Test Solutions for DisplayPort 1.2b
Automated Conformance and Embedded DisplayPort Conformance SW

The Tektronix DP12 software, combined with a DisplayPort AUX controller automates DisplayPort physical layer source compliance testing. DP-AUX eliminates the need for user interaction during testing and the need to use vendor-specific proprietary software. Engineers can simply select the desired tests to run and work on other tasks while the tests are being executed. The DP-AUX stand-alone GUI can also be used in validation, debug, and characterization of DisplayPort Source and Sink devices. The new TEK-GRL-DP-SINKSW automates the DP Rx testing.

Key features
- Speeds up test time – No user interaction is required to change source output signal or validate sink silicon state or error count
- Automates DisplayPort 1.2b physical layer testing
- Fully Integrated with DisplayPort Physical Layer Source Automation Software (Option DP12)
- Stand-alone GUI provides flexibility to perform DisplayPort tests without automation software
- No need to learn vendor-specific software – a single GUI supports all vendors
- View decoded AUX traffic and Hot Plug Detect (HPD) events from the Device Under Test to the DP-AUX DisplayPort AUX Controller
- Ability to read and write DPCD registers supports debug activities
- USB Interface enables the DP-AUX to run on a PC, oscilloscope, or arbitrary waveform generator
- Option eDP provides dynamic mask generation to ensure proper testing

- Adds DP++ Clock jitter and eye diagram tests as per DP1.2b CTS
- Adds DP-AUX Manchester Channel Eye Diagram and sensitivity test as per DP 1.2b. CTS (requires AUX Test fixture from VTM, or the Wilder DP-AUX fixture can be used)
- Introduces automated DP RX solution for BERTScope
- Adds DP++ fixtures in Tektronix ordering system
- New report format

Applications
DisplayPort/eDP debug, characterization and compliance for:
- Silicon validation
- Computer system validation and integration

Complete automation for DisplayPort testing
DP-AUX connects using USB to a PC, Tektronix DPO/DSA/MSO70000 Series (8 GHz minimum) oscilloscope, or BERTScope BSA85C Bit Error Rate Analyzer and connects directly to the DisplayPort Plug Test Fixture (TF-DP-TPA-P) and the DisplayPort Receptacle Test Fixture (TF-DP-TPA-R). The AUX channel connects through SMA connectors on the DP-AUX to the SMA connectors on the DisplayPort test fixture. The Hot Plug Detect line connects from the 4-pin header on the DisplayPort test fixture to the DP-AUX Auxiliary Controller using the included hot-plug cable.

The DP12 Physical Layer Measurement and Automation system from Tektronix is a performance (8 GHz and higher) oscilloscope software application option designed to perform the core measurements found in the DisplayPort Version 1.2b Compliance Test Specification or CTS.

The VESA DisplayPort 1.2b specification adds a new series of compliance test specifications which supersedes the legacy DP1.1a specification. A third speed grade of higher performance, DP1.2 introduces a new higher data rate of 5.4 Gb/s known as HBR2 speed. This allows for increased resolutions, higher refresh rates, and greater color depth. Other improvements include multiple independent video streams (daisy-chain connection with multiple monitors) and support for stereoscopic 3D media.
Transmitter testing

The Version 1.2b CTS outlines 21 transmitter physical layer validation tests which are typically evaluated with an 8 GHz or higher bandwidth oscilloscope. DP++ Clock Jitter and DP++ Eye Diagram tests added along with DP-AUX Eye Diagram and sensitivity tests.

Source Test Suite:
- EYE diagram
- Non pre-emphasis level verification
- Pre-emphasis level and post-cursor2
- Inter-pair skew
- Intra-pair skew
- Differential transition time
- Single-ended rise and fall time mismatch
- Overshoot and undershoot test
- Frequency accuracy
- AC common mode noise
- Non-ISI jitter measurement
- Total jitter and random jitter measurement
- Unit interval
- Main link frequency compliance stability
- Spread spectrum modulation frequency
- Spread spectrum deviation
- dF/dt spread spectrum deviation HF variation
- Dual Mode TMDS Clock
- Dual Mode Eye Diagram Testing
- AUX Manchester Channel Eye Test (requires AUX Test fixture from VTM, or the Wilder DP-AUX fixture can be used)
- AUX Manchester Channel Sensitivity Test (requires AUX Test fixture from VTM, or the Wilder DP-AUX fixture can be used)

DisplayPort sources (transmitters) have state control requirements in order to transmit the data patterns and signal properties required to demonstrate conformance to the Compliance Test Specification.

