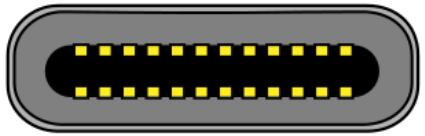
UNIGRAF

USB-C and DP Alt Mode Testing

With UCD-340

Data, Power and Display in One Interface



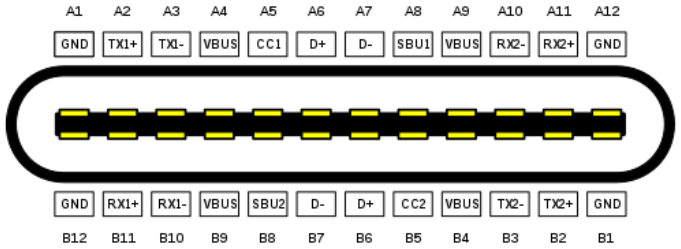
USB Type-C

USB Type-C =  +  + DisplayPort

USB Type-C | High Speed Data | Power Management | Display Connection

Superior Features in USB-C

- Entirely new design
  - ✓ Replaces all existing USB connectors
- Small size to match the connected products
- Usability enhancements
  - ✓ Reversible plug orientation & cable direction
  - ✓ Supports scalable power charging



- Same port can supports various data & power roles
- Future Scalability
  - ✓ Designed to establish future USB performance needs
  - ✓ Alternate modes to expose additional interfaces

A Multitude of Possible DUT Roles

- Data Role: DFP, UFP, DRP
- Power Role: Power Source, Power Sink
- Power Level Capability:
  - ✓ Default USB, 1.5 A, 3.0 A
  - ✓ Up to 5 A @ 20 V
- Two cable orientations
- Alternate modes:
  - ✓ DisplayPort Alt Mode Sink and Source
  - ✓ Etc.

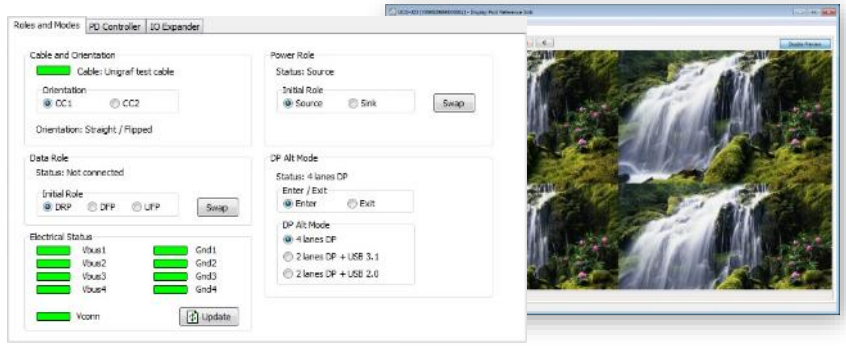
This all creates a testing challenge!

Different Test Intents

- R&D
  - ✓ Verify USB-C and DP Alt Mode on system level
  - ✓ Enable all possible role variations
  - ✓ Enable test automation for e.g. SW release testing
- Production
  - ✓ Verify assembly & soldering quality
  - ✓ Validate component operation
  - ✓ Validate functional components

Unigraf Test Solution for USB-C

- Includes all SW and HW needed to test a USB-C interface
  - ✓ UCD Console GUI for R&D
  - ✓ TSI SDK with ready Test Cases
  - ✓ UCD-340 test equipment hardware
- Supports various test intents
  - ✓ GUI with full controls for R&D and QA use
  - ✓ Customizable high level API for end-of-design regression testing
  - ✓ Ready to integrate Test Cases for most USB-C product types
- Integrated DP Alt Mode testing
  - ✓ Video and audio capture
  - ✓ Video pattern generator



UCD-340

Test Unit for USB-C DP Alt Mode Sinks and Sources

- Test DP Alt Mode video and audio
- Test USB-C Power Delivery with DP Alt Mode
- Verify interface signal continuity
- HDCP 1.3 and HDCP 2.2 support
- USB signal pass-thru
- GUI for lab use and API for test automation

UCD-340 Hardware Options

UCD-340

USB Type-C DP Alt Mode tester*

UCD-340

USB Type-C DP Alt Mode tester
with
Electrical Test*

External USB-C Power Test Unit for UCD-340*

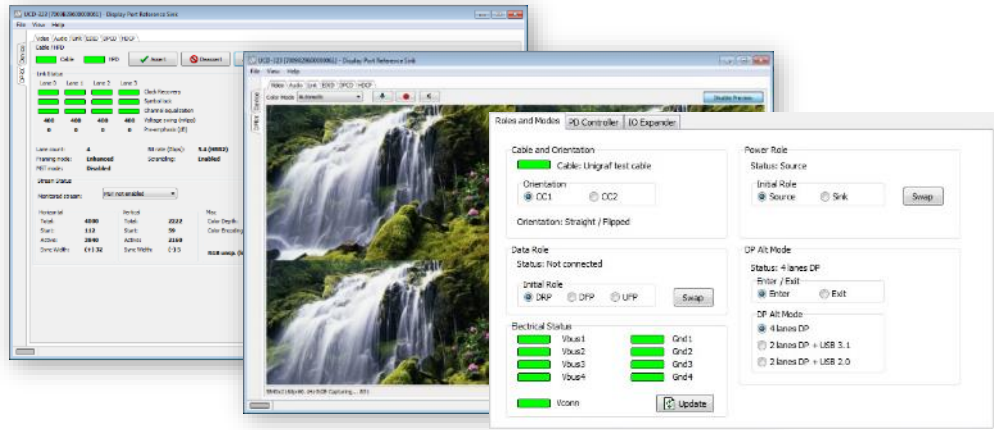
*) Please find description of the products below

