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**Universal serial bus interfaces for data and power -
Part 1-2: Common components -
USB power delivery specification**

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NATIONAL FOREWORD

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EN IEC 62680-1-2

NORME EUROPÉENNE

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**Universal serial bus interfaces for data and power - Part 1-2:
Common components - USB Power Delivery specification
(IEC 62680-1-2:2024)**

Interfaces de bus universel en série pour les données et
l'alimentation électrique - Partie 1-2: Composants communs
- Spécification de l'alimentation électrique par port USB
(IEC 62680-1-2:2024)

Universelle Bus-Schnittstellen für Daten und Energie - Teil
1-2: Gemeinsame Komponenten - Festlegung für die
Energieübertragung über USB
(IEC 62680-1-2:2024)

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European foreword

The text of document 100/4138/CDV, future edition 7 of IEC 62680-1-2, prepared by TC 100/Technical Area 18 "Multimedia home systems and applications for end-user networks" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62680-1-2:2025.

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**Universal serial bus interfaces for data and power –
Part 1-2: Common components – USB Power Delivery specification**

**Interfaces de bus universel en série pour les données et l'alimentation
électrique –
Partie 1-2: Composants communs – Spécification de l'alimentation électrique
par port USB**



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électrique –
Partie 1-2: Composants communs – Spécification de l'alimentation électrique
par port USB**

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100/4138/CDV	100/4176/RVC

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Table of Contents

Contents

Universal Serial Bus 2

Power Delivery Specification..... 4

LIMITED COPYRIGHT LICENSE 5

INTELLECTUAL PROPERTY DISCLAIMER 5

Editors 6

Contributors 6

Revision History..... 13

Table of Contents 16

List of Tables..... 23

List of Figures 30

1. Introduction 38

1.1 Overview 38

1.2 Purpose..... 39

1.2.1 Scope..... 40

1.3 Section Overview..... 40

1.4 Conventions 41

1.4.1 Precedence 41

1.4.2 Keywords 41

1.4.3 Numbering 42

1.5 Related Documents..... 43

1.6 Terms and Abbreviations..... 45

1.7 Parameter Values 55

1.8 Changes from Revision 3.0..... 55

1.9 Compatibility with Revision 2.0 55

2. Overview 56

2.1 Introduction..... 56

2.1.1 Power Delivery Source Operational Contracts..... 56

2.1.2 Power Delivery Contracts..... 56

2.1.3 Other Uses for Power Delivery 57

2.2 Compatibility with Revision 2.0 58

2.3 USB Power Delivery Capable Devices 58

2.4 SOP* Communication 60

2.4.1 Introduction..... 60

2.4.2 SOP* Collision Avoidance..... 60

2.4.3 SOP Communication 60

2.4.4 SOP'/SOP'' Communication with Cable Plugs..... 60

2.5 Operational Overview 62

2.5.1 Source Operation..... 62

2.5.2 Sink Operation..... 65

2.5.3	Cable Plugs	68
2.6	Architectural Overview	69
2.6.1	Policy	72
2.6.2	Message Formation and Transmission	73
2.6.3	Collision Avoidance	74
2.6.4	Power supply	74
2.6.5	DFP/UFP	75
2.6.6	Cable and Connectors	75
2.6.7	Interactions between Non-PD, BC, and PD devices	75
2.6.8	Power Rules	76
2.7	Extended Power Range (EPR) Operation	77
2.8	Charging Models	79
2.8.1	Fixed Voltage Charging Models	79
2.8.2	Programmable Power Supply (PPS) Charging Models	79
2.8.3	Adjustable Voltage Supply (AVS) Charging Models	80
3.	USB Type-A and USB Type-B Cable Assemblies and Connectors	81
4.	Electrical Requirements	82
4.1	Interoperability with other USB Specifications	82
4.2	Dead Battery Detection / Unpowered Port Detection	82
4.3	Cable IR Ground Drop (IR Drop)	82
4.4	Cable Type Detection	82
5.	Physical Layer	84
5.1	Physical Layer Overview	84
5.2	Physical Layer Functions	84
5.3	Symbol Encoding	85
5.4	Ordered Sets	86
5.5	Transmitted Bit Ordering	88
5.6	Packet Format	89
5.6.1	Packet Framing	89
5.6.2	CRC	92
5.6.3	Packet Detection Errors	94
5.6.4	Hard Reset	94
5.6.5	Cable Reset	95
5.7	Collision Avoidance	96
5.8	Biphase Mark Coding (BMC) Signaling Scheme	97
5.8.1	Encoding and signaling	97
5.8.2	Transmit and Receive Masks	101
5.8.3	Transmitter Load Model	109
5.8.4	BMC Common specifications	111
5.8.5	BMC Transmitter Specifications	111
5.8.6	BMC Receiver Specifications	116
5.9	Built in Self-Test (BIST)	119
5.9.1	BIST Carrier Mode	119
5.9.2	BIST Test Data	119
6.	Protocol Layer	120
6.1	Overview	120
6.2	Messages	120
6.2.1	Message Construction	120
6.3	Control Message	134

6.3.1	GoodCRC Message	135
6.3.2	GotoMin Message	135
6.3.3	Accept Message	136
6.3.4	Reject Message	136
6.3.5	Ping Message	137
6.3.6	PS_RDY Message	137
6.3.7	Get_Source_Cap Message	137
6.3.8	Get_Sink_Cap Message	137
6.3.9	DR_Swap Message	138
6.3.10	PR_Swap Message	138
6.3.11	VCONN_Swap Message	139
6.3.12	Wait Message	140
6.3.13	Soft Reset Message	141
6.3.14	Data_Reset Message	142
6.3.15	Data_Reset_Complete Message	142
6.3.16	Not_Supported Message	143
6.3.17	Get_Source_Cap_Extended Message	143
6.3.18	Get_Status Message	143
6.3.19	FR_Swap Message	143
6.3.20	Get_PPS_Status	144
6.3.21	Get_Country_Codes	144
6.3.22	Get_Sink_Cap_Extended Message	144
6.3.23	Get_Source_Info Message	144
6.3.24	Get_Revision Message	144
6.4	Data Message	145
6.4.1	Capabilities Message	146
6.4.2	Request Message	162
6.4.3	BIST Message	169
6.4.4	Vendor Defined Message	172
6.4.5	Battery_Status Message	213
6.4.6	Alert Message	215
6.4.7	Get_Country_Info Message	219
6.4.8	Enter_USB Message	220
6.4.9	EPR_Request Message	223
6.4.10	EPR_Mode Message	224
6.4.11	Source_Info Message	231
6.4.12	Revision Message	233
6.5	Extended Message	234
6.5.1	Source_Capabilities_Extended Message	236
6.5.2	Status Message	242
6.5.3	Get_Battery_Cap Message	248
6.5.4	Get_Battery_Status Message	249
6.5.5	Battery_Capabilities Message	250
6.5.6	Get_Manufacturer_Info Message	252
6.5.7	Manufacturer_Info Message	253
6.5.8	Security Messages	255
6.5.9	Firmware Update Messages	257
6.5.10	PPS_Status Message	258
6.5.11	Country_Codes Message	260
6.5.12	Country_Info Message	261
6.5.13	Sink_Capabilities_Extended Message	262

6.5.14	Extended_Control Message.....	268
6.5.15	EPR Capabilities Message.....	270
6.5.16	Vendor_Defined_Extended Message.....	272
6.6	Timers.....	274
6.6.1	CRCReceiveTimer.....	274
6.6.2	SenderResponseTimer.....	274
6.6.3	Capability Timers.....	275
6.6.4	Wait Timers and Times.....	277
6.6.5	Power Supply Timers.....	278
6.6.6	NoResponseTimer.....	280
6.6.7	BIST Timers.....	281
6.6.8	Power Role Swap Timers.....	282
6.6.9	Soft Reset Timers.....	283
6.6.10	Data Reset Timers.....	284
6.6.11	Hard Reset Timers.....	285
6.6.12	Structured VDM Timers.....	286
6.6.13	VCONN Timers.....	288
6.6.14	tCableMessage.....	288
6.6.15	DiscoverIdentityTimer.....	288
6.6.16	Collision Avoidance Timers.....	289
6.6.17	Fast Role Swap Timers.....	290
6.6.18	Chunking Timers.....	291
6.6.19	Programmable Power Supply Timers.....	293
6.6.20	tEnterUSB.....	293
6.6.21	EPR Timers.....	294
6.6.22	Time Values and Timers.....	295
6.7	Counters.....	299
6.7.1	MessageID Counter.....	299
6.7.2	Retry Counter.....	300
6.7.3	Hard Reset Counter.....	300
6.7.4	Capabilities Counter.....	300
6.7.5	Discover Identity Counter.....	300
6.7.6	VDMBusyCounter.....	300
6.7.7	Counter Values and Counters.....	301
6.8	Reset.....	302
6.8.1	Soft Reset and Protocol Error.....	302
6.8.2	Data Reset.....	304
6.8.3	Hard Reset.....	304
6.8.4	Cable Reset.....	305
6.9	Accept, Reject and Wait.....	306
6.10	Collision Avoidance.....	306
6.11	Message Discarding.....	306
6.12	State behavior.....	308
6.12.1	Introduction to state diagrams used in Chapter 6.....	308
6.12.2	State Operation.....	309
6.12.3	List of Protocol Layer States.....	331
6.13	Message Applicability.....	333
6.13.1	Applicability of Control Messages.....	334
6.13.2	Applicability of Data Messages.....	336
6.13.3	Applicability of Extended Messages.....	338
6.13.4	Applicability of Extended Control Messages.....	340

6.13.5	Applicability of Structured VDM Commands	341
6.13.6	Applicability of Reset Signaling.....	342
6.13.7	Applicability of Fast Role Swap signal.....	342
6.14	Value Parameters	343
7.	Power Supply	344
7.1	Source Requirements	344
7.1.1	Behavioral Aspects	344
7.1.2	Source Bulk Capacitance	344
7.1.3	Types of Sources	345
7.1.4	Source Transitions	346
7.1.5	Response to Hard Resets.....	359
7.1.6	Changing the Output Power Capability	360
7.1.7	Robust Source Operation	361
7.1.8	Output Voltage Tolerance and Range.....	363
7.1.9	Charging and Discharging the Bulk Capacitance on V_{BUS}	364
7.1.10	Swap Standby for Sources	364
7.1.11	Source Peak Current Operation	365
7.1.12	Source Capabilities Extended Parameters	366
7.1.13	Fast Role Swap.....	369
7.1.14	Non-application of V_{BUS} Slew Rate Limits.....	371
7.1.15	V_{CONN} Power Cycle.....	372
7.2	Sink Requirements	374
7.2.1	Behavioral Aspects	374
7.2.2	Sink Bulk Capacitance	374
7.2.3	Sink Standby.....	375
7.2.4	Suspend Power Consumption.....	375
7.2.5	Zero Negotiated Current	375
7.2.6	Transient Load Behavior.....	375
7.2.7	Swap Standby for Sinks.....	376
7.2.8	Sink Peak Current Operation.....	376
7.2.9	Robust Sink Operation	377
7.2.10	Fast Role Swap.....	379
7.3	Transitions	380
7.3.1	Transitions caused by a Request Message	382
7.3.2	Transitions Caused by Power Role Swap.....	418
7.3.3	Transitions Caused by GotoMin.....	424
7.3.4	Transitions Caused by Hard Reset.....	426
7.3.5	Transitions Caused by Fast Role Swap.....	430
7.4	Electrical Parameters	433
7.4.1	Source Electrical Parameters	433
7.4.2	Sink Electrical Parameters	441
7.4.3	Common Electrical Parameters	443
8.	Device Policy	444
8.1	Overview	444
8.2	Device Policy Manager.....	444
8.2.1	Capabilities.....	445
8.2.2	System Policy.....	446
8.2.3	Control of Source/Sink.....	446
8.2.4	Cable Detection	446
8.2.5	Managing Power Requirements.....	447

