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Universal serial bus interfaces for data and power – Part 3: USB Battery Charging Specification, Revision 1.2

Interfaces de bus universel en série pour les données et l'alimentation électrique – Partie 3: Spécification de chargement des batteries USB, révision 1.2

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UNIVERSAL SERIAL BUS INTERFACES FOR DATA AND POWER –

Part 3: USB Battery Charging Specification, Revision 1.2

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The text of this standard is based on documents prepared by the USB Implementers Forum (USB-IF). The structure and editorial rules used in this publication reflect the practice of the organization which submitted it.

The text of this standard is based on the following documents:

FDIS	Report on voting
100/2157/FDIS	100/2190/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

A list of all the parts in the IEC 62680 series, published under the general title *Universal serial bus interfaces for data and power* can be found on the IEC website.

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INTRODUCTION

The IEC 62680 series is based on a series of specifications that were originally developed by the USB Implementers Forum (USB-IF). These specifications were submitted to the IEC under the auspices of a special agreement between the IEC and the USB-IF.

The USB Implementers Forum, Inc. (USB-IF) is a non-profit corporation founded by the group of companies that developed the Universal Serial Bus specification. The USB-IF was formed to provide a support organization and forum for the advancement and adoption of Universal Serial Bus technology. The Forum facilitates the development of high-quality compatible USB peripherals (devices), and promotes the benefits of USB and the quality of products that have passed compliance testing.

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This series covers the Universal Series Bus interfaces for data and power and consists of the following parts:

IEC 62680-1, *Universal Serial Bus interfaces for data and power - Part 1: Universal Serial Bus Specification, Revision 2.0*

IEC 62680-2, *Universal Serial Bus interfaces for data and power - Part 2: USB Micro-USB Cables and Connectors Specification, Revision 1.01*

IEC 62680-3, *Universal Serial Bus interfaces for data and power - Part 3: USB Battery Charging Specification, Revision 1.2*

IEC 62680-4, *Universal Serial Bus interfaces for data and power - Part 4: Universal Serial Bus Cables and Connectors Class Document Revision. 2.0*

This part of the IEC 62680 series consists of several distinct parts:

- the main body of the text, which consists of the original specification and all ECN and Errata developed by the USB-IF;

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Battery Charging Specification (Including errata and ECNs through March 15, 2012)

Revision 1.2
March 15, 2012

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Revision History

Revision	Date	Author	Description
BC1.0	Mar 8, 2007	Terry Remple	First release
BC1.1	April 15, 2009	Terry Remple	Major updates to all sections. Added Data Contact Detect protocol, and Accessory Charger Adapter.
BC1.2	Oct 5, 2010	Terry Remple Adam Burns	Following items indicate changes from BC1.1 to BC1.2. References below to Section, Figures and Tables refer to BC1.2, unless BC1.1 is specifically indicated. 1. Allow DCPs to output more than 1.5A. Allows Portable Devices (PDs) with switch mode chargers to draw more power. Section 4.4.1. 2. Increase minimum CDP current to 1.5A. Without change, PDs had to draw less than 500mA, to avoid CDP shutdown. Table 5-2. 3. Indicate that ICDP max and IDCP max limits of 5A come from USB 2.0, and are safety limits. Table 5-2 note 1. 4. Allow PDs to draw up to 1.5A during HS chirp and traffic. Remove previous limits of 560mA and 900mA which was based on HS common mode ranges. Section 3.5. 5. Require CDPs to support 1.5A during HS chirp and traffic. Affects CDP common mode range. Section 3.5. 6. Reduce maximum PD current from 1.8A to 1.5A, to avoid shutdown when attached to CDP. Table 5-2. 7. Rename Docking Station to ACA-Dock, to avoid confusion with other types of Docking Stations. 8. Require ACA-Dock to differentiate itself from an ACA, by enabling VDM_SRC during no activity. Section 3.2.4.4. 9. Allow CDP to leave VDM_SRC enabled while peripheral not connected. Section 3.2.4.2. 10. Remove ICHG_SHTDWN. This was a recommended max output current for Charging Ports with VBUS grounded. BC1.1 Section 4.1. 11. Require VDP_SRC to not pull D+ below 2.2V when D+ is being pulled to VDP_UP through RDP_UP. Require VDM_SRC to not pull D- below 2.2V when D- is being pulled high. Required for ACA-Dock support. Table 5-1 notes 1 and 2. 12. Make DCD current source optional for PDs. Section 3.2.3. 13. Make DCD timeout required for PDs. Section 3.2.3. 14. Make Secondary Detection optional for PDs. Section 4.6.2. 15. Make Good Battery Algorithm required behavior for PDs. Section 3.2.4. 16. Remove resistive detection. BC1.1 Section 3.9. 17. Change PD Required Operating Range to include 4.5V at 500mA. Figure 4-3. 18. Allow any downstream port to act as a DCP. Section 4.1.3. 19. Require PDs to enable VDP_SRC or RDP_PU when charging from a DCP. Section 3.3.2. 20. Allow chargers to renegotiate current with PD by dropping and reasserting VBUS. Section 4.1.3.

