



M41h 48G Video Analyzer/Generator

for HDMI 8K Testing

User Guide

Rev: A1



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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 is able to parse HDMI streams from source devices with an FRL data rate of 48Gb/s.

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 PC application 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 as installed in the M41h. 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 standalone PC application, i.e. the M41h 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 include start up procedures** for the M41h Test Platform. The start-up procedures are covered in the *M41h Advanced Test Platform Quick Start Guide*.

1.3 What options are available with the M41h 48G Video Analyzer/Generator?

There are several options available with the: 1) The Protocol Analyzer function and 2) the Video Generator function, 3) eARC functional testing for Tx, 4) eARC functional testing for Rx, 5) eARC compliance testing for Tx, 6) eARC compliance testing for Rx, 7) FRL source compliance testing, 8) FRL sink compliance testing. Procedures for both are described 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

This is a new User Guide.

1.5 M41h User Interface

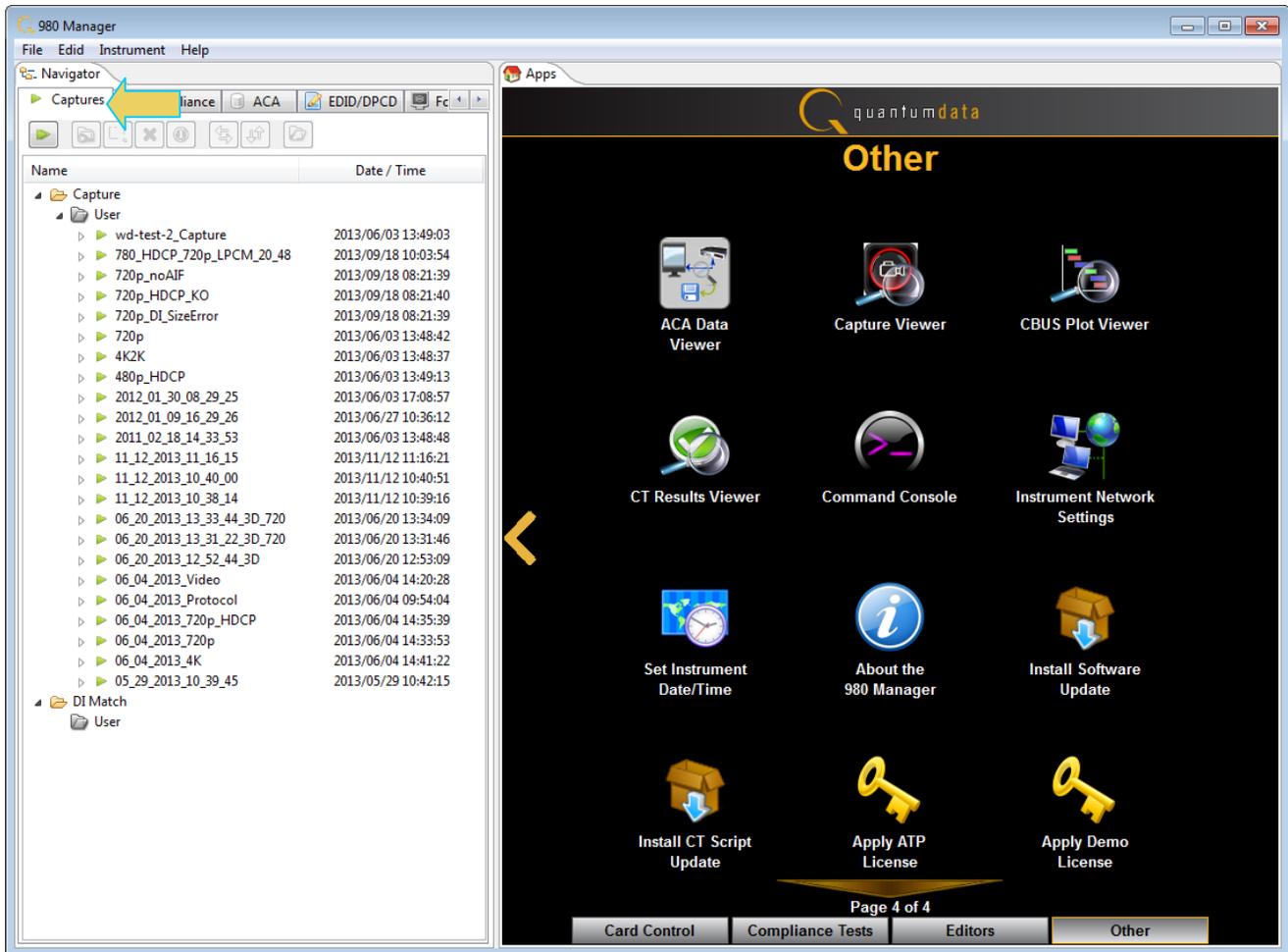
The M41h provides a graphical user interface (ATP Manager) for operation. This GUI can run both on the M41h itself through external display or as a standalone application running on a PC (external ATP Manager). The look and feel and functions are similar but not identical.

1.5.1 ATP Manager

The external ATP Manager provides easy access to the captured data on your PC for sharing with others. Also the external ATP Manager 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 External ATP Manager layout differences

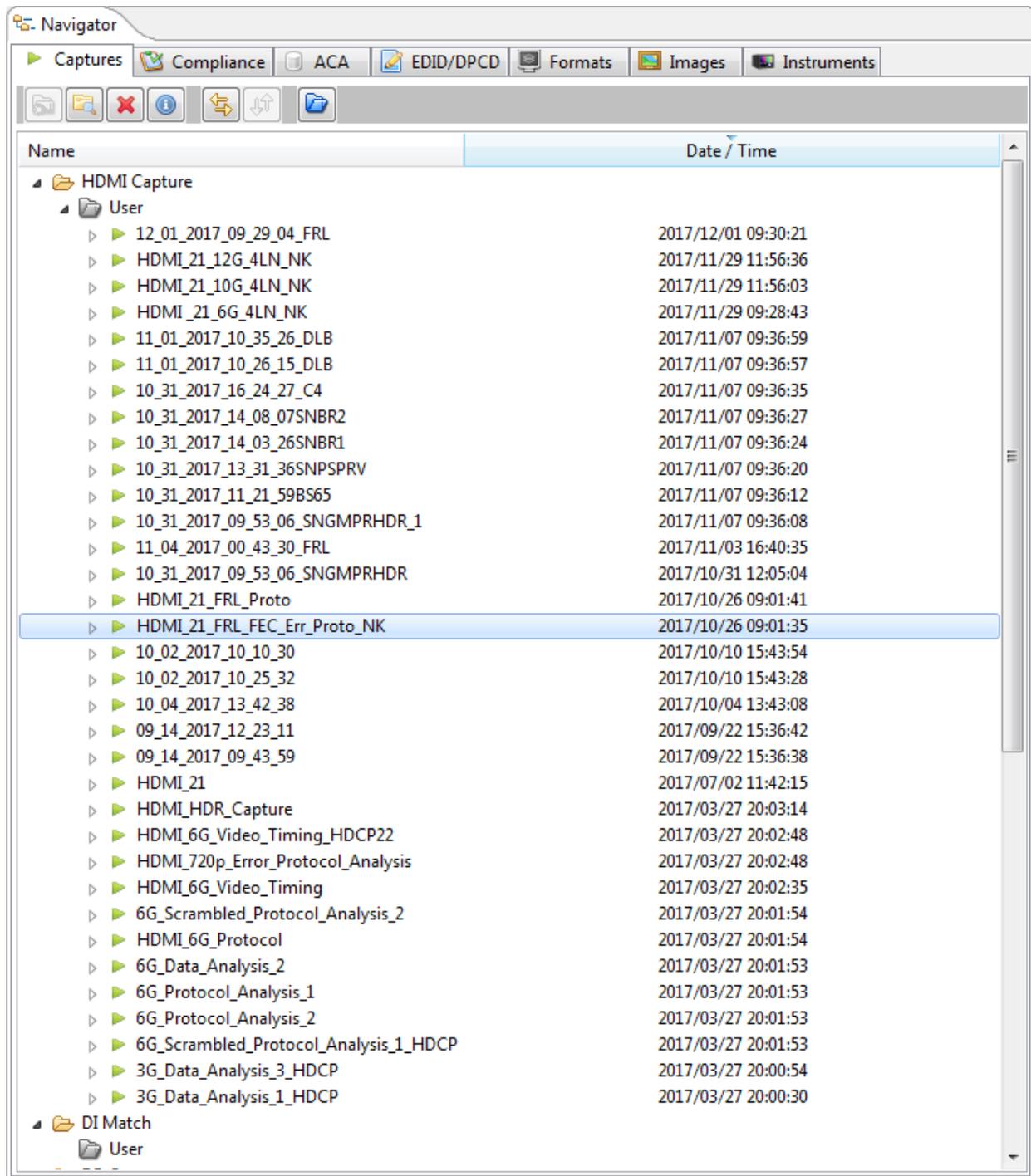
There are a few other differences in the layouts between the ATP Manager running on an external display and the ATP Manager running on a host PC. The primary difference is the Navigator panel which enables you to access the data elements and test results from an instrument. In the PC ATP Manager, the **Navigator** panel is always present on the left side of the ATP Manager application window as shown below.



In the ATP Manager displayed on an external monitor, the **Navigator** panel must be opened. You can access it either from the **Other** Page of the Apps window, refer to the first screen example below or you can access the **Navigator** from the Real Time window as shown in the second screen example. Finally you can also access the **Navigator** from any window in the ATP Manager displayed on a remote monitor using the activation key at the bottom of any screen as shown below.



When you access the **Navigator** it will appear in the window as shown below.



1.6 What kinds of data does the M41h 48G Video Analyzer/Generator allow you to view?

By providing visibility into the HDMI FRL protocol, and the underlying protocol, video and data island blocs 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 (currently):

- Fixed Rate Link (FRL)

- Fixed Rate Link packets
- Character blocks
- Super blocks
- FEC blocks
- Active Video
 - Guard bands
 - Preambles
- Data Islands, including:
 - Guard bands
 - Preambles
- DDC, transactions, including:
 - EDID
 - SCDC
- Control data (Vsync, Hsync, encryption enable)

2 Getting Started

This chapter explains what is involved in getting your M41h 48G Video Analyzer/Generator up and operating to capture data. Detailed Getting Started procedures are provided in the M41h Advanced Test Platform Quick Start Guide. 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 will contain the following additional items:

- AC Power Line Cord.
- CE mark declaration.
- Hi-Speed HDMI Cable.
- Ethernet Cable.
- Mouse.
- Quick Start Guide.

2.2 Operational workflow for Source Analysis Testing

The following are the high level steps you will need to follow to get your M41h 48G Video Analyzer/Generator up and running. Note the first set of these procedures are covered in the M41h Quick Start Guide and not in this User Guide.

2.2.1 Procedures covered in M41h Advanced Test Platform Quick Start Guide:

2.1 Getting the M41h Up and Running

Use the following procedures to get your M41h up and running.

1. Remove the M41h from the shipping box and lay it flat or upright on your desktop or benchtop.
2. Connect the M41h power cable (provided) to a suitable outlet (110-240V 50/60Hz). The power receptacle is on the back of the M41h as shown below.



3. Connect an external HDMI or DisplayPort monitor to the HDMI or DisplayPort connectors on the back of the M41h; labeled "External Monitor" at the location indicated below.



Important Note: You can connect a wide variety of displays to either the HDMI or the DisplayPort admin port on the back of the M41h as shown. However, if the incoming video from the source device under test is content protected with HDCP 2.3, then unless you connect a display that supports HDCP 2.3 you will not be able to see the incoming video in the Real Time window. You will receive a notification informing you of this.

The setup is depicted below.



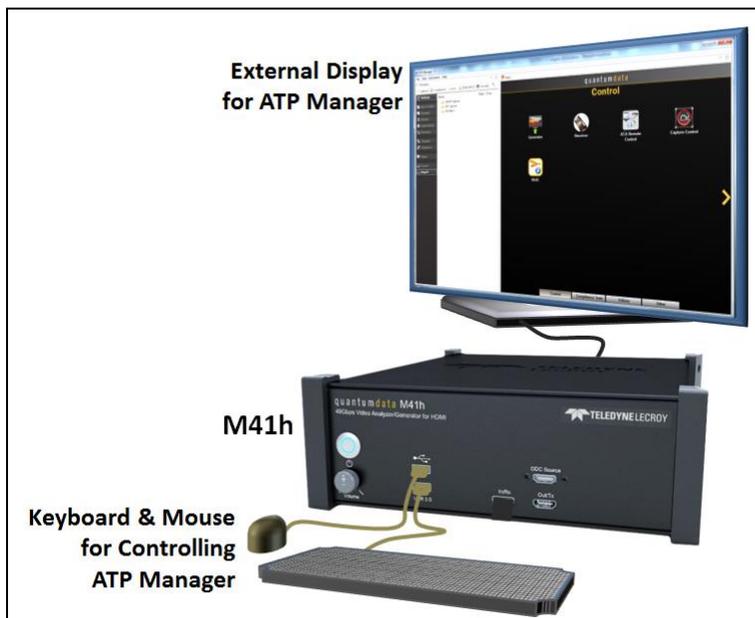
4. Connect a mouse to one of the USB ports on the front or back of the M41h as shown below.
5. Optionally connect a keyboard to one of the other USB ports on the front or the back of the M41h. You can also use the virtual keyboards that present themselves in the ATP Manager.



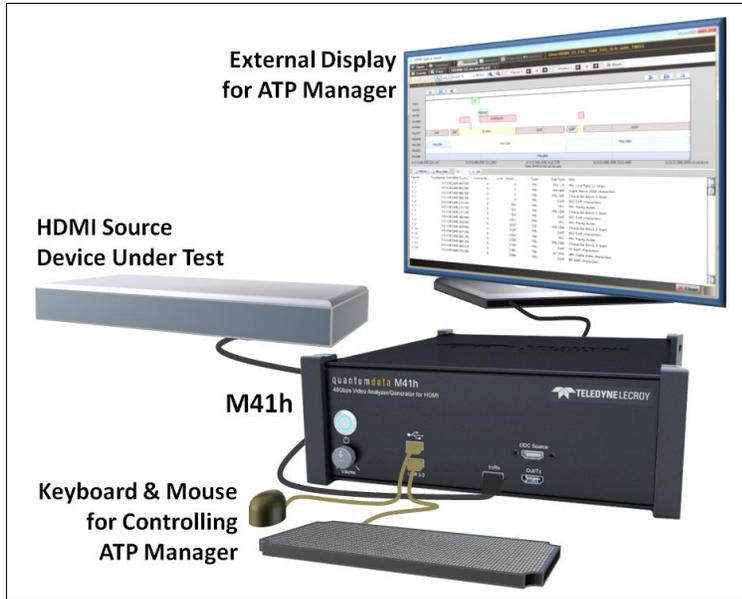
6. Power up the M41h via the power button on the front of the M41h.



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



7. 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 following example shows an HDMI source device connected.



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

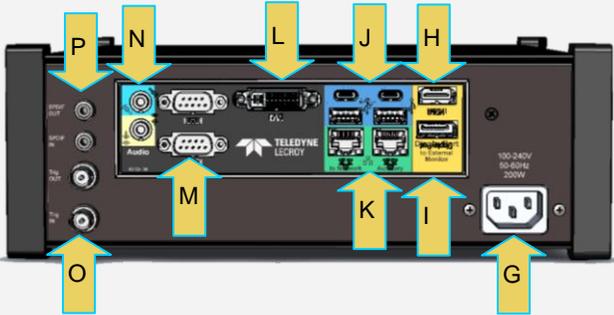
Important Note: As stated above, you can connect a wide variety of displays to either the HDMI or the DisplayPort admin port on the back of the M41h as shown. However, if the incoming video from the source device under test is content protected with HDCP 2.3, then unless you connect a display that supports HDCP 2.3 you will not be able to see the incoming video in the Real Time window. You will receive a notification informing you of this.

2.3 Connector Description

This User Guide covers three configurations of the M41h rear panels with the M41h 48G Video Analyzer/Generator installed. Each illustration shows a single M41h 48G Video Analyzer/Generator installed in the M41h along with an auxiliary bus board.

Use the following table to identify the connector function and descriptions on your M41h system configuration.

M41h Configurations	Information / Function
<p>Protocol Analyzer in M41h</p> <p>The image shows the front panel of the M41h device with several connectors and controls labeled with letters A through F. A is the HDMI 2.1 Rx port, B is the HDMI 2.1 Tx port, C is the HDMI 2.1 Rx port for EDID, D is the USB 3.0 port, E is the volume knob, and F is the power button.</p>	<p>The following is a description of each connector:</p> <p>M41h 48G Video Analyzer/Generator - Front:</p> <ul style="list-style-type: none"> ▪ A – HDMI 2.1 Rx port for testing HDMI 2.1 sources. ▪ B – HDMI 2.1 Tx port for analyzing HDMI 2.1 sinks. ▪ C – HDMI 2.1 Rx port used for reading the EDID over the DDC channel (applies to eARC Tx test). ▪ D – USB ports (2) used for connecting a mouse and keyboard. ▪ E – Volume knob for turning up or down the volume for the internal speaker. ▪ F – Power button; press and release.

M41h Configurations	Information / Function
 <p>The image shows the rear panel of the M41h 48G Video Analyzer/Generator. It features a variety of ports including TRIG IN/OUT (O), RCA SPDIF OUT (P), Audio (N), RS-232 (M), DVI (L), DisplayPort (I), RJ45 (K), USB/USB-C (J), HDMI (H), and a Power plug (G). The device is labeled 'TELEDYNE LECROY' and '100-240V 50/60Hz 200W'.</p>	<p>M41h 48G Video Analyzer/Generator - Back:</p> <ul style="list-style-type: none"> ▪ G – Power plug (100-240VAC 50/60Hz; 200 Watts) ▪ H - HDMI – Admin port for connecting external HDMI UHD display for M41h ATP Manager. ▪ I - DisplayPort – Admin port for connecting the external display for M41h ATP Manager. ▪ J - USB/USB-C (2 ea.) – For mouse & keyboard. ▪ K - RJ45 (2) - E1 Network for connecting host PC running ATP Mgr. E2 Aux – Not used. ▪ L - DVI – Possible future use. ▪ M - RS-232 (2) – Possible future use. ▪ N - Audio (2) – Possible future use. ▪ O - TRIG IN/OUT – Future. ▪ P - RCA SPDIF OUT – OUT: Monitors eARC audio; IN: Possible future use.

2.4 M41h 48G Video Analyzer/Generator Operational Modes

The M41h 48G Video Analyzer/Generator can be operated in the Capture and Store mode.

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 built-in touch display GUI and the external 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.

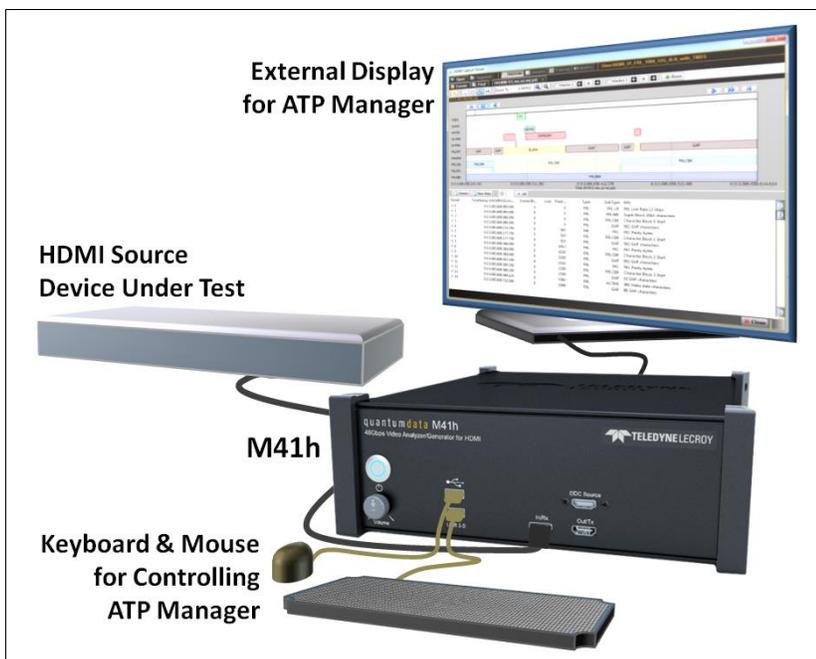
2.4.2 Real Time Monitoring

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.

Important Note: You can connect a wide variety of displays to either the HDMI or the DisplayPort admin port on the back of the M41h as shown. However, if the incoming video from the source device under test is content protected with HDCP 2.3, then unless you connect a display that supports HDCP 2.3 you will not be able to see the incoming video in the Real Time window. You will receive a notification informing you of this.

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.



HDMI 2.1 Source Analysis Configuration – M41h ATP

2.6 M41h Data Analysis Capture Modes

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

2.6.1 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 Data Decode window. The underlying TMDS video and protocol elements such as the preamble and data island blocks are also shown.

2.7 Getting Started Procedures

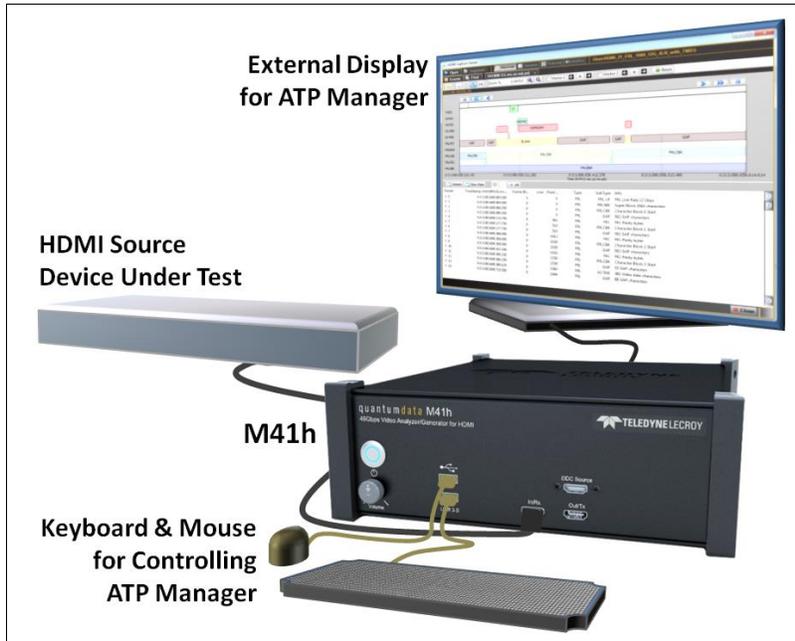
The getting started procedures involve the following tasks:

- Downloading, unzipping and launching the ATP Manager application to allow you to operate the M41h. (Not required if using the embedded ATP Manager on the built-in display exclusively.)
- Powering up the M41h platform.
- Establishing a physical connection from the HDMI source device you wish to test and the M41h platform.
- (Not required if using the built-in display exclusively) Changing the IP address of the M41h platform so that it is compatible with your PC and or corporate LAN.
- (Not required if using the built-in display exclusively) Establishing an initial IP connection from the M41h Manager (residing on your host PC) and the M41h platform.

2.7.1 Establishing a physical HDMI connection from an HDMI 2.1 source device to the M41h

Use the following procedures to connect your HDMI source device to the M41h 48G Video Analyzer/Generator.

1. Connect the HDMI-to-HDMI cable provided from your HDMI source device under test to the top-most HDMI connector on the back of the M41h 48G Video Analyzer/Generator. Refer to the picture below.



HDMI 2.1 FRL sink emulation for source analysis – M41h



3 Overview of the ATP Manager

3.1 Overview

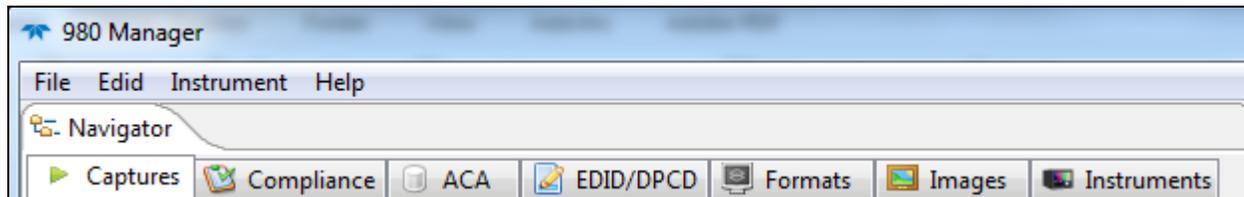
This chapter describes the ATP Manager panels on the external ATP Manager. The ATP Manager is an application that runs on your local PC. It enables you to examine the data captured by the M41h 48G Video Analyzer/Generator through a user friendly graphical interface.

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

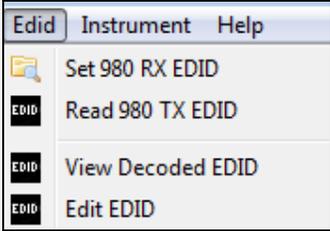
The main window of the ATP Manager has a **Top Level menu** and two panels: 1) **Navigator** panel and 2) **Apps** panel.

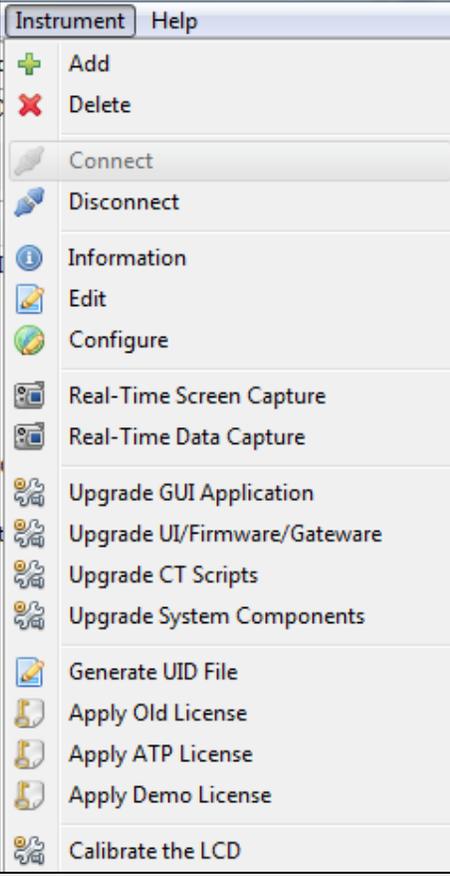
3.2 Top Level Menu

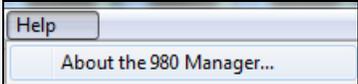
The Top level menu is shown in the figure below. There are several tabs which are described in the table below the figure.



Top Level Menu Items	Selection	Function
	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.
	View Info/Text	Enables you to view the information related to a the selected data file that the Navigator/Data view.
	Rename	Enables you to rename a data file.
	Delete	Enables you to delete a data file from the M41h Manager application.
	Import...	Enables you to import a file that resides on the M41h Manager host into the M41h Manager application. This can be a capture, ACA data, EDID, or any compliance result. The file must be a zip file.
	Export...	Enables you to export a file that you have highlighted in the M41h Manager. The file is compressed to a zip file. This can be a capture, ACA data, EDID, or any compliance result.
	Refresh List...	Enables you to refreshes the list of captures to

Top Level Menu Items	Selection	Function
		remove captures that you have marked for deletion. Also resets the list to the default unexploded view.
	Switch Workspace... 	Browse to store captures in a different capture directory other than the default.
	Exit	Enables you to exit out of the M41h Manager application.
EDID  <p>Note: This menu is context sensitive. Its contents depend on whether the EDID Editor Panel is open and being used.</p>	Set M41h RX EDID 	Configures the M41h Rx port with the specified EDID.
	Read M41h TX EDID 	Loads an EDID from the HDMI sink device connected to the M41h Tx port.
	View Decoded EDID	Enables you to view the human readable text of the selected EDID
	Add Data	Enables you to add an EDID data element such as a CEA extension block or a Video or Data block to the CEA extension block.
	Delete EDID Block	Deletes a selected EDID block.
	Delete Selected CEA Data Block or Timing	Deletes a selected CEA data block.
Instrument	Add 	Clicking on this item will open up the Add Instrument dialog box which enables you to define a M41h. Note that you can have multiple M41hs defined in the ATP Manager. This action is required before connecting to a M41h.
	Delete 	Enables you do delete the selected M41h 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 a 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 a M41h.
	Information 	Provides information about the M41h that the M41h Manager is currently selected. This information includes: <ul style="list-style-type: none"> o M41h Name

Top Level Menu Items	Selection	Function
		<ul style="list-style-type: none"> ○ 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
	Edit [the Instrument Entry] 	Enables you to edit certain information about the M41h that you have selected. You can edit the name and IP address.
	Configure [Instrument Network] 	Allows you to view and set the network information such as the M41h IP address, netmask and gateway IP address.
	Real Time Screen Capture 	Enables you to make a capture of the current Real Time screen contents of the M41h platform. When activated you will be prompted with a dialog box to save the captured bitmap file on your host PC.
	Real Time Data Capture 	Enables you to text file of the current data panels of the Real Time mode on the M41h platform. When activated you will be prompted with a dialog box to save the captured text file on your host PC.
	Upgrade UI Firmware/Gateware 	Upgrade GUI Firmware/Gateware - Enables you to apply an upgrade of the M41h built-in GUI as well as the firmware and gateware of a M41h ATP. You can download new GUI release and firmware and gateware from the Quantum Data website on the downloads page.
	Upgrade CT Scripts 	Upgrade CT Scripts - Enables you to apply an upgrade to the M41h compliance test application scripts. You can download new releases from the Quantum Data website on the downloads page.
	Upgrade System Components 	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 on the

Top Level Menu Items	Selection	Function
		downloads page.
	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 Data Customer Support in order to activate an option on the M41h system and(s).
	Apply Old License 	No longer used.
	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.
	Apply Demo License 	This is a license key file that enables you to activate a license key temporarily for an optional feature.
	Apply Old License 	No longer used.
	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.
	Apply Demo License 	This is a license key file that enables you to activate a license key temporarily for an optional feature.
	Calibrate the LCD	Enables you to calibrate the embedded display for touch accuracy.
Help 	About the M41h Manager	Provides release and version information about the M41h Manager software components.

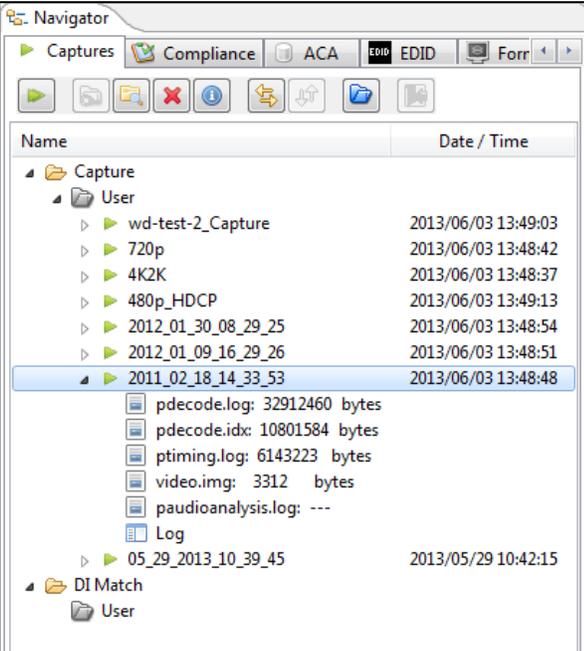
3.3 Navigator Panel

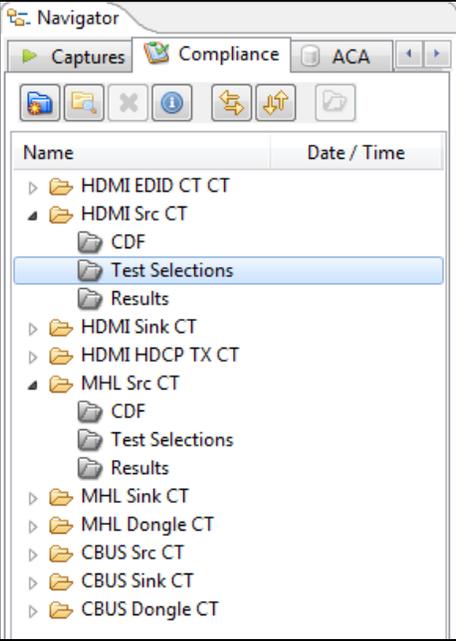
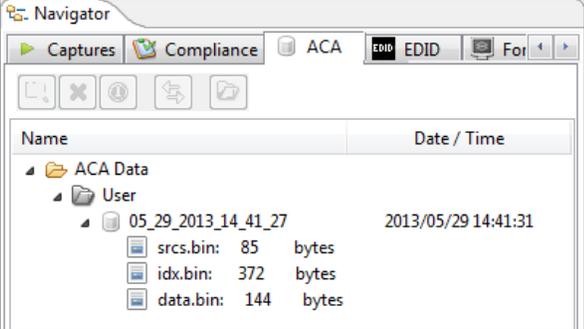
The **Navigator** panel is shown in the figure below. There are a set of sub-tabs which provide access to data associated with each type of tab.



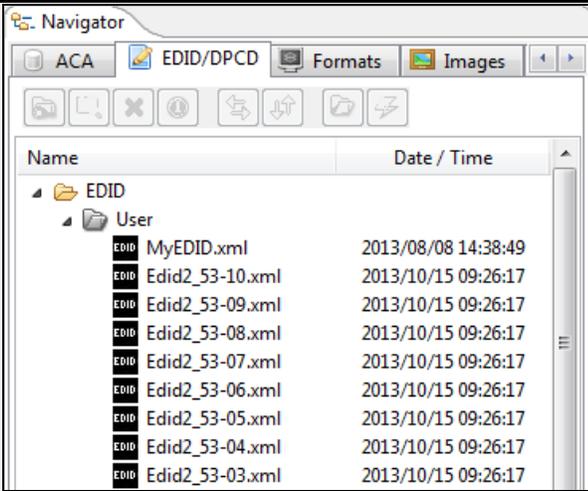
3.3.1 M41h Navigation Panels and their Icons

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 icons associated with these **Navigator** tabs are described in the table that follows these screens. These icons also appear on the right click menus of the directories where the various data types are stored or the data items themselves.

Navigator Tab	Associated Icons
<p>Captures</p> <p>Provides access to the list of captures.</p> 	<ul style="list-style-type: none"> ▪ 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 a M41h  - Enables you to add or define a M41h instrument in the M41h Manager application. This is required before connecting to a M41h. Only appears when the Navigator/Instrument tab is selected.
<p>Compliance</p> <p>Provides access to the data for the various compliance tests.</p>	<ul style="list-style-type: none"> ▪ 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. ▪ 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. ▪ 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. ▪ 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

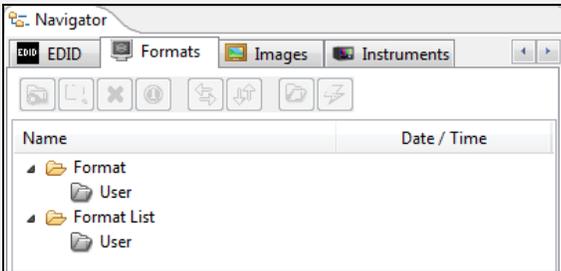
Navigator Tab	Associated Icons
<p>Navigator</p>  <p>ACA</p> <p>Provides access to ACA trace files that have been saved. You can open a trace file through the right click menu or the icon associated with it. When you</p>  <p>EDID</p> <p>Provides access to EDID files that have been saved.</p>	<p>for all Navigator tabs except Instruments tab.</p> <ul style="list-style-type: none">  - Enables you to create a folder under the highlighted directory. Available for all Navigator tabs except Instruments and ACA tab.  - Opens up the FTP browser enabling you to transfer data between locations on the host PC. Available for all Navigator tabs except Instruments and ACA tab.  - Opens up a window to the folder location of the selected file. Available for all Navigator tabs except Instruments tab.  - Deletes a data item that you have selected. Available for all Navigator tabs except Instruments tab.  - Provides information about the selected data type and the M41h used to capture the data. Available for all Navigator tabs except Instruments tab.  - Loads the selected data item into the M41h Manager for viewing and analysis. Available for all Navigator tabs except Instruments tab.  - Applies the selected data item into the M41h instrument. Available only for the EDID, Formats and Images tabs.

Navigator Tab **Associated Icons**



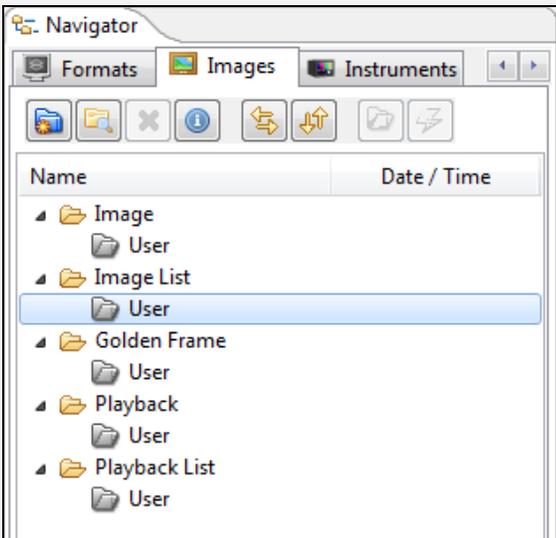
Formats

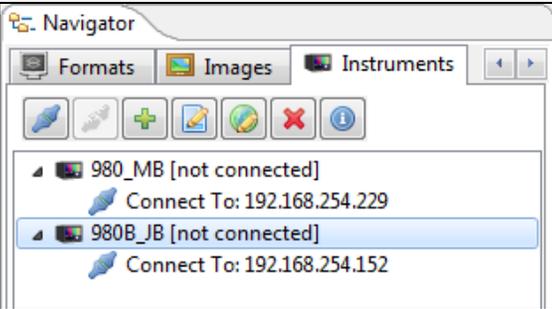
Provides access to format files that have been saved and format library lists that have been configured.



Images

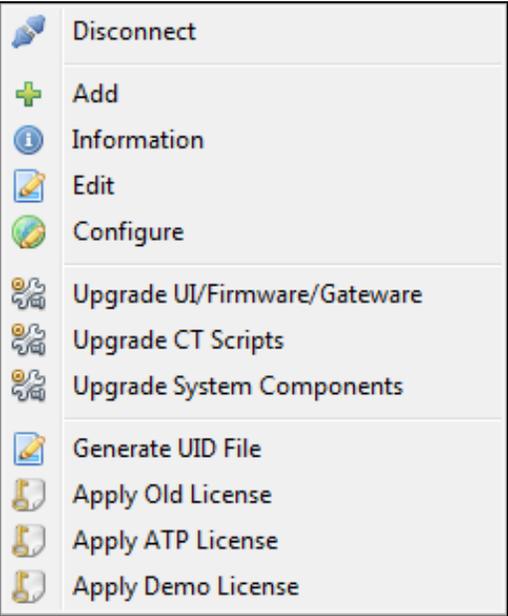
Provides access to bitmap image files that have been saved and image library lists that have been configured.



Navigator Tab	Associated Icons
<p>Instruments</p> <p>Provides access M41hs that have been configured through the ATP Manager.</p>  <p>The screenshot shows a software window titled "Navigator" with three tabs: "Formats", "Images", and "Instruments". The "Instruments" tab is active. Below the tabs is a toolbar with icons for connect, disconnect, add, edit, refresh, delete, and help. The main area lists two instrument entries:</p> <ul style="list-style-type: none">980_MB [not connected] Connect To: 192.168.254.229980B_JB [not connected] Connect To: 192.168.254.152	

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.

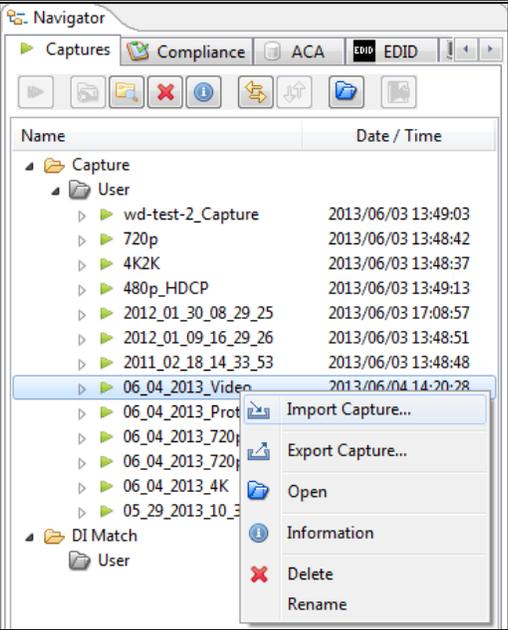
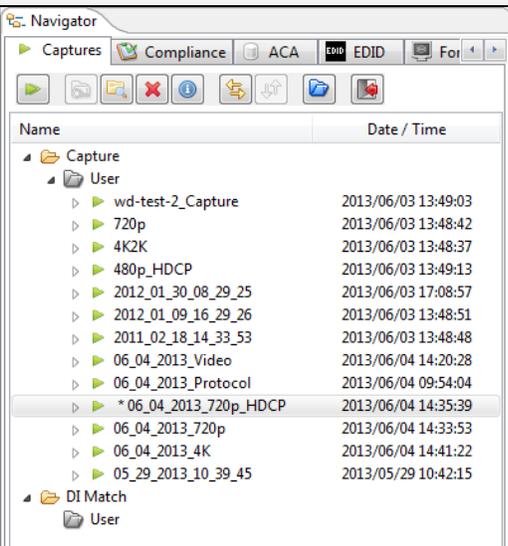
Navigator Panel - Item	Function
<p>Right click on a M41h Instrument</p> 	<ul style="list-style-type: none"> ▪ Connect/Disconnect   – Enables you to connect or disconnect to the selected M41h, if you have not already established a connection to it. This item will not be available if you have already connected to the selected device. ▪ [Instrument] Information  - Provides information about the M41h that the M41h Manager is currently connected to. This information includes: <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 ▪ Edit Instrument Entry  - Enables you to edit certain information about the M41h that you have selected. ▪ [Instrument Network] Configure  - Allows you to view and set the network information such as the M41h IP address, subnet mask and gateway IP address. ▪ 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. ▪ Upgrade Firmware/Gateware  - Enables you to apply an upgrade of the M41h built-in GUI as well as the firmware and gateware of a M41h ATP. You can download new GUI release and firmware and gateware from the Quantum Data website on the downloads page.

Navigator Panel - Item	Function
	<ul style="list-style-type: none"> <li>▪ 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. <li>▪ 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. <li>▪ 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 Data Customer Support in order to activate an option on the M41h system and(s). <li>▪ Apply Old License  - No longer used. <li>▪ 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. <li>▪ Apply Demo License  - This is a license key file that enables you to activate a license key temporarily for a specific feature option.

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
Right click on M41h Capture	<ul style="list-style-type: none"> <li>▪ Import Capture Data  - 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. <li>▪ Export Capture Data  - 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. <li>▪ Open [the Selected Capture]  - Loads the selected

Navigator Panel - Item	Function
	<p>capture into the M41h Manager for viewing and analysis. The capture that is currently loaded has an asterisk next to it.</p> <ul style="list-style-type: none"> ▪ [Capture] Information  - Provides information about the selected capture and the M41h used to capture the data: <ul style="list-style-type: none"> ○ Creation date and time of the capture. ○ Status of the capture, i.e. was it successful or were there errors. ○ Configuration of the triggering and pre-capture filtering. ○ All information shown above for the Instrument Information. ▪ Rename - Enables you to rename a capture file. A useful practice might be to rename the file to include the device tested. ▪ Delete [a Capture]  - Enables you to delete a capture from the M41h Manager application. ▪ Rename – Rename the capture file.
	<ul style="list-style-type: none"> ▪ Capture Valid  - Indicates that the capture completed successfully and all data was saved. ▪ Active Capture * - Indicates that this is the capture that is currently loaded.

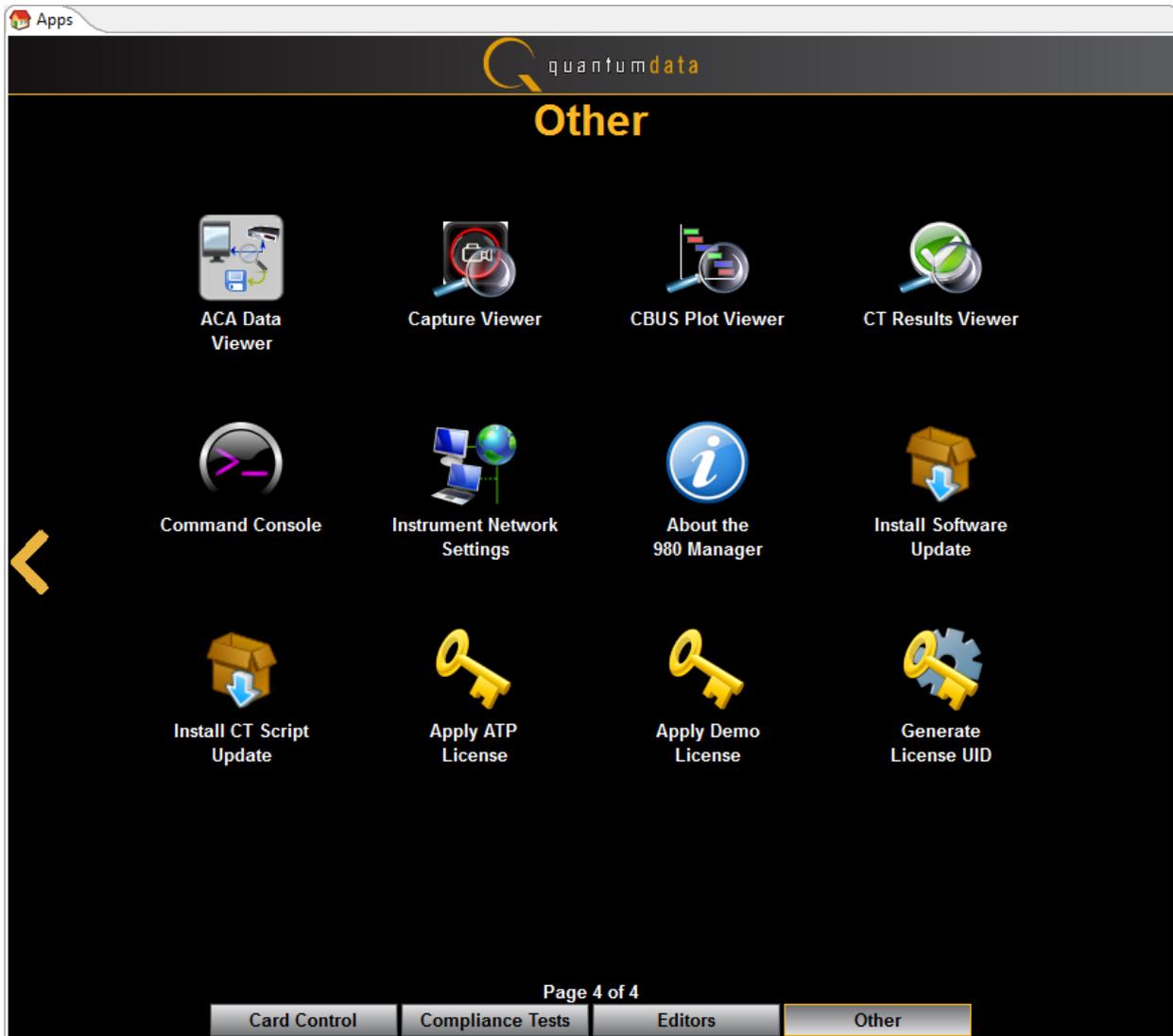
3.4 Apps Panels

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:

- Page 1 of 4 - **Card Control**
 - Generator (future)
 - Receiver (HDMI 2.1)
 - ACA Remote Control
 - Capture Control
 - HEAC
- Page 2 of 4 - **Compliance Tests (Not currently applicable to HDMI 2.1)**
 - DisplayPort (directory)
 - HDMI 1.4 (directory)
 - HDMI 2.1 (directory)
 - MHL/CBUS (directory)
 - UHDA Source CTS
- Page 3 of 4 - **Editors**
 - EDID Editor
 - Format Editor
 - Format List Editor
 - Pattern List Editor
 - Playback List Editor
 - DPCD Editor (DisplayPort)
- Page 4 of 4 – **Other (Not all items are applicable to HDMI 2.1)**
 - ACA Data Viewer
 - Capture Viewer
 - CBUS Plot Viewer
 - CT Results Viewer
 - Command Console
 - Instrument Network Settings
 - Set Instrument Date/Time
 - About the M41h Manager
 - Install Software Update
 - Install CT Script Update
 - Apply ATP License
 - Apply Demo License
 - Generate License UID.

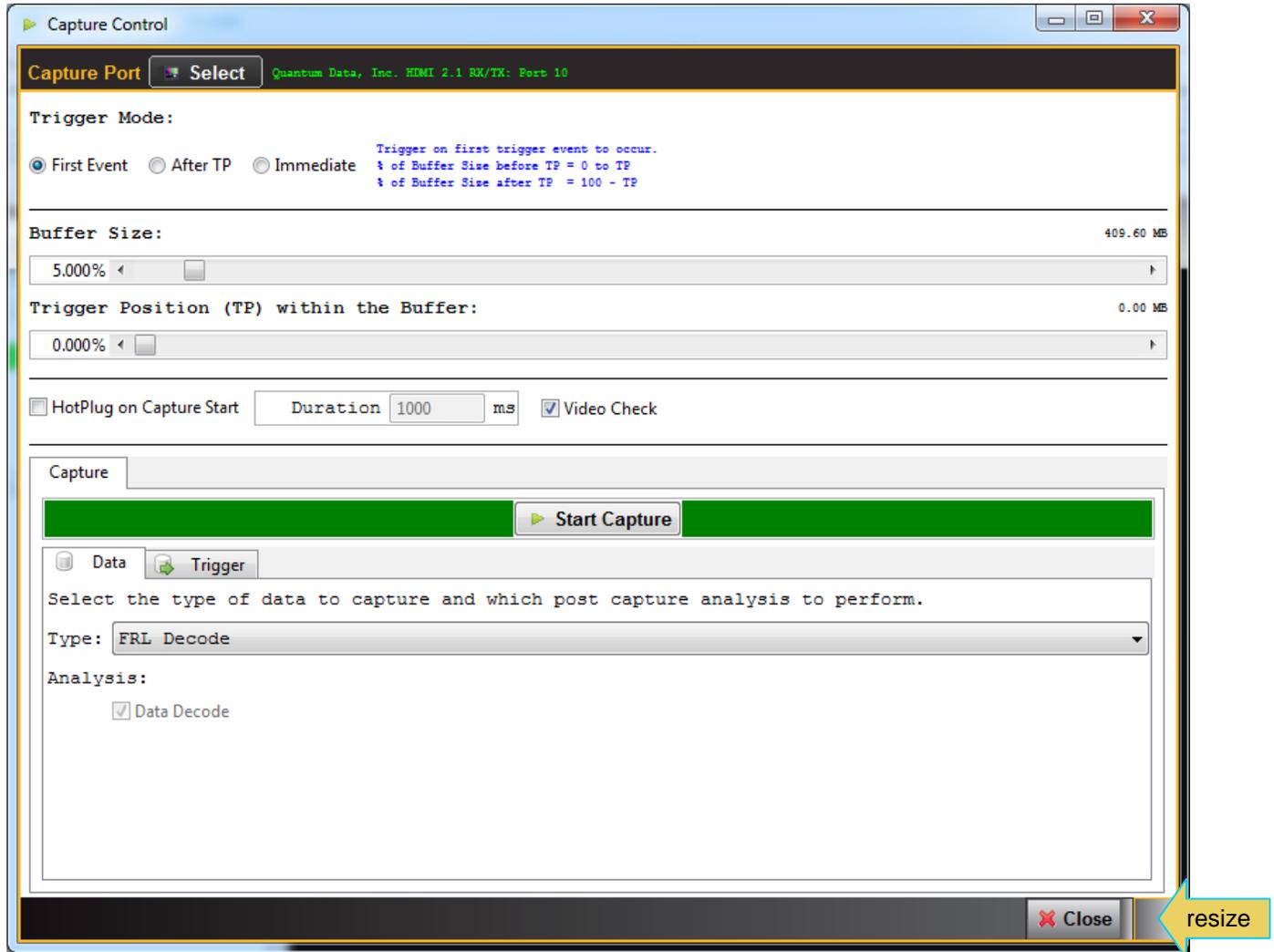
The first of those panels, the **Card Control** panel is shown in the example below. You can navigate from page to page either with the forward and backward arrows on the side or the tab buttons on the bottom.



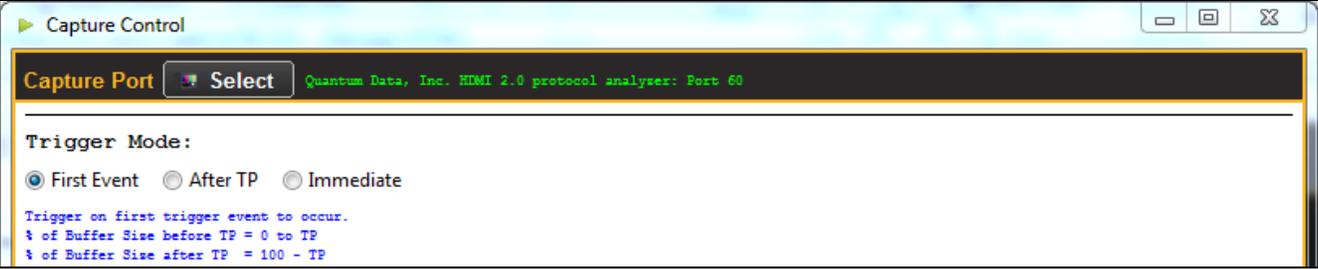
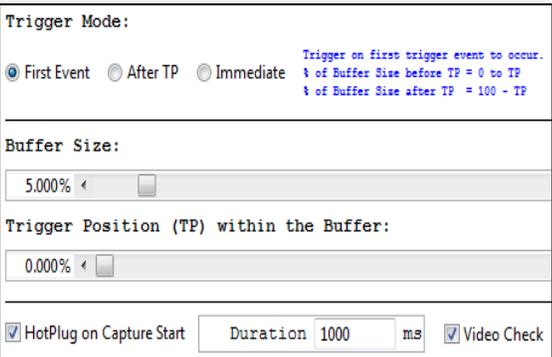


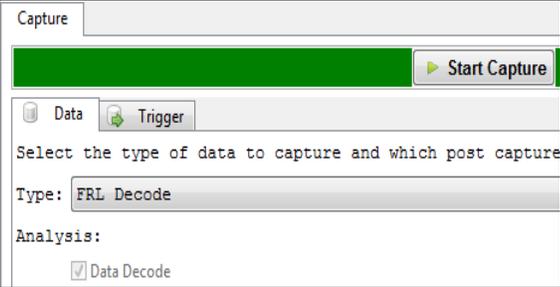
3.5 Capture Control Panel

The **Capture Control** panel enables you to setup the capture parameters. The figure below shows the **Capture Control** panel and its control and selection items. 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								
<p>Instrument Selection</p> 	<p>The Select button above will open up a dialog box enabling 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.</p>								
<p>Capture Trigger Configuration</p>	<p>Enables you to define the capture trigger criteria. Use the information below.</p>								
	<table border="0"> <tr> <td>Trigger Mode</td> <td> <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) – <i>Not supported in this initial release.</i></p> <p>Immediate – <i>Not supported in this initial release.</i></p> </td> </tr> <tr> <td>[Capture] Buffer Size Slider</td> <td> <p>Enables you to set the size of the captured data in percent. This is a sidebar 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.</p> </td> </tr> <tr> <td>[Capture] Trigger Position within Buffer Sidebar</td> <td> <p><i>Not supported in this initial release.</i></p> </td> </tr> <tr> <td>Generate HotPlug on Captured Start</td> <td> <p>Causes a hot plug 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 hot plug pulse in milliseconds. A hot plug pulse, issued by the M41h, will reinitiate HDCP authentication if the video content from the</p> </td> </tr> </table>	Trigger Mode	<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) – <i>Not supported in this initial release.</i></p> <p>Immediate – <i>Not supported in this initial release.</i></p>	[Capture] Buffer Size Slider	<p>Enables you to set the size of the captured data in percent. This is a sidebar 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.</p>	[Capture] Trigger Position within Buffer Sidebar	<p><i>Not supported in this initial release.</i></p>	Generate HotPlug on Captured Start	<p>Causes a hot plug 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 hot plug pulse in milliseconds. A hot plug pulse, issued by the M41h, will reinitiate HDCP authentication if the video content from the</p>
Trigger Mode	<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) – <i>Not supported in this initial release.</i></p> <p>Immediate – <i>Not supported in this initial release.</i></p>								
[Capture] Buffer Size Slider	<p>Enables you to set the size of the captured data in percent. This is a sidebar 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.</p>								
[Capture] Trigger Position within Buffer Sidebar	<p><i>Not supported in this initial release.</i></p>								
Generate HotPlug on Captured Start	<p>Causes a hot plug 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 hot plug pulse in milliseconds. A hot plug pulse, issued by the M41h, will reinitiate HDCP authentication if the video content from the</p>								

Capture Control Panel - Function	Item - Description	
		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)	Current 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.	

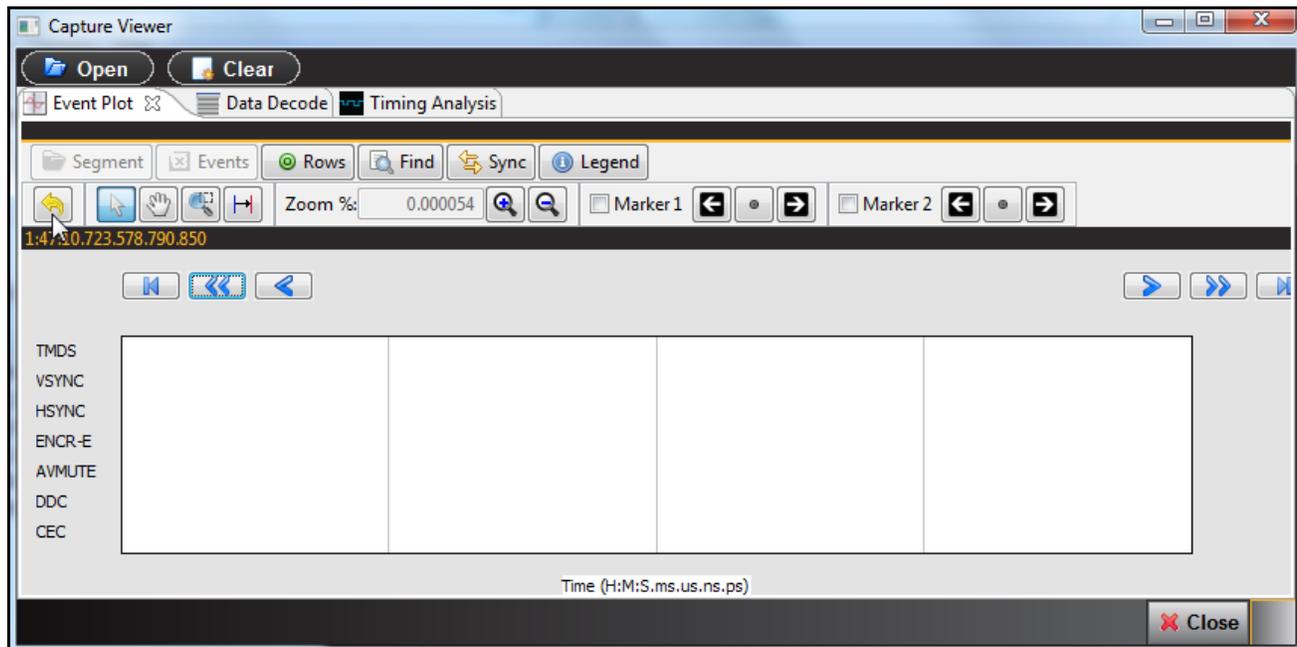
3.5.1 Defining Precision Triggering and Pre-Capture Filtering

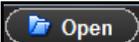
3.6 Capture Viewer Panel

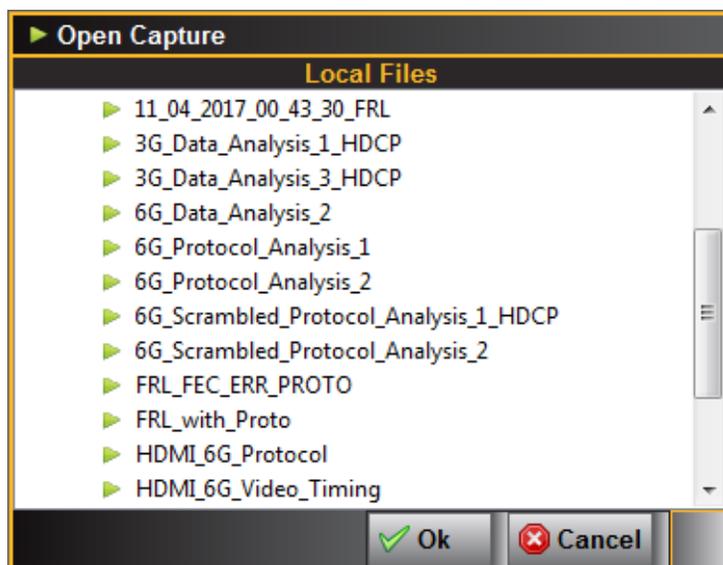
The Capture Viewer Panel is on the 4th page **Other** of the Apps panel. It provides access to the following windows for viewing captured data:

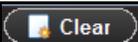
- Event Plot – Provides graphical view of metadata.
- Data Decode – Provides tabular view of metadata.

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



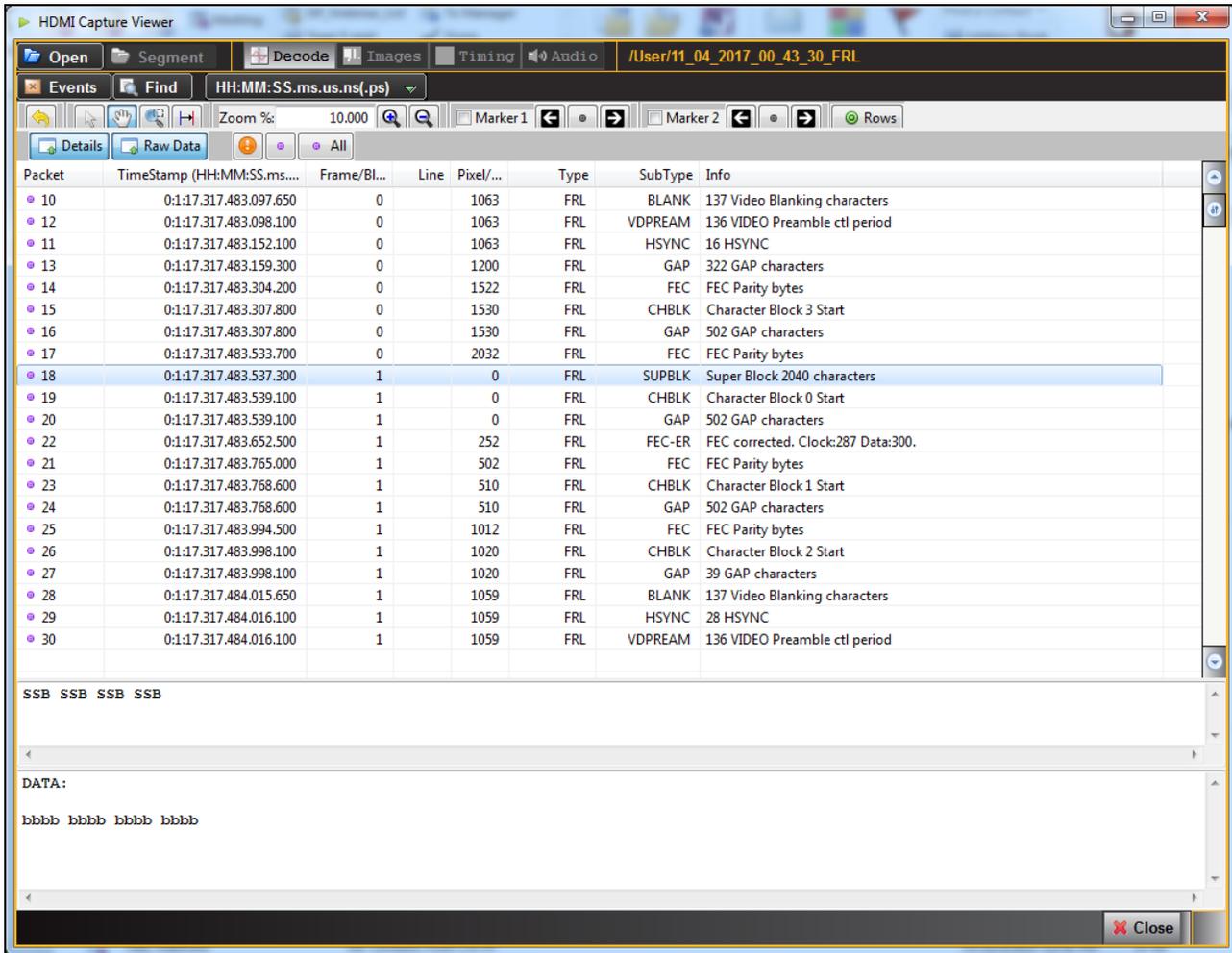
You can open a capture for viewing in the **Event Plot** or **Data Decode** window either from the **Navigator** panel or the **Open**  button on the top of the window. When you select Open a dialog box appears enabling you to select a capture:



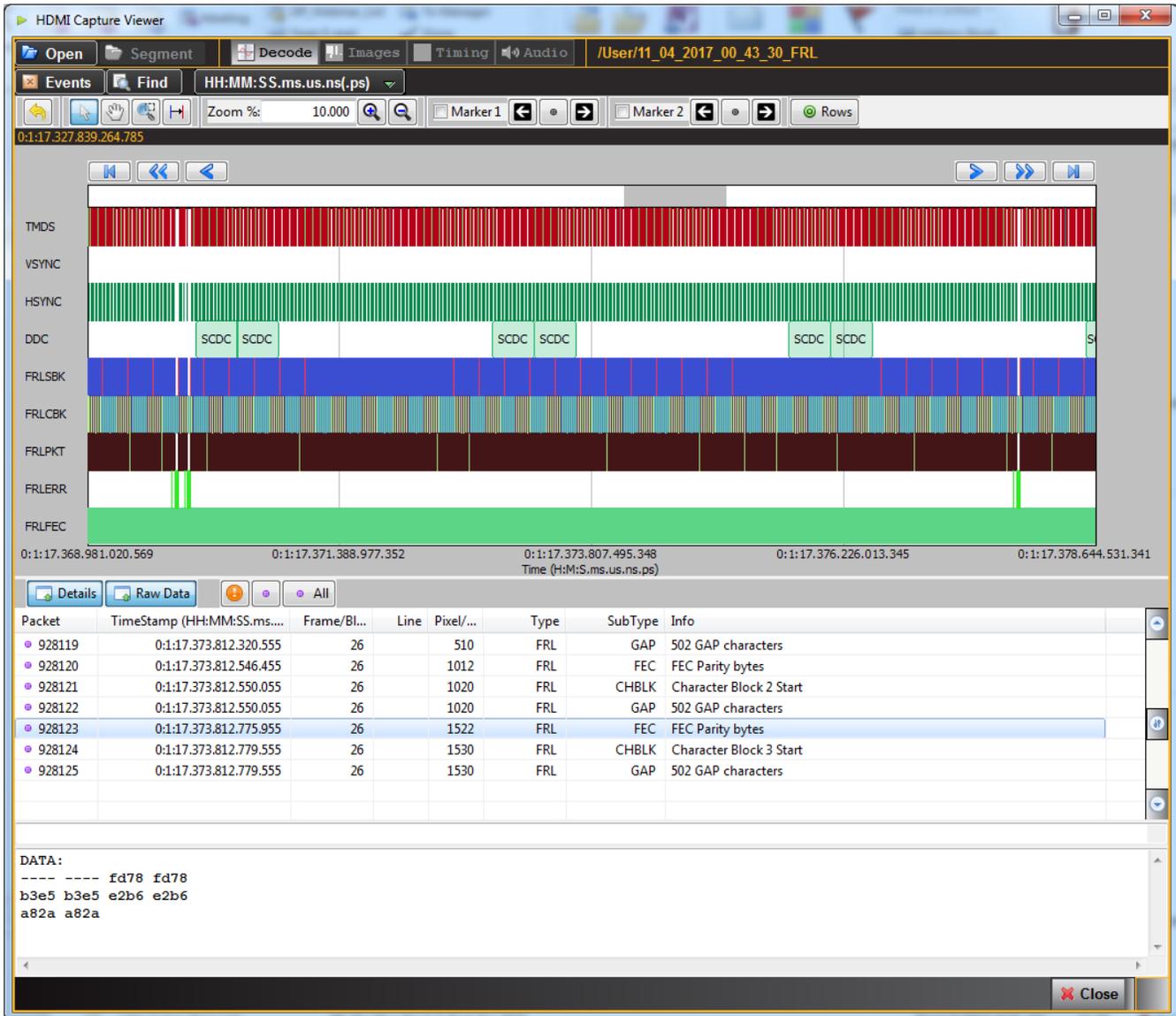
You can clear the capture using the **Clear**  button.

3.7 Data Decode Panel

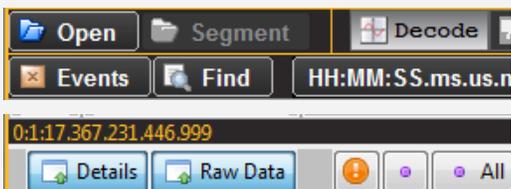
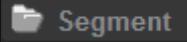
The **Data Decode** panel (shown below) is the primary panel for examining data at the detail level. The example shows data captured in the Data Analysis mode where the FRL, FEC and TMD5 data are captured.

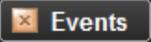
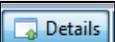


When you select a packet in the **Data Decode** panel that packet is highlighted in the **Event Plot** panel. It is only visible if the **Event Plot** is zoomed to show each distinct packet. Refer to the screen shot below.



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

Data Decode Status Icons	Function
<p>Icons – Navigator / Data</p> 	<ul style="list-style-type: none"> User path status <code>/User/11_04_2017_00_43_30_FRL</code> – 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.

Data Decode Status Icons	Function
	<p>This dialog box is described further below.</p> <ul style="list-style-type: none"> ▪ 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 do select or deselect data types individually or a page at a time. This dialog box is described further below. ▪ Find  – The Find activation button enables you to locate captured data by type. When you click on the Find button a dialog box appears enable you do specify a data type to search on. individually or a page at a time. This dialog box is described further below. ▪ Details  – The Details activation button enables you to toggle the view of the Details subpanel. The Details subpanel provides human readable text description of the data of the record that is highlighted. ▪ Raw Data  – The Raw Data activation button enables you to toggle the view of the hex data on and off. ▪ Marker icon  – The Marker icon enables you to flag certain important records for easy identification. You can also flag a record by double clicking on the record. ▪ Clear Marker icon  – The Clear Marker and Clear All icons 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.

There is a vertical scroll bar available on the right side of the **Data Decode** panel. This enables you to browse through the **Data 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.

The screenshot displays the HDMI Capture Viewer interface. At the top, the file path is `/User/HDMI_21_12G_4LN_NK`. The main window shows a waveform diagram with various signal lines (TMDS, VSYNC, HSYNC, DDC, FRLSBK, FRLCBK, FRLPKT, FRLERR, FRLFEC) and colored blocks representing different data types. A yellow arrow points to an 'ACTIVE' block in the FRLPKT line. Below the waveform is a packet list table:

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame/Block	Line	Pixel/Offset	Type	SubType	Info
154980	0:28:37.831.650.636.234	5		1530	FRL	GAP	502 GAP characters
154981	0:28:37.831.650.824.484	5		2032	FRL	FEC	FEC Parity bytes
154982	0:28:37.831.650.827.484	6		0	FRL	SUPBLK	Super Block 2040 characters
154983	0:28:37.831.650.828.984	6		0	FRL	CHBLK	Character Block 0 Start
154984	0:28:37.831.650.828.984	6		0	FRL	GAP	51 GAP characters
154986	0:28:37.831.650.848.109	6		51	FRL	ACTIVE	361 Video data characters
154985	0:28:37.831.650.848.484	6		51	FRL	GB	Video Guard Band.
154987	0:28:37.831.650.983.484	6		412	FRL	GAP	90 GAP characters
154988	0:28:37.831.651.017.234	6		502	FRL	FEC	FEC Parity bytes
154989	0:28:37.831.651.020.234	6		510	FRL	CHBLK	Character Block 1 Start
154990	0:28:37.831.651.020.234	6		510	FRL	GAP	502 GAP characters

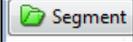
Below the table, a 'DATA:' section shows a hex dump:

```

----- 0969
55ab abab ab55 0201
0403 0605 0807 0a09
0c0b
    
```

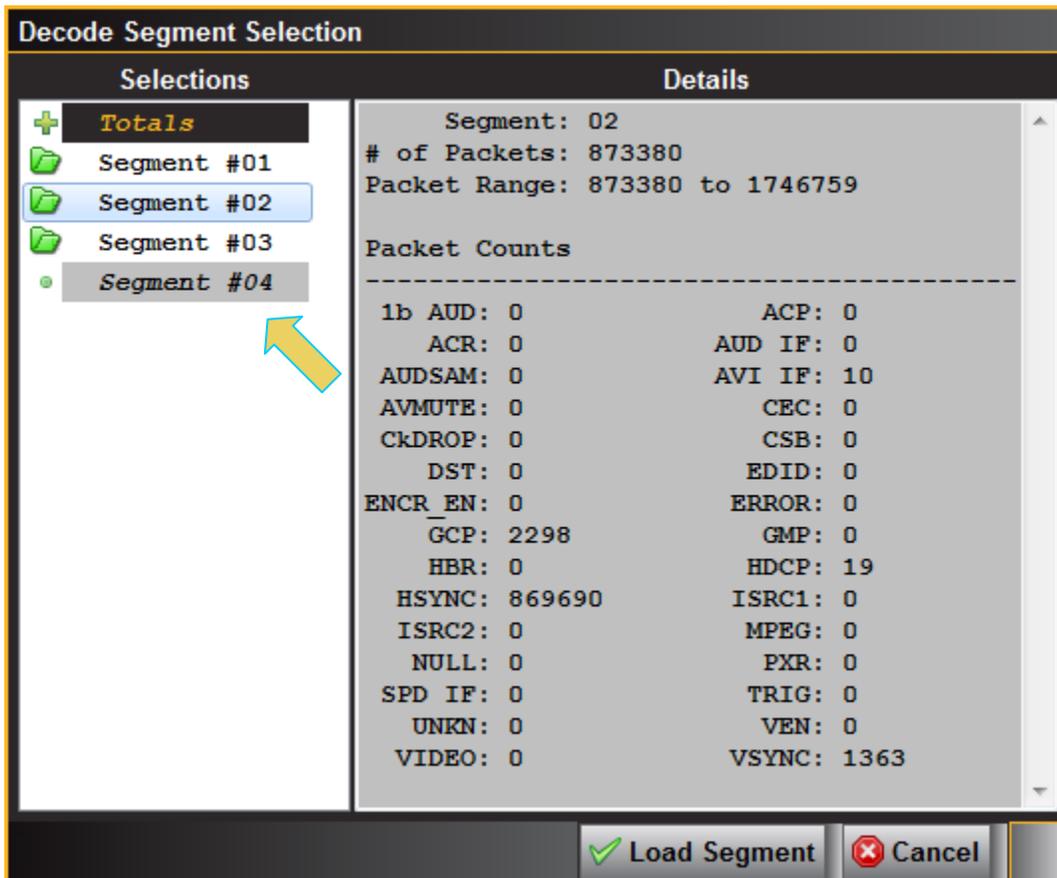
Yellow arrows highlight the 'ACTIVE' packet in the list, the corresponding 'ACTIVE' block in the waveform, and the hex dump.

3.7.1 Working with Segments in the Data 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.

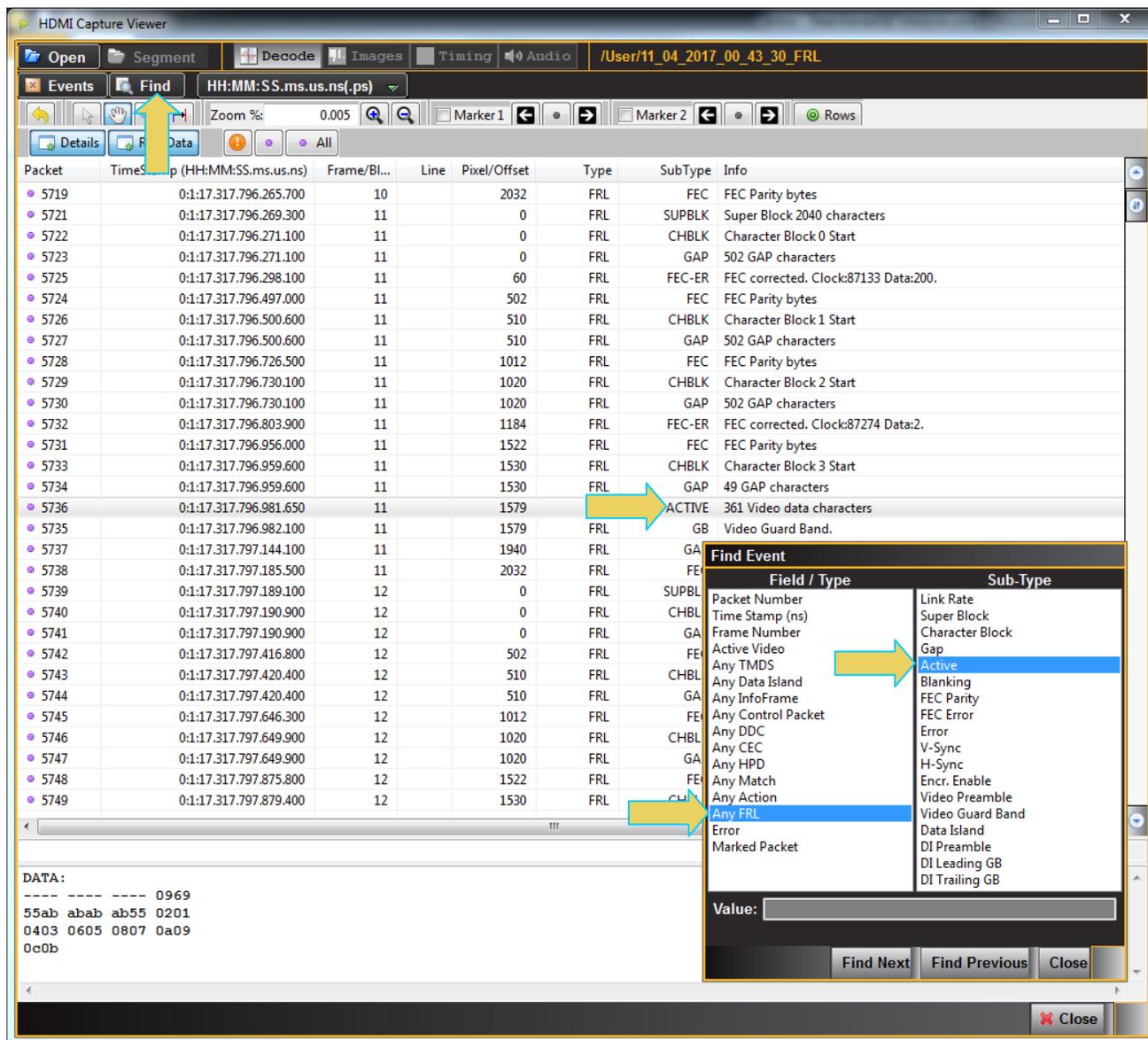
From the Selections panel you can select and load a different segment by highlight a segment and then clicking on the Load Segment activation button on the bottom right. You can also select any segment to view its packet contents in the Details panel. If you wish to view the total packets of all segments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

 button.



3.7.2 Searching for Data in the Data Decode Panel

You can search for data in the **Data Decode** panel using the search function. The search function is accessible using the magnifying glass icon  on the upper left of the **Data 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**).

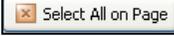


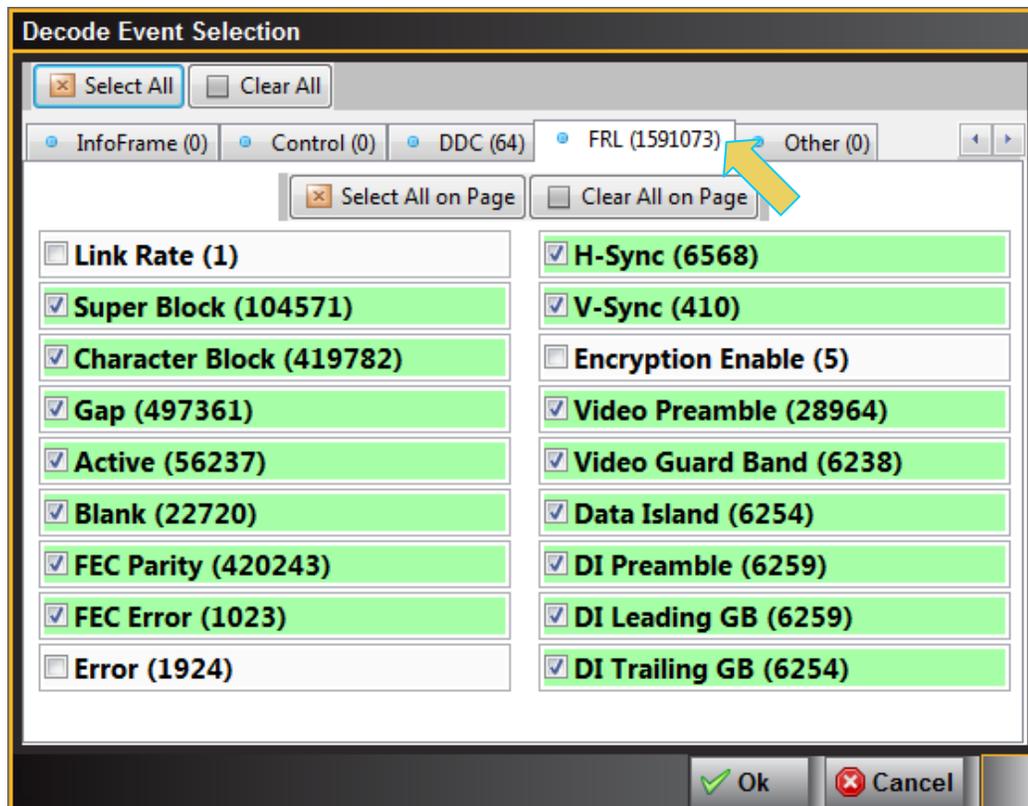
3.7.3 Post-Capture Filter Selection tab

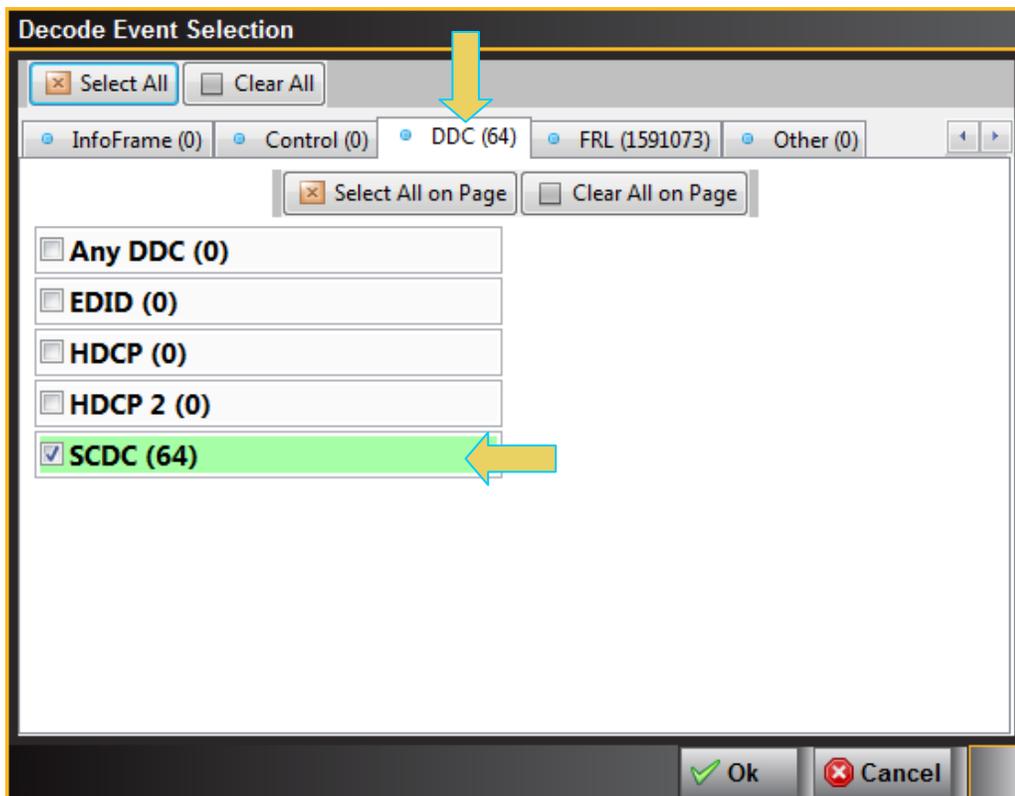
The **Post-Capture Events** button  on the **Data Decode** panel enables you to do the following:

- Specify the data that you want to view in the **Event Plot** and **Data 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 **Data Decode** panel will show all the data captured.

Note that you can select or deselect all items on a page with the **Select All on Page**  or **Clear All on Page**  buttons or you can individually select an item. There is a pair of navigation buttons  on the right to enable you to see all the tabs in the panel. You can also select and deselect all items on all pages with the **Select All** and **Clear All** buttons.





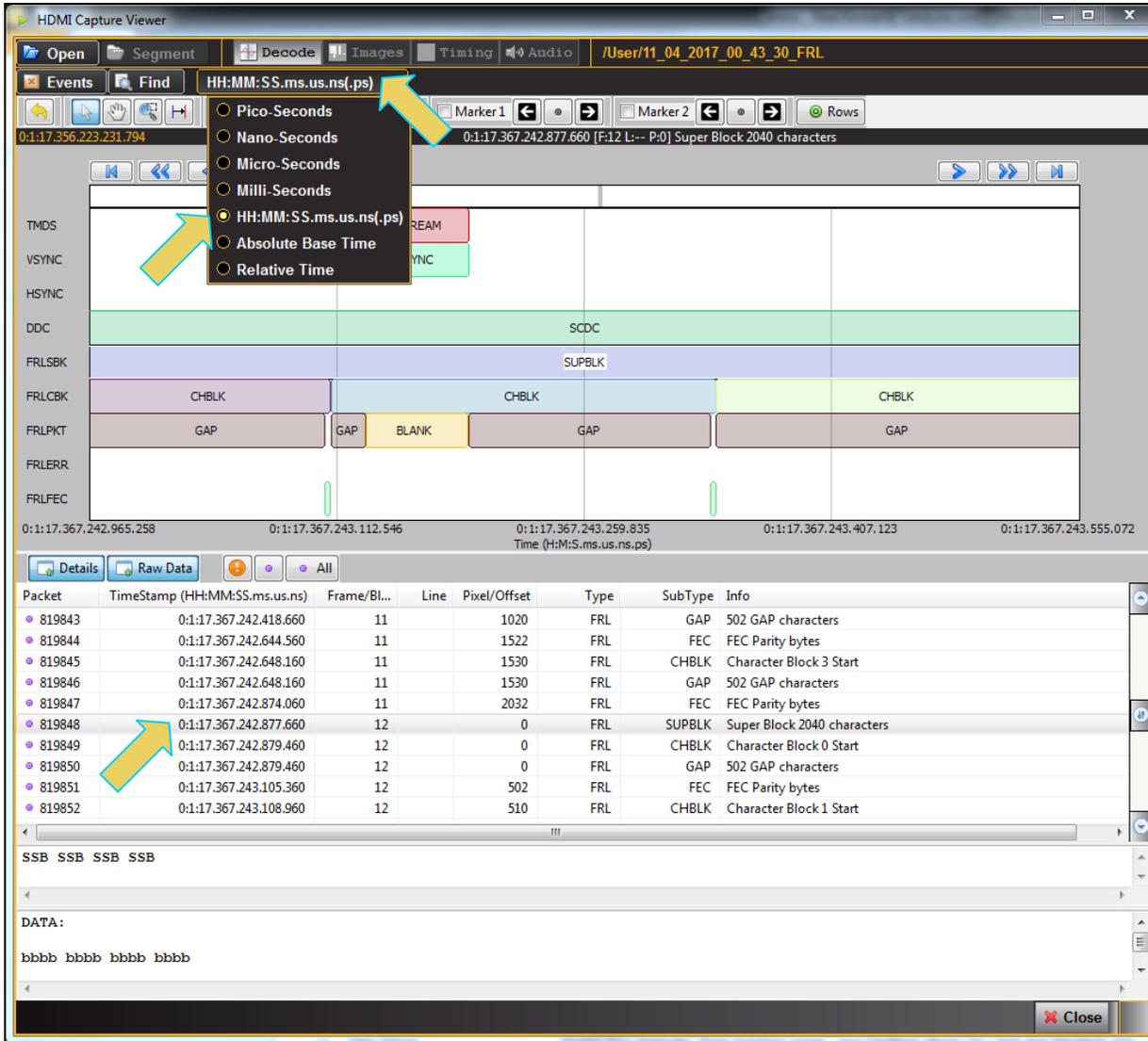
3.7.4 Data Decode Record Field Descriptions

The **Data 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 **Data Decode** panel.

Field	Function
Packet	Lists the packet numbers in sequential order beginning from the first packet captured.
Timestamp	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 they are counted sequentially.
Line	Lists the line number of the particular frame.
Pixel	Lists the pixel number in the particular line
Type	The type of data of the selected record. This could be one of: TMDS or DDC.
SubType	The sub type 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.

3.7.5 Data Decode Timing mode

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

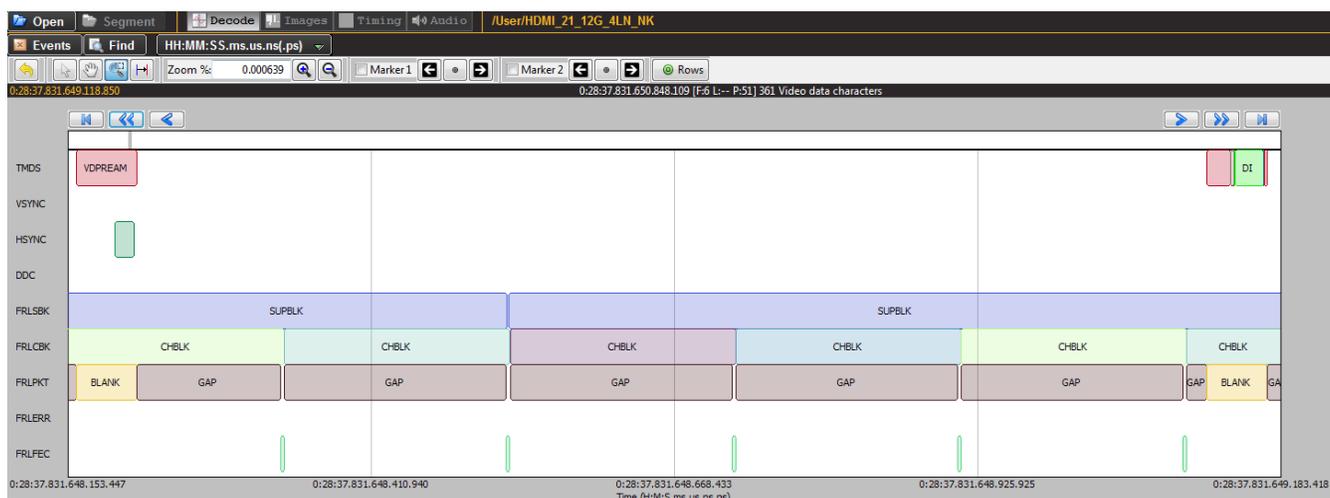


Right click option	Description
Nano-Seconds [HHMMSSmsusns]	Time is shown in nanoseconds. The baseline time is the time from the time of the last boot of the M41h.
Micro-Seconds [HHMMSSmsusns]	Time is shown in microseconds. The baseline time is the time from the time of the last boot of the M41h.
HH:MM:SS.ms.us.ns	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.

Right click option	Description
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 from the time of the last boot of the M41h.

3.8 Event Plot Panel

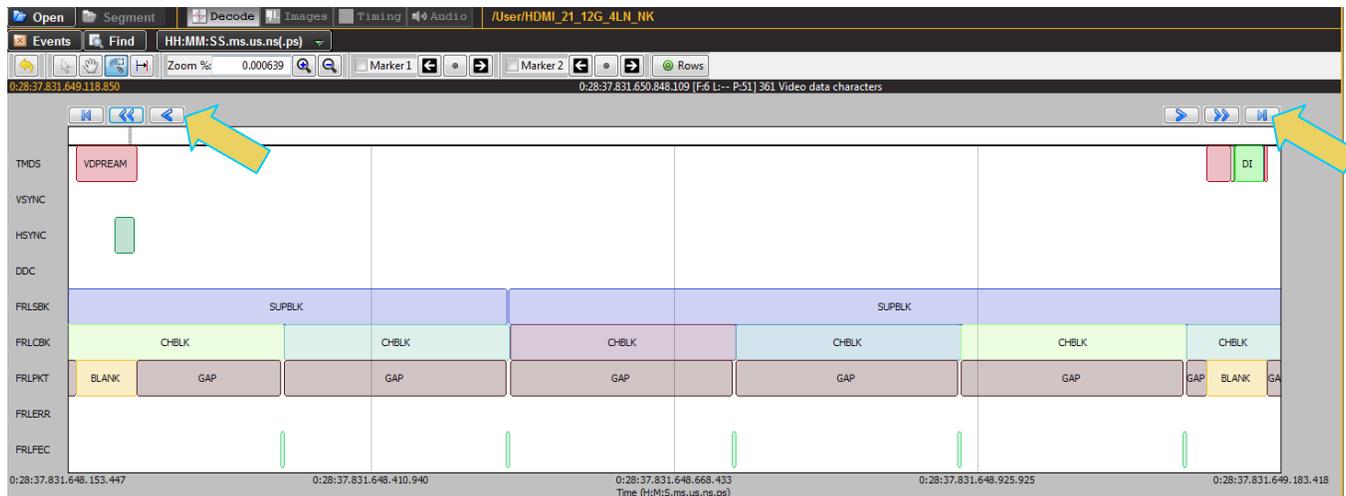
The **Event Plot** panel (shown below) is the primary panel for locating the data for high level navigation to the detail level provided by the **Data Decode** panel. The vertical axis is the data types. The **Event Plot** panel provides a set of data types labeled on the left of the panel that inform 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.



3.8.1 Locating Data in the Event Plot Panel

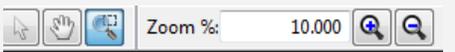
The **Event Plot** enables you to locate data by searching for specific data types, panning, scrolling and zooming using various techniques. You can filter the data by type to limit the amount of data to sift through. You can synchronize the **Data Decode** and **Timing** panels to the **Event Plot** or you can synchronize the **Event Plot** to the **Data Decode** panel.

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



3.8.2 Zooming in the Event Plot Panel

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

Even Plot Zoom & Panning Icons	Function
<p>Icons – Zoom and Panning</p> 	<ul style="list-style-type: none"> Surround  activation button – 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. Zoom % – The Zoom % function enables you to enter a specific zoom amount in the associated field provided. Zoom In/Out icons   – The Zoom In/Out function buttons enables you to zoom in and zoom out by clicking on the activation button. The centered point will remain the same. Panning  – The panning function enables you scan across the data quickly by clicking and dragging. Pointer  – The pointer icon 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 and below the icons.

3.8.3 Viewing the Timestamps of the Data

The timestamp indicated on the dark status panel just below the icons indicates the location of the scroll bar. When you scroll or pan through the data, the timestamps 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 **Data Decode** panel.

The screenshot displays the HDMI Capture Viewer interface. The main display area shows a timeline of video signals. A yellow arrow points to a 'BLANK' packet in the timeline. Below the main display is a 'Details' panel with a table of packets and a 'Raw Data' section showing hexadecimal data.

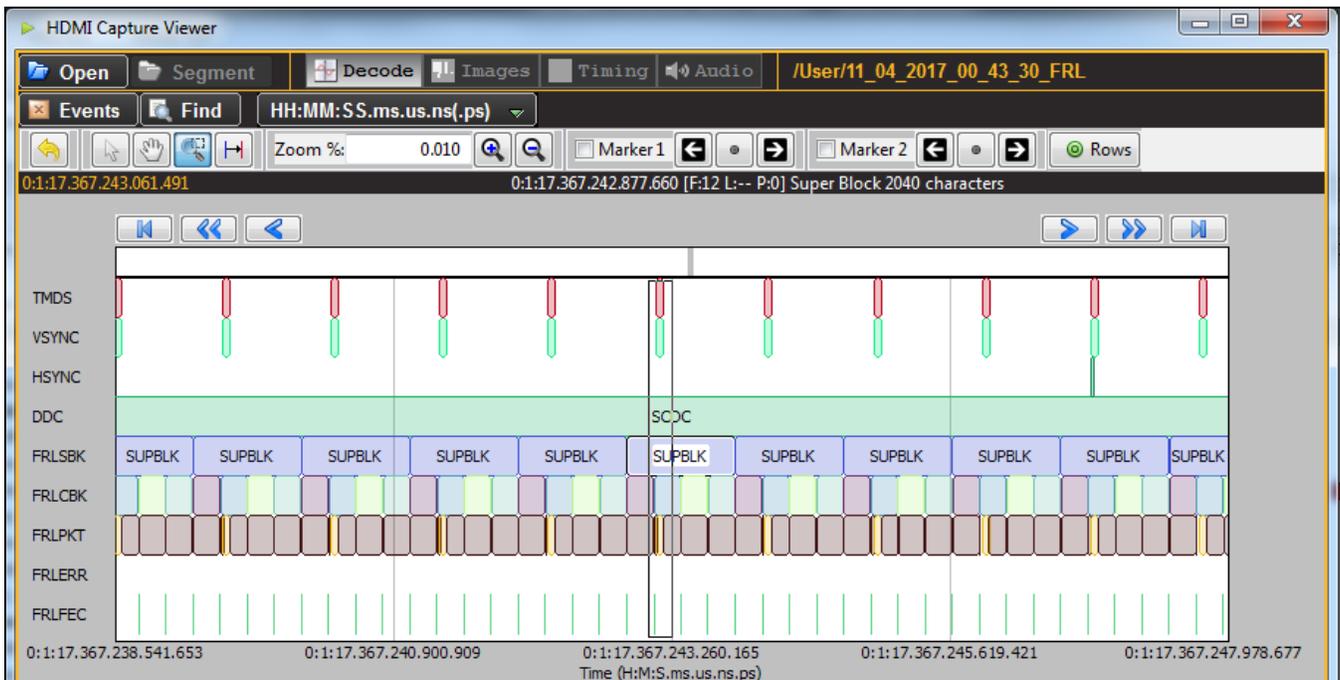
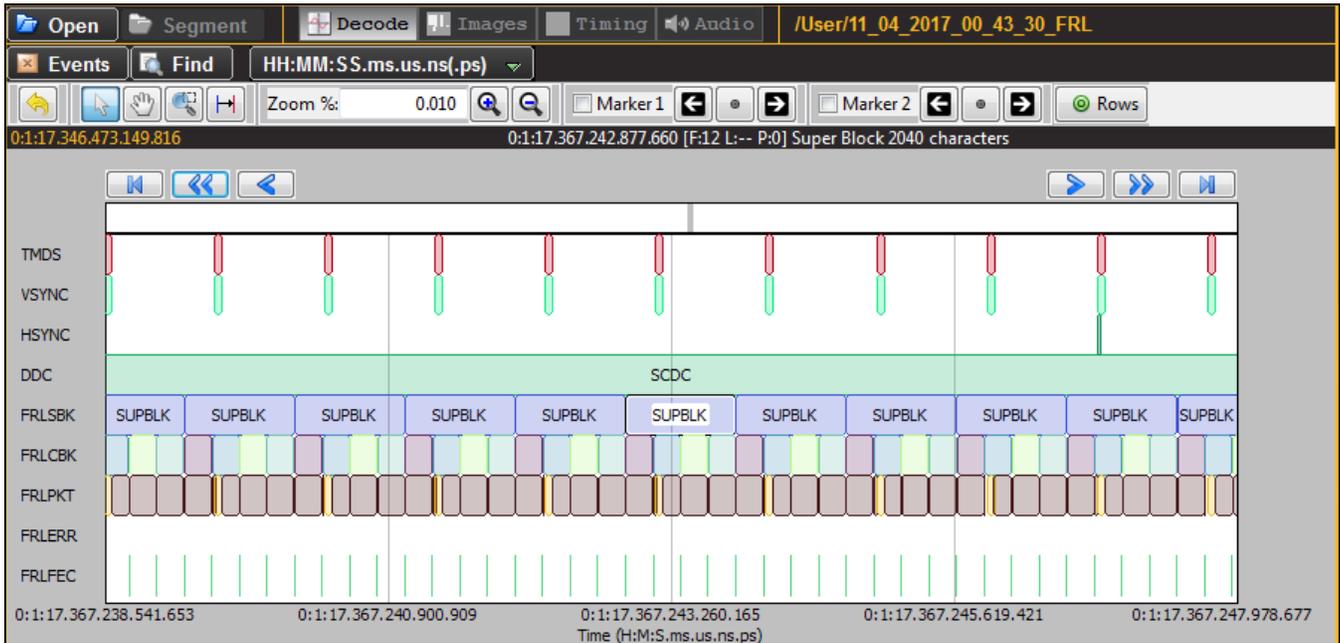
Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame/Bl...	Line	Pixel/Offset	Type	SubType	Info
819843	0:1:17.367.242.418.660	11		1020	FRL	GAP	502 GAP characters
819844	0:1:17.367.242.644.560	11		1522	FRL	FEC	FEC Parity bytes
819845	0:1:17.367.242.648.160	11		1530	FRL	CHBLK	Character Block 3 Start
819846	0:1:17.367.242.648.160	11		1530	FRL	GAP	502 GAP characters
819847	0:1:17.367.242.874.060	11		2032	FRL	FEC	FEC Parity bytes
819848	0:1:17.367.242.877.660	12		0	FRL	SUPBLK	Super Block 2040 characters
819849	0:1:17.367.242.879.460	12		0	FRL	CHBLK	Character Block 0 Start
819850	0:1:17.367.242.879.460	12		0	FRL	GAP	502 GAP characters
819851	0:1:17.367.243.105.360	12		502	FRL	FEC	FEC Parity bytes
819852	0:1:17.367.243.108.960	12		510	FRL	CHBLK	Character Block 1 Start

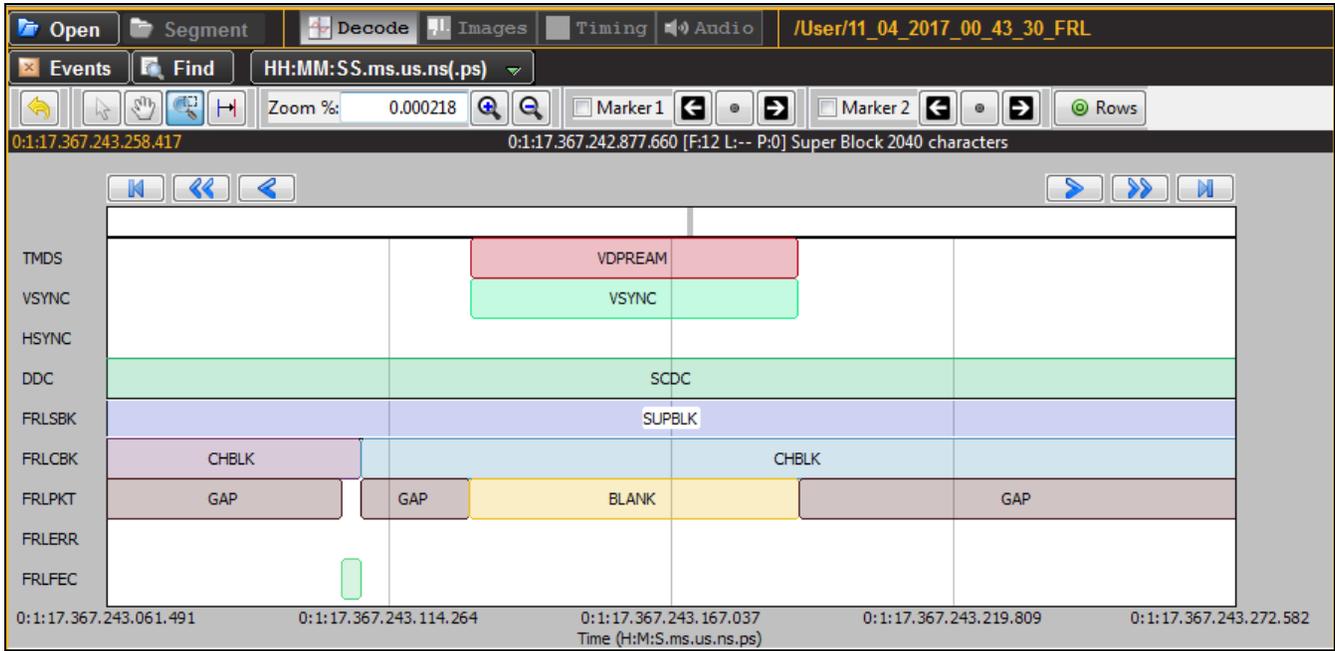
Raw Data:

```
bbbb bbbb bbbb bbbb
```

3.8.4 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 surrounding a segment of data. The dotted indicates the resultant section that is surrounded. The second view shows the resulting view.





3.8.5 Selecting Data to View in the Event Plot

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

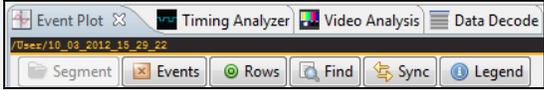
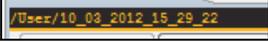
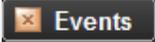
Row Selection

INFO-FR Info Frames	TMDS Any other TMDS Event	VSYNC Vertical Sync
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		

Ok Cancel

3.8.6 General Controls – Event Plot

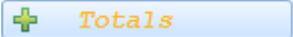
The various other icons and controls in the **Event Plot** are described in the tables and screens that follow.

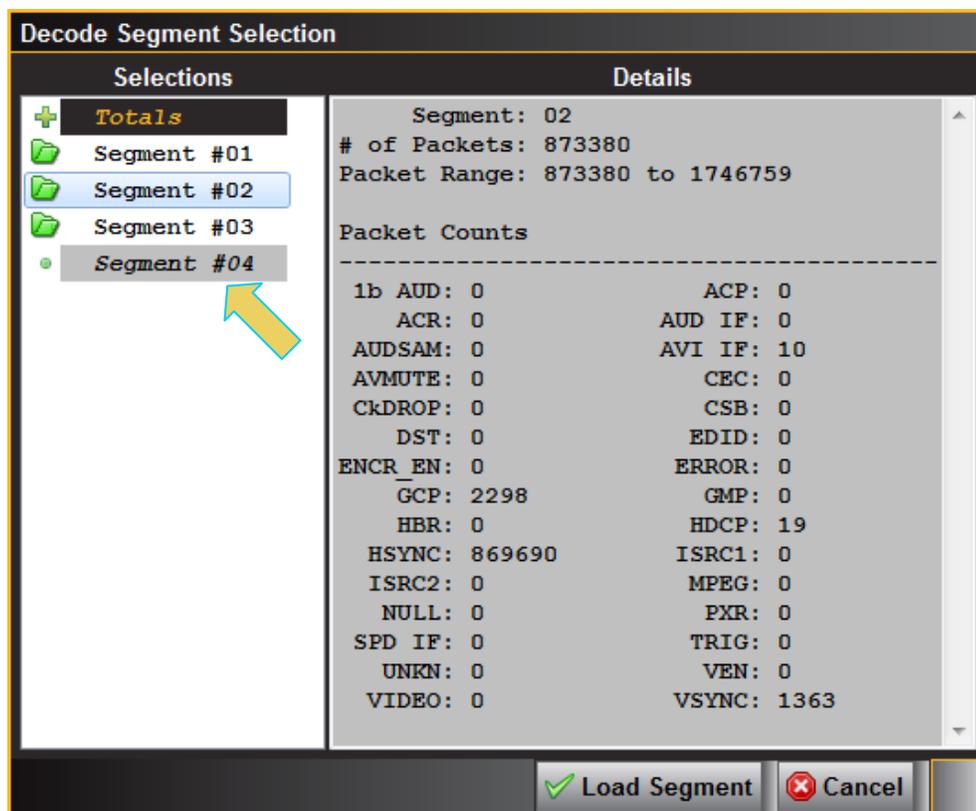
Even Plot Icons	Function
<p>Icons – General Control</p> 	<ul style="list-style-type: none"> ▪ User path status  – shows the name of the capture file and its location. ▪ Segment – Large captures are broken into smaller distinct sections called segments to make them more manageable and to improve speed and performance. When you click on the Segment activation button, a dialog box appears enabling you to select and load another segment. In the example to the left, there are no segments to the button is grayed out. 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 do select or deselect data types individually or a page at a time. This dialog box is described further below. ▪ Rows  – The Rows activation button enables you to configure the data types that appears in the Event Plot window. When you click on this icon a dialog box appears enabling you to configure the rows. This dialog box is described further below. ▪ Find  – The Find activation button enables you to locate captured data by type. When you click on the Find button a dialog box appears enable you do specify a data type to search on. This dialog box is described further below.

3.8.7 Working with Segments in the Event Plot Panel

The Segments in the **Event Plot** panel work the same way they do as the **Data 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 highlight 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.

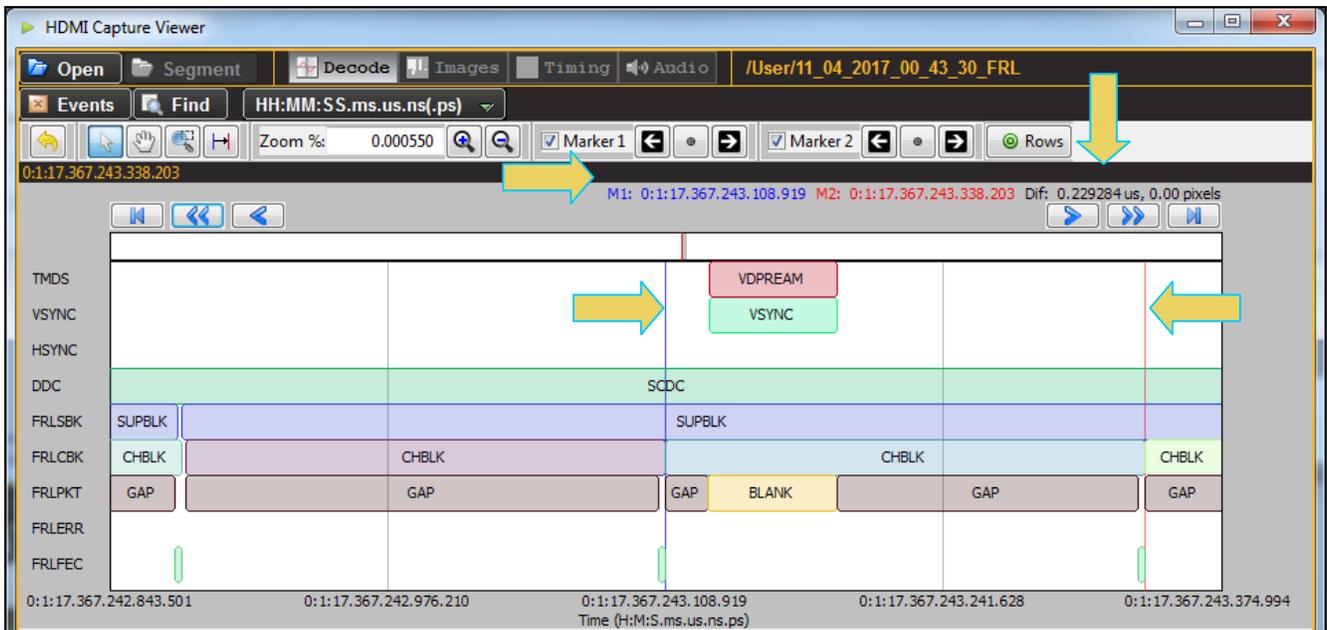
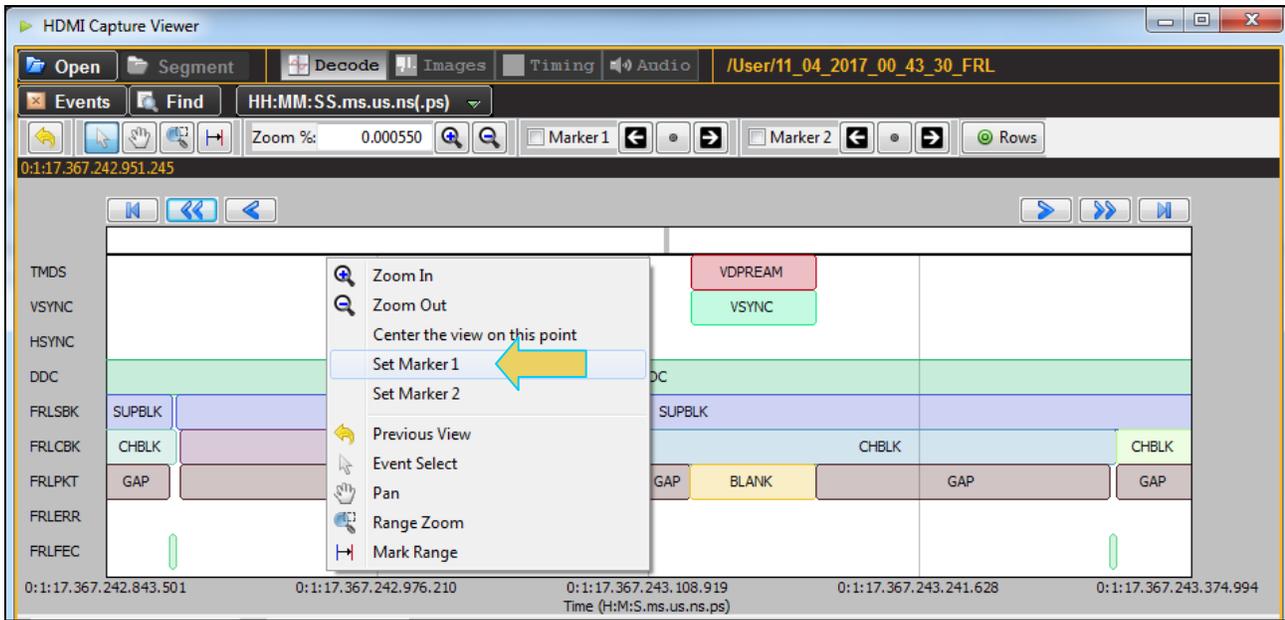


3.8.8 Working with Markers

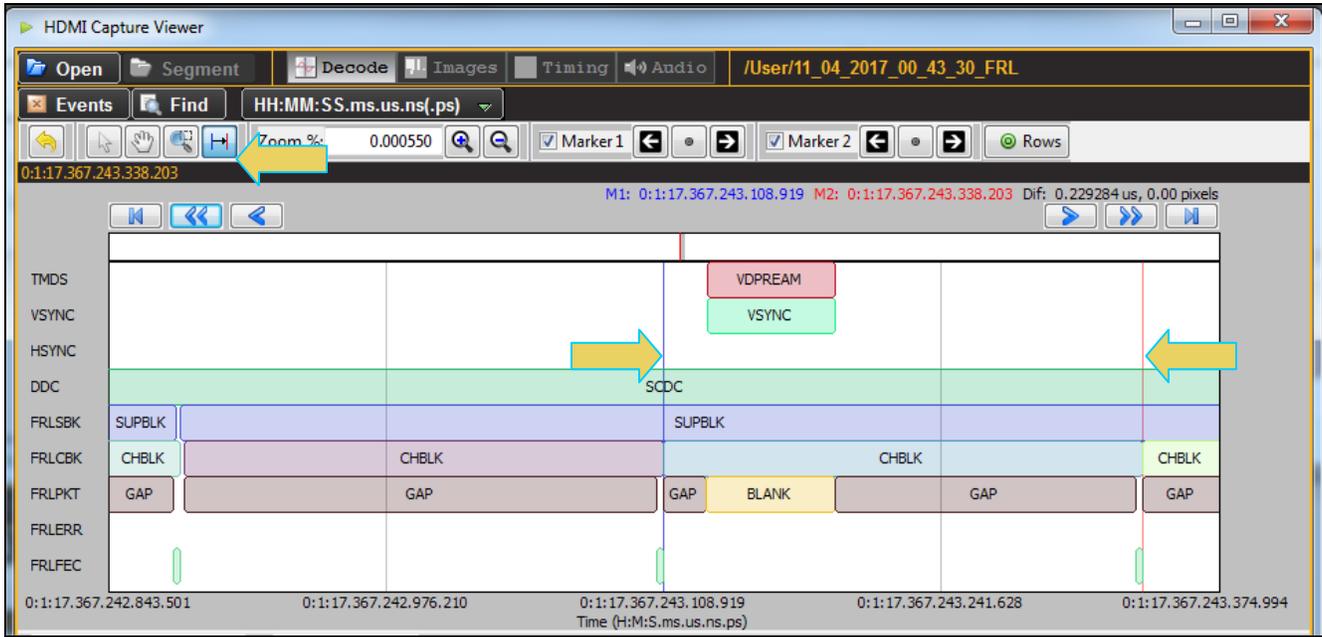
The **Event Plot** panel enables you to view the data at a high level and identify points of interest for further analysis. You can set two cursors or "markers" in the **Event Plot** panel at particular points of interest. The **Event Plot** will show you the time difference between the two cursors. You can fine tune the position of the cursors with the left

and right arrows associated with each marker . The  center icon 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 also shown below and this is the preferred method because the markers will appear exactly where you right click.

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

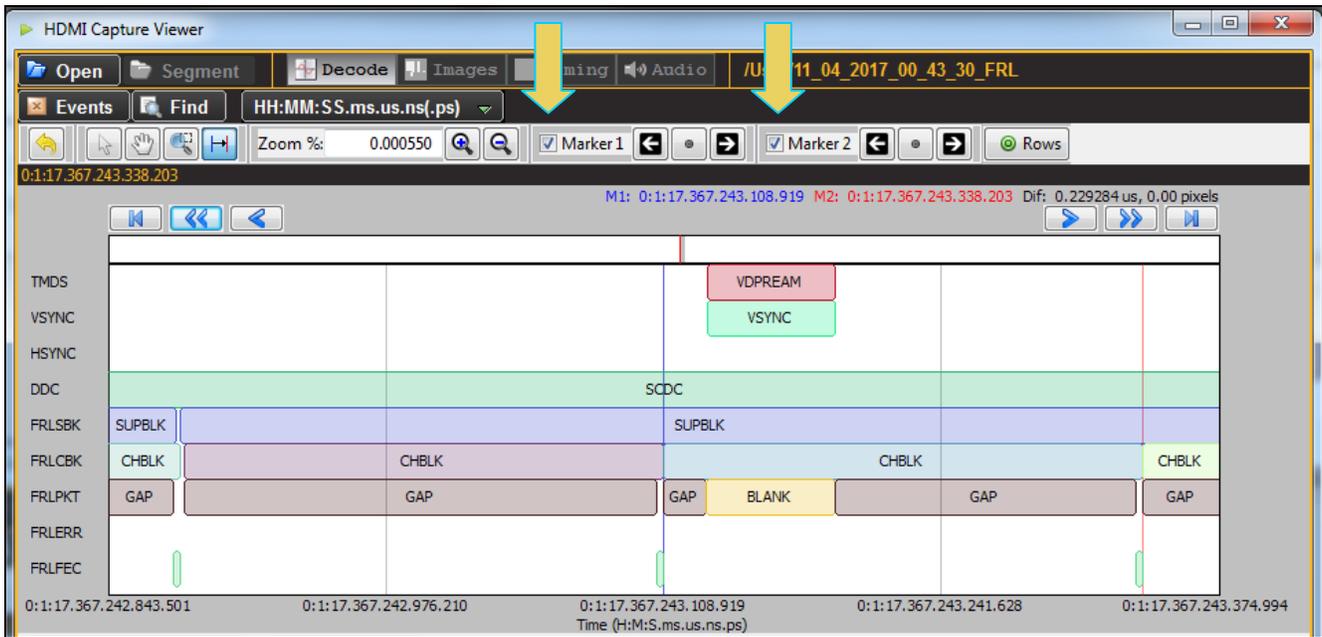


You can also set the markers with the Marker tool as shown below.