8.2.6	Use of “Unconstrained Power” bit with Batteries and AC supplies.....	449
8.2.7	Interface to the Policy Engine	451
8.3	Policy Engine	453
8.3.1	Introduction.....	453
8.3.2	Atomic Message Sequence Diagrams.....	453
8.3.3	State Diagrams.....	865
9.	States and Status Reporting	1021
9.1	Overview.....	1021
9.1.1	PDUSB Device and Hub Requirements	1023
9.1.2	Mapping to USB Device States	1024
9.1.3	PD Software Stack	1026
9.1.4	PDUSB Device Enumeration	1027
9.2	PD Specific Descriptors	1029
9.2.1	USB Power Delivery Capability Descriptor	1029
9.2.2	Battery Info Capability Descriptor	1031
9.2.3	PD Consumer Port Capability Descriptor	1032
9.2.4	PD Provider Port Capability Descriptor	1033
9.3	PD Specific Requests and Events.....	1034
9.3.1	PD Specific Requests.....	1034
9.4	PDUSB Hub and PDUSB Peripheral Device Requests.....	1035
9.4.1	GetBatteryStatus.....	1035
9.4.2	SetPDFeature.....	1036
10.	Power Rules	1039
10.1	Introduction.....	1039
10.2	Source Power Rules.....	1039
10.2.1	Source Power Rule Considerations	1039
10.2.2	Normative Voltages and Currents	1041
10.2.3	Optional Voltages/Currents.....	1051
10.2.4	Power sharing between ports.....	1060
10.3	Sink Power Rules	1061
10.3.1	Sink Power Rule Considerations.....	1061
10.3.2	Normative Sink Rules	1061
A.	CRC calculation.....	1063
A.1	C code example.....	1063
B.	PD Message Sequence Examples.....	1066
B.1	External power is supplied downstream.....	1066
B.2	External power is supplied upstream.....	1070
B.3	Giving back power	1076
C.	VDM Command Examples.....	1086
C.1	Discover Identity Example	1086
C.1.1	Discover Identity Command request.....	1086
C.1.2	Discover Identity Command response – Active Cable.....	1087
C.1.3	Discover Identity Command response – Hub.	1089
C.2	Discover SVIDs Example	1090
C.2.1	Discover SVIDs Command request.....	1090
C.2.2	Discover SVIDs Command response	1091
C.3	Discover Modes Example.....	1092
C.3.1	Discover Modes Command request.....	1092
C.3.2	Discover Modes Command response.....	1093

C.4 Enter Mode Example.....1094

 C.4.1 Enter Mode Command request1094

 C.4.2 Enter Mode Command response1095

 C.4.3 Enter Mode Command request with additional VDO1096

C.5 Exit Mode Example1097

 C.5.1 Exit Mode Command request.....1097

 C.5.2 Exit Mode Command response.....1098

C.6 Attention Example1099

 C.6.1 Attention Command request.....1099

 C.6.2 Attention Command request with additional VDO.....1100

D. BMC Receiver Design Examples1101

D.1 Finite Difference Scheme1101

 D.1.1 Sample Circuitry1101

 D.1.2 Theory.....1101

 D.1.3 Data Recovery1103

 D.1.4 Noise Zone and Detection Zone1104

D.2 Subtraction Scheme.....1105

 D.2.1 Sample Circuitry1105

 D.2.2 Output of Each Circuit Block1105

 D.2.3 Subtractor Output at Power Source and Power Sink.....1105

 D.2.4 Noise Zone and Detection Zone1106

E. FRS System Level Example1107

E.1 Overview1107

E.2 FRS Initial Setup.....1110

E.3 FRS Process.....1113

List of Tables

Table 1.1 Section Overview	40
Table 1.2 Document References	43
Table 1.3 Terms and Abbreviations	45
Table 2.1 “Fixed Voltage Power Ranges”	79
Table 2.2 “PPS Voltage Power Ranges”	80
Table 2.3 “Adjustable Voltage Supply Voltage Ranges”	80
Table 5.1 “4b5b Symbol Encoding Table”	85
Table 5.2 “Ordered Sets”	86
Table 5.3 “Validation of Ordered Sets”	87
Table 5.4 “Data Size”	88
Table 5.5 “SOP ordered set”	89
Table 5.6 “SOP’ ordered set”	90
Table 5.7 “SOP” ordered set”	90
Table 5.8 “SOP’_Debug ordered set”	91
Table 5.9 “SOP”_Debug ordered set”	91
Table 5.10 “CRC-32 Mapping”	93
Table 5.11 “Hard Reset ordered set”	94
Table 5.12 “Cable Reset ordered set”	95
Table 5.13 “R _p values used for Collision Avoidance”	96
Table 5.14 “BMC Tx Mask Definition, X Values”	102
Table 5.15 “BMC Tx Mask Definition, Y Values”	103
Table 5.16 “BMC Rx Mask Definition”	108
Table 5.17 “BMC Common Normative Requirements”	111
Table 5.18 “BMC Transmitter Normative Requirements”	112
Table 5.19 “BMC Receiver Normative Requirements”	116
Table 6.1 “Message Header”	122
Table 6.2 “Revision Interoperability during an Explicit Contract”	125
Table 6.3 “Extended Message Header”	126
Table 6.4 “Use of Unchunked Message Supported bit”	128
Table 6.5 “Control Message Types”	134
Table 6.6 “Data Message Types”	145
Table 6.7 “Power Data Object”	147
Table 6.8 “Augmented Power Data Object”	147
Table 6.9 “Fixed Supply PDO – Source”	150
Table 6.10 “Fixed Power Source Peak Current Capability”	152
Table 6.11 “Variable Supply (non-Battery) PDO – Source”	153
Table 6.12 “Battery Supply PDO – Source”	153
Table 6.13 “SPR Programmable Power Supply APDO – Source”	154
Table 6.14 “EPR Adjustable Voltage Supply APDO – Source “	154
Table 6.15 “EPR AVS Power Source Peak Current Capability”	155
Table 6.16 “SPR Adjustable Voltage Supply APDO – Source”	156
Table 6.17 “Fixed Supply PDO – Sink”	158
Table 6.18 “Variable Supply (non-Battery) PDO – Sink”	159
Table 6.19 “Battery Supply PDO – Sink”	160
Table 6.20 “Programmable Power Supply APDO – Sink”	160
Table 6.21 “EPR Adjustable Voltage Supply APDO – Sink”	161
Table 6.22 “Fixed and Variable Request Data Object”	162
Table 6.23 “Fixed and Variable Request Data Object with GiveBack Support”	163
Table 6.24 “Battery Request Data Object”	163

Table 6.25 “Battery Request Data Object with GiveBack Support”	163
Table 6.26 “PPS Request Data Object”	164
Table 6.27 “AVS Request Data Object”	164
Table 6.28 “BIST Data Object”	170
Table 6.29 “Unstructured VDM Header”	173
Table 6.30 “Structured VDM Header”	175
Table 6.31 “Structured VDM Commands”	176
Table 6.32 “SVID Values”	176
Table 6.33 “Commands and Responses”	179
Table 6.34 “ID Header VDO”	182
Table 6.35 “Product Types (UFP)”	183
Table 6.36 “Product Types (Cable Plug/VPD)”	183
Table 6.37 “Product Types (DFP)”	184
Table 6.38 “Cert Stat VDO”	184
Table 6.39 “Product VDO”	185
Table 6.40 “UFP VDO”	186
Table 6.41 “DFP VDO”	188
Table 6.42 “Passive Cable VDO”	190
Table 6.43 “Active Cable VDO 1”	193
Table 6.44 “Active Cable VDO 2”	195
Table 6.45 “VPD VDO”	199
Table 6.46 “Discover SVIDs Responder VDO”	201
Table 6.47 “Battery Status Data Object (BSDO)”	213
Table 6.48 “Alert Data Object (ADO)”	216
Table 6.49 “Country Code Data Object (CCDO)”	219
Table 6.50 “Enter_USB Data Object (EUDO)”	221
Table 6.51 “EPR Mode Data Object (EPRMDO)”	225
Table 6.52 “Source_Info Data Object (SIDO)”	231
Table 6.53 “Revision Message Data Object (RMDO)”	233
Table 6.54 “Extended Message Types”	235
Table 6.55 “Source Capabilities Extended Data Block (SCEDB)”	236
Table 6.56 “SOP Status Data Block (SDB)”	243
Table 6.57 “SOP’/SOP” Status Data Block (SDB)”	247
Table 6.58 “Get Battery Cap Data Block (GBCDB)”	248
Table 6.59 “Get Battery Status Data Block (GBSDB)”	249
Table 6.60 “Battery Capability Data Block (BCDB)”	250
Table 6.61 “Get Manufacturer Info Data Block (GMIDB)”	252
Table 6.62 “Manufacturer Info Data Block (MIDB)”	253
Table 6.63 “PPS Status Data Block (PPSSDB)”	258
Table 6.64 “Country Codes Data Block (CCDB)”	260
Table 6.65 “Country Info Data Block (CIDB)”	261
Table 6.66 “Sink Capabilities Extended Data Block (SKEDB)”	263
Table 6.67 “Extended Control Data Block (ECDB)”	268
Table 6.68 “Extended Control Message Types”	268
Table 6.69 “Time Values”	296
Table 6.70 “Timers”	298
Table 6.71 “Counter parameters”	301
Table 6.72 “Counters”	301
Table 6.73 “Response to an incoming Message (except VDM)”	303
Table 6.74 “Response to an incoming VDM”	303
Table 6.75 “Message discarding”	307