Revision	Date	Author	Description
			21. Require PDs to discharge their own VBUS input after VBUS drops to support charger port renegotiation request. Section 4.6.3. 22. Allow PDs to disconnect and repeat Charger Detection multiple times while attached, with specified timing. Section 4.6.3. 23. Reduce DCP input impedance between D+, D- to VBUS and ground from 1MΩ to 300kΩ. Section 4.4.3. 24. Require CDPs to recover after over-current condition. Section 4.2.2. 25. Allow greater DCP undershoot for large load current steps, to enable low quiescent current chargers required by Europe. Section 4.4.2. 26. Define ACAs and ACA-Docks as types of Charging Ports. Section 1.4.5. 27. Use session valid voltage range defined in EH and OTG Supplement rev 2.0. Section 3.2.2. 28. Only devices that can operate stand-alone from internal battery power are allowed to use the Dead Battery Provision. Section 2.2. 29. Allow compound PDs to draw ISUSP plus an responsible for protecting themselves against higher voltages on VBUS. BC1.1 Section 6.7. 45. Require ACAs to continue providing power to OTG device from Charging Port, even if ground offsets or USB reset cause D- to go below VDAT_REF. Section 6.2.6. 46. Change charger shutdown recovery time (TSHTDWN_REC) from 2 seconds to 2 minutes. Table 5-5. 47. Indicate that ACA-Dock is required to pull D+ to VDP_UP with RDP_UP when VBUS is asserted. Section 3.2.4.4. 48. Remove statements regarding devices with multiple receptacles. Covered in Multiple Receptacle white paper at http://www.usb.org/developers/docs/. 49. Improve readability by adding and updating drawings, re-structuring sections, and clarifying text.
BC 1.2 plus errata	Oct 12, 2011	Pat Crowe	Includes errata changes from Oct 12, 2011
BC 1.2 plus further errata	Mar 15, 2012	Pat Crowe	Includes errata changes from Mar 15, 2012: 1. Corrections to Micro ACA specification.

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

1 Introduction

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.

If a PD has a Dead or Weak Battery, then the Connect Timing Engineering Change Notice (ECN) issued by the USB-IF on the USB 2.0 spec allows that device to draw up to IUNIT while attached but not connected. The conditions associated with this ECN are contained in Section 2 of this specification, and are referred to as the Dead Battery Provision (DBP).

1.3 Reference Documents

The following specifications contain information relevant to the Battery Charging Specification.

- OTG and Embedded Host Supplement, Revision 2.0
- USB 2.0 Specification
- USB 3.0 Specification

1.4 Definitions of Terms

This section contains definitions for some of the terms used in this specification.

1.4.1 Accessory Charger Adaptor

An Accessory Charger Adaptor (ACA) is an adaptor which allows a single USB port to be attached to both a charger and another device at the same time.

The following terminology is used when referring to an ACA:

- ACA-A An ACA with ID resistance of R_{ID_A}
- ACA-B An ACA with ID resistance of R_{ID_B}
- ACA-C An ACA with ID resistance of R_{ID_C}

See Section 6 for details on an ACA.

1.4.2 ACA-Dock

An ACA-Dock is a docking station that has one upstream port, and zero or more downstream ports. The upstream port can be attached to a PD, and is capable of sourcing I_{CDP} to the PD. An ACA-Dock signals it is an ACA-Dock to the PD by enabling V_{DM_SRC} during USB idle, and by pulling ID to ground through a resistance of R_{ID_A}. See Section 3.2.4.4 for more details.

1.4.3 Attach versus Connect

This specification makes a distinction between the words “attach” and “connect”. A downstream device is considered to be attached to an upstream port when there is a physical cable between the two.

A downstream device is considered to be connected to an upstream port when it is attached to the upstream port, and when the downstream device has pulled either the D+ or D- data line high through a 1.5 kΩ resistor, in order to enter Low-Speed, Full-Speed or High-Speed signaling.

1.4.4 Charging Downstream Port

A Charging Downstream Port (CDP) is a downstream port on a device that complies with the USB 2.0 definition of a host or a hub, except that it shall support the Charging Downstream Port features specified herein.

A CDP shall output a voltage of V_{DM_SRC} on its D- line when it senses a voltage greater than V_{DAT_REF} but less than V_{LGC} on its D+ line when not connected to a peripheral. A CDP shall not output a voltage of V_{DM_SRC} on its D- line from the time that the peripheral is connected, to the time that the peripheral is disconnected.

1.4.5 Charging Port

A Charging Port is a DCP, CDP, ACA-Dock or ACA.

1.4.6 Dead Battery Threshold

The Dead Battery Threshold is defined as the maximum charge level of a battery such that below this threshold, a device is assured of not being able to power up successfully.

A Dead Battery is defined as one that is below the Dead Battery Threshold.

1.4.7 Dedicated Charging Port

A Dedicated Charging Port (DCP) is a downstream port on a device that outputs power through a USB connector, but is not capable of enumerating a downstream device. A DCP shall source I_{DCP} at an average voltage of V_{CHG}.

A DCP shall short the D+ line to the D- line.