



# SLOVENSKI STANDARD

## SIST EN 62680-1-3:2017

01-maj-2017

---

**Vmesniki univerzalnega serijskega vodila za prenos podatkov in napajanje - 1-3.  
del: Vmesniki univerzalnega serijskega vodila - Skupne komponente - Specifikacija  
za kable in priključke univerzalnega serijskega vodila tipa CTM, revizija 1.1**

Universal Serial Bus interfaces for data and power - Part 1-3: Universal Serial Bus  
interfaces - common components - Universal Serial Bus Type-CTM Cable and Connector  
Specification, Revision 1.1

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

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

[https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-  
3b56e90a1616/sist-en-62680-1-3-2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

**Ta slovenski standard je istoveten z: EN 62680-1-3:2016**

---

**ICS:**

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

**SIST EN 62680-1-3:2017**

**en,fr,de**

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

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>

EUROPEAN STANDARD

**EN 62680-1-3**

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2016

ICS 33.120.20; 33.120.30; 35.200

English Version

Universal serial bus interfaces for data and power - Part 1-3:  
Universal Serial Bus interfaces - Common components - USB  
Type-C™ cable and connector specification  
(IEC 62680-1-3:2016)

Interfaces de bus universel en série pour les données et  
l'alimentation électrique - Partie 1-3 : Interfaces de bus  
universel en série - Composants communs - Spécification  
des câbles et connecteurs de type C™ de bus universel en  
série  
(IEC 62680-1-3:2016)

Universelle serielle Bus Schnittstellen für Daten und  
Energie - Teil 1-3: Universelle serielle Bus Schnittstellen -  
Gemeinsame Komponenten - USB-Typ-C™ Kabel und  
Steckverbinder Spezifikation  
(IEC 62680-1-3:2016)

This European Standard was approved by CENELEC on 2016-09-21. 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.

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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, 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: Avenue Marnix 17, B-1000 Brussels**

**EN 62680-1-3:2016****European foreword**

The text of document 100/2587/CDV, future edition 1 of IEC 62680-1-3, prepared by Technical Area 14 "Interfaces and methods of measurement for personal computing equipment" of IEC/TC 100 "Audio, video and multimedia systems and equipment" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62680-1-3:2016.

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) 2017-06-21
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2019-09-21

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

**Endorsement notice**

The text of the International Standard IEC 62680-1-3:2016 was approved by CENELEC as a European Standard without any modification.

**ITEH STANDARD PREVIEW**  
**(standards.iteh.ai)**

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>



IEC 62680-1-3

Edition 1.0 2016-08

# INTERNATIONAL STANDARD



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

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

ICS 33.120.20; 33.120.30; 35.200

ISBN 978-2-8322-3603-1

**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: Universal Serial Bus interfaces –  
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. 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.

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.

IEC 62680-1-3:2016 © IEC 2016  
© USB-IF:2015

– 3 –

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

CDV	Report on voting
100/2587/CDV	100/2681/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.

A list of all 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.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.**

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>

## 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 1.1.

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 SPECIFICATION.**

### iTeh STANDARD PREVIEW

**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.**

SIST EN 62680-1-3:2017

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/devclass\\_docs#approved](http://www.usb.org/developers/docs/http://www.usb.org/developers/devclass_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

**Revision 1.1  
April 3, 2015**

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

[SIST EN 62680-1-3:2017](#)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>

**Copyright © 2014-2015, 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.

**(standards.iteh.ai)**

[SIST EN 62680-1-3:2017](https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017)

<https://standards.iteh.ai/catalog/standards/sist/5b6f3040-29fd-4706-bf6b-3b56e90a1616/sist-en-62680-1-3-2017>

