DPODSPT

DisplayPort Source Compliance Test Automation Software for DPO/DSA70000 Series Oscilloscopes

Getting Started Guide

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Tektronix

DPODSPT DisplayPort Transmitter Compliance Test Automation Software
Version 1.1 – Getting Started Guide, Part # 077- 0186- 00

Acknowledgements: iTextSharp Library Copyright © 1997-2007 by Bruno Lowagie, and is freely available at http://itextsharp.sourceforge.net/

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Pre-requisites

Before running the DPODSPT application software, please ensure that:

- Allow a minimum of 20 minutes warm-up time for oscilloscope. .
- The oscilloscope should have SPC (Signal Path Compensation) run to assure accuracy of the acquisition system. Remove all probes from the scope before running SPC.
- Perform de-skew to compensate for skew between measurement channels. Note that it is critical to select “Off” for the “Display Only” control on the de-skew setup window. This will assure that the de-skew data is stored with any waveforms that are stored.
- Any unused connections on the DisplayPort test fixture should be terminated using 50-Ohm terminators.
- Up-to-date versions of the TekScope and DPOJET applications are required to ensure best operation of this software. The “readme” file for DPODSPT has information on the required versions. Please ensure that these versions (or later) are installed on your oscilloscope and update them from Tektronix.com if necessary.
- 100Mb available hard drive space recommended
- DPO70804, DSA70804 or higher-bandwidth model of DPO/DSA oscilloscope is required

Note: A secondary monitor is recommended (but not necessary) to display the scope application and DisplayPort application individually/separately.

Instrument Connection

The DPODSPT software can perform testing on a connected device-under-test ("DUT") or on stored waveforms that have been acquired previously. Direct connection to the DUT (Device-Under-Test) requires at least one skew-matched pair of SMA cables and the DisplayPort test fixture. The test fixture is available from Tektronix as part # ET-DP-TPA-STX. Differential probes P7380SMA or P7313SMA can also be used, and include their own phase-matched SMA cable sets. If probes are not used, phase-matched SMA cable sets are available from Tektronix as part # 174-4944-01.

When using a direct connection of SMA cables to the oscilloscope inputs, CH1 and CH2 of the oscilloscope should be connected to the DisplayPort lane to be tested. Oscilloscope CH3 and CH4 can optionally be connected to another DisplayPort lane for inter-pair skew testing. Any unused connections on the DisplayPort test fixture should be terminated using 50-Ohm terminators.

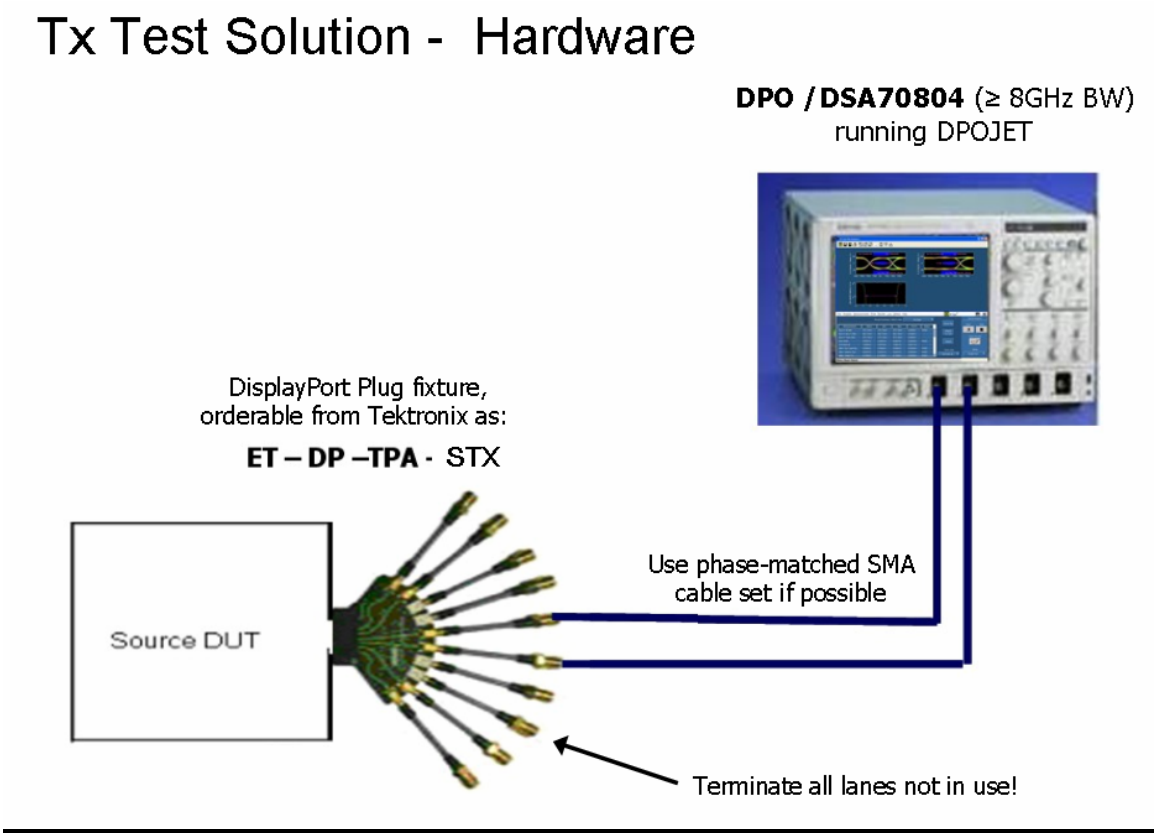

Figure 1: Transmitter test setup for compliance test using matched SMA Cable set.

About the Application Software

The DPODSPT application software has five tabs.

“Configure” Tab:

This tab shows the controls for configuring the test setup. It shows information about the connection between the oscilloscope and the DUT, which lane(s) are assigned to the oscilloscpe channels and types of signal that will be made available for the compliance tests. The selection of ‘supported signal types’ on the CONFIGURE tab will determine the list of available / applicable tests on the “SELECT” tab. The CONFIGURE tab also allows the user to select saved waveform files for testing in place of a connected DUT. Selecting the “Verbose Logging /Reporting” check box at the bottom of the screen will generate a detailed log file and adds additional screen shot information to the test report.