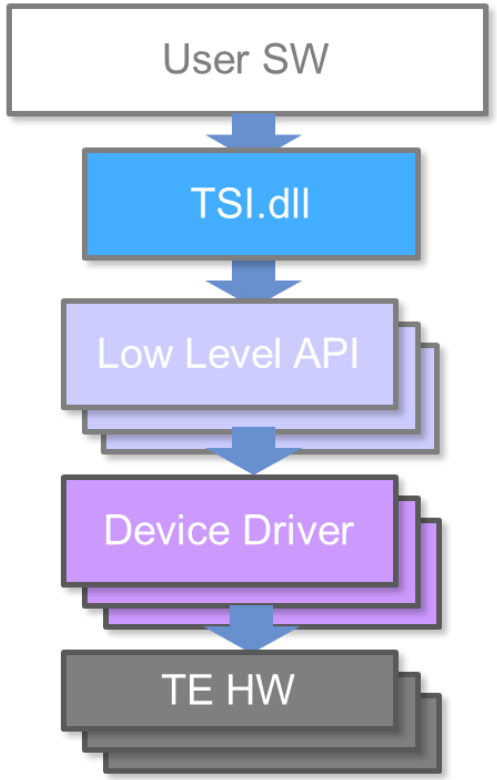
UCD-340 HW Products

Product	Prod #	Description
UCD-340 USB-C DP Alt Mode Tester	066514	4K capable test unit for USB-C DP Alt Mode Sinks or Sources. USB 3.0 Interface to Host PC. TSI SDK Basic Test Set included.
UCD-340 USB-C DP Alt Mode Tester with Electrical Test	066515	4K capable test unit for USB-C DP Alt Mode Sinks or Sources with Electrical Test. USB 3.0 Interface to Host PC. TSI SDK Basic Test Set included.
USB-C External Power Test Unit	066522	External USB-C Power Test unit for testing Power load for Sink or Source DUT.

Unigraf USB-C Test Software

- *UCD Console GUI* for R&D desktop evaluation
- *TSI API with Test Cases* separately for DP Alt Mode Sink and DP Alt Mode Source





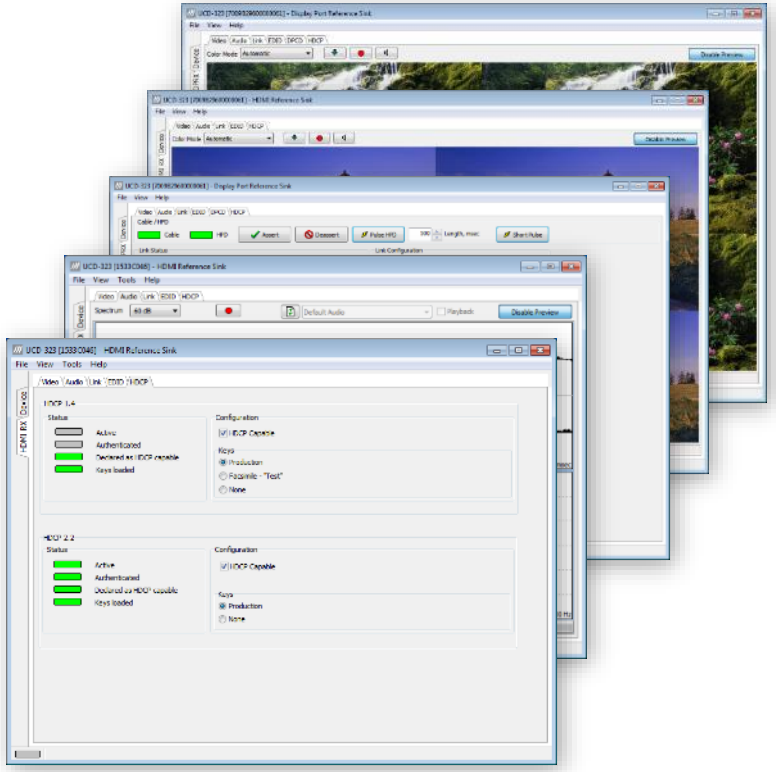
UCD-340 SW Products

Product	Prod #	Description
UCD Console Pro for Type-C DP Sink	MT6640	Advanced features for UCD Console GUI for testing USB-C DP Alt Mode Source devices*
UCD Console Pro for Type-C DP Source	MT6641	Advanced features for UCD Console GUI for testing USB-C DP Alt Mode Sink devices*
HDCP 2.2 support	MT6504	Add on feature for UCD Console GUI for testing HDCP 2.2. TSI SDK Advanced Test Set with HDCP 2.2 support included. *
HDCP 2.2 CTS for testing Source DUT on DP	MT6634	HDCP 2.2 on DisplayPort compliance tests for testing Source DUT. (Sets 1A + 1B) *
HDCP 2.2 CTS for testing Sink DUT on DP	MT6636	HDCP 2.2 on DisplayPort compliance tests for testing Sink DUT. (Set 2C)*
TSI SDK Advanced Test Set	MT6501	Advanced features for TSI SDK. *
TSI SDK Advanced Test Set with HDCP 2.2 support	MT6516	Advanced features with HDCP 2.2 support for TSI SDK. *

