BS EN IEC 62680-1-2:2018

BSI Standards Publication

Universal Serial Bus interfaces for data and power

Part 1-2: Common components - USB Power Delivery Specification

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National foreword

This British Standard is the UK implementation of EN IEC 62680-1-2:2018. It is identical to IEC 62680-1-2:2018. It supersedes BS EN 62680-1-2:2017, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/100, Audio, video and multimedia systems and equipment.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Universal Serial Bus interfaces for data and power - Part 1-2: Common components - USB Power Delivery Specification (IEC 62680-1-2:2018)

Interfaces bus série universel (USB) pour les données et l'alimentation électrique - Partie 1-2: Composants communs - Spécification USB pour la fourniture de courant (IEC 62680-1-2:2018)

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The text of document 100/2968/CDV, future edition 3 of IEC 62680-1-2, 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 IEC 62680-1-2:2018.

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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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This third edition cancels and replaces the second edition published in 2017 and constitutes a technical revision.

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

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The text of this International Standard is based on the following documents:

CDV	Report on voting
100/2968/CDV	100/3045/RVC

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

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

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INTRODUCTION

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

This standard is the USB-IF publication USB Power Delivery Specification Revision 3.0 V.1.1 and ECNs through 12 June 2017.

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

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Version: ***1.1+ ECNs through 12 June 2017***

Release date: ***12 January 2017***

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1.0	1.1	Including errata through 31-October-2012	31 October 2012
1.0	1.2	Including errata through 26-June-2013	26 June, 2013
1.0	1.3	Including errata through 11-March-2014	11 March 2014
2.0	1.0	Initial release Revision 2.0	11 August 2014
2.0	1.1	Including errata through 7-May 2015	7 May 2015
2.0	1.2	Including errata through 25-March-2016	25 March 2016
2.0	1.3	Including errata through 11-January-2017	11 January 2017
3.0	1.0	Initial release Revision 3.0	11 December 2015
3.0	1.0a	Including errata through 25-March-2016	25 March 2016
3.0	1.1	Including errata through 12-January-2016	12 January 2017
3.0	1.1+ECNs	Markup including ECNs through 12-June-2017: • Add VPD Product Type • Specification Revision Interoperability • VCONN_Swap Clarification • Chapter 7 Source and Sink Behavior • Battery Numbering • Chunking Clarification • FR_Swap State Operation • GoodCRC Specification Revision • Slew Rate Exception for Source	12 June 2017

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Full document details: BS EN IEC 62680-1-2:2018

Table of Contents

FOREWORD ... 2
INTRODUCTION ... 4
Editors ... 6
Contributors ... 6
Revision History ... 14
INTELLECTUAL PROPERTY DISCLAIMER ... 15
Table of Contents ... 16
List of Tables ... 22
List of Figures ... 28
1 Introduction ... 36
1.1 Overview ... 36
1.2 Purpose ... 37
1.3 Scope ... 37
1.4 Conventions ... 37
1.4.1 Precedence ... 37
1.4.2 Keywords ... 38
1.4.3 Numbering ... 39
1.5 Related Documents ... 39
1.6 Terms and Abbreviations ... 40
1.7 Parameter Values ... 47
1.8 Changes From Revision 2.0 ... 48
1.9 Compatibility with Revision 2.0 ... 48
2 Overview ... 48
2.1 Introduction ... 48
2.2 Section Overview ... 50
2.3 Revision 2.0 Changes and Compatibility ... 51
2.3.1 Changes From Revision 2.0 ... 51
2.3.2 Compatibility with Revision 2.0 ... 51
2.4 USB Power Delivery Capable Devices ... 52
2.5 SOP* Communication ... 53
2.5.1 Introduction ... 53
2.5.2 SOP* Collision Avoidance ... 53
2.5.3 SOP Communication ... 53
2.5.4 SOP'/SOP'' Communication with Cable Plugs ... 53
2.6 Operational Overview ... 55
2.6.1 Source Operation ... 55
2.6.2 Sink Operation ... 58
2.6.3 Cable Plugs ... 60
2.7 Architectural Overview ... 61
2.7.1 Policy ... 63

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

2.7.2 Message Formation and Transmission ... 64
2.7.3 Collision Avoidance ... 64
2.7.4 Power supply ... 65
2.7.5 DFP/UFP ... 65
2.7.6 VCONN Source ... 65
2.7.7 Cable and Connectors ... 66
2.7.8 Interactions between Non-PD, BC and PD devices ... 66
2.7.9 Power Rules ... 66
3 USB Type-A and USB Type-B Cable Assemblies and Connectors ... 66
4 Electrical Requirements ... 66
4.1 Interoperability with other USB Specifications ... 66
4.2 Dead Battery Detection / Unpowered Port Detection ... 66
4.3 Cable IR Ground Drop (IR Drop) ... 67
4.4 Cable Type Detection ... 67
5 Physical Layer ... 68
5.1 Physical Layer Overview ... 68
5.2 Physical Layer Functions ... 68
5.3 Symbol Encoding ... 69
5.4 Ordered Sets ... 70
5.5 Transmitted Bit Ordering ... 71
5.6 Packet Format ... 72
5.6.1 Packet Framing ... 72
5.6.2 CRC ... 74
5.6.3 Packet Detection Errors ... 76
5.6.4 Hard Reset ... 76
5.6.5 Cable Reset ... 77
5.7 Collision Avoidance ... 78
5.8 Biphase Mark Coding (BMC) Signaling Scheme ... 78
5.8.1 Encoding and signaling ... 79
5.8.2 Transmit and Receive Masks ... 84
5.8.3 Transmitter Load Model ... 91
5.8.4 BMC Common specifications ... 92
5.8.5 BMC Transmitter Specifications ... 92
5.8.6 BMC Receiver Specifications ... 95
5.9 Built in Self-Test (BIST) ... 98
5.9.1 BIST Carrier Mode ... 98
5.9.2 BIST Test Data ... 98
6 Protocol Layer ... 99
6.1 Overview ... 99
6.2 Messages ... 99
6.2.1 Message Construction ... 99
6.3 Control Message ... 111
6.3.1 GoodCRC Message ... 112
6.3.2 GotoMin Message ... 112

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

6.3.3 Accept Message ... 113
6.3.4 Reject Message ... 113
6.3.5 Ping Message ... 114
6.3.6 PS_RDY Message ... 114
6.3.7 Get_Source_Cap Message ... 114
6.3.8 Get_Sink_Cap Message ... 114
6.3.9 DR_Swap Message ... 114
6.3.10 PR_Swap Message ... 115
6.3.11 VCONN_Swap Message ... 115
6.3.12 Wait Message ... 116
6.3.13 Soft Reset Message ... 117
6.3.14 Not_Supported Message ... 118
6.3.15 Get_Source_Cap_Extended Message ... 118
6.3.16 Get_Status Message ... 118
6.3.17 FR_Swap Message ... 118
6.3.18 Get_PPS_Status ... 119
6.3.19 Get_Country_Codes ... 119
6.4 Data Message ... 119
6.4.1 Capabilities Message ... 120
6.4.2 Request Message ... 130
6.4.3 BIST Message ... 135
6.4.4 Vendor Defined Message ... 136
6.4.5 Battery_Status Message ... 162
6.4.6 Alert Message ... 163
6.4.7 Get_Country_Info Message ... 165
6.5 Extended Message ... 165
6.5.1 Source_Capabilities_Extended Message ... 166
6.5.2 Status Message ... 170
6.5.3 Get_Battery_Cap Message ... 173
6.5.4 Get_Battery_Status Message ... 173
6.5.5 Battery_Capabilities Message ... 173
6.5.6 Get_Manufacturer_Info Message ... 174
6.5.7 Manufacturer_Info Message ... 175
6.5.8 Security Messages ... 176
6.5.9 Firmware Update Messages ... 177
6.5.10 PPS_Status Message ... 178
6.5.11 Country_Codes Message ... 179
6.5.12 Country_Info Message ... 179
6.6 Timers ... 180
6.6.1 CRCReceiveTimer ... 180
6.6.2 SenderResponseTimer ... 180
6.6.3 Capability Timers ... 181
6.6.4 Wait Timers and Times ... 181
6.6.5 Power Supply Timers ... 182