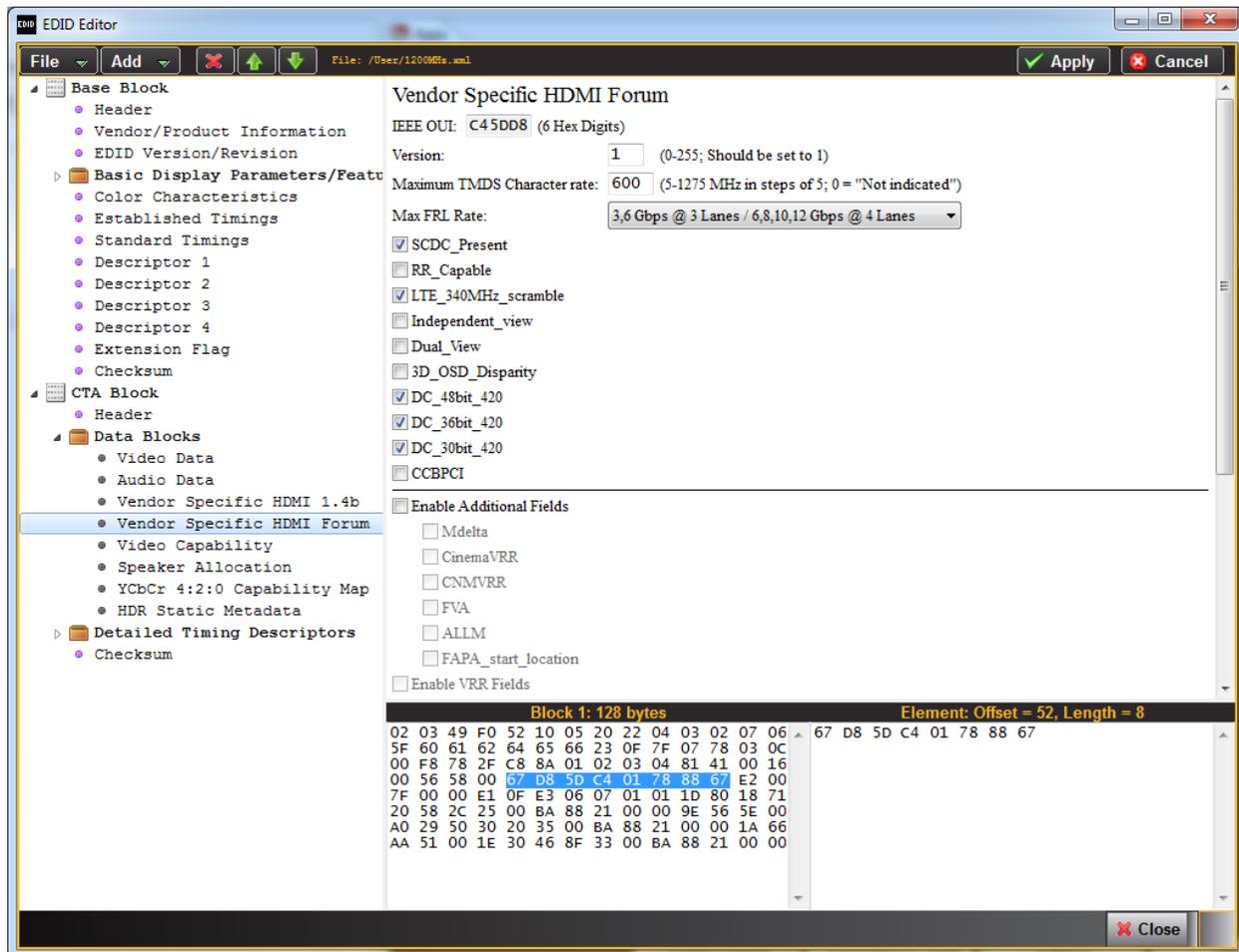
When you begin the sweep the Marker tool cursor will appear as the icon  shown in the menu bar.

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



3.9 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.



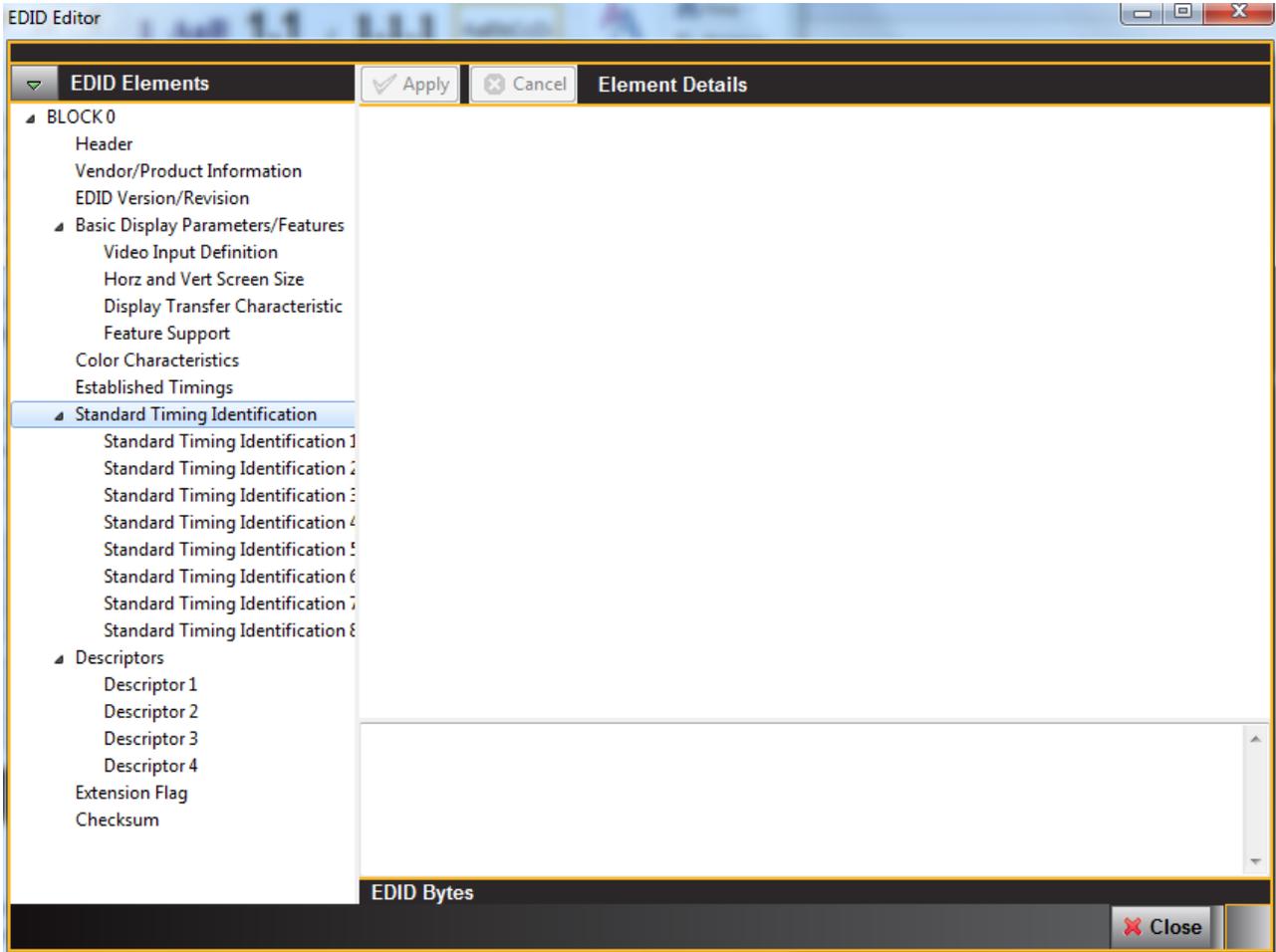
3.10 Opening up the EDID Editor

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 it and resave it under a different name.

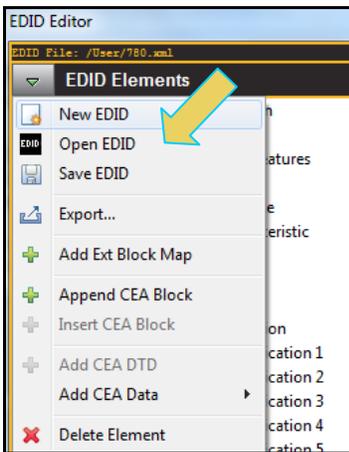
To open an EDID stored on your host PC:

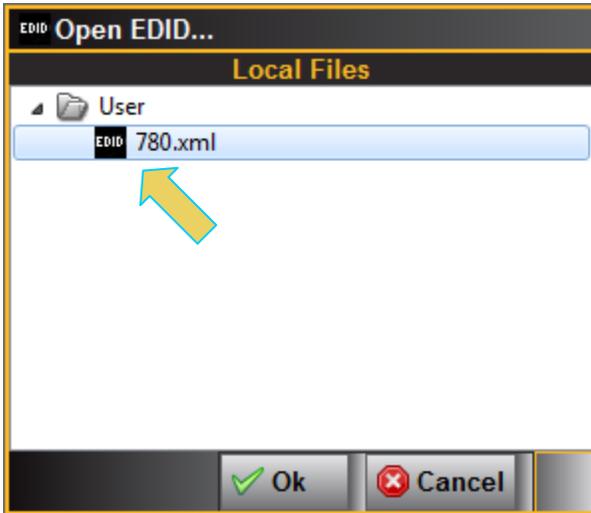
1. Open the EDID Editor from the **Editors** page on the **App** panel.

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



2. Open up an EDID stored on the PC using the pull-down menu and selecting **Open EDID**.

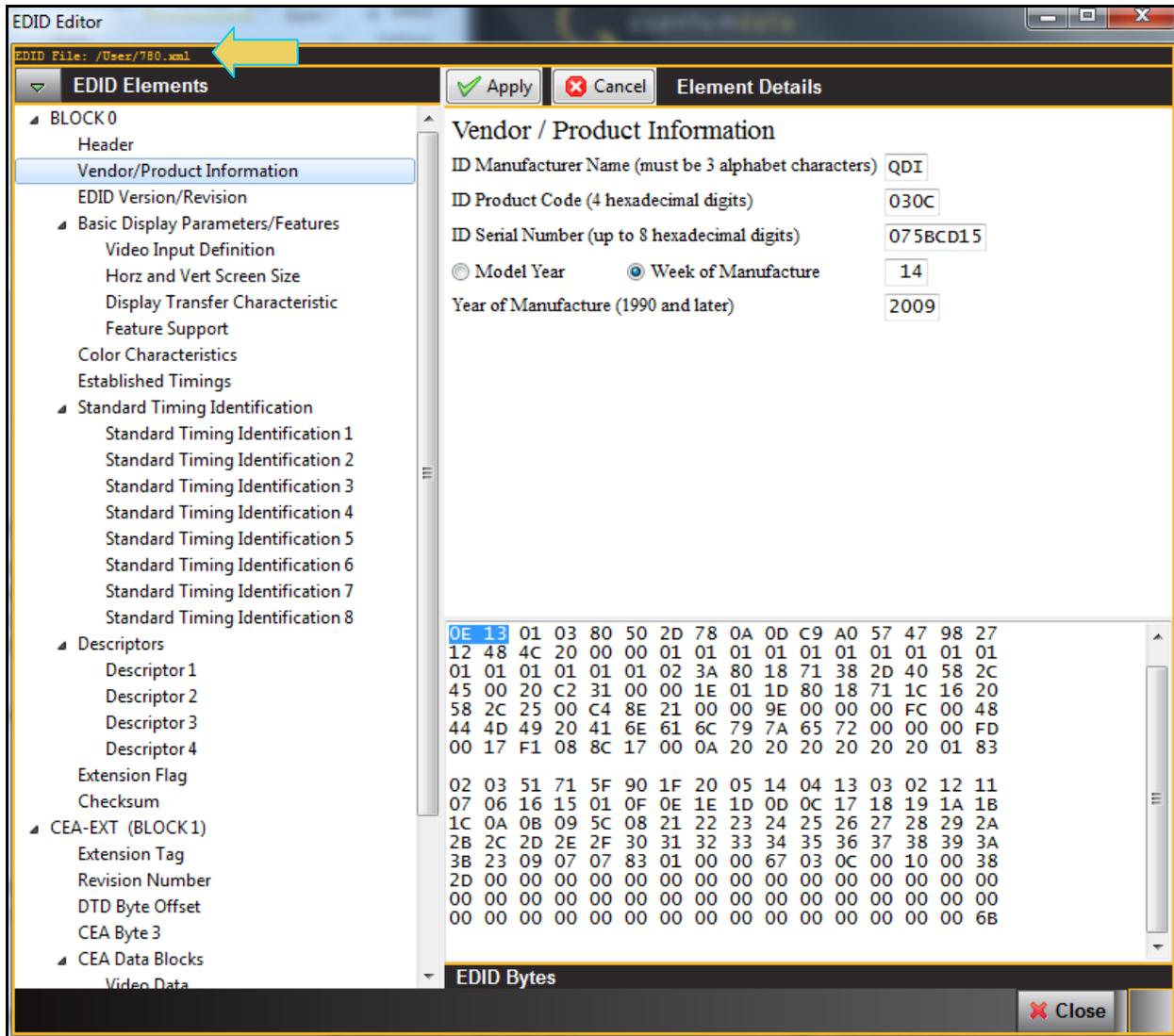




3. Select the EDID and click on the **OK** activation button. Click **Cancel** if you cannot find an appropriate EDID.

Note: You must have downloaded EDIDs or saved EDIDs into the EDID directory in order 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.

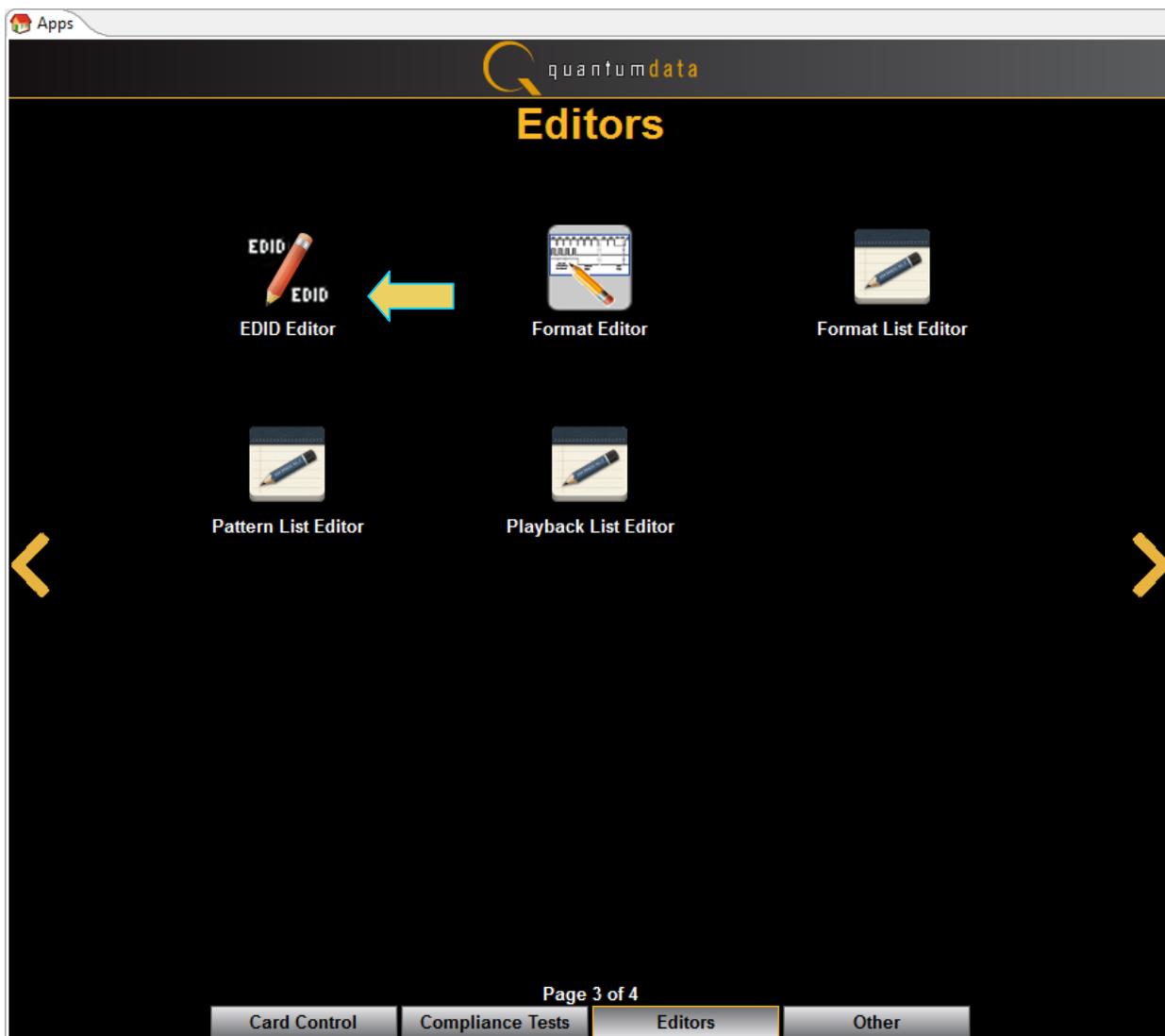


3.11 Loading an EDID into the EDID Editor

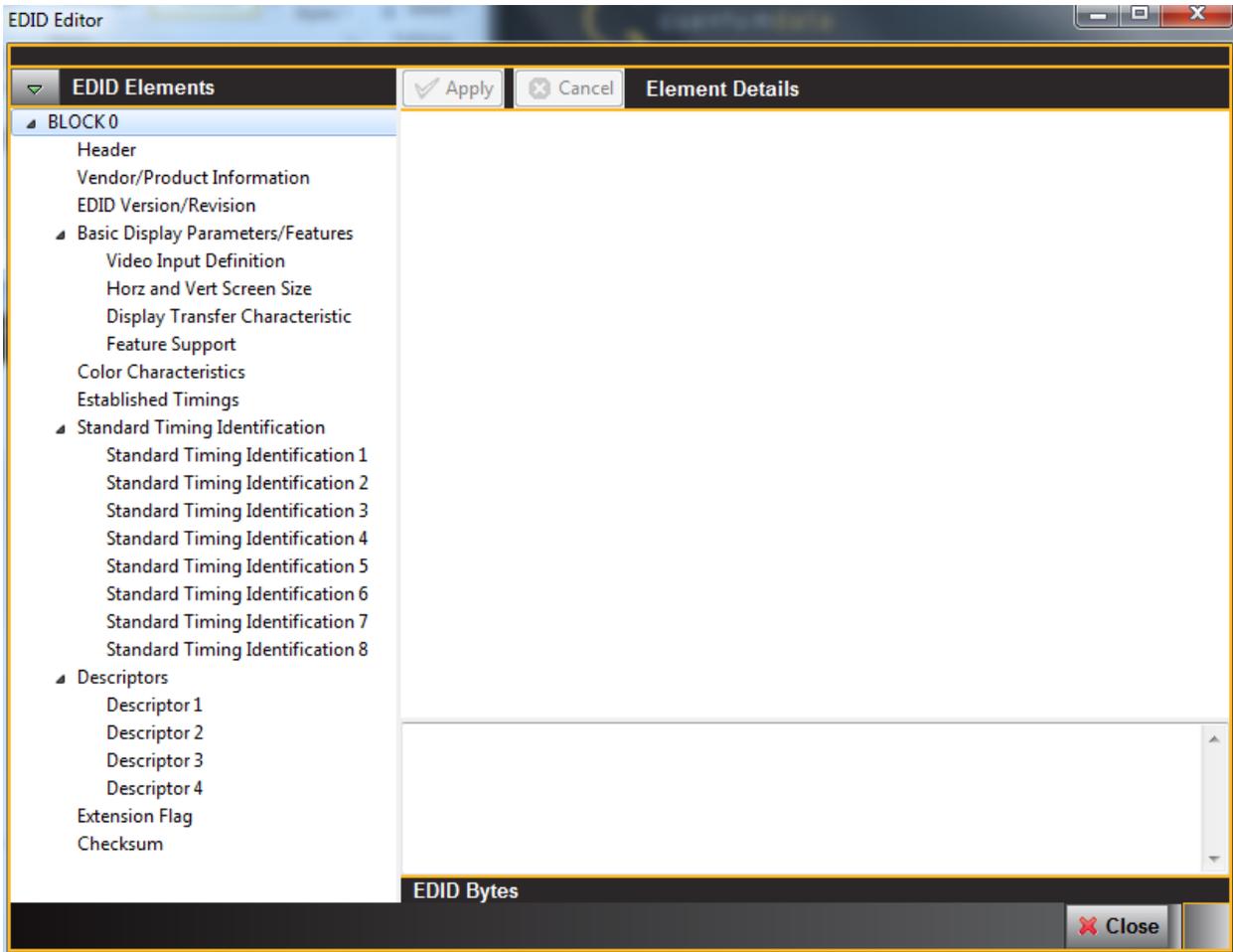
You can either load a new EDID or modify an existing EDID. In the latter case, you may have many EDIDs stored in the EDID directory of the external ATP Manager suite of directories. You can open any one of these EDIDs, modify it and resave it under a different name.

To open up the EDID Editor:

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

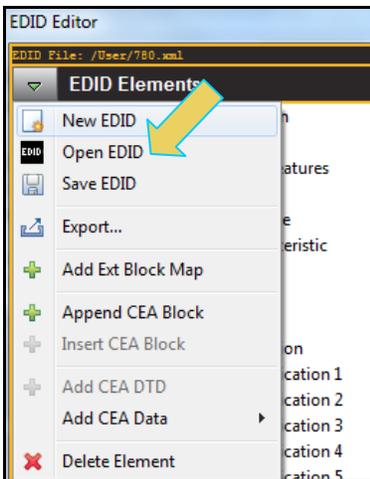


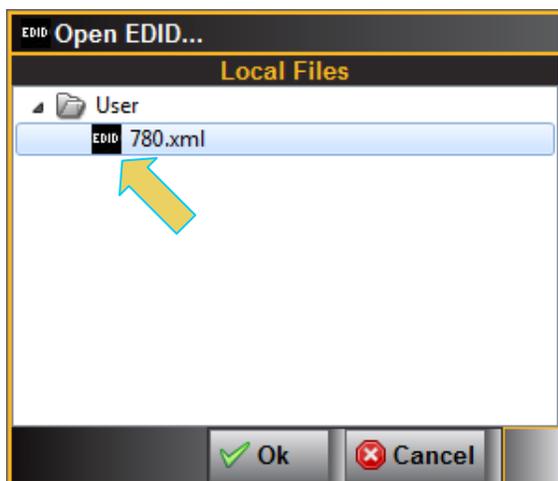
The EDID Editor opens up without and EDID loaded as shown below.



To open up an EDID stored on your PC.

1. Open up an EDID stored on the PC using the pull-down menu as shown below. Select **Open EDID**.

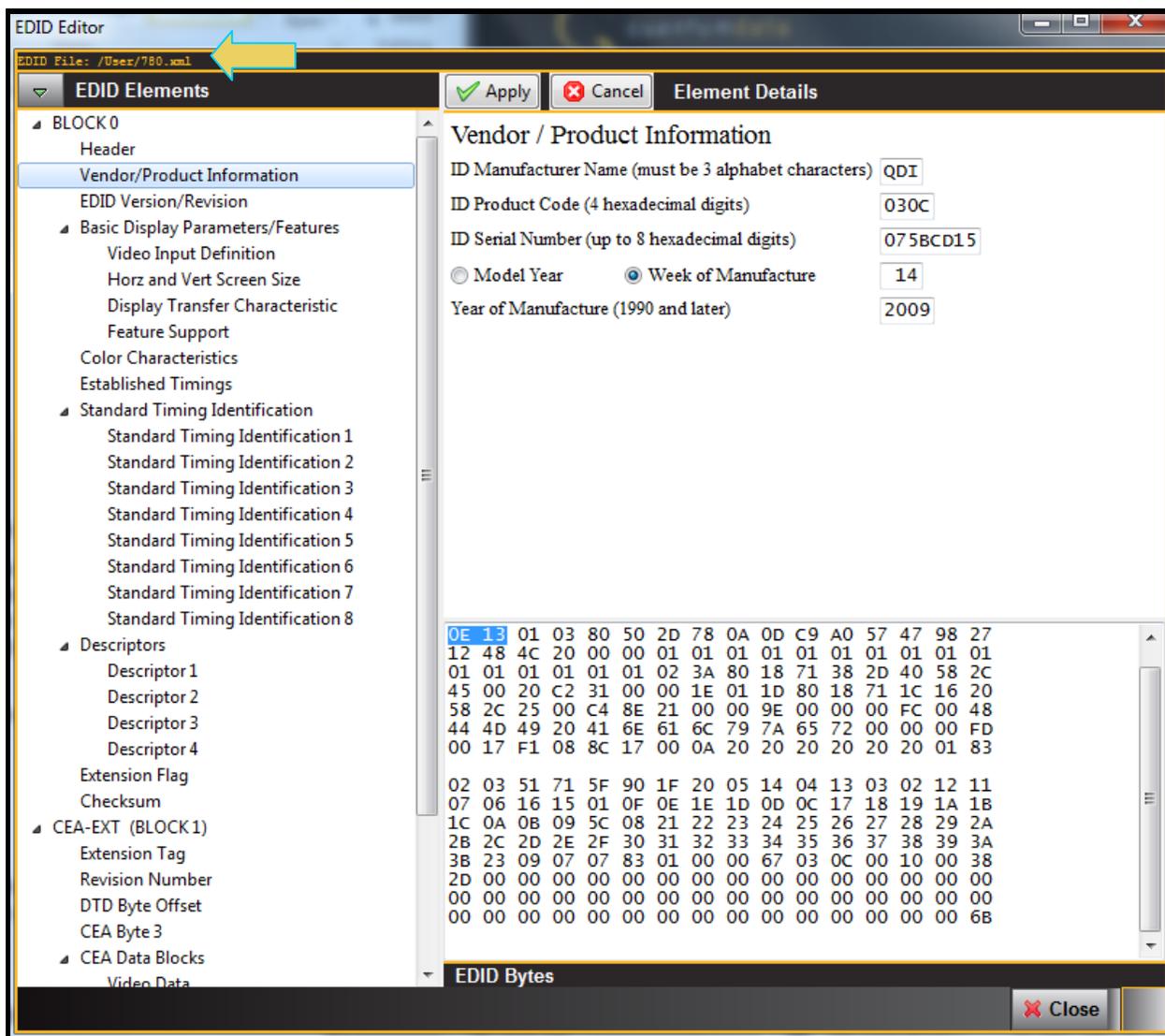




2. Select the EDID and click on the **OK** activation button. Click **Cancel** if you cannot find an appropriate EDID.

Note: You must have downloaded EDIDs or saved EDIDs into the EDID directory in order 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.



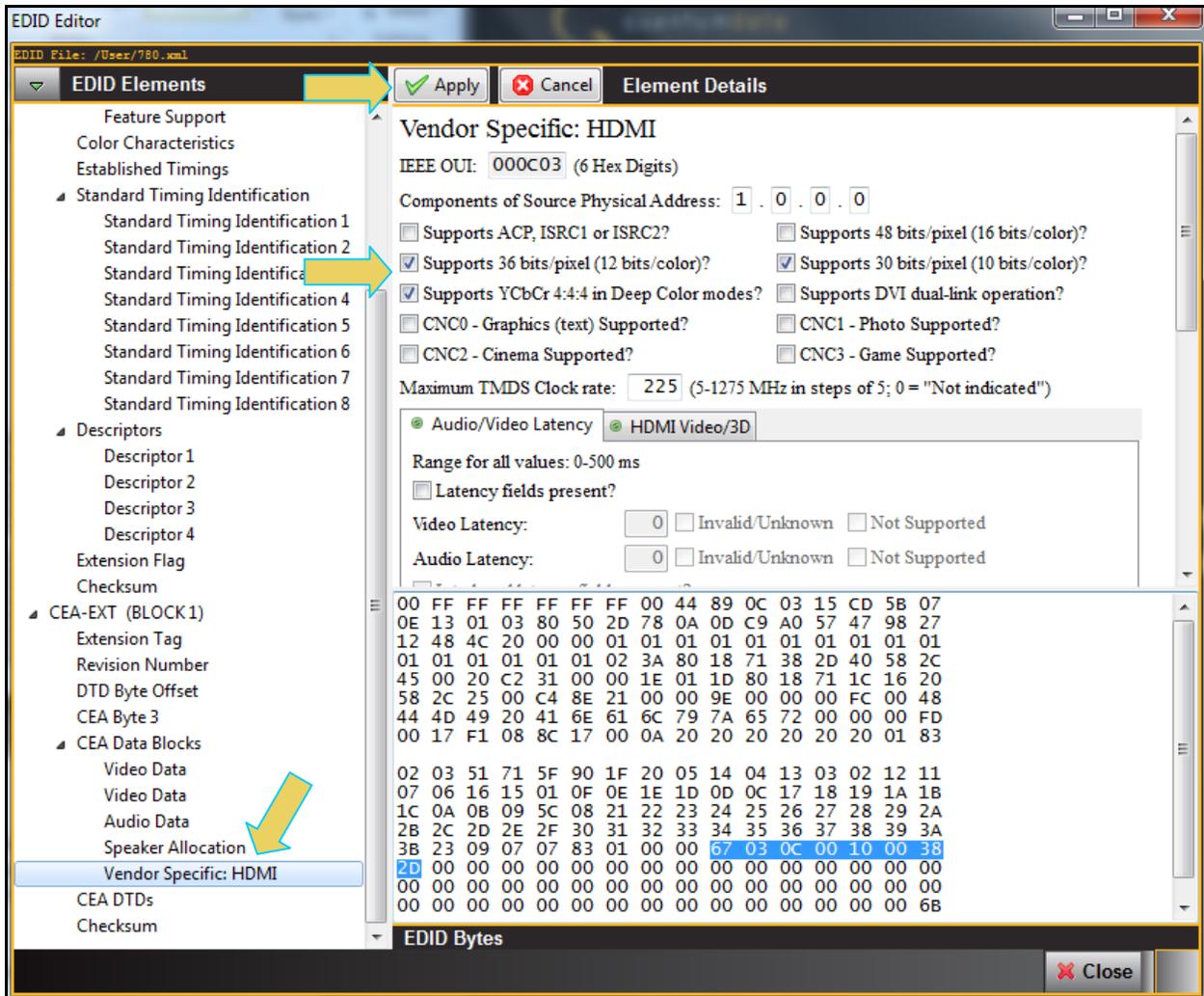
3.12 Making Modifications to an EDID with the EDID Editor

Once you have loaded an EDID you can make changes to individual field values, add data blocks, delete data blocks, add or 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.

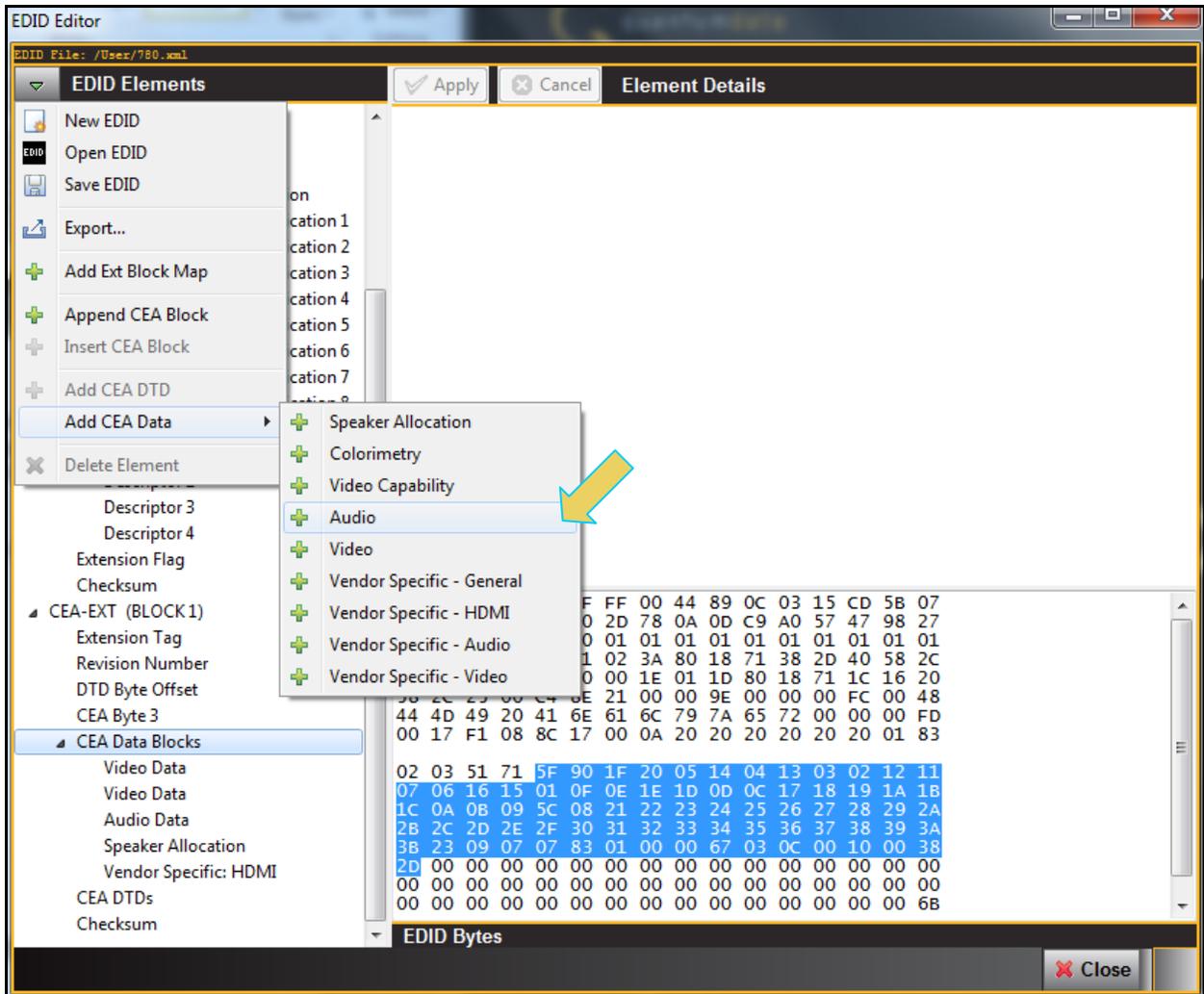
To make a change to an EDID loaded into the EDID Editor:

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.

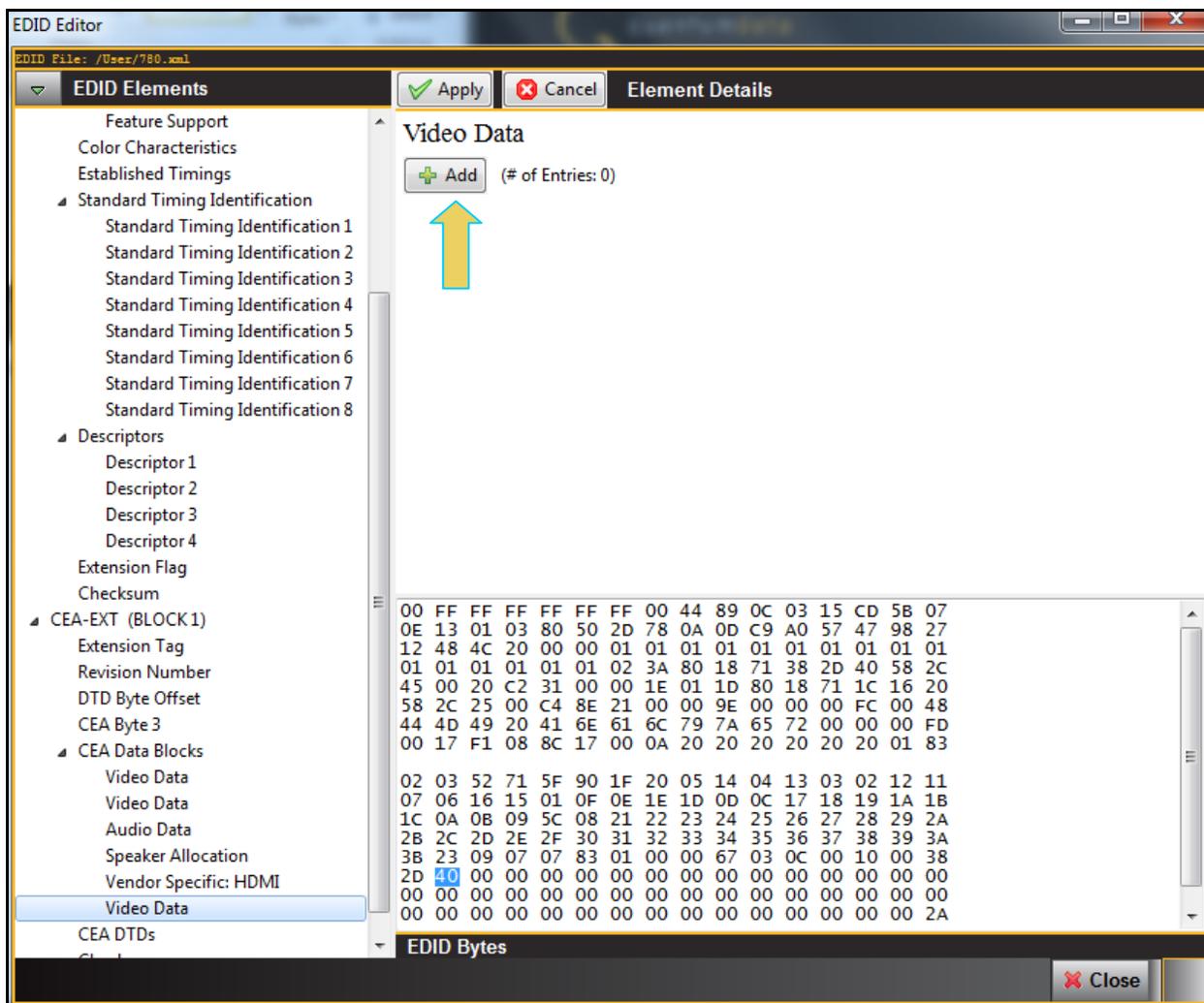
Use the check boxes or fields to make the change, then click on the **Apply** activation button to enable the change. The example below shows the Deep Color definition being changed in the Vendor Specific block.



- 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):

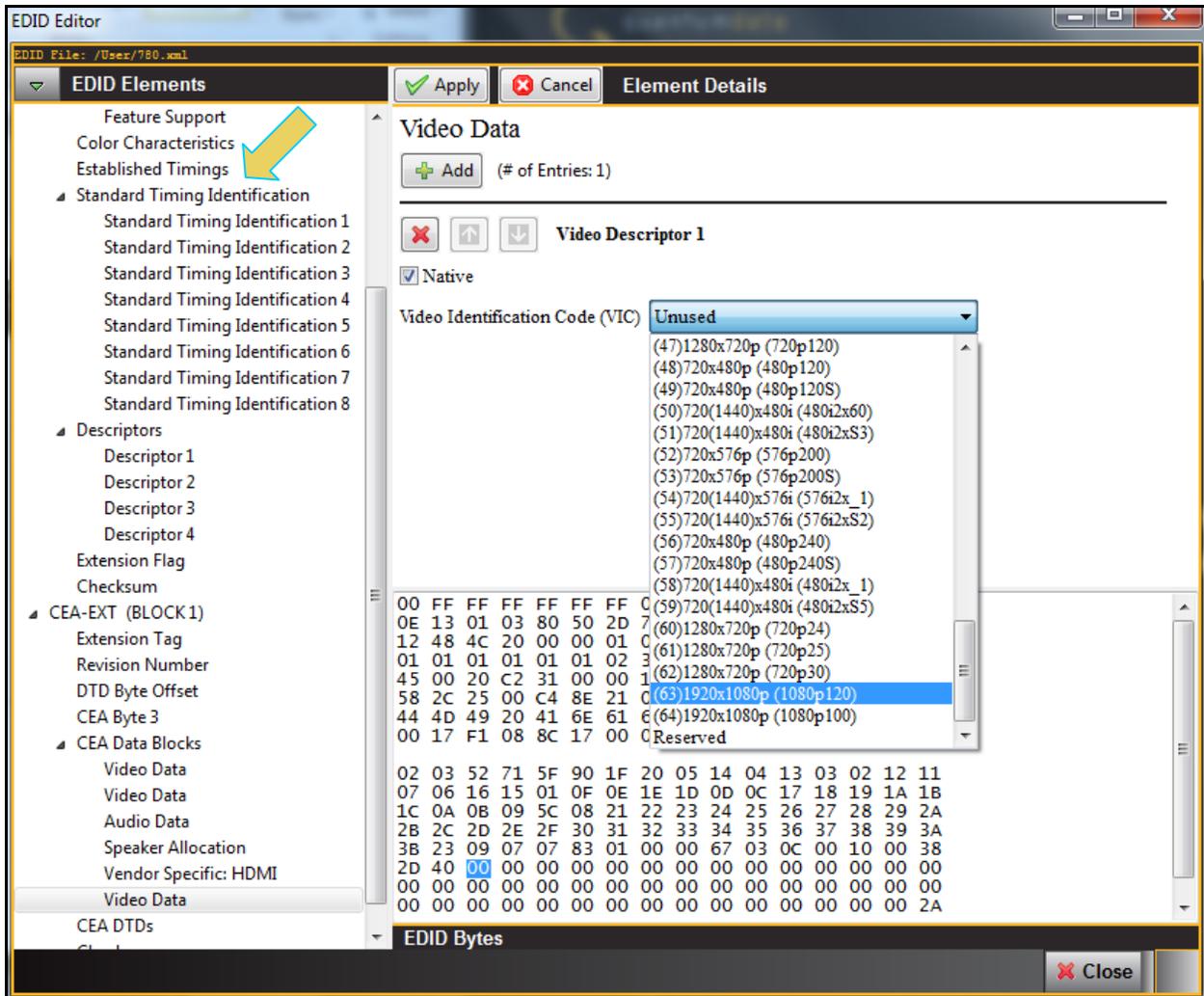


3. Select the block of EDID data that you wish to view or modify using the EDID Elements list on the left of the **EDID Editor** panel. Examples below.



4. 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.

EDID Editor

EDID File: /User/780.xml

EDID Elements

- Feature Support
- Color Characteristics
- Established Timings
- Standard Timing Identification
 - Standard Timing Identification 1
 - Standard Timing Identification 2
 - Standard Timing Identification 3
 - Standard Timing Identification 4
 - Standard Timing Identification 5
 - Standard Timing Identification 6
 - Standard Timing Identification 7
 - Standard Timing Identification 8
- Descriptors
 - Descriptor 1
 - Descriptor 2
 - Descriptor 3
 - Descriptor 4
- Extension Flag
- Checksum
- CEA-EXT (BLOCK 1)
 - Extension Tag
 - Revision Number
 - DTD Byte Offset
 - CEA Byte 3
 - CEA Data Blocks
 - Video Data
 - Video Data
 - Audio Data
 - Speaker Allocation
 - Vendor Specific: HDMI
 - CEA DTDs
 - Checksum

Apply Cancel Element Details

Audio Data

+ Add (# of Entries: 1)

Short Audio Descriptor 1

Audio Format: PCM

Max Channels: 2

Sampling Rates (kHz): 32 44.1 48 88.2 96 176.4 192

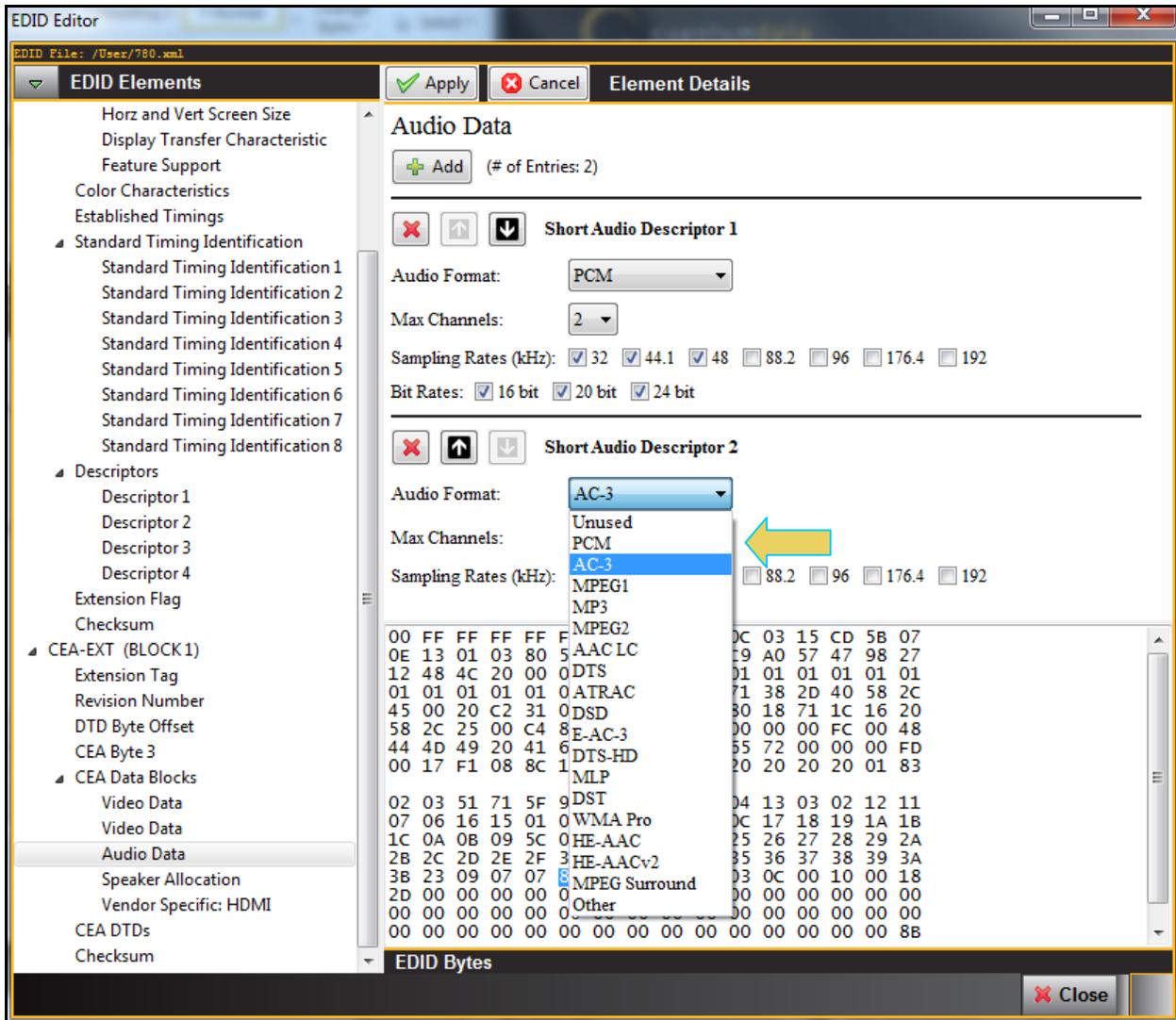
Bit Rates: 16 bit 20 bit 24 bit

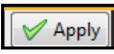
```
00 FF FF FF FF FF FF 00 44 89 0C 03 15 CD 5B 07
0E 13 01 03 80 50 2D 78 0A 0D C9 A0 57 47 98 27
12 48 4C 20 00 00 01 01 01 01 01 01 01 01 01 01
01 01 01 01 01 01 02 3A 80 18 71 38 2D 40 58 2C
45 00 20 C2 31 00 00 1E 01 1D 80 18 71 1C 16 20
58 2C 25 00 C4 8E 21 00 00 9E 00 00 00 FC 00 48
44 4D 49 20 41 6E 61 6C 79 7A 65 72 00 00 00 FD
00 17 F1 08 8C 17 00 0A 20 20 20 20 20 01 83

02 03 51 71 5F 90 1F 20 05 14 04 13 03 02 12 11
07 06 16 15 01 0F 0E 1E 1D 0D 0C 17 18 19 1A 1B
1C 0A 0B 09 5C 08 21 22 23 24 25 26 27 28 29 2A
2B 2C 2D 2E 2F 30 31 32 33 34 35 36 37 38 39 3A
3B 23 09 07 07 83 01 00 00 67 03 0C 00 10 00 18
2D 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
```

EDID Bytes

Close



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

5. Once you make a change on a particular EDID block you use the **Apply** button to invoke the change.
6. 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.

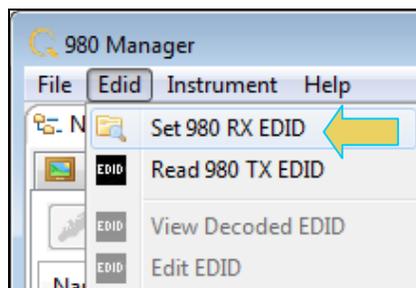
Item	Item - Column	Description
	Add CEA Audio Data Block	Enables you to add a new Audio Data Block to the CEA extension block.
	Add CEA Video Data Block	Enables you to add a new Video Data Block to the CEA extension block.
	Add CEA Vendor Specific Data Block - General	Enables you to add a new Vendor 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.

3.13 Emulating a Specific EDID

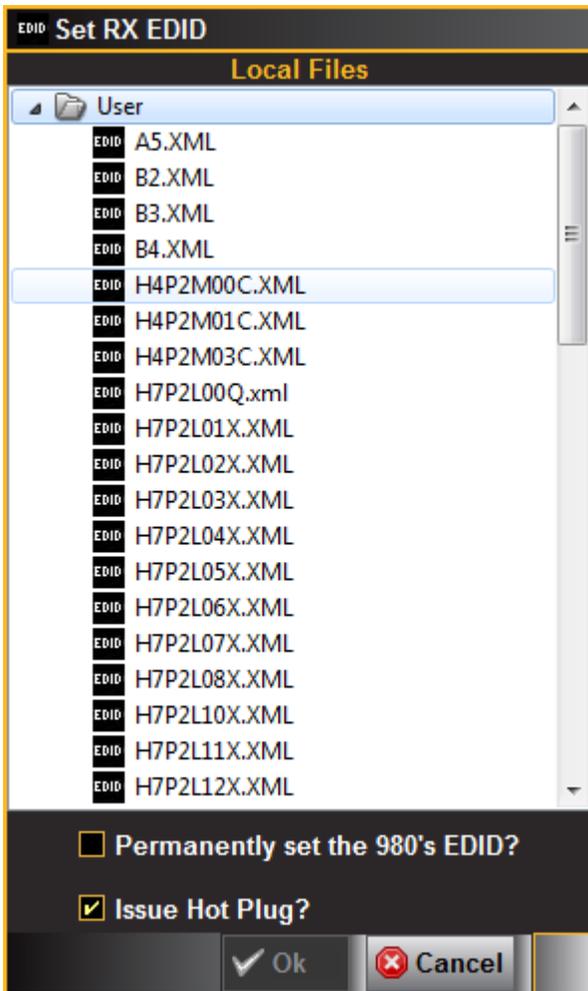
Once you have loaded an EDID and made your changes to it you can assign it to the M41h 48G Video Analyzer/Generator Rx port for emulation and testing your source device. This subsection describes how you can do that.

To assign an EDID to the Rx port:

1. Use the EDID pull-down menu and select **Set M41h Rx EDID**.



The dialog box shown below opens up.



2. 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 checkbox 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.

4 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 built-in front panel display. It is not supported through the external ATP Manager.** The Real Time mode enables you can view the following data in real time:

- **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.

4.1 Accessing the Real Time mode

The Real Time mode can be accessed from Page 1 of the App panel **Card Control** using the procedures below.

To access the Real Time mode:

1. Touch select the **HDMI RX-PA** icon on the page 1 of the **Apps** panel on the embedded ATP Manager:

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:



4.2 Real Time Mode Overview

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

4.2.1 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).

PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX					
Update Cnt: 37	Type: HDMI	Char Rate: 297.00	HDCP: 2.3 enabled	PassTh: 1	SCAN: --
Active: -- x --	Total: -- x --	H-Sync: F:-- W:-- P:+	V-Sync: F:-- W:-- P:+		
CTA VIC=97: 3840x2160p @ 60 Hz 16:9 3840 x 2160 Progressive (24 bpp), YCbCr-420, BT.709 Not Encrypted					

- Home
- Back
- Nav.
- Port
- Stop
- Video
 - AVI-IF
 - GCP
 - VS-IF
 - AUD-IF
 - HDR-IF
 - EMP
 - ACA
- Tools

6.01.02

PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX

Update Cnt: 57 | Type: HDMI | Char Rate: 297.00 | HDCP: 2.3 enabled | PassTh: 1 | SCAN: --

Active: -- x -- | Total: -- x -- | H-Sync: F:-- W:-- P:+ | V-Sync: F:-- W:-- P:+

CTA VIC=97: 3840x2160p @ 60 Hz 16:9 | 3840 x 2160 | Progressive | (24 bpp), YCbCr-420, BT.709 | Not Encrypted

AVI: 0 (0) 9960

AVI InfoFrame

```

check sum:          verified
version:            2
length:            13
scan info:         all active pixels & lines are displayed
Bar Info:          no Data
active info:       no data
RGB/YCC indicator: YCbCr 4:2:0
active format:     not defined
picture aspect ratio: 16:9
colorimetry:      ITU709 [6]
non-uniform picture scale: not known
quantization range: default (depends on video format)
extended colorimetry: xvYCC601 Not used - Colorimetry (C) bits are not set to 3
video format:     VIC=97 (3840x2160p @ 59.94Hz/60Hz)
IT content:       no data
IT content Type:  graphics Not used - IT content bit (IT) bit is set to 0
YCC quantization range: limited range
pixel repetition: none
line number of end of top bar: 0
line number of start of bottom bar: 2161
pixel number of end of left bar: 0
pixel number of start of right bar: 3841
  
```

```

HB: 82 02 0d e4 |
SP0: 7b 62 a8 00 61 00 00 20 | {b..a.. |
SP1: 00 71 08 00 00 01 0f 9a | .q..... |
SP2: 00 00 00 00 00 00 00 00 | ..... |
SP3: 00 00 00 00 00 00 00 00 | ..... |
#
  
```

6.01.02

PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX

Update Cnt: 160 | Type: HDMI | Char Rate: 370.88 | HDCP: 2.3 enabled | PassTh: 1 | SCAN: --

Active: -- x -- | Total: -- x -- | H-Sync: F:-- W:-- P:+ | V-Sync: F:-- W:-- P:+

CTA VIC=93: 3840x2160p @ 24 Hz 16:9 | 3840 x 2160 | Progressive | 30 bpp, RGB, BT.2020-RGB | Not Encrypted

HDR: 0 (0) 1358

Dynamic Range and Mastering

InfoFrame version: 0x01

Length of HDR Metadata: 26

EOTF: SMPTE ST 2084 (0x02)

Static Metadata Descriptor ID: Static Metadata Type 1 (0x00)

Static Metadata Descriptor:

display primaries_x[0]:	0.26500
display primaries_y[0]:	0.69000
display primaries_x[1]:	0.15000
display primaries_y[1]:	0.06000
display primaries_x[2]:	0.68000
display primaries_y[2]:	0.32000
white_point_x:	0.31270
white_point_y:	0.32900
max_display_mastering_luminance:	1000 cd/m2
min_display_mastering_luminance:	0.00000 cd/m2
Maximum Content Light Level:	1000 cd/m2
Maximum Frame-average Light Level:	400 cd/m2

HB: 87 01 1a 27 |

SP0: a6 02 00 c2 33 c4 86 05 |....3...|

SP1: 4c 1d b8 0b d0 84 80 2b |L.....+|

SP2: 3e 13 3d 42 40 e8 03 5a |>.=B@..Z|

SP3: 00 00 e8 03 90 01 00 f1 |.....|

#

Home

Back

Nav.

Port

Stop

Video

AVI-IF

GCP

VS-IF

AUD-IF

HDR-IF

EMP

ACA

Tools

6.01.02

The screenshot displays the software interface for the M41h 48G Video Analyzer/Generator. At the top, a status bar provides technical details: **PORT: 48G Protocol Analyzer HDMI RX - Card 6 - RX**, **Update Cnt: 362**, **Type: FRL 5**, **Char Rate: 1485.00**, **HDCP: NONE**, **PassTh: 0**, **SCAN: Progressive**, **Active: 4800 x 4320**, **Total: 5625 x 4400**, **H-Sync: F:345 W:110 P:+**, **V-Sync: F:16 W:20 P:+**, **CTA VIC=199: 7680x4320p @ 60 Hz 16:9**, **7680 x 4320**, **Progressive**, **30 bpp, YCbCr-420, BT.709**, and **Not Encrypted**.

The main display area features a color calibration chart with the following color blocks: a grey square, a yellow square, a cyan square, a green square, a magenta square, a red square, and a blue square. Below these are smaller blocks of blue, black, magenta, black, cyan, black, and grey. Further down are blocks of dark blue, white, and purple. The bottom-most section of the chart is black.

A vertical sidebar on the right contains the following menu items: **Home**, **Back**, **Nav.**, **Port** (with a dropdown arrow), **Stop**, **Video** (with a dropdown arrow), **AVI-IF**, **GCP**, **VS-IF**, **AUD-IF**, **HDR-IF**, **EMP**, **ACA**, a home icon, and **Tools** (with a dropdown arrow). At the bottom of the sidebar, the version number **6.01.02** is displayed.

4.2.2 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

Two example Dashboards are shown. The first with TMDS mode and the second in the FRL mode.

PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX						
Update Cnt: 160	Type: HDMI	Char Rate: 370.88	HDCP: 2.3 enabled	PassTh: 1	SCAN: --	
Active: -- x --	Total: -- x --	H-Sync: F:-- W:-- P:+	V-Sync: F:-- W:-- P:+			
CTA VIC=93: 3840x2160p @ 24 Hz 16:9 3840 x 2160 Progressive 30 bpp, RGB, BT.2020-RGB Not Encrypted						
PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX						
Update Cnt: 362	Type: FRL 5	Char Rate: 1485.00	HDCP: NONE	PassTh: 0	SCAN: Progressive	
Active: 4800 x 4320	Total: 5625 x 4400	H-Sync: F:345 W:110 P:+	V-Sync: F:16 W:20 P:+			
CTA VIC=199: 7680x4320p @ 60 Hz 16:9 7680 x 4320 Progressive 30 bpp, YCbCr-420, BT.709 Not Encrypted						

The following items are on the Real Time dashboard:

Top Row Items – and Port:

- Port and Card** –The Port area shows the current Rx port that is being displayed on the Real Time Mode **PORT:48G Protocol Analyzer HDMI RX - Card 6 - RX**. Currently the only analyzer port is the M41h 48G Video Analyzer/Generator port.

Second Row Items – TMDS and FRL Modes:

- Update Cnt** – Increments every time the screen contents are updated **Update Cnt: 160**.
- Type** – HDMI for TMDS mode; FRL for Fixed Rate Link (FRL) mode **Update Cnt: 362 Type: FRL 5**.
- Char Rate:** – The HDMI character rate **Char Rate: 594.00**.
- TMDS Clock Ratio:** – The ratio of the TMDS clock rate to the TMDS bit rate **TMDS Clock Ratio: 1/40**.
- Scrambling:** – Whether or not scrambling is enables or not **Scrambling: enabled**.
- HDCP** – Indicates whether HDCP is enabled or disabled **HDCP: disabled**.
- PassThru** – Indicates if pass through is active. Pass Thru is not currently supported on this.
- Scan:** Progressive or Interlaced **SCAN: Progressive**.

Third Row Items – FRL Mode:

- Active:** – The Active video horizontal and vertical pixels and lines of the format resolution **Active: 4800 x 4320**.
- Total:** – The Total video horizontal and vertical pixels and lines of the format resolution **Total: 5625 x 4400**.
- H-Sync:** – Indicates the horizontal Front Porch sync pulse width **H-Sync: F:345 W:110 P:+**.
- V-Sync:** – Indicates the vertical Front Porch and vertical sync pulse width and the pulse polarity **V-Sync: F:16 W:20 P:+**.

Fourth Row Items – FRL and TMDS modes:

- Video Identification (format)** – The first item indicates the video identification code (if there is one) **CEA VIC=97: 3840x2160p @ 60 Hz 16:9**. 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.”
- Resolution** - The next item is the. In the first example the active horizontal and vertical resolution is 3840 x

Real Time Mode – Dashboard Items

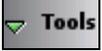
2160 **3840 x 2160**. The second example shows an 8K format at 7680 x 4320.

- **Scan.** The next item is the scan. In this example the field indicates Progressive **Progressive**. The other option is Interlaced.
- **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 **(24 bpp), RGB**. The other options are: RGB, YCbCr 4:2:2 and deep color at either 30 or 36 bit color depth.
- **HDCP Status.** The next item is HDCP status which could either be Encrypted or Not Encrypted **Not Encrypted**.

4.2.3 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 pulldown menu associated with them. The purpose of each button and their basic control functions are described below:</p> <ul style="list-style-type: none"> ▪ Start/Stop –The Start / Stop button  /  is used to enable and disable the active collection of real time data. ▪ Video – The video button  and associated pulldown menu (not shown) is used to display the Video Info panel which provides timing, resolution and other basic information about the incoming video. ▪ Scale – The Scale button  and associated pulldown menu (not shown) enables you to control how the video image is displayed in the Real Time mode window. ▪ AVI-IF - The AVI-IF button  and associated pulldown 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. ▪ VS-IF - The VS-IF button  and associated pulldown 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. ▪ GCP - The GCP button  and associated pulldown 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.

Real Time Mode – Main Control Panel	Control Button Descriptions
	<ul style="list-style-type: none"> ▪ ACA - The ACA button  launches the Auxiliary Channel Analyzer (ACA) application for monitoring the DDC transactions. ▪ Back - The arrow button  enables you to toggle between the current view and the previous view. ▪ Tools - The Tools button  provides access to various tools such as Set EDID management, HP, 5 Volts, SCDC and HDCP management.

4.3 Real Time Mode Data Panels

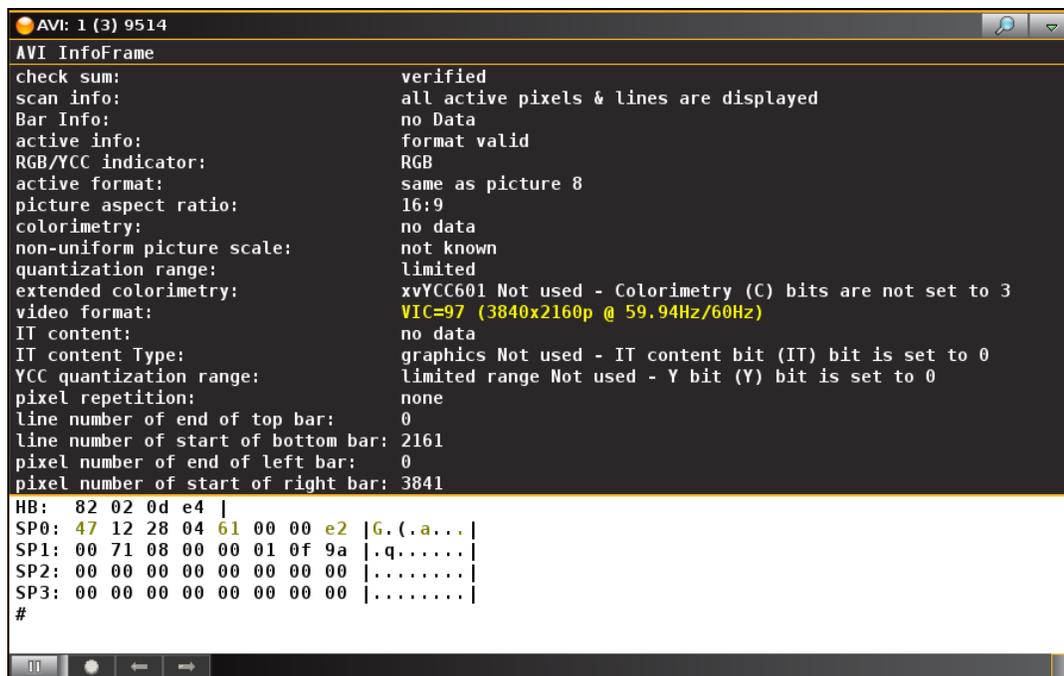
This section describes the **Real Time** controls and data panels. The **Real Time** mode is only available through the embedded GUI. It is not available through the external ATP Manager.

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

4.3.1 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 up 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 up 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. Differences are highlighted in **gold** text.



```

AVI: 1 (3) 9514
AVI InfoFrame
check sum:                verified
scan info:                all active pixels & lines are displayed
Bar Info:                 no Data
active info:              format valid
RGB/YCC indicator:       RGB
active format:            same as picture 8
picture aspect ratio:    16:9
colorimetry:              no data
non-uniform picture scale: not known
quantization range:      limited
extended colorimetry:    xvYCC601 Not used - Colorimetry (C) bits are not set to 3
video format:             VIC=97 (3840x2160p @ 59.94Hz/60Hz)
IT content:               no data
IT content Type:          graphics Not used - IT content bit (IT) bit is set to 0
YCC quantization range:  limited range Not used - Y bit (Y) bit is set to 0
pixel repetition:        none
line number of end of top bar: 0
line number of start of bottom bar: 2161
pixel number of end of left bar: 0
pixel number of start of right bar: 3841
HB: 82 02 0d e4 |
SP0: 47 12 28 04 61 00 00 e2 |G.(.a...|
SP1: 00 71 08 00 00 01 0f 9a |.q.....|
SP2: 00 00 00 00 00 00 00 00 |.....|
SP3: 00 00 00 00 00 00 00 00 |.....|
#

```

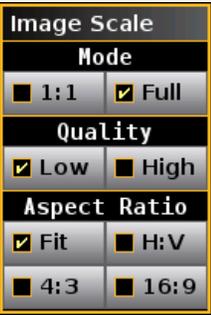
4.3.2 Zoom Feature

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 to any of three settings: 1) Small, 2) Medium, and 3) Large. The zoom dialog box is accessible from the upper right corner of each panel. Simply touch select the desired checkbox. The following image depicts a typical zoom dialog box.



4.3.3 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 the **Video** pop-out dialog box on the right side control panel. When you select the **Scale** button of this pop-out menu, 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
<p>Image Scale dialog box</p>  <p>The screenshot shows the 'Image Scale' dialog box with the following settings: Mode is set to 'Full' (checked), Quality is set to 'Low' (checked), and Aspect Ratio is set to 'Fit' (checked). Other options include '1:1' for Mode, 'High' for Quality, and 'H:V', '4:3', and '16:9' for Aspect Ratio.</p>	<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> <ul style="list-style-type: none"> ▪ Mode – The Mode can be either 1:1 or Full. Use the checkbox 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. ▪ 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. ▪ 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.

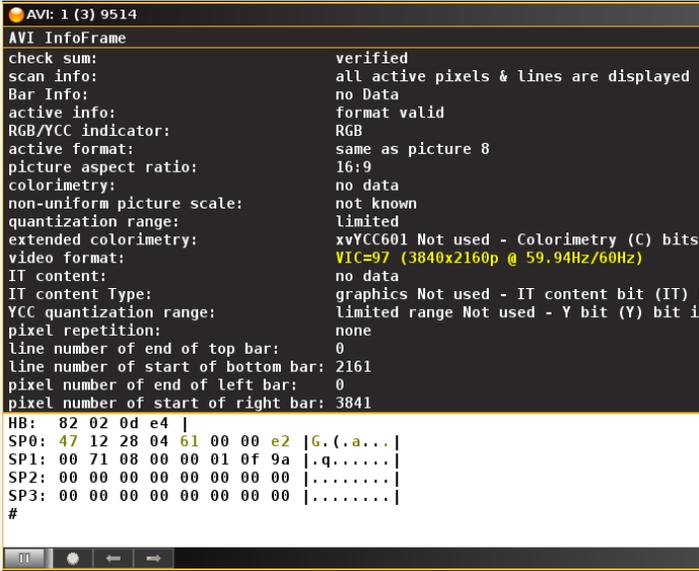
4.3.4 Video Info Panel

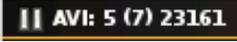
The **Video Color** panel (shown below) enables you to view the pixel values of the incoming video content. The table below describes the information in this panel.

Real Time Mode – Video Color	Information
<p>Video Color panel</p> 	<p>The following information is provided in the Video Timing dialog box:</p> <ul style="list-style-type: none"> 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>There are a series of arrows on the bottom of the Video Info dialog box. These arrows are described below:</p> <ul style="list-style-type: none"> Up Arrow – The up arrow  enables you to move up to an adjacent pixel to view its color components. Down Arrow – The down arrow  enables you to move down to an adjacent pixel to view its color components. Left Arrow – The left arrow  enables you to move left to an adjacent pixel to view its color components. Right Arrow – The right arrow  enables you to move right to an adjacent pixel to view its color components.

4.3.5 AVI Inframe Panel

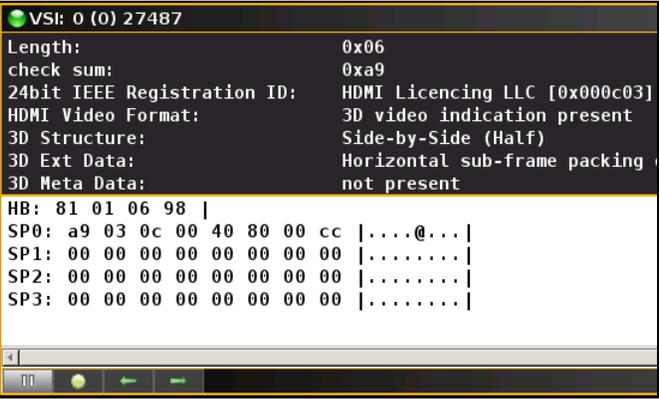
The **AVI-IF** button to open up the **AVI** panel (shown below). The AVI panel enables you to view the AVI inframe data. There is a control pull down menu associated with the AVI Info panel. The control menu can be accessed either from the panel itself (the pull down tab on the upper right corner) or 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.

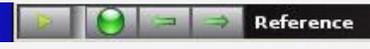
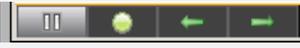
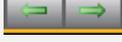
Real Time – AVI Inframe	Information / Function
<p>AVI Inframe</p>  <pre> AVI: 1 (3) 9514 AVI InfoFrame check sum: verified scan info: all active pixels & lines are displayed Bar Info: no Data active info: format valid RGB/YCC indicator: RGB active format: same as picture 8 picture aspect ratio: 16:9 colorimetry: no data non-uniform picture scale: not known quantization range: limited extended colorimetry: xvYCC601 Not used - Colorimetry (C) bits video format: VIC=97 (3840x2160p @ 59.94Hz/60Hz) IT content: no data IT content Type: graphics Not used - IT content bit (IT) YCC quantization range: limited range Not used - Y bit (Y) bit i pixel repetition: none line number of end of top bar: 0 line number of start of bottom bar: 2161 pixel number of end of left bar: 0 pixel number of start of right bar: 3841 HB: 82 02 0d e4 SP0: 47 12 28 04 61 00 00 e2 G.(.a... SP1: 00 71 08 00 00 01 0f 9a .q..... SP2: 00 00 00 00 00 00 00 00 SP3: 00 00 00 00 00 00 00 00 # </pre>	<p>The following information is provided in the AVI Inframe dialog box:</p> <ul style="list-style-type: none"> ▪ Checksum – Calculation of a checksum to ensure integrity of the data. ▪ Scan Info – Indicates whether there is any underscan or overscanning applied to the video. ▪ Active info – Indicates whether the Active Format Descriptor is information is valid. ▪ 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) ▪ Active format – Active format aspect ratio. ▪ Picture aspect ratio – The aspect ratio of the video format transmitted. ▪ Colorimetry – The colorimetry standard used; typically ITU-601 or ITU-709. ▪ Non-uniform scaling – Indicates if the picture has been scaled vertically and/or horizontally. ▪ Quantization range – Indicates the range of values for defining the data is limited or full. ▪ IT content – Indicates when the picture content is composed in accordance with common IT practices. ▪ Video format – The CEA video identification code (VIC) and the resolution and frame rate. ▪ Pixel repetition – Indicates to the DTV how many of each unique pixels are transmitted. ▪ Line number of end of top bar. ▪ Line number of start of bottom bar. ▪ Pixel number of end of left bar. ▪ Pixel number of start of right bar.
<p>AVI Pull-down Menu</p>	<p>There is a pull-down menu associated with the</p>

Real Time – AVI Inframe	Information / Function
	<p>AVI Info panel. You can access either from the main control panel or from the AVI panel via the icon on the upper right of the panel. The AVI pull-down menu provides the following functions:</p> <ul style="list-style-type: none"> Show/Hide – Enable or disable the appearance of the AVI inframe panel in the Real Time window. Pause/Start – Halt the updates of the data to the AVI panel or Start collection. Clear – Clear the currently displayed reference frame. Set Ref – Set a new reference frame.
<p>Upper Status Bar</p> <p>Pause mode</p>  <p>Resume (active) mode</p> 	<p>The upper status bar shows the following information from left to right:</p> <ul style="list-style-type: none">  The pause/resume (active) status.  The type of data panel (e.g. AVI).  The number of changes defined since you set the reference frame.  The number of distinct data views in parentheses.  The total number of frames captured since the panel was opened or since the last clear.
<p>Lower Control Panel</p> <p>Pause mode</p>  <p>Pause mode after going to the reference frame</p>  <p>Resume (active) mode</p> 	<p>The lower control panel enables you to control and view the following:</p> <ul style="list-style-type: none">  Set the pause/resume (active) status.  Go to the Reference Frame (must be in paused mode).  Navigate left or right through the distinct data views (must be in pause mode).  The data view currently displayed. This field shows “Reference” if you are at the reference frame.  The number of distinct data views.

4.3.6 VS-IF Infoframe Panel

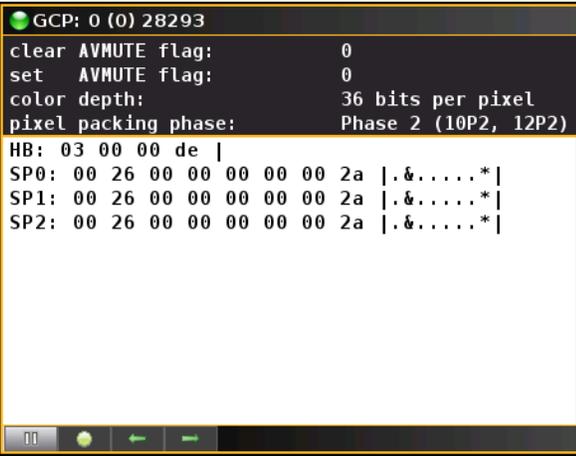
The **VS-IF** button opens up the **VS-IF** panel (shown below). The **VS-IF** panel enables you to view the Vendor Specific infoframe data. There is a control pull down menu associated with the **VS-IF** panel. The control menu can be accessed either from the panel itself (the pull down tab on the upper 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.

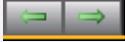
Real Time – VS-IF	Information / Function
<p>Vendor Specific Infoframe</p>  <pre> VSI: 0 (0) 27487 Length: 0x06 check sum: 0xa9 24bit IEEE Registration ID: HDMI Licencing LLC [0x000c03] HDMI Video Format: 3D video indication present 3D Structure: Side-by-Side (Half) 3D Ext Data: Horizontal sub-frame packing 3D Meta Data: not present HB: 81 01 06 98 SP0: a9 03 0c 00 40 80 00 cc @... 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 </pre>	<p>The following information is provided in the Vendor Specific Infoframe dialog box:</p> <ul style="list-style-type: none"> Length – The length in hex of the Vendor Specific infoframe. Checksum – A checksum to verify the integrity of the infoframe. Registration ID – IEEE Registration ID HDMI Video Format – Provides additional information such as 4K by 2K or 3D format structure. 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) 3D Extra Data – Applies when the 3D structure is Side-by-Side (half). Indicates the horizontal sub-sampling and Quincunx matrix. 3D Meta Data – Indicates whether 3D metadata is present or not.
<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 via the icon on the upper right of the panel. The AV-IF pull-down menu provides the following functions:</p> <ul style="list-style-type: none"> Show/Hide – Enable or disable the appearance of the VS-IF infoframe panel in the Real Time window. Pause – Halt the updates of the data to the VS IF panel. Clear – Clear the currently displayed reference frame. Set Ref – Set a new reference frame.
<p>Upper Status Bar</p>	<p>The upper status bar shows the following information</p>

Real Time – VS-IF	Information / Function
<p>Pause mode</p>  <p>Resume (active) mode</p> 	<p>from left to right:</p> <ul style="list-style-type: none"> ▪   The pause/resume (active) status. ▪  The type of data panel (e.g. VS-IF). ▪  The number of changes defined since you set the reference frame. ▪  The number of distinct data views in parentheses. ▪  The total number of frames captured since the panel was opened or since the last clear.
<p>Lower Control Panel</p> <p>Pause mode</p>  <p>Pause mode after going to the reference frame</p>  <p>Resume (active) mode</p> 	<p>The lower control panel enables you to control and view the following:</p> <ul style="list-style-type: none"> ▪   Set the pause/resume (active) status. ▪  Go to the Reference Frame (must be in paused mode). ▪  Navigate left or right through the distinct data views (must be in paused mode). ▪  The data view currently displayed. ▪  The number of distinct data views.

4.3.7 General Control Packet Data Panel

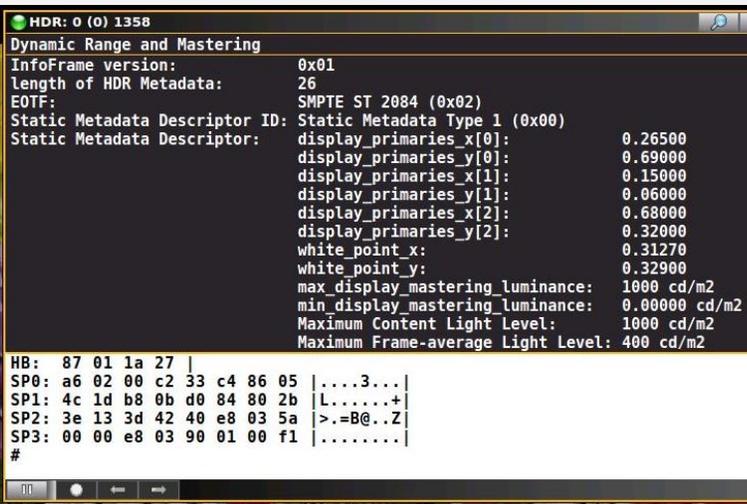
The **GCP** (General Control Packet) button opens up the **GCP** panel (shown below). The **GCP** panel enables you to view the General Control Packet data. There is a control pull down menu associated with the **GCP** panel. The control menu can be accessed either from the panel itself (the pull down 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.

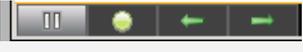
Real Time – General Control Packet	Information / Function
<p>General Control Packet</p>  <pre> GCP: 0 (0) 28293 clear AVMUTE flag: 0 set AVMUTE flag: 0 color depth: 36 bits per pixel pixel packing phase: Phase 2 (10P2, 12P2) HB: 03 00 00 de SP0: 00 26 00 00 00 00 00 2a .&.....* SP1: 00 26 00 00 00 00 00 2a .&.....* SP2: 00 26 00 00 00 00 00 2a .&.....* </pre>	<p>The following information is provided in the General Control Packet data island dialog box:</p> <ul style="list-style-type: none"> AVmute flag (clear/set) – Identifies whether the AVmute is set or cleared. Color depth – Indicates the color depth in bits per pixel 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>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 via the icon on the upper right of the panel. The GCP pull-down menu provides the following functions:</p> <ul style="list-style-type: none"> Show/Hide – Enable or disable the appearance of the GCP panel in the Real Time window. Pause – Halt the updates of the data to the GCP panel. Clear – Clear the currently displayed reference frame. Set Ref – Set a new reference frame.
<p>Upper Status Bar</p> <p>Resume (active) mode</p>  <p>Pause mode</p> 	<p>The upper status bar shows the following information from left to right:</p> <ul style="list-style-type: none">   The pause/resume (active) status. Deep Color GCP: The type of data panel (e.g. GCP). 1 The number of changes defined since you set the reference frame. (1) The number of distinct data views in parentheses. 183288 The total number of frames captured since the panel was opened or since the last clear.

Real Time – General Control Packet	Information / Function
<p>Lower Control Panel</p> <p>Pause mode</p>  <p>Pause mode after going to the reference frame</p>  <p>Resume (active) mode</p> 	<p>The lower control panel enables you to control and view the following:</p> <ul style="list-style-type: none">   Set the pause/resume (active) status.  Go to the Reference Frame (must be in paused mode).  Navigate left or right through the distinct data views (must be in paused mode).  The data view currently displayed.  The number of distinct data views.

4.3.8 HDR InfoFrame Panel

The **HDR IF** (InfoFrame) button opens up 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
<p>HDR InfoFrame Packet</p> 	<p>The following information is provided in the HDR InfoFrame Packet dialog box:</p> <ul style="list-style-type: none"> InfoFrame Version – Identifies the version of the HDR InfoFrame. Length of HDR Metadata – Indicates the number of bytes of data in the HDR InfoFrame. EOTF – Electro Optical Transfer Function industry standard used. Static Metadata Descriptor ID – The Static Metadata Type used. Static Metadata Descriptor – The Static Metadata parameters used for the display primaries, white point, display luminance, light level and frame average light level.
<p>HDR IF Pull-down Menu</p>	<p>There is a pull-down menu associated with the HDR IF Info panel. You can access either from the main control panel or from the panel via the icon on the upper right of the panel. The pull-down menu provides the following functions:</p> <ul style="list-style-type: none"> Show/Hide – Enable or disable the

Real Time – HDR InfoFrame Packet	Information / Function
	<p>appearance of the GCP panel in the Real Time window.</p> <ul style="list-style-type: none"> ▪ Pause – Halt the updates of the data to the GCP panel. ▪ Clear – Clear the currently displayed reference frame. ▪ Set Ref – Set a new reference frame.
<p>Upper Status Bar</p> <p>Resume (active) mode</p>  <p>Pause mode</p> 	<p>The upper status bar shows the following information from left to right:</p> <ul style="list-style-type: none"> ▪   The pause/resume (active) status. ▪  The type of data panel (e.g. GCP). ▪  The number of changes defined since you set the reference frame. ▪  The number of distinct data views in parentheses. ▪  The total number of frames captured since the panel was opened or since the last clear.
<p>Lower Control Panel</p> <p>Pause mode</p>  <p>Pause mode after going to the reference frame</p>  <p>Resume (active) mode</p> 	<p>The lower control panel enables you to control and view the following:</p> <ul style="list-style-type: none"> ▪   Set the pause/resume (active) status. ▪  Go to the Reference Frame (must be in paused mode). ▪   Navigate left or right through the distinct data views (must be in paused mode). ▪  The data view currently displayed. ▪  The number of distinct data views.

4.4 Enabling HDCP Authentication and Encryption

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

3.14 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 device under test responds to a sink that does not support HDCP. Use the following procedures to set the HDCP mode and registers.

1. Select the Rx HDCP Settings... item 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.



- 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.

5 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.

5.1 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.

5.2 Operational workflow for capturing data with your M41h 48G Video Analyzer/Generator

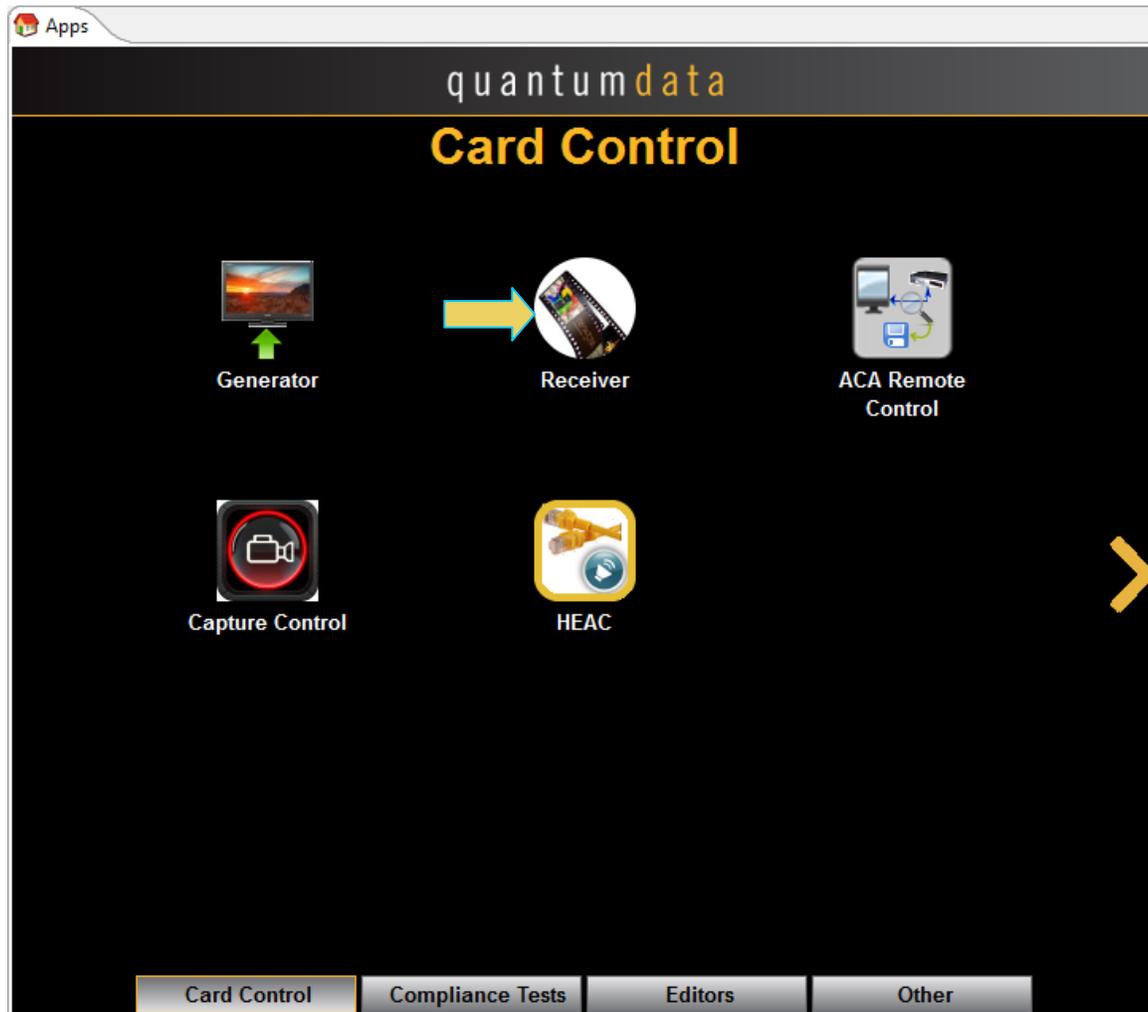
This subsection describes how to use the M41h 48G Video Analyzer/Generator to capture and analyze HDMI source devices. Testing an HDMI 2.1 source device involves the following high level steps:

1. Configure the M41h 48G Video Analyzer/Generator in the proper mode HDMI.
3. Set the +5V threshold level.
4. Configure the M41h 48G Video Analyzer/Generator's Rx port with the proper EDID.
6. Specify a trigger method (There is only one default trigger condition currently support which is the first instance of a Scrambler Reset character sequence in a Super Block).
7. 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.
8. Initiate the capturing of the data.
9. Examine the test data through the ATP Manager at the high level view on the **Event Plot** panel or the **Video Analysis** panel.
10. Drill down to examine the data at the lower level through the details of the **Data Decode** panel view.
11. Examine the data through the capture viewer.

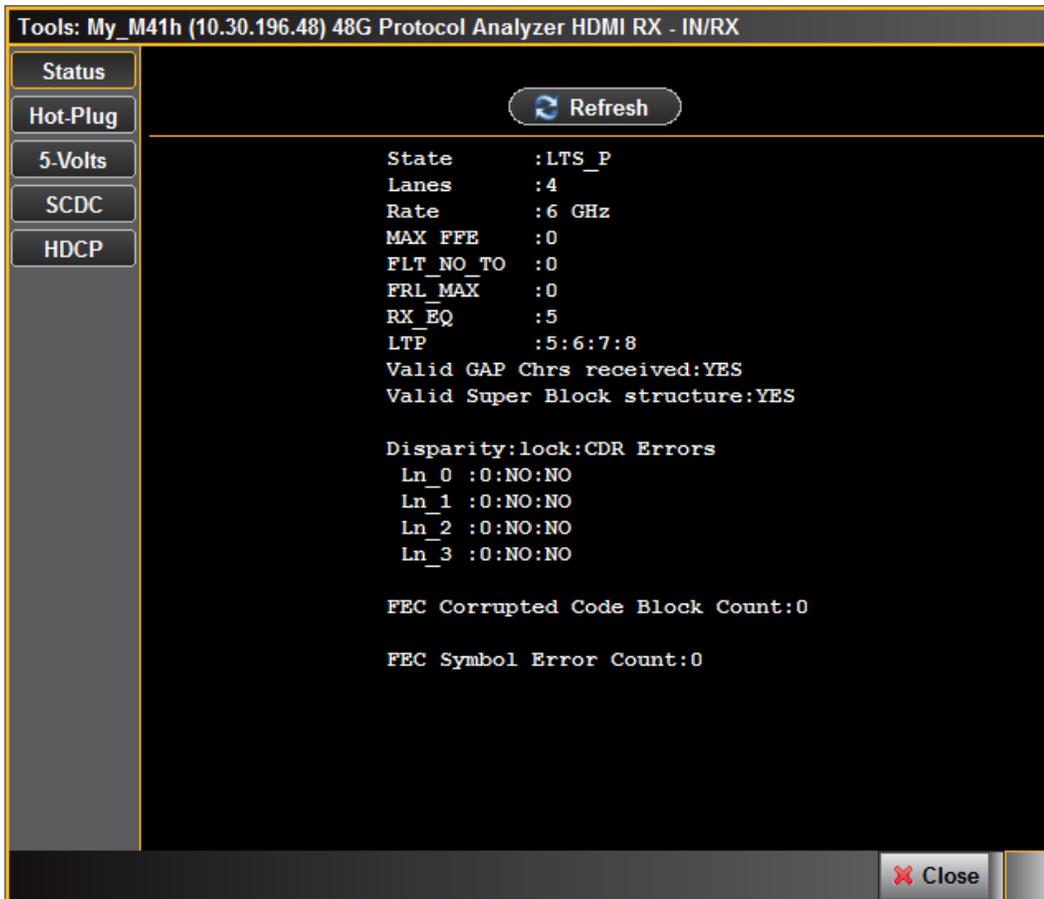
5.3 Configuring the M41h 48G Video Analyzer/Generator Rx Interface

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 during. Through this dialog box you can also view the SCDC registers and the status of the FRL lanes.

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.

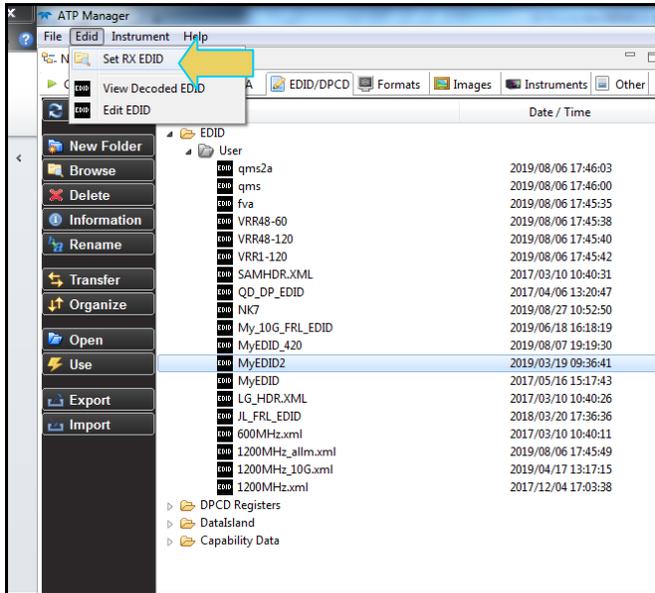


To provision the EDID:

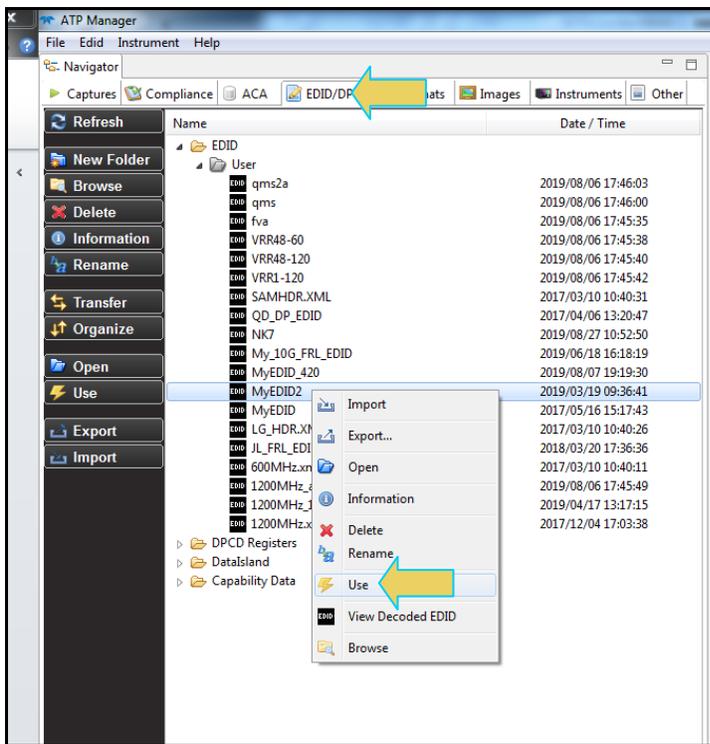
There are two ways to provision the M41h 48G Video Analyzer/Generator's Rx port with an EDID of your choosing. Not that the EDID has to support FRL. The default EDID does support FRL.

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.

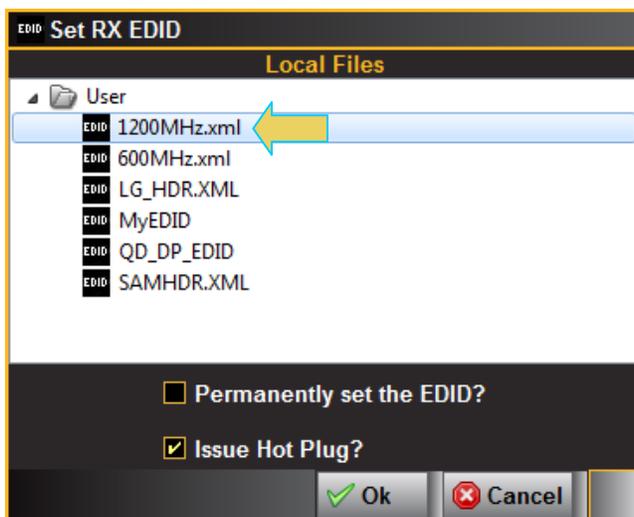
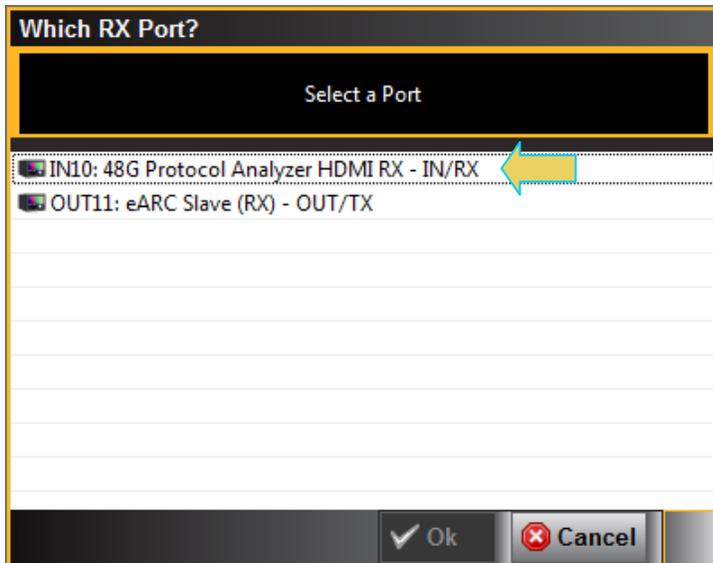
The default EDID in the M41h 48G Video Analyzer/Generator has a preferred timing of 4Kp60 and supports FRL. You can provision the M41h 48G Video Analyzer/Generator with a different EDID. Sample EDIDs are available from the Quantum Data website on the downloads page (<http://www.quantumdata.com/support/M41hreadme.asp#edid>). 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 up as shown below. You will have to select which M41h 48G Video Analyzer/Generator if there are more than one installed in your M41h system. The example below shows the selection of the M41h 48G Video Analyzer/Generator.



Select the EDID that you wish to provision the Rx port with. The example above shows 1200MHz 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 checkbox 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.

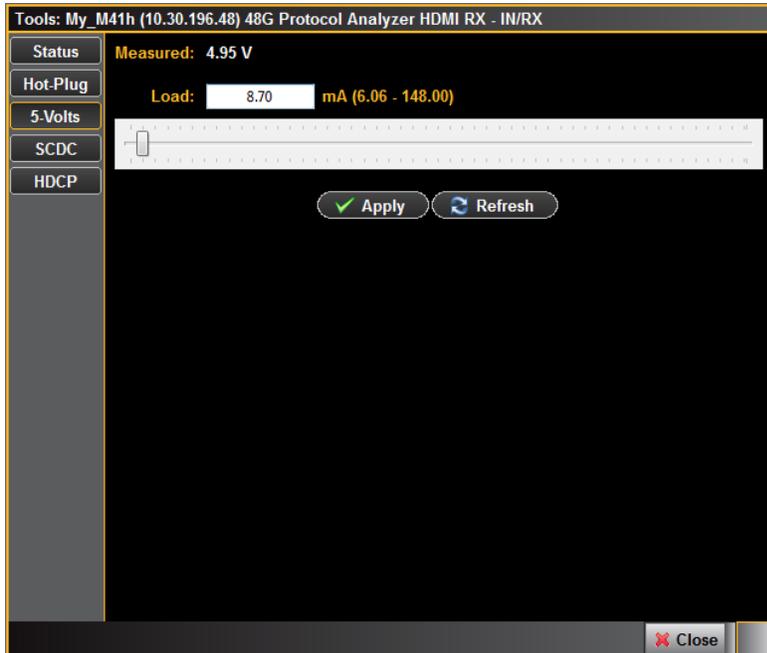
To Set the Hot Plug duration:

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 in 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 slide bar 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:

- (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.



5.4 Capturing HDMI FRL Incoming Streams

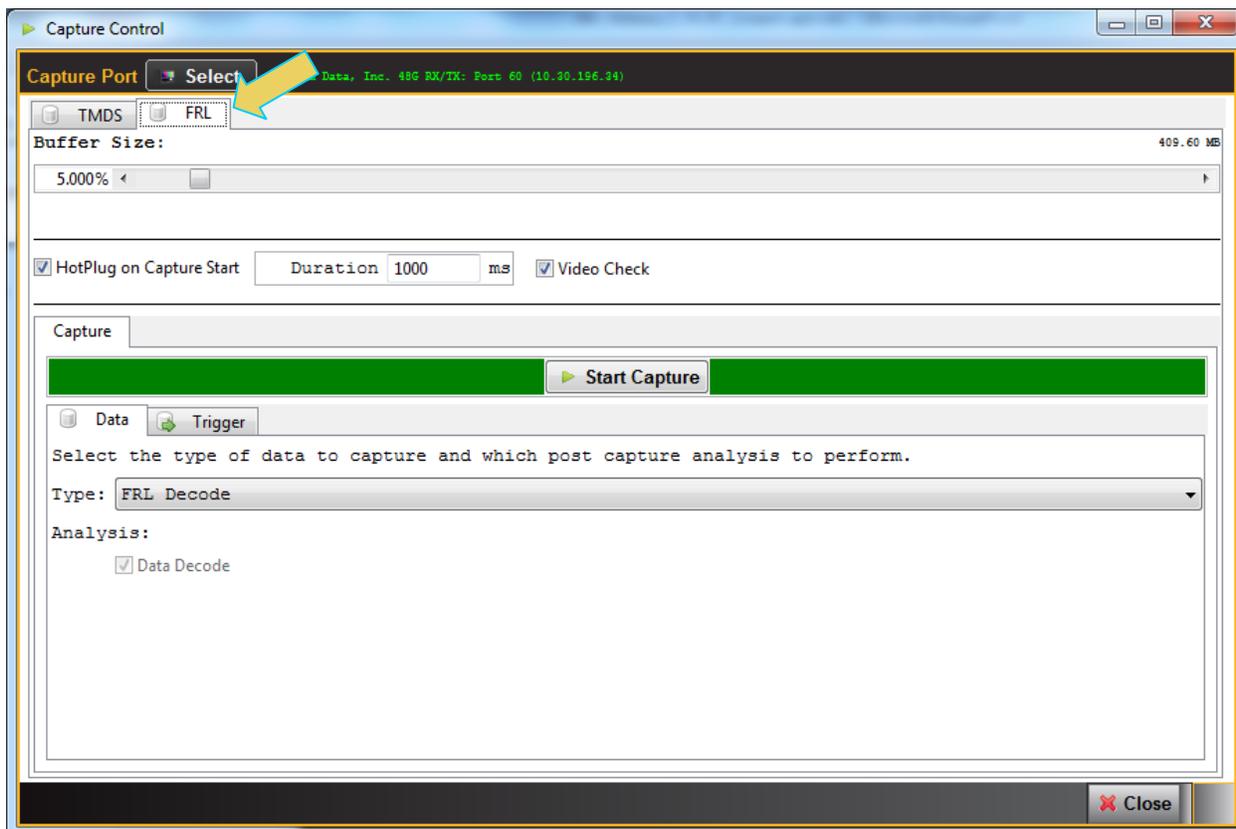
The M41h 48G Video Analyzer/Generator supports the capturing of both HDMI TMDS incoming streams and Fixed Rate Link (FRL) incoming streams. This subsection describes the procedures for capturing FRL streams. The following subsection provides procedures for capturing TMDS incoming streams.

To capture FRL streams:

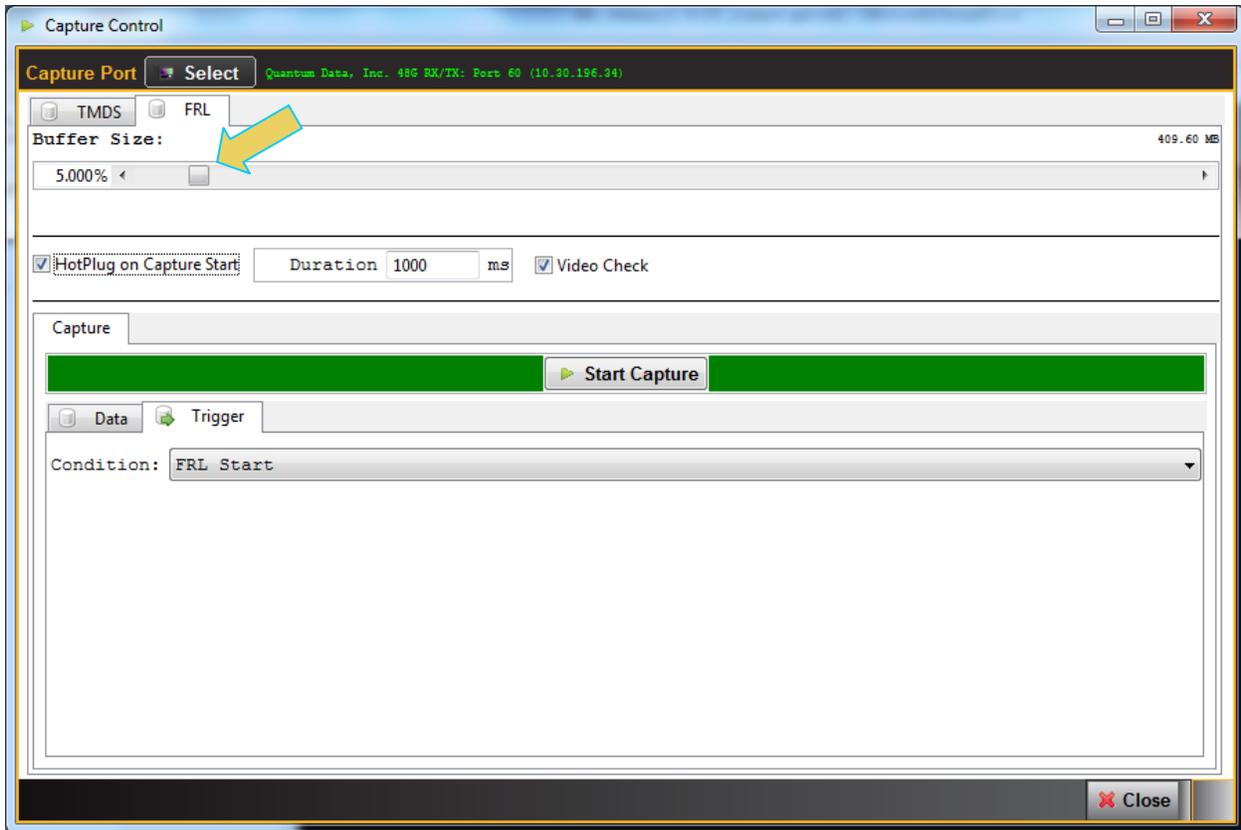
1. Select the **Capture Control** application from the **Control Page** of the Main screen.



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

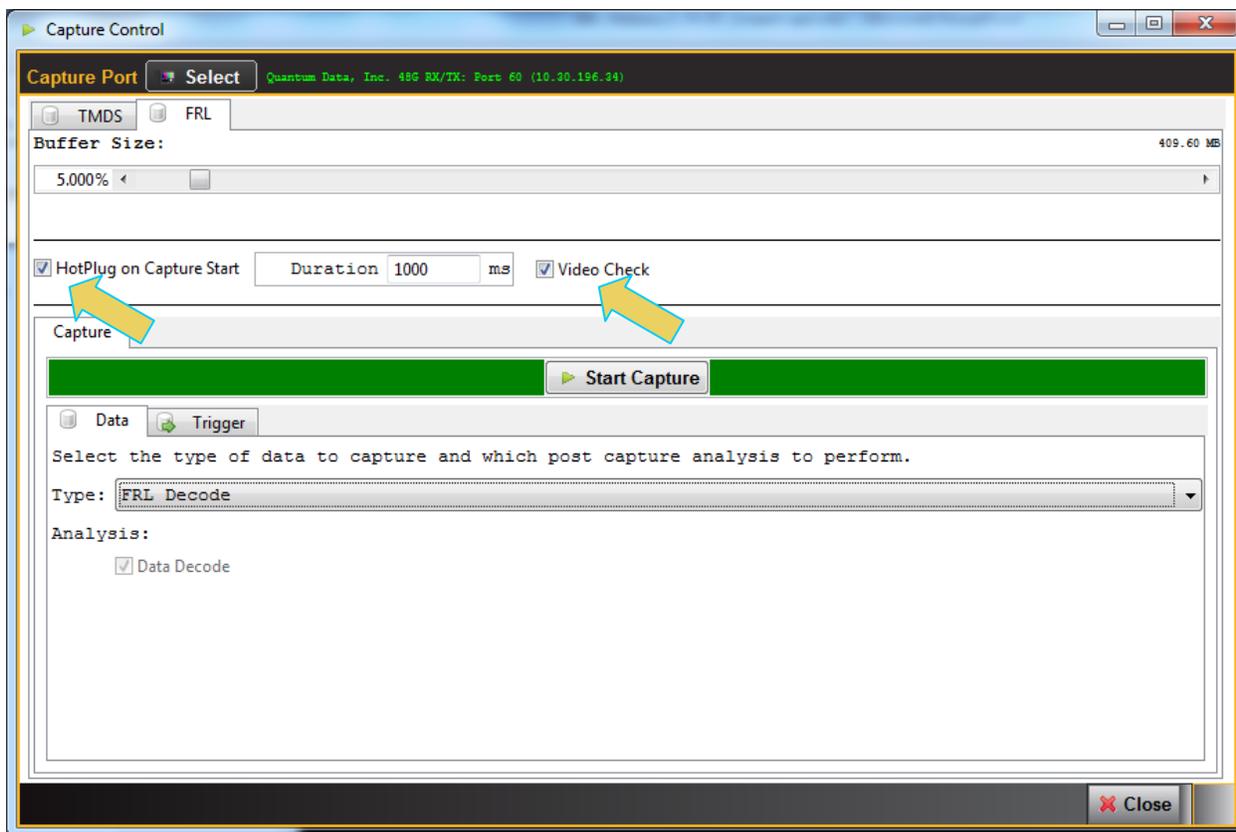


3. Set the **Capture Buffer Size** sidebar to a percent value to meet your requirements. You can capture up to about 8GB of data.



4. Check the **Generate Hot Plug on Capture Start** 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.

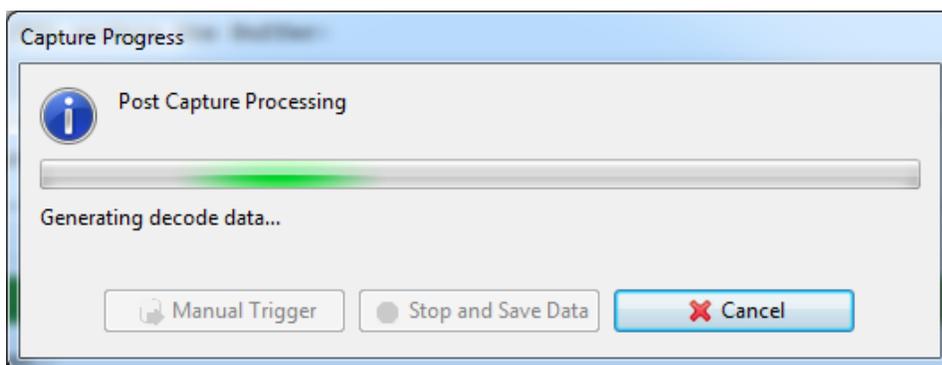
Note: If you are going to be taking some action on the device under test that will halt video, such as unseating and reseating the HDMI cable, you will need to check the **Video Check** box in the Capture Configuration section of the **Capture Control** dialog box.



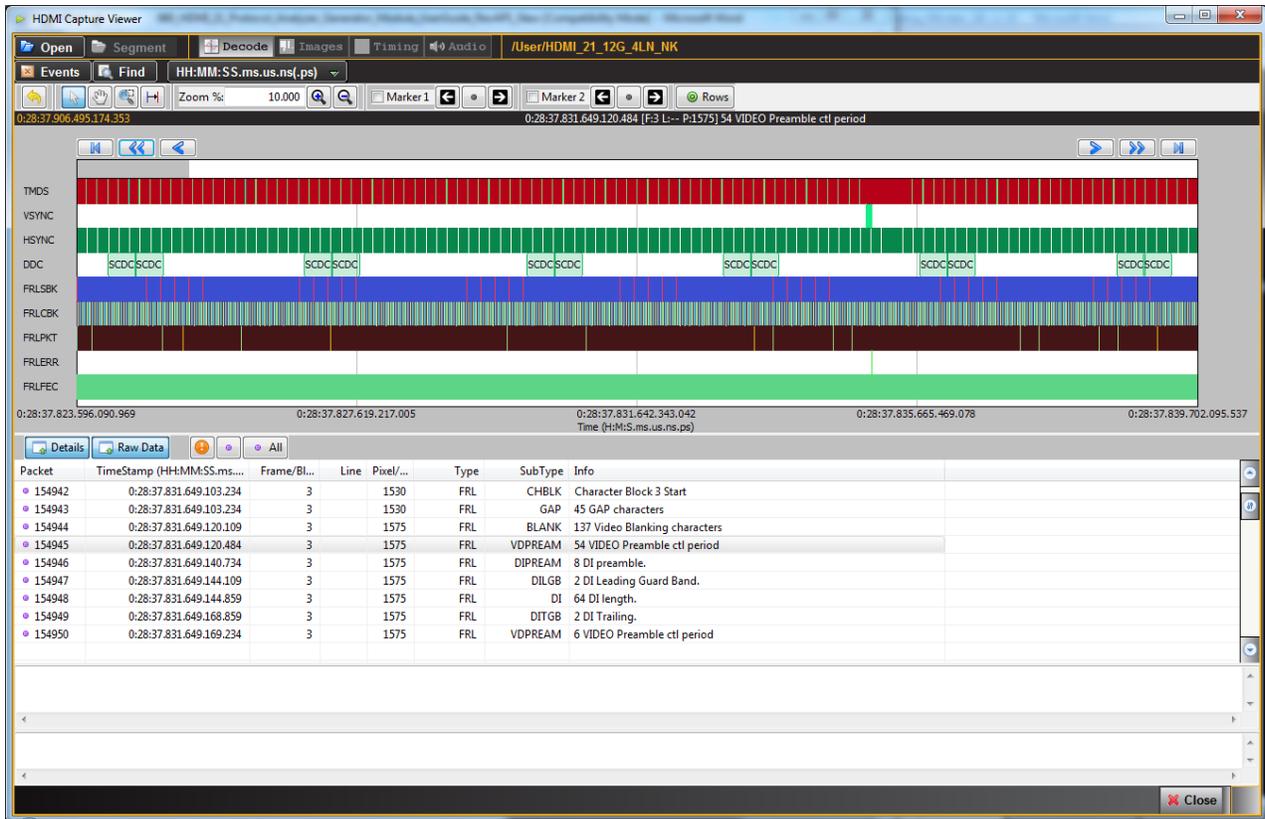
- 5. Click on the **Execute Capture** button.

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 in order to cause the trigger condition occur, the capture dialog box will stating **“Waiting for capture trigger to occur...”** This is shown in the following screen shot.



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



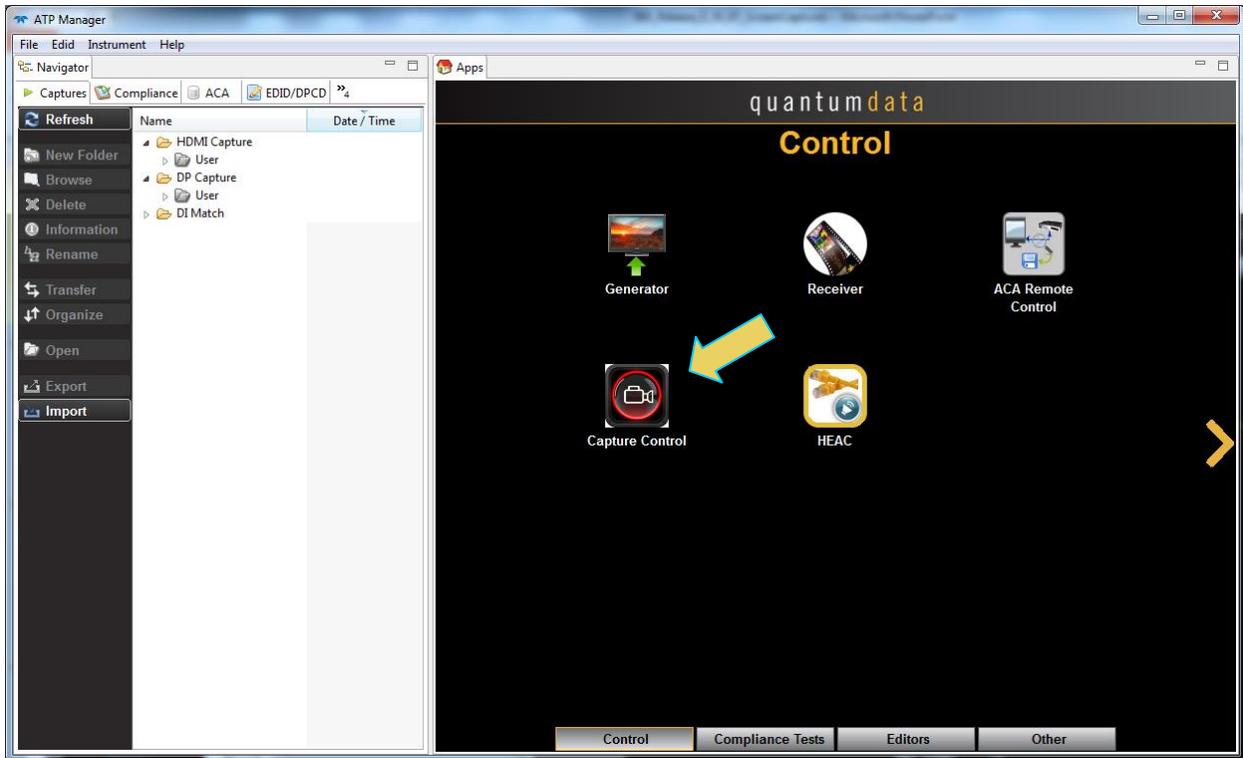
5.5 Capturing HDMI TMDS Incoming Streams

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.

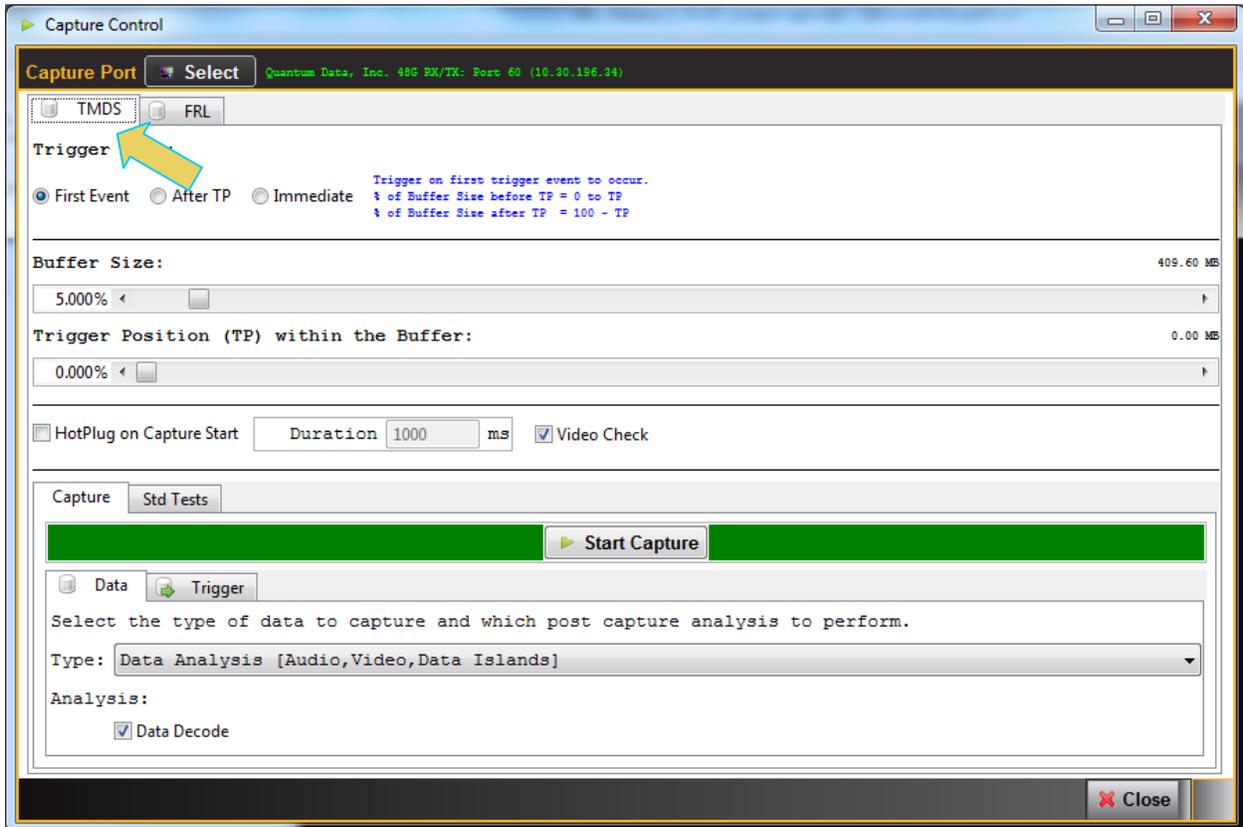
To capture TMDS streams:

Use the procedures below to initiate a new capture.

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



2. Select the TMDs tab at the top of the Capture Control window.



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

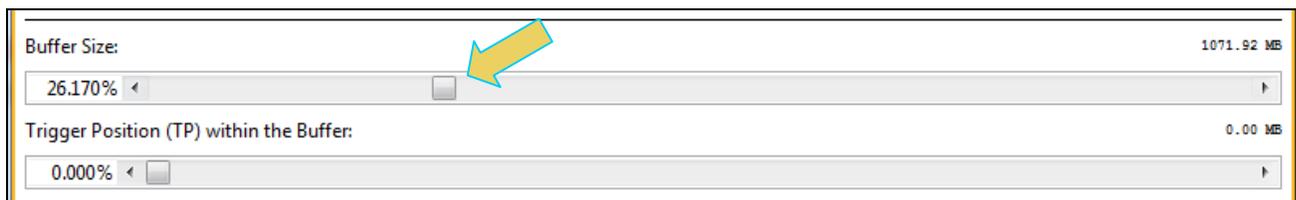


First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slide bar, you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

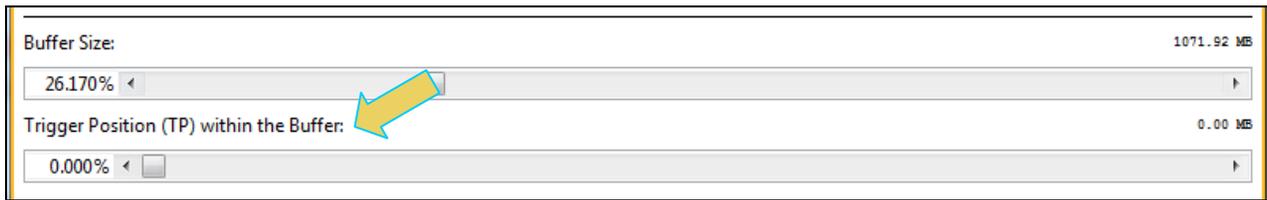
- Set the **Capture Buffer Size** sidebar to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 1150 frames at 576p/480p and about 204 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can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



- Set the **Trigger Position within the Buffer** sidebar to a percent value to meet your requirements. This slide bar enables you to set the position of the trigger event within the captured data. This is a sidebar 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.

