TELEDYNE LECROY
Everywhereyoulook™

quantumdata™ 980
DisplayPort 1.4 / USB-C / eDP Video Generator / Protocol Analyzer

Video Generation and Analysis
Testing up to 8.1Gb/s Link Rates
Link, FEC & DSC Compliance Suites now Approved!

Key Features

- Run DisplayPort functional tests and protocol compliance tests up to full DP 1.4 specification
- Equipped with both DP standard and USB-C ports for Tx and Rx function—all test features supported through either type of connector
- View Power Delivery (PD) negotiations for USB-C DP Alt Mode
- Run functional tests on displays and monitors up to 8.1 Gb/s link rates with large format and test pattern library
- Generate Display Stream Compression (DSC) select patterns and configure slices and video parameters
- Configure link training parameters to test display's handling
- View EDID and DPCD registers
- Access DSC Test CRC registers for automated verification of source DSC compression
- Test DP sources up to 8.1 Gb/s link rates; view incoming video and meta-data—including DSC compressed--from a source device in real time
- Capture and decode incoming video, protocol and control packets—including Display Stream Compression (DSC)
- UPDATE! Run DP 1.4 EDID compliance tests on sink devices
- Monitor Aux Channel transactions as a DP source or sink
- Passively monitor Aux Channel between a source & display even at 8.1Gb/s link rates
- Run DP 1.4 Link Layer compliance tests on sources and sinks up to 8.1 Gb/s link rates
- NEW! Run DP 1.4 EDID compliance tests on sinks
- Run DP 1.4 Forward Error Correction (FEC) compliance tests
- Run DP 1.4 Display Stream Compression compliance tests for sources and sinks
- Run DCP-approved HDCP 2.2 compliance tests on DisplayPort sources, sinks and repeaters
- Run audio tests using programmable LPCM sine wave audio tones and compressed formats
- Run tests on embedded DisplayPort (eDP) 1.4b sources and panels using fast link training and ALPM
- Test eDP backlight control functions on panel using either backlight control pins or Aux Channel control commands

The Teledyne LeCroy quantumdata 980 DP1.4/USB-C/eDP Video Generator/ Analyzer module provides an unprecedented combination of functional and compliance testing for video, audio and protocol of DisplayPort devices. The module supports 1.62, 2.7, 5.4 & 8.1 Gb/s data rates on 1, 2 & 4 lanes on its Tx video generator port and its Rx analyzer port for both the standard DP ports and the new USB-C ports with DP Alt Mode.

The module's protocol analyzer supports real time analysis and deep analysis using captures of incoming DisplayPort streams from source devices including DSC/FEC compressed streams. The module's video generator can be used for testing displays, USB-C adapters, extenders, etc. The module is equipped with all the standard video timings and test patterns necessary for testing modern displays.

The 980 DP 1.4 Video Generator / Protocol Analyzer module supports a full suite of link layer and NEW! EDID compliance tests for both sources and sinks including compliance tests for forward error correction (FEC).

The full-size DP and USB-C Tx and Rx ports support Auxiliary Channel analysis of the DP Aux Channel, and the USB-C ports support Aux Channel Analysis of the USB-C Configuration Channel. An included Aux Chan monitoring board supports passive monitoring of the DP aux channel via full-size DisplayPort connectors, between a source and display. This enables analysis of link training and HDCP interoperability between devices.

For developers of Embedded DisplayPort (eDP), the new module offers the hardware necessary to support a variety of optional eDP features. Initial support includes fast link training, alternate scrambler seed, Advanced Link Power Management (ALPM) and Tx backlight control. A pin header is available to provide access to the backlight Tx control test feature.

The module can be equipped in the 980B Test Platform and controlled either through the embedded 980 GUI Manager or the PC-based GUI Manager

Source Testing

The 980 DP 1.4 Video Generator / Analyzer module emulates a DP display device (sink) for analyzing source devices. There are two options for the analysis function for testing DisplayPort source devices:

- Basic Analyzer – Provides real time viewing of video and metadata for functional testing.
- Capture/Store Protocol Analyzer – Provides capture and store of the main link including protocol and control packets, main stream attributes and secondary data.

Display Testing

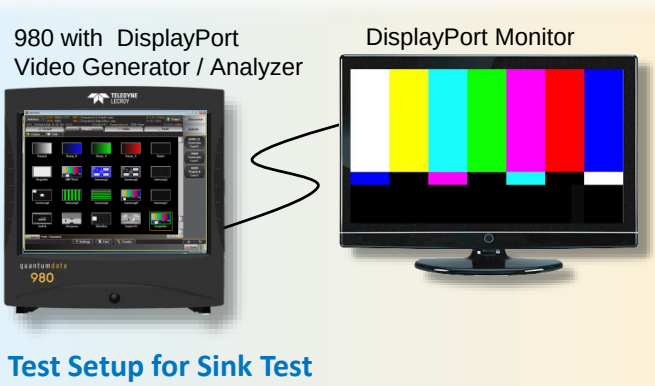
The 980 DP 1.4 Video Generator / Analyzer module supports video, audio and protocol functional testing of high-end DP displays. The module supports 1.62, 2.7, 5.4 & 8.1 Gb/s data rates on 1, 2 & 4 lanes on both its Tx ports and its Rx ports.

The module also supports DP 1.4 Link Layer HDCP 2.2 compliance testing for DisplayPort source, sink and repeater devices and link layer compliance testing for sink devices.

DISPLAY TESTS – VIDEO/AUDIO TESTING

Video Generation

The 980 DP 1.4 Video Generator / Analyzer module supports video and audio functional testing at link rates up to 8.1 Gb/s on 1, 2 and 4 lanes to support high resolution formats. The module has an extensive set of video formats and library of test patterns. You can set any pattern in motion to test motion artifacts with the Image Shift feature.



Test Setup for Sink Test

Link Training Control and Configuration

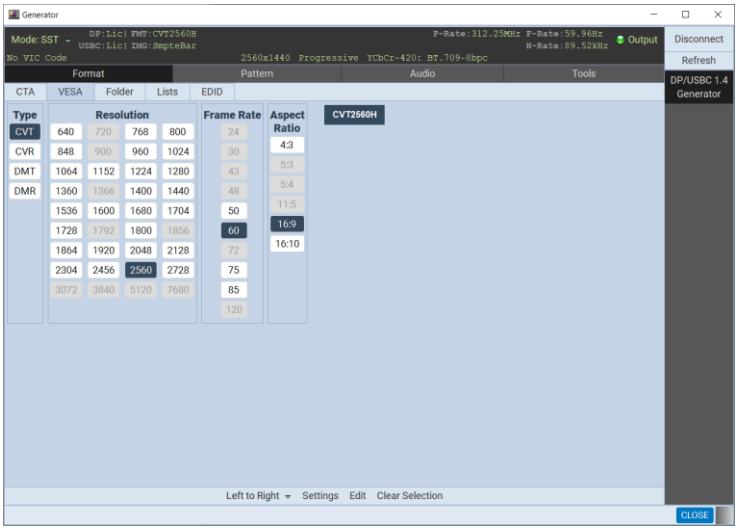
The module's link training control feature enables you to configure the link training parameters during testing. You can set limits on the lane count and link rate and allow the link training engine to establish link training based on those limitations or you can force link training parameters—lane count, link rate, voltage swing, pre-emphasis.

Link Training Control and Configuration

Alt Mode Negotiation

The USB Type C Transmit connector participates in discovery, power contract negotiation, and DP Alt Mode negotiation. The protocol messages can be monitored on the Auxiliary Channel Analyzer (right).

