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Introduction to USB Type-C™

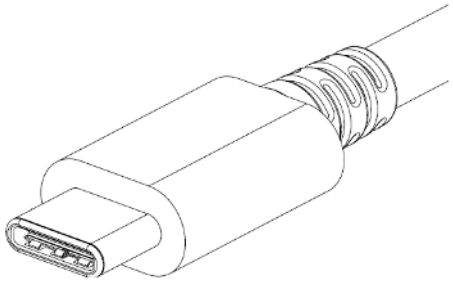
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INTRODUCTION

The USB-IF has secured the ubiquitous nature of USB for years to come with the radically updated USB Type-C™ connector. While the sleek new reversible form factor has been significant for generating buzz and excitement from the general consumer market, the significantly expanded feature-set is what will eventually transform the desktop and entertainment environment.

The USB Type-C cable is now poised to become the “universal” cable, as it is capable of supplying blazing fast data transfer speeds of up to 10Gb/s, 100W of continuous power flow, and ultra high bandwidth video capabilities made available through Alternate Modes all in parallel with a single connection.

This document is intended for those already familiar with USB2.0/USB3.0/USB3.1 who are interested in the high level details of the expanded feature set that the USB Type-C cable brings to USB.



SECTIONS

Section 1.0, General Information
Section 2.0, USB Type-C Cables
Section 3.0, CC Pins
Section 4.0, VCONN Supply
Section 5.0, USB Power Delivery 2.0
Section 6.0, Alternate Modes

REFERENCES

This document is an introduction to USB Type-C™ and is not intended to be a replacement to the official specification. Consult the following specifications for technical details not described in this document.

- *USB Type-C™ Specification*
- *USB Power Delivery 2.0 Specification*
- *USB 2.0 Specification*
- *USB 3.0 Specification*
- *USB 3.1 Specification*
- *USB Battery Charging BC1.2*

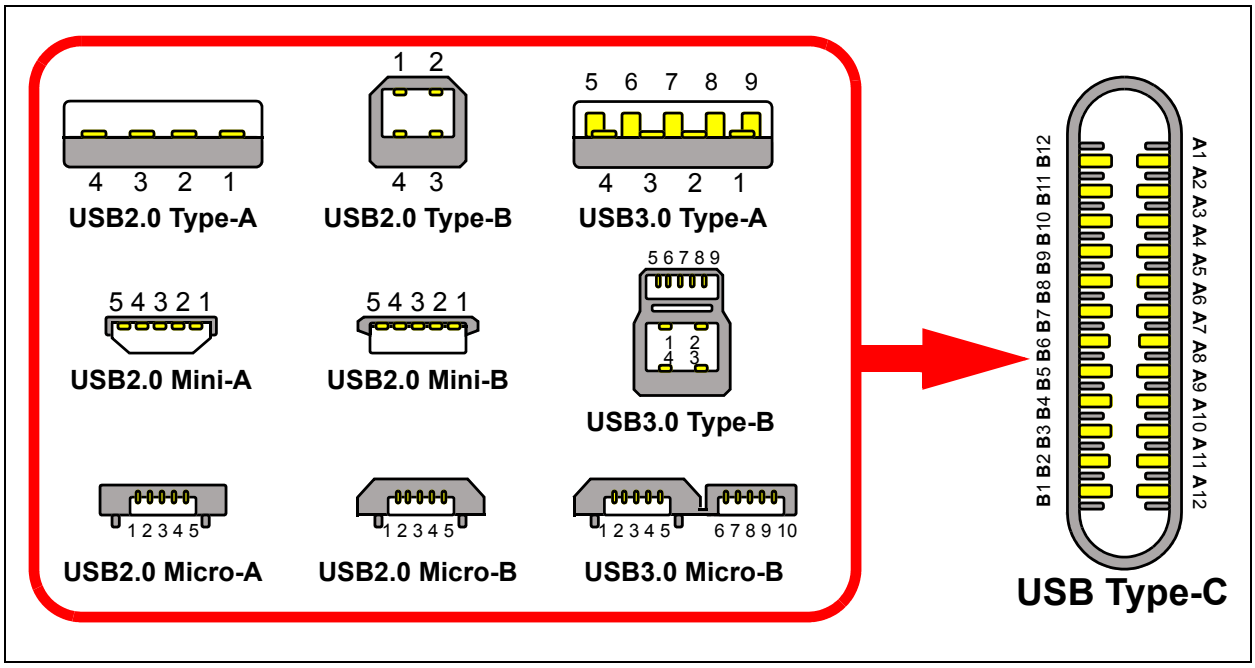
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1.0 GENERAL INFORMATION

The USB Type-C™ cable is a reversible 24-pin interconnect created by the USB-IF. The USB Type-C™ specification was first released in August 2014.

The USB Type-C cable is a universal cable that addresses the needs for a wide range of computing, display, and charging applications. The long-term objective of the USB Type-C cable is to replace all previous iterations of the USB cable while greatly expanding the overall capabilities. The recent introduction of the USB Power Delivery and Alternate Mode capabilities further expand the raw potential for even greater adoption of the USB standard in a wider range of applications.

FIGURE 1: USB CABLE PLUG FORM FACTORS



1.1 Port Behavior

Prior to the introduction of USB Type-C™ and USB Power Delivery, data and power roles were typically fixed. The shape of the receptacle/plug dictated both its data role and power role. USB Type-C connections are much more flexible; ports may be host-mode only, device-mode only, or dual-role and both the data and power roles can be independently and dynamically swapped using USB Power Delivery protocol. Because of this, there is some new terminology that is used to describe USB Type-C systems.

