TELEDYNE LECROY
Everywhereyoulook™
quantumdata

quantumdata™ M41h
48G Video Analyzer/Generator *for* HDMI Testing
Deep Analysis & Generation of HDMI 2.1 Fixed Rate Link (FRL) w/ Forward Error Correction (FEC)
Entry Level Functional Tester Upgradable to Full Compliance

Key Features

- Verify the 16b/18b encoding for Fixed Rate Link (FRL) Packets in both 3 and 4 lane configurations
- Use generator or analyzer in three (3) Lane configuration mode at 3Gbps & 6Gbps data rates and four (4) Lane configurations at 6Gbps, 8Gbps, 10Gbps and 12Gbps (48Gbps aggregate)
- Video generator function supports TMDS and FRL for video resolutions up to 8K at 1485MHz pixel rates
- View captured data elements graphically in Event Plot and in Data Decode Table; use searching and filtering to find data
- View FRL packet mapping into Character Blocks and Character Block (including FEC characters) mapping into Super Blocks
- Run complete suite of FRL source & sink compliance tests
- Run eARC the full suite of compliance tests on an eARC Tx or Rx device; all tests supported
- Run complete suite of TMDS source & sink compliance tests
- Run complete suite of HDCP 2.3 source, sink & repeater compliance tests
- View TMDS video and protocol elements, data island blocks, preamble data and sync control elements
- Monitor of FRL Link Training transactions in the Auxiliary Channel Analyzer (ACA) utility to show SCDC reads and writes over the DDC channel
- View Lane Error Counts and Reed Solomon Corrections Count in the SCDC CED registers
- Verify the eARC common mode channel on either an eARC Tx or Rx device
- Provides an extensive command line API to support automated testing

The Teledyne LeCroy quantumdata M41h 48Gbps Video Analyzer / Generator *for* HDMI Testing is a compact, versatile test instrument that can be easily extended from an entry level functional tester to a full certified compliance tester. The M41h is equipped with both HDMI Tx and Rx ports supporting HDMI 2.1 Fixed Rate Link and FEC capture analysis and decode up to 48Gbps (12Gbps/Lane). The HDMI Rx analyzer port provides visibility into the Fixed Rate Link packetization —super blocks, character blocks and FRL packets and underlying TMDS video, protocol, control and metadata elements. The HDMI Tx video generator port transmits Fixed Rate Link video streams with embedded TMDS video, protocol, control and metadata elements. The M41h also supports the full suite of FRL source and sink compliance tests as well as Enhanced Audio Return Channel (eARC) compliance testing for both Tx and Rx devices. An extensive Application Programming Interface (API) is supported for automated testing systems available thru a command line interface.

Operation

The M41h supports video generation and analysis of the FRL/FEC HDMI data streams through the user friendly GUI Manager which presents the data in an easy to under-stand way. The GUI can be controlled either via a laptop connected to the M41h RJ45 LAN port or through a USB keyboard and mouse and a connected UHD HDMI admin display.

Admin display for ATP Mgr

M41h 48Gbps Video Analyzer / Generator

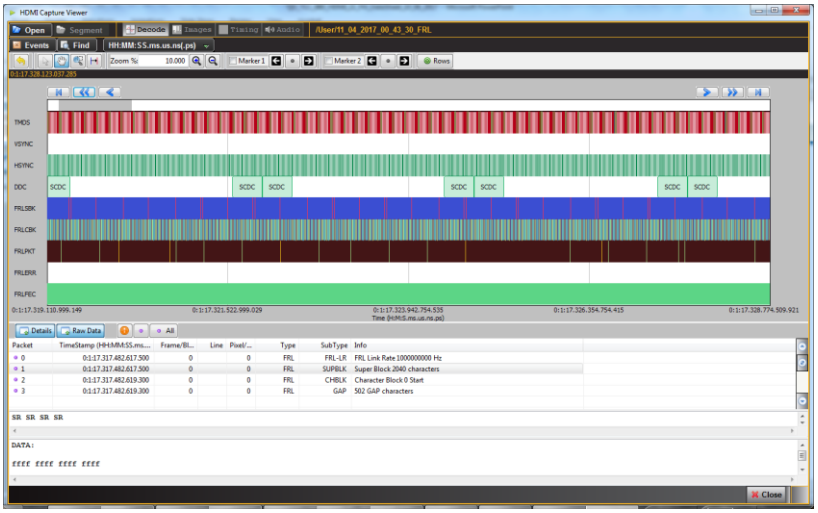
Keyboard & mouse for ATP Manager control

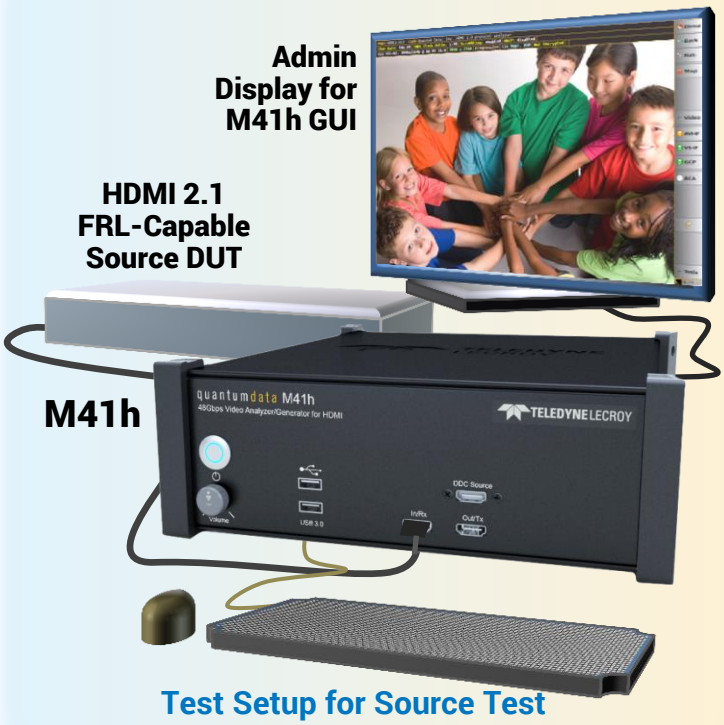
FIXED RATE LINK (FRL) CAPTURE/DECODE ANALYSIS

Capture and Decode (FRL & FEC)

The M41h analyzer captures and decodes incoming HDMI 2.1 streams that have been packetized with FRL packet structures. These FRL-related data elements are depicted graphically in the Event Plot . The decoded data and the raw data is shown in table form in the Data Decode window. The Forward Error Correction (FEC) characters are also shown as well. The module reports the Lane Error Counts and the FEC Reed Solomon Corrections Count in the SCDC CED registers. The underlying TMDS video and protocol elements such as the active video, data island and preamble blocks, are also depicted and decoded. Each element is assigned a precise time stamp. Users can search and filter the FRL captured data by type.