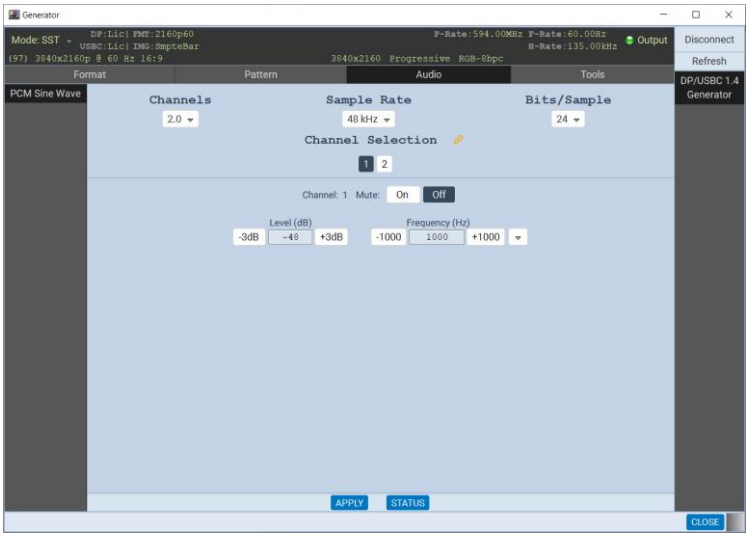
Format Selection



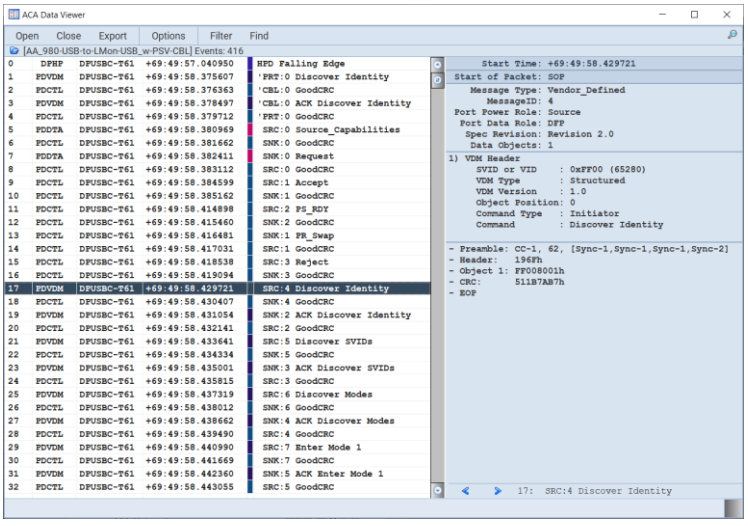
Audio Testing

The module offers a programmable LPCM audio sine wave generator enabling you to set the number of channels (up to 8), the amplitude, frequency, sampling rate and bit depth for uncompressed formats.

LPCM Audio Testing



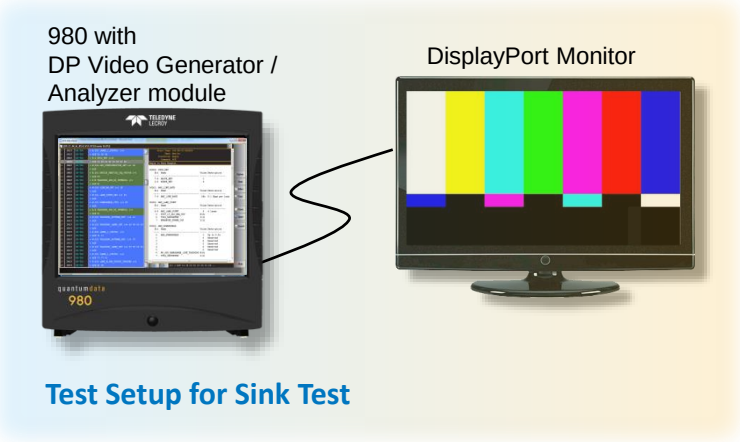
Aux Channel Analyzer – DP Alt Mode Negotiation



DISPLAY TESTS - PROTOCOL TEST FEATURES

Protocol Testing

The 980 DP 1.4 Video Generator / Analyzer module offers a variety of features for testing DisplayPort protocols. You can verify HDCP 1.3 and HDCP 2.2 authentication transactions between the module's Tx port and a DP display. The module's EDID Decode feature enables you to examine the EDID of the connected display. The DPCD Decode feature enables you to examine the DPCD registers of the connected display. You can read the EDID and/or the DPCD of downstream MST nodes.



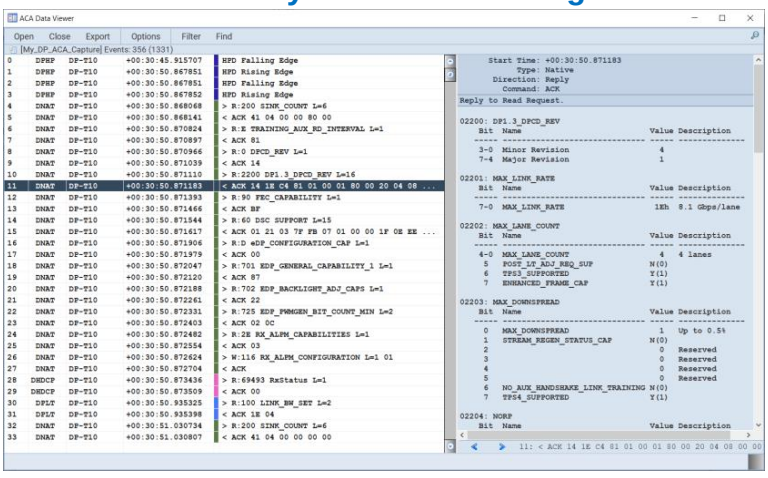
Multi-Stream Transport

The DP 1.4 Video Generator / Analyzer module emulates an MST source for testing an MST branch device or MST-capable monitor. Up to four (4) streams are supported with a depth of one. The Auxiliary Channel Analyzer (ACA) utility depicts the MST negotiations with the connected MST Rx device.

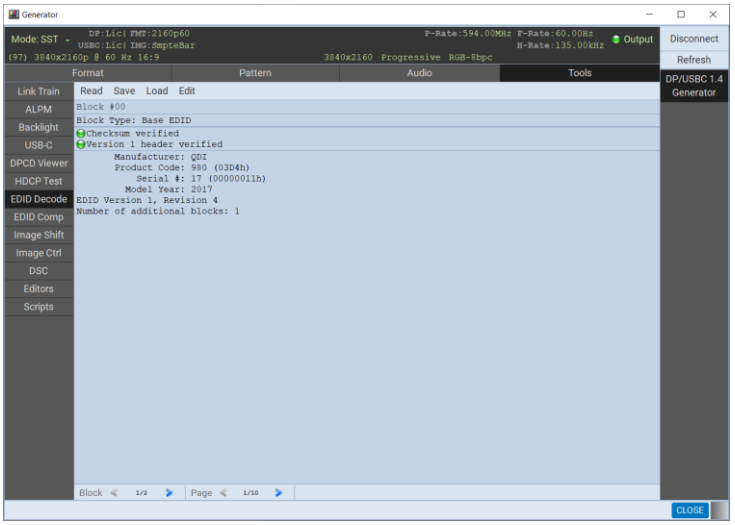
Auxiliary Channel Analyzer

The 980 DP 1.4 Video Generator / Analyzer module's Auxiliary Channel Analyzer (ACA) feature enables you to monitor the DP Aux Channel for link training and MST negotiations, HDCP transactions and EDID exchanges between the DP 1.4 module and a connected display. The ACA logs these events and assigns precise timestamps to them. You can view the details of each transaction. These ACA logs can be saved and disseminated for further analysis by colleagues and other subject matter experts.

