DisplayPort™ Cable Testing With UCD-400

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Why to Test Cables with Unigraf Test Tools

- Faster and cheaper than any PHY test equipment
  - ➢ Oscilloscopes cost up to USD250k
  - ➢ UCD-400 for cable testing ~ USD30k
- Designed for mass production (thousands of plugins)
  - ➢ Affordable protection adaptors to protect test equipment and interfaces
- Remove human error from testing
  - ➢ Detect common issues (soldering issues, raw material, assembly issues)
  - ➢ Error counter shown in UCD Console GUI
  - ➢ Individual dead pixels are not detecetable with human eye
  - ➢ Automated scripts to run the test and record results
- Easy-to-use and instructions available in English and Chinese

Automatic Cable Testing

- Testing based on actual cable performance
  - ➢ Cable evaluated between a test transmitter and test receiver
- Highly reliable and repeatable test result
  - ➢ Based on numerical data, not human observation
- Automatic test start and end – short cycle time
- Test results available for Quality Analysis
 - ➢ Numerical data can be used for many purposes

Testing Actual Cable Performance

- Test Transmitter sends selected link data
- Test Receiver detects errors in received link symbols
- Errors in each link data lane can be detected separately
  - Direct feedback to manufacturing quality
- Pass / Fail criteria can be set based on detected error level
- Test can be programmed to filter random errors
  - If no errors, keep short test cycle
  - E.g. extend test time if suspect connector inject errors

Highly Reliable

- Test result based solely on "real life" performance
- No "human fatigue" effect in results
  - Constant evaluation criteria 24/7
- Testing done with "Reference" transmitter and receiver
  - Reliable, state-of-the-art design
  - No "Image Enhancement" functionality affecting the test result
  - Full access to real measurement data
- 100% repeatable test result
  - Special attention should be paid on test connector wear and tear! Use protection adapters to solve this.

Short Cycle Time
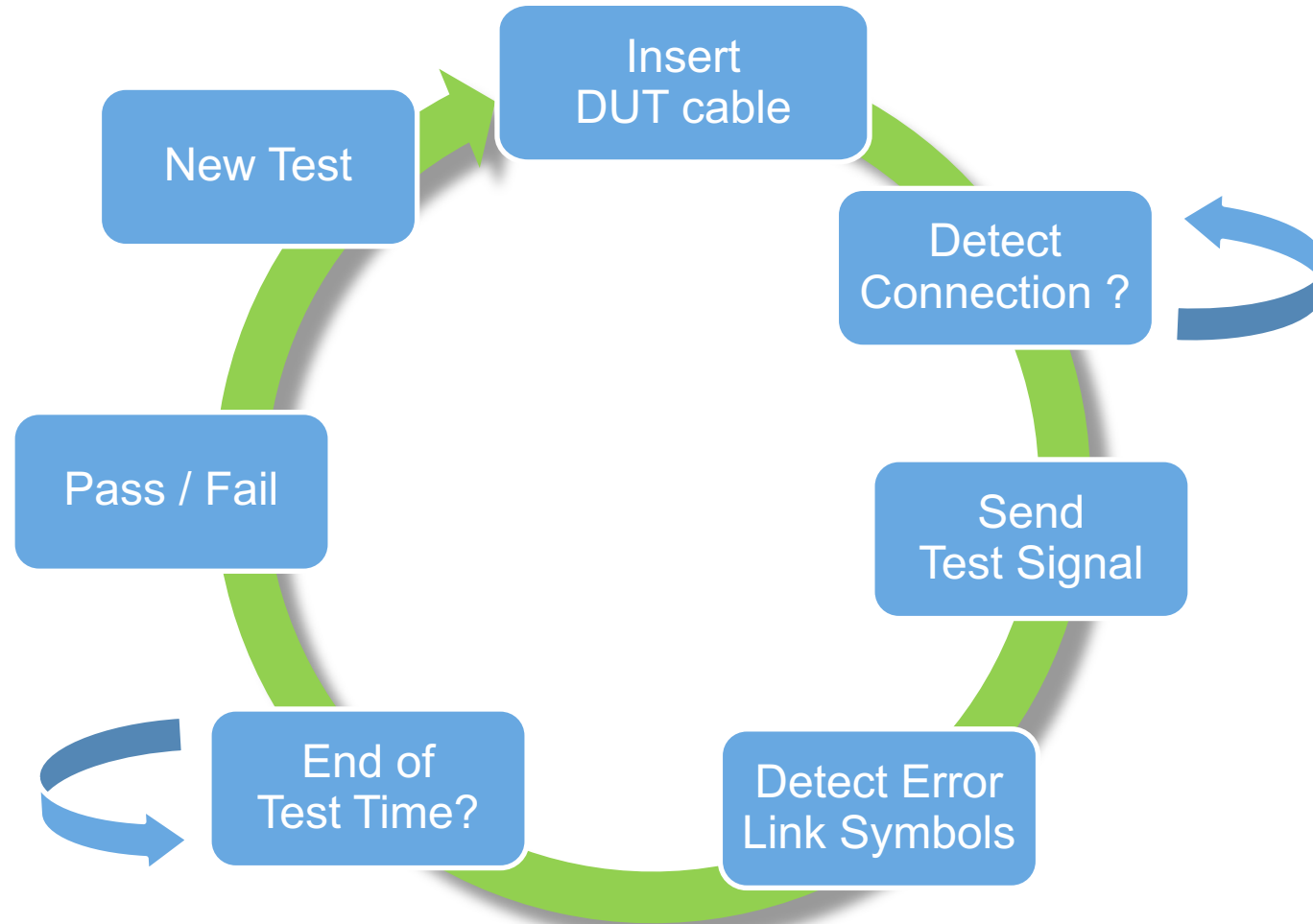
Ready for Quality Analysis