The following properties and patterns need to be transmitted for full measurement coverage:
- Bit rates: RBR, HBR, or HBR2
- Data patterns: D10.2, PRBS7, COMP, PLTPAT, PCTPAT
- FFE (pre-emphasis): 0 dB, 3.5 dB, 6 dB, 9.5 dB
- Output levels: 400 mV, 600 mV, 800 mV, 1200 mV
- SSC (spread spectrum): On/Off
- Post-cursor2: Level 0, 1, 2, 3
These states can be either controlled manually (key during early silicon turn-on) or with a Tektronix DP-AUX controller. This control accessory interacts with the DUT’s DPCD registers to automate the extensive number of measurements required to comprehensively test all 4 DisplayPort lanes. The DP-AUX controller can read and write DPCD registers directly, supporting both physical-layer and digital validation and debug.

A full-featured DP 1.2 device requires 432 acquired signals to completely test all elements of the silicon per lane. X4 lanes results in 1728 automated acquisitions per DUT.

**DP-AUX for DisplayPort test system support**

The DP-AUX system is a vital component to support the debug or automated testing of DisplayPort systems. The DP-AUX system interfaces to either a DisplayPort Source or Sink device’s auxiliary channels and hot-plug detect system to permit full access to the internal DPCD registers.

The DP-AUX Source Test tab permits full DPCD-based control of the three DP 1.2 bit rates (1.6, 2.7, and 5.4 Gb/s) as well as the broadcast patterns and transmitter attributes.

The Sink Test facilities in the DP-AUX system permit DPCD-based interaction with a Sink (receiver) based error detection system to permit evaluation of receiver’s conformance status to impaired compliance test signals or for determining device margin.

The DP-AUX sets the receiver up to receive the frequency lock and symbol lock patterns to validate that link training was successful. This then enables users to conduct the receiver testing in-line with the Version 1.2 Compliance Test Specification.
DP-AUX debug

User-level debug which permits direct DPCD register read/write operations as well as monitoring AUX-level protocol traffic, offers a unique level of transaction and link training monitoring options. The DP-AUX accessory can be loaded on any Windows XP or Windows 7 PC, however it’s typically resident on the instrument as a control agent for the DP 1.2 measurement and automation system. The DP12 performance instrument option for DSA70000 Series oscilloscopes offers a comprehensive DisplayPort Version 1.2 Physical Layer Conformance Verification and Automation system.

Features:
- User-defined automation or custom controls of the device states
- Variable test controls based on the product’s intrinsic capabilities
  - RBR, HBR, or HBR2 speed selections
  - Voltage swing: 400-1200 mV
  - Post-cursor2 levels
  - Pre-emphasis controls
  - Test pattern selection
- 1, 2, or 4-lane configurations
- Full test pattern validation controls
This RF switch configuration permits comprehensive and fully automated 4-lane input testing of all DisplayPort input channels, including all common mode and intra-/inter-pair skew measurements.

The DP12 transmitter test solution can be configured for 3 different signal input configurations, listed below:

- P7313SMA differential probe based input, which offers the most efficient test configuration, by offering inputs for all 4 differential DisplayPort signals concurrently. This configuration precludes the testing of common mode and skew measurements.

- TCA-based single-ended input (direct Tektronix oscilloscope inputs) supports both differential and single-ended tests including intra-pair skew measurements on up to 2 concurrent DisplayPort signals.

- Keithley RF Switch 12:4 Mux Input
  
  Part Number: KEITHLEY SYSTEM 46
  Model Number: S46T – BBBB0000UUUA

Full CTS 1.2 conformant measurement list tailored to the user-specified DUT capabilities

Comprehensive user-defined and configurable .MHTL report generation with variable degrees of report detail and full append capability.
Receiver testing as per DisplayPort 1.2b CTS

For receiver test verification in the DisplayPort 1.2 spec, Tektronix recommends the use of a BERTScope BSA85C Bit Error Rate Analyzer. The BSA85C, in conjunction with the Interconnect Compliance Channel fixturing from Tektronix, will generate a known amount of ISI, RJ, and TJ at different frequencies to enable proper stress levels on the design’s receiver. Once the crosstalk is applied to the test pattern, the BERTScope can measure the final eye width expected without crosstalk. Then a measurement can be made at each frequency with crosstalk applied and compared with the results above.