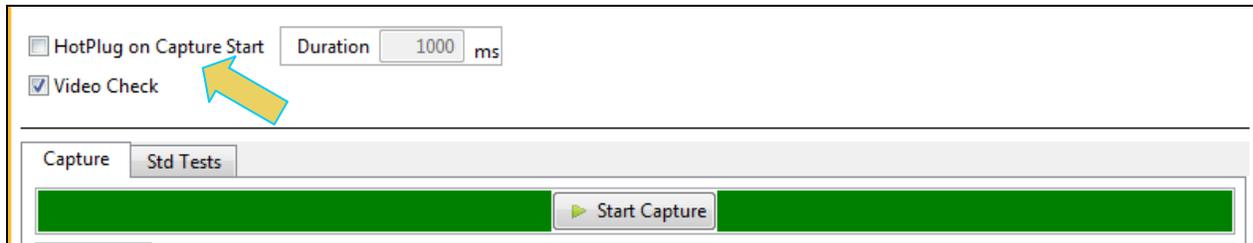
Note: When using a **Manual** trigger it is important to set the Trigger Position to ensure that there is some captured data prior to the manual trigger start point. The manual trigger is particularly useful when you are observing the behavior of a connected sink and then manually initiating the trigger 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 you initiate the trigger. Refer to the settings below which are typical.

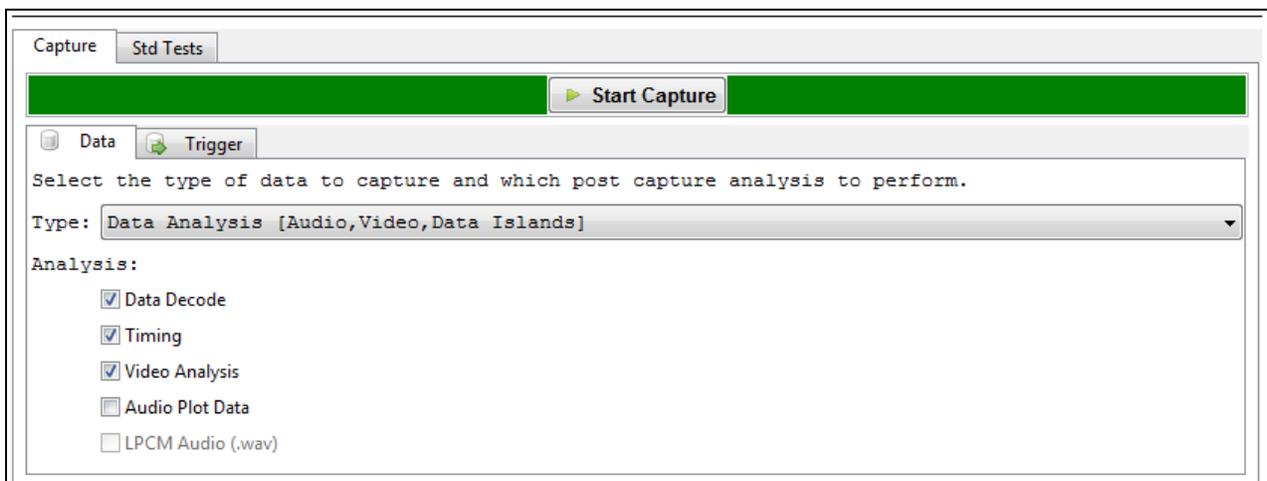


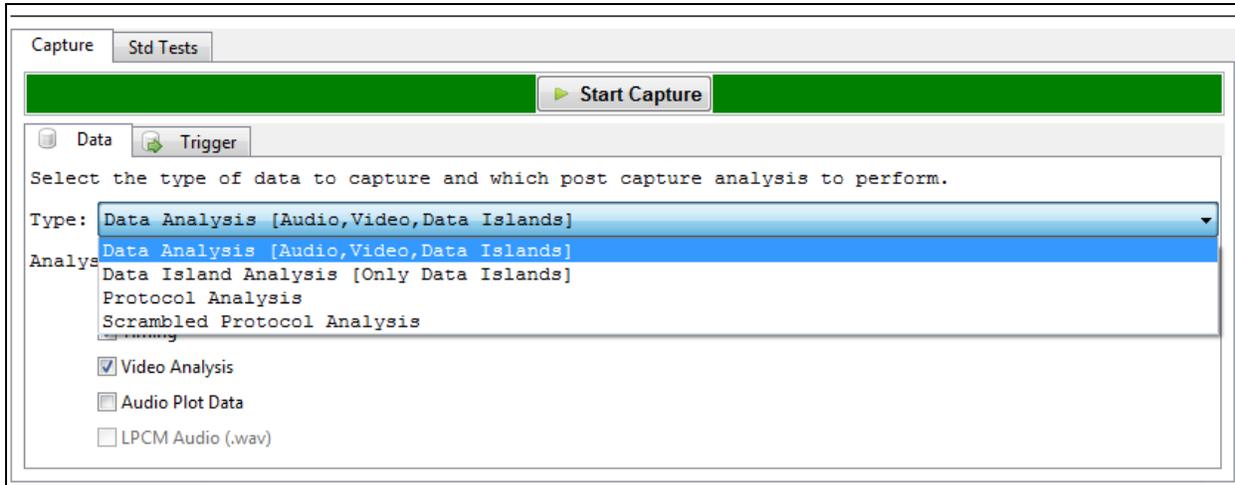
6. Check the **Generate Hot Plug on Capture Start** button if you want the M41h 48G Video Analyzer/Generator to issue a hot plug to initiate HDCP authentication. You also need to specify the duration of hot plug pulse in milliseconds.

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 check the **Video Check** box in the Capture Configuration section of the **Capture Control** dialog box.

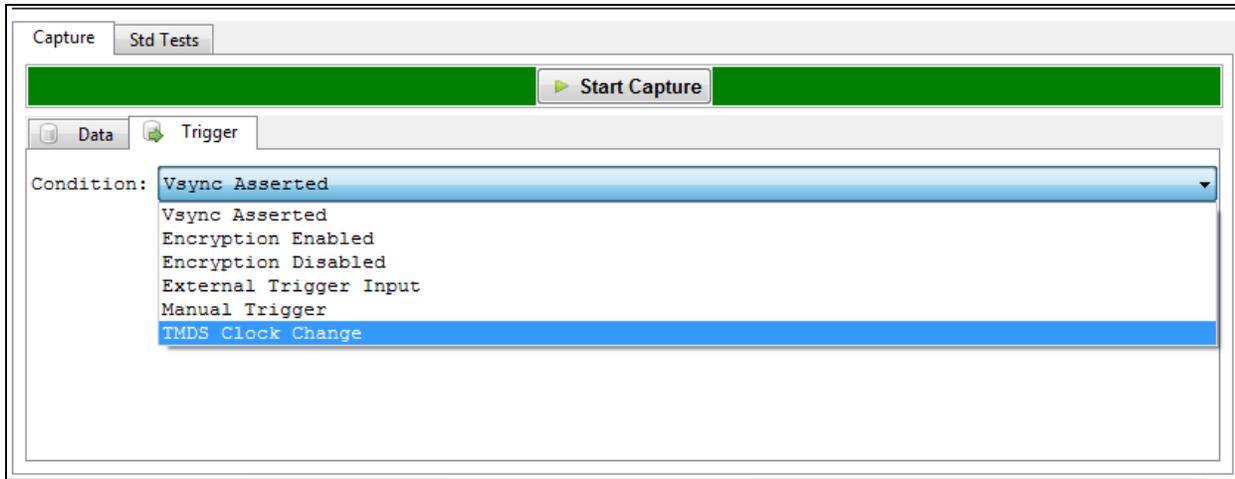


7. Select the **Capture** tab.
8. Select the **Data Selection Type** from the pull-down menu provided.

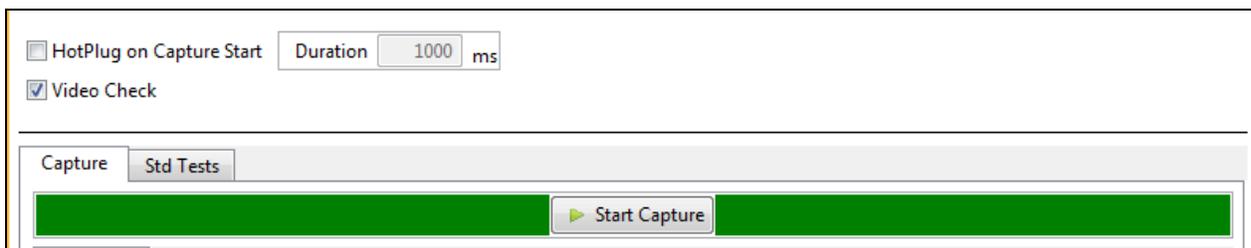




9. Select the Trigger selection **Condition**.

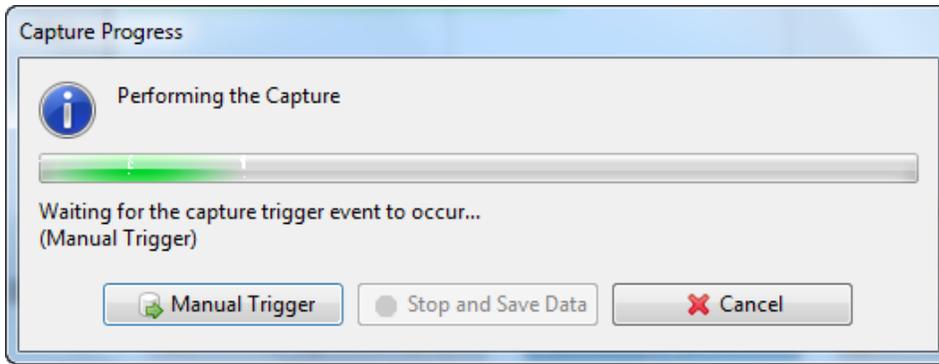


10. Click on the **Execute Capture** button.

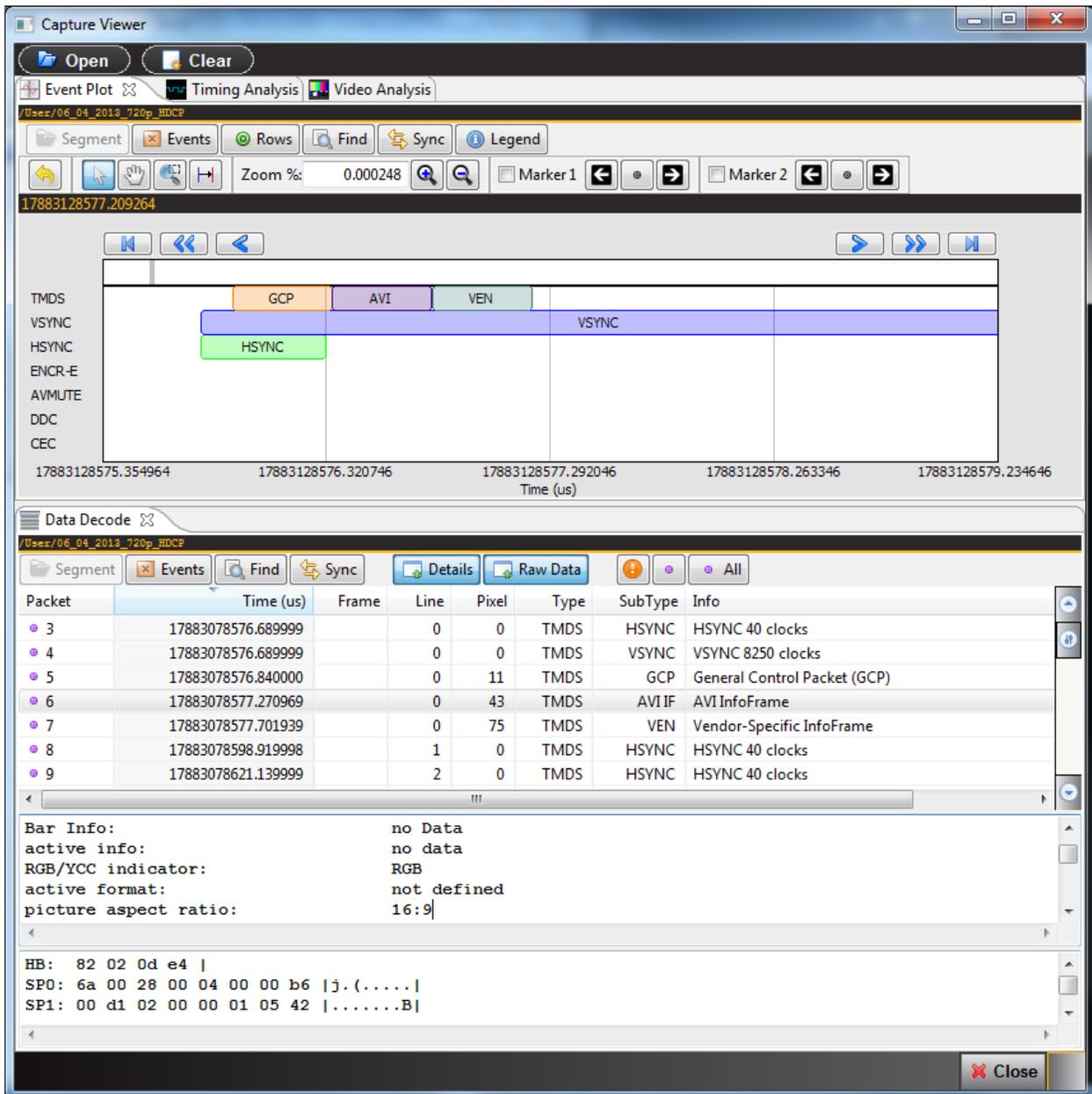


The M41h 48G Video Analyzer/Generator will capture the data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

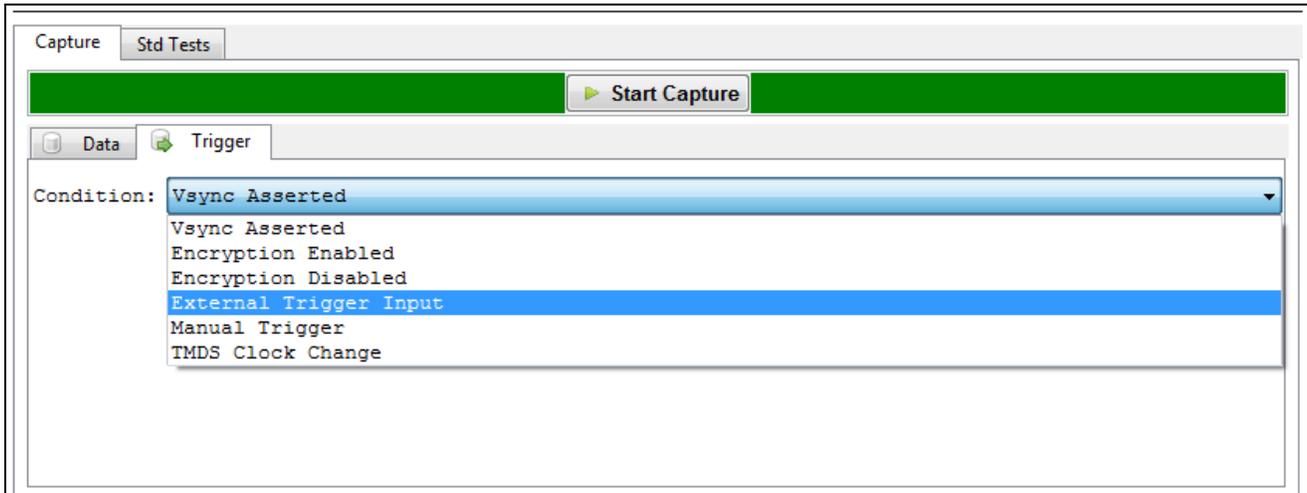
Note: If there is some action that needs to be taken by a user in order to cause the trigger condition occur, the capture dialog box will stating **“Waiting for capture trigger to occur...”** This is shown in the following screen shot.



When the M41h 48G Video Analyzer/Generator is done capturing data a decode file is shown in the **Event Plot** panel and the **Data 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:



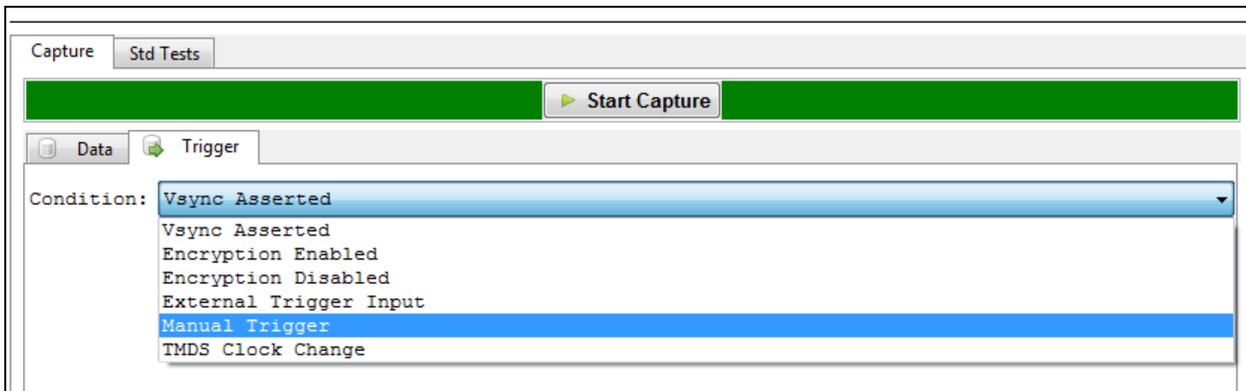
The minimum voltage required to activate the external trigger is 2.1 volts and will accept up to 5V. The pulse duration of the External Trigger must be greater than 1 TMDS pulse clock period. The Trigger Input is on the rear of the M41h. It is the top most BNC connector. There are a few M41h configurations;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



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

5.6 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.

5.6.1 Initiating a Capture with Manual Triggering

With the manual capture, you can monitor the downstream HDMI sink device for particular behavior or symptom to a problem and then initiate a capture when the particular 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:

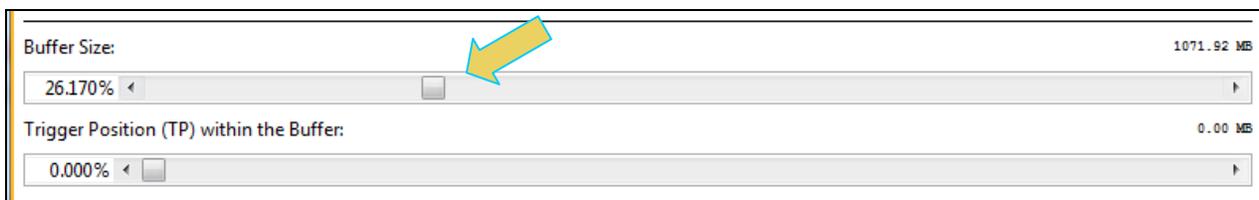


First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slide bar, you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

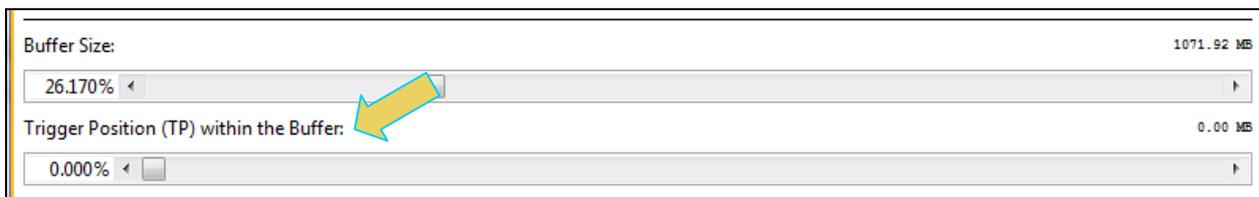
Immediate – Data capture begins accumulating immediately when the Start Capture button is activated. Data capture halts when buffer is filled. This setting will not provide any capture history, i.e. none of the captured data accumulated in the capture buffer will be data that occurred prior to the capture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

2. Set the **Capture Buffer Size** sidebar 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.



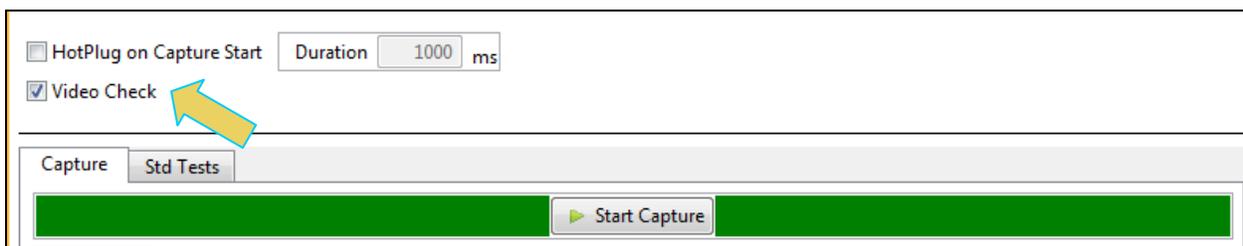
- Set the **Trigger Position within the Buffer** slider to a percent value to meet your requirements. This slider enables you to set the position of the trigger event within the captured data. This is a slider that provides an indication (on the left) of the location within the captured data, expressed 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 you initiate the trigger. Refer to the settings below which are typical.

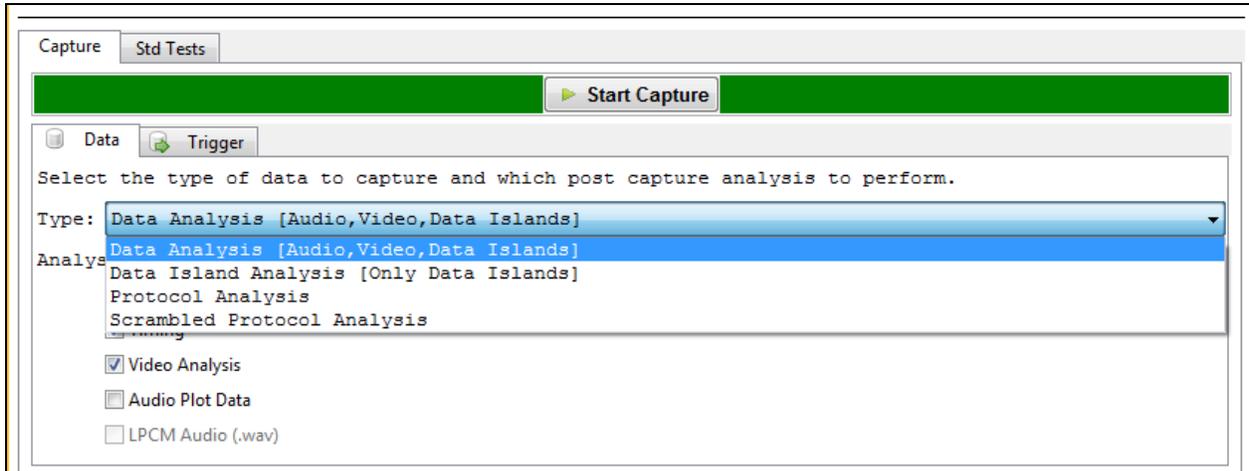


- Check the **Generate Hot Plug on Capture Start** button if you want the M41h HDMI 2.0 Protocol Analyzer to issue a hot plug to initiate HDCP authentication. You also need to specify the duration of hot plug pulse in milliseconds.

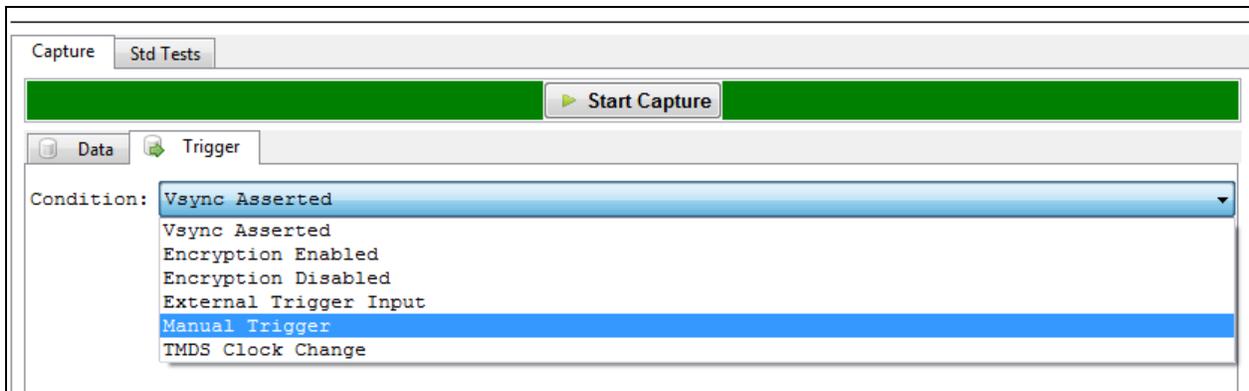
Note: If you are going to be taking some action on the device under test that will halt video, such as unseating and reseating the HDMI cable, you will need to check the **Video Check** box in the Capture Configuration section of the **Capture Control** dialog box.



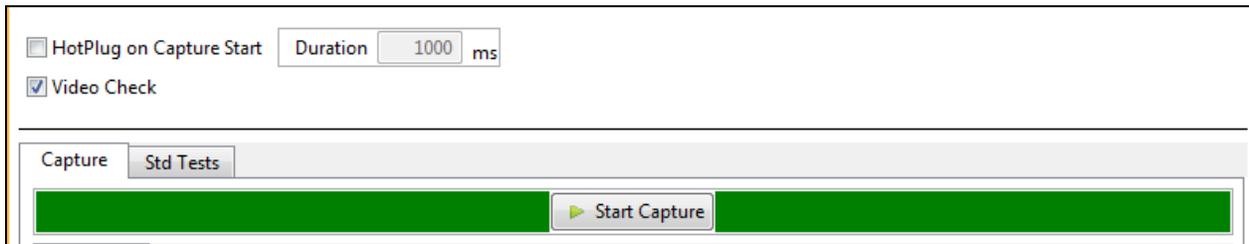
- Select the **Capture** tab.
- Select the **Data Selection Type** from the pull-down menu provided.



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

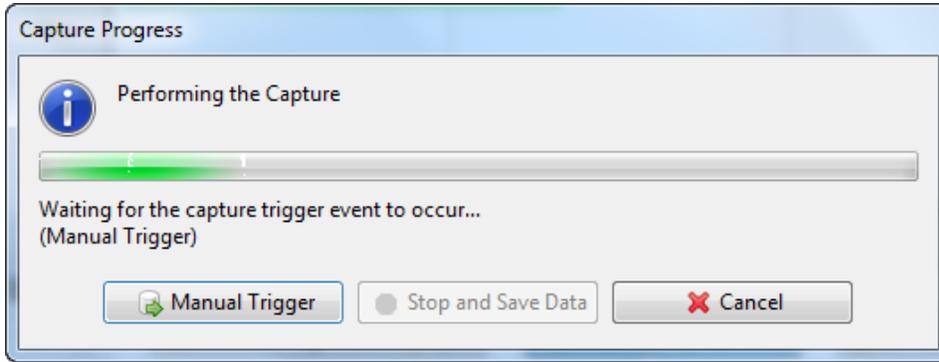


8. Click on the **Execute Capture** button.

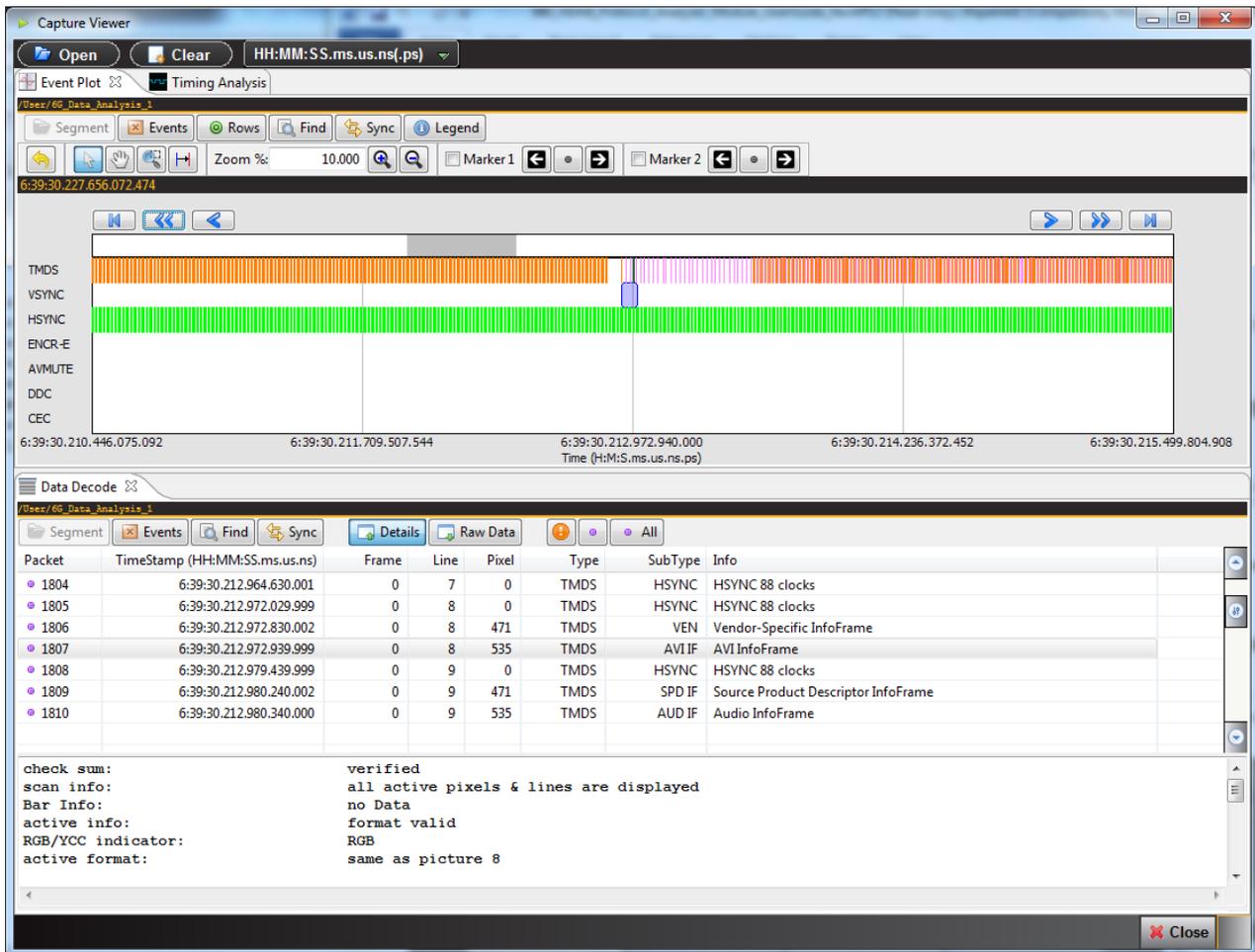


The M41h 48G Video Analyzer/Generator will capture the data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

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



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



The following screen shots show zoomed in views on the AVI infoframe.

Data Decode

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
1804	6:39:30.212.964.630.001	0	7	0	TMS	HSYNC	HSYNC 88 clocks
1805	6:39:30.212.972.029.999	0	8	0	TMS	HSYNC	HSYNC 88 clocks
1806	6:39:30.212.972.830.002	0	8	471	TMS	VEN	Vendor-Specific InfoFrame
1807	6:39:30.212.972.939.999	0	8	535	TMS	AVI IF	AVI InfoFrame
1808	6:39:30.212.979.439.999	0	9	0	TMS	HSYNC	HSYNC 88 clocks
1809	6:39:30.212.980.240.002	0	9	471	TMS	SPD IF	Source Product Descriptor InfoFrame

```

check sum:          verified
scan info:          all active pixels & lines are displayed
Bar Info:           no Data
active info:        format valid
RGB/YCC indicator:  RGB
active format:      same as picture 8
picture aspect ratio: 16:9
colorimetry:        no data
non-uniform picture scale: not known
quantization range: limited
extended colorimetry: xvYCC601 Not used - Colorimetry (C) bits are not set to 3
video format:       VIC=97 (3840x2160p @ 59.94Hz/60Hz)
    
```

Capture Viewer

Open Clear HH:MM:SS.ms.us.ns(.ps)

Event Plot Timing Analysis Video Analysis

/User/3G_Data_Analysis_2_HDCP

Segment Events Rows Find Sync Legend

Zoom %: 0.000001 Marker1 Marker2

0:32:39.980.624.833.849

TMDS AVI

VSYNC

HSYNC

ENCR-E

AVMUTE

DDC

CEC

0:37:13.103.829.533.340 0:37:13.103.829.695.843 0:37:13.103.829.859.078 0:37:13.103.830.021.580 0:37:13.103.830.184.815

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

Data Decode

/User/3G_Data_Analysis_2_HDCP

Segment Events Find Sync Details Raw Data All

Packet	TimeStamp (HH:MM:SS.ms....)	Frame	Line	Pixel	Type	SubType	Info
3117	0:37:13.103.798.200.000	0	6	0	TMDS	HSYNC	HSYNC 88 clocks
3119	0:37:13.103.813.010.000	0	7	0	TMDS	HSYNC	HSYNC 88 clocks
3120	0:37:13.103.827.830.000	0	8	0	TMDS	HSYNC	HSYNC 88 clocks
3122	0:37:13.103.829.630.000	0	8	535	TMDS	AVI IF	AVI InfoFrame
3124	0:37:13.103.842.640.000	0	9	0	TMDS	HSYNC	HSYNC 88 clocks
3125	0:37:13.103.844.230.000	0	9	471	TMDS	SPD IF	Source Product Descriptor InfoFrame

check sum: verified

scan info: all active pixels & lines are displayed

Bar Info: no Data

active info: format valid

RGB/YCC indicator: RGB

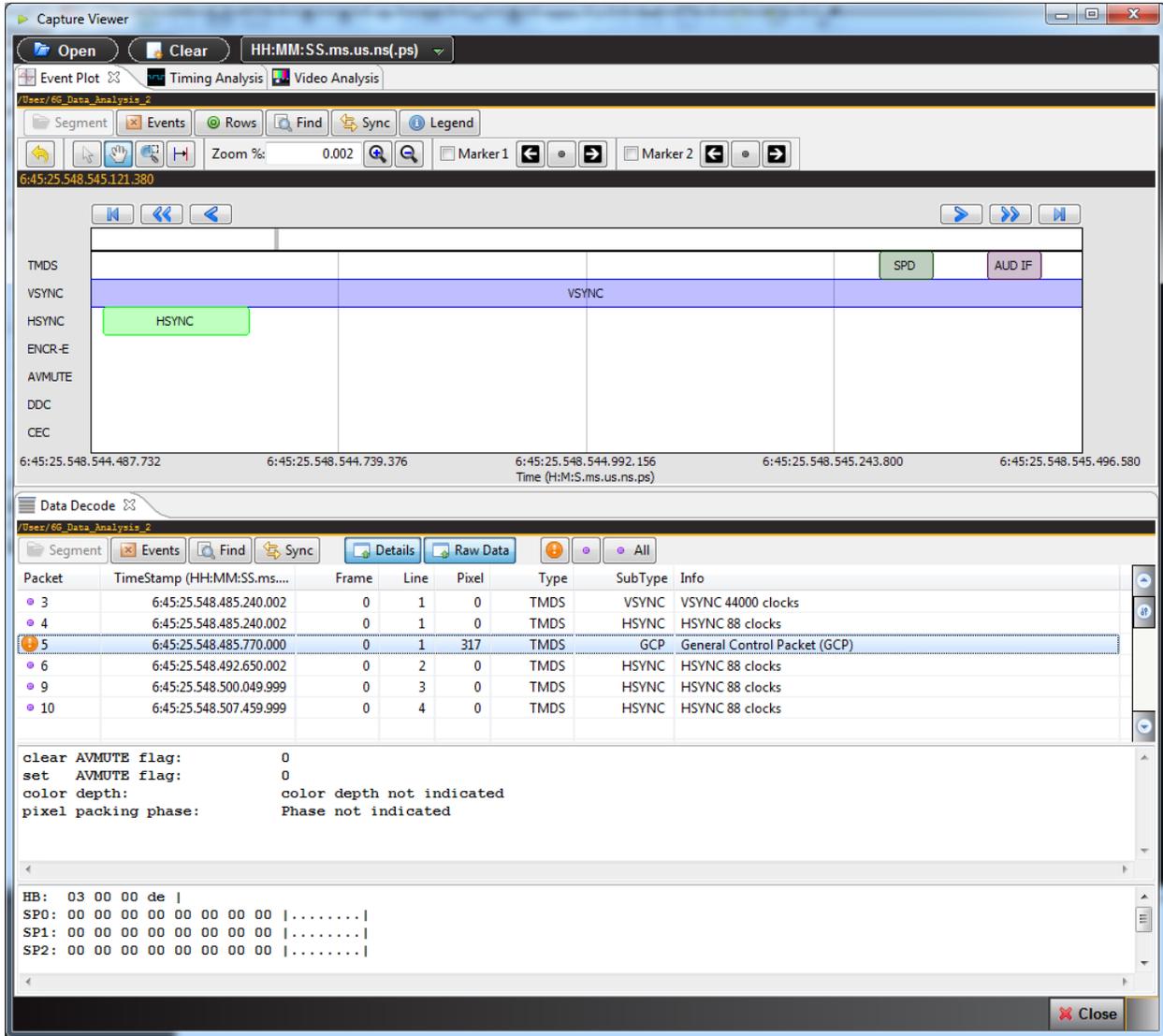
active format: same as picture 8

```

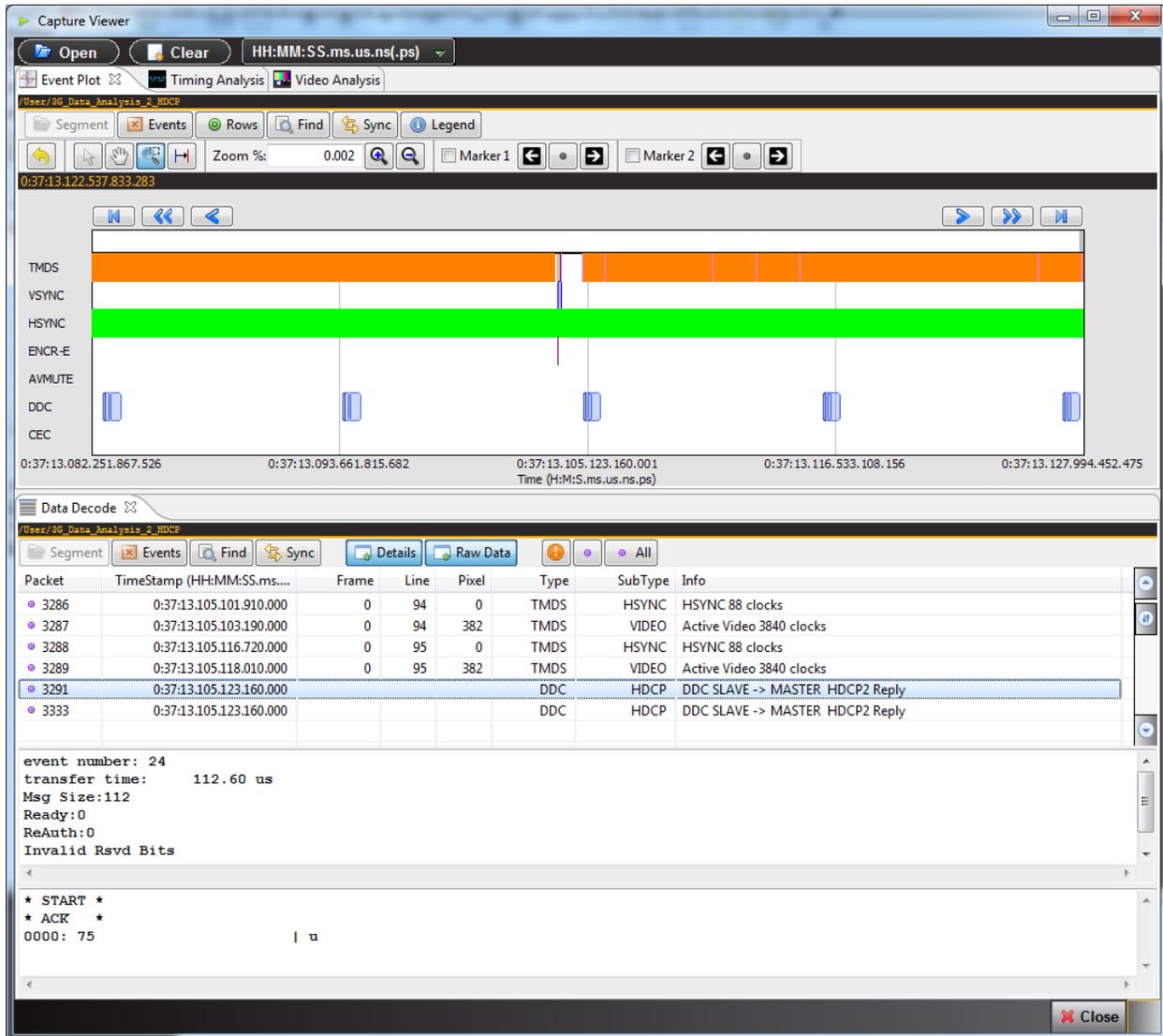
HB: 82 02 0d e4 |
SP0: a8 12 28 04 00 00 00 6c |..{...}|
SP1: 00 71 08 00 00 01 0f 9a |.q.....|
SP2: 00 00 00 00 00 00 00 00 |.....|
    
```

Close

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.



5.6 Examining HDMI 2.1 FRL Captured Data

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

5.6.2 Viewing Data Analysis captures through the Data Decode panel

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

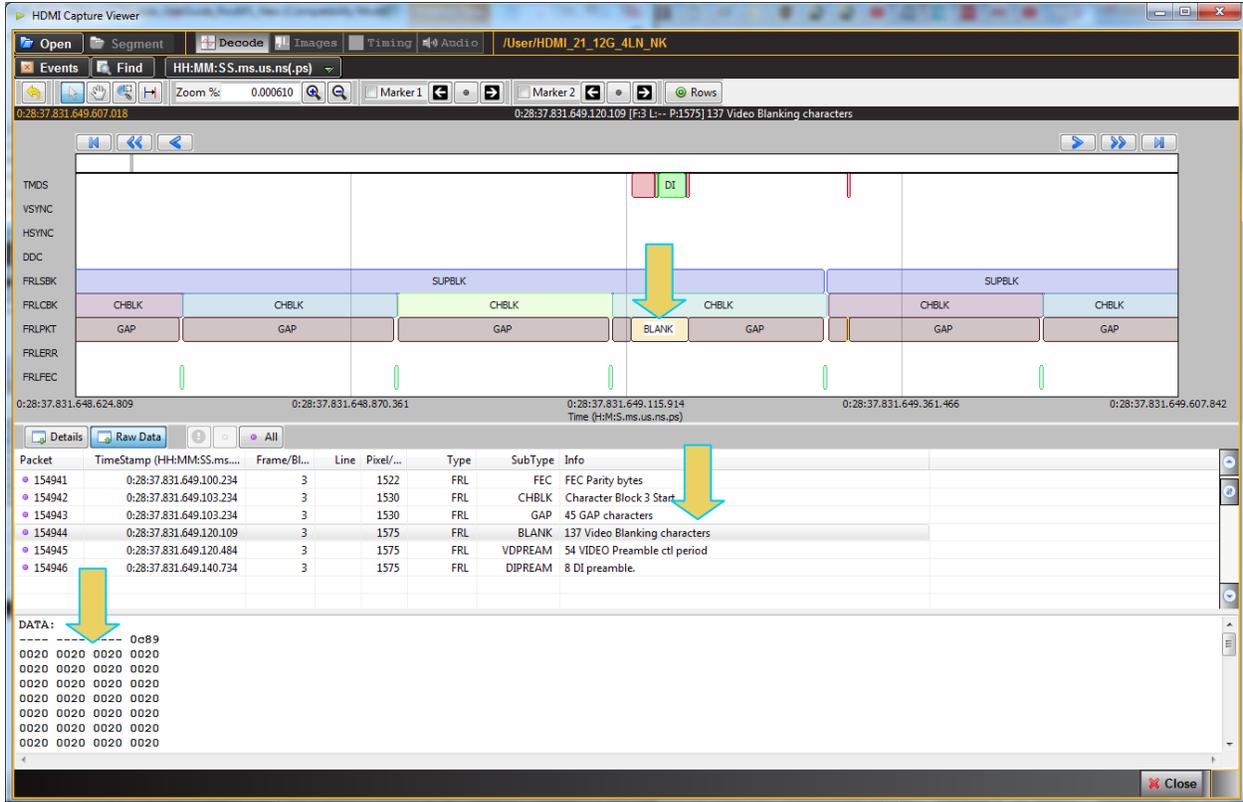
To view captured data through the Data Decode panel:

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

The **Data Decode** window shows the protocol data in a report. Highlight an AVI infoframe record to view its contents as shown below. The **Data 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.



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

Packet	TimeStamp (HH:MM:SS.ms.us.ns(.ps))	Frame/Bl...	Line	Pixel/...	Type	SubType	Info
124447	0:28:37.830.064.938.987	16	0	0	FRL	SUPBLK	Super Block 2040 characters
124448	0:28:37.830.064.940.487	16	0	0	FRL	CHBLK	Character Block 0 Start
124449	0:28:37.830.064.940.487	16	0	0	FRL	GAP	502 GAP characters
3108439	0:28:37.830.065.120.000				DDC	SCDC	DDC MASTER -> SLAVE SCDC Read Update_0
124450	0:28:37.830.065.128.737	16	502		FRL	FEC	FEC Parity bytes
124451	0:28:37.830.065.131.737	16	510		FRL	CHBLK	Character Block 1 Start

event number: 9
transfer time: 402.80 us

```

* START *
* ACK *
0000: a8 10 | ..

```

5.6.3 Filtering the data in the Data Decode panel

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

To apply filters to the data:

- From the **Data 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

Select All Clear All

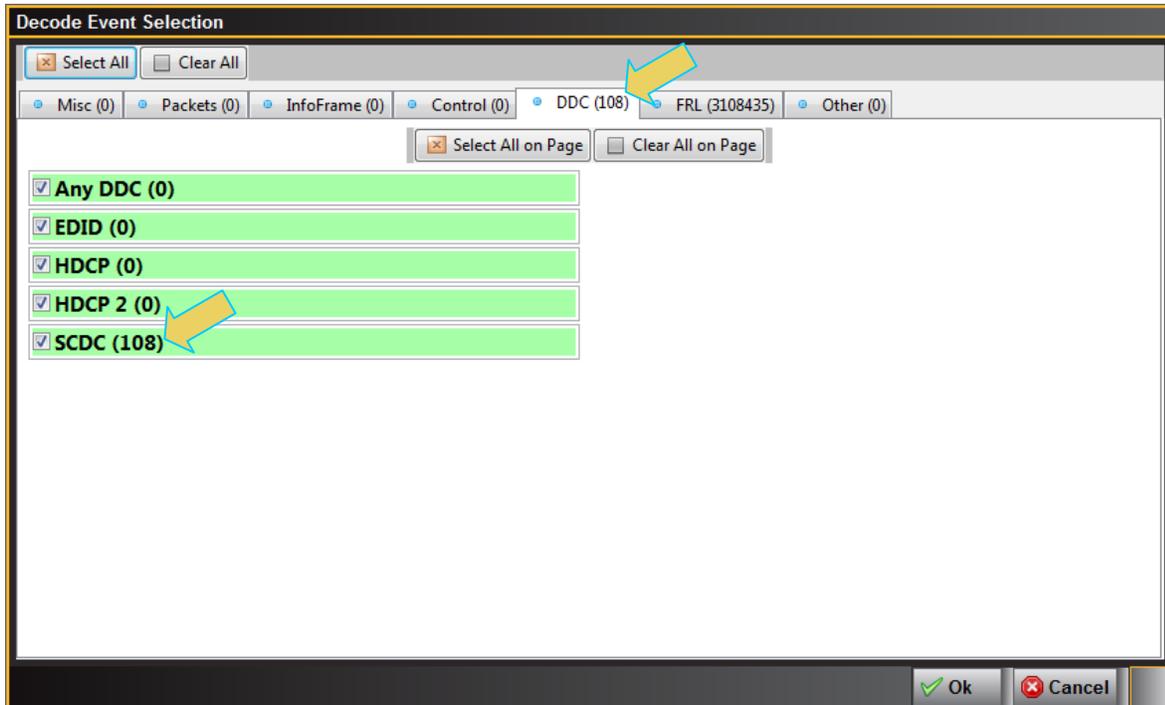
Misc (0) Packets (0) InfoFrame (0) Control (0) DDC (108) FRL (3108435) Other (0)

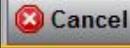
Select All on Page Clear All on Page

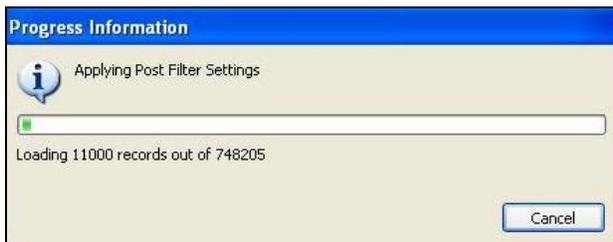
<input checked="" type="checkbox"/> Link Rate (1)	<input checked="" type="checkbox"/> H-Sync (10991)
<input checked="" type="checkbox"/> Super Block (210124)	<input checked="" type="checkbox"/> V-Sync (738)
<input checked="" type="checkbox"/> Character Block (840496)	<input checked="" type="checkbox"/> Encryption Enable (9)
<input checked="" type="checkbox"/> Gap (972638)	<input checked="" type="checkbox"/> Video Preamble (48401)
<input checked="" type="checkbox"/> Active (94199)	<input checked="" type="checkbox"/> Video Guard Band (10467)
<input checked="" type="checkbox"/> Blank (37944)	<input checked="" type="checkbox"/> Data Island (10476)
<input checked="" type="checkbox"/> FEC Parity (840495)	<input checked="" type="checkbox"/> DI Preamble (10485)
<input checked="" type="checkbox"/> FEC Error (0)	<input checked="" type="checkbox"/> DI Leading GB (10485)
<input checked="" type="checkbox"/> Error (10)	<input checked="" type="checkbox"/> DI Trailing GB (10476)

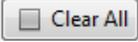
Ok Cancel

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



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

5.6.4 Searching through the data in the Data Decode panel

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

To search through the data:

1. Click on the Search icon.



You can search on a variety of packet types and some of the fields in the **Data 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 associated radio button.

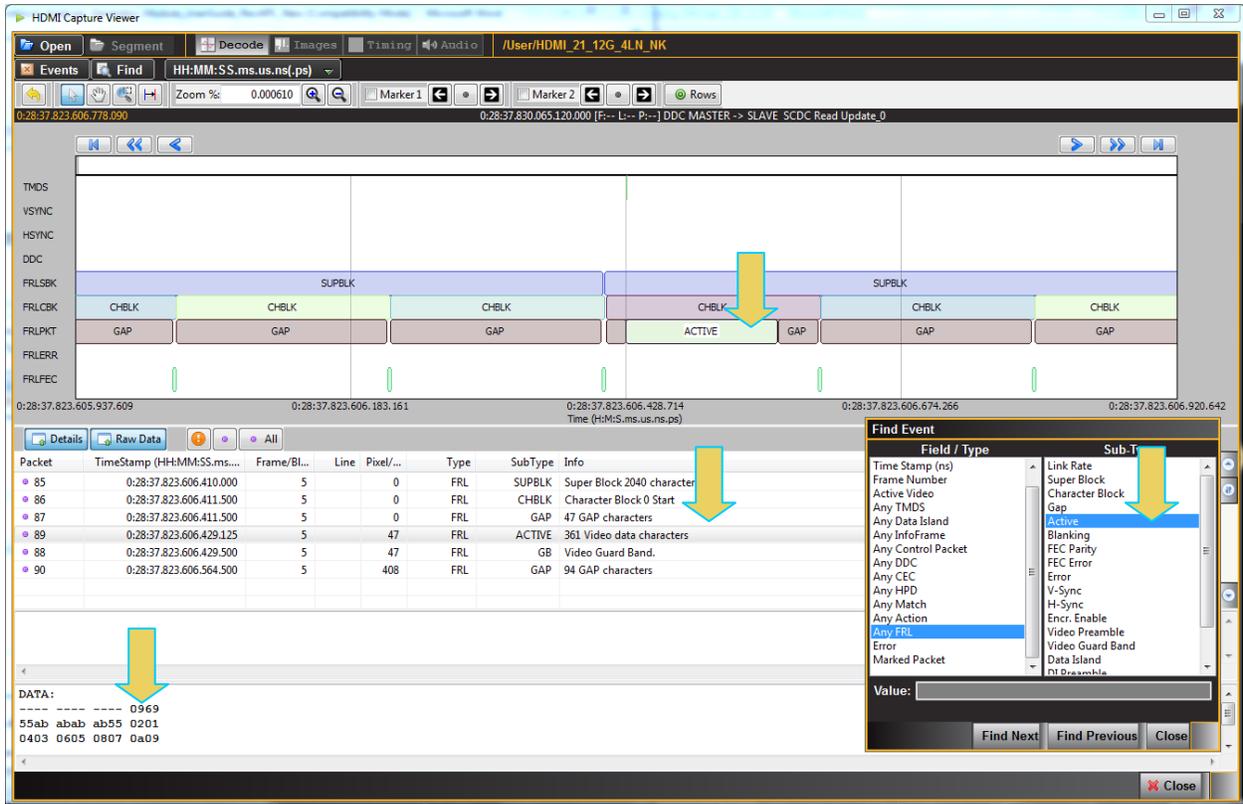
A dialog box appears that enables you can enter search criteria. In this example we will search for an Audio Clock Regeneration packet. The **Data Decode** panel will then show the next General Control Packet (GCP) packet. If you are searching for a specific packet number, timestamp or frame you will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

The screenshot shows the HDMI Capture Viewer interface. The main window displays a timeline of data packets. A yellow arrow points to the 'Find' icon in the top toolbar. Another yellow arrow points to the 'VDPREAM' packet in the timeline. A third yellow arrow points to the 'Find Event' dialog box, which is open in the bottom right corner. The dialog box has a 'Field / Type' list on the left and a 'Sub-Type' list on the right. A yellow arrow points to 'Any FRL' in the 'Field / Type' list, and another yellow arrow points to 'Video Preamble' in the 'Sub-Type' list. The 'Value' field is empty. The 'Find Next' and 'Find Previous' buttons are visible at the bottom of the dialog box.

Packet	TimeStamp (HH-MM:SS.ms.us.ns(ps))	Frame/Bl...	Line	Pixel/...	Type	SubType	Info
25	0:28:37.823.603.728.000	1		1020	FRL	CHBLK	Character Block 2 Start
26	0:28:37.823.603.728.000	1		1020	FRL	GAP	43 GAP characters
27	0:28:37.823.603.744.125	1		1063	FRL	BLANK	137 Video Blanking characters
29	0:28:37.823.603.744.500	1		1063	FRL	VDPREAM	136 VIDEO Preamble cti period
28	0:28:37.823.603.777.500	1		1063	FRL	HSYNC	44 HSYNC
30	0:28:37.823.603.795.500	1		1200	FRL	GAP	322 GAP characters

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.

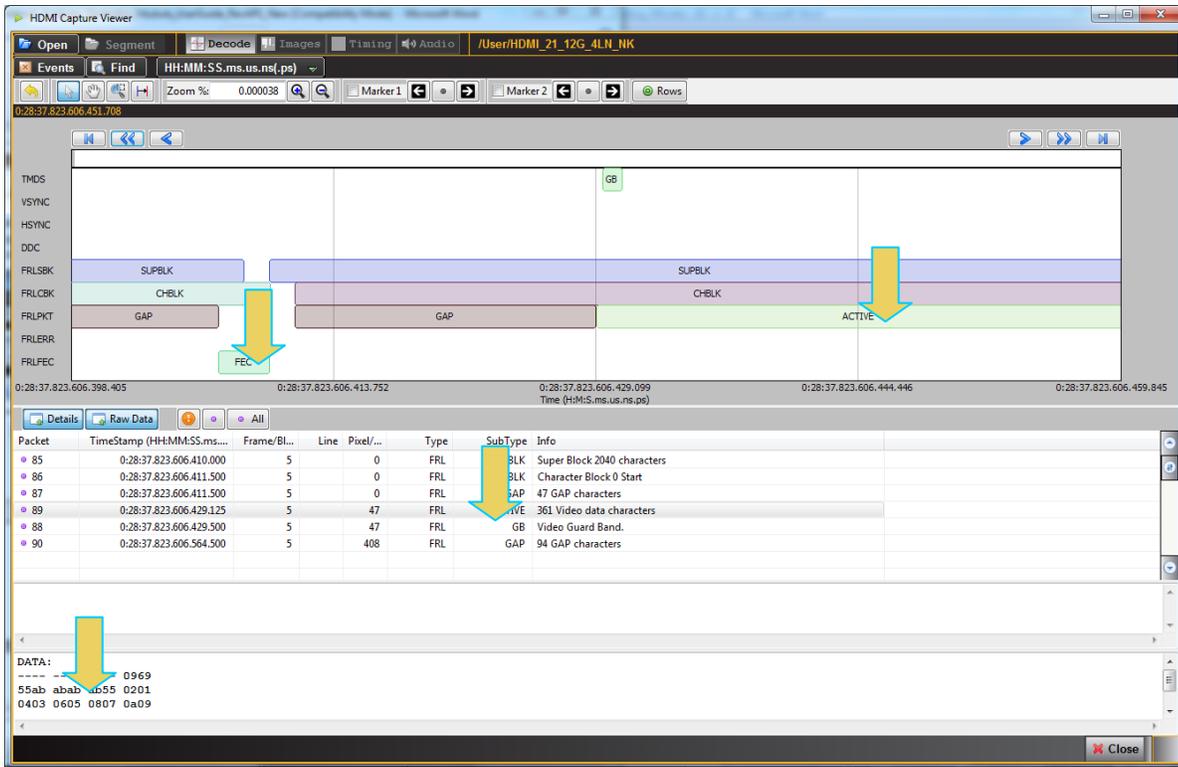


5.6.5 Viewing data through the Event Plot panel

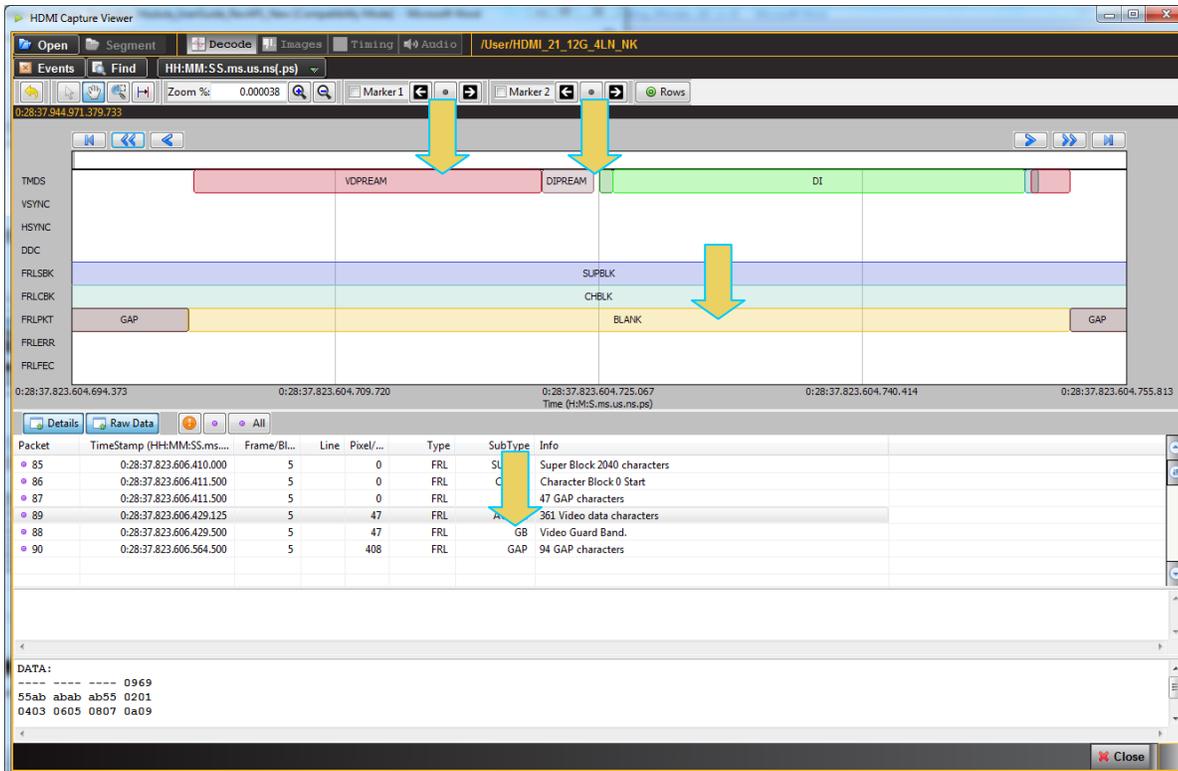
The Event Plot panel provides you with a graphical view of the data. It enables you to see relationships between the various data types on a time line. A sample screen of the **Event Plot** is shown below. The operation of the **Event Plot** is described at: [Event Plot Panel](#).

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.

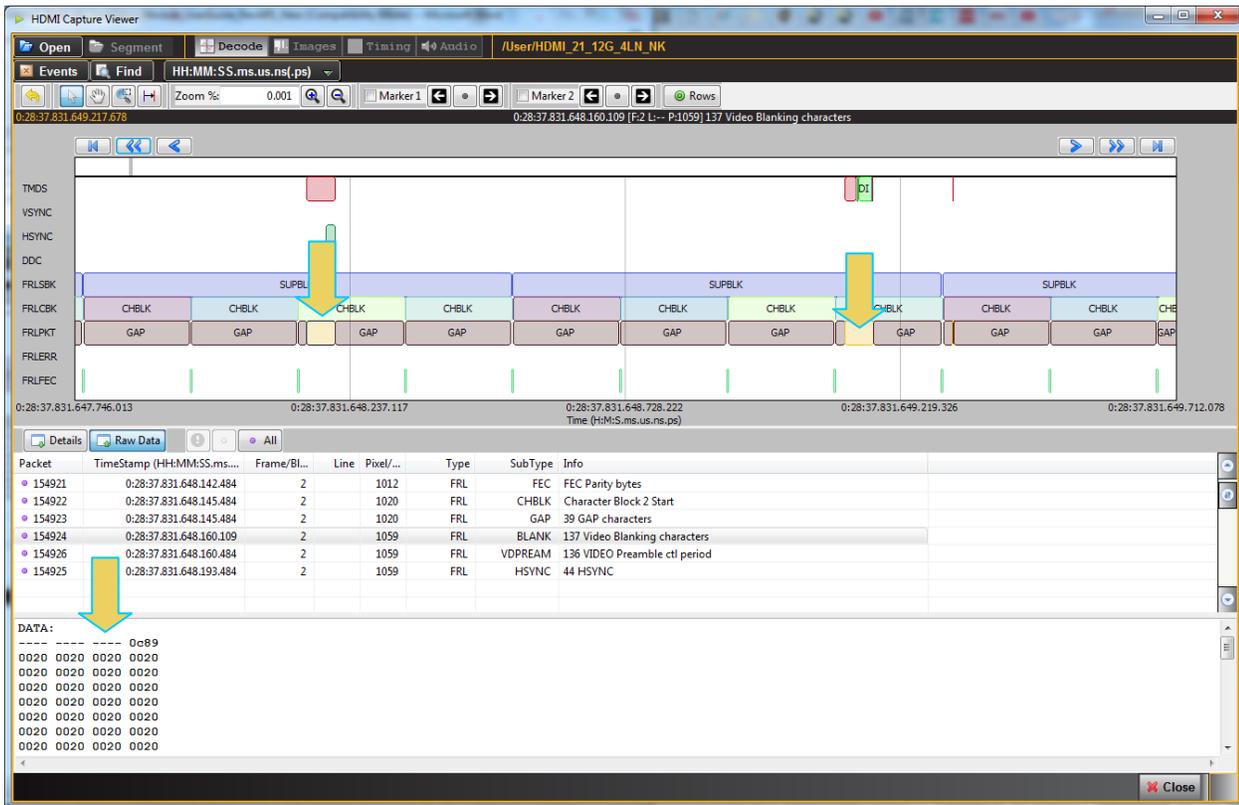


The following example shows a blanking period with the video preamble, data island preamble, data island guard band, etc.



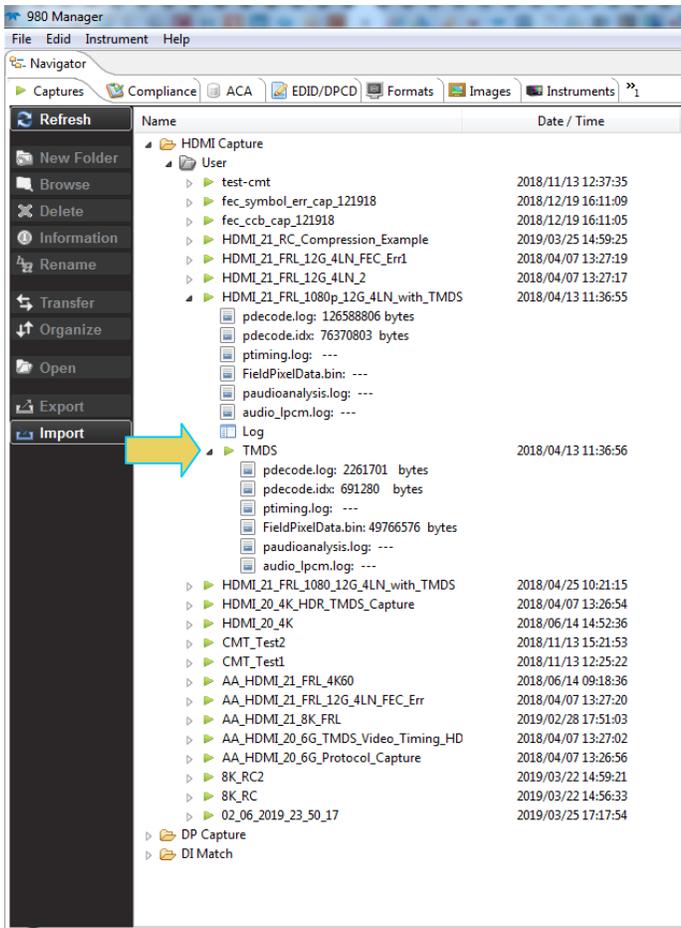
The following example shows a couple of blanking periods, vsync and hsync elements and the FRL packet structure.

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.



5.6.6 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.



Simply double click on the embedded TMDS capture icon to view the TMDS capture as shown below.

Packet	TimeStamp (HH:MM:SS.ms.us...)	Frame/BL...	Line	Pixel/...	Type	SubType	Info
5287	0:1:20.110.453.260.000	2	8	0	TMDS	HSYNC	HSYNC 44 clocks
5288	0:1:20.112.291.660.000	2	8	273	TMDS	VEN	Vendor-Specific InfoFrame
5288	0:1:20.112.722.640.000	2	8	337	TMDS	AVI IF	AVI InfoFrame
5290	0:1:20.125.066.210.000	2	9	2170	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
5291	0:1:20.125.268.240.000	2	9	0	TMDS	HSYNC	HSYNC 44 clocks
5292	0:1:20.127.106.640.000	2	9	273	TMDS	SPD IF	Source Product Descriptor InfoFrame
5293	0:1:20.127.537.620.000	2	9	337	TMDS	AUD IF	Audio InfoFrame
5294	0:1:20.139.881.190.000	2	10	2170	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
5295	0:1:20.140.083.220.000	2	10	0	TMDS	HSYNC	HSYNC 44 clocks
5296	0:1:20.154.898.200.000	2	11	0	TMDS	HSYNC	HSYNC 44 clocks
5297	0:1:20.169.511.160.000	2	12	2170	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)

```

RGB/YCC indicator:      RGB
active format:          not defined
picture aspect ratio:  16:9
colorimetry:            no data
non-uniform picture scale: not known
quantization range:    limited
extended colorimetry:  xvYCC601 Not used - Colorimetry (C) bits are not set to 3
video format:          VIC=16 (1920x1080p 59.9/60Hz,16:9, 1:1)

HB: 82 02 0d e4 |
SP0: 6c 02 28 04 10 00 00 7c |1.(....)|
SP1: 00 39 04 00 00 81 07 69 |.9.....i|
SP2: 00 00 00 00 00 00 00 |.....|
SP3: 00 00 00 00 00 00 00 |.....|

```

5.7 Examining TMDS Captured Data

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

5.7.1 Viewing Data Analysis captures through the Data Decode panel

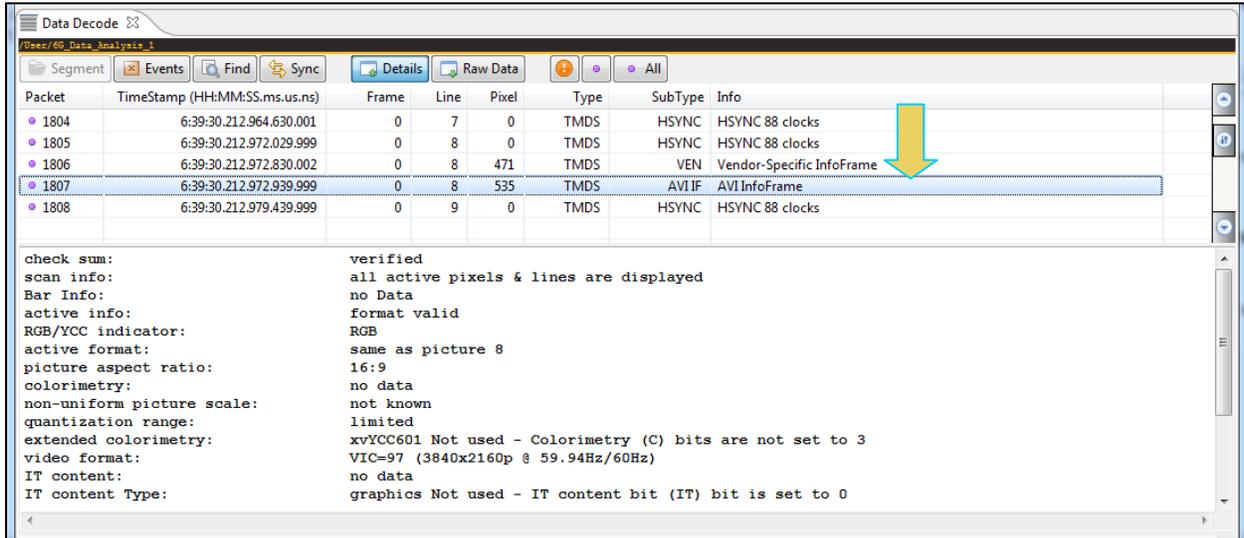
This subsection provides procedures for viewing the captured data taken using one of the Data Analysis capture modes through the **Data Decode** panel in the ATP Manager.

To view captured data through the Data Decode panel:

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

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

2. Highlight an AVI infoframe record to view its contents as shown below. The **Data 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.



The screenshot shows the 'Data Decode' window with the following table of packets:

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
1804	6:39:30.212.964.630.001	0	7	0	TMDS	HSYNC	HSYNC 88 clocks
1805	6:39:30.212.972.029.999	0	8	0	TMDS	HSYNC	HSYNC 88 clocks
1806	6:39:30.212.972.830.002	0	8	471	TMDS	VEN	Vendor-Specific InfoFrame
1807	6:39:30.212.972.939.999	0	8	535	TMDS	AVI IF	AVI InfoFrame
1808	6:39:30.212.979.439.999	0	9	0	TMDS	HSYNC	HSYNC 88 clocks

The selected AVI InfoFrame record (Packet 1807) is shown in the lower panel with the following details:

```

check sum:          verified
scan info:         all active pixels & lines are displayed
Bar Info:         no Data
active info:      format valid
RGB/YCC indicator: RGB
active format:    same as picture 8
picture aspect ratio: 16:9
colorimetry:     no data
non-uniform picture scale: not known
quantization range: limited
extended colorimetry: xvYCC601 Not used - Colorimetry (C) bits are not set to 3
video format:    VIC=97 (3840x2160p @ 59.94Hz/60Hz)
IT content:      no data
IT content Type:  graphics Not used - IT content bit (IT) bit is set to 0
  
```

- 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 a 'Data Decode' window with a table of packets. The table has columns for Packet, TimeStamp (HH:MM:SS.ms.us.ns), Frame, Line, Pixel, Type, SubType, and Info. Packet 1806 is highlighted in blue, and its 'Info' field is 'Vendor-Specific InfoFrame'. A yellow arrow points to this row, and another yellow arrow points to the 'Info' column header.

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
1804	6:39:30.212.964.630.001	0	7	0	TMDS	HSYNC	HSYNC 88 clocks
1805	6:39:30.212.972.029.999	0	8	0	TMDS	HSYNC	HSYNC 88 clocks
1806	6:39:30.212.972.830.002	0	8	471	TMDS	VEN	Vendor-Specific InfoFrame
1807	6:39:30.212.972.939.999	0	8	535	TMDS	AVI IF	AVI InfoFrame
1808	6:39:30.212.979.439.999	0	9	0	TMDS	HSYNC	HSYNC 88 clocks

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

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

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
7033	6:39:30.229.579.549.999	0	2250	0	TMDS	HSYNC	HSYNC 88 clocks
7034	6:39:30.229.586.750.000	0	2250	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
7035	6:39:30.229.586.959.999	1	1	0	TMDS	VSYNC	VSYNC 44000 clocks
7036	6:39:30.229.586.959.999	1	1	0	TMDS	HSYNC	HSYNC 88 clocks
7037	6:39:30.229.587.490.002	1	1	317	TMDS	GCP	General Control Packet (GCP)
7039	6:39:30.229.587.549.999	1	2	163	TMDS	SSCP	SSCP 8 clocks
7038	6:39:30.229.594.360.001	1	2	0	TMDS	HSYNC	HSYNC 88 clocks

```

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

- Highlight an audio infoframe record to view its contents as shown below.

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
1808	6:39:30.212.979.439.999	0	9	0	TMDS	HSYNC	HSYNC 88 clocks
1809	6:39:30.212.980.240.002	0	9	471	TMDS	SPD IF	Source Product Descriptor InfoFrame
1810	6:39:30.212.980.340.000	0	9	535	TMDS	AUD IF	Audio InfoFrame
1811	6:39:30.212.986.650.002	0	9	4280	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
1812	6:39:30.212.986.849.998	0	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
    
```

```

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 |.....|
    
```

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

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
2007	6:39:30.213.831.299.999	0	124	0	TMDS	HSYNC	HSYNC 88 clocks
2008	6:39:30.213.831.939.999	0	124	382	TMDS	VIDEO	Active Video 3840 clocks
2009	6:39:30.213.838.509.998	0	124	4280	TMDS	ACR	Audio Clock Regeneration Packet
2010	6:39:30.213.838.563.869	0	124	4312	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2011	6:39:30.213.838.709.999	0	125	0	TMDS	HSYNC	HSYNC 88 clocks
2012	6:39:30.213.839.349.998	0	125	382	TMDS	VIDEO	Active Video 3840 clocks
2013	6:39:30.213.846.119.999	0	126	0	TMDS	HSYNC	HSYNC 88 clocks
2014	6:39:30.213.846.759.998	0	126	382	TMDS	VIDEO	Active Video 3840 clocks
2015	6:39:30.213.853.520.000	0	127	0	TMDS	HSYNC	HSYNC 88 clocks

audio clock regeneration: N = 5824, Cycle Time Stamp (CTS) = 563061
audio clock freq: 48.000kHz

```

HB: 01 00 00 4a |
SP0: 00 08 97 75 00 16 c0 d8 |...u...|
SP1: 00 08 97 75 00 16 c0 d8 |...u...|
SP2: 00 08 97 75 00 16 c0 d8 |...u...|
SP3: 00 08 97 75 00 16 c0 d8 |...u...|
    
```

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

Packet	TimeStamp (HH:MM:SS.ms.us.ns)	Frame	Line	Pixel	Type	SubType	Info
2007	6:39:30.213.831.299.999	0	124	0	TMDS	HSYNC	HSYNC 88 clocks
2008	6:39:30.213.831.939.999	0	124	382	TMDS	VIDEO	Active Video 3840 clocks
2009	6:39:30.213.838.509.998	0	124	4280	TMDS	ACR	Audio Clock Regeneration Packet
2010	6:39:30.213.838.563.869	0	124	4312	TMDS	AUDSAM	Audio Sample Packet(L-PCM and IEC 61937 compressed formats)
2011	6:39:30.213.838.709.999	0	125	0	TMDS	HSYNC	HSYNC 88 clocks
2012	6:39:30.213.839.349.998	0	125	382	TMDS	VIDEO	Active Video 3840 clocks
2013	6:39:30.213.846.119.999	0	126	0	TMDS	HSYNC	HSYNC 88 clocks
2014	6:39:30.213.846.759.998	0	126	382	TMDS	VIDEO	Active Video 3840 clocks
2015	6:39:30.213.853.520.000	0	127	0	TMDS	HSYNC	HSYNC 88 clocks

layout 0: max channels=2, samples=4
subpacket 0: carries audio data

```

HB: 02 01 00 65 |
SP0: 40 9f 9c 40 9f 9c 88 e4 |@..@...|
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 |.....|
    
```

8. 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 shows the 'Data Decode' window with a table of packets. A yellow arrow points to the selected packet (3133) in the table. Below the table, the 'Details' panel shows the following information:

```

Bits accumulated      : 192
Use of channel status block: Consumer
Data use              : LPCM sample
Copyright is         : asserted
Additional Info      : 2 audio channels without pre-emphasis
Channel status mode  : 0
Category code       : 0x00
Source number       : ignored
Channel number (audio) : ignored
Sampling frequency  : 48kHz
Clock accuracy      : Level II
Max. audio sample word size: 24 bits
Word length         : 24 bits
Original sampling freq. : Not indicated(default)

```

At the bottom of the window, a bit stream is displayed in a grid format:

```

00:  0|  1|  2|  3|  4|  5|  6|  7|
    0|  0|  0|  0|  0|  0|  0|  0|
01:  8|  9| 10| 11| 12| 13| 14| 15|
    0|  0|  0|  0|  0|  0|  0|  0|
02: 16| 17| 18| 19| 20| 21| 22| 23|
    0|  0|  0|  0|  0|  0|  0|  0|
03: 24| 25| 26| 27| 28| 29| 30| 31|
    0|  1|  0|  0|  0|  0|  0|  0|

```

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

Packet	TimeStamp (HH:MM:SS.ms....)	Frame	Line	Pixel	Type	SubType	Info
3286	0:37:13.105.101.910.000	0	94	0	TMDS	HSYNC	HSYNC 88 clocks
3287	0:37:13.105.103.190.000	0	94	382	TMDS	VIDEO	Active Video 3840 clocks
3288	0:37:13.105.116.720.000	0	95	0	TMDS	HSYNC	HSYNC 88 clocks
3289	0:37:13.105.118.010.000	0	95	382	TMDS	VIDEO	Active Video 3840 clocks
3291	0:37:13.105.123.160.000				DDC	DDC	DDC SLAVE -> MASTER HDCP2 Reply
3333	0:37:13.105.123.160.000				DDC	DDC	DDC SLAVE -> MASTER HDCP2 Reply

event number: 24
transfer time: 112.60 us
Msg Size:112
Ready:0
ReAuth:0
Invalid Rsvd Bits

```
* START *
* ACK *
0000: 75          | u
```

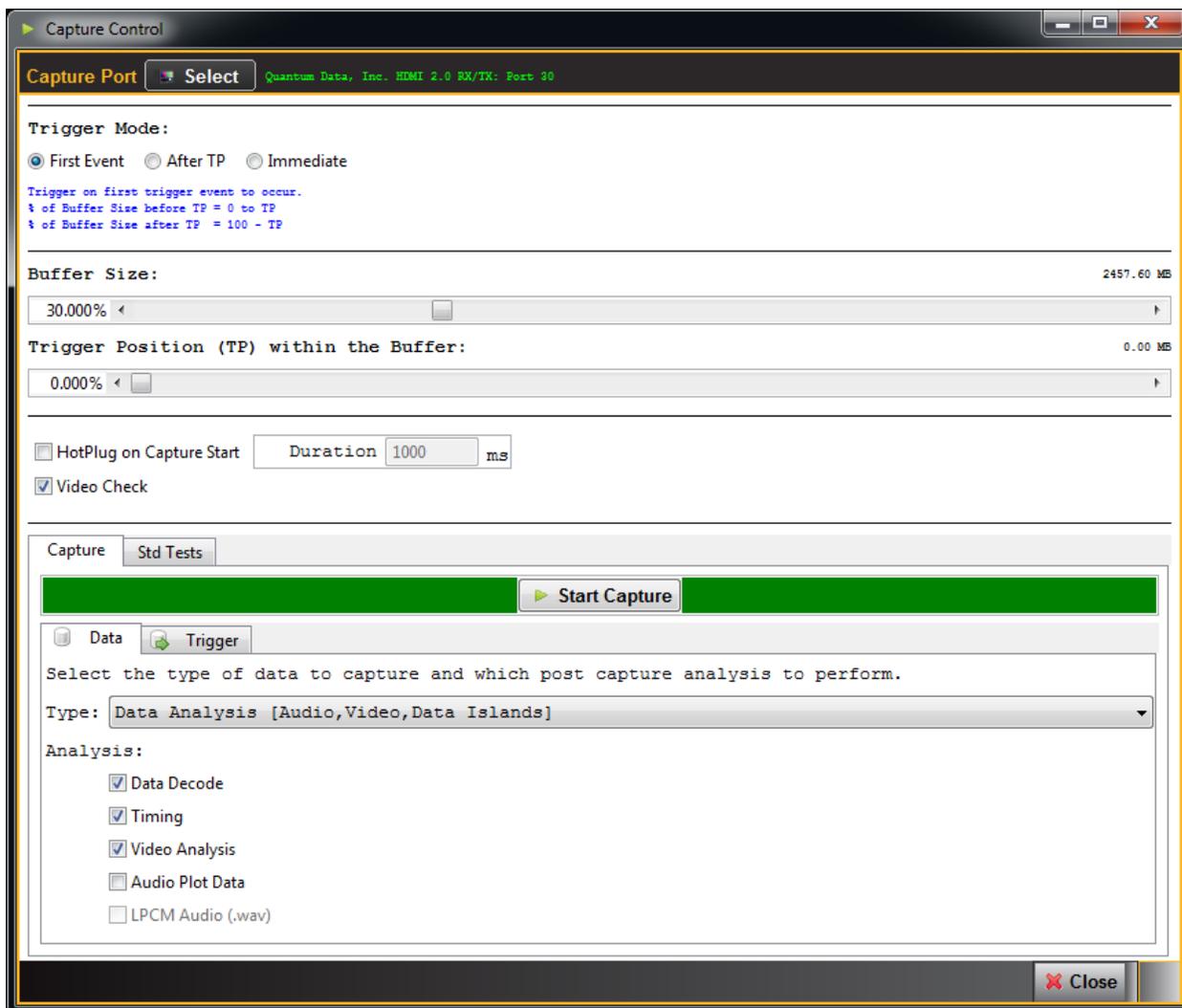
5.7.2 Viewing Protocol Analysis captures through the Data Decode panel

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

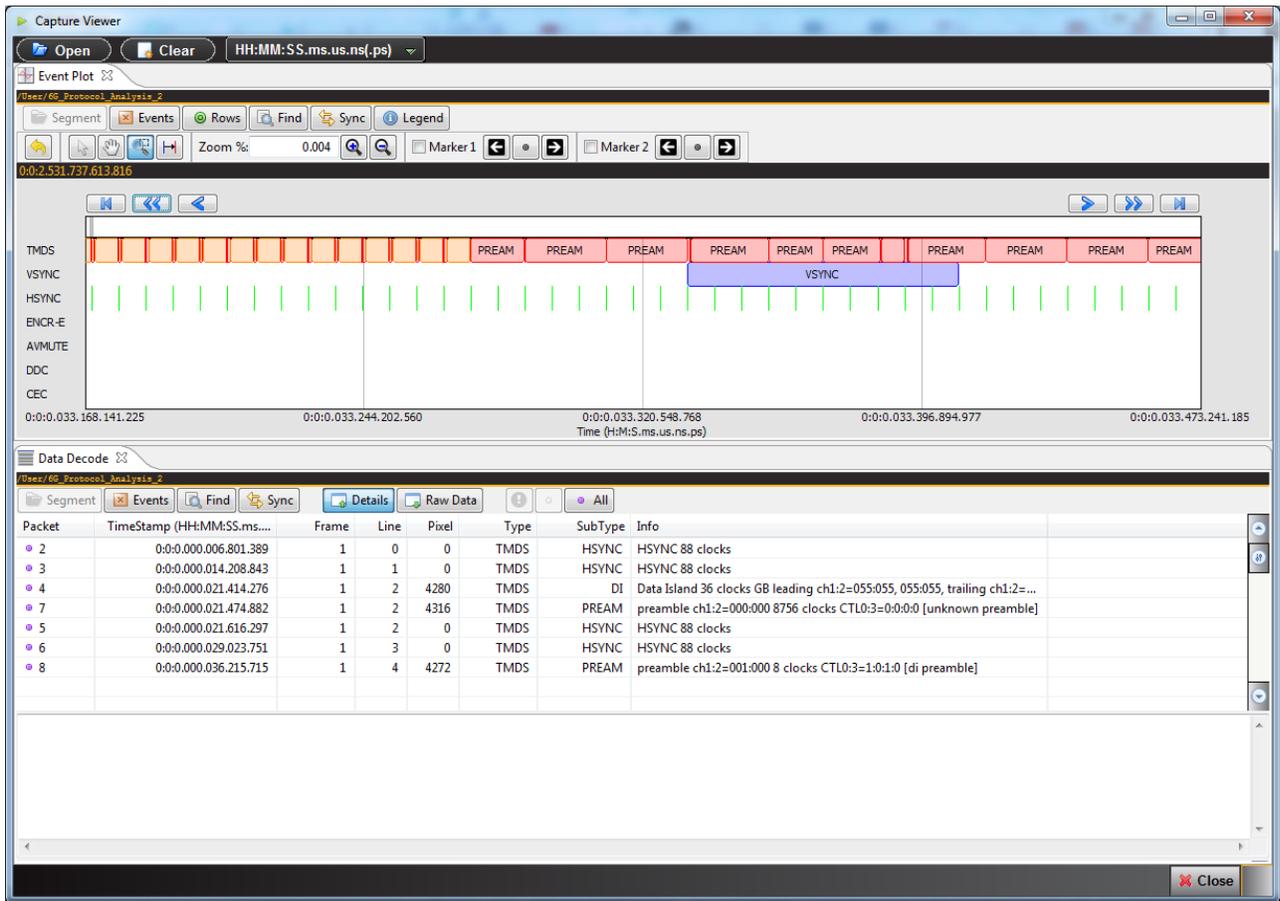
To view captured data through the Data Decode panel:

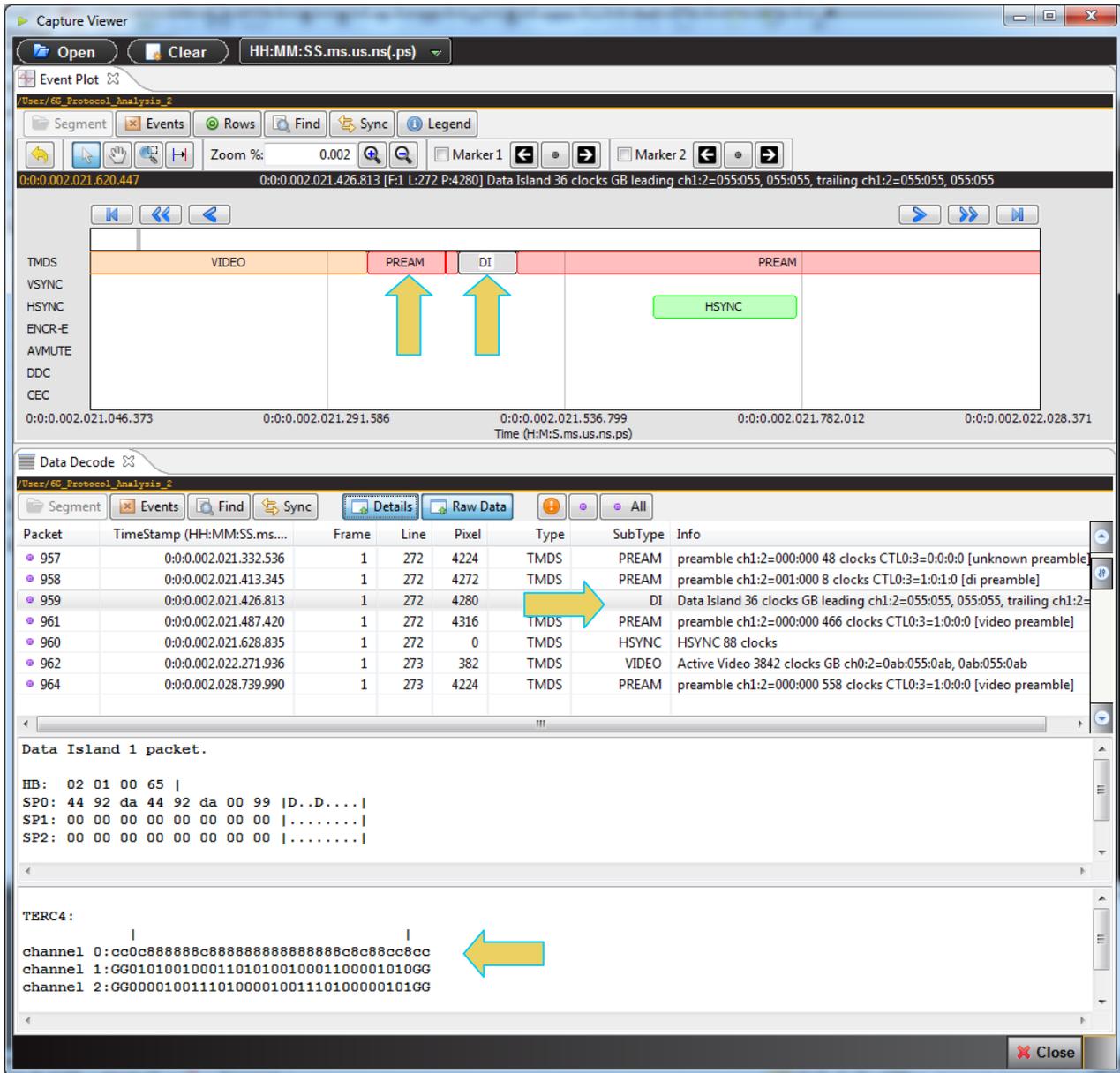
- To view the Protocol Analysis data transactions on the **Data Decode** and **Event Plot** panels, activate the **Data Decode** and **Event Plot** tabs.

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 **Data Decode**. The guard band data is shown as part of the Video data period in the example.



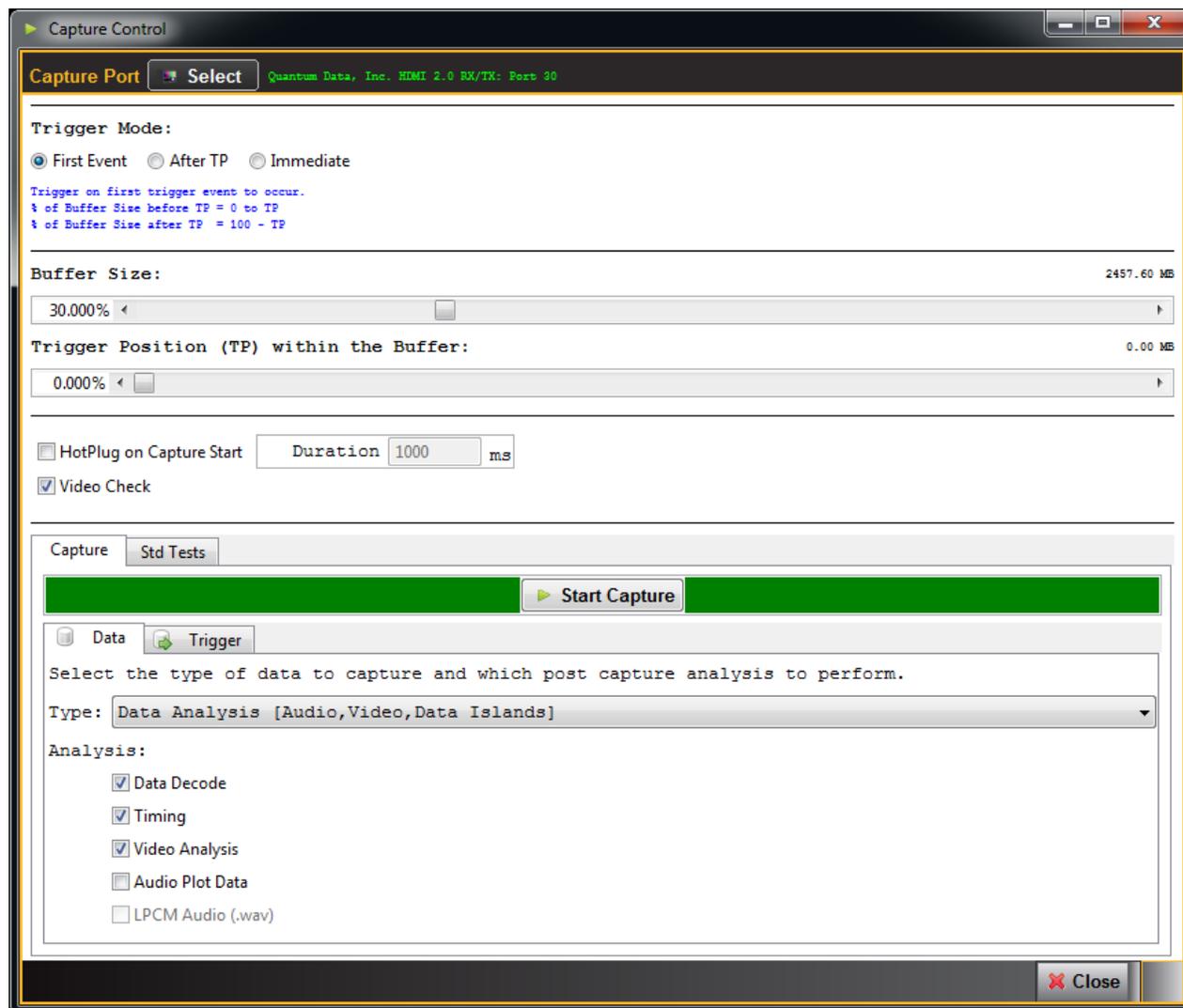
The following screen shots show examples of the protocol captured data showing the guard bands and preambles.



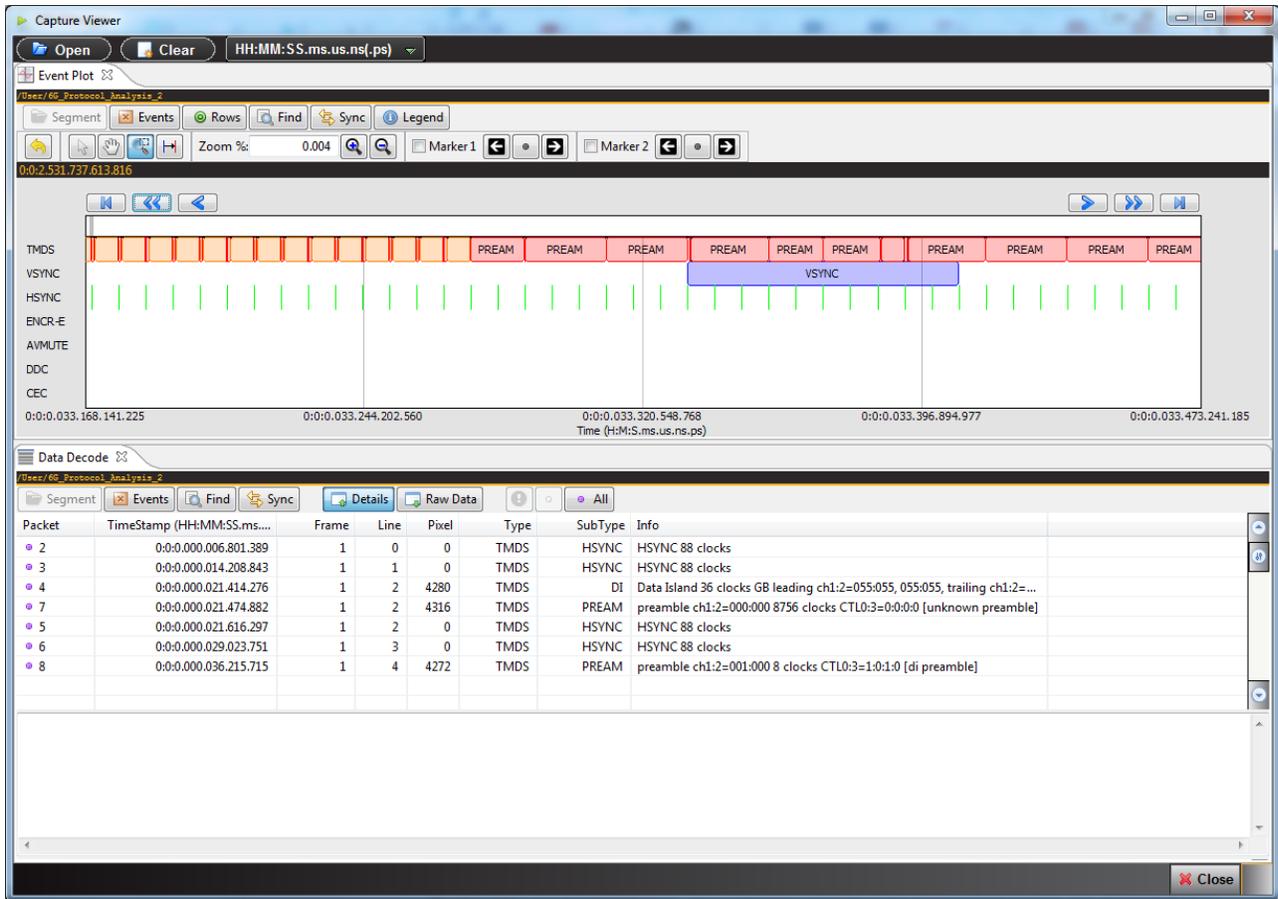


5.7.3 Viewing Scrambled Protocol Analysis captures through the Data Decode panel

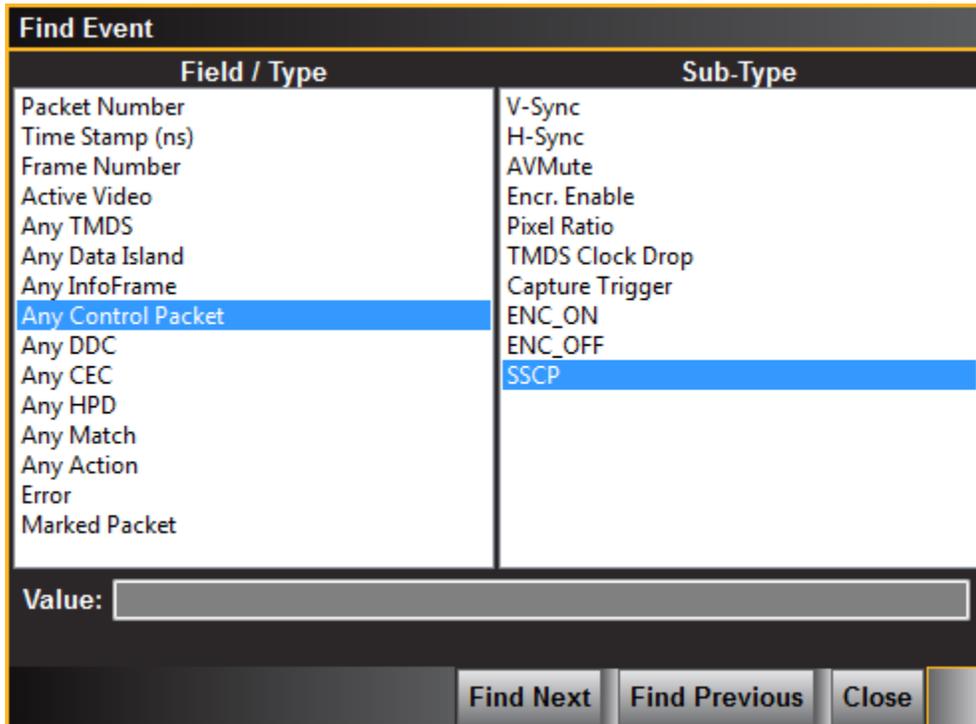
This subsection provides procedures for viewing the captured data taken using the Scrambled Protocol Analysis capture mode through the **Data Decode** and **Event Plot** panels in the ATP Manager.



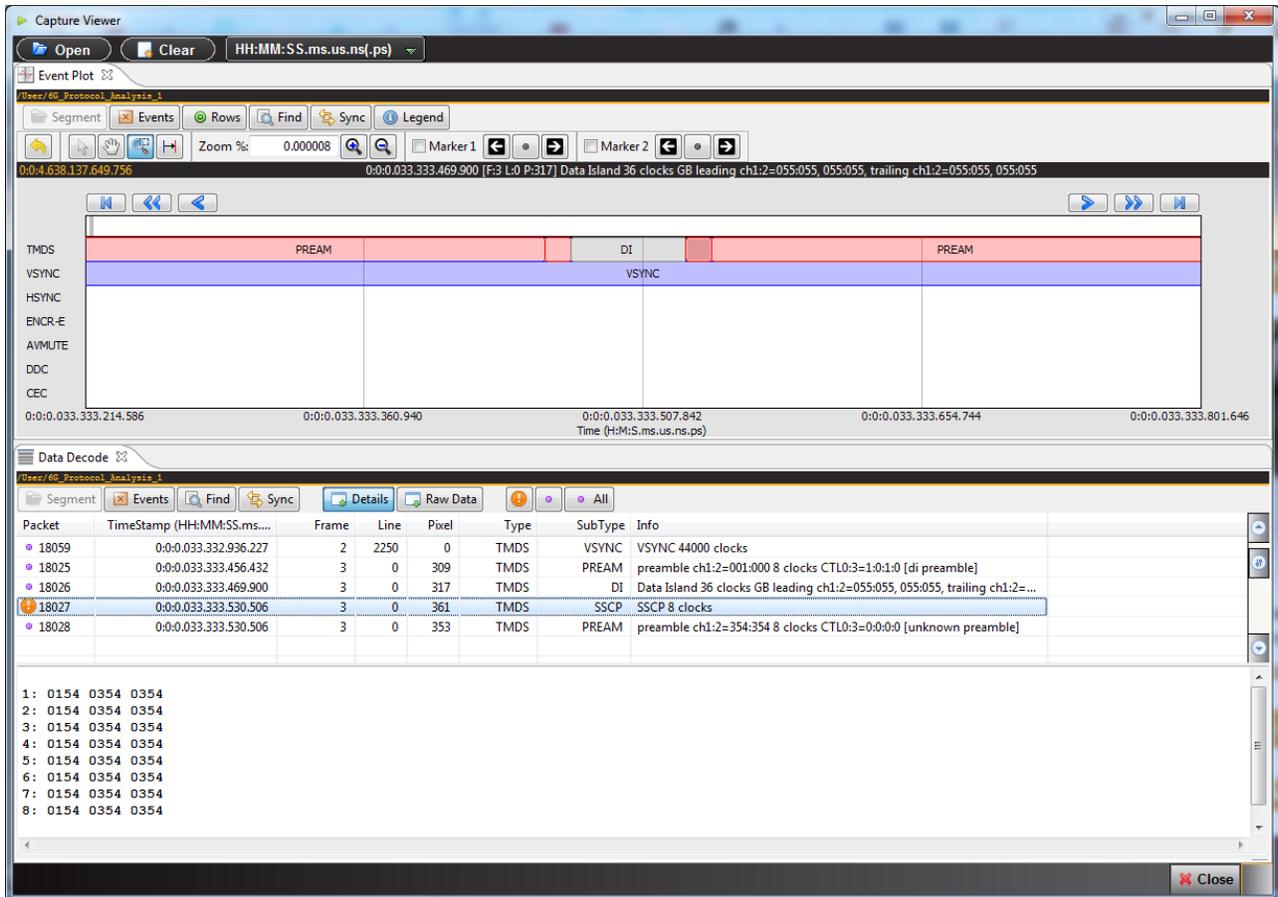
The following screen shot shows an example of the protocol data capture with scrambling enabled.



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.

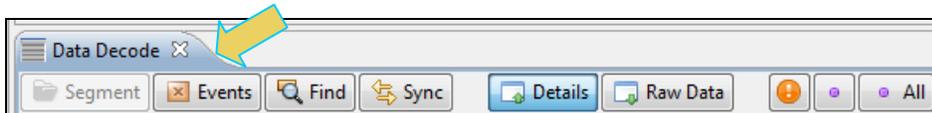


5.7.4 Filtering the data in the Data Decode panel

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

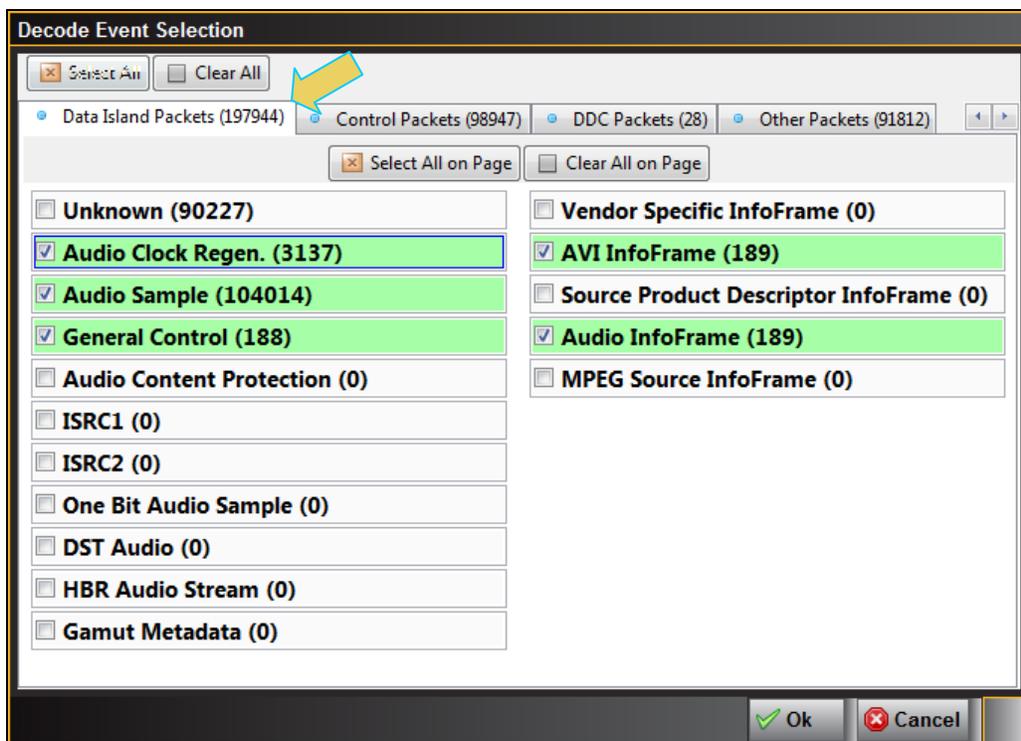
To apply filters to the data:

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

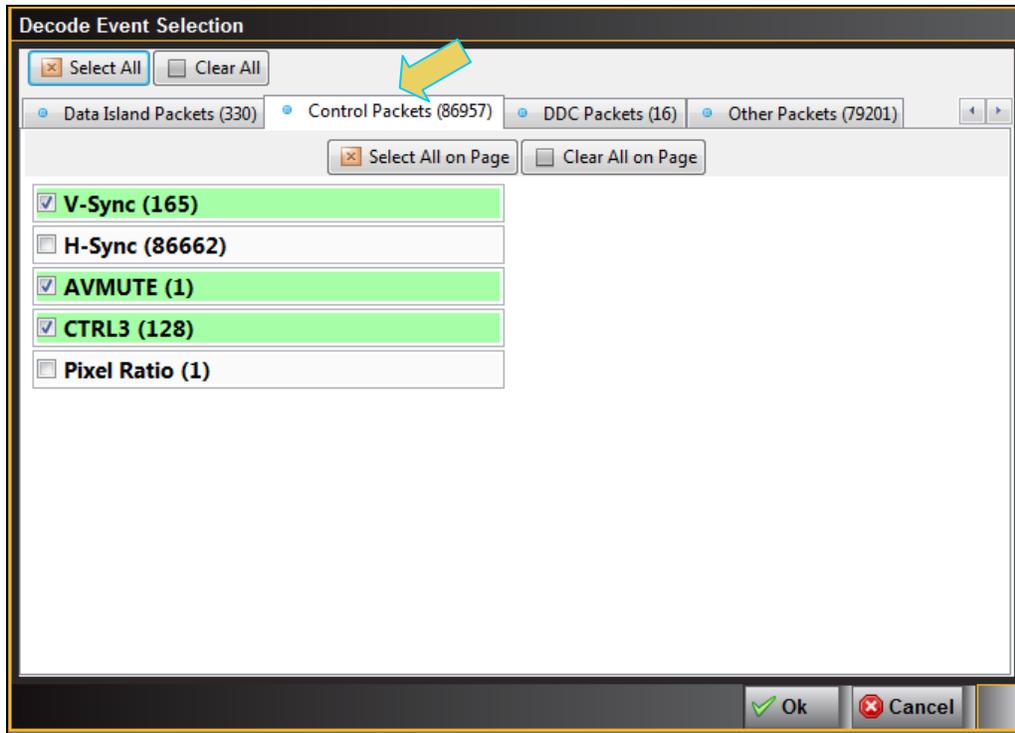


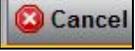
The **Decode Event Selection** dialog box is shown below.

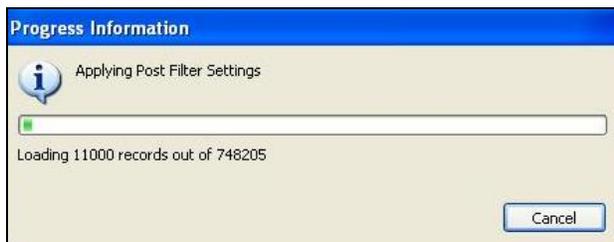
In the example below, only some of the data islands are selected.

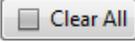


The following is a screen example of the **Control Packets** page.



2. Select the data items you want to appear in the **Data 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. Alternatively 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.

5.7.5 Searching through the data in the Data Decode panel

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

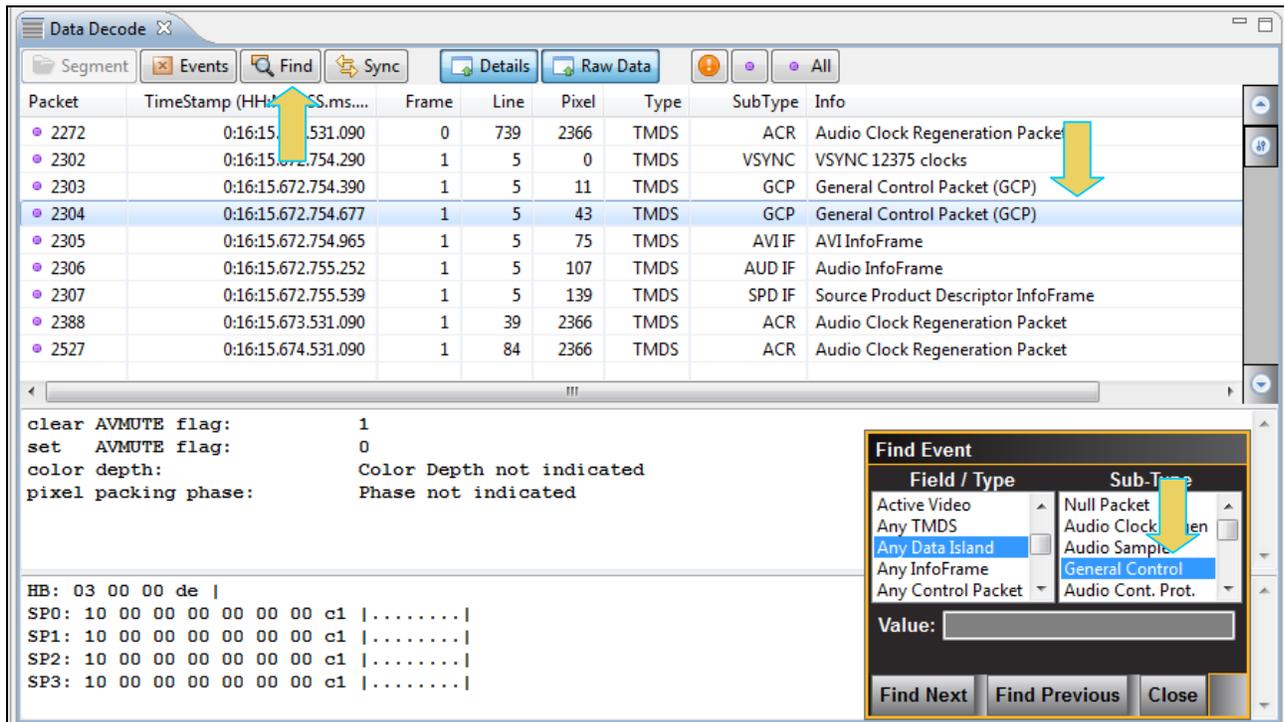
To search through the data:

1. Click on the Search icon. 

You can search on a variety of packet types and some of the fields in the **Data 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 associated radio button.

A dialog box appears that enables you can enter search criteria. In this example we will search for an Audio Clock Regeneration packet. The **Data 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 value in the Find/Goto field.

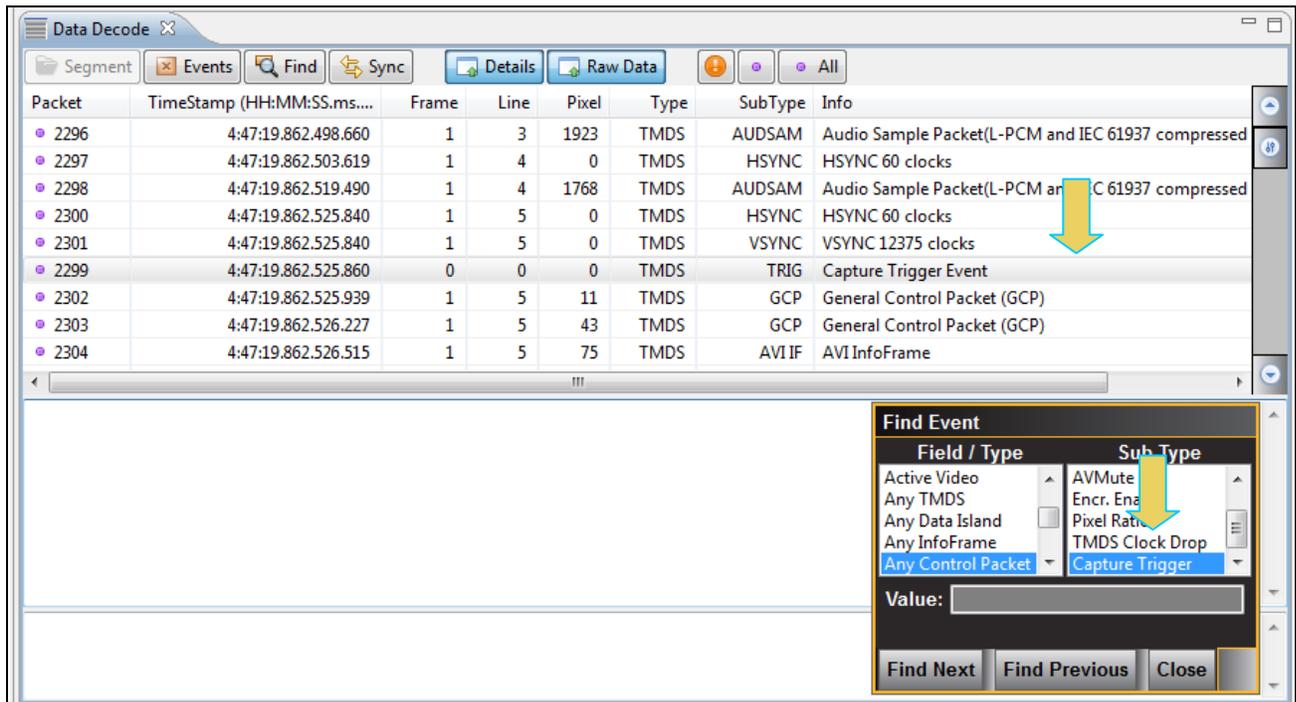


The screenshot shows the Data Decode panel with a search for an Audio Clock Regeneration packet. The search results table is as follows:

Packet	TimeStamp (HH:MM:SS.ms...)	Frame	Line	Pixel	Type	SubType	Info
2272	0:16:15.672.531.090	0	739	2366	TMDS	ACR	Audio Clock Regeneration Packet
2302	0:16:15.672.754.290	1	5	0	TMDS	VSYNC	VSYNC 12375 clocks
2303	0:16:15.672.754.390	1	5	11	TMDS	GCP	General Control Packet (GCP)
2304	0:16:15.672.754.677	1	5	43	TMDS	GCP	General Control Packet (GCP)
2305	0:16:15.672.754.965	1	5	75	TMDS	AVI IF	AVI InfoFrame
2306	0:16:15.672.755.252	1	5	107	TMDS	AUD IF	Audio InfoFrame
2307	0:16:15.672.755.539	1	5	139	TMDS	SPD IF	Source Product Descriptor InfoFrame
2388	0:16:15.673.531.090	1	39	2366	TMDS	ACR	Audio Clock Regeneration Packet
2527	0:16:15.674.531.090	1	84	2366	TMDS	ACR	Audio Clock Regeneration Packet

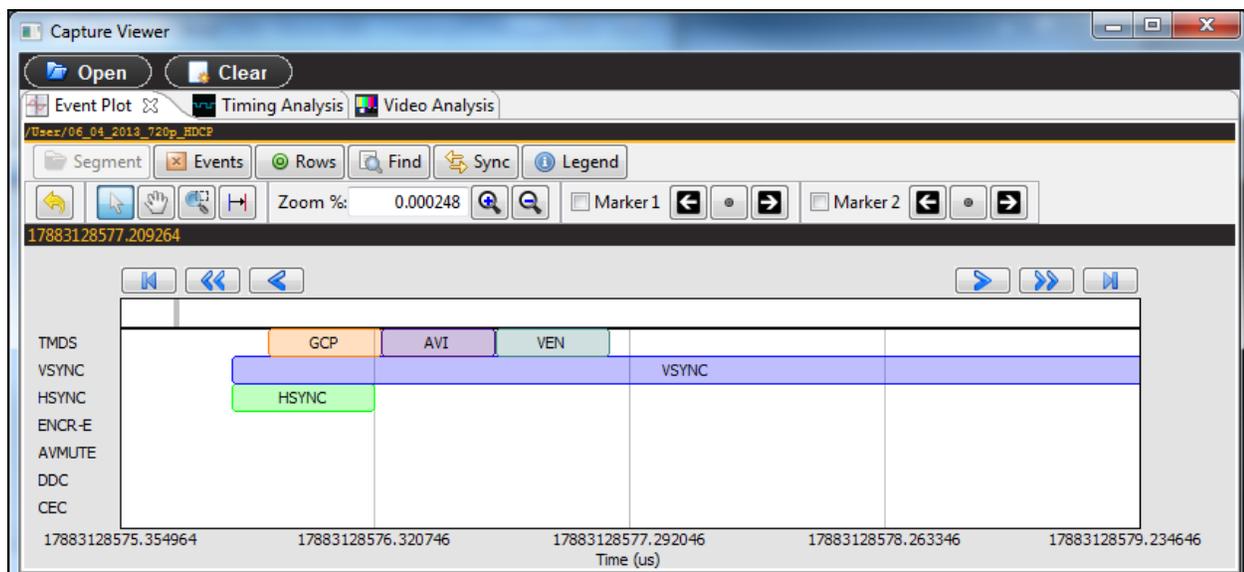
The 'Find Event' dialog box is open, showing search criteria for 'General Control' under the 'Sub-Type' field. The dialog box also includes a 'Value' field and buttons for 'Find Next', 'Find Previous', and 'Close'.