*) UCD-340 delivery includes Basic version of UCD Console GUI Software and Basic version of high level TSI SDK for C/C++ programming

UCD Console for R&D Desktop Use

- Monitor all status changes
  - ✓ PD Sniffer to monitor PD message exchange
  - ✓ Mode status indicators
  - ✓ Connector signal status
- Role change controls
  - ✓ Data role, power role, power level
  - ✓ Cable flip
- DP Alt Mode
  - ✓ Sink and Source status and control
  - ✓ Video and audio capture and transmit



UCD Console Features

Feature Category	Feature	Console Basic*	Console Pro*
USB-C Modes Common	USB Data Role status	✓	✓
	USB-C Power Role status	✓	✓
	USB-C Power Role Control		✓
	USB Data Role Control		✓
	Power Delivery protocol monitoring		✓
DP Alt Mode Common	USB-C DP ALT Mode status	✓	✓
	USB-C DP ALT Mode control		✓
	EDID Editor		✓
	DPCD Editor		✓
	AUX Monitor		✓

*) Please find description of the products below

UCD Console Features

Feature Category	Feature	Console Basic*	Pro for Type-C DP Sink*	Pro for Type-C DP Source*
Testing DP Alt Mode Source DUT	DP Link Status Information of the upstream link	✓	✓	✓
	Video mode and control of the upstream link		✓	
	Audio monitoring and saving	✓	✓	✓
	DP Alt Mode capture, preview and saving	✓	✓	✓
Testing DP Alt Mode Sink DUT	DP Link Status Information of the downstream link	✓	✓	✓
	Control of the downstream link			✓
	Video Pattern Generator (Fixed test Patterns and Timings)	✓	✓	✓
	Video Pattern Generator (Custom Patterns and Timings)			✓

*) Please find description of the products below

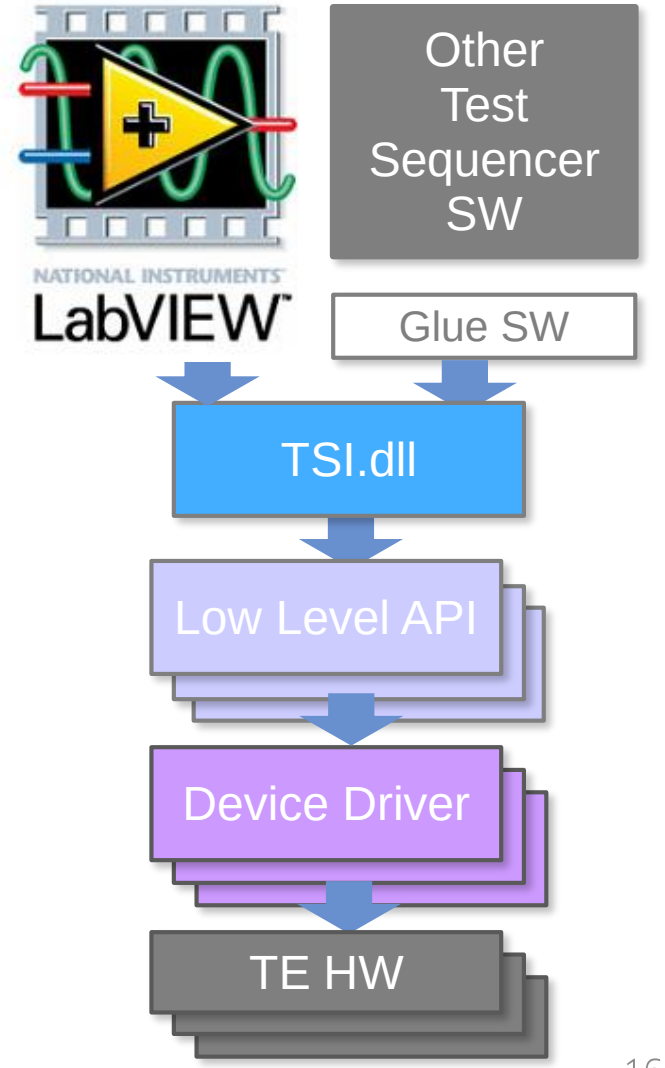
UCD Console Features

Feature Category	Feature	Console Basic*	Pro for Sink / Source*	HDCP 2.2 Support*	DP HDCP 2.2 CTS*
Testing HDCP	HDCP preview up to HDCP 1.3		✓	✓	
	HDCP status monitor and control up to HDCP 1.3		✓	✓	
	HDCP Test Key support		✓	✓	
	Advanced features for testing HDCP 2.2			✓	
	DP HDCP 2.2 CTS for Testing Sink DUT				✓
	DP HDCP 2.2 CTS for Testing Source DUT				✓