- **Downstream Facing Port (DFP)** - A host or downstream hub port. Typical of a legacy standard Type-A port.
- **Upstream Facing Port (UFP)** - A device or upstream hub port. Typical of a legacy standard Type-B port.
- **Dual-Role Port (DRP)** - A port that transitions between DFP and UFP port states until an attach event occurs. DRPs may be dynamically swapped using USB Power Delivery Protocol Negotiation after an initial attach event.
- **Power Source or Provider** - A source of 5V-20V up to 5A. Typical of a legacy standard Type-A port.
- **Power Sink or Consumer** - A sink of 5V-20V up to 5A. Typical of a legacy standard Type-B port.

1.2 Features

1.2.1 MINIMUM FEATURE SET

A basic USB Type-C application can still be cost-effective.USB Type-C ports are ***not*** required to implement all of the advanced features that are defined in the specification. The minimum required feature set includes the following:

- USB2.0 Connection
- Cable attach and detach detection
- VCONN active cable supply

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1.2.2 BATTERY CHARGING

While BC1.2 is still supported over USB Type-C because it depends on the USB2.0 lane, a significantly simplified and higher power current capability mechanism is also implemented. This simplified approach involves resistor pull-down/pull-up relationships. These pull-down/pull-up resistors are connected to the CC wire and the upstream facing port (UFP) must monitor the voltage on the CC1 and CC2 pins in order to detect the current sourcing capability of the downstream facing port (DFP) it is connected to. This is a substantial improvement over the complicated handshake mechanisms involved with USB BC1.2.

The basic USB Type-C current capabilities are Default USB (500mA for USB2.0 and 900mA for USB3.0), 1.5A@5V, and 3A@5V.

For additional details see Section 3.0, CC Pins.

1.2.3 USB2.0, USB3.0, USB3.1, AND BEYOND

The USB Type-C cable is designed to support current generation USB2.0 (480 Mb/s), USB3.0 (5Gb/s), USB3.1 (10Gb/s), and future USB specifications reaching up to 20Gb/s data rates.

For additional details see please refer to the individual specifications as published by the USB-IF.

1.2.4 POWER DELIVERY 2.0

USB Power Delivery protocol is a singled-ended, 1-wire protocol created by the USB-IF which specifies the methods for serial communication over the USB Type-C CC wire. USB Power Delivery is required for implementation of the following advanced features:

- Communicating with an electronically marked/active cable
- Elevating the VBUS voltage above 5.5V
- Increasing current sourcing/sinking above 3A
- Changing default power roles (Provider or Consumer)
- Using Alternate Modes (see section 1.2.5)

The Power Delivery 2.0 is a port-to-port and port-to-cable communication protocol. The communication can not propagate throughout an entire device tree like standard USB protocols.

For additional details see Section 5.0, USB Power Delivery 2.0.

1.2.5 ALTERNATE MODES (THIRD PARTY PROTOCOLS)

The USB Type-C cable allows for any third party protocol to be used as long as the cable can support it. Alternate Modes are negotiated and entered on a port-to-port basis using the USB Power Delivery protocol. The following signals may be reassigned when entering an Alternate Mode.

- TX1+/-
- RX1+/-
- TX2+/-
- RX2+/-
- SBU1/SBU2

Separate specifications define the rules for each Alternate Mode. Currently, specifications exist for DisplayPort (authored by VESA) and ThunderBolt (authored by Intel). For additional details see Section 6.0, Alternate Modes.

1.3 Connector/Receptacle Pins

FIGURE 2: USB TYPE-C RECEPTACLE

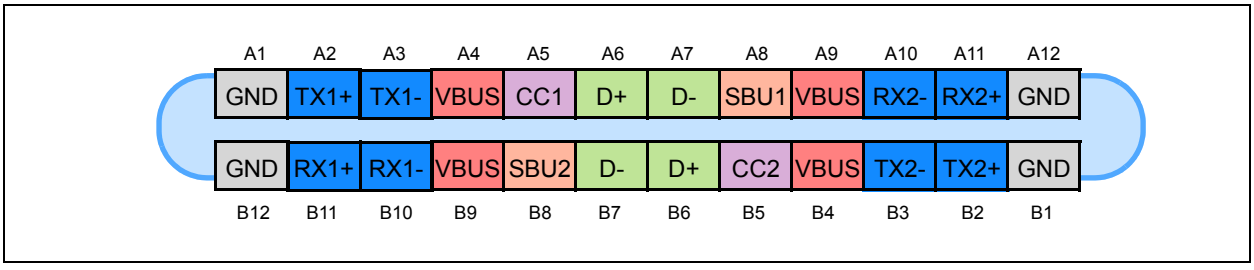
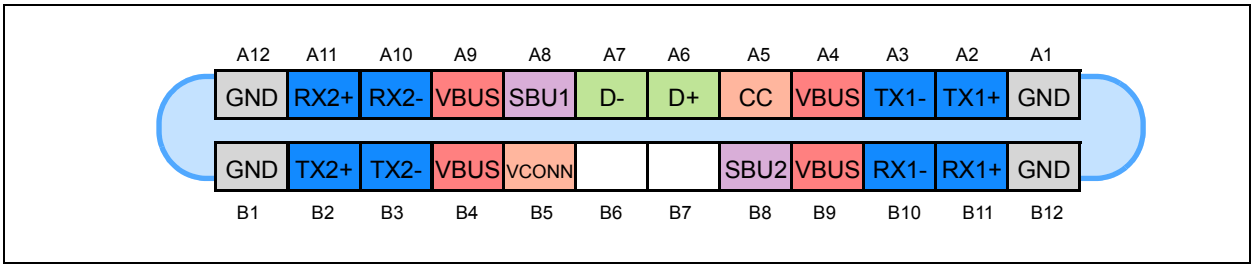


FIGURE 3: USB TYPE-C PLUG



The USB Type-C connector has 24 pins. Because of its reversibility, the pins are arranged in a mirrored configuration. There are a total of 6 differential pairs in a full-featured cable assembly. There are also 4 pins that serve functions new to USB: CC1, CC2, SBU1, SBU2.

