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USB-grænseflader for data og energi – Del 1-3: Fælles komponenter – Specifikation af USB-type-C®-kabler og -konnektorer

Universal Serial Bus interfaces for data and power – Part 1-3: Common components – USB Type-C® cable and connector specification

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European foreword

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Universal Serial Bus interfaces for data and power - Part 1-3: Common components - USB Type-C® cable and connector specification

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Draft	Report on voting
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Full information on the voting for its approval can be found in the report on voting indicated in the above table.

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Universal Serial Bus Type-C Cable and Connector Specification

Release 2.4
October 2024

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Pre-Release Draft Industry Reviewing Companies That Provided Feedback

Aces	JST Mfg. Co., Ltd.	Pericom
Fairchild Semiconductor	Korea Electric Terminal	Semtech Corporation
Fujitsu Ltd.	Marvell Semiconductor	Silicon Image
Industrial Technology Research Institute (ITRI)	Motorola Mobility LLC	SMK Corporation
Joinsoon Electronics Mfg. Co. Ltd.	PalCONN/PalNova (Palpilot International Corp.)	Toshiba Corporation

Revision History

Release	Date	Description
1.0	August 11, 2014	Initial Release
1.1	April 3, 2015	Reprint release including incorporation of all approved ECNs as of the revision date plus editorial clean-up.
1.2	March 25, 2016	Reprint release including incorporation of all approved ECNs as of the revision date plus editorial clean-up.
1.3	July 14, 2017	Reprint release including incorporation of all approved ECNs as of the revision date plus editorial clean-up.
1.4	March 29, 2019	Reprint release including incorporation of all approved ECNs as of the revision date plus editorial clean-up.
2.0	August 2019	New release primarily for enabling ***USB4*** over USB Type-C connectors and cables. Also includes incorporation of all approved ECNs as of the revision date plus editorial clean-up.
2.1	May 2021	New release primarily for enabling Extended Power Range (EPR) and defining EPR cables aligning with ***USB Power Delivery*** Specification R3.1 V1.0. Also includes incorporation of all approved ECNs as the revision date plus editorial clean-up.
2.2	October 2022	New release primarily for enabling ***USB4*** Version 2.0 (80 Gbps) over USB Type-C connectors and cables. Also includes incorporation of all approved ECNs as of the revision date plus editorial clean-up.
2.3	October 2023	New release primarily for *deprecating* the ***Audio Adapter Accessory Mode*** and *replacing it with* the ***Liquid Corrosion Mitigation Mode***, and for updating the ***Multi-port Charger Shared Capacity*** definition and behaviors. Also includes incorporation of all other approved ECNs as of the revision date. Note: this release was created using a newly developed document template that includes some style adjustments and editorial clean-up.
2.4	October 2024	Reprint release including incorporation of all approved ECNs as of the revision date plus editorial clean-up.

1 Introduction

With the continued success of the USB interface, there exists a need to adapt USB technology to serve newer computing platforms and devices as they trend toward smaller, thinner, and lighter form-factors. Many of these newer platforms and devices are reaching a point where existing USB receptacles and plugs are inhibiting innovation, especially given the relatively large size and internal volume constraints of the Standard-A and Standard-B versions of USB connectors. Additionally, as platform usage models have evolved, usability and robustness requirements have advanced, and the existing set of USB connectors were not originally designed for some of these newer requirements. This specification establishes a new USB connector ecosystem that addresses the evolving needs of platforms and devices while retaining all the functional benefits of USB that form the basis for this most popular computing device interconnect.

1.1 Purpose

This specification defines the USB Type-C® receptacles, plug and cables.

The USB Type-C Cable and Connector Specification is guided by the following principles:

- Enable new and exciting host and device form-factors where size, industrial design and style are important parameters
- Work seamlessly with existing USB host and device silicon solutions
- Enhance ease of use for connecting USB devices with a focus on minimizing user confusion for plug and cable orientation

The USB Type-C Cable and Connector Specification defines a receptacle, plug, cable, and detection mechanisms that are compatible with existing USB interface electrical and functional specifications. This specification covers the following aspects that are needed to produce and use this new USB cable/connector solution in newer platforms and devices, and that interoperate with existing platforms and devices:

- USB Type-C receptacles, including electro-mechanical definition and performance requirements
- USB Type-C plugs and cable assemblies, including electro-mechanical definition and performance requirements
- USB Type-C to legacy cable assemblies and adapters
- USB Type-C-based device detection and interface configuration, including support for legacy connections
- ***USB Power Delivery*** optimized for the USB Type-C connector

The USB Type-C Cable and Connector Specification defines a standardized mechanism that supports ***Alternate Modes***, such as repurposing the connector for docking-specific applications.