Table 6.76 “Protocol Layer States”	331
Table 6.77 “Message Applicability Abbreviations”	333
Table 6.78 “Applicability of Control Messages”	334
Table 6.79 “Applicability of Data Messages”	336
Table 6.80 “Applicability of Extended Messages”	338
Table 6.81 “Applicability of Extended Control Messages”	340
Table 6.82 “Applicability of Structured VDM Commands”	341
Table 6.83 “Applicability of Reset Signaling”	342
Table 6.84 “Applicability of Fast Role Swap signal”	342
Table 6.85 “Value Parameters”	343
Table 7.1 “Sequence Description for Changing the Source to another (A)PDO”	384
Table 7.2 “Sequence Description for Increasing the Voltage”	386
Table 7.3 “Sequence Diagram for Increasing the Voltage and Current”	388
Table 7.4 “Sequence Description for Increasing the Voltage and Decreasing the Current”	390
Table 7.5 “Sequence Description for Decreasing the Voltage and Increasing the Current”	392
Table 7.6 “Sequence Description for Decreasing the Voltage”	394
Table 7.7 “Sequence Description for Decreasing the Voltage and the Current”	396
Table 7.8 “Sequence Description for no change in Current or Voltage”	398
Table 7.9 “Sequence Description for Increasing the Current”	400
Table 7.10 “Sequence Description for Decreasing the Current”	402
Table 7.11 “Sequence Description for Increasing the Programmable Power Supply Voltage”	404
Table 7.12 “Sequence Description for Decreasing the Programmable Power Supply Voltage”	406
Table 7.13 “Sequence Description for increasing the Current in PPS mode”	408
Table 7.14 “Sequence Description for decreasing the Current in PPS mode”	410
Table 7.15 “Sequence Description for no change in Current or Voltage in PPS mode”	412
Table 7.16 “Sequence Description for Increasing the Adjustable Voltage Supply Voltage”	414
Table 7.17 “Sequence Description for Decreasing the Adjustable Voltage Supply Voltage”	416
Table 7.18 “Sequence Description for no change in Current or Voltage in AVS mode”	417
Table 7.19 “Sequence Description for a Sink Requested Power Role Swap”	419
Table 7.20 “Sequence Description for a Source Requested Power Role Swap”	422
Table 7.21 “Sequence Description for a GotoMin Current Decrease”	425
Table 7.22 “Sequence Description for a Source Initiated Hard Reset”	427
Table 7.23 “Sequence Description for a Sink Initiated Hard Reset”	429
Table 7.24 “Sequence Description for Fast Role Swap”	431
Table 7.25 “Source Electrical Parameters”	433
Table 7.26 “Sink Electrical Parameters”	441
Table 7.27 “Common Source/Sink Electrical Parameters”	443
Table 8.1 “Basic Message Flow”	454
Table 8.2 “Potential issues in Basic Message Flow”	456
Table 8.3 “Basic Message Flow with CRC failure”	458
Table 8.4 “Atomic Message Sequences”	460
Table 8.5 “AMS: Power Negotiation (SPR)”	461
Table 8.6 “AMS: Power Negotiation (EPR)”	462
Table 8.7 “AMS: Unsupported Message”	463
Table 8.8 “AMS: Ping”	464
Table 8.9 “AMS: Soft Reset”	464
Table 8.10 “AMS: Data Reset”	465
Table 8.11 “AMS: Power Role Swap”	466
Table 8.12 “AMS: Fast Role Swap”	466
Table 8.13 “AMS: Data Role Swap”	467
Table 8.14 “AMS: VCONN Swap”	468

Table 8.15 “AMS: Alert”468

Table 8.16 “AMS: Status”469

Table 8.17 “AMS: Source/Sink Capabilities (SPR)”470

Table 8.18 “AMS: Source/Sink Capabilities (EPR)”471

Table 8.19 “AMS: Extended Capabilities”472

Table 8.20 “AMS: Battery Capabilities”472

Table 8.21 “AMS: Manufacturer Information”473

Table 8.22 “AMS: Country Codes”473

Table 8.23 “AMS: Country Information”474

Table 8.24 “AMS: Revision Information”474

Table 8.25 “AMS: Source Information”474

Table 8.26 “AMS: Security”475

Table 8.27 “AMS: Firmware Update”475

Table 8.28 “AMS: Structured VDM”476

Table 8.29 “AMS: Built-In Self-Test (BIST)”477

Table 8.30 “AMS: Enter USB”477

Table 8.31 “AMS: Unstructured VDM”477

Table 8.32 “AMS: Hard Reset”478

Table 8.33 “Steps for a successful Power Negotiation”481

Table 8.34 “Steps for a rejected Power Negotiation”485

Table 8.35 “Steps for a Wait response to a Power Negotiation”488

Table 8.36 “Steps for a GotoMin Negotiation”491

Table 8.37 “Steps for SPR PPS Keep Alive”494

Table 8.38 “Steps for SPR Sink Makes Request (Accept)”498

Table 8.39 “Steps for SPR Sink Makes Request (Reject)”501

Table 8.40 “Steps for SPR Sink Makes Request (Wait)”504

Table 8.41 “Steps for Entering EPR Mode (Success)”507

Table 8.42 “Steps for Entering EPR Mode (Failure due to non-EPR cable)”510

Table 8.43 “Steps for Entering EPR Mode (Failure of VCONN Swap)”513

Table 8.44 “Steps for a successful EPR Power Negotiation”517

Table 8.45 “Steps for a Rejected EPR Power Negotiation”521

Table 8.46 “Steps for a Wait response to an EPR Power Negotiation”524

Table 8.47 “Steps for EPR Keep Alive”527

Table 8.48 “Steps for Exiting EPR Mode (Sink Initiated)”530

Table 8.49 “Steps for Exiting EPR Mode (Source Initiated)”533

Table 8.50 “Steps for EPR Sink Makes Request (Accept)”536

Table 8.51 “Steps for EPR Sink Makes Request (Reject)”539

Table 8.52 “Steps for EPR Sink Makes Request (Wait)”542

Table 8.53 “Steps for an Unsupported Message”545

Table 8.54 “Steps for a Ping”548

Table 8.55 “Steps for a Soft Reset”550

Table 8.56 “Steps for a DFP Initiated Data Reset where the DFP is the VCONN Source”553

Table 8.57 “Steps for a DFP Receiving a Data Reset where the DFP is the VCONN Source”557

Table 8.58 “Steps for a DFP Initiated Data Reset where the UFP is the VCONN Source”561

Table 8.59 “Steps for a DFP Receiving a Data Reset where the UFP is the VCONN Source”566

Table 8.60 “Steps for Source initiated Hard Reset”571

Table 8.61 “Steps for Sink initiated Hard Reset”574

Table 8.62 “Steps for Source initiated Hard Reset – Sink long reset”577

Table 8.63 “Steps for a Successful Source Initiated Power Role Swap Sequence”581

Table 8.64 “Steps for a Rejected Source Initiated Power Role Swap Sequence”585

Table 8.65 “Steps for a Source Initiated Power Role Swap with Wait Sequence”588

Table 8.66 “Steps for a Successful Sink Initiated Power Role Swap Sequence”	592
Table 8.67 “Steps for a Rejected Sink Initiated Power Role Swap Sequence”	596
Table 8.68 “Steps for a Sink Initiated Power Role Swap with Wait Sequence”	599
Table 8.69 “Steps for a Successful Fast Role Swap Sequence”	603
Table 8.70 “Steps for Data Role Swap, UFP operating as Sink initiates”	607
Table 8.71 “Steps for Rejected Data Role Swap, UFP operating as Sink initiates”	610
Table 8.72 “Steps for Data Role Swap with Wait, UFP operating as Sink initiates”	613
Table 8.73 “Steps for Data Role Swap, UFP operating as Source initiates”	616
Table 8.74 “Steps for Rejected Data Role Swap, UFP operating as Source initiates”	619
Table 8.75 “Steps for Data Role Swap with Wait, UFP operating as Source initiates”	622
Table 8.76 “Steps for Data Role Swap, DFP operating as Source initiates”	625
Table 8.77 “Steps for Rejected Data Role Swap, DFP operating as Source initiates”	628
Table 8.78 “Steps for Data Role Swap with Wait, DFP operating as Source initiates”	631
Table 8.79 “Steps for Data Role Swap, DFP operating as Sink initiates”	634
Table 8.80 “Steps for Rejected Data Role Swap, DFP operating as Sink initiates”	637
Table 8.81 “Steps for Data Role Swap with Wait, DFP operating as Sink initiates”	640
Table 8.82 “Steps for Source to Sink VCONN Source Swap”	643
Table 8.83 “Steps for Rejected VCONN Source Swap”	646
Table 8.84 “Steps for VCONN Source Swap with Wait”	649
Table 8.85 “Steps for VCONN Source Swap, Initiated by non- VCONN Source”	652
Table 8.86 “Steps for Rejected VCONN Source Swap, Initiated by non- VCONN Source”	655
Table 8.87 “Steps for VCONN Source Swap with Wait, Initiated by non- VCONN Source”	658
Table 8.88 “Steps for Source Alert to Sink”	661
Table 8.89 “Steps for Sink Alert to Source”	663
Table 8.90 “Steps for a Sink getting Source Status Sequence”	665
Table 8.91 “Steps for a Source getting Sink Status Sequence”	668
Table 8.92 “Steps for a VCONN Source getting Cable Plug Status Sequence”	671
Table 8.93 “Steps for a Sink getting Source PPS status Sequence”	674
Table 8.94 “Steps for a Sink getting Source Capabilities Sequence”	677
Table 8.95 “Steps for a Dual-Role Source getting Dual-Role Sink’s capabilities as a Source Sequence”	680
Table 8.96 “Steps for a Source getting Sink Capabilities Sequence”	683
Table 8.97 “Steps for a Dual-Role Sink getting Dual-Role Source capabilities as a Sink Sequence”	686
Table 8.98 “Steps for a Sink getting EPR Source Capabilities Sequence”	689
Table 8.99 “Steps for a Dual-Role Source getting Dual-Role Sink’s capabilities as an EPR Source Sequence”	692
Table 8.100 “Steps for a Source getting Sink EPR Capabilities Sequence”	695
Table 8.101 “Steps for a Dual-Role Sink getting Dual-Role Source capabilities as an EPR Sink Sequence”	698
Table 8.102 “Steps for a Sink getting Source extended capabilities Sequence”	701
Table 8.103 “Steps for a Dual-Role Source getting Dual-Role Sink extended capabilities Sequence”	704
Table 8.104 “Steps for a Source getting Sink extended capabilities Sequence”	707
Table 8.105 “Steps for a Dual-Role Sink getting Dual-Role Source extended capabilities Sequence”	710
Table 8.106 “Steps for a Sink getting Source Battery capabilities Sequence”	713
Table 8.107 “Steps for a Source getting Sink Battery capabilities Sequence”	716
Table 8.108 “Steps for a Sink getting Source Battery status Sequence”	719
Table 8.109 “Steps for a Source getting Sink Battery status Sequence”	722
Table 8.110 “Steps for a Source getting Sink’s Port Manufacturer Information Sequence”	725
Table 8.111 “Steps for a Source getting Sink’s Port Manufacturer Information Sequence”	728
Table 8.112 “Steps for a Source getting Sink’s Battery Manufacturer Information Sequence”	731
Table 8.113 “Steps for a Source getting Sink’s Battery Manufacturer Information Sequence”	734
Table 8.114 “Steps for a VCONN Source getting Sink’s Port Manufacturer Information Sequence”	737
Table 8.115 “Steps for a Source getting Country Codes Sequence”	740
Table 8.116 “Steps for a Source getting Sink’s Country Codes Sequence”	743