*) Please find description of the products below

TSI API for Test Automation

- Suitable for Test Automation in R&D and Production Line
- Straightforward to use
  - ✓ High level interface
  - ✓ Pre-programmed Test Cases
  - ✓ No need for low-level TE-specific controls
- Example applications with source code
- NI / LabVIEW support



TSI API Features

Feature Category	Feature	Basic TSI API*	TSI Advanced*	TSI Advanced with HDCP 2.2 Support*
USB-C Modes Common	USB Data Role status	✓	✓	✓
	USB Data Role Control		✓	✓
	USB-C Power Role status	✓	✓	✓
	USB-C Power Role Control		✓	✓
	Support for USB-C External Power Unit	✓	✓	✓
DP Alt Mode Common	USB-C DP ALT Mode status	✓	✓	✓
	USB-C DP ALT Mode control		✓	✓
	Support for Electrical Test option and Cable	✓	✓	✓
	Orientation Test with Electrical Test Cable	✓	✓	✓
	HTML reporting		✓	✓

*) Please find description of the products below

TSI API Features

Feature Category	Feature	Basic TSI API*	TSI Advanced*	TSI Advanced with HDCP 2.2 Support*
Testing DP Alt Mode Source DUT	DP Alt Mode preview and saving	✓	✓	✓
	Video test (software pixel comparison)	✓	✓	✓
	Audio test	✓	✓	✓
	CRC based video test set		✓	✓
	EDID read/write		✓	✓
	DPCD read/write		✓	✓
Testing HDCP	HDCP 1.3 support	✓	✓	✓
	HDCP preview up to HDCP 1.3		✓	✓
	HDCP support up to HDCP 2.2			✓

*) Please find description of the products below

TSI API Test Cases

- Pre-programmed high level test routines
- Designed to address specific DUT features
  - ✓ Created by Unigraf experts
  - ✓ Verified with multiple DUTs
- Test details and severity specified with parameters
- Example TSI applications provided
  - ✓ Test the routine before integration
  - ✓ Follow the example source code for smooth integration

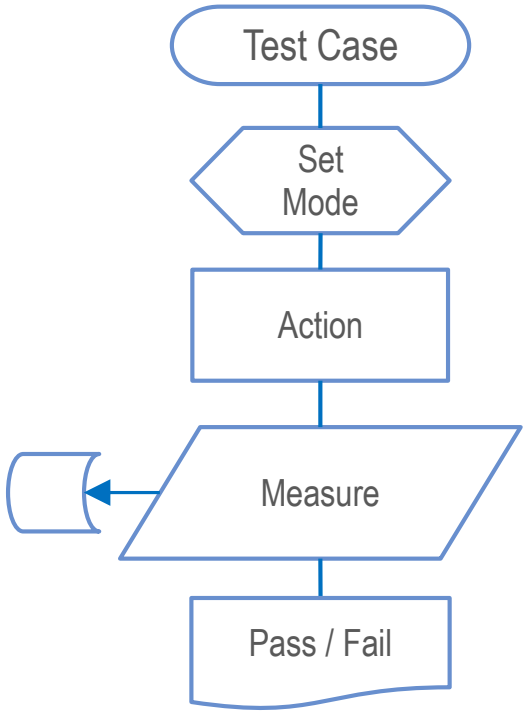
```
#define TSI_TEST_DP_EL_MAIN_LINK 0x00010001

Configuration Items:

TSI_DP_RX_TEST_TIMEOUT
TSI_DP_RX_LINKS_LOW_VOLTAGE
TSI_DP_RX_LINKS_HI_VOLTAGE
TSI_DP_RX_MAX_DUT_LANE_COUNT
TSI_DP_RX_MAX_DUT_LINK_RATE
```