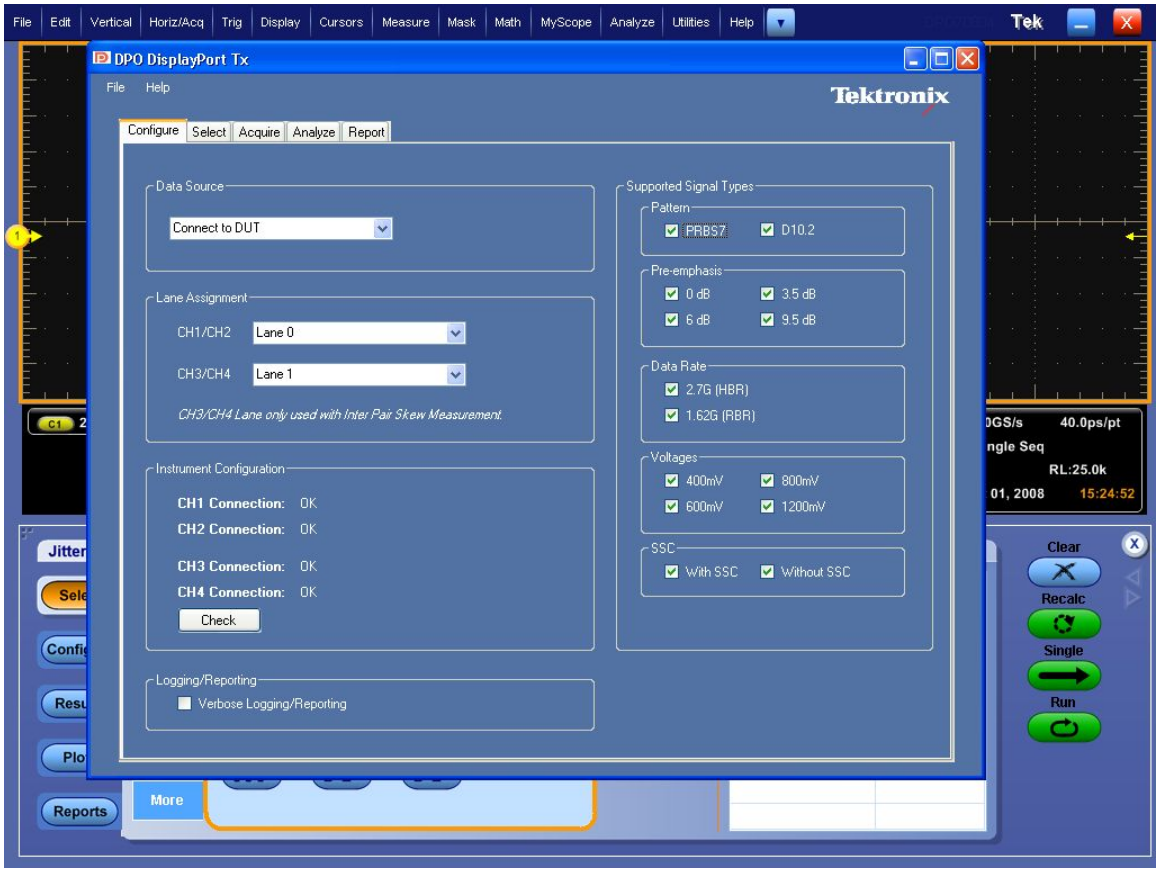

Figure 2: “Configure” screen of DPODSPT application.

“Supported signal types” checkboxes help the user to let the application know which type of signals will be made available to it for compliance testing. For example, having 0dB and 3.5dB checked in the “pre-emphasis” group indicates that the device-under-test can generate signals with these parameters and that they should be included in the test suite. Similarly, if signal with SSC enabled is not available, the user would uncheck the ‘With SSC’ option, and the tests that require SSC will be bypassed.

”Select” Tab:

This tab gives users the options of selecting the tests and assigning the test session with a DUT name and user comments. The DUT name and the user comments appear in the test report as well. A data file folder will be created using “DUT NAME” (as you enter it here) for the folder name, where waveforms and other data files will be stored for this test session. NOTE: If you use the same DUT name for successive test runs, the previous test result data will be overwritten.

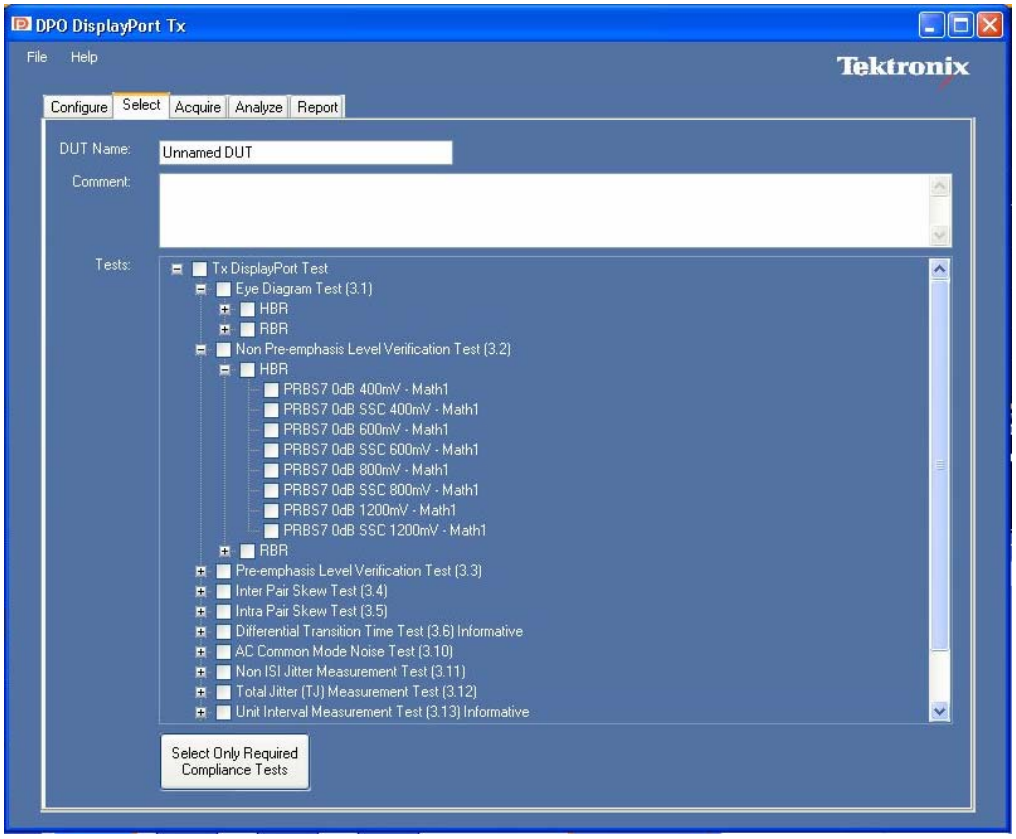

Figure 3: “Select” screen of DPODSPT application.