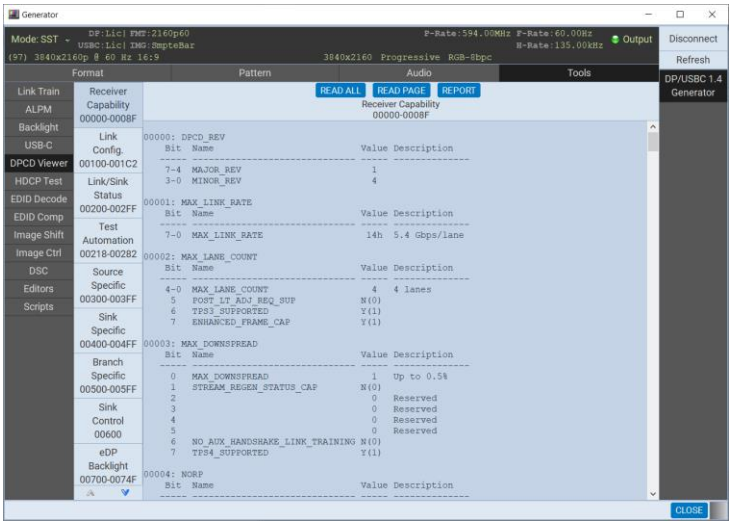
Aux Channel Analyzer – Link Training



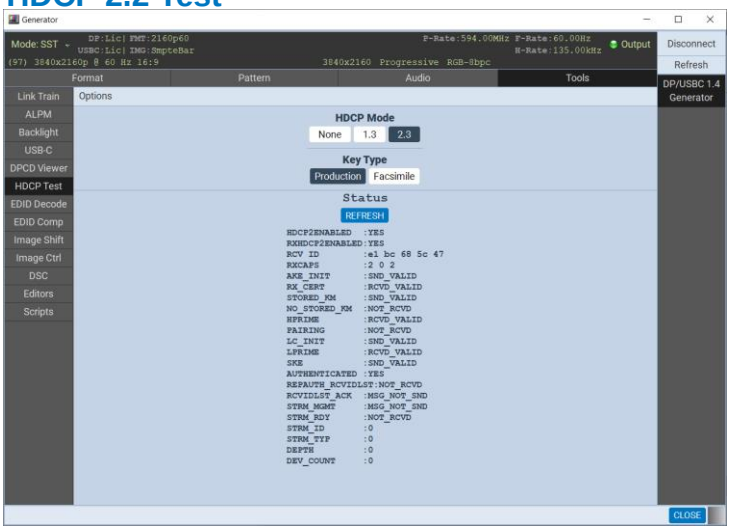
EDID Decode View



DPCD Register View



HDCP 2.2 Test



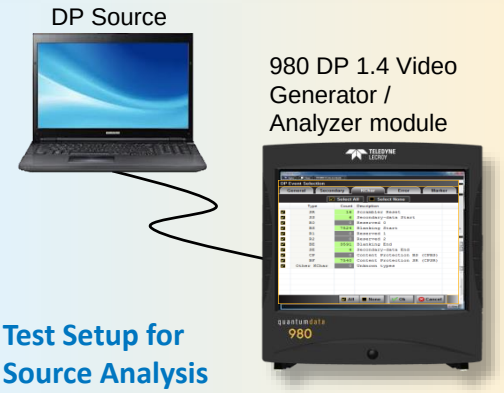
SOURCE TESTS – CAPTURE & DECODE FOR DEEP

Capture and Decode

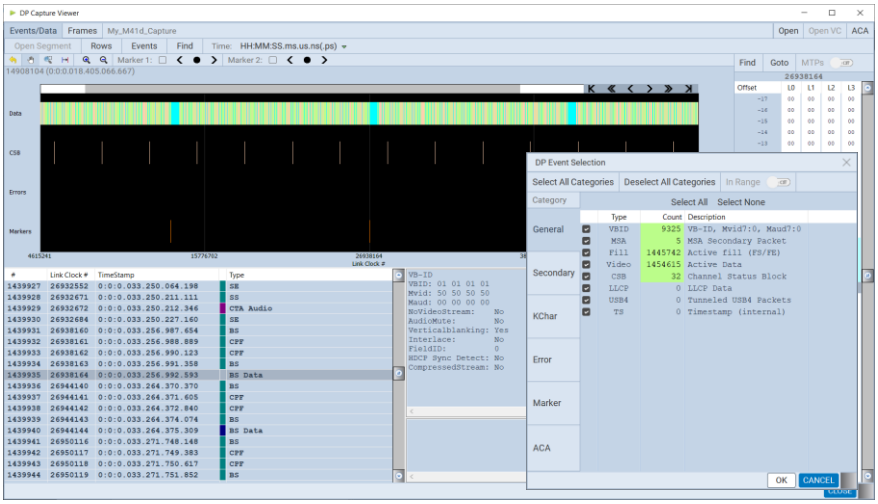
The 980 DP 1.4 USB-C Video Generator / Analyzer captures and decodes the main link attributes in order to diagnose interoperability issues related to them. The Protocol Analyzer captures & stores main link data and provides visibility into main stream attributes, secondary data elements, K-Characters and protocol errors. The Protocol Analyzer presents these elements on a graphical timeline and in a table. You can search for data and select any transaction in the table to view its details. The capture utility also enables you to capture specific MST streams from the source.

DP Alt Mode Negotiation

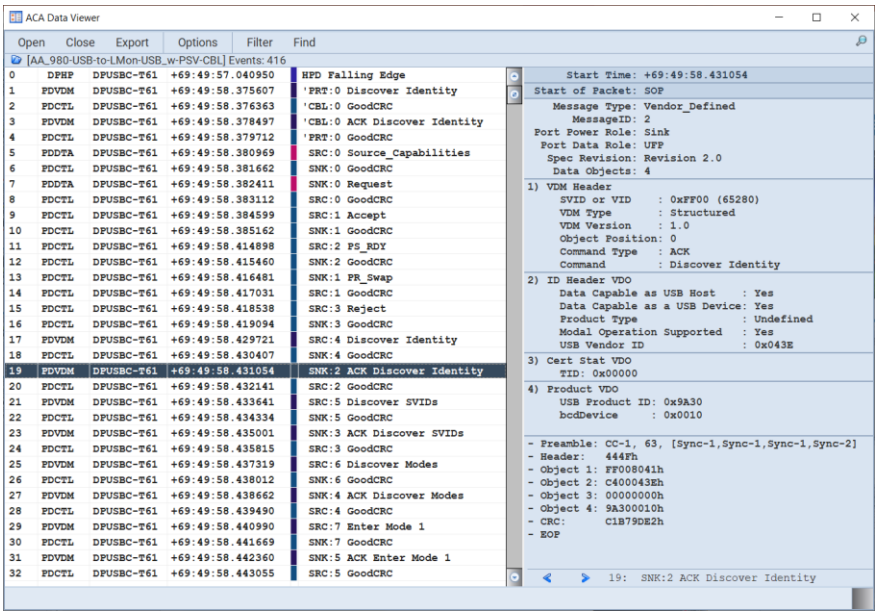
The 980 DP 1.4 USB-C Generator / Analyzer USB-C Rx connector participates in discovery, power contract negotiation, and DP Alt Mode negotiation. The protocol messages can be monitored on the Auxiliary Channel Analyzer.

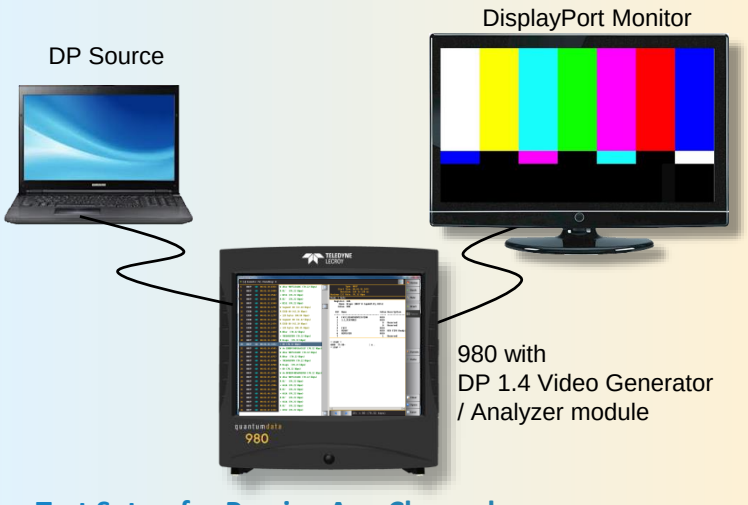


Capture and Decode (Filter View showing only Audio Packets)



DP Connection Sequence with DP Alt Mode Negotiations





(Passive) Auxiliary Channel Analyzer

The 980 DP 1.4 Video Generator / Analyzer module's Adjunct Auxiliary Channel Analyzer board enables you to monitor the DP Aux Channel for link training and MST negotiations, HDCP transactions and EDID exchanges between a DisplayPort source and display device. This enables developers to investigate interoperability problems between DisplayPort devices involving link training, HDCP and EDID. Solution is provided using a custom cable provided by Teledyne LeCroy. The ACA logs these events and assigns precise timestamps to them. You can view the details of each transaction. These ACA logs can be saved and disseminated for further analysis by colleagues and other subject matter experts.

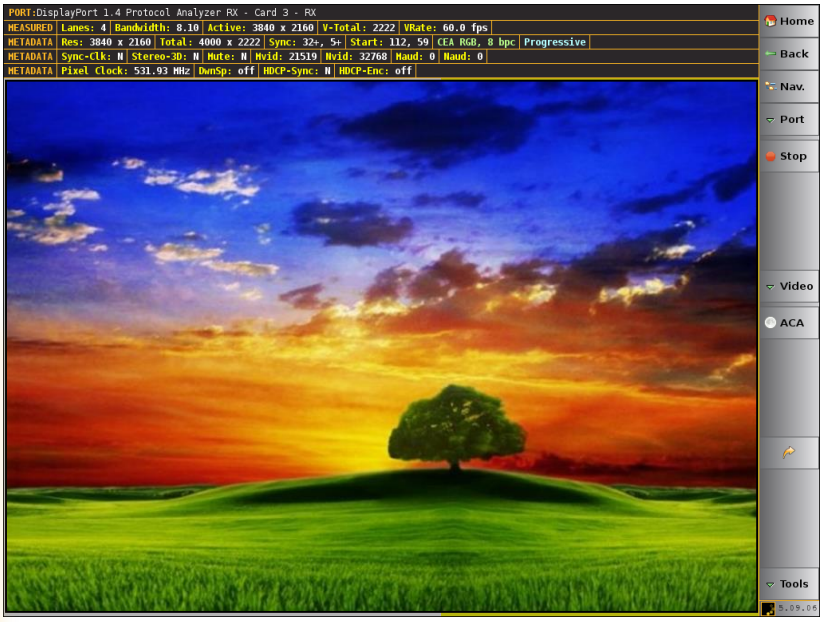
UDPATE! SOURCE ANALYSIS & AUX CHANNEL ANALYSIS

Analyzer

The 980 DP 1.4 module's Analyzer enables you to view the incoming video, link rate, timing, colorimetry and various other metadata at a glance. The Analyzer provides a basic confidence test to verify that the incoming video is essentially correct. The Rx port emulates any EDID to test a source devices handling of various EDIDs. You can also configure DPCD registers for emulating on the DP Rx port using the DPCD Editor (below).

