Test Equipment for DisplayPort™ and DisplayPort™ over USB Type-C

Sergey Grushin
CTO, Unigraf Oy
Overview

- About Unigraf
- Unigraf Test Equipment
- DP 1.4a Link Layer compliance testing
- HDCP 2.2/2.3 compliance testing
- HDR and AV Sync testing
Unigraf Oy

- Privately owned
- Established in 1990
- Located in Espoo, Finland
- World-leading video electronics testing company
- Contributor for DisplayPort standards
- Unique product range for DP, HDMI & USB-C
- Comprehensive distribution network
- Strategic partnerships with

\[\text{VESA} \quad \text{DCP}\]
UCD-400 DisplayPort™ 1.4a Test Tool

- VESA Approved DP 1.4a Link Layer CTS Test Tool
- DCP Approved HDCP 2.2 and HDCP 2.3 CTS Tool
- 8K and 4K Reference Sink & Source
- DP 1.4a / HBR3 input and output in one unit
- MST support (4 streams)
- DSC 1.2a, FEC and LTTPR support
- HDCP 1.3 and HDCP 2.2/2.3 support
- UCD Console GUI for debugging
- High level API for easy integration
UCD-424 USB-C DP1.4a Alt Mode Tester

- USB-C input and output with Power Delivery 3.0
  - ✓ Capable to sink & source 9V@3A
  - ✓ PD Role swaps supported
- DP 1.4a / HBR3
  - ✓ Same capabilities as UCD-400
- USB3.1 Gen2 bypass
- UCD Console GUI for debugging
- High level API for easy integration
- Prototype testing ongoing. ETA December 2019
UCD-340 USB-C DP Alt Mode Sink and Source

- Test DP Alt Mode video and audio
- Test USB-C Power Delivery with DP Alt Mode
- USB-C and PD2.0 controls
- Power source and load up to 100W
- Electrical test for DUT connector pins
- Cable flip with SW
- The only USB-C TE approved by DCP for HDCP 2.2 and HDCP 2.3 CTS
- UCD Console GUI for debugging
- High level API for easy integration
DPA-400 with the AUX Channel Monitor GUI

- Compatible with all DP versions
  - **DP 2.0 supported**
- Time stamped interaction log
- Detect and parse all DPCD locations
- Decode Sideband Channel Communication messages
- Flexible in MST testing
- Decode HDCP transactions
- USB controlled & powered, small and light weight

AUX Channel Monitor is mandatory tool for any engineer verifying or debugging Compliance Test or Interoperability
DP 1.4a Link Layer CTS

- **Source Device Tests**
  4.2.1 – AUX reads after HPD Plug event
  4.2.2 – EDID and DPCD reads
  4.3.1 – Link Training
  4.3.2 – Link Maintenance
  4.3.3 – Video Time Stamp generation
  4.4.1 – Main Stream Data Mapping
  4.4.2 – Video Stream Format Change Handling
  4.4.3 – Power Management
  4.4.4 – Audio Stream Transmission
  4.5.1 – Source FEC Protocol
  4.6.1 – Source DSC Protocol (released)

- **Sink Device Tests**
  5.2.1 – AUX Channel Protocol
  5.2.2 – Sink Device DPCD Field Implementation
  5.3.1 – Link Training
  5.3.2 – Link Maintenance
  5.4.1 – Video Stream Reconstruction
  5.4.2 – Video Stream Format Change Handling
  5.4.3 – Power Management
  5.4.4 – Audio Stream Reconstruction
  5.5.1 – Sink FEC Protocol
  5.6.1 – Sink DSC Protocol (released)
  5.6.2 – Sink DSC Protocol Extension (in progress)
HDCP 2.2/2.3 CTS

• Transmitter Tests (UCD family certified by DCP)
  - 1A test set – downstream procedure with Receiver
  - 1B test set – downstream procedure with Repeater

• Receiver Tests (UCD family certified by DCP)
  - 2C test set – upstream procedure with Transmitter

• Repeater Tests (UCD-400 certified by DCP)
  - 3A test set – downstream procedure with Receiver
  - 3B test set – downstream procedure with Repeater
  - 3C test set – upstream procedure with Transmitter
High-dynamic-range Video

High-dynamic-range video (HDR video) describes video having a dynamic range greater than that of standard-dynamic-range video (SDR video).

HDR video involves capture, production, content / encoding, and display.

HDR capture and displays are capable of brighter whites and deeper blacks.

To accommodate this, HDR encoding standards allow for a higher maximum luminance and use at least a 10-bit dynamic range in order to maintain precision across this extended range.

While technically "HDR" refers strictly to the ratio between the maximum and minimum luminance, the term "HDR video" is commonly understood to imply wide color gamut as well.

Wikipedia
HDR Types

Image credit: Yoeri Geutskens
HDR Types

Image credit: Yoeri Geutskens
HDR Ecosystem

- HDR Content
- Video & Metadata
- Conversion parameters
- SDR Video
- Extract parameters
- Dynamic range conversion
- Display tuning
- Display capabilities
- HDR video

HDR Content → Video & Metadata → Conversion parameters → SDR Video → Extract parameters → Dynamic range conversion → Display tuning → Display capabilities → HDR video
HDR Testing with Unigraf Tools

Source Test
• Verify that the source correctly provides video and related metadata

Sink Test
• Verify that the sink correctly interprets and displays video content
D.U.T. Source Test

Video, Audio & Metadata

DP / HDMI

HDR Test Content

- Verify Video, Audio & Metadata
- Verify Video / Audio timing

Capture Video
Capture Audio
Capture Metadata

Unigraf Reference Sink

Test SW
Sink Test

- Verify DUT DisplayID/EDID
- Send Test Content

Unigraf Reference Source

Video & Audio Test Stream + Metadata

Read EDID

DP / HDMI

Test SW

D.U.T.
Thank You!

www.unigraf.fi
www.unigraf-china.cn
info@unigraf.fi