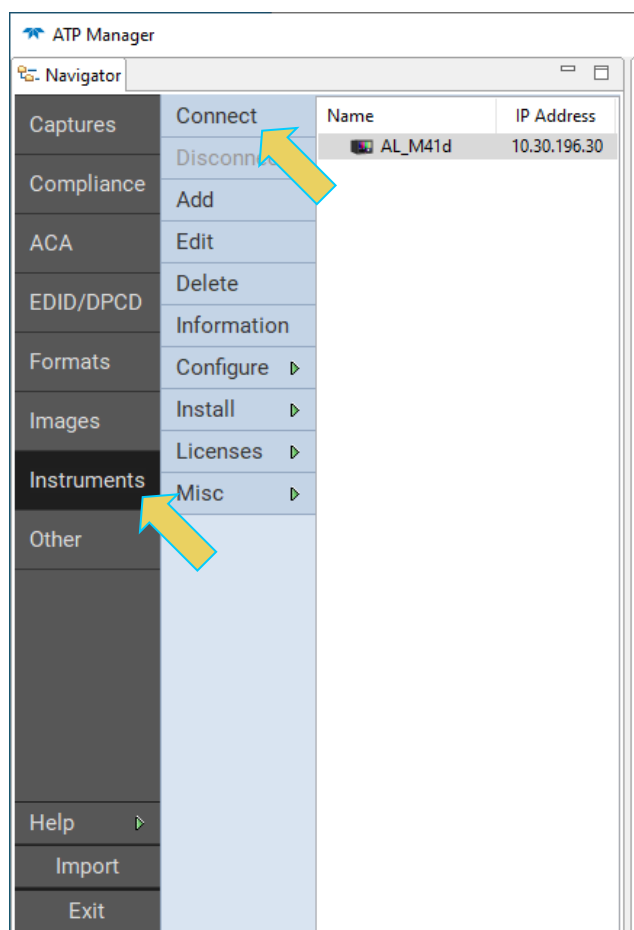
9. Enter the name (any suitable name) and IP address of the M41h that you want to connect to in the **Add Instrument** dialog box (above) and click on the **Add** activation button.

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

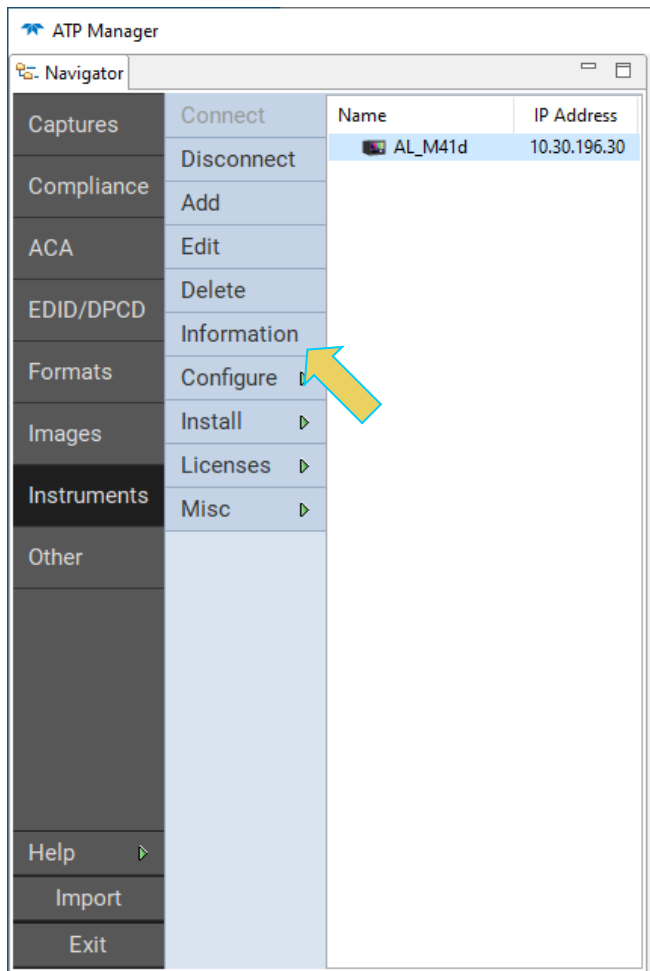


The M41h with the IP address you entered appears on the list in the **ATP Navigator** panel. The ATP Manager application will automatically connect to the M41h once you add the M41h to the application.

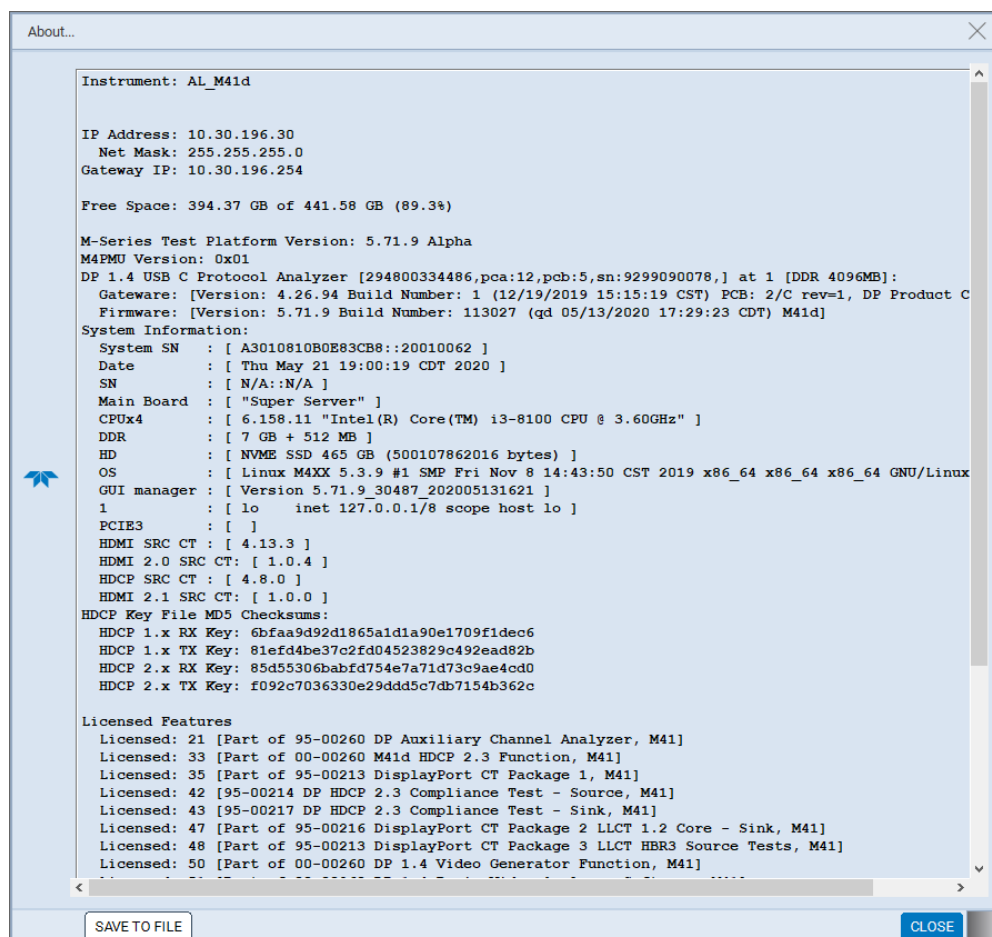
10. If not already connected, connect to the M41h using either the **Connect** icon or the **Connect** item on the right click menu as shown in the screen below. Note that you can also double click on the M41h in the **Instrument** dialog box to initiate a connection.



Once the connection is made the information about the connected M41h is available via the right click menu as shown below.



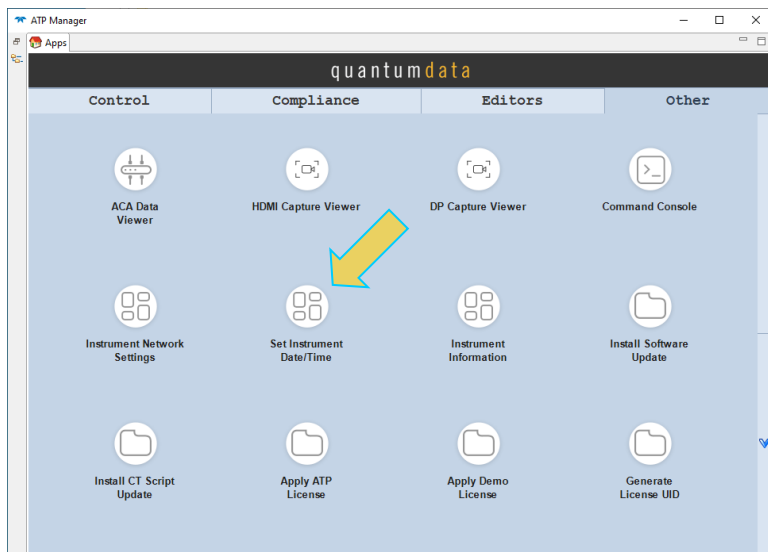
The information is then displayed in a separate window. The information on the **About...** window tells you the firmware and hardware release and version information as well as what options you have. This information will be helpful if you call quantumdata customer support during an upgrade process.



2.3.2 Setting the Instrument Date and Time

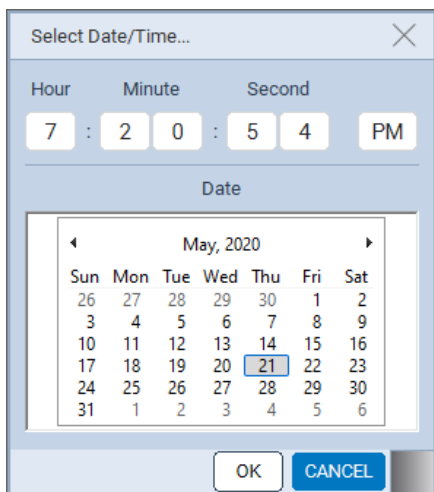
This procedure describes how to set a ATP Manager's data and time from your PC. The procedure assumes that you have connected to an M41h through the external ATP Manager.

1. From the **Other** page of the **Apps** (home) screen, select **Set Instrument Date/Time**.



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

2. Set the time buttons and calendar.



3. Click **OK**.

2.4 M41h 48G Video Analyzer/Generator Operational Modes

2.4.1 Capture, Store and Post Analysis

The Capture and Post Analysis mode is the typical mode of operation and the mode used to analyze HDMI 2.1 data and is available both through the embedded GUI ATP Manager and the remote host PC ATP Manager. You can capture various sets of data: 1) Data islands, 2) Data islands with video and audio, 3) Control data and 4) DDC SCDC transactions.

2.4.2 Real Time Monitoring

The Real Time Monitoring mode enables you to view the incoming video and essential video and timing parameters. You can also view the metadata through the flyout panels. The Real Time mode works in for both TMDS and FRL modes. To view the incoming video in Real Time you need to connect an external monitor to the HDMI monitor port on the back.

2.4.3 M41h Data Analysis Capture Modes

The M41h 48G Video Analyzer/Generator can view different types of data in a capture and store application.

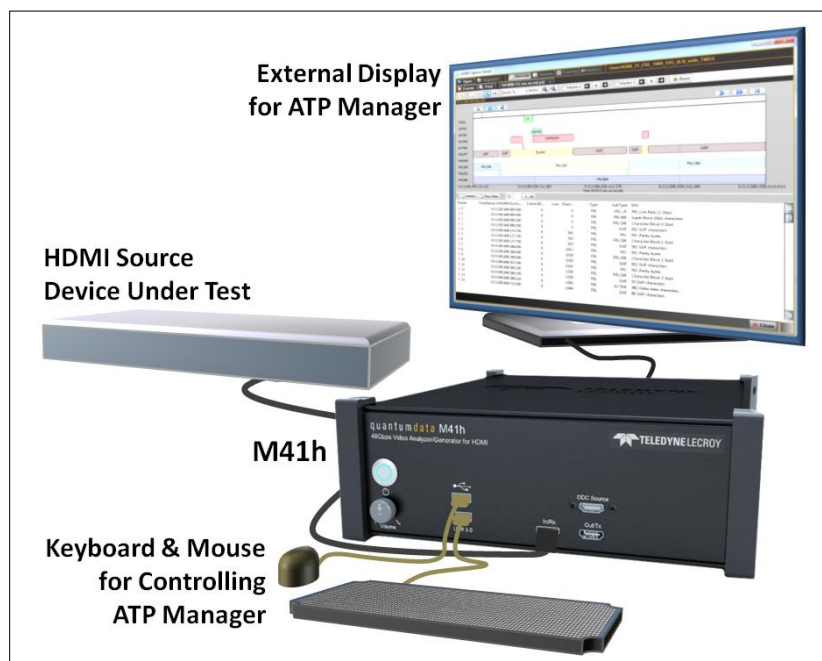
Fixed Rate Link (FRL) and Forward Error Correction (FEC) Analysis

The M41h 48G Video Analyzer/Generator will capture all the FRL and FEC protocol packets and elements and depict them graphically on the Event Plot and in table form in the Decode window. The underlying TMDS video and protocol elements such as the preamble and data island blocks are also shown.

2.5 M41h 48G Video Analyzer/Generator Analysis Configurations

The M41h 48G Video Analyzer/Generator uses sink emulation with its HDMI Rx port connected directly to the source device under test. In the sink emulation mode, you monitor the HDMI transactions between the source device under test and the M41h 48G Video Analyzer/Generator's Rx port.

Note: Use the high-quality HDMI cable provided with the M41h.



HDMI 2.1 Source Analysis Configuration – M41h ATP

2.6 VNC

This chapter has discussed controlling the M41h device either directly using an external monitor, or remotely using the ATP Manager application on a remote host PC. However, the M41h 48G HDMI Vide Analyzer/Generator does come with another built-in option for controlling the device remotely.

The instruments come with the **VNC 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.

2.6.1 Changing the VNC Server Password

As an option, the password for the VNC login can be changed. To change the VNC login password, perform the following steps.

Note: If using a local USB keyboard, **Ctrl-Alt-F1** switches to a command prompt window, and **Ctrl-Alt-F7** switches back to the GUI window.

Note: **qd** is both the Linux account login and password. They are separate from the VNC Server password and will not be changed.

1. Log into the instrument's Linux BASH shell prompt using Telnet, SSH, or your local USB keyboard. Login is **qd** and password is **qd**.

When you first log in, you will be at the instrument scope command prompt.

2. Enter the single letter **q**.
3. Click the **Enter** key to exit to the Linux BASH shell.
4. From the Linux BASH shell prompt, enter the following command line to change the VNC Server password:

```
sudo x11vnc -storepasswd "newpassword" /etc/x11vnc/vncpwd
```
5. The sudo command will probably prompt you to enter a password. You need to enter the Linux account password (**qd**) to continue.

Note: "**newpassword**" is the new password that you will set. It must be inside double quotes, but the double quotes will not be part of the actual password that is set. There are no other requirements for password selection.

6. Enter the new password within quotation marks.

2.6.2 Restarting VNC Server Installed on the M41h

There may be a point when the VNC Server is not properly responding, and you need to restart the VNC Server from the M41h. There is a simple command to do so that can be executed if.

Procedures for accessing the command line can be found in the **Command Reference chapter**.

To restart the VNC Server on the M41h instrument, type the following into the command line:

```
svnc
```

This will restart the VINC server and make it accessible via a VNC Viewer once again.

```
Last login: Fri Dec 17 08:30:08 CST
#dp20-scope>svnc
INFO: VNC server restarted
#dp20-scope>
```

2.7 Compliance Test Trial Licenses

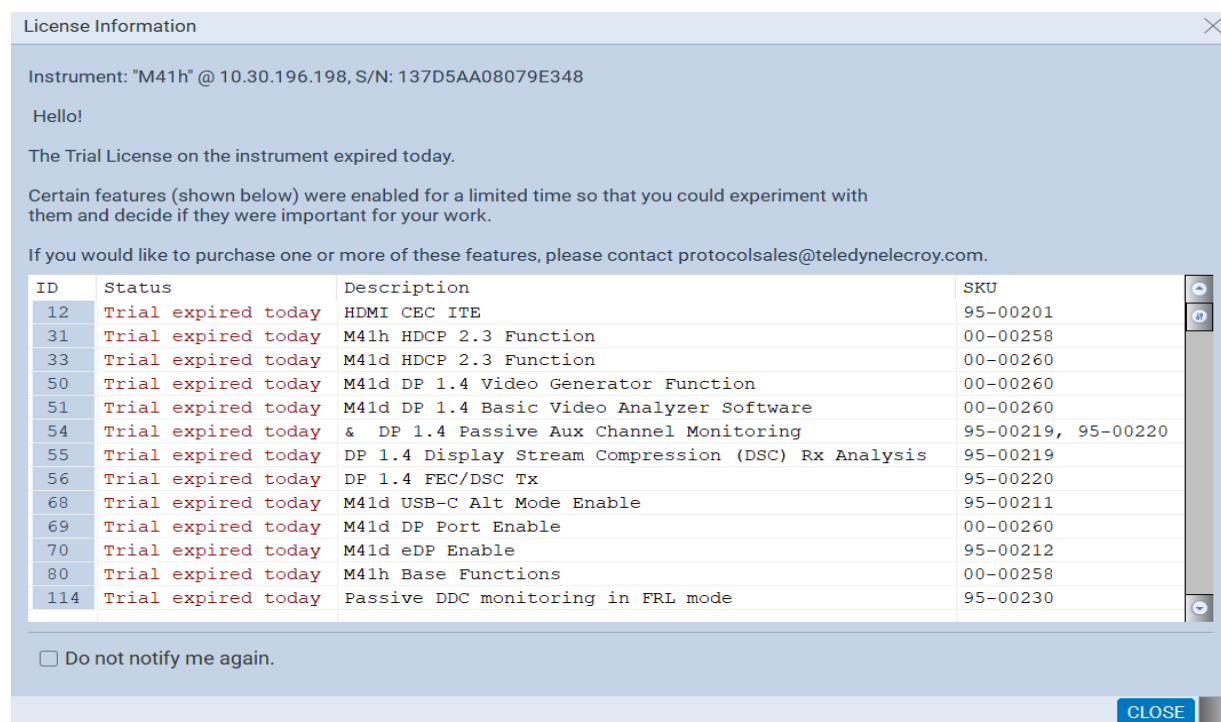
In addition to a demo license, the M41h includes a Compliance Test Trial License pre-loaded prior to shipment and functional upon first start-up.

This trial license offers users the ability to test specific Compliance Tests prior to purchasing the license required for full access to the Compliance Test Suite. The trial Compliance Test set includes various frequently used tests for each source and sink. The next subsection contains a table with a full listing of Compliance Tests offered within this trial.

License Information			
Instrument: "M41h" @ 10.30.196.198, S/N: 137D5AA08079E348			
Hello!			
Certain features (shown below) are enabled for a limited time so that you can experiment with them and decide if they are important for your work.			
If you would like to purchase one or more of these features, please contact protocolsales@teledynelecroy.com .			
ID	Status	Description	SKU
12	Trial expires in 19 days	HDMI CEC ITE	95-00201
31	Trial expires in 19 days	M41h HDCP 2.3 Function	00-00258
33	Trial expires in 19 days	M41d HDCP 2.3 Function	00-00260
50	Trial expires in 19 days	M41d DP 1.4 Video Generator Function	00-00260
51	Trial expires in 19 days	M41d DP 1.4 Basic Video Analyzer Software	00-00260
54	Trial expires in 19 days	& DP 1.4 Passive Aux Channel Monitoring	95-00219, 95-00220
55	Trial expires in 19 days	DP 1.4 Display Stream Compression (DSC) Rx Analysis	95-00219
56	Trial expires in 19 days	DP 1.4 FEC/DSC Tx	95-00220
68	Trial expires in 19 days	M41d USB-C Alt Mode Enable	95-00211
69	Trial expires in 19 days	M41d DP Port Enable	00-00260
70	Trial expires in 19 days	M41d eDP Enable	95-00212
80	Trial expires in 19 days	M41h Base Functions	00-00258
114	Trial expires in 19 days	Passive DDC monitoring in FRL mode	95-00230
122	Trial expires in 19 days	M41d M41h Trial License Feature	
126	Trial expires in 19 days	M41h Dolby Vision Source Test	95-00195

The Trial License comes pre-loaded on each instrument and is functional upon first-start up. The trial period takes effect when activated on the instrument during the manufacturing process. The trial license will last 30 days for domestic shipments and 45 days for non-domestic shipments, allowing ample time after receiving the instrument for utilization.

Time remaining on the trial period will be displayed upon startup of the instrument GUI. The following screenshot demonstrates the message received with an expired trial.



Note: In the event that shipment is delayed, or extenuating circumstances occur, please contact Teledyne-LeCroy PSG support for an extension/re-issuance of the trial license.

2.7.1 Accessible Tests with CT Trial License

Refer to the following table for a reference of the Compliance Tests included within the CT Trial License. The table includes the corresponding Compliance Test Suite (CTS) that would include the trial Compliance Test when licensed. Also shown are CTS SKU and License Key for a convenient reference when contacting Support for full licenses.

Trial Compliance Test	Corresponding Compliance Test Suite	CTS SKU	CTS License Key
HDMI TMDS Source	M41h HDMI TMDS Source CTS (requires 00-00258 and 95-00195)	95-00197	2:25:38:81:88
HDMI TMDS Sink	M41h HDMI TMDS Sink CTS (requires 00-00258 and 95-00201)	95-00203	3:6:24:27:82:90
HDMI FRL Source	M41h HDMI FRL & DSC Source CTS (requires 00-00258 and 95-00195)	95-00196	66:78
HDMI FRL Sink	M41h HDMI FRL & DSC Sink CTS (requires 00-00258 and 95-00201)	95-00202	67:79
HDMI eARC Tx	M41h HDMI eARC Tx CTS (requires 95-00201 and 95-00204)	95-00205	59
HDMI eARC Rx	M41h HDMI eARC Rx CTS (requires 95-00195 and 95-00199)	95-00200	60
HDMI HDCP 2.3 Tx	M41h HDCP 1.4 & 2.3 Source CTS (requires 00-00258 and 95-00195)	95-00195	13:28:31:89

HDMI HDCP 2.3 Rx	M41h HDCP 2.3 Sink CTS (requires 00-00258 and 95-00201)	95.00206	29:31
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2.7.2 CT Evaluation License Information via Command Line

Easily determine the remaining time on the CT Trial License in the command line of the M41h. For procedures to access the instrument's command line, see the chapter on **Command Line Interface**.

Within the command line interface, simply enter the command **lic**

The resulting output will display two pertinent lines, indicating remaining days on the general Evaluation License as well as the CT Trial License, as shown below.

```
Linux Mint 19.1 Tessa
M4XX-8829 login: qd
Password:
Last login: Thu Dec  2 10:45:30 CST 2021 from ::ffff:10.
#p21-scope>lic
Evaluation License: 0 Remaining Days.
CT Evaluation License: 0 Remaining Days.
Licensed: 02 [95-00062 HDMI CTS 1.4b Source Compliance
```

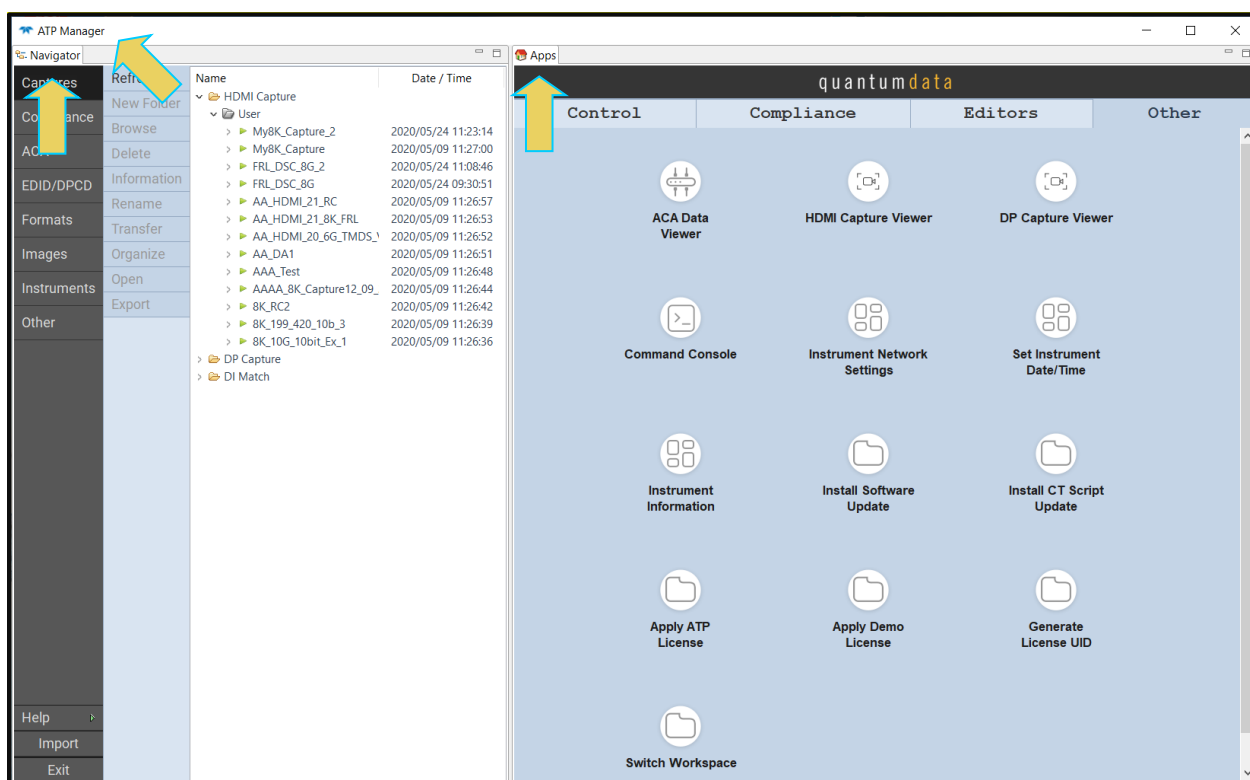
3 The ATP Manager

3.1 Overview

This chapter describes the ATP Manager panels on the external ATP Manager. The ATP Manager is an application that runs on your local PC. It enables you to examine the data captured by the M41h 48G Video Analyzer/Generator through a user-friendly graphical interface.

Note: The M41h embedded ATP Manager displayed on a connected monitor works almost identically.

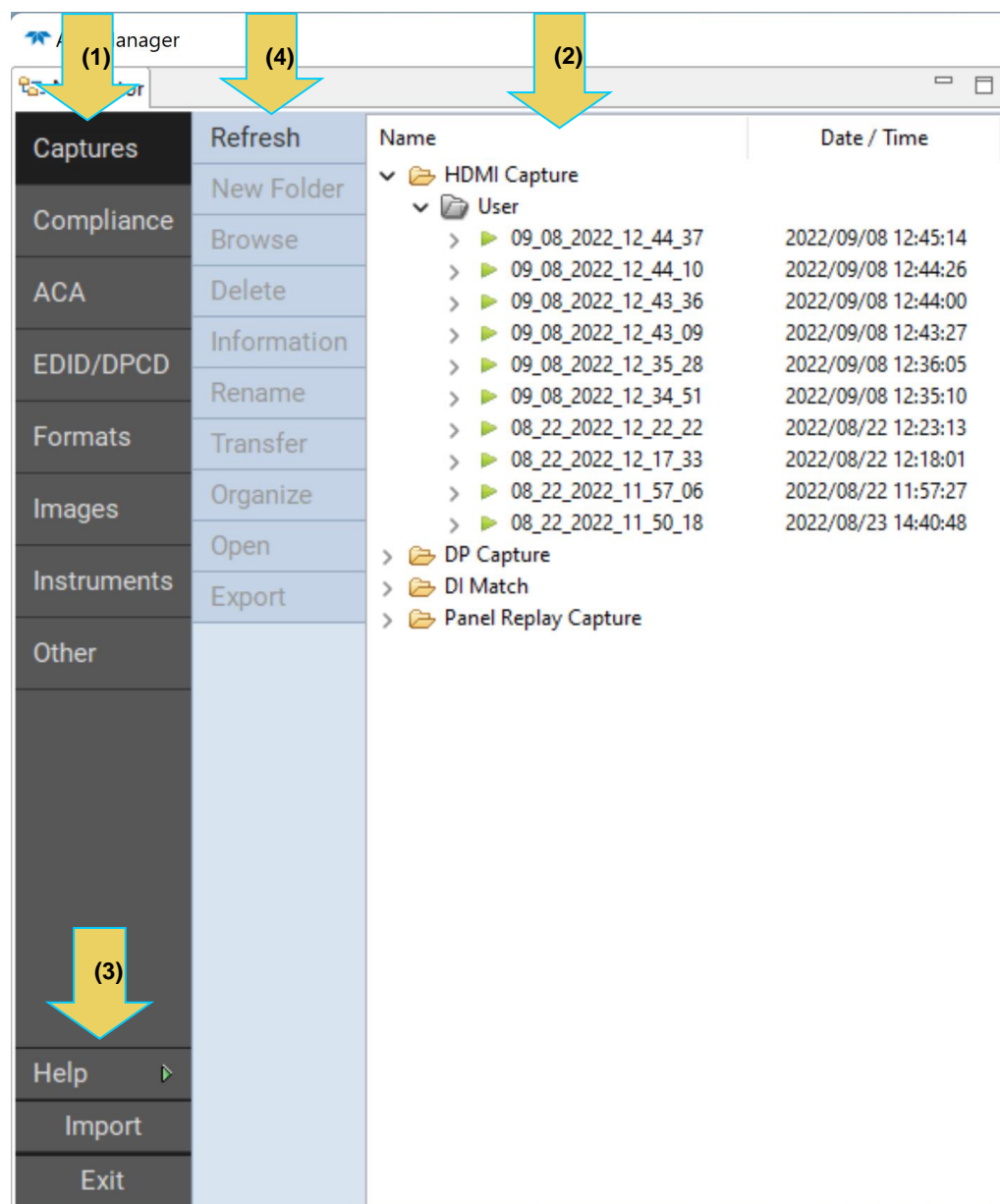
The **ATP Manager** screen includes two panels: **Navigator** panel and **Apps** panel.



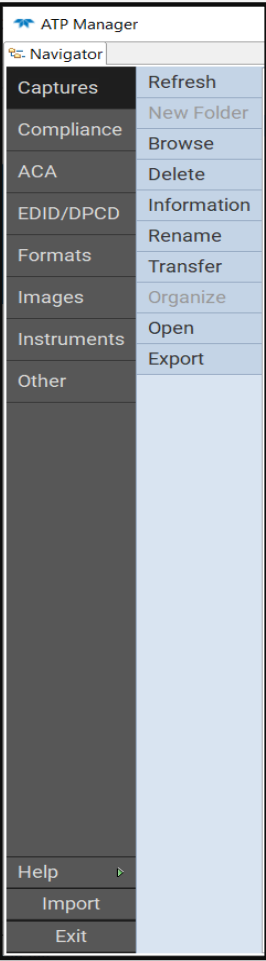
3.2 Navigator

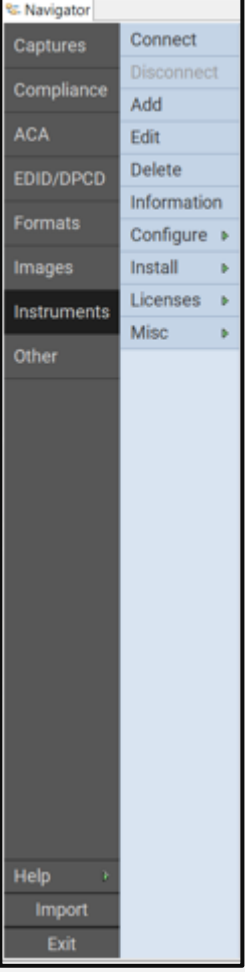
The **Navigator** panel is shown in the figure below. The left column **(1)** includes a static list of eight tabs which provide applicable directories (files) in the right panel **(2)**; the three tabs at the bottom of the column **(3)** provide general functions. The center panel **(4)** comprises a dynamic list of tabs that become highlighted (enabled) as their function becomes applicable when navigating through the directories.

Note: You can right-click on the files displayed in the right panel for additional functions.



The menu is shown in the figure below. There are several tabs which are described in the table

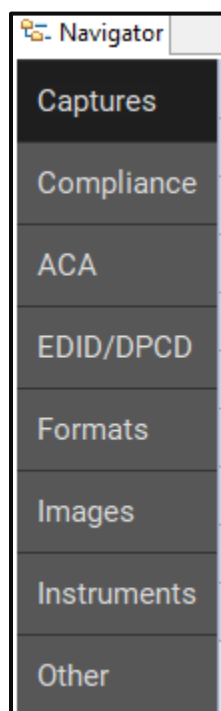
Top-Level Menu Items	Selection	Function
File 	Refresh	Refreshes the view of capture files.
	New Folder	Enables you to create a new folder.
	Browse	Opens a Windows browse window to the stored location of the captures.
	Delete	Enables you to delete a capture file from the M41h Manager application (on the host PC or the M41h if using the embedded ATP).
	Information	Enables you to view the information related to connected M41h.
	Rename	Enables you to rename a capture file.
	Transfer	Enables you to transfer files between the M41h and the host PC that the external ATP Manager is running on.
	Open...	Opens a capture or whatever data file type (examples: compliance data, format or image list, EDID, ACA file, etc.) is highlighted in the GUI. You must select a data file type for this option to be available.
	Export...	Enables you to export a capture file that you have highlighted in the M41h Manager. The file is compressed to a zip file.
Instrument	Connect	Clicking on this item will initiate a connection to the M41h that is selected in the list. This item will not be highlighted if you have not selected an M41h.
	Disconnect	Clicking on this item will initiate a disconnection from the M41h that is selected in the list that you are currently connected to. This item will not be highlighted if you have not selected an M41h.
	Add	Clicking on this item opens the Add Instrument dialog box which enables you to define an M41h. Note that you can have multiple M41hs defined in the

Top-Level Menu Items	Selection	Function
		ATP Manager. This action is required before connecting to an M41h.
	Edit	Enables you to edit the name of the IP address of the selected M41h.
	Delete	<ul style="list-style-type: none"> Enables you do delete the selected M41h instrument from the external ATP Manager.
	Information	<p>Provides information about the M41h that the M41h Manager is currently selected. This information includes:</p> <ul style="list-style-type: none"> M41h Name IP address of the M41h Netmask Gateway IP address Hardware revisions of the M41h circuit boards Firmware/Gateway version of the release applied to the M41h Serial number of the M41h OS version <p>Licensed options applied to the M41h</p>
	Configure	<p>Opens a submenu for:</p> <ul style="list-style-type: none"> - Setting the network IP address, Netmask and Gateway as well as enabling and disabling DHCP. - Setting the Date and time.
	Install	<p>Opens a submenu for:</p> <ul style="list-style-type: none"> - Installing new firmware or gateway. - Enables you to apply an upgrade to the M41h compliance test application scripts. - Upgrade System Components - Enables you to apply an upgrade to the M41h HDMI Source Compliance Test application or any other optional application. - Installing GUI components MORE
	Licenses	<p>Opens a submenu for:</p> <ul style="list-style-type: none"> - Generating a UID file MORE. - Apply ATP License key file (QDATP.lic) that enables you to activate a license key obtained from Quantum Data Customer Support for an option.

Top-Level Menu Items	Selection	Function
		<ul style="list-style-type: none"> - Apply an old license (No longer used). - Applying a Demo License key file that enables you to activate a license key temporarily for an optional feature.
	Misc	<p>Opens a submenu for:</p> <ul style="list-style-type: none"> - Calibrate the LCD - Enables you to calibrate the embedded display for touch accuracy. - Configuring the Auto Boot feature which enables you to reboot a remote M41h (requires a 3rd party network controlled device at the M41h). - Real Time Screen Capture enables you to capture a screen from the Basic Analyzer "Real Time" mode screen displayed on the display connected to the HDMI Admin port on the back of the M41h. - Real Time Data Capture enables you to capture a screen from the ACA Remote Control.

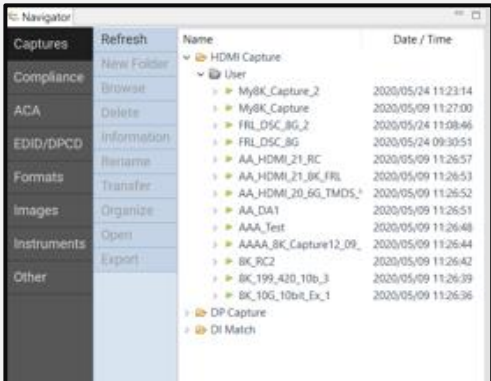
3.3 Navigator Panel

The **Navigator** panel is shown in the figure below. There are a set of sub-tabs which provide access to data associated with each type of tab.

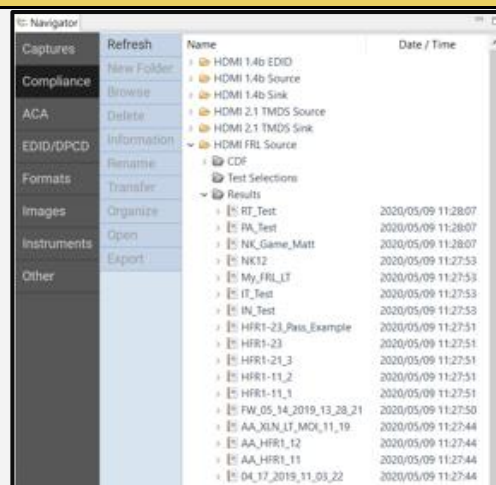


3.3.1 M41h Navigation Panels

The M41h **Navigator** panel provides a set of tabs to access a variety of data sets and panels as shown in the screen examples in the table below. The **Navigator** tabs are described in the table that follows these screens. These also appear on the right-click menus of the directories where the various data types are stored.

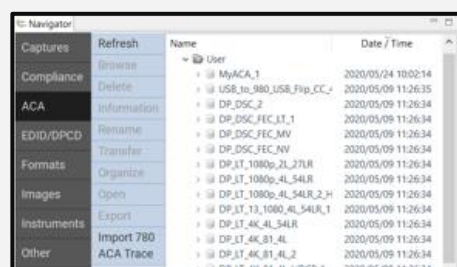
Navigator Tab	
<p>Captures Provides access to the list of captures.</p>  <p>Compliance Provides access to the data for the various compliance tests.</p>	<p>Execute a Capture - Initiates a capture on the selected M41h device. This requires that your source device is connected to the M41h and that it is sending video. Only appears when the Navigator/Capture tab is selected.</p> <p>Transfer data to/from instrument - Opens up the FTP browser enabling you to transfer data to and from the host PC and the M41h instrument. Available for all Navigator tabs except Instruments tab.</p> <p>Create new folder - Enables you to create a folder under the highlighted directory. Available for all Navigator tabs except Instruments and ACA tab.</p> <p>Organize (move/copy) local data - Opens the FTP browser enabling you to transfer data between locations on the</p>

Navigator Tab



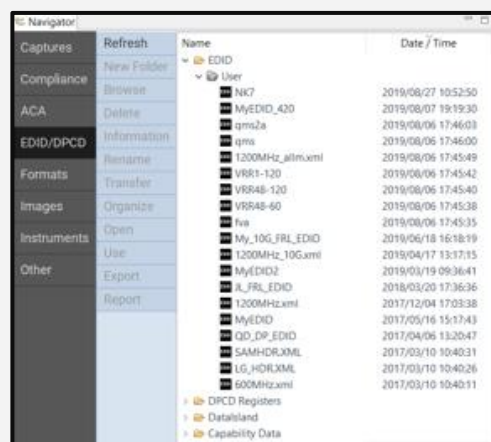
ACA

Provides access to ACA trace files that have been saved.



EDID

Provides access to EDID files that have been saved.



Formats

Provides access to format files that have been saved and format library lists that have been configured.

host PC. Available for all **Navigator** tabs except **Instruments** and **ACA** tab.

Open Selected Item in a file browser - Opens a window to the folder location of the selected file. Available for all **Navigator** tabs except **Instruments** tab.

Delete the Selected Item - Deletes a data item that you have selected. Available for all **Navigator** tabs except **Instruments** tab.

Show Information about selected item - Provides information about the selected data type and the M41h used to capture the data. Available for all **Navigator** tabs except **Instruments** tab.

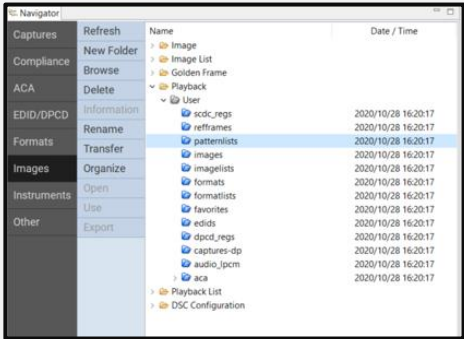
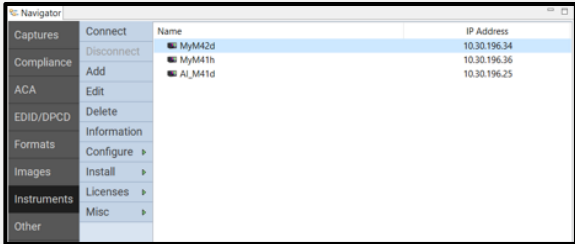
Open [the Selected item] - Loads the selected data item into the M41h Manager for viewing and analysis. Available for all **Navigator** tabs except **Instruments** tab.

Use Selected Item on Instrument [the Selected item] - Applies the selected data item into the M41h instrument. Available only for the **EDID**, **Formats** and **Images** tabs.

Connect – Enables you to connect to the selected M41h if you have not already established a connection to it. This item will not be available if you have already connected to the selected device. Only appears when the **Navigator/Instrument** tab is selected.

Disconnect – Enables you to disconnect from the selected M41h, if you have already established a connection to it. This item will not be available if you are not already connected to the selected device. Only appears when the **Navigator/Instrument** tab is selected.

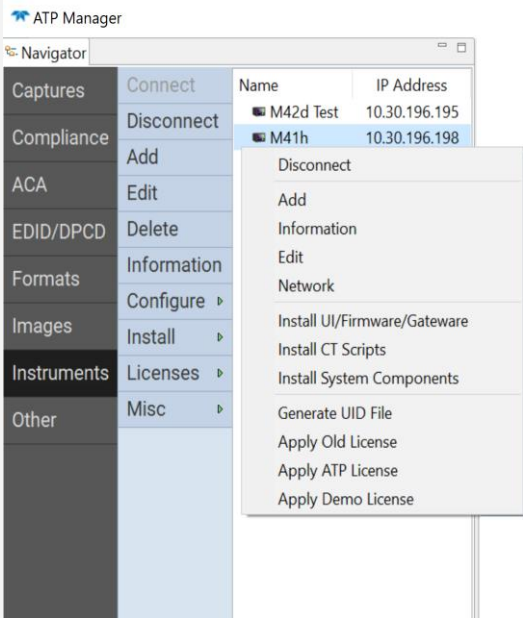
Add - Enables you to add or define an M41h instrument in the M41h Manager application. This is required before connecting to an M41h. Only appears

Navigator Tab	
<p>Images</p> <p>Provides access to bitmap image files that have been saved and image library lists that have been configured.</p>  <p>Instruments</p> <p>Provides access to any instruments that have been configured through the ATP Manager.</p> 	<p>when the Navigator/Instrument tab is selected.</p> <p>Edit Instrument Information - Enables you to edit name and IP address of the M41h that you have selected. Only appears when the Navigator/Instrument tab is selected.</p> <p>Instrument Network Information - Allows you to view and set the network information such as the M41h IP address, subnet mask and gateway IP address. Only appears when the Navigator/Instrument tab is selected.</p>

3.3.2 M41h Navigation Instruments Panel and Right-Click Items

The M41h **Navigator Instruments** panel provides a set of right-click functions when a specific M41h instrument is selected. These are described in the following table.

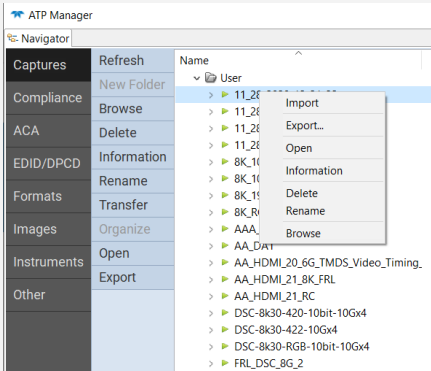
Navigator Panel - Item	Function
Right-click on an Instrument	Connect/Disconnect – Enables you to connect or disconnect to the selected M41h, if you have not already established a connection to it. This item will not be available if you have already connected to the selected device.

Navigator Panel - Item	Function
	<p>[Instrument] Information - Provides information about the M41h that the ATP Manager is currently connected to. This information includes:</p> <ul style="list-style-type: none"> ○ M41h Name ○ IP address of the M41h ○ Netmask ○ Gateway IP address ○ Hardware revisions of the M41h circuit boards ○ Firmware/Gateware version of the release applied to the M41h ○ Serial number of the M41h ○ OS version ○ Licensed options applied to the M41h <p>Edit Instrument Entry - Enables you to edit certain information about the M41h that you have selected.</p> <p>[Instrument Network] Configure - Allows you to view and set the network information such as the M41h IP address, subnet mask and gateway IP address.</p> <p>Upgrade GUI Application - Upgrade GUI Application - Enables you to apply an upgrade of the M41h built-in GUI. You can download new GUI release from the Quantum Data website.</p> <p>Upgrade Firmware/Gateware - Enables you to apply an upgrade of the M41h built-in GUI as well as the firmware and gateware of an M41h ATP. You can download new GUI release and firmware and gateware from the Quantum Data website on the downloads page.</p> <p>Upgrade HDMI CT Scripts - Enables you to apply and upgrade to the optional HDMI Compliance Test application. You can download new releases from the Quantum Data website.</p> <p>Upgrade System Components - Enables you to apply an upgrade to the M41h HDMI Source Compliance Test application or any other optional application. You can download new releases from the Quantum Data website.</p> <p>Generate UID File - This enables you to activate a license for an optional feature you have purchased. When you click on this item, a text file will appear showing a license key that you will send to Quantum</p>

Navigator Panel - Item	Function
	<p>Data Customer Support to activate an option on the M41h system and(s).</p> <p>Apply Old License – No longer used.</p> <p>Apply ATP License - This is a license key file (QDATP.lic) that enables you to activate a license key obtained from Quantum Data Customer Support for an option.</p> <p>Apply Demo License - This is a license key file that enables you to activate a license key temporarily for a specific feature option.</p>

3.3.3 M41h Navigation Captures Panels and Right-Click items

The M41h **Navigator Capture** panel provides a set of right-click functions when a specific M41h instrument is selected. These are described in the following table.

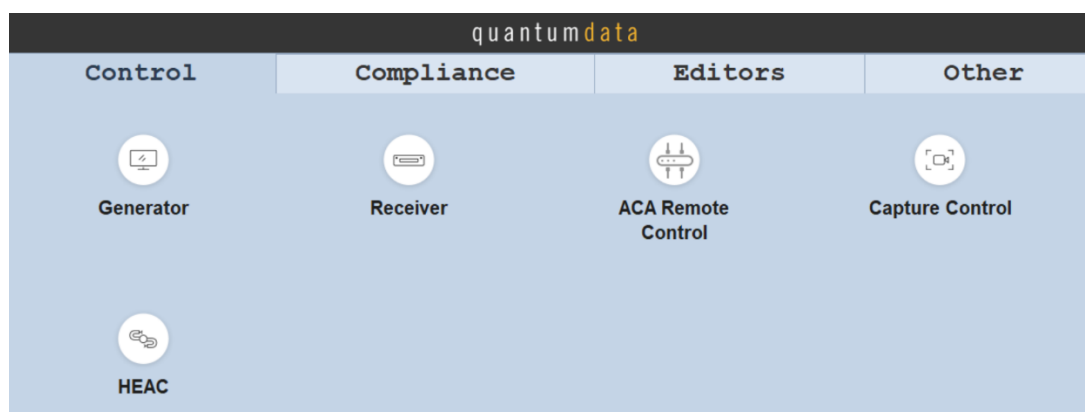
Navigator Panel - Item	Function
<p>Right-click on M41h Capture</p> 	<p>Import - Enables you to import a zipped capture file that resides on the M41h Manager host PC. You can then disseminate this file to other colleagues who can view the captured data using the ATP Manager, i.e. they do not need the M41h Protocol Analyzer.</p> <p>Export - Enables you to export a capture file that resides on the M41h Manager host PC. All captured data is zipped up into a single file.</p> <p>Open [the Selected Capture] - Loads the selected capture into the M41h Manager for viewing and analysis.</p> <p>[Capture] Information - Provides information about the selected capture and the M41h used to capture the data:</p> <p>Delete [a Capture] - Enables you to delete a capture from the M41h Manager application.</p> <p>Rename - Enables you to rename a capture file. A useful practice might be to rename the file to include the device tested.</p>

3.4 Apps Panels

The **Apps** panel is shown in the figure below. The **Apps** panel provides access to all the capture related applications, compliance tests and various other utilities. There are four pages to the **Apps** panel, and several applications within each page:

Control

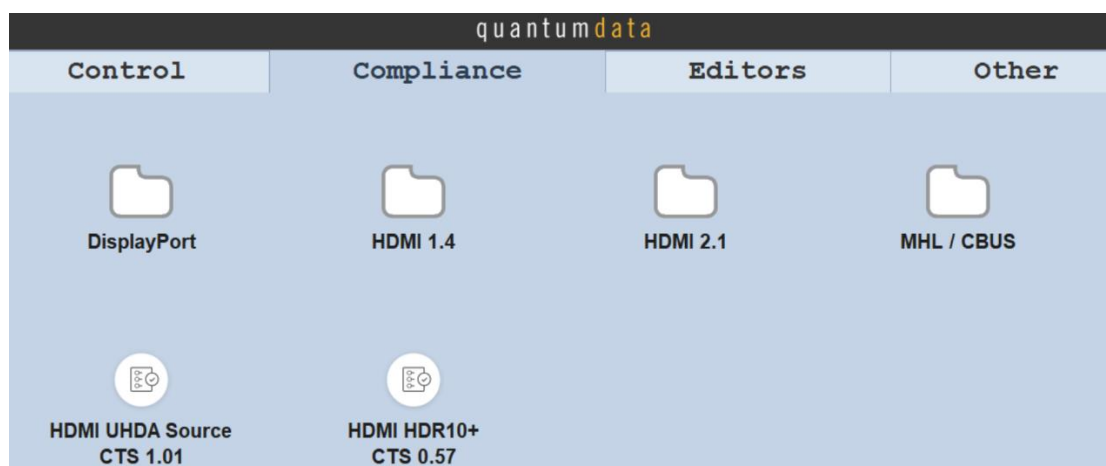
- **Generator**
- **Receiver (HDMI 2.1)**
- **ACA Remote Control**
- **Capture Control**
- **HEAC**



Compliance (Tests)

- **HDMI 1.4 (directory)**
- **HDMI 2.1 (directory)**
- **MHL/CBUS (directory)**
- **UHDA Source CTS**
- **HDMI HDR10+ CTS**

Note: DisplayPort (directory) is not applicable to the M41h instrument



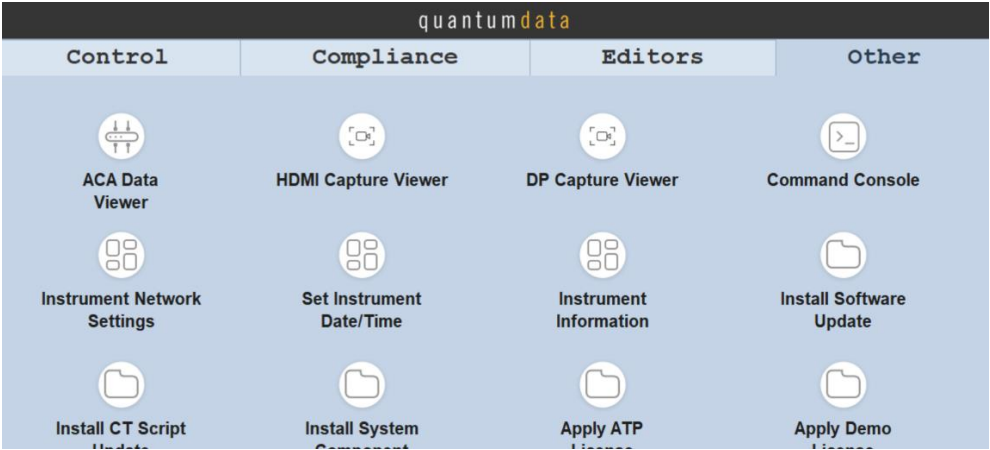
Editors

- **EDID Editor**
- **CDS Editor**
- **Format Editor**
- **Format List Editor**
- **Pattern List Editor**
- **Playback List Editor**



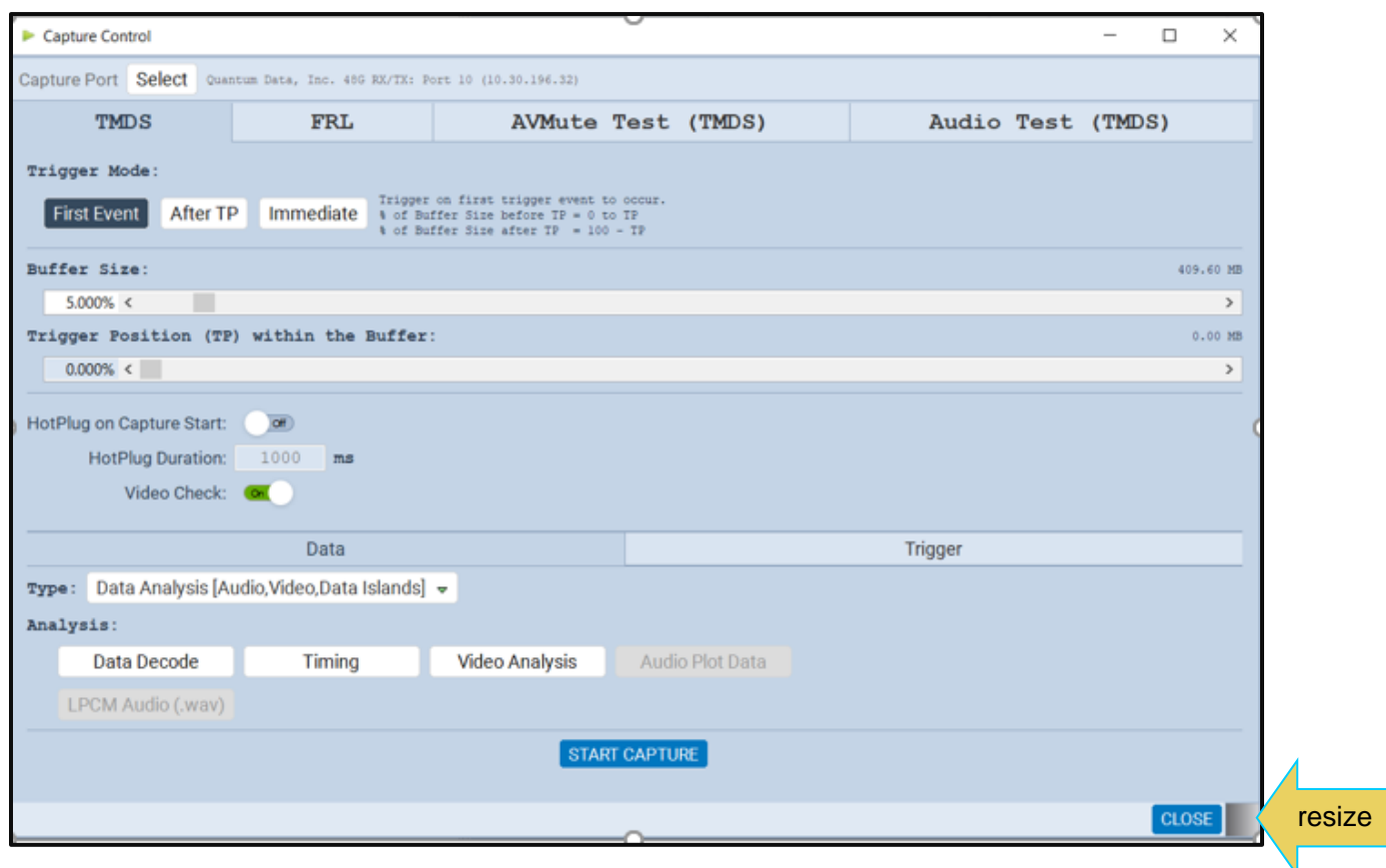
Other (Note: any applications not applicable to M41h instrument have been left off this list)

- **ACA Data Viewer**
- **HDMI Capture Viewer**
- **Command Console**
- **Instrument Network Settings**
- **Set Instrument Date/Time**
- **Instrument Information**
- **Install Software Update**
- **Install CT Script Update**
- **Install System Component**
- **Apply ATP License**
- **Apply Demo License**
- **Generate License UID**
- **Switch Workspace**
- **Select Theme**
- **Configure Autoboot**



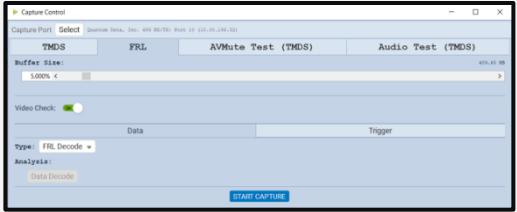
4 Capture Control Panel

The **Capture Control** panel enables you to setup the capture HDMI® parameters. The figure below shows the **Capture Control** panel and its control and selection items. You can resize the window with the box on the lower right corner of the panel indicated by the arrow below.



The following table describes the functions of the **Capture Control** panel.

Capture Control Panel - Function		Item - Description
Instrument Selection		
<div><div>Capture Control</div><div>Capture Port <div>Select</div>Quantum Data, Inc. 48G RX/TX: Port 10 (10.30.196.32)</div></div>		
	The Select button above allows you to select which M41h system you want to use assuming you have more than one. Typically, you will only have a single M41h system on the network in which case the text next to the Select button will indicate your M41h system.	
Capture Trigger Configuration		Enables you to define the capture trigger criteria. Use the information below.
<div><div>Trigger Mode:</div><div><div>First Event</div><div>After TP</div><div>Immediate</div></div><div><div>Trigger on first trigger event to occur.</div><div>% of Buffer Size before TP = 0 to TP</div><div>% of Buffer Size after TP = 100 - TP</div></div><div>Buffer Size:</div><div><div>5.000%</div><div></div></div><div>Trigger Position (TP) within the Buffer:</div><div><div>0.000%</div><div></div></div><div>HotPlug on Capture Start: <div>ON</div></div><div>HotPlug Duration: <div>1000</div> ms</div><div>Video Check: <div>ON</div></div></div>	Trigger Mode	<p>Note: Supported in FRL mode, but not in TMDS mode.</p> <p>First Event – The capture function will trigger on the first Scrambler Reset character sequence of the first Super Block.</p> <p>After TP (Trigger Position) – No Trigger will occur until TP is reached.</p> <p>Immediate – No Trigger; Data recording begins immediately upon Capture start.</p>
	[Capture] Buffer Size Slider	Enables you to set the size of the captured data in percent. This is a slider that provides an indication (on the left) of the percent of the total possible size to be captured (max is 8Gbytes). A lower value will require less time for the captured data to accumulate.
	[Capture] Trigger Position within Buffer Slider	Enables you to set the percentage of the capture from zero up to 100.
	HotPlug on Captured Start	Causes a HotPlug event when the data capture begins, in other words when you click on the Start Capture activation button. Enables you to specify the length of the HotPlug pulse

Capture Control Panel - Function	Item - Description	
		in milliseconds. A HotPlug pulse, issued by the M41h, will reinitiate HDCP authentication if the video content from the source is content protected.
	Video Check	Verifies that there is incoming video prior to a capture.
	Start Capture (Capture Tab)	Initiates a capture using the criteria defined in the Data , Trigger and Match tabs below.
	Data Tab (Capture Tab)	Currently, there is a default Type and there are no other configurations supported. <ul style="list-style-type: none"> FRL Decode – Supports the capture and storage of FRL and FEC protocol elements while also showing underlying TMDS elements.
	Trigger Tab (Capture Tab)	The only currently supported trigger is the initial scrambler reset in a Super Block.

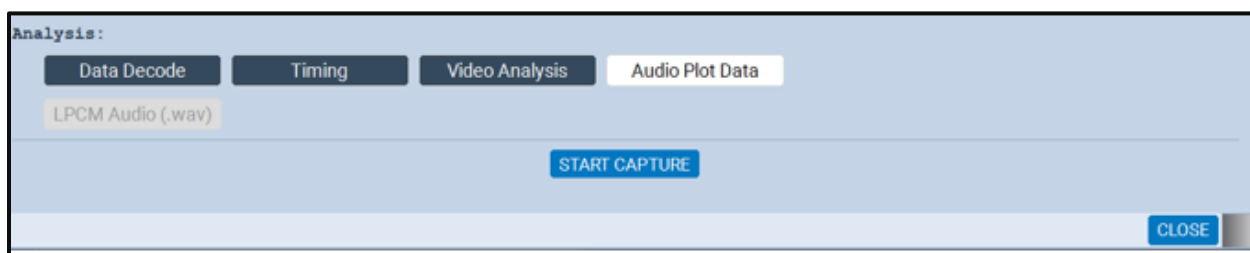
4.1 Capture Viewer Panel

The Capture Viewer Panel is on the 4th page **Other** of the Apps panel. It provides access to the following windows for viewing captured data:

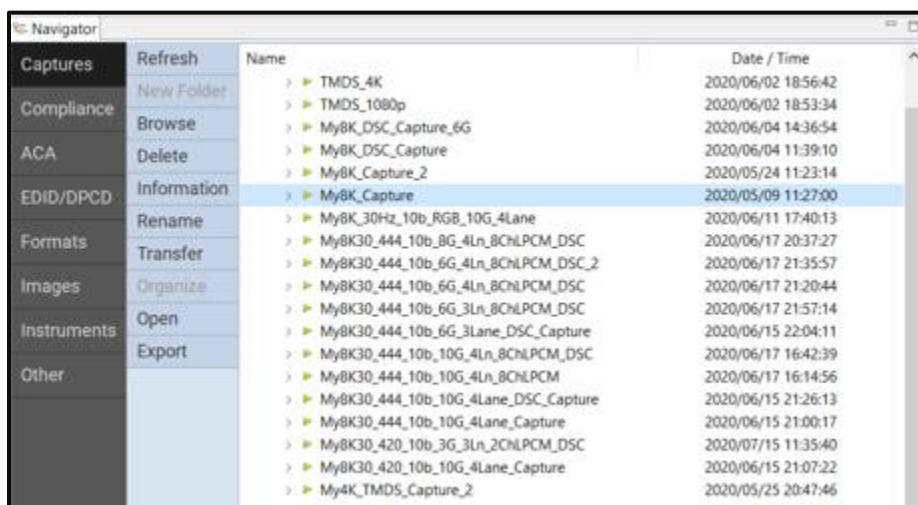
Event Plot – Provides graphical view of metadata.

Decode – Provides tabular view of metadata.

When you open a capture the **Event Plot** and **Decode** windows will always be shown by default.

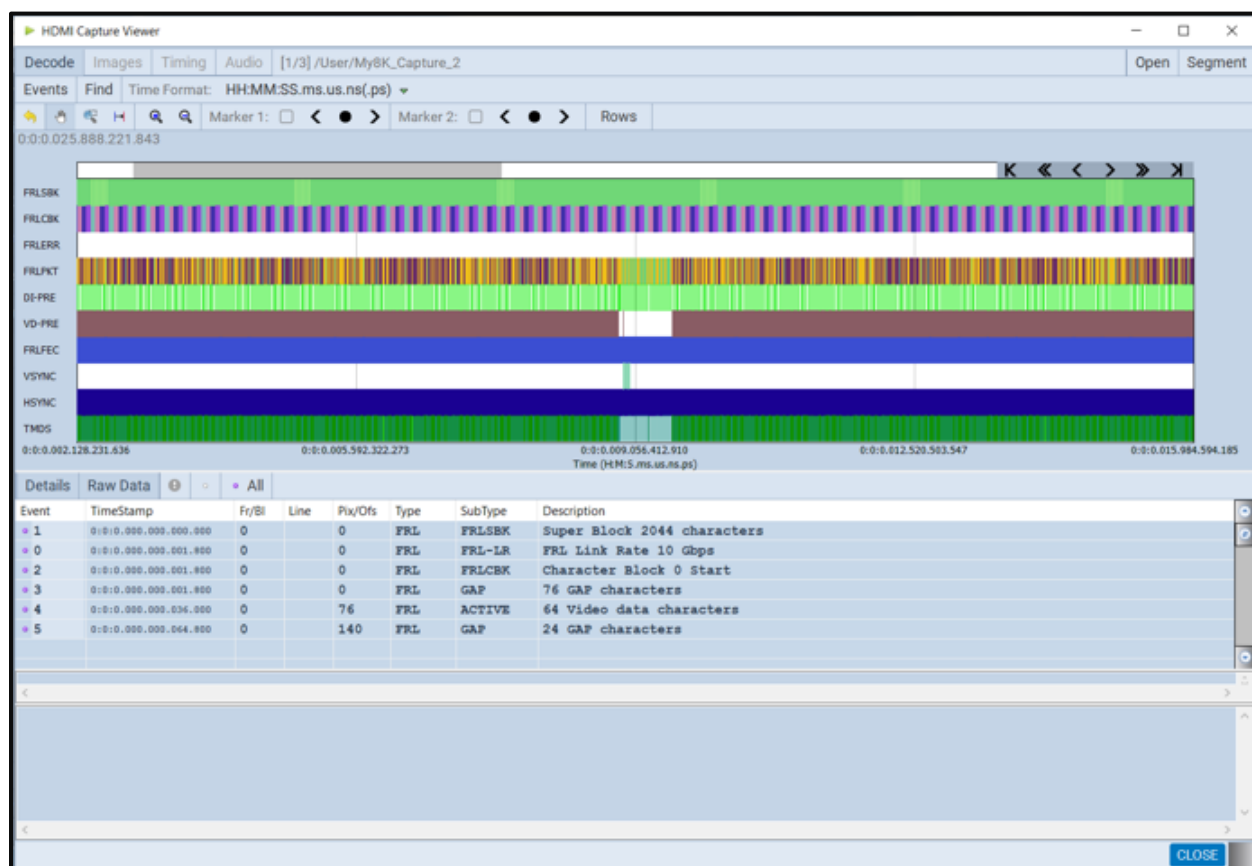


You can open a capture for viewing in the **Event Plot** or **Decode** window either from the **Navigator** panel or the **Open** button on the top of the window. When you select Open a dialog box appears enabling you to select a capture:

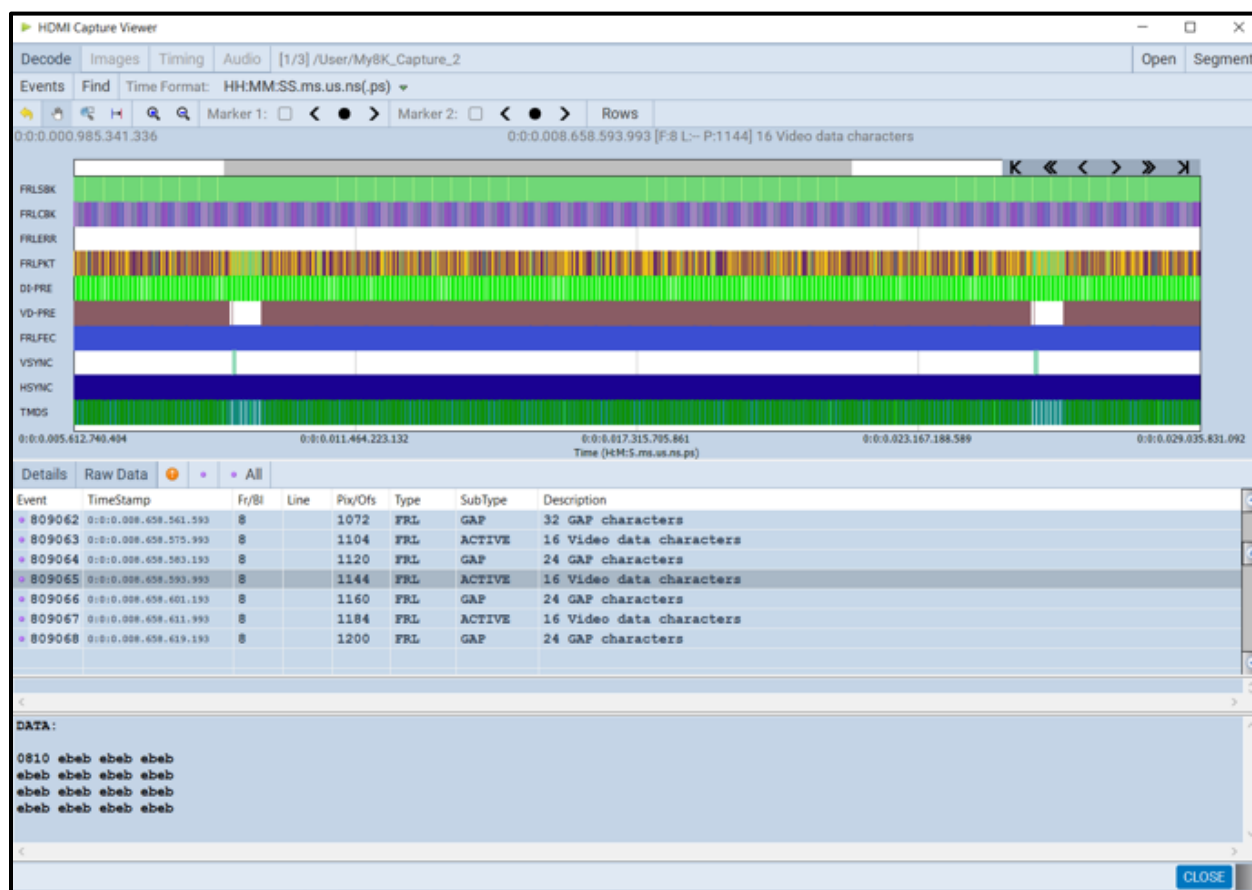


4.2 Decode Panel

The **Decode** panel (shown below) is the primary panel for examining data at the detail level. The example shows data captured in the Data Analysis mode where the FRL, FEC and TMD5 data are captured.






When you select a packet in the **Decode** panel that packet is highlighted in the **Event Plot** panel. It is only visible if the **Event Plot** is zoomed to show each distinct packet. Refer to the screen shot below.

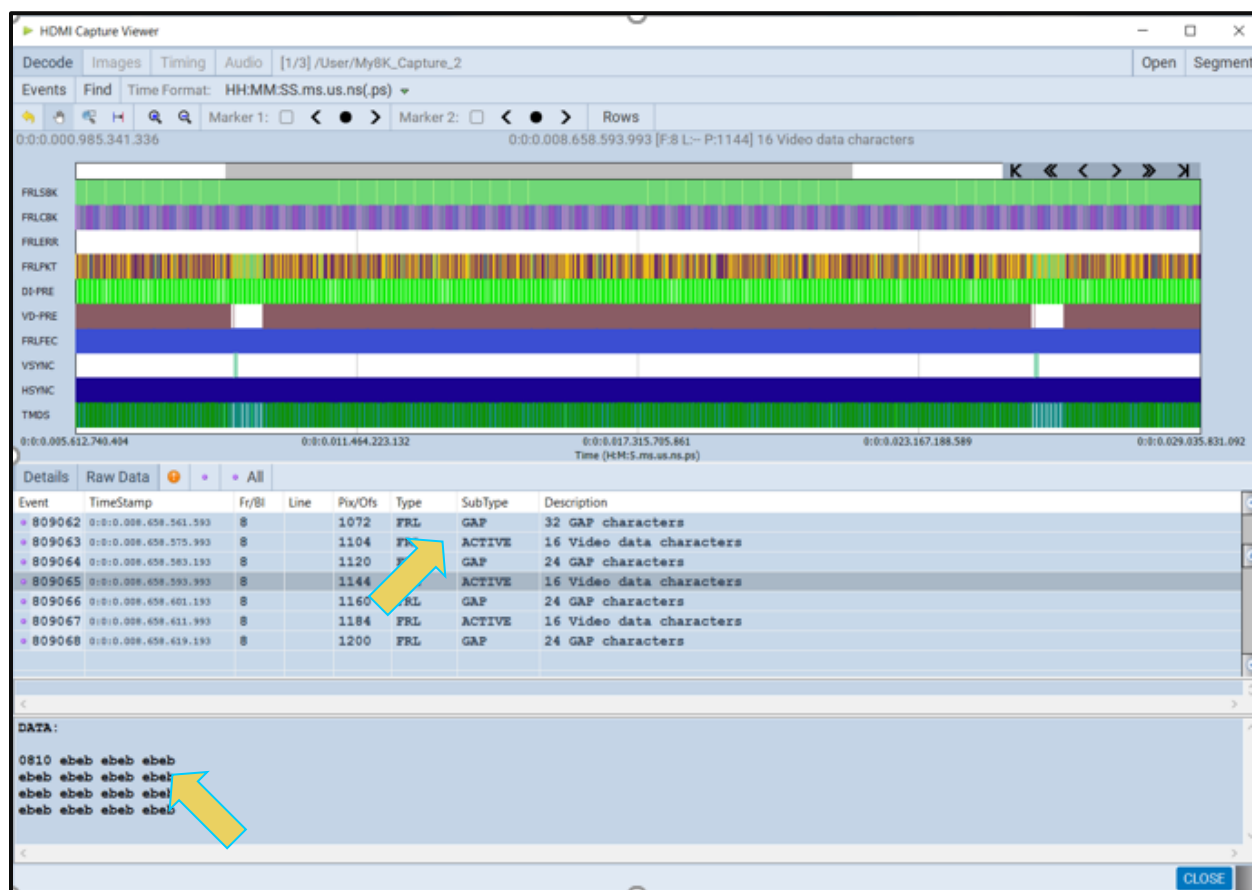


The following table describes the activation buttons available through the **Decode** panel. In some cases, clicking on these buttons opens a dialog box. These dialog boxes are described in detail in the following the table.


Decode Status	Function
Navigator / Data 	User path status – shows the name of the capture file and its location. Segment – Large captures are broken into smaller distinct sections called segments to make them more manageable and to improve speed and performance. When you click on the Segment activation button, a dialog box appears enabling you to select and load another segment. This dialog box is described further below. Events – The Events activation button enables you to filter the captured data by type. When you click on the Events button a dialog box appears enable you to select or deselect data types individually or a page at

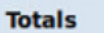
Decode Status	Function
	<p>a time. This dialog box is described further below.</p> <p>Find – The Find activation button enables you to locate captured data by type. When you click on the Find button a dialog box appears to enable you to specify a data type to search on individually or a page at a time. This dialog box is described further below.</p> <p>Details – The Details activation button enables you to toggle the view of the Details subpanel. The Details subpanel provides a human readable text description of the data of the record that is highlighted.</p> <p>Raw Data – The Raw Data activation button enables you to toggle the view of the hex data on and off.</p> <p>Marker – The Marker enables you to flag certain important records for easy identification. You can also flag a record by double-clicking on the record.</p> <p>Clear Marker – The Clear Marker and Clear All enable you to clear the flags on specific records or all records. You can also clear the flag on a record by double-clicking on the record.</p>

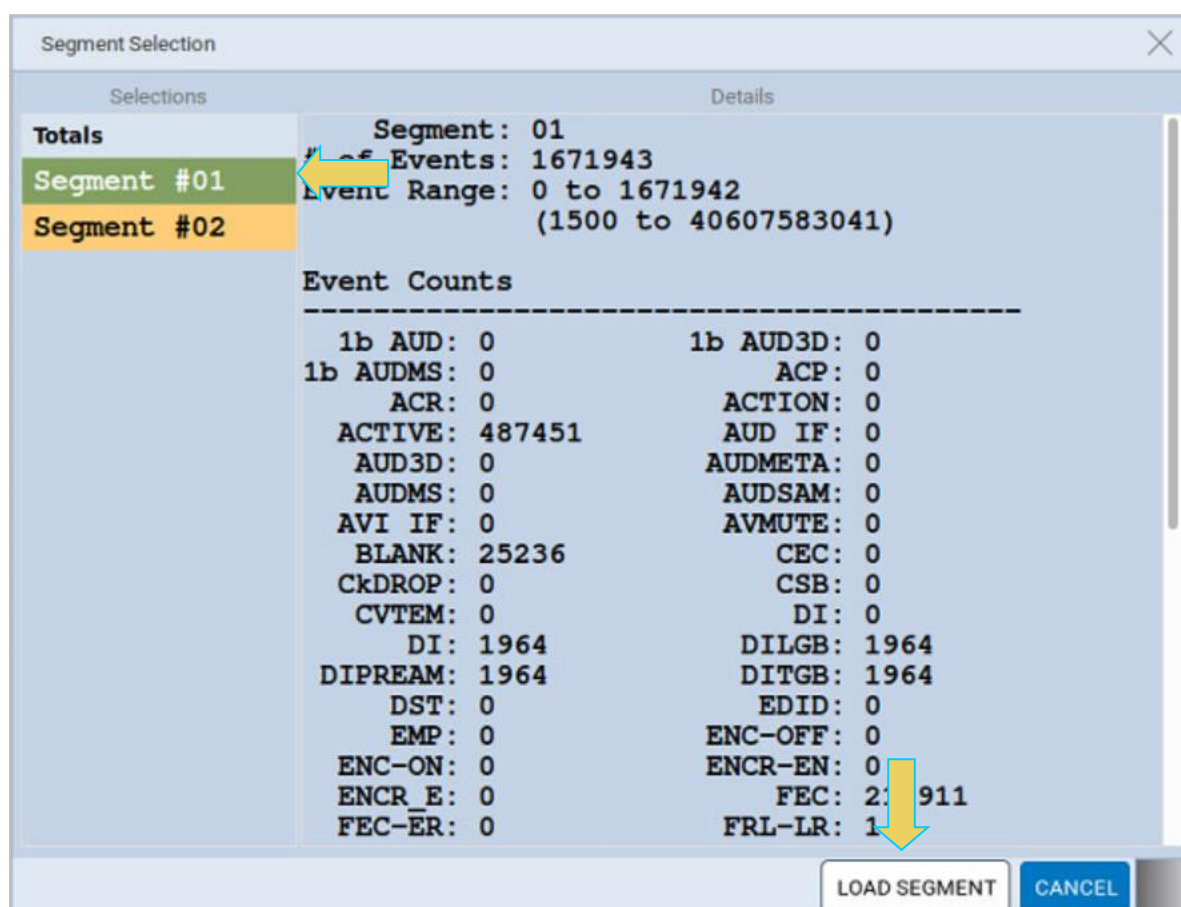
There is a vertical scroll bar available on the right side of the **Decode** panel. This enables you to browse through the **Decode** records. The   buttons enable you to advance downward or upward one record at a time. The  button is a scroll button that you can slide up or down.



4.2.1 Working with Segments in the Decode Panel

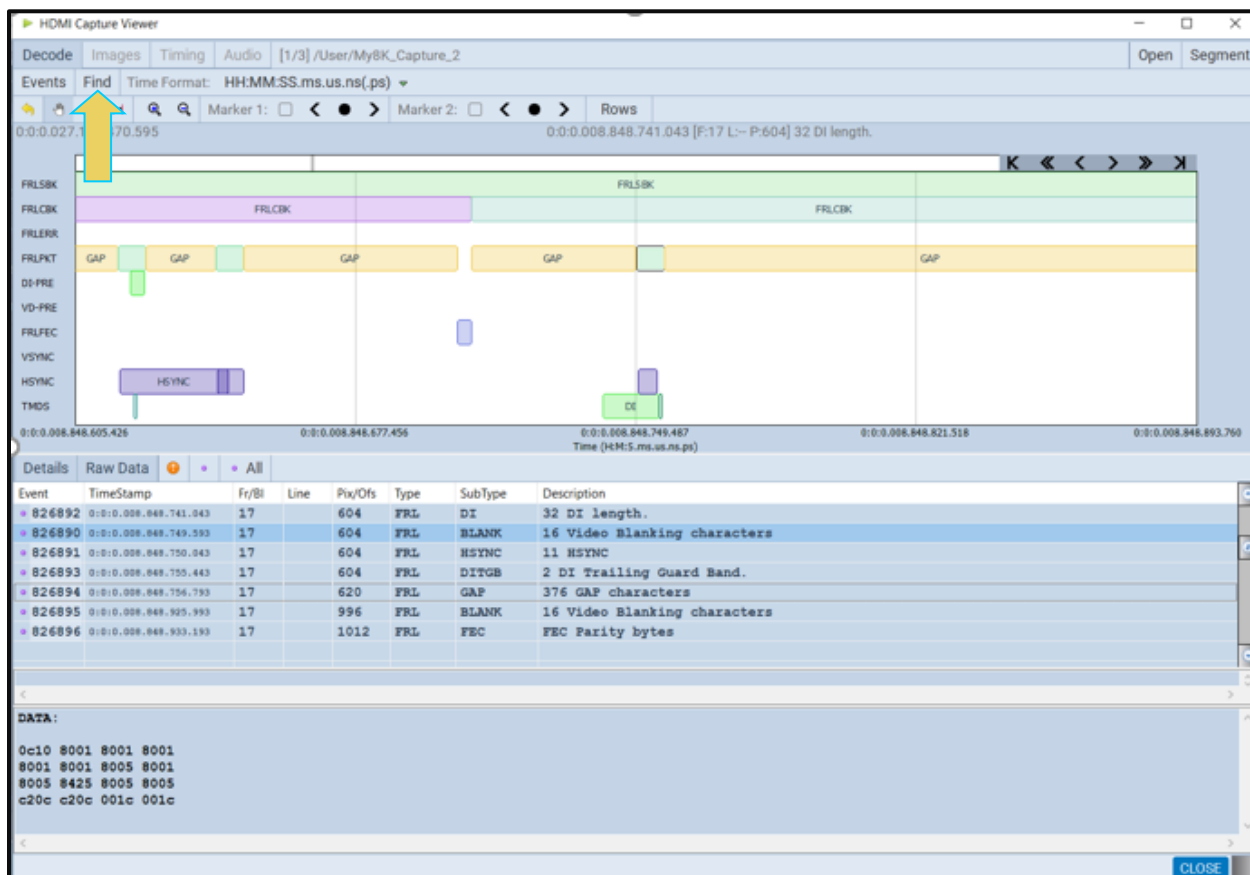
Large captures are broken into smaller distinct sections called segments to make them more manageable and to improve speed and performance. When you click on the Segment activation button , a dialog box appears (shown below) enabling you to select and load another segment. The Selections section on the left lists the segments in the capture. The Details section on the right shows you the packet makeup of the segment as well as the number of packets and the range of packets in the overall capture.

From the Selections panel you can select and load a different segment by highlighting a segment and then clicking on the **Load Segment** activation button on the bottom right. You can also select any segment to view its packet contents in the Details panel. If you wish to view the total packets of all segments simply highlight the Totals  button.



4.2.2 Searching for Data in the Decode Panel

You can search for data in the **Decode** panel using the search function. The search function is accessible using **Find** on the upper left of the **Decode** panel. In the example below, a search for the next occurrence of an AVI InfoFrame is being initiated. You can specify a search forward (**Find Next**) or backward (**Find Previous**).



4.2.3 Post-Capture Filter Selection Tab

The **Post-Capture Events** button **Events** on the **Decode** panel enables you to do the following:

Specify the data that you want to view in the **Event Plot** and **Decode** panels.

View the number of packets for each data type and each category of data type. These are shown in parentheses after each data type or on the tab for each category.

The screens below show the **Post-Capture Decode Event Selection** panel and its control and selection items. In this example all items are checked meaning that the **Decode** panel will show all the data captured.

Note that you can select or deselect all items on a page with the **Select All** **Select All** or **Clear**

All **Clear All** buttons or you can individually select an item. You can also select and deselect all items on all pages with the **Select All Categories & Events** and **Clear All Categories & Events**

buttons. **SELECT ALL CATEGORIES & EVENTS** **CLEAR ALL CATEGORIES & EVENTS**

Decode Event Selection

Category	Events	Select All	Clear All
Misc (0)	<input checked="" type="checkbox"/> Link Rate (1)	<input checked="" type="checkbox"/> H-Sync (0)	
Packets (0)	<input checked="" type="checkbox"/> Super Block (38376)	<input checked="" type="checkbox"/> V-Sync (871)	
InfoFrame (0)	<input checked="" type="checkbox"/> Character Block (153504)	<input checked="" type="checkbox"/> Encryption Enable (0)	
Control (0)	<input checked="" type="checkbox"/> Gap (1436286)	<input checked="" type="checkbox"/> Video Preamble (7610)	
DDC (0)	<input checked="" type="checkbox"/> Active (1330966)	<input checked="" type="checkbox"/> Video Guard Band (7606)	
FRL (3145728)	<input checked="" type="checkbox"/> Blank (11129)	<input checked="" type="checkbox"/> Data Island (1469)	
Other (0)	<input checked="" type="checkbox"/> FEC Parity (153503)	<input checked="" type="checkbox"/> DI Preamble (1469)	
	<input checked="" type="checkbox"/> FEC Error (0)	<input checked="" type="checkbox"/> DI Leading GB (1469)	
	<input checked="" type="checkbox"/> Error (0)	<input checked="" type="checkbox"/> DI Trailing GB (1469)	

SELECT ALL CATEGORIES & EVENTS CLEAR ALL CATEGORIES & EVENTS OK CANCEL

Decode Event Selection

Category	Events	Select All	Clear All
Misc (0)	<input checked="" type="checkbox"/> Any DDC (0)		
Packets (0)	<input checked="" type="checkbox"/> EDID (0)		
InfoFrame (0)	<input checked="" type="checkbox"/> HDCP (0)		
Control (0)	<input checked="" type="checkbox"/> HDCP 2 (0)		
DDC (0)	<input checked="" type="checkbox"/> SCDC (0)		
FRL (3145728)			
Other (0)			

SELECT ALL CATEGORIES & EVENTS CLEAR ALL CATEGORIES & EVENTS OK CANCEL

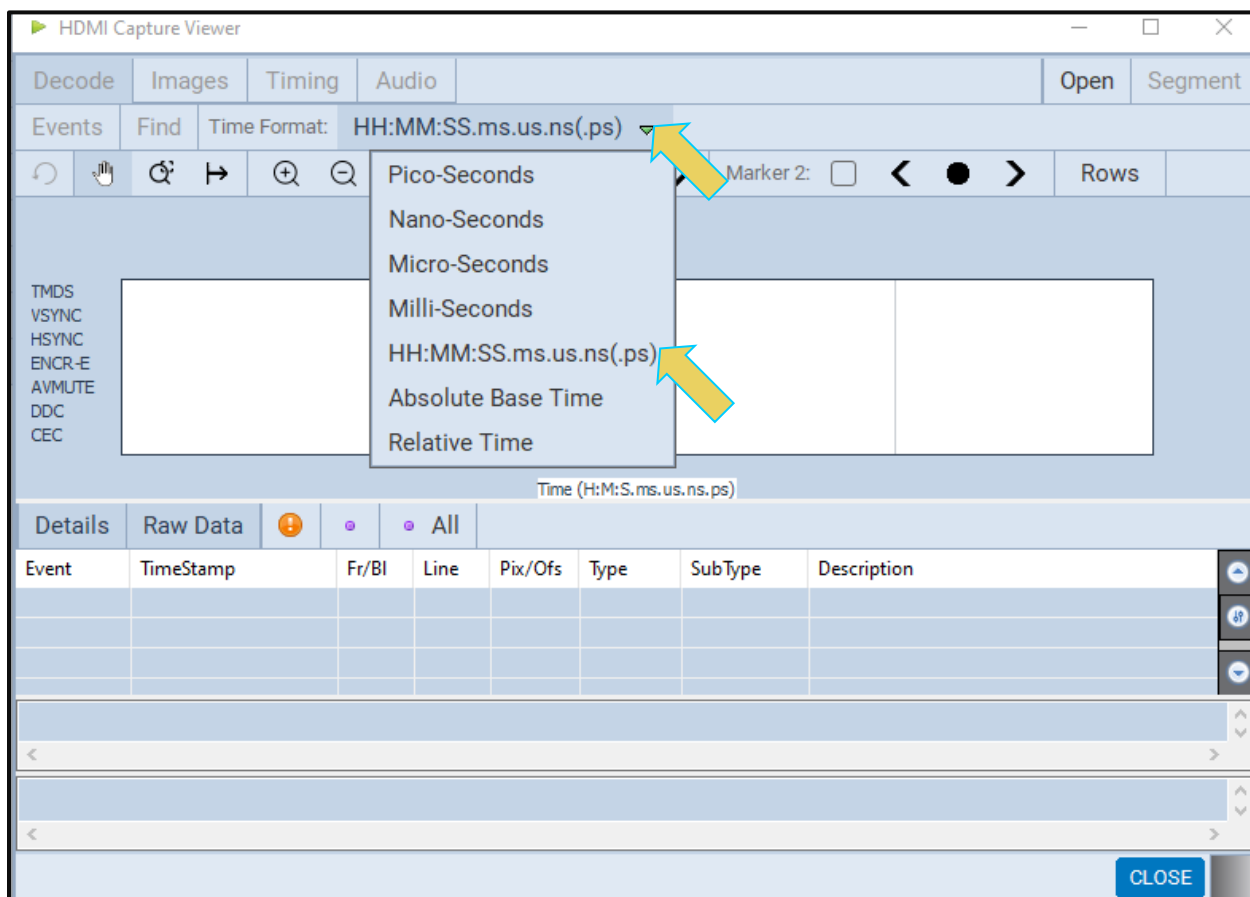
4.2.4 Decode Record Field Descriptions

The **Decode** panel enables you to select the individual protocol transactions (records). When you highlight a transaction, the details for the selected transaction, are shown in the lower panels. There are two lower panels: top and bottom. The top lower panel shows the data for the selected transaction parsed out in human readable form. The bottom panel shows the data for the selected transaction parsed out in hex form. The following table describes the information on the **Decode** panel.

Field	Function
Packet	Lists the packet numbers in sequential order beginning from the first packet captured.
Timestamp	Provides the timestamp in nanoseconds for each transaction since the beginning of the captured data.
Frame	Lists the frame number of the record. The frame count begins when the capture begins and are counted sequentially.
Line	Lists the line number of the frame.
Pixel	Lists the pixel number in the line.
Type	The type of data of the selected record. This could be one of: TMDS or DDC.
SubType	The SubType of the data for a selected record. This is a more specific designation of the type of data. For example, for a Type of TMDS this could be a data island such as an audio sample, InfoFrame, control signal, etc.
Info	A description of the data of a selected line.

4.2.5 Decode Timing Mode

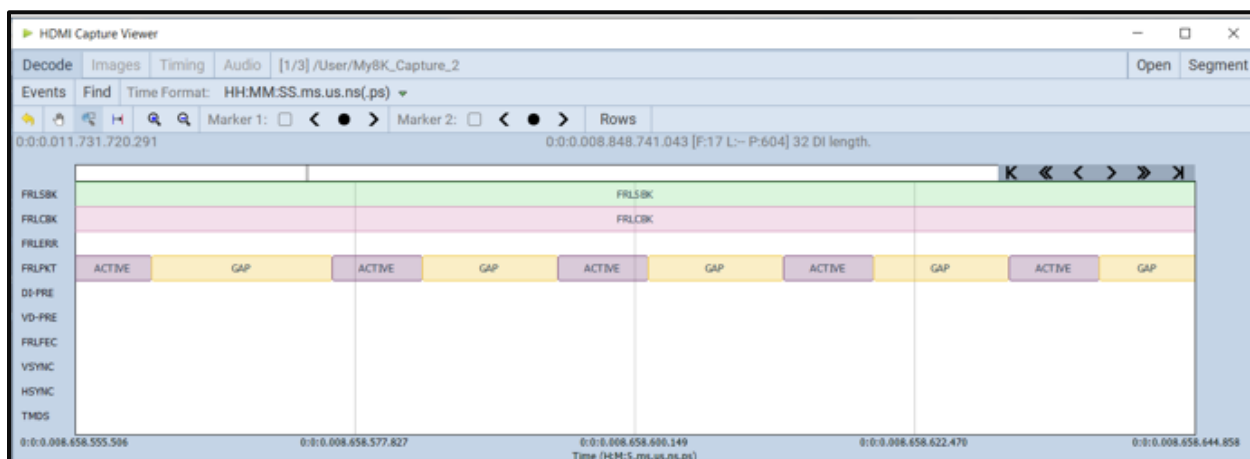
The **Capture Viewer** provides a pull-down menu to define how the time stamps are displayed on the **Decode** records. This is shown below. The table that follows the screen image defines each option:



Right-click option	Description
Nano-Seconds [HHMMSSmsusns]	Time is shown in nanoseconds. The baseline time is the time of the last boot of the M41h.
Micro-Seconds [HHMMSSmsusns]	Time is shown in microseconds. The baseline time is the time of the last boot of the M41h.
HH:MM:SS.ms.us.ns	Time is shown in relative time meaning the time from the previous event listed.
Absolute Base Time	Time for each item is shown from the time of the beginning of the capture.
Relative Time	Time is shown in relation to the previous item.
Milli-Seconds [HHMMSSms.usns]	Time is shown in milliseconds. The baseline time is the time of the last boot of the M41h.


4.3 Event Plot Panel

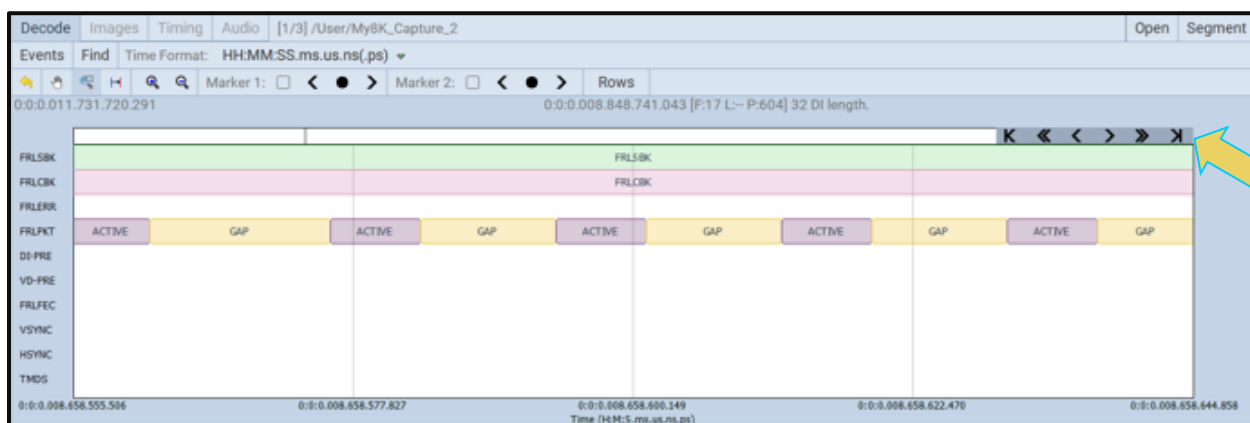
The **Event Plot** panel (shown below) is the primary panel for locating the data for high level navigation to the detail level provided by the **Decode** panel. The vertical axis is the data types. The **Event Plot** panel provides a set of data types labeled on the left of the panel that inform you of the type of data for that layer. (You can change this configuration.) The horizontal axis is time. The scale along the bottom of the **Event Panel** shows the timestamp for each point in time.



4.3.1 Locating Data in the Event Plot Panel






The **Event Plot** 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. You can synchronize the **Decode** and **Timing** panels to the **Event Plot** or you can synchronize the **Event Plot** to the **Decode** panel.

A scroll bar is provided to enable you to quickly browse through the data. The scroll bar is under the set of functions 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  buttons. See the screen shot below.



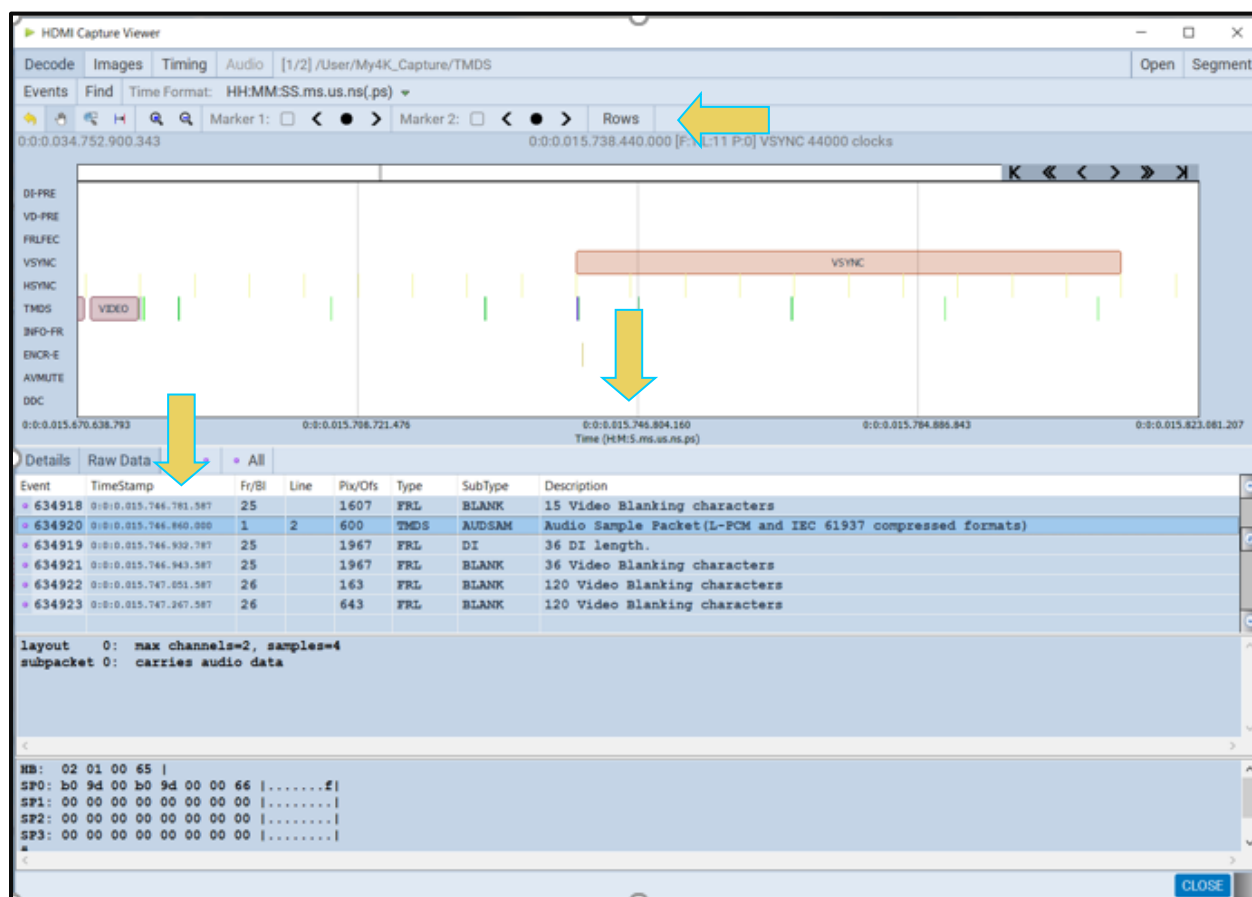
4.3.2 Zooming in the Event Plot Panel

You can zoom in and zoom out and pan across the data using the sliders 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 & Panning	Function
Zoom and Panning 	<p>Surround  – 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.</p> <p>Zoom % – The Zoom % function enables you to enter a specific zoom amount in the associated field provided.</p> <p>Zoom In/Out  – The Zoom In/Out function buttons enables you to zoom in and zoom out by clicking on the activation button. The centered point will remain the same.</p> <p>Panning  – The panning function enables you to scan across the data quickly by clicking and dragging.</p> <p>Pointer  – The pointer enables you to click on any point and obtain information such as the data packet type and the timestamp, about that data packet. The information is displayed in a dark panel just above the scroll bar.</p>

4.3.3 Viewing the Time Stamps of the Data

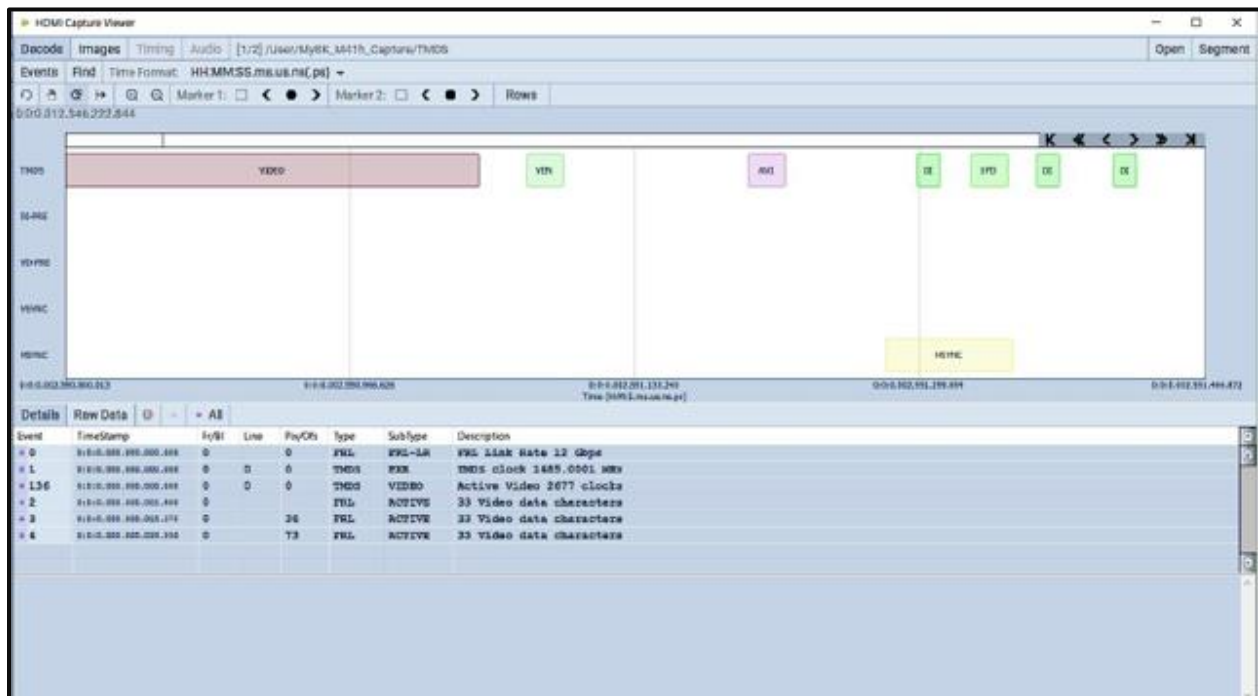
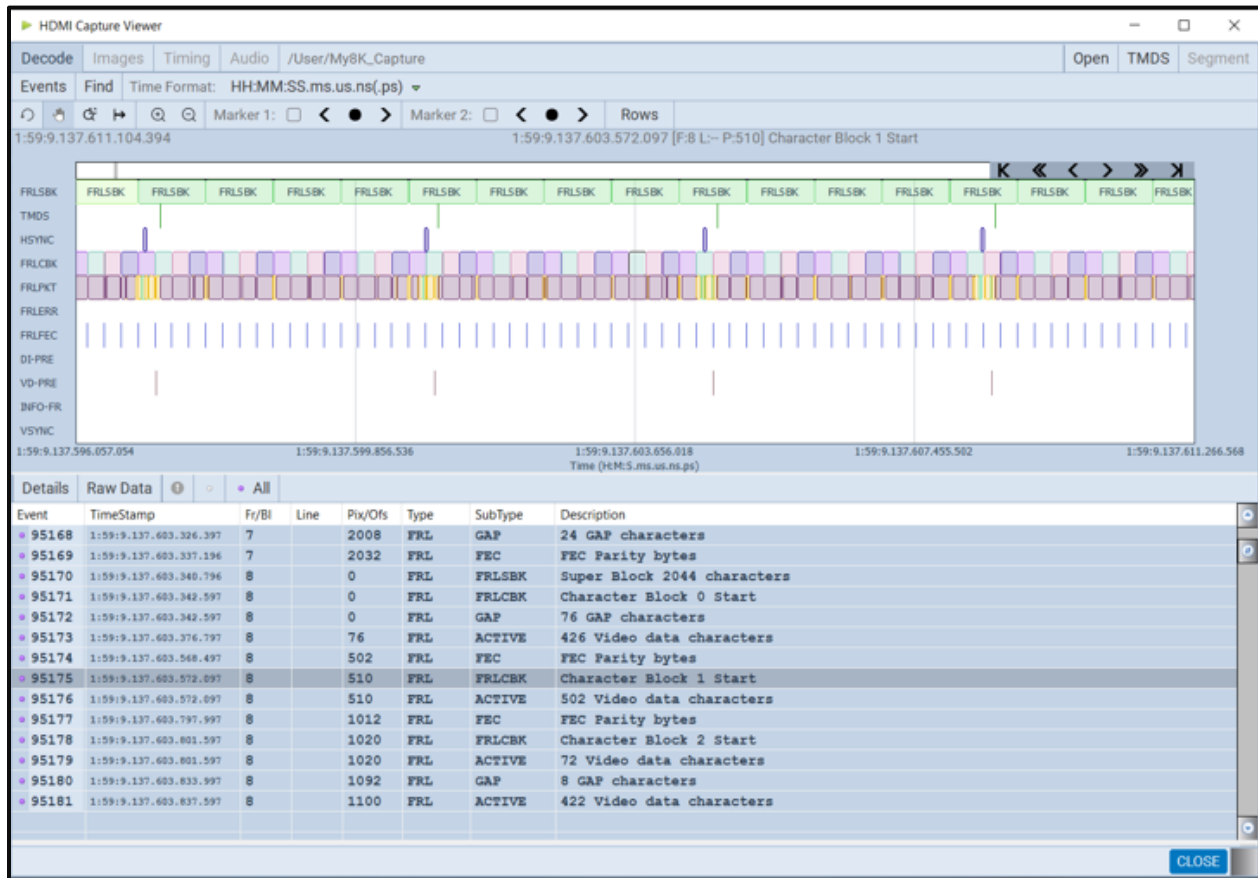
The timestamp indicated on the dark status panel indicates the location of the scroll bar. When you scroll or pan through the data, the time stamps are shown in the status panel. If you use the pointer tool to select a particular point, the timestamp and data element will be shown in the center of the dark status panel. In the example below, a selection has been made on an AVI InfoFrame either with the pointer tool or in the **Decode** panel.



4.3.4 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 two screens below show an example of a surrounding segment of data.

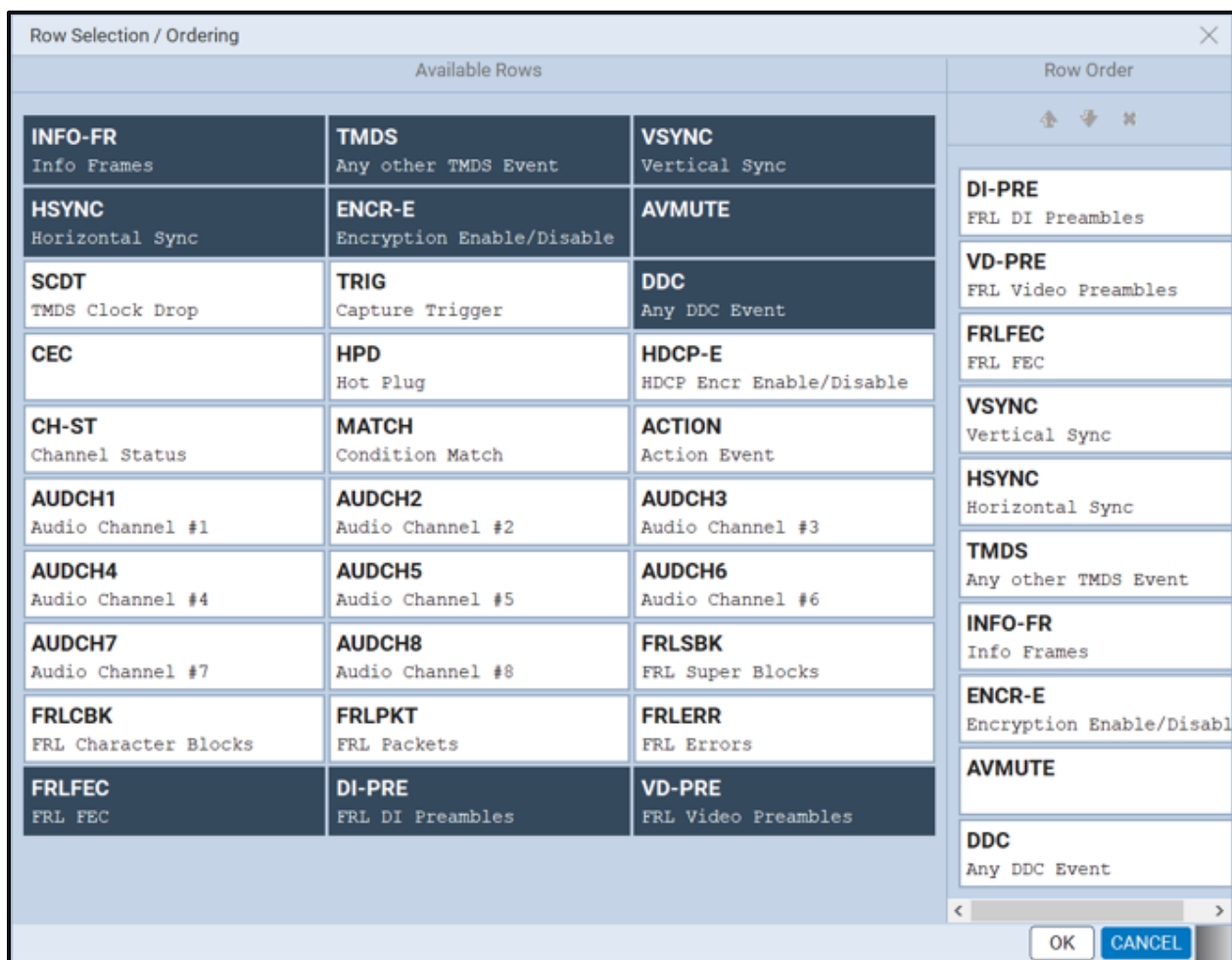
The dotted indicates the resultant section that is surrounded. The second view shows the resulting view.





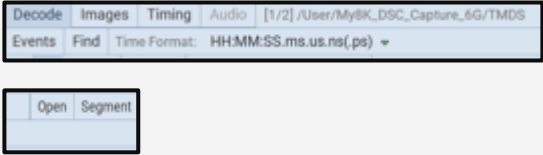




4.3.5 Selecting Data to View in the Event Plot

The **Event Plot** enables you to select what data elements to display. You use the Rows **Rows** button to access the dialog box. The following dialog box will appear allowing you to select what data to display in the **Event Plot**.




4.3.6 General Controls – Event Plot

The various other controls in the **Event Plot** are described in the tables and screens that follow.

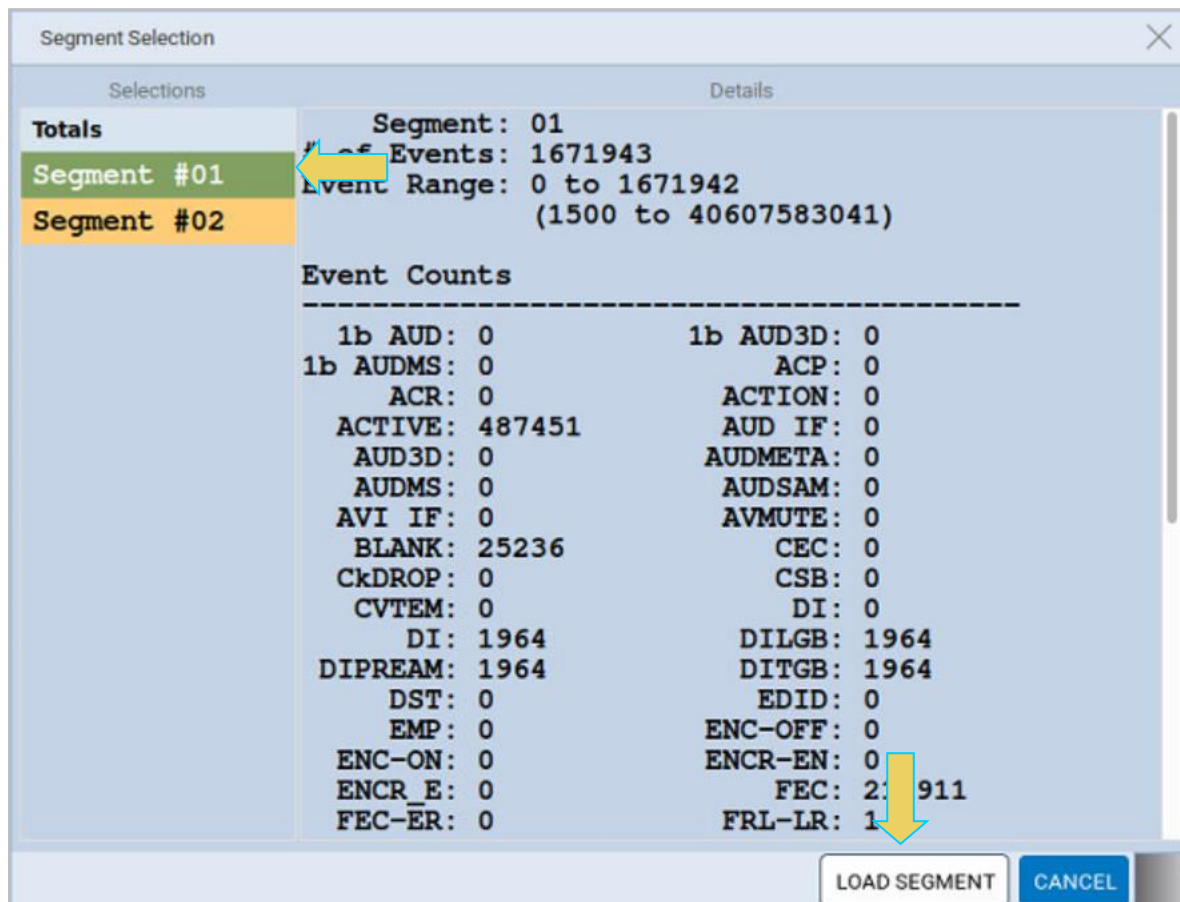
Even Plot	Function
<p>General Control</p> 	<p>User path status [1/2] /User/My8K_DSC_Capture_6G/TMDS – shows the name of the capture file and its location.</p> <p>Segment  – Large captures are broken into smaller distinct sections called segments to make them more manageable and to improve speed and performance. When you click on the Segment activation button, a dialog box appears enabling you to select and load another segment. In the example to the left, there are no segments to the left, there are no segments to the left, the button is grayed out. This dialog box is described further below.</p> <p>Events  – The Events activation button enables you to filter the captured data by type. When you click on the Events button a dialog box appears to enable you to select or deselect data types individually or a page at a time. This dialog box is described further below.</p> <p>Rows  – The Rows activation button enables you to configure the data types that appear in the Event Plot window. When you click on this a dialog box appears enabling you to configure the rows. This dialog box is described further below.</p> <p>Find  – The Find activation button enables you to locate captured data by type. When you click on the Find button a dialog box appears to enable you to specify a data type to search on. This dialog box is described further below.</p>

4.3.7 Working with Segments in the Event Plot Panel

The Segments in the **Event Plot** panel work the same way they do as the **Decode** panel. Large captures are broken into smaller distinct sections called segments to make them more manageable and to improve speed and performance. When you click on the Segment activation button , a dialog box appears (shown below) enabling you to select and load another segment. This dialog box is shown below. The Selections section on the left lists the segments in the capture. The Details section on the right shows you the packet makeup of the segment as well as the number of packets and the range of packets in the overall capture.

From the Selections panel you can select and load a different segment by highlighting a segment and then clicking on the Load Segment activation button on the bottom right. You can also select

any segment to view its packet contents in the Details panel. If you wish to view the total packets of all segments simply highlight the Totals **Totals** button.



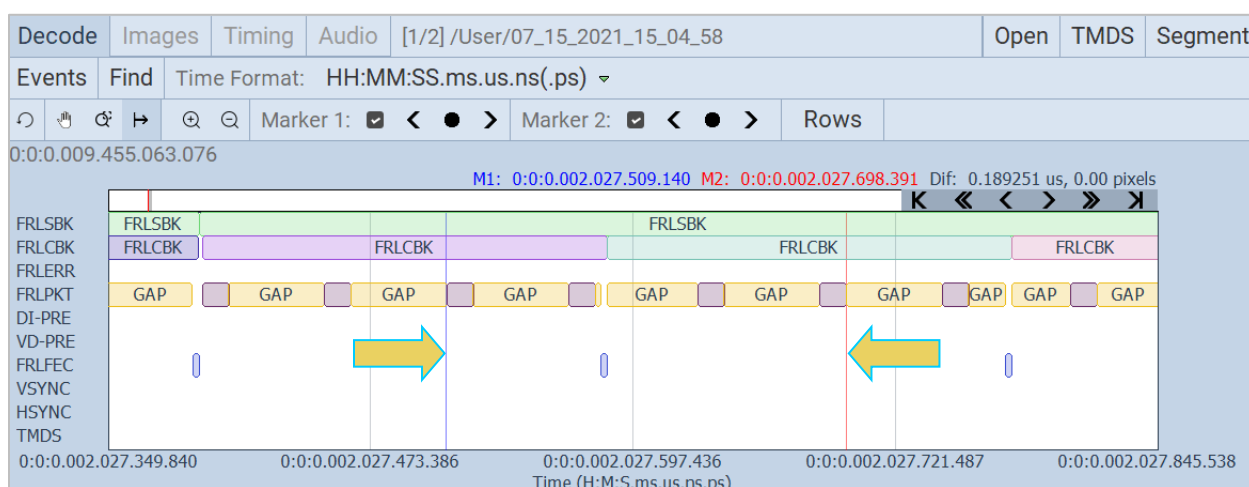
4.3.8 Working with Markers

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" in the **Event Plot** panel at particular points of interest.

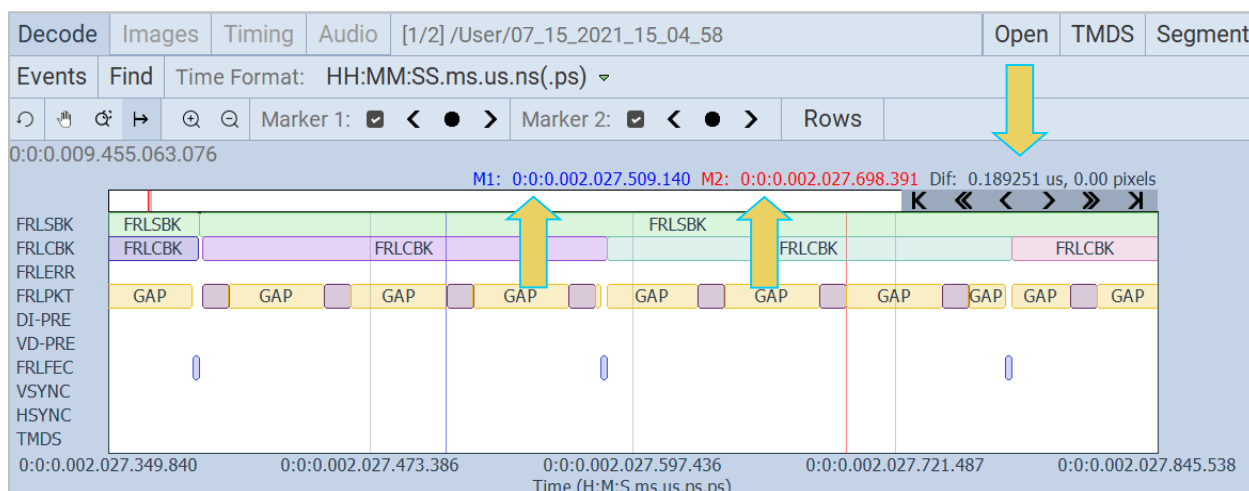
The **Event Plot** will show you the time difference between the two cursors. You can fine tune the position of the cursors with the left and right arrows associated with each marker

Marker 1: ☐ < ● > Marker 2: ☐ < ● > . The ● center allows you to center the particular marker on the Event Plot window.

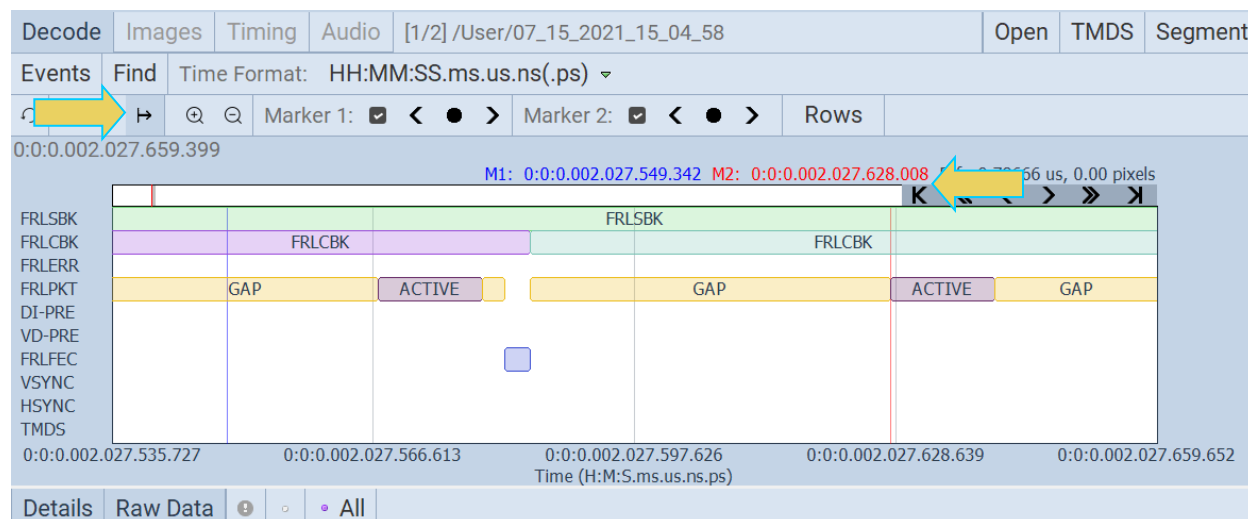
The screens below show the markers being set and the resulting markers placed in the **Event Plot** panel. Note that you can also set the markers using the right-click menu. This is typically the preferred method because the markers will appear exactly where you right-click.



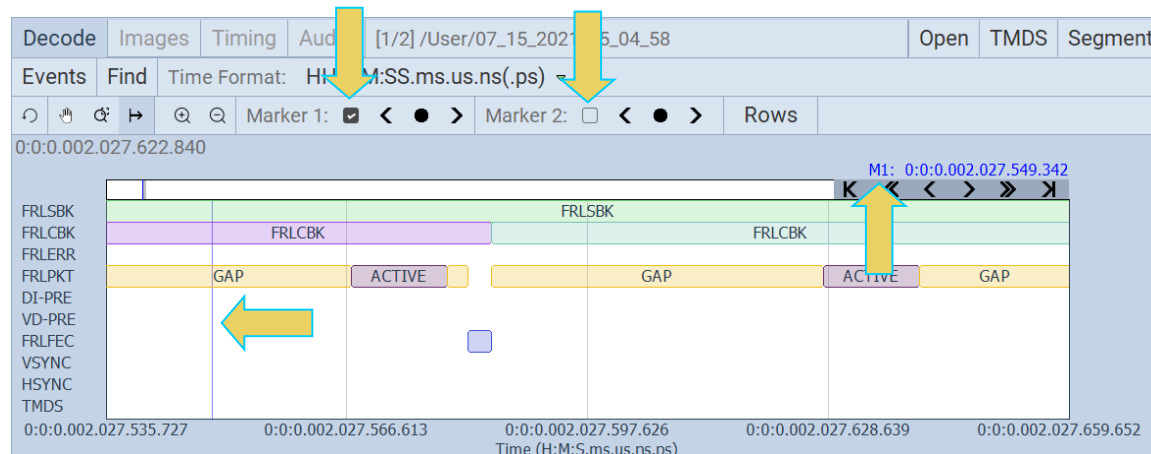
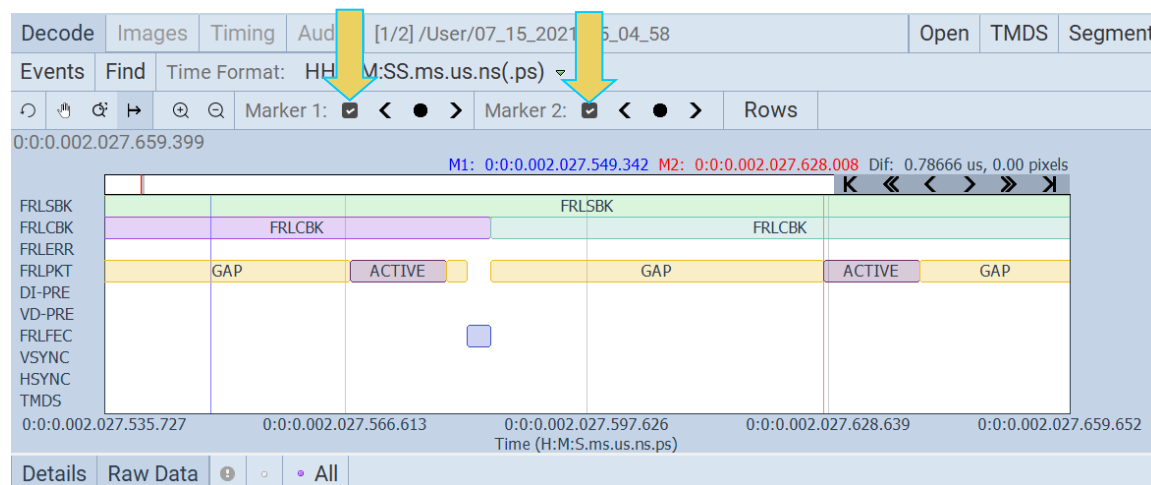
You can see the timestamp associated with each marker just above the area where the data is shown. The text to the right shows the difference in microseconds and pixels between the two markers.



You can also set the markers with the Marker tool as shown below. When you begin the sweep the Marker tool cursor will appear as shown in the menu bar.

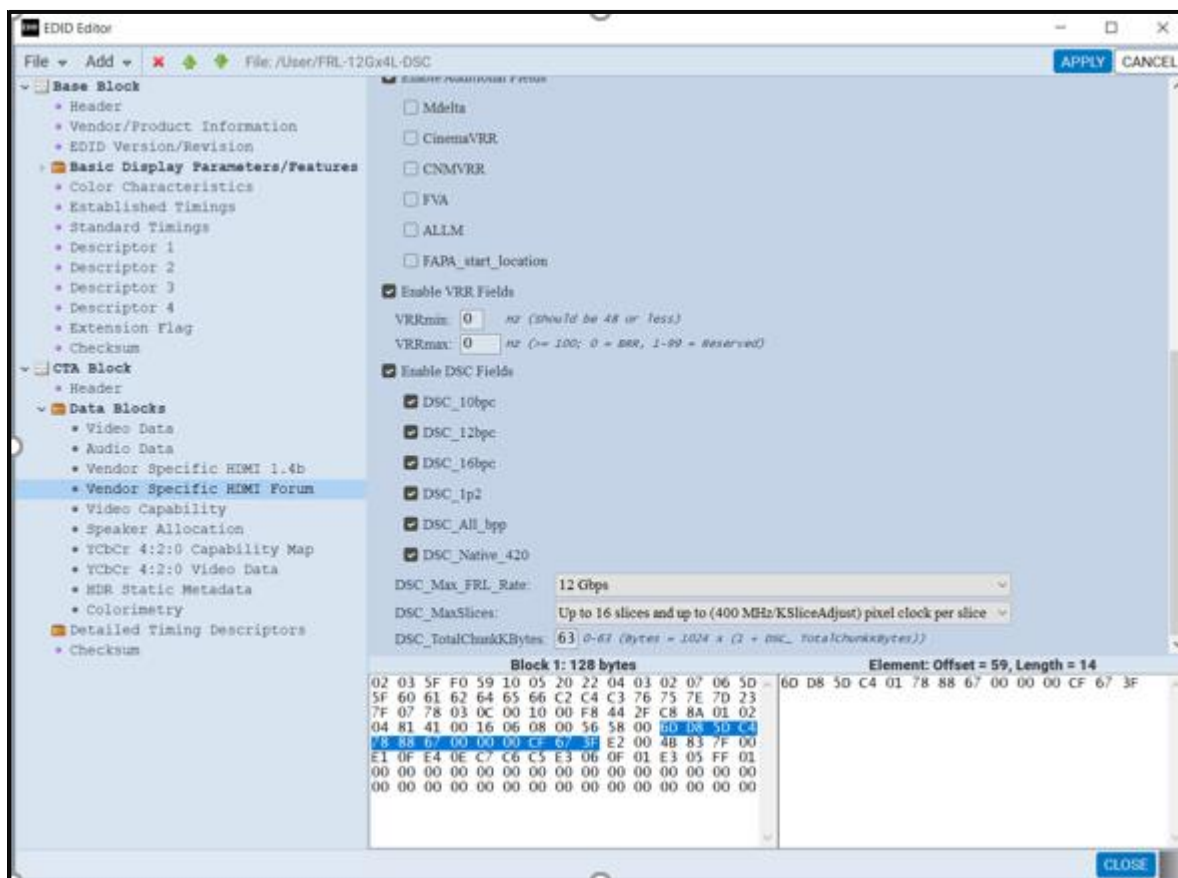


You can remove the marker using the check boxes associated with each Marker on the top menu bar. Refer to the screens example below.



5 EDID Editor Panel

The **EDID Editor** panel enables you to modify existing EDIDs or create new ones through a graphical interface. You can import .xml based EDID files from your PC for use on the M41h 48G Video Analyzer/Generator Rx port. In this way you can emulate any EDID at the M41h 48G Video Analyzer/Generator Rx port to ensure that your source responds correctly to it. A sample screen shot of the **EDID Editor** is shown below.

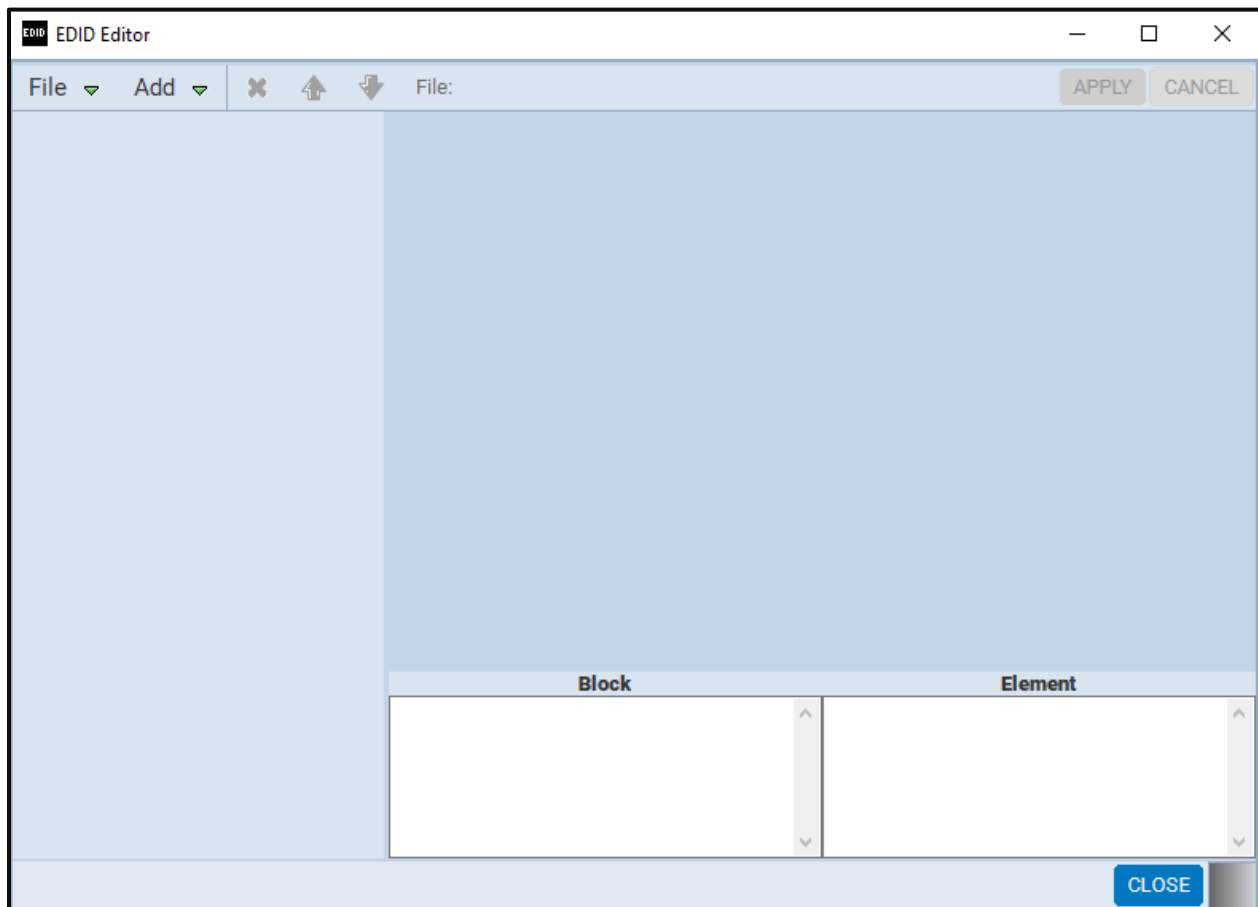


5.1 Opening the EDID Editor

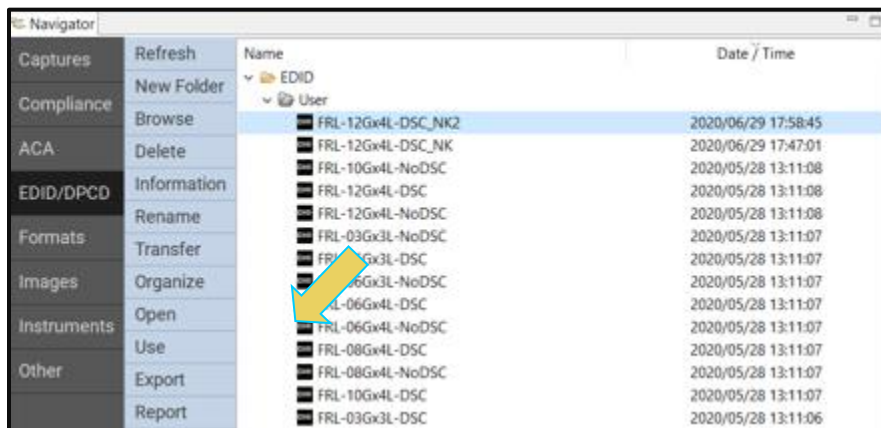
You may have many EDIDs stored in the EDID directory of the external ATP Manager suite of directories. You can open any one of these EDIDs, modify and resave under a different name.

To open an EDID stored on your host PC:

1. Open the EDID Editor from the Editors page on the App panel.
The EDID Editor opens without an EDID loaded as shown below.



1. Open an EDID stored on the PC.

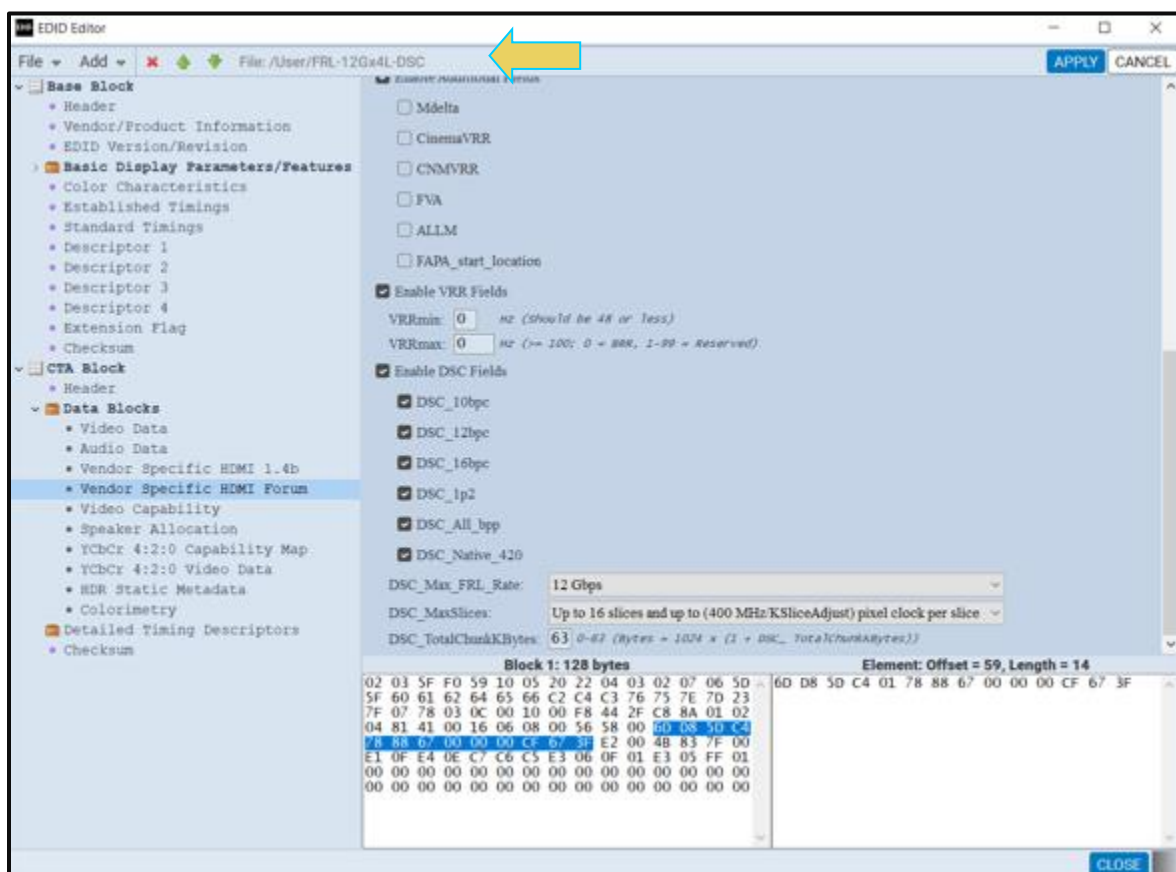


Name	Date / Time
EDID	
User	
FRL-12Gx4L-D5C_NK2	2020/06/29 17:58:45
FRL-12Gx4L-D5C_NK	2020/06/29 17:47:01
FRL-10Gx4L-NoDSC	2020/05/28 13:11:08
FRL-12Gx4L-D5C	2020/05/28 13:11:08
FRL-12Gx4L-NoDSC	2020/05/28 13:11:08
FRL-03Gx3L-NoDSC	2020/05/28 13:11:07
FRL-06Gx3L-D5C	2020/05/28 13:11:07
FRL-06Gx3L-NoDSC	2020/05/28 13:11:07

2. Select the EDID and click on the OK activation button. Click Cancel if you cannot find an appropriate EDID.

Note: You must have downloaded EDIDs or saved EDIDs into the EDID directory to see them in the EDID navigator tab shown above. You can use the Quantum Data EDID Library to obtain these EDIDs. The EDID Library which uses a naming convention for all its EDIDs; these are represented in the screen shot above. Also note that there is a M41h EDID Library Application Note available on the EDID Library website which describes how to use the EDID Library with the M41h 48G Video Analyzer/Generator.

Once you load an EDID the name appears on the status strip on the top of the panel as shown below.

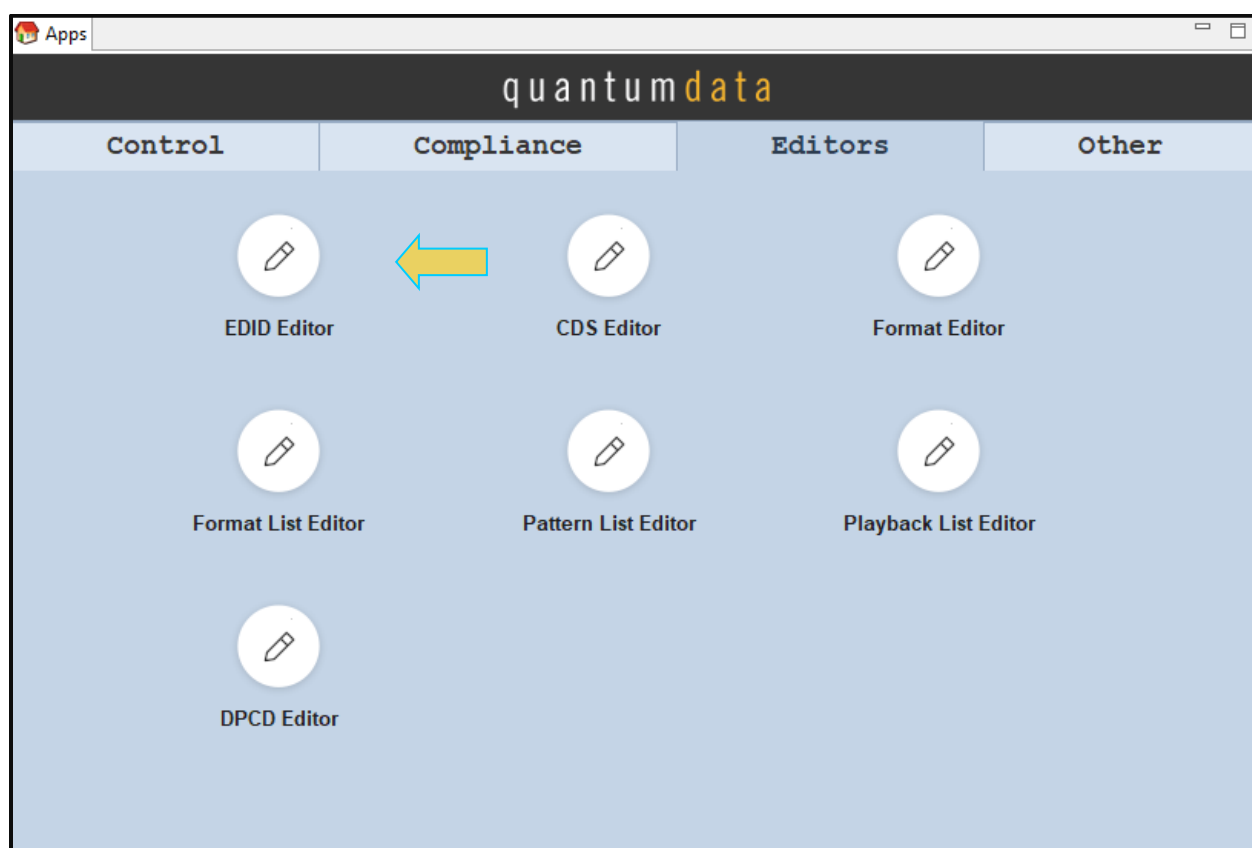


5.2 Loading an EDID into the EDID Editor

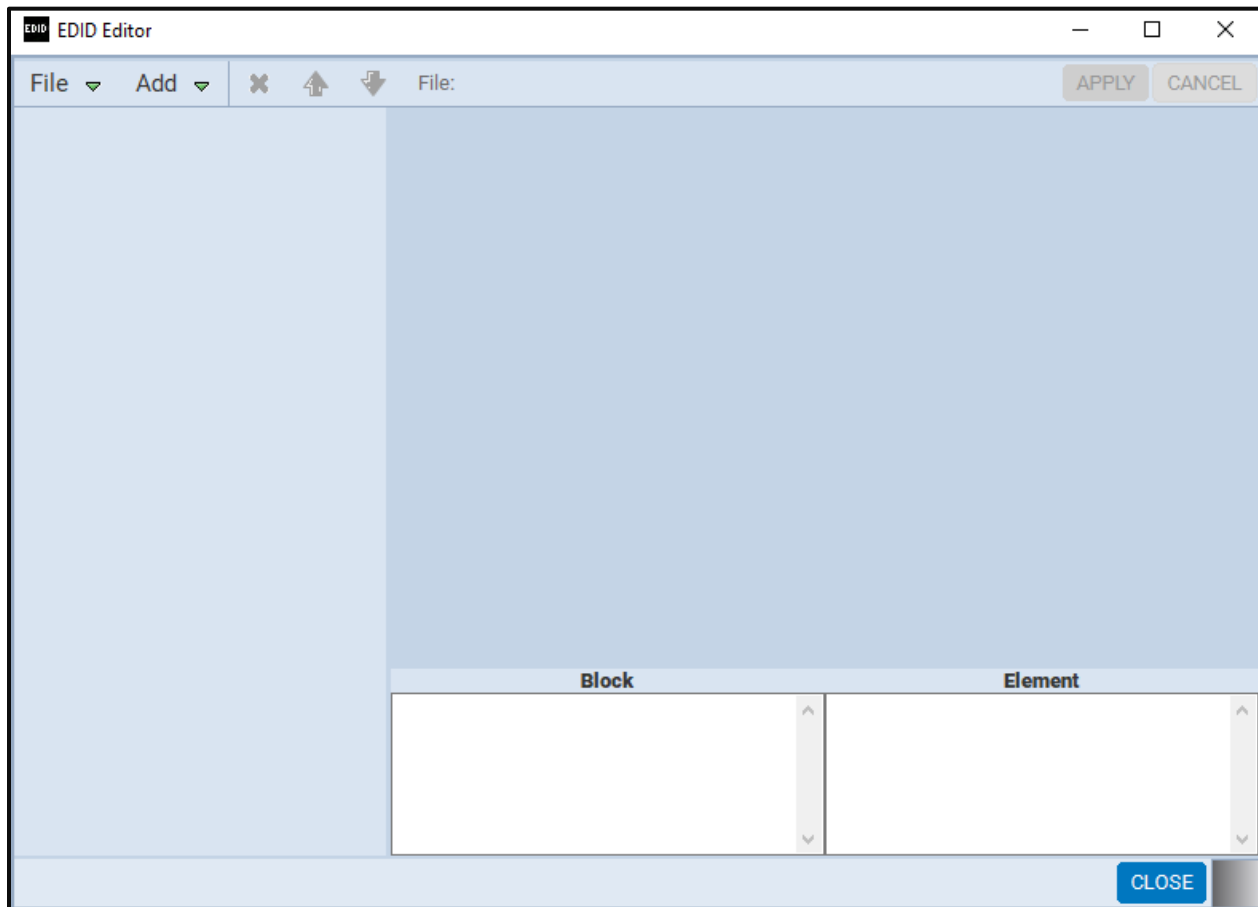
You can either load a new EDID or modify an existing EDID. When modifying an existing EDID case, you may have many EDIDs stored in the EDID directory of the external ATP Manager suite of directories. You can open any one of these EDIDs, modify and resave under a different name.

To open the EDID Editor:

1. Open the EDID Editor from the Editors page on the App panel. Click on **EDID Editor**.

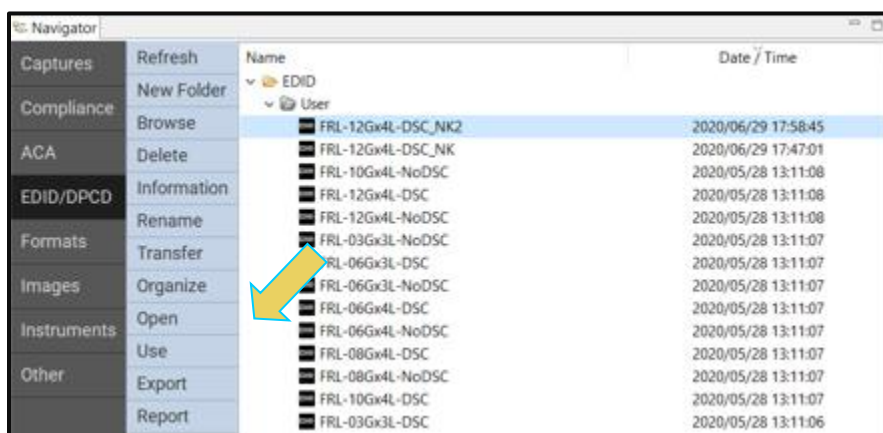


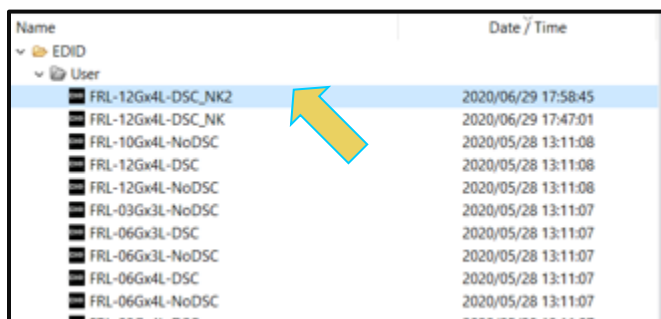
The EDID Editor opens up without an EDID loaded as shown below.



To open an EDID stored on your PC.

1. Open an EDID stored on the PC.

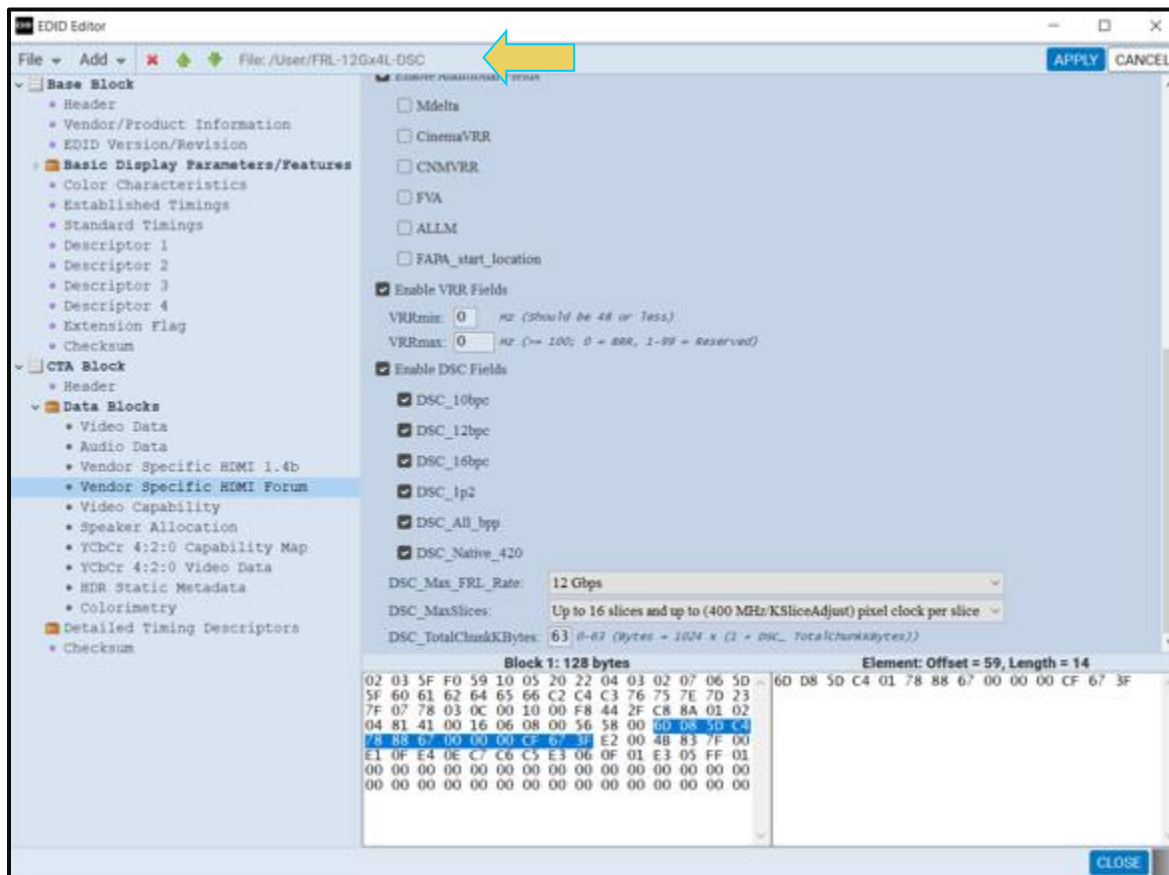




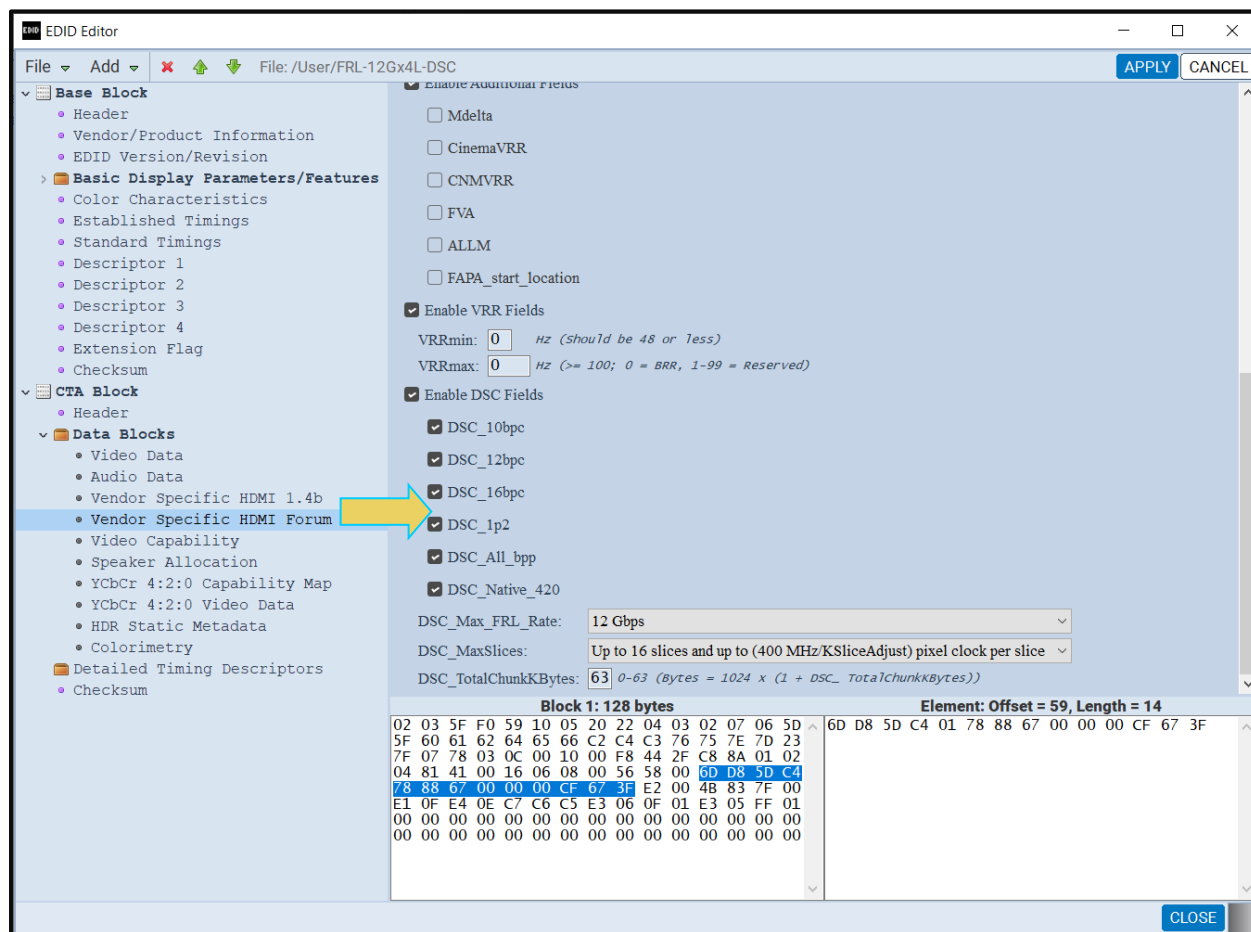
3. Select the EDID and click on the OK activation button. Click Cancel if you cannot find an appropriate EDID.

Note: You must have downloaded EDIDs or saved EDIDs into the EDID directory to see them in the EDID navigator tab shown above.

Once you load an EDID the name appears on the status strip on the top of the panel as shown below.



The following example shows an EDID that indicates support for Display Stream Compression (DSC).



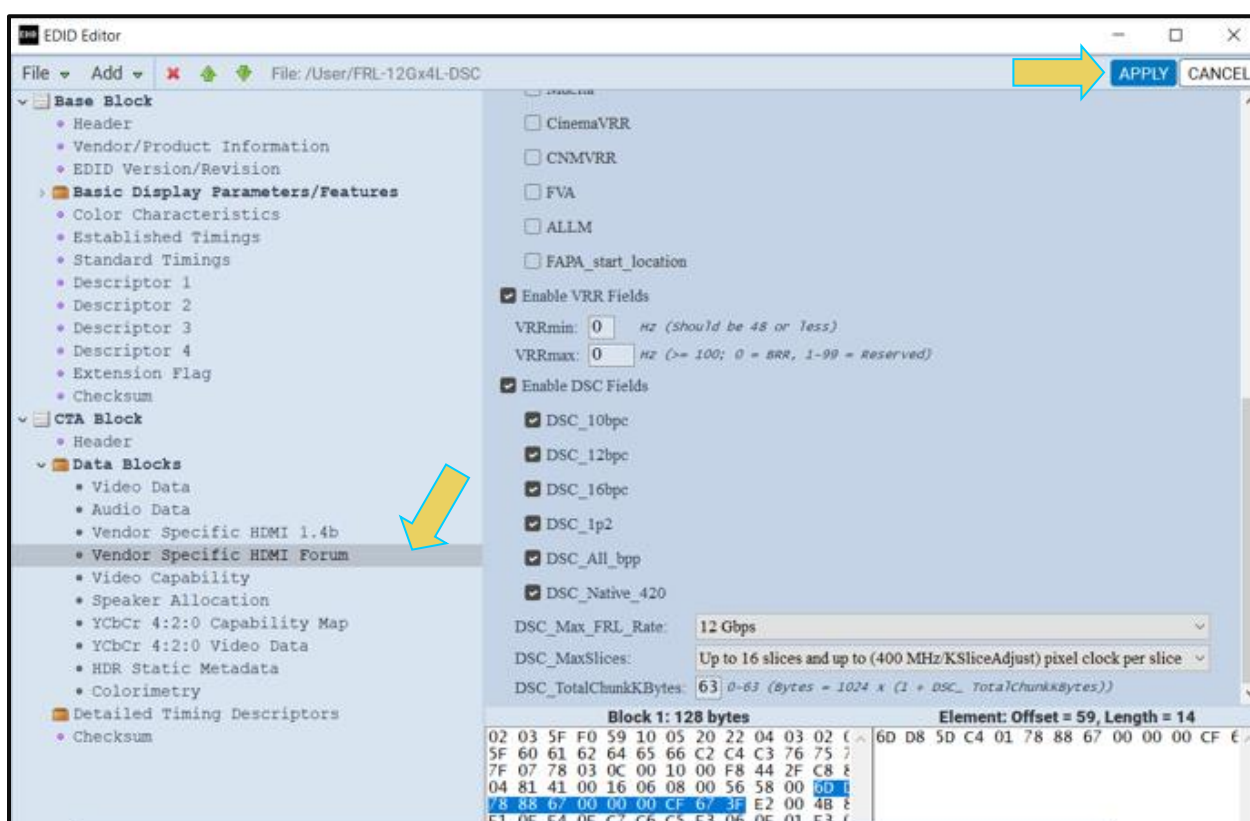
5.3 Making Modifications to an EDID with the EDID Editor

Once you have loaded an EDID you can make changes to individual field values, add data blocks, delete data blocks, add timings, delete timings or audio formats supported, etc. You can enable or disable parameters using radio buttons or check boxes and you can change values through pull-down menus or text field boxes.

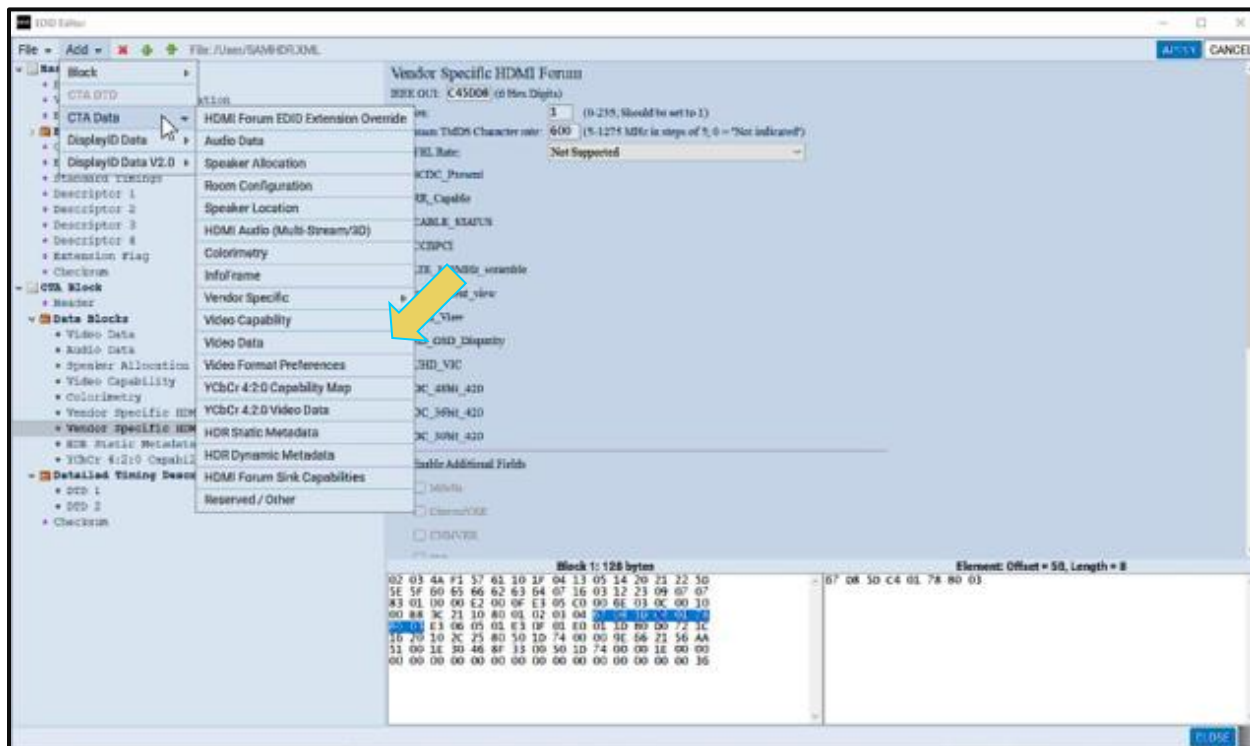
To make a change to an EDID loaded into the EDID Editor:

1. To make a change to an existing EDID on an existing data block, select that data block using the navigator panel EDID Elements on the left.

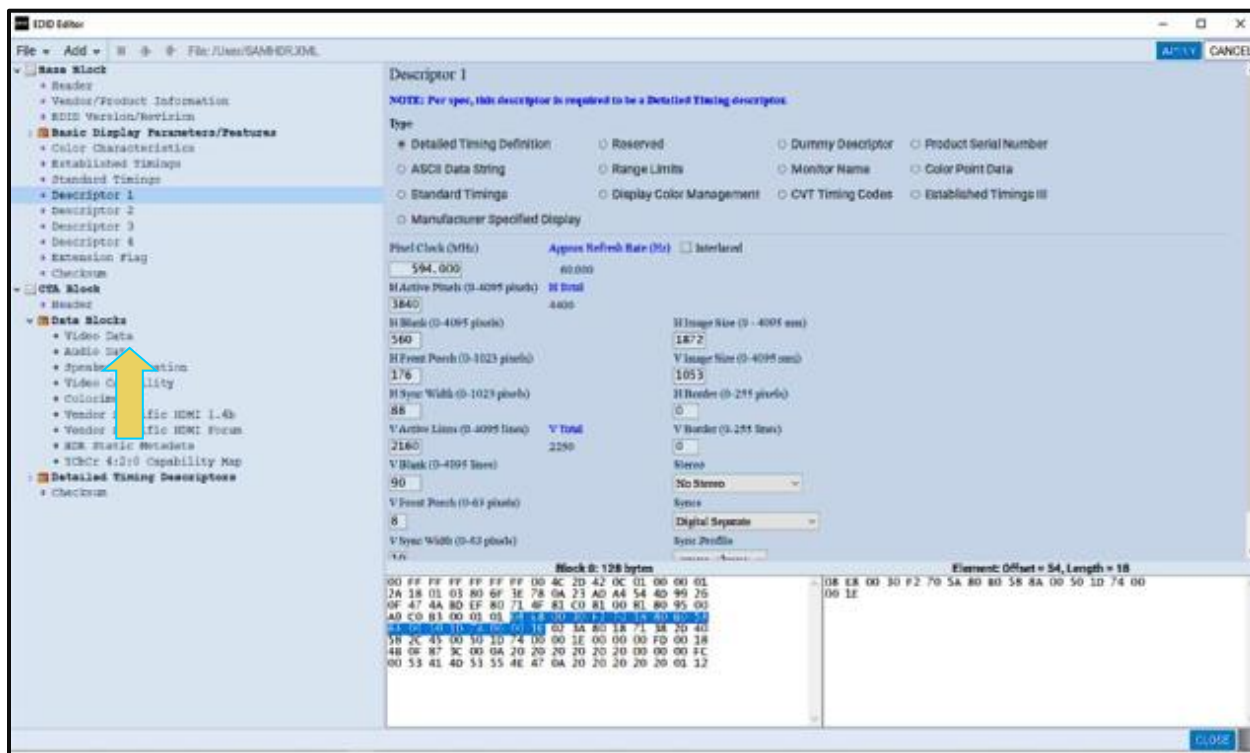
Use the check boxes or fields to make the change, then click on the **Apply** activation button to enable the change. The example below shows the Deep Color definition being changed in the Vendor Specific block.