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

6.6.6 NoResponseTimer ... 184
6.6.7 BIST Timers ... 184
6.6.8 Power Role Swap Timers ... 184
6.6.9 Soft Reset Timers ... 185
6.6.10 Hard Reset Timers ... 185
6.6.11 Structured VDM Timers ... 185
6.6.12 VCONN Timers ... 187
6.6.13 tCableMessage ... 187
6.6.14 DiscoverIdentityTimer ... 187
6.6.15 Collision Avoidance Timers ... 187
6.6.16 tFRSwapInit ... 188
6.6.17 Chunking Timers ... 188
6.6.18 Programmable Power Supply Timers ... 189
6.6.19 Time Values and Timers ... 189
6.7 Counters ... 193
6.7.1 MessageID Counter ... 193
6.7.2 Retry Counter ... 193
6.7.3 Hard Reset Counter ... 194
6.7.4 Capabilities Counter ... 194
6.7.5 Discover Identity Counter ... 194
6.7.6 VDMBusyCounter ... 194
6.7.7 Counter Values and Counters ... 194
6.8 Reset ... 195
6.8.1 Soft Reset and Protocol Error ... 195
6.8.2 Hard Reset ... 197
6.8.3 Cable Reset ... 197
6.9 Collision Avoidance ... 198
6.10 Message Discarding ... 198
6.11 State behavior ... 199
6.11.1 Introduction to state diagrams used in Chapter 6 ... 199
6.11.2 State Operation ... 199
6.11.3 List of Protocol Layer States ... 221
6.12 Message Applicability ... 223
6.12.1 Applicability of Control Messages ... 224
6.12.2 Applicability of Data Messages ... 225
6.12.3 Applicability of Extended Messages ... 226
6.12.4 Applicability of Structured VDM Commands ... 227
6.12.5 Applicability of Reset Signaling ... 227
6.12.6 Applicability of Fast Role Swap signal ... 228
6.13 Value Parameters ... 228
7 Power Supply ... 229
7.1 Source Requirements ... 229
7.1.1 Behavioral Aspects ... 229
7.1.2 Source Bulk Capacitance ... 229

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

7.1.3 Types of Sources ... 229
7.1.4 Source Transitions ... 230
7.1.5 Response to Hard Resets ... 234
7.1.6 Changing the Output Power Capability ... 235
7.1.7 Robust Source Operation ... 235
7.1.8 Output Voltage Tolerance and Range ... 236
7.1.9 Charging and Discharging the Bulk Capacitance on V_{BUS} ... 238
7.1.10 Swap Standby for Sources ... 238
7.1.11 Source Peak Current Operation ... 238
7.1.12 Source Capabilities Extended Parameters ... 239
7.1.13 Fast Role Swap ... 241
7.1.14 Non-application of V_{BUS} Slew Rate Limits ... 242
7.2 Sink Requirements ... 242
7.2.1 Behavioral Aspects ... 242
7.2.2 Sink Bulk Capacitance ... 243
7.2.3 Sink Standby ... 243
7.2.4 Suspend Power Consumption ... 244
7.2.5 Zero Negotiated Current ... 244
7.2.6 Transient Load Behavior ... 244
7.2.7 Swap Standby for Sinks ... 244
7.2.8 Sink Peak Current Operation ... 244
7.2.9 Robust Sink Operation ... 244
7.2.10 Fast Role Swap ... 246
7.3 Transitions ... 247
7.3.1 Increasing the Current ... 248
7.3.2 Increasing the Voltage ... 250
7.3.3 Increasing the Voltage and Current ... 252
7.3.4 Increasing the Voltage and Decreasing the Current ... 254
7.3.5 Decreasing the Voltage and Increasing the Current ... 256
7.3.6 Decreasing the Current ... 258
7.3.7 Decreasing the Voltage ... 260
7.3.8 Decreasing the Voltage and the Current ... 262
7.3.9 Sink Requested Power Role Swap ... 264
7.3.10 Source Requested Power Role Swap ... 267
7.3.11 GotoMin Current Decrease ... 270
7.3.12 Source Initiated Hard Reset ... 272
7.3.13 Sink Initiated Hard Reset ... 274
7.3.14 No change in Current or Voltage ... 276
7.3.15 Fast Role Swap ... 278
7.3.16 Increasing the Programmable Power Supply Voltage ... 280
7.3.17 Decreasing the Programmable Power Supply Voltage ... 282
7.3.18 Changing the Source PDO or APDO ... 284
7.4 Electrical Parameters ... 286
7.4.1 Source Electrical Parameters ... 286

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

7.4.2 Sink Electrical Parameters ... 290
7.4.3 Common Electrical Parameters ... 291
8 Device Policy ... 293
8.1 Overview ... 293
8.2 Device Policy Manager ... 293
8.2.1 Capabilities ... 294
8.2.2 System Policy ... 294
8.2.3 Control of Source/Sink ... 294
8.2.4 Cable Detection ... 295
8.2.5 Managing Power Requirements ... 295
8.2.6 Use of “Unconstrained Power” bit with Batteries and AC supplies ... 297
8.2.7 Interface to the Policy Engine ... 299
8.3 Policy Engine ... 300
8.3.1 Introduction ... 300
8.3.2 Atomic Message Sequence Diagrams ... 300
8.3.3 State Diagrams ... 446
9 States and Status Reporting ... 531
9.1 Overview ... 531
9.1.1 PDUSB Device and Hub Requirements ... 534
9.1.2 Mapping to USB Device States ... 535
9.1.3 PD Software Stack ... 537
9.1.4 PDUSB Device Enumeration ... 537
9.2 PD Specific Descriptors ... 539
9.2.1 USB Power Delivery Capability Descriptor ... 539
9.2.2 Battery Info Capability Descriptor ... 540
9.2.3 PD Consumer Port Capability Descriptor ... 541
9.2.4 PD Provider Port Capability Descriptor ... 542
9.3 PD Specific Requests and Events ... 543
9.3.1 PD Specific Requests ... 543
9.4 PDUSB Hub and PDUSB Peripheral Device Requests ... 544
9.4.1 GetBatteryStatus ... 544
9.4.2 SetPDFeature ... 545
10 Power Rules ... 548
10.1 Introduction ... 548
10.2 Source Power Rules ... 548
10.2.1 Source Power Rule Considerations ... 548
10.2.2 Normative Voltages and Currents ... 549
10.2.3 Optional Voltages/Currents ... 552
10.2.4 Power sharing between ports ... 554
10.3 Sink Power Rules ... 554
10.3.1 Sink Power Rule Considerations ... 554
10.3.2 Normative Sink Rules ... 554
A. CRC calculation ... 554
A.1 C code example ... 554

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

A.2 Table showing the full calculation over one Message ... 556
B. PD Message Sequence Examples ... 557
B.1 External power is supplied downstream ... 557
B.2 External power is supplied upstream ... 561
B.3 Giving back power ... 569
C. VDM Command Examples ... 582
C.1 Discover Identity Example ... 582
C.1.1 Discover Identity Command request ... 582
C.1.2 Discover Identity Command response – Active Cable ... 582
C.1.3 Discover Identity Command response – Hub ... 584
C.2 Discover SVIDs Example ... 585
C.2.1 Discover SVIDs Command request ... 585
C.2.2 Discover SVIDs Command response ... 585
C.3 Discover Modes Example ... 587
C.3.1 Discover Modes Command request ... 587
C.3.2 Discover Modes Command response ... 587
C.4 Enter Mode Example ... 589
C.4.1 Enter Mode Command request ... 589
C.4.2 Enter Mode Command response ... 589
C.4.3 Enter Mode Command request with additional VDO ... 590
C.5 Exit Mode Example ... 591
C.5.1 Exit Mode Command request ... 591
C.5.2 Exit Mode Command response ... 591
C.6 Attention Example ... 593
C.6.1 Attention Command request ... 593
C.6.2 Attention Command request with additional VDO ... 593
D. BMC Receiver Design Examples ... 594
D.1 Finite Difference Scheme ... 594
D.1.1 Sample Circuitry ... 594
D.1.2 Theory ... 594
D.1.3 Data Recovery ... 596
D.1.4 Noise Zone and Detection Zone ... 597
D.2 Subtraction Scheme ... 597
D.2.1 Sample Circuitry ... 597
D.2.2 Output of Each Circuit Block ... 598
D.2.3 Subtractor Output at Power Source and Power Sink ... 598
D.2.4 Noise Zone and Detection Zone ... 599