1.3.1 USB2.0 DIFFERENTIAL PAIRS

The 2 sets of USB2.0 differential pairs in the connector pinout only connect to a single differential pair in standard USB2.0 or Full Featured USB Type-C cables. In a typical design, the D+ and D- pins are simply shorted on the PCB so that a multiplexer or switch is not required.

The second set of pins (B6/B7) may only be re-purposed in docking type applications where only 1 orientation is possible.

1.3.2 USB3.1 DIFFERENTIAL PAIRS

By default, only one set of TX/RX differential pairs are used for USB3.0/USB3.1 communication, depending on cable insertion orientation. Because of the cable reversibility, the USB3.0/USB3.1 lanes must be rerouted upon orientation connection. A typical application may use a 2:1 multiplexer to achieve this.

USB Power Delivery protocol and Alternate Modes allow some or all of the TX/RX differential pairs to be reassigned.

1.3.3 CC1/CC2 PINS

The CC1 and CC2 pins are used to connect to the either the CC or VCONN wire in a USB Type-C cable. Both CC1 and CC2 pins must be able to support both CC and VCONN functions. The function is detected upon cable insertion.

The CC wire is used to cable orientation detection, USB Type-C current capability advertisement and detection, and USB2.0 BMC communication. See Section 3.0, CC Pins for additional details.

The VCONN wire is used to power active or electronically marked cables. See Section 4.0, VCONN Supply for additional details.

1.3.4 SBU1/SBU2

The SBU wires are lower speed signal wires that is allocated for Alternate Mode use only. USB Power Delivery is required for Alternate Mode negotiation before these pins may be used for any purpose.

TABLE 1: USB TYPE-C™ RECEPTACLE PINOUT

Pin	Name	Function	Note
A1	GND	Power	Support for 60W minimum (combined with all VBUS pins)
A2	TX1+	USB3.1 or Alternate Mode	10Gb/s differential pair with TX1-
A3	TX1-	USB3.1 or Alternate Mode	10Gb/s differential pair with TX1+
A4	VBUS	Power	Support for 60W minimum (combined with all VBUS pins)
A5	CC1	CC or VCONN	—
A6	D+	USB2.0	—
A7	D-	USB2.0	—
A8	SBU1	Alternate Mode	Lower speed side band signal
A9	VBUS	Power	Support for 60W minimum (combined with all VBUS pins)
A10	RX2-	USB3.1 or Alternate Mode	10Gb/s differential pair with RX2+
A11	RX2+	USB3.1 or Alternate Mode	10Gb/s differential pair with RX2-
A12	GND	Power	Support for 60W minimum (combined with all VBUS pins)

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TABLE 1: USB TYPE-C™ RECEPTACLE PINOUT (CONTINUED)

Pin	Name	Function	Note
B1	GND	Power	Support for 60W minimum (combined with all VBUS pins)
B2	TX2+	USB3.1 or Alternate Mode	10Gb/s differential pair with TX2-
B3	TX2-	USB3.1 or Alternate Mode	10Gb/s differential pair with TX2+
B4	VBUS	Power	Support for 60W minimum (combined with all VBUS pins)
B5	CC2	CC or VCONN	—
B6	D+	USB2.0	—
B7	D-	USB2.0	—
B8	SBU2	Alternate Mode	Lower speed side band signal
B9	VBUS	Power	Support for 60W minimum
B10	RX1-	USB3.1 or Alternate Mode	10Gb/s differential pair with RX1+
B11	RX1+	USB3.1 or Alternate Mode	10Gb/s differential pair with RX1-
B12	GND	Power	Support for 60W minimum

1.4 Power Supply Options

The USB Type-C Interconnect introduces two new native charging options, but is also compatible with legacy charging options. USB Power Delivery is also supported but optional.

TABLE 2: USB TYPE-C™ POWER SUPPLY OPTIONS

Mode	Nominal Voltage	Maximum Current
USB2.0	5V	500mA
USB3.0/USB3.1	5V	900mA
USB BC1.2	5V	1.5A
USB Type-C Current @ 1.5A	5V	1.5A
USB Type-C Current @ 2.0A	5V	3.0A
USB Power Delivery	Up to 20V	Up to 5A

2.0 USB TYPE-C CABLES

2.1 Physical Specifications

2.1.1 SIZE

The USB Type-C receptacle opening is 8.34mm x 2.56mm. For comparison, the Type-A receptacle opening is 12.50mm x 5.12mm while the USB3.0 micro-AB receptacle opening is 12.25mm x 1.85mm

2.1.2 DURABILITY

The USB Type-C cable must minimally support 10,000 mating cycles.

2.1.3 WIRE GAUGE

Signal wire gauge is not explicitly specified in the USB Type-C™ specifications, but wires must be appropriately sized for the length and capabilities of the cable such that:

- Signal integrity on the USB2.0 and USB3.0 wires is preserved
- ~50Ω impedance on the CC and SBU1/SBU2 wires
- Maximum IR drop of 250mV on GND return
- Maximum IR drop of 500mV on VBUS

2.1.4 CABLE LENGTH

Cable lengths are not explicitly specified in the USB Type-C™ specifications. However, the electrical requirements create some practical limits. USB3.1 Type-C to Type-C cable assemblies are allocated -6 dB loss at 5GHz, effectively limiting cable lengths to 1 meter. USB3.0 Type-C to Type-C cable assembly are allocated -7 dB loss at 5GHz, effectively limiting cable lengths to 2 meters.