- Quality analysis with numerical data
  - ➢ Easy to prove stable quality internally and externally
  - ➢ Variation easy to detect as early warning

- Test result per data lane
  - ➢ Detailed analysis of possible failure root causes

- Long term quality analysis also possible
  - ➢ Numerical data is easy to store and recall for extended periods

Cost Effective

- Highly reliable
  - No false positive – no false negative results
- Short Cycle Time
  - Automatic start – immediate result
  - No human evaluation – can easily be fully automated
- High Quality
  - Quality status can easily be attested
- Informative
  - Full test details available
- Flexible
  - Pass / Fail criteria can be adjusted to avoid random errors

UCD-400 series Test Tools

- Automated cable test sequence is available for all UCD-400 series test tools.
- UCD-400 series test tools enable testing of DisplayPort, HDMI and USB-C cables.
- The automated test sequence is delivered with each purchased test tool
- UCD Console GUI is delivered with each test tool

UCD-400 Test Tool for Cable Testing

- DP 1.4a / HBR3 capable video analyzer and generator
  - ➢ DisplayPort input and output in the same unit
- Supports resolutions up to:
  - ➢ 8K@30 Hz without DSC and 8K@60 Hz with DSC
  - ➢ 4K@120 Hz

- Supports FEC, DSC, LTTPR

- Official Compliance Test Tool
  - ➢ Certified by VESA for DP 1.4a Link Layer CTS
  - ➢ Approved by DCP for HDCP 2.3 CTS for DP Sinks, Sources and Repeaters

UCD-422 Test Tool for HDMI Cable Testing

- HDMI 2.1 (FRL/TMDS) 10K video analyzer and generator
  - ➢ DisplayPort input and output in the same unit
- Supports resolutions up to:
  - ➢ 4K@120Hz, 8K@60Hz and 10K@30Hz with uncompressed video
- Supports FEC, DSC, eARC

- Dolby Vision™ Test Tool

UCD-424 Test Tool for USB-C Cable Testing

- UCD-424 is an 8K Reference Sink, Source and Branch for verifying DisplayPort™ Alt Mode over USB-C

- Supports resolutions up to:
  - ➢ 8K@30 Hz without DSC and 8K@60 Hz with DSC
  - ➢ 4K@120 Hz

- USB-C v1.3 input and output with Power Delivery 3.0

- Supports MST (4 streams), FEC, DSC, LTTPR

- Compliance Test Tool
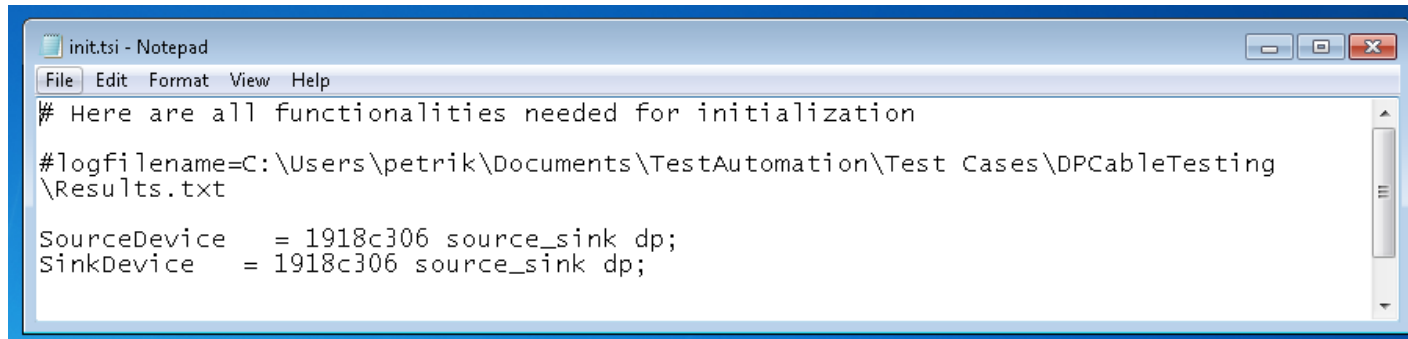 - ➢ DP 1.4a Link Layer CTS
  - ➢ HDCP 2.3 CTS