Table 8.117 “Steps for a VCONN Source getting Sink’s Country Codes Sequence”	746
Table 8.118 “Steps for a Source getting Country Information Sequence”	749
Table 8.119 “Steps for a Source getting Sink’s Country Information Sequence”	752
Table 8.120 “Steps for a VCONN Source getting Sink’s Country Information Sequence”	755
Table 8.121 “Steps for a Source getting Revision Information Sequence”	758
Table 8.122 “Steps for a Source getting Sink’s Revision Information Sequence”	761
Table 8.123 “Steps for a VCONN Source getting Sink’s Revision Information Sequence”	764
Table 8.124 “Steps for a Sink getting Source Information Sequence”	767
Table 8.125 “Steps for a Dual-Role Source getting Dual-Role Sink’s Information as a Source Sequence”	770
Table 8.126 “Steps for a Source requesting a security exchange with a Sink Sequence”	773
Table 8.127 “Steps for a Sink requesting a security exchange with a Source Sequence”	776
Table 8.128 “Steps for a VCONN Source requesting a security exchange with a Cable Plug Sequence”	779
Table 8.129 “Steps for a Source requesting a firmware update exchange with a Sink Sequence”	782
Table 8.130 “Steps for a Sink requesting a firmware update exchange with a Source Sequence”	785
Table 8.131 “Steps for a VCONN Source requesting a firmware update exchange with a Cable Plug Sequence”	788
Table 8.132 “Steps for Initiator to UFP Discover Identity (ACK)”	791
Table 8.133 “Steps for Initiator to UFP Discover Identity (NAK)”	794
Table 8.134 “Steps for Initiator to UFP Discover Identity (BUSY)”	797
Table 8.135 “Steps for DFP to UFP Discover SVIDs (ACK)”	800
Table 8.136 “Steps for DFP to UFP Discover SVIDs (NAK)”	803
Table 8.137 “Steps for DFP to UFP Discover SVIDs (BUSY)”	806
Table 8.138 “Steps for DFP to UFP Discover Modes (ACK)”	809
Table 8.139 “Steps for DFP to UFP Discover Modes (NAK)”	812
Table 8.140 “Steps for DFP to UFP Discover Modes (BUSY)”	815
Table 8.141 “Steps for DFP to UFP Enter Mode”	818
Table 8.142 “Steps for DFP to UFP Exit Mode”	821
Table 8.143 “Steps for DFP to Cable Plug Enter Mode”	824
Table 8.144 “Steps for DFP to Cable Plug Exit Mode”	827
Table 8.145 “Steps for Initiator to Responder Attention”	830
Table 8.146 “Steps for BIST Carrier Mode Test”	832
Table 8.147 “Steps for BIST Test Data Test”	835
Table 8.148 “Steps for BIST Shared Capacity Test Mode Test”	839
Table 8.149 “Steps for UFP USB4® Mode Entry (Accept)”	842
Table 8.150 “Steps for UFP USB4® Mode Entry (Reject)”	845
Table 8.151 “Steps for UFP USB4® Mode Entry (Wait)”	848
Table 8.152 “Steps for Cable Plug USB4® Mode Entry (Accept)”	851
Table 8.153 “Steps for Cable Plug USB4® Mode Entry (Reject)”	854
Table 8.154 “Steps for Cable Plug USB4® Mode Entry (Wait)”	857
Table 8.155 “Steps for Unstructured VDM Message Sequence”	860
Table 8.156 “Steps for VDEM Message Sequence”	863
Table 8.157 Policy Engine States.....	1013
Table 9.1 “USB Power Delivery Type Codes”	1029
Table 9.2 USB Power Delivery Capability Descriptor.....	1029
Table 9.3 “Battery Info Capability Descriptor”	1031
Table 9.4 “PD Consumer Port Descriptor”	1032
Table 9.5 “PD Provider Port Descriptor”	1033
Table 9.6 “PD Requests”	1034
Table 9.7 “PD Request Codes”	1034
Table 9.8 “PD Feature Selectors”	1034
Table 9.9 “Get Battery Status Request”	1035
Table 9.10 “Battery Status Structure”	1035

Table 9.11 “Set PD Feature”	1036
Table 9.12 “Battery Wake Mask”	1037
Table 9.13 “Charging Policy Encoding”	1038
Table 10.1 “Considerations for Sources”	1040
Table 10.2 “SPR Normative Voltages and Minimum Currents”	1041
Table 10.3 “SPR Source Capabilities When Port Present PDP is less than Port Maximum PDP”	1042
Table 10.4 “SPR Source Port Present PDP less than Port Maximum PDP Examples”	1043
Table 10.5 “Fixed Supply PDO – Source 5V”	1046
Table 10.6 “Fixed Supply PDO – Source 9V”	1046
Table 10.7 “Fixed Supply PDO – Source 15V”	1047
Table 10.8 “Fixed Supply PDO – Source 20V”	1047
Table 10.9 “SPR Adjustable Voltage Supply (AVS) Voltage Ranges”	1050
Table 10.10 “SPR Programmable Power Supply PDOs and APDOs based on the Port Maximum PDP”	1052
Table 10.11 SPR “Programmable Power Supply Voltage Ranges”	1052
Table 10.12 “EPR Source Capabilities based on the Port Maximim PDP and using an EPR Capable Cable”	1056
Table 10.13 “EPR Source Capabilities when Port Present PDP is less than Port Maximum PDP and using an EPR-capable cable”	1056
Table 10.14 “EPR Source Examples when Port Present PDP is less than Port Maximum PDP”	1058
Table 10.15 “EPR Adjustable Voltage Supply (AVS) Voltage Ranges”	1059
Table A-1 “Table showing the full calculation over one Message”	1065
Table B-1 External power is supplied downstream	1067
Table B.2 External power is supplied upstream	1070
Table B.3 Giving back power	1077
Table C-1 “Discover Identity Command request from Initiator Example”	1086
Table C.2 “Discover Identity Command response from Active Cable Responder Example”	1087
Table C-3 “Discover Identity Command response from Hub Responder Example”	1089
Table C-4 “Discover SVIDs Command request from Initiator Example”	1090
Table C-5 “Discover SVIDs Command response from Responder Example”	1091
Table C-6 “Discover Modes Command request from Initiator Example”	1092
Table C-7 “Discover Modes Command response from Responder Example”	1093
Table C-8 “Enter Mode Command request from Initiator Example”	1094
Table C-9 “Enter Mode Command response from Responder Example”	1095
Table C-10 “Enter Mode Command request from Initiator Example”	1096
Table C-11 “Exit Mode Command request from Initiator Example”	1097
Table C-12 “Exit Mode Command response from Responder Example”	1098
Table C-13 “Attention Command request from Initiator Example”	1099
Table C-14 “Attention Command request from Initiator with additional VDO Example”	1100
Table E-1 “Sequence Table for setup of a Fast Role Swap (Hub connected to Power Adapter first)”	1111
Table E-2 “Sequence Table for setup of a Fast Role Swap (Hub connected to Notebook before Power Adapter)”	1112
Table E-3 Sequence Table for slow Vbus discharge (it discharges after FR_Swap message is sent)	1114
Table E-4 “Vbus discharges quickly after adapter disconnected”	1116

List of Figures

Figure 2-1 “Logical Structure of USB Power Delivery Capable Devices”	58
Figure 2-2 “Example SOP’ Communication between VCONN Source and Cable Plug(s)”	61
Figure 2-3 “USB Power Delivery Communications Stack”	70
Figure 2-4 “USB Power Delivery Communication Over USB”	71
Figure 2-5 “High Level Architecture View”	72
Figure 2-6 “Example of a Normal EPR Mode Operational Flow”	78
Figure 5-1 “Interpretation of ordered sets”	86
Figure 5-2 “Transmit Order for Various Sizes of Data”	88
Figure 5-3 “USB Power Delivery Packet Format”	89
Figure 5-4 “CRC 32 generation”	92
Figure 5-5 “Line format of Hard Reset”	95
Figure 5-6 “Line format of Cable Reset”	95
Figure 5-7 “BMC Example”	97
Figure 5-8 “BMC Transmitter Block Diagram”	97
Figure 5-9 “BMC Receiver Block Diagram”	98
Figure 5-10 “BMC Encoded Start of Preamble”	98
Figure 5-11 “Transmitting or Receiving BMC Encoded Frame Terminated by Zero with High-to-Low Last Transition”	99
Figure 5-12 “Transmitting or Receiving BMC Encoded Frame Terminated by One with High-to-Low Last Transition”	99
Figure 5-13 “Transmitting or Receiving BMC Encoded Frame Terminated by Zero with Low to High Last Transition”	100
Figure 5-14 “Transmitting or Receiving BMC Encoded Frame Terminated by One with Low to High Last Transition”	100
Figure 5-15 “BMC Tx ‘ONE’ Mask”	101
Figure 5-16 “BMC Tx ‘ZERO’ Mask”	102
Figure 5-17 “BMC Rx ‘ONE’ Mask when Sourcing Power”	104
Figure 5-18 “BMC Rx ‘ZERO’ Mask when Sourcing Power”	105
Figure 5-19 “BMC Rx ‘ONE’ Mask when Power neutral”	105
Figure 5-20 “BMC Rx ‘ZERO’ Mask when Power neutral”	106
Figure 5-21 “BMC Rx ‘ONE’ Mask when Sinking Power”	106
Figure 5-22 “BMC Rx ‘ZERO’ Mask when Sinking Power”	107
Figure 5-23 “Transmitter Load Model for BMC Tx from a Source”	109
Figure 5-24 “Transmitter Load Model for BMC Tx from a Sink”	109
Figure 5-25 Transmitter diagram illustrating zDriver	113
Figure 5-26 “Inter-Frame Gap Timings”	114
Figure 5-27 “Example Multi-Drop Configuration showing two DRPs”	117
Figure 5-28 “Example Multi-Drop Configuration showing a DFP and UFP”	118
Figure 5-29 “Test Data Frame”	119
Figure 6-1 “USB Power Delivery Packet Format including Control Message Payload”	121
Figure 6-2 “USB Power Delivery Packet Format including Data Message Payload”	121
Figure 6-3 “USB Power Delivery Packet Format including an Extended Message Header and Payload”	121
Figure 6-4 “Example Security_Request sequence Unchunked (Chunked bit = 0)”	129
Figure 6-5 “Example byte transmission for Security_Request Message of Data Size 7 (Chunked bit is set to zero)”	129
Figure 6-6 “Example byte transmission for Security_Response Message of Data Size 7 (Chunked bit is set to zero)”	130
Figure 6-7 “Example Security_Request sequence Chunked (Chunked bit = 1)”	131
Figure 6-8 “Example Security_Request Message of Data Size 7 (Chunked bit set to 1)”	132
Figure 6-9 “Example Chunk 0 of Security_Response Message of Data Size 30 (Chunked bit set to 1)”	132