TABLE 3: USB TYPE-C CABLE LENGTH SUMMARY

USB Version	Cable Length	Current Rating	USB	Electronically Marked
USB2.0	≤ 4 meters	3A	Supported	Optional
		5A		Required
USB3.0	≤ 2 meters	3A	Supported	Optional
		5A		Required
USB3.1	≤ 1 meter	3A	Supported	Required
		5A		

2.2 USB2.0

A standard USB2.0 Type-C cable assembly is shown in Figure 4 and Table 4.

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FIGURE 4: USB2.0 TYPE-C PLUG PIN-OUT

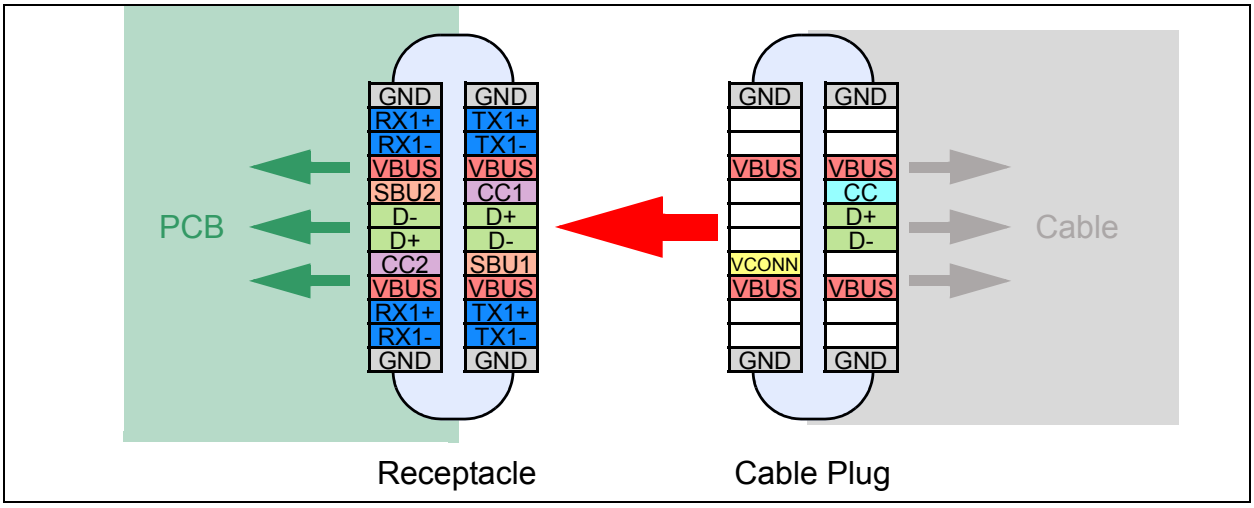


TABLE 4: USB TYPE-C™ USB2.0 CABLE ASSEMBLY WIRING

USB Type-C Plug 1		Wire		USB Type-C Plug 2	
Pin	**Signal Name**	**Wire Number**	**Signal Name**	**Pin**	**Signal Name**
A1, B1, A12, B12	GND	1	GND_PWRrt1 [GND_PWRrt2]*	A1, B1, A12, B12	GND
A4, B4, A9, B9	VBUS	2	PWR_VBUS1 [PWR_VBUS2]*	A4, B4, A9, B9	VBUS
A5	CC	3	CC	A5	CC
B5	VCONN	[18]	[PWR_VCONN]*	B5	VCONN
A6	DP	4	UTP_Dp	A6	DP
A7	DM	5	UTP_Dm	A7	DM
Shell	Shield	Braid	Shield	Shell	Shield

* Optional wires

2.3 Full Featured

A standard full-featured USB Type-C cable assembly is shown in Figure 5 and Table 5.