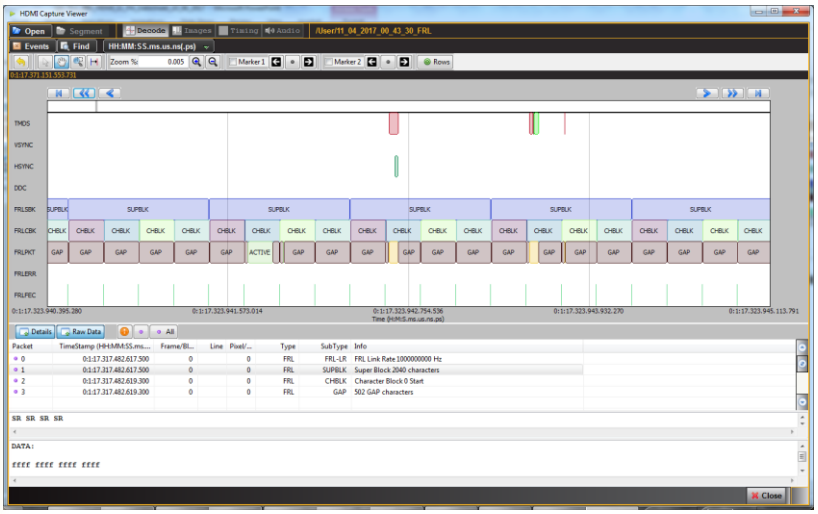
Capture Showing SCDC, FRL & TMDS Elements



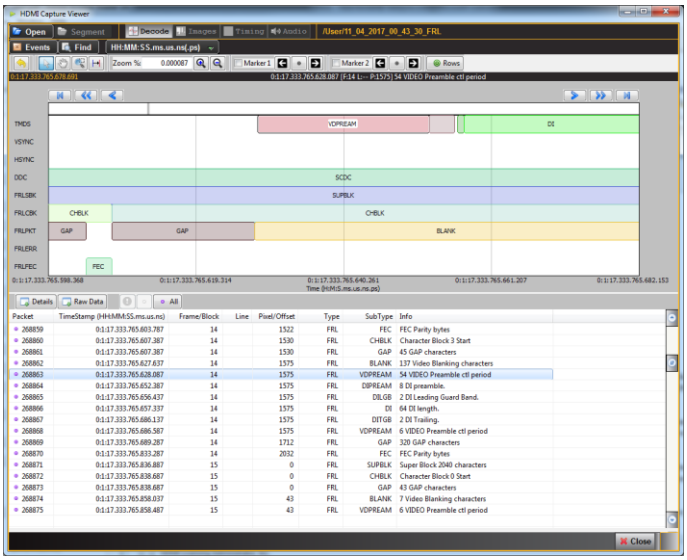


Test Setup for Source Test

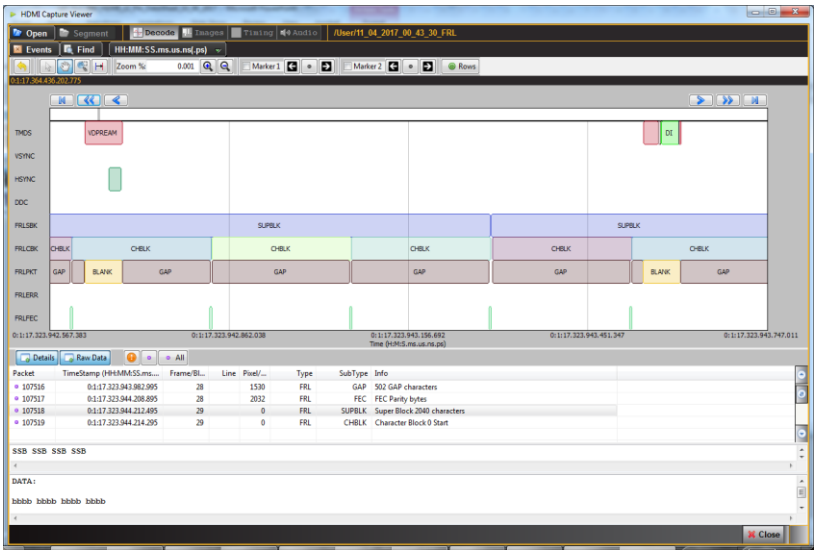
Capture Showing FRL Packets, Character & Super Blocks



Capture Showing Active Video Elements and FEC



Capture Showing FRL Elements & TMDS Video & Data



FIXED RATE LINK (FRL) LINK TRAINING ANALYSIS

Link Training

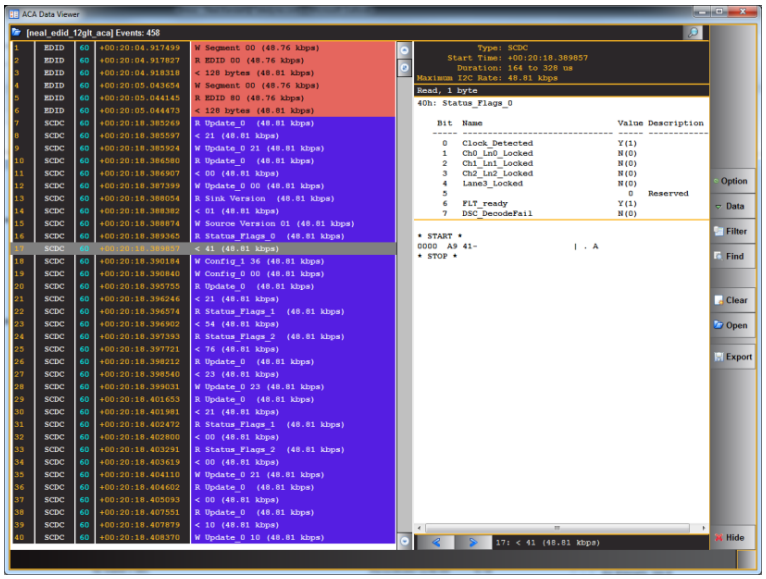
The M41h supports Link Training configuration and control. The module emulates an HDMI 2.1 sink indicating the max FRL rate in the HF-VSDB of the EDID and various other essential link training parameters in the SCDC control registers.

Test Setup for Source Test

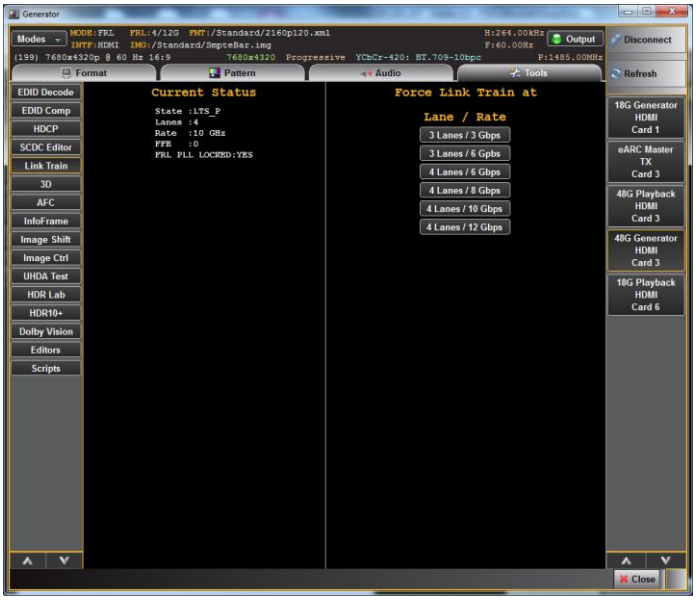
Auxiliary Channel Analyzer

You can use the M41h to monitor the Link Training transactions—EDID exchange and reads and writes to the SCDC registers over the DDC channel--with the Aux Channel Analyzer (ACA) utility. This enables you to verify link training functions to identify potential interoperability problems.