The tree of tests can be expanded to select tests for a particular type of signal such as PRBS7 signal of 400mV amplitude and with 3.5dB of pre-emphasis level. The user can select/deselect all the tests of a branch by checking/un-checking the higher-level check box. The available selections include combinations that are not required for compliance; you can limit the measurement set by clicking the box titled “Select Only Required Compliance Tests.” Some tests rely on other tests, and will automatically select them.

Note 1: The tree of tests is built based on the ‘supported signal types’ selected in the ‘Configure’ tab. Any change in the ‘Configure’ tab resets the test selection.

Note 2: Stored waveforms and other test data may fill several GB of hard disk space from each test session. You may need to move data if running many test sessions.

“Acquire” Tab:

This tab lists the required signals that need to be acquired, based on the test selection in the Select tab. Details about the required signal(s) such as type of pattern, data rate, pre-emphasis level, amplitude, SSC and oscilloscope channel (signal to be acquired from) are shown.

The Acquire button is used to initiate the process of signal acquisition. The acquired signals are saved as ‘oscilloscope reference waveforms’ in the folder specified by the DUT name. (“c:\Program Files\Tektronix\DPODSPT\AAA_Display_Port” where AAA = name provided for the device under test)

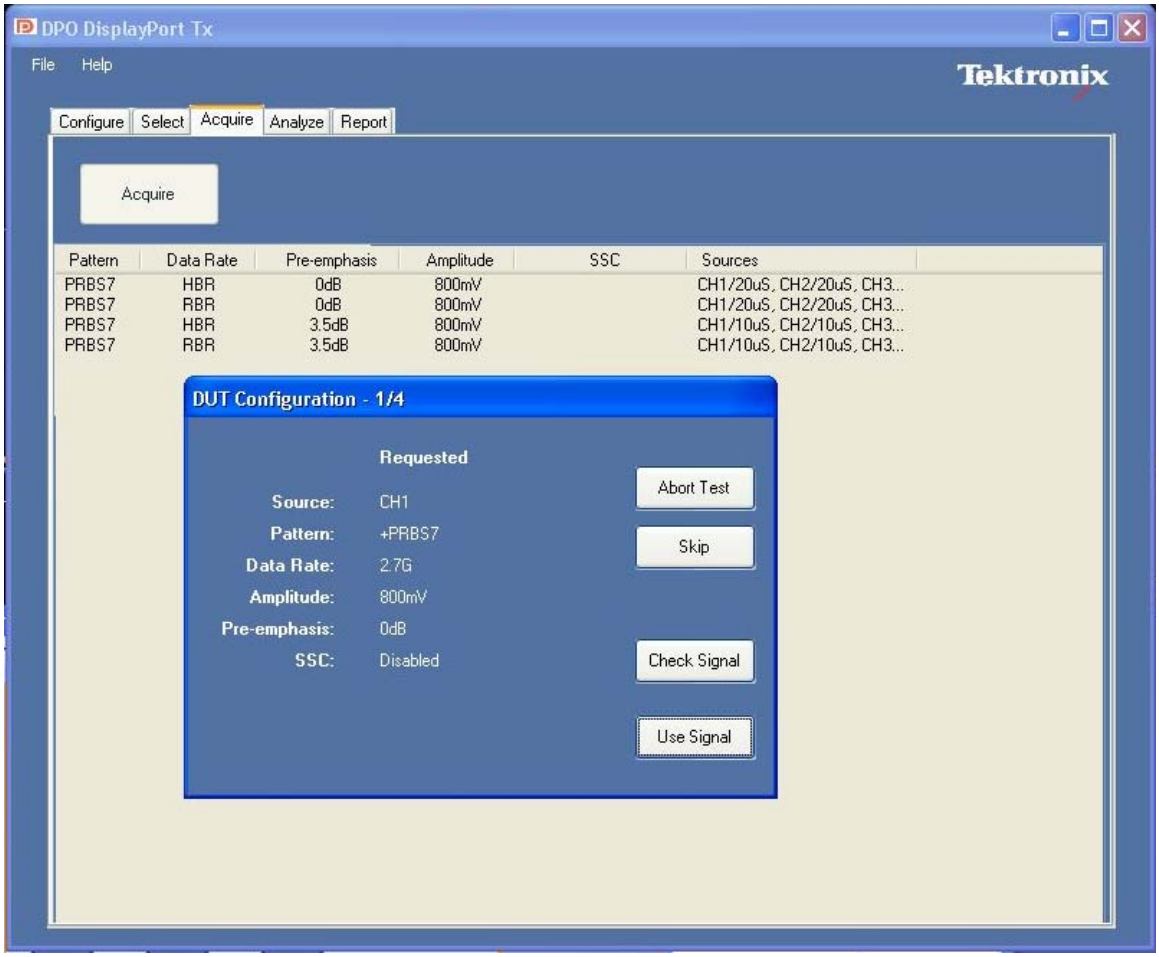

Figure 4: “Acquire” screen of DPODSPT application.

Note: Some of the signals can support multiple tests. The list of signals to be acquired doesn’t show such duplication of signals for multiple measurements.

When a user starts the acquisition by clicking on the Acquire button, a pop-up message box, as shown in figure 5, displays the signal being acquired. Attributes of the signal to be acquired are displayed.

There are four buttons provided in this dialogue box.

Abort Test: Clicking this button will abort the entire test session. No acquisition takes place.

Skip: Clicking this button will skip acquisition of this signal and move to the next signal type to be acquired for this test session. Measurements that depend on the skipped signal type will not be performed.

Check Signal: Clicking this button will manually validate the signal i.e., it will compare and show the required and actual attributes of the signal acquired. If they do not match, an alert message is displayed for the user. One such comparison is shown in figure 5.

Use Signal: Clicking this button will guide the application to acquire and use the acquired signal for the test. In this case signal validation takes place by default. In case of a mismatch between required and acquired signal attributes, the user will see a "warning" screen similar to Figure 5 below, and then has the option to change the DUT's output signal or else let the application use the existing signal by clicking on the Use Signal button.