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



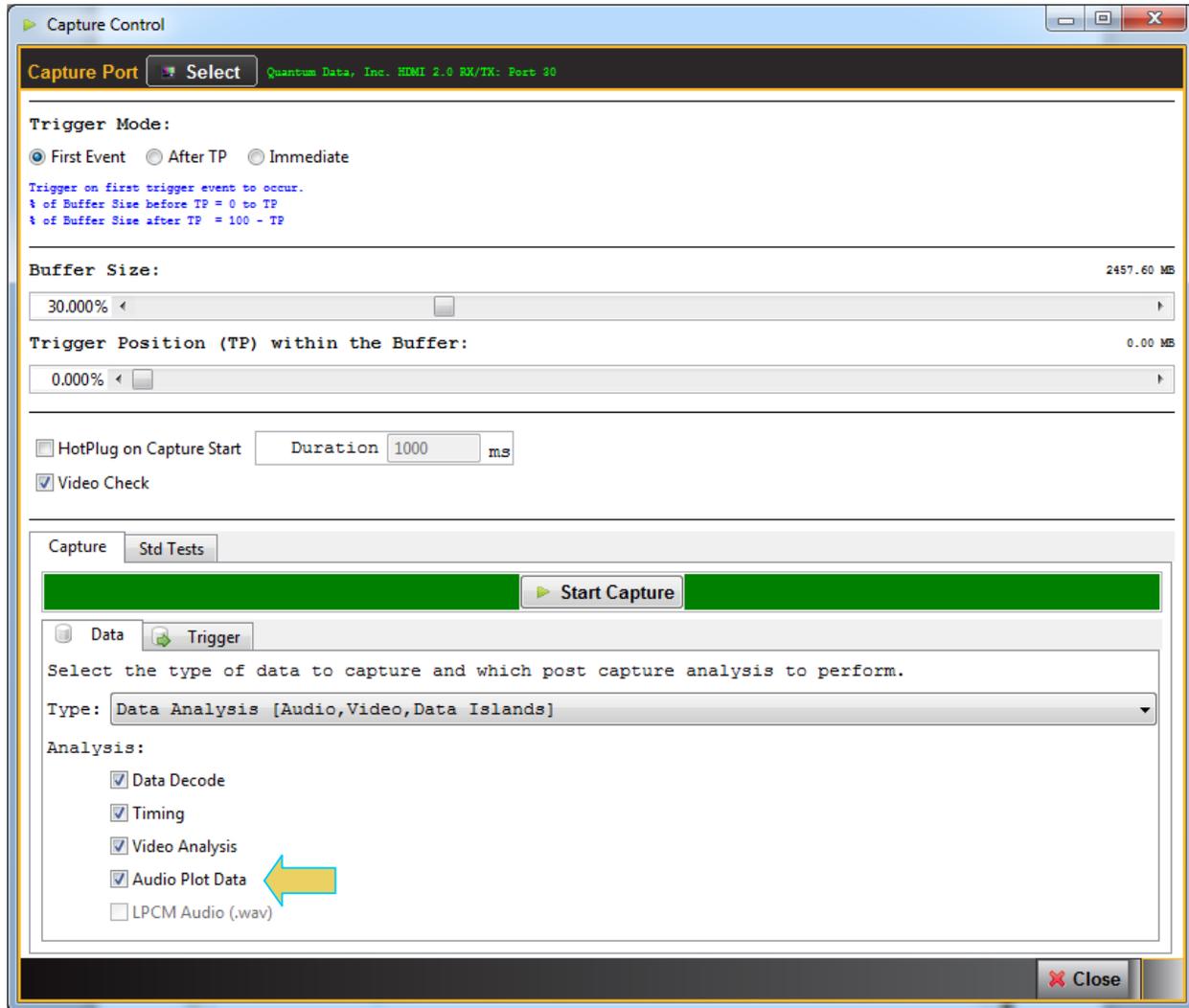
5.7.6 Viewing data through the Event Plot panel

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 time line. A sample screen of the **Event Plot** is shown below. The operation of the **Event Plot** is described at: [Event Plot Panel](#).

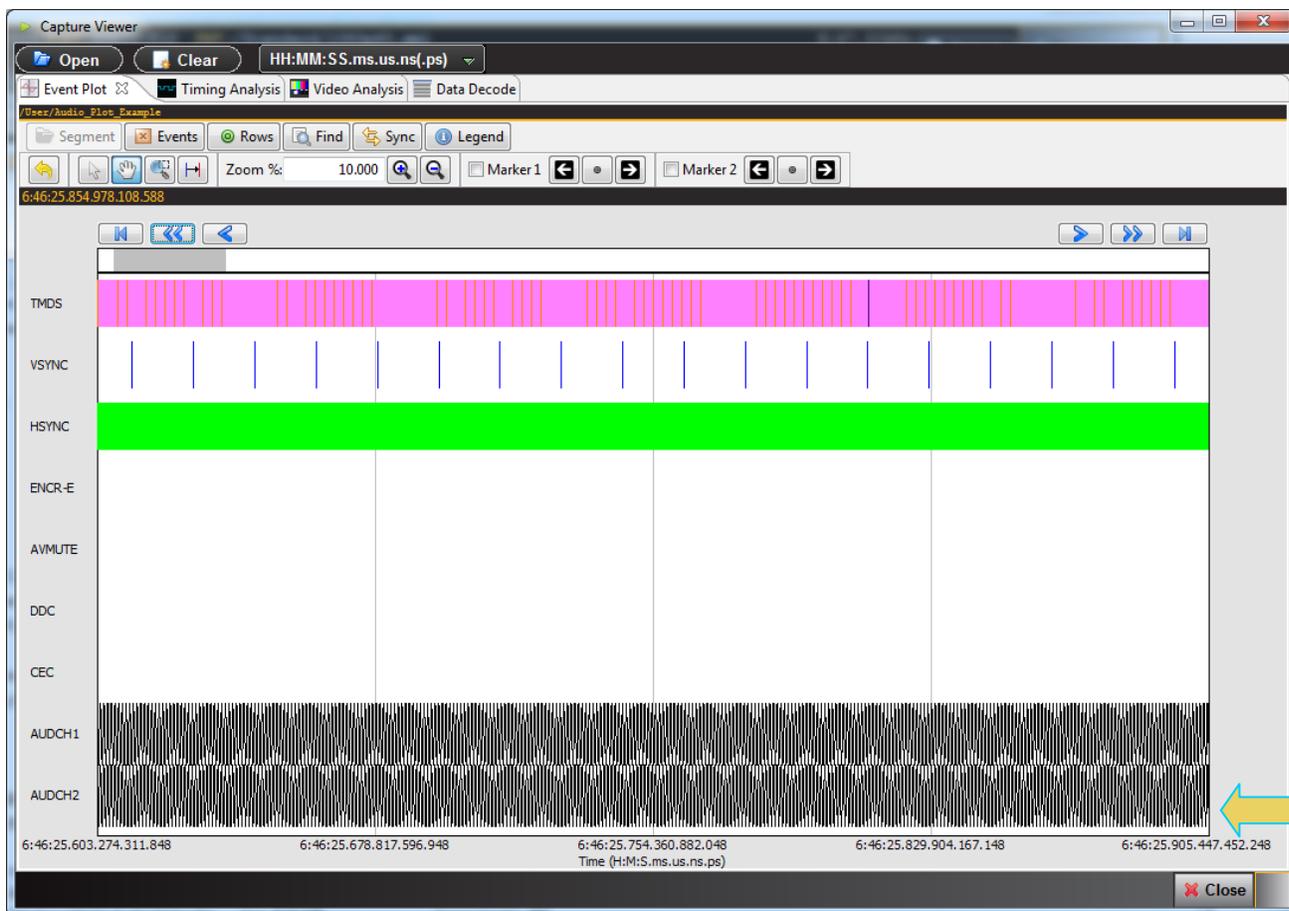


5.7.7 Viewing Audio Plot data through the Event Plot panel

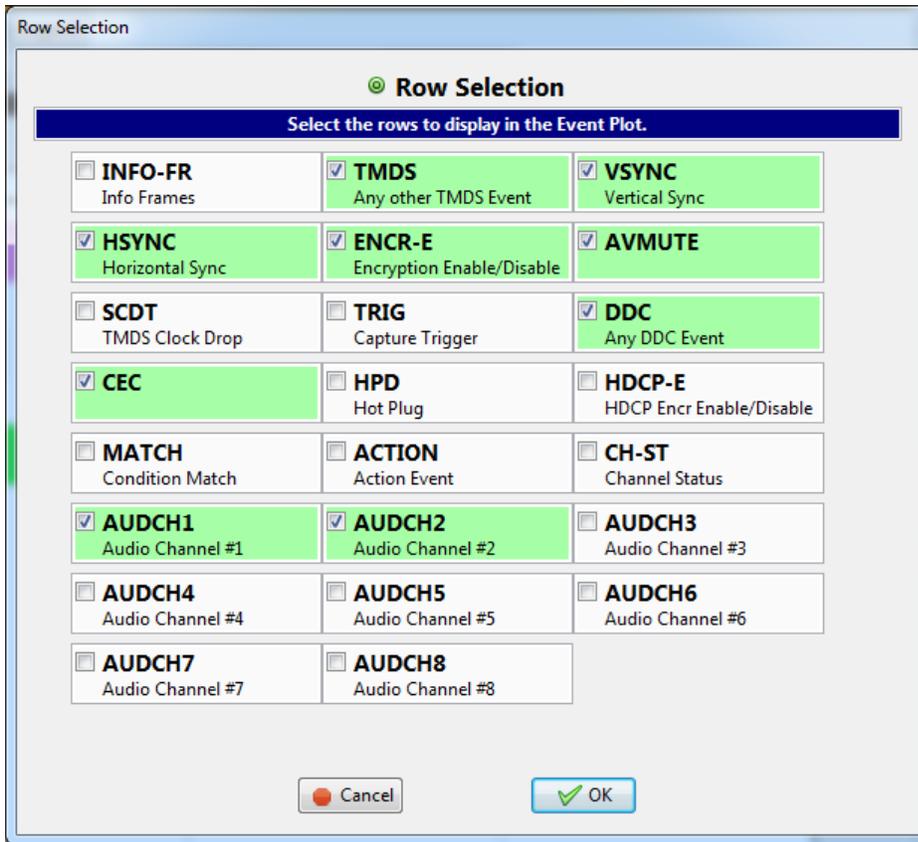
This subsection provides procedures for viewing the Audio Plot data on the **Event Plot** panels in the ATP Manager. You have to have selected Audio Plot Data as indicated below. You can only view LPCM data. You cannot view compressed audio formats.



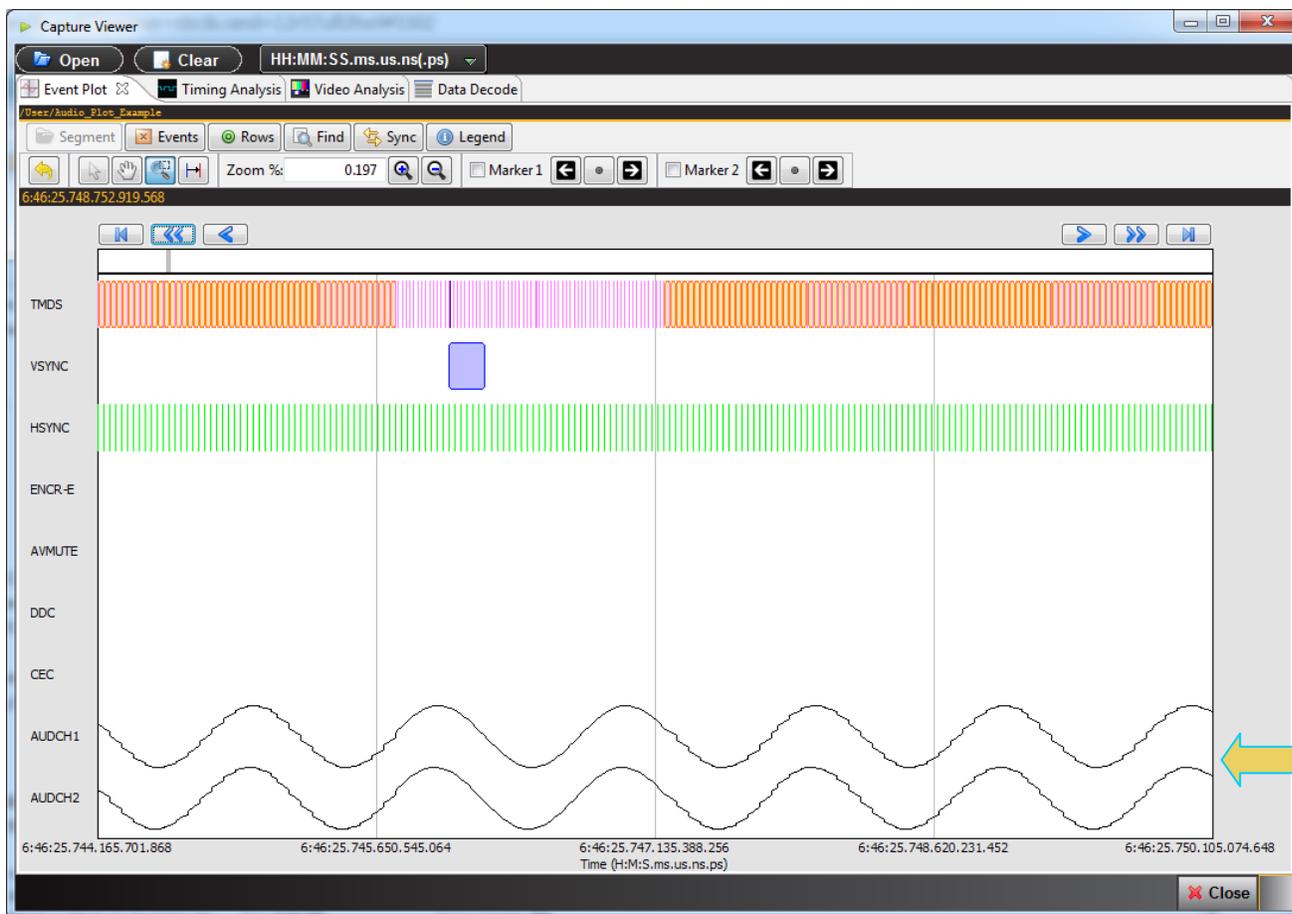
The following screen shot shows an example of the Audio Plot data for 2 channel LPCM.



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



The following screen example shows the same data zoomed in.



6 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.

6.1 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:

1. Set the threshold of the +5V.
2. 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.



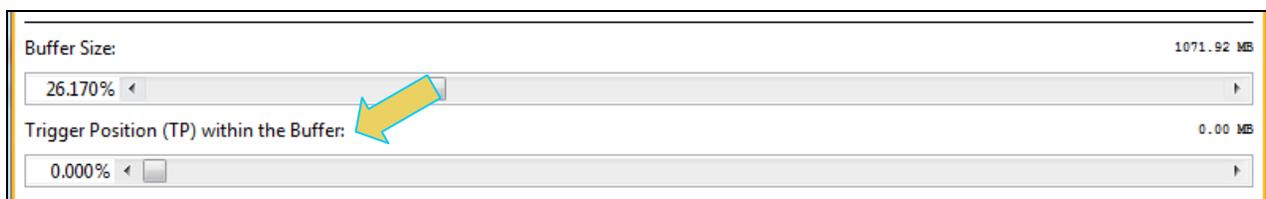
First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slide bar, you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

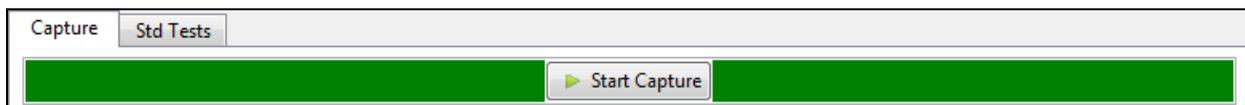
After TP (Trigger Position) – In this setting the trigger condition specified in the Trigger Type pull-down menu will be ignored until data has accumulated in the capture buffer up to the point where the Trigger Position slide-bar is set. Once the data has accumulated to the setting of the Trigger Position, 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).

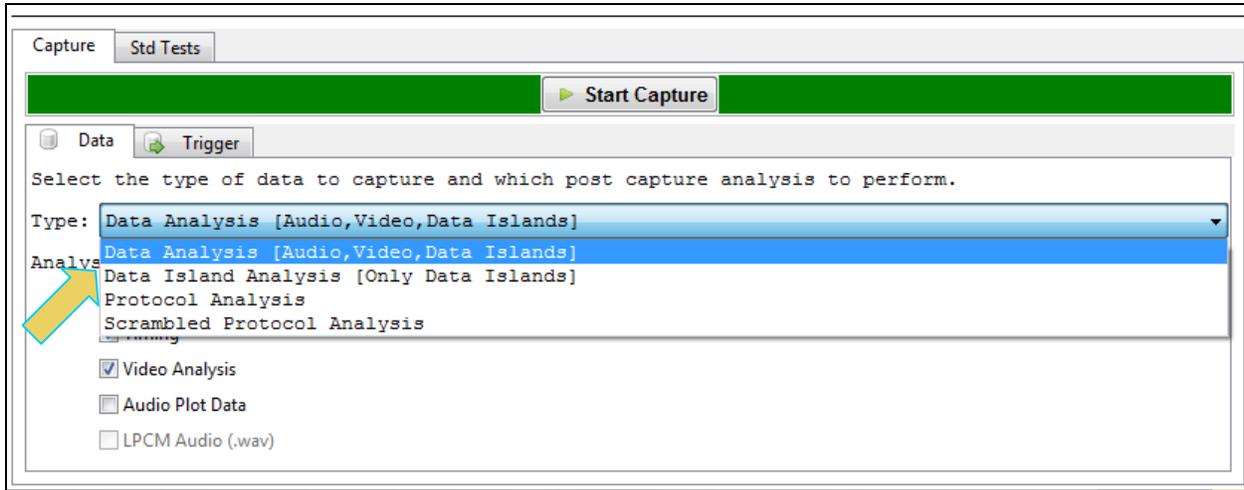
3. Set the **Capture Buffer Size** slidebar to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you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



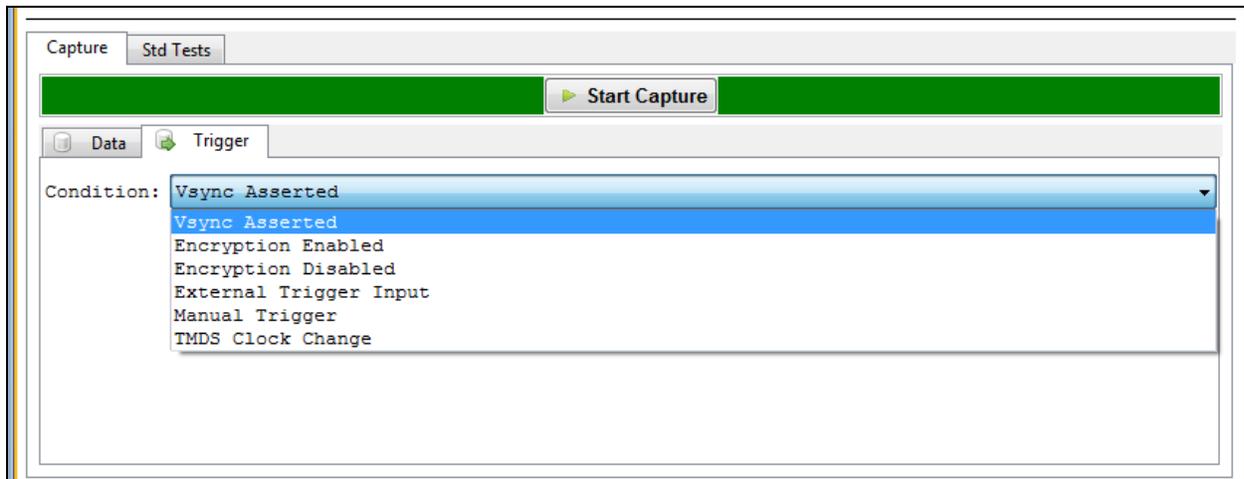
4. Set the **Capture Buffer Position** sidebar to a percent value to meet your requirements. This slide bar enables you to set the position of the trigger event within the captured data. This is a sidebar that provides an indication (on the right) of the location within the captured data, expressed as 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.



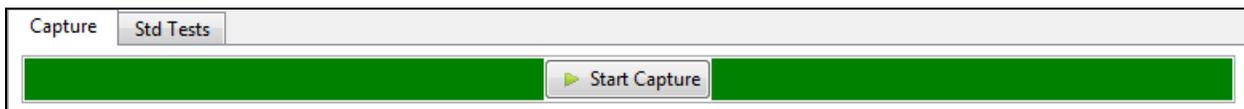
6. Select Data Analysis (Audio, Video, Data Islands) in the **Data Selection Type** pull-down menu provided as shown below. Then make sure you check the **Timing** check box.



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

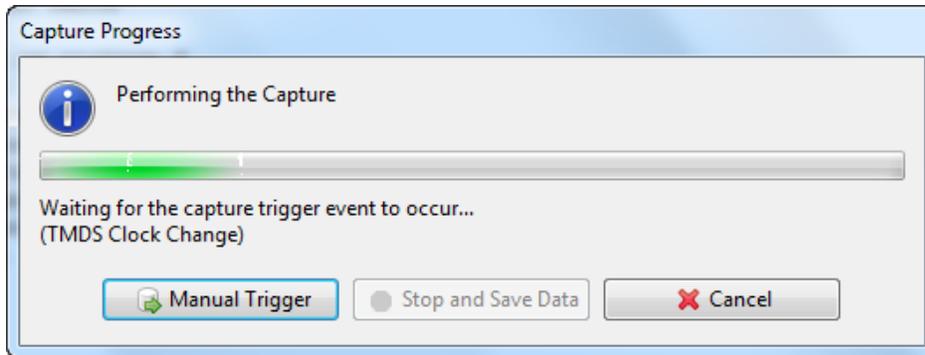


8. Click on the **Execute Capture** button to initiate the test.



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 in order to cause the trigger condition occur, the capture dialog box will indicate that. This is shown in the following screen shot.



When the M41h 48G Video Analyzer/Generator is done 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 screenshot shows the 'Capture Viewer' application window. At the top, there are buttons for 'Open' and 'Clear', and a menu bar with 'Event Plot', 'Timing Analysis', and 'Analysis'. Below this is a file path: '/User/06_04_2013_720p_HDCP'. There are also buttons for 'Frame Stats' and 'Line Stats'. The 'Video Format' section contains a table with columns: Format, VIC, BPP, HFreq (kHz), Interlaced, Htotal, Vtotal, Hactive, Hfront, HSync Width, VActive, Vfront, VSync Width, HSync Polarity, VSync Polarity, and HToVPu. The format is 720p60, VIC is 4, BPP is 24, HFreq is 45.0, and other parameters are listed. Below this is the 'Frame Statistics' section with a 'Sync' button and a table with columns: CEA Name, Frame, TimeStamp (HH:MM:SS.ms.us.ns), Duration (HH:MM:SS.ms.us.ns), VFreq (Hz), HFreq (kHz), Vtotal, Vactive, and Pix Freq (M...). The table lists frames 0 through 8. Below that is the 'Line Statistics' section with a 'Sync' button and a table with columns: Frame, Line, TimeStamp (HH:MM:SS.ms.us.ns), Duration (HH:MM:SS.ms.us.ns), HTotal, TMDS HTotal, HSync Width, HBack, and HActive. The table lists lines 000 through 012. A 'Close' button is in the bottom right corner. Three yellow arrows point to the 'Analysis' menu, the 'Frame Stats' button, and the 'Frame Statistics' table.

Format	VIC	BPP	HFreq (kHz)	Interlaced	Htotal	Vtotal	Hactive	Hfront	HSync Width	VActive	Vfront	VSync Width	HSync Polarity	VSync Polarity	HToVPu
720p60	4	24	45.0	No	1650	750	1280	110	40	720	5	8250	Positive	Positive	

CEA Name	Frame	TimeStamp (HH:MM:SS.ms.us.ns)	Duration (HH:MM:SS.ms.us.ns)	VFreq (Hz)	HFreq (kHz)	Vtotal	Vactive	Pix Freq (M...)
1280x720p 59.94/60Hz	0	4:58:3.078.576.693	0:0:0.016.666.000	60.00	44.70	745	720	74.251
1280x720p 59.94/60Hz	1	4:58:3.095.243.055	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	2	4:58:3.111.909.415	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	3	4:58:3.128.575.775	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	4	4:58:3.145.242.138	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	5	4:58:3.161.908.498	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	6	4:58:3.178.574.860	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	7	4:58:3.195.241.220	0:0:0.016.666.000	60.00	45.00	750	720	74.251
1280x720p 59.94/60Hz	8	4:58:3.211.907.580	0:0:0.016.666.000	60.00	45.00	750	720	74.251

Frame	Line	TimeStamp (HH:MM:SS.ms.us.ns)	Duration (HH:MM:SS.ms.us.ns)	HTotal	TMDS HTotal	HSync Width	HBack	HActive
4	000	4:58:3.161.797.387	0:0:0.000.022.222	1650	1650	40	0	0
4	001	4:58:3.161.819.610	0:0:0.000.022.222	1650	1650	40	0	0
4	002	4:58:3.161.841.832	0:0:0.000.022.222	1650	1650	40	0	0
4	003	4:58:3.161.864.052	0:0:0.000.022.225	1650	1650	40	0	0
4	004	4:58:3.161.886.277	0:0:0.000.022.220	1650	1650	40	0	0
4	005	4:58:3.161.908.497	0:0:0.000.022.222	1650	1650	40	0	0
4	006	4:58:3.161.930.720	0:0:0.000.022.222	1650	1650	40	0	0
4	007	4:58:3.161.952.942	0:0:0.000.022.220	1650	1650	40	0	0
4	008	4:58:3.161.975.162	0:0:0.000.022.223	1650	1650	40	0	0
4	009	4:58:3.161.997.385	0:0:0.000.022.222	1650	1650	40	0	0
4	010	4:58:3.162.019.607	0:0:0.000.022.222	1650	1650	40	0	0
4	011	4:58:3.162.041.830	0:0:0.000.022.220	1650	1650	40	0	0
4	012	4:58:3.162.064.050	0:0:0.000.022.222	1650	1650	40	0	0

The screen shot of the Timing Analysis panel below shows an example of a 6G timing data.

The screenshot displays the 'Timing Analysis' panel in the Capture Viewer software. It shows the video format and frame statistics for a 3840x2160p @ 59.94Hz/60Hz signal. A yellow arrow points to the 'Pix Freq (M...)' column in the video format table.

Format	VIC	BPP	HFreq (kHz)	Interlaced	Htotal	Vtotal	Hactive	Hfront	HSync Width	Vactive	Vfront	VSync Wi...	HSync Polarity	VSync Polarity	HToVPulse Del...	Pix Freq (M...
VIC97	97	24	135.0	No	4400	2250	3840	176	88	2160	8	44000	Positive	Positive	0	593.996

CEA Name	Frame	TimeStamp (HH:M...	Duration (HH:M...	VFreq (Hz)	HFreq (kHz)	Vtotal	Vactive	Pix Freq (M...	HSync Wi...	VSync	Start Video ...	HToVD
3840x2160p @ 59.94Hz/60Hz	0	6:45:25.565.152.007	0:0:0.016.666.000	60.00	135.00	2250	2160	593.996	88	10		82
3840x2160p @ 59.94Hz/60Hz	1	6:45:25.581.818.780	0:0:0.016.666.000	60.00	135.00	2250	2160	593.996	88	10		82

Frame	Line	TimeStamp (HH:MM:SS.ms....	Duration (HH:MM:SS.ms.us....	HTotal	TMDS HTotal	HSync Width	HBack	HActive
0	000	6:45:25.565.152.007	0:0:0.000.007.408	4400	4400	88	0	0
0	001	6:45:25.565.159.415	0:0:0.000.007.408	4400	4400	88	0	0
0	002	6:45:25.565.166.822	0:0:0.000.007.410	4400	4400	88	0	0
0	003	6:45:25.565.174.232	0:0:0.000.007.405	4400	4400	88	0	0
0	004	6:45:25.565.181.637	0:0:0.000.007.408	4400	4400	88	0	0
0	005	6:45:25.565.189.045	0:0:0.000.007.407	4400	4400	88	0	0
0	006	6:45:25.565.196.452	0:0:0.000.007.408	4400	4400	88	0	0
0	007	6:45:25.565.203.860	0:0:0.000.007.408	4400	4400	88	0	0
0	008	6:45:25.565.211.267	0:0:0.000.007.407	4400	4400	88	0	0
0	009	6:45:25.565.218.675	0:0:0.000.007.408	4400	4400	88	0	0
0	010	6:45:25.565.226.082	0:0:0.000.007.408	4400	4400	88	0	0
0	011	6:45:25.565.233.490	0:0:0.000.007.407	4400	4400	88	0	0
0	012	6:45:25.565.240.897	0:0:0.000.007.408	4400	4400	88	0	0
0	013	6:45:25.565.248.305	0:0:0.000.007.408	4400	4400	88	0	0
0	014	6:45:25.565.255.712	0:0:0.000.007.407	4400	4400	88	0	0
0	015	6:45:25.565.263.120	0:0:0.000.007.408	4400	4400	88	0	0
0	016	6:45:25.565.270.527	0:0:0.000.007.408	4400	4400	88	0	0
0	017	6:45:25.565.277.935	0:0:0.000.007.407	4400	4400	88	0	0
0	018	6:45:25.565.285.342	0:0:0.000.007.408	4400	4400	88	0	0
0	019	6:45:25.565.292.750	0:0:0.000.007.408	4400	4400	88	0	0
0	020	6:45:25.565.300.157	0:0:0.000.007.407	4400	4400	88	0	0
0	021	6:45:25.565.307.565	0:0:0.000.007.408	4400	4400	88	0	0
0	022	6:45:25.565.314.972	0:0:0.000.007.408	4400	4400	88	0	0
0	023	6:45:25.565.322.380	0:0:0.000.007.408	4400	4400	88	0	0

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

The screenshot shows the 'Capture Viewer' application window. At the top, there are buttons for 'Open' and 'Clear', and a file path 'HH:MM:SS.ms.us.ns(.ps)'. Below this, there are tabs for 'Event Plot', 'Timing Analysis', and 'Video Analysis'. The 'Video Analysis' tab is active, showing a 'Video Format' table and two statistics tables: 'Frame Statistics' and 'Line Statistics'.

Video Format Table:

Format	VIC	BPP	HFreq (kHz)	Interlaced	Htotal	Vtotal	Hactive	Hfront	HSync Width	VActive	Vfront	VSync Width	HSync Polarity	VSync Polarity	HToVPulse Del...	Pix Freq (MHz)
VIC97	0	24	135.0	No	4400	2250	3840	176	88	2160	8	44000	Positive	Positive	0	593.995

Frame Statistics Table:

Frame	TimeStamp (HH:M...	Duration (HH:M...	VFreq (Hz)	HFreq (kHz)	Vtotal	Vactive	Pix Freq (M...	HSync Wi...	VSync	Start Video ...	HToVDelay	Encr Sta
0	2:30:28.523.318.975	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
1	2:30:28.539.985.773	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
2	2:30:28.556.652.570	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
3	2:30:28.573.319.368	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
4	2:30:28.589.986.165	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
5	2:30:28.606.652.960	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
6	2:30:28.623.319.757	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
7	2:30:28.639.986.555	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	
8	2:30:28.656.653.353	0:0:0.016.666.000	60.00	135.00	2250	2160	593.995	88	10	90	0	

Line Statistics Table:

Frame	Line	TimeStamp (HH:MM:SS.ms.us.ns)	Duration (HH:MM:SS.ms.us.ns)	HTotal	TMDS HTotal	HSync Width	HBack	HActive
1	000	2:30:28.539.926.512	0:0:0.000.007.407	4400	4400	88	0	0
1	001	2:30:28.539.933.920	0:0:0.000.007.407	4400	4400	88	0	0
1	002	2:30:28.539.941.327	0:0:0.000.007.408	4400	4400	88	0	0
1	003	2:30:28.539.948.735	0:0:0.000.007.407	4400	4400	88	0	0
1	004	2:30:28.539.956.142	0:0:0.000.007.407	4400	4400	88	0	0
1	005	2:30:28.539.963.550	0:0:0.000.007.408	4400	4400	88	0	0
1	006	2:30:28.539.970.957	0:0:0.000.007.407	4400	4400	88	0	0
1	007	2:30:28.539.978.365	0:0:0.000.007.408	4400	4400	88	0	0
1	008	2:30:28.539.985.772	0:0:0.000.007.407	4400	4400	88	0	0
1	009	2:30:28.539.993.180	0:0:0.000.007.407	4400	4400	88	0	0
1	010	2:30:28.540.000.587	0:0:0.000.007.408	4400	4400	88	0	0
1	011	2:30:28.540.007.995	0:0:0.000.007.407	4400	4400	88	0	0
1	012	2:30:28.540.015.402	0:0:0.000.007.407	4400	4400	88	0	0

A yellow arrow points to the 'Pix Freq (MHz)' column in the Video Format table.

6.2 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 **Data Decode** panel to view the transactions for that frame. The **Video Analysis** panel can synchronize with the **Data Decode** panel by pressing the ALT key and clicking on a frame. You can also synchronize by activating the sync button  on the upper left side of the **Data Decode** panel. Once you synchronize the **Data Decode** panel to a frame you can view the transactions for that frame in the **Data 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:

1. Set the threshold of the +5V.
2. 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.



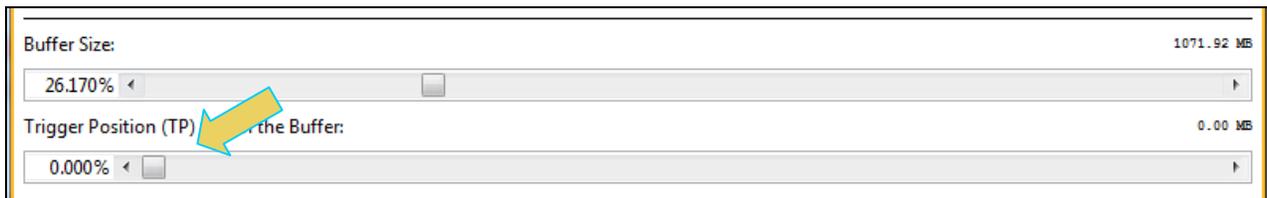
First Event – The trigger occurs on the first event—first occurrence—of the trigger condition defined in the Trigger Type pull-down menu (Vsync, encryption Enabled, Encryption Disabled, External Trigger, Manual Trigger, TMDS Clock Change). Depending on the setting of the Trigger Position slide bar, you 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 slide-bar is set. Once the data has accumulated to the setting of the Trigger Position, any event matching the

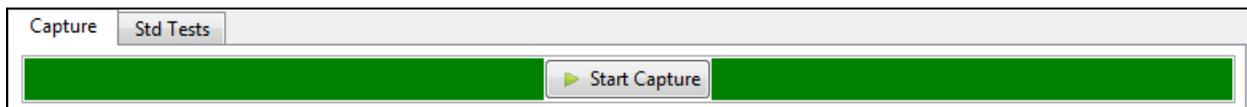
Trigger Type specified will cause a trigger condition and data accumulation will begin. Some of the data in the capture buffer will be data that has accumulated prior to the trigger condition being met and some of the data in the capture buffer will be data that has accumulated after the trigger condition 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).

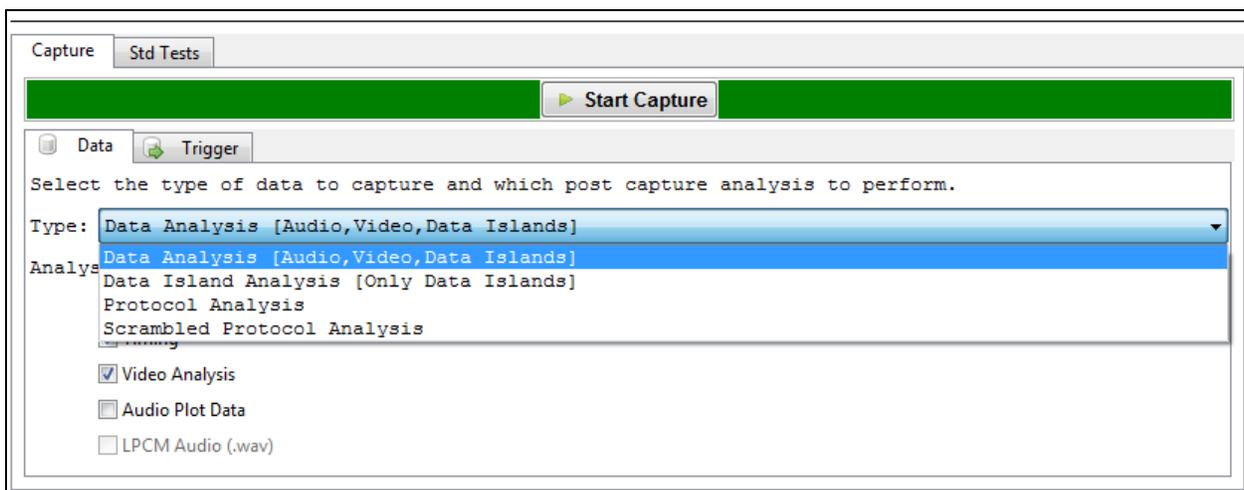
1. Set the **Capture Buffer Size** sliderbar to a percent value to meet your requirements. You can capture up to about 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you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



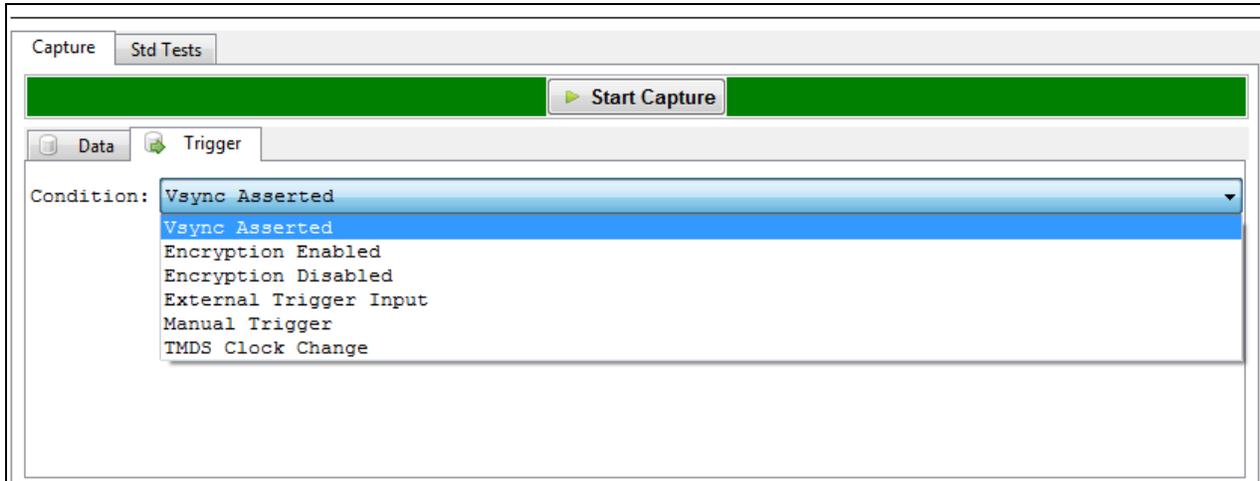
3. Set the **Capture Buffer Position** sliderbar to a percent value to meet your requirements. This slide bar enables you to set the position of the trigger event within the captured data. This is a sliderbar that provides an indication (on the right) of the location within the captured data, expressed 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.
4. Select the **Capture** tab under the **Options** section of the **Capture Control** panel.



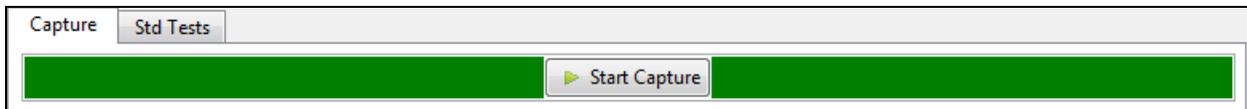
5. Select Data Analysis (Audio, Video, Data Islands) in the **Data Selection Type** pull-down menu provided as shown below. Then make sure you check the **Video Analysis** check box.



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

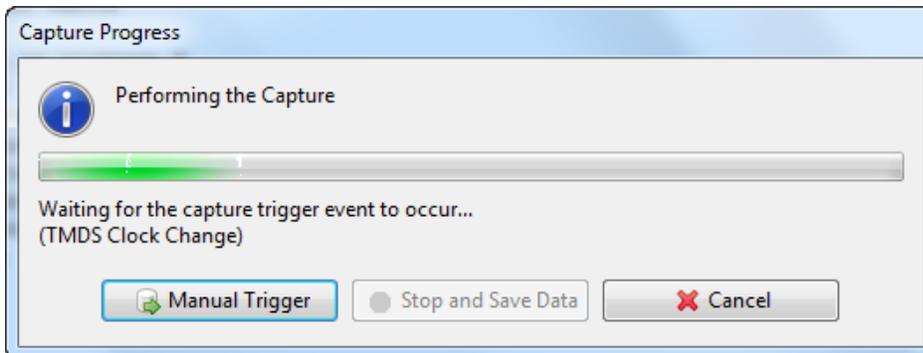


- Click on the **Execute Capture** button to initiate the test.

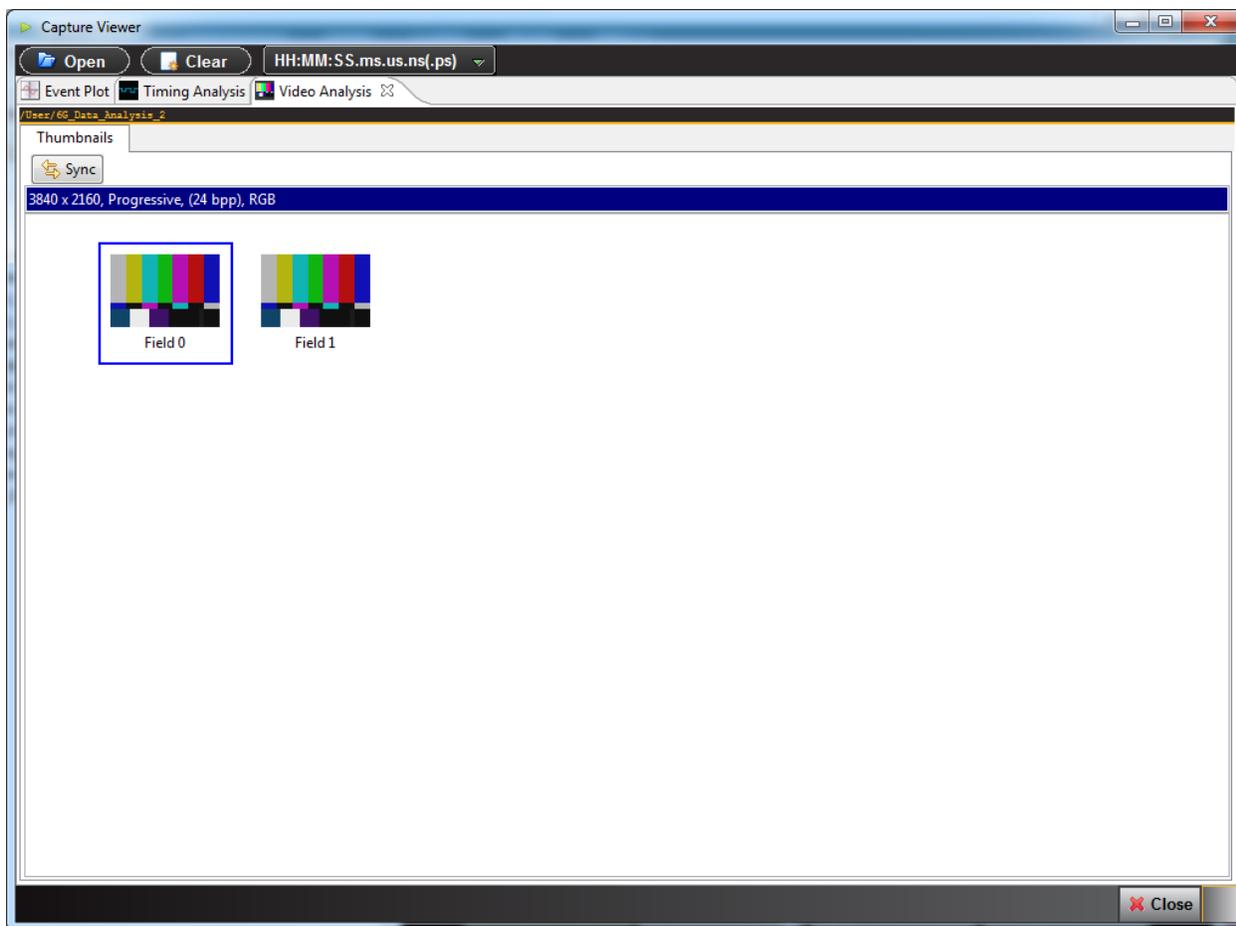


The M41h 48G Video Analyzer/Generator will capture the data including the video data. A series of dialog boxes will appear showing the capturing in progress (one example shown below).

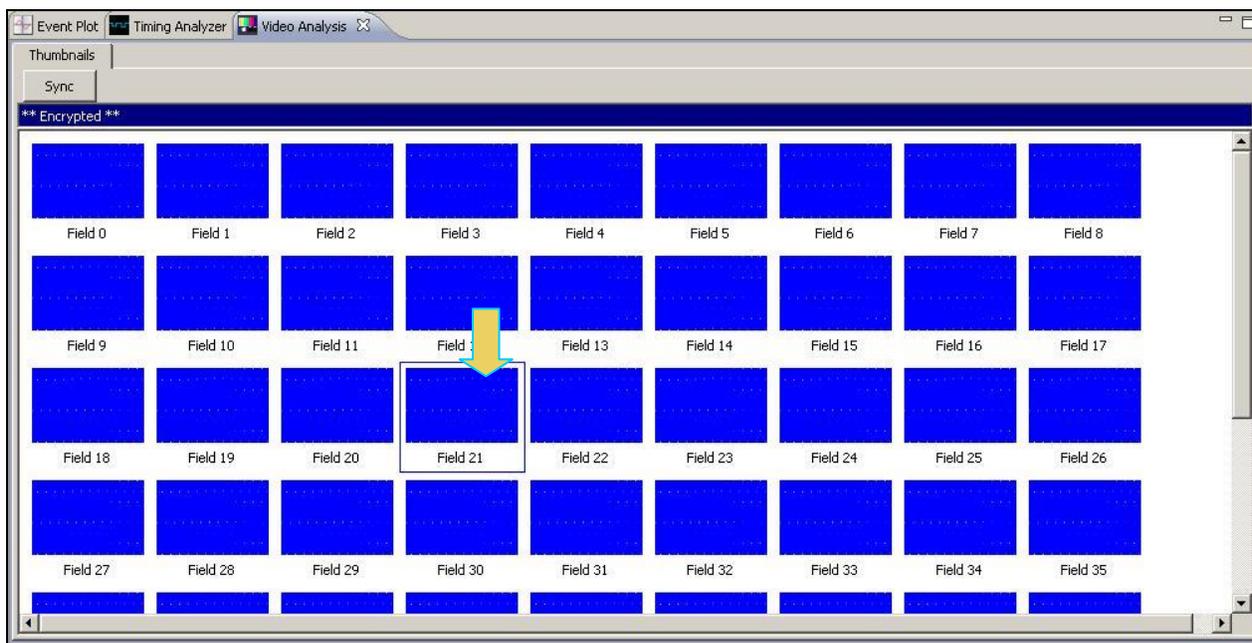
Note: If there is some action that needs to be taken by a user in order to cause the trigger condition occur, the capture dialog box will indicate that. This is shown in the following screen shot.



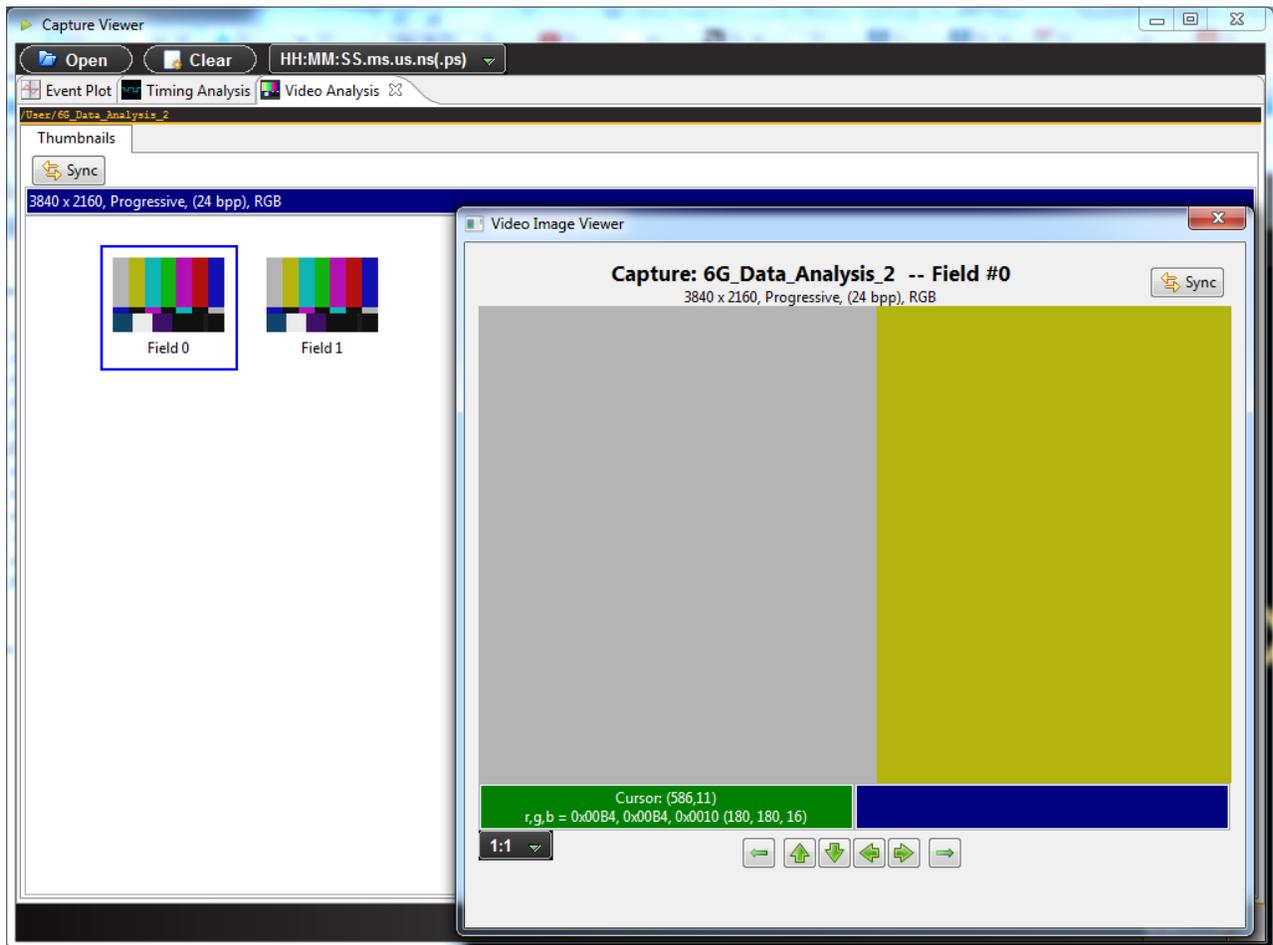
When the M41h 48G Video Analyzer/Generator is done capturing data you can view the video thumbnails in the **Video Analysis** panel. The **Video Analysis** panel enables you to view the captured video images. It provides thumbnails of each captured frame.



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



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



The **Video Analysis** panel enables you 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 thick green arrow buttons



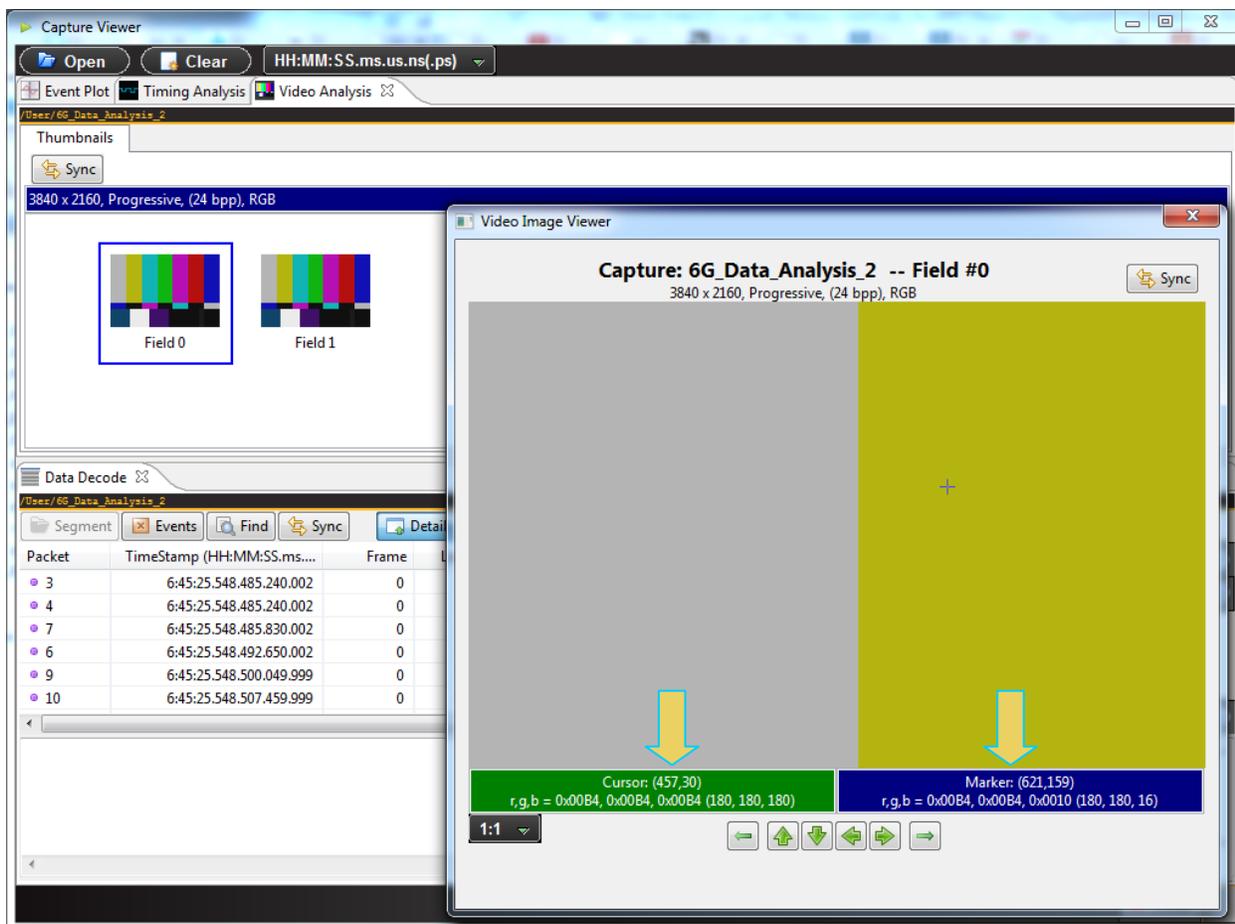
on the bottom of the **Video Image Viewer** panel.

You can advance to the image of an adjacent frame (earlier or later) using the thin green arrow buttons



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

These are shown in the screen image below.



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

The **Video Analysis** panel can synchronize with the **Data Decode** panel by pressing the ALT key and clicking on a frame. You can also synchronize by activating the sync button  on the upper left side of the **Data Decode** panel.

6.3 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:

1. Set the threshold of the +5V.
2. Configure the M41h 48G Video Analyzer/Generator Rx port with the proper EDID.

To run the audio analysis test:

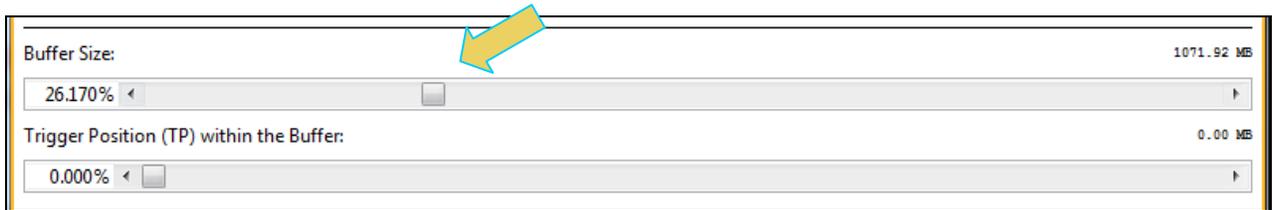
1. Select the M41h 48G Video Analyzer/Generator that you are using to capture the data from your HDMI source device under test from the pull-down menu.



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

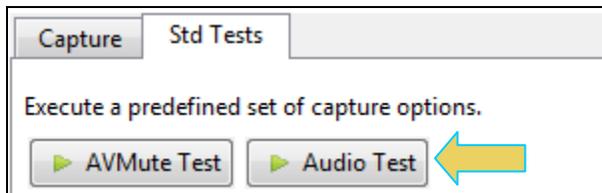


- Set the **Capture Buffer Size** sliderbar to a percent value to meet your requirements. You can capture up to 4GB of data which is about 2300 frames at 576p/480p and about 400 frames at 1080p which includes the video. If you do not want to capture the video and only capture the metadata, you can store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



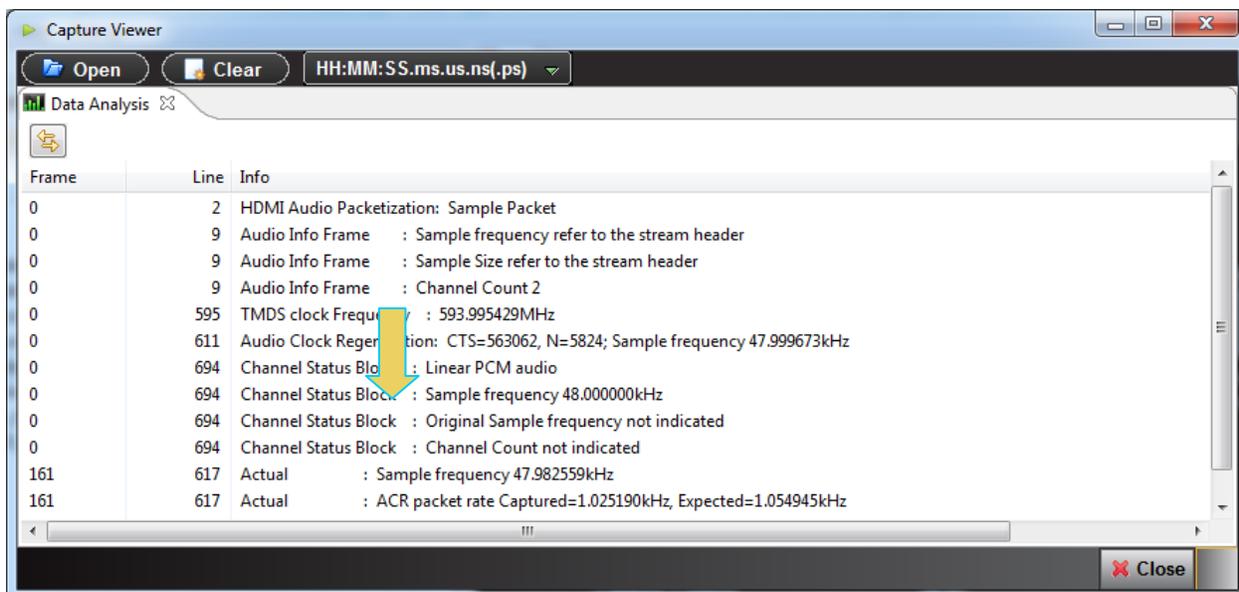
Note: You do not need to set the **Trigger Position** or the **Trigger Selection** when running the **Audio Analysis** test. The Trigger Position is always reset to 0% and the **Trigger Selection** is set to Vsync. These settings occur as part of the test when you initiate the test.

- 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.



7 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.

7.1 EARC Tx Functional Testing

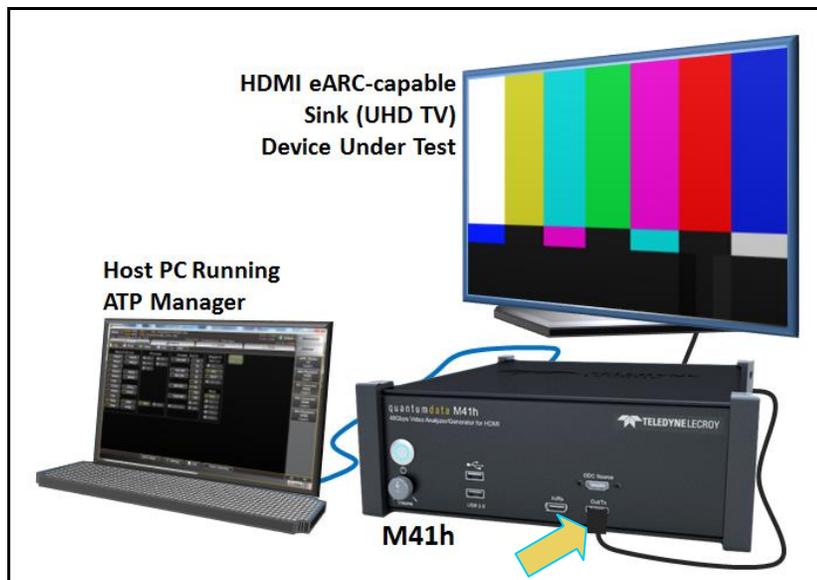
This subsection provides procedures on testing eARC Tx devices. The M41h 48G Video Analyzer/Generator provides eARC Rx emulation and diagnostic testing to run functional verification tests on eARC Tx devices such as eARC capable UHD TVs. You can monitor the Common mode transactions and view the audio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

3. Access the eARC Slave (Rx) control panel from the **Card Control** panel as shown below.

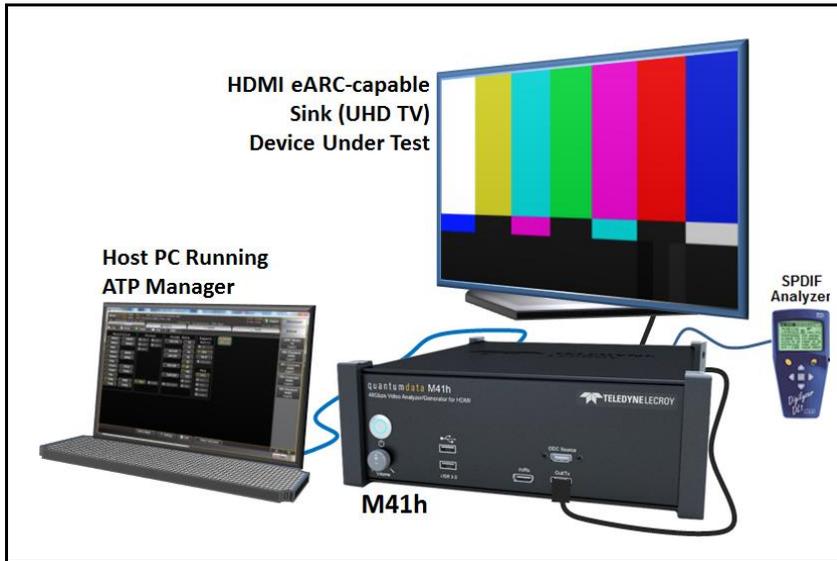


The eARC Slave Control dialog box will appear as shown below.

4. Select the LPCM 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.



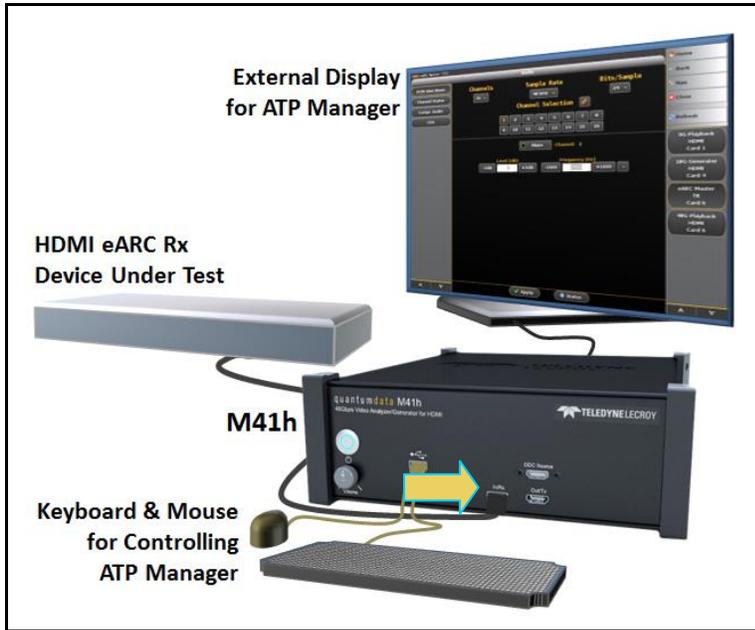
7.2 EARC Rx Functional Testing

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.

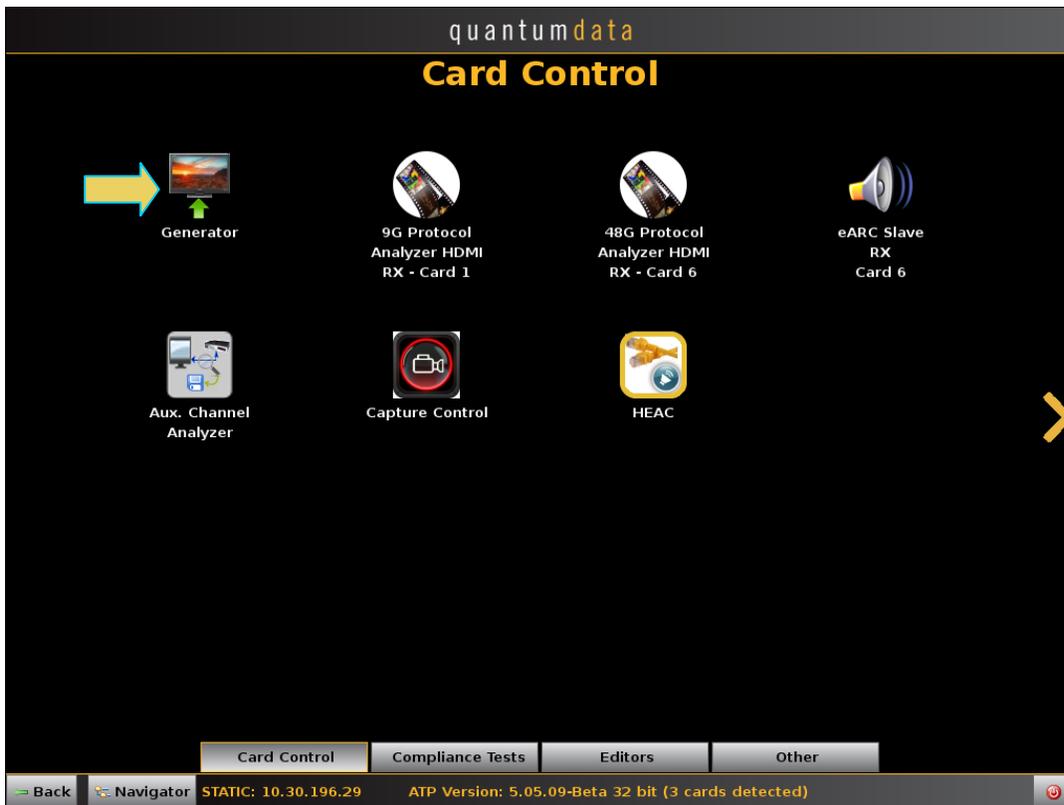
1. Establish the physical connection from the eARC Rx DUT to the M41h 48G Video Analyzer/Generator's HDMI Input port.
2. Prior to making the physical connection, you can initiate the Aux Channel Analyzer utility to monitor the eARC Common mode transactions. See the subsection below.

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.

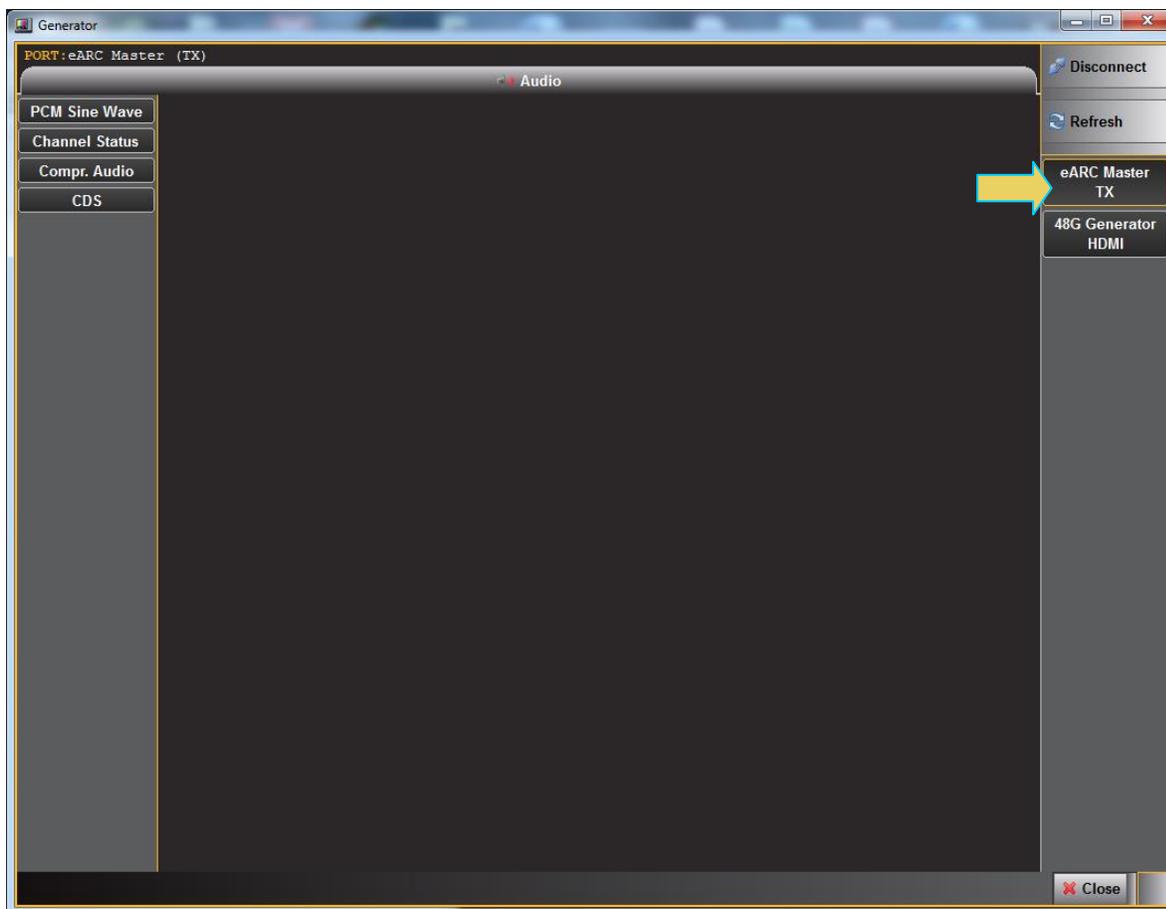


Setup for Testing eARC Rx devices

3. Access the eARC Master (Tx) control panel from the Card Control panel as shown below.

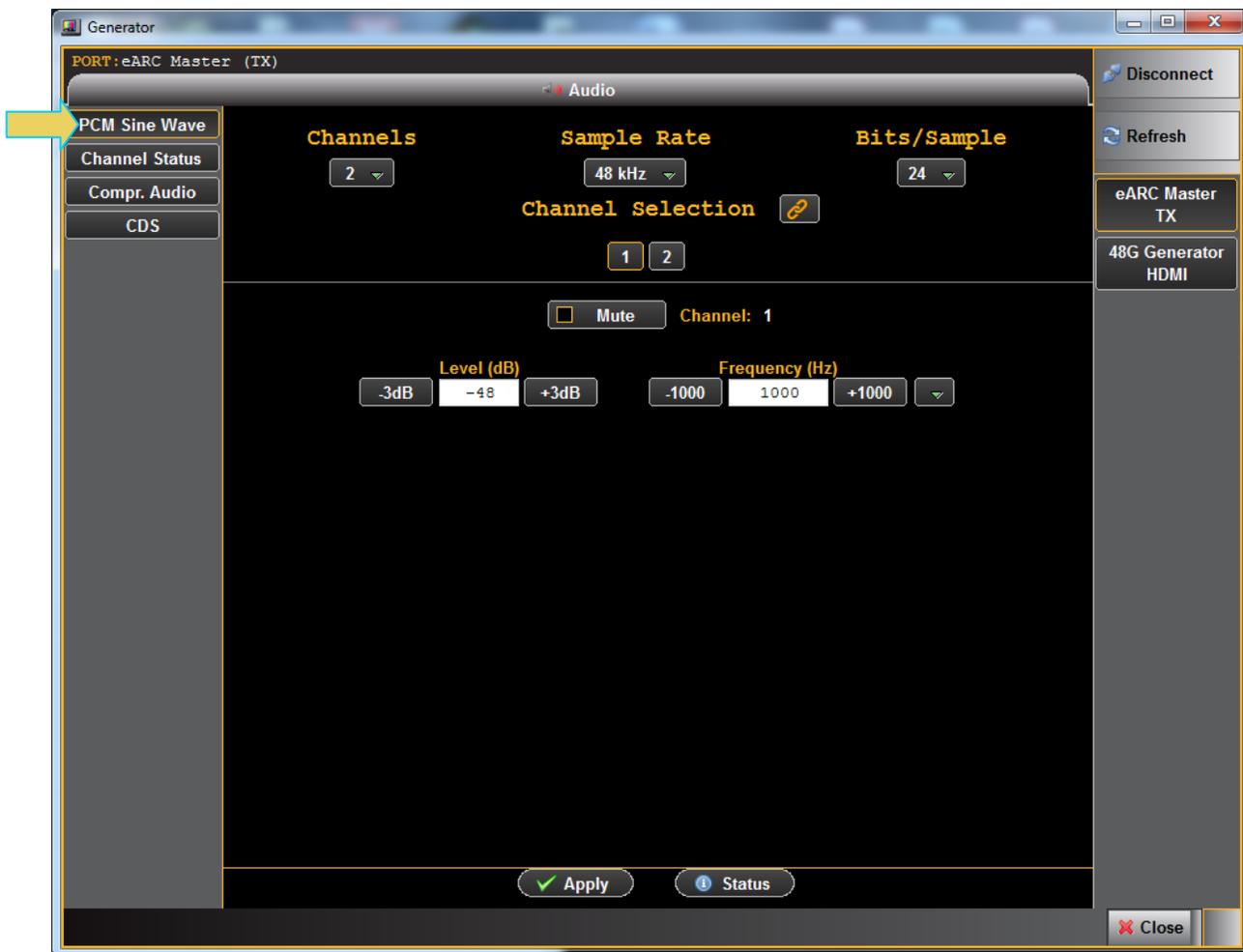


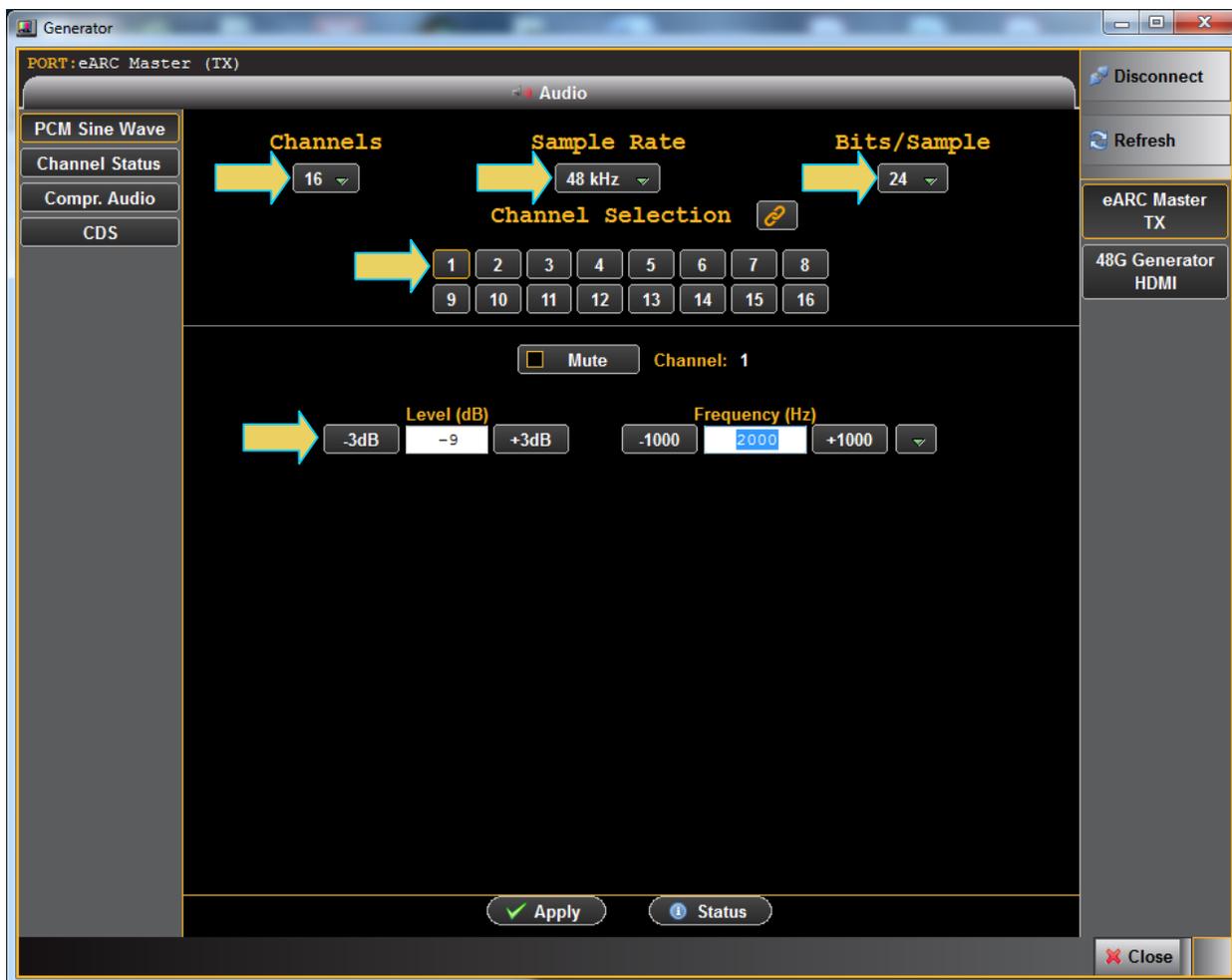
4. Click on the Generator and select eARC Tx Master as shown below.



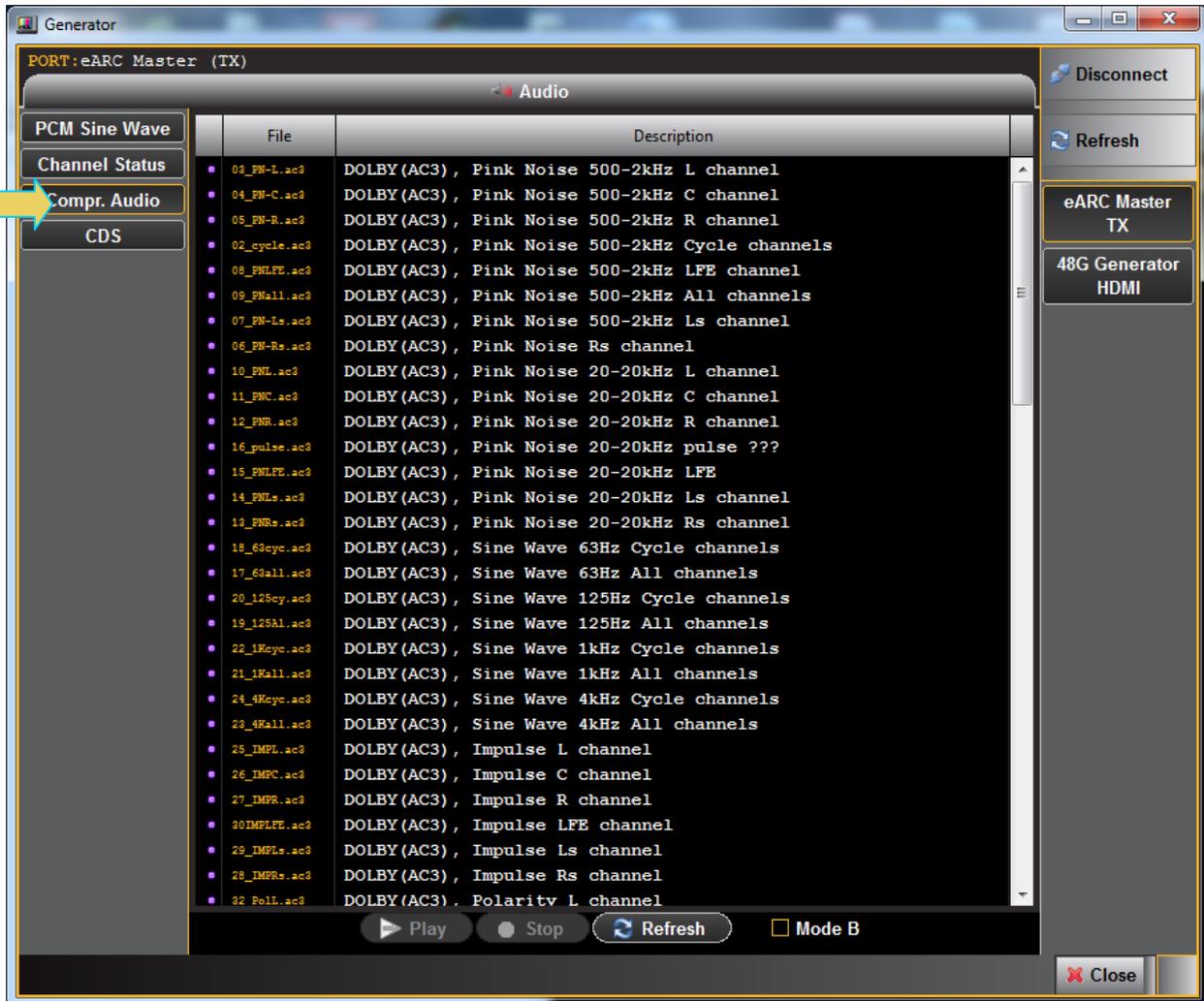
5. Click on the PCM Sine Wave button to select the LPCM audio to transmit out the eARC Differential mode channel.

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.

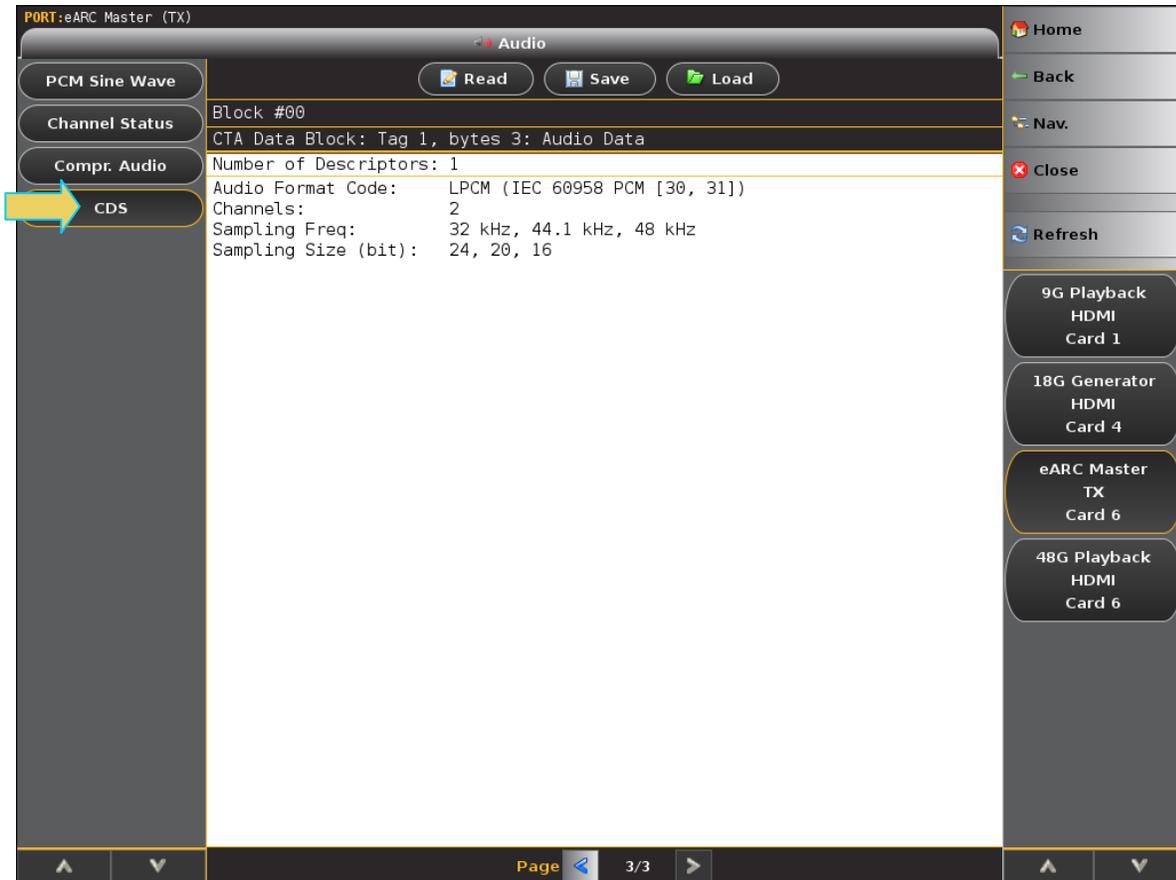




You can also transmit compressed audio files, but Dolby and DTS formats, out the eARC channel.



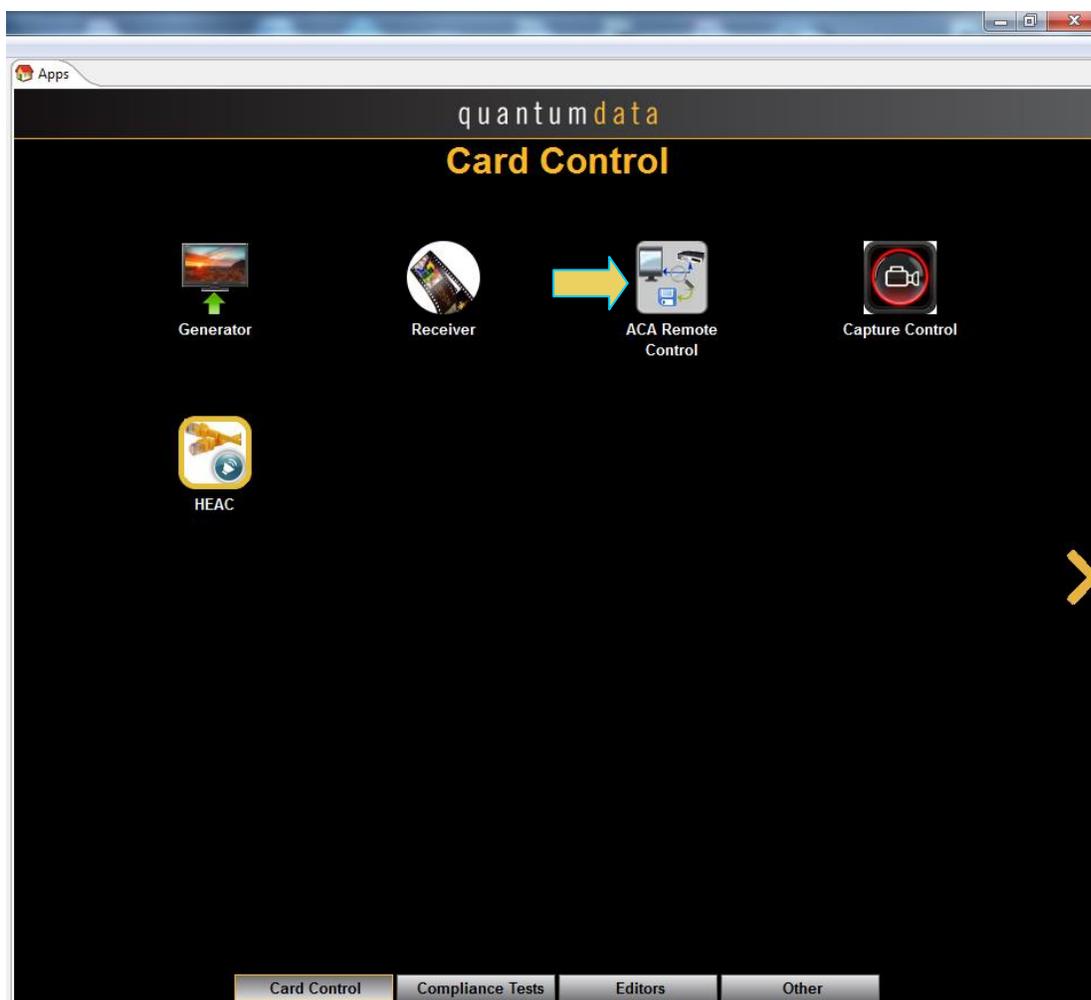
- View the Capabilities Data Structure (CDS) of the connected eARC Rx device. The CDS shows the audio capabilities of the eARC Rx device.



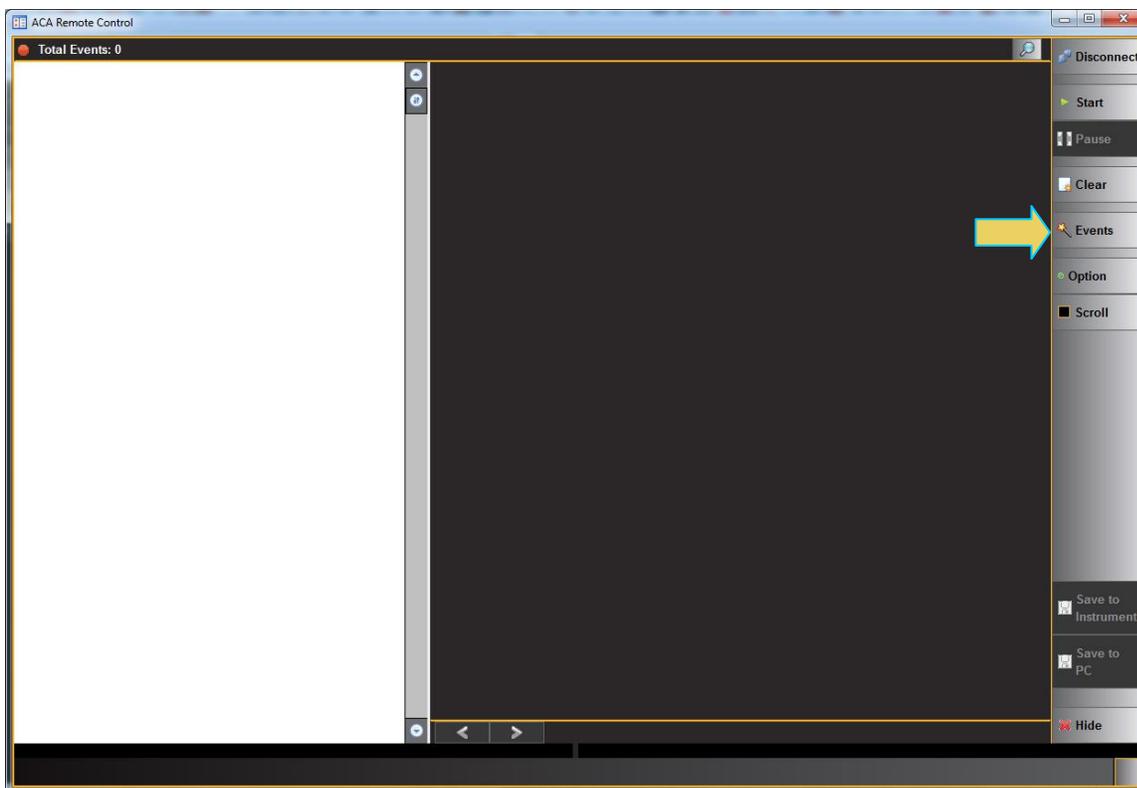
7.3 Monitoring the EARC Common Mode Transactions

The eARC common mode transactions can be monitored 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.

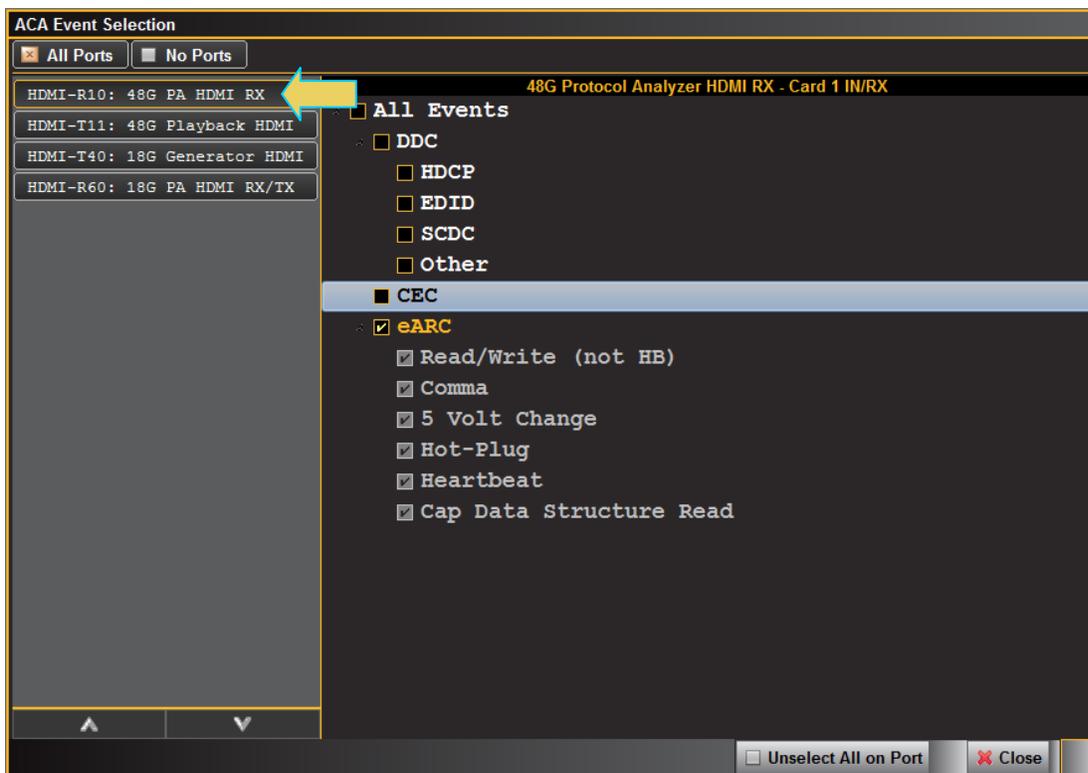
1. Access the ACA utility either through the embedded GUI or the remote GUI (shown below).

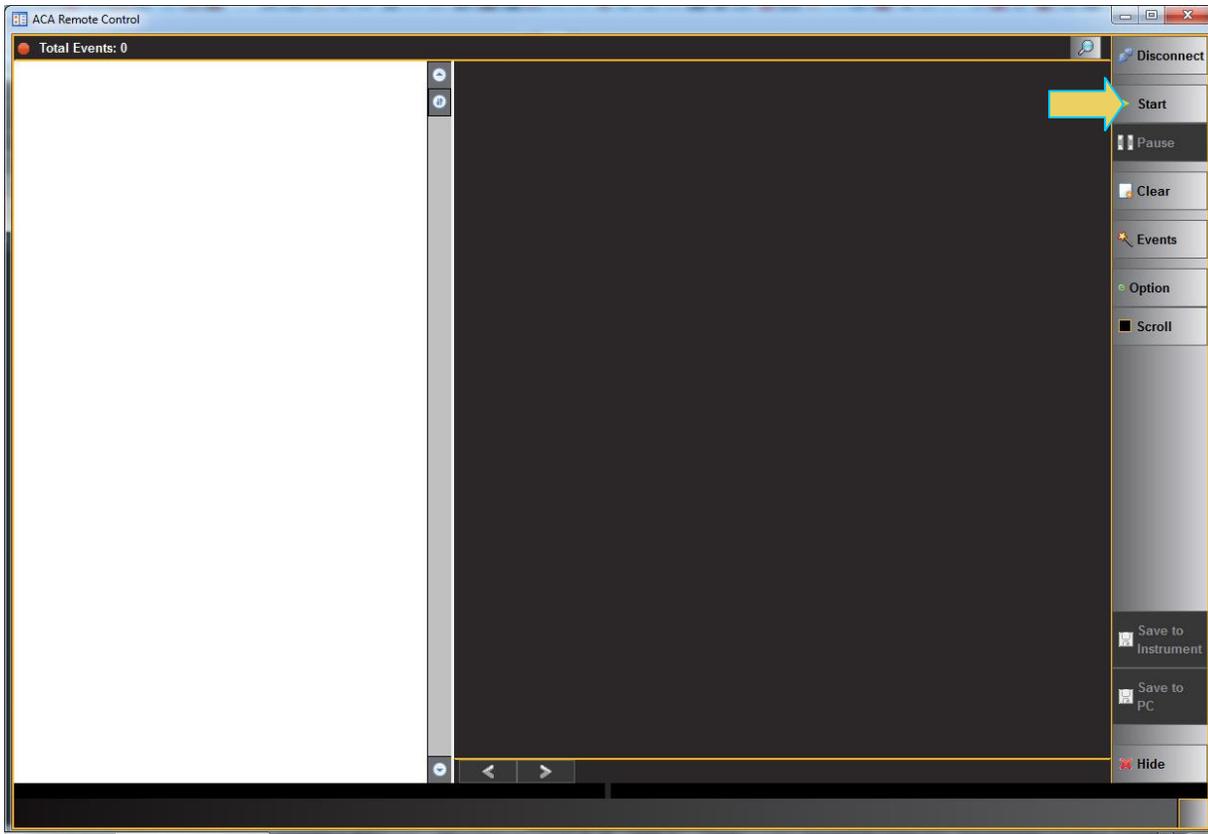


2. Access the **Event Selection** panel.

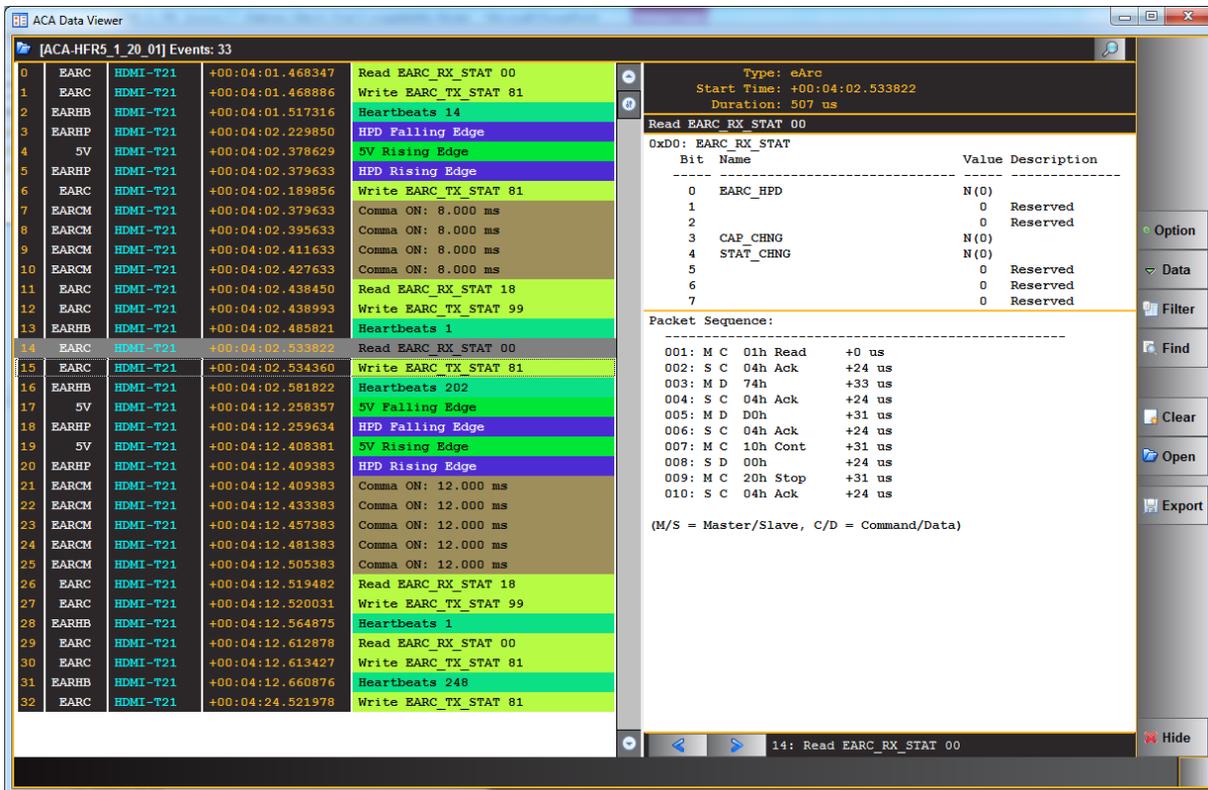


3. Select the eARC elements from the **Event Selection** panel.





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



Refer to the [ACA Section](#) below for more details on using the ACA utility.

8 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 receive 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 a M41h test instrument to view these transactions.

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

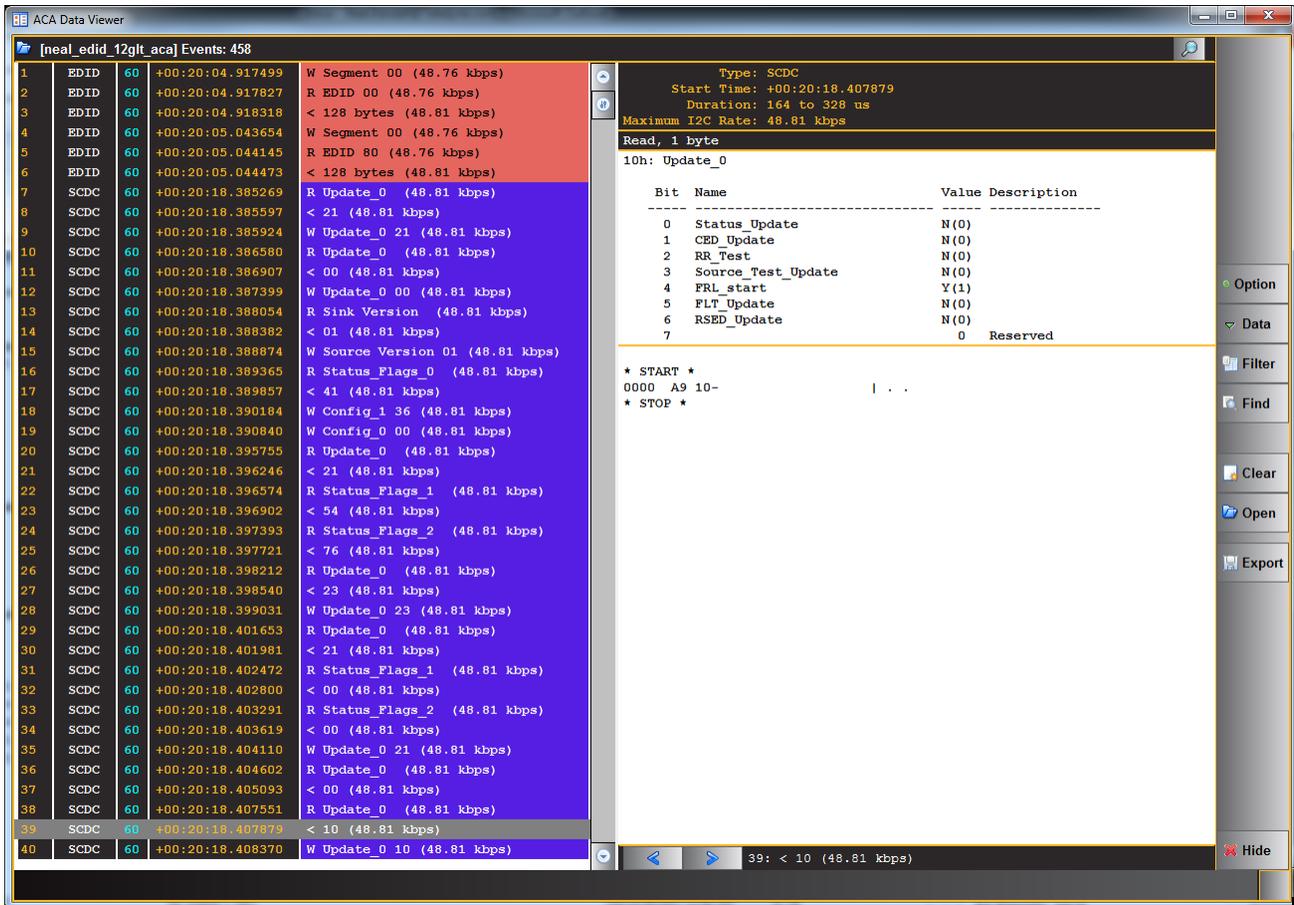
This subsection describes the **Aux Channel Analyzer** utility used for viewing the real time auxiliary channel data through the *embedded* ATP Manager.

8.1.1 Aux Channel Analyzer (ACA) – Panel Description

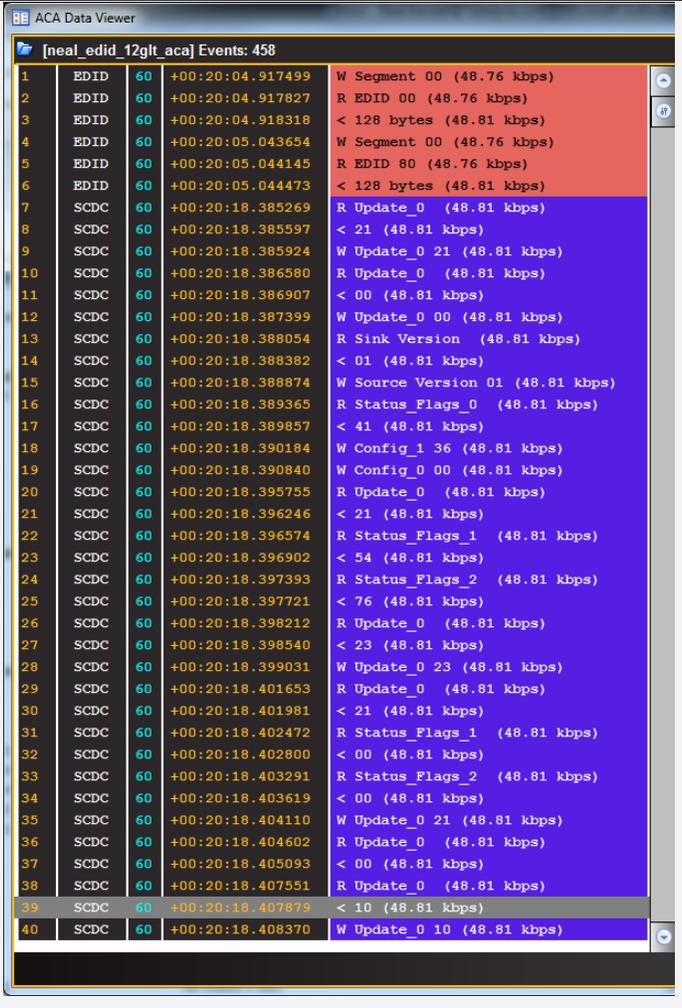
The Aux Channel Analyzer panel is described in the table below. There is a control menu panel on the right side. The control menu and elements of the ACA panel are described in the following table.

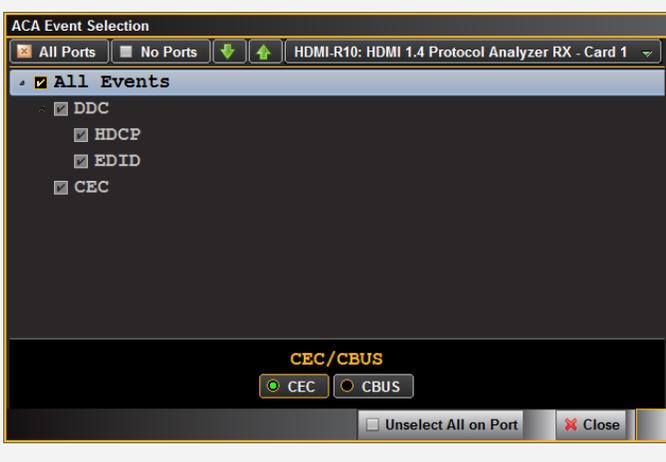


The following is an example of a populated ACA window.



Real Time – ACA	Information / Function
<p>Aux Channel Analyzer (ACA)</p> <p>ACA Trace Panel</p> <p>FRL Link Training Transaction Example</p>	<p>The following information is provided in the ACA data dialog box for each Event:</p> <ul style="list-style-type: none"> ▪ 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.

Real Time – ACA	Information / Function
 <pre> ACA Data Viewer [neal_edid_12glt_aca] Events: 458 1 EDID 60 +00:20:04.917499 W Segment 00 (48.76 kbps) 2 EDID 60 +00:20:04.917827 R EDID 00 (48.76 kbps) 3 EDID 60 +00:20:04.918318 < 128 bytes (48.81 kbps) 4 EDID 60 +00:20:05.043654 W Segment 00 (48.76 kbps) 5 EDID 60 +00:20:05.044145 R EDID 80 (48.76 kbps) 6 EDID 60 +00:20:05.044473 < 128 bytes (48.81 kbps) 7 SCDC 60 +00:20:18.385269 R Update_0 (48.81 kbps) 8 SCDC 60 +00:20:18.385597 < 21 (48.81 kbps) 9 SCDC 60 +00:20:18.385924 W Update_0 21 (48.81 kbps) 10 SCDC 60 +00:20:18.386580 R Update_0 (48.81 kbps) 11 SCDC 60 +00:20:18.386907 < 00 (48.81 kbps) 12 SCDC 60 +00:20:18.387399 W Update_0 00 (48.81 kbps) 13 SCDC 60 +00:20:18.388054 R Sink Version (48.81 kbps) 14 SCDC 60 +00:20:18.388382 < 01 (48.81 kbps) 15 SCDC 60 +00:20:18.388874 W Source Version 01 (48.81 kbps) 16 SCDC 60 +00:20:18.389365 R Status_Flags_0 (48.81 kbps) 17 SCDC 60 +00:20:18.389857 < 41 (48.81 kbps) 18 SCDC 60 +00:20:18.390184 W Config_1 36 (48.81 kbps) 19 SCDC 60 +00:20:18.390840 W Config_0 00 (48.81 kbps) 20 SCDC 60 +00:20:18.395755 R Update_0 (48.81 kbps) 21 SCDC 60 +00:20:18.396246 < 21 (48.81 kbps) 22 SCDC 60 +00:20:18.396574 R Status_Flags_1 (48.81 kbps) 23 SCDC 60 +00:20:18.396902 < 54 (48.81 kbps) 24 SCDC 60 +00:20:18.397393 R Status_Flags_2 (48.81 kbps) 25 SCDC 60 +00:20:18.397721 < 76 (48.81 kbps) 26 SCDC 60 +00:20:18.398212 R Update_0 (48.81 kbps) 27 SCDC 60 +00:20:18.398540 < 23 (48.81 kbps) 28 SCDC 60 +00:20:18.399031 W Update_0 23 (48.81 kbps) 29 SCDC 60 +00:20:18.401653 R Update_0 (48.81 kbps) 30 SCDC 60 +00:20:18.401981 < 21 (48.81 kbps) 31 SCDC 60 +00:20:18.402472 R Status_Flags_1 (48.81 kbps) 32 SCDC 60 +00:20:18.402800 < 00 (48.81 kbps) 33 SCDC 60 +00:20:18.403291 R Status_Flags_2 (48.81 kbps) 34 SCDC 60 +00:20:18.403619 < 00 (48.81 kbps) 35 SCDC 60 +00:20:18.404110 W Update_0 21 (48.81 kbps) 36 SCDC 60 +00:20:18.404602 R Update_0 (48.81 kbps) 37 SCDC 60 +00:20:18.405093 < 00 (48.81 kbps) 38 SCDC 60 +00:20:18.407551 R Update_0 (48.81 kbps) 39 SCDC 60 +00:20:18.407879 < 10 (48.81 kbps) 40 SCDC 60 +00:20:18.408370 W Update_0 10 (48.81 kbps) </pre>	
<h3>ACA Control Menu</h3>	<p>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:</p> <ul style="list-style-type: none"> ▪ Home – Navigates you back to the Home menu screen of the embedded ATP Manager. ▪ Back – Navigates back to the previous screen in the Real Time mode. ▪ Nav – Takes you to the Navigation window. ▪ Close – Closes out the ACA application. ▪ Start/Stop – Starts and Stops the collection of DDC data. ▪ Resume/Pause – Halts the updates of the data to the ACA panel to view traces and allows you to resume. ▪ Events – Opens up the ACA Event Selection window (below left) enabling you to specify the

Real Time – ACA	Information / Function
	<p>and 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> <ul style="list-style-type: none"> ▪ Options – Opens up a flyout menu described below-left. ▪ Data – Opens up flyout menu with the following options (described below). ▪ Clear – Clears the ACA Trace Panel. ▪ Open – Opens an existing trace file stored on the M41h. ▪ Save – Saves a current trace file to the M41h file system.
<p>ACA Event Selection</p>	
	

Real Time – ACA	Information / Function
 <p>The screenshot shows the following text:</p> <pre> Type: HDCP Start Time: 08:49:51.0471 Duration: 164 to 328 us Maximum I2C Rate: 93.98 kbps ----- The master read the following data: Register 0x40 (Bcaps (HDCP B Capability Bits)) = 0x8 REPEATER: 0 READY: 0 FAST: 0 1.1_FEATURES: 0 FAST_REAUTHENTICATION: 0 ----- * START * 0000 75 80- u . * STOP * </pre>	<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> <ul style="list-style-type: none"> ▪ Type – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP and CEC messages. ▪ 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>Note: The information in the Details panel will vary depending on the type of log record that is selected.</p> <ul style="list-style-type: none"> ▪ Duration – The duration in milliseconds of the transaction. ▪ Direction – The direction of the transaction either a request or a reply. ▪ Maximum I2C Rate – The rate that the I2C channel clock is operating. ▪ Details (text) – The contents of the transaction in human readable text. ▪ Details (hex) – The contents of the transaction in hex data.
 <p>The screenshot shows a control bar with a left arrow, a right arrow, the text "78: Reply 5F7E", and a "Save" button.</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> <ul style="list-style-type: none"> ▪ Left arrow – The left arrow allows you to see the details of the next transaction. ▪ Right arrow – The right arrow allows you to see the details of the previous transaction. ▪ Status field – Shows the sequence number and the description of the selected transaction.
<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> <ul style="list-style-type: none"> ▪ Scroll Lock – The left arrow allows you to see the details of the next transaction. ▪ 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. ▪ Show Port Name – Enables you to display or

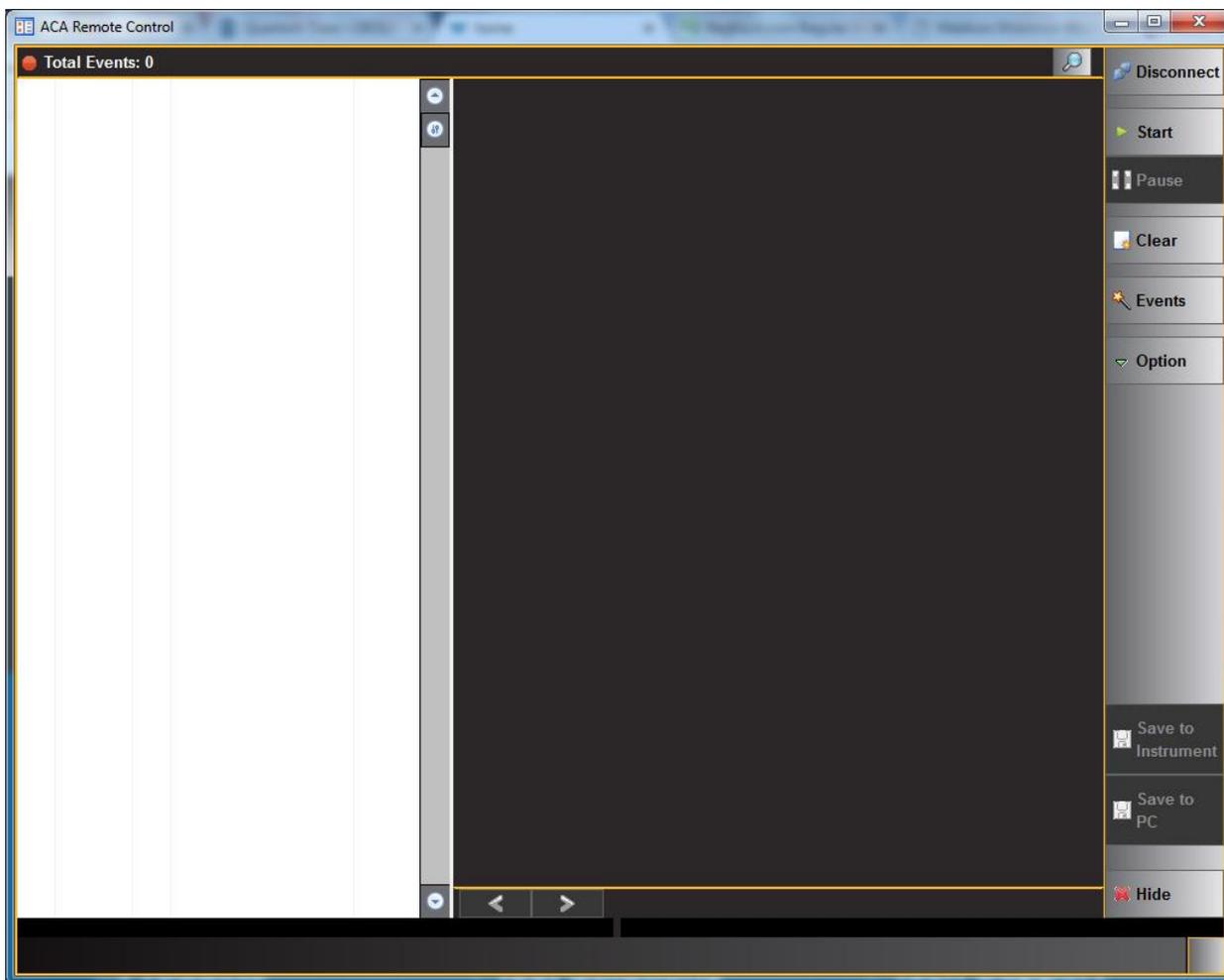
Real Time – ACA	Information / Function
	<p>not display the Port number.</p> <ul style="list-style-type: none"> ▪ Show Time-stamp – Enables you to show or not show the time stamps for each transaction. ▪ Show Time-deltas – Enables you to show the time stamps relative to the previous transaction. Only available when Time-Stamps are shown (see above). ▪ Set Zero Time – Enables you to set a log record to zero. Subsequent log records are relative to this new zero time record. ▪ Reset to Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.
<p>Data Flyout Menu</p> 	<p>The Data flyout menu items are described below:</p> <ul style="list-style-type: none"> ▪ Sort by time checkbox – Greyed out. ▪ Filter – Opens up a dialog box for filtering the current ACA log based on criteria you select. The Filter function is described in detail in the procedures in the following subsection. The Filter function is only available when the logging is stopped. ▪ Find – Opens up a dialog box for searching the current ACA log based on criteria you select. The Find function is described in detail in the procedures in the following subsection. The Find function is only available when the logging is stopped.

8.2 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.

8.2.1 ACA Remote Control – Panel Description

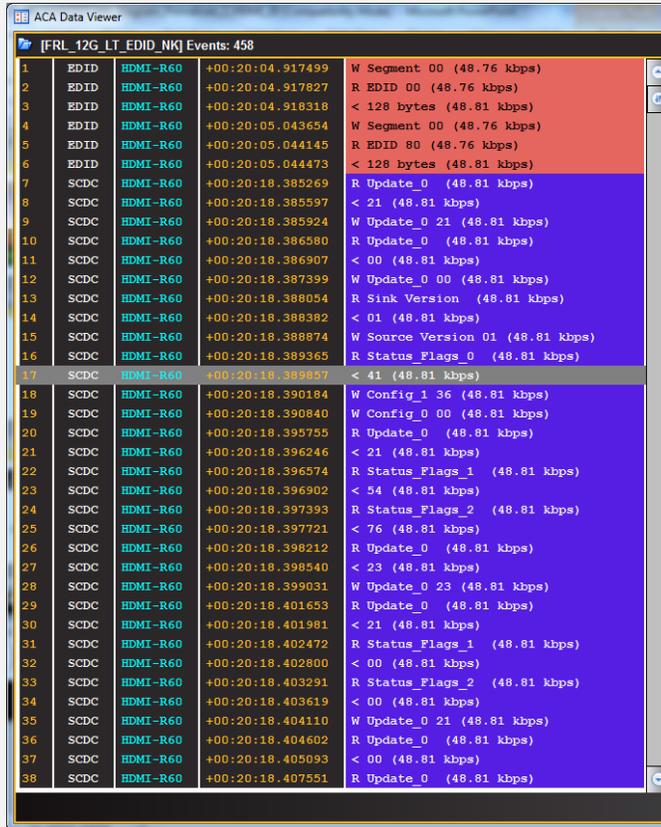
The **ACA Remote Control** panel application is available only on the *external* ATP Manager. It enables you to collect and view the ACA transactions in real time from a remotely connected PC with the ATP Manager application. The control panel elements are described in the table below.