#### 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

FOREWORD.....	2
INTRODUCTION.....	4
Specification Work Group Chairs / Specification Editors.....	15
Specification Work Group Contributors.....	15
Pre-Release Draft Industry Reviewing Companies That Provided Feedback.....	17
Revision History.....	17
1 Introduction.....	18
1.1 Purpose.....	18
1.2 Scope.....	18
1.3 Related Documents.....	19
1.4 Conventions.....	19
1.4.1 Precedence.....	19
1.4.2 Keywords.....	19
1.4.3 Numbering.....	20
1.5 Terms and Abbreviations.....	21
2 Overview.....	22
2.1 Introduction.....	22
2.2 USB Type-C Receptacles, Plugs and Cables.....	23
2.3 Configuration Process.....	25
2.3.1 DFP-to-UFP Attach/Detach Detection.....	25
2.3.2 Plug Orientation/Cable Twist Detection.....	25
2.3.3 Initial DFP-to-UFP (host-to-device) and Power Relationships Detection.....	25
2.3.4 USB Type-C VBUS Current Detection and Usage.....	26
2.3.5 USB PD Communication.....	27
2.3.6 Functional Extensions.....	27
2.4 Vbus.....	27
2.5 Vconn.....	28
2.6 Hubs.....	28
3 Mechanical.....	28
3.1 Overview.....	28
3.1.1 Compliant Connectors.....	28
3.1.2 Compliant Cable Assemblies.....	28
3.1.3 Compliant USB Type-C to Legacy Cable Assemblies.....	29
3.1.4 Compliant USB Type-C to Legacy Adapter Assemblies.....	29
3.2 USB Type-C Connector Mating Interfaces.....	30
3.2.1 Interface Definition.....	30
3.2.2 Reference Designs.....	45
3.2.3 Pin Assignments and Descriptions.....	52
3.3 Cable Construction and Wire Assignments.....	54
3.3.1 Cable Construction (Informative).....	54
3.3.2 Wire Assignments.....	55
3.3.3 Wire Gauges and Cable Diameters (Informative).....	57
3.4 Standard USB Type-C Cable Assemblies.....	58
3.4.1 USB Full-Featured Type-C Cable Assembly.....	58
3.4.2 USB 2.0 Type-C Cable Assembly.....	60

3.4.3	USB Type-C Captive Cable Assemblies .....	60
3.5	Legacy Cable Assemblies .....	60
3.5.1	USB Type-C to <i>USB 3.1</i> Standard-A Cable Assembly .....	61
3.5.2	USB Type-C to <i>USB 2.0</i> Standard-A Cable Assembly .....	61
3.5.3	USB Type-C to <i>USB 3.1</i> Standard-B Cable Assembly .....	62
3.5.4	USB Type-C to <i>USB 2.0</i> Standard-B Cable Assembly .....	63
3.5.5	USB Type-C to <i>USB 2.0</i> Mini-B Cable Assembly .....	64
3.5.6	USB Type-C to <i>USB 3.1</i> Micro-B Cable Assembly .....	65
3.5.7	USB Type-C to <i>USB 2.0</i> Micro-B Cable Assembly .....	66
3.6	Legacy Adapter Assemblies .....	67
3.6.1	USB Type-C to <i>USB 3.1</i> Standard-A Receptacle Adapter Assembly .....	67
3.6.2	USB Type-C to <i>USB 2.0</i> Micro-B Receptacle Adapter Assembly .....	69
3.7	Electrical Characteristics .....	69
3.7.1	Raw Cable (Informative) .....	70
3.7.2	Mated Connector (Normative) .....	71
3.7.3	USB Type-C to Type-C Passive Cable Assemblies (Normative) .....	75
3.7.4	USB Type-C to Legacy Cable Assemblies (Normative) .....	86
3.7.5	USB Type-C to USB Legacy Adapter Assemblies (Normative) .....	89
3.7.6	Shielding Effectiveness Requirements (Normative) .....	91
3.7.7	DC Electrical Requirements (Normative) .....	92
3.8	Mechanical and Environmental Requirements (Normative) .....	93
3.8.1	Mechanical Requirements .....	94
3.8.2	Environmental Requirements .....	97
3.9	Docking Applications (Informative) .....	98
3.10	Implementation Notes and Design Guides .....	99
3.10.1	EMC Management (Informative) .....	99
3.10.2	Stacked and Side-by-Side Connector Physical Spacing (Informative) .....	101
3.10.3	Cable Mating Considerations (Informative) .....	102
4	Functional .....	103
4.1	Signal Summary .....	103
4.2	Signal Pin Descriptions .....	103
4.2.1	SuperSpeed USB Pins .....	103
4.2.2	USB 2.0 Pins .....	104
4.2.3	Auxiliary Signal Pins .....	104
4.2.4	Power and Ground Pins .....	104
4.2.5	Configuration Pins .....	104
4.3	Sideband Use (SBU) .....	104
4.4	Power and Ground .....	104
4.4.1	IR Drop .....	104
4.4.2	VBUS .....	105
4.4.3	VCONN .....	106
4.5	Configuration Channel (CC) .....	107
4.5.1	Architectural Overview .....	107
4.5.2	CC Functional and Behavioral Requirements .....	116
4.5.3	USB Port Interoperability Behavior .....	134
4.6	Power .....	144
4.6.1	Power Requirements during USB Suspend .....	145