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Protection Adaptors

- Durable design up to 10 000 connections
- Easy to replace
- Cost effective
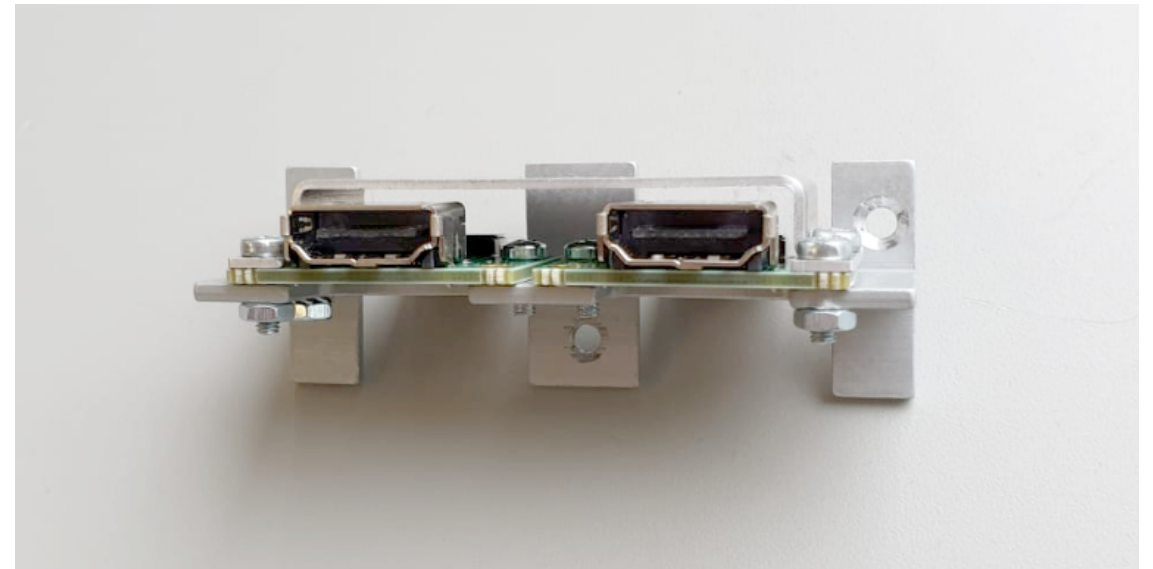
Running Automated DisplayPort Cable Test Sequences

Setting up the Device

- The first thing that needs to be done is edit the *init.tsi* file to define your Source Device and your Sink Device.

- *init.tsi* file looks like this (lines with #'s are comments):

- Replace 1918c306 with the serial number of your UCD-400 device
  - As we are using UCD-400 as a sink and source, replace both serial numbers

Setting up the Device
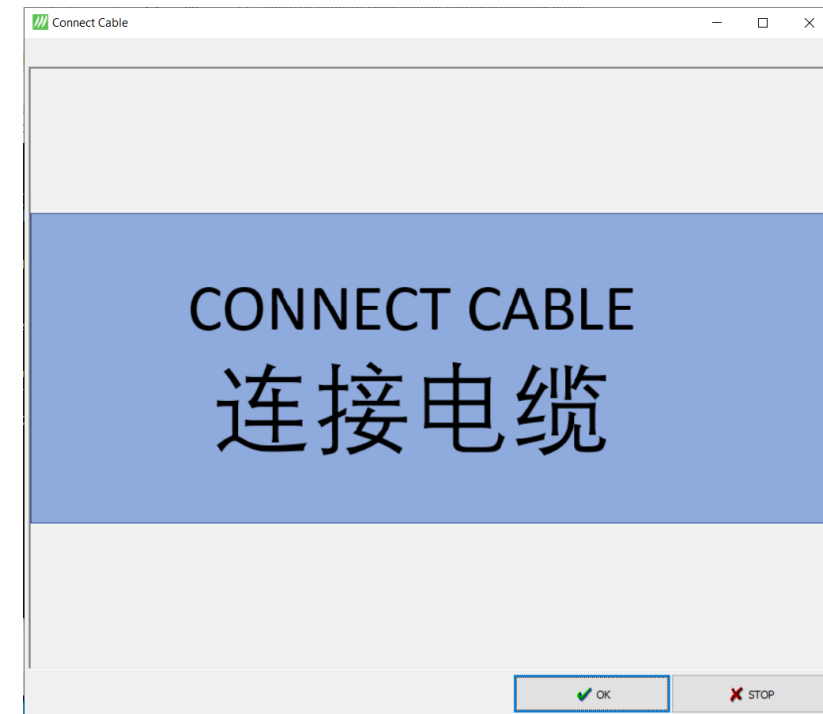
- To start, make sure **no cables are attached** to the UCD-400.
- The tests in the automated cable tets sequence will be run in loop-back mode which means you will plug in a DisplayPort cable from the *DP in* to the *DP out* sockets in your UCD-400 device.
  - ➢ UCD-400 can act as a DisplayPort sink and source simultaneously