ACA Remote Control **Information / Function**

Auxiliary Channel Analyzer

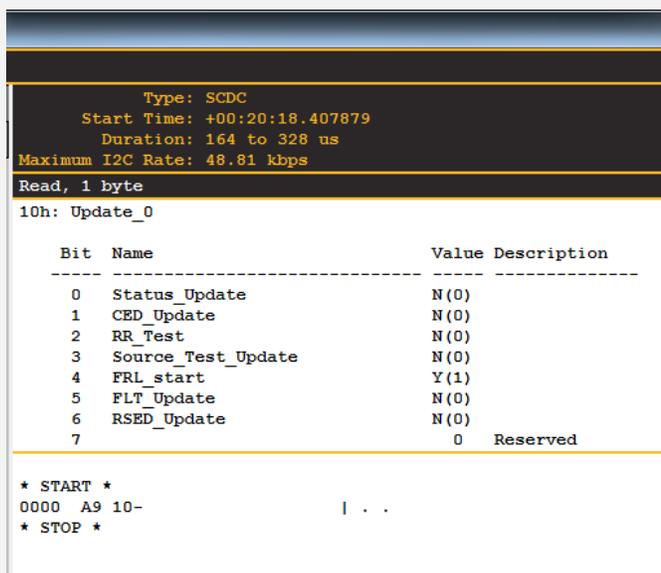
ACA Trace Panel



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.

Details Panel

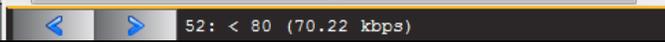


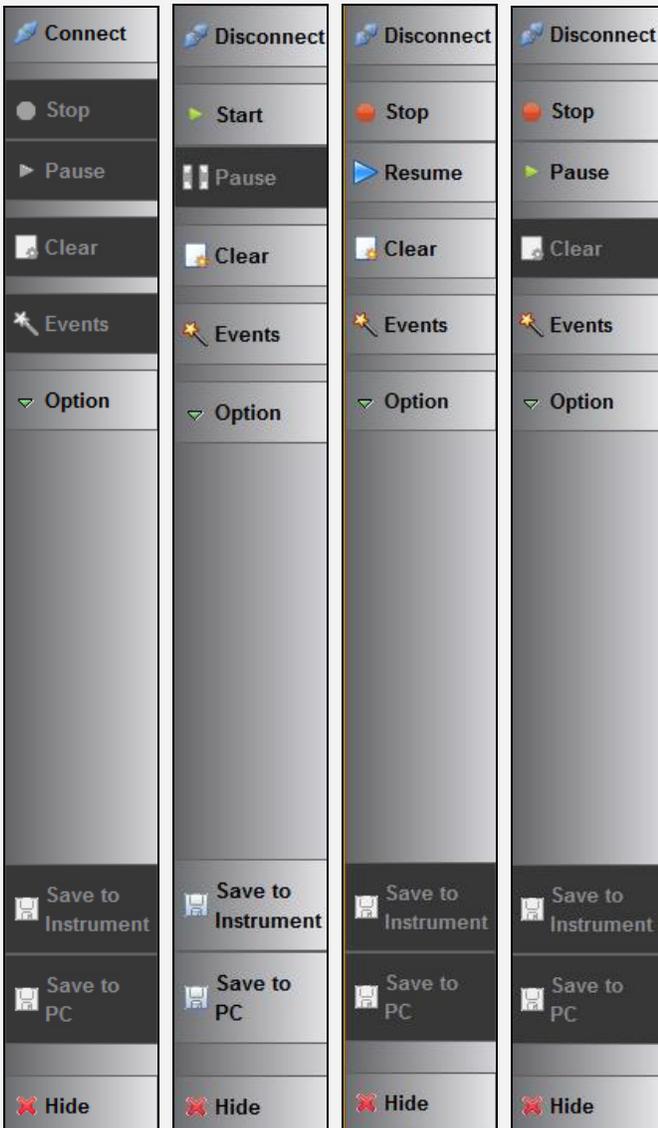
The following information is provided in the ACA **Event Details** dialog box. Two examples are shown on the left. One for HDCP transactions and another for Link Training transactions:

- **Type** – There are various types of data that can be monitored on the HDMI interfaces: EDID, HDCP, SCDC and CEC messages. Only SCDC applies to at this time.
- **Start Time** – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began.

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

- **Duration** – The duration in milliseconds of the transaction.
- **Maximum I2C Rate** – The rate that the I2C

ACA Remote Control	Information / Function
	<p>channel clock is operating.</p> <ul style="list-style-type: none"> ▪ Details (text) – The contents of the transaction in human readable text. ▪ Details (hex) – The contents of the transaction in hex data.
 <p>The screenshot shows a dark grey control bar with a left-pointing blue arrow, a right-pointing blue arrow, and a status field containing the text "52: < 80 (70.22 kbps)".</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> <ul style="list-style-type: none"> ▪ Left arrow – The left arrow allows you to see the details of the next transaction. ▪ Right arrow – The right arrow allows you to see the details of the previous transaction. ▪ Status field – Shows the sequence number and the description of the selected transaction.

ACA Remote Control	Information / Function
	<p>There is a menu associated with the ACA Remote Control Info panel. It is location on the right side of the panel. There are four examples shown to the left reflecting the differ states:</p> <ul style="list-style-type: none"> ▪ “Viewing Glass”  – This icon 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. ▪ Connect/Disconnect – Connects or disconnects the ACA Remote Control application from a M41h System. ▪ Start/Stop – Starts and Stops the collection of auxiliary channel data. ▪ Resume/Pause – Pauses and/or Resumes the collection of auxiliary channel data to the ACA panel. ▪ Clear – Clears the ACA Trace Panel. The trace collection has to be paused or stopped in order to clear the traces. ▪ 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. ▪ Options – Opens up a flyout menu described below. ▪ Save to Instrument – Saves the file to the M41h system that the host PC is connected to. ▪ Save to PC – Saves a current trace file to the Host PC. ▪ Hide – Makes the ACA Remote Viewer window disappear.
<p>ACA Event Selection</p> 	

ACA Remote Control	Information / Function
<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> <ul style="list-style-type: none"> ▪ Scroll Lock – The left arrow allows you to see the details of the next transaction. ▪ 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. ▪ Show Port Name – Enables you to display or not display the Port number. ▪ Show Time-stamp – Enables you to show or not show the time stamps for each transaction. ▪ Show Time-deltas – Enables you to show the time stamps relative to the previous transaction. Only available when Time-Stamped are shown (see above). ▪ Set Zero Time – Enables you to set a log record to zero. Subsequent log records are relative to this new zero time record. ▪ Reset to Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.

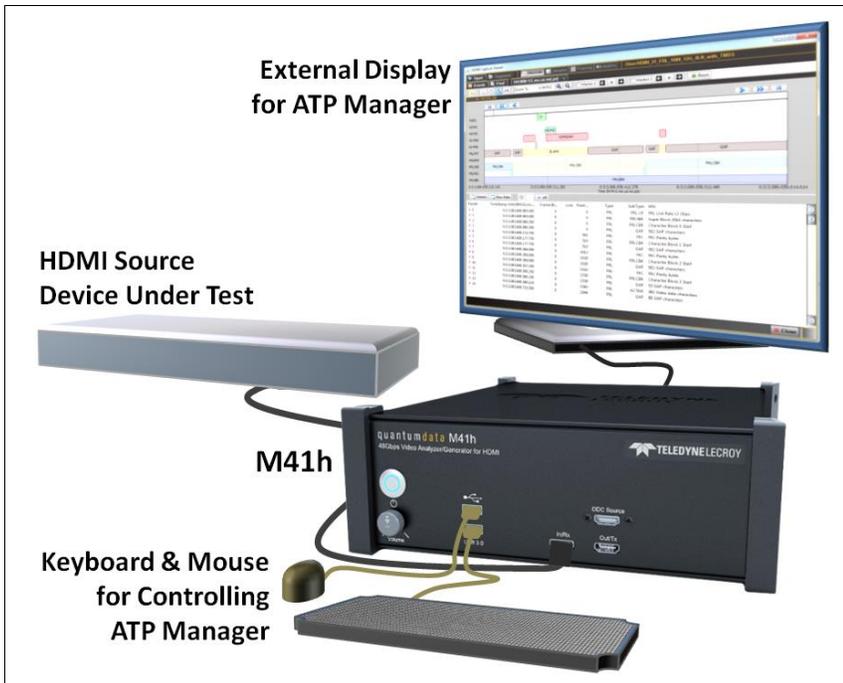
8.3 Monitoring the HDMI auxiliary channel with the ACA utilities

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.

8.3.1 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

8.3.2 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.

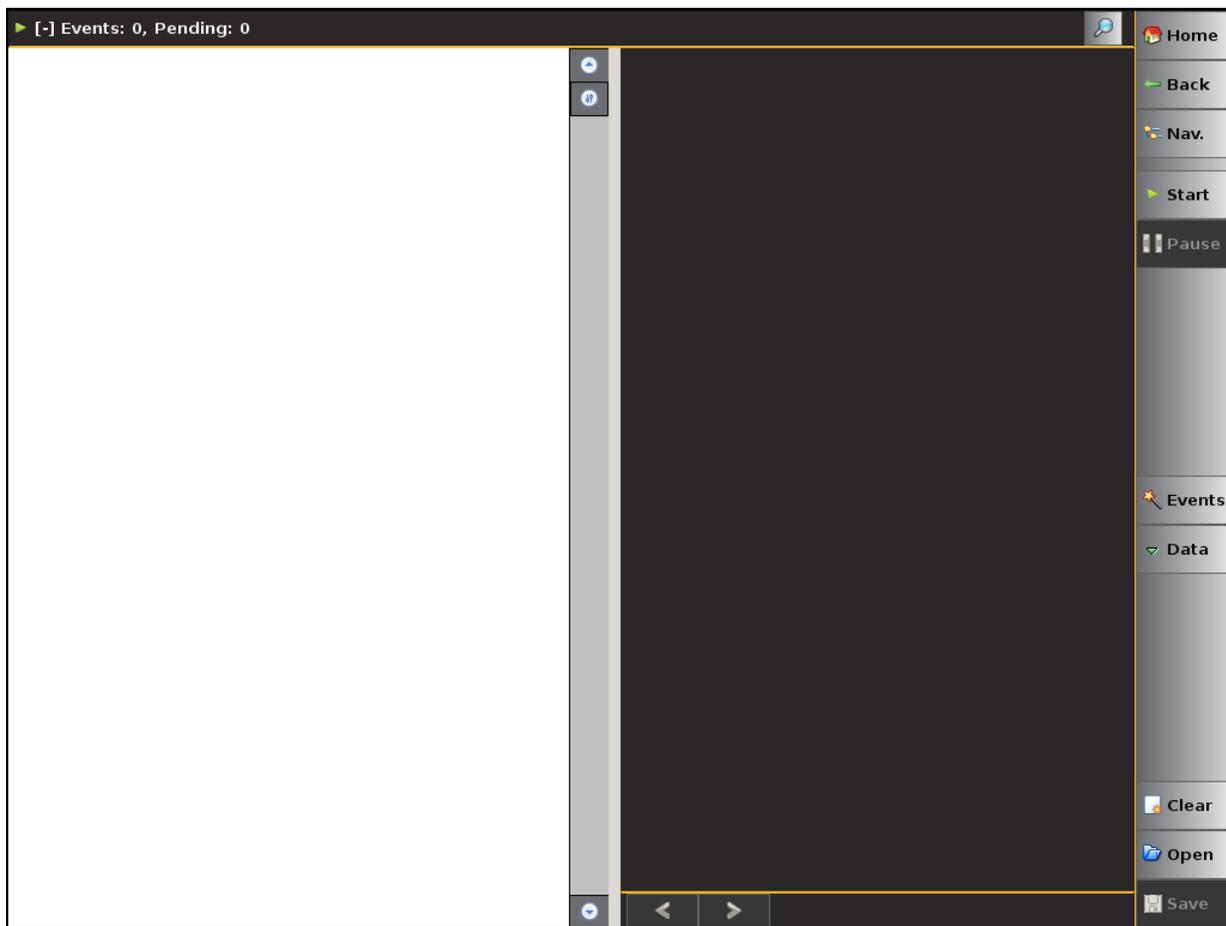
Important Note: You can filter and search through the ACA traces. Procedures for searching and sorting are provided in a separate subsection further below.

To monitor the HDMI DDC transactions:

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



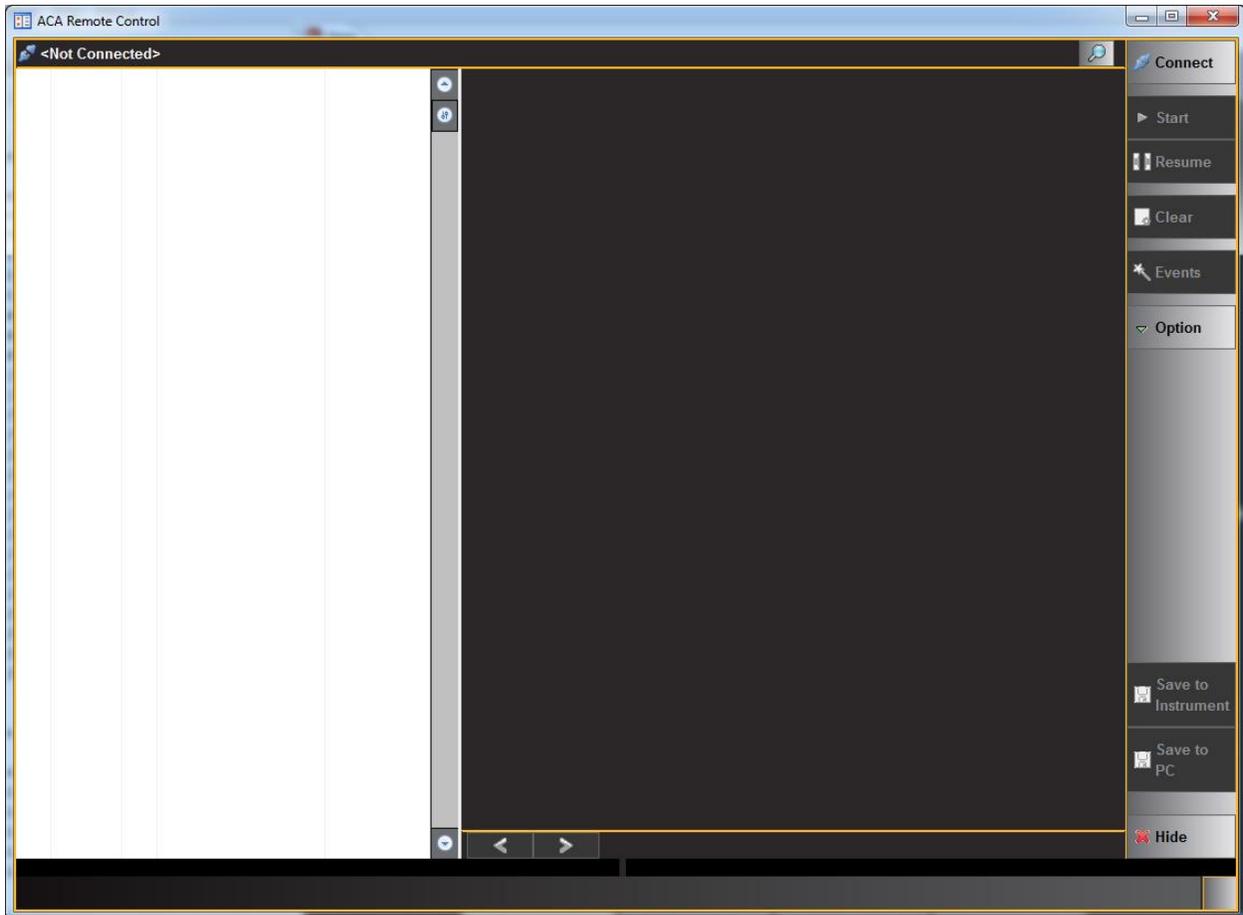
The **Aux Channel Analyzer** panel appears as shown below:



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

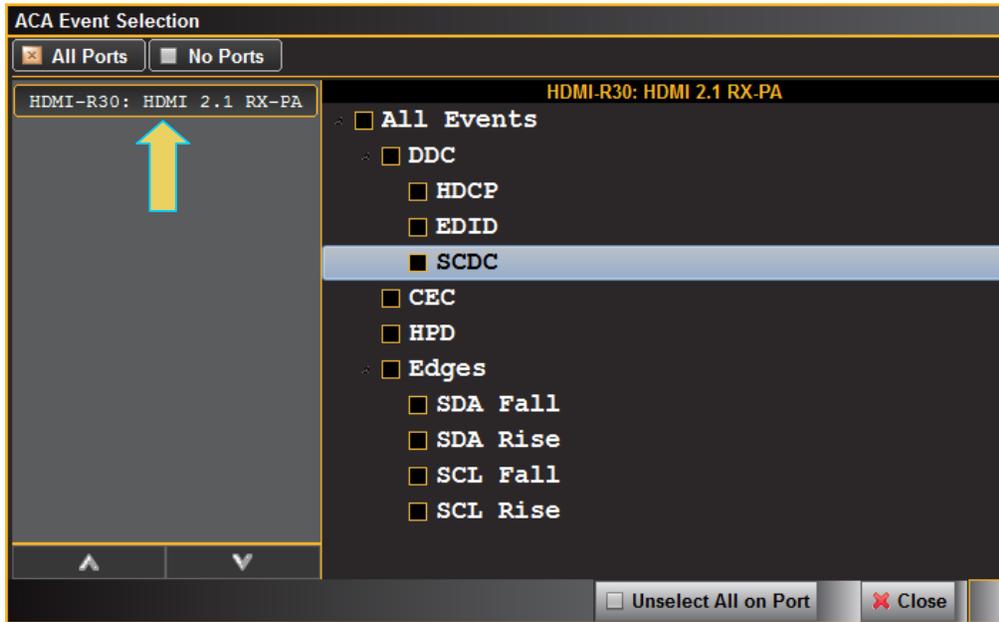


The **ACA Remote Control** panel appears as shown below:



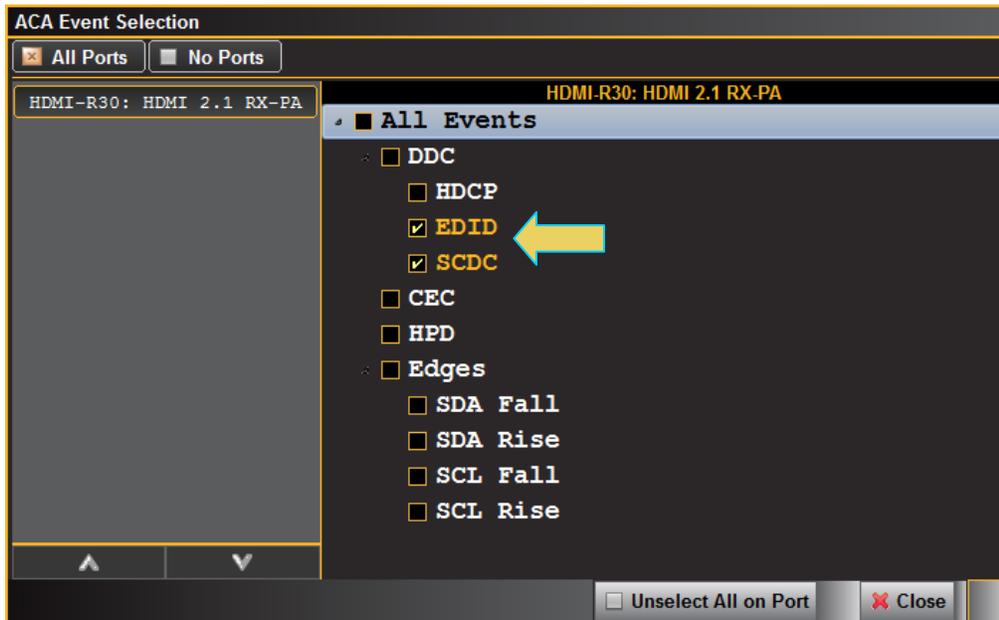
For the **ACA Remote Control** panel you will have to connect to a M41h Instrument that you have provisioned in the external ATP Manager application. The **ACA Remote Control** dialog box will appear showing all the M41h systems you have provisioned in the M41h GUI Manger. Typically you will only have 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.

3. 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.

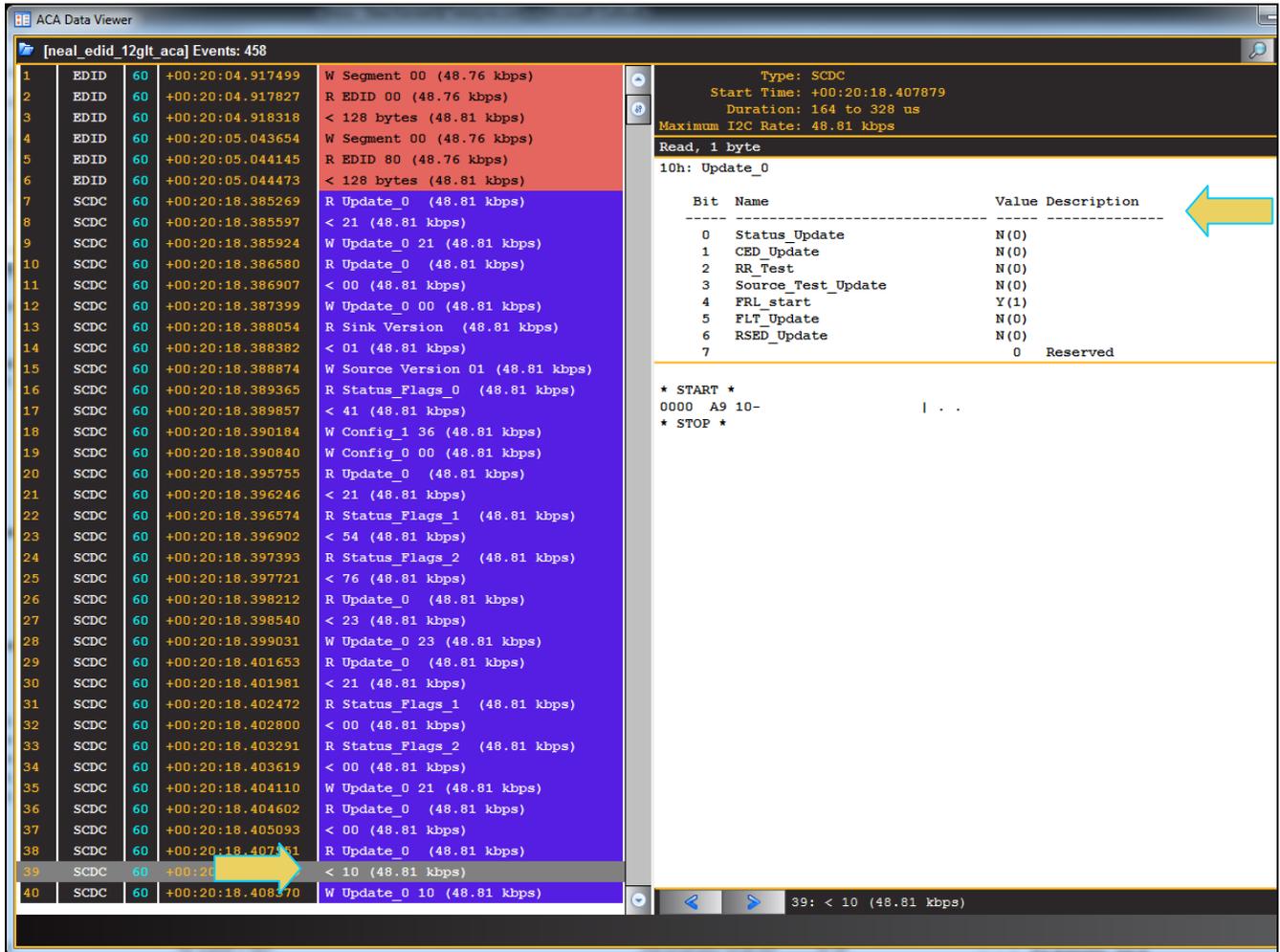


The **ACA Event Selection** dialog box is shown below.

Specify which events you wish to monitor. You can select **All Events** of 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.



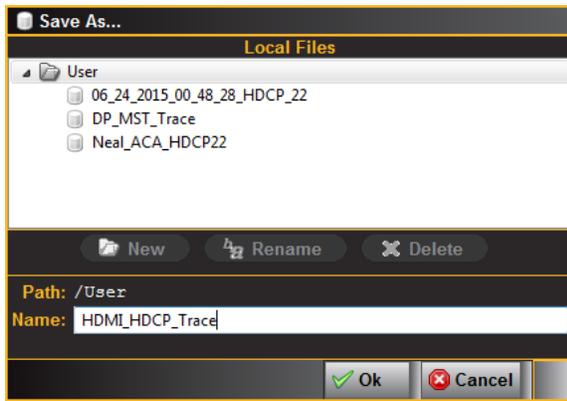
The screenshot displays the ACA Data Viewer interface. The main window shows a list of events for the trace 'neal_edid_12glt_aca'. The events are numbered 1 through 40. The selected event (row 39) is highlighted in blue. The detailed view on the right shows the event type as SCDC, with a start time of +00:20:18.407879 and a duration of 164 to 328 us. The maximum I2C rate is 48.81 kbps. The read data is 1 byte, and the bit stream is 10h: Update_0. A table below shows the bit stream details:

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	Y(1)	
5	FLT_Update	N(0)	
6	RSED_Update	N(0)	
7		0	Reserved

At the bottom of the detailed view, there are control buttons for * START * and * STOP *. The * START * button is currently active, and the * STOP * button is disabled. A yellow arrow points to the * START * button.

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



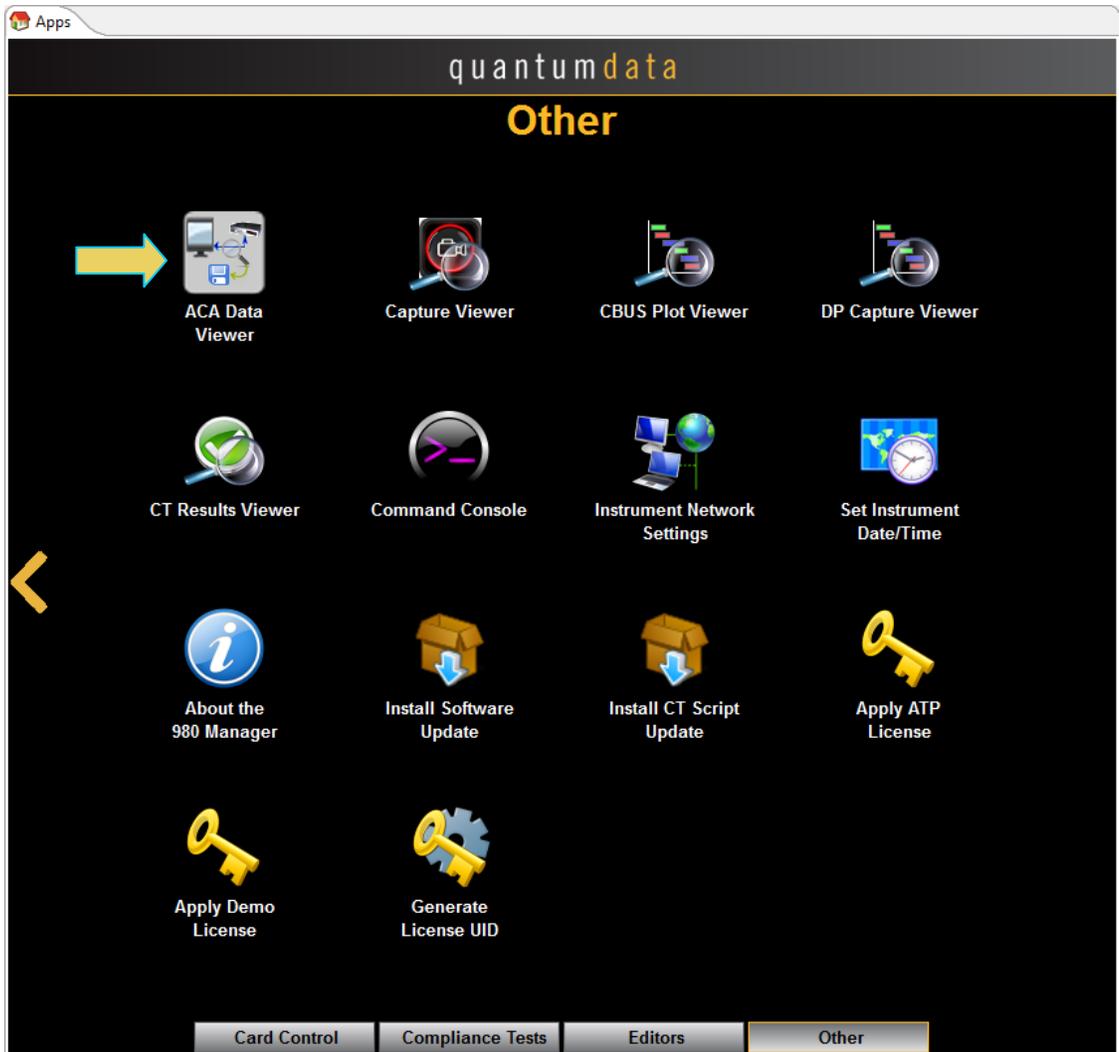
Please note that in order to use the **ACA Data Viewer** utility (next subsection) on your PC to view the traces or the ACA viewer on the M41h embedded display with the powerful searching and filtering features, you must save the file. If you are working on the embedded **Aux Channel Analyzer** viewer 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.

8.4 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 similar to the embedded version.

8.4.1 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.

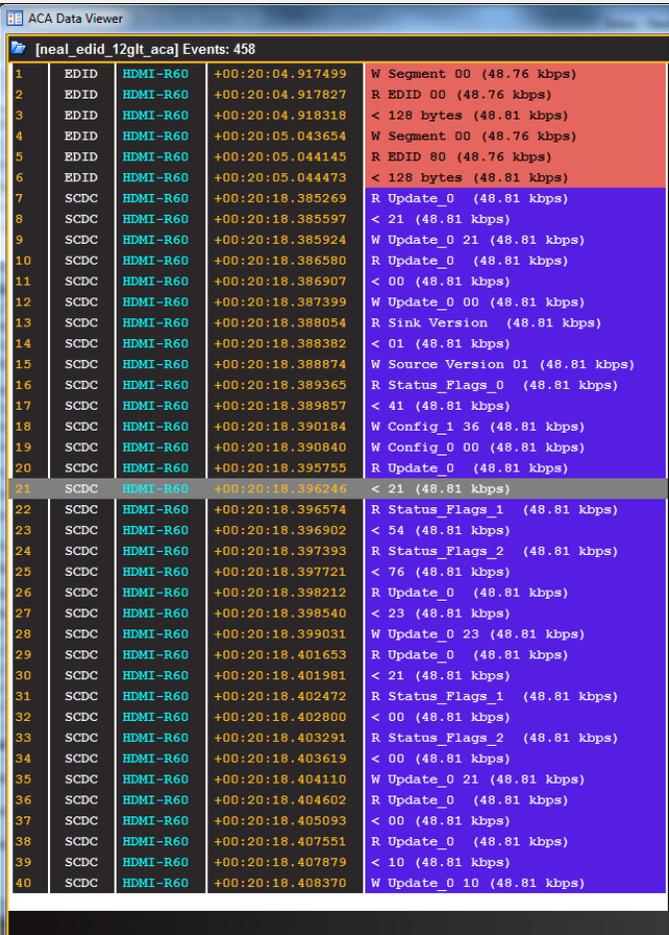


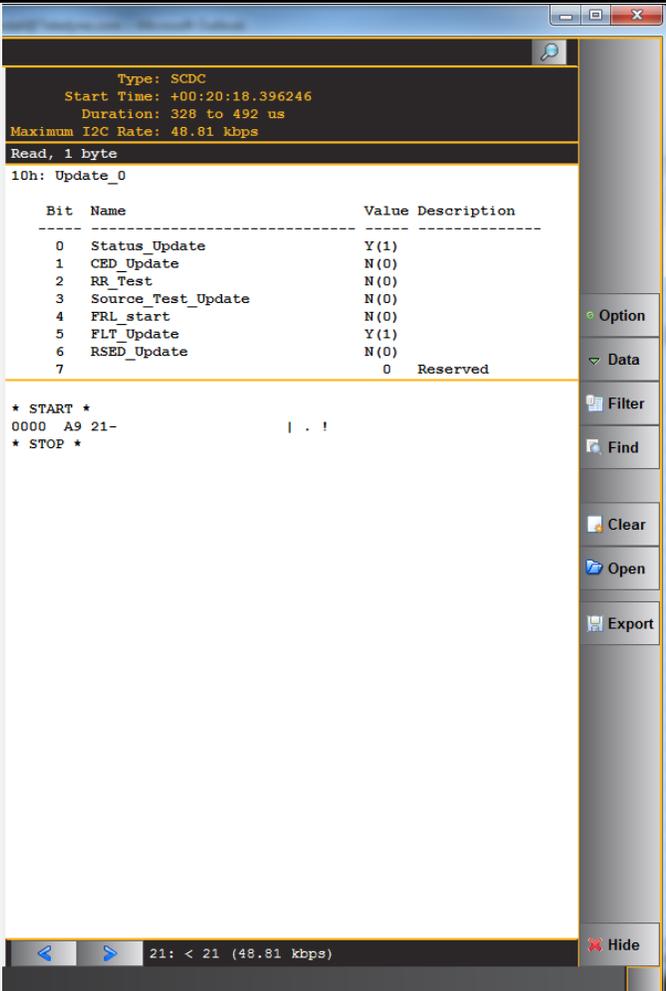
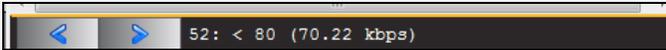
The screenshot displays the ACA Data Viewer application. The main window shows a list of events for the file 'neal_edid_12glt_aca'. The events are numbered 1 through 40. The selected event (row 21) is expanded to show its details in a right-hand pane.

Event No.	Type	Source	Time	Description
1	EDID	HDMI-R60	+00:20:04.917499	W Segment 00 (48.76 kbps)
2	EDID	HDMI-R60	+00:20:04.917827	R EDID 00 (48.76 kbps)
3	EDID	HDMI-R60	+00:20:04.918318	< 128 bytes (48.81 kbps)
4	EDID	HDMI-R60	+00:20:05.043654	W Segment 00 (48.76 kbps)
5	EDID	HDMI-R60	+00:20:05.044145	R EDID 80 (48.76 kbps)
6	EDID	HDMI-R60	+00:20:05.044473	< 128 bytes (48.81 kbps)
7	SCDC	HDMI-R60	+00:20:18.385269	R Update_0 (48.81 kbps)
8	SCDC	HDMI-R60	+00:20:18.385597	< 21 (48.81 kbps)
9	SCDC	HDMI-R60	+00:20:18.385924	W Update_0 21 (48.81 kbps)
10	SCDC	HDMI-R60	+00:20:18.386580	R Update_0 (48.81 kbps)
11	SCDC	HDMI-R60	+00:20:18.386907	< 00 (48.81 kbps)
12	SCDC	HDMI-R60	+00:20:18.387399	W Update_0 00 (48.81 kbps)
13	SCDC	HDMI-R60	+00:20:18.388054	R Sink Version (48.81 kbps)
14	SCDC	HDMI-R60	+00:20:18.388382	< 01 (48.81 kbps)
15	SCDC	HDMI-R60	+00:20:18.388874	W Source Version 01 (48.81 kbps)
16	SCDC	HDMI-R60	+00:20:18.389365	R Status_Flags_0 (48.81 kbps)
17	SCDC	HDMI-R60	+00:20:18.389857	< 41 (48.81 kbps)
18	SCDC	HDMI-R60	+00:20:18.390184	W Config_1 36 (48.81 kbps)
19	SCDC	HDMI-R60	+00:20:18.390840	W Config_0 00 (48.81 kbps)
20	SCDC	HDMI-R60	+00:20:18.395755	R Update_0 (48.81 kbps)
21	SCDC	HDMI-R60	+00:20:18.396246	< 21 (48.81 kbps)
22	SCDC	HDMI-R60	+00:20:18.396574	R Status_Flags_1 (48.81 kbps)
23	SCDC	HDMI-R60	+00:20:18.396902	< 54 (48.81 kbps)
24	SCDC	HDMI-R60	+00:20:18.397393	R Status_Flags_2 (48.81 kbps)
25	SCDC	HDMI-R60	+00:20:18.397721	< 76 (48.81 kbps)
26	SCDC	HDMI-R60	+00:20:18.398212	R Update_0 (48.81 kbps)
27	SCDC	HDMI-R60	+00:20:18.398540	< 23 (48.81 kbps)
28	SCDC	HDMI-R60	+00:20:18.399031	W Update_0 23 (48.81 kbps)
29	SCDC	HDMI-R60	+00:20:18.401653	R Update_0 (48.81 kbps)
30	SCDC	HDMI-R60	+00:20:18.401981	< 21 (48.81 kbps)
31	SCDC	HDMI-R60	+00:20:18.402472	R Status_Flags_1 (48.81 kbps)
32	SCDC	HDMI-R60	+00:20:18.402800	< 00 (48.81 kbps)
33	SCDC	HDMI-R60	+00:20:18.403291	R Status_Flags_2 (48.81 kbps)
34	SCDC	HDMI-R60	+00:20:18.403619	< 00 (48.81 kbps)
35	SCDC	HDMI-R60	+00:20:18.404110	W Update_0 21 (48.81 kbps)
36	SCDC	HDMI-R60	+00:20:18.404602	R Update_0 (48.81 kbps)
37	SCDC	HDMI-R60	+00:20:18.405093	< 00 (48.81 kbps)
38	SCDC	HDMI-R60	+00:20:18.407551	R Update_0 (48.81 kbps)
39	SCDC	HDMI-R60	+00:20:18.407879	< 10 (48.81 kbps)
40	SCDC	HDMI-R60	+00:20:18.408370	W Update_0 10 (48.81 kbps)

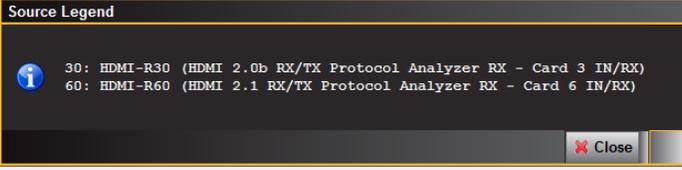
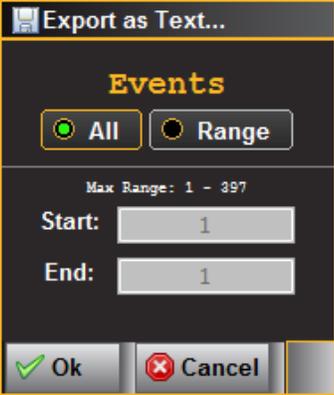
Type: SCDC		
Start Time: +00:20:18.396246		
Duration: 328 to 492 ns		
Maximum I2C Rate: 48.81 kbps		
Read, 1 byte		
10h: Update_0		
Bit	Name	Value Description
0	Status_Update	Y(1)
1	CED_Update	N(0)
2	RR_Test	N(0)
3	Source_Test_Update	N(0)
4	FRL_start	N(0)
5	FLT_Update	Y(1)
6	RSED_Update	N(0)
7		0 Reserved

★ START ★
0000 A9 21- | . !
★ STOP ★

ACA Data Viewer	Information / Function																																																																																																																																																																																																													
<p>ACA Data Viewer - Trace Panel</p>  <table border="1"> <thead> <tr> <th>Event #</th> <th>Type</th> <th>Interface</th> <th>Timestamp</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>1</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:04.917499</td><td>W Segment 00 (48.76 kbps)</td></tr> <tr><td>2</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:04.917827</td><td>R EDID 00 (48.76 kbps)</td></tr> <tr><td>3</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:04.918318</td><td>< 128 bytes (48.81 kbps)</td></tr> <tr><td>4</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:05.043654</td><td>W Segment 00 (48.76 kbps)</td></tr> <tr><td>5</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:05.044145</td><td>R EDID 80 (48.76 kbps)</td></tr> <tr><td>6</td><td>EDID</td><td>HDMI-R60</td><td>+00:20:05.044473</td><td>< 128 bytes (48.81 kbps)</td></tr> <tr><td>7</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.385269</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>8</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.385597</td><td>< 21 (48.81 kbps)</td></tr> <tr><td>9</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.385924</td><td>W Update_0 21 (48.81 kbps)</td></tr> <tr><td>10</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.386580</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>11</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.386907</td><td>< 00 (48.81 kbps)</td></tr> <tr><td>12</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.387399</td><td>W Update_0 00 (48.81 kbps)</td></tr> <tr><td>13</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.388054</td><td>R Sink Version (48.81 kbps)</td></tr> <tr><td>14</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.388382</td><td>< 01 (48.81 kbps)</td></tr> <tr><td>15</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.388874</td><td>W Source Version 01 (48.81 kbps)</td></tr> <tr><td>16</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.389365</td><td>R Status_Flags_0 (48.81 kbps)</td></tr> <tr><td>17</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.389857</td><td>< 41 (48.81 kbps)</td></tr> <tr><td>18</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.390184</td><td>W Config_1 36 (48.81 kbps)</td></tr> <tr><td>19</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.390840</td><td>R Config_0 00 (48.81 kbps)</td></tr> <tr><td>20</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.395755</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>21</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.396246</td><td>< 21 (48.81 kbps)</td></tr> <tr><td>22</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.396574</td><td>R Status_Flags_1 (48.81 kbps)</td></tr> <tr><td>23</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.396902</td><td>< 54 (48.81 kbps)</td></tr> <tr><td>24</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.397393</td><td>R Status_Flags_2 (48.81 kbps)</td></tr> <tr><td>25</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.397721</td><td>< 76 (48.81 kbps)</td></tr> <tr><td>26</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.398212</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>27</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.398540</td><td>< 23 (48.81 kbps)</td></tr> <tr><td>28</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.399031</td><td>W Update_0 23 (48.81 kbps)</td></tr> <tr><td>29</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.401653</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>30</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.401981</td><td>< 21 (48.81 kbps)</td></tr> <tr><td>31</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.402472</td><td>R Status_Flags_1 (48.81 kbps)</td></tr> <tr><td>32</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.402800</td><td>< 00 (48.81 kbps)</td></tr> <tr><td>33</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.403291</td><td>R Status_Flags_2 (48.81 kbps)</td></tr> <tr><td>34</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.403619</td><td>< 00 (48.81 kbps)</td></tr> <tr><td>35</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.404110</td><td>W Update_0 21 (48.81 kbps)</td></tr> <tr><td>36</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.404602</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>37</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.405093</td><td>< 00 (48.81 kbps)</td></tr> <tr><td>38</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.407551</td><td>R Update_0 (48.81 kbps)</td></tr> <tr><td>39</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.407879</td><td>< 10 (48.81 kbps)</td></tr> <tr><td>40</td><td>SCDC</td><td>HDMI-R60</td><td>+00:20:18.408370</td><td>W Update_0 10 (48.81 kbps)</td></tr> </tbody> </table>	Event #	Type	Interface	Timestamp	Description	1	EDID	HDMI-R60	+00:20:04.917499	W Segment 00 (48.76 kbps)	2	EDID	HDMI-R60	+00:20:04.917827	R EDID 00 (48.76 kbps)	3	EDID	HDMI-R60	+00:20:04.918318	< 128 bytes (48.81 kbps)	4	EDID	HDMI-R60	+00:20:05.043654	W Segment 00 (48.76 kbps)	5	EDID	HDMI-R60	+00:20:05.044145	R EDID 80 (48.76 kbps)	6	EDID	HDMI-R60	+00:20:05.044473	< 128 bytes (48.81 kbps)	7	SCDC	HDMI-R60	+00:20:18.385269	R Update_0 (48.81 kbps)	8	SCDC	HDMI-R60	+00:20:18.385597	< 21 (48.81 kbps)	9	SCDC	HDMI-R60	+00:20:18.385924	W Update_0 21 (48.81 kbps)	10	SCDC	HDMI-R60	+00:20:18.386580	R Update_0 (48.81 kbps)	11	SCDC	HDMI-R60	+00:20:18.386907	< 00 (48.81 kbps)	12	SCDC	HDMI-R60	+00:20:18.387399	W Update_0 00 (48.81 kbps)	13	SCDC	HDMI-R60	+00:20:18.388054	R Sink Version (48.81 kbps)	14	SCDC	HDMI-R60	+00:20:18.388382	< 01 (48.81 kbps)	15	SCDC	HDMI-R60	+00:20:18.388874	W Source Version 01 (48.81 kbps)	16	SCDC	HDMI-R60	+00:20:18.389365	R Status_Flags_0 (48.81 kbps)	17	SCDC	HDMI-R60	+00:20:18.389857	< 41 (48.81 kbps)	18	SCDC	HDMI-R60	+00:20:18.390184	W Config_1 36 (48.81 kbps)	19	SCDC	HDMI-R60	+00:20:18.390840	R Config_0 00 (48.81 kbps)	20	SCDC	HDMI-R60	+00:20:18.395755	R Update_0 (48.81 kbps)	21	SCDC	HDMI-R60	+00:20:18.396246	< 21 (48.81 kbps)	22	SCDC	HDMI-R60	+00:20:18.396574	R Status_Flags_1 (48.81 kbps)	23	SCDC	HDMI-R60	+00:20:18.396902	< 54 (48.81 kbps)	24	SCDC	HDMI-R60	+00:20:18.397393	R Status_Flags_2 (48.81 kbps)	25	SCDC	HDMI-R60	+00:20:18.397721	< 76 (48.81 kbps)	26	SCDC	HDMI-R60	+00:20:18.398212	R Update_0 (48.81 kbps)	27	SCDC	HDMI-R60	+00:20:18.398540	< 23 (48.81 kbps)	28	SCDC	HDMI-R60	+00:20:18.399031	W Update_0 23 (48.81 kbps)	29	SCDC	HDMI-R60	+00:20:18.401653	R Update_0 (48.81 kbps)	30	SCDC	HDMI-R60	+00:20:18.401981	< 21 (48.81 kbps)	31	SCDC	HDMI-R60	+00:20:18.402472	R Status_Flags_1 (48.81 kbps)	32	SCDC	HDMI-R60	+00:20:18.402800	< 00 (48.81 kbps)	33	SCDC	HDMI-R60	+00:20:18.403291	R Status_Flags_2 (48.81 kbps)	34	SCDC	HDMI-R60	+00:20:18.403619	< 00 (48.81 kbps)	35	SCDC	HDMI-R60	+00:20:18.404110	W Update_0 21 (48.81 kbps)	36	SCDC	HDMI-R60	+00:20:18.404602	R Update_0 (48.81 kbps)	37	SCDC	HDMI-R60	+00:20:18.405093	< 00 (48.81 kbps)	38	SCDC	HDMI-R60	+00:20:18.407551	R Update_0 (48.81 kbps)	39	SCDC	HDMI-R60	+00:20:18.407879	< 10 (48.81 kbps)	40	SCDC	HDMI-R60	+00:20:18.408370	W Update_0 10 (48.81 kbps)	<p>The following information is provided in the ACA Remote Control Panel data dialog box for each event:</p> <ul style="list-style-type: none"> ▪ Item number – This is a unique sequence number of the transaction. ▪ Type – The type of; either EDID, HDCP or CEC. ▪ M41h Card Type, 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.
Event #	Type	Interface	Timestamp	Description																																																																																																																																																																																																										
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<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> <ul style="list-style-type: none"> ▪ Start Time – This the start time of the transaction in microseconds from a reference time determined when the capture of real time data began. ▪ Type – The type of transaction; either EDID, or CEC. <p>Note: The information in the Details panel will vary depending on the type of log record that is selected.</p> <ul style="list-style-type: none"> ▪ Duration – The duration in milliseconds of the transaction. ▪ Direction – The direction of the transaction either a request or a reply. 																																																																																																																																																																																																													

ACA Data Viewer	Information / Function
	<ul style="list-style-type: none"> ▪ Maximum I2C Rate – The rate that the I2C channel clock is operating. ▪ Details (text) – The contents of the transaction in human readable text. ▪ Details (hex) – The contents of the transaction in hex data.
	<p>There are some control arrows and a status panel on the bottom of the ACA Event Details panel. These are as follows:</p> <ul style="list-style-type: none"> ▪ Left arrow – The left arrow allows you to see the details of the next transaction. ▪ Right arrow – The right arrow allows you to see the details of the previous transaction. ▪ Status field – Shows the sequence number and the description of the selected transaction.

ACA Data Viewer	Information / Function
	<p>There is a menu associated with the ACA Remote Control Info panel. It is location on the right side of the panel:</p> <ul style="list-style-type: none"> ▪ “Viewing Glass”  – This icon 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. ▪ Options – Opens up a flyout menu. Described below. ▪ Data – Opens up a flyout checkbox enabling you to sort the log records by time. ▪ Clear – Clears the ACA Trace panel. ▪ Open – Enables you to open an ACA trace file stored on your PC. ▪ 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>Options Flyout Menu</p> 	<p>The Options flyout menu items are described below.</p> <ul style="list-style-type: none"> ▪ Source Legend – Window that lists the ports and their definition on each available in the M41h system. ▪ Show Port Name – Checkbox enabling you to display or not display the Port number. ▪ Time-stamp – Checkbox enabling you to show or not show the timestamps for each transaction. ▪ Time-deltas – Checkbox enabling you to show the time stamps relative to the previous transaction. ▪ Set Zero Time – Enables you to set a log

ACA Data Viewer	Information / Function
	<p>record to zero. Subsequent log records are relative to this new zero time record.</p> <ul style="list-style-type: none"> ▪ Reset Zero Time – Resets the initial record in the active log in the ACA Trace window to zero.
<p>Export as Text</p> 	<p>The Export as Text dialog box elements are described below.</p> <ul style="list-style-type: none"> ▪ All – Radio button to specify that you wish to export the entire ACA trace file to a text file stored on your PC. ▪ Range – Checkbox enabling you to display or not display the Port number. ▪ Start – Field available only when Range radio button is active to specify the first record of the range of records to include in the export operation. ▪ End – Field available only when Range radio button is active to specify the last record of the range of records to include in the export operation. ▪ OK – Button to initiate the export. ▪ Cancel – Cancel the export operation.

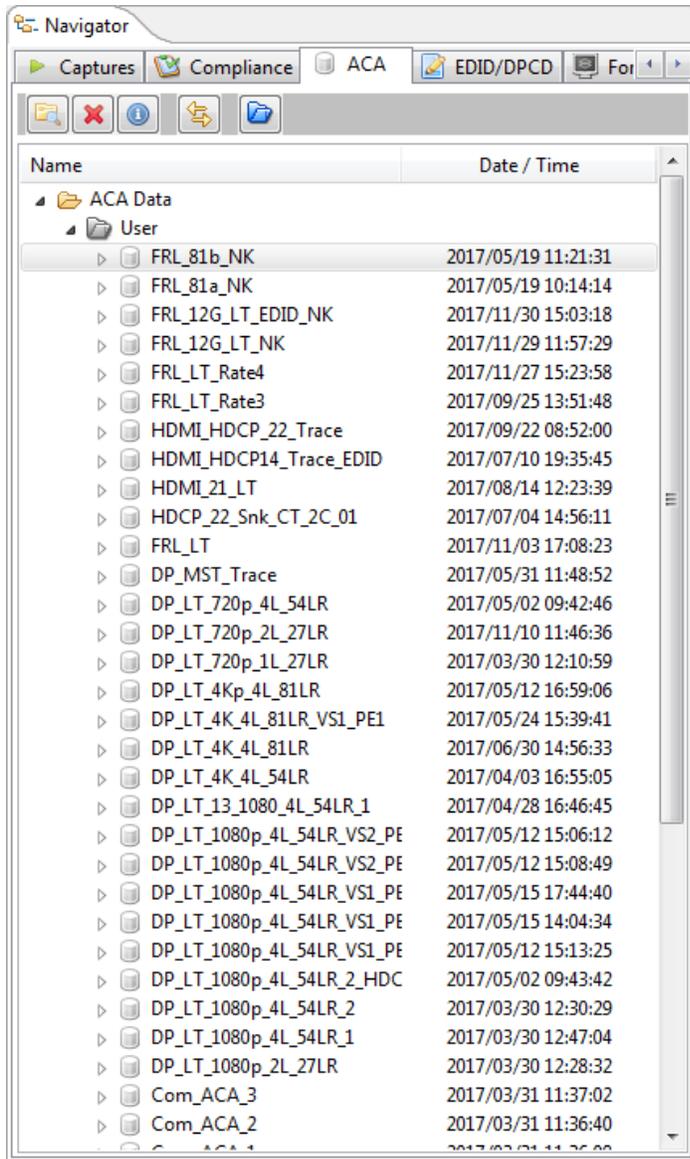
8.5 Viewing Stored HDMI DDC-SCDC traces on a PC with the ACA Data Viewer utility

This subsection describes how you can view ACA traces using the ACA viewer off-line on your PC with the **ACA Data Viewer** utility. In order 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 a M41h test instrument. You simply download the ATP Manager from the Quantum Data website on the downloads page.

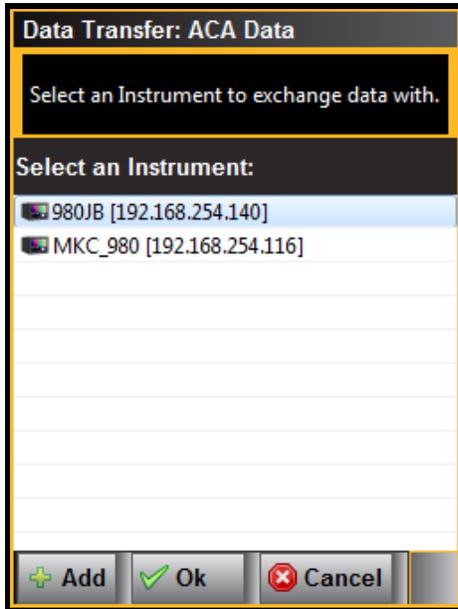
Transferring ACA trace files from the M41h to a host PC with the ATP Manager:

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.

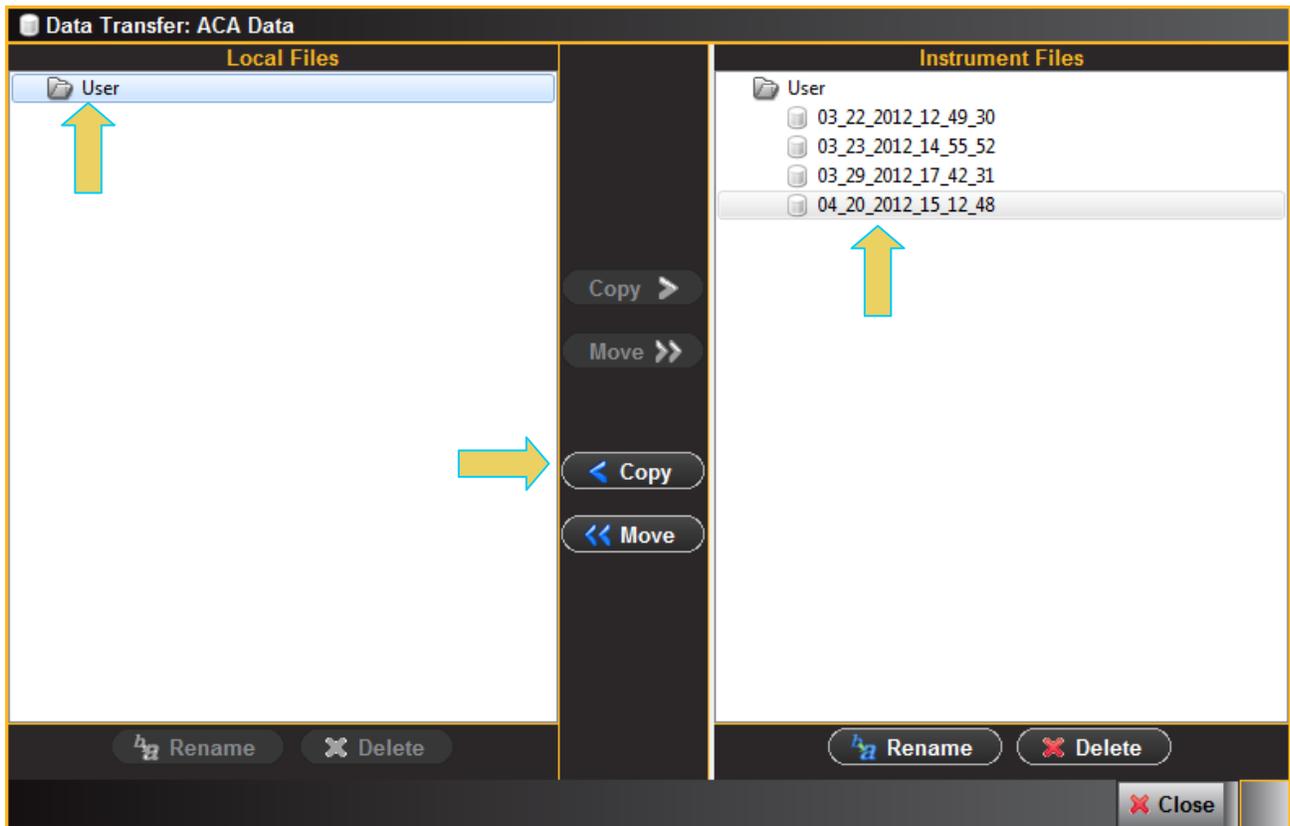


3. Access the **Data Transfer** utility by double clicking on the Transfer Data icon .

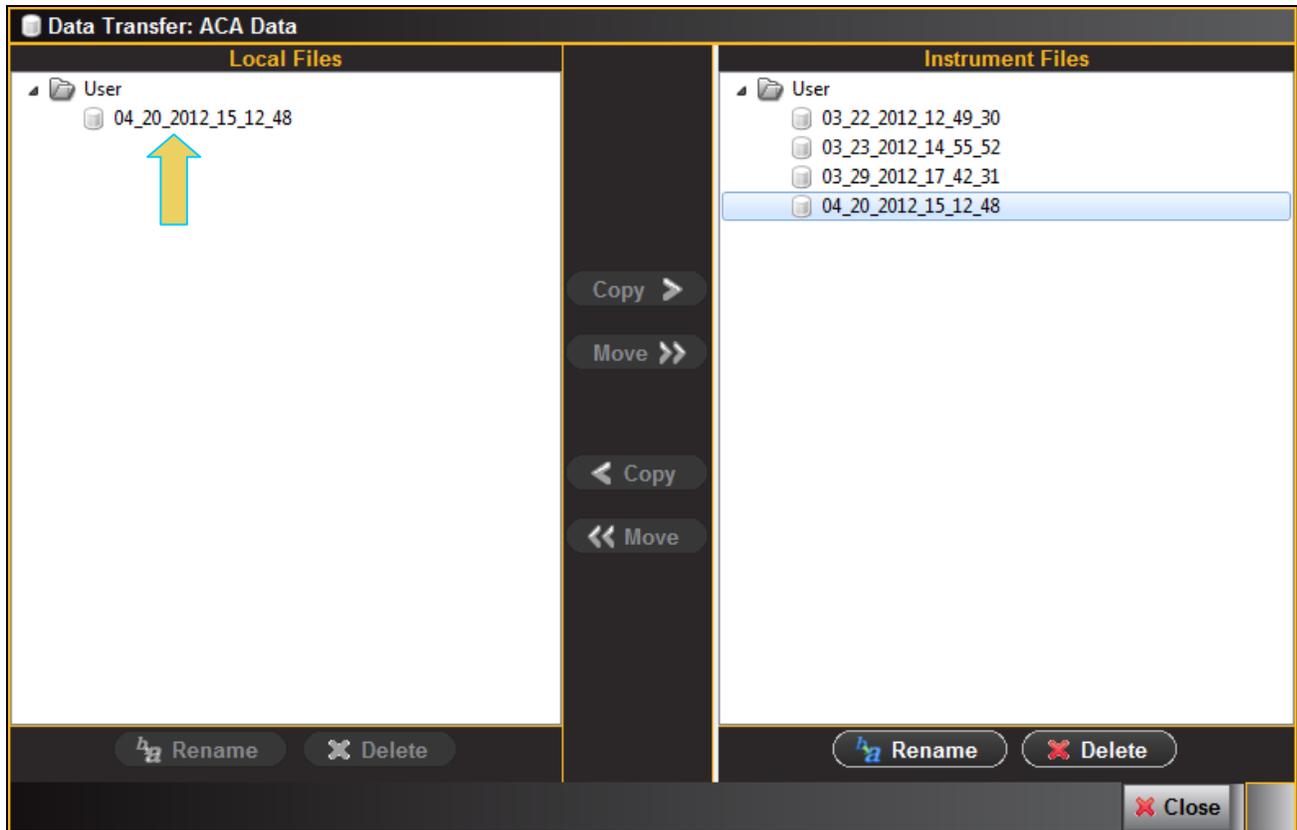
The **Data Transfer: ACA Data** dialog box appears (below) enabling you to select the M41h that you want to transfer data from. Select the desired M41h and click OK. The **Data Transfer: ACA Data** panel will appear.



4. Access the **Data Transfer** panel by double clicking on the Transfer Data icon .
5. The **Data Transfer** panel appears in context with the ACA files on the M41h (Instrument) under the **Instrument Files** available as shown below.



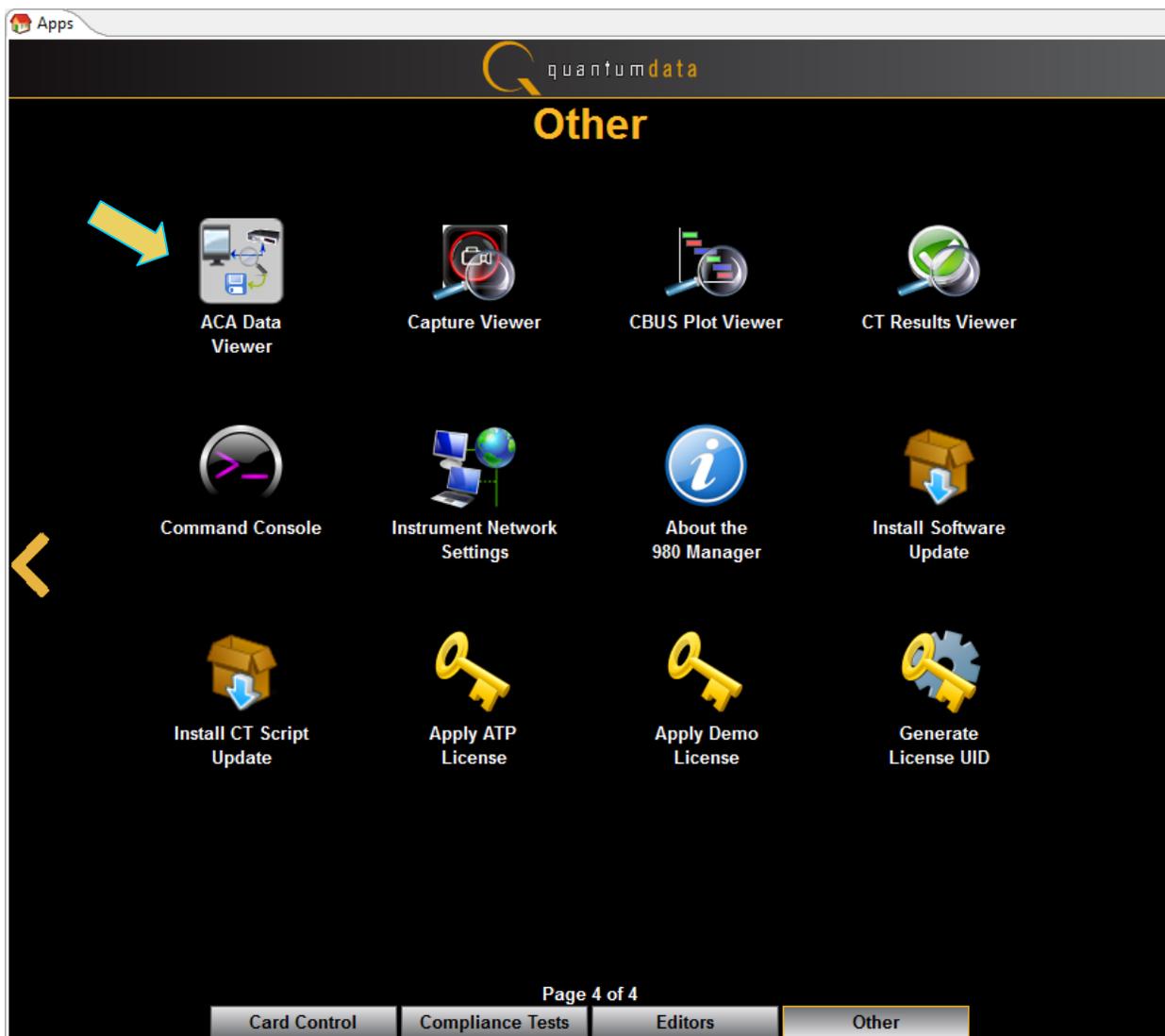
6. Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.
The file appears on the PC host **Local Files** (below).



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

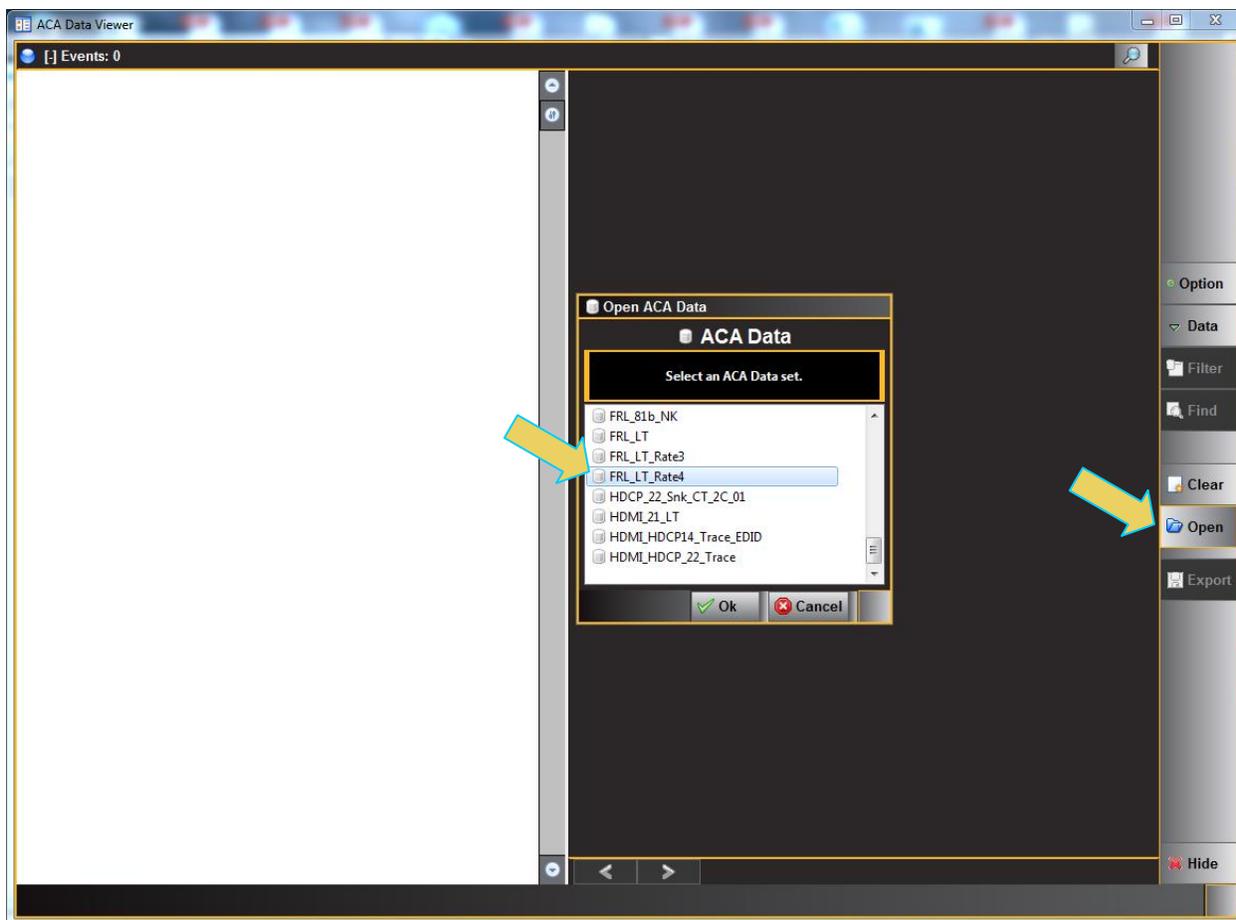
Viewing ACA trace files with the ACA Data Viewer:

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

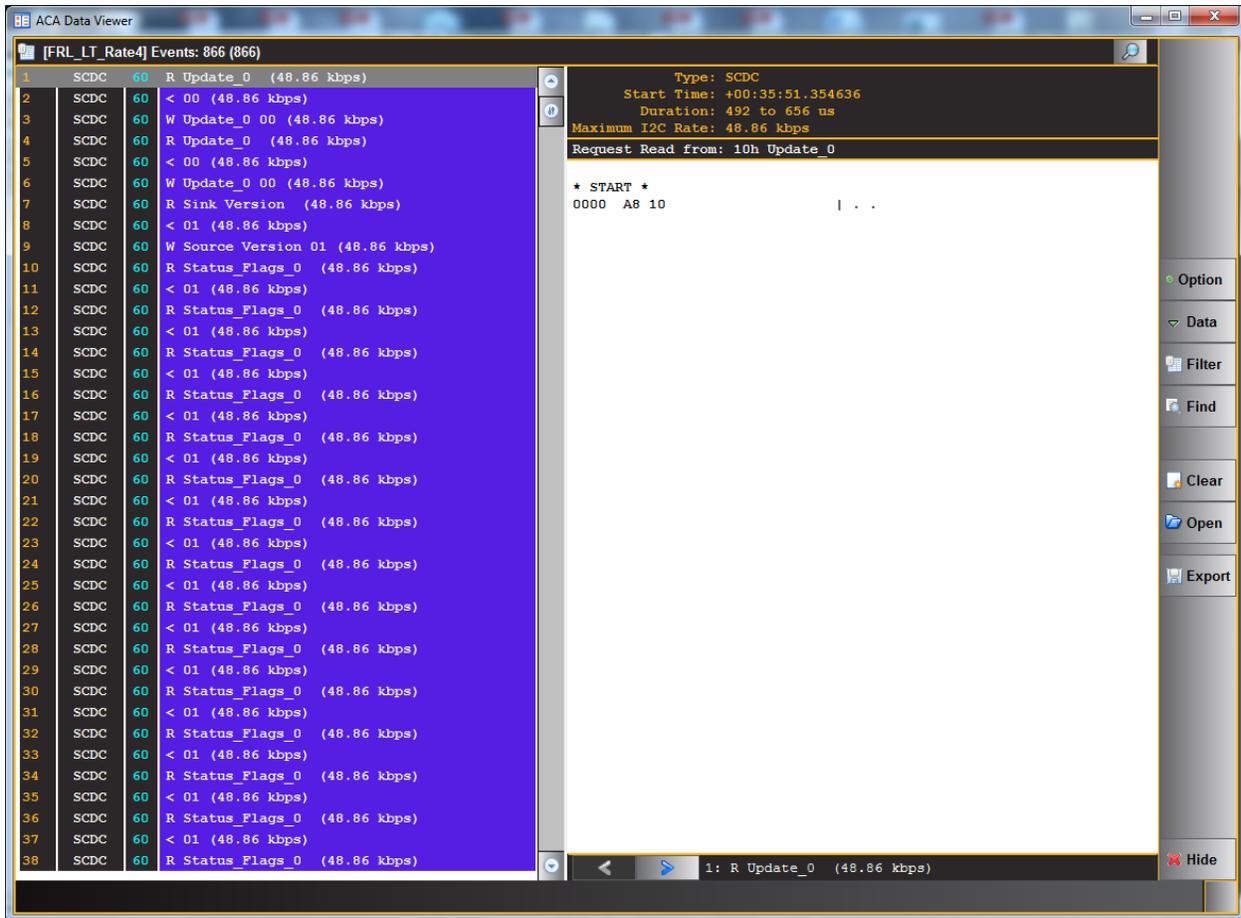


The **Aux Channel Analyzer** panel appears.

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



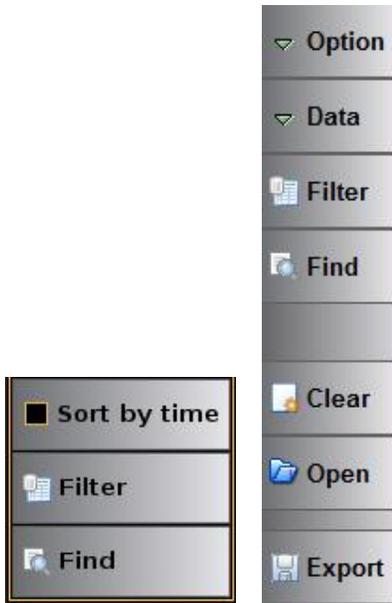
3. Click the **OK** activation button on the Open **ACA Data** dialog box. The ACA trace file will appear in the window.



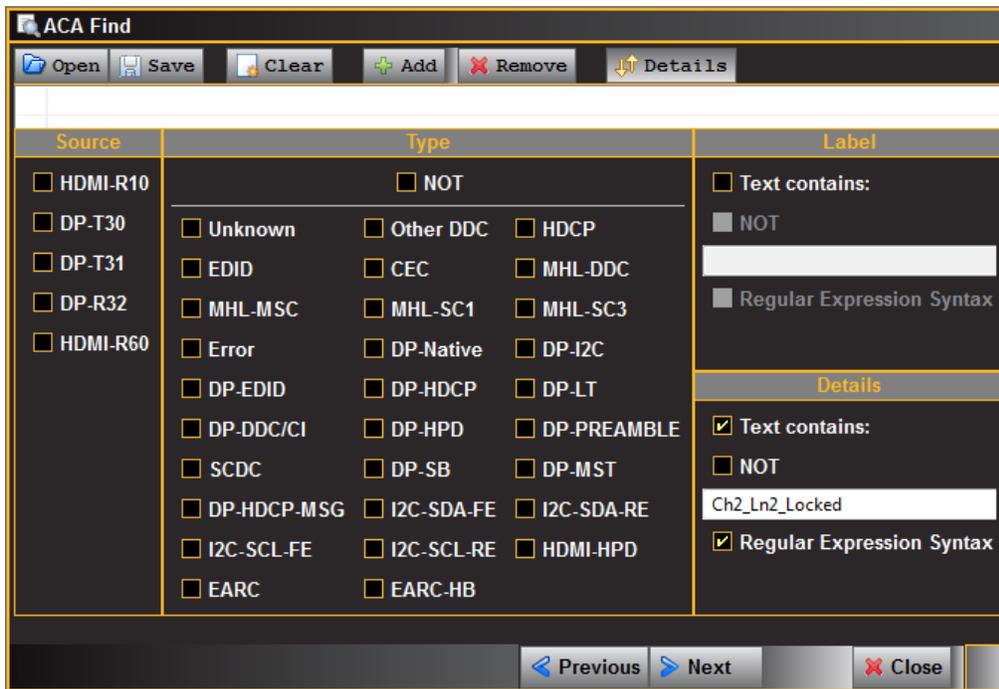
8.6 Using the ACA Find Feature

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 you have to 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.

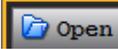
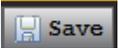
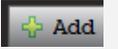
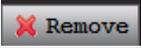
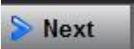


The **Find** function enables you to select data types in the **Type** field and then search based on text string occurrences in the log record labels or the message details.

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

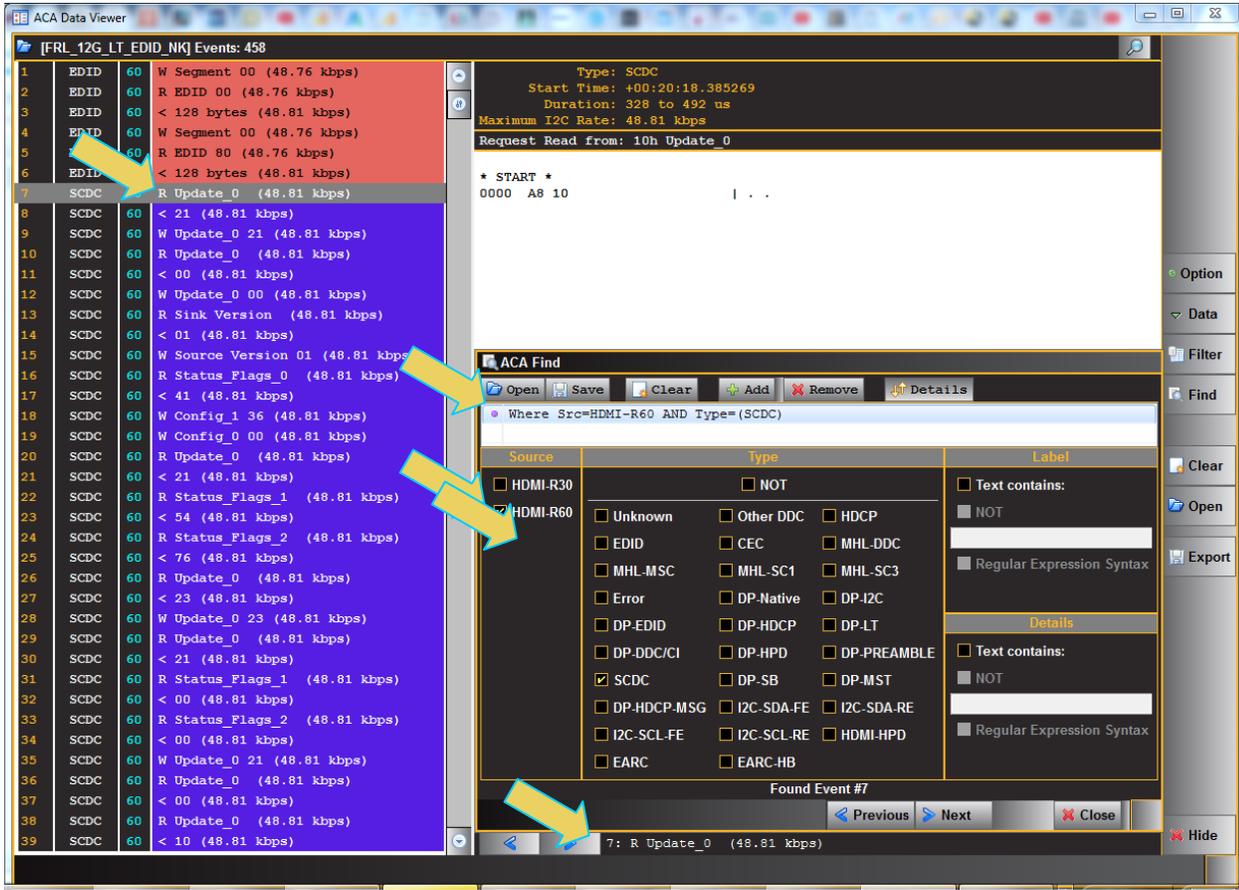
ACA Find Window		
Buttons (Top)	Function	Description
Open 	Opens a stored user created Find configuration.	You can store commonly used search configurations using the Save function and recall them for quick access using the Open button.
Save 	Saves a user created Find configuration.	
Clear 	Clear the existing Find criteria.	<p>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.</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 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.</p>
Add 	Sets the currently defined Find criteria defined in either the Source, Type, Label or Details sub-panels and adds another row for a new Find 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
Source	Checkbox to select the port on a particular that you want to search. Please note that you can collect data in the ACA Trace window from multiple ports.	<p>When you select multiple Source ports they behave as a logical OR function.</p> <p>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.</p>

ACA Find Window		
Buttons (Top)	Function	Description
Type	Check boxes enabling you to specify which data types you wish to 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 checkboxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter a criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<ul style="list-style-type: none"> Text Contains – A checkbox to activate the Label criteria. Not – A checkbox which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it. Text Field – A text field to enter a string that will be matched (or Not matched). 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 checkbox is checked, you can enter in any regular expression into the text field for a string match.
Details	Combination checkboxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter a criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<ul style="list-style-type: none"> Text Contains – A checkbox to activate the Label criteria. Not – A checkbox which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it. Text Field – A text field to enter a string that will be matched (or Not matched). 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 checkbox is checked, you can enter in any regular expression into the text field for a string match.
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 (interface on the), enter the following (example uses port HDMI-T60 transport port 1).



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

The screenshot displays the ACA Data Viewer interface. On the left, a list of events is shown with columns for line number, protocol, and data. The main window shows details for an event of Type: SDCD, Start Time: +00:20:18.385597, Duration: 164 to 328 us, and Maximum I2C Rate: 48.81 kbps. Below this, a bit stream is shown: 10h: Update_0. A table lists bit names and their values: Status_Update (Y(1)), CED_Update (N(0)), RR_Test (N(0)), Source_Test_Update (N(0)), FRL_start (N(0)), FLT_Update (Y(1)), RSED_Update (N(0)), and Reserved (0). The ACA Find window is open, showing search criteria: Where Src=HDMI-R60 AND Type=(SCDC). It lists sources (HDMI-R30, HDMI-R60) and types (Unknown, EDID, MHL-MSD, Error, DP-EDID, DP-DDC/CI, SCDC, DP-HDCP-MSG, I2C-SCL-FE, EARC, Other DDC, CEC, MHL-SC1, DP-Native, DP-HDCP, DP-HPD, DP-SB, I2C-SDA-FE, I2C-SCL-RE, EARC-HB, HDCP, MHL-DDC, MHL-SC3, MHL-SC3, DP-I2C, DP-LT, DP-PREAMBLE, DP-MST, HDMI-HPD). The 'Next' button is highlighted with a yellow arrow.

- To find all data types from a specific port (interface on the) and that are SCDC transactions, enter the following (example uses port HDMI-T60 transport port). This search behaves like a logical AND function.

The screenshot shows the ACA Data Viewer interface. The main window displays a list of events for the port [FRL_LT_Rate4]. The events are filtered to show SCDC transactions. A detailed view of a selected event shows its parameters: Type: SCDC, Start Time: +00:35:51.355455, Duration: 656 to 820 us, Maximum I2C Rate: 48.86 kbps, and Write, 1 byte. A bit field table is also shown with bit names and values.

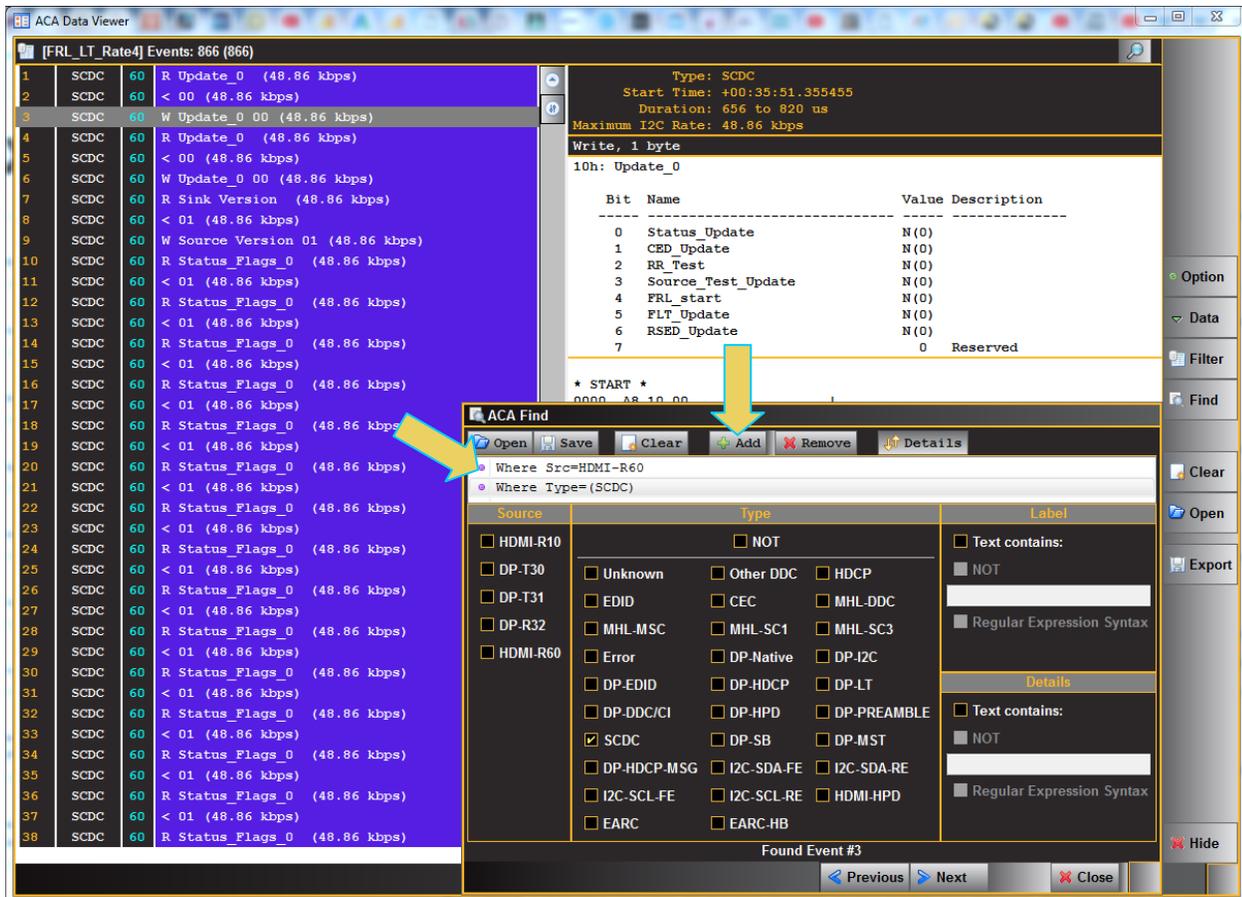
The ACA Find dialog box is open, showing search criteria: `Where Src=HDMI-R60 AND Type=(SCDC)`. The dialog has a table of sources and types with checkboxes:

Source	Type	Label
<input type="checkbox"/> HDMI-R10	<input type="checkbox"/> NOT	<input type="checkbox"/> Text contains:
<input type="checkbox"/> DP-T30	<input type="checkbox"/> Unknown	<input type="checkbox"/> NOT
<input type="checkbox"/> DP-T31	<input type="checkbox"/> EDID	<input type="checkbox"/> Regular Expression Syntax
<input type="checkbox"/> DP-R32	<input type="checkbox"/> MHL-MSC	<input type="checkbox"/> Details
<input checked="" type="checkbox"/> HDMI-R60	<input type="checkbox"/> Error	<input type="checkbox"/> Text contains:
	<input type="checkbox"/> DP-EDID	<input type="checkbox"/> NOT
	<input type="checkbox"/> DP-DDC/CI	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> DP-DDC/CI	<input type="checkbox"/> Details
	<input type="checkbox"/> DP-HPD	<input type="checkbox"/> Text contains:
	<input type="checkbox"/> DP-HPD	<input type="checkbox"/> NOT
	<input type="checkbox"/> DP-SB	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> DP-SB	<input type="checkbox"/> Details
	<input type="checkbox"/> I2C-SDA	<input type="checkbox"/> Text contains:
	<input type="checkbox"/> I2C-SDA	<input type="checkbox"/> NOT
	<input type="checkbox"/> I2C-SDA-RE	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> I2C-SDA-RE	<input type="checkbox"/> Details
	<input type="checkbox"/> I2C-SCL-FE	<input type="checkbox"/> Text contains:
	<input type="checkbox"/> I2C-SCL-FE	<input type="checkbox"/> NOT
	<input type="checkbox"/> I2C-SCL-RE	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> I2C-SCL-RE	<input type="checkbox"/> Details
	<input type="checkbox"/> HDMI-HPD	<input type="checkbox"/> Text contains:
	<input type="checkbox"/> HDMI-HPD	<input type="checkbox"/> NOT
	<input type="checkbox"/> EARC	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> EARC	<input type="checkbox"/> Details

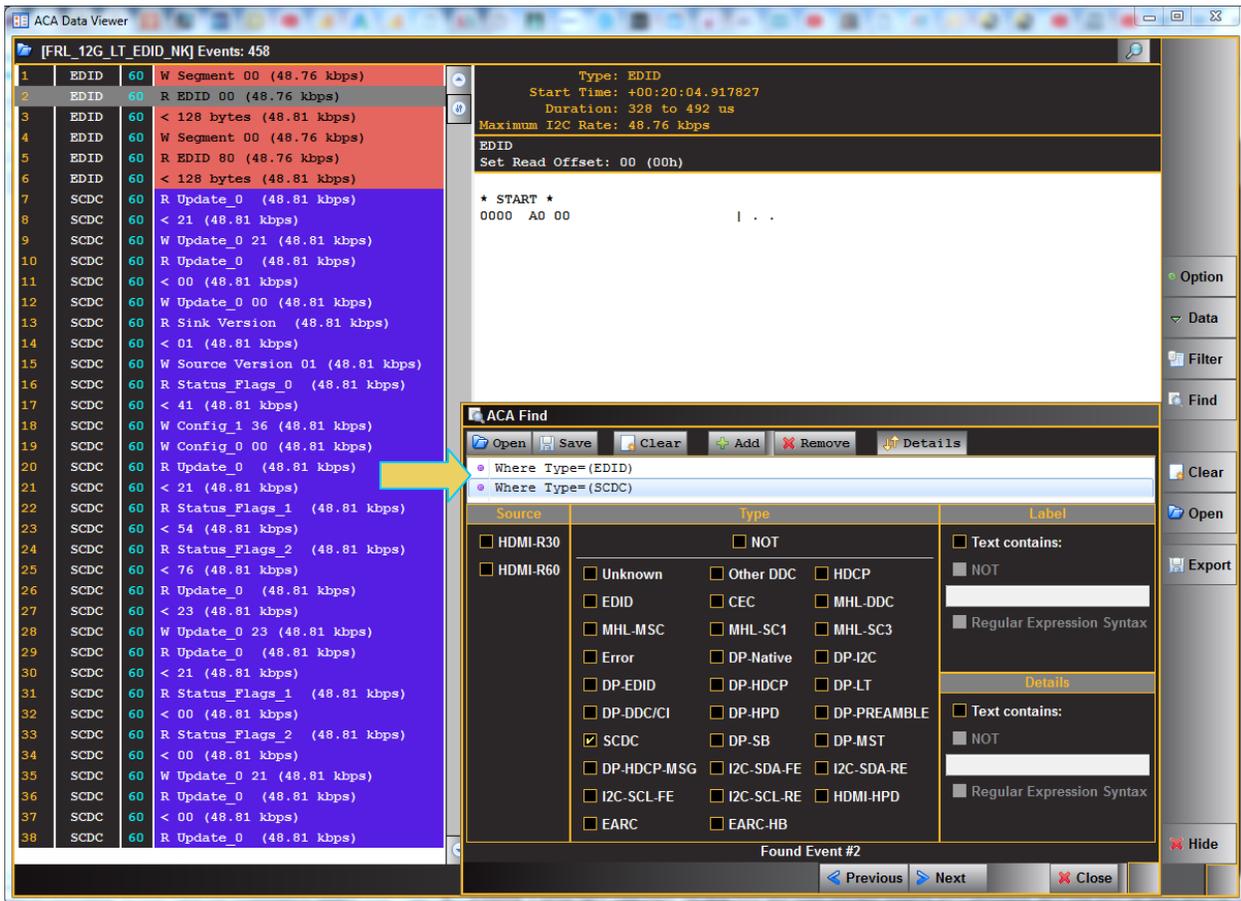
The dialog also shows a search filter: `Where Src=HDMI-R60 AND Type=(SCDC)`. A yellow arrow points to the 'SCDC' checkbox in the Type column.

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

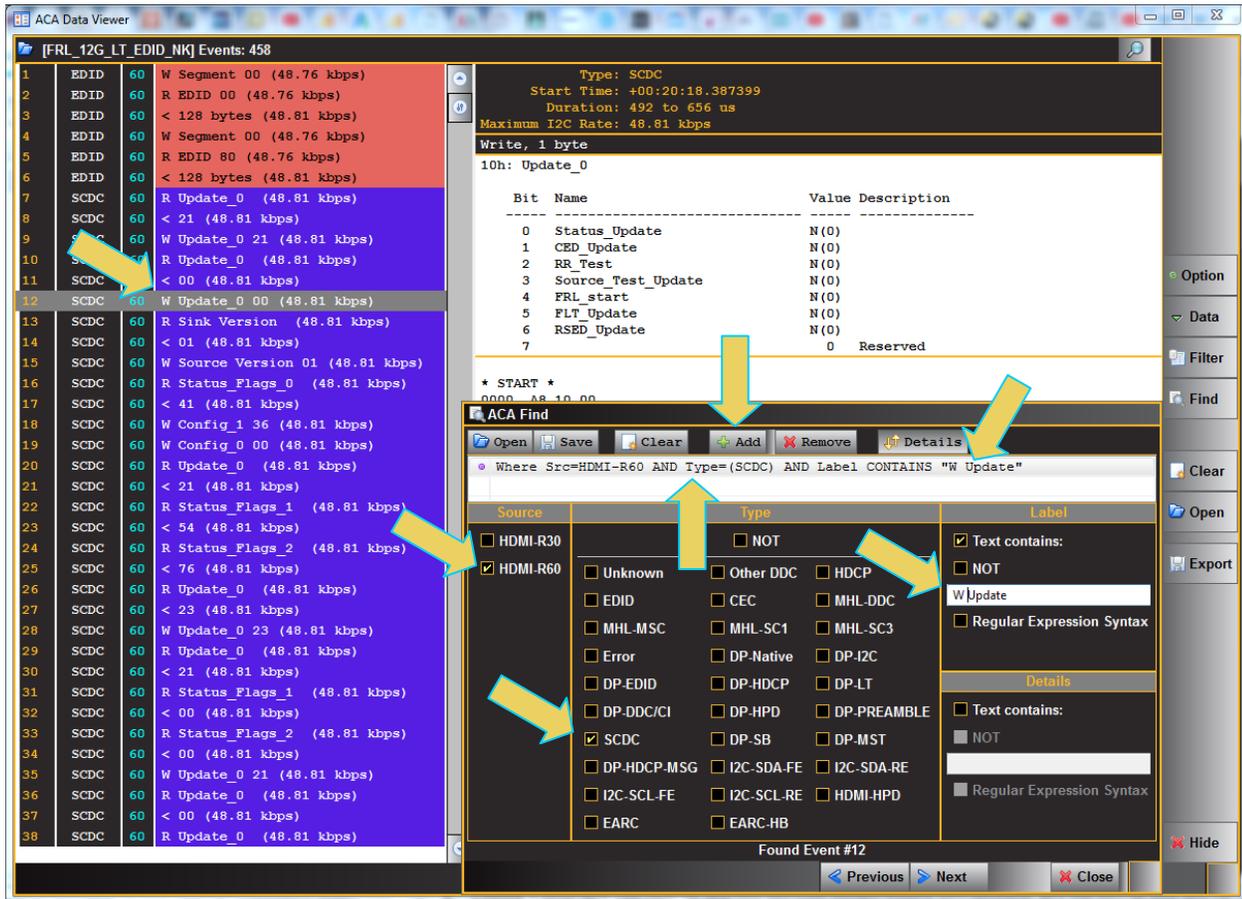
Note that when you select different data type definitions in the same search configuration, example port type and data Type above, the search uses a logical AND function. But if you use two distinct definitions, the search will function as a logical OR function as shown on the screen example below. Note that you will have to click on the **Add** button to add the second of the two OR find criteria.



If you specify two different types of data in the **Type** field, the search will be a logical OR function as shown below. Use the **Add** button to add the second item.



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.

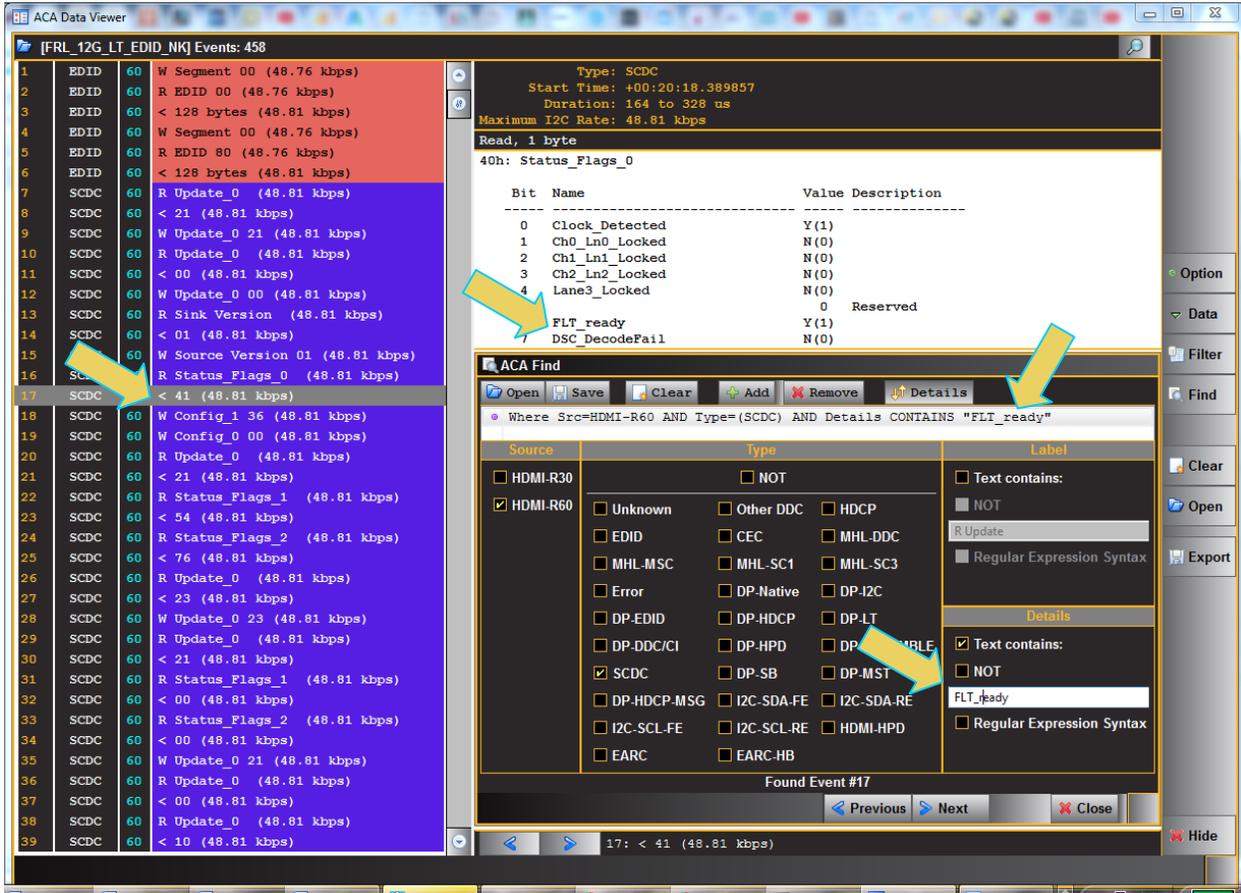


However, if you enter these same criteria using separate configurations as shown below, the search will behave as a logical OR function. In this case it will find the next instance of an SCDC transaction.

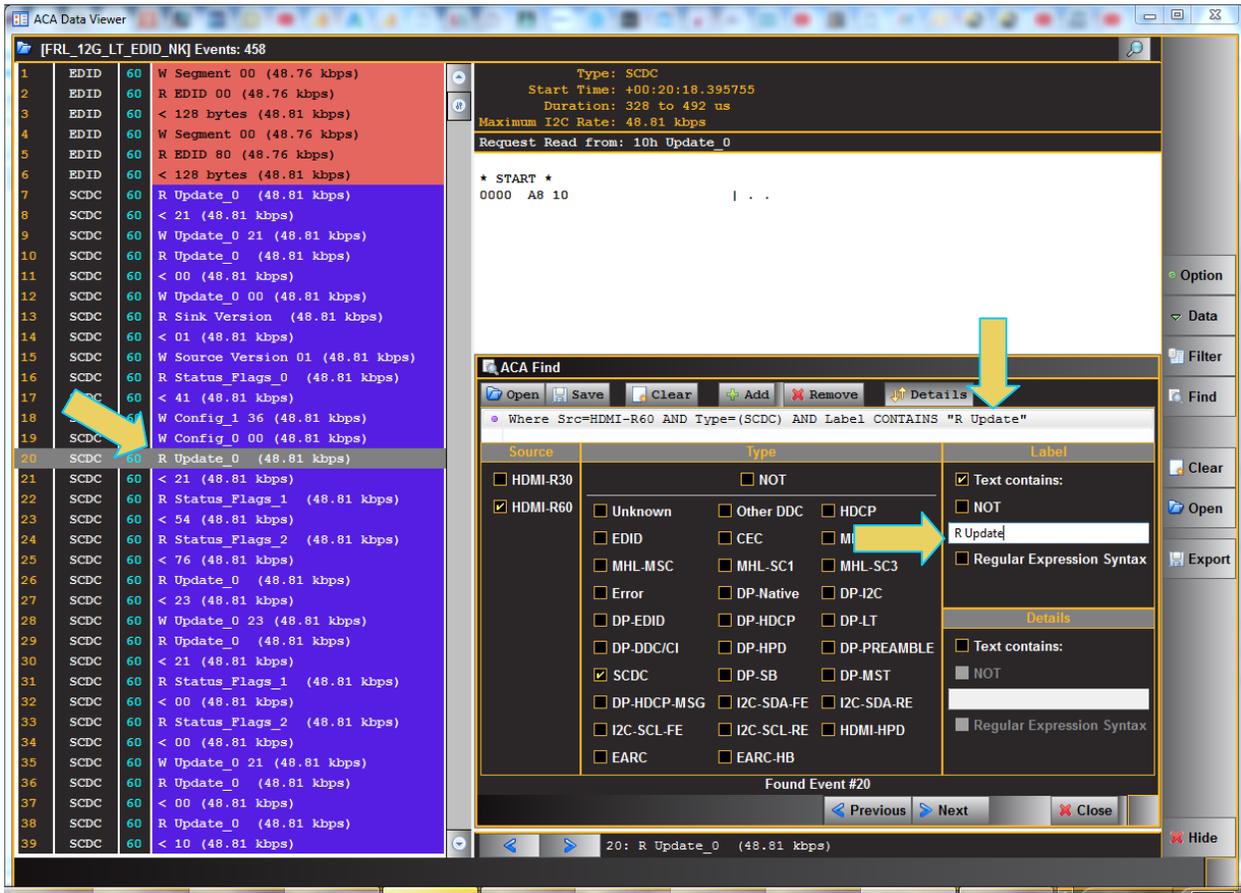
The screenshot displays the ACA Data Viewer interface. On the left, a list of events is shown, with event #20 highlighted. The main window displays details for event #20, including its type (SCDC), start time, duration, and maximum I2C rate. The ACA Find window is open, showing search criteria: 'Where Label CONTAINS "W Update"' and 'Where Type=(SCDC)'. The search results table shows event #20: R Update_0 (48.81 kbps). The search window also includes a list of sources (HDMI-R30, HDMI-R60) and a list of types (Unknown, Other DDC, HDCP, EDID, CEC, MHL-DDC, MHL-MSC, MHL-SC1, MHL-SC3, Error, DP-Native, DP-I2C, DP-EDID, DP-HDCP, DP-LT, DP-DDC/CI, DP-HPD, DP-PREAMBLE, SCDC, DP-SB, DP-MST, DP-HDCP-MSG, I2C-SDA-FE, I2C-SDA-RE, I2C-SCL-FE, I2C-SCL-RE, HDMI-HPD, EARC, EARC-HB). The search results table shows event #20: R Update_0 (48.81 kbps).

Source	Type	Label
<input type="checkbox"/> HDMI-R30	<input type="checkbox"/> NOT	<input type="checkbox"/> Text contains: <input type="checkbox"/> NOT
<input type="checkbox"/> HDMI-R60	<input type="checkbox"/> Unknown <input type="checkbox"/> Other DDC <input type="checkbox"/> HDCP	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> EDID <input type="checkbox"/> CEC <input type="checkbox"/> MHL-DDC	<input type="checkbox"/> Text contains: <input type="checkbox"/> NOT
	<input type="checkbox"/> MHL-MSC <input type="checkbox"/> MHL-SC1 <input type="checkbox"/> MHL-SC3	<input type="checkbox"/> Regular Expression Syntax
	<input type="checkbox"/> Error <input type="checkbox"/> DP-Native <input type="checkbox"/> DP-I2C	
	<input type="checkbox"/> DP-EDID <input type="checkbox"/> DP-HDCP <input type="checkbox"/> DP-LT	
	<input type="checkbox"/> DP-DDC/CI <input type="checkbox"/> DP-HPD <input type="checkbox"/> DP-PREAMBLE	
	<input checked="" type="checkbox"/> SCDC <input type="checkbox"/> DP-SB <input type="checkbox"/> DP-MST	
	<input type="checkbox"/> DP-HDCP-MSG <input type="checkbox"/> I2C-SDA-FE <input type="checkbox"/> I2C-SDA-RE	
	<input type="checkbox"/> I2C-SCL-FE <input type="checkbox"/> I2C-SCL-RE <input type="checkbox"/> HDMI-HPD	
	<input type="checkbox"/> EARC <input type="checkbox"/> EARC-HB	

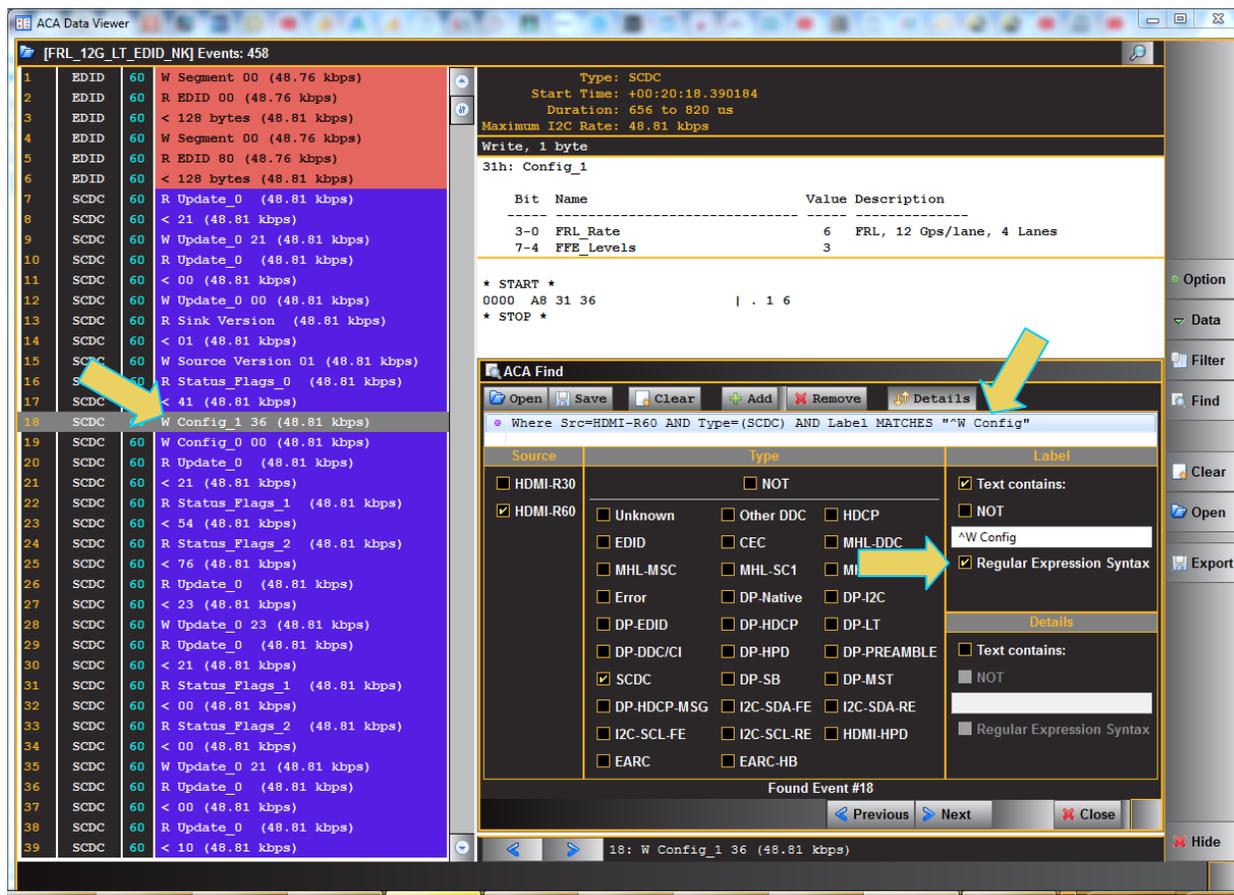
You can also search through the **Details** panel of a record. The following examples depicts this. In this example, we have also restricted the search to SCDC on Port 60 and searching for the text string "FLT_ready" in Details panel.



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.



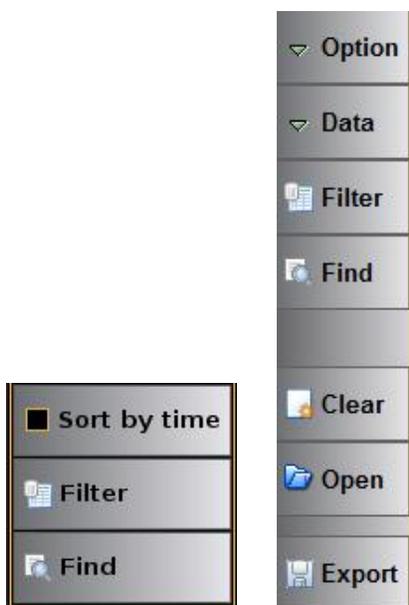
You can use regular expressions as well in either the **Label** field or the **Details** field. The following example shows how you can advance to HDMI SCDC transaction that contains the string "> W Config" at the beginning (^ operator) of it.



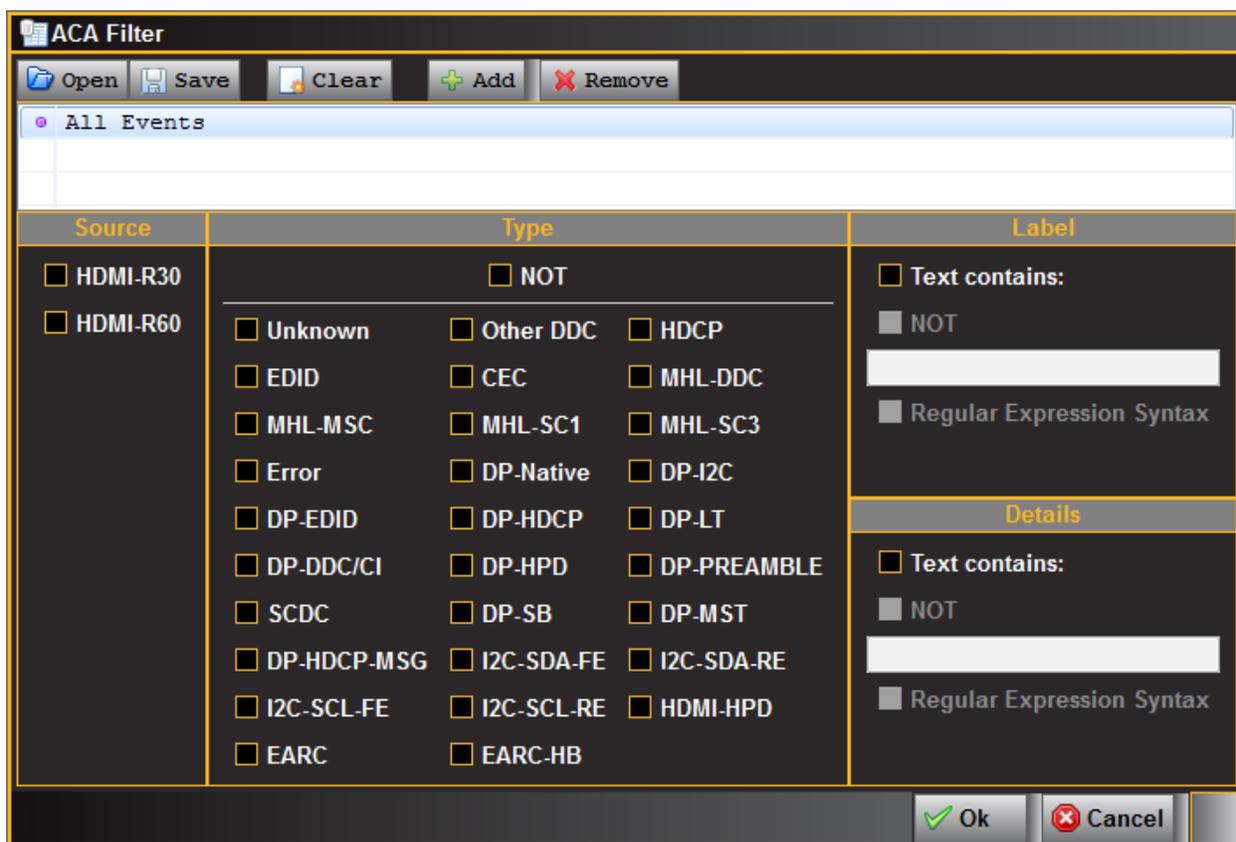
8.7 Using the ACA Filter Feature

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 have to 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**.



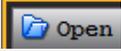
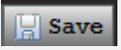
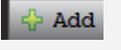
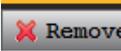
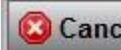
The **ACA Filter** dialog box is shown below.



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.	
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 screen shots 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 a 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	Checkbox to select the port on a particular that you want to filter. Please note that you can collect data in the ACA Trace window from multiple ports.	<p>When you select multiple Source ports they behave as a logical OR function.</p> <p>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.</p>
Type	Check boxes enabling you to specify which data types you wish to data types you wish to filter on based on the string.	<p>When you select multiple data Types they behave as a logical OR function.</p> <p>If only the Type field is specified the next or previous of that data type will be highlighted.</p>
Label	Combination checkboxes and text	<ul style="list-style-type: none"> Text Contains – A checkbox to activate the Label

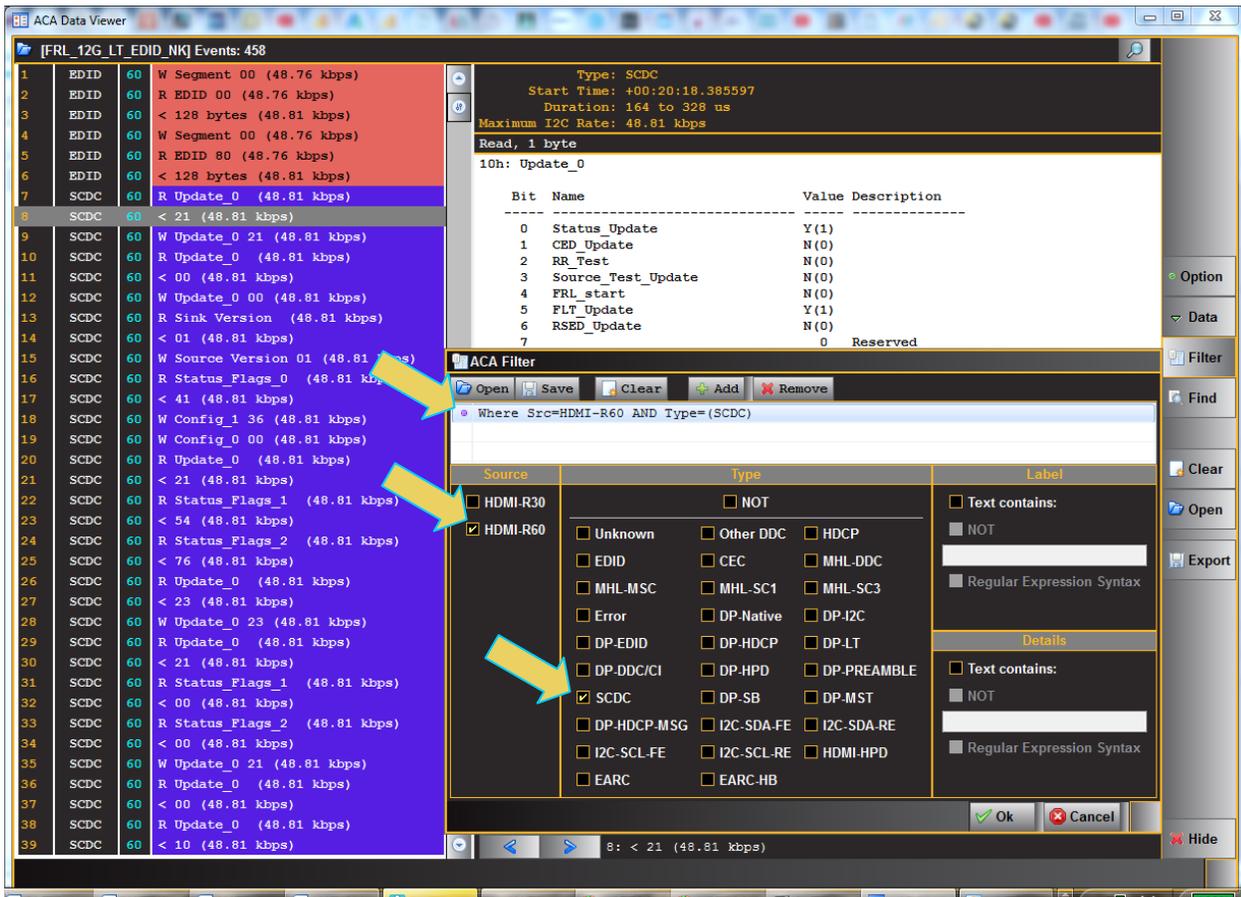
ACA Filter Window		
Buttons (Top)	Function	Description
	fields for specifying criteria for text that appears in the Label field of the message. When you enter a criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<p>criteria.</p> <ul style="list-style-type: none"> • Not – A checkbox which when checked will filter for records that <i>do not</i> meet the criteria in the field beneath it. • Text Field – A text field to enter a string that will be matched (or Not matched). • 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 filtering the text. You can find detailed examples on the web including Wikipedia. If Regular Expression checkbox is checked, you can enter in any regular expression into the text field for a string match.
Details	Combination checkboxes and text fields for specifying criteria for text that appears in the Label field of the message. When you enter a criteria in the Label field, it will automatically be added to the set of criteria in the panel above it.	<ul style="list-style-type: none"> • Text Contains – A checkbox to activate the Label criteria. • Not – A checkbox which when checked will search for records that <i>do not</i> meet the criteria in the field beneath it. • Text Field – A text field to enter a string that will be matched (or Not matched). • 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 filtering the text. You can find detailed examples on the web including Wikipedia. If Regular Expression checkbox is checked, you can enter in any regular expression into the text field for a string match.
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.