1.2 Scope

This specification is intended as a supplement to the existing ***USB 2.0***, ***USB 3.2***, ***USB4***® and ***USB Power Delivery*** specifications. It addresses only the elements required to implement and support the USB Type-C receptacles, plugs and cables.

Normative information is provided to allow interoperability of components designed to this specification. ***Informative*** information, when provided, may illustrate possible design implementations.

1.3 Related Documents

USB 2.0 ***Universal Serial Bus Revision 2.0 Specification***
This includes the entire document release package.

USB 3.2 ***Universal Serial Bus Revision 3.2 Specification***
This includes the entire document release package.
USB 3.1 Legacy Cable and Connector Specification, Revision 1.0

USB4 ***USB4 Specification, Version 2.0, June 2023***
(including posted errata and ECNs)

TBT3 *Chapter 13 of* ***USB4 Specification, Version 2.0, June 2023***

USB PD ***USB Power Delivery Specification, Revision 2.0, Version 1.3, January 12, 2017***
USB Power Delivery Specification, Revision 3.2, Version 1.1, October 2024
(including posted errata and ECNs)

USB BB ***USB Billboard Device Class Specification, Revision 1.2.2, January 29, 2021***

USB BC ***Battery Charging Specification, Revision 1.2, March 15, 2012***
(including posted errata and ECNs)

DP AM ***DisplayPort™ Alt Mode on USB Type-C Standard, Version 2.1a, August 2024***

All USB-specific documents are available for download at http://www.usb.org/documents.
The ***DisplayPort Alt Mode*** specification is available from VESA (http://www.vesa.org).

1.4 Conventions

1.4.1 Precedence

If there is a conflict between text, figures, and tables, the precedence ***shall*** be tables, figures, and then text.

1.4.2 Keywords

The following keywords differentiate between the levels of requirements and options.

1.4.2.1 Informative

Informative is a keyword that describes information with this specification that intends to discuss and clarify requirements and features as opposed to mandating them.

1.4.2.2 May

May is a keyword that indicates a choice with no implied preference.

1.4.2.3 May Not

May not is a keyword that is the inverse of ***May***. Indicates a choice to not implement a given feature with no implied preference.

1.4.2.4 N/A

N/A is a keyword that indicates that a field or value is not applicable and has no defined value and ***shall not*** be checked or used by the recipient.

1.4.2.5 Normative

Normative is a keyword that describes features that are mandated by this specification.

1.4.2.6 Optional and Optionally

Optional and ***Optionally*** are equivalent keywords that describe features not mandated by this specification. However, if an ***optional*** feature is implemented, the feature ***shall*** be implemented as defined by this specification (***optional normative***).

1.4.2.7 Reserved

Reserved is a keyword indicating reserved bits, bytes, words, fields, and code values that are set-aside for future standardization. Their use and interpretation may be specified by future extensions to this specification and, unless otherwise stated, ***shall not*** be utilized, or adapted by vendor implementation. A reserved bit, byte, word, or field ***shall*** be set to zero by the sender and ***shall*** be ignored by the receiver. ***Reserved*** field values ***shall not*** be sent by the sender and, if received, ***shall*** be ignored by the receiver.

1.4.2.8 Shall

Shall is a keyword indicating a mandatory (***normative***) requirement. Designers are mandated to implement all such requirements to ensure interoperability with other compliant Devices.

1.4.2.9 Shall Not

Shall not is a keyword that is the inverse of ***Shall*** indicating non-compliant operation.

1.4.2.10 Should

Should is a keyword indicating flexibility of choice with a preferred alternative. Equivalent to the phrase "it is recommended that ...".

1.4.2.11 Should Not

Should not is a keyword that is the inverse of ***Should***. Equivalent to the phrase "it is recommended that implementations do not ...".