List of Tables

Table 1-1 Terms and Abbreviations ... 40
Table 5-1 4b5b Symbol Encoding Table ... 69
Table 5-2 Ordered Sets ... 70

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table 5-3 Validation of Ordered Sets ... 70
Table 5-4 Data Size ... 71
Table 5-5 SOP ordered set ... 72
Table 5-6 SOP' ordered set ... 73
Table 5-7 SOP'' ordered set ... 73
Table 5-8 SOP'_Debug ordered set ... 74
Table 5-9 SOP''_Debug ordered set ... 74
Table 5-10 CRC-32 Mapping ... 75
Table 5-11 Hard Reset ordered set ... 76
Table 5-12 Cable Reset ordered set ... 77
Table 5-13 Rp values used for Collision Avoidance ... 78
Table 5-14 BMC Tx Mask Definition, X Values ... 85
Table 5-15 BMC Tx Mask Definition, Y Values ... 85
Table 5-16 BMC Rx Mask Definition ... 90
Table 5-17 BMC Common Normative Requirements ... 92
Table 5-18 BMC Transmitter Normative Requirements ... 92
Table 5-19 BMC Receiver Normative Requirements ... 95
Table 6-1 Message Header ... 101
Table 6-2 Revision Interoperability during an Explicit Contract ... 104
Table 6-3 Extended Message Header ... 105
Table 6-4 Use of Unchunked Message Supported bit ... 107
Table 6-5 Control Message Types ... 111
Table 6-6 Data Message Types ... 120
Table 6-7 Power Data Object ... 121
Table 6-8 Augmented Power Data Object ... 121
Table 6-9 Fixed Supply PDO - Source ... 123
Table 6-10 Fixed Power Source Peak Current Capability ... 125
Table 6-11 Variable Supply (non-Battery) PDO - Source ... 126
Table 6-12 Battery Supply PDO - Source ... 126
Table 6-13 Programmable Power Supply APDO - Source ... 127
Table 6-14 Fixed Supply PDO - Sink ... 127
Table 6-15 Variable Supply (non-Battery) PDO - Sink ... 129
Table 6-16 Battery Supply PDO - Sink ... 129
Table 6-17 Programmable Power Supply APDO - Sink ... 130
Table 6-18 Fixed and Variable Request Data Object ... 130
Table 6-19 Fixed and Variable Request Data Object with GiveBack Support ... 130
Table 6-20 Battery Request Data Object ... 131
Table 6-21 Battery Request Data Object with GiveBack Support ... 132
Table 6-22 Programmable Request Data Object ... 132

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table 6-23 BIST Data Object ... 136
Table 6-24 Unstructured VDM Header ... 138
Table 6-25 Structured VDM Header ... 138
Table 6-26 Structured VDM Commands ... 139
Table 6-27 SVID Values ... 140
Table 6-28 Commands and Responses ... 142
Table 6-29 ID Header VDO ... 143
Table 6-30 Product Types (UFP) ... 144
Table 6-31 Product Types (Cable Plug) ... 144
Table 6-32 Product Types (DFP) ... 145
Table 6-33 Cert Stat VDO ... 145
Table 6-34 Product VDO ... 145
Table 6-35 Passive Cable VDO ... 146
Table 6-36 Active Cable VDO ... 148
Table 6-37 AMA VDO ... 150
Table 6-38 VPD VDO ... 151
Table 6-39 Discover SVIDs Responder VDO ... 153
Table 6-40 Battery Status Data Object (BSDO) ... 162
Table 6-41 Alert Data Object ... 163
Table 6-42 Country Code Data Object ... 165
Table 6-43 Extended Message Types ... 165
Table 6-44 Source Capabilities Extended Data Block (SCEDB) ... 166
Table 6-45 Status Data Block (SDB) ... 171
Table 6-46 Get Battery Cap Data Block (GBCDB) ... 173
Table 6-47 Get Battery Status Data Block (GBSDB) ... 173
Table 6-48 Battery Capability Data Block (BCDB) ... 174
Table 6-49 Get Manufacturer Info Data Block (GMIDB) ... 175
Table 6-50 Manufacturer Info Data Block (MIDB) ... 175
Table 6-51 PPS Status Data Block (PPSSDB) ... 178
Table 6-52 Country Codes Data Block (CCDB) ... 179
Table 6-53 Country Info Data Block (CIDB) ... 180
Table 6-54 Time Values ... 190
Table 6-55 Timers ... 191
Table 6-56 Counter parameters ... 194
Table 6-57 Counters ... 195
Table 6-58 Response to an incoming Message (except VDM) ... 196
Table 6-59 Response to an incoming VDM ... 196
Table 6-60 Message discarding ... 198
Table 6-61 Protocol Layer States ... 221

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table 6-62 Applicability of Control Messages ... 224
Table 6-63 Applicability of Data Messages ... 225
Table 6-64 Applicability of Extended Messages ... 226
Table 6-65 Applicability of Structured VDM Commands ... 227
Table 6-66 Applicability of Reset Signaling ... 228
Table 6-67 Applicability of Fast Role Swap signal ... 228
Table 6-68 Value Parameters ... 228
Table 7-1 Sequence Description for Increasing the Current ... 249
Table 7-2 Sequence Description for Increasing the Voltage ... 251
Table 7-3 Sequence Diagram for Increasing the Voltage and Current ... 253
Table 7-4 Sequence Description for Increasing the Voltage and Decreasing the Current ... 255
Table 7-5 Sequence Description for Decreasing the Voltage and Increasing the Current ... 257
Table 7-6 Sequence Description for Decreasing the Current ... 259
Table 7-7 Sequence Description for Decreasing the Voltage ... 261
Table 7-8 Sequence Description for Decreasing the Voltage and the Current ... 263
Table 7-9 Sequence Description for a Sink Requested Power Role Swap ... 265
Table 7-10 Sequence Description for a Source Requested Power Role Swap ... 268
Table 7-11 Sequence Description for a GotoMin Current Decrease ... 271
Table 7-12 Sequence Description for a Source Initiated Hard Reset ... 273
Table 7-13 Sequence Description for a Sink Initiated Hard Reset ... 275
Table 7-14 Sequence Description for no change in Current or Voltage ... 277
Table 7-15 Sequence Description for Fast Role Swap ... 279
Table 7-16 Sequence Description for Increasing the Programmable Power Supply Voltage ... 281
Table 7-17 Sequence Description for Decreasing the Programmable Power Supply Voltage ... 283
Table 7-18 Sequence Description for Changing the Source PDO or APDO ... 285
Table 7-19 Source Electrical Parameters ... 286
Table 7-20 Sink Electrical Parameters ... 290
Table 7-21 Common Source/Sink Electrical Parameters ... 291
Table 8-1 Basic Message Flow ... 301
Table 8-2 Potential issues in Basic Message Flow ... 302
Table 8-3 Basic Message Flow with CRC failure ... 303
Table 8-4 Interruptible and Non-interruptible AMS ... 304
Table 8-5 Steps for a successful Power Negotiation ... 306
Table 8-6 Steps for a GotoMin Negotiation ... 310
Table 8-7 Steps for a Soft Reset ... 312
Table 8-8 Steps for Source initiated Hard Reset ... 316
Table 8-9 Steps for Sink initiated Hard Reset ... 319
Table 8-10 Steps for Source initiated Hard Reset – Sink long reset ... 322
Table 8-11 Steps for a Successful Source Initiated Power Role Swap Sequence ... 326