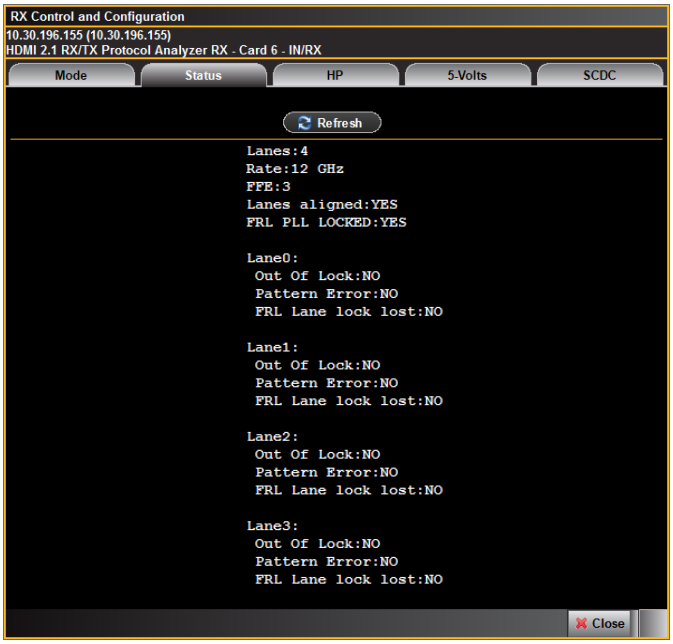
Auxiliary Channel Analyzer (Link Training over DDC)



Generator Link Training Status & Control Screen



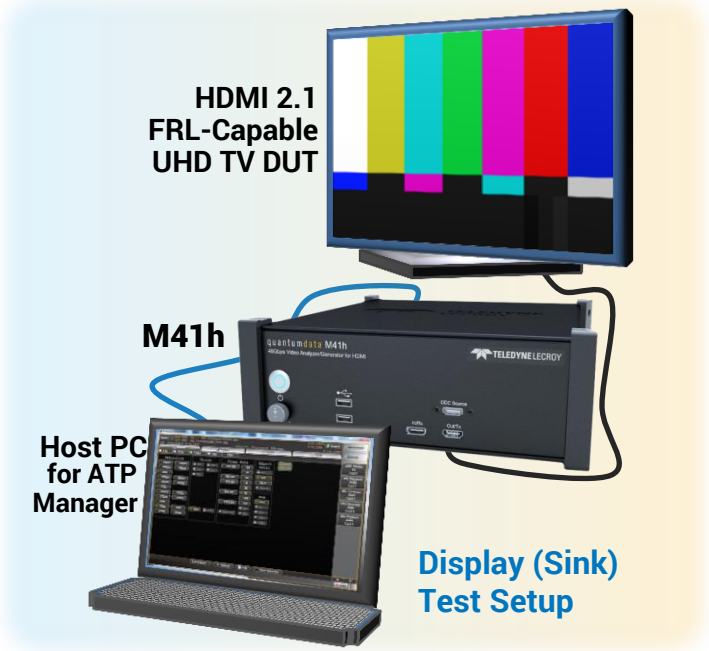
Analyzer Link Training Status Screen



FIXED RATE LINK (FRL) VIDEO GENERATION

FRL Video Generation

The M41h for HDMI Testing enables developers of HDMI and TMDS FRL-capable sink devices and silicon makers to run functional tests on their FRL-capable display devices by rendering uncompressed, unencrypted FRL streams at up to 8K video resolutions at lane rates up to 12Gb/s and at an aggregate link rate of 48Gb/s and up to pixel rates of 1485MHz. The enhanced video generator function enables specific selections of video formats, colorimetry, bit depth, chroma subsampling, color space and test patterns.



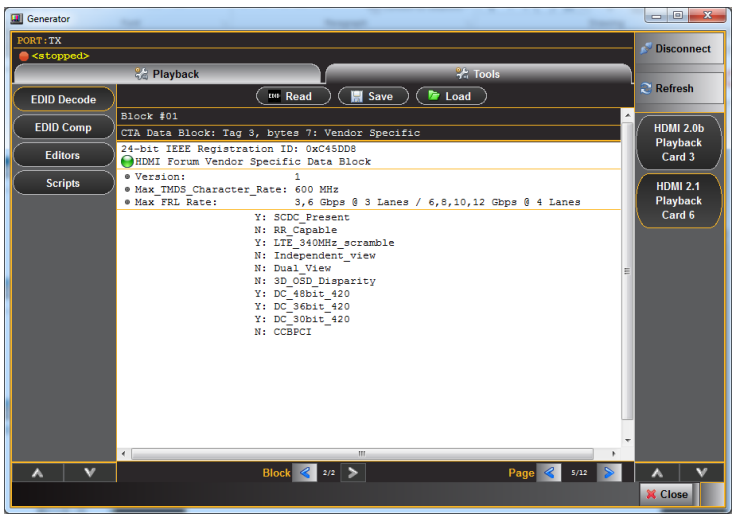
Link Training Configuration

The M41h 's video generation function enables you to configure the lane rate and number of lanes for transmission of the FRL stream.

EDID Read

The M41h enables you to view the EDID of the connected display (below). You can page through each block and save for later viewing.

Reading the EDID



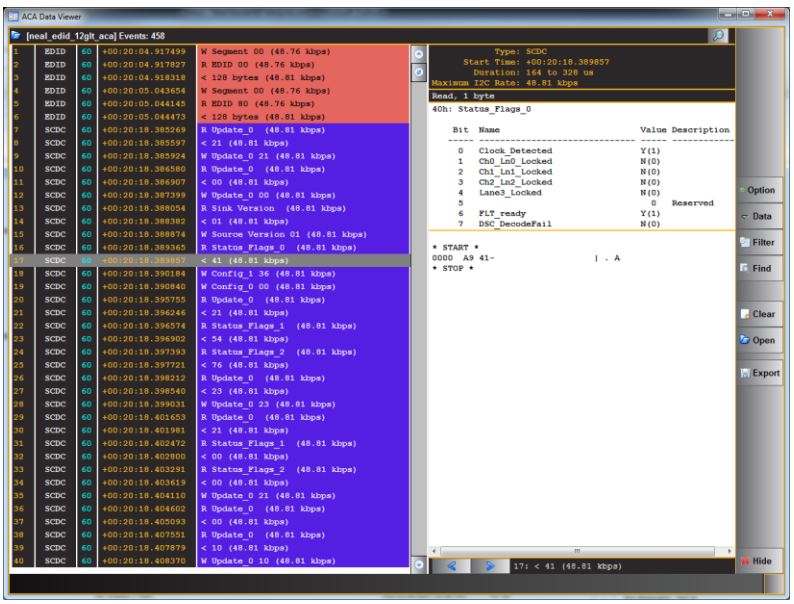
Selection of FRL and TMDS Video Resolutions

Link Training Configuration

Auxiliary Channel Analyzer (ACA)

You can use the M41h to monitor the Link Training transactions—EDID exchange and reads and writes to the SCDC registers over the DDC channel--with the Aux Channel Analyzer utility. The FRL link training transactions enable developers to verify that their displays are properly conducting their role in the link training process.