TSI Test Cases for USB-C

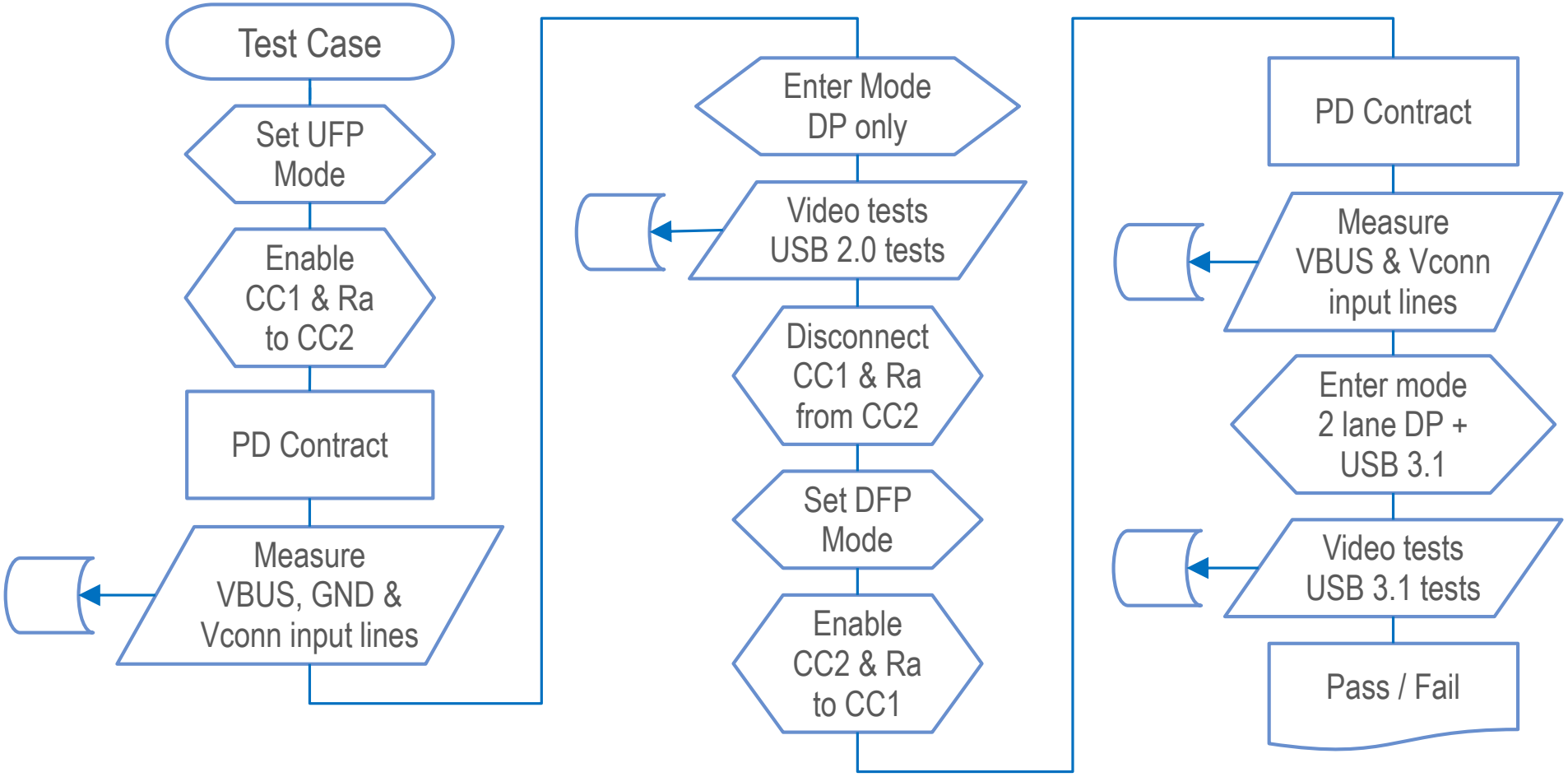
- Dedicated Test Case for each DP Sink and Source role
- Complete
  - ✓ Verify all functions in the product type
  - ✓ Separate Test Case for each combination
- Compact and Fast
  - ✓ Skip roles that are not applicable
- Reliable
  - ✓ Implemented directly from the standard
- Easy to Integrate
  - ✓ High level, parameterized



Test Cases vs. Product Type

Test Cases		Example Product Type
DP Alt Mode Role	Data Role	
DP Source	DRP	Mobile phone, tablet, 2 in 1, laptop PC
DP Source	DFP	Laptop and desktop PC
DP Source	UFP	Mobile phone, action camera, drone
DP Sink	DRP	Monitor
DP Sink	DFP	Monitor
DP Sink	UFP	Protocol adapter, monitor, VR head-set
DP Sink	UFP	Protocol adapter with power output capability

TSI Test Case Example: DP Source & DRP



Unigraf Special Features

- USB-C Electrical Test
  - ✓ Electrical Test Cable includes individual cords for each GND and V_{BUS} input
  - ✓ Measure the continuity of VBUS and Ground inputs
    - Enables verification of each input separately
  - ✓ Measure the voltage levels of CC and SBU connections
    - Full functionality measured in modes where SBU lines are operational
- Cable Flip
  - ✓ Electrically swap the role of CC lines
- Power Delivery Test

