

**SLOVENSKI STANDARD  
SIST EN IEC 62680-1-3:2021****01-december-2021****Nadomešča:  
SIST EN IEC 62680-1-3:2019**

---

**Vmesniki univerzalnega serijskega vodila za prenos podatkov in napajanje - 1-3.  
del: Skupne komponente - Specifikacija za kable in priključke univerzalnega  
serijskega vodila tipa C® (IEC 62680-1-3:2021)**

Universal serial bus interfaces for data and power - Part 1-3: Common components -  
USB Type-C® Cable and Connector Specification (IEC 62680-1-3:2021)

**iTeh STANDARD PREVIEW**

Schnittstellen des Universellen Seriellen Busses für Daten und Energie - Teil 1-3:  
Gemeinsame Bauteile - Festlegung für USB-Typ-C™-Kabel und -Steckverbinder  
(IEC 62680-1-3:2021)

[SIST EN IEC 62680-1-3:2021](#)

<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-1ec774cc78b7>  
Interfaces de bus universel en série pour les données et l'alimentation électrique - Partie  
1-3: Composants communs - Spécification des câbles et connecteurs USB Type-C(r)  
(IEC 62680-1-3:2021)

**Ta slovenski standard je istoveten z: EN IEC 62680-1-3:2021**

---

**ICS:**

35.200	Vmesniška in povezovalna oprema	Interface and interconnection equipment
--------	------------------------------------	--

**SIST EN IEC 62680-1-3:2021**

**en,fr,de**

## iTeh STANDARD PREVIEW (standards.iteh.ai)

[SIST EN IEC 62680-1-3:2021](#)

<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021>

**EUROPEAN STANDARD**  
**NORME EUROPÉENNE**  
**EUROPÄISCHE NORM**

**EN IEC 62680-1-3**

March 2021

ICS 33.120.20; 33.120.30; 35.200

Supersedes EN IEC 62680-1-3:2018 and all of its  
amendments and corrigenda (if any)

## English Version

**Universal serial bus interfaces for data and power - Part 1-3:  
 Common components - USB Type-C(r) Cable and Connector  
 Specification  
 (IEC 62680-1-3:2021)**

Interfaces de bus universel en série pour les données et  
 l'alimentation électrique - Partie 1-3: Composants communs  
 - Spécification des câbles et connecteurs USB Type-C(r)  
 (IEC 62680-1-3:2021)

Schnittstellen des Universellen Seriellen Busses für Daten  
 und Energie - Teil 1-3: Gemeinsame Bauteile - Festlegung  
 für USB-Typ-CTM-Kabel und -Steckverbinder  
 (IEC 62680-1-3:2021)

This European Standard was approved by CENELEC on 2021-03-23. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

**THE STANDARD PREVIEW**  
**(Standards.iteh.ai)**

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.  
<https://standards.iteh.ai/catalog/standards/sist-en-iec-62680-1-3-2021>

c9c17b73f0e4/sist-en-iec-62680-1-3-2021

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization  
 Comité Européen de Normalisation Electrotechnique  
 Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

**EN IEC 62680-1-3:2021 (E)****European foreword**

The text of document 100/3439/CDV, future edition 4 of IEC 62680-1-3, prepared by IEC/TC 100 "Audio, video and multimedia systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62680-1-3:2021.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-12-23
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2024-03-23

This document supersedes EN IEC 62680-1-3:2018 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

**Endorsement notice****iTeh STANDARD PREVIEW**

The text of the International Standard IEC 62680-1-3:2021 was approved by CENELEC as a European Standard without any modification.  
[standards.iteh.ai](https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021)

[SIST EN IEC 62680-1-3:2021](#)

<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021>



# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



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

**SIST EN IEC 62680-1-3:2021**  
**Interfaces de bus universel en série pour les données et l'alimentation**  
**électrique –**  
**Partie 1-3: Composants communs – Spécification des câbles et connecteurs**  
**USB Type-C®**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

**Warning! Make sure that you obtained this publication from an authorized distributor.**  
**Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## 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 co-operation 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 interested 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.  
SIST EN IEC 62680-1-3:2021  
IEC 62680-1-3:2021  
IEC 62680-1-3:2021  
IEC 62680-1-3:2021  
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 18: Multimedia home systems and applications for end-user networks, of IEC technical committee 100: Audio, video and multimedia systems and equipment.

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 International Standard is based on the following documents:

CDV	Report on voting
100/3439/CDV	100/3501/RVC

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

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

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

**IMPORTANT – The "colour inside" logo on the cover page of this document 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.**

SIST EN IEC 62680-1-3:2021  
<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021>

## 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 Universal Serial Bus Type-C Cable and Connector Specification Revision 2.0.