FIGURE 5: USB TYPE-C RECEPTACLE AND CABLE PLUG

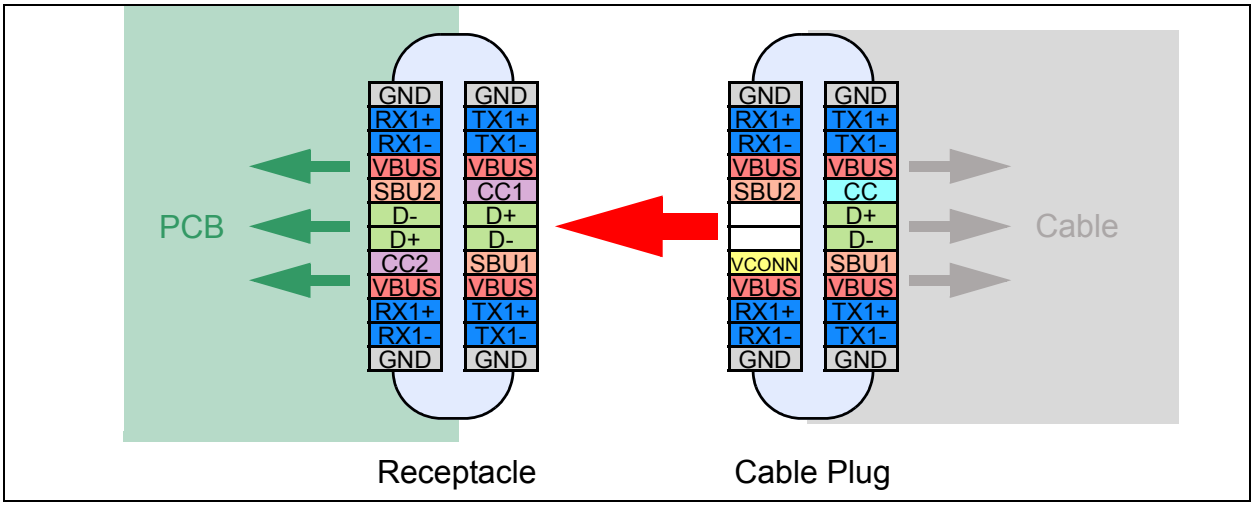


TABLE 5: USB TYPE-C™ FULL FEATURED CABLE ASSEMBLY WIRING

USB Type-C Plug 1		Wire		USB Type-C Plug 2	
Pin	**Signal Name**	**Wire Number**	**Signal Name**	**Pin**	**Signal Name**
A1, B1, A12, B12	GND	1[16]*	GND_PWRrt1 [GND_PWRrt2]*	A1, B1, A12, B12	GND
A4, B4, A9, B9	VBUS	2[17]*	PWR_VBUS1 [PWR_VBUS2]*	A4, B4, A9, B9	VBUS
A5	CC	3	CC	A5	CC
B5	VCONN	18	PWR_VCONN	B5	VCONN
A6	DP	4	UTP_Dp	A6	DP
A7	DM	5	UTP_Dm	A7	DM
A2	SSTX1+	6	SDPp1	B11	SSRX1+
A3	SSTX1-	7	SDPn2	B10	SSRX1-
B11	SSRX1+	8	SDPp2	A2	SSTX1+
B10	SSRX1-	9	SDPn2	A3	SSTX1-
B2	SSTX2+	10	SDPp3	A11	SSRX2+
B3	SSTX2-	11	SDPn3	A10	SSRX2-
A11	SSRX2+	12	SDPp4	B2	SSTX2+
A10	SSRX2-	13	SDPn4	B3	SSTX2-
A8	SBU1	14	SBU_A	B8	SBU2
B8	SBU2	15	SBU_B	A8	SBU1
Shell	Shield	Braid	Shield	Shell	Shield

* Optional wires

2.4 Passive Cables

A passive USB Type-C cable does not have embedded powered electronics. All passive cables must minimally support USB2.0, and it can support USB Power Delivery up to 60W of power.

2.5 Powered Cable: Electronically Marked

An electronically marked cable has embedded electronics that can communicate with the USB ports via USB Power Delivery 2.0 BMC protocol. An electronically marked cable may be powered from the VCONN supply or directly from VBUS and may draw up to 70mW of total power.

Use-case Example 1: All USB3.1 compatible USB Type-C cables must be electronically marked.

Use-case Example 2: A 100W Power Delivery cable. Any cable capable of exceeding 60W of power carrying capability must be electronically marked and communicate is capabilities to the DFP port.

An electronically marked cable will behave identically to a standard passive cable if inserted into a receptacle that does not support USB Power Delivery 2.0.

2.6 Powered Cable: Managed Active Cable

A managed active cable is an electronically marked cable that also has powered USB data reconditioning circuitry. A managed active cable may be powered from the VCONN supply or directly from VBUS and may draw up to 1.0W of total power.

Use-case Example: An active cable that uses repeaters/re-conditioners to extend the maximum cable length.

A managed active cable will behave identically to a standard active cable if inserted into a receptacle that does not support USB Power Delivery 2.0. It will still be able to power itself from VCONN or VBUS.

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2.7 USB Type-C to Legacy USB Cables

The USB Type-C™ specification also defines the allowable USB Type-C to Legacy USB cable assemblies. The following full cable assemblies are supported:

- USB Type-C to Type-A (USB2.0)
- USB Type-C to Type-A (USB3.0/3.1)
- USB Type-C to Type-B (USB2.0)
- USB Type-C to Type-B (USB3.0/3.1)
- USB Type-C to Mini-B (USB2.0)
- USB Type-C to Micro-B (USB2.0)
- USB Type-C to Micro-B (USB3.0/3.1)

Only two USB Type-C to Legacy adapters are defined:

- USB Type-C to Type-A receptacle adapter
- USB Type-C to Micro-B (USB2.0)

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3.0 CC PINS

The CC1 and CC2 pins are critical for basic USB Type-C operation. Resistors are attached to the CC pins in various configurations depending on whether the application is a downstream facing port (DFP), upstream facing port (UFP), or an electronically marked/active cable:

- Rp pull-up resistors on downstream facing ports (Section 3.1)
- Rd pull-down resistors on upstream facing ports (Section 3.2)
- Ra pull-down resistor on electronically marked/active cables (Section 3.3)

The CC1 and CC2 pins must be constantly monitored by the port to perform the following functions:

- Cable attach and removal detection (Section 3.4)
- Cable orientation detection (Section 3.5)
- Basic USB Type-C current capability advertisement (Section 3.6)

3.1 DFP Rp Pull-Up Resistors

The Rp pull-up resistors on a downstream facing port must be connected to both CC1 and CC2 pins, and may be pulled up to either 3.3V or 5.0V (a current source may also be used). The value of the resistor selected advertises the current supplying capability of the port to the device. The acceptable (per the USB Type-C™ specification) values for the Rp pull-up resistors and current sources are shown in the table below.

TABLE 6: VALID DFP RP PULL-UP RESISTOR VALUES

DFP Current Capability	Resistor Pull-up to 4.75V - 5.5V	Resistor Pull-up to 3.3V ± 5%	Current Source to 1.7V - 5.5V
Default USB Power (500mA for USB2.0, 900mA for USB3.0)	56 kΩ ± 20%	36 kΩ ± 20	80 µA ± 20%
1.5A @ 5V	22 kΩ ± 5%	12 kΩ ± 5%	180 µA ± 8%
3.0A @ 5V	10 kΩ ± 5%	4.7 kΩ ± 5%	330 µA ± 8%

3.2 UFP Rd Pull-Down Resistors.

An upstream facing port must connect a valid Rp pull-down resistor to GND (or optionally, a voltage clamp) to both CC1 and CC2 pins. A 5.1kΩ ± 10% is the only acceptable resistor if USB Type-C charging of 1.5A@5V or 3.0A@5V is to be used. The details are shown in the table below.