Figure 6-10 “Example byte transmission for a Security_Response Message Chunk request (Chunked bit is set to 1)”	133
Figure 6-11 “Example Chunk 1 of Security_Response Message of Data Size 30 (Chunked bit set to 1)”	133
Figure 6-12 “Example Capabilities Message with 2 Power Data Objects”	146
Figure 6-13 “BIST Message”	169
Figure 6-14 “Vendor Defined Message”	172
Figure 6-15 “Discover Identity Command response”	181
Figure 6-16 “Discover Identity Command response for a DRD”	181
Figure 6-17 “Example Discover SVIDs response with 3 SVIDs”	202
Figure 6-18 “Example Discover SVIDs response with 4 SVIDs”	202
Figure 6-19 “Example Discover SVIDs response with 12 SVIDs followed by an empty response”	202
Figure 6-20 “Example Discover Modes response for a given SVID with 3 Modes”	203
Figure 6-21 “Successful Enter Mode sequence”	205
Figure 6-22 “Unsuccessful Enter Mode sequence due to NAK”	206
Figure 6-23 “Exit Mode sequence”	207
Figure 6-24 “Attention Command request/response sequence”	208
Figure 6-25 “Command request/response sequence”	209
Figure 6-26 “Enter/Exit Mode Process”	211
Figure 6-27 “Battery_Status Message”	213
Figure 6-28 “Alert Message”	215
Figure 6-29 “Get_Country_Info Message”	219
Figure 6-30 “Enter_USB Message”	220
Figure 6-31 “EPR_Request Message”	223
Figure 6-32 “EPR Mode DO Message”	224
Figure 6-33 “Illustration of process to enter EPR Mode”	227
Figure 6-34 “Source_Info Message”	231
Figure 6-35 “Revision Message Data Object”	233
Figure 6-36 “Source_Capabilities_Extended Message”	236
Figure 6-37 “SOP Status Message”	242
Figure 6-38 “SOP’/SOP” Status Message”	247
Figure 6-39 “Get_Battery_Cap Message”	248
Figure 6-40 “Get_Battery_Status Message”	249
Figure 6-41 “Battery_Capabilities Message”	250
Figure 6-42 “Get_Manufacturer_Info Message”	252
Figure 6-43 “Manufacturer_Info Message”	253
Figure 6-44 “Security_Request Message”	255
Figure 6-45 “Security_Response Message”	256
Figure 6-46 “Firmware_Update_Request Message”	257
Figure 6-47 “Firmware_Update_Response Message”	257
Figure 6-48 “PPS_Status Message”	258
Figure 6-49 “Country_Codes Message”	260
Figure 6-50 “Country_Info Message”	261
Figure 6-51 “Sink_Capabilities_Extended Message”	262
Figure 6-52 “Extended_Control Message”	268
Figure 6-53 “Mapping SPR Capabilities to EPR Capabilities”	270
Figure 6-54 “Vendor_Defined_Extended Message”	272
Figure 6-55 “Outline of States”	308
Figure 6-56 “References to states”	308
Figure 6-57 “Chunking architecture Showing Message and Control Flow”	310
Figure 6-58 “Chunked Rx State Diagram”	311
Figure 6-59 “Chunked Tx State Diagram”	314

Figure 6-60 “Chunked Message Router State Diagram” 318

Figure 6-61 “Common Protocol Layer Message Transmission State Diagram” 320

Figure 6-62 “Source Protocol Layer Message Transmission State Diagram” 323

Figure 6-63 “Sink Protocol Layer Message Transmission State Diagram” 325

Figure 6-64 “Protocol layer Message reception” 326

Figure 6-65 “Hard/Cable Reset” 328

Figure 7-1 “Placement of Source Bulk Capacitance” 344

Figure 7-2 “Transition Envelope for Positive Voltage Transitions” 346

Figure 7-3 “Transition Envelope for Negative Voltage Transitions” 347

Figure 7-4 “PPS Positive Voltage Transitions” 349

Figure 7-5 “PPS Negative Voltage Transitions” 350

Figure 7-6 “Expected PPS Ripple Relative to an LSB” 350

Figure 7-7 “Allowed DNL errors and tolerance of Voltage and Current in PPS mode” 351

Figure 7-8 “SPR PPS Programmable Voltage and Current Limit” 353

Figure 7-9 “SPR PPS Constant Power” 354

Figure 7-10 “AVS Positive Voltage Transitions” 356

Figure 7-11 “AVS Negative Voltage Transitions” 357

Figure 7-12 “Expected AVS Ripple Relative to an LSB” 357

Figure 7-13 “Source V_{BUS} and V_{CONN} Response to Hard Reset” 359

Figure 7-14 “Application of v_{SrcNew} and $v_{SrcValid}$ limits after $t_{SrcReady}$ ” 363

Figure 7-15 “Source Peak Current Overload” 365

Figure 7-16 “Holdup Time Measurement” 367

Figure 7-17 “ V_{BUS} Power during Fast Role Swap” 369

Figure 7-18 “ V_{BUS} detection and timing during Fast Role Swap, initial V_{BUS} (at new source) > $v_{Safe5V(min)}$ ” 370

Figure 7-19 “ V_{BUS} detection and timing during Fast Role Swap, initial V_{BUS} (at new source) < $v_{Safe5V(min)}$ ” 370

Figure 7-20 “Data Reset UFP V_{CONN} Power Cycle” 372

Figure 7-21 “Data Reset DFP V_{CONN} Power Cycle” 373

Figure 7-22 “Placement of Sink Bulk Capacitance” 374

Figure 7-23 “Generic Change for the Source to another (A)PDO” 383

Figure 7-24 “Transition Diagram for Increasing the Voltage” 385

Figure 7-25 “Transition Diagram for Increasing the Voltage and Current” 387

Figure 7-26 “Transition Diagram for Increasing the Voltage and Decreasing the Current” 389

Figure 7-27 “Transition Diagram for Decreasing the Voltage and Increasing the Current” 391

Figure 7-28 “Transition Diagram for Decreasing the Voltage” 393

Figure 7-29 “Transition Diagram for Decreasing the Voltage and the Current” 395

Figure 7-30 “Transition Diagram for no change in Current or Voltage” 397

Figure 7-31 “Transition Diagram for Increasing the Current” 399

Figure 7-32 “Transition Diagram for Decreasing the Current” 401

Figure 7-33 “Transition Diagram for Increasing the Programmable Power Supply Voltage” 403

Figure 7-34 “Transition Diagram for Decreasing the Programmable Power Supply Voltage” 405

Figure 7-35 “Transition Diagram for increasing the Current in PPS mode” 407

Figure 7-36 “Transition Diagram for decreasing the Current in PPS mode” 409

Figure 7-37 “Transition Diagram for no change in Current or Voltage in PPS mode” 411

Figure 7-38 “Transition Diagram for Increasing the Adjustable Power Supply Voltage” 413

Figure 7-39 “Transition Diagram for Decreasing the Adjustable Voltage Supply Voltage” 415

Figure 7-40 “Transition Diagram for no change in Current or Voltage in AVS mode” 417

Figure 7-41 “Transition Diagram for a Sink Requested Power Role Swap” 418

Figure 7-42 “Transition Diagram for a Source Requested Power Role Swap” 421

Figure 7-43 “Transition Diagram for a GotoMin Current Decrease” 424

Figure 7-44 “Transition Diagram for a Source Initiated Hard Reset” 426

Figure 7-45 “Transition Diagram for a Sink Initiated Hard Reset” 428

Figure 7-46 “Transition Diagram for Fast Role Swap”	430
Figure 8-1 “Example of daisy chained displays”	450
Figure 8-2 “Basic Message Exchange (Successful)”	454
Figure 8-3 “Basic Message flow indicating possible errors”	455
Figure 8-4 “Basic Message Flow with Bad CRC followed by a Retry”	457
Figure 8-5 “Successful Fixed, Variable or Battery SPR Power Negotiation”	480
Figure 8-6 “Rejected Fixed, Variable or Battery SPR Power Negotiation”	484
Figure 8-7 “Wait response to Fixed, Variable or Battery SPR Power Negotiation”	487
Figure 8-8 “Successful GotoMin operation”	490
Figure 8-9 “SPR PPS Keep Alive”	493
Figure 8-10 “SPR Sink Makes Request (Accept)”	497
Figure 8-11 “SPR Sink Makes Request (Reject)”	500
Figure 8-12 “SPR Sink Makes Request (Wait)”	503
Figure 8-13 “Entering EPR Mode (Success)”	506
Figure 8-14 “Entering EPR Mode (Failure due to non-EPR cable)”	509
Figure 8-15 “Entering EPR Mode (Failure of VCONN Swap)”	512
Figure 8-16 “Successful Fixed EPR Power Negotiation”	516
Figure 8-17 “Rejected Fixed EPR Power Negotiation”	520
Figure 8-18 “Wait response to Fixed EPR Power Negotiation”	523
Figure 8-19 “EPR Keep Alive”	526
Figure 8-20 “Exiting EPR Mode (Sink Initiated)”	529
Figure 8-21 “Exiting EPR Mode (Source Initiated)”	532
Figure 8-22 “EPR Sink Makes Request (Accept)”	535
Figure 8-23 “EPR Sink Makes Request (Reject)”	538
Figure 8-24 “EPR Sink Makes Request (Wait)”	541
Figure 8-25 “Unsupported message”	544
Figure 8-26 “Ping”	547
Figure 8-27 “Soft Reset”	549
Figure 8-28 “DFP Initiated Data Reset where the DFP is the VCONN Source”	552
Figure 8-29 “DFP Receives Data Reset where the DFP is the VCONN Source”	556
Figure 8-30 “DFP Initiated Data Reset where the UFP is the Vconn Source”	560
Figure 8-31 “DFP Receives a Data Reset where the UFP is the VCONN Source”	565
Figure 8-32 “Source initiated Hard Reset”	570
Figure 8-33 “Sink Initiated Hard Reset”	573
Figure 8-34 “Source initiated reset - Sink long reset”	576
Figure 8-35 “Successful Power Role Swap Sequence Initiated by the Source”	580
Figure 8-36 “Rejected Power Role Swap Sequence Initiated by the Source”	584
Figure 8-37 “Power Role Swap Sequence with wait Initiated by the Source”	587
Figure 8-38 “Successful Power Role Swap Sequence Initiated by the Sink”	591
Figure 8-39 “Rejected Power Role Swap Sequence Initiated by the Sink”	595
Figure 8-40 “Power Role Swap Sequence with wait Initiated by the Sink”	598
Figure 8-41 “Successful Fast Role Swap Sequence”	602
Figure 8-42 “Data Role Swap, UFP operating as Sink initiates”	606
Figure 8-43 “Rejected Data Role Swap, UFP operating as Sink initiates”	609
Figure 8-44 “Data Role Swap with Wait, UFP operating as Sink initiates”	612
Figure 8-45 “Data Role Swap, UFP operating as Source initiates”	615
Figure 8-46 “Rejected Data Role Swap, UFP operating as Source initiates”	618
Figure 8-47 “Data Role Swap with Wait, UFP operating as Source initiates”	621
Figure 8-48 “Data Role Swap, DFP operating as Source initiates”	624
Figure 8-49 “Rejected Data Role Swap, DFP operating as Source initiates”	627
Figure 8-50 “Data Role Swap with Wait, DFP operating as Source initiates”	630