1.4.3 Numbering

Numbers that are immediately followed by a lowercase "b" (e.g., 01b) are binary values. Numbers that are immediately followed by an uppercase "B" are byte values. Numbers that are immediately followed by a lowercase "h" (e.g., 3Ah) are hexadecimal values. Numbers not immediately followed by either a "b", "B", or "h" are decimal values.

1.5 Terms and Abbreviations

Term	Description
Accessory Mode	A reconfiguration of the connector based on the presence of ***Rd***/***Rd*** on CC1/CC2, respectively.
Active cable	Active cables are USB Full-Featured Type-C Cables that incorporate repeaters in the ***USB 3.2*** data path. All active cables, regardless of length, are expected to comply with this specification, the ***USB 3.2*** Appendix E, and the ***USB 3.2*** active cable CTS. Active cables ***may*** incorporate repeaters in both ends of the cable, one end, or anywhere in the cable. See Chapter 6.
Alternate Mode	Operation defined by a vendor or standards organization that is associated with a SVID assigned by the ***USB-IF***. Entry and exit into and from an ***Alternate Mode*** is controlled by the ***USB PD*** Structured VDM Enter Mode and Exit Mode commands. See Appendix E.
Alternate Mode Adapter (AMA)	A ***USB PD*** Device which supports ***Alternate Modes*** and acts as a UFP.

Term	Description
Assured Capacity Port	A charger port that, in terms of ***USB PD***, is either a Guaranteed Capability or Managed Capability port that is always capable of delivering its Port Maximum PDP.
Audio Adapter Accessory Mode	The Accessory Mode defined by the presence of ***Ra***/***Ra*** on CC1/CC2, respectively. This mode is ***deprecated*** and replaced by ***Liquid Corrosion Mitigation Mode***.
BMC	Biphase Mark Coding used for ***USB PD*** communication over the CC wire.
Cable Port Partner	The USB Type-C DRP, Source, or Sink connected to the cable plug.
Captive cable	A cable that is terminated on one end with a USB Type-C plug and has a vendor-specific connect means (hardwired or custom detachable) on the opposite end.
CC	Configuration Channel (CC) used in the discovery, configuration, and management of connections across a USB Type-C cable. See Section 4.5.
Charge-Through VPD (***CTVPD***)	A VCONN-Powered USB Device that has the mechanism to pass power and CC communication from one port to the other without any reregulation. See Section 4.10.2.
Configuration Lane	The ***USB 3.2*** Configuration Lane is used to establish and manage dual-lane SuperSpeed USB operation. The Configuration Lane is specifically the SuperSpeed USB TX1/RX1 differential signal set in the cable/plug.
Debug Accessory Mode (DAM)	The Accessory Mode defined by the presence of ***Rd***/***Rd*** or ***Rp***/***Rp*** on CC1/CC2, respectively. See Appendix B.
Debug and Test System (DTS)	The combined hardware and software system that provides a system developer debug visibility and control when connected to a ***Target System*** in ***Debug Accessory Mode***.
Default VBUS	VBUS voltage as defined by the ***USB 2.0*** and ***USB 3.2*** specifications. Note: where used, 5V VBUS connotes the same meaning.
DFP	Downstream Facing Port, specifically associated with the flow of data in a USB connection. Typically, the ports on a host or the ports on a hub to which devices are connected. In its initial state, the DFP sources VBUS and VCONN, and supports data. A charge-only DFP port only sources VBUS.
Direct connect device	A device with either a captive cable or just a USB Type-C plug (e.g., thumb drive).
DRD (Dual-Role-Data)	The acronym used in this specification to refer to a USB port that can operate as either a DFP (Host) or UFP (Device). The role that the port initially takes is determined by the port's power role at attach. A Source port takes on the data role of a DFP and a Sink port takes on the data role of a UFP. The port's data role ***may*** be changed dynamically using ***USB PD*** Data Role Swap.
DRP (Dual-Role-Power)	The acronym used in this specification to refer to a USB port that can operate as either a Source or a Sink. The role that the port offers ***may*** be fixed to either a Source or Sink or ***may*** alternate between the two port states. Initially when operating as a Source, the port will also take on the data role of a DFP and when operating as a Sink, the port will also take on the data role of a UFP. The port's power role ***may*** be changed dynamically using ***USB PD*** Power Role Swap.
DR_Swap	***USB PD*** Data Role Swap.
Dual-lane (x2)	Dual-lane operation is defined as simultaneously signaling on both sets of USB transmit and receive differential pairs (TX1/RX1 and TX2/RX2 in the cable/plug).