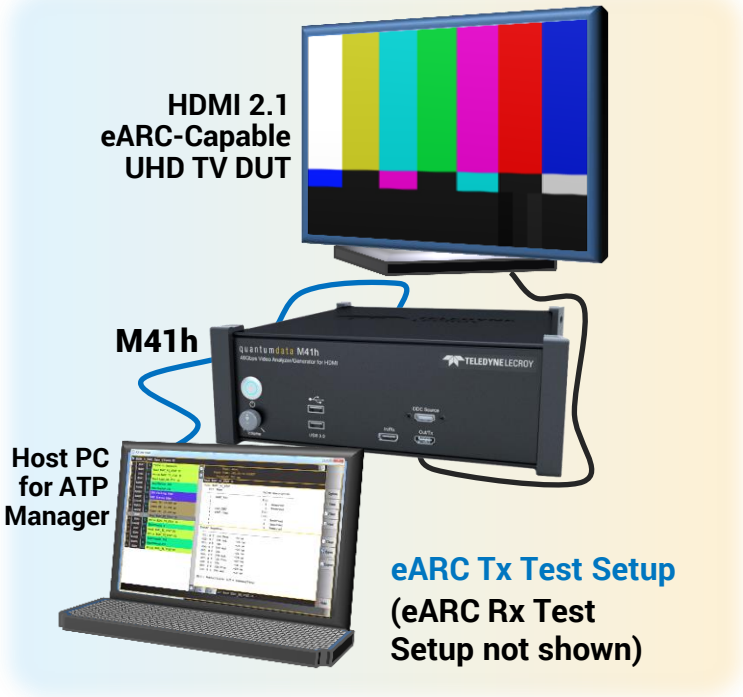
Auxiliary Channel Analyzer (Link Training)



eARC FUNCTIONAL AND COMPLIANCE TESTING

eARC Functional Testing

The 48G Video Analyzer / Generator is also supports enhanced Audio Return Channel (eARC) Tx/Rx functional testing. The solution provides emulation of an eARC Tx and Rx functions over the eARC Common Mode and Differential mode data channels. Solution supports discovery and disconnect, heartbeat, status and capabilities data structure and transmission over the differential channel. (Sample screen showing monitoring incoming audio stream, right.)

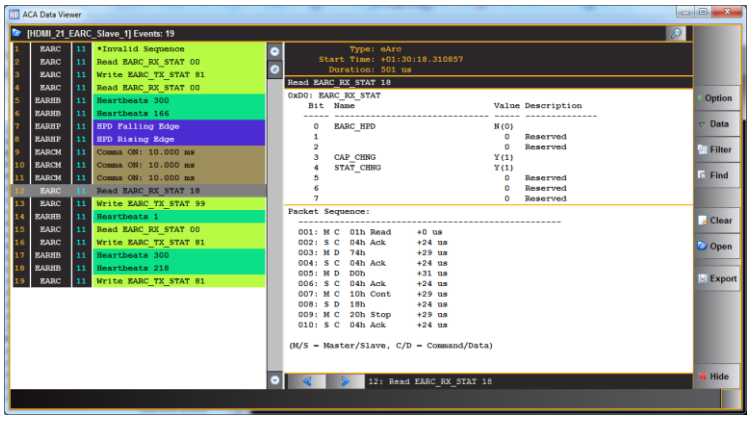


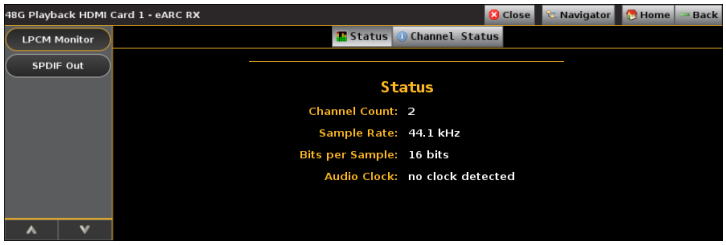
eARC Tx Test Setup
(eARC Rx Test Setup not shown)

Auxiliary Channel Analyzer (ACA)

The M41h can monitor the Link Training transactions—EDID exchange and reads and writes to the SCDC registers over the DDC channel -with the Aux Channel Analyzer (ACA) utility. Viewing the FRL link training transactions enables developers to verify their displays are properly conducting the link training process properly.

Aux Chan Analyzer Traces (Common Mode Discovery)

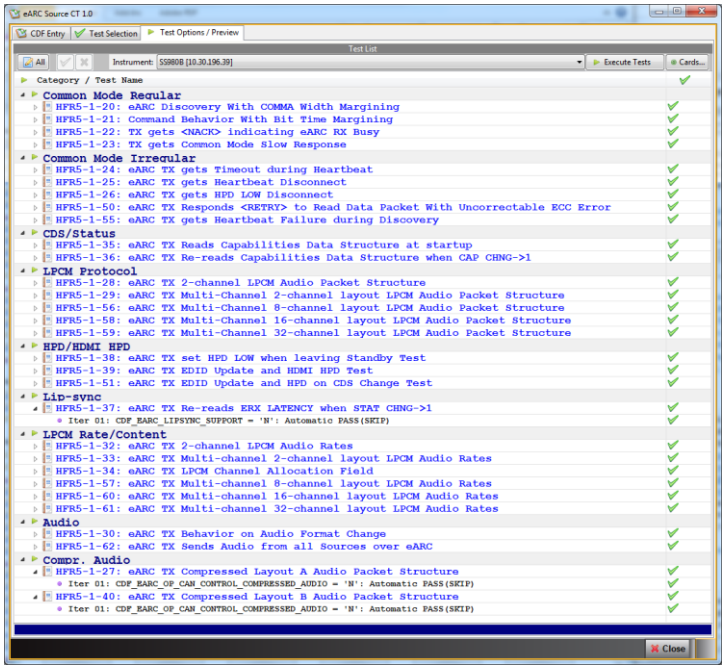




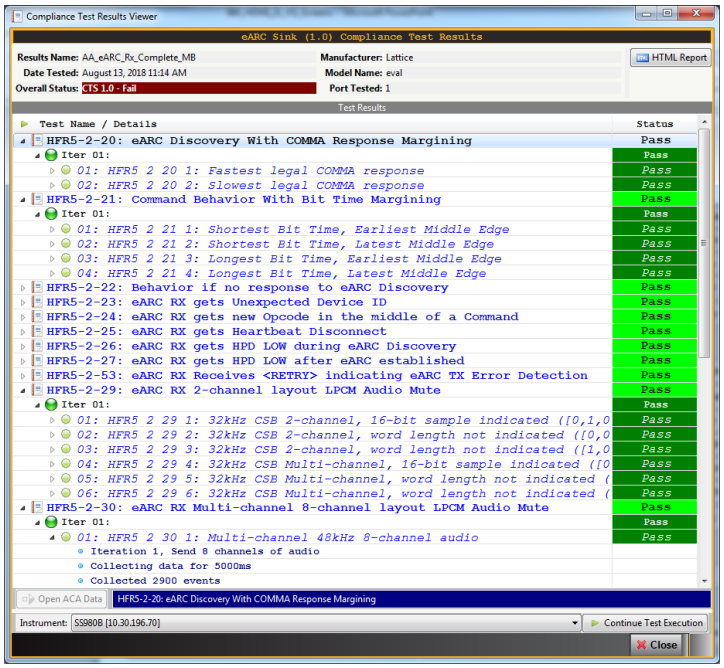
eARC Compliance Testing

The M41h enables developers of HDMI eARC Tx and Rx devices to run compliance tests on their eARC-capable. The compliance tests run with little or no human interaction. Detailed results are provided for each test to help identify the root cause of failures. The reports can be exported and disseminated to colleagues and other subject matter experts.