Source Test Setup

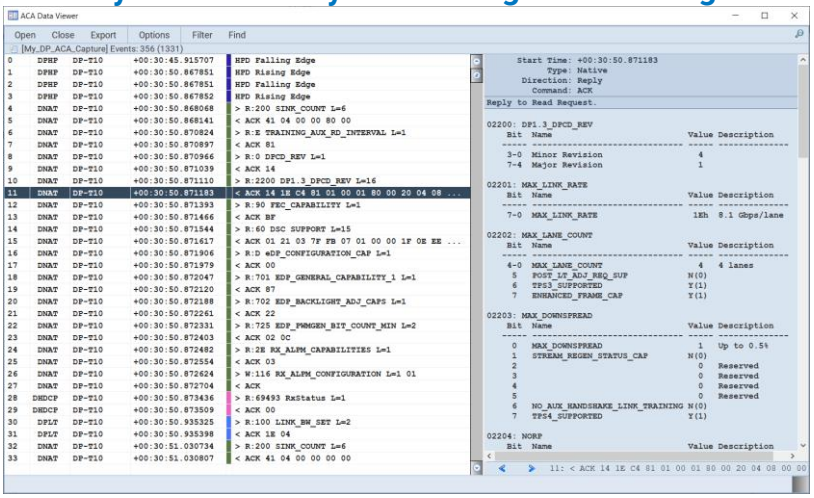
Real Time Analysis



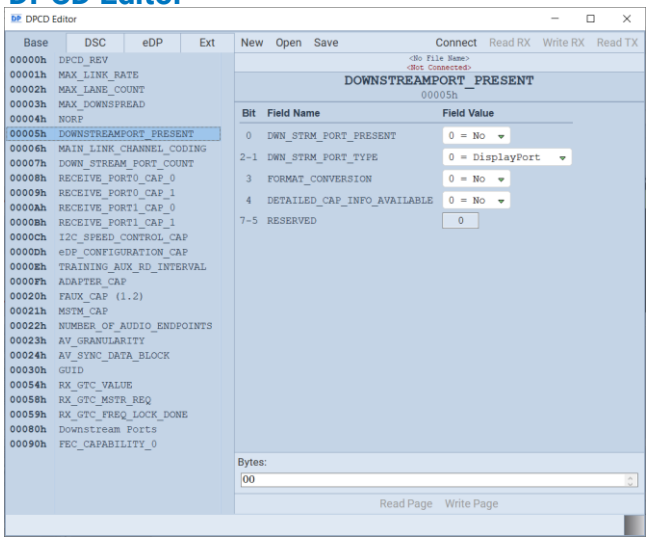
Aux Channel Analyzer (ACA)

The 980 DP 1.4 module's Auxiliary Channel Analyzer (ACA) feature enables you to monitor the DP Aux Channel for link training, MST negotiations, HDCP transactions and EDID exchanges between the M41d Rx port and a source device. The ACA logs the events and assigns precise timestamps to them. You can view the details of each transaction. These ACA logs can be saved and disseminated for further analysis by colleagues and other subject matter experts.

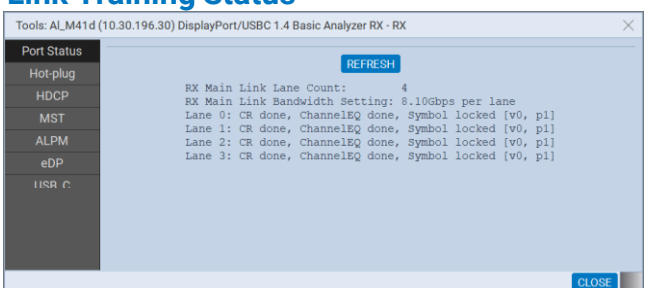
Auxiliary Channel Analyzer Showing Link Training



DPCD Editor

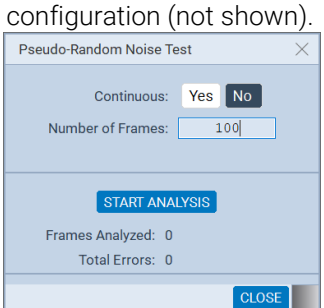


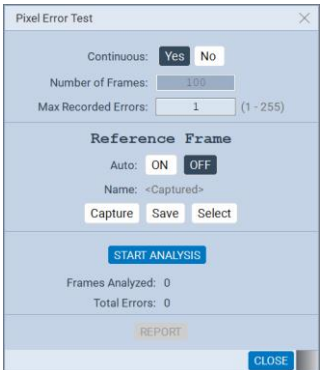
Link Training Status



Pixel Error Test for Cables and Distribution Devices

The M41d support a Pixel Error test (or a Pseudo-Random Noise tests for verifying cables and distribution equipment, The test is run in a loopback configuration (not shown).

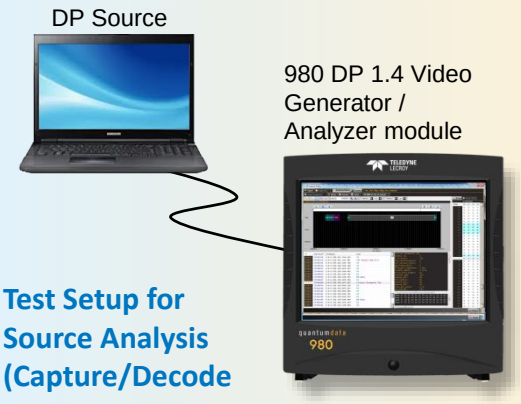




DISPLAY STREAM COMPRESSION (DSC) TESTING

DSC Analysis

The 980 DP 1.4 Video Generator / Analyzer module's DSC analysis feature enables developers to view the DisplayPort DSC related protocol elements such as the picture parameter set, end of chunk packets and compression flag settings in the VBID to ensure that these elements are occurring in the video stream and that they are occurring in the proper sequence. The DSC analysis feature also captures and decompresses the video frames enabling developers to examine them for compression artifacts. The Forward Error Correction (FEC) transport mechanism, which ensures reliable, error free video transport, can also be verified.

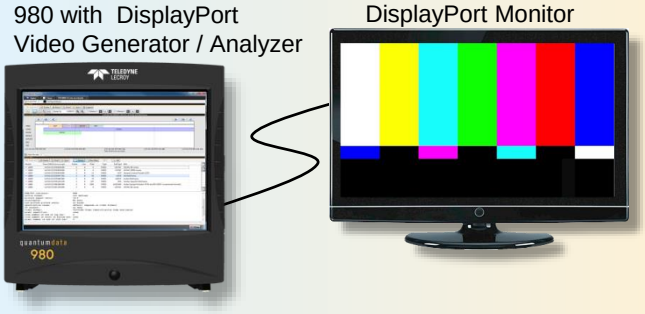


ACA DPCD Reads for DSC Capabilities

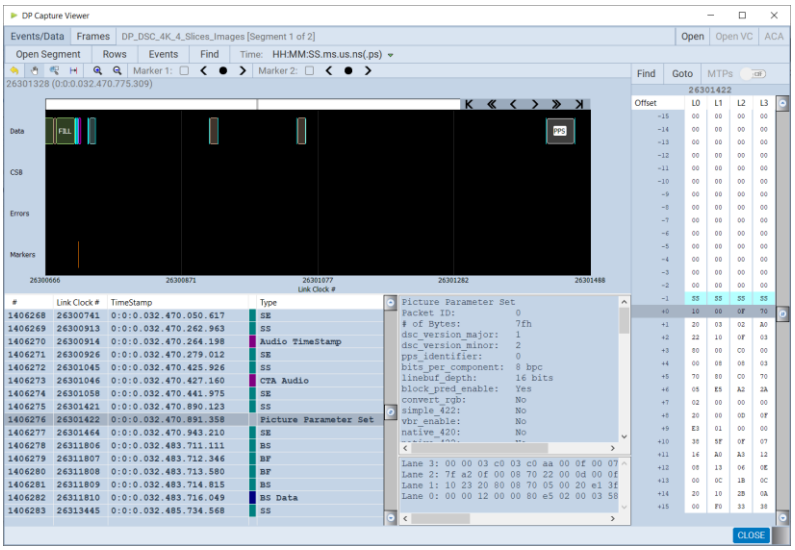
The 980 DP 1.4 Video Generator / Analyzer module's ACA utility provides a log of the Aux Channel transactions. The link training can be viewed as well as the DPCD register reads and writes involved in the setup and maintenance of Display Stream Compression (DSC) and Forward Error Correction (FEC).