TABLE 7: VALID UFP RD PULL-DOWN RESISTOR VALUES

Rd Implementation	Nominal Value	Detect Power Capability?	Current Source to 1.7V - 5.5V
± 20% voltage clamp	1.1V	No	1.32V
± 20% resistor to GND	5.1kΩ	No	2.18V
± 10% resistor to GND	5.1kΩ	Yes	2.04V

3.3 Active Cable Ra Pull-Down Resistors

An active cable must connect an Ra resistor from the VCONN pin to GND. The Ra resistor may range from 800Ω to 1.2kΩ.

3.4 Cable Attach and Removal Detection

A cable attach is detected when either of the CC1 or CC2 pins detects a valid Rp/Rd connection. For a standard USB connection, only one of the CC1/CC2 pins may detect a valid Rp/Rd connection, not both.

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5V to VBUS may only be applied when a valid cable attachment is detected. This prevents two downstream facing ports from back-driving current into each other.

TABLE 8: CONNECTION STATES (FROM DFP PERSPECTIVE)

CC1	CC2	State	Position
Open	Open	Nothing Connected*	—
Rd	Open	UFP Connected	Unflipped
Open	Rd	UFP Connected	Flipped
Open	Ra	Powered Cable/No UFP connected	Unflipped
Ra	Open	Powered Cable/No UFP connected	Flipped
Rd	Ra	Powered Cable/UFP connected	Unflipped
Ra	Rd	Powered Cable/UFP connected	Flipped
Rd	Rd	Debug Accessory Mode connected	—
Ra	Ra	Audio Adapter Mode connected	—

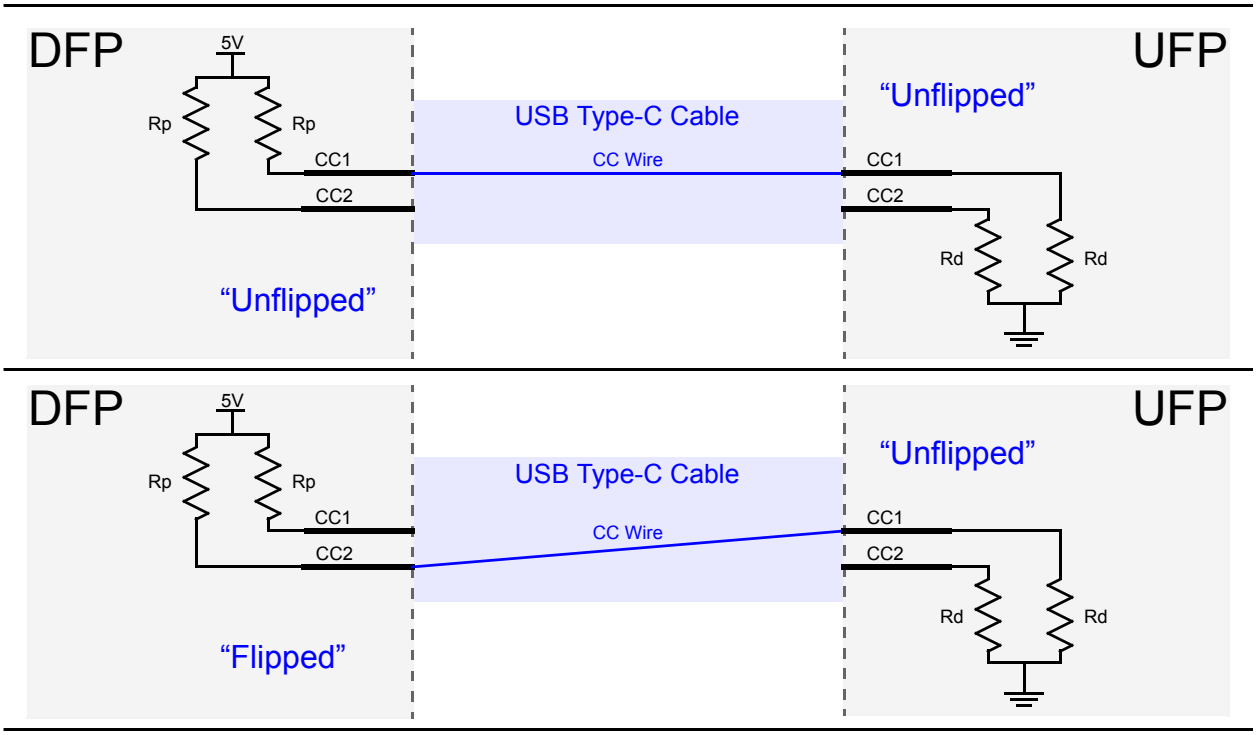
Note: *DFP-to-DFP and UFP-to-UFP are undetectable states.

3.5 Cable Orientation Detection

The cable orientation is detected in the following way:

- If the CC1 pin detects a valid Rp/Rd connection, then the cable is in the “Unflipped” orientation at that receptacle.
- If the CC2 pin detects a valid Rp/Rd connection, then the cable is in the “Flipped” orientation at that receptacle.