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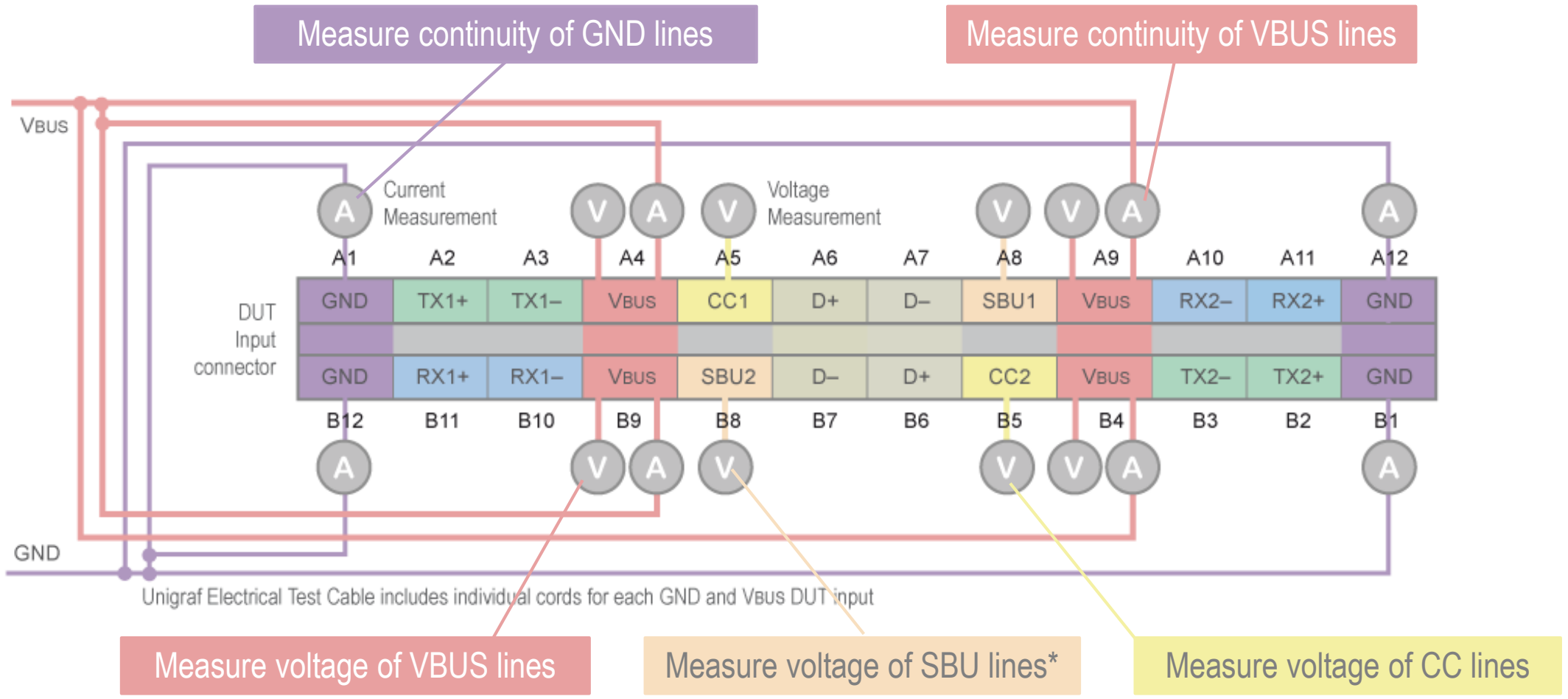
USB-C Electrical Testing