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:

<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021>

<https://www.usb.org/documents>

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 STANDARD PREVIEW  
([standards.iteh.ai](https://standards.iteh.ai))

Release 2.0  
August 2019

[SIST EN IEC 62680-1-3:2021](#)  
<https://standards.iteh.ai/catalog/standards/sist/dab1b057-69e1-419f-bdd2-c9c17b73f0e4/sist-en-iec-62680-1-3-2021>

**Copyright © 2014-2019, USB 3.0 Promoter Group:  
 Apple Inc., Hewlett-Packard Inc., 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.

## iTeh STANDARD PREVIEW

### INTELLECTUAL PROPERTY DISCLAIMER

(standards.iteh.ai)

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®, USB-C®, USB 2.0 Type-C™ and USB4™ are trademarks of the Universal Serial Bus Implementers Forum (USB-IF). DisplayPort™ is a trademark of VESA. All product names are trademarks, registered trademarks, or service marks of their respective owners.

Thunderbolt™ is a trademark of Intel Corporation. You may only use the Thunderbolt™ trademark or logo in conjunction with products designed to this specification that complete proper certification and executing a Thunderbolt™ trademark license – see [usb.org/compliance](http://usb.org/compliance) for further information.

## CONTENTS

Specification Work Group Chairs / Specification Editors .....	19
Specification Work Group Contributors .....	19
Pre-Release Draft Industry Reviewing Companies That Provided Feedback.....	24
Revision History.....	25
<b>1</b> Introduction .....	26
1.1 Purpose .....	26
1.2 Scope.....	26
1.3 Related Documents .....	27
1.4 Conventions.....	27
1.4.1 Precedence .....	27
1.4.2 Keywords .....	27
1.4.3 Numbering.....	28
1.5 Terms and Abbreviations .....	28
<b>2</b> Overview .....	33
2.1 Introduction .....	33
2.2 USB Type-C Receptacles, Plugs and Cables.....	34
2.3 Configuration Process .....	35
2.3.1 Source-to-Sink (Source-to-Sink) Detection and Establishing the Data (Host-to-Device) Relationship.....	36
2.3.2 Plug Orientation/Cable Twist Detection.....	36
2.3.3 Initial Power (Source-to-Sink) Detection and Establishing the Data (Host-to-Device) Relationship.....	36
2.3.4 USB Type-C VBUS Current Detection and Usage .....	37
2.3.5 USB PD Communication.....	37
2.3.6 Functional Extensions.....	38
2.4 VBUS.....	38
2.5 VCONN .....	39
2.6 Hubs .....	39
<b>3</b> Mechanical .....	40
3.1 Overview .....	40
3.1.1 Compliant Connectors.....	40
3.1.2 Compliant Cable Assemblies.....	40
3.1.3 Compliant USB Type-C to Legacy Cable Assemblies .....	40
3.1.4 Compliant USB Type-C to Legacy Adapter Assemblies .....	41
3.2 USB Type-C Connector Mating Interfaces .....	41
3.2.1 Interface Definition .....	42
3.2.2 Reference Designs .....	63
3.2.3 Pin Assignments and Descriptions.....	70
3.3 Cable Construction and Wire Assignments.....	71
3.3.1 Cable Construction (Informative) .....	71
3.3.2 Wire Assignments .....	73
3.3.3 Wire Gauges and Cable Diameters (Informative).....	74
3.4 Standard USB Type-C Cable Assemblies .....	76