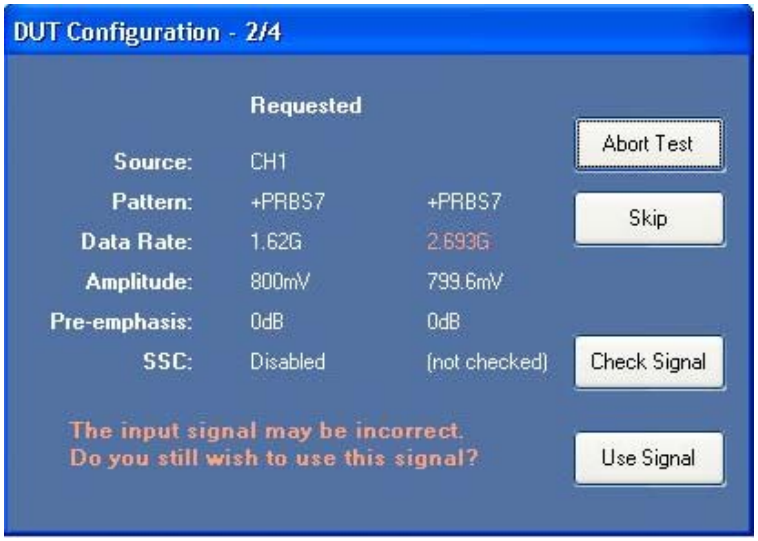

Figure 5: Signal check during acquisition

Note: Validation of the signal acquired against what is required happens by default for all the acquisitions. The "Check Signal" button is provided to manually invoke signal validation.

"**Acquire" Tab (if using previously-stored waveforms):**

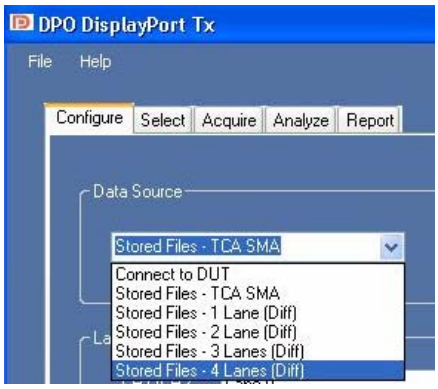

Figure 6*:* "*Stored Files*" dropdown menu

If the user has selected the data source as ***"Stored Files"*** rather than ***"Connect to DUT"*** in the Configure tab, then the Acquire tab will present a different set of choices.

Instead of the "Acquire" button, in this case the user is presented with two choices - "Load Individual Files" and "Load All From Directory."

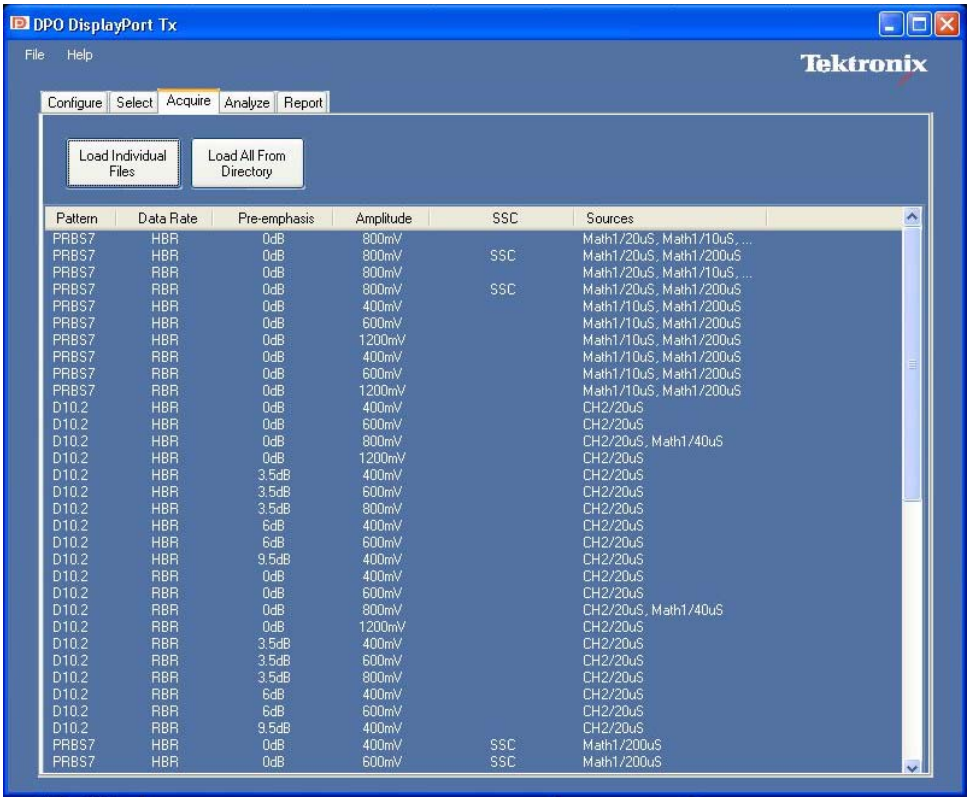

Figure 7: "Load Stored Files" opening screen

If the “Load Individual Files” button is pressed, a pop-up window appears with a description of the first signal type needed. Press the “Read Waveform” button and then navigate to the file to be used. The waveform file must meet signal conditions shown in the popup window.

The user will find this step more convenient if they use a file naming convention that describes each signal’s parameters (e.g., “PRBS7_HBR_400mV _0dB.wfm”)
If the waveform files were saved from an earlier test session using DPODSPT, the file naming conventions will automatically be compatible.