Test Suite (eARC Tx Test Suite Example Shown)



Sample eARC Test Results (eARC Rx Tests Shown)



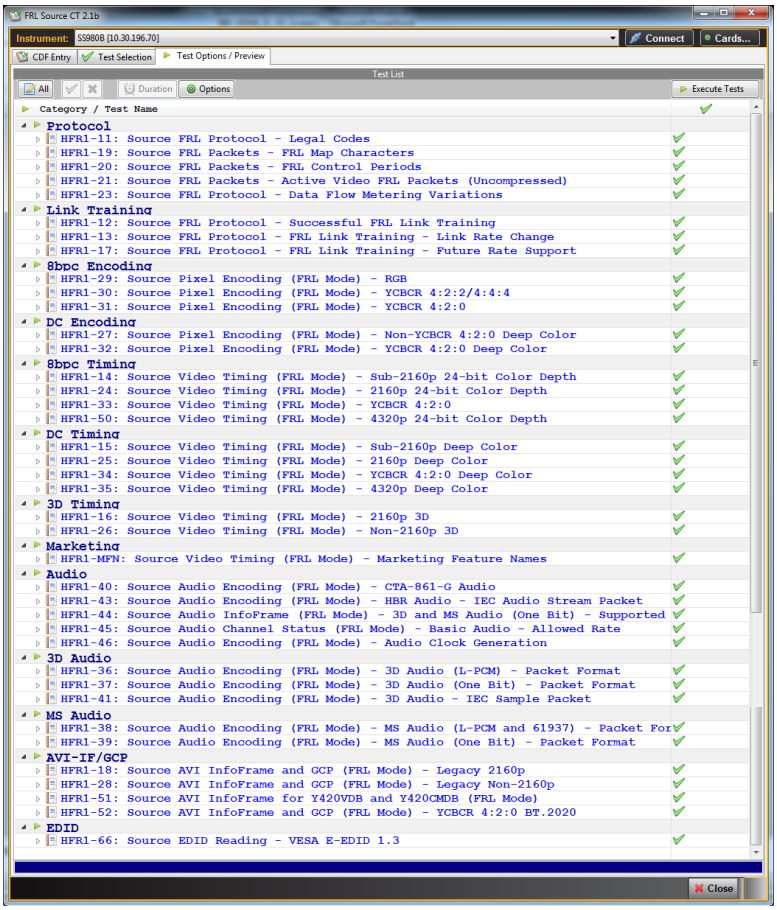
FIXED RATE LINK (FRL) SOURCE COMPLIANCE

FRL Source Compliance Testing

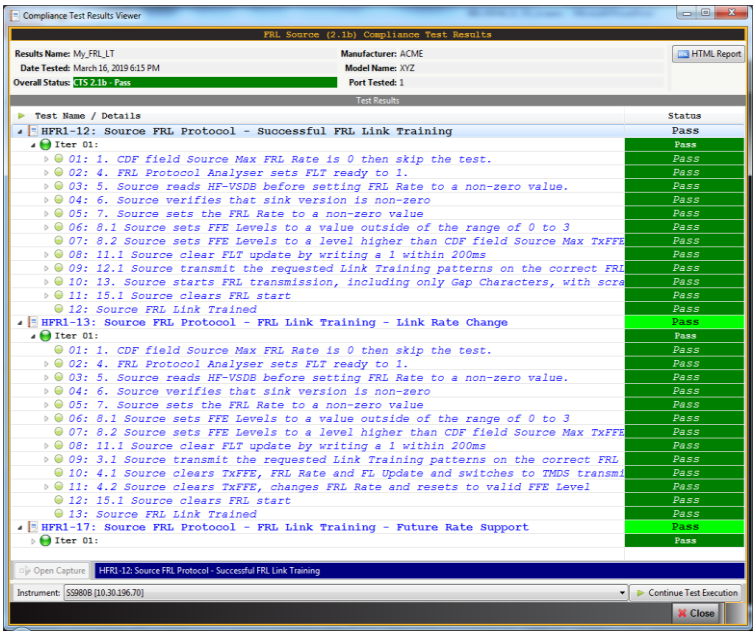
The M41h for HDMI Testing enables developers of HDMI FRL-capable source devices and silicon makers to run compliance tests on their FRL-capable source devices on unencrypted FRL streams at up to 8K video resolutions at lane rates up to 12Gb/s and at an aggregate link rate of 48Gb/s. All compliance test data, including the captured data, is exportable and can be disseminated to colleagues and other subject matter experts.

Test Setup for Source Test

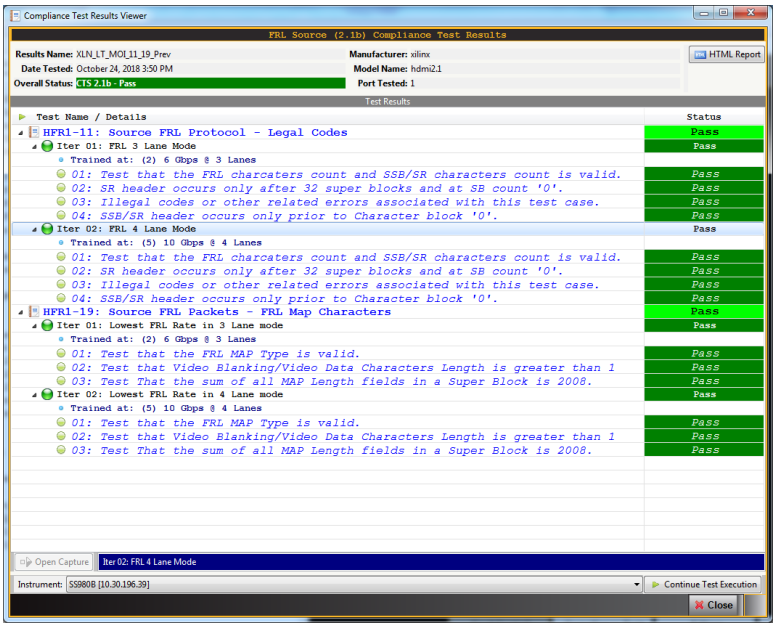
Selection of FRL Source Compliance tests



Sample FRL Source Compliance (Link Training Tests)



Sample FRL Source Compliance (Protocol Tests)

