

Superior New Features with USB-C and DP Alt mode



Data, Power and Display in One Interface





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 Ioles
- Future Scalability
 - ✓ Designed to establish future USB performance needs
 - ✓ Alternate modes to expose additional interfaces







USB Type-C Receptacle Pins



CAPTURING THE WORLD

Data and Power Roles

- Data roles:
 - ✓ Downstream Facing Port (DFP) –typical of Standard-A host or hub ports
 - Upstream Facing Port (UFP) –typical of Standard-B or Micro-B device ports
 - A Dual-Role Port (DRP) transitions between DFP and UFP port states until it resolves to the appropriate state upon an attach event
- Power roles:
 - ✓ Type-C port has no VBUS available before data roles are defined
 - ✓ Source –typical of Standard-A host or hub ports
 - ✓ Sink –typical of Standard-B or Micro-B device ports
- Roles can be dynamically swapped using USB PD
 - ✓ Data role, power role & VCONN swap

USB Type-C – Pull-Up/Pull-Down CC Model

- Host side can substitute current sources for Rp
- Powered cables introduce Ra at one CC pin which is used to indicate the need for VCONN over that pin



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USB Type-C – Host Detected Connection States

CC1	CC2	State	Position	
Open	Open	Nothing connected	N/A	
Rd	Open	UFP connected	1	
Open	Rd	UFP connected	2	
Open	Ra	Powered Cable/No UFP connected	1	
Ra	Open	Powered Cable/No UFP connected	2	
Rd	Ra	Powered Cable/UFP connected	1	
Ra	Rd	Powered Cable/UFP connected	2	
Rd	Rd	Debug Accessory Mode connected (Appendix B)	N/A	
Ra	Ra	Audio Adapter Accessory Mode connected (Appendix A)	N/A	

Host-to-Host (DFP-to-DFP) and Device-to-Device (UFP-to-UFP) are undetectable sub-states of Open/Open



⇒ Un-flipped straight through – Position ① ⇔ Position ①



⇒ Un-flipped twisted through – Position ① ⇔ Position ②



Imped straight through – Position ② Imped straight through – Position ②



Imposition Imposition ⇒ Flipped twisted through – Position ⇒ Position

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USB-C Power - UFP Interpretation of CC Voltages

- For a UFP sink that supports multiple USB Type-C Current ranges:
- A single connect threshold differentiates the CC to the DFP from a powered cable termination
- Additional connect thresholds differentiate current levels



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USB-C Power

- All solutions required to support Default USB Power appropriate to product – as defined by USB 2.0 and USB 3.1
- Extension options:
 - ✓ USB Power Delivery (PD) –Variable voltage/current up to 5 A @ 20 V
 - ✓ USB Type-C Current Defines 1.5 A and 3 A @ 5 V ranges
 - DFP is advertising its power rating with adequate Rd in CC-line
 - ✓ USB BC 1.2 (also requires support of USB Type-C High Current)
 - ✓ USB default current (500 mA for USB 2.0 and 900 mA for USB 3.0)

Priority

USB-C Power Delivery

- Voltage and current values negotiated
 - ✓ Higher voltage and current allows power up to ~100W
 - ✓ Limits to match cable capabilities (3 A / 5 A)
 - ✓ Upper limit bound by international safety requirements
- Coexists with USB Battery Charging 1.2
- Swapping of power direction, data direction and source of VCONN
- Communication with USB Type-C Electronically Marked Cables
- Support for Alternate Modes of operation

USB Type-C Power Delivery



USB-C Power Delivery

 USB PD for USB Type-C implementation is DC coupled and is based on Biphase Mark Coding (BMC) signal encoding over CC, half duplex system with 300kbps bit rate.



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USB-C Power Delivery

- USB-C Control
 - ✓ USB Type-C state operation (attach/detach)
 - Power Source/Sink (Chapter 7)
 - Controls power transitic
- Physical Layer (Chapter 5)
 - Port to Port over CC wire
- Protocol Layer (Chapter 6)
 - ✓ Handles retries and message c
- Device Policy (Chapter 8)
 - ✓ Policy Engine
 - Drives the Atomic Message Sec
- Device Policy Manager
 - ✓ Handles PD across multiple po
 - ✓ Makes decisions on how to allocate power
 - ✓ Talks to Power Source/Sink and Cable Detection



USB-C Electronically Marked Cable

- Uses USB PD to get cable's capabilities
- VCONN only powered by DFP



USB-C Power Delivery 3.0 Power Capability



CAPTURING THE WORLD

DisplayPort[™] Alt Mode on USB-C

- The VESA DisplayPort Alt Mode Standard, Version 1, was released on Sept 22, 2014
- Enables the use of the USB Type-C interface for DisplayPort
- Alternate modes reconfigure the connector
 - ✓ Repurpose pins to support another bus
 - ✓ Change the mode of operation of a bus
 - ✓ Enable sideband signals

A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2-	VBUS	SBU1	D-	D+	СС	VBUS	TX1-	TX1+	GND
	•	•									
GND	TX2+	TX2-	VBUS	VCONN			SBU2	VBUS	RX1-	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B 9	B10	B11	B12

Upgrade to Standard DisplayPort[™]

- Full featured USB-C to USB-C cable can carry up to four DisplayPort lanes
 - This will offer the same performance and feature capability as a standard DisplayPort connections
 - This will also allow DisplayPort data rates to increase in the future, since the USB-C connector has high data rate capability





DP + USB + Power Delivery

- DisplayPort can be combined with USB 3.1 operation over the same USB-C cable
 - Implemented with two high speed pairs for DP and two high speed pair for USB3.1
- USB 2.0 and USB Power Delivery is available in all configurations
 - USB 2.0 and USB PD use dedicated wires in the USB-C and both of these services are always available, even using all four USB-C high speed pairs for DisplayPort



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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.



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
 - ✓ Configurable 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 Tester for USB-C DP Alt Mode

- Test DP Alt Mode Sink and Source
- Test 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



Unigraf USB-C Test Software



UCD Console GUI for R&D desktop evaluation



Summary

- UCD-340 is the first integrated USB-C tester with DP Alt Mode
- 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 100 W
- USB 3.1 Gen1 signal pass-thru for USB testers



Please contact us for more detailed information.

Thank you.

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