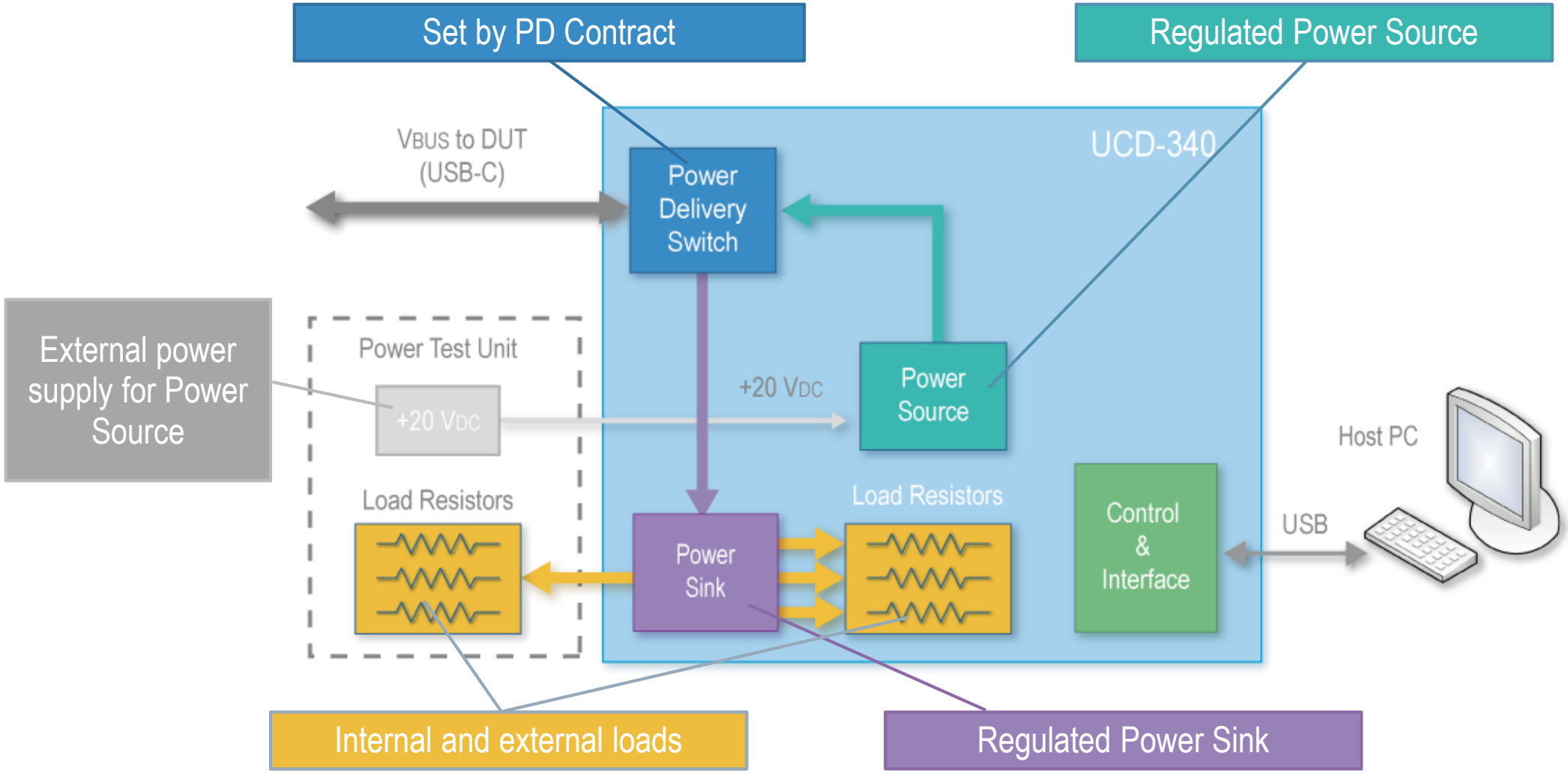


*) Full functionality measured in modes where SBU lines are operational

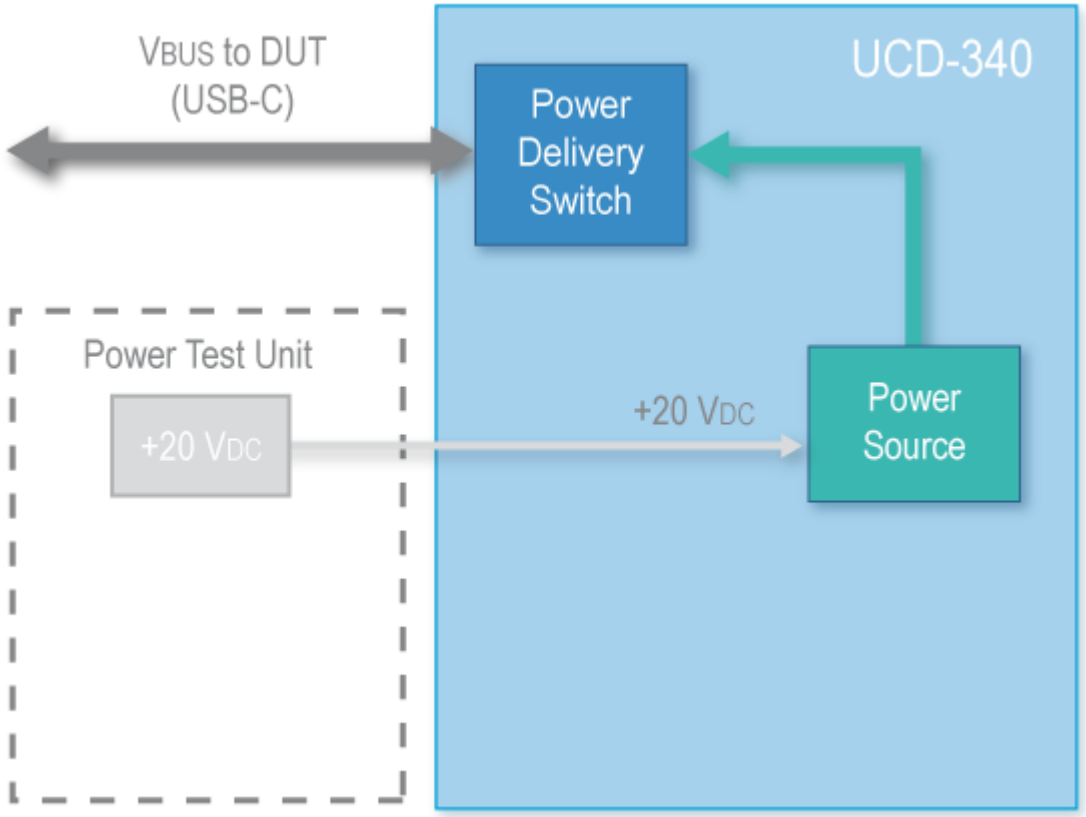
Unigraf USB-C Power Delivery Test

- UCD-340 with Unigraf Test Cable and Unigraf Power Test Unit can test all power sink and source alternatives up to 20 V / 5 A
- UCD-340 Power capabilities (PDOs) can be freely defined in UCD Console GUI or TSI SDK.
- Unigraf Power Test Unit
  - ✓ 5 V power modes can be tested with UCD-340 alone
  - ✓ Testing 9 V to 20 V power modes Unigraf Power Test Unit provides the necessary power input or power sink capability.