Cable Test Sequence

- The ready-made automated cable testing sequence includes the following tests for testing DisplayPort cables:
  - ➢ Video Signal Timing Test for timing 7680 x 4320 @ 30 Hz
  - ➢ Link Error Test
  - ➢ CRC Based Single Frame Video Stability Test
  - ➢ HDCP 1.x Test
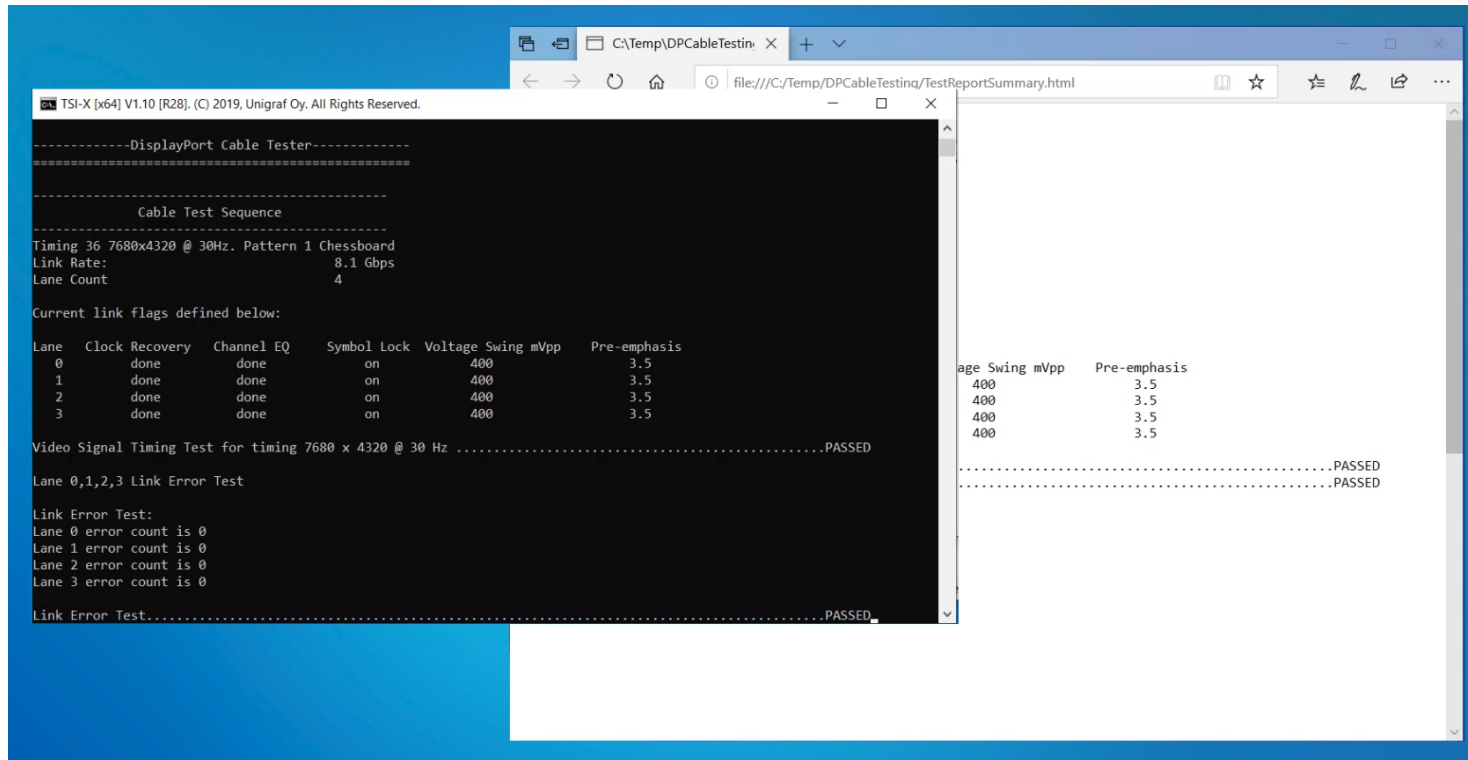 - ➢ HDCP 2.x Test

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Cable Test Sequence

- Start Cable Test with double-clicking the *RunTest.bat* file.
- A *Connect Cable* dialog will appear asking you to connect the cables.
- The script will detect when the cable has been connected and will continue to run tests automatically

Test Sequence Run on Command Line

- Test run will be shown on the command-line

Test Report

- When the tests are done, you will be shown the test results in a *Passed/Failed* dialog.

- The dialog will disappear in 5 seconds or it can be dismissed via the "OK" button.