3.4.1	USB Full-Featured Type-C Cable Assembly .....	76
3.4.2	USB 2.0 Type-C Cable Assembly.....	77
3.4.3	USB Type-C Captive Cable Assemblies.....	78
3.5	Legacy Cable Assemblies .....	78
3.5.1	USB Type-C to <i>USB 3.1 Standard-A</i> Cable Assembly .....	79
3.5.2	USB Type-C to <i>USB 2.0 Standard-A</i> Cable Assembly .....	80
3.5.3	USB Type-C to <i>USB 3.1 Standard-B</i> Cable Assembly .....	81
3.5.4	USB Type-C to <i>USB 2.0 Standard-B</i> Cable Assembly .....	82
3.5.5	USB Type-C to <i>USB 2.0 Mini-B</i> Cable Assembly .....	83
3.5.6	USB Type-C to <i>USB 3.1 Micro-B</i> Cable Assembly.....	84
3.5.7	USB Type-C to <i>USB 2.0 Micro-B</i> Cable Assembly.....	86
3.6	Legacy Adapter Assemblies .....	87
3.6.1	USB Type-C to <i>USB 3.1 Standard-A</i> Receptacle Adapter Assembly .....	87
3.6.2	USB Type-C to <i>USB 2.0 Micro-B</i> Receptacle Adapter Assembly.....	89
3.7	Electrical Characteristics .....	90
3.7.1	Raw Cable (Informative) .....	90
3.7.2	USB Type-C to Type-C Passive Cable Assemblies (Normative) .....	91
3.7.3	Mated Connector (Informative – <i>USB 3.2 Gen2</i> and <i>USB4 Gen2</i> ) .....	109
3.7.4	Mated Connector (Normative – <i>USB4 Gen3</i> ) .....	113
3.7.5	USB Type-C to Legacy Cable Assemblies (Normative) .....	114
3.7.6	USB Type-C to <i>USB Legacy Adapter</i> Assemblies (Normative) .....	118
3.7.7	Shielding Effectiveness Requirements (Normative).....	120
3.7.8	DC Electrical Requirements (Normative).....	122
3.8	Mechanical and Environmental Requirements (Normative).....	125
3.8.1	Mechanical Requirements.....	125
3.8.2	Environmental Requirements .....	130
3.9	Docking Applications (Informative) .....	131
3.10	Implementation Notes and Design Guides .....	132
3.10.1	EMC Management (Informative) .....	132
3.10.2	Stacked and Side-by-Side Connector Physical Spacing (Informative) .....	134
3.10.3	Cable Mating Considerations (Informative).....	135
4	Functional .....	136
4.1	Signal Summary.....	136
4.2	Signal Pin Descriptions .....	136
4.2.1	SuperSpeed USB Pins .....	136
4.2.2	USB 2.0 Pins .....	137
4.2.3	Auxiliary Signal Pins.....	137
4.2.4	Power and Ground Pins .....	137
4.2.5	Configuration Pins .....	137
4.3	Sideband Use (SBU) .....	137
4.4	Power and Ground.....	137
4.4.1	IR Drop .....	137
4.4.2	VBUS .....	138
4.4.3	VCONN.....	141

4.5	Configuration Channel (CC).....	145
4.5.1	Architectural Overview .....	145
4.5.2	CC Functional and Behavioral Requirements .....	159
4.5.3	USB Port Interoperability Behavior.....	194
4.6	Power .....	213
4.6.1	Power Requirements during USB Suspend.....	214
4.6.2	VBUS Power Provided Over a USB Type-C Cable .....	215
4.7	USB Hubs .....	220
4.8	Power Sourcing and Charging.....	220
4.8.1	DFP as a Power Source .....	221
4.8.2	Non-USB Charging Methods .....	223
4.8.3	Sinking Host .....	224
4.8.4	Sourcing Device.....	224
4.8.5	Charging a System with a Dead Battery .....	224
4.8.6	USB Type-C Multi-Port Chargers .....	224
4.9	Electronically Marked Cables.....	227
4.9.1	Parameter Values .....	228
4.9.2	Active Cables.....	229
4.10	<b>iTech STANDARD PREVIEW</b> <b>(standards.iteh.ai)</b> VCONN-Powered Accessories (VPAs) and VCONN-Powered USB Devices (VPDs).....	229
4.10.1	VCONN-Powered Accessories (VPAs) .....	229
4.10.2	VCONN-Powered USB Devices (VPDs) .....	229
4.11	Parameter Values.....	231
4.11.1	Termination Parameters..... <a href="https://standards.iteh.cat/standards/sist/dab1b057-69e1-419fbfd2">https://standards.iteh.cat/standards/sist/dab1b057-69e1-419fbfd2</a> .....	231
4.11.2	Timing Parameters..... <a href="https://standards.iteh.cat/standards/sist-en-iec-62680-1-3-2021">https://standards.iteh.cat/standards/sist-en-iec-62680-1-3-2021</a> .....	233
4.11.3	Voltage Parameters.....	236
5	USB4 Discovery and Entry .....	238
5.1	Overview of the Discovery and Entry Process.....	238
5.2	USB4 Functional Requirements.....	239
5.2.1	USB4 Host Functional Requirements .....	239
5.2.2	USB4 Device Functional Requirements .....	239
5.2.3	USB4 Alternate Mode Support.....	239
5.2.3.1	USB4 Alternate Mode Support on Hosts.....	239
5.2.3.2	USB4 Alternate Mode Support on Hubs and USB4-based Docks.....	239
5.3	USB4 Power Requirements.....	240
5.3.1	Source Power Requirements.....	240
5.3.2	Sink Power Requirements .....	240
5.3.3	Device Power Management Requirements .....	240
5.4	USB4 Discovery and Entry Flow Requirements .....	241
5.4.1	USB Type-C Initial Connection .....	241
5.4.2	USB Power Delivery Contract.....	241
5.4.3	USB4 Discovery and Entry Flow .....	241
5.4.3.1	USB4 Device Discovery (SOP).....	242
5.4.3.2	USB4 Cable Discovery (SOP').....	243
5.4.3.3	USB4 Operational Entry .....	245