FIGURE 6: CABLE ORIENTATION DETECTION



3.6 USB Type-C Current Advertisement

Both the upstream facing port and the downstream facing port must monitor the voltage on the CC1 and CC2 pins to determine if a valid Rp/Rd or Rp/Ra connection has been made. The USB Type-C™ specification defines the following voltage ranges:

TABLE 9: USB TYPE-C VOLTAGE RANGES

Current Advertisement	No Connection (Detached)	Rp / Rd Connection	Rp / Ra Connection
3A	>2.75V	2.60V - 0.85V	0.80V - 0.00V
1.5A	>1.65V	1.60V - 0.45V	0.40V - 0.00V
Default USB (500mA/900mA)	>1.65V	1.60V - 0.25V	0.20V - 0.00V

Once a valid connection is established, the upstream facing port (device) may is responsible for drawing the appropriate amount of maximum current.

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4.0 VCONN SUPPLY

VCONN is a 5V(4.75V - 5.5V allowable range) 1.0W power supply used to power circuits within the plug that are needed to implement electronically marked cables and VCONN-powered accessories. The DFP is responsible for supplying VCONN by default. If two Dual-Role ports with USB Power Delivery support are connected to each other, the VCONN supplier can be swapped via USB PD negotiation.

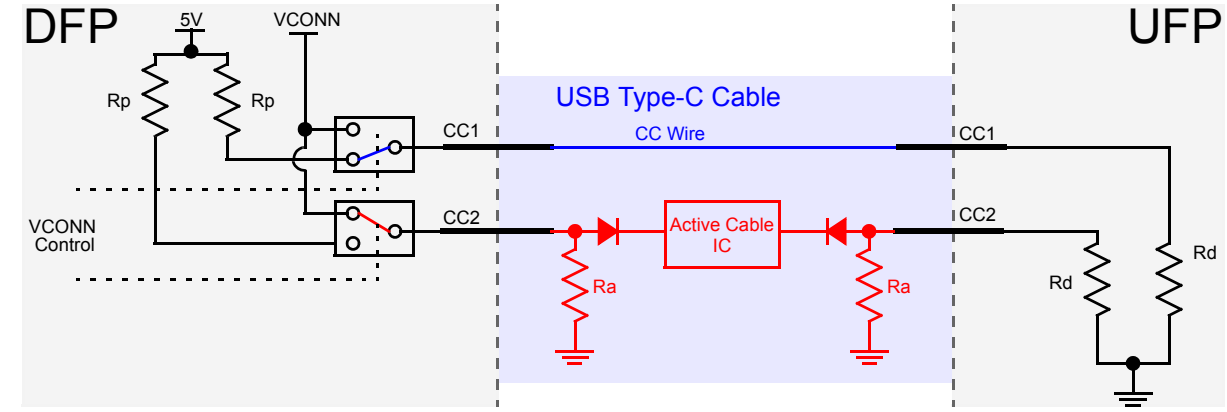
VCONN is required for PD-enabled port and USB3 support. The VCONN power supply can be supplied in one of two ways:

a) If a valid Rp/Rd connection is detected on one of the CC pins, the VCONN supply can be blindly routed to the opposite CC pin

b) After a valid Rp/Rd connection is detected on one of the CC pins, the opposite CC pin can be monitored for a valid Rp/Ra connection before routing the VCONN supply to the pin.

Because of the reversible nature of the USB Type-C cable, both CC1 and CC2 pins must be able to assume the role of CC and VCONN upon cable insertion. A typical solution is presented in fig xx below.

FIGURE 7: VCONN SUPPLY AND ACTIVE CABLE



Note: While all USB Type-C ports are required to source VCONN to active cables, active cables are permitted to source power from either VCONN or VBUS.

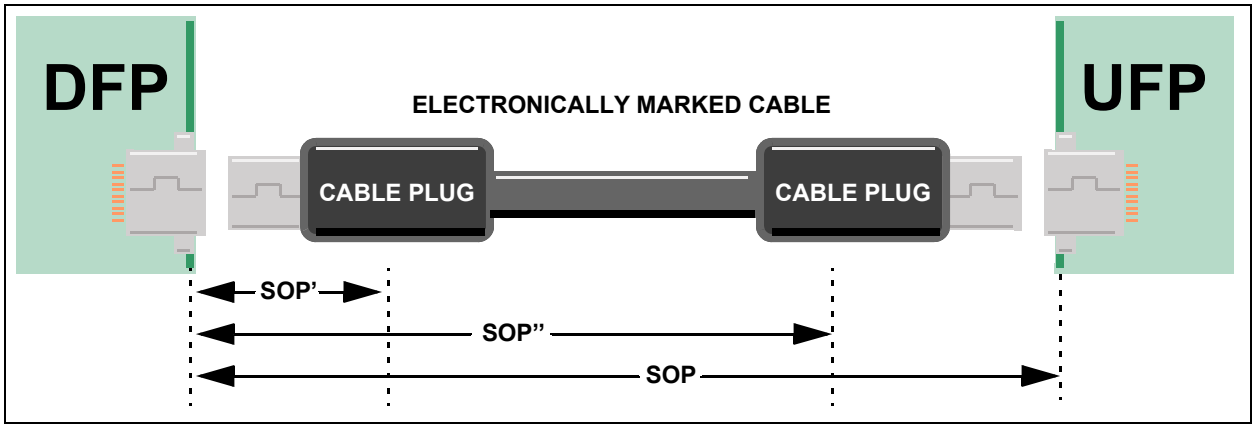
5.0 USB POWER DELIVERY 2.0

USB Power Delivery 2.0 refers to a single wire protocol (on CC wire) created by the USB-IF. The name “USB Power Delivery” can be somewhat misleading as it allows for much more than just power negotiations; it unlocks the advanced capabilities of the USB Type-C cable. The PD messaging occurs completely independently of USB2.0 or USB3.0/USB3.1 data and is used for port-to-port negotiation of power roles, voltage level, maximum supplying current capability, data roles, and Alternate Modes. Port-to-powered cable communication is also handled by USB PD.