- You can adjust how long the dialog lingers via the "-timeout 5000" commands in *ShowPassed.txt* and *ShowFailed.txt*.
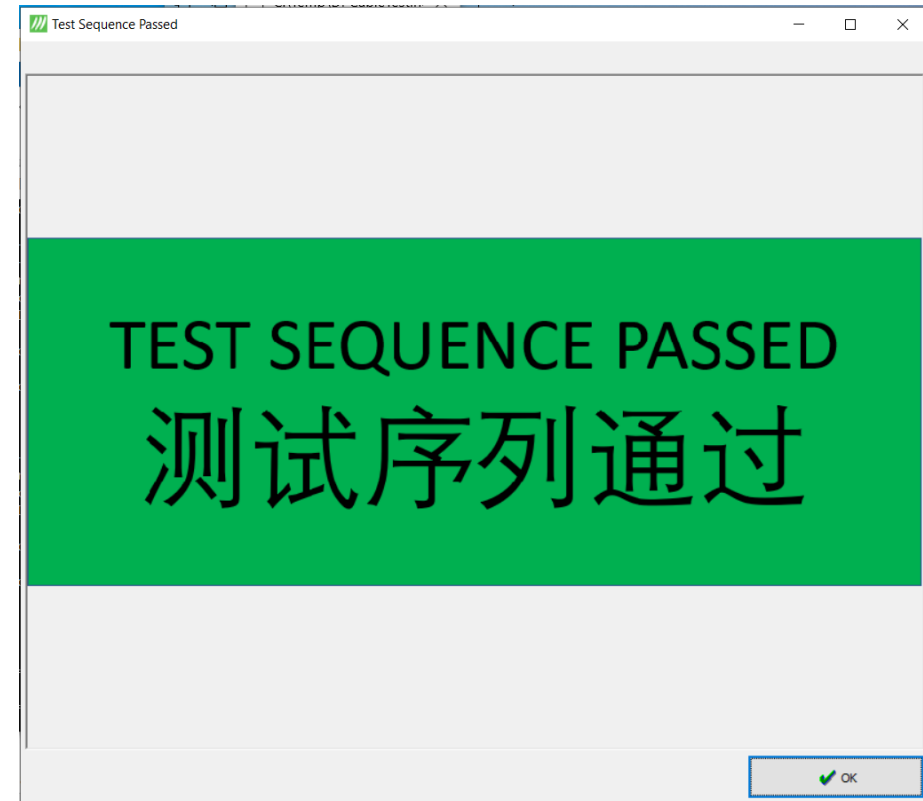
Test Report

- File *RunTests_timestamp_log.txt*, (where timestamp is year, day, month, time) contains the detailed log of the test run.
  - ➢ E.g. *RunTests_20200506140137_log*
- File *TestReportSummary.txt* is the PASS/FAIL summary of the tests. Beginning of each test run this file is copied with timestamp.

End Test Sequence

- A *DisconnectCable* dialog will appear asking you to disconnect.
- The script will detect when the cable has been disconnected or the dialog can be dismissed via the "OK" button
- The tests may be stopped at any time by pressing the "Stop" button on the Connect/DisconnectCable dialogs.
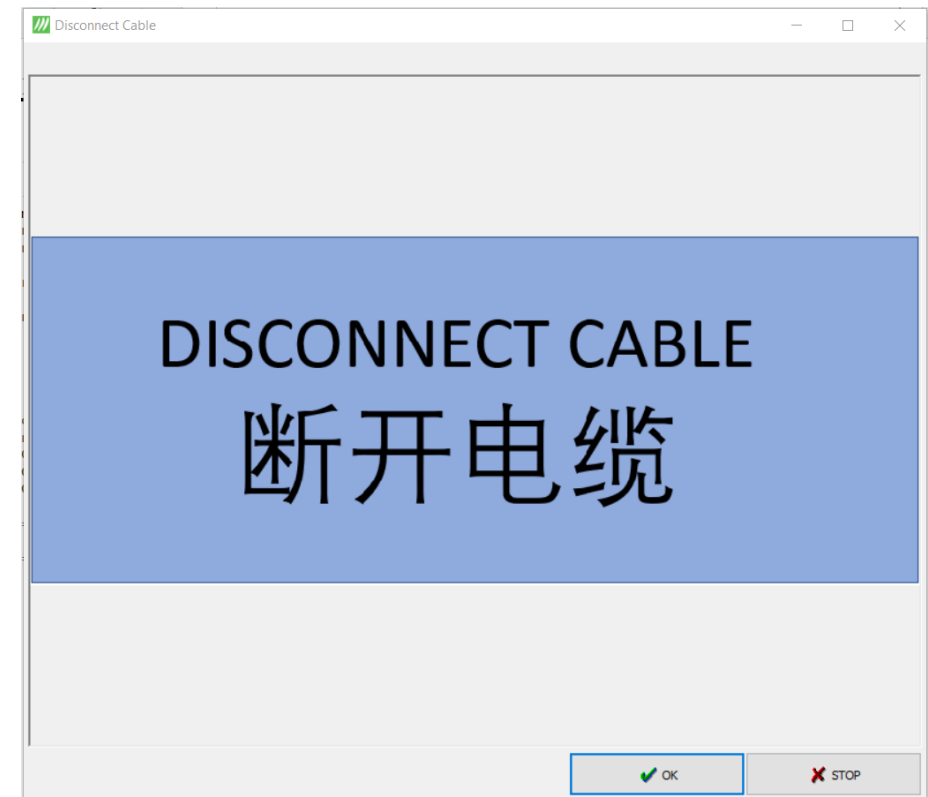
Example Test Report Summary

