

Edition 2.0 2017-09

INTERNATIONAL STANDARD





THIS PUBLICATION IS COPYRIGHT PROTECTED Copyright © 2016 USB-IF

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from IEC, or USB-IF at the respective address given below. Any questions about USB-IF copyright should be addressed to the USB-IF. Enquiries about obtaining additional rights to this publication and other information requests should be addressed to the IEC or your local IEC member National Committee.

IEC Secretariat 3, rue de Varembé CH-1211 Geneva 20 Switzerland Tel. +41 22 919 02 11

info@iec.ch www.iec.ch USB Implementers Forum, Inc. 3855 S.W. 153rd Drive Beaverton, OR 97003 United States of America Tel. +1 503-619-0426 Admin@usb.org

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

www.usb.org

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

2011-aae3-4790-969a-1362



Edition 2.0 2017-09

INTERNATIONAL STANDARD



Universal serial bus interfaces for data and power –
Part 1-3: Common components – USB Type-C™ Cable and Connector Specification

IEX 82680-1-12017

https://standards.iteh.arcatalog/standards/sist/45220fl-aae3-4790-969a-1362255189df/iec
62680-1-3-2017

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.120.20; 33.120.30; 35.200

ISBN 978-2-8322-4842-3

Warning! Make sure that you obtained this publication from an authorized distributor.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

UNIVERSAL SERIAL BUS INTERFACES FOR DATA AND POWER -

Part 1-3: Common components – USB Type-C[™] Cable and Connector Specification

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62680-1-3 has been prepared by technical area 14: Interfaces and methods of measurement for personal computing equipment, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

This second edition cancels and replaces the first edition published in 2016 and constitutes a technical revision.

The text of this standard was 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:

CDV	Report on voting
100/2853/CDV	100/2958/RVC

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.



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.

This standard is the USB-IF publication USB Type-C[™] Cable and Connector Specification Revision 1.2 as of March 25, 2016.

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.

ANY USB SPECIFICATIONS ARE PROVIDED TO YOU "AS IS, "WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR ANY PARTICULAR PURPOSE. THE USB IMPLEMENTERS FORUM AND THE AUTHORS OF ANY USB SPECIFICATIONS DISCLAIM ALL LIABILITY, INCLUDING LIABILITY FOR INFRINGEMENT OF ANY PROPRIETARY RIGHTS, RELATING TO USE OR IMPLEMENTATION OR INFORMATION IN THIS SPECIFICAITON.

THE PROVISION OF ANY USB SPECIFICATIONS TO YOU DOES NOT PROVIDE YOU WITH ANY LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS.

Entering into USB Adopters Agreements may, however, allow a signing company to participate in a reciprocal, RAND-Z licensing arrangement for compliant products. For more information, please see:

http://www.usb.org/developers/docs/

http://www.usb.org/developers/develass_docs#approved

IEC DOES NOT TAKE ANY POSITION AS TO WHETHER IT IS ADVISABLE FOR YOU TO ENTER INTO ANY USB ADOPTERS AGREEMENTS OR TO PARTICIPATE IN THE USB IMPLEMENTERS FORUM."

Universal Serial Bus Type-C Cable and Connector Specification

iTeh STANDARA PREVIEW
(standards.iteh.ai)

Revision 1.2
March 25, 2016

IEC 62(80 1-380)7

https://standards.iteh.ai/cazalog/standards/sist/47220f1-ae3-4790-969a-1362255189df/iec-62680 1-3-2017

Copyright © 2014-2016, USB 3.0 Promoter Group: Hewlett-Packard Company, Intel Corporation, Microsoft Corporation, Renesas, STMicroelectronics, and Texas Instruments All rights reserved.

NOTE: Adopters may only use the USB Type-C™ cable and connector to implement USB or third party functionality as expressly described in this Specification; all other uses are prohibited.

LIMITED COPYRIGHT LICENSE: The USB 3.0 Promoters grant a conditional copyright license under the copyrights embodied in the USB Type-C Cable and Connector Specification to use and reproduce the Specification for the sole purpose of, and solely to the extent necessary for, evaluating whether to implement the Specification in products that would comply with the specification. Without limiting the foregoing, use of the Specification for the purpose of filing or modifying any patent application to target the Specification or USB compliant products is not authorized. Except for this express copyright license, no other rights or licenses are granted, including without limitation any patent licenses. In order to obtain any additional intellectual property licenses or licensing commitments associated with the Specification a party must execute the USB 3.0 Adopters Agreement. NOTE: By using the Specification, you accept these license terms on your own behalf and, in the case where you are doing this as an employee, on behalf of your employer.

INTELLECTUAL PROPERTY DISCLAIMER

THIS SPECIFICATION IS PROVIDED TO YOU "AS IS" WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR ANY PARTICULAR PURPOSE. THE AUTHORS OF THIS SPECIFICATION DISCLAIM ALL LIABILITY, INCLUDING LIABILITY FOR INFRINGEMENT OF ANY PROPRIETARY RIGHTS, RELATING TO USE OR IMPLEMENTATION OF INFORMATION IN THIS SPECIFICATION. THE PROVISION OF THIS SPECIFICATION TO YOU DOES NOT PROVIDE YOU WITH ANY LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS.

All implementation examples and reference designs contained within this Specification are included as part of the limited patent license for those companies that execute the USB 3.0 Adopters Agreement.

USB Type-C™ and USB-C™ are trademarks of the Universal Serial Bus Implementers Forum (USB-IF). All product names are trademarks, registered trademarks, or service marks of their respective owners.

CONTENTS

Sp	pecificat	ion Work Group Chairs / Specification Editors	16
Sp	ecificat	ion Work Group Contributors	16
Pr	e-Relea	se Draft Industry Reviewing Companies That Provided Feedback	18
Re	evision l	History	18
1		duction	
	1.1	Purpose	19
	1.2	Scope	
	1.3	Related Documents	
	1.4	Conventions	20
	1.4.1	Precedence	20
	1.4.2	Keywords	20
	1.4.3		21
	1.5	Terms and Abbreviations	21
2	Over	view	23
	2.1	Introduction	23
	2.2	USB Type-C Receptacles Plugs and Cables	25
	2.3	Configuration Process Source-to-Sink Attach/Detach Detection	26
	2.3.1	Source-to-Sink Attach/Detach Detection	26
	2.3.2	Plug Orientation/Cable Twist Detection	27
	2.3.3	Initial Power (Source-to-Sink) Detection and Establishing the Data (Host-to-Device) Relationship	_ 27
	2.3.4	6.268(N = 3 = 20)	
	2.3.5		28
	2.3.6	Functional Extensions	28
	2.4	VBUS	28
	2.5	VCONN	29
	2.6	Hubs	29
3	Mech	anical	30
	3.1	Overview .	30
	3.1.1	Compliant Connectors	30
	3.1.2	Compliant Cable Assemblies	30
	3.1.3		
	3.1.4	Compliant USB Type-C to Legacy Adapter Assemblies	31
	3.2	USB Type-C Connector Mating Interfaces	31
	3.2.1	Interface Definition	31
	3.2.2	Reference Designs	50
	3.2.3	Pin Assignments and Descriptions	57
	3.3	Cable Construction and Wire Assignments	59
	3.3.1	Cable Construction (Informative)	60
	3.3.2	Wire Assignments	61
	3.3.3	Wire Gauges and Cable Diameters (Informative)	62
	3.4	Standard USB Type-C Cable Assemblies	64
	3.4.1	USB Full-Featured Type-C Cable Assembly	64

3.4.3 USB Type-C Captive Cable Assemblies .66 3.5.1 USB Type-C to USB 3.1 Standard-A Cable Assembly .67 3.5.2 USB Type-C to USB 2.0 Standard-A Cable Assembly .68 3.5.3 USB Type-C to USB 2.0 Standard-B Cable Assembly .70 3.5.4 USB Type-C to USB 2.0 Standard-B Cable Assembly .70 3.5.5 USB Type-C to USB 2.0 Min-B Cable Assembly .71 3.5.6 USB Type-C to USB 2.0 Min-B Cable Assembly .72 3.5.7 USB Type-C to USB 2.0 Minro-B Cable Assembly .72 3.6 Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7 Electrical Characteristics .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to USB Legacy Adapter Assemblies (Normative) .93 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .93 3.7.6<	3.4.2	USB 2.0 Type-C Cable Assembly	65
3.5.1 USB Type-C to USB 3.1 Standard-A Cable Assembly .67 3.5.2 USB Type-C to USB 2.0 Standard-A Cable Assembly .68 3.5.3 USB Type-C to USB 3.1 Standard-B Cable Assembly .69 3.5.4 USB Type-C to USB 2.0 Standard-B Cable Assembly .70 3.5.5 USB Type-C to USB 2.0 Mini-B Cable Assembly .71 3.5.6 USB Type-C to USB 3.1 Mincr-B Cable Assembly .72 3.5.7 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .76 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.6.1 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.6.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Legacy Cable Assemblies (Normative) .91 3.7.4 USB Type-C to USB Legacy Adapter Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shiedding Effectiveness Requirements (Normative) .103 3.8 <td< td=""><td>3.4.3</td><td>USB Type-C Captive Cable Assemblies</td><td>66</td></td<>	3.4.3	USB Type-C Captive Cable Assemblies	66
3.5.2 USB Type-C to USB 2.0 Standard-A Cable Assembly .68 3.5.3 USB Type-C to USB 3.1 Standard-B Cable Assembly .69 3.5.4 USB Type-C to USB 2.0 Standard-B Cable Assembly .70 3.5.5 USB Type-C to USB 2.0 Mini-B Cable Assembly .71 3.5.6 USB Type-C to USB 3.1 Micro-B Cable Assembly .72 3.5.7 USB Type-C to USB 2.0 Micro-B Cable Assembly .74 3.6 Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7 Electrical Characteristics .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .99 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to Legacy Adapter Assemblies (Normative) .93 3.7.6 Shielding Effectiveness Requirements (Normative) .93 3.7.6 Shielding Effectiveness Requirements (Normative) .10 <td< td=""><td>3.5 Leg</td><td>gacy Cable Assemblies</td><td>66</td></td<>	3.5 Leg	gacy Cable Assemblies	66
3.5.3 USB Type-C to USB 3.1 Standard-B Cable Assembly 70 3.5.4 USB Type-C to USB 2.0 Standard-B Cable Assembly 70 3.5.5 USB Type-C to USB 2.0 Mini-B Cable Assembly 71 3.5.6 USB Type-C to USB 3.1 Micro-B Cable Assembly 72 3.5.7 USB Type-C to USB 3.0 Micro-B Cable Assembly 74 3.6 Legacy Adapter Assemblies 74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly 76 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly 76 3.7 Electrical Characteristics 78 3.7.1 Raw Cable (Informative) 78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) 79 3.7.3 Mated Connector (Informative) 91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) 95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) 93 3.7.6 Shielding Effectiveness Requirements (Normative) 103 3.8.1 Mechanical Requirements (Normative) 103 3.8.2 Environmental Requirements (Normative) 112 3.10.1 EMC Manag	3.5.1	USB Type-C to USB 3.1 Standard-A Cable Assembly	67
3.5.4 USB Type-C to USB 2.0 Standard-B Cable Assembly. 70 3.5.5 USB Type-C to USB 2.0 Mini-B Cable Assembly. 71 3.5.6 USB Type-C to USB 2.0 Micro-B Cable Assembly. 74 3.5.7 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly. 74 3.6 Legacy Adapter Assemblies. 74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly. 75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly. 76 3.7 Electrical Characteristics. 78 3.7.1 Raw Cable (Informative). 78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative). 79 3.7.3 Mated Connector (Informative). 95 3.7.5 USB Type-C to Legacy Cable Assemblies (Normative). 95 3.7.6 Shielding Effectiveness Requirements (Normative). 101 3.7.7 DC Electrical Requirements (Normative). 105 3.8.1 Mechanical Requirements (Normative). 105 3.8.2 Environmental Requirements (Normative). 105 3.8.1 Mechanical Requirements (Normative). 113 3.10.1 EMC	3.5.2	USB Type-C to USB 2.0 Standard-A Cable Assembly	68
3.5.5 USB Type-C to USB 2.0 Mini-B Cable Assembly. .71 3.5.6 USB Type-C to USB 3.1 Micro-B Cable Assembly. .72 3.5.7 USB Type-C to USB 2.0 Micro-B Cable Assembly. .74 3.6 Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly. .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly. .76 3.7 Electrical Characteristics. .78 3.7.1 Raw Cable (Informative). .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative). .91 3.7.3 Mated Connector (Informative). .91 3.7.4 USB Type-C to USB Legacy Cable Assemblies (Normative). .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative). .95 3.7.7 DC Electrical Requirements (Normative). .101 3.8.1 Mechanical and Environmental Requirements (Normative). .103 3.8.2 Environmental Requirements. .105 3.8.2 Environmental Requirements. .11 3.10.1 EMC Management (Informative). .112 3.10.2 Stacked and Si	3.5.3	USB Type-C to USB 3.1 Standard-B Cable Assembly	69
3.5.6 USB Type-C to USB 3.1 Micro-B Cable Assembly .72 3.5.7 USB Type-C to USB 2.0 Micro-B Cable Assembly .74 3.6.1 Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7 Electrical Characteristics .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .99 3.7.3 Mated Connector (Informative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .95 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.8.1 Mechanical Requirements (Normative) .103 3.8.2 Environmental Requirements (Normative) .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10.1 Implementation Notes and Design Guides .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mat	3.5.4	USB Type-C to USB 2.0 Standard-B Cable Assembly	70
3.5.7 USB Type-C to USB 2.0 Micro-B Cable Assembly. .74 3.6 Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly. .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly. .76 3.7 Electrical Characteristics. .78 3.7.1 Raw Cable (Informative). .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative). .91 3.7.3 Mated Connector (Informative). .91 3.7.4 USB Type-C to USB Legacy Adapter Assemblies (Normative). .91 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative). .99 3.7.6 Shielding Effectiveness Requirements (Normative). .103 3.8 Mechanical and Environmental Requirements (Normative). .103 3.8.1 Mechanical Requirements. .105 3.8.2 Environmental Requirements. .105 3.8.2 Environmental Requirements. .111 3.9 Docking Applications (Informative). .112 3.10.1 EMC Management (Informative). .1	3.5.5	USB Type-C to USB 2.0 Mini-B Cable Assembly	71
3.6. Legacy Adapter Assemblies .74 3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7 Electrical Characteristics .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .95 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10.1 Implementation Notes and Design Guides .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .113 3.10.3 Cable Mating Considerations (Informative) .116 Functional	3.5.6		
3.6.1 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly .75 3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .103 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10.1 Implementation Notes and Design Guides .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .113 3.10.3 Cable Mating Considerations (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.2 Signal Pin Descriptions			
3.6.2 USB Type-C to USB 2.0 Micro-B Receptacle Adapter Assembly .76 3.7 Electrical Characteristics .78 3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.2 Signal Pin Descriptions .117	3.6 Leg		
3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 USB 2.0 Pins .117 4.2.3 Auxiliary S	3.6.1		\ /
3.7.1 Raw Cable (Informative) .78 3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 <			
3.7.2 USB Type-C to Type-C Passive Cable Assemblies (Normative) .79 3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 USB 2.0 Pins .117 4.2.3 Auxiliary Signal Pins .118	3.7 Ele		
3.7.3 Mated Connector (Informative) .91 3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 USB 2.0 Pins .117 4.2.3 Auxiliary Signal Pins .118 4.2.4 Power and Ground Pins .118 4.2.5 Configurat	3.7.1		
3.7.4 USB Type-C to Legacy Cable Assemblies (Normative) .95 3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 USB 2.0 Pins .117 4.2.3 Auxiliary Signal Pins .118 4.2.4 Power and Ground Pins .118 4.2.5 Configuration Pins .118 <	3.7.2		
3.7.5 USB Type-C to USB Legacy Adapter Assemblies (Normative) .99 3.7.6 Shielding Effectiveness Requirements (Normative) .101 3.7.7 DC Electrical Requirements (Normative) .103 3.8 Mechanical and Environmental Requirements (Normative) .105 3.8.1 Mechanical Requirements .105 3.8.2 Environmental Requirements .111 3.9 Docking Applications (Informative) .112 3.10 Implementation Notes and Design Guides .113 3.10.1 EMC Management (Informative) .113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) .115 3.10.3 Cable Mating Considerations (Informative) .116 Functional .117 4.1 Signal Pin Descriptions .117 4.2.1 SuperSpeed USB Pins .117 4.2.2 USB 2.0 Pins .117 4.2.3 Auxiliary Signal Pins .118 4.2.4 Power and Ground Pins .118 4.2.5 Configuration Pins .118 4.4.1 IR Drop .118 4.4.2	3.7.3		
3.7.6 Shielding Effectiveness Requirements (Normative) 101 3.7.7 DC Electrical Requirements (Normative) 103 3.8 Mechanical and Environmental Requirements (Normative) 105 3.8.1 Mechanical Requirements 105 3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 <td>3.7.4</td> <td></td> <td></td>	3.7.4		
3.7.7 DC Electrical Requirements (Normative) 103 3.8 Mechanical and Environmental Requirements (Normative) 105 3.8.1 Mechanical Requirements 105 3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2.1 SuperSpeed USB Pins 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC	3.7.5	USB Type-C to USB Legacy Adapter Assemblies (Normative)	99
3.8 Mechanical and Environmental Requirements (Normative) 105 3.8.1 Mechanical Requirements 105 3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview <	3.7.6	Shielding Effectiveness Requirements (Normative)	101
3.8.1 Mechanical Requirements 105 3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121 <td>3.7.7</td> <td>DC Electrical Requirements (Normative)</td> <td>103</td>	3.7.7	DC Electrical Requirements (Normative)	103
3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 Super Speed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 117 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.8 Me	chanical and Environmental Requirements (Normative)	105
3.8.2 Environmental Requirements 111 3.9 Docking Applications (Informative) 112 3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 Super Speed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 117 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.8.1	Mechanical Requirements	dt/lec 105
3.10 Implementation Notes and Design Guides 113 3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.8.2	Environmental Requirements	111
3.10.1 EMC Management (Informative) 113 3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.9 Do	cking Applications (Informative)	112
3.10.2 Stacked and Side-by-Side Connector Physical Spacing (Informative) 115 3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.10 Imp	olementation Notes and Design Guides	113
3.10.3 Cable Mating Considerations (Informative) 116 Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.10.1	EMC Management (Informative)	113
Functional 117 4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.10.2	Stacked and Side-by-Side Connector Physical Spacing (Informative)	115
4.1 Signal Summary 117 4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	3.10.3	Cable Mating Considerations (Informative)	116
4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	Function	a(117
4.2 Signal Pin Descriptions 117 4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	4.1 Sig	nal Summary	117
4.2.1 SuperSpeed USB Pins 117 4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121			
4.2.2 USB 2.0 Pins 117 4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	_		
4.2.3 Auxiliary Signal Pins 118 4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	4.2.2		
4.2.4 Power and Ground Pins 118 4.2.5 Configuration Pins 118 4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	4.2.3		
4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	4.2.4	, ,	
4.3 Sideband Use (SBU) 118 4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121	4.2.5	Configuration Pins	118
4.4 Power and Ground 118 4.4.1 IR Drop 118 4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121			
4.4.1 IR Drop. 118 4.4.2 VBUS. 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121		· · · ·	
4.4.2 VBUS 119 4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121			
4.4.3 VCONN 120 4.5 Configuration Channel (CC) 121 4.5.1 Architectural Overview 121		·	
4.5Configuration Channel (CC)1214.5.1Architectural Overview121			
4.5.1 Architectural Overview			
		· , ,	
	4.5.2	CC Functional and Behavioral Requirements	

4

	4.5.3	USB Port Interoperability Behavior	. 155
	4.6	Power	. 165
	4.6.1	Power Requirements during USB Suspend	. 166
	4.6.2	VBUS Power Provided Over a USB Type-C Cable	. 167
	4.7	USB Hubs	. 169
	4.8	Chargers	. 170
	4.8.1	DFP as a Power Source	. 170
	4.8.2	Non-USB Charging Methods	. 172
	4.8.3	Sinking Host	. 172
	4.8.4	Sourcing Device	. 173
	4.8.5	Sourcing Device	. 173
	4.9	Electronically Marked Cables	. 173
	4.10	VCONN-Powered Accessories	. 174
	4.11	Parameter Values	. 175
	4.11.	1 Termination Parameters	. 175
	4.11.	2 Timing Parameters	177
	4.11.	3 Voltage Parameters	. 179
5	Func	tional Extensions	. 180
	5.1	Alternate Modes	. 180
	5.1.1		. 181
	5.1.2	Alternate Mode Requirements	. 181
	5.1.3	Alternate Mode Requirements	. 185
	5.1.4	atandarda itah ailan alamatakan da Miat/At/A/IIII baad /I/UII UAUa IZA/I/AAIXUdt/ia	.185
	5.2	Managed Active Cables	. 188
	5.2.1	Requirements for Managed Active Cables that respond to SOP' and SOP".	. 188
	5.2.2		
	5.2.3	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	
Α	Audio	o Adapter Accessory Mode	
	A.1.	Overview	. 190
	A.2.	Detail	
		Electrical Requirements	
	A.4.	Example Implementations	
	A.4.1		
	A.4.2		
В	Debu	ug Accessory Mode	
	B.1.	Overview	
	B.2.	Functional	
	B.2.1		
	B.2.2	·	
	B.2.3	,	
	B.2.4	,	
	B.2.5	-	
	B.2.6	·	
	B.3.	Security/Privacy Requirements:	
С		Type-C Digital Audio	. 216

FIGURES

Figure 2-1 U	SB Type-C Receptacle Interface (Front View)	24
Figure 2-2 U	SB Full-Featured Type-C Plug Interface (Front View)	25
Figure 3-1 U	SB Type-C Receptacle Interface Dimensions	33
Figure 3-2 Re	eference Design USB Type-C Plug External EMC Spring Contact Zones	37
Figure 3-3 U	SB Full-Featured Type-C Plug Interface Dimensions	38
Figure 3-4 Ro (Informative)	eference Footprint for a USB Type-C Vertical Mount Receptacle	41
	eference Footprint for a USB Type-C Dual-Row SMT Right Angle Receptacle	42
-	eference Footprint for a USB Type-C Hybrid Right-Angle Receptacle	43
	eference Footprint for a USB Type-C Mid-Mount Dual-Row SMT Receptacle	44
	eference Footprint for a USB Type-C Mid-Mount Hybrid Receptacle	45
Figure 3-9 U	SB 2.0 Type-C Plug Interface Dimensions	47
Figure 3-10 l	USB Type-C Plug EMC Shielding Spring Tip Requirements	50
Figure 3-11 F	Reference Design of Receptacle Mid-Plate	50
Figure 3-12 F	Reference Design of the Retention Latch	51
Figure 3-13 I	Illustration of the Latch Soldered to the Paddle Card Ground	51
_ ~ .	Reference Design of the USB Full-Featured Type-C Plug Internal EMC	53
Figure 3-15 F	Reference Design of the USB 2.0 Type-C Plug Internal EMC Spring	54
Figure 3-16 F	Reference Design of Internal EMC Pad	55
Figure 3-17 F	Reference Design of a USB Type-C Receptacle with External EMC Springs	56
Figure 3-18 F	Reference Design for a USB Full-Featured Type-C Plug Paddle Card	57
	Illustration of a USB Full-Featured Type-C Cable Cross Section, a Coaxial with VCONN	60
	Illustration of a USB Full-Featured Type-C Cable Cross Section, a Coaxial without VCONN	60
Figure 3-21 l	USB Full-Featured Type-C Standard Cable Assembly	64
Figure 3-22 l	USB Type-C to USB 3.1 Standard-A Cable Assembly	67
Figure 3-23 l	USB Type-C to USB 2.0 Standard-A Cable Assembly	68
Figure 3-24 l	USB Type-C to <i>USB 3.1</i> Standard-B Cable Assembly	69
Figure 3-25 l	USB Type-C to USB 2.0 Standard-B Cable Assembly	70
Figure 3-26 l	USB Type-C to <i>USB 2.0</i> Mini-B Cable Assembly	71
Figure 3-27 l	USB Type-C to <i>USB 3.1</i> Micro-B Cable Assembly	72
Figure 3-28 l	USB Type-C to <i>USB 2.0</i> Micro-B Cable Assembly	74
Figure 3-29 l	USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly	75
Figure 3-30 l	USB Type-C to <i>USB 2.0</i> Micro-B Receptacle Adapter Assembly	76
	Copyright © 2016 USB 3.0 Promoter Group. All rights reserved.	

Figure 3-31 Illustration of Test Points for a Mated Cable Assembly	79
Figure 3-32 Recommended Differential Insertion Loss Requirement	79
Figure 3-33 Recommended Differential Return Loss Requirement	80
Figure 3-34 Recommended Differential Crosstalk Requirement	80
Figure 3-35 Recommended Differential Near-End and Far-End Crosstalk Requirement between USB D+/D- Pair and USB SuperSpeed Pair	81
Figure 3-36 Illustration of Insertion Loss Fit at Nyquist Frequency	82
Figure 3-37 Input Pulse Spectrum	83
Figure 3-38 IMR Limit as Function of ILfitatNq	83
Figure 3-39 IRL Limit as Function of ILfitatNq	85
Figure 3-40 Differential-to-Common-Mode Conversion Requirement	85
Figure 3-41 Requirement for Differential Coupling between CC and D+/D	87
Figure 3-42 Requirement for Single-Ended Coupling between CC and D- in USB 2.0 Type-C Cables	87
Figure 3-43 Requirement for Single-Ended Coupling between CC and D- in USB Full-Featured Type-C Cables	88
Figure 3-44 Requirement for Differential Coupling between VBUs and D+/D	88
Figure 3-45 Requirement for Single-Ended Coupling between SBU_A and SBU_B	89
Figure 3-46 Requirement for Single-Ended Coupling between SBU_A/SBU_B and CC	89
Figure 3-47 Requirement for Coupling between SBU_A and differential D+/D-, and SBU_B and differential D+/D	90
Figure 3-48 Illustration of USB Type-C Mated Connector	91
Figure 3-49 Recommended Impedance Limits of a USB Type-C Mated Connector	92
Figure 3-50 Recommended Ground Void Dimensions for USB Type-C Receptacle	93
Figure 3-51 Recommended Differential Near-End and Far-End Crosstalk Limits between D+/D- Pair and SuperSpeed Pairs	95
Figure 3-52 Recommended Limits for Differential-to-Common-Mode Conversion	95
Figure 3-53 IMR Limit as Function of ILfitatNq for USB Type-C to Legacy Cable Assembly	98
Figure 3-54 IRL Limit as Function of ILfitatNq for USB Type-C to Legacy Cable Assembly	/98
Figure 3-55 Cable Assembly Shielding Effectiveness Testing	102
Figure 3-56 Shielding Effectiveness Pass/Fail Criteria	102
Figure 3-57 LLCR Measurement Diagram	103
Figure 3-58 Temperature Measurement Point	104
Figure 3-59 Example Current Rating Test Fixture Trace Configuration	105
Figure 3-60 Example of 4-Axis Continuity Test Fixture	107
Figure 3-61 Example Wrenching Strength Test Fixture for Plugs without Overmold	109
Figure 3-62 Reference Wrenching Strength Continuity Test Fixture	110
Figure 3-63 Example of Wrenching Strength Test Mechanical Failure Point	110
Figure 3-64 Wrenching Strength Test with Cable in Fixture	111
Figure 3-65 USB Type-C Cable Receptacle Flange Example	113
Figure 3-66 EMC Guidelines for Side Latch and Mid-plate	114
Copyright © 2016 USB 3.0 Promoter Group. All rights reserved.	

Figure 3-67 EMC Finger Connections to Plug Shell	114
Figure 3-68 EMC Pad Connections to Receptacle Shell	115
Figure 3-69 Examples of Connector Apertures	115
Figure 3-70 Recommended Minimum Spacing between Connectors	116
Figure 3-71 Recommended Minimum Plug Overmold Clearance	116
Figure 3-72 Cable Plug Overmold and an Angled Surface	116
Figure 4-1 Cable IR Drop	119
Figure 4-2 Cable IR Drop for powered cables	119
Figure 4-3 Logical Model for Data Bus Routing across USB Type-C-based Ports	122
Figure 4-4 Logical Model for USB Type-C-based Ports for the Direct Connect Device	123
Figure 4-5 Pull-Up/Pull-Down CC Model	
Figure 4-6 Current Source/Pull-Down CC Model	
Figure 4-7 Source Functional Model for CC1 and CC2	128
Figure 4-8 Source Functional Model Supporting USB PD PR_Swap	
Figure 4-9 Sink Functional Model for CC1 and CC2	129
Figure 4-10 UFP Functional Model Supporting USB PD PR_Swap and VCONN_Swap	
Figure 4-11 DRP Functional Model for CC1 and CC2	131
Figure 4-12 Connection State Diagram: Source	135
Figure 4-13 Connection State Diagram: Sink	136
Figure 4-14 Connection State Diagram: Sink with Accessory Support	<u></u> 137
Figure 4-15 Connection State Diagram: DRP	138
Figure 4-16 Connection State Diagram: DRP with Accessory and Try.SRC Support	139
Figure 4-17 Connection State Diagram: DRP with Accessory and Try.SNK Support	140
Figure 4-18 Sink Power Sub-States	151
Figure 4-19 Source to Sink Functional Model	
Figure 4-20 Source to DRP Functional Model	156
Figure 4-21 DRP to Sink Functional Model	156
Figure 4-22 DRP to DRP Functional Model – CASE 1	158
Figure 4-23 DRP to DRP Functional Model – CASE 2 & 3	159
Figure 4-24 Source to Source Functional Model	161
Figure 4-25 Sink to Sink Functional Model	162
Figure 4-26 Source to Legacy Device Port Functional Model	162
Figure 4-27 Legacy Host Port to Sink Functional Model	163
Figure 4-28 DRP to Legacy Device Port Functional Model	164
Figure 4-29 Legacy Host Port to DRP Functional Model	164
Figure 4-30 Sink Monitoring for Current in Pull-Up/Pull-Down CC Model	168
Figure 4-31 Sink Monitoring for Current in Current Source/Pull-Down CC Model	
Figure 4-32 USB PD over CC Pins	
Figure 4-33 USB PD BMC Signaling over CC	169

Figure 4-34 USB Type-C Cable's Output as a Function of Load for Non-PD-based USB Type-C Charging	. 171
Figure 4-35 0 – 3 A USB PD-based Charger USB Type-C Cable's Output as a Function of Load	. 171
Figure 4-36 3 – 5 A USB PD-based Charger USB Type-C Cable's Output as a Function of Load	. 172
Figure 4-37 Electronically Marked Cable with VCONN connected through the cable	. 174
Figure 4-38 Electronically Marked Cable with SOP' at both ends	. 174
Figure 4-39 DRP Timing	
Figure 5-1 Pins Available for Reconfiguration over the Full-Featured Cable	. 182
Figure 5-2 Pins Available for Reconfiguration for Direct Connect Applications	. 182
Figure 5-3 Alternate Mode Implementation using a USB Type-C to USB Type-C Cable	. 183
Figure 5-4 Alternate Mode Implementation using a USB Type-C to Alternate Mode Cable or Device	. 184
or Device	. 186
Figure 5-6 Managed Active Cable Plug SOP' and SOP" Assignment	. 188
Figure 5-7 Managed Active Cable	. 189
Figure 5-7 Managed Active Cable	. 193
Figure A-2 Example 3.5 mm to USB Type-C Adapter Supporting 500 mA Charge-Through	
Figure B-1 USB Type-C Debug Accessory Layered Behavior	
Figure B-2 DTS Plug Interface	. 196
Figure B-2 DTS Plug Interface	. 197
Figure B-4 Connection State Diagram: DTS Sink	
Figure B-5 Connection State Diagram: DTS DRP	. 199
Figure B-6 TS Sink Power Sub-States	. 204
TABLES	
Table 2-1 Summary of power supply options	20
Table 3-1 USB Type-C Standard Cable Assemblies	
Table 3-2 USB Type-C Legacy Cable Assemblies	
Table 3-3 USB Type-C Legacy Adapter Assemblies	
Table 3-4 USB Type-C Receptacle Interface Pin Assignments	
Table 3-5 USB Type-C Receptacle Interface Pin Assignments for USB 2.0-only Support	
Table 3-6 USB Type-C Standard Cable Wire Assignments	
Table 3-7 USB Type-C Cable Wire Assignments for Legacy Cables/Adapters	
Table 3-8 Reference Wire Gauges for standard USB Type-C Cable Assemblies	
Table 3-9 Reference Wire Gauges for USB Type-C to Legacy Cable Assemblies	
Table 3-10 USB Full-Featured Type-C Standard Cable Assembly Wiring	
Table 3-11 USB 2.0 Type-C Standard Cable Assembly Wiring	
Table 3-12 USB Type-C to USB 3.1 Standard-A Cable Assembly Wiring	
Table 3-13 USB Type-C to USB 2.0 Standard-A Cable Assembly Wiring	
Copyright © 2016 USB 3.0 Promoter Group. All rights reserved.	