Figure 8-51 “Data Role Swap, DFP operating as Sink initiates”633

Figure 8-52 “Rejected Data Role Swap, DFP operating as Sink initiates”636

Figure 8-53 “Data Role Swap with Wait, DFP operating as Sink initiates”639

Figure 8-54 “Successful VCONN Source Swap, initiated by VCONN Source”642

Figure 8-55 “Rejected VCONN Source Swap, initiated by VCONN Source”645

Figure 8-56 “VCONN Source Swap with Wait, initiated by VCONN Source”648

Figure 8-57 “VCONN Source Swap, initiated by non- VCONN Source”651

Figure 8-58 “Rejected VCONN Source Swap, initiated by non- VCONN Source”654

Figure 8-59 “VCONN Source Swap with Wait, initiated by non- VCONN Source”657

Figure 8-60 “Source Alert to Sink”660

Figure 8-61 “Sink Alert to Source”662

Figure 8-62 “Sink Gets Source Status”664

Figure 8-63 “Source Gets Sink Status”667

Figure 8-64 “VCONN Source Gets Cable Plug Status”670

Figure 8-65 “Sink Gets Source PPS Status”673

Figure 8-66 “Sink Gets Source’s Capabilities”676

Figure 8-67 “Dual-Role Source Gets Dual-Role Sink’s Capabilities as a Source”679

Figure 8-68 “Source Gets Sink’s Capabilities”682

Figure 8-69 “Dual-Role Sink Gets Dual-Role Source’s Capabilities as a Sink”685

Figure 8-70 “Sink Gets Source’s EPR Capabilities”688

Figure 8-71 “Dual-Role Source Gets Dual-Role Sink’s Capabilities as an EPR Source”691

Figure 8-72 “Source Gets Sink’s EPR Capabilities”694

Figure 8-73 “Dual-Role Sink Gets Dual-Role Source’s Capabilities as an EPR Sink”697

Figure 8-74 “Sink Gets Source’s Extended Capabilities”700

Figure 8-75 “Dual-Role Source Gets Dual-Role Sink’s Extended Capabilities”703

Figure 8-76 “Source Gets Sink’s Extended Capabilities”706

Figure 8-77 “Dual-Role Sink Gets Dual-Role Source’s Extended Capabilities”709

Figure 8-78 “Sink Gets Source’s Battery Capabilities”712

Figure 8-79 “Source Gets Sink’s Battery Capabilities”715

Figure 8-80 “Sink Gets Source’s Battery Status”718

Figure 8-81 “Source Gets Sink’s Battery Status”721

Figure 8-82 “Source Gets Sink’s Port Manufacturer Information”724

Figure 8-83 “Sink Gets Source’s Port Manufacturer Information”727

Figure 8-84 “Source Gets Sink’s Battery Manufacturer Information”730

Figure 8-85 “Sink Gets Source’s Battery Manufacturer Information”733

Figure 8-86 “VCONN Source Gets Cable Plug’s Manufacturer Information”736

Figure 8-87 “Source Gets Sink’s Country Codes”739

Figure 8-88 “Sink Gets Source’s Country Codes”742

Figure 8-89 “VCONN Source Gets Cable Plug’s Country Codes”745

Figure 8-90 “Source Gets Sink’s Country Information”748

Figure 8-91 “Sink Gets Source’s Country Information”751

Figure 8-92 “VCONN Source Gets Cable Plug’s Country Information”754

Figure 8-93 “Source Gets Sink’s Revision Information”757

Figure 8-94 “Sink Gets Source’s Revision Information”760

Figure 8-95 “VCONN Source Gets Cable Plug’s Revision Information”763

Figure 8-96 “Sink Gets Source’s Information”766

Figure 8-97 “Dual-Role Source Gets Dual-Role Sink’s Information as a Source”769

Figure 8-98 “Source requests security exchange with Sink”772

Figure 8-99 “Sink requests security exchange with Source”775

Figure 8-100 “VCONN Source requests security exchange with Cable Plug”778

Figure 8-101 “Source requests firmware update exchange with Sink”781

Figure 8-102 “Sink requests firmware update exchange with Source”	784
Figure 8-103 “VCONN Source requests firmware update exchange with Cable Plug”	787
Figure 8-104 “Initiator to Responder Discover Identity (ACK)”	790
Figure 8-105 “Initiator to Responder Discover Identity (NAK)”	793
Figure 8-106 “Initiator to Responder Discover Identity (BUSY)”	796
Figure 8-107 “Initiator to Responder Discover SVIDs (ACK)”	799
Figure 8-108 “Initiator to Responder Discover SVIDs (NAK)”	802
Figure 8-109 “Initiator to Responder Discover SVIDs (BUSY)”	805
Figure 8-110 “Initiator to Responder Discover Modes (ACK)”	808
Figure 8-111 “Initiator to Responder Discover Modes (NAK)”	811
Figure 8-112 “Initiator to Responder Discover Modes (BUSY)”	814
Figure 8-113 “DFP to UFP Enter Mode”	817
Figure 8-114 “DFP to UFP Exit Mode”	820
Figure 8-115 “DFP to Cable Plug Enter Mode”	823
Figure 8-116 “DFP to Cable Plug Exit Mode”	826
Figure 8-117 “Initiator to Responder Attention”	829
Figure 8-118 “BIST Carrier Mode Test”	831
Figure 8-119 “BIST Test Data Test”	834
Figure 8-120 “BIST Share Capacity Mode Test”	838
Figure 8-121 “UFP Entering USB4® Mode (Accept)”	841
Figure 8-122 “UFP Entering USB4® Mode (Reject)”	844
Figure 8-123 “UFP Entering USB4® Mode (Wait)”	847
Figure 8-124 “Cable Plug Entering USB4® Mode (Accept)”	850
Figure 8-125 “Cable Plug Entering USB4® Mode (Reject)”	853
Figure 8-126 “Cable Plug Entering USB4® Mode (Wait)”	856
Figure 8-127 “Unstructured VDM Message Sequence”	859
Figure 8-128 “VDEM Message Sequence”	862
Figure 8-129 “Outline of States”	865
Figure 8-130 “References to states”	866
Figure 8-131 “Example of state reference with conditions”	866
Figure 8-132 “Example of state reference with the same entry and exit”	866
Figure 8-133 “SenderResponseTimer Policy Engine State Diagram”	868
Figure 8-134 “Source Port State Diagram”	870
Figure 8-135 “Sink Port State Diagram”	878
Figure 8-136 “SOP Source Port Soft Reset and Protocol Error State Diagram”	884
Figure 8-137 “Sink Port Soft Reset and Protocol Error Diagram”	886
Figure 8-138 “DFP Data_Reset Message State Diagram”	888
Figure 8-139 “UFP Data_Reset Message State Diagram”	891
Figure 8-140 “Source Port Not Supported Message State Diagram”	894
Figure 8-141 “Sink Port Not Supported Message State Diagram”	896
Figure 8-142 “Source Port Ping State Diagram”	898
Figure 8-143 “Source Port Source Alert State Diagram”	899
Figure 8-144 “Sink Port Source Alert State Diagram”	901
Figure 8-145 “Sink Port Sink Alert State Diagram”	902
Figure 8-146 “Source Port Sink Alert State Diagram”	904
Figure 8-147 “Sink Port Get Source Capabilities Extended State Diagram”	905
Figure 8-148 “Source Give Source Capabilities Extended State Diagram”	906
Figure 8-149 “Source Port Get Sink Capabilities Extended State Diagram”	907
Figure 8-150 “Sink Give Sink Capabilities Extended State Diagram”	908
Figure 8-151 “Sink Port Get Source Information State Diagram”	909
Figure 8-152 “Source Give Source Information State Diagram”	910