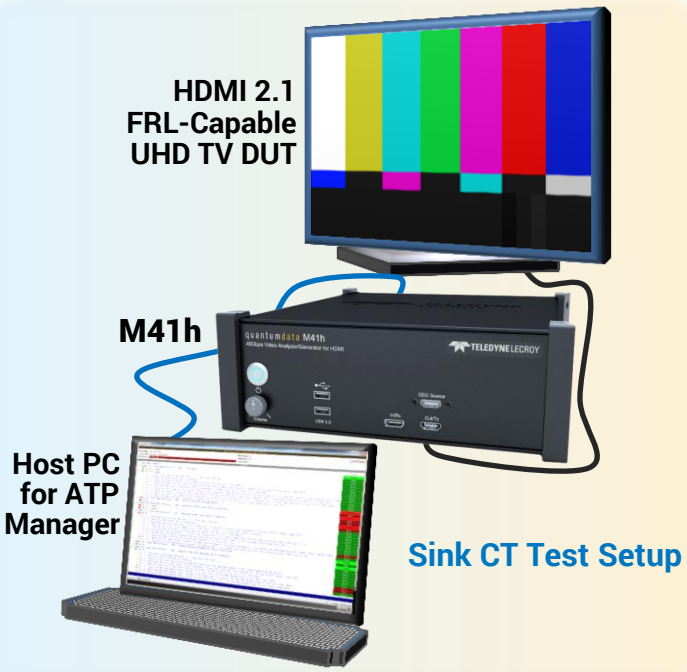


FIXED RATE LINK (FRL) SINK COMPLIANCE

FRL Sink Compliance Testing

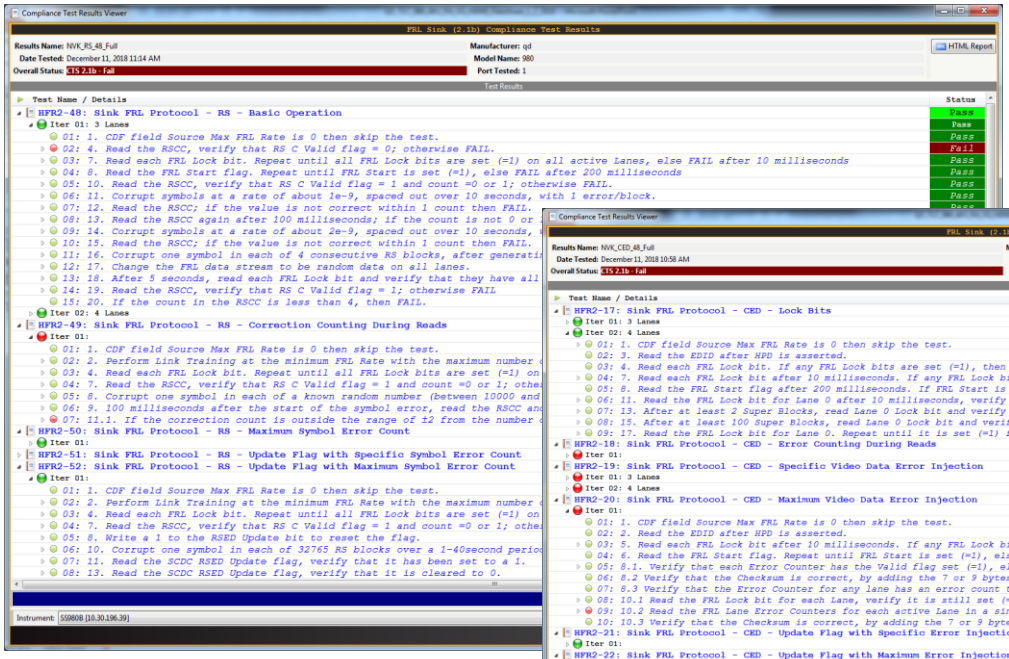
The M41h for HDMI Testing enables developers of HDMI FRL-capable sink devices and silicon makers to run compliance tests on their FRL-capable sink devices with FRL streams at up to 8K video resolutions at lane rates up to 12Gb/s and at an aggregate link rate of 48Gb/s and pixel rates up to 1485MHz. All compliance test data, including the captured data, is exportable and can be disseminated to colleagues and other subject matter experts.