5.1 Protocol Details

- All communication occurs over CC wire.
- The DFP is the Bus Master and initiates all communication.
- All messages are 32-bit 4b/5b encoded Bi-phase mark coded (BMC).
- 300k Baud rate
- CRC32 error detection + message retries
- Terminology:
  - SOP: DFP to DFP messaging
  - SOP’: DFP to active cable plug messaging
  - SOP’’: DFP to active cable plug messaging

FIGURE 8: SOP SIGNALING



Note:	SOP’ is assigned to one plug of the cable while SOP’’ is assigned to the other. The cable plugs cannot tell which side that they are connected to, just that one end may respond to SOP’ addressed messages and the other may respond SOP’’ addressed messages.

5.2 Power Delivery Negotiation

USB Power Delivery allows power configuration of a USB connection to be dynamically modified. The default 5V voltage on VBUS can be reconfigured up to any level up to 20V. The maximum current supplying capability can also be raised to a maximum of 5A with a 100W compatible electronically marked USB PD Type-C cable.

The default roles (Provider or Consumer) can also be dynamically swapped at any time if both ports support dual power role functionality and the port accepts the swap request.

5.3 Alternate Mode and Data Role Negotiation.

Alternate Modes allow third party protocols to be transmitted over the USB Type-C cable. They are negotiated on port-to-port basis with Power Delivery protocol. See Section 6.0, Alternate Modes for more information.

Data roles can also be swapped dynamically over USB PD protocol negotiation.

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5.4 Billboard Device

Because of the wide range of capabilities enabled with USB PD, it can become confusing for the end user. There may be times when a user connects two devices and expects a different result than what actually occurs. To provide some amount of feedback to the user, a USB2.0 “Billboard” class device connected to the Power Delivery system can provide messages to the user that can explain errors or compatibility issues.

6.0 ALTERNATE MODES

Alternate Modes and USB Power Delivery are the two key features that will allow the USB Type-C cable to become a true “universal” cable. Alternate Modes allow the USB Type-C cable to be reconfigured to support third party protocols. This feature is enabled only if both ports support the USB Power Delivery protocol and are both compatible with the specific Alternate Mode.

There are no specific limits on Alternate Modes. As long as the cable can support the third party protocol signaling while maintaining a USB2.0 connection, then the Alternate Mode can be implemented. The USB Type-C™ specification does not define any Alternate Modes; Each third party must maintain its own USB Type-C Alternate Mode specification.

Alternate Mode negotiation is performed via USB Power Delivery protocol on a port-to-port basis.

6.1 Reconfigurable Pins

All Alternate Modes must minimally maintain a USB2.0 and USB Power Delivery connection. The following pins/wires may be reconfigured for the use with the Alternate Mode.

FIGURE 9: RECONFIGURABLE PINS ON A FULL FEATURED CABLE

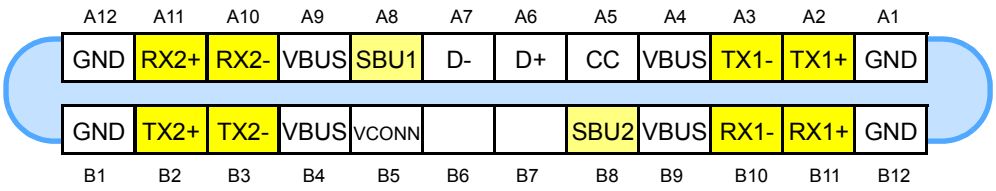
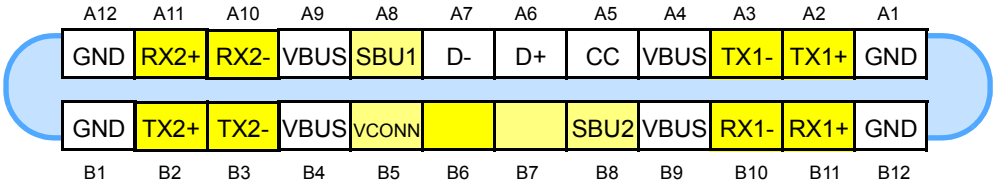


FIGURE 10: RECONFIGURABLE PINS ON A DIRECT CONNECT APPLICATION

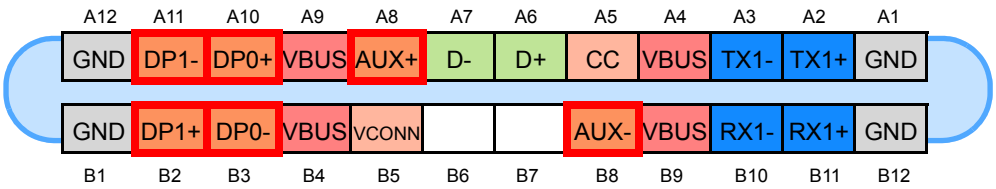


6.2 Example: DisplayPort

DisplayPort was one of the first 3rd part protocols to be specified as a USB Type-C™ Alternate Mode. The DisplayPort Alternate mode supports the following modes of operation:

- (2) Display Port lanes + (1) USB3.1 lane
- (4) Display Port lanes

FIGURE 11: (2) DISPLAY PORT LANES + (1) USB3.1 LANE EXAMPLE



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APPENDIX A: APPLICATION NOTE REVISION HISTORY

TABLE A-1: REVISION HISTORY

Revision Level & Date	Section/Figure/Entry	Correction
A (2-9-15)	Unfinished Pre-Release	

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