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table 8-12 Steps for a Successful Sink Initiated Power Role Swap Sequence 331
Table 8-13 Steps for a Successful Fast Role Swap Sequence 336
Table 8-14 Steps for Data Role Swap, UFP operating as Sink initiates 340
Table 8-15 Steps for Data Role Swap, UFP operating as Source initiates 343
Table 8-16 Steps for Data Role Swap, DFP operating as Source initiates 346
Table 8-17 Steps for Data Role Swap, DFP operating as Sink initiates 349
Table 8-18 Steps for Source to Sink VCONN Source Swap 352
Table 8-19 Steps for Sink to Source VCONN Source Swap 355
Table 8-20 Steps for Source Alert to Sink 357
Table 8-21 Steps for Sink Alert to Source 359
Table 8-22 Steps for a Sink getting Source status Sequence 361
Table 8-23 Steps for a Source getting Sink status Sequence 363
Table 8-24 Steps for a Sink getting Source PPS status Sequence 365
Table 8-25 Steps for a Sink getting Source capabilities Sequence 367
Table 8-26 Steps for a Dual-Role Source getting Dual-Role Sink's capabilities as a Source Sequence 369
Table 8-27 Steps for a Source getting Sink capabilities Sequence 371
Table 8-28 Steps for a Dual-Role Sink getting Dual-Role Source capabilities as a Sink Sequence 373
Table 8-29 Steps for a Sink getting Source extended capabilities Sequence 375
Table 8-30 Steps for a Dual-Role Source getting Dual-Role Sink extended capabilities Sequence 377
Table 8-31 Steps for a Sink getting Source Battery capabilities Sequence 379
Table 8-32 Steps for a Source getting Sink Battery capabilities Sequence 381
Table 8-33 Steps for a Sink getting Source Battery status Sequence 383
Table 8-34 Steps for a Source getting Sink Battery status Sequence 385
Table 8-35 Steps for a Source getting Sink's Port Manufacturer information Sequence 387
Table 8-36 Steps for a Source getting Sink's Port Manufacturer information Sequence 389
Table 8-37 Steps for a Source getting Sink's Battery Manufacturer information Sequence 391
Table 8-38 Steps for a Source getting Sink's Battery Manufacturer information Sequence 393
Table 8-39 Steps for a VCONN Source getting Sink's Port Manufacturer information Sequence 395
Table 8-40 Steps for a Source getting Country Codes Sequence 397
Table 8-41 Steps for a Source getting Sink's Country Codes Sequence 399
Table 8-42 Steps for a VCONN Source getting Sink's Country Codes Sequence 401
Table 8-43 Steps for a Source getting Country Information Sequence 403
Table 8-44 Steps for a Source getting Sink's Country Information Sequence 405
Table 8-45 Steps for a VCONN Source getting Sink's Country Information Sequence 407
Table 8-46 Steps for a Source requesting a security exchange with a Sink Sequence 409
Table 8-47 Steps for a Sink requesting a security exchange with a Source Sequence 411
Table 8-48 Steps for a Vconn Source requesting a security exchange with a Cable Plug Sequence ... 413

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table 8-49 Steps for a Source requesting a firmware update exchange with a Sink Sequence ... 415
Table 8-50 Steps for a Sink requesting a firmware update exchange with a Source Sequence ... 417
Table 8-51 Steps for a Vconn Source requesting a firmware update exchange with a Cable Plug Sequence ... 419
Table 8-52 Steps for DFP to UFP Discover Identity ... 421
Table 8-53 Steps for Source Port to Cable Plug Discover Identity ... 423
Table 8-54 Steps for DFP to Cable Plug Discover Identity ... 426
Table 8-55 Steps for DFP to UFP Enter Mode ... 429
Table 8-56 Steps for DFP to UFP Exit Mode ... 431
Table 8-57 Steps for DFP to Cable Plug Enter Mode ... 434
Table 8-58 Steps for DFP to Cable Plug Exit Mode ... 436
Table 8-59 Steps for UFP to DFP Attention ... 439
Table 8-60 Steps for BIST Carrier Mode Test ... 442
Table 8-61 Steps for BIST Test Data Test ... 444
Table 8-62 Policy Engine States ... 524
Table 9-1 USB Power Delivery Type Codes ... 539
Table 9-2 USB Power Delivery Capability Descriptor ... 539
Table 9-3 Battery Info Capability Descriptor ... 540
Table 9-4 PD Consumer Port Descriptor ... 541
Table 9-5 PD Provider Port Descriptor ... 542
Table 9-6 PD Requests ... 543
Table 9-7 PD Request Codes ... 543
Table 9-8 PD Feature Selectors ... 543
Table 9-9 Battery Status Structure ... 544
Table 9-10 Battery Wake Mask ... 546
Table 9-11 Charging Policy Encoding ... 546
Table 10-1 Considerations for Sources ... 548
Table 10-2 Normative Voltages and Currents ... 549
Table 10-3 Fixed Supply PDO – Source 5V ... 550
Table 10-4 Fixed Supply PDO – Source 9V ... 551
Table 10-5 Fixed Supply PDO – Source 15V ... 551
Table 10-6 Fixed Supply PDO – Source 20V ... 551
Table 10-7 Programmable Power Supply PDOs and APDOs based on the PDP ... 552
Table 10-8 Programmable Power Supply Voltage Ranges ... 553
Table B-1 External power is supplied downstream ... 558
Table B-2 External power is supplied upstream ... 562
Table B-3 Giving back power ... 569
Table C-1 Discover Identity Command request from Initiator Example ... 582

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Table C-2 Discover Identity Command response from Active Cable Responder Example 583
Table C-3 Discover Identity Command response from Hub Responder Example 584
Table C-4 Discover SVIDs Command request from Initiator Example 585
Table C-5 Discover SVIDs Command response from Responder Example 585
Table C-6 Discover Modes Command request from Initiator Example 587
Table C-7 Discover Modes Command response from Responder Example 587
Table C-8 Enter Mode Command request from Initiator Example 589
Table C-9 Enter Mode Command response from Responder Example 589
Table C-10 Enter Mode Command request from Initiator Example 590
Table C-11 Exit Mode Command request from Initiator Example 591
Table C-12 Exit Mode Command response from Responder Example 591
Table C-13 Attention Command request from Initiator Example 593
Table C-14 Attention Command request from Initiator with additional VDO Example 593

List of Figures

Figure 2-1 Logical Structure of USB Power Delivery Capable Devices 52
Figure 2-2 Example SOP' Communication between VCONN Source and Cable Plug(s) 54
Figure 2-3 USB Power Delivery Communications Stack 61
Figure 2-4 USB Power Delivery Communication Over USB 62
Figure 2-5 High Level Architecture View 63
Figure 5-1 Interpretation of ordered sets 70
Figure 5-2 Transmit Order for Various Sizes of Data 71
Figure 5-3 USB Power Delivery Packet Format 72
Figure 5-4 CRC 32 generation 75
Figure 5-5 Line format of Hard Reset 77
Figure 5-6 Line format of Cable Reset 78
Figure 5-7 BMC Example 79
Figure 5-8 BMC Transmitter Block Diagram 79
Figure 5-9 BMC Receiver Block Diagram 80
Figure 5-10 BMC Encoded Start of Preamble 80
Figure 5-11 Transmitting or Receiving BMC Encoded Frame Terminated by Zero with High-to-Low Last Transition 81
Figure 5-12 Transmitting or Receiving BMC Encoded Frame Terminated by One with High-to-Low Last Transition 82
Figure 5-13 Transmitting or Receiving BMC Encoded Frame Terminated by Zero with Low to High Last Transition 83
Figure 5-14 Transmitting or Receiving BMC Encoded Frame Terminated by One with Low to High Last Transition 84
Figure 5-15 BMC Tx 'ONE' Mask 84
Figure 5-16 BMC Tx 'ZERO' Mask 85