4.6.2	VBUS Power Provided Over a USB Type-C Cable .....	145
4.6.3	Supporting USB PD BFSK in Addition to USB PD BMC .....	148
4.7	USB Hubs .....	149
4.8	Chargers.....	149
4.8.1	DFP as a Power Source .....	149
4.8.2	Non-USB Charging Methods.....	150
4.8.3	Sinking DFP.....	151
4.8.4	Charging UFP .....	151
4.8.5	Charging a System with a Dead Battery.....	151
4.9	Electronically Marked Cables.....	151
4.10	Vconn-Powered Accessories .....	153
4.11	Parameter Values .....	153
4.11.1	Termination Parameters .....	153
4.11.2	Timing Parameters.....	154
4.11.3	Voltage Parameters .....	156
4.12	Summary of Ports by Product Type.....	157
5	Functional Extensions.....	160
5.1	Alternate Modes.....	160
5.1.1	Alternate Mode Architecture .....	160
5.1.2	Alternate Mode Requirements .....	160
5.1.3	Parameter Values .....	162
5.1.4	Example Alternate Mode – USB/PCIe Dock .....	162
5.2	Managed Active Cables.....	165
5.2.1	Requirements for Managed Active Cables that respond to SOP' and SOP" .....	165
5.2.2	Cable Message Structure.....	167
5.2.3	Modal Cable Management.....	167
A	Audio Adapter Accessory Mode.....	168
A.1	Overview.....	168
A.2	Detail.....	168
A.3	Electrical Requirements.....	169
A.4	Example Implementations.....	171
A.4.1	Passive 3,5 mm to USB Type-C Adapter – Single Pole Detection Switch .....	171
A.4.2	3,5 mm to USB Type-C Adapter Supporting 500 mA Charge-Through.....	171
B	Debug Accessory Mode .....	173
Figure 2-1 – USB Type-C Receptacle Interface (Front View).....		23
Figure 2-2 – USB Full-Featured Type-C Plug Interface (Front View).....		23
Figure 3-1 – USB Type-C Receptacle Interface Dimensions .....		32
Figure 3-2 – Reference Design USB Type-C Plug External EMC Spring Contact Zones .....		34
Figure 3-3 – USB Full-Featured Type-C Plug Interface Dimensions.....		35
Figure 3-4 – Reference Footprint for a USB Type-C Vertical Mount Receptacle (Informative).....		38
Figure 3-5 – Reference Footprint for a USB Type-C Dual-Row SMT Right Angle Receptacle (Informative).....		39
Figure 3-6 – Reference Footprint for a USB Type-C Hybrid Right-Angle Receptacle (Informative).....		40

Figure 3-7 – Reference Footprint for a USB Type-C Mid-Mount Dual-Row SMT Receptacle (Informative).....	41
Figure 3-8 – Reference Footprint for a USB Type-C Mid-Mount Hybrid Receptacle (Informative).....	42
Figure 3-9 – <i>USB 2.0</i> Type-C Plug Interface Dimensions .....	43
Figure 3-10 – Reference Design of Receptacle Mid-Plate .....	46
Figure 3-11 – Reference Design of the Retention Latch .....	47
Figure 3-12 – Illustration of the Latch Soldered to the Paddle Card Ground.....	47
Figure 3-13 – Reference Design of the USB Full-Featured Type-C Plug Internal EMC Spring .....	48
Figure 3-14 – Reference Design of the <i>USB 2.0</i> Type-C Plug Internal EMC Spring.....	49
Figure 3-15 – Reference Design of Internal EMC Pad .....	50
Figure 3-16 – Reference Design of a USB Type-C Receptacle with External EMC Springs.....	51
Figure 3-17 – Reference Design for a USB Full-Featured Type-C Plug Paddle Card.....	52
Figure 3-18 – Illustration of a USB Full-Featured Type-C Cable Cross Section, a Coaxial Wire Example with VCONN.....	55
Figure 3-19 – Illustration of a USB Full-Featured Type-C Cable Cross Section, a Coaxial Wire Example without VCONN.....	55
Figure 3-20 – USB Full-Featured Type-C Standard Cable Assembly.....	59
Figure 3-21 – USB Type-C to USB 3.1 Standard-A Cable Assembly.....	61
Figure 3-22 – USB Type-C to <i>USB 2.0</i> Standard-A Cable Assembly.....	62
Figure 3-23 – USB Type-C to <i>USB 3.1</i> Standard-B Cable Assembly.....	62
Figure 3-24 – USB Type-C to <i>USB 2.0</i> Standard-B Cable Assembly.....	63
Figure 3-25 – USB Type-C to <i>USB 2.0</i> Mini-B Cable Assembly .....	64
Figure 3-26 – USB Type-C to <i>USB 3.1</i> Micro-B Cable Assembly .....	65
Figure 3-27 – USB Type-C to <i>USB 2.0</i> Micro-B Cable Assembly .....	66
Figure 3-28 – USB Type-C to <i>USB 3.1</i> Standard-A Receptacle Adapter Assembly.....	68
Figure 3-29 – USB Type-C to <i>USB 2.0</i> Micro-B Receptacle Adapter Assembly .....	69
Figure 3-30 – Illustration of USB Type-C Mated Connector .....	71
Figure 3-31 – Recommended Impedance Limits of a USB Type-C Mated Connector.....	71
Figure 3-32 – Recommended Ground Void Dimensions for USB Type-C Receptacle.....	72
Figure 3-33 – Recommended Differential Insertion Loss Limits .....	72
Figure 3-34 – Recommended Differential Return Loss Limits .....	73
Figure 3-35 – Recommended Differential Crosstalk Limits between SuperSpeed Pairs .....	73
Figure 3-36 – Recommended Differential Near-End and Far-End Crosstalk Limits between D+/D- Pair and SuperSpeed Pairs.....	74
Figure 3-37 – Recommended Limits for Differential-to-Common-Mode Conversion .....	74
Figure 3-38 – Illustration of Test Points for a Mated Cable Assembly .....	75
Figure 3-39 – Recommended Differential Insertion Loss Requirement.....	75
Figure 3-40 – Recommended Differential Return Loss Requirement.....	76
Figure 3-41 – Recommended Differential Crosstalk Requirement.....	76
Figure 3-42 – Recommended Differential Near-End and Far-End Crosstalk Requirement between USB D+/D- Pair and USB SuperSpeed Pair .....	77