Term	Description
Electronically Marked Cable	A USB Type-C cable that uses ***USB PD*** to provide the cable's characteristics. See Section 4.9.
eMarker	The element in an Electronically Marked Cable that returns information about the cable in response to a ***USB PD Discover Identity*** command.
Guaranteed Capability Port	As defined by the ***USB PD*** specification.
Hybrid Optical Active Cable	A cable that uses an intermediate optical transmission line for the high-speed signaling path (TX/RX) while retaining a metallic conductor-based solution for the rest of the defined interfaces, e.g., CC, ***USB 2.0***, SBUs, etc.
Initiator	The port initiating a Vendor Defined Message. It is independent of the port's PD role (e.g., Provider, Consumer, Provider/Consumer, or Consumer/Provider). In most cases, the Initiator will be a host.
Internal Temperature	In reference to an active cable, the temperature measured inside a plug. It is not the skin temperature. There is a relationship between the plug's internal temperature and the skin temperature, but that relationship is design dependent.
Liquid Corrosion Mitigation Mode	The mode defined by the presence of ***Ra***/***Ra*** on CC1/CC2, respectively. See Appendix A.
Local Plug	The cable plug being referred to.
Managed Capability Port	As defined by the ***USB PD*** specification.
Optically Isolated Active Cable (OIAC)	A cable that uses an intermediate optical transmission line for all signaling. This cable has no metallic conductors and is electrically isolated between the two plugs. This cable has a USB Type-C Plug on each end with one Cable Plug supporting SOP' and the other supporting SOP".
Passive cable	A cable that does not incorporate any electronics to condition the data path signals. A passive cable ***may*** or ***may not*** be electronically marked.
Port Partner	Refers to the port (device or host) a port is attached to.
Power Bank	A device with a battery whose primary function is to charge or otherwise extend the runtime of other USB Type-C devices.
Power Delivery Mode	A mode where the port partners are in a ***USB PD*** power contract (either Explicit or Implicit).
Port Maximum PDP	As defined by the ***USB PD*** specification.
Port Present PDP	As defined by the ***USB PD*** specification.
Power Sinking Devices (PSD)	Sink which draws power but has no other USB or ***Alternate Mode*** communication function, e.g., a USB-powered light.
Powered cable	A cable with electronics in the plug that requires VCONN indicated by the presence of ***Ra*** between the VCONN pin and ground.
PR_Swap	***USB PD*** Power Role Swap.
Re-driver	Re-driver refers to an analog component that operates on the signal without re-timing it. This ***may*** include equalization, amplification, and transmitter. The re-

Term	Description
	driver does not include a clock-data recovery (CDR) circuit. Re-drivers are beyond the scope of this document.
Remaining Shared Capacity	The remaining power available for a Shared Capacity group of ports after power has been allocated to one or more of its ports.
Remote Plug	A remote cable plug in the context of OIAC plugs is the plug at the other end of the Optically Isolated Active Cable.
Repeater	Repeater refers to any active component that acts on a signal in order to increase the physical lengths and/or interconnect loss over which the signal can be transmitted successfully. The category of repeaters includes both re-timers and re-drivers.
Responder	The port responding to the Initiator of a Vendor Defined Message (VDM). It is independent of the port's ***USB PD*** role (e.g., Provider, Consumer, Provider/Consumer, or Consumer/Provider). In most cases, the Responder will be a device.
Re-timer	Re-timer refers to a component that contains a clock-data recovery (CDR) circuit that "retimes" the signal. The re-timer latches the signal into a synchronous memory element before re-transmitting it. It is used to extend the physical length of the system without accumulating high frequency jitter by creating separate clock domains on either side of the re-timer. Re-timers are defined in ***USB 3.2*** Appendix E and ***USB4***.
SBU	Sideband Use.
Shared Capacity Port	A charger port that, in terms of ***USB PD***, is a Managed Capability port that is not always capable of delivering its Port Maximum PDP due to it being part of a group of ports that share a common source that is less than the sum of the individual port's Port Maximum PDPs.
Shared Port Power Available	The power available, up to the port's PDP, to an unattached port in a Shared Capacity group of ports. This power represents what is available to each port in the group when a Sink is attached after considering power that is already allocated to ports with connected Sinks. This power will be a minimum of 7.5 W, initially offered as USB Type-C Current @ 1.5 A.
Short Active Cable (SAC)	A cable with a USB Type-C Plug on each end, at least one of which is a Cable Plug supporting SOP'. Cable length up to 5 meters.
SID	A Standard ID (SID) is a unique 16-bit value assigned by the ***USB-IF*** to identify an industry standard.
Single-lane (x1)	***USB 3.2*** single-lane operation is defined as signaling on only one set of SuperSpeed USB transmit and receive differential pairs (TX1/RX1 in the cable/plug).
Sink	Port asserting ***Rd*** on CC and when attached is consuming power from VBUS; most commonly a Device.
Skin Temperature	In reference to an active cable, the temperature of a plug's over-mold.
Source	Port asserting ***Rp*** on CC and when attached is providing power over VBUS; most commonly a Host or Hub DFP.
SVID	General reference to either a SID or a VID. Used by ***USB PD*** Structured VDMs when requesting SIDs and VIDs from a device.
Target System (TS)	The system being debugged in ***Debug Accessory Mode***.