5.4.4	USB4 Post-Entry Operation.....	245
5.4.4.1	During USB4 Operation .....	245
5.4.4.2	Exiting USB4 Operation.....	245
5.5	USB4 Hub Connection Requirements .....	246
5.5.1	USB4 Hub Port Initial Connection Requirements.....	246
5.5.2	USB4 Hub UFP and Host Capabilities Discovery.....	246
5.5.3	Hub DFP Connection Requirements.....	247
5.5.3.1	Speculative Connections .....	247
5.5.3.2	Operational Connections.....	247
5.5.4	Hub Ports Connection Behavior Flow Model .....	247
5.5.5	Connecting to Downstream USB4 Hubs.....	253
5.5.6	Fallback Functional Requirements for USB4 Hubs .....	253
5.6	USB4 Device Connection Requirements .....	254
5.6.1	Fallback Mapping of USB4 Peripheral Functions to USB Device Class Types..	254
5.7	Parameter Values.....	255
5.7.1	Timing Parameters.....	255
6	Active Cables.....	256
6.1	USB Type-C State Machine .....	257
6.2	USB PD Requirements .....	258
6.2.1	Active Cable USB PD Requirements .....	259
6.2.2	USB PD Messages for OIAC .....	259
6.2.3	Short Active Cable Behaviors in Response to Power Delivery Events .....	271
6.3	OIAC Connection Flow and State Diagrams.....	271
6.3.1	OIAC Connection Flow – Discovery – Phase 1.....	272
6.3.2	OIAC Connection Flow – Reboot – Phase 2 .....	273
6.3.3	OIAC Connection Flow – Configuration – Phase 3 .....	274
6.3.4	OIAC Connection State Diagram Master .....	277
6.3.5	OIAC Connection State Diagram Slave .....	285
6.4	Active Cable Power Requirements .....	290
6.4.1	VBUS Requirements .....	290
6.4.2	OIAC VBUS Requirements.....	290
6.4.3	USB PD Rules in Active State .....	291
6.4.4	VCONN Requirements .....	292
6.5	Mechanical .....	293
6.5.1	Thermal .....	293
6.5.2	Plug Spacing .....	293
6.6	Electrical Requirements .....	294
6.6.1	Shielding Effectiveness Requirement.....	294
6.6.2	Low Speed Signal Requirement.....	294
6.6.3	USB 2.0.....	294
6.6.4	USB 3.2.....	295
6.6.5	Return Loss .....	301
6.7	Active Cables That Support Alternate Modes.....	302
6.7.1	Discover SVIDs .....	302

6.7.2	Discover Modes .....	302
6.7.3	Enter/Exit Modes .....	302
6.7.4	Power in Alternate Modes .....	302
A	Audio Adapter Accessory Mode .....	303
A.1	Overview .....	303
A.2	Detail .....	303
A.3	Electrical Requirements .....	304
A.4	Example Implementations .....	306
A.4.1	Passive 3.5 mm to USB Type-C Adapter – Single Pole Detection Switch .....	306
A.4.2	3.5 mm to USB Type-C Adapter Supporting 500 mA Charge-Through .....	306
B	Debug Accessory Mode .....	308
B.1	Overview .....	308
B.2	Functional .....	308
B.2.1	Signal Summary .....	309
B.2.2	Port Interoperability .....	309
B.2.3	Debug Accessory Mode Entry .....	309
B.2.4	Connection State Diagrams .....	310
B.2.5	DTS Port Interoperability Behavior .....	318
B.2.6	Orientation Detection .....	327
B.3	Security/Privacy Requirements .....	328
C	USB Type-C Digital Audio .....	329
C.1	Overview .....	329
C.2	USB Type-C Digital Audio Specifications .....	329
D	Thermal Design Considerations for Active Cables .....	331
D.1	Introduction .....	331
D.2	Model .....	331
D.2.1	Assumptions .....	331
D.2.2	Model Architecture .....	332
D.2.3	Heat Sources .....	333
D.2.4	Heat Flow .....	333
D.3	USB 3.2 Single Lane Active Cable .....	334
D.3.1	USB 3.2 Single-Lane Active Cable Design Considerations .....	334
D.4	Dual-Lane Active Cables .....	337
D.4.1	USB 3.2 Dual-Lane Active Cable Design Considerations .....	337
D.4.2	USB 3.2 Dual-Lane Active Cable in a Multi-Port Configuration .....	339
D.5	USB 3.2 Host and Device Design Considerations .....	341
D.5.1	Heat Spreading or Heat Sinking from Host or Device .....	341
D.5.2	Motherboard Temperature Control .....	342
D.5.3	Wider Port Spacing for Multi-Port Applications .....	342
D.5.4	Power Policies .....	342
E	Alternate Modes .....	343
E.1	Alternate Mode Architecture .....	343
E.2	Alternate Mode Requirements .....	343
E.2.1	Alternate Mode Pin Reassignment .....	344