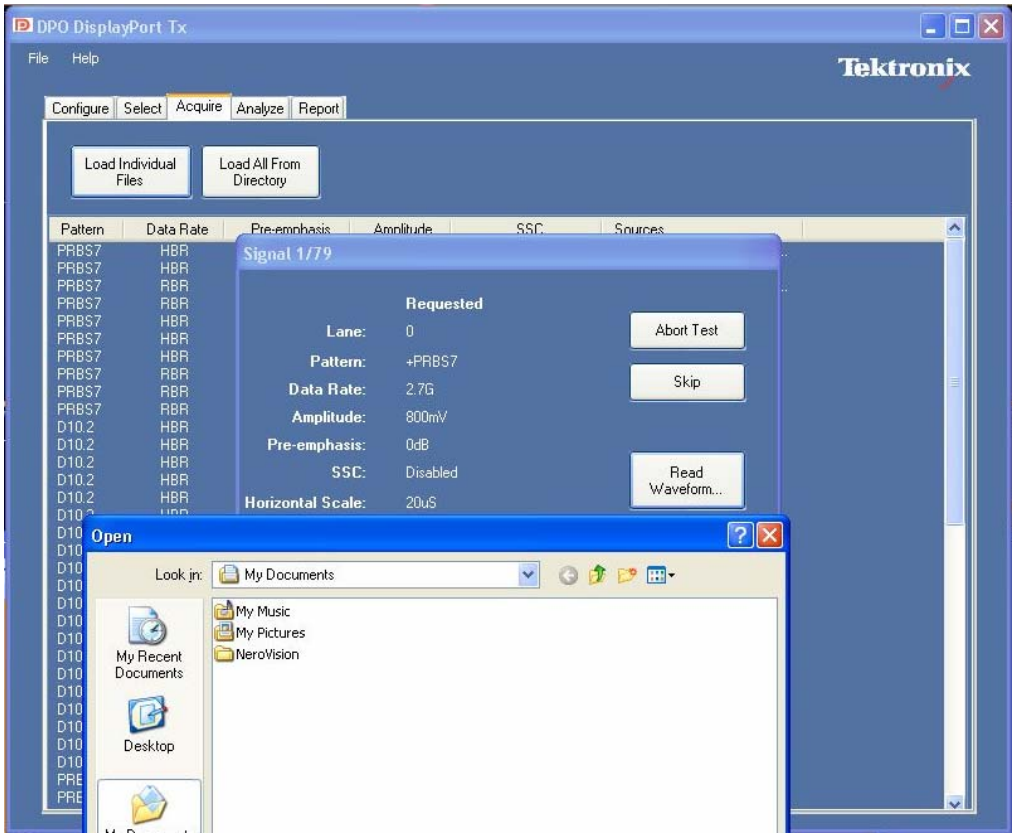

Figure 8*:* “Load Individual Files” navigation screen

In cases where a large collection of waveform files have been previously saved, the "*Load All From Directory*" button can be a valuable option to help automate and speed testing. When this button is pressed, a pop-up window appears, allowing navigation to the folder where the files are stored. After the user points to a folder, the software will attempt to perform all the selected tests, using the waveform files in that folder.

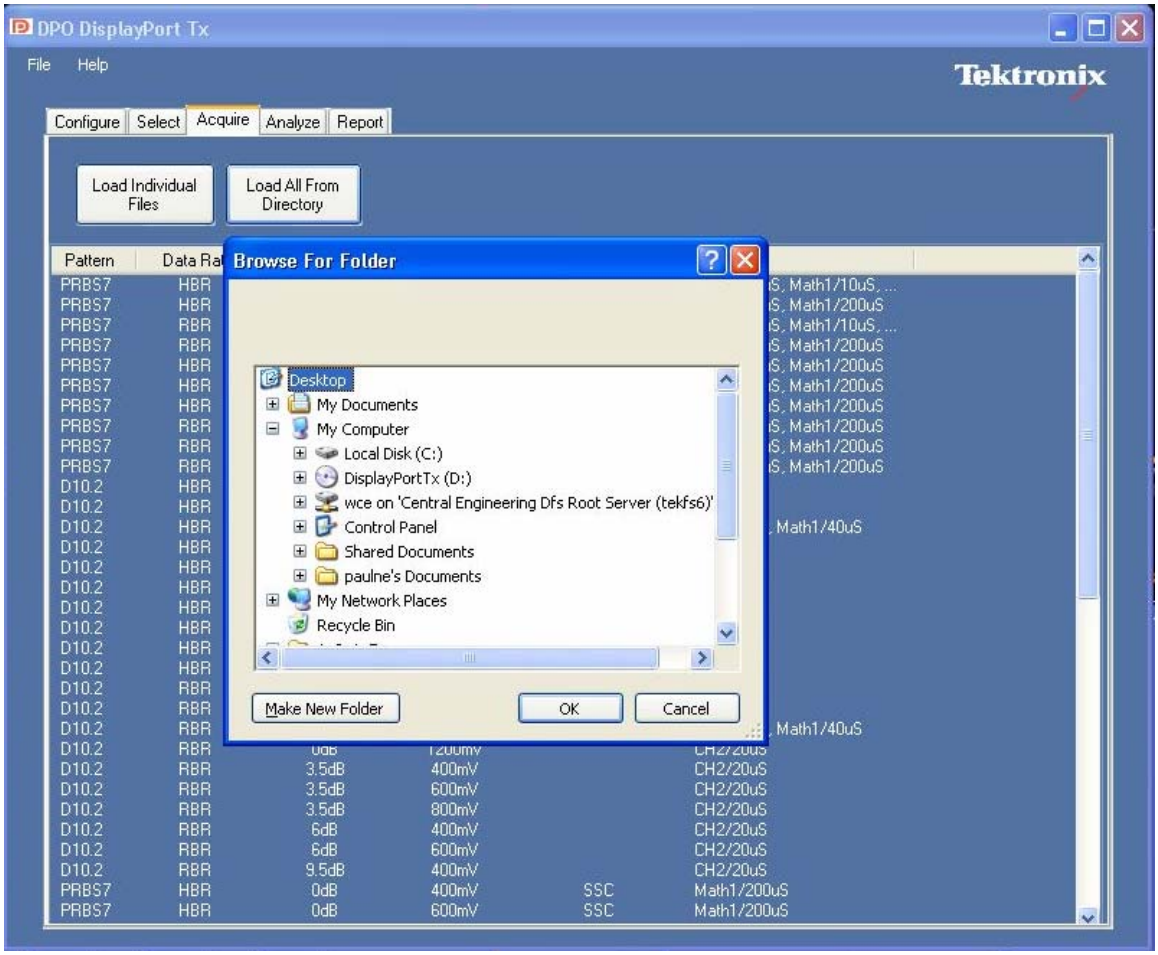

Figure 9: "Load All From Directory" navigation screen

“Analyze” Tab:

Completion of signal acquisition automatically directs the application to this tab. This tab displays the sequence of tests that will automatically execute after all the necessary signals are acquired. The contents sequence of operations can be recorded into a log file by checking the ‘Verbose Logging /Reporting’ option on the Configure tab.