Video Generation (DSC/FEC)

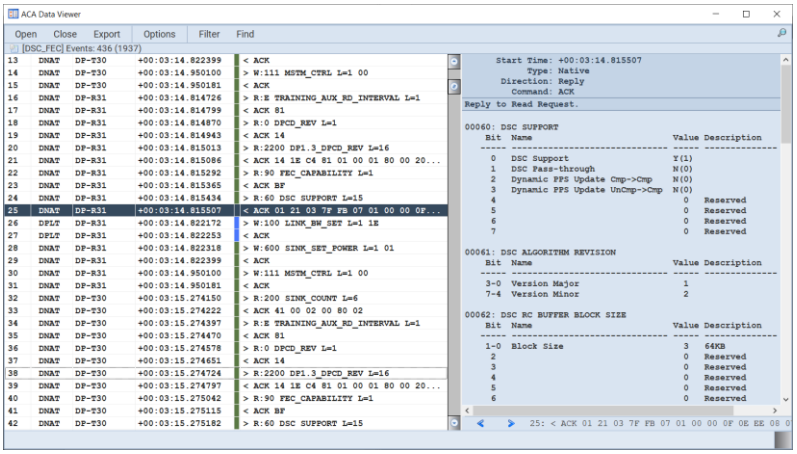
The module's DSC/FEC video generator feature enables display developers to transmit DSC/FEC streams. Users can selection from several test patterns and configure the colorimetry, bits per component, bits per pixel, line buffer bit depth and DSC slice configurations.



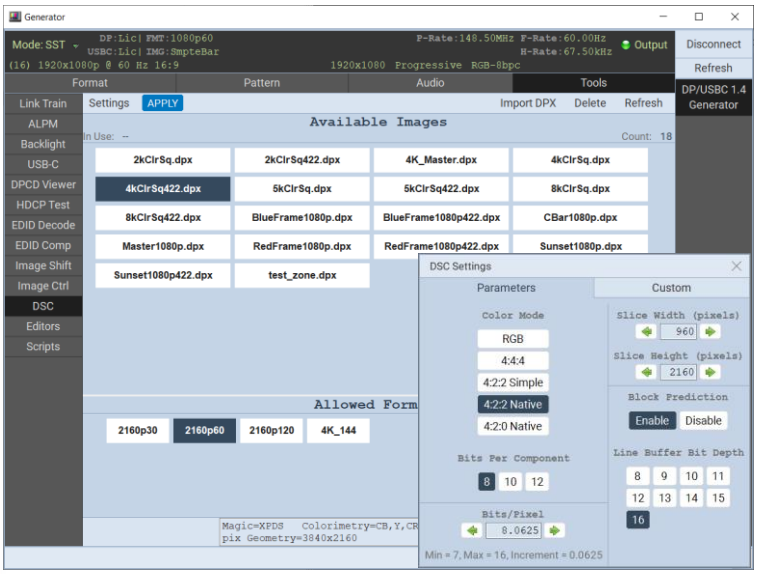
DSC Analysis showing Picture Parameter Set (PPS)



ACA showing DPCD reads for DSC capabilities



DSC / FEC Video Generation

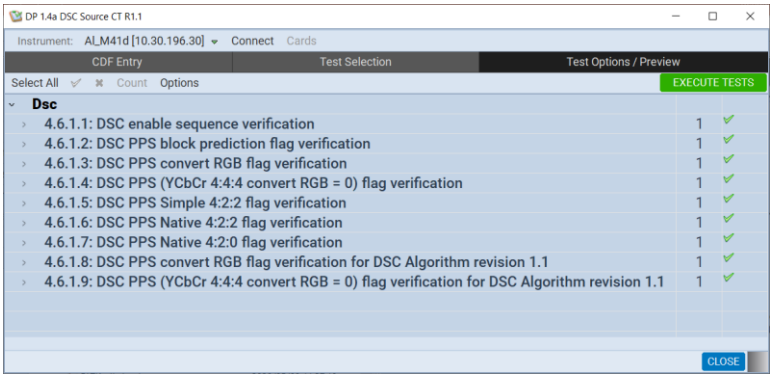


DISPLAY STREAM COMPRESSION (DSC) COMPLIANCE

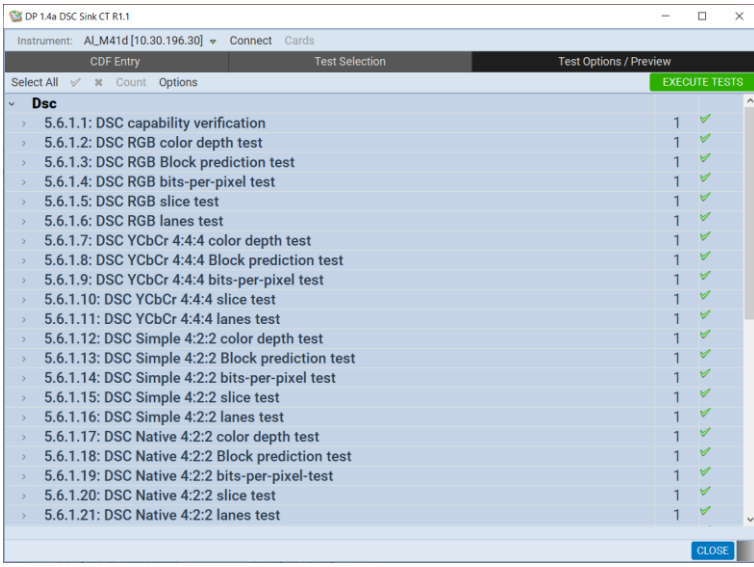
DSC Compliance

The 980 DSC source and sink compliance tests are ideal for pre-testing your DisplayPort 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. (Refer to the test setups on the previous page.)