DisplayPort Cable Test Report

```
-------------------------------------------------
                 Cable Test Sequence
-------------------------------------------------
Timing 36 7680x4320 @ 30Hz. Pattern 1
Link Rate:                        8.1 Gbps
Lane Count                        4

Current link flags defined below:

Lane    Clock Recovery    Channel EQ    Symbol Lock    Voltage Swing mVpp    Pre-emphasis
  0         done             done           on               400                3.5
  1         done             done           on               400                3.5
  2         done             done           on               400                3.5
  3         done             done           on               400                3.5


Video Signal Timing Test for timing 7680 x 4320 @ 30 Hz ........................................PASSED
Link Error Test...............................................................................PASSED
CRC Based Single Frame Video Stability Test...................................................PASSED
HDCP 1.x Test.................................................................................PASSED
HDCP 2.x Test.................................................................................PASSED


=================================================================================================
                                    TEST SEQUENCE PASSED
=================================================================================================
```

Test configuration details

Results from all tests

Detailed Test Log Example • CRC Test

```
-------------------CRC Based Single Frame Video Stability Test-------------------

[2020-05-06, 14:02:16.571]: Starting CRC video test (Test ID 393217)
[2020-05-06, 14:02:16.571]: Stage 1: Test initialization.
[2020-05-06, 14:02:16.571]: Test params:
[2020-05-06, 14:02:16.571]:    - Test timeout (ms) = 5000
[2020-05-06, 14:02:16.571]:    - Test duration (# frames) = 50
[2020-05-06, 14:02:16.571]:    - Allowed mismatches (# frames) = 0
[2020-05-06, 14:02:16.571]:    - Reference width (# pixels) = 7680
[2020-05-06, 14:02:16.571]:    - Reference height (# Lines) = 4320
[2020-05-06, 14:02:16.571]:    - Reference colordepth (bpp) = 24
[2020-05-06, 14:02:16.571]:    - CRC Value set count = 50
[2020-05-06, 14:02:16.571]:    - Require frame rate (mHz) = 0
[2020-05-06, 14:02:16.571]:    - Frame rate tolerance (mHz) = 0
[2020-05-06, 14:02:16.571]:    - Motion test iterations (# loops): 0
[2020-05-06, 14:02:16.571]:    - Color format (ID): 0
[2020-05-06, 14:02:16.665]: Test max runtime 300000 ms
[2020-05-06, 14:02:16.680]: 0001.741.089:    50 frames were tested.
[2020-05-06, 14:02:16.680]: 0001.741.160:    0 mismatches were found.
[2020-05-06, 14:02:16.680]: 0001.741.227:    done.
[2020-05-06, 14:02:16.680]: 0001.741.270: Stage 5: - test data collection completed
[2020-05-06, 14:02:16.680]: 0001.741.506: Test PASSED: "CRC based single frame video stability test"
[2020-05-06, 14:02:16.680]: 0000.000.001: Start test "CRC based single frame video stability test"
[2020-05-06, 14:02:16.680]: 0000.000.107: Test params:
[2020-05-06, 14:02:16.680]: 0000.000.248:    Frames to test   = 50
[2020-05-06, 14:02:16.680]: 0000.000.313: Stage 1: - connecting to input interface...
[2020-05-06, 14:02:16.680]: 0000.006.883:    done.
[2020-05-06, 14:02:16.680]: 0000.006.924: Stage 2: - measure timings and check params...
[2020-05-06, 14:02:16.680]: 0000.007.157:    done.
[2020-05-06, 14:02:16.680]: 0000.007.198: Stage 3: - synchronization...
[2020-05-06, 14:02:16.712]: 0000.040.344:    Reference frame has crc     : 0x7eb8, 0x7eb8, 0x7eb8
[2020-05-06, 14:02:16.712]: 0000.040.475:    done.
[2020-05-06, 14:02:16.712]: 0000.040.518: Stage 4: - gathering information...
[2020-05-06, 14:02:18.383]: 0001.707.010:    50 frames were tested.
[2020-05-06, 14:02:18.383]: 0001.707.080:    0 mismatches were found.
[2020-05-06, 14:02:18.383]: 0001.707.144:    done.
[2020-05-06, 14:02:18.383]: 0001.707.186: Stage 5: - test data collection completed
[2020-05-06, 14:02:18.383]: 0001.707.421: Test PASSED: "CRC based single frame video stability test"
[2020-05-06, 14:02:18.383]:
[2020-05-06, 14:02:18.383]: Test Complete
CRC Based Single Frame Video Stability Test.....................................................PASSED
```