Figure 8-153 “Get Status State Diagram”	911
Figure 8-154 “Give Status State Diagram”	912
Figure 8-155 “Sink Port Get Source PPS Status State Diagram”	913
Figure 8-156 “Source Give Source PPS Status State Diagram”	914
Figure 8-157 “Get Battery Capabilities State Diagram”	915
Figure 8-158 “Give Battery Capabilities State Diagram”	916
Figure 8-159 “Get Battery Status State Diagram”	917
Figure 8-160 “Give Battery Status State Diagram”	918
Figure 8-161 “Get Manufacturer Information State Diagram”	919
Figure 8-162 “Give Manufacturer Information State Diagram”	920
Figure 8-163 “Get Country Codes State Diagram”	921
Figure 8-164 “Give Country Codes State Diagram”	922
Figure 8-165 “Get Country Information State Diagram”	923
Figure 8-166 “Give Country Information State Diagram”	924
Figure 8-167 “Get Revision State Diagram”	925
Figure 8-168 “Give Revision State Diagram”	926
Figure 8-169 “DFP Enter_USB Message State Diagram”	927
Figure 8-170 “UFP Enter_USB Message State Diagram”	928
Figure 8-171 “Send security request State Diagram”	929
Figure 8-172 “Send security response State Diagram”	930
Figure 8-173 “Security response received State Diagram”	931
Figure 8-174 “Send firmware update request State Diagram”	932
Figure 8-175 “Send firmware update response State Diagram”	933
Figure 8-176 “Firmware update response received State Diagram”	934
Figure 8-177: “DFP to UFP Data Role Swap State Diagram”	935
Figure 8-178: “UFP to DFP Data Role Swap State Diagram”	938
Figure 8-179: “Dual-Role Port in Source to Sink Power Role Swap State Diagram”	941
Figure 8-180: “Dual-role Port in Sink to Source Power Role Swap State Diagram”	944
Figure 8-181: “Dual-Role Port in Source to Sink Fast Role Swap State Diagram”	947
Figure 8-182: “Dual-role Port in Sink to Source Fast Role Swap State Diagram”	950
Figure 8-183 “Dual-Role (Source) Get Source Capabilities diagram”	953
Figure 8-184 “Dual-Role (Source) Give Sink Capabilities diagram”	954
Figure 8-185 “Dual-Role (Sink) Get Sink Capabilities State Diagram”	955
Figure 8-186 “Dual-Role (Sink) Give Source Capabilities State Diagram”	956
Figure 8-187 “Dual-Role (Source) Get Source Capabilities Extended State Diagram”	956
Figure 8-188 “Dual-Role (Sink) Give Source Capabilities Extended diagram”	958
Figure 8-189 “Dual-Role (Sink) Get Sink Capabilities Extended State Diagram”	958
Figure 8-190 “Dual-Role (Source) Give Sink Capabilities Extended diagram”	959
Figure 8-191 “Dual-Role (Source) Get Source Information State Diagram”	960
Figure 8-192 “Dual-Role (Source) Give Source Information diagram”	961
Figure 8-193 “VCONN Swap State Diagram”	962
Figure 8-194 “Initiator to Port VDM Discover Identity State Diagram”	965
Figure 8-195 “Initiator VDM Discover SVIDs State Diagram”	967
Figure 8-196 “Initiator VDM Discover Modes State Diagram”	969
Figure 8-197 “Initiator VDM Attention State Diagram”	971
Figure 8-198 “Responder Structured VDM Discover Identity State Diagram”	972
Figure 8-199 “Responder Structured VDM Discover SVIDs State Diagram”	973
Figure 8-200 “Responder Structured VDM Discover Modes State Diagram”	974
Figure 8-201 “Receiving a Structured VDM Attention State Diagram”	975
Figure 8-202 “DFP VDM Mode Entry State Diagram”	976
Figure 8-203 “DFP VDM Mode Exit State Diagram”	978

Figure 8-204 “UFP Structured VDM Enter Mode State Diagram”	980
Figure 8-205 “UFP Structured VDM Exit Mode State Diagram”	982
Figure 8-206 “Cable Ready State Diagram”	984
Figure 8-207 “Cable Plug Soft Reset State Diagram”	985
Figure 8-208 “Cable Plug Hard Reset State Diagram”	986
Figure 8-209 “DFP/VCONN Source Soft Reset or Cable Reset of a Cable Plug or VPD State Diagram”	987
Figure 8-210 “UFP/VCONN Source Soft Reset of a Cable Plug or VPD State Diagram”	989
Figure 8-211 “Source Startup Structured VDM Discover Identity State Diagram”	991
Figure 8-212 “Cable Plug Structured VDM Enter Mode State Diagram”	993
Figure 8-213 “Cable Plug Structured VDM Exit Mode State Diagram”	995
Figure 8-214 “Source EPR Mode Entry State Diagram”	997
Figure 8-215 “Sink EPR Mode Entry State Diagram”	1000
Figure 8-216 “Source EPR Mode Exit State Diagram”	1002
Figure 8-217 “Sink EPR Mode Exit State Diagram”	1004
Figure 8-218 “BIST Carrier Mode State Diagram”	1006
Figure 8-219 “BIST Test Mode State Diagram”	1008
Figure 8-220 “BIST Shared Capacity Test Mode State Diagram”	1010
Figure 9-1 “Example PD Topology”	1022
Figure 9-2 “Mapping of PD Topology to USB”	1023
Figure 9-3 “USB Attached to USB Powered State Transition”	1024
Figure 9-4 “Any USB State to USB Attached State Transition (When operating as a Consumer)”	1025
Figure 9-5 “Any USB State to USB Attached State Transition (When operating as a Provider)”	1025
Figure 9-6 “Any USB State to USB Attached State Transition (After a USB Type-C® Data Role Swap)”	1026
Figure 9-7 “Software stack on a PD aware OS”	1026
Figure 9-8 “Enumeration of a PDUSB Device”	1027
Figure 10-1 “SPR Source Power Rule Illustration for Fixed PDOs”	1044
Figure 10-2 “SPR Source Power Rule Example For Fixed PDOs”	1045
Figure 10-3 “Valid SPR AVS Operating Region for a Source advertising in the range of $27W < PDP \leq 45W$ ”	1048
Figure 10-4 “Valid SPR AVS Operating Region for a Source advertising in the range of $45W < PDP \leq 60W$ ”	1049
Figure 10-5 “Valid SPR AVS Operating Region for a Source advertising in the range of $60W < PDP \leq 100W$ ”	1049
Figure 10-6 “Valid EPR AVS Operating Region”	1058
Figure 10-7 “EPR Source Power Rule Illustration for Fixed PDOs”	1059
Figure B-1 “External Power supplied downstream”	1066
Figure B-2 External Power supplied upstream	1070
Figure B-3 “Giving Back Power”	1076
Figure D-1 “Circuit Block of BMC Finite Difference Receiver”	1101
Figure D-2 “BMC AC and DC noise from VBUS at Power Sink”	1102
Figure D-3 “Sample BMC Signals (a) without USB 2.0 SE0 Noise (b) with USB 2.0 SE0 Noise”	1102
Figure D-4 “Scaled BMC Signal Derivative with 50ns Sampling Rate”	1103
Figure D-5 “BMC Signal and Finite Difference Output with Various Time Steps”	1103
Figure D-6 “Output of Finite Difference in dash line and Edge Detector in solid line”	1104
Figure D-7 “Noise Zone and Detect Zone of BMC Receiver”	1104
Figure D-8 “Circuit Block of BMC Subtraction Receiver”	1105
Figure D-9 “(a) Output of LPF1 and LPF2 (b) Subtraction of LPF1 and LPF2 Output”	1105
Figure D-10 “Output of the BMC LPF1 in blue dash curve and the Subtractor in red solid curve”	1106
Figure E-1 “Example FRS Capable System”	1107
Figure E-2 “Slow V_{BUS} Discharge”	1108
Figure E-3 “Fast V_{BUS} Discharge”	1109
Figure E-4 “Sequence Diagram for slow V_{BUS} discharge (it discharges after FR_Swap message is sent)”	1113
Figure E-5 Sequence for Vbus discharges quickly (before FR_Swap message is sent) after adapter disconnected... ..	1115

1. Introduction

USB has evolved from a data interface capable of supplying limited power to a primary provider of power with a data interface. Today many devices charge or get their power from USB ports contained in laptops, cars, aircraft or even wall sockets. USB has become a ubiquitous power socket for many small devices such as cell phones, MP3 players and other hand-held devices. Users need USB to fulfil their requirements not only in terms of data but also to provide power to, or charge, their devices simply, often without the need to load a driver, in order to carry out “traditional” USB functions.

There are, however, still many devices which either require an additional power connection to the wall, or exceed the USB rated current in order to operate. Increasingly, international regulations require better energy management due to ecological and practical concerns relating to the availability of power. Regulations limit the amount of power available from the wall which has led to a pressing need to optimize power usage. The USB Power Delivery Specification has the potential to minimize waste as it becomes a standard for charging devices that are not satisfied by [\[USBBC 1.2\]](#).

Wider usage of wireless solutions is an attempt to remove data cabling but the need for “tethered” charging remains. In addition, industrial design requirements drive wired connectivity to do much more over the same connector.

USB Power Delivery is designed to enable the maximum functionality of USB by providing more flexible power delivery along with data over a single cable. Its aim is to operate with and build on the existing USB ecosystem; increasing power levels from existing USB standards, for example Battery Charging, enabling new higher power use cases such as USB powered Hard Disk Drives (HDDs) and printers.

With USB Power Delivery the power direction is no longer fixed. This enables the product with the power (Host or Peripheral) to provide the power. For example, a display with a supply from the wall can power, or charge, a laptop. Alternatively, USB power bricks or chargers are able to supply power to laptops and other battery powered devices through their, traditionally power providing, USB ports.

USB Power Delivery enables hubs to become the means to optimize power management across multiple peripherals by allowing each device to take only the power it requires, and to get more power when required for a given application. For example, battery powered devices can get increased charging current and then give it back temporarily when the user’s HDD requires spinning up. **Optionally** the hubs can communicate with the PC to enable even more intelligent and flexible management of power either automatically or with some level of user intervention.

USB Power Delivery allows Low Power cases such as headsets to negotiate for only the power they require. This provides a simple solution that enables USB devices to operate at their optimal power levels.

The Power Delivery Specification, in addition to providing mechanisms to negotiate power also can be used as a side-band channel for standard and vendor defined messaging. Power Delivery enables alternative modes of operation by providing the mechanisms to discover, enter and exit Alternate Modes. The specification also enables discovery of cable capabilities such as supported speeds and current levels.

1.1 Overview

This specification defines how USB Devices can negotiate for more current and/or higher or lower Voltages over the USB cable (using the USB Type-C® CC wire as the communications channel) than are defined in the [\[USB 2.0\]](#), [\[USB 3.2\]](#), [\[USB4\]](#), [\[USB Type-C 2.3\]](#) or [\[USBBC 1.2\]](#) specifications. It allows Devices with greater power requirements than can be met with today’s specification to get the power they require to operate from V_{BUS} and negotiate with external power sources (e.g., Wall Warts). In addition, it allows a Source and Sink to swap power roles such that a Device could supply power to the Host. For example, a display could supply power to a notebook to charge its battery.

The USB Power Delivery Specification is guided by the following principles:

- Works seamlessly with legacy USB Devices
- Compatible with existing spec-compliant USB cables
- Minimizes potential damage from non-compliant cables (e.g., ‘Y’ cables etc.)
- Optimized for low-cost implementations.

This specification defines mechanisms to discover, enter and exit Modes defined either by a standard or by a particular vendor. These Modes can be supported either by the Port Partner or by a cable connecting the two Port Partners.

The specification defines mechanisms to discover the capabilities of cables which can communicate using Power Delivery.

This specification adds a mechanism to swap the data roles such that the upstream facing Port becomes the downstream facing Port and vice versa. It also enables a swap of the end supplying VCONN to a powered cable.

To facilitate optimum charging, the specification defines two mechanisms a USB Charger can Advertise for the Device to use:

- 1) A list of fixed Voltages each with a maximum current. The Device selects a Voltage and current from the list. This is the traditional model used by Devices that use internal electronics to manage the charging of their battery including modifying the Voltage and current actually supplied to the battery. The side-effect of this model is that the charging circuitry generates heat that can be problematic for small form factor devices.
- 2) A list of programmable Voltage ranges each with a maximum current (PPS). The Device requests a Voltage (in 20mV increments in SPR PPS Mode and in 100mV increments in EPR AVS Mode) that is within the Advertised range and a maximum current. The USB Charger delivers the requested Voltage until the maximum current is reached at which time the USB charger reduces its output Voltage so as not to supply more than the requested maximum current. During the high current portion of the charge cycle, the USB Charger can be directly connected (through an appropriate safety device) to the battery. This model is used by Devices that want to minimize the thermal impact of their internal charging circuitry.

1.2 Purpose

The USB Power Delivery specification defines a power delivery system covering all elements of a USB system including Hosts, Devices, Hubs, Chargers and cable assemblies. This specification describes the architecture, protocols, power supply behavior, connectors and cabling necessary for managing power delivery over USB at up to 100W. This specification is intended to be fully compatible and extend the existing USB infrastructure. It is intended that this specification will allow system OEMs, power supply and peripheral developers adequate flexibility for product versatility and market differentiation without losing backwards compatibility.

USB Power Delivery is designed to operate independently of the existing USB bus defined mechanisms used to negotiate power which are:

- **[USB 2.0], [USB 3.2]** in band requests for high power interfaces.
- **[USBBC 1.2]** mechanisms for supplying higher power (not mandated by this specification).
- **[USB Type-C 2.3]** mechanisms for supplying higher power.

Initial operating conditions remain the USB Default Operation as defined in [\[USB 2.0\]](#), [\[USB 3.2\]](#), [\[USB Type-C 2.3\]](#) or [\[USBBC 1.2\]](#).

- The DFP sources *vSafe5V* over V_{BUS} .
- The UFP consumes power from V_{BUS} .

1.2.1 Scope

This specification is intended as an extension to the existing [\[USB 2.0\]](#), [\[USB 3.2\]](#), [\[USB Type-C 2.3\]](#) and [\[USBBC 1.2\]](#) specifications. It addresses only the elements required to implement USB Power Delivery. It is targeted at power supply vendors, manufacturers of [\[USB 2.0\]](#), [\[USB 3.2\]](#), [\[USB Type-C 2.3\]](#) and [\[USBBC 1.2\]](#) Platforms, Devices and cable assemblies.

Normative information is provided to allow interoperability of components designed to this specification. **Informative** information, when provided, illustrates possible design implementation.

1.3 Section Overview

This specification contains the following sections:

Table 1.1 Section Overview

Section	Description
<i>Section 1 "Introduction"</i>	Introduction, conventions used in the document, list of terms and abbreviations, references, and details of parameter usage.
<i>Section 2 "Overview"</i>	Overview of the document including a description of the operation of PD and the architecture.
<i>Section 3 "USB Type-A and USB Type-B Cable Assemblies and Connectors"</i>	Mechanical and electrical characteristics of the cables and connectors used by PD. Section Deprecated . See [USBPD 2.0] for legacy PD connector specification.
<i>Section 4 "Electrical Requirements"</i>	Electrical requirements for Dead Battery operation and cable detection.
<i>Section 5 "Physical Layer"</i>	Details of the PD PHY Layer requirements
<i>Section 6 "Protocol Layer"</i>	Protocol Layer requirements including the Messages, timers, counters, and state operation.
<i>Section 7 "Power Supply"</i>	Power supply requirements for both Providers and Consumers.
<i>Section 8 "Device Policy"</i>	Device Policy Manager requirements. Policy Engine Message sequence diagrams and state diagrams
<i>Section 9 "States and Status Reporting"</i>	USBPD Device requirements including mapping of V_{BUS} to USB states. System Policy Manager requirements including descriptors, events, and requests.
<i>Section 10 "Power Rules"</i>	Rated Output Power definitions for PD.
<i>Appendix A "CRC calculation"</i>	Example CRC calculations.
<i>Appendix B "PD Message Sequence Examples"</i>	Scenarios illustrating Device Policy Manager operation.
<i>Appendix C "VDM Command Examples"</i>	Examples of Structured VDM usage.
<i>Appendix D "BMC Receiver Design Examples"</i>	BMC Receiver Design Examples.
<i>Appendix E "FRS System Level Example"</i>	FRS System Level Example.

1.4 Conventions

1.4.1 Precedence

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

In there is a conflict between a generic statement and a more specific statement, the more specific statement **Shall** apply.

1.4.2 Keywords

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

1.4.2.1 Conditional Normative

Conditional Normative is a keyword used to indicate a feature that is mandatory when another related feature has been implemented. Designers are mandated to implement all such requirements, when the dependent features have been implemented, to ensure interoperability with other compliant Devices.

1.4.2.2 Deprecated

Deprecated is a keyword used to indicate a feature, supported in previous releases of the specification, which is no longer supported.

1.4.2.3 Discarded

Discard, **Discards** and **Discarded** are equivalent keywords indicating that a Packet when received **Shall** be thrown away by the PHY Layer and not passed to the Protocol Layer for processing. No **GoodCRC** Message **Shall** be sent in response to the Packet.

1.4.2.4 Ignored

Ignore, **Ignores** and **Ignored** are equivalent keywords indicating Messages or Message fields which, when received, **Shall** result in no special action by the receiver. An **Ignored** Message **Shall** only result in returning a **GoodCRC** Message to acknowledge Message receipt. A Message with an **Ignored** field **Shall** be processed normally except for any actions relating to the **Ignored** field.

1.4.2.5 Informative

Informative is a keyword indicating text with no specific requirements, provided only to improve understanding.

1.4.2.6 Invalid

Invalid is a keyword when used in relation to a Packet indicates that the Packet's usage or fields fall outside of the defined specification usage. When **Invalid** is used in relation to an Explicit Contract it indicates that a previously established Explicit Contract which can no longer be maintained by the Source. When **Invalid** is used in relation to individual K-codes or K-code sequences indicates that the received Signaling falls outside of the defined specification.

1.4.2.7 May

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

1.4.2.8 May Not

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

1.4.2.9 N/A

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

1.4.2.10 Optional/Optionally/Optional Normative

Optional, **Optionally** and **Optional Normative** are equivalent keywords that describe features not mandated by this specification. However, if an **Optional** feature is implemented, the feature **Shall** be implemented as defined by this specification.

1.4.2.10.1 Reserved

Reserved is a keyword indicating **Reserved** bits, bytes, words, fields, and code values that are set-aside for future standardization. Their use and interpretation **May** be specified by future extensions to this specification and **Shall Not** be utilized or adapted by vendor implementation. A **Reserved** bit, byte, word, or field **Shall** be set to zero by the sender and **Shall** be **Ignored** by the receiver. **Reserved** field values **Shall Not** be sent by the sender and **Shall** be **Ignored** by the receiver.

1.4.2.11 Shall/Normative

Shall and **Normative** are equivalent keywords indicating a mandatory requirement. Designers are mandated to implement all such requirements to ensure interoperability with other compliant Devices.

1.4.2.12 Shall Not

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

1.4.2.13 Should

Should is a keyword indicating flexibility of choice with a preferred alternative; equivalent to the phrase “it is recommended that...”.

1.4.2.14 Should Not

Should Not is a keyword is the inverse of **Should**; equivalent to the phrase “it is recommended that implementations do not...”.

1.4.2.15 Valid

Valid is a keyword that is the inverse of **Invalid** indicating either a Packet or Signaling that fall within the defined specification or an Explicit Contract that can be maintained by the Source.

1.4.3 Numbering

Numbers that are immediately followed by a lowercase “b” (e.g., 01b) are binary values. Numbers that are immediately followed by an uppercase “B” are byte values. Numbers that are immediately followed by a lowercase “h” (e.g., 3Ah) or are preceded by “0x” (e.g., 0xFF00) are hexadecimal values. Numbers not immediately followed by either a “b”, “B”, or “h” are decimal values.

1.5 Related Documents

Document references listed below are inclusive of all approved and published ECNs and Errata:

Table 1.2 Document References

Bookmark Reference	Title	Revision and date
[DPTC2.1]	DisplayPort™ Alt Mode on USB Type-C® Standard www.vesa.org .	Version 2.1 2022-11
[IEC 60950-1]	IEC 60950-1:2005 Information technology equipment – Safety – Part 1: General requirements: Amendment 1:2009, Amendment 2:2013. www.iec.ch .	2005, 2009, 2013
[IEC 60958-1]	IEC 60958-1:2021 Digital Audio Interface Part:1 General. www.iec.ch .	2021-09-10
[IEC 62368-1]	IEC 62368-1:2018 Audio/Video, information, and communication technology equipment – Part 1: Safety requirements. www.iec.ch .	2018-10-04
[IEC 62368-3]	IEC 62368-3:2017 Audio/video, information, and communication technology equipment - Part 3: Safety aspects for DC power transfer through communication cables and ports www.iec.ch .	2017-12-07
[IEC 63002]	IEC 63002:2021 Interoperability specifications and communication method for external power supplies used with computing and consumer electronics devices www.iec.ch .	2021-05-27
[ISO 3166]	ISO 3166 international Standard for country codes and codes for their subdivisions. http://www.iso.org/iso/home/standards/country_codes.htm .	
[TBT3]	see [USB4] Chapter 13 for Thunderbolt™ 3 device operation.	
[UCSI]	USB Type-C® Connector System Software Interface (UCSI) Specification https://www.usb.org/documents .	2023-06-23
[USB 2.0]	Universal Serial Bus 2.0 Specification, , https://www.usb.org/documents .	Revision 2.0
[USB 3.2]	Universal Serial Bus 3.2 Specification https://www.usb.org/documents .	Revision 1.1 June 2022
[USB Type-C 2.3]	Universal Serial Bus Type-C® Cable and Connector Specification, https://www.usb.org/documents .	Release 2.3 October 2023
[USB4]	Universal Serial Bus 4 Specification (USB4®), https://www.usb.org/documents .	Version 2.0 October 2022
[USBBC 1.2]	Universal Serial Bus Battery Charging Specification plus Errata (referred to in this document as the Battery Charging specification). https://www.usb.org/documents .	Revision 1.2
[USBPD 2.0]	Universal Serial Bus Power Delivery Specification, https://www.usb.org/documents .	Revision 2 Version 1.2 March 25, 2016
[USBPDCompliance]	USB Power Delivery Compliance Test Specification, https://www.usb.org/documents .	Revision Q2, 2023 OR April 2023

[USBPD Firmware Update 1.0]	Universal Serial Bus Power Delivery Firmware Update Specification, https://www.usb.org/documents .	Revision 1.0, September 15, 2016
[USB Type-C Authentication 1.0]	Universal Serial Bus Type-C® Authentication Specification, https://www.usb.org/documents .	Revision 1.0, March 25, 2016
[USB Type-C Bridge 1.1]	Universal Serial Bus Type-C® Bridge Specification, https://www.usb.org/documents .	Revision 1.1 September 2017