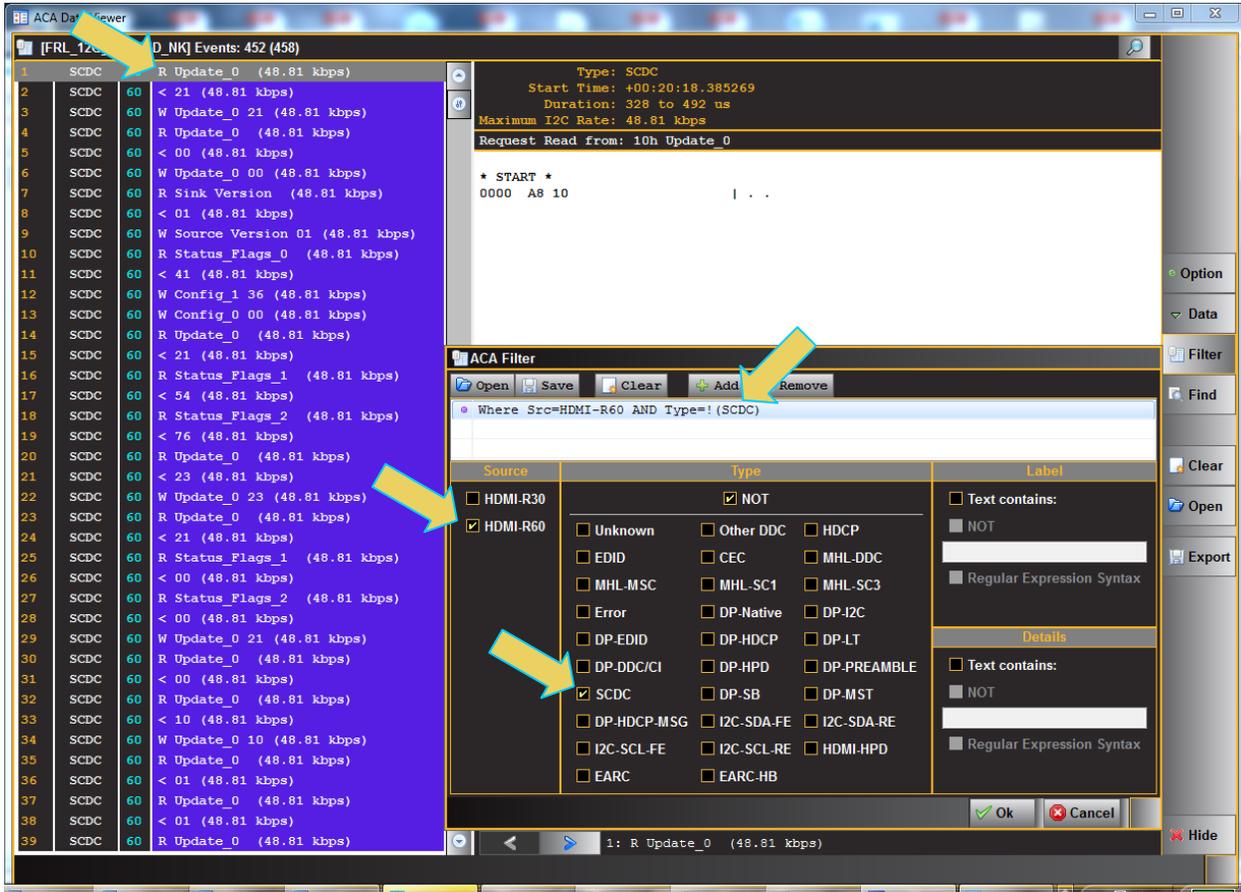
The screenshot displays the ACA Data Viewer interface. The main window is titled "[FRL_12G_LT_EDID_NK] Events: 452 (458)". The left pane shows a list of 39 events, each with a line number, SCDC type, value, and data rate. A yellow arrow points to the first event. The right pane shows the details for the selected event (line 1):

```
Type: SCDC
Start Time: +00:20:18.385269
Duration: 328 to 492 us
Maximum I2C Rate: 48.81 kbps
Request Read from: 10h Update_0

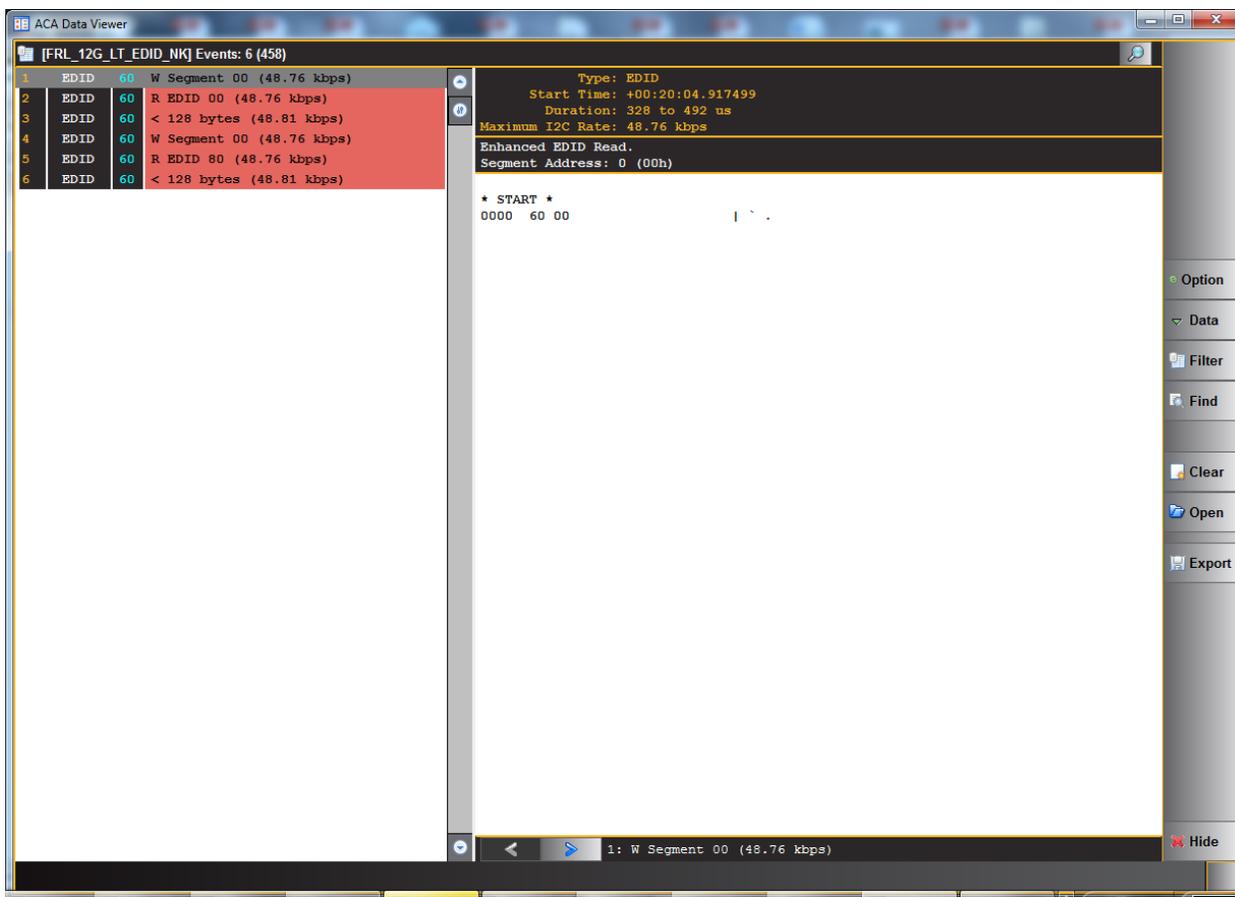
* START *
0000 A8 10 | . .
```

The bottom status bar shows "1: R Update_0 (48.81 kbps)". On the right side, there is a vertical toolbar with buttons for Option, Data, Filter, Find, Clear, Open, Export, and Hide.

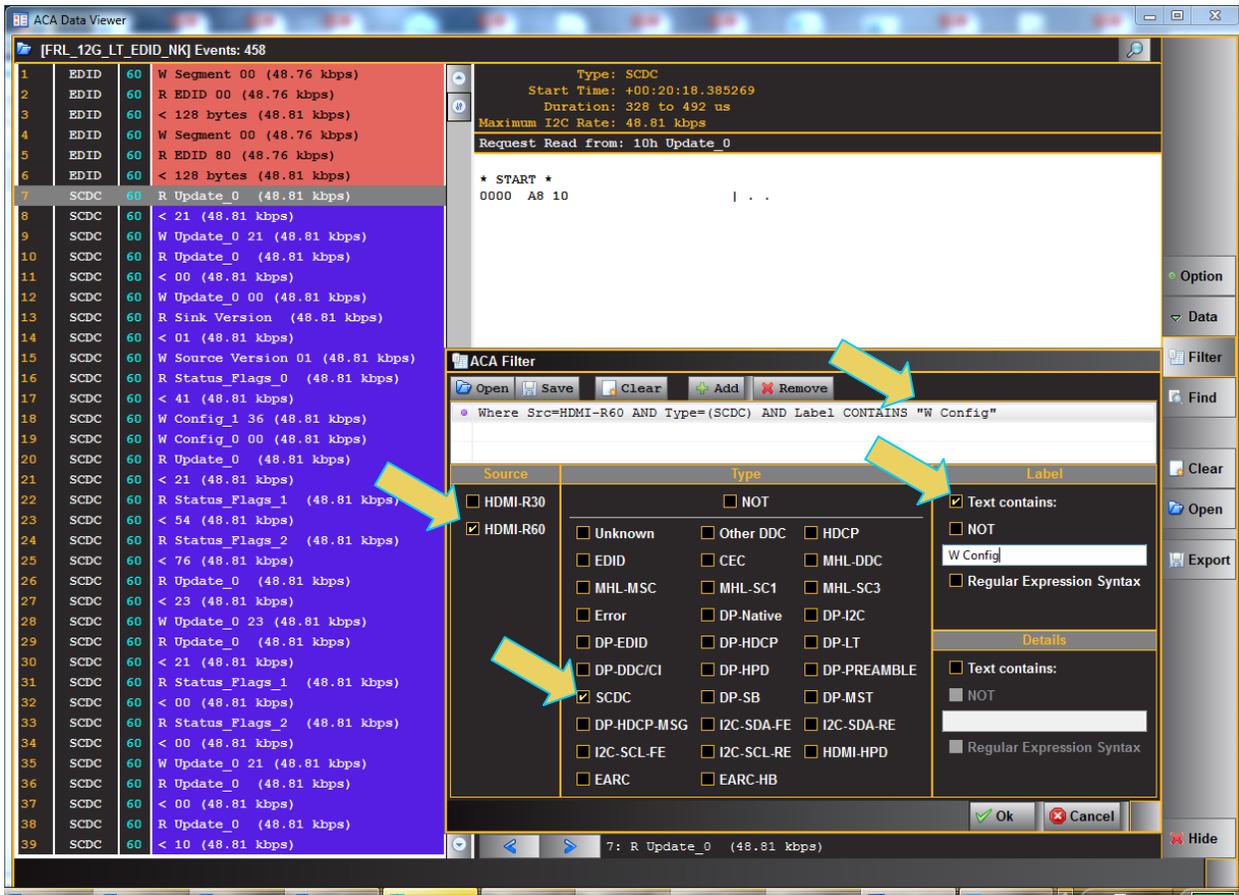
2. To filter out all SCDC messages use the NOT operator as follows.



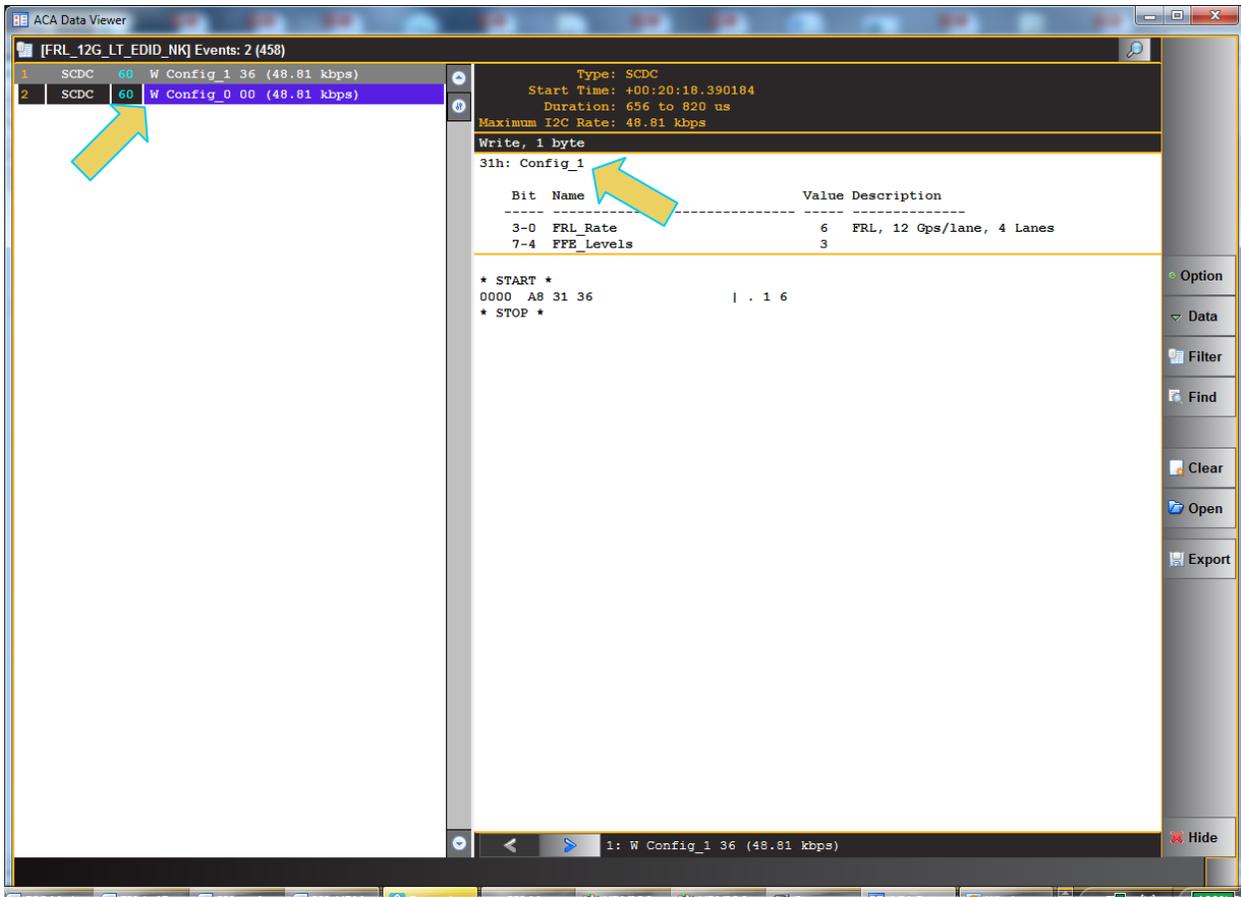
Click on the **Ok** button to initiate the filter. The result is shown below. The HDMI SCDC message are stripped from the list leaving only the EDID transactions.



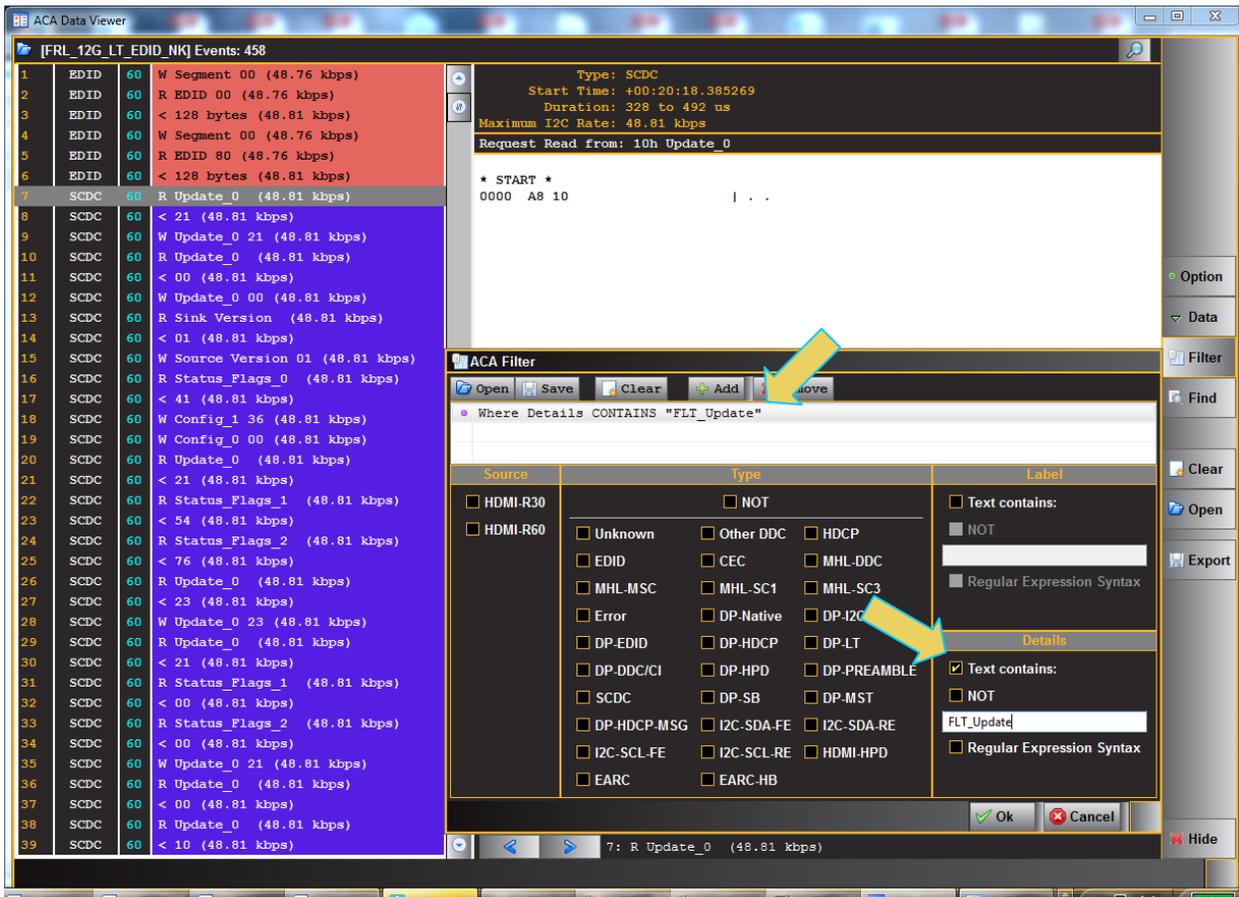
- To filter using text strings appearing in the message label, use the checkbox(es) on the **Label** section of the **ACA Filter** window. You can also include a text string filter with a filter applied to the **Type** field. For example if you wish to establish a filter based on a source (HDMI-R60) and **Type** and a text string that includes “W Config” you would use the following.



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



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



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

The screenshot shows the ACA Data Viewer interface. The left pane displays a list of 39 events, all of type SCDC, with a rate of 48.81 kbps. A yellow arrow points to the first event in the list: "1 SCDC 60 < 21 (48.81 kbps)".

The right pane shows the details for the selected event. It includes the following information:

- Type: SCDC
- Start Time: +00:20:18.385597
- Duration: 164 to 328 us
- Maximum I2C Rate: 48.81 kbps
- Read, 1 byte
- 10h: Update_0

A table below the details shows the bit fields:

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

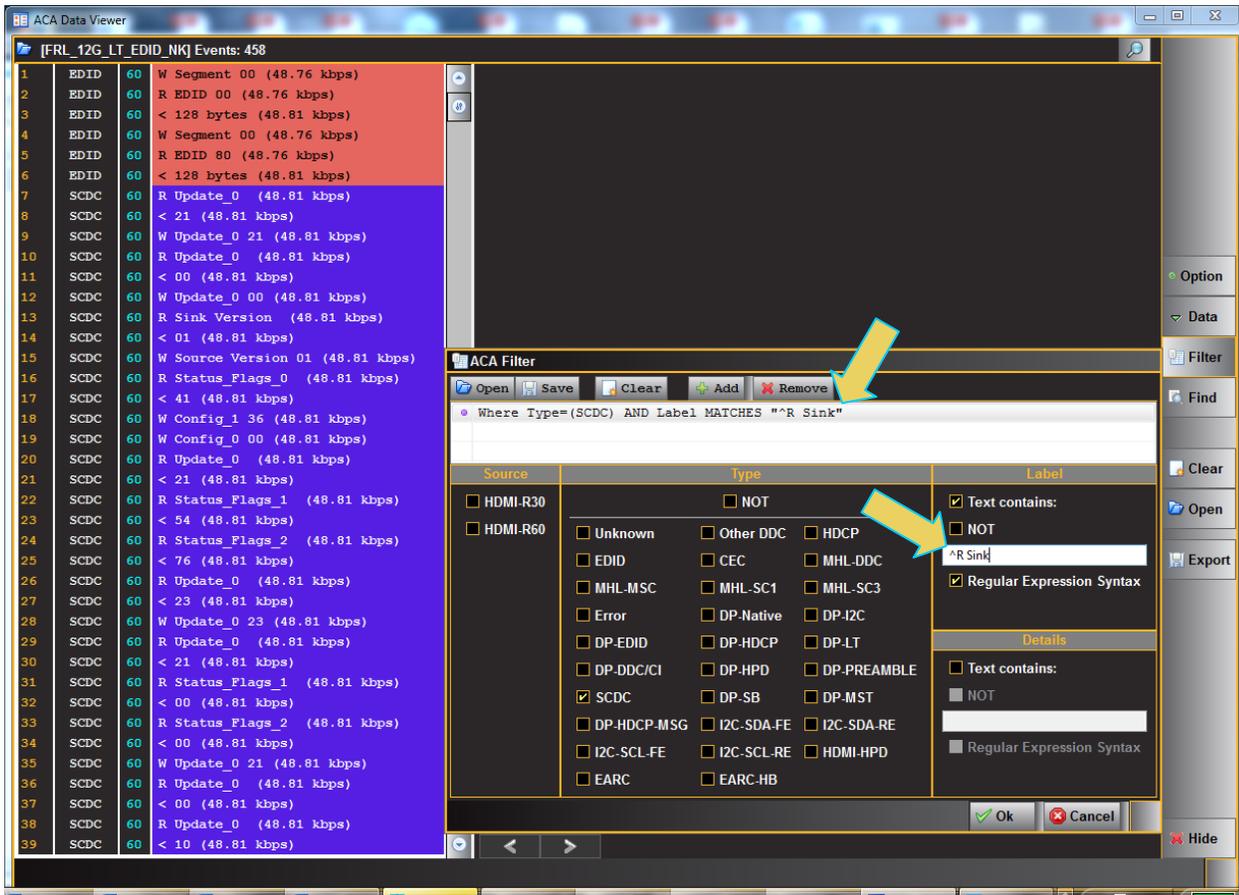
Below the table, there is a hex dump and ASCII representation:

```
* START *  
0000_A9 21- | . !  
* STOP *
```

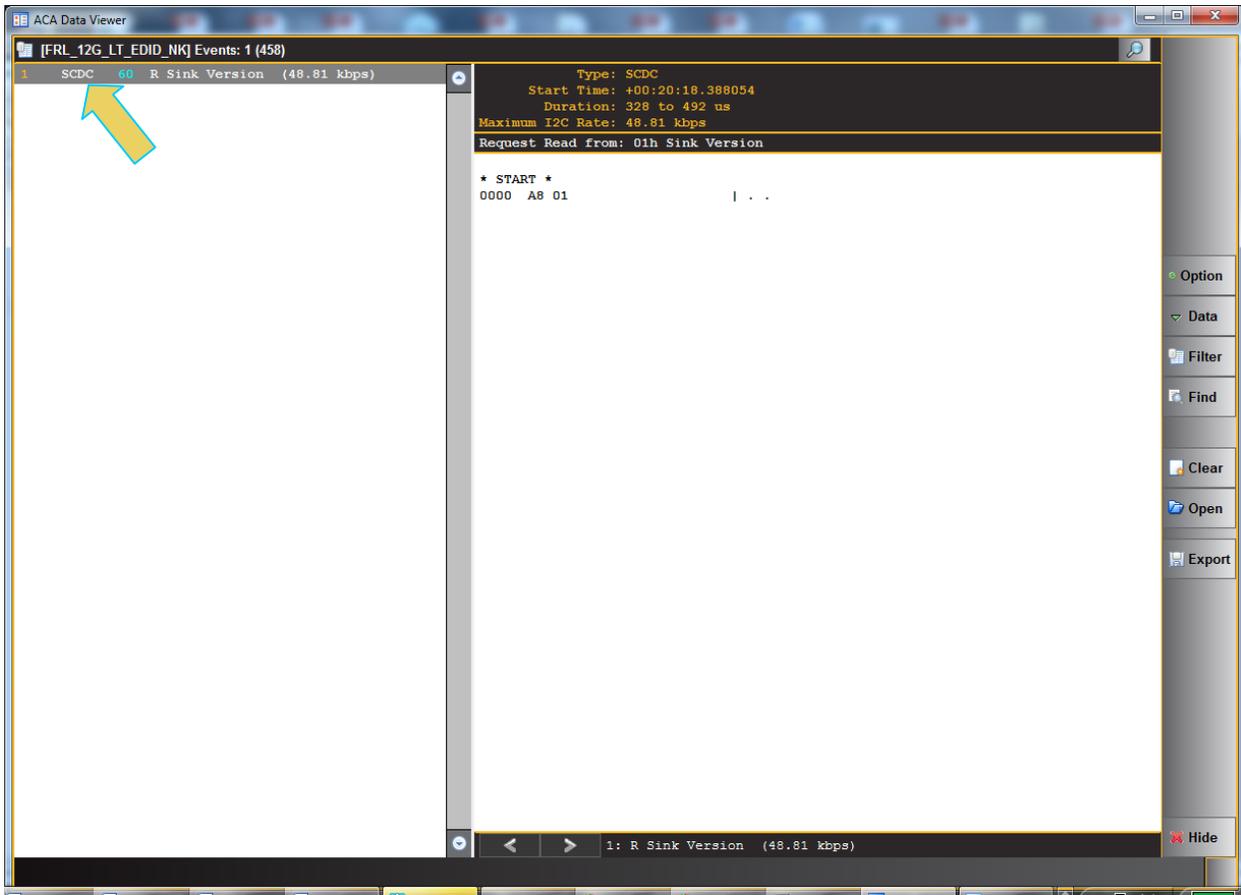
A yellow arrow points to the "RSED_Update" bit in the table.

On the right side of the interface, there is a vertical toolbar with buttons for "Option", "Data", "Filter", "Find", "Clear", "Open", "Export", and "Hide".

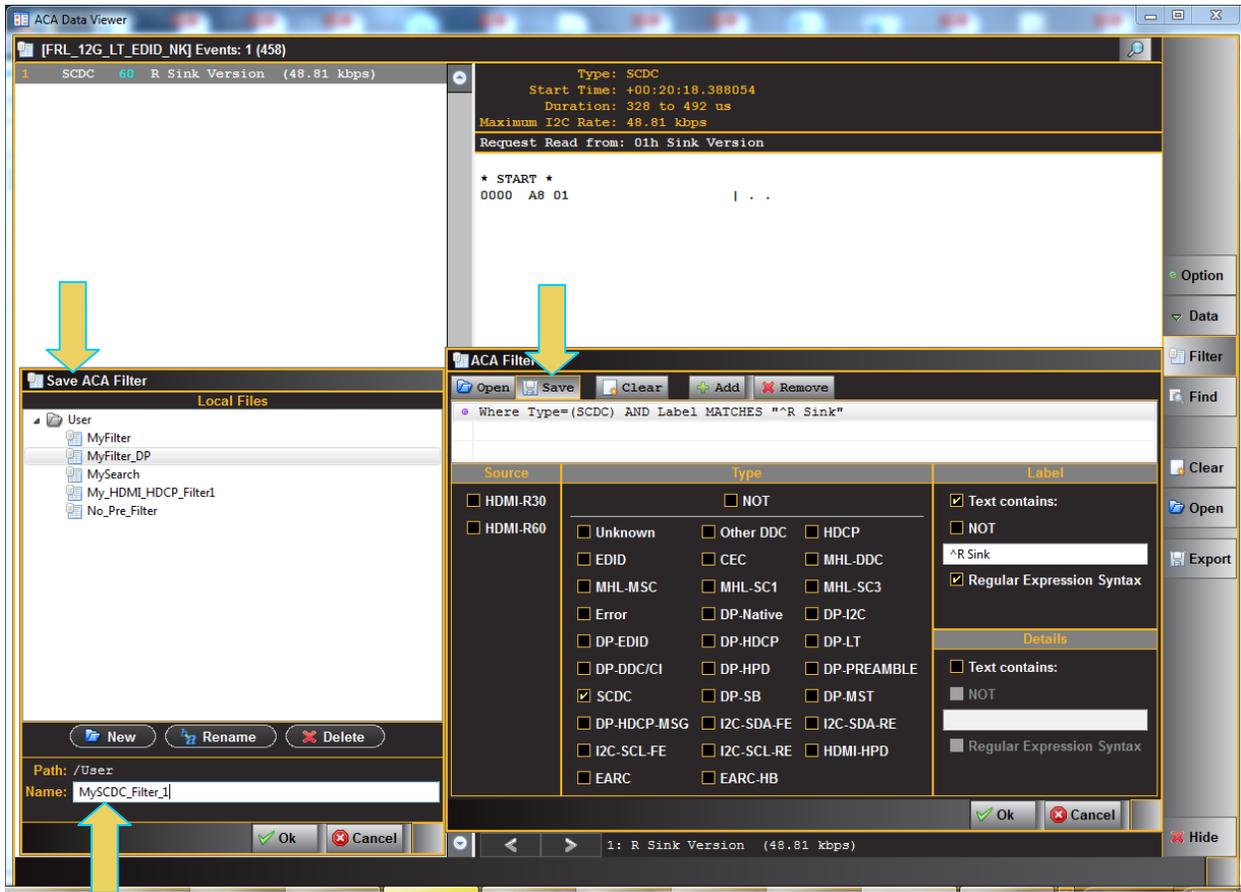
- To filter using regular expression text in the message label, text strings in the message details, use the **Regular Expression Syntax** checkbox on the **Label** section of the **ACA Filter** window. Refer to the following example. Note that the (^) operator filters for text strings that begin with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



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

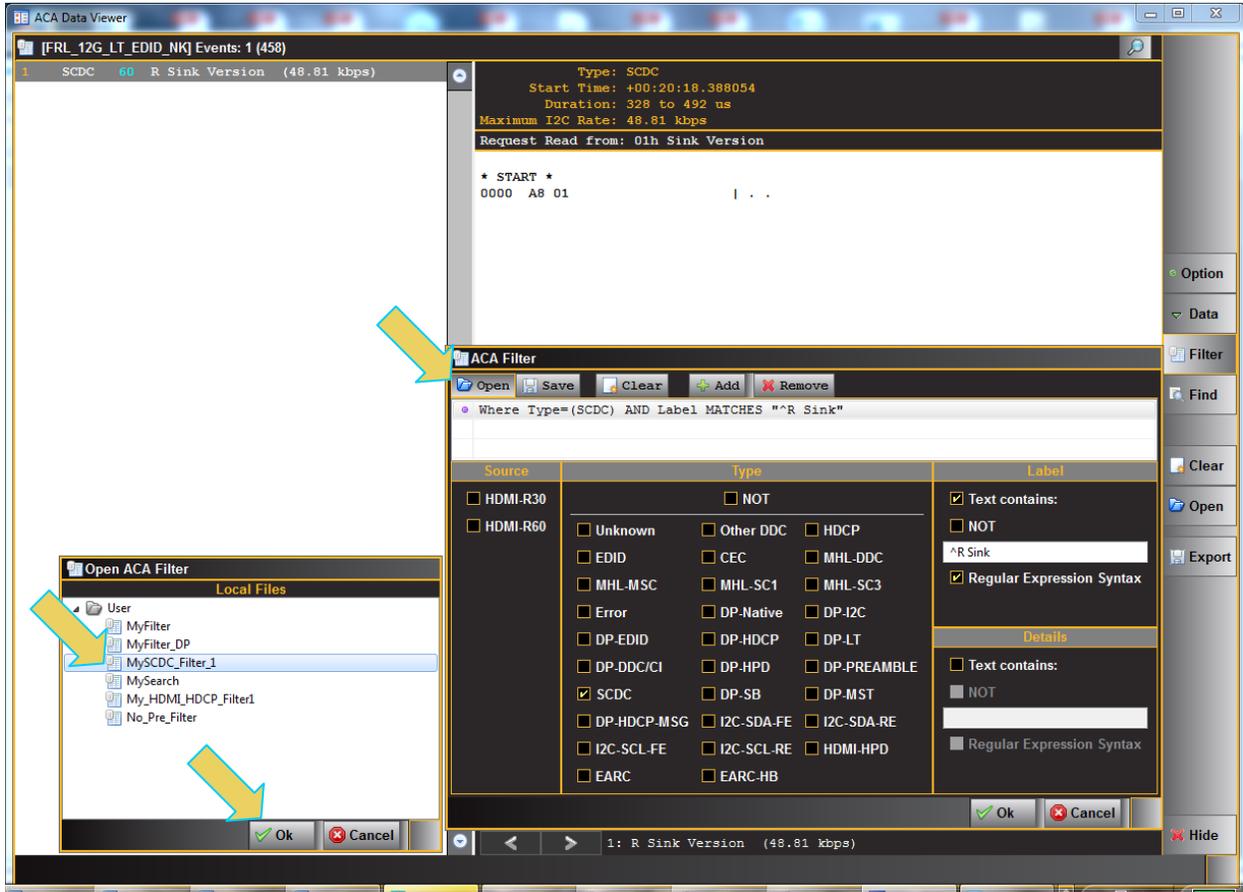


6. To save a filter configuration for quick recall, use the **Save** button.



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.



9 Loading and Importing Capture files

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

9.1 Loading an existing captures with the M41h 48G Video Analyzer/Generator

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

9.1.1 Loading an existing capture

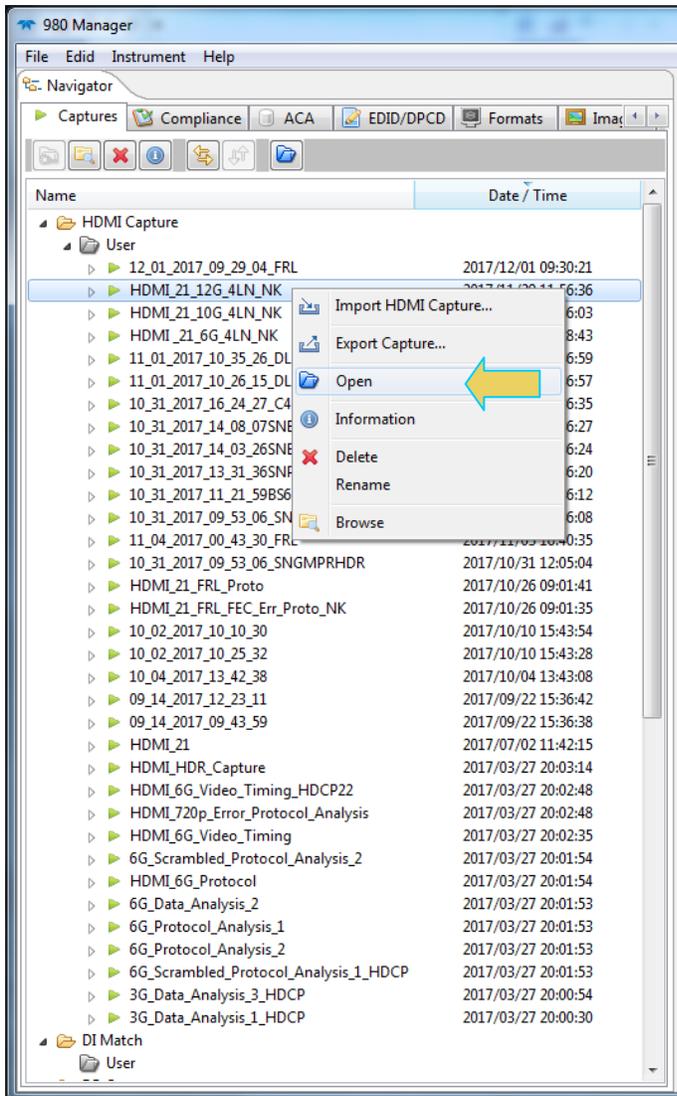
Use the following procedures to load a capture that you have listed in the ATP Manager for the M41h 48G Video Analyzer/Generator. You can load a file in one of three ways:

- 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 the **Open** icon  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:

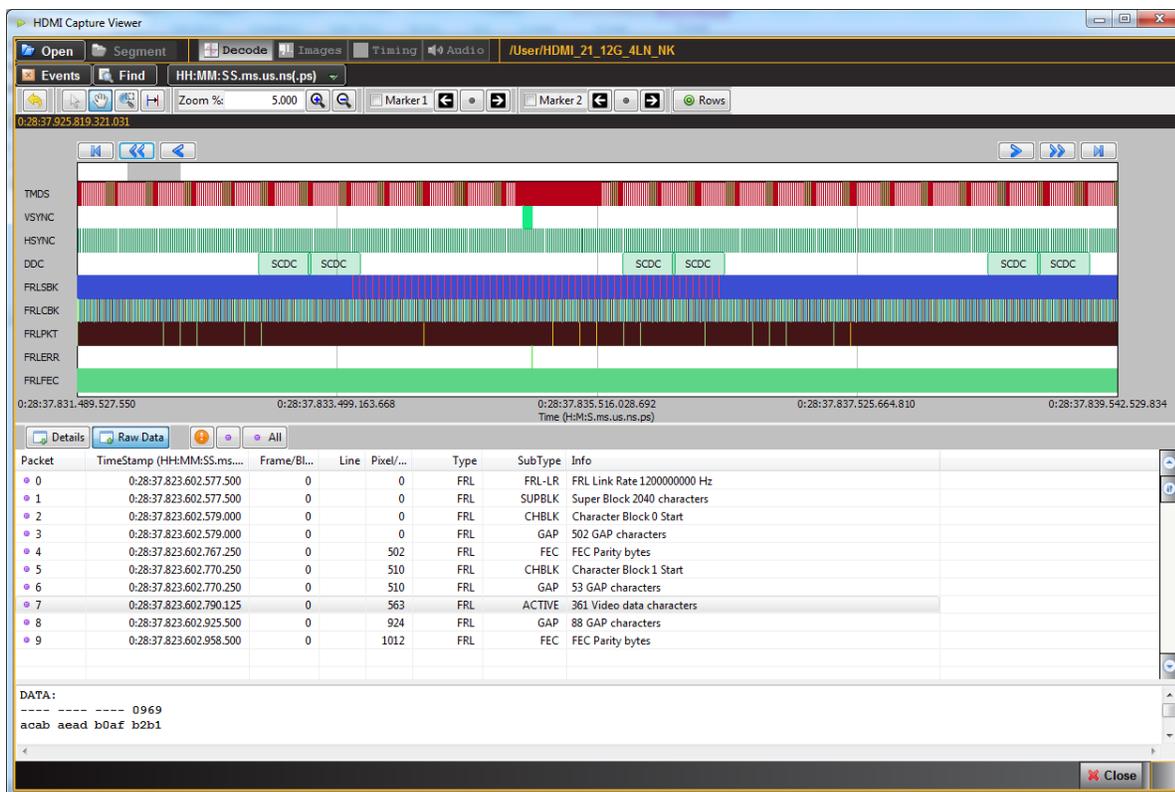
1. Load a capture for analysis by right clicking on it and then select the **Open** item on the list.



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 **Data Decode** panels.



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



9.2 Importing Capture Files from other M41h Systems

This subsection provides procedures on loading a previously captured file and also 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 up captured files that have been taken by any other M41h 48G Video Analyzer/Generator at any other location. You do not need a 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 a 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 a 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.

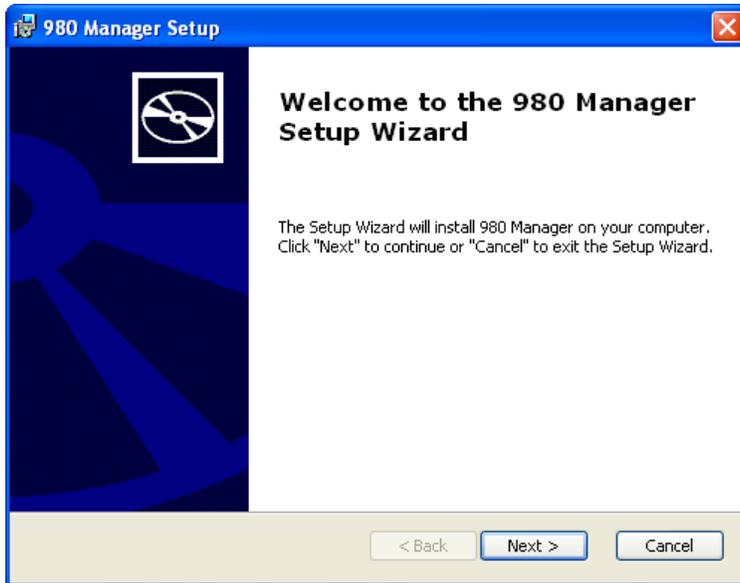
9.2.1 Importing Capture files

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.

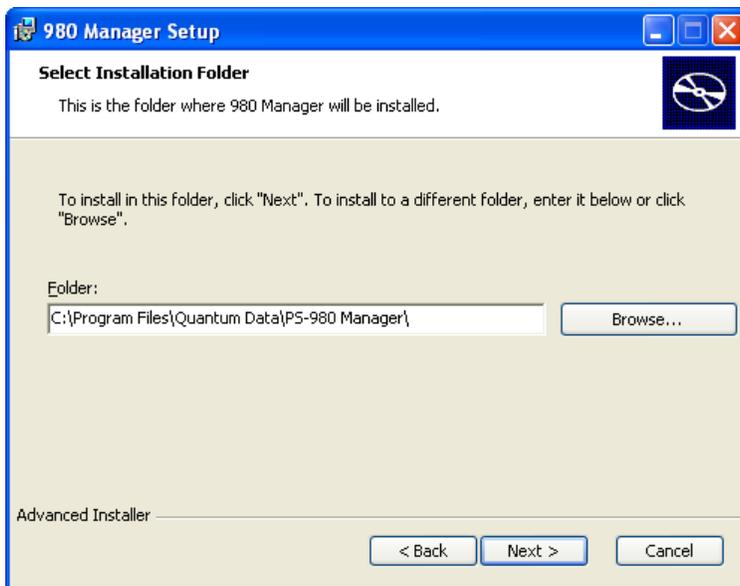
To Install the ATP Manager on your PC:

1. Download the ATP Manager from the Quantum Data *downloads* page to your PC. The link to the *downloads* page is: <http://www.quantumdata.com/downloads>.
2. Start the installation by double-clicking on your downloaded *.msi file.

The Setup Wizard will launch.



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

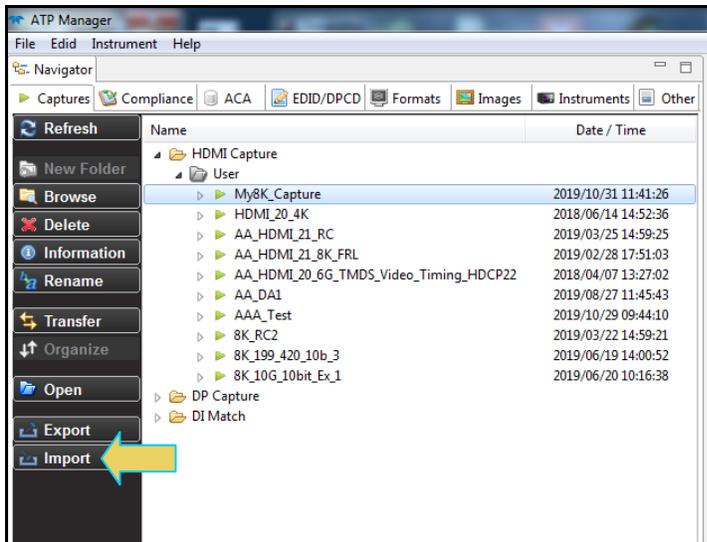


4. After installation completes, run the new ATP Manager. It should be available in the Start Menu under **All Programs** → **Quantum Data**, and also from an icon on your Desktop.

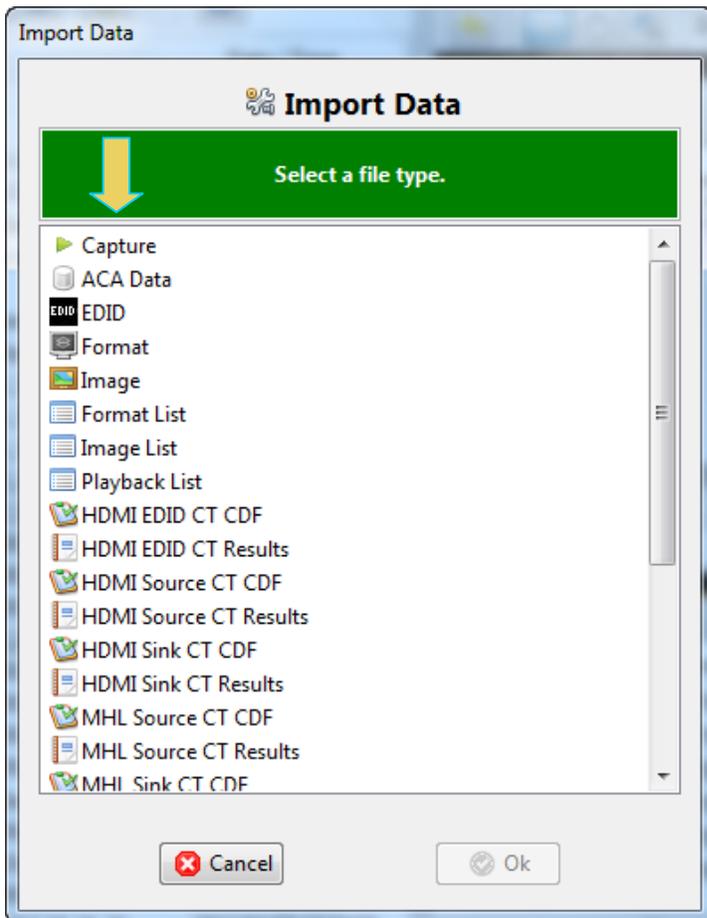
5. Verify that the version number in the title bar matches the version on the website.

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.)



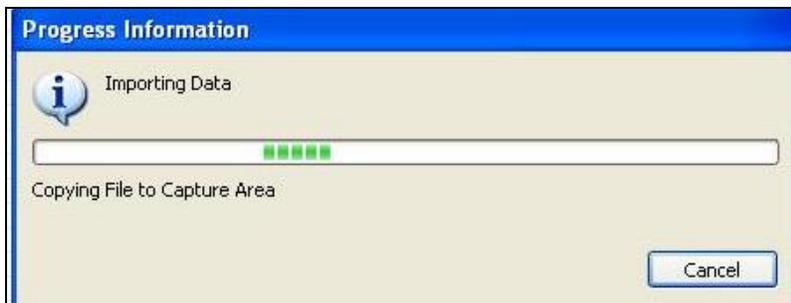
3. Select **Import**. A dialog box will appear enabling you to select which data type (EDID, Capture, etc.) you want to import. In this example, you want to import a capture. Select **Capture** and click Ok (see below).



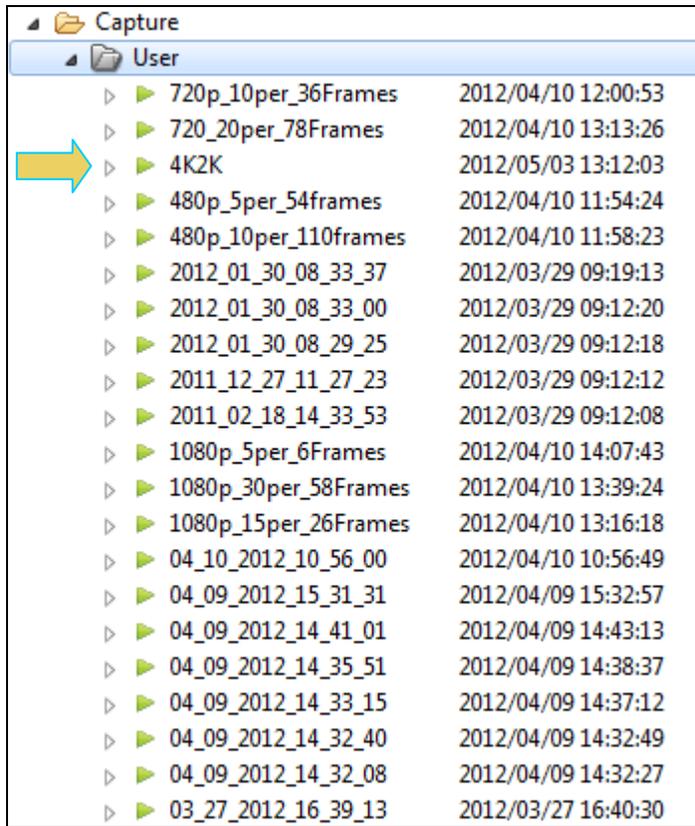
You will be asked to browse for a file through a standard Windows dialog.

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_DI_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:



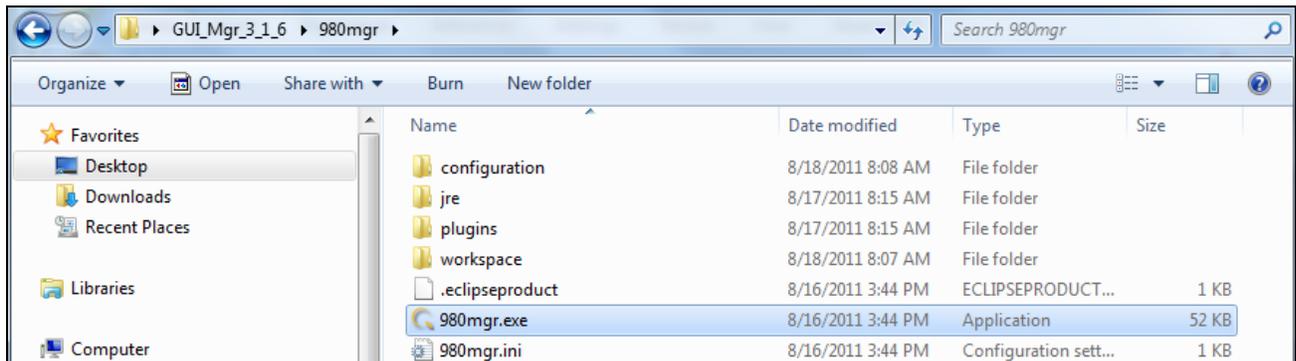
The imported file will then appear in the **Data** directory of the **M41h Navigator** panel as shown below. The captured file is loaded automatically and has an asterisk in front of it to indicate that this capture is the one that is loaded:



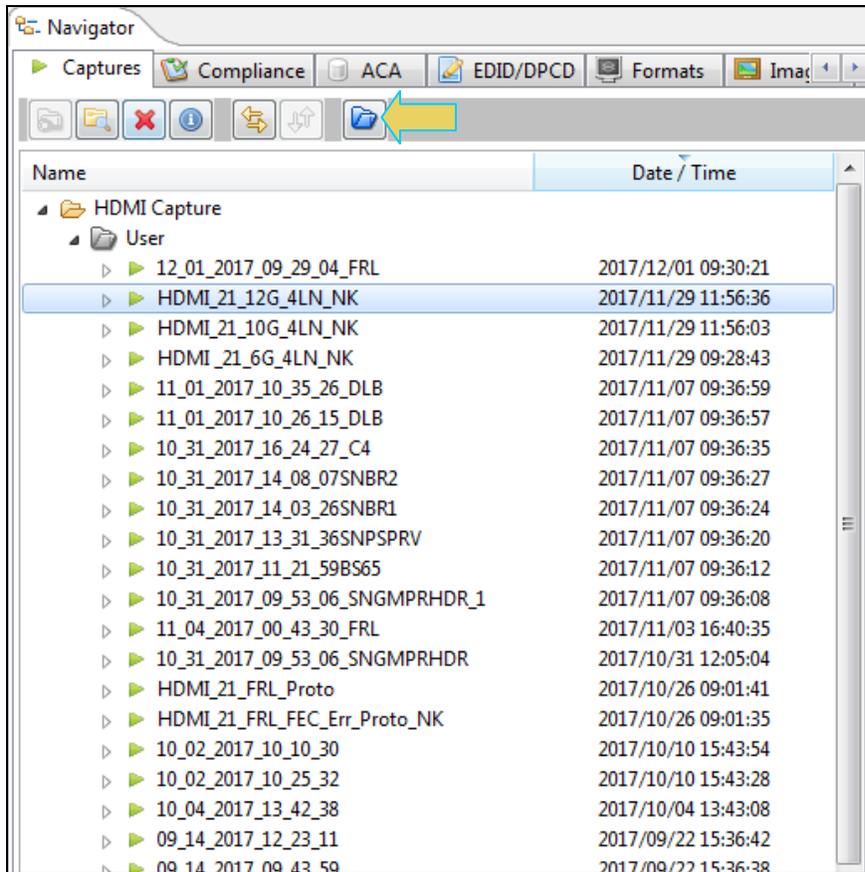
Relocating capture files to the ATP Manager directory

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.

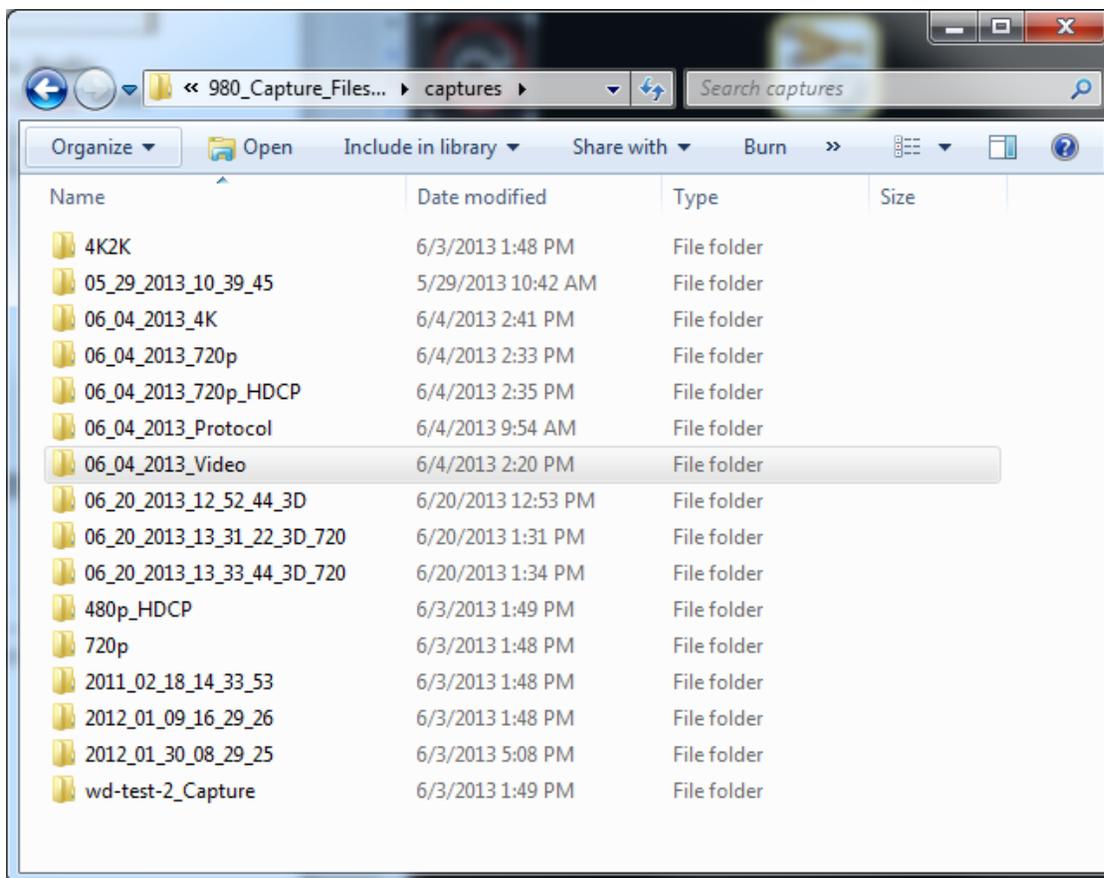


2. Launch the ATP Manager.
3. Locate the ATP Manager **captures** directory using the Open Selected Folder icon indicated below.



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



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

10 Transferring Capture Files from the M41h 48G Video Analyzer/Generator to a PC

The M41h 48G Video Analyzer/Generator 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, captures playback files but you can transfer EDIDs, ImageLists, 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.

10.1 Transferring Capture Files using the Data Transfer Utility

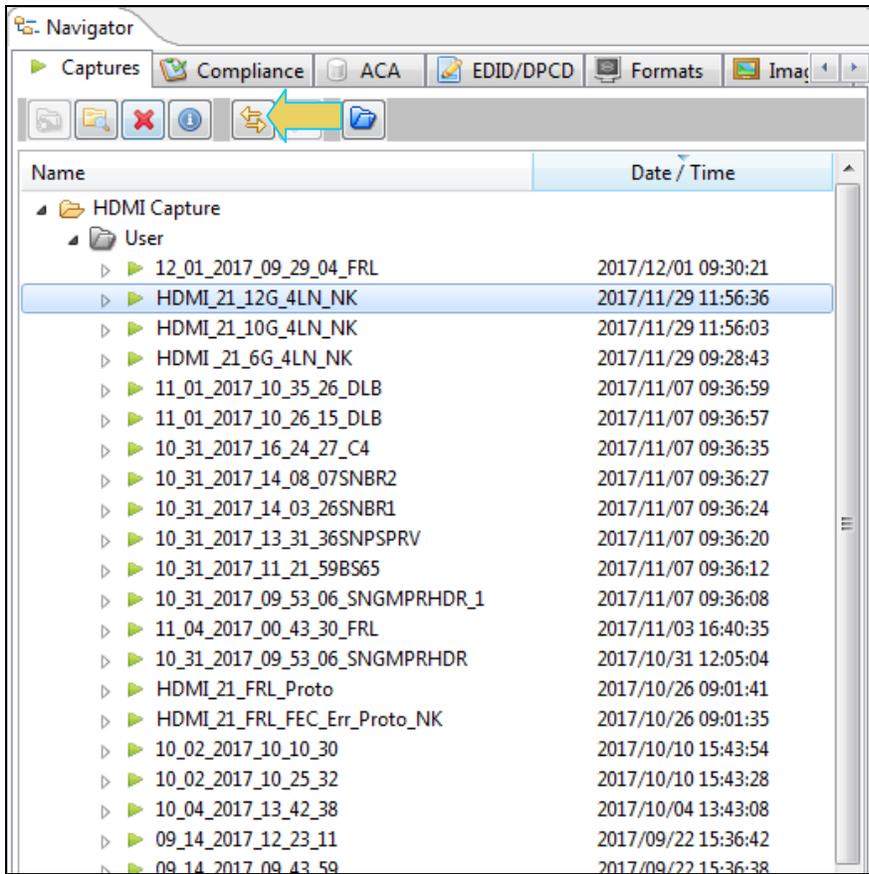
You can transfer files easily using the ATP Manager's **Data Transfer** utility. Follow the procedures below.

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

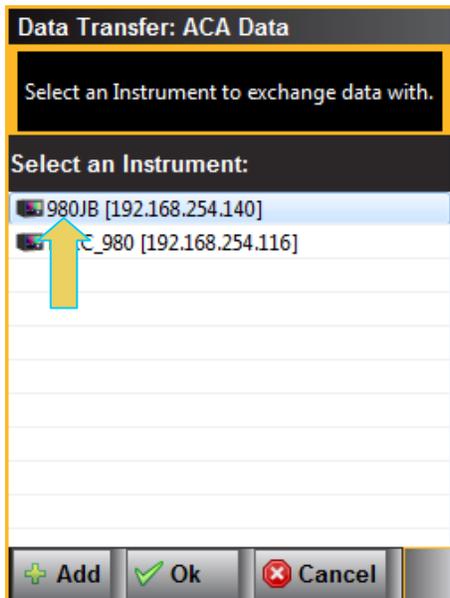
1. Through the external ATP Manager, access the **Generator/Port Control** panel either through the **View** pull-down menu or the **Generator** button located on the top of the interface. Refer to the screen shots below.

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

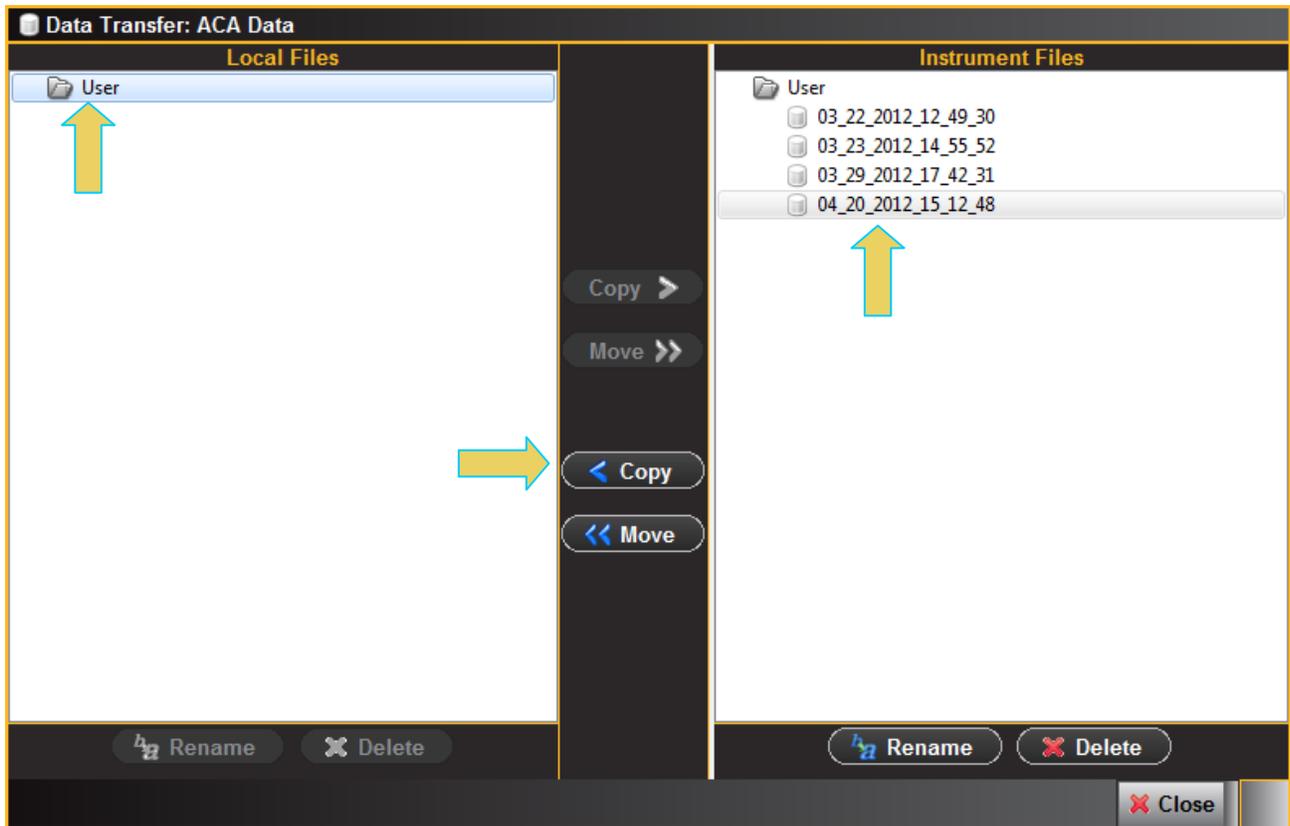
2. Access the **Data Transfer** utility by double clicking on the Transfer Data icon  on one of the data sets in the Navigator window.



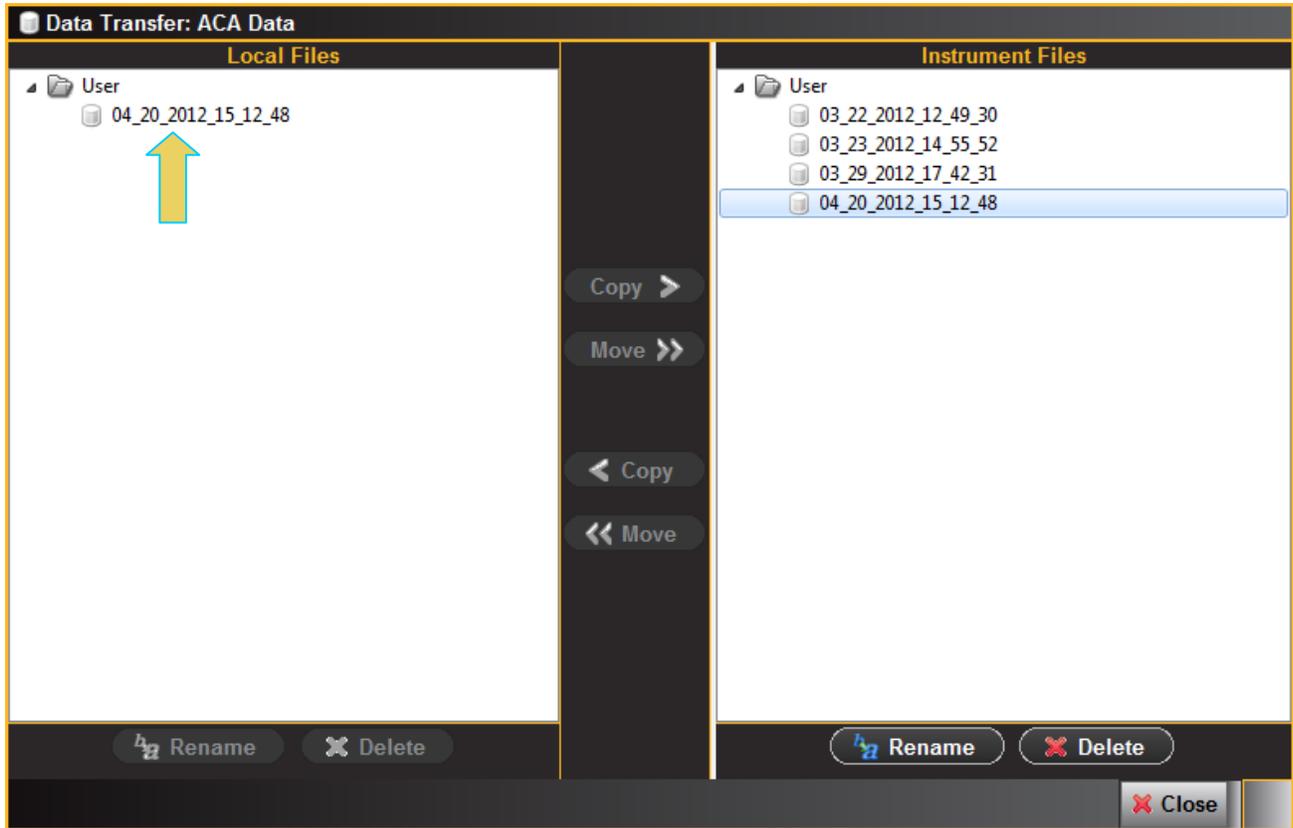
The **Data Transfer: ACA Data** dialog box appears (below) enabling you to select the M41h 48G Video Analyzer/Generator that you want to transfer data from. Select the desired M41h 48G Video Analyzer/Generator and click OK. The **Data Transfer: ACA Data** panel will appear.



The **Data Transfer** panel appears in context with the ACA files on the M41h (Instrument) under the **Instrument Files** available as shown below.



3. 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).

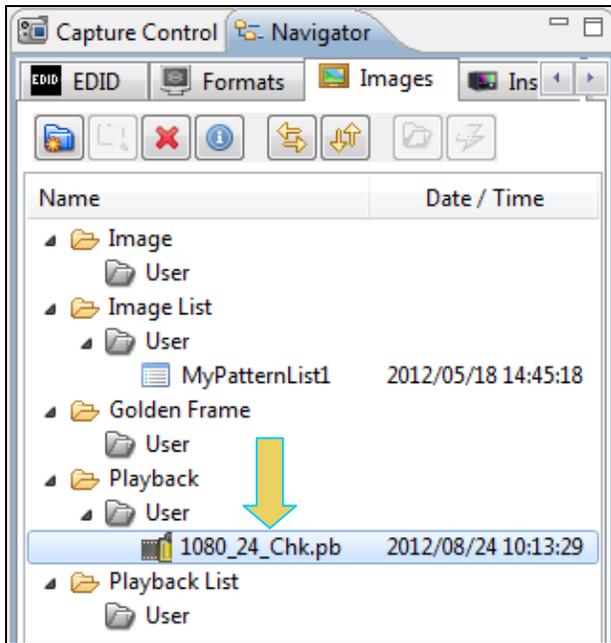


To transfer Playback files from the M41h to your PC using the Data Transfer utility:

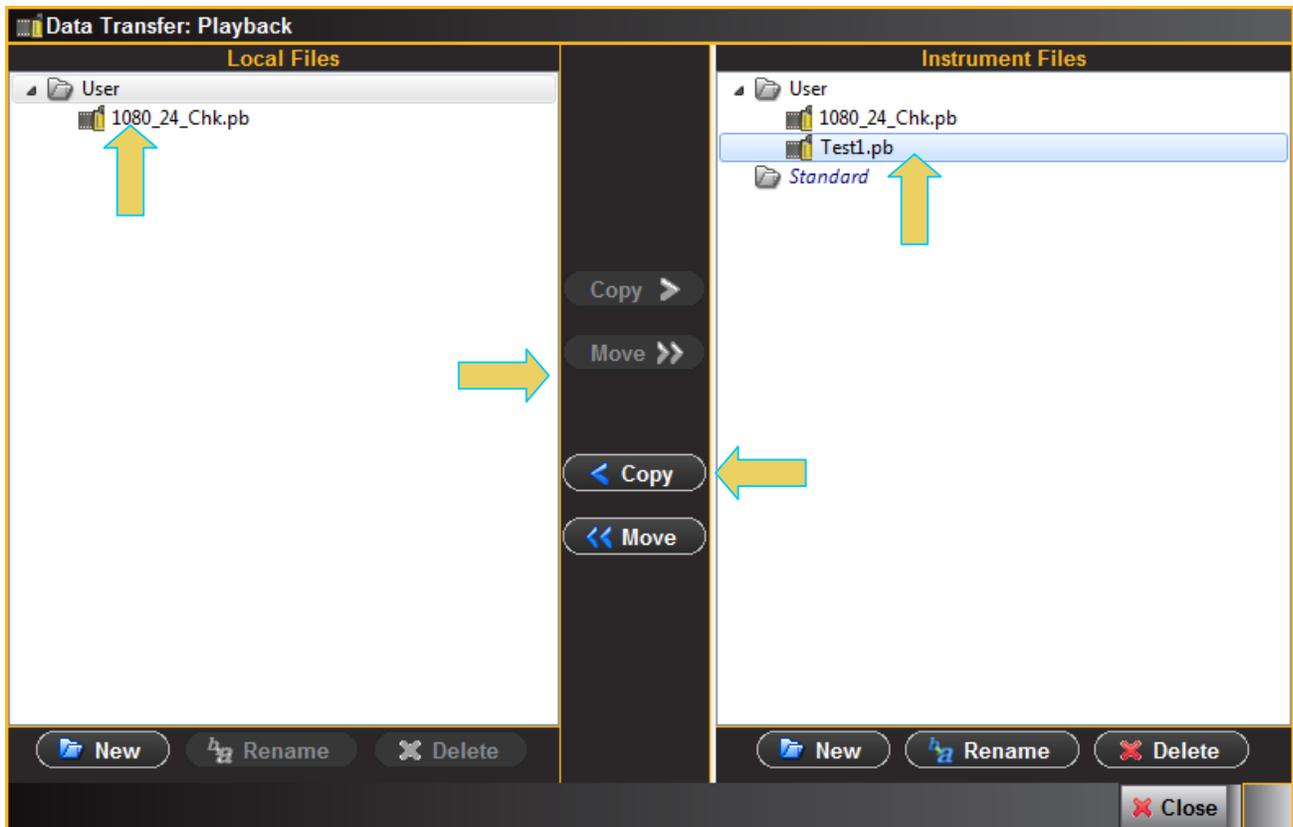
1. Through the external ATP Manager, access the **Generator/Port Control** panel either through the **View** pull-down menu or the **Generator** button located on the top of the interface. Refer to the screen shots below.

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

2. Access the **Data Transfer** utility by double clicking on the Transfer Data icon  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.

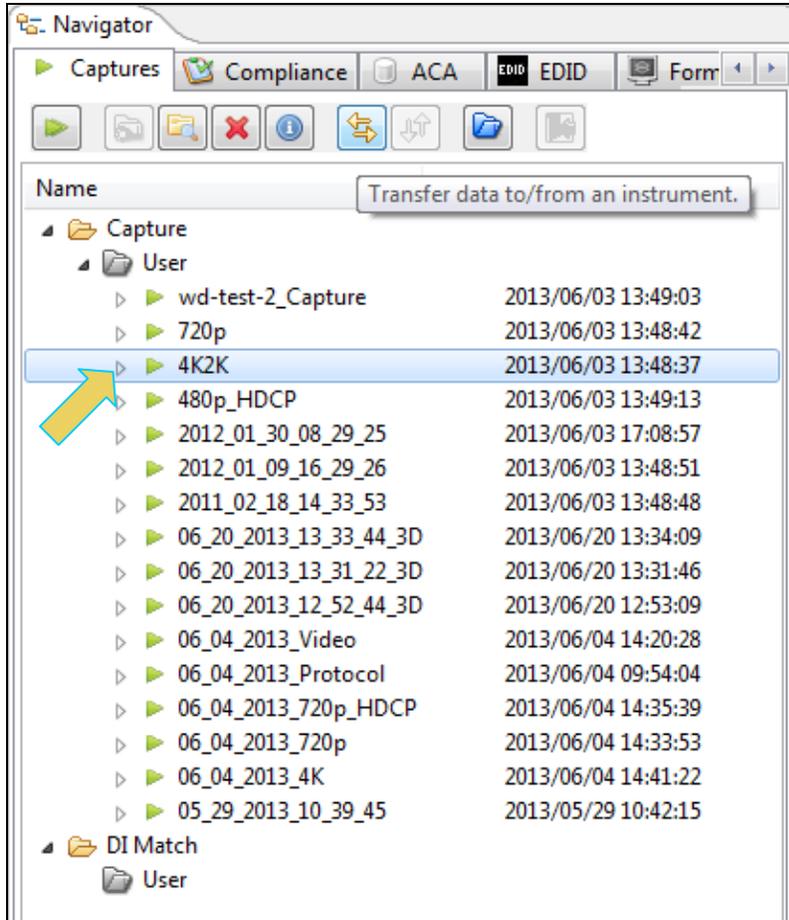


3. Highlight a directory on the **Local Files** side (host PC) and then initiate a **Copy** or **Move**.

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

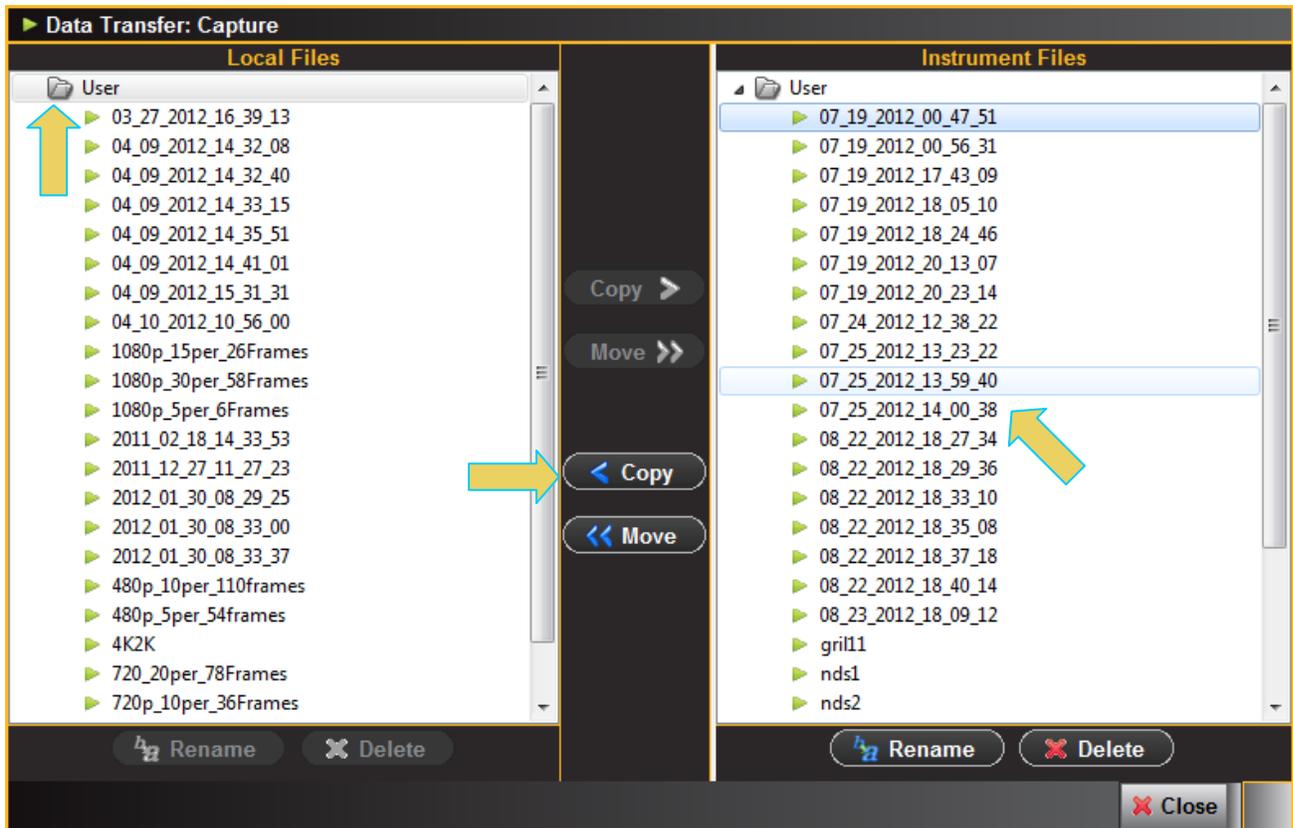
To transfer Capture files from the M41h to your PC using the Data Transfer utility:

1. 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.
2. Access the **Data Transfer** utility by double clicking on the Transfer Data icon  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.



3. 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**.

10.2 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:

1. Open up the DOS utility window on your PC.
2. 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
```

3. 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
```

4. Use the binary mode for the FTP transfer.

```
ftp> bin
```

5. Initiate the FTP get command on the **pdecode.log** file.

```
ftp> get pdecode.log
```

6. 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.

7. Exit the FTP command line with the following command:

```
ftp> bye
```

8. Recreate the directory with an appropriate name in the ATP Manager's working directories:

```
quantumdata/M41hManager/M41hmgr/workspace/captures/.
```

9. 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.

10.3 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

2. Minimize or close the embedded GUI by touch selecting the **Quantumdata M41h Manager** icon on the bottom status panel of the GUI.
3. Touch the workspace icon on the touch screen desktop.

A navigation directory window appears.

4. Browse and locate the capture files in /home/qd/workspace/captures/
5. Touch select and highlight the captures directory
6. Touch select the top level Edit pull-down menu and select Copy.
7. 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).
8. Touch select the USB flash disk to change the right panel view to show the USB thumb drive's contents.
9. Touch any white space on the right panel to focus it.
10. Touch select Edit at top and then touch Paste to copy the capture directory to your USB drive.
11. 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/.

11 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.

11.1 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](#).

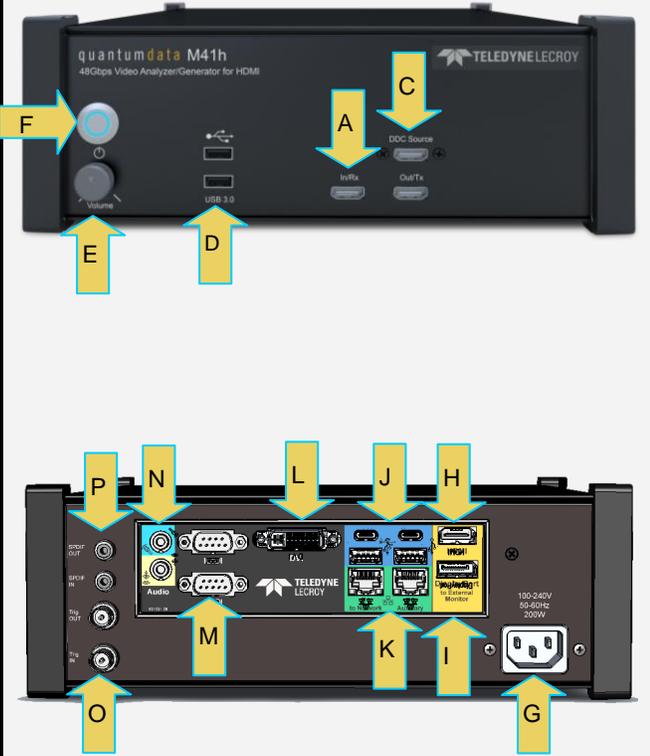
Note: The power switch in the front is used when you are turning off the M41h for a short period of time. For extended periods of off time, it is best to power the M41h down by first using the power button on the front and then the rocker switch on the back.

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.

11.1 Connector Description

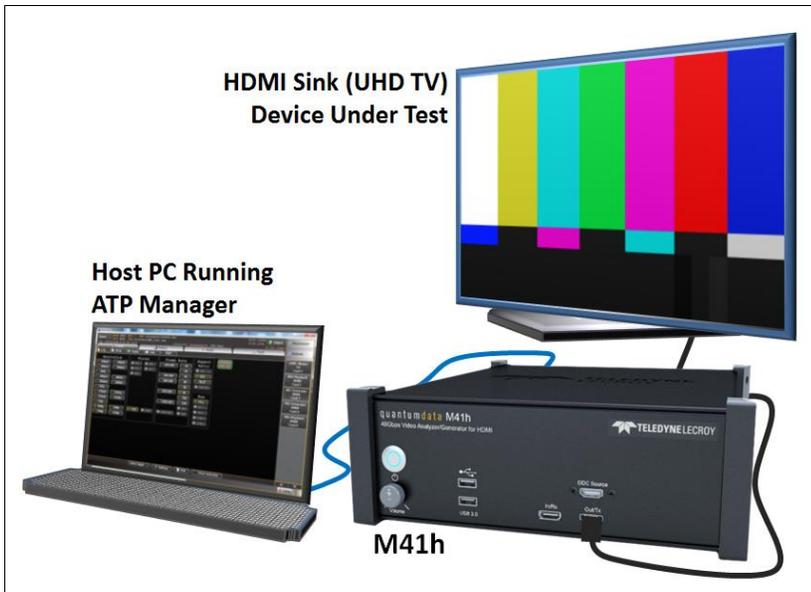
Use the following table to identify the connector function and descriptions on your M41h 48G Video Analyzer/Generator.

Use the following table to identify the connector function and descriptions on your M41h system configuration.

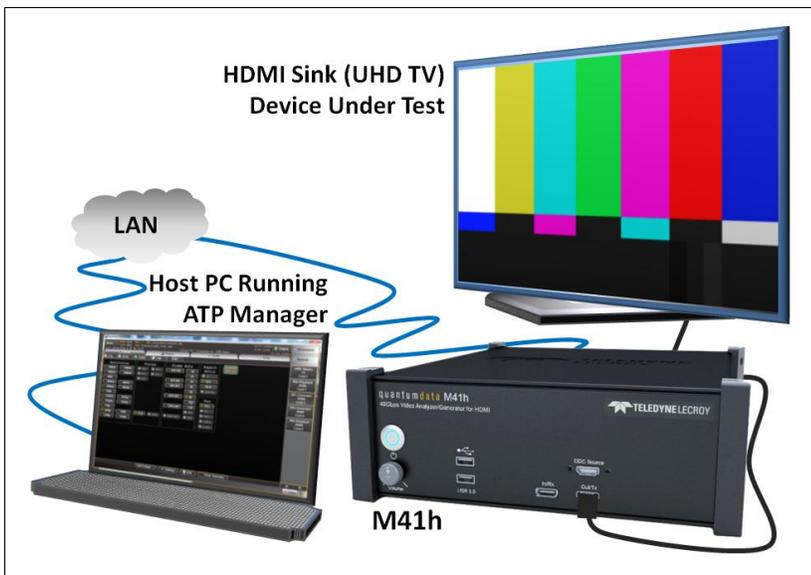
M41h Configurations	Information / Function
<p>Protocol Analyzer in M41h</p> 	<p>The following is a description of each connector:</p> <p>M41h 48G Video Analyzer/Generator - Front:</p> <ul style="list-style-type: none"> ▪ A – HDMI 2.1 Rx port for testing HDMI 2.1 sources. ▪ B – HDMI 2.1 Tx port for analyzing HDMI 2.1 sinks. ▪ C – HDMI 2.1 Rx port used for reading the EDID over the DDC channel (applies to eARC Tx test). ▪ D – USB ports (2) used for connecting a mouse and keyboard. ▪ E – Volume knob for turning up or down the volume for the internal speaker. ▪ F – Power button; press and release. <p>M41h 48G Video Analyzer/Generator - Back:</p> <ul style="list-style-type: none"> ▪ G – Power plug (100-240VAC 50/60Hz; 200 Watts) ▪ H - HDMI – Admin port for connecting external HDMI UHD display for M41h ATP Manager. ▪ I - DisplayPort – Admin port for connecting the external display for M41h ATP Manager. ▪ J - USB/USB-C (2 ea.) – For mouse & keyboard. ▪ K - RJ45 (2) - E1 Network for connecting host PC running ATP Mgr. E2 Aux – Not used. ▪ L - DVI – Possible future use. ▪ M - RS-232 (2) – Possible future use. ▪ N - Audio (2) – Possible future use. ▪ O - TRIG IN/OUT – Future. ▪ P - RCA SPDIF OUT – OUT: Monitors eARC audio; IN: Possible future use.

11.2 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

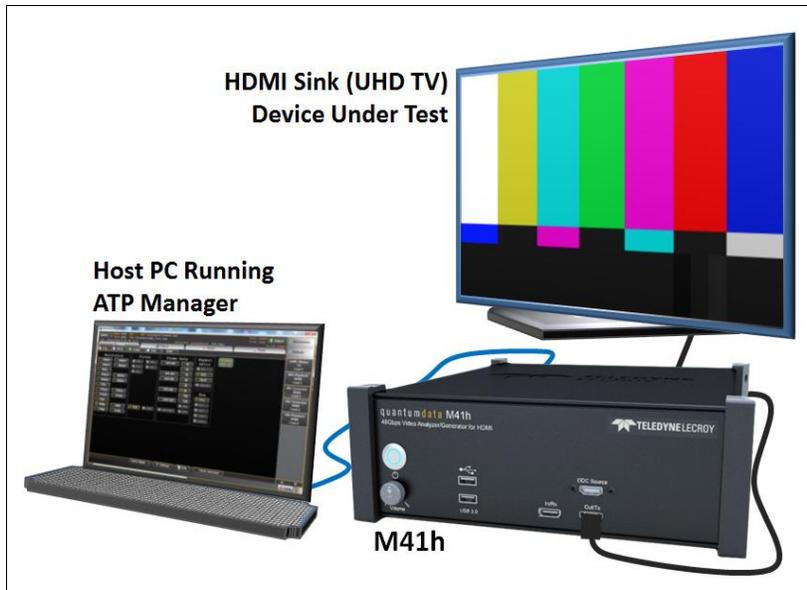


Connection for Video Testing – M41h Ethernet Hub or Corporate LAN

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.

1. 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.



11.3 Navigating through the ATP Manager interface

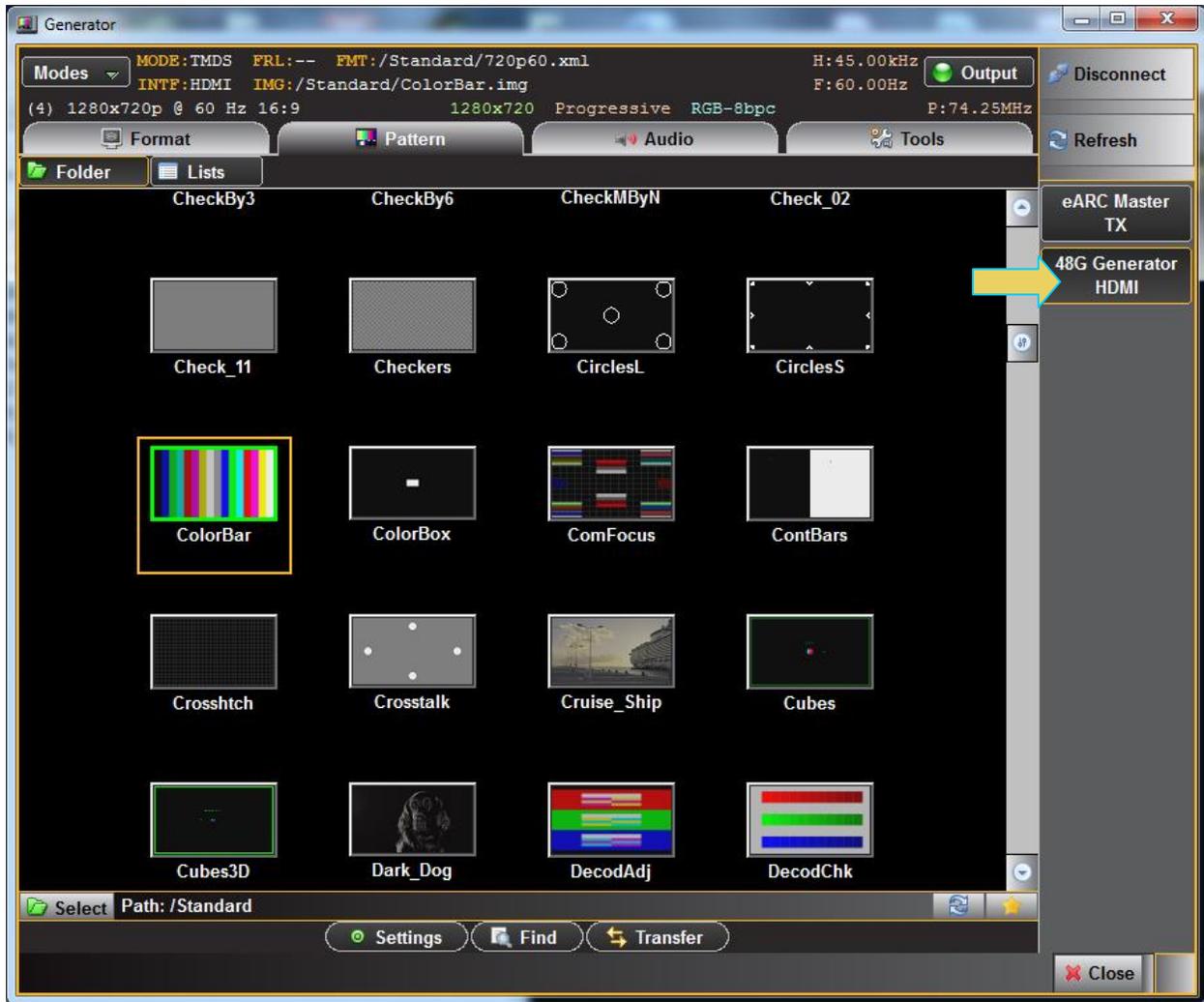
Use the following procedures to navigate to the M41h 48G Video Analyzer/Generator testing functions. You can access the M41h 48G Video Analyzer/Generator functionality through the Card Control tab (Page 1 of 4) of the Apps panel as described below.

To navigate to the video test functions:

1. From the **View** menu, enable select the **Generator** item.

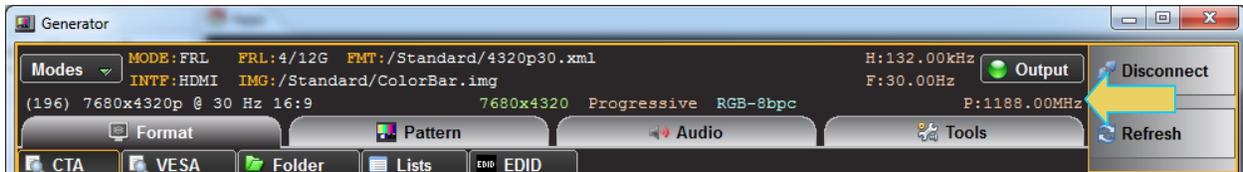


Once you establish the connection, the **Generator** panel will be populated as shown below:



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
Card	The name of the. In all cases this will be the HDMI generator analyzer.
Port	Active port, in this case the two Tx connectors (T30 and T31).
INTF	The currently selected interface type for the. This could be either HDMI or DVI. The

Generator Status Area (Top)	
Item	Description
	sampling mode is included in parentheses after the interface.
FMT	The currently active format (selected resolution) and its directory path.
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.

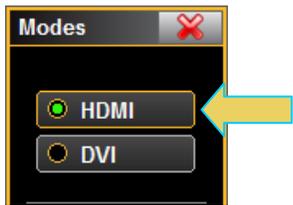
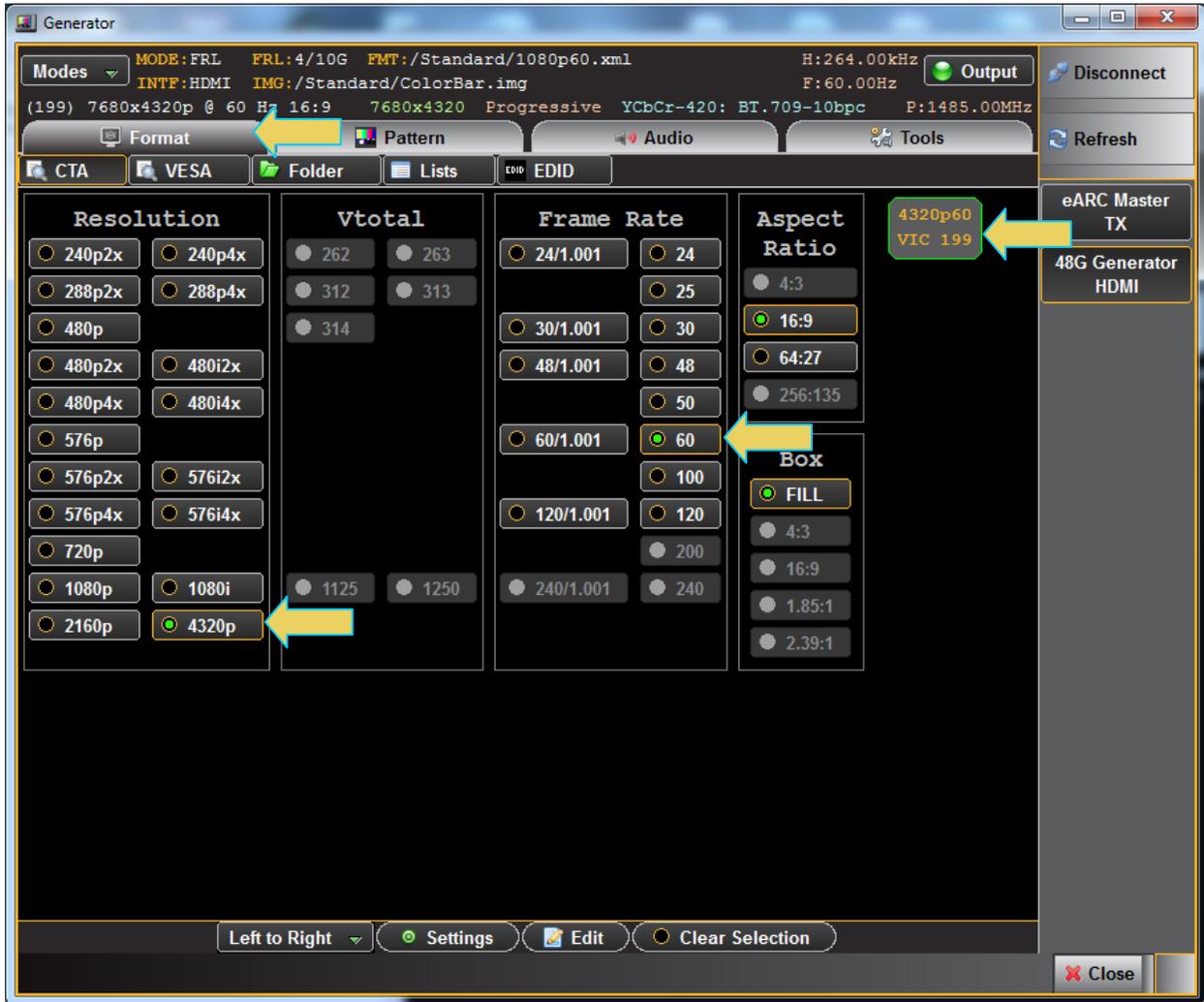
Please note that if you are also making changes through the command line the information in the status area is not automatically updated. You must click on the **Refresh**  activation button to re-sync the status area.

11.4 Selecting HDMI or DVI formats

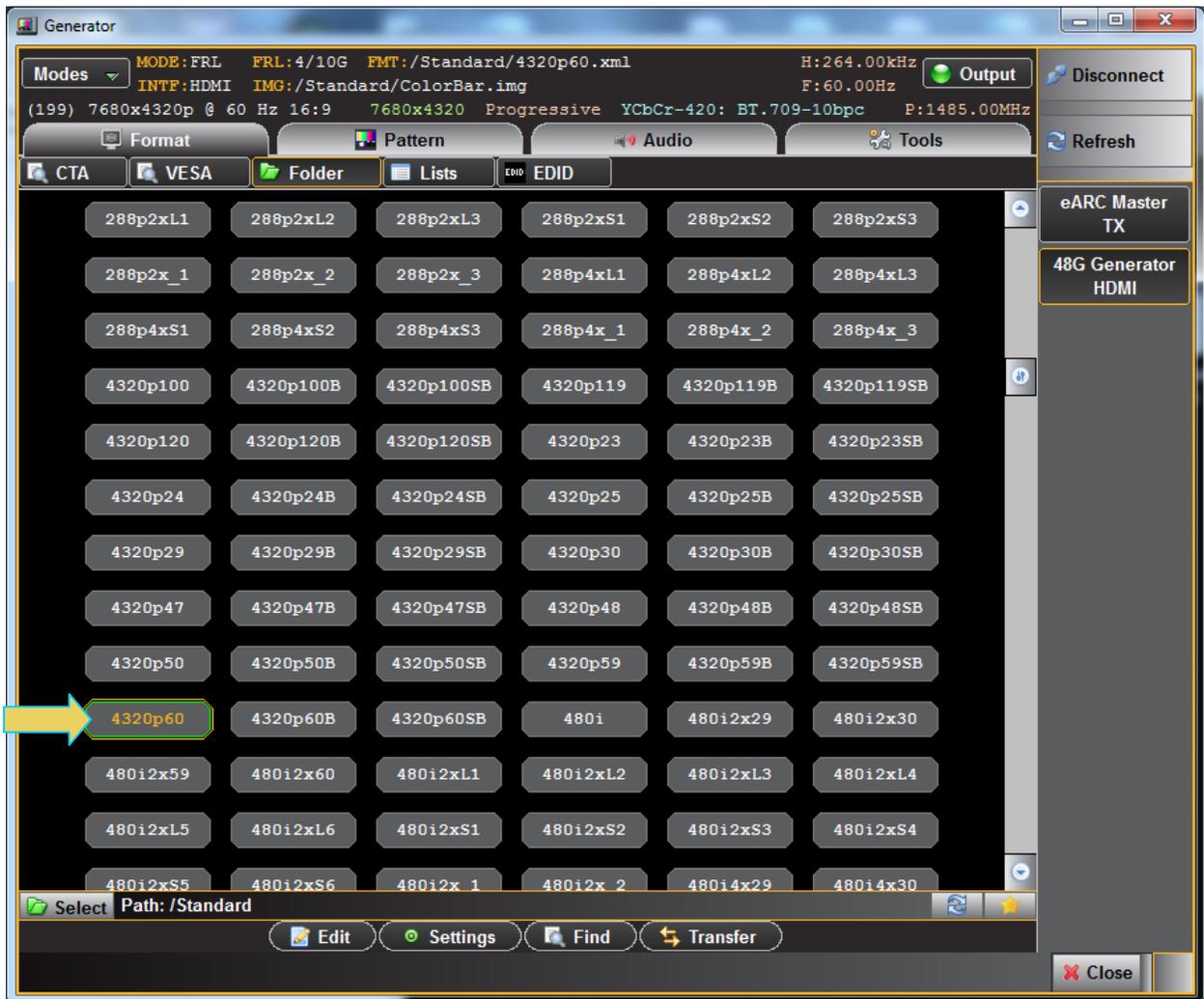
Use the following procedures to select the mode, HDMI or DVI on the M41h 48G Video Analyzer/Generator.

To select Modes:

1. From the **Main** menu of the M41h 48G Video Analyzer/Generator, click the **Modes** pulldown 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.



11.5 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:

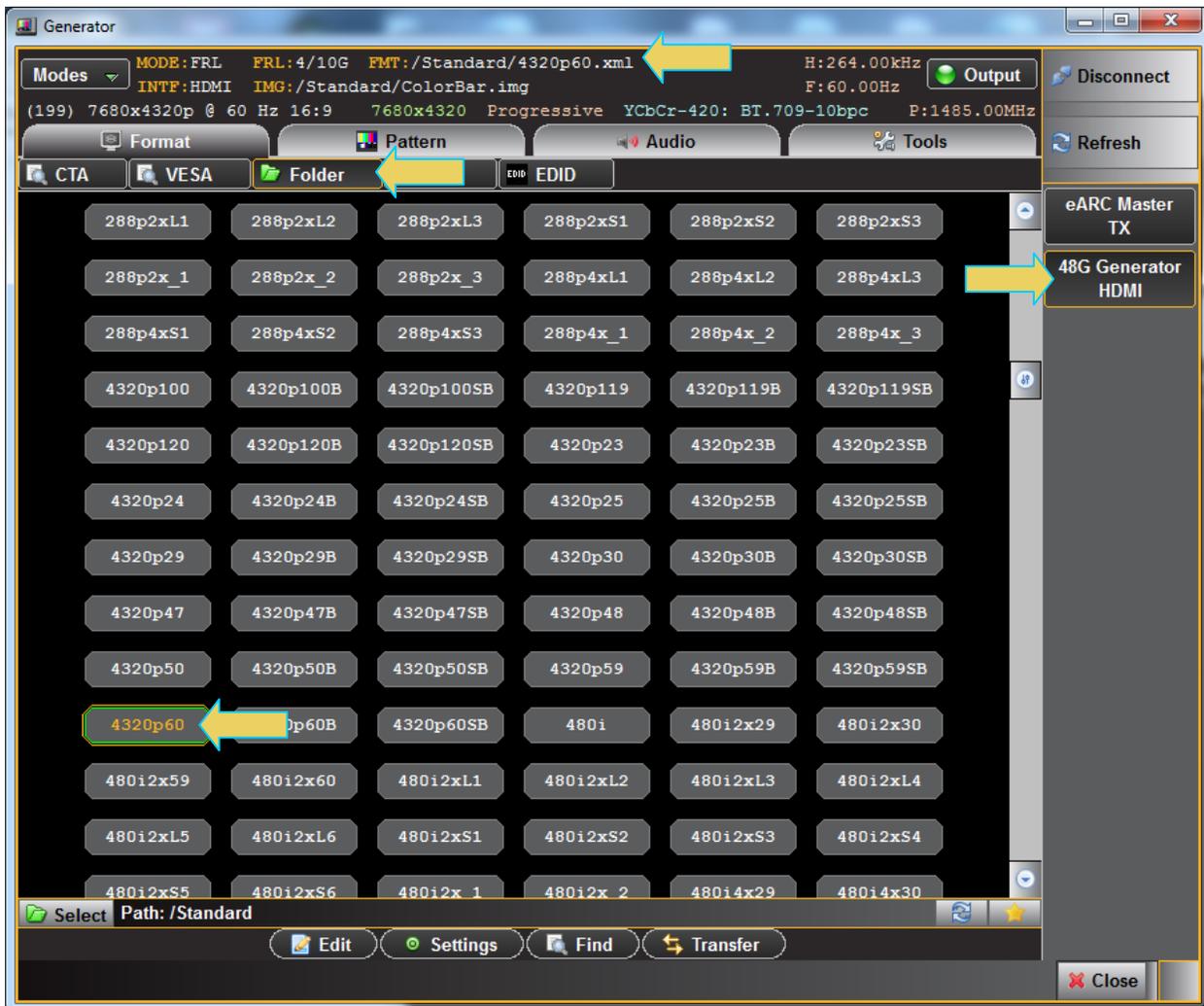
- Select from a custom list you have created using the Format List Editor.
- Select from a list of formats configured from the EDID of the connected display.

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.

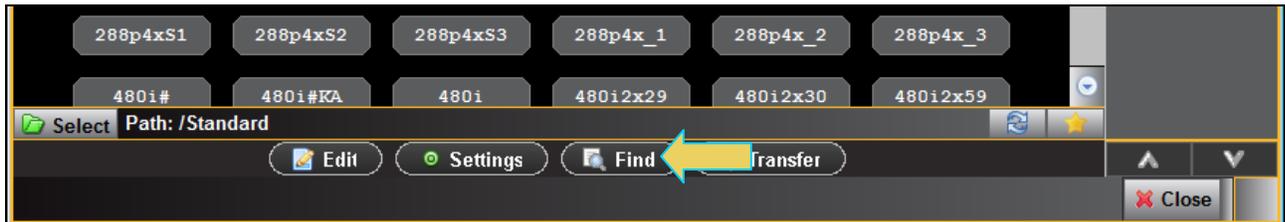


The highlighted format is the format that is active. You can also determine this from the status information at the top of the panel. Alternatively you can click on the Star  button to show the selected format. When

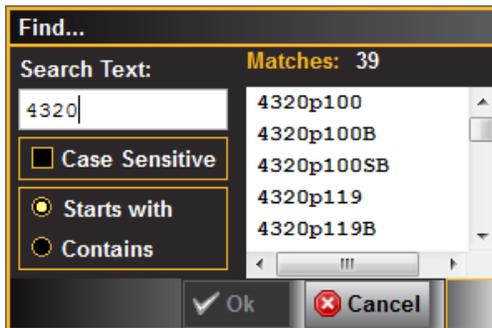
you click on the Star button the list of formats will be repositioned such that the selected format is shown on the top line.

Note that you can browse for a format using the scroll bar. You can also search for a format using a 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.

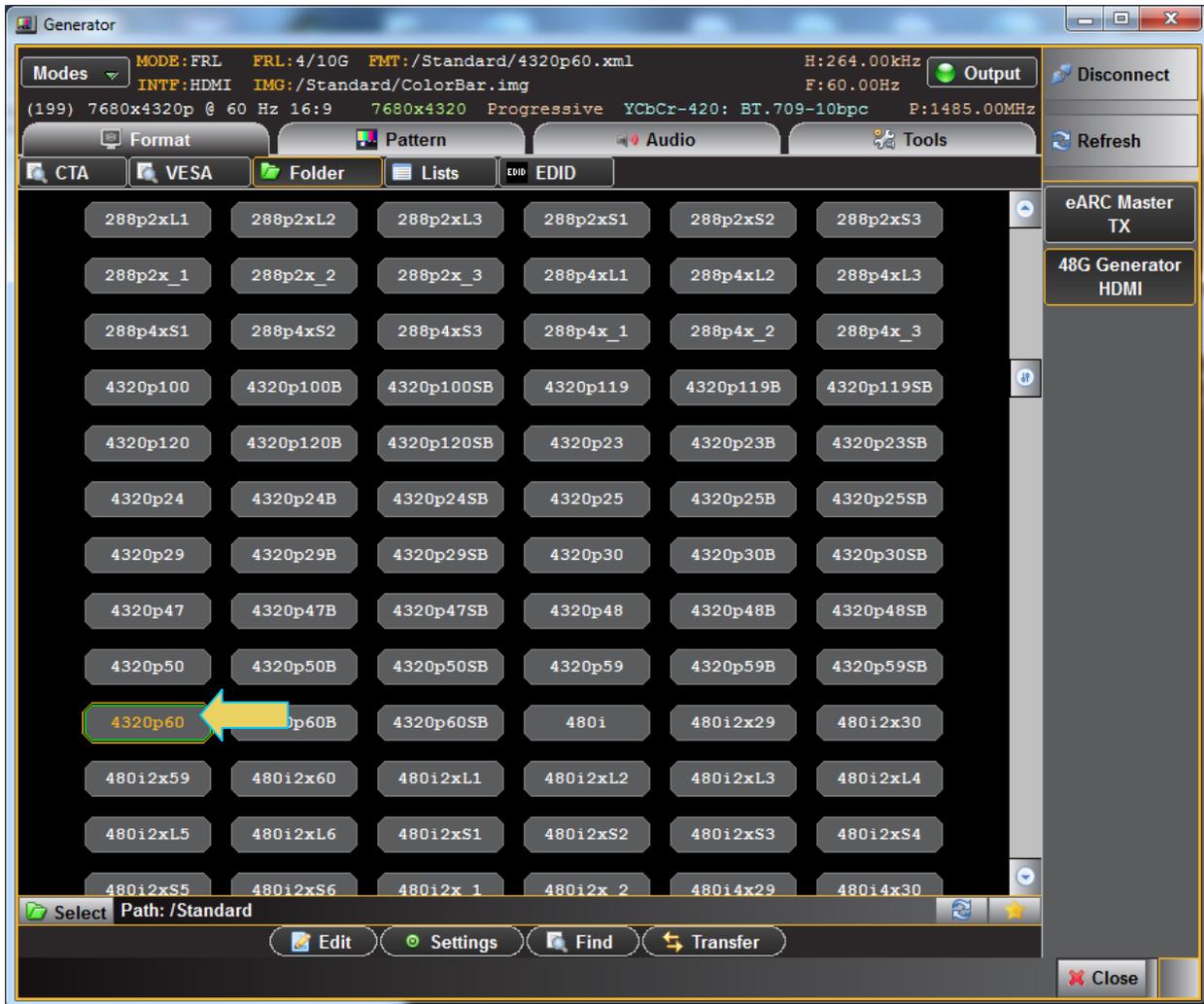


4. Click on the EDID smart activation button on the upper panel under the tabs to configure the list of formats in accordance with the EDID for the connected display.



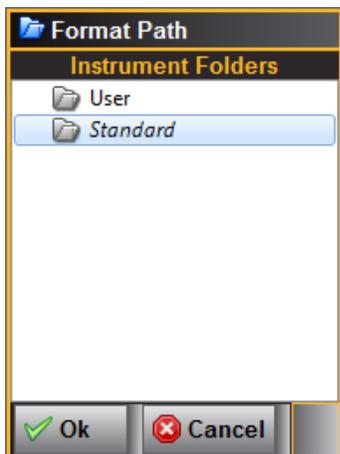
You can determine if the list of formats displayed is derived from the EDID of the connected display by looking at lower status bar: **Read EDID and Generate Formats**.

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.

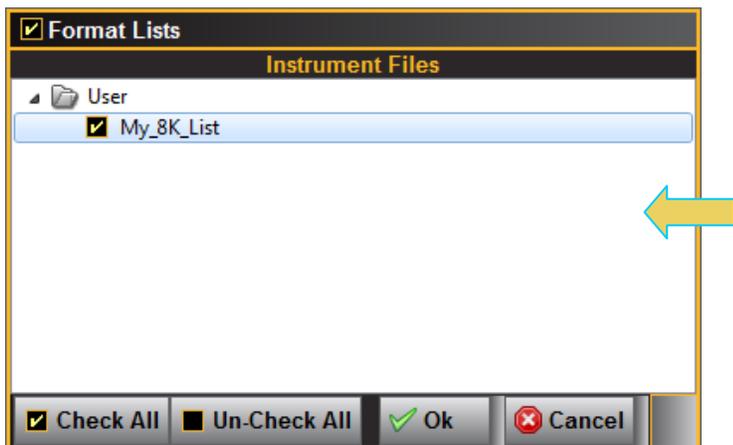


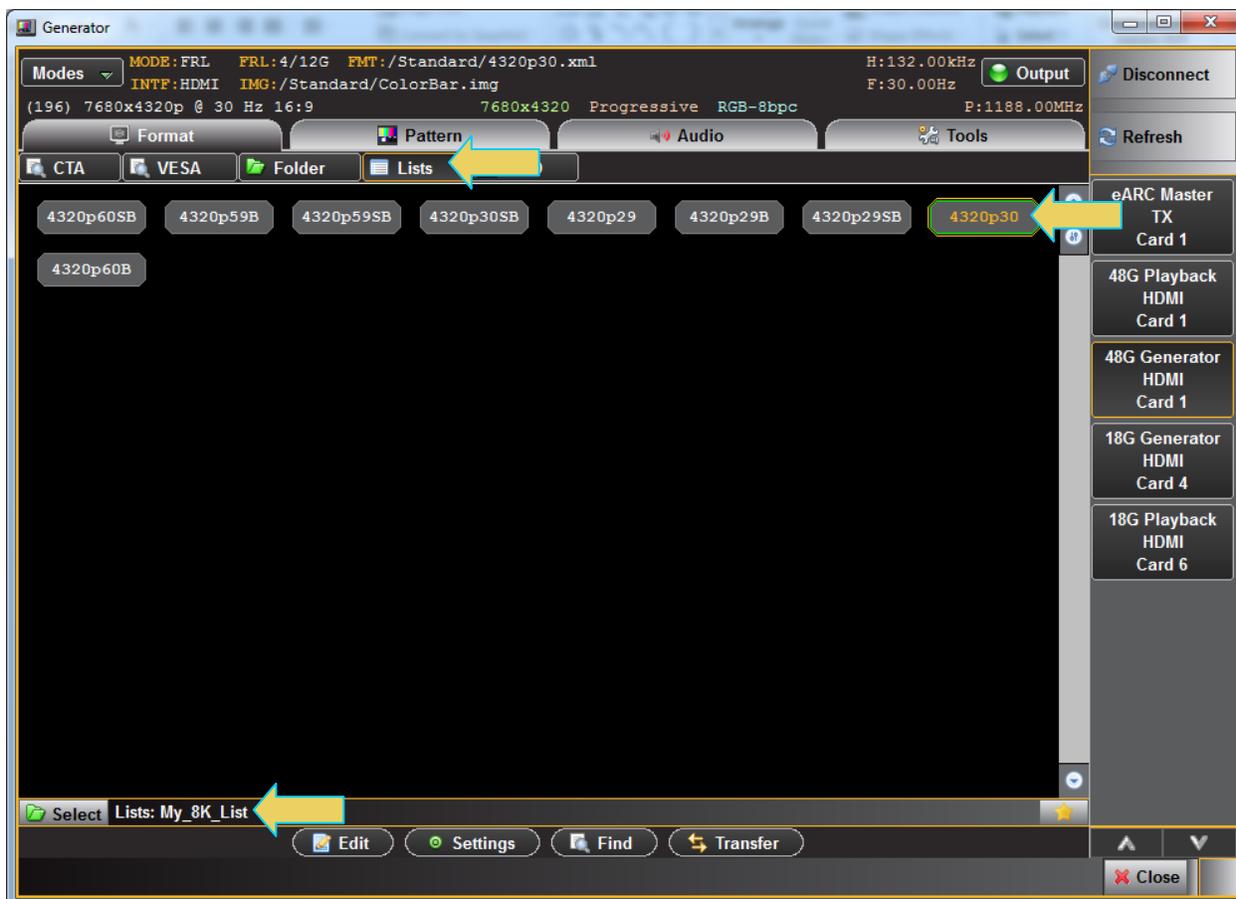
You can change the directory of formats using the directory activation button  **Select Path: /Standard**. You might wish to change the directory path if you have created your own custom formats using the [Format Editor](#) to create custom formats. Note also that you can configure a smaller list of 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 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.

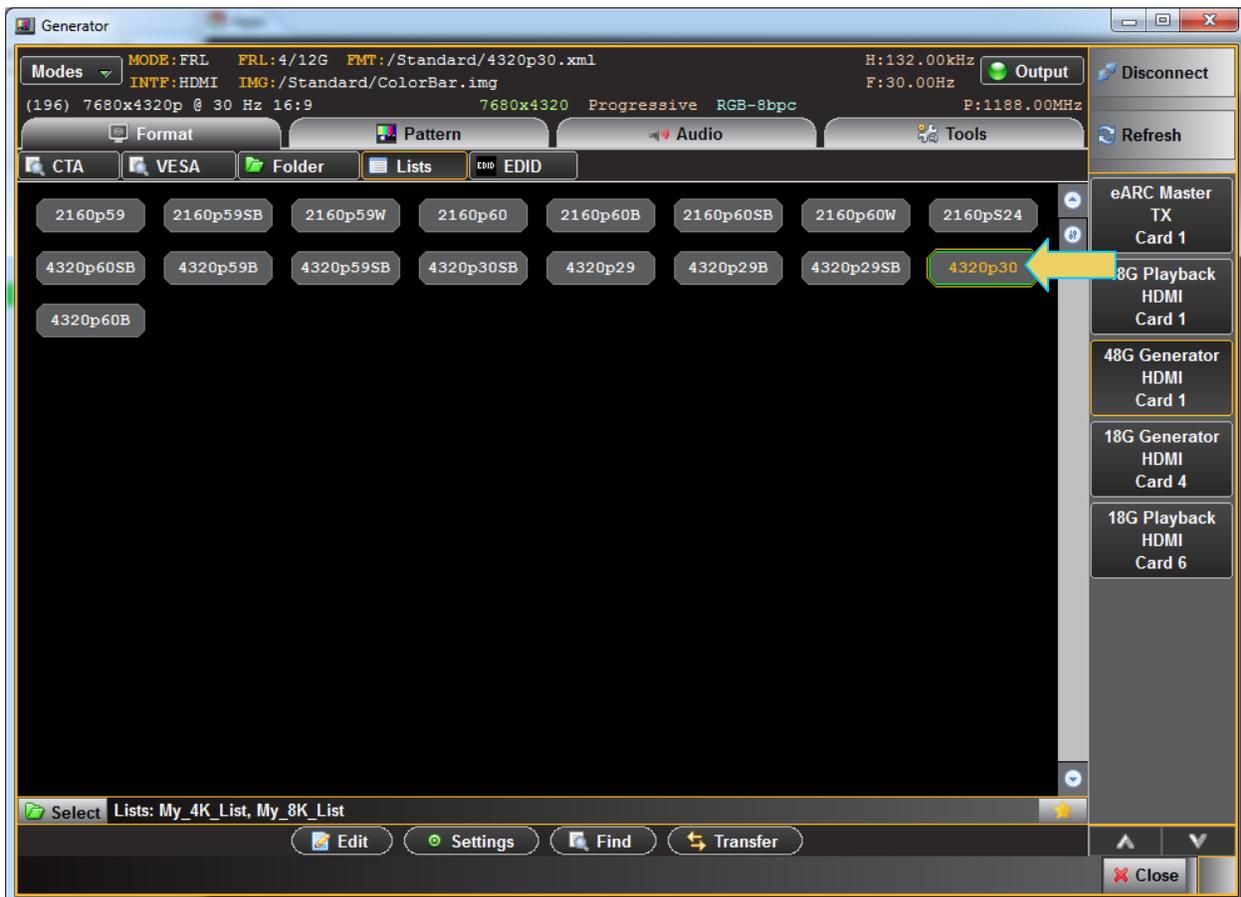
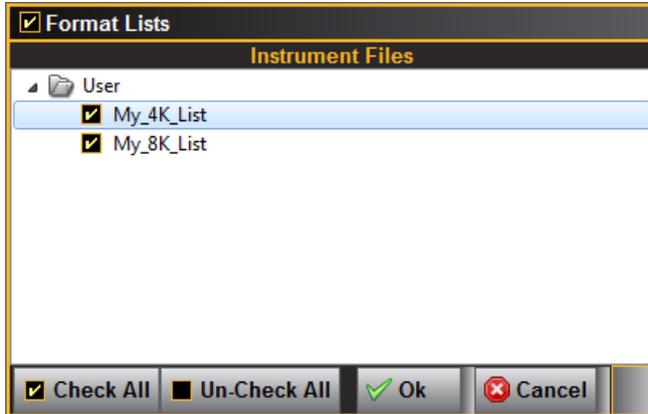


You can open up and activate any custom Format Lists you have previously defined with the associated icon  **Select Path: /Standard**. A dialog box will appear enabling you to select a custom format list or lists (below).





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 CEA smart filtering list as shown below. If the CEA button is not active, simply click on the CEA button on the upper left of the top panel (indicted in the screen shot below). The CEA

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 screens.



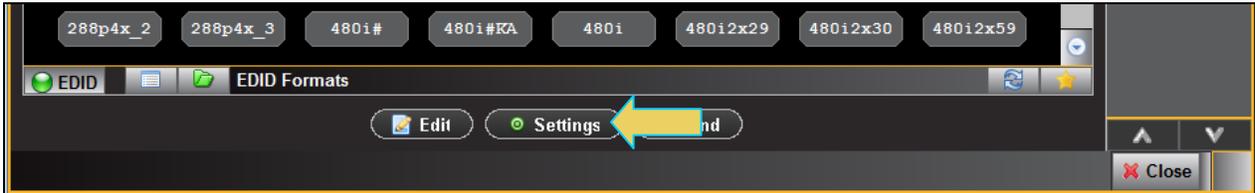


11.6 Configuring the format Settings

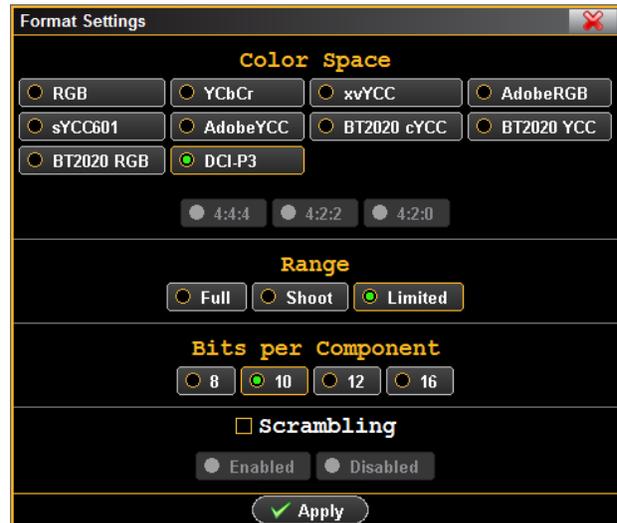
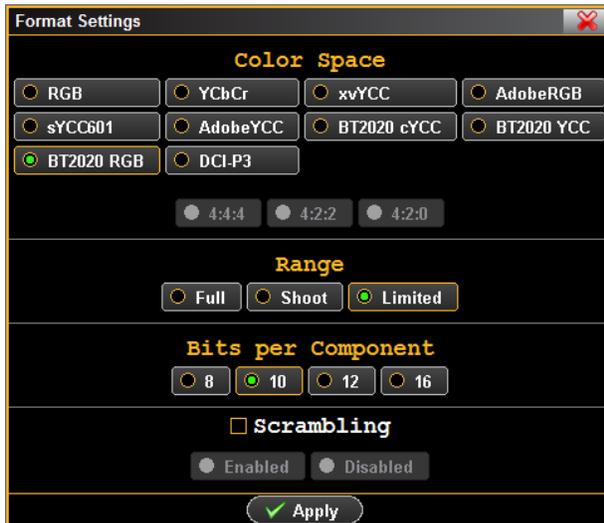
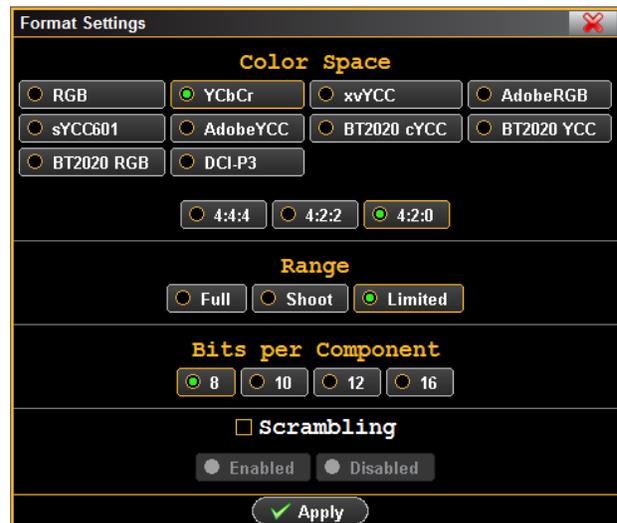
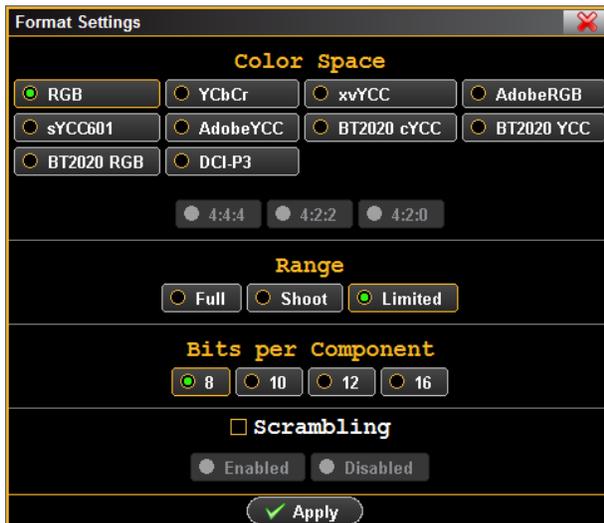
Use the following procedures to configure the format settings. The Settings dialog box enables you to configure the Color Space, Range and Bits per Component.