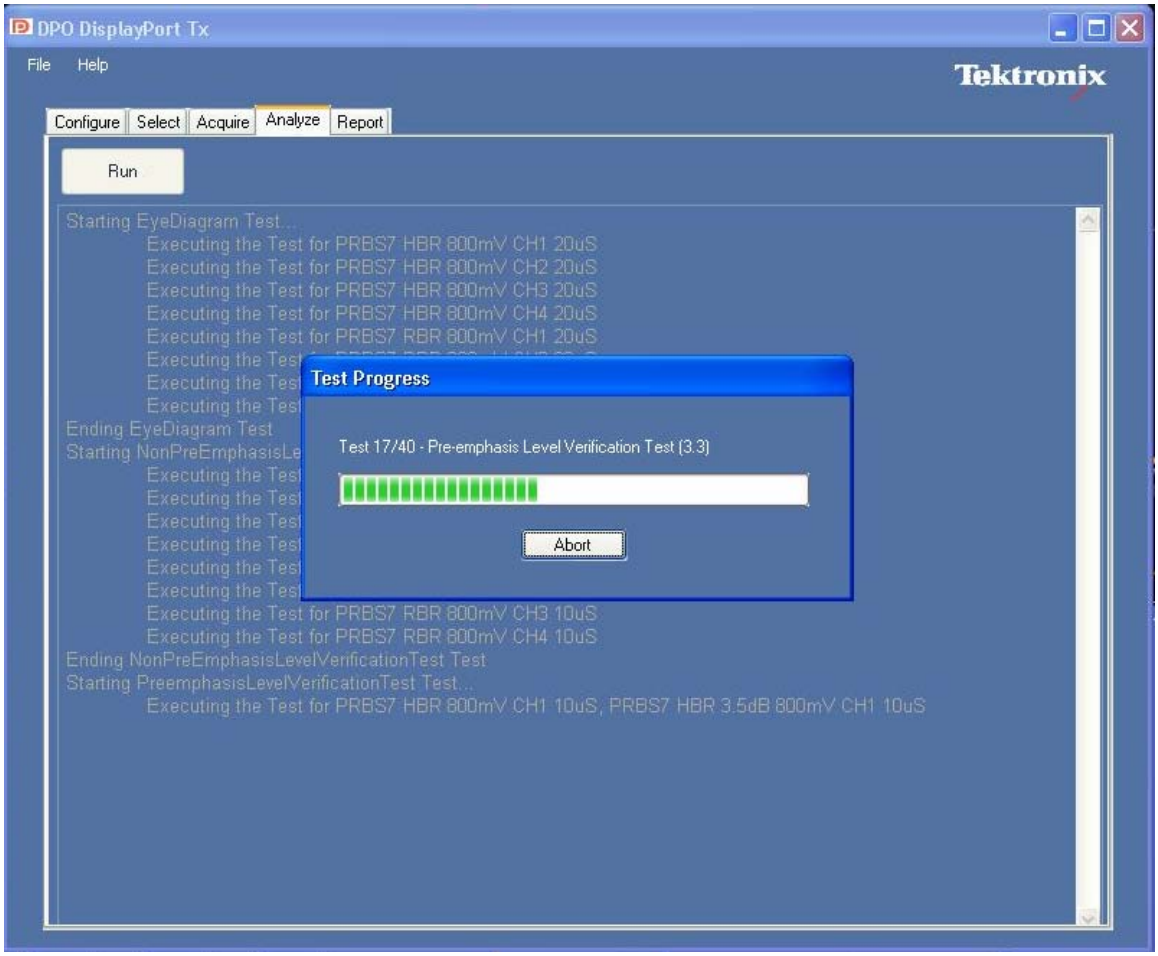

Figure 10: “Analyze” screen showing test progress indicator

A progress bar is used to show the progress of execution of the selected tests.

Note: The ‘Run’ button is provided for re-running the tests with already acquired signals. If the user is acquiring a new set of signals using the ‘Acquire’ button, the tests are automatically executed at the end of the acquisition process.

“Report” Tab:

Completion of test execution automatically triggers the application to display this tab. The Report tab displays the results of the tests executed, in PDF format. Another test data report in .csv file format is also saved in the data file folder associated with this test session.

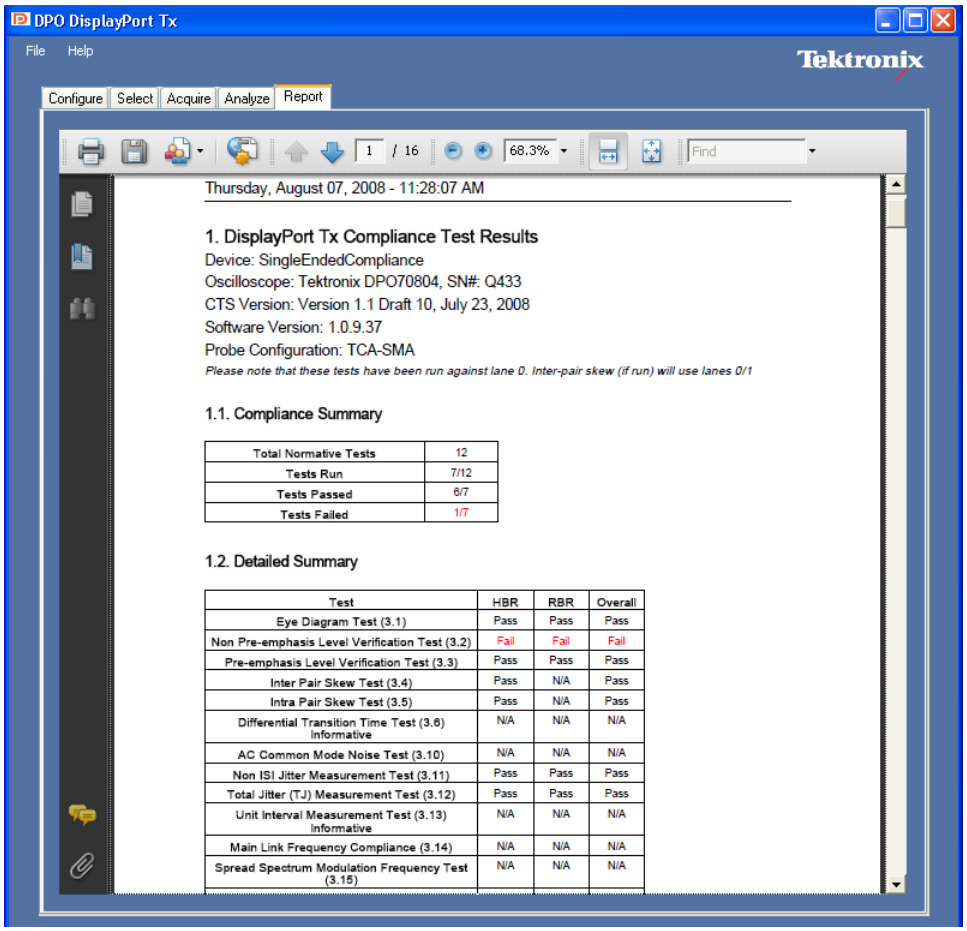

Figure 11: “Report” screen of DPODSPT application.