Test Parameters

Tests Run

Test Result

Test Visualization in UCD Console GUI

UCD Console GUI

- UCD Console GUI is a common PC user interface for all UCD series products
- With UCD Console you can control all functionalities and tests to verify DisplayPort, HDMI and USB-C interfaces
- Before running automated test sequences, with UCD Console you can test that the test parameters work seamesly with your device
- More detailed introduction to UCD Console, visit: Introducing: UCD Console GUI

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Test Visualization • Vide Signal Timing

- Video Signal Timing Test for timing 7680 x 4320 @ 30 Hz
  - ➢ UCD Console has a built-in video pattern generator for DP TX functionality and video capture and preview for DP RX functionality
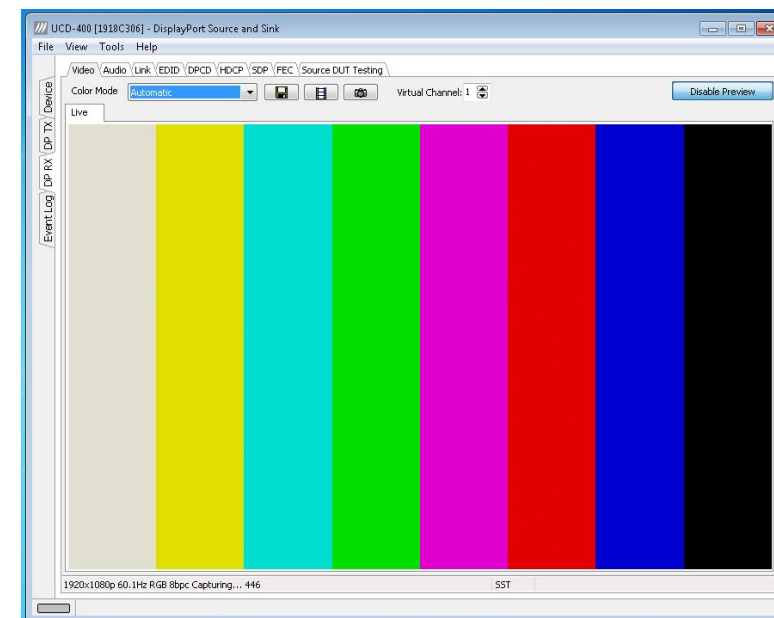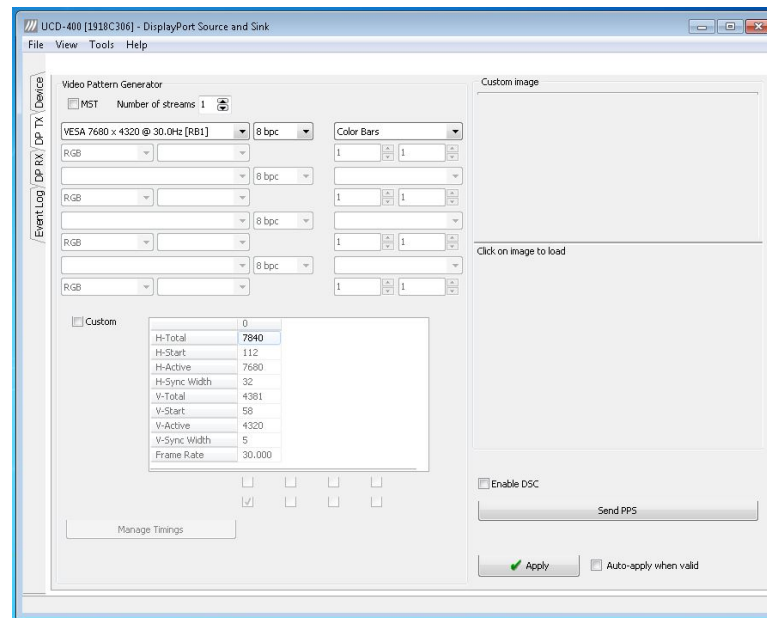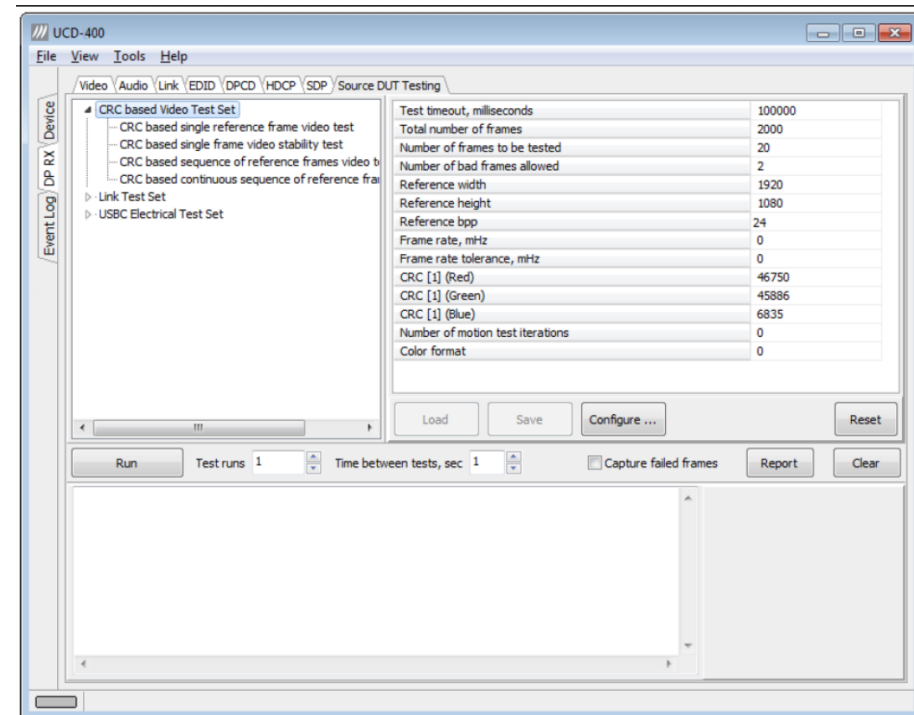
Test Visualization • Link