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.



2. Select the Color Space, Range and Bits per Component from the **Format Settings** dialog box in accordance with your requirements.

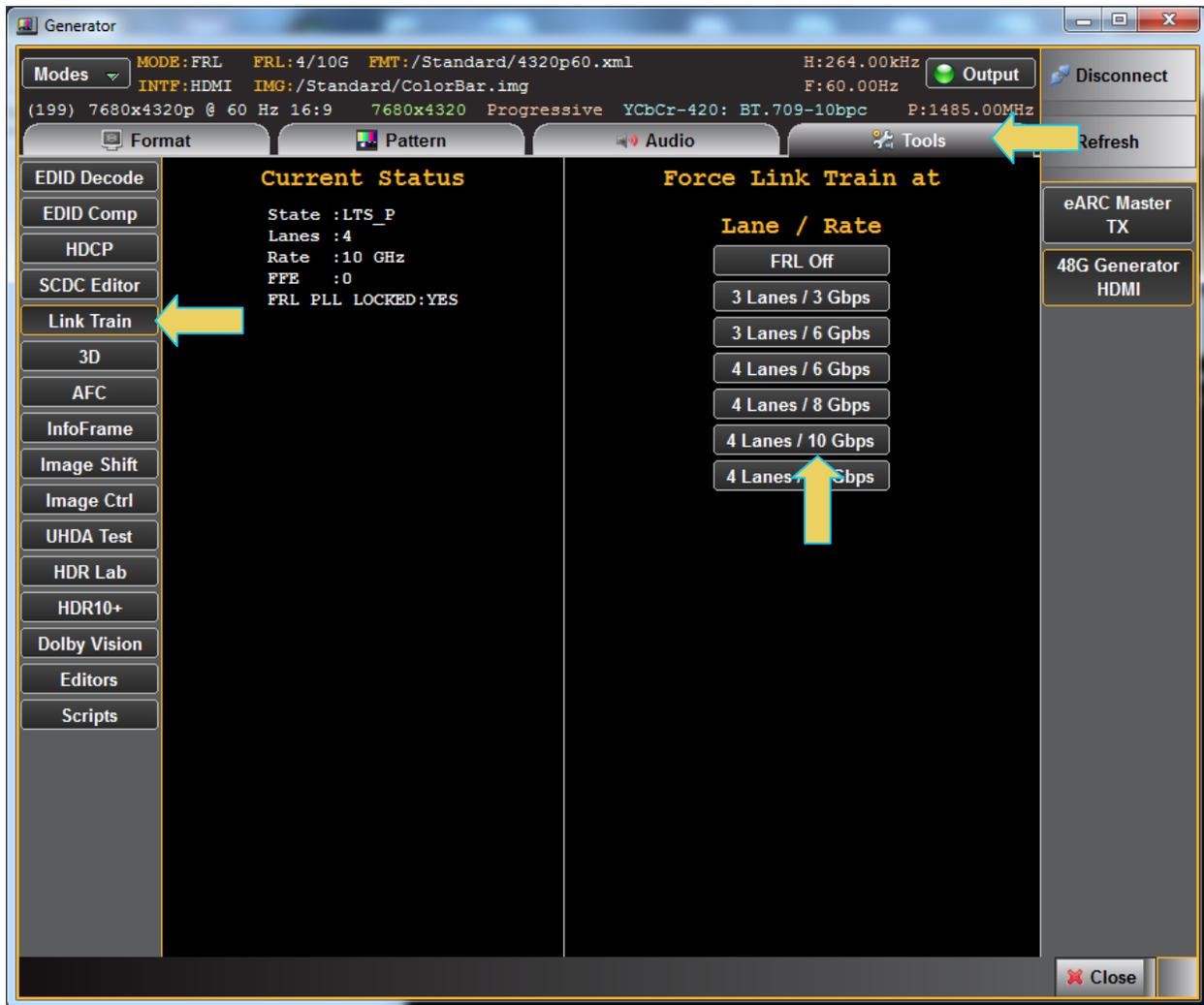
Format Settings		
Parameter	Description	Options
Color Space	Colorimetry and video pixel encoding settings	<ul style="list-style-type: none"> • RGB – Uses 4:4:4 sampling. • YCbCr – Uses either 4:4:4, 4:2:2 or 4:2:0 sampling. • xvYCC – High definition colorimetry based on IEC 61966 2-4. • AdobeRGB – The 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. • sYCC601 – Colorimetry based on IEC 61966-2-1/Amendment 1. • 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. • BT.2020 YCC – Rec 2020 for YCbCr • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.

11.7 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).

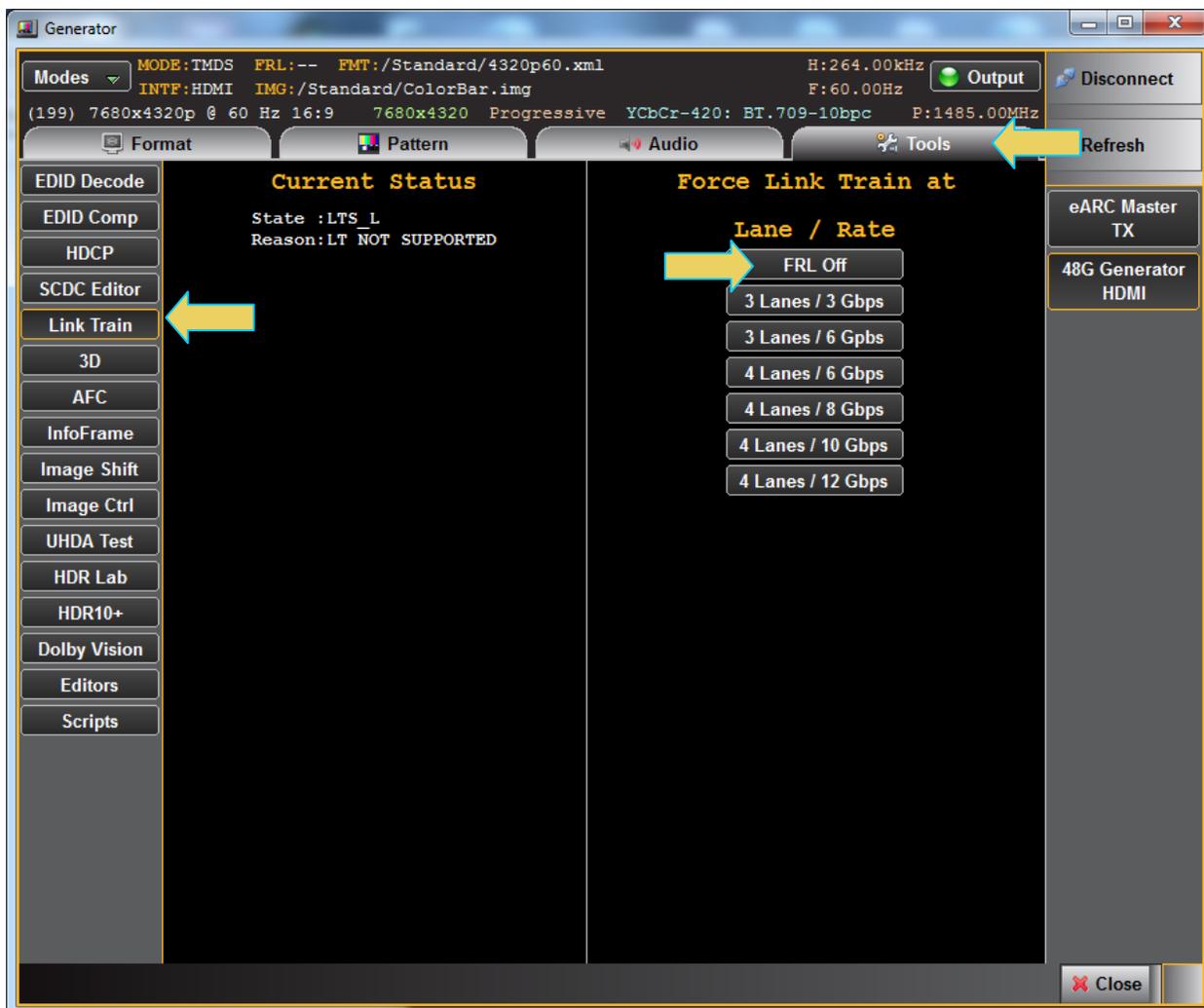


11.8 Generating TMDS Video Streams

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:

1. 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.

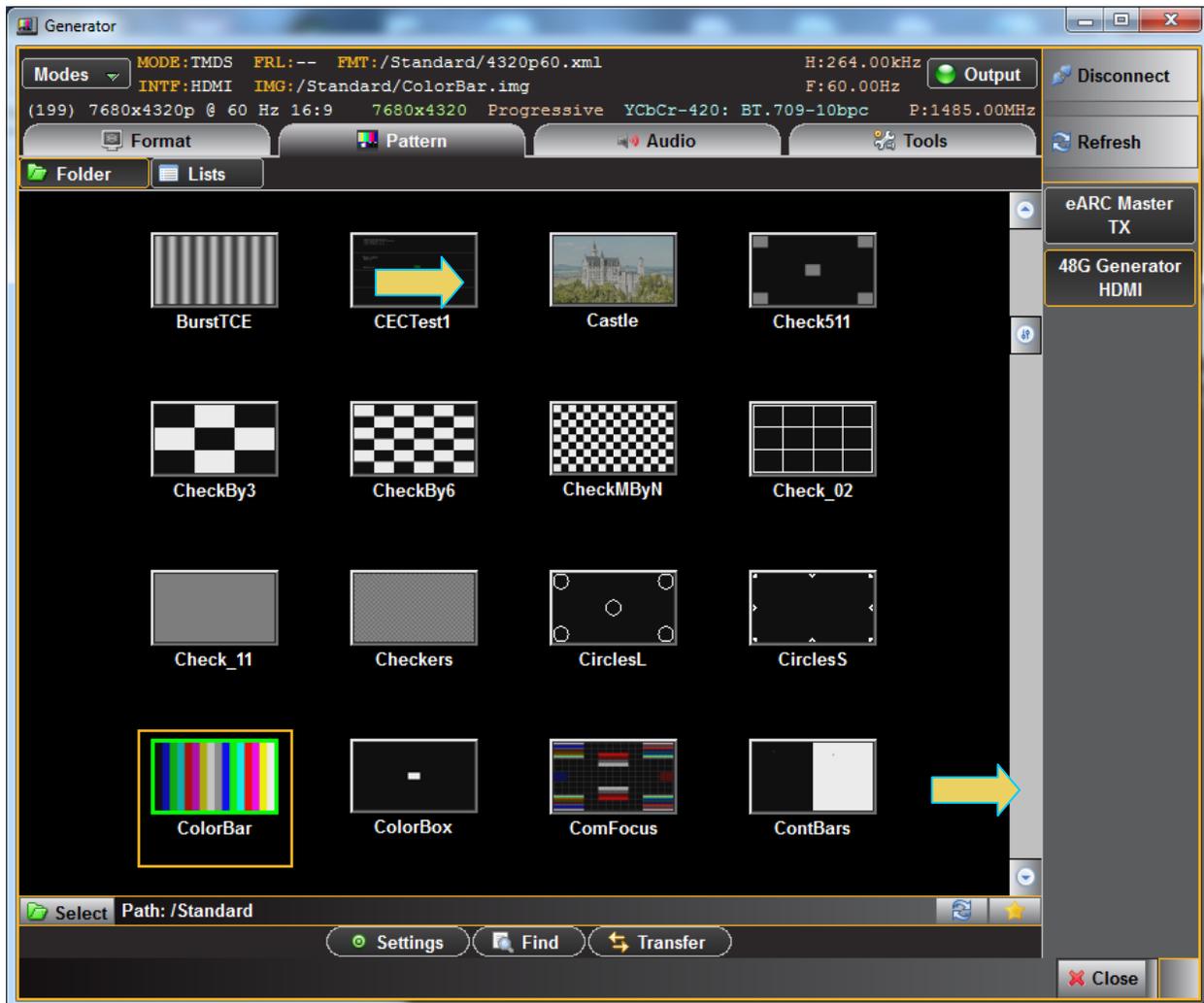


11.9 Selecting Test Patterns

Use the following procedures to select a test pattern.

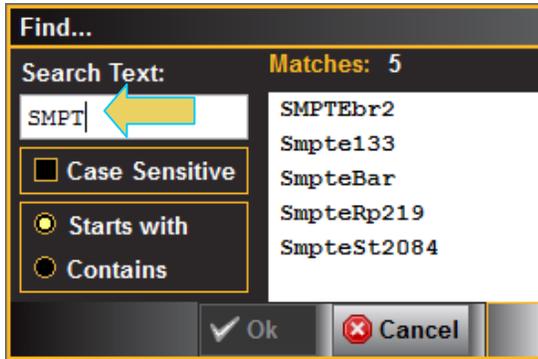
To select a test pattern:

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).

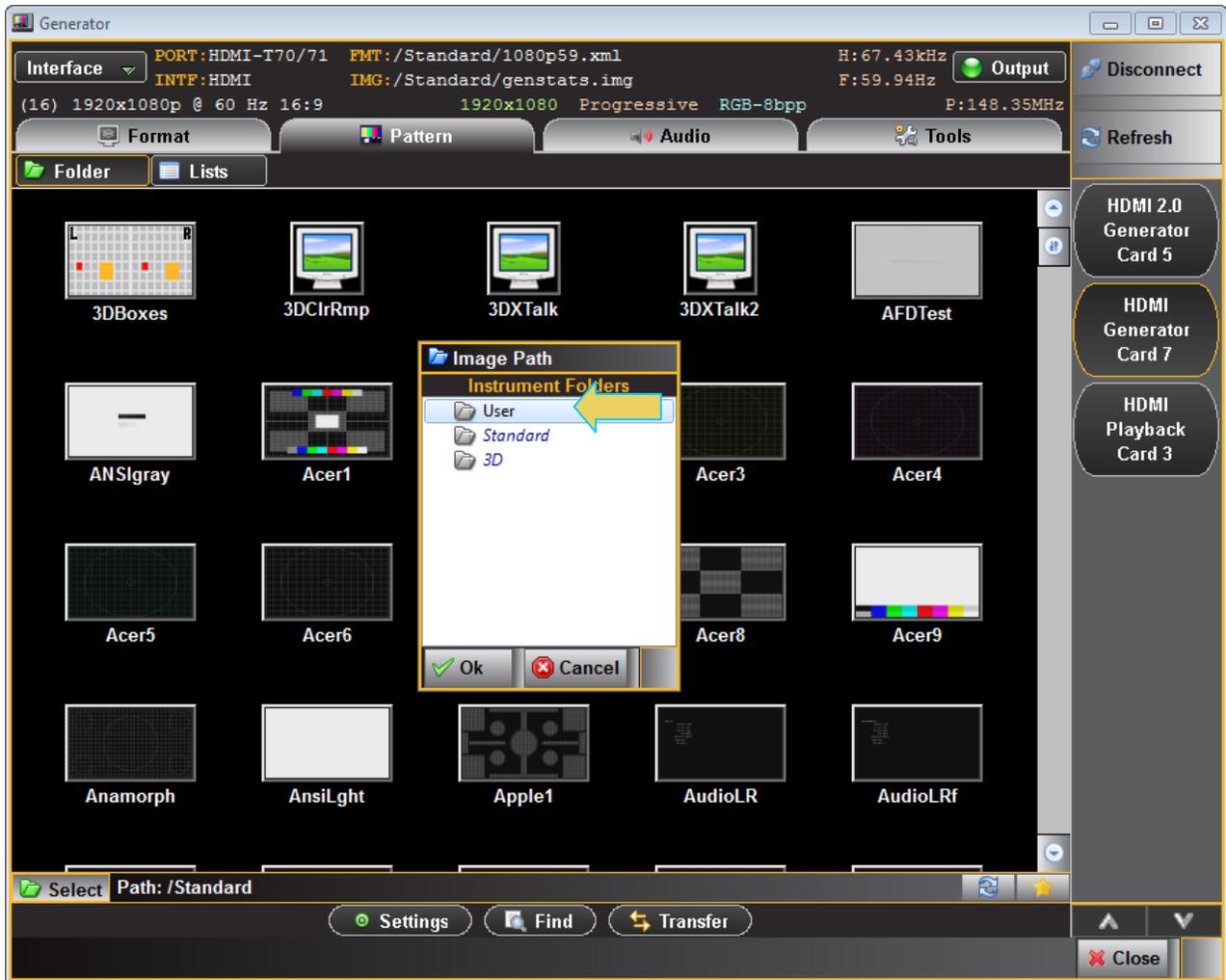


The directory whose images (patterns) are being displayed is listed in the lower panel as indicated below. In the example below, the path is set to Standard which will display the entire test pattern library and is the default path.

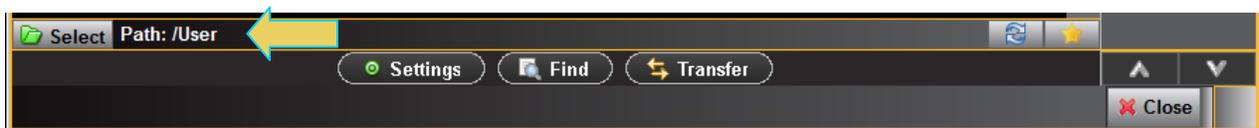
You might wish to change the directory path if you have added your own bitmap patterns and wanted to select them without scrolling through the complete list. You may also have created a custom Pattern List using the **Pattern List Editor**. Refer to [Pattern List Editor](#) for details on creating a custom Pattern List.



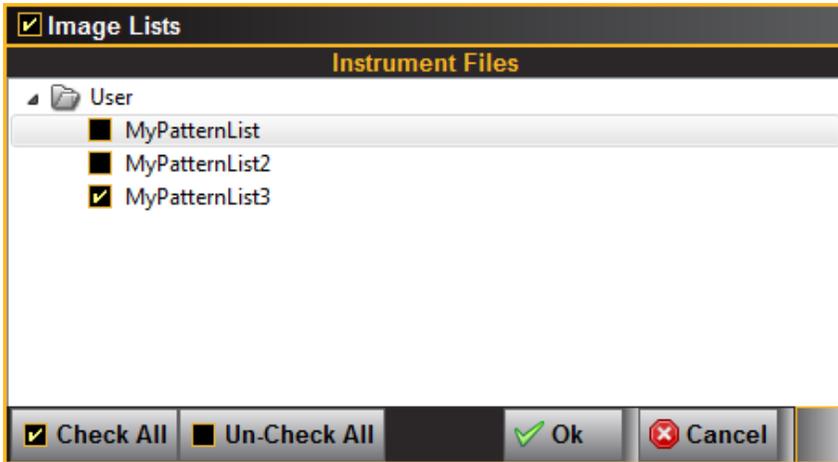
You can change the directory path with the directory activation button  **Path: /Standard**. When you select the directory icon a dialog box will appear allowing you to select the alternative path such as the User path shown in the dialog box below.



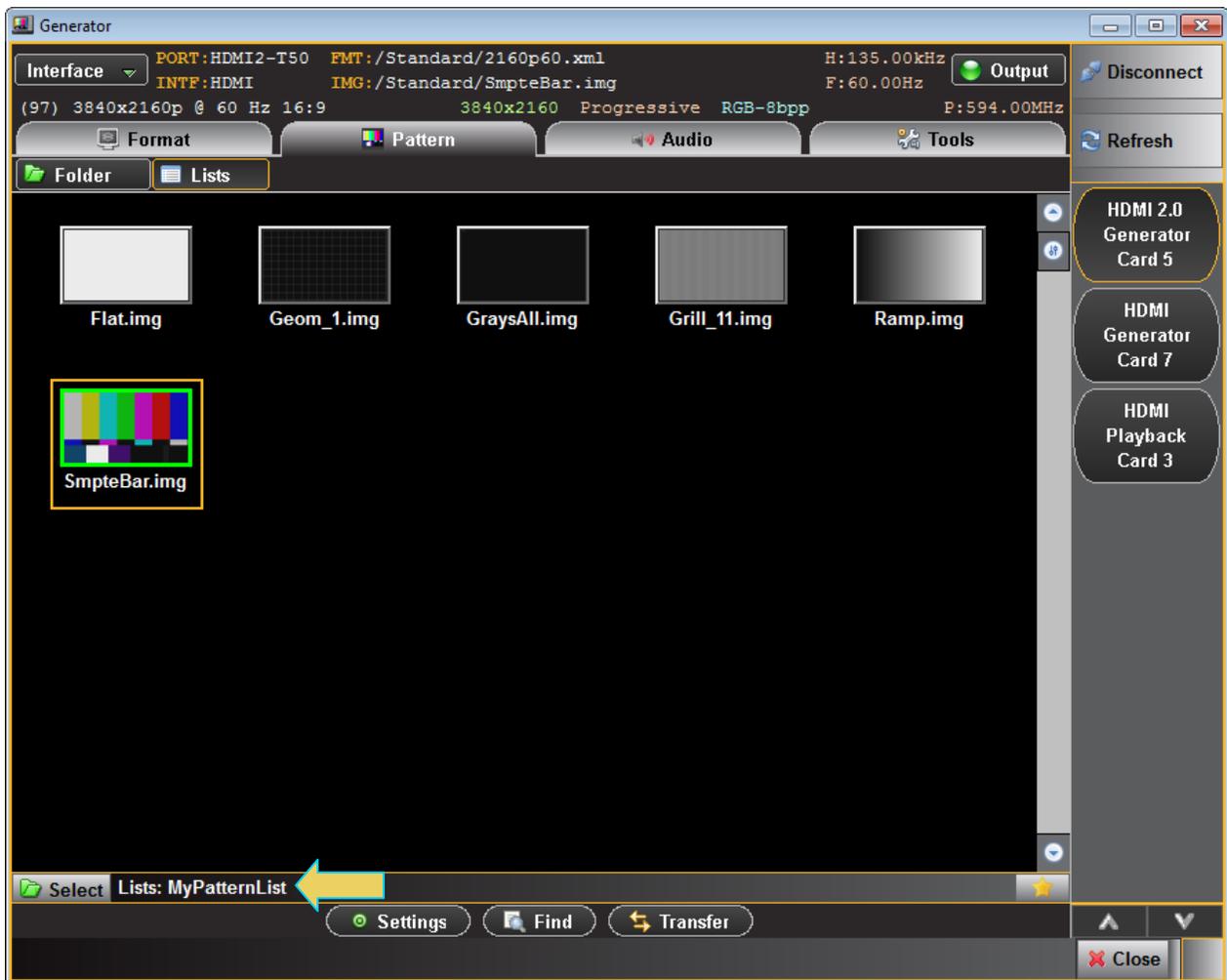
When you have changed the directory the User directory will be indicated on the lower panel beside the associated icon as shown below.



Now you can configure the list of patterns in accordance with a custom Pattern List by clicking on the associated icon **Select Path: /User**. 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).

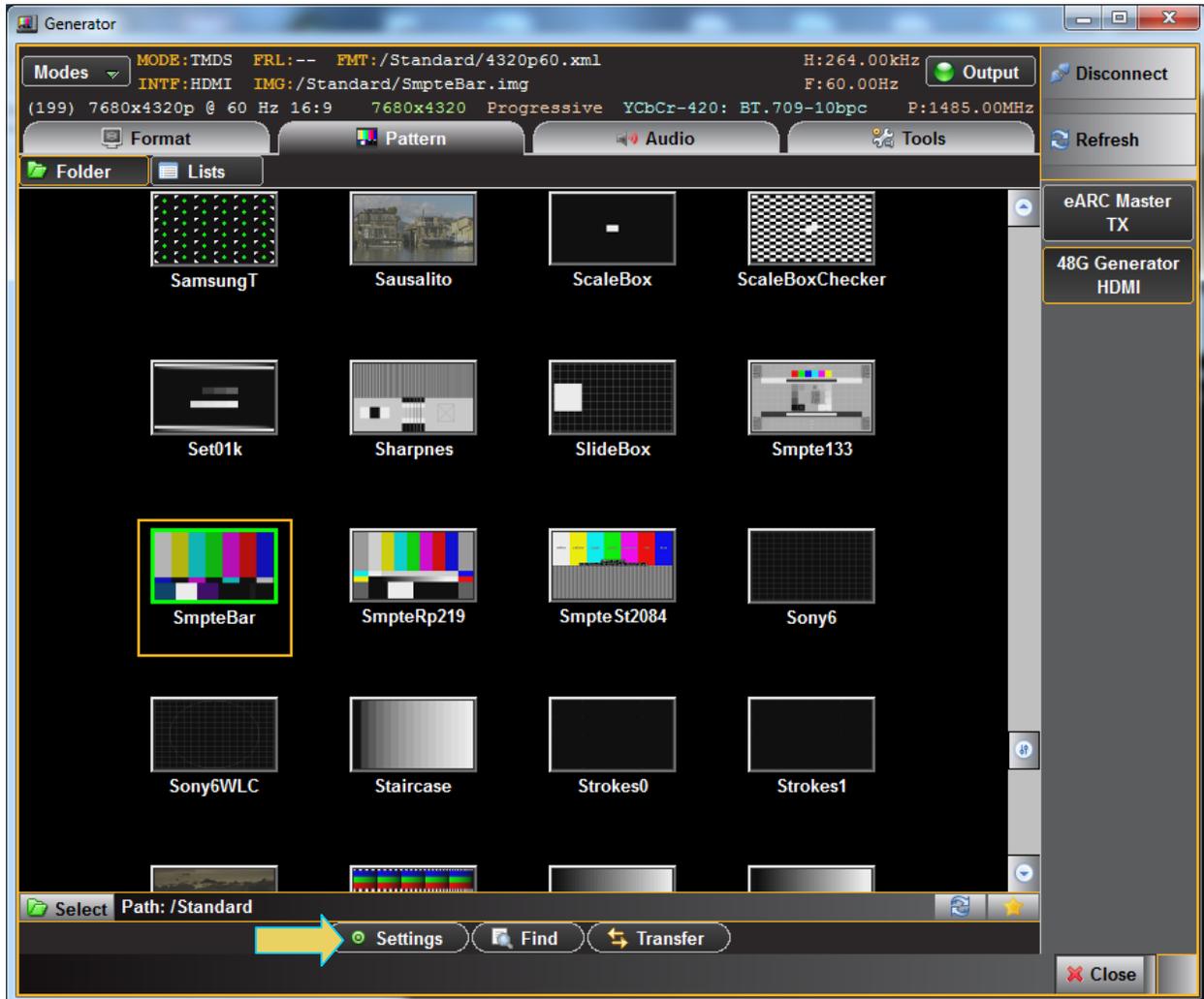


11.9.1 Selecting Test Patterns Settings

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

Pattern Settings - Gating	Description	Options
Gamma Correction	Enables or disables gamma correction which compensate for properties of human vision, to maximize the use of the bits or bandwidth relative to how humans perceive light and color.	<ul style="list-style-type: none"> • On • Off
Pseudo-Random Noise	Renders a test pattern with high level of volatility between adjacent pixels.	<ul style="list-style-type: none"> • On • Off
Component Gating	Turns on or off the three primary color components.	<ul style="list-style-type: none"> • 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 2 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.



6. 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). Parameter. The default setting and setting of 8 allows 256 colors on an image (test pattern) to be rendered. This is suitable for the majority of test patterns. However, some test patterns contain more colors and either

require PELD 32 or look optimal only when PELD is set to 32. The test pattern will indicate when PELD 32 setting is required.

- Default - uses the M41h video generator default
- 8 - 8 bits-per-pixel (256 colors)
- 24 - 24 bits-per-pixel (16,777,216 colors).

7. 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 parameters and their values are as follows:

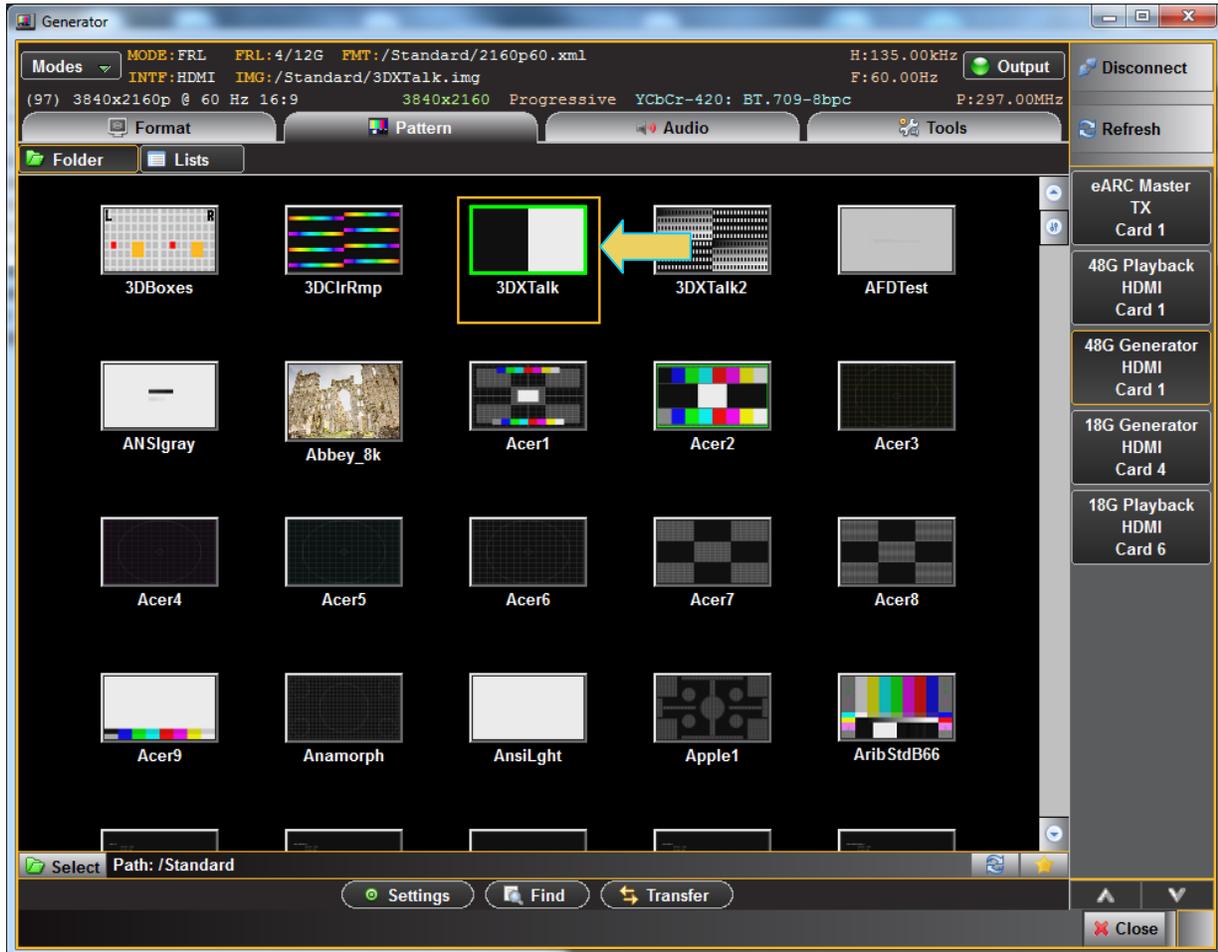
Parameter	Value
OFFX	0
OFFY	0
PENW	77
PENH	77
DELX	4
DELY	4
SPAX	320
SPAY	180
DWEL	1
NCYC	1

11.10 Testing 3D Displays

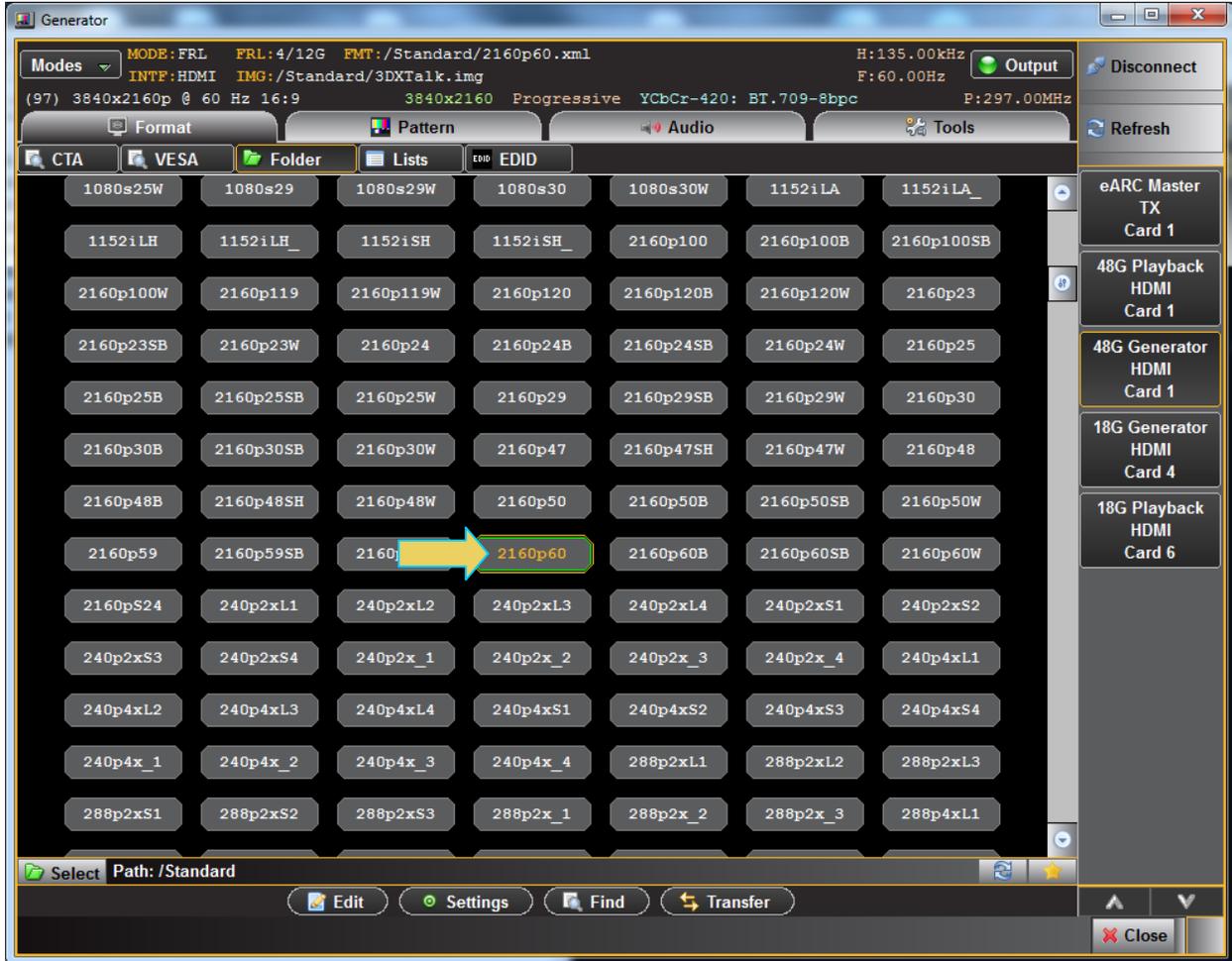
Use the following procedures to test 3D displays.

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).



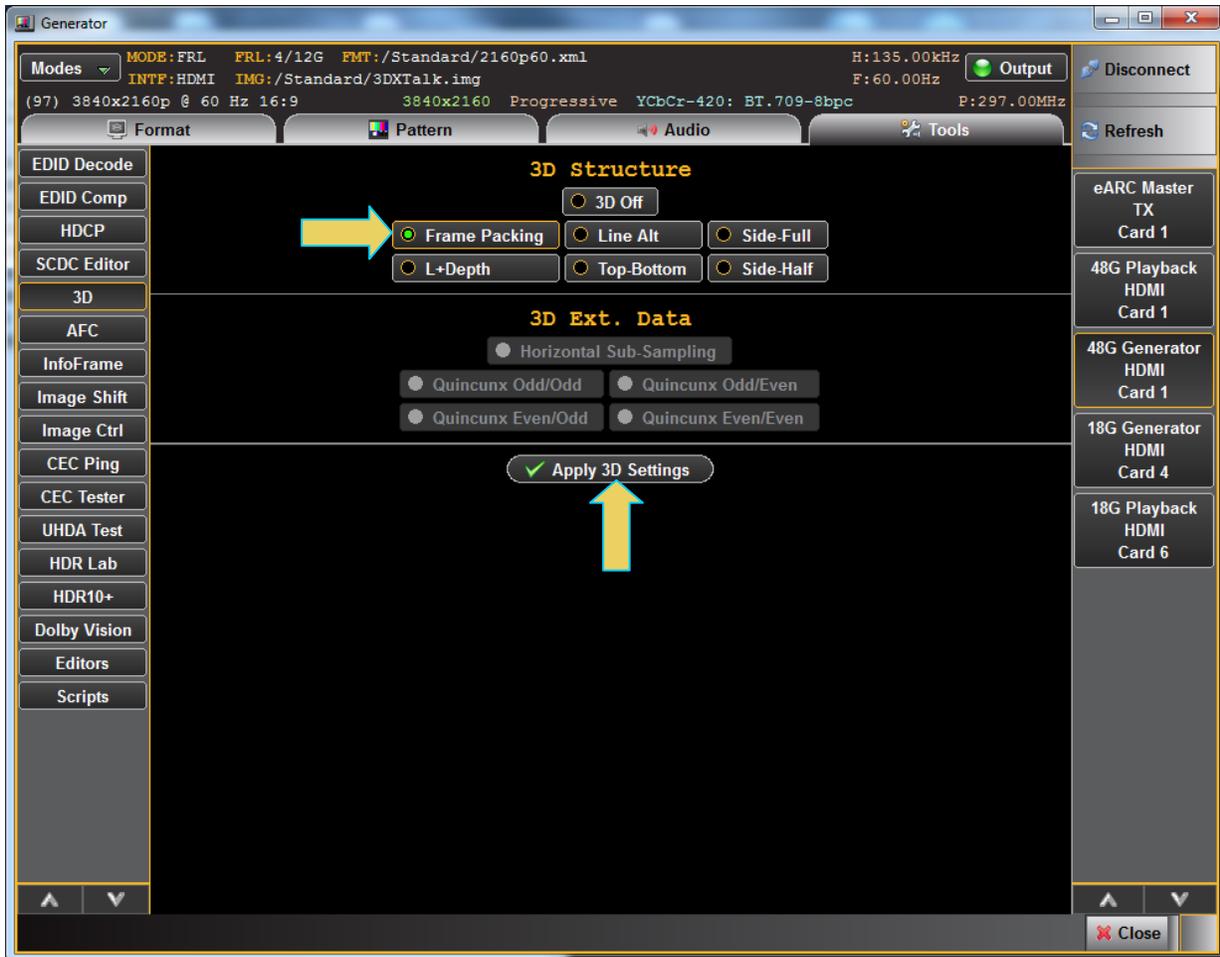
3. Select the **Tools** tab to access the 3D configuration utilities.

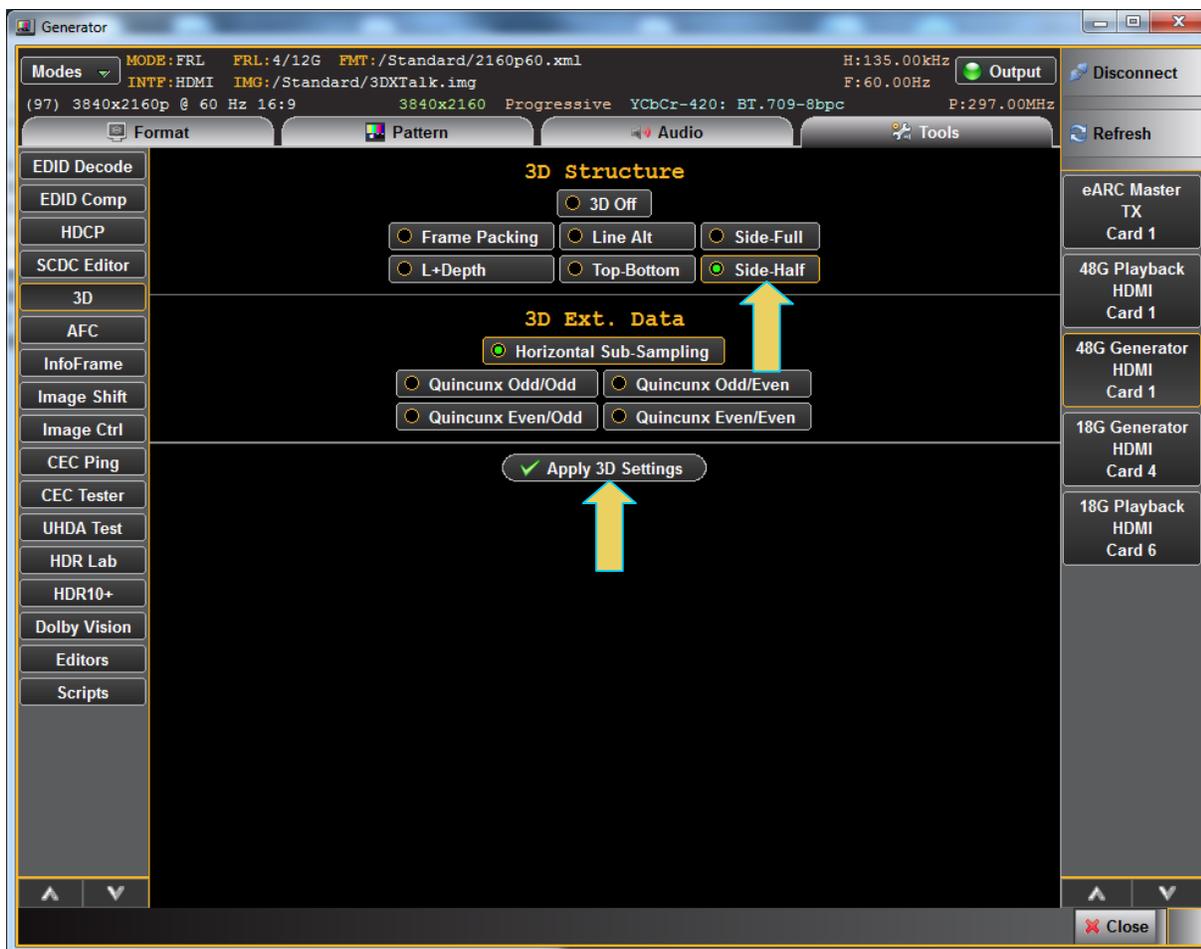


The following table describes the information on the **3D** dialog box.

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.





11.11 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:

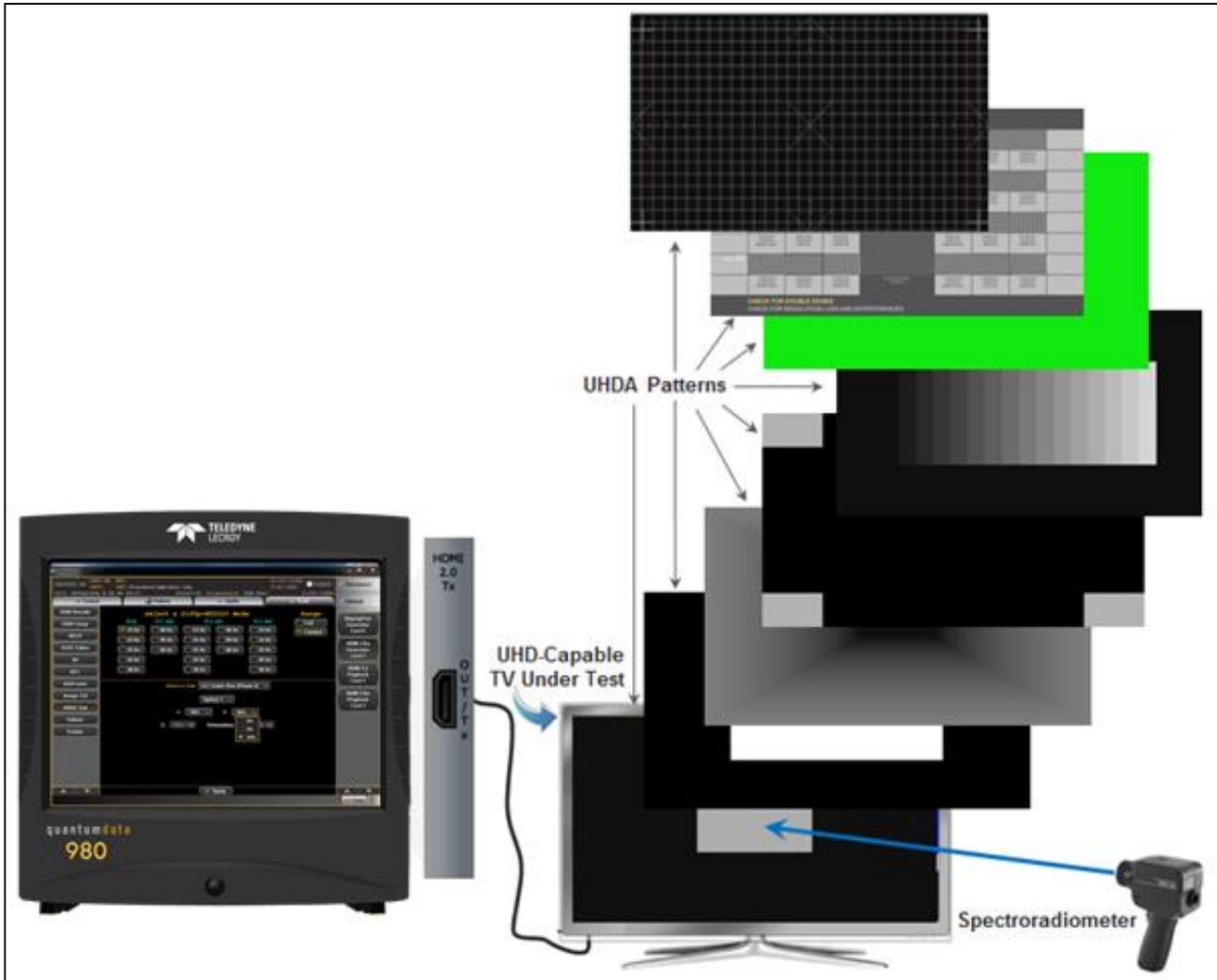
- Section 4.2 High Dynamic Range: Peak White
- Section 4.3 High Dynamic Range: Black Level
- Section 4.4 High Dynamic Range: Tone Mapping
- Section 4.5 Wide Color Gamut
- Section 4.6 Resolution
- Section 4.7 Input Frame Rate and Bit Depth
- Section 4.8 Grey-Scale Tracking

11.11.1UHD 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, the emulates an UHD-capable source by transmitting the UHD test pattern and, where required, the 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.



11.11.2 UHD Test Procedures

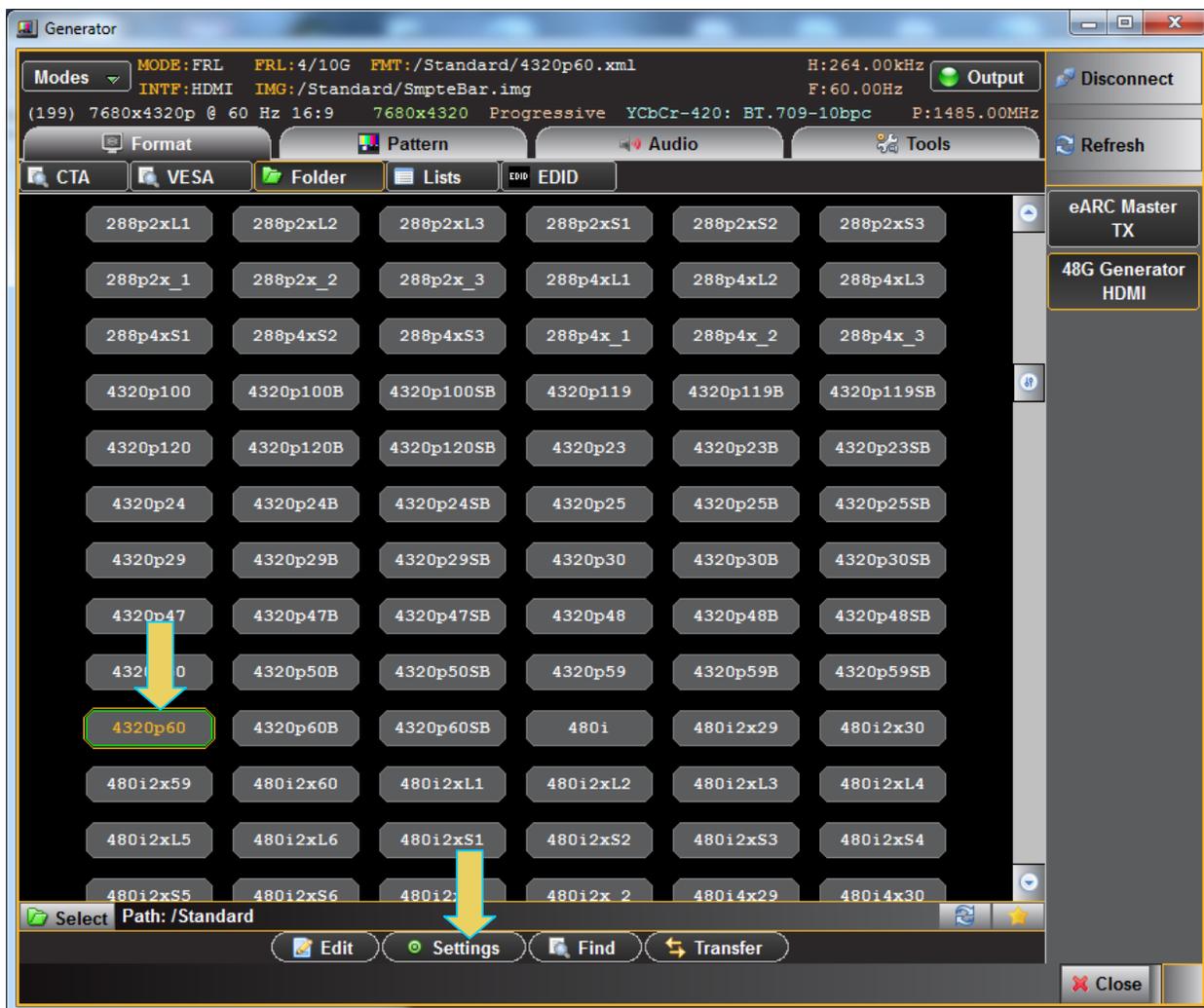
For detailed procedures to test UHD capable HDMI displays refer to the [UHD Alliance Application Note](#).

11.12 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.

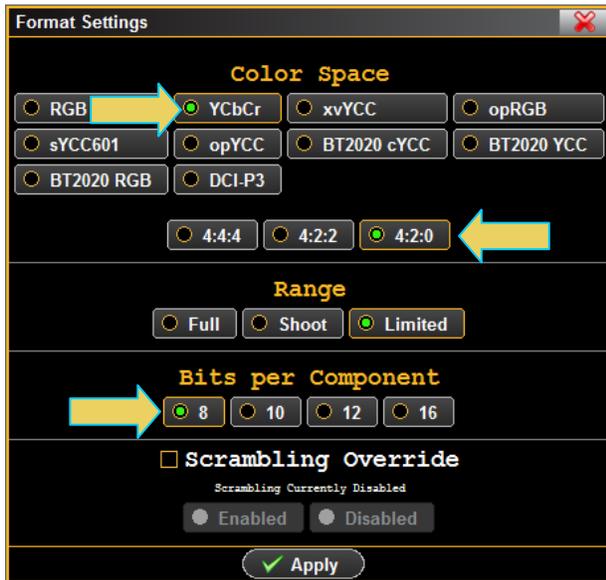
To select test 4:2:0 pixel encoding:

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:



3. Select YCbCr for the Color Space and then select 4:2:0 (above). Note that the pixel rate indication on the top status bar will indicate 297MHz.

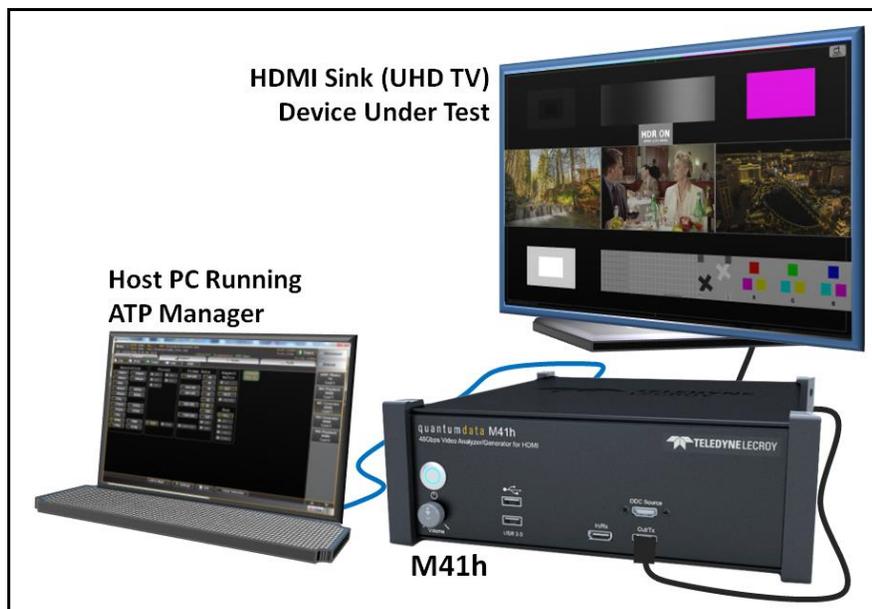
11.13 Testing UHD Displays with HDR Lab Test Patterns

The HDR Lab utility is an optional test pattern pack that requires a license to use.

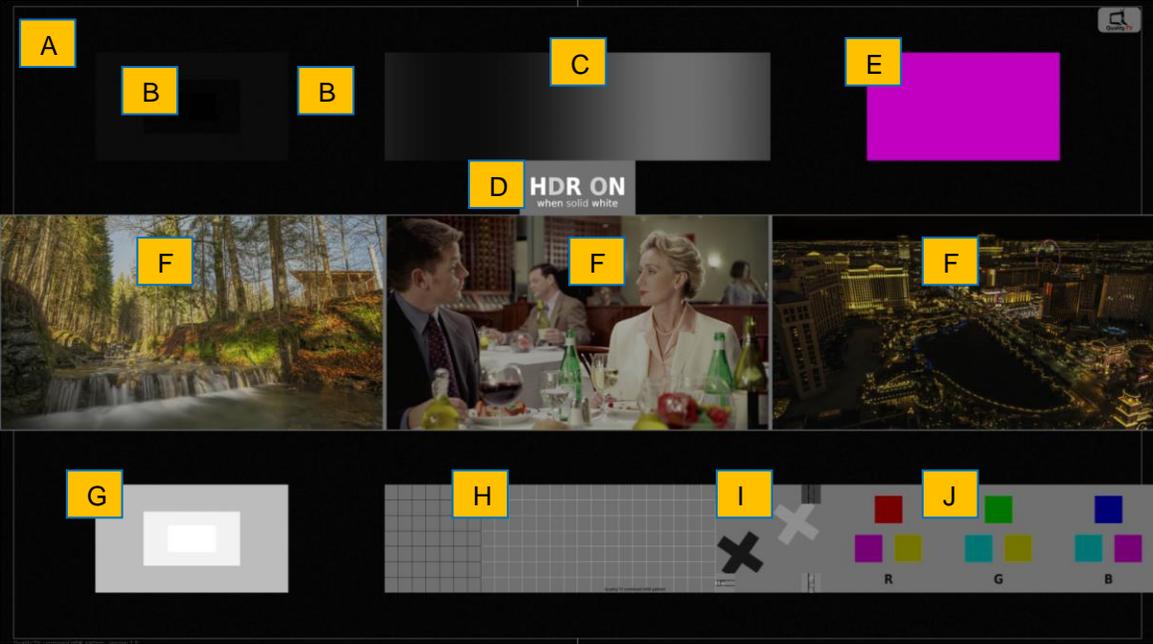
In order to address the HDR needs of the industry from Device Manufacturers to HDR content Post-Production, Teledyne LeCroy has worked together with industry experts Joe Kane of Joe Kane Productions and Florian Friedrich to develop this new test option “HDR Lab.” The solutions use the M41h 48G Video 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.

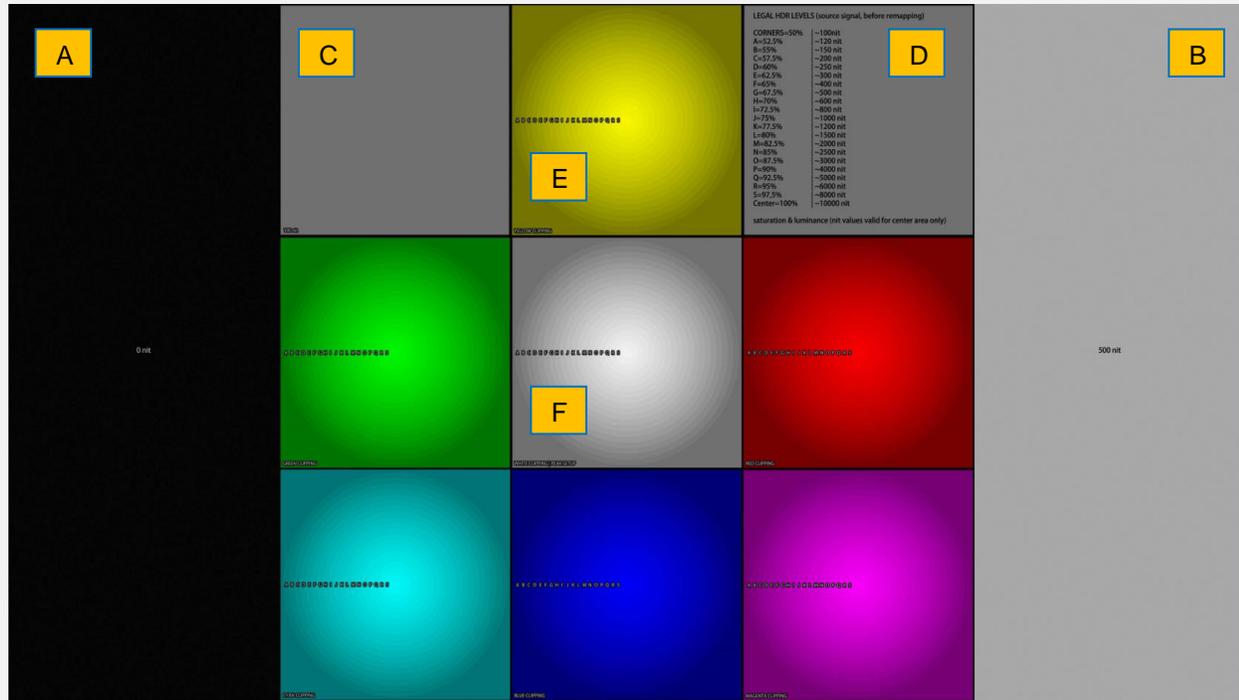
HDR Lab Test Patterns	
Test Pattern Name	Function, Pattern Layout and Use
Combination Test Pattern	
Function	<p>The Combination Test Pattern's top and bottom portion provide a quick overview of display conditions for black level, white level, HDR on (status information) in the display, color, gray scale 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 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'll 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' are all 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's used for determining if there is any excessive image enhancement happening in the picture. You'll see ringing around the edges of the grid if there is image enhancement. The white in the pattern doesn't 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 shouldn't 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 is capable of converting it using the BT 2020 Y Cb Cr equations. Using the red, green and blue only capability of some sets you'll 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 as long as there are no image uniformity issues or significant APL limitations.</p>

HDR Lab Test Patterns

Test Pattern Name	Function, Pattern Layout and Use
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Clipping Test Pattern



<p>Function</p>	<p>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.</p>
<p>Pattern Layout</p>	<p>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 remaining 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 boxes (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.</p> <p>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.</p>

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.</p> <p>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.</p> <p>Alternatively, were the display under test to be 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>

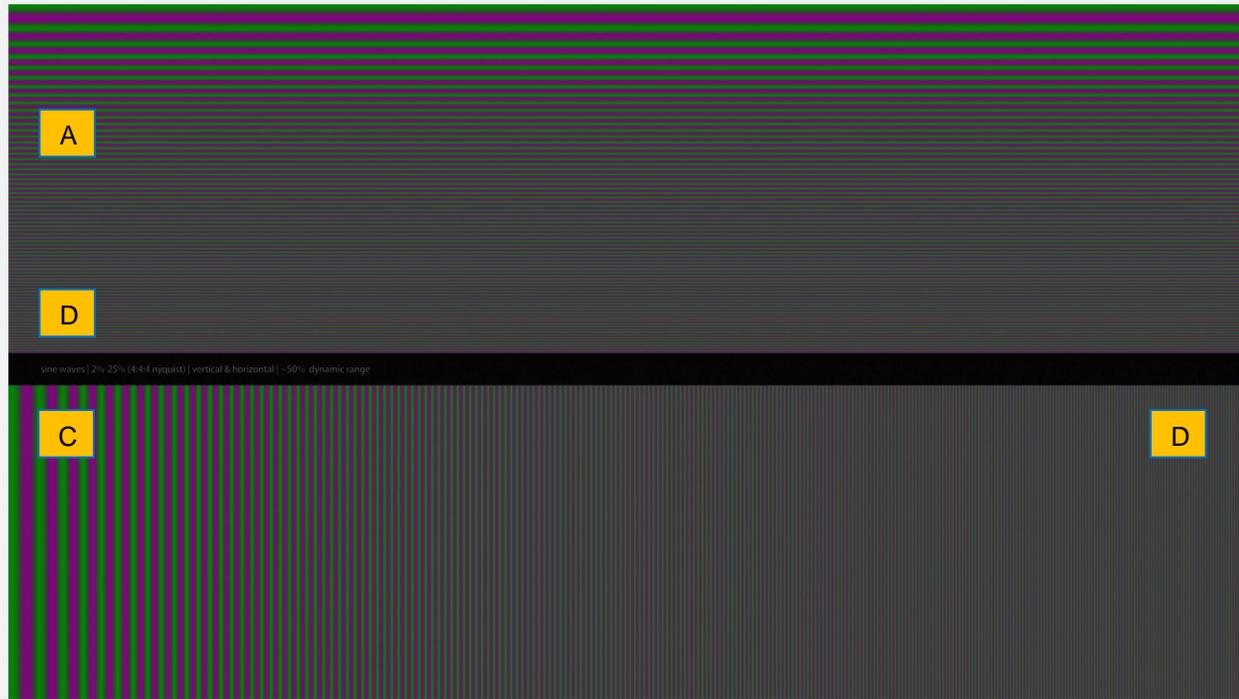
Luma Resolution Test Pattern



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

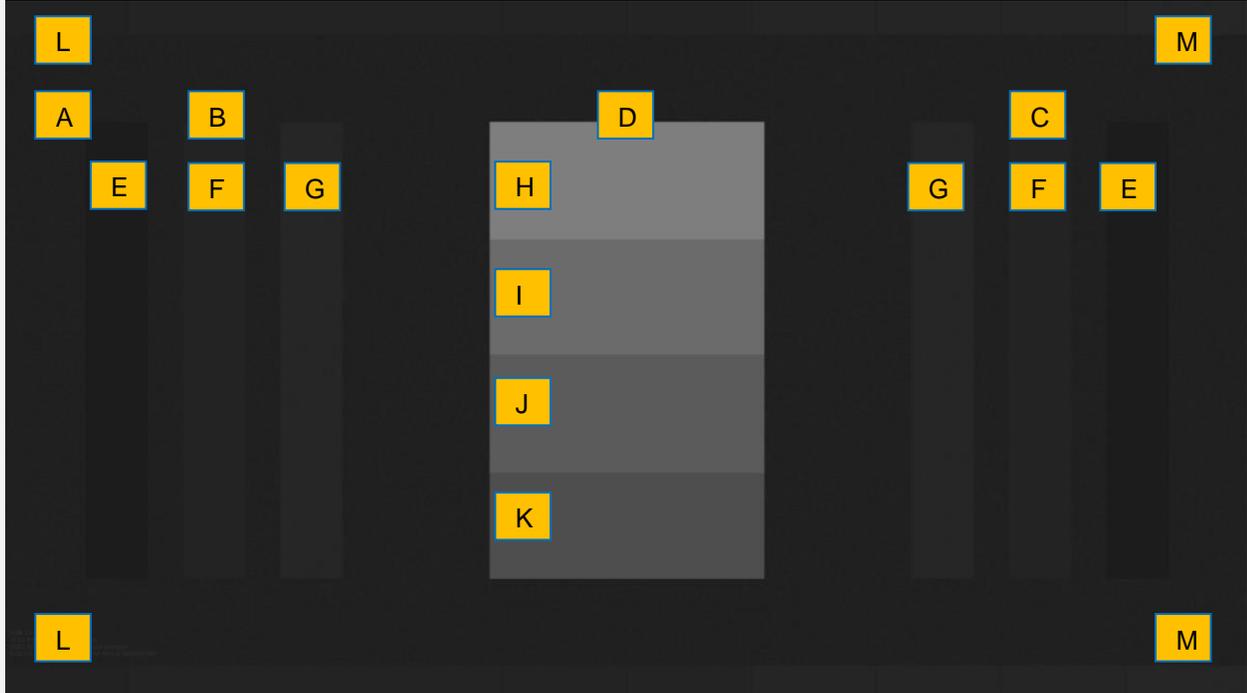


Function	The Chroma Resolution pattern is designed to be a quick human inspection pattern to subjectively test for proper handling of chroma resolution and chroma subsampling.
Pattern Layout	The Chroma Resolution pattern is comprised of the following elements: A chroma sine wave resolution vertical sweep 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 the 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

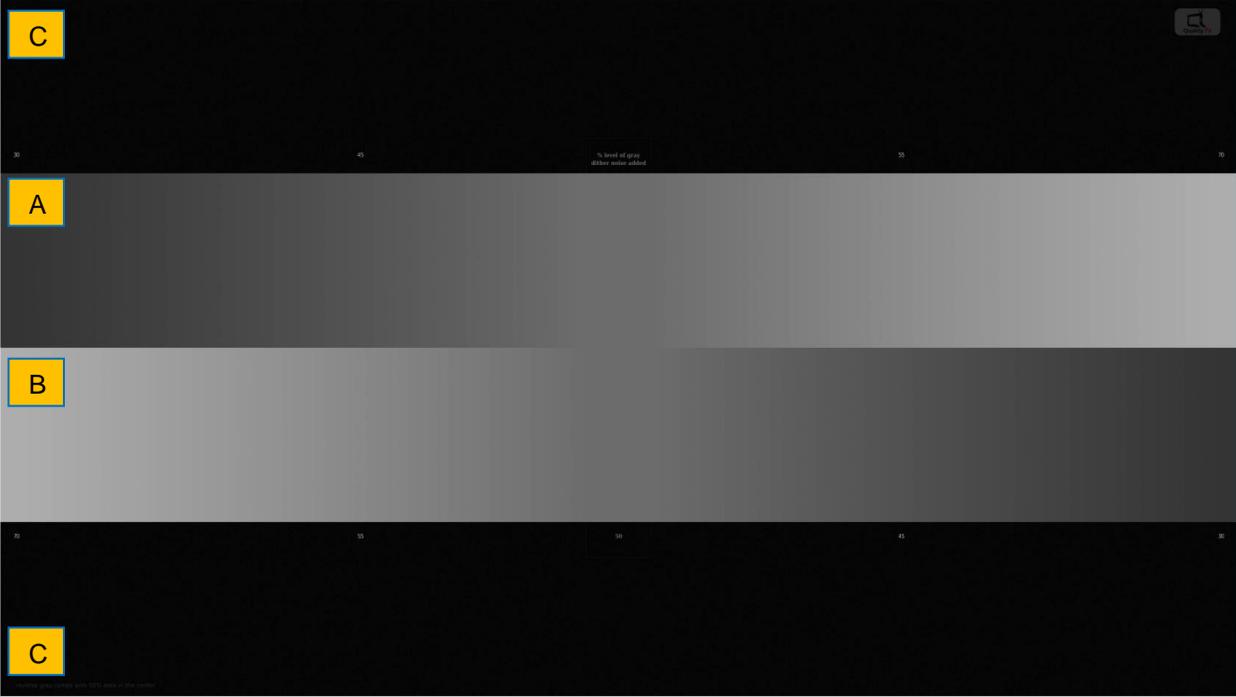
Test Pattern Name	Function, Pattern Layout and Use
<p>Description of Use</p>	<p>Check the pattern in both RGB and YCbCr in all sampling modes: 4:4:4, 4:2:2 and 4:2:0. Also check for different bit depths. In none of these colorimetry or sampling modes should the observer see any chroma other than magenta 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.</p>

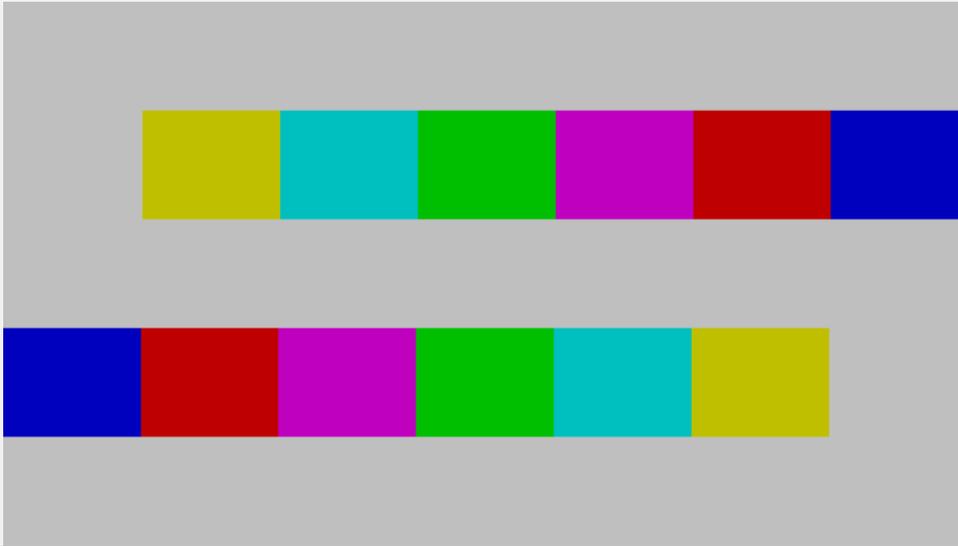
HDR Pluge Test Pattern



<p>Function</p>	<p>To assess/adjust the brightness of a display in HDR</p>
<p>Pattern Layout</p>	<p>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.</p>

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 really 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 won't 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'll 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 can't 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	
	
Function	<p>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.</p>
Pattern Layout	<p>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.</p>
Description of Use	<p>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.</p>

ColorBars Test Pattern**Function**

To assess color decoding and or assist in determining the best operating positions of the Color and or Tint control.

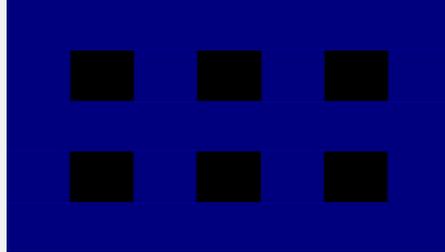
Pattern Layout

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).

Description of Use

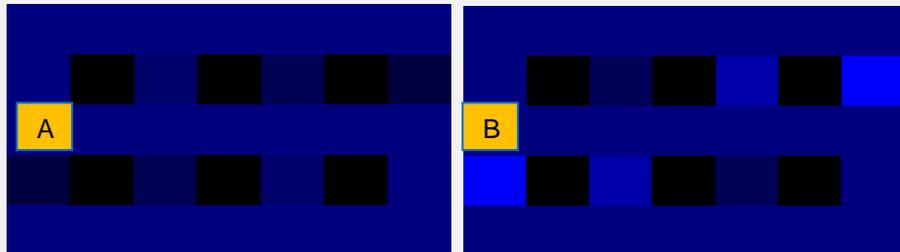
This pattern was designed to better serve the function of checking and adjusting color decoding in all component video systems. Its larger area of reference gray makes it much easier to use, especially when dealing with user menu graphics that often cover just the area you want to see in the conventional 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.

Decoder adjustments should be made looking at the blue channel. You'll 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 all of the areas of the blue in the image should be the same intensity.



All areas of blue should be the same intensity (above).

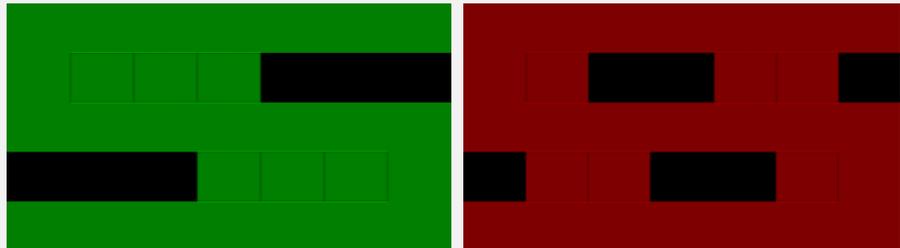
The two images below show the adjustment color control:



If the color control is low in level some of the areas will be desaturated as shown above [A]. If the color control is set high in some of the areas they will look oversaturated as shown above [B].

In a component video system the Tint control should not be active but a number of 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 won't do exactly as it is supposed to do get as close to correct as you can.

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.



All levels of green and red should be equal.

The decoder is most likely not functioning properly if the blue channel is correct and the red and or green channel is (are) wrong.

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
Castle Reference Image	
	
Function	<p>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 and also the ability to maintain detail within highly saturated colors.</p>
Pattern Layout	<p>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 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].</p>
Description of Use	<p>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.</p> <p>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.</p> <p>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.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
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Flowers Reference Image

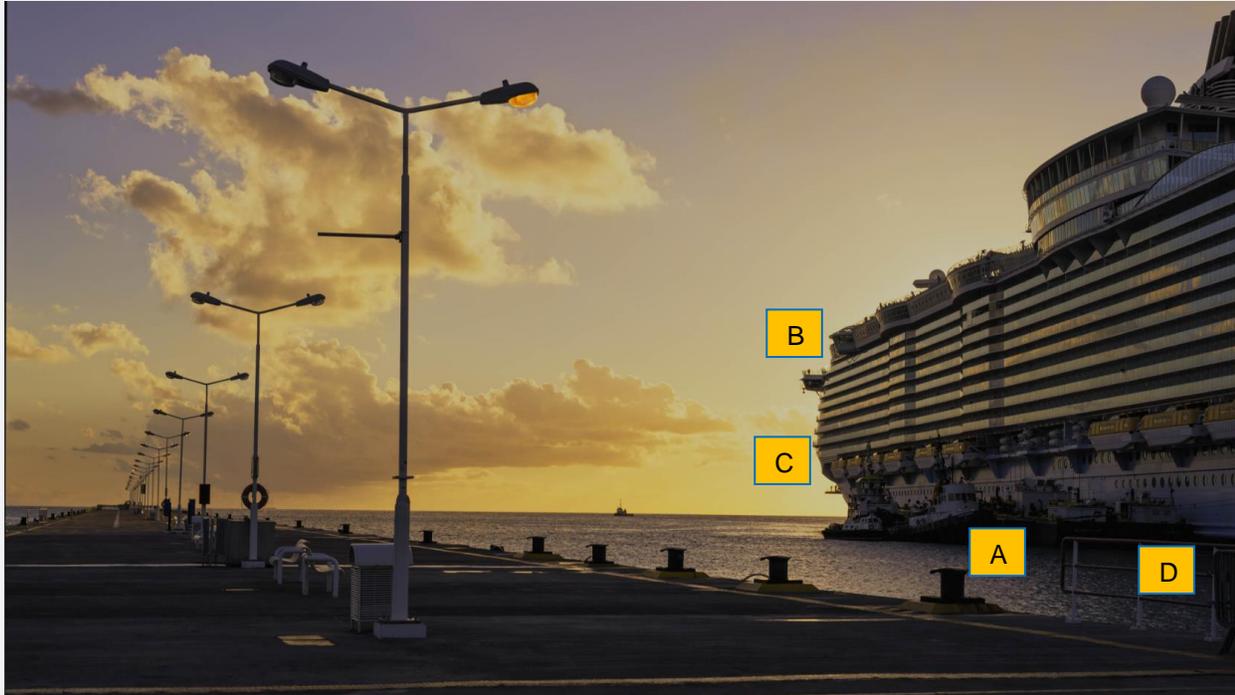


Function	The Montage Flower image is a natural image used to gain a subjective assessment of the displays rendering capabilities with respect to color saturation and maintaining differentiated colors throughout the highly saturated natural flowers.
Pattern Layout	The Montage Flower image contains an 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
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Cruise Ship Reference Image

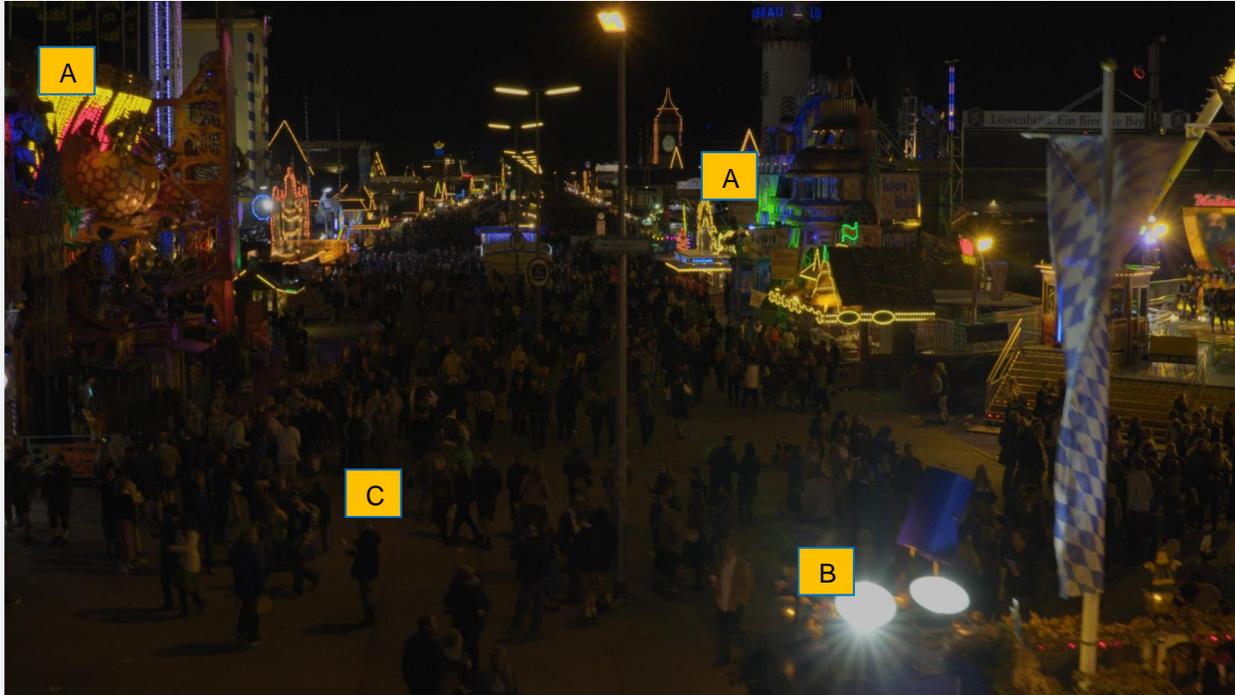


Function	The Cruise Ship image is a natural image shot in time lapse with a Canon 5D Mark 2 camera. The image is used to gain a subjective assessment of a display's ability to render details in a high dynamic range setting.
Pattern Layout	The Cruise Ship image offers high dynamic range image. The image 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.</p> <p>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
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OktoberFest Reference Image

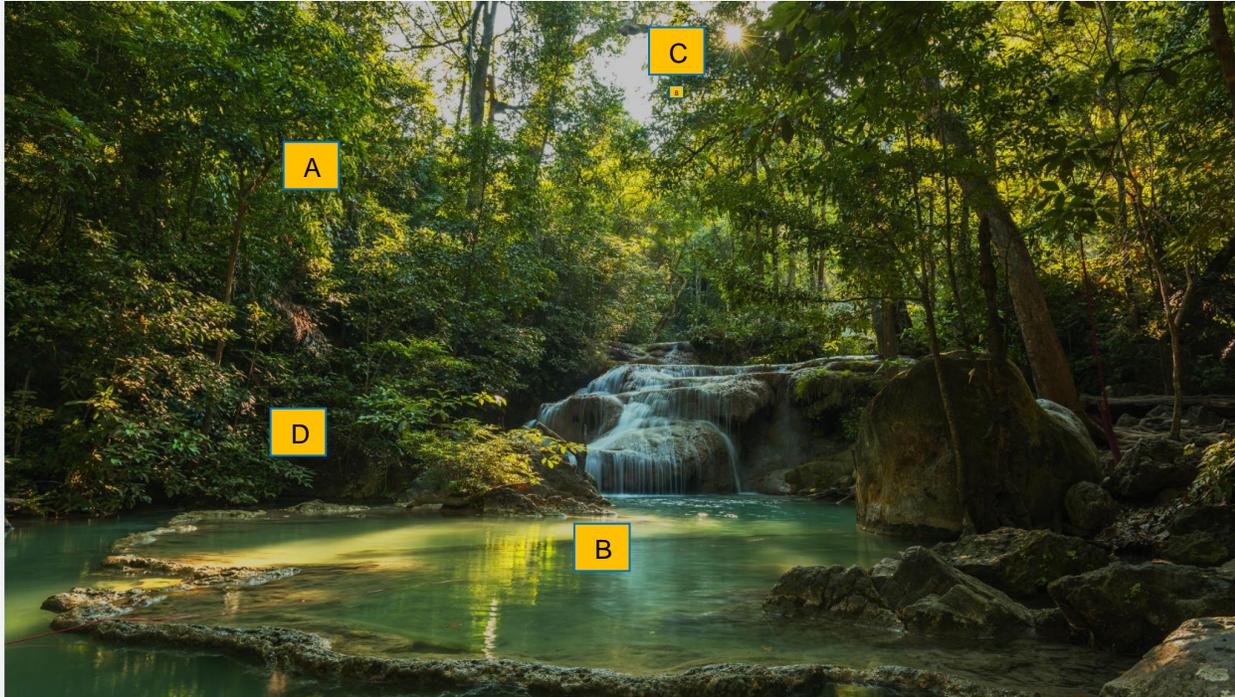


Function	The Oktoberfest Reference Image was shot from atop a Ferris wheel. The image has some challenging elements for an HDR display to test for details in the dark portions against a bright light and also for wide color gamut.
Pattern Layout	The main elements to examine are the LED lights in the background [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 though a very narrow color spectrum.. They should appear as modern LED lights.</p> <p>Another challenging element of this image is the amount 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
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Forest and Waterfall Reference Image



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 is capable of producing 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 the sunlight and 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.</p> <p>One particular 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 a ideal HDR display, it should actually 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 properly representing the visual elements.</p>

HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
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Bottles and Glasses Reference Image



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.
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Pattern Layout	<p>This reference image provides some visual elements that are very 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>
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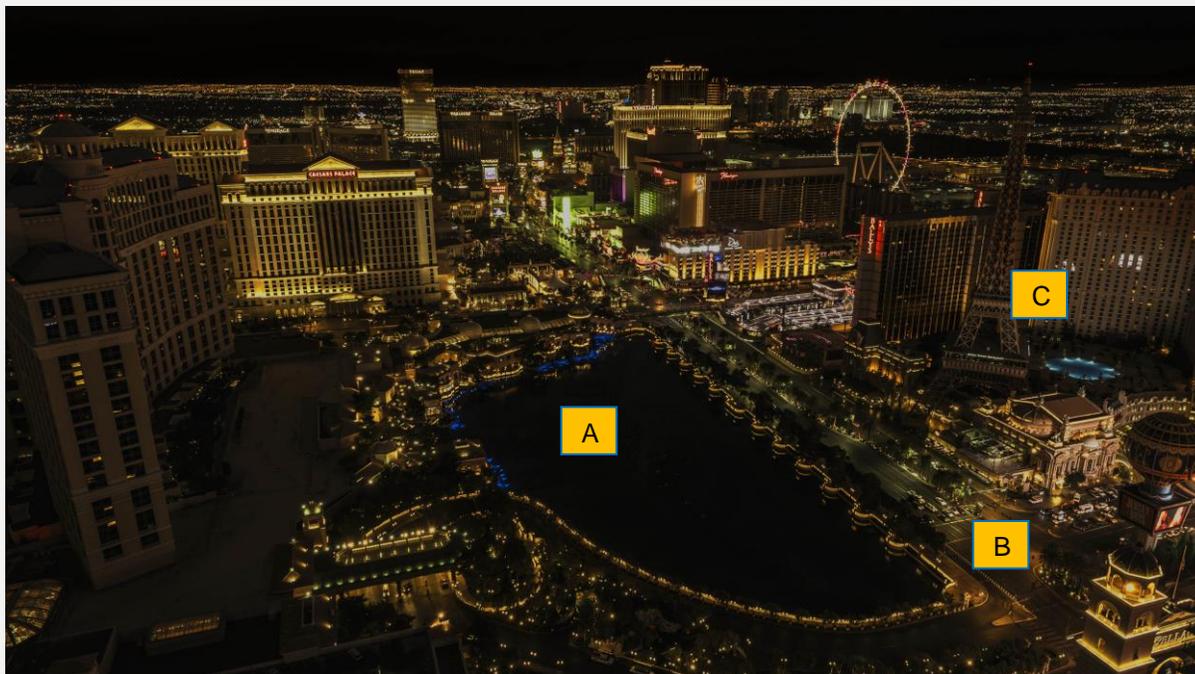
HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
<p>Description of Use</p>	<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 would be indication that the HDR display cannot produce an image with a high average picture level and still produce saturated colors.</p> <p>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>

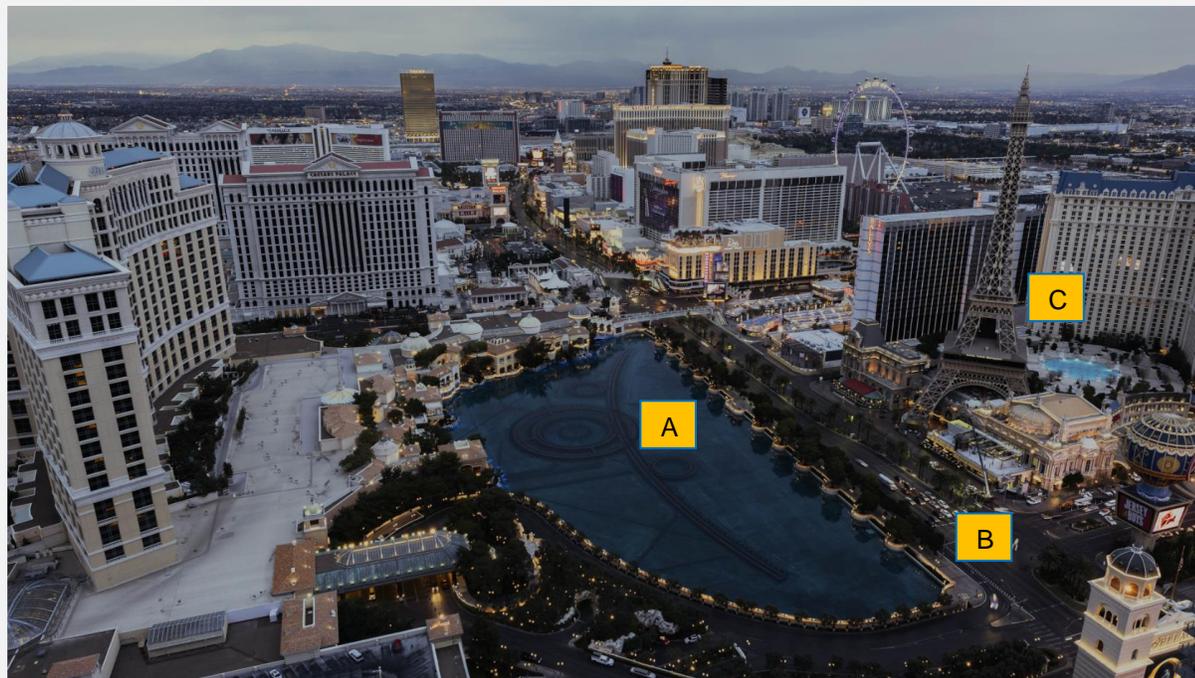
HDR Lab Reference Images

Reference Image Name	Function, Pattern Layout and Use
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Las Vegas Dark and Bright Reference Image



Las Vegas - Dark



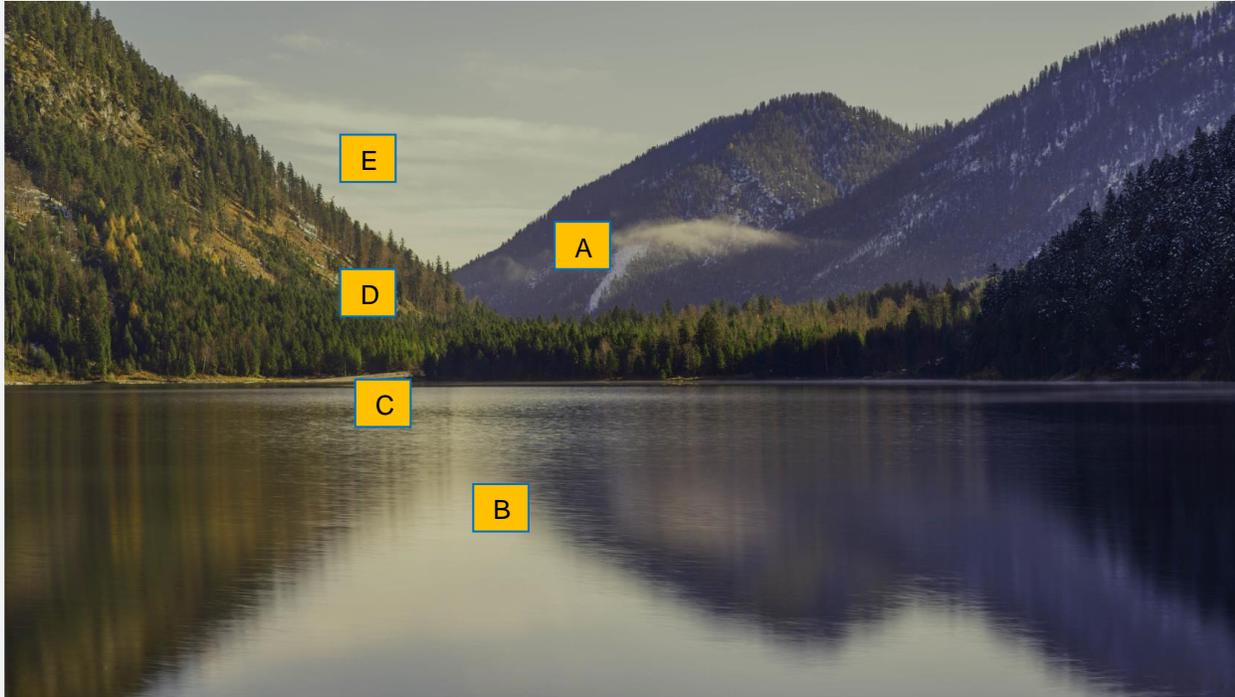
Las Vegas - Bright

HDR Lab Reference Images	
Reference Image Name	Function, Pattern Layout and Use
Function	<p>This pair of images is good for evaluating how OLEDs and LCDs handle highlights in differing Average Picture Levels of brightness. The set of image 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 very 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.</p>
Pattern Layout	<p>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.</p>
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.</p> <p>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]. 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 lights 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
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Mountain Lake Reference Image

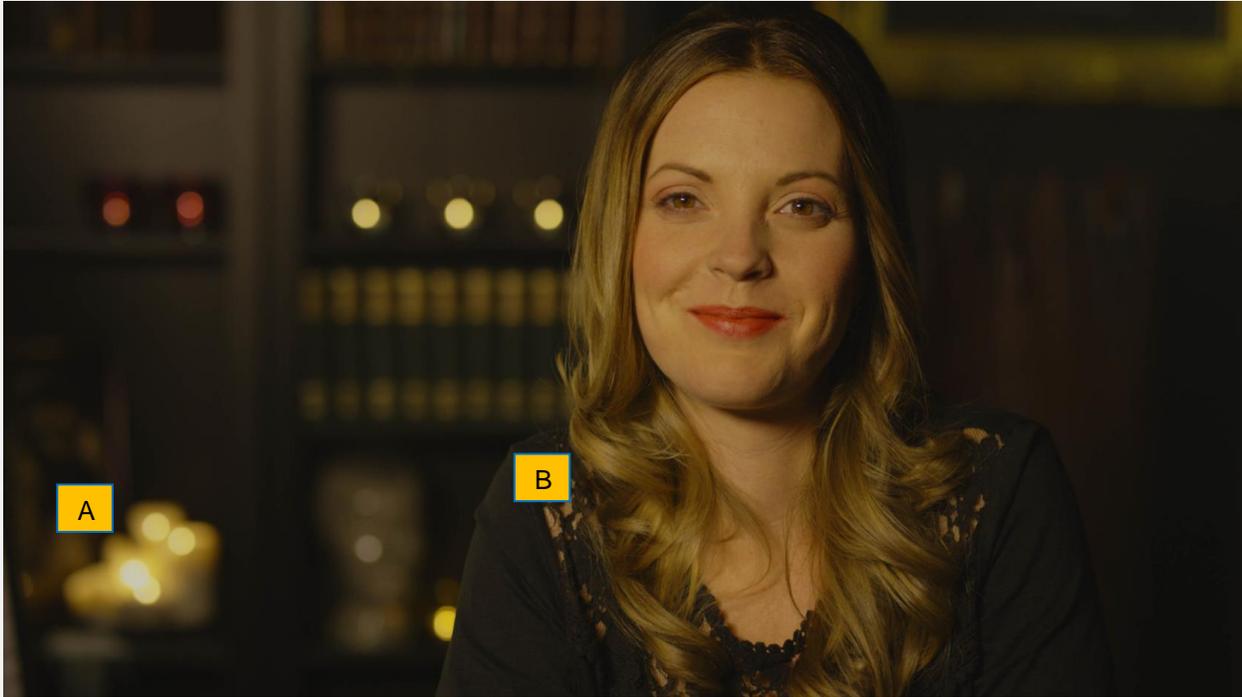


Function	The Mountain Lake reference image German Alps in the early morning contains several useful elements for evaluating HDR displays.
Pattern Layout	<p>There is a low hanging cloud in the foreground floating just above the lake. The cloud should really pop out on good HDR display. The lake gives 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 a 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
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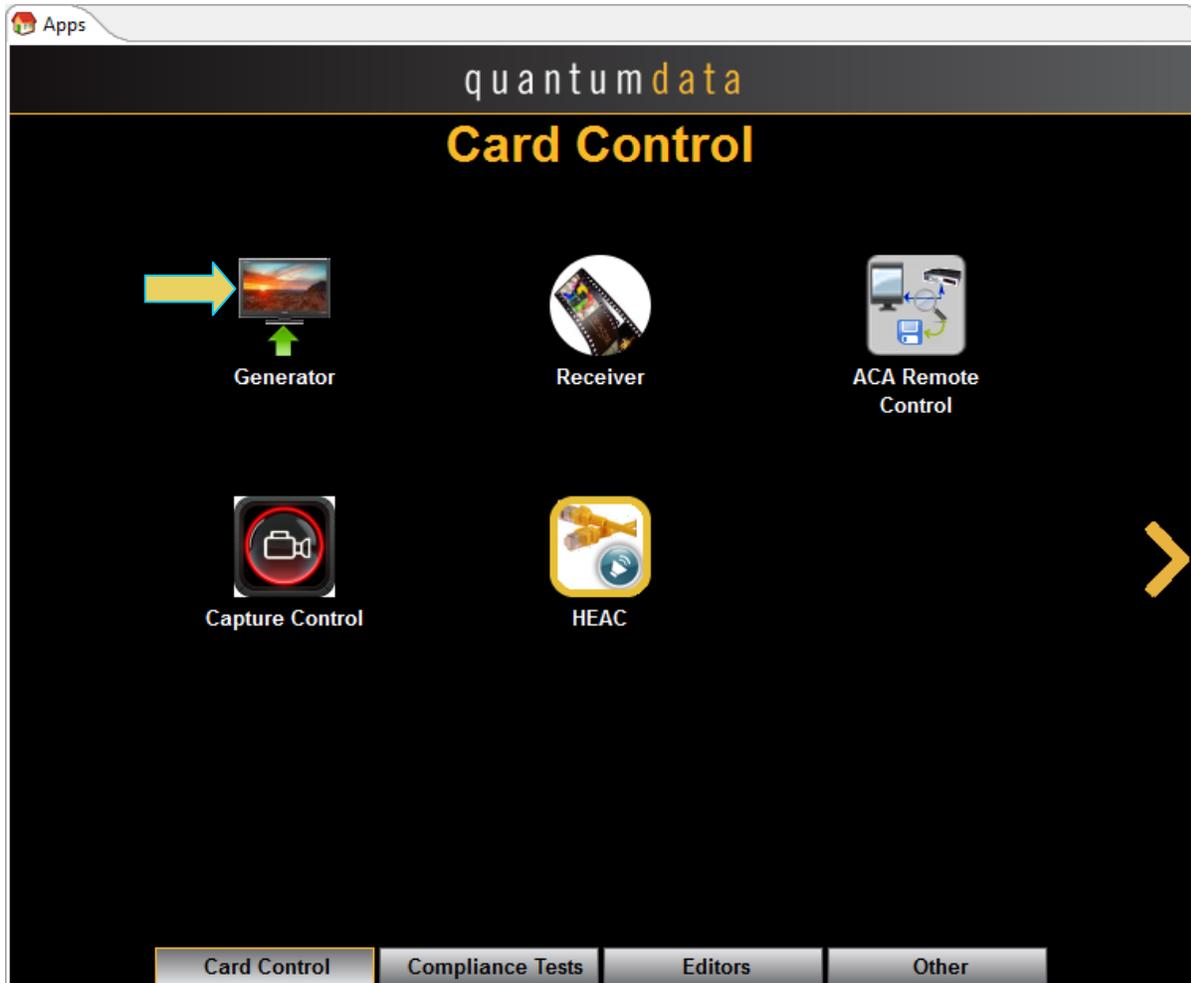
Faces Reference Image



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.</p> <p>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.</p> <p>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>In order 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:

1. Make the physical connections as shown in [Making the physical HDMI connections](#).
2. 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.

3. Select the **Format** tab menu and select 8K at 30Hz format.



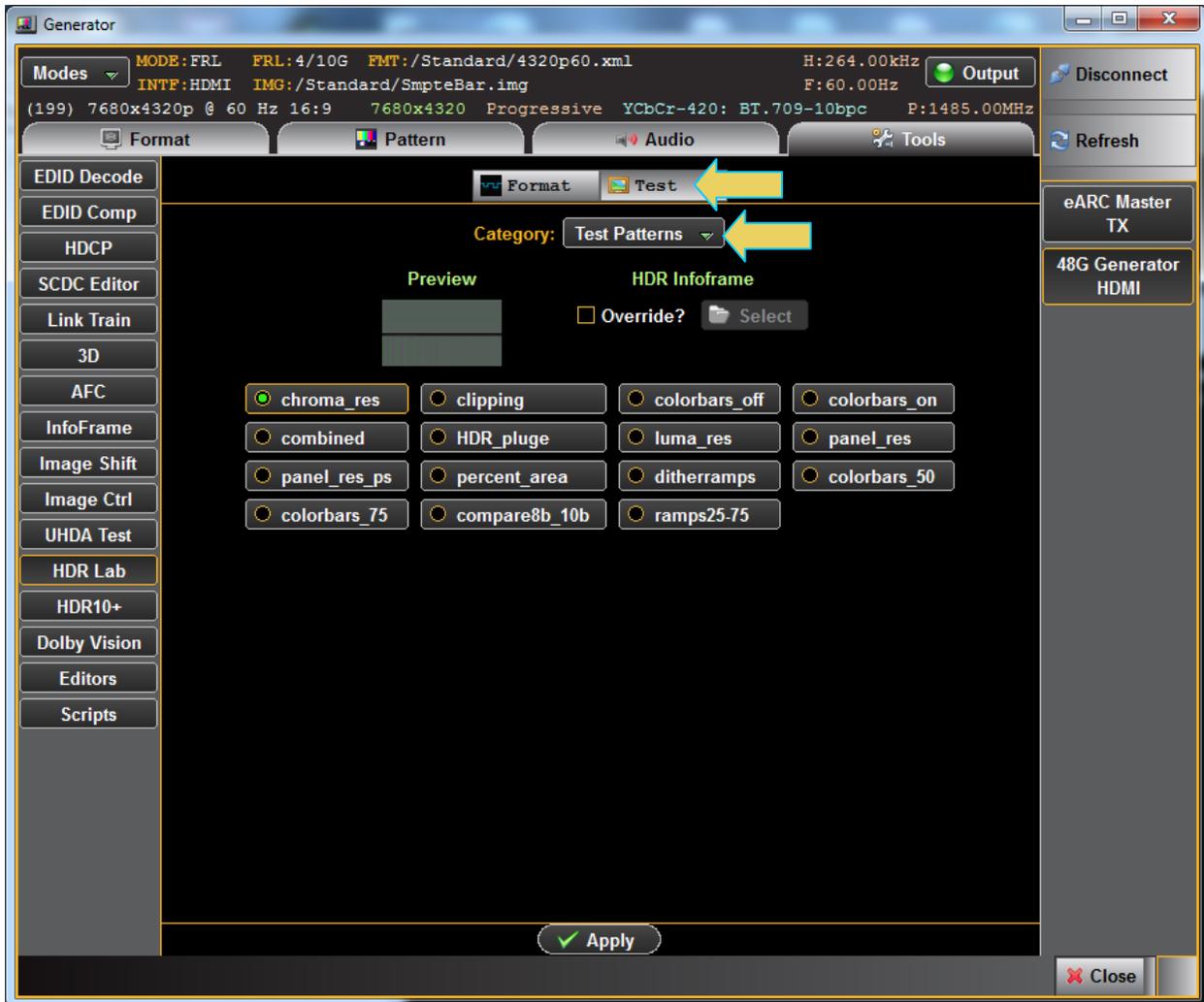
4. Select the **Tools** tab and then the **HDR Lab** utility.
The HDR Lab utility window appears as shown below.



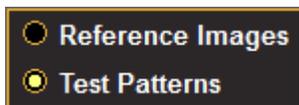
5. Select the **Format** button to access the video parameter selection page (above).
6. Select the Colorimetry, sampling mode and bit depth in accordance with your specifications.
7. Select the **Image** button to access the pull-down menu enabling you to select either the HDR test patterns or the test images (below).



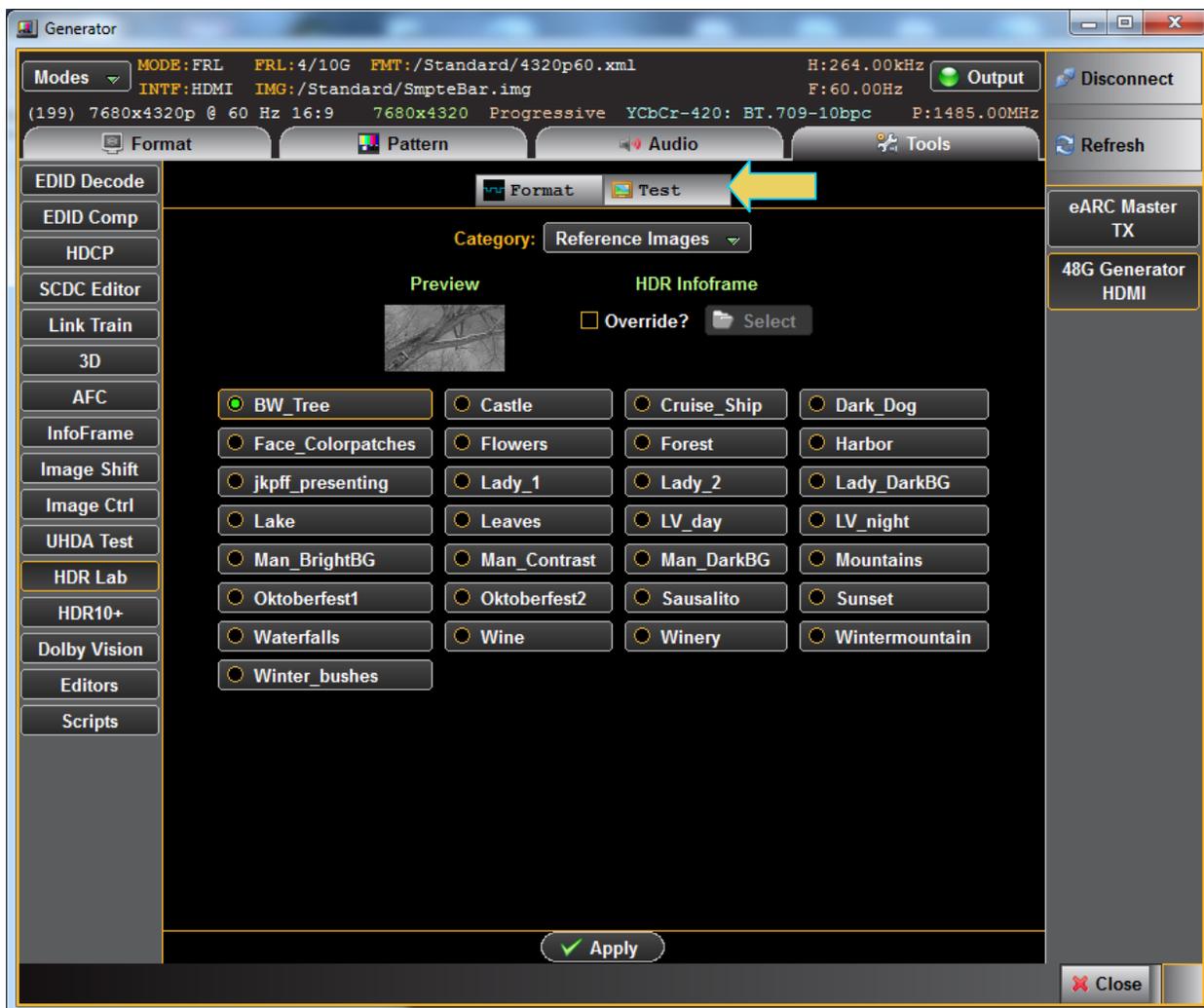
- From the **Category** pull-down menu select either Test Patterns or Test Images (below).



The following pulldown appears:



Test Patterns shown above; Reference images shown below.



9. 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.

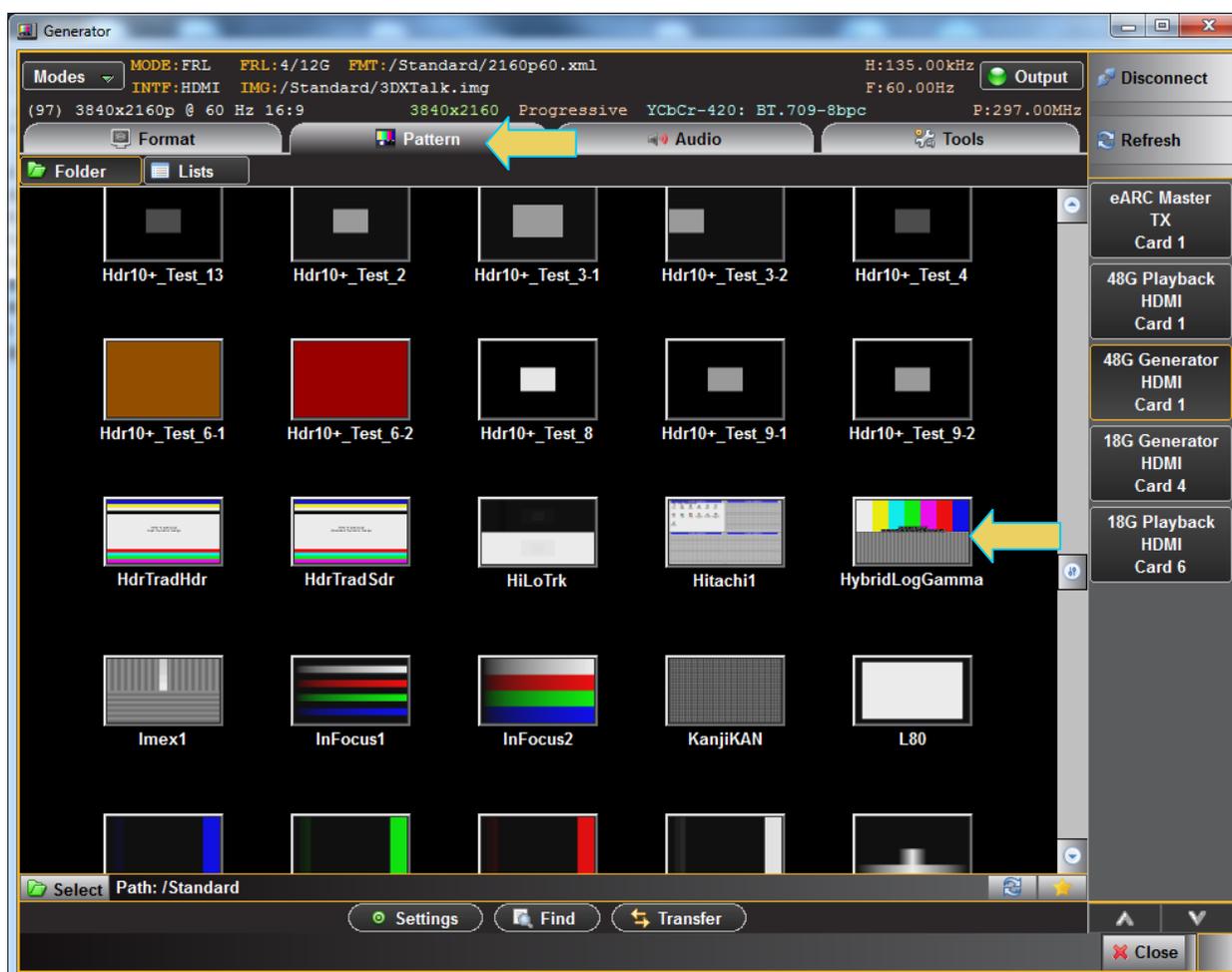
11.14 Testing HDR Displays with HDR Test Patterns

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 inframes. These test patterns require separate licenses for use.

Currently there two specialized HDR test patterns:

- **Hybrid Gamma Log** – This pattern itself it not useful for checking the video attributes of HLG HDR. Its purpose is to provide assurance that the inframe is not impeding the ability of the display to render of 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.

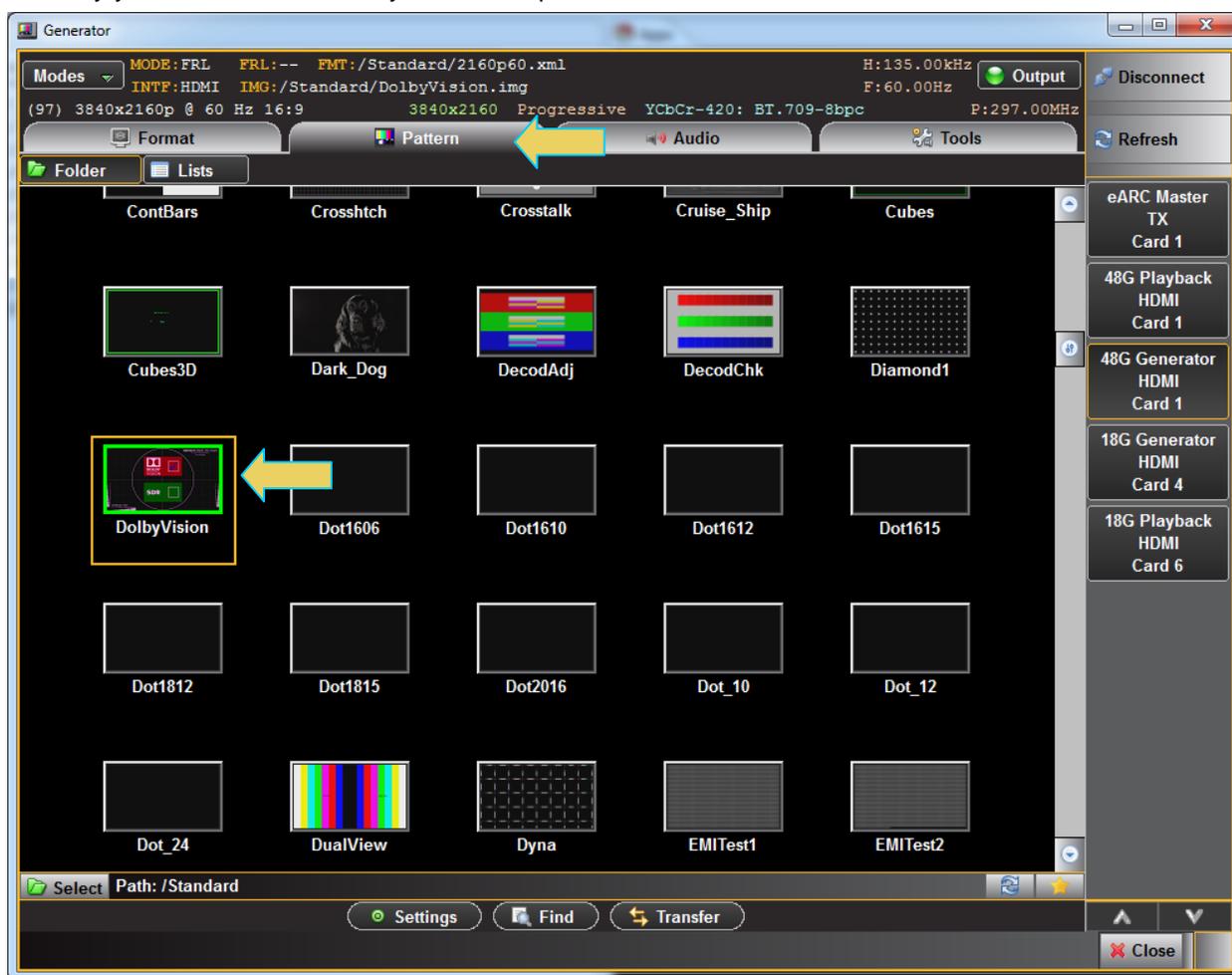
You select the pattern (e.g. Hybrid Log Gamma) as you would any other pattern from the **Patterns** tab shown below.



The HLG test pattern is shown below for reference.



Similarly you can select the Dolby Vision test pattern as shown below.



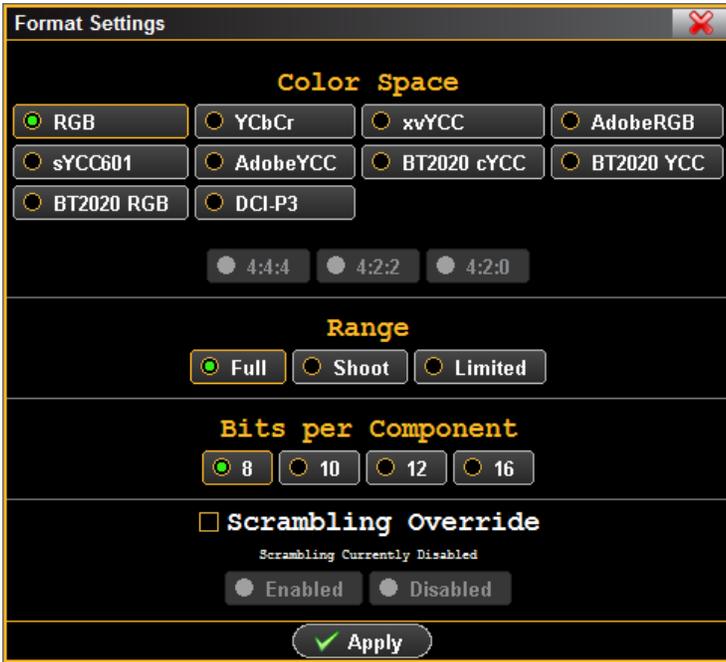
You will set the video format to any 2160p or 1080p image using the following settings:

- Colorimetry: RGB

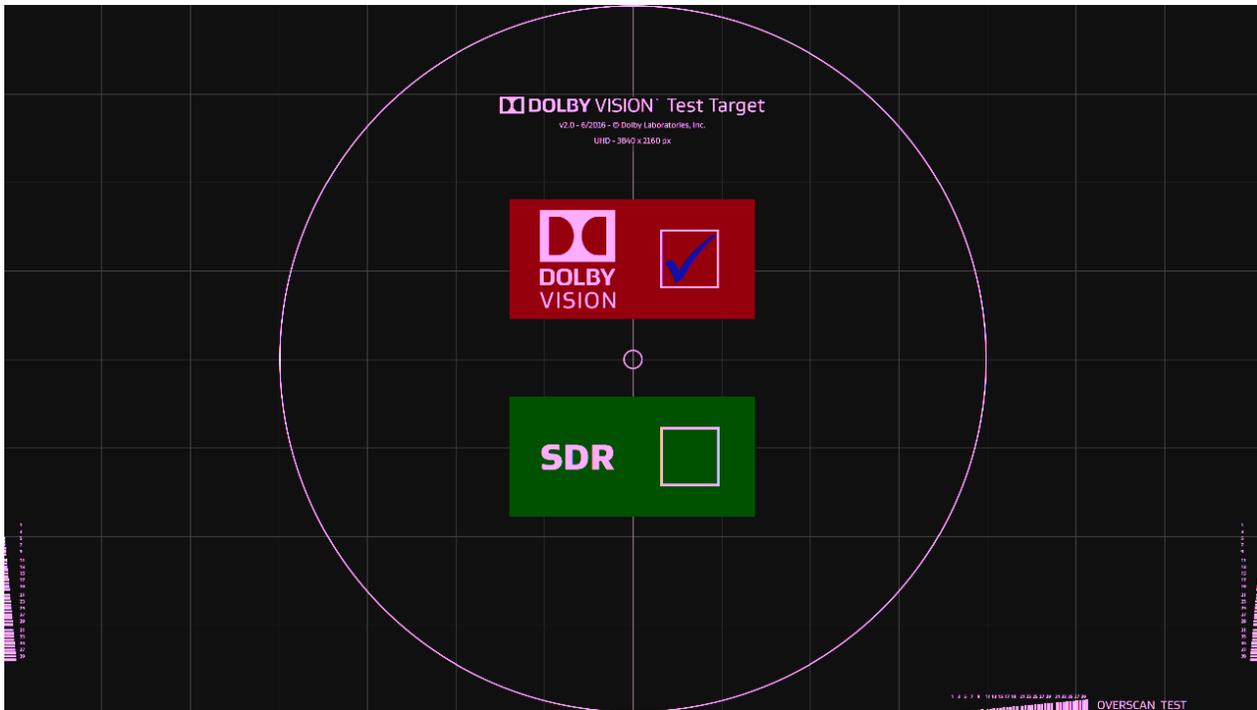
- Range: Full
- Bit depth: 8 bits per component

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.