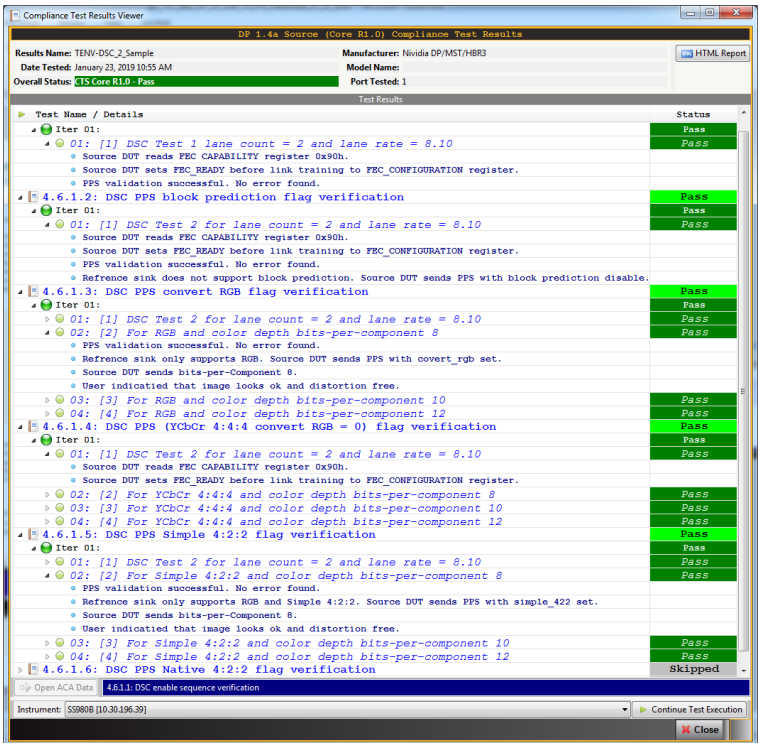
DSC Source Tests



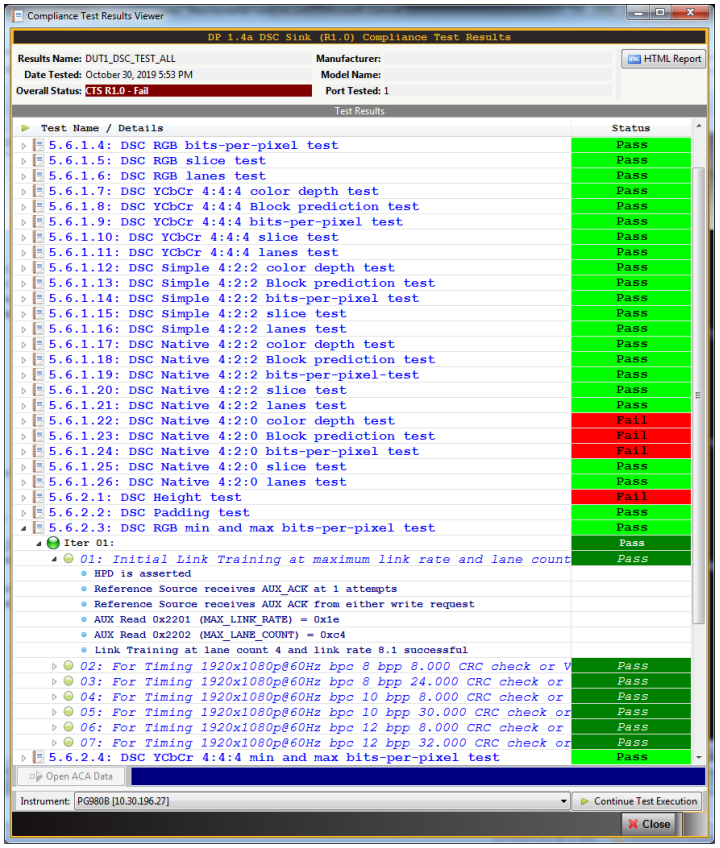
DSC Sink Tests



DSC Source Tests - Test Results



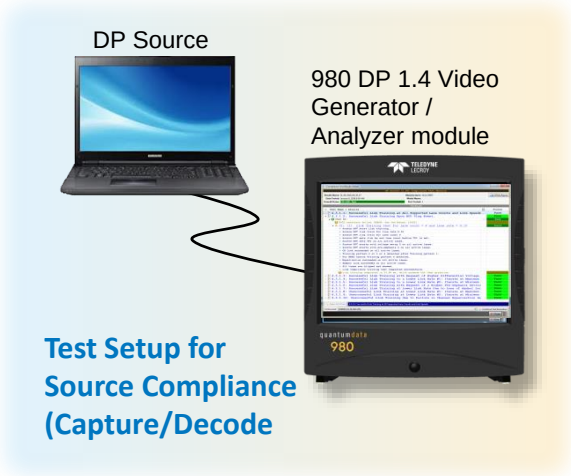
DSC Sink Tests – Test Results



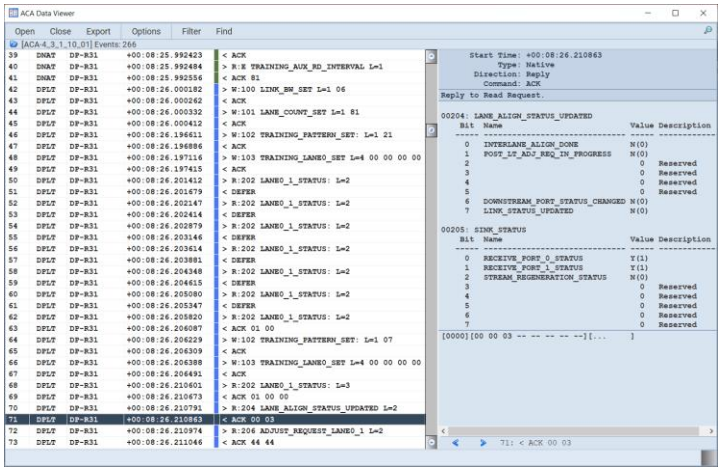
DP 1.4 LINK LAYER SOURCE COMPLIANCE

Source Link Layer Compliance Approved!

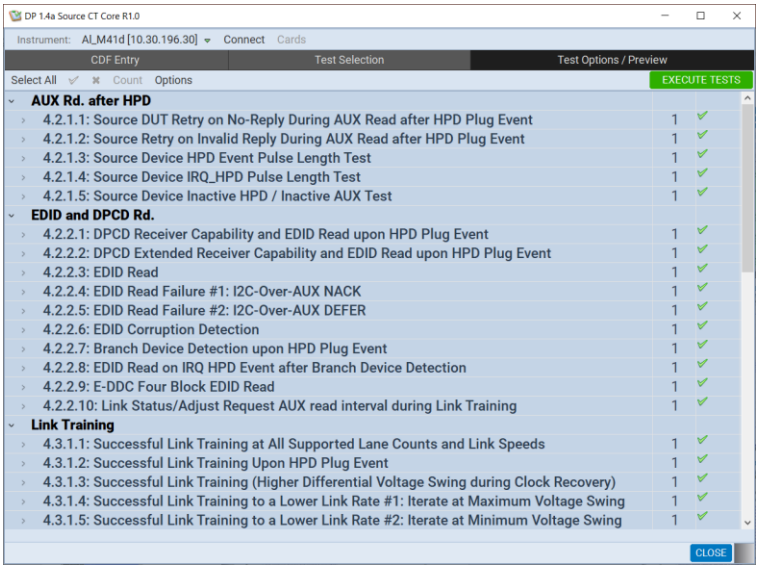
The 980 DP source HBR3 link layer compliance tests are approved by VESA and are ideal for self-testing or pre-testing your HBR3-capable DisplayPort 1.4 source product prior to submission to an Authorized Test Center for approval. Pre-testing provides added assurance that your product will pass at the ATC when submitted. The compliance tests (below right) enable you to view the captured data and detailed test results which help pinpoint the cause of compliance test failures. The link layer compliance test suite now includes tests for forward error correction (FEC). You can link to the aux channel traces in the Aux Channel Analyzer (ACA) to view the root cause of failures (below).



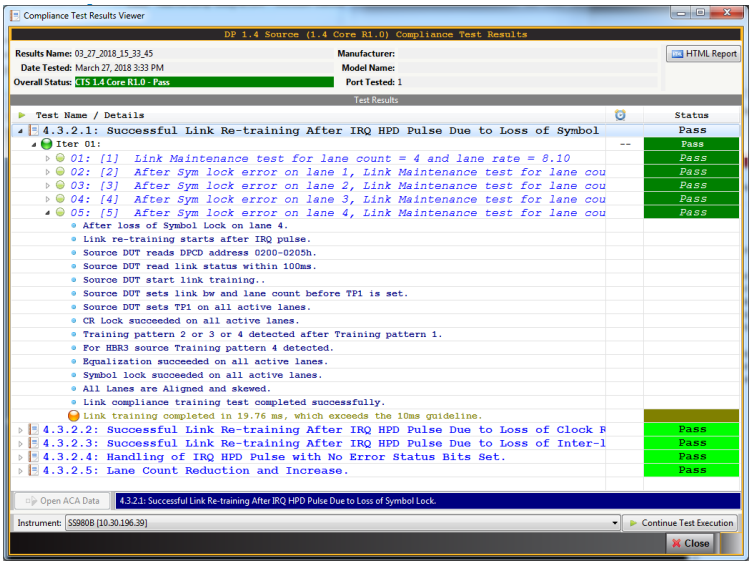
DP Aux Channel Traces – From LLC Test



DP 1.4 Source Link Layer Compliance - Test Selection



DP 1.4 Source Link Layer Compliance Test



DP 1.4 LINK LAYER SINK COMPLIANCE

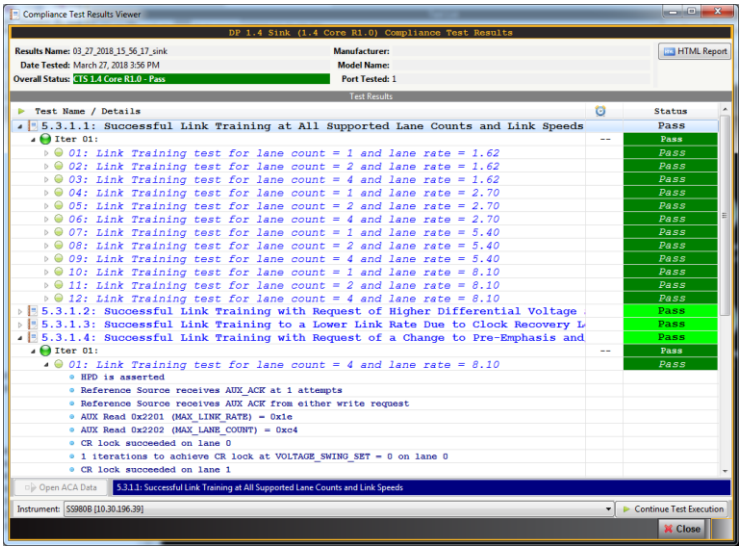
Sink Link Layer Compliance Approved!

The 980 DP sink (display) link layer compliance tests are ideal for pre-testing your DisplayPort 1.4 display 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. The compliance tests (below right) enable you to view the captured data and detailed test results which help pinpoint the cause of compliance test failures. The link layer compliance test suite now includes tests for forward error correction (FEC). You can link to the aux channel traces in the Aux Channel Analyzer (ACA) to view the root cause of failures (below).