PDF report generated by DPODSPT application contains (A sample is shown in figure 12 and figure 13):

- Date and time of the test session (from the system clock)
- Device / DUT name and User comments (as entered in the Select Tab)
- Compliance test summary
- Detailed test summary
- Individual test results with necessary graphic(s) / plot(s)

Note: The PDF report, .csv report, log file and waveforms used for the tests are stored / saved in the folder specified by DUT name:
e.g., (c:\Program Files\TekApplications\DPODSPT\AAA_Display_Port)

How to perform compliance test using DPODSPT application:

- Refer to “Instrument Connection” and “Pre-Requisites” above, to prepare the necessary instrument connection and preparation.
- Launch the DPOJET application. Wait until you see DPOJET menu.
- Start the DPODSPT application, from the “Analyze” menu in the oscilloscope main control menu.
- The application will automatically detect what is connected to each oscilloscope input channel - either a differential probe or TCA-SMA adapter. The “Lane Assignment” section of the Configure tab will show the input configuration.
- If using TCA-SMA connections, configure the lane assignment for the oscilloscope channels.
- Based on the signals that will be supported / generated by the DUT, configure the options provided in the Configure tab.
- To log the sequence of operation/test execution, verbose logging option should be checked.
- Go to Select tab and choose the tests to be performed. The tree of tests can be expanded for detailed view by clicking on the “+” icon.
- Enter the DUT name – The same name is assigned to the folder where all the waveforms (used for the tests), log file and final test report (PDF file) will be saved.
- Any comment entered in the ‘User Comment’ section will be reflected in the final test report (PDF).
- After selecting the tests that need to be performed, go to “Acquire” tab. This tab will list all the possible signals that need to be acquired for performing selected tests.
- Click on the Acquire button to initiate the acquisition of signal(s).
- The signals are validated against what is required. On the ‘acquisitions status dialogue’, click on ‘Use Signal’ button when you find the signal acquired is correct.
- In case the signal acquired is not what is required for the test, then recheck your DUT setting/connection and validate the new signal by clicking on “Check Signal” button. Once you have the correct signal, click on “Use Signal” button to continue to next acquisition. If signal problems cannot be resolved, press the “Skip” button.
- Keep changing the DUT setting / connection to feed appropriate test signals as prompted by the ‘acquisition status dialogue’.
- Once all the signals are acquired, tests will automatically begin (if not, click on Run button in the “’Analyze” tab).
- Test execution progress will be shown by the application as a separate popup window. Once the tests are executed, the report will be shown in the “Report” tab.
- The waveforms and report will be available for post-analysis in the specified folder.

Appendix A: Scope/Probe/Cable Calibration

Before beginning any test or data acquisition, the oscilloscope must be warmed up, calibrated, and cables de-skewed. This section will include the procedure for calibrating the scope and de-skewing the cables.

The DSA/DPO70000 series oscilloscope must be calibrated manually and this is recommended after a 20-minute warm-up period or whenever a new measurement session is going to begin.

Calibration can be performed in the following order:

1. Signal Path Compensation which compensates the signal pathways for gain and offset errors.
2. Cable de-skew compensates for timing differences between any two cables.

   Once these calibrations are performed, they are not permanent. It is recommended the signal path compensation be performed once a week and whenever the ambient temperature of the oscilloscope has changed by more than 5^0 C, whereas the cable de-skews can be performed before starting any new measurement session using the scope and cables.

Signal Path Compensation:

This type of calibration can be done through the scope's utilities menu. Select Utilities → Instrument Calibration.

Figure 1: Utilities → Instrument Calibration Menu

To perform this operation, all input cables to the scope channels must be disconnected. Ensure the Tektronix TCA-SMA (or TCA-292MM) input adapters are installed in all four channels and nothing is connected to the SMA inputs.

This prevents transient voltages from leaking into the input amplifiers and ADC's that could adversely affect the quality of the calibration routine. Click on the "Calibrate" button. It takes about 10 minutes to get the calibration result. Final status should be "Pass"

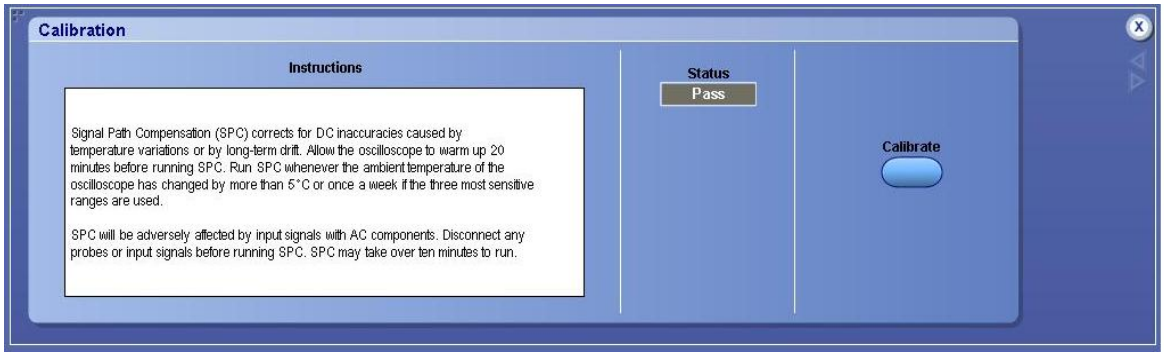

Figure 1: Signal Path Compensation

Cable de-skewing:

Use the following procedure to compensate for timing differences between SMA cables and input channels:
(This procedure is performed on a pair of cables at a time.)

1. Connect TCA-SMA TekConnect adapters to all four channels of the scope.
2. Press “Default Setup”
3. Connect the SMA cables to the channels Ch1, Ch2, Ch3 and Ch4 of the scope. Use a torque-wrench to tighten the connections. (7-10 in lbs)
4. Select Ch1 and Ch2 using buttons on scope front panel.
5. Make sure that channels Ch3 and Ch4 are de-selected.
6. Connect a power splitter to the “Fast Edge” output of the scope. (Refer to Figure 3 below.)