AVA Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 5-17 BMC Rx ‘ONE’ Mask when Sourcing Power ... 87
Figure 5-18 BMC Rx ‘ZERO’ Mask when Sourcing Power ... 88
Figure 5-19 BMC Rx ‘ONE’ Mask when Power neutral ... 88
Figure 5-20 BMC Rx ‘ZERO’ Mask when Power neutral ... 89
Figure 5-21 BMC Rx ‘ONE’ Mask when Sinking Power ... 89
Figure 5-22 BMC Rx ‘ZERO’ Mask when Sinking Power ... 90
Figure 5-23 Transmitter Load Model for BMC Tx from a Source ... 91
Figure 5-24 Transmitter Load Model for BMC Tx from a Sink ... 91
Figure 5-25 Transmitter diagram illustrating zDriver ... 93
Figure 5-26 Inter-Frame Gap Timings ... 94
Figure 5-27 Example Multi-Drop Configuration showing two DRPs ... 96
Figure 5-28 Example Multi-Drop Configuration showing a DFP and UFP ... 97
Figure 5-29 Test Data Frame ... 98
Figure 6-1 USB Power Delivery Packet Format including Control Message Payload ... 100
Figure 6-2 USB Power Delivery Packet Format including Data Message Payload ... 100
Figure 6-3 USB Power Delivery Packet Format including an Extended Message Header and Payload ... 101
Figure 6-4 Example Security_Request sequence Unchunked (Chunked bit = 0) ... 107
Figure 6-5 Example byte transmission for Security_Request Message of Data Size 7 (Chunked bit is set to 0) ... 108
Figure 6-6 Example byte transmission for Security_Response Message of Data Size 7 (Chunked bit is set to 0) ... 108
Figure 6-7 Example Security_Request sequence Chunked (Chunked bit = 1) ... 109
Figure 6-8 Example Security_Request Message of Data Size 7 (Chunked bit set to 1) ... 110
Figure 6-9 Example Chunk 0 of Security_Response Message of Data Size 30 (Chunked bit set to 1) ... 110
Figure 6-10 Example byte transmission for a Security_Request Message Chunk request (Chunked bit is set to 1) ... 111
Figure 6-11 Example Chunk 1 of Security_Response Message of Data Size 30 (Chunked bit set to 1) ... 111
Figure 6-12 Example Capabilities Message with 2 Power Data Objects ... 120
Figure 6-13 BIST Message ... 135
Figure 6-14 Vendor Defined Message ... 137
Figure 6-15 Discover Identity Command response ... 143
Figure 6-16 Example Discover SVIDs response with 3 SVIDs ... 153
Figure 6-17 Example Discover SVIDs response with 4 SVIDs ... 153
Figure 6-18 Example Discover SVIDs response with 12 SVIDs followed by an empty response ... 153
Figure 6-19 Example Discover Modes response for a given SVID with 3 Modes ... 154
Figure 6-20 Successful Enter Mode sequence ... 155
Figure 6-21 Enter Mode sequence Interrupted by Source Capabilities and then Re-run ... 156

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 6-22 Unsuccessful Enter Mode sequence due to NAK 157
Figure 6-23 Exit Mode sequence 158
Figure 6-24 Attention Command request/response sequence 159
Figure 6-25 Command request/response sequence 159
Figure 6-26 Enter/Exit Mode Process 161
Figure 6-27 Battery_Status Message 162
Figure 6-28 Alert Message 163
Figure 6-29 Get_Country_Info Message 165
Figure 6-30 Source_Capabilities_Extended Message 166
Figure 6-31 Status Message 171
Figure 6-32 Get_Battery_Cap Message 173
Figure 6-33 Get_Battery_Status Message 173
Figure 6-34 Battery_Capabilities Message 174
Figure 6-35 Get_Manufacturer_Info Message 175
Figure 6-36 Manufacturer_Info Message 175
Figure 6-37 Security_Request Message 177
Figure 6-38 Security_Response Message 177
Figure 6-39 Firmware_Update_Request Message 177
Figure 6-40 Firmware_Update_Response Message 178
Figure 6-41 PPS_Status Message 178
Figure 6-42 Country_Codes Message 179
Figure 6-43 Country_Info Message 180
Figure 6-44 Outline of States 199
Figure 6-45 References to states 199
Figure 6-46 Chunking architecture Showing Message and Control Flow 200
Figure 6-47 Chunked Rx State Diagram 202
Figure 6-48 Chunked Tx State Diagram 205
Figure 6-49 Chunked Message Router State Diagram 208
Figure 6-50 Common Protocol Layer Message transmission State Diagram 210
Figure 6-51 Source Protocol Layer Message transmission State Diagram 213
Figure 6-52 Sink Protocol Layer Message transmission State Diagram 215
Figure 6-53 Protocol layer Message reception 216
Figure 6-54 Hard/Cable Reset 218
Figure 7-1 Placement of Source Bulk Capacitance 229
Figure 7-2 Transition Envelope for Positive Voltage Transitions 230
Figure 7-3 Transition Envelope for Negative Voltage Transitions 231
Figure 7-4 PPS Positive Voltage Transitions 232
Figure 7-5 PPS Negative Voltage Transitions 233
Figure 7-6 Expected PPS Ripple Relative to an LSB 233

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 7-7 PPS Programmable Voltage and Foldback ... 234
Figure 7-8 Source V_{BUS} and VCONN Response to Hard Reset ... 235
Figure 7-9 Application of vSrcNew and vSrcValid limits after tSrcReady ... 237
Figure 7-10 Source Peak Current Overload ... 239
Figure 7-11 Holdup Time Measurement ... 240
Figure 7-12 V_{BUS} Power during Fast Role Swap ... 241
Figure 7-13 V_{BUS} detection and timing during Fast Role Swap ... 242
Figure 7-14 Placement of Sink Bulk Capacitance ... 243
Figure 7-15 Transition Diagram for Increasing the Current ... 248
Figure 7-16 Transition Diagram for Increasing the Voltage ... 250
Figure 7-17 Transition Diagram for Increasing the Voltage and Current ... 252
Figure 7-18 Transition Diagram for Increasing the Voltage and Decreasing the Current ... 254
Figure 7-19 Transition Diagram for Decreasing the Voltage and Increasing the Current ... 256
Figure 7-20 Transition Diagram for Decreasing the Current ... 258
Figure 7-21 Transition Diagram for Decreasing the Voltage ... 260
Figure 7-22 Transition Diagram for Decreasing the Voltage and the Current ... 262
Figure 7-23 Transition Diagram for a Sink Requested Power Role Swap ... 264
Figure 7-24 Transition Diagram for a Source Requested Power Role Swap ... 267
Figure 7-25 Transition Diagram for a GotoMin Current Decrease ... 270
Figure 7-26 Transition Diagram for a Source Initiated Hard Reset ... 272
Figure 7-27 Transition Diagram for a Sink Initiated Hard Reset ... 274
Figure 7-28 Transition Diagram for no change in Current or Voltage ... 276
Figure 7-29 Transition Diagram for Fast Role Swap ... 278
Figure 7-30 Transition Diagram for Increasing the Programmable Power Supply Voltage ... 280
Figure 7-31 Transition Diagram for Decreasing the Programmable Power Supply Voltage ... 282
Figure 7-32 Transition Diagram for Changing the Source PDO or APDO ... 284
Figure 8-1 Example of daisy chained displays ... 298
Figure 8-2 Basic Message Exchange (Successful) ... 301
Figure 8-3 Basic Message flow indicating possible errors ... 302
Figure 8-4 Basic Message Flow with Bad CRC followed by a Retry ... 303
Figure 8-5 Successful Power Negotiation ... 306
Figure 8-6 Successful GotoMin operation ... 310
Figure 8-7 Soft Reset ... 312
Figure 8-8 Source initiated Hard Reset ... 315
Figure 8-9 Sink Initiated Hard Reset ... 318
Figure 8-10 Source initiated reset - Sink long reset ... 321
Figure 8-11 Successful Power Role Swap Sequence Initiated by the Source ... 325
Figure 8-12 Successful Power Role Swap Sequence Initiated by the Sink ... 330
Figure 8-13 Successful Fast Role Swap Sequence ... 335