With the new TEK-GRL-DP-SINKSW, the DP Rx testing is fully automated addressing the biggest pain point effectively. The Rx test automation SW covers the following:

- Calibration: calibration for all stresses, eye height, and amplitudes for RBR, HBR, and HBR2. This also includes Crosstalk calibration.
- Testing: using the Tektronix AUX Controller, the software will step through Frequency Lock Symbol Lock Test automatically (if your DUT supports automation) at all requires sweep frequencies
- Margin or Compliance: testing can be done in compliance or margin mode
- Test Report: test reports can be generated at the end of each test
Embedded DisplayPort solution

Option EDP is designed to provide component and system designers with a comprehensive verification and debug solution the latest Embedded DisplayPort Specification 1.4. Using the familiar DPOJET look and feel the user can select the setup based on their specific measurements requirements. In addition, as the 1.4 specification allows the data rate to be anywhere within a range of speeds from RBR to HBR2 rates, opt EDP will provide the dynamic mask generation required to ensure proper testing.

Tektronix supports multiple probing solutions for eDP designs. The one of the two common will be a soldered-in probe where the target DUT does not have a connection for a fixture. The second common method is using an eDP test fixture with P7300 Series SMA Probes. Either one of these two methods will allow for complete four lane testing when using four probes.

One additional method the user will have is the direct connections to the fixture with SMA cables. This method allows the user to test one or two lanes at once.
eDP standard tab

**eDP source measurements:**
- Test 3.1 - Eye diagram test
- Test 3.2 - Inter pair skew test
- Test 3.3 - Non-ISI jitter measurements
- Test 3.4 - Total jitter
- Test 3.5 - Deterministic jitter
- Test 3.6 - Random jitter
- Test 3.7 - Main link frequency stability
- Test 3.8 - Spread spectrum modulation frequency
- Test 3.9 - Spread spectrum modulation deviation

**Oscilloscope requirements**
Option EDP requires a DPO/DSA/MSO 70K oscilloscope running firmware version 6.4.0 or higher and DPOJet version 6.0 or higher.

For customers testing RBR (1.62 Gb/sec) and HBR (2.7 Gb/sec) a minimum bandwidth of 8 GHz is required.

For customers testing HBR2 (5.4 Gb/sec) a minimum 12.5 GHz BW is required.

**Probing**
For customers testing RBR (1.62 Gb/sec) or HBR (2.7 Gb/sec), Qty 4 P7380 or P7380SMA probes are required if testing more than two lanes at one time.

For customers testing HBR2 (5.4 Gb/sec) and HBR (2.7 Gb/sec) and RBR (1.62 Gb/sec), Qty 4 P7313 or P7313SMA probes are required if testing more than two lanes at one time.

An optional eDP fixture is available on the Tektronix PAL.

**Physical characteristics**

**Cables**

<table>
<thead>
<tr>
<th>Type</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB Type A-to-Type B</td>
<td>91.44</td>
<td>36</td>
<td></td>
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<tr>
<td>SMA-to-SMA</td>
<td>200</td>
<td>78.74</td>
<td></td>
</tr>
<tr>
<td>Hot plug cable</td>
<td>96.42</td>
<td>38</td>
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</table>

**AUX Controller**

<table>
<thead>
<tr>
<th>Type</th>
<th>Height</th>
<th>Width</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height</td>
<td>27.3</td>
<td>1.075</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>78.1</td>
<td>3.075</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>123.2</td>
<td>4.85</td>
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Ordering information

**DP12**

DP12 software can be ordered separately as an upgrade option for a Tektronix oscilloscope or ordered along with a new oscilloscope. Please refer to http://www.tektronix.com/displayport for detailed product configuration on Source and Sink testing.

**DP12 options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP12</td>
<td>TekExpress DP12 Conformance Automation Solution: Instrument License</td>
</tr>
<tr>
<td>DPO-UP DP12</td>
<td>TekExpress DP12 Conformance Automation Solution: Upgrade</td>
</tr>
<tr>
<td>DPOFL-DP12</td>
<td>TekExpress DP12 Conformance Automation Solution: Floating License</td>
</tr>
<tr>
<td>DPOFT-DP12</td>
<td>TekExpress DP12 Conformance Automation Solution: Trial License</td>
</tr>
<tr>
<td>TEK-GRL-DP-SINKSW</td>
<td>DisplayPort Rx Test Automation Software</td>
</tr>
</tbody>
</table>

**DP-AUX**

DisplayPort AUX Controller and accessories

Includes:

- DisplayPort AUX controller hardware and software
- (2) SMA-to-SMA cables
- Hot plug detect cable
- USB Type A-to-Type B cable