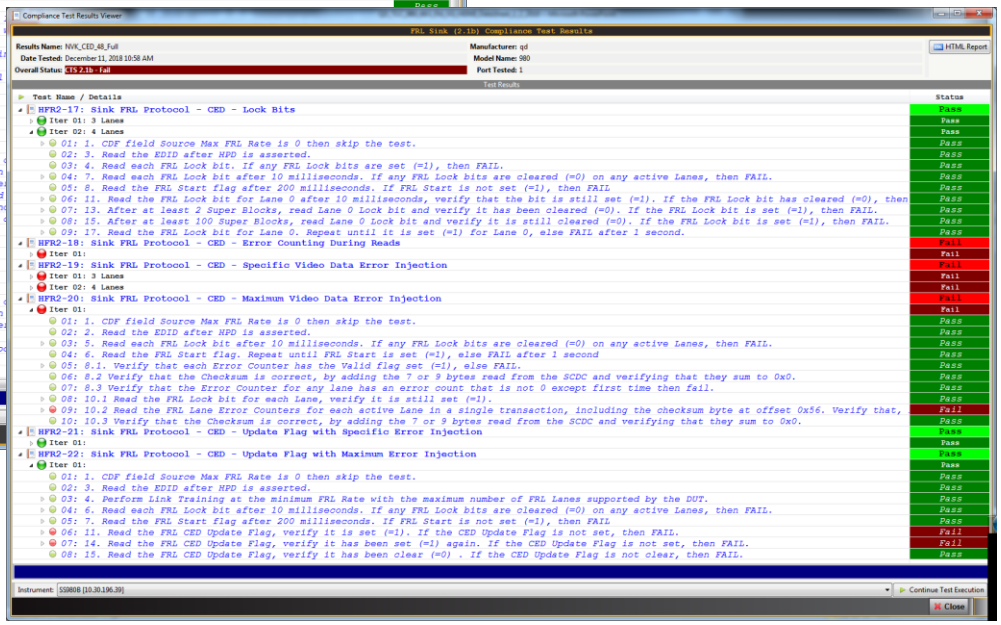
Selection of FRL Sink Compliance tests



Sink CT Test Setup

Sample Test Results of FRL Sink Compliance tests

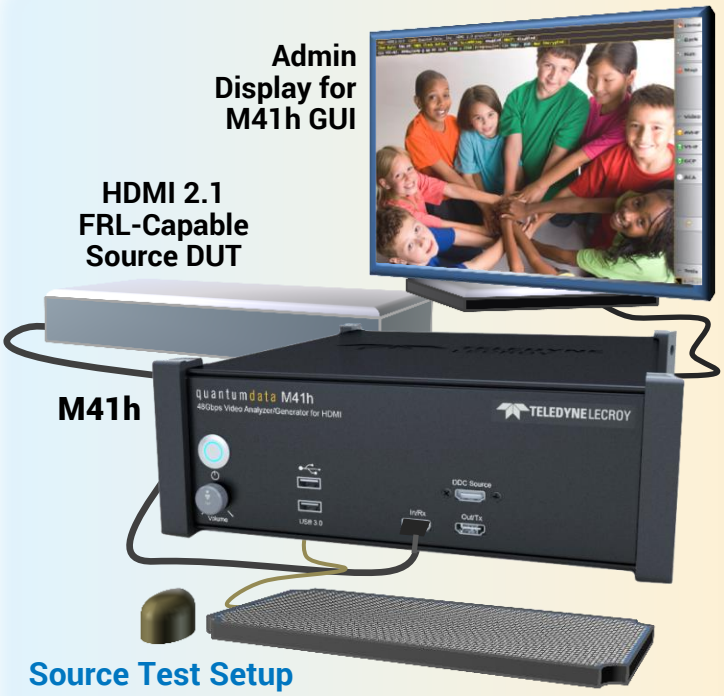




HDMI 2.0 SOURCE COMPLIANCE TESTS

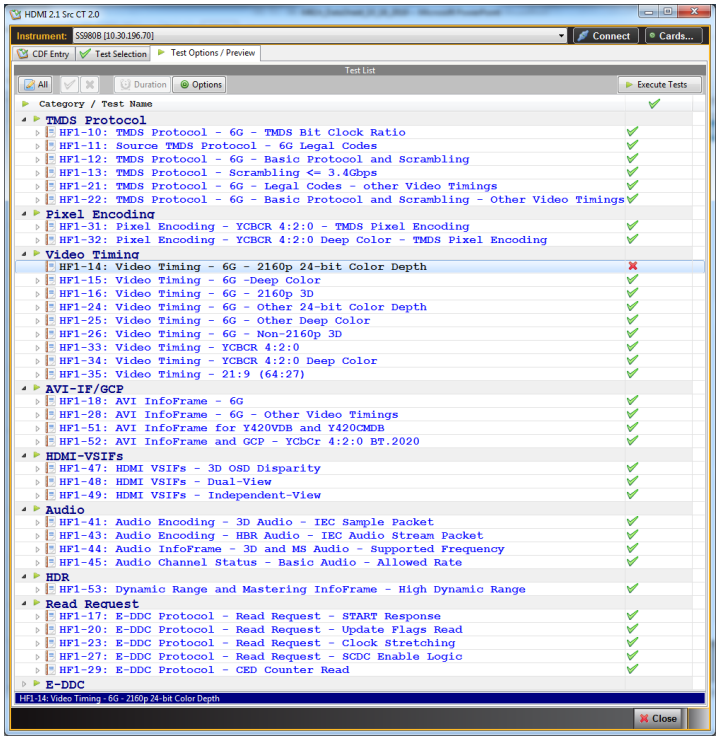
HDMI 2.0 Source Compliance

The M41h source compliance tests are ideal for pre-testing your HDMI 2.0 source product prior to submission to an Authorized Test Center for approval. Pre-testing provides added assurance that your product will pass at the ATC when submitted. Where permitted, the M41h can be used to self-test your product. Self-testing offers greater benefits for time to market and cost reduction than pre-testing by avoiding submission to the ATC for approval. The compliance tests enable you to view the captured data and detailed test results which help pinpoint the cause of compliance test failures.

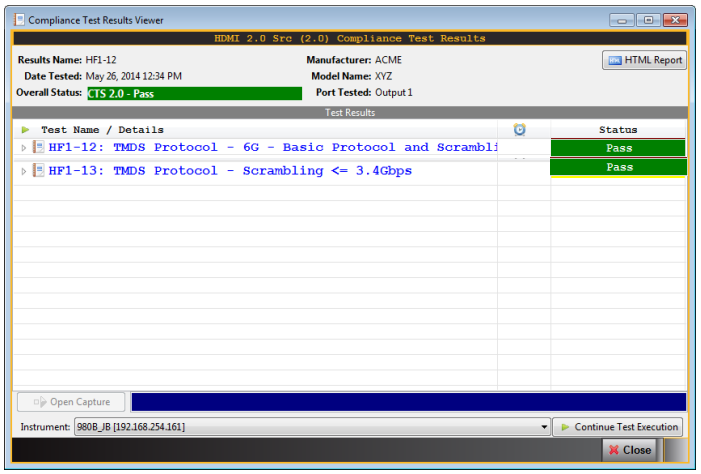


Source Test Setup

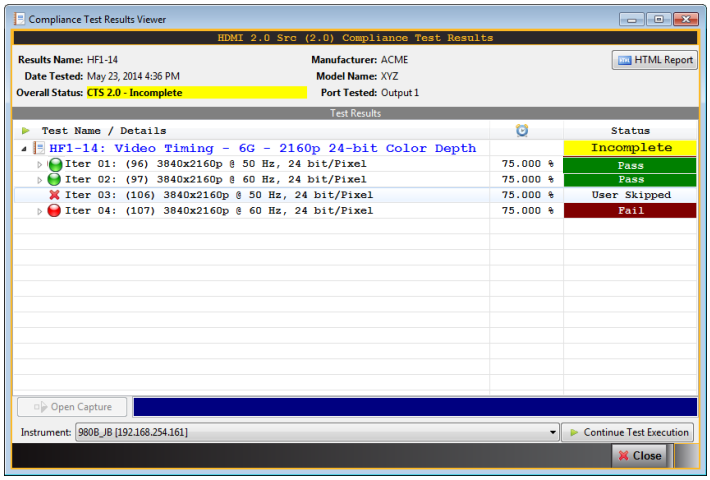
HDMI 2.0 Compliance Test List



HDMI 2.0 Test Results–TMDS Protocol Tests



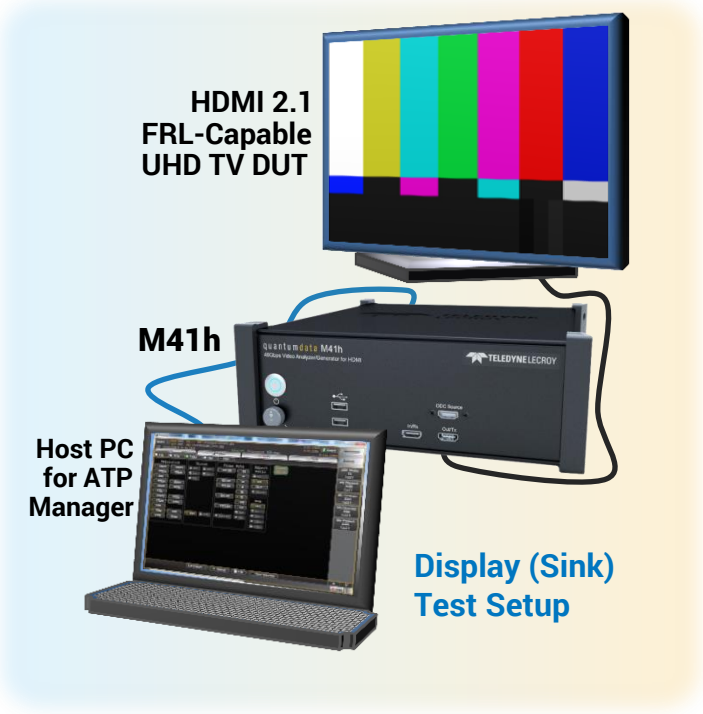
HDMI 2.0 Test Results– Video Timing Tests