Unigraf USB-C Power Test

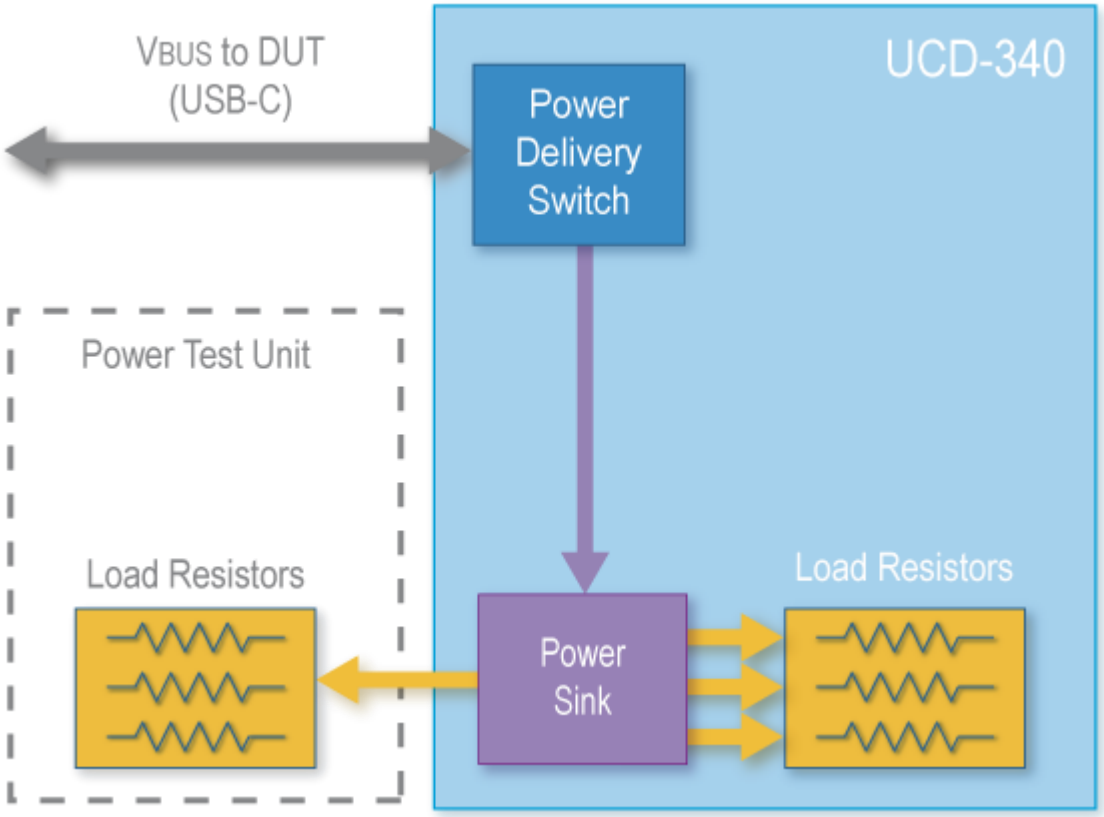


Power Source PDOs



- Power Source options +5 V / 0.5, 0.9, 1.5 and 3 A generated internally
- Power Source options +9 V / 3 A, +12 V / 3 A, +15 V / 3 A and +20 V / 5 A generated from an external power input (+20 Vdc) from Unigraf Power Test Unit

Power Sink PDOs



- Power Sink for
  +5 V / 0.5 A to 3 A dissipated with internal loads
- Power Sink for
  +9 V / 3 A to +20 V / 5 A dissipated with external loads in Unigraf Power Test Unit

Test Setup Example: USB-C Dongle

UCD-340

USB Type-C
DP Alt Mode tester

&

Basic TSI API Software

(Included in UCD-340 default configuration)

Prod #: 066514

Test Setup Example: Mobile Phone

UCD-340

USB Type-C DP Alt Mode tester
with Electrical Test*

&

Basic TSI API Software

(Included in UCD-340 default configuration)

Prod #: 066515

Test Setup Example: Laptop Computer

UCD-340

USB Type-C DP Alt Mode tester with Electrical Test*

&

Basic TSI API Software

(Included in UCD-340 default configuration)

External USB-C Power Test Unit for UCD-340

Prod #: 066515 + 066522

Test Setup Example: R&D Laboratory Desktop

UCD-340
USB Type-C
DP Alt Mode tester

&

UCD Console GUI Software
HDCP 2.2 Support for
Console GUI + HDCP 2.2 CTS

External USB-C
Power Test Unit
for UCD-340

Prod #: 066514 + MT6632 + MT6504 + 066522 + MT6634 + MT6636

Test Setup Example: R&D Test Automation

UCD-340
USB Type-C
DP Alt Mode tester

&

TSI Advanced Test Set with
HDCP 2.2 Support

External USB-C
Power Test Unit
for UCD-340

Prod #: 066514 + MT6516 + 066522

Summary

- UCD-340 is the first integrated USB-C tester with DP Alt
- UCD-340 supports both R&D and production needs
  - ✓ Automated test sequences with TSI for production environment
  - ✓ Easy to use graphical user interface for R&D
- Unique electrical testing to verify pin connections of the USB-C receptacle
  - ✓ Detect open, short and grounding

Summary (cont'd)

- Software based cable flip to verify both cable orientations of DUT's USB-C receptacle in production
  - ✓ No need for manual operation
- Find source interoperability issues without the physical monitors
  - ✓ Simulate the monitors with EDID test
- Test power sink and source up to 100W
- USB 3.1 Gen1 signal pass-thru for USB testers
  - ✓ Oscilloscope based or standalone tester

Thank You!

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