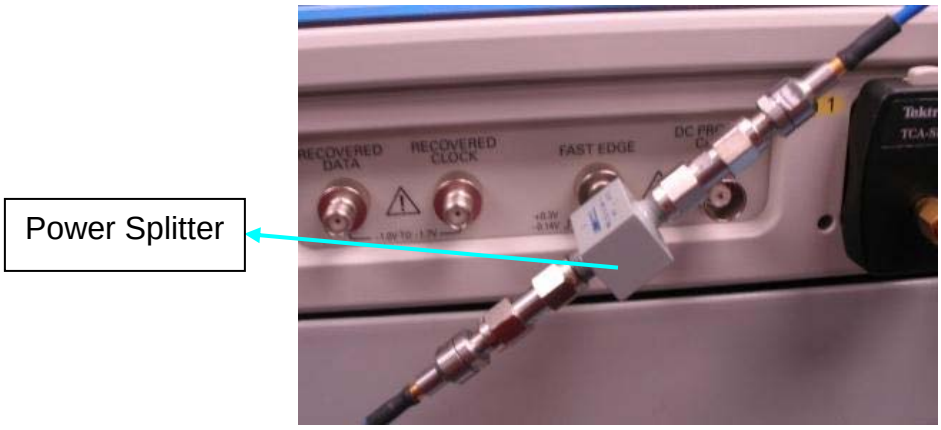

Figure 2: Cable de-skew connections

7. Connect the cables from Ch1 and Ch2 to the power splitter outputs.
8. Click on scope “Autoset” button on front panel
9. Click “Ok” on the confirmation window.
10. Adjust the Vertical Scale (increase it without any clipping) and Position controls for each channel so that the signals overlap and are centered on the display.
11. Click Horiz/Acq->Horizontal/Acquisition Setup.
12. Click on “Acquisition” tab. Refer to Figure 32 below.
13. Select “Average” acquisition mode.
14. Keep the “# of Wfms” as default which is 16.

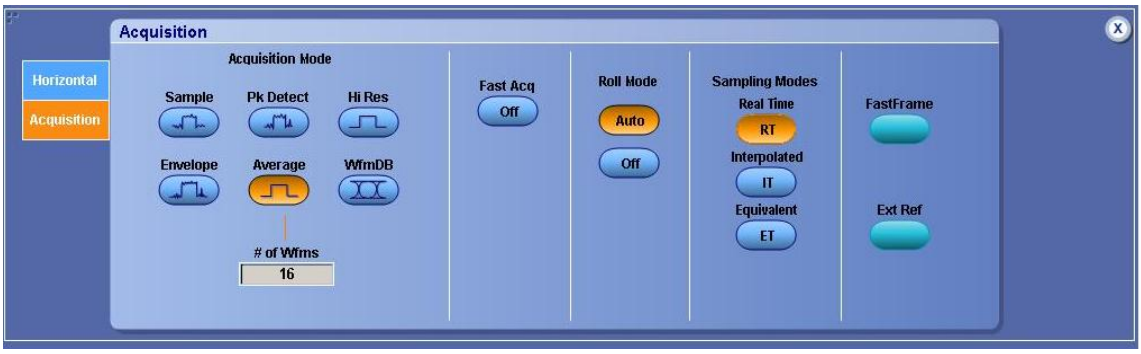

Figure 4: Setting Average Mode

15. Adjust the Horizontal Position so that a rising edge is triggered at the center of the display.
16. Adjust the horizontal Scale (Lower time/pt) so that the differences in the channel delays are clearly visible. Refer to Figure 5 below.

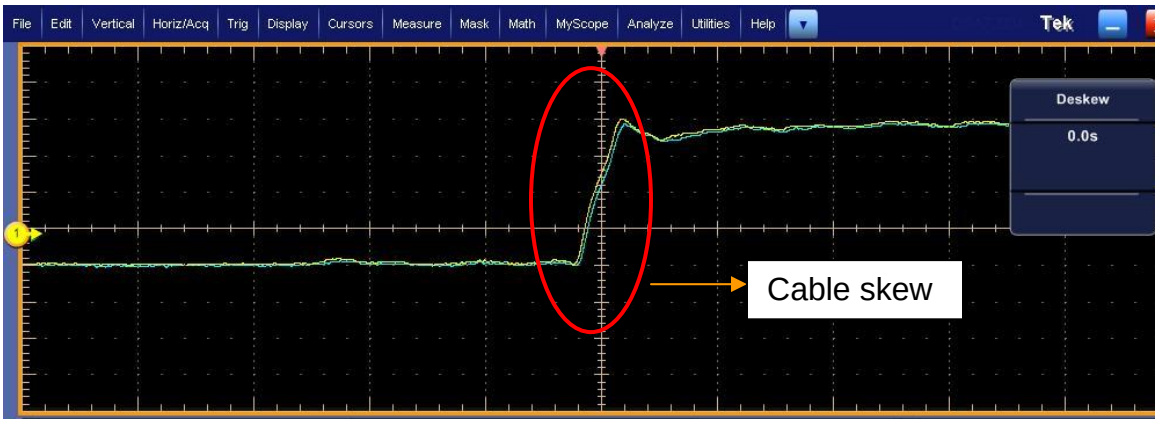

Figure 5: Visible Cable Skew

17. Adjust the horizontal Position again so that the first rising edge is exactly at the center of the display. The short length (electrical length) cable is connected to this channel.
18. Select Vertical → Deskew from the scope menu to open the Deskew control window.
19. Select Ch2.
20. Adjust the de-skew time for Ch2 so that its signal aligns with Ch1.

Figure 6: Cable Skew Adjusted

21. Remove the cable attached to Ch2 from the power splitter. Keep the other end of the cable attached to the scope input.
22. Repeat above steps from 3 to 22 by connecting the cable from Ch3 to the de-skew attachment. Make sure to de-select Ch2 and select Ch3.
23. Repeat steps from 3 to 22 by connecting the cable from Ch4 to the de-skew attachment. Make sure to de-select Ch3 and select Ch4
24. De-skew procedure is complete when CH2, CH3 and CH4 have all been de-skewed to CH1. Take care to leave cable-scope connections undisturbed for the duration of testing on the DisplayPort source device.
25. NOTE: If using differential probes instead of direct SMA cable connection to the scope, the procedure should be performed as above except using the cables connected to the + input side of each probe.