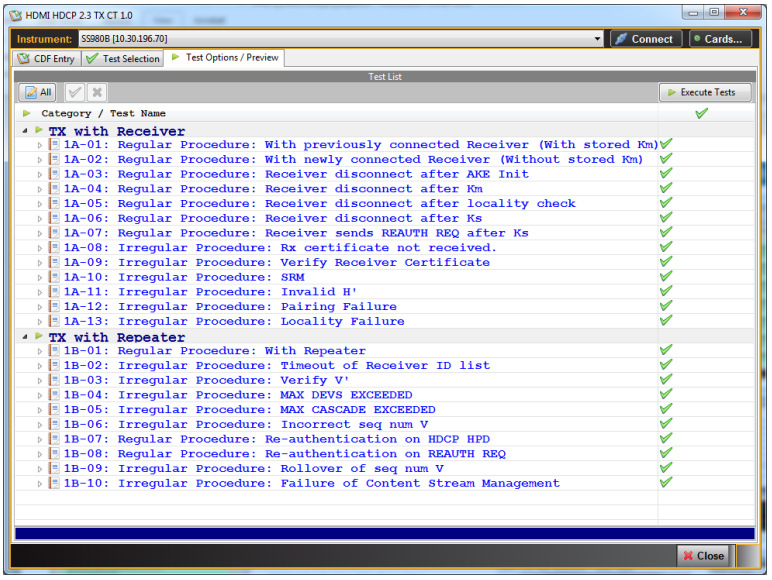
HDCP 2.2 SOURCE, SINK, REPEATER COMPLIANCE TESTS

HDCP 2.2 Compliance

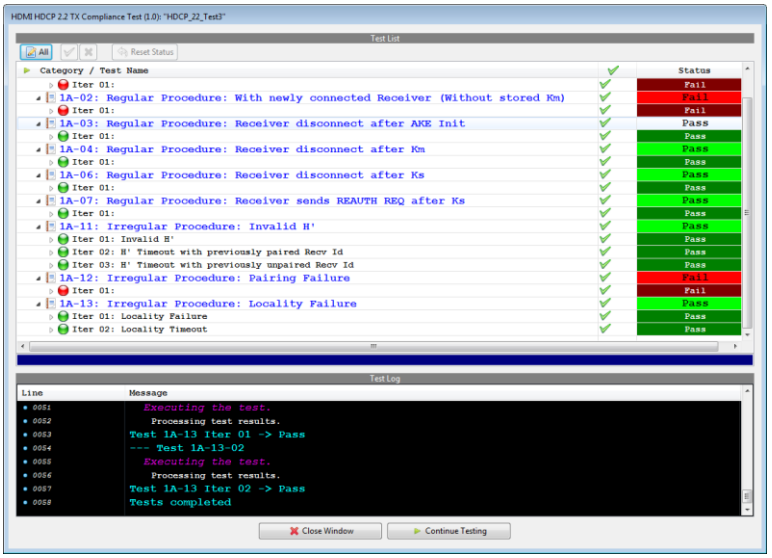
The M41h HDCP 2.2 compliance tests are ideal for pre-testing your HDMI source, sink or repeater product prior to submission to an Authorized Test Center for approval. Pre-testing provides assurance that your product will pass at the ATC when submitted. The compliance tests enable you to view the auxiliary channel analyzer traces logged during the test to help diagnose the cause of compliance test failures.



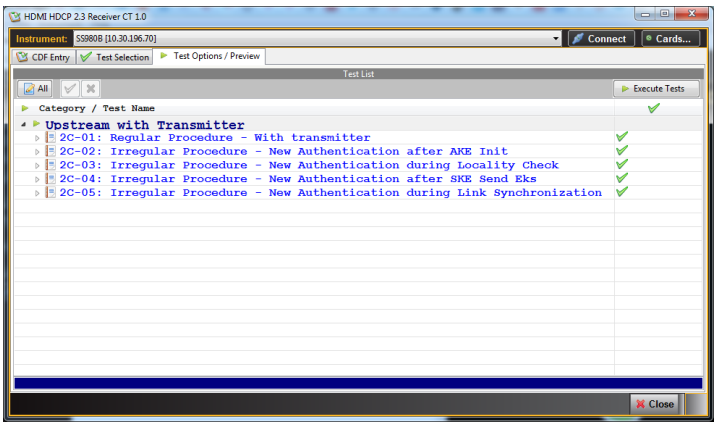
HDCP 2.2 Test Selection – Source Tests



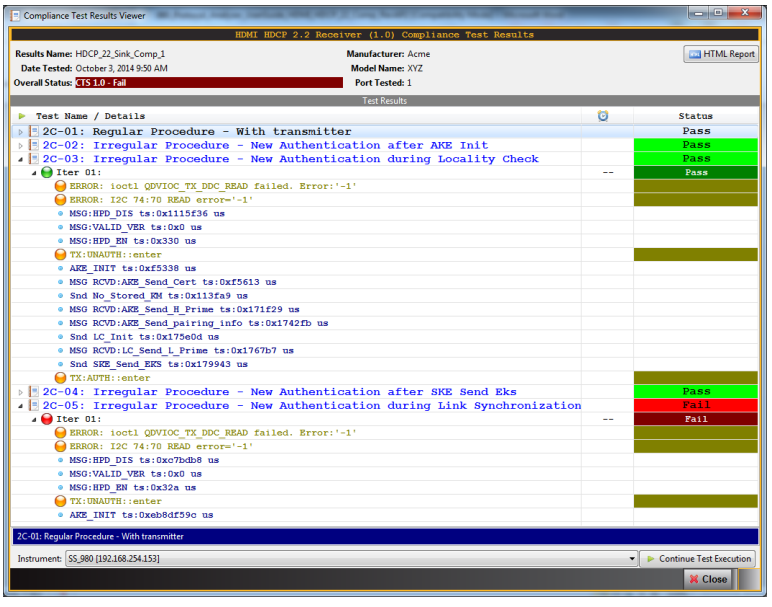
HDCP 2.2 Test Results– Source Tests



HDCP 2.2 Test Selection – Sink Tests



HDCP 2.2 Test Results – Sink Tests



SPECIFICATIONS

HDMI Capabilities

Version	up to HDMI 2.1
Standard Formats	CEA, VESA
Protocols	FRL with FEC; TMDS, eARC Common Mode and Differential Mode
FRL bit rates	3Gbps; 6Gbps; 8Gbps; 10Gbps; 12Gbps (48Gbps aggregate)
Max Pixel Rate	1485MHz
Capture memory	8 GBytes

Connectors - Front

HDMI Connectors (2)	In/Rx HDMI Type A; Category 2 Out/Tx HDMI Type A: Category 2
DDC Source	Used for eARC Tx EDID test
USB (2)	For connecting keyboard and mouse for ATP Manager control of external storage

Connectors - Back

HDMI - Admin Connector	HDMI Port for M41h ATP Manager for external 4K UHDTV at Admin HDMI port
USB (2); USB-C (2)	Keyboard / mouse connected to USB ports
RJ45 E1	For admin control over LAN from computer running M41h ATP Manager
RCA (2)	SPDIF IN for injecting audio; SPDIF OUT for extracting incoming audio
BNC (2)	Trigger IN / OUT for triggering captures
All other connectors	Not used

Physical / Electrical / Admin

Power	100-240 VAC, 50-60 Hz, 200 Watts
Weight	11.15 LBS; 5.057 Kg
Size	Height: 3.44 in. (8.74 cm) Width: 9.57 in. (24.30 cm) Depth: 10.94 in. (27.79 cm)
Rack mountable	2 RU mounts in 19 inch rack with rack mounting brackets (provided)
Internal speaker	Speaker with volume control for monitoring incoming audio
Command Line Control	Ethernet (RJ-45) for external GUI and telnet
GUI Control	Either through External PC connected over LAN to Ethernet RJ45 or:
	Keyboard / mouse connected to USB ports; External 4K UHDTV at Admin HDMI port
Environmental	Operating Temp: 32 to 90 (F); 0 to 32 (C)

Ordering - Product Code	Description
00-00258	M41h hardware and base functional unit
95-00209	M41x rack-mount kit
95-00195	Source functional test – Includes Capture Analysis and UHDA Tests
95-00201	Sink functional test - Includes UHDA Tests
95-00204	eARC Tx (Sink) functional test
95-00199	eARC Rx (Source) functional test
95-00196	FRL Source compliance tests (requires 95-00195)
95-00202	FRL Sink compliance tests (requires 95-00201)
95-00205	eARC Tx (Sink) compliance tests (required 95-00204)
95-00200	eARC Rx (Source) compliance tests (requires 95-00199)
95-00198	HDCP 2.2 Source compliance (requires 95-00195)
95-00206	HDCP 2.2 Sink compliance (requires 95-00201)
95-00197	HDMI 2.0 (2.1) & 1.4 TMDS Source compliance tests (requires 95-00195)
95-00203	HDMI 2.0 (2.1) & 1.4 TMDS Sink compliance tests (requires 95-00201)
95-00207	Sink HDR Tests (Dolby , HDR Lab) (requires 95-00201)

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Local sales offices are located throughout the world.
Visit our website to find the most convenient location.