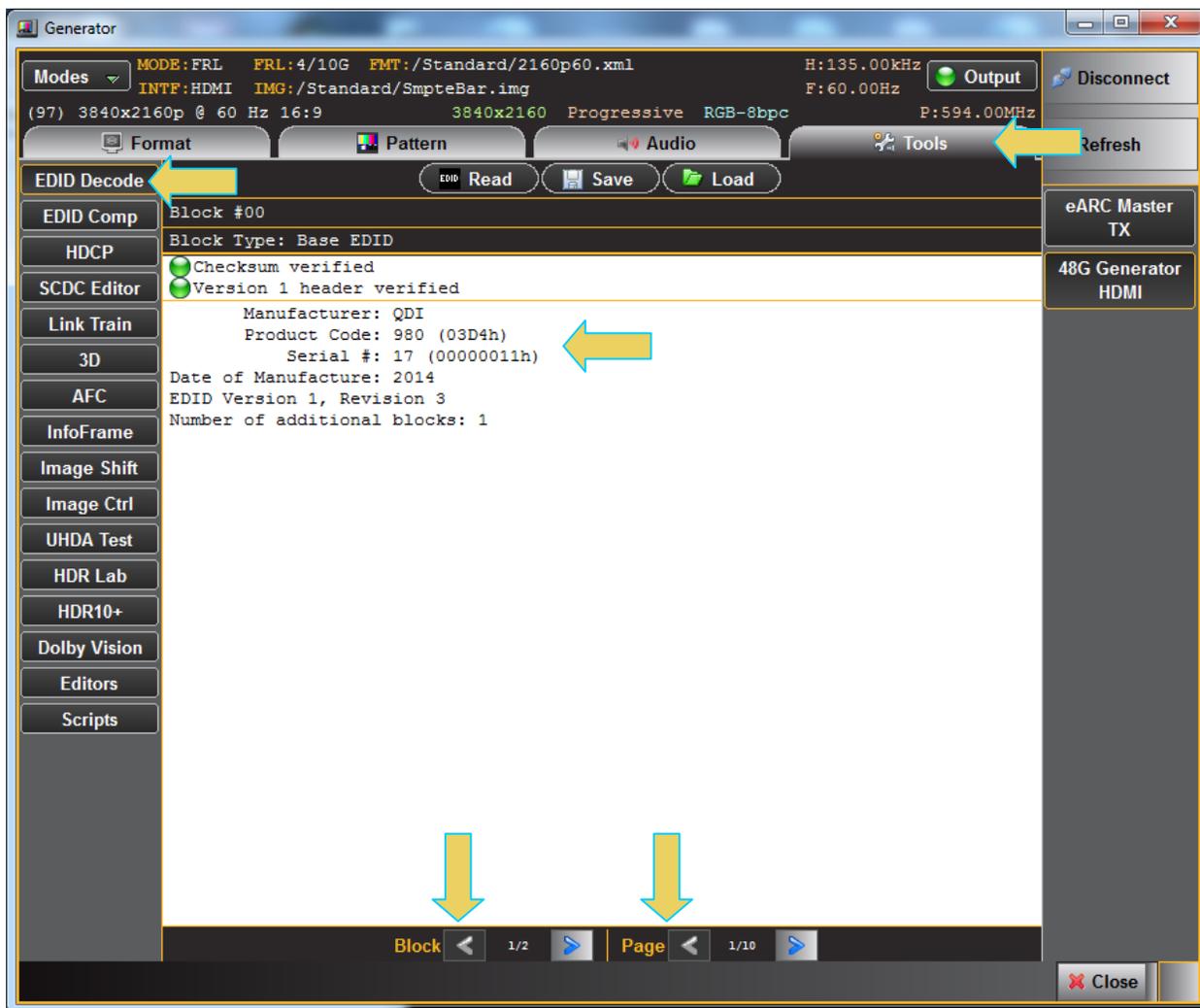
11.15 Viewing the EDID of a connected display

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:

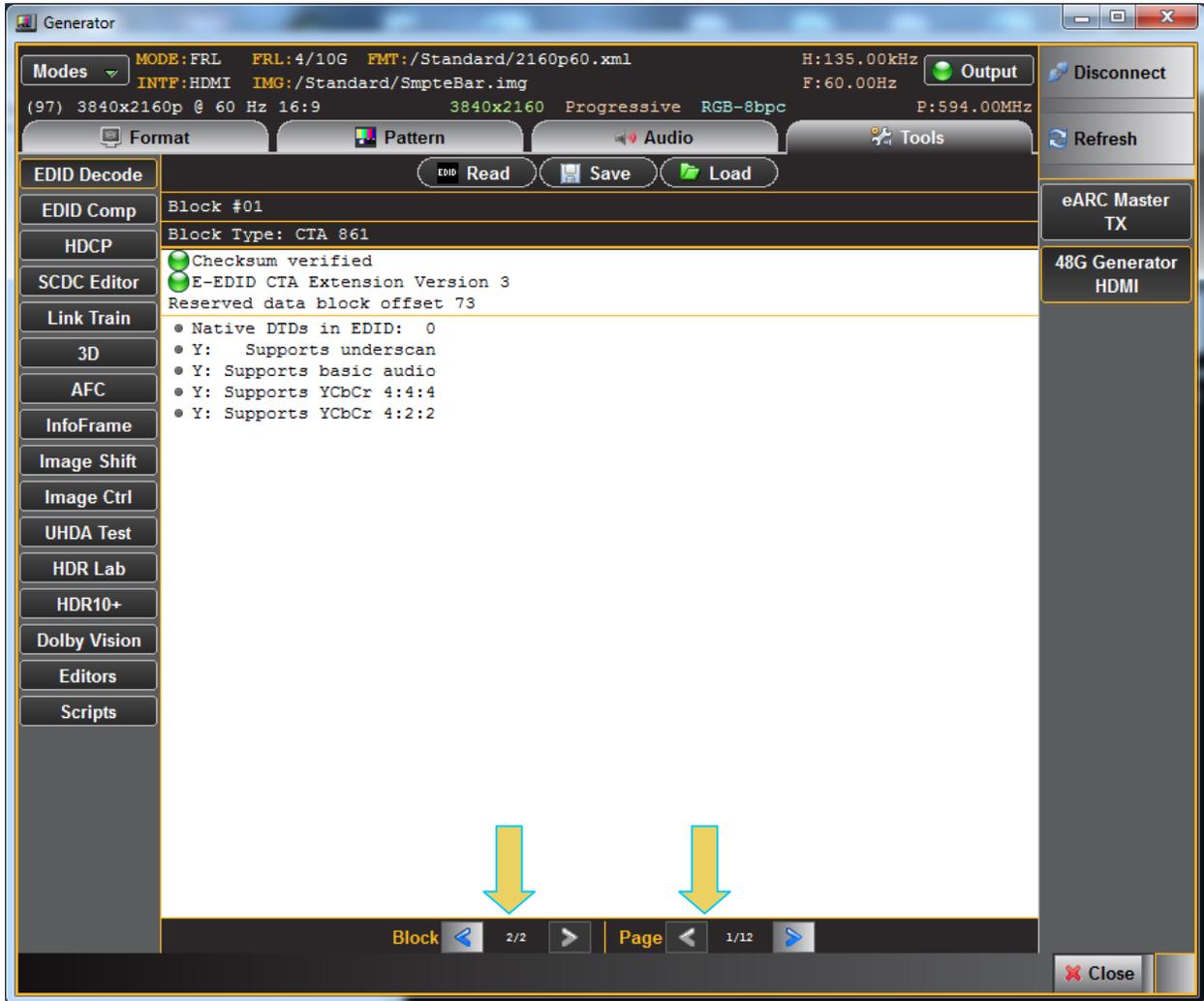
1. From the main window of the M41h 48G Video Analyzer/Generator, select the **Tools** tab.
2. Activate the **EDID Decode** button on the upper left (indicated below).

Contents of the initial data in the first block of the EDID will be displayed (below).

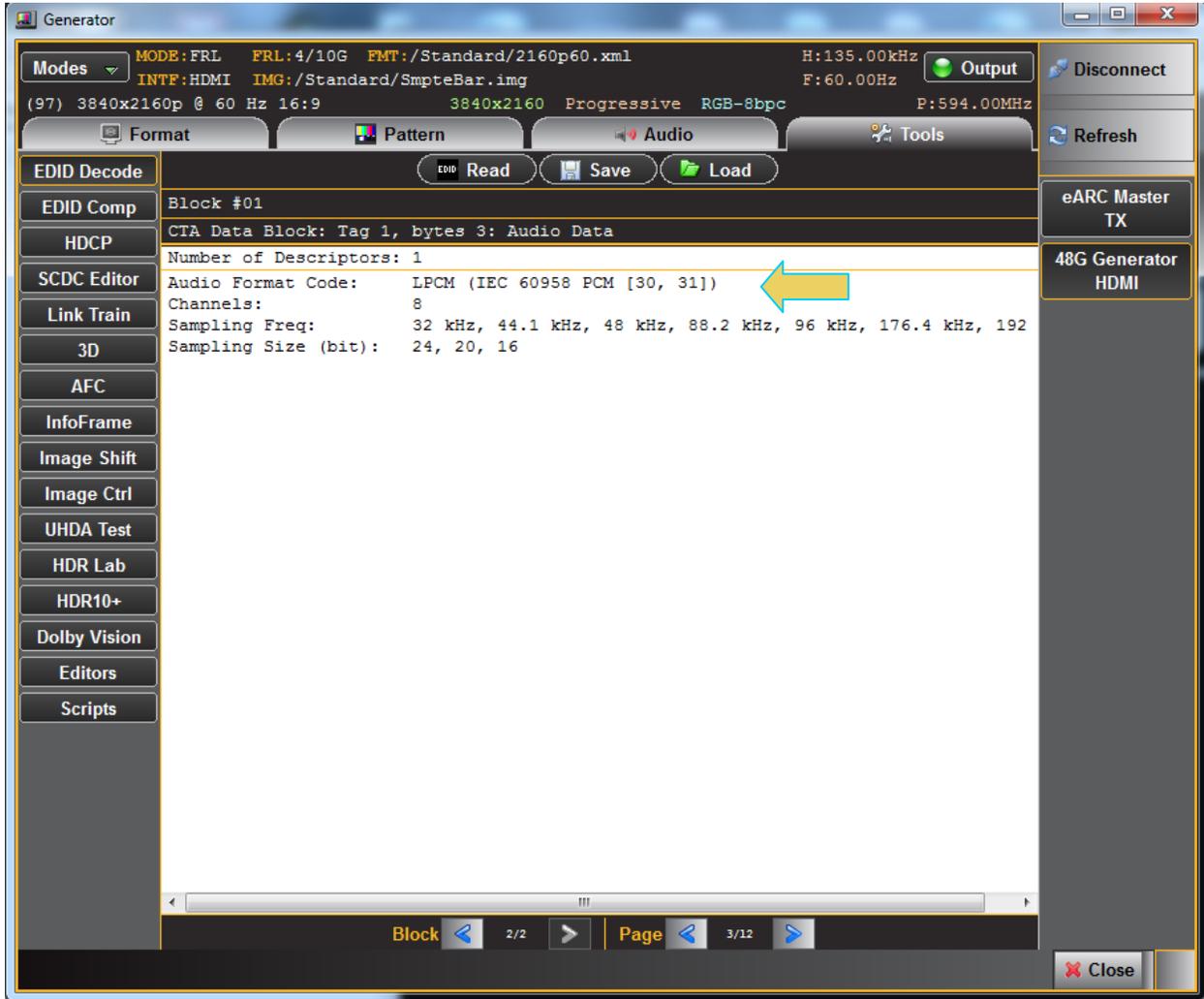


Navigate through the blocks and pages of the EDID using the arrow buttons on the lower panel (indicated above).

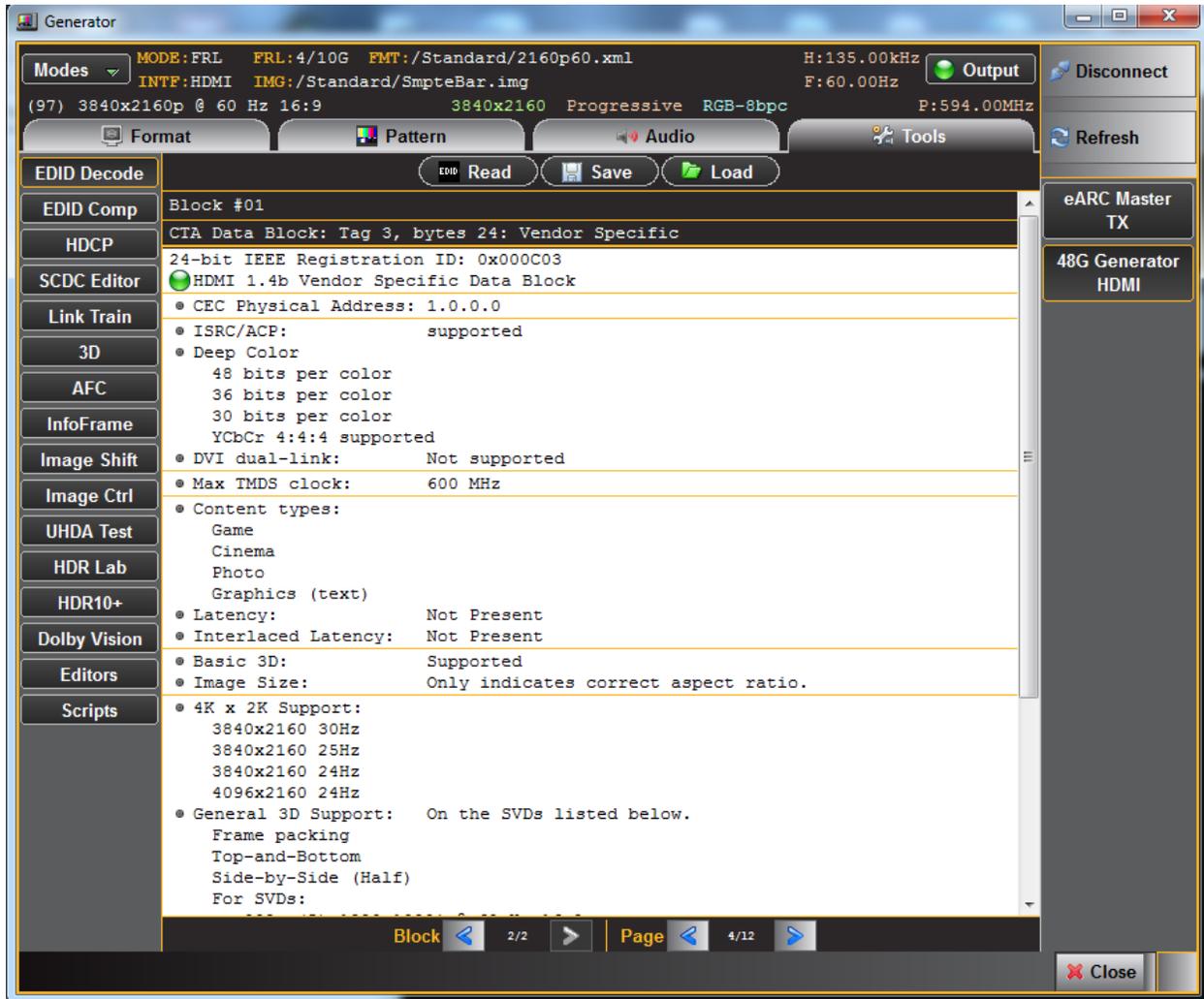
Examples of the **EDID Decode** content are shown in the following screens.



The CEA Audio Block is shown below.



The CEA Vendor Specific Data Block is shown below.

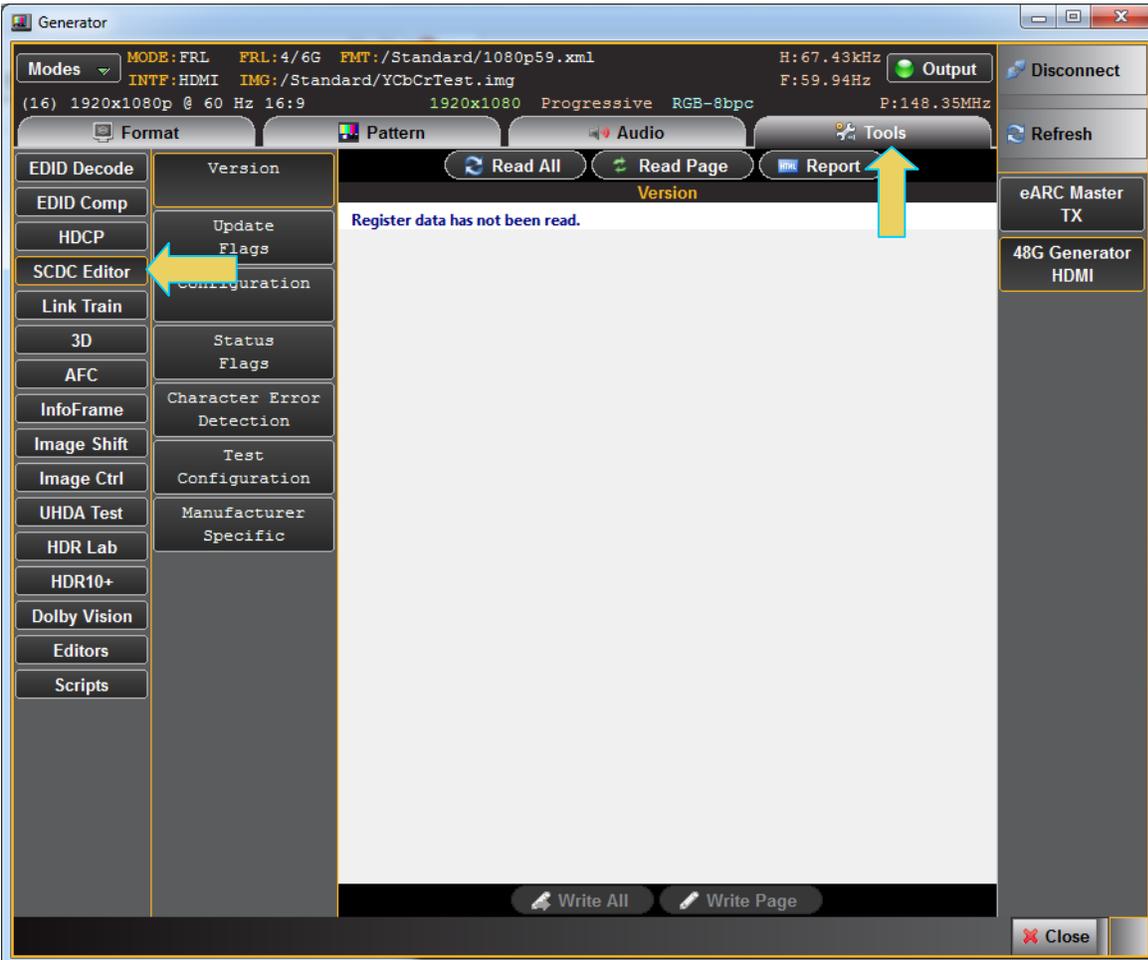


11.16 Viewing the SCDC register contents of a connected display

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 the Tx port.

To view the SCDC register contents of a connected display:

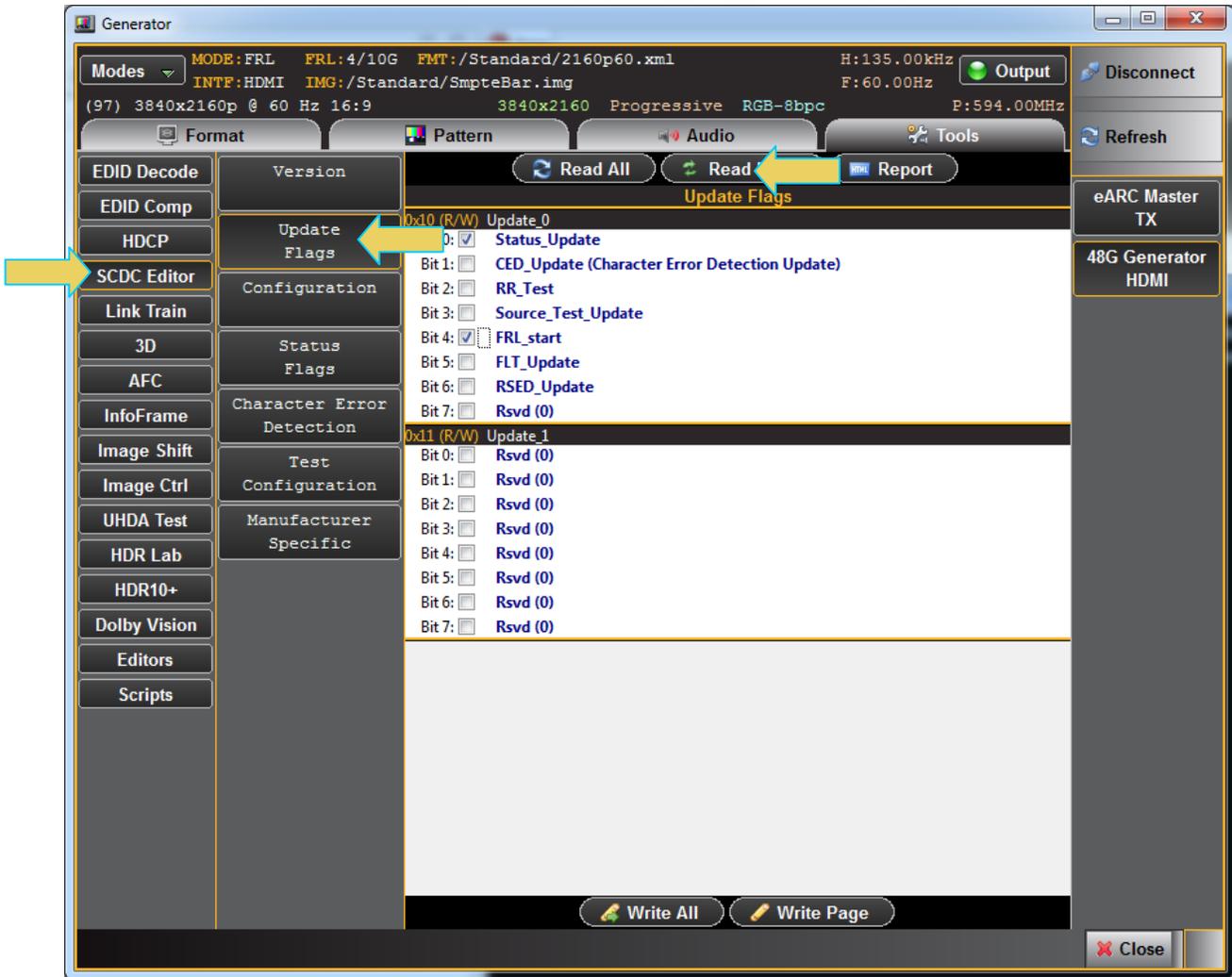
1. From the main window of the M41h 48G Video Analyzer/Generator, select the **Tools** tab.



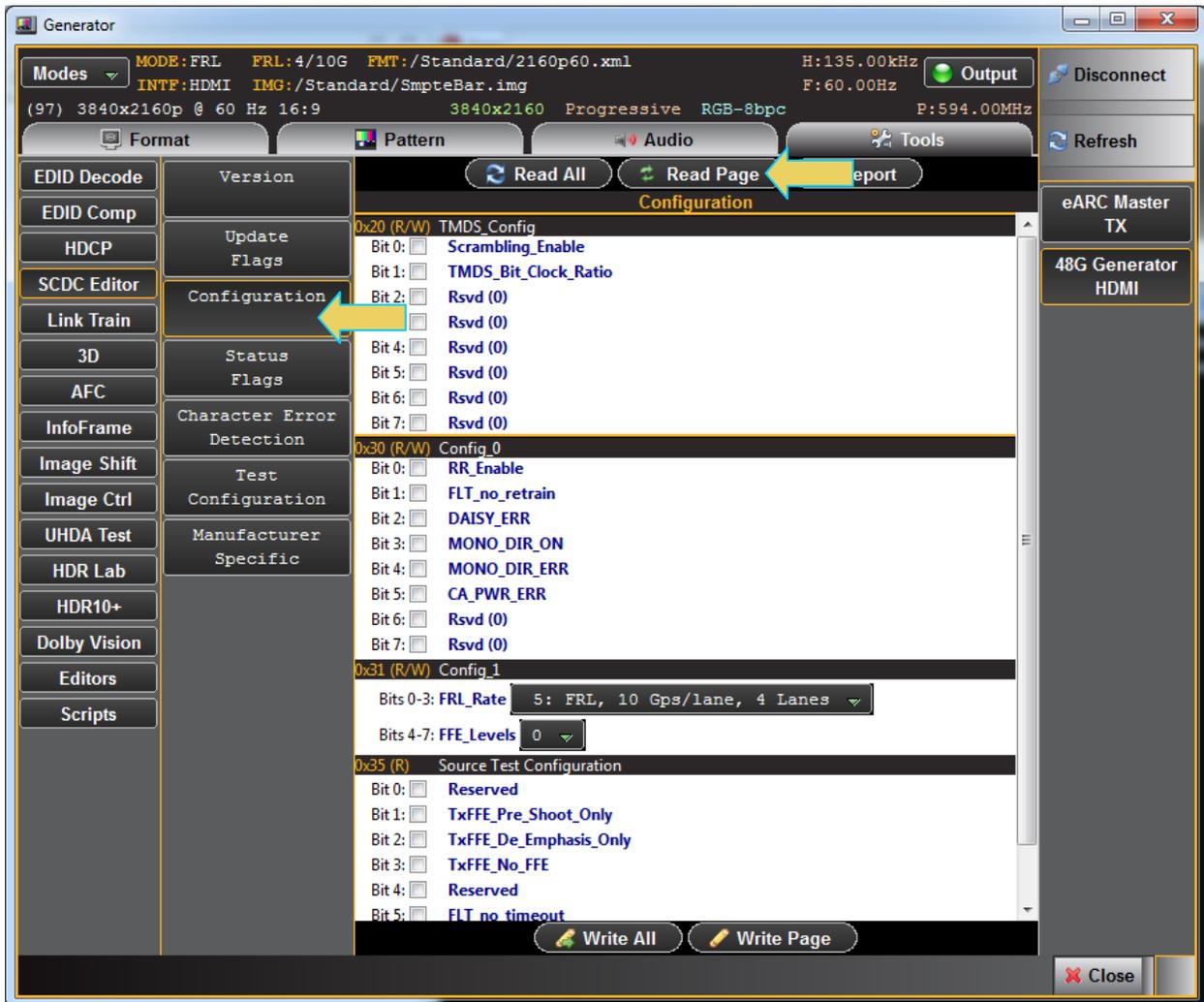
Make sure the M41h 48G Video Analyzer/Generator is selected.

2. Activate the **SCDC Decode** button on the upper left (indicated below).
3. Select a register set to view (example Update Flags)
4. Select **Read All** or **Read Page**.

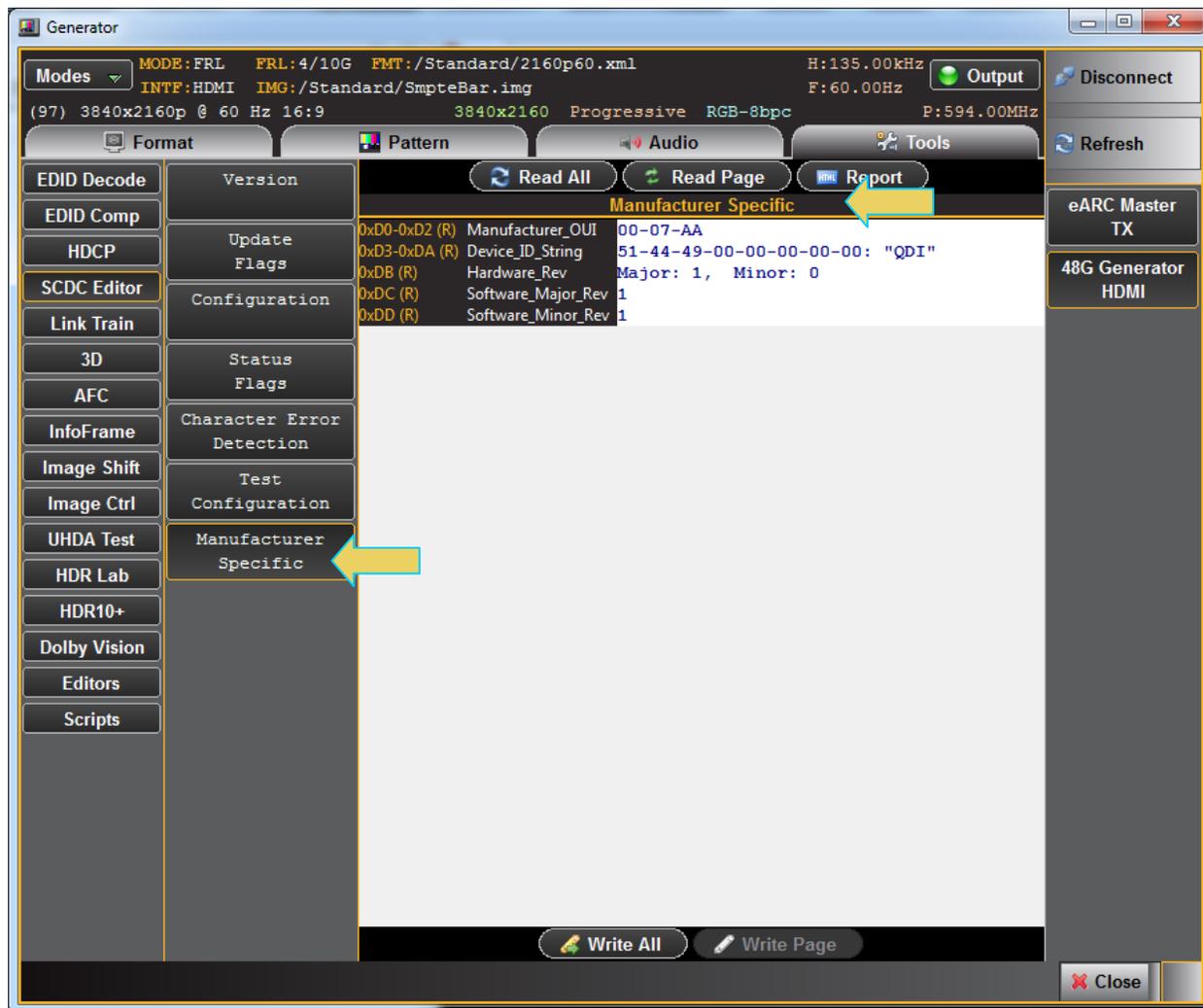
The following screen example shows the SCDC Update Flags. (No data is shown in the following screen example.)



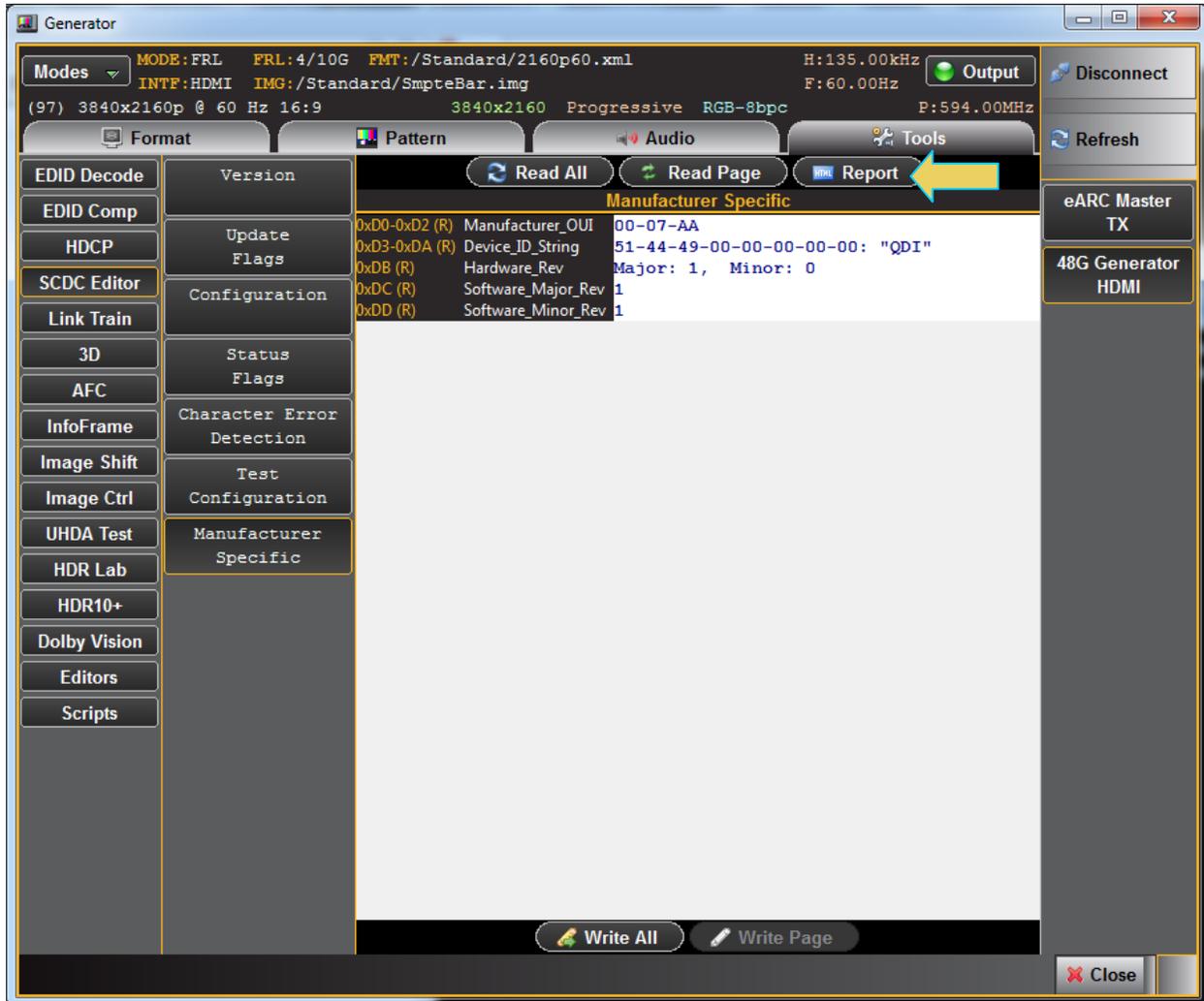
The following screen example shows the SCDC Status Flags. (No data is shown in the following screen example.)



The following screen example shows the SCDC Manufacturing Specific data.



5. (Optionally) issue an HTML report with the Report activation button as shown below.



11.17 Selecting audio formats

Use the following procedures to select HDMI formats.

To select an audio format:

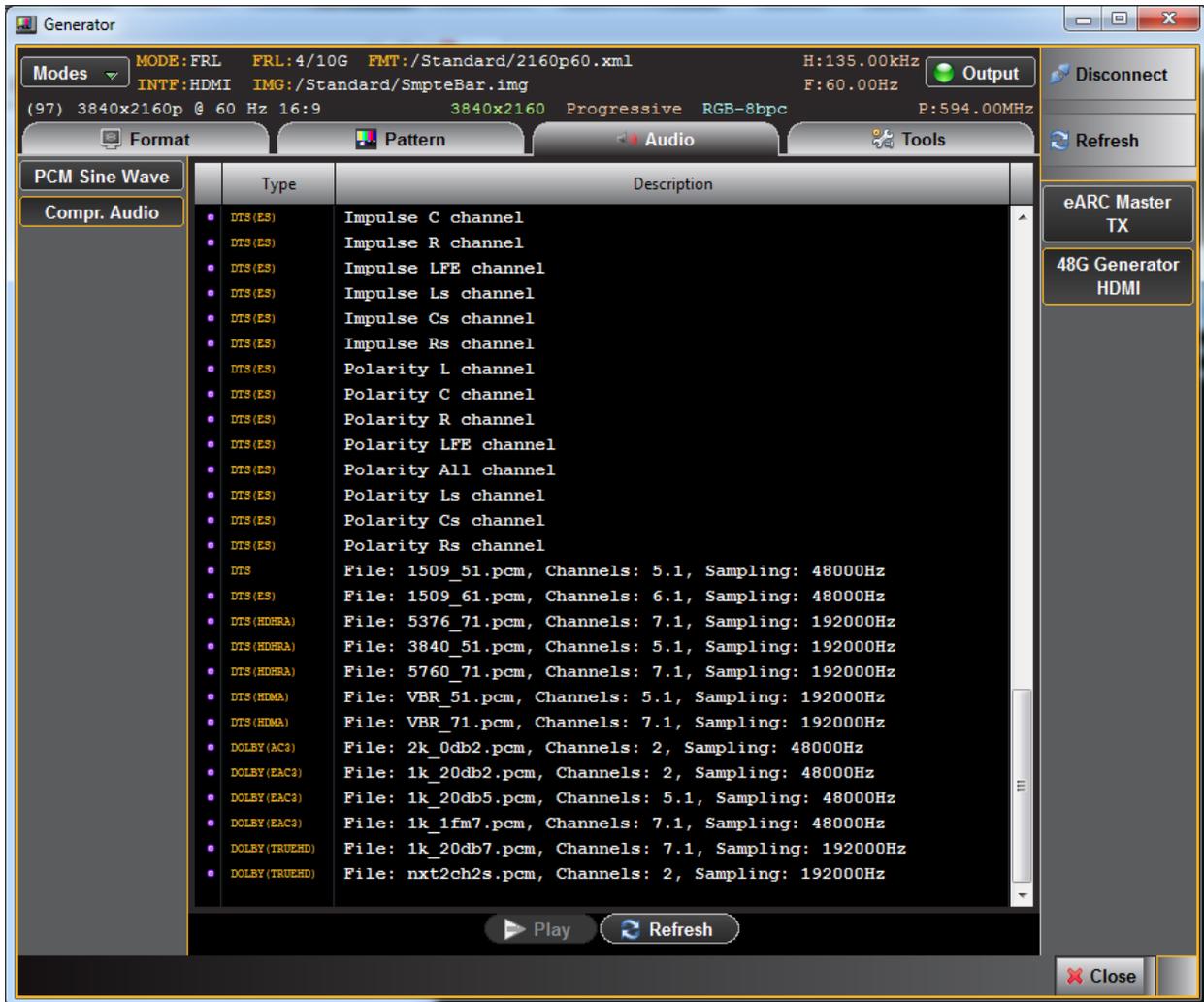
- From the main window of the M41h 48G Video Analyzer/Generator, select the **Audio** tab indicated below. The following example shows LPCM selection. The second slide shows selection of compressed audio formats.



The screenshot shows the 'Generator' application window. At the top, it displays configuration details: MODE:FRL, FRL:4/10G, FMT:/Standard/2160p60.xml, H:135.00kHz, INTF:HDMI, IMG:/Standard/SmpteBar.img, F:60.00Hz, and a green 'Output' indicator. Below this, it shows '(97) 3840x2160p @ 60 Hz 16:9' and '3840x2160 Progressive RGB-8bpc P:594.00MHz'. On the right side, there are 'Disconnect' and 'Refresh' buttons, and a section for 'eARC Master TX' and '48G Generator HDMI'. The main area is a table of audio test patterns:

Type	Description
DOLBY (AC3)	Pink Noise 500-2kHz L channel
DOLBY (AC3)	Pink Noise 500-2kHz C channel
DOLBY (AC3)	Pink Noise 500-2kHz R channel
DOLBY (AC3)	Pink Noise 500-2kHz Cycle channels
DOLBY (AC3)	Pink Noise 500-2kHz LFE channel
DOLBY (AC3)	Pink Noise 500-2kHz All channels
DOLBY (AC3)	Pink Noise 500-2kHz Ls channel
DOLBY (AC3)	Pink Noise Rs channel
DOLBY (AC3)	Pink Noise 20-20kHz L channel
DOLBY (AC3)	Pink Noise 20-20kHz C channel
DOLBY (AC3)	Pink Noise 20-20kHz R channel
DOLBY (AC3)	Pink Noise 20-20kHz pulse ???
DOLBY (AC3)	Pink Noise 20-20kHz LFE
DOLBY (AC3)	Pink Noise 20-20kHz Ls channel
DOLBY (AC3)	Pink Noise 20-20kHz Rs channel
DOLBY (AC3)	Sine Wave 63Hz Cycle channels
DOLBY (AC3)	Sine Wave 63Hz All channels
DOLBY (AC3)	Sine Wave 125Hz Cycle channels
DOLBY (AC3)	Sine Wave 125Hz All channels
DOLBY (AC3)	Sine Wave 1kHz Cycle channels
DOLBY (AC3)	Sine Wave 1kHz All channels
DOLBY (AC3)	Sine Wave 4kHz Cycle channels
DOLBY (AC3)	Sine Wave 4kHz All channels
DOLBY (AC3)	Impulse L channel
DOLBY (AC3)	Impulse C channel
DOLBY (AC3)	Impulse R channel
DOLBY (AC3)	Impulse LFE channel
DOLBY (AC3)	Impulse Ls channel

At the bottom of the table area are 'Play' and 'Refresh' buttons. In the bottom right corner, there is a 'Close' button. A yellow arrow on the left points to the 'Compr. Audio' button in the sidebar.



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.	<ul style="list-style-type: none"> • 2.1 • 2.1 • 5.1 • 6.1 • 7.1
Sampling Rate	This is the sampling rate of the audio sine wave test tone.	<ul style="list-style-type: none"> • 32kHz • 44.1kHz • 48kHz • 88.2kHz • 96kHz • 176.4kHz

LPCM Programmable Sine Wave options		
Parameter	Description	Options
		<ul style="list-style-type: none"> • 192kHz
Bits per Sample	This is the number of bits per channel of the audio sine wave test tone.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Increments in 3dB throughout a range of – 0dB to -99dB (per channel).
Mute	Mutes or unmutes the audio for a particular channel.	<ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 1Hz • 10Hz • 100Hz • 1kHz

11.18 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 image is selectable through the **Pattern** tab.

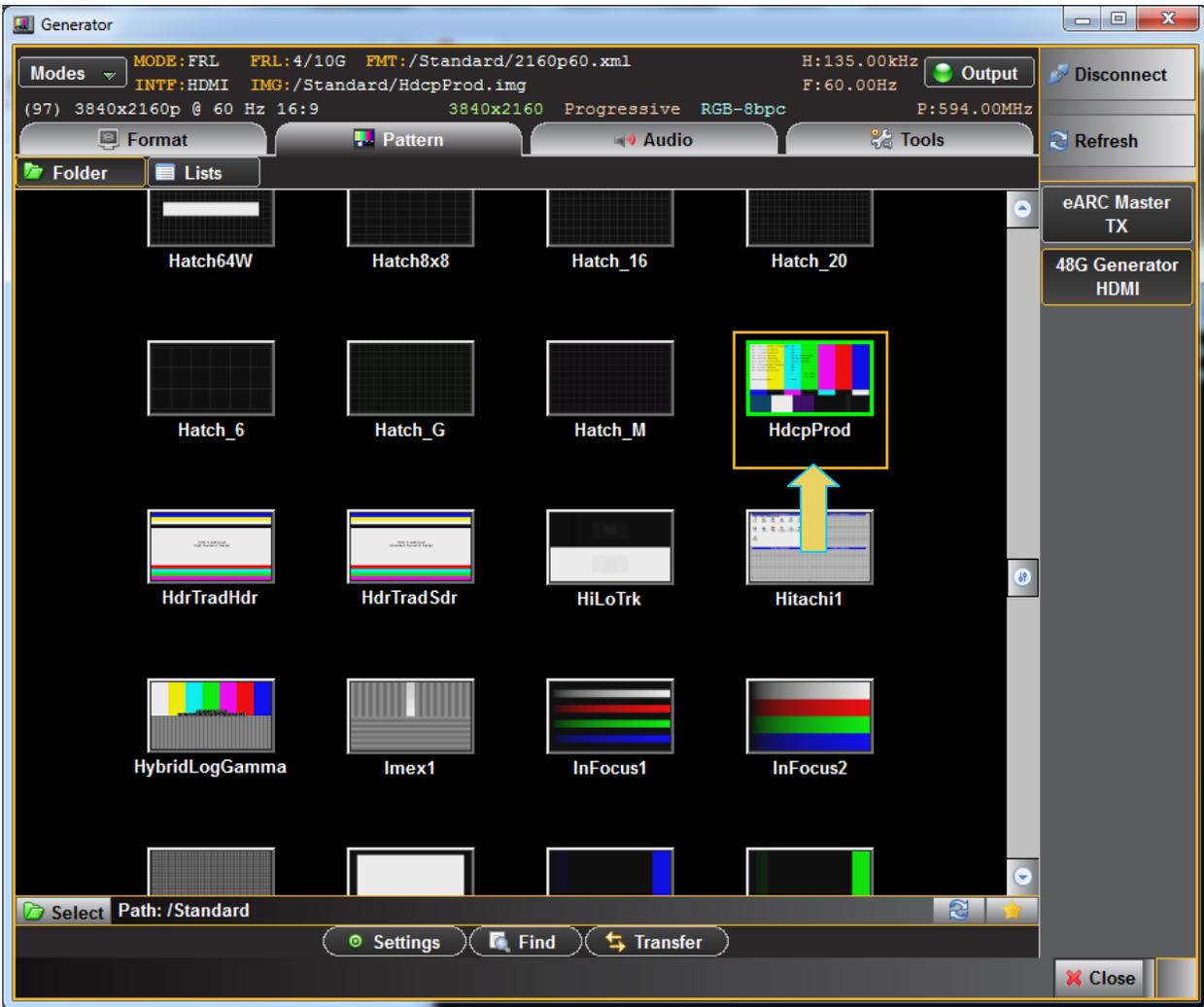
Note that you can view the HDCP 2.2 authentication transactions using the Auxiliary Channel Analyzer (ACA) utility. Please refer to [Auxiliary Channel Analyzer \(ACA\)](#) for more details.

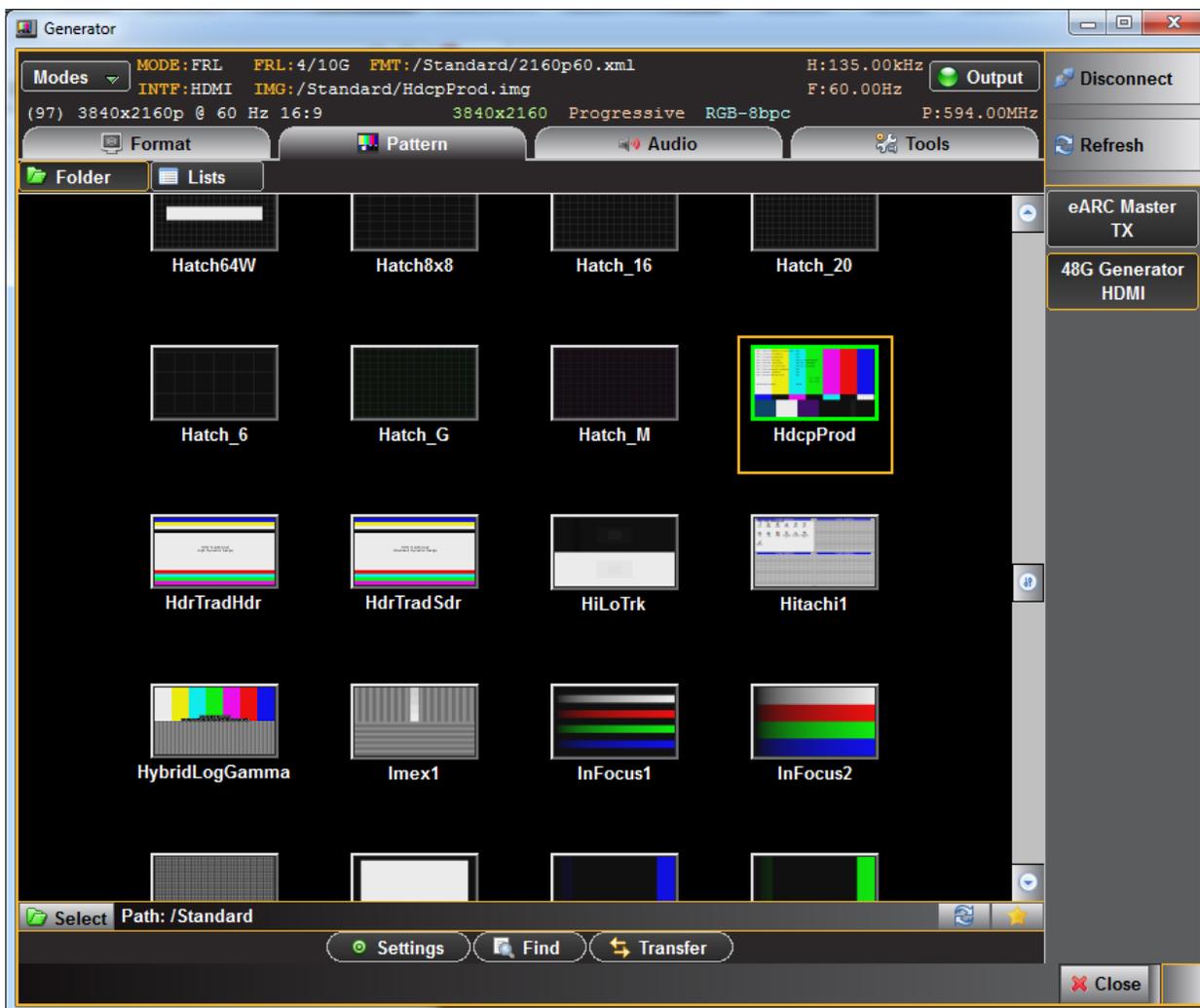
11.18.1 Running the HDCP 2.2 test

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):

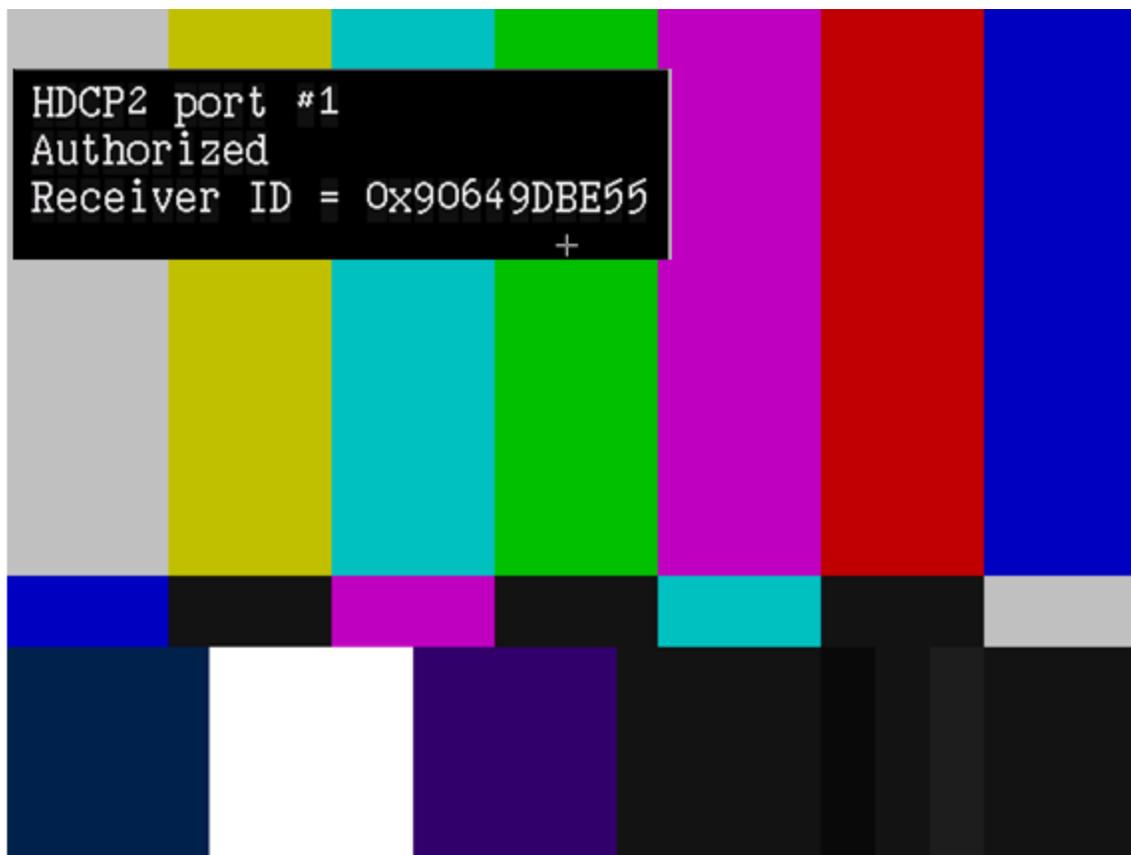
1. Access the **Pattern** tab to view the test patterns.





2. 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.

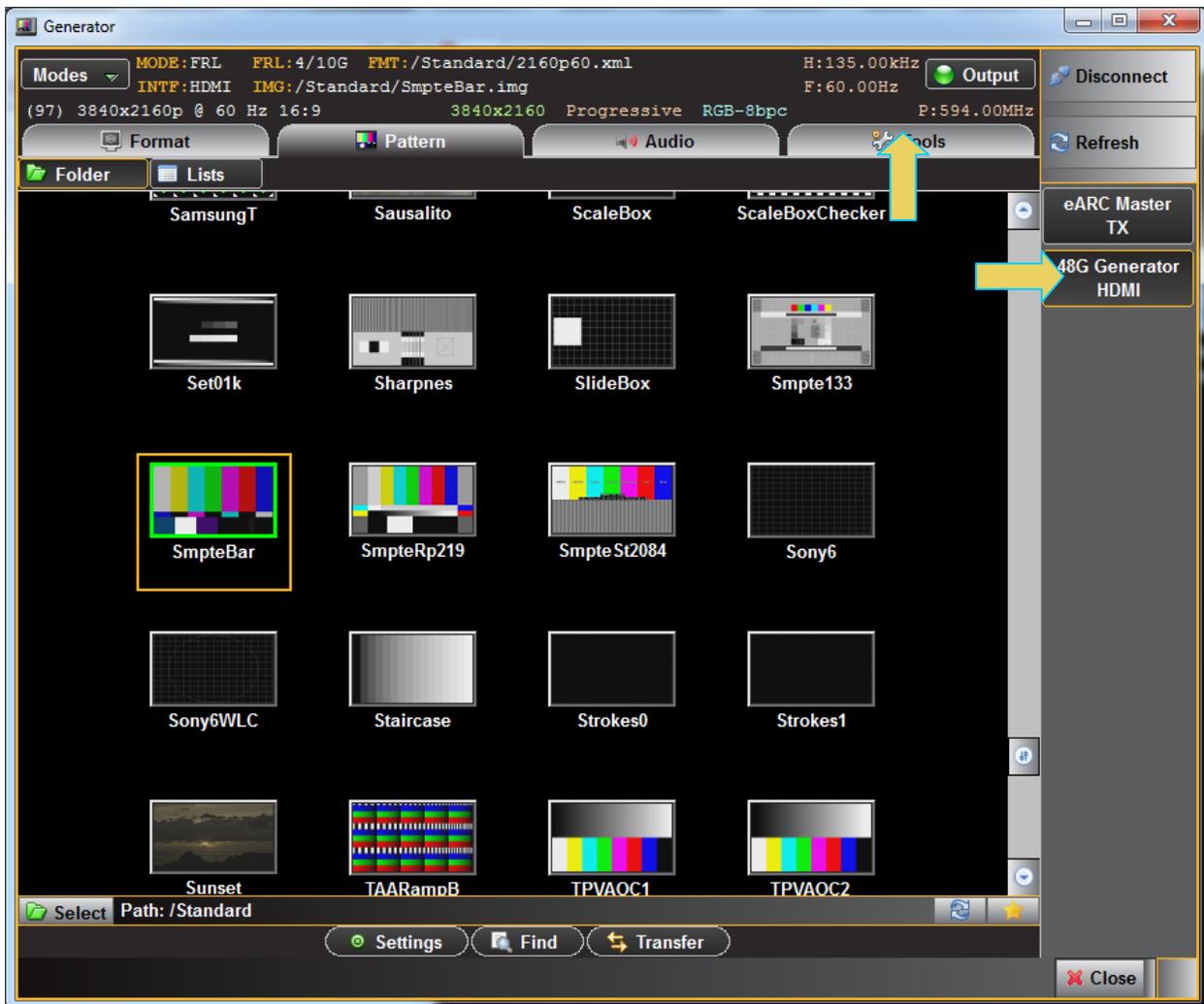
To test HDCP on a connected display (HDCP Tx Control Dialog Box):

1. From the **View** menu, enable select the **Generator** item.



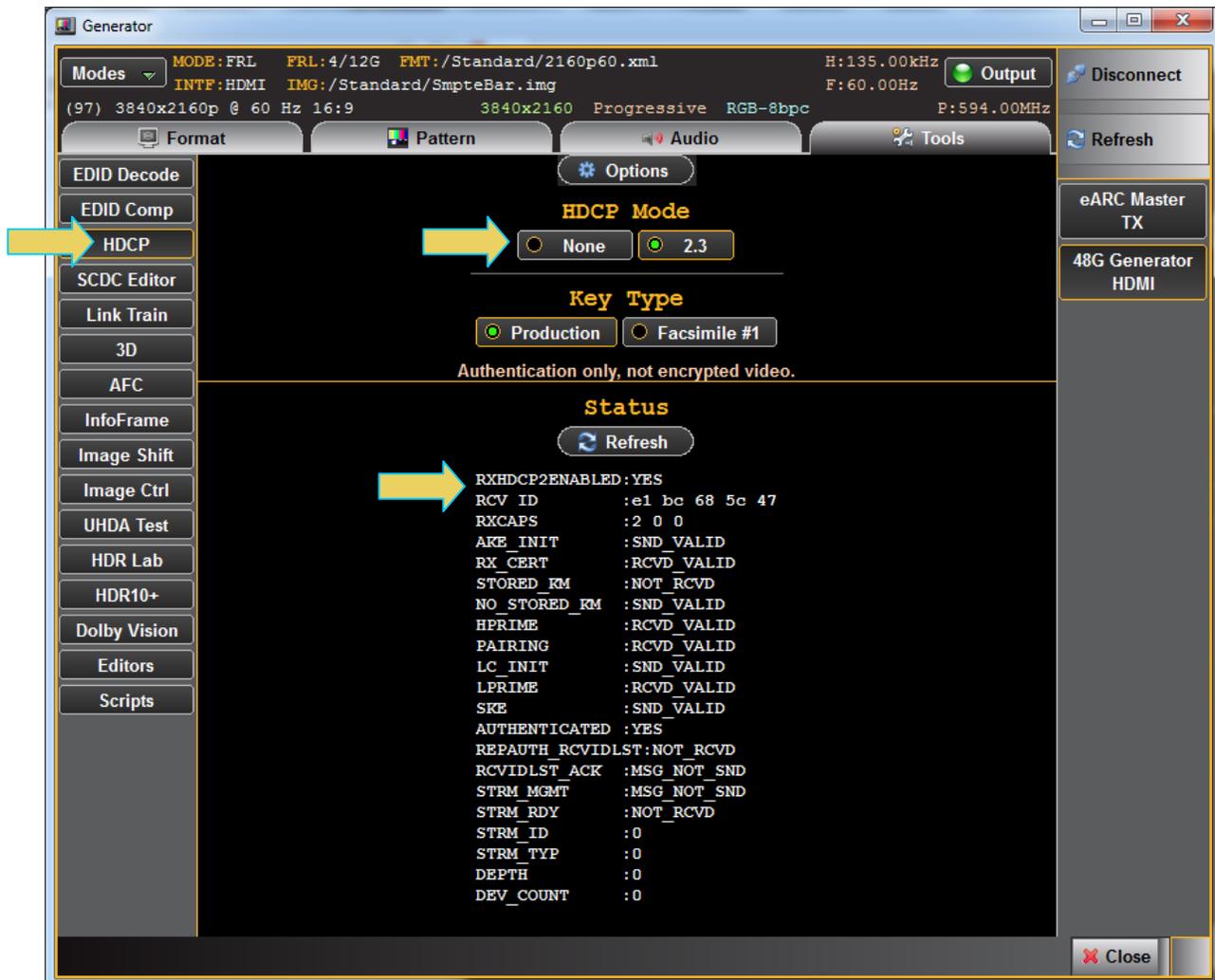
The **Generator** panel will be populated as shown below.

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.

11.18 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.

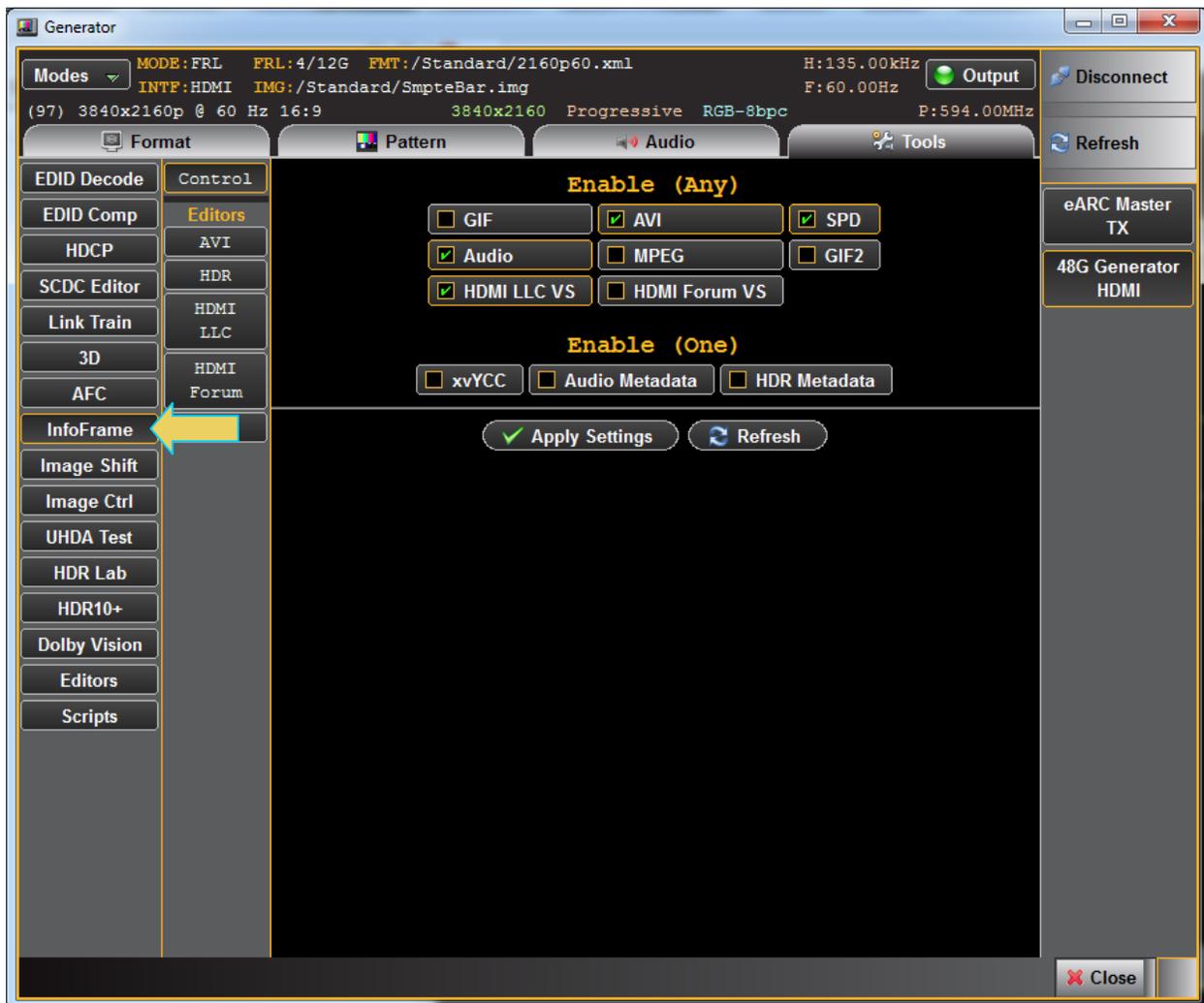
- Gamut Metadata Packet (xvYCC) – Enable or disable transmission of this data island.
- High Dynamic Range (HDR) – Enable or disable transmission and configure custom values.
- Audio Metadata – Enable or disable transmission of this metadata for 3D audio and multi-stream audio.

11.18.1 Configuring Metadata for Transmission

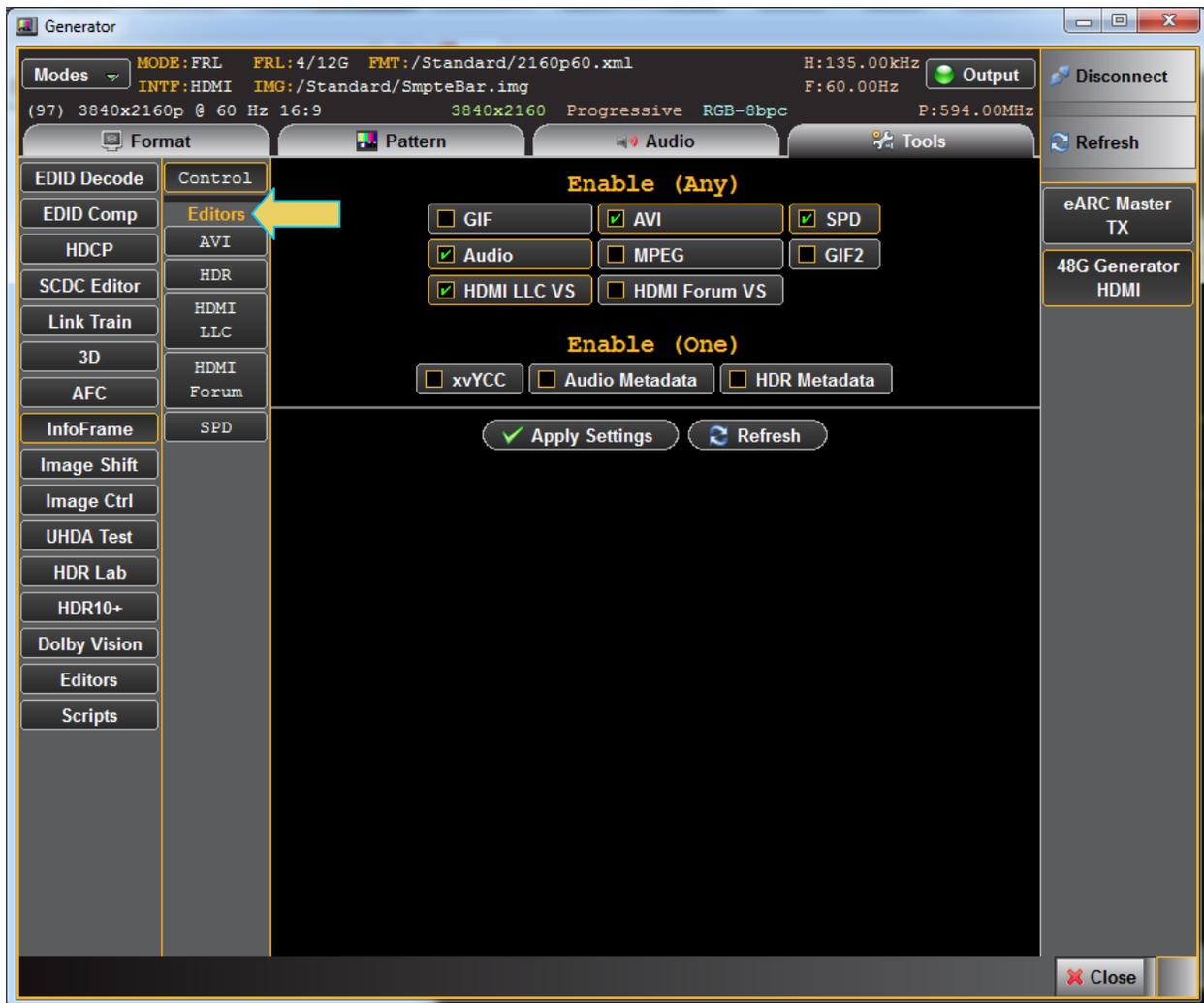
Use the procedures below to enable/disable the transmission of metadata and configure custom metadata values.

To enable/disable transmission of specific metadata types:

1. Access **InfoFrame** Utility from the **Tools** tab (below).



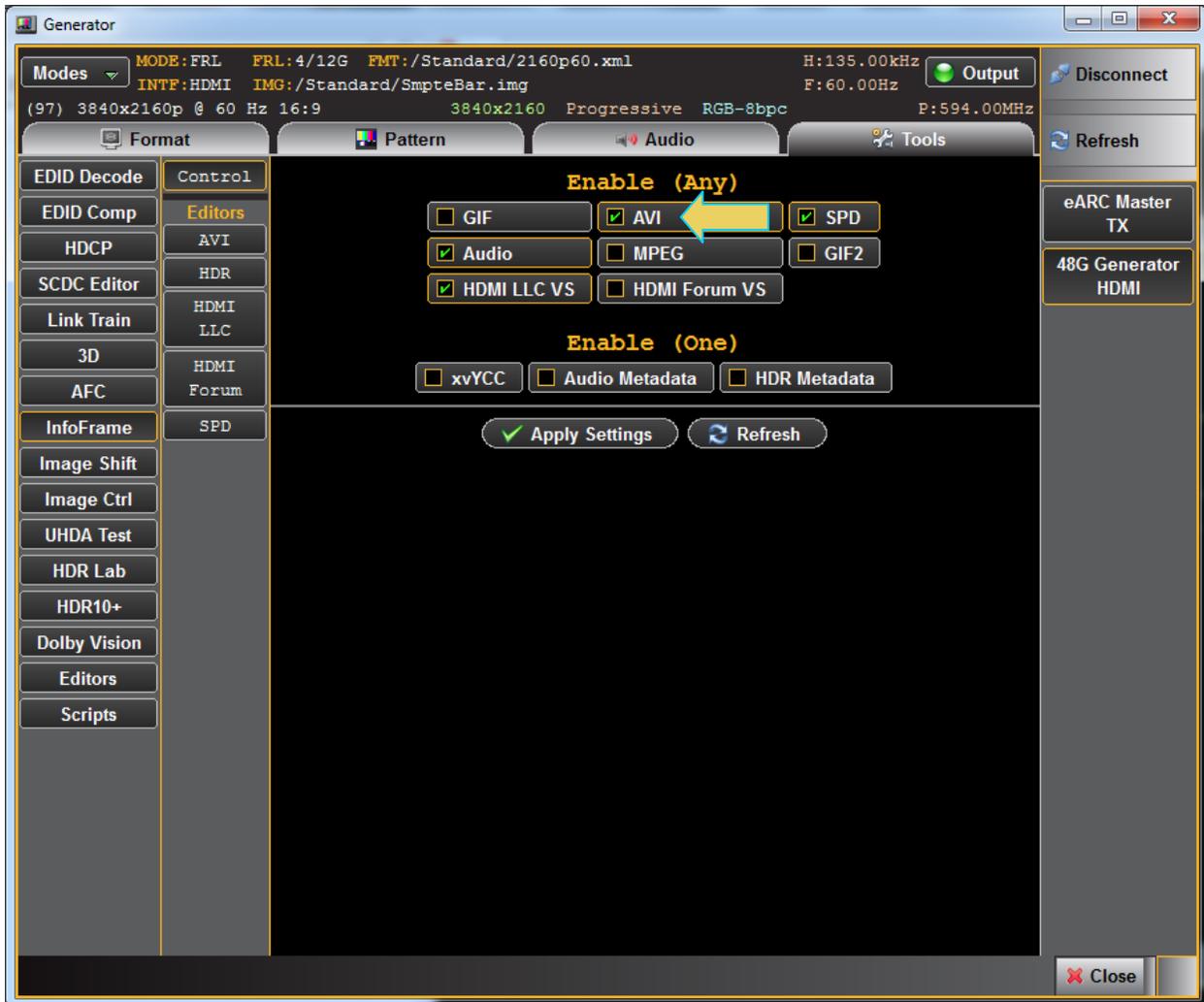
2. Select the **Control** button on the left side as indicated below.



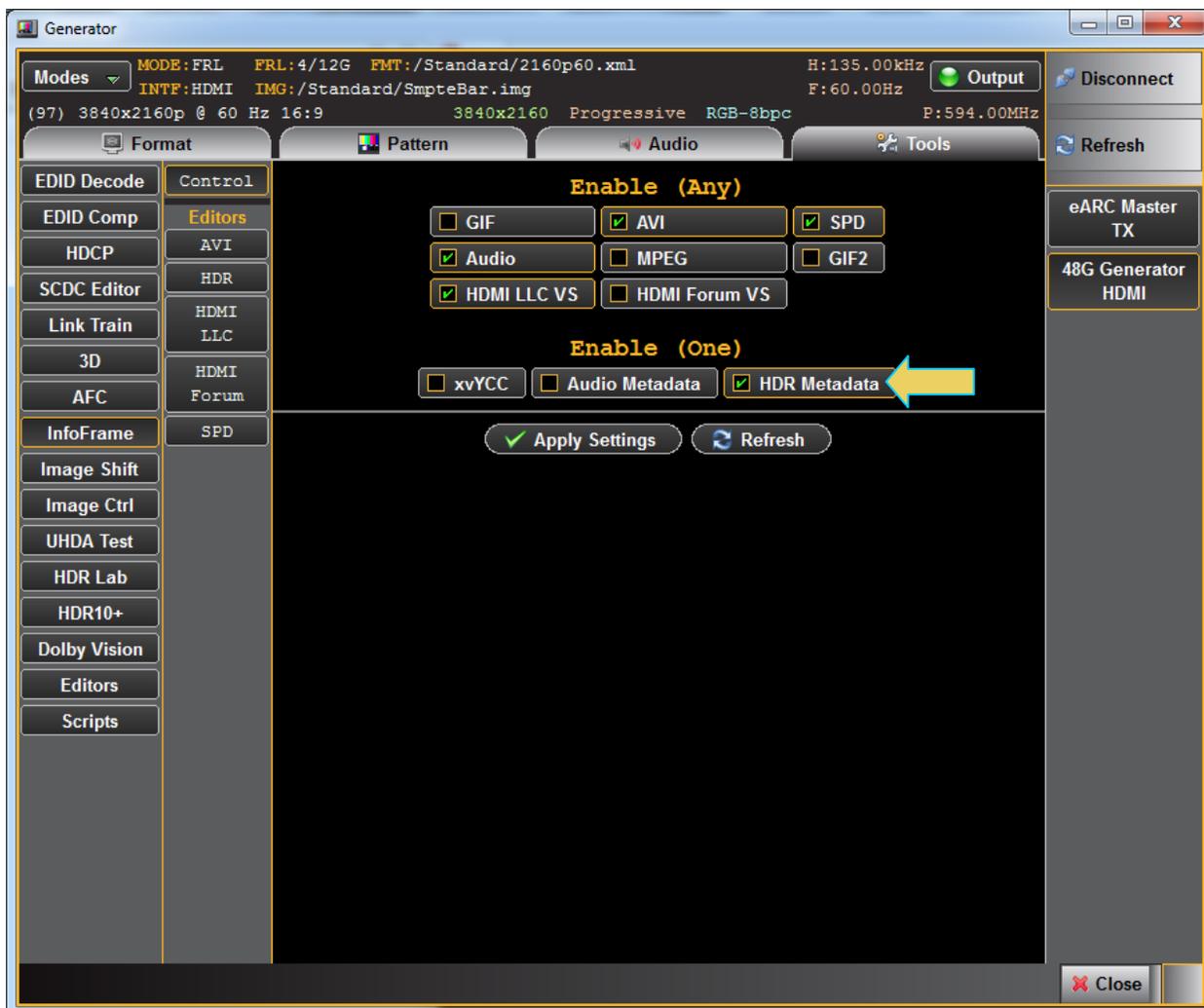
3. Select the metadata types that you wish to enable or disable using the checkboxes under the **Enable (Any)** area of the **InfoFrame** Utility window.
4. Click on the **Apply Settings** activation button  to initiate the change.

Note: The **Refresh** button  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.



5. 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), only it will be transmitted and the other two types (xvYCC and Audio Metadata) will not.

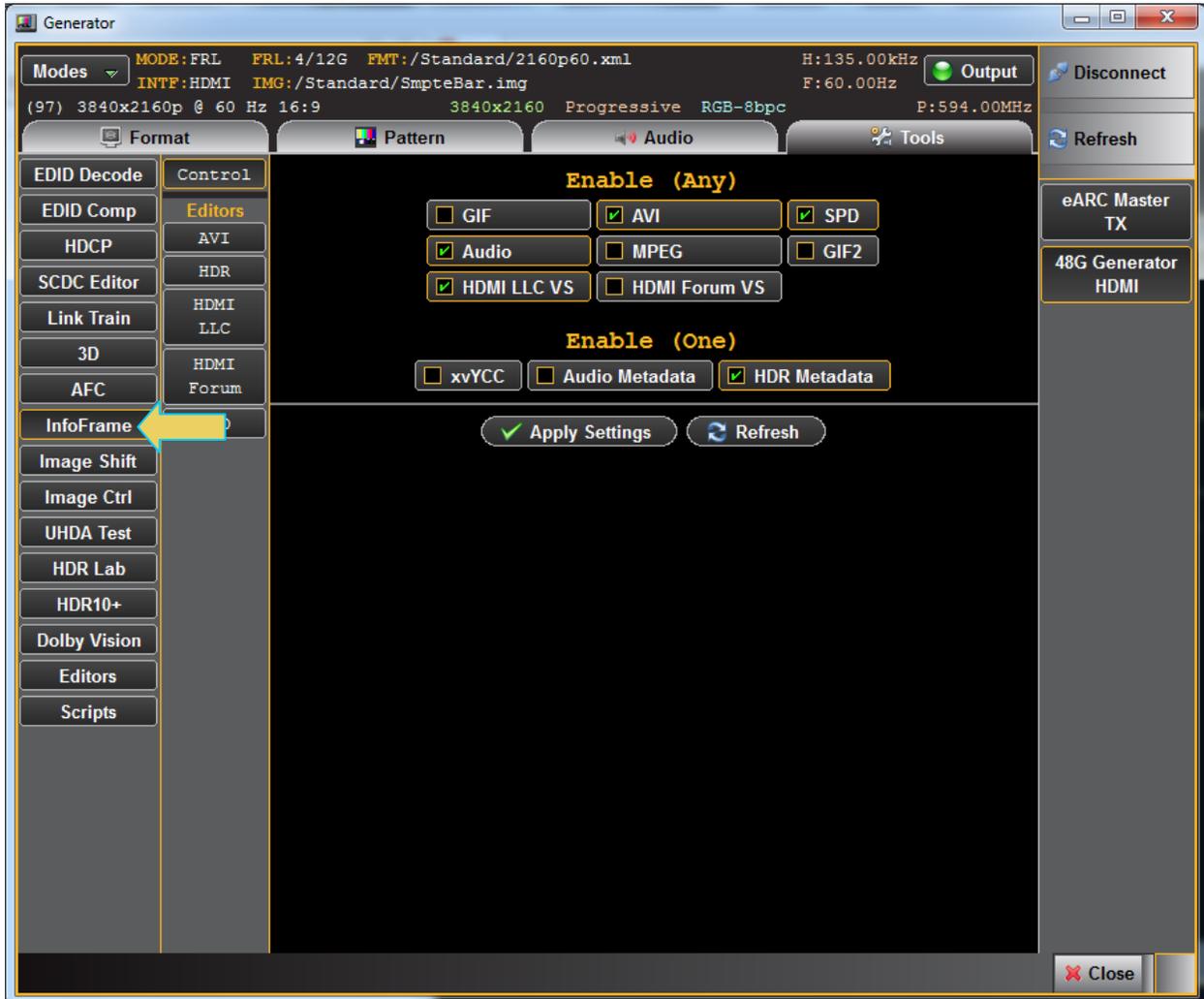


6. Click on the **Apply Settings** activation button  to initiate the change.

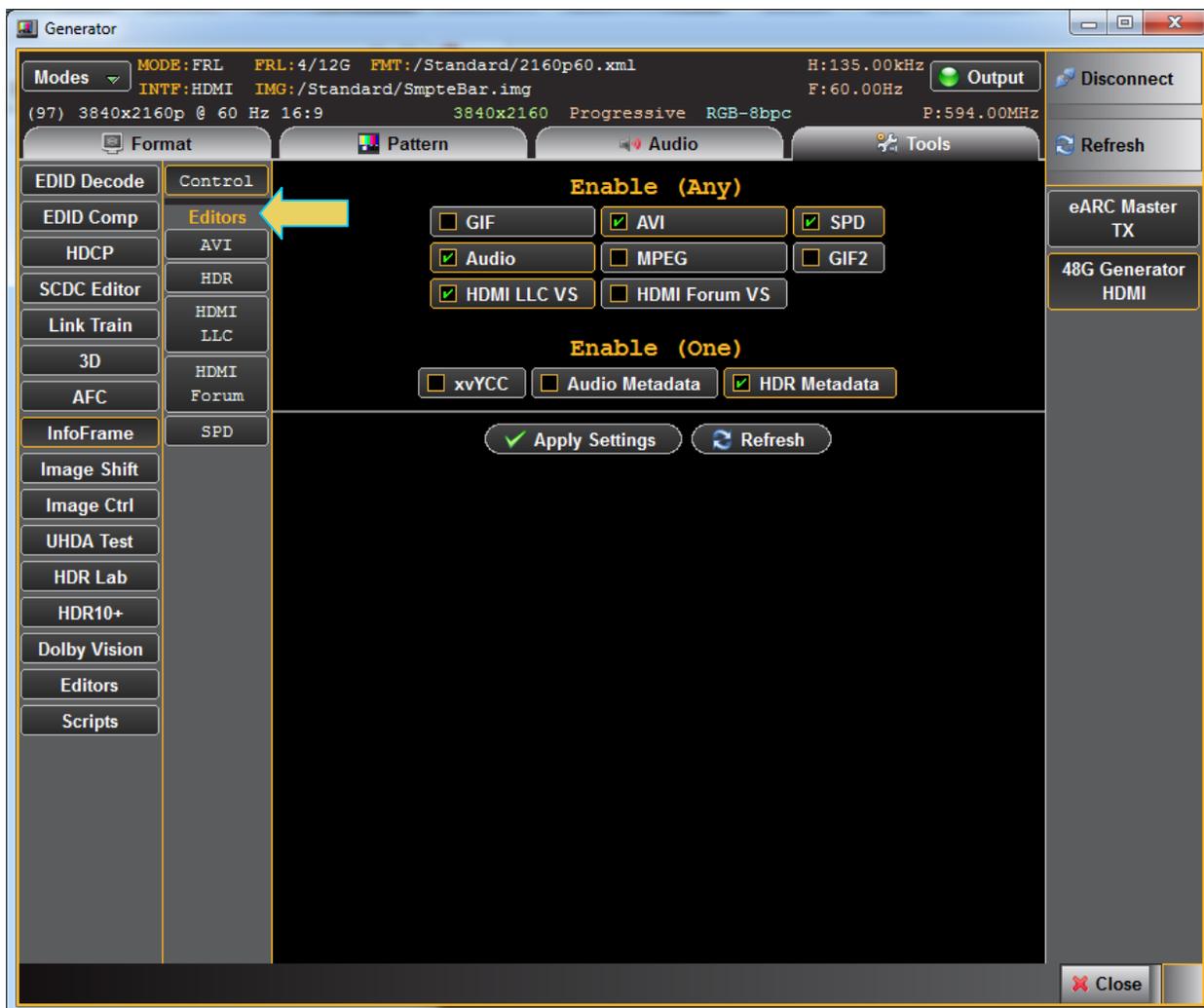
Note: The **Refresh** button  reasserts the default state with all applicable metadata transmitted.

To configure InfoFrame and metadata parameter values:

1. Access **InfoFrame** Utility from the **Tools** tab (below).

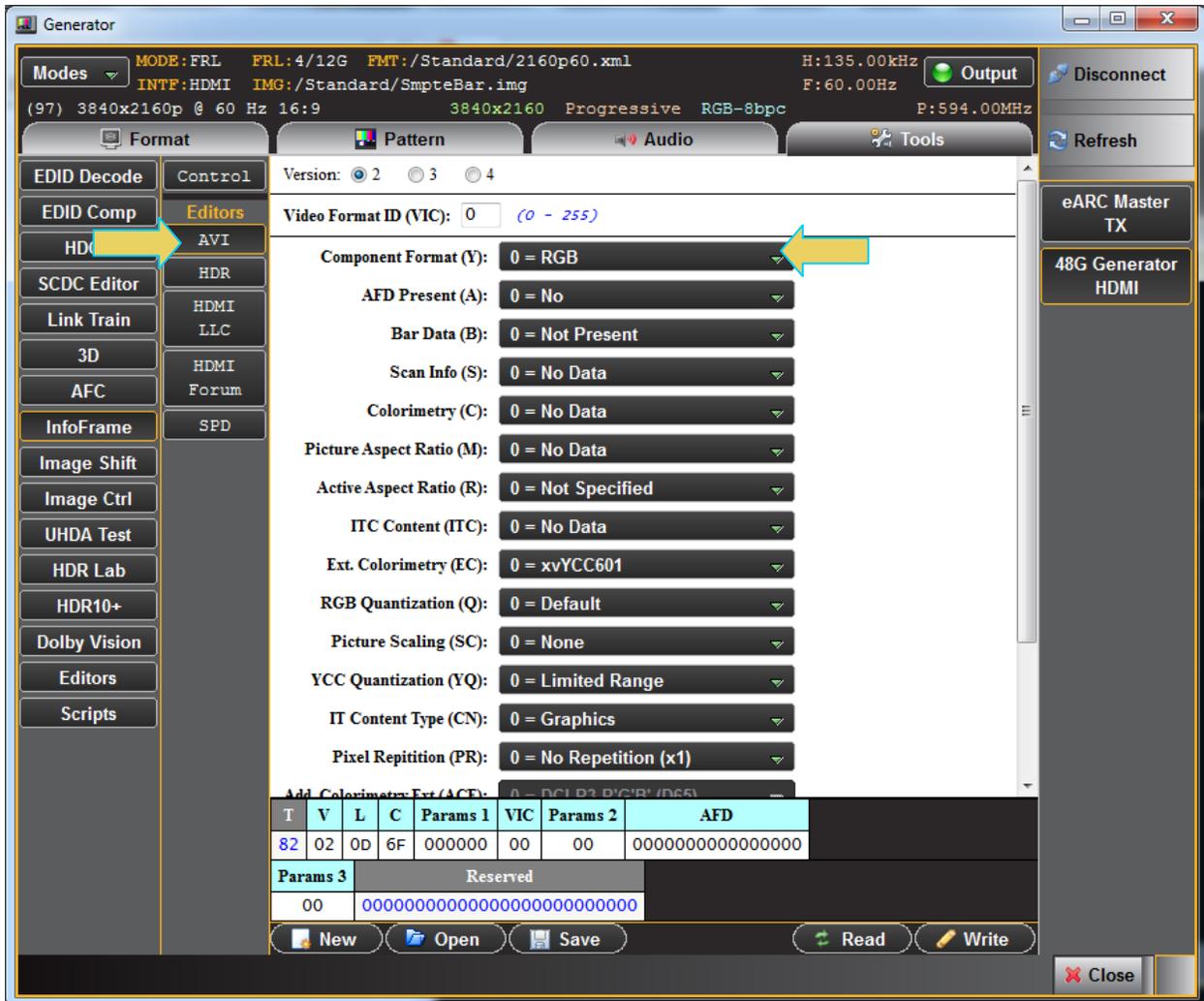


2. Select the **Control** button on the left side as indicated below.



In the example below, the AVI InfoFrame is being configured. In the two screens below the **Component Format** parameter is being changed from RGB to YCbCr 4:2:2.

Note: To activate the pull-down menu you have to double-click on the item.

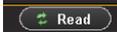


The pull-down meny for the Component Format is shown below.

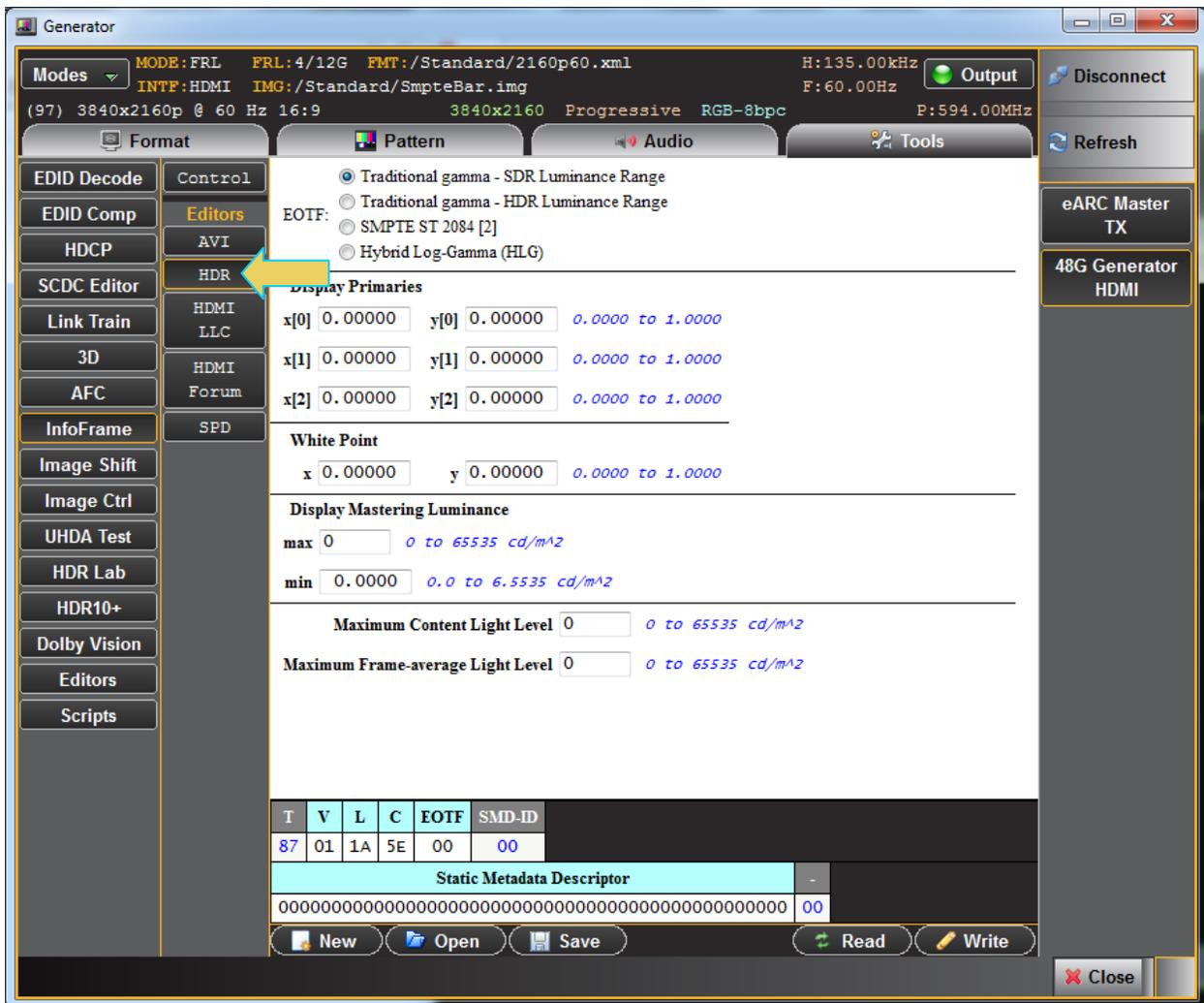
- 0 = RGB
- 1 = YCbCr-422
- 2 = YCbCr-444
- 3 = YCbCr-420
- 4 = Reserved
- 5 = Reserved
- 6 = Reserved
- 7 = IDO-Defined

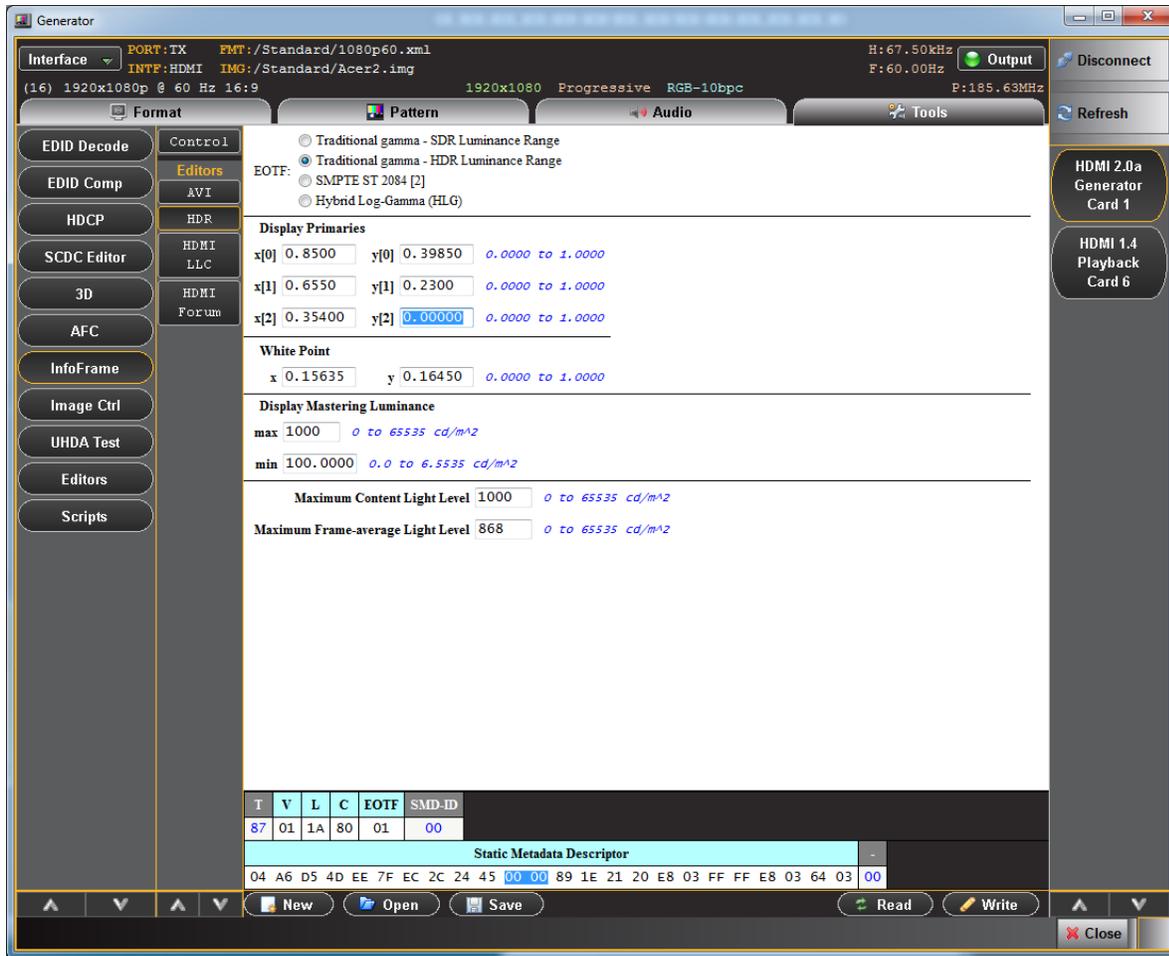
Select YCbCr 4:2:2 for example:

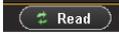
- 0 = RGB
- 1 = YCbCr-422
- 2 = YCbCr-444
- 3 = YCbCr-420
- 4 = Reserved
- 5 = Reserved
- 6 = Reserved
- 7 = IDO-Defined

3. Click on the **Write** activation button  to initiate the change and the transmission. The **Reset** button  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  to initiate the change and the transmission of the new HDR values. Click on the **Reset** button  to re-establish the default configuration.

11.19 Viewing Metadata Packets Transmitted to a Connected Display

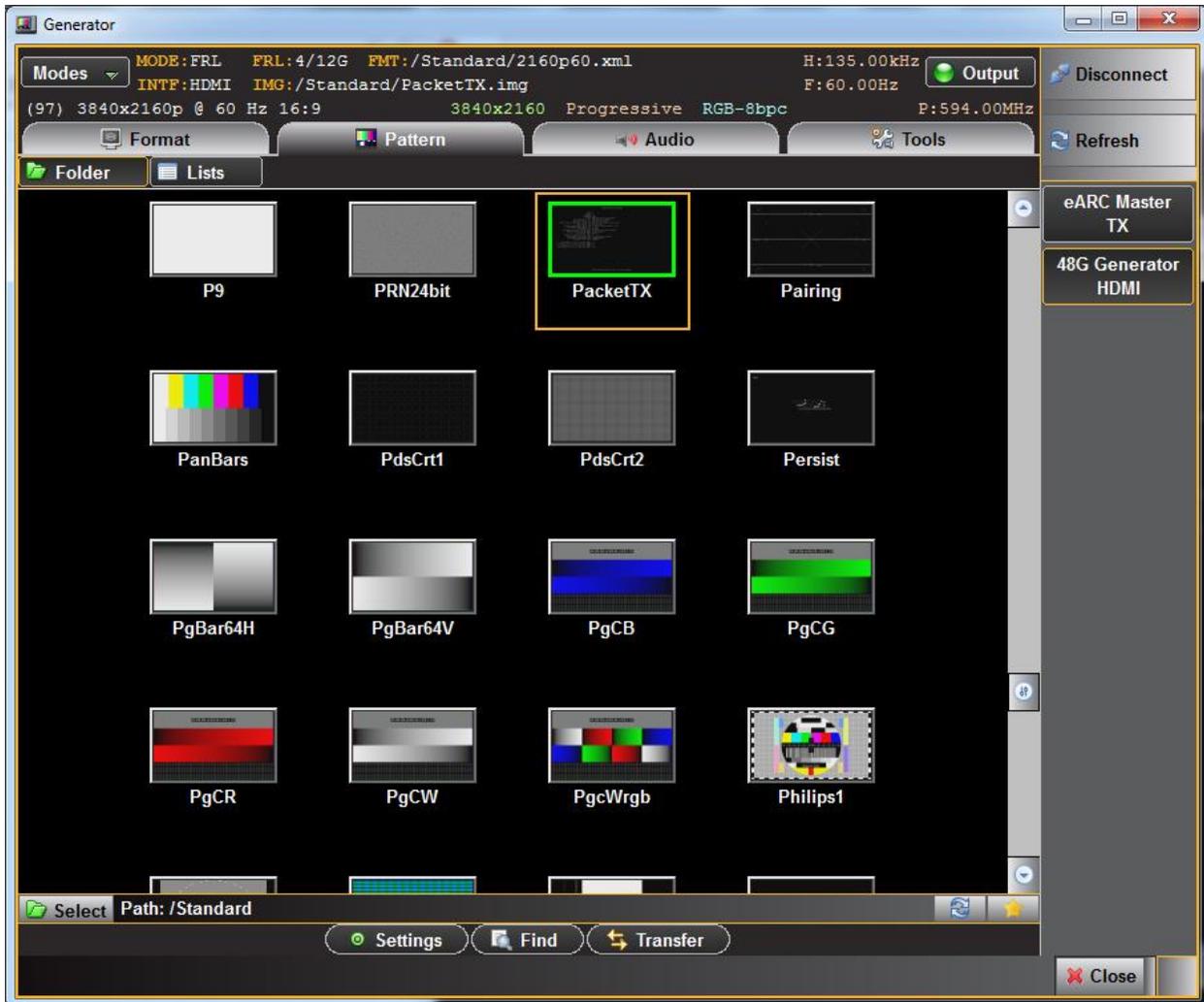
Use the following procedures to view the HDMI metadata packets transmitted to your display under test. The test image used to view the metadata is selectable through the **Pattern** tab.

11.19.1 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.

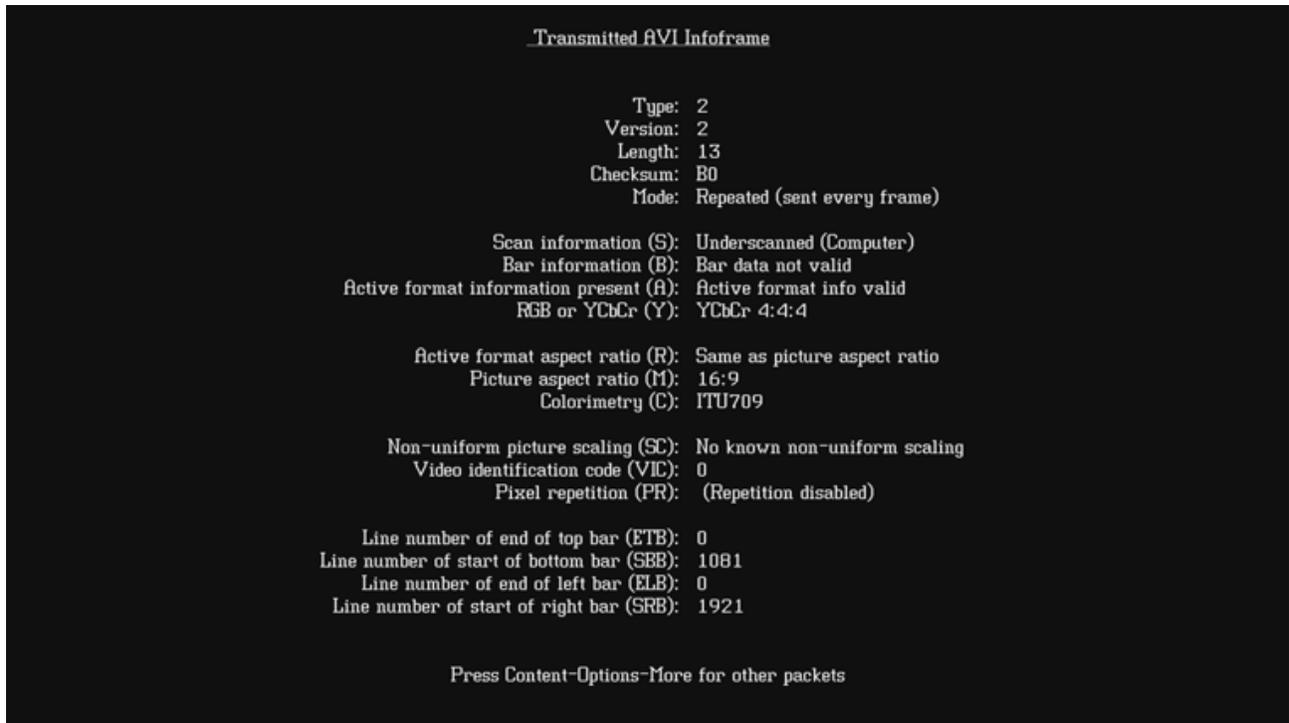


2. Select the PacketTx test.

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.



The procedure below is a general procedure that is not specific to a release.

12 Command Line Interface for Capturing Data

This chapter describes the command line interface for captured data.

12.1 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 the 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 you have to transfer the captured data to your host PC using an FTP utility. This procedure is described in the section:

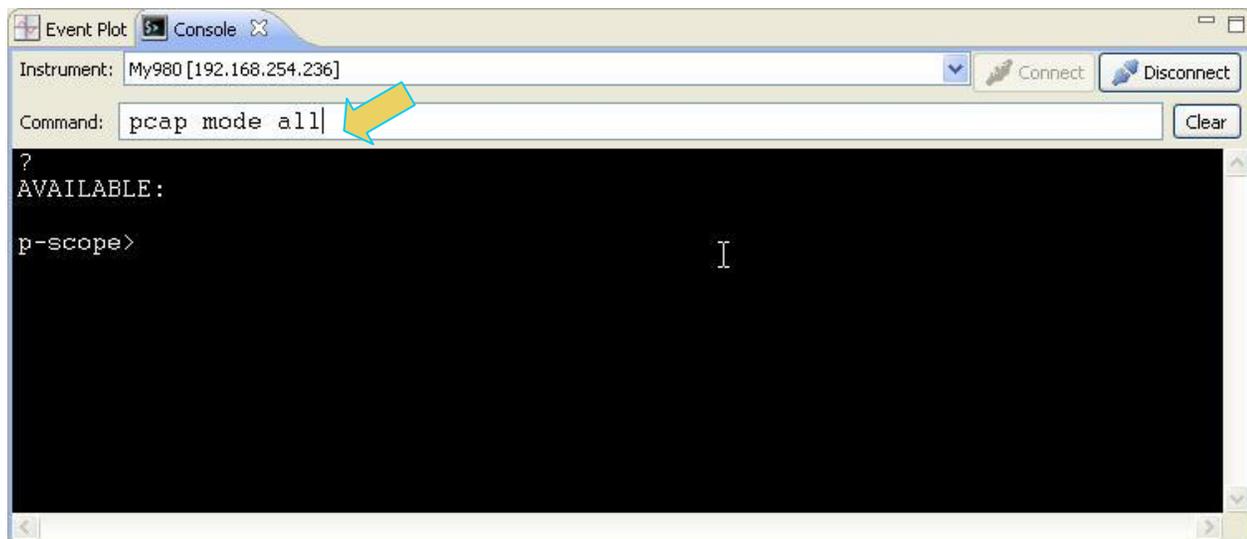
[Transferring Capture Files from the M41h to a PC.](#)

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 pscope 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.



5. 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 command 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@scope:~$
```

2. Enter the following to exit out of the console session:

```
qd@scope:~$ exit
```

To establish a command line session through a telnet session:

1. Launch the Command Prompt utility from the Windows Accessories.
2. 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.
```

3. 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 command and these are explained in the table in the procedures below.

List of PCAP Commands

Note: Commands are lower case.

Command	Description	Syntax	Command Example
pcap size	Defines the capture buffer size in percent of total (2GB).	pcap size <size> Where <size> can be 0 to 100 percent.	To set the capture buffer size to 50% of the total buffer capacity: >pcap size 50 Captures data up to 50% of the capacity of the buffer.
pcap mode	Defines the data that is captured. In other words determines if video and data islands	pcap mode <data> Where <data> can be: <ul style="list-style-type: none"> ▪ 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).

List of PCAP Commands

Note: Commands are lower case.

Command	Description	Syntax	Command Example
pcap trig	Defines the trigger mechanism	pcap trig <type> <pos> Where <type> can be: <ul style="list-style-type: none"> ▪ 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: <ul style="list-style-type: none"> ▪ 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.

12.2 Command Line Examples

The following is an example of how to use the command line. You use the capture control commands at the pscope 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.

12.2.1 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
```

5. 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
```

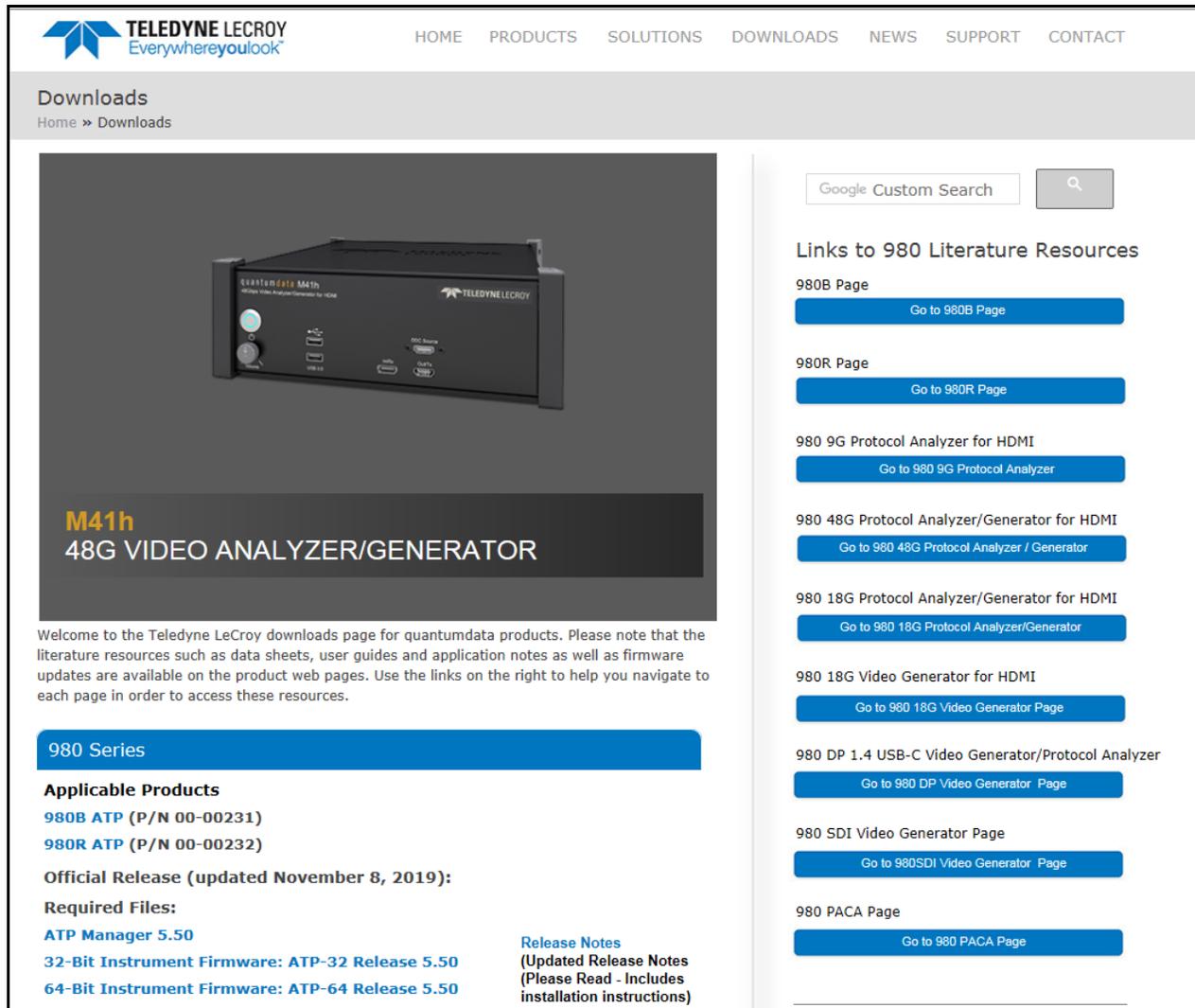
6. To return to the pscope prompt: **qd@spscope:~\$ sudo /qd/ptalk**

13 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 Quantum Data website.

<http://www.quantumdata.com/downloads/index.asp>



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M41h
48G VIDEO ANALYZER/GENERATOR

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980 Series

Applicable Products

980B ATP (P/N 00-00231)

980R ATP (P/N 00-00232)

Official Release (updated November 8, 2019):

Required Files:

ATP Manager 5.50

32-Bit Instrument Firmware: ATP-32 Release 5.50

64-Bit Instrument Firmware: ATP-64 Release 5.50

Release Notes
(Updated Release Notes
(Please Read - Includes
installation instructions))

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980 18G Protocol Analyzer/Generator for HDMI
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980 DP 1.4 USB-C Video Generator/Protocol Analyzer
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980 SDI Video Generator Page
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980 PACA Page
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Two software packages are available for upgrading the M41h:

1. Embedded firmware and gateway package 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 availables.
2. 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.

12.3 Workflow for Upgrading M41h Firmware/Gateware

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 have to upgrade the ATP Manager before using the ATP Manager to upgrade the M41h firmware and gateware.

1. Download the ATP Manager and M41h Firmware/Gateware files from the Quantum Data website downloads page:

The screenshot shows the Teledyne LeCroy website's Downloads page. The main heading is "Downloads" with a breadcrumb "Home > Downloads". Below this is a large image of the M41h 48G Video Analyzer/Generator. To the right of the image is a search bar and a list of links to literature resources. A yellow arrow points to the "ATP Manager 5.50" link under the "Required Files" section.

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M41h
48G VIDEO ANALYZER/GENERATOR

Welcome to the Teledyne LeCroy downloads page for quantumdata products. Please note that the literature resources such as data sheets, user guides and application notes as well as firmware updates are available on the product web pages. Use the links on the right to help you navigate to each page in order to access these resources.

980 Series

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980R ATP (P/N 00-00232)

Official Release (updated November 8, 2019):

Required Files

ATP Manager 5.50

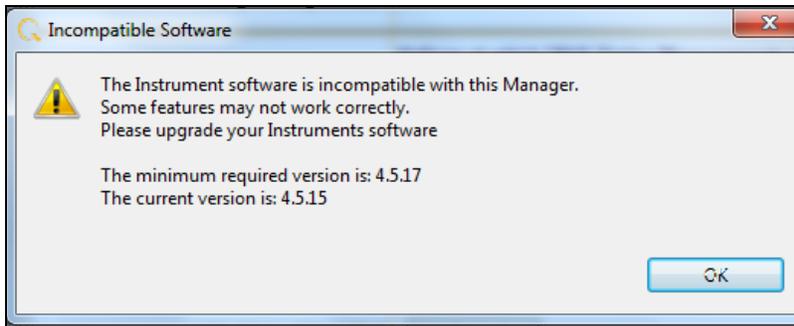
32-Bit Instrument Firmware: ATP-32 Release 5.50

64-Bit Instrument Firmware: ATP-64 Release 5.50

Release Notes
(Updated Release Notes
(Please Read - Includes
installation instructions))

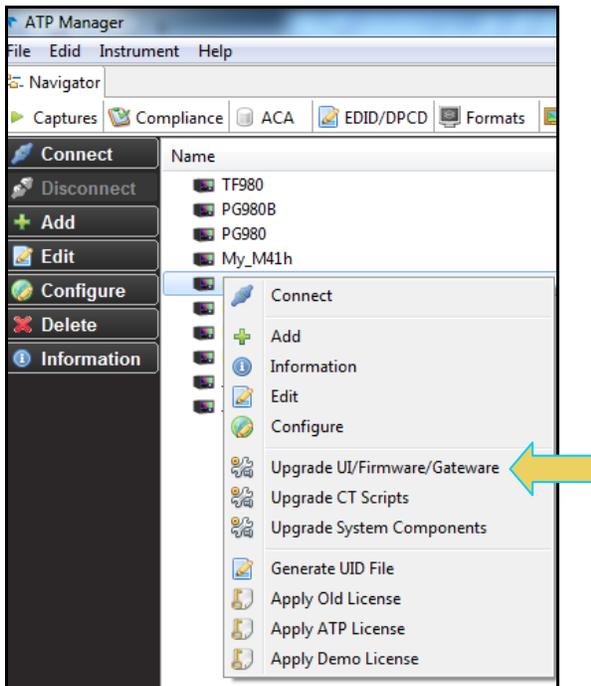
2. Upgrade the ATP Manager and restart.

Note: You may receive the following error indicating that you must update the M41h firmware/gateware.



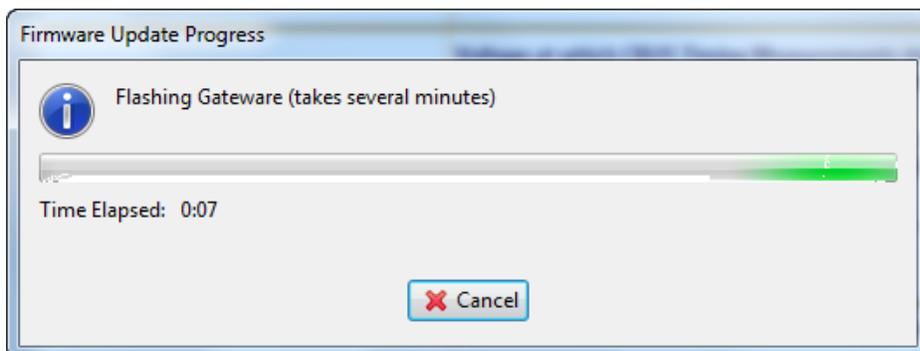
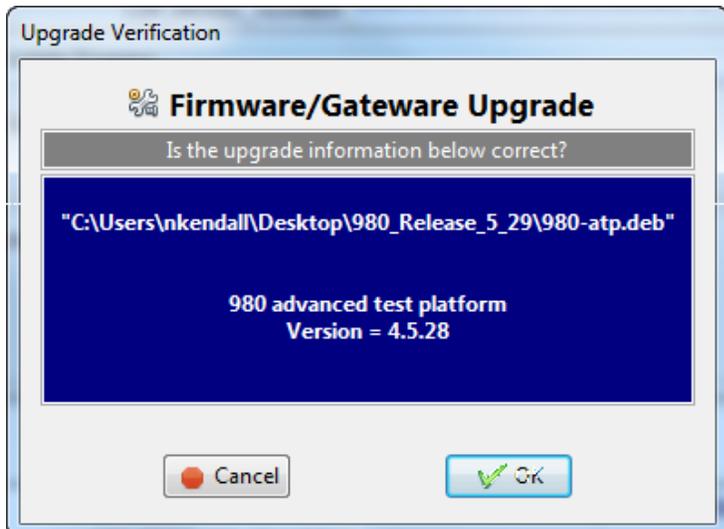
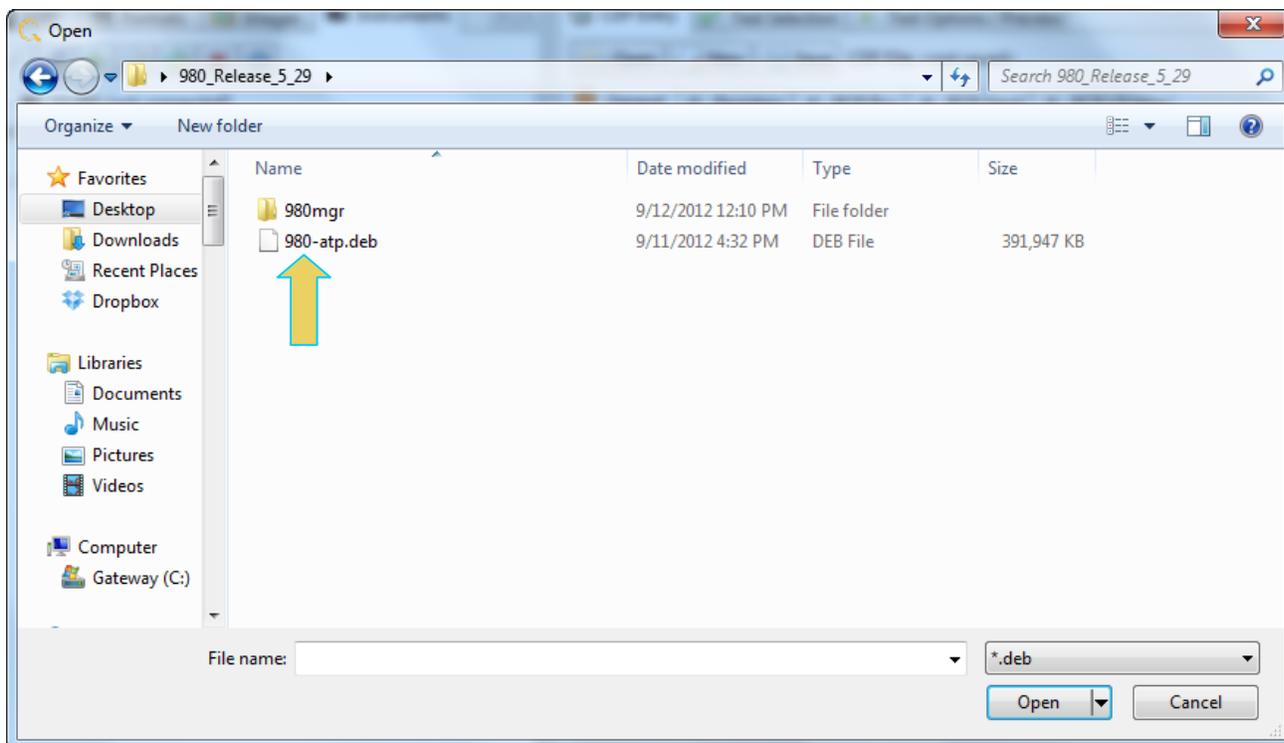
3. Connect to the M41h that you wish to upgrade.

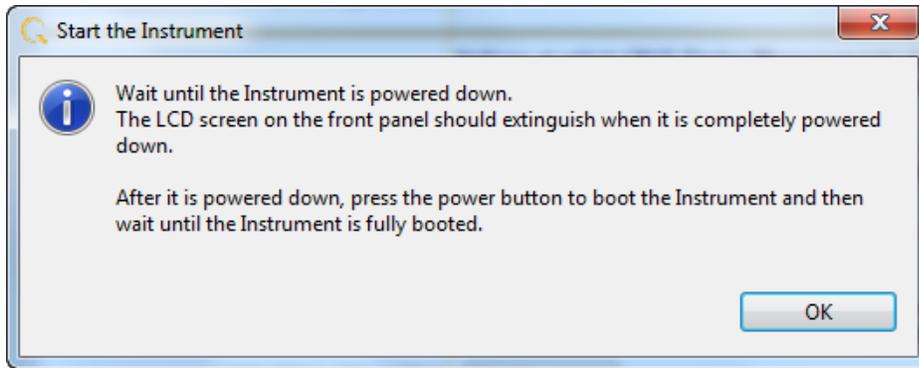
Access the **Upgrade Firmware/Gateware** option from the **Instrument** pull-down.



4. Update the M41h Firmware/Gateware.

Browse to the Deb file and select it. Follow the on-screen prompts.





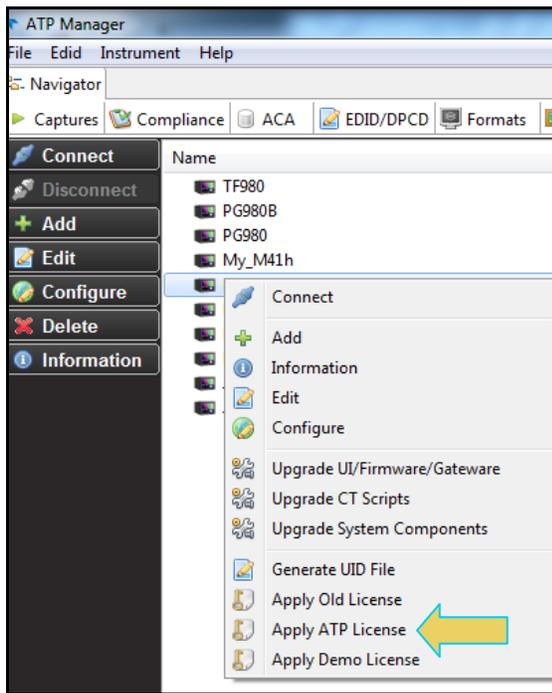
5. Reconnect the ATP Manager to the M41h.

12.4 Workflow for Adding License for optional feature

This section describes the workflow of the upgrade your M41h Protocol Analyzer with an optional feature using a license key. process. 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.
4. Teledyne LeCroy will provide a QDATP.lic file. Store this on your host PC.
5. From the **Instrument** pull-down menu (below) select Apply ATP License.



END OF USER GUIDE