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 8-14 Data Role Swap, UFP operating as Sink initiates 339
Figure 8-15 Data Role Swap, UFP operating as Source initiates 342
Figure 8-16 Data Role Swap, DFP operating as Source initiates 345
Figure 8-17 Data Role Swap, DFP operating as Sink initiates 348
Figure 8-18 Source to Sink VCONN Source Swap 351
Figure 8-19 Sink to Source VCONN Source Swap 354
Figure 8-20 Source Alert to Sink 357
Figure 8-21 Sink Alert to Source 359
Figure 8-22 Sink Gets Source Status 361
Figure 8-23 Source Gets Sink Status 363
Figure 8-24 Sink Gets Source PPS Status 365
Figure 8-25 Sink Gets Source's Capabilities 367
Figure 8-26 Dual-Role Source Gets Dual-Role Sink's Capabilities as a Source 369
Figure 8-27 Source Gets Sink's Capabilities 371
Figure 8-28 Dual-Role Sink Gets Dual-Role Source's Capabilities as a Sink 373
Figure 8-29 Sink Gets Source's Extended Capabilities 375
Figure 8-30 Dual-Role Source Gets Dual-Role Sink's Extended Capabilities 377
Figure 8-31 Sink Gets Source's Battery Capabilities 379
Figure 8-32 Source Gets Sink's Battery Capabilities 381
Figure 8-33 Sink Gets Source's Battery Status 383
Figure 8-34 Source Gets Sink's Battery Status 385
Figure 8-35 Source Gets Sink's Port Manufacturer Information 387
Figure 8-36 Sink Gets Source's Port Manufacturer Information 389
Figure 8-37 Source Gets Sink's Battery Manufacturer Information 391
Figure 8-38 Sink Gets Source's Battery Manufacturer Information 393
Figure 8-39 VCONN Source Gets Cable Plug's Manufacturer Information 395
Figure 8-40 Source Gets Sink's Country Codes 397
Figure 8-41 Sink Gets Source's Country Codes 399
Figure 8-42 VCONN Source Gets Cable Plug's Country Codes 401
Figure 8-43 Source Gets Sink's Country Information 403
Figure 8-44 Sink Gets Source's Country Information 405
Figure 8-45 VCONN Source Gets Cable Plug's Country Information 407
Figure 8-46 Source requests security exchange with Sink 409
Figure 8-47 Sink requests security exchange with Source 411
Figure 8-48 Vconn Source requests security exchange with Cable Plug 413
Figure 8-49 Source requests firmware update exchange with Sink 415
Figure 8-50 Sink requests firmware update exchange with Source 417
Figure 8-51 Vconn Source requests firmware update exchange with Cable Plug 419
Figure 8-52 DFP to UFP Discover Identity 421

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 8-53 Source Port to Cable Plug Discover Identity 423
Figure 8-54 DFP to Cable Plug Discover Identity 426
Figure 8-55 DFP to UFP Enter Mode 429
Figure 8-56 DFP to UFP Exit Mode 431
Figure 8-57 DFP to Cable Plug Enter Mode 433
Figure 8-58 DFP to Cable Plug Exit Mode 436
Figure 8-59 UFP to DFP Attention 439
Figure 8-60 BIST Carrier Mode Test 441
Figure 8-61 BIST Test Data Test 443
Figure 8-62 Outline of States 446
Figure 8-63 References to states 446
Figure 8-64 Example of state reference with conditions 447
Figure 8-65 Example of state reference with the same entry and exit 447
Figure 8-66 Source Port Policy Engine State Diagram 448
Figure 8-67 Sink Port State Diagram 455
Figure 8-68 Source Port Soft Reset and Protocol Error State Diagram 460
Figure 8-69 Sink Port Soft Reset and Protocol Error Diagram 461
Figure 8-70 Source Port Not Supported Message State Diagram 463
Figure 8-71 Sink Port Not Supported Message State Diagram 464
Figure 8-72 Source Port Ping State Diagram 465
Figure 8-73 Source Port Source Alert State Diagram 465
Figure 8-74 Sink Port Source Alert State Diagram 466
Figure 8-75 Sink Port Sink Alert State Diagram 466
Figure 8-76 Source Port Sink Alert State Diagram 466
Figure 8-77 Sink Port Get Source Capabilities Extended State Diagram 467
Figure 8-78 Source Give Source Capabilities Extended State Diagram 467
Figure 8-79 Sink Port Get Source Status State Diagram 468
Figure 8-80 Source Give Source Status State Diagram 468
Figure 8-81 Source Port Get Sink Status State Diagram 469
Figure 8-82 Sink Give Sink Status State Diagram 469
Figure 8-83 Sink Port Get Source PPS Status State Diagram 470
Figure 8-84 Source Give Source PPS Status State Diagram 470
Figure 8-85 Get Battery Capabilities State Diagram 471
Figure 8-86 Give Battery Capabilities State Diagram 472
Figure 8-87 Get Battery Status State Diagram 472
Figure 8-88 Give Battery Status State Diagram 473
Figure 8-89 Get Manufacturer Information State Diagram 473
Figure 8-90 Give Manufacturer Information State Diagram 474
Figure 8-91 Get Country Codes State Diagram 474

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 8-92 Give Country Codes State Diagram 475
Figure 8-93 Get Country Information State Diagram 475
Figure 8-94 Give Country Information State Diagram 476
Figure 8-95 Send security request State Diagram 476
Figure 8-96 Send security response State Diagram 477
Figure 8-97 Security response received State Diagram 477
Figure 8-98 Send firmware update request State Diagram 478
Figure 8-99 Send firmware update response State Diagram 478
Figure 8-100 Firmware update response received State Diagram 479
Figure 8-101: DFP to UFP Data Role Swap State Diagram 480
Figure 8-102: UFP to DFP Data Role Swap State Diagram 482
Figure 8-103: Dual-Role Port in Source to Sink Power Role Swap State Diagram 485
Figure 8-104: Dual-role Port in Sink to Source Power Role Swap State Diagram 488
Figure 8-105: Dual-Role Port in Source to Sink Fast Role Swap State Diagram 491
Figure 8-106: Dual-role Port in Sink to Source Fast Role Swap State Diagram 494
Figure 8-107 Dual-Role (Source) Get Source Capabilities diagram 496
Figure 8-108 Dual-Role (Source) Give Sink Capabilities diagram 496
Figure 8-109 Dual-Role (Sink) Get Sink Capabilities State Diagram 497
Figure 8-110 Dual-Role (Sink) Give Source Capabilities State Diagram 498
Figure 8-111 Dual-Role (Source) Get Source Capabilities Extended State Diagram 498
Figure 8-112 Dual-Role (Source) Give Sink Capabilities diagram 499
Figure 8-113 VCONN Swap State Diagram 500
Figure 8-114 Initiator to Port VDM Discover Identity State Diagram 503
Figure 8-115 Initiator VDM Discover SVIDs State Diagram 504
Figure 8-116 Initiator VDM Discover Modes State Diagram 505
Figure 8-117 Initiator VDM Attention State Diagram 506
Figure 8-118 Responder Structured VDM Discover Identity State Diagram 506
Figure 8-119 Responder Structured VDM Discover SVIDs State Diagram 507
Figure 8-120 Responder Structured VDM Discover Modes State Diagram 508
Figure 8-121 Receiving a Structured VDM Attention State Diagram 509
Figure 8-122 DFP VDM Mode Entry State Diagram 510
Figure 8-123 DFP VDM Mode Exit State Diagram 511
Figure 8-124 UFP Structured VDM Enter Mode State Diagram 512
Figure 8-125 UFP Structured VDM Exit Mode State Diagram 513
Figure 8-126 Cable Ready VDM State Diagram 514
Figure 8-127 Cable Plug Soft Reset State Diagram 514
Figure 8-128 Cable Plug Hard Reset State Diagram 515
Figure 8-129 DFP Soft Reset or Cable Reset of a Cable Plug State Diagram 516
Figure 8-130 UFP Source Soft Reset of a Cable Plug State Diagram 517

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Figure 8-131 Source Startup Structured VDM Discover Identity State Diagram 518
Figure 8-132 Cable Plug Structured VDM Enter Mode State Diagram 520
Figure 8-133 Cable Plug Structured VDM Exit Mode State Diagram 521
Figure 8-134 BIST Carrier Mode State Diagram 522
Figure 9-1 Example PD Topology 532
Figure 9-2 Mapping of PD Topology to USB 534
Figure 9-3 USB Attached to USB Powered State Transition 535
Figure 9-4 Any USB State to USB Attached State Transition (When operating as a Consumer) 536
Figure 9-5 Any USB State to USB Attached State Transition (When operating as a Provider) 536
Figure 9-6 Any USB State to USB Attached State Transition (After a USB Type-C Data Role Swap) 537
Figure 9-7 Software stack on a PD aware OS 537
Figure 9-8 Enumeration of a PDUSB Device 538
Figure 10-1 Source Power Rule Illustration 549
Figure 10-2 Source Power Rule Example 550
Figure B-1 External Power supplied downstream 557
Figure B-2 External Power supplied upstream 561
Figure B-3 Giving Back Power 569
Figure D-1 Circuit Block of BMC Finite Difference Receiver 594
Figure D-2 BMC AC and DC noise from VBUS at Power Sink 595
Figure D-3 Sample BMC Signals (a) without *[USB 2.0]* SE0 Noise (b) with *[USB 2.0]* SE0 Noise 595
Figure D-4 Scaled BMC Signal Derivative with 50ns Sampling Rate (a) without *[USB 2.0]* Noise (b) with *[USB 2.0]* Noise 596
Figure D-5 BMC Signal and Finite Difference Output with Various Time Steps 596
Figure D-6 Output of Finite Difference in dash line and Edge Detector in solid line 597
Figure D-7 Noise Zone and Detect Zone of BMC Receiver 597
Figure D-8 Circuit Block of BMC Subtraction Receiver 598
Figure D-9 (a) Output of LPF1 and LPF2 (b) Subtraction of LPF1 and LPF2 Output 598
Figure D-10 Output of the BMC LPF1 in blue dash curve and the Subtractor in red solid curve (a) at Power Source (b) at Power Sink 599

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

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 fulfill 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 3.1]*, *[USB Type-C 1.2]* 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.