**DP-AUX service options**

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DP-AUX-CA1</td>
<td>Provides a single calibration event or coverage for the designated calibration interval, whichever comes first.</td>
</tr>
<tr>
<td>DP-AUX-R1PW</td>
<td>Repair service coverage 1 year post warranty. This option is available if the 1-year time period does not extend beyond Long-term Product Support.</td>
</tr>
<tr>
<td>DP-AUX-R2PW</td>
<td>Repair service coverage 2 years post warranty. This option is available if the 2-year time period does not extend beyond Long-term Product Support.</td>
</tr>
<tr>
<td>DP-AUX-R3DW</td>
<td>Repair service coverage 3 years (includes product warranty period). 3-year period starts at time of customer instrument purchase. This option is available if the instrument is within product warranty.</td>
</tr>
<tr>
<td>DP-AUX-R5DW</td>
<td>Repair service coverage 5 years (includes product warranty period). 5-year period starts at time of customer instrument purchase. This option is available if the instrument is within product warranty. It is not available once instrument exits warranty period.</td>
</tr>
<tr>
<td>SILV900</td>
<td>Standard warranty extended to 5 years.</td>
</tr>
</tbody>
</table>

Please refer to the Tektronix website for full details and ordering information.
DP-AUX accessories

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Qty per probe</th>
<th>Part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>USB Type A-to-Type B cable</td>
<td>1</td>
<td>174-5611-00</td>
</tr>
<tr>
<td>SMA-to-SMA cable</td>
<td>1</td>
<td>174-5612-00</td>
</tr>
<tr>
<td>Hot plug detect cable</td>
<td>2</td>
<td>174-5711-00</td>
</tr>
</tbody>
</table>

eDP essential options

eDP software can be ordered separately as an upgrade option for a Tektronix Oscilloscope or ordered along with a new oscilloscope. Please refer to http://www.tektronix.com/displayport for detailed product configuration on Source and Sink testing.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>eDP</td>
<td>Embedded DisplayPort Essentials: Instrument License</td>
</tr>
<tr>
<td>DPO-UP eDP</td>
<td>Embedded DisplayPort Essentials: Upgrade</td>
</tr>
<tr>
<td>DPOFL-eDP</td>
<td>Embedded DisplayPort Essentials: Floating License</td>
</tr>
<tr>
<td>DPOFT-eDP</td>
<td>Embedded DisplayPort Essentials: Trial License</td>
</tr>
</tbody>
</table>

Recommended DisplayPort accessories

The following are fixtures/accessories that enable the integration of test signals from the Device Under Test (DUT) into the Tektronix testing system. Receiver testing is performed through a series combination of TF-DP-CIC-C1 and BSA-ISI ISI boards.

<table>
<thead>
<tr>
<th>Accessory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSA12500ISI</td>
<td>ISI generator board</td>
</tr>
<tr>
<td>TF-MINI-DP-TPA-PT</td>
<td>miniDisplayPort Plug</td>
</tr>
<tr>
<td>TF-MINI-DP-TPA-R</td>
<td>miniDisplayPort Receptacle</td>
</tr>
<tr>
<td>TF-MINI-DP-TPA-PR2XT</td>
<td>miniDisplayPort Plug, Receptacle, Dual 2X Calibration, with 18 inch Aux Box Pigtail Cable</td>
</tr>
<tr>
<td>TF-MINI-DP-TPA-PRT</td>
<td>miniDisplayPort Plug, Receptacle, with 18 inch Aux Box Pigtail Cable</td>
</tr>
<tr>
<td>TF-DP-TPA-2XC</td>
<td>DisplayPort with Dual 2X Calibration</td>
</tr>
<tr>
<td>TF-DP-TPA-PT</td>
<td>DisplayPort Plug with 18 inch Aux Box Pigtail Cable</td>
</tr>
<tr>
<td>TF-DP-TPA-PR2XCT</td>
<td>DisplayPort Plug, Receptacle, with Dual 2X Calibration with 18 inch Aux Box Pigtail Cable</td>
</tr>
<tr>
<td>P7313SMA</td>
<td>&gt;13.0 GHz Differential SMA Probe</td>
</tr>
<tr>
<td>Keithley RF Switch</td>
<td>Model Number: S46T – BBBB00000UUUUA</td>
</tr>
<tr>
<td>TF-DPI-TPA-PA</td>
<td>Includes DisplayPort Interop D++ Plug, Aux Controller</td>
</tr>
<tr>
<td>TF-DPI-TPA-PRRCA</td>
<td>Includes DisplayPort Interop D++ Plug, (2) Receptacles, Calibration, Aux Controller</td>
</tr>
<tr>
<td>TF-MDPI-TPA-PA</td>
<td>Includes miniDisplayPort Interop D++ Plug, Aux Controller</td>
</tr>
<tr>
<td>TF-MDPI-TPA-PRRCA</td>
<td>Includes miniDisplayPort Interop D++ Plug, (2) Receptacles, Calibration, Aux Controller</td>
</tr>
</tbody>
</table>
Mini DisplayPort fixtures

DisplayPort plug receptacle and calibration structures
CE Marking Not Applicable.