To add a block into an EDID, use the right-click menus or pull-down menus as shown below (adding a Video Data Block into the CEA Extension block):

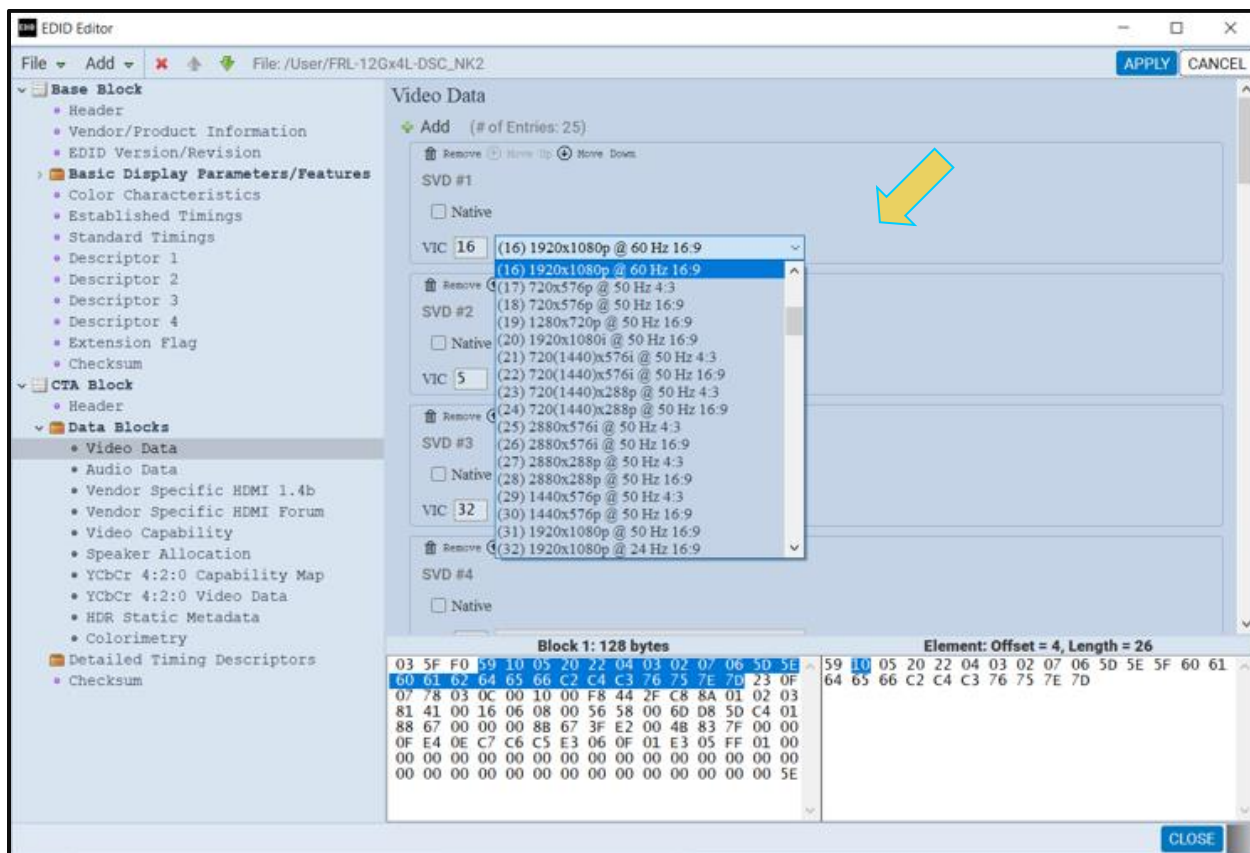



4. Select the block of EDID data that you wish to view or modify using the EDID Elements list on the left of the **EDID Editor** panel. Examples below.

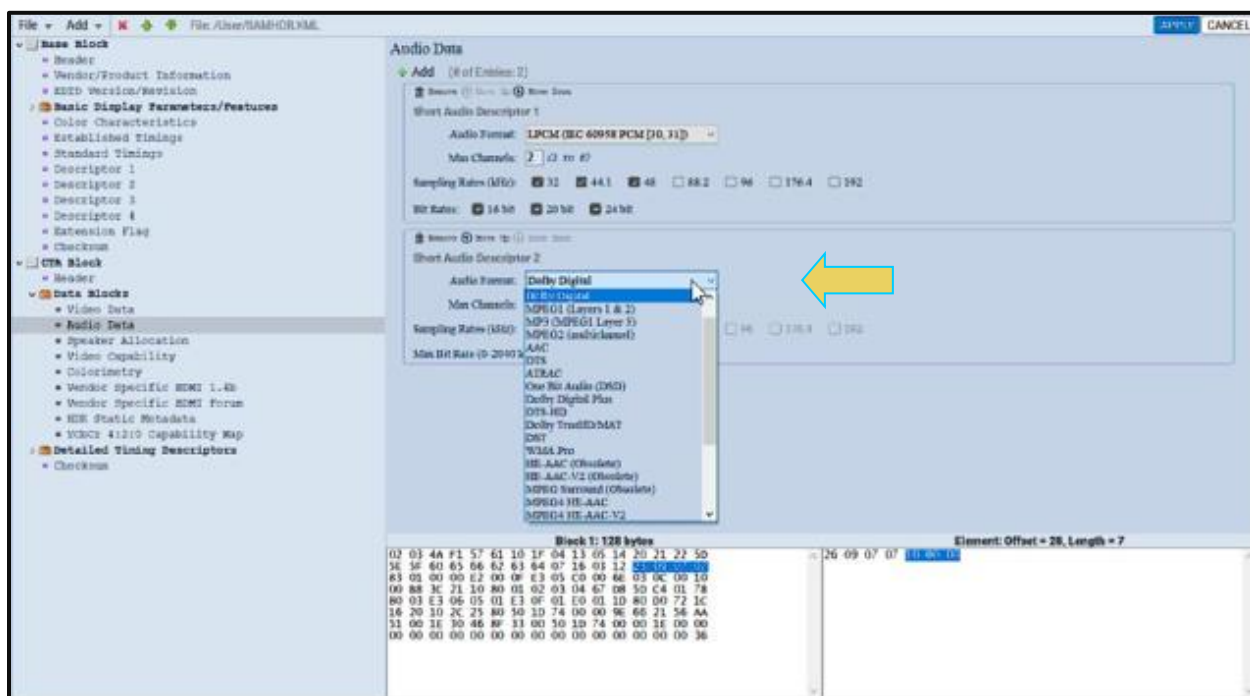
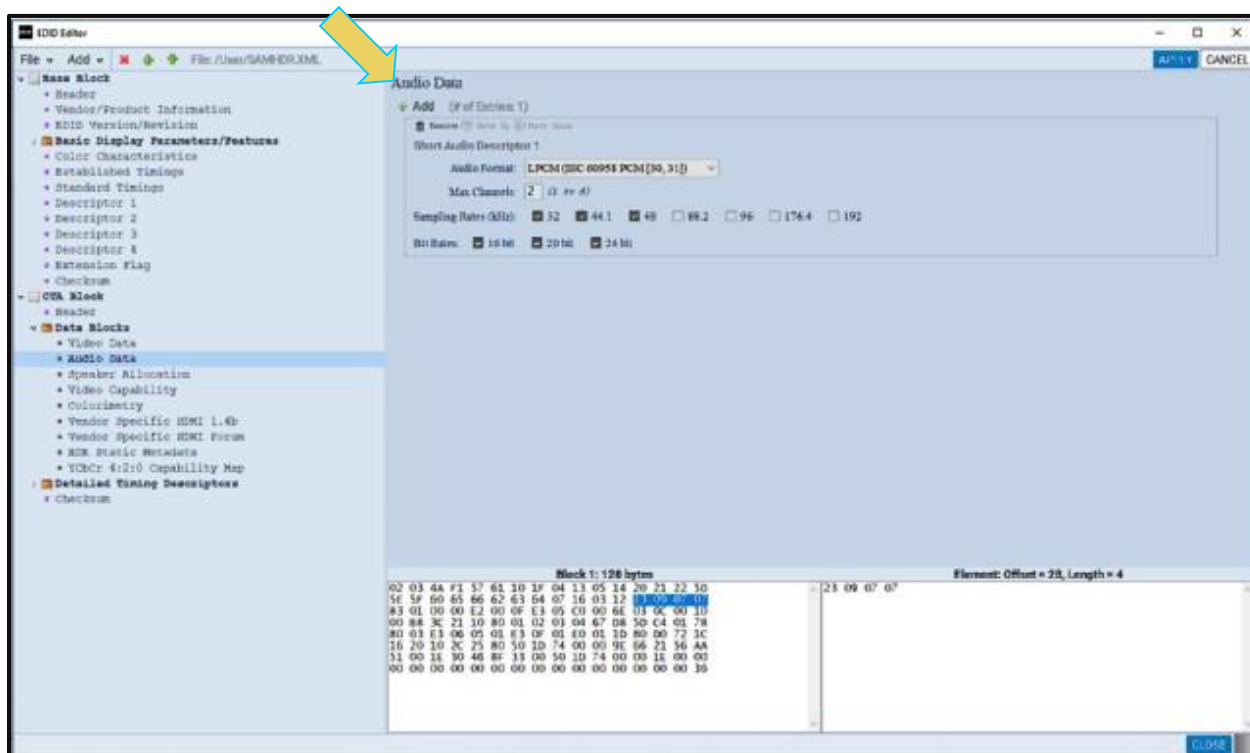


5. Define the new data block in accordance with your specifications.

The example below shows a **Video Data** block's Native timing being defined.



The second example shows additional audio descriptor added to an **Audio Block**. The first screen example only a single audio descriptor, the second screen example shows selecting the audio format. To add a descriptor you click on the **Add**  activation button.



6. Click the **Apply**  button to save the change. Then click on Close to exit the **EDID Editor**.

Once you make a change on a particular EDID block you use the **Apply** button to invoke the change.

Use the following table as a guide to make other changes in the **EDID Editor**.

Item	Item - Column	Description
EDID Edit	Append CEA Block	Adds a CEA extension block to the existing VESA block.
	Append CEA DTD	Adds a CEA Detailed Timing Data block.
	Add CEA Speaker Allocation Data Block	Enables you to add a new Speaker Allocation Data Block to the CEA extension block.
	Add CEA Colorimetry Data Block	Enables you to add a new Colorimetry Data Block to the CEA extension block.
	Add CEA Video Capability	Enables you to add a new Video Data Block to the CEA extension block.
	Add CEA Audio Data Block	Enables you to add a new Audio Data Block to the CEA extension block.
	Add CEA Video Data Block	Enables you to add a new Video Data Block to the CEA extension block.
	Add CEA Vendor Specific Data Block - General	Enables you to add a new Vendor Specific Data Block to the CEA extension block.
	Add CEA Vendor Specific Data Block - HDMI	Enables you to add HDMI information to new Vendor Specific Data Block to the CEA extension block.
	Insert CEA Vendor Specific Audio Data Block	Enables you to add a new Vendor Specific Audio Data Block to the CEA extension block.
	Add CEA Vendor Specific Video Data Block	Enables you to add a new Vendor Specific Video Data Block to the CEA extension block.
	Delete Element	Deletes a selected EDID element or block.

5.4 Emulating a Specific EDID

Once you have loaded an EDID and made your changes to it you can assign it to the M41h 48G Video Analyzer/Generator Rx port for emulation and testing your source device. This subsection describes how you can do that.

To assign an EDID to the Rx port:

1. Select Set M41h Rx EDID.



7. Select an EDID to assign to the M41h 48G Video Analyzer/Generator's Rx port. Click OK after selecting the EDID.

Note that there are two check box options on the dialog box. The following is a description of each:

Permanently set the M41h HDMI Protocol Analyzer's EDID – This means that the EDID that you provision will persist through a reboot of the M41h. Otherwise, the default M41h EDID will be reprovisioned when a reboot occurs.

Issue Hot Plug – This means that the M41h HDMI 2.1 Protocol Analyzer will issue a hot plug when you click the Ok activation button on this dialog box.

6 Basic Analyzer (Snap Shot “Real Time” Mode)

This chapter describes how to view the incoming HDMI® TMDS and FRL video metadata in real time using the Real Time mode. ***The Real Time mode is only available through the embedded GUI using an external monitor. It is not supported through the ATP Manager operating on a remote host PC.***

The Real Time mode allows you to view the following data in a series of **snap shots** of the incoming video frames:

Video – View the incoming video even when encrypted with HDCP 2.2 (in TMDS mode only).

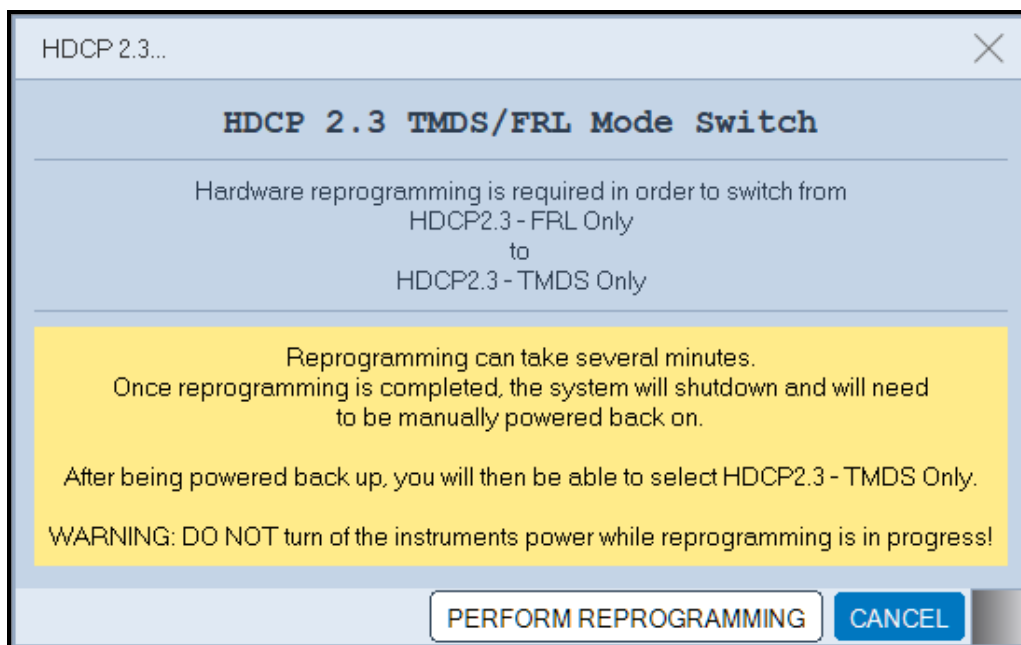
InfoFrames – View the AVI, Audio, Vendor Specific InfoFrames.

Data Islands – View various other data islands such as General Control Packet and Source Product Descriptor.

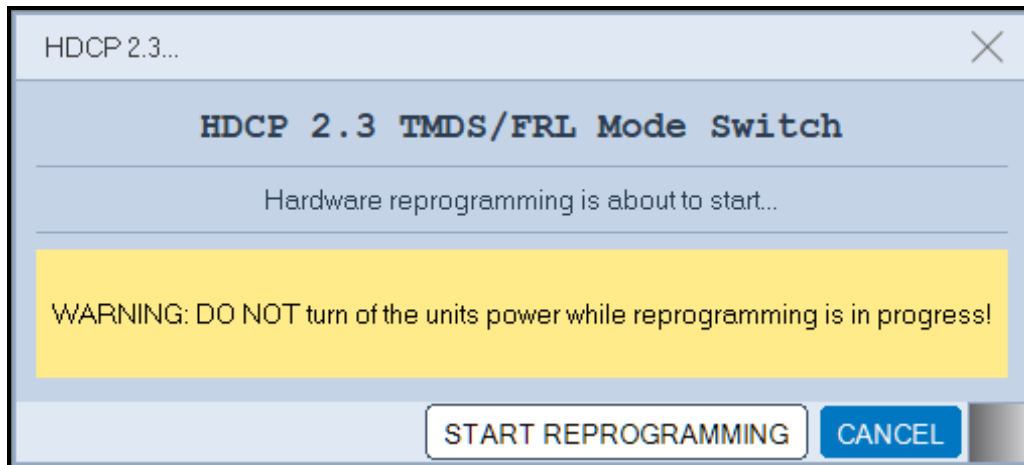
Video Timing Data – View the format, resolution, color depth, video type and specific pixel values.

DDC Data – View the DDC transactions such as the EDID and HDCP 2.2 transactions.

Important Note: There is a **known issue** that requires users to restart the M41h when there is a switch from analyzing incoming FRL streams to analyzing incoming TMDS streams when HDCP is active on the source. This applies to both the Capture Analysis and the snap shot “Real Time” mode. The issue is that the M41h will require a restart in order to reprogram the application for analyzing TMDS. The reverse scenario is also true, i.e. if a user is analyzing TMDS and then sends in FRL that is HDCP encrypted, a restart will be required when there is a switch in the source to start sending content in the FRL mode with HDCP. The user will be prompted with a dialog box indicating the need for the change and also providing basic instructions. The following dialog box shows the message the user will see.



Once the user confirms that reprogramming is required, the following dialog box will appear.



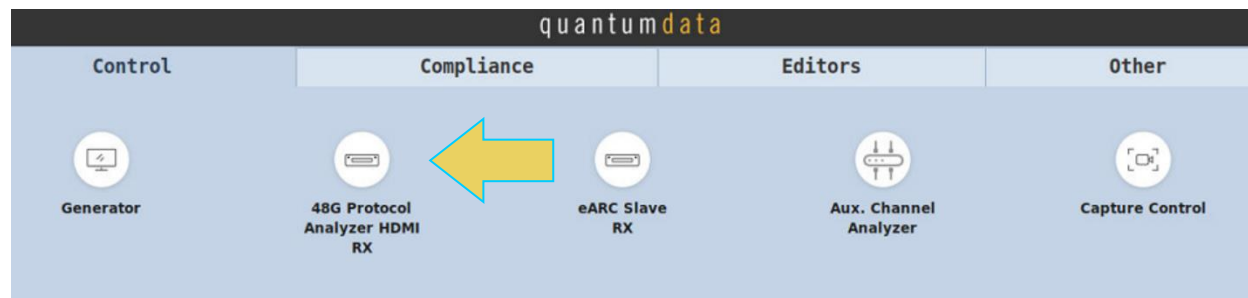
6.1 Accessing the Real Time mode

The Real Time mode can be accessed from the App panel **Control** using the procedures below.

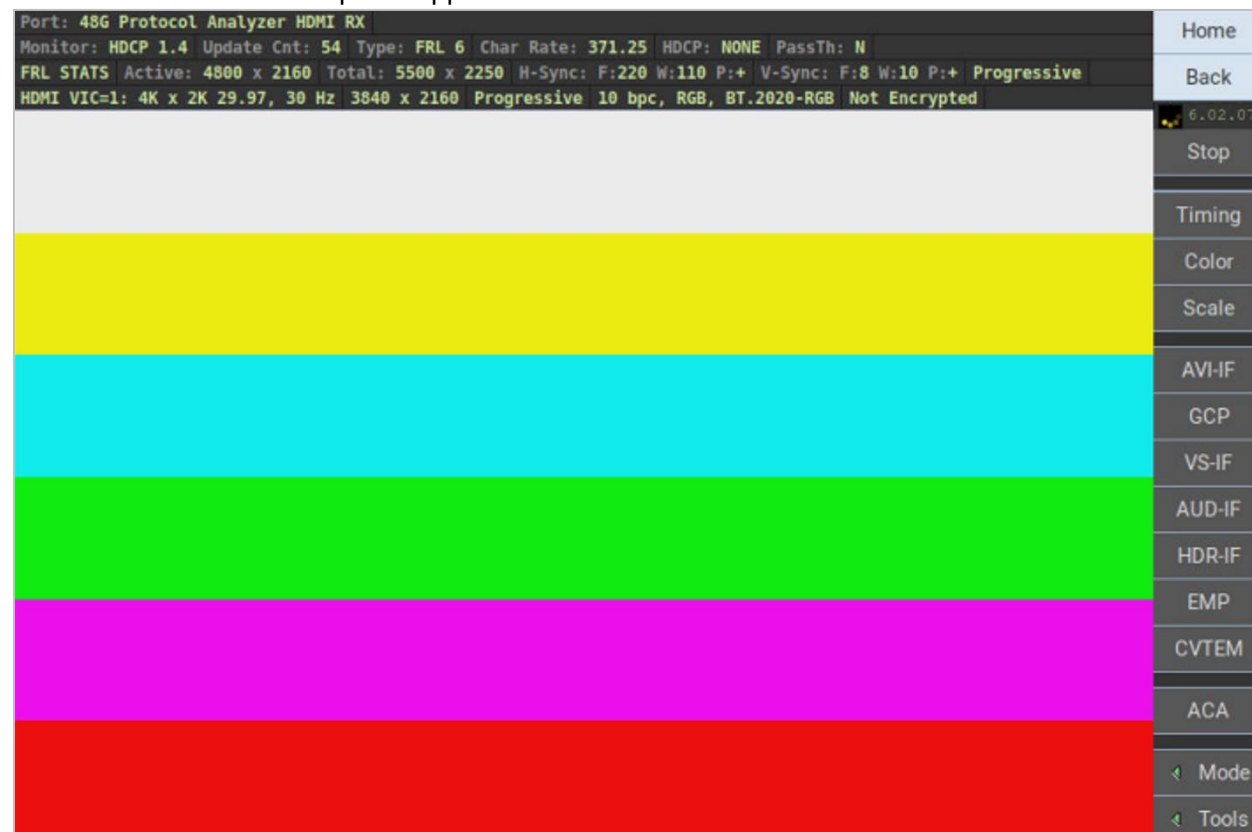
To access the Real Time mode:

1. Select the **48G Protocol Analyzer HDMI RX** within the **Control** tab on the embedded ATP Manager home screen.

Note: The Real Time viewing windows are not available on the PC-based external ATP Manager.



The Receiver “Real Time” panel appears as shown below:



6.2 Real Time Mode Overview

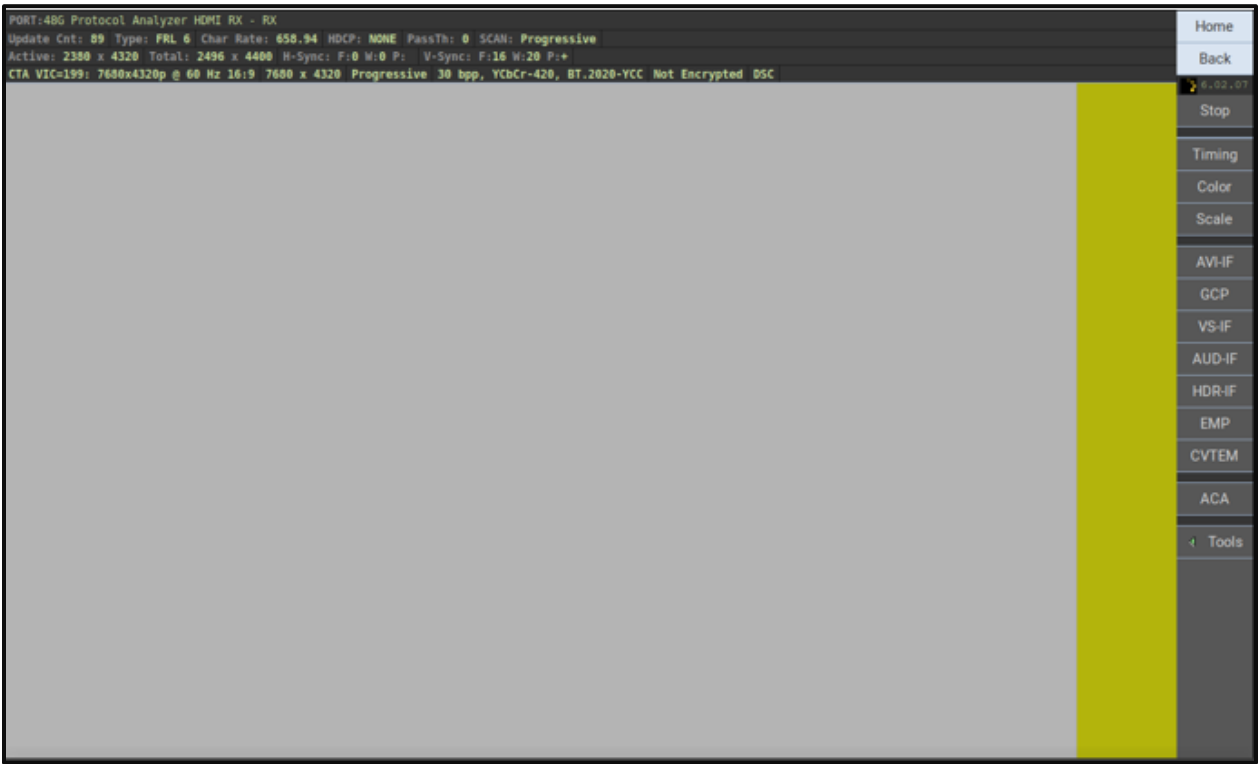
This section describes the **Real Time** mode user-interface.

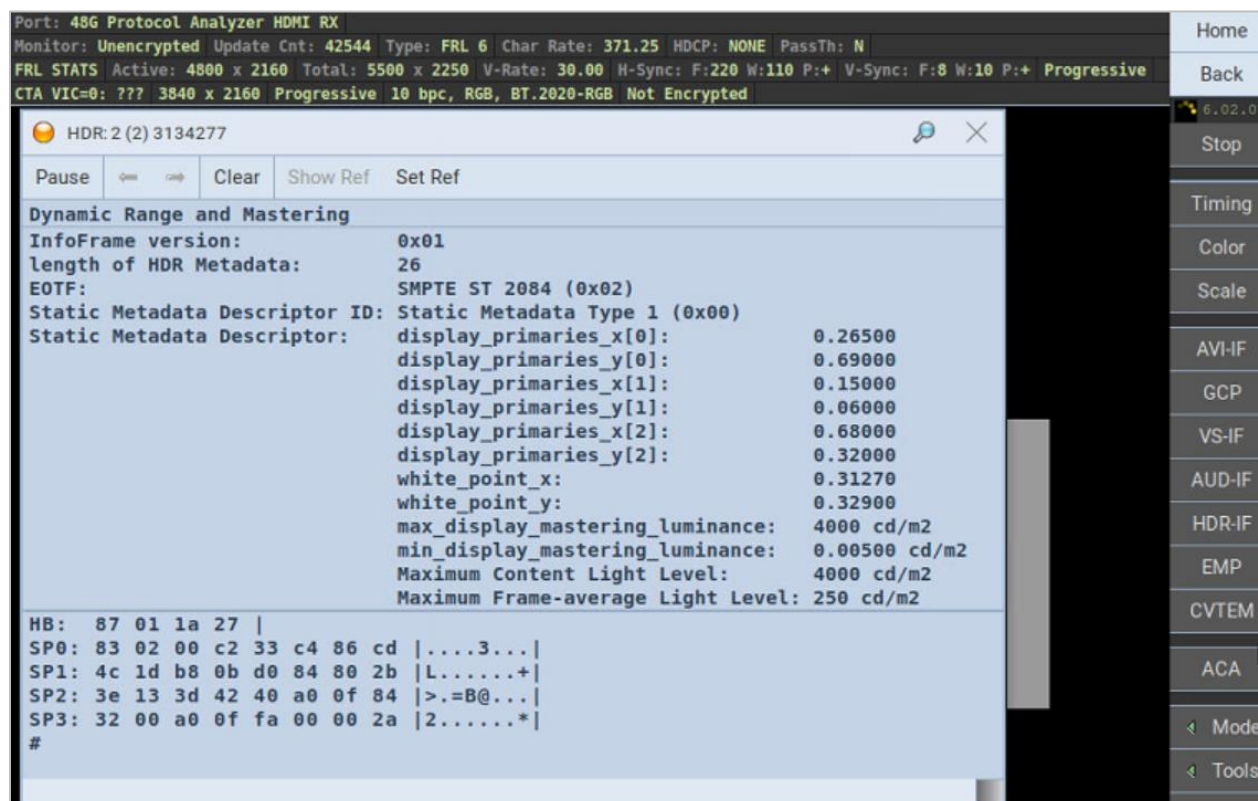
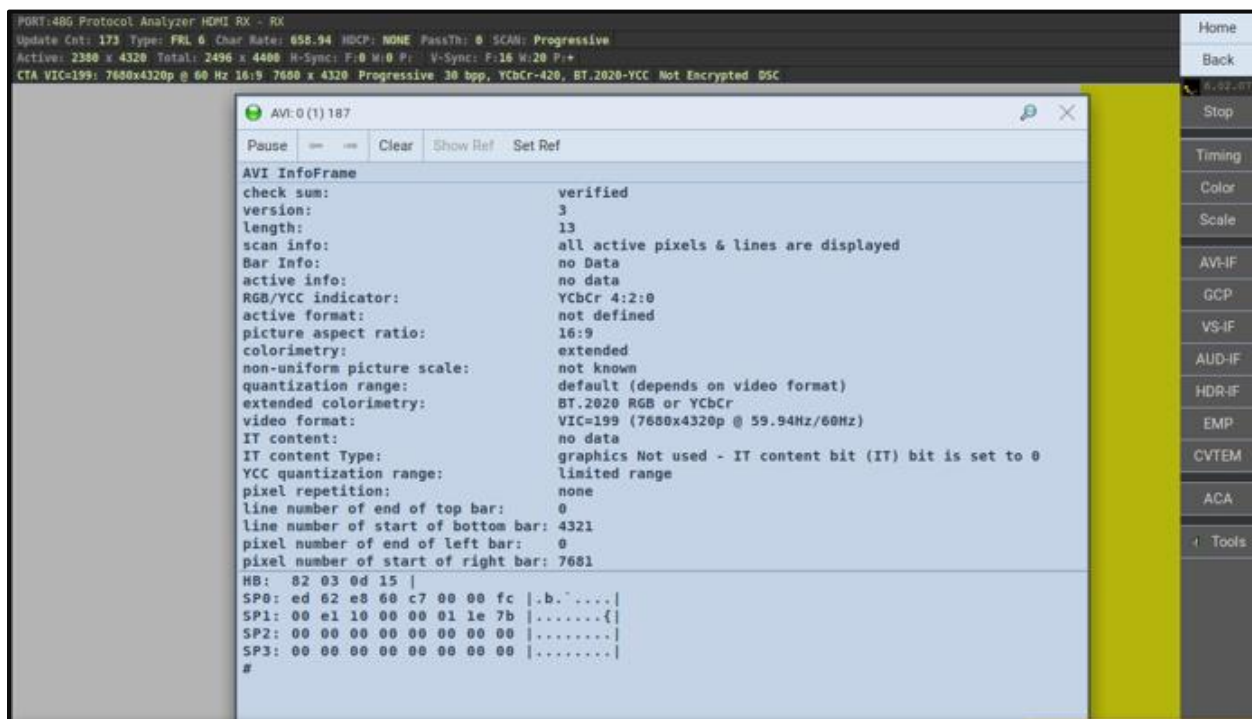
6.2.1 Real Time Mode - Interface Description

This subsection describes the functions of the main interface of the **Real Time** mode. The Real Time mode is supported in both the TMDS and FRL modes.

The **Real Time** mode interface is shown in the example screens below. The first screen image shows the **Real Time** mode without any of the viewing windows open in the TMDS mode. This screen shows you the **Real Time** mode with only the main control panel on the right and the dashboard on the top and the incoming video image. The second **Real Time** screen example shows incoming TMDS with HDCP 2.3 authentication and encryption and with the AVI InfoFrame dialog box shown. The third **Real Time** screen shows Real Time mode with incoming TMDS with HDR active and the HDR InfoFrame dialog box shown. The final screen example shows incoming HDMI stream in the FRL mode at 1485MHz pixel rate with an 8K resolution.

The table that follows describes the data in the Real Time dashboard (or Status Bar).

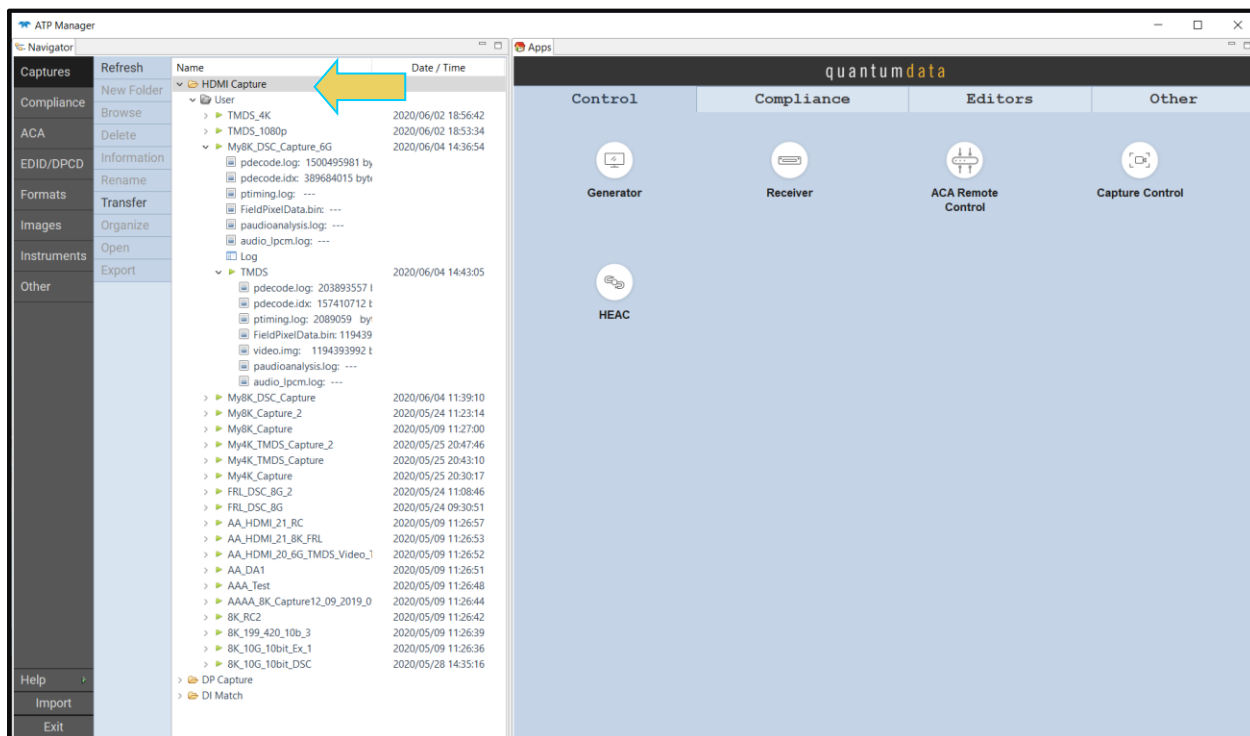




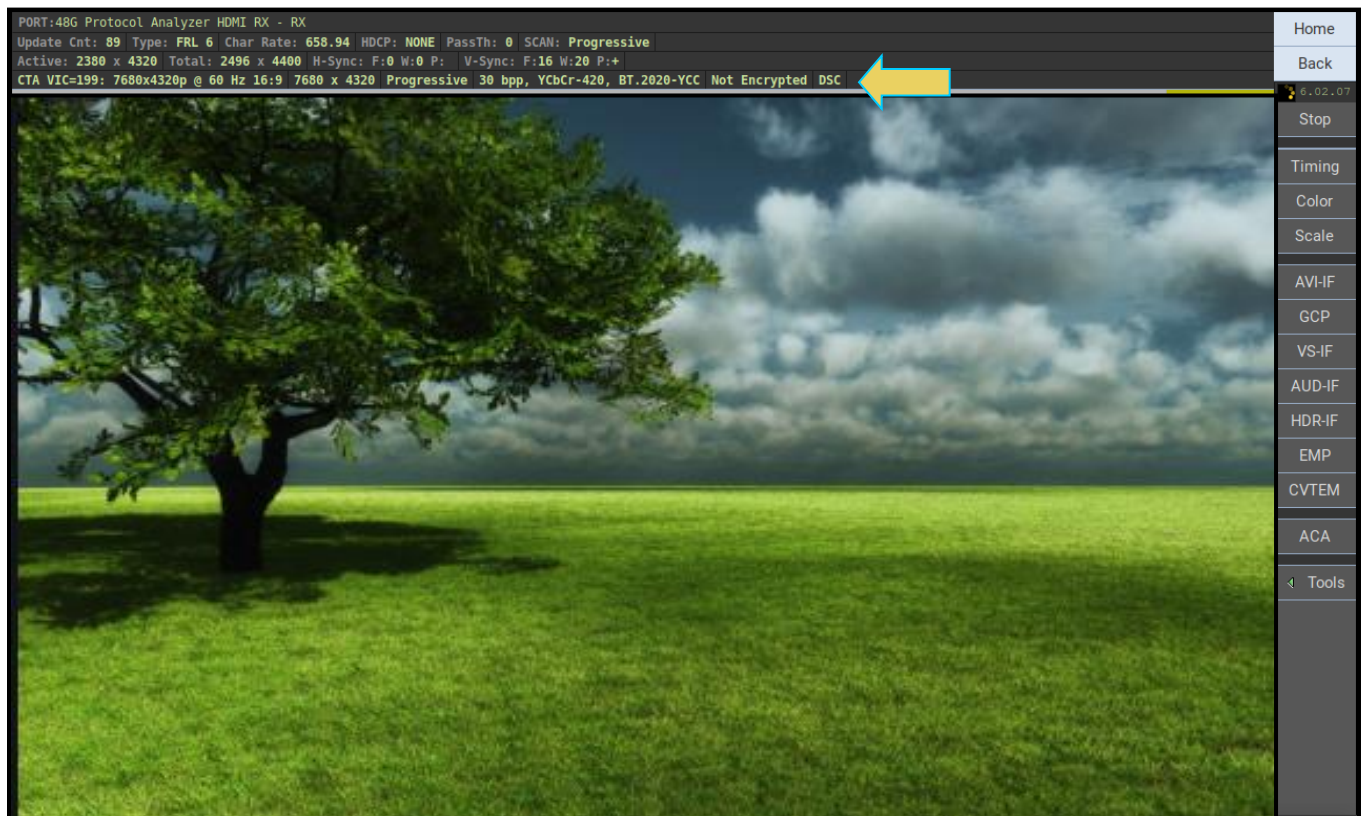
6.3 Viewing the Display Stream Compression (DSC) Capture

You can view the data of an FRL Display Stream Compression stream through the Capture Viewer. You can view these FRL/DSC captures under in the Navigator as shown below. The incoming DSC stream is captured as a series of snapshots of the incoming frames. The feature does not support capturing of every frame.

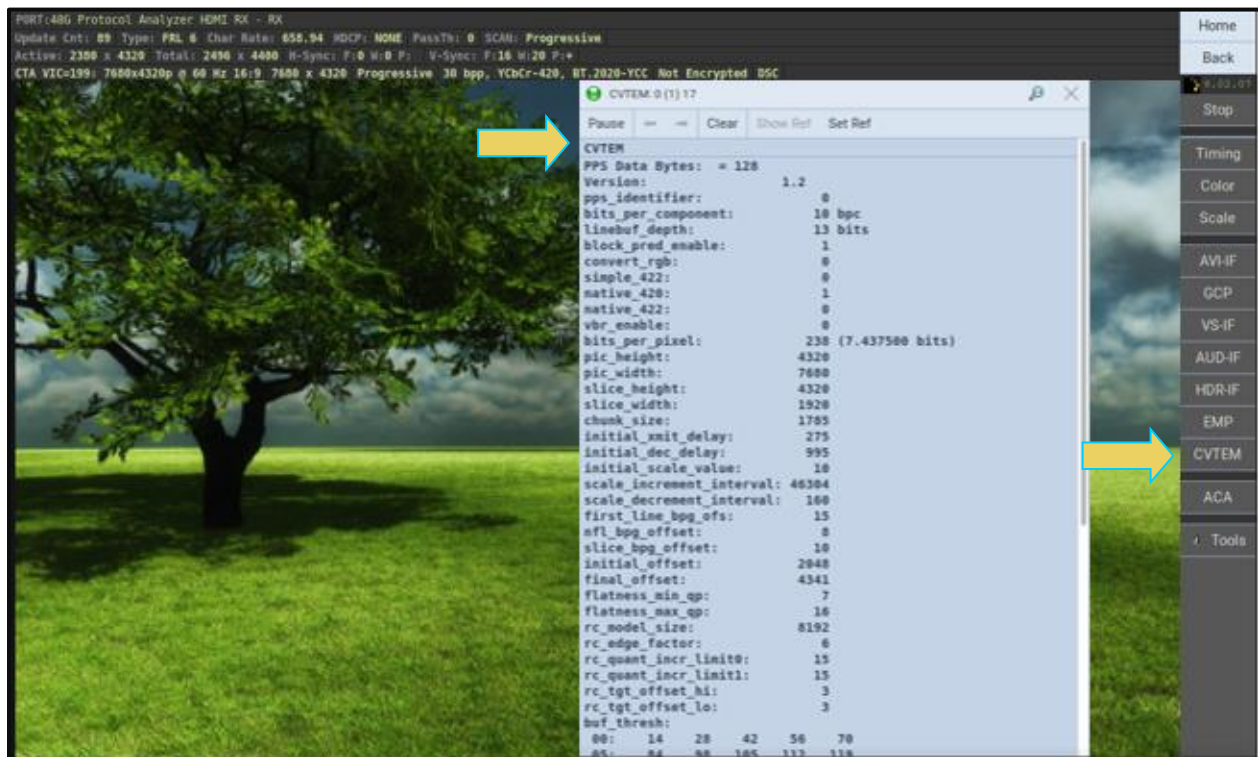
Note: It may take some time for the initial image to appear in the analyzer window.



The following example shows an incoming stream with Display Stream Compression (DSC) active.



The following screen shows the Compressed Video Transport Extended Metadata packet (CVTEM) which shows the DSC Picture Parameter Set (PPS).

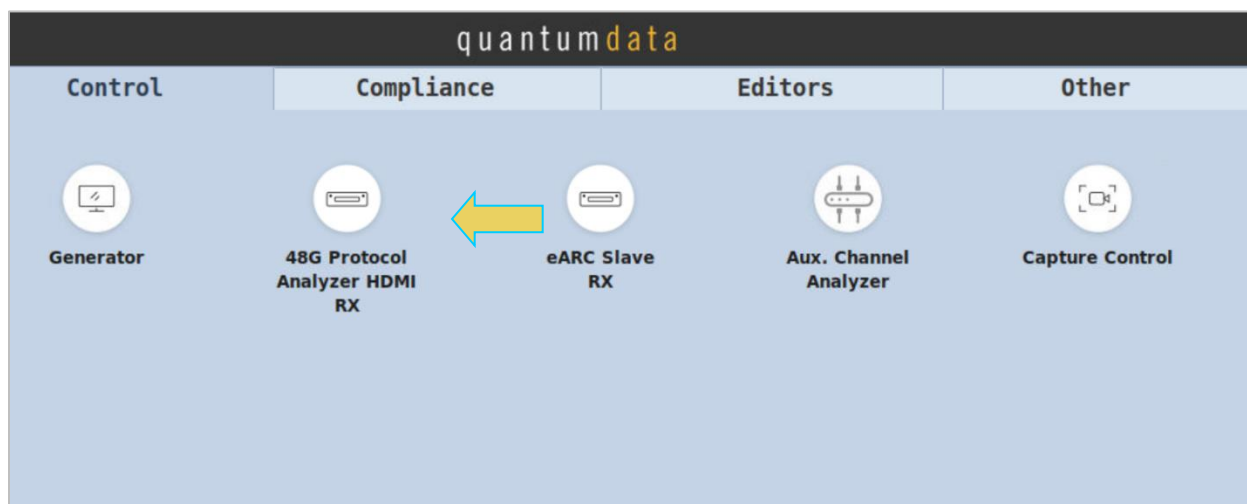


6.3.1 Disabling DSC Video Processing in Realtime

The M41h 48G Video Analyzer has the option to disable DSC video decoding in real-time while allowing Data Island processing and timing measurements. Useful for checking timings, taking captures, and checking Data Island contents such as AVI Inframes, Audio Packets, and CVTEMs.

Use the following procedure to disable DSC Video processing:

1. Navigate to the Real-Time viewer (Basic Analyzer)



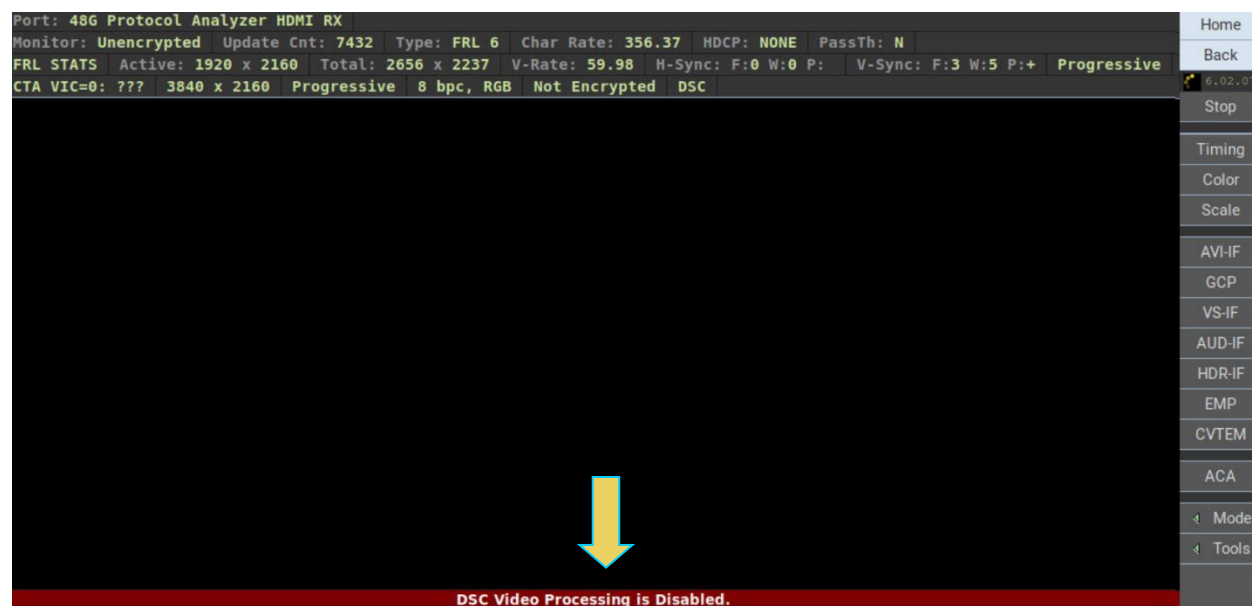
2. Within the right-side toolbar, select Mode, and turn DSC Video Off



3. In this mode, when the DSC video is detected, the dashboard will continue to update:

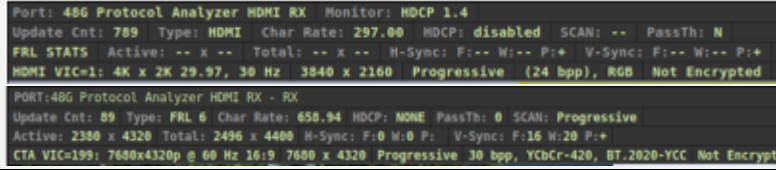
Port: 48G Protocol Analyzer HDMI RX											
Monitor: Unencrypted		Update Cnt: 7432		Type: FRL 6		Char Rate: 356.37		HDCP: NONE		PassTh: N	
FRL STATS		Active: 1920 x 2160		Total: 2656 x 2237		V-Rate: 59.98		H-Sync: F:0 W:0 P:		V-Sync: F:3 W:5 P+: Progressive	
CTA VIC=0: ???		3840 x 2160		Progressive		8 bpc, RGB		Not Encrypted		DSC	

8. You will see the following message at the bottom of the screen when the incoming video from the source DUT is stable:



6.4 Dashboard Panel

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

Real Time Mode – Dashboard Items
<p>Two example Dashboards are shown. The first with TMDS mode and the second in the FRL mode.</p>  <p>The following items are on the Real Time dashboard:</p> <p>Top Row Items – and Port:</p> <p>Port and Card – The Port area shows the current Rx port that is being displayed on the Real Time Mode <code>Port: 48G Protocol Analyzer HDMI RX Monitor: HDCP 1.4</code>. Currently the only analyzer port is the M41h 48G Video Analyzer/Generator port.</p> <p>Second Row Items – TMDS and FRL Modes:</p> <p>Update Cnt – Increments every time the screen contents are updated. <code>Update Cnt: 789</code></p> <p>Type – HDMI for TMDS mode; FRL for Fixed Rate Link (FRL) mode. <code>Update Cnt: 789 Type: HDMI</code></p> <p>Char Rate: – The HDMI character rate. <code>Char Rate: 297.00</code></p> <p>TMDS Clock Ratio: – The ratio of the TMDS clock rate to the TMDS bit rate.</p> <p>Scrambling: – Whether or not scrambling is enabled or not.</p> <p>HDCP – Indicates whether HDCP is enabled or disabled. <code>HDCP: disabled</code></p> <p>PassThru – Indicates if pass through is active. Pass Thru is not currently supported on this.</p> <p>Scan: Progressive or Interlaced. <code>SCAN: --</code></p> <p>Third Row Items – FRL Mode:</p> <p>Active: – The Active video horizontal and vertical pixels and lines of the format resolution <code>Active: -- x --</code>.</p> <p>Total: – The Total video horizontal and vertical pixels and lines of the format resolution. <code>Total: -- x --</code></p> <p>H-Sync: – Indicates the horizontal Front Porch sync pulse width. <code>H-Sync: Fi-- Wi-- Pi+</code></p> <p>V-Sync: – Indicates the vertical Front Porch and vertical sync pulse width and the pulse polarity. <code>V-Sync: Fi-- Wi-- Pi+</code></p> <p>Fourth Row Items – FRL and TMDS modes:</p> <p>Video Identification (format) – The first item indicates the video identification code (if there is one). This includes the active horizontal and vertical resolution, vertical frame rate and aspect ratio. If the incoming video is not determined to be a CEA format, there will be an indication of CEA VIC 0 and a note: “No Video Identification Code Available.”</p> <p>Resolution – The next item is the resolution information. In the first example the active horizontal and vertical resolution is 3840 x 2160. <code>3840 x 2160</code> The second example shows an 8K format at 7680 x 4320.</p> <p>Scan – The next item is the scan. In this example the field indicates Progressive. <code>Progressive</code> The other option is Interlaced.</p> <p>Bit Depth and Video colorimetry – The next item is the bit depth and video mode. In this example the field indicates YCbCr with 4:4:4 sampling and 24-bit color depth. <code>(24 bpp), RGB</code> The other options are: RGB, YCbCr 4:2:2 and deep color at either 30 or 36-bit color depth.</p>


Real Time Mode – Dashboard Items

HDCP Status. The next item is HDCP status which could either be Encrypted or Not Encrypted.

Not Encrypted

6.4.1 Main Control Panel

This subsection describes the main control panel for the Real Time mode. Refer to the table below for a description of these controls.

Real Time Mode – Main Control Panel	Control Button Descriptions
<p>Main Control Panel (two views – Active / Inactive)</p> 	<p>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:</p> <p>Start/Stop – The Start / Stop button / is used to enable and disable the active collection of real time data.</p> <p>Video – The video button and associated pull-down menu (not shown) is used to display the Video Info panel which provides timing, resolution, and other basic information about the incoming video.</p> <p>Scale – The Scale button and associated pull-down menu (not shown) enables you to control how the video image is displayed in the Real Time mode window.</p> <p>AVI-IF - The AVI-IF button and associated pull-down menu (not shown) enables you to show or hide the AVI info panel and pause and resume updates to the panel. It also enables you to control which set of data serves as a “Reference Frame” of data that can be used for comparisons with subsequent frames collected.</p> <p>VS-IF - The VS-IF button and associated pull-down menu (not shown) enables you to show or hide the Vendor Specific InfoFrame info panel and pause and resume updates to the panel. It also enables you to control which set of data serves as a “Reference Frame” of data that can be used for comparisons with subsequent frames collected.</p> <p>GCP - The GCP button and associated pull-down menu (not shown) enables you to show or hide the General Control Packet panel and pause and resume updates to the panel. It also enables you to control which set of data serves as a “Reference Frame” of data that can be used for comparisons with subsequent frames collected.</p> <p>ACA - The ACA button launches the Auxiliary Channel Analyzer (ACA) application for monitoring the DDC transactions.</p> <p>Back - The arrow button enables you to toggle between the current view and the previous view.</p> <p>Tools - The Tools button provides access to various tools such as Set EDID management, HP, 5 Volts, SCDC and HDCP management.</p>

6.5 Real Time Mode Data Panels

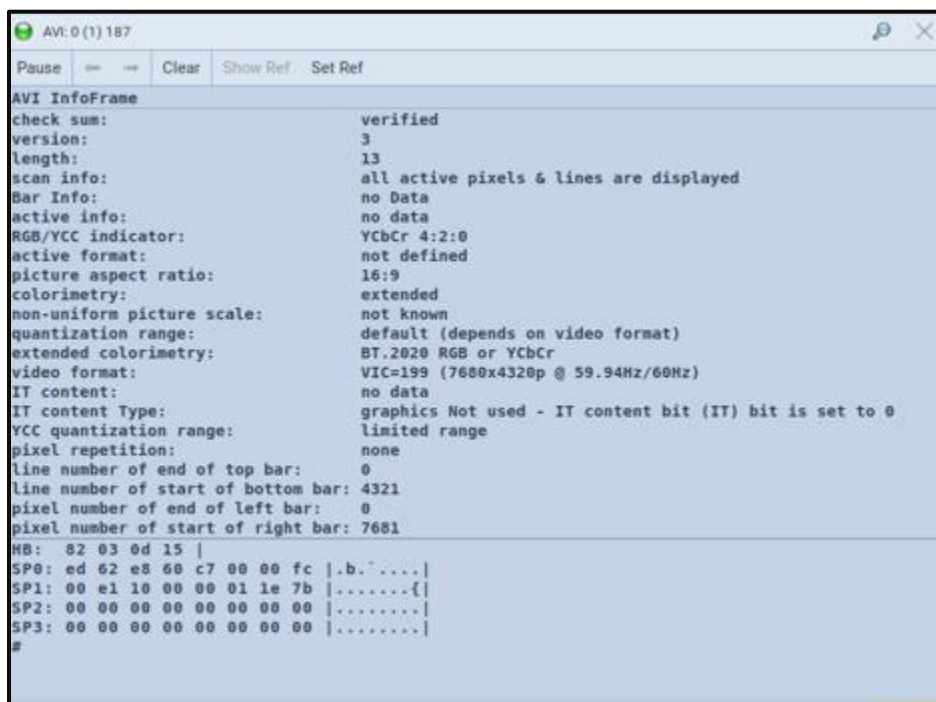
This section describes the **Real Time** controls and data panels. The **Real Time** mode is only available through the embedded GUI. It is not available through the external ATP Manager.

Note: Detailed procedures for operating the M41h 48G Video Analyzer/Generator through the built-in GUI are provided in the M41h Quick Start Guide.

6.5.1 Reference Frames Concept

The M41h 48G Video Analyzer/Generator Real Time feature uses the concept of “Reference Frames” which are sets of data values that you can compare with other collected frames of data of the same type. As you collect data in the **Real Time** mode, the feature will create a distinct view for each change in the source stream for that specific data type. For example, if you have opened the AVI InfoFrame panel, a change in any data that is part of the InfoFrame, such as the video type (RGB, YCbCr), will result in a new distinct view of the data.

By default, the **Real Time** mode establishes the initial data set as the Reference Frame. The initial view is the view of data that occurs when you open a panel or when you initiate a Clear operation. You can change the Reference Frame at any time using a pull-down menu. The data in all other views is compared against the data in the Reference Frame.



6.5.2 Zoom Feature

Because the **Real Time** mode can only be viewed in the embedded M41h GUI where screen real estate is limited, the interface has a zoom feature for setting the viewing size of each dialog box. The zoom feature enables you to set the viewing size of a data panel. The zoom is accessible from the upper right corner of each panel.


6.5.3 Image Scale Dialog Box

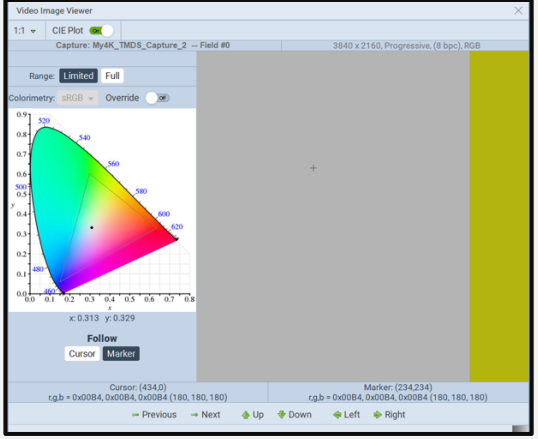



The incoming video content, whether it be full motion video or a basic test pattern, is shown in the window (refer to the screen examples above). You can control the way the incoming video is displayed using **Video** from the control panel on the right. When you select **Scale**, the Image Scale dialog box appears. The control features of the Image Scale dialog box are described in the following table.

Real Time Mode – Image Scale	Controls
Image Scale dialog box	<p>The following controls are provided in the Image Scale dialog box. These controls determine how the incoming video is displayed in the Real Time main window.</p> <p>Mode – The Mode can be either 1:1 or Full. Use the check box adjacent to each item to select. The 1:1 selection will show the image in its true size; because the Real Time window on the built-in front panel display does not support higher resolutions, much of the content will not be viewable in the window when 1:1 is selected. The Full mode enables you to view the entire image. When Full is selected you can also select which Aspect Ratio setting to use.</p> <p>Quality – The Quality setting determines the frame rate used to show the incoming video. Selecting Low reduces the frame rate. The High selection will display the video in its native frame rate.</p> <p>Aspect Ratio – The Aspect Ratio options can be set only if the Mode is set to Full. The Fit option will cause the image to be scaled such that it occupies the entire window. The H:V option will display the image at its native aspect ratio with letter boxing used to fill in the blank area. The 4:3 option will cause the image to scale to a 4:3 aspect ratio. The 16:9 option will cause the image to be scaled to 16:9.</p>

6.5.4 Video Color Panel

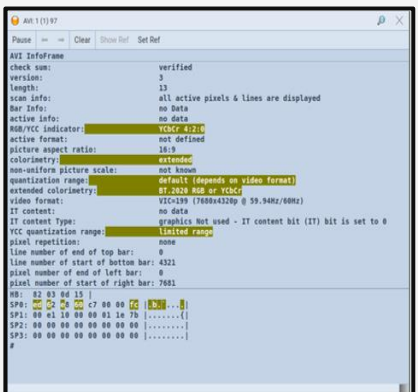
The **Video Color** panel (shown below) enables you to view the pixel values of the incoming video content. The table below describes the information in this panel.

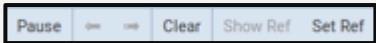
Real Time Mode – Video Color	Information
Video Color panel	<p>The following info is provided in the Video Color:</p> <p>Pixel and pixel values – The pixel x/y coordinates and the color values for any selected pixel are shown in their format RGB or YCbCr.</p> <p>There are a series of arrows on the bottom of the Video Info dialog box. These arrows are described below:</p> <p>Up Arrow – The up arrow  enables you to move up to an adjacent pixel to view its color components.</p>

Real Time Mode – Video Color	Information
	<p>Down Arrow – The down arrow  enables you to move down to an adjacent pixel to view its color components.</p> <p>Left Arrow – The left arrow  enables you to move left to an adjacent pixel to view its color components.</p> <p>Right Arrow – The right arrow  enables you to move right to an adjacent pixel to view its color components.</p>

6.5.5 AVI InfoFrame Panel

The **AVI-IF** button opens the **AVI** panel (shown below). The AVI panel enables you to view the AVI InfoFrame data. There is a control pull-down menu associated with the AVI Info panel. The control menu can be accessed either from the panel itself (the pull-down tab on the upper right corner) or from the AVI-IF button on the main control panel on the right side of the **Real Time** window. The table below describes the information in the AVI Info panel and the associated control menu.

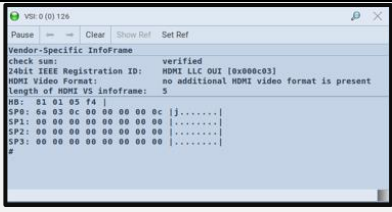
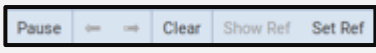





Real Time – AVI InfoFrame	Information / Function
	<p>The following information is provided in the AVI InfoFrame dialog box:</p> <p>Checksum – Calculation of a checksum to ensure integrity of the data.</p> <p>Scan Info – Indicates whether there is any underscanning or overscanning applied to the video.</p> <p>Active info – Indicates whether the Active Format Descriptor information is valid.</p> <p>RGB/YCC indicator – Indicates whether the incoming video is in the RGB mode or the YCC mode and what sampling mode is used with YCC (YCbCr 4:4:4 or 4:2:2)</p> <p>Active format – Active format aspect ratio.</p> <p>Picture aspect ratio – The aspect ratio of the video format transmitted.</p> <p>Colorimetry – The colorimetry standard used; typically, ITU-601 or ITU-709.</p> <p>Non-uniform scaling – Indicates if the picture has been scaled vertically and/or horizontally.</p> <p>Quantization range – Indicates the range of values for defining the data is limited or full.</p> <p>IT content – Indicates when the picture content is composed in accordance with common IT practices.</p>

Real Time – AVI InfoFrame	Information / Function
	<p>Video format – The CEA video identification code (VIC) and the resolution and frame rate.</p> <p>Pixel repetition – Indicates to the DTV how many of each pixel are transmitted.</p> <p>Line number at end of top bar.</p> <p>Line number at start of bottom bar.</p> <p>Pixel number at end of left bar.</p> <p>Pixel number at start of right bar.</p>
<p>AVI Pull-down Menu</p> 	<p>There is a pull-down menu associated with the AVI Info panel. You can access either from the main control panel or from the AVI panel. The AVI pull-down menu provides the following functions:</p> <p>Show/Hide – Enable or disable the appearance of the AVI InfoFrame panel in the Real Time window.</p> <p>Pause/Start – Halt the updates of the data to the AVI panel or Start collection.</p> <p>Clear – Clear the currently displayed reference frame.</p> <p>Set Ref – Set a new reference frame.</p>
Upper Status Bar	<p>The upper status bar shows the following information from left to right:</p> <p>The pause/resume (active) status.</p> <p>AVI The type of data panel (e.g. AVI).</p> <p>1 The number of changes defined since you set the reference frame.</p> <p>(1) The number of distinct data views in parentheses.</p> <p>97 The total number of frames captured since the panel was opened or since the last clear.</p>

6.5.6 VS-IF InfoFrame Panel

The **VS-IF** button opens the **VS-IF** panel (shown below). The **VS-IF** panel enables you to view the Vendor Specific InfoFrame data. There is a control pull-down menu associated with the **VS-IF** panel. The control menu can be accessed either from the panel itself (the pull-down tab on the upper right corner) or from the **VS-IF** button on the main control panel on the right side of the **Real Time** window. The table below describes the information in the AVI Info panel and the associated control menu.

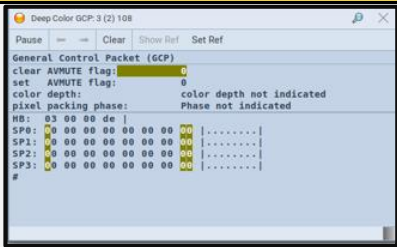
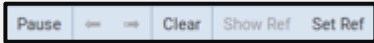

Real Time – VS-IF	Information / Function
Vendor Specific InfoFrame	<p>The following information is provided in the Vendor Specific InfoFrame:</p> <p>Length – The length in hex of the Vendor Specific InfoFrame.</p> <p>Checksum – A checksum to verify the integrity of the InfoFrame.</p>

Real Time – VS-IF	Information / Function
	<p>Registration ID – IEEE Registration ID</p> <p>HDMI Video Format – Provides additional information such as 4K by 2K or 3D format structure.</p> <p>3D Structure – This is the 3D format structure used. This could be one of: Frame Packing, Field Alternative, Line Alternative, Side-by-Side (Full), L + depth, L + depth + Graphics-Depth, Side-by-Side (half)</p> <p>3D Extra Data – Applies when the 3D structure is Side-by-Side (half). Indicates the horizontal sub-sampling and Quincunx matrix.</p> <p>3D Meta Data – Indicates whether 3D metadata is present or not.</p>
<p>VS-IF Pull-down Menu</p> 	<p>There is a pull-down menu associated with the VS-IF Info panel. You can access either from the main control panel or from the VS-IF panel. The AV-IF pull-down menu provides the following functions:</p> <p>Show/Hide – Enable or disable the appearance of the VS-IF InfoFrame panel in the Real Time window.</p> <p>Pause – Halt the updates of the data to the VS IF panel.</p> <p>Clear – Clear the currently displayed reference frame.</p> <p>Set Ref – Set a new reference frame.</p>
<p>Upper Status Bar</p>	<p>The upper status bar shows the following information from left to right:</p> <p> The pause/resume (active) status.</p> <p> The type of data panel (e.g. VS-IF).</p> <p> The number of changes defined since you set the reference frame.</p> <p> The number of distinct data views in parentheses.</p> <p> The total number of frames captured since the panel was opened or since the last clear.</p>

6.5.7 General Control Packet Data Panel

The **GCP** (General Control Packet) button opens the **GCP** panel (shown below). The **GCP** panel enables you to view the General Control Packet data. There is a control pull-down menu associated with the **GCP** panel. The control menu can be accessed either from the panel itself (the pull-down tab on the upper right corner) or from the **GCP** button on the main control panel on the right side of the **Real Time** window. The table below describes the information in the GCP Info panel and the associated control menu.

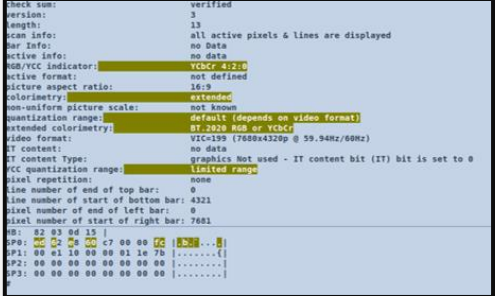
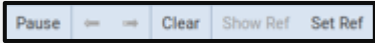






Real Time – General Control Packet	Information / Function
General Control Packet	The following information is provided in the General Control Packet data island:

Real Time – General Control Packet	Information / Function
	<p>AVmute flag (clear/set) – Identifies whether the AVmute is set or cleared.</p> <p>Color depth – Indicates the color depth in bits per pixel.</p> <p>Pixel packing phase – Indicates the pixel packing phase of the last pixel character sent prior to the GCP when the source is transmitting deep color.</p>
<p>GCP Pull-down Menu</p> 	<p>There is a pull-down menu associated with the GCP Info panel. You can access either from the main control panel or from the GCP panel. The GCP pull-down menu provides the following functions:</p> <p>Show/Hide – Enable or disable the appearance of the GCP panel in the Real Time window.</p> <p>Pause – Halt the updates of the data to the GCP panel.</p> <p>Clear – Clear the currently displayed reference frame.</p> <p>Set Ref – Set a new reference frame.</p>
<p>Upper Status Bar</p>	<p>The upper status bar shows the following information from left to right:</p> <p>Pause  The pause/resume (active) status.</p> <p>Deep Color GCP: The type of data panel (e.g. GCP).</p> <p>3 The number of changes defined since you set the reference frame.</p> <p>(2) The number of distinct data views in parentheses.</p> <p>108 The total number of frames captured since the panel was opened or since the last clear.</p>

6.5.8 HDR InfoFrame Panel

The **HDR IF** (InfoFrame) button opens the **HDR IF** panel (shown below). The **HDR IF** panel enables you to view the HDR InfoFrame Packet data. The table below describes the information in the GCP Info panel and the associated control menu.

Real Time – HDR InfoFrame Packet	Information / Function
HDR InfoFrame Packet	<p>The following information is provided in the HDR InfoFrame Packet:</p> <p>InfoFrame Version – Identifies the version of the HDR InfoFrame.</p> <p>Length of HDR Metadata – Indicates the number of bytes of data in the HDR InfoFrame.</p> <p>EOTF – Electro Optical Transfer Function industry standard used.</p>

Real Time – HDR InfoFrame Packet	Information / Function
	<p>Static Metadata Descriptor ID – The Static Metadata Type used.</p> <p>Static Metadata Descriptor – The Static Metadata parameters used for the display primaries, white point, display luminance, light level, and frame average light level.</p>
<p>HDR IF Pull-down Menu</p> 	<p>There is a pull-down menu associated with the HDR IF Info panel. You can access from the main control panel. The pull-down menu provides the following functions:</p> <p>Show/Hide – Enable or disable the appearance of the GCP panel in the Real Time window.</p> <p>Pause – Halt the updates of the data to the GCP panel.</p> <p>Clear – Clear the currently displayed reference frame.</p> <p>Set Ref – Set a new reference frame.</p>
<p>Upper Status Bar</p>	<p>The upper status bar shows the following information from left to right:</p> <p>  The pause/resume (active) status.</p> <p> Deep Color GCP: 3 (2) 108 The type of data panel (e.g. GCP).</p> <p> The number of changes defined since you set the reference frame.</p> <p> The number of distinct data views in parentheses.</p> <p> The total number of frames captured since the panel was opened or since the last clear.</p>

6.5.9 Testing QMS on a Source Device

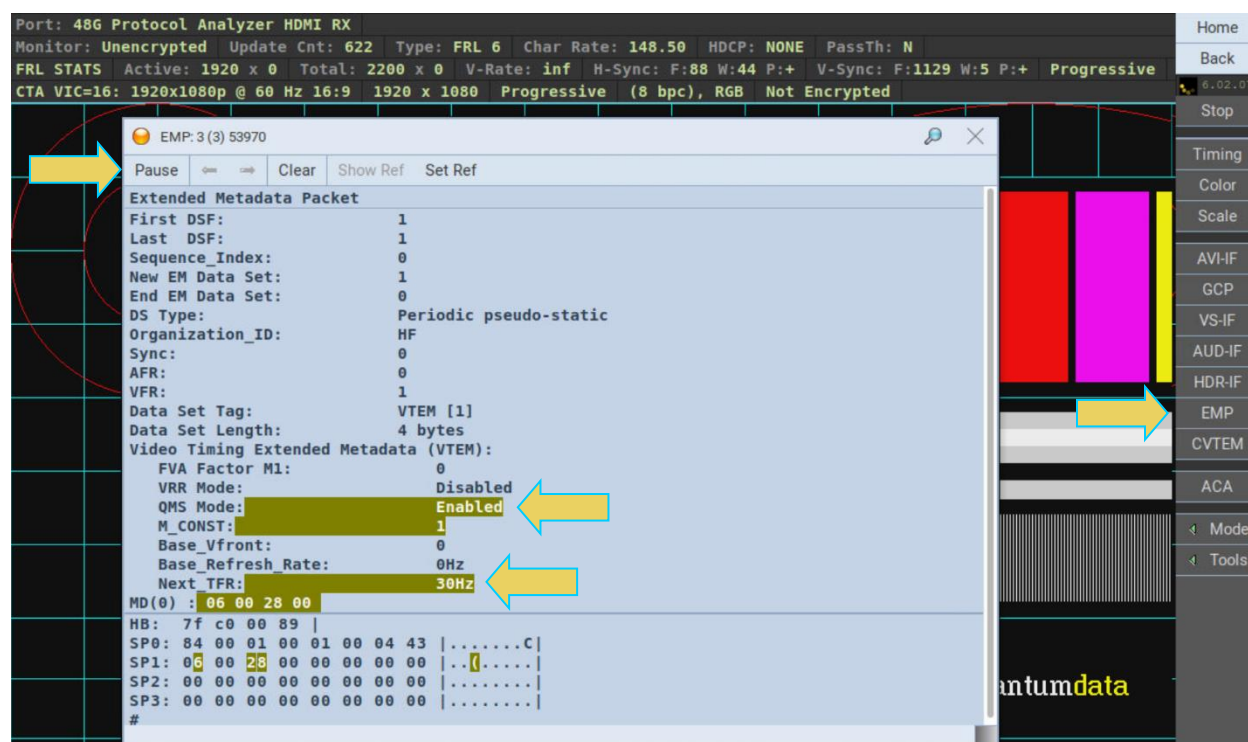
Use the following procedure to test Quick Media Switching on a source device.

Ensure that QMS has been enabled on the source DUT and navigate to the 48G Protocol Analyzer HDMI RX within the embedded ATP Manager GUI of the M41h.

Access the **Extended Metadata Packet** tool by clicking the **EMP** button on the righthand sidebar.

Press the **Start** button at the top left if necessary. You may **Pause** or **Clear** the data at any time as well using the top tool bar.

The EMP tool will indicate whether QMS is enabled, as well as the next target frame rate within the **Next_TFR** field, as shown in the example below. In this example, the Source DUT is generating a 60 Hz signal with QMS Target Frame Rate at 30 Hz



The above example is with a source signal trainer in FRL mode. QMS is also available in TMDS mode, demonstrated on the next page.

In addition to the Extended Metadata Packets tool, when the source DUT and M41h RX Analyzer are trained in TMDS mode, you can view the video timing data as well.

Access the **Video Timing** tool using the **Timing** button on the righthand side of the RX Analyzer, as shown below.

Following the previous example of 60 Hz frame rate switching to 30 Hz using QMS, the screen below demonstrates the video timing data for this configuration.

Port: 48G Protocol Analyzer HDMI RX

Monitor: Unencrypted Update Cnt: 1705 Type: HDMI Char Rate: 148.50 HDCP: disabled PassTh: N Scrambled: N

FRL STATS Active: -- x -- Total: -- x -- V-Rate: -- H-Sync: F:-- W:-- P:+ V-Sync: F:-- W:-- P:+

CTA VIC=16: 1920x1080p @ 60 Hz 16:9 1920 x 1080 Progressive (8 bpc), RGB Not Encrypted

6.02.07

Stop

Timing

Color

Scale

AVI-IF

GCP

VS-IF

AUD-IF

HDR-IF

EMP

CVTEM

ACA

Mode

Tools

Video Timing: 0 / 10

Pause Clear

I/P=Prog, Vpol=P, Hpol=P, Hfreq=67.5000 kHz, Vfreq=30.0000 Hz, TMDS Clock Freq=148.50000 MHz, Type=HDMI

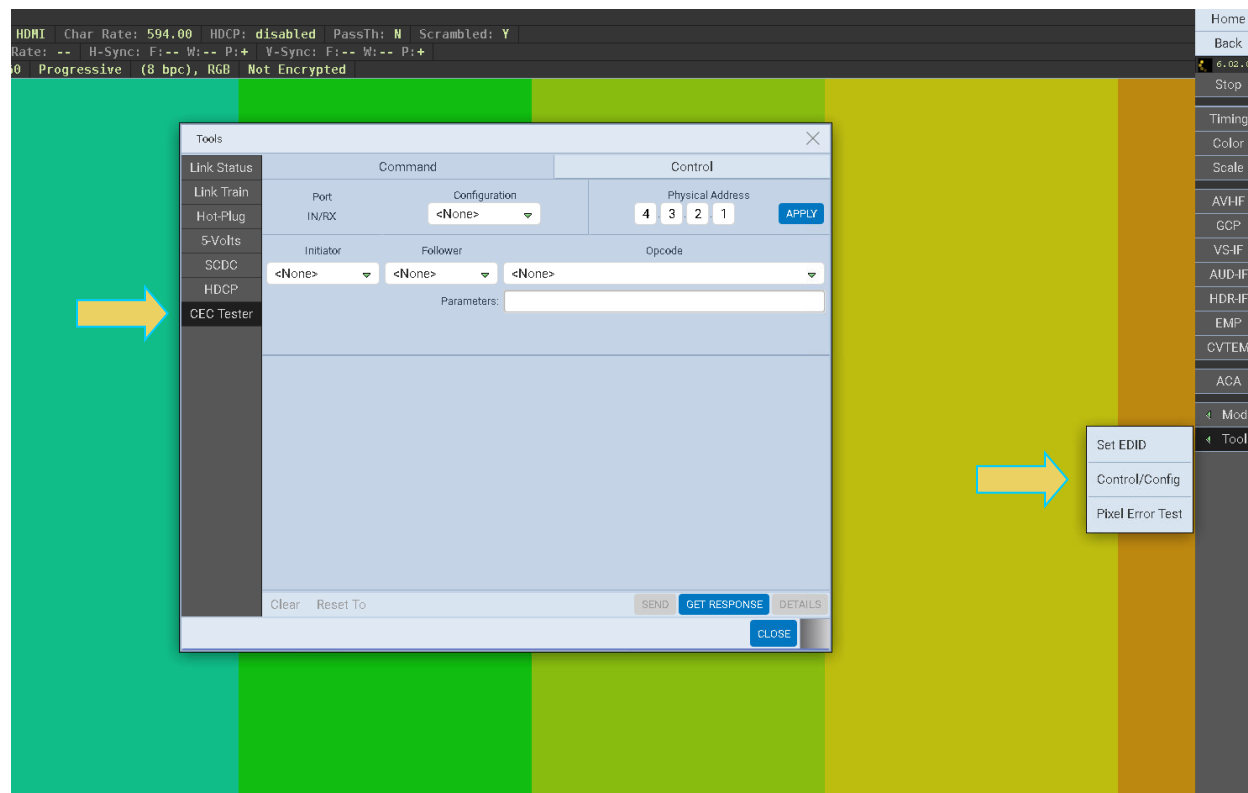
Protocol Errors: None

	F1 Hactive	Vactive	H/V	Htotal	Hblank	Vtotal	Vblank	Hfront	Hsync	Hback	Vfront	Vsync
min	1920	1080	0	2200	280	2250	1170	88	44	148	1129	
max	1920	1080	0	2200	280	2250	1170	88	44	148	1129	
avg	1920	1080	0	2200	280	2250	1170	88	44	148	1129	

Note: all horizontal measurements in TMDS clocks

6.5.10 Rx CEC Tester

The M41h provides CEC (Consumer Electronics Control) functional testing within the RX Analyzer. Access the CEC Tester via the Tools flyout button on the righthand side bar. Select the CEC Tester within the pop up window, as shown below.



The CEC Tester tool allows you to edit the register entries on the emulated receiver within the RX Analyzer. See below tables for configurable options:

Configuration Options Dropdown Menu	
Register	Entry
0x00	TV
0x01	REC1
0x02	REC2
0x03	TUNE1
0x04	PLAY1
0x05	AUDIO
0x06	TUNE2
0x07	TUNE3
0x08	PLAY2
0x09	REC3
0x0A	TUNE4
0x0B	PLAY3
0x0C	RSVD
0x0D	RSVD
0x0E	SPEC
0x0F	*ALL*

Initiator Dropdown Menu	
Register	Entry
0x00	TV
0x01	REC1
0x02	REC2
0x03	TUNE1
0x04	PLAY1
0x05	AUDIO
0x06	TUNE2
0x07	TUNE3
0x08	PLAY2
0x09	REC3
0x0A	TUNE4
0x0B	PLAY3
0x0C	RSVD
0x0D	RSVD
0x0E	SPEC
0x0F	*ALL*

Follower Options Dropdown Menu	
Register	Entry
0x00	TV
0x01	REC1
0x02	REC2
0x03	TUNE1
0x04	PLAY1
0x05	AUDIO
0x06	TUNE2
0x07	TUNE3
0x08	PLAY2
0x09	REC3
0x0A	TUNE4
0x0B	PLAY3
0x0C	RSVD
0x0D	RSVD
0x0E	SPEC
0x0F	*ALL*

Opcode Options Dropdown Menu	
Register	Entry
0x00	Feature Abort
0x04	Image View On
0x05	Tuner Step Increment
0x06	Tuner Step Decrement
0x07	Tuner Device Status
0x08	Give Tuner Device Status
0x09	Record On
0x0A	Record Status
0x0B	Record Off

Opcode Options Dropdown Menu	
Register	Entry
0x0D	Text View On

The following procedure allows you to operate the CEC Tester:

1. Specify the physical address and click **APPLY**.
2. Optionally, enter testing **Parameters**.
3. Once all settings have been configured, click the **GET RESPONSE** button, as demonstrated below.

The screenshot shows the CEC Tester software interface. On the left is a sidebar with tool selection options: Link Status, Link Train, Hot-Plug, 5-Volts, SCDC, HDCP, and CEC Tester (which is currently selected). The main window is titled 'Tools' and has a close button (X) in the top right. It is divided into two main tabs: 'Command' and 'Control'. The 'Control' tab is active. Under the 'Command' section, there is a 'Port' dropdown set to 'IN/RX' and a 'Configuration' dropdown set to '<None>'. A yellow arrow points from the 'Configuration' dropdown to the 'Physical Address' section. The 'Physical Address' section consists of four input boxes containing the digits '4', '3', '2', and '1', followed by an 'APPLY' button. Below the 'Physical Address' section, there are three dropdown menus for 'Initiator', 'Follower', and 'Opcode', all of which are set to '<None>'. A yellow arrow points from the 'Follower' dropdown to a yellow-highlighted 'Parameters' input field. At the bottom of the interface, there are buttons for 'Clear', 'Reset To', 'SEND', 'GET RESPONSE', 'DETAILS', and 'CLOSE'. A large 'X' is displayed in the center of the main workspace area. A yellow arrow points down towards the 'GET RESPONSE' button.

4. Within the Control tab of the CEC Tester, you can configure settings for the functional tests as shown in the following table:

Control Tab Settings for Functional Tests	
Setting	Options
Test Arbitration	<ul style="list-style-type: none"> - Seize Start Bit - Seize Address Bits - Seize Data Bits

Control Tab Settings for Functional Tests	
Setting	Options
Enable ACKs	<ul style="list-style-type: none"> - Directed Header - Directed Data - Broadcast Header - Broadcast Data
Start Bit Low Period (ms)	3.5 – 3.9 ms
Start Bit Total Period (ms)	4.3 – 4.7 ms
1 Bit Low Period (ms)	0.4 – 0.8 ms
1 Bit Total Period (ms)	2.05 – 2.75 ms
0 Bit Low Period (ms)	1.8 – 1.7 ms
0 Bit Total Period (ms)	2.05 – 2.75 ms
Corrupt Bit	<ul style="list-style-type: none"> - Choose from bits 1–8 to emulate as corrupted - Choose from bytes 1–16 within the selected bit

Tools ×

Link Status

Link Train

Hot-Plug

5-Volts

SCDC

HDCP

CEC Tester

Command

Control

Test Arbitration

Seize Start Bit

Seize Address Bits

Seize Data Bits

Enable ACKs

Directed Header

Directed Data

Broadcast Header

Broadcast Data

Timing Control

Start Bit Low Period (3.5 - 3.9 ms)

3.70

Start Bit Total Period (4.3 - 4.7 ms)

4.50

1 Bit Low Period (0.4 - 0.8 ms)

0.60

1 Bit Total Period (2.05 - 2.75 ms)

2.40

0 Bit Low Period (1.3 - 1.7 ms)

1.50

0 Bit Total Period (2.05 - 2.75 ms)

2.40

Corrupt Bit

Bit 1

Byte 1

RESET ALL TO DEFAULTS

CLOSE

- To start over, you may reset all configurations to their default values using the **RESET ALL TO DEFAULTS** button, as shown above.

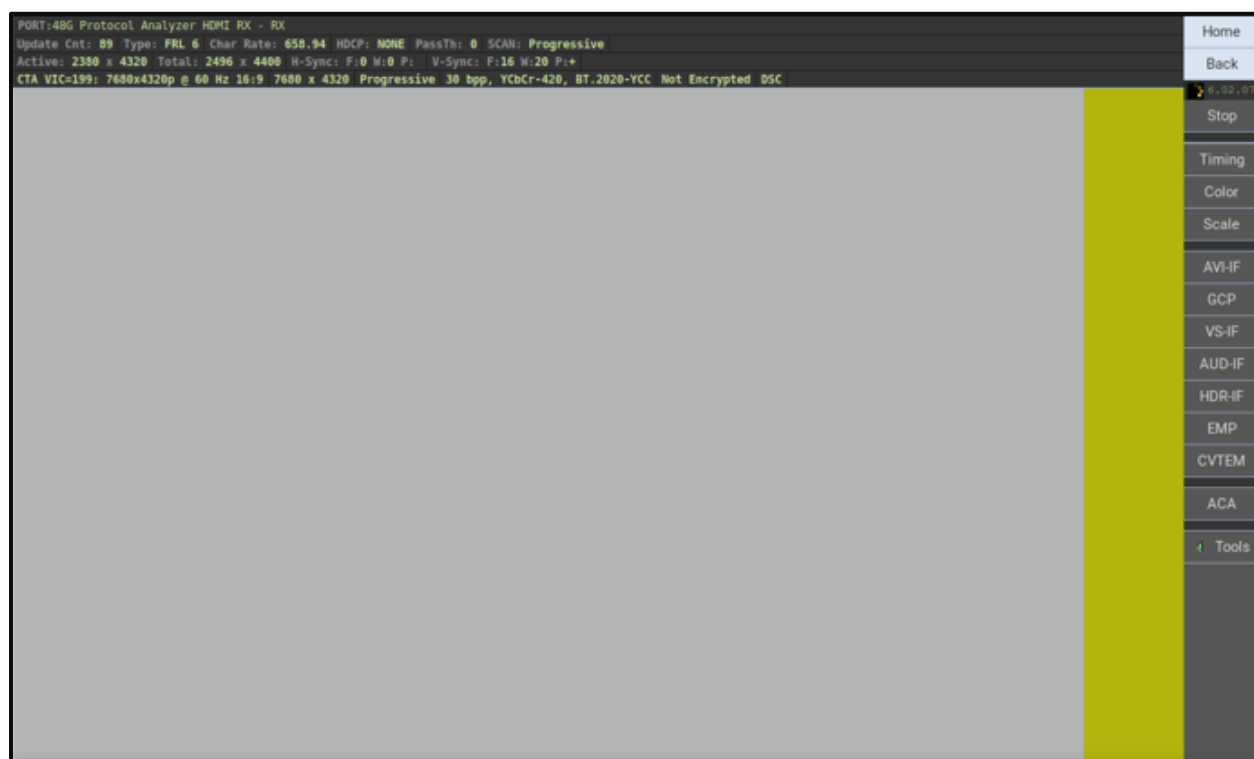
6.6 Enabling HDCP Authentication and Encryption

This section describes the procedure for enabling HDCP authentication and encryption within the Basic Analyzer to test a source HDCP functionality.

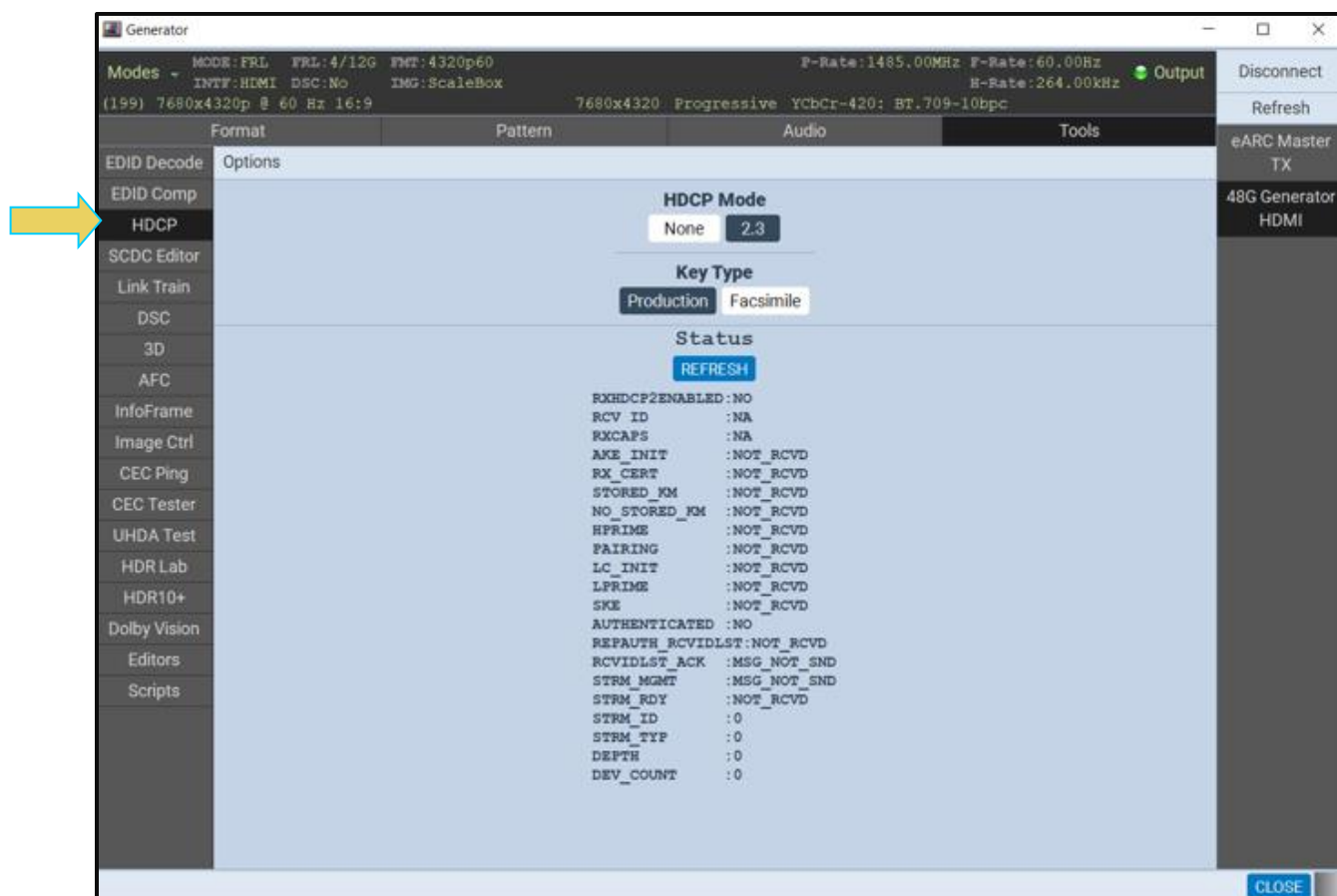
Setting the HDCP 2.3 mode

The M41h enables you to enable and disable HDCP on the Rx sink emulation port. This enables you to test how your source DUT responds to a sink that may or may not support HDCP. Use the following procedures to set the HDCP mode and registers.

1. Select Rx HDCP Settings from the Instrument pull-down menu on the built-in front panel as shown below.



The **RX HDCP 2.2 Settings** dialog box appears as shown below.



9. Select the **RX Control and Configuration** dialog box using the check boxes.

Enabled – In the Enabled mode, the M41h 48G Video Analyzer/Generator sink emulator will respond to HDCP 2.3 authentication request from a source device under test.

Disabled – In the Disabled mode, the M41h 48G Video Analyzer/Generator sink emulator will not respond to HDCP 2.3 authentication from a source device under test.

Repeater – This check box enables you to indicate whether the M41h 48G Video Analyzer/Generator emulates an HDCP 2.3 repeater device.

Depth – This indicates the depth count if M41h 48G Video Analyzer/Generator is emulating an HDCP 2.3 repeater device.

Device Count – This indicates the Device count if the M41h 48G Video Analyzer/Generator is emulating an HDCP 2.3 repeater device.

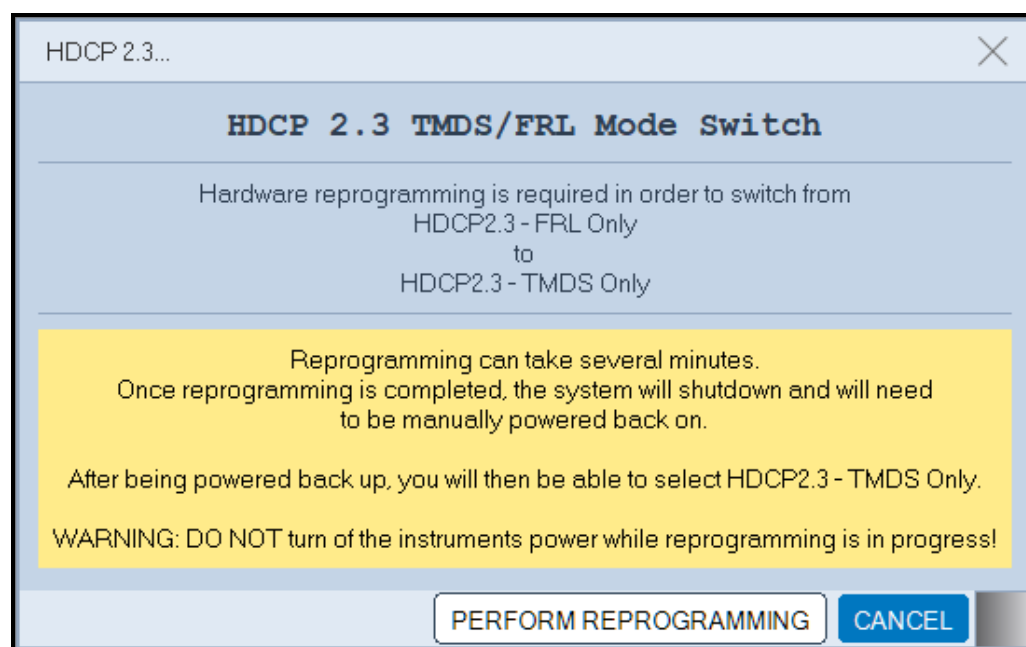
Refresh – This activation button refreshes the HDCP 2.3 status area of the dialog box.

NOTE: HDCP 2.3 Compliance Tests will only pass when executed in standard definition format (480p or 576p). Executing an HDCP 2.3 Compliance Test in 1080p or above will result in a failed test.

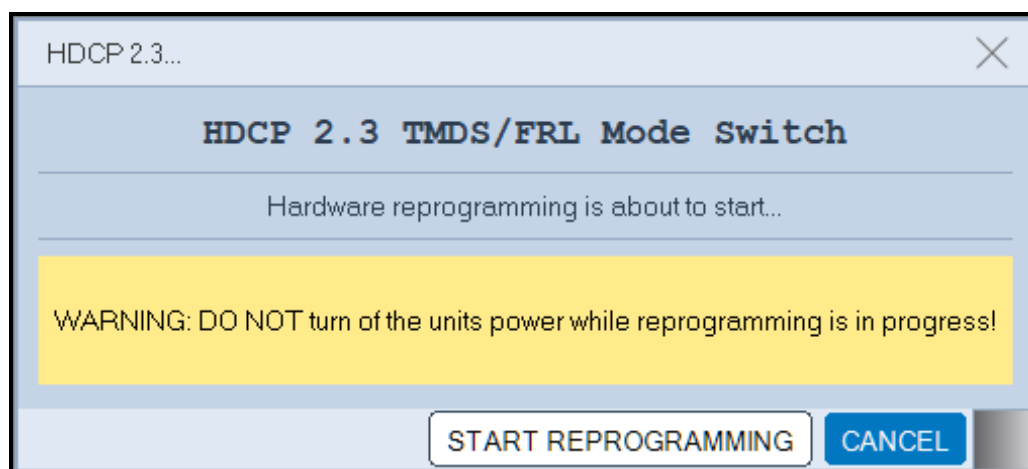
Analyzing HDMI Data with the M41h 48G Video Analyzer/Generator Capture Analysis Utility

This chapter describes how to use the M41h 48G Video Analyzer/Generator to view HDMI protocol data from the HDMI source device under test in the M41h 48G Video Analyzer/Generator Capture Utility. Analysis of TMDS and FRL incoming streams are supported.

Important Note: There is a **known issue** that requires users to restart the ATP Manager application when there is a switch from analyzing incoming FRL streams to analyzing incoming TMDS streams when HDCP is active on the source. This applies to both the Capture Analysis and the snap shot “Real Time” mode. The issue is that the ATP Manager application will require a restart in order to reprogram the application for analyzing TMDS. The reverse scenario is also true, i.e. if a user is analyzing TMDS and then sends in FRL that is HDCP encrypted, a restart will be required when there is a switch in the source to start sending content in the FRL mode with HDCP. The user will be prompted with a dialog box indicating the need for the change and also providing basic instructions. The following dialog box shows the message the user will see.



Once the user confirms that reprogramming is required, the following dialog box will appear.



7 Capture Control Overview

These procedures assume that you have powered up the M41h system, connected your HDMI 2.1 source device, connected the Ethernet cable, and established an IP connection from the ATP Manager running on your PC to the M41h system that the M41h 48G Video Analyzer/Generator resides in. You should now have the ATP Manager open on your PC.

7.1.1 Operational Workflow for Capturing Data with your M41h 48G Video Analyzer/Generator

This subsection describes how to use the M41h 48G Video Analyzer/Generator to capture and analyze HDMI source devices. Testing an HDMI 2.1 source device involves the following high-level steps:

- Configure the M41h 48G Video Analyzer/Generator in the proper mode HDMI.
- Set the +5V threshold level.
- Configure the M41h 48G Video Analyzer/Generator's Rx port with the proper EDID.
- Specify a trigger method (There is only one default trigger condition currently supported which is the first instance of a Scrambler Reset character sequence in a Super Block).
- Specify the data that you want to capture and how much data you want to capture. Currently all data is captured; there is no pre-capture filtering supported.
- Initiate the capturing of the data.

Examine the test data through the ATP Manager at the high-level view on the **Event Plot** panel or the **Video Analysis** panel.

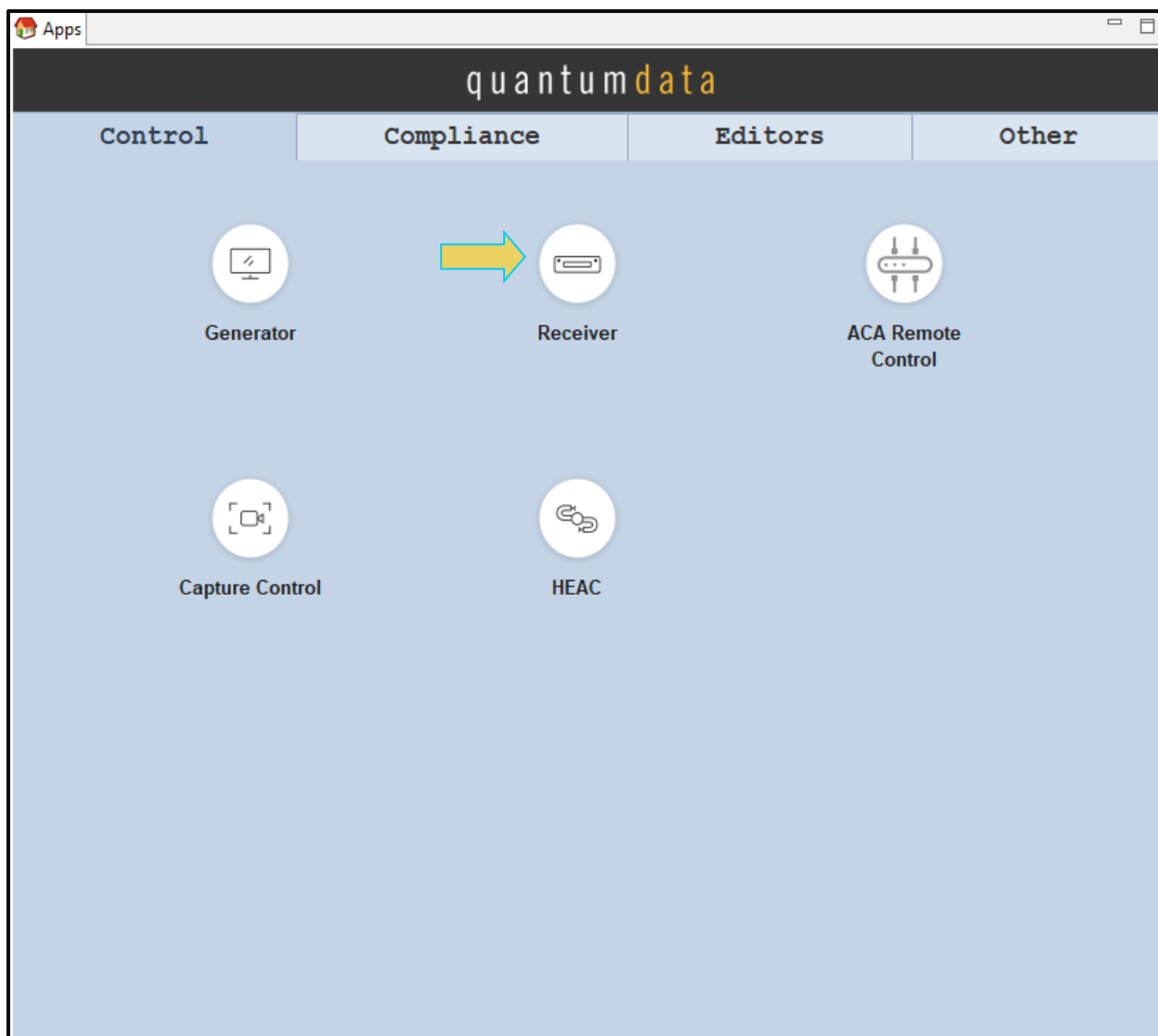
Drill down to examine the data at the lower level through the details of the **Decode** panel view.

Examine the data through the capture viewer.

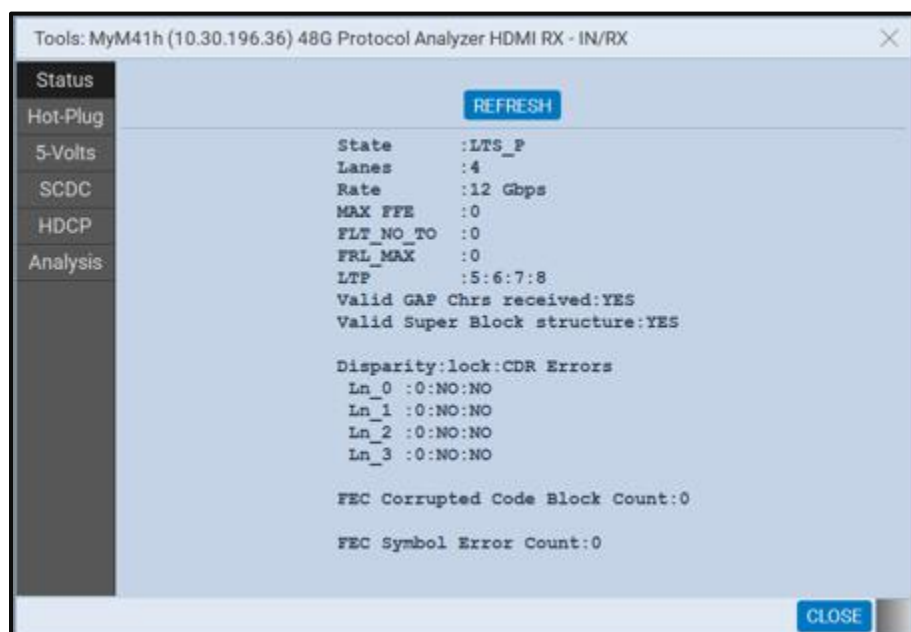
7.2 Configuring the M41h 48G Video Analyzer/Generator Rx Interface

Use the procedures below to provision the M41h 48G Video Analyzer/Generator's Rx port through a **Tools** dialog box. You can configure the Rx port with an EDID, the +5V load, generated hot plug. Through this dialog box you can also view the SCDC registers and the status of the FRL lanes.

1. Access the **Tools** dialog box from **Card Control** page of Apps menu as shown below.



The **Tools** dialog box appears as shown below. By default the **Tools** dialog box shows the **Status** of the FRL lanes if FRL is active. The following is an example. In this example the interface is trained at 12Gbps on 4 FRL lanes. The lanes are aligned and FRL lanes in the locked state with no pattern errors.



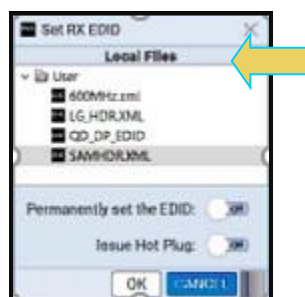
To provision the EDID:

There are two ways to provision the M41h 48G Video Analyzer/Generator's Rx port with an EDID of your choosing. Not that the EDID must support FRL. The default EDID does support FRL.

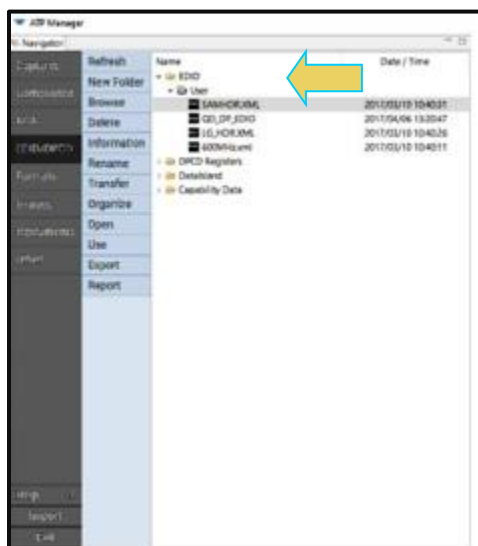
1. (optional) Load the EDID to use in the M41h 48G Video Analyzer/Generator. This is the EDID that the M41h 48G Video Analyzer/Generator will be emulating.

The default EDID in the M41h 48G Video Analyzer/Generator has a preferred timing of 4Kp60 and supports FRL. You can provision the M41h 48G Video Analyzer/Generator with a different EDID.

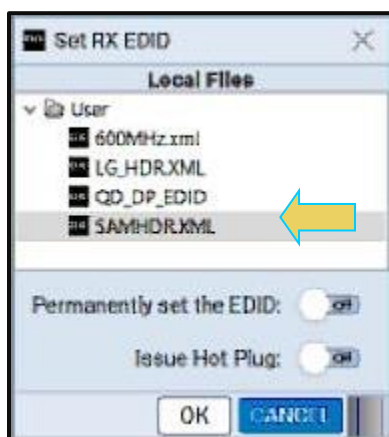
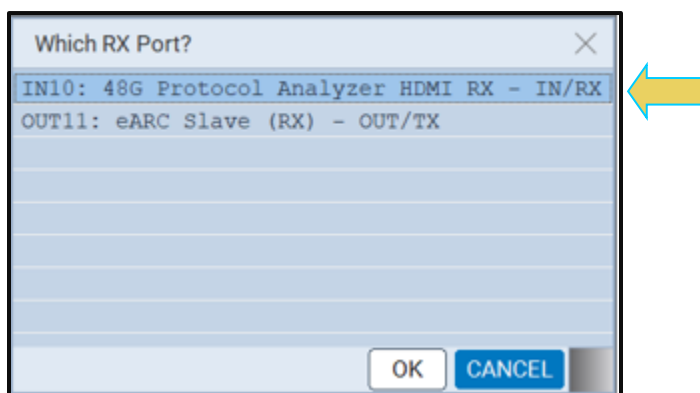
Sample EDIDs are available from the Quantum Data website on the downloads page (<http://www.quantumdata.com/support/M41hreadme.asp#edid>). You can download these EDIDs to the host PC where the ATP Manager is running. Select an EDID file by activating the **Set M41h Rx EDID** (shown on the screen below).



Alternatively, you can use the EDID/DPCD tab to select and EDID as shown below. Select the EDID and then right-click to access a pull-down menu. Select Use to set the Rx port with the selected EDID as shown below.



The dialog box shown below opens. You will have to select which M41h 48G Video Analyzer/Generator if there are more than one installed on your M41h system. The example below shows the selection of the M41h 48G Video Analyzer/Generator.



10. Select the EDID that you wish to provision the Rx port with. The example above shows 5AMHDRXML EDID being selected. Select the desired EDID and then click on the OK button.

Select **Issue Hot Plug** check box if you want to issue a hot plug once the selection is made.

Select the **Permanently set the EDID** if you want this EDID to be the new default EDID.

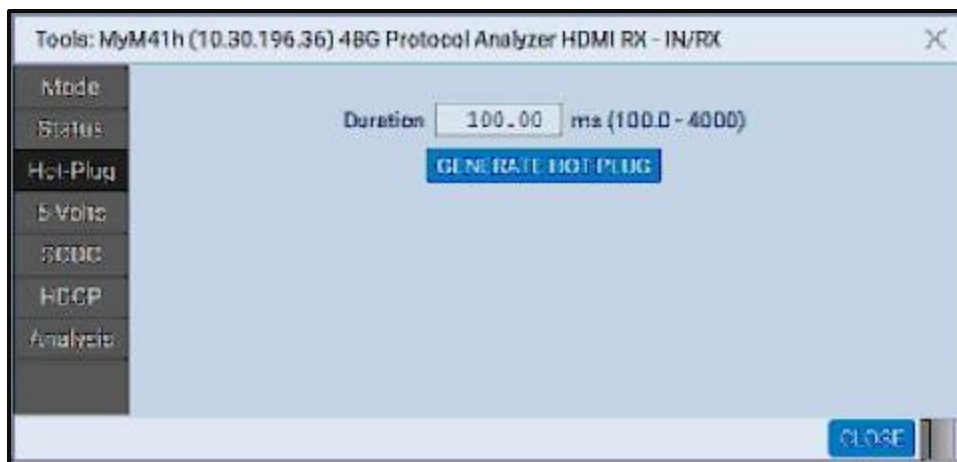
Note that there are two check box options on the dialog box. The following is a description of each:

Permanently set the EDID M41h HDMI 2.1 Protocol Analyzer's EDID – This means that the EDID that you provision will persist through a reboot of the M41h. Otherwise the default M41h EDID will be reprovisioned when a reboot occurs.

Issue Hot Plug – This means that the M41h 48G Video Analyzer/Generator will issue a hot plug when you click the OK activation button on this dialog box.

To Set the Hot Plug duration:

1. (optional) Set the Hot Plug duration and generate a hot plug as shown on the screen below. Select the **Hot-Plug** access button on the **Tools** menu as shown below. Specify the duration of the hot plug using milliseconds.

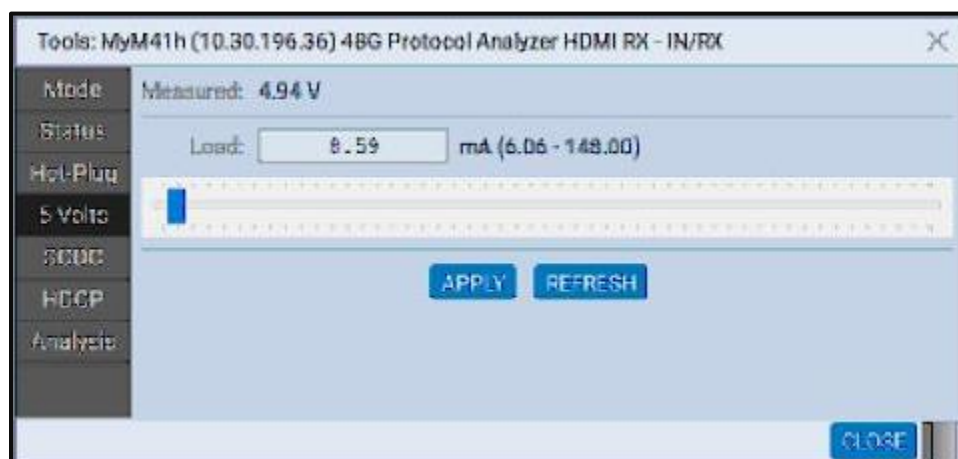


To Set the +5V load:

- (optional) Set the Rx port's +5V load via the 5 Volts access button through the **Tools** menu as shown below.
- Specify the current load in milliamps. Use the slider or enter the value in the field provided.

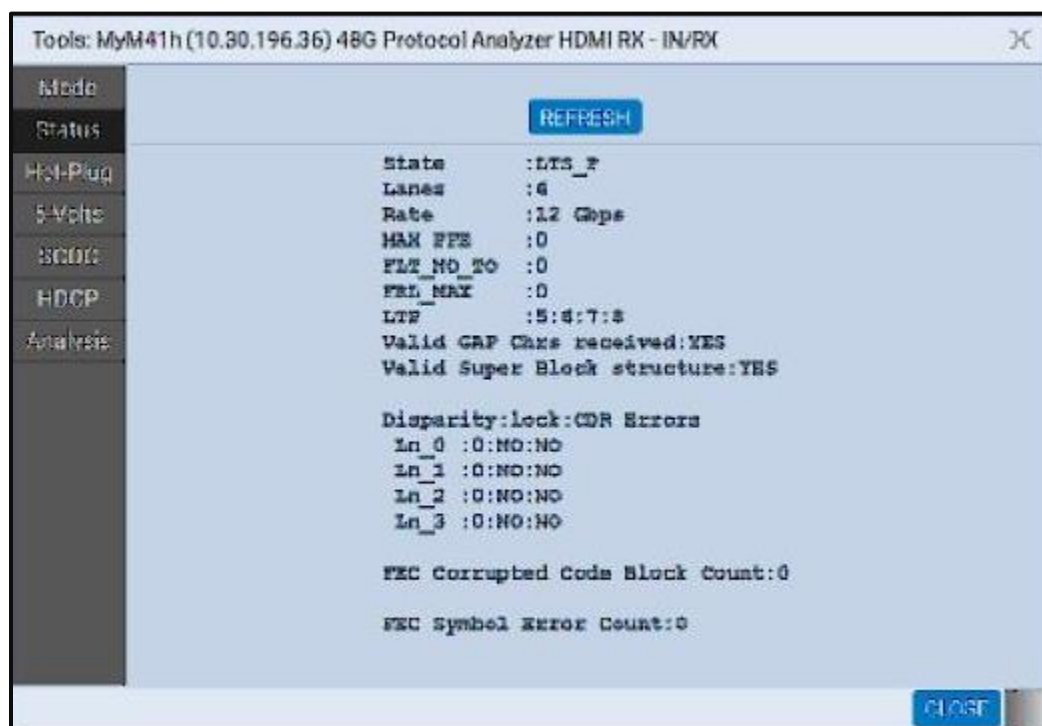
The **Measured** value of the +5V is shown (4.97 V in the example below).

- Hit the Apply button when you have set the desired load. Use **Refresh** to view the new measured value of the +5V.



To View the SCDC Registers:

1. (optional) View the SCDC registers using the SCDC access button. The values of various status and configuration registers are shown. Use Refresh to update the values displayed.

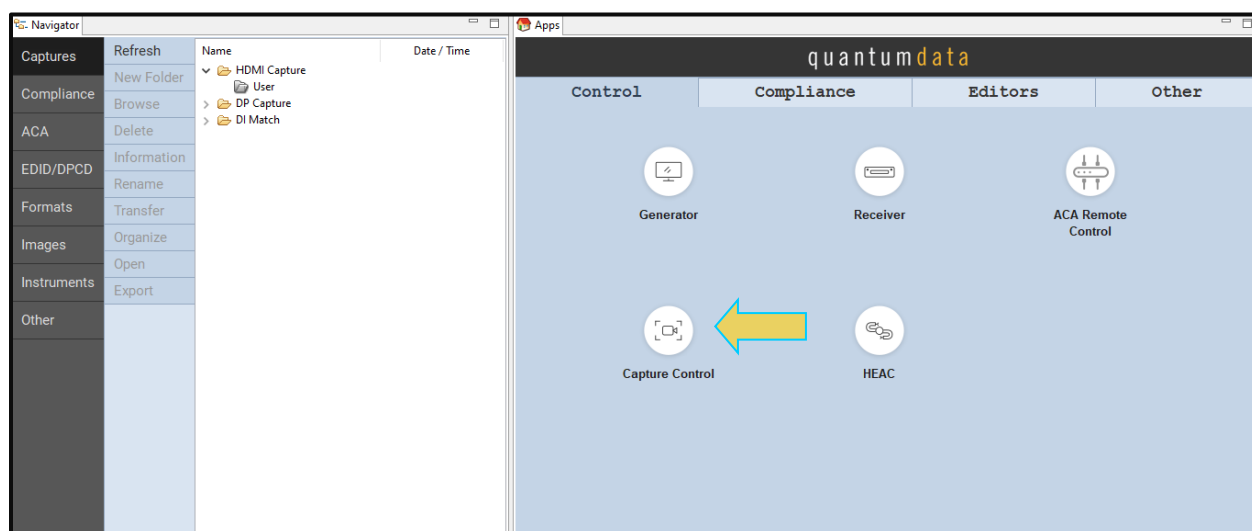


7.3 Capturing HDMI FRL Incoming Streams

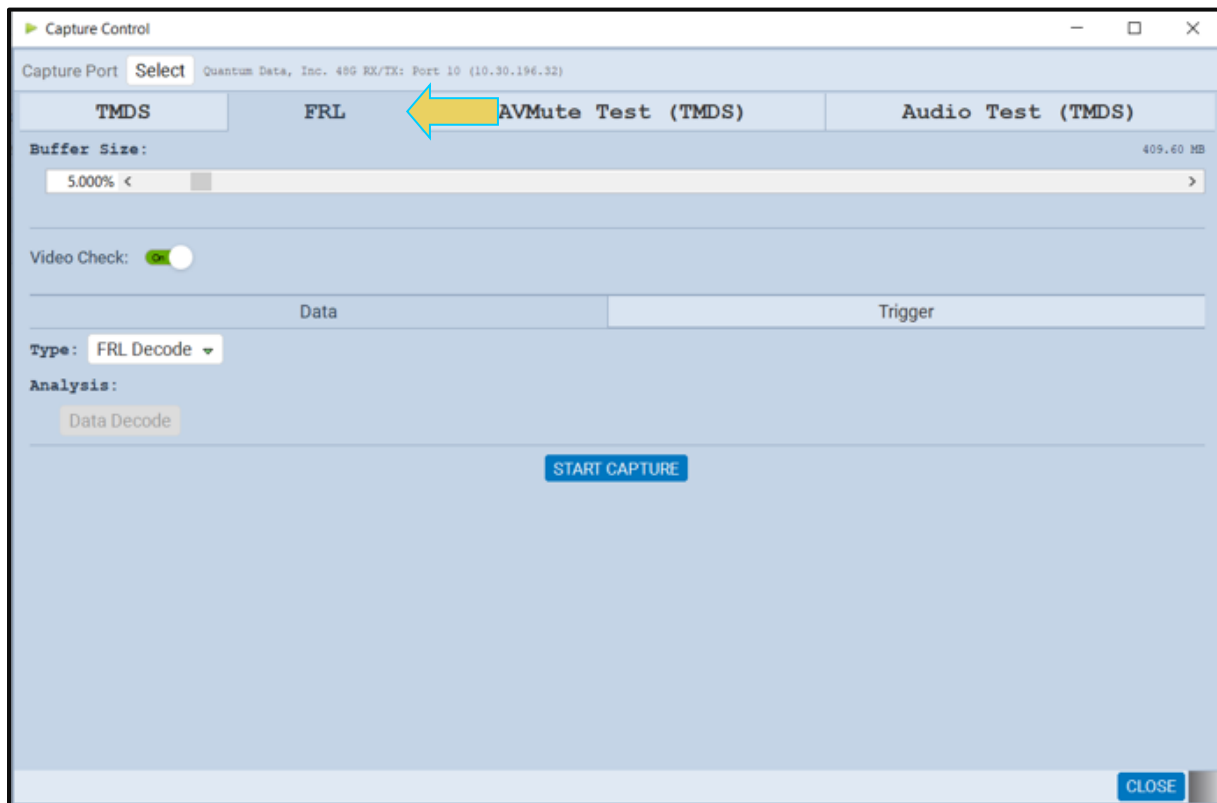
The M41h 48G Video Analyzer/Generator supports the capturing of both HDMI TMDS incoming streams and Fixed Rate Link (FRL) incoming streams. This subsection describes the procedures for capturing FRL streams. The following subsection provides procedures for capturing TMDS incoming streams.

To capture FRL streams:

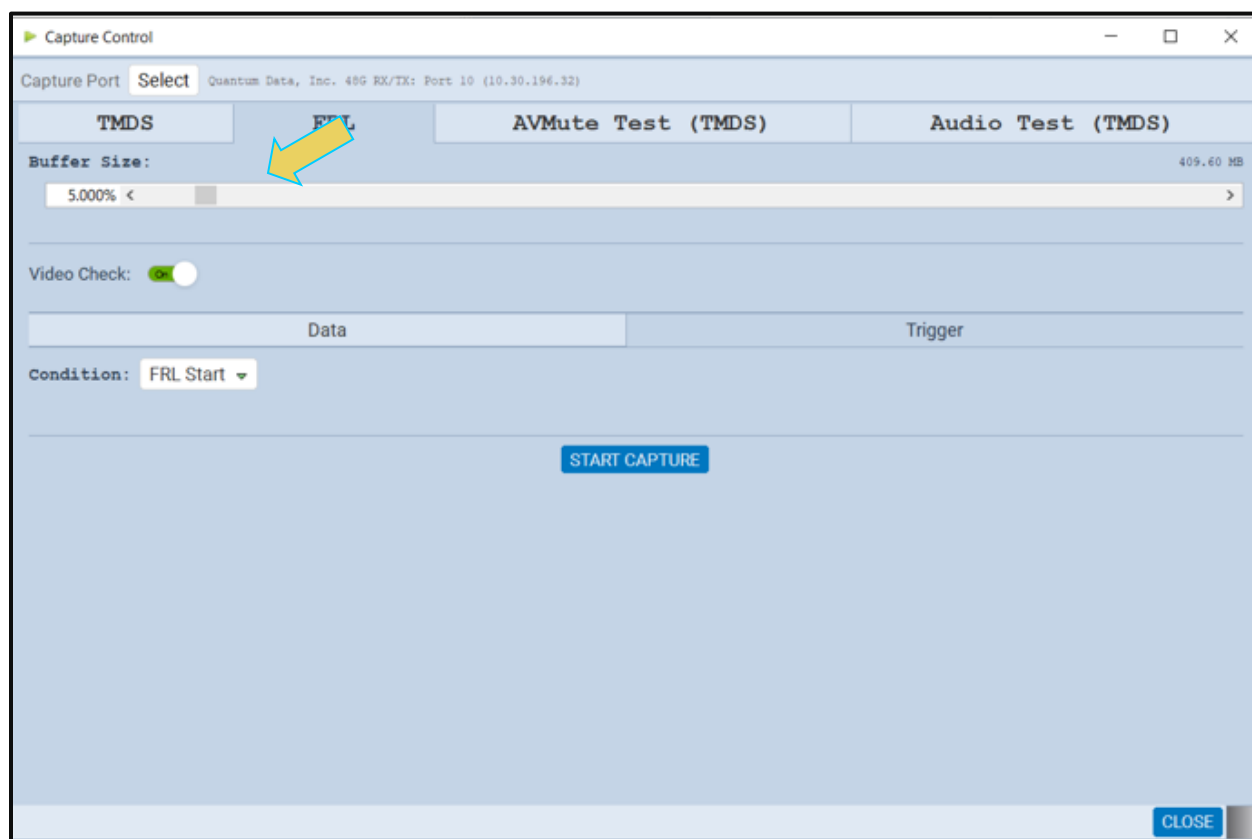
1. Select the **Capture Control** application from the **Control Page** of the Main screen.



11. Select the FRL tab from the **Capture Control** window.

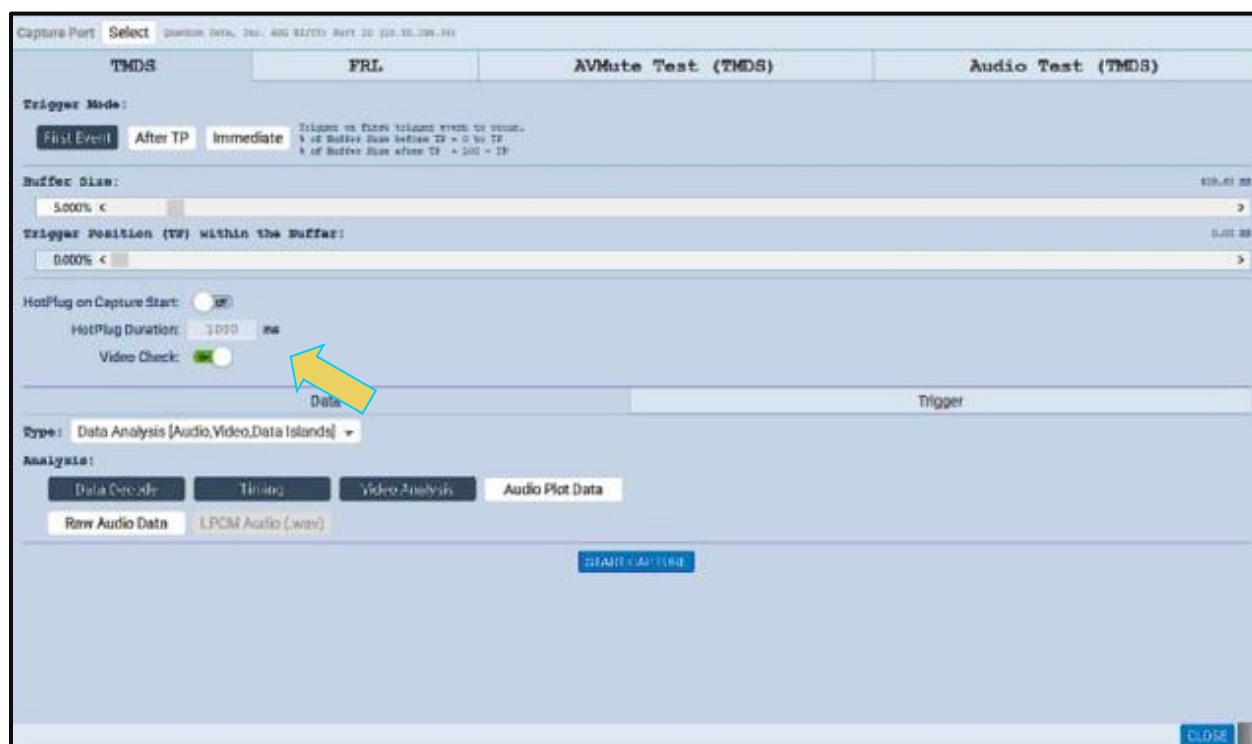


- Set the **Buffer Size** slider to a percent value to meet your requirements. You can capture up to about 8GB of data.



13. Check the **Hot Plug** on **Start Capture** button if you want the M41h 48G Video Analyzer/Generator to issue a hot plug to initiate HDCP authentication. You also need to specify the duration of hot plug pulse in milliseconds.

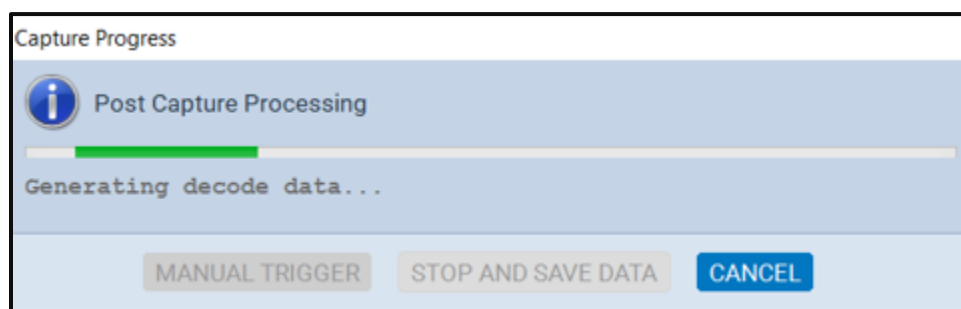
Note: If you are going to be taking some action on the device under test that will halt video, such as unseating and reseating the HDMI cable, you will need to slide the **Video Check** to on in the Capture Configuration section of the **Capture Control** dialog box.



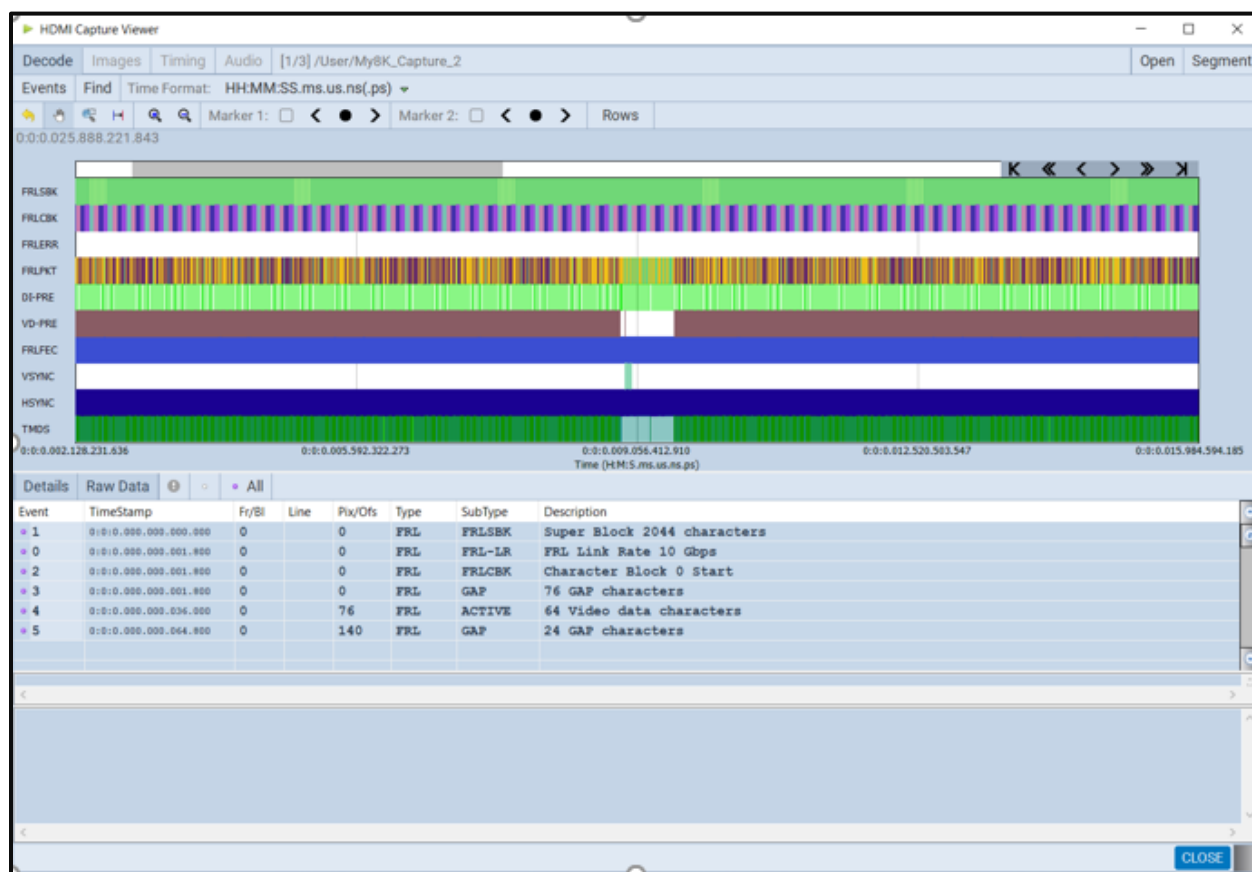
14. Click on the **Start Capture** button.

The M41h 48G Video Analyzer/Generator will capture the data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will state “**Waiting for capture trigger to occur...**”



When the M41h Protocol Analyzer is finished capturing the data a decode file is shown in the **Event Plot** panel and the **Decode** panel.



Note: The null packets may be present in the capture. These null packets assure proper FRL flow metering. Therefore, the product does not offer an option to disable them; however, you can filter them out with the filter function.

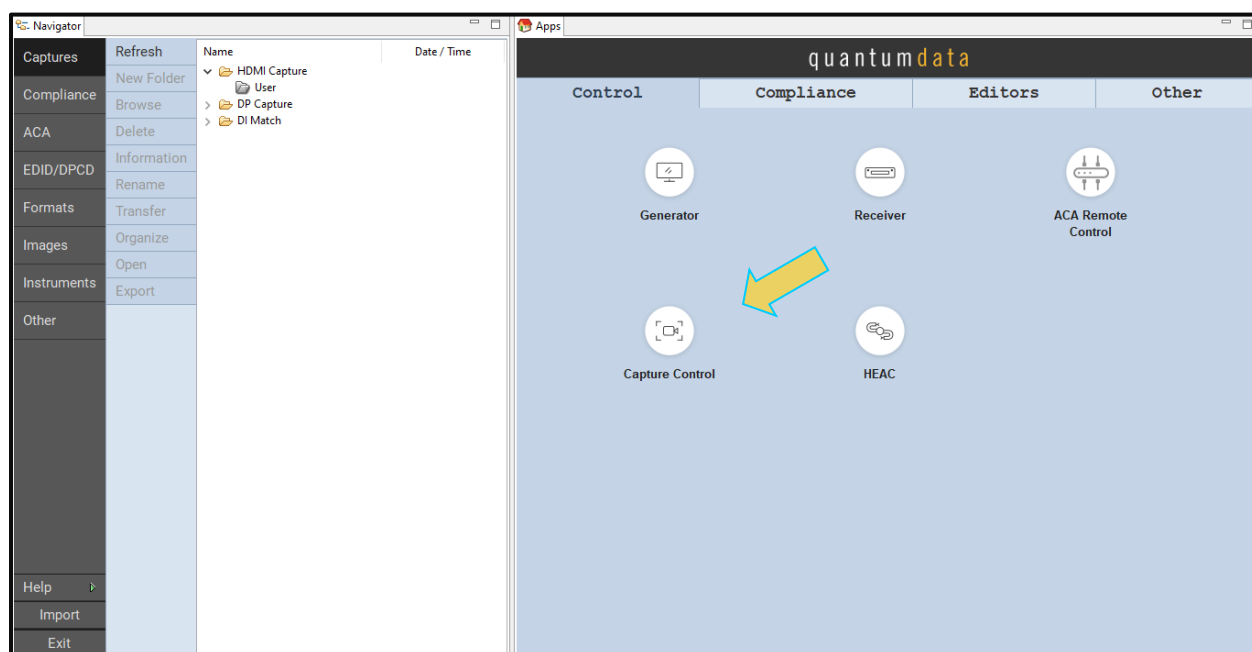
7.4 Capturing HDMI TMDS Incoming Streams

The M41h 48G Video Analyzer/Generator supports the capturing of both HDMI TMDS incoming streams and Fixed Rate Link (FRL) incoming streams. This subsection describes the procedures for capturing TMDS streams. The previous subsection provides procedures for capturing FRL incoming streams.

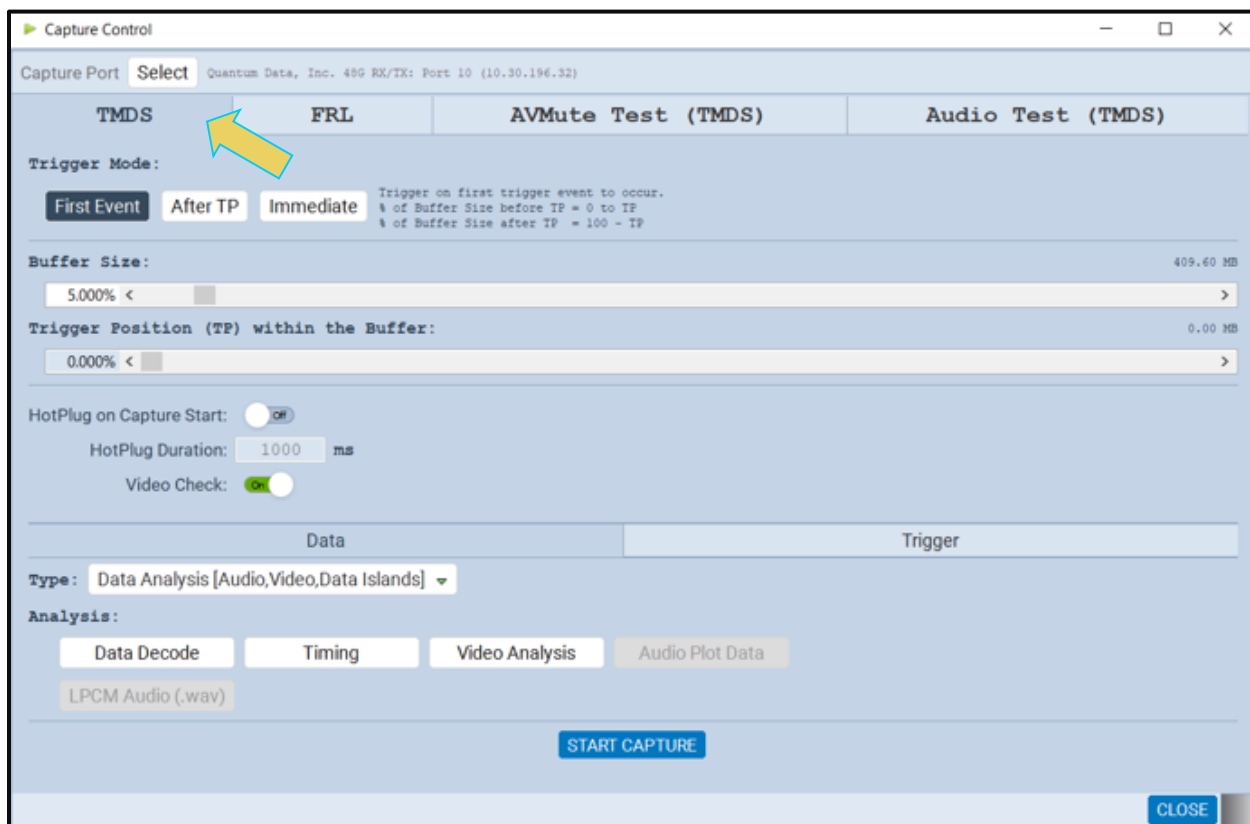
To capture TMDS streams:

Use the procedures below to initiate a new capture.

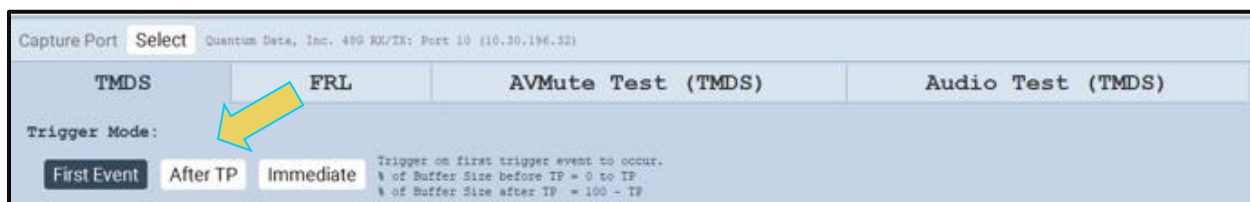
1. Select the **Capture Control** application from the **Control Page** of the Main screen.



15. Select the TMDS tab at the top of the Capture Control window.



16. Set the Video Trigger mode using the information described below:



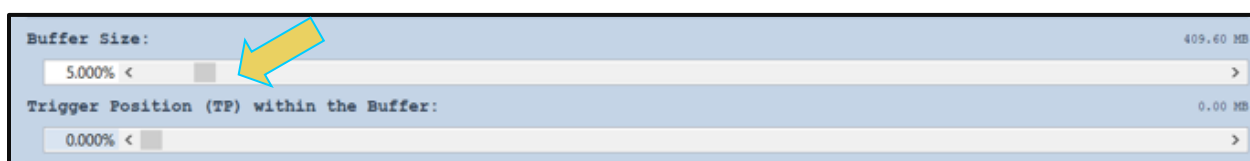
First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slider, you may have some of the captured data in the buffer that accumulated prior to the trigger condition and some of the captured data in the buffer that accumulated after the trigger condition. At the left most position there will be no data in the capture buffer that occurred prior to the trigger event. At the right most position, all the data in the capture buffer will be data that accumulated prior to the trigger event. Because the trigger condition could be met quite quickly, the capture buffer may not be filled to the amount specified in Buffer Size.

After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slider is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has

accumulated after the trigger condition was met. This setting will ensure that the capture buffer is filled to the Buffer Size setting.

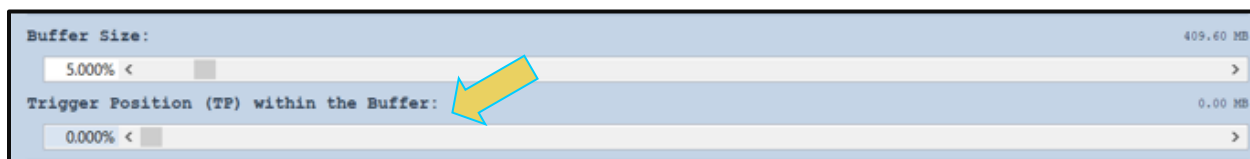
Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture trigger event (activating the Start Capture button).

17. Set the Buffer Size slider to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 1150 frames at 576p/480p and about 204 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store well over 200,000 frames of data with the 4GByte storage capabilities.



18. Set the Trigger **Position** within the **Buffer** slider to a percent value to meet your requirements. This slider enables you to set the position of the trigger event within the captured data. This is a slider that provides an indication (on the left) of the location within the captured data, expressed as a percent with 0% indicating that the trigger event occurs at the beginning of the captured data and 100% indicating that the trigger event occurs at the end of the captured data.

Note: When using **Manual** trigger, it is important to set the Trigger Position to ensure that there is some captured data prior to the manual trigger start point. The manual trigger is particularly useful when you are observing the behavior of a connected sink and then manually initiating the trigger when a particular symptom exhibits itself. Typically, you should move the trigger position to the right nearest the 100% mark. This way you ensure that there is data prior to the trigger event by accounting for reaction time between the time the symptom occurs and the time you initiate the trigger. Refer to the settings below which are typical.



19. Select **Hot Plug** on **Start Capture** button if you want the M41h 48G Video Analyzer/Generator to issue a hot plug to initiate HDCP authentication. You also need to specify the duration of hot plug pulse in milliseconds.

Note: If you are going to be taking some action on the device under test that will halt video, such as unseating and reseating the HDMI cable, you will need to turn on the **Video Check** radio button in the Capture Configuration section of the **Capture Control** dialog box.

HotPlug on Capture Start: ☐ OFF

HotPlug Duration: 1000 ms

Video Check: ☒ ON

Data Trigger

Type: Data Analysis [Audio, Video, Data Islands]

Analysis:

Data Decode Timing Video Analysis Audio Plot Data

LPCM Audio (.wav)

START CAPTURE

20. Select the **Capture** tab.

21. Select the **Data Selection** Type from the pull-down menu provided.

Capture Control

Capture Port: Select

TMDS FRL AVMute Test (TMDS) Audio Test (TMDS)

Trigger Mode: First Event After TP Immediate

Buffer Size: 50000

Trigger Position (VF) within the Buffer: 0000%

HotPlug on Capture Start: ☐ OFF

HotPlug Duration: 1000 ms

Video Check: ☒ ON

Data Trigger

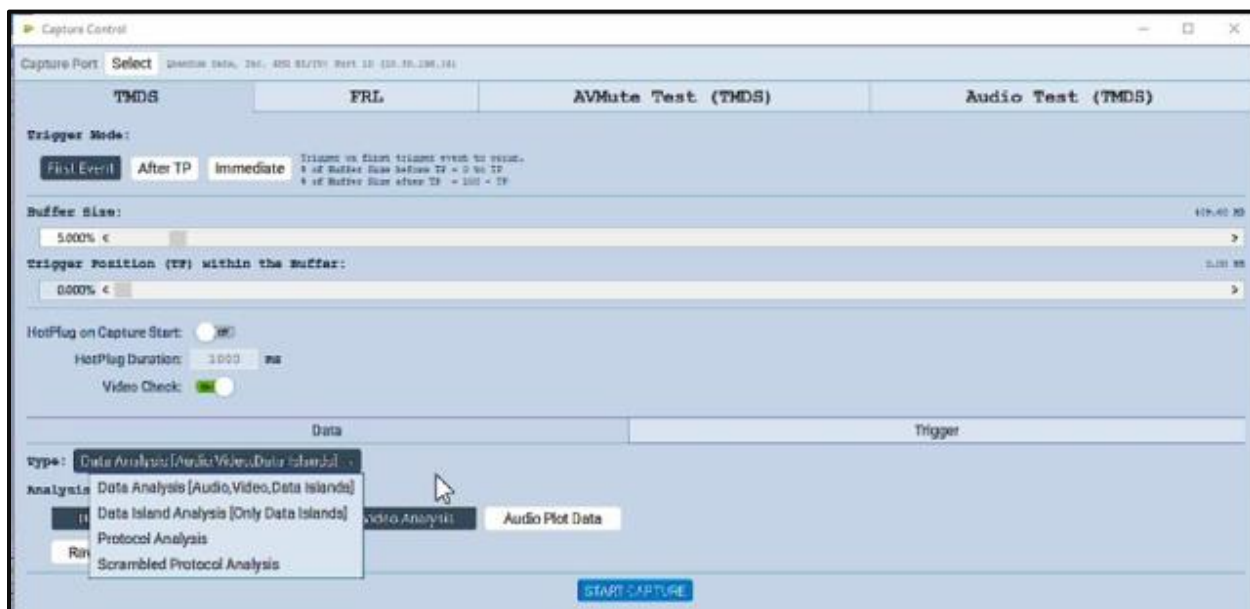
Type: Data Analysis [Audio, Video, Data Islands]

Analysis:

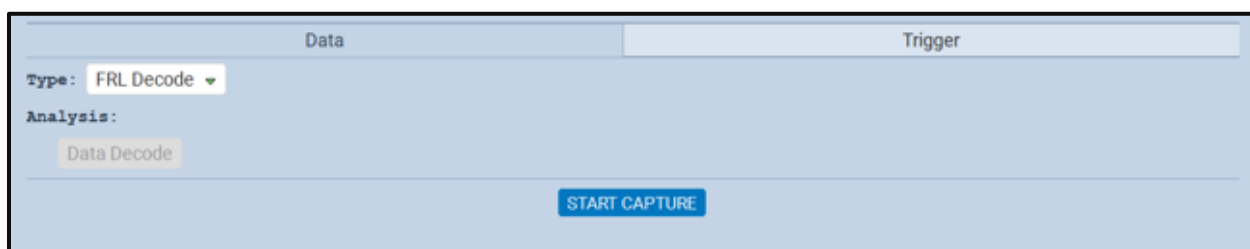
Data Decode Timing Video Analysis Audio Plot Data

Raw Audio Data LPCM Audio (.wav)

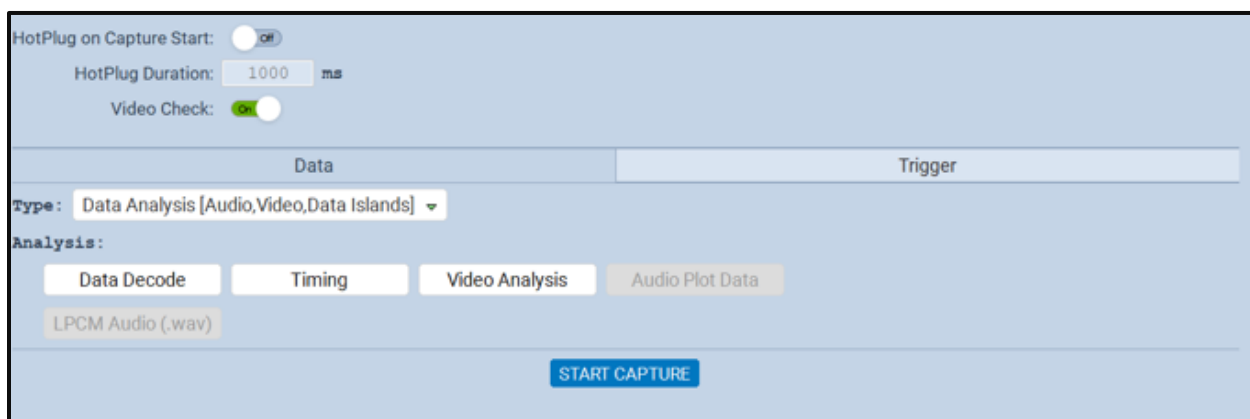
START CAPTURE



22. Select the Trigger selection **Condition**.

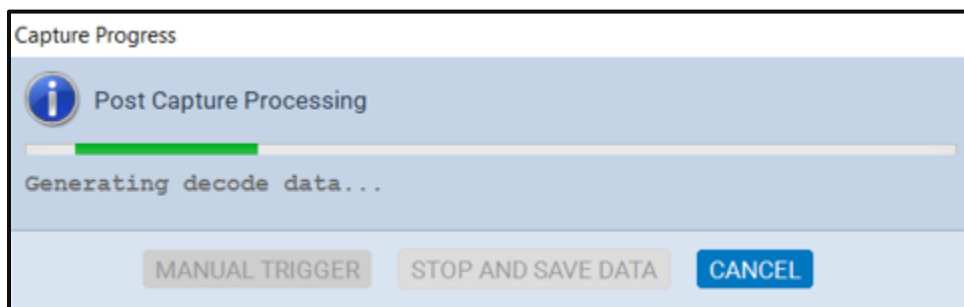


23. Click on the **Start Capture** button.

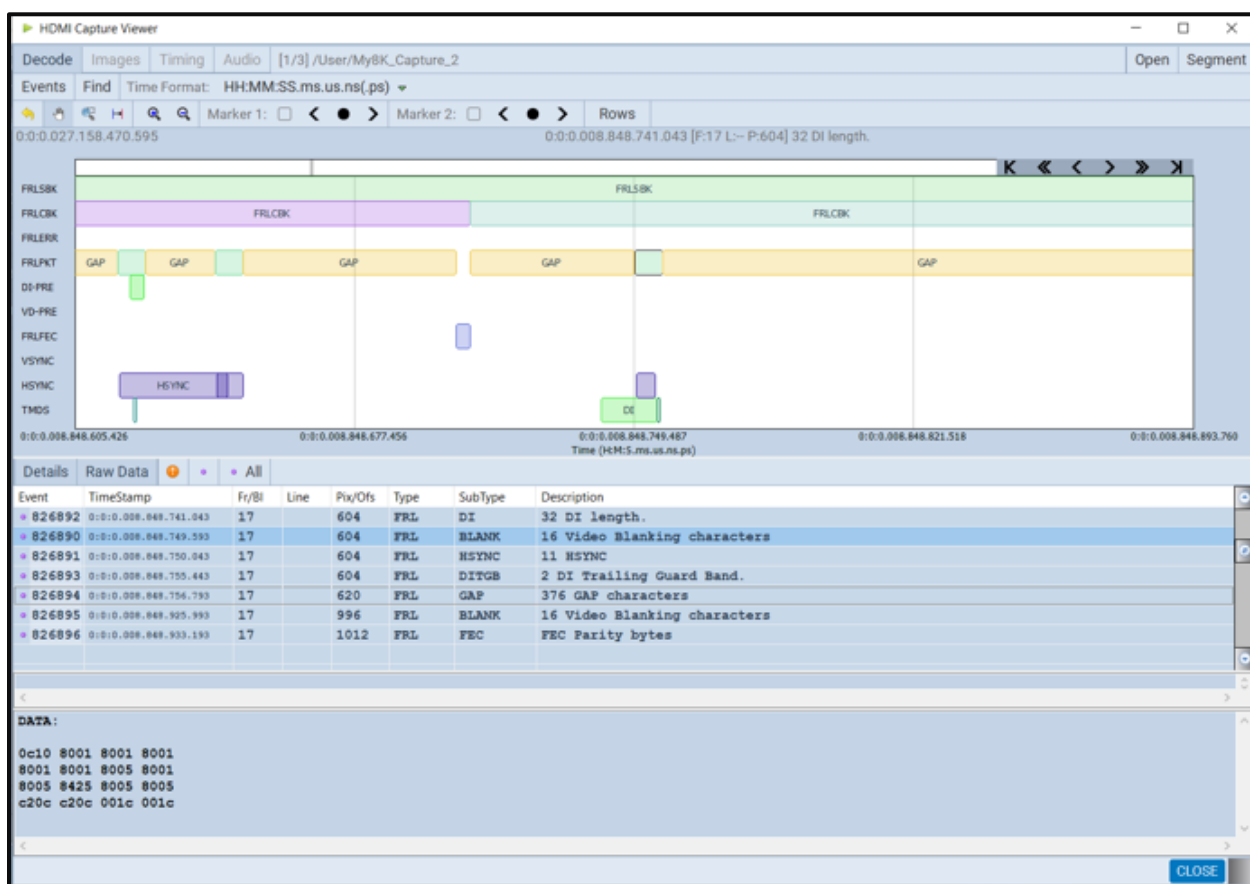


The M41h 48G Video Analyzer/Generator will capture the data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

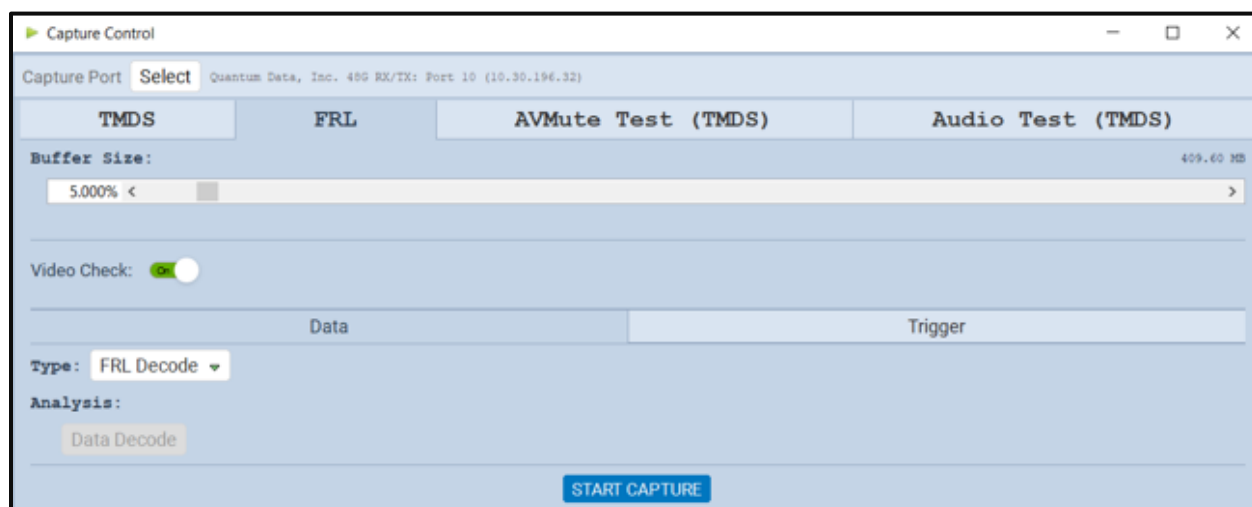
Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will state “**Waiting for capture trigger to occur...**”



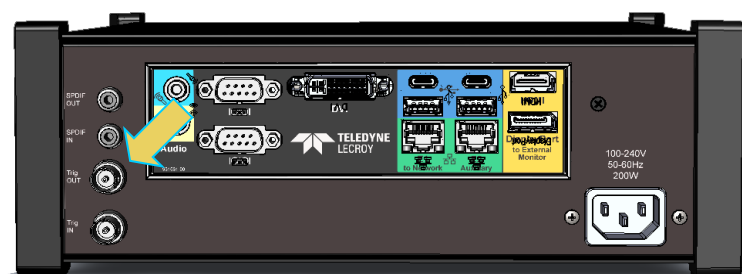
When the M41h 48G Video Analyzer/Generator is finished capturing data a decode file is shown in the **Event Plot** panel and the **Decode** panel.



Note: This feature is not currently supported. The External Trigger Input enables you to initiate a capture trigger event from an external source. You select the external trigger from the Trigger pull-down menu as shown below:



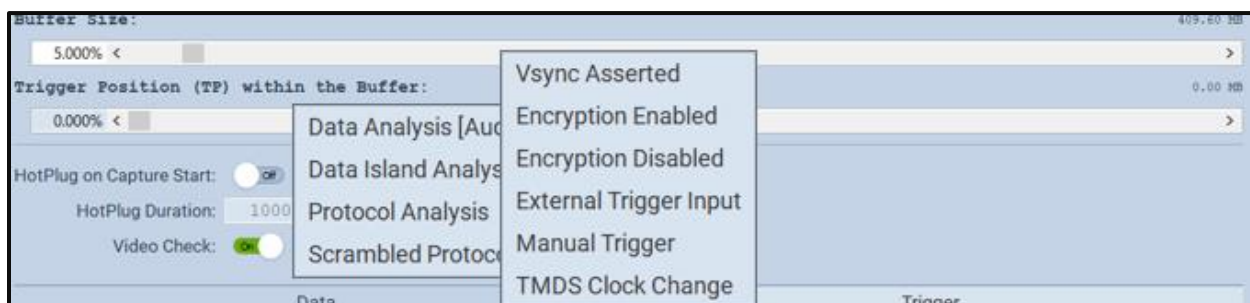
The minimum voltage required to activate the external trigger is 2.1 volts and will accept up to 5V. The pulse duration of the External Trigger must be greater than 1 TMDS pulse clock period. The Trigger Input is on the rear of the M41h. It is the topmost BNC connector. There are a few M41h configurations; the most common are shown below.



M41h Advanced Test Platform – Trigger IN (Not Currently Supported)

7.5 Initiating a Capture with Manual Triggering

In addition to the triggers provided in the pull-down menu, you can select to manually trigger on an event. Refer to the screen shot below:



Typically, manual triggers are used in the Pass-through mode. In these modes there is a display connected to the M41h HDMI Protocol Analyzer Tx port. A common application would be to observe the connected display and when it exhibits the behavior you are looking for you can initiate the manual trigger.

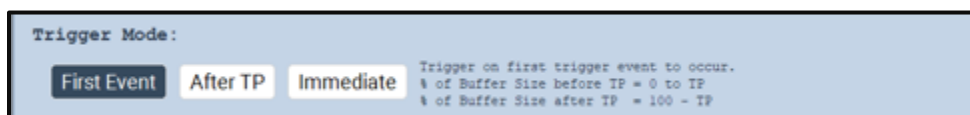
7.5.1 Initiating a Capture with Manual Triggering

With the manual capture, you can monitor the downstream HDMI sink device for behavior or symptoms that could be an issue and then initiate a capture when the condition exhibits itself. This ensures that the relevant data—data related to interoperability—is captured.

To capture data using manual triggering:

Use the procedures below to initiate a new capture.

1. Set the Video Trigger mode using the information described below:



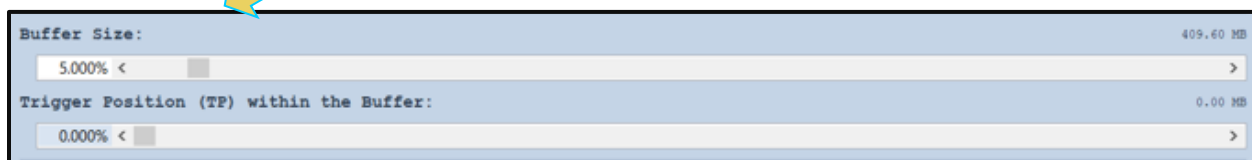
First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slider, you may have some of the captured data in the buffer that accumulated prior to the trigger condition and some of the captured data in the buffer that accumulated after the trigger condition. At the left most position there will be no data in the capture buffer that occurred prior to the trigger event. At the right most position, all the data in the capture buffer will be data that accumulated prior to the trigger event. Because the trigger condition could be met quite quickly, the capture buffer may not be filled to the amount specified in Buffer Size.

After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slider is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has

accumulated after the trigger condition was met. This setting will ensure that the capture buffer is filled to the Buffer Size setting.

Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture trigger event (activating the Start Capture button).

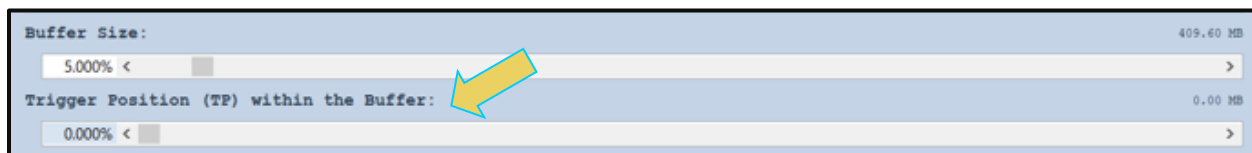
24. Set the **Buffer Size** slider to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 1150 frames at 576p/480p and about 204 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store well over 200,000 frames of data with the 4GByte storage capabilities.



25. Set the **Trigger Position** within the Buffer slider to a percent value to meet your requirements.

This slider enables you to set the position of the trigger event within the captured data. This is a slider that provides an indication (on the left) of the location within the captured data, expressed as a percent with 0% indicating that the trigger event occurs at the beginning of the captured data and 100% indicating that the trigger event occurs at the end of the captured data.

Note: When using a **Manual** trigger, it is important to set the Trigger Position to ensure that there is some captured data prior to the manual trigger start point. The manual trigger is particularly useful when you are observing the behavior of a connected sink and then manually initiating the trigger when a particular symptom exhibits itself. Typically, you should move the trigger position to the right nearer the 100% mark. This way you ensure that there is data prior to the trigger event by accounting for reaction time between the time the symptom occurs and when you initiate the trigger. Refer to the settings below which are typical.



26. Check the **Hot Plug on Start Capture** button if you want the M41h HDMI 2.0 Protocol Analyzer to issue a hot plug to initiate HDCP authentication. You also need to specify the duration of hot plug pulse in milliseconds.

Note: If you are going to be taking some action on the device under test that will halt video, such as unseating and reseating the HDMI cable, you will need to turn on the **Video Check** radio button in the Capture Configuration section of the **Capture Control** dialog box.

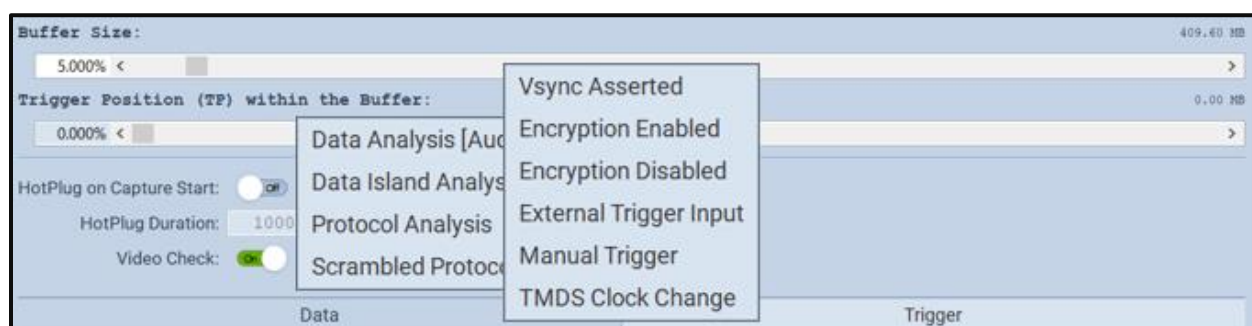


27. Select the **Capture** tab.

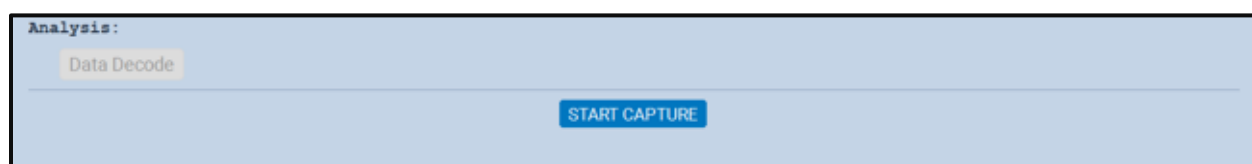
28. Select the Data Selection Type from the pull-down menu provided.



29. Select the Manual Trigger selection **Condition**.

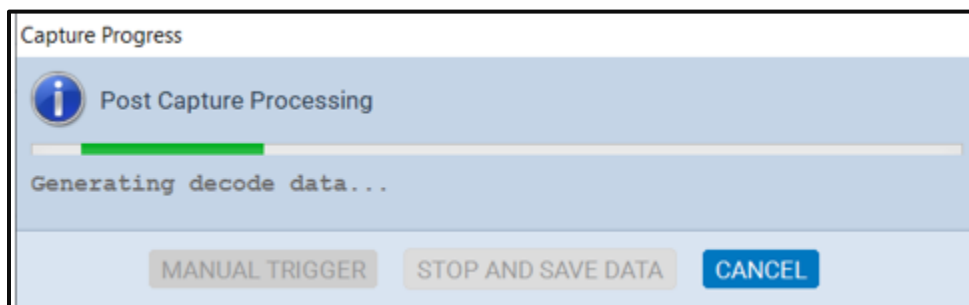


30. Click on the **Start Capture** button.

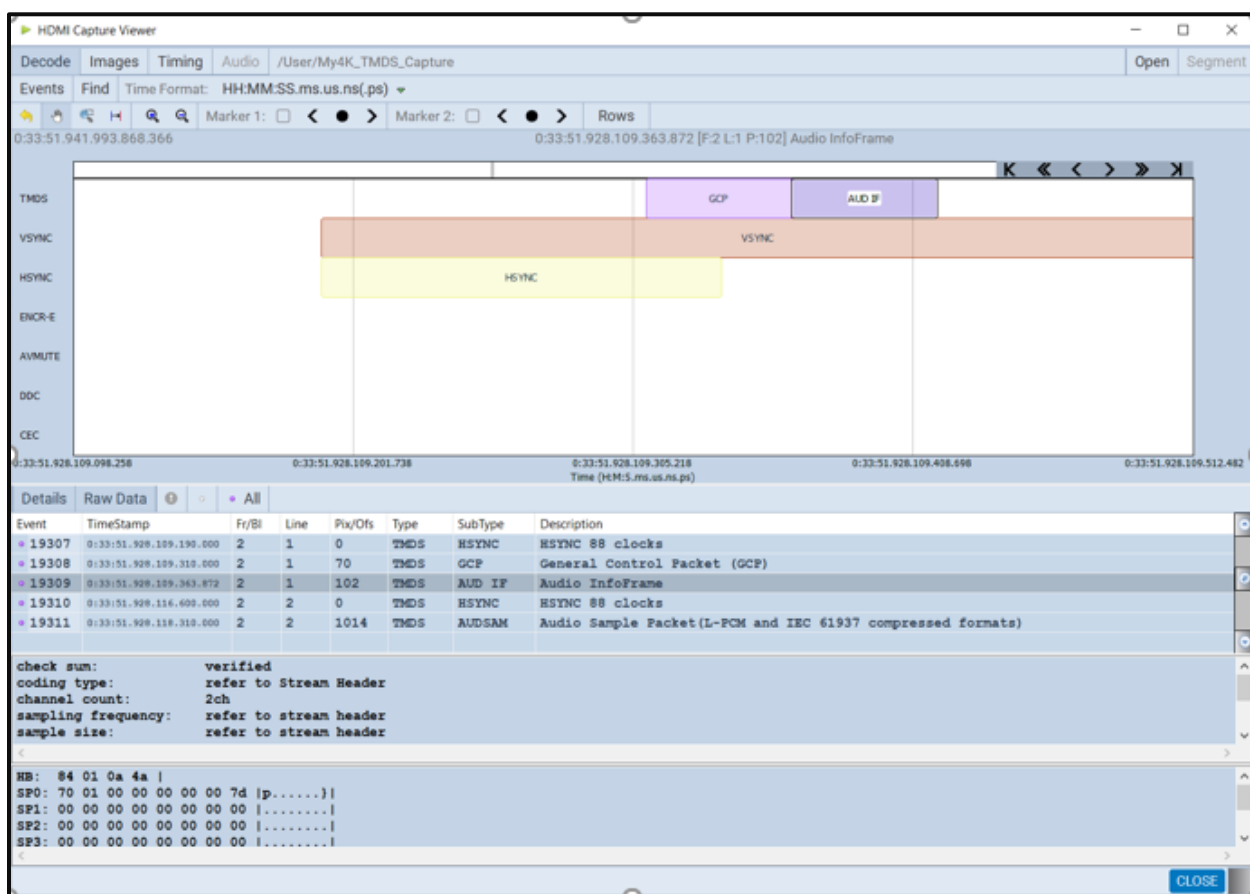


The M41h 48G Video Analyzer/Generator will capture the data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

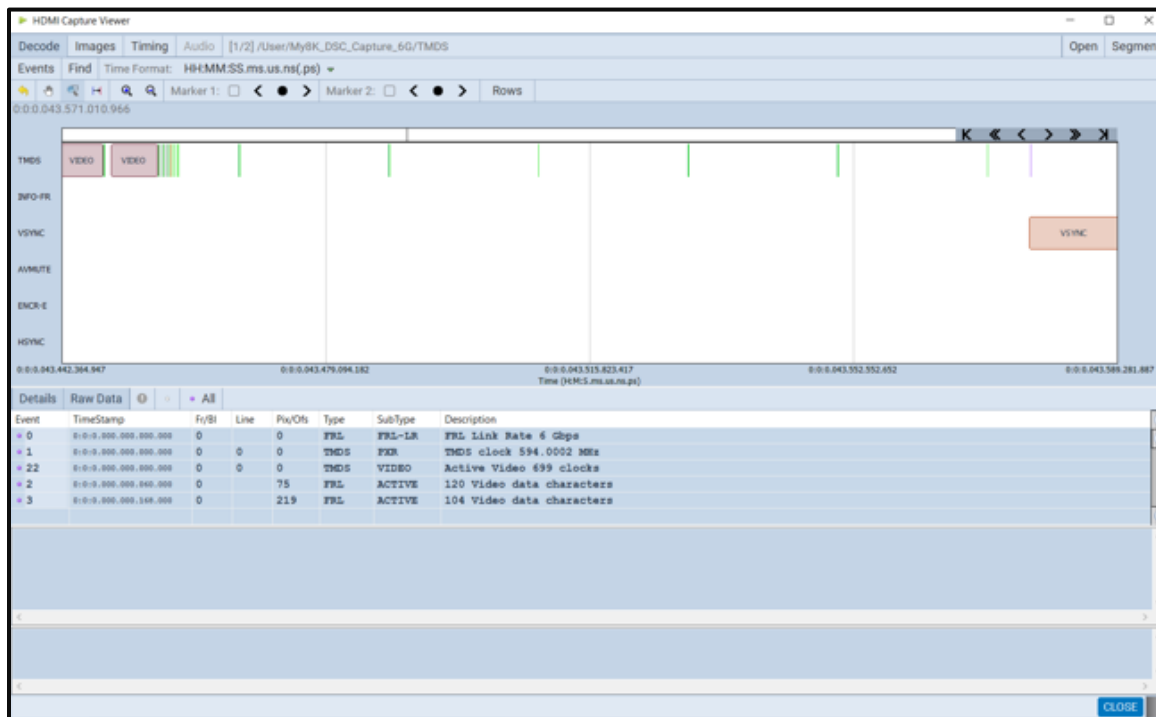
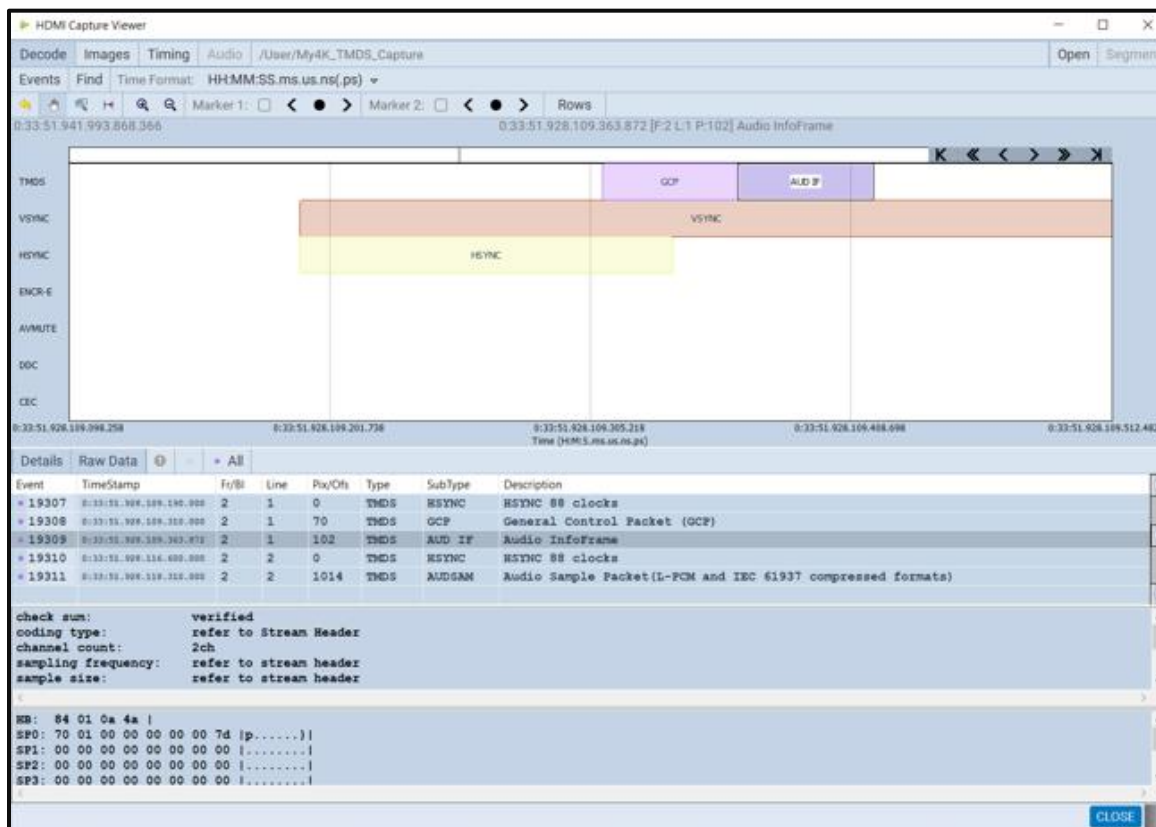
Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will state “**Waiting for capture trigger to occur...**”



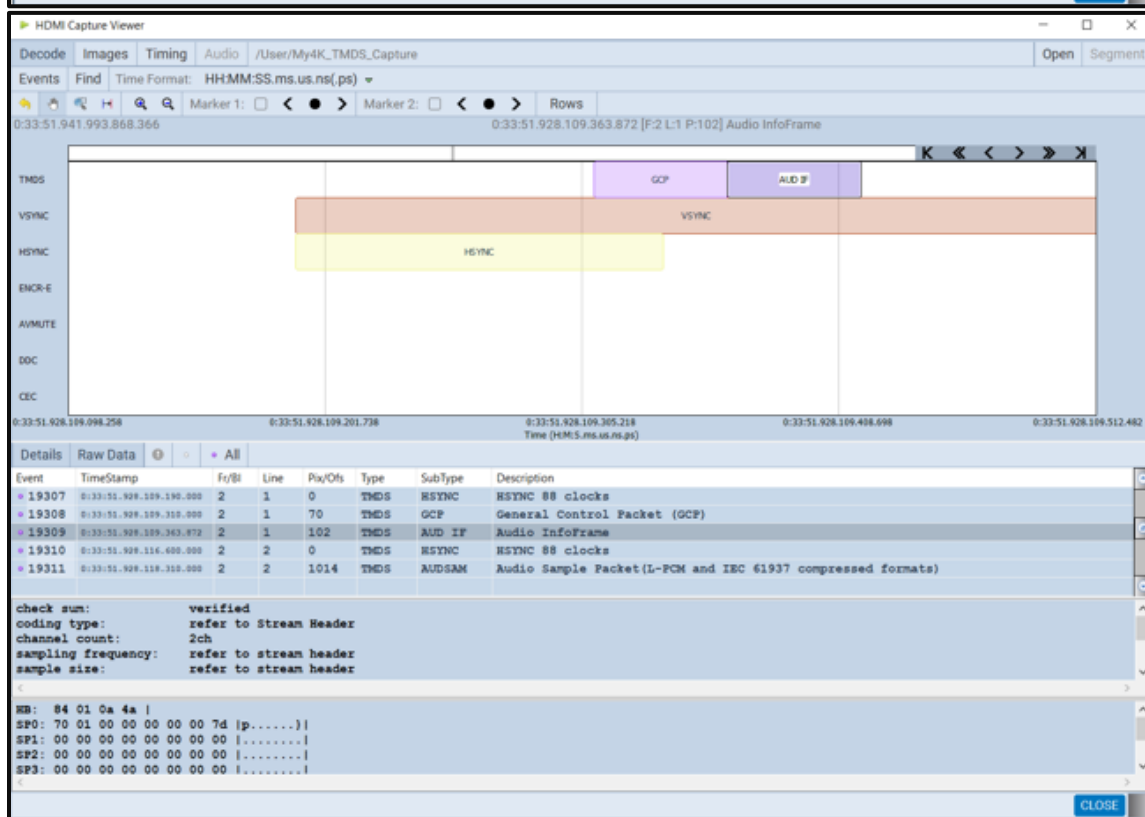
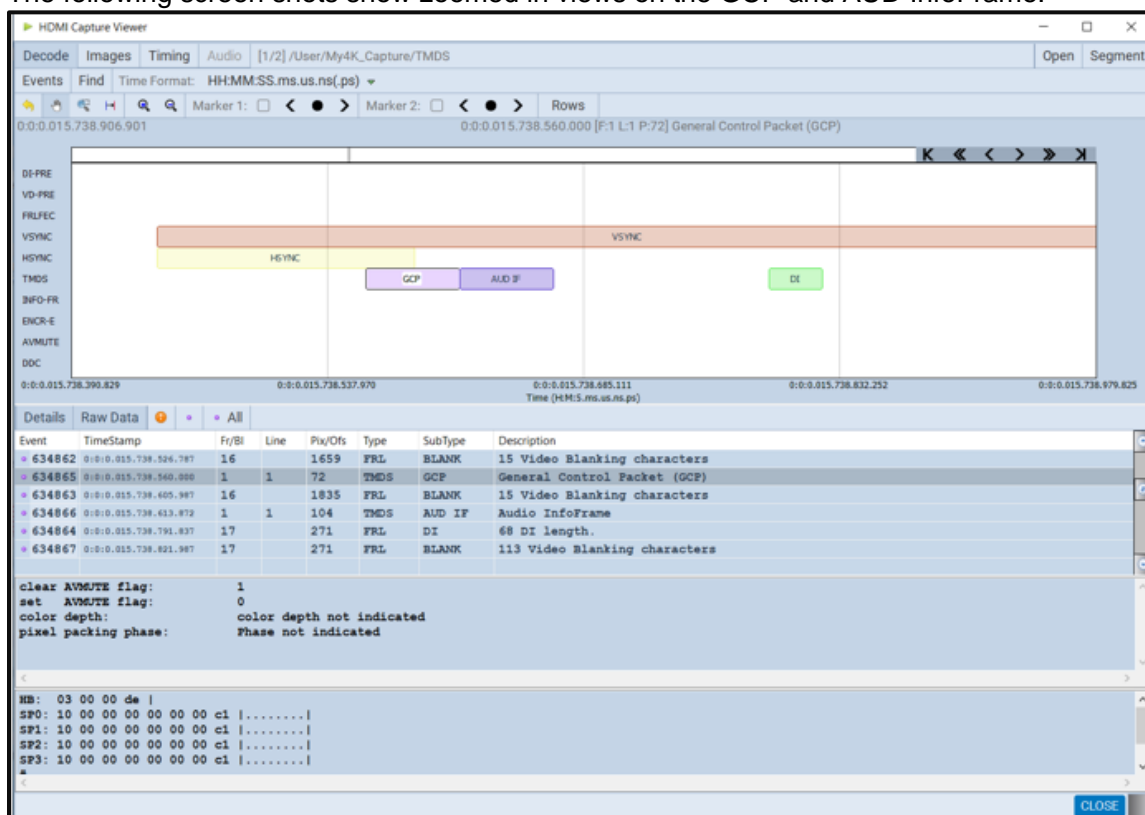
When the M41h 48G Video Analyzer/Generator is done capturing data a decode file is shown in the **Event Plot** panel and the **Decode** panel. The following screen shots show examples of captures.



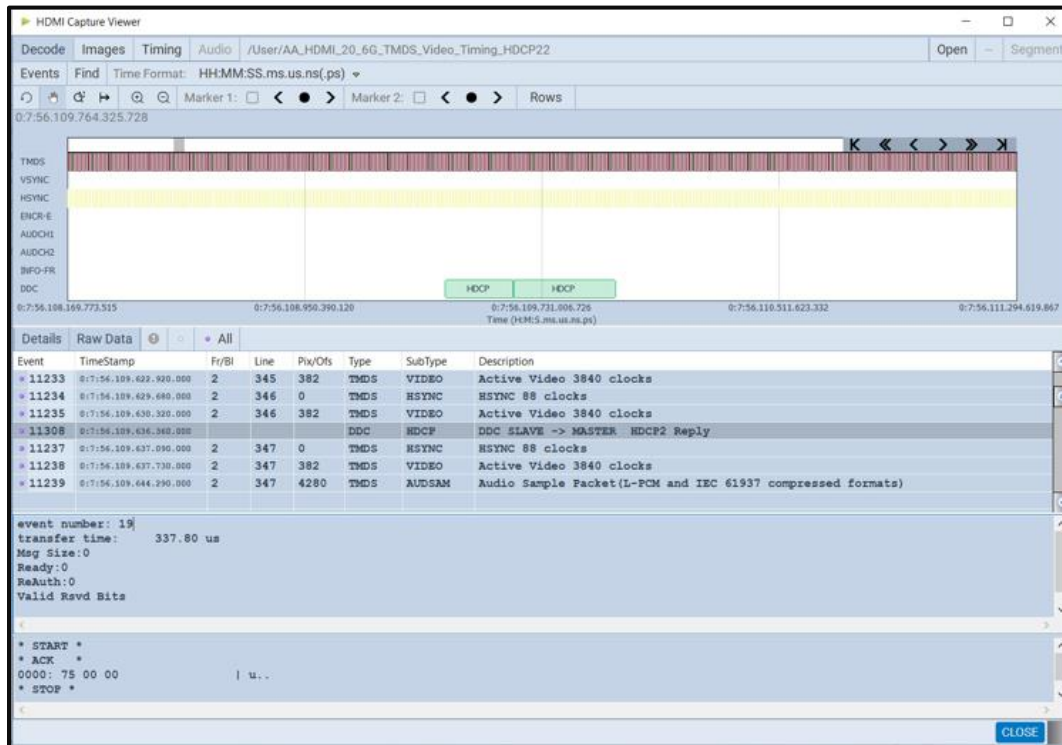
The following screen shots show zoomed in views on the InfoFrame.



The following screen shots show zoomed in views on the GCP and AUD InfoFrame.

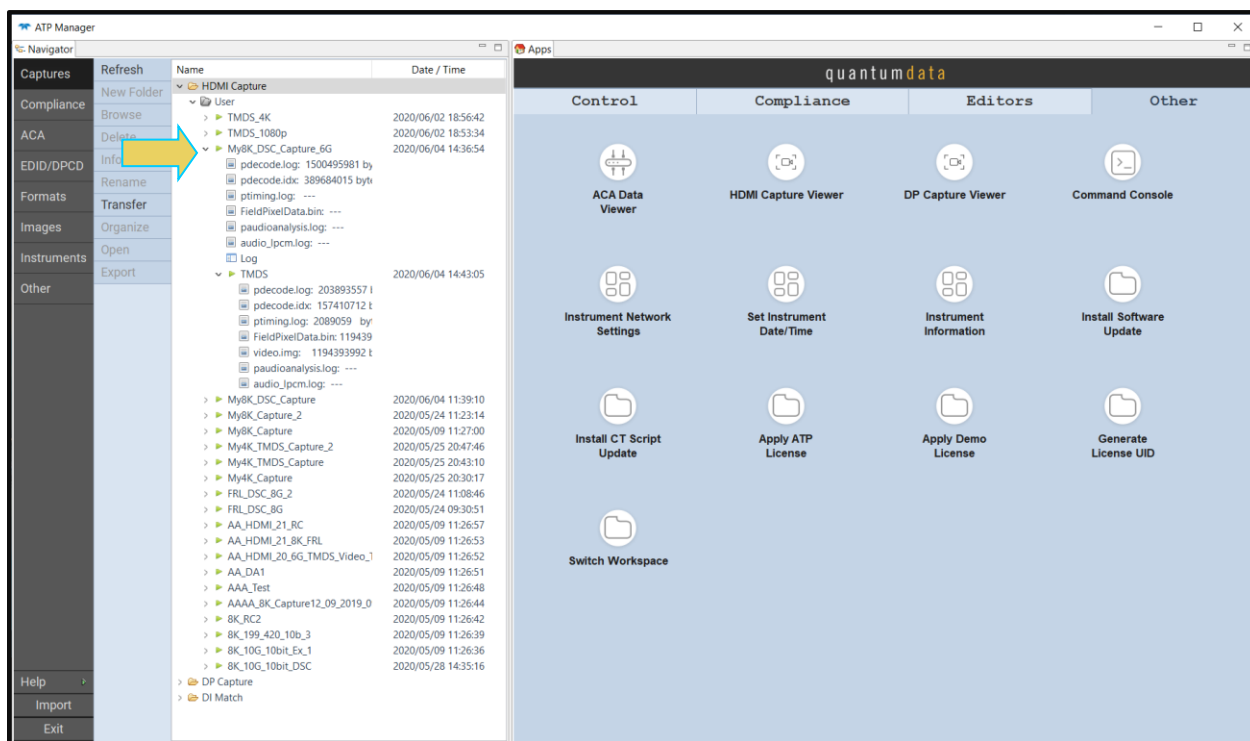


The following screen shot example shows a capture with HDCP 2.2 active.

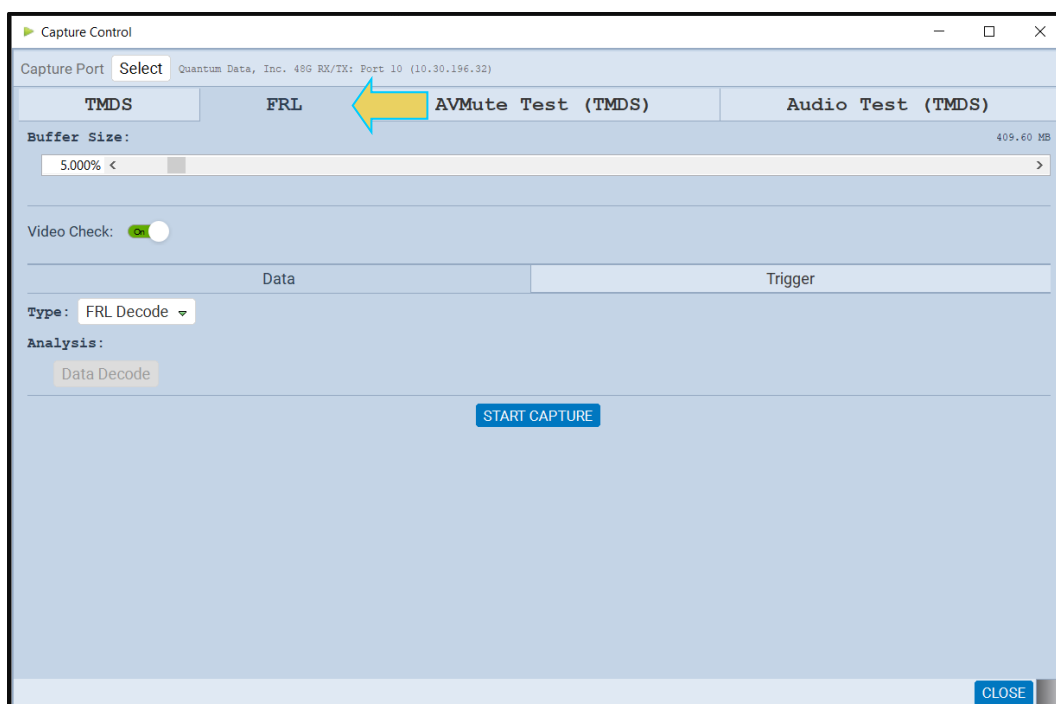


7.6 Viewing the Display Stream Compression (DSC) Capture

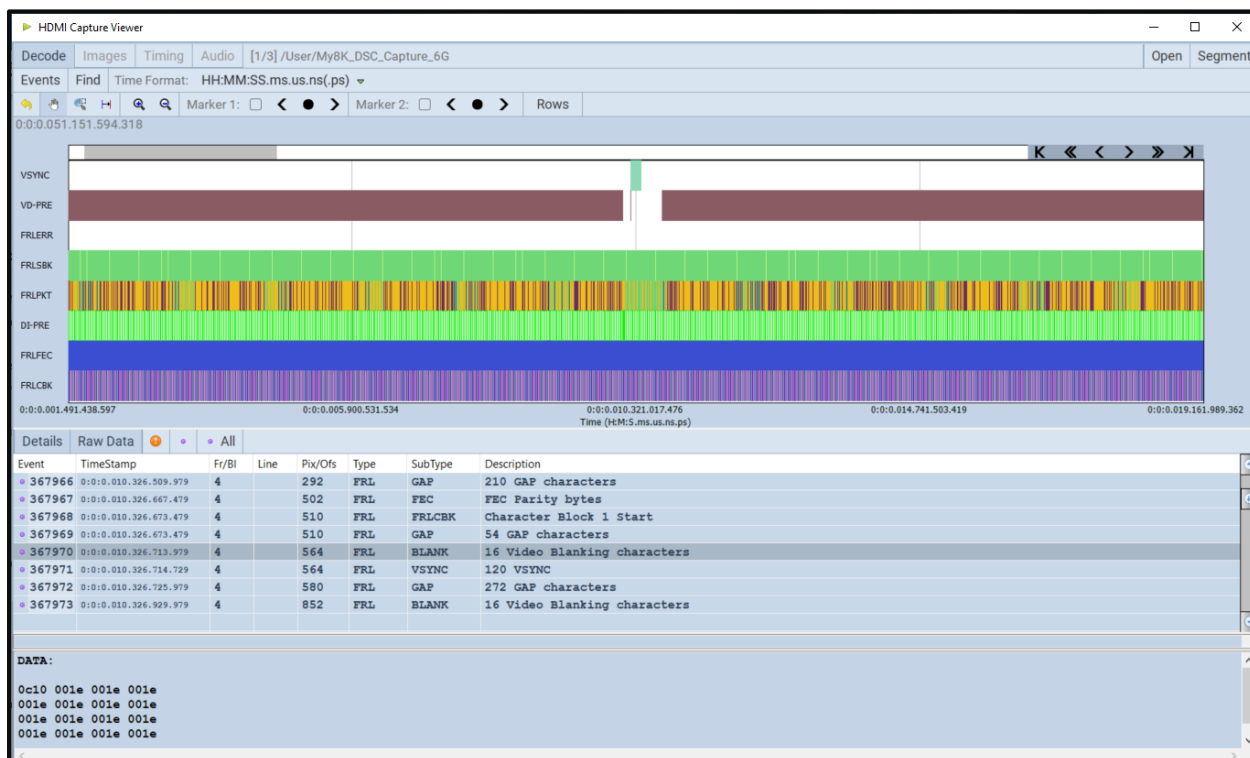
You can view the data of an FRL Display Stream Compression (DSC) stream through the Capture Viewer. You can view these FRL/DSC captures under in the Navigator as shown below.



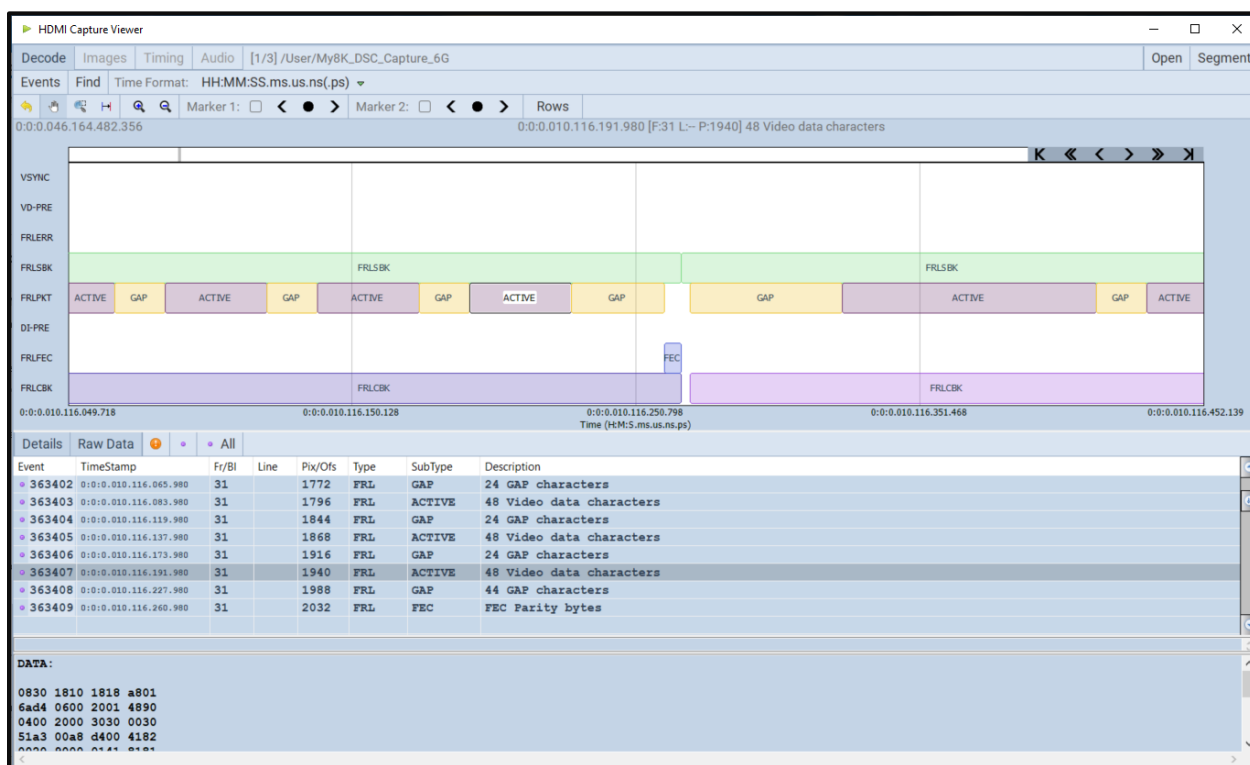
To capture an incoming Display Stream Compression (DSC) stream you must capture in the FRL mode as shown below.



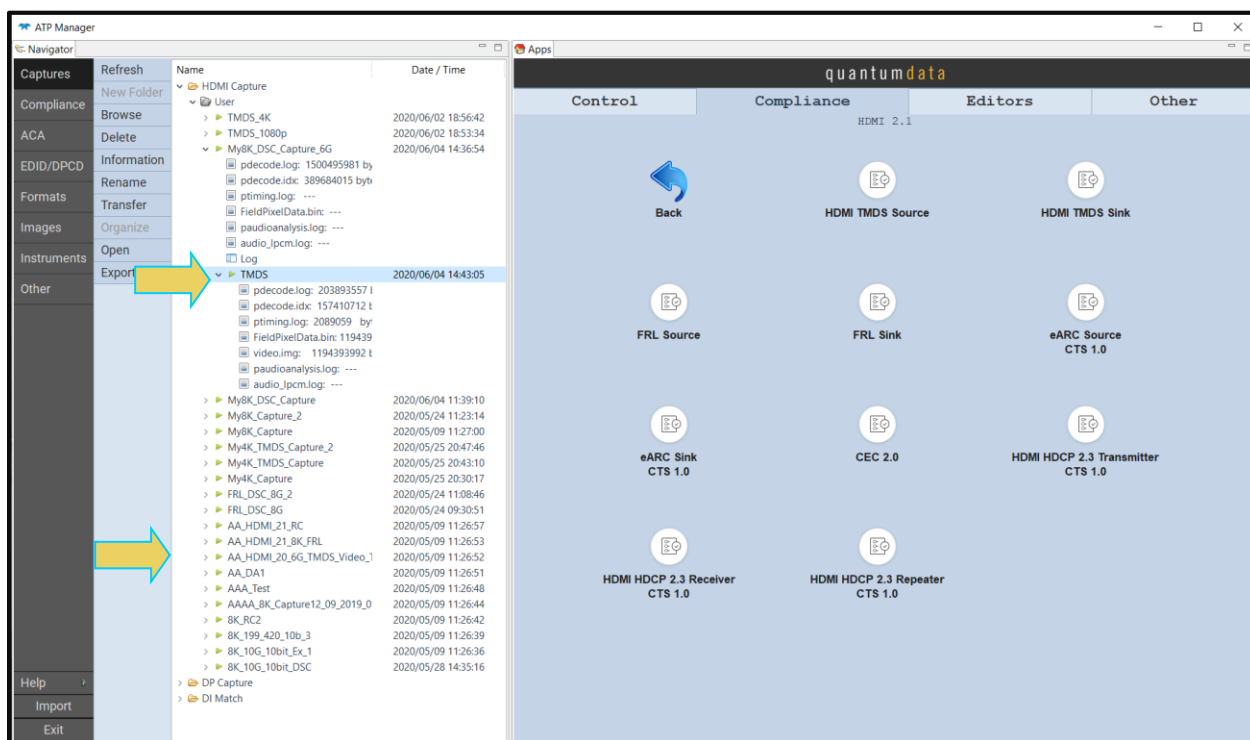
Hit the **Start Capture** button to initiate the capture. When the capture is ready it will appear in the **Capture Viewer**.



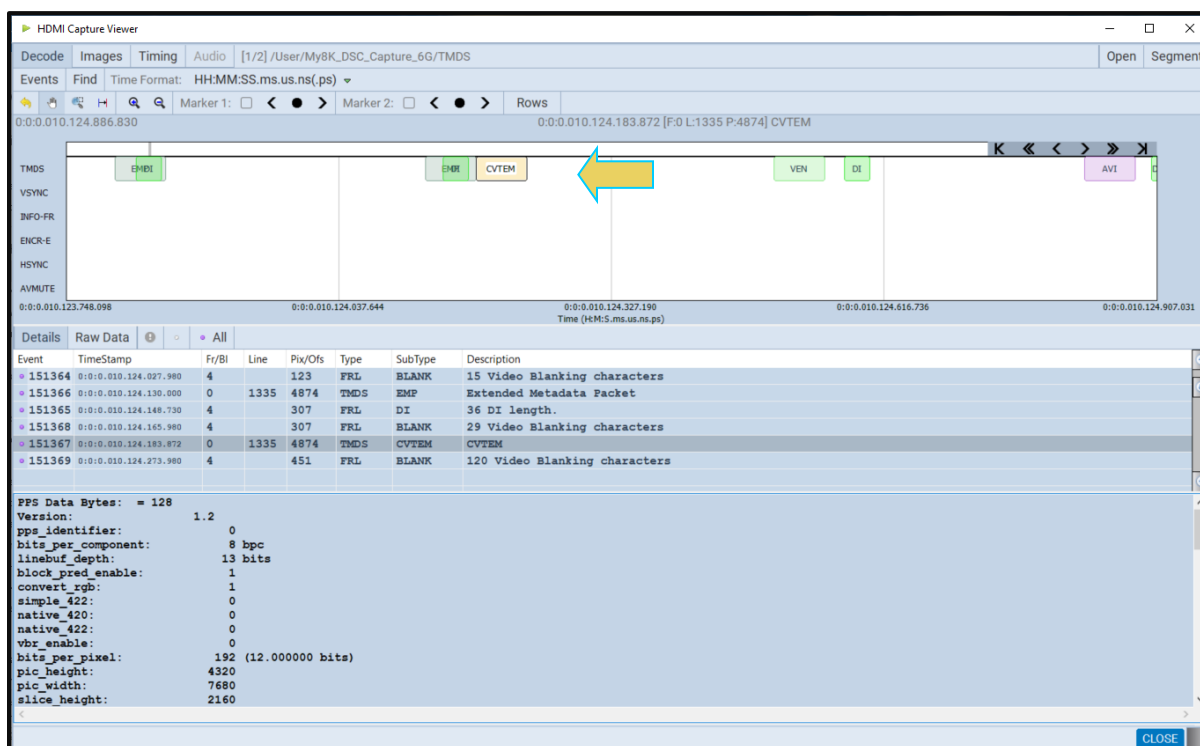
The following is a zoomed in view of the capture.



You can view the underlying Tri-Byte data which is indicated as “TMDS” in the example below.



You can view the Compressed Video Transport extended metadata (CVTEM) packet in the TMDs capture as shown below. The CVTEM shows the DSC Picture Parameter Set (PPS) data that is used to indicate the DSC parameters to a DSC-capable sink device.



7.7 Examining HDMI 2.1 FRL Captured Data

The procedures below describe how to view various types of captured data through the **Decode** and **Event Plot** panels. This procedure assumes that you have captured the data or have opened a previously captured data file.

7.7.1 Viewing Data Analysis Captures through the Decode panel

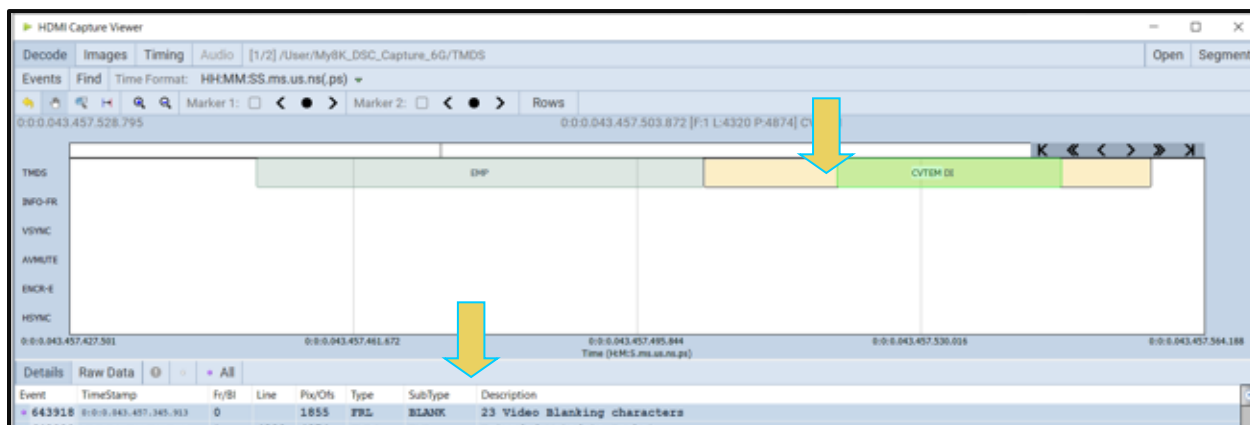
This subsection provides procedures for viewing the captured data taken using one of the Data Analysis capture modes through the **Decode** panel in the ATP Manager.

To view captured data through the Decode panel:

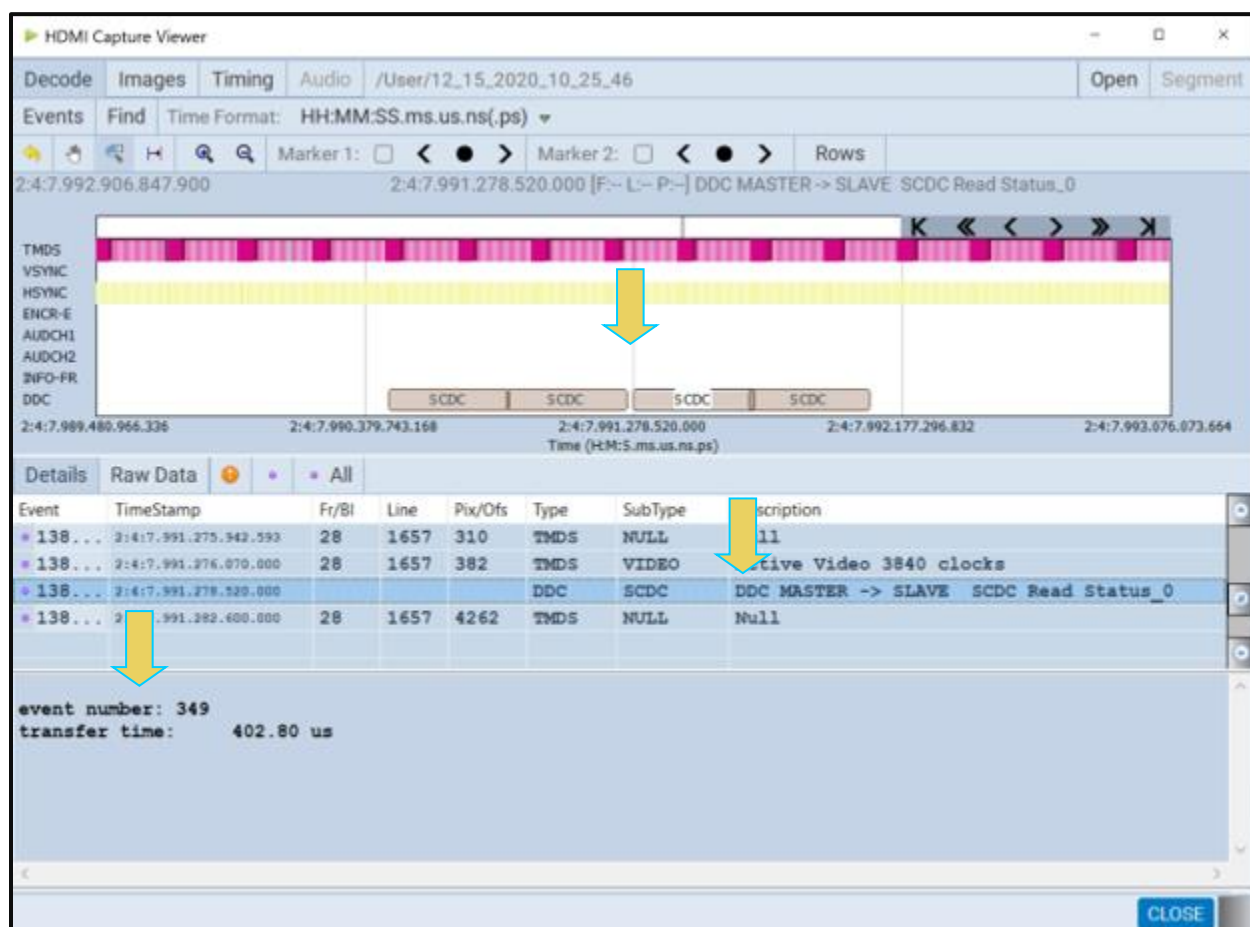
1. To view the protocol data transactions on the **Decode** panel, activate the **Decode** tab.

The **Decode** window shows the protocol data in a report. Highlight an AVI InfoFrame record to view its contents as shown below. The **Decode** window above shows the AVI InfoFrame data record selected. The AVI InfoFrame contents are parsed out in human readable text on the upper panel. The hex representation of the contents is presented in the lower panel.

Note: In the screen capture below the 4-lane data is depicted in columns under DATA in the Raw Data window. This is indicated below.



31. Highlight a SCDC transaction to view its contents as shown below. The example below shows a register read.

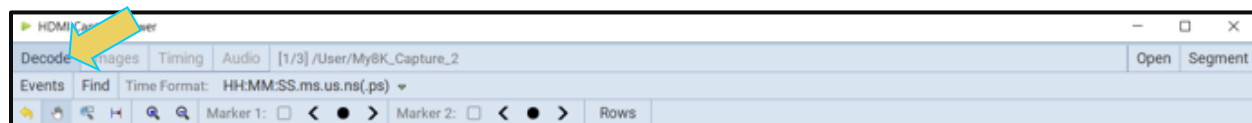


7.7.2 Filtering the Data in the Decode panel

The procedures below describe how to filter the data in the **Decode** panel. You use the panel on the right that is adjacent to the **Decode** panel to apply filtering on the data displayed on the **Decode** panel.

To apply filters to the data:

1. From the **Decode** panel, select the Events activation button to access the Decode Event Selection dialog box.



The **Decode Event Selection** dialog box is shown below.

In the example below, only some of the data islands are selected.

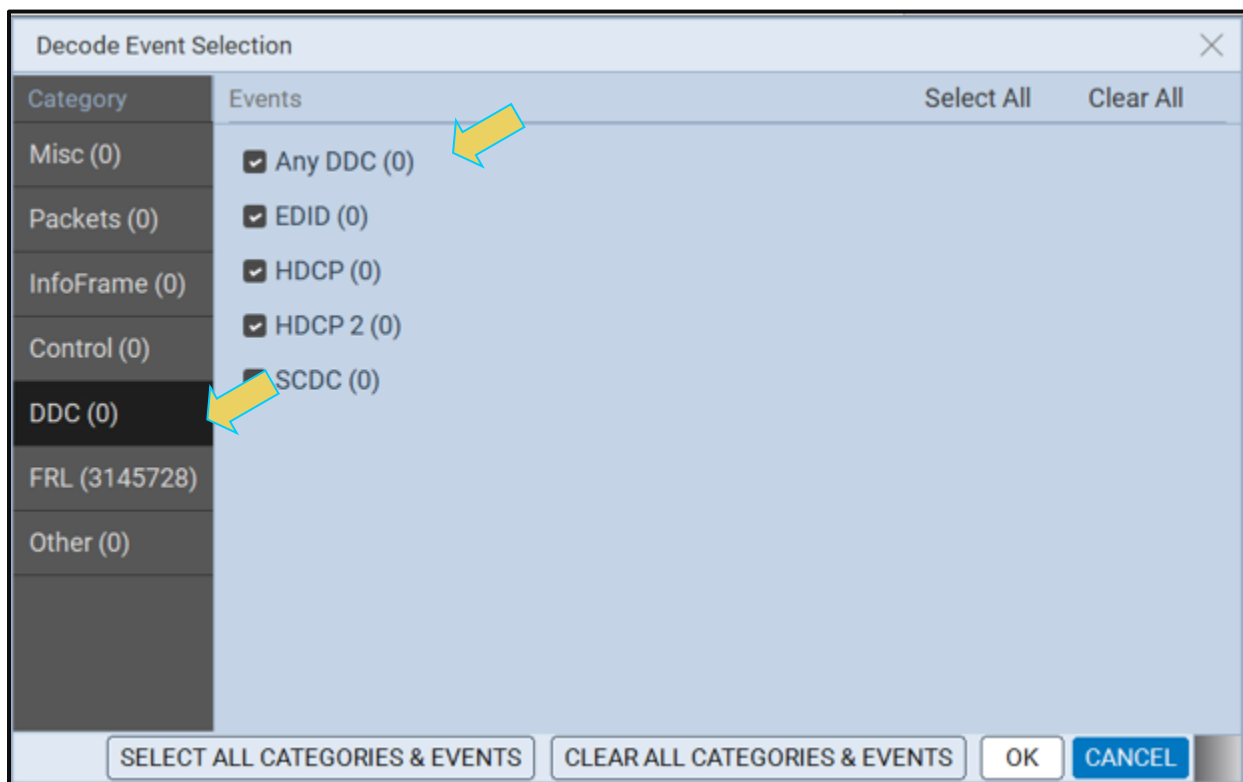


Decode Event Selection

Category	Events	Select All	Clear All
Misc (0)	<input checked="" type="checkbox"/> Link Rate (1)	<input checked="" type="checkbox"/> H-Sync (0)	
Packets (0)	<input checked="" type="checkbox"/> Super Block (38376)	<input checked="" type="checkbox"/> V-Sync (871)	
InfoFrame (0)	<input checked="" type="checkbox"/> Character Block (153504)	<input checked="" type="checkbox"/> Encryption Enable (0)	
Control (0)	<input checked="" type="checkbox"/> Gap (1436286)	<input checked="" type="checkbox"/> Video Preamble (7610)	
DDC (0)	<input checked="" type="checkbox"/> Active (1330966)	<input checked="" type="checkbox"/> Video Guard Band (7606)	
	<input checked="" type="checkbox"/> Blank (11129)	<input checked="" type="checkbox"/> Data Island (1469)	
FRL (3145728)	<input checked="" type="checkbox"/> FEC Parity (153503)	<input checked="" type="checkbox"/> DI Preamble (1469)	
Other (0)	<input checked="" type="checkbox"/> FEC Error (0)	<input checked="" type="checkbox"/> DI Leading GB (1469)	
	<input checked="" type="checkbox"/> Error (0)	<input checked="" type="checkbox"/> DI Trailing GB (1469)	

SELECT ALL CATEGORIES & EVENTS CLEAR ALL CATEGORIES & EVENTS OK CANCEL

The following is a screen example of the **DDC** page.


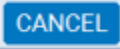


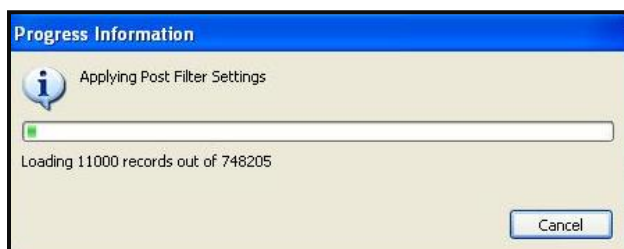
Decode Event Selection

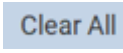
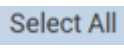
Category	Events	Select All	Clear All
Misc (0)	<input checked="" type="checkbox"/> Any DDC (0)		
Packets (0)	<input checked="" type="checkbox"/> EDID (0)		
InfoFrame (0)	<input checked="" type="checkbox"/> HDCP (0)		
Control (0)	<input checked="" type="checkbox"/> HDCP 2 (0)		
DDC (0)	<input checked="" type="checkbox"/> SCDC (0)		
FRL (3145728)			
Other (0)			

SELECT ALL CATEGORIES & EVENTS CLEAR ALL CATEGORIES & EVENTS OK CANCEL

32. Select the data items you want to appear in the **Decode** panel. The filtering you apply in this series of dialog boxes also applies to the **Event Plot** panel.

33. Click the **OK**  button on the bottom right to set your selections or click on the **Cancel**  button to exit without saving the changes.



Note that you can clear all the selections on all pages with the Clear All  activation button on the top left. You can also select all items on all pages with the Select All  activation button.

You can also apply the same Select and Clear operations to each tab of the **Decode Event Selection** dialog box.

7.7.3 Searching Through the Data in the Decode Panel

The procedures below describe how to search through the data in the **Decode** panel.

To search through the data:

1. Click on Find. 

You can search on a variety of packet types and some of the fields in the **Decode** panel such as Packet, Timestamp, Frame, Line, and Pixel. You can also search for a variety of control events such as the occurrence of Avmute in an ACR packet or a Vsync/Hsync.

The default is to search Forward which is a search for events that occur later in time. You can change that to search backward by selecting the associated radio button.

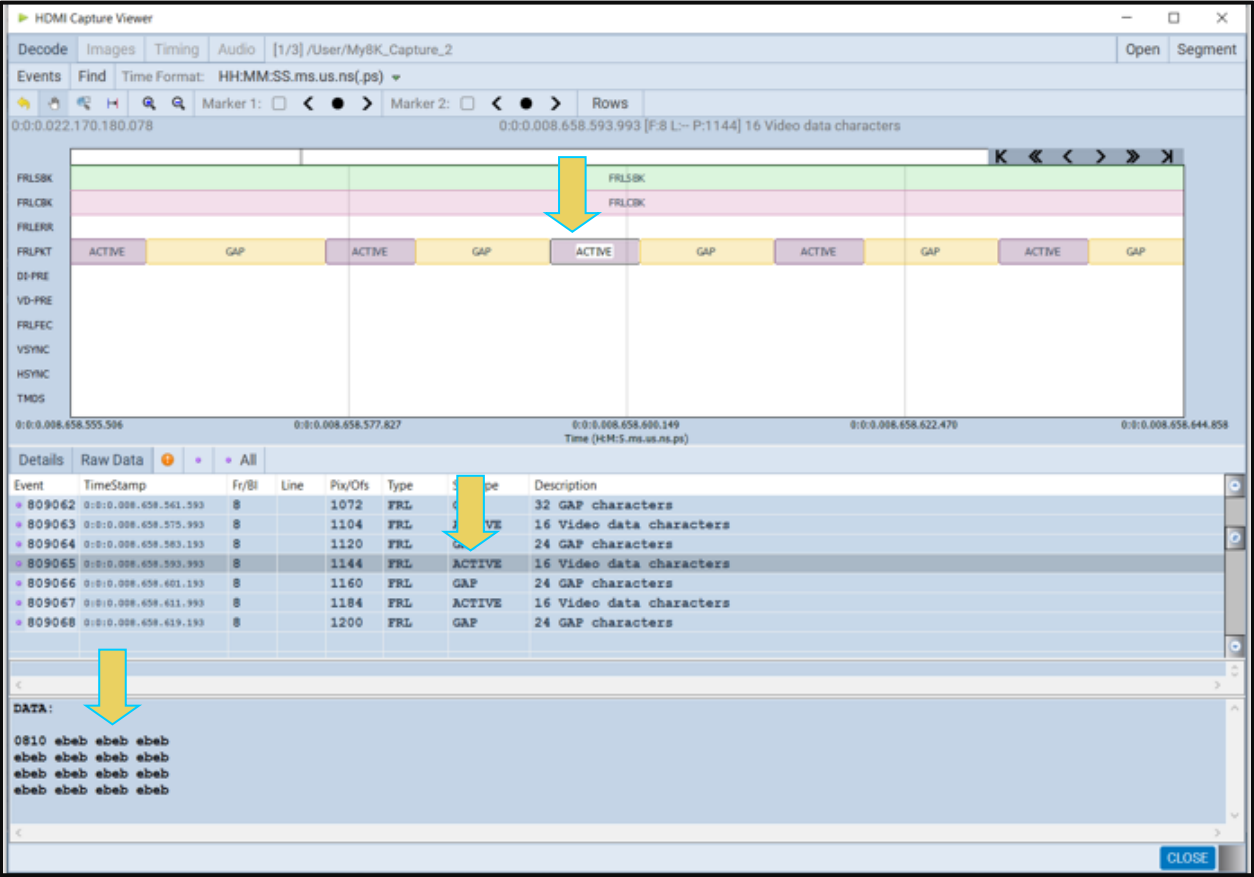
A dialog box appears that enables you to enter search criteria. In this example we will search for an Audio Clock Regeneration packet. The **Decode** panel will then show the next General Control Packet (GCP) packet. If you are searching for a specific packet number, timestamp or frame you will have to enter the value in the Find/Goto field.

The screenshot displays the HDMI Capture Viewer application. The top menu bar includes 'Decode', 'Images', 'Timing', and 'Audio'. The 'Timing' tab is selected, showing a timeline with various video signals: FRLSBK, FRLCBK, TMDS, FRLPKT, FRLERR, DE-PRE, FRLFEC, VDPRE, VSYNC, and HSYNC. A search bar at the top right contains the text 'Find'. A yellow arrow points to the search bar. Below the timeline, a table lists events with columns: Event, TimeStamp, Fr/Bi, Line, Pix/Ofs, Type, SubType, and Description. A yellow arrow points to the 'SubType' column. A 'Find Event' dialog box is open, showing a list of fields and sub-types. A yellow arrow points to the 'Active' sub-type under the 'Link Rate' field. The 'Find Event' dialog box also has buttons for 'FIND NEXT', 'FIND PREVIOUS', and 'CLOSE'.

Event	TimeStamp	Fr/Bi	Line	Pix/Ofs	Type	SubType	Description
299	0:0:0.000.002.105.250	2		1522	FRL	FEC	FEC Parity bytes
300	0:0:0.000.002.108.250	2		1530	FRL	FRLCBK	Character Block 3 st
301	0:0:0.000.002.108.250	2		1530	FRL	GAP	502 GAP characters
302	0:0:0.000.002.294.500	2		2032	FRL	FEC	FEC Parity bytes
303	0:0:0.000.002.299.500	3		0	FRL	FRLSBK	Super Block 2044 cha
304	0:0:0.000.002.301.000	3		0	FRL	FRLCBK	Character Block 0 st
305	0:0:0.000.002.301.000	3		0	FRL	BLANK	24 Video Blanking ch
306	0:0:0.000.002.309.625	3		0	FRL	VDPREAM	8 VIDEO Preamble ctl
307	0:0:0.000.002.310.000	3		24	FRL	GAP	4 GAP characters
309	0:0:0.000.002.311.500	3		28	FRL	ACTIVE	33 Video data charac
308	0:0:0.000.002.311.875	3		28	FRL	GB	Video Guard Band.
310	0:0:0.000.002.323.875	3		61	FRL	GAP	4 GAP characters
311	0:0:0.000.002.325.375	3		65	FRL	ACTIVE	33 Video data charac
312	0:0:0.000.002.337.750	3		98	FRL	GAP	4 GAP characters
313	0:0:0.000.002.339.250	3		102	FRL	ACTIVE	33 Video data charac

This example shows a search for Active video.

Note: In the screen capture below the 4-lane data is depicted in columns under DATA in the Raw Data window. This is indicated below.

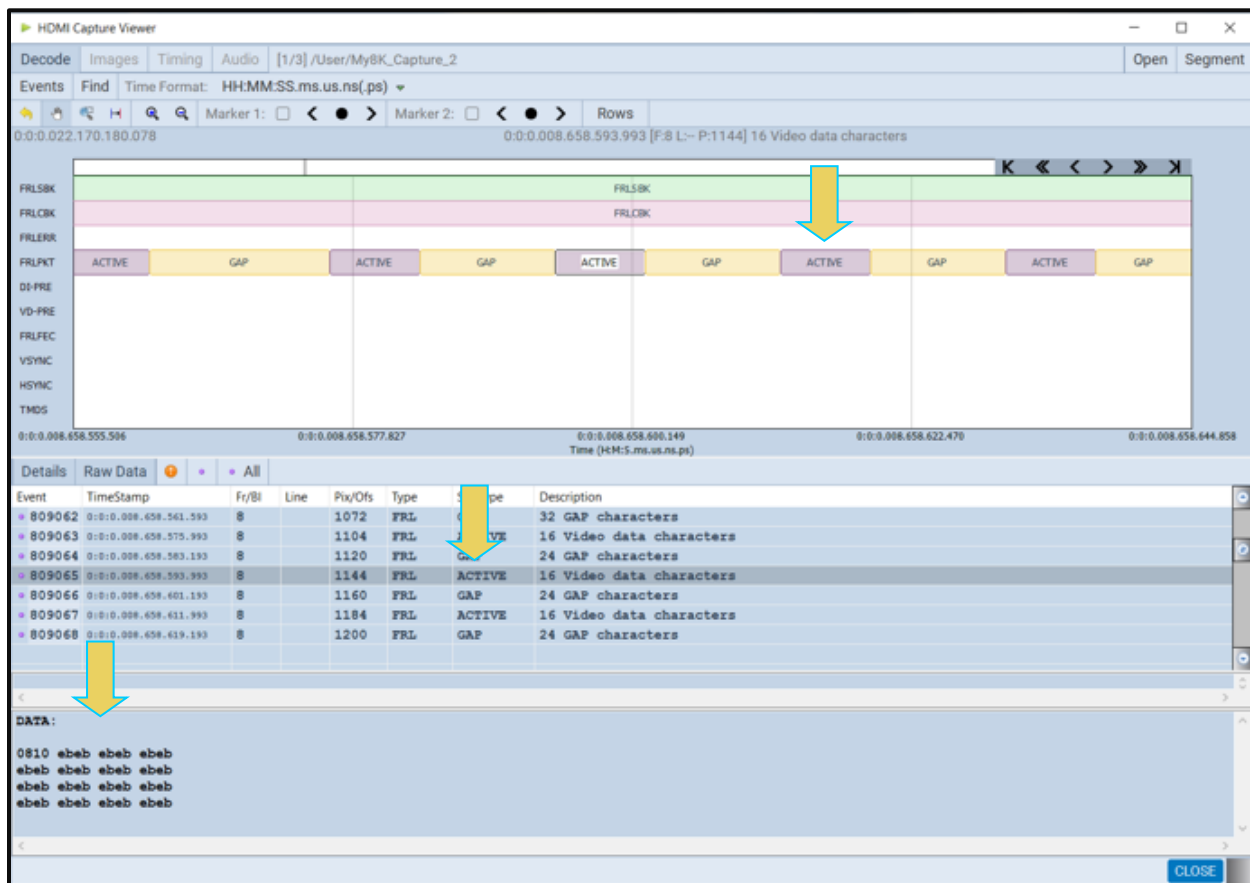


7.7.4 Viewing Data Through the Event Plot Panel

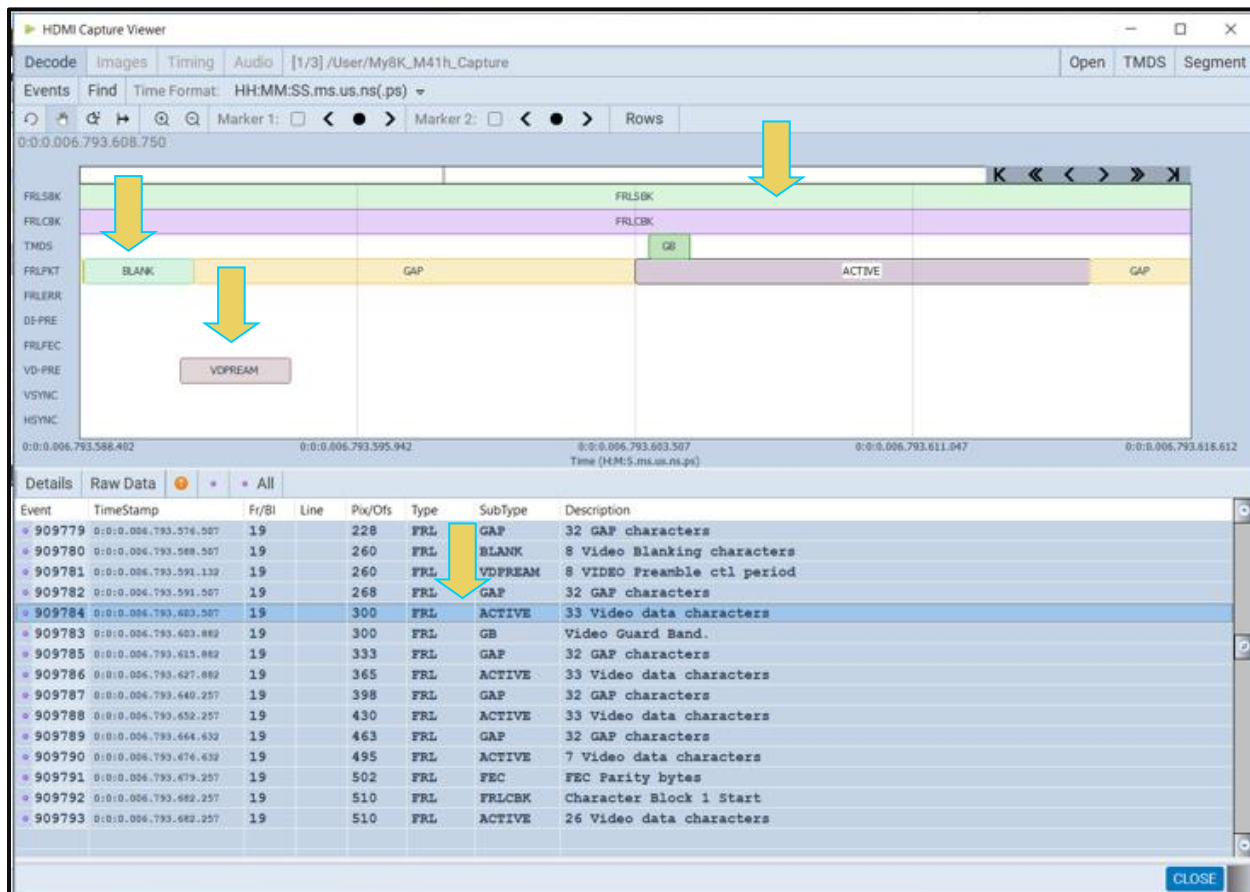
The Event Plot panel provides you with a graphical view of the data. It enables you to see relationships between the various data types on a timeline. A sample screen of the **Event Plot** is shown below. The operation of the **Event Plot** is described at: [Event Plot Panel](#).

The following example shows active video, video guard band, FRL packets and the FEC block packet.

Note: In the screen capture below the 4-lane data is depicted in columns under DATA in the Raw Data window. This is indicated below.

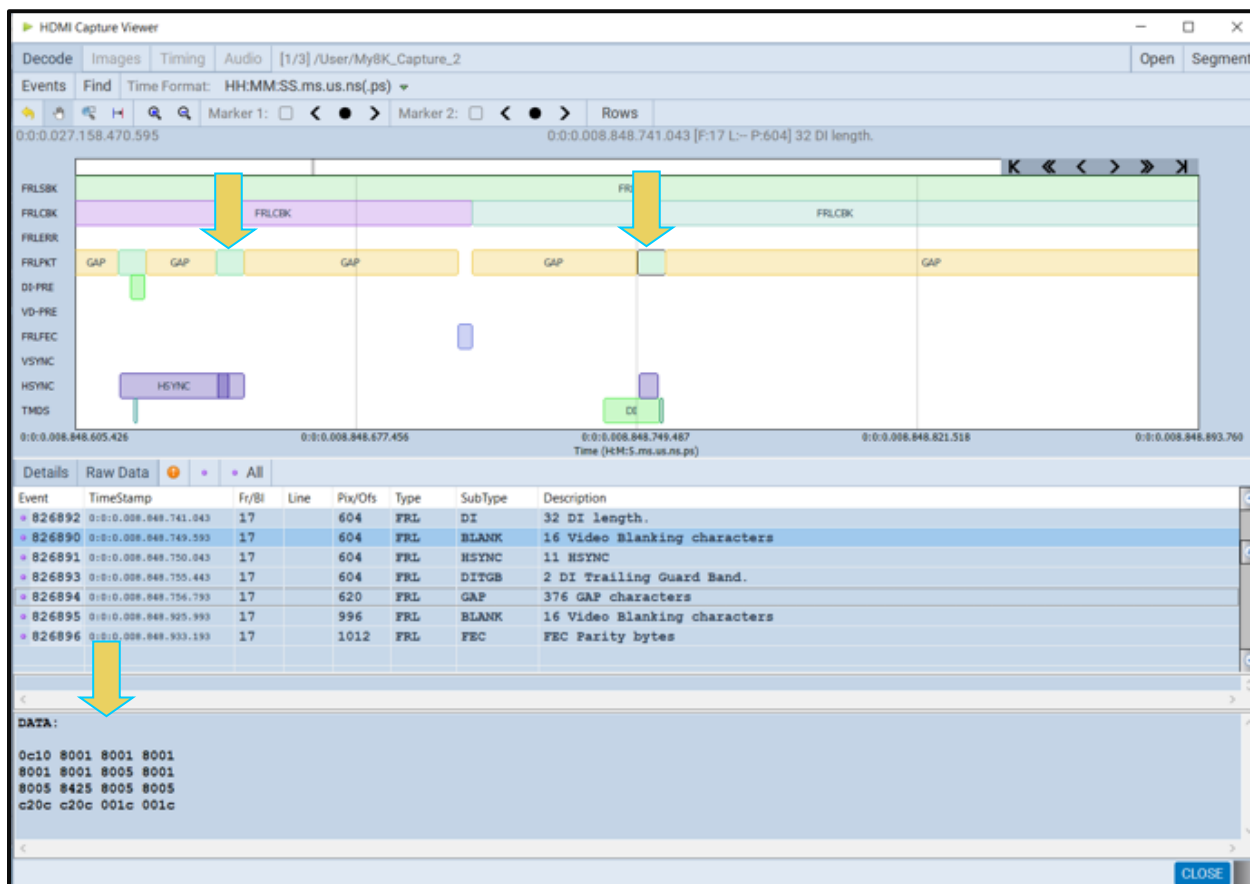


The following example shows a blanking period with the video preamble, data island preamble, data island guard band, etc.



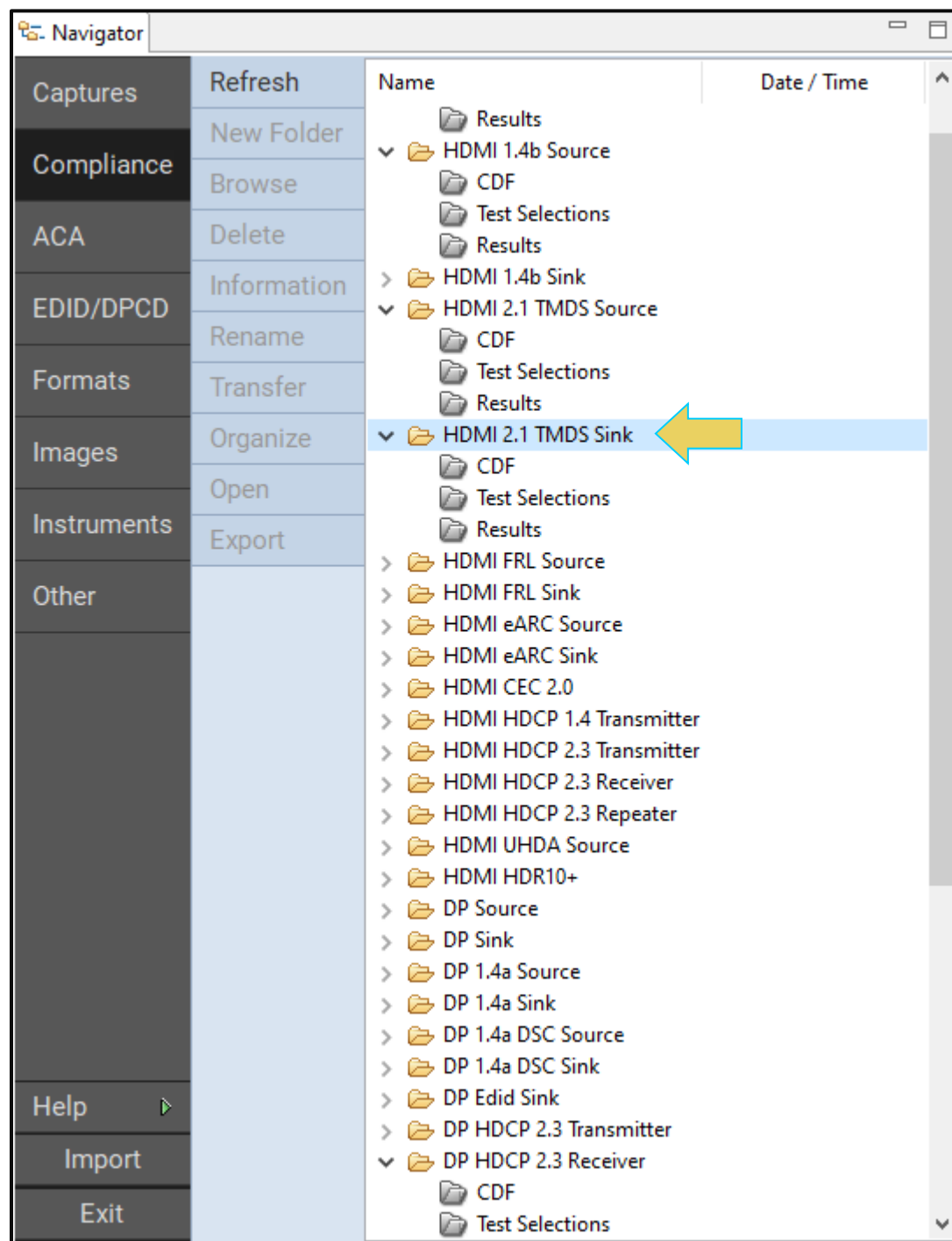
The following example shows a couple of blanking periods, vsync and hsync elements and the FRL packet structure.

Note: In the screen capture below the 4-lane data is depicted in columns under DATA in the Raw Data window. This is indicated below.

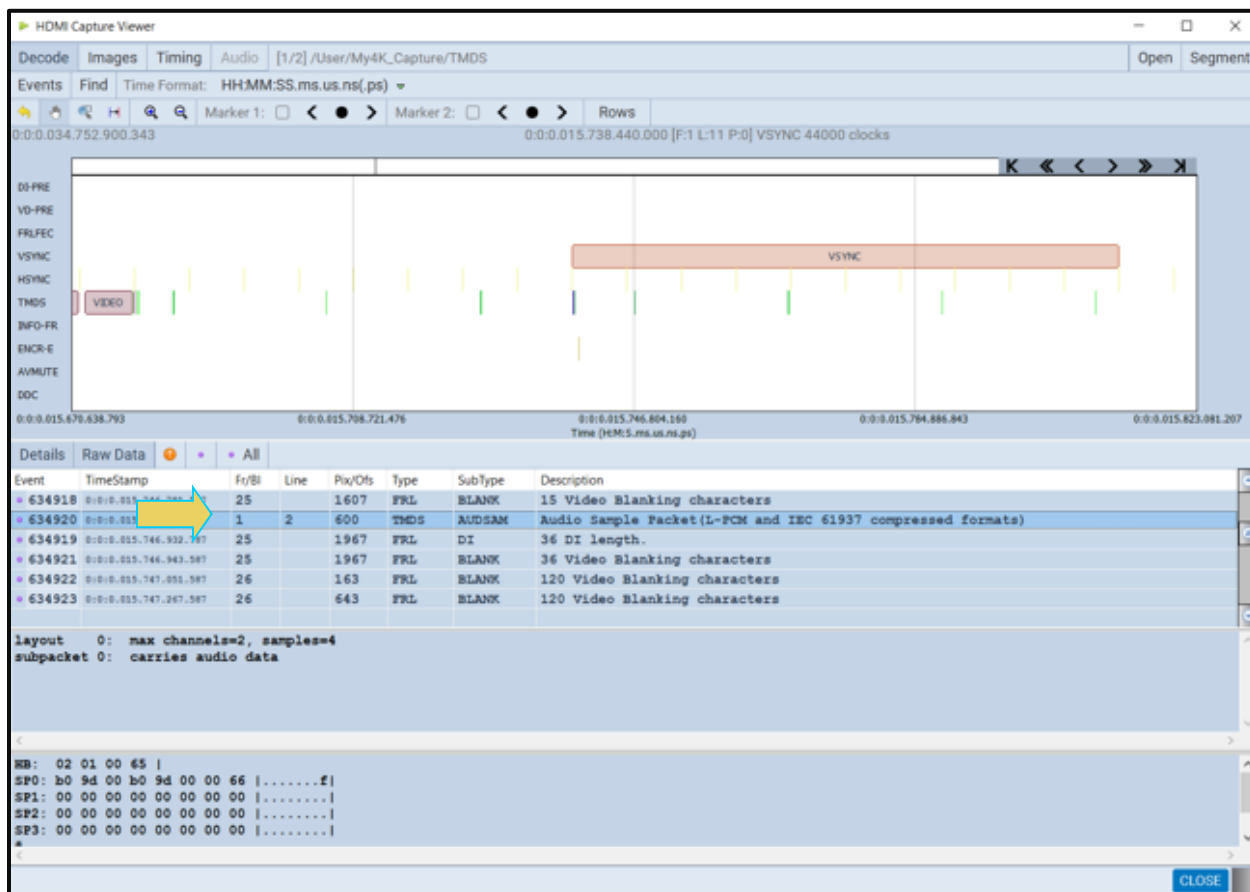


7.7.5 Viewing the Embedded TMDS Capture

You can view the underlying TMDS capture of an FRL capture. You can view these TMDS captures under in the Navigator as shown below.



1. Double-click on the embedded TMDS capture to view the TMDS capture as shown below.



7.8 Examining TMDS Captured Data

The procedures below describe how to view various types of TMDS captured data through the **Decode** and **Event Plot** panels. This procedure assumes that you have captured the data or have opened a previously captured data file.

7.8.1 Viewing Data Analysis Captures Through the Decode panel

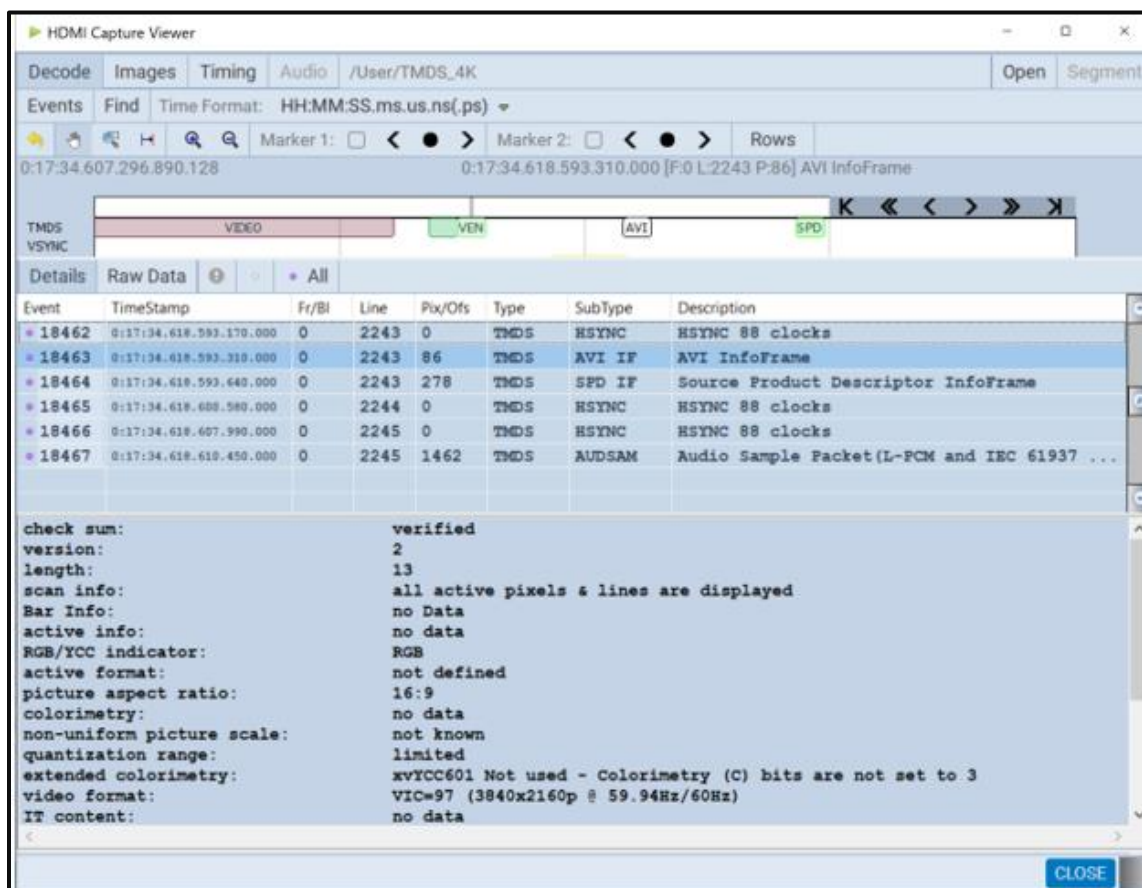
This subsection provides procedures for viewing the captured data taken using one of the Data Analysis capture modes through the **Decode** panel in the ATP Manager.

To view captured data through the Decode panel:

1. To view the protocol data transactions on the **Decode** panel, activate the **Decode** tab.

The **Decode** window shows the protocol data in a report.

34. Highlight an AVI InfoFrame record to view its contents as shown below. The **Decode** window above shows the AVI InfoFrame data record selected. The AVI InfoFrame contents are parsed out in human readable text on the upper panel. The hex representation of the contents is presented in the lower panel.



35. Highlight a Vendor Specific InfoFrame record to view its contents. The example below shows a Vendor Specific InfoFrame where the HDMI source is transmitting 3D content in Frame Packing.

The screenshot shows the HDMI Capture Viewer application. The top menu bar includes Decode, Images, Timing, Audio, and /User/TMDS_4K. The Events panel shows a list of events with columns for Event, TimeStamp, Fr/Bt, Line, Pix/Ofs, Type, SubType, and Description. The event 18461 is highlighted, which is a Vendor-Specific InfoFrame (Type: TMDS, SubType: VEN). A yellow arrow points to this event. Below the event list, the details for the selected event are displayed, showing a check sum: verified, 24bit IEEE Registration ID: HDMI LLC OUI [0x000c03], HDMI Video Format: no additional HDMI video format is present, and length of HDMI VS infoframe: 5. A yellow arrow points to the 'verified' status. The bottom right corner has a CLOSE button.

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
18458	0:17:34.618.585.760.000	0	2242	0	TMDS	HSYNC	HSYNC 88 clocks
18459	0:17:34.618.586.410.000	0	2242	382	TMDS	VIDEO	Active Video 3840 clocks
18460	0:17:34.618.592.940.000	0	2242	4262	TMDS	AUDS	Audio Sample Packet (L-PCM and IEC 61937 ...
18461	0:17:34.618.592.993.872	0	2242	4294	TMDS	VEN	Vendor-Specific InfoFrame
18462	0:17:34.618.593.170.000	0	2243	0	TMDS	HSYNC	HSYNC 88 clocks
18463	0:17:34.618.593.310.000	0	2243	86	TMDS	AVI IF	AVI InfoFrame
18464	0:17:34.618.593.640.000	0	2243	278	TMDS	SPD IF	Source Product Descriptor InfoFrame
18465	0:17:34.618.600.560.000	0	2244	0	TMDS	HSYNC	HSYNC 88 clocks
18466	0:17:34.618.607.990.000	0	2245	0	TMDS	HSYNC	HSYNC 88 clocks
18467	0:17:34.618.610.450.000	0	2245	1462	TMDS	AUDSAM	Audio Sample Packet (L-PCM and IEC 61937 ...

check sum: verified
 24bit IEEE Registration ID: HDMI LLC OUI [0x000c03]
 HDMI Video Format: no additional HDMI video format is present
 length of HDMI VS infoframe: 5

36. Highlight a General Control Packet record to view its contents as shown below.

The screenshot displays the HDMI Capture Viewer application. The top menu bar includes Decode, Images, Timing, and Audio. The main window shows a timeline of HDMI events. A yellow arrow points to the event 10492, which is a General Control Packet (GCP). The event list table below the timeline provides details for each event.

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
10489	0:7:56.107.066.690.000	1	2250	0	TMDS	HSYNC	HSYNC clocks
10490	0:7:56.107.074.100.000	2	1	0	TMDS	VSYNC	VSYNC 00 clocks
10491	0:7:56.107.074.100.000	2	1	0	TMDS	HSYNC	HSYNC clocks
10492	0:7:56.107.074.630.000	2	1	317	TMDS	GCP	General Control Packet (GCP)
10496	0:7:56.107.074.640.000	2	1	320	TMDS	SSCP	SSCP 8 clocks
10493	0:7:56.107.074.940.000	2	1	512	TMDS	ENCR-EN	ENC_EN pulse 16 clocks

Below the event list, the following fields are displayed:

- clear AVMUTE flag: 0
- set AVMUTE flag: 0
- color depth: color depth not indicated
- pixel packing phase: Phase not indicated

The bottom section shows the raw data in hexadecimal and ASCII format:

```
HB: 03 00 00 de |
SP0: 00 00 00 00 00 00 00 00 | .....|
SP1: 00 00 00 00 00 00 00 00 | .....|
SP2: 00 00 00 00 00 00 00 00 | .....|
SP3: 00 00 00 00 00 00 00 00 | .....|
#
```

37. Highlight an audio InfoFrame record to view its contents as shown below.

The screenshot displays the HDMI Capture Viewer application. The top menu bar includes Decode, Images, Timing, Audio, and a file path. The main window shows a timeline with various video signals (TMDs, VSYNC, HSYNC, ENCR-E, DDC) and a list of events. The event list is filtered to show 'All' records. The 'Audio InfoFrame' record (Event 5265) is highlighted. Below the event list, the details of the selected record are shown, including a check sum, coding type, channel count, sampling frequency, sample size, channel speaker alloc, level shift value, LFE playback level, and down mixed stereo out. The raw data is also displayed at the bottom.

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
5260	0:7:56.090.459.130.000	1	8	0	TMDs	HSYNC	HSYNC 88 clocks
5261	0:7:56.090.459.920.000	1	8	471	TMDs	VEN	Vendor-Specific InfoFrame
5262	0:7:56.090.460.030.000	1	8	535	TMDs	AVI IF	Audio InfoFrame
5263	0:7:56.090.466.540.000	1	9	0	TMDs	HSYNC	HSYNC 88 clocks
5264	0:7:56.090.467.330.000	1	9	471	TMDs	SPD IF	Product Descriptor InfoFrame
5265	0:7:56.090.467.440.000	1	9	535	TMDs	AUD IF	Audio InfoFrame
5266	0:7:56.090.473.940.000	1	10	0	TMDs	HSYNC	HSYNC 88 clocks

check sum: verified
coding type: refer to Stream Header
channel count: 2ch
sampling frequency: refer to stream header
sample size: refer to stream header
channel speaker alloc: [- - - - - FR FL]
level shift value: 0dB
LFE playback level: no information
down mixed stereo out: permitted

Raw Data:
HB: 84 01 0a 4a |
SP0: 70 01 00 00 00 00 00 7d |p.....|
SP1: 00 00 00 00 00 00 00 00 |.....|
SP2: 00 00 00 00 00 00 00 00 |.....|
SP3: 00 00 00 00 00 00 00 00 |.....|

38. Highlight an Audio Clock Regeneration packet record to view its contents as shown below.

The screenshot displays the HDMI Capture Viewer application. The top menu bar includes Decode, Images, Timing, and Audio. The main window shows a timeline with various signal types: VIDEO, ACR, and HSYNC. Below the timeline, a table lists events. Event 2376 is highlighted, showing it is an Audio Clock Regeneration Packet (ACR) at timestamp 0:7:56.081.406.990.000. The bottom section shows the raw data for the selected event, including the packet structure and timing information.

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
2371	0:7:56.081.392.170.000	0	1033	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2372	0:7:56.081.392.306.000	0	1034	0	TMDS	HSYNC	HSYNC 88 clocks
2373	0:7:56.081.393.020.000	0	1034	382	TMDS	VIDEO	Active Video 3840 clocks
2374	0:7:56.081.399.700.000	0	1035	0	TMDS	HSYNC	HSYNC 88 clocks
2375	0:7:56.081.400.430.000	0	1035	382	TMDS	VIDEO	Active Video 3840 clocks
2376	0:7:56.081.406.990.000	0	1035	4280	TMDS	ACR	Audio Clock Regeneration Packet
2377	0:7:56.081.407.190.000	0	1036	0	TMDS	HSYNC	HSYNC 88 clocks
2378	0:7:56.081.407.830.000	0	1036	382	TMDS	VIDEO	Active Video 3840 clocks
2379	0:7:56.081.414.400.000	0	1036	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2380	0:7:56.081.414.600.000	0	1037	0	TMDS	HSYNC	HSYNC 88 clocks

audio clock regeneration: N = 6144, Cycle Time Stamp (CTS) = 593996
audio clock freq: 48.000kHz

HB: 01 00 00 4a |
SP0: 00 09 10 4c 00 18 00 93 |...L....|
SP1: 00 09 10 4c 00 18 00 93 |...L....|
SP2: 00 09 10 4c 00 18 00 93 |...L....|
SP3: 00 09 10 4c 00 18 00 93 |...L....|

39. Highlight an audio sample packet record to view its contents as shown below. The number of channels and samples provided as well as the content of the samples is shown in the lower panel.

The screenshot displays the HDMI Capture Viewer application. The top menu bar includes Decode, Images, Timing, Audio, and a file path. The main window shows a timeline with various video and audio signals. A yellow arrow points to the event list table, specifically to the row for event 2072, which is an Audio Sample Packet (AUDSAM).

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
2071	0:7:56.080.452.270.000	0	907	382	TMDS	VIDEO	Active Video 3840 clocks
2072	0:7:56.080.458.830.000	0	907	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2073	0:7:56.080.458.830.000	0	907	4316	TMDS	CSB	Channel Status Block (IEC 60958 first sub-frame) (starts @ 0:367:4316:4760...
2074	0:7:56.080.458.830.000	0	907	4316	TMDS	CSB	Channel Status Block (IEC 60958 second sub-frame) (starts @ 0:367:4316:476...
2075	0:7:56.080.459.030.000	0	908	0	TMDS	HSYNC	HSYNC 88 clocks
2076	0:7:56.080.459.080.000	0	908	382	TMDS	VIDEO	Active Video 3840 clocks
2077	0:7:56.080.466.440.000	0	909	0	TMDS	HSYNC	HSYNC 88 clocks
2078	0:7:56.080.467.080.000	0	909	0	TMDS	VIDEO	Active Video 3840 clocks
2079	0:7:56.080.473.850.000	0	910	0	TMDS	HSYNC	HSYNC 88 clocks
2080	0:7:56.080.474.490.000	0	910	0	TMDS	VIDEO	Active Video 3840 clocks

Below the table, the layout and subpacket details are shown:

layout 0: max channels=2, samples=4
subpacket 0: carries audio data, contains first frame in a channel status block

The bottom panel displays the raw data in hexadecimal and ASCII format:

```
HB: 02 01 10 d6 |
SP0: 00 50 ff 00 50 ff 00 d2 |.P..P...|
SP1: 00 00 00 00 00 00 00 00 |.....|
SP2: 00 00 00 00 00 00 00 00 |.....|
SP3: 00 00 00 00 00 00 00 00 |.....|
```

40. Highlight an audio sample packet channel status block record to view its contents as shown below.

The channel status block is shown in the detailed data window when it is fully acquired, i.e. after the 192 frames are all captured. There are two blocks, one for each subframe A and B. The first subframe (A) corresponds to the Left channel and the second subframe (B) corresponds to the Right channel.

You can determine when the channel status bits begin to be acquired by looking at the top section of the Details panel (not shown below).

The screenshot displays the HDMI Capture Viewer interface. The top section shows a timeline with various packets. A yellow arrow points to the 'Audio Sample Packet' record in the event list. The bottom section shows the raw data for the selected packet, including the channel status block.

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	SubType	Description
2071	0:7:56.080.452.270.000	0	907	382	TMDS	VIDEO	Active Video 3840 clocks
2072	0:7:56.080.458.830.000	0	907	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2073	0:7:56.080.458.830.000	0	907	4316	TMDS	CSB	Channel Status Block (IEC 60958 first sub-frame) (starts @ 0:367:4316:4760...
2074	0:7:56.080.458.830.000	0	907	4316	TMDS	CSB	Channel Status Block (IEC 60958 second sub-frame) (starts @ 0:367:4316:4760...
2075	0:7:56.080.459.030.000	0	908	0	TMDS	HSYNC	HSYNC 88 clocks
2076	0:7:56.080.459.030.000	0	908	382	TMDS	VIDEO	Active Video 3840 clocks
2077	0:7:56.080.466.440.000	0	909	0	TMDS	HSYNC	HSYNC 88 clocks
2078	0:7:56.080.467.080.000	0	909	382	TMDS	VIDEO	Active Video 3840 clocks
2079	0:7:56.080.473.850.000	0	910	0	TMDS	HSYNC	HSYNC 88 clocks
2080	0:7:56.080.474.490.000	0	910	382	TMDS	VIDEO	Active Video 3840 clocks

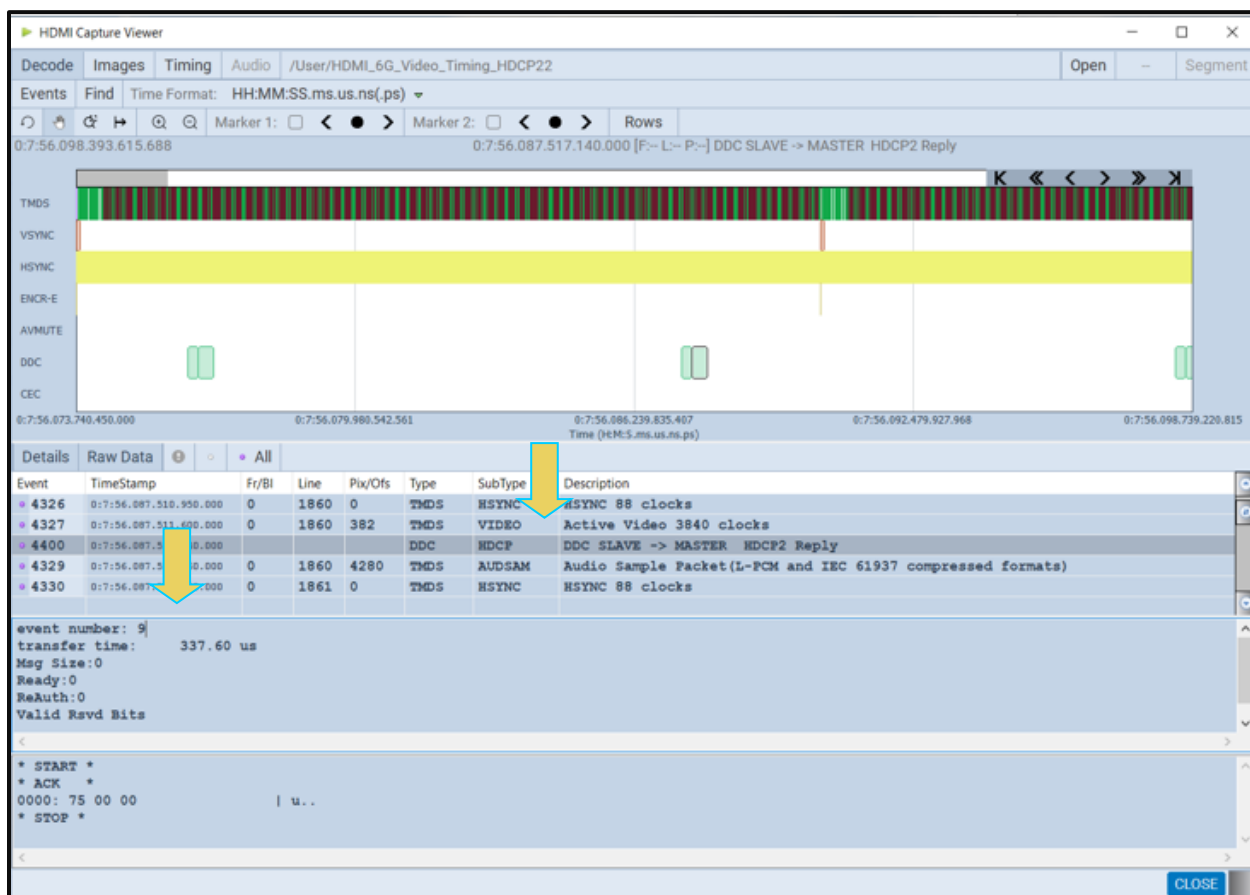
layout 0: max channels=2, samples=4
subpacket 0: carries audio data, contains first frame in a channel status block

```

NB: 02 01 10 d6 |
SP0: 00 50 ff 00 50 ff 00 d2 | .P..P...|
SP1: 00 00 00 00 00 00 00 00 | .....|
SP2: 00 00 00 00 00 00 00 00 | .....|
SP3: 00 00 00 00 00 00 00 00 | .....|

```

41. Highlight a DDC transaction to view its contents as shown below. The example below shows a register read.



HDMI Capture Viewer

Decode Images Timing Audio /User/HDMI_6G_Video_Timing_HDCP22 Open Segment

Events Find Time Format: HH:MM:SS.ms.us.ns(.ps) Marker 1: Marker 2: Rows

0:7:56.098.393.615.688 0:7:56.087.517.140.000 [F-- L-- P--] DDC SLAVE -> MASTER HDCP2 Reply

TMDS
VSYNC
HSYNC
ENCR-E
AVMUTE
DDC
CEC

0:7:56.073.740.450.000 0:7:56.079.980.542.561 0:7:56.086.239.835.407 0:7:56.092.479.927.968 0:7:56.098.739.220.815

Time (H:M:S.ms.us.ns.ps)

Event	TimeStamp	Fr/Bt	Line	Pix/Ofs	Type	Subtype	Description
4326	0:7:56.087.510.950.000	0	1860	0	TMDS	HSYNC	HSYNC 88 clocks
4327	0:7:56.087.511.400.000	0	1860	382	TMDS	VIDEO	Active Video 3840 clocks
4400	0:7:56.087.511.400.000	0			DDC	HDCP	DDC SLAVE -> MASTER HDCP2 Reply
4329	0:7:56.087.511.400.000	0	1860	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
4330	0:7:56.087.511.400.000	0	1861	0	TMDS	HSYNC	HSYNC 88 clocks

event number: 9
transfer time: 337.60 us
Msg Size: 0
Ready: 0
ReAuth: 0
Valid Rsvd Bits

* START *
* ACK *
0000: 75 00 00 | u..
* STOP *

CLOSE

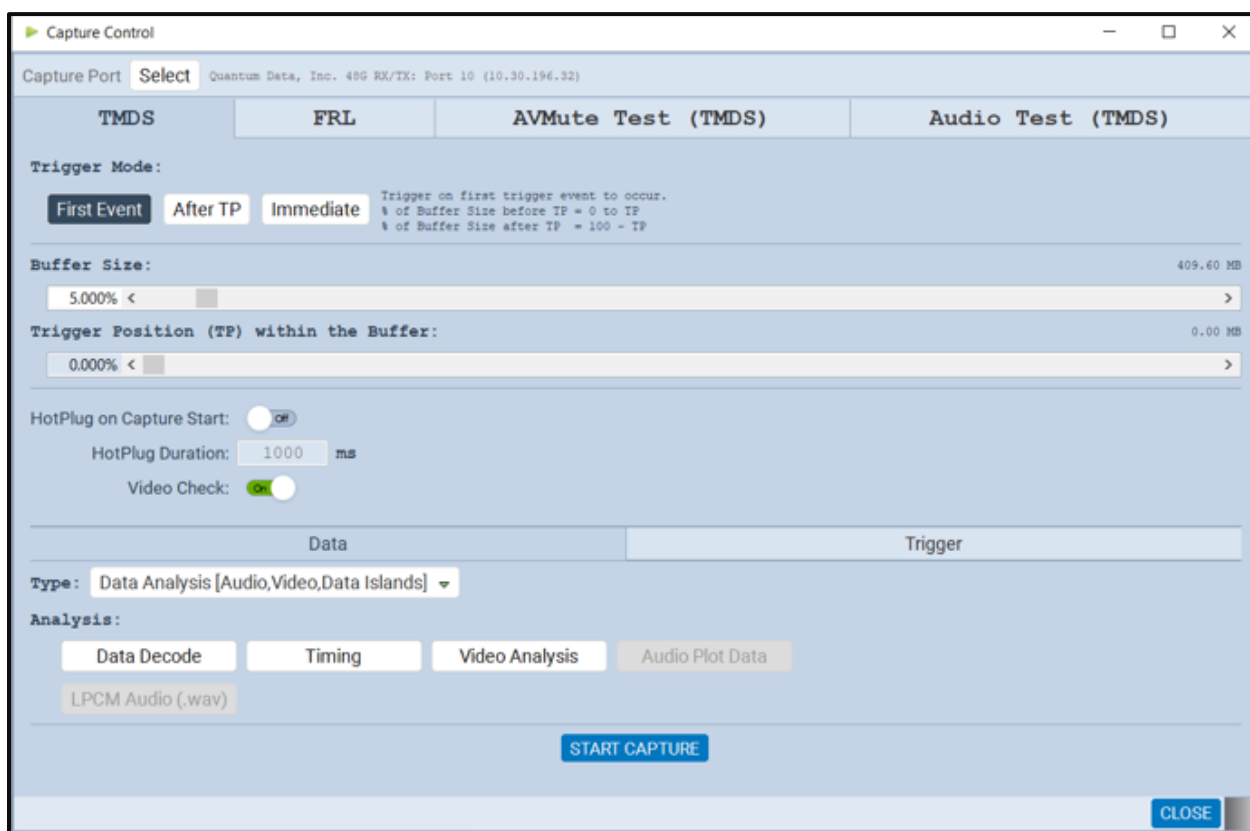
7.8.2 Viewing Protocol Analysis Captures Through the Decode Panel

This subsection provides procedures for viewing the captured data taken using the Protocol Analysis capture mode through the **Decode** and **Event Plot** panels in the ATP Manager.

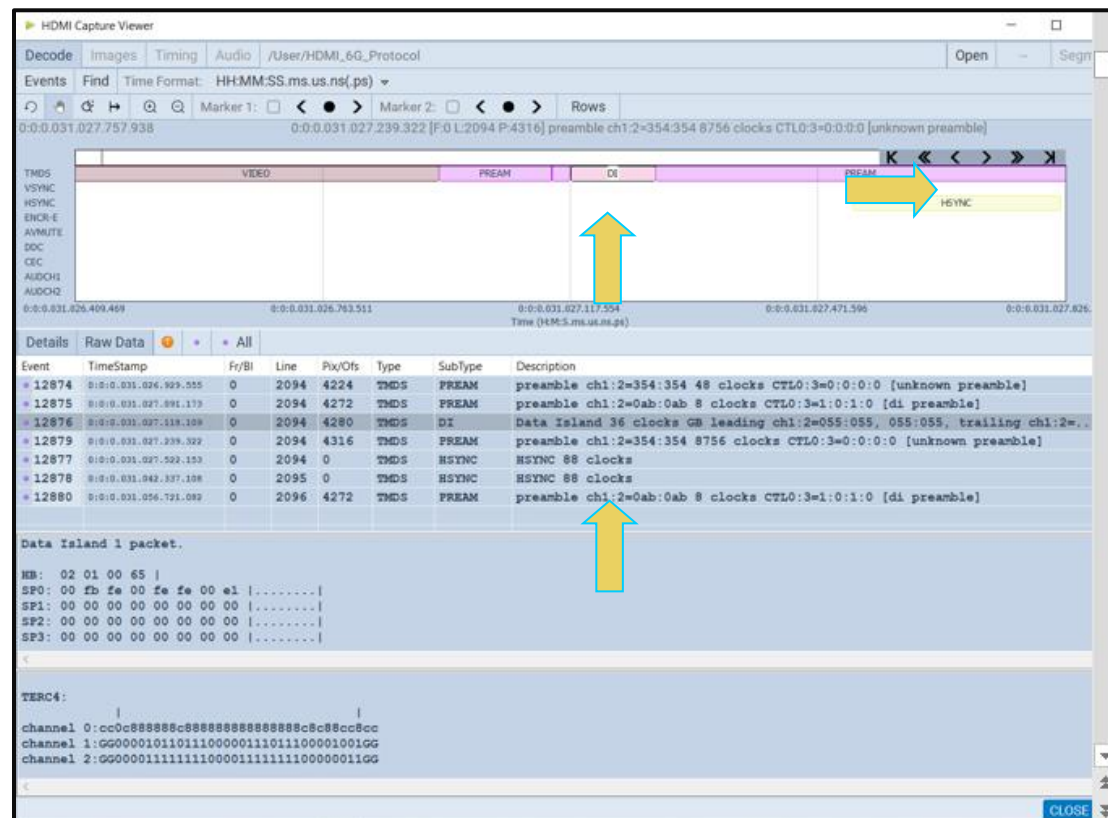
To view captured data through the Decode panel:

1. To view the Protocol Analysis data transactions on the **Decode** and **Event Plot** panels, activate the **Decode** and **Event Plot** tabs.

The screen example below shows data captured using the Protocol Analysis mode. The preamble data is shown as a distinct data type in both the **Event Plot** and the **Decode**. The guard band data is shown as part of the Video data period in the example.

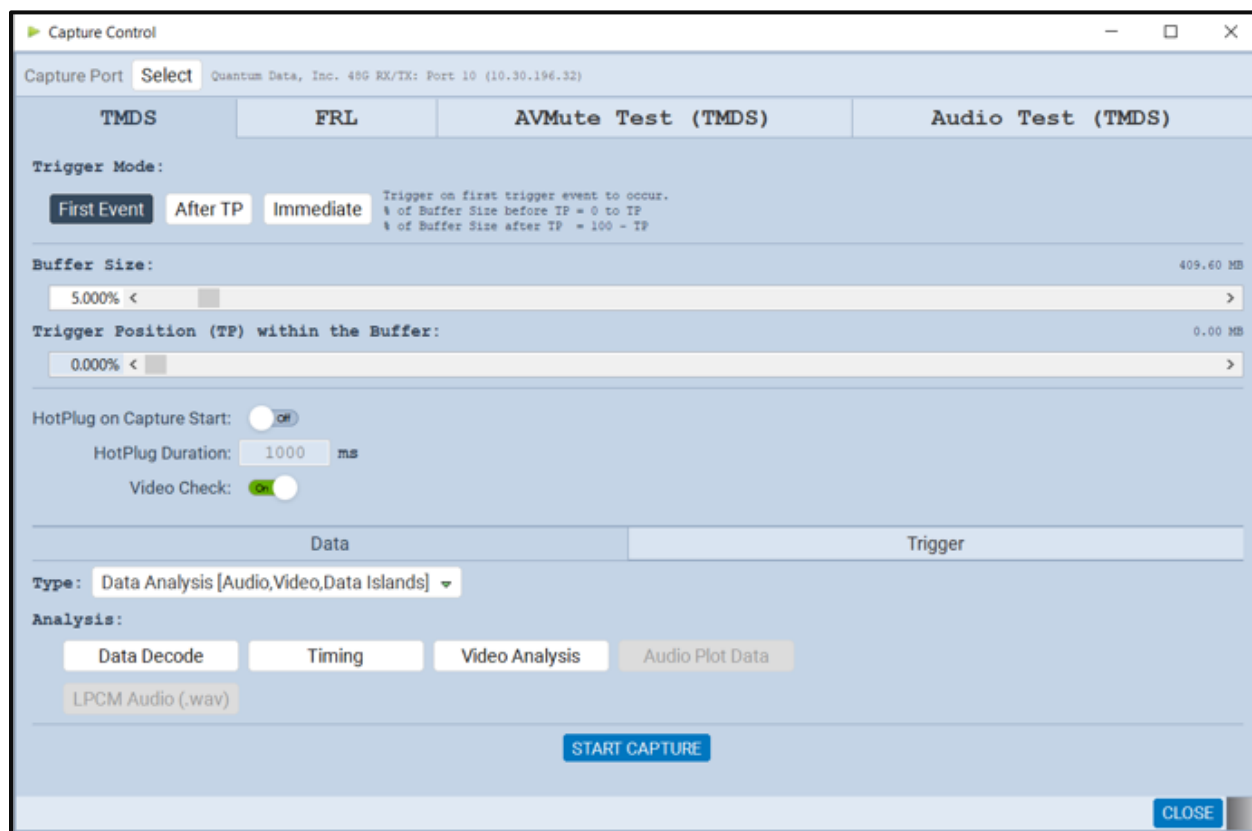


The screenshot shows the HDMI Capture Viewer application. The top menu bar includes 'Decode', 'Images', 'Timing', 'Audio', and a file path. The main area is a timeline view showing various HDMI signals over time. The timeline is divided into sections for TMD5, VSYNC, HSYNC, ENCR-E, AVMUTE, DDC, and CEC. The TMD5 section contains a GCP (General Control Packet) and an AUD IF (Audio InfoFrame). The VSYNC section contains a VSYNC packet. The HSYNC section contains an HSYNC packet. The ENCR-E, AVMUTE, DDC, and CEC sections are empty. The timeline is marked with time values: 0:32:51.941.993.868.366, 0:33:51.928.109.363.872, and 0:33:51.928.109.408.698. The bottom of the window shows a hex dump of the data.

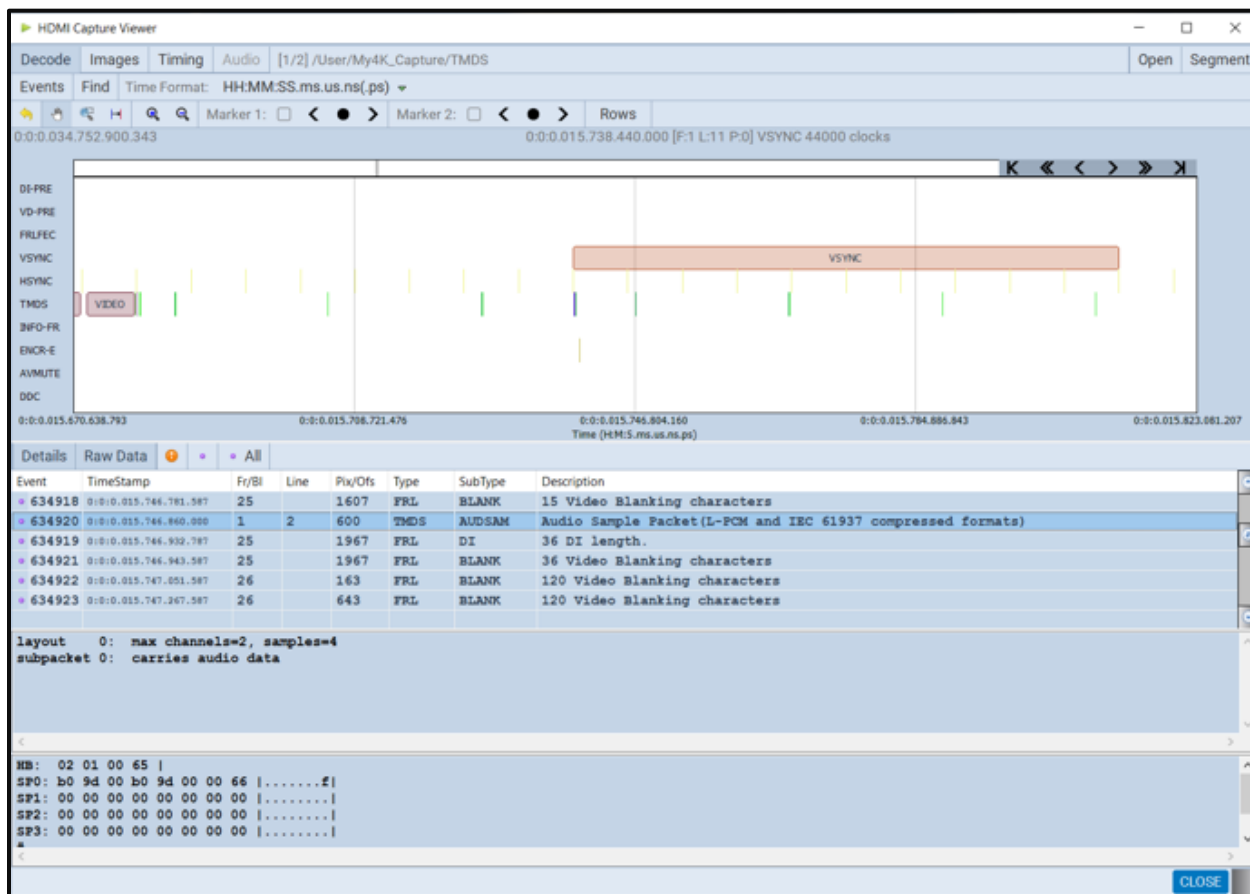


7.8.3 Viewing Scrambled Protocol Analysis Captures Through the Decode Panel

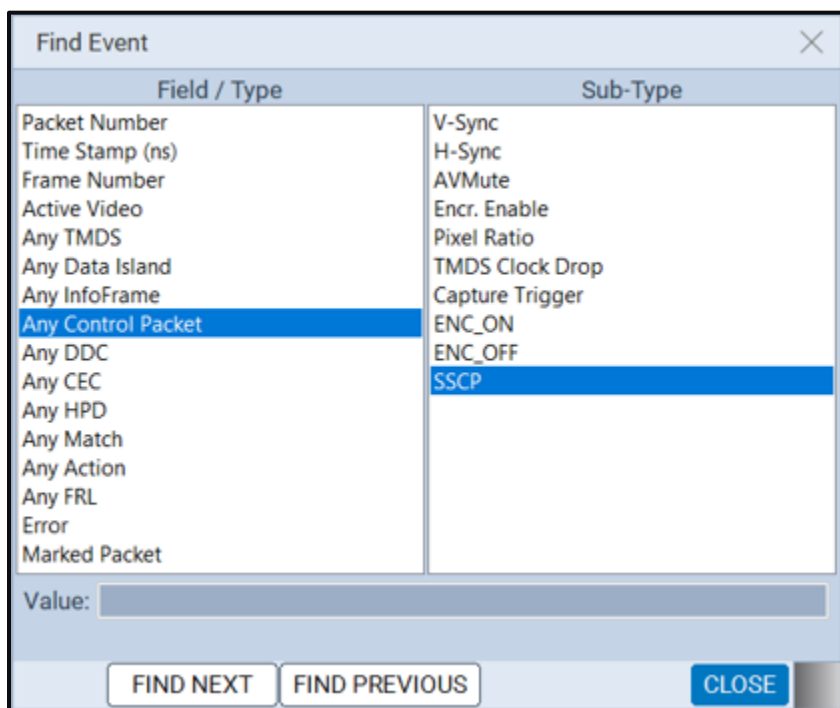
This subsection provides procedures for viewing the captured data taken using the Scrambled Protocol Analysis capture mode through the **Decode** and **Event Plot** panels in the ATP Manager.



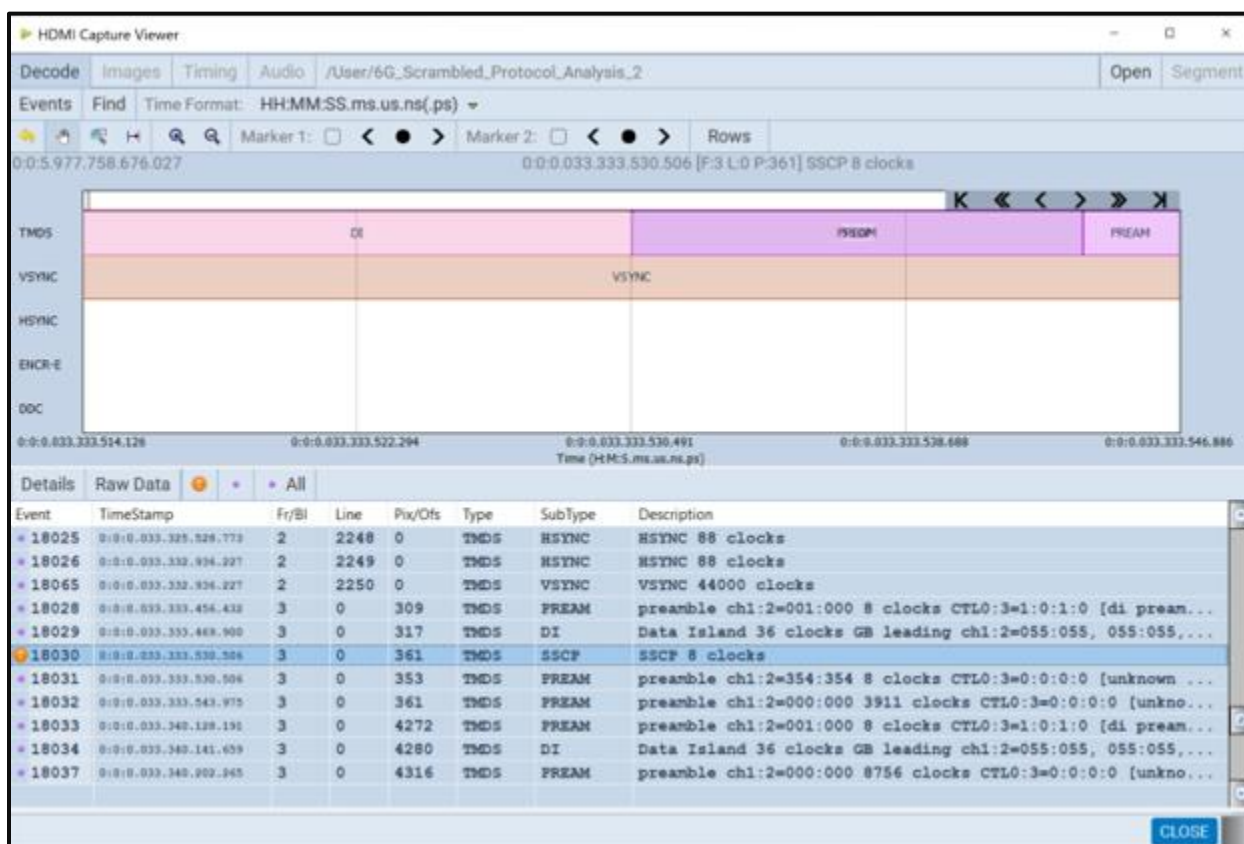
The following screen shot shows an example of the protocol data capture with scrambling enabled.



You can search for the Scrambler Synchronization Control Period (SSCP) bytes.



The following screen shot shows an example of the protocol data with the SSCP byte.

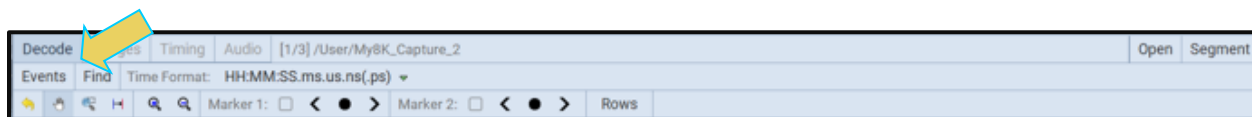


7.8.4 Filtering the Data in the Decode Panel

The procedures below describe how to filter the data in the **Decode** panel. You use the panel on the right that is adjacent to the **Decode** panel to apply filtering on the data displayed on the **Decode** panel.

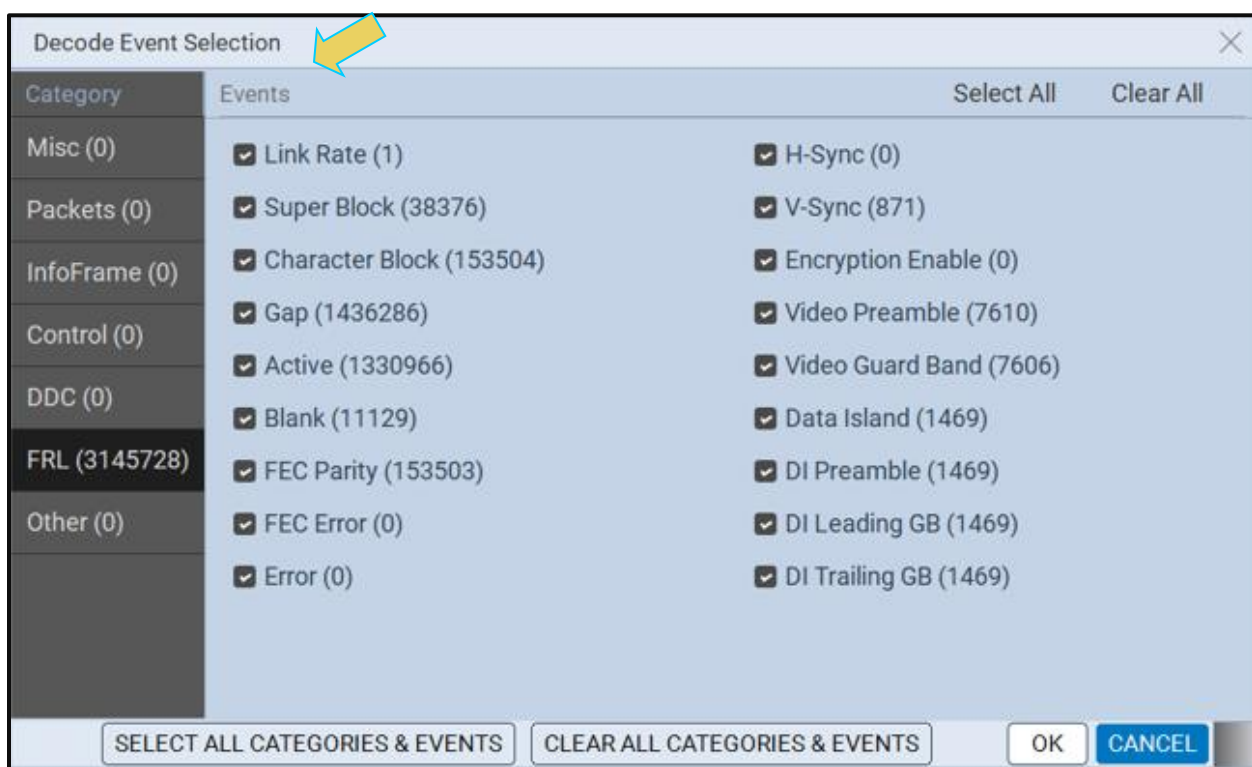
To apply filters to the data:

1. From the **Decode** panel, select the **Events** activation button to access the **Decode Event Selection** dialog box

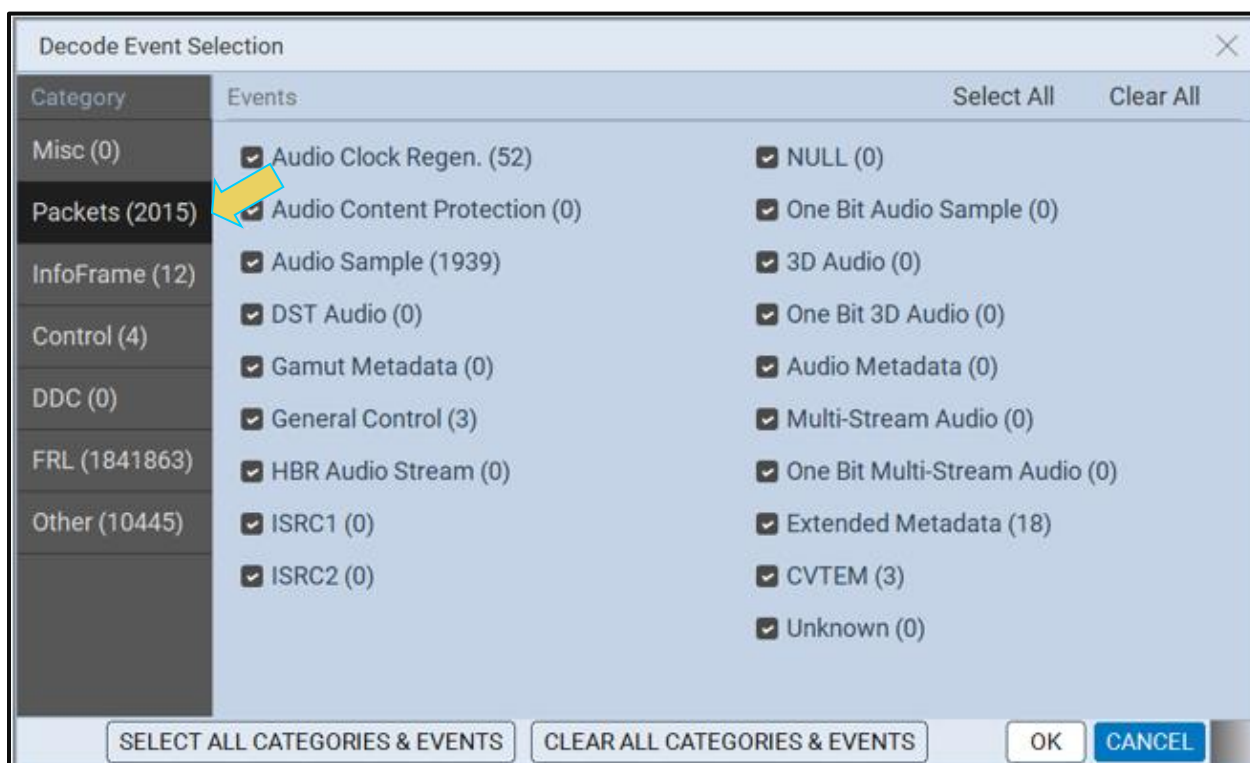


The **Decode Event Selection** dialog box is shown below.

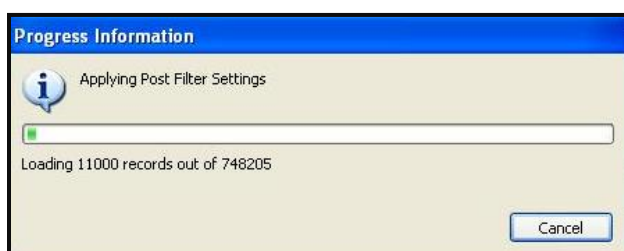
In the example below, only some of the data islands are selected.



The following is a screen example of the **Control Packets** page.



2. Select the data items you want to appear in the **Decode** panel. The filtering you apply in this series of dialog boxes also applies to the **Event Plot** panel.
3. Click the **OK** button on the bottom right to set your selections or click on the **Cancel** button to exit without saving the changes.



Note that you can clear all the selections on all pages with the **Clear All** activation button on the top left. You can select all items on all pages with the **Select All** activation button.

You can also apply the same Select and Clear operations to each tab of the **Decode Event Selection** dialog box.

7.8.5 Searching Through the Data in the Decode Panel

The procedures below describe how to search through the data in the **Decode** panel.

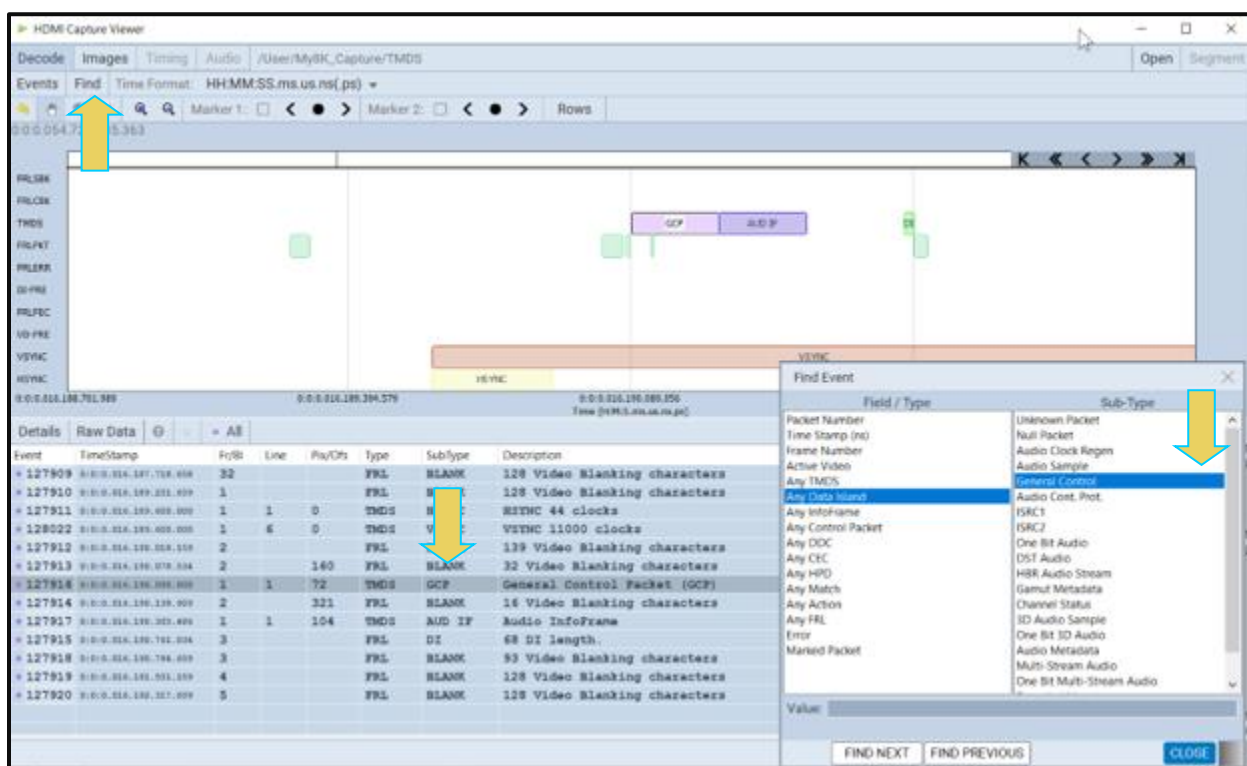
To search through the data:

1. Click on Find. Find

You can search on a variety of packet types and some of the fields in the **Decode** panel such as Packet, Timestamp, Frame, Line and Pixel. You can also search for a variety of control events such as the occurrence of Avmute in an ACR packet or a Vsync/Hsync.

The default is to search Forward which is a search for events that occur later in time. You can change that to search backward by selecting the associated radio button.

A dialog box appears that enables you to enter search criteria. In this example we will search for an Audio Clock Regeneration packet. The **Decode** panel will then show the next General Control Packet (GCP) packet. If you are searching for a specific packet number, timestamp or frame you will have to enter the value in the Find/Goto field.



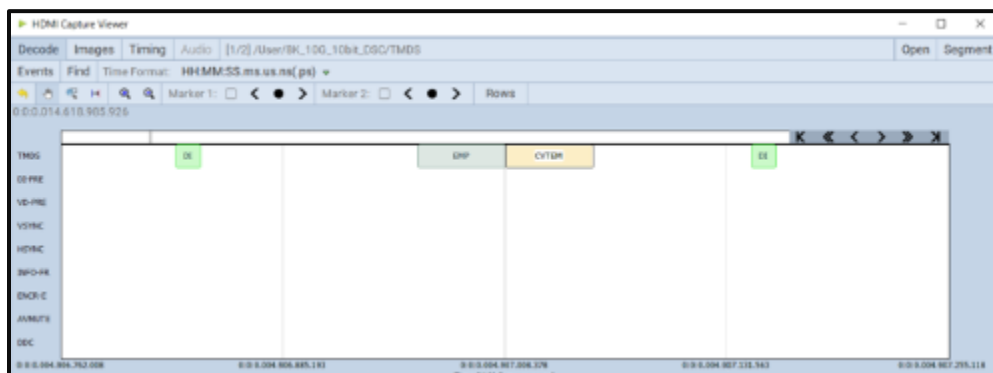
Sometimes you may wish to search for the trigger event. In this case you select Any Control Packet under Field / Type and then select Capture Trigger under Sub-Type as shown below.

The screenshot shows the M41h 48G Video Analyzer/Generator interface. The top menu bar includes Decode, Images, Timing, Audio, and a file path. The main window displays a waveform with various signal traces. A 'Find Event' dialog box is open, showing a list of events. The 'Field / Type' dropdown is set to 'Any Control Packet' and the 'Sub-Type' dropdown is set to 'Capture Trigger'. A yellow arrow points to the 'Capture Trigger' option in the 'Sub-Type' dropdown. The background shows a waveform display with various signal traces. Below the waveform is a table of events.

Event	TimeStamp	Fr/Bl	Line	Pix/Ofs	Type	SubType	Description
511546	0:0:0.038.561.030.000	1	11	0	TMD5	VSUNC	VSUNC 68750 clocks
511201	0:0:0.038.561.083.539	0	0	0	TMD5	TRIG	Capture Trigger
511204	0:0:0.038.561.290.000	1	1	99	TMD5	GCP	General Control Packet (GCP)
511202	0:0:0.038.561.339.289	16		681	FRL	BLANK	32 Video Blanking characters
511205	0:0:0.038.561.376.282	1	1	131	TMD5	AUD IF	Audio InfoFrame
511203	0:0:0.038.561.571.414	16		1363	FRL	DI	68 DI length.
511206	0:0:0.038.561.595.039	16		1363	FRL	BLANK	93 Video Blanking characters
511207	0:0:0.038.561.850.039	17			FRL	BLANK	255 Video Blanking characters
511208	0:0:0.038.562.000.414	17		400	FRL	BLANK	32 Video Blanking characters
511209	0:0:0.038.562.153.789	17		809	FRL	BLANK	32 Video Blanking characters

7.8.6 Viewing Data Through the Event Plot Panel

The Event Plot panel provides you with a graphical view of the data. It enables you to see relationships between the various data types on a timeline. A sample screen of the **Event Plot** is shown below. The operation of the **Event Plot** is described at: [Event Plot Panel](#).



7.8.7 Viewing Audio Plot Data Through the Event Plot Panel

This subsection provides procedures for viewing the Audio Plot data on the **Event Plot** panels in the ATP Manager. You must have Audio Plot Data selected as indicated below. You can only view LPCM data. You cannot view compressed audio formats.

Trigger Mode:

☒ First Event ☐ After TP ☐ Immediate

Trigger on first trigger event to occur.
 % of Buffer Size before TP = 0 to TP
 % of Buffer Size after TP = 100 - TP

Buffer Size: 409.60 MB

5.000% < [Progress Bar] >

Trigger Position (TP) within the Buffer: 0.00 MB

0.000% < [Progress Bar] >

HotPlug on Capture Start: ☐ OFF

HotPlug Duration: 1000 ms

Video Check: ☒ ON

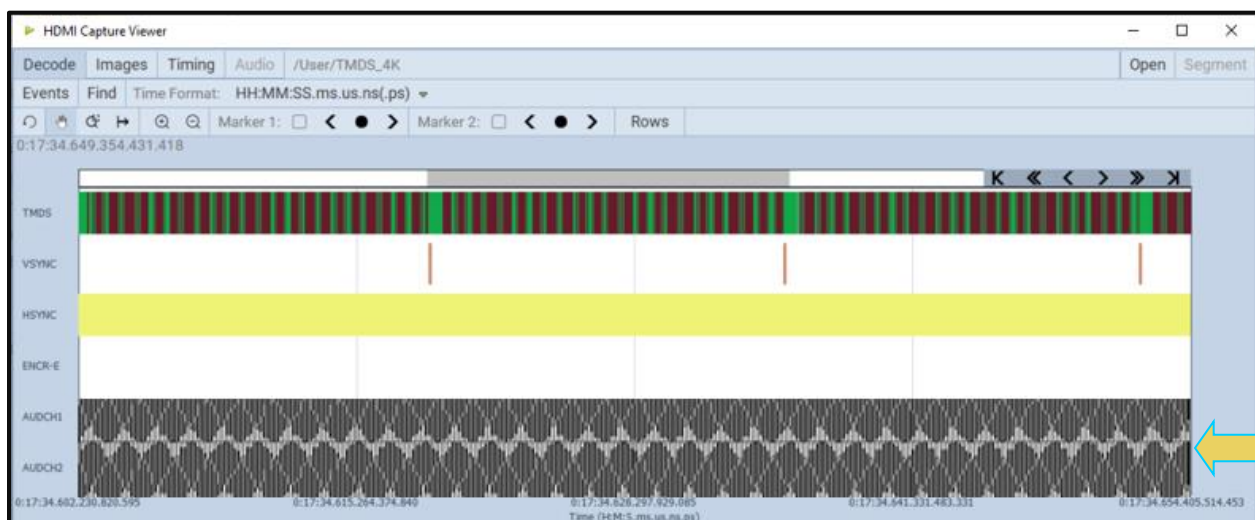
Data Trigger

Type: Data Analysis [Audio, Video, Data Islands]

Analysis:

LPCM Audio (.wav)

The following screen shot shows an example of the Audio Plot data for 2 channel LPCM.



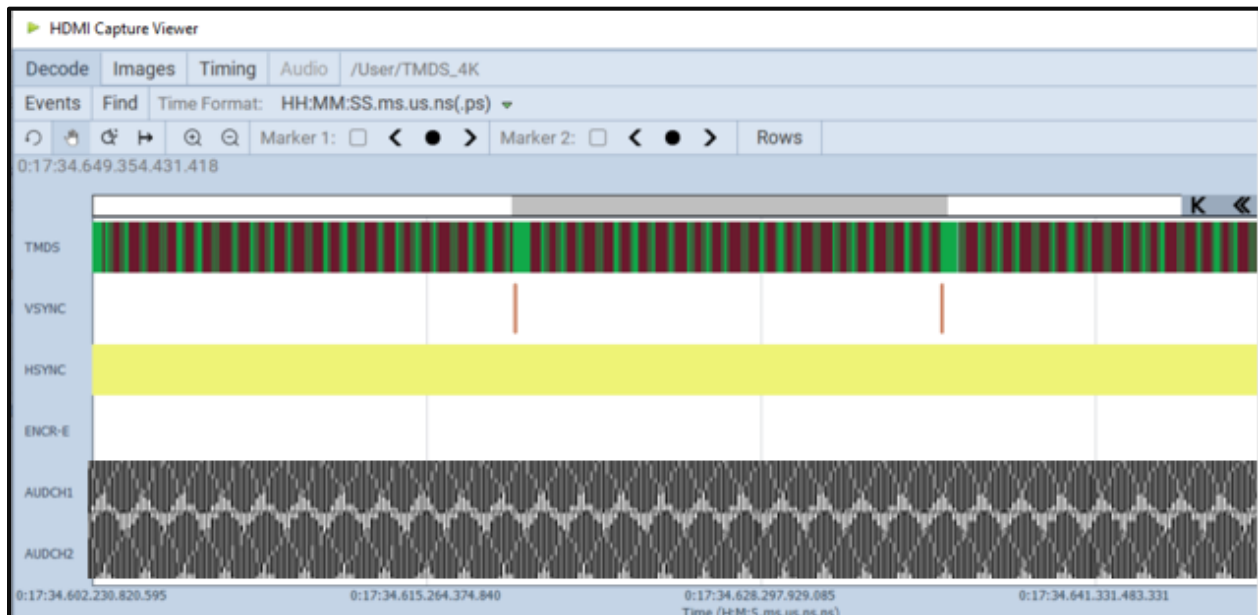
Note: You must be sure to have selected the audio channels using the Rows button on the Event Plot panel (below).

Row Selection / Ordering

Available Rows			Row Order
INFO-FR Info Frames	TMDS Any other TMDS Event	VSNC Vertical Sync	TMDS Any other TMDS Event VSNC Vertical Sync HSYNC Horizontal Sync ENCR-E Encryption Enable/Disable AUDCH1 Audio Channel #1 AUDCH2 Audio Channel #2 DDC Any DDC Event
HSYNC Horizontal Sync	ENCR-E Encryption Enable/Disable	AVMUTE	
SCDT TMDS Clock Drop	TRIG Capture Trigger	DDC Any DDC Event	
CEC	HPD Hot Plug	HDCP-E HDCP Encr Enable/Disable	
CH-ST Channel Status	MATCH Condition Match	ACTION Action Event	
AUDCH1 Audio Channel #1	AUDCH2 Audio Channel #2	AUDCH3 Audio Channel #3	
AUDCH4 Audio Channel #4	AUDCH5 Audio Channel #5	AUDCH6 Audio Channel #6	
AUDCH7 Audio Channel #7	AUDCH8 Audio Channel #8	FRLSBK FRL Super Blocks	
FRLCBK FRL Character Blocks	FRLPKT FRL Packets	FRLERR FRL Errors	
FRLFEC FRL FEC	DI-PRE FRL DI Preambles	VD-PRE FRL Video Preambles	

OK CANCEL

The following screen example shows the same data zoomed in.



8 Running Standard Tests

This chapter describes how to use the M41h 48G Video Analyzer/Generator special tests. The M41h 48G Video Analyzer/Generator supports the following special tests:

Video timing analysis – Verifies that the timing parameters from an HDMI® source device including all horizontal and vertical parameters.

Video analysis – Enables you to check the video parameters and pixel values from the HDMI source device.

Audio analysis - Identify audio inconsistencies in metadata related to sampling rate and audio clock recover that could result in interoperability problems.

Note: These tests are currently only available in the TMDS mode.

AV mute – Verifies that an HDMI source has implemented Avmute properly.

8.1.1 Running a Video Timing Test

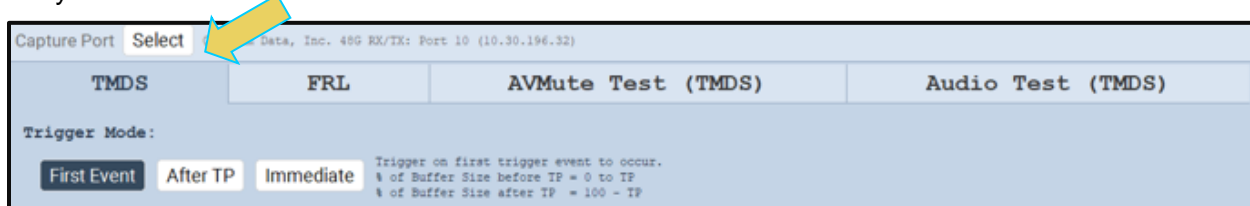
The procedures below describe how to run the video timing test on an HDMI source device through the ATP Manager. This subsection describes how to use the M41h 48G Video Analyzer/Generator to run a timing test on an HDMI source device. The setup procedures described above in the section: Analyzing HDMI Data with your M41h Protocol Analyzer should be followed for the timing tests. These setup procedures are listed below:

Set the threshold of the +5V.

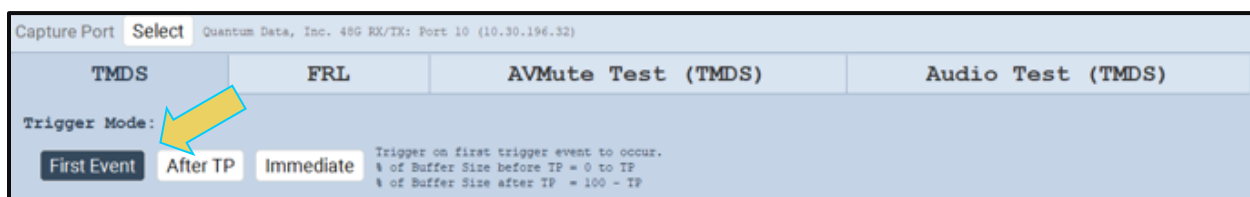
Configure the M41h 48G Video Analyzer/Generator Rx port with the proper EDID.

To run the video timing analysis test:

1. Select the M41h 48G Video Analyzer/Generator that you are using to capture the data from your HDMI source device under test by clicking on the **Select** button and selecting the proper instrument from the list (not shown). Typically, you would only have one M41h Test System in your lab.



2. Set the Video Trigger mode using the information provided below. Note that typically for a Video Timing test you would select either Immediate or First Event.



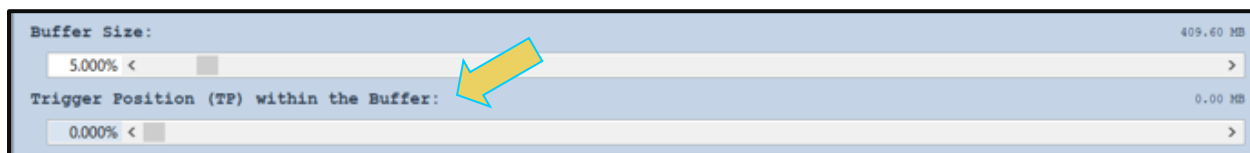
First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, Encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position

slider, you may have some of the captured data in the buffer that accumulated prior to the trigger condition and some of the captured data in the buffer that accumulated after the trigger condition. At the left most position there will be no data in the capture buffer that occurred prior to the trigger event. At the right most position, all the data in the capture buffer will be data that accumulated prior to the trigger event. Because the trigger condition could be met quite quickly, the capture buffer may not be filled to the amount specified in Buffer Size.

After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slider is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has accumulated after the trigger condition was met. This setting will ensure that the capture buffer is filled to the Buffer Size setting.

Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture trigger event (activating the Start Capture button).

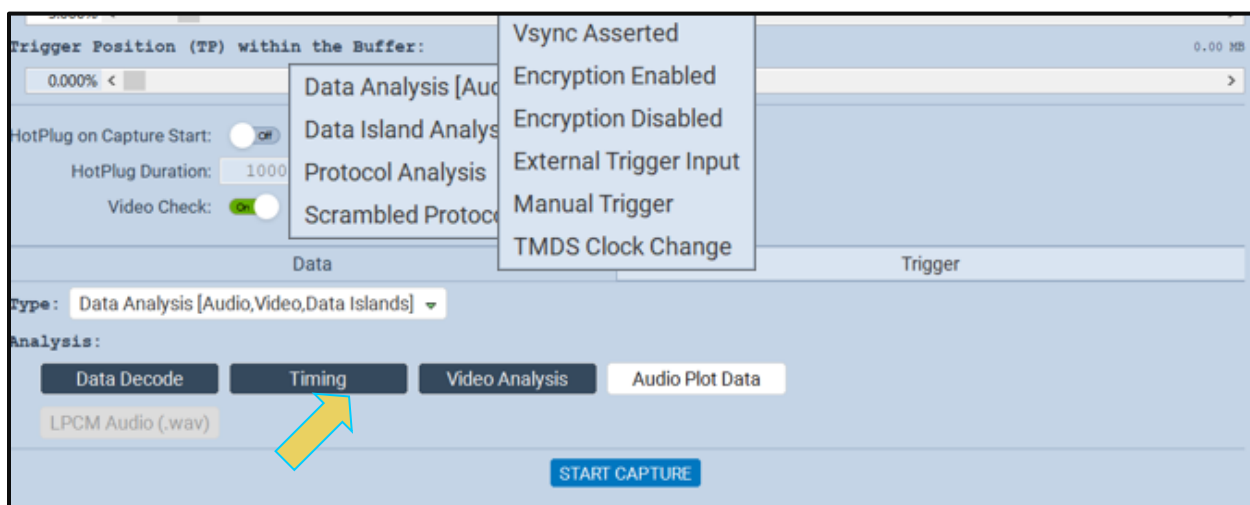
3. Set the **Buffer Size** slider to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store well over 200,000 frames of data.



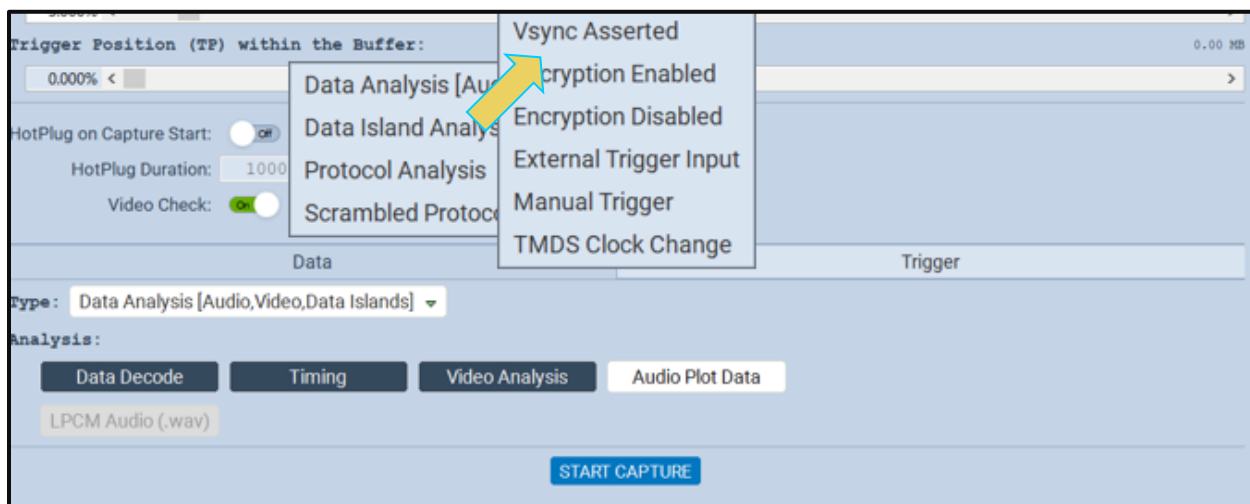
4. Set the **Capture Buffer Position** slider to a percent value to meet your requirements. This slider enables you to set the position of the trigger event within the captured data. This is a slider that provides an indication (on the right) of the location within the captured data, expressed as a percent with 0% indicating that the trigger event occurs at the beginning of the captured data and 100% indicating that the trigger event occurs at the end of the captured data.
5. Select the **Capture** tab in the **Capture Control** panel.



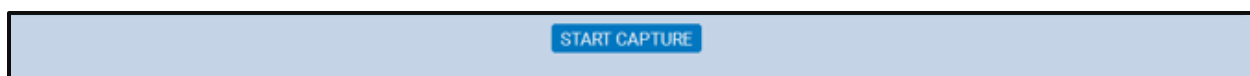
6. Select **Data Analysis** (Audio, Video, Data Islands) in the **Data Selection Type** pull-down menu provided as shown below. Then make sure you check the **Timing** check box.



7. Select Vsync Asserted for the **Trigger Selection** condition.

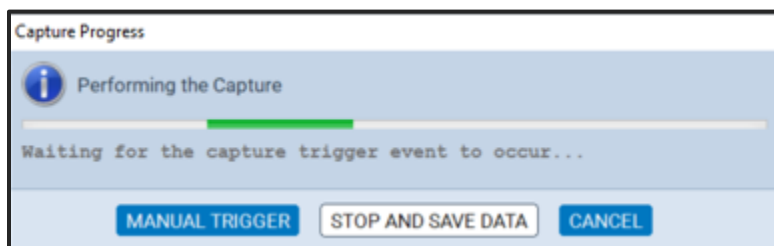


8. Click on the **Start Capture** button to initiate the test.



The M41h 48G Video Analyzer/Generator will capture the data including the timing data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

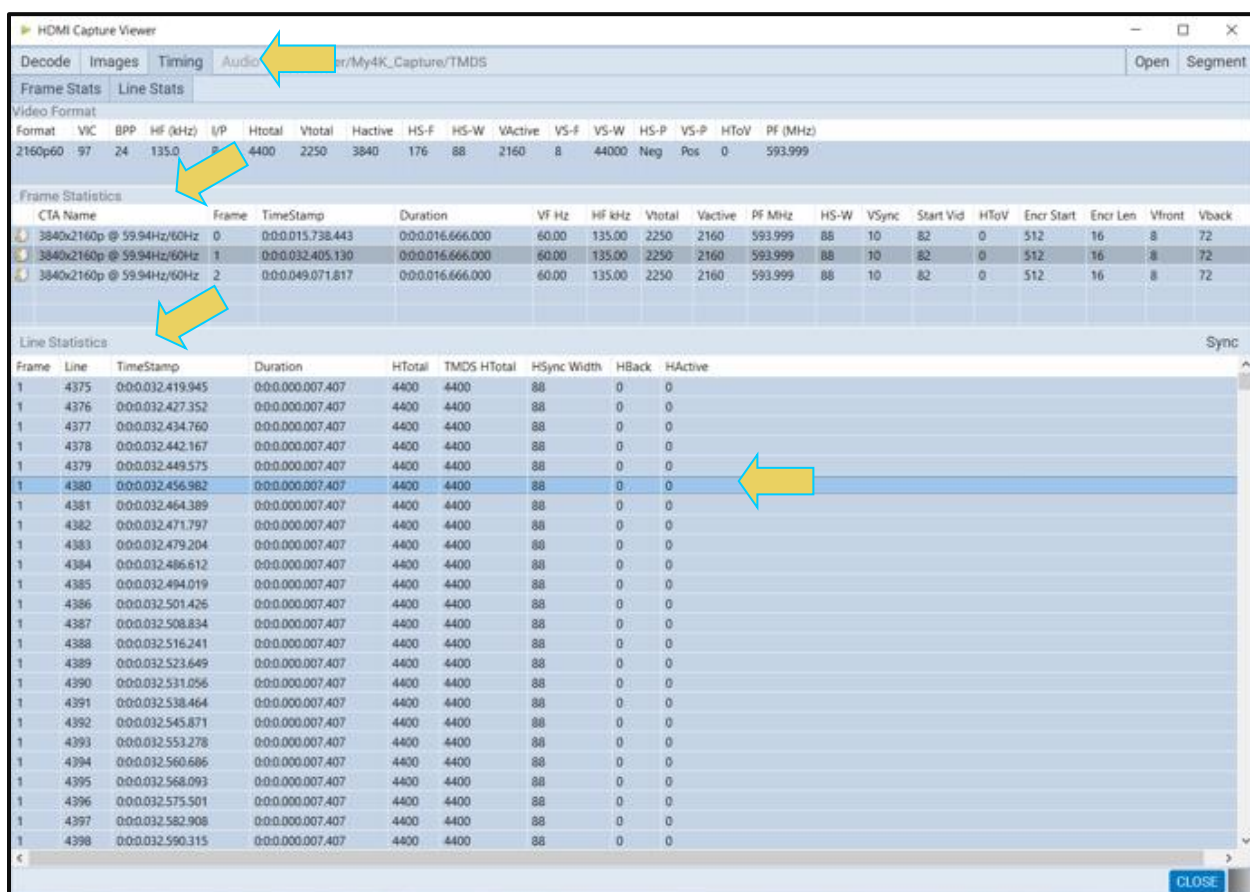
Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will indicate that. This is shown in the following screen shot.



When the M41h 48G Video Analyzer/Generator is finished capturing data you can view the timing parameters in the **Timing Analyzer** panel. The **Timing Analysis** panel has three subpanels: 1) **Video Format**, 2) **Frame Statistics** 3) **Line Statistics**. The **Video Format** panel shows a summary of the key parameters and indicates the standard format timing that the timing parameters detected from the source match. If there is not a precise match between the timing parameters of a format in the M41h 48G Video Analyzer/Generator format library and the measured values, the M41h will select the format nearest to the values measured and indicate any parameters that deviate from that standard timing.

The **Frame Statistics** panel shows the frame or vertical parameters. When you highlight a particular frame, the parameters for each of the lines in that frame are listed in the **Line Statistics** panel.

The **Frame Statistics** panel also indicates whether the frame is encrypted or not. If the frame is encrypted a key icon will be shown on the left side of each frame. Refer to the screen example below.



The screen shot of the Timing Analysis panel shown below.

HDMI Capture Viewer

Decode Images Timing Audio /User/My4K_TMD5_Capture_2 Open Segment

Frame Stats Line Stats

Video Format

Format	VIC	BPP	HF (kHz)	I/P	Htotal	Vtotal	Hactive	HS-F	HS-W	Vactive	VS-F	VS-W	HS-P	VS-P	HToV	PF (MHz)
2160p60	97	24	135.0	P	4400	2250	3840	176	88	2160	8	44000	Pos	Pos	0	594.0

Frame Statistics

CTA Name	Frame	TimeStamp	Duration	VF Hz	HF kHz	Vtotal	Vactive	PF MHz	HS-W	VSync	Start Vid	HToV	Encr Start	Encr Len	Vfront	Vback
3840x2160p @ 59.94Hz/60Hz	0	0:38:27.928.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	1	0:38:27.944.775.858	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	2	0:38:27.961.442.525	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	3	0:38:27.978.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	4	0:38:27.994.775.858	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	5	0:38:28.011.442.525	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	6	0:38:28.028.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72

Line Statistics

Frame	Line	TimeStamp	Duration	HTotal	TMDS HTotal	HSync Width	HBack	HActive
3	000	0:38:27.978.109.192	0:0:0.000.007.407	4400	4400	88	0	0
3	001	0:38:27.978.116.600	0:0:0.000.007.408	4400	4400	88	0	0
3	002	0:38:27.978.124.007	0:0:0.000.007.407	4400	4400	88	0	0
3	003	0:38:27.978.131.415	0:0:0.000.007.408	4400	4400	88	0	0
3	004	0:38:27.978.138.822	0:0:0.000.007.405	4400	4400	88	0	0
3	005	0:38:27.978.146.227	0:0:0.000.007.408	4400	4400	88	0	0
3	006	0:38:27.978.153.635	0:0:0.000.007.407	4400	4400	88	0	0
3	007	0:38:27.978.161.042	0:0:0.000.007.408	4400	4400	88	0	0
3	008	0:38:27.978.168.450	0:0:0.000.007.407	4400	4400	88	0	0
3	009	0:38:27.978.175.857	0:0:0.000.007.407	4400	4400	88	0	0
3	010	0:38:27.978.183.265	0:0:0.000.007.408	4400	4400	88	0	0
3	011	0:38:27.978.190.672	0:0:0.000.007.407	4400	4400	88	0	0
3	012	0:38:27.978.198.080	0:0:0.000.007.408	4400	4400	88	0	0
3	013	0:38:27.978.205.487	0:0:0.000.007.407	4400	4400	88	0	0
3	014	0:38:27.978.212.895	0:0:0.000.007.408	4400	4400	88	0	0
3	015	0:38:27.978.220.302	0:0:0.000.007.407	4400	4400	88	0	0
3	016	0:38:27.978.227.710	0:0:0.000.007.407	4400	4400	88	0	0
3	017	0:38:27.978.235.117	0:0:0.000.007.408	4400	4400	88	0	0
3	018	0:38:27.978.242.525	0:0:0.000.007.407	4400	4400	88	0	0
3	019	0:38:27.978.249.932	0:0:0.000.007.408	4400	4400	88	0	0

CLOSE

You can view 4K by 2K timing data on the M41h 48G Video Analyzer/Generator.

The screenshot shows the 'HDMI Capture Viewer' application window. It has tabs for Decode, Images, Timing, and Audio. The 'Timing' tab is selected, showing video format information and two tables: 'Frame Statistics' and 'Line Statistics'.

Video Format:

Format	VIC	BPP	HF (kHz)	I/P	Htotal	Vtotal	Hactive	HS-F	HS-W	VActive	VS-F	VS-W	HS-P	VS-P	HToV	PF (MHz)
2160p60	97	24	135.0	P	4400	2250	3840	176	88	2160	8	44000	Pos	Pos	0	594.0

Frame Statistics:

CTA Name	Frame	TimeStamp	Duration	VF Hz	HF kHz	Vtotal	Vactive	PF MHz	HS-W	VSync	Start Vid	HToV	Encr Start	Encr Len	Vfront	Vback
3840x2160p @ 59.94Hz/60Hz	0	0:38:27.928.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	1	0:38:27.944.775.858	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	2	0:38:27.961.442.525	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	3	0:38:27.978.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	4	0:38:27.994.775.858	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	5	0:38:28.011.442.525	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72
3840x2160p @ 59.94Hz/60Hz	6	0:38:28.028.109.193	0:0:0.016.666.000	60.00	135.00	2250	2160	594.000	88	10	82	0	0	0	8	72

Line Statistics:

Frame	Line	TimeStamp	Duration	HTotal	TMD5 HTotal	HSync Width	HBack	HActive
3	000	0:38:27.978.109.192	0:0:0.000.007.407	4400	4400	88	0	0
3	001	0:38:27.978.116.600	0:0:0.000.007.408	4400	4400	88	0	0
3	002	0:38:27.978.124.007	0:0:0.000.007.407	4400	4400	88	0	0
3	003	0:38:27.978.131.415	0:0:0.000.007.408	4400	4400	88	0	0
3	004	0:38:27.978.138.822	0:0:0.000.007.405	4400	4400	88	0	0
3	005	0:38:27.978.146.227	0:0:0.000.007.408	4400	4400	88	0	0
3	006	0:38:27.978.153.635	0:0:0.000.007.407	4400	4400	88	0	0
3	007	0:38:27.978.161.042	0:0:0.000.007.408	4400	4400	88	0	0
3	008	0:38:27.978.168.450	0:0:0.000.007.407	4400	4400	88	0	0
3	009	0:38:27.978.175.857	0:0:0.000.007.407	4400	4400	88	0	0
3	010	0:38:27.978.183.265	0:0:0.000.007.408	4400	4400	88	0	0
3	011	0:38:27.978.190.672	0:0:0.000.007.407	4400	4400	88	0	0
3	012	0:38:27.978.198.080	0:0:0.000.007.408	4400	4400	88	0	0
3	013	0:38:27.978.205.487	0:0:0.000.007.407	4400	4400	88	0	0
3	014	0:38:27.978.212.895	0:0:0.000.007.408	4400	4400	88	0	0
3	015	0:38:27.978.220.302	0:0:0.000.007.407	4400	4400	88	0	0
3	016	0:38:27.978.227.710	0:0:0.000.007.407	4400	4400	88	0	0
3	017	0:38:27.978.235.117	0:0:0.000.007.408	4400	4400	88	0	0
3	018	0:38:27.978.242.525	0:0:0.000.007.407	4400	4400	88	0	0
3	019	0:38:27.978.249.932	0:0:0.000.007.408	4400	4400	88	0	0

8.2 Running a Video Analysis Test

The procedures below describe how to run the video analysis test on an HDMI source device through the M41h Manager. The **Video Analysis** panel enables you to view the captured video images. It provides thumbnails of each captured frame. It also enables you to navigate to the **Decode** panel to view the transactions for that frame. The **Video Analysis** panel can synchronize with the **Decode** panel by pressing the ALT key and clicking on a frame. Once you synchronize the **Decode** panel to a frame you can view the transactions for that frame in the **Decode** panel.

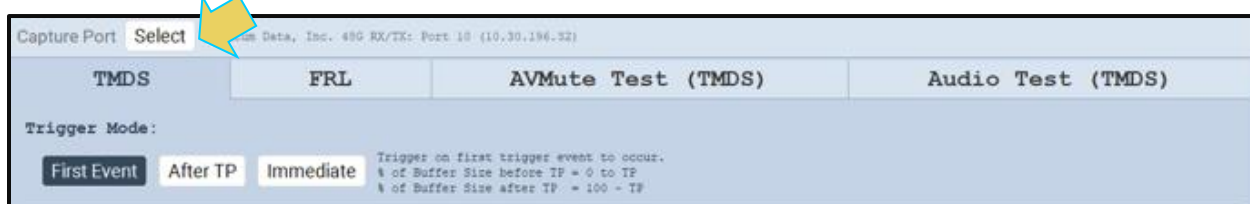
The setup procedures described above in the section: Analyzing HDMI Data with your M41h Protocol Analyzer should be followed for the video analysis tests. These setup procedures are listed below:

Set the threshold of the +5V.

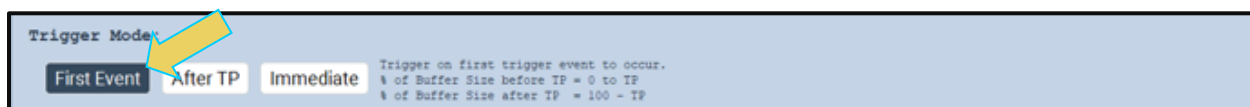
Configure the M41h Rx port with the proper EDID.

To run the video analysis test:

1. Select the M41h 48G Video Analyzer/Generator that you are using to capture the data from your HDMI source device under test from the pull-down menu.



2. Set the Video Trigger mode using the information provided below. Note that typically for a Video Timing test you would select either Immediate or First Event.

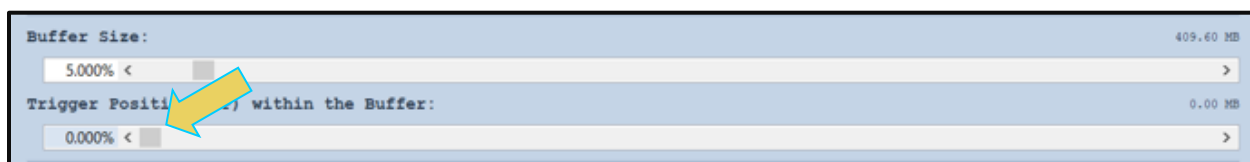


First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, Encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slider, you may have some of the captured data in the buffer that accumulated prior to the trigger condition and some of the captured data in the buffer that accumulated after the trigger condition. At the left most position there will be no data in the capture buffer that occurred prior to the trigger event. At the right most position, all the data in the capture buffer will be data that accumulated prior to the trigger event. Because the trigger condition could be met quite quickly, the capture buffer may not be filled to the amount specified in Buffer Size.

After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slider is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has accumulated after the trigger condition was met. This setting will ensure that the capture buffer is filled to the Buffer Size setting.

Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture trigger event (activating the Start Capture button).

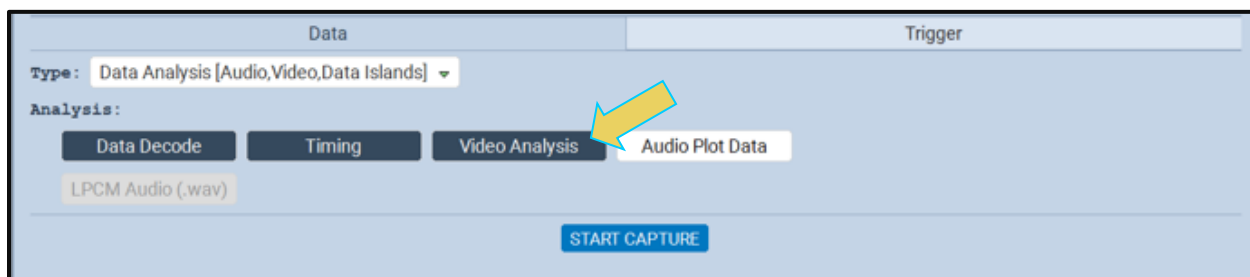
3. Set the **Buffer Size** slider to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store well over 200,000 frames of data.



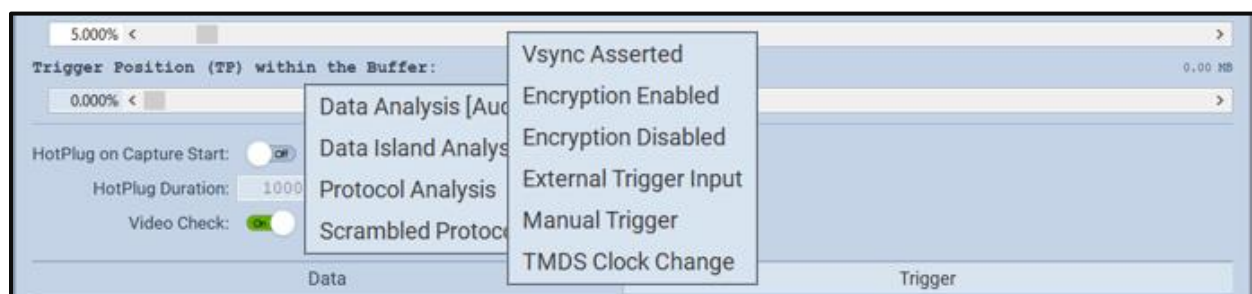
4. Set the **Capture Buffer Position** slider to a percent value to meet your requirements. This slider enables you to set the position of the trigger event within the captured data. This is a slider that provides an indication (on the right) of the location within the captured data, expressed as a percent with 0% indicating that the trigger event occurs at the beginning of the captured data and 100% indicating that the trigger event occurs at the end of the captured data.
5. Select the **Capture** tab under the **Options** section of the **Capture Control** panel.



6. Select Data Analysis (Audio, Video, Data Islands) in the **Data Selection Type** pull-down menu provided as shown below. Then make sure you select **Video Analysis**.



7. Select Vsync Asserted for the **Trigger Selection** condition.

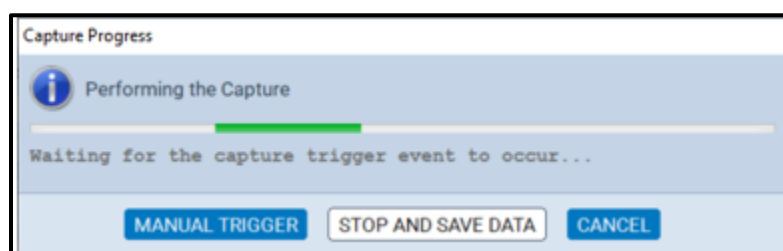


8. Click on the **Start Capture** button to initiate the test.

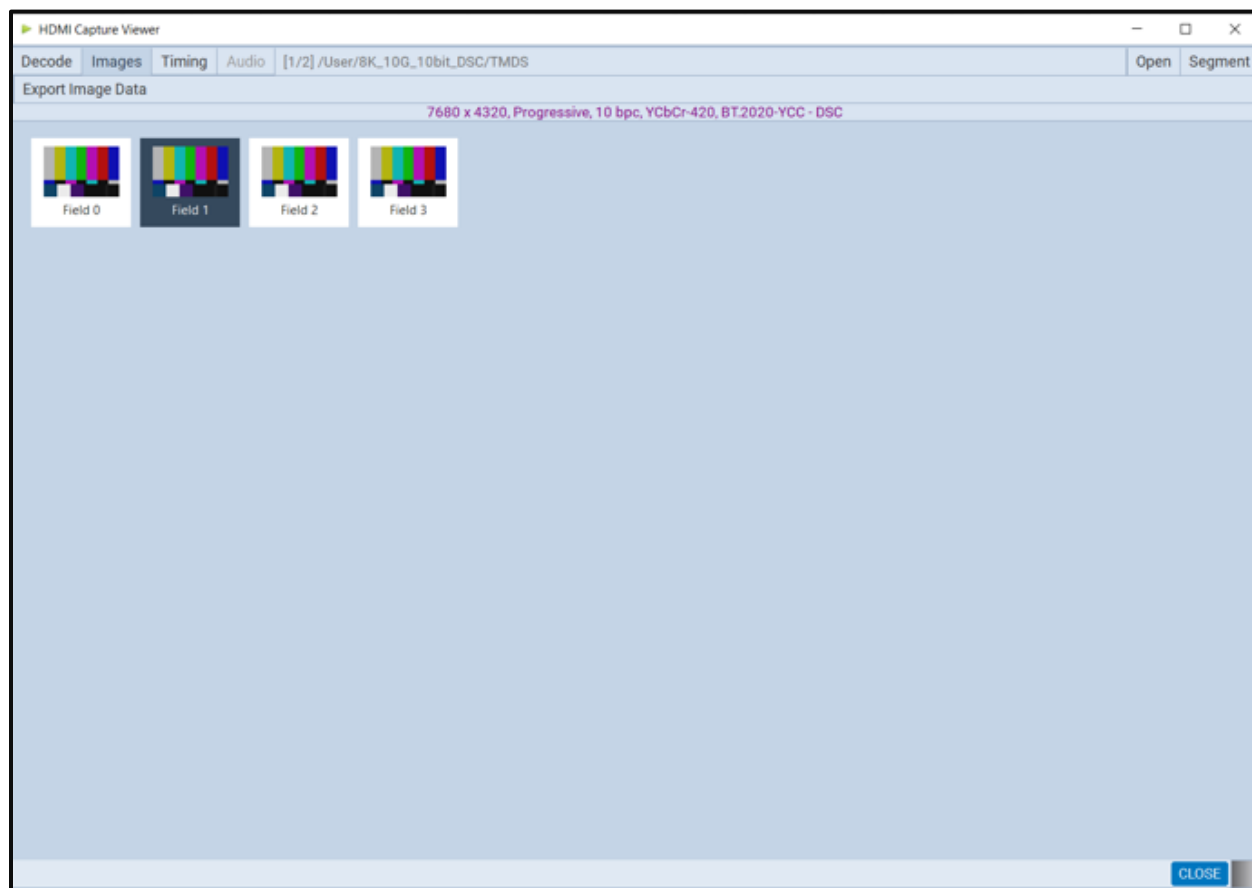


The M41h 48G Video Analyzer/Generator will capture the data including the video data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

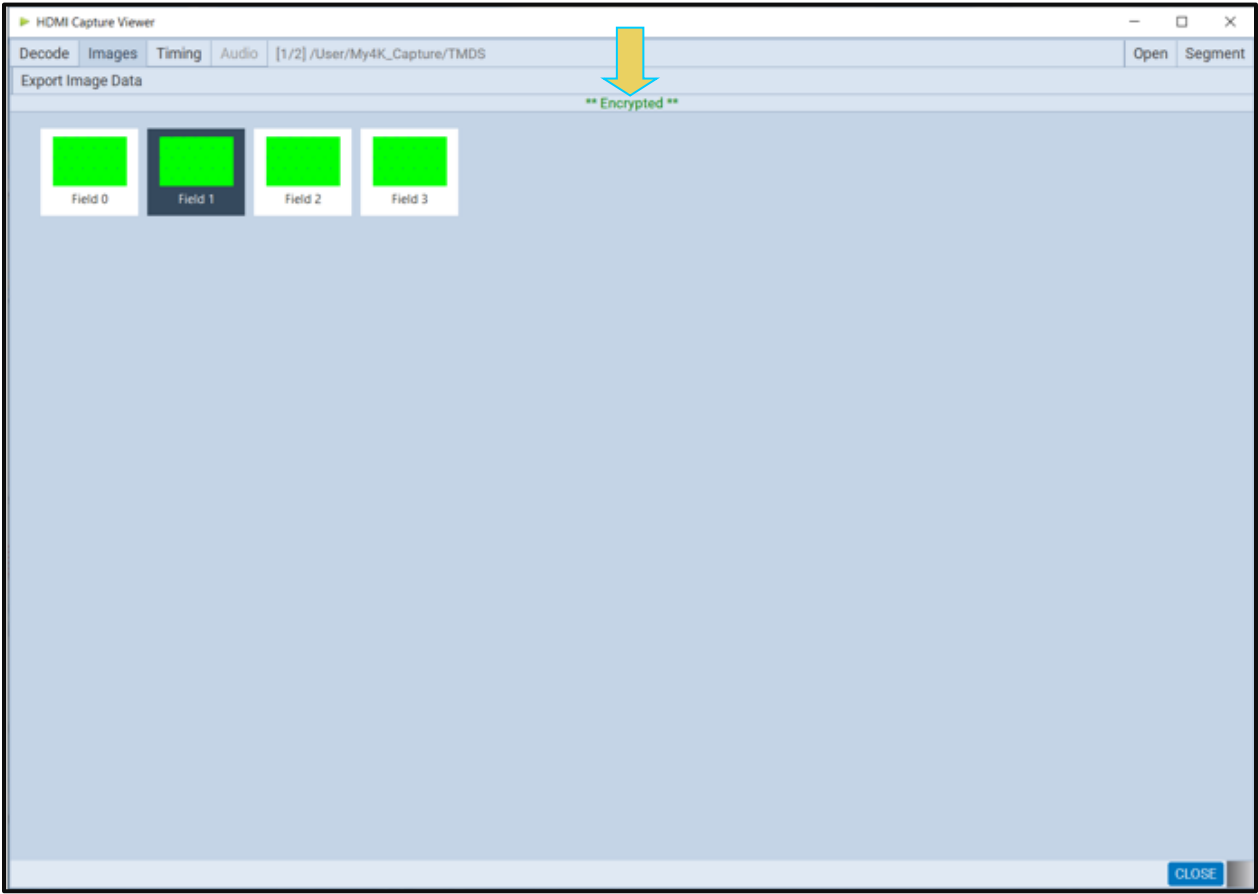
Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will indicate that. This is shown in the following screen shot.



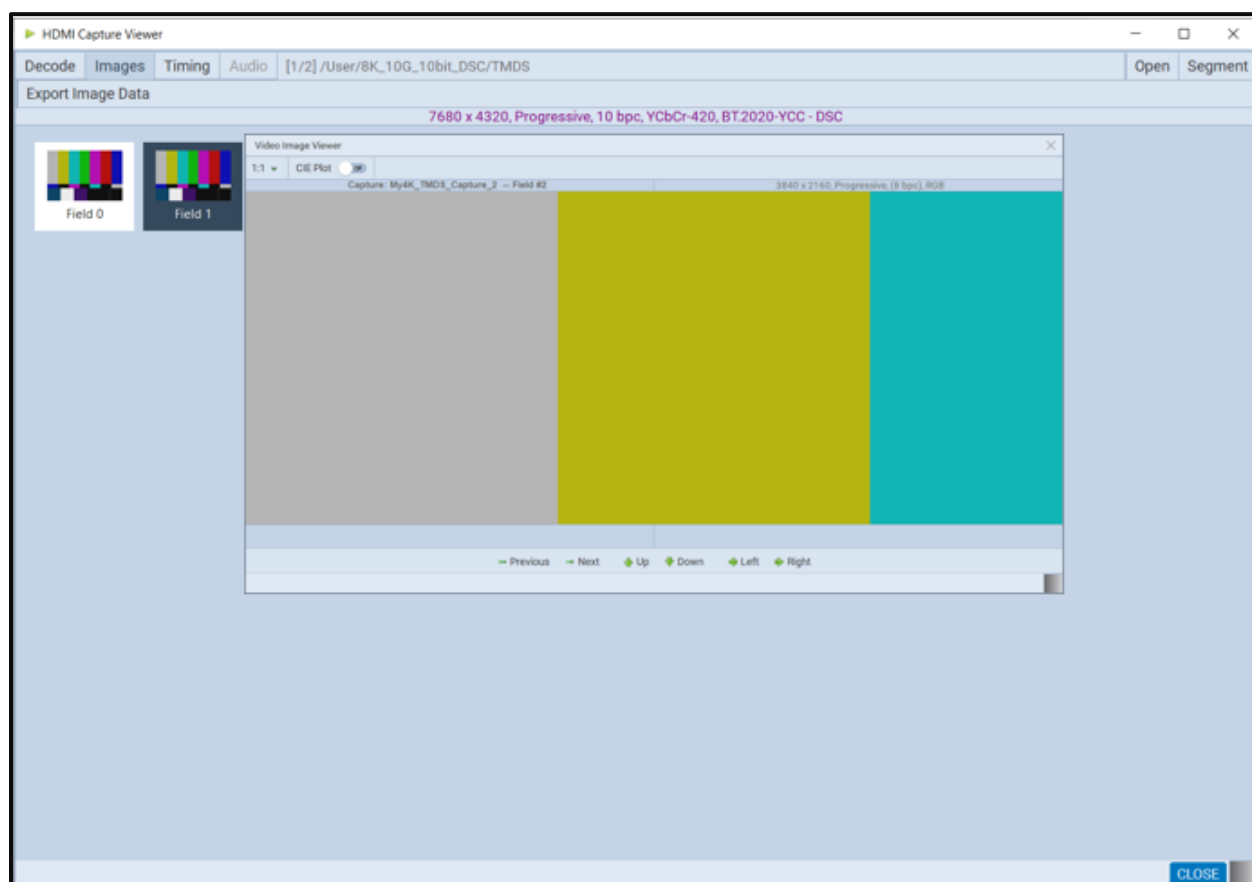
When the M41h 48G Video Analyzer/Generator is finished capturing data you can view the video thumbnails in the **Video Analysis** panel. The **Video Analysis** panel enables you to view the captured video images. It provides thumbnails of each captured frame.



Note: You cannot view video frames of video that is encrypted with HDCP. The **Video Analysis** will show green thumbnails and the word “Encrypted” will be shown on the panel as shown below.



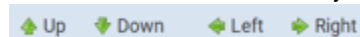
- View the pixel values of any frame by double-clicking on any frame to open the **Video Image Viewer** panel (shown below).



The **Video Analysis** panel enables you to view the video pattern or content for a frame in full size by simply double-clicking on a frame. Once you have activated the full view of a frame in the **Video Image Viewer** panel you can view the pixel values for any pixel by moving your mouse over the pattern.

You can view the pixel value by clicking on an area on the image (Marker) and/or by moving the mouse cursor over the image (Cursor). In the example below the Cursor is over pixel (x=684, y=223) and the Marker is set on pixel (x=380, y=198). If the color space is YCbCr the Video Image Viewer will show these values and indicate the color space. Deep color values are also shown in either YCbCr or RGB color space.

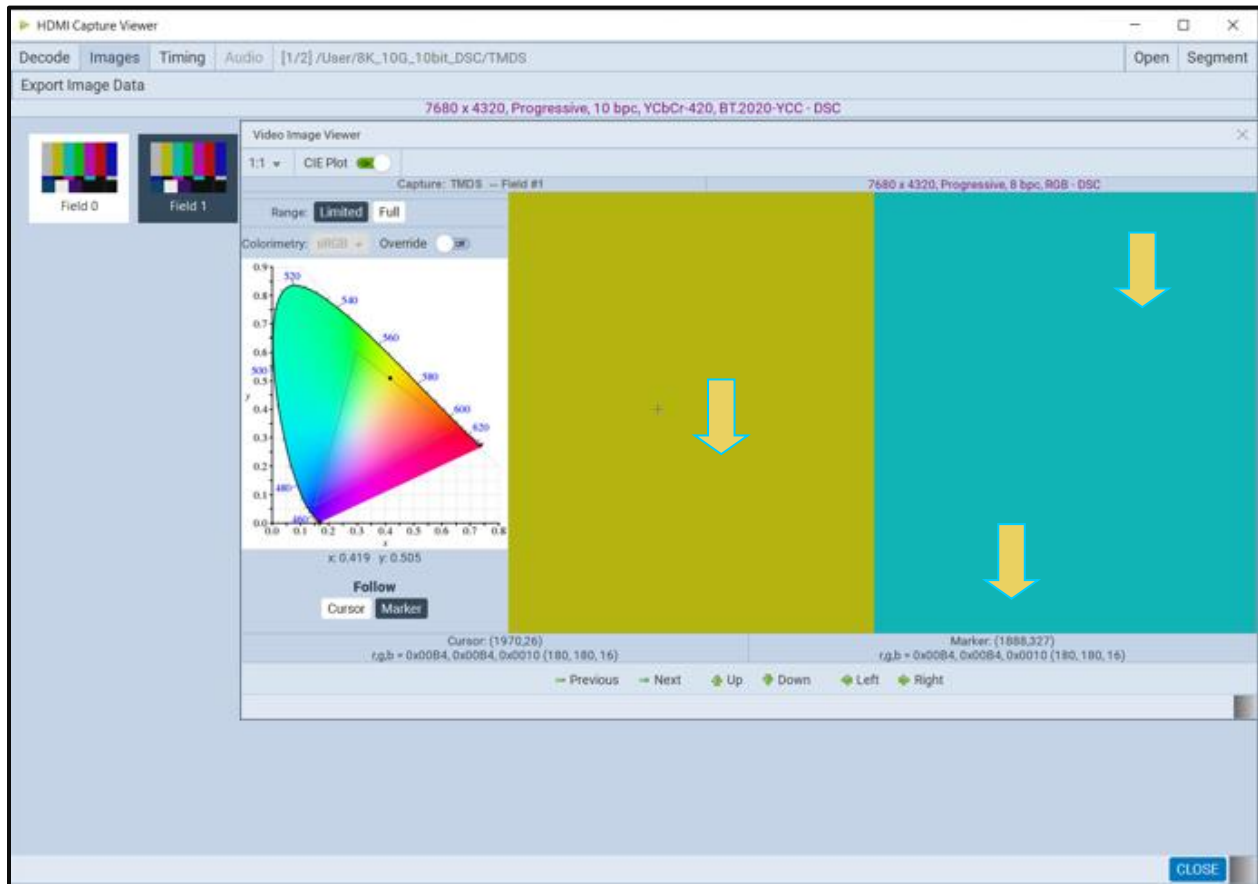
You can advance to an adjacent pixel (up/down or left/right) using the green arrow buttons on



the bottom of the **Video Image Viewer** panel.

You can advance to the image of an adjacent frame (previous or next) using the thin green arrow buttons  on the bottom of the **Video Image Viewer** panel.

These are shown in the screen image below.



10. Navigate to the **Decode** panel by first synchronizing the **Decode** Panel to the **Video Analysis** panel and then activating the **Decode** panel. The **Video Analysis** panel is shown in the screen image below.

The **Video Analysis** panel can synchronize with the **Decode** panel by pressing the ALT key and clicking on a frame.

8.3 Audio Analysis

The **Audio (Data) Analysis** feature enables you to detect inconsistencies in the metadata relating to the sampling rate and the audio clock regeneration values. The following items are listed and/or verified during the test:

- Sampling rate shown in the Audio InfoFrame.**
- Sampling size (bit depth) in the Audio InfoFrame.**
- Channel count in the Audio InfoFrame.**
- N and CTS values in the Audio Clock Regeneration packets.**
- Audio type listed in the Channel Status Blocks.**
- Sampling frequency in the Channel Status Blocks.**
- Original sampling frequency listed in the Channel Status Blocks.**
- Channel count listed in the Channel Status Blocks.**
- Sampling rate calculated from the audio samples.**
- Rate that the ACR packets are transmitted.**

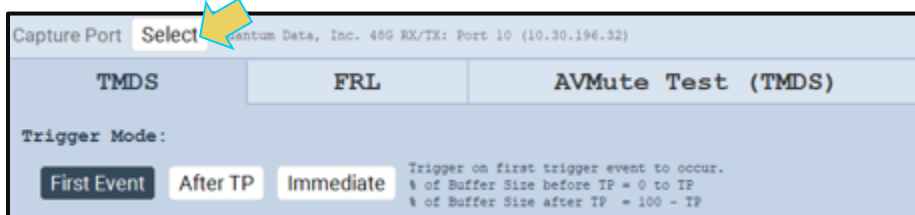
The setup procedures described above in the section: Analyzing HDMI Data with your M41h Protocol Analyzer should be followed for the audio analysis tests. These setup procedures are listed below:

Set the threshold of the +5V.

Configure the M41h 48G Video Analyzer/Generator Rx port with the proper EDID.

To run the audio analysis test:

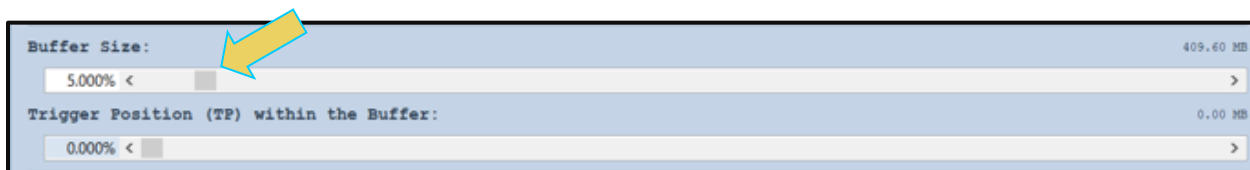
1. Select the M41h 48G Video Analyzer/Generator that you are using to capture the data from your HDMI source device under test from the pull-down menu.



2. Set the Video Trigger mode using the information provided below. Note that typically for the Audio test you would select First Event.

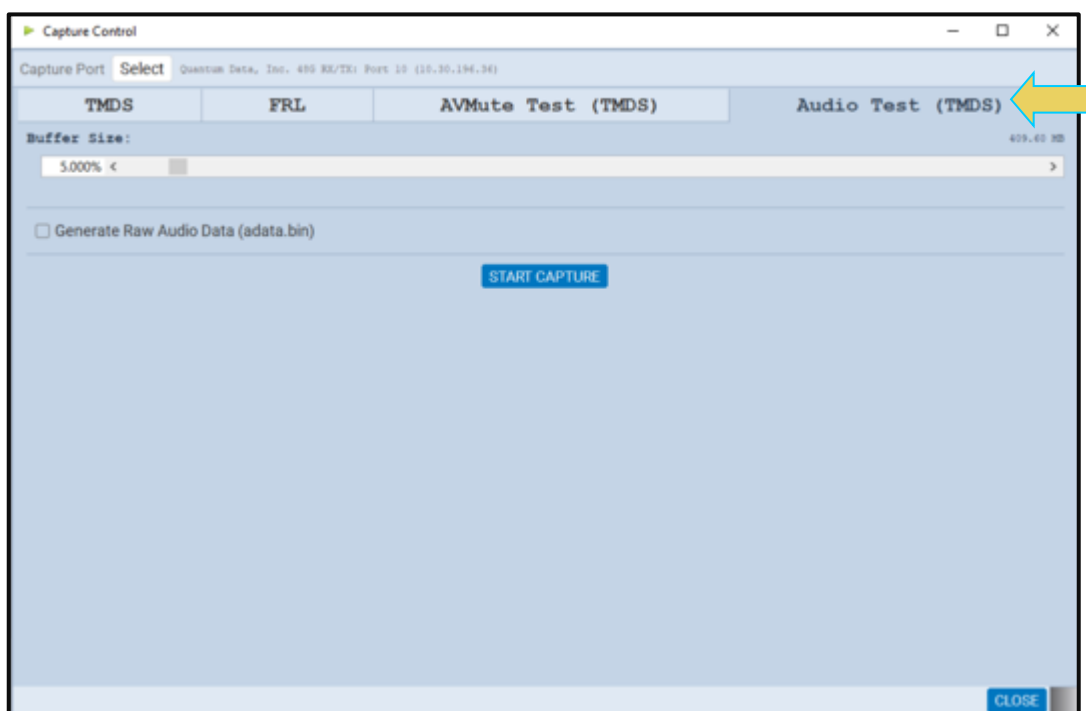


- Set the **Buffer Size** slider to a percent value to meet your requirements. You can capture up to 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store well over 200,000 frames of data.



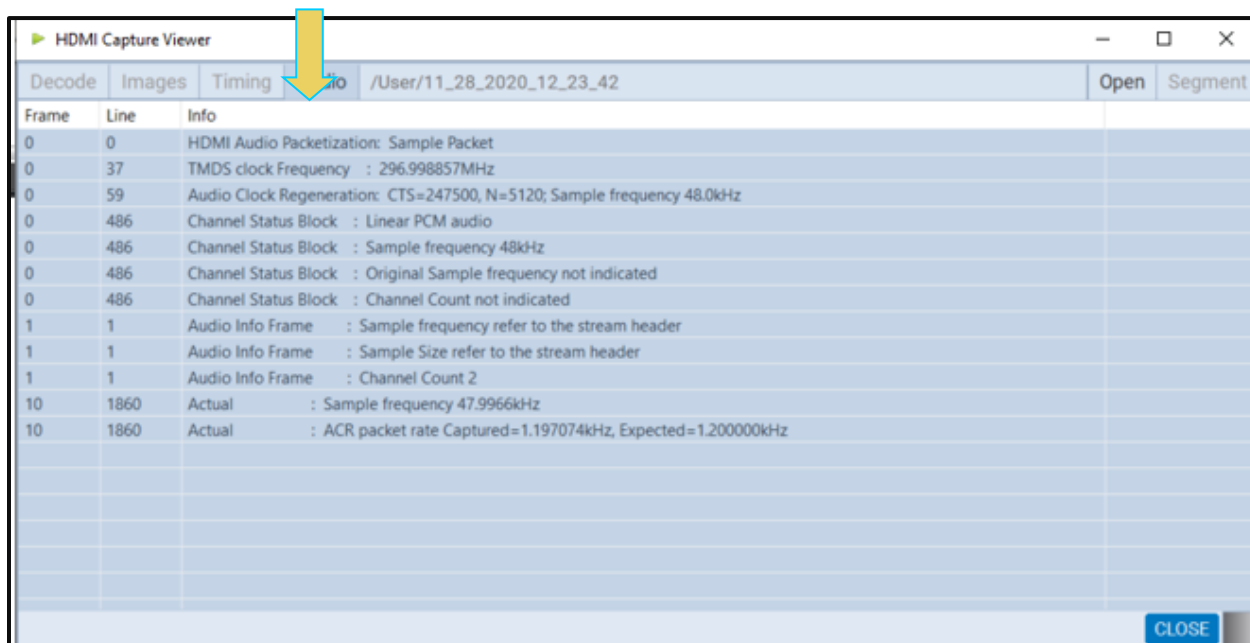
Note: You do not need to set the **Trigger Position** or the **Trigger Selection** when running the **Audio Analysis** test. The Trigger Position is always reset to 0% and the **Trigger Selection** is set to Vsync. These settings occur as part of the test when you initiate the test.

- Select the **Std Tests** tab under the **Options** section of the **Capture Control** panel (below).



- Click on the Audio Test to initiate the Audio Analysis test.

The results are shown in the **Data Analysis** panel in the main window of the M41h Manager. A sample is shown below.



The screenshot shows the 'HDMI Capture Viewer' window. The 'Data' tab is selected, indicated by a yellow arrow. The window displays a table of HDMI data analysis results. The table has columns for Frame, Line, and Info. The data is organized into sections: HDMI Audio Packetization, TMDs clock Frequency, Audio Clock Regeneration, Channel Status Block, Audio Info Frame, and Actual packet rate. The 'Actual' section shows the sample frequency and ACR packet rate.

Frame	Line	Info
0	0	HDMI Audio Packetization: Sample Packet
0	37	TMDs clock Frequency : 296.998857MHz
0	59	Audio Clock Regeneration: CTS=247500, N=5120; Sample frequency 48.0kHz
0	486	Channel Status Block : Linear PCM audio
0	486	Channel Status Block : Sample frequency 48kHz
0	486	Channel Status Block : Original Sample frequency not indicated
0	486	Channel Status Block : Channel Count not indicated
1	1	Audio Info Frame : Sample frequency refer to the stream header
1	1	Audio Info Frame : Sample Size refer to the stream header
1	1	Audio Info Frame : Channel Count 2
10	1860	Actual : Sample frequency 47.9966kHz
10	1860	Actual : ACR packet rate Captured=1.197074kHz, Expected=1.200000kHz

9 Enhanced Audio Return Channel (eARC) Functional Testing

This Section provides information and procedures about testing eARC Tx and eARC Rx devices. This Section does not provide procedures for running eARC compliance tests. Compliance tests are provided in the HDMI® Forum MOIs.

9.1 EARC Tx Functional Testing

This subsection provides procedures on testing eARC Tx devices. The M41h 48G Video Analyzer/Generator provides eARC Rx emulation and diagnostic testing to run functional verification tests on eARC Tx devices such as eARC capable UHD TVs. You can monitor the Common mode transactions and view the audio metadata status. You can also extract the 2 Channel LPCM or

Digital audio out the SPDIF port on the M41h for audible monitoring.

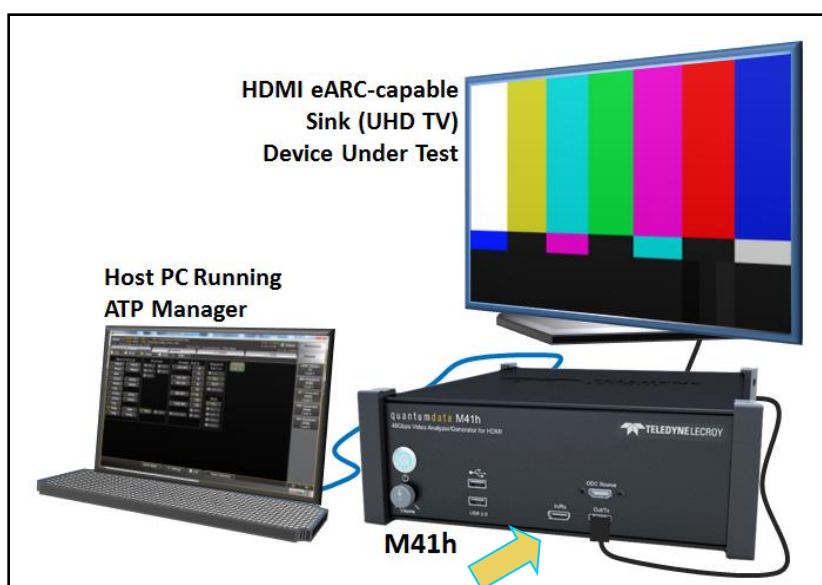
To view the incoming audio metadata over the eARC channel:

1. Establish the physical connection from the eARC Rx DUT to the M41h 48G Video Analyzer/Generator's HDMI Output port.

Prior to making the physical connection, you can initiate the Aux Channel Analyzer utility to monitor the eARC Common mode transactions. See the subsection below.

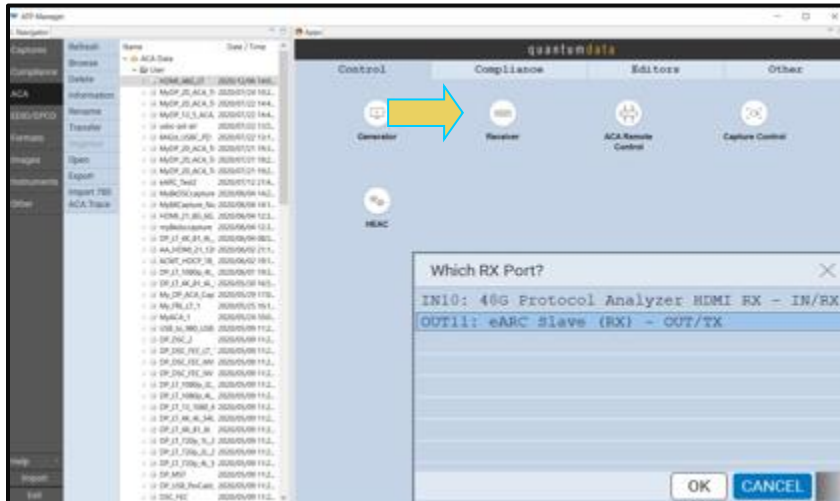
The test setup is shown below. The eARC Tx device is connected via a suitable eARC capable HDMI cable to the M41h 48G's Output port as shown below.

The test setup is depicted below.



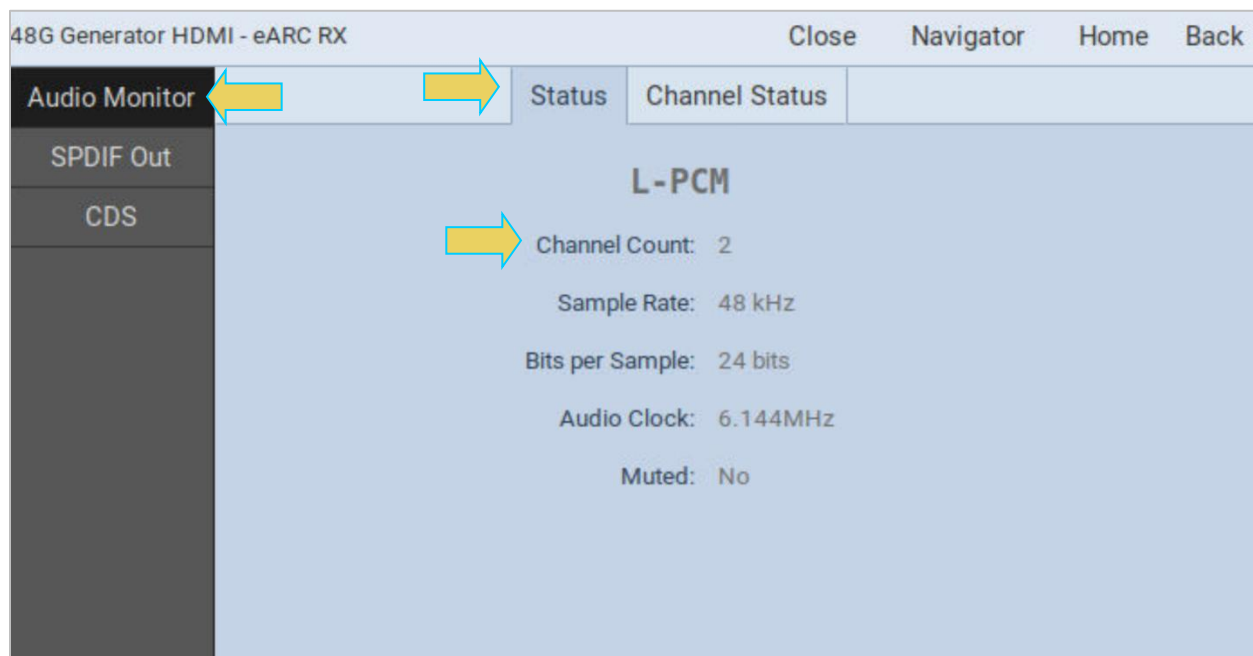
Setup for Testing eARC Tx devices

1. Access **Receiver** from the **Card Control** panel as shown below.

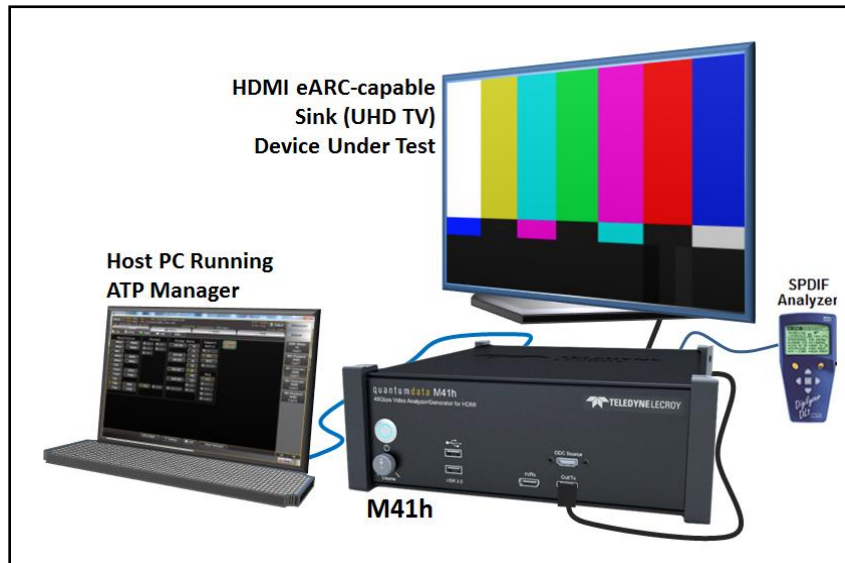


The **Which RX Port** dialog will appear as shown above.

6. Select the **Audio Monitor** button and view the Status of incoming audio metadata.



To eject the LPCM or Dolby Digital eARC audio out the SPDIF out port on the M41h. You can use a SPDIF analyzer to verify the LPCM audio. Use the setup below.



The SPDIF port is on the back of the M41h and identified in the illustration below.



Then select the SPDIF Out button on the eARC Slave Control panel as shown below.



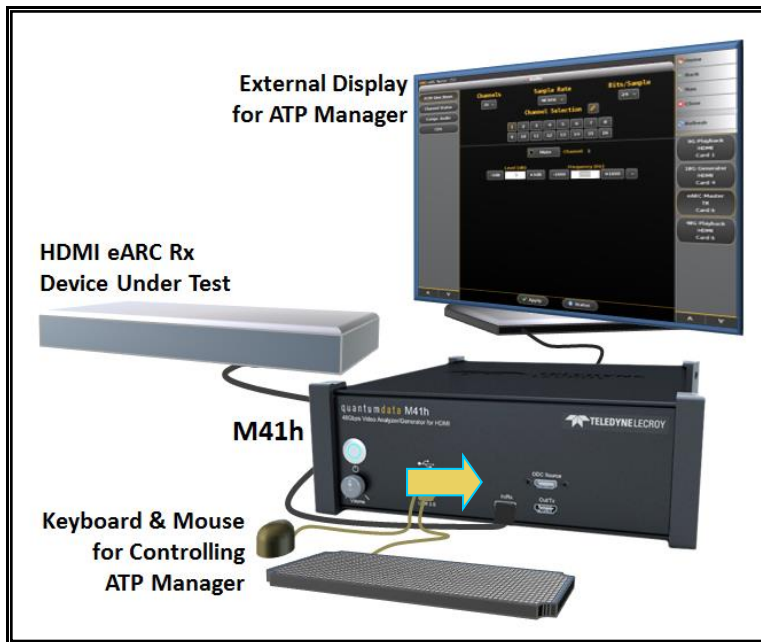
9.2 EARC Rx Functional Testing

This subsection provides procedures on testing eARC Rx devices. The M41h 48G Video Analyzer/Generator emulates an eARC Tx device. The function will invoke the Common mode commands to establish an eARC connection. You can monitor the Common mode channel transactions using the Aux Channel Analyzer (ACA) utility. Procedures for this are provided in the next subsection. You can then select from LPCM or compressed audio formats for transmission over the Differential mode channel. You can select between the Multi-Channel or 2 channel audio layout and mute the audio stream.

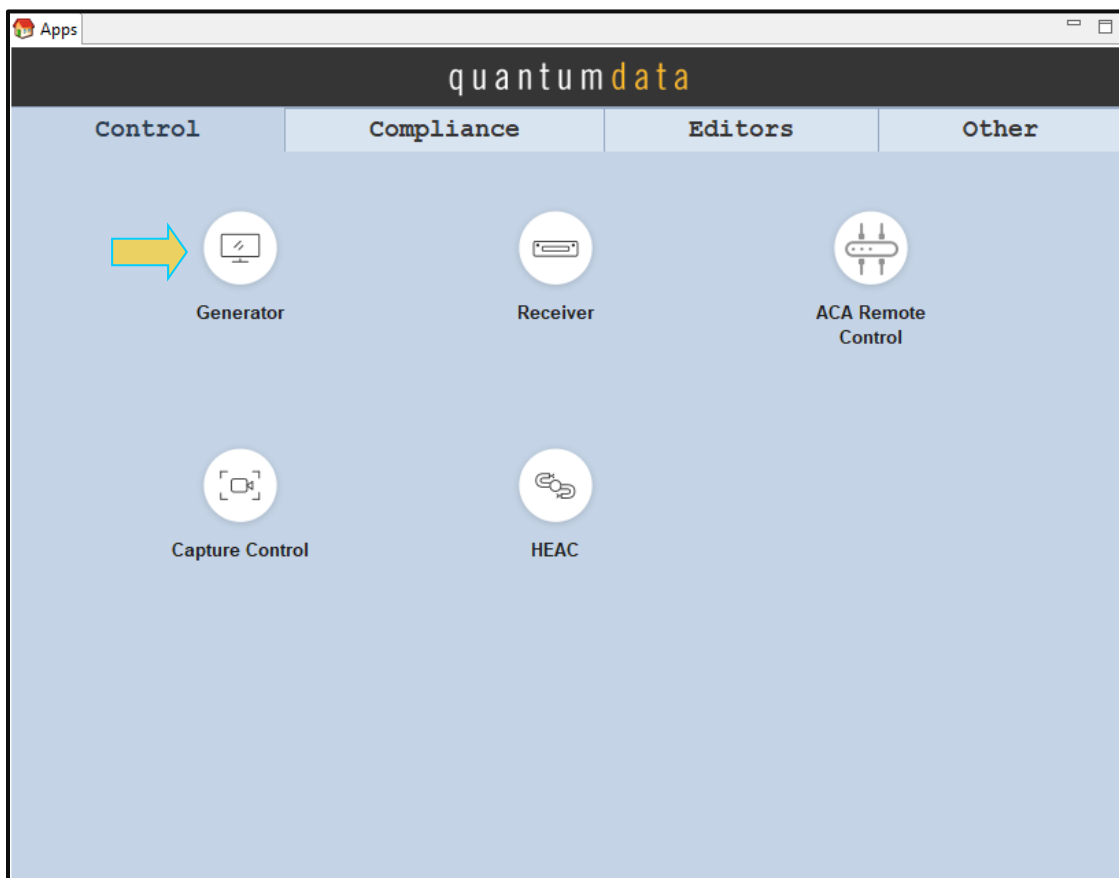
Use the procedures below to transmit eARC audio to test an eARC Rx device.

1. Establish the physical connection from the eARC Rx DUT to the M41h 48G Video Analyzer/Generator's HDMI Input port.
7. Prior to making the physical connection, you can initiate the Aux Channel Analyzer utility to monitor the eARC Common mode transactions. See the subsection below.

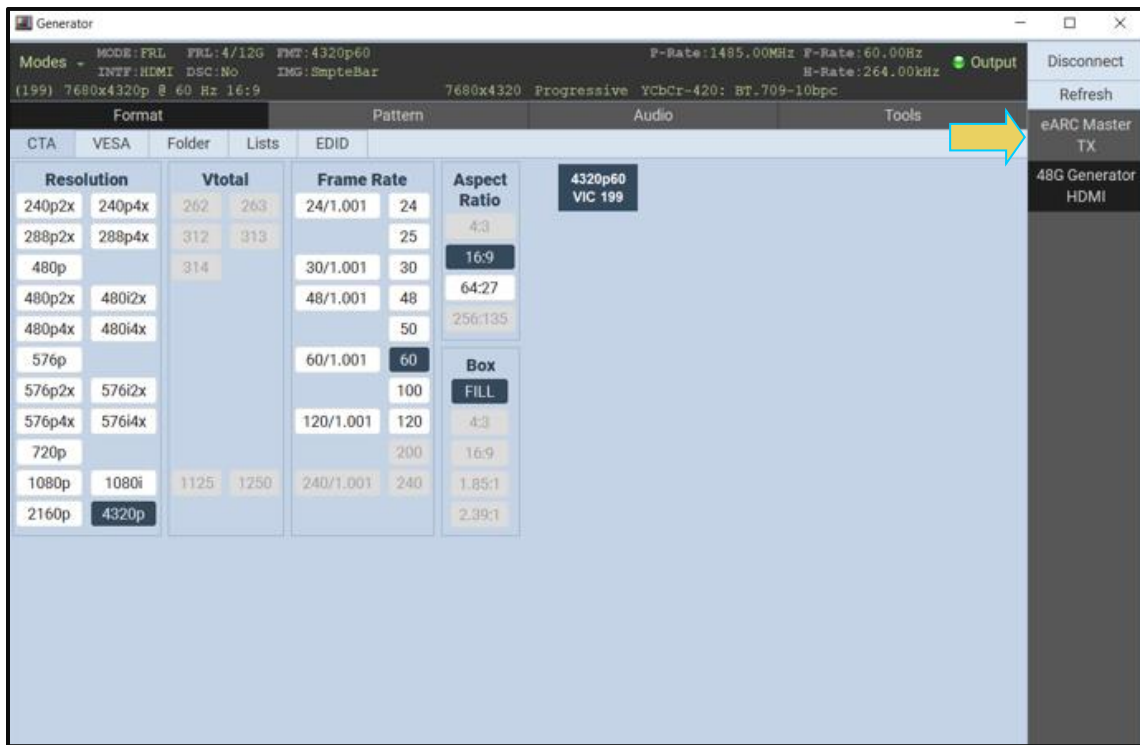
The test setup is shown below. The eARC Rx device is connected via a suitable eARC capable HDMI cable to the M41h 48G's Input port as shown below.



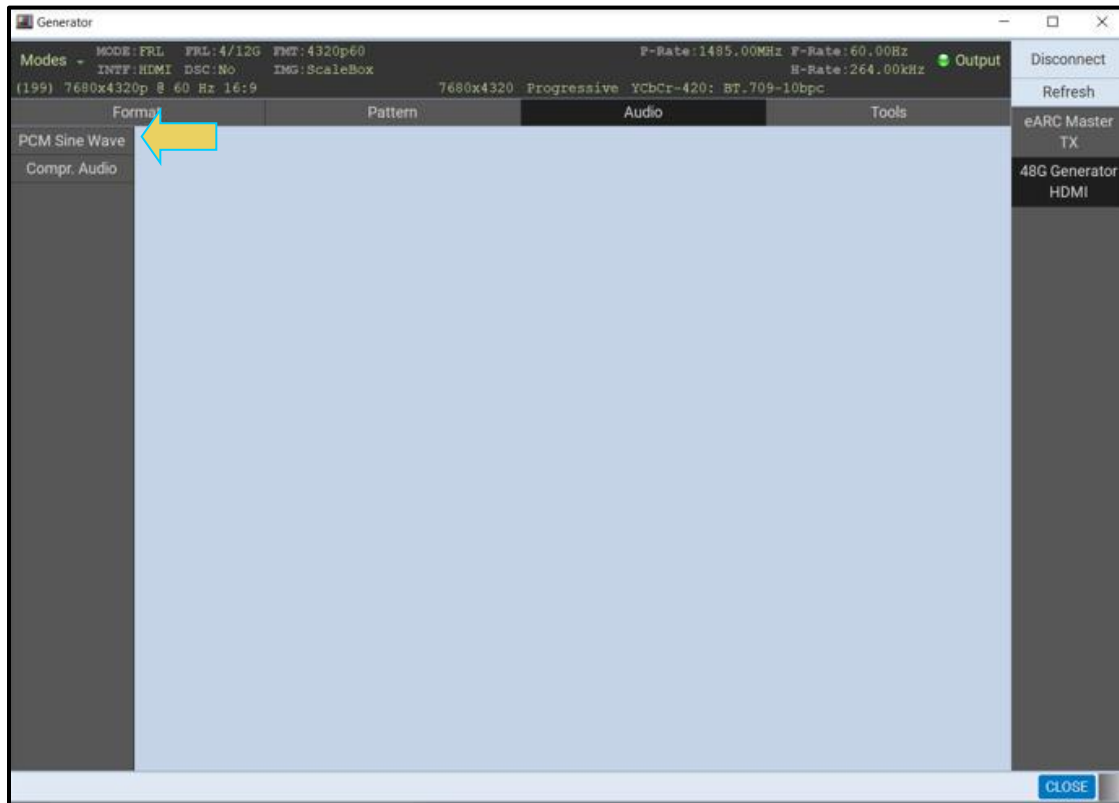
Setup for Testing eARC Rx devices



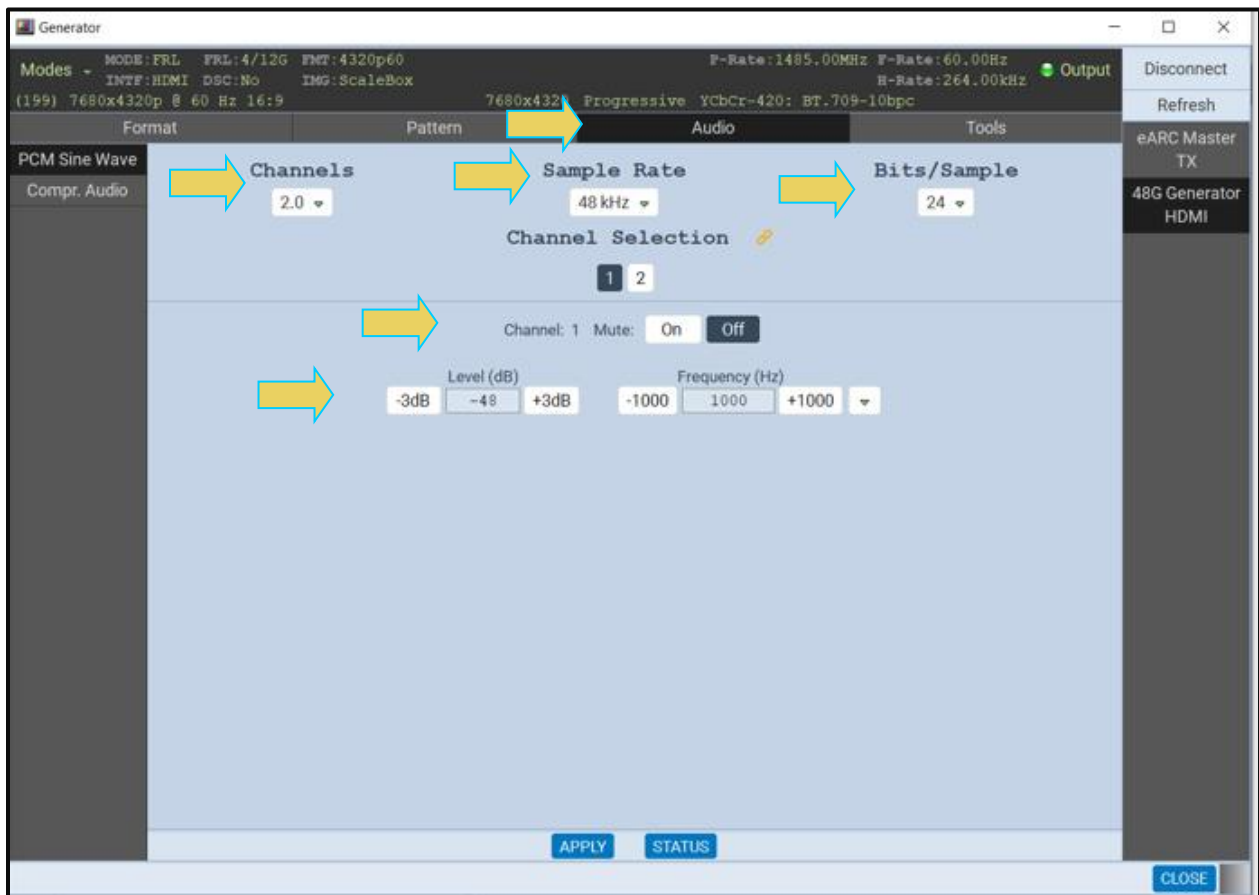
8. Click on the Generator and select eARC Tx Master as shown below.



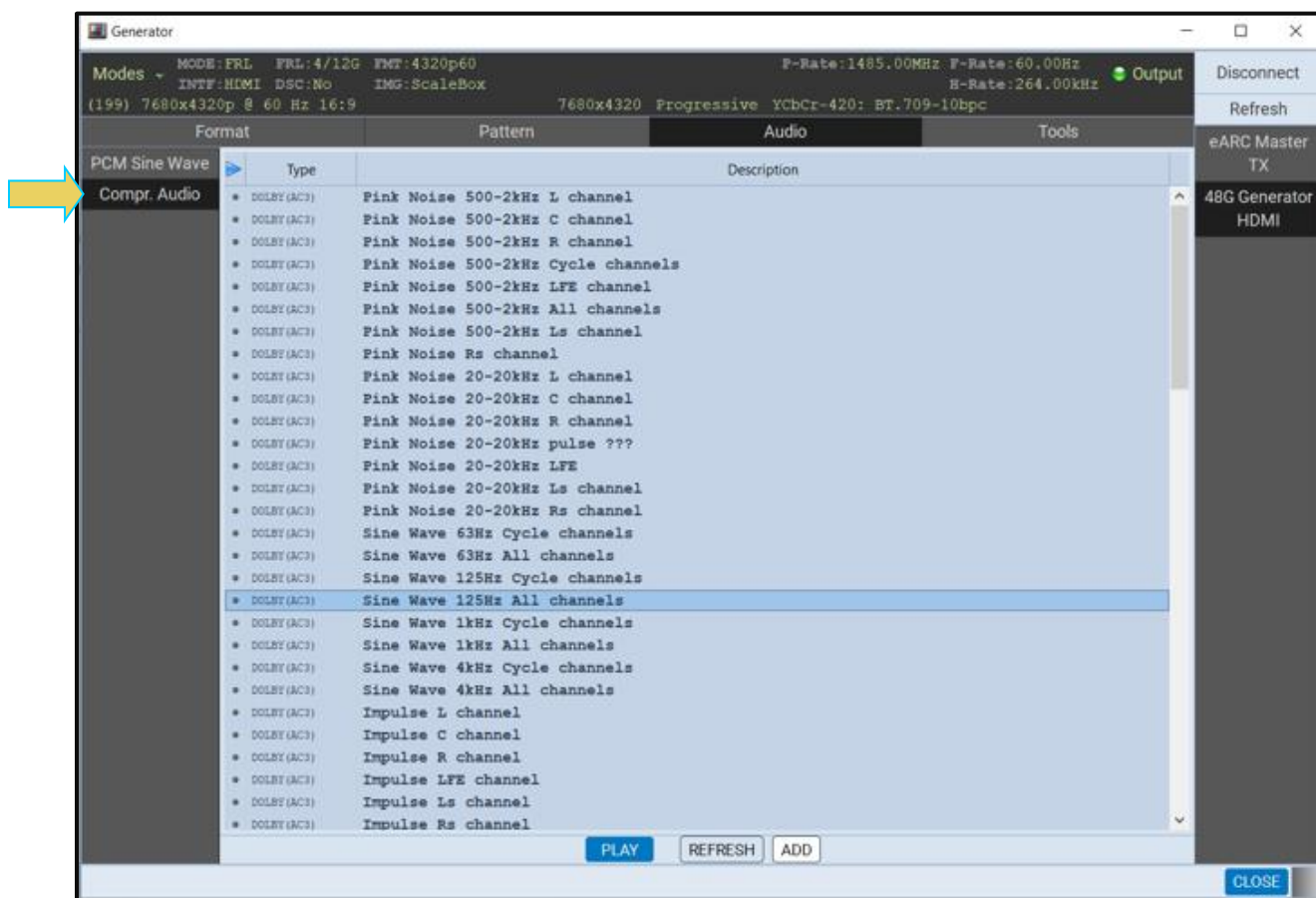
9. Click on the PCM Sine Wave button to select the LPCM audio to transmit out the eARC Differential mode channel.



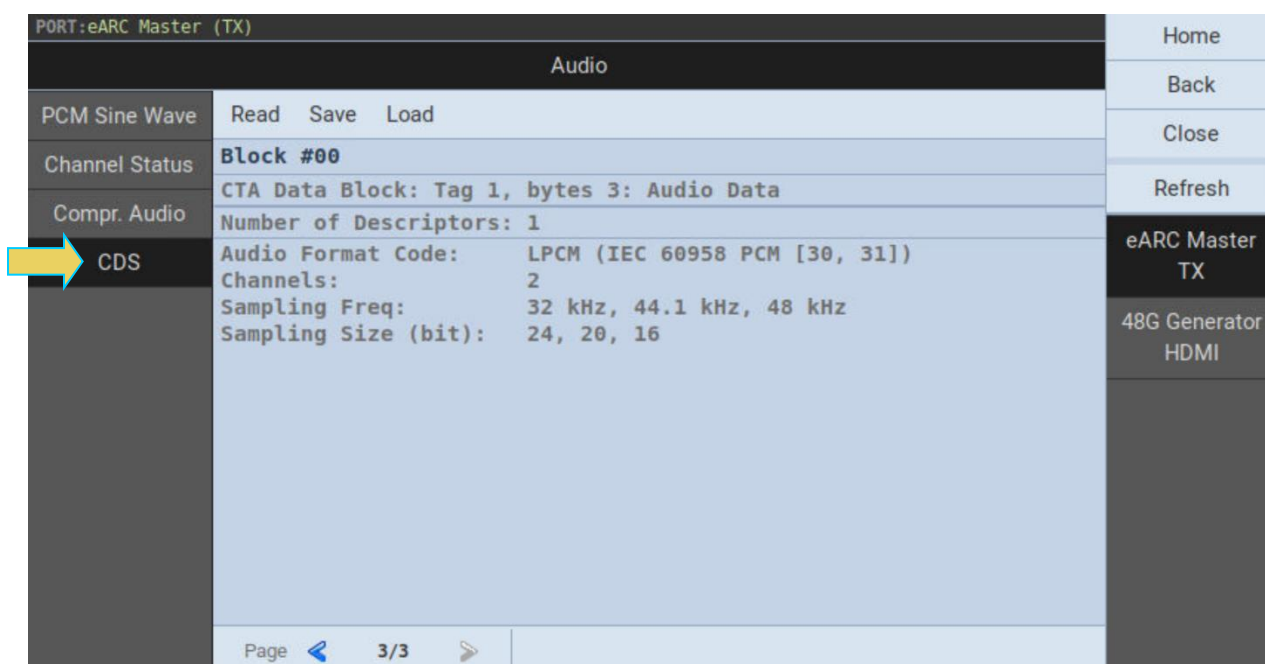
You can select the number of channels, sampling rate, bits per sample from the pull-down menus. You can also mute selected channels and set their amplitude. Refer to the screen examples below.



You can also transmit compressed audio files, but Dolby and DTS formats, out the eARC channel.



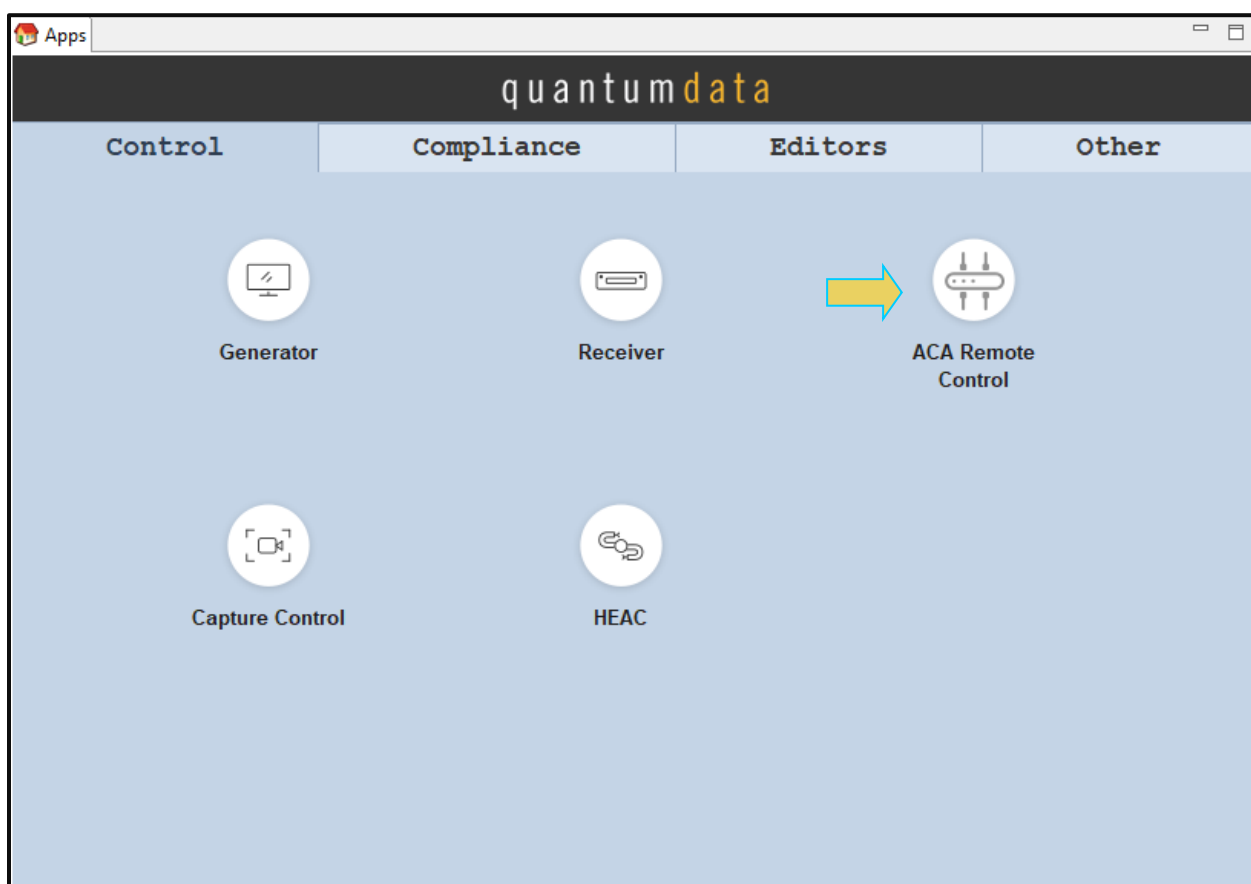
10. View the Capabilities Data Structure (CDS) of the connected eARC Rx device. The CDS shows the audio capabilities of the eARC Rx device.



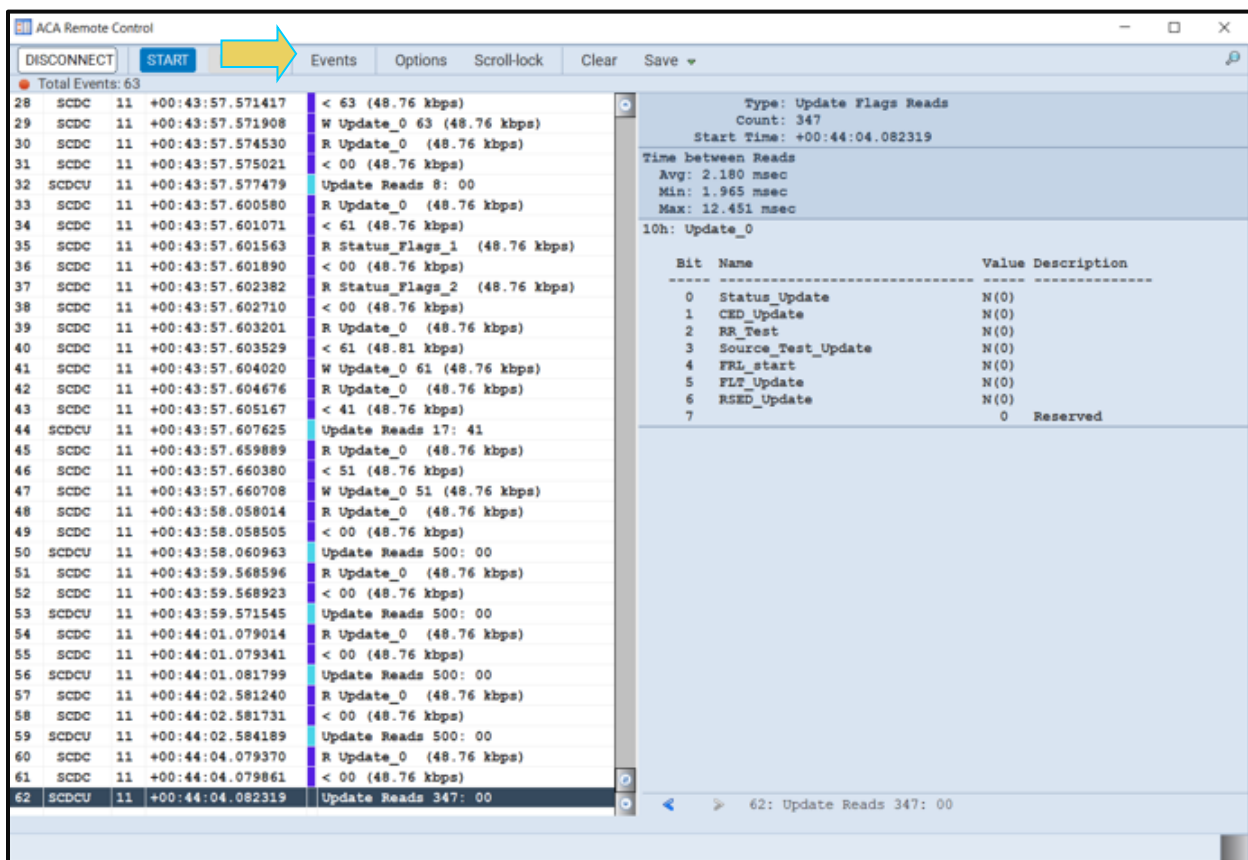
9.3 Monitoring the EARC Common Mode Transactions

The eARC common mode transactions can monitor using the Aux Channel Analyzer (ACA) utility. The procedures for using the Aux Channel Analyzer are provided in the Section that follows. The screen shows an example of the Common mode transactions viewed in the Aux Channel Analyzer.

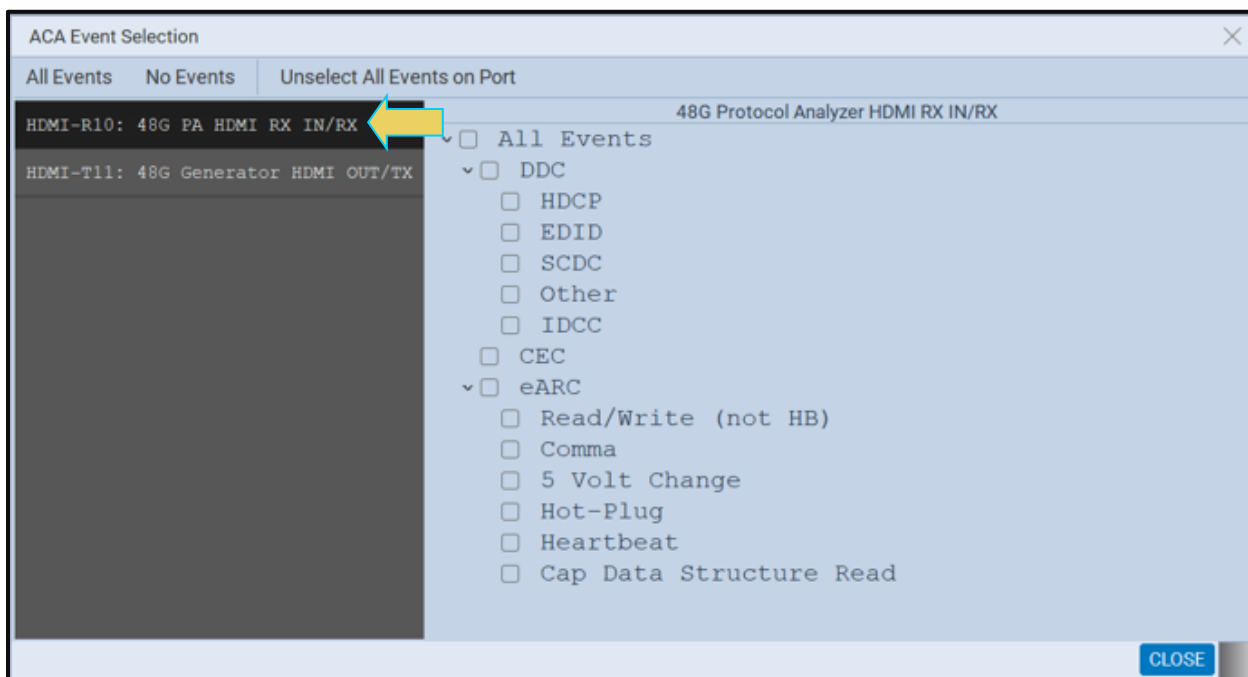
1. Access the ACA utility either through the embedded GUI or the remote GUI (shown below).



11. Access the **Event Selection** panel.



12. Select the eARC elements from the **Event Selection** panel.



The screenshot displays the ACA Remote Control software interface. The top menu bar includes DISCONNECT, START, PAUSE, Events, Options, Scroll-lock, Clear, and Save. The main window is divided into two panes. The left pane shows a list of events with columns for ID, Type, Time, and Data. The right pane provides a detailed view of the selected event (ID 62).

Event List (Left Pane):

ID	Type	Time	Data
28	SCDC	11	+00:43:57.571417 < 63 (48.76 kbps)
29	SCDC	11	+00:43:57.571908 W Update_0 63 (48.76 kbps)
30	SCDC	11	+00:43:57.574530 R Update_0 (48.76 kbps)
31	SCDC	11	+00:43:57.575021 < 00 (48.76 kbps)
32	SCDCU	11	+00:43:57.577479 Update Reads 8: 00
33	SCDC	11	+00:43:57.600580 R Update_0 (48.76 kbps)
34	SCDC	11	+00:43:57.601071 < 61 (48.76 kbps)
35	SCDC	11	+00:43:57.601563 R Status_Flags_1 (48.76 kbps)
36	SCDC	11	+00:43:57.601890 < 00 (48.76 kbps)
37	SCDC	11	+00:43:57.602382 R Status_Flags_2 (48.76 kbps)
38	SCDC	11	+00:43:57.602710 < 00 (48.76 kbps)
39	SCDC	11	+00:43:57.603201 R Update_0 (48.76 kbps)
40	SCDC	11	+00:43:57.603529 < 61 (48.81 kbps)
41	SCDC	11	+00:43:57.604020 W Update_0 61 (48.76 kbps)
42	SCDC	11	+00:43:57.604676 R Update_0 (48.76 kbps)
43	SCDC	11	+00:43:57.605167 < 41 (48.76 kbps)
44	SCDCU	11	+00:43:57.607625 Update Reads 17: 41
45	SCDC	11	+00:43:57.659889 R Update_0 (48.76 kbps)
46	SCDC	11	+00:43:57.660380 < 51 (48.76 kbps)
47	SCDC	11	+00:43:57.660708 W Update_0 51 (48.76 kbps)
48	SCDC	11	+00:43:58.058014 R Update_0 (48.76 kbps)
49	SCDC	11	+00:43:58.058505 < 00 (48.76 kbps)
50	SCDCU	11	+00:43:58.060963 Update Reads 500: 00
51	SCDC	11	+00:43:59.568596 R Update_0 (48.76 kbps)
52	SCDC	11	+00:43:59.568923 < 00 (48.76 kbps)
53	SCDCU	11	+00:43:59.571545 Update Reads 500: 00
54	SCDC	11	+00:44:01.079014 R Update_0 (48.76 kbps)
55	SCDC	11	+00:44:01.079341 < 00 (48.76 kbps)
56	SCDCU	11	+00:44:01.081799 Update Reads 500: 00
57	SCDC	11	+00:44:02.581240 R Update_0 (48.76 kbps)
58	SCDC	11	+00:44:02.581731 < 00 (48.76 kbps)
59	SCDCU	11	+00:44:02.584189 Update Reads 500: 00
60	SCDC	11	+00:44:04.079370 R Update_0 (48.76 kbps)
61	SCDC	11	+00:44:04.079861 < 00 (48.76 kbps)
62	SCDCU	11	+00:44:04.082319 Update Reads 347: 00

Event Details (Right Pane):

Type: Update Flags Reads
Count: 347
Start Time: +00:44:04.082319

Time between Reads
Avg: 2.180 msec
Min: 1.965 msec
Max: 12.451 msec

10h: Update_0

Bit	Name	Value	Description
0	Status_Update	N(0)	
1	CED_Update	N(0)	
2	RR_Test	N(0)	
3	Source_Test_Update	N(0)	
4	FRL_start	N(0)	
5	FLT_Update	N(0)	
6	RSED_Update	N(0)	
7		0	Reserved

62: Update Reads 347: 00

You will then see the eARC Common mode transactions in the ACA window.

The screenshot displays the ACA Data Viewer application. The main window is titled 'ACA Data Viewer' and contains a menu bar with 'Open', 'Close', 'Export', 'Options', 'Filter', and 'Find'. Below the menu bar, there is a toolbar with icons for opening, saving, and other functions. The main area is divided into two panes. The left pane shows a list of events, with the selected event highlighted. The right pane shows the details of the selected event.

Line	Type	Direction	Time	Speed	Message
43	HDCP	HDMI-R30	+05:15:22.866548	R RxStatus (87.46 kbps)	
44	HDCP	HDMI-R30	+05:15:22.866712	< 0000 (87.46 kbps)	
45	SCDC	HDMI-T10	+05:15:13.982459	R TMDS_Config (77.28 kbps)	
46	SCDC	HDMI-T10	+05:15:13.982623	< 00 (77.28 kbps)	
47	SCDC	HDMI-T10	+05:15:13.982951	W TMDS_Config 00 (77.28 kbps)	
48	HDCP	HDMI-R30	+05:15:25.709784	R HDCP2Version (87.46 kbps)	
49	HDCP	HDMI-R30	+05:15:25.710111	< 04 (87.46 kbps)	
50	HDCP	HDMI-R30	+05:15:25.715682	W AKE_Init (87.46 kbps)	
51	DDC	HDMI-T10	+05:15:15.741746	Missing leading START	
52	SCDC	HDMI-T10	+05:15:16.660547	R TMDS_Config (77.28 kbps)	
53	SCDC	HDMI-T10	+05:15:16.660875	< 00 (77.28 kbps)	
54	SCDC	HDMI-T10	+05:15:16.661039	W TMDS_Config 00 (77.40 kbps)	
55	HDCP	HDMI-T10	+05:15:18.374451	R HDCP2Version (87.46 kbps)	
56	HDCP	HDMI-T10	+05:15:18.374779	< 04 (87.30 kbps)	
57	HDCP	HDMI-T10	+05:15:18.380349	W AKE_Init (87.46 kbps)	
58	HDCP	HDMI-T10	+05:15:18.394767	R RxStatus (87.46 kbps)	
59	HDCP	HDMI-T10	+05:15:18.394931	< 1602 (87.46 kbps)	
60	HDCP	HDMI-T10	+05:15:18.395750	R Read_Message (87.46 kbps)	
61	HDCP	HDMI-R30	+05:15:28.387871	R HDCP2Version (87.46 kbps)	
62	HDCP	HDMI-R30	+05:15:28.388199	< 04 (87.46 kbps)	
63	HDCP	HDMI-R30	+05:15:28.393770	W AKE_Init (87.46 kbps)	
64	HDCP	HDMI-R30	+05:15:28.408187	R RxStatus (87.46 kbps)	
65	HDCP	HDMI-R30	+05:15:28.408515	< 1602 (87.30 kbps)	
66	HDCP	HDMI-R30	+05:15:28.409334	R Read_Message (87.46 kbps)	
67	HDCP	HDMI-T10	+05:15:18.396078	< AKE_Send_Cert (87.46 kbps)	
68	HDCP	HDMI-T10	+05:15:18.571384	W AKE_Stored_km (87.46 kbps)	
69	HDCP	HDMI-T10	+05:15:18.585474	R RxStatus (87.46 kbps)	
70	HDCP	HDMI-T10	+05:15:18.585638	< 2100 (87.46 kbps)	
71	HDCP	HDMI-T10	+05:15:18.586457	R Read_Message (87.46 kbps)	
72	HDCP	HDMI-T10	+05:15:18.586621	< AKE_Send_N_prime (87.46 kbps)	
73	HDCP	HDMI-T10	+05:15:18.597762	W LC_Init (87.46 kbps)	
74	HDCP	HDMI-T10	+05:15:18.614309	R RxStatus (87.46 kbps)	
75	HDCP	HDMI-T10	+05:15:18.614473	< 2100 (87.46 kbps)	
76	HDCP	HDMI-T10	+05:15:18.615292	R Read_Message (87.46 kbps)	
77	HDCP	HDMI-T10	+05:15:18.615620	< LC_Send_L_prime (87.46 kbps)	

The right pane shows the details of the selected event (Line 57: W AKE_Init (87.46 kbps)). The details include:

- Type: HDCP
- Start Time: +05:15:18.380349
- Duration: 1.311 msec
- Maximum I2C Rate: 87.46 kbps
- Write, 12 bytes
- Register: 60h
- Name: Write_Message
- Message: AKE_Init (12 bytes)
- msg_id: 2
- r_tx[63..0]: 4B DA F8 11 46 0A 6F 77
- TxCaps: 02 00 00
- VERSION: 2

Below the details, there is a hex dump of the message data:

```

* START *
0000 74 60 02 4B DA F8 11 46 | t . K . . . F
0008 0A 6F 77 02 00 00      | . o w . . .
* STOP *

```

The status bar at the bottom of the window shows the current event: 57: W AKE_Init (87.46 kbps).

Refer to the ACA Section below for more details on using the ACA utility.

10 Auxiliary Channel Analyzer (ACA) Utilities

The Auxiliary Channel Analyzer (**ACA**) utilities enable you to view the DDC channel traffic for HDMI® streams in real time or from stored real time log files. You can view the HDCP authentication transactions, EDID exchanges, SCDC transactions for FRL link training and CEC messages in real time with the ACA either through the embedded M41h GUI or the external ATP Manager application running on a host PC. You can view the transactions between the M41h 48G Video Analyzer/Generator receiver port and a connected HDMI source device or you can monitor the auxiliary channel passively between an HDMI source and sink device.

There are three (3) Auxiliary Channel Analyzer utilities:

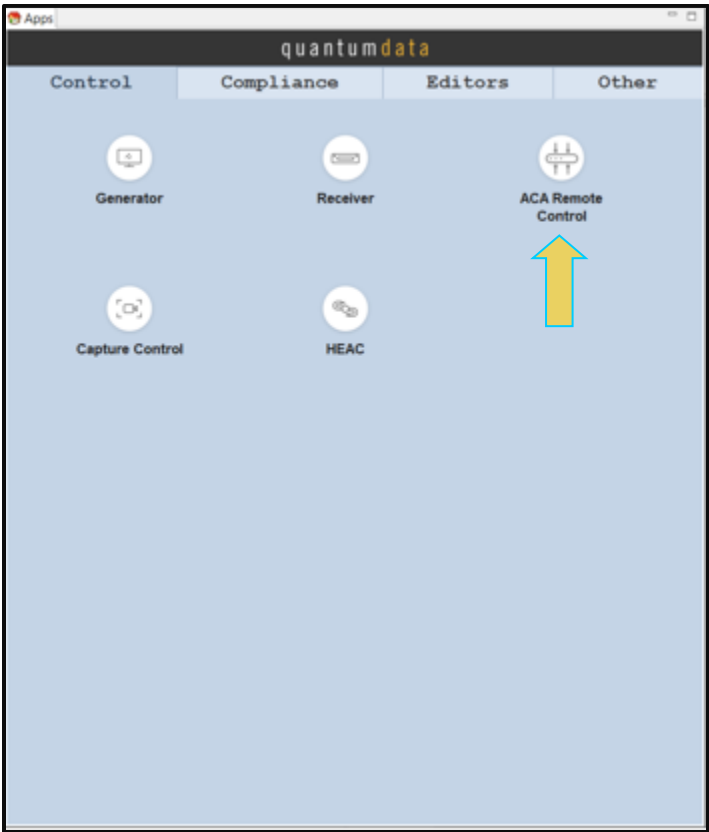
- Auxiliary Channel Analyzer (“ACA”) – Used for real time viewing auxiliary channel HDMI DDC channel data through the *embedded* ATP Manager. You can also open existing ACA trace files stored on the M41h Instrument.
- ACA Remote Control - Used for viewing auxiliary channel HDMI DDC channel data through the *external* ATP 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 an M41h test instrument to view these transactions.

10.1 Aux Channel Analyzer (ACA) – For Real Time Viewing of Auxiliary Channel Data

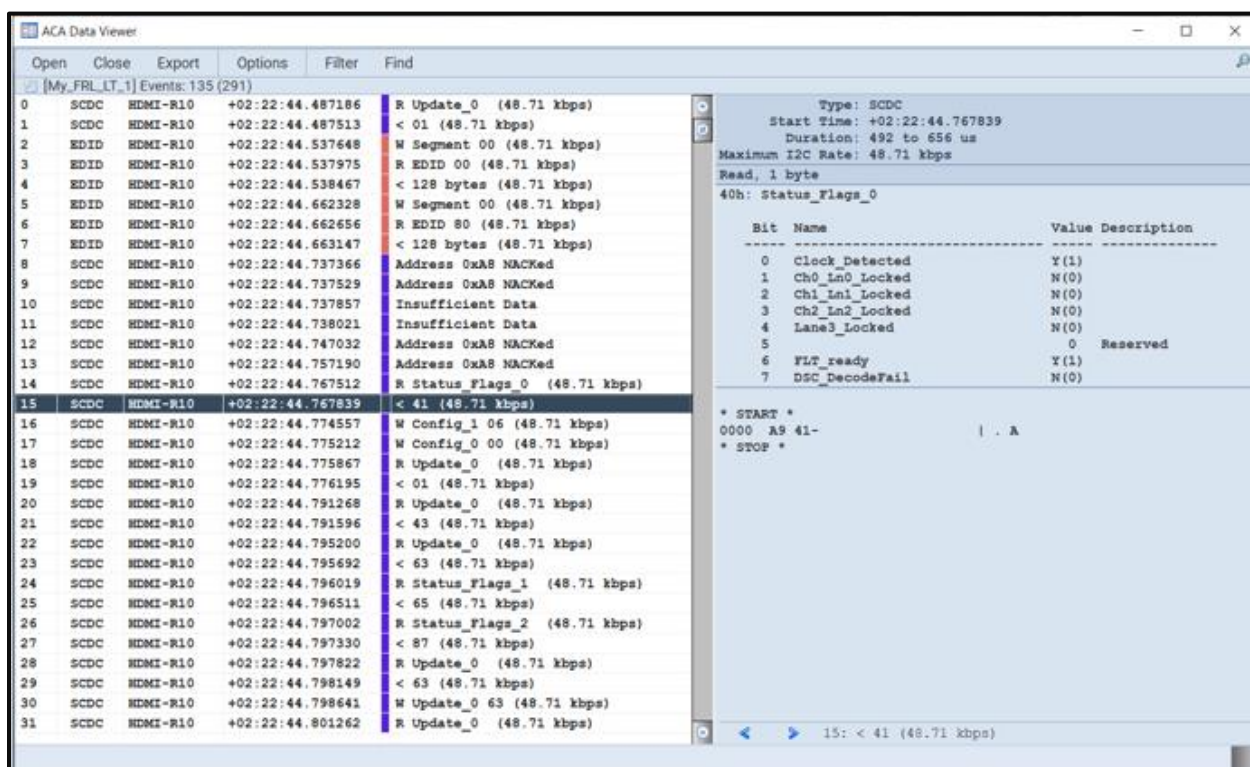
This subsection describes the **Aux Channel Analyzer** utility used for viewing the real time auxiliary channel data through the *embedded* ATP Manager.

10.1.1 Aux Channel Analyzer (ACA) – Panel Description

The Aux Channel Analyzer panel is described in the table below. There is a control menu panel on the right side. The control menu and elements of the ACA panel are described in the following table.



The following is an example of a populated ACA window.

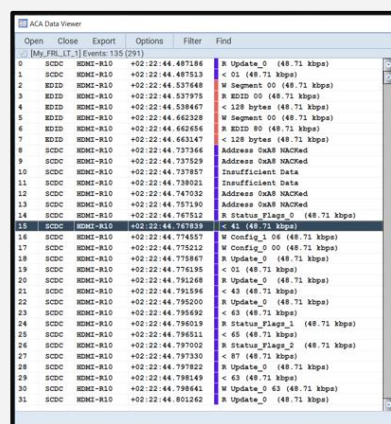


Real Time – ACA

Aux Channel Analyzer (ACA)

ACA Trace Panel

FRL Link Training Transaction Example



Information / Function

The following information is provided in the ACA data dialog box for each Event:

Item number – This is a unique sequence number of the transaction.

Type – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP and CEC messaging.

M41h Port number, slot number.

Time stamp (optional viewing field) – Shows the timestamp of each transaction. Can either be absolute time based (shown) on the M41h system clock or relative time (Time -deltas) referenced from the initial transaction in the trace.

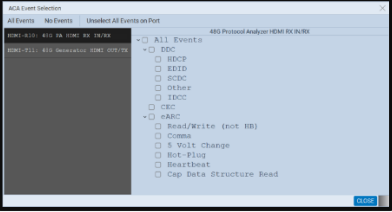
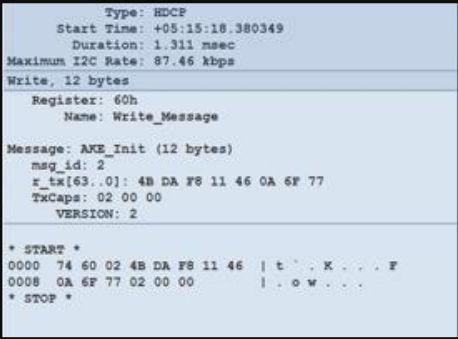
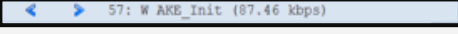
Transaction Description – A description of the transaction.

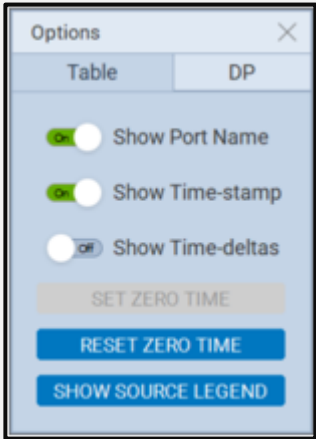
ACA Control Menu

ACA Event Selection

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:

Home – Navigates you back to the Home menu screen of the embedded ATP Manager.

Real Time – ACA	Information / Function
	<p>Back – Navigates back to the previous screen in the Real Time mode.</p> <p>Nav – Takes you to the Navigation window.</p> <p>Close – Closes out the ACA application.</p> <p>Start/Stop – Starts and Stops the collection of DDC data.</p> <p>Resume/Pause – Halts the updates of the data to the ACA panel to view traces and allows you to resume.</p> <p>Events – Opens up the ACA Event Selection window (below left) enabling you to specify the port that you wish to collect trace data from. Also selects which events you wish to collect. Use the check boxes to select which event you wish to collect or collect All Events.</p> <p>Options – Opens up a flyout menu described below-left.</p> <p>Data – Opens up flyout menu with the following options (described below).</p> <p>Clear – Clears the ACA Trace Panel.</p> <p>Open – Opens an existing trace file stored on the M41h.</p> <p>Save – Saves a current trace file to the M41h file system.</p>
	<p>The following information is provided in the ACA Event Details dialog box. Two examples are shown on the left. One for HDCP transactions and another for Link Training transactions:</p> <p>Type – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP and CEC messages.</p> <p>Start Time – This start time of the transaction in microseconds from a reference time determined when the capture of real time data began.</p> <p>Note: The information in the Details panel will vary depending on the type of log record that is selected.</p> <p>Duration – The duration in milliseconds of the transaction.</p> <p>Direction – The direction of the transaction either a request or a reply.</p> <p>Maximum I2C Rate – The rate that the I2C channel clock is operating.</p> <p>Details (text) – The contents of the transaction in human readable text.</p> <p>Details (hex) – The contents of the transaction in hex data.</p>
	<p>There are some control arrows and a status panel on the bottom of the ACA Event Details panel. These are as follows:</p>

Real Time – ACA	Information / Function
	<p>Left arrow – The left arrow allows you to see the details of the next transaction.</p> <p>Right arrow – The right arrow allows you to see the details of the previous transaction.</p> <p>Status field – Shows the sequence number and the description of the selected transaction.</p>
<p>Options Flyout Menu</p> 	<p>The Options flyout menu items are described below. These options are only available on the Real Time ACA when the trace logging is stopped.</p> <p>Scroll Lock – The left arrow allows you to see the details of the next transaction.</p> <p>Source Legend – Displays a dialog box listing the interface cards on the M41h Instrument and their slot and port numbers, e.g. 32 is Slot 3, Port 2.</p> <p>Show Port Name – Enables you to display or not display the Port number.</p> <p>Show Time-stamp – Enables you to show or not show the time stamps for each transaction.</p> <p>Show Time-deltas – Enables you to show the time stamps relative to the previous transaction. Only available when time stamps are shown (see above).</p> <p>Set Zero Time – Enables you to set a log record to zero. Subsequent log records are relative to this new zero record.</p> <p>Reset to Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.</p>

10.2 ACA Remote Control – For Real Time Viewing of HDMI Aux Channel Data

This subsection describes the **ACA Remote Control** utility used for viewing the real time HDMI DDC Channel transactions through the *external* ATP Manager.

10.2.1 ACA Remote Control – Panel Description

The **ACA Remote Control** panel application is available only on the *external* ATP Manager. It enables you to collect and view the ACA transactions in real time from a remotely connected PC with the ATP Manager application. The control panel elements are described in the table below.

The screenshot displays the ACA Remote Control software interface. The top menu bar includes DISCONNECT, START, PAUSE, Events, Options, Scroll-lock, Clear, and Save. The main window is divided into two panes. The left pane shows a list of events with columns for Item number, Type, M41h Card number, Interface number, Time stamp, and Transaction Description. The right pane provides a detailed view of the selected event (Item 62), including its Type (Update Flags Reads), Count (347), Start Time (+00:44:04.082319), and Time between Reads (Avg: 2.180 msec, Min: 1.965 msec, Max: 12.451 msec). Below this, a table lists the bit names and values for the update flags.

Bit	Name	Value	Description
0	Status_Update	N(0)	
1	CEC_Update	N(0)	
2	RR_Test	N(0)	
3	Source_Test_Update	N(0)	
4	FRL_start	N(0)	
5	FLT_Update	N(0)	
6	RSED_Update	N(0)	
7		0	Reserved

ACA Remote Control

Auxiliary Channel Analyzer

ACA Trace Panel

The screenshot displays the ACA Remote Control software interface, showing a list of events. The table has columns for Item number, Type, M41h Card number, Interface number, Time stamp, and Transaction Description. The events listed include various update reads and status updates.

Item	Type	M41h Card	Interface	Time stamp	Transaction Description
28	SCDC	11		+00:43:57.571417	< 63 (48.76 kbps)
29	SCDC	11		+00:43:57.571908	W Update_0 63 (48.76 kbps)
30	SCDC	11		+00:43:57.574530	R Update_0 (48.76 kbps)
31	SCDC	11		+00:43:57.575021	< 00 (48.76 kbps)
32	SCDCU	11		+00:43:57.577479	Update Reads 8: 00
33	SCDC	11		+00:43:57.600580	R Update_0 (48.76 kbps)
34	SCDC	11		+00:43:57.601071	< 61 (48.76 kbps)
35	SCDC	11		+00:43:57.601563	R Status_Flags_1 (48.76 kbps)
36	SCDC	11		+00:43:57.601890	< 00 (48.76 kbps)
37	SCDC	11		+00:43:57.602382	R Status_Flags_2 (48.76 kbps)
38	SCDC	11		+00:43:57.602710	< 00 (48.76 kbps)
39	SCDC	11		+00:43:57.603201	R Update_0 (48.76 kbps)
40	SCDC	11		+00:43:57.603529	< 61 (48.81 kbps)
41	SCDC	11		+00:43:57.604020	W Update_0 61 (48.76 kbps)
42	SCDC	11		+00:43:57.604676	R Update_0 (48.76 kbps)
43	SCDC	11		+00:43:57.605167	< 41 (48.76 kbps)
44	SCDCU	11		+00:43:57.607625	Update Reads 17: 41
45	SCDC	11		+00:43:57.659889	R Update_0 (48.76 kbps)
46	SCDC	11		+00:43:57.660380	< 51 (48.76 kbps)
47	SCDC	11		+00:43:57.660708	W Update_0 51 (48.76 kbps)
48	SCDC	11		+00:43:58.058014	R Update_0 (48.76 kbps)
49	SCDC	11		+00:43:58.058505	< 00 (48.76 kbps)
50	SCDCU	11		+00:43:58.060963	Update Reads 500: 00
51	SCDC	11		+00:43:59.568596	R Update_0 (48.76 kbps)
52	SCDC	11		+00:43:59.568923	< 00 (48.76 kbps)
53	SCDCU	11		+00:43:59.571545	Update Reads 500: 00
54	SCDC	11		+00:44:01.079014	R Update_0 (48.76 kbps)
55	SCDC	11		+00:44:01.079341	< 00 (48.76 kbps)
56	SCDCU	11		+00:44:01.081799	Update Reads 500: 00
57	SCDC	11		+00:44:02.581240	R Update_0 (48.76 kbps)
58	SCDC	11		+00:44:02.581731	< 00 (48.76 kbps)
59	SCDCU	11		+00:44:02.584189	Update Reads 500: 00
60	SCDC	11		+00:44:04.079370	R Update_0 (48.76 kbps)
61	SCDC	11		+00:44:04.079861	< 00 (48.76 kbps)
62	SCDCU	11		+00:44:04.082319	Update Reads 347: 00

Information / Function

The following information is provided in the ACA Remote Control Panel data dialog box for each event:

Item number – This is a unique sequence number of the transaction.

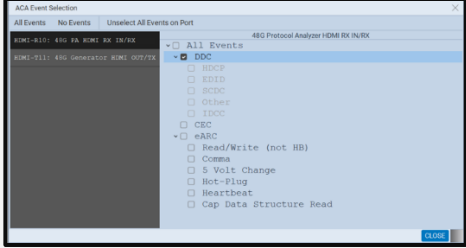
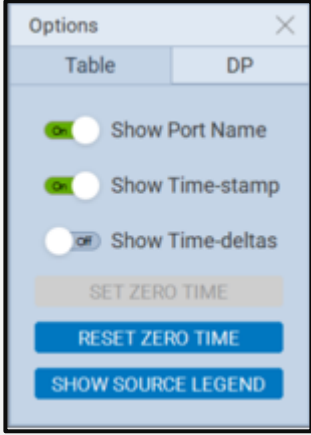
Type – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP and CEC messages.

M41h Card number, **Interface number**.

Time stamp (optional viewing field) – Shows the timestamp of each transaction. Can either be absolute time based (shown) on the M41h system clock or relative time (Time-deltas) referenced from the initial transaction in the trace.

Transaction Description – A description of the transaction.

ACA Remote Control	Information / Function																																				
<div>Details Panel</div> <div><div>Type: SCDC Start Time: +02:22:44.767839 Duration: 492 to 656 us Maximum I2C Rate: 48.71 kbps Read, 1 byte 40h: Status_Flags_0</div><table><thead><tr><th>Bit</th><th>Name</th><th>Value</th><th>Description</th></tr></thead><tbody><tr><td>0</td><td>Clock_Detected</td><td>Y(1)</td><td></td></tr><tr><td>1</td><td>Ch0_Ln0_Locked</td><td>N(0)</td><td></td></tr><tr><td>2</td><td>Ch1_Ln1_Locked</td><td>N(0)</td><td></td></tr><tr><td>3</td><td>Ch2_Ln2_Locked</td><td>N(0)</td><td></td></tr><tr><td>4</td><td>Ln3_Locked</td><td>N(0)</td><td></td></tr><tr><td>5</td><td></td><td>0</td><td>Reserved</td></tr><tr><td>6</td><td>FLT_ready</td><td>Y(1)</td><td></td></tr><tr><td>7</td><td>DSC_DecodeFail</td><td>N(0)</td><td></td></tr></tbody></table><div>* START * 0000 A9 41- . A * STOP *</div></div>	Bit	Name	Value	Description	0	Clock_Detected	Y(1)		1	Ch0_Ln0_Locked	N(0)		2	Ch1_Ln1_Locked	N(0)		3	Ch2_Ln2_Locked	N(0)		4	Ln3_Locked	N(0)		5		0	Reserved	6	FLT_ready	Y(1)		7	DSC_DecodeFail	N(0)		<p>The following information is provided in the ACA Event Details dialog box. Two examples are shown on the left. One for HDCP transactions and another for Link Training transactions:</p> <p>Type – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP, SCDC and CEC messages. Only SCDC applies at this time.</p> <p>Start Time – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.</p> <p>Note: The information in the Details panel will vary depending on the type of log record that is selected.</p> <p>Duration – The duration in milliseconds of the transaction.</p> <p>Maximum I2C Rate – The rate that the I2C channel clock is operating.</p> <p>Details (text) – The contents of the transaction in human readable text.</p> <p>Details (hex) – The contents of the transaction in hex data.</p>
Bit	Name	Value	Description																																		
0	Clock_Detected	Y(1)																																			
1	Ch0_Ln0_Locked	N(0)																																			
2	Ch1_Ln1_Locked	N(0)																																			
3	Ch2_Ln2_Locked	N(0)																																			
4	Ln3_Locked	N(0)																																			
5		0	Reserved																																		
6	FLT_ready	Y(1)																																			
7	DSC_DecodeFail	N(0)																																			
<div><div>< > 15: < 41 (48.71 kbps)</div></div>	<p>There are some control arrows and a status panel on the bottom of the ACA Event Details panel. These are as follows:</p> <p>Left arrow – The left arrow allows you to see the details of the next transaction.</p> <p>Right arrow – The right arrow allows you to see the details of the previous transaction.</p> <p>Status field – Shows the sequence number and the description of the selected transaction.</p>																																				
<div><div>DISCONNECT Start Pause Events Options Scroll lock Clear Save +</div><div>Total Events: 63</div><div>28 SCDC 11 +00:43:57.571417 < 63 (48.74 kbps)</div><div>29 SCDC 11 +00:43:57.571908 W Update_0 63 (48.76 kbps)</div><div>30 SCDC 11 +00:43:57.574330 A Update_0 (48.74 kbps)</div><div>31 SCDC 11 +00:43:57.575021 < 60 (48.74 kbps)</div><div>Save to Instrument</div><div>Save to PC</div><div>Status Time taken: 0.00 s</div></div>	<p>There is a menu associated with the ACA Remote Control Info panel. It is located on the right side of the panel. There are four examples shown to the left reflecting the differ states:</p> <p>“Viewing Glass” – This is on the upper left of the ACA window. It is not part of the control menu. When activated it displays a pop-up window that enables you to display the text in Small, Medium, or Large text.</p> <p>Connect/Disconnect – Connects or disconnects the ACA Remote Control application from an M41h System.</p> <p>Start/Stop – Starts and Stops the collection of auxiliary channel data.</p> <p>Resume/Pause – Pauses and/or Resumes the collection of auxiliary channel data to the ACA panel.</p>																																				
ACA Event Selection																																					

ACA Remote Control	Information / Function
	<p>Clear – Clears the ACA Trace Panel. The trace collection must be paused or stopped to clear the traces.</p> <p>Events – Opens up the ACA Event Selection window (below left) enabling you to specify the and port that you wish to collect trace data from. Also selects which events you wish to collect (left). Use the check boxes to select which event you wish to collect or collect All Events.</p> <p>Options – Opens up a flyout menu described below.</p> <p>Save to Instrument – Saves the file to the M41h system that the host PC is connected to.</p> <p>Save to PC – Saves a current trace file to the Host PC.</p> <p>Hide – Makes the ACA Remote Viewer window disappear.</p>
<p>Options Flyout Menu</p> 	<p>The Options flyout menu items are described below. These options are only available on the real time ACA when the trace logging is stopped.</p> <p>Scroll Lock – The left arrow allows you to see the details of the next transaction.</p> <p>Source Legend – Displays a dialog box listing the interface cards on the M41h Instrument and their slot and port numbers, e.g. 32 is Slot 3, Port 2.</p> <p>Show Port Name – Enables you to display or not display the Port number.</p> <p>Show Time-stamp – Enables you to show or not show the time stamps for each transaction.</p> <p>Show Time-deltas – Enables you to show the time stamps relative to the previous transaction. Only available when time stamps are shown (see above).</p> <p>Set Zero Time – Enables you to set a log record to zero. Subsequent log records are relative to this new zero record.</p> <p>Reset to Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.</p>

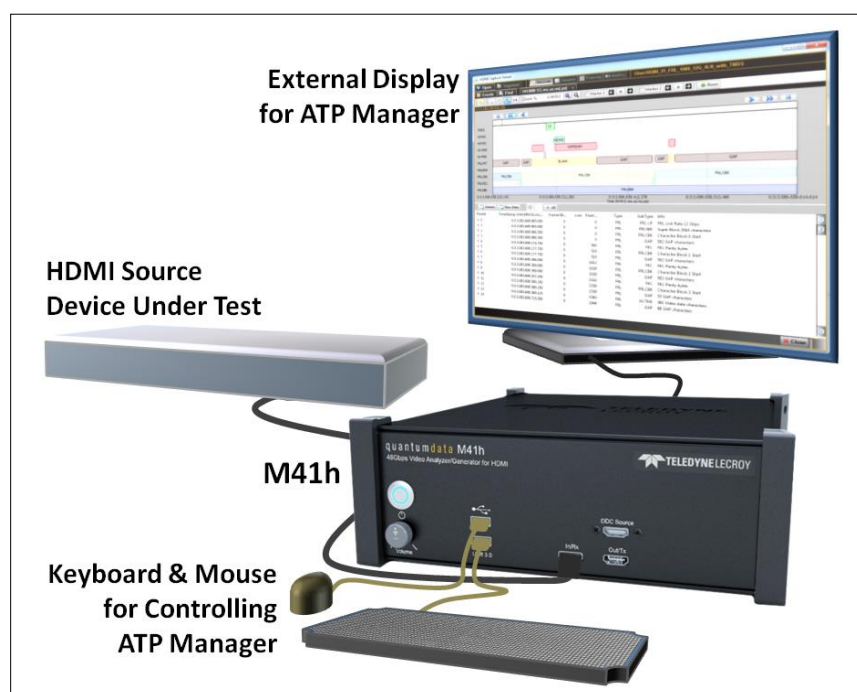
10.3 Monitoring the HDMI Auxiliary Channel with the ACA Utilities

This subsection describes the procedures for monitoring the auxiliary channel data through the ATP Manager using the Aux Channel Analyzer real time utilities. You can monitor the HDMI DDC transactions in real time either while the M41h 48G Video Analyzer/Generator is emulating a sink device or you can monitor the transactions passively. Most of the screen examples are from the Aux. Channel Analyzer utility which is the embedded M41h GUI utility.

10.3.1 Making the physical connections.

Use the following procedures to make the physical connection from the UHD source to the M41h 48G Video Analyzer/Generator's Rx port.

1. Connect the output of the UHD HDMI source to the input (Rx) port on the M41h 48G Video Analyzer/Generator as shown in the diagram below:



Connection for HDMI sink emulation and source testing – M41h



Connection for HDMI sink emulation and source testing – M41h

10.3.2 Monitoring the HDMI DDC Transactions in Real Time with the ACA Utilities

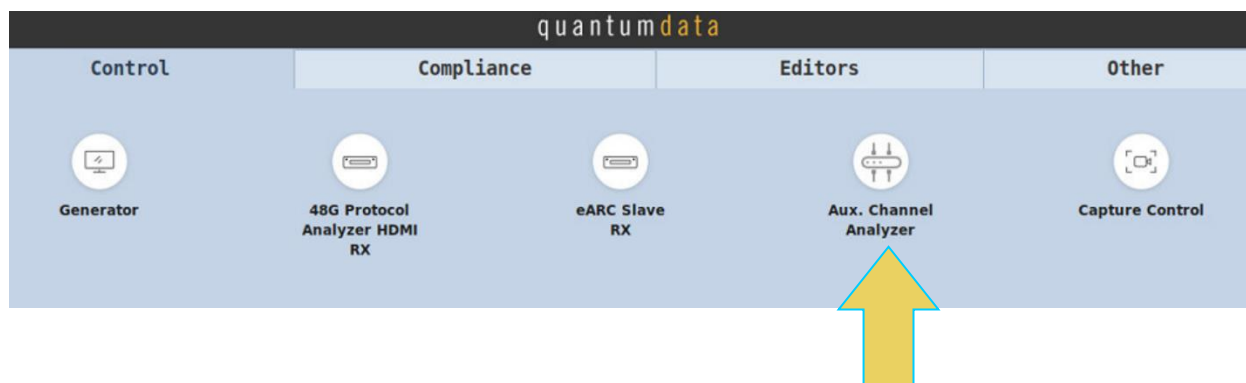
Use the following procedures to monitor the HDMI DDC transactions with an HDMI device in real time. The procedures assume that the HDMI device under test is powered up and connected to one of the M41h 48G Video Analyzer/Generator ports. The operation of the ACA is the same when testing a source or a sink.

The operation of the two ACA real time utilities—**Aux Channel Analyzer** on the *embedded* M41h GUI and the **ACA Remote Control** on the *external* ATP Manager-- is similar. The screen examples used in this subsection are from the **ACA Remote Control** utility on the *external* ATP Manager exceptions related to the operation of the ACA on the embedded ATP Manager are noted.

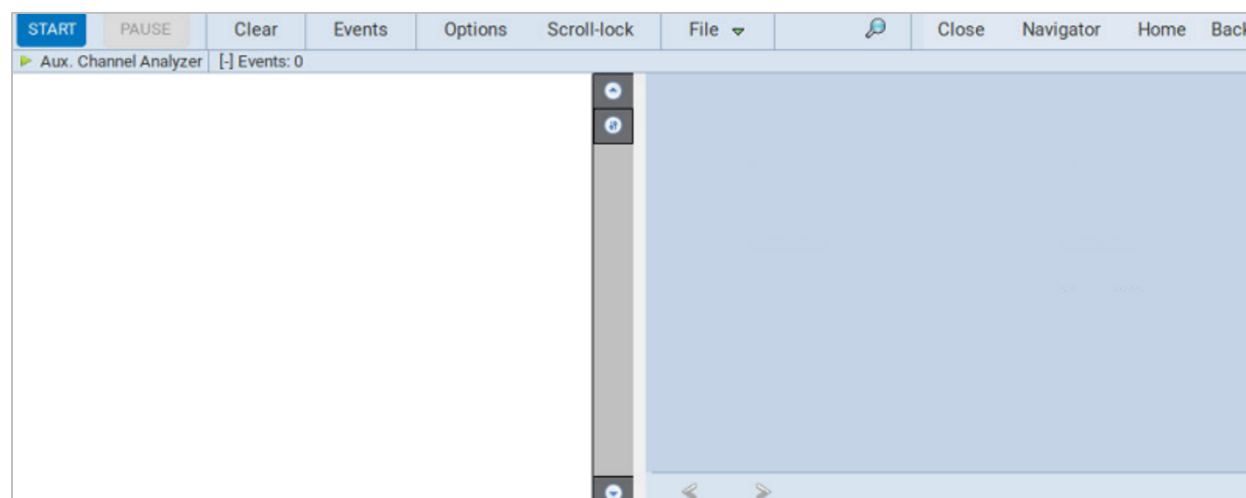
Important Note: You can filter and search through the ACA traces. Procedures for searching and sorting are provided in a separate subsection further below.

To monitor the HDMI DDC transactions:

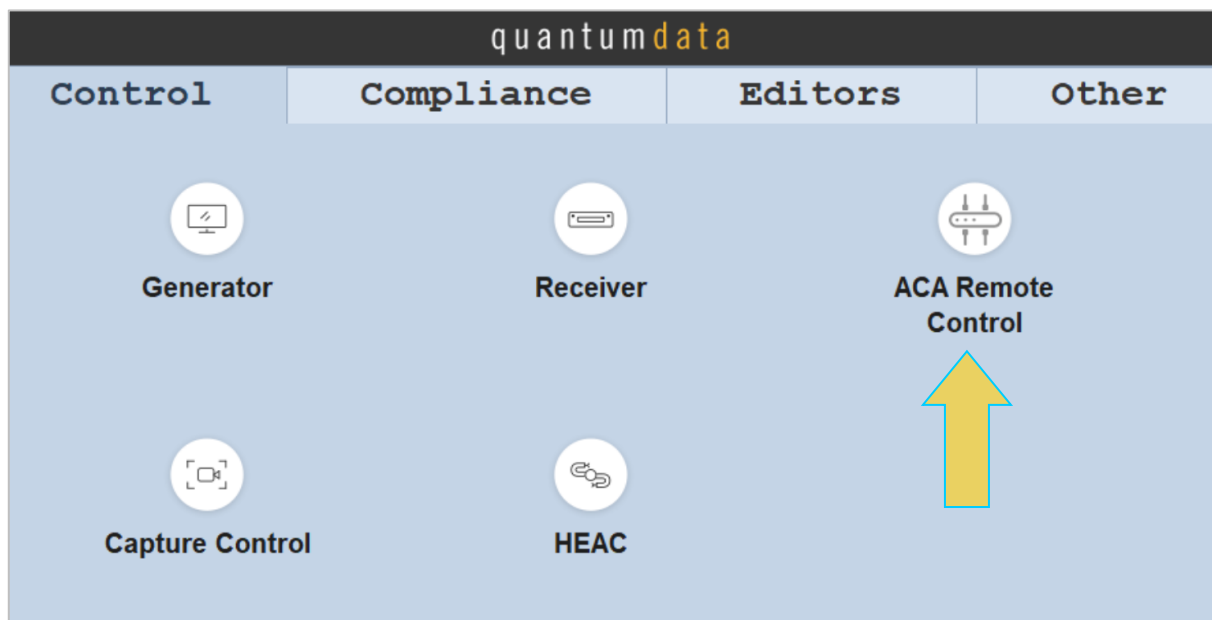
1. For the *embedded* ACA utility, select the **Aux Channel Analyzer** on the page 1 (Card Control) of the **Apps** panel:



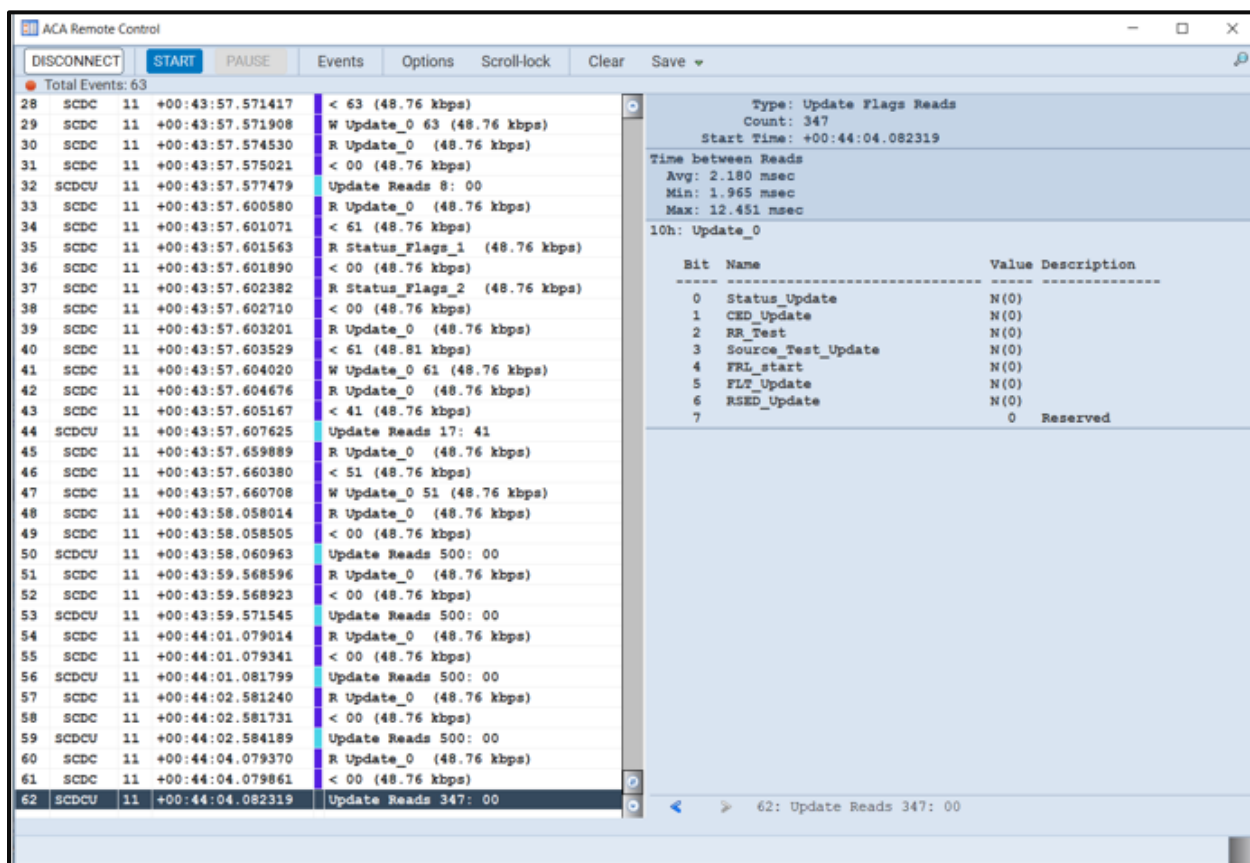
The **Aux Channel Analyzer** panel appears as shown below:



For the remote host PC ACA utility, touch select the **ACA Remote Control** on the page 1 (Card Control) of the **Apps** panel:

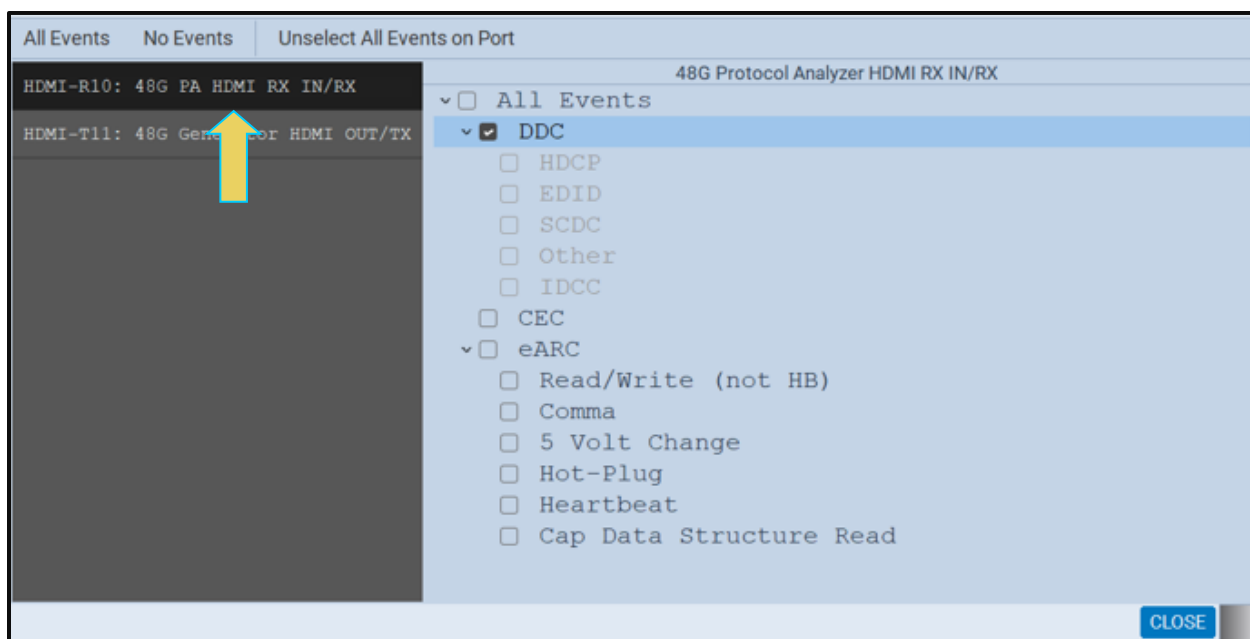


The **ACA Remote Control** panel appears as shown below:



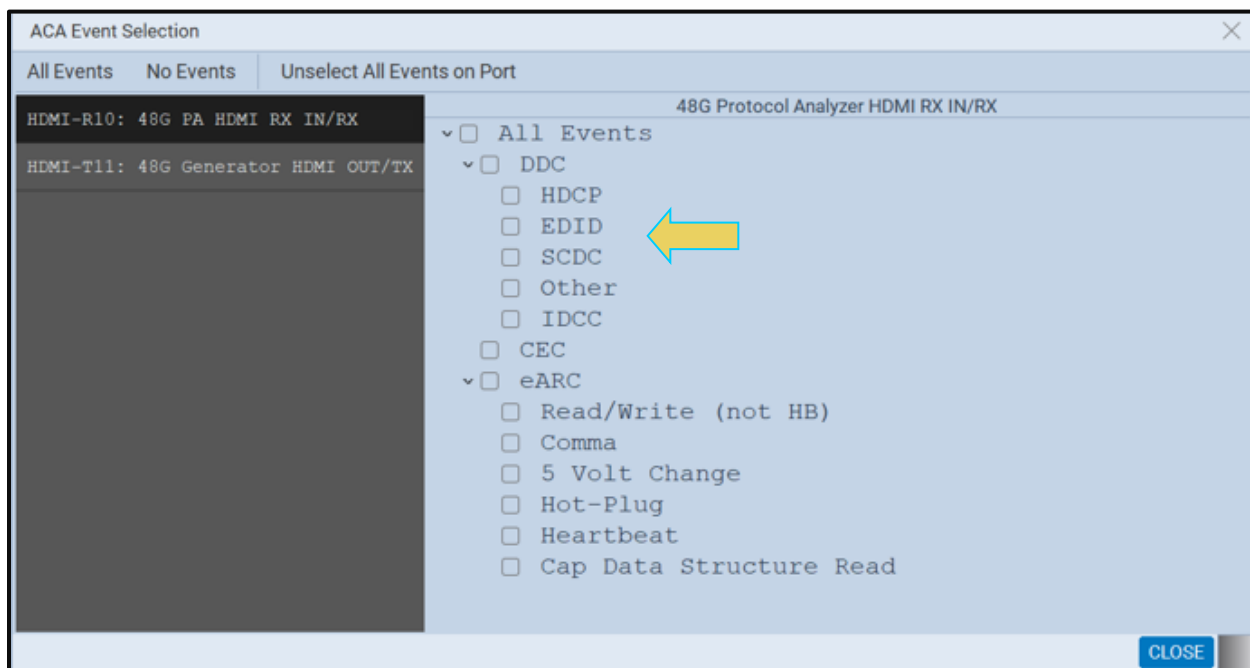
For the **ACA Remote Control** panel you will have to connect to an M41h Instrument that you have provisioned in the external ATP Manager application. The **ACA Remote Control** dialog box will appear showing all the M41h systems you have provisioned in the M41h GUI Manger. Typically you will only have one M41h system provisioned in the application, so you will simply select your lone M41h system and click the **OK** button on the dialog box.

From the **Events**  button on the ACA panel, select the HDMI's port that you are monitoring using the pull-down menu . Refer to the screen example below.



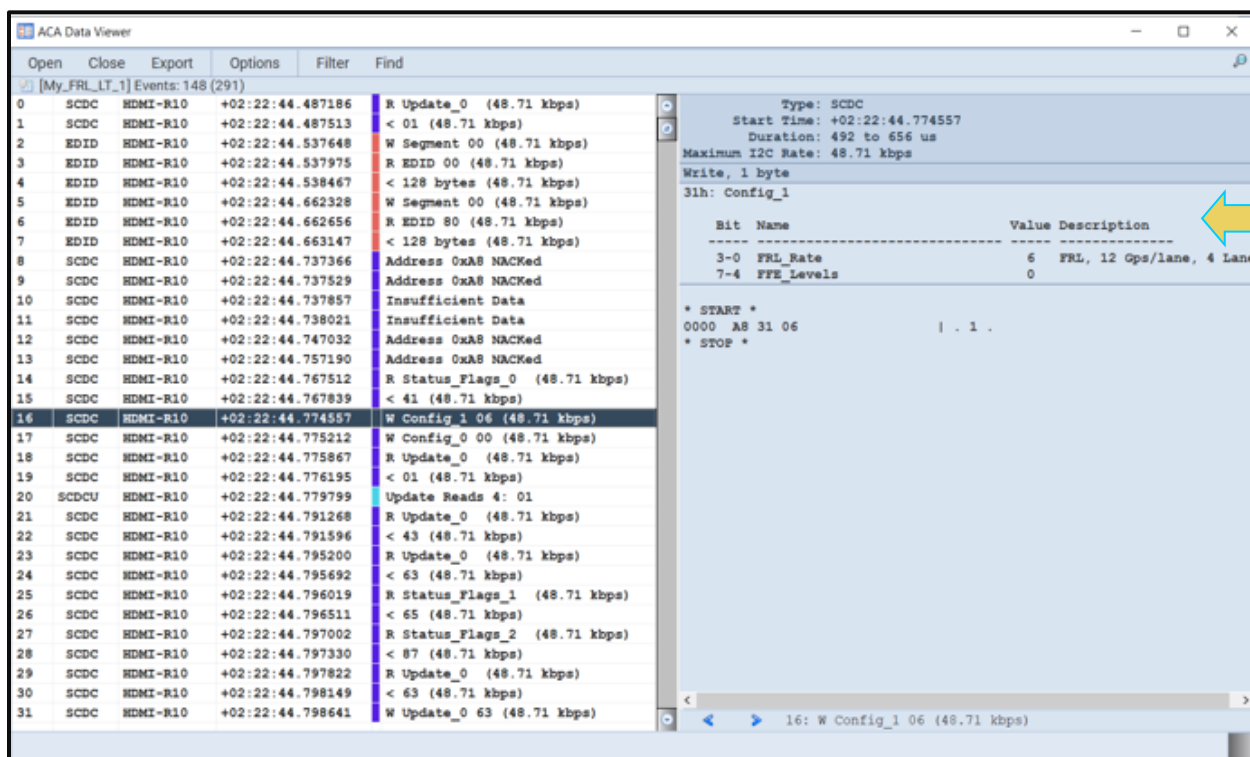
The **ACA Event Selection** dialog box is shown below.

2. Specify which events you wish to monitor. You can select All Events or any set of individual events.



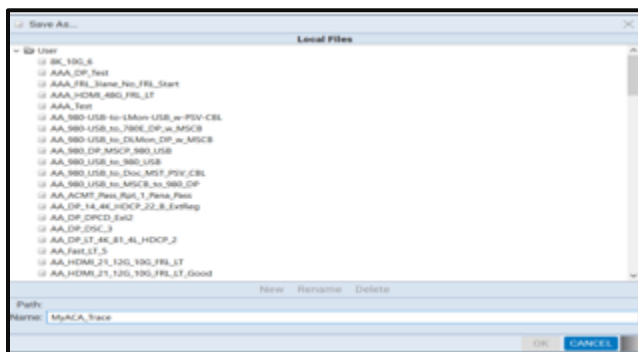
Take the necessary action—such as a hot plug—to initiate EDID, HDCP or CEC transactions. You will see the Aux Chan transactions in the ACA panel as shown below.

Touch select the **Start** button on the ACA Menu panel on the right to initiate the viewing of the HDMI (or MHL) DDC transactions. An example showing monitored data is shown below. You can stop or pause the collection at any time using the buttons on the ACA menu panel on the right. These are indicated in the screen example below.



Important Note: You can filter and search through the ACA traces. Procedures for searching and sorting are provided in a separate subsection further below.

3. 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**.



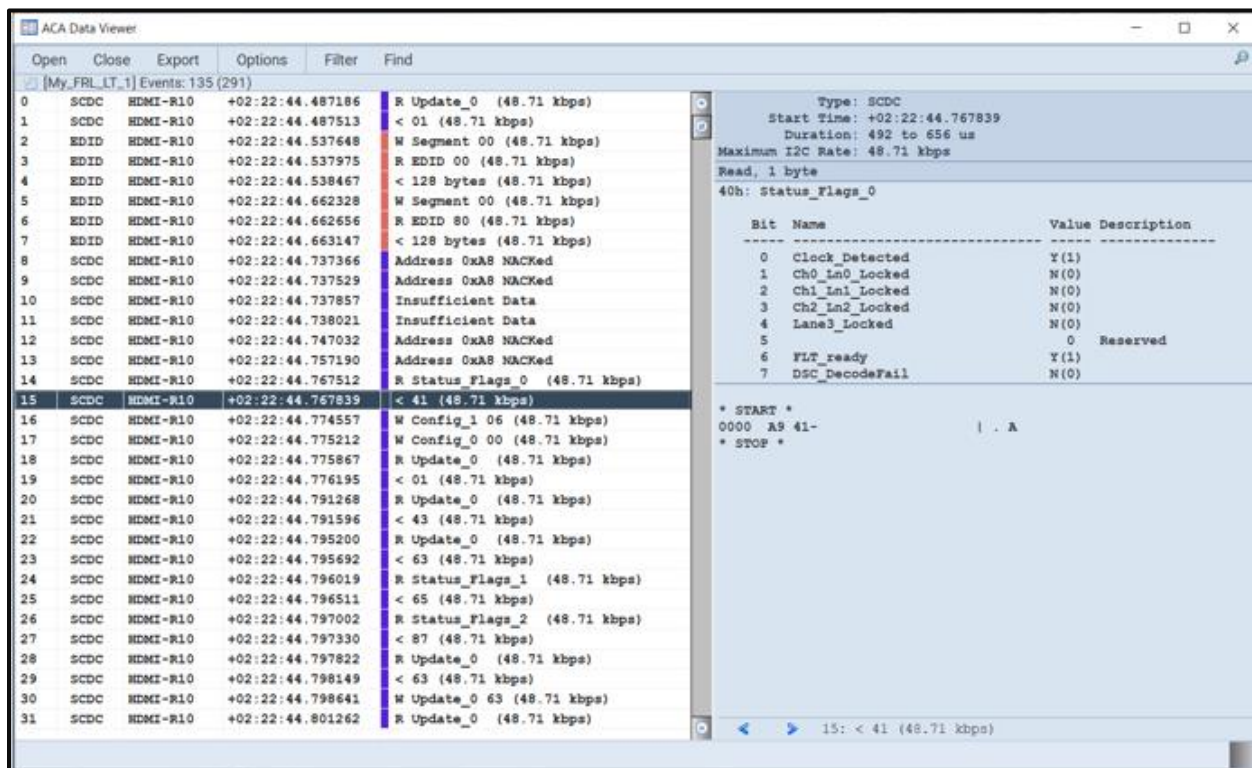
Please note to use the **ACA Data Viewer** utility (next subsection) on your PC to view the traces or the ACA viewer on the M41h embedded display with the powerful searching and filtering features, you must save the file. If you are working on the embedded **Aux Channel Analyzer** viewer but prefer to use **ACA Data Viewer** on the external ATP Manager, you will have to transfer the saved file to your PC using the external ATP Manager.

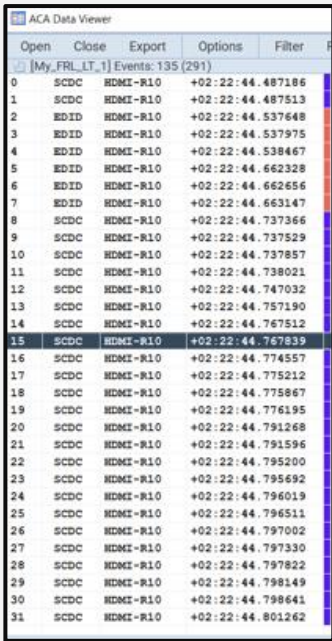
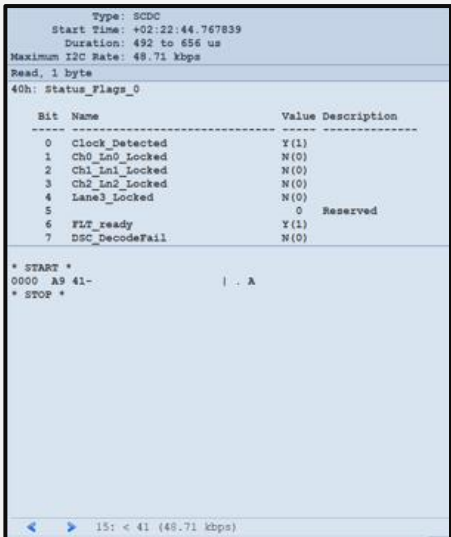
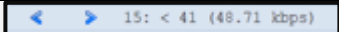
10.4 ACA Data Viewer – Viewing Stored Aux Channel Data

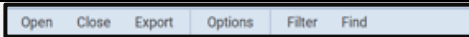


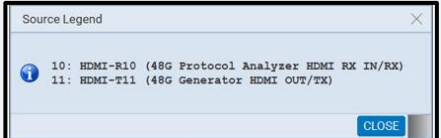
This subsection describes the **ACA Data Viewer** utility used for viewing HDMI (or MHL) DDC transactions that have been stored on the PC hosting the *external* ATP Manager. You can use the **ACA** utility on the *embedded* display to view ACA trace files stored on the M41h instrument itself. The operation 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 like the embedded version.

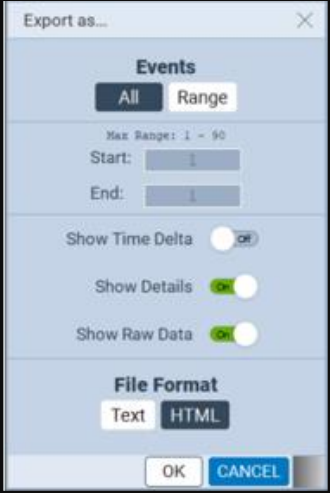
10.4.1 ACA Data Viewer – Panel Description

The **ACA Remote Control** panel application is available on the *external* ATP Manager. It enables you to collect and view the ACA transactions in real time from a remotely connected PC with the ATP Manager application. The control panel elements are described in the table below.



ACA Data Viewer	Information / Function
<p>ACA Data Viewer - Trace Panel</p> 	<p>The following information is provided in the ACA Remote Control Panel data dialog box for each event:</p> <p>Item number – This is a unique sequence number of the transaction.</p> <p>Type – The type of; either EDID, HDCP or CEC.</p> <p>M41h Card Type, Interface number.</p> <p>Time stamp (optional viewing field) – Shows the time stamp of each transaction. Can either be absolute time based (shown) on the M41h system clock or relative time (Time-deltas) referenced from the initial transaction in the trace.</p> <p>Transaction Description – A description of the transaction.</p>
<p>Details Panel</p> 	<p>The data that is displayed in the Details panel will vary depending on the type of record. following information is provided in the ACA Event Details dialog box:</p> <p>Start Time – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.</p> <p>Type – The type of transaction; either EDID, or CEC.</p> <p>Note: The information in the Details panel will vary depending on the type of log record that is selected.</p> <p>Duration – The duration in milliseconds of the transaction.</p> <p>Direction – The direction of the transaction either a request or a reply.</p> <p>Maximum I2C Rate – The rate that the I2C channel clock is operating.</p> <p>Details (text) – The contents of the transaction in human readable text.</p> <p>Details (hex) – The contents of the transaction in hex data.</p>
	<p>There are some control arrows and a status panel on the bottom of the ACA Event Details panel. These are as follows:</p> <p>Left arrow – The left arrow allows you to see the details of the next transaction.</p>

ACA Data Viewer	Information / Function
	<p>Right arrow – The right arrow allows you to see the details of the previous transaction.</p> <p>Status field – Shows the sequence number and the description of the selected transaction.</p> <p>There is a menu associated with the ACA Remote Control Info panel. It is located on the right side of the panel:</p> <p>“Viewing Glass”  – This is on the upper right of the ACA window. It is not part of the control menu. When activated it displays a pop-up window that enables you to display the text in Small, Medium, or Large text.</p> <p>Options – Opens up a flyout menu. Described below.</p> <p>Data – Opens up a flyout check box enabling you to sort the log records by time.</p> <p>Clear – Clears the ACA Trace panel.</p> <p>Open – Enables you to open an ACA trace file stored on your PC.</p> <p>Export – Enables you to export the entire trace file or a range of records in the trace file, to a text file. See dialog box below left.</p>
<p>Options Flyout Menu</p>  	<p>The Options flyout menu items are described below.</p> <p>Source Legend – Window that lists the ports and their definition on each available in the M41h system.</p> <p>Show Port Name – Check box enabling you to display or not display the Port number.</p> <p>Time-stamp – Check box enabling you to show or not show the time stamps for each transaction.</p> <p>Time-deltas – Check box enabling you to show the time stamps relative to the previous transaction.</p> <p>Set Zero Time – Enables you to set a log record to zero. Subsequent log records are relative to this new zero record.</p> <p>Reset Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.</p>
<p>Export as Text</p>	<p>The Export as Text dialog box elements are described below.</p> <p>All – Enables you to specify that you wish to export the entire ACA trace file to a text file stored on your PC.</p>

ACA Data Viewer	Information / Function
	<p>Range – Enables you to display or not display the Port number.</p> <p>Start – Field available only when Range button is active to specify the first record of the range of records to include in the export operation.</p> <p>End – Field available only when Range button is active to specify the last record of the range of records to include in the export operation.</p> <p>OK – Button to initiate the export.</p> <p>Cancel – Cancel the export operation.</p>

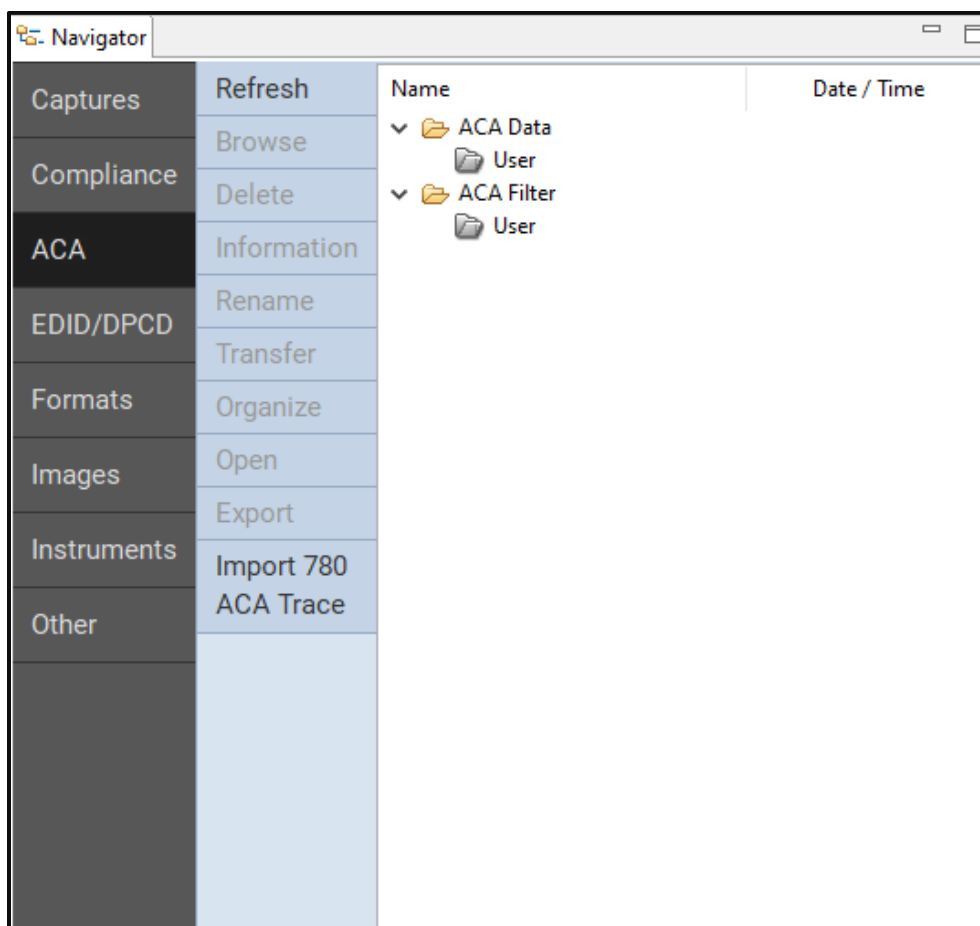
10.5 Viewing Stored HDMI DDC-SCDC traces on a PC with the ACA Data Viewer utility

This subsection describes how you can view ACA traces using the ACA viewer off-line on your PC with the **ACA Data Viewer** utility. To view the ACA files on your PC with the ATP 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 Quantum Data for support. You can view the ACA traces without an M41h test instrument. You simply download the ATP Manager from the Quantum Data website on the downloads page.

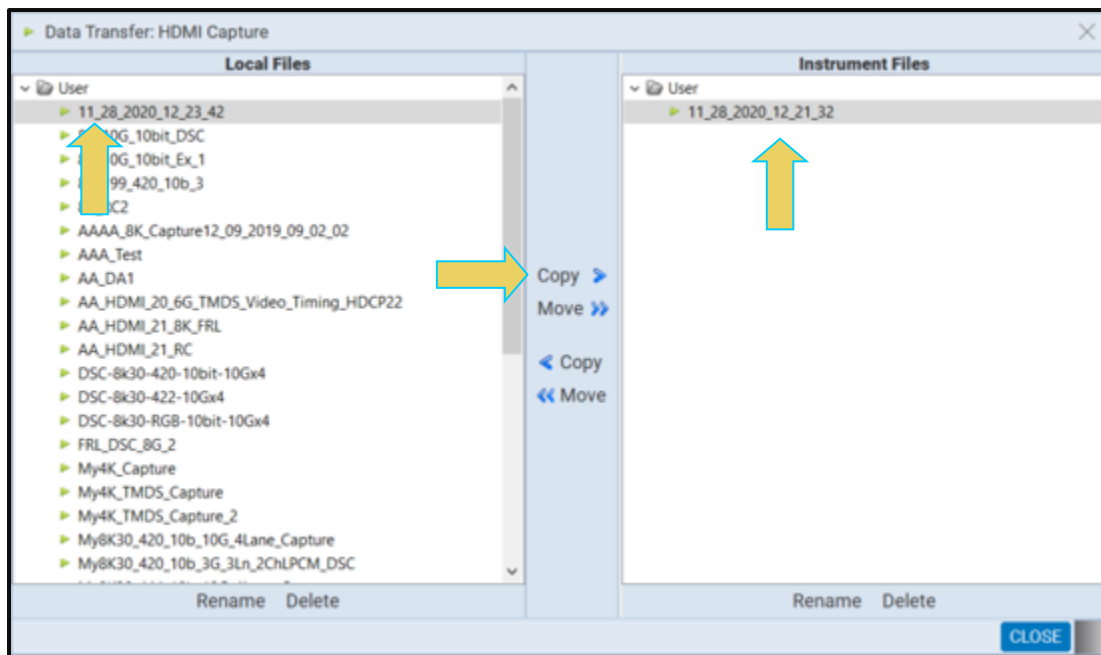
Transferring ACA Trace Files from the M41h to a Host PC with the ATP Manager:

1. Make sure the ATP Manager is installed on your PC. Use the procedures at Downloading and installing the ATP Manager.
2. Access a stored ACA data from the **Navigator** panel and highlight a directory as shown below.



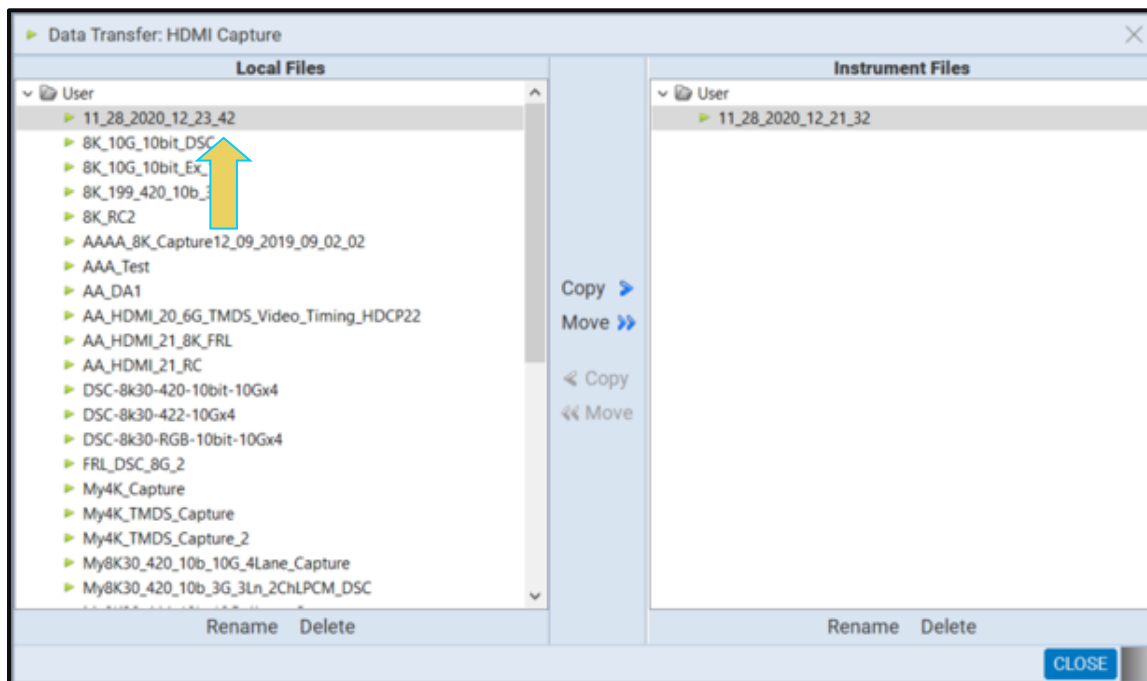
3. Access the **Data Transfer** utility.

This enables you to select what you want to transfer data from.



4. Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.

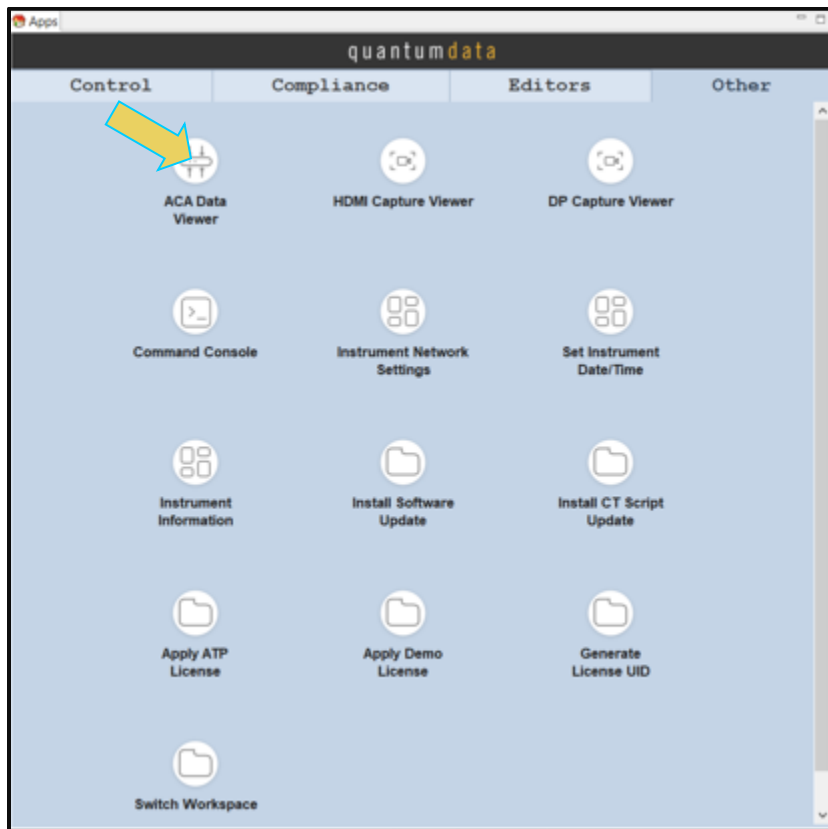
The file appears on the PC host **Local Files** (below).



The data appears in the **Navigator** panel under the ACA data.

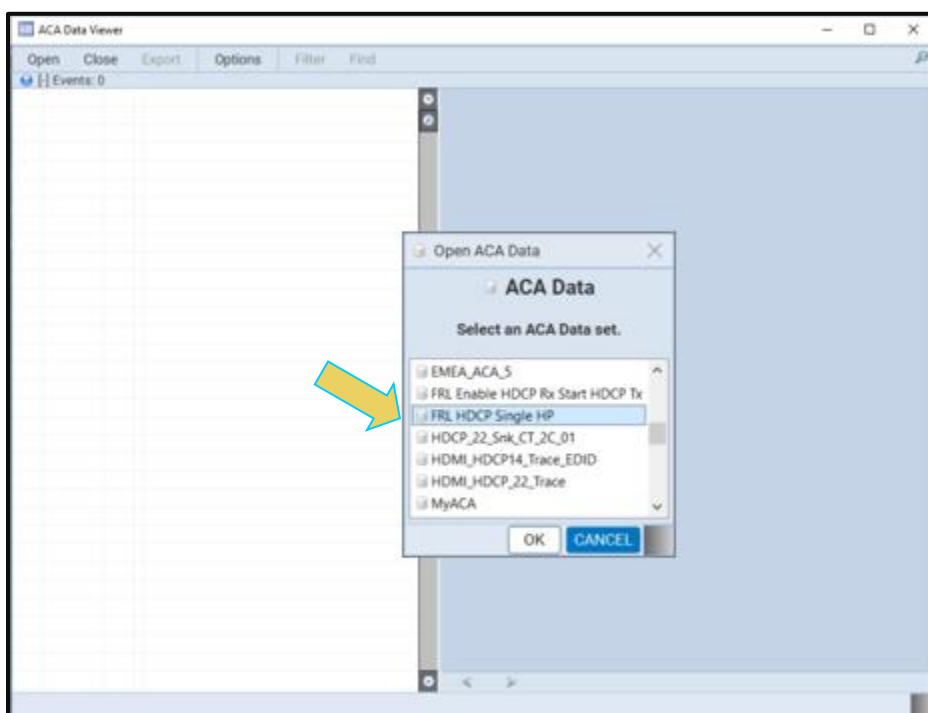
Viewing ACA trace files with the ACA Data Viewer:

1. Open the ACA panel to view the transferred file. You can access the ACA panel from the **Other** Apps panel (Page 4).

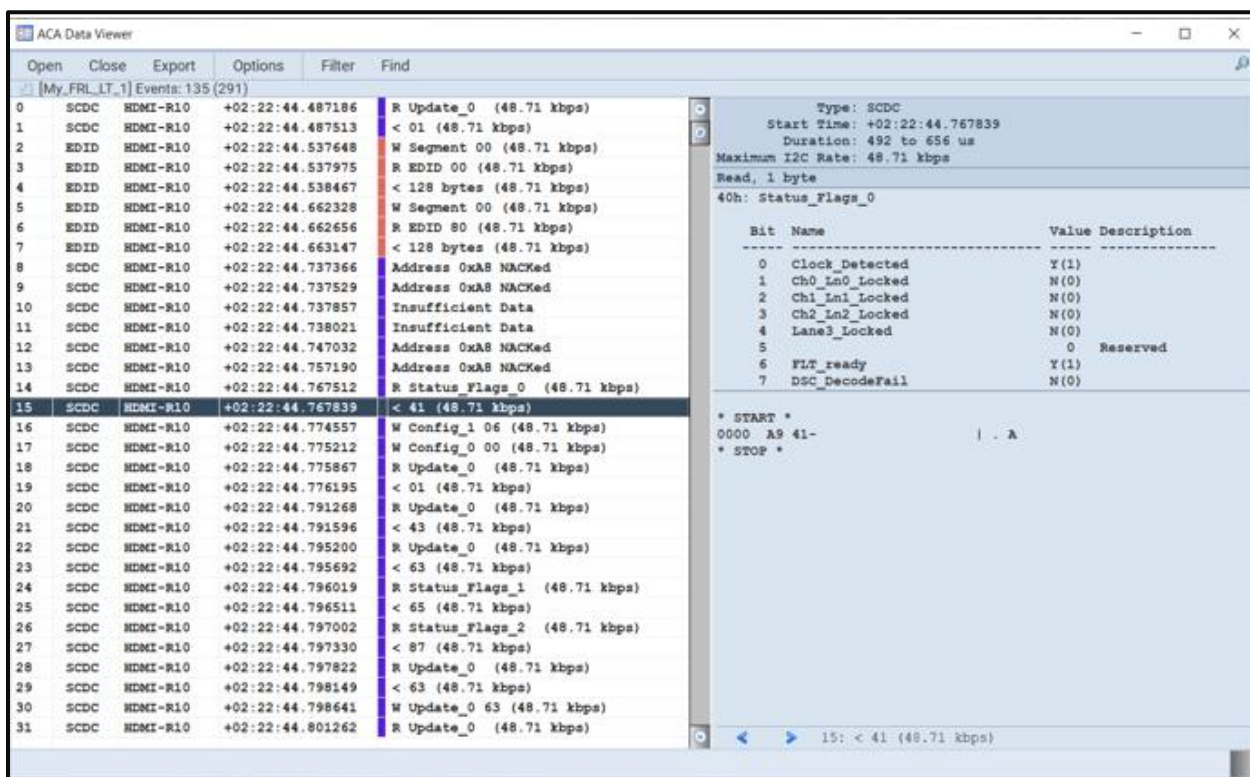


The Aux Channel Analyzer panel appears.

2. Select the **Open** button to open the ACA file as shown below:



3. Click the **OK** activation button on the Open **ACA Data** dialog box. The ACA trace file will appear in the window.

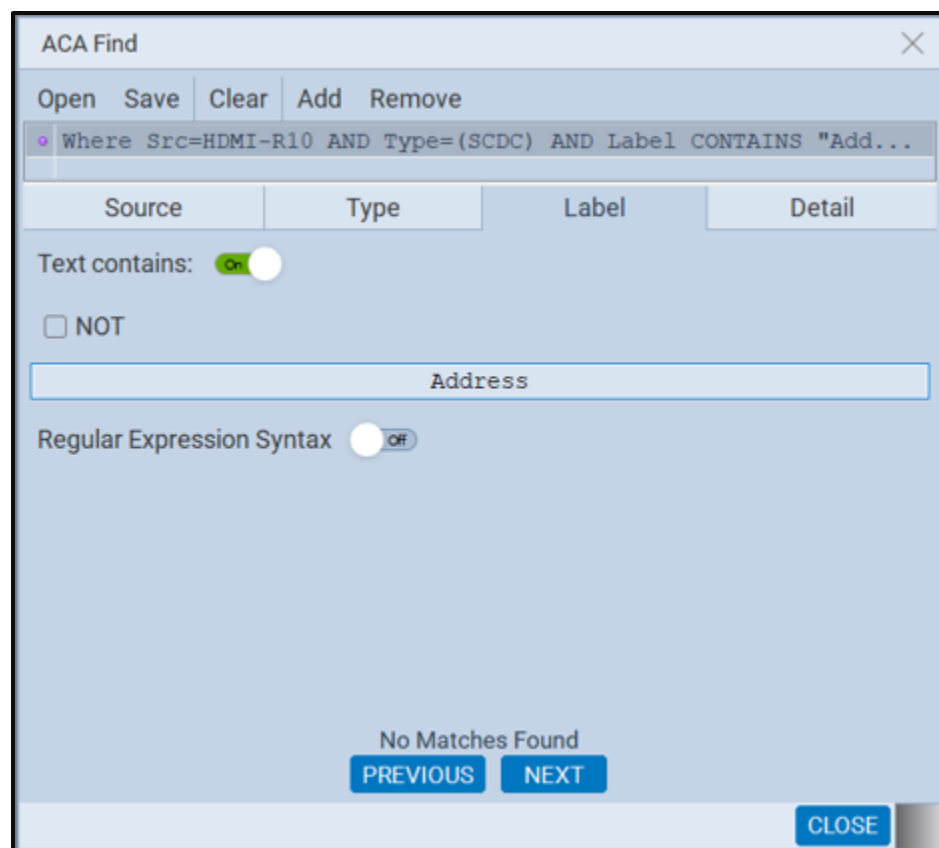


10.6 Using the ACA Find Feature

The **ACA Find** dialog box is accessible through the **Data** pop-out menu shown in the screen example below. The **ACA Find** function enables you to quickly locate different types of events. The ACA Find feature is not available with the **ACA Remote Control** utility. It is only available with the **ACA** feature in the embedded GUI and the **ACA Data Viewer**. If you wish to use the **Find** feature on ACA traces that you have captured using the **ACA Remote Control** utility save the traces as a file and reload them through the **ACA Data Viewer** utility.

You access the **Find** function through the **Data** flyout menu on the control panel of the embedded **ACA utility** and directly from the **Find** button on the control panel of the **ACA Data Viewer**.





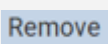
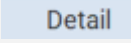
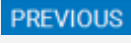


The **Find** dialog box is shown below.



The **Find** function enables you to select data types in the **Type** field and then search based on text string occurrences in the log record labels or the message details.

Note: For the **ACA** utility on the embedded ATP Manager, you have to Stop the collection of real time trace activity using the Start/Stop button on the right side control panel.

The following table describes the **Find** function buttons, fields and functions.

ACA Find Window		
Buttons (Top)	Function	Description
Open 	Opens a stored user created Find configuration.	You can store commonly used search configurations using the Save function and recall them for quick access using the Open button.
Save 	Saves a user created Find configuration.	
Clear 	Clear the existing Find criteria.	You can build up complex Find configurations by concatenating multiple search 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 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 new Find criteria.	
Remove 	Removes a highlighted Find criterion of an existing Find configuration.	
Details 	Enables or disables the Details panel.	
Buttons (bottom)	Function	
Previous 	Enables you to move back to the previous record that meets your search criteria.	
Next 	Enables you to advance to the next record that meets your search criteria.	
Close 	Closes the ACA Find window.	
Fields	Function	Description

ACA Find Window		
Buttons (Top)	Function	Description
Source	Check box to select the port that you want to search. 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.
Type	Check boxes enabling you to specify which data types you wish to search through for the string.	When you select multiple data types they behave as a logical OR function. If only the Type field is specified, the next or previous of that data type will be highlighted.
Label	Combination check boxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<p>Text Contains – A check box to activate the Label criteria.</p> <p>Not – A check box which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it.</p> <p>Text Field – A text field to enter a string that will be matched (or Not matched).</p> <p>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 search text. You can find detailed examples on the web including Wikipedia. If Regular Expression check box is checked, you can enter in any regular expression into the text field for a string match.</p>
Details	Combination check boxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter criteria in the Label field, it will automatically be added to	<p>Text Contains – A check box to activate the Label criteria.</p> <p>Not – A check box which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it.</p>

ACA Find Window		
Buttons (Top)	Function	Description
	the set of criteria in the panel above it.	<p>Text Field – A text field to enter a string that will be matched (or Not matched).</p> <p>Regular Expression Syntax – A check box to specify whether the text the Text Field will be treated as plain text or a regular expression. Regular expression syntax is a commonly used set of operators for search text. You can find detailed examples on the web including Wikipedia. If Regular Expression check box is checked, you can enter in any regular expression into the text field for a string match.</p>
Close	Closes the Find window.	

Searching Through the ACA Trace Files with the Find Function:

Here are some screen examples of the **Find** function. Note that the screen examples use the **ACA Data Viewer** utility but the embedded **ACA Data Viewer** works the same way. The only difference is the **ACA** embedded utility uses a pop-up keypad.

1. To find all data types from a specific port, check the respective source in the ACA Find dialog box.

ACA Data Viewer

Open Close Export Options Filter Find

[01_18_2021_12_51] Events: 154

Index	Type	Source	Destination	Value
0	SCDC	HDMI-T11		< 00 (48.81 kbps)
1	SCDC	HDMI-T11		< 00 (48.81 kbps)
2	SCDCU	HDMI-T11		Update Reads 407: 00
3	SCDC	HDMI-T11		R Update_0 (48.81 kbps)
4	SCDC	HDMI-T11		< 00 (48.81 kbps)
5	SCDC	HDMI-T11		R Update_0 (48.81 kbps)
6	SCDC	HDMI-T11		< 00 (48.81 kbps)
7	SCDCU	HDMI-T11		Update Reads 507: 00
8	SCDC	HDMI-T11		R Update_0 (48.81 kbps)
9	SCDC	HDMI-T11		< 00 (48.81 kbps)
10	SCDC	HDMI-T11		R Update_0 (48.81 kbps)
11	SCDC	HDMI-T11		< 00 (48.81 kbps)
12	SCDCU	HDMI-T11		Update Reads 507: 00
13	SCDC	HDMI-T11		R Update_0 (48.81 kbps)
14	SCDC	HDMI-T11		< 00 (48.81 kbps)
15	SCDC	HDMI-T11		< 00 (48.81 kbps)
16	SCDCU	HDMI-T11		Update Reads 1107: 00
17	SCDC	HDMI-T11		Address 0xA8 NA
18	EDID	HDMI-T11		R EDID 80 (48.81 kbps)
19	SCDC	HDMI-T11		< 01 (48.81 kbps)
20	EDID	HDMI-T11		R EDID 00 (48.81 kbps)
21	EDID	HDMI-T11		R EDID 00 (48.81 kbps)
22	EDID	HDMI-T11		< 128 bytes (48.81 kbps)

Type: SCDC
Start Time: +00:55:19.002381
Duration: 328 to 492 us
Maximum I2C Rate: 48.81 kbps
Read, 1 byte

ACA Find

Open Save Clear Add Remove

Where Src=HDMI-T11

Source	Type	Label	Detail
<input type="checkbox"/> HDMI-R10			
<input checked="" type="checkbox"/> HDMI-T11			

PREVIOUS NEXT CLOSE

Value Desc:
N(0)
N(0)
N(0)
N(0)
N(0)
N(0)
N(0)
0 Rese:

- Click on the **Next** button to advance to the recording meeting that criteria. The result is shown below.

The screenshot shows the ACA Data Viewer application window. The main window displays a list of events (0 to 22) with columns for Source, Type, Label, and Detail. A yellow arrow points to event 13, which is highlighted. An ACA Find dialog box is open, showing a search criteria of "Where Src=HDMI-T11". The dialog box has a table with columns Source, Type, Label, and Detail. It lists two items: HDMI-R10 (unchecked) and HDMI-T11 (checked). A yellow arrow points to the "Found Event #14" text, and a blue arrow points to the "NEXT" button. The dialog box also has buttons for "Open", "Save", "Clear", "Add", and "Remove".

Source	Type	Label	Detail
<input type="checkbox"/>	HDMI-R10		
<input checked="" type="checkbox"/>	HDMI-T11		

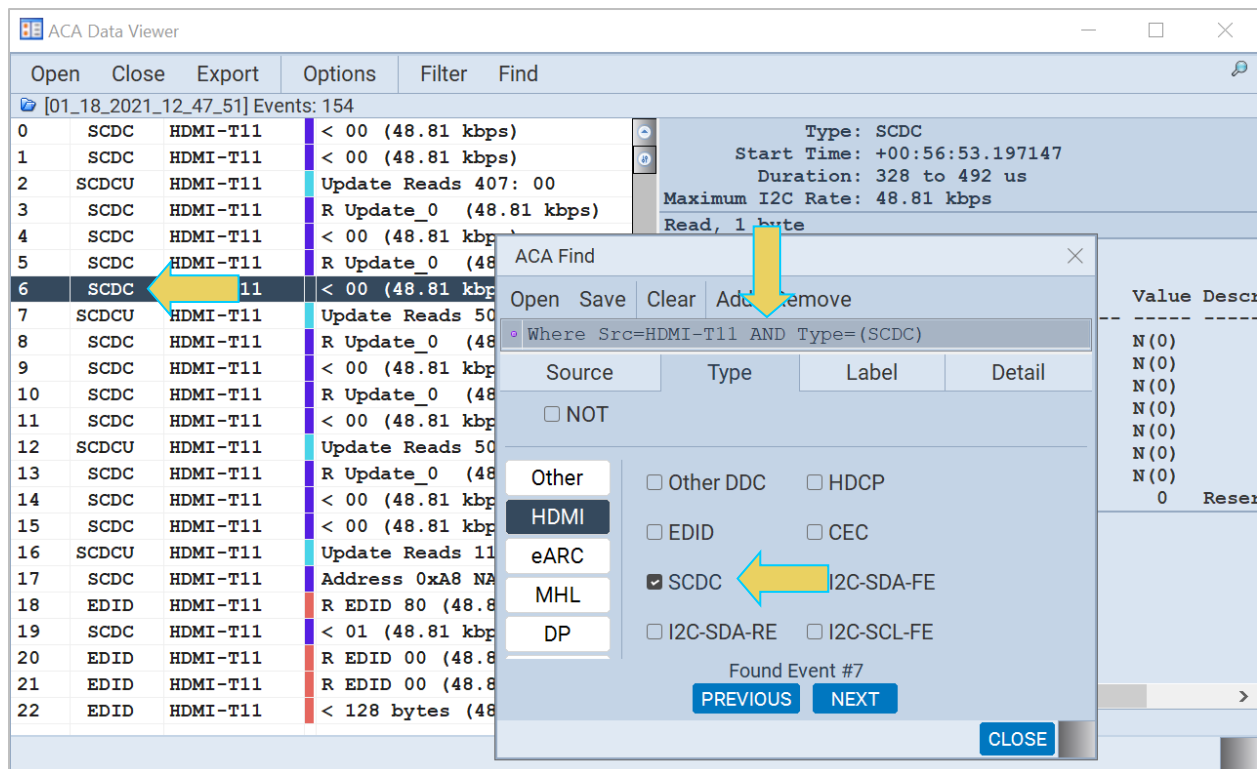
Found Event #14

PREVIOUS NEXT

CLOSE

To find all data types from a specific port and that are SCDC transactions, select **SCDC** from the **Type** tab in the ACA Find dialog box. This search behaves like a logical AND function.

- Click on the **Next** button to advance to the log record meeting that criteria. The result is shown below.



Note that when you select different data type definitions in the same search configuration, example port type and data Type above, the search uses a logical AND function.

If you specify two different types of data in the **Type** field, the search will be a logical OR function as shown below.

The screenshot shows the ACA Data Viewer application window. The main window displays a list of events with columns for Event ID, Type, Source, and Data. The events are filtered by Source 'HDMI-T11'. The 'ACA Find' dialog box is open, showing a search filter 'Where Src=HDMI-T11 AND Type=(SCDC|EDID)'. The dialog box has tabs for 'Source', 'Type', 'Label', and 'Detail'. The 'Type' tab is selected, and it contains checkboxes for various data types: Other, HDMI, eARC, MHL, DP, Other DDC, HDCP, EDID, CEC, SCDC, I2C-SDA-FE, I2C-SDA-RE, and I2C-SCL-FE. The 'EDID' and 'SCDC' checkboxes are checked. The dialog box also shows 'Found Event #104' and buttons for 'PREVIOUS', 'NEXT', and 'CLOSE'. A yellow arrow points to the 'Type' field in the search filter, and another yellow arrow points to the 'Type' tab in the dialog box.

Event ID	Type	Source	Data
102	EDID	HDMI-T11	R EDID 80 (48.81 kbps)
103	EDID	HDMI-T11	< 128 bytes (48.81 kbps)
104	SCDC	HDMI-T11	R Sink Version (48.81 kbps)
105	SCDC	HDMI-T11	< 01 (48.81 kbps)
106	SCDC	HDMI-T11	W Source Version (48.81 kbps)
107	SCDC	HDMI-T11	R Source Test (48.81 kbps)
108	SCDC	HDMI-T11	< 00 (48.81 kbps)
109	SCDC	HDMI-T11	R Status_Flags (48.81 kbps)
110	SCDC	HDMI-T11	< 41 (48.81 kbps)
111	SCDC	HDMI-T11	W Config_1 06 (48.81 kbps)
112	SCDC	HDMI-T11	W Config_0 00 (48.81 kbps)
113	SCDC	HDMI-T11	R Update_0 (48.81 kbps)
114	SCDC	HDMI-T11	< 01 (48.81 kbps)
115	SCDCU	HDMI-T11	Update Reads 6: (48.81 kbps)
116	SCDC	HDMI-T11	R Update_0 (48.81 kbps)
117	SCDC	HDMI-T11	< 03 (48.81 kbps)
118	SCDC	HDMI-T11	R Update_0 (48.81 kbps)
119	SCDC	HDMI-T11	< 23 (48.81 kbps)
120	SCDC	HDMI-T11	R Status_Flags (48.81 kbps)
121	SCDC	HDMI-T11	< 65 (48.81 kbps)
122	SCDC	HDMI-T11	R Status_Flags (48.81 kbps)
123	SCDC	HDMI-T11	< 87 (48.81 kbps)
124	SCDC	HDMI-T11	R Update_0 (48.81 kbps)

ACA Find

Open Save Clear Add Remove

Where Src=HDMI-T11 AND Type=(SCDC|EDID)

Source Type Label Detail

☐ NOT

Other ☐ Other DDC ☐ HDCP

HDMI ☒ EDID ☐ CEC

eARC ☒ SCDC ☐ I2C-SDA-FE

MHL ☐ I2C-SDA-RE ☐ I2C-SCL-FE

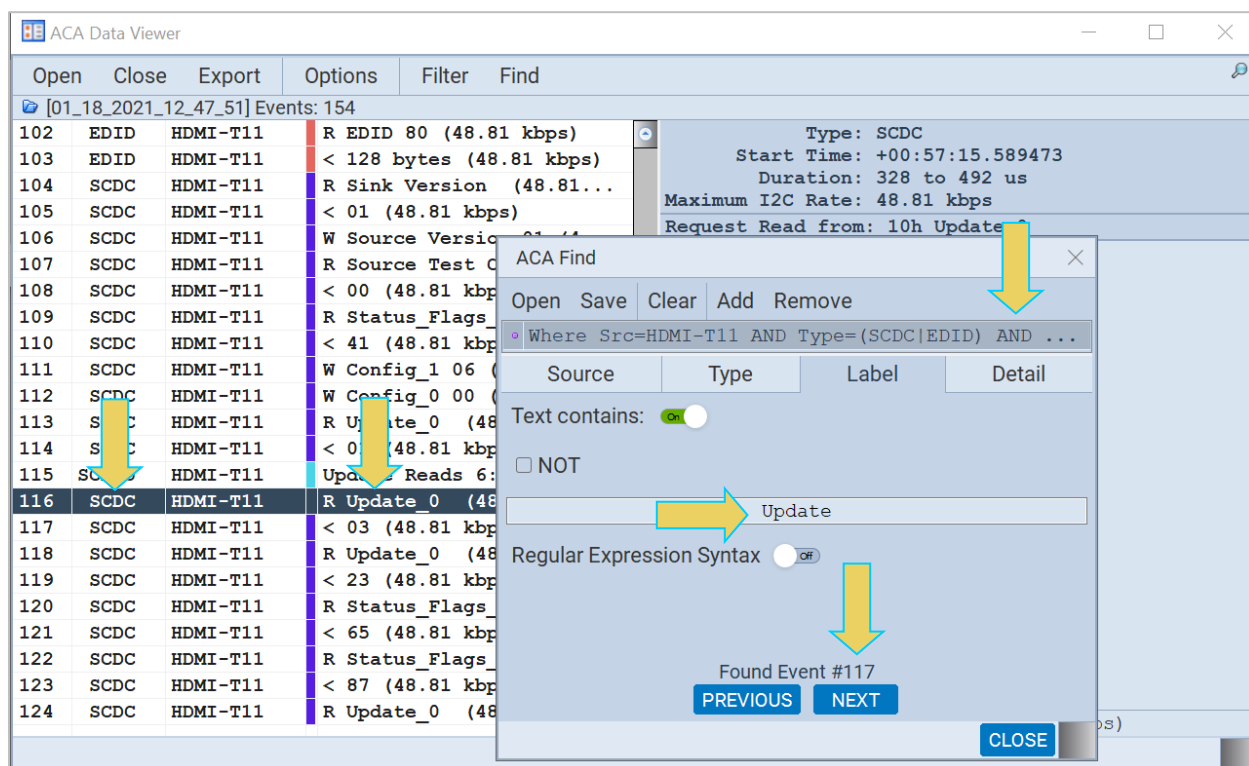
DP

Found Event #104

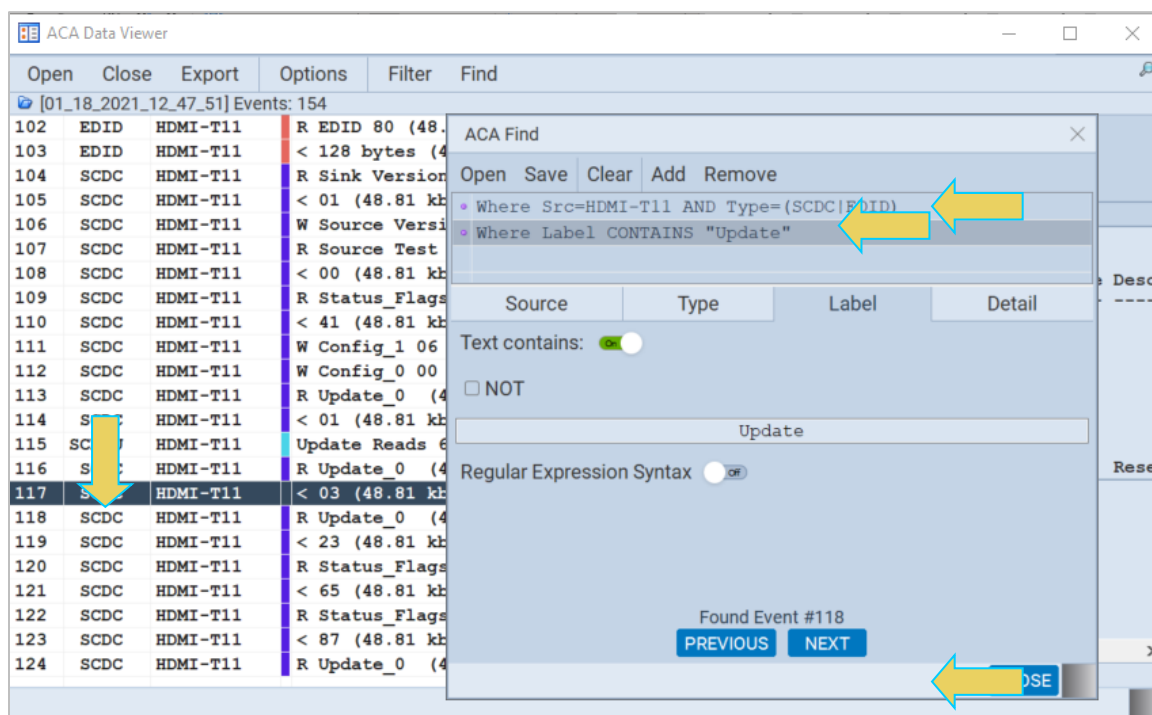
PREVIOUS NEXT

CLOSE

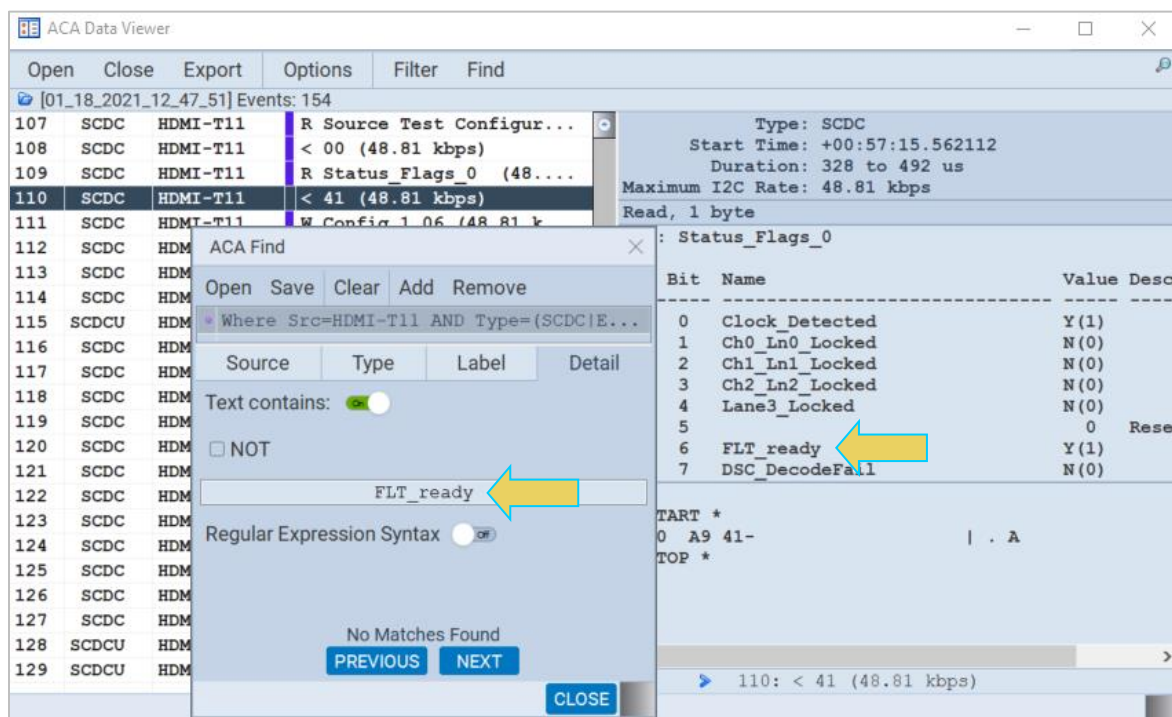
If you specify one or more data types in the **Type** field and enter a string in the **Label** text field in the same search configuration, the search will behave as a logical OR for the data types and a logical AND with the **Type** and the **Label** field as shown below.



However, if you enter these same criteria using separate configurations as shown below, the search will behave as a logical OR function. In this case it will find the next instance of an SCDC transaction.



You can also search through the **Details** panel of a record. The following examples depicts this. In this example, we have also restricted the search to SCDC and searching for the text string "FLT_ready" in Details panel.



You can also conduct a string search with a NOT function to exclude message labels or details that contain a specific string. There are not many uses of this type of search but it is supported. The following example shows this type of search.

The screenshot displays the ACA Data Viewer application. The main window shows a list of events from 107 to 133. Event 120 is highlighted. An 'ACA Find' dialog box is open, showing search criteria. The dialog has tabs for 'Source', 'Type', 'Label', and 'Detail'. The 'Detail' tab is selected, and the search criteria is 'Where Details !CONTAINS "Update"'. The 'Text contains' checkbox is checked, and the 'NOT' checkbox is also checked, with a yellow arrow pointing to it. The search results show 'Found Event #121'. The dialog also includes buttons for 'Open', 'Save', 'Clear', 'Add', 'Remove', 'PREVIOUS', 'NEXT', and 'CLOSE'.

Open	Close	Export	Options	Filter	Find
[01_18_2021_12_47_51] Events: 154					
107	SCDC	HDMI-T11	R Source Test Configuration (...)		
108	SCDC	HDMI-T11	< 00 (48.81 kbps)		
109	SCDC	HDMI-T11	R Status_Flags_0 (48.81 kbps)		
110	SCDC	HDMI-T11	< 41 (48.81 kbps)		
111	SCDC	HDMI-T11	W Config_1 06 (48.81 kbps)		
112	SCDC	HDMI-T11	W Config_0 00 (48.81 kbps)		
113	SCDC	HDMI-T11	R Update_0 (48.81 kbps)		
114	SCDC	HDMI-T11	< 01 (48.81 kbps)		
115	SCDCU	HDMI-T11	Update Reads 6: 01		
116	SCDC	HDMI-T11	R Update_0 (48.81 kbps)		
117	SCDC	HDMI-T11	< 03 (48.81 kbps)		
118	SCDC	HDMI-T11	R Update_0 (48.81 kbps)		
119	SCDC	HDMI-T11	< 23 (48.81 kbps)		
120	SCDC	HDMI-T11	R Status_Flags_1 (48.81 kbps)		
121	SCDC	HDMI-T11	< 65 (48.81 kbps)		
122	SCDC	HDMI-T11	R Status_Flags_2 (48.81 kbps)		
123	SCDC	HDMI-T11	< 87 (48.81 kbps)		
124	SCDC	HDMI-T11	R Update_0 (48.81 kbps)		
125	SCDC	HDMI-T11	< 63 (48.81 kbps)		
126	SCDC	HDMI-T11	W Update_0 63 (48.81 kbps)		
127	SCDC	HDMI-T11	R Update_0 (48.81 kbps)		
128	SCDCU	HDMI-T11	Update Reads 9: 00		
129	SCDCU	HDMI-T11	Update Reads 9: 00		
130	SCDC	HDMI-T11	< 61 (48.81 kbps)		
131	SCDC	HDMI-T11	< 61 (48.81 kbps)		
132	SCDC	HDMI-T11	R Status_Flags_1 (48.81 kbps)		
133	SCDC	HDMI-T11	< 00 (48.81 kbps)		

ACA Find

Open Save Clear Add Remove

Where Details !CONTAINS "Update"

Source Type Label Detail

Text contains: ☒ ☐

☒ NOT

Update

Regular Expression Syntax ☐

Found Event #121

PREVIOUS NEXT

CLOSE

You can use regular expressions as well in either the **Label** field or the **Details** field. The following example shows how you can advance to HDMI SCDC transaction that contains the string "> W Config" at the beginning (^ operator) of it.

The screenshot displays the ACA Data Viewer application. The main window shows a list of events from 14 to 40. Event 32 is highlighted, showing a write transaction labeled "W Config_1 06". A search dialog titled "ACA Find" is open, showing the search criteria "Where Label MATCHES '^W Config'". The dialog includes a "Text contains:" checkbox (checked), a "NOT" checkbox (unchecked), and a "Regular Expression Syntax" checkbox (checked). The search results show "Found Event #33". A yellow arrow points to the search criteria, and another yellow arrow points to the "Regular Expression Syntax" checkbox.

Bit	Name	Value	Description
14	SCDC	HDMI-T11	< 00 (48.81 kbps)
15	SCDC	HDMI-T11	< 00 (48.81 kbps)
16	SCDCU	HDMI-T11	Update Reads 119: 00
17	SCDC	HDMI-T11	Address 0xA8 NACKed
18	EDID	HDMI-T11	R EDID 80 (48.81 kbps)
19	SCDC	HDMI-T11	< 01 (48.81 kbps)
20	EDID	HDMI-T11	R EDID 00 (48.81 kbps)
21	EDID	HDMI-T11	R EDID 00 (48.81 kbps)
22	EDID	HDMI-T11	< 128 bytes (48.81 kbps)
23	EDID	HDMI-T11	W Segment 00 (48.81 kbps)
24	EDID	HDMI-T11	R EDID 80 (48.81 kbps)
25	EDID	HDMI-T11	< 128 bytes (48.81 kbps)
26	SCDC	HDMI-T11	< 01 (48.81 kbps)
27	SCDC	HDMI-T11	< 01 (48.81 kbps)
28	SCDC	HDMI-T11	W Source Version 01 (48.81 kbps)
29	SCDCU	HDMI-T11	R Source Test Configuration (...)
30	SCDC	HDMI-T11	R Status Flags_0 (48.81 kbps)
31	SCDC	HDMI-T11	R Status Flags_0 (48.81 kbps)
32	SCDC	HDMI-T11	W Config_1 06 (48.81 kbps)
33	SCDC	HDMI-T11	W Config_1 06 (48.81 kbps)
34	SCDC	HDMI-T11	W Config_0 00 (48.81 kbps)
35	SCDC	HDMI-T11	R Update_0 (48.81 kbps)
36	SCDC	HDMI-T11	< 01 (48.81 kbps)
37	SCDCU	HDMI-T11	Update Reads 6: 01
38	SCDC	HDMI-T11	R Update_0 (48.81 kbps)
39	SCDC	HDMI-T11	< 03 (48.81 kbps)
40	SCDC	HDMI-T11	R Update_0 (48.81 kbps)

ACA Find

Open Save Clear Add Remove

Where Label MATCHES "^W Config"

Source Type Label Detail

Text contains: ☒

☐ NOT

^W Config

Regular Expression Syntax ☒

Found Event #33

PREVIOUS NEXT

CLOSE

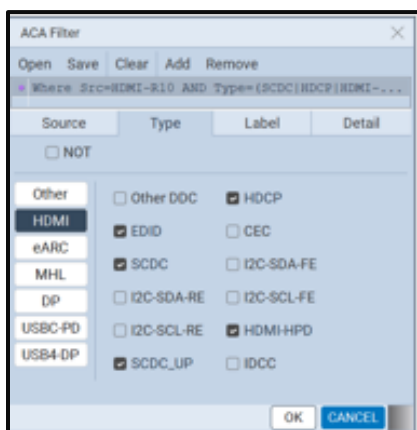
10.7 Using the ACA Filter Feature

The **ACA Filter** dialog box is accessible through the **Data** pop-out menu. The **ACA Filter** function enables you to filter an ACA trace file to view a subset of the log records in a particular file. The ACA Filter feature is not available with the **ACA Remote Control** utility. It is only available with the ACA feature in the embedded GUI (once you have reloaded a stored ACA trace file) and the **ACA Data Viewer**. If you wish to use the Filter feature on ACA traces that you have captured using the **ACA Remote Control** utility, you must save the traces as a file and reload them through the **ACA Data Viewer** utility.

You access the ACA Filter function through the **Data** flyout menu on the control panel of the embedded **ACA utility** and directly from the **Filter** button on the control panel of the **ACA Data Viewer**.



The **ACA Filter** dialog box is shown below.



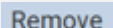

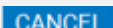


The **Filter** function enables you to select data types in the **Type** field and then search based on text string occurrences in the log record labels or the message details.

Note: For the **ACA** utility, you have to Stop the collection of real time trace activity using the Start/Stop button on the right side control panel.

The following table describes the **Filter** function buttons, fields and functions.

ACA Filter Window		
Buttons (Top)	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 a user created Filter configuration.	

ACA Filter Window		
Buttons (Top)	Function	Description
Clear 	Clear the existing Filter criteria.	<p>You can build up complex filter configurations by concatenating 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.</p> <p>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 Manager interface.</p> <p>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.</p> <p>Example screenshots are shown below.</p>
Add 	Sets the currently defined Filter criteria defined in either the Source, Type, Label or Details sub-panels and adds another row for new filter criteria.	
Remove 	Removes a highlighted filter criterion of an existing filter configuration.	
Buttons (bottom)		Function
OK 		Initiate the filter and closes the ACA Filter window.
Cancel 		Cancels and closes the filter configuration.
Fields	Function	Description
Source	Check box to select the port 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, by clicking on the Next or Previous button, the Filter 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.
Type	Check boxes enabling you to specify which data	When you select multiple data types they behave as a logical OR function.

ACA Filter Window		
Buttons (Top)	Function	Description
	types you wish to data types you wish to filter on based on the string.	If only the Type field is specified, the next or previous of that data type will be highlighted.
Label	Combination check boxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<p>Text Contains – A check box to activate the Label criteria.</p> <p>Not – A check box which when checked will filter for records that <i>do not</i> meet the criteria in the field beneath it.</p> <p>Text Field – A text field to enter a string that will be matched (or Not matched).</p> <p>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 check box is checked, you can enter in any regular expression into the text field for a string match.</p>
Details	Combination check boxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<p>Text Contains – A check box to activate the Label criteria.</p> <p>Not – A check box which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it.</p> <p>Text Field – A text field to enter a string that will be matched (or Not matched).</p> <p>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</p>

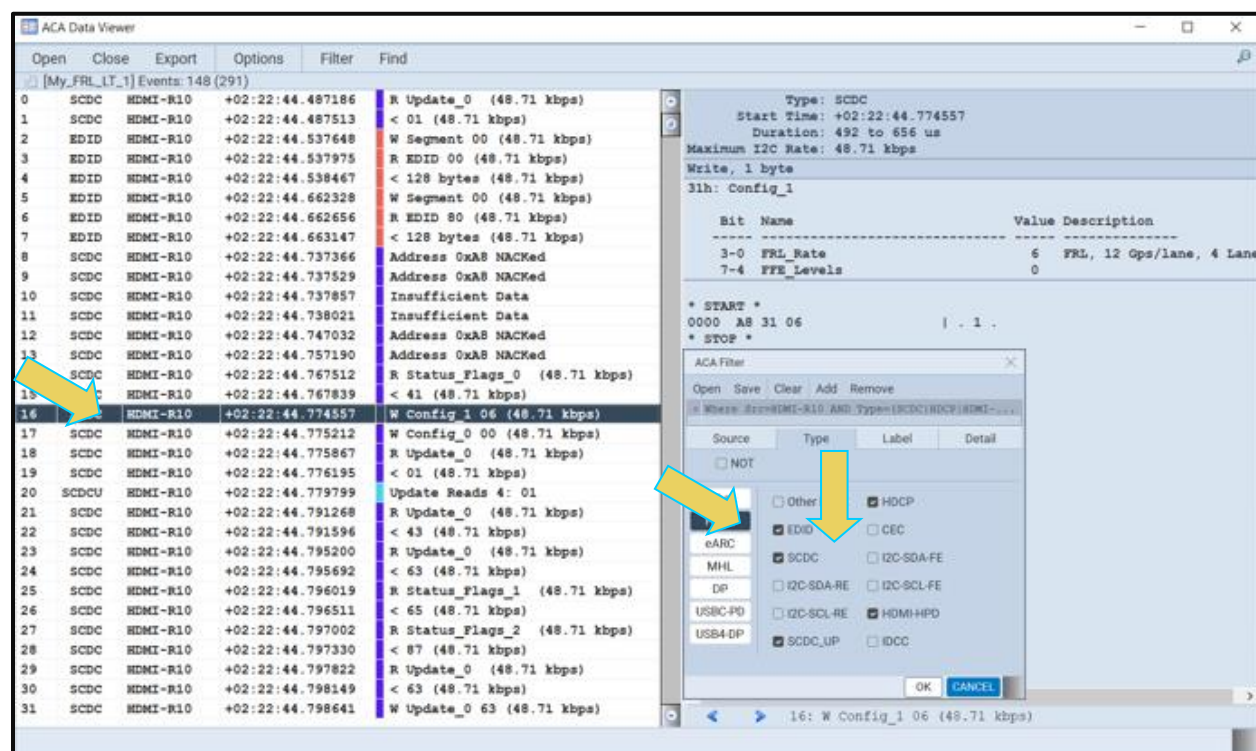
ACA Filter Window		
Buttons (Top)	Function	Description
		Expression check box is checked, you can enter in any regular expression into the text field for a string match.
Close	Closes the Filter window.	

Here are some screen examples of the **Filter** function. Note that the screen examples use the **ACA Data Viewer** utility but the embedded **ACA Data Viewer** works the same way. The only difference is the **ACA** embedded utility uses a pop-up keypad.

Filtering the ACA trace files with the Filter function:

Here are some screen examples of the **Filter** function. Note that the screen examples use the **ACA Data Viewer** utility but the embedded **ACA Data Viewer** works the same way. The only difference is the **ACA** embedded utility uses a pop-up keypad.

- To filter all data types from a specific port (interface on the), enter the following (example uses port HDMI-T70 transmit port).



- Click on the **OK** button to initiate the filter. The result is shown below. Notice the EDID entries go away.

ACA Data Viewer

Open Close Export Options Filter Find

[My_FRL_LT_1] Events: 135 (291)

0	SCDC	HDMI-R10	+02:22:44.487186	R Update_0 (48.71 kbps)
1	SCDC	HDMI-R10	+02:22:44.487513	< 01 (48.71 kbps)
2	EDID	HDMI-R10	+02:22:44.537648	W Segment 00 (48.71 kbps)
3	EDID	HDMI-R10	+02:22:44.537975	R EDID 00 (48.71 kbps)
4	EDID	HDMI-R10	+02:22:44.538467	< 128 bytes (48.71 kbps)
5	EDID	HDMI-R10	+02:22:44.662328	W Segment 00 (48.71 kbps)
6	EDID	HDMI-R10	+02:22:44.662656	R EDID 80 (48.71 kbps)
7	EDID	HDMI-R10	+02:22:44.663147	< 128 bytes (48.71 kbps)
8	SCDC	HDMI-R10	+02:22:44.737366	Address 0xA8 NACKed
9	SCDC	HDMI-R10	+02:22:44.737529	Address 0xA8 NACKed
10	SCDC	HDMI-R10	+02:22:44.737857	Insufficient Data
11	SCDC	HDMI-R10	+02:22:44.738021	Insufficient Data
12	SCDC	HDMI-R10	+02:22:44.747032	Address 0xA8 NACKed
13	SCDC	HDMI-R10	+02:22:44.757190	Address 0xA8 NACKed
14	SCDC	HDMI-R10	+02:22:44.767512	R Status_Flags_0 (48.71 kbps)
15	SCDC	HDMI-R10	+02:22:44.767839	< 41 (48.71 kbps)
16	SCDC	HDMI-R10	+02:22:44.774557	W Config_1 06 (48.71 kbps)
17	SCDC	HDMI-R10	+02:22:44.775212	W Config_0 00 (48.71 kbps)
18	SCDC	HDMI-R10	+02:22:44.775867	R Update_0 (48.71 kbps)
19	SCDC	HDMI-R10	+02:22:44.776195	< 01 (48.71 kbps)
20	SCDC	HDMI-R10	+02:22:44.791268	R Update_0 (48.71 kbps)
21	SCDC	HDMI-R10	+02:22:44.791596	< 43 (48.71 kbps)
22	SCDC	HDMI-R10	+02:22:44.795200	R Update_0 (48.71 kbps)
23	SCDC	HDMI-R10	+02:22:44.795692	< 63 (48.71 kbps)
24	SCDC	HDMI-R10	+02:22:44.796019	R Status_Flags_1 (48.71 kbps)
25	SCDC	HDMI-R10	+02:22:44.796511	< 65 (48.71 kbps)
26	SCDC	HDMI-R10	+02:22:44.797002	R Status_Flags_2 (48.71 kbps)
27	SCDC	HDMI-R10	+02:22:44.797330	< 87 (48.71 kbps)
28	SCDC	HDMI-R10	+02:22:44.797822	R Update_0 (48.71 kbps)
29	SCDC	HDMI-R10	+02:22:44.798149	< 63 (48.71 kbps)
30	SCDC	HDMI-R10	+02:22:44.798641	W Update_0 63 (48.71 kbps)
31	SCDC	HDMI-R10	+02:22:44.801262	R Update_0 (48.71 kbps)

To filter out all SCDC messages use the NOT operator as follows.

ACA Data Viewer

Open Close Export Options Filter Find

[MyMATH_ACA_1] Events: 141 (277)

Type: SCDC
Start Time: +00:34:44.988328
Duration: 432 to 656 us
Maximum I2C Rate: 48.81 kbps
Read: 1 byte
I2C: Update_0

Bit	Name	Value	Description
0	Status_Update	Y(1)	
1	CEC_Update	N(0)	
2	FR_Test	N(0)	
3	Source_Test_Update	N(0)	
4	FRL_start	N(0)	
5	FRL_Update	N(0)	

ACA Filter

Open Save Clear Add Remove

Where: 220=HDMI-T11 AND 220=SCDC

Source Label Detail

☒ NOT

Other

HDMI ☒ SCDC

eARC ☐ EDID ☐ CEC

MHL ☐ I2C-SDA-RE ☐ I2C-SCL-FE

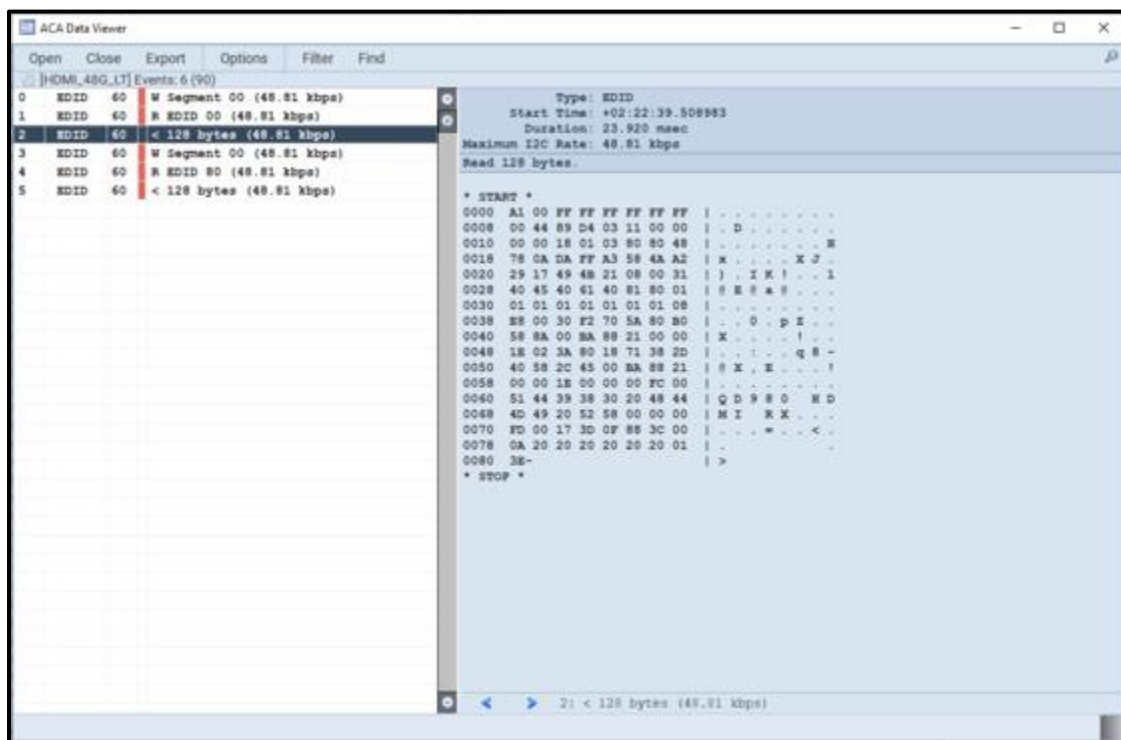
DP ☐ I2C-SCL-RE ☐ HDMI-HPD

USBC-PD ☐ SCDC_UP ☐ IDCC

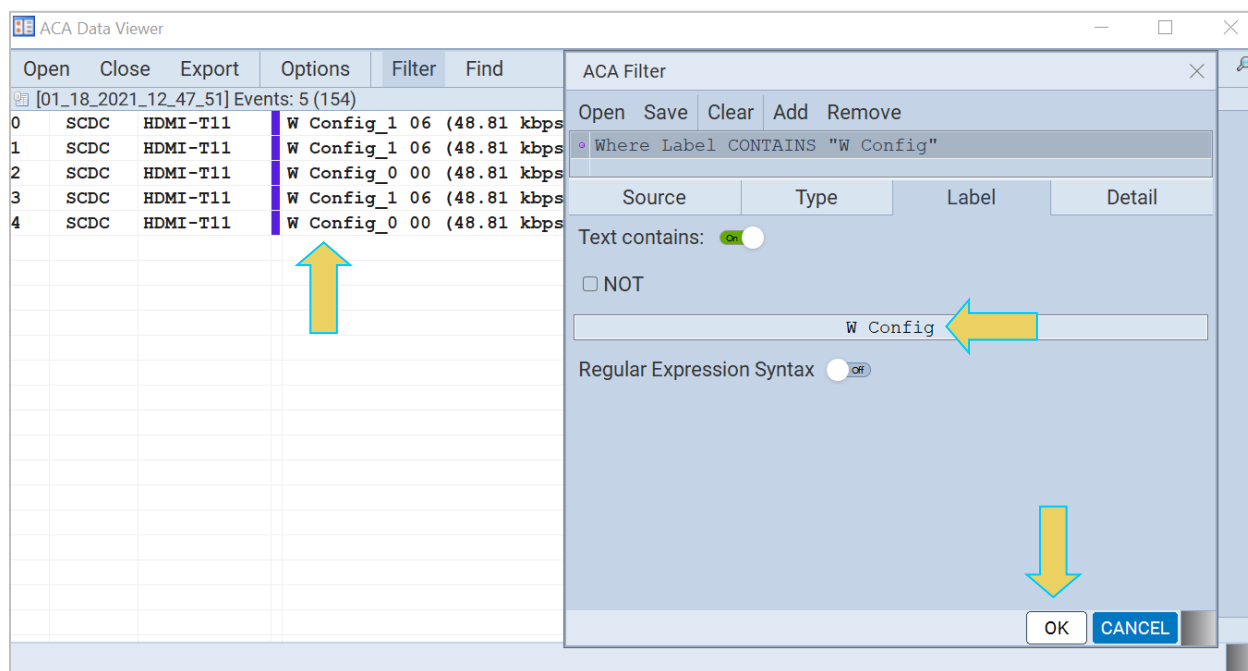
USB4-DP ☐

OK CANCEL

Click on the **OK** button to initiate the filter. The result is shown below. The HDMI SCDC message are stripped from the list leaving only the EDID transactions.



To filter using text strings appearing in the message label, use the check box(es) on the **Label** section of the **ACA Filter** window. You can also include a text string filter with a filter applied to the **Type** field. For example, if you wish to establish a filter based on a text string that includes “W Config” you would use the following:



To filter using text strings in the message details, use the check box on the **Details** section of the **ACA Filter** window. The following example uses filters using a text string in the **Details** field.

The screenshot shows the ACA Data Viewer interface. The top menu bar includes DISCONNECT, START, PAUSE, Events, Options, ScrollLock, Clear, and Save. The main window displays a list of events with columns for Time, Type, and Data. A yellow arrow points to the 'Save' button. The right pane shows the details of the selected event (62: Update Reads 347: 00). The details include the Type (Update Flags Reads), Count (347), Start Time (+00:44:04.082319), Time between Reads (Avg: 2.180 msec, Min: 1.965 msec, Max: 12.451 msec), and a table of bit names and values.

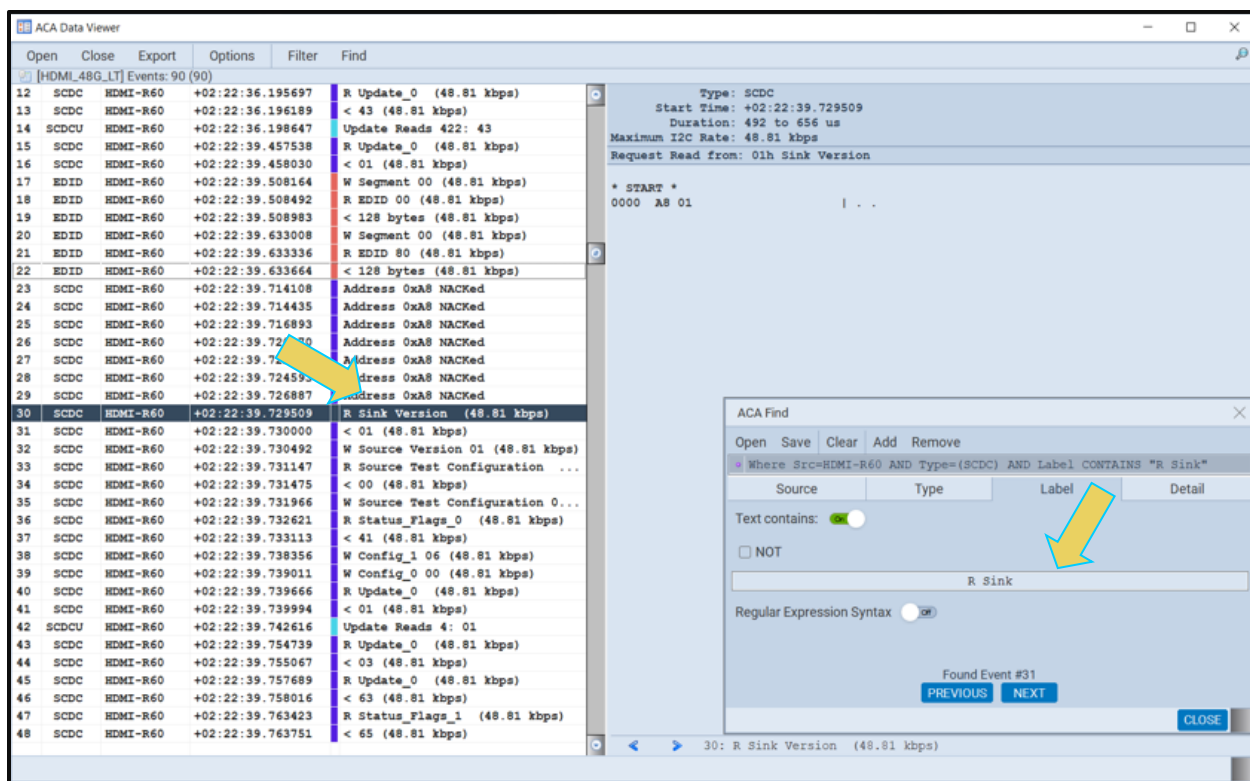
Bit	Name	Value	Description
0	Status_Update	N(0)	
1	CHD_Update	N(0)	
2	RR_Test	N(0)	
3	Source_Test_Update	N(0)	
4	FRL_start	N(0)	
5	FLT_Update	N(0)	
6	RSED_Update	N(0)	
7		0	Reserved

The result of the above filter criteria would be the following.

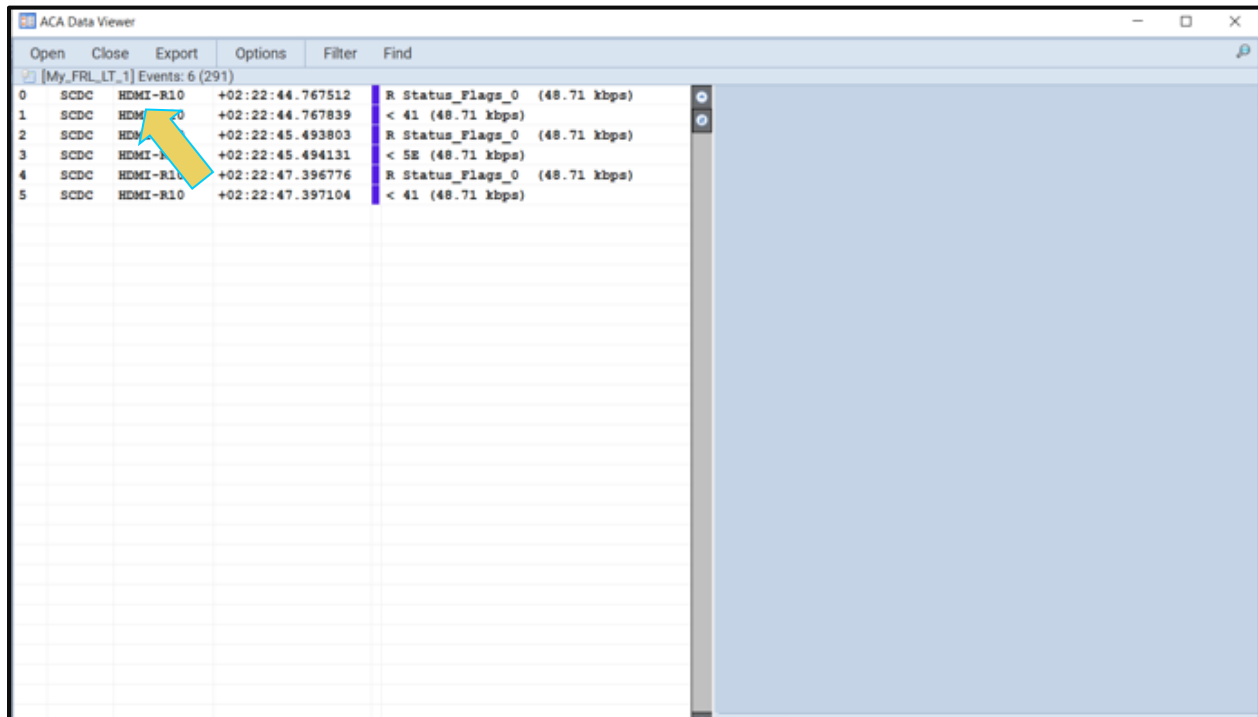
The screenshot shows the ACA Data Viewer interface with the Filter window open. The Filter window has tabs for Open, Close, Export, Options, Filter, and Find. The Filter tab is active, showing a list of filter criteria. A yellow arrow points to the 'Filter' tab. The main window displays a list of events, with the filtered results shown. The right pane shows the details of the selected event (14: < 01 (48.81 kbps)). The details include the Type (SCDC), Start Time (+00:34:44.988325), Duration (492 to 456 us), Maximum I2C Rate (48.81 kbps), Read, 1 byte, and a table of bit names and values.

Bit	Name	Value	Description
0	Status_Update	Y(1)	
1	CHD_Update	N(0)	
2	RR_Test	N(0)	
3	Source_Test_Update	N(0)	
4	FRL_start	N(0)	
5	FLT_Update	N(0)	
6	RSED_Update	N(0)	
7		0	Reserved

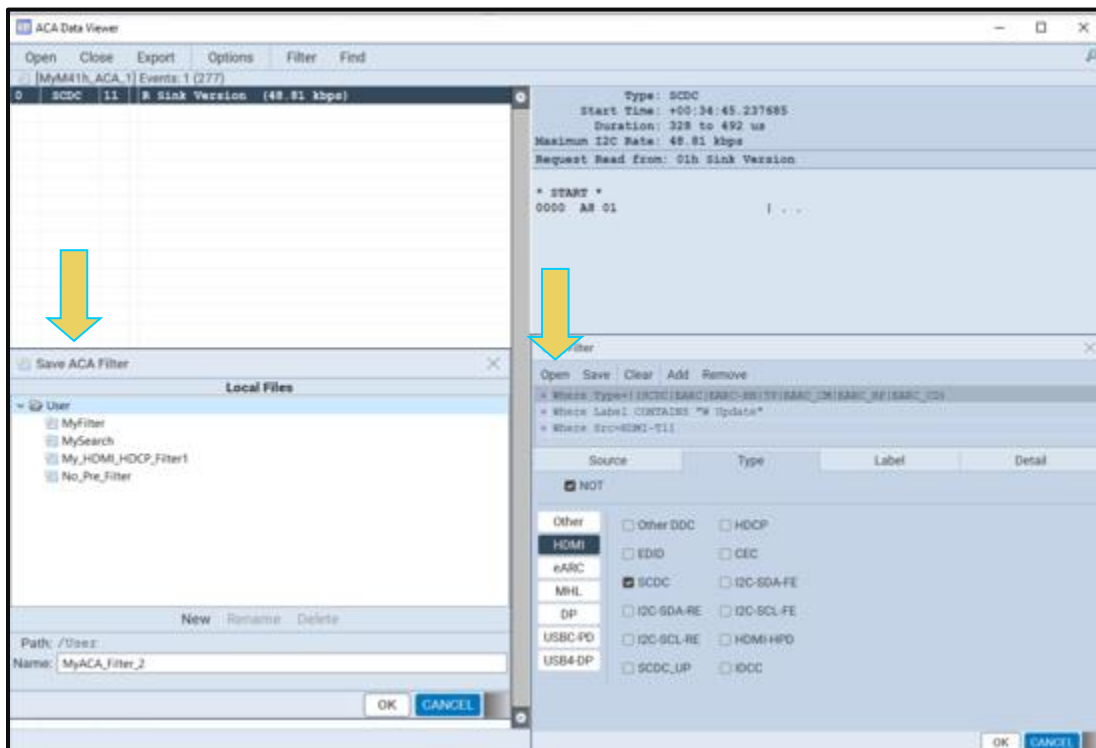
To filter using regular expression text in the message label, text strings in the message details, use the **Regular Expression Syntax** check box on the **Label** section of the **ACA Filter** window. Refer to the following example. Note that the (^) operator filters for text strings that begin with the text you enter after it, in this case, "> R Sink"



The result of the above filter criteria would be the following.

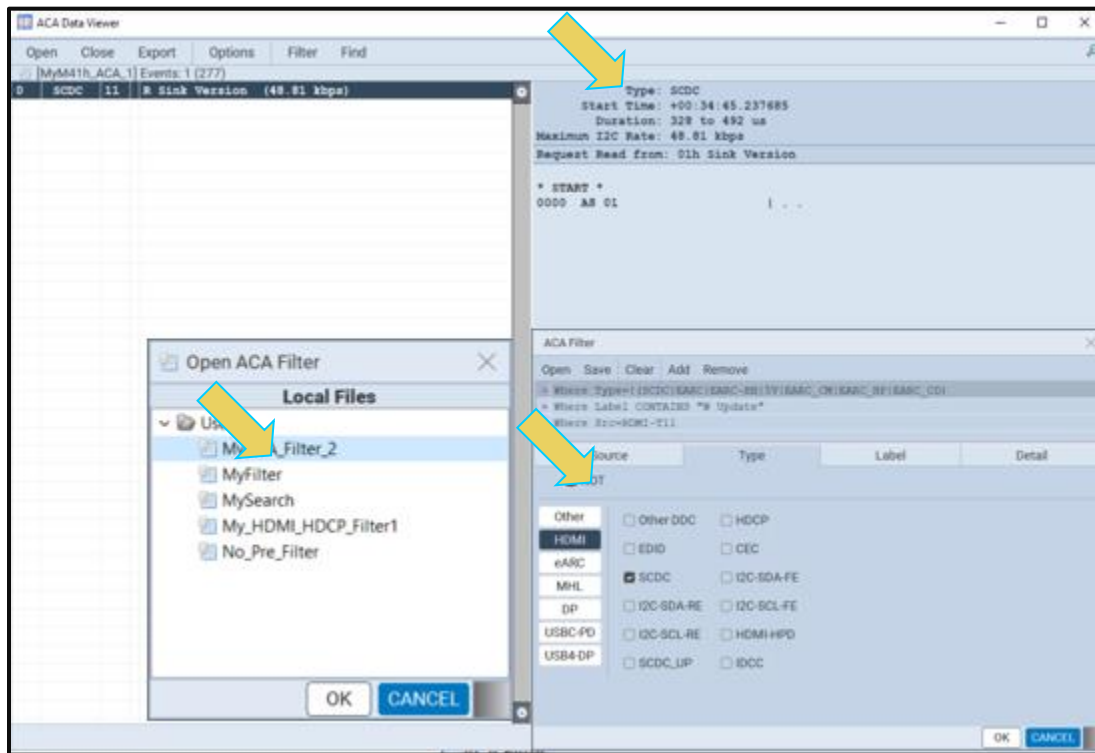


To save a filter configuration for quick recall, use the **Save** button.



A dialog box appears as shown above. Enter a name and click on **OK**.

To recall a filter simply click on the open button and an open dialog box appears as shown below.



11 Loading and Importing Capture Files

This chapter describes how to use access captured files taken from other M41h 48G Video Analyzer/Generator HDMI® systems and how to transfer capture files taken through the embedded ATP Manager.

11.1 Loading an Existing Capture with the M41h 48G Video Analyzer/Generator

You can load a decoded file that had been captured previously for analysis.

11.1.1 Loading an existing capture

Use the following procedures to load a capture that you have listed in the ATP Manager for the M41h 48G Video Analyzer/Generator. You can load a file in one of three ways:

Double-clicking on the captured file in the Captures panel

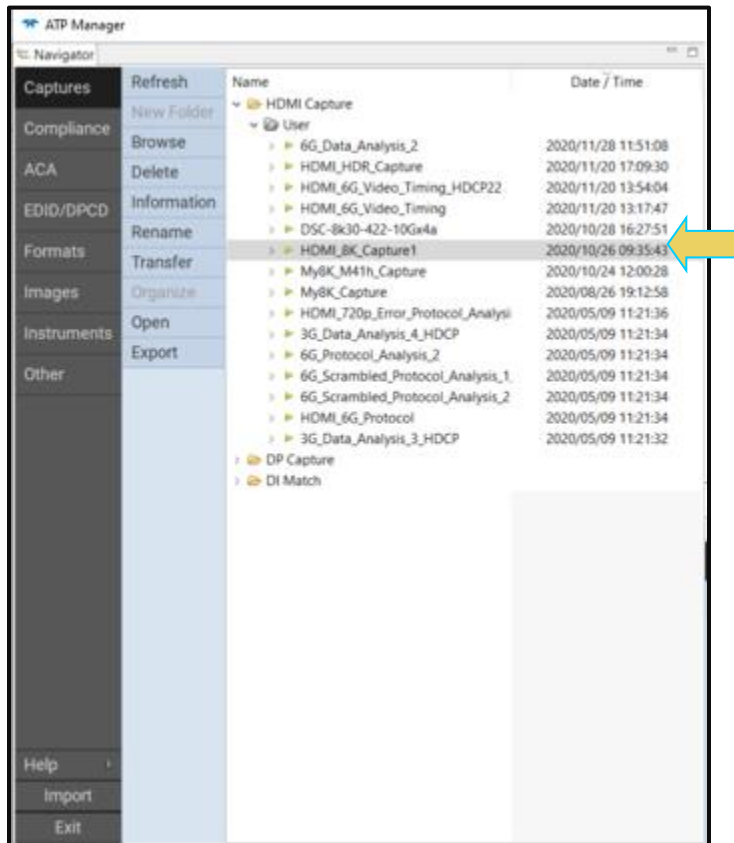
Accessing the Open option from the right-click menu of a selected capture in the Data pull-down menu

Clicking on Open  in the area near the top of the Data panel

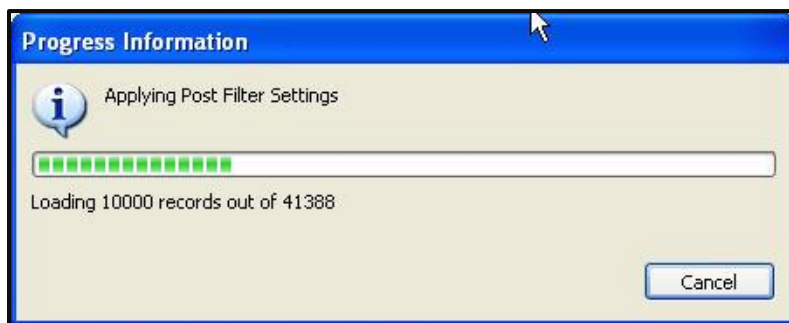
The procedures below show you how to load the capture from the right-click menu.

To Load a captured data file:

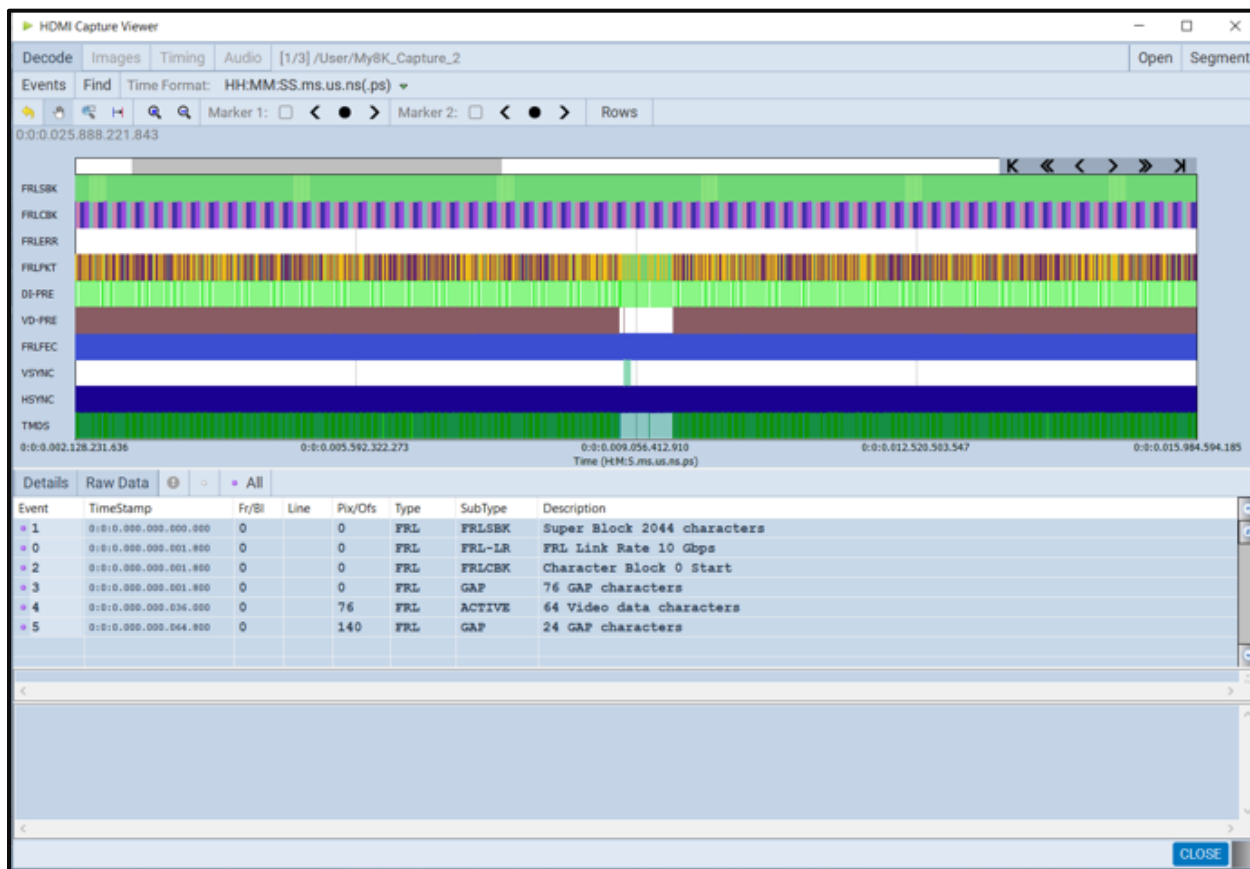
1. Load a capture for analysis by right-clicking on it and then select the **Open** item on the list.



A dialog box will display indicating the progress in loading the capture (sample shown below). Once the data is fully loaded it is displayed through the ATP Manager in both the **Event Plot** and **Decode** panels.



The captured file appears in the **Capture Viewer** window as shown below.



11.2 Importing Capture Files from Other M41h Systems

This subsection provides procedures on loading a previously captured file and procedures for importing captured files taken from another M41h 48G Video Analyzer/Generator.

The captured data from the M41h 48G Video Analyzer/Generator is portable. You can open captured files that have been taken by any other M41h 48G Video Analyzer/Generator at any other location. You do not need an M41h 48G Video Analyzer/Generator to examine captured files taken elsewhere; you just need the ATP Manager. For example, you may wish to send a set of captured files to a colleague at a different location and this colleague may not have an M41h Protocol Analyzer. In that case, the colleague can simply download the ATP Manager from the Quantum Data website to view the captured files that you sent them. Of course, it may be the case that your colleague is sending you a set of captured files as well. Typically, the file would be posted on an FTP site as a zip file. You would then need to download the file, unzip it, and then access it by browsing utilities provided in the ATP Manager.

In some cases, you may wish to put a series of captured files in an ATP Manager local directory for easy access. In this case move these files to the proper ATP Manager directory. Procedures for this are provided below as well.

11.2.1 Importing Capture Files

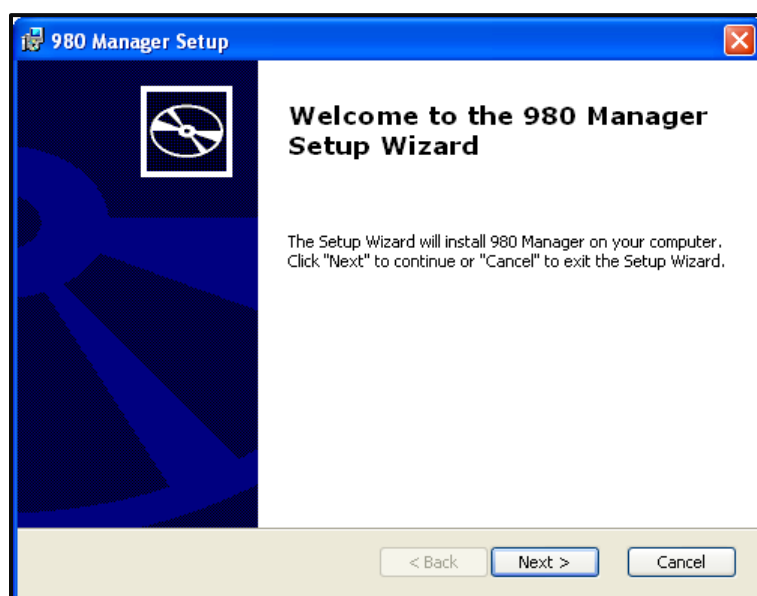
Use the following procedures to import a capture. The first procedure describes how to install the ATP Manager on your PC. The second procedure describes how to import the capture.

To Install the ATP Manager on your PC:

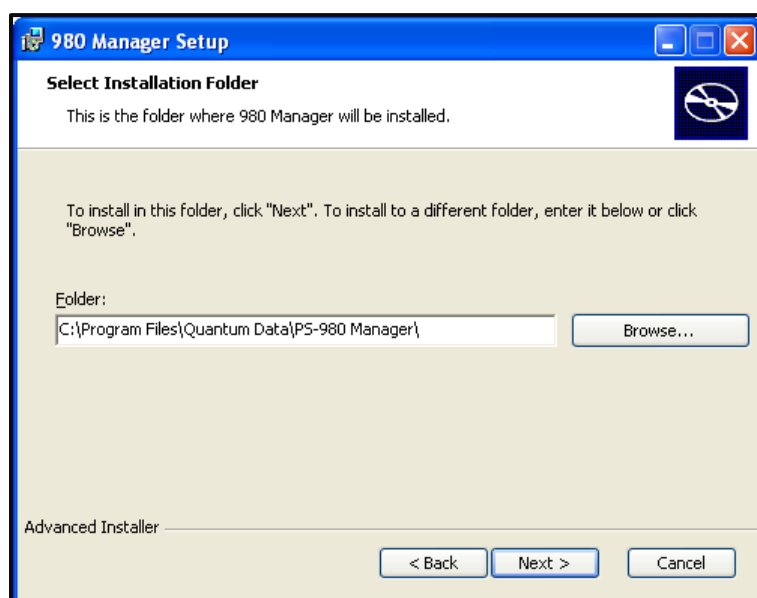
Download the ATP Manager from the quantumdata *downloads* page to your PC. The link to the *downloads* page is: <http://www.quantumdata.com/downloads>.

Start the installation by double-clicking on your downloaded *.msi file.

The Setup Wizard will launch.



Select the installation folder. We recommend installation in the default folder.

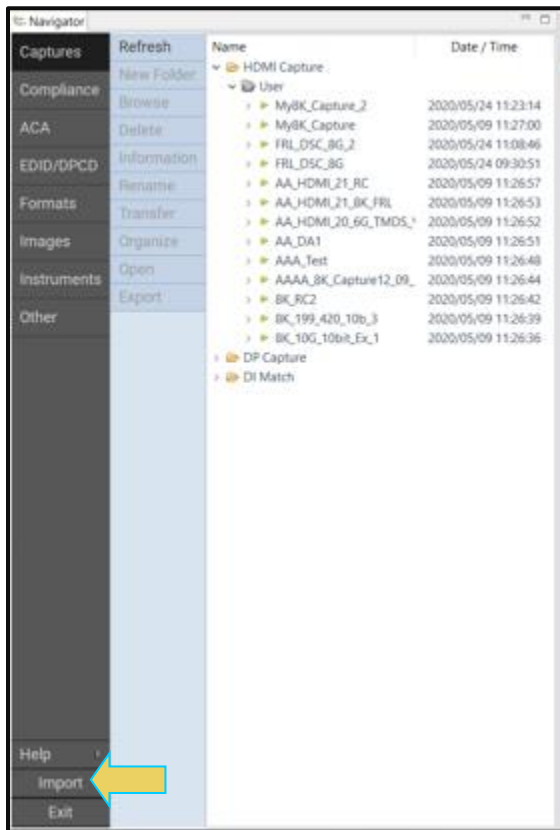


After installation completes, run the new ATP Manager. It should be available in the Start Menu under **All Programs** → **Quantum Data**, and from an icon on your Desktop.

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

Importing capture files

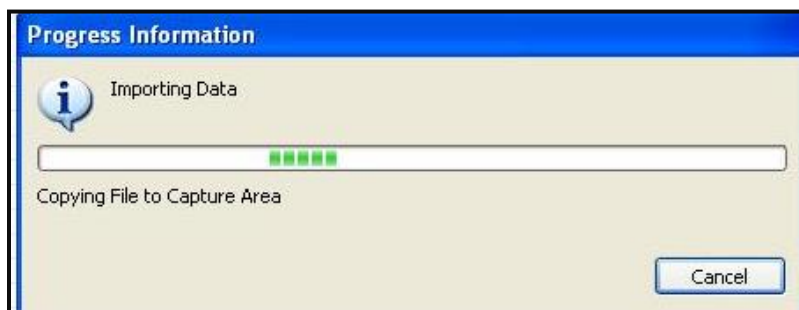
1. Download the captures zip file from your FTP site, save it and unzip it on your PC that now has the ATP Manager installed.
2. Import a previous capture using the **Import** utility available from the **File** menu. (See below.)



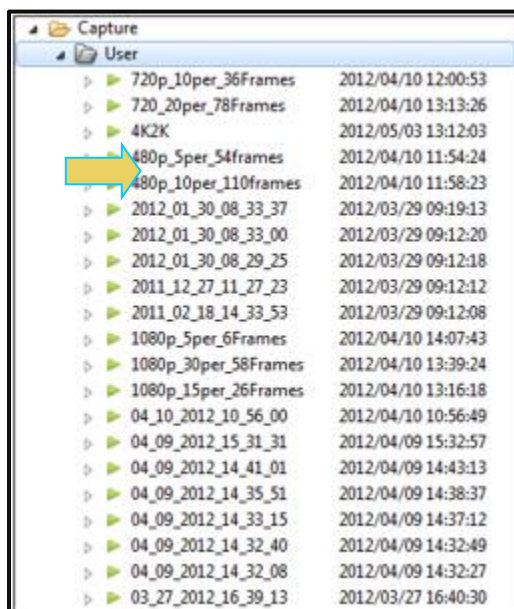
You will be asked to browse for a file through a standard Windows dialog.

Name	Date modified	Type	Size
4K2K	3/26/2012 5:03 PM	File folder	
480p_HDCP	3/26/2012 5:03 PM	File folder	
720p	3/26/2012 5:03 PM	File folder	
720p_DL_SizeError	3/26/2012 5:03 PM	File folder	
720p_HDCP_KO	3/26/2012 5:03 PM	File folder	
720p_noAIF	3/26/2012 5:04 PM	File folder	
1080p	3/26/2012 5:02 PM	File folder	
2011_02_18_14_33_53	3/26/2012 5:02 PM	File folder	
2011_12_27_11_27_23	3/26/2012 5:02 PM	File folder	
2012_01_09_16_29_26	3/26/2012 5:02 PM	File folder	
2012_01_30_08_07_44	3/26/2012 5:02 PM	File folder	
2012_01_30_08_27_41	3/26/2012 5:02 PM	File folder	
2012_01_30_08_29_25	3/26/2012 5:02 PM	File folder	
2012_01_30_08_33_00	3/26/2012 5:02 PM	File folder	
2012_01_30_08_33_37	3/26/2012 5:02 PM	File folder	
4K2K.zip	5/3/2012 1:11 PM	WinZip File	7,827 KB

Once you select the file you will see a progress dialog box as shown below:



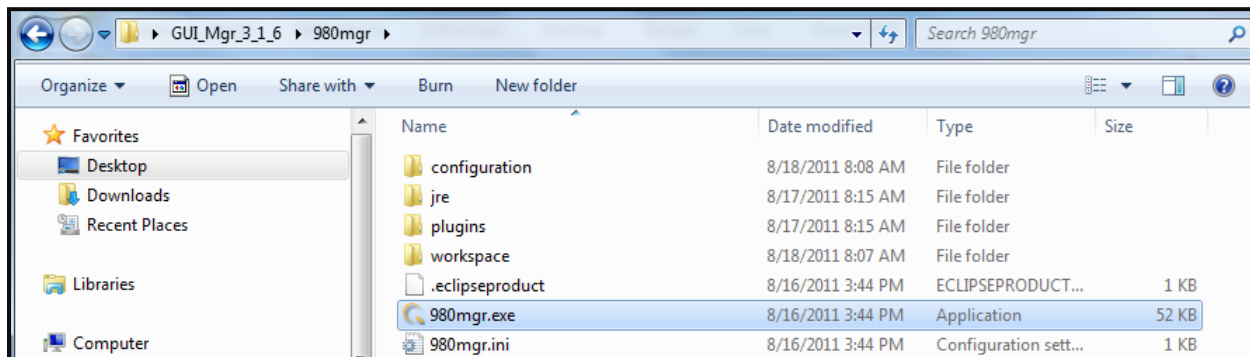
The imported file will then appear in the **Data** directory of the **M41h Navigator** panel as shown below. The captured file is loaded automatically and has an asterisk in front of it to indicate that this capture is the one that is loaded:



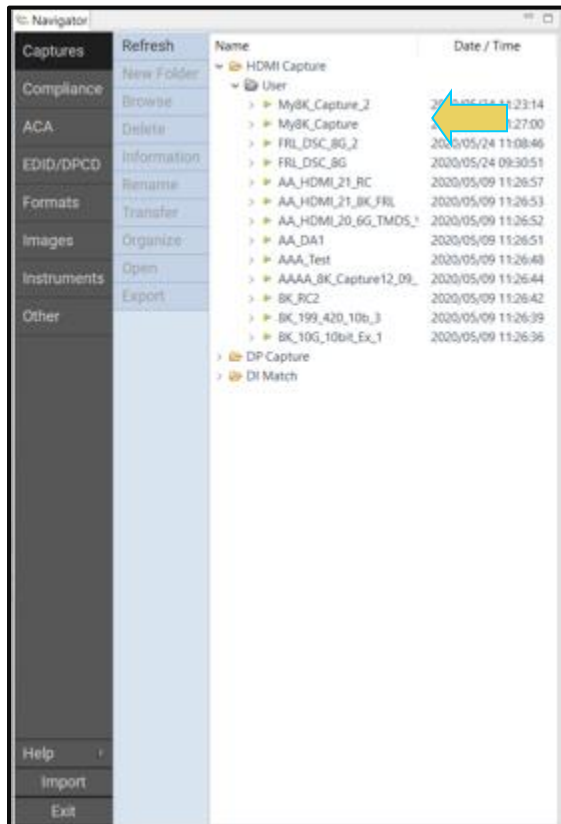
Relocating capture files to the ATP Manager directory

If you receive a capture file from a colleague for analysis, you will need to be able to access it on your ATP Manager. To do this you will need to place the file in a directory that the ATP Manager will be able to access it. Use the following procedures.

1. Download the captured zip file from your FTP site, save it and unzip it on your PC that now has the ATP Manager installed.

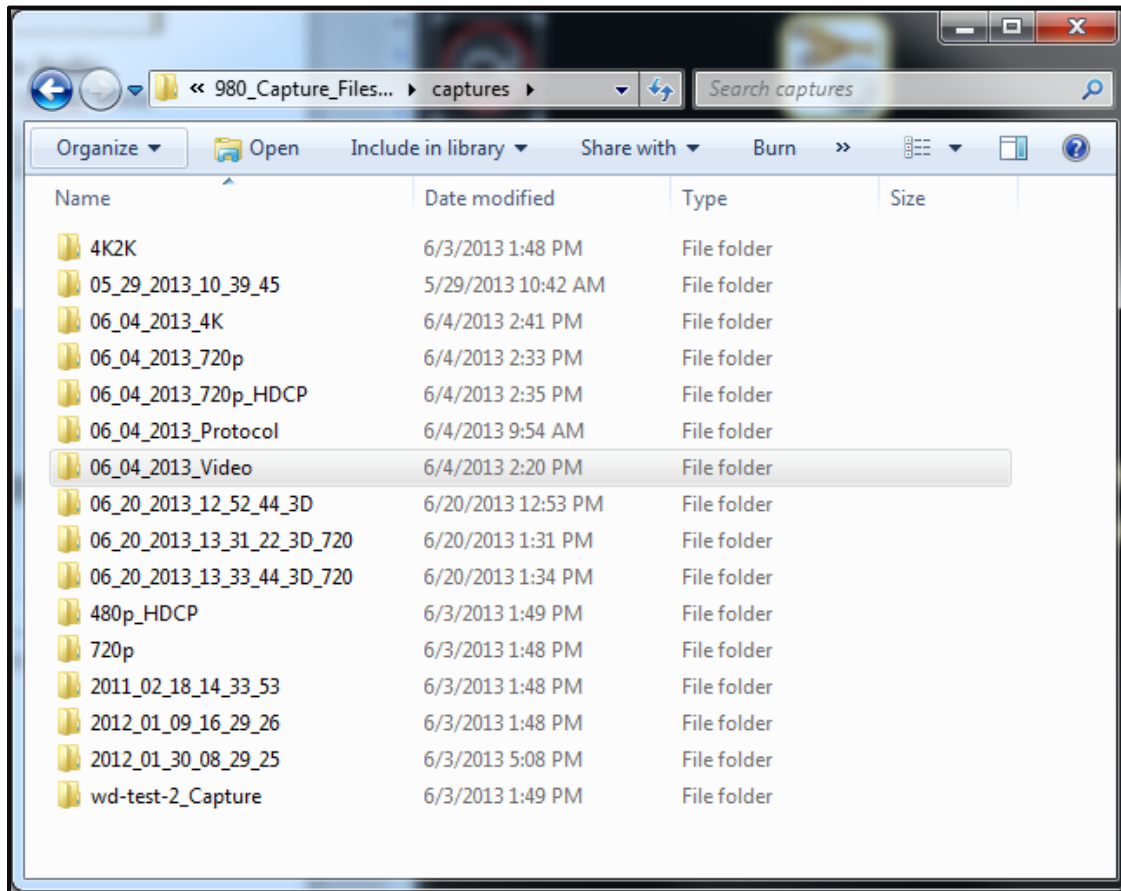


2. Launch the ATP Manager.
3. Locate the ATP Manager **captures** directory using the Open Selected Folder icon indicated below.



A Windows Explorer window will appear at the captured file. From there you can determine the location of the **capture** directory.

4. Transfer the capture directory (from the file you unzipped) to the ATP Manager **captures** directory using standard Windows methods. The screen example below shows the resulting files stored in the directory.



When you relaunch the ATP Manager you will see all the capture files that you transferred to the directory.

12 Transferring Capture Files from the M41h to a PC

The M41h 48G Video Analyzer/Generator for HDMI® offers portability of data. You can disseminate captured files or even compliance tests to other locations for analysis by other colleagues. When you make a capture using the embedded GUI the captured files are retained on the M41h test instrument.

Note: The procedures provided in this chapter show how to transfer ACA traces and captures playback files, but you can transfer EDIDs, image lists, or any other type of data type under the Navigator tab.

If you want to disseminate these captured files to others you will have to transfer these capture files to your PC. You can transfer files from the M41h 48G Video Analyzer/Generator to your host PC in three ways: 1) Data Transfer GUI utility, 2) USB drive, 3) command line FTP.

12.1 Transferring Capture Files Using the Data Transfer Utility

You can transfer files easily using the ATP Manager's **Data Transfer** utility. Follow the procedures below.

To transfer ACA files from the M41h to your PC using the Data Transfer utility:

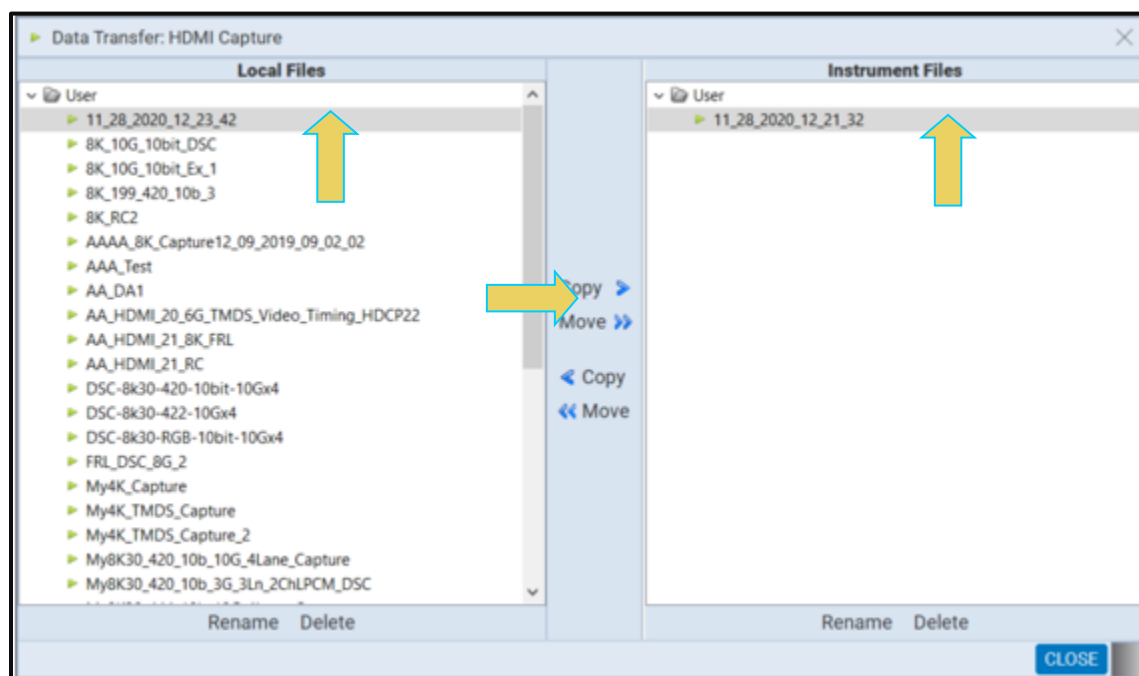
- Through the external ATP Manager, access the **Generator/Port Control** panel either through the **View** pull-down menu or the **Generator** button located on the top of the interface. Refer to the screen shots below.

Note: This procedure shows examples of transferring ACA traces, capture files and Playback files but you can transfer EDIDs, image lists or any other type of data type under the Navigator tab.

- Access the **Data Transfer** utility by double-clicking on **Transfer** on one of the data sets in the Navigator window.

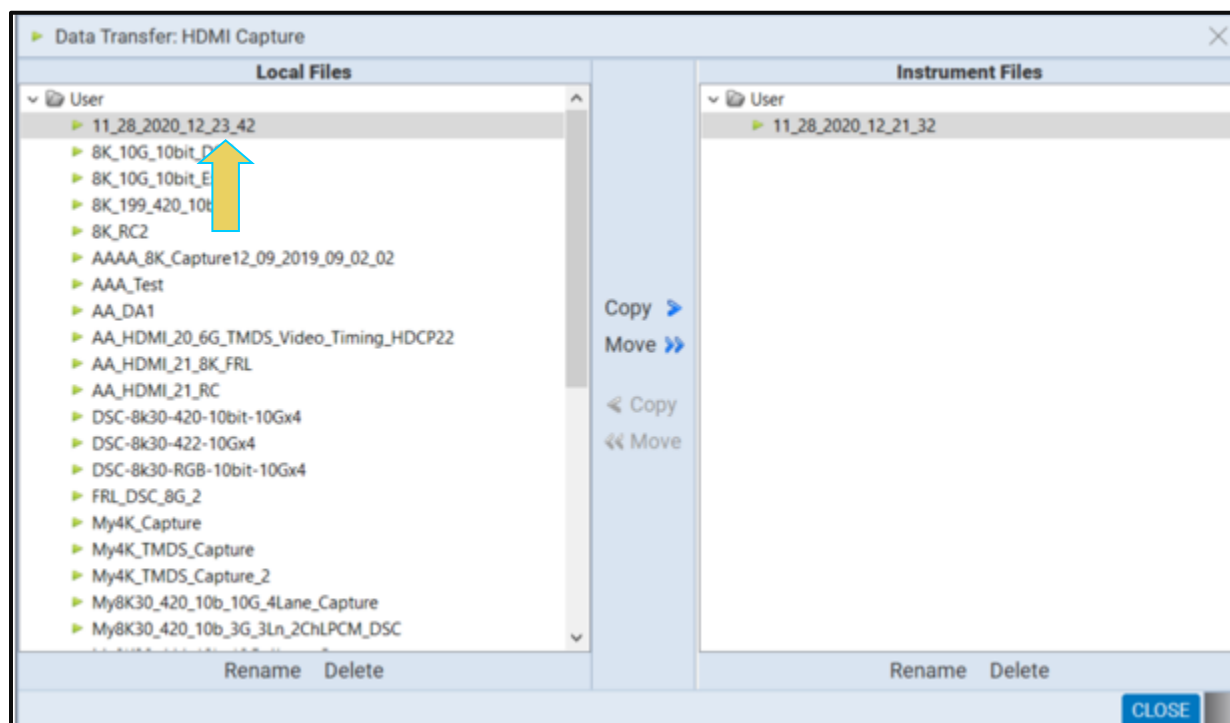
This enables you to select the M41h 48G Video Analyzer/Generator that you want to transfer data from.

The **Data Transfer** panel appears in context with the ACA files on the M41h (Instrument) under the **Instrument Files** available as shown below.



- Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.

The file appears on the PC host **Local Files** (below).

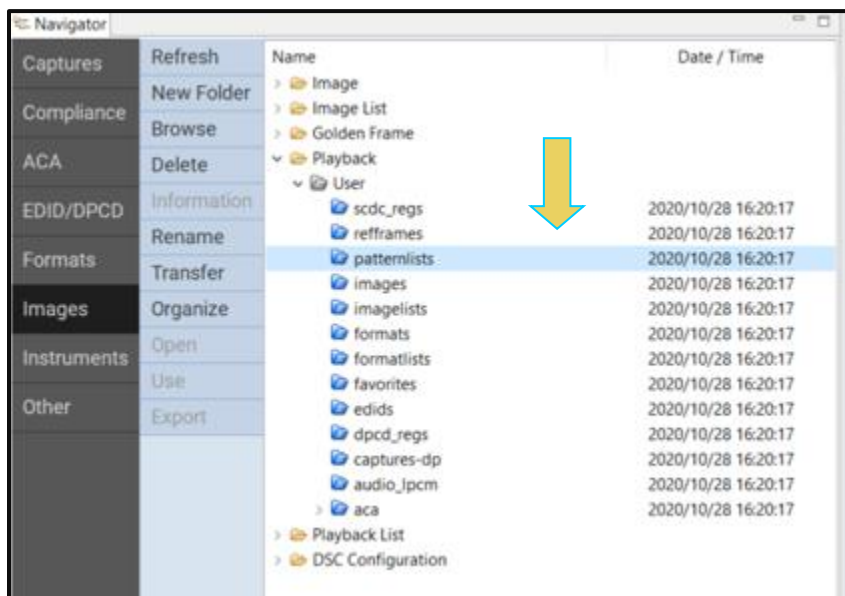


To transfer Playback files from the M41h to your PC using the Data Transfer utility:

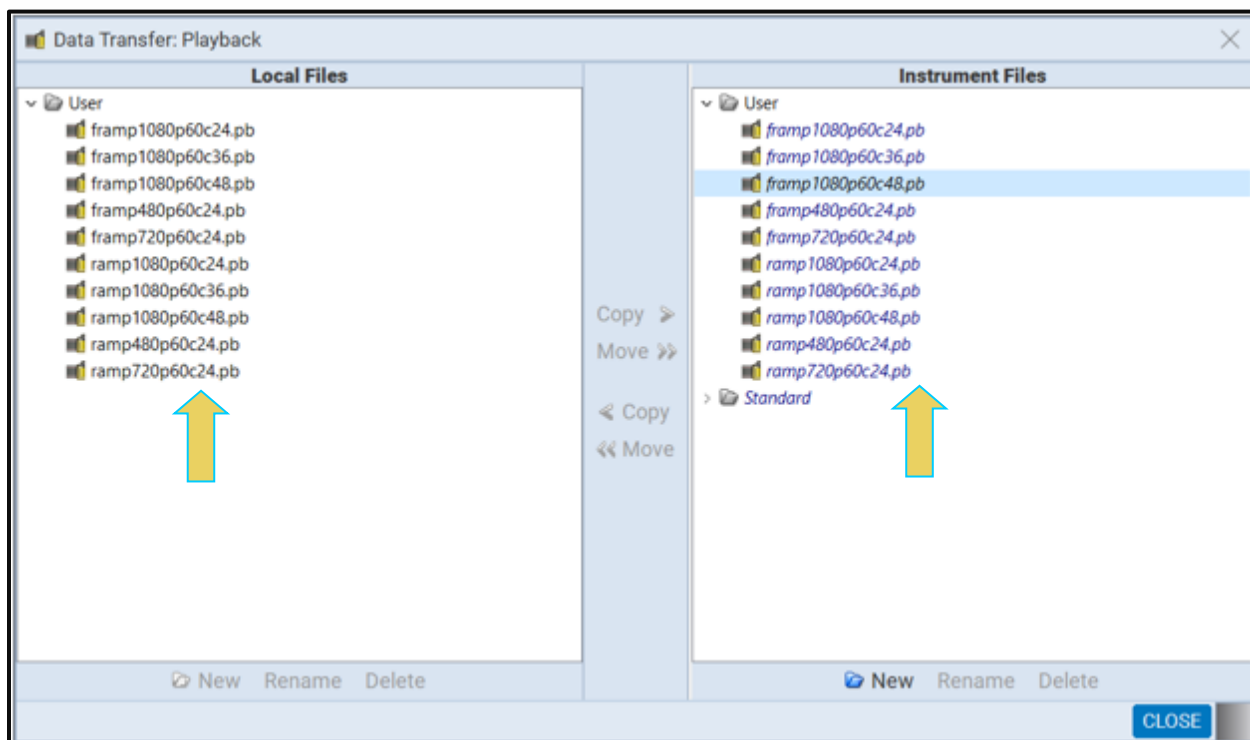
- Through the external ATP Manager, access the **Generator/Port Control** panel either through the **View** pull-down menu or the **Generator** button located on the top of the interface. Refer to the screen shots below.

Note: This procedure shows examples of transferring ACA traces, capture files and Playback files but you can transfer EDIDs, image lists, or any other type of data type under the Navigator tab.

- Access the **Data Transfer** utility by double-clicking on **Transfer** on one of the data sets in the Navigator window.



The **Data Transfer** panel appears in context with the ACA files on the M41h (Instrument) under the **Instrument Files** available as shown below.

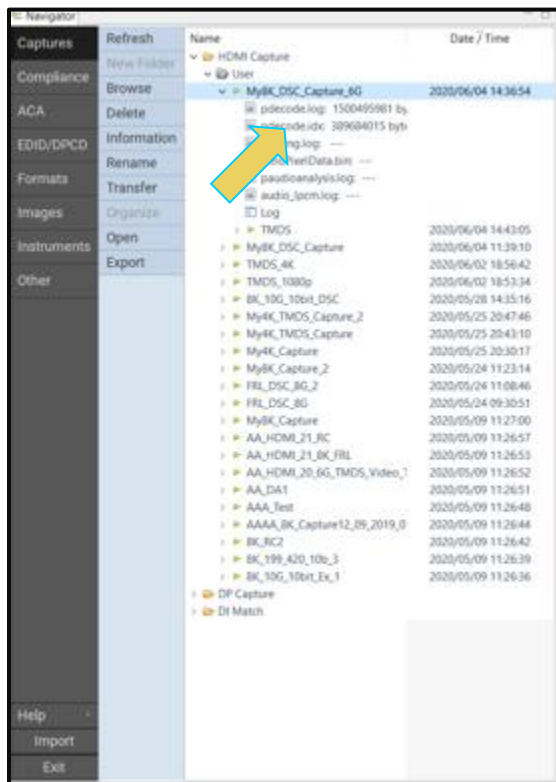


- Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.

The file appears on the PC host **Local Files** (below).

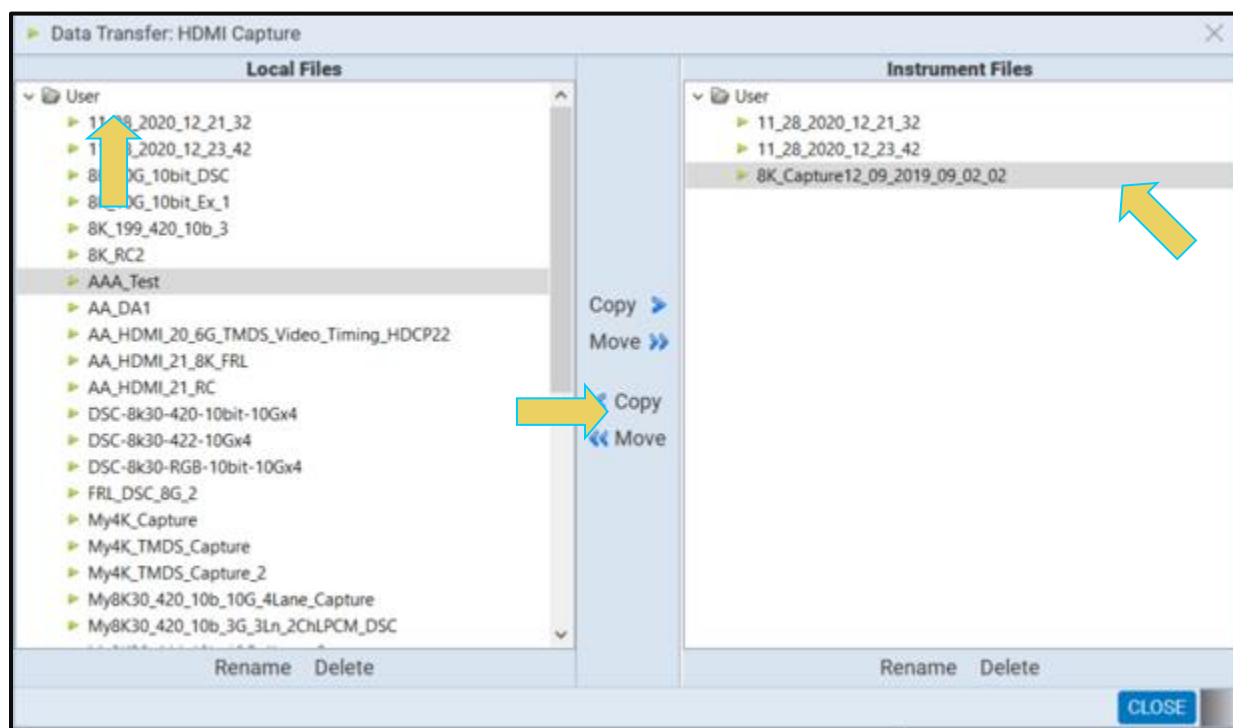
To transfer Capture files from the M41h to your PC using the Data Transfer utility:

- Through the external ATP Manager, access the **Generator/Port Control** panel either through the **View** pull-down menu or the **Generator** button located on the top of the interface. Refer to the screen shots below.
- Access the **Data Transfer** utility by double-clicking on **Transfer** on one of the data sets in the Navigator window.



The **Data Transfer: Capture Data** dialog box appears (below) enabling you to select the M41h 48G Video Analyzer/Generator that you want to transfer data from. Select the desired M41h 48G Video Analyzer/Generator and click OK.

The **Data Transfer** panel appears in context with the Capture files on the M41h (Instrument) under the **Instrument Files** available as shown below.



- Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.

The file appears on the PC host **Local Files**.

12.2 Transferring Capture Files Using the Command Line

If you have initiated captures through the embedded ATP Manager through the built-in touch screen, you can transfer these capture files to your PC where the external ATP Manager is installed. This enables you to view the captured data on the external ATP Manager and to disseminate these captures to other colleagues for additional analysis.

There are three ways you can transfer files from the M41h to the PC. 1) using an FTP utility, 2) using the FTP command, or 3) saving the files to a USB drive connected to the M41h.

Instructions for transferring files using the command line FTP and saving to a USB are provided. Procedures for transferring the captured files using an FTP utility such as FileZilla are not provided. Please refer to the user documentation provided with FileZilla. You can download FileZilla at: https://www.ohloh.net/projects/filezilla/download?filename=FileZilla_3.3.2_win32-setup.exe.

You will need to use the username of **qd** and the password of **qd** to login to the M41h in each case.

To transfer capture files using the FTP command:

- Open the DOS utility window on your PC.
- Enter the following command at the prompt:

`ftp 192.168.254.237 //` where 192.168.254.237 is the IP address of the M41h

You will then be prompted for a login. Enter **qd** and **qd** for the username and password as shown below.

```
User (192.168.254.237:(none)): qd
Password required for qd
```

- Change directories to the specific **workspace** directory using the DIR and CD commands.

```
ftp> dir
ftp> cd workspace
ftp> cd captures
ftp> cd 2010_07_14_01_37_01
```

- Use the binary mode for the FTP transfer.

```
ftp> bin
```

- Initiate the FTP get command on the **pdecode.log** file.

```
ftp> get pdecode.log
```

- Repeat the FTP GET command for the other files you wish to view through the external ATP Manager. You will want to transfer the .log files at a minimum. You may also want to transfer the .img files for the video thumbnails.
- Exit the FTP `command` line with the following command:

```
ftp> bye
```

- Recreate the directory with an appropriate name in the ATP Manager's working directories: `quantumdata/M41hManager/M41hmgr/workspace/captures/`.
- Move the `pdecode.log` file and other files that you transferred to your PC into the new directory.

You will now be able to view the files through the ATP Manager.

12.3 Transferring Capture Files Using USB Drives

If you have initiated captures through the embedded ATP Manager through the built-in touch screen, you can transfer these capture files to a PC using a USB drive.

To transfer capture files using a USB drive:

1. Connect a USB thumb drive on the back of the M41h.



M41h Advanced Test Platform

5. Minimize or close the embedded GUI by touch selecting the **Quantumdata M41h Manager** icon on the bottom status panel of the GUI.
6. Touch the workspace icon on the touch screen desktop.

A navigation directory window appears.

7. Browse and locate the capture files in `/home/qd/workspace/captures/`
8. Touch select and highlight the captures directory
9. Touch select the top-level Edit pull-down menu and select Copy.
10. Touch select the lower left button just above the Start button to change the left panel view.

You should see qd, Desktop, USB flash disk, and 2 GB Volume if you touched the correct button on lower left.

11. Touch select the USB flash disk to change the right panel view to show the USB thumb drive's contents.
12. Touch any white space on the right panel to focus it.
13. Touch select Edit at top and then touch Paste to copy the capture directory to your USB drive.

You can now place the USB drive in your PC and move the files over to the M41h Manager's working directories: `quantumdata/M41hManager/M41hmgr/workspace/captures/`.

13 Passive Probing and Pass Through Mode

The M41h offers the ability to monitor video/transactional data in two passive modes:

- **Passively Probing:** monitor DDC Channel transactions between a source and sink in FRL and TMDS mode
- **Card Pass Through:** monitor video and metadata between a source and sink in TMDS mode

There are certain restrictions when working with these two features, which are detailed in the following sections.

Note: These features require License 114 (SKU 95-00230) to enable functionality. Contact Teledyne-LeCroy support for information on obtaining new licenses.

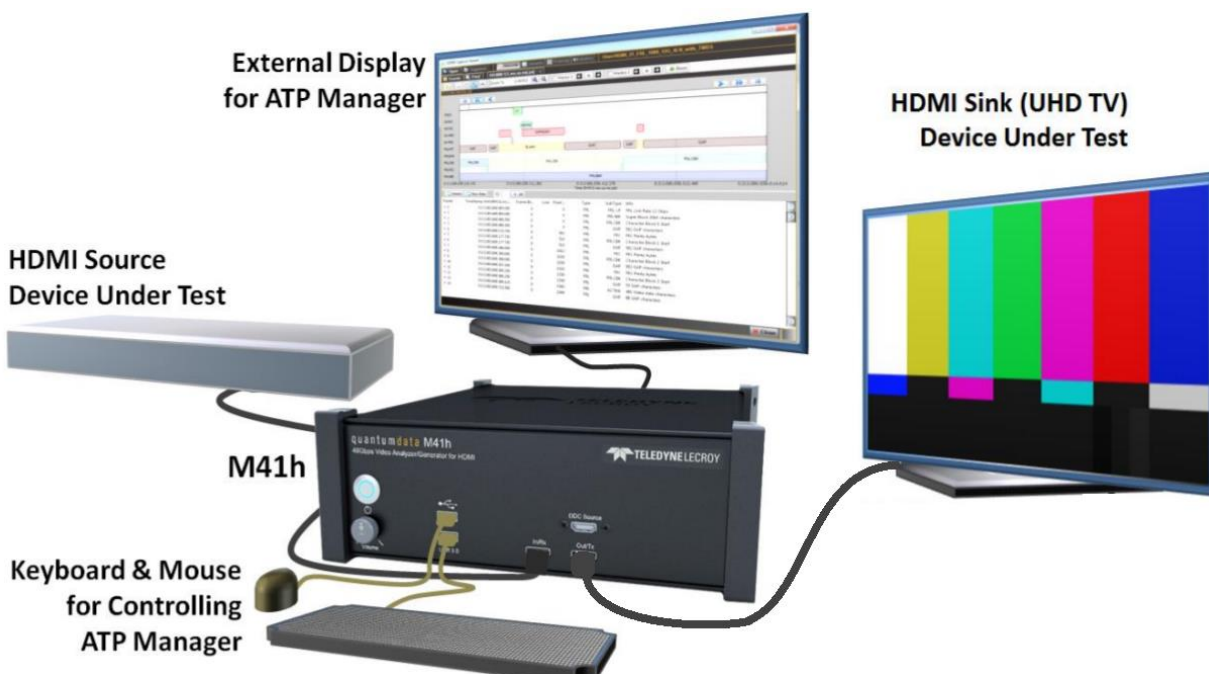
13.1 Physical Connections for Pass Through Mode and Passive Probing

Special connections need to be made between the source and sink devices and the M41h for both Pass-Through Mode and Passive Probing. Pass-through Mode has a typical Passive Monitoring physical connection setup, while Passive Probing (or “sniffing”) of DDC Channel Transactions requires a custom-made cable that Teledyne-LeCroy provides.

13.1.1 Connections for Pass through Mode (TMDS Only)

You must establish a new connection when using Pass-through mode to monitor video and metadata in TMDS mode. This procedure describes how to connect a source and sink to the M41h for Pass through Mode.

Use the diagram below as a guideline. Connect the HDMI Source DUT to the M41h In/Rx port, and connect the HDMI® Sink DUT to the M41h Out/Tx port, as shown below.



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.

13.1.2 Connections for Passive Probing of DDC Channel Transactions (FRL and TMDS)

For passive probing of DDC Channel, you must establish connection between the Source, Sink, and M41h devices using a custom HDMI cable. The cable, shown below, is supplied by Teledyne-Lecroy.



This procedure describes how to monitor the DDC channel passively between a source and sink device in either TMDS or FRL mode. This feature is optional and requires a license.

Refer to the example test setup below. Connect one end of the special HDMI cable to each the HDMI FRL Source DUT, the HDMI FRL Sink DUT, and the In/Rx port of the M41h instrument, as shown below.



13.2 Enabling Passive Mode in Realtime Analyzer

Use the following procedure to connect your source and sink DUT to the M41h in Passive mode:

1. Open the “RealTime” Receiver (Basic Analyzer) window of the embedded ATP (running on the externally connected display connected to the HDMI port in the back).
2. Click on the Mode flyout button on the right-hand side bar. Sink Emulation should be enabled prior to activating Pass-through mode.



3. Click on Pass-Through (indicated above) to enable passive monitoring.

Passive monitoring will be indicated in the **PassTh** field of the Analyzer Dashboard, as shown below.



13.3 Card Pass Through for Monitoring TMDS Video and Metadata

Pass Through mode is used to monitor only TMDS video and metadata. TMDS DDC Channel Monitoring is possible, and procedures for that are in the next section.

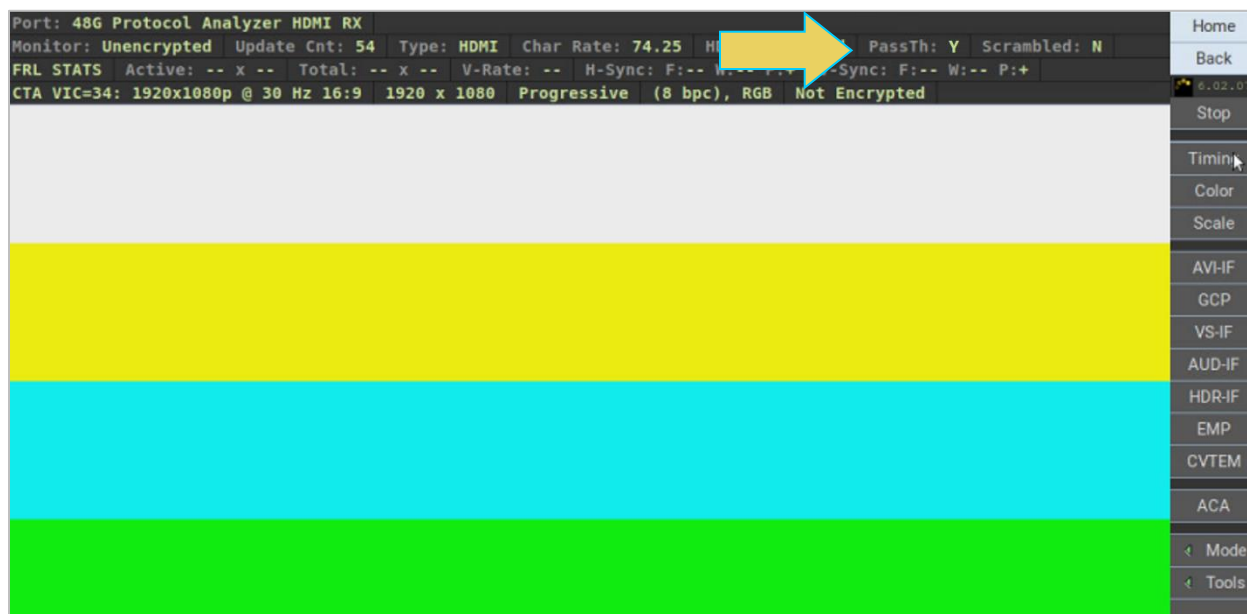
After establishing the physical connections and enabling passive monitoring per the procedures in the previous section, Pass Through mode is enabled.

Use the procedures in this section to monitor TMDS video and metadata in Pass Through mode.

13.3.1 Verifying Passed-Through Video

Prior to initiating a capture of the passed-through video, verify that the video signal is being properly transmitted by the source. Navigate to the Basic Analyzer and verify that the image is properly displayed, and the snapshot data in the Analyzer dashboard is correct for the transmitted signal.

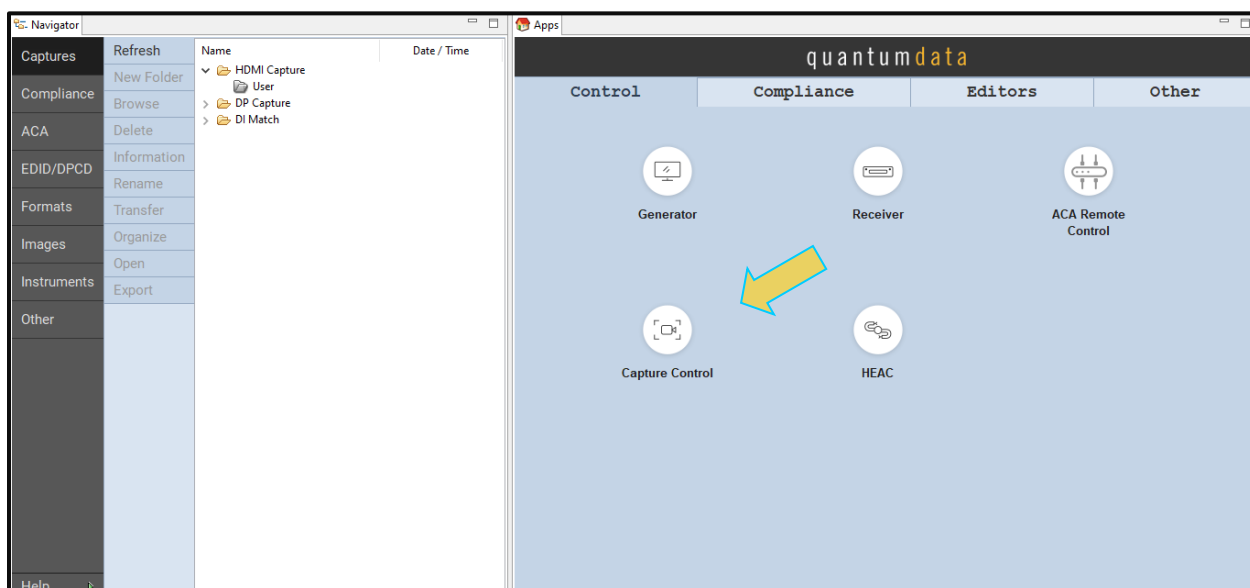
The Analyzer will also indicate in the dashboard if Pass-through mode is enabled, which it should be if you follow the procedures in the previous section. See the example below for details.



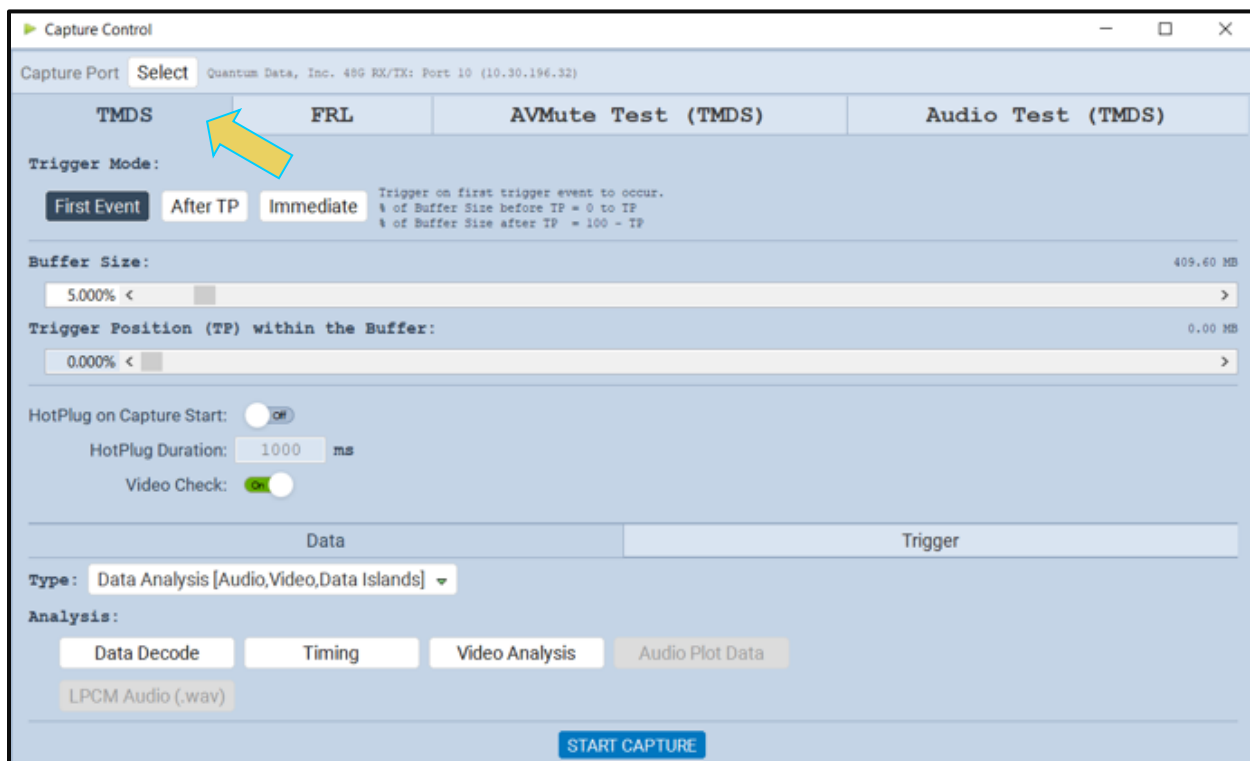
13.3.2 Capture Control

This subsection briefly describes the procedures for capturing passed-through TMDS streams. Detailed explanation/procedures can be found in the **Capture Control Chapter**. The functions are the same for Capture Control during basic source testing and Pass-through mode.

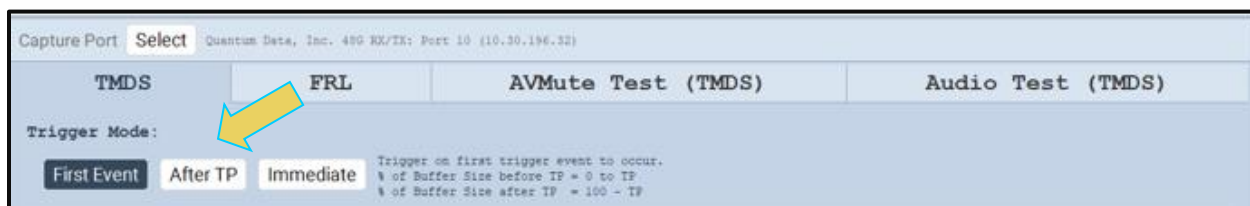
1. Select the **Capture Control** application from the **Control Page** of the Main screen.



2. Select the TMDS tab at the top of the Capture Control window.



3. Set the Video Trigger mode using the information described below:

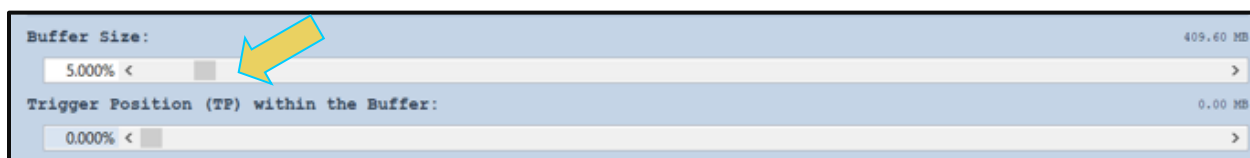


First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slider, you may have some of the captured data in the buffer that accumulated prior to the trigger condition and some of the captured data in the buffer that accumulated after the trigger condition. At the left most position there will be no data in the capture buffer that occurred prior to the trigger event. At the right most position, all the data in the capture buffer will be data that accumulated prior to the trigger event. Because the trigger condition could be met quite quickly, the capture buffer may not be filled to the amount specified in Buffer Size.

After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slider is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has accumulated after the trigger condition was met. This setting will ensure that the capture buffer is filled to the Buffer Size setting.

Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture trigger event (activating the Start Capture button).

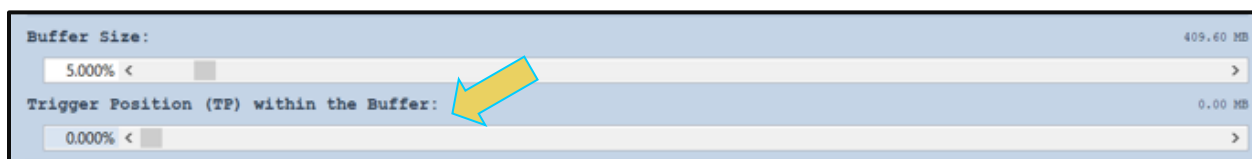
4. Set the Buffer Size slider to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 1150 frames at 576p/480p and about 204 frames at 1080p which includes the passed-through video. If you do not want to capture the video and only capture the passed-through metadata, you can store well over 200,000 frames of data with the 4GByte storage capabilities.



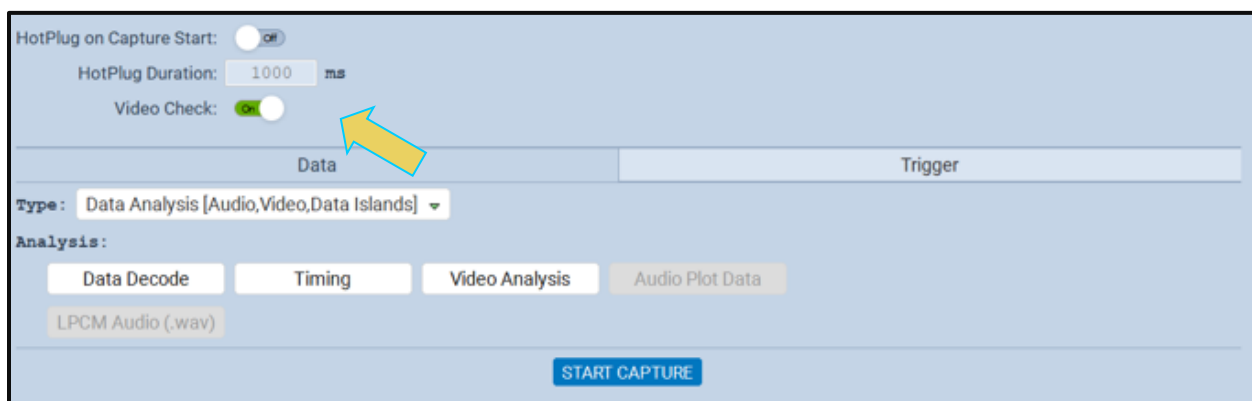
5. Set the Trigger **Position** within the **Buffer** slider to a percent value to meet your requirements. This slider enables you to set the position of the trigger event within the captured pass-through data. This is a slider that provides an indication (on the left) of the location within the captured data, expressed as a percent with 0% indicating that the trigger event occurs at the beginning of

the captured data and 100% indicating that the trigger event occurs at the end of the captured data.

Note: When using **Manual** trigger, it is important to set the Trigger Position to ensure that there is some captured data prior to the manual trigger start point. The manual trigger is particularly useful when you are observing the behavior of a connected sink and then manually initiating the trigger when a particular symptom exhibits itself. Typically, you should move the trigger position to the right nearest the 100% mark. This way you ensure that there is data prior to the trigger event by accounting for reaction time between the time the symptom occurs and the time you initiate the trigger. Refer to the settings below which are typical.

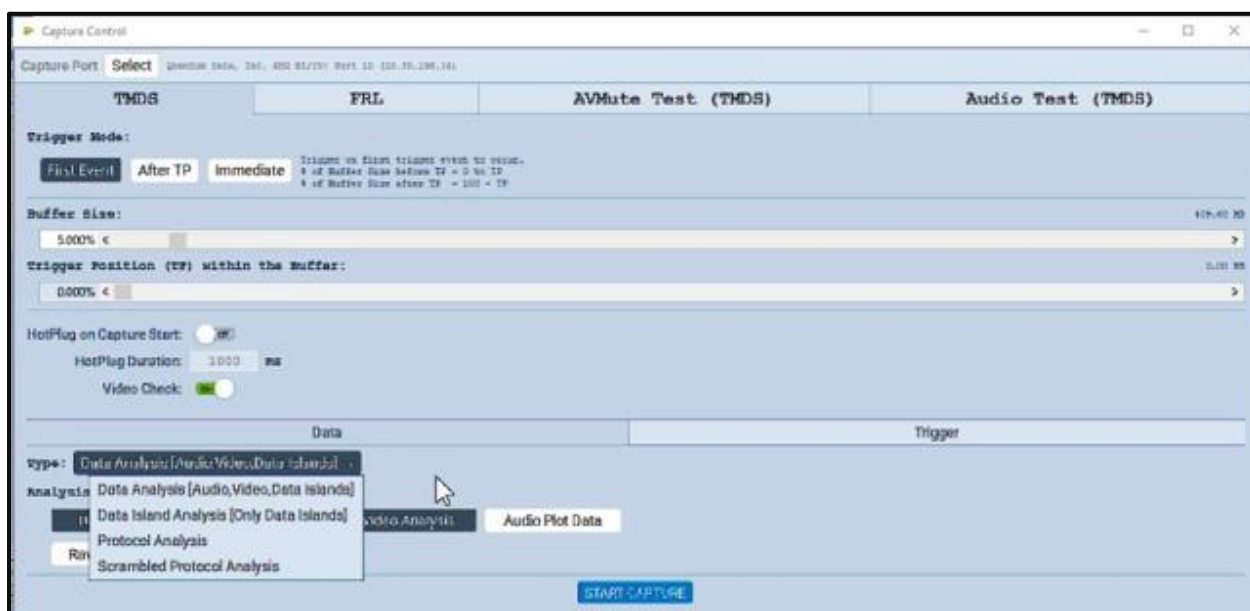
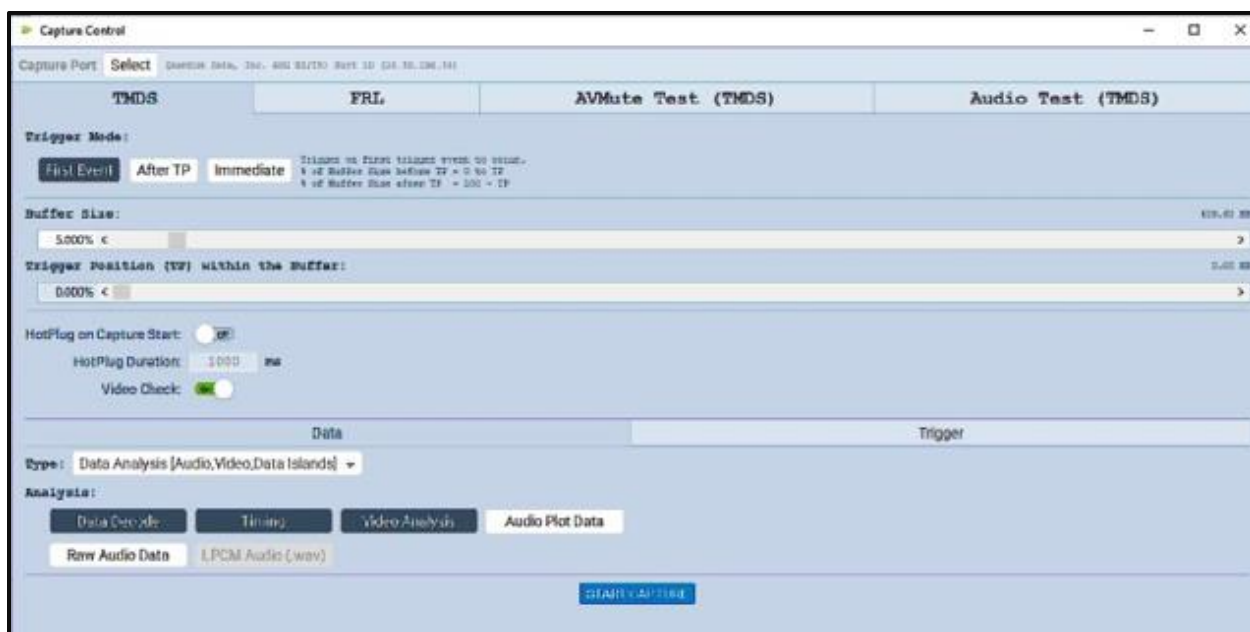


Note: If you are going to be taking some action on the device under test that will halt video being passed-through, such as unseating and reseating the HDMI cable, you will need to turn on the **Video Check** radio button in the Capture Configuration section of the **Capture Control** dialog box.

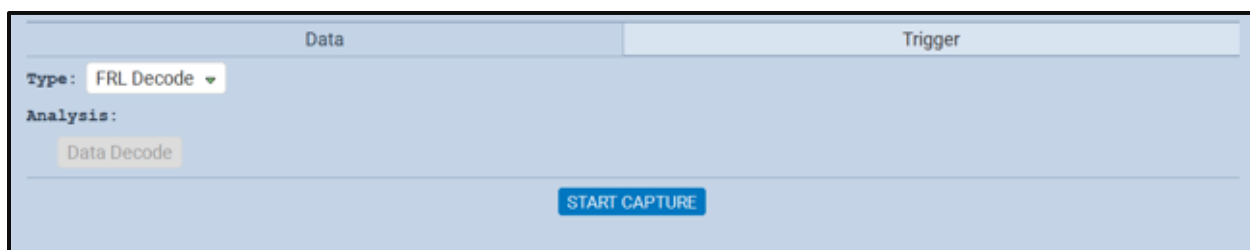


6. Select the **Capture** tab.

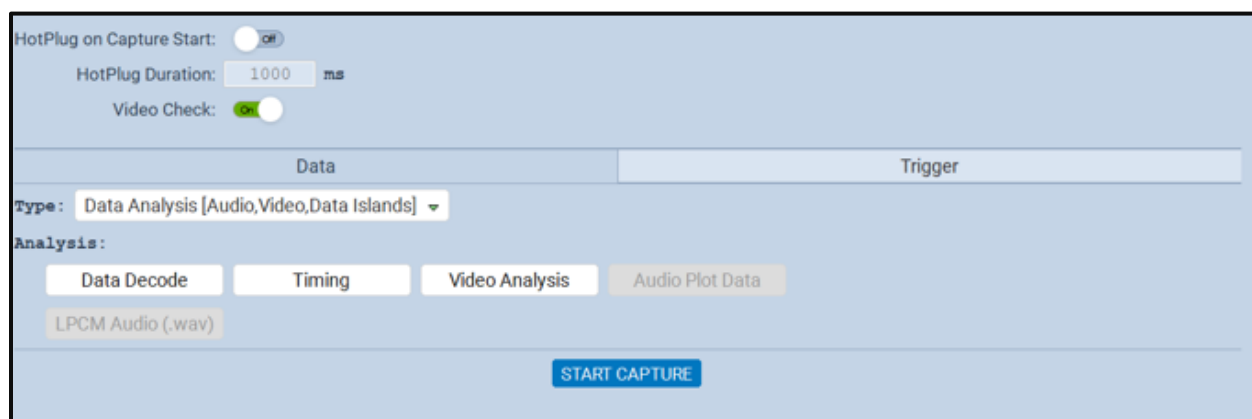
7. Select the **Data Selection** Type from the pull-down menu provided.



8. Select the Trigger selection **Condition**.

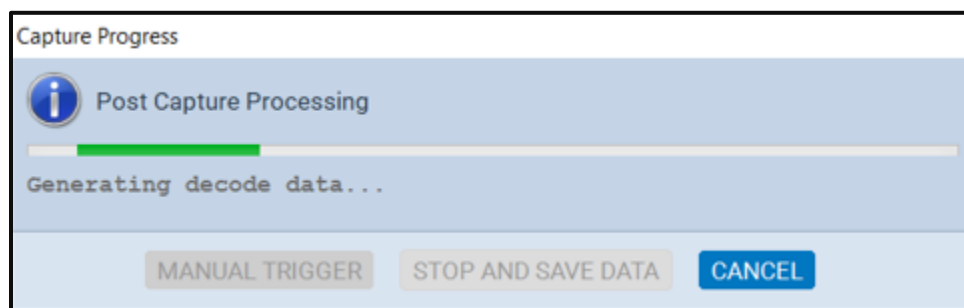


9. Click on the **Start Capture** button.

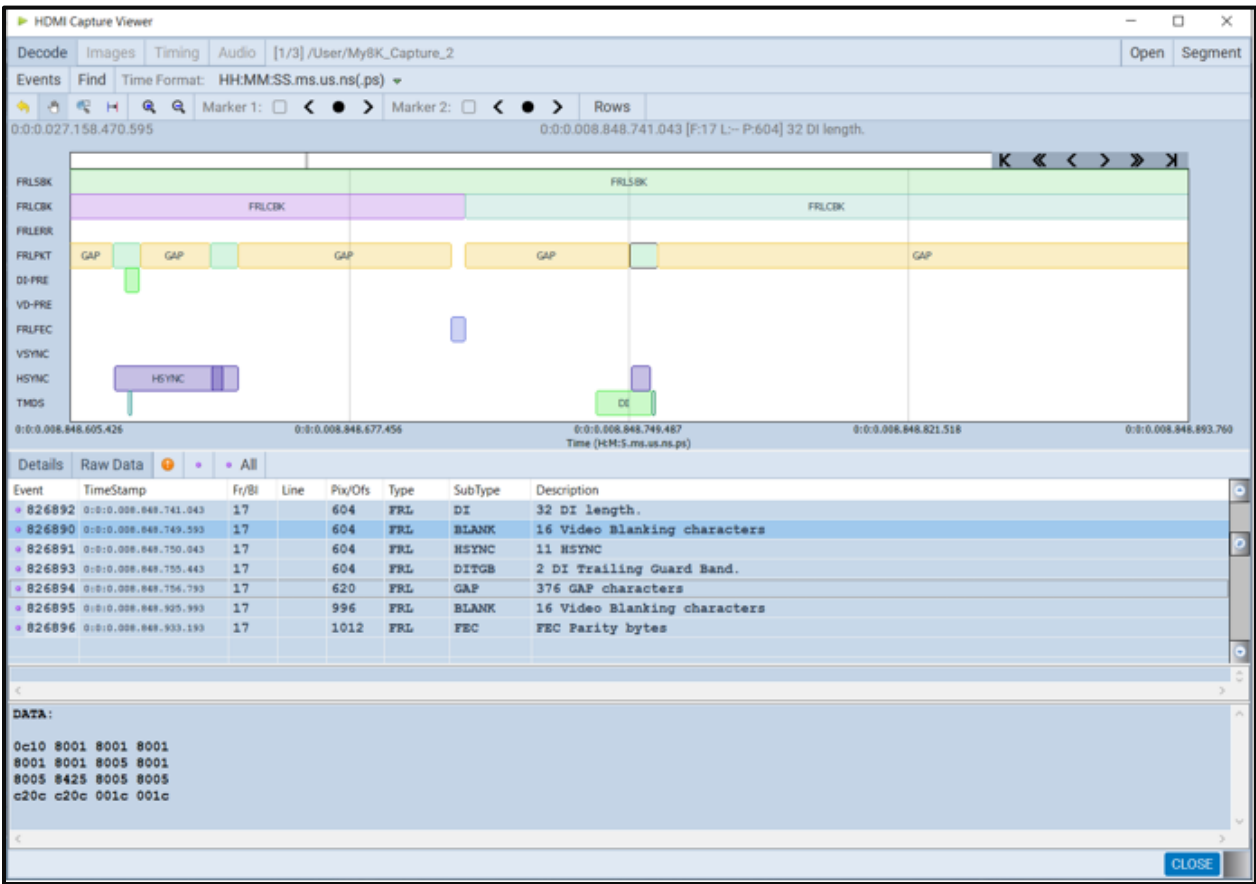


The M41h 48G Video Analyzer/Generator will capture the passed-through data for analysis. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

Note: If there is some action that needs to be taken by a user to cause the trigger condition to occur, the capture dialog box will state “**Waiting for capture trigger to occur...**”



When the M41h 48G Video Analyzer/Generator is finished capturing data a decode file is shown in the **Event Plot** panel and the **Decode** panel.



Detailed explanation/procedures for the Capture Viewer can be found in the **TMDS Capture Viewer section** of the Capture Control chapter. The functions are the same for Capture Control during source testing and Pass-through mode.

13.4 Passive Probing for Monitoring DDC Channel Transactions

The M41h is also capable of Passive Probing for monitoring DDC Channel Transactions with both TMDS and FRL video streams. Passive Probing may also be referred to as “sniffing” the DDC Channel transactions.

13.4.1 Establishing Connections

For passive probing of DDC Channel, you must establish connection between the Source, Sink, and M41h devices using a custom HDMI cable. The cable, shown below, is supplied by Teledyne-Lecroy.



This procedure describes how to monitor the DDC channel passively between a source and sink device in either TMDS or FRL mode. This feature is optional and requires a license.

Refer to the example test setup below. Connect one end of the special HDMI cable to each the HDMI FRL Source DUT, the HDMI FRL Sink DUT, and the In/Rx port of the M41h instrument, as shown below.



13.4.2 Operating ACA Utility for DDC Channel Analysis

This subsection briefly covers the ACA Utility for Passive DDC Channel Capture/Analysis. For full explanation/procedures, refer to the **ACA Utility Chapter**. The operation of the ACA is the same during passive monitoring as when testing a source or a sink.

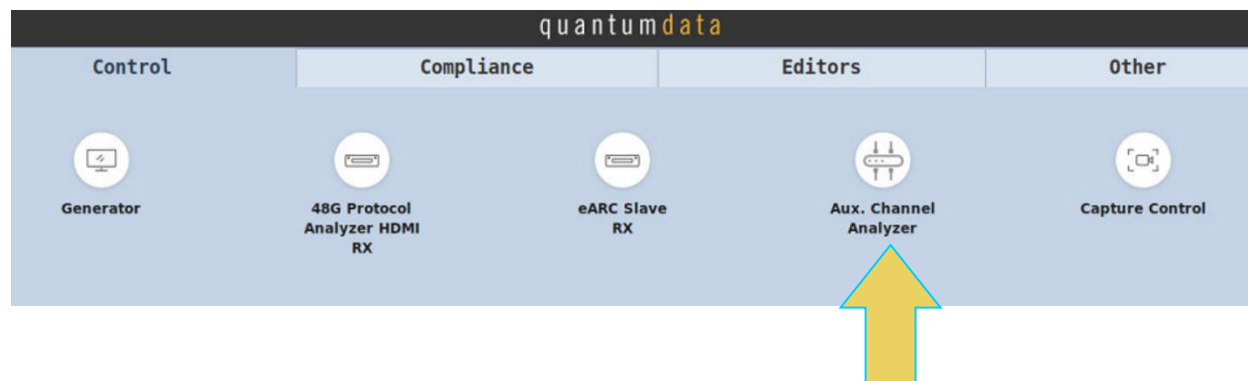
Use the following procedures to passively monitor the HDMI DDC transactions with an HDMI device in real time. The procedures assume that the HDMI device under test is powered up and connected to one of the M41h 48G Video Analyzer/Generator ports.

The operation of the two ACA real time utilities—**Aux Channel Analyzer** on the *embedded* M41h GUI and the **ACA Remote Control** on the *external* ATP Manager-- is similar. The screen examples used in this subsection are from the **ACA Remote Control** utility on the *external* ATP Manager exceptions related to the operation of the ACA on the embedded ATP Manager are noted.

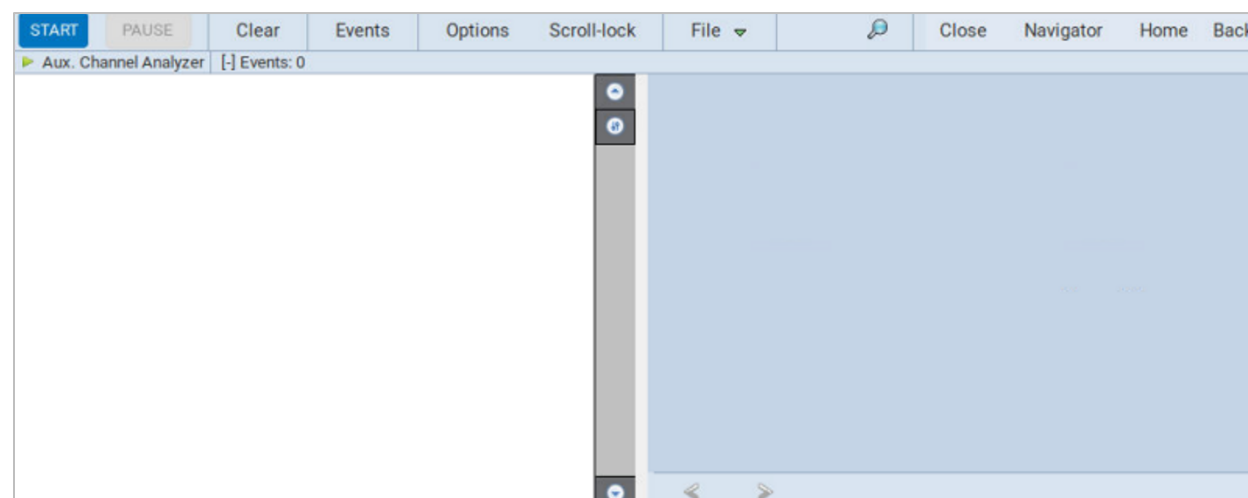
Important Note: You can filter and search through the passively captured ACA traces. Procedures for searching and sorting are provided in the **Find/Filter sections within the ACA Chapter**.

To monitor the HDMI DDC transactions:

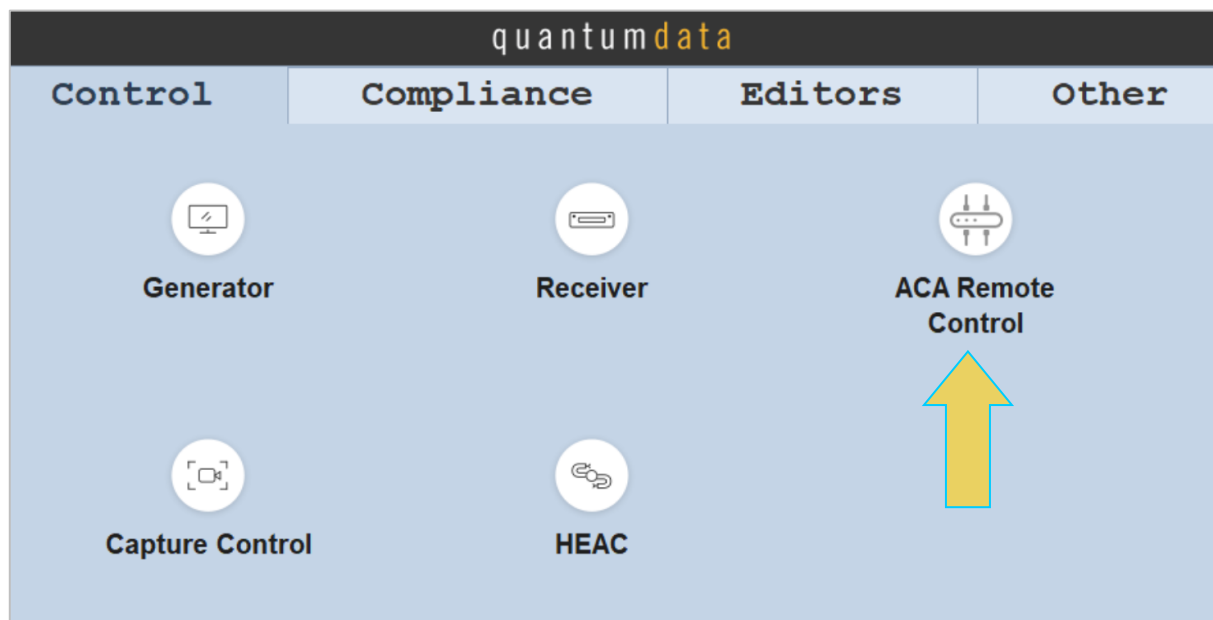
1. For the *embedded* ACA utility, select the **Aux Channel Analyzer** on the page 1 (Card Control) of the **Apps** panel:



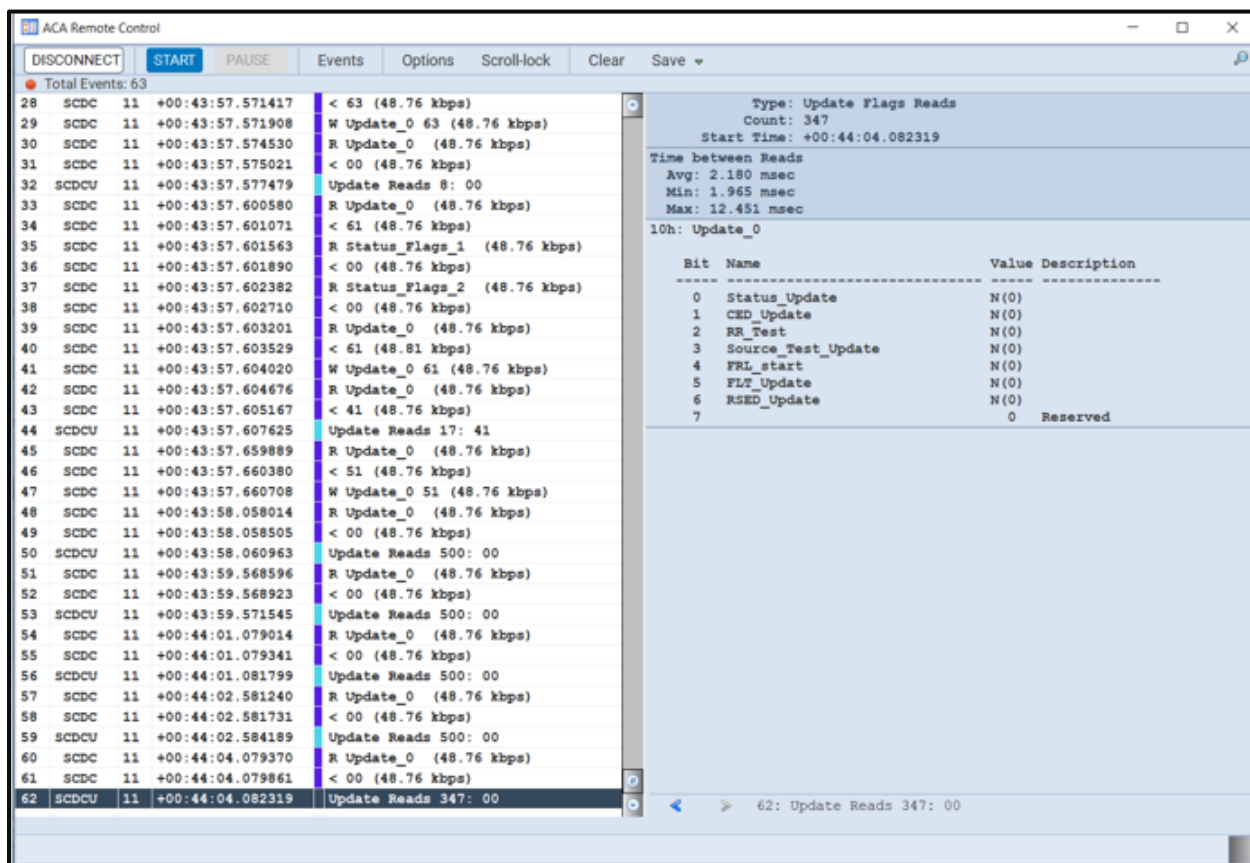
The **Aux Channel Analyzer** panel appears as shown below:



For the remote host PC ACA utility, touch select the **ACA Remote Control** on the page 1 (Card Control) of the **Apps** panel:



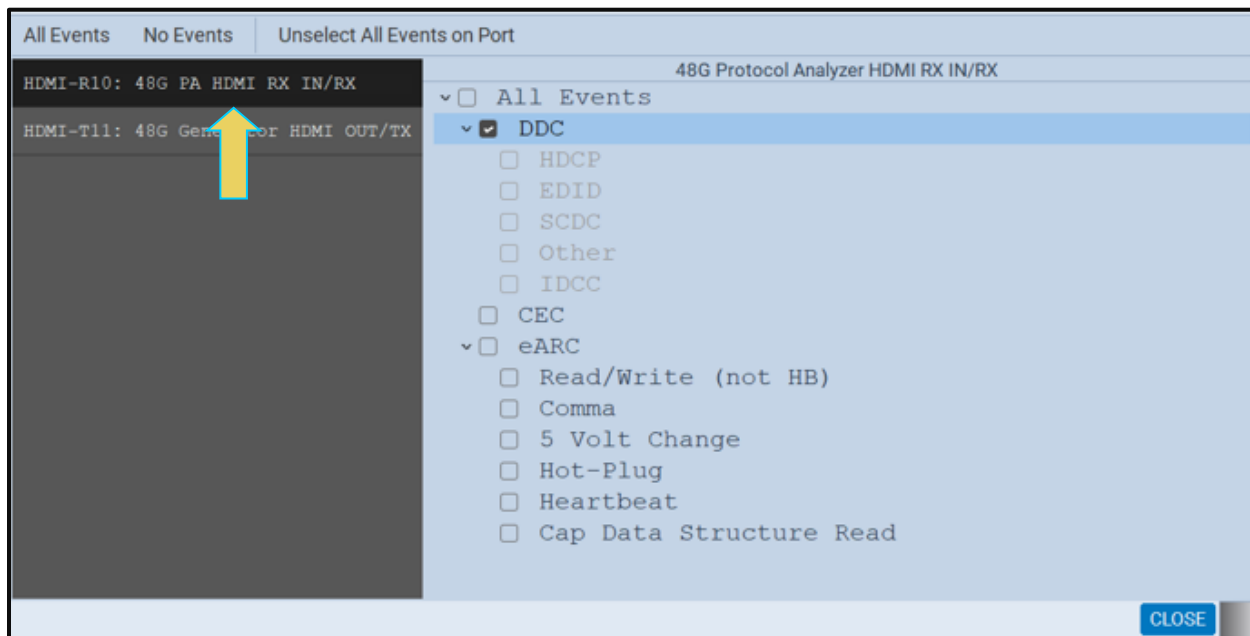
The **ACA Remote Control** panel appears as shown below:



For the **ACA Remote Control** panel you will have to connect to an M41h Instrument that you have provisioned in the external ATP Manager application. The **ACA Remote Control** dialog box will appear showing all the M41h systems you have provisioned in the M41h GUI Manager. Typically you

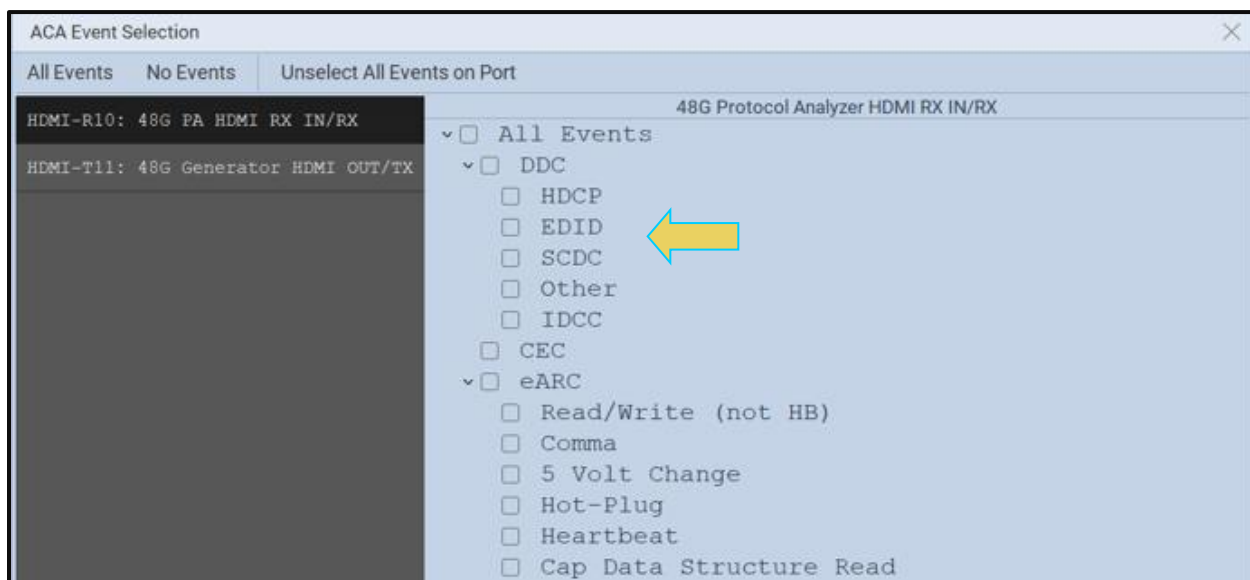
will only have one M41h system provisioned in the application, so you will simply select your lone M41h system and click the **OK** button on the dialog box.

From the **Events** button on the ACA panel, select the HDMI's port that you are monitoring using the pull-down menu **HDMI-R10: 48G PA HDMI RX IN/RX**. Refer to the screen example below.




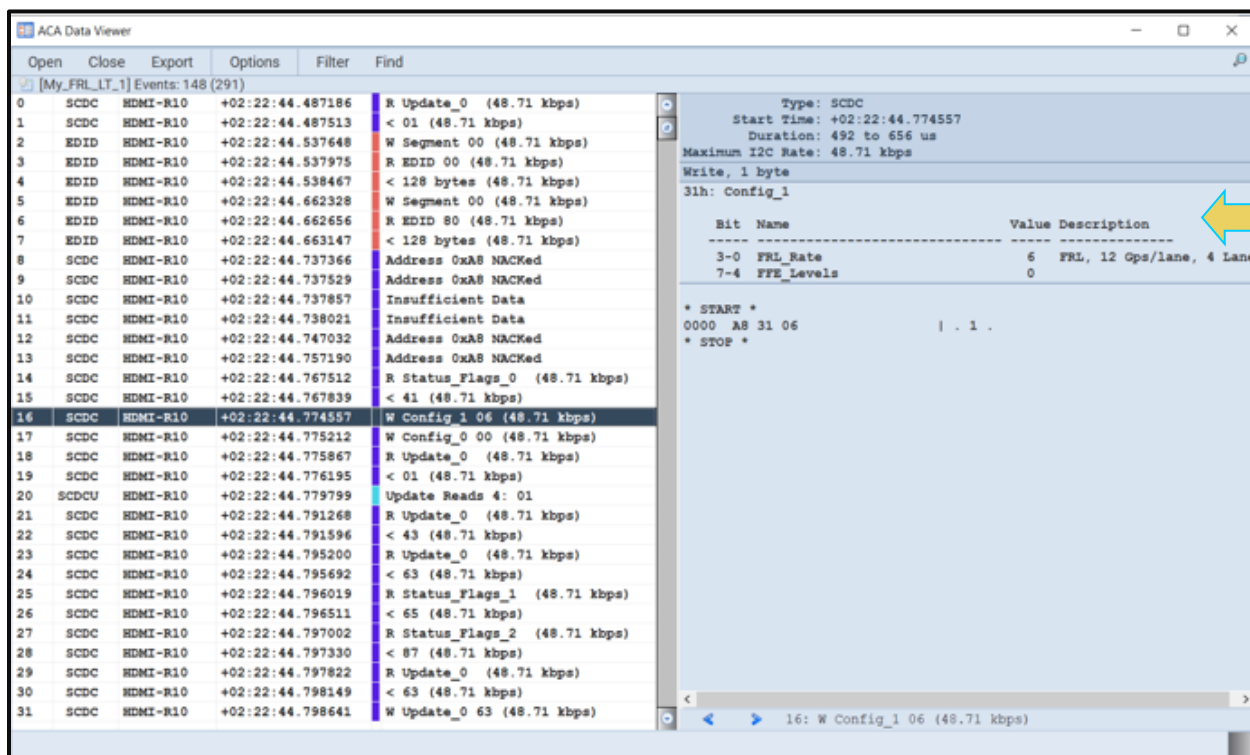
The **ACA Event Selection** dialog box is shown below.

- Specify which events you wish to passively monitor. You can select All Events or any set of individual events.

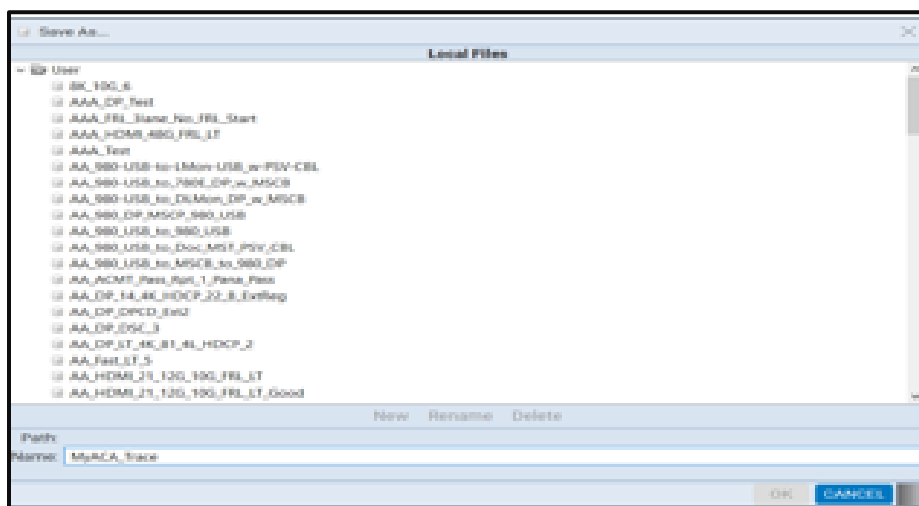


Take the necessary action—such as a hot plug—to initiate EDID, HDCP or CEC transactions. You will see the Aux Chan transactions in the ACA panel as shown below.

Touch select the **Start**  button on the ACA Menu panel on the right to initiate the passive viewing of the HDMI (or MHL) DDC transactions. An example showing passively monitored data is shown below. You can stop or pause the collection at any time using the buttons on the ACA menu panel on the right. These are indicated in the screen example below.



- 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 to use the **ACA Data Viewer** utility on your PC to view the traces or the ACA viewer on the M41h embedded 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 Manager, you will have to transfer the saved file to your PC using the external ATP Manager.

Detailed explanation/procedures for the ACA Data Viewer can be found in the **ACA Data Viewer section** of the Chapter on the ACA Utility.

14 Testing HDMI Displays with the M41h 48G Video Analyzer/Generator

This chapter describes how to operate the M41h 48G Video Analyzer/Generator to test HDMI® 2.1 ultra-high-definition displays.

14.1 Workflow for running the video pattern testing of HDMI 2.1 displays

The workflow below is a high-level set of tasks for operating the M41h 48G Video Analyzer/Generator. Note that the installation of the external ATP Manager and the Ethernet session are optional; you can run the tests through the embedded ATP Manager.

1. Power up the M41h. Refer to the procedures in Powering up the M41h.

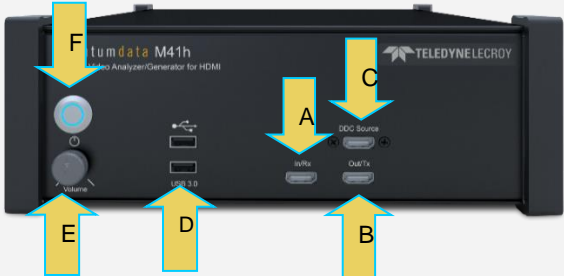
Note: The power switch in the front is used when you are turning off the M41h for a short period of time. For extended periods of off time, it is best to power the M41h down by first using the power button on the front and then the rocker switch on the back.

2. (Optional) Establish an Ethernet/IP connection between the external ATP Manager and the M41h Advanced Test Platform using the procedures in the M41h Quick Start Guide.
3. Connect the HDMI sink device under test to one of the Tx ports.
4. Access M41h's interface through the ATP Manager.
5. Select HDMI.
6. Select the formats (timing or resolution).
7. Select the test patterns you wish to test with.
8. Select any video options and settings.
9. Read the EDID of the connected display.
10. Read the SCDC registers of the connected display.
11. Select the audio format.
12. Test HDCP authentication response on the HDTV.
13. Monitor the sink DUT for any anomalies.

14.2 Connector Description

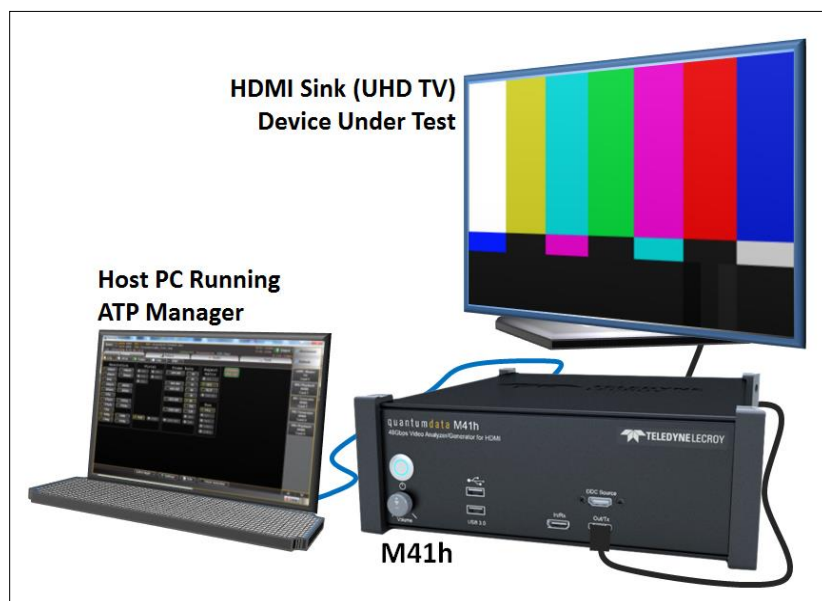
The following table provides images and descriptions of the front and rear panel features of the M41h 48G Video Analyzer/Generator.

Note: The M41h 48G Video Analyzer/Generator contains an internal speaker for audio monitoring. Speaker level is controlled by the front panel **Volume** knob. Audio monitoring and the volume control are specifically for eARC Rx audio.

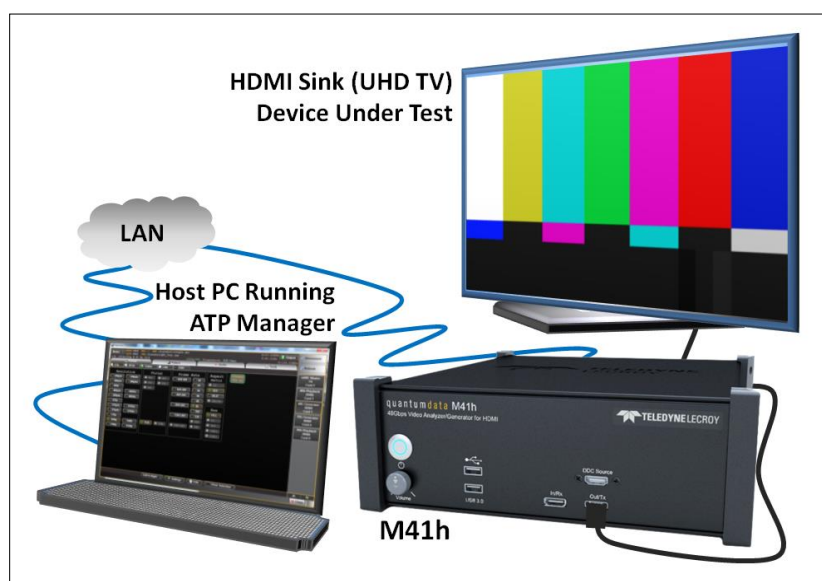
M41h Configurations	Information / Function
	<p>M41h 48G Video Analyzer/Generator front panel:</p> <p>A – In/Rx: HDMI 2.1 receive port for testing HDMI 2.1 sources.</p> <p>B – Out/Tx: HDMI 2.1 transmit port for analyzing HDMI 2.1 sinks.</p> <p>C – DDC Source: HDMI 2.1 receive port used for reading the EDID over the DDC channel (applies to eARC Tx test).</p> <p>D – USB ports (2 ea) used for connecting a mouse and keyboard.</p> <p>E – Volume knob for adjusting the internal speaker level. Used for eARC Rx audio only.</p> <p>F – Power button; press and release to select on/off. Power button color modes:</p> <ul style="list-style-type: none"> • 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. • Flashing Yellow = Instrument is powering up. • Flashing Green = Instrument is nearly done powering up (FPGA is ready, firmware still loading). • Flashing Red = Error. <p>M41h 48G Video Analyzer/Generator rear panel:</p> <p>G – Power cable connection (100-240VAC 50-60Hz; 200 watts).</p> <p>H – HDMI port (Admin) for connecting ext HDMI UHD display for M41h ATP Manager.</p> <p>I – DisplayPort for possible future use.</p> <p>J – USB & USB-C ports (2 ea) for mouse & keyboard.</p> <p>K – RJ45 ports (2 ea); E1 Network for connecting host PC running ATP Manager (E2 Auxiliary not used).</p> <p>L – DVI for possible future use.</p> <p>M – RS-232 (2 ea) for possible future use.</p> <p>N – Audio (2 ea) for possible future use.</p> <p>O – TRIG IN/OUT for possible future use.</p> <p>P - RCA ports: SPDIF OUT monitors eARC audio; SPDIF IN for possible use.</p>

14.3 Making the Physical HDMI Connections

This subsection describes the physical HDMI connections required to run the video pattern tests on an HDMI display.



Connection for Video Testing – M41h Ethernet Direct Connection

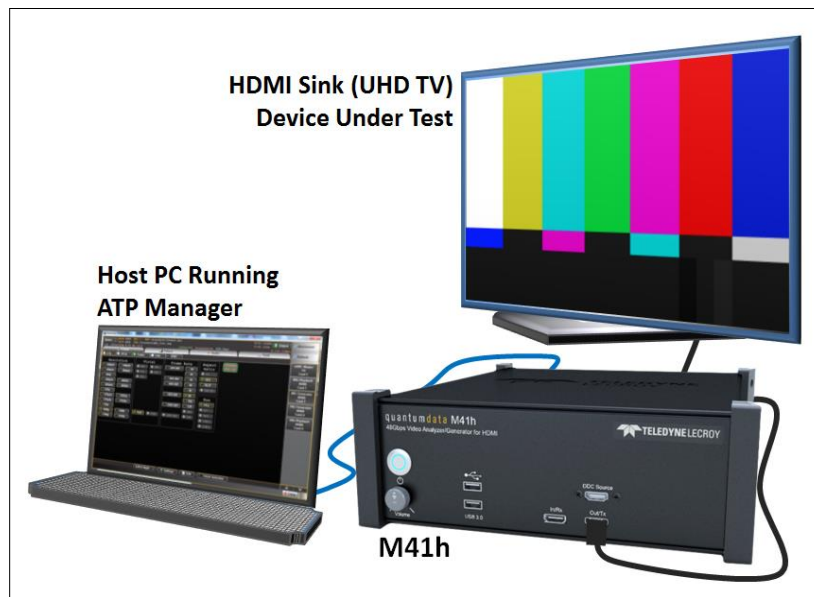


Connection for Video Testing – M41h Ethernet Hub or Corporate LAN

To make the physical HDMI connections:

This procedure assumes that you have assembled the M41h with the M41h 48G Video Analyzer/Generator and the HDMI sink device under test and applied power to all these devices. Refer to the procedures below and the diagrams above.

Connect your HDMI 2.1 sink device under test to the HDMI Tx/Out connector on the M41h 48G Video Analyzer/Generator. Use an HDMI high speed compliant cable. Refer to the illustrations below.



14.4 Navigating through the ATP Manager interface

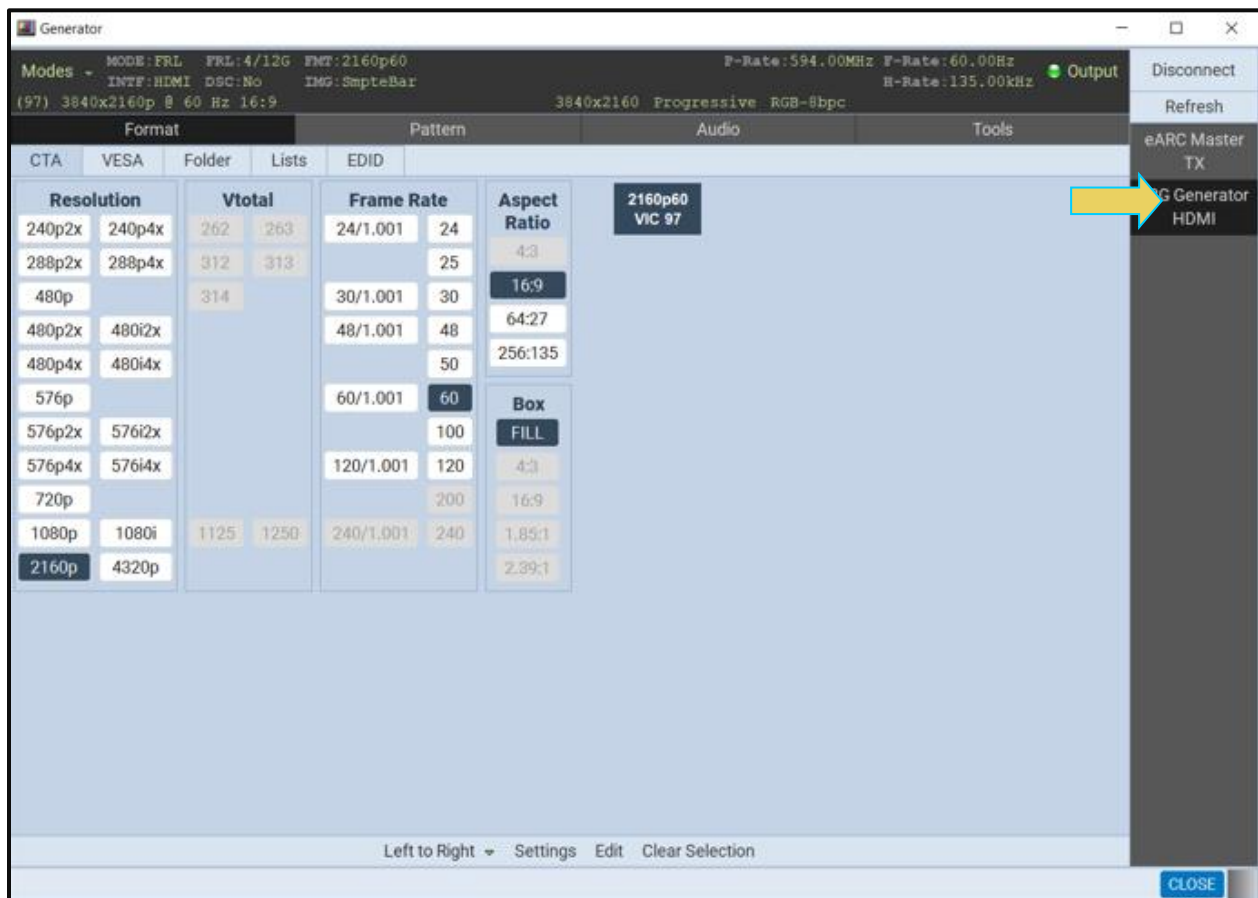
Use the following procedures to navigate to the M41h 48G Video Analyzer/Generator testing functions. You can access the M41h 48G Video Analyzer/Generator functionality through the Card Control tab (Page 1 of 4) of the Apps panel as described below.

To navigate to the video test functions:

1. From the **View** menu, enable select the **Generator** item.

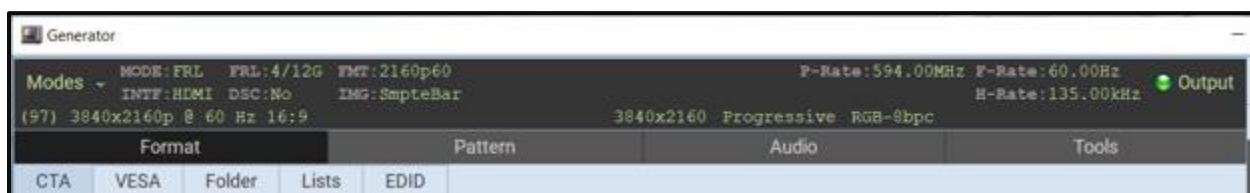


Once you establish the connection, the **Generator** panel will be populated as shown below:



The M41h 48G Video Analyzer/Generator can be identified by its name and slot number (Card 5) in the example above.

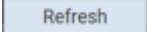
The Generator screen has a status area on the top of its panel.



The status area provides the following information:

Generator Status Area (Top)	
Item	Description
INTF	The currently selected interface type for test. This could be either HDMI or DVI. The sampling mode is included in parentheses after the interface.
FMT	The currently active format (selected resolution) and its directory path.

Generator Status Area (Top)	
Item	Description
IMG	The currently active image (selected test pattern) and its directory path.
Video Identification Code (VIC)	The VIC code is shown on the lower left of the upper status panel
Resolution, scan and color and color depth	The resolution, scan and colorimetry type and color depth are shown on in the lower portion of the upper status panel in the center.
H:(Rate)	The horizontal refresh rate of the selected timing.
F:(Rate)	The frame or vertical refresh rate of the selected timing.
P:(Pixel Rate)	The pixel clock rate of the selected timing.

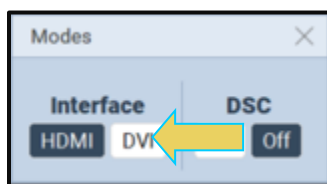
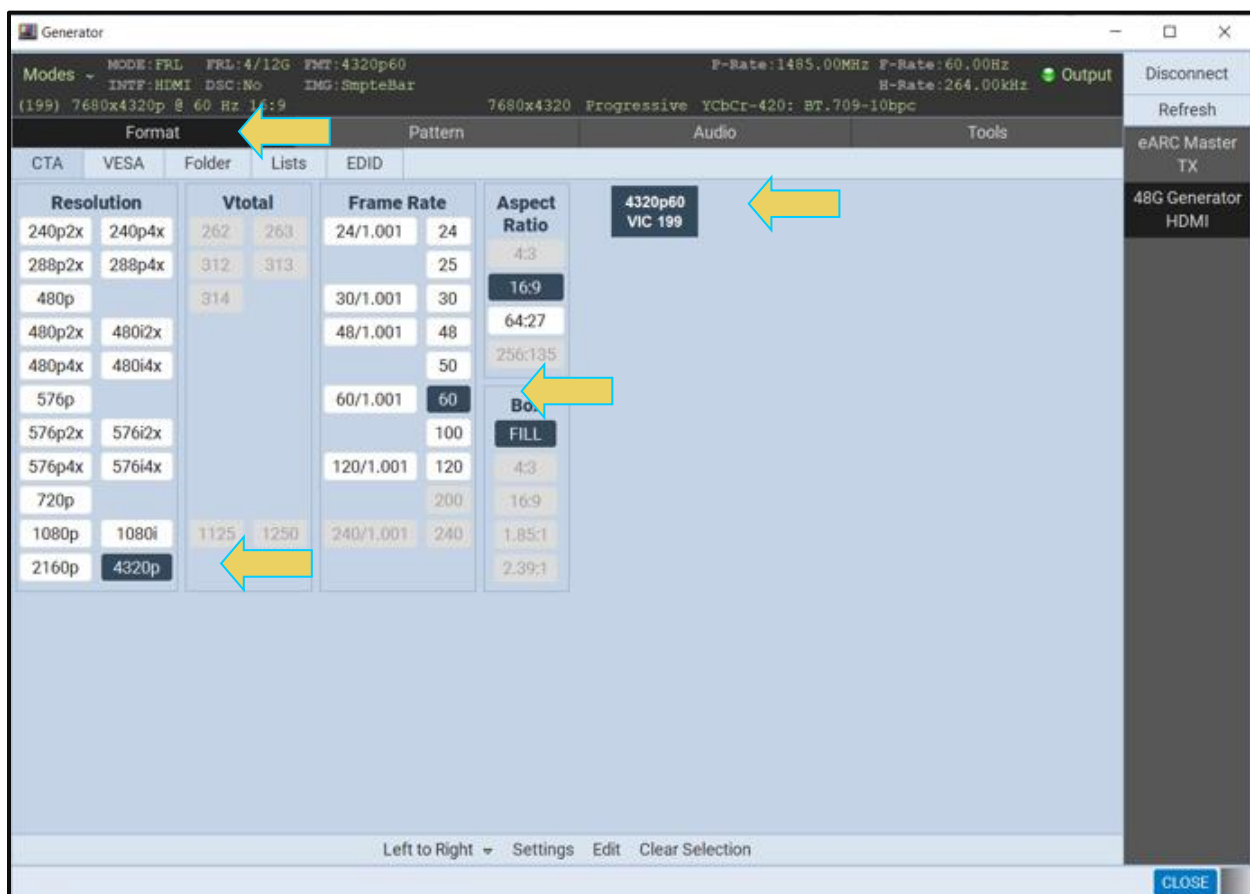
Please note that if you are also making changes through the command line the information in the status area it is not automatically updated. You must click on the **Refresh**  activation button to re-sync the status area.

14.5 Selecting HDMI or DVI Formats

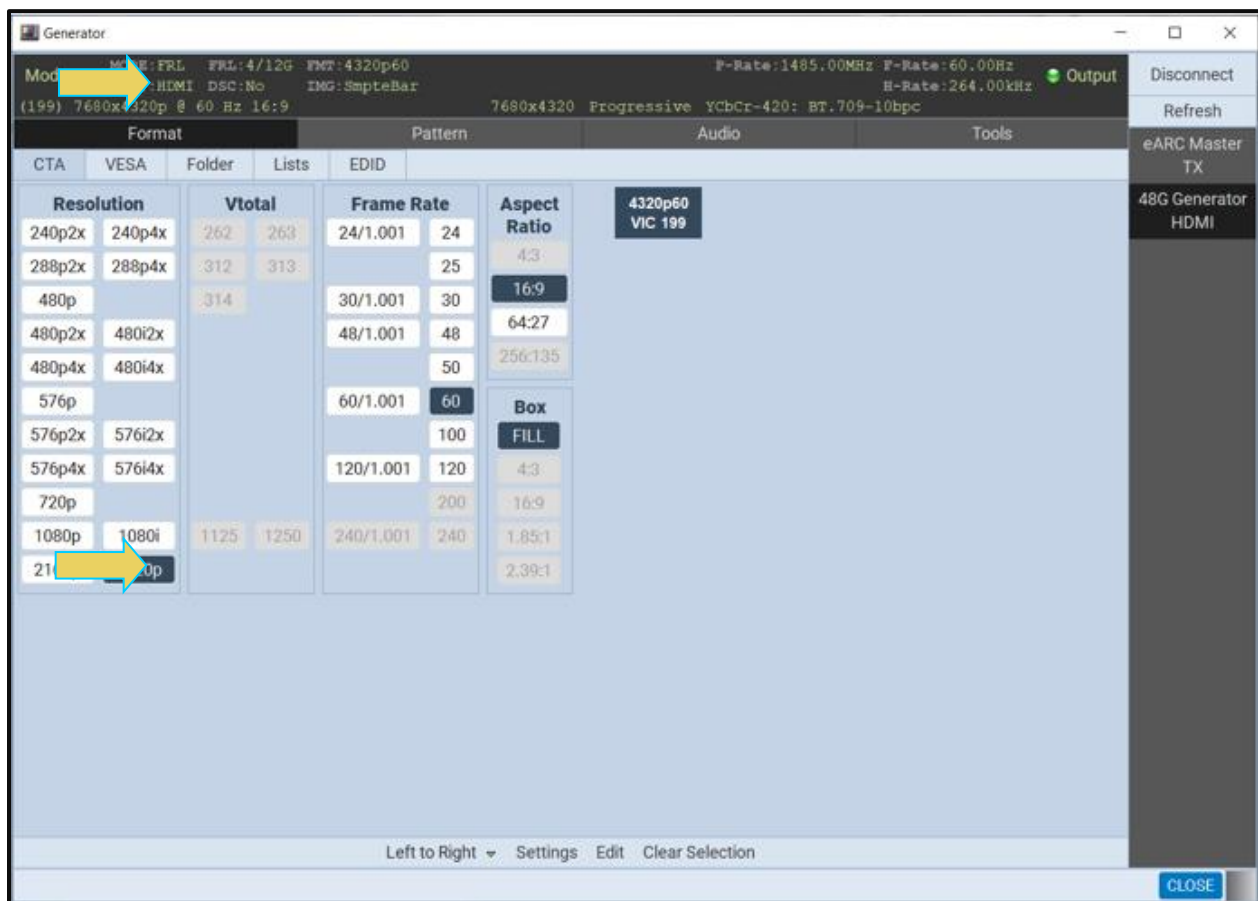
Use the following procedures to select the mode, HDMI or DVI on the M41h 48G Video Analyzer/Generator.

To select Modes:

From the **Main** menu of the M41h 48G Video Analyzer/Generator, click the **Modes** pull-down menu to select HDMI or DVI. Example shows 8K format at 1485MHz pixel rate.



When you select the interface type you will get a listing of HDMI (or DVI) formats and the **INTF** field in the status area will show HDMI (or DVI). The screen example below depicts a set of HDMI formats.



14.6 Selecting Formats (Resolutions) – FRL Mode

You can select formats (timings) from the M41h 48G Video Analyzer/Generator's format library. You can select either from the entire list of formats or you can select from a subset or reduced set of the formats that have or can define. You can select from a reduced set or subset of formats in either of two ways:

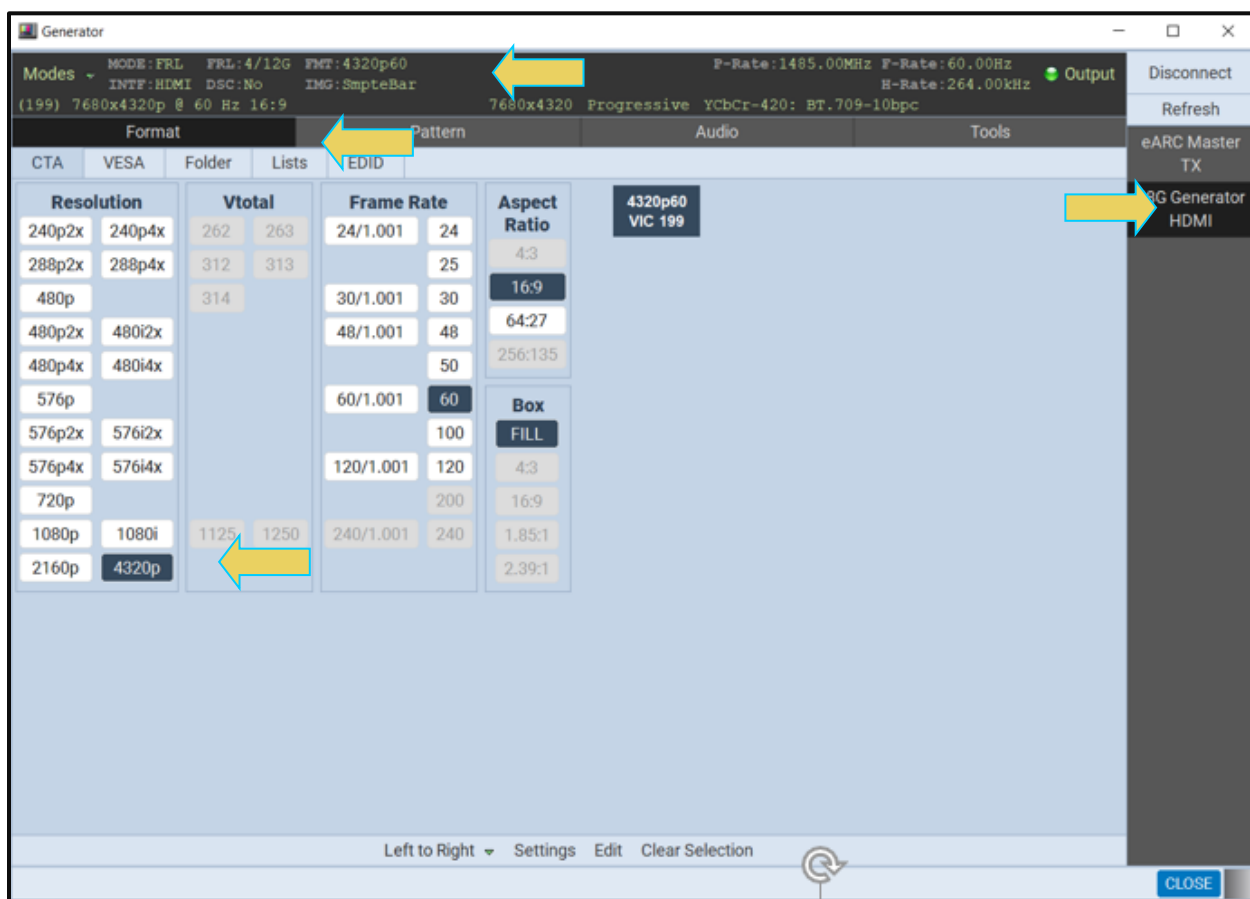
- Select from a custom list you have created using the Format List Editor.
- Select from a list of formats configured from the EDID of the connected display.


Use the following procedures to select a video resolution (format). The procedure assumes that you have already selected an interface (HDMI or DVI).

To select a format:

1. From the main window of the M41h 48G Video Analyzer/Generator, click the **Format** tab.

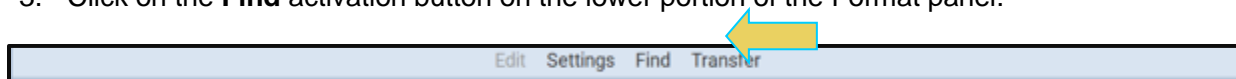
A list of HDMI or DVI formats will appear as shown in the example below.



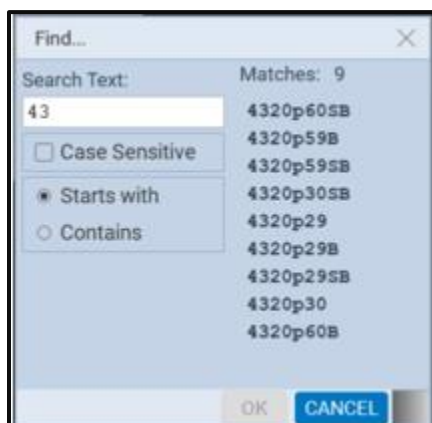
The highlighted format is the format that is active. You can also determine this from the status information at the top of the panel. Alternatively, you can click on the Star  button to show the selected format. When you click on the Star button the list of formats will be repositioned such that the selected format is shown on the top line.

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

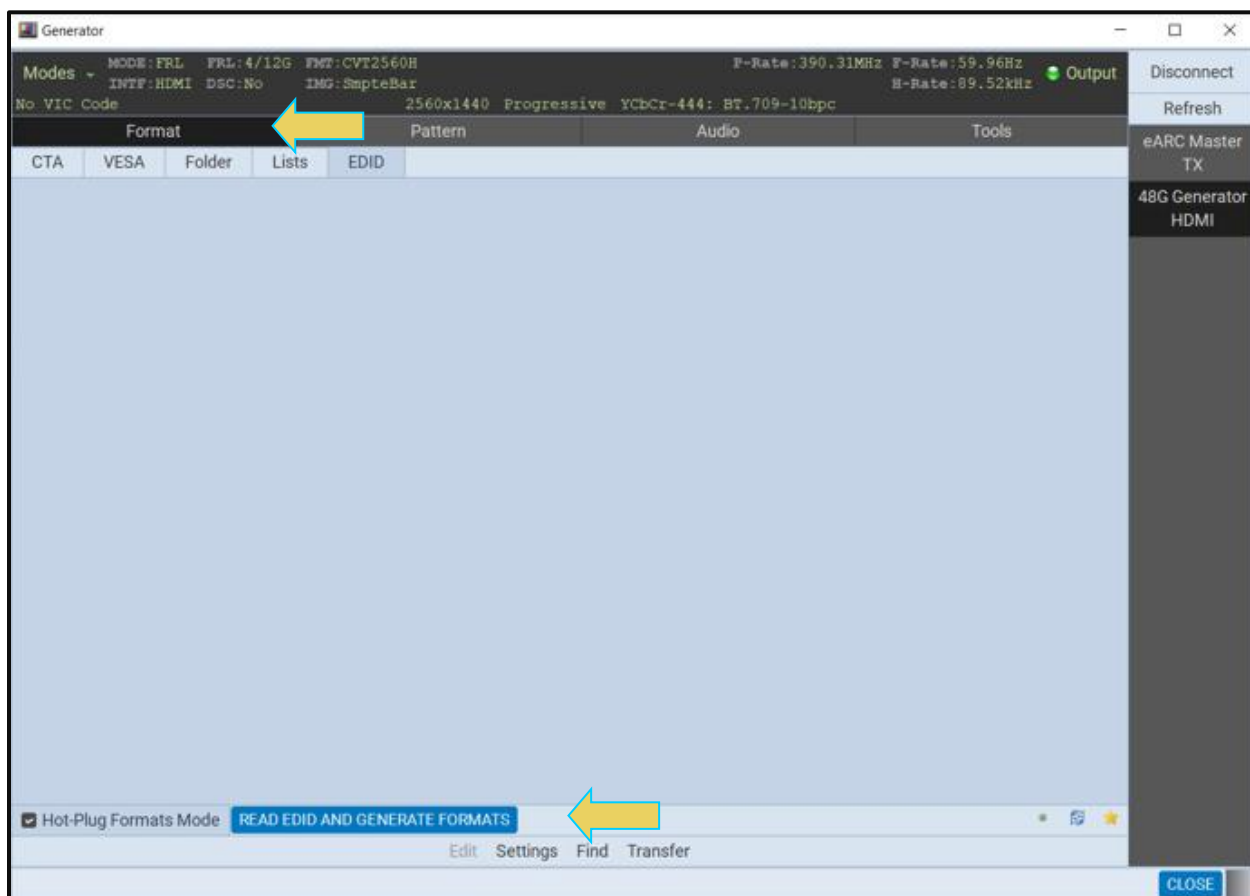
2. Select a format from the list by clicking on it.
3. Click on the **Find** activation button on the lower portion of the Format panel.



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.

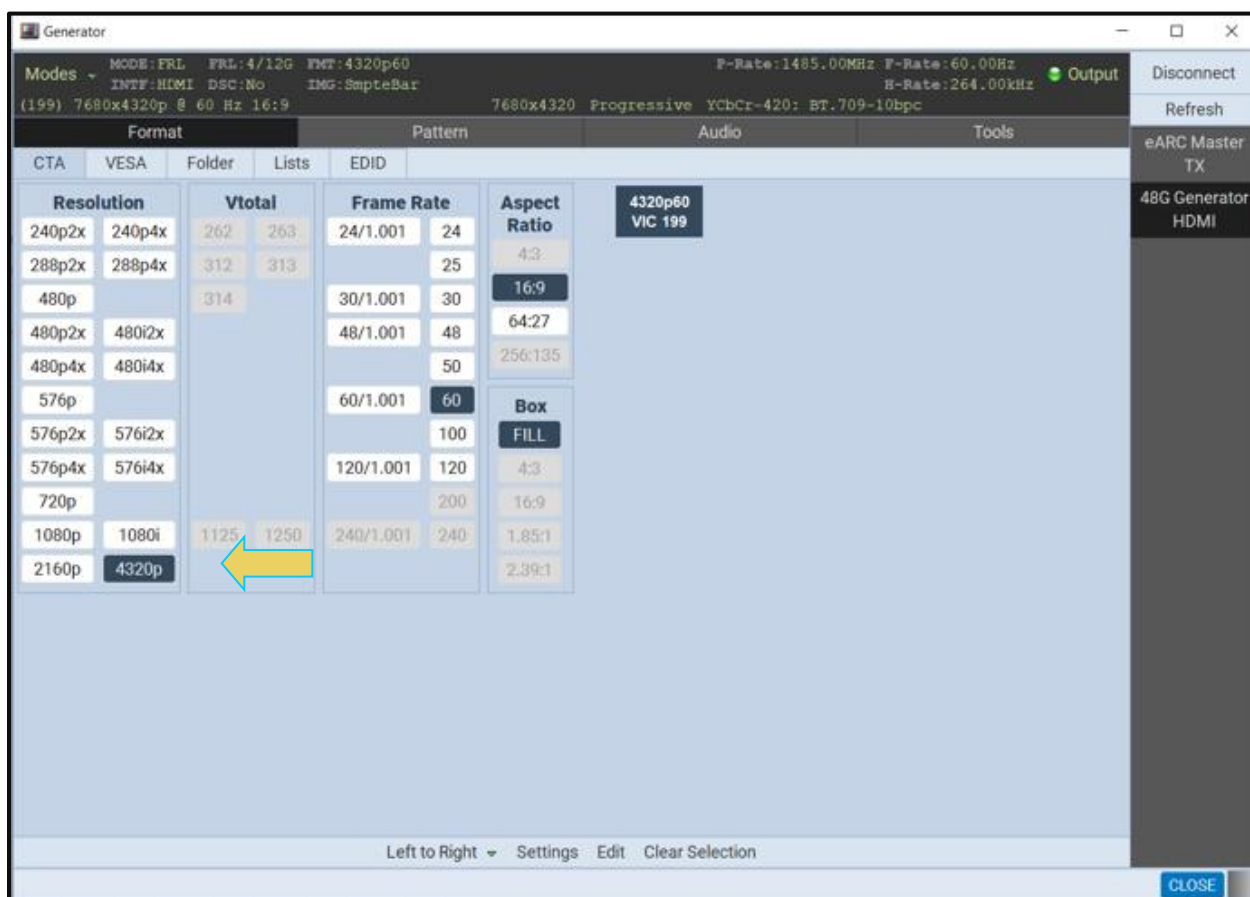


4. Click on the EDID smart activation button on the upper panel under the tabs to configure the list of formats in accordance with the EDID for the connected display.



You can determine if the list of formats displayed is derived from the EDID of the connected display by looking at lower status bar: **READ EDID AND GENERATE FORMATS**.

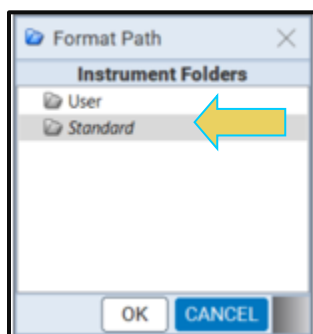
When EDID formats are not active, the directory whose formats are being displayed is listed in the lower panel as indicated below. Typically, this would be the Standard directory where the M41h's format list is stored. The default path is the Standard path. The following screen example shows the Standard list indicated.



You can change the directory of formats using the directory activation button

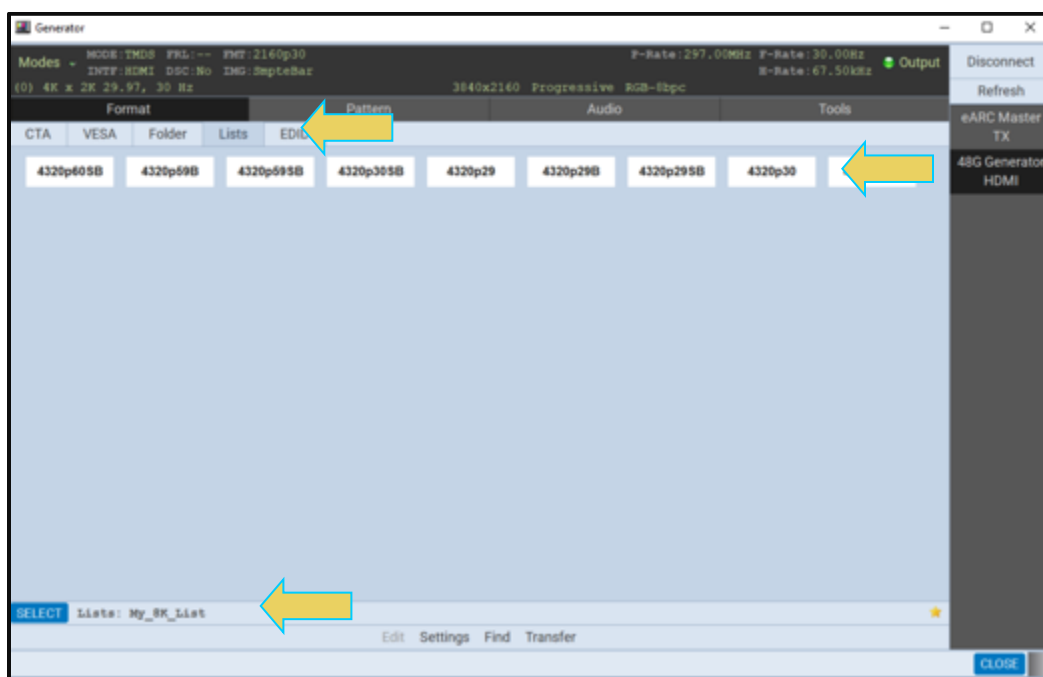
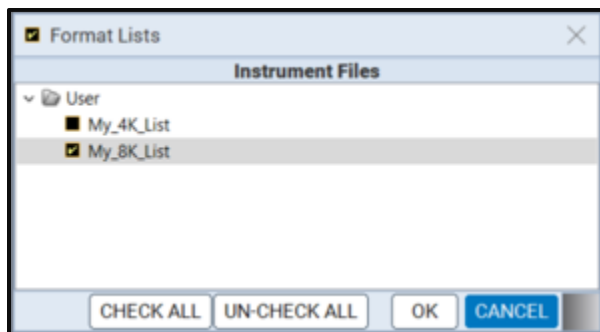
SELECT FOLDER Path: /Standard. You might wish to change the directory path if you have created your own custom formats using the Format Editor to create custom formats. Note also that you can configure a smaller list of formats to choose from using the **Format List Edit**; refer to Format List Editor.

By default, when you create a custom format, the new format will be saved in the User directory. When you select the directory activation button **SELECT FOLDER** Path: /Standard a dialog box will appear allowing you to select the alternative path such as the User path shown highlighted and selected in the dialog box below.

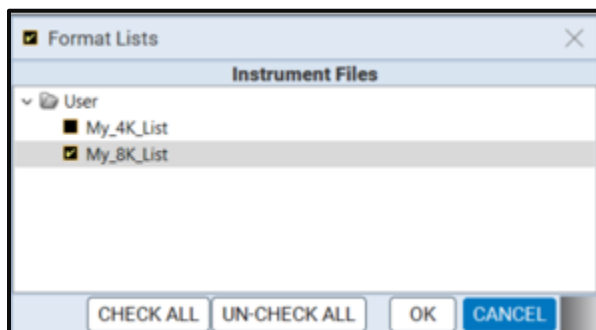


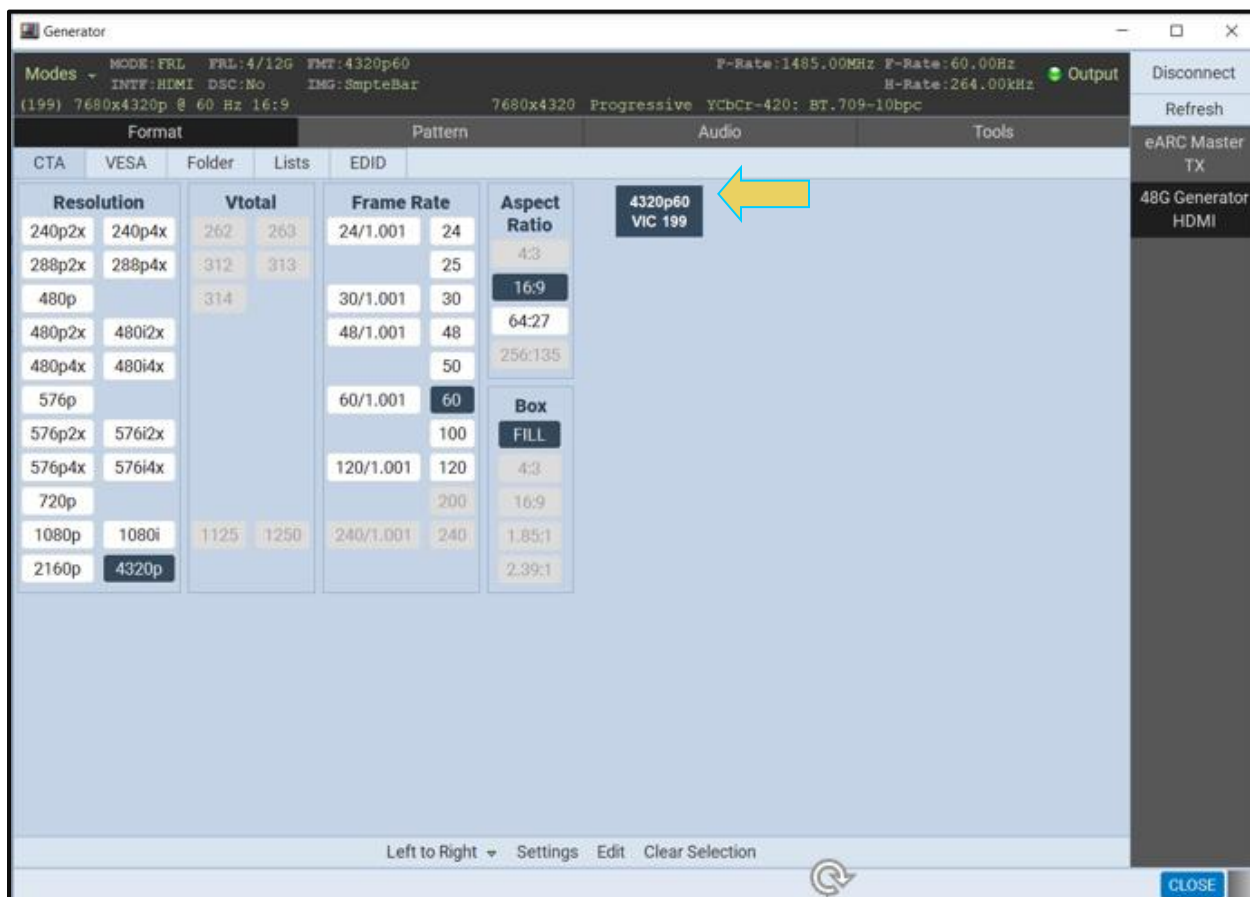
You can open and activate any custom Format Lists you have previously defined using

SELECT FOLDER Path: /Standard . A dialog box will appear enabling you to select a custom format list or lists (below).



You can select all or one custom Format List or any combination if you have several defined. The example here shows selecting one Format List. The **CHECK ALL** and **UN-CHECK ALL** activation buttons allow convenient selection where you have many Format Lists to choose from. The result of selecting one custom Format List is shown in the screen example below. A limited set of formats are displayed. The Path icon on the bottom status panel will display that new list (indicated below).





To select a format from the CEA smart filtering button:

1. From the main window of the M41h 48G Video Analyzer/Generator, click the **Format** tab.

The default for HDMI is to present the CTA smart filtering list as shown below. If the CTA button is not active, simply click on the CTA button on the upper left of the top panel (indicated in the screen shot below). The CTA smart filtering screen enables you to select formats through filtering of various video parameters such as Resolution, Vtotal, Frame Rate and Aspect Ratio. As you optionally move from left to right on the screen the list of available formats that meet the filtering criteria is shown on the right.

Generator

Modes MODE: FRL FRL: 4/12G FMT: 4320p60 F-Rate: 1485.00MHz F-Rate: 60.00Hz Output
INTF: HDMI DSC: No IMG: SmpteBar H-Rate: 264.00kHz
(199) 7680x4320p @ 60 Hz 16:9 7680x4320 Progressive YCbCr-420: BT.709-10bpc

Format Pattern Audio Tools

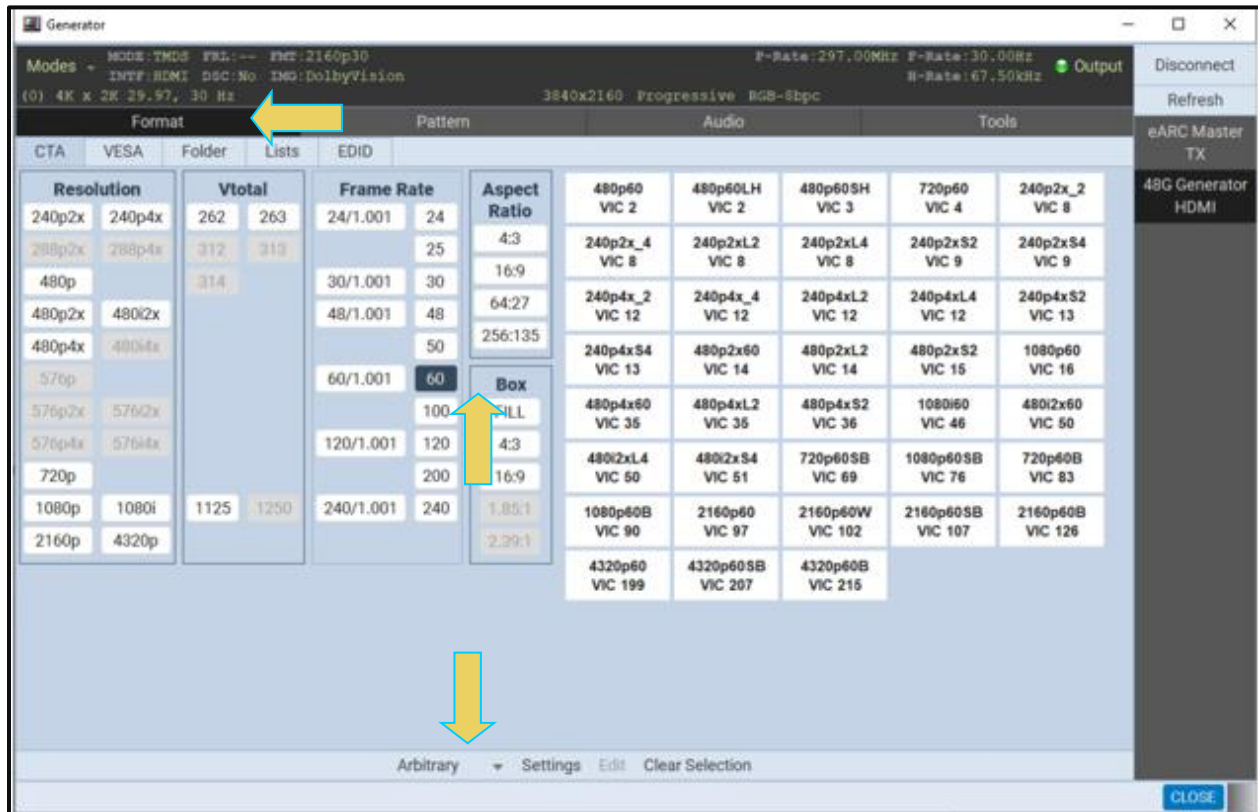
CTA	VESA	Folder	Lists	EDID
Resolution				
240p2x	240p4x	262	263	
288p2x	288p4x	312	313	
480p		314		
480p2x	480i2x			
480p4x	480i4x			
576p				
576p2x	576i2x			
576p4x	576i4x			
720p				
1080p	1080i	1125	1250	
2160p	4320p			
Frame Rate				
24/1.001		24		
25		25		
30/1.001		30		
48/1.001		48		
50		50		
60/1.001		60		
100		100		
120/1.001		120		
200		200		
240/1.001		240		
Aspect Ratio				
4:3				
16:9				
64:27				
256:135				
Box				
FILL				
4:3				
16:9				
1.85:1				
2.39:1				

4320p60 VIC 199

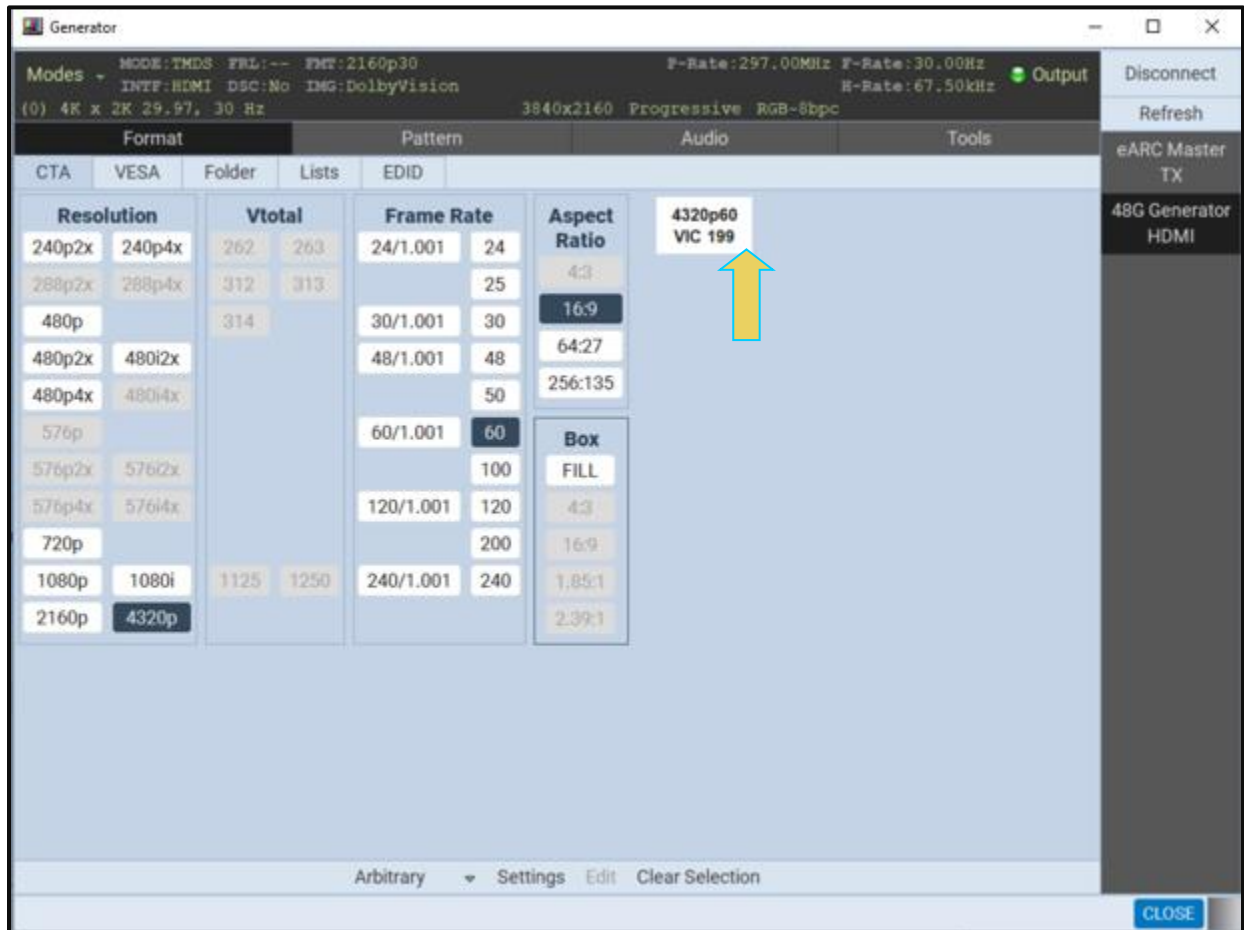
Left to Right Settings Edit Clear Selection

CLOSE

Alternatively, you can select Arbitrary on the pull-down list on the lower control panel. The Arbitrary selection enables you to specify filtering criteria in any order. Refer to the example below.



Regardless of whether you choose Arbitrary or Left to Right, once you specify enough criteria, you will be presented with one or a few format options on the right as shown in the example below.



The selection of formats works the same way when selecting VESA formats as shown in the following sample screen.

Generator

Modes: MODE:FRL FRL:4/12G FMT:CVT2560H F-Rate:390.31MHz F-Rate:59.96Hz
 INTF:HDMI DSC:No IMG:SmpteBar H-Rate:89.52kHz Output

No VIC Code 2560x1440 Progressive YCbCr-444: BT.709-10bpc

Format Pattern Audio Tools

CTA VESA Folder Lists EDID

Type	Resolution				Frame Rate	Aspect Ratio
CVT	640	720	768	800	24	4:3
CVR	848	900	960	1024	30	5:3
DMT	1064	1152	1224	1280	43	5:4
DMR	1360	1366	1400	1440	48	11:5
	1536	1600	1680	1704	50	16:9
	1728	1792	1800	1856	60	16:10
	1864	1920	2048	2128	72	
	2304	2456	2560	2728	75	
	3072	3840	5120	7680	85	
					120	

CVT2560H

Left to Right Settings Edit Clear Selection

Disconnect Refresh

eARC Master TX

48G Generator HDMI

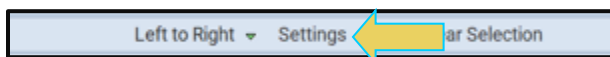
CLOSE

14.7 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.

To select a format:

1. Specify the format settings by clicking on the **Settings** button on the lower center of the panel (indicated below).



The **Settings** dialog box appears as shown below. Four examples are shown below; the first with RGB selected, the second with YCbCr selected and the third with BT.2020 and fourth with DCI-P3 colorimetry selected.



Format Settings

✕

Color Space

RGB

YCbCr

xvYCC

opRGB

sYCC601

opYCC

BT2020 cYCC

BT2020 YCC

BT2020 RGB

DCI-P3

4:4:4

4:2:2

4:2:0

Range

Full

Shoot

Limited

Bits per Component

8

10

12

16

Scrambling Override

☐

OFF

Scrambling Currently Enabled

Enabled

Disabled

APPLY

Format Settings

✕

Color Space

RGB

YCbCr

xvYCC

opRGB

sYCC601

opYCC

BT2020 cYCC

BT2020 YCC

BT2020 RGB

DCI-P3

4:4:4

4:2:2

4:2:0

Range

Full

Shoot

Limited

Bits per Component

8

10

12

16

Scrambling Override

☐

OFF

Scrambling Currently Enabled

Enabled

Disabled

APPLY

Format Settings

Color Space

RGB

YCbCr

xvYCC

opRGB

sYCC601

opYCC

BT2020 cYCC

BT2020 YCC

BT2020 RGB

DCI-P3

4:4:4

4:2:2

4:2:0

Range

Full

Shoot

Limited

Bits per Component

8

10

12

16

Scrambling Override

Scrambling Currently Disabled

Enabled

Disabled

APPLY

2. 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	<p>RGB – Uses 4:4:4 sampling.</p> <p>YCbCr – Uses either 4:4:4, 4:2:2 or 4:2:0 sampling.</p> <p>xvYCC – High-definition colorimetry based on IEC 61966 2-4.</p> <p>AdobeRGB – The AdobeRGB color space is defined in IEC 61966-2-5. If the connected display does not support Adobe color modes, then the sink shall not transmit Adobe encoded video.</p> <p>sYCC601 – Colorimetry based on IEC 61966-2-1/Amendment 1.</p> <p>AdobeYCC - The AdobeRGB color space is defined in Annex A of IEC 61966-2-5. If the connected display does not support Adobe color modes, then the sink shall not transmit Adobe encoded video.</p> <p>BT.2020 YCC – Rec 2020 for YCbCr</p>

Format Settings		
Parameter	Description	Options
		BT.2020 cYCC Rec 2020 for YCbCr with linear encoding BT.2020 RGB – Rec 2020 for RGB. DCI-P3 – Digital Cinema Initiatives color space.
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 HDMI 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 HDMI specification section on Video Quantization Ranges for more details.
Bits per Component	Color depth per component.	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.

14.7.1 Important Note Regarding HDMI Formats

Some of the formats require a slight modification to the HFront in order for the M41h Video Generator to produce the correct video signal.

The HFront (also referred to as Front Porch, Pulse Delay, Horizontal Offset) must be greater than or equal to 8 pixels. This setting can easily be changed within the Format Editor utility. The formats affected by this are:

- ICS1160
- ICS1176
- SUN1667G
- ICS1660
- ICS1676
- IBM0660D
- IBM0660
- IBM1043

Format					Pattern			Audio	
CTA	VESA	Folder	Lists	EDID					
CVT2075D		CVT2075H		CVT2085	CVT2085D	CVT2085H	CVT2175H	CVT2185H	
CVT2360D		CVT2375D		CVT2385D	CVT2450D	CVT2460D	CVT2550	CVT2550D	
CVT2560		CVT2560D		CVT2560H	CVT2575	CVT2575H	CVT2750H	CVT2760H	
DMT1775		DMT1860		DMT1875	DMT1960	DMT1975	DOM12660	DOM1770X	
HWP1060		HWP1070		HWP1075	HWP1075_	HWP1260G	IBM0660	IBM0660D	
IBM0770H		IBM0770U		IBM1043	IBM1043_	IBM1060Q	IBM1260G	IBM1267G	
IBM1352		ICS1160		ICS1176	ICS1660	ICS1676	Md2	Md2SBX	
RAMP160		SMT0660		SMT0660D	SMT0760H	SMT0760V	SNY1276G	STANAGA	
SUN1061Q		SUN1077		SUN1166X	SUN1166_	SUN1176X	SUN1267_	SUN1276G	
TEST150		TEST165		TEST25	TEST250	TEST81	VSC1660V	VSC1875V	
VSC1960H		VSC1975D		VSC1975H	VSC1975V	VSC1985D	VSC2060	XGA2	

SELECT FOLDER Path: /Standard Edit Settings Find

Screenshot showing a few of the affected HDMI Formats

In order to edit the format's specifications, highlight the format you wish to use, and click **Edit** at the bottom of the menu, as shown below.

DMT1285G	DMT1360H	DMT1360_	DMT1648	DMT1660	DMT1665	DMT1670	DMT1675	DMT1680	DMT1685
DMT1760	DMT1775	DMT1860	DMT1875	DMT1960	DMT1975	DMT2060	DMT2075	DOM12660	DOM1770X
DOM2060Q	HWP1060	HWP1070	HWP1075	HWP1075_	HWP1260G	HWP1272G	HWP1275G	IBM0660	IBM0660D
IBM0675	IBM0770H	IBM0770U	IBM1043	IBM1043_	IBM1060Q	IBM1070	IBM1076	IBM1260G	IBM1267G
IBM1267_	IBM1352	ICS1160	ICS1176	ICS1660	MATROX	MDA_m7	Md2	Md2SBX	
NEC1140B	RAMP160	SMT0660	SMT0660D	SMT0760H	SMT0760V	SNY1072	SNY1274G	SNY1276G	STANAGA
STANAGB	SUN1061Q	SUN1077	SUN1166X	SUN1166_	SUN1176X	SUN1176_	SUN1267G	SUN1267_	SUN1276G
SUN1667G	TEST150	TEST165	TEST25	TEST250	TEST81	VSC1660	VSC1660V	VSC1875V	

SELECT FOLDER Path: /Standard Edit Settings Find

The M41h Format Editor will appear, as shown below. The Format Editor is covered in detail within another chapter, but this subsection will provide only the procedures for modifying the horizontal pulse delay (Hfront).

To adjust the Horizontal Pulse Delay (Hfront), first ensure that **Back Porch** is **NOT** selected on the right-hand side of the Editor utility, as shown in the above screenshot.

Select the text box corresponding to the **PD** label in the **Horizontal** column of configurations, as shown in the screenshot below. Enter a value of 8 or more and click **Enter**.

Certain fields within the Format Editor utility will automatically adjust based on the values of other fields, but you may need to manually update the Horizontal Pulse Width after adjusting the Pulse Delay.

In the example below, the Pulse Width has been lowered to 440 pixels.

Format Editor: /Standard/ICS1660.xml

New Open Save Use

Timing General Digital Video Digital Audio AFD

Pixel Rate		Horizontal		Vertical		Entry Units
164.609297 MHz		77.940008 KHz		60.000006 Hz		
6.074991 ns		Tune 1.000000 Base 77.940008 KHz				<input checked="" type="radio"/> Time
Rt						Scan Type
Act	1664 Pixels	10.108785 us		1248 Lines		<input checked="" type="radio"/> Progressive
Blk	448 Pixels	2.721596 us		51 Lines		<input checked="" type="radio"/> Interlace
Tot	2112 Pixels	12.830381 us		1299 Lines		<input type="checkbox"/> Back Porch
PD	8 Pixels	0.048600 us		0 Lines		<input type="checkbox"/> Clock Pulse
PW	440 Pixels	2.672996 us		15 Lines		<input type="checkbox"/> PreEmphasis
Serration width Adjustment 0 Pixels		H to V Pulse Delay 0 Pixels		Eq. Before 0 Lines		<input type="checkbox"/> DC Balance
Horizontal Broad Pulse Delay 0 Pixels				Eq. After 0 Lines		<input type="checkbox"/> Flat Front Porch
						<input type="checkbox"/> TriLevel
						<input type="checkbox"/> Repeat Field

Once the required configurations have been made to the format file, click **Use** at the top of the screen to begin generating video signal with the modified format.

Format Editor: /Standard/ICS1660.xml

New Open Save Use

Timing General Digital Video Digital Audio AFD

Pixel Rate 164.609297 MHz 6.074991 ns

Horizontal Vertical

Note: You may also **Save** the modified format file if you wish.

The following screenshots demonstrate another example. Format **IBM0660** has been modified to increase the Horizontal Pulse Delay to 8 pixels, as well.

The first two screenshots on this page show the default configurations of format IBM0660, with the following specifications:

- **Horizontal Blanking: 186 pixels**
- **Hfront (Front Porch): 3 pixels**
- **Hback (Back Porch): 73 pixels (second screenshot)**
- **Pulse Width: 110 pixels**

Format Editor: /Standard/IBM0660.xml

New Open Save Use

Timing General Digital Video Digital Audio AFD

Pixel Rate MHz ns

	Horizontal		Vertical	
Rt	<input type="text" value="30.296000"/> KHz		<input type="text" value="59.637795"/> Hz	
Tune	<input type="text" value="1.000000"/>	<input type="text" value="30.296000"/> KHz		
Act	<input type="text" value="640"/> Pixels <input type="text" value="25.574941"/> us		<input type="text" value="480"/> Lines <input type="text" value="15.843676"/> ms	
Blk	<input type="text" value="186"/> Pixels <input type="text" value="7.432717"/> us		<input type="text" value="28"/> Lines <input type="text" value="0.924214"/> ms	
Tot	<input type="text" value="826"/> Pixels <input type="text" value="33.007658"/> us		<input type="text" value="508"/> Lines <input type="text" value="16.767890"/> ms	
PD	<input type="text" value="3"/> Pixels <input type="text" value="0.119883"/> us		<input type="text" value="4"/> Lines <input type="text" value="0.132031"/> ms	
PW	<input type="text" value="110"/> Pixels <input type="text" value="4.395693"/> us		<input type="text" value="2"/> Lines <input type="text" value="0.066015"/> ms	

Serration width Adjustment Pixels

H to V Pulse Delay Pixels

Horizontal Broad Pulse Delay Pixels

Eq. Before Lines

Eq. After Lines

Entry Units
☒ Machine
☐ Time

Scan Type
☒ Progressive
☐ Interlace

☐ Back Porch

☐ Clock Pulse
☐ PreEmphasis
☐ DC Balance
☐ Flat Front Porch
☐ TriLevel
☐ Repeat Field

Pixel Rate MHz ns

	Horizontal		Vertical	
Rt	<input type="text" value="30.296000"/> KHz		<input type="text" value="59.637795"/> Hz	
Tune	<input type="text" value="1.000000"/>	<input type="text" value="30.296000"/> KHz		
Act	<input type="text" value="640"/> Pixels <input type="text" value="25.574941"/> us		<input type="text" value="480"/> Lines <input type="text" value="15.843676"/> ms	
Blk	<input type="text" value="186"/> Pixels <input type="text" value="7.432717"/> us		<input type="text" value="28"/> Lines <input type="text" value="0.924214"/> ms	
Tot	<input type="text" value="826"/> Pixels <input type="text" value="33.007658"/> us		<input type="text" value="508"/> Lines <input type="text" value="16.767890"/> ms	
BP	<input type="text" value="73"/> Pixels <input type="text" value="2.917142"/> us		<input type="text" value="22"/> Lines <input type="text" value="0.726168"/> ms	
PW	<input type="text" value="110"/> Pixels <input type="text" value="4.395693"/> us		<input type="text" value="2"/> Lines <input type="text" value="0.066015"/> ms	

Serration width Adjustment Pixels

H to V Pulse Delay Pixels

Horizontal Broad Pulse Delay Pixels

Eq. Before Lines

Eq. After Lines

Entry Units
☒ Machine
☐ Time

Scan Type
☒ Progressive
☐ Interlace

☒ Back Porch

☐ Clock Pulse
☐ PreEmphasis
☐ DC Balance
☐ Flat Front Porch
☐ TriLevel
☐ Repeat Field

The following two screenshots show the specifications after configuring the Front Porch Pulse Delay:

- **Horizontal Blanking: 186 pixels (unchanged)**
- **Hfront (Front Porch): 8 pixels (manually configured)**
- **Hback (Back Porch): 68 pixels (second screenshot- automatically set based on Hfront value)**
- **Pulse Width: 110 pixels (unchanged)**

Pixel Rate MHz ns

Horizontal

Rt KHz

Tune **Base** KHz

Act Pixels us

Blk Pixels us

Tot Pixels us

PD Pixels us

PW Pixels us

Vertical

Rt Hz

Lines ms

Lines ms

Lines ms

Lines ms

Lines ms

Serration width Adjustment Pixels

H to V Pulse Delay Pixels

Horizontal Broad Pulse Delay Pixels

Eq. Before Lines

Eq. After Lines

Entry Units

☒ Machine

☐ Time

Scan Type

☒ Progressive

☐ Interlace

☐ Back Porch

☐ Clock Pulse

☐ PreEmphasis

☐ DC Balance

☐ Flat Front Porch

☐ TriLevel

☐ Repeat Field

Pixel Rate MHz ns

Horizontal

Rt KHz

Tune **Base** KHz

Act Pixels us

Blk Pixels us

Tot Pixels us

BP Pixels us

PW Pixels us

Vertical

Rt Hz

Lines ms

Lines ms

Lines ms

Lines ms

Lines ms

Serration width Adjustment Pixels

H to V Pulse Delay Pixels

Horizontal Broad Pulse Delay Pixels

Eq. Before Lines

Eq. After Lines

Entry Units

☒ Machine

☐ Time

Scan Type

☒ Progressive

☐ Interlace

☒ Back Porch

☐ Clock Pulse

☐ PreEmphasis

☐ DC Balance

☐ Flat Front Porch

☐ TriLevel

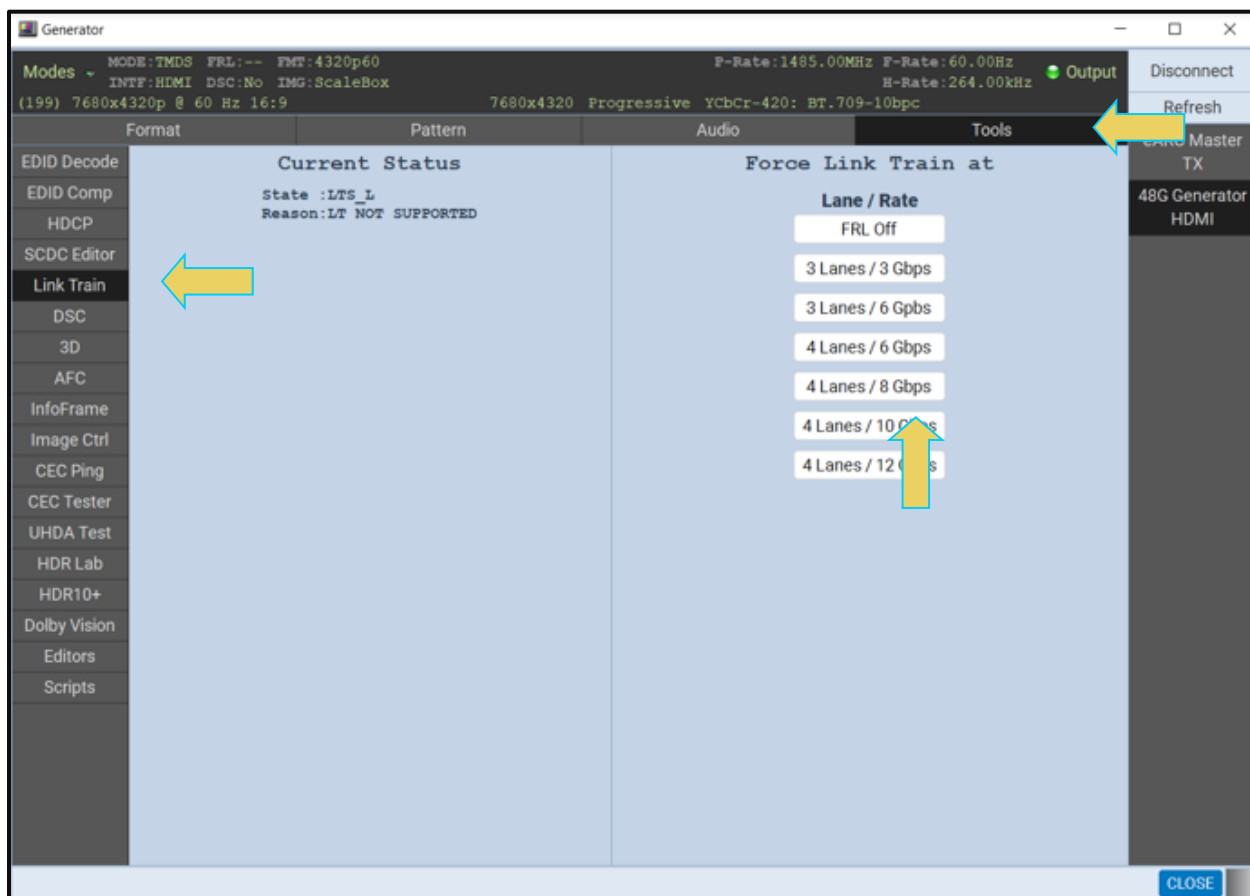
☐ Repeat Field

14.8 Configuring the Link Training Settings

Use the following procedures to configure the link training settings. The link training panel is accessible from the Link Train button on the **Tools** tab. You can set the Lane/Rate configuration using the provided buttons on the right side of the panel **Force Link Train** rate. The link training status is shown on the left side **Current Status**.

To select a format:

1. Specify the link training configuration by clicking on the desired button on the right side of the Link Train panel button (indicated below).

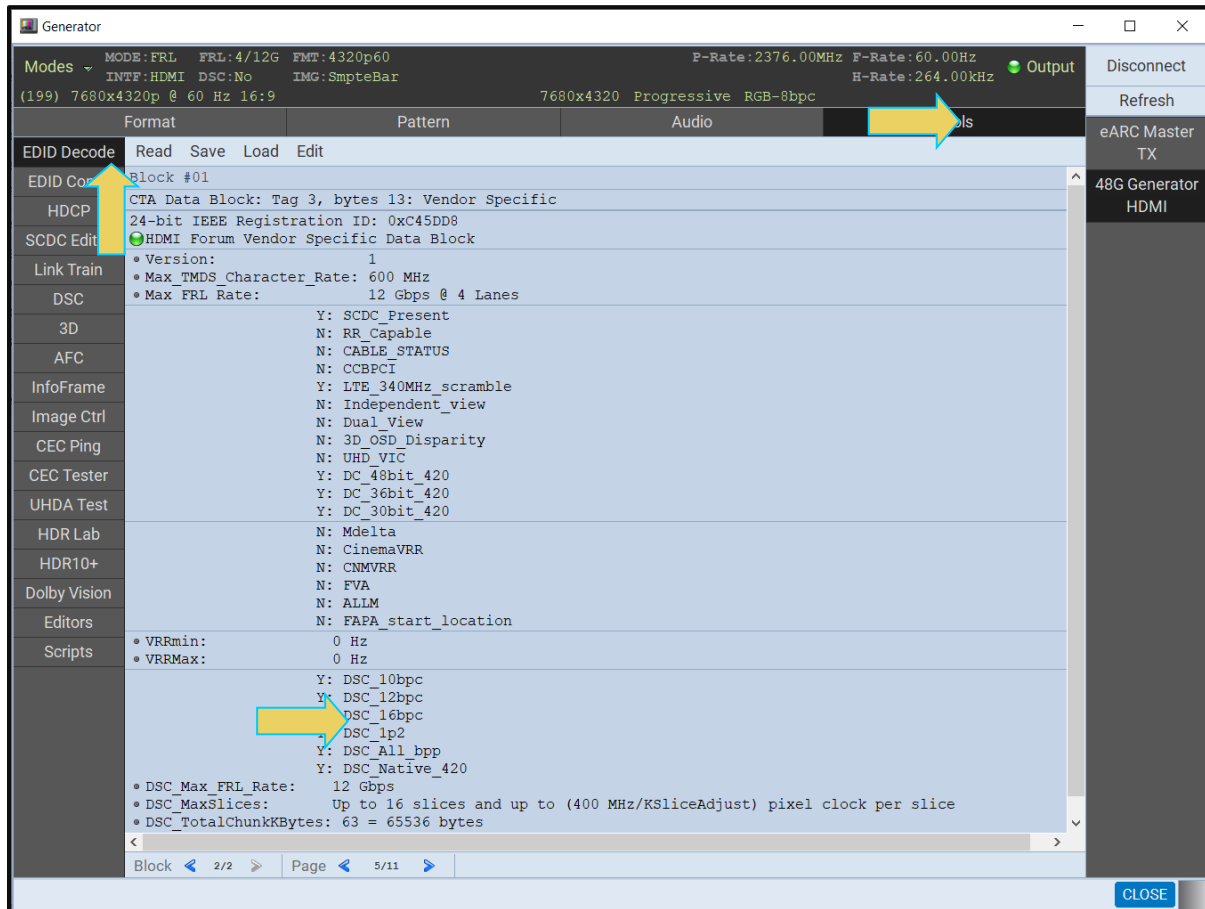


14.9 Generating FRL Display Stream Compression (DSC) Video Streams

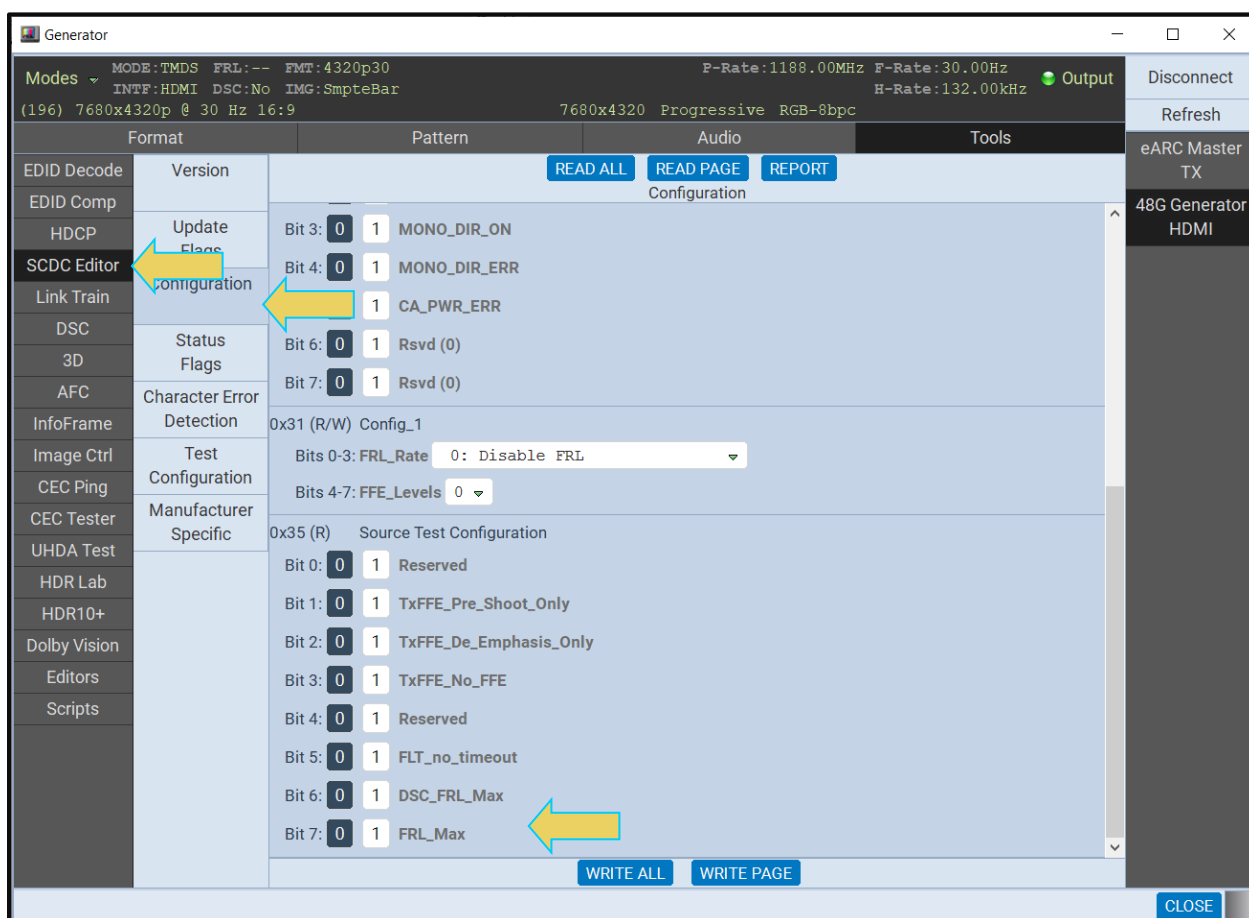
Use the following procedures to configure the 980 48G Protocol Analyzer/Generator module to generate an FRL Display Stream Compression (DSC) stream. You can only generate DSC when the generator is in the FRL mode. You can disable FRL using the FRL Off button.

To specify FRL Display Stream Compression (DSC) mode:

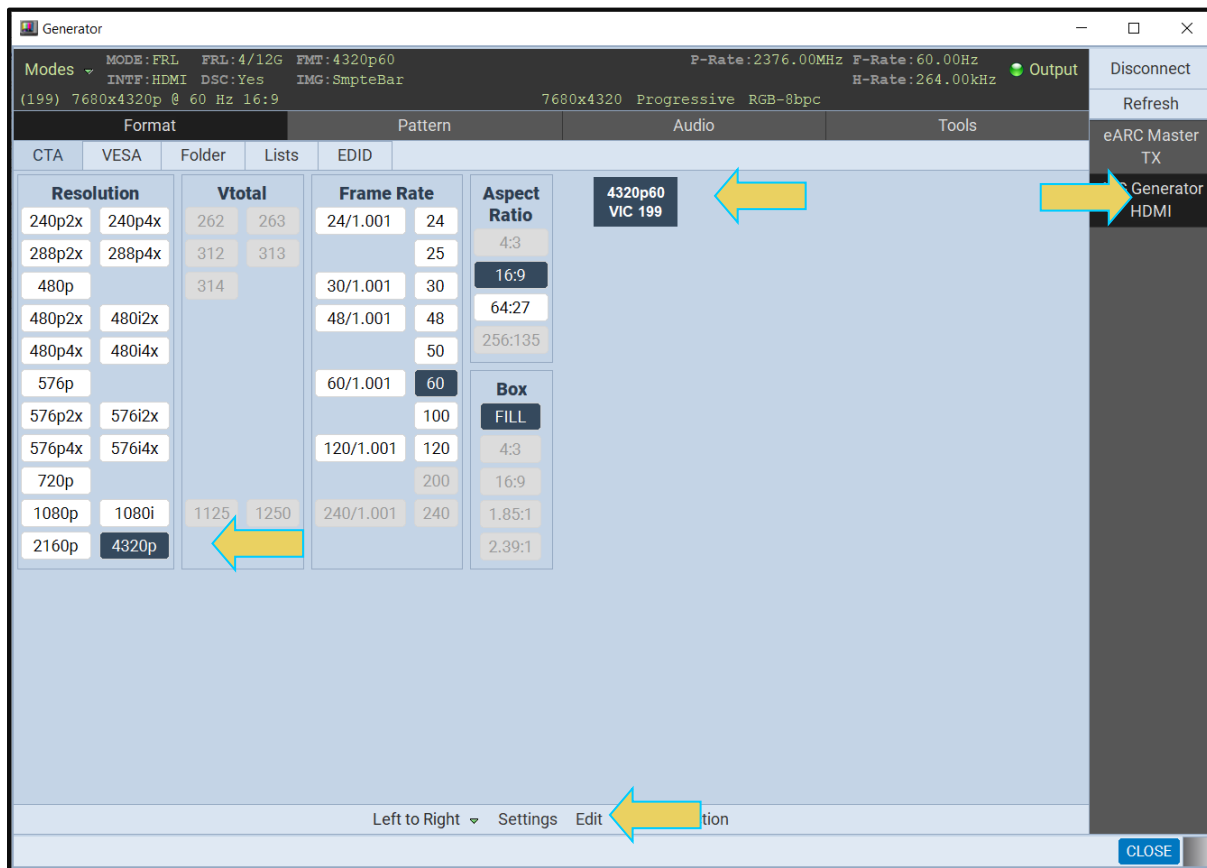
1. To specify the DSC mode first ensure that the display you are connected supports Display Stream Compression (DSC). To do this you read the EDID and verify the Vendor Specific Data Block of the EDID shown below.



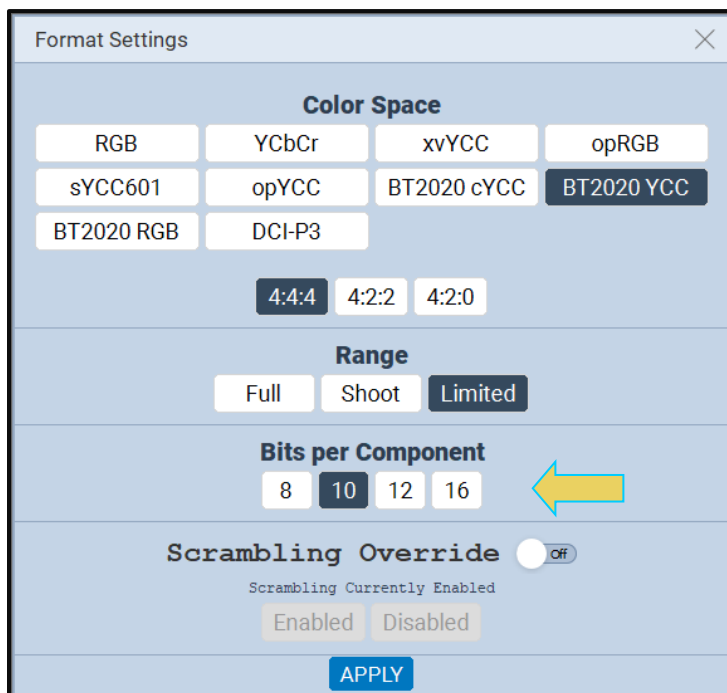
You can also read the SCDC registers as there are some configuration flags that indicate DSC support as shown below.



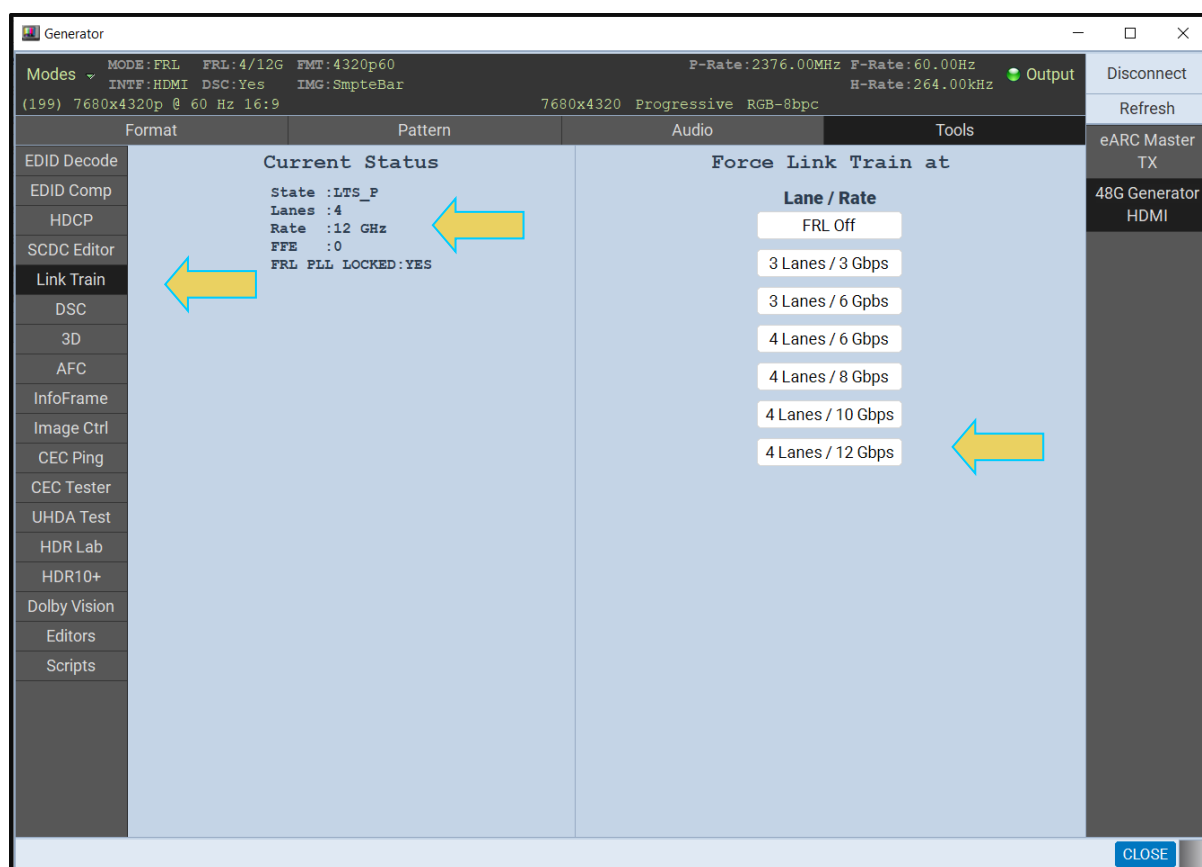
2. Configure the generator for the FRL mode and select a 4K or an 8K format as shown below.



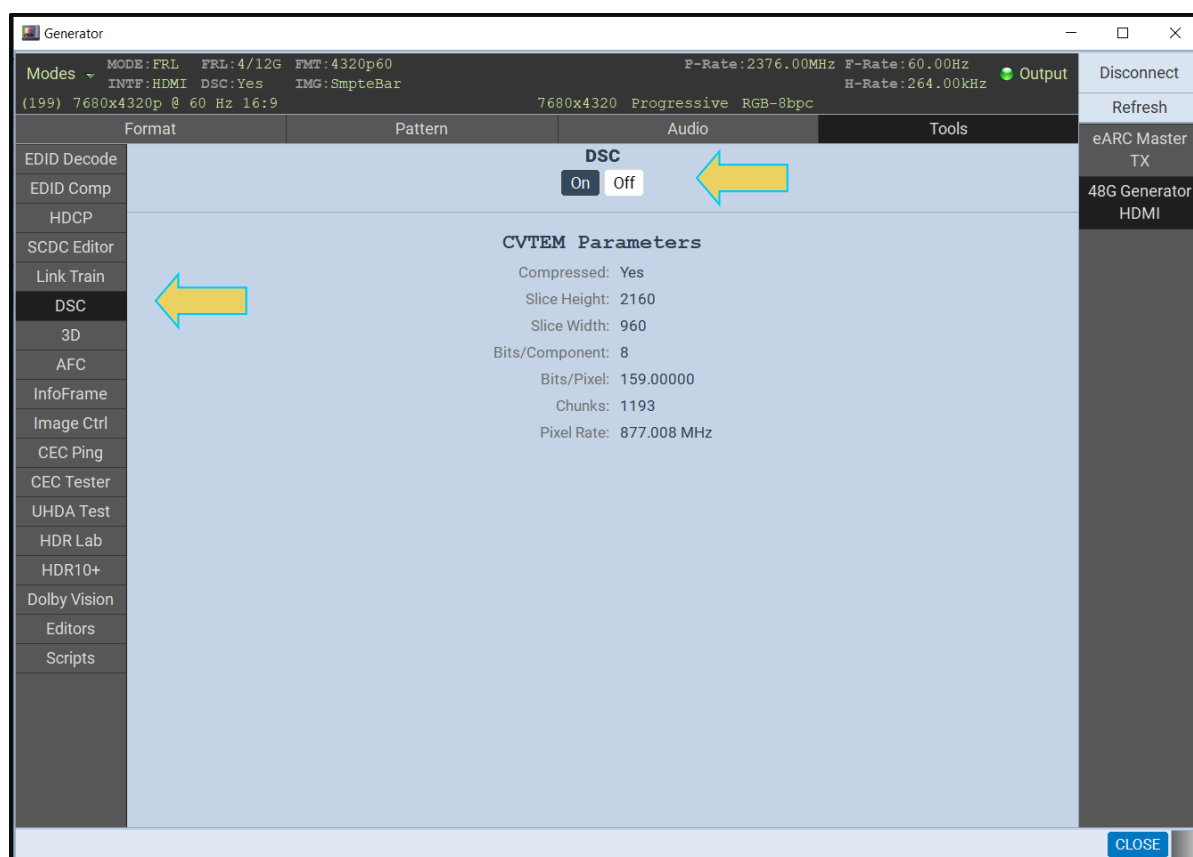
3. Select the settings from the Format Settings dialog box for chroma subsampling, color depth and colorimetry.



4. Configure the Lane and Lane rate of the FRL transmission stream as shown below.



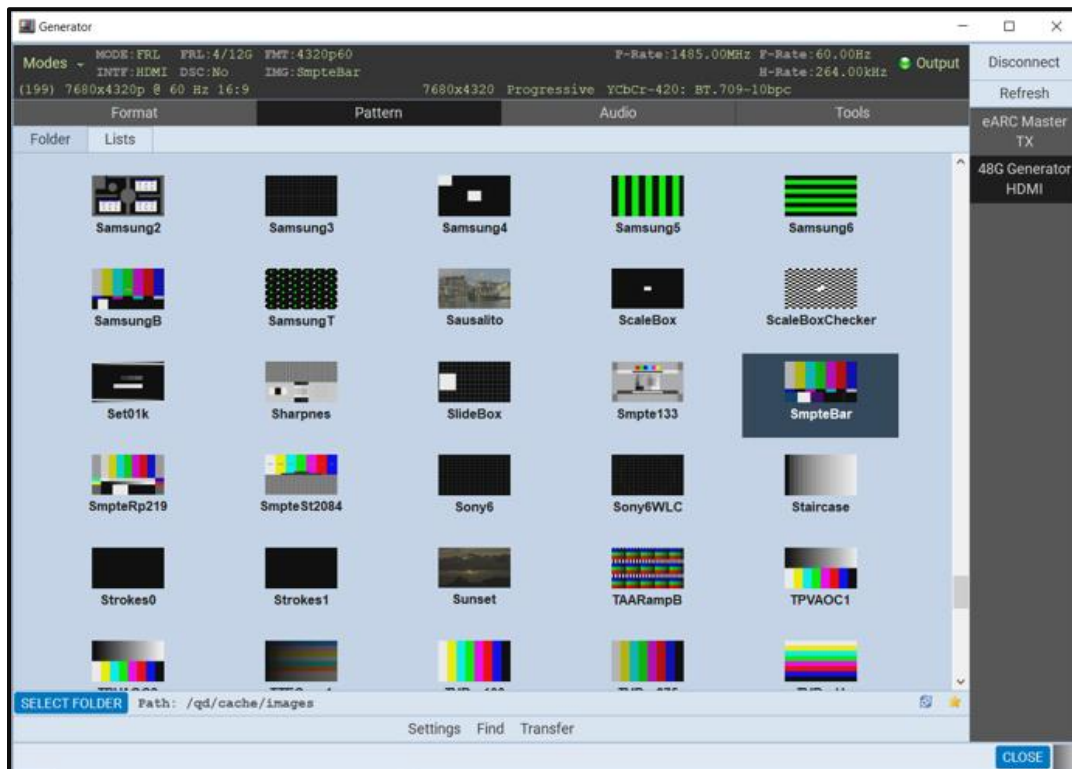
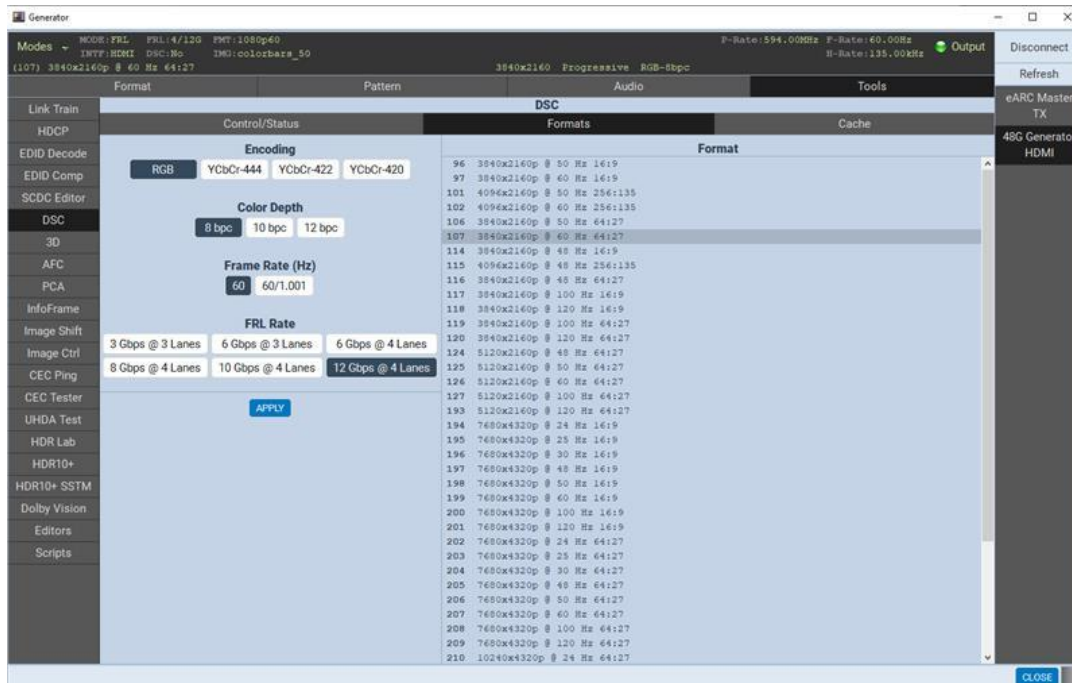
5. Enable Display Stream Compression (DSC) from the DSC window as shown below.



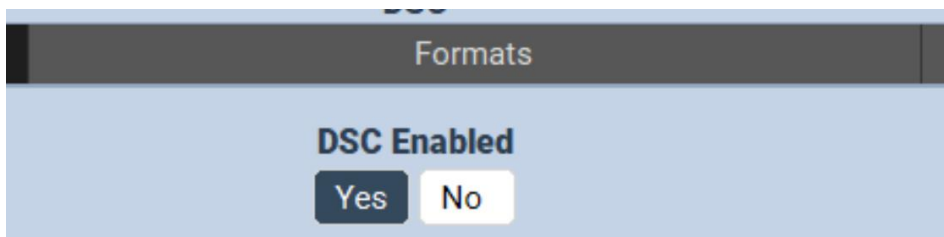
14.9.1 Adding a DSC image to Cache

Use the following procedure to add a DSC image to the cache. The procedure assumes that you have already selected an HDMI interface.

1. Select the FRL format and pattern in the generator. Refer to [Section 14.6](#) and [Section 14.11](#) as needed. See the following two images.

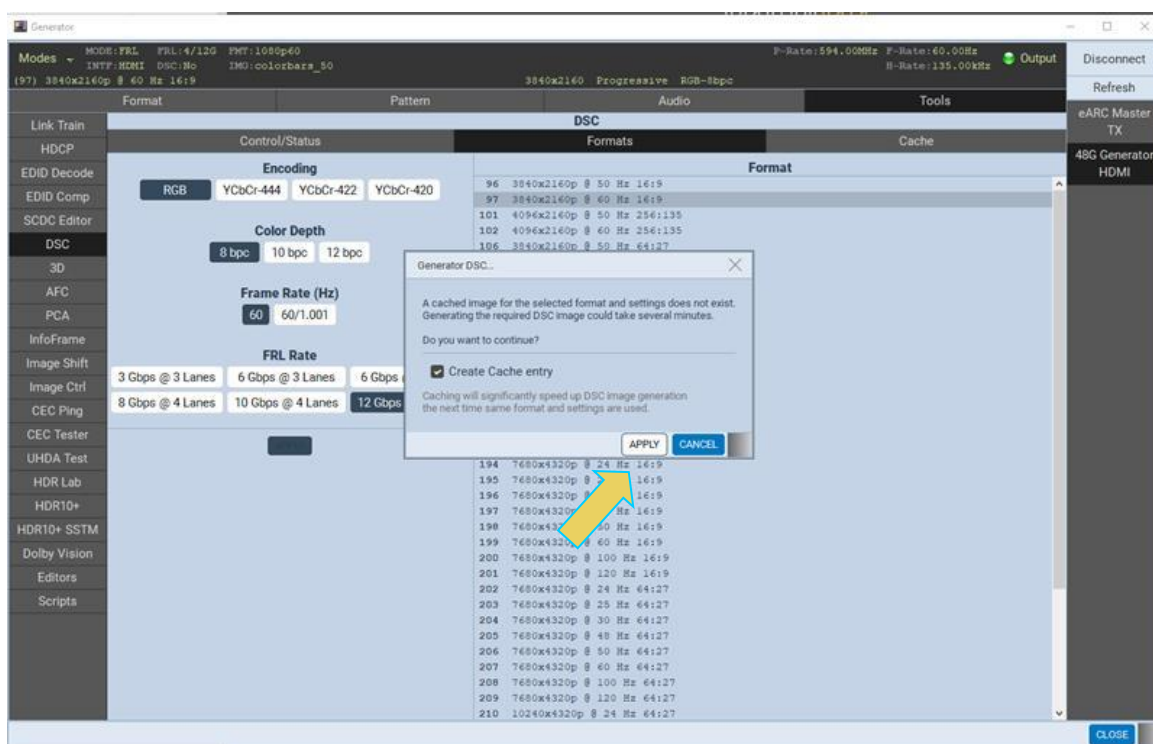


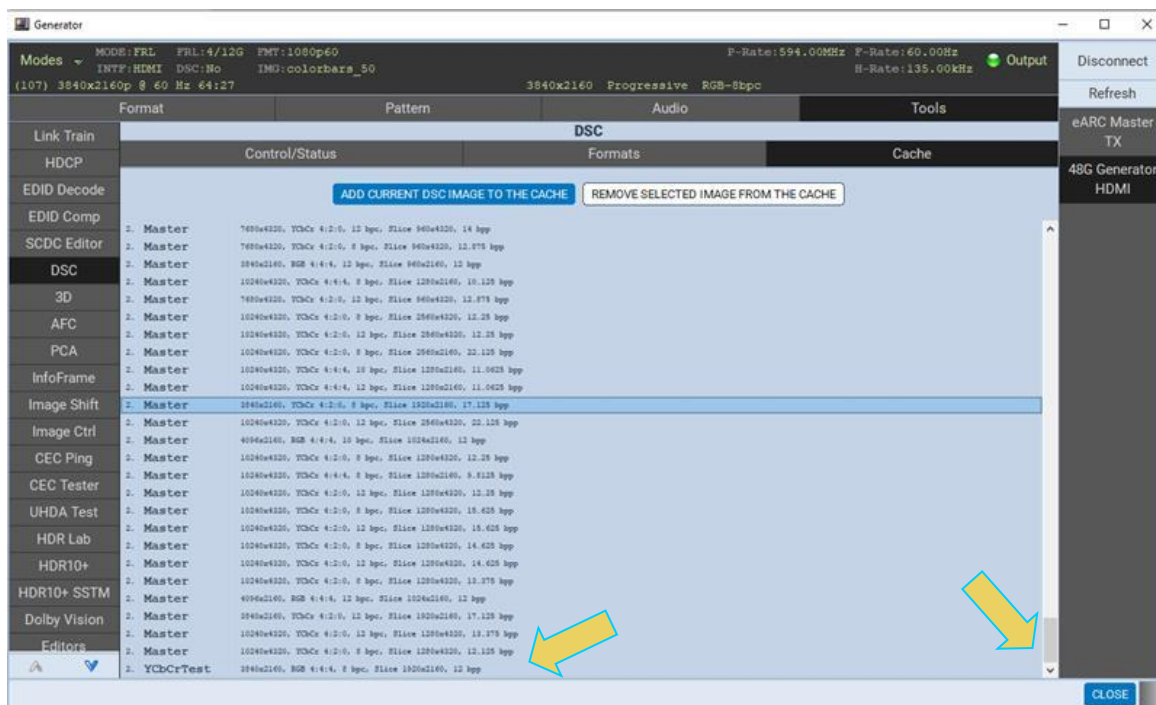
2. Go to **Tools -> DSC -> Control/Status**. Select **Yes** to the **DSC Enabled** prompt.



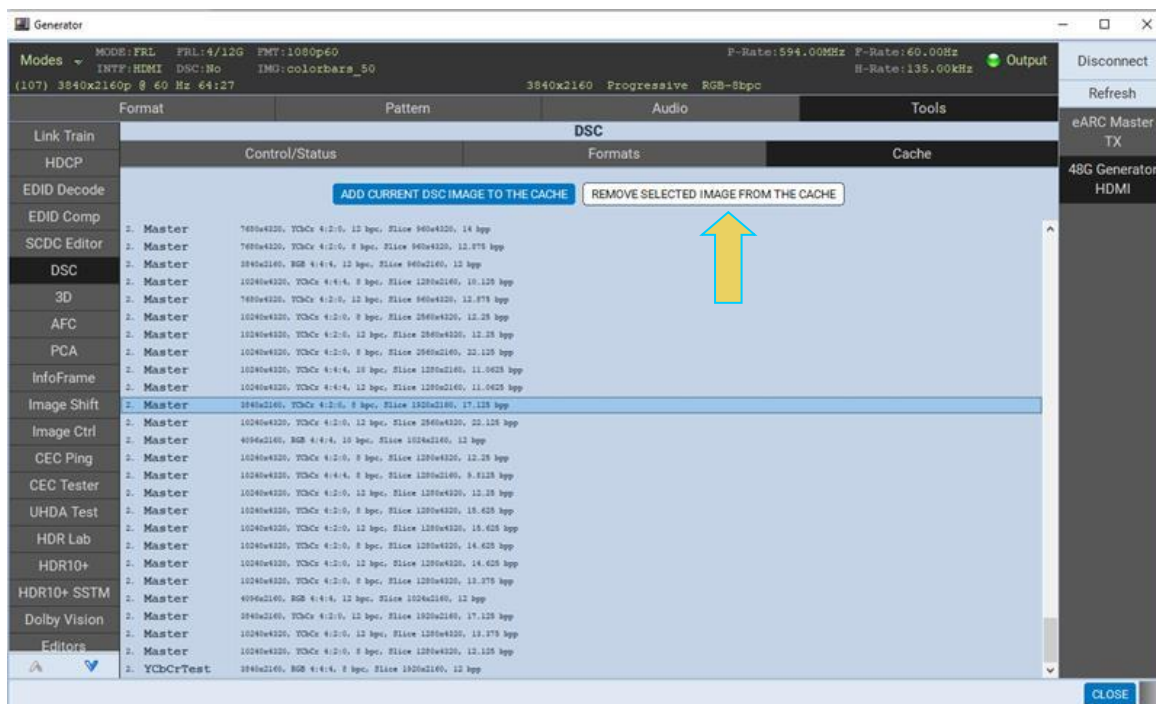
Note: When you enable DSC, if the configuration (format/pattern) is not in the cache, DSC generation will start. This may take a minute or two.

- Once you have a new DSC format you can add it to the cache by selecting **APPLY**. See following image. The new entry should appear at the bottom of the list. See second image below.





4. From this screen you may also remove a DSC format entry from the cache by selecting the format and then clicking **REMOVE SELECTED IMAGE FROM THE CACHE**.

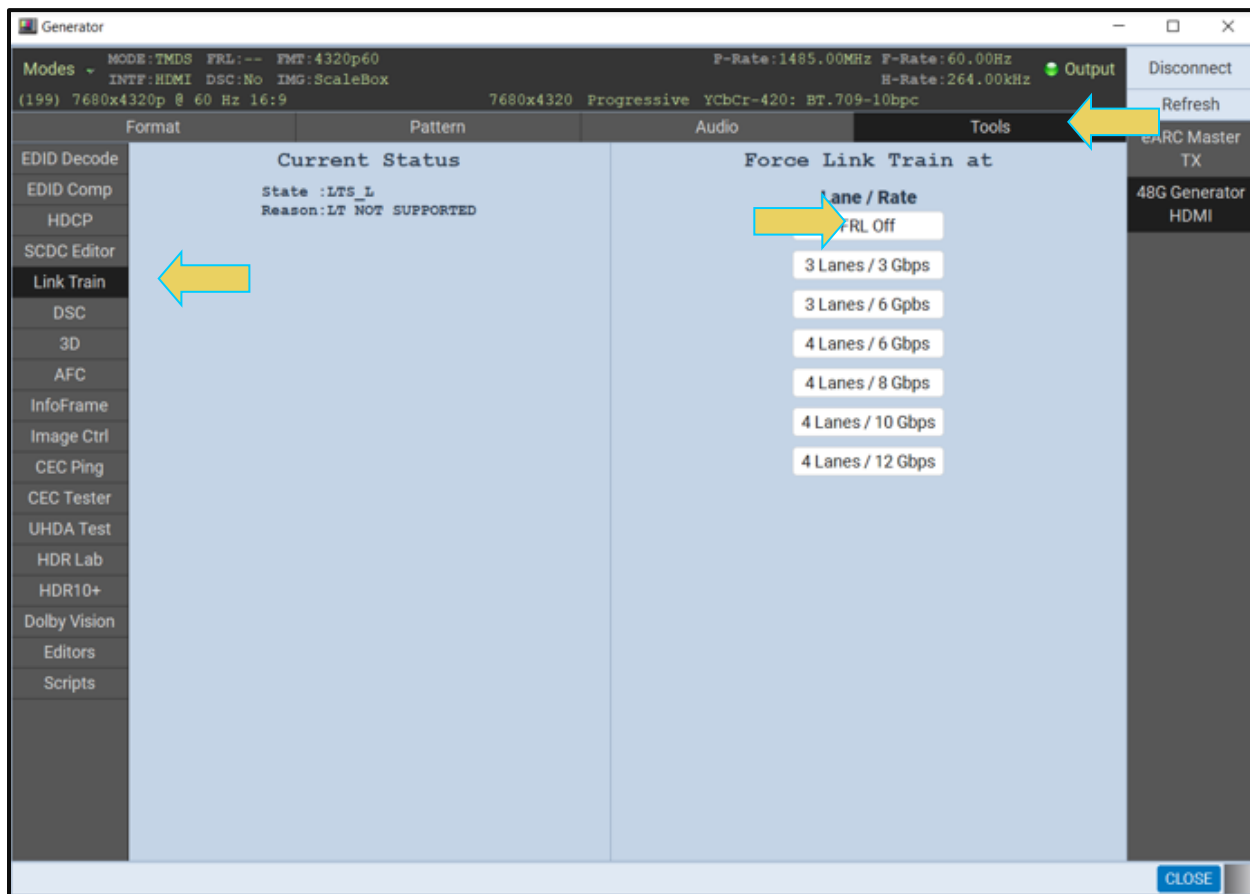


14.10 Generating TMDS Video Streams

Use the following procedures to configure the M41h 48G Video Analyzer/Generator to generate TMDS streams instead of FRL streams. You will use the Link Training panel to set this. The Link Training panel is accessible from the Link Train button on the **Tools** tab. You can disable FRL using the FRL Off button.

To specify TMDS mode:

Specify the TMDS mode by disabling the FRL mode as shown below. Once you have disabled FRL you can select Formats and Patterns in the same manner as you select FRL formats.

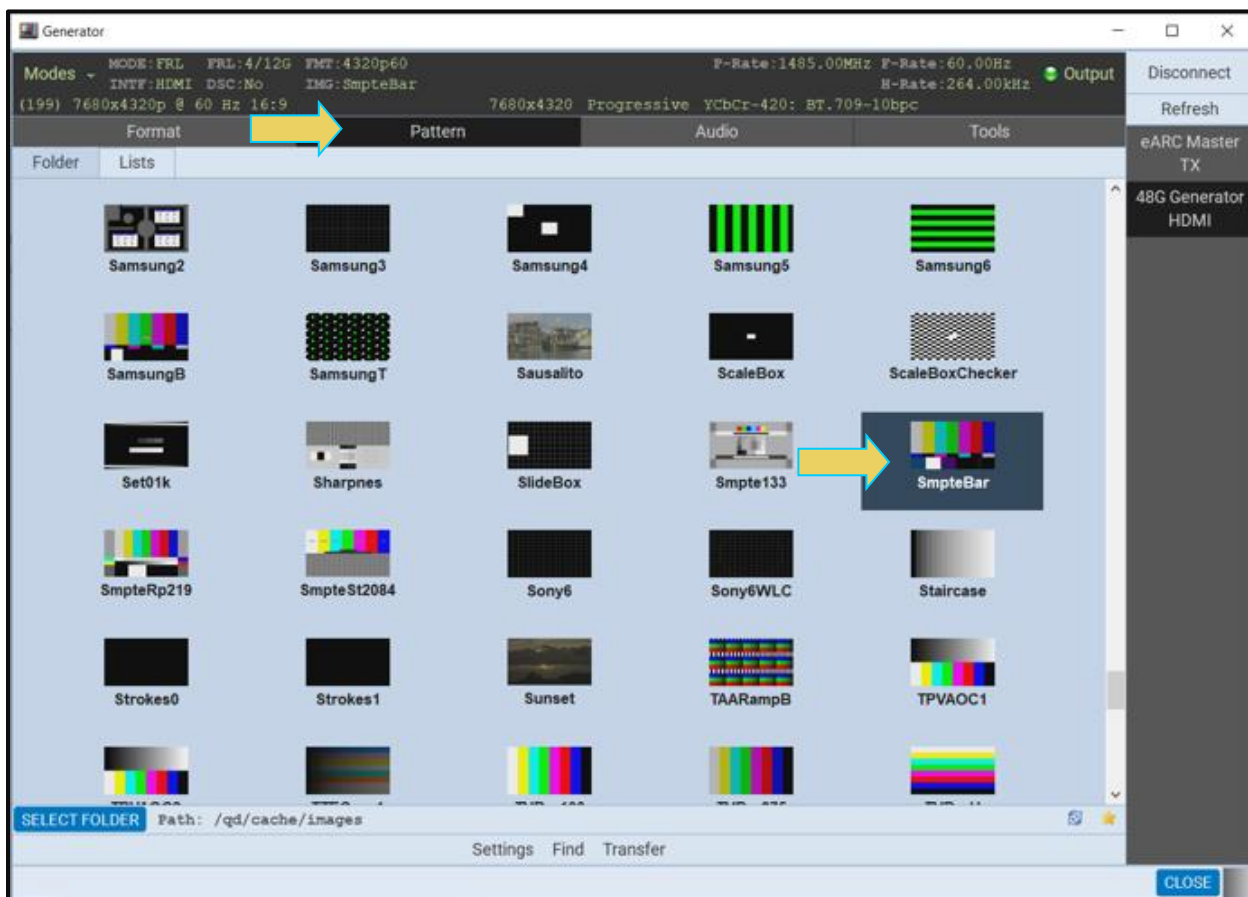


14.11 Selecting Test Patterns

Use the following procedures to select a test pattern.

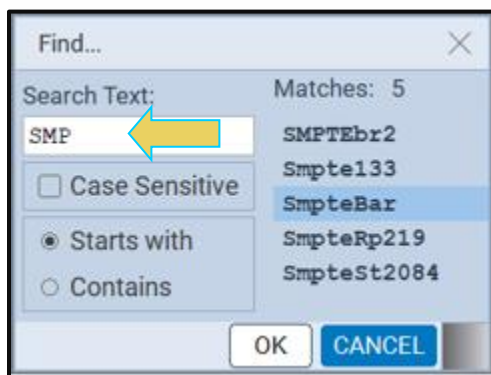
To select a test pattern:

1. From the main window of the M41h 48G Video Analyzer/Generator, click the **Pattern** tab to access the list of test patterns. Clicking the star on the bottom right shows the active pattern.



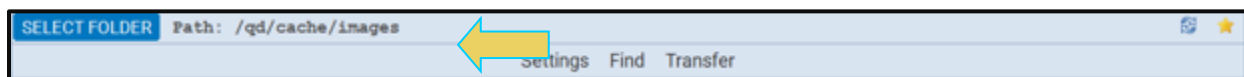
2. Select a test pattern from the list by clicking or selecting it. There is a scroll bar on the right to allow access to the entire list by browsing.

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, you are presented with a dialog window where you can search for a pattern by name using initial and mid string partial searches (below).



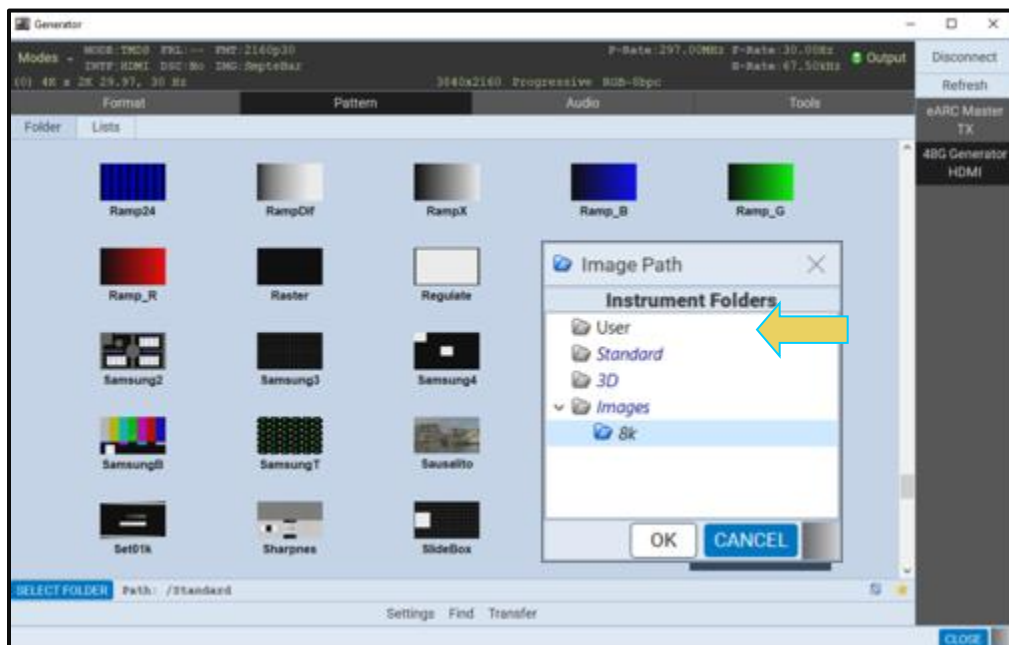
The directory whose images (patterns) are being displayed is listed in the lower panel as indicated below. In the example below, the path is set to Standard which will display the entire test pattern library and is the default path.

You might wish to change the directory path if you have added your own bitmap patterns and wanted to select them without scrolling through the complete list. You may also have created a custom Pattern List using the **Pattern List Editor**. Refer to Pattern List Editor for details on creating a custom Pattern List.

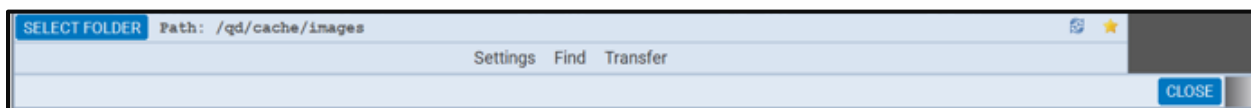


You can change the directory path with the directory activation button

SELECT FOLDER Path: /qd/cache/images . When you select the directory a dialog box will appear allowing you to select the alternative path such as the User path shown in the dialog box below.

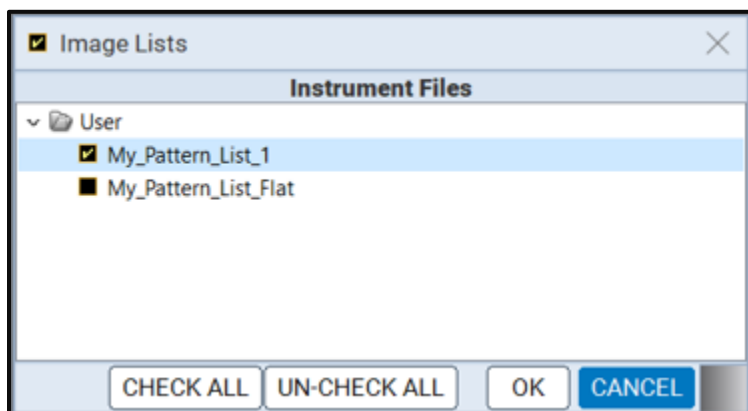


When you have changed the directory the User directory will be indicated on the lower panel beside the associated icon as shown below.

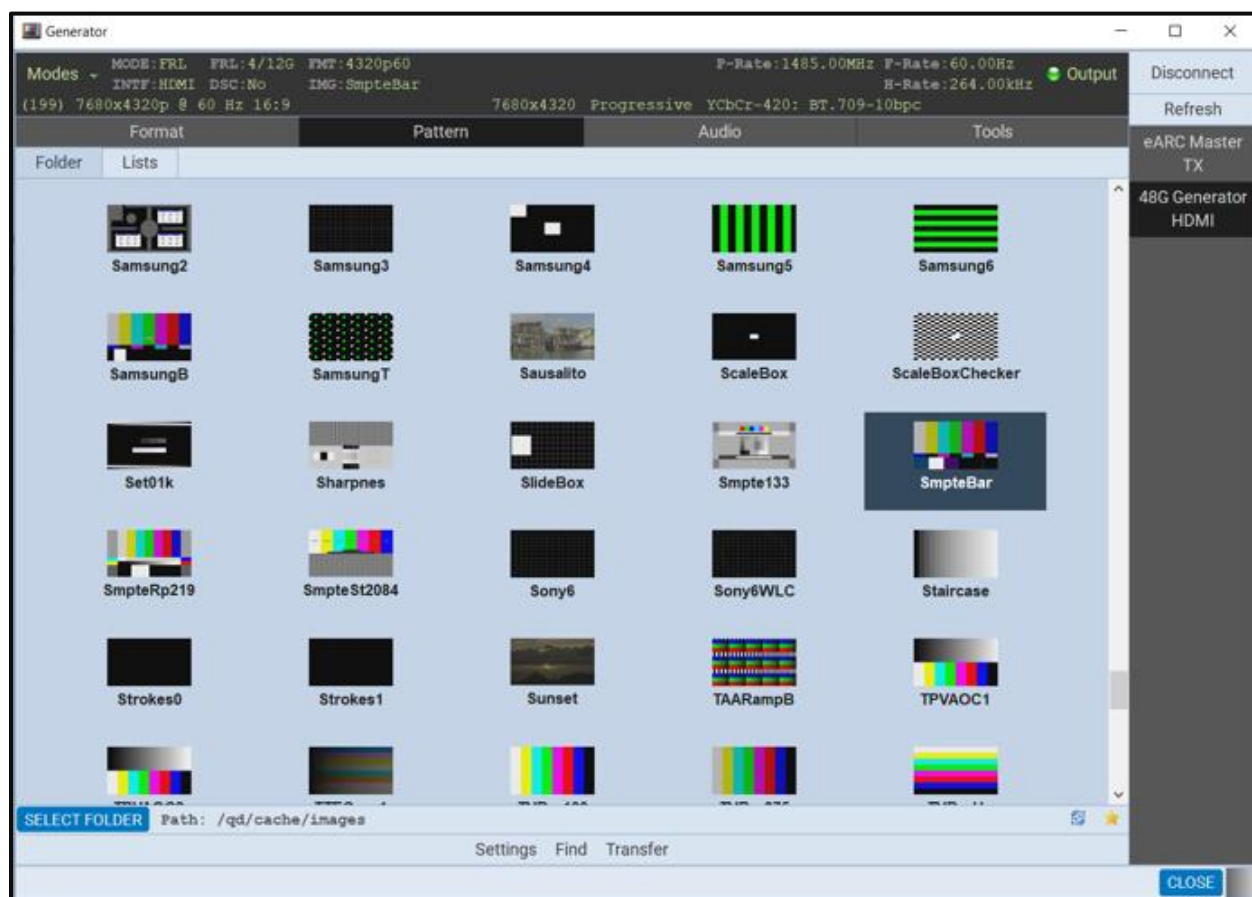


Now you can configure the list of patterns in accordance with a custom Pattern List by using

SELECT FOLDER Path: /qd/cache/images . A dialog box will appear enabling you to select a custom image list (below).



You can select all or one custom Pattern List or any combination if you have several defined. The example above shows selecting one Pattern List. The **CHECK ALL** and **UN-CHECK ALL** activation 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 screen example below. A limited set of patterns are displayed. The Path icon on the bottom status panel will display that new list (indicated below).

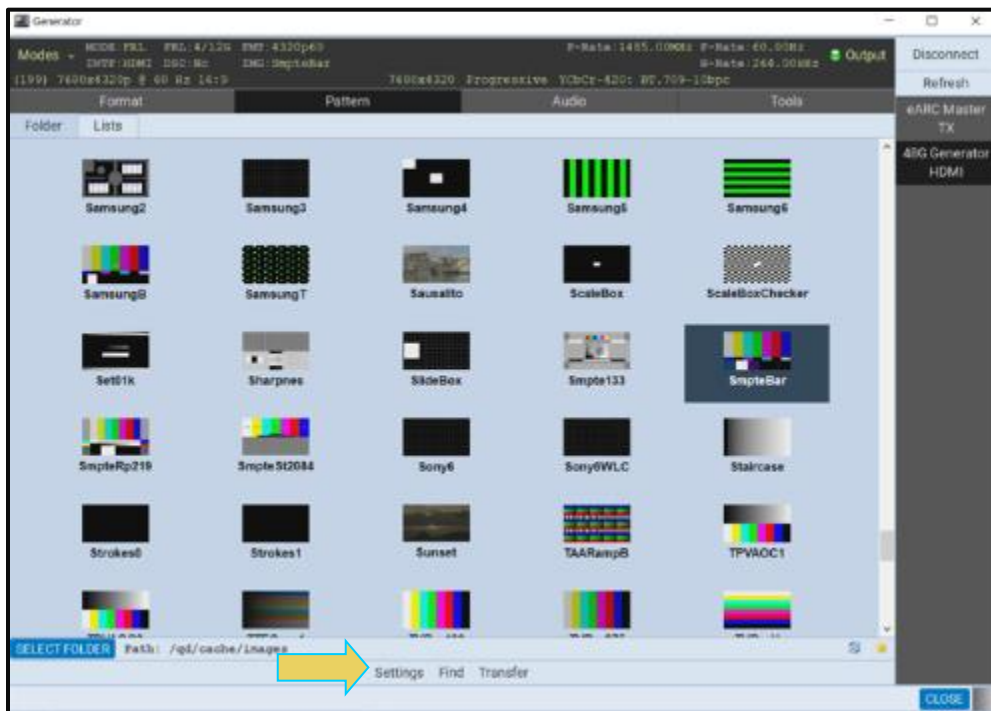


14.12 Selecting Test Patterns Settings

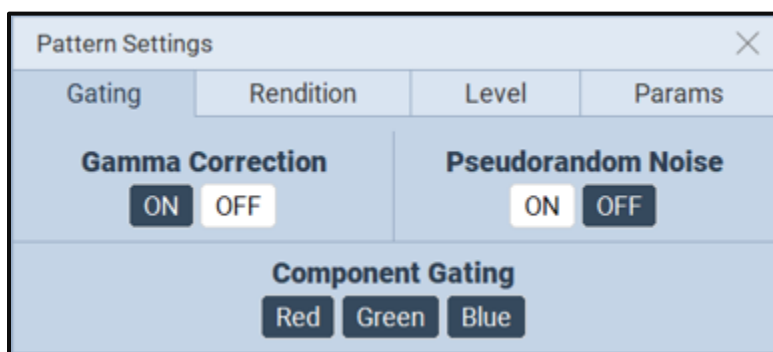
Use the following procedures to select a test pattern.

To specify test pattern settings:

1. From the main window of the M41h 48G Video Analyzer/Generator, click the **Pattern** tab to access the list of test patterns.
2. Specify the image settings by clicking on the **Settings** button on the lower center of the panel.



The **Settings** dialog box appears as shown below:

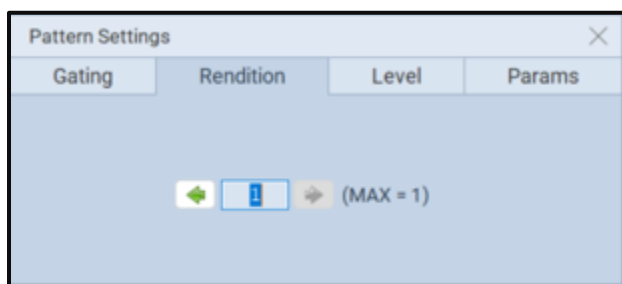


3. Enable and disable Gamma and Pseudorandom noise and set the gating as desired. Refer to the table below for details on these optional settings.

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
Pseudorandom 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

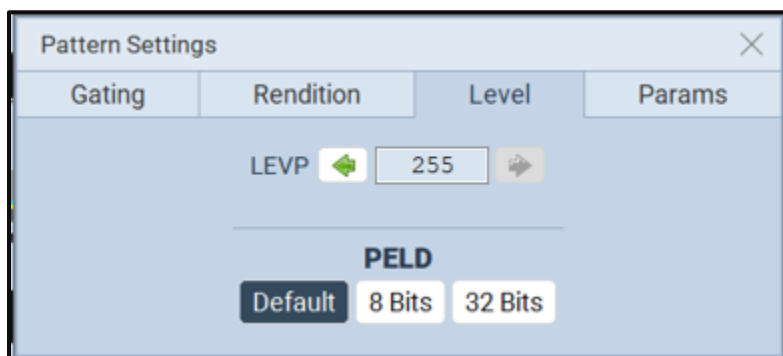
4. Select the rendition where applicable using the Rendition button. The associated dialog box is shown further below.

Some test patterns have multiple versions such as GraysAll. 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 1 is currently being rendered on the sink DUT.



5. 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.



- Set the pixel depth (PELD) if necessary, through the Level button and associated dialog box shown above.

PELD establishes the number of data bits that represent each active pixel in video memory (frame buffer). The default setting and setting of 8 allows 256 colors on an image (test pattern) to be rendered. This is suitable for most 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 M41h video generator default

8 - 8 bits-per-pixel (256 colors)

24 - 24 bits-per-pixel (16,777,216 colors).

- 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

The screenshot shows the 'Pattern Settings' dialog box with the 'Params' tab selected. The dialog contains the following parameters and their values:

Parameter	Value
OFFX	0
OFFY	0
DELX	4
DELY	4
DWEL	1
PENW	0
PENH	0
SPAX	32
SPAY	32
NCYC	1

14.13 Testing Variable Refresh Rate (VRR) Capable Sink Display

The M41h HDMI 48G Generator offers support for Variable Refresh Rate (VRR) functional testing. This feature is also referred to as Gaming Option Functional Testing.

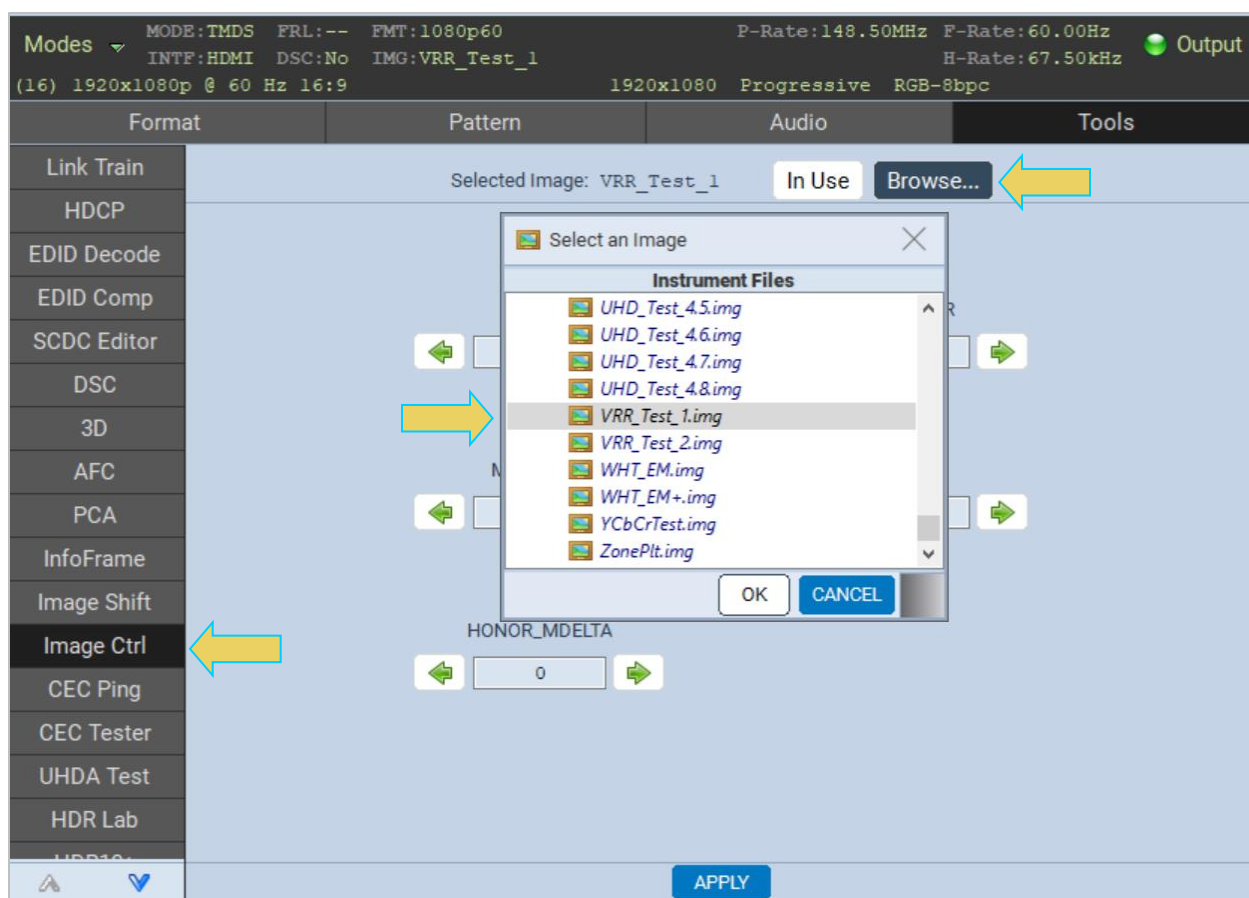
Testing VRR on a Sink Device

Use the following procedure to test VRR on a sink display.

Note: This feature is currently only supported on the embedded ATP manager of the M41h.

Set a format as normal within the **Format** tab of the generator. See section 14.6-14.7 for further instruction on setting formats.

Navigate to the **Image Ctrl** tab within the **Tools** utility of the 48G HDMI Generator, and **Browse** for the **VRR_Test_1.img** Instrument File, as shown below.



Set the controls as desired according to your testing specifications. Below is a list of the configurable controls and their definitions.

- **MVRR:** For static VRR mode, used to set the precise amount to of lines to add to VFront
- **MODE:** Set to 0 for Static Mode or 1 for Dynamic Mode. MAX/MIN MVRR are used to randomly generate new VRR values every frame if set to dynamic mode.
- **MAX_MVRR:** Set the maximum number of lines for Dynamic Mode VRR
- **MIN_MVRR:** Set the minimum number of lines for Dynamic Mode VRR
- **HONOR_MDELTA:** Set to 0 for Delta mode off or 1 for Delta mode on. With Delta mode on, refresh rate changes in step increments, rather than all at once.

The example below has set Dynamic mode, with the maximum number of lines set to 120 and minimum set to 60

The screenshot displays the software interface for configuring a VRR test image. At the top, a status bar shows various settings: MODE:TMDS, FRL:--, FMT:1080p60, P-Rate:148.50MHz, F-Rate:60.00Hz, INTF:HDMI, DSC:No, IMG:VRR_Test_1, H-Rate:67.50kHz, and a green 'Output' indicator. Below this, a header bar categorizes controls into Format, Pattern, Audio, and Tools. The left sidebar lists various tools, with 'Image Ctrl' currently selected. The main area shows the 'Selected Image: VRR_Test_1' with 'In Use' and 'Browse...' buttons. A 'REFRESH' button is located above the control fields. The controls include:

- MVRR:** A numeric input field set to 0, flanked by left and right arrow buttons.
- MAX_MVRR:** A numeric input field set to 120, flanked by left and right arrow buttons.
- MIN_MVRR:** A numeric input field set to 60, flanked by left and right arrow buttons.
- MODE:** A numeric input field set to 1, flanked by left and right arrow buttons.
- HONOR_MDELTA:** A numeric input field set to 0, flanked by left and right arrow buttons.

 An 'APPLY' button is positioned at the bottom right of the configuration area.

Click **APPLY** when finished configuring the VRR test image to begin signal generation.

For detailed information on timing transitions, you can go to the Capture tool and perform a small data island capture (1% or less). You will then be able to see all the transitions to V-Freq and V-Front for each frame. See Chapter 7 for a detailed overview of the Capture Control tool.

14.14 Testing Quick Media Switching

The M41h HDMI 48G Generator offers support for QMS (Quick Media Switching) functional testing.

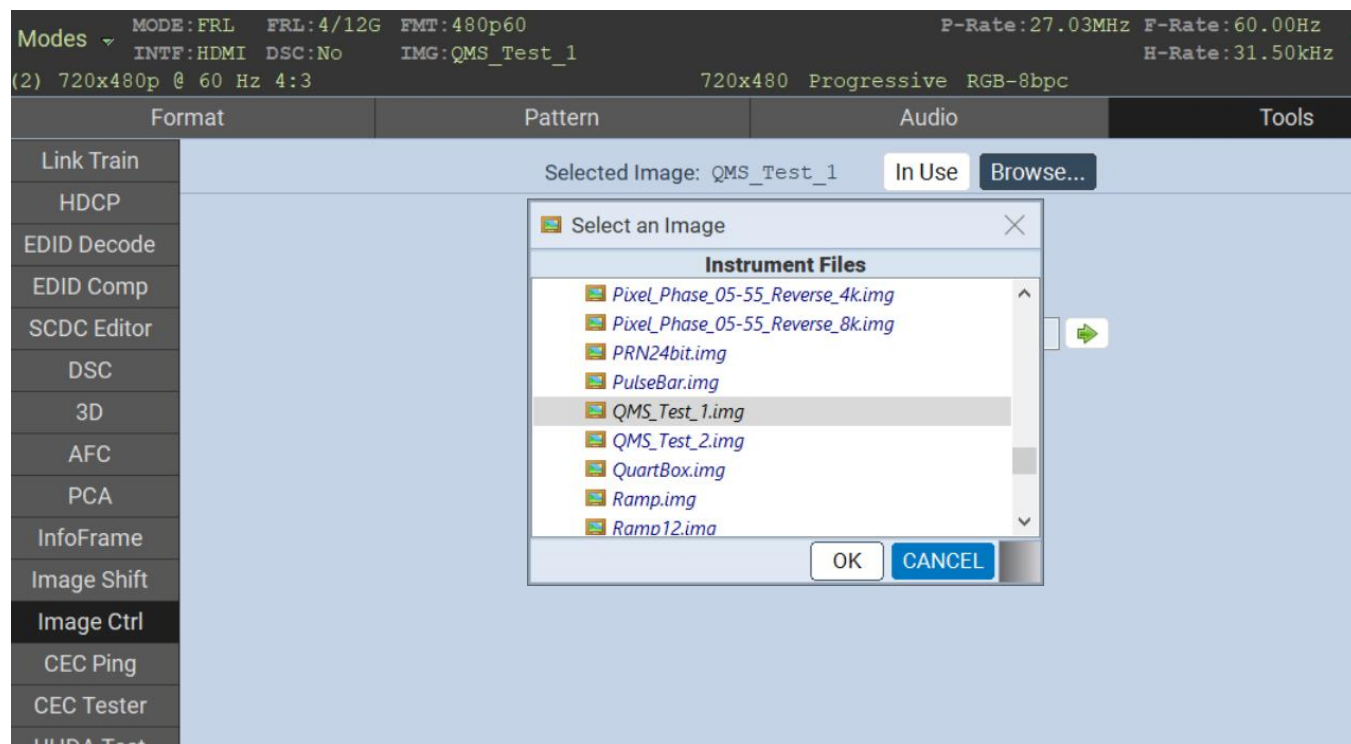
Testing QMS on a Sink Device

Use the following procedure to test QMS on a sink display.

Note: This feature is currently only supported on the embedded ATP manager of the M41h.

Set a format as normal within the **Format** tab of the generator. See section 14.6-14.7 for further instruction on setting formats.

Navigate to the **Image Ctrl** tab within the **Tools** utility of the 48G HDMI Generator, and **Browse** for the **QMS_Test_1.img** Instrument File.

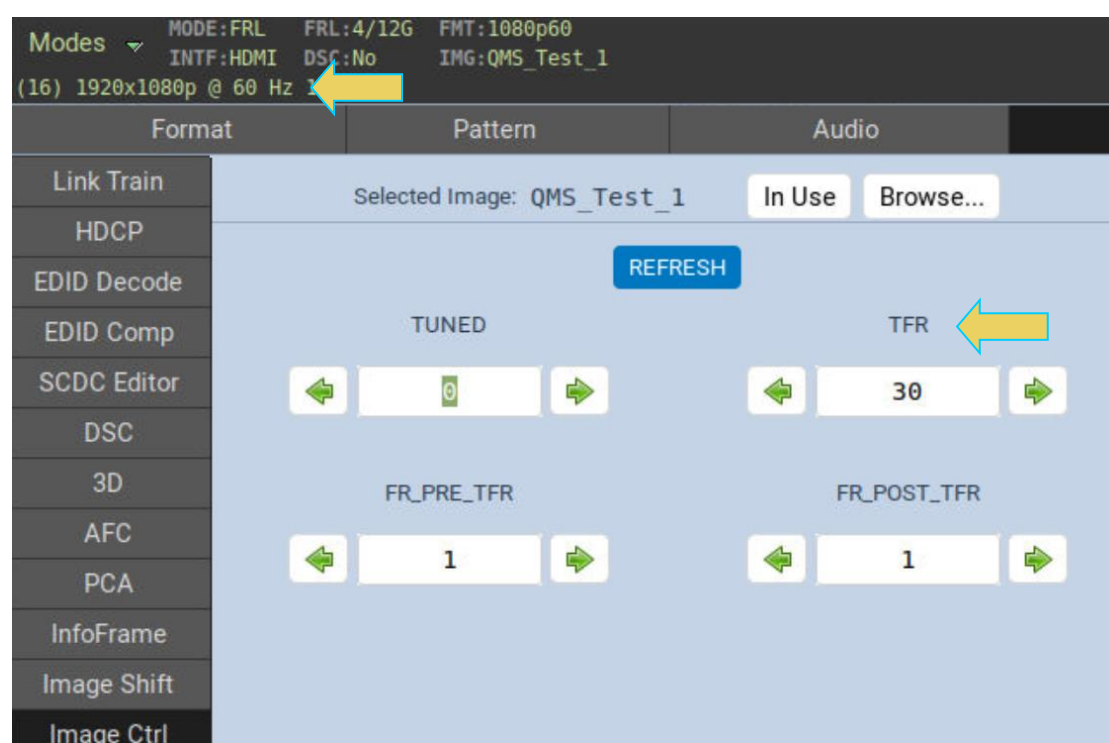


Note that loading or changing the selected image or format, QMS default state is off. Verify that the QMS_Test_1 image is selected by clicking the **In Use** button, pictured above.

Once the QMS_Test image is selected, set your parameters to configure QMS within the M41h Generator.

- **TUNED** – Allows user to use a factorial refresh rate such as 48/1.001. Set to 1 for True, set to 0 for False
- **TFR** – Target frame rate. According to spec, the TFR value should be set between 24 – 120 Hz.
- **FR_PRE_TFR** – Number of frames before frame rate change once **MCONST** bit is set to zero (0).
- **FR_POST_TFR** – Number of frames after frame rate change before setting **MCONST** to one (1).

The example below shows the generator Tx set at 60 Hz with the Target Frame Rate (TFR) set to 30 Hz.



Once the parameters are set according to your testing specifications, click the **APPLY** button at the bottom of the window to begin signal generation.

To disable QMS, simply change the **TFR** field to 0 (zero), and click **APPLY** again, as shown below.

The screenshot displays the configuration interface for the M41h 48G Video Analyzer/Generator. At the top, it shows 'Selected Image: QMS_Test_1' with 'In Use' and 'Browse...' buttons. Below this is a 'REFRESH' button. The main configuration area contains four fields: 'TUNED' (set to 0), 'TFR' (set to 0), 'FR_PRE_TFR' (set to 1), and 'FR_POST_TFR' (set to 1). Each field has a left arrow, a text input box, and a right arrow. A yellow arrow points to the 'TFR' field, which contains the value '0'. At the bottom, there is an 'APPLY' button, also highlighted with a yellow arrow.

14.15 Testing PCA-Capable Sink Display

The M41h 48G HDMI 2.1 Generator offers support for PCA-capable signal generation. Currently the feature is only available via the command line.

See Chapter 17 for instructions on accessing the command line.

Use the following procedures to operate testing of PCA capability.

Default PCA-capability is off, use the following command to enable PCA-capable generation:

```
OUT<port number>:setpca 1
```

To turn off PCA-capability, issue the following command:

```
OUT<port number>:setpca 0
```

Use the following command to check the status of PCA Capability in the generator:

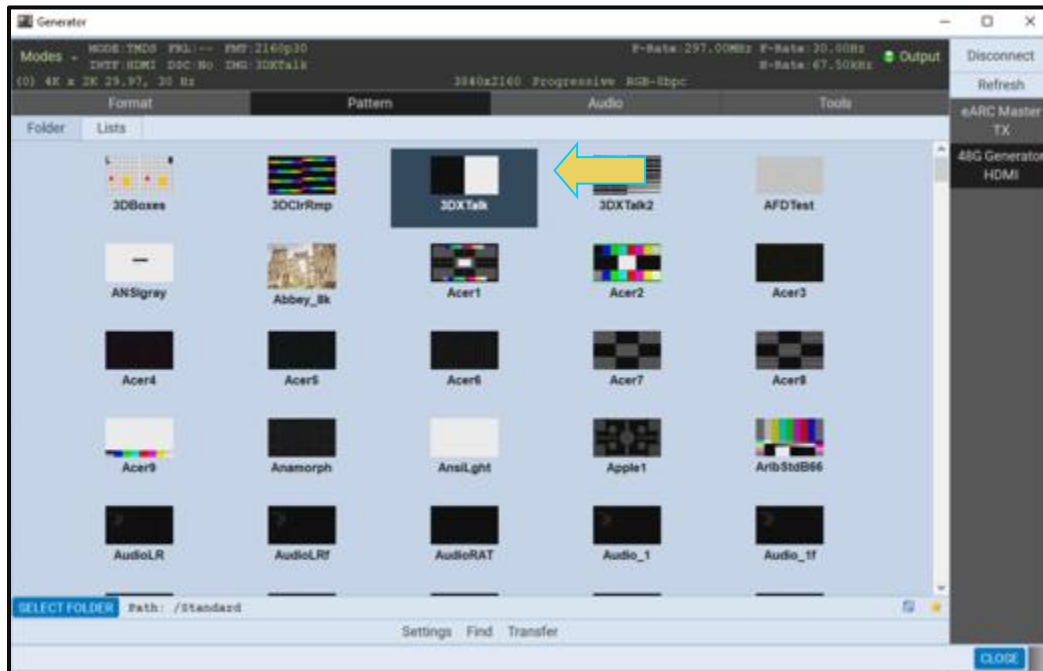
```
OUT<port number>:setpca?
```

14.16 Testing 3D Displays

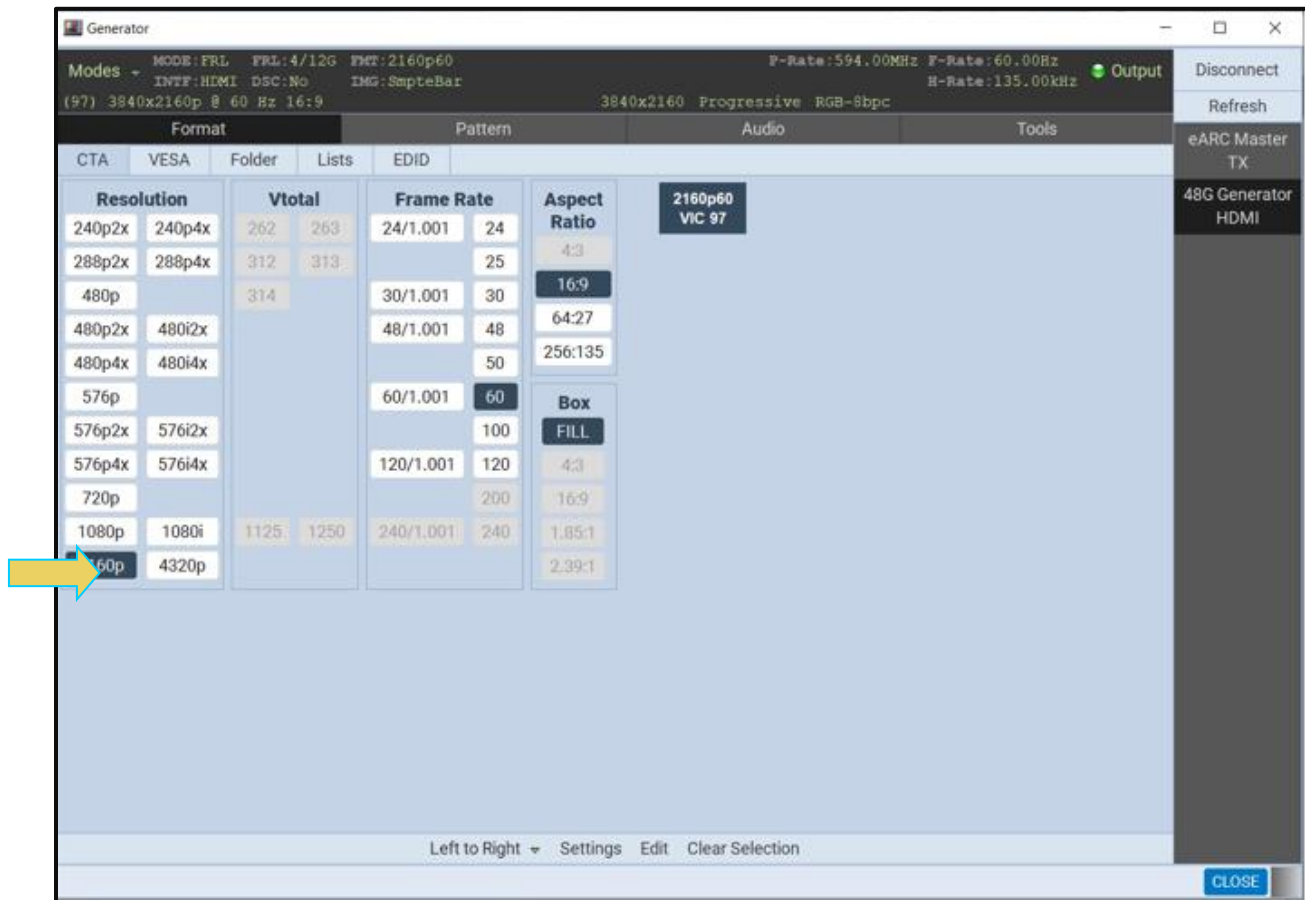
Use the following procedures to test 3D displays.

To test 3D capable HDMI displays:

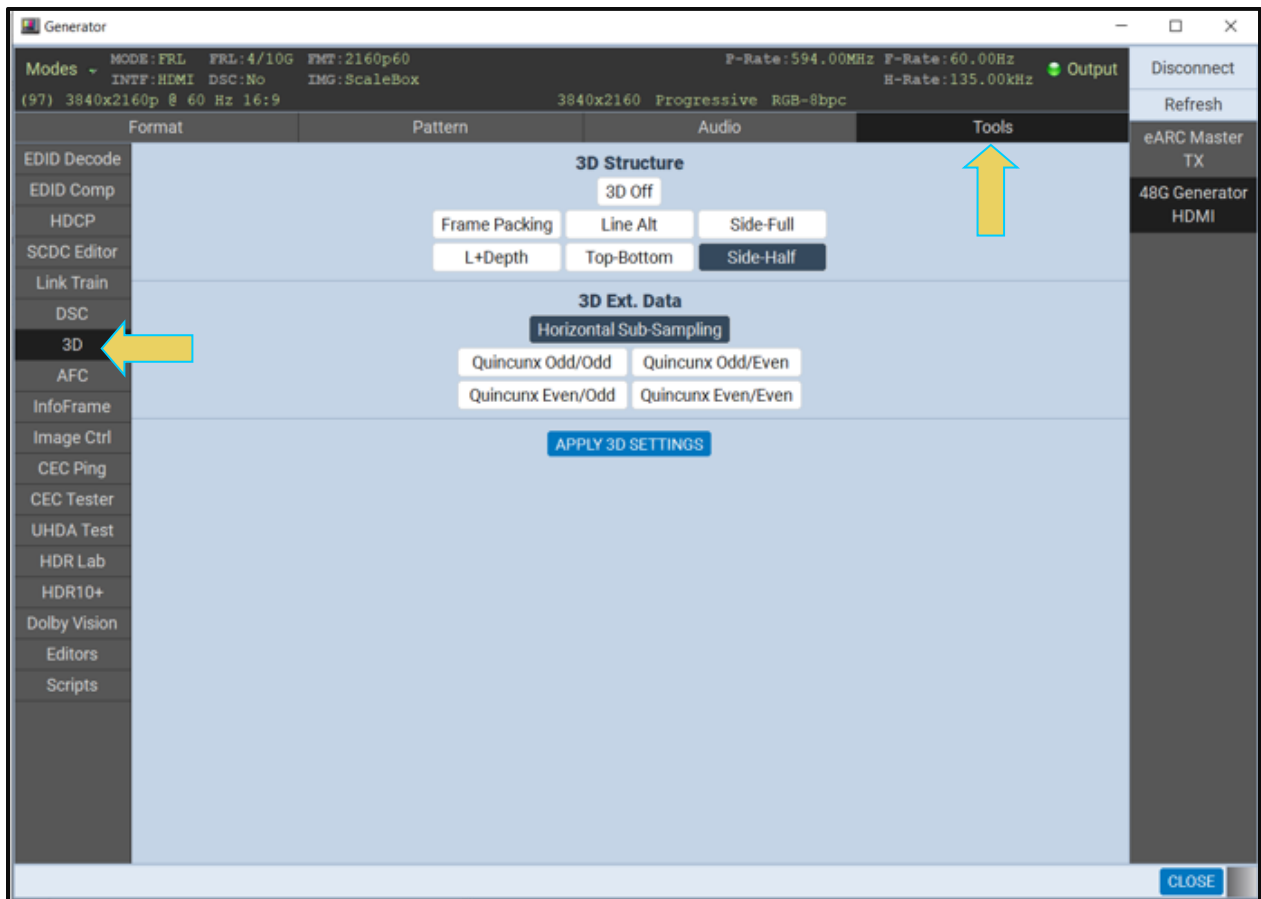
1. From the main window of the M41h 48G Video Analyzer/Generator, select a 3D test pattern for example 3DXTalk indicated in the screen example below.



2. Select the **Format** tab to select a format (resolution).



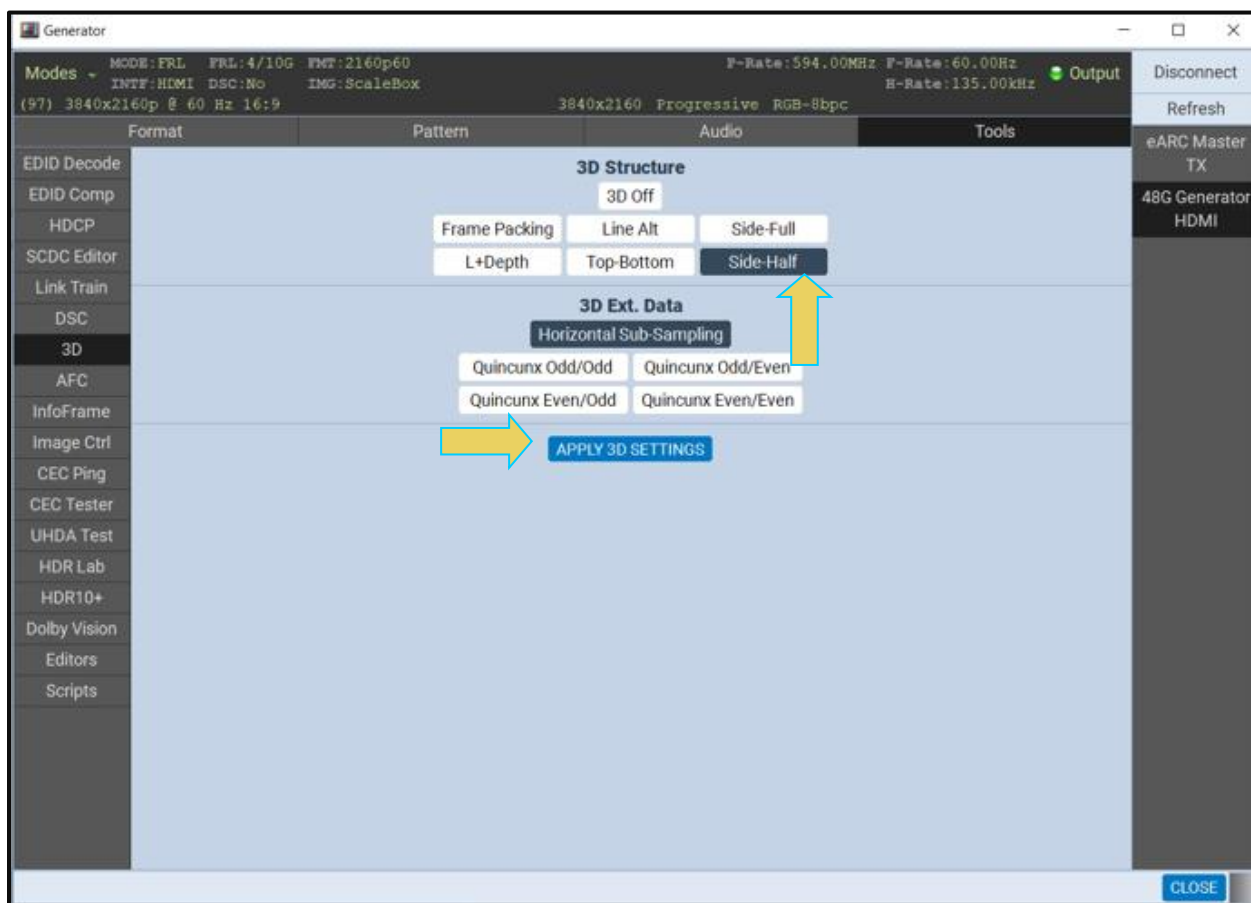
3. Select the **Tools** tab to access the 3D configuration utilities.



The following table describes the information on the **3D** dialog box.

3D Structure Method	Half Sampling Method	Left Sampling Position	Parameter – Vertical Blanking Lines	Right Sampling Position	Maximum pixel rate
Frame Packing	Not Applicable	Not Applicable	The number of lines between the left and right eye image - typically set to 30 lines for 720 timings and 45 lines for 1080 timings	Not Applicable	150MHz
Top and Bottom	Not Applicable	Not Applicable	Not Applicable	Not Applicable	300MHz
Side by Side (Full)	Not Applicable	Not Applicable	Not Applicable	Not Applicable	150MHz
Side by Side (Half)	One of: - Horizontal - Quincunx	One of: - Odd position - Even position	Not Applicable	One of: - Odd position - Even position	300MHz

4. Apply 3D settings with the activation button provided.



14.17 Testing UHD Displays with UHD Alliance Test Patterns

The UHD Alliance test patterns are called out in the Ultra-High Definition Alliance Test Specification. The test pattern pack is required to assess a UHD TV's compliance to all tests in the specification including:

- Section 4.2 High Dynamic Range: Peak White
- Section 4.3 High Dynamic Range: Black Level
- Section 4.4 High Dynamic Range: Tone Mapping
- Section 4.5 Wide Color Gamut
- Section 4.6 Resolution
- Section 4.7 Input Frame Rate and Bit Depth
- Section 4.8 Grey-Scale Tracking

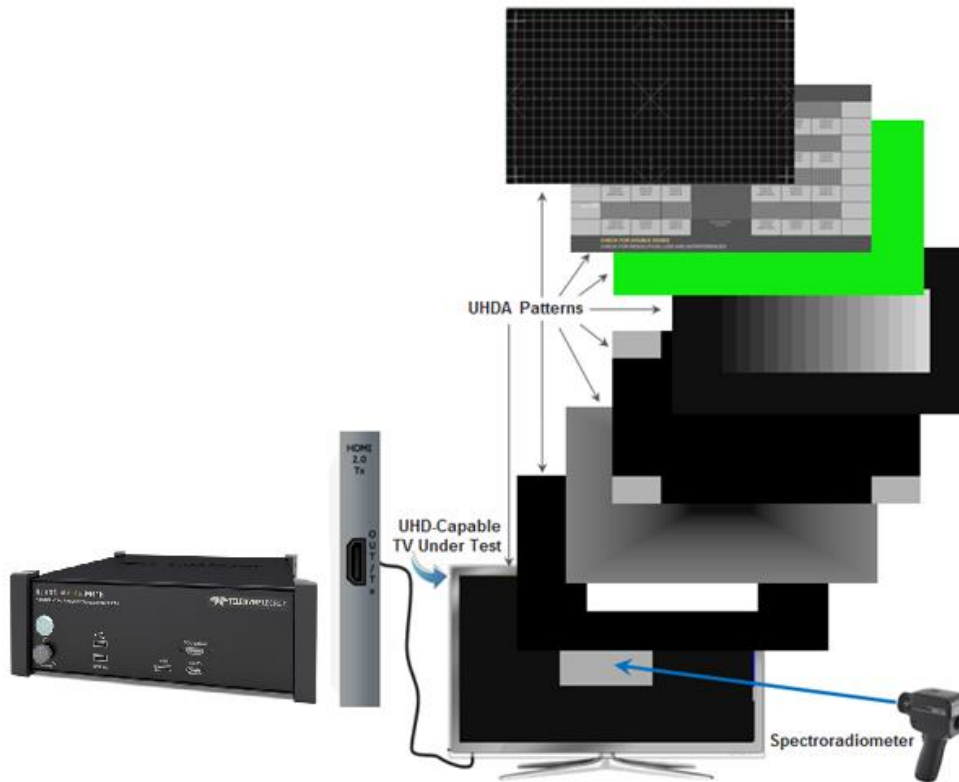
14.17.1 UHD Test Setup

For testing a UHD-Capable TV, the M41h 48G Video Analyzer/Generator offers the necessary high-resolution format, the test patterns and ease of use to quickly conduct functional testing using visual assessment or to conduct UHD compliance tests (Spectroradiometer required). When the UHD test patterns are selected through the M41h GUI interface, it emulates an UHD-capable source by transmitting the UHD test pattern and, where required, will also transmit the necessary Dynamic Range and Mastering InfoFrame metadata.

The Dynamic Range and Mastering InfoFrame data includes an Electro-Optical Transfer Function (EOTF) and the Static Metadata with the dynamic range of the video stream.

The following illustration depicts the test setup.

PELD establishes the number of data bits that represent each active pixel in video memory (frame buffer). PELD establishes the number of data bits that represent each active pixel in video memory (frame buffer).



14.17.2 UHD Test Procedures

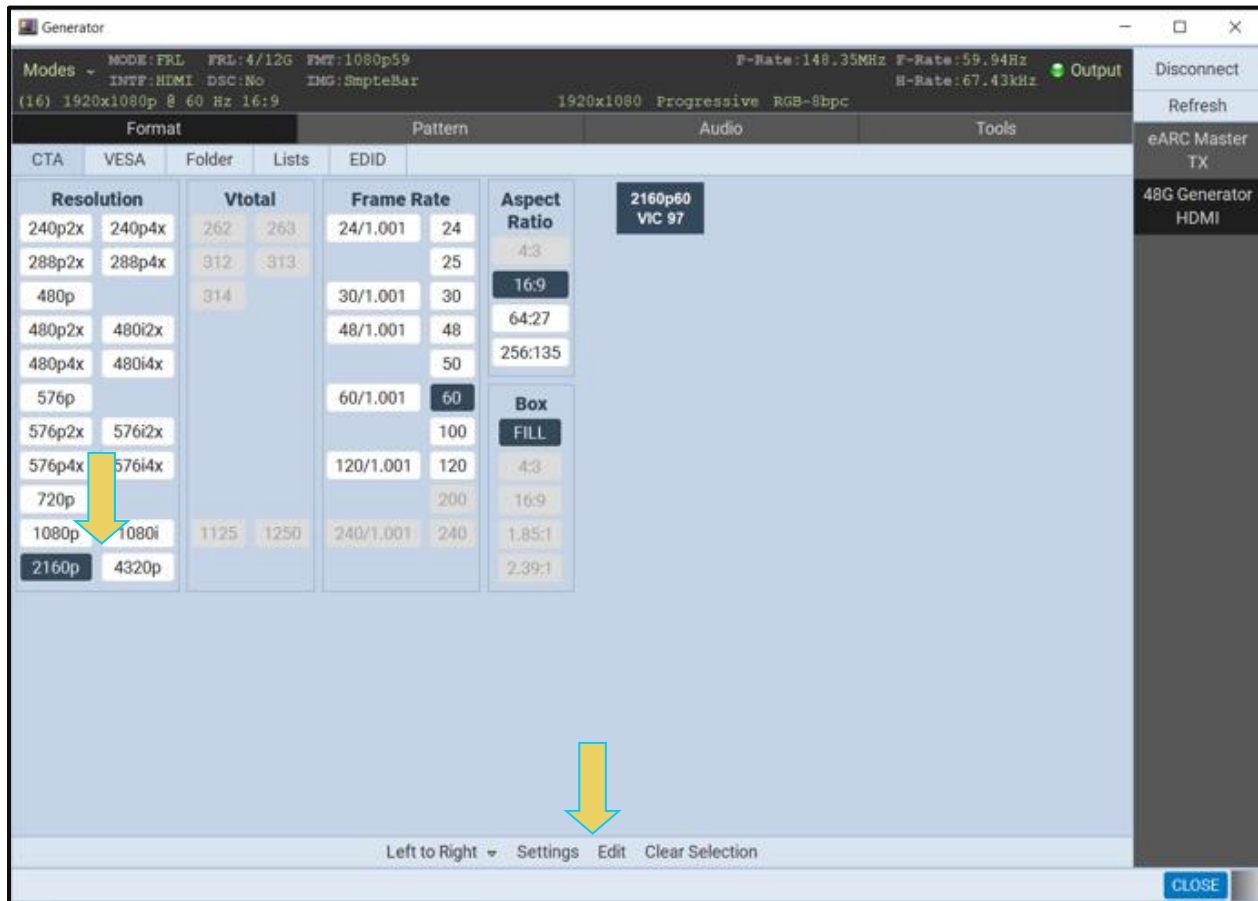
For detailed procedures to test UHD capable HDMI displays refer to the UHD Alliance Application Note.

14.18 Testing 4:2:0 Capable Displays

Use the following procedures to send HDMI 2.1-compliant 4:2:0 pixel encoding to a 4K-capable HDMI HDTV.

To select test 4:2:0 pixel encoding:

1. From the main window of the M41h 48G Video Analyzer/Generator, access the **Format** tab and select a 4K format such as 2160p as shown below.



2. Select the **Settings** (refer to screen example above).

The **Settings** dialog box will appear as shown below:



The image shows a 'Format Settings' dialog box with a light blue background and a close button (X) in the top right corner. The dialog is organized into several sections:

- Color Space:** A grid of buttons including RGB, YCbCr (highlighted with a yellow arrow), xvYCC, opRGB, sYCC601, opYCC, BT2020 cYCC, BT2020 YCC, BT2020 RGB, and DCI-P3.
- Range:** Buttons for Full, Shoot, and Limited (highlighted with a yellow arrow).
- Bits per Component:** Buttons for 8 (highlighted with a yellow arrow), 10, 12, and 16.
- Scrambling Override:** A toggle switch currently set to 'Off', with the text 'Scrambling Currently Enabled' below it. Below the toggle are 'Enabled' and 'Disabled' buttons.
- APPLY:** A blue button at the bottom center.

3. Select YCbCr for the Color Space and then select 4:4:4 (above). Note that the pixel rate indication on the top status bar will indicate 297MHz.

14.19 Testing UHD Displays with HDR Lab Test Patterns

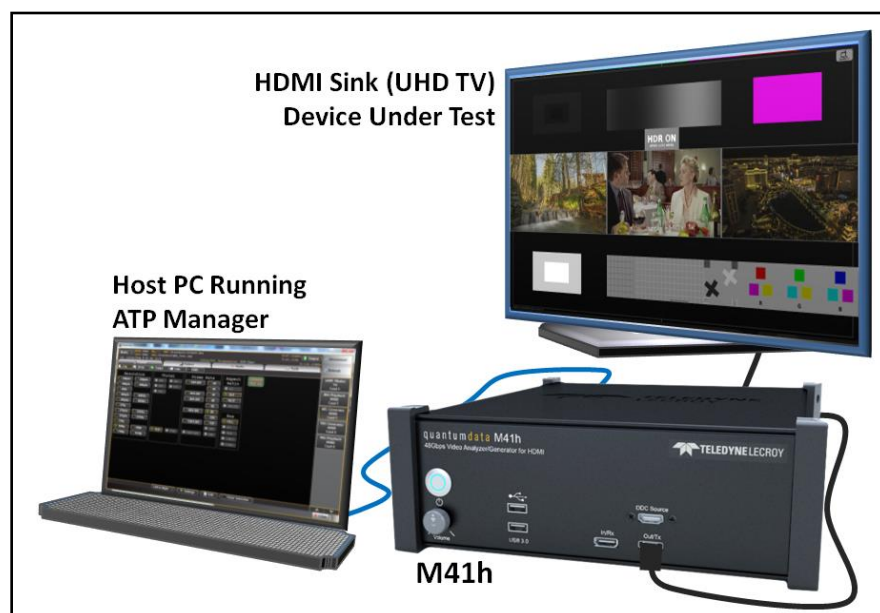
The HDR Lab utility is an optional test pattern pack that requires a license to use.

To address the HDR needs of the industry from Device Manufacturers to HDR content Post-Production, Teledyne LeCroy has worked together with industry experts Joe Kane of Joe Kane Productions and Florian Friedrich to develop this new test option “HDR Lab.” The solutions use the M41h 48G Video Analyzer/Generator. There are two test applications:

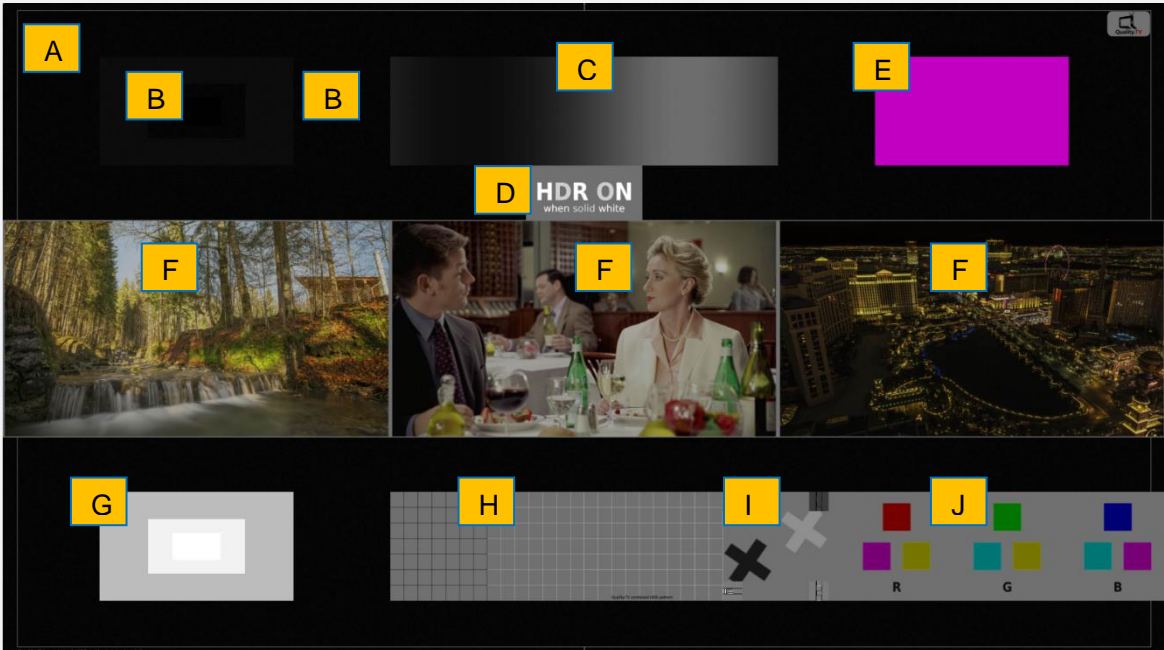
HDR Display Test Suite – Verifies various HDR attributes such as: peak brightness, native contrast, color decoding, signal clipping, and color gamut on an HDR-capable UHD TV using a variety of test patterns (below) while enabling the user to change important signal parameters to test the response of any given HDR display.

HDR End-to-End Validation in Post-Production – Verifies HDR metadata, signal levels and many more relevant parameters throughout the post-production process. Reference images can be compared with HDR workflow outputs.

The HDR Lab utility is supported by the M41h 48G Video Analyzer/Generator. The HDR Lab utility is an optional test pattern pack that requires a license to use. The illustration below depicts the test setup.



The following table describes just some of the Test Patterns and Reference Images that comprise the HDR Lab utility. Additional test patterns and test images are included and will be described in subsequent versions of this application note.

HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Combination Test Pattern	
Function	<p>The Combination Test Pattern's top and bottom portion provide a quick overview of display conditions for black level, white level, HDR on (status information) in the display, color, gray scale with bit depth, resolution, overscan, color decoding, and a 50% gray level. The three images in the center provide example of images color graded for HDR-10, P3 color in a BT.2020 container, mastered at 1,000 nits.</p>

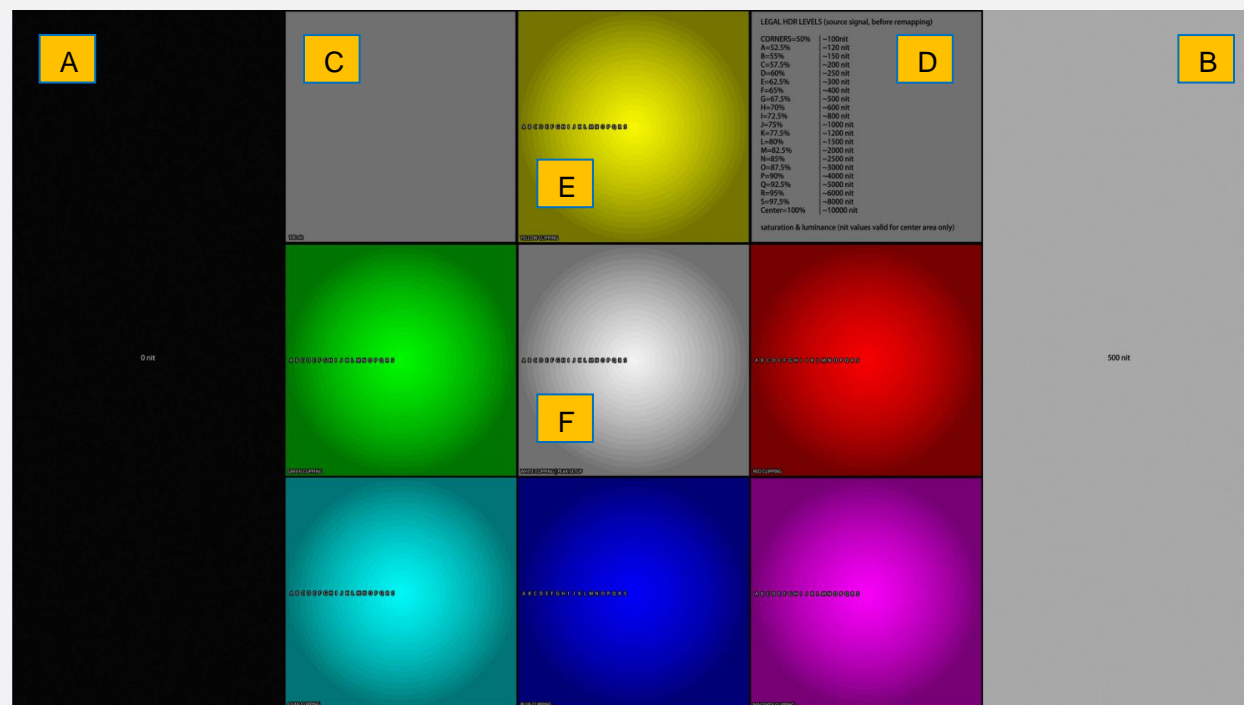
HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Pattern Layout	<p>The patterns at the top of the image deal primarily with the dark part of what can be conveyed in an image while the ones at the bottom deal with resolution color and the bright parts of the image.</p> <p>At the top left [A] we have steps near black. Since the PQ curve is absolute, we will call out specific intensities as light levels instead of signal levels. The center of and outside of the rectangle [B] is at black. The band in between is at 0.1 nits.</p> <p>The top middle contains a sine wave taking us from 0.1 to 100 nits [C]. Just below the gray ramp is our on-screen indication of HDR being on or off. If the letters in 'HDR ON [D] when solid white, then HDR is on in your set. If there are changing shades of gray, then HDR is off or tone mapping is not working correctly. You can set metadata in the generator to indicate to the display that HDR should be on or should be off.</p> <p>The top right shows patches of primary and secondary colors (red, green, blue, cyan, magenta, and yellow) [E]. They are 75% in luminance level, 100% color saturation. The 75% level was chosen as it is about 1,000 nits, the level at which most of the current HDR content is being mastered. When we say it is 100% saturated, we mean it is a single color with other color channels set to black level. If it is red, it is only red, and the red is at a level of 75%. There is no blue or green content.</p> <p>The center of the combination pattern shows parts of demonstration materials [F]. For the purposes of the generator, they are currently single frames from a motion sequence that may later be available in motion from the generator.</p> <p>The bottom left is a set of rectangles at levels above 1,000 nits [G]. In a 1,000 nit display they should all appear to be one level.</p> <p>The grid in the center varies from dark to light on a 100 nit background [H]. It is used for determining if there are any excessive image enhancement happening in the picture. If you see ringing around the edges of the grid if there is image enhancement. The white in the pattern does not go any higher than 1,000 nits.</p> <p>Just to the right of center are two plus symbols [I], one black and the other at 250 nits. Their edges have been slightly softened so the diagonal edges should not be jagged. Under some circumstances they might trigger streaking in the display. They are against a 100 nit background. In the corners of this section there are references for full and half resolution, vertically, horizontally and in a checkerboard.</p> <p>The bottom right portion of the pattern is a reference for color decoding [J]. The source signal is stored in RGB, while the generator has the capability of converting using the BT 2020 Y Cb Cr equations. Using the red, green, and blue only capability you will be able to inspect how well each of the channels is represented. Details for what you should be seeing are illustrated in the section describing color bars with a gray reference.</p>
Description of Use	<p>This pattern is designed to be fully functional in the HDR mode of a UHD set as levels in it are specific to the PQ based HDR-10. It serves as a quick reference for black and white levels, BT 2020 Y Cr Cb color decoding, sharpness, resolution, and overall image quality. Primary color measurements can be made on the patches in the upper right corner and peak light output capability can be measured in the bottom left of the pattern if there are no image uniformity issues or significant APL limitations.</p>

HDR Lab Test Patterns

Test Pattern Name

Function, Pattern Layout and Use

Clipping Test Pattern



Function


The Clipping pattern is designed to be a quick human inspection pattern to subjectively test for clipping, tone mapping, peak luminance, and adherence to the PQ curve. The clipping and tone mapping can be assessed subjectively by inspection. The measuring and calibration of the luminance can be assessed objectively using a measurement sensor or a professional camera with descent manual exposure. The UHD TV under test should be set in the HDR mode for all tests.

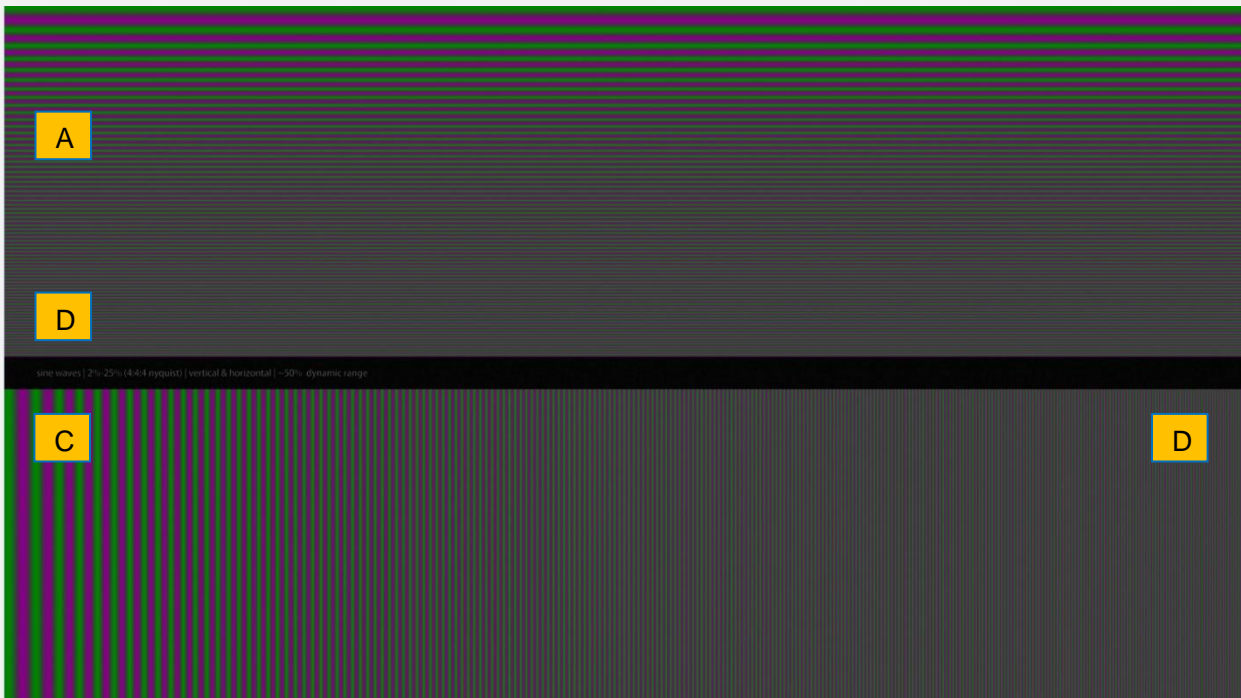
Pattern Layout

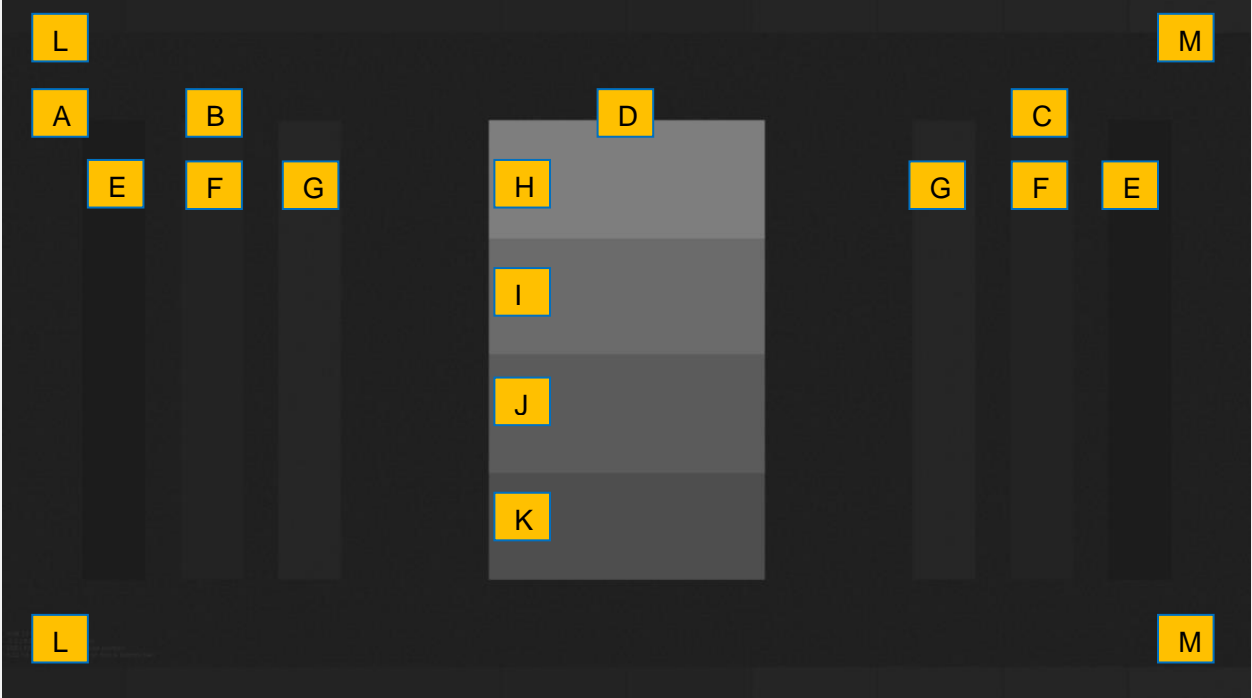
The Clipping Test pattern is comprised of the following elements: There is a 0 nit vertical band on left side [A] and the 500 nit vertical band on the right side [B]. There is a set of 9 elements in the center arranged as a 3x3 grid. The upper left box [C] in the 3x3 grid is a 100 nit box. The upper right box [D] in the 3x3 grid is an index indicating the percent luminance for each of the letter gradations in the colored elements in the 3x3 colored box grid. The index also relates the percent luminance to a nit value assuming a display following the absolute PQ EOTF (SMPTE 2084). There are six colored boxes for the primary and secondary colors. These colored boxes are 100% color saturation. Each colored box (example yellow [E]) and the luminance box [F] are concentric bands which have lettered indications on each of the bands that correspond to the percent luminance and the number of nits in each circular band.

On a 1000 nit display, with 1000 nit metadata for the maximum luminance of the mastering display, we expect a solid circle in the center reaching out to the 1000 nit indicator (J) +/- 5% according to the tone mapping strategy of the display manufacturer.

HDR Lab Test Patterns

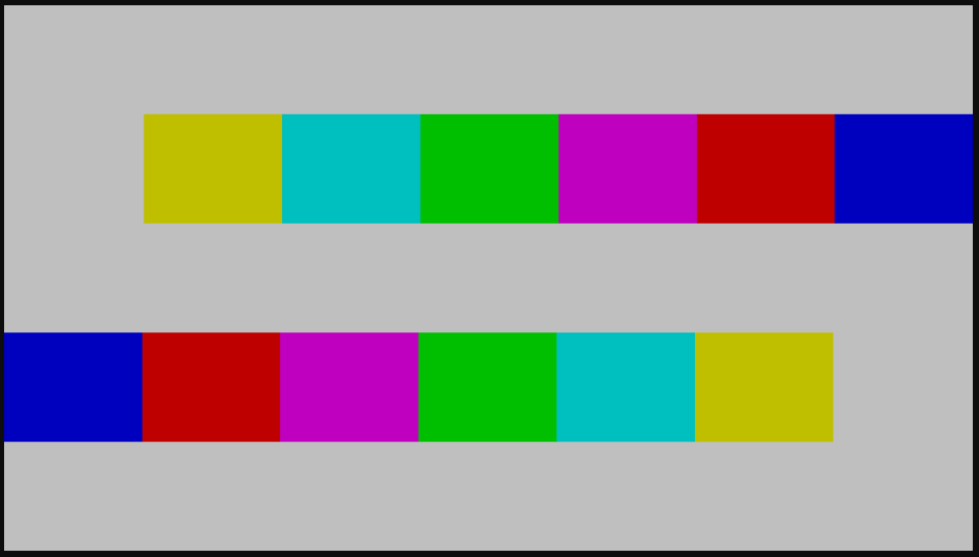
Test Pattern Name	Function, Pattern Layout and Use
Description of Use	<p>The pattern is valid for multiple mastering situations, if the HDR metadata is injected accordingly. 1,000 nit mastering luminance is the default value set for this pattern. The vertical bands on the left [A] and the right [B], and the box at [F] may be used to determine if the display is properly following the Perceptual Quantization (PQ) curve.</p> <p>The 100% saturated primary and secondary colored concentric bands in the 3x3 grid are used to test for clipping according to the mastering luminance set by the HDR metadata (default: 1000 nit). As you move inward on any of these circular bands from A to S, you are increasing the luminance. On a 1,000 nit display and using the 1000 nit mastering luminance metadata, you should be able to distinguish the bands from A to about J (75% luminance on a 1000 nit display) but from about J to S, you should not be able to distinguish the bands, in other words the colors should be clipped from about J (+/- 5%) inward toward the center at S. With 1,400 nit metadata, you should be able to distinguish the bands from A to about L with the remaining bands from L to S indistinguishable. The last band that is distinguishable, example J would represent the peak luminance of the display, which for a 1000 nit display would be 1,000 nits. If the metadata were mastered at 10,000 nit luminance, you would be able to distinguish all the bands because in that case the display would tone map the colors and luminance levels that were beyond to the capabilities of the display to the display's color or luminance capabilities. Alternatively, the display under test is set in the SDR mode, you would expect to be able to distinguish all bands. All luminance levels would be viewable up to 100% which would correspond to 100 nits. In this case tone mapping would occur to reassign color and luminance values that were beyond to the capabilities of the display to the display's color or luminance capabilities.</p> <p>The user could use the M41h HDMI Video Generator InfoFrame Utility to test different metadata scenarios such as 1,000 nit, 4,000 nit and 10,000 nit mastering luminance.</p>
Luma Resolution Test Pattern	 <p>The image displays a Luma Resolution Test Pattern. It consists of a dark gray background with a grid of concentric circular bands of varying luminance. The pattern is divided into four quadrants by a horizontal and vertical line. The top-left quadrant is labeled 'A' in a yellow box. The top-right quadrant is labeled 'B' in a yellow box. The bottom-left quadrant is labeled 'C' in a yellow box. The bottom-right quadrant is labeled 'D' in a yellow box. A small text label 'sine waves 2%-50% equispaced vertical & horizontal 1-100 nits' is visible in the center of the pattern.</p>

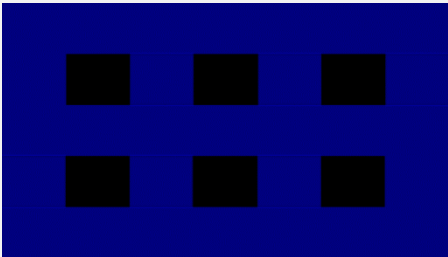
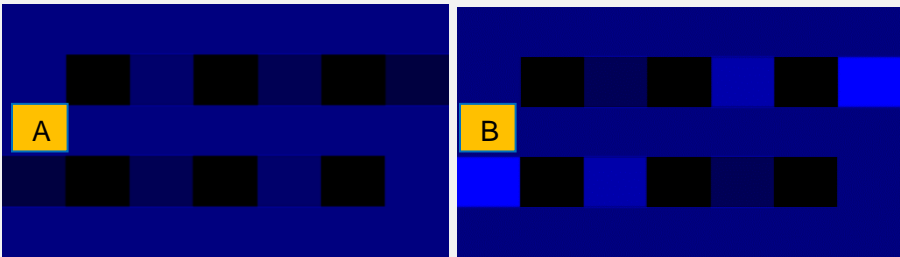
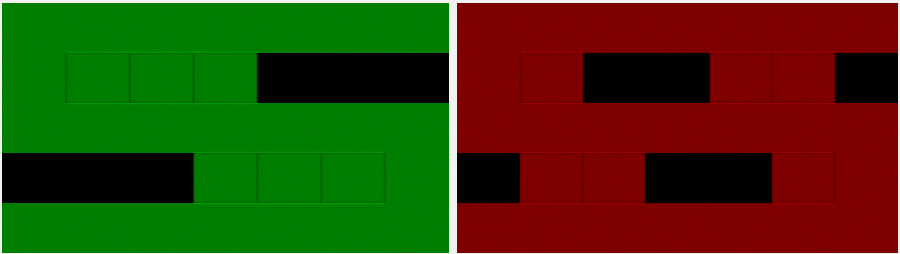
HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Function	This Luma Resolution pattern is designed to be a quick human inspection pattern to subjectively test for proper handling of resolution without color being involved. It uses 1 to 100 nits in HDR mode to ensure that there should never be any clipping
Pattern Layout	The Luma Resolution Test pattern is comprised of the following elements: A luma sine wave resolution vertical sweep on the top [A] to [B] and a luma sine wave resolution horizontal sweep on the bottom [C] to [D]. The sine waves vary from a luminance of 1 to 100 nits for each cycle and at a frequency that ranges from 2% to 50% of the Nyquist frequency from start to end of each sweep. Both frequency sweeps are linear.
Description of Use	Check the pattern in both RGB and YCbCr in all sampling modes: 4:4:4, 4:2:2 and 4:2:0. Also check for different bit depths. In none of these colorimetry or sampling modes should the observer see any chroma. There should be no loss of resolution; the waves should all be distinguishable. Interferences (ringing) are indicating edge enhancement, masking some of the original information.
Chroma Resolution Test Pattern 	
Function	The Chroma Resolution pattern is designed to be a quick human inspection pattern to subjectively test for proper handling of chroma resolution and chroma subsampling.
Pattern Layout	The Chroma Resolution pattern is comprised of the following elements: A chroma sine wave resolution vertical sweep on the top [A] to [B] and a chroma sine wave resolution horizontal sweep on the bottom [C] to [D]. The sine wave's green and magenta colors are fully saturated at their peaks at each frequency but vary in dynamic range only up to 50% throughout each sine wave cycle at their peak. The frequency of sine wave sweep ranges from 2% to 25% of the Nyquist frequency from start to end of each sweep. Both frequency sweeps are linear.

HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Description of Use	Check the pattern in both RGB and YCbCr in all sampling modes: 4:4:4, 4:2:2 and 4:2:0. Also check for different bit depths. In none of these colorimetry or sampling modes should the observer see any chroma other than magenta or green or something in between. The green and magenta at their peaks should look equally saturated. There should be no gray, black or highlighted color between the colors nor should there be any blue or red chroma even in 4:2:2 or 4:2:0. The edges should not be desaturated, i.e. the area between the peaks should not look grayish or black. There should be no loss of resolution; the waves should all be distinguishable. Interferences (ringing) are indicating edge enhancement, masking some of the original information.
HDR Pluge Test Pattern	
	
Function	To assess/adjust the brightness of a display in HDR
Pattern Layout	The pattern consists of a background at video black [A] with a symmetrical PLUGE on the left and right sides [B] & [C] of the log gray scale in the middle of the pattern [D]. It is based on a pattern used for adjusting the Brightness control in SDR displays. It has been adapted to meet the needs of adjusting the Brightness control in the HDR mode of a UHD TV display. The outer part of the PLUGE contains three bars: a below black bar -0.1 nit [E], 0.05 nit bar [F], 0.1 nit bar [G] on the video black background. The gray scale in the middle represents steps of 100 nit [H], 50 nit [I], 25 nit [J] and 12.5 nit [K]. These values were chosen based on the Perceptual Quantization (PQ) Electro-Optical Transfer Function (EOTF) of an HDR display. There are 10 rectangles on the top and bottom which range from 0.01 nits [L] to 0.1 nits [M] in 0.01 nit steps.


HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Description of Use	<p>The levels in this PLUGE pattern are specific to the 1,000 nit master using the PQ version of HDR. The pattern has been designed to function the same way as the SDR version of PLUGE but at levels specific to 1,000 nit PQ curve. This particular pattern is not correct for use in the SDR mode of a display.</p> <p>The PLUGE is on both sides of the center to provide a greater opportunity to set black taking image uniformity and viewing angle into account when setting the brightness control. There are two above black steps [F] [G] in the PLUGE, one close to black and the other a little further above it. The step below black may or may not be visible depending on where the individual set clips black.</p> <p>The HDR-10 system we are using assumes nothing useful in picture information will go below black. Some sets will accommodate the below black portion of this signal just to make it easier to properly set the Brightness control. Others will not and there will be nothing lost in the picture if the set clips everything below black.</p> <p>Turn the brightness control up far enough so the strip just above black [G] is clearly visible. Turn the control down to the point where the just above black stripe disappears into the black background. Raise the Brightness control just enough for the strip to reappear. This is the correct setting for black.</p> <p>If the below black stripe is visible when the Brightness control is turned up, turn the control back down to the point where the below black [E] stripe disappears into the background with the just above black strip still being visible.</p> <p>The pattern has a low average picture level (APL). As much as white levels may change in the HDR mode depending on APL black level should remain fixed.</p> <p>In some displays you will never actually reach black, an absence of light. What you reach is a digital cut-off, a point where information in the video signal is no longer displayed. Any information in the signal above black will be displayed, even if it looks slightly washed out because the set cannot make an absence of light.</p> <p>The center grayscale [D] allows for a quick determination of the color of gray. Many calibrators use this pattern as a reference for quickly adjusting a grayscale as it allows one to see what is happening to the entire gray scale as adjustments are being made.</p>

HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Reverse Ramp Test Pattern	
<p>The image shows a test pattern with a black background. In the center, there are two horizontal luminance ramps. The top ramp, labeled 'A', transitions from a dark gray on the left to a light gray on the right. The bottom ramp, labeled 'B', transitions from a light gray on the left to a dark gray on the right. The top and bottom edges of the image are black, labeled 'C'. Small numerical indicators (25, 50, 75) are visible along the ramps to denote luminance levels. A small icon is in the top right corner.</p>	
Function	The Reverse Dither Ramps test pattern provides a look at how well the display is doing at producing a smooth gray scale with no apparent steps. It helps assess color bit depth handling and gray tracking. Through visual inspection an assessment can be made as to whether the display is handling 10 bit color properly. Also, the bidirectional nature of the ramps enables an assessment as to whether improper bit depth handling or setting is related to a problem at a specific luminance level or a region of the display.
Pattern Layout	The Reverse Dither Ramp test pattern is comprised of two luminance ramps running in the opposite directions [A] and [B]. The top and bottom horizontal bands [C] are at black. There has been some low-level static dither noise added across the entire image to make it easier to discern banding. The ramps are in the center of the image. The top ramp goes from 25% luminance on the left to 75% luminance on the right. The lower ramp goes from 75% luminance on the left to 25% luminance on the right. There are indicators on the ramp to show the luminance level.
Description of Use	The ramps in this pattern should be smooth with no visible stepping (banding) from one level to another which would indicate improper rendering of 10 bit content. The amplitude is limited to 75% reflecting the 1,000 nit mastering level. There should be no chroma artifacts—no color detectable. If color is observed this means that the gray tracking on the display is improper. Switch between 8 bit mode and 10 bit mode on the video generator and verify that there is a difference on the display.


ColorBars Test Pattern	
	
Function	To assess color decoding and or assist in determining the best operating positions of the Color and or Tint control.
Pattern Layout	This pattern is specific to HDR-10 and the PQ EOTF, but also works for SDR. It consists of a 50 % gray background with yellow, cyan, green, magenta, red, and blue rectangles on the top and bottom rows in the image. The colors are 50% in level and are reversed in direction from the top to the bottom. The original signal in the generator is stored as a RGB signal gets converted according to the requirements (for example the ITU 2020 specifications for YCrCb).

<p>Description of Use</p>	<p>This pattern was designed to better serve the function of checking and adjusting color decoding in all component video systems. Its larger area of reference gray makes it much easier to use, especially when dealing with user menu graphics that often cover just the area you want to see in the conventional color bar pattern. This pattern is particularly useful when trying to evaluate the conditions of the green and red channels after levels have been properly set while looking at the blue channel.</p> <p>Decoder adjustments should be made looking at the blue channel. You will find a blue only function in the user menu of several brands of TV sets. Alternately you can use the blue filter that comes with some calibration discs. When looking at the blue channel the areas of the blue in the image should be the same intensity.</p>  <p>All areas of blue should be the same intensity (above).</p> <p>The two images below show the adjustment color control:</p>  <p>If the color control is low in level some of the areas will be desaturated as shown above [A]. If the color control is high in level some of the areas will look oversaturated as shown above [B].</p> <p>In a component video system, the Tint control should not be active, but many TV set manufacturers make it active anyway. If it is functional adjusting it will affect the inside squares more than the outside squares. Adjust it so the squares are equal in level with the reference areas. If the Tint control is active it may interact with the Color control making it necessary to go back and forth between the two controls to get the desired results. If the set does not exactly do as it is supposed to do get as close to correct as you can.</p> <p>Once the blue channel is set properly the other two channels should be checked. Details of how you might do this are covered in the Background on UHD section of this document. If you have access to the green only and red only; they should look like the following illustrations.</p>  <p>All levels of green and red should be equal.</p> <p>The decoder is most likely not functioning properly if the blue channel is correct and the red and or green channel is (are) wrong.</p>
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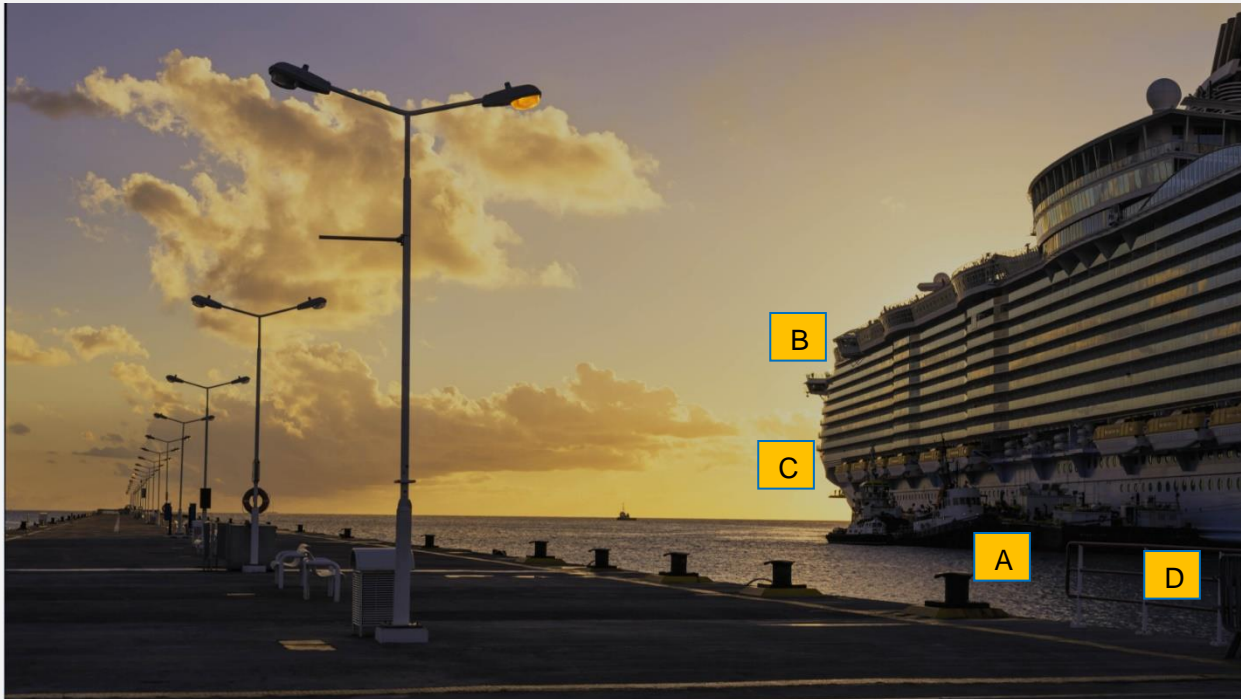
HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Castle Reference Image	
	
Function	The Castle image is a natural image shot with a Nikon D800E still picture camera. The image offers rich dynamic range and detail that usually is not produced by a motion picture camera. The image is used to gain a subjective assessment of the display's ability to render details in a high dynamic range setting as well as the ability to maintain detail within highly saturated colors.
Pattern Layout	The Castle image offers high dynamic range and color saturation and a high level of detail with maximum resolution where there are single pixel transitions between image elements. The image contains details in the highlights (example e on the left side wall of the castle at [A]) and in the shadows (example on the windows in the roof at [B]). The image also has a lot of highly saturated colors in the greens on the trees in the foreground at [C].
Description of Use	Visually inspect the image for sharpness. The details of the bricks on the left side of the castle wall [A] should be discernable despite the highlights of the wall; in some cases, you should be able to see each individual brick. The wall should not look washed out. The details in the shadows should be discernable as well, for example on the windows of the roof at [B]. You should be able to see the details of the grid on these windows. Check for resolution artifacts such as double edges or loss of chromatic details in the leaves on the trees in the foreground example [C]. The individual leaves should be distinguishable and not desaturated. You should not see a uniformly colored patch of green.

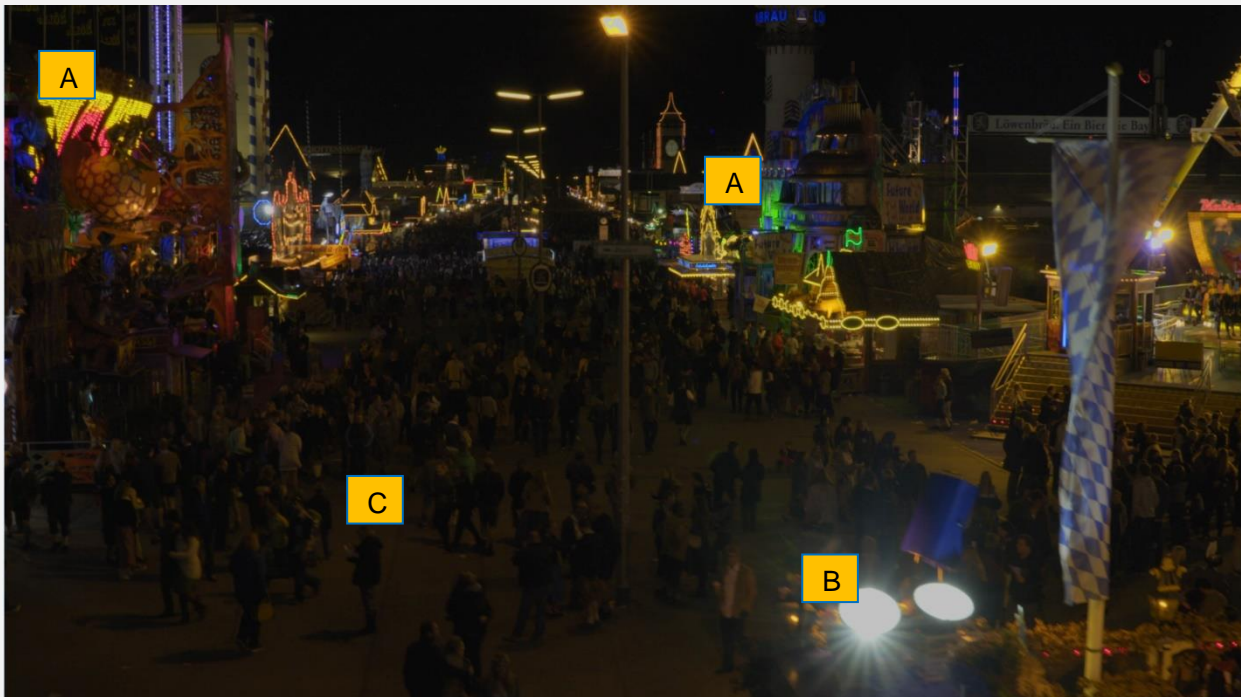
HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Flowers Reference Image	
	
Function	The Montage Flower image is a natural image used to gain a subjective assessment of the displays rendering capabilities with respect to color saturation and maintaining differentiated colors throughout the highly saturated natural flowers.
Pattern Layout	The Montage Flower image contains an arrangement of fully chroma saturated flowers of various hues. The image was shot with a 4K Red ONE Mx digital motion picture camera in a warm ambience light environment ~3000 degrees Kelvin. The warm nature of the image was maintained throughout the color grading process. The image was mastered such that it appears naturally on a P3 color gamut display, while using BT.2020 as a container.
Description of Use	Upon visual inspection the colors in the flowers should be differentiated without any patches of uniform color. The lighter parts of the image especially should not be uniform in color which would indicate that the colors were clipped.

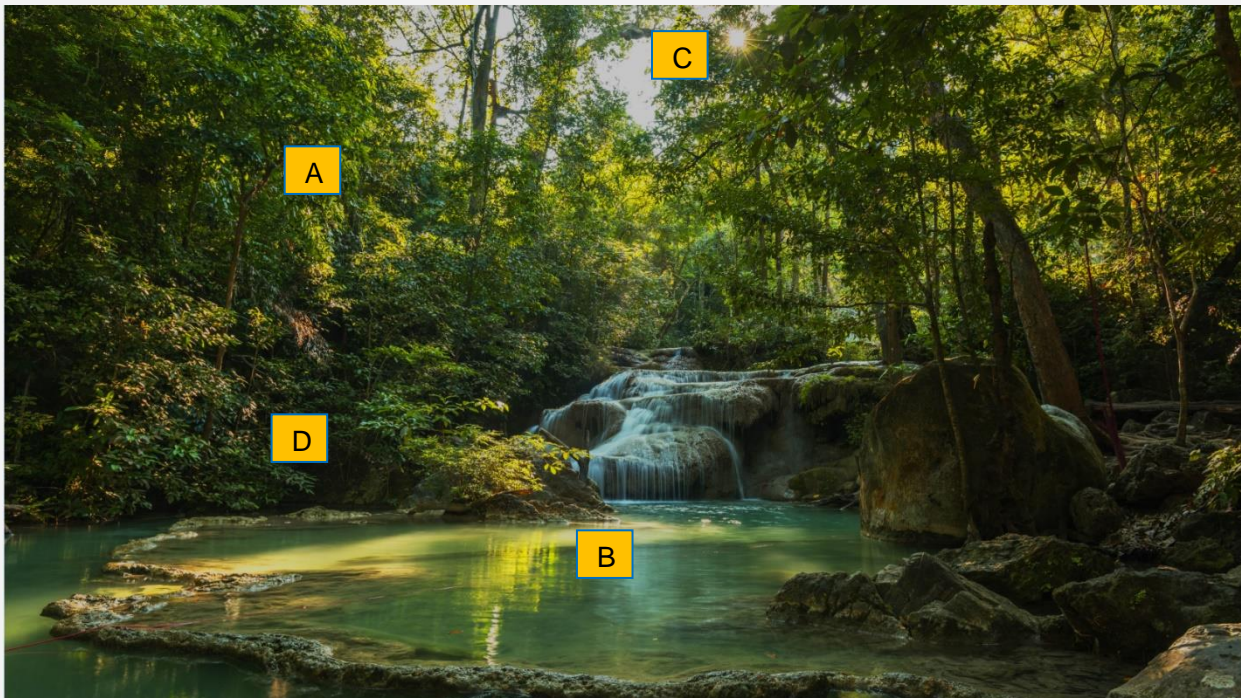
HDR Lab Reference Images


Reference Image Name	Function, Pattern Layout and Use
Cruise Ship Reference Image	
	
Function	The Cruise Ship image is a natural image shot in time lapse with a Canon 5D Mark 2 camera. The image is used to gain a subjective assessment of a display's ability to render details in a high dynamic range setting.
Pattern Layout	The Cruise Ship image offers high dynamic range image. The image depicts a sunset with the sun behind a cruise ship at dock. The clouds contain nearly white elements. The sun is behind the ship and the image is graded in such a way that you see the transition from the violet bluish sky a yellowish sunset.
Description of Use	<p>Visually inspect the image for details in the carrier vessels beside. A high level of details in these vessels should be discernable. The lights on these smaller vessels [A] aiming toward the viewer, should appear considerably brighter than the diffuse white parts of the image. Inspect the windows on the navigator's deck on the front of the ship; notice the reflections on the glass [B] which should exhibit some color and should be brighter than the windows adjacent to them.</p> <p>Overall, the image should reveal a dramatic effect exhibiting stark dynamic range transition from the sun light clouds at [C] to the shadows aside the ship [D]. The impression that the sun is behind the ship should be pronounced. This dramatic level of high dynamic range will not be visible when the display is in the SDR mode.</p> <p>There should be a significant difference in the brightness between the outer and inner portions of the cloud nearest the sun at [C]. The yellows in the clouds should be highly saturated.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
OktoberFest Reference Image	
 <p>The image shows a crowded festival street at night. In the foreground, a bright white light source (B) is visible. In the background, there are colorful LED lights (A) and a crowd of people walking in the shadows (C). The sky is black.</p>	
Function	The Oktoberfest Reference Image was shot from atop a Ferris wheel. The image has some challenging elements for an HDR display to test for details in the dark portions against a bright light and for wide color gamut.
Pattern Layout	The main elements to examine are the LED lights in the background [A], the bright white 1000 nit light in the foreground [B] and the people walking in the shadows [C]. Note that the sky in the background should be uniformly black.
Description of Use	<p>The bright 1,000 nit light in the foreground is pointing directly at toward the camera. Ideally, it should appear like a real light. The LED red, green and blue lights in the background are great examples of why a modern HDR display needs to have a wider color gamut than the current BT.709. There are elements of these LEDs that extend into coordinates of the P3 and BT.2020 color space. They are highly saturated and radiate through a very narrow color spectrum. They should appear as modern LED lights.</p> <p>Another challenging element of this image is the abundance of details in the people walking in the shadows. These elements are near black, but a viewer should be able to discern the individuals and differentiate their clothing. Their shadows should also be clearly visible.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Forest and Waterfall Reference Image	
 <p>The image shows a lush forest scene with a waterfall cascading over rocks into a pool of water. The scene is filled with dense green foliage. Four yellow boxes with black letters are overlaid on the image: 'A' is on the upper left foliage, 'B' is on the water in the foreground, 'C' is on the sun peeking through the trees in the upper right, and 'D' is on the lower left foliage.</p>	
Function	The Forest and Waterfall reference image contains many elements that are ideal for evaluating HDR displays. This is a good representation of what HDR should be able to do. It can show bright highlights differentiation in bright colors and subtle differentiation in the dark portion of the images.
Pattern Layout	The image offers several challenging visual elements with varying levels of bright and highly saturated greens as well as greens in the shadow. The image should show this differentiation in the greens. To accurately represent these colors, it would be necessary to have a display that produces bright colors without losing color information. In a poorly engineered HDR display, the greens would tend to appear the same color.
Description of Use	<p>The leaves should not appear to be the same color throughout the area at [A]. Some are reflecting the sunlight, and some are in the shadows. Some of the leaves are younger and in sunlight, so they should appear with a vivid green. Some are older and should appear less saturation.</p> <p>The same sort of differentiation in the greens should also be apparent in the water [B]. Examination of the water elements should show a variety of blue, cyan and green colors. One element that is challenging is the sun peeking through the leaves [C] and reflecting off the leaves. A well-engineered HDR display should be able to reproduce that these highlights. On an ideal HDR display, it should look like the sun is hitting your eyes.</p> <p>The image also contains some details in the dark elements. Close examination of these elements should reveal some details and differentiation even in the darkest areas [D]. This is what makes a good HDR TV; it should be possible for a viewer to distinguish between the darks. If you see a uniform black area in the picture this means that the HDR display is not representing the visual elements.</p>

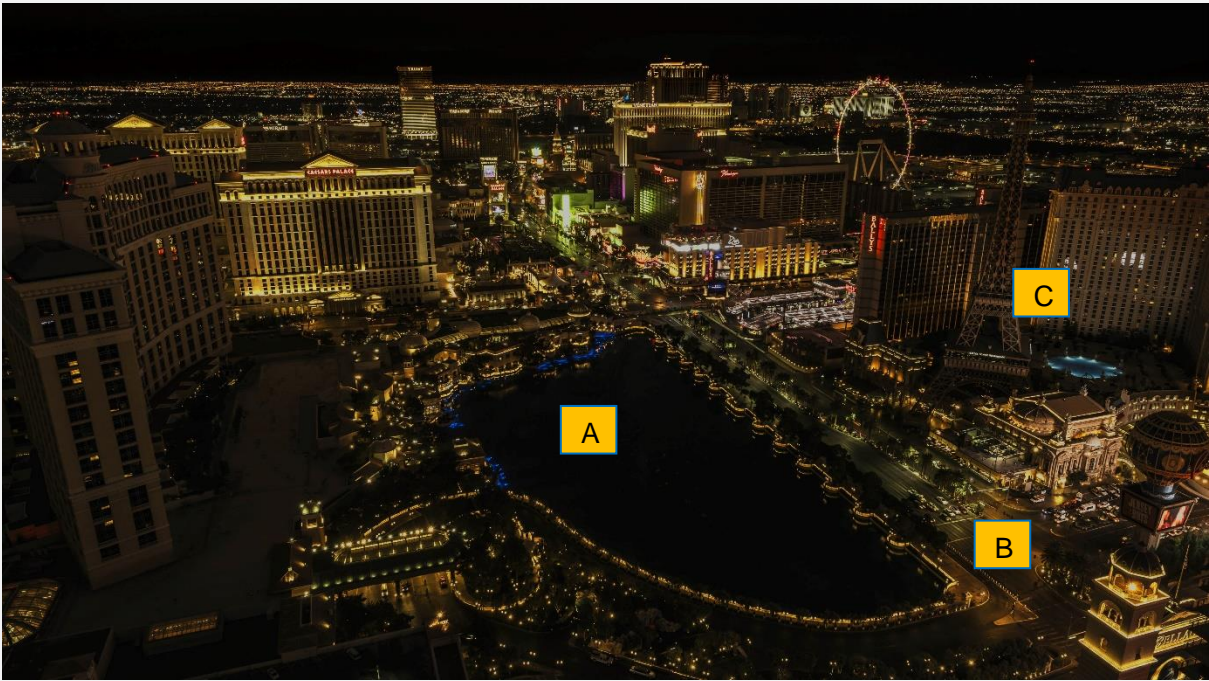
HDR Lab Reference Images	
Reference Image Name	Function, Pattern Layout and Use
Bottles and Glasses Reference Image	
 The image shows a still life arrangement of two wine bottles and four glasses on a reflective surface against a light gray background. From left to right: two glasses filled with red wine (labeled B), a bottle of Chardonnay (labeled D), a bottle of Riesling (labeled E), and two glasses filled with blue wine (labeled G). Labels A, C, and F point to specific areas on the bottles and glasses. Label A points to the neck of the Riesling bottle. Label C points to the label of the Riesling bottle. Label F points to the base of the Riesling bottle. Label B points to the rim of the first red wine glass. Label D points to the label of the Chardonnay bottle. Label E points to the label of the Riesling bottle. Label G points to the base of the first blue wine glass.	
Function	The Bottles and Glasses Reference Image is an excellent image for evaluating bit depth artifacts, proper color space, average picture level and tone mapping on HDR displays.
Pattern Layout	<p>This reference image provides some visual elements that are useful for evaluating HDR displays. The white background offers a fine high luminance gradation for evaluating bit depth and proper color space.</p> <p>The colors in the bottles also provide some visual elements which along with the background are useful for assessing how well an HDR display can produce an image with a high average picture level while still maintaining vivid, high saturated colors.</p>

HDR Lab Reference Images	
Reference Image Name	Function, Pattern Layout and Use
Description of Use	<p>Examine the light background behind the bottles and glasses in the foreground. The background should be a smooth gradation from the brightest portion in the center [A] to the slightly darker areas on the edges [B]. There should be no discernable steps or banding. If there is any banding that is an indication that the display is not handling the color depth properly. Also, there should be no chromatic elements apparent in the background. An appearance of greenish or reddish chroma elements in the background would be an indication that the wrong color space standard is being used. For example: If the display would decode YCbCr following the BT.709 matrix coefficients, while the generator created it with BT.2020 matrix coefficients.</p> <p>Examine the bottles. The green [C] on the bottle should pop out; some of the elements should be vivid, highly saturated green. The transitions in the color should look natural with no stark changes. If the colors do not appear highly saturated this is an indication that the HDR display cannot produce an image with a high average picture level and still produce saturated colors. The brightness of the specular highlight on the bottle [D] should be significantly brighter than the white background [A]. The reflections should not appear as diffuse light. If there is not a significant difference between the reflections and the diffuse background, then this is a sign that the display is doing aggressive tone mapping.</p> <p>The round label on the green bottle at [E] has some structural elements. These structural elements should be readily discernable.</p> <p>The bottom of the glasses at [F] and the bottom of the bottle at [G] are near dark, but they should not appear as being completely black. They should appear as a gradation.</p>

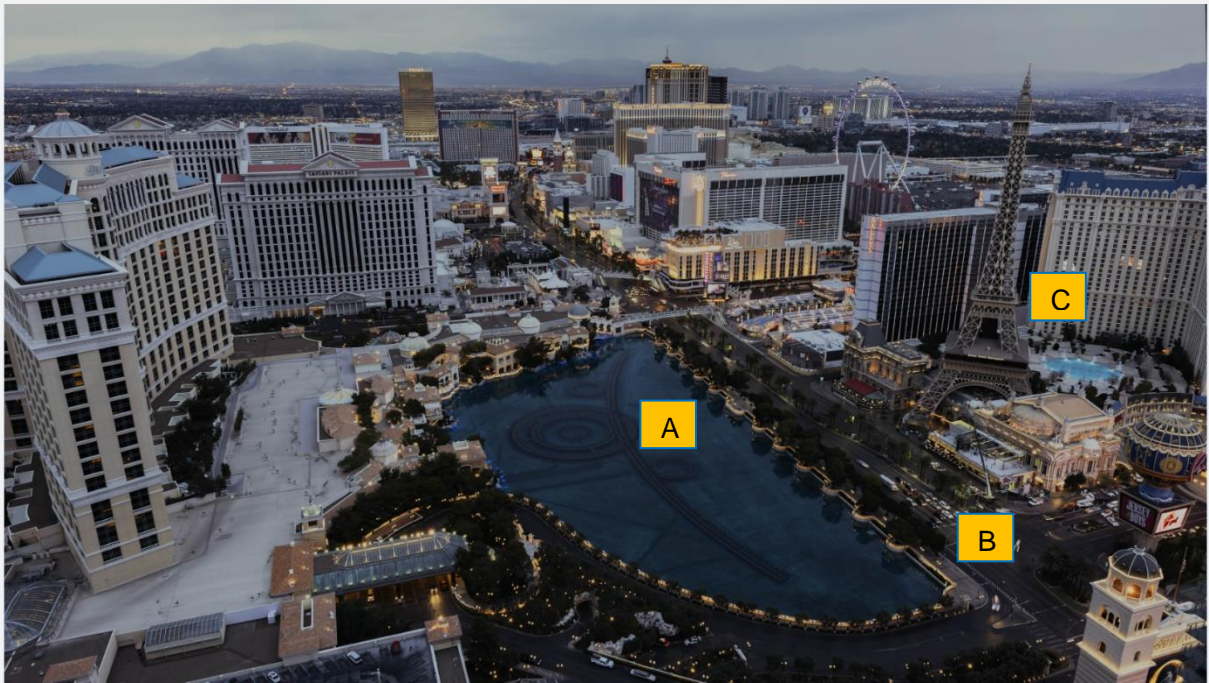
HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
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Las Vegas Dark and Bright Reference Image



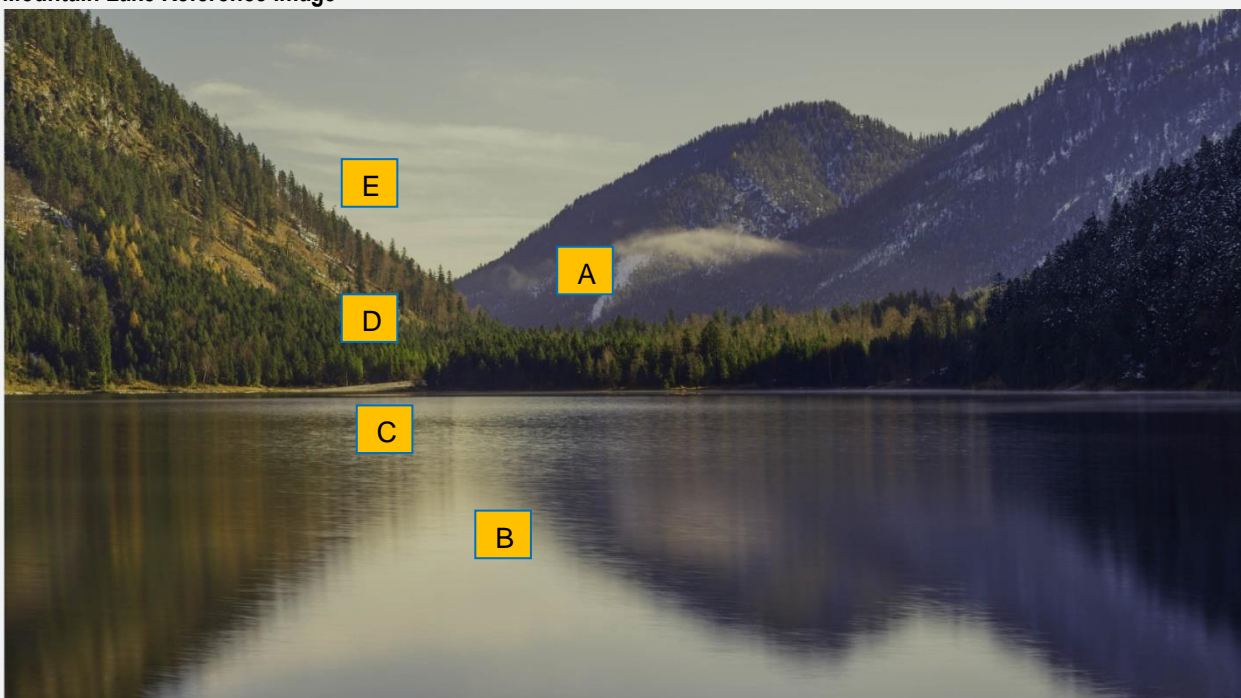
Las Vegas - Dark




Las Vegas - Bright

HDR Lab Reference Images	
Reference Image Name	Function, Pattern Layout and Use
Function	This pair of images is good for evaluating how OLEDs and LCDs handle highlights in differing Average Picture Levels of brightness. The set of images is also useful for testing projection system's ability to reproduce black levels or contrast. The pair of images presents different challenges for OLED HDR TVs vs LCD HDR TVs because the highlights remain the same intensity of light but the ambient light changes dramatically. The Las Vegas Dark image starts off with a low Average Picture Level (APL) and the Las Vegas Bright Image has a much higher APL which is challenging an APL dependent TV. Some HDR TVs can produce bright highlights when the whole scene is dark, but they cannot produce these bright highlights when the scene is getting brighter. As a result, some TVs would look less rich in contrast.
Pattern Layout	There are two images of the Las Vegas Strip taking from the Cosmopolitan hotel using time lapse photography. The Las Vegas Dark image was taken in the middle of the night. The Las Vegas Bright image was taken in the early morning hours.
Description of Use	<p>Images with high Average Picture Level are sometimes difficult to reproduce with current OLED TVs. This technology will result in a loss of contrast where an image has highlights with a high APL. Therefore the Las Vegas Bright image is challenging for OLEDs.</p> <p>Images with a low Average Picture Level are sometimes difficult to reproduce with LCD TVs. When subjectively evaluating these images, you should look out for good differentiation in the darkest parts of the image, like the underlying structure in the water in the center of the image [A].</p> <p>Cars on the street [B] should be individually distinguishable while still providing texture.</p> <p>The individual letters of the Eiffel tower restaurant [C] advertising should be perfectly sharp and separated. In some of these letters, you should be able to see single pixel transitions, where one pixel is white and the next is nearly black.</p> <p>The street and hotel lighting should appear like realistic lights, adding depth to the scene.</p> <p>The image with the higher APL should reveal many more details of the area, while maintaining the intensity of lights in a realistic way, still reasonably differentiated from the background.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Mountain Lake Reference Image	
	
Function	The Mountain Lake reference image German Alps in the early morning contains several useful elements for evaluating HDR displays.
Pattern Layout	<p>There is a low hanging cloud in the foreground floating just above the lake. The cloud should really pop out on good HDR display. The lake gives off a reflection that should appear bright silver almost a metallic surface [B].</p> <p>The image overall should have a warm appearance and should not look bluish in the clouds or sky. If the color temperature on the display is not adjusted correctly, then the mountains in the background would show an intense blue.</p>
Description of Use	<p>There should be a lot of detail visible in the trees. There is a path [C] that should be discernable. The fresh younger trees on the left of the path [D] are in the sunlight and should show a lot of detail and there should be some differentiation in the green colors. They should really pop out from the duller greens in the shade in front and older trees behind them.</p> <p>An examination of the cloud area just above the horizon [E] where the mountains forming the valley occur should not show banding, nor should they look uniform in color at any point. There should not be any chroma elements in the clouds.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Faces Reference Image	
	
Function	<p>The woman's face was shot with a RED Epic Dragon camera. The lighting that was used had a warm color temperature slightly below 3000K to match the candles in the background. The pattern is designed to reveal the TV's capability to reproduce warm skin tones, soft highlights, and clear differentiation in the darkest parts of HDR images.</p> <p>It also shows potential viewing angle issues and halos around bright objects if the display has such issues.</p>
Pattern Layout	<p>The skin tones should look natural and well differentiated in the lights as well as the shadow part below her chin. Hairs should show good structure with no ringing or other artificial edges. The candles in the background [A] should appear with a soft bouquet, while being noticeably brighter than the face itself.</p>
Description of Use	<p>The image should look soft in the background and sharp in the foreground, while the scene light should provide an ambience like in a dinner situation with a lot of near black details. Hair and skin should show shadow details [B]. The system is not set up properly when there are larger areas of uniform black in the image.</p> <p>To test for viewing angle dependencies, you may choose a specific angle like 30 degree or 45 degree relative to the screen and look for luminance and color changes especially in the dark part of the image.</p>

To test your UHD display with HDR Lab:

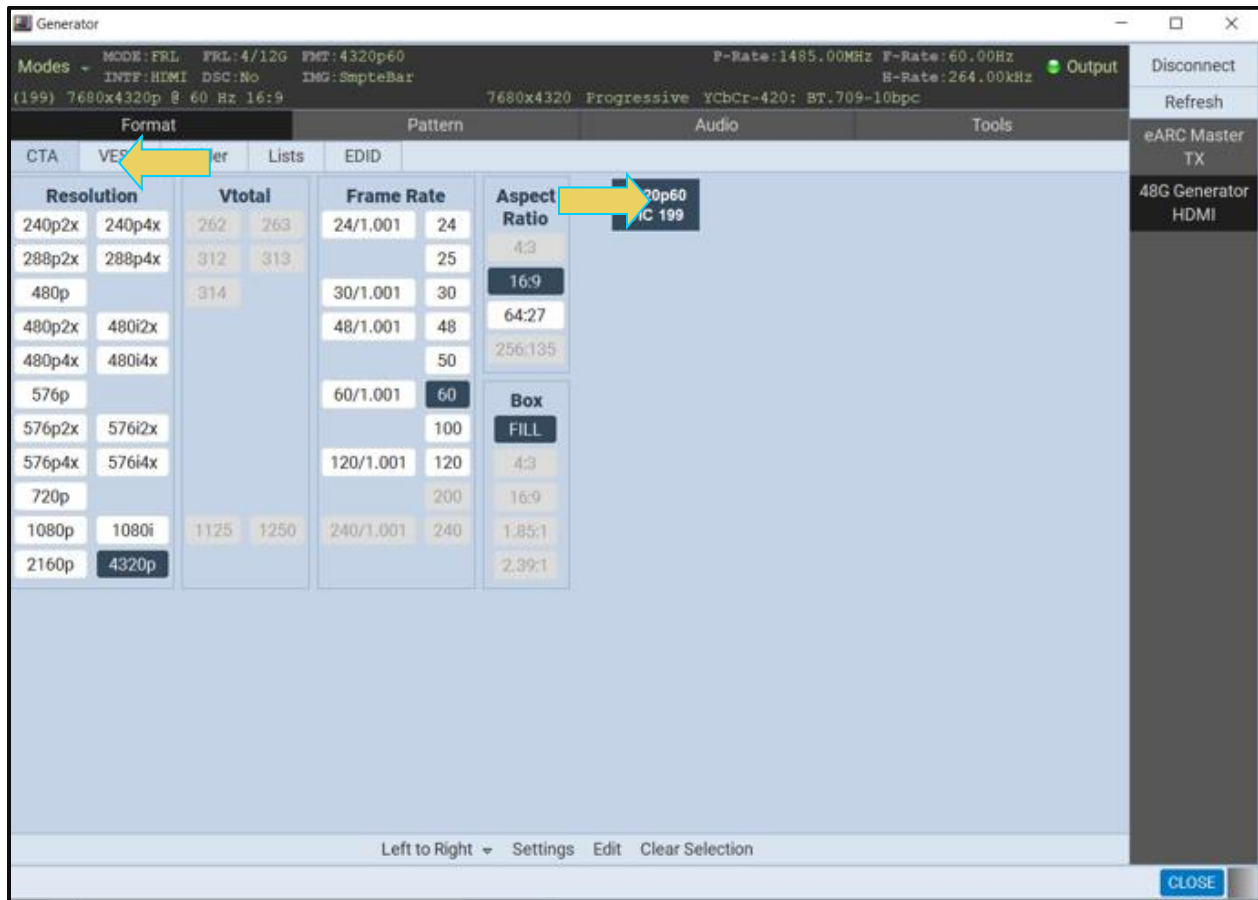
- Make the physical connections as shown in Making the physical HDMI connections.
- Access the **Generator** window from the **Card Control** page.



The Generator window opens.

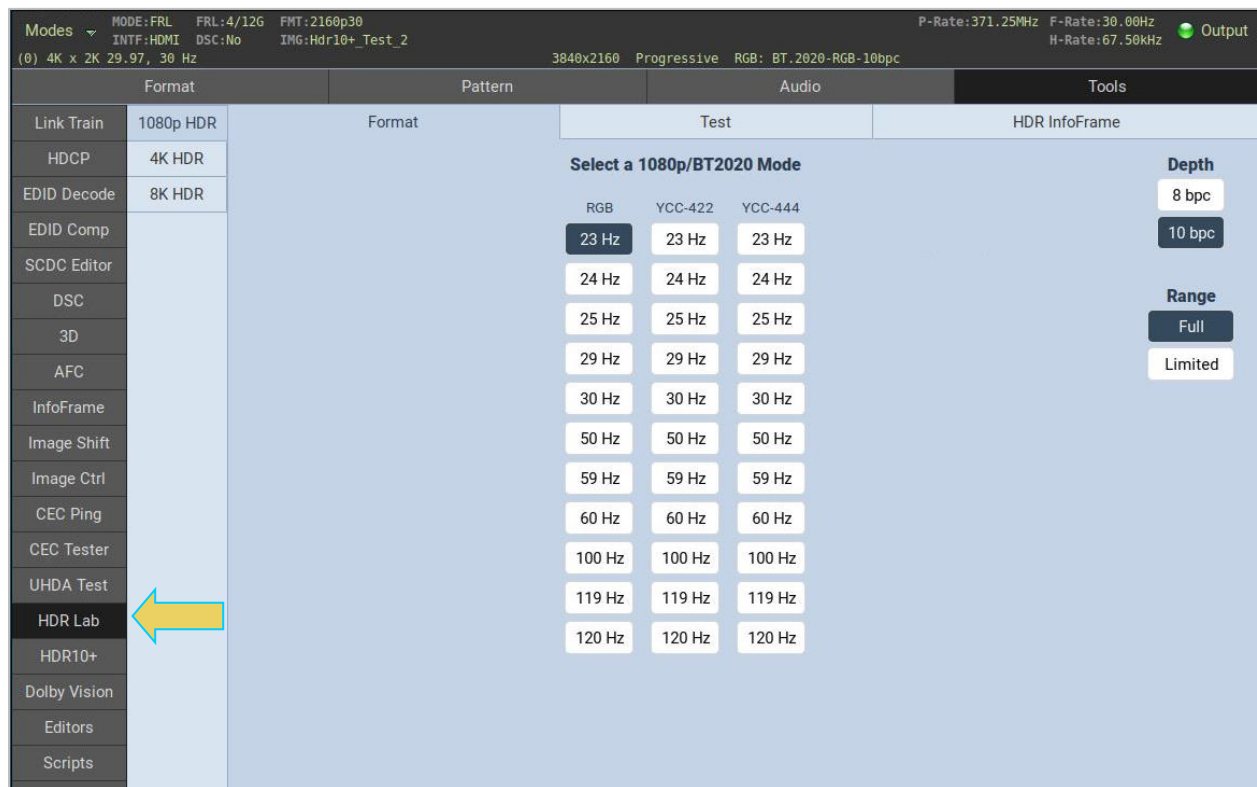
Note: You can access the HDR Lab patterns from the **Patterns** tab individually or use the **HDR Lab** utility. The instructions below use the HDR Lab Utility under the **Tools** menu and this is the recommended way.

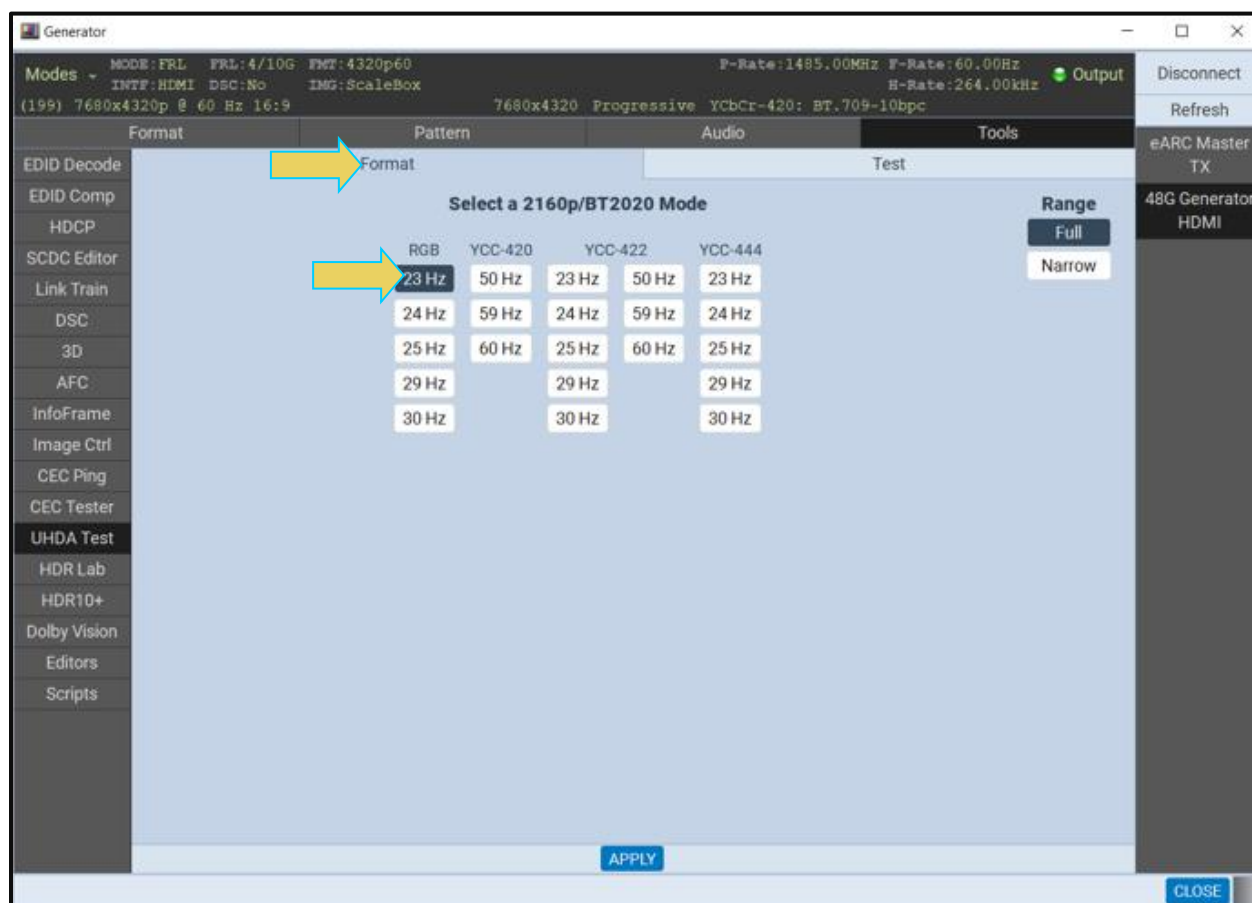
- Select the **Format** tab menu and select 8K at 60Hz format.



- Select the Tools tab and then the **HDR Lab** utility.

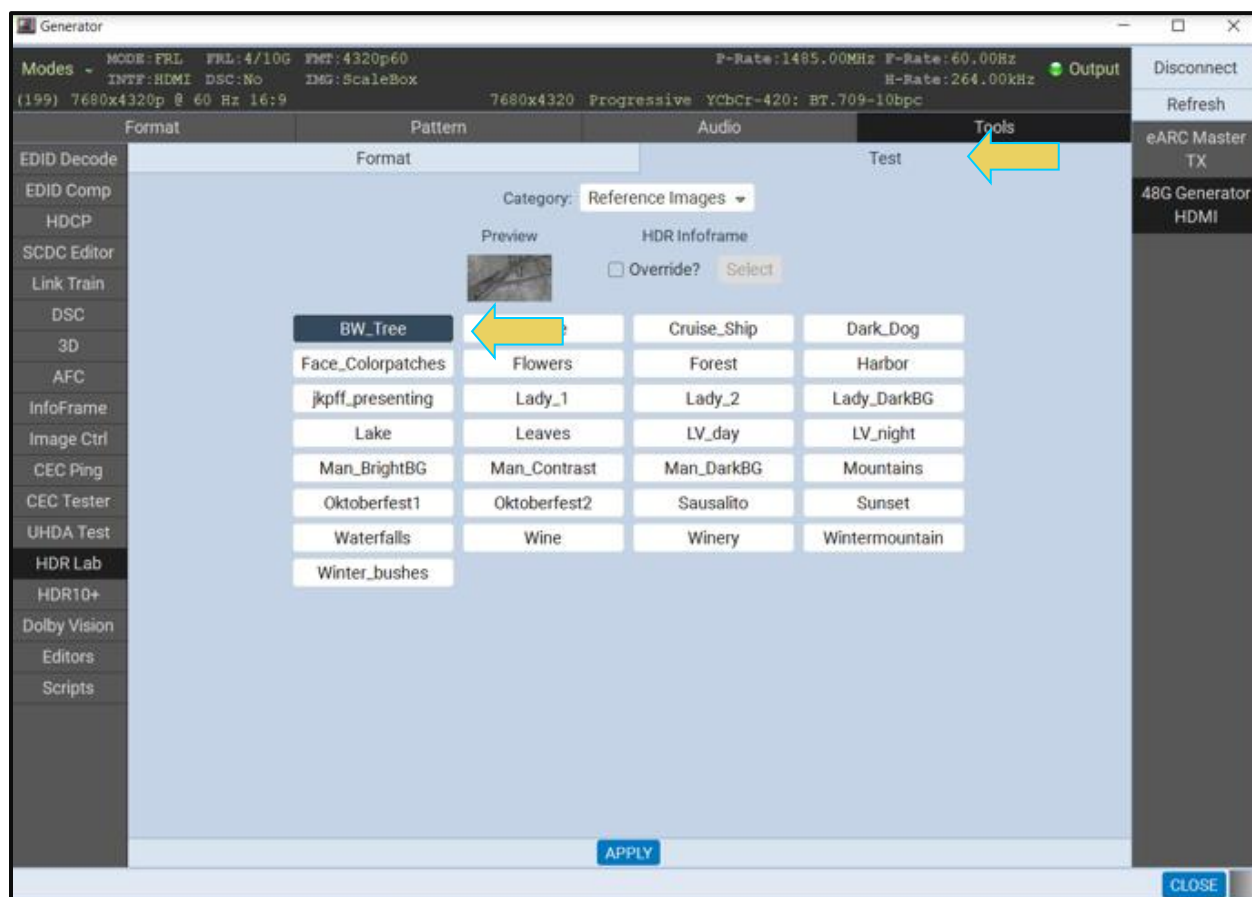
The HDR Lab utility window appears as shown below.



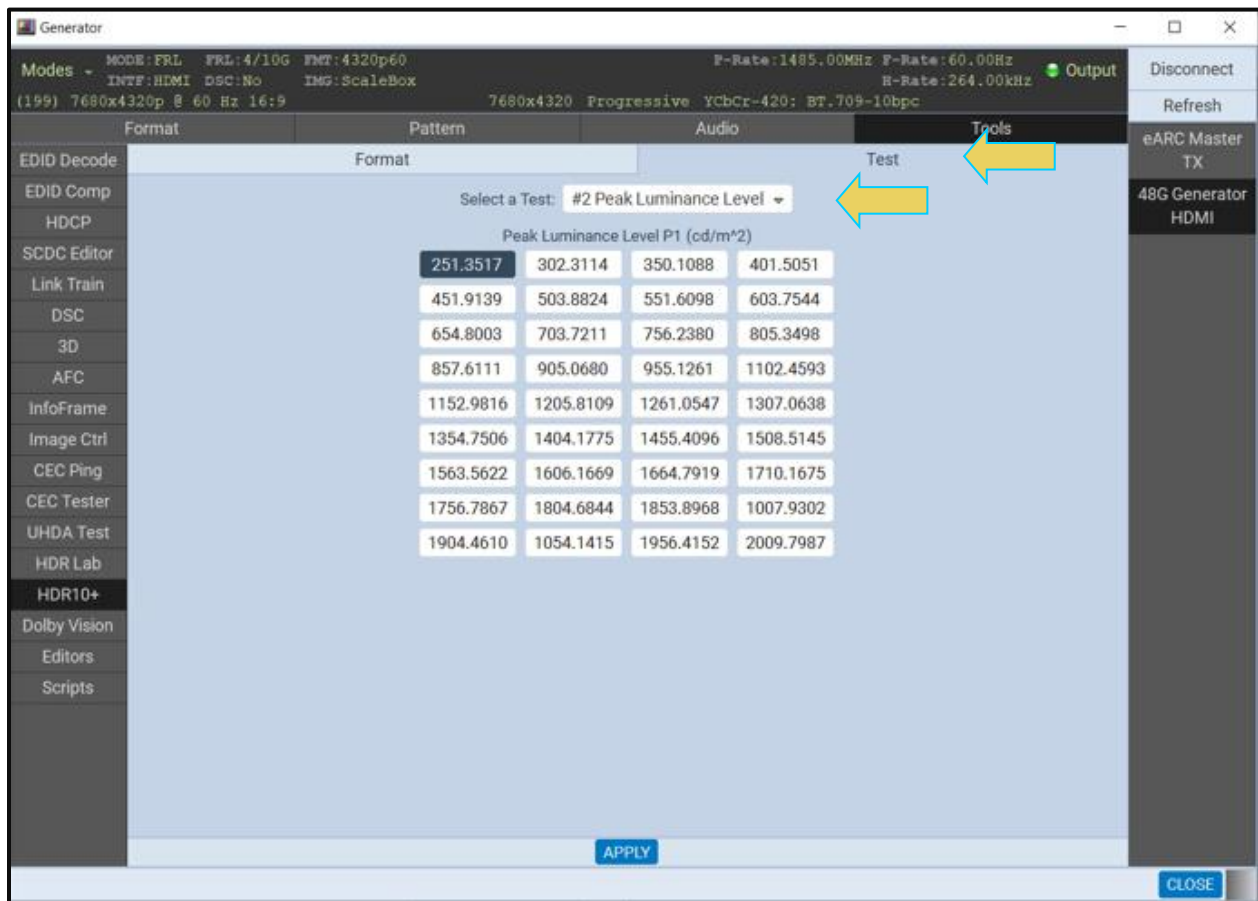


- Select the **Format** button to access the video parameter selection page (above).
- Select the Colorimetry, sampling mode and bit depth in accordance with your specifications.

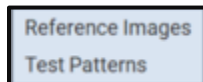
- Select the **Image** button to access the pull-down menu enabling you to select either the HDR test patterns or the test images (below).



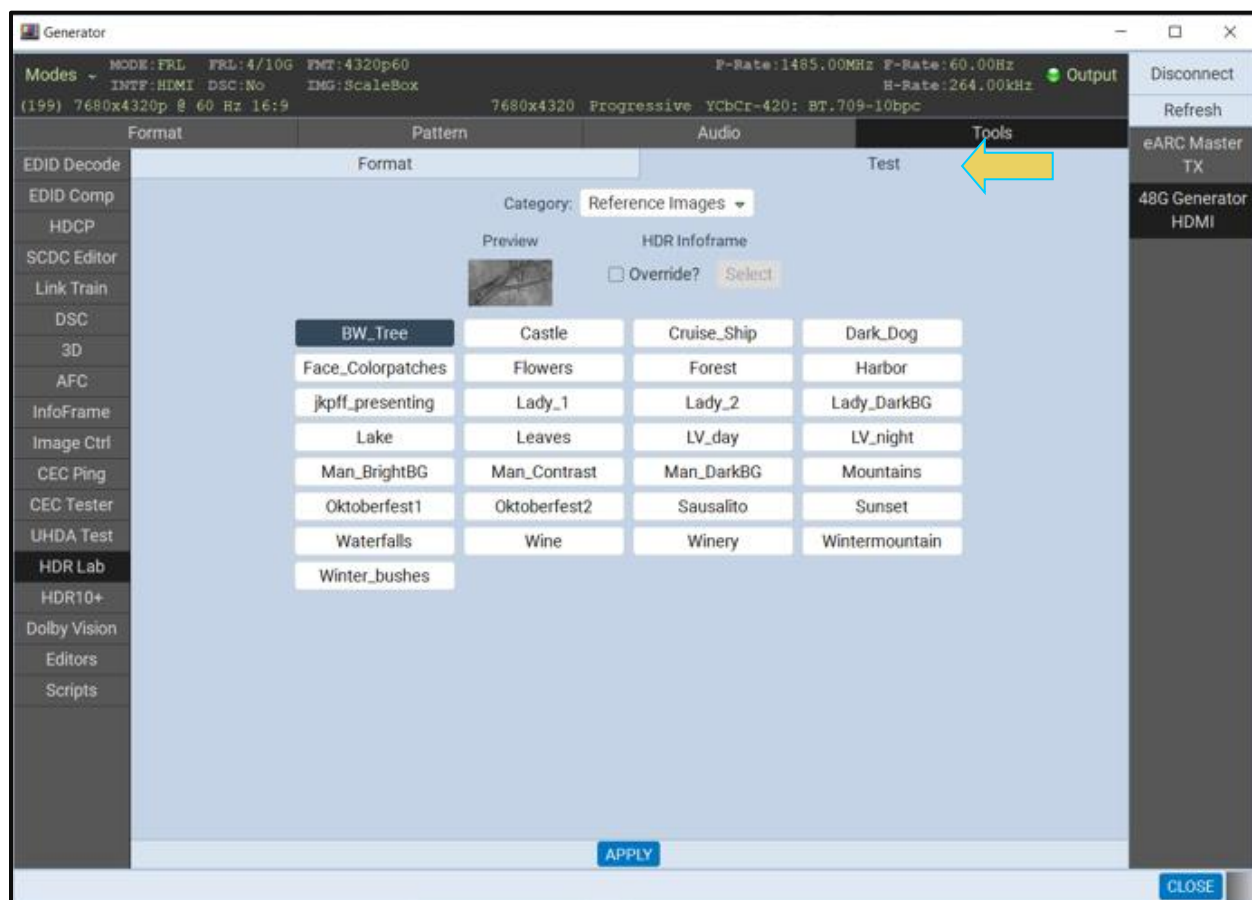
- From the **Category** pull-down menu select either Test Patterns or Test Images (below).



The following pull-down appears:



Test Patterns shown above; Reference images shown below.



- Select a Reference Image or Test Pattern and examine how it is rendered on your HDR display to assess proper rendering in accordance with the table above.

14.20 Testing HDR Displays with HDR Test Patterns

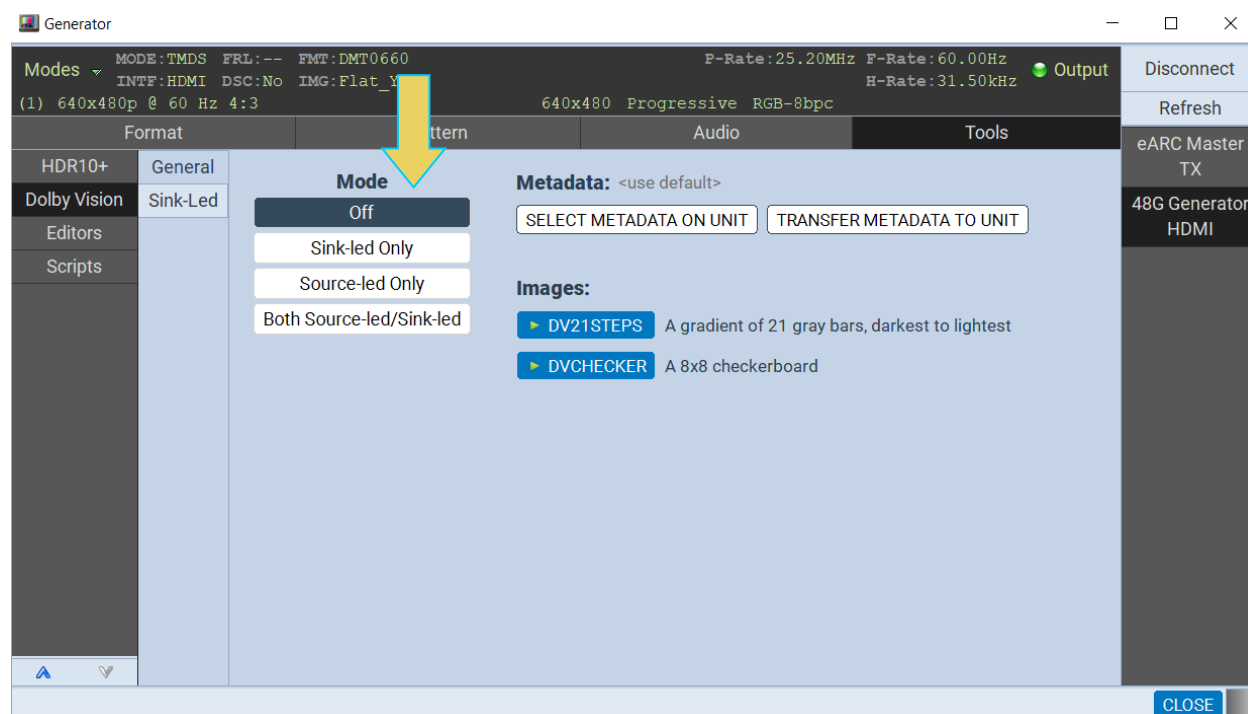
There are HDR related test images and functions that can be used for testing HDR apart from the UHD Alliance test patterns described in the previous subsection. When the patterns are selected, the appropriate metadata is transmitted through the AVI and HDR InfoFrames. These test patterns require separate licenses for use.

Currently there are two specialized HDR test patterns:

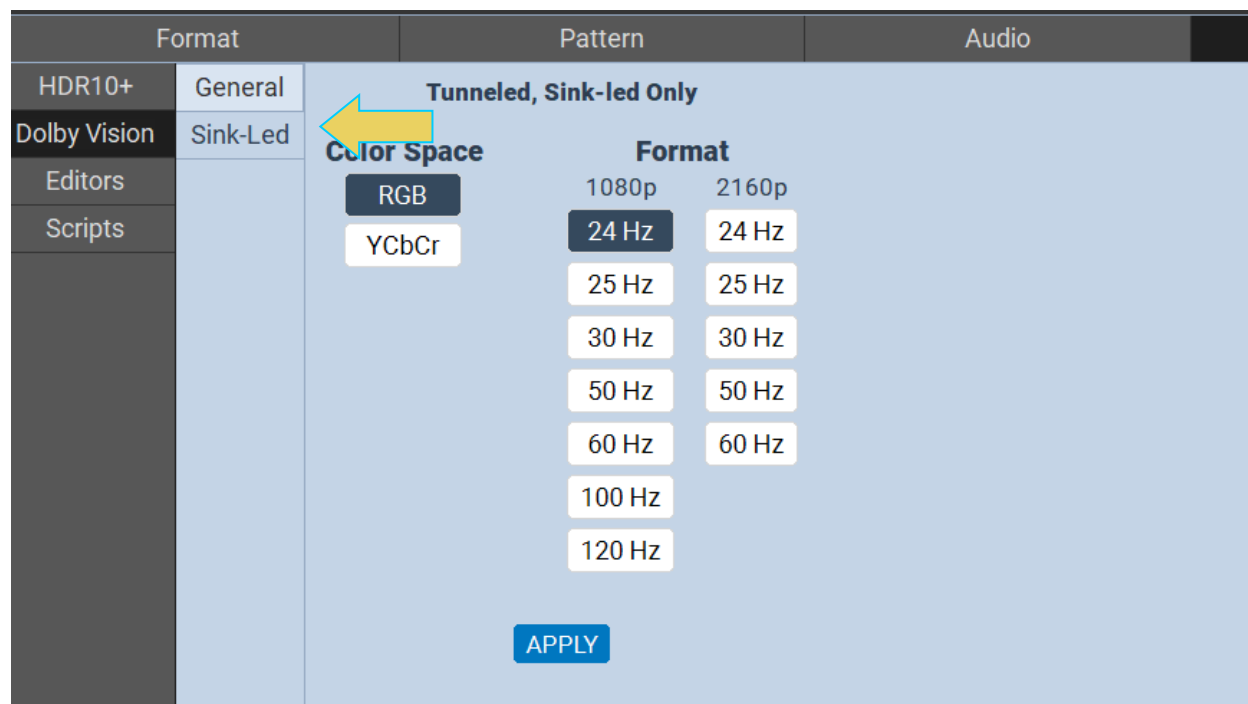
Hybrid Gamma Log – This pattern itself is not useful for checking the video attributes of HLG HDR. Its purpose is to provide assurance that the InfoFrame is not impeding the ability for the display to render the image.

Dolby Vision – The Dolby Vision test image verifies a Dolby Vision display's Dolby Vision-specific EDID data, its response to the Dolby Vision protocol handshake and its handling of the Dolby Vision signal and metadata. The Dolby Vision test image will be rendered with a checkmark in the proper location if the display has properly interpreted the color space, metadata, and checksum correctly.

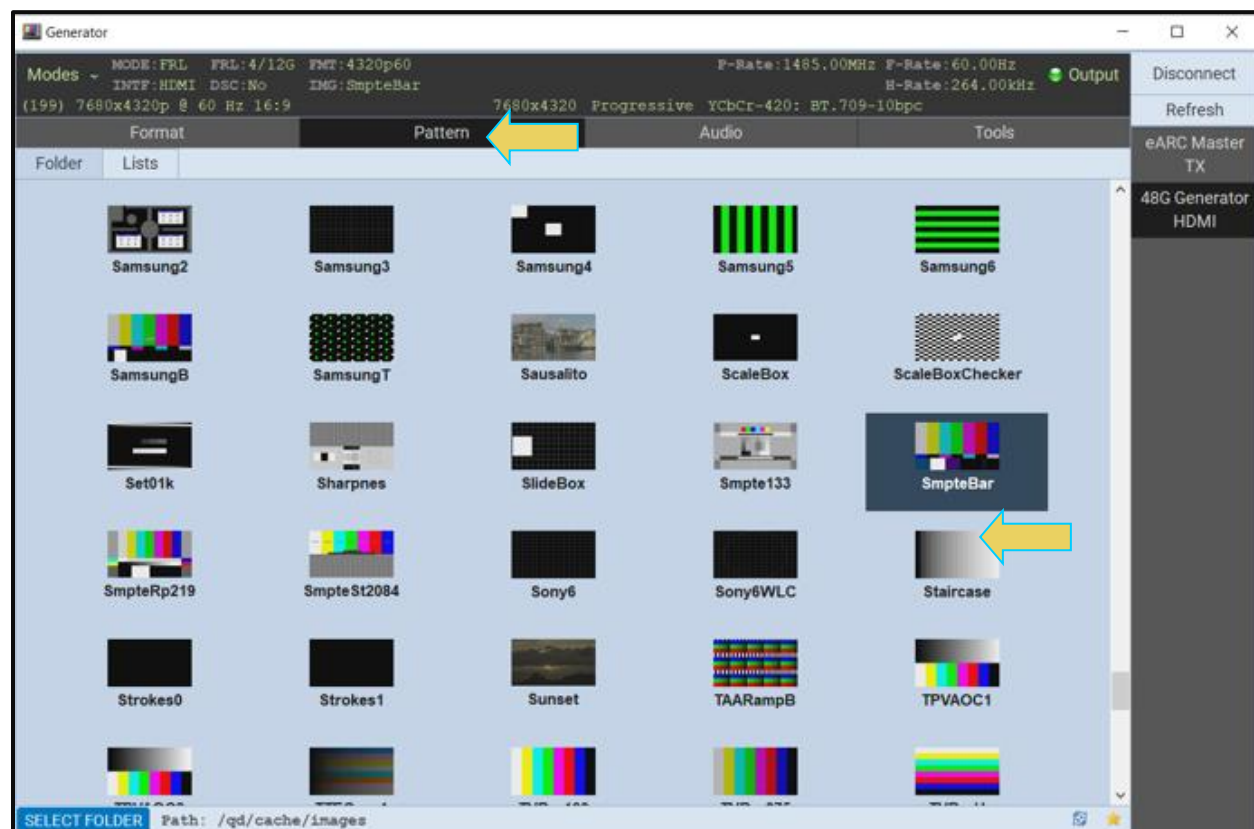
The M41h Dolby Vision Testing Utility offers the ability to select between Sink-led and/or Source-led Mode when testing, as shown below.



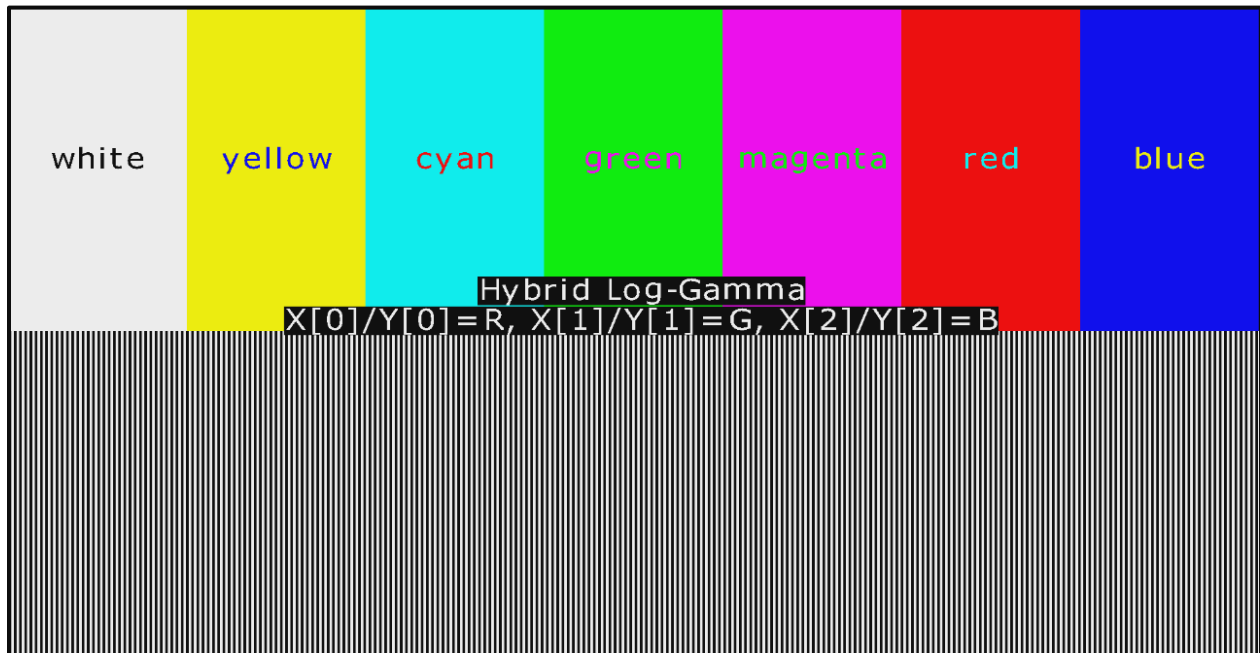
Select the tab on the side-bar labeled **Sink-Led** for additional Sink-led options, as shown below.



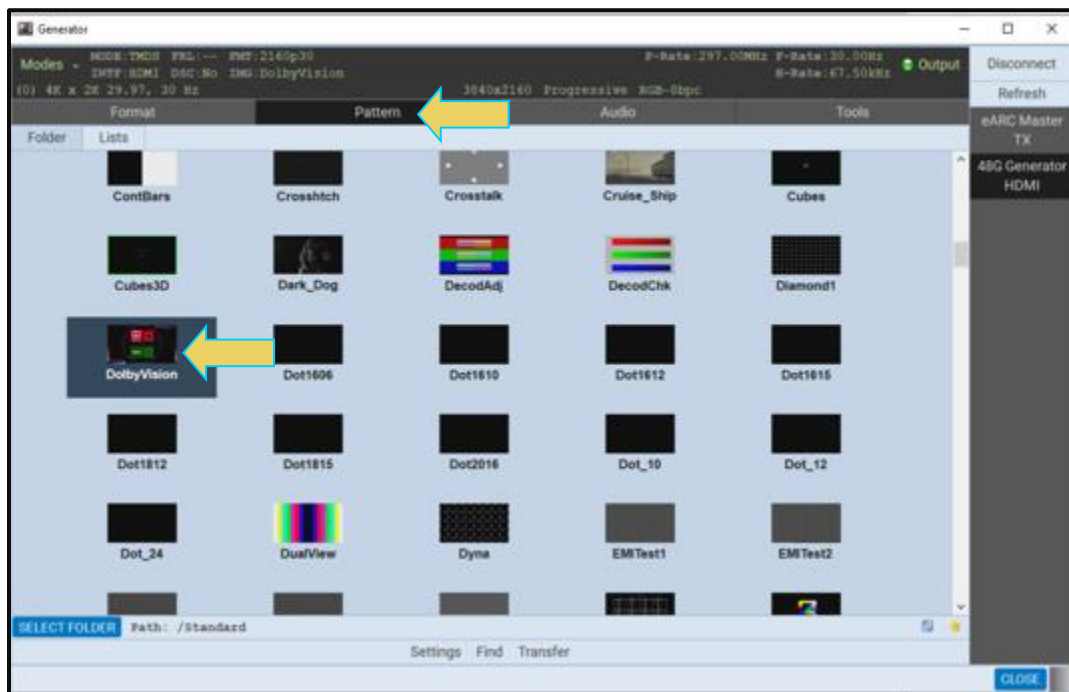
You select the pattern (e.g. Hybrid Log Gamma) as you would any other pattern from the **Patterns** tab shown below.



The HLG test pattern is shown below for reference.



Similarly, you can select the Dolby Vision test pattern as shown below.



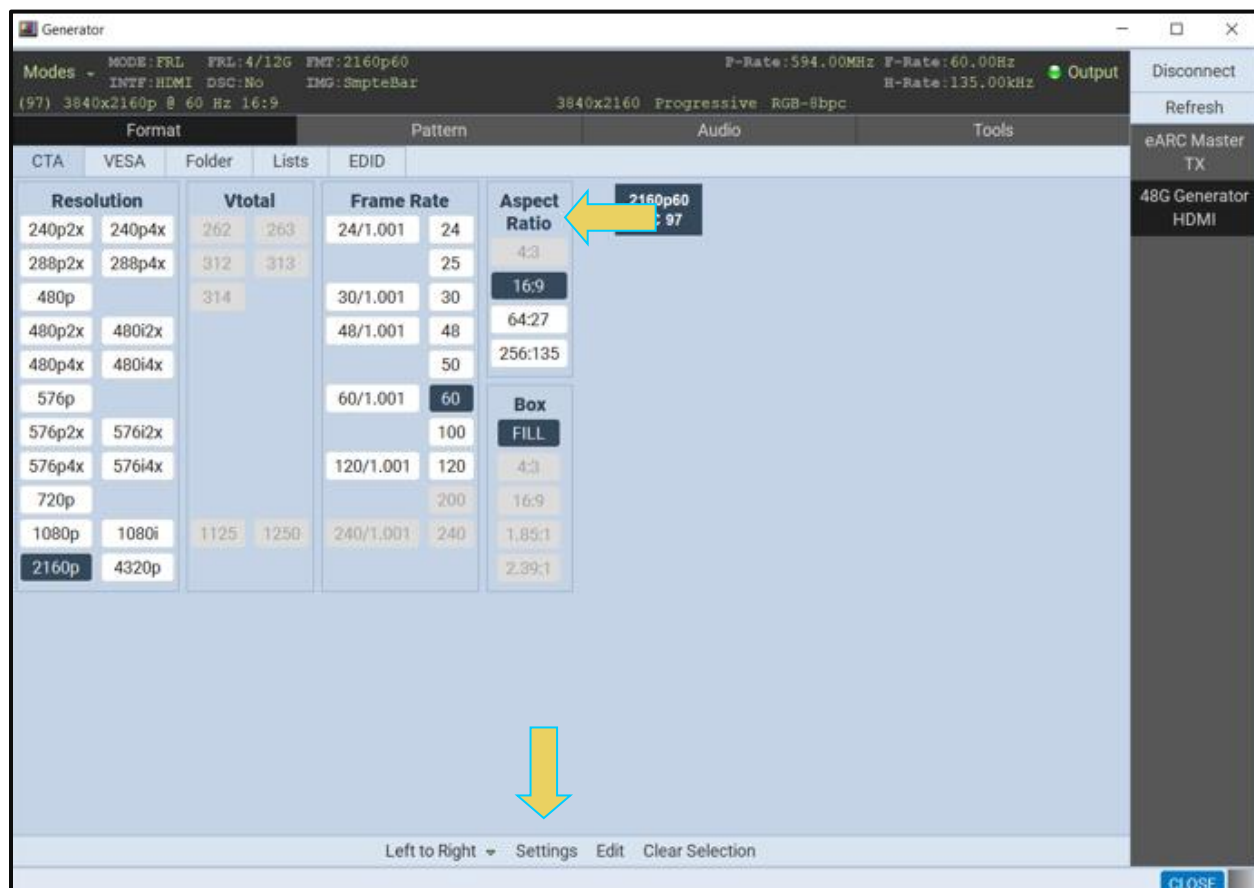
You will set the video format to any 2160p or 1080p image using the following settings:

Colorimetry: RGB

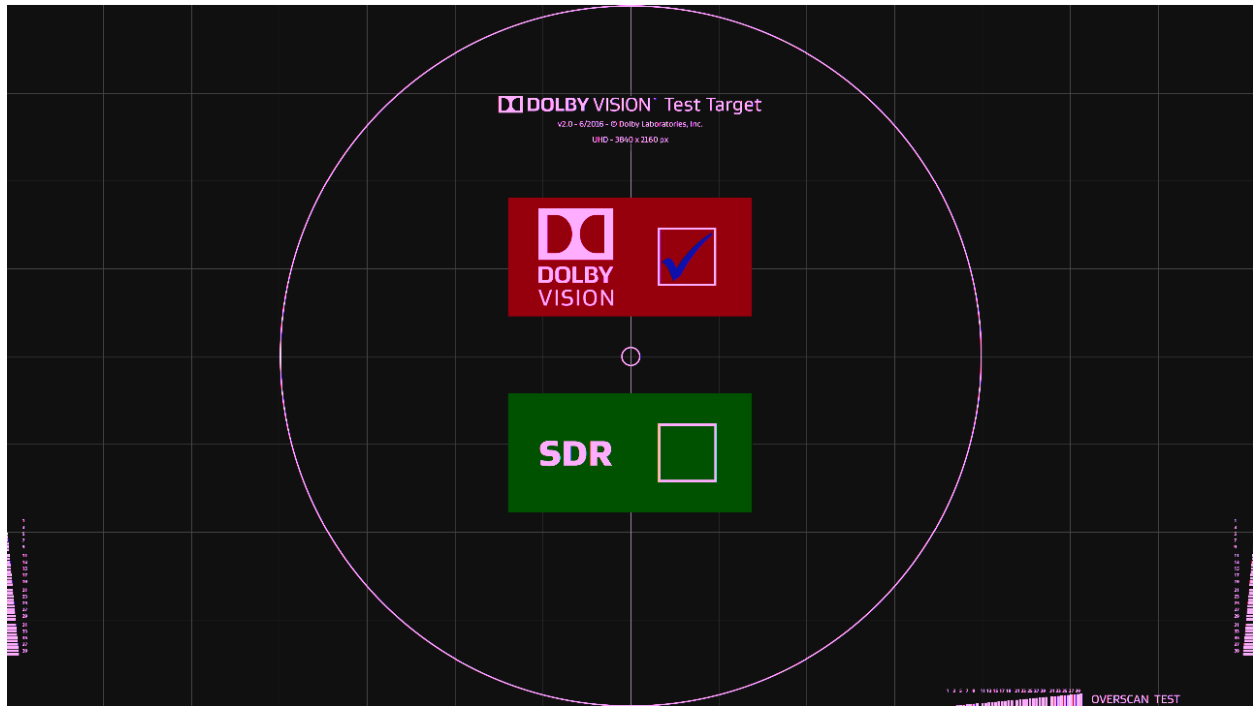
Range: Full

Bit depth: 8 bits per component

The format selection and format settings are depicted sample screen examples below.



The Dolby Vision image provides a check mark in the HDR box when the image is rendered properly.



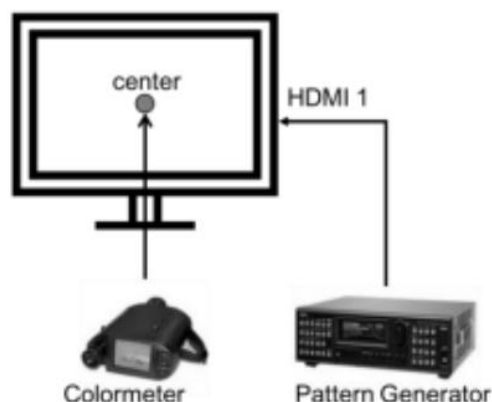
14.21 Testing HDR10+ Capable Displays using HDR10+ Utility

14.21.1 Important Note Regarding HDR10+

This section explains accessing the HDR10+ testing features of the M41h using the ATP Manager. All of the HDR10+ tests are defined in the HDR10+ Technologies, LLC specifications located on their website. You must be a member/adopter to access the test specifications and methods of instruction. HDR10+ should not be equated with “HDR” and/or “HDR10” - it’s a specific standard defined by the LLC.

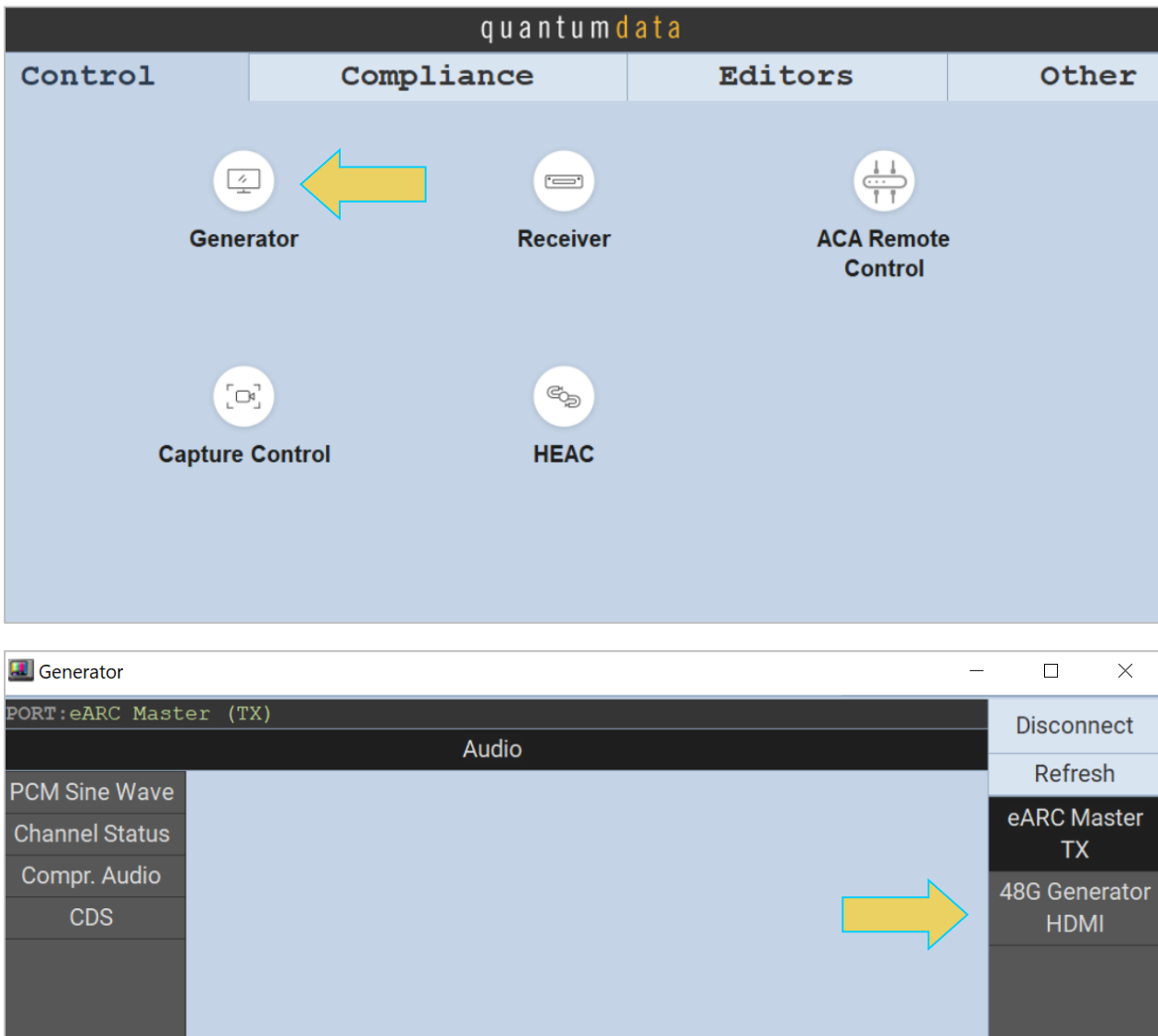
These tests require a separately controlled colorimeter, frustum (focusing device) and qualified HDR10+ display device to test. The part of the equation that we supply is the generator (HDMI 2.1 48G module) output and method of manipulating a predefined set of info frame values via the GUI as required for a portion of the tests outlined in the HDR10+ CTS.

See below diagram for a reference of setting up generator (M41h instrument), colorimeter, and display.

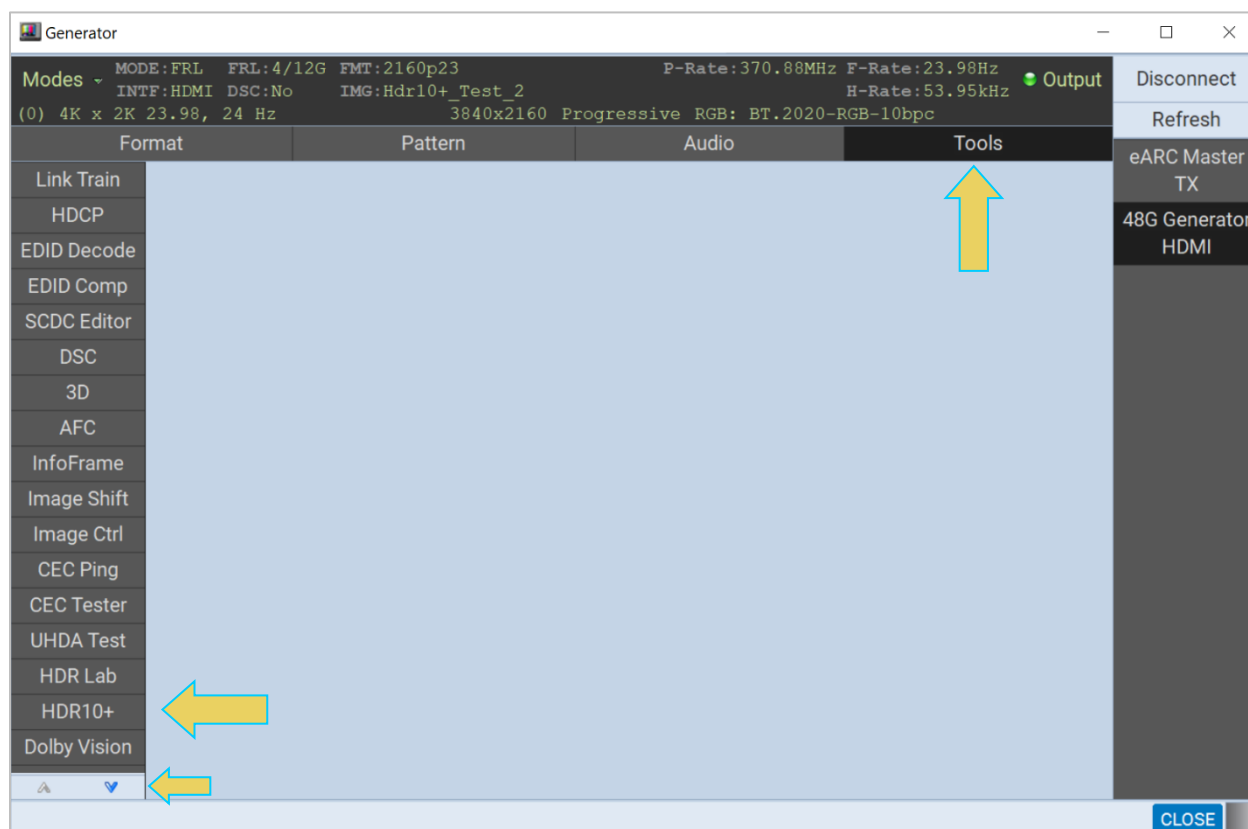


14.21.2 Accessing the HDR10+ Utility

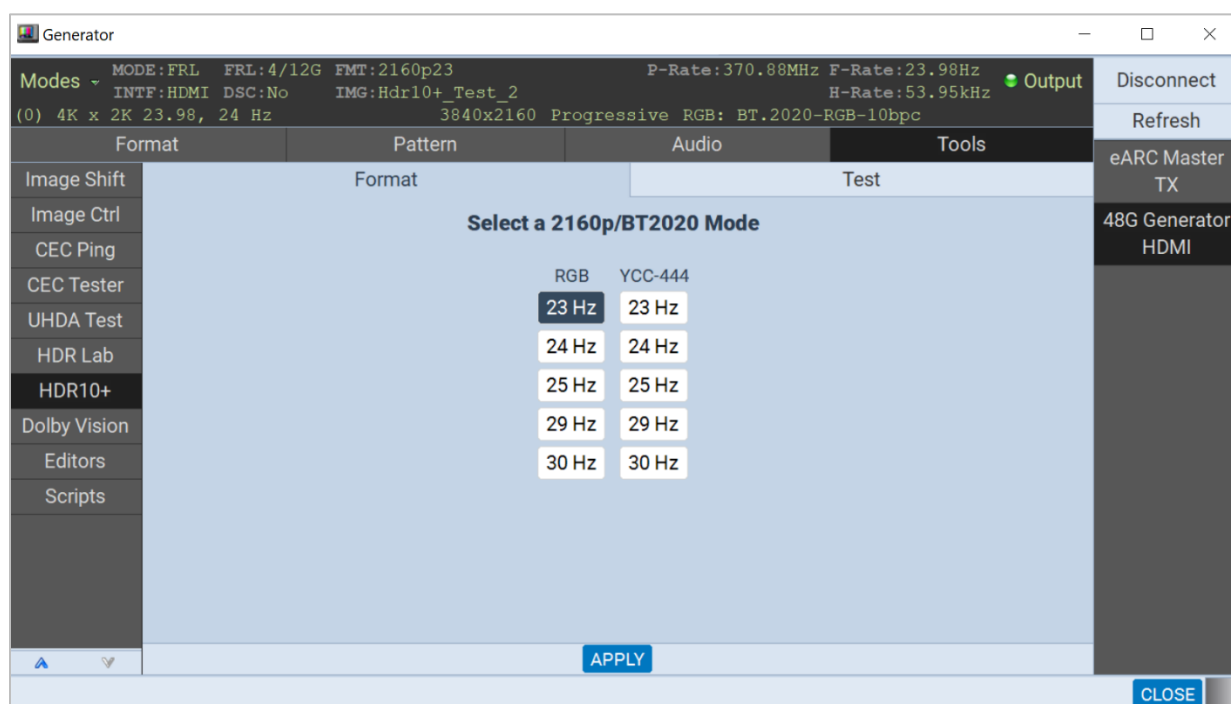
Access the utility within the generator by selecting **Generator** from the Home Screen, and selecting **48G Generator HDMI** on the righthand side bar, as shown below.



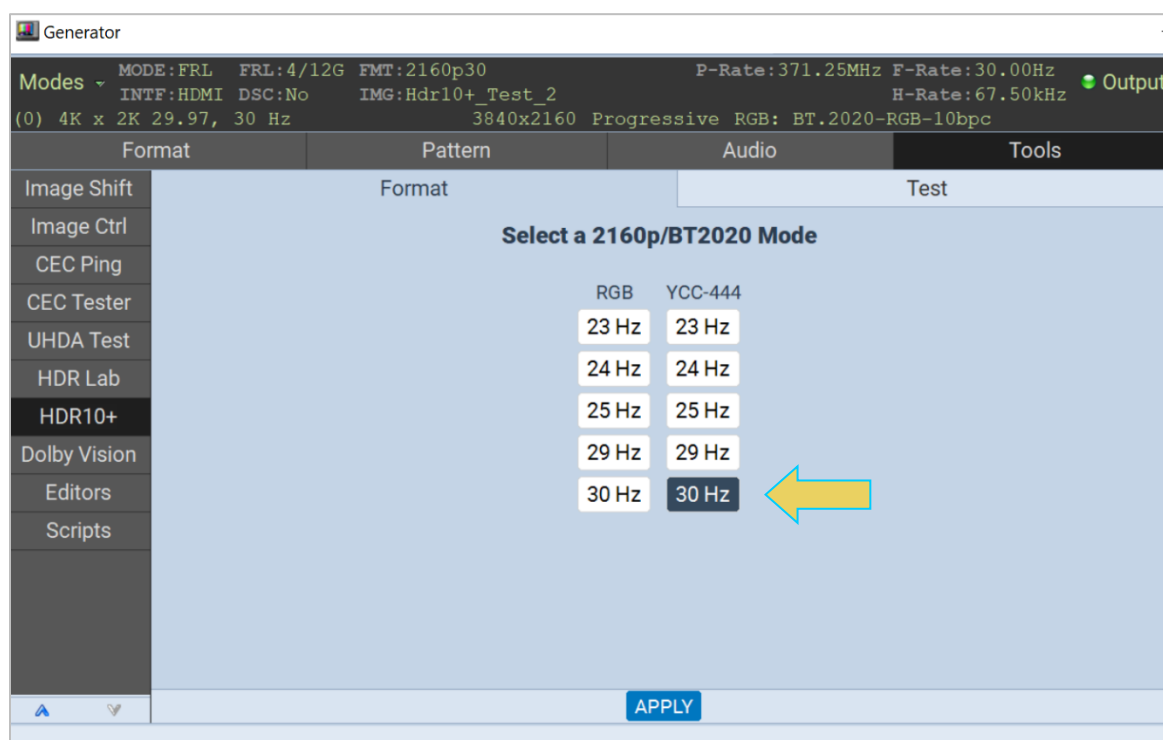
Select the **Tools** tab at the top of the Generator window. Scroll down on the left sidebar if necessary, and select **HDR10+** to open the utility.



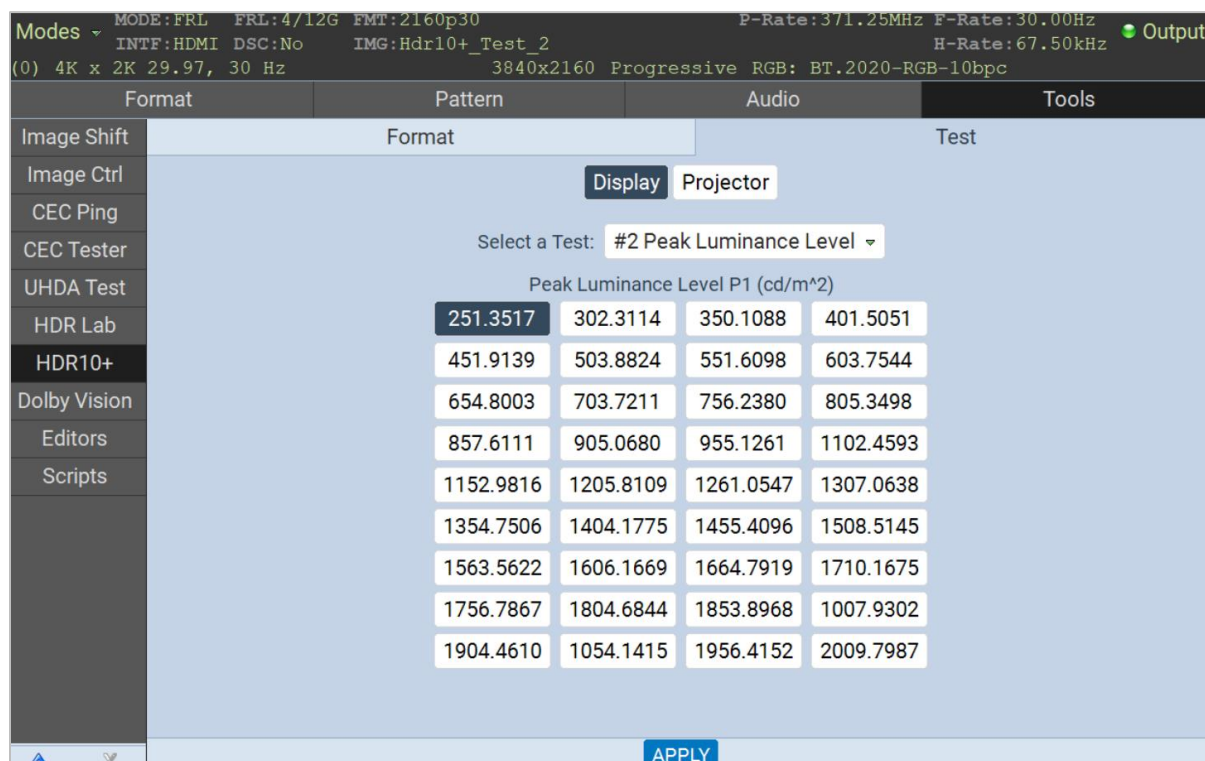
The HDR10+ Utility will appear, as shown below.



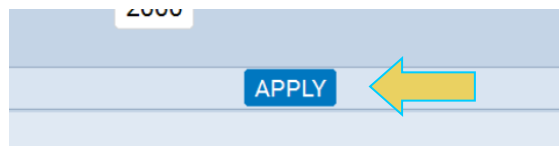
The **Format** tab will be shown, and here you can configure the frame rate and color space for the generated 4k video in accordance with your testing specifications. In the example below, YCbCr 4:4:4 30 Hz has been selected.

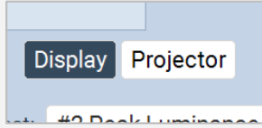



Next, click the **Test** tab at the top right for all available testing options.



The following table describes the options featured within the **Test** window. Once the desired test and testing options are selected, click **APPLY** at the bottom of the window to begin HDR10+ testing.

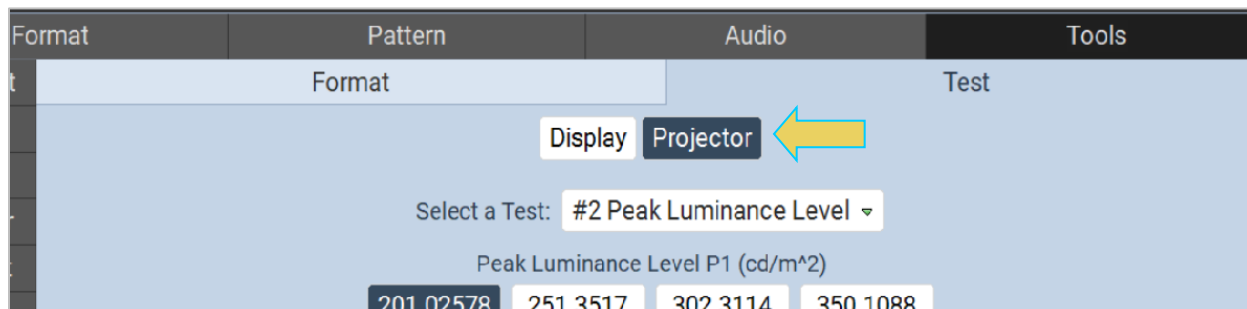


Feature	Description
Display/Projector 	Select the type of sink to be tested. Options vary based on the selection. Testing a projector is covered at the end of this subsection.
Select a Test 	Select the desired test. Available tests are as follows: <ul style="list-style-type: none"> • #2 Peak Luminance Level • #3-1 Peak Luminance Stability • #3-2 Peak Luminance Stability • #4 Transfer Curve • #6-1 Color Gamut Coverage • #6-2 Color Gamut Coverage • #8 Target Peak Luminance Measurement • #9-1 HDR10+ Metadata • #9-2 HDR10+ Metadata • #10 Bypass • #11 Clipping • #12 Monotonic Increase • #13 Shadow Preservation

Test/Options	Available Testing Options																																				
<div>Tests:</div> <div><ul style="list-style-type: none">#2 Peak Luminance Level#3-2 Peak Luminance Stability</div> <div>Options:</div> <div><ul style="list-style-type: none">Peak Luminance Level P1 (cd/m^2)</div>	<div>Select a Test: #2 Peak Luminance Level ▾</div> <div>Peak Luminance Level P1 (cd/m^2)</div> <table><tr><td>251.3517</td><td>302.3114</td><td>350.1088</td><td>401.5051</td></tr><tr><td>451.9139</td><td>503.8824</td><td>551.6098</td><td>603.7544</td></tr><tr><td>654.8003</td><td>703.7211</td><td>756.2380</td><td>805.3498</td></tr><tr><td>857.6111</td><td>905.0680</td><td>955.1261</td><td>1102.4593</td></tr><tr><td>1152.9816</td><td>1205.8109</td><td>1261.0547</td><td>1307.0638</td></tr><tr><td>1354.7506</td><td>1404.1775</td><td>1455.4096</td><td>1508.5145</td></tr><tr><td>1563.5622</td><td>1606.1669</td><td>1664.7919</td><td>1710.1675</td></tr><tr><td>1756.7867</td><td>1804.6844</td><td>1853.8968</td><td>1007.9302</td></tr><tr><td>1904.4610</td><td>1054.1415</td><td>1956.4152</td><td>2009.7987</td></tr></table>	251.3517	302.3114	350.1088	401.5051	451.9139	503.8824	551.6098	603.7544	654.8003	703.7211	756.2380	805.3498	857.6111	905.0680	955.1261	1102.4593	1152.9816	1205.8109	1261.0547	1307.0638	1354.7506	1404.1775	1455.4096	1508.5145	1563.5622	1606.1669	1664.7919	1710.1675	1756.7867	1804.6844	1853.8968	1007.9302	1904.4610	1054.1415	1956.4152	2009.7987
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654.8003	703.7211	756.2380	805.3498																																		
857.6111	905.0680	955.1261	1102.4593																																		
1152.9816	1205.8109	1261.0547	1307.0638																																		
1354.7506	1404.1775	1455.4096	1508.5145																																		
1563.5622	1606.1669	1664.7919	1710.1675																																		
1756.7867	1804.6844	1853.8968	1007.9302																																		
1904.4610	1054.1415	1956.4152	2009.7987																																		
<div>Test:</div> <div><ul style="list-style-type: none">#3-1 Peak Luminance Stability</div> <div>Options:</div> <div><ul style="list-style-type: none">Peak Luminance Level P1 (cd/m^2)Test Pattern A Patch SizeTest Pattern B Patch Size</div>	<div>Select a Test: #3-1 Peak Luminance Stability ▾</div> <div>Luminance Level P2 (cd/m^2)</div> <table><tr><td>251.3517</td><td>302.3114</td><td>350.1088</td><td>401.5051</td></tr><tr><td>451.9139</td><td>503.8824</td><td>551.6098</td><td>603.7544</td></tr><tr><td>654.8003</td><td>703.7211</td><td>756.2380</td><td>805.3498</td></tr><tr><td>857.6111</td><td>905.0680</td><td>955.1261</td><td>1102.4593</td></tr><tr><td>1152.9816</td><td>1205.8109</td><td>1261.0547</td><td>1307.0638</td></tr><tr><td>1354.7506</td><td>1404.1775</td><td>1455.4096</td><td>1508.5145</td></tr><tr><td>1563.5622</td><td>1606.1669</td><td>1664.7919</td><td>1710.1675</td></tr><tr><td>1756.7867</td><td>1804.6844</td><td>1853.8968</td><td>1007.9302</td></tr><tr><td>1904.4610</td><td>1054.1415</td><td>1956.4152</td><td>2009.7987</td></tr></table> <div>Test Pattern A Patch Size: 10% ▾</div> <div>Test Pattern B Patch Size: 10% ▾</div>	251.3517	302.3114	350.1088	401.5051	451.9139	503.8824	551.6098	603.7544	654.8003	703.7211	756.2380	805.3498	857.6111	905.0680	955.1261	1102.4593	1152.9816	1205.8109	1261.0547	1307.0638	1354.7506	1404.1775	1455.4096	1508.5145	1563.5622	1606.1669	1664.7919	1710.1675	1756.7867	1804.6844	1853.8968	1007.9302	1904.4610	1054.1415	1956.4152	2009.7987
251.3517	302.3114	350.1088	401.5051																																		
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654.8003	703.7211	756.2380	805.3498																																		
857.6111	905.0680	955.1261	1102.4593																																		
1152.9816	1205.8109	1261.0547	1307.0638																																		
1354.7506	1404.1775	1455.4096	1508.5145																																		
1563.5622	1606.1669	1664.7919	1710.1675																																		
1756.7867	1804.6844	1853.8968	1007.9302																																		
1904.4610	1054.1415	1956.4152	2009.7987																																		

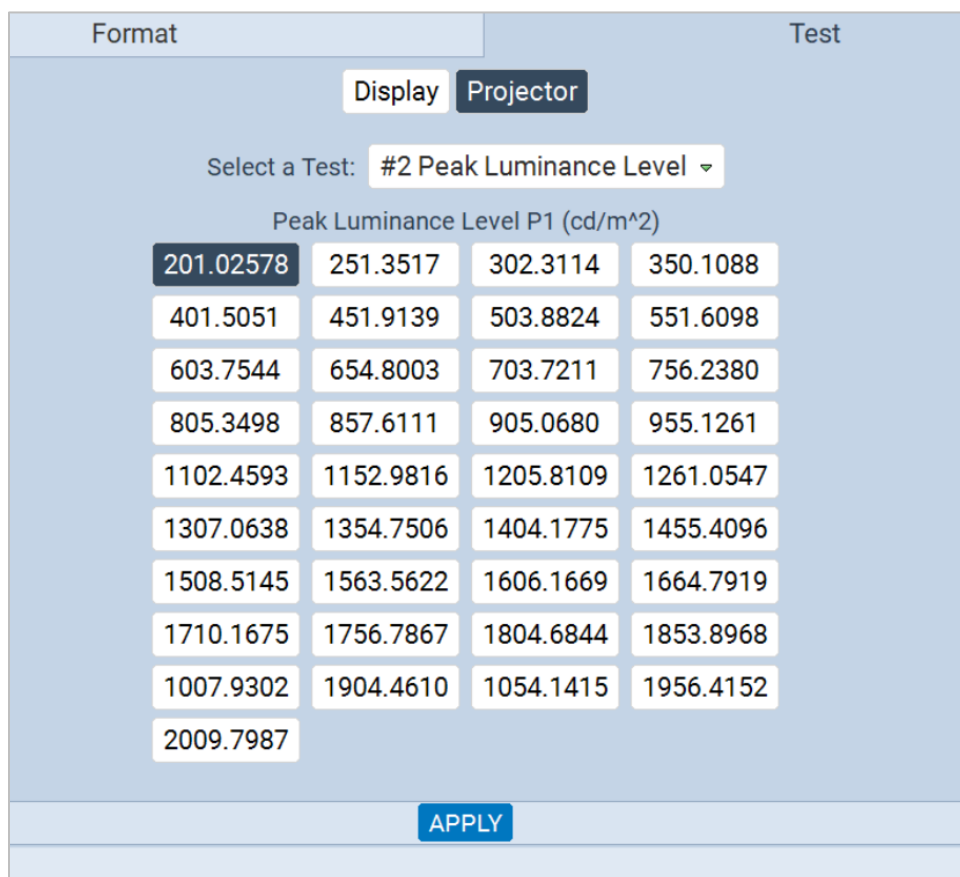
Test/Options	Available Testing Options
Tests: <ul style="list-style-type: none"> #6-1 Color Gamut Coverage #6-2 Color Gamut Coverage Options: <ul style="list-style-type: none"> Peak Luminance Level P2 (cd/m²) 	<div> Select a Test: #6-1 Color Gamut Coverage ▾ </div> <div> Luminance Level P2 (cd/m²) <div> 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 </div> </div>
Tests: <ul style="list-style-type: none"> #9-1 HDR10+ Metadata #9-2 HDR10+ Metadata Options: <ul style="list-style-type: none"> Target T (cd/m²) 	<div> Select a Test: #9-1 HDR10+ Metadata ▾ </div> <div> Target T (cd/m²) <div> 250 300 350 400 450 500 550 600 650 700 750 800 850 900 950 1000 1050 1100 1150 1200 1250 1300 1350 1400 1450 1500 1550 1600 1650 1700 1750 1800 1850 1900 1950 2000 </div> </div>
<ul style="list-style-type: none"> #4 Transfer Curve #8 Target Peak Luminance Measurement #10 Bypass #11 Clipping #12 Monotonic Increase #13 Shadow Preservation 	No Configurable Options

The M41h also offers the ability to test projectors using the HDR10+ utility. Simply select the **Projector** option at the top of the **Test** window, as shown below.



A few additional options are available to suit testing needs for a Projector, with examples below.

#2 Peak Luminance Level testing options for a projector:



#6-1 Color Gamut Coverage test for a projector:

Format

Test

Display


Projector

Select a Test: #6-1 Color Gamut Coverage ▾

Luminance Level P2 (cd/m²)

200	250	300	350
400	450	500	550
600	650	700	750
800	850	900	950
1000	1050	1100	1150
1200	1250	1300	1350
1400	1450	1500	1550
1600	1650	1700	1750
1800	1850	1900	1950
2000			

APPLY

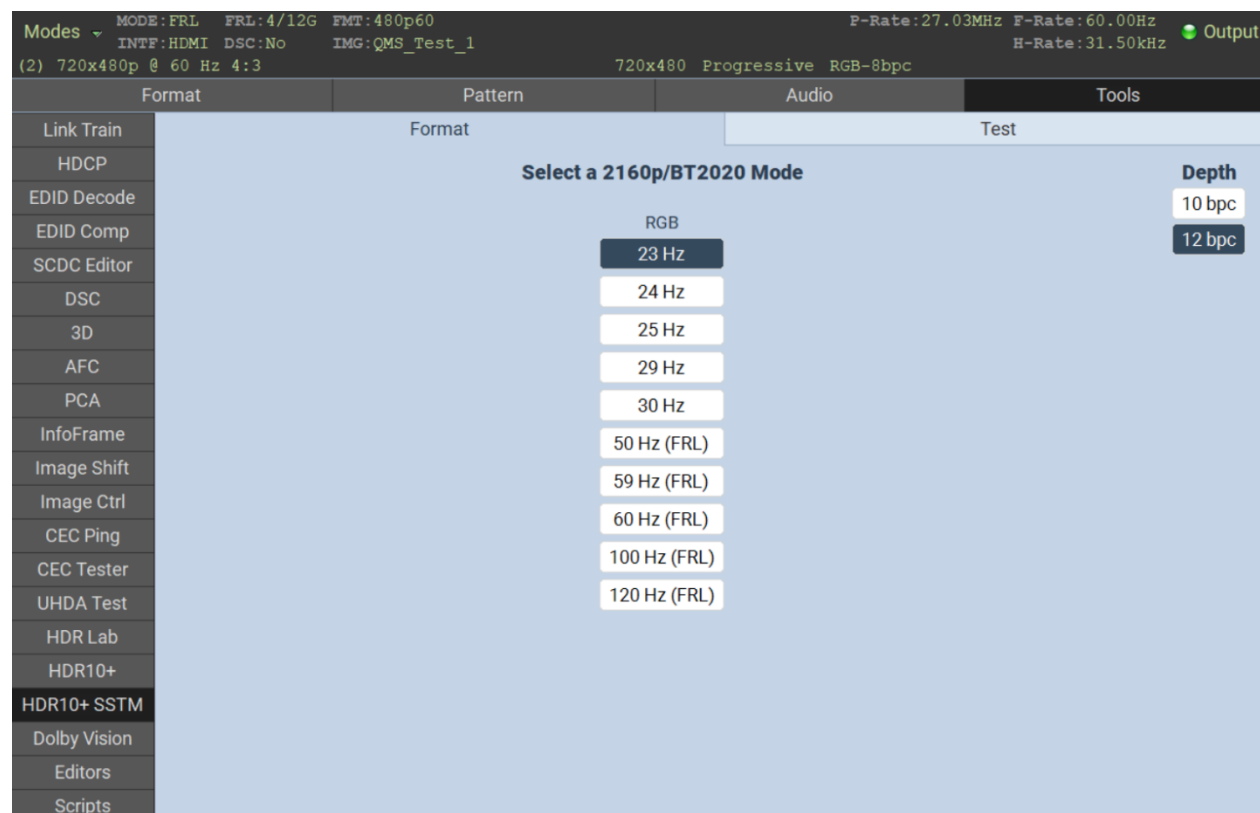


As with testing a display, select **APPLY** to begin testing the projector.

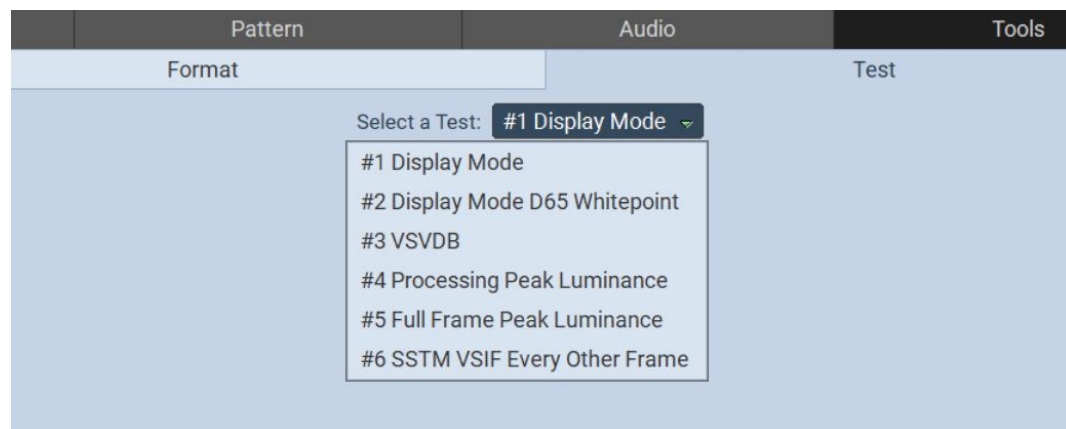
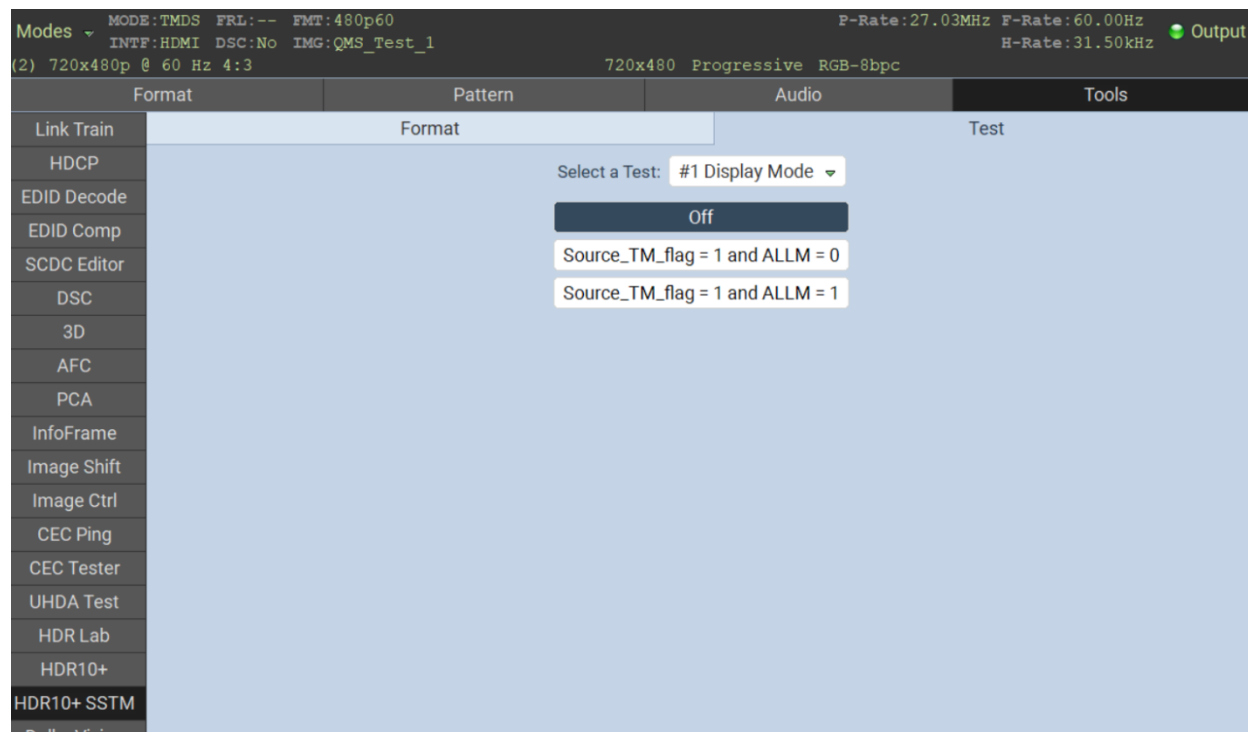
14.22 Testing SSTM of HDR10+ Capable Displays

The M41h offers support for HDR10+ Source Side Tone Mapping (SSTM). Use the following procedure to test HDR10+ SSTM in a capable sink display.

1. Access the utility via the Tools tab within the 48G HDMI Generator, as shown below.



2. Select the format (as shown in the above screen), and select a test, as demonstrated on the screens below.



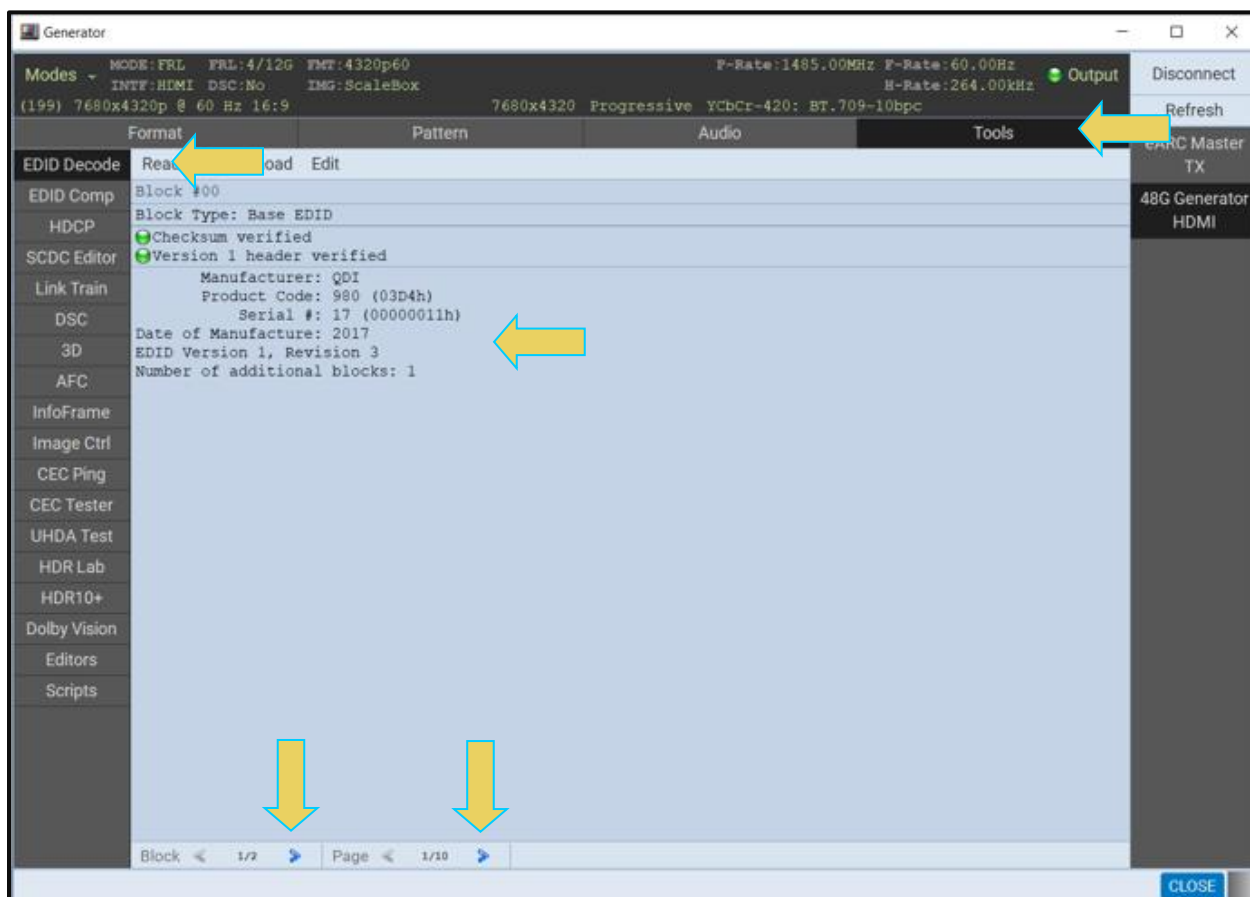
14.23 Viewing the EDID of a connected display

Use the following procedures to view the EDID of the connected display. This procedure assumes that you have an HDTV or other sink device connected to the Tx port.

To view the EDID of a connected display:

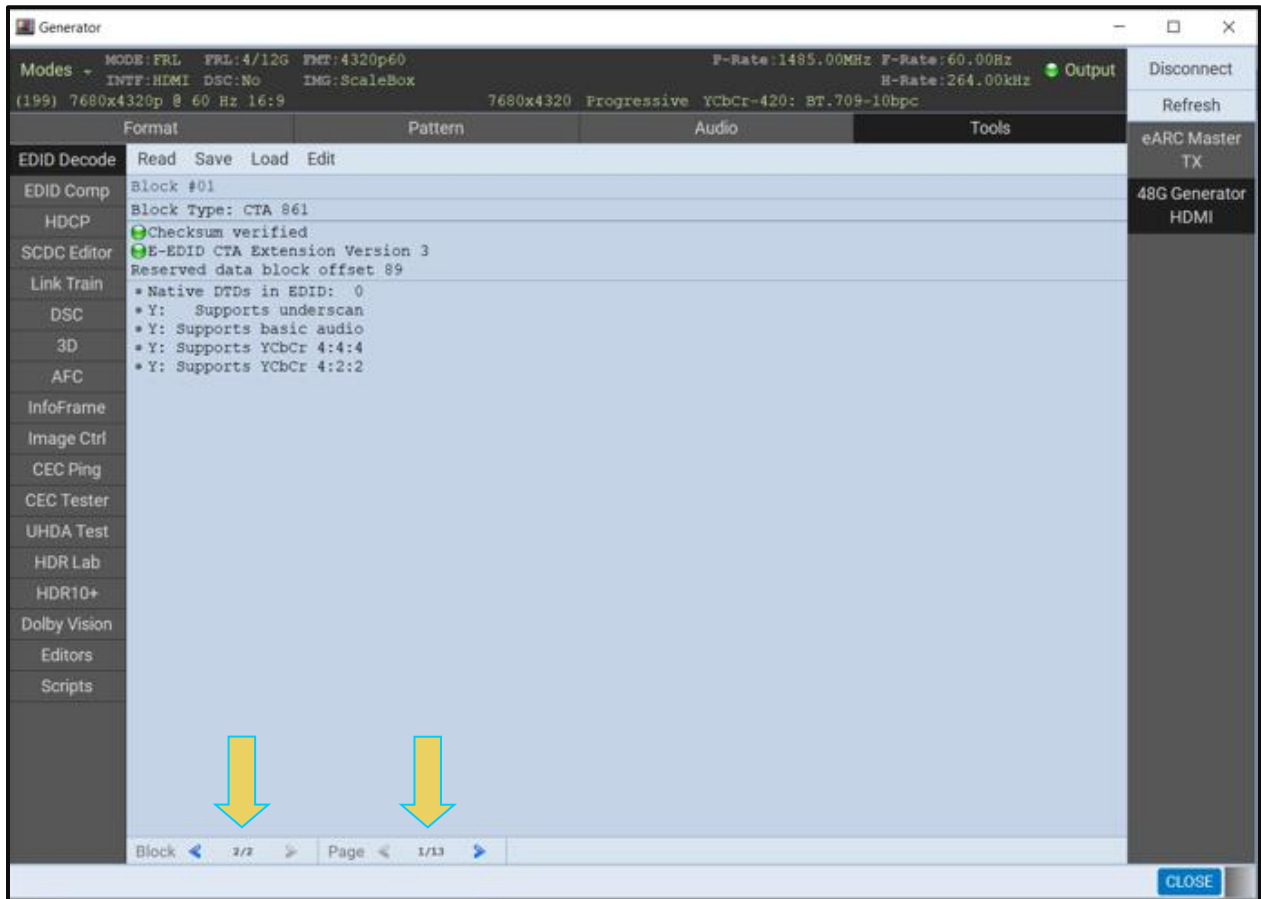
3. From the main window of the M41h 48G Video Analyzer/Generator, select the **Tools** tab.
4. Activate the **EDID Decode** button on the upper left (indicated below).

Contents of the initial data in the first block of the EDID will be displayed (below).

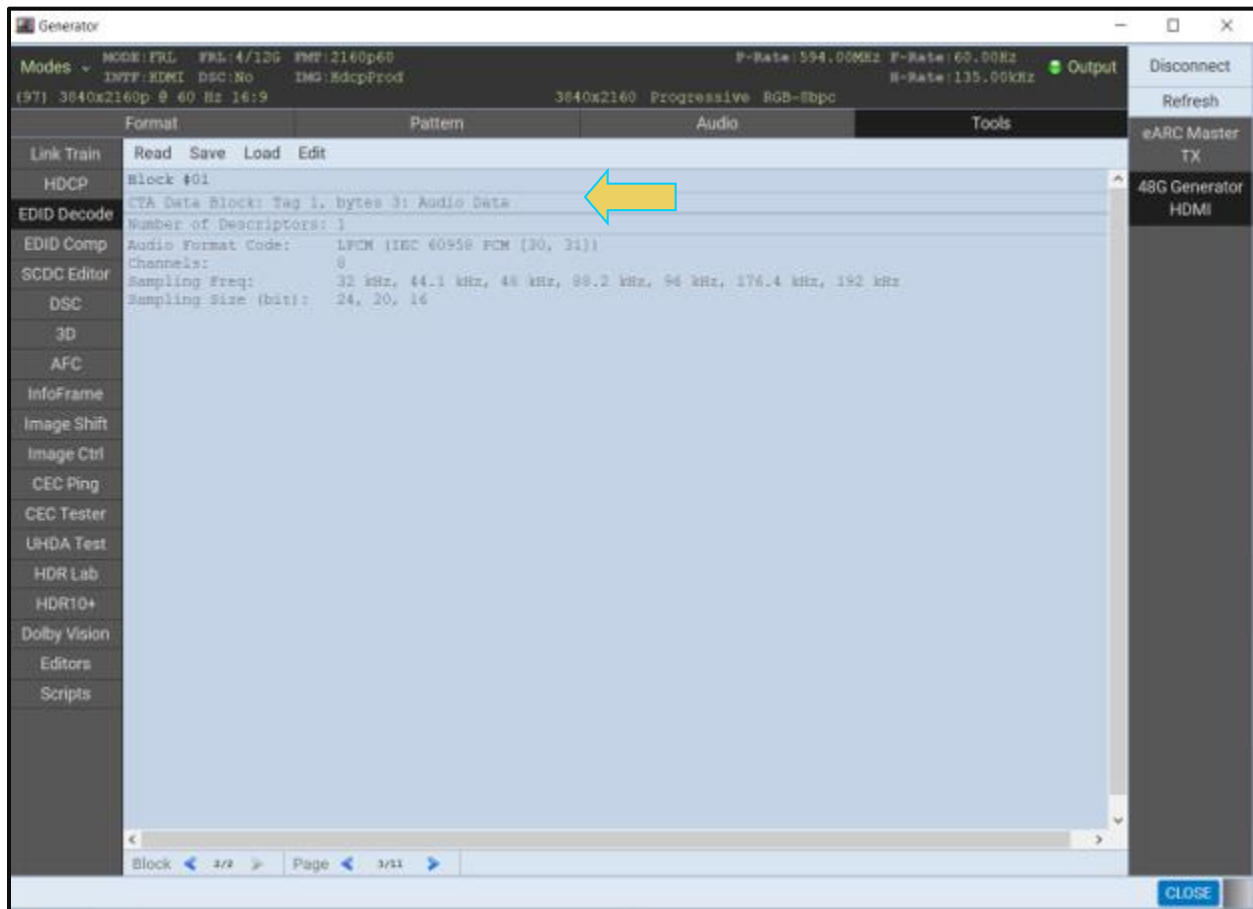


Navigate through the blocks and pages of the EDID using the arrow buttons on the lower panel (indicated above).

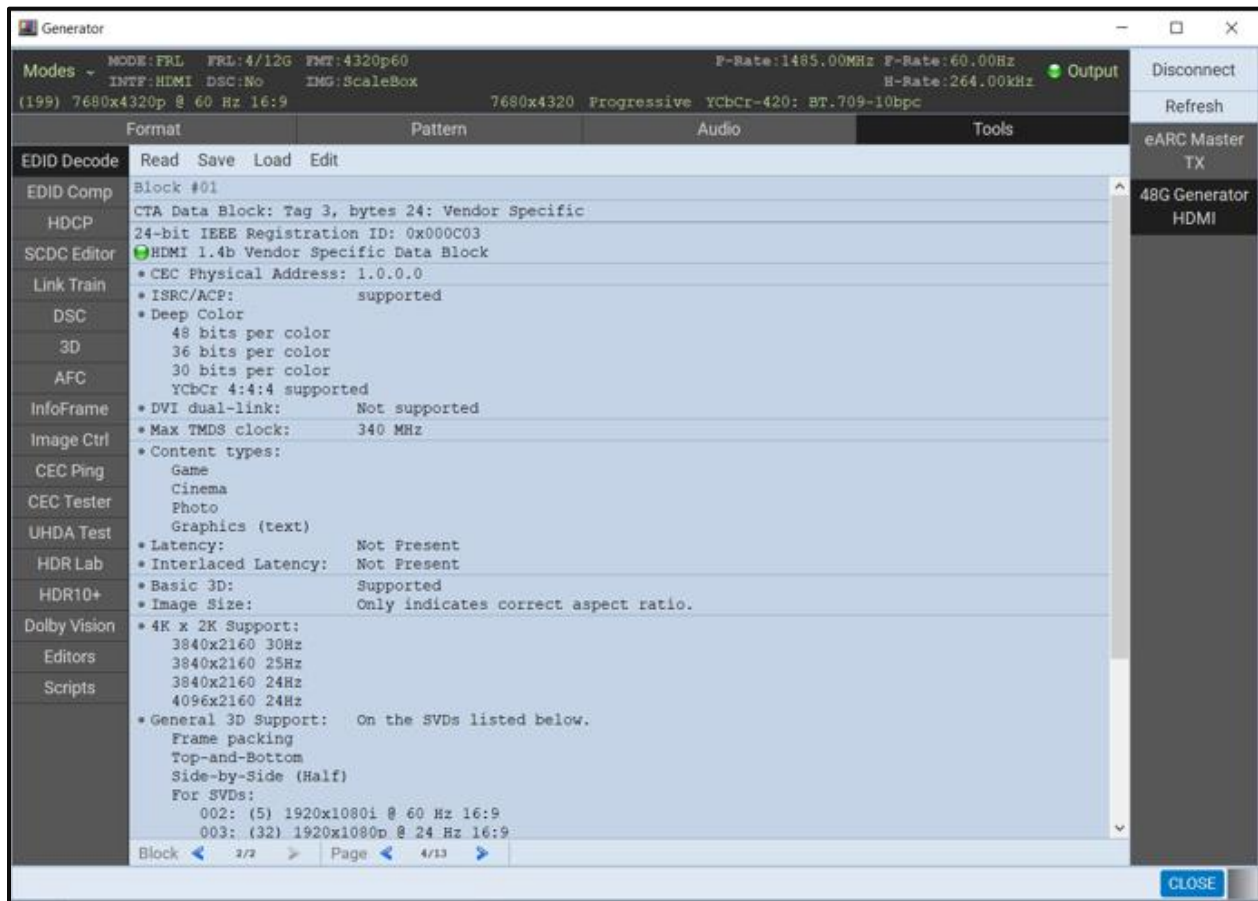
Examples of the **EDID Decode** content are shown in the following screens.



The CEA Audio Block is shown below.



The CEA Vendor Specific Data Block is shown below.

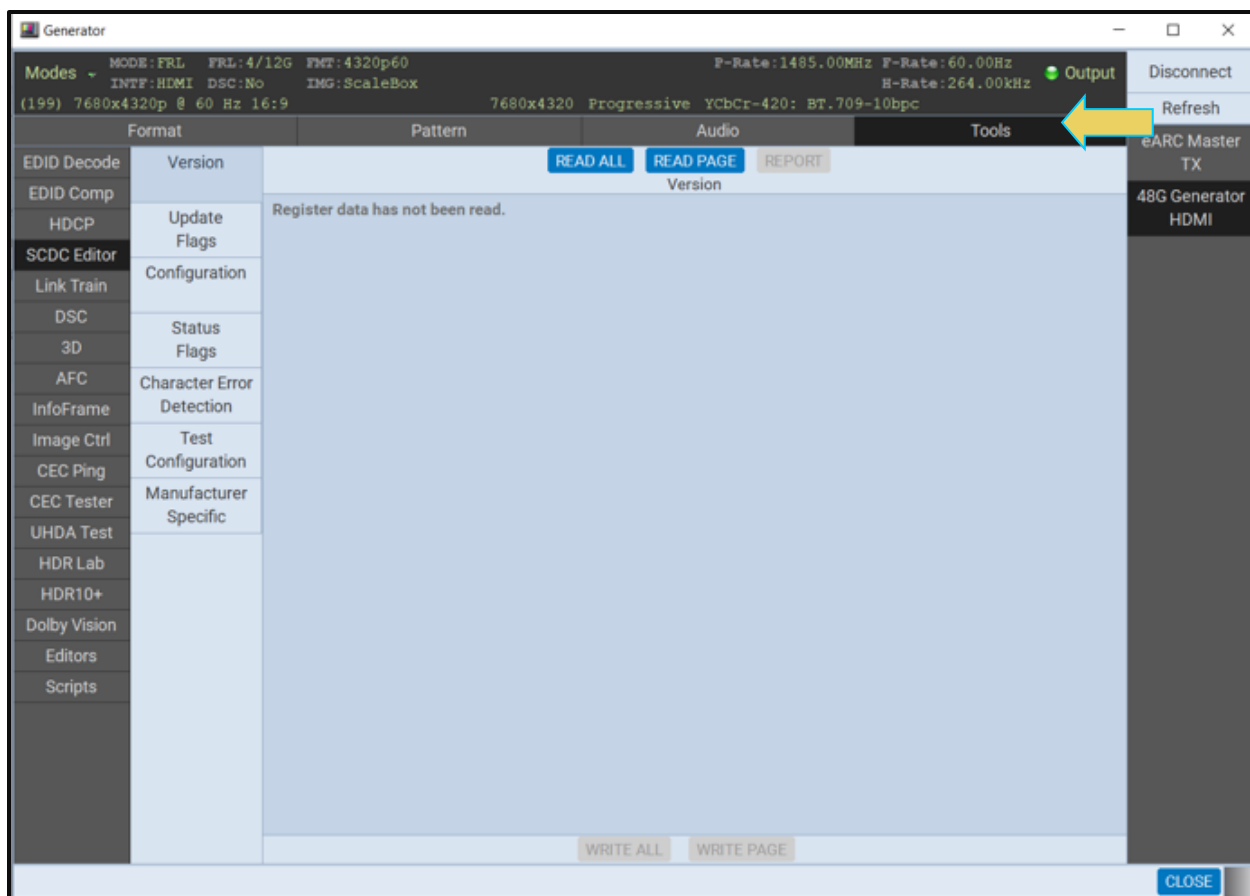


14.24 Viewing the SCDC register contents of a connected display

Use the following procedures to view the SCDC register contents of the connected display. These procedures assume that you have connected the HDMI 2.1 HDTV to these Tx port.

To view the SCDC register contents of a connected display:

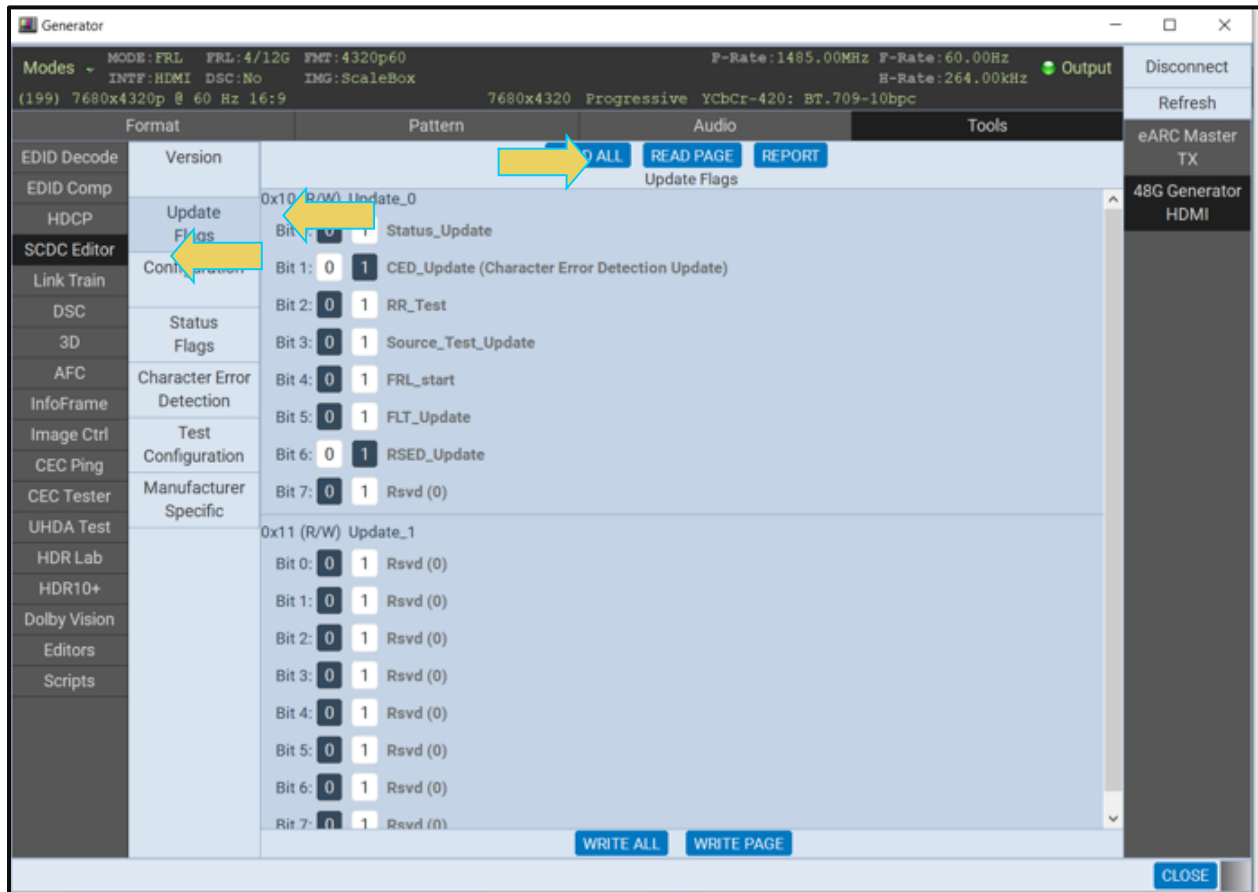
1. From the main window of the M41h 48G Video Analyzer/Generator, select the **Tools** tab.



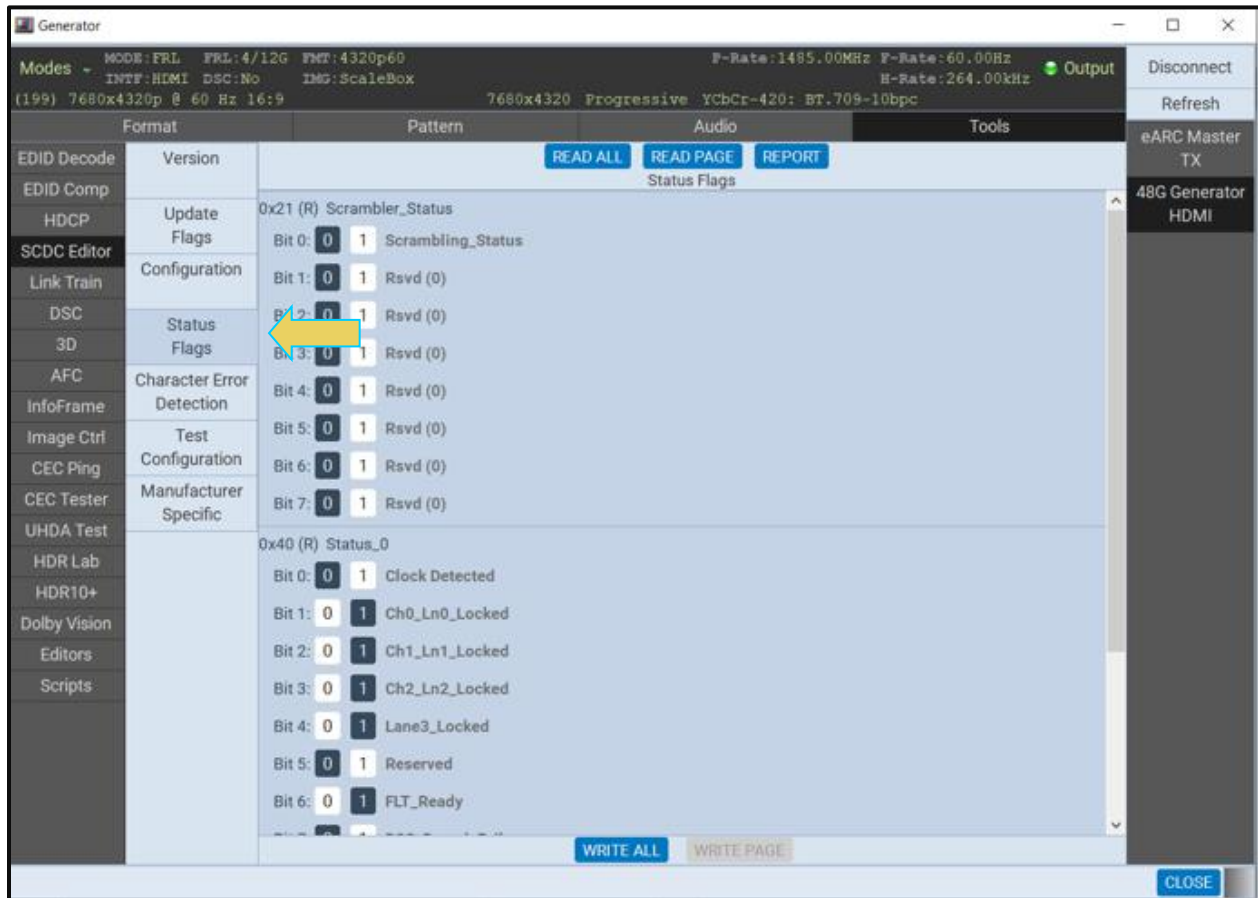
Make sure the M41h 48G Video Analyzer/Generator is selected.

2. Activate the **SCDC Editor** button on the upper left (indicated below).
3. Select a register set to view (example Update Flags)
4. Select Read All or Read Page.

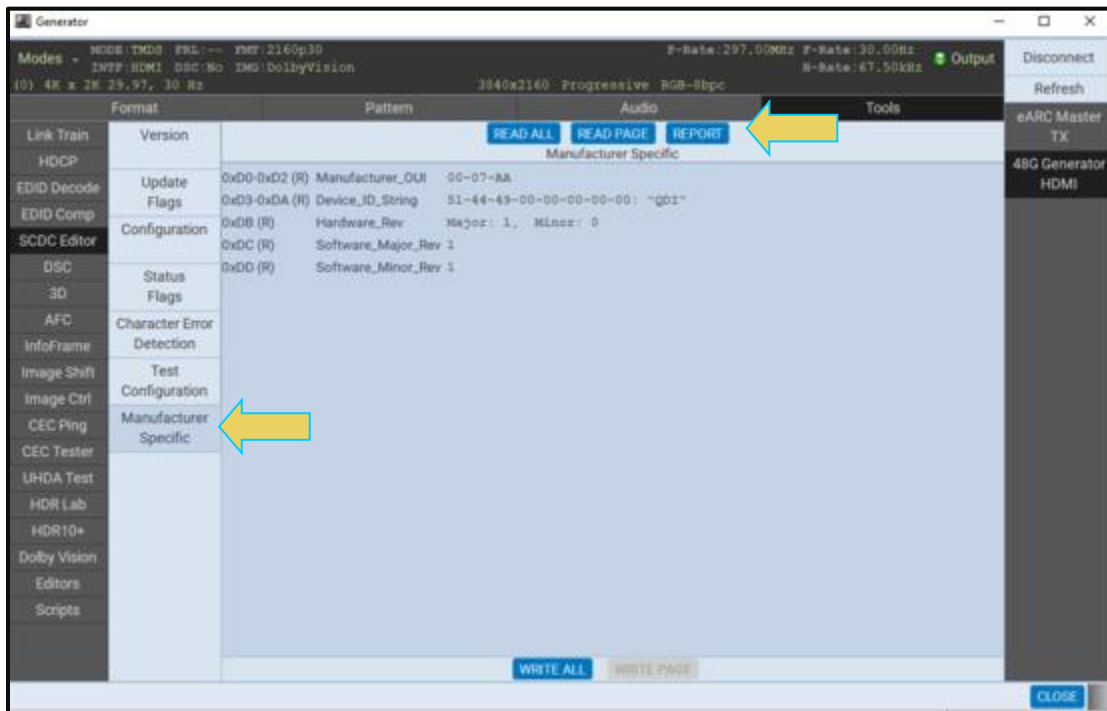
The following screen example shows the SCDC Update Flags. (No data is shown in the following screen example.)



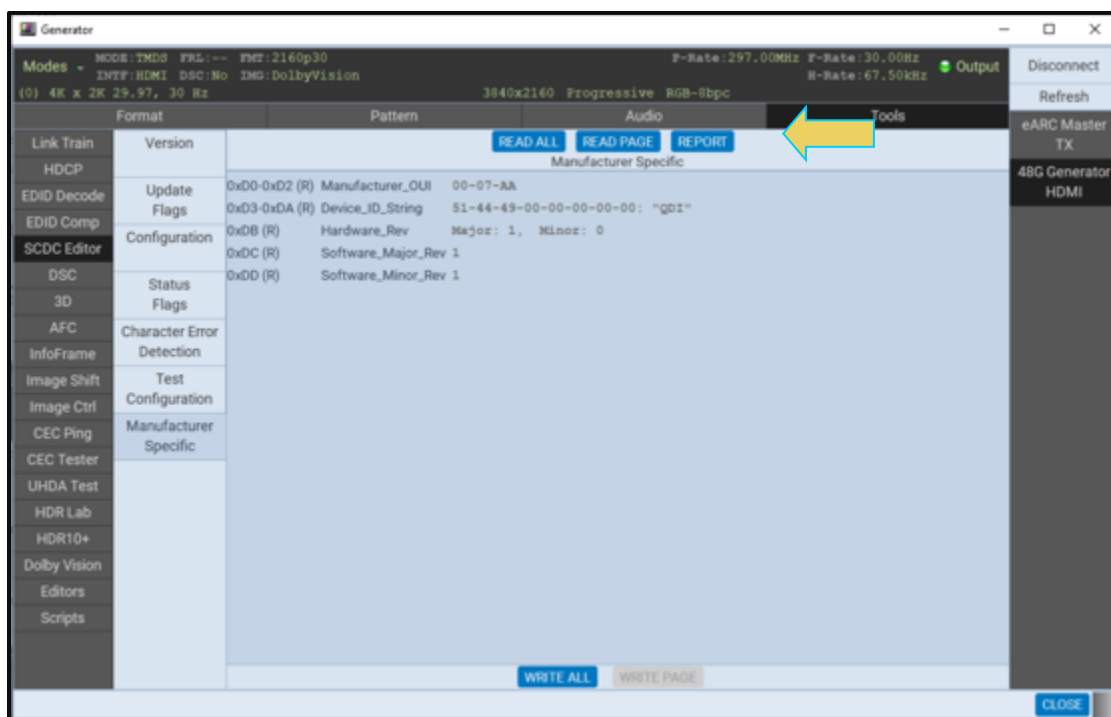
The following screen example shows the SCDC Status Flags. (No data is shown in the following screen example.)



The following screen example shows the SCDC Manufacturing Specific data.



5. (Optionally) issue an HTML report with the Report activation button as shown below.



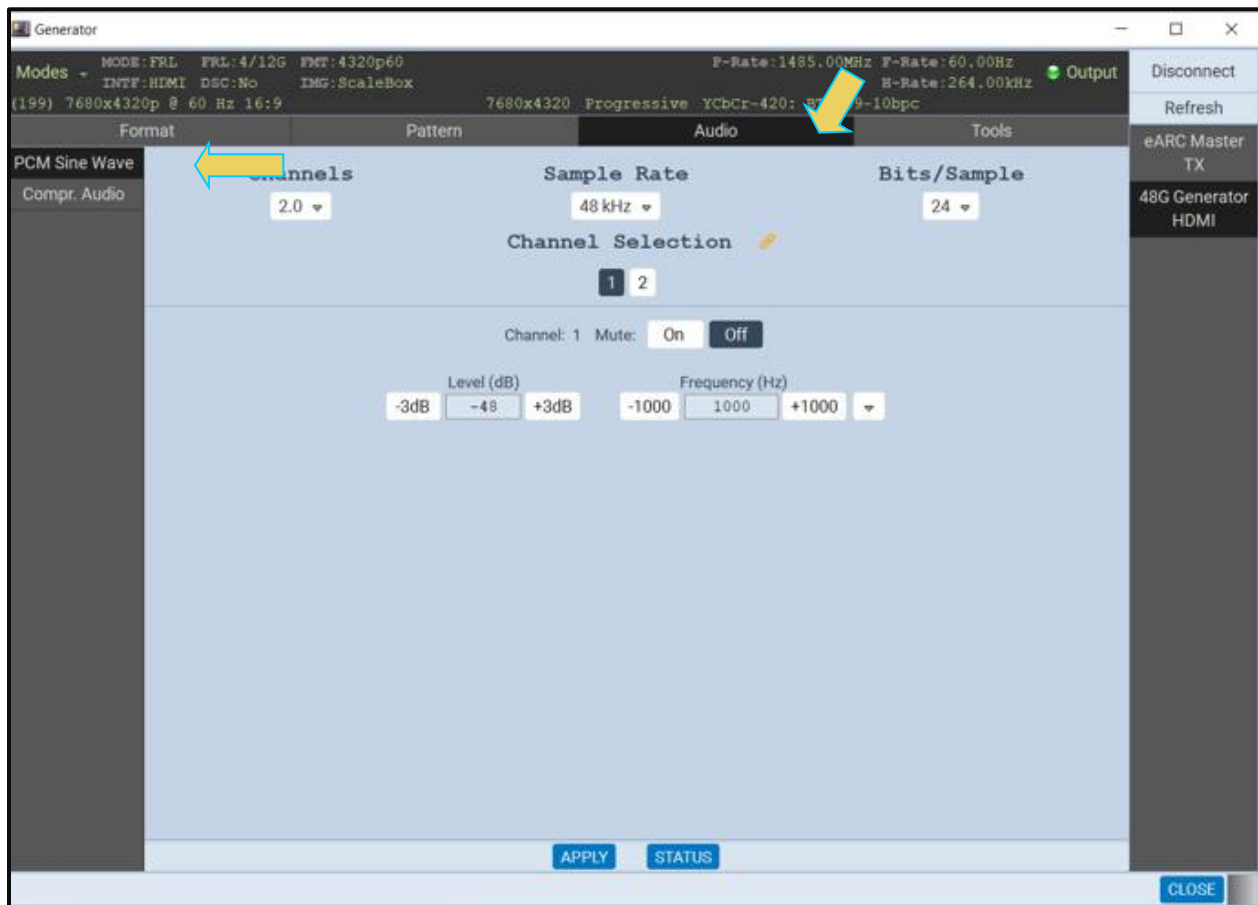
14.25 Selecting audio formats

Use the following procedures to select HDMI formats.

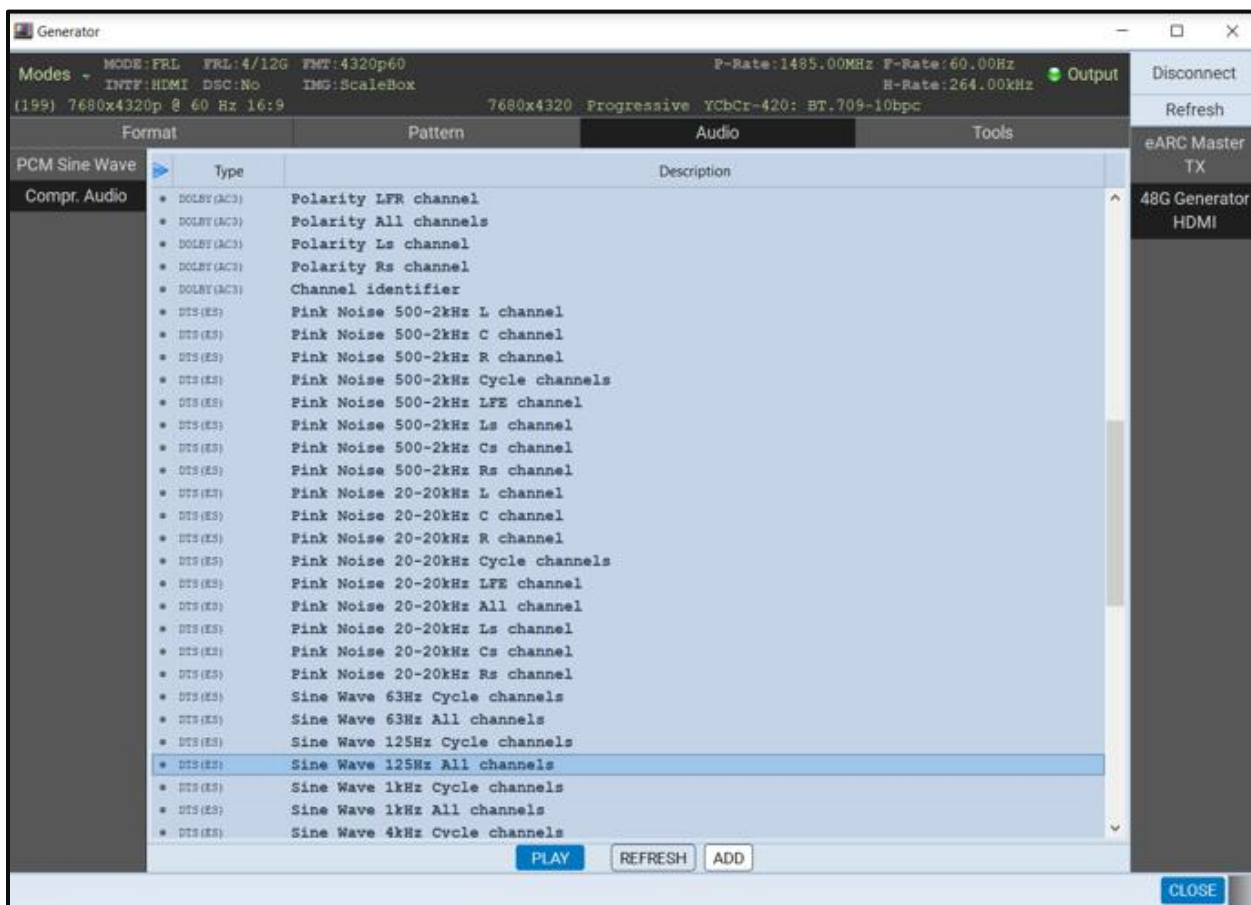
To select an audio format:

1. From the main window of the M41h 48G Video Analyzer/Generator, select the **Audio** tab indicated below.

The following example shows LPCM selection. The second slide shows selection of compressed audio formats.







The table below summarizes the M41h 48G 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.	2.1 2.1 5.1 6.1 7.1
Sampling Rate	This is the sampling rate of the audio sine wave test tone.	32kHz 44.1kHz 48kHz 88.2kHz 96kHz 176.4kHz 192kHz

LPCM Programmable Sine Wave options		
Parameter	Description	Options
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.	FL – Front Left FR – Front Right LFE – Low Frequency Effects FC – Front Center RL – Rear Left RR – Rear Right RLC – Rear Left Center 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 unmutes the audio for a particular channel.	On Off
Frequency (Hz)	The frequency of the audio sine wave test tone.	Programmable throughout a range of – 0.01kHz to 20kHz (per channel) in increments of: 1Hz 10Hz 100Hz 1kHz

14.25.1 AV Mute Commands

The HDMI 48G Generator provides the option to configure the AVMUTE Flag via the command line, as well. The AV Mute Commands will immediately configure the 2 AVMUTE flags in the transmitted General Control Packet:

- **Clear AVMUTE flag**
- **Set AVMUTE flag**

For instructions on accessing the command line of the M41h, see the chapter in this user guide titled **Command Line Interface**

The following three commands can be used to configure the AVMute flags.

```
mute 0
```

This sets the flags to their default state:

- **Clear AVMUTE Flag = 1**
- **Set AVMUTE Flag = 0**

```
mute 1
```


This sets the flags to muted state:

- **Clear AVMUTE Flag = 0**
- **Set AVMUTE Flag = 1**

```
mute 2
```

This clears the flags, leaving no AVMUTE information:

- **Clear AVMUTE Flag = 0**
- **Set AVMUTE Flag = 0**

 10.30.196.150 - PuTTY

```
Linux Mint 19.1 Tessa
M4XX-95df login: qd
Password:
Last login: Sun Aug  7 21:50:31 CDT 2022 from ::ffff:10.2
#p21-scope>mute 1
```

Command to set AVMUTE flags to muted state

14.26 Testing HDCP 2.2 on a connected display

Use the following procedures to test HDCP authentication on a connected display. HDCP 2.2 is tested using a special test image called HDCP2.2. This test images are selectable through the **Pattern** tab.

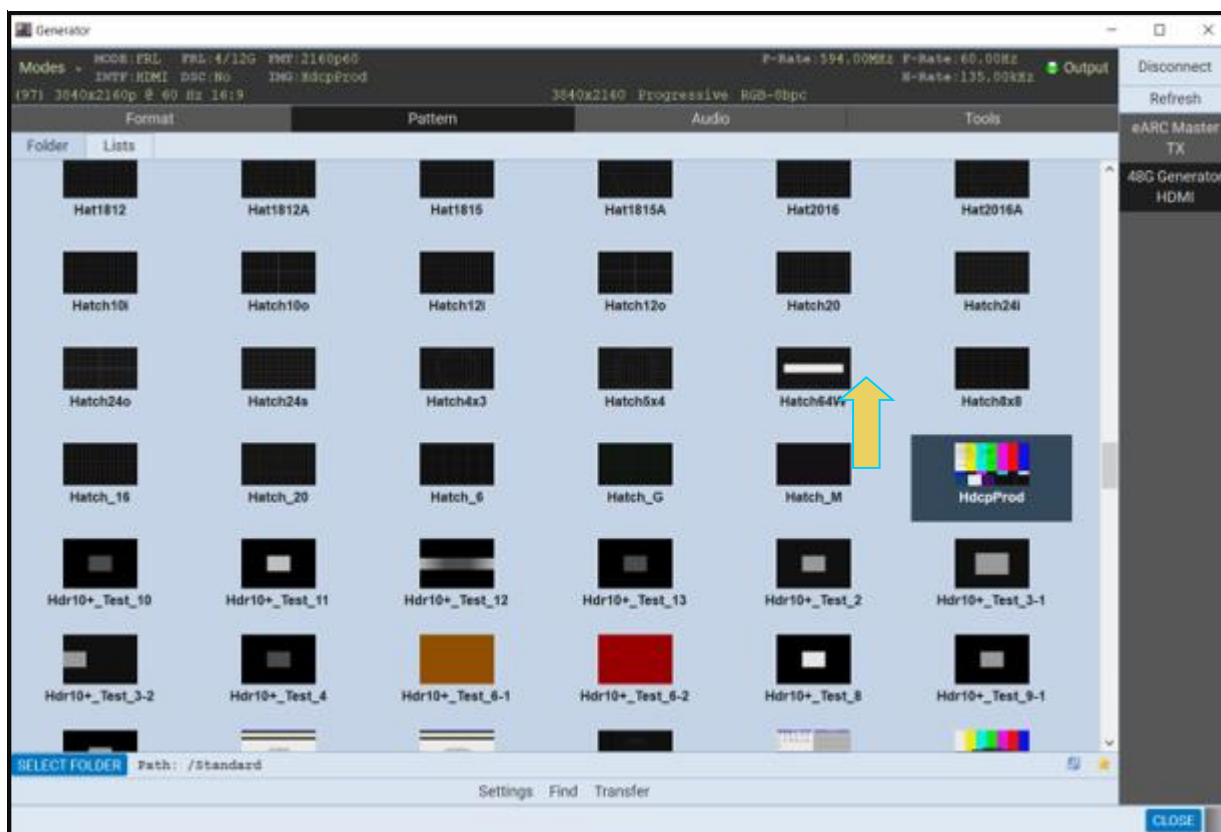
Note that you can view the HDCP 2.2 authentication transactions using the Auxiliary Channel Analyzer (ACA) utility. Please refer to Auxiliary Channel Analyzer (ACA) for more details.

14.26.1 Running the HDCP 2.2 test

You can enable HDCP 2.2 in one of two ways: 1) Using the HDCP2.2 test image and 2) Using the Tx Control dialog box. Use the procedures below to run an HDCP 2.2 test on a connected display.

To test HDCP on a connected display (HDCP2.2 Test Image):

Access the **Pattern** tab to view the test patterns.



Select the HDCP2.2 test image (above).

A typical result is shown below.



Note that you can view the HDCP 2.2 authentication transactions using the Auxiliary Channel Analyzer (ACA) utility. Please refer to Auxiliary Channel Analyzer (ACA) for more details.

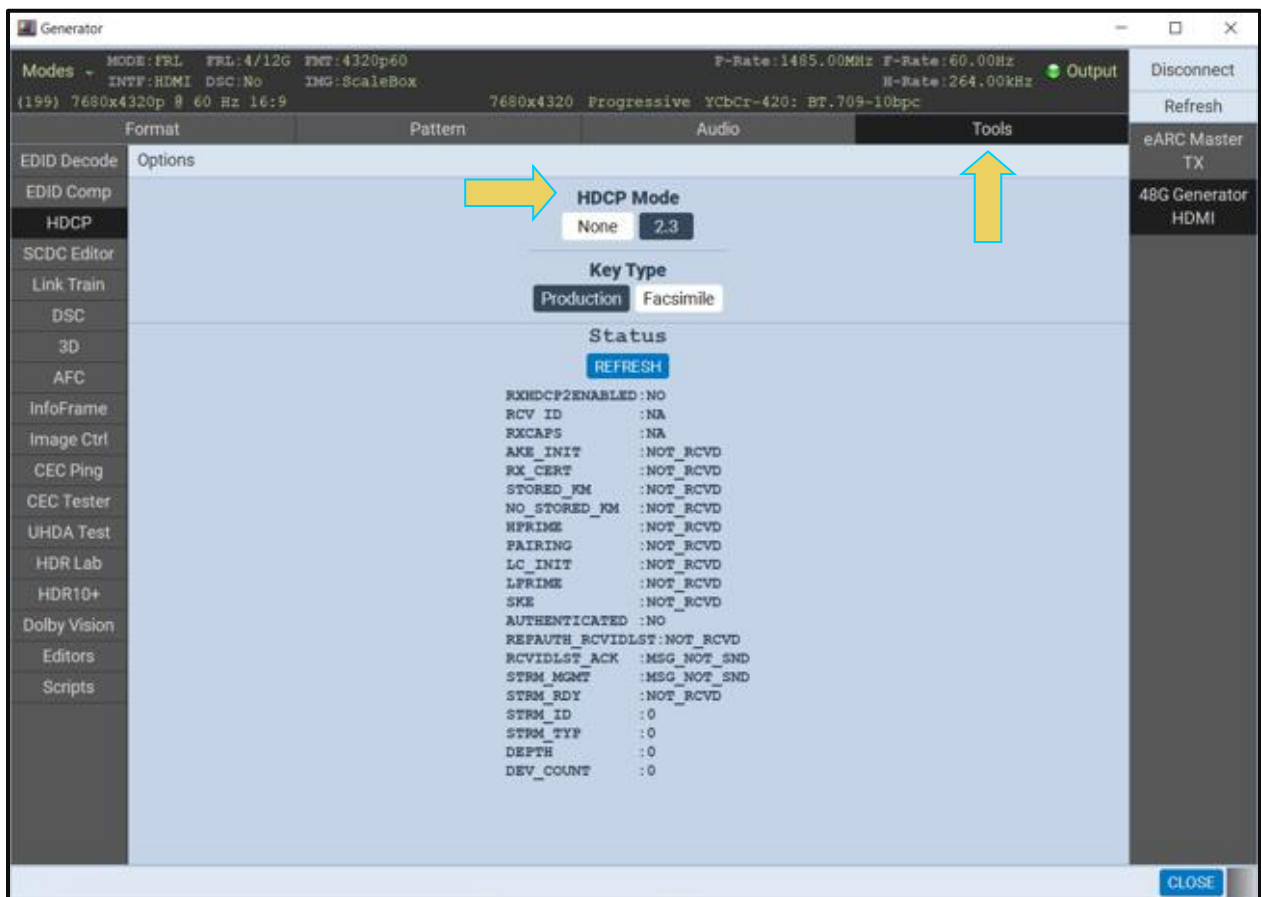
To test HDCP on a connected display (HDCP Tx Control Dialog Box):

1. From the **View** menu, select the **Generator** item.



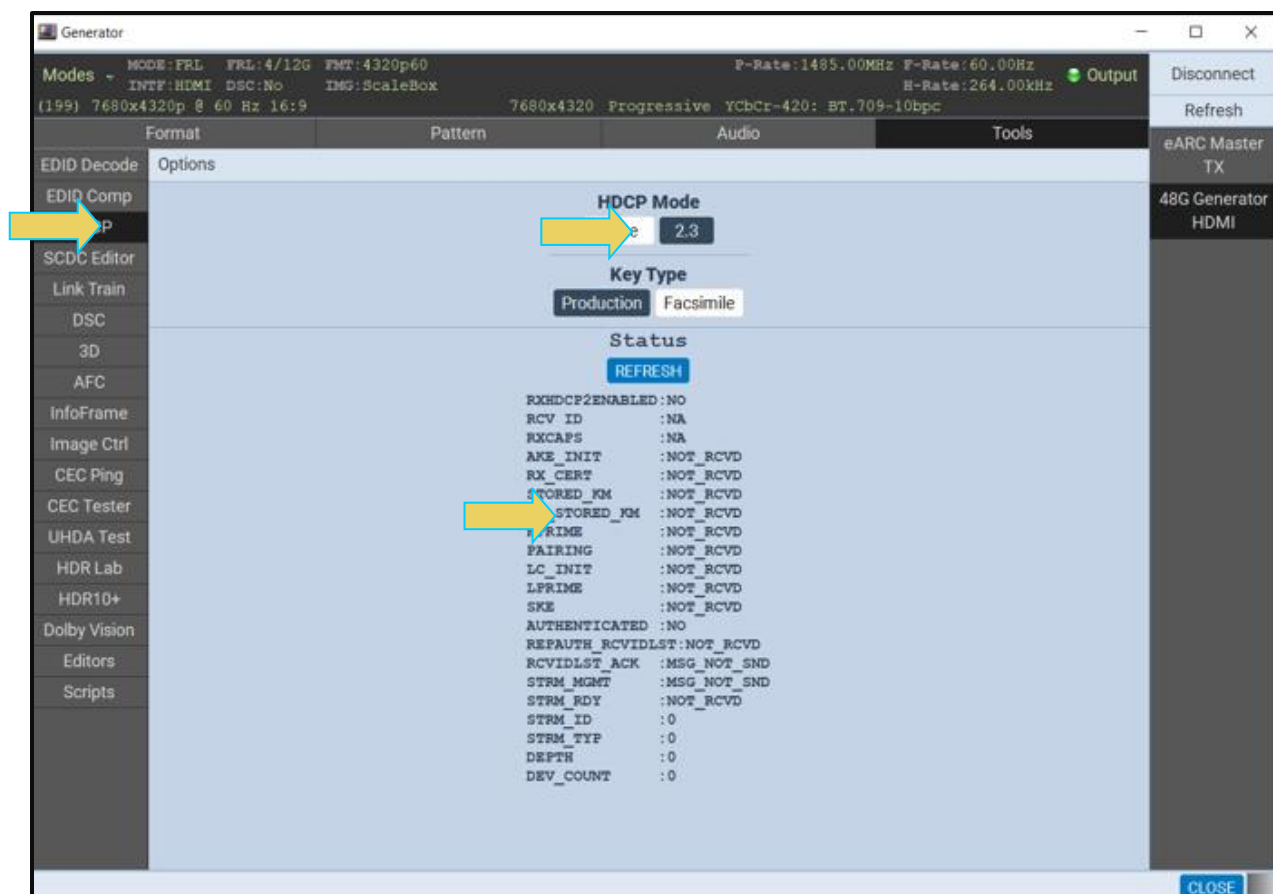
The **Generator** panel will be populated as shown below.

2. Select the **Tools** tab (indicated below).



3. Select the **HDCP** button (indicated below).
4. Enable HDCP 2.2 using the radio button as indicated on the screen examples below.

The status is shown in the center portion of the panel. Hit the refresh button when any changes are made to refresh the view.



Note that you can view the HDCP 2.2 authentication transactions using the Auxiliary Channel Analyzer (ACA) utility. Please refer to Auxiliary Channel Analyzer (ACA) for more details.

14.27 Configuring and Transmitting Custom Metadata Values with the InfoFrame Utility

Use the following procedures to configure and transmit custom metadata over the HDMI interface. You can use the InfoFrame Utility to configure and disable/enable the transmission of the following types of metadata:

Auxiliary Video InfoFrame (AVI) – Enable or disable transmission and configure custom values.

Audio InfoFrame – Enable or disable transmission of this InfoFrame.

Source Product Descriptor (SPD) – Enable or disable transmission of this InfoFrame.

Vendor Specific InfoFrame (VSIF) – Enable or disable transmission and configure custom values.

HDMI 2.1 Forum Vendor Specific InfoFrame (HF-VSIF) – Enable or disable transmission and configure custom values.

MPEG – Enable or disable transmission of this InfoFrame.

GIF – Enable or disable transmission of this InfoFrame.

GIF2 – Enable or disable transmission of this InfoFrame.

Gamut Metadata Packet (xvYCC) – Enable or disable transmission of this data island.

High Dynamic Range (HDR) – Enable or disable transmission and configure custom values.

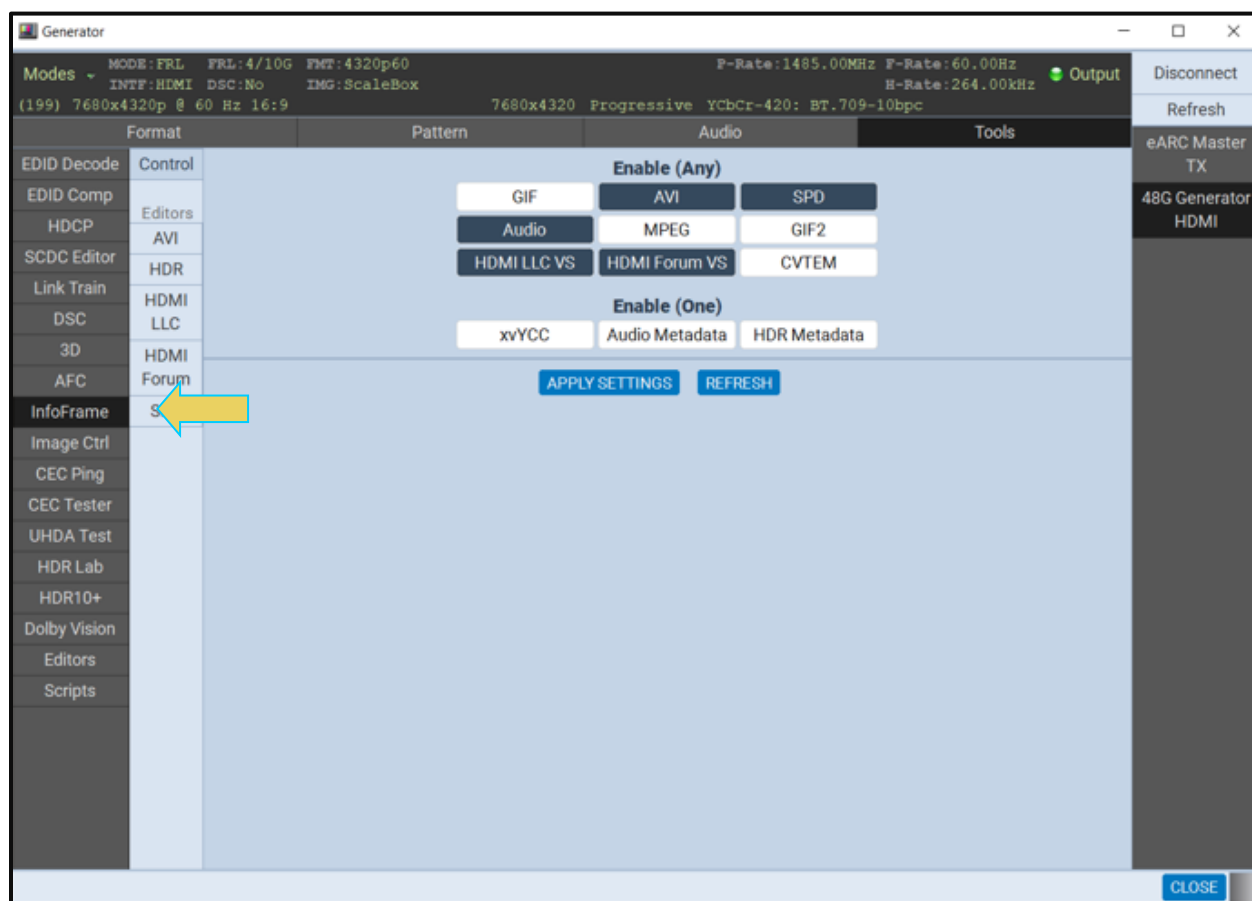
Audio Metadata – Enable or disable transmission of this metadata for 3D audio and multi-stream audio.

14.27.1 Configuring Metadata for Transmission

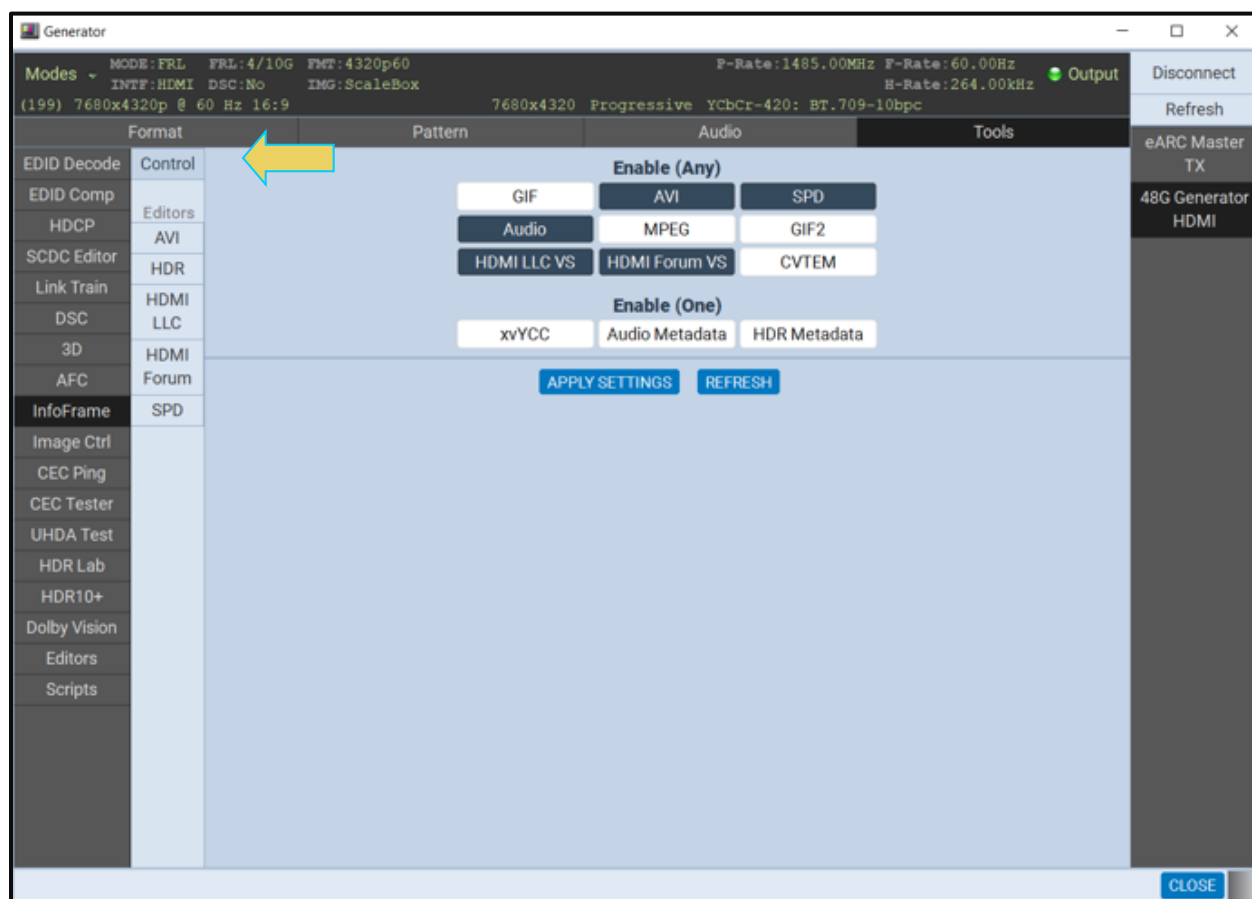
Use the procedures below to enable/disable the transmission of metadata and configure custom metadata values.

To enable/disable transmission of specific metadata types:

1. Access **InfoFrame** Utility from the **Tools** tab (below).



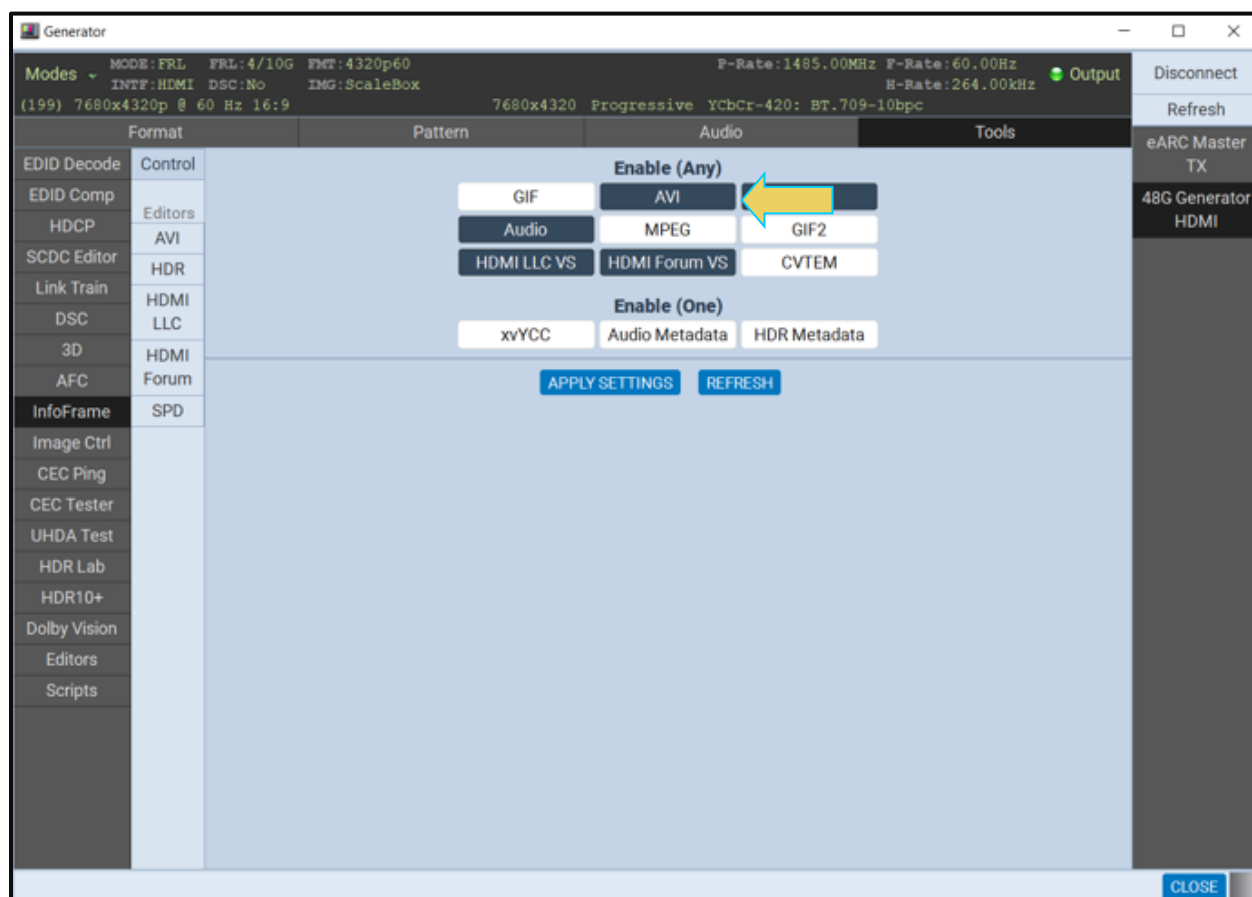
2. Select the **Control** button on the left side as indicated below.



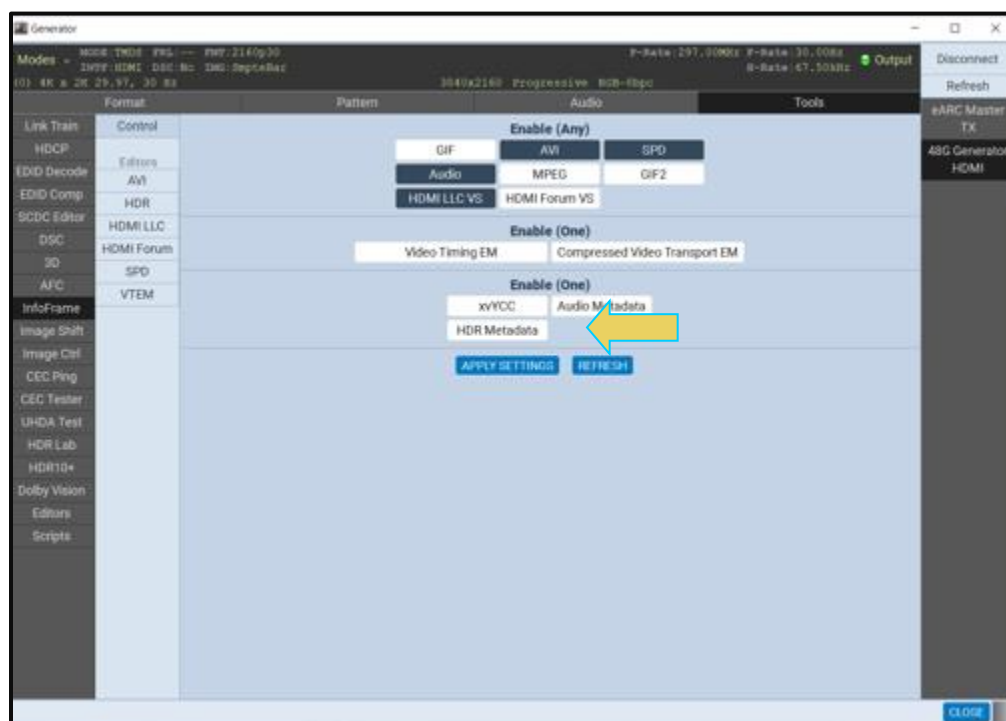
3. Select the metadata types that you wish to enable or disable using the check boxes under the **Enable (Any)** area of the **InfoFrame** Utility window.
4. Click on the **Apply Settings** activation button **APPLY SETTINGS** to initiate the change.

Note: The **Refresh** button **REFRESH** reasserts the default state with all applicable metadata transmitted.

The example below shows a configuration where AVI, HDMI LLC VSIF and SPD metadata are enabled for transmission but Audio InfoFrames are not transmitted.



You can specifically enable only a single type of metadata for a particular set of types under the **Enable (One)** area. The **Enable One** operates as a one or none case. If you select one type, for example HDR Metadata (below), transmits and the other two types (xvYCC and Audio Metadata) will not.

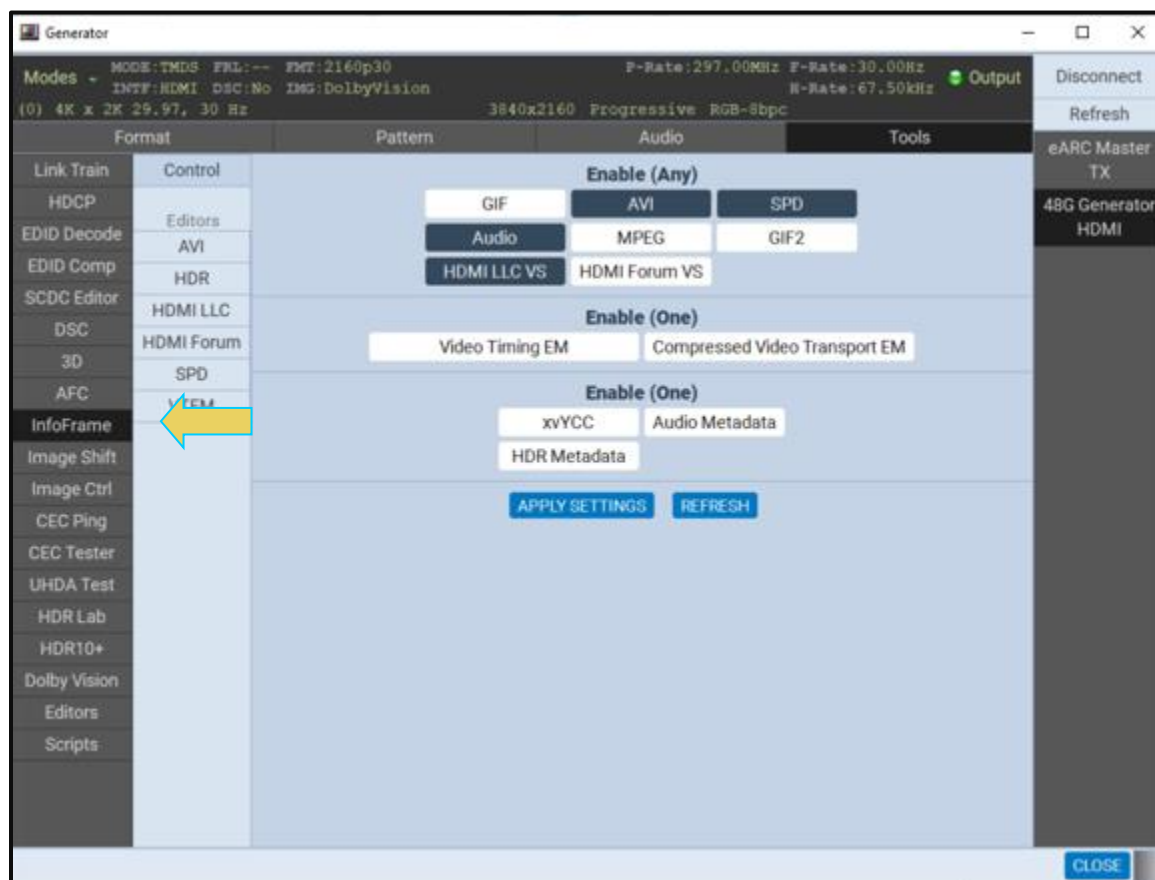


- Click on the **Apply Settings** activation button **APPLY SETTINGS** to initiate the change.

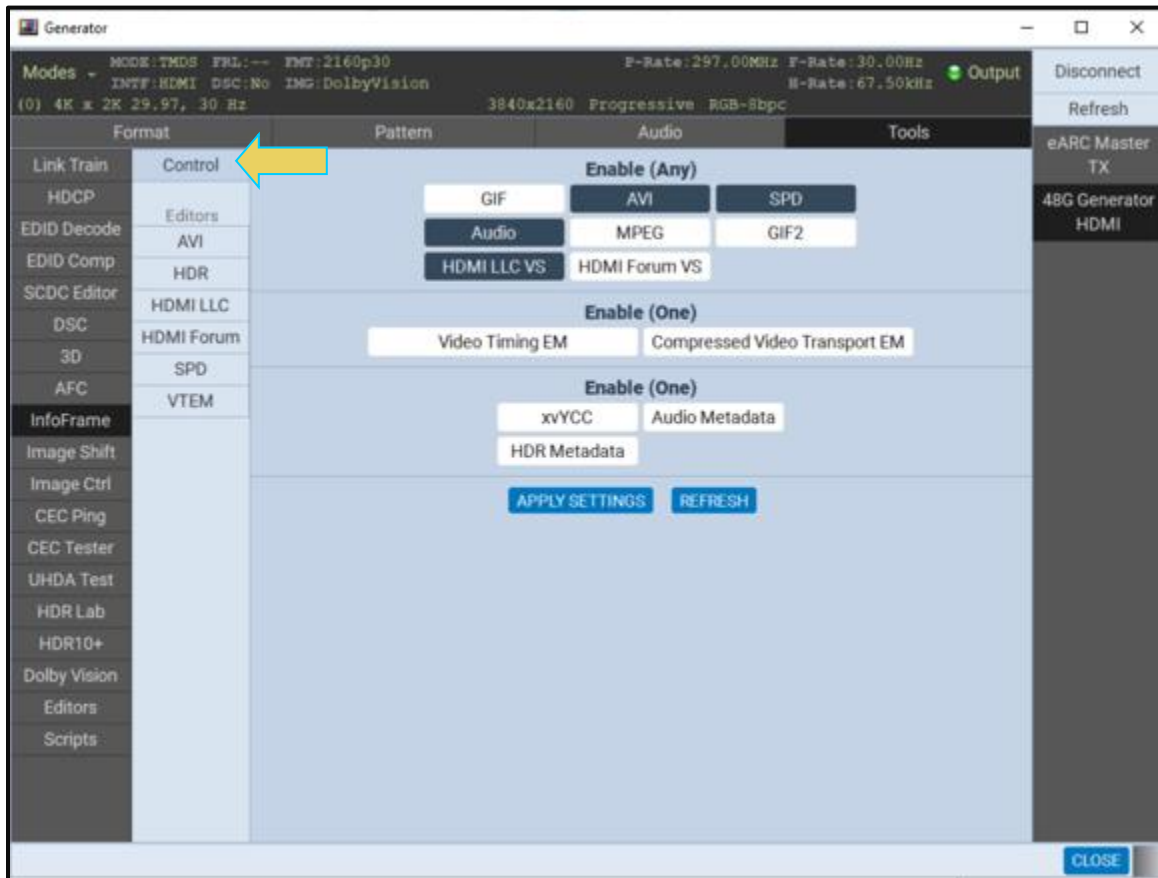
Note: The **Refresh** button **REFRESH** reasserts the default state with all applicable metadata transmitted.

To configure InfoFrame and metadata parameter values:

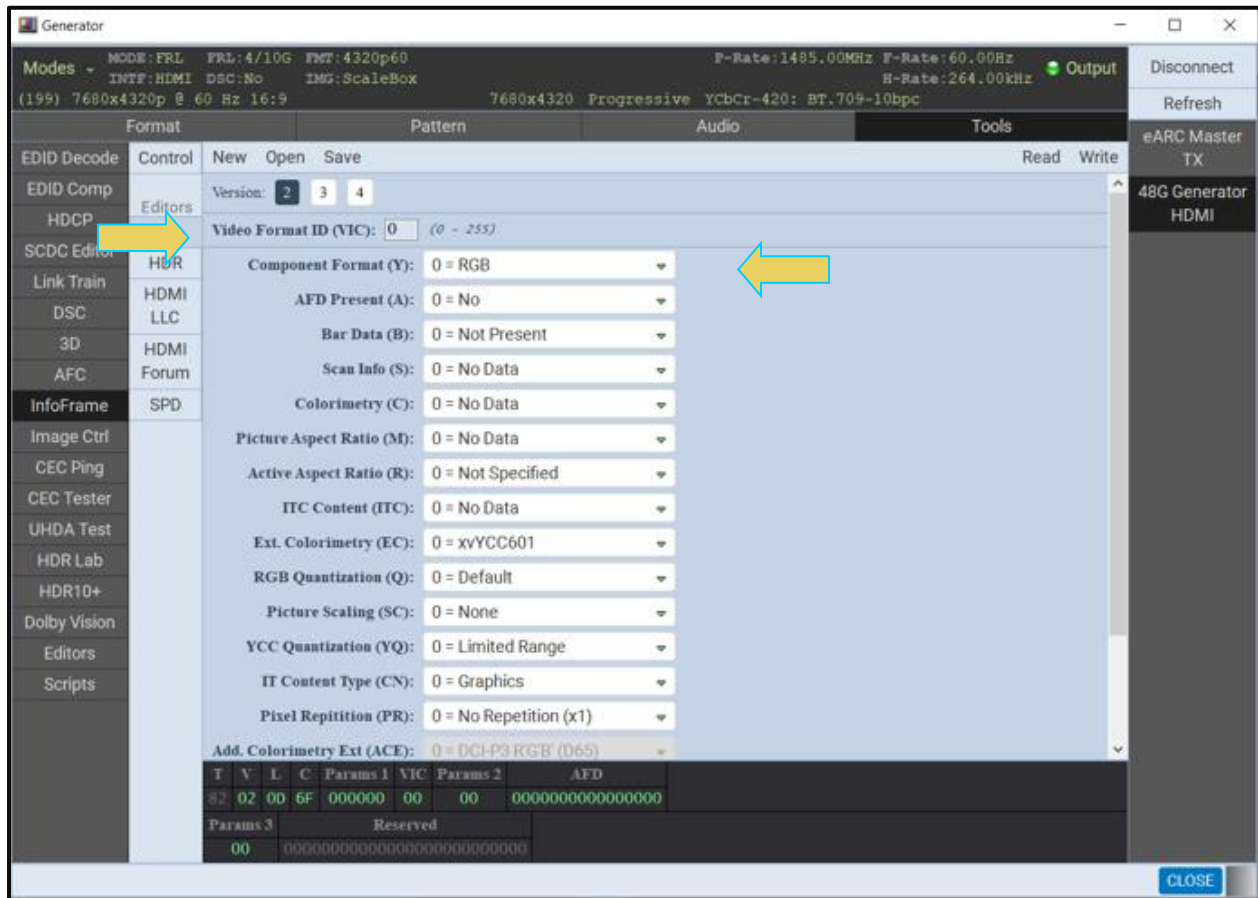
1. Access **InfoFrame** Utility from the **Tools** tab (below).



2. Select the **Control** button on the left side as indicated below.



In the example below, the AVI InfoFrame is being configured.

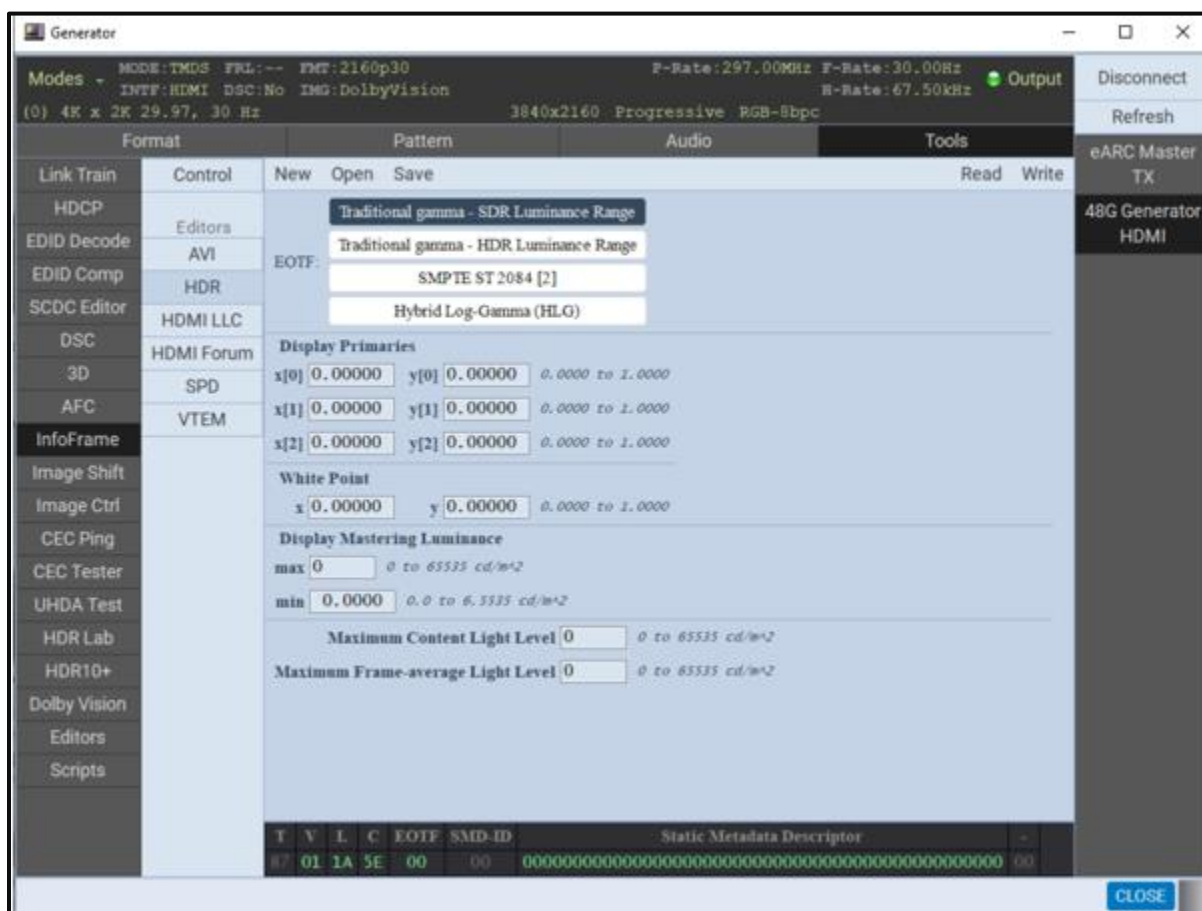


The drop-down menu for the Component Format is visible in the above screen.

3. Select RGB for example.
4. Click on the **Write** activation button **Write** to initiate the change and the transmission. The **Reset** button **Read** re-establishes the default configuration.

In the second example, the HDR InfoFrame is being configured with appropriate values (screens below).





- Click on the **Write** activation button **Write** to initiate the change and the transmission of the new HDR values. Click on the **Reset** button **Read** to re-establish the default configuration.

14.28 Viewing Metadata Packets Transmitted to a Connected Display

Use the following procedures to view the HDMI metadata packets transmitted to your display under test. The test image used to view the metadata is selectable through the **Pattern** tab.

14.28.1 Viewing Metadata Packets

Use the procedures below to view metadata packets transmitted to a connected display. These procedures assume that you have an HDMI HDTV connected to M41h's Tx port.

To view the metadata packets transmitted to a connected display:

- Access the **Pattern** tab to view the test patterns.



2. Select the PacketTx test.
3. View the results on the connected display. A typical example of the first packet type (AVI InfoFrame) is shown below. The following is a list of packet types viewable through the PacketTx test image:

AVI InfoFrame.

Audio InfoFrame.

Source product descriptor InfoFrame.

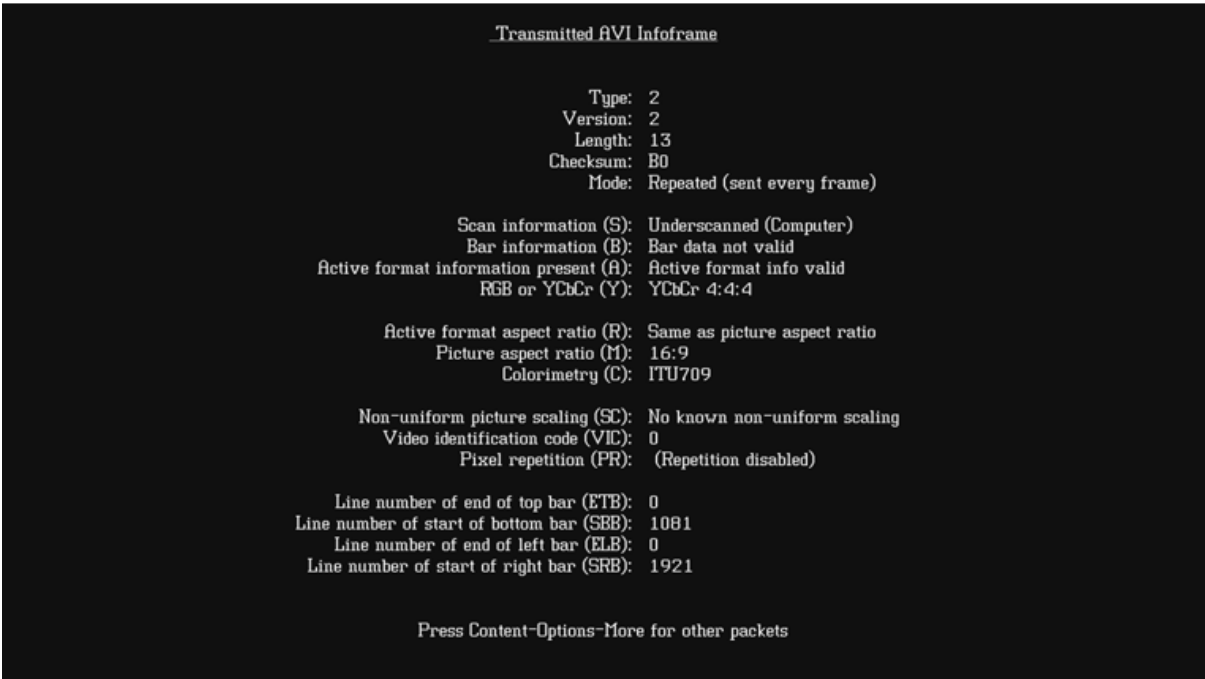
Other packets:

Audio Clock Regeneration packets

Channel Status bits

Vendor Specific InfoFrame.

The image below is the first page of the multi-page test image. This screen shows the AVI InfoFrame.



To advance to the next metadata packet type, access the **Renditions** dialog box through the **Settings** activation button as shown below.



15 Testing HDMI Sources and Distribution Networks for Pixel Errors

The M41h enables you to test the video quality of an HDMI® TMDS stream. Using the Pixel Error test feature. This test is only available through the Receiver application in the “Real Time” mode on the embedded ATP GUI Manager display. The test is not available on the external ATP GUI Manager.

The Pixel Error test can also be run through the command line. The commands necessary for running these tests are included in this chapter.

The Pixel Error test (Frame Compare) checks for pixel errors in the HDMI stream from an upstream source device through a cable or distribution network. The Pixel Error test enables you to verify either the source or distribution network. For example, if your application is to test distribution network components such as splitters, switches, and extenders then you would use the high-quality HDMI cable provided with the M41h.

For testing a source, you would use the Pixel Error test with a short known-good HDMI cable (**Note:** Use the high-quality HDMI cable provided with the M41h.)

15.1 Accessing the Real Time Mode

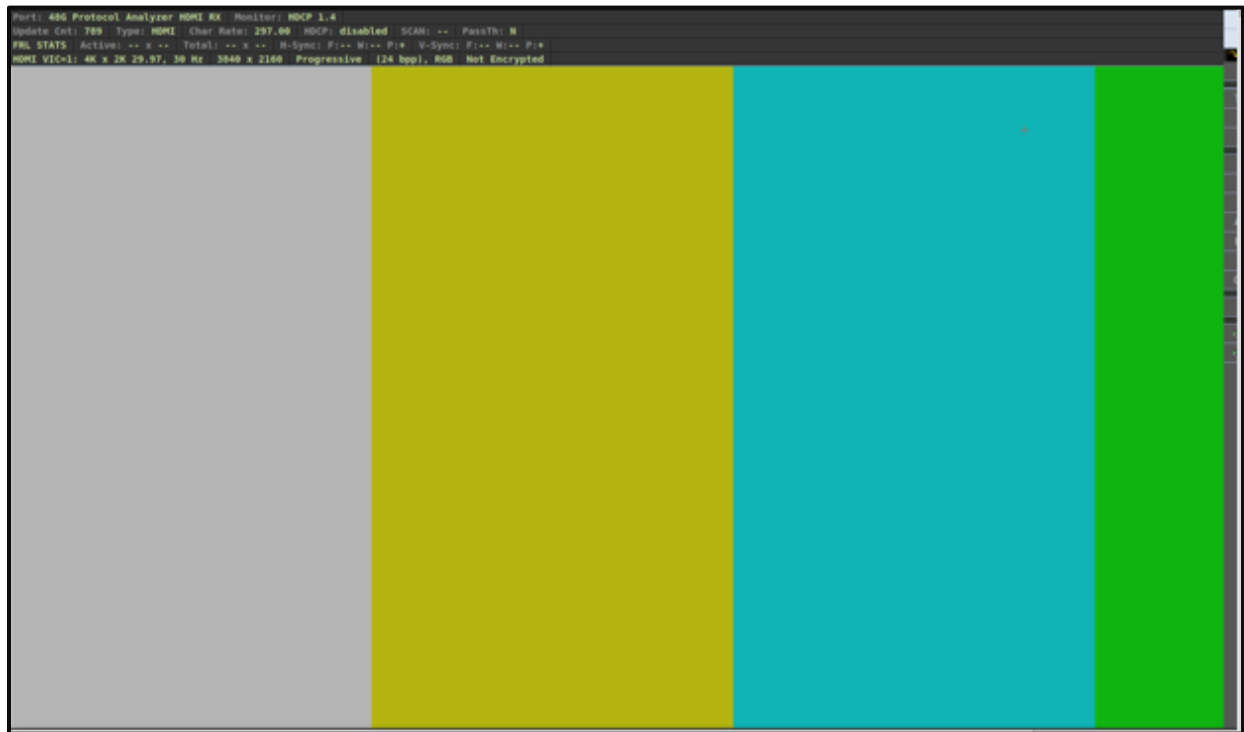
To access the Real Time mode:

Touch select **Receiver** on page 1 of the **Apps** panel on the embedded ATP GUI Manager:

Note: The Real Time viewing windows are not available on the PC-based external GUI Manager.



The Receiver “Real Time” panel appears as shown below:



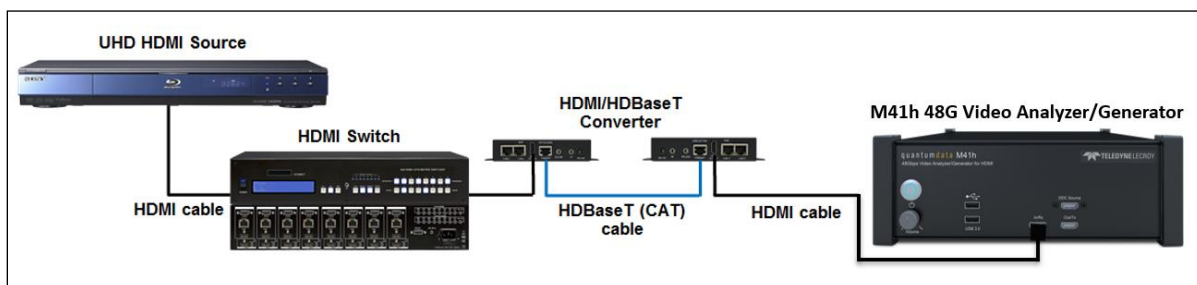
15.2 Testing HDMI Distribution Network Components with the Pixel Error Test

Use the following procedures to setup and test HDMI Distribution Network components. This procedure assumes that you are in the Real Time mode through the **Receiver** application panel.

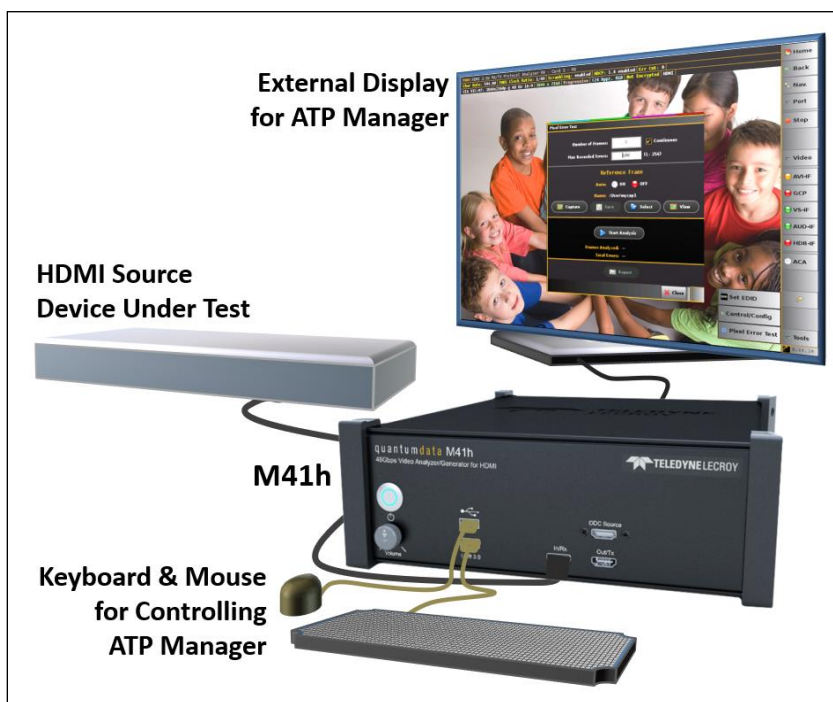
To Run the Pixel Error test:

1. Connect the source and HDMI distribution network to the M41h Rx port as shown below. The diagrams below depict the connections with the M41h.

Note: Use the high-quality HDMI cable provided with the M41h.

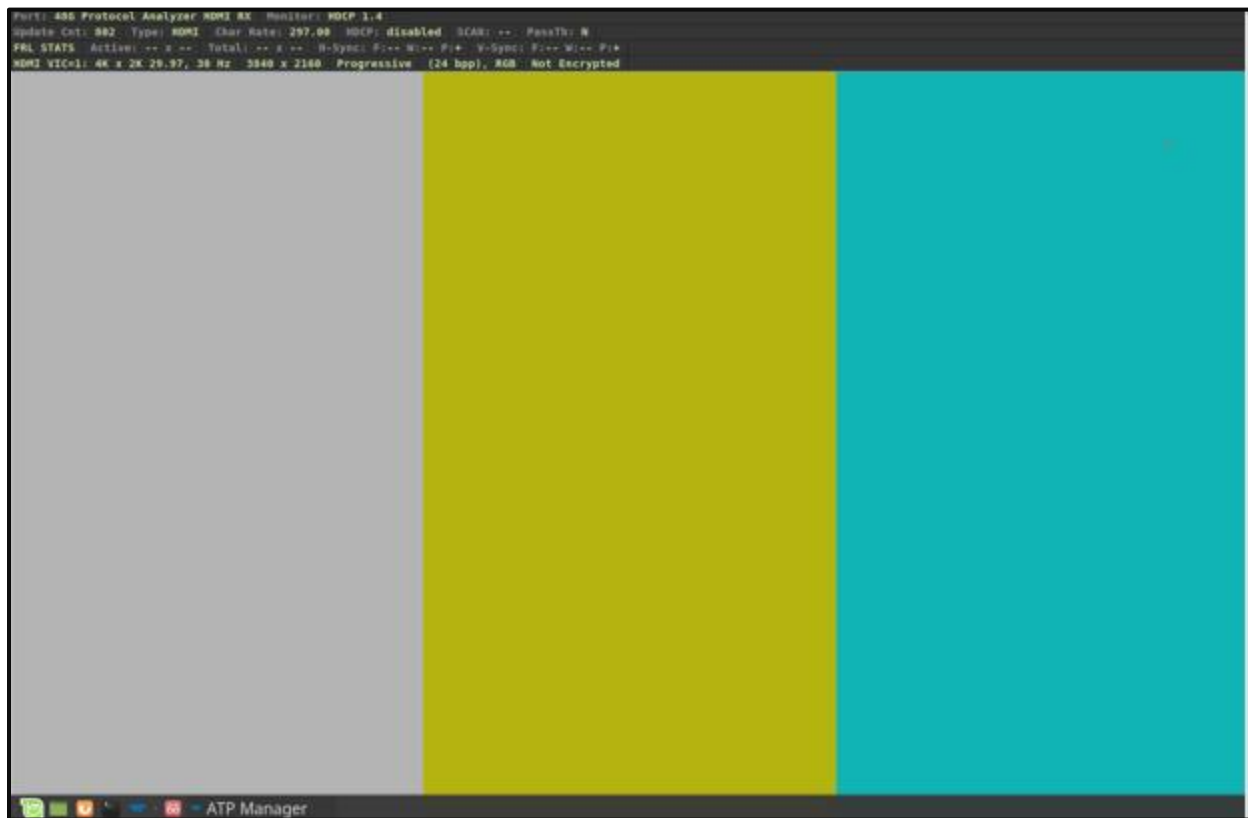


Connection for running pixel error test on HDMI distribution network



Connection for HDMI source analysis

2. From the Real Time window select the **Tools** menu as shown below:



The **Pixel Error** test dialog box appears as shown below:

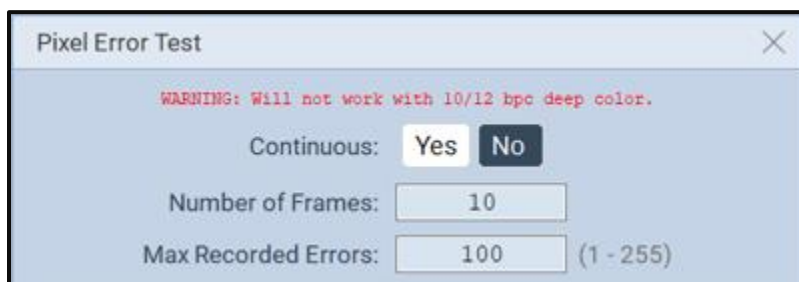
The table below describes the fields and buttons on the Pixel Error Test dialog box.

Pixel Error test dialog box - Item	Information / Function
	<p>The following is a description of the items on the Pixel Error Test dialog box:</p> <p>Number of Frames – This is the number of frames to test when Continuous is deselected.</p> <p>Max Recorded Errors – This is the maximum number of errors that can be recorded and presented in the Report. Enter in the range of 1 top 256; default 100.</p> <p>Continuous – A check box indicating whether the test runs continuously and requires manual intervention to stop or unchecked with the test stopping after the number specified in Number of Frames.</p> <p>Reference Frame; Auto – Radio buttons indicating whether the test will use a reference frame video image generated from the source as the test in initiated (ON) or if the test will use a reference frame video image stored on the PC (OFF).</p> <p>Path – This field is used only if Reference Frame; Auto is disabled. The field indicates the file name and path where the reference frame is obtained from.</p>

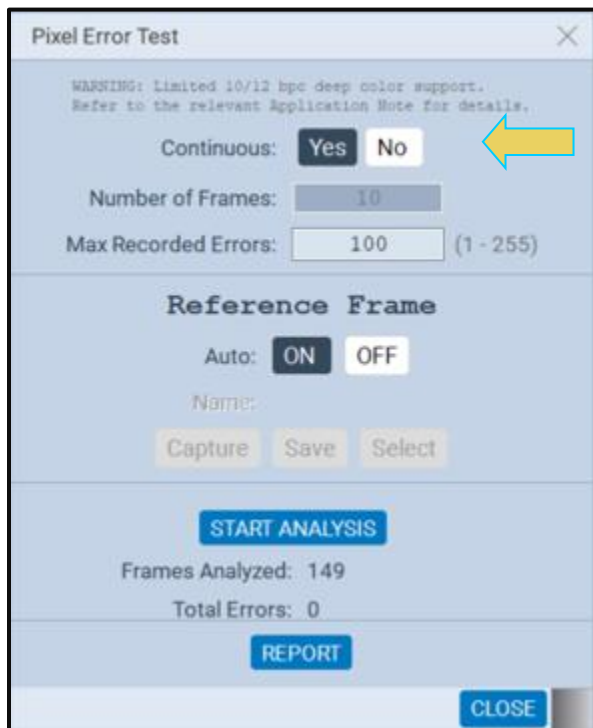
Pixel Error test dialog box - Item	Information / Function
	<p>Capture – Used only when using a video reference frame stored on the M41h (Auto=OFF). Enables you to capture a video reference frame from a source to use a reference frame in subsequent testing.</p> <p>Save – Saves the captured reference frame to the 980.</p> <p>Select – Enables you to browse for a video reference frame stored on the M41h for testing.</p> <p>View – Enables you to view the reference frame captured from the source or loaded from the 980.</p> <p>Start Analysis – Activation button to initiate the test. Turns to a Stop Analysis when running in the Continuous mode.</p> <p>Frames Analyzed – Indicates the number of frames currently analyzed or completed in the analysis once the test completes.</p> <p>Total Errors – Indicates the number of errors currently identified or the total errors determined when the test is completed.</p> <p>Report – Enables you to view an HTML report of the test results.</p>

3. Use the **Continuous** check box to specify whether you wish to run the test manually for an arbitrary number of frames or for a specific number of frames.

- For testing with a specific number of frames deselect the **Continuous** check box and enter the number of frames.



- For testing in the continuous mode select the **Continuous** check box.



Pixel Error Test

WARNING: Limited 10/12 bpc deep color support.
Refer to the relevant Application Note for details.

Continuous: **Yes** **No** ←

Number of Frames: 10

Max Recorded Errors: 100 (1 - 255)

Reference Frame

Auto: **ON** **OFF**

Name:

Capture Save Select

START ANALYSIS

Frames Analyzed: 149


Total Errors: 0

REPORT

CLOSE

- Specify whether you wish to run the test using a reference frame generated dynamically from the source under test or use a reference (“golden frame”) stored on your M41h.

- For testing with a reference frame generated from the source during the test, select the **Auto ON** radio button.



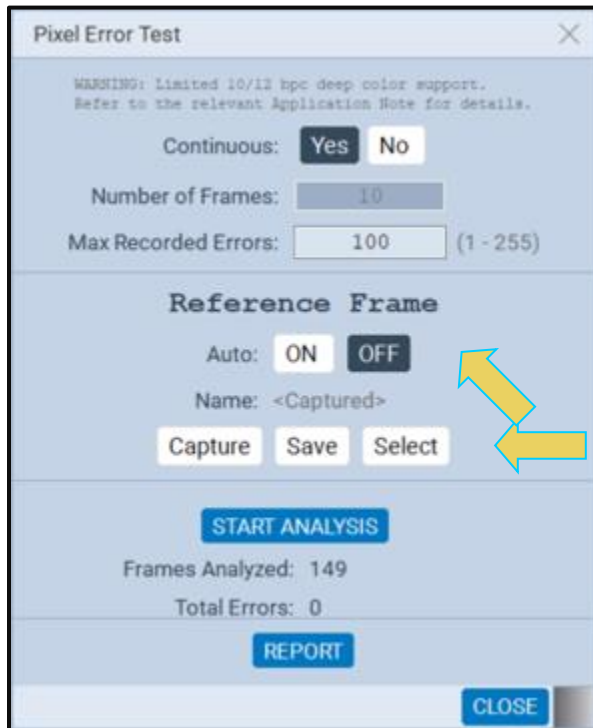
Reference Frame

Auto: **ON** **OFF** ←

Name:

Capture Save Select

- For testing with a reference frame obtained from the file stored on your M41h, select the **Auto OFF** radio button and then activate the **Select** button to browse for a file on the M41h.



Pixel Error Test

WARNING: Limited 10/12 bpc deep color support.
Refer to the relevant Application Note for details.

Continuous: **Yes** No

Number of Frames: 10

Max Recorded Errors: 100 (1 - 255)

Reference Frame

Auto: ON **OFF**

Name: <Captured>

Capture Save Select

START ANALYSIS

Frames Analyzed: 149

Total Errors: 0

REPORT

CLOSE

5. Activate the **Start Analysis** button to initiate the test.

The **Frames Analyzed** and the **Total Errors** fields will indicate the progress and status of the test.

6. If you are running the test non-continuously, then the test will stop automatically when the number of frames specified in the **Number of Frames** field is reached.

The **Frames Analyzed** and the **Total Errors** fields will indicate the progress and status of the test.

Pixel Error Test

WARNING: Limited 10/12 bpc deep color support.
Refer to the relevant Application Note for details.

Continuous: ☒ Yes ☐ No

Number of Frames:

Max Recorded Errors: (1 - 255)

Reference Frame

Auto: ☒ ON ☐ OFF

Name:

Frames Analyzed: 149

Total Errors: 0

7. Touch select the **Report** button to obtain a report of the results.

In the example shown below there are no errors. The second example shows a report with many errors.

HTML Viewer

Detailed Error Report

Report generated on: August 14, 2012 5:00 PM www.quantumdata.com

Quantum Data

Pixel Error Test: Detailed Report

Error Summary

Frames Analyzed : 616
Total Errors : 0

Error Details

Error #	Frame	Line	Char	Measured			Expected		
				CH-0	CH-1	CH-2	CH-0	CH-1	CH-2
No Errors									

Generated on: August 14, 2012 5:00 PM www.quantumdata.com

HTML Viewer

Detailed Error Report

Report generated on: September 12, 2012 4:47 PM www.quantumdata.com

Quantum Data

Pixel Error Test: Detailed Report

Error Summary

Frames Analyzed : 25
Total Errors : 40195257

Error Details

Error #	Frame	Line	Char	Measured			Expected		
				CH-0	CH-1	CH-2	CH-0	CH-1	CH-2
1	0	54	1	128	16	128	128	16	127
2	0	54	2	128	16	128	128	16	127
3	0	54	3	128	16	128	128	16	127
4	0	54	4	128	16	128	128	16	127
5	0	54	5	128	16	128	128	16	127
6	0	54	6	128	16	128	128	16	127
7	0	54	35	128	16	128	127	16	128
8	0	54	36	128	16	128	127	16	128
9	0	54	37	128	16	128	127	16	128
10	0	54	38	128	16	128	128	16	127

Back Forward Save As Close

15.3 Running the Pixel Error Test Through the Command Line

You can run the Pixel Error test through the command line. Refer to the Chapter Command Line Interface for Capturing Data for information on how to establish a command line session with the M41h.

Commands for Pixel Error Test

Note: Commands are not case sensitive.

Command	Description	Syntax	Command Example
PDAX:NFRS	Set number of frames to analyze in pixel data analysis test or sets test to continuous mode requiring user intervention to terminate.	PDAX:NFRS < <i>frames</i> > Where < <i>frames</i> > is the number of frames to capture and compare during the test. Set to 0 for continuous mode which requires user interaction to stop test.	To set number of frames to analyze in pixel data analysis test to 50: >PDAX:NFRS 50
PDAX:CAPF	Capture a reference frame for pixel data analysis test	PDAX:CAPF	To capture a reference frame for pixel data analysis test: >PDAX:CAPF
PDAX:GFCA	Saves a captured frame to a file. This is used as a reference frame ("golden" frame) for comparison with subsequent captured frames.	PDAX:GFCA < <i>path</i> > Where < <i>path</i> > is the directory path and file name of the stored reference frame. If the path is omitted the default path is used.	To save a captured frame to a file to use as a reference frame: >PDAX:GFCA /user/cap1 or: >PDAX:GFCA cap1
PDAX:GFCL	Load a captured reference frame from a file.	PDAX:GFCL < <i>path</i> > Where < <i>path</i> > is the directory path and file name of the reference frame to load. If the path is omitted the default path is used.	To load a captured reference frame from a file: >PDAX:GFCL /user/cap1 or: >PDAX:GFCL cap1

Commands for Pixel Error Test

Note: Commands are not case sensitive.

Command	Description	Syntax	Command Example
PDAX:MXER	Set maximum number of detailed errors to record in pixel data analysis test.	PDAX:MXER <errors> Where <errors> is maximum number of errors to provide a detailed report for up to 256 errors.	To set maximum number of detailed errors to record in pixel data analysis test to 100: >PDAX:MXER 100
PDAX:ERRQ	Get recorded detailed error records. Returns the following: Frame number that an error occurred X,Y coordinate that the error occurred. The measured red component value. The measured green component value. The measured blue component value. The reference expected red component value. The reference expected green value. The reference expected blue value.	PDAX:ERRQ	To get recorded detailed error records: > PDAX:ERRQ 007: [1450:0000:0006] 0xb4b4b4 0xebebeb 008: [1450:0000:0007] 0xb4b4b4 0xebebeb 009: [1450:0000:0008] 0xb4b4b4 0xebebeb 010: [1450:0000:0009] 0xb4b4b4 0xebebeb 011: [1450:0000:0010] 0xb4b4b4 0xebebeb 012: [1450:0000:0011] 0xb4b4b4 0xebebeb 013: [1450:0000:0012] 0xb4b4b4 0xebebeb
PDAX:NERR	Get number of errors during a pixel data analysis test.	PDAX:NERR	To obtain the number of errors during a pixel data analysis test: > PDAX:NERR 21879466
PDAX:PDAU	Initiates the pixel data analysis test.	PDAX:PDAU	To initiate the pixel data analysis test: > PDAX:PDAU
PDAX:STOP	Stops the pixel data analysis test.	PDAX:STOP	To stop a pixel data analysis test: > PDAX:STOP

Commands for Pixel Error Test**Note:** Commands are not case sensitive.

Command	Description	Syntax	Command Example
PDAX:STAT	Returns the test status including running or done, frames analyzed, errors detected, etc. Can be run either during a test or after a test is terminated. Provides results from the last test.	PDAX:STAT	To obtain the test status: > PDAX:STAT pdax: in progress frames: 1659 threshold 0 errors: 21879466. threshold 0
Note: The commands are not case sensitive.			

To Run the Pixel Error test for a specified number of frames from the command line:

1. Set the number of frames to use during the test.

```
#p-scope>pdax:nfrs 255
```

```
pdax:nfrs 255
```

2. Capture a reference frame for the test:

```
#p-scope>pdax:capf
```

```
pdax_capf: capture buffer size 179MB bs=128
```

```
INFO: Capture Trigger condition is satisfied
```

```
END: pcap_capture_start Capture complete
```

```
END: pcap_info info request type=118 complete
```

3. Save the captured frame to a file:

```
#p-scope>pdax:gfca myrefrm2
```

```
pdax:gfca myrefrm2
```

4. Load the captured frame:

```
#p-scope>pdax:gfc1 myrefrm2
```

```
pdax:gfc1 myrefrm2
```

```
pdax_gfc1: Loading Reference frame: [myrefrm2]
```

5. Run the pixel error test (will run for 255 frames)

```
#p-scope>pdax:pdau
```

```
pdax:pdau
```

6. Get statistics for the test:

```
#p-scope>pdax:stat  
pdax:stat  
pdax: stopped  
frames: 255 threshold 255  
errors: 0. threshold 255
```

To Run the Pixel Error test continuously from the command line:**1. Set the pixel error test to run continuously:**

```
#p-scope>pdax:nfrs 0  
pdax:nfrs 0
```

2. Initiate the test

```
#p-scope>pdax:pdau  
pdax:pdau
```

3. Query statistics for the test:

```
#p-scope>pdax:stat  
pdax:stat  
pdax: in progress  
frames: 1071 threshold 0  
errors: 47004766. threshold 255
```

4. Stop the test:

```
#p-scope>pdax:stop  
pdax:stop
```

5. Get the number of errors.

```
#p-scope>pdax:nerr  
pdax:nerr  
84974760
```

6. Get a detailed list out of the 255 errors:

```
#p-scope>pdax:errq  
0x090909 0x101010  
008: [0699:0646:0742] 0x090909 0x101010
```

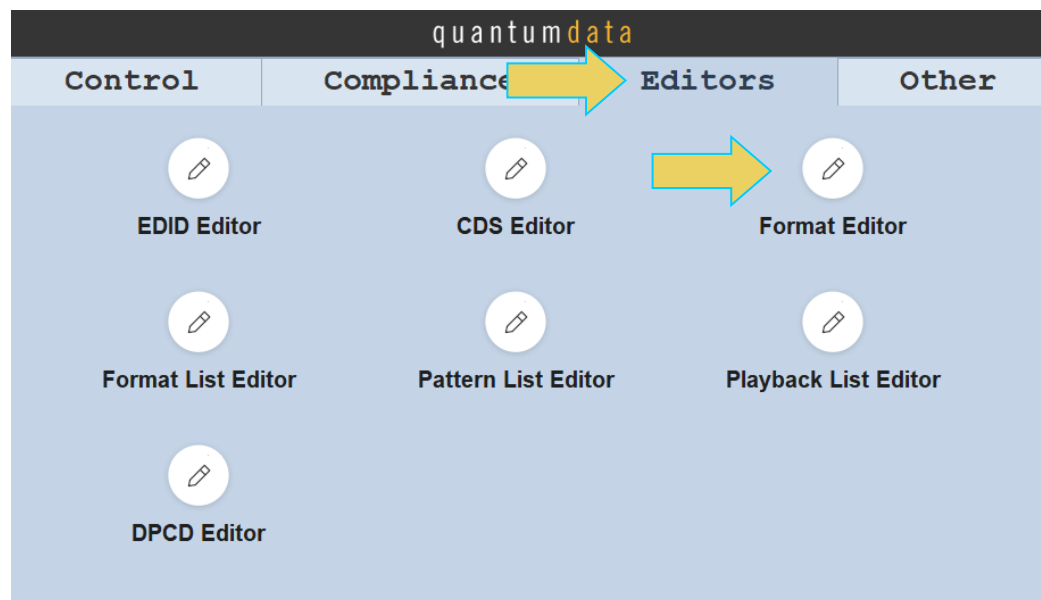
009: [0699:0646:0743] 0x090909 0x101010
010: [0699:0646:0744] 0x090909 0x101010
. . .
253: [0699:0646:1170] 0x171717 0x101010
254: [0699:0646:1171] 0x171717 0x101010
255: [0699:0646:1172] 0x171717 0x101010

16 Format Editor

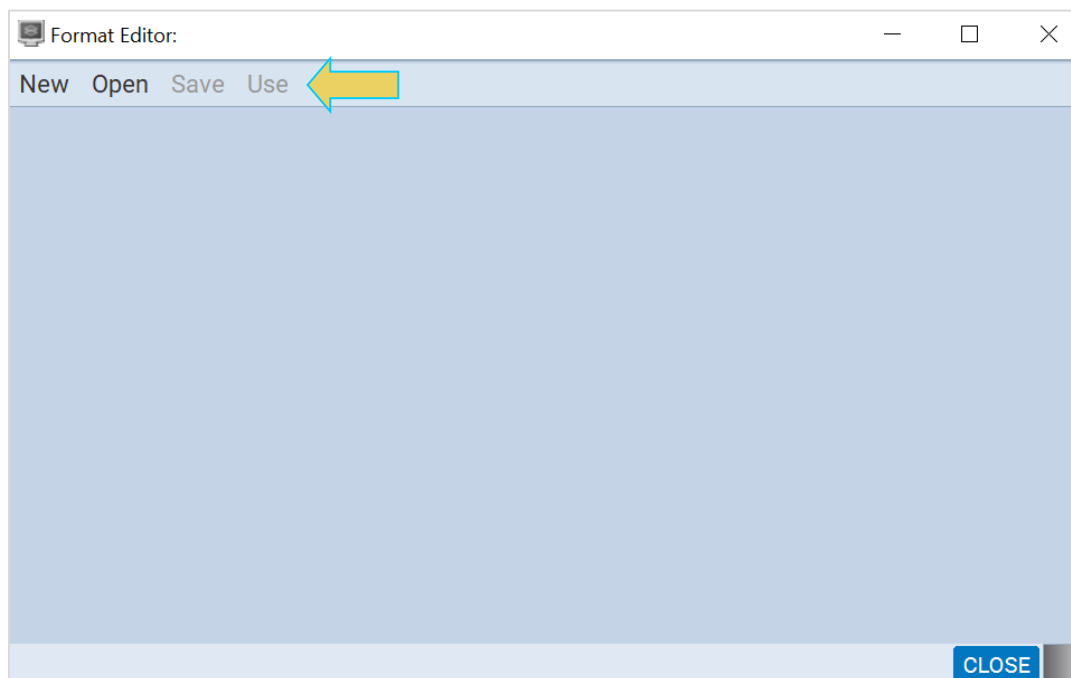
The **Format Editor** provides a graphical user interface for modifying existing HDMI® formats, creating custom formats and viewing format parameters. The **Format Editor** can be run on the embedded ATP GUI Manager or on the external ATP GUI Manager.

16.1 Accessing the Format Editor

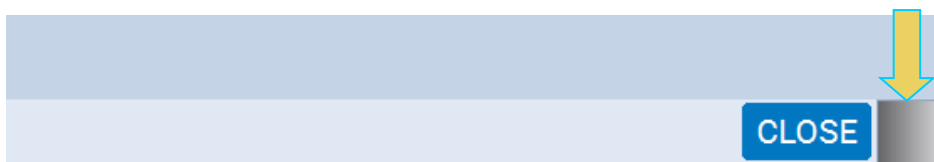
Access the **Format Editor** through the **Editors Page** of the **Apps** panel as shown below.



When you first open the **Format Editor**, the window will be blank as shown below. There are a set of activation buttons on the bottom of the screen that enable you to load, save and create formats.



You can resize the window using the silver square area on the lower right side (indicated below).



Format Editor – Top Toolbar Activation Buttons

The following table describes the **Format Editor** menu buttons.

Button	Description
Use	Activates the custom format you create/modify within the Editor
New Format	Opens up the New Format at the Timing tab. Enables you to create new formats
Open	Enables you to browse to and open an xml format file on your PC
Save	Enables you to save an xml format file on your PC

(Optionally) access the **Format Editor** through the **Format** tab by selecting a format and using the **Edit** button on the bottom of the window (indicated below).

Mode: MST ▾ DSC:Off | FMT:2160p60 P-Rate:594.00MHz F-Rate:60.00Hz ● Output Disconnect
 IMG:TVBar100 H-Rate:135.00kHz Refresh
 (97) 3840x2160p @ 60 Hz 16:9 3840x2160 Progressive RGB-8bpc DP/USBC 2.0 Generator

Format		Pattern		Audio		Tools		Topology	
CTA	Folder	Lists	EDID						
Resolution		Vtotal		Frame Rate		Aspect Ratio		2160p60 VIC 97	
240p2x	240p4x	262	263	24/1.001	24	4:3			
288p2x	288p4x	312	313		25	16:9			
480p		314		30/1.001	30	64:27			
480p2x	480i2x			48/1.001	48	256:135			
480p4x	480i4x				50				
576p				60/1.001	60	Box			
576p2x	576i2x				100	FILL			
576p4x	576i4x			120/1.001	120	4:3			
720p					200	16:9			
1080p	1080i	1125	1250	240/1.001	240	85:1			
2160p	4320p					89:1			

Left to Right ▾ Settings Edit Clear Selection

CLOSE

In this case the Format Editor is provisioned with the format timing settings of the format that had been selected in the Format tab window. This is shown below.

The screenshot shows the 'Timing' tab of the Format Editor. The interface is divided into several sections:

- Calculated:** A red square icon and the text 'Calculated'.
- Pixel Rate:** A green box with '108.000001' MHz and a grey box with '9.259259' ns.
- Horizontal:**
 - Rate:** A red box with '63.981043' KHz.
 - Tune:** A red box with '1.000000'.
 - Base:** A red box with '63.981043' KHz.
 - Active:** A green box with '1280' Pixels and a grey box with '11.851852' us.
 - Blank:** A red box with '408' Pixels and a grey box with '3.777778' us.
 - Total:** A green box with '1688' Pixels and a grey box with '15.629630' us.
 - Pulse Delay:** A black box with '48' Pixels and a grey box with '0.444444' us.
 - Pulse Width:** A black box with '112' Pixels and a grey box with '1.037037' us.
- Vertical:**
 - Rate:** A red box with '60.019740' Hz.
 - Active:** A green box with '1024' Lines and a grey box with '16.004741' ms.
 - Blank:** A red box with '42' Lines and a grey box with '0.656444' ms.
 - Total:** A green box with '1066' Lines and a grey box with '16.661185' ms.
 - Pulse Delay:** A black box with '1' Lines and a grey box with '0.015630' ms.
 - Pulse Width:** A black box with '3' Lines and a grey box with '0.046889' ms.
- Bottom Section:**
 - Serration width Adjustment:** A black box with '0' Pixels.
 - H to V Pulse Delay:** A black box with '0' Pixels.
 - Horizontal Broad Pulse Delay:** A black box with '0' Pixels.
 - Eq. Before:** A black box with '0' Lines.
 - Eq. After:** A black box with '0' Lines.
- Right Panel:**
 - Entry Units:** Radio buttons for 'Machine' (selected) and 'Time'.
 - Scan Type:** Radio buttons for 'Progressive' (selected) and 'Interlace'.
 - Back Porch:** A checkbox.
 - Clock Pulse:** A checkbox.
 - PreEmphasis:** A checkbox.
 - DC Balance:** A checkbox.
 - Flat Front Porch:** A checkbox.
 - TriLevel:** A checkbox.
 - Repeat Field:** A checkbox.

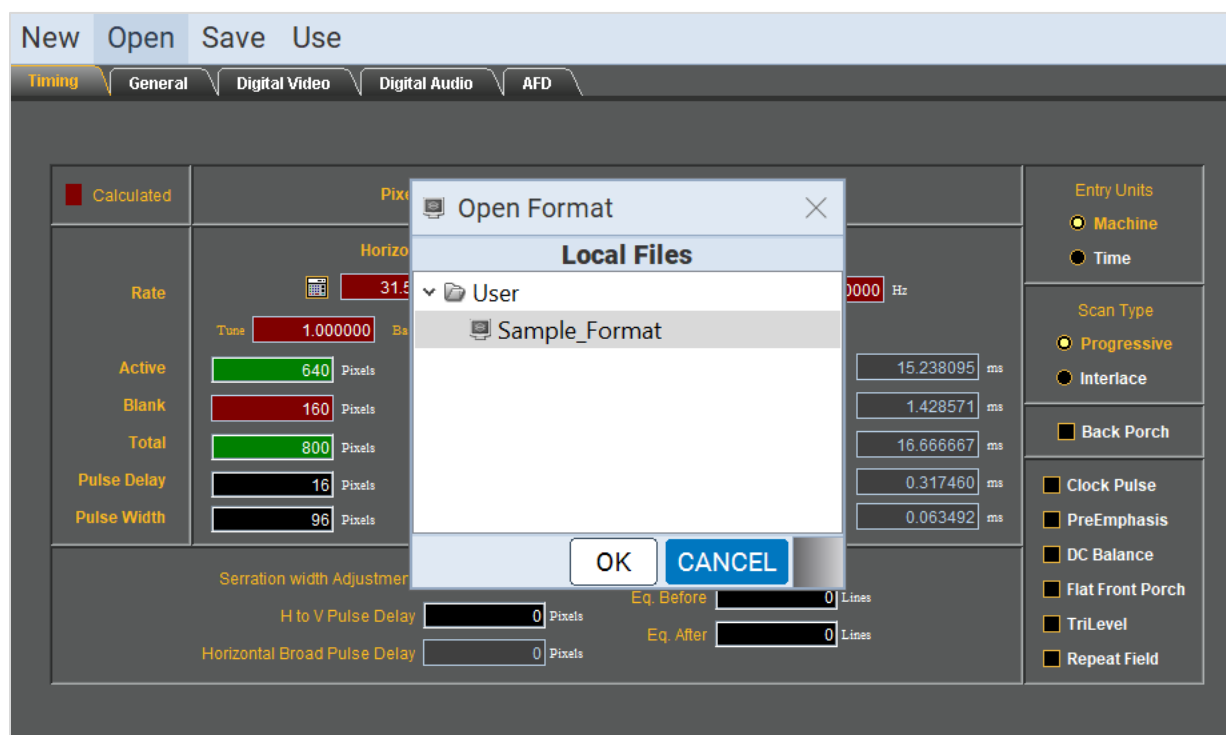
16.1.1 Saving and Opening a Format

To save a format, simply click the **Save** activation button in the top toolbar. A dialog box will pop up as shown below. Select a folder, enter a name and click **OK**.

The screenshot shows the 'Save Format' dialog box over the Format Editor. The dialog box has a title bar 'Save Format' and a close button. It contains a list of 'Local Files' with a folder icon and the name 'User'. Below the list are buttons for 'New', 'Rename', and 'Delete'. A text field labeled 'Path:' shows '/User'. Another text field labeled 'Name:' shows 'Sample_Format'. At the bottom are 'OK' and 'CANCEL' buttons. A yellow arrow points to the 'Save' button in the top toolbar of the Format Editor, and another yellow arrow points to the 'OK' button in the dialog box.

Opening a Previously Saved or Imported Format

Similarly, to open a format, click the **Open** activation button in the top toolbar, select the desired format, and click **OK**. Example shown below.



16.2 Format Editor- Top Level Tabs

This subsection defines the tabs and status panels available with Format Editor.

Important Note: Many of the settings and parameters in the Format Editor screens apply only to HDMI or analog, while some apply only to DisplayPort and are not relevant for the M41h instrument.

When you select the New activation button a populated window will appear as shown below.

The screenshot shows the 'Timing' tab of the Format Editor. At the top, there are buttons for 'New', 'Open', 'Save', and 'Use'. Below these are tabs for 'Timing', 'General', 'Digital Video', 'Digital Audio', and 'AFD'. The 'Timing' tab is active, displaying a grid of parameters. On the left, a 'Calculated' status indicator is shown. The main area is divided into 'Horizontal' and 'Vertical' sections. The 'Horizontal' section includes 'Rate' (31.500000 KHz), 'Tune' (1.000000), 'Base' (31.500000 KHz), 'Active' (640 Pixels, 25.396825 us), 'Blank' (160 Pixels, 6.349206 us), 'Total' (800 Pixels, 31.746032 us), 'Pulse Delay' (16 Pixels, 0.634921 us), and 'Pulse Width' (96 Pixels, 3.809524 us). The 'Vertical' section includes 'Rate' (60.000000 Hz), 'Active' (480 Lines, 15.238095 ms), 'Blank' (45 Lines, 1.428571 ms), 'Total' (525 Lines, 16.666667 ms), 'Pulse Delay' (10 Lines, 0.317460 ms), and 'Pulse Width' (2 Lines, 0.063492 ms). At the bottom, there are 'Serration width Adjustment' (0 Pixels), 'H to V Pulse Delay' (0 Pixels), 'Horizontal Broad Pulse Delay' (0 Pixels), 'Eq. Before' (0 Lines), and 'Eq. After' (0 Lines). On the right side, there are checkboxes for 'Entry Units' (Machine, Time), 'Scan Type' (Progressive, Interlace), 'Back Porch', 'Clock Pulse', 'PreEmphasis', 'DC Balance', 'Flat Front Porch', 'TriLevel', and 'Repeat Field'.

There are a series of tabs on the top as shown below.

This image shows a close-up of the top tabs in the Format Editor. The tabs are 'Timing', 'General', 'Digital Video', 'Digital Audio', and 'AFD'. The 'Timing' tab is currently selected and highlighted.

The following table describes the top-level tabs in the Format Editor.

Tab	Description / Function
Timing	Selecting the Timing tab opens up an application screen that enables you to define the timing parameters for a custom format or modify the timing parameters of an existing format.
General	Selecting the General tab opens up an application screen that enables you to define the sync, level, pixel depth, gamma and pedestal parameters for a custom format or modify these parameters of an existing format.

Tab	Description / Function
Digital Video	Selecting the Digital Video tab opens up an application screen that enables you to define the digital video parameters for a custom format or modify these parameters of an existing format.
Digital Audio	Selecting the Digital Audio tab opens up an application screen that enables you to define the digital audio parameters for a custom format or modify these parameters of an existing format.
AFD	Selecting the AFD tab opens up an application screen that enables you to define the AFD parameters for a custom format or modify these parameters of an existing format.

16.2.1 Timing Tab

The **Timing** window of the **Format Editor** is shown below. This window is activated by pressing the **Timing** tab.

The screenshot shows the **Timing** tab selected in the **Format Editor**. The interface is divided into several sections:

- Pixel Rate:** 25.200000 MHz, 39.682540 ns.
- Horizontal:**
 - Frequency:** 31.500000 KHz.
 - Line Rate:** 1.000000 Hz.
 - Base:** 31.500000 KHz.
 - Act:** 640 Pixels, 25.396825 ns.
 - Blk:** 160 Pixels, 6.349206 ns.
 - Tot:** 800 Pixels, 31.746032 ns.
 - PD:** 16 Pixels, 0.634921 ns.
 - PW:** 96 Pixels, 3.809524 ns.
- Vertical:**
 - Frequency:** 60.000000 Hz.
 - Line Rate:** 15.238095 ms.
 - Act:** 480 Lines, 1.428571 ms.
 - Blk:** 45 Lines, 16.666667 ms.
 - Tot:** 525 Lines, 0.317460 ms.
 - PD:** 10 Lines, 0.063492 ms.
 - PW:** 2 Lines, 0.063492 ms.
- Serration width Adjustment:** 0 Pixels.
- H to V Pulse Delay:** 0 Pixels.
- Horizontal Broad Pulse Delay:** 0 Pixels.
- Eq. Before:** 0 Lines.
- Eq. After:** 0 Lines.
- Options:**
 - Entry Units:** ☒ Machine, ☐ Time.
 - Scan Type:** ☒ Progressive, ☐ Interlace.
 - ☐ Back Porch.
 - ☐ Clock Pulse.
 - ☐ PreEmphasis.
 - ☐ DC Balance.
 - ☐ Flat Front Porch.
 - ☐ TriLevel.
 - ☐ Repeat Field.




The main panel of the **Timing** tab is shown below.

Calculated Pixel Rate MHz ns

	Horizontal		Vertical	
Rate	<input type="text" value="31.500000"/> KHz		<input type="text" value="60.000000"/> Hz	
Active	<input type="text" value="640"/> Pixels <input type="text" value="25.396825"/> us		<input type="text" value="480"/> Lines <input type="text" value="15.238095"/> ms	
Blank	<input type="text" value="160"/> Pixels <input type="text" value="6.349206"/> us		<input type="text" value="45"/> Lines <input type="text" value="1.428571"/> ms	
Total	<input type="text" value="800"/> Pixels <input type="text" value="31.746032"/> us		<input type="text" value="525"/> Lines <input type="text" value="16.666667"/> ms	
Pulse Delay	<input type="text" value="16"/> Pixels <input type="text" value="0.634921"/> us		<input type="text" value="10"/> Lines <input type="text" value="0.317460"/> ms	
Pulse Width	<input type="text" value="96"/> Pixels <input type="text" value="3.809524"/> us		<input type="text" value="2"/> Lines <input type="text" value="0.063492"/> ms	

The table that follows describes each of the fields in the main panel of the **Timing** tab.

Tab	Field	Description / Function
Pixel Rate		Sets the pixel rate in pixels (Machine) or microseconds (Time) of the format.
Horizontal	Rate	The horizontal line rate of the format. The HRAT is the fundamental frequency in the 882. Parameter: HRAT.
	Tune	The tuning value of the base frame rate (base/tune) for NTSC color broadcast compatibility. The tuning value is base/1.001
	Base	The base frame rate.
	Active	The number of active pixels (machine) or microseconds (Time) of the horizontal video. Parameter: HRES.
	Blank	The number of active pixels (Machine) or microseconds (Time) of the horizontal video. This parameter is calculated.
	Total	The total number of active pixels (Machine) or microseconds (Time) of the horizontal video. The total is the sum of the Active and Blanking. Parameter: HTOT.
	Pulse Delay	The number of pixels (Machine) or microseconds (Time) in the blanking preceding the horizontal sync pulse. Parameter: HSPD.
	Pulse Width	The number of pixels (Machine) or microseconds (Time) of the horizontal sync pulse. Parameter: HSPW.
Vertical	Rate	The vertical frame rate of the format. Parameter: VRAT.
	Active	The number of active lines (machine) or milliseconds (Time) of the vertical video. Parameter: VRES.
	Blank	The number of active lines (Machine) or milliseconds (Time) of the vertical video. This parameter is calculated.
	Total	The total number of active lines (Machine) or milliseconds (Time) of the vertical video. The total is the sum of the Active and Blanking. Parameter: VTOT.
	Pulse Delay	The number of lines (Machine) or milliseconds (Time) in the

Tab	Field	Description / Function
		blanking preceding the vertical sync pulse. Parameter: VSPD.
	Pulse Width	The number of lines (Machine) or milliseconds (Time) of the vertical sync pulse. Parameter: VSPW.
 (green calculator)		Indicates that the value in the field is calculated by the Format Editor.
 (red calculator)		Indicates that the value in the field is calculated by the Format Editor, and that the new value has replaced the value previously in the field.
		Indicates that the values in this field are settable in the current configuration.
Red Field		Indicates that the fields are in the read only mode. These fields will show a change in value when the value in a field affecting these fields is modified.
Green Field		Indicates that the fields are in the read/write mode. When you make a change and hit the enter key new values will be calculated.
Black Field		Indicates that the fields can be modified directly and are calculated when other related fields are modified.
Grey Field		Indicates that the fields are disabled because the Entry Units are selected such that the fields are not used. However these fields will show a change when the value in a field affecting these fields is modified.

The right side panel of the **Timing** tab in the Format Editor is shown below. The table that follows describes each of the fields in the panel.

Entry Units

☒ Machine

☐ Time

Scan Type

☒ Progressive

☐ Interlace

☐ Back Porch

☐ Clock Pulse

☐ PreEmphasis

☐ DC Balance

☐ Flat Front Porch

☐ TriLevel

☐ Repeat Field

This table describes each of the fields in the main panel of the **Timing** tab.

Tab	Field	Description / Function
Pixel Rate	Machine	Activates the fields in the timing tab window such that the timing parameter values are expressed and settable in terms of pixels and lines.
	Time	Activates the fields in the timing tab window such that the timing parameter values are expressed and settable in terms of time increments such as milliseconds and microseconds.
Scan Type	Progressive	Sets the format scan type to Progressive. Parameter: SCAN = 2
	Interlace	Sets the format scan type to Interlaced. Parameter: SCAN = 1
Check boxes	Back Porch	Toggles the Pulse Delay field so that the value is provided for the back porch rather than the front porch.
	Clock Pulse	Enables and disables the pixel clock pulse output on generators that have a pixel clock output available.

Tab	Field	Description / Function
		The pixel clock output appears on the special sync BNC connector.
	Pre-Emphasis	Enables and disables adding pre-emphasis to the Open LVDI digital outputs on generators that support LVDI outputs.
	DC Balance	Not used.
	Flat Front Porch	Determines if composite sync will have all equalization pulses removed in the vertical sync front porch (delay) period as required by certain military HOBO and Maverik video formats.
	Tri-Level Sync	Enables or disables Tri-Level sync.
	Repeat Field	Determines if identical video information is output for each field of an interlaced (SCAN = 2) format.

16.2.2 General Tab

The **Format Editor General** tab is shown below. The table that follows describes each of the fields in the tab.

New Format - General Tab (Top Left Panel)

The top left panel of the General tab in the Format Editor is shown below.

The table that follows describes each of the fields in the top left panel of the General tab.

Field / Entity	Type	Description / Function
Horizontal	Entry field	The horizontal aperture of the display under test.
Vertical	Entry field	The vertical aperture of the display under test.
Unit Size	Radio Buttons:	
	inches	Selects the unit size of the Horizontal and Vertical Size entities to be expressed in inches.
	mm	Selects the unit size of the Horizontal and Vertical Size entities to be expressed in millimeters.

New Format - General Tab (Top Right Panel)

The top right panel of the **General** tab in the **Format Editor** is shown below.

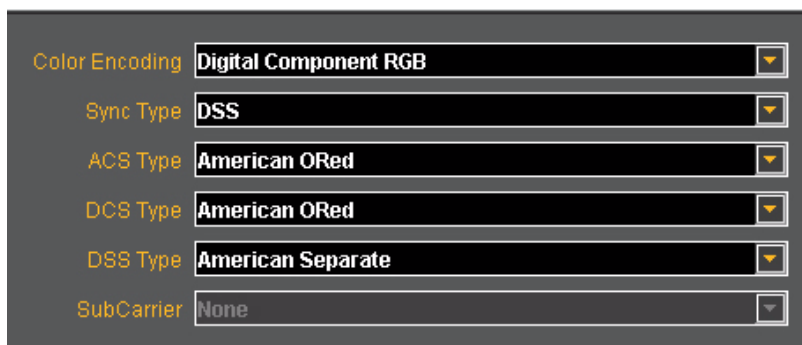


The table that follows describes each of the fields in the top right panel of the **General** tab.

Field / Entity	Type	Description / Function
Pixel Depth	Pull-down menu	Establishes the number of data bits that represent each active pixel in video memory (frame buffer). Parameter: PELD. There are three settings: <ul style="list-style-type: none"> • Default - uses the generator default • 8 - 8 bits-per-pixel (256 colors) • 24 - 24 bits-per-pixel (16,777,216 colors)

New Format – General Tab (Center Panel)

The center panel of the **General** tab in the **Format Editor** is shown below.



The table below describes the pull-down menus in the center panel of the **General** tab.

Field / Entity	Description / Function
Color Encoding	Sets the colorimetry of the format. The parameter is AVST or DVST. The following are the selections: <ul style="list-style-type: none"> • Digital Component RGB • Digital Component YCbCr SDTV (ITU-R BT.601-5) • Digital Component YCbCr HDTV Legacy (SMPTE 240M) • Digital Component YCbCr HDTV Modern (ITU-R BT.709-5) • Digital BT.601 xvYCC • Digital BT.709 xvYCC Note: Several options are not shown and are not applicable to HDMI.
Sync Type Not used for HDMI	Sets the sync type of the format. The following are the selections: <ul style="list-style-type: none"> • (0) None • (1) DSS - Digital Separate Sync

Field / Entity	Description / Function
	<ul style="list-style-type: none"> • (2) DCS - Digital Composite Sync • (3) ACS - Analog Composite Sync • (4) ACS, DSS - Analog Composite Sync, Digital Separate Sync • (5) ACS, DCS - Analog Composite Sync, Digital Composite Sync • (6) ACS, DCS, DSS - Analog Composite Sync, Digital Composite Sync and Digital Separate Sync • (7) DPMS OFF • (8) DPMS Suspend • (9) DPMS Standby • (10) DPMS ON <p>Note: Several options are not shown and are not applicable to HDMI.</p>
ACS Type (Not used)	
DCS Type (Not used)	
SubCarrier (Not used)	

New Format - General Tab (Right Panel)

The right panel of the General tab in the Format Editor is shown below.

Analog Video Swing volts white minus blank
 Analog Sync Swing volts blank minus sync
 Gamma ☒
 Pedestal ☒ IRE
 Analog Cal. Mode Interpolate
 Analog Color Order R-G-B

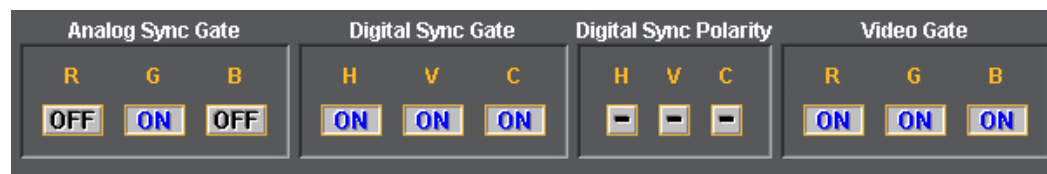
The table below describes the entities and fields of the right-side panel of the **General** tab.

Field / Entity	Entity Type	Description / Function
Analog Video Swing Not used for HDMI	Entry field	Sets the analog video swing.
Analog Sync Swing Not used for HDMI	Entry field	Sets the analog sync swing.
Gamma Not used for HDMI	Check box	Enables or disables Gamma. Used with the entry field below.
	Entry field	Enables you to set the Gamma once the Gamma check box above is enabled (checked). The allowable ranges of values is 0.1 to 10.0.

Field / Entity	Entity Type	Description / Function
Pedestal Not used for HDMI	Check box	Enables or disables the Pedestal. Used with the entry field below. Pedestal is only supported on NTSC format types.
	Entry field	Enables you to set the Pedestal once the Pedestal check box above is enabled (checked). The allowable ranges of values is 0 IRE to 100 IRE.
Analog Cal. Mode Not used for HDMI	Pull-down select	Sets the analog calibration mode. Determines how the generator tests and calibrates its analog video outputs. The following are the selections: <ul style="list-style-type: none"> Interpolate Measure Interpolate Measure Set Absolute Test Levels
Analog Color Order Not used for HDMI	Pull-down select	Sets the mapping of the analog video colors to the video output connections. Parameter: AVCO. The following are the selections: <ul style="list-style-type: none"> RGB - R to R, G to G, B to B (default) RBG - R to R, B to G, G to B GRB - G to R, R to G, B to B GBR - G to R, B to G, G to B BRG - B to R, R to G, G to B BGR - B to R, G to G, R to B

New Format - General Tab (Bottom Panel)

The bottom panel of the **General** tab in the **Format Editor** is shown below.



The table below describes the gating functions of the right-side panel of the **General** tab.

Field / Entity	Entity Name	Description / Function
Analog Sync Gate Not used for HDMI	Select buttons	Enables you to put the analog composite sync on one of the components when analog composite sync is selected as the sync type . Multiple selections can be made.
	R	Puts the analog composite sync on the Red component.
	G	Puts the analog composite sync on the Green component.
	B	Puts the analog composite sync on the Blue

Field / Entity	Entity Name	Description / Function
		component.
Digital Sync Gate Not used for HDMI	Select buttons	
	H	Enables and disables the digital horizontal sync output.
	V	Enables and disables the digital vertical sync output. To use digital vertical sync, the digital separate H and V sync must be selected.
	C	Enables and disables the digital vertical sync output.
Digital Sync Polarity Not used for HDMI	Select buttons	
	H	Determines whether the digital horizontal sync pulse polarity is positive going or negative going.
	V	Determines whether the digital vertical sync pulse polarity is positive going or negative going.
	C	Determines whether the digital composite sync pulse polarity is positive going or negative going.
Video Gate	Select buttons	Enables you to gate ON or OFF any of the video components. More than one can be selected.
	R	Gates ON or OFF the Red component. Parameter: REDG
	G	Gates ON or OFF the Green component. Parameter: GRNG.
	B	Gates ON or OFF the Blue component. Parameter: BLUG.

16.2.3 Digital Video Tab

The **Format Editor Digital Video** tab is shown below.

The table that follows describes each of the fields in the **Digital Video** tab.

Field / Entity	Entity Type	Description / Function
Range	Entry field	Specifies the quantization range for the digital video. Parameter: DVQM. The values available are described in CIA-861E: <ul style="list-style-type: none"> 0 - Full Range for computer applications. 1 – for testing the undershoot/overshoot signal code margins. 2 – Limited range for reduced range required by television standards.
Clocks per Pixel	Entry field	Specifies the number of clocks per pixel (double clocking factor for whole line. Parameter: NCPP. This parameter is used to boost the clock rate to the minimum supported by TMDS interface. Allowable values are: <ul style="list-style-type: none"> 1 - one clock per pixel. 2 - two clocks per pixel.

Field / Entity	Entity Type	Description / Function
Pixels per Pixel	Entry field	Specifies the number of pixels per pixel. This parameter specifies the pixel repetition factor for the active portion of the line. Allowable values are: <ul style="list-style-type: none"> 0 - disables repetition mode 1 to 10 - enables pixel repetition (inserts extra left and right pixel repetition bars) Parameter: NPPP.
AVI Video Identification Code	Entry field	The digital video code corresponding to the EIA/CEA-861 standard. Parameter: DVIC.
Number of Links	Radio button	
	1	Sets the number of links to 1 by the DVI output.
	2	Sets the number of links to 2 for the DVI output
Protocol Type	Pull-down select	Specifies which digital output is active through the HDMI interface. Allowable values are: <ul style="list-style-type: none"> DVI - Enables DVI mode out the DVI output or the HDMI output. HDMI - Enables HDMI mode out the HDMI output. Parameter: XVSI
Sampling Mode	Pull-down select	Specifies the digital sampling mode. Allowable values are: <ul style="list-style-type: none"> Default - RGB 4:4:4. 4:2:2 - Color difference components are sampled at half the pixel rate. Luminance is sampled at the full pixel rate. Requires that the YCbCr color mode be selected with the DVST command. 4:4:4 - Color difference components and luminance component is sampled at the full pixel rate. Requires that the YCbCr color mode be selected with the DVST command. Parameter: DVSM
Bits per Color Component	Pull-down select	Specifies the number of bits per component. Allowable values are: <ul style="list-style-type: none"> Default - Use the default setting in the generator. 6 - Six bits per component. 8 - Eight bits per component. 10 - Ten bits per component. 12 - Twelve bits per component. Parameter: NBPC

16.2.4 Digital Audio Tab

The **Format Editor Digital Audio** tab is shown below. The table that follows describes each of the fields in the tab.

Format Editor: <Not Saved> Home Back

Timing General Digital Video **Digital Audio** AFD

Signal Interface: SPDIF Signal Type: IEC 60958-3 Consumer LPCM

Level Shift: 0 -dBFS

Sampling Rate: 48000.000000 Hz

Number of Streams: 1

Number of Channels: 2

Bits per Sample: 16

Contents Gated: 3

Contents Available: 3

Mix Down Gate: ☒

Channels Available: 3

Channels Gated: 3

Use New Open Save

The table below describes each of the fields in the **Digital Audio** tab.

Field	Type	Description / Function
Signal Interface	Pull-down select	Sets the digital audio signal interface. The valid values are: <ul style="list-style-type: none"> None - Use DP. SPDIF. AES3 (not used). AESid (not used). TOSlink optical (not used). MiniPlug (not used).
Signal Type	Pull-down select	Sets the digital audio signal interface. The valid values are: <ul style="list-style-type: none"> None

Field	Type	Description / Function
		<ul style="list-style-type: none"> • IEC 60958-3 Consumer LPCM. • IEC 60958-4 Professional LPCM. • IEC 61937 w/AC-3 (Dolby Digital). • MP2 (Video CD) (not used). • MP3 (MPEG1 Layer 3) (not used). • MPEG2 5.1 channels Advanced Audio Coding (AAC) • MPEG2 7.1 channel CBR or VBR • IEC 61937 w/DTS • ATRAC
Level Shift	Entry field	Sets the digital audio level shift value for linear PCM. The valid values are: 0 - 15 dBFS. Parameter is: DAL5
Sampling Rate	Entry field	Sets the digital audio sampling rate for linear PCM. The valid values are: <ul style="list-style-type: none"> • 32.0kHz • 44.1kHz • 48.0kHz • 88.2kHz • 96.0kHz • 176.4kHz • 192.0kHz Parameter is: ARAT
Number of Streams	Entry field	Sets the digital audio streams. The valid value is: 1. Parameter is: NDAS.
Number of Channels	Entry field	Sets the digital audio sampling rate for linear PCM. The valid values are: 2 through 8 Parameter is: NDAC.
Bits per Sample	Pull-down select	Sets the digital audio sampling rate for linear PCM. The valid values are: <ul style="list-style-type: none"> • 16 • 20 • 24 Parameter is: NBPA.
Contents Gated	Entry field	Sets the digital audio content gate. The valid values are: 0 through 4095. Refer to EIA/CEA-861-x.

Field	Type	Description / Function
Contents Available	Entry field	Sets the digital audio content available. The valid values are: 0 through 4095. Refer to EIA/CEA-861-x.
Mix Down Gate Not applicable	Check box	Sets the digital audio down-mix gate. The valid values are: enabled (0) or disabled (1).
Channels Available	Entry field	Sets the digital audio channels available. The valid values are: 0 through 255. Refer to EIA/CEA-861.
Channels Gated	Entry field	Sets the digital audio channel gate. The valid values are: 0 through 255. Refer to EIA/CEA-861.

16.2.5 AFD Tab

The **Format Editor AFD** tab is shown below. The table that follows describes each of the fields in the tab.

Active Format		Bars	
Content Aspect Ratio	1.333333	Left	0 Pixels
Embedded Aspect Ratio	1.333333	Right	0 Pixels
Signal Aspect Ratio	1.333333	Top	0 Pixels
Emb. From Content Apert. Map	0	Bottom	0 Pixels
Signal from Emb. Apert. Map	0		

The table that follows describes each of the text entry fields in the **AFD** tab.

Heading	Field	Description / Function
Active Format	Content Aspect Ratio	Sets the aspect ratio of the source image content. The valid parameter range is: 0.75 to 2.39.
	Embedded Aspect Ratio	Sets the aspect ratio of the extended image content. The valid parameter range is: 0.75 to 2.39.
	Signal Aspect Ratio	Sets the aspect ratio of the video signal image content. The valid parameter range is: 0.75 to 2.39.
	Extended From Content Apert. Map	Enables you to set the mapping type for mapping CXAR-shaped image content into the extended EXAR-shaped aperture.
	Signal from Extended Apert. Map	Enables you to set the mapping type for mapping EXAR-shaped image content into the SXAR-shaped signal interface.
Bars	Left	Sets the left side letterbox bars in pixels.
	Right	Sets the right side letterbox bars in pixels.
	Top	Sets the top letterbox bars in pixels.
	Bottom	Sets the bottom letterbox bars in pixels.

16.3 Modifying an Existing Format Using the Format Editor

The procedure below describes how to make a few changes on an existing format using the **Format Editor**. This enables you to quickly run tests a display by tweaking a few timing parameters at a time.

Optionally, you can save these modified formats to easily recall later, and add them to a **Format List** to quickly access your preferred custom or standard formats.

To modify an existing format with the Format Editor:

Use the procedure in the previous subsection to **Open** an existing format. The format parameters of the selected format will appear in the new format **Timing** window as shown below.

The screenshot shows the **Timing** tab of the Format Editor. The interface is divided into several sections:

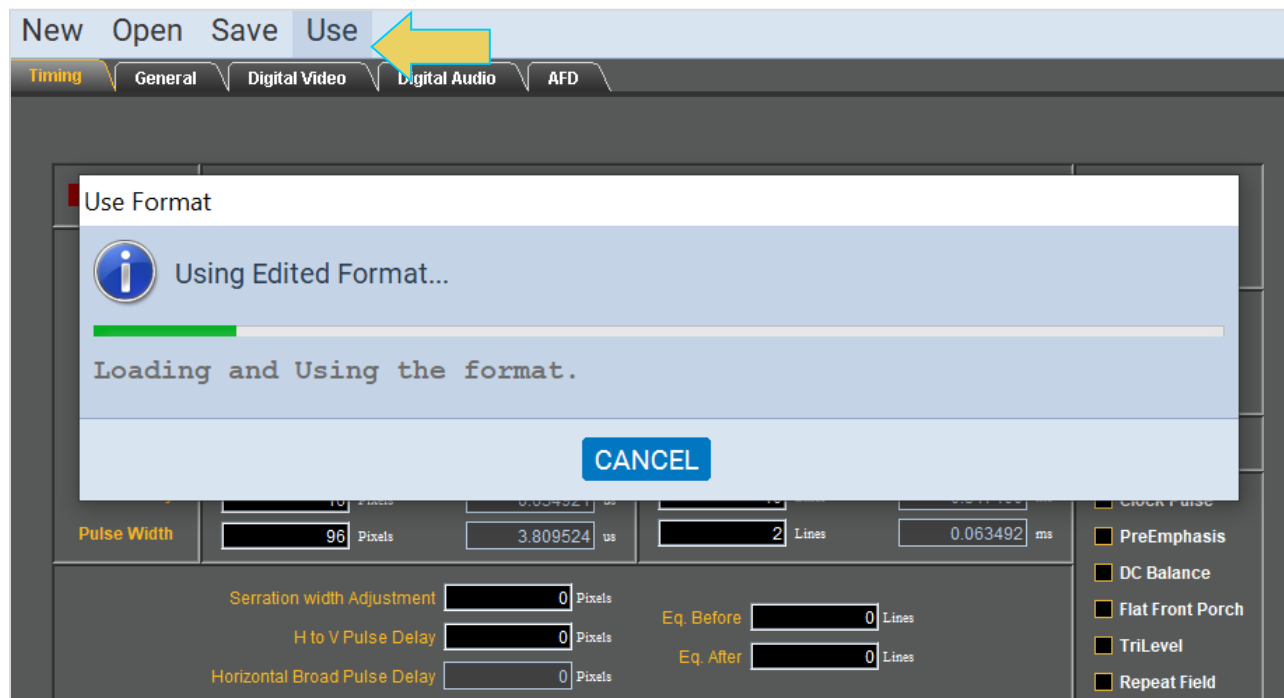
- Pixel Rate:** 74.250000 MHz (editable, green background) and 13.468013 ns (disabled, gray background).
- Horizontal:**
 - Rate:** 45.000000 KHz (disabled, red background).
 - Time:** 1.000000 (disabled, red background).
 - Base:** 45.000000 KHz (disabled, red background).
 - Act:** 1280 Pixels (editable, green background), 17.239057 us (disabled, gray background).
 - Blk:** 370 Pixels (disabled, red background), 4.983165 us (disabled, gray background).
 - Tot:** 1650 Pixels (editable, green background), 22.222222 us (disabled, gray background).
 - PD:** 110 Pixels (disabled, black background), 1.481481 us (disabled, gray background).
 - PW:** 40 Pixels (disabled, black background), 0.538721 us (disabled, gray background).
- Vertical:**
 - Rate:** 60.000000 Hz (disabled, red background).
 - Act:** 720 Lines (editable, green background), 16.000000 ns (disabled, gray background).
 - Blk:** 30 Lines (disabled, red background), 0.666667 ns (disabled, gray background).
 - Tot:** 750 Lines (editable, green background), 16.666667 ns (disabled, gray background).
 - PD:** 5 Lines (disabled, black background), 0.111111 ns (disabled, gray background).
 - PW:** 5 Lines (disabled, black background), 0.111111 ns (disabled, gray background).
- Adjustments:**
 - Serration width Adjustment: 0 Pixels (disabled, black background).
 - H to V Pulse Delay: 0 Pixels (disabled, black background).
 - Horizontal Broad Pulse Delay: 0 Pixels (disabled, black background).
 - Eq. Before: 0 Lines (disabled, black background).
 - Eq. After: 0 Lines (disabled, black background).
- Options:**
 - Entry Units:** ☒ Machine, ☐ Time.
 - Scan Type:** ☒ Progressive, ☐ Interlace.
 - ☐ Back Porch.
 - ☐ Clock Pulse.
 - ☐ PreEmphasis.
 - ☐ DC Balance.
 - ☐ Flat Front Porch.
 - ☒ TriLevel.
 - ☐ Repeat Field.

Modify the parameters as required for the new format. The following guidelines will help you modify the format parameters.

- When selecting a parameter to modify on the **Timing** tab, ensure that the value is editable. To be editable, the field either needs to have a pencil icon next to it or a black field background. Gray fields are disabled for editing. Fields in red (with the calculator icon) cannot be modified. However you can change whether a field can be modified by clicking on the calculator icon which will cause it to change to a pencil icon allowing you to change its value.
- Upon modifying a format value hit the enter key to invoke the change. The **Format Editor** applies the new value to the timing algorithm and updates any values dependent on the value you entered (or changed).
- For example, to change the horizontal resolution to 660, enter the value in the **Active** field under Pixels in the Horizontal area.

- You will notice that the Format Editor has calculated and written values to the **Blank** and **Period** fields as indicated by the red calculator (🧮) symbol. Although the Period value has not changed, the **Format Editor** still indicates it is a calculated value by displaying the red calculator.

Apply the modified format by clicking on the **Use** activation button on the bottom of window, as shown below. Optionally, save the format to add to a **Format List** (Format List Editor described in the next section).



17 Compliance Testing

Overview

The Teledyne LeCroy quantumdata M41h 48Gbps Video Analyzer / Generator for HDMI® can be easily extended from an entry level functional tester to a full certified compliance tester. The M41h also supports the full suite of FRL source and sink compliance tests as well as Enhanced Audio Return Channel (eARC) compliance testing for both Tx and Rx devices.

Below is a summary of the various suites of compliance tests that the M41h offers:

Fixed Rate Link (FRL) Source Compliance Test – Run compliance tests on your Fixed Rate Link-capable source device. Test suite includes Protocol, Link Training, Video Encoding, Video Timing, Audio, InfoFrame, EDID, etc.

Fixed Rate Link (FRL) Sink Compliance Test – Run compliance tests on your Fixed Rate Link-capable sink device. Test suite includes Character Error Detection, Reed Solomon, Video Decoding, Video Timing, Audio, InfoFrame, EDID, etc.

Display Stream Compression (DSC) Sink Compliance Test – Run compliance tests on your Display Stream Compression (DSC)-capable sink device. The test patterns and formats necessary to run the DSC sink compliance tests are precached for fast rendering.

Display Stream Compression (DSC) Source Compliance Test – Run compliance tests on your Display Stream Compression (DSC)-capable source device.

eARC Compliance Test – The M41h enables developers of HDMI eARC Tx and Rx devices to run compliance tests on their eARC-capable. The compliance tests run with little or no human interaction. Detailed results are provided for each test to help identify the root cause of failures.

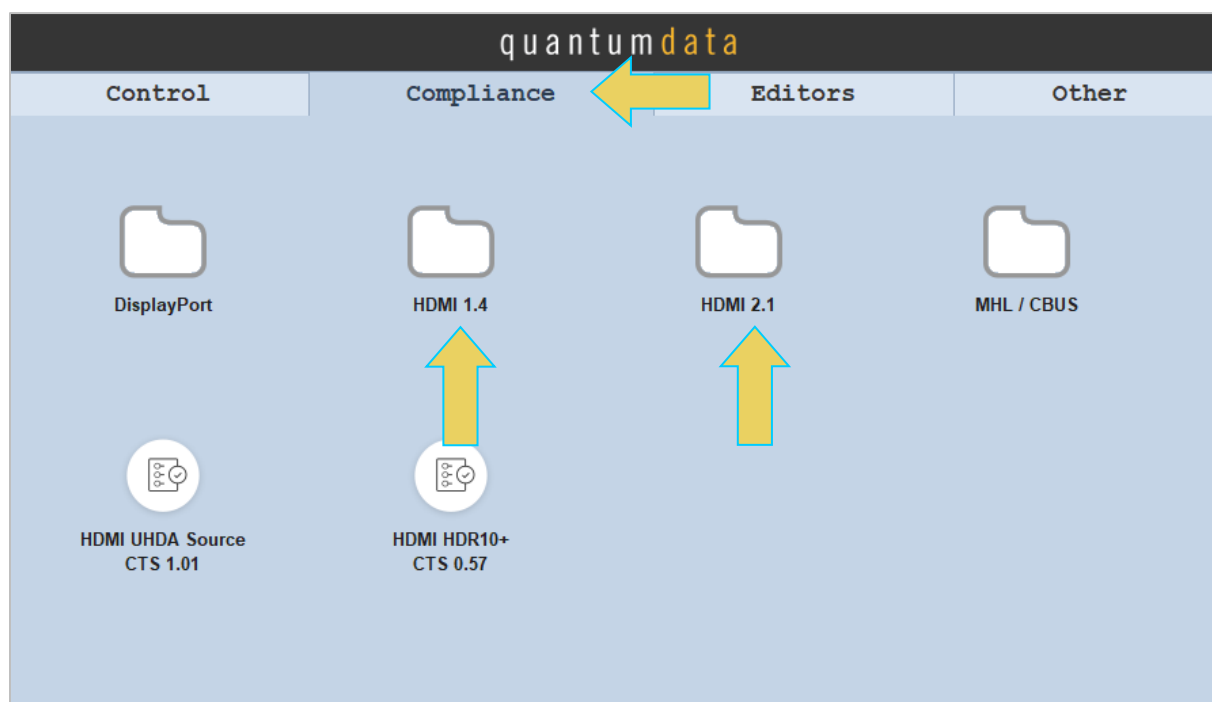
HDMI TMDS Source Compliance Test – The M41h for HDMI Testing enables developers of HDMI source devices and silicon makers to run compliance tests on their TMDS source devices on streams at up to 4K video resolutions.

HDMI TMDS sink Compliance Test – The M41h for HDMI Testing enables developers of HDMI sink devices and silicon makers to run compliance tests on their TMDS sink devices at up to 4K video resolutions.

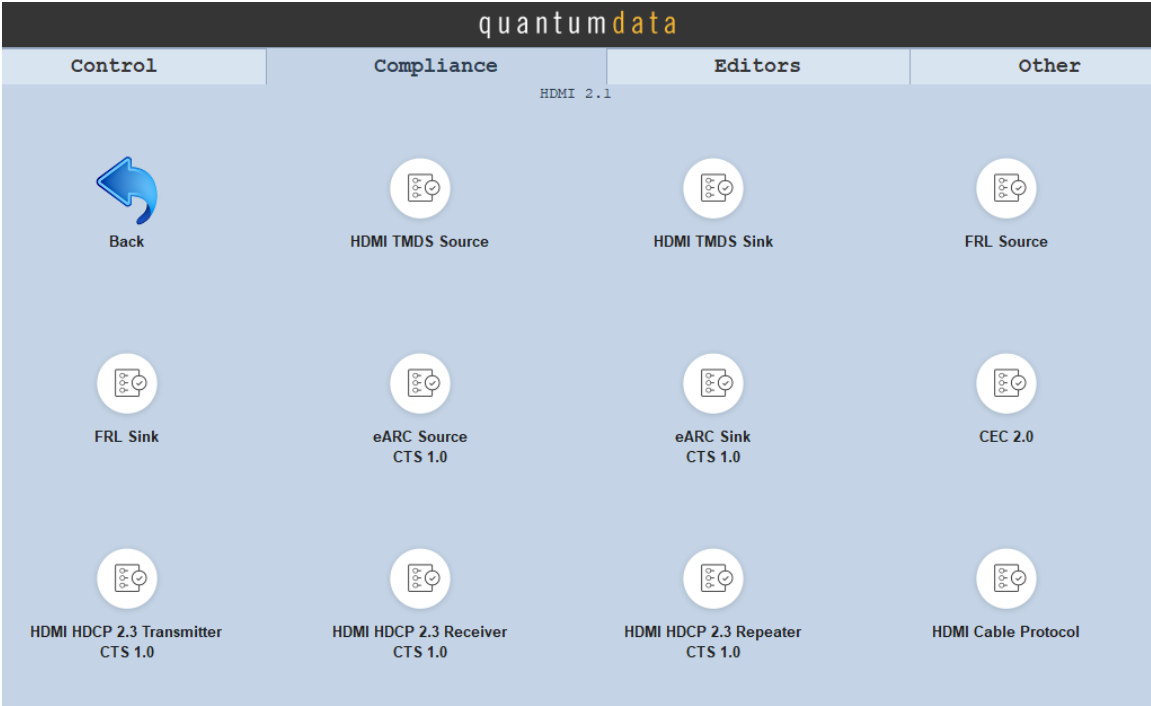
HDCP 2.2 Compliance (Source and Sink) Test – The M41h HDCP 2.2 compliance tests are ideal for pretesting your HDMI source, sink or repeater product prior to submission to an Authorized Test Center for approval. Pretesting provides assurance that your product will pass at the ATC when submitted. The compliance tests enable you to view the auxiliary channel analyzer traces logged during the test to help diagnose the cause of compliance test failures.

17.1 Accessing the Compliance Test Suites

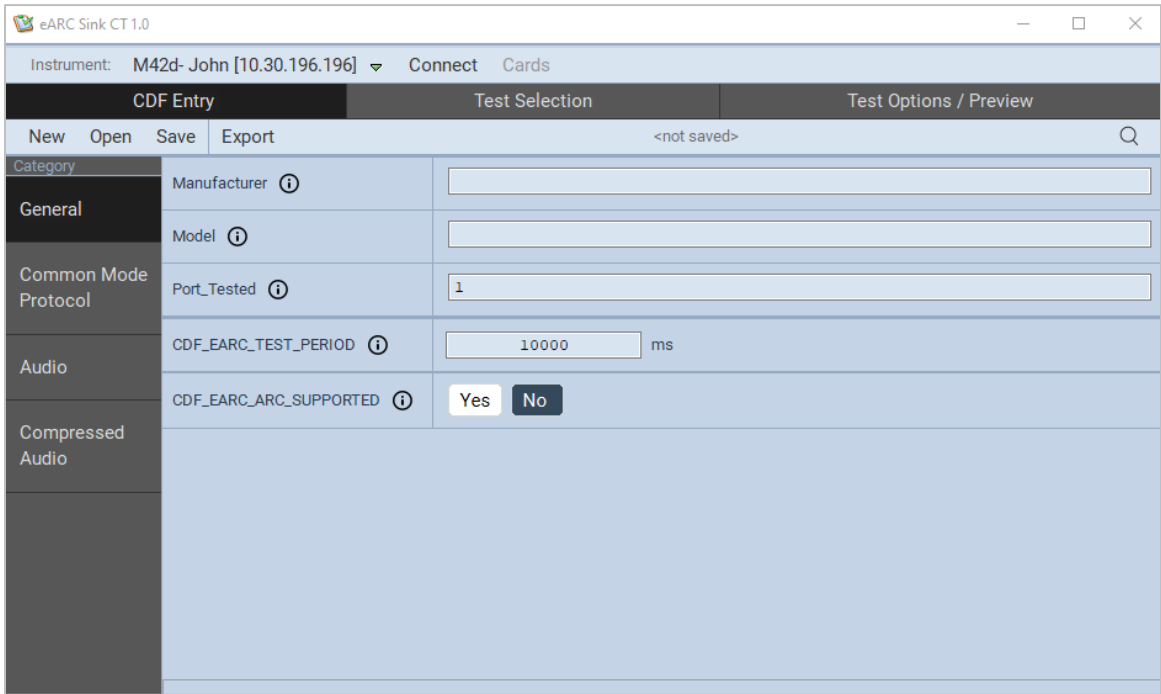
To access all of the Compliance Tests, navigate to the **Compliance** tab of the home screen and select **HDMI 1.4** or **HDMI 2.1**, according to your testing requirements, as shown below.



The below screen is the list of available HDMI 2.1 Compliance Test Suites (often referred to as CTS).



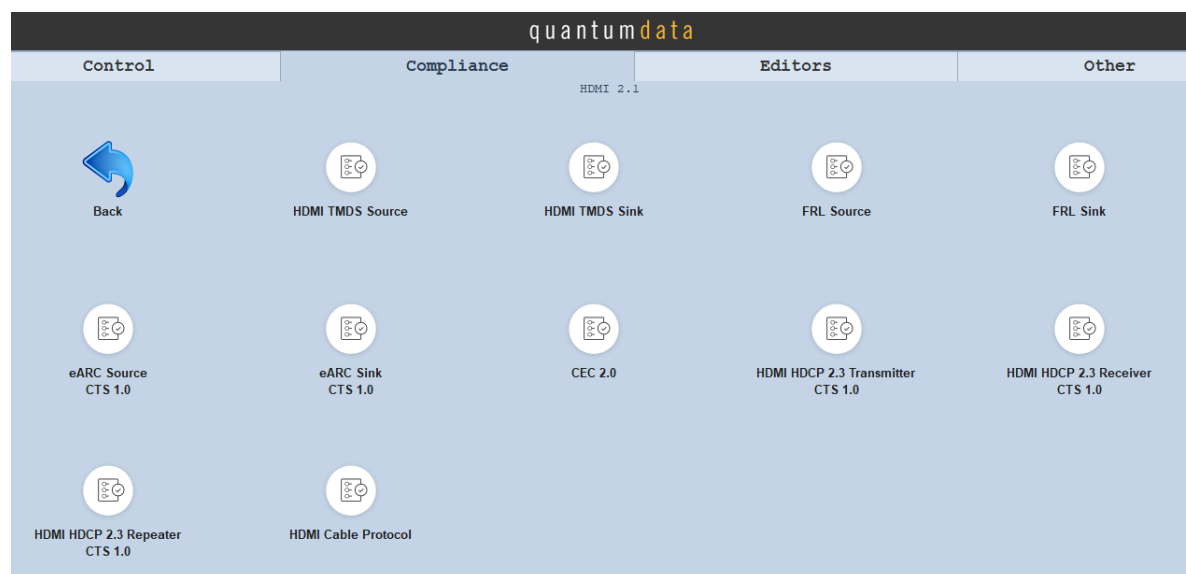
Click on a CTS to access the compliance testing utility. On the remote ATP Manager this will be a pop up; on the embedded instrument GUI it is in the same window. See below for an example of the eARC Sink CT 1.0 testing screen.



Operation of the CTS will be discussed in a later section, but all follow the specifications of the MOI.

17.2 Compliance Tests Available

Refer to the screen below to see the available Compliance Test Suites. A brief description of each follows.



HDMI TMDS Source Compliance Test – The M41h for HDMI Testing enables developers of HDMI source devices and silicon makers to run compliance tests on their TMDS source devices on streams at up to 4K video resolutions.

HDMI TMDS sink Compliance Test – The M41h for HDMI Testing enables developers of HDMI sink devices and silicon makers to run compliance tests on their TMDS sink devices at up to 4K video resolutions.

Fixed Rate Link (FRL) Source Compliance Test – Run compliance tests on your Fixed Rate Link-capable source device. Test suite includes Protocol, Link Training, Video Encoding, Video Timing, Audio, InfoFrame, EDID, etc. Includes Compliance Testing for DSC-Capable Source Devices.

Fixed Rate Link (FRL) Sink Compliance Test – Run compliance tests on your Fixed Rate Link-capable sink device. Test suite includes Character Error Detection, Reed Solomon, Video Decoding, Video Timing, Audio, InfoFrame, EDID, etc. Includes Compliance Testing for DSC-Capable Sink Devices

eARC Source and Sink Compliance Tests – The M41h enables developers of HDMI eARC Tx and Rx devices to run compliance tests on their eARC-capable. The compliance tests run with little or no human interaction. Detailed results are provided for each test to help identify the root cause of failures.

Consumer Electronic Control (CEC) Compliance Tests – The M41h allows the user to execute compliance testing to ensure that the HDMI feature Consumer Electronic Control (CEC) is compliant with spec.

HDCP 2.2 Compliance (Source and Sink) Test – The M41h HDCP 2.2 compliance tests are ideal for pretesting your HDMI source, sink or repeater product prior to submission to an Authorized Test Center for approval. Pretesting provides assurance that your product will pass at the ATC when

submitted. The compliance tests enable you to view the auxiliary channel analyzer traces logged during the test to help diagnose the cause of compliance test failures.

17.2.1 Important Note Regarding HDCP Compliance Test Formats

HDCP Compliance Tests on our products are limited to standard definition formats such as 480p60 and 576p50. Devices can pass compliance testing by using only 480p60 or 576p50.

A suggested way to validate HDCP operation in the Device Under Test is to pass the HDCP compliance tests, and also to pass HDCP functional testing with any other supported formats.

17.3 Executing Compliance Tests

17.3.1 CDF Entry

Upon opening a Compliance Test Suite, the first window displayed is the **CDF Entry** tab, as shown below.

The **Capabilities Declaration Form** is similar but *not* interchangeable with the HDMI Forum's CDF. There will be several tabs on the lefthand side within the **CDF Entry** tab. The screen example above is of eARC Sink CTS, and the subtabs at left are as follows:

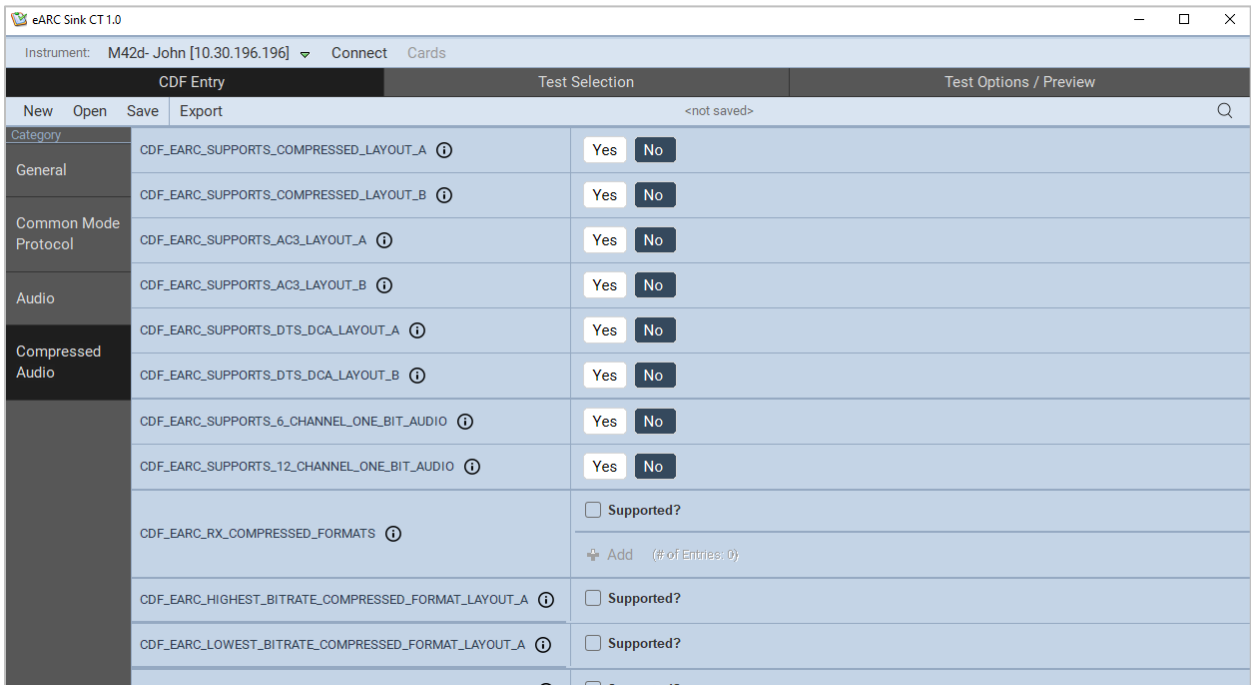
- **General**
- **Common Mode Protocol**
- **Audio**
- **Compressed Audio**

Depending on the Compliance Tests that are being executed, the **CDF Entry** window will have more or less categories on the left. Examples follow on the next page.

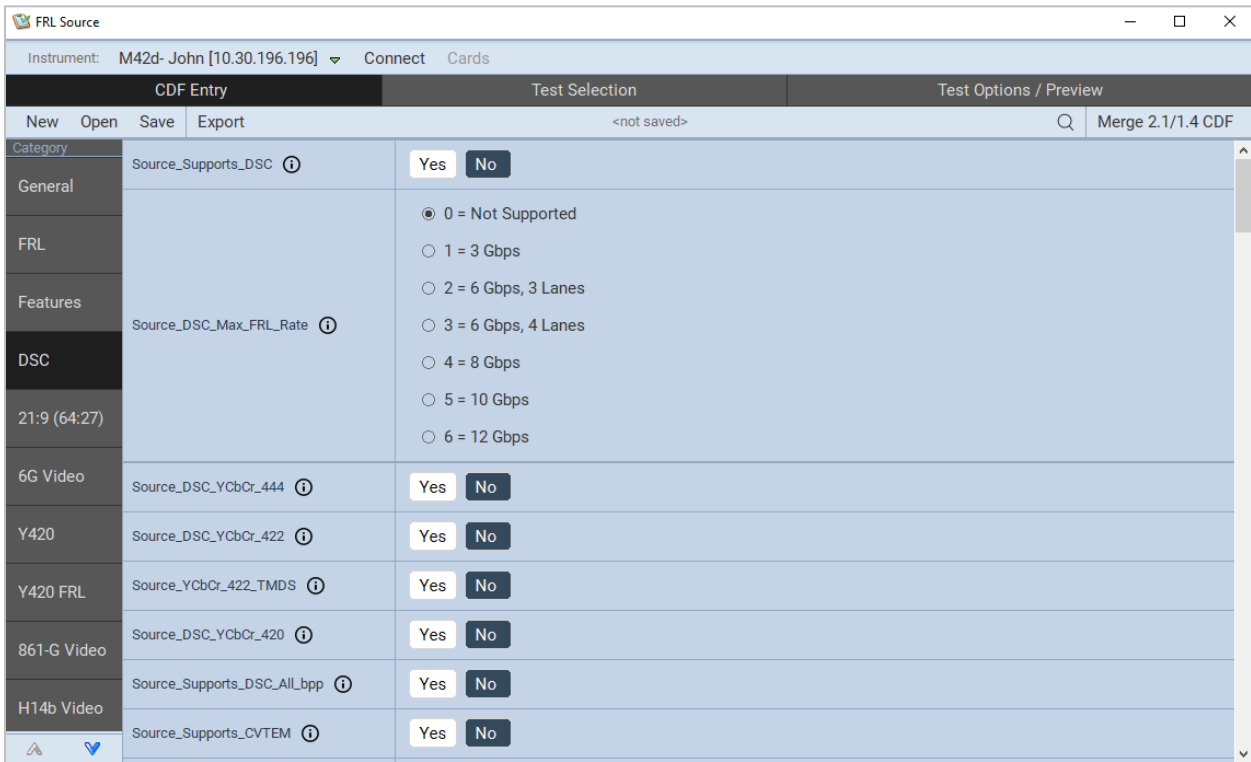
Complete the CDF Entry per your testing specifications.

Once CDF Entry is complete, you may **Save** or **Export** the entry for later use or dissemination to colleagues. Additionally, you may **Open** a previously saved CDF Entry. These options can be found at the top toolbar underneath the CDF Entry tab, as shown in the above image.

Use these subtabs to enter the capabilities of the DUT. A few screen examples of subtabs are below.



Compressed Audio CDF Entry within eARC Sink CT 1.0



Display Stream Compression (DSC) CDF Entry within FRL Source CTS

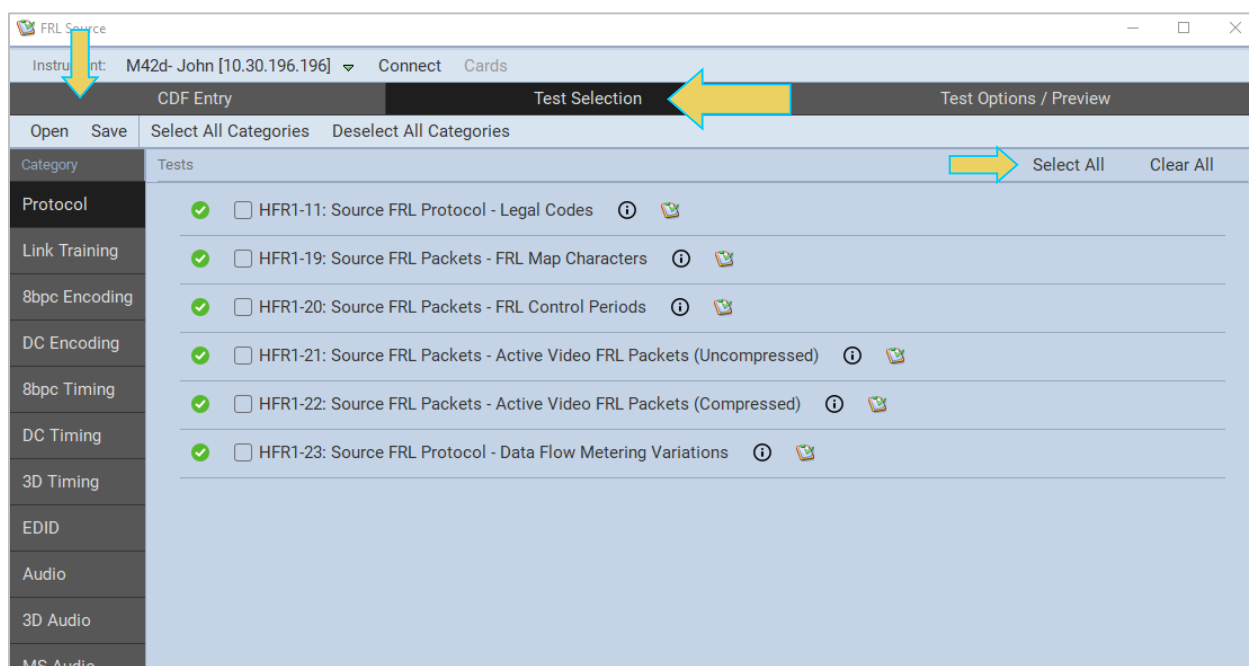
17.3.2 Test Selection


The **Test Selection** tab is directly to the right of the CDF Entry tab at the top of the window. The default window when clicking this tab will be the first **Category** listed as subtabs on the left. The screen below demonstrates what a user would see when selecting **Test Selection** in the FRL Source CTS.

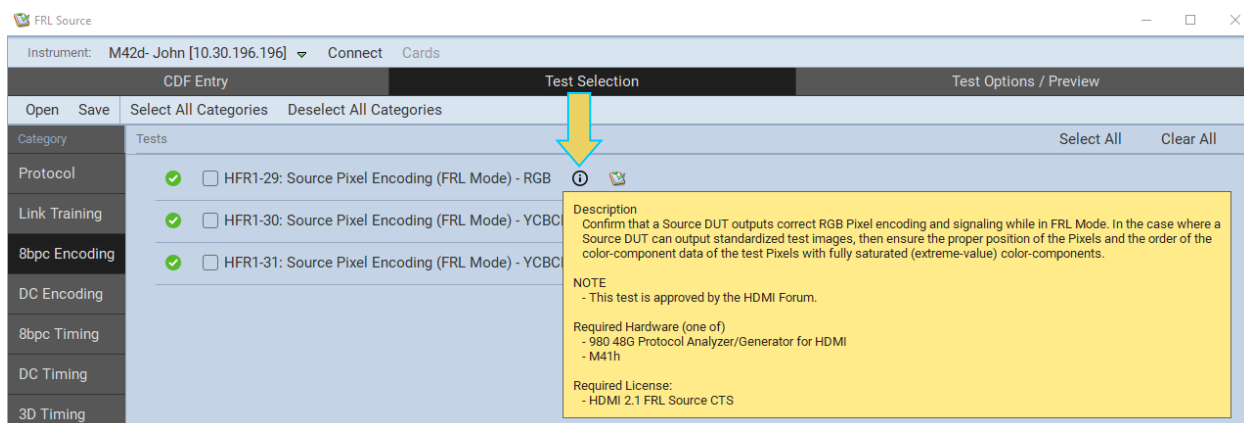
Easily **Select All** or **Clear All** selected tests within a category using the options at the top right.

Additionally, you can select every test in every category or deselect the same using the **Select All Categories** or **Deselect All Categories** buttons in the toolbar at the top left.

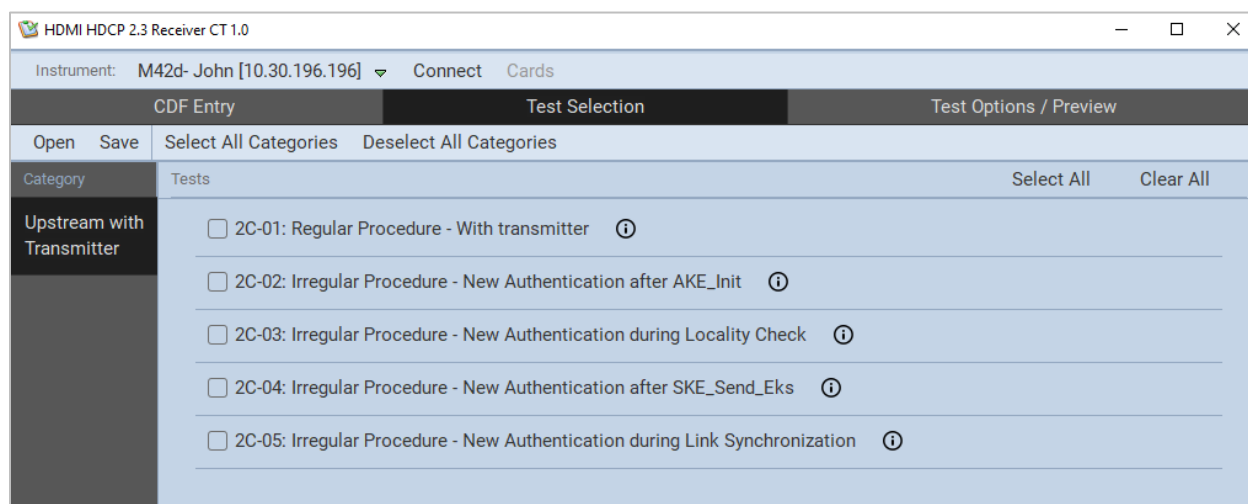
Similar to the CDF Entry tab, you may **Save** a selection of tests or **Open** a previously saved set of selections using the buttons at the top left as well, as demonstrated below.



Select the required Compliance Tests within each category according to your testing specifications. A brief description of a test can be seen by clicking the small  icon to the right of the test name, as shown below.

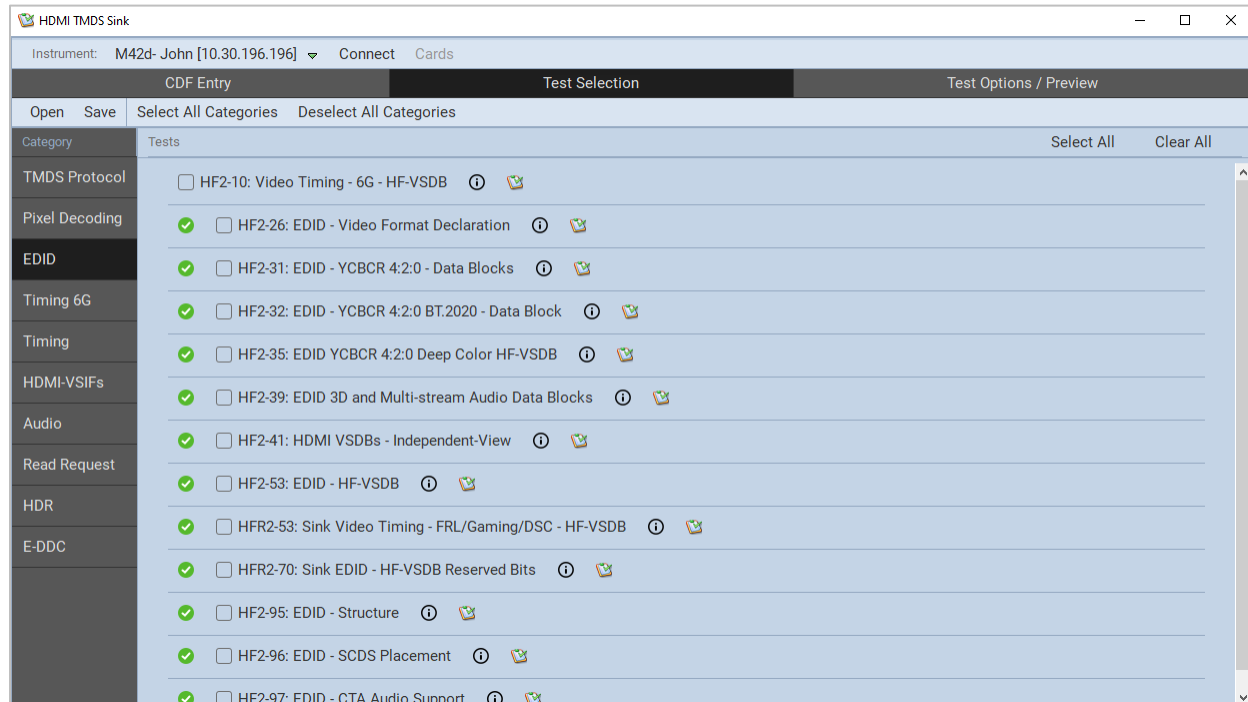


Below are some examples of Test Selection listings within various categories of different CTS.



Upstream with Transmitter Category within HDMI HDCP 2.3 Receiver CT 1.0

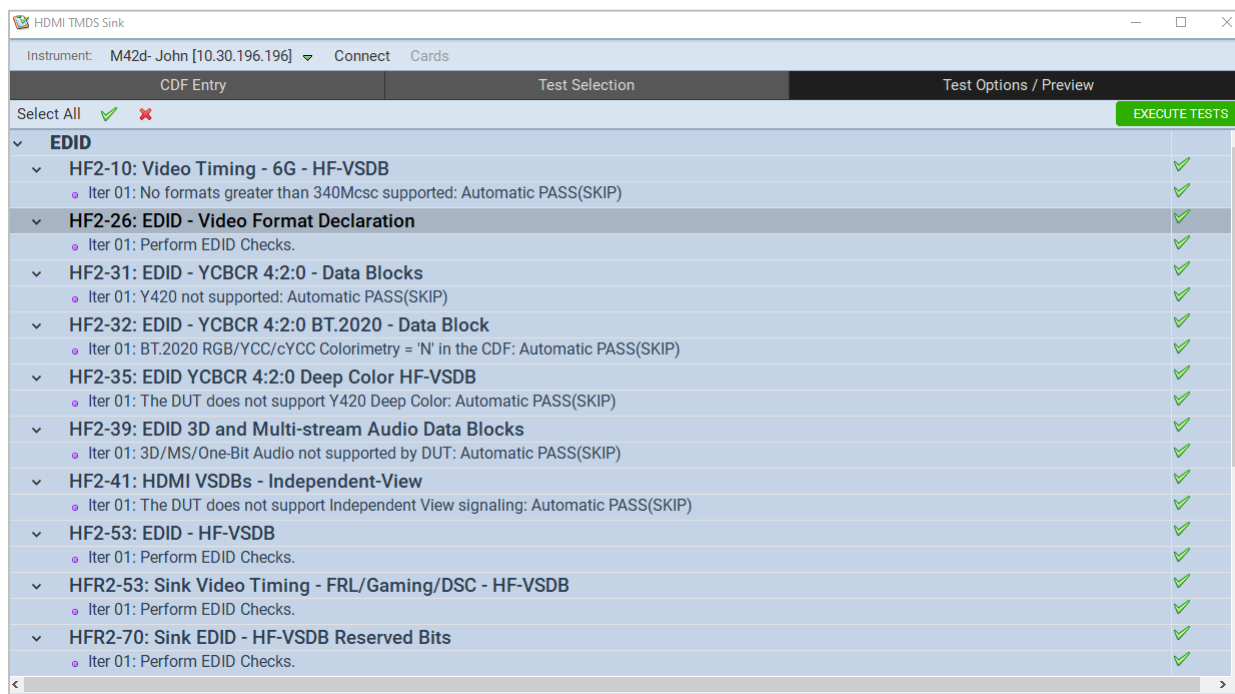
****Important note:** HDMI HDCP 2.3 Compliance Tests require standard definition formats such as 480p60 and 576p50. Devices can pass compliance testing by using only 480p60 or 576p50**



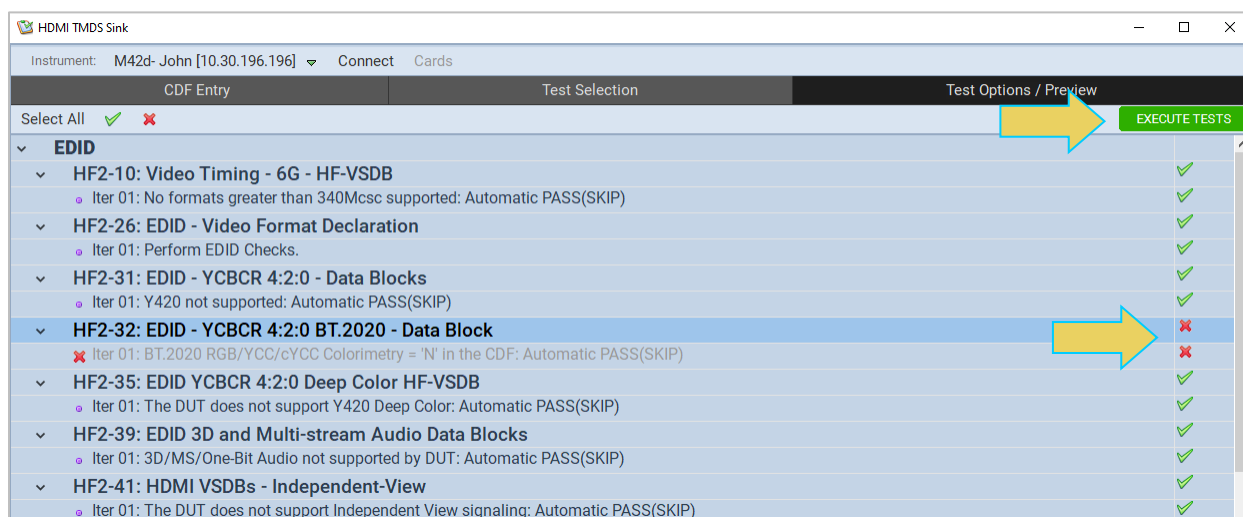
EDID Category within HDMI TMDS Sink CTS

17.3.3 Test Options / Preview

The last tab within the Compliance Test Suite is the **Test Options / Preview** tab, as shown below.



Here you will have the option of disabling/enabling certain tests by clicking the green check or red x on the righthand side of the window, as shown below.



Once all final selections are made, execute the Compliance tests by clicking the green **EXECUTE TESTS** button at the top right. Results will be available and displayed on screen as soon as the tests are complete.

17.4 API Compliance Test Execution

The following subsections provide whether or not a particular compliance test is compatible with the API.

17.4.1 HDMI Source TMDS Tests

API-compatible HDMI Source TMDS compliance tests:

HF1-10	HF1-18	HF1-27	HF1-41	HF1-52
HF1-11	HF1-20	HF1-28	HF1-43	HF1-53
HF1-12	HF1-21	HF1-29	HF1-44	HF1-66
HF1-13	HF1-22	HF1-31	HF1-45	HF1-71
HF1-14	HF1-23	HF1-32	HF1-47	HF1-72
HF1-15	HF1-24	HF1-33	HF1-48	HF1-74
HF1-16	HF1-25	HF1-34	HF1-49	HF1-75
HF1-17	HF1-26	HF1-35	HF1-51	

API non-compatible HDMI Source TMDS compliance tests:

HF1-54	HF1-55	HF1-67	HF1-73
--------	--------	--------	--------

17.4.2 HDMI Sink TMDS Tests

API-compatible HDMI Sink TMDS compliance tests:

HF2-5	HF2-10	HF2-30	HF2-40	HF2-71
HF2-6	HF2-23	HF2-31	HF2-41	HF2-72
HF2-7	HF2-24	HF2-32	HF2-43	HF2-94
HF2-8	HF2-25	HF2-35	HF2-53	HFR2-53
HF2-9	HF2-26	HF2-39	HF2-54	HFR2-70

API non-compatible HDMI Sink TMDS compliance tests:

HF2-12	HF2-37	HF2-66	HF2-95	HF2-55
HF2-16	HF2-38	HF2-74	HF2-96	HF2-56
HF2-34	HF2-44	HF2-76	HF2-97	HF2-57
HF2-36	HF2-50	HF2-86	HF2-98	HF2-58

17.4.3 FRL Source Tests

API-compatible FRL Source compliance tests:

HFR1-10	HFR1-15	HFR1-20	HFR1-25	HFR1-30
HFR1-11	HFR1-16	HFR1-21	HFR1-26	HFR1-31
HFR1-12	HFR1-17	HFR1-22	HFR1-27	HFR1-32
HFR1-13	HFR1-18	HFR1-23	HFR1-28	HFR1-33
HFR1-14	HFR1-19	HFR1-24	HFR1-29	HFR1-34

HFR1-35	HFR1-41	HFR1-51	HFR1-81	HF1-57
HFR1-36	HFR1-43	HFR1-52	HFR1-82	HF1-58
HFR1-37	HFR1-44	HFR1-58	HFR1-83	HF1-60
HFR1-38	HFR1-45	HFR1-68	HFR1-84	
HFR1-39	HFR1-46	HFR1-69	HFR1-85	
HFR1-40	HFR1-50	HFR1-80	HFR1-65	

API non-compatible FRL Source compliance tests:

HFR1-79	HFR1-67	HF1-56	HF1-59	HFR1-73
---------	---------	--------	--------	---------

17.4.4 FRL Sink Tests**API-compatible FRL Sink compliance tests:**

HFR2-17	HFR2-21	HFR2-49	HFR2-53	HFR2-82
HFR2-18	HFR2-22	HFR2-50	HFR2-70	HFR2-83
HFR2-19	HFR2-23	HFR2-51	HFR2-80	HFR2-84
HFR2-20	HFR2-48	HFR2-52	HFR2-81	HFR2-85

API non-compatible FRL Sink compliance tests:

HFR2-11	HFR2-16	HFR2-33	HFR2-69	HF2-61
HFR2-12	HFR2-24	HFR2-40	HFR2-73	HF2-63
HFR2-13	HFR2-30	HFR2-43	HFR2-86	HF2-73
HFR2-14	HFR2-31	HFR2-61	HFR2-94	
HFR2-15	HFR2-32	HFR2-66	HF2-60	

17.4.5 eARC Source Tests**API-compatible eARC Source compliance tests:**

HFR5-1-20	HFR5-1-25	HFR5-1-33	HFR5-1-38	HFR5-1-55
HFR5-1-21	HFR5-1-26	HFR5-1-34	HFR5-1-39	HFR5-1-56
HFR5-1-22	HFR5-1-28	HFR5-1-35	HFR5-1-50	HFR5-1-58
HFR5-1-23	HFR5-1-29	HFR5-1-36	HFR5-1-51	HFR5-1-59
HFR5-1-24	HFR5-1-32	HFR5-1-37	HFR5-1-52	

API non-compatible eARC Source compliance tests:

HFR5-1-27	HFR5-1-31	HFR5-1-41	HFR5-1-60	HFR5-1-62
HFR5-1-30	HFR5-1-40	HFR5-1-57	HFR5-1-61	

17.4.6 eARC Sink Tests

API-compatible eARC Sink compliance tests:

HFR5-2-20	HFR5-2-22	HFR5-2-24
HFR5-2-21	HFR5-2-23	HFR5-2-25

API non-compatible eARC Sink compliance tests:

HFR5-2-26	HFR5-2-31	HFR5-2-36	HFR5-2-50	HFR5-2-56
HFR5-2-27	HFR5-2-32	HFR5-2-37	HFR5-2-52	
HFR5-2-28	HFR5-2-33	HFR5-2-39	HFR5-2-53	
HFR5-2-29	HFR5-2-34	HFR5-2-40	HFR5-2-54	
HFR5-2-30	HFR5-2-35	HFR5-2-41	HFR5-2-55	

18 Command Line Interface for Capturing Data

This chapter describes the command line interface for captured data.

18.1 Overview

The command line enables you to capture data and search through captures for specific subsets of data. You can control the M41h 48G Video Analyzer/Generator through the command line via a telnet session or from the M41h Manager Console panel. When searching through the captured data, Teledyne LeCroy recommends that you use Telnet or some other terminal program such as Putty because there is a limited set of Linux commands supported through the M41h Console.

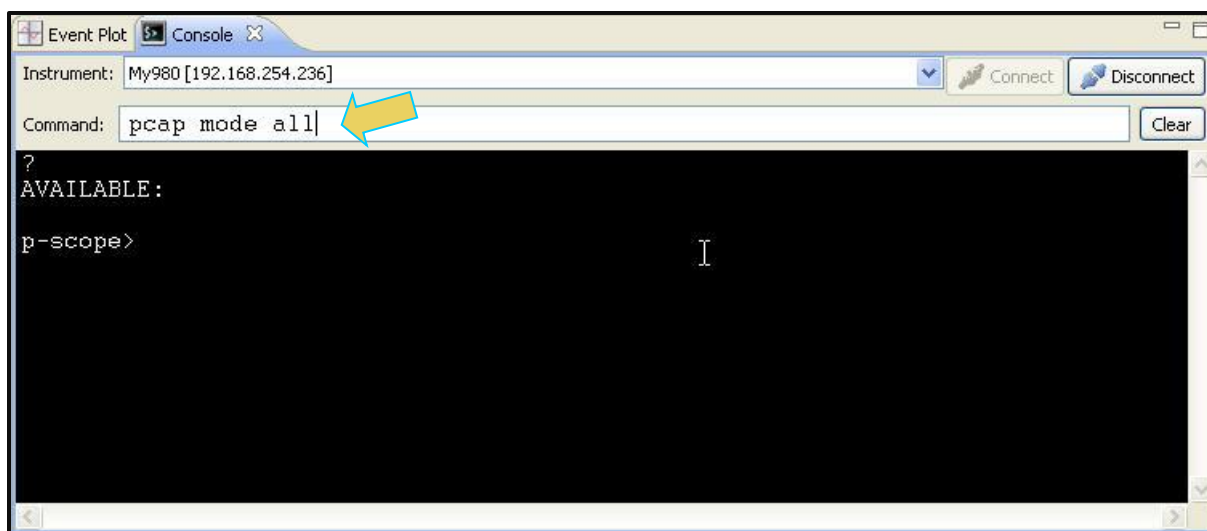
There are M41h-based commands that enable you to initiate commands to capture data. Once you capture data, you can conduct searches either on your host PC or the M41h itself. To conduct searches on your PC, transfer the captured data to your host PC using an FTP utility. This procedure is described in the section: Transferring Capture Files from the M41h to a PC.

The M41h 48G Video Analyzer/Generator is based on the Linux operating system; therefore, to conduct searches directly on the M41h you use the Linux search and filter utilities such as `grep`.

You can access the Linux prompt from the p-scope prompt available from the **Console** panel or through a separate telnet window. Procedures for both are shown below.

To establish a command line session through the M41h Console window:

1. Establish an Ethernet connection between the M41h 48G Video Analyzer/Generator using the procedures defined in: Connection Scenarios for external ATP Manager.
2. Highlight the M41h that you want to execute commands on.
3. Activate the **Console** tab to access the **Console** panel interface.
4. Click on the **Open Connection** activation button to establish a telnet session with the M41h 48G Video Analyzer/Generator.



The **p-scope>** prompt will appear allowing you to enter commands.

Note: You enter commands in the **Command** field above the terminal area.

The primary command for setting up and initiating the capture data is the **PCAP** command (not case sensitive). There are several arguments of the PCAP and these are explained in the table in the procedures below.

To quit out of the M41h Console window session:

1. To quit out of the console session enter the following sequence:

```
p-scope>quit      // Takes you to the Linux shell prompt.
qd@spcope:~$
```

7. Enter the following to exit out of the console session:

```
qd@spcope:~$ exit
```

To establish a command line session through a telnet session:

1. Launch the Command Prompt utility from the Windows Accessories.
8. Establish a telnet session with the M41h using the following command. Note you will enter in the IP address of the M41h (192.168.254.001 in example below):

```
>telnet 192.168.254.001
```

The M41h login prompt will then appear as shown below. The M41h login and password are **qd**.

```
Pscope login: qd
```

```
Password: qd // you will not be able to see the entry.
```

The **p-scope>** prompt will appear allowing you to enter commands.

The primary commands for setting up and initiating the capture data is the **PCAP** command (not case sensitive). There are several arguments of the PCAP and these are explained in the table and procedures below.

List of PCAP Commands

Note: Commands are lower case.

Command	Description	Syntax	Command Example
pcap size	Defines the Buffer Size in percent of total (2GB).	pcap size < size > Where <size> can be 0 to 100 percent.	To set the Buffer Size to 50% of the total buffer capacity: >pcap size 50 Captures data up to 50% of the capacity of the buffer.

List of PCAP Commands**Note:** Commands are lower case.

Command	Description	Syntax	Command Example
pcap mode	Defines the data that is captured. In other words, determines if video and data islands	pcap mode <data> Where <data> can be: all - video & data di – data islands only tmds – raw protocol data	To set the mode: >pcap mode di Captures only data island information (not video).
pcap trig	Defines the trigger mechanism	pcap trig <type> <pos> Where <type> can be: vsync – when a vsync event occurs encr- – encryption enable pulse is disabled (not detected in window of opportunity) encr+ - encryption enable pulse occurs in – external trigger input prat – a change in the pixel rate match – matched values in the data islands Where <pos> can be a percent in the range of: 0 to 100	To set the trigger criteria: >pcap trig vsync 50 This example would set the trigger event to the occurrence of vsync and the position such that the trigger event would be midway between the data accumulated in the capture buffer.
pcap start	Initiates the capture of video stream.	pcap start	To initiate a capture: > pcap start
pcap decode	Decodes an existing capture in the capture buffer and creates a decode file.	pcap decode	To a decode of a capture: > pcap decode Creates a file using the default name of pdecode.log on the M41h
pcap stat	Obtain a list of the video format timing statistics.	pcap stat	To obtain a list of the video format timing information: > pcap stat

Note: The commands are not case sensitive.

18.2 Command Line Examples

The following is an example of how to use the command line. You use the capture control commands at the p-scope prompt. Once you have captured data you can transfer into the Linux shell and run typical Unix commands.

Note: You can run Linux commands on a capture file (decode.log) that either resides in the M41h instrument or that resides on your PC. However, the method is different. For captures that reside on the M41h, you must run the capture through the command line either through a telnet session or through the M41h Manager Console.

18.2.1 Searching Through Captured Text

This example shows you how to search through captured text. The primary capture utility in Linux is grep. Consult the man pages for the grep filter to determine how best to use this command.

To search through the captured text:

1. Enter the following commands to capture the data:

```
p-scope> pcap size 25           // Sets the capture buffer to 25%
                                of its maximum size
p-scope> pcap mode di          // Only captures data islands (no video
                                is captured)
p-scope> pcap trig vsync 10     // Initiates the capture when vsync
                                is detected
p-scope> pcap start             // Initiates the capture
p-scope> pcap decode           // Decodes the hex file into human
                                readable text and stores in
                                default directory:
                                /home/qd/pdecode.log
```

Note: If you want to recapture and save a decode file you will have to move the existing decode file to another directory or rename it.

2. To run the Timing Analyzer utility enter the following:

```
p-scope> pcap timing // Creates the timing analysis file
```

3. To run the Audio Analyzer utility enter the following:

```
p-scope> pcap auda // Creates the audio analysis file
```

4. Quit out of the pscope command line to access the Linux utilities in the bash shell:

```
p-scope> quit // quits out of the pscope shell to the bash
               shell where you enter linux command
```

Here you can navigate to the proper directory or use the full directory path and enter any Linux shell command to search through the data.

```
qd@spscope:~$ cd /home/qd/workspace/captures/2010_05_27_17_15_28
```

Where "2010_05_27_17_15_28" is the name of a capture directory.

```
qd@spscope:~$ grep "CTS = 74250" pdecode.log
```

The command above will return all lines in the captured data where CTS is equal to the value specified.

```
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
audio clock regeneration N = 6144, cycle time Stamp CTS = 74250
```

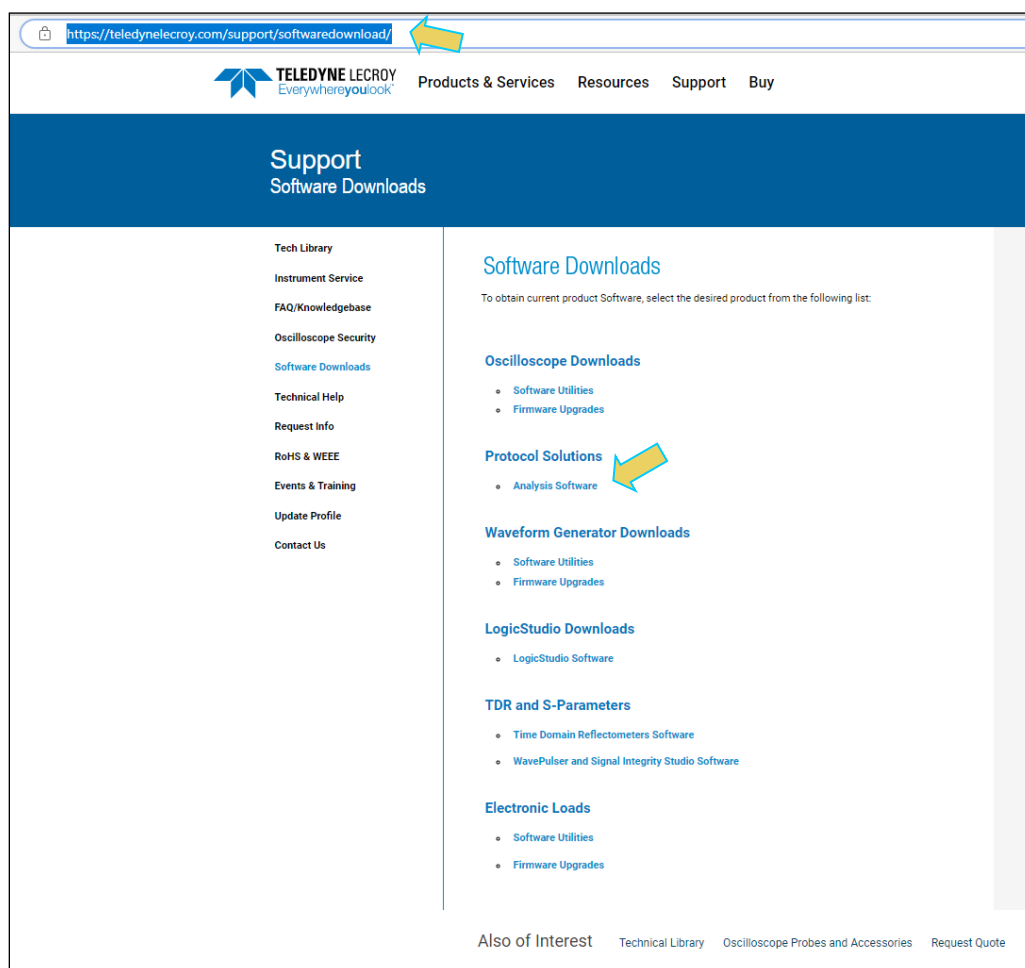
5. To return to the p-scope prompt: **qd@pscope:~\$** sudo /qd/ptalk

19 Upgrading the M41h Manager and M41h

This Chapter provides information about upgrading your M41h and 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 downloads page of the Teledyne LeCroy website.

Download the ATP Manager GUI application from the Teledyne LeCroy downloads page:
<https://teledynelecroy.com/support/softwaredownload/>.



Two software packages are available for upgrading the M41h:

Embedded firmware and gateway packages for the M41h 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 Graphical User-interface that will be installed for the Touch Screen User-interface. The M41h software package includes the firmware and gateway for all available.

Graphical User-interface for Windows PCs. This is the M41h Manager GUI that can be used to control all M41h instruments from a Windows PC.

Notes:

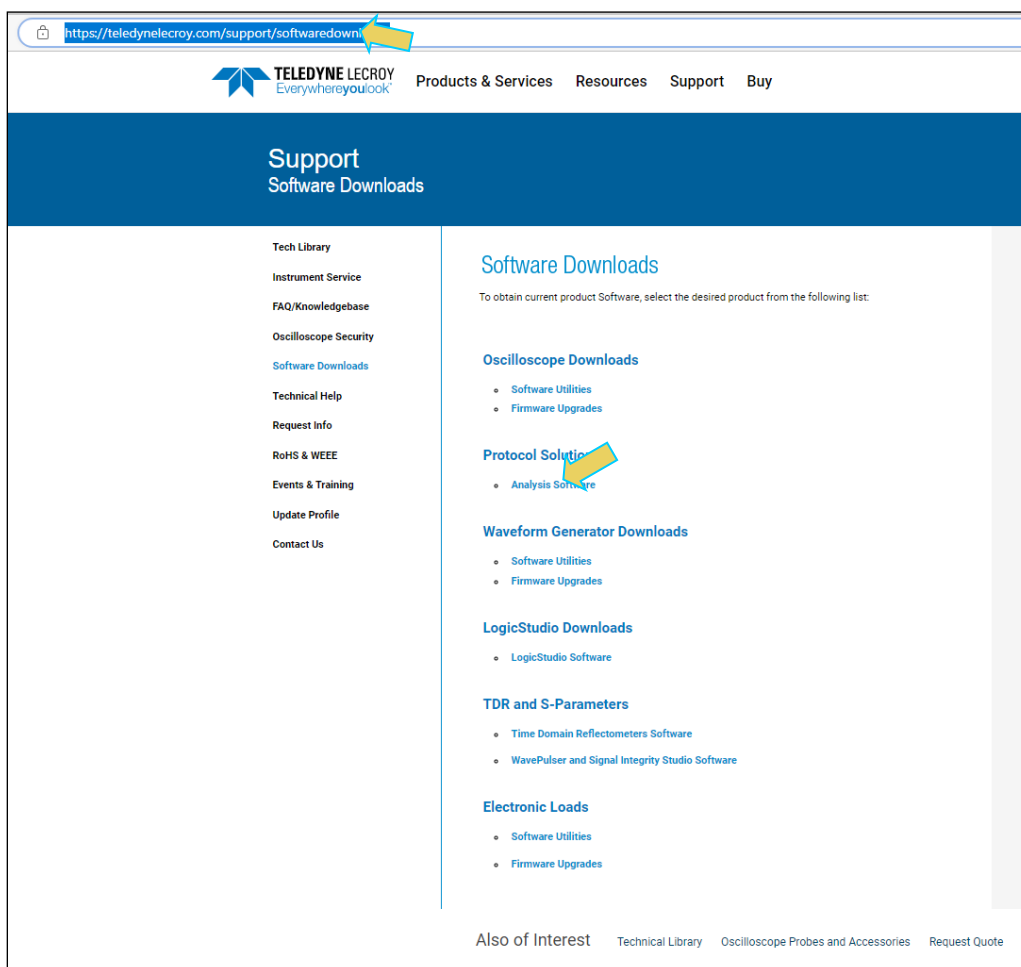
1. If the Windows-based M41h Manager GUI and the embedded firmware are both being upgraded, you will need to upgrade the M41h Manager first, and then upgrade the embedded firmware.
2. Be sure to check the release notes associated with the download files. Any special installation instructions will be noted in the release notes.
3. In some cases, if your M41h is not at the most recent version, you may have to first upgrade to the most current version and then to the new version.

19.1 Workflow for Upgrading M41h Firmware/Gateway

This section describes the workflow of the upgrade process. It is not intended to be a detailed procedure. **Please refer to the Release Notes for detailed upgrade procedures.**

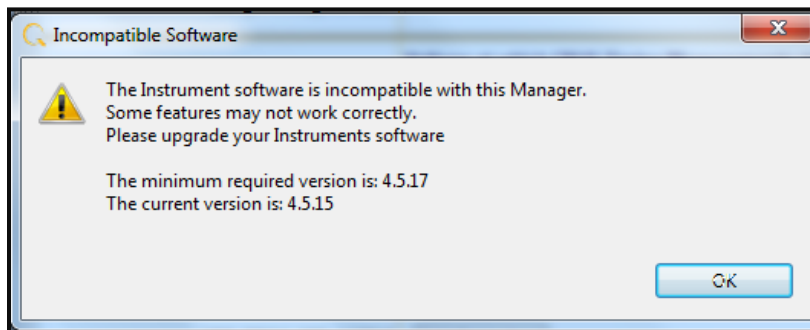
Please note that you must upgrade the ATP Manager before using the ATP Manager to upgrade the M41h firmware and gateway.

1. Download the ATP Manager and M41h Firmware/Gateway files from the Teledyne LeCroy website downloads page: <https://teledynelecroy.com/support/softwaredownload/>.

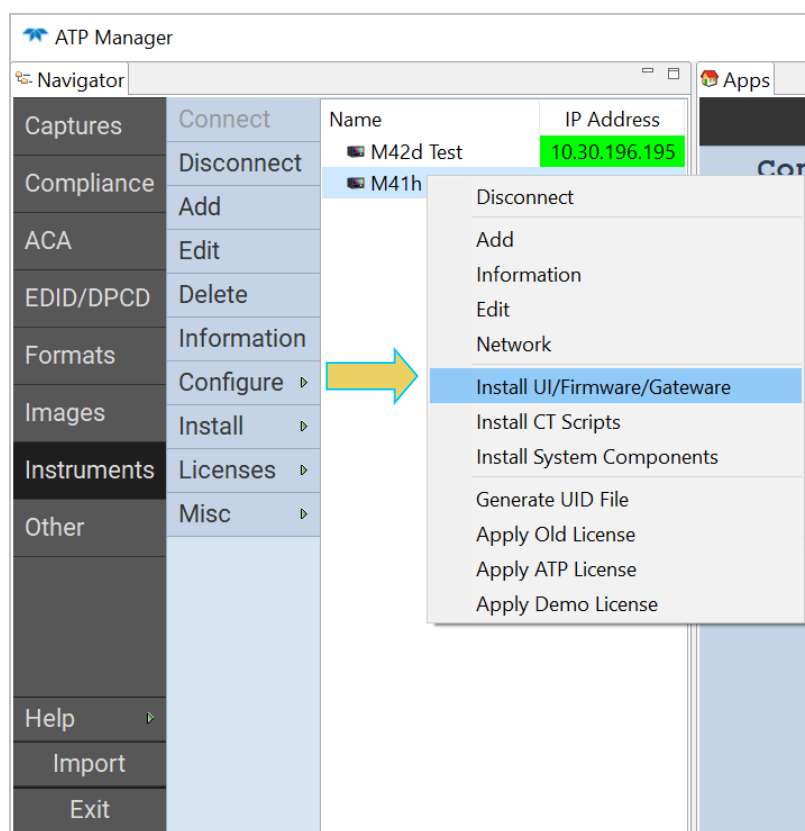


2. Upgrade the ATP Manager and restart.

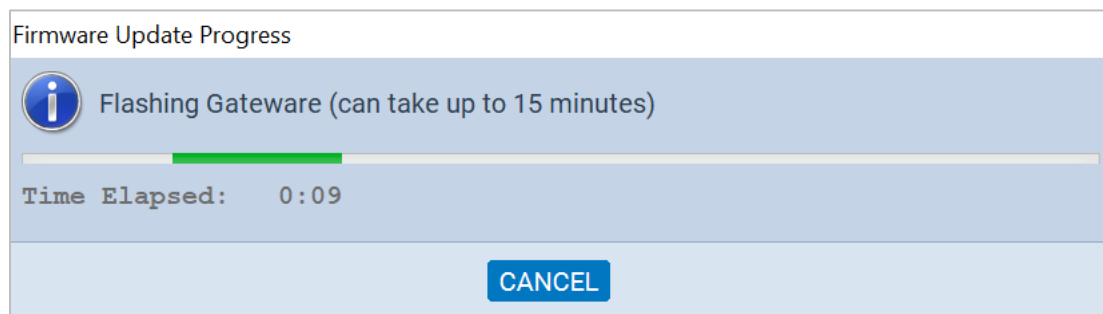
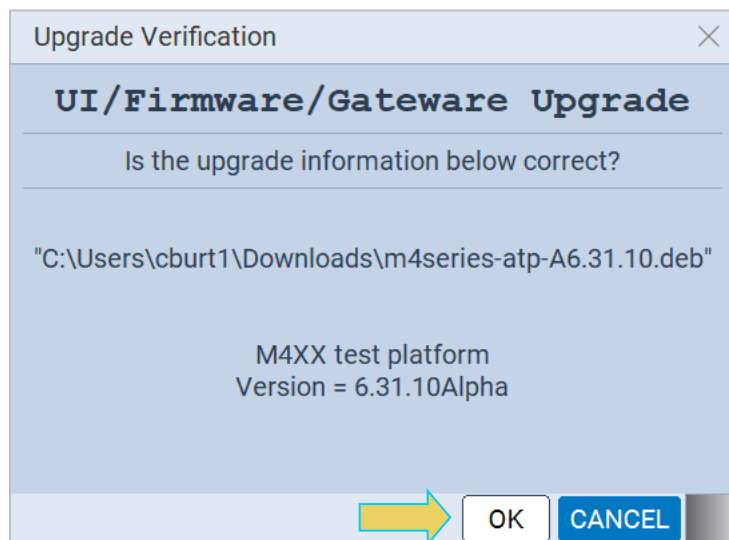
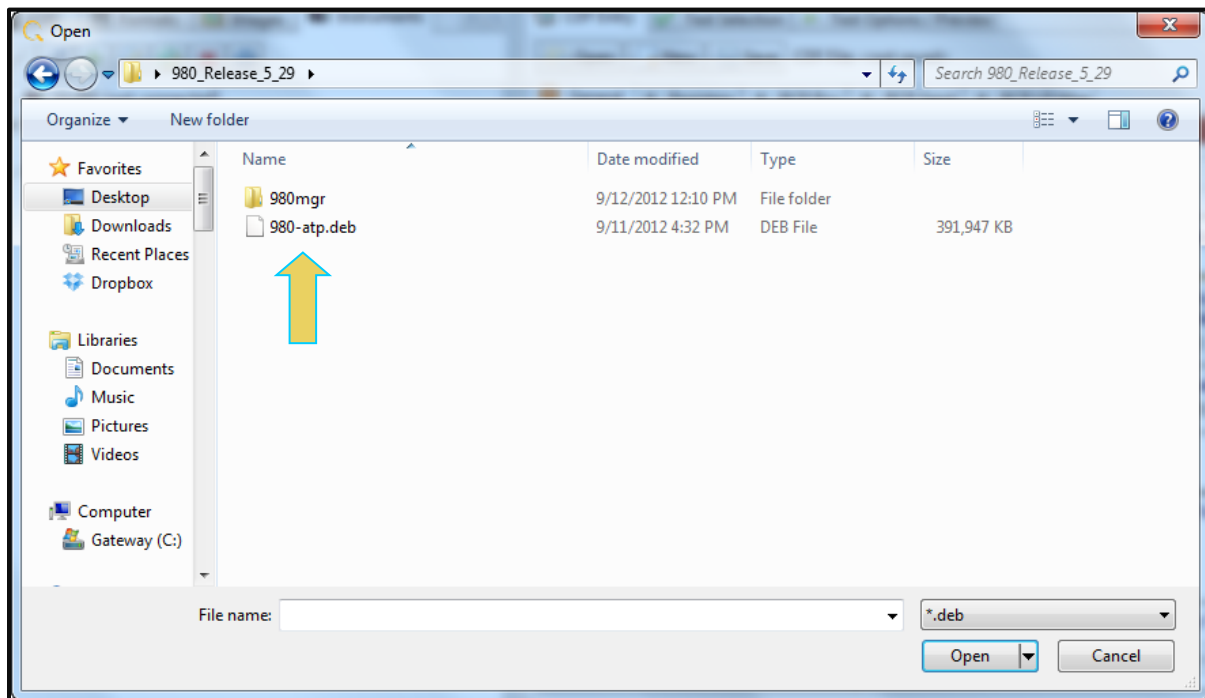
Note: You may receive the following error indicating that you must update the M41h firmware/gateway.

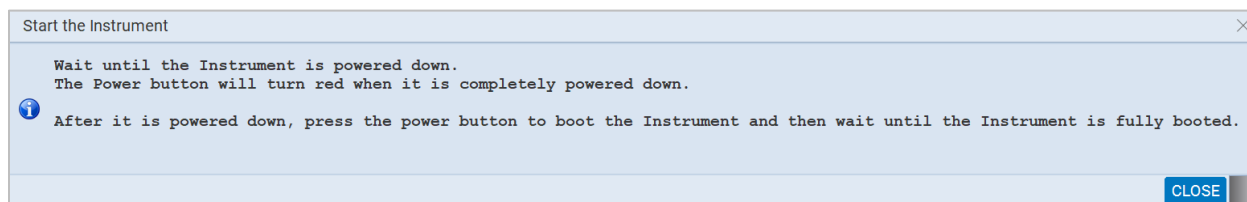


3. Connect to the M41h that you wish to upgrade.
4. Access the Upgrade Firmware/Gateway option from the Instrument pull-down.



5. Update the M41h Firmware/Gateway.
6. Browse to the Deb file and select it. Follow the on-screen prompts.





7. Reconnect the ATP Manager to the M41h.

19.2 Workflow for Adding License for optional feature

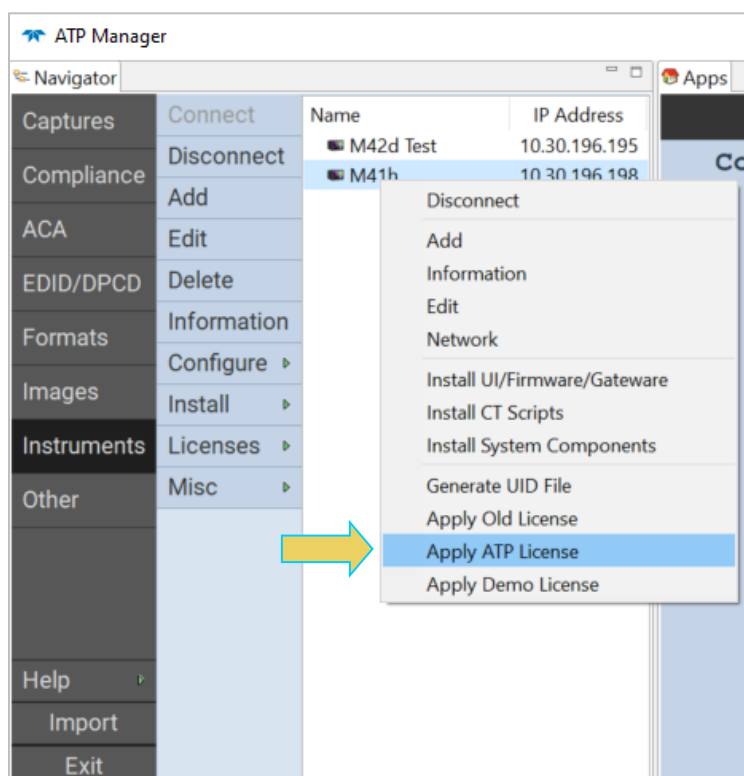
This section describes the workflow of the upgrade for the M41h Protocol Analyzer with an optional feature using a license key. It is not intended to be a detailed procedure. **Please consult Teledyne LeCroy Customer Support for details.**

Note: You must have purchased the optional feature through the normal channels of your Quantum Data representative or distributor.

1. Purchase optional feature from Teledyne LeCroy distributor or representative.
2. Call Teledyne LeCroy customer support.
3. Generate UID text file from the **Instrument** pull-down menu (below) and convey to Teledyne LeCroy customer support.

Teledyne LeCroy will provide a QDATP.lic file. Store this on your host PC.

4. From the **Instrument** pull-down menu (below) select Apply ATP License.



END OF USER GUIDE