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Full document details: BS EN IEC 62680-1-2:2018

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

1. Works seamlessly with legacy USB Devices
2. Compatible with existing spec-compliant USB cables
3. Minimizes potential damage from non-compliant cables (e.g. 'Y' cables etc.)
4. 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 V_{CONN} to a powered cable.

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

Initial operating conditions remain the USB Default Operation as defined in *[USB 2.0]*, *[USB 3.1]*, *[USB Type-C 1.2]* or *[USBBC 1.2]*.

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

1.3 Scope

This specification is intended as an extension to the existing *[USB 2.0]*, *[USB 3.1]*, *[USB Type-C 1.2]* 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 3.1]*, *[USB Type-C 1.2]* 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.

1.4 Conventions

1.4.1 Precedence

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

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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 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.

1.4.2.6 May

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

1.4.2.7 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.

1.4.2.8 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.

1.4.2.9 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 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.

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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, 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

- ***[USB 2.0]*** – Universal Serial Bus Specification, Revision 2.0, plus ECN and Errata http://www.usb.org/developers/docs/usb20_docs/.
- ***[USB 3.1]*** – Universal Serial Bus 3.1 Specification, Revision 1 plus ECN and Errata (this includes the entire document release package including the OTG&EH v3.0 specification). www.usb.org/developers/docs.
- ***[USBTypeCAuthentication 1.0]***, Universal Serial Bus Type-C Authentication Specification, Revision 1.0, March 25, 2016. www.usb.org/developers/docs.
- ***[USBPDFirmwareUpdate 1.0]***, Universal Serial Bus Power Delivery Firmware Update Specification, Revision 1.0. www.usb.org/developers/docs. Expected publication date H2 2016.
- ***[USBBC 1.2]*** – Universal Serial Bus Battery Charging Specification, Revision 1.2 plus Errata (referred to in this document as the Battery Charging specification). www.usb.org/developers/devclass_docs#approved.
- ***[USBBridge 1.0]*** – Universal Serial Bus Type-C Bridge Specification, Revision 1.0, March 25, 2016. www.usb.org/developers/docs.
- ***[USBTypeCBridge 1.0]*** – Universal Serial Bus Type-C Bridge Specification, Revision 1.0, March 25, 2016. www.usb.org/developers/docs.
- ***[USBPD 2.0]*** – Universal Serial Bus Power Delivery Specification, Revision 2, Version 1.2, March 25, 2016. www.usb.org/developers/docs.
- ***[USBPDCompliance]*** – USB Power Delivery Compliance Plan version 1.0 http://www.usb.org/developers/docs/devclass_docs/.
- ***[USB Type-C 1.2]*** – Universal Serial Bus Type-C Cable and Connector Specification, Revision 1.2, March 25, 2016. www.usb.org/developers/docs.

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Full document details: BS EN IEC 62680-1-2:2018

- *[IEC 60958-1]* IEC 60958-1 Digital Audio Interface Part:1 General Edition 3.0 2008-09 www.iec.ch
- *[IEC 60950-1]* IEC 60950-1:2005 Information technology equipment – Safety – Part 1: General requirements: Amendment 1:2009, Amendment 2:2013
- *[IEC 62368-1]* IEC 62368-1 Audio/Video, information and communication technology equipment – Part 1: Safety requirements
- *[IEC 63002]* Draft CD for IEC 63002 Identification and Communication Interoperability Method for External DC Power Supplies Used With Portable Computing Devices.
- *[ISO 3166]* ISO 3166 international Standard for country codes and codes for their subdivisions. http://www.iso.org/iso/home/standards/country_codes.htm.

1.6 Terms and Abbreviations

This section defines terms used throughout this document. For additional terms that pertain to the Universal Serial Bus, see Chapter 2, "Terms and Abbreviations," in *[USB 2.0]*, *[USB 3.1]*, *[USB Type-C 1.2]* and *[USBBC 1.2]*.

Table 1-1 Terms and Abbreviations

Term	Description
Active Cable	A cable with a USB Plug on each end at least one of which is a Cable Plug supporting SOP', that also incorporates data bus signal conditioning circuits. The cable supports the Structured VDM ***Discover Identity*** Command to determine its characteristics in addition to other Structured VDM Commands (Electronically Marked Cable see *[USB Type-C 1.2]*).
Active Mode	A Mode which has been entered and not exited.
Alternate Mode	As defined in *[USB Type-C 1.2]*. Equivalent to Mode in the PD Specification.
Alternate Mode Adapter (AMA)	A PDUSB Device which supports Alternate Modes as defined in *[USB Type-C 1.2]*. Note that since an AMA is a PDUSB Device it has a single UFP that is only addressable by SOP Packets.
Alternate Mode Controller (AMC)	A DFP that supports connection to AMAs as defined in *[USB Type-C 1.2]*. A DFP that is an AMC can also be a PDUSB Host.
Augmented Power Data Object (APDO)	Data Object used to expose a Source Port's power capabilities or a Sink's power requirements as part of a ***Source_Capabilities*** or ***Sink_Capabilities*** Message respectively. Programmable Power Supply Data Object is defined.
Atomic Message Sequence (AMS)	A fixed sequence of Messages as defined in Section 8.3.2 typically starting and ending in one of the following states: ***PE_SRC_Ready***, ***PE_SNK_Ready*** or ***PE_CBL_Ready***. An AMS can be Interruptible or Non-interruptible.
Attach	Mechanical joining of the Port Pair by a cable.
Attached	USB Power Delivery ports which are mechanically joined with USB cable.
Battery	A power storage device residing behind a Port that can either be a source or sink of power.
Battery Slot	A physical location where a Hot Swappable Battery can be installed. A Battery Slot might or might not have a Hot Swappable Battery present in a Battery Slot at any given time.
Battery Supply	A power supply that directly applies the output of a Battery to V_{BUS}. This is exposed by the Battery Supply PDO (see Section 6.4.1.2.4)
Binary Frequency Shift Keying (BFSK)	A Signaling Scheme now ***Deprecated*** in this specification. BFSK used a pair of discrete frequencies to transmit binary (0s and 1s) information over V_{BUS}. See *[USBPD 2.0]* for further details.
Biphase Mark Coding (BMC)	Modification of Manchester coding where each zero has one transition and a one has two transitions (see *[IEC 60958-1]*).
BIST	Built In Self-Test – Power Delivery testing mechanism for the PHY Layer.
BIST Data Object (BDO)	Data Object used by ***BIST*** Messages.
BIST Mode	A BIST receiver or transmitter test mode enabled by a ***BIST*** Message.