- Link Error Test
  - ➢ UCD Console has a *Link* tab where you can monitor up to four lanes. The GIF below shows an error on the link between the sink and source
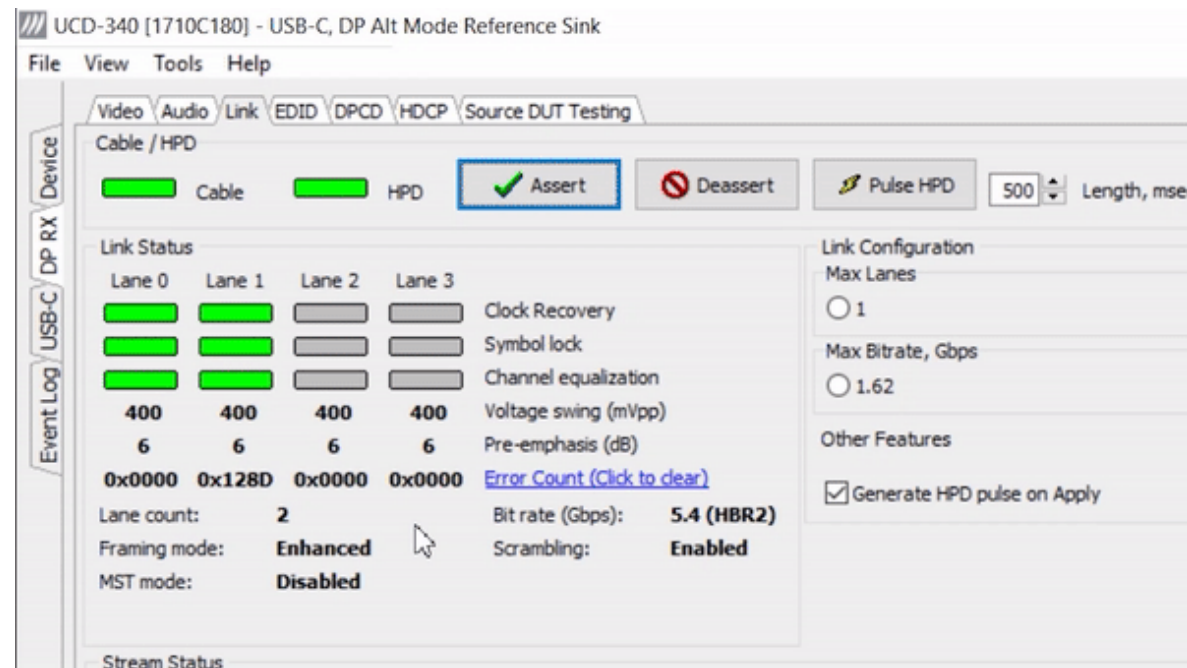
Test Visualization • CRC Tests

- CRC Based Single Frame Video Stability Test
  - ➤ *CRC based single frame video stability test* uses one captured frame and compares that with the incoming video stream. If the frames match, the video is stabile

- UCD Console features ready-made CRC based video test set

Test Visualization • CRC Tests

- You can configure the CRC tests and save the configuration. Automated test sequence will use these settings to run the automated tests.

- You can also run CRC tests in UCD Console to make sure that the test configuration works with you device under test.

Test Visualization • UCD Console GUI

- HDCP 1.x Test & HDCP 2.x Test
  - ➢ UCD Console has a *HDCP* tab where you can monitor and control HDCP encryption up to HDCP 2.3
  - ➢ HDCP 2.3 CTS tests are also available

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