Figure 3-43 – Illustration of Insertion Loss Fit at Nyquist Frequency.....	78
Figure 3-44 – Input Pulse Spectrum .....	79
Figure 3-45 – IMR Limit as Function of ILfitatNq .....	79
Figure 3-46 – IRL Limit as Function of ILfitatNq .....	81
Figure 3-47 – Differential-to-Common-Mode Conversion Requirement.....	81
Figure 3-48 – Requirement for Differential Coupling between CC and D+/D- .....	82
Figure 3-49 – Requirement for Single-Ended Coupling between CC and D- in USB 2.0 Type-C Cables.....	83
Figure 3-50 – Requirement for Single-Ended Coupling between CC and D- in USB Full-Featured Type-C Cables .....	83
Figure 3-51 – Requirement for Differential Coupling between VBUS and D+/D- .....	84
Figure 3-52 – Requirement for Single-Ended Coupling between SBU_A and SBU_B .....	84
Figure 3-53 – Requirement for Single-Ended Coupling between SBU_A/SBU_B and CC.....	85
Figure 3-54 – Requirement for Coupling between SBU_A and differential D+/D-, and SBU_B and differential D+/D- .....	85
Figure 3-55 – IMR Limit as Function of ILfitatNq for USB Type-C to Legacy Cable Assembly.....	89
Figure 3-56 – IRL Limit as Function of ILfitatNq for USB Type-C to Legacy Cable Assembly.....	89
Figure 3-57 – Cable Assembly Shielding Effectiveness Testing.....	92
Figure 3-58 – Shielding Effectiveness Pass/Fail Criteria .....	92
Figure 3-59 – LLCR Measurement Diagram .....	93
Figure 3-60 – 4-Axis Continuity Test.....	95
Figure 3-61 – Reference Wrenching Strength Continuity Test Fixture .....	96
Figure 3-62 – Example of Wrenching Strength Test Mechanical Failure Point.....	96
Figure 3-63 – Wrenching Strength Test with Cable in Fixture .....	97
Figure 3-64 – USB Type-C Cable Receptacle Flange Example.....	99
Figure 3-65 – EMC Guidelines for Side Latch and Mid-plate.....	100
Figure 3-66 – EMC Finger Connections to Plug Shell.....	100
Figure 3-67 – EMC Pad Connections to Receptacle Shell .....	101
Figure 3-68 – Examples of Connector Apertures.....	101
Figure 3-69 – Recommended Minimum Spacing between Connectors .....	102
Figure 3-70 – Recommended Minimum Plug Overmold Clearance.....	102
Figure 3-71 – Cable Plug Overmold and an Angled Surface .....	102
Figure 4-1 – Cable IR Drop .....	105
Figure 4-2 – Cable IR Drop for powered cables .....	105
Figure 4-3 – Logical Model for Data Bus Routing across USB Type-C-based Ports.....	108
Figure 4-4 – Logical Model for USB Type-C-based Ports for the Direct Connect Device.....	109
Figure 4-5 – Pull-Up/Pull-Down CC Model .....	110
Figure 4-6 – Current Source/Pull-Down CC Model .....	110
Figure 4-7 – DFP Functional Model for CC1 and CC2 .....	113
Figure 4-8 – DFP Functional Model Supporting USB PD Provider/Consumer .....	114
Figure 4-9 – UFP Functional Model for CC1 and CC2 .....	114