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Term	Description
Cable Plug	Term used to describe a PD Capable element in a Multi-Drop system addressed by SOP'/SOP'' Packets. Logically the Cable Plug is associated with a USB plug at one end of the cable. In a practical implementation the electronics might reside anywhere in the cable.
Cable Reset	This is initiated by ***Cable Reset*** Signaling from the DFP. It restores the Cable Plugs to their default, power up condition and resets the PD communications engine to its default state. It does not reset the Port Partners but does restore VCONN to its Attachment state.
Charge Through	A mechanism for a VCONN-powered USB Device to pass power and CC communication from one Port to the other without any interference or re-regulation. This will be defined in a future specification.
Charge Through Port	The USB Type-C receptacle on a USB Device that is designed to allow a Source to be connected through the USB Device to charge a system it is Attached to. Most common use is to allow a single Port Host to support a USB device while being charged.
Chunk	A ***MaxExtendedMsgChunkLen*** (26 byte) or less portion of a Data Block. Data Blocks can be sent either as a single Message or as a series of Chunks.
Chunking	The process of breaking up a Data Block larger than ***MaxExtendedMsgLegacyLen*** (26-bytes) into two of more Chunks.
Cold Socket	A Port that does not apply ***vSafe5V*** on V_{BUS} until a Sink is Attached.
Command	Request and response pair defined as part of a Structured Vendor Defined Message (see Section 6.4.4.2)
Configuration Channel (CC)	Single wire used by the BMC PHY Layer Signaling Scheme (see ***[USB Type-C 1.2]***).
Connected	USB Power Delivery ports that have exchanged a Message and a ***GoodCRC*** Message response using the USB Power Delivery protocol so that both Port Partners know that each is PD Capable.
Consumer	The capability of a PD Port (typically a Device's UFP) to sink power from the power conductor (e.g. V_{BUS}). This corresponds to a USB Type-C Port with Rd asserted on its CC Wire.
Consumer/Provider	A Consumer with the additional capability to act as a Provider. This corresponds to a Dual-Role Port with Rd asserted on its CC Wire.
Continuous BIST Mode	A BIST Mode where the Port or Cable Plug being tested sends a continuous stream of test data.
Constant Voltage (CV)	A mode in which the Source output Voltage remains constant as the load changes.
Contract	An agreement on both power level and direction reached between a Port Pair. A Contract could be explicitly negotiated between the Port Pair or could be an Implicit power level defined by the current state. While operating in Power Delivery mode there will always be either an Explicit or Implicit Contract in place. The Contract can only be altered in the case of a (re-)negotiation, Power Role Swap, Data Role Swap, Hard Reset or failure of the Source.
Control Message	A Message is defined as a Control Message when the ***Number of Data Objects*** field in the Message Header is set to 0. The Control Message consists only of a Message Header and a CRC.
Current Foldback (CF)	A current limiting feature for a Source. When the Sink attempts to draw more current from the Source than the requested current foldback value, the Source reduces its output voltage so the current it supplies remains at or below the requested value.
Data Block	An Extended Message payload data unit. The size of each type of Data Block is specified as a series of bytes up to ***MaxExtendedMsgLen*** bytes in length. This is distinct from a Data Object used by a Data Message which is always a 32-bit object.
Data Message	A Data Message consists of a Message Header followed by one or more Data Objects. Data Messages are easily identifiable because the ***Number of Data Objects*** field in the Message Header is a non-zero value.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Data Object	A Data Message payload data unit. This 32 bit object contains information specific to different types of Data Message. Power, Request, BIST and Vendor Data Objects are defined.
Data Role Swap	Process of exchanging the DFP (Host) and UFP (Device) roles between Port Partners using the ***[USB Type-C 1.2]*** connector.
Dead Battery	A device has a Dead Battery when the Battery in a device is unable to power its functions.
Detach	Mechanical unjoining of the Port Pair by removal of the cable.
Detached	USB Power Delivery ports which are no longer mechanically joined with USB cable.
Device	When lower cased (device), it refers to any USB product, either USB Device or USB Host. When in upper case refers to a USB Device (Peripheral or Hub).
Device Policy Manager (DPM)	Module running in a Source or Sink that applies Local Policy to each Port in the Device via the Policy Engine.
Discovery Process	Command sequence using Structured Vendor Defined Messages resulting in identification of the Port Partner, its supported SVIDs and Modes.
Downstream Facing Port (DFP)	Indicates the Port's position in the USB topology which typically corresponds to a USB Host root Port or Hub downstream Port as defined in ***[USB Type-C 1.2]***. At connection the Port defaults to operation as a USB Host (when USB Communication is supported) and Source.
Dual-Role Data (DRD)	Capability of operating as either a DFP or UFP.
Dual-Role Data Port	A Port Capable of operating as DRD..
Dual-Role Power (DRP)	Capability of operating as either a Source or Sink.
Dual-Role Power Device	A product containing one or more Dual-Role Power Ports that are capable of operating as either a Source or a Sink.
Dual-Role Power Port	A Port capable of operating as a DRP.
End of Packet (EOP)	K-code marker used to delineate the end of a packet.
Enter Mode Process	Command sequence using Structured Vendor Defined Messages resulting in the Port Partners entering a Mode.
Error Recovery	Error recovery process as defined in ***[USB Type-C 1.2]***.
Exit Mode Process	Command sequence using Structured Vendor Defined Messages resulting in the Port Partners exiting a Mode.
Explicit Contract	An agreement reached between a Port Pair as a result of the Power Delivery negotiation process. An Explicit Contract is established (or continued) when a Source sends an ***Accept*** Message in response to a ***Request*** Message sent by a Sink followed by a ***PS_RDY*** Message indicating that the power supply is ready; this corresponds to the ***PE_SRC_Ready*** state for a Source Policy Engine and the ***PE_SNK_Ready*** state for a Sink Policy Engine. The Explicit Contract can be altered through the re-negotiation process. All Port pairs are required to make an Explicit Contract.
Extended Message (EM)	A Message containing Data Blocks. The Extended Message is defined by the ***Extended*** field in the Message Header being set to one and contains an Extended Message Header immediately following the Message Header.
Extended Message Header	Every Extended Message contains a 16-bit Extended Message Header immediately following the Message Header containing information about the Data Block and any Chunking being applied.
Fast Role Swap	Process of exchanging the Source and Sink roles between Port Partners rapidly due to the disconnection of an external power supply.
Fixed Battery	A Battery that is not easily removed or replaced by an end user e.g. requires a special tool to access or is soldered in.
Fixed Supply	A well-regulated fixed voltage power supply. This is exposed by the Fixed Supply PDO (see Section 6.4.1.2.2)
Frame	Generic term referring to an atomic communication transmitted by PD such as a Packet, Test Frame or Signaling.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Hard Reset	This is initiated by ***Hard Reset*** Signaling from either Port Partner. It restores V_{BUS} to USB Default Operation and resets the PD communications engine to its default state in both Port Partners as well as in any Attached Cable Plugs. It restores both Port Partners to their default Data Roles and returns the VCONN Source to the Source Port.
HDD	A Hard Disk Drive.
Hot Swappable Battery	A Battery that is easily accessible for a user to remove or change for another Battery.
ID Header VDO	The VDO in a ***Discover Identity*** Command immediately following the VDM Header. The ID Header VDO contains information corresponding to the Power Delivery Product.
Implicit Contract	An agreement on power levels between a Port Pair which occurs, not as a result of the Power Delivery negotiation process, but as a result of a Power Role Swap or Fast Role Swap. Implicit Contracts are transitory since the Port pair is required to immediately negotiate an Explicit Contract after the Power Role Swap. An Implicit Contract ***Shall*** be limited to USB Type-C Current (see ***[USB Type-C 1.2]***).
Initiator	The initial sender of a Command request in the form of a query.
Interruptible	An AMS that, on receiving a Protocol Error, returns to the appropriate ready state in order to process the incoming Message is said to be Interruptible. Every AMS is Interruptible until the first Message in the AMS has been sent (a ***GoodCRC*** Message has been received). An AMS of Vendor Messages is Interruptible during the entire sequence.
IoC	The negotiated current value as defined in ***[IEC 63002]***.
IR Drop	The voltage drop across the cable and connectors between the Source and the Sink. It is a function of the resistance of the ground and power wire in the cable plus the contact resistance in the connectors times the current flowing over the path.
K-code	Special symbols provided by the 4b5b coding scheme. K-codes are used to signal Hard Reset and Cable reset, and delineate Packet boundaries.
Local Policy	Every PD Capable device has its own Policy, called the Local Policy that is executed by its Policy Engine to control its power delivery behavior. The Local Policy at any given time might be the default policy, hard coded or modified by changes in operating parameters or one provided by the system Host or some combination of these. The Local Policy ***Optionally*** can be changed by a System Policy Manager.
LPS	Limited Power Supply as defined in ***[IEC 62368-1]***.
Message	The packet payload consisting of a Message Header for Control Messages and a Message Header and data for Data Messages and Extended Messages as defined in Section 0.
Message Header	Every Message starts with a 16-bit Message Header containing basic information about the Message and the PD Port's Capabilities.
Messaging	Communication in the form of Messages as defined in Chapter 0.
Modal Operation	State where there are one or more Active Modes. Modal Operation ends when there are no longer any Active Modes.
Mode	Operation defined by a Vendor or Standard's organization, which is associated with a SVID, whