IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

COMARCO WIRELESS SYSTEMS LLC, Plaintiff, v. **WALGREEN CO.,** Defendant.	C.A. No. 4:23-cv-1111 **JURY TRIAL DEMANDED** **PATENT CASE**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Comarco Wireless Systems LLC files this Original Complaint for Patent Infringement against Walgreen Co., and would respectfully show the Court as follows:

I. THE PARTIES

1. Plaintiff Comarco Wireless Systems LLC ("Comarco" or "Plaintiff") is a Texas limited liability company, having a mailing address at 5511 Parkcrest Dr., Ste 103, Austin, TX 78731.

2. On information and belief, Defendant Walgreen Co. ("Defendant") is a corporation organized and existing under the laws of Illinois with a place of business at 5415 S Broadway Ave, Tyler, TX 75703. Defendant has a registered agent at Prentice Hall Corporation, 211 E. 7th Street, Suite 620, Austin, TX 78701.

II. JURISDICTION AND VENUE

3. This action arises under the patent laws of the United States, Title 35 of the United States Code. This Court has subject matter jurisdiction of such action under 28 U.S.C. §§ 1331 and 1338(a).

4. On information and belief, Defendant is subject to this Court's specific and general personal jurisdiction, pursuant to due process and the Texas Long-Arm Statute, due at least to its

business in this forum, including at least a portion of the infringements alleged herein. Furthermore, Defendant is subject to this Court's specific and general personal jurisdiction because Defendant maintains places of business at 5415 Broadway Ave, Tyler, TX 75703, 1620 S Broadway Ave, Tyler, TX 75701, 2120 E SE Loop 323, Tyler, TX 75701, and many more.

5. Without limitation, on information and belief, within this state, Defendant has used the patented inventions thereby committing, and continuing to commit, acts of patent infringement alleged herein. In addition, on information and belief, Defendant has derived revenues from its infringing acts occurring within Texas. Further, on information and belief, Defendant is subject to the Court's general jurisdiction, including from regularly doing or soliciting business, engaging in other persistent courses of conduct, and deriving substantial revenue from services provided to persons or entities in Texas. Further, on information and belief, Defendant is subject to the Court's personal jurisdiction at least due to its providing services within Texas. Defendant has committed such purposeful acts and/or transactions in Texas such that it reasonably should know and expect that it could be haled into this Court as a consequence of such activity.

6. Venue is proper in this district under 28 U.S.C. § 1400(b). On information and belief, Defendant maintains places of business at 5415 Broadway Ave, Tyler, TX 75703, 1620 S Broadway Ave, Tyler, TX 75701, 2120 E SE Loop 323, Tyler, TX 75701and many more. On information and belief, from and within this District Defendant has committed at least a portion of the infringements at issue in this case.

7. For these reasons, personal jurisdiction exists and venue is proper in this Court under 28 U.S.C. § 1400(b).

III. FACTUAL ALLEGATIONS UNDERLYING ALL CLAIMS

8. Plaintiff incorporates the above paragraphs herein by reference.

9. The patents at issue in this matter arose from the pioneering work of Thomas W. Lanni, an accomplished electrical engineer. Mr. Lanni began working in the field of power supply and conversion in the early 1980s. In 1994, Mr. Lanni joined Comarco, Inc. as Vice President and Chief Technology Officer.

10. Through his work at Comarco, Inc., Mr. Lanni recognized that the increasing use of a variety of portable devices and myriad power sources (e.g., automobile outlets and wall sockets) created the problem of a given device receiving the wrong level of power from a given power source. This mismatch could result in a failure to charge, or could cause damage to the device being charged by causing the battery to overheat or even catch fire.

11. To address this shortcoming in the prior art, Mr. Lanni invented a charging system whereby the charger and the portable device engage in a "handshake" process in order to determine the appropriate level of power to be delivered to the portable device. Mr. Lanni's power supply system includes a charger comprising power circuitry to provide power along with data circuitry to receive a signal from the device to be charged and to provide a signal in response. Conductors within the power supply transfer DC power and a ground reference voltage to the portable electronic device. A third conductor receives the signal from the portable electronic device and a fourth conductor transmits the response signal to the portable electronic device. The portable electronic device is able to use this responsive signal to determine the power level of the power supply system. This system enables the portable electronic device to receive the appropriate power level from the charger.

12. Mr. Lanni's work led to a large family of patent applications claiming priority to U.S. Patent Application No. 10/758,933 ("the '933 Application") filed on January 15, 2004. Mr. Lanni is the sole named inventor on these patents.

13. On July 16, 2013, U.S. Patent Application No. 13/943,453 was filed, claiming priority to the '933 Application. After examination, the USPTO issued U.S. Patent No. 9,413,187 ("the '187 Patent"), entitled "Power Supply System Providing Power and Analog Data Signal for Use by Portable Electronic Device to Control Battery Charging" on Augest 9, 2016. A true and correct copy of the '187 Patent is attached as Exhibit 1.

14. On August 12, 2020, U.S. Patent Application No. 16/991,295 was filed, claiming priority to the '933 Application. After examination, the USPTO issued U.S. Patent No. 10,855,087 ("the '087 Patent"), entitled "Power Supply Systems" on December 1, 2020. A true and correct copy of the '087 Patent is attached as Exhibit 2.

15. On October 22, 2020, U.S. Patent Application No. 17/077,699 was filed, claiming priority to the '933 Application. After examination, the USPTO issued U.S. Patent No. 10,951,042 ("the '042 Patent"), entitled "Power Supply Systems" on March 16, 2021. A true and correct copy of the '042 Patent is attached as Exhibit 3.

16. Comarco is the assignee of all right, title, and interest in the '960 Patent, '087 Patent, '042 Patent, and '187 Patent, (collectively "the Patents-in-Suit") including all rights to enforce and prosecute actions for infringement and to collect damages for all relevant times against infringers of the Patents-in-Suit. Accordingly, Comarco possesses the exclusive right and standing to prosecute the present action for infringement of the Patents-in-Suit by Defendant.

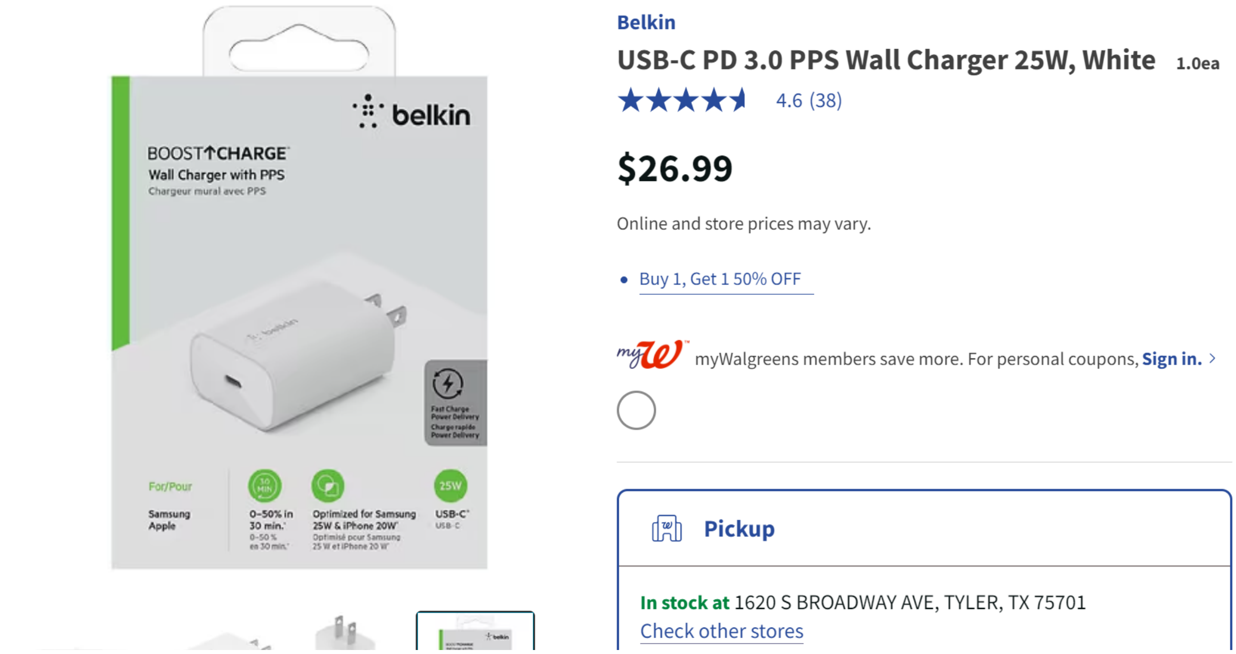
IV. COUNT I
(PATENT INFRINGEMENT OF UNITED STATES PATENT NO. 9,413,187)

27. Upon information and belief, Defendant has directly and/or indirectly infringes claim 1-2, and 7-9, of the '187 patent in this District, Texas, and elsewhere in the United States, by making, using, selling, offering for sale and/or importing a system including a portable electronic device and a power supply system, the portable electronic device including a

rechargeable battery (such as a mobile phone or a power bank), the power supply system being external to the portable electronic device and providing DC power including, but not limited to, Belkin USB-C PD 3.0 PPS Wall Charger 25W, White; Belkin Dual 20W USB-C Wall Charger, White; Belkin Dual Phone Charger 37W Fast Charging; Belkin 20W Fast Charging Phone Charger with USB-C to Lightning Charging Cable, White ("Accused Chargers").

28. Defendant makes, uses, sells, offers for sale and/or imports a system including a portable electronic device and the Accused Chargers, the portable electronic device including a rechargeable battery, the Accused Chargers being external to the portable electronic device and providing DC power. This element is infringed literally, or in the alternative, under the doctrine of equivalents. Defendant makes, uses, sells, offers for sale and/or imports an external USB power supply ("Accused Chargers") that ships with the portable electronic device and acts as a power supply while charging the device's battery ("rechargeable battery") via a USB cable. The power supply outputs voltage, current, and power values. Upon information and belief, the USB Accused Chargers includes circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic device. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 is used to output 5V voltage, 1.5A current, and 7.5W power. USB-complaint devices at USB 3.0 or above are compatible with the USB BC 1.2 specification. Further, to charge the battery in a portable electronic device, the portable electronic device is connected to the USB power supply. The other end of the USB cable is connected to the charging port of portable electronic device and the power supply is plugged into a standard wall

socket. Therefore, the USB power supply comprises a power circuitry to provide DC power to portable electronic devices.



(*E.g.*, https://www.walgreens.com/store/c/belkin-usb-c-pd-3.0-pps-wall-charger-25w/ID=300421437-product).

Home > Shop > Electronics & Office > Cell Phones & Accessories > Cell Phone Chargers & Adapters

Belkin

Dual 20W USB-C Wall Charger, White 1.0ea

★★★★★ 4.8 (54)

$32.99

Online and store prices may vary.

myW myWalgreens members save more. For personal coupons, **Sign in.** >

Pickup

In stock at 1620 S BROADWAY AVE, TYLER, TX 75701
Check other stores

(*E.g.*, https://www.walgreens.com/store/c/belkin-dual-20w-usb-c-wall-charger/ID=300421459-product)

Home > Shop > Electronics & Office > Cell Phones & Accessories > Cell Phone Chargers & Adapters

Belkin

Dual Port Car Charger 37W Fast Charging 1.0ea

★★★★★ 4.7 (77)

$25.99

Online and store prices may vary.

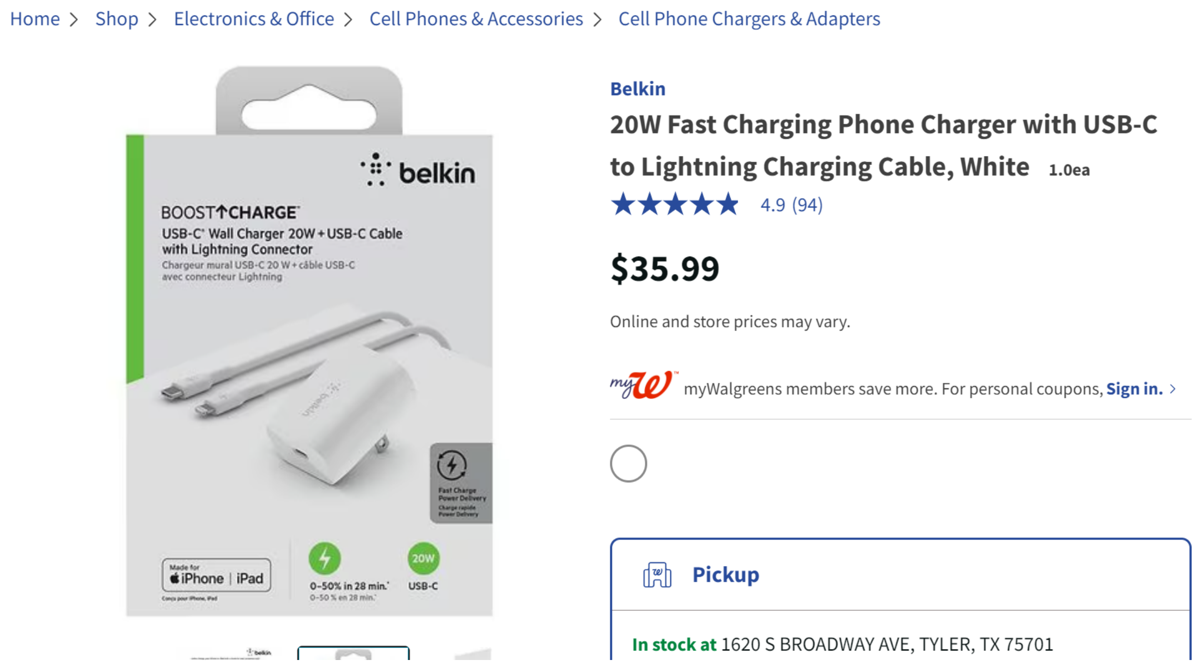
myW myWalgreens members save more. For personal coupons, **Sign in.** >

Pickup

In stock at 1620 S BROADWAY AVE, TYLER, TX 75701
Check other stores

Ready in as little as **30 minutes** if ordered placed by 9pm. Curbside or drive-thru pickup available.$10 minimum order required. Details

(*E.g.*, https://www.walgreens.com/store/c/belkin-dual-port-car-charger-37w-fast-charging/ID=300431586-product).

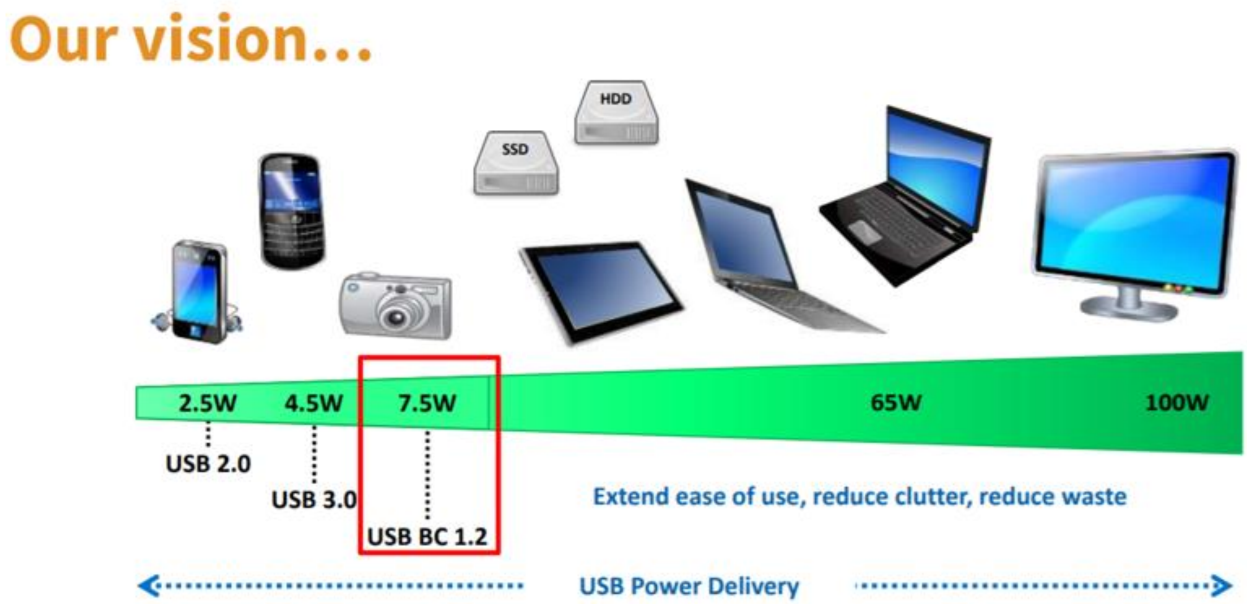


(*E.g.*, https://www.walgreens.com/store/c/belkin-20w-fast-charging-phone-charger-with-usb-c-to-lightning-charging-cable/ID=300432822-product).

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

29. On information and belief, Defendant provides the Accused Chargers which includes power circuitry to provide the DC power. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, to charge a portable electronic device, a USB cable is connected to the USB power supply. Further, the other end of USB cable is connected to the charging port of portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the USB power supply comprises power circuitry to provide DC power to a portable electronic device.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

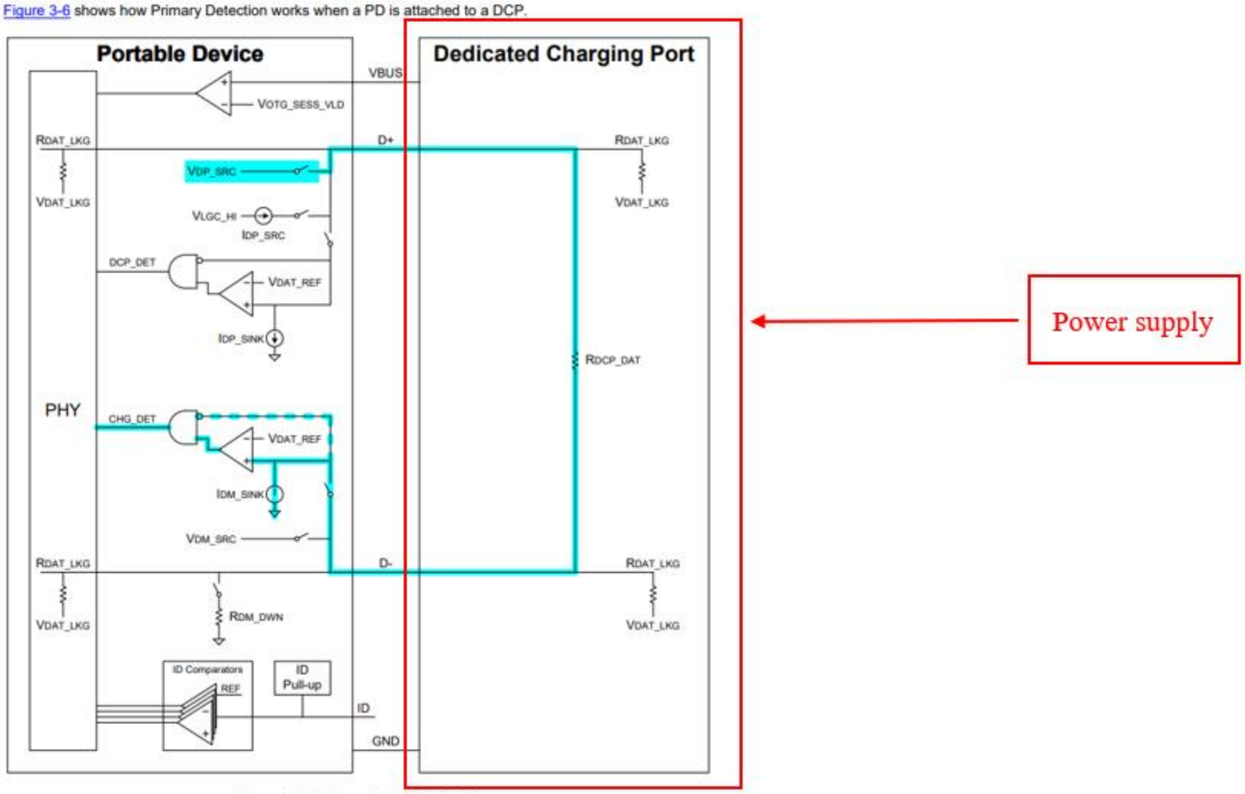


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

30. Defendant provides a system wherein the Accused Chargers includes data circuitry to receive a first signal originating from the portable electronic device and to provide a second signal to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply comprises data circuitry configured to use the Primary Detection method as described in the USB BC 1.2 specification. For example, during Primary Detection, when a portable electronic device is connected with the power supply through the USB cable, the portable electronic device generates a D+ signal ("first signal").

Data circuitry of the USB power supply receives a D+ signal ("first signal") and provides a D- signal ("second signal") to the portable electronic device to detect the type of connected power supply (standard downstream port or charging port). To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw I_{DEV_CHG} without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

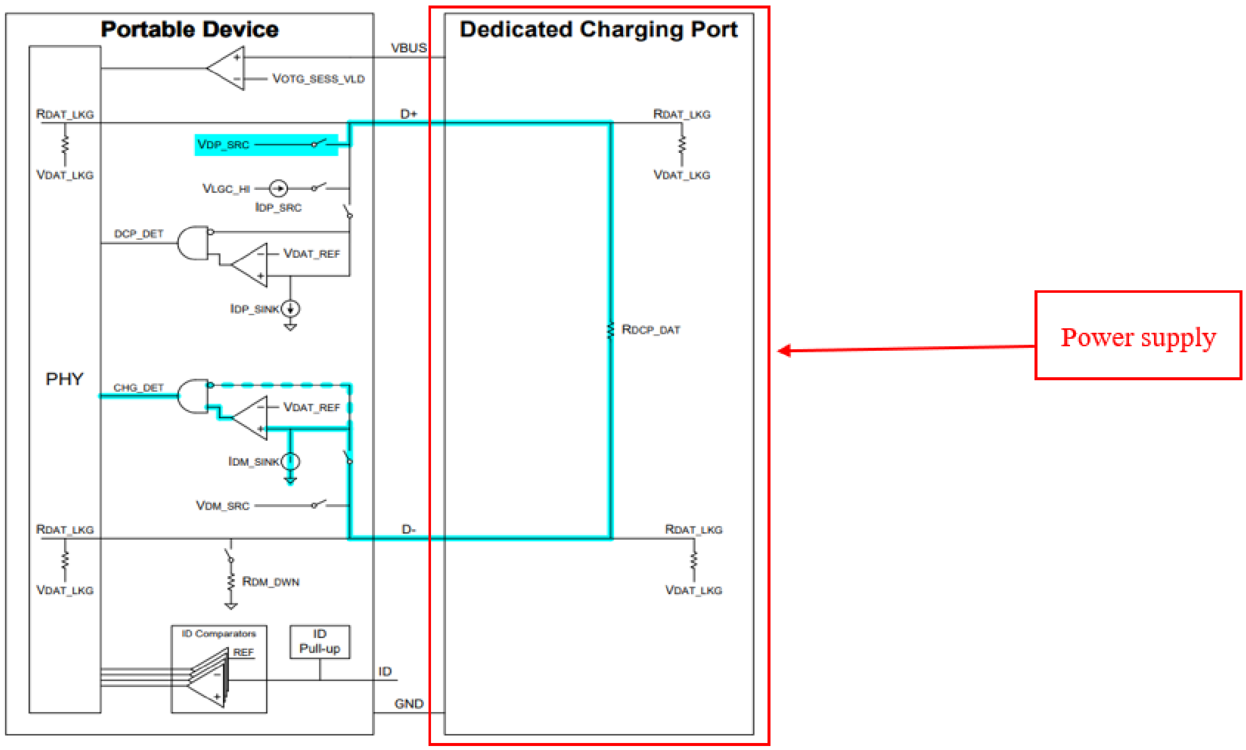


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

31. Defendant provides a system wherein the Accused Chargers include a connector disposed on a cable end, the connector having four conductors for detachably mating with a power input opening of the portable electronic device, the first and second conductors transferring the DC power and its ground reference to the portable electronic device, the third conductor transferring the first signal from the portable electronic device to the data circuitry, and the fourth conductor transferring the second signal from the data circuitry to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply connects to the portable electronic device through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port of a portable electronic device. The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor") pins. The VBUS pin is the voltage line that provides DC power to the portable electronic device and GND pin provides a

ground reference to the portable electronic device. The D+ pin provides the D+ signal ("first signal") from the portable electronic device to the data circuitry of the USB power supply and the D- pin provides the D- signal ("second signal") from the data circuitry of the USB power supply to the portable electronic device.

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

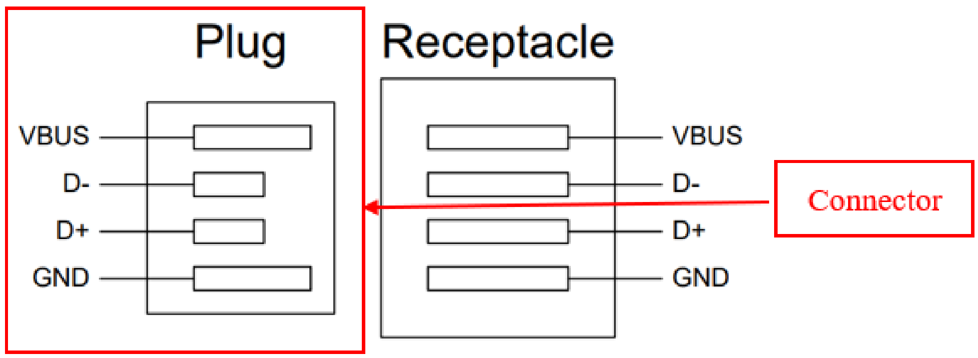


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

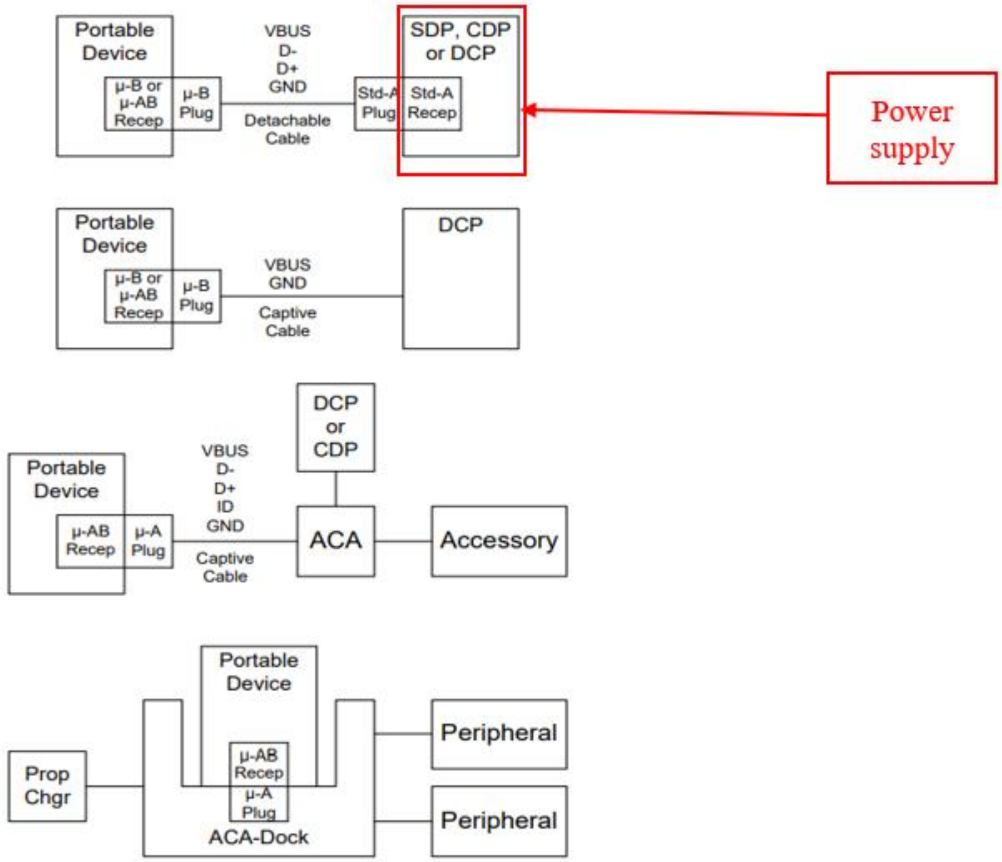


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.5 Ground Current and Noise Margins

As shown in Figure 7-47 of the USB 2.0 specification, a current of 100 mA through the ground wire of a USB cable can result in a voltage difference of 25 mV between the host ground and the device ground. This ground difference has the effect of reducing noise margins for both signaling and charger detection.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 36).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

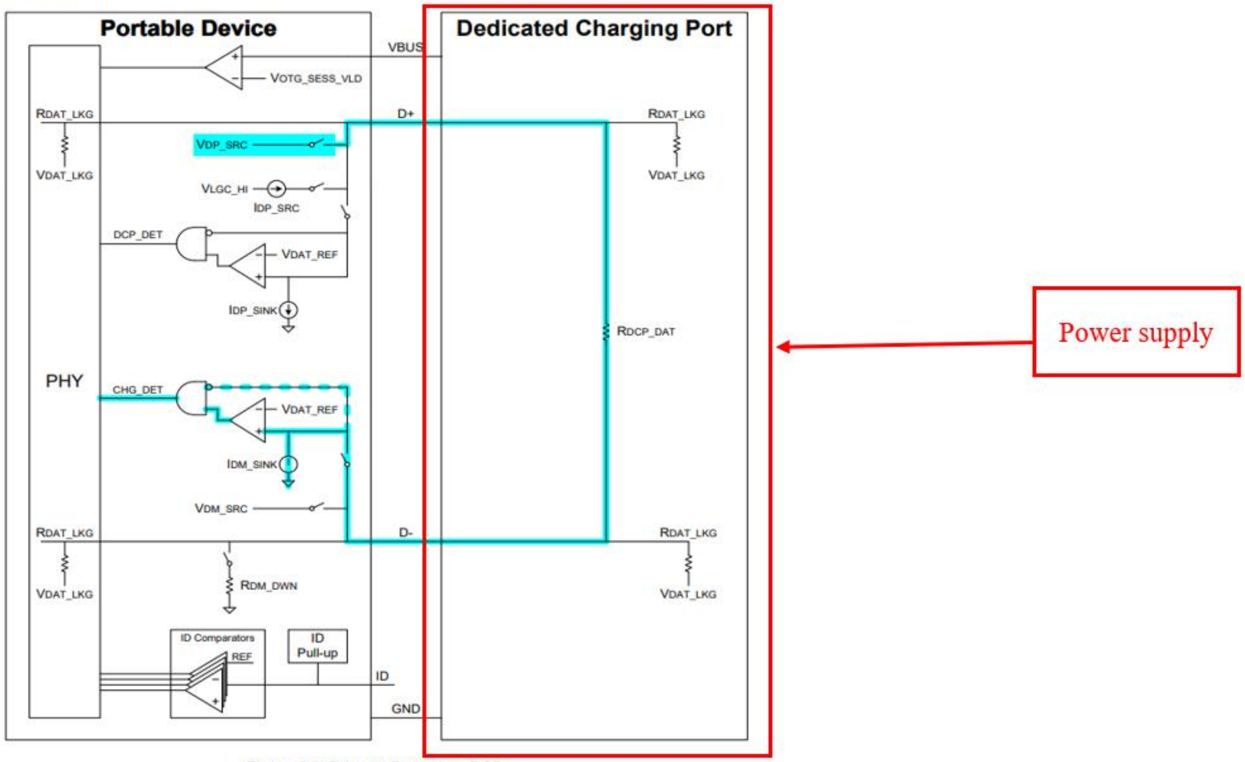


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

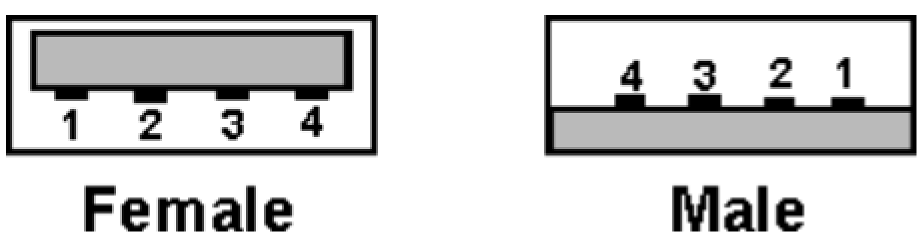
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

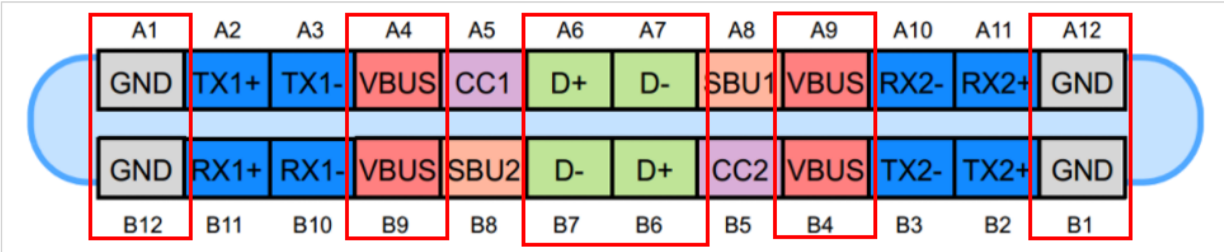


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

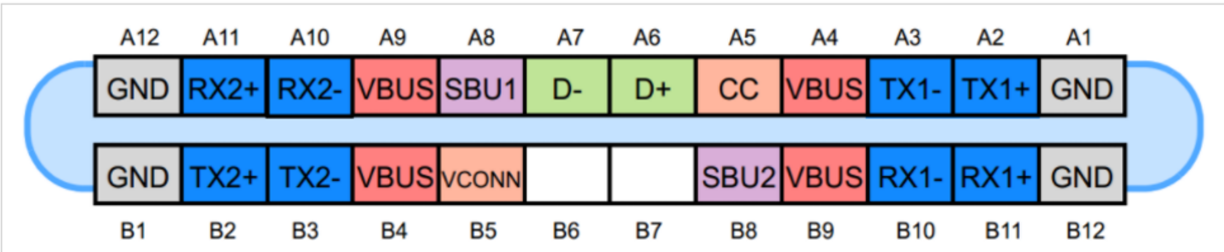


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

32. Defendant provides a system wherein the portable electronic device provides the first signal. This element is infringed literally, or in the alternative, under the doctrine of equivalents. The portable electronic device connects to the USB power supply through its USB-C port which is compliant with the USB BC 1.2 specification. During Primary Detection, the portable electronic device provides the D+ signal ("first signal") through its USB port to detect the type of connected power supply (standard downstream port or charging port).

USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

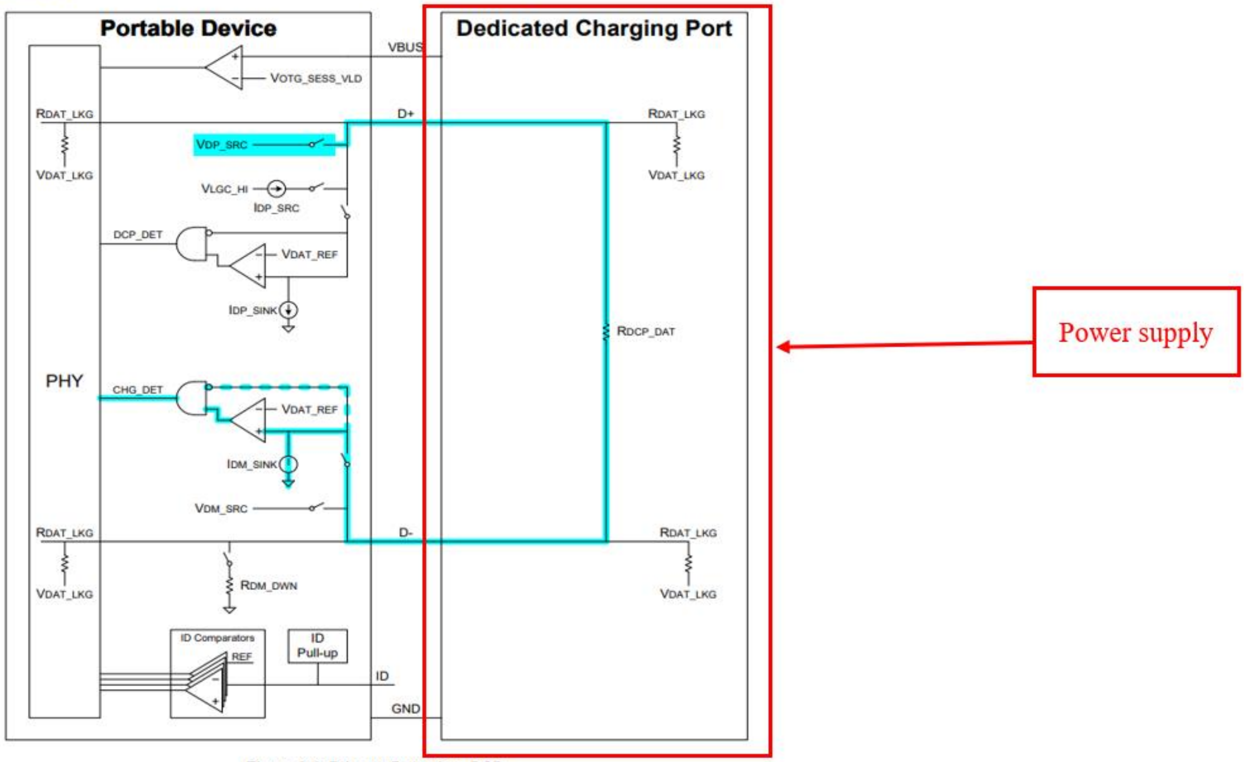


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

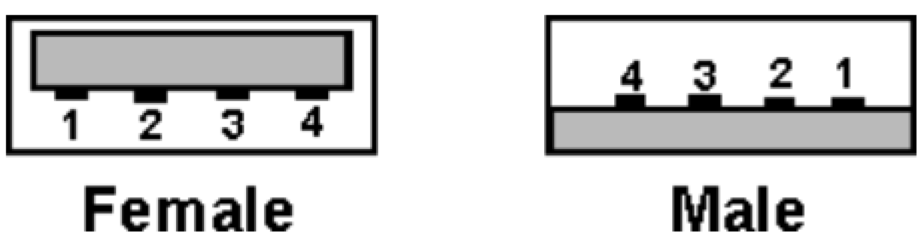
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

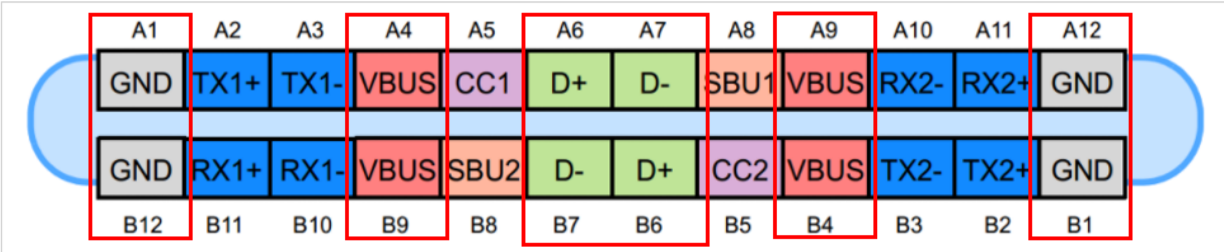


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

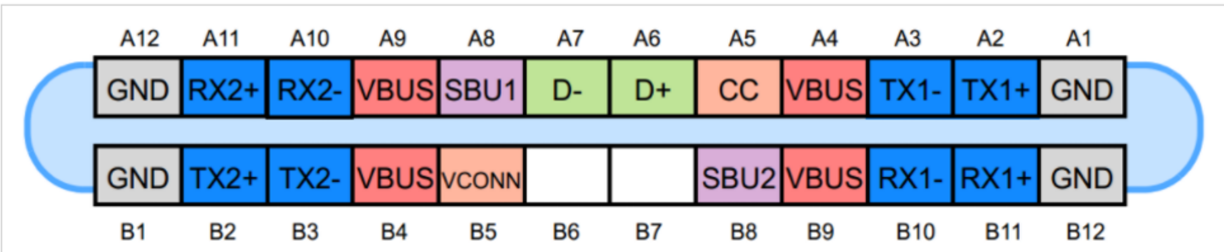


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

33. Defendant provides a system wherein the data circuitry, in response to the first signal, provides the second signal, the second signal being an analog signal. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply shorts the D+ to D- through a resistance of R_{DCP_DAT}, such that in response to the D+ signal ("first signal"), the data circuitry of the power supply provides the D- signal ("second signal") to the portable electronic device. The portable electronic device compares the D- signal's voltage ("parameter") level with a reference voltage to detect the type of connected power supply. Therefore, the D- signal is an analog signal. The D+ signal and D- signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the resistance causes the voltage to drop, creating a new D- signal to be transmitted to the portable electronic device via the D- pin. Thus,

the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

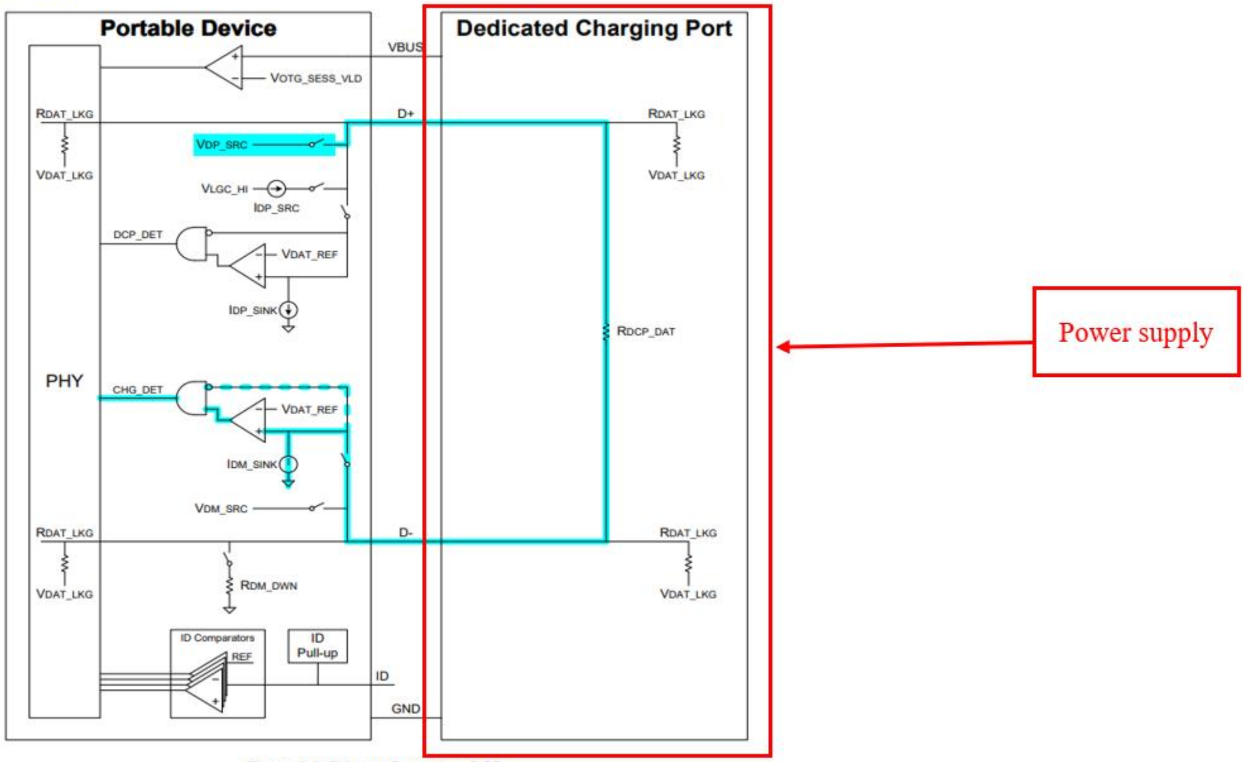


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

34. Defendant provides a system wherein the portable electronic device, upon receipt of the second signal, determines a parameter level of the second signal and based on the determined parameter level controls charging of the battery within the portable electronic device from the DC power provided by the Accused Chargers. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device receives the D- signal (“second signal”) from the USB power supply to compare the voltage (“parameter”) level of the D- signal with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic device draws current to charge a rechargeable battery of the portable electronic device from the direct current power provided by the USB power supply.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

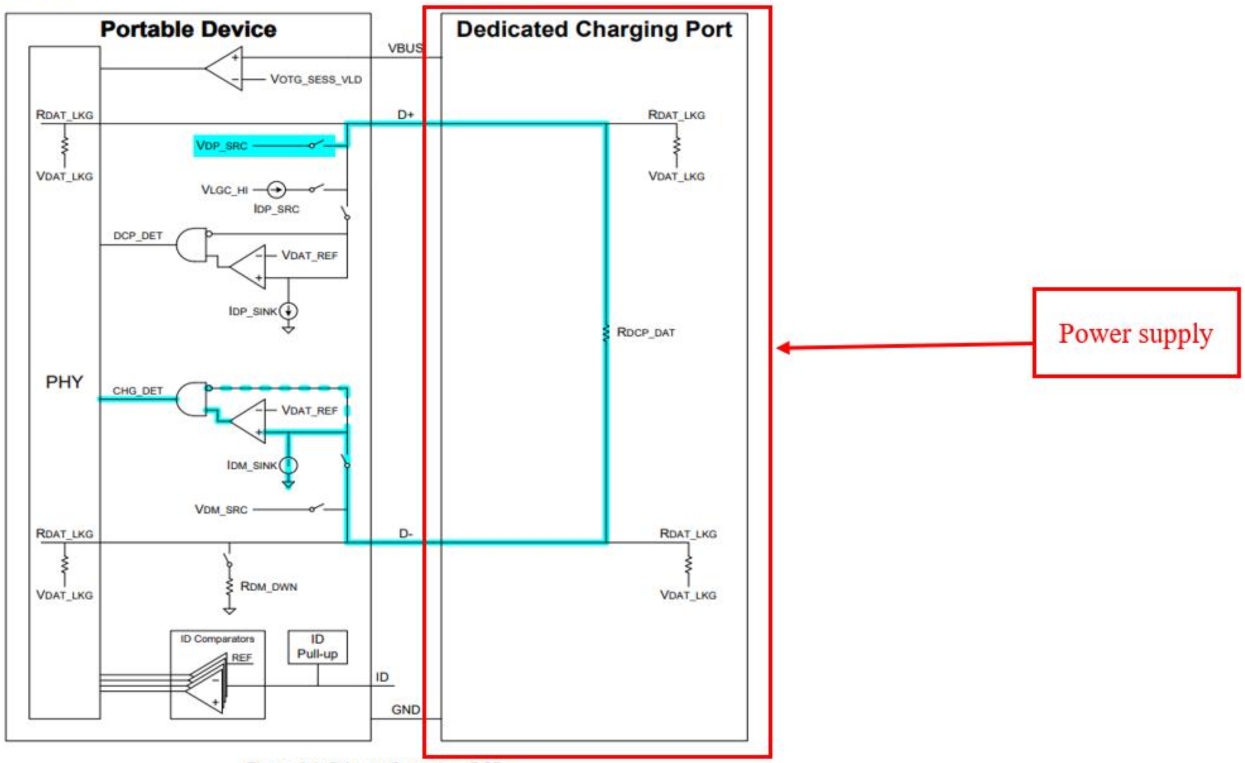


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on V_{DP_SRC} and I_{DM_SINK}. Since a DCP is required to short D+ to D- through a resistance of R_{DCP_DAT}, the PD will detect a voltage on D- that is close to V_{DP_SRC}.

A PD shall compare the voltage on D- with V_{DAT_REF}. If D- is greater than V_{DAT_REF}, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with V_{LGC} as well, and only determine that it is attached to a DCP or CDP if D- is greater than V_{DAT_REF}, but less than V_{LGC}. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than V_{DAT_REF}, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw I_{DEV_CHG}. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than V_{LGC}, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than V_{LGC}, then the PD would determine that it was attached to an SDP, and only be able to draw I_{SUSP}.

The choice of whether or not to compare D- to V_{LGC} depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

35. As discussed above, "the other end of USB cable is connected to the charging port of portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the USB power supply comprises power circuitry to provide DC power to portable electronic devices."

36. Defendant provides a system wherein the portable electronic device includes a controller which allows or does not allow charging of the battery within the portable electronic device in response to the determined parameter level of the second signal. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device receives the D- signal ("second signal") from the USB power supply to compare the voltage ("parameter") level of the D- signal with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic device draws current to charge a rechargeable battery of the portable electronic

device from the direct current power provided by the USB power supply. Because the portable electronic device determines which current level to draw, if any, from the charger, the system includes a controller which allows or does not allow charging of the battery within the portable electronic device in response to the determined parameter level of the second signal.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

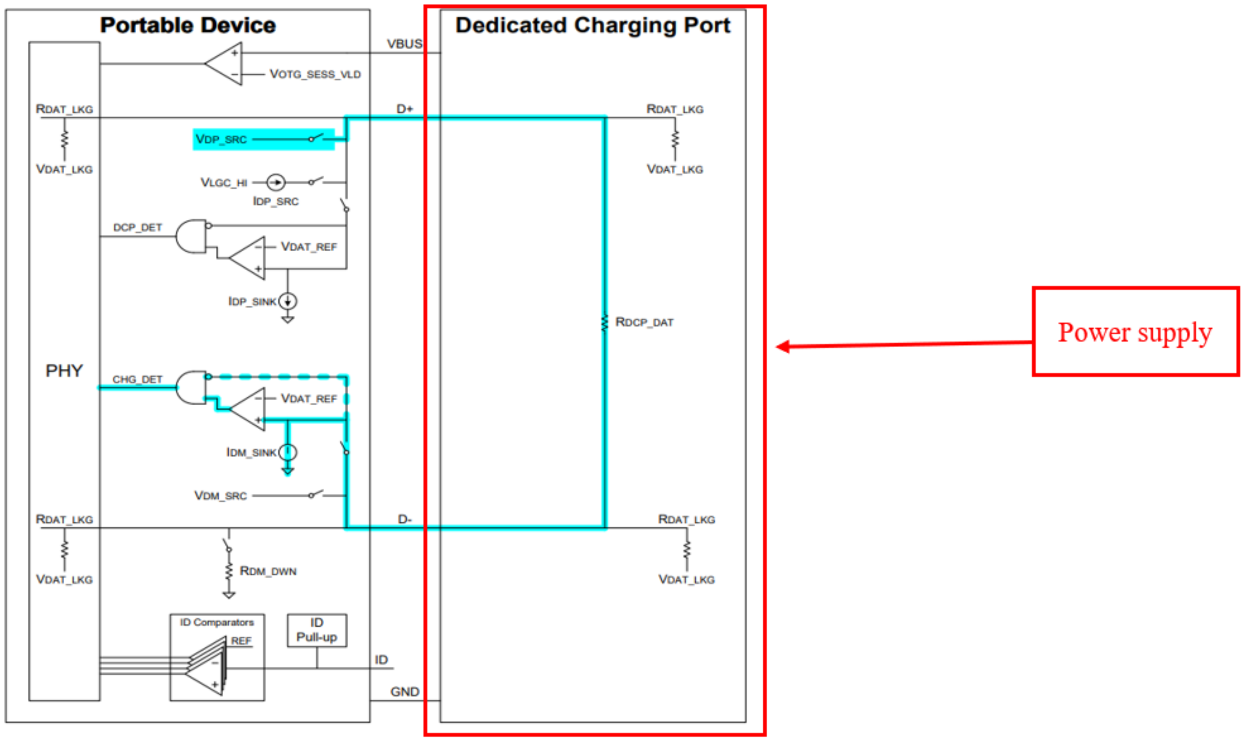


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

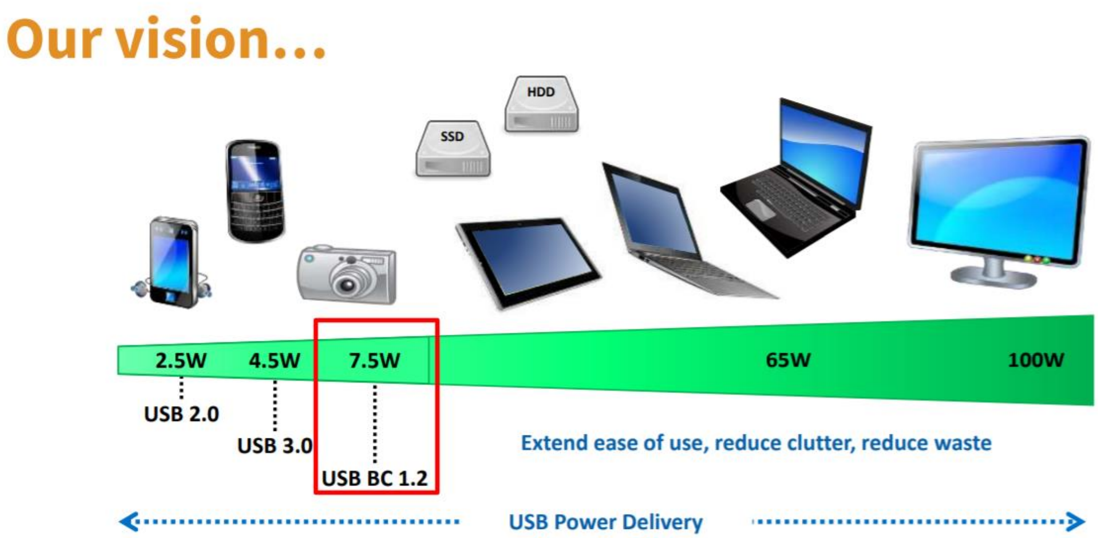
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

37. Defendant makes, uses, sells, offers for sale and/or imports a system including a Accused Chargers, the Accused Chargers for providing DC power to a portable electronic device and being external to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. Upon information and belief, the USB power supply includes circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic device. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 is used to output 5V voltage, 1.5A current, and 7.5W power.

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

38. Defendant provides the Accused Chargers which includes power circuitry to provide the DC power. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, to charge a portable electronic device, a USB cable is connected to

the USB power supply. Further, the other end of USB cable is connected to the charging port of the portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the USB Accused Chargers comprises power circuitry to provide DC power to the portable electronic device.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

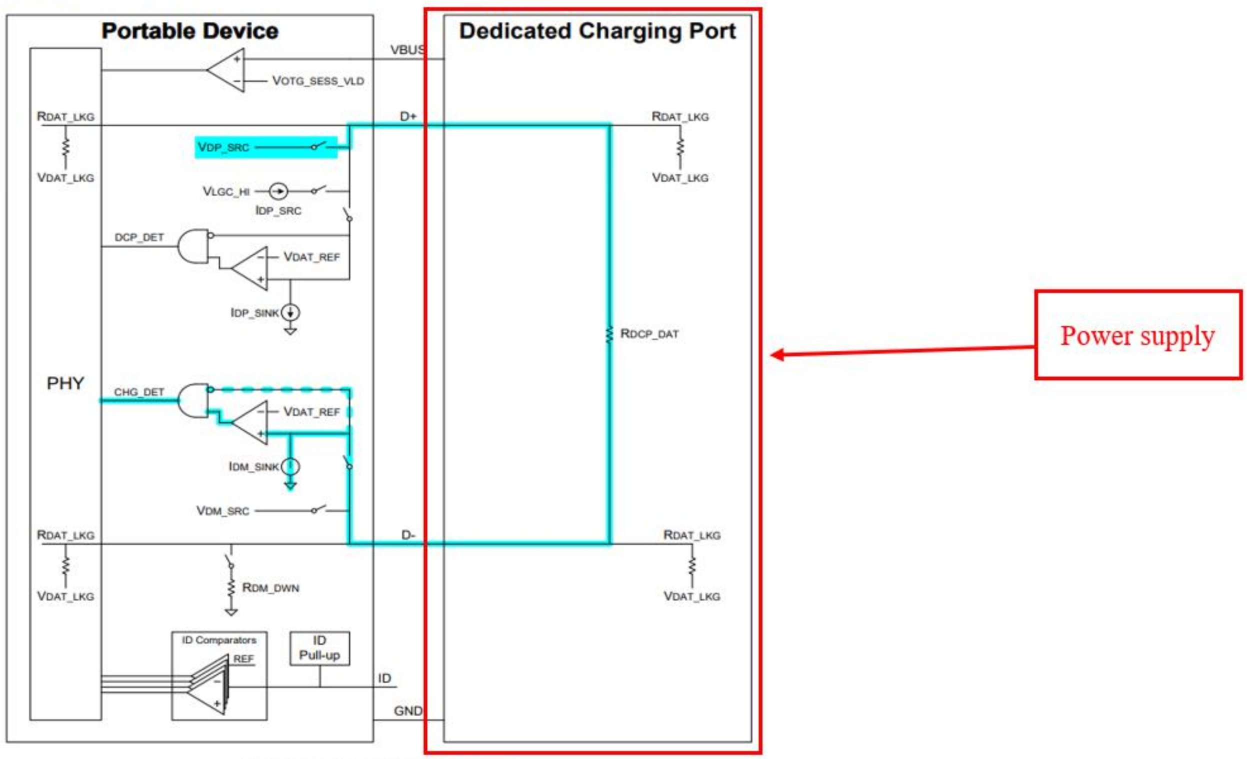


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

39. Defendant provides a system wherein the Accused Chargers includes data circuitry to receive a first signal originating from the portable electronic device and to provide a second signal to the portable electronic device. This element is infringed literally, or in the alternative,

under the doctrine of equivalents. For example, the USB power supply comprises data circuitry configured to use the Primary Detection method as described in the USB BC 1.2 specification. For example, during Primary Detection, when a portable electronic device is connected with the power supply through the USB cable, the portable electronic device generates a D+ signal ("first signal"). Data circuitry of the USB power supply receives a D+ signal ("first signal") and provides a D- signal ("second signal") to the portable electronic device to detect the type of connected power supply (standard downstream port or charging port). The D+ signal and D- signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the resistance causes the voltage to drop, creating a new D- signal to be transmitted to the portable electronic device via the D- pin. Thus, the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage. To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 **Primary Detection**

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 **Primary Detection, DCP**

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

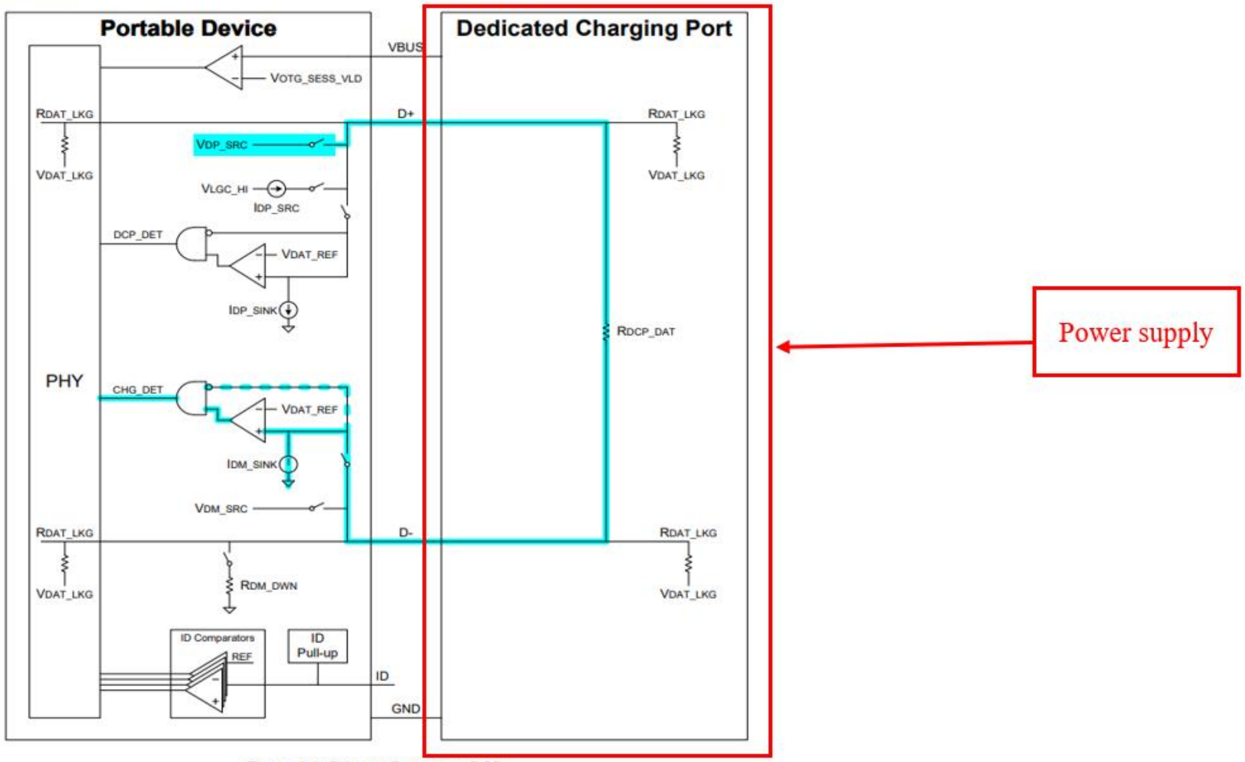


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

40. Defendant provides a system wherein the Accused Chargers includes a connector disposed on a cable end, the connector having four conductors for detachably mating with a power input opening of the portable electronic device, the first and second conductors transferring the DC power and its ground reference to the portable electronic device, the third conductor transferring the first signal from the portable electronic device to the data circuitry, and the fourth conductor transferring the second signal from the data circuitry to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply connects to the portable electronic device through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port of a portable electronic device. The connector comprises VBUS (“first conductor”), GND (“second conductor”), D+ (“third conductor”) and D- (“fourth conductor”) pins. The VBUS pin is the voltage line that provides DC power to the portable electronic device and GND pin provides a

ground reference to the portable electronic device. The D+ pin provides the D+ signal ("first signal") from the portable electronic device to the data circuitry of the USB power supply and the D- pin provides the D- signal ("second signal") from the data circuitry of the USB power supply to the portable electronic device. To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

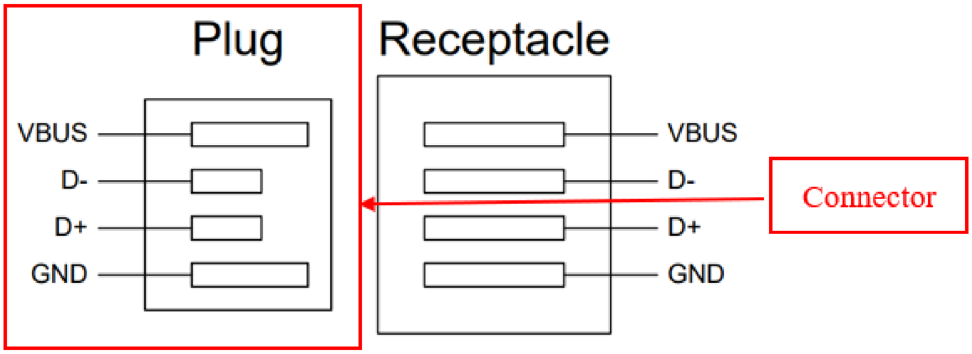


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

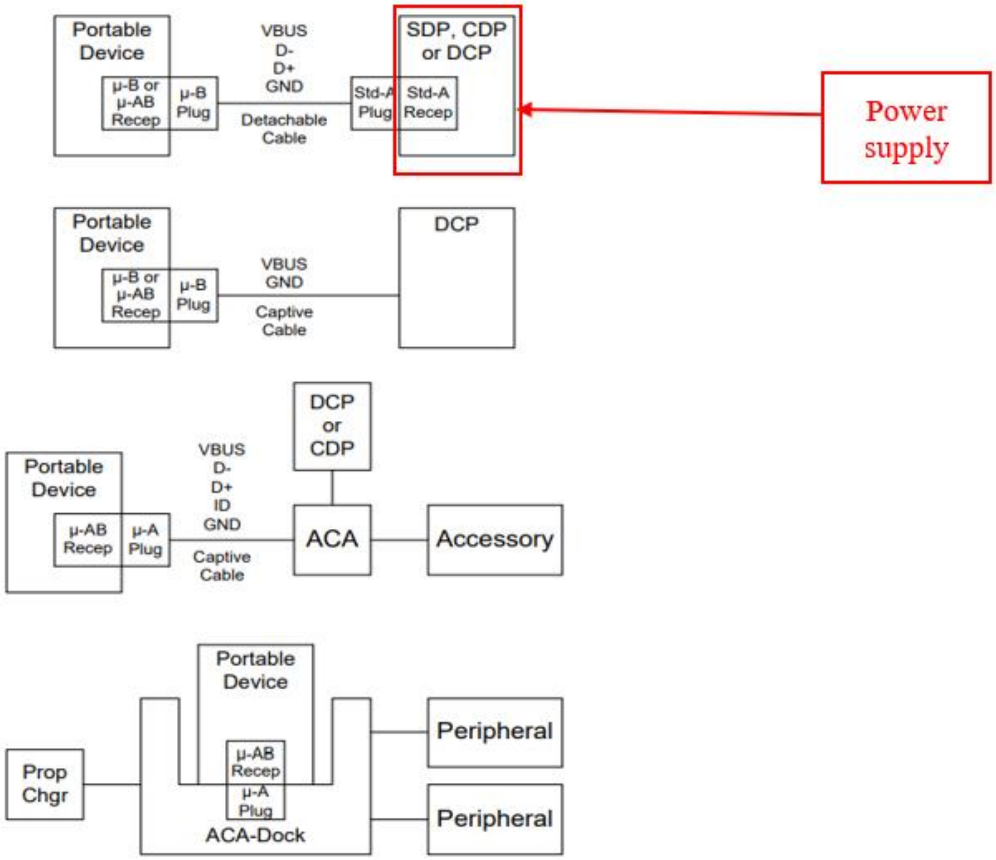


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.5 Ground Current and Noise Margins

As shown in Figure 7-47 of the USB 2.0 specification, a current of 100 mA through the ground wire of a USB cable can result in a voltage difference of 25 mV between the host ground and the device ground. This ground difference has the effect of reducing noise margins for both signaling and charger detection.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 36).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

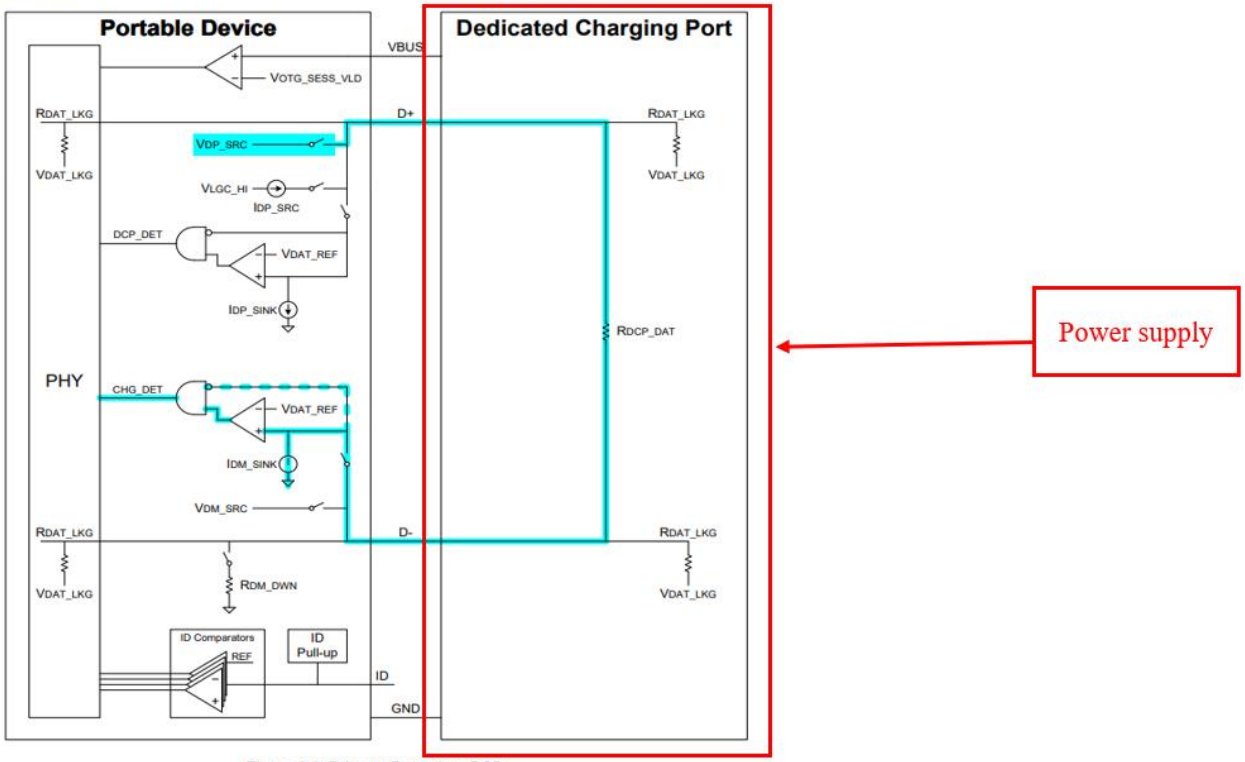


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on V_{DP_SRC} and I_{DM_SINK}. Since a DCP is required to short D+ to D- through a resistance of R_{DCP_DAT}, the PD will detect a voltage on D- that is close to V_{DP_SRC}.

A PD shall compare the voltage on D- with V_{DAT_REF}. If D- is greater than V_{DAT_REF}, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with V_{LGC} as well, and only determine that it is attached to a DCP or CDP if D- is greater than V_{DAT_REF}, but less than V_{LGC}. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than V_{DAT_REF}, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw I_{DEV_CHG}. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than V_{LGC}, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than V_{LGC}, then the PD would determine that it was attached to an SDP, and only be able to draw I_{SUSP}.

The choice of whether or not to compare D- to V_{LGC} depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

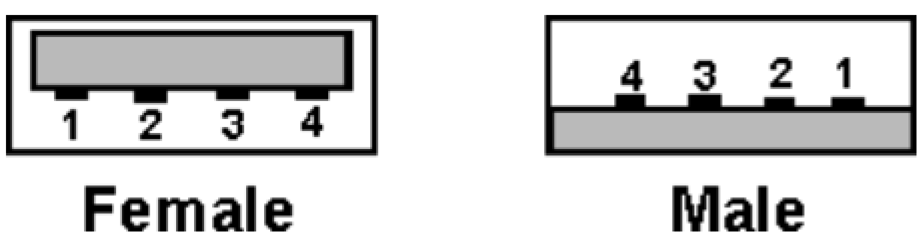
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

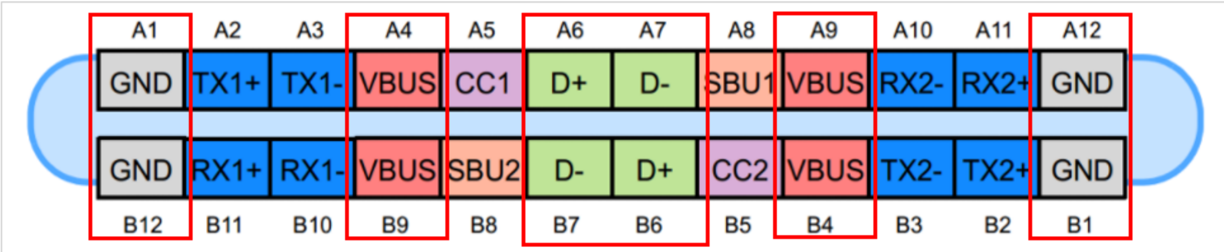


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

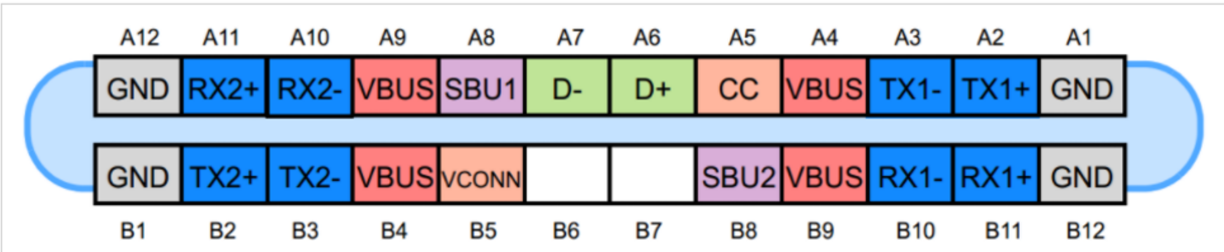


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

41. Defendant provides a system wherein the data circuitry, in response to the first signal, provides the second signal to the portal electronic device, the second signal being an analog signal having a parameter level to indicate to the portable electronic device the potential power output level of the Accused Chargers. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, as described above, the USB power supply comprises data circuitry configured to use the Primary Detection method of the USB BC 1.2 specification. The USB power supply shorts the D+ to D- through a resistance of R_{DCP_DAT}, such that in response to the D+ signal ("first signal"), the data circuitry of the power supply provides the D- signal ("second signal") to the portable electronic device. The portable electronic device compares the D- signal's voltage ("parameter") level with a reference voltage to indicate the potential power output level of the connected power supply. Therefore, the D- signal is an analog signal. To the

extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

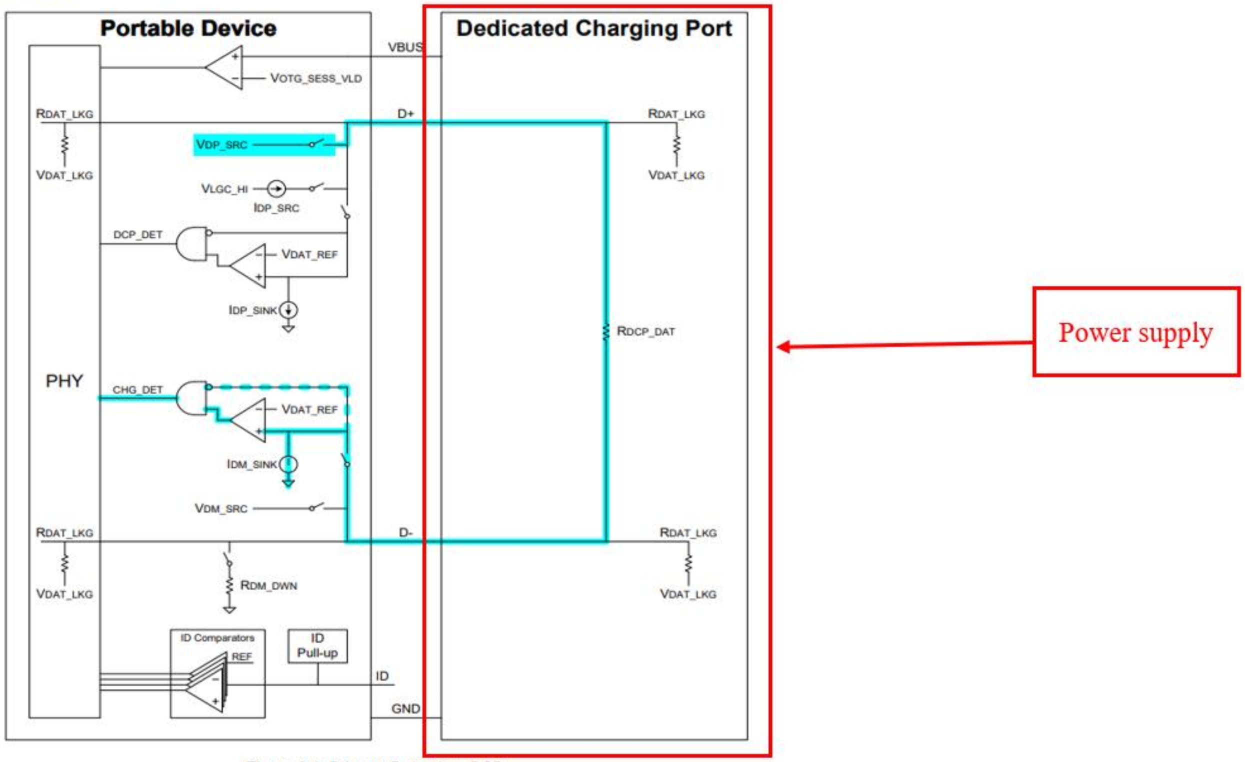


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

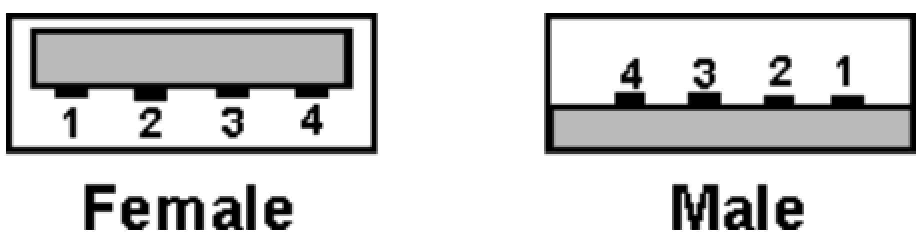
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

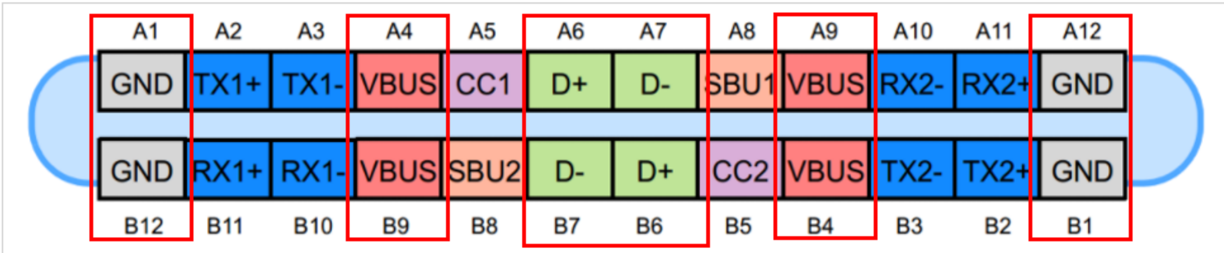


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

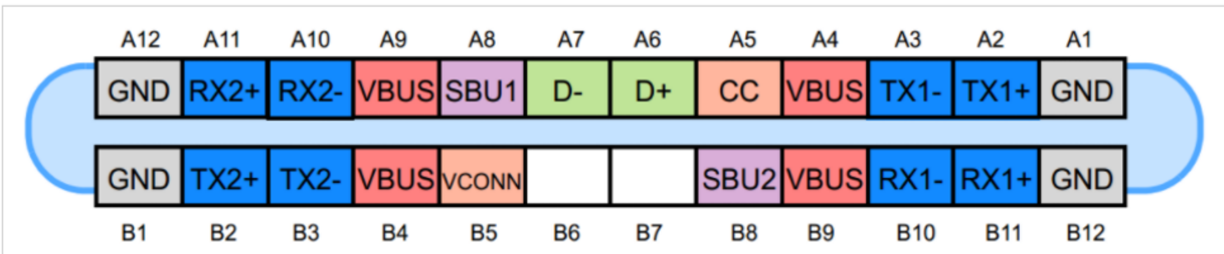


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

42. As discussed above, the power circuitry of the Accused Chargers converts power from an external power source to DC power. For example, to charge a portable electronic device, a USB cable is connected to the external USB power supply. Further, the other end of USB cable is connected to the charging port of the portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the external USB Accused Chargers comprises power circuitry to provide DC power to the portable electronic device.

43. Upon information and belief, Defendant has been and now is indirectly infringing by way of inducing infringement and contributing to the infringement of the asserted claims of the '187 patent in the State of Texas, in this District, and elsewhere in the United States, by providing the Accused Instrumentalities for use as described above by Defendant's customers. Defendant advertised, offered for sale, and/or sold the Accused Instrumentalities to its customers for use in a

manner that Defendant knew infringed at least one claim of the ‘187 patent. For example, Defendant sells the Belkin USB-C PD 3.0 PPS Wall Charger 25W, White; Belkin Dual 20W USB-C Wall Charger, White; Belkin Dual Phone Charger 37W Fast Charging; Belkin 20W Fast Charging Phone Charger with USB-C to Lightning Charging Cable, White, which are identified as a “Charger” or a “Phone Charger.” Defendant is a direct and indirect infringer, and its customers using the Accused Instrumentalities are direct infringers. Defendant had actual knowledge of the ‘187 patent at least as early as when they received a letter from Plaintiff sent on September 15, 2023, asserting that the Accused Chargers infringed claims of the ‘187 patent and they were provided a chart of the infringement. Defendant has known of its infringement since at least that date as a result of the accusations of infringement in the letter. Defendant has therefore also known that the use of the Accused Instrumentalities by its customers infringed at least one claim of the ‘187 patent since at least the date they received the letter.

44. On information and belief, since becoming aware of the ‘187 patent and of the infringement through advertising and offering for sale the Accused Chargers for use by its customers, Defendant is and has been committing the act of inducing infringement by specifically intending to induce infringement by providing the Accused Chargers to its customers and by aiding and abetting its use in a manner known to infringe by Defendant. Since becoming aware of the infringing use of the Accused Charger, Defendant knew that the use of the Accused Chargers by its customers as a charger with a portable electronic device including a rechargeable battery that constituted direct patent infringement. Despite this knowledge, Defendant continued to encourage and induce its customers to use the Accused Chargers to infringe as described above and provided instructions for using the Accused Chargers to infringe, including through advertisements.

Defendant therefore knowingly induced infringement and specifically intended to encourage and induce the infringement of the ‘187 patent by its customers.

45. On information and belief, since Defendant became aware of the infringement at least as of the date of receipt of the letter, Defendant is and has been committing the act of contributory infringement by intending to provide the identified Accused Chargers to its customers knowing that it is a material part of the invention, knowing that its use was made and adapted for infringement of the ‘187 patent as described above, and further knowing that the accused aspect of the Accused Chargers described above is not a staple article or commodity of commerce suitable for substantially noninfringing use. As described above, Defendant was aware that all material claim limitations are satisfied by the use and implementation of the Accused Chargers by Defendant’s customers in the manner described above yet continued to provide the Accused Chargers to its customers knowing that it is a material part of the invention. As described above, since learning of the infringement, Defendant knew that the use and implementation of the Accused Chargers by its customers was made and adapted for infringement of the ‘187 patent. A new act of direct infringement occurred each time a customer implemented and/or used the Accused Chargers in the manner described above. After Defendant became aware that the use of the Accused Chargers infringes at least one claim of the ‘187 patent, Defendant knew that each such new use was made and adapted for infringement of at least one claim of the ‘187 patent and Defendant continued to advertise and provide the Accused Chargers for such infringing activities. Furthermore, as described more fully above, the Accused Chargers has functionality designed for use in the system in the manner described above and is therefore not a staple article or commodity of commerce suitable for substantially noninfringing use.

46. Upon information and belief, Defendant has been and now is willfully infringing the asserted claims of the '187 patent in the Texas, in this District, and elsewhere in the United States. As explained above, Defendant was informed of its infringement of the '187 patent by way of the September 15, 2023, letter sent to Defendant, including claim charts demonstrating Defendant's infringement. As a result of the letter, Defendant should have known that its actions constituted an unjustifiably high risk of infringement. Despite the letter and knowledge that the risk of infringement was either known or so obvious that it should have been known, Defendant continued its infringing actions.

47. Plaintiff has been damaged as a result of Defendant's infringing conduct. Defendant is thus liable to Plaintiff for damages in an amount that adequately compensates Plaintiff for such Defendant's infringement of the '187 patent, *i.e.*, in an amount that by law cannot be less than would constitute a reasonable royalty for the use of the patented technology, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

48. On information and belief, Defendant will continue its infringement of one or more claims of the '187 patent unless enjoined by the Court. Each and all of the Defendant's infringing conduct thus causes Plaintiff irreparable harm and will continue to cause such harm without the issuance of an injunction.

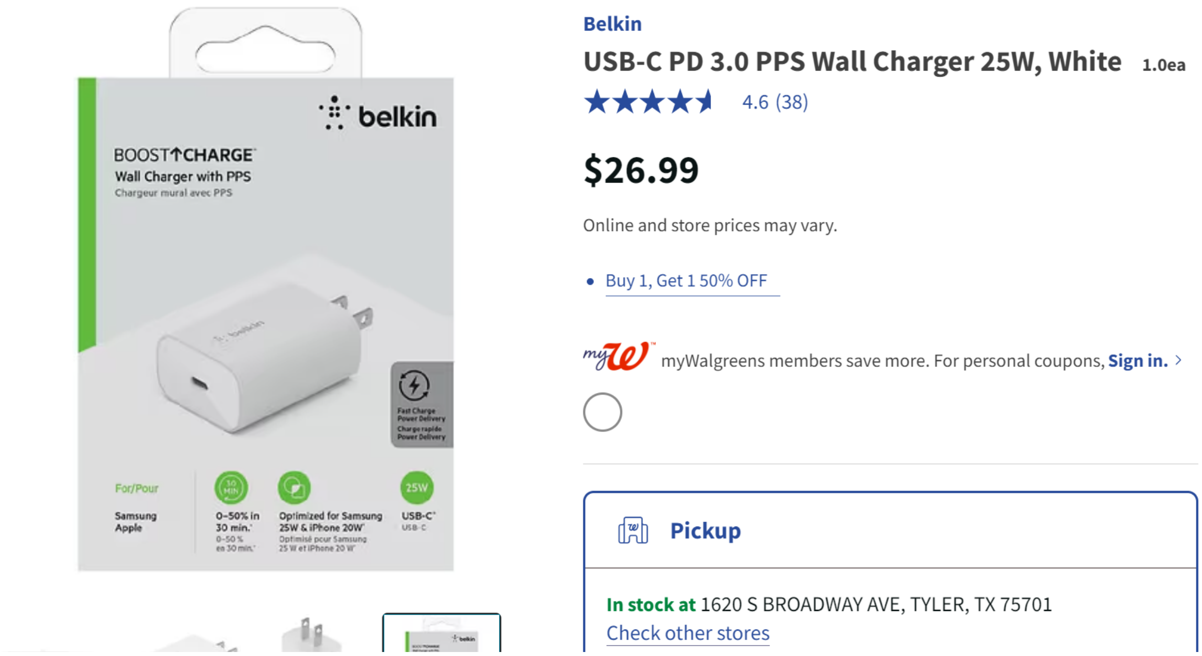
49. On information and belief, to the extent marking is required, Comarco complied with all marking requirements.

V. <u>COUNT II</u>
<u>(PATENT INFRINGEMENT OF UNITED STATES PATENT NO. 10,855,087)</u>

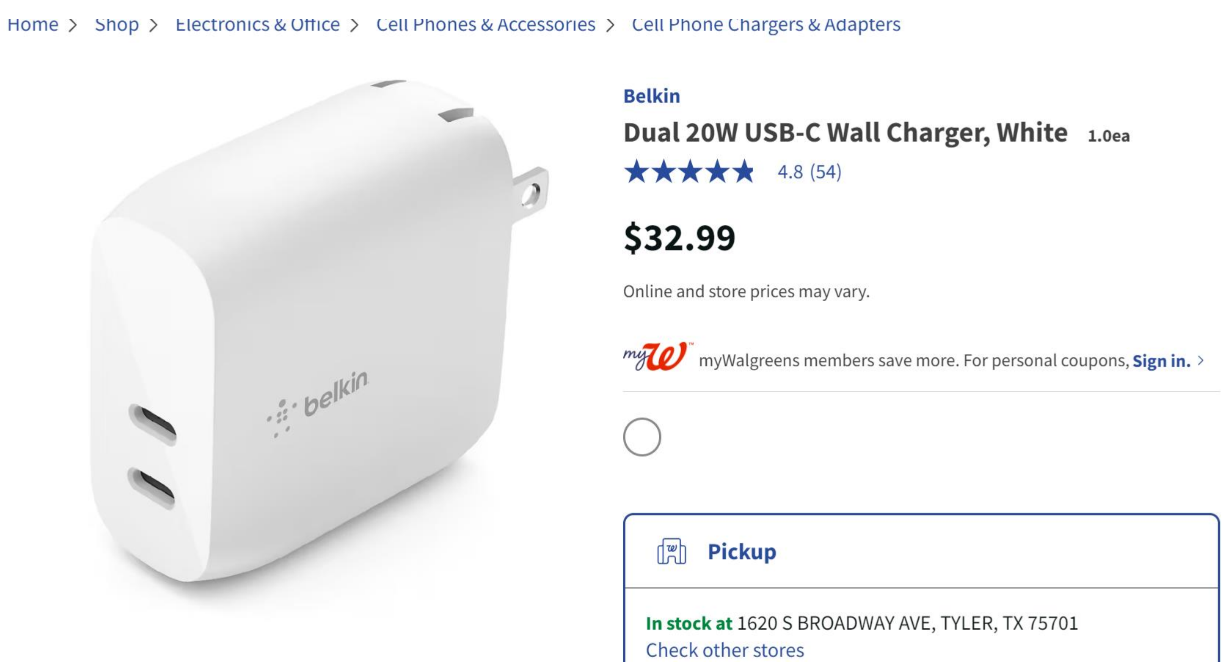
44. Upon information and belief, Defendant has directly infringed claim 1, 2, 5-8, 11-12, and 15-18 of the '087 patent in Texas, and elsewhere in the United States, by makes, uses, sells, offers for sale and/or imports a power supply system comprising power circuitry configured

to provide direct current power including, but not limited to, Belkin USB-C PD 3.0 PPS Wall Charger 25W, White; Belkin Dual 20W USB-C Wall Charger, White; Belkin Dual Phone Charger 37W Fast Charging; Belkin 20W Fast Charging Phone Charger with USB-C to Lightning Charging Cable, White ("Accused Chargers").

45. Upon information and belief, Company makes, uses, sells, offers for sale and/or imports a USB power supply (*i.e.*, "Accused Chargers") with portable electronic devices to supply power to the portable electronic device. The USB power supply outputs voltage, current, and power values. USB-complaint devices at USB 3.0 or above are compatible with the USB BC 1.2 specification. Upon information and belief, each of the Accused Chargers includes circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic device. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 is used to output 5V voltage, 1.5A current, and 7.5W power. Further, to charge the battery in a portable electronic device, the portable electronic device is connected to the USB power supply. The other end of the USB cable is connected to the charging port of the device and the power supply is plugged into a standard wall socket. Therefore, the USB power supply comprises power circuitry to provide DC power to the portable electronic device.



(*E.g.*, https://www.walgreens.com/store/c/belkin-usb-c-pd-3.0-pps-wall-charger-25w/ID=300421437-product).



(*E.g.*, https://www.walgreens.com/store/c/belkin-dual-20w-usb-c-wall-charger/ID=300421459-product)

Home > Shop > Electronics & Office > Cell Phones & Accessories > Cell Phone Chargers & Adapters

Belkin

Dual Port Car Charger 37W Fast Charging 1.0ea

★★★★★ 4.7 (77)

$25.99

Online and store prices may vary.

myWalgreens members save more. For personal coupons, **Sign in.** >

Pickup

In stock at 1620 S BROADWAY AVE, TYLER, TX 75701

Check other stores

Ready in as little as **30 minutes** if ordered placed by 9pm. Curbside or drive-thru pickup available.$10 minimum order required. Details

(*E.g.*, https://www.walgreens.com/store/c/belkin-dual-port-car-charger-37w-fast-charging/ID=300431586-product).

Home > Shop > Electronics & Office > Cell Phones & Accessories > Cell Phone Chargers & Adapters

Belkin

20W Fast Charging Phone Charger with USB-C to Lightning Charging Cable, White 1.0ea

★★★★★ 4.9 (94)

$35.99

Online and store prices may vary.

myWalgreens members save more. For personal coupons, **Sign in.** >

Pickup

In stock at 1620 S BROADWAY AVE, TYLER, TX 75701

(*E.g.*, https://www.walgreens.com/store/c/belkin-20w-fast-charging-phone-charger-with-usb-c-to-lightning-charging-cable/ID=300432822-product).

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See *USB 2.0*	
USB 3.2	5 V	See *USB 3.2*	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).

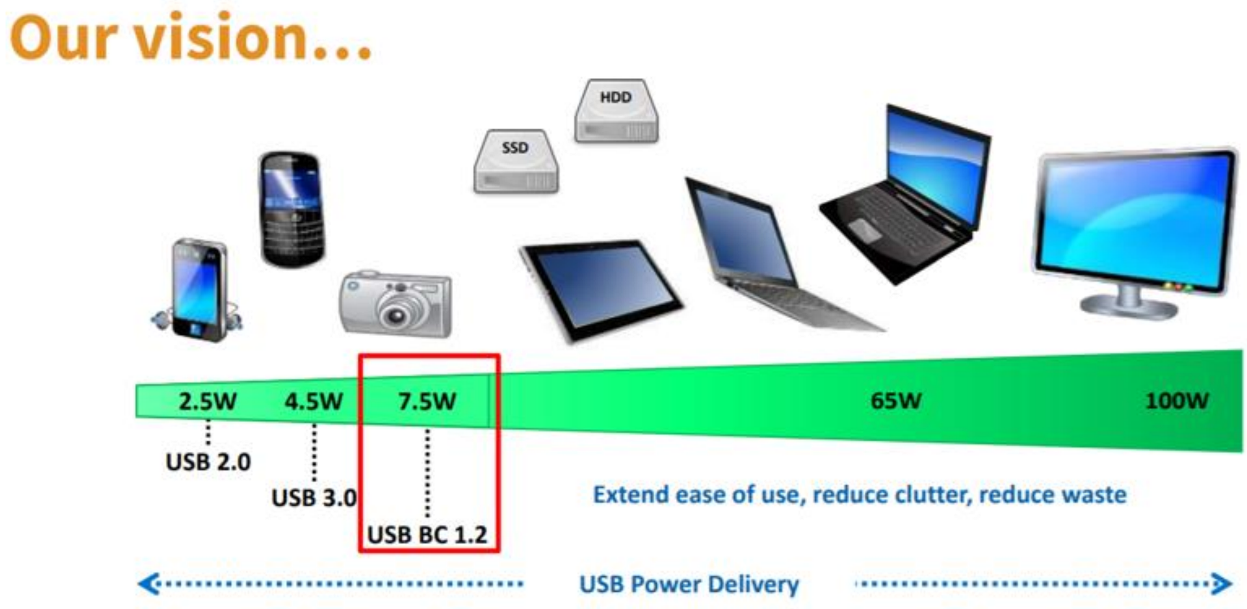
USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

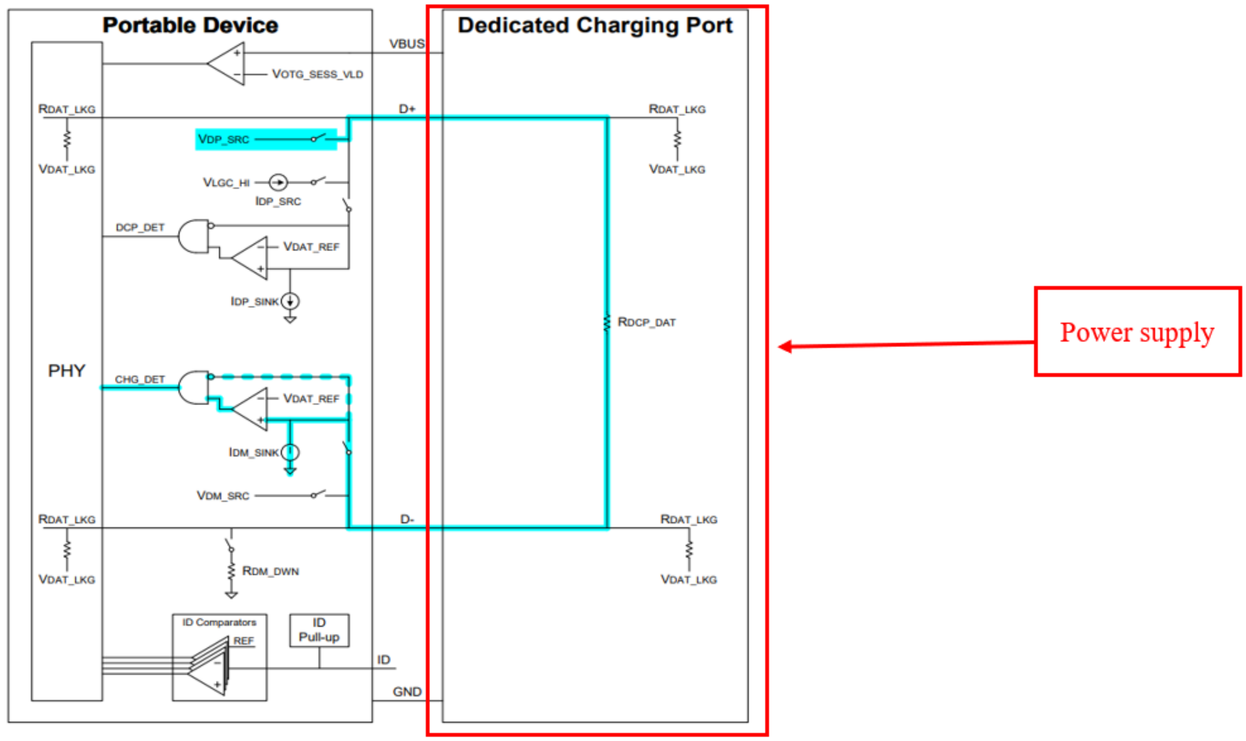


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

46. On information and belief, Defendant provides a power supply system comprising data circuitry configured to receive a first signal that originates from a portable electronic device and to provide a second signal to be sent to the portable electronic device, the data circuitry and the power circuitry configured to be coupled via a connector to the portable electronic device, the connector comprising a first conductor, a second conductor, a third conductor, and a fourth conductor, the connector configured to be detachably mated with a power input interface of the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply comprises data circuitry configured

to use the Primary Detection method as described in the USB BC 1.2 specification. The USB power supply connects to the portable electronic device through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port of portable electronic device. The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor") pins. Further, during Primary Detection, when a portable electronic device is connected with the USB power supply through the USB cable, the portable electronic device generates a D+ signal ("first signal"). Data circuitry of the USB power supply receives the D+ signal ("first signal") and provides a D- signal ("second signal") to the portable electronic device to detect the type of connected power supply (standard downstream port or charging port). To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

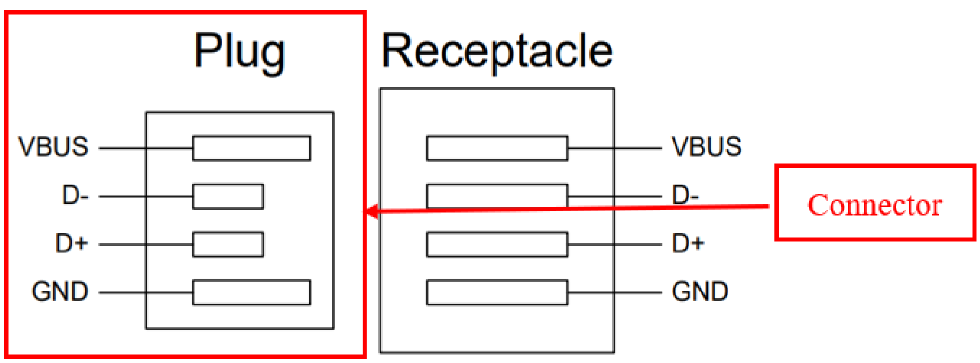


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

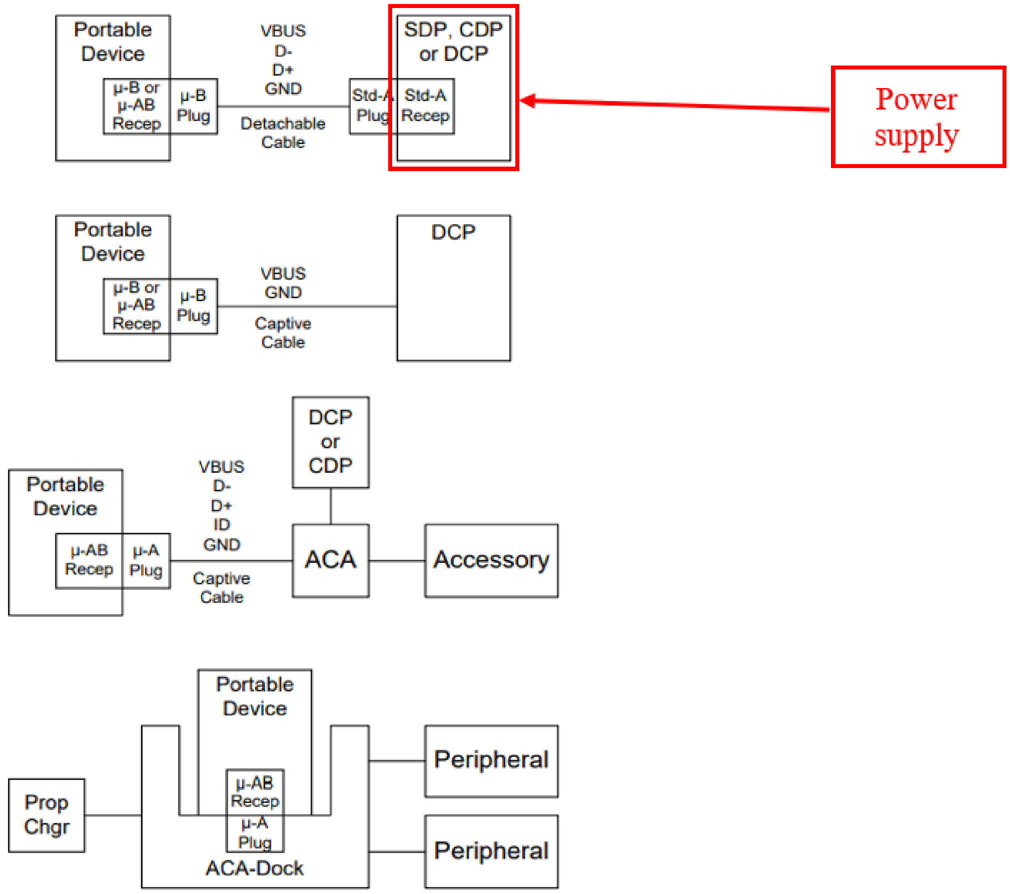


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

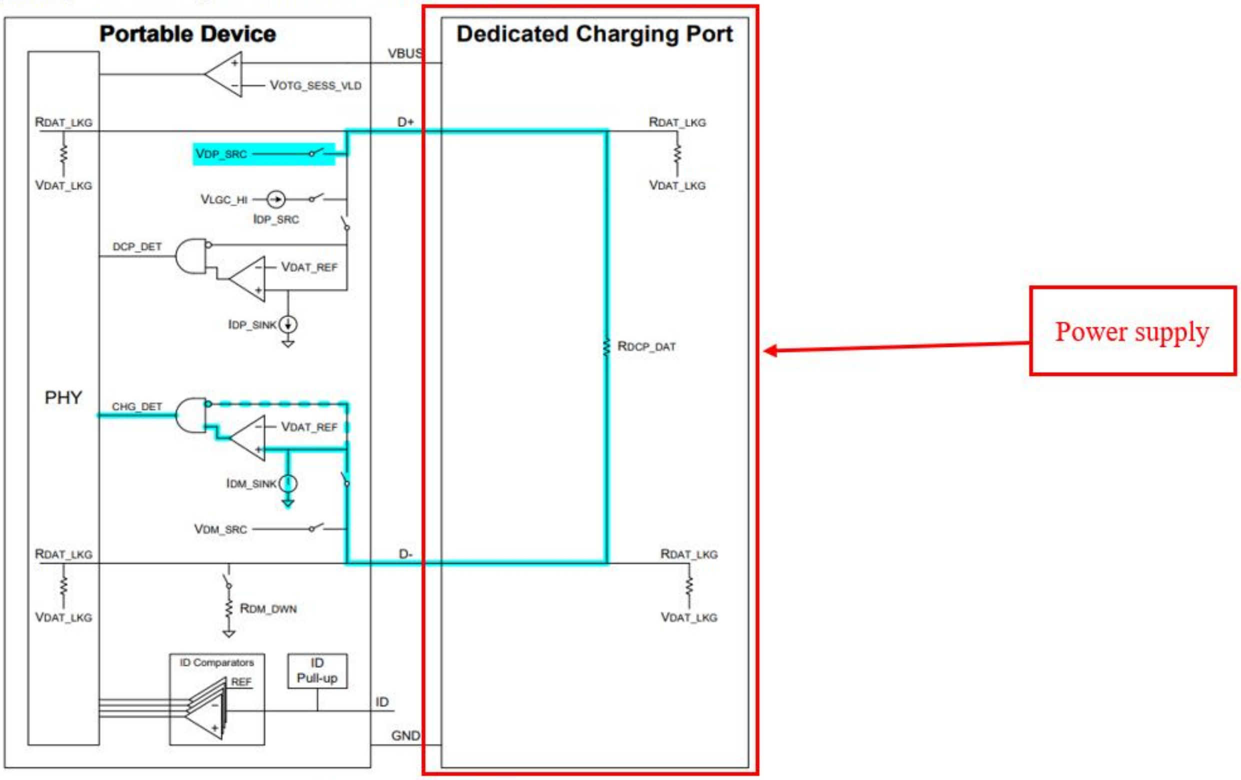


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

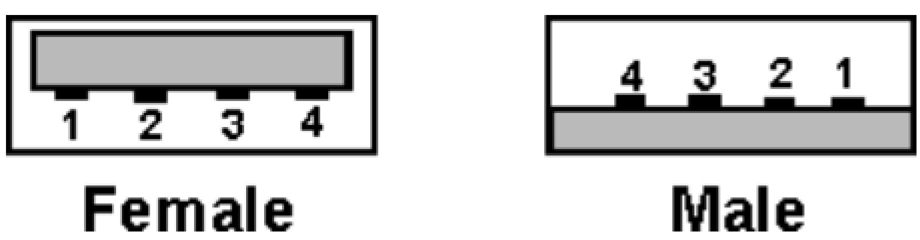
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

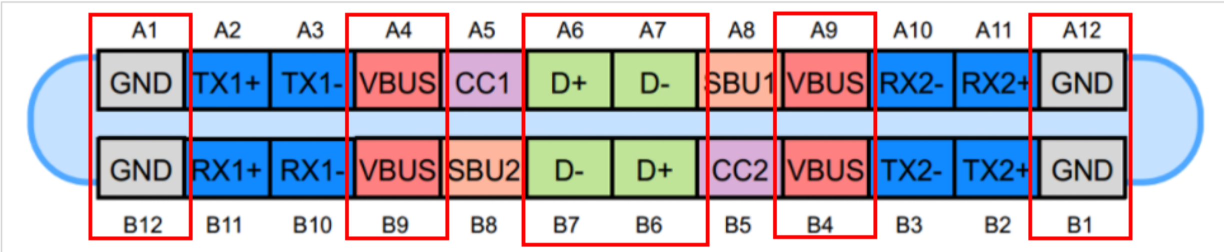


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

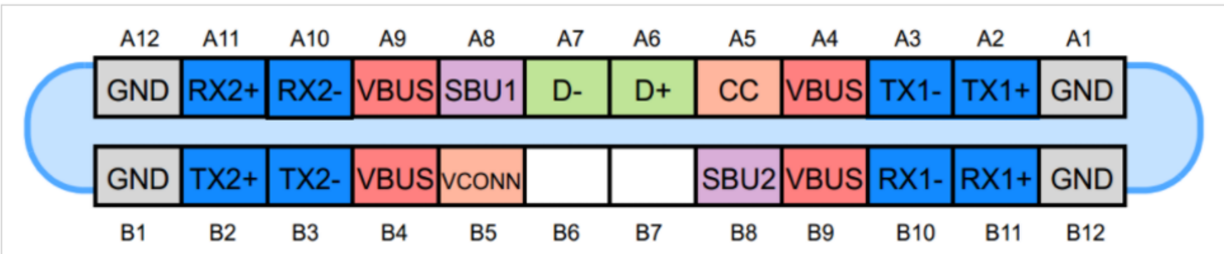


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

47. Defendant provides a power supply system to transfer, via the first conductor, the direct current power to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the VBUS pin is the voltage line that provides DC power to the portable electronic device.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

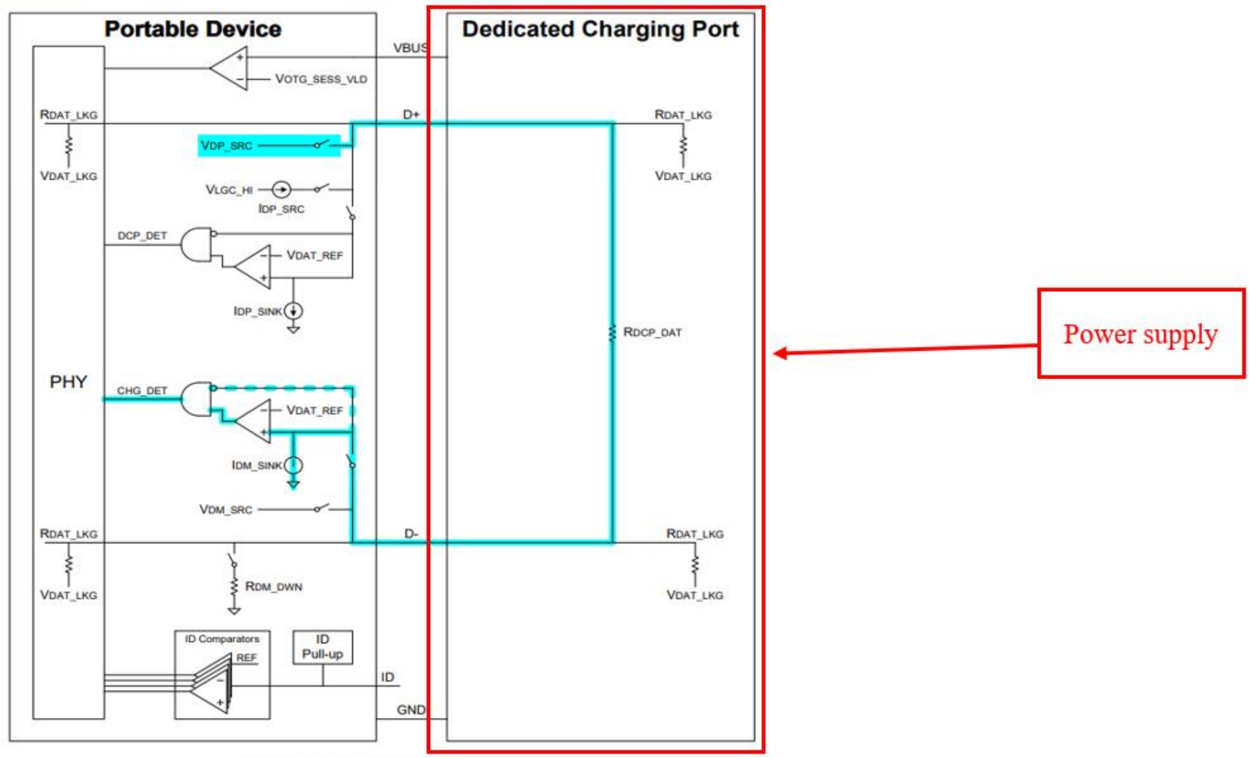


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

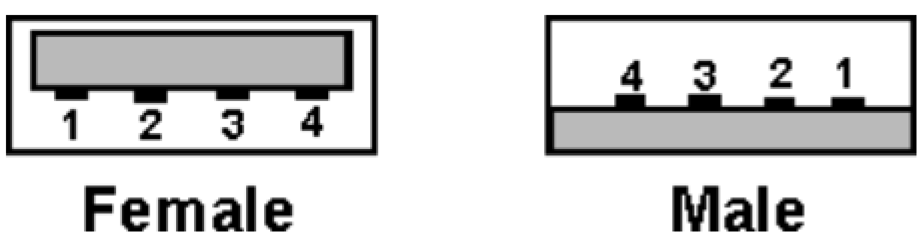
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

48. Defendant provides a power supply system to transfer, via the second conductor, a ground reference to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the GND pin provides a ground reference to the portable electronic device.

3.5 Ground Current and Noise Margins

As shown in Figure 7-47 of the USB 2.0 specification, a current of 100 mA through the ground wire of a USB cable can result in a voltage difference of 25 mV between the host ground and the device ground. This ground difference has the effect of reducing noise margins for both signaling and charger detection.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 36).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

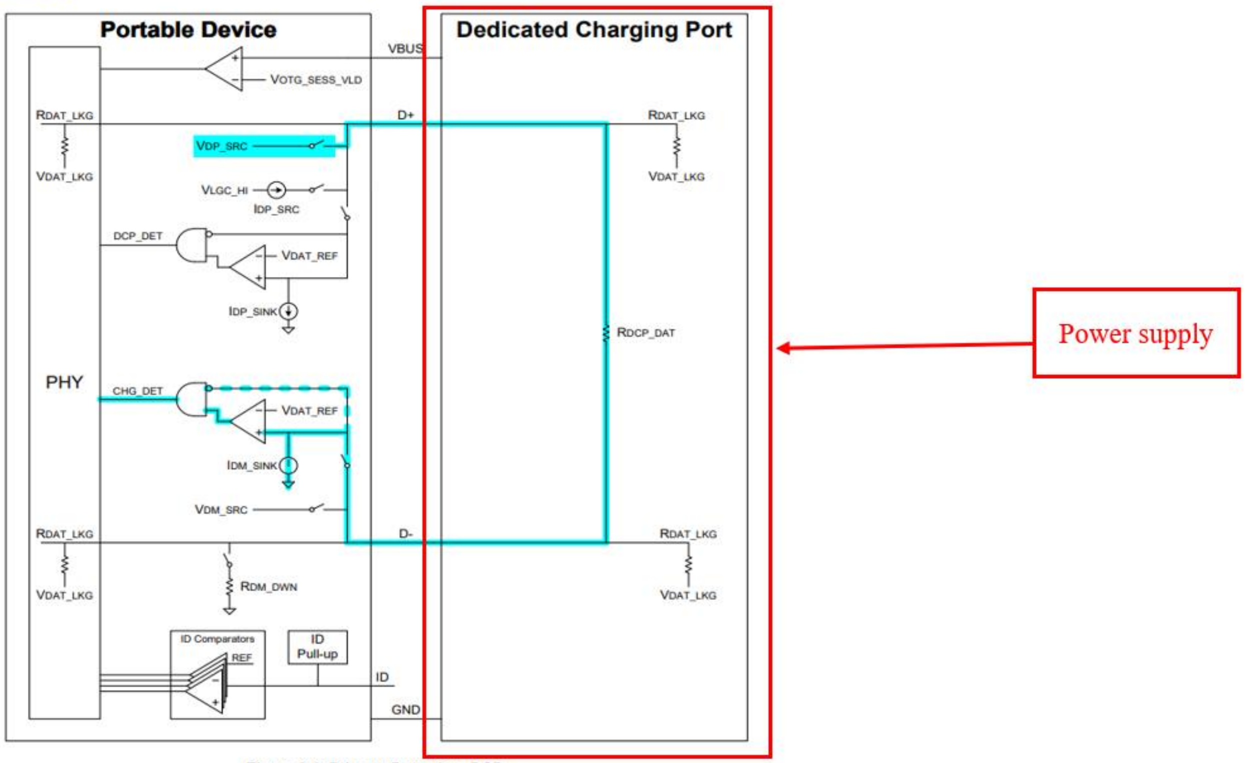


Figure 3-6 Primary Detection, DCP

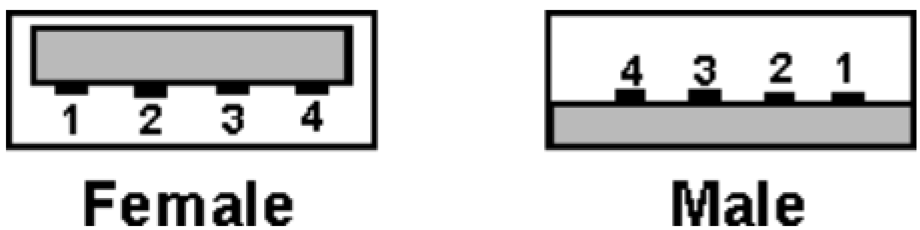
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

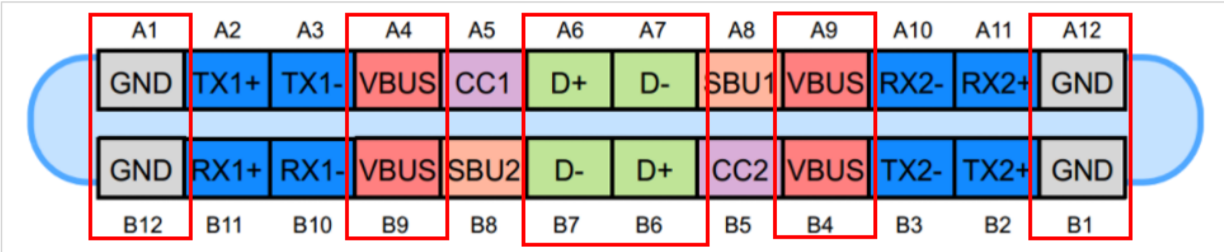


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

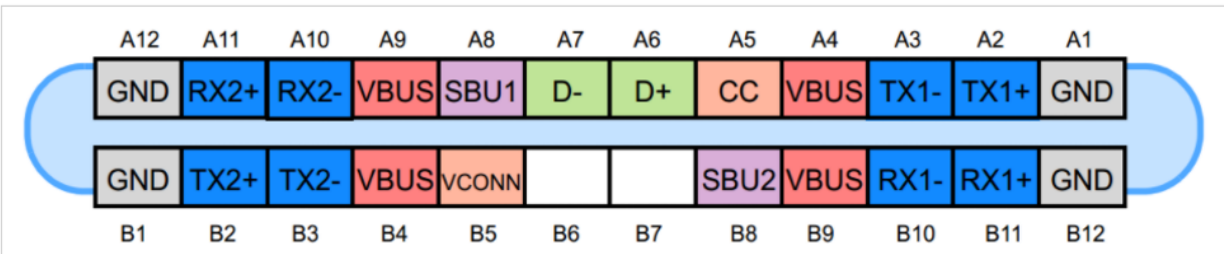


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

49. Defendant provides a power supply system to transfer, via the third conductor, the first signal from the portable electronic device to the data circuitry. This element is met literally, or in the alternative, under the doctrine of equivalents. For example, the D+ pin provides the D+ signal ("first signal") from the portable electronic device to the data circuitry of the USB power supply.

3.2.4 **Primary Detection**

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 **Primary Detection, DCP**

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

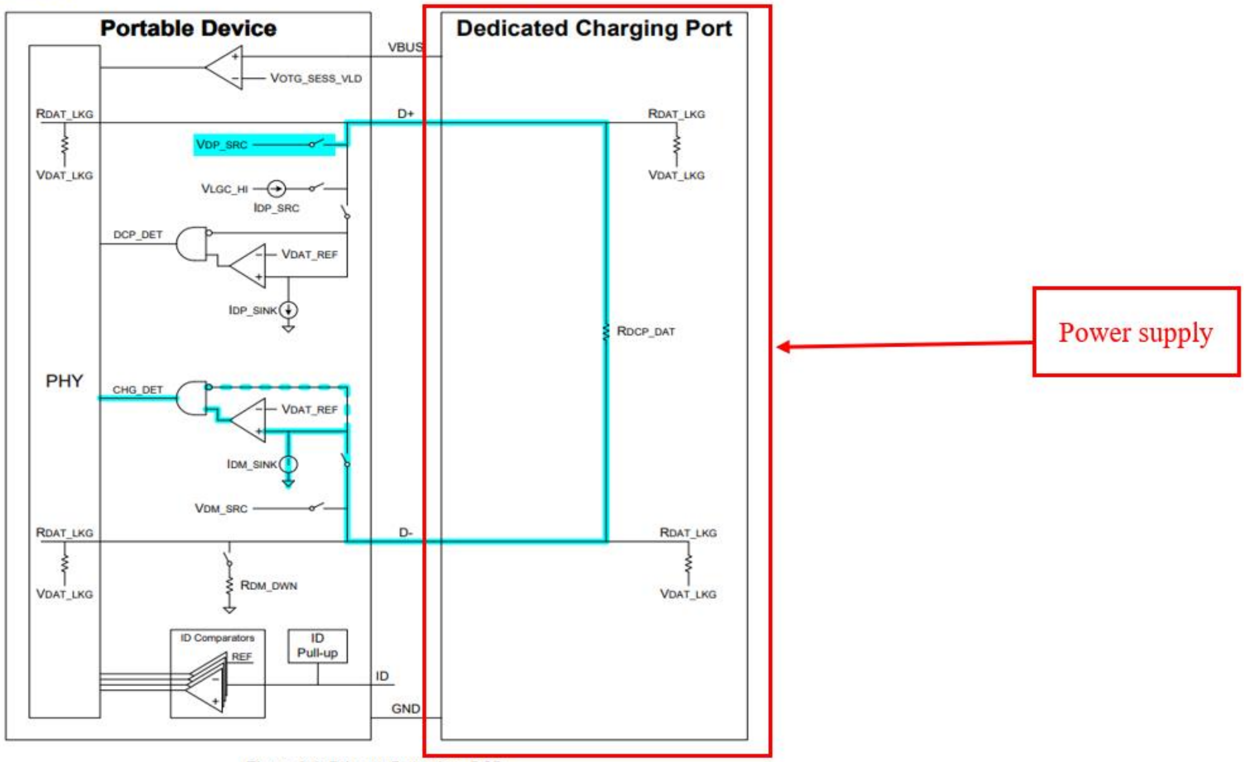


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

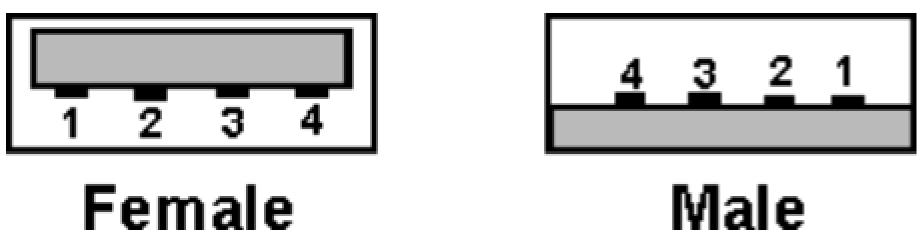
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

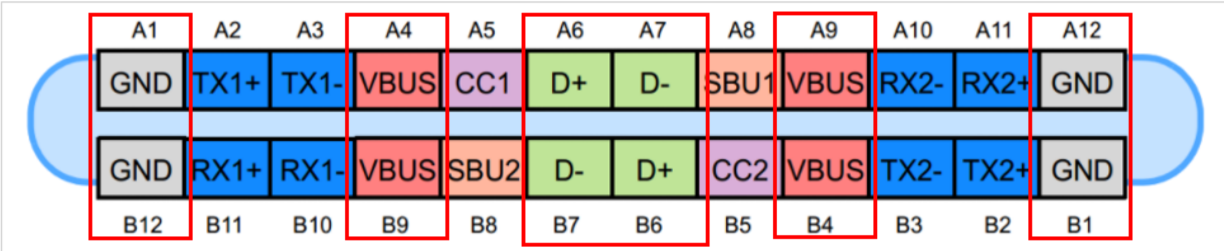


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

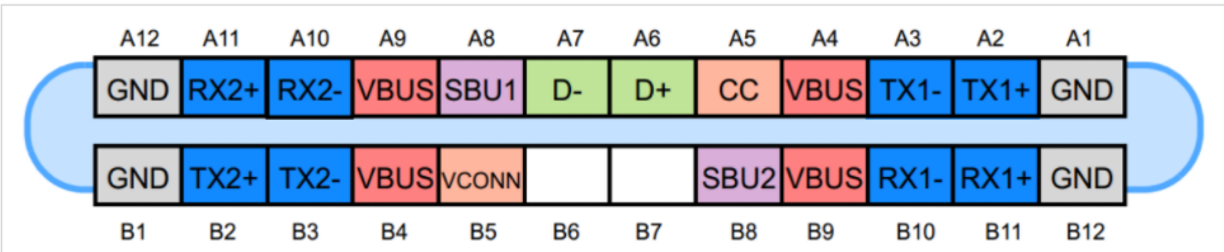


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

50. Defendant provides a power supply system to transfer, via the fourth conductor, the second signal from the data circuitry to the portable electronic device. This element is met literally, or in the alternative, under the doctrine of equivalents. For example, the D- pin provides the D- signal ("second signal") from the data circuitry of the USB power supply to the portable electronic device. To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same

function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

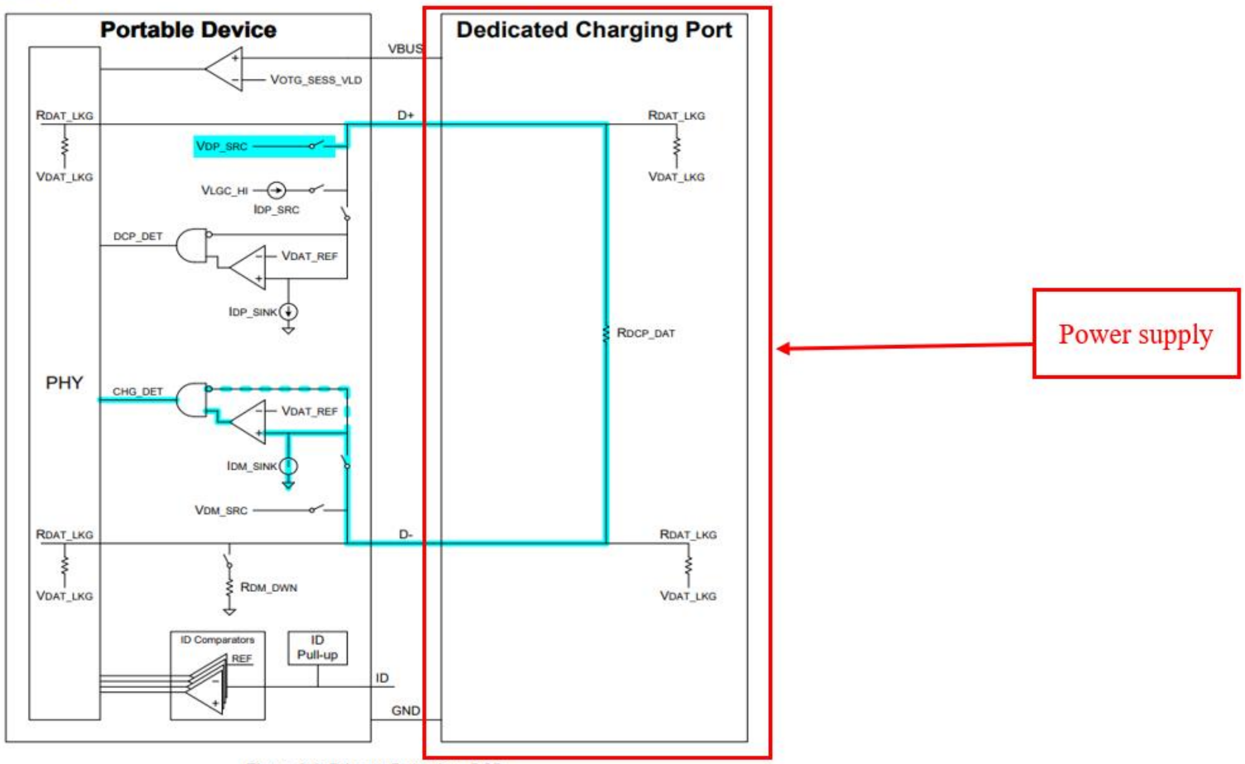


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

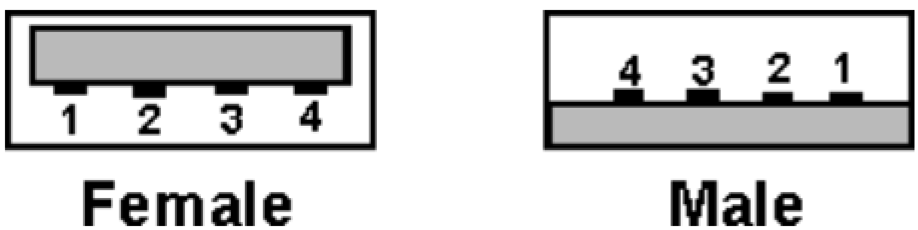
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

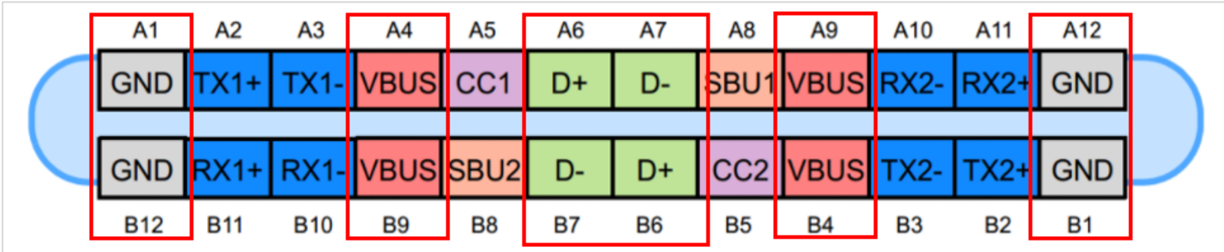


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

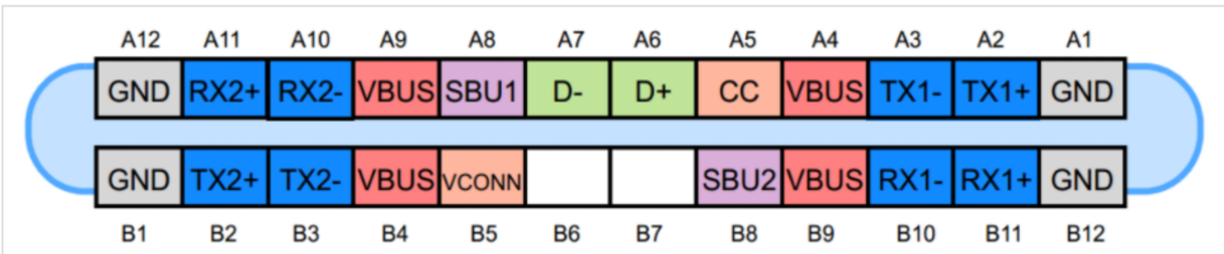


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

51. Defendant provides a power supply system wherein the data circuitry is further configured, in coordination with the first signal, to provide the second signal, the second signal having a parameter level that is usable by the portable electronic device in connection with control of charging a rechargeable battery of the portable electronic device based on the direct current power provided by the power circuitry. This element is met literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply shorts the D+ to D- through a resistance of R_{DCP_DAT}, such that the portable electronic device detects a voltage on D-. Therefore, the data circuitry of the power supply is configured, in coordination with the D+ signal ("first signal") to provide D- signal ("second signal") to the portable electronic device. The D+ signal and D- signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the

resistance causes the voltage to drop, creating a new D- signal to be transmitted to the portable electronic device via the D- pin. Thus, the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage. Further, the portable electronic device compares the D- signal's voltage ("parameter") level with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic devices draw current to charge a rechargeable battery of the portable electronic device from the direct current power provided by the power supply.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

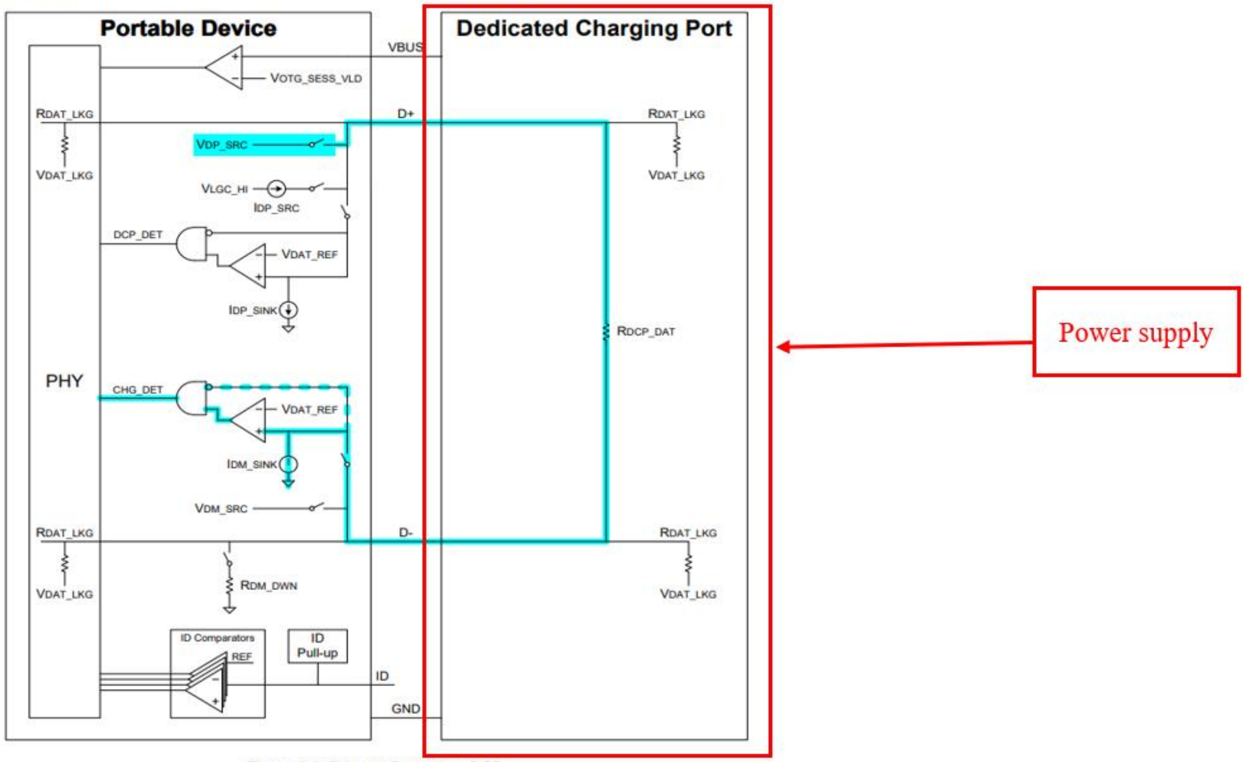


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

52. As discussed above, "[t]he USB cable has a USB-C connector at one end to detachably mate with the charging port of portable electronic device."

53. As discussed above, "the portable electronic device compares the D- signal's voltage ("parameter") level with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic devices draw current to charge a rechargeable battery of the portable electronic device from the direct current power provided by the power supply."

54. As discussed above, the parameter level is the D- signal's voltage.

55. Defendant provides a power supply in which the first signal is received by the data circuitry in response to the power circuitry providing the direct current power and the ground reference to the portable electronic device. As explained above in connection with Claim 1, the power supply comprises data circuity and power circuitry configured to use the Primary Detection

method of the USB BC 1.2 specification. Using the VBUS pin and GRN pin, current power and ground reference are provided to and detected by the portable electronic device, respectively. This detection triggers the portable electronic device to send a voltage signal D+, which is the "first signal" received by the data circuitry of the power supply.

56. As discussed above with respect to Claim 1, the portable electronic device can be a computer, such as a laptop or tablet.

57. Defendant makes, uses, sells, offers for sale and/or imports a power supply system comprising power circuitry configured to provide direct current power. This element is infringed literally, or in the alternative, under the doctrine of equivalents. Upon information and belief, Defendant makes, uses, sells, offers for sale, and/or imports a USB power supply (*i.e.*, "Accused Chargers") to supply power to the portable electronic device. USB-complaint devices at USB 3.0 or above are compatible with the USB BC 1.2 specification. Upon information and belief, each of the Accused Chargers includes power circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic device. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 is used to output 5V voltage, 1.5A current, and 7.5W power. Further, to charge the battery in a portable electronic device, the portable electronic device is connected to the USB power supply. The other end of the USB cable is connected to the charging port of the device and the power supply is plugged into a standard wall socket. Therefore, the USB power supply comprises power circuitry to provide DC power to the electronic device.

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See *USB 2.0*	
USB 3.2	5 V	See *USB 3.2*	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).

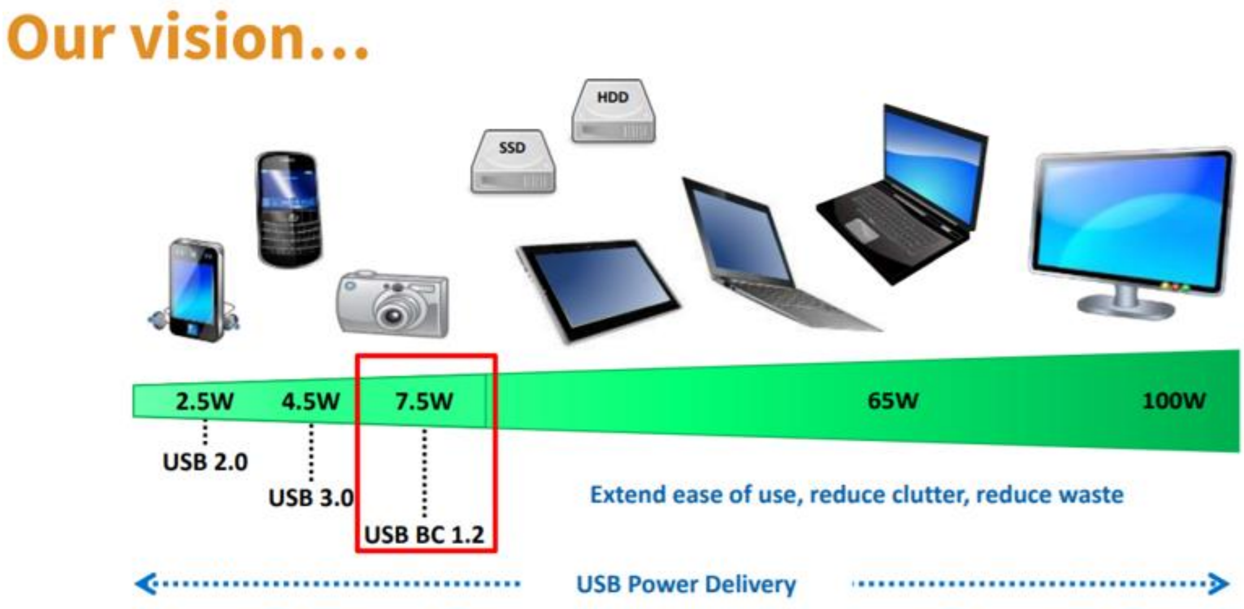
USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

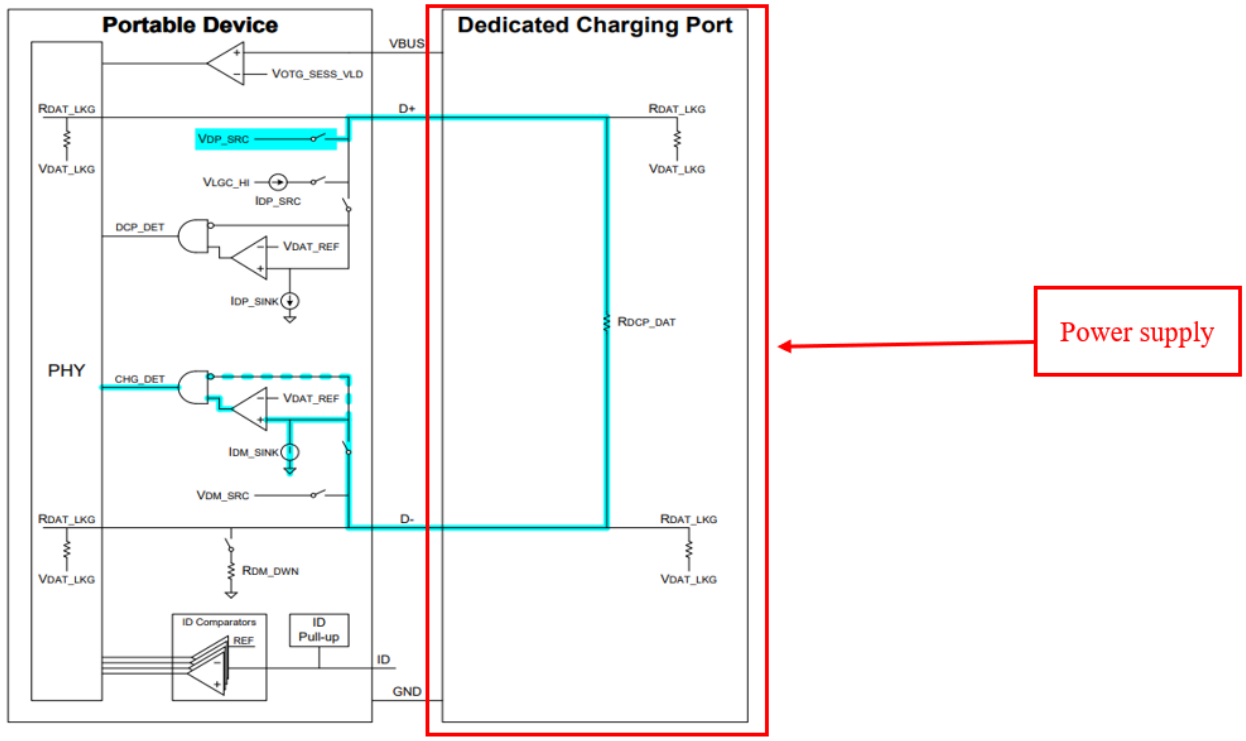


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

58. Defendant provides a power supply system comprising data circuitry configured to receive an input signal that originates from a portable electronic device and to provide an output signal to be sent to the portable electronic device, the data circuitry and the power circuitry configured to be coupled via a connector to the portable electronic device, the connector comprising a first conductor, a second conductor, a third conductor, and a fourth conductor, the connector configured to be detachably mated with a power input interface of the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply comprises data circuitry configured to use the Primary

Detection method as described in the USB BC 1.2 specification. The USB power supply connects to the portable electronic device through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port of portable electronic device. The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor") pins. Further, during Primary Detection, when a portable electronic device is connected with the USB power supply through the USB cable, the portable electronic device generates a D+ signal ("input signal"). Data circuitry of the USB power supply receives the D+ signal ("input signal") and provides a D- signal ("output signal") to the portable electronic device to detect the type of connected power supply (standard downstream port or charging port). To the extent the D- signal (*i.e.*, "output signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

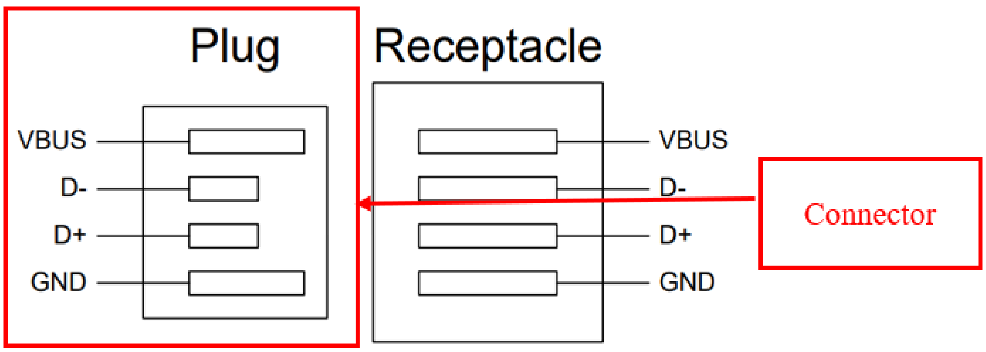


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

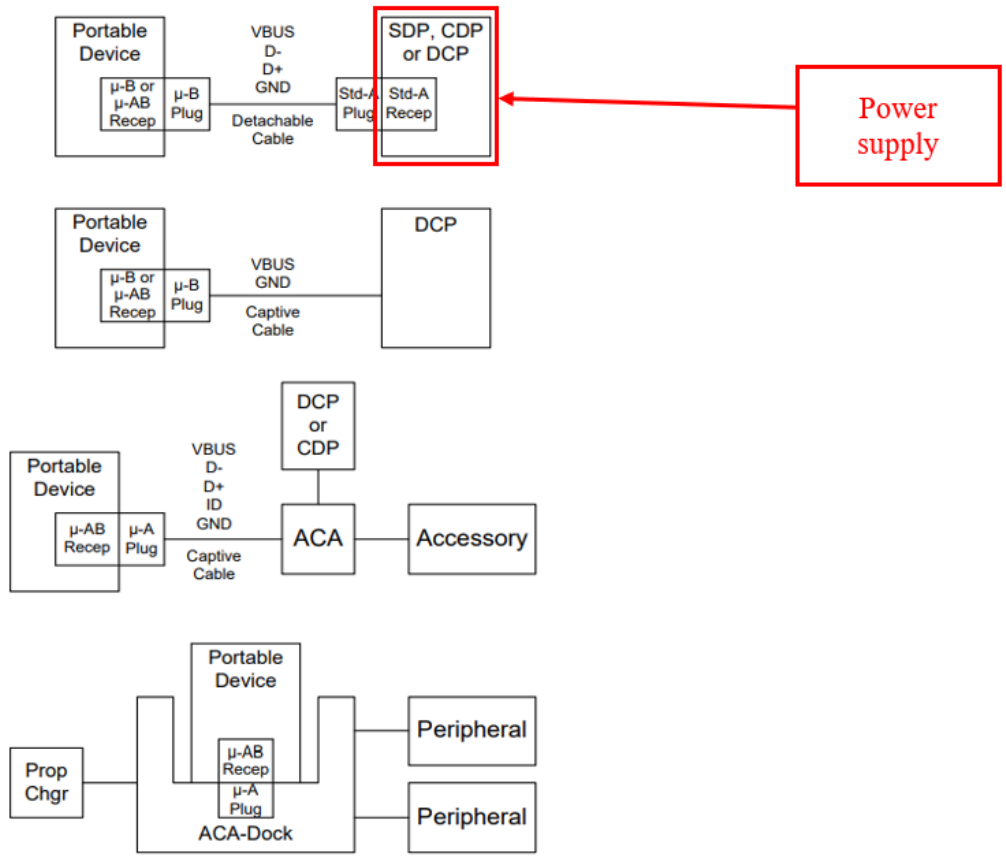


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.2.4 **Primary Detection**

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 **Primary Detection, DCP**

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

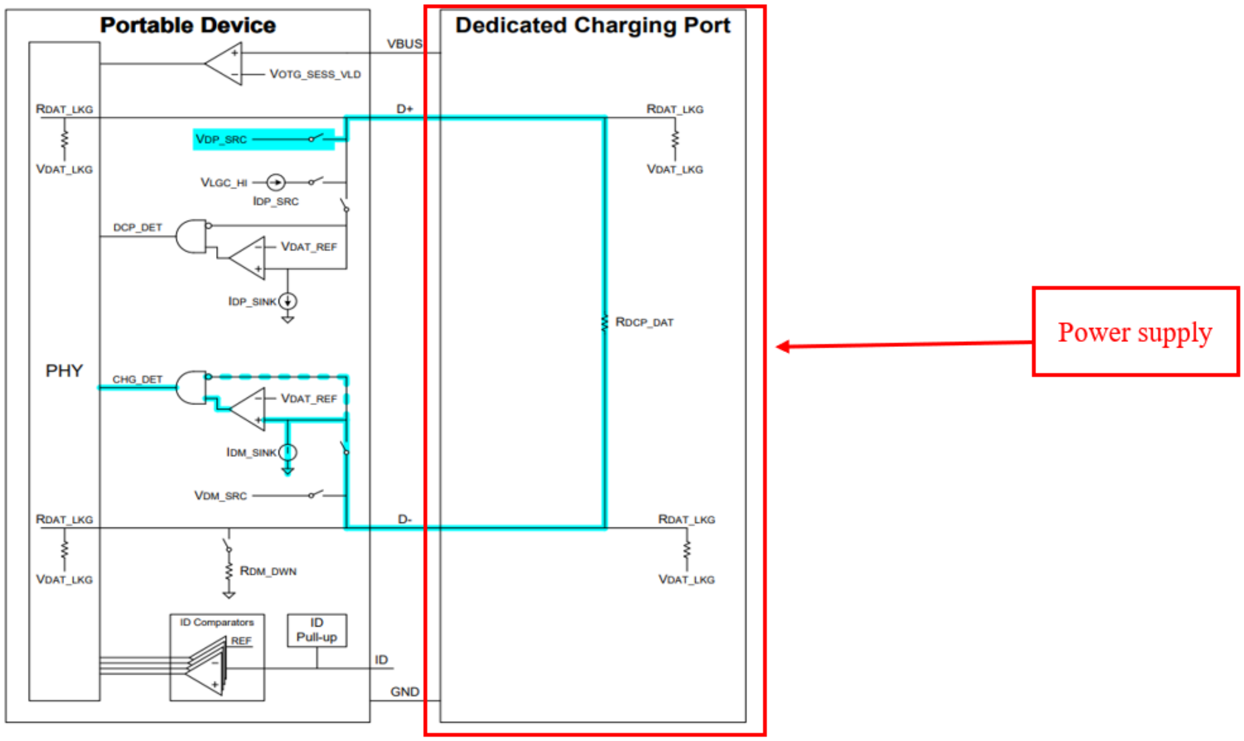


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

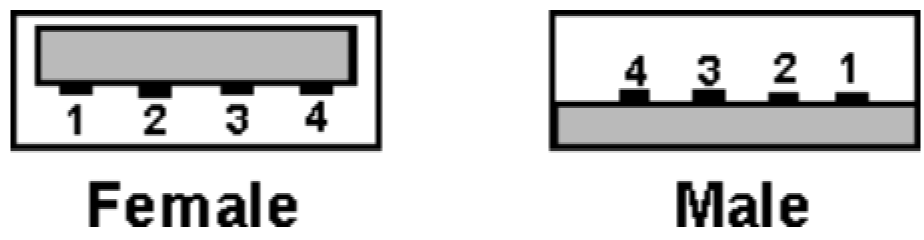
> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

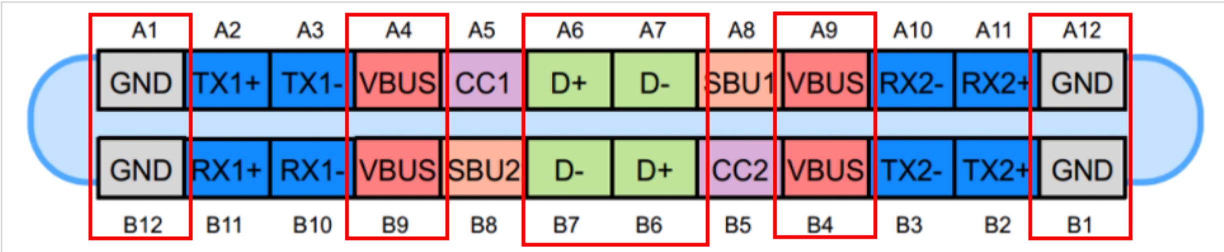


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

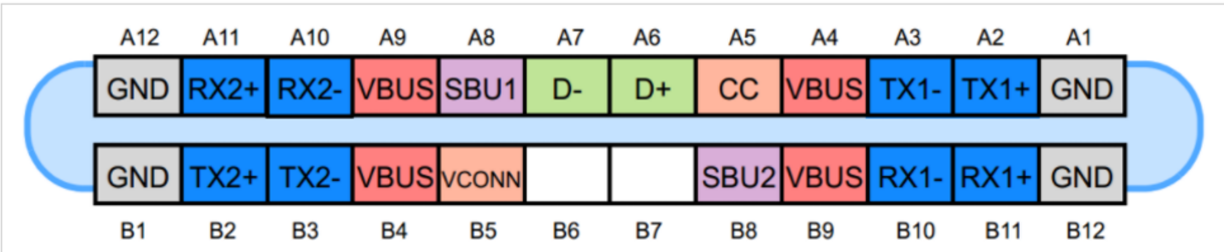


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

59. Defendant provides a power supply system to transfer, via the first conductor, the direct current power to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the VBUS pin is the voltage line that provides DC power to the portable electronic device.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

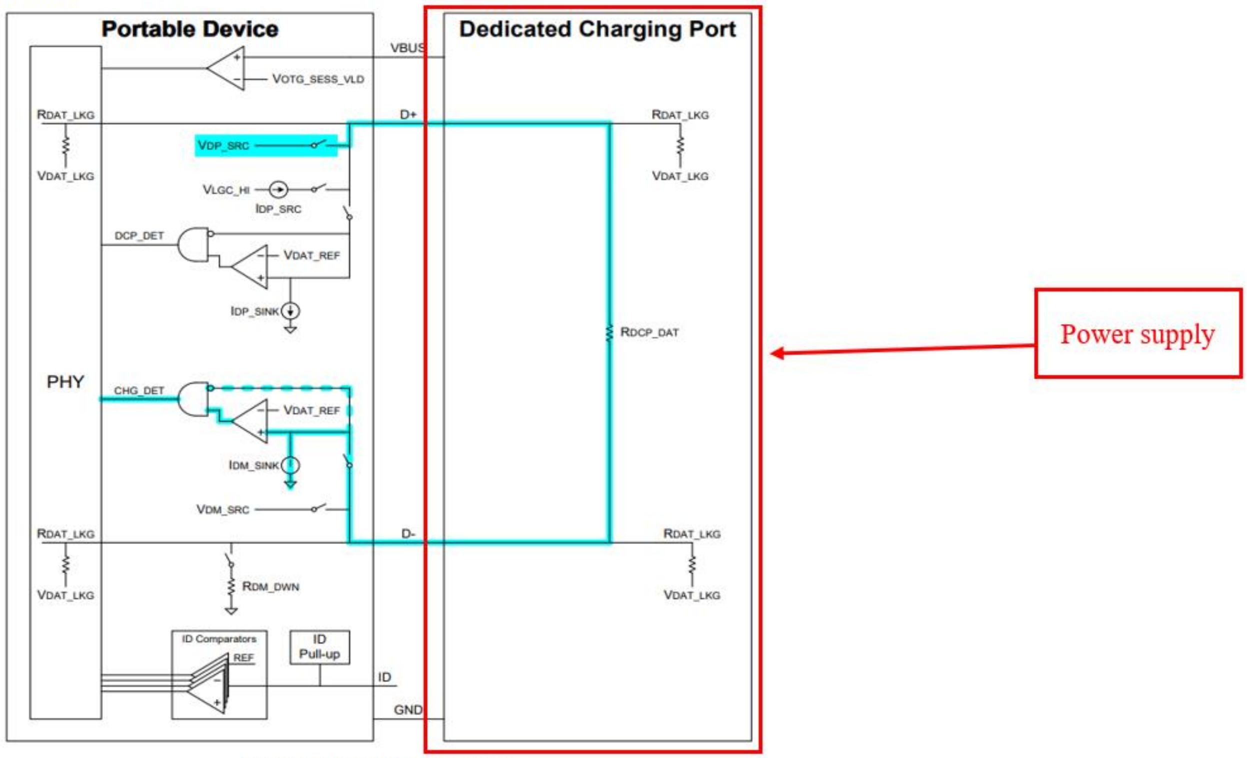


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

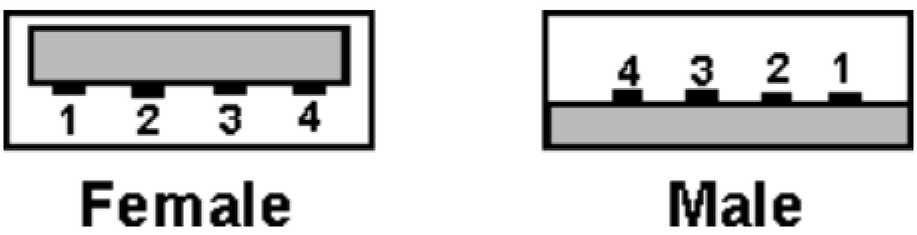
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

60. Defendant provides a power supply system to transfer, via the second conductor, a ground reference to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the GND pin provides a ground reference to the portable electronic device.

3.5 Ground Current and Noise Margins

As shown in Figure 7-47 of the USB 2.0 specification, a current of 100 mA through the ground wire of a USB cable can result in a voltage difference of 25 mV between the host ground and the device ground. This ground difference has the effect of reducing noise margins for both signaling and charger detection.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 36).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

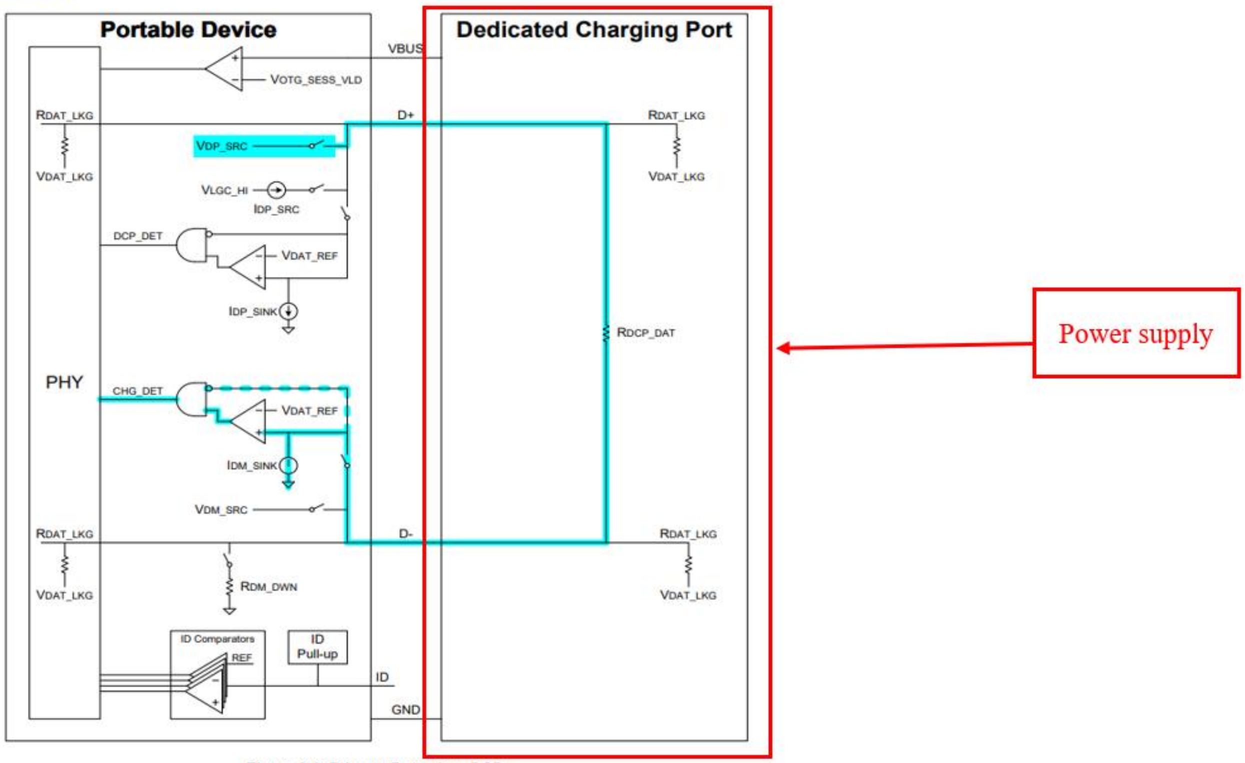


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

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PIN	WIRE COLOUR	SIGNAL NAMES
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5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
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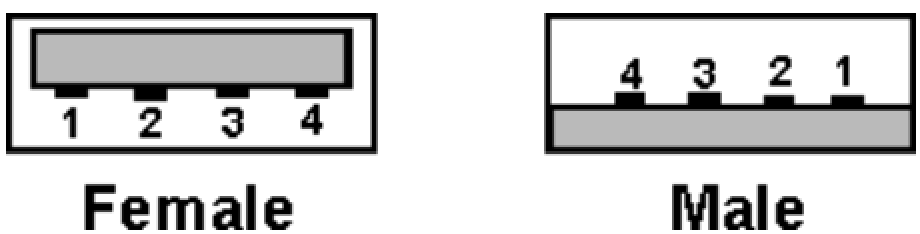
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

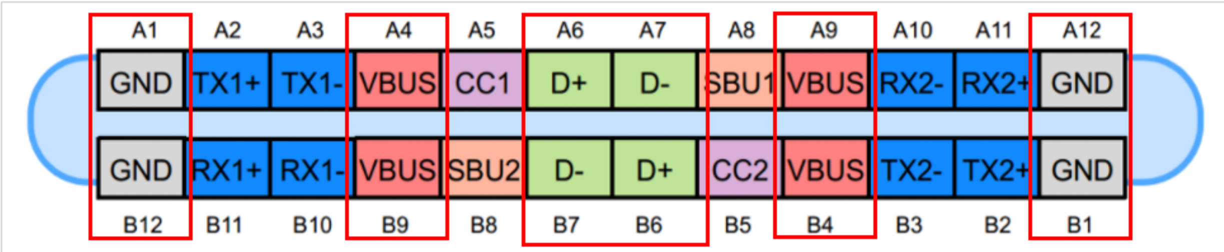


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

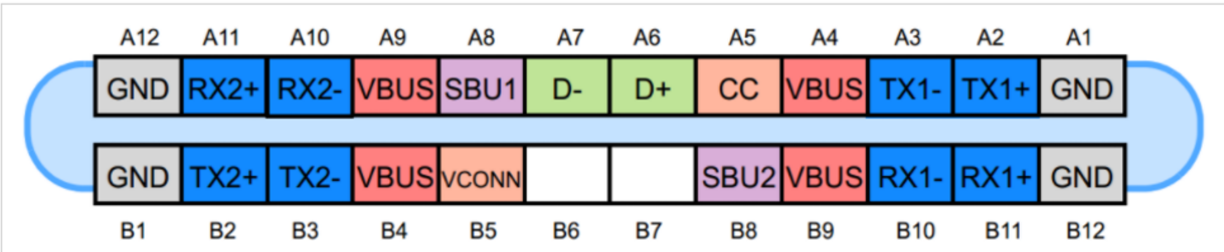


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

61. Defendant provides a power supply system to transfer, via the third conductor, the output signal from the data circuitry to the portable electronic device. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the D- pin provides the D- signal ("output signal") from the data circuitry of the USB power supply to the portable electronic device.

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

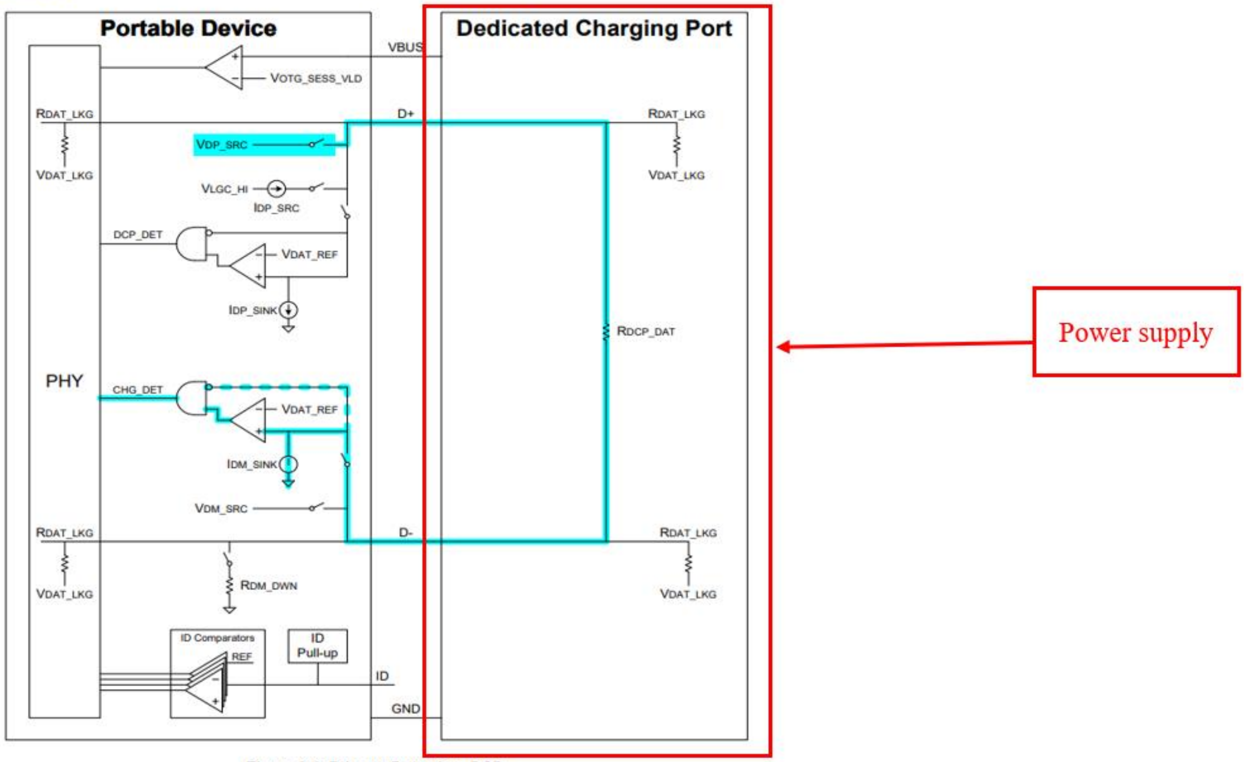


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on V_{DP_SRC} and I_{DM_SINK}. Since a DCP is required to short D+ to D- through a resistance of R_{DCP_DAT}, the PD will detect a voltage on D- that is close to V_{DP_SRC}.

A PD shall compare the voltage on D- with V_{DAT_REF}. If D- is greater than V_{DAT_REF}, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with V_{LGC} as well, and only determine that it is attached to a DCP or CDP if D- is greater than V_{DAT_REF}, but less than V_{LGC}. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than V_{DAT_REF}, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw I_{DEV_CHG}. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than V_{LGC}, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than V_{LGC}, then the PD would determine that it was attached to an SDP, and only be able to draw I_{SUSP}.

The choice of whether or not to compare D- to V_{LGC} depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

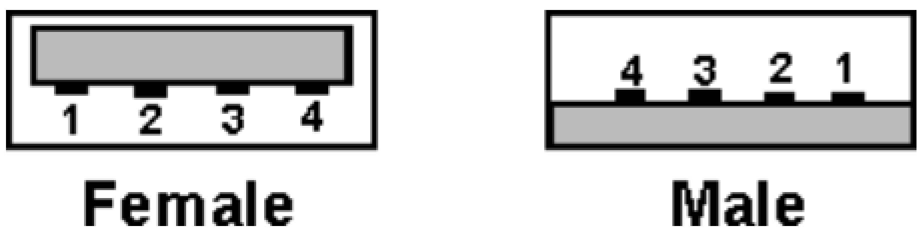
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

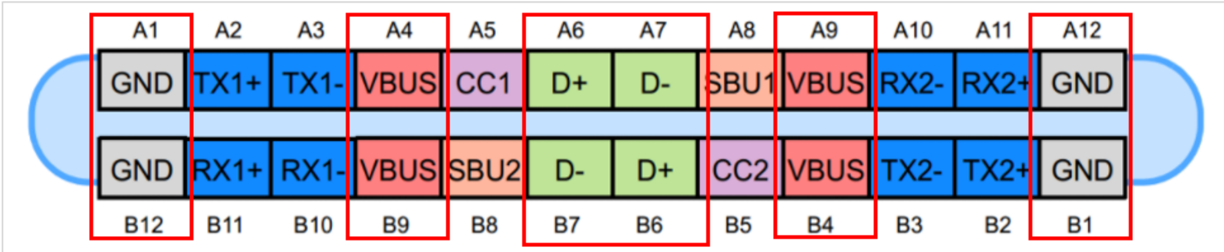


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

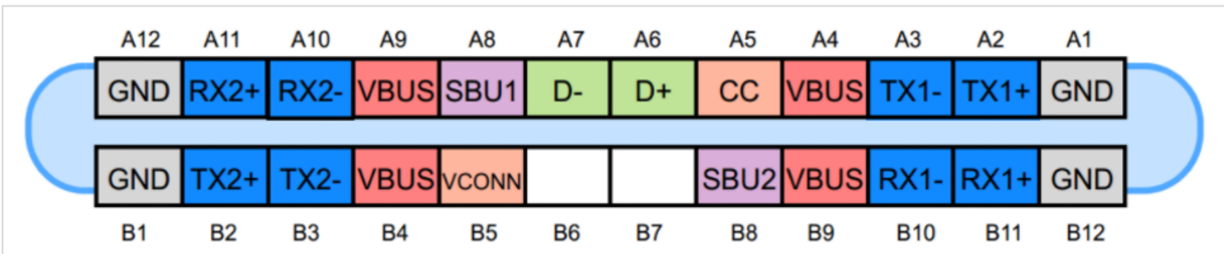


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

62. Defendant provides a power supply system to transfer, via the fourth conductor, the input signal from the portable electronic device to the data circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the D+ pin provides the D+ signal ("input signal") from the portable electronic device to the data circuitry of the USB power supply. To the extent the D- signal (*i.e.*, "output signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs

the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

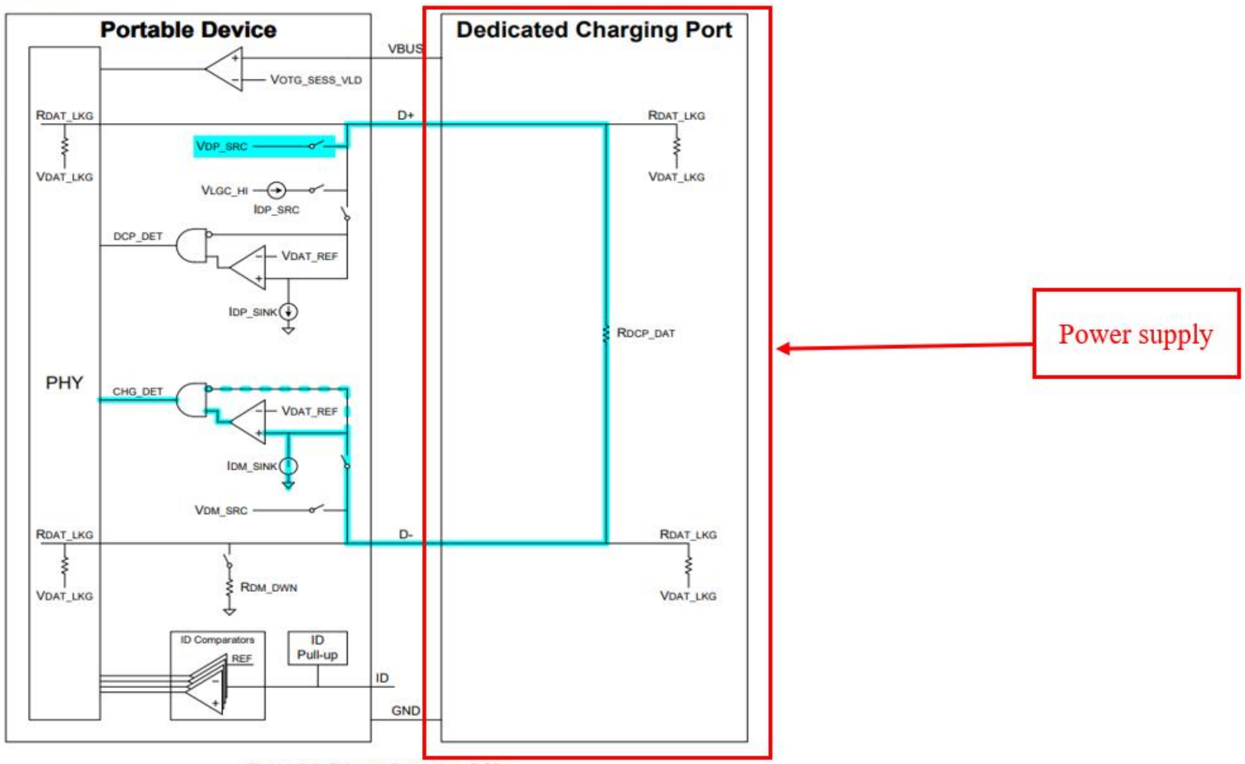


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

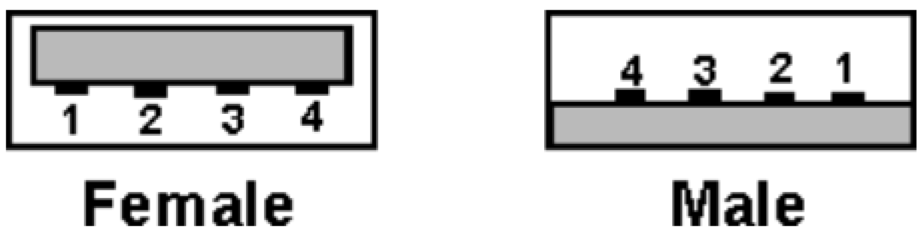
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

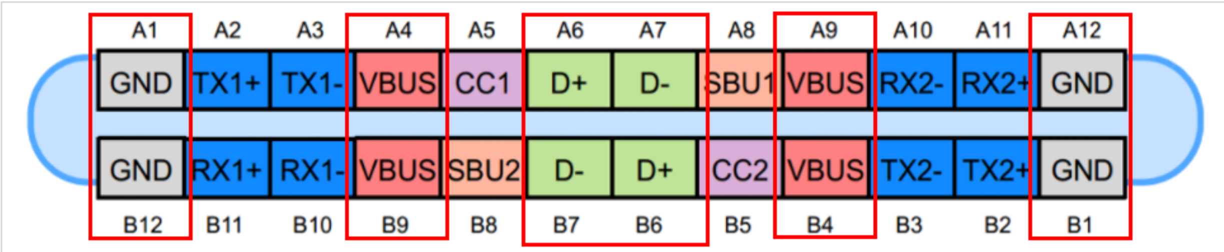


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

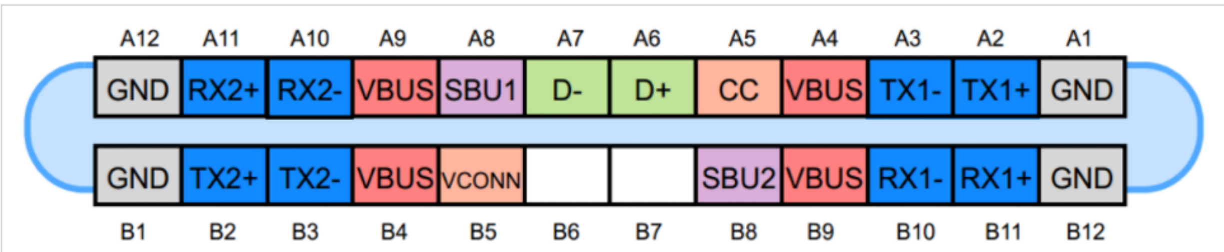


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

63. Defendant provides a power supply system wherein the data circuitry is further configured, in coordination with the input signal, to provide the output signal, the output signal usable by the portable electronic device in connection with control of charging a rechargeable battery of the portable electronic device based on the direct current power provided by the power circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the USB power supply shorts the D+ to D- through a resistance of R_{DCP_DAT}, such that the portable electronic device detects a voltage on D-. Therefore, the data circuitry of the power supply is configured, in coordination with the D+ signal ("input signal") to provide D-signal ("output signal") to the portable electronic device. The D+ signal and D- signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the resistance causes the voltage

to drop, creating a new D- signal to be transmitted to the portable electronic device via the D- pin. Thus, the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage. Further, the portable electronic device compares the D- signal's voltage level with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic devices draw current to charge a rechargeable battery of the portable electronic device from the direct current power provided by the power supply.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw I_{DEV_CHG} without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

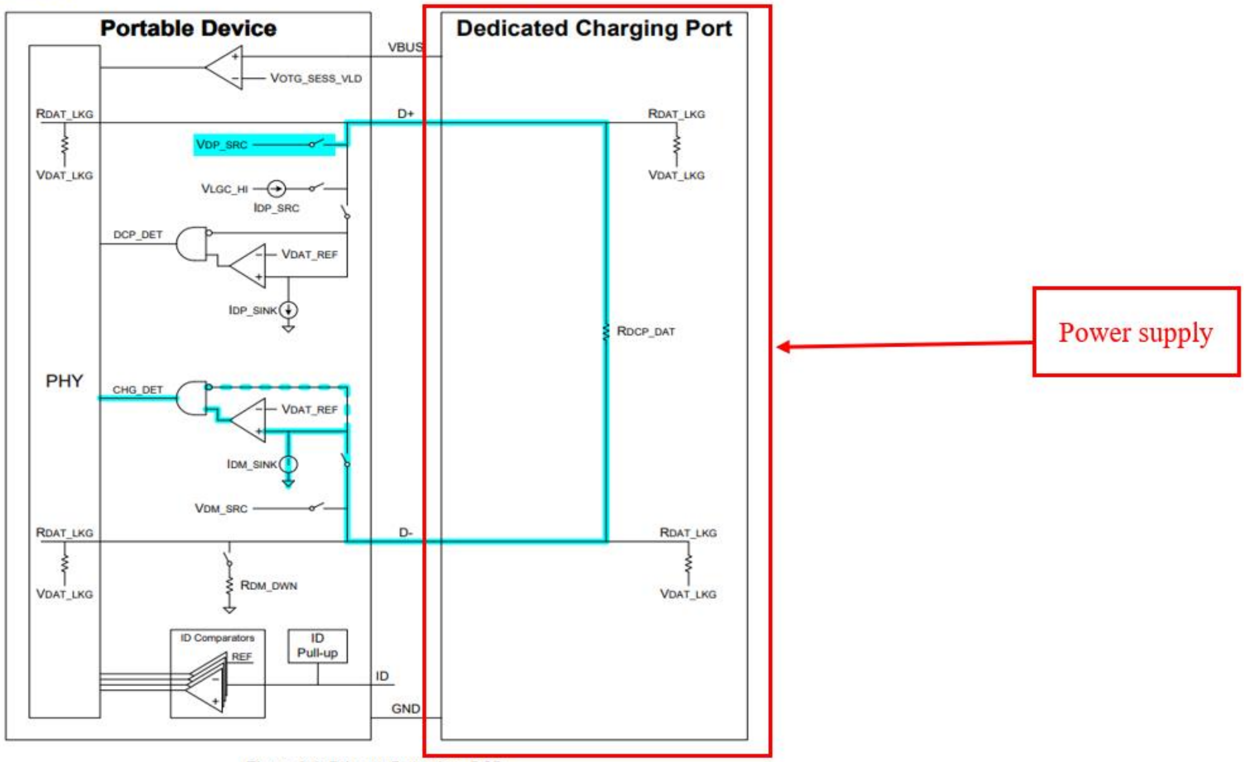


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

64. As discussed above, "[t]he USB cable has a USB-C connector at one end to detachably mate with the charging port of portable electronic device."

65. As discussed above, "the portable electronic device compares the D- signal's voltage ["Parameter"] level with a reference voltage to detect the type of power supply (standard downstream port or charging port). Based on the type of power supply, the portable electronic devices draw current to charge a rechargeable battery of the portable electronic device from the direct current power provided by the power supply."

66. As discussed above, the parameter level is the D- signal's voltage.

67. Defendant provides a power supply in which the input signal is received by the data circuitry in response to the power circuitry providing the direct current power and the ground reference to the portable electronic device. As explained above, the power supply comprises data circuity and power circuitry configured to use the Primary Detection method of the USB BC 1.2

specification. Using the VBUS pin and GRN pin, current power and ground reference are provided to and detected by the portable electronic device, respectively. This detection triggers the portable electronic device to send a voltage signal D+, which is the "input signal" received by the data circuitry of the power supply.

68. As discussed above, Defendant provides a power supply system that can be used to charge a computer, such as a laptop.

69. Upon information and belief, Defendant has been and now is willfully infringing the asserted claims of the '087 patent in the Texas, in this District, and elsewhere in the United States. Defendant had actual knowledge of the '087 patent at least as early as when they received a letter from Plaintiff sent on September 15, 2023, asserting that the Accused Chargers infringed claims of the '087 patent and they were provided a chart of the infringement. Defendant has known of its infringement since at least that date as a result of the accusations of infringement in the letter. Defendant has therefore also known that the use of the Accused Instrumentalities by its customers infringed at least one claim of the '087 patent since at least the date they received the letter. Defendant was informed of its infringement of the '087 patent by way of the September 15, 2023, letter sent to Defendant, including claim charts demonstrating Defendant's infringement. As a result of the letter, Defendant should have known that its actions constituted an unjustifiably high risk of infringement. Despite the letter and knowledge that the risk of infringement was either known or so obvious that it should have been known, Defendant continued its infringing actions.

70. Plaintiff has been damaged as a result of Defendant's infringing conduct. Defendant is thus liable to Plaintiff for damages in an amount that adequately compensates Plaintiff for such Defendant's infringement of the '087 patent, *i.e.*, in an amount that by law cannot

be less than would constitute a reasonable royalty for the use of the patented technology, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

71. On information and belief, Defendant will continue its infringement of one or more claims of the '087 patent unless enjoined by the Court. Each and all of the Defendant's infringing conduct thus causes Plaintiff irreparable harm and will continue to cause such harm without the issuance of an injunction.

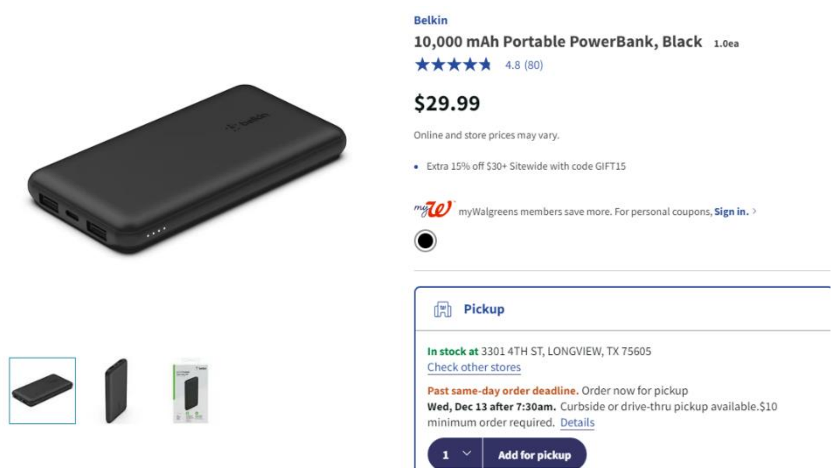
72. On information and belief, to the extent marking is required, Comarco complied with all marking requirements.

VI. COUNT III
(PATENT INFRINGEMENT OF UNITED STATES PATENT NO. 10,951,042)

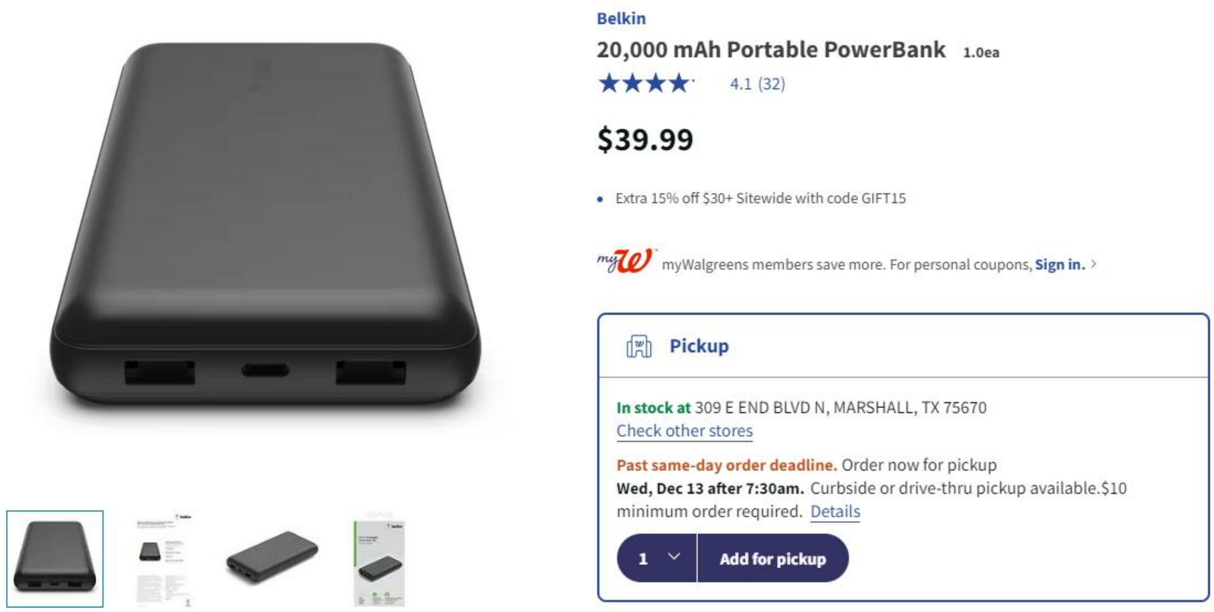
71. Upon information and belief, Defendant has directly and/or indirectly infringed claim 1, 2, 5-6, 8, 11-12, 15-16, and 18 of the '042 patent in Texas, and elsewhere in the United States, by makes, uses, sells, offers for sale and/or imports a power supply system comprising power circuitry configured to provide direct current power including, but not limited to, Belkin 10,000 mAh Portable PowerBank, Belkin 20,000 mAh Portable PowerBank, Infinitive Power Bank 5000mAh, Infinitive Power Bank 10000mAh, and Infinitive Power Bank 20000 mAh ("Accused Devices").

72. Defendant makes, uses, sells, offers for sale and/or imports a portable electronic device comprising a rechargeable battery. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, Defendant provides a portable electronic device with a rechargeable battery and a USB power supply that ships with the devices and acts as a power supply while charging the device's rechargeable battery. The USB power supply outputs voltage, current, and power values. Upon information and belief, the USB power supply includes circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic

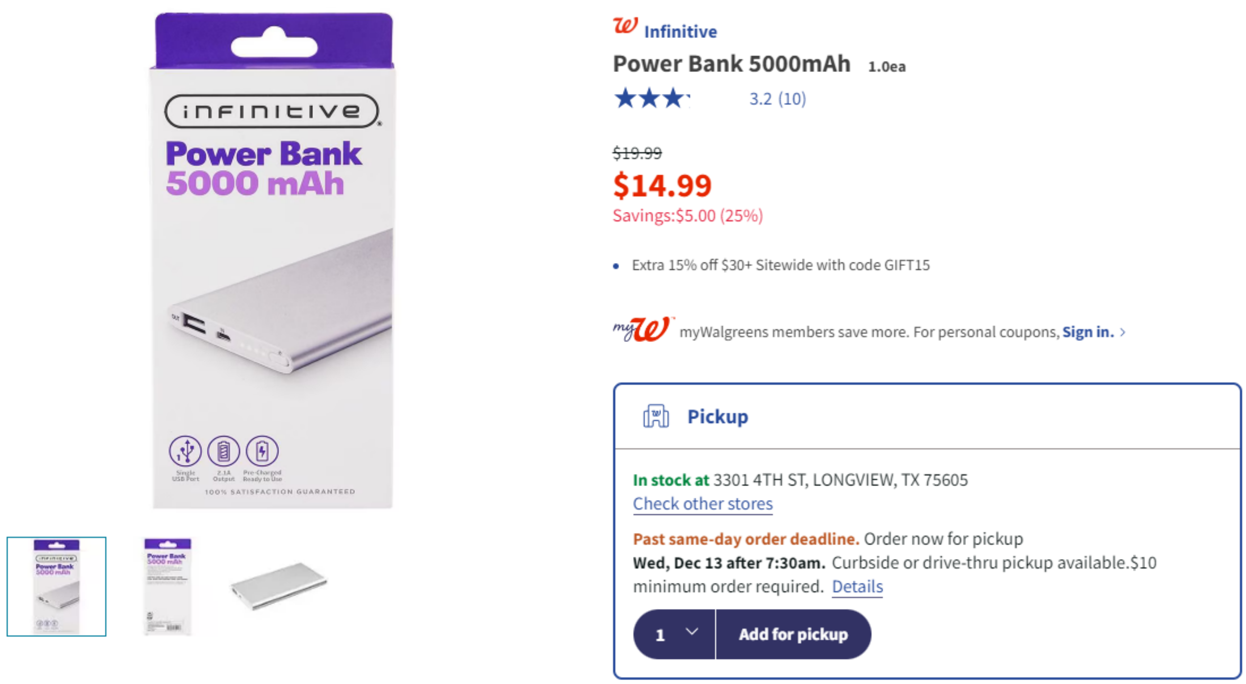
devices. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 outputs 5V voltage, 1.5A current, and 7.5W power. USB-complaint devices at USB 3.0 or above are compatible with the USB BC 1.2 specification. Further, to charge a battery in a portable electronic device, the portable electronic device is connected to the USB power supply. The other end of the USB cable is connected to the charging port of portable electronic device and the power supply is plugged into a standard wall socket.



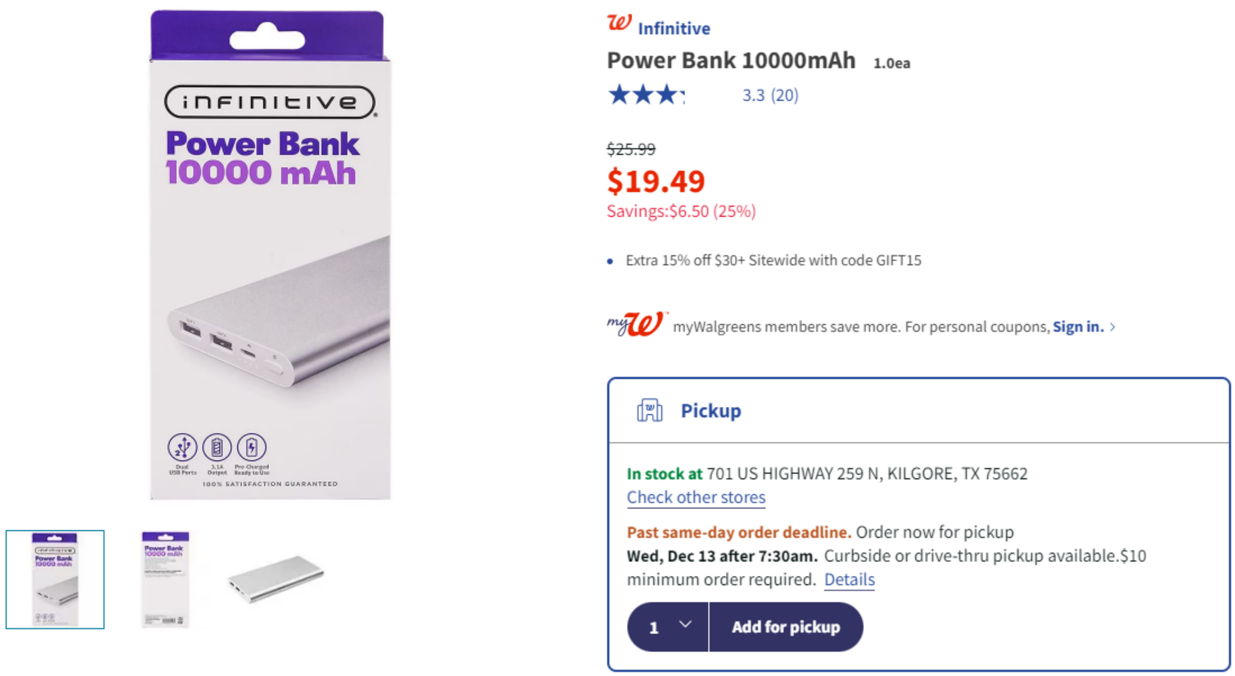
(*E.g.*, https://www.walgreens.com/store/c/belkin-10,000-mah-portable-powerbank/ID=300432823-product).



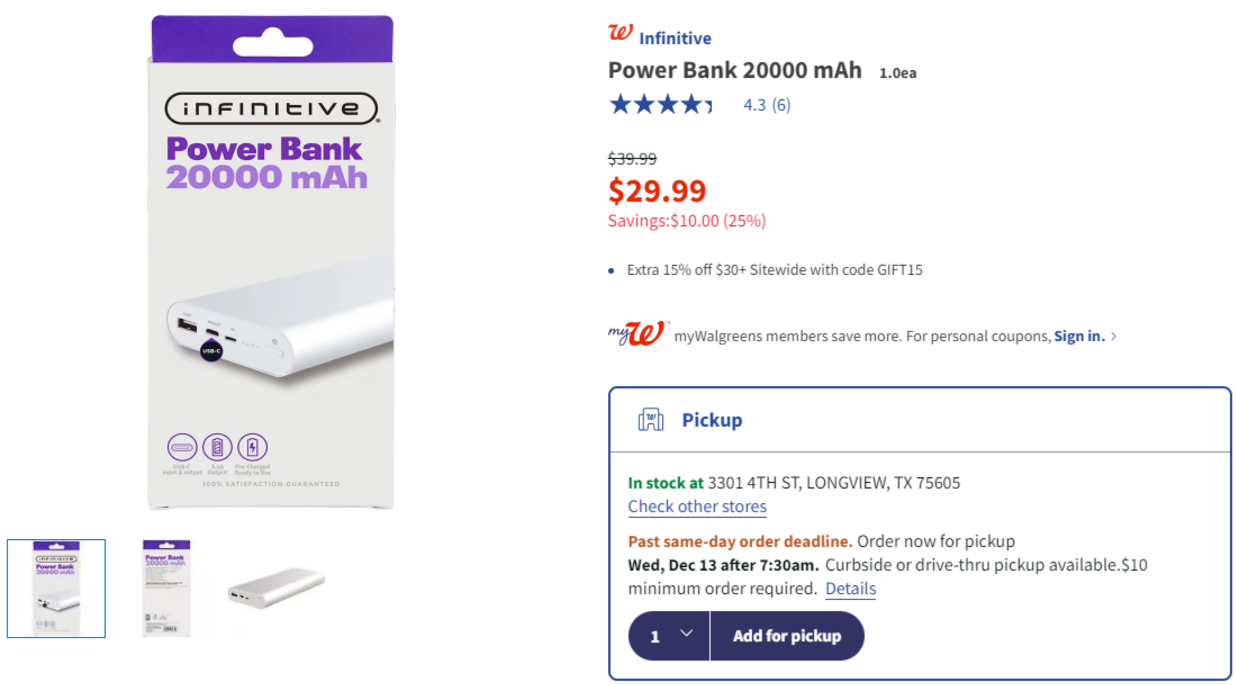
(*E.g.*, https://www.walgreens.com/store/c/belkin-20,000-mah-portable-powerbank/ID=300432856-product).



(*E.g.*, https://www.walgreens.com/store/c/belkin-20,000-mah-portable-powerbank/ID=300432856-product).



(*E.g.*, https://www.walgreens.com/store/c/infinitive-power-bank-10000mah/ID=300411279-product).

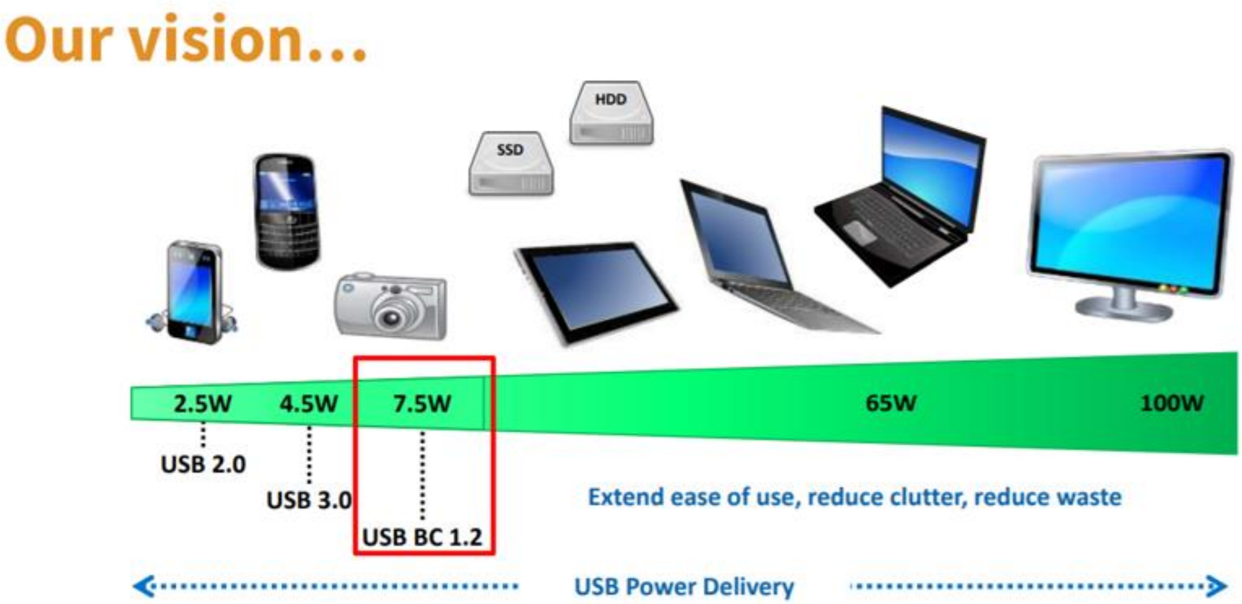


(*E.g.*, https://www.walgreens.com/store/c/infinitive-power-bank-20000-mah/ID=300435782-product).

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).

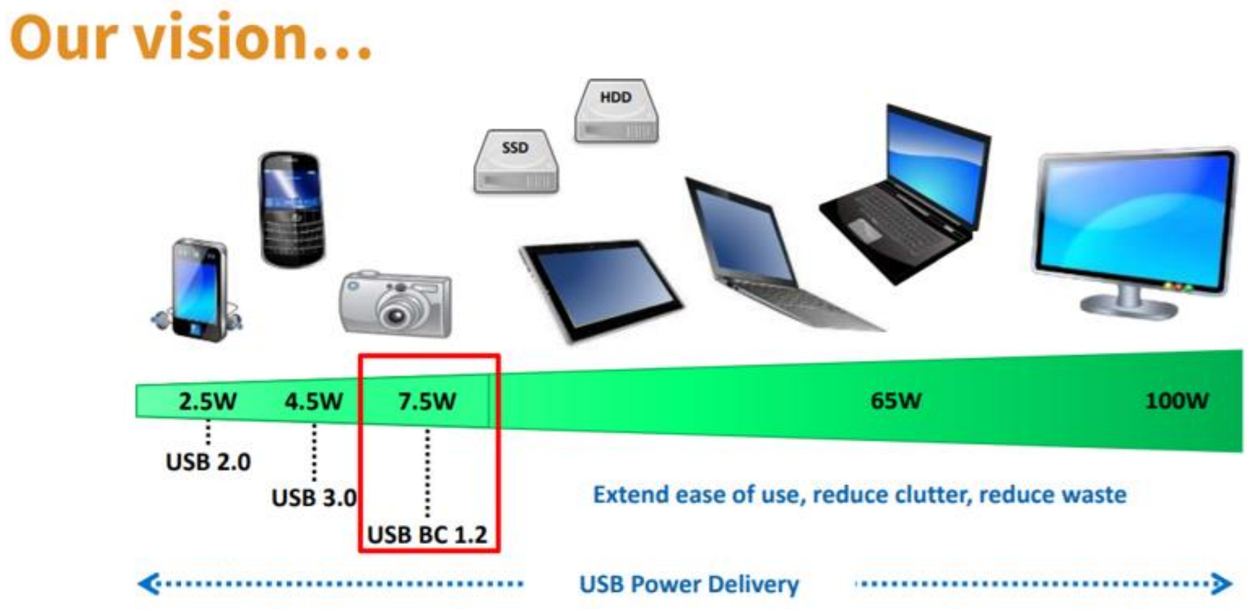
73. On information and belief, Defendant provides a portable electronic device comprising power circuitry configured to receive direct current and to charge the rechargeable battery. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, to charge the rechargeable battery of a portable electronic device, a USB cable is connected to the USB power supply acting as a power supply. The other end of USB cable is

connected to the charging port of the portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the portable electronic device comprises power circuitry to receive DC power from the power supply.

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

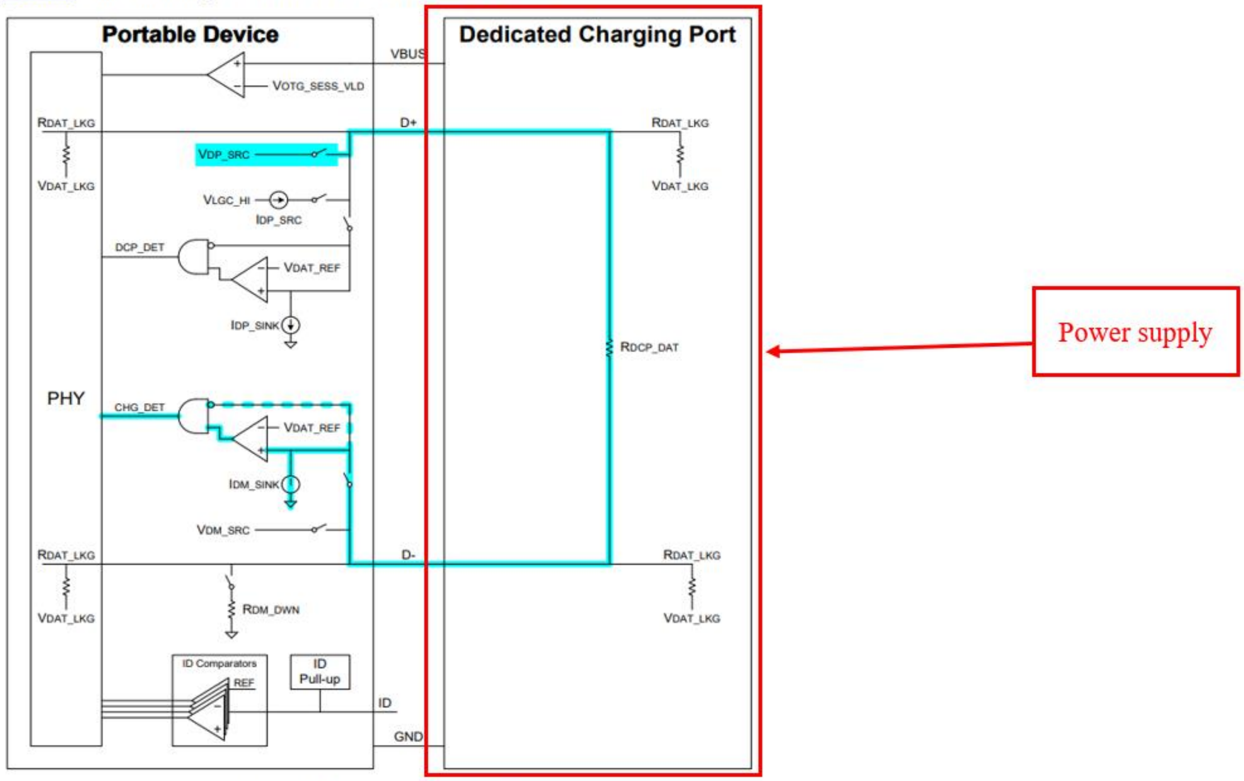


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

74. Defendant provides a portable electronic device comprising a data circuitry configured to provide a first signal to a power supply and to receive a second signal from the power supply. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device comprises data circuitry configured to use the Primary Detection method as described in the USB BC 1.2 specification. Further, during Primary Detection, when the portable electronic device is connected with the power supply through the USB cable, the portable electronic device generates a D+ signal ("first signal") such that the data

circuitry of the portable electronic device provides a D+ signal ("first signal") to a power supply and receives a D- signal ("second signal") from the power supply to detect the type of connected power supply (standard downstream port or charging port).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

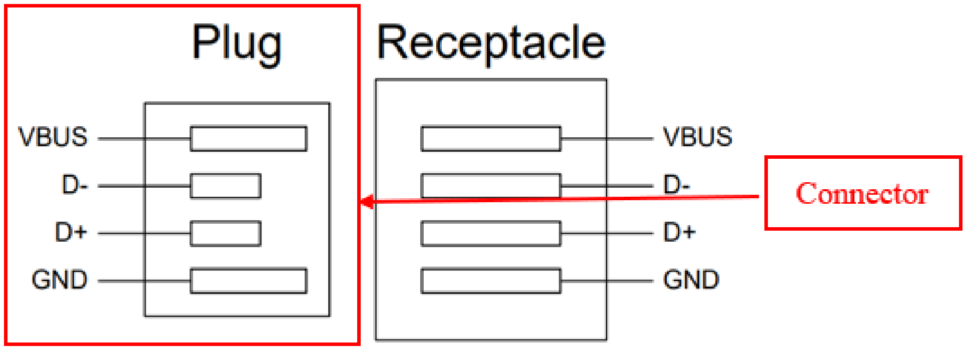


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

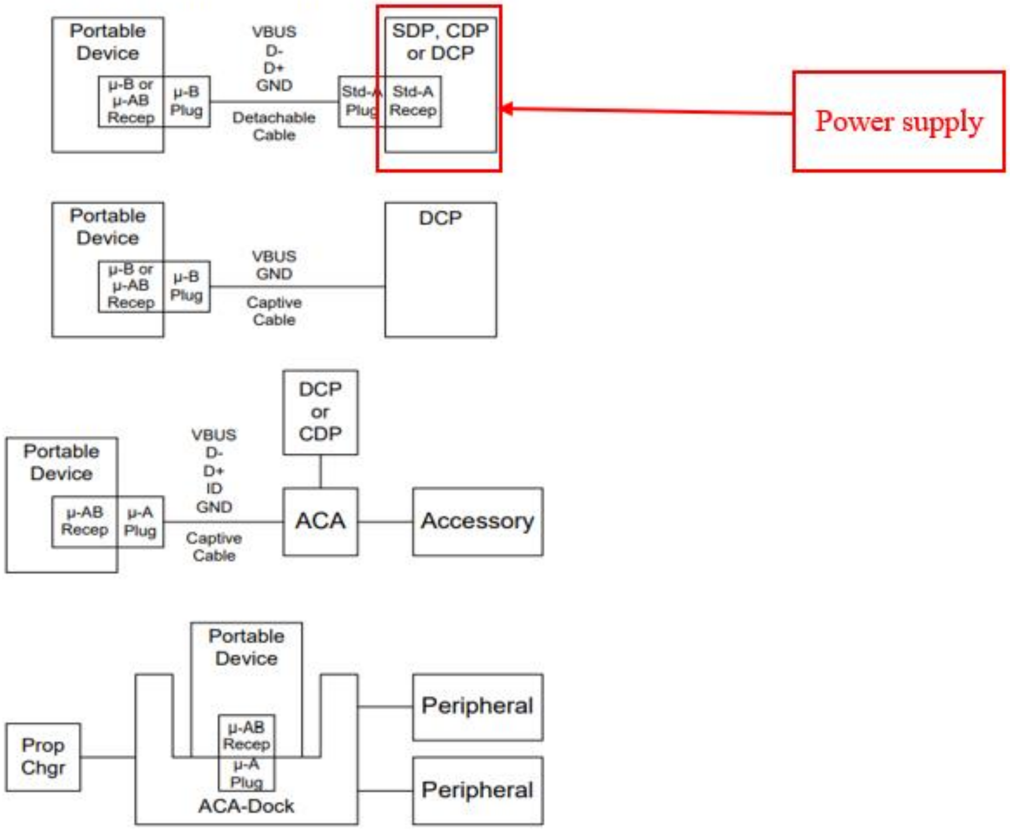


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

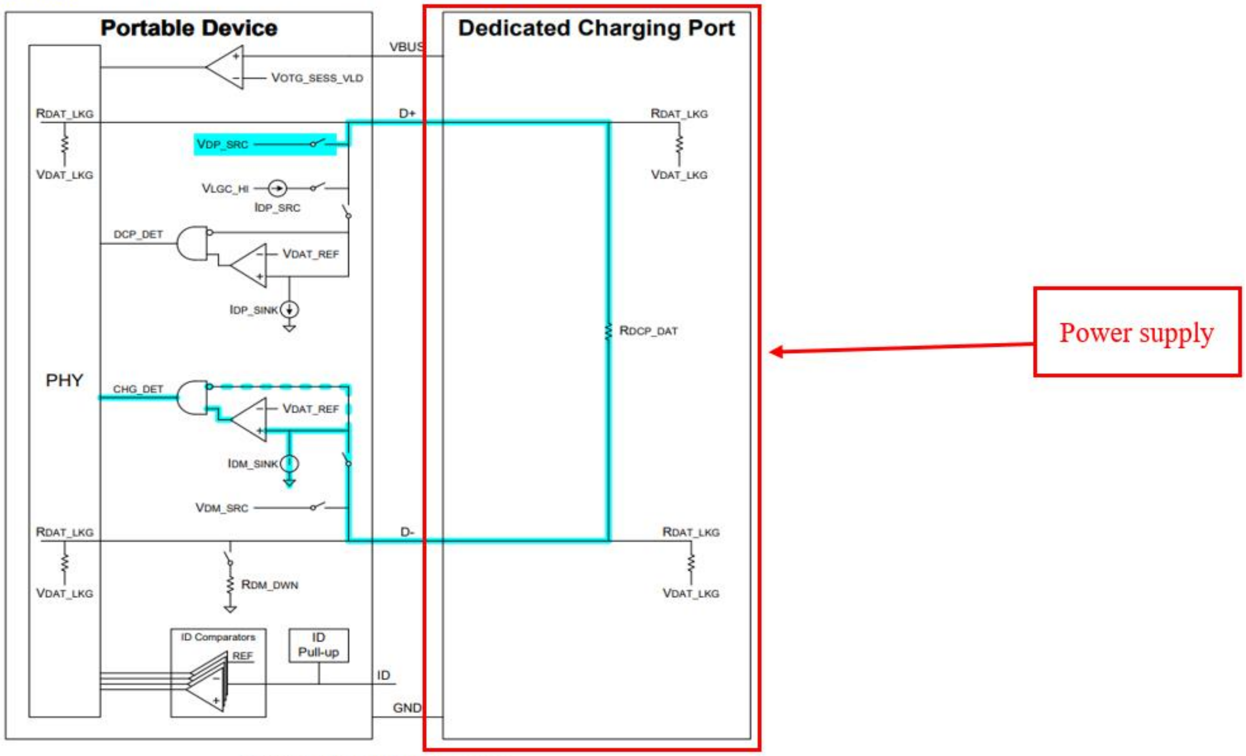


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

75. Defendant provides a portable electronic device comprising the data circuitry and the power circuitry configured to be coupled via a connector to the power supply, the connector comprising a first conductor, a second conductor, a third conductor, and a fourth conductor, the connector configured to be detachably mated with an interface of the power supply. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device connects to the power supply (USB power supply) through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port ("power output") of the USB power supply ("power supply"). The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor") pins.

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

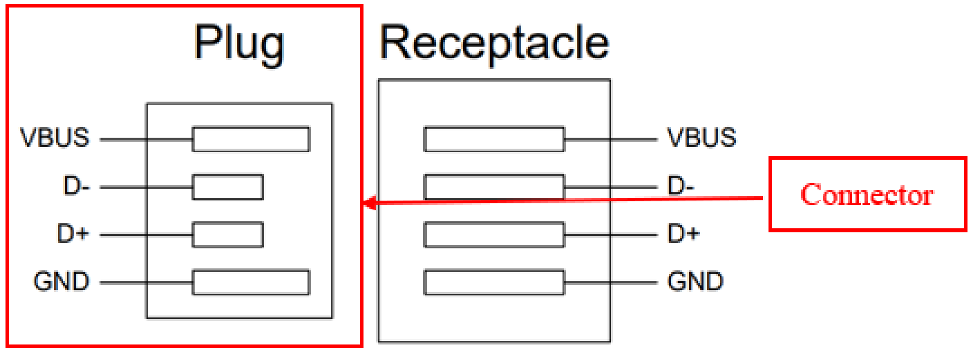


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

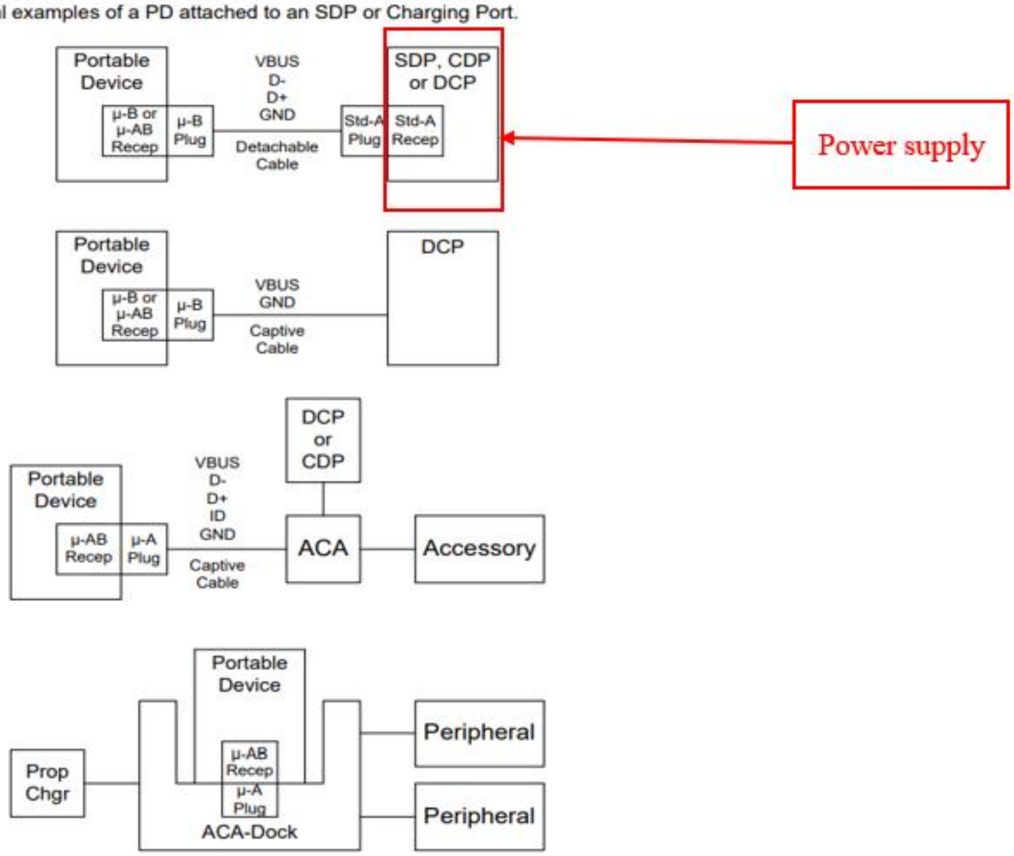


Figure 3-1 System Overview

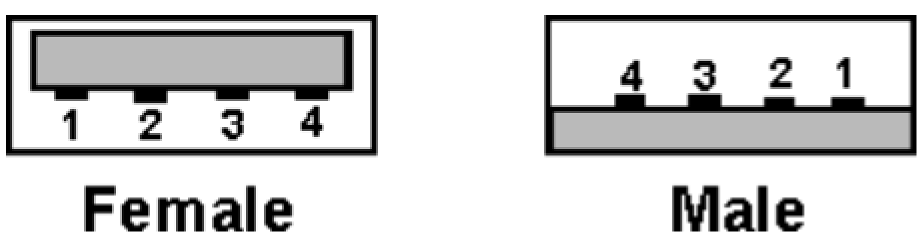
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

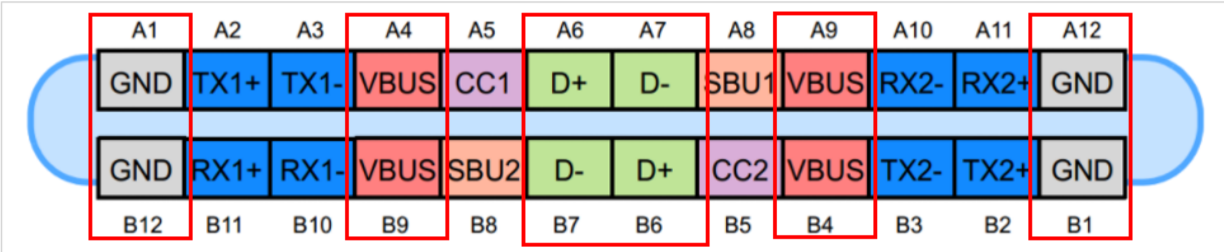


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

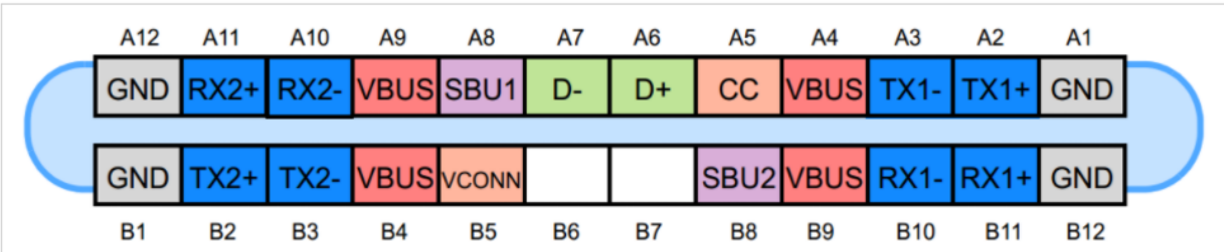
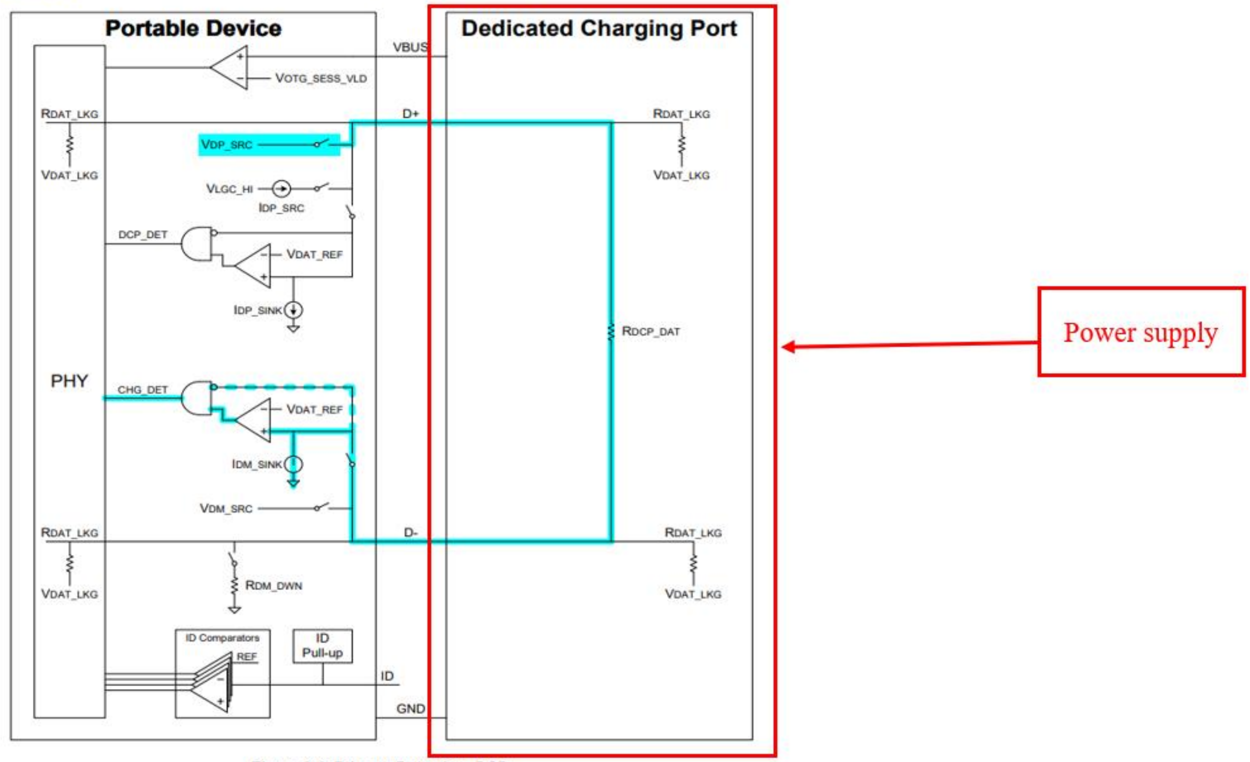


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).



3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

76. Defendant provides a portable electronic device to transfer, via the first conductor, the direct current from the power supply, provide, via the second conductor, a ground reference from the power supply, communicate, via the third conductor, the first signal from the data circuitry to the power supply, and communicate, via the fourth conductor, the second signal from the power supply to the data circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the VBUS pin is the voltage line that provides DC power to the portable electronic device. For example, the GND pin provides a ground reference to the portable electronic device. For example, the D+ pin provides the D+ signal ("first signal") from

the portable electronic device to the data circuitry of the power supply and passes the D+ signal through a resistor (R_{DCP_DAT}). For example, the D- pin provides the D- signal ("second signal") from the data circuitry of the power supply to the portable electronic device. The D+ signal and D-signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the resistance causes the voltage to drop, creating a new D- signal to be transmitted to the portable device via the D- pin. Thus, the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage. To the extent the D- signal (*i.e.*, "second signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

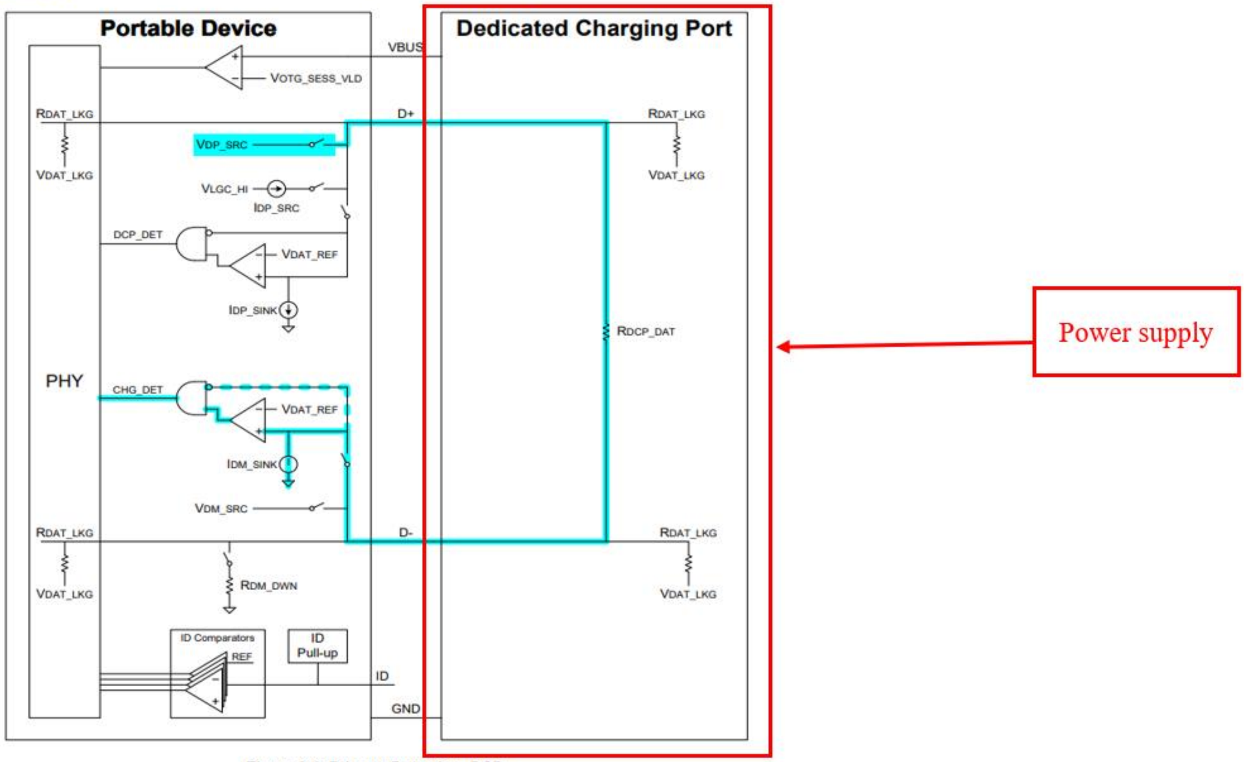


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on V_{DP_SRC} and I_{DM_SINK}. Since a DCP is required to short D+ to D- through a resistance of R_{DCP_DAT}, the PD will detect a voltage on D- that is close to V_{DP_SRC}.

A PD shall compare the voltage on D- with V_{DAT_REF}. If D- is greater than V_{DAT_REF}, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with V_{LGC} as well, and only determine that it is attached to a DCP or CDP if D- is greater than V_{DAT_REF}, but less than V_{LGC}. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than V_{DAT_REF}, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw I_{DEV_CHG}. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than V_{LGC}, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than V_{LGC}, then the PD would determine that it was attached to an SDP, and only be able to draw I_{SUSP}.

The choice of whether or not to compare D- to V_{LGC} depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

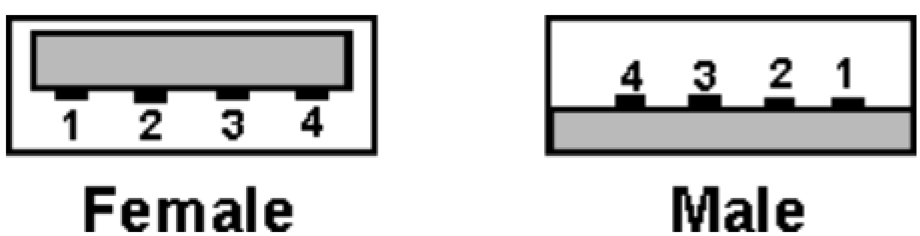
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

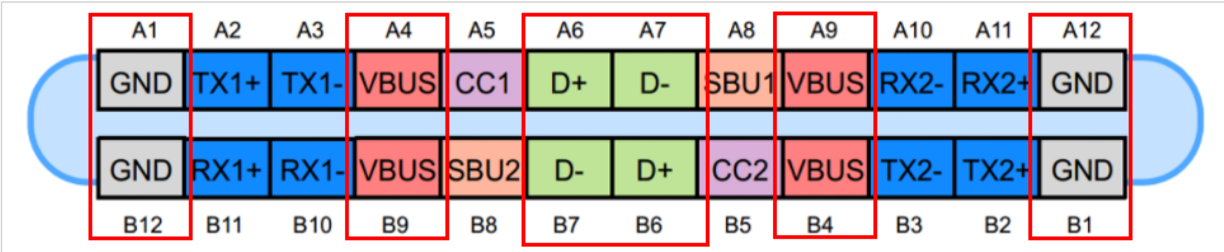


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

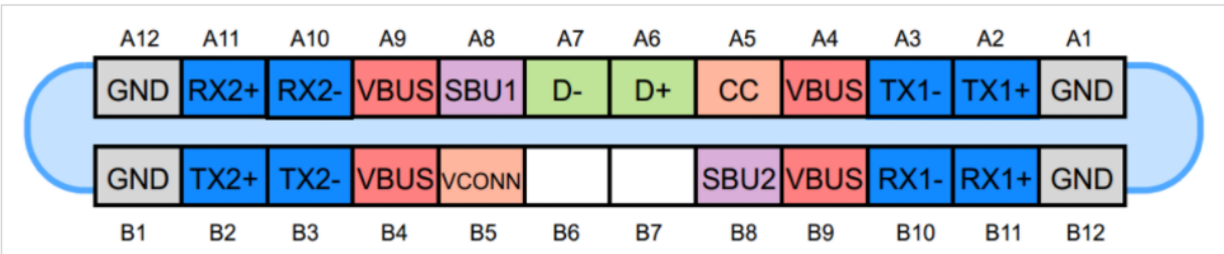


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

77. Defendant provides a portable electronic device wherein the second signal has a parameter level that is usable by the data circuitry in connection with control of charging the rechargeable battery based on the direct current received by the power circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device compares the D- signal's voltage ("parameter") level with a reference voltage to detect the type of power supply (standard downstream port or charging port). The data circuitry of the portable electronic device draws current based on the type of power supply to charge the rechargeable battery.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

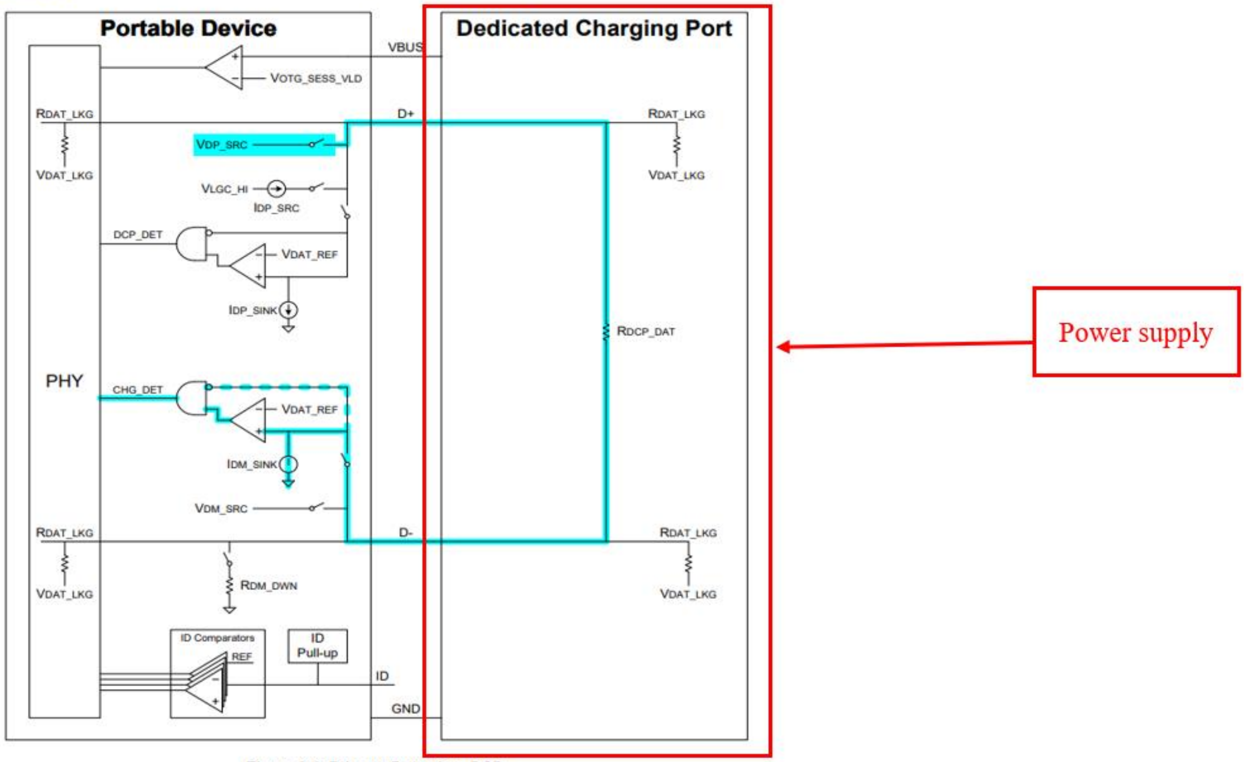


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

78. As discussed above with respect to element 1.3, "[t]he USB cable has a USB-C connector at one end to detachably mate with the charging port ("power output") of the USB power supply ("power supply"). The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor")."

79. As discussed above with respect to element 1.5, "the Accused PED compares the D- signal's voltage ("parameter") level with a reference voltage to detect the type of power supply (standard downstream port or charging port). The data circuitry of the portable electronic device draws current based on the type of power supply to charge the rechargeable battery."

80. As discussed above with respect to element 1.4, the parameter level is a voltage signal from the D- pin.

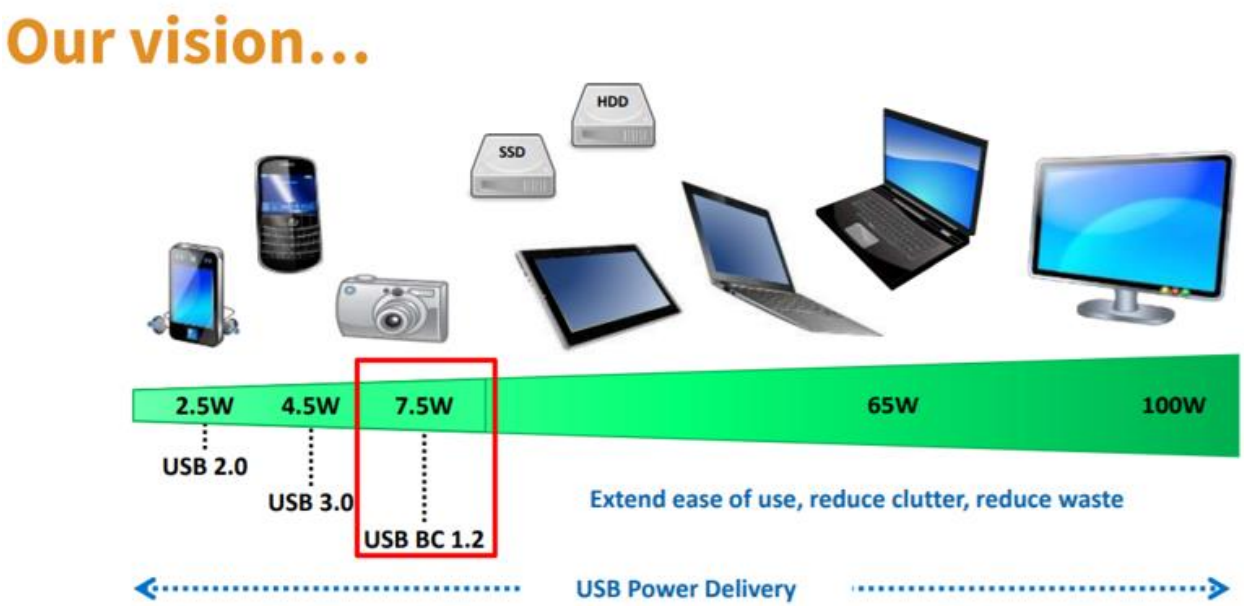
81. As discussed above with respect to element 1.P, the portable electronic device is a computer, such a laptop or tablet.

82. Defendant makes, uses, sells, offers for sale and/or imports a portable electronic device comprising a rechargeable battery. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, Defendant provides a portable electronic device with a rechargeable battery. Defendant provides a USB power with the devices that acts as a power supply while charging the device's battery. The USB power supply outputs voltage, current, and power values. Upon information and belief, the USB power supply includes circuitry compliant with the Battery Charging (BC) 1.2 specification to charge the portable electronic devices. The Table 2-1 (https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36) and the diagram depicting the power consumed by different USB specifications (https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5) disclose that BC 1.2 outputs 5V voltage, 1.5A current, and 7.5W power. USB-complaint devices at USB 3.0 or above are compatible with the USB BC 1.2 specification. Further, to charge a battery in a portable electronic device, the portable electronic device is connected to the USB power supply. The other end of the USB cable is connected to the charging port of portable electronic device and the power supply is plugged into a standard wall socket.

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

USB battery charging specifications

Battery Charging Specification Revision 1.2 (BC1.2)

The different port types described in the above section were first defined in the *Battery Charging Specification Revision 1.2* (BC1.2) published in 2010. In addition to the port definitions, BC1.2 specifies primary and secondary charge port detection sequences and port specific performance requirements. These include required operating range, undershoot, detection signaling, and connectors for each port type. Also included are dead, weak, and good battery charge conditions, port shutdown procedures, and other details associated with battery charging.

BC1.2 was published after USB 2.0 but before USB 3.1 and so the information in BC1.2 refers to USB 2.0. The specification is, however, consistent and compatible with USB 3.1.

(*E.g.*, https://www.lightingglobal.org/wp-content/uploads/2017/12/Issue-24_USB-smartphone-charging-final.pdf, page 4).

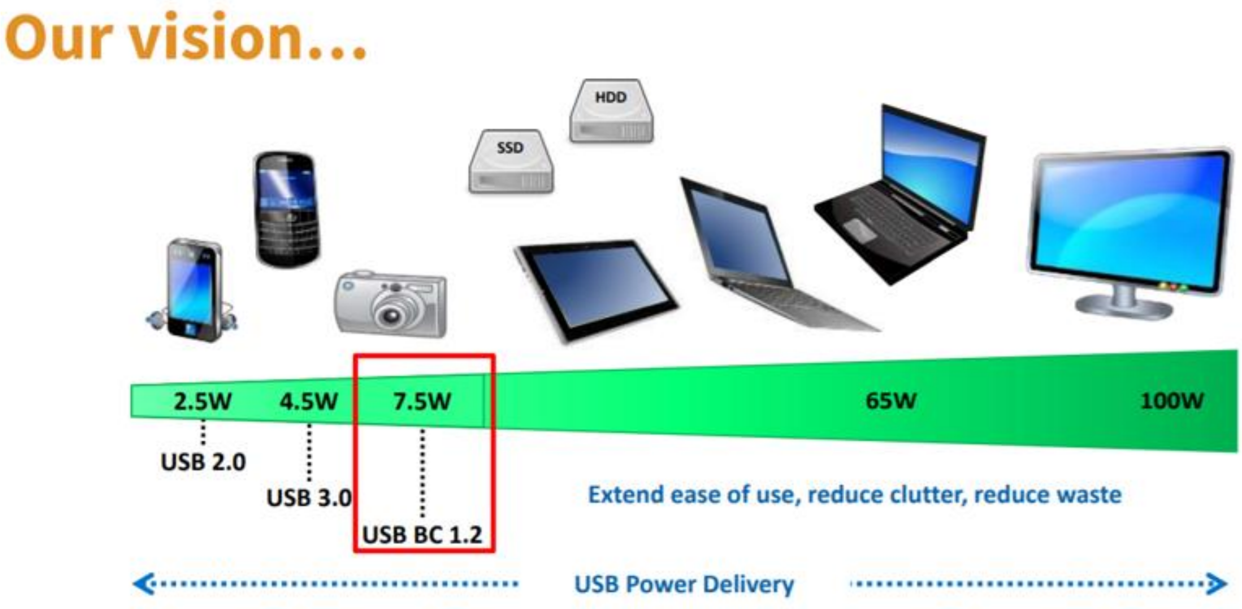
83. Defendant provides a portable electronic device comprising power circuitry configured to receive direct current and to charge the rechargeable battery. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, to charge the rechargeable battery of a portable electronic device, a USB cable is connected to the USB power supply acting as a power supply. The other end of USB cable is connected to the charging

port of the portable electronic device and the power supply is plugged into a standard wall socket. Therefore, the portable electronic device comprises power circuitry to receive DC power from the power supply.

Table 2-1 Summary of power supply options

Mode of Operation	Voltage	Current	Notes
USB 2.0	5 V	See USB 2.0	
USB 3.2	5 V	See USB 3.2	
USB4	5 V	1.5 A	See Section 5.3.
USB BC 1.2	5 V	1.5 A[1]	Legacy charging
USB Type-C Current @ 1.5 A	5 V	1.5 A	Supports higher power devices
USB Type-C Current @ 3.0 A	5 V	3 A	Supports higher power devices
USB PD	Configurable up to 20 V	Configurable up to 5 A	Directional control and power level management

(*E.g.*, https://www.usb.org/sites/default/files/USB%20Type-C%20Spec%20R2.0%20-%20August%202019.pdf, page 36).



(*E.g.*, https://usb.org/sites/default/files/D2T2-1%20-%20USB%20Power%20Delivery.pdf, page 5).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

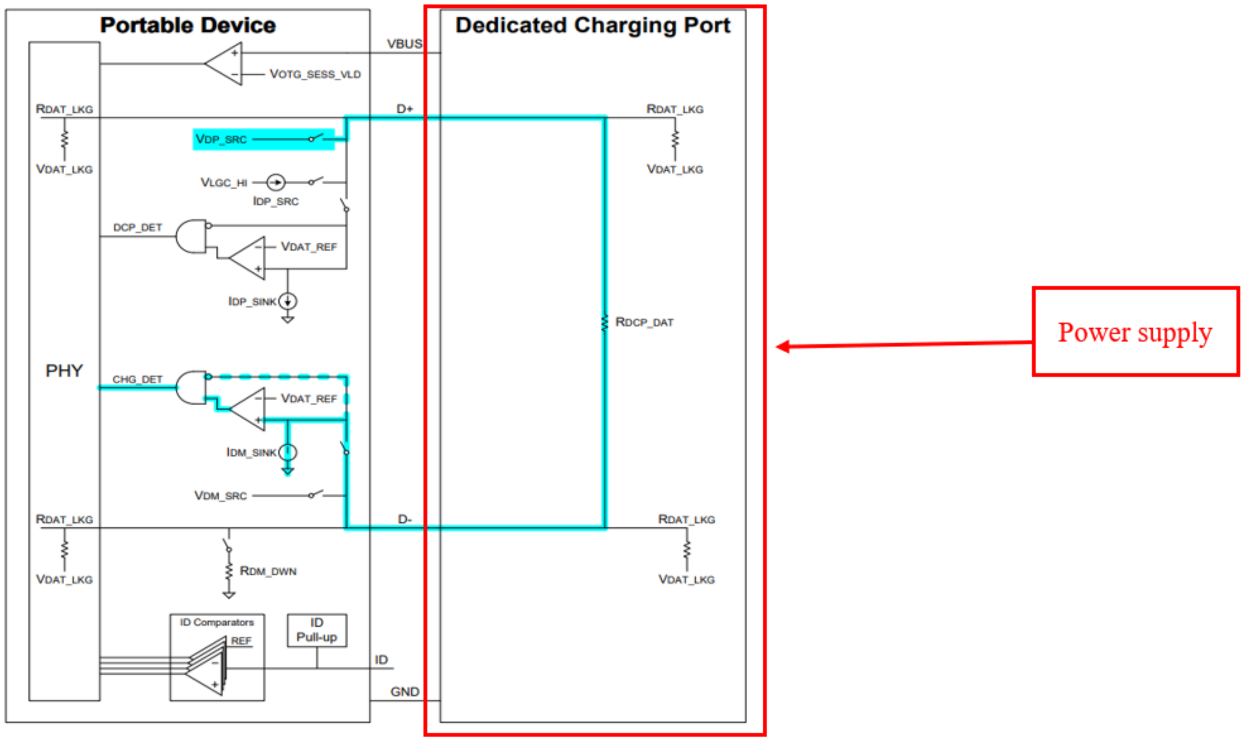


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

84. Defendant provides a portable electronic device comprising a data circuitry configured to provide an output signal to a power supply and to receive an input signal from the power supply. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device comprises data circuitry configured to use the Primary Detection method as described in the USB BC 1.2 specification. Further, during Primary Detection, when the portable electronic device is connected with the power supply through the USB cable, the portable electronic device generates a D+ signal ("output signal") such that the data circuitry of the portable electronic device provides a D+ signal ("output signal") to a

power supply and receives a D- signal ("input signal") from the power supply to detect the type of connected power supply (standard downstream port or charging port).

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

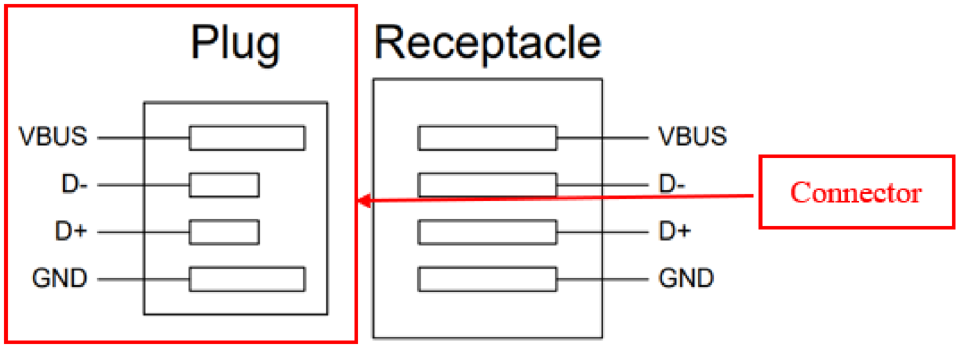


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

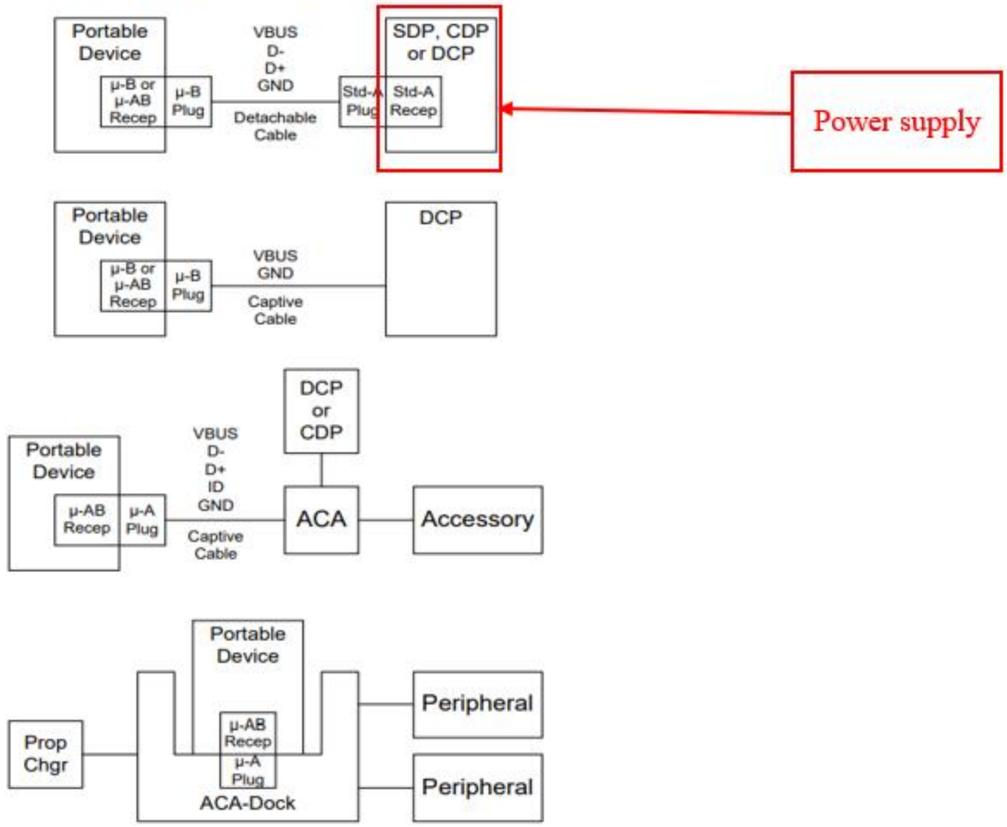


Figure 3-1 System Overview

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

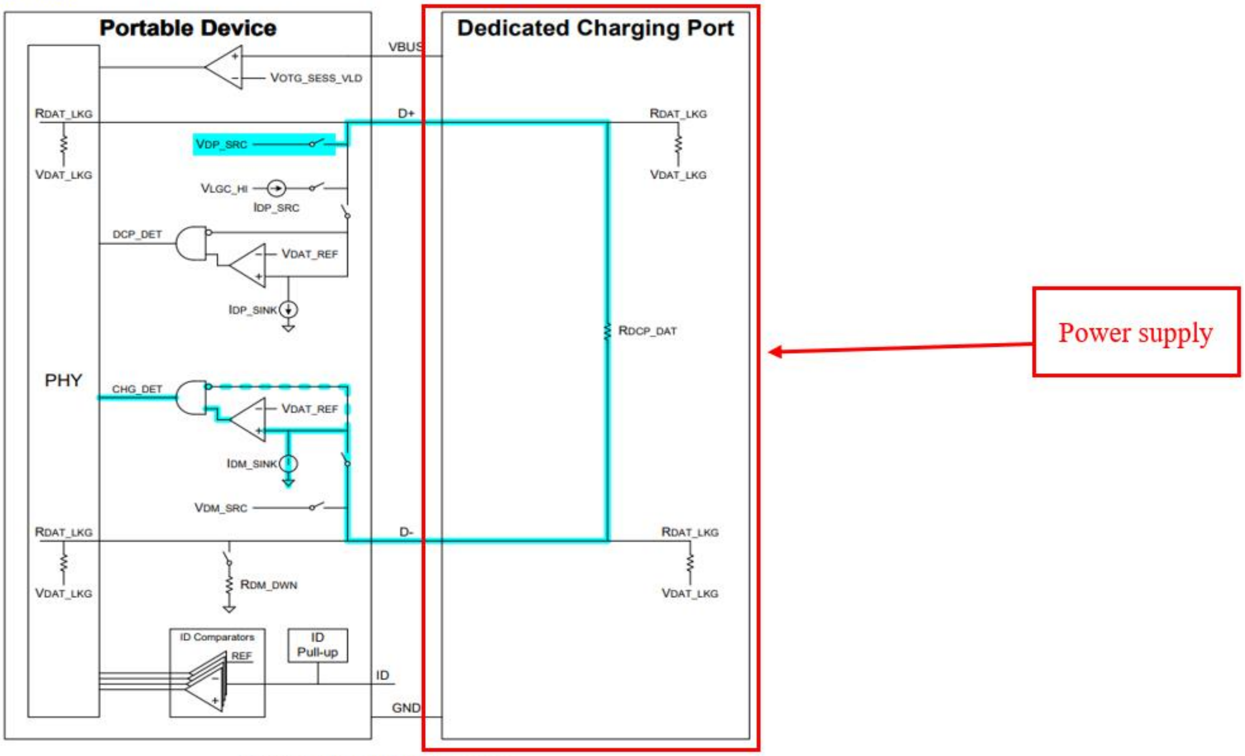


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

85. Defendant provides a portable electronic device comprising the data circuitry and the power circuitry configured to be coupled via a connector to the power supply, the connector comprising a first conductor, a second conductor, a third conductor, and a fourth conductor, the connector configured to be detachably mated with an interface of the power supply. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device connects to the power supply (USB power supply) through a USB cable. The USB cable has a USB-C connector at one end to detachably mate with the charging port ("power output") of the USB power supply ("power supply"). The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor") pins.

3.2.3.2 Problem Description

USB plugs and receptacles are designed such that when the plug is inserted into the receptacle, the power pins make contact before the data pins make contact. This is illustrated in Figure 3-3.

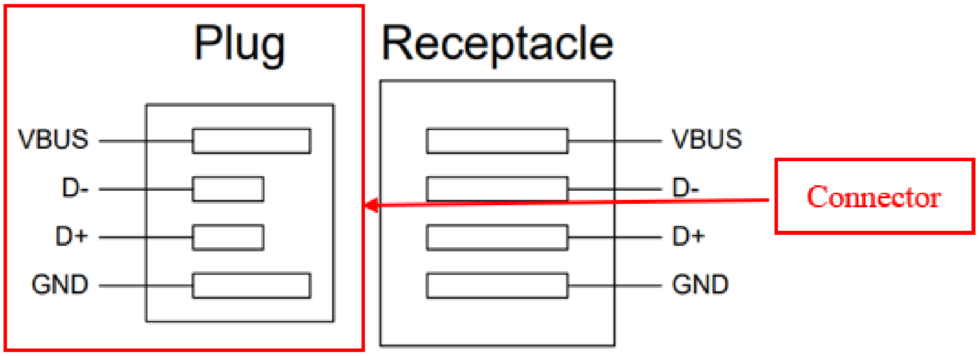


Figure 3-3 Data Pin Offset

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 10).

3. Charging Port Detection

3.1 Overview

Figure 3-1 shows several examples of a PD attached to an SDP or Charging Port.

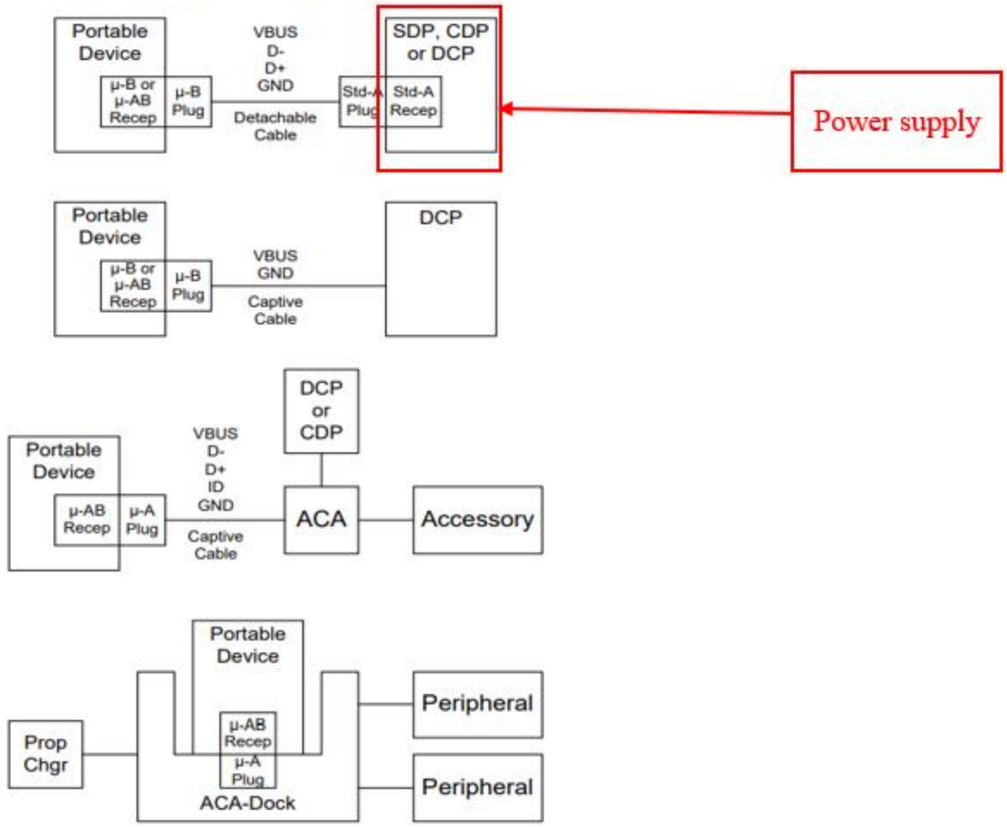


Figure 3-1 System Overview

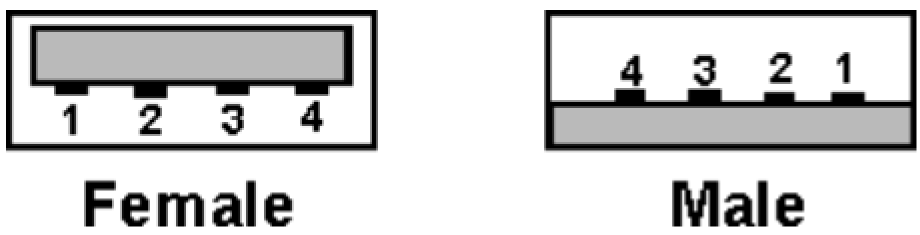
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 6).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

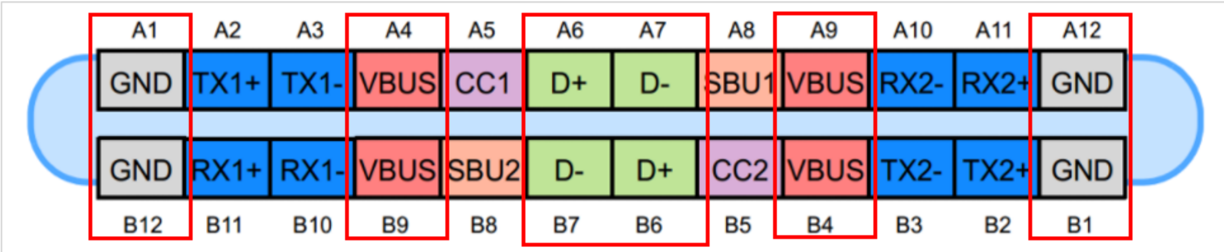


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

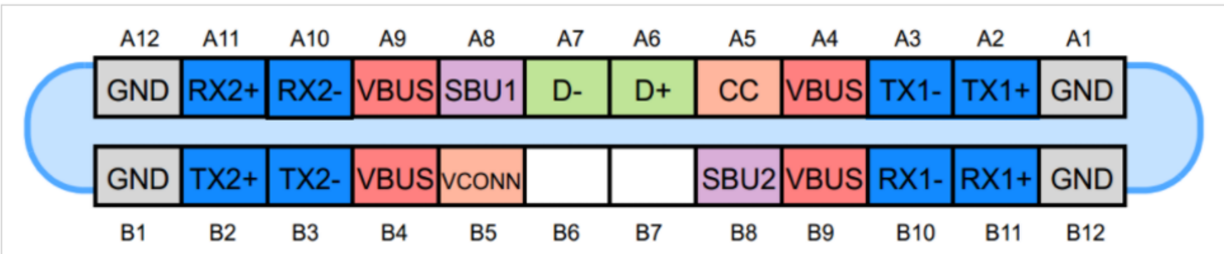


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

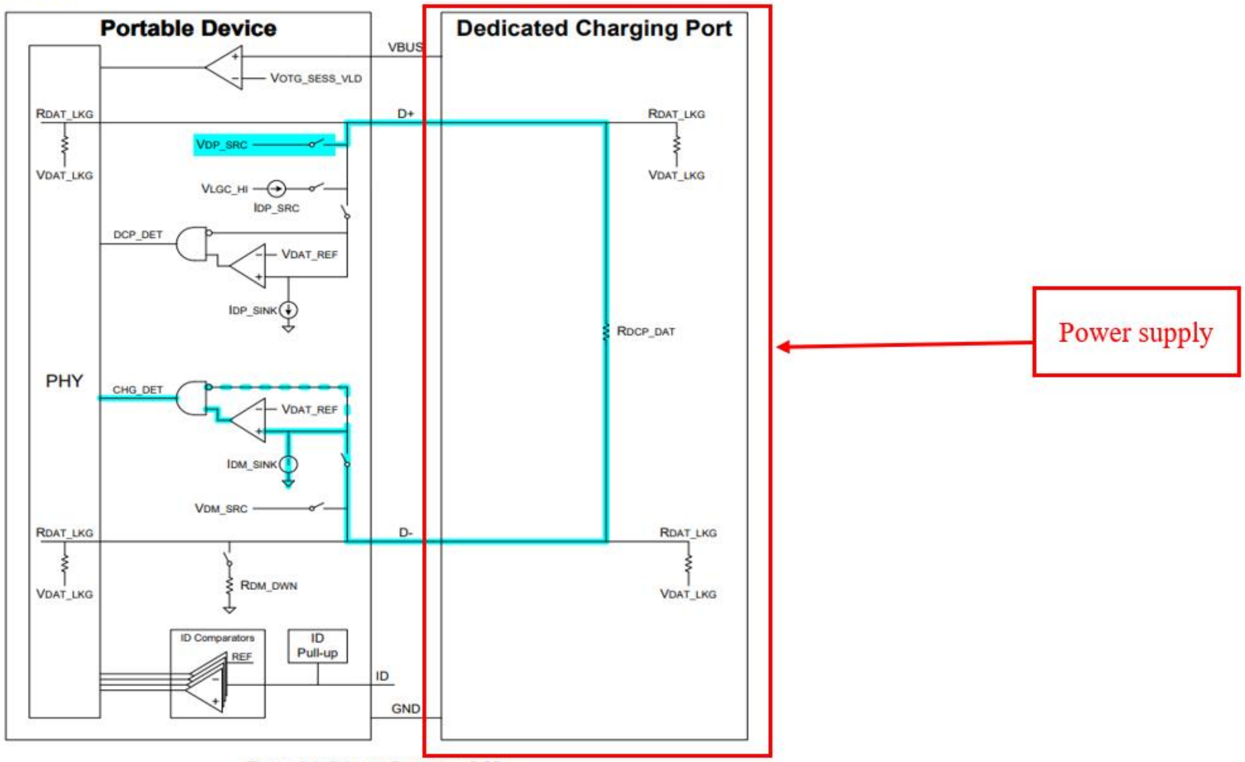


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

86. Defendant provides a portable electronic device to transfer, via the first conductor, the direct current power from the power supply, provide, via the second conductor, a ground reference from the power supply, transmit, via the third conductor, the output signal from the data circuitry to the power supply, and receive, via the fourth conductor, the input signal from the power supply to the data circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the VBUS pin is the voltage line that provides DC power to the portable electronic device. For example, the GND pin provides a ground reference to the portable electronic device. For example, the D+ pin provides the D+ signal ("output signal") from

the portable electronic device to the data circuitry of the power supply and passes the D+ signal through a resistor (R_{DCP_DAT}). For example, the D- pin provides the D- signal ("input signal") from the data circuitry of the power supply to the portable electronic device. The D+ signal and D-signal are separate signals. The D+ signal originates at the portable electronic device and is received by the power supply. When the D+ signal passes through the resistor R_{DCP_DAT}, the resistance causes the voltage to drop, creating a new D- signal to be transmitted to the portable device via the D-pin. Thus, the D+ signal is received by the power supply at one voltage and the D- signal is transmitted to the portable electronic device at a second voltage. To the extent the D- signal (*i.e.*, "input signal") is not found to literally satisfy this claim element because it is a modified signal originating in the portable electronic device, it satisfies this claim element under the doctrine of equivalents. The function of the D- signal is to inform the portable electronic device that the portable electronic device is to receive current from the power supply and charge its battery. Provided the D- signal is of the appropriate voltage, the portable electronic device interprets the D- signal received from the power supply as enabling battery charging regardless of the initial origin of the D- signal. The D- signal therefore performs the same function (informing the portable electronic device that it can receive current from the power supply for the purpose of charging its battery) in the same way (by receiving a signal from the power supply) with the same result (the portable electronic device is able to charge its battery using the current from the power supply).

Acronyms

ACA	Accessory Charger Adapter
CDP	Charging Downstream Port
DBP	Dead Battery Provision
DCD	Data Contact Detect
DCP	Dedicated Charging Port
FS	Full Speed
HS	High-Speed
LS	Low-Speed
OTG	On-The-Go
PC	Personal Computer
PD	Portable Device
PHY	Physical Layer Interface for High-Speed USB
PS2	Personal System 2
SDP	Standard Downstream Port
SRP	Session Request Protocol
TPL	Targeted Peripheral List
USB	Universal Serial Bus
USBCV	USB Command Verifier
USB-IF	USB Implementers Forum
VBUS	Voltage line of the USB interface

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page xi).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

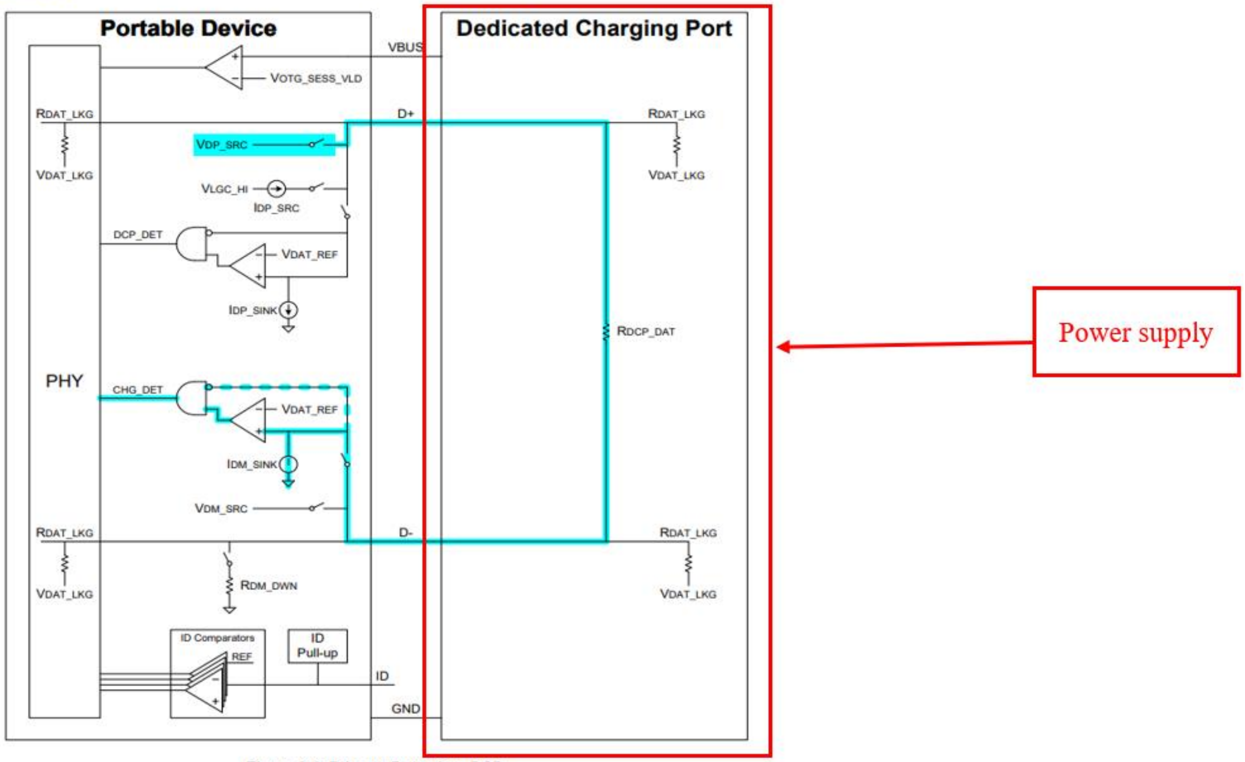


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

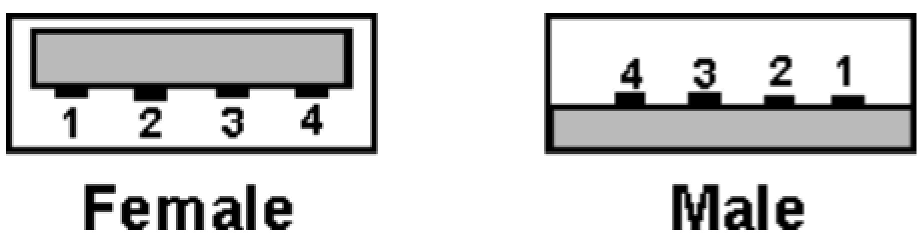
(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

> MINI & MICRO USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4		Not connected, although it can sometimes be ground or used as a presence indicator.
5	Black	Ground
Shell	Drain wire	Shield

TYPE A & B USB CONNECTOR PIN CONNECTIONS

PIN	WIRE COLOUR	SIGNAL NAMES
1	Red	Vbus (4.75 - 5.25 V)
2	White	Data -
3	Green	Data +
4	Black	Ground
Shell	Drain wire	Shield



Type A USB connector pinout

(*E.g.*, https://www.electronics-notes.com/articles/connectivity/usb-universal-serial-bus/connectors-pinouts-cables.php).

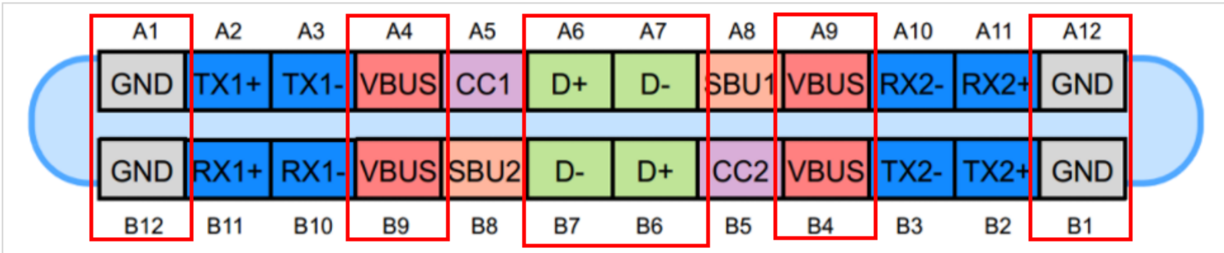


Figure 1. *The USB Type-C receptacle. Image courtesy of Microchip.*

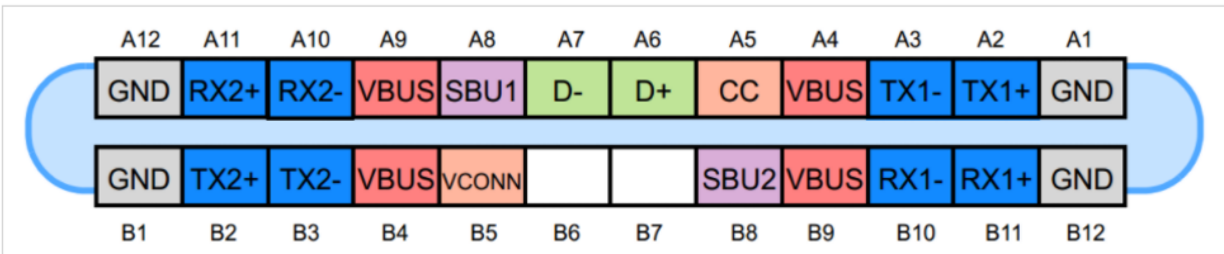


Figure 2. *The USB Type-C plug. Image courtesy of Microchip.*

(*E.g.*, https://www.allaboutcircuits.com/technical-articles/introduction-to-usb-type-c-which-pins-power-delivery-data-transfer/).

87. Defendant provides a portable electronic device wherein the input signal is usable by the data circuitry in connection with control of charging the rechargeable battery based on the direct current received by the power circuitry. This element is infringed literally, or in the alternative, under the doctrine of equivalents. For example, the portable electronic device compares the D- signal's voltage level with a reference voltage to detect the type of power supply (standard downstream port or charging port). The data circuitry of the portable electronic device draws current based on the type of power supply to charge the rechargeable battery.

1.1 Scope

The Battery Charging Working Group is chartered with creating specifications that define limits as well as detection, control and reporting mechanisms to permit devices to draw current in excess of the USB 2.0 specification for charging and/or powering up from dedicated chargers, hosts, hubs and charging downstream ports. These mechanisms are backward compatible with USB 2.0 compliant hosts and peripherals.

1.2 Background

The USB ports on personal computers are convenient places for Portable Devices (PDs) to draw current for charging their batteries. This convenience has led to the creation of USB Chargers that simply expose a USB standard-A receptacle. This allows PDs to use the same USB cable to charge from either a PC or from a USB Charger.

If a PD is attached to a USB host or hub, then the USB 2.0 specification requires that after connecting, a PD must draw less than:

- 2.5 mA average if the bus is suspended
- 100 mA if bus is not suspended and not configured
- 500 mA if bus is not suspended and configured for 500 mA

If a PD is attached to a Charging Port, (i.e. CDP, DCP, ACA-Dock or ACA), then it is allowed to draw IDEV_CHG without having to be configured or follow the rules of suspend.

In order for a PD to determine how much current it is allowed to draw from an upstream USB port, there need to be mechanisms that allow the PD to distinguish between a Standard Downstream Port and a Charging Port. This specification defines just such mechanisms.

Since PDs can be attached to USB chargers from various manufacturers, it is important that all provide an acceptable user experience. This specification defines the requirements for a compliant USB charger, which is referred to in this spec as a USB Charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 1).

3.2.4 Primary Detection

Primary Detection is used to distinguish between an SDP and different types of Charging Ports. A PD is required to implement Primary Detection.

3.2.4.1 Primary Detection, DCP

Figure 3-6 shows how Primary Detection works when a PD is attached to a DCP.

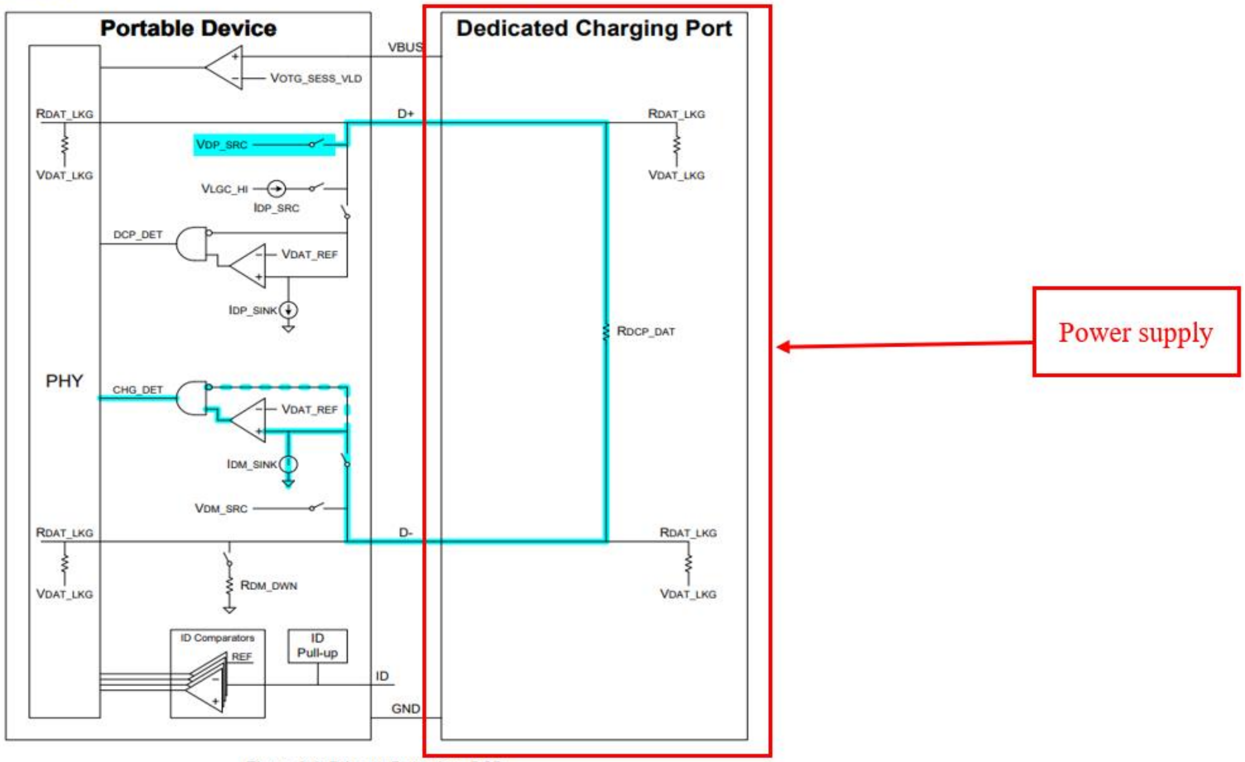


Figure 3-6 Primary Detection, DCP

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 14).

During Primary Detection the PD shall turn on VDP_SRC and IDM_SINK. Since a DCP is required to short D+ to D- through a resistance of RDCP_DAT, the PD will detect a voltage on D- that is close to VDP_SRC.

A PD shall compare the voltage on D- with VDAT_REF. If D- is greater than VDAT_REF, then the PD is allowed to detect that it is attached to either a DCP or CDP. A PD is optionally allowed to compare D- with VLGC as well, and only determine that it is attached to a DCP or CDP if D- is greater than VDAT_REF, but less than VLGC. The reason for this option is as follows.

PS2 ports pull D+/- high. If a PD is attached to a PS2 port, and the PD only checks for D- greater than VDAT_REF, then a PD attached to a PS2 port would determine that it is attached to a DCP or CDP and proceed to draw IDEV_CHG. This much current could potentially damage a PS2 port. By only determining it is attached to DCP or CDP if D- is less than VLGC, the PD can avoid causing damage to a PS2 port.

On the other hand, some proprietary chargers also pull D+/- high. If a PD is attached to one of these chargers, and it determined it was not attached to a charger because D- was greater than VLGC, then the PD would determine that it was attached to an SDP, and only be able to draw ISUSP.

The choice of whether or not to compare D- to VLGC depends on whether the PD is more likely to be attached to a PS2 port, or to a proprietary charger.

(*E.g.*, https://www.usb.org/sites/default/files/BCv1.2_070312_0.zip, USB Battery Charging Specification (Including errata and ECNs through March 15, 2012), Revision 1.2, March 15, 2012, Page 15).

88. As discussed above with respect to element 11.3, "[t]he USB cable has a USB-C connector at one end to detachably mate with the charging port ("power output") of the USB power supply ("power supply"). The connector comprises VBUS ("first conductor"), GND ("second conductor"), D+ ("third conductor") and D- ("fourth conductor")."

89. As discussed above with respect to element 11.5, "the portable electronic device compares the D- signal's voltage [("parameter")] level with a reference voltage to detect the type of power supply (standard downstream port or charging port)."

90. As discussed above with respect to elements 11.4, 11.5, and Claim 15, the parameter level is a voltage signal from the D- pin.

91. As discussed above with respect to element 11.P, the portable electronic device is a computer, such as a laptop or tablet.

92. Upon information and belief, Defendant has been and now is willfully infringing the asserted claims of the '042 patent in the Texas, in this District, and elsewhere in the United States. Defendant had actual knowledge of the '042 patent at least as early as when they received a letter from Plaintiff sent on September 15, 2023, asserting that the Accused Chargers infringed claims of the '042 patent and they were provided a chart of the infringement. Defendant has known of its infringement since at least that date as a result of the accusations of infringement in the letter. Defendant has therefore also known that the use of the Accused Instrumentalities by its customers infringed at least one claim of the '042 patent since at least the date they received the letter. Defendant was informed of its infringement of the '042 patent by way of the September 15, 2023, letter sent to Defendant, including claim charts demonstrating Defendant's infringement. As a result of the letter, Defendant should have known that its actions constituted an unjustifiably high risk of infringement. Despite the letter and knowledge that the risk of infringement was either known or so obvious that it should have been known, Defendant continued its infringing actions.

93. Plaintiff has been damaged as a result of Defendant's infringing conduct. Defendant is thus liable to Plaintiff for damages in an amount that adequately compensates Plaintiff for such Defendant's infringement of the '042 patent, *i.e.*, in an amount that by law cannot be less than would constitute a reasonable royalty for the use of the patented technology, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

94. On information and belief, Defendant will continue its infringement of one or more claims of the '042 patent unless enjoined by the Court. Each and all of the Defendant's infringing conduct thus causes Plaintiff irreparable harm and will continue to cause such harm without the issuance of an injunction.

95. On information and belief, to the extent marking is required, Comarco complied with all marking requirements.

VII. JURY DEMAND

Plaintiff, under Rule 38 of the Federal Rules of Civil Procedure, requests a trial by jury of any issues so triable by right.

VIII. PRAYER FOR RELIEF

WHEREFORE, Plaintiff respectfully requests that the Court find in its favor and against Defendant, and that the Court grant Plaintiff the following relief:

a. Judgment that one or more claims of United States Patent No. 9,413,187 have been infringed directly or indirectly, either literally and/or under the doctrine of equivalents, by Defendant;

b. Judgment that one or more claims of United States Patent No. 10,855,087 have been infringed directly or indirectly, either literally and/or under the doctrine of equivalents, by Defendant;

c. Judgment that one or more claims of United States Patent No. 10,951,042 have been infringed, directly or indirectly, either literally and/or under the doctrine of equivalents, by Defendant;

d. Judgment that Defendant account for and pay to Plaintiff all damages to and costs incurred by Plaintiff because of Defendant's infringing activities and other conduct complained of herein, and an accounting of all infringements and damages not presented at trial;

e. Adjudging that Defendant's infringement of the RE'365 Patent was willful and trebling all damages awarded to Mobile Motherboard Inc. for such infringement pursuant to 35 U.S.C. § 284;

f. Permanently enjoining Defendant from any further activity or conduct that infringes one or more claims of United States Patent Nos. 9,413,187, 10,855,087, and 10,951,042;

g. Granting Plaintiff infringing activities and other conduct complained of herein; and

h. Granting Plaintiff such other and further relief as the Court may deem just and proper under the circumstances.

December 15, 2023

DIRECTION IP LAW

/s/ David R. Bennett
David R. Bennett
(*Admitted to the U.S. Dist. Ct. for the E.D. Texas*)
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Attorney for Plaintiff
Comarco Wireless Systems LLC