Term	Description
Total Shared Capacity	The total power available for a Shared Capacity group of ports. This is the overall power available when none of the ports in the group are connected to Sinks.
Type-A	A general reference to all versions of USB "A" plugs and receptacles.
Type-B	A general reference to all versions of USB "B" plugs and receptacles.
Type-C Plug	A USB plug conforming to the mechanical and electrical requirements in this specification.
Type-C Port	The USB port associated to a USB Type-C receptacle. This includes the USB signaling, CC logic, multiplexers, and other associated logic.
Type-C Receptacle	A USB receptacle conforming to the mechanical and electrical requirements of this specification.
UFP	Upstream Facing Port, specifically associated with the flow of data in a USB connection. The port on a device or a hub that connects to a host or the DFP of a hub. In its initial state, the UFP sinks VBUS and supports data.
USB 2.0 Type-C Cable	A USB Type-C to Type-C cable that only supports ***USB 2.0*** data operation. This cable does not include ***USB 3.2*** or SBU wires.
USB 2.0 Type-C Plug	A USB Type-C plug specifically designed to implement the ***USB 2.0*** Type-C cable.
USB Full-Featured Type-C Cable	A USB Type-C to Type-C cable that supports ***USB 2.0***, ***USB 3.2*** and ***USB4*** data operation. This cable includes SBU wires and is an Electronically Marked Cable.
USB Full-Featured Type-C Plug	A USB Type-C plug specifically designed to implement the USB Full-Featured Type-C cable.
USB4 Hub	A ***USB4*** hub product is used for USB port expansion, includes only USB upstream and downstream ports, and does not include any additional capability that exposes other connector types or functions except as defined in Section 5.2.3 (***Alternate Modes*** Support).
USB4-based Dock	A ***USB4***-based dock product combines a ***USB4*** hub (including at least one exposed USB Type-C downstream port) with additional capabilities that either exposes other connector types and/or includes other user-visible functions, e.g., storage, networking, etc. Examples of functions that are not considered user-visible include firmware update and device authentication.
USB Safe State	The USB Safe State as defined by the ***USB PD*** specification.
VCONN-Powered Accessory (***VPA***)	An accessory that is powered from VCONN to operate in an ***Alternate Mode***. ***VPA***s cannot implement the charge-through mechanism described for ***VPD***s, and instead must intermediate by negotiating ***USB Power Delivery*** with both the connected host and source in order to enable similar functionality. See Section 4.10.1.
VCONN-Powered USB Device (***VPD***)	A USB direct-connect or captive-cable device that can be powered solely from either VCONN or VBUS. ***VPD***s ***may optionally*** support the ***VPD*** charge-through capability. See Section 4.10.2.
VCONN_Swap	***USB PD*** VCONN Swap.
VDM	Vendor Defined Message as defined by the ***USB PD*** specification.
VID	A Vendor ID (VID) is a unique 16-bit value assigned by the ***USB-IF*** to identify a vendor.

Term	Description
vSafe0V	VBUS "0 volts" as defined by the ***USB PD*** specification.
vSafe5V	VBUS "5 volts" as defined by the ***USB PD*** specification.
x1	See Single-lane.
x2	See Dual-lane.