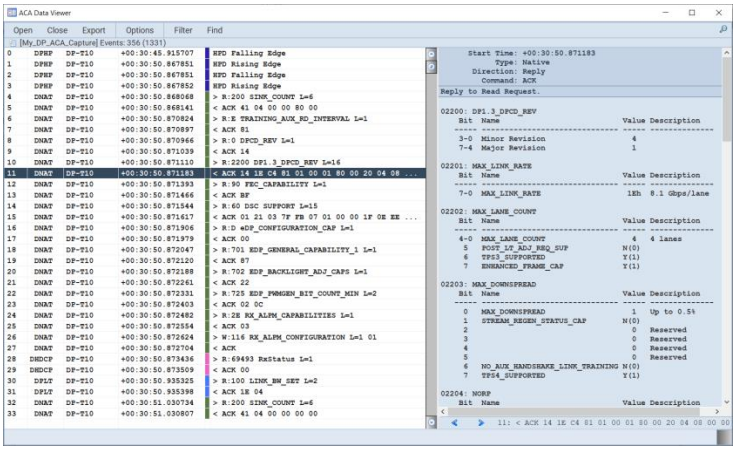
Test Setup for Sink Test

DP 1.4 Link Layer Compliance - Test Selection

DP 1.4 Link Layer Compliance - Test Results



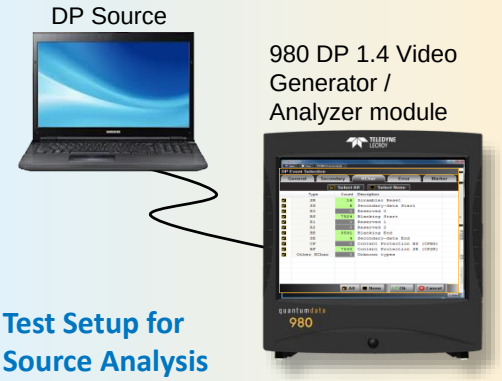
DP Aux Channel Traces – From LLC Test



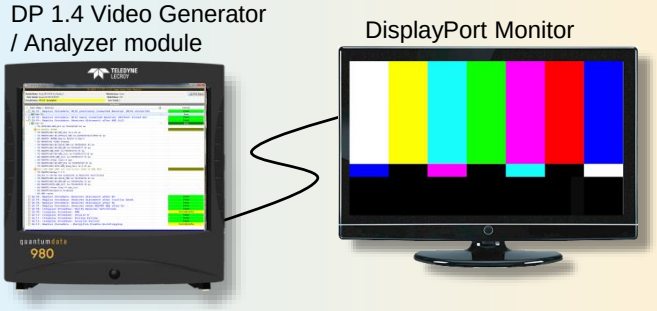
HDCP 2.2 SOURCE, SINK & REPEATER COMPLIANCE

HDCP 2.2 Compliance

The 980 HDCP 2.2 compliance tests are ideal for pre-testing your DisplayPort 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 (not shown) during the test to help diagnose the cause of compliance test failures.

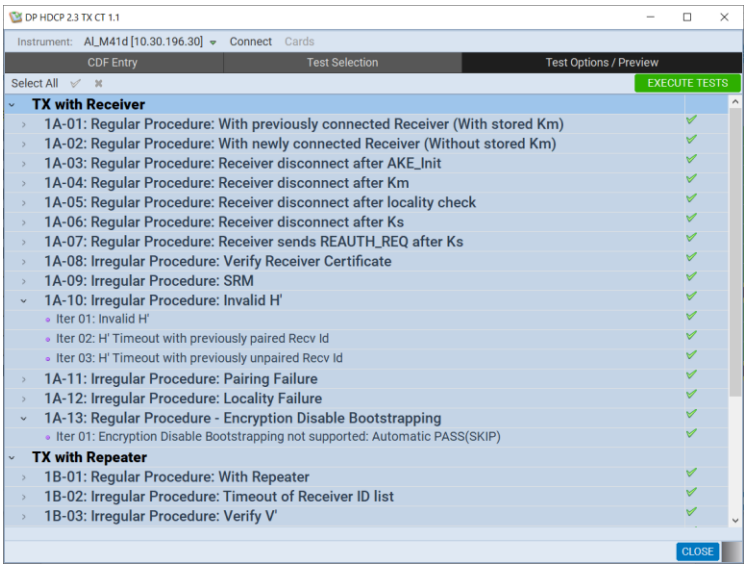


Test Setup for Source Analysis (Capture/Decode

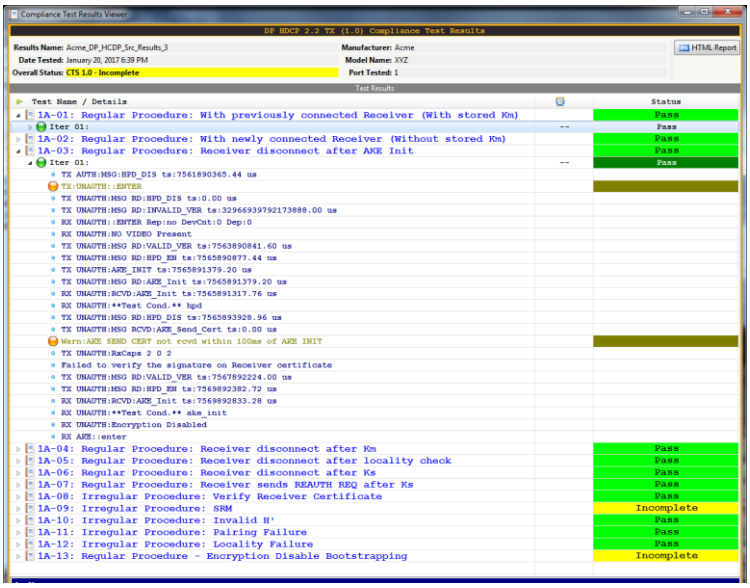


Test Setup for Sink Test

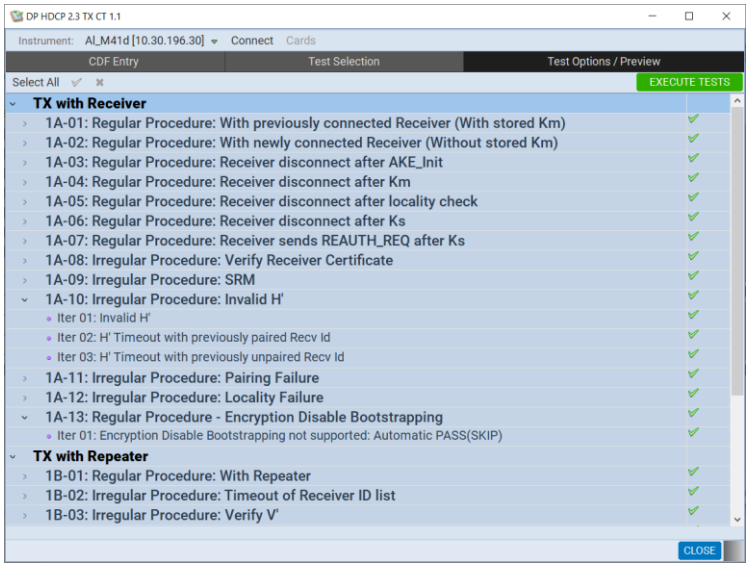
HDCP 2.2 Source Tests - Test Selection



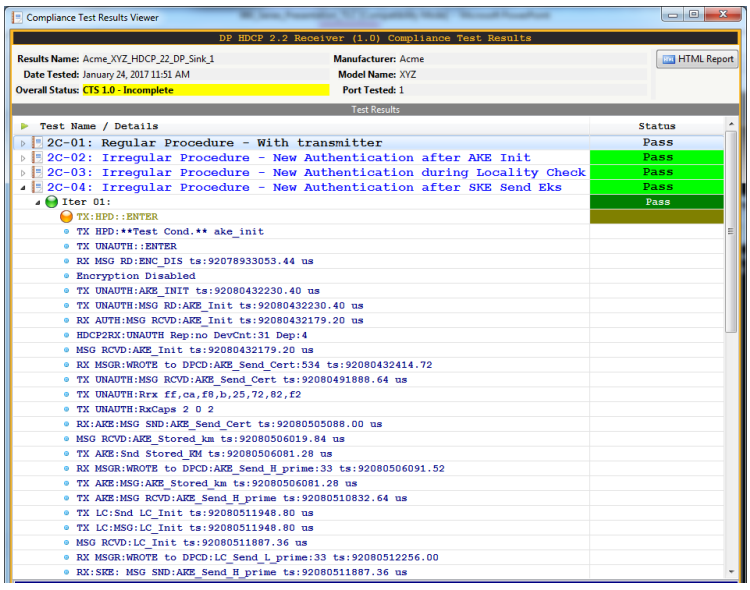
HDCP 2.2 Source Tests - Test Results



HDCP 2.2 Sink Tests - Test Selection



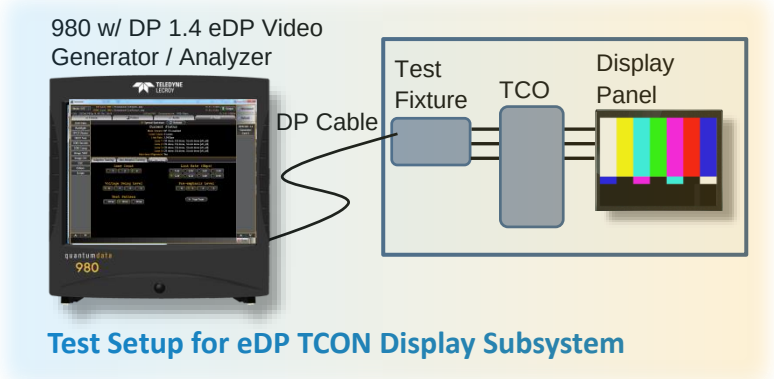
HDCP 2.2 Sink Tests – Test Results



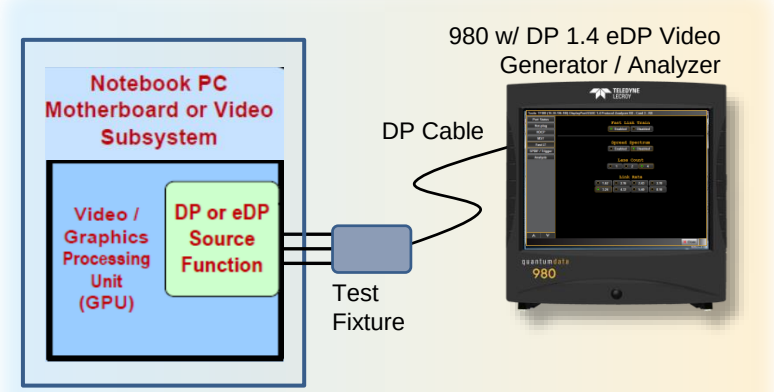
EMBEDDED DISPLAYPORT (EDP) 1.4B TESTING

Embedded DisplayPort eDP - ALPM

The 980 DP 1.4 USB-C/eDP Video Generator / Analyzer supports testing of both eDP source and display subsystems. A standard DP connection from the 980 DP 1.4 eDP-capable module to a test fixture is required to enable connection to the eDP subsystem. For display panel TCON testing, once the connection is made, you can use the Advanced Link Power Management (ALPM) feature to test the display's ALPM function (right) and run any other video tests using the DP 1.4 module's Video Generation function. For eDP source subsystem testing, you can monitor the link training and ALPM state and run captures for analysis, etc. The test setups are shown below.



Test Setup for eDP TCON Display Subsystem



Test Setup for testing eDP source Subsystem

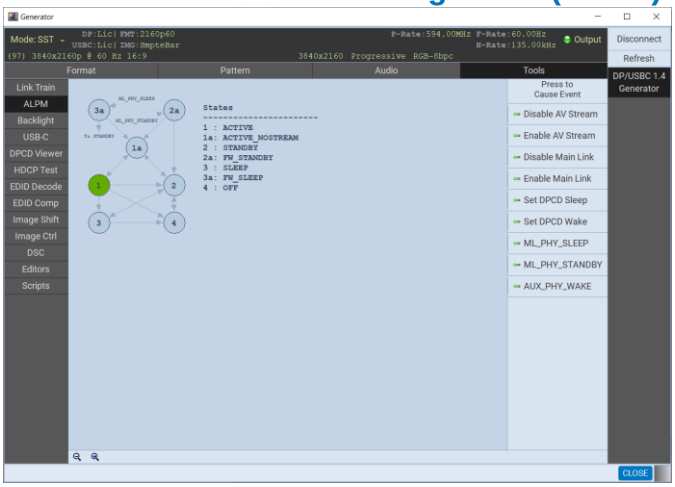
eDP Fast Link Training

The 980 DP 1.4 USB-C/eDP Video Generator / Analyzer supports fast link training acting either as an eDP source subsystem or an eDP display subsystem. The module emulates the necessary Fast Link training DPCD registers When testing a display you can select the Lane Count, Link rate (including "intermediate "eDP lane rates), Voltage Swing, Pre-Emphasis and Training Test Pattern. You can monitor the Aux Channel transactions with the 980 Aux Channel Analyzer utility. (eDP Fast Link Training Source test not shown.)

eDP Tx Backlight Control

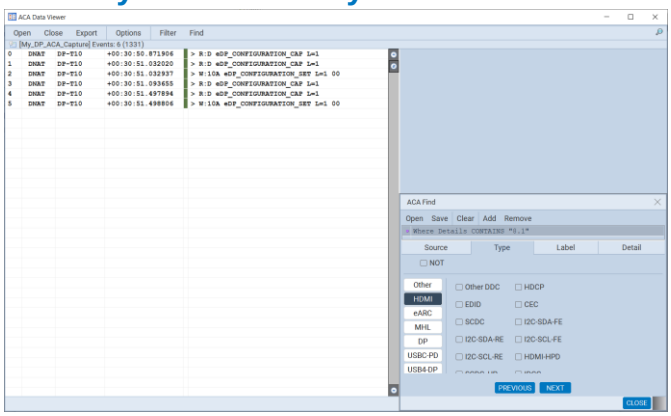
The 980 DP 1.4 USB-C/eDP module supports testing of the eDP backlight control function on eDP TCON display subsystems. Backlight control is supported through the Aux Channel and the backlight control lead. The connection is made through the module's eDP header pins on the faceplate. You can select between High and Low backlight enable, set the PWM duty cycle, pre-scaling and PWM generator divider.

Advanced Link Power Management (ALPM)



Link Training Control and Configuration

Auxiliary Channel Analyzer – Fast Link Train



eDP Tx Backlight Control

SPECIFICATIONS

DisplayPort 1.4 / USB-C/ eDP Module

Version	DisplayPort 1.4a
Standard Formats	VESA, CTA
Connectors/Ports	
DP Full-Size	Tx (1) DP Full-size; Rx (1) DP Full-size
USB-C	Tx (1) USB-C with DP Alt Mode; Rx (1) USB-C with DP Alt Mode
eDP Header	Pins to access eDP Tx backlight controls
Aux Chan Adjunct Board	Tx (1), DP Full-size; Rx (1) DP Full-size
Protocol	DisplayPort
Video Data Rates	1.62, 2.7, 5.4, 8.1 Gb/s Link rates 1, 2, 4 Lanes
Color Depths	8, 10, 12, 16 bits
Video Encoding	RGB, YCbCr
Video Sampling Modes	4:4:4, 4:2:2, 4:2:0
HDCP	Versions 2.2 & (1.3 on 1 & 2 lanes only)
Audio	8 Channel LPCM programmable sine wave
Capture memory	8 GBytes

Options

DisplayPort Tx / Rx	Either or both: - DP Tx for display testing; selectable between DP Standard and USB-C - DP Rx port, two options; selectable between DP Standard and USB-C: - Basic Analyzer - Capture/Store Protocol Analyzer (requires Basic analyzer option)
DP Passive Aux Channel Analyzer	Monitor DisplayPort Aux Channel transactions in real time passively between a source or sink. Includes custom cable and Aux Adjunct board.
DP Capture Analysis of DSC Streams	Capture and analyze incoming Display Stream Compression (DSC) streams. There are no limits on the number of DSC slices for analysis.
DP Video Generation of DSC/FEC Streams	Select from a variety of DSC/FEC test patterns. Select colorimetry and configure slices. There are no limits on the number of DSC slices supported.
DP HDCP 2.2 Compliance Test	Run HDCP 2.2 compliance test on DisplayPort sources, sinks and repeaters (3 separate options) – Now Approved by DCP.
DP 1.4 Source Link Layer Compliance (Package #3)	Run DisplayPort 1.4 source Link Layer compliance test. (Sections: 4.3.1, 4.3.2, 4.3.3, 4.4.4, 4.5.1 [FEC])
DP 1.4 Sink Link Layer Compliance (Package #4)	Run DisplayPort 1.4 sink Link Layer compliance test (displays). (Sections: 5.2.1, 5.3.1, 5.3.2, 5.4.1/2 5.4.3, 5.4.4, 5.5.1 [FEC].)
DP 1.4 Sink EDID Compliance.	Run DisplayPort 1.4 sink EDID/DisplayID compliance test (displays).
NEW! DP 1.4 Source EDID Comp.	Run DisplayPort 1.4 source EDID/DisplayID compliance test.
DP 1.4 Source DSC/FEC Compliance	Run DisplayPort 1.4 source DSC/FEC compliance test Sections. 4.6.1/4.5.1.1. **Requires 64-bit 980 system.**
DP 1.4 Sink DSC/FEC Compliance	Run DisplayPort 1.4 Sink DSC/FEC compliance test. Sections 5.6.1, 5.6.2/5.5.1.1
Embedded DisplayPort (eDP) 1.4b	Test eDP source and display devices using fast link training, Advanced Link Power Management (ALPM) and backlight control testing of displays.

980 Test Platforms

Embedded Display	980B: 15" diagonal; Resolution: 1024(H); x 768 (V) resolution; 24 bit RGB color. 980R: 7" diagonal: Resolution: 800 (H) x 480 (V); 24 bit RGB color.
Power	90-264 VAC, 47-63Hz
Weight	23.76 LBS; 10.78 Kg
Size	980B: Height: 15.25 in. (38.7cm) Width: 14.57in. (36.5cm) Depth: 6.29in. (15.9cm) 980R: Height: 6.29 in. (15.9cm); Width: 15.25in. (38.7cm); Depth: 14.57in. (36.5cm
Command Line Control	Ethernet (RJ-45) for external GUI and telnet
Environmental	Operating Temp: 32 to 104 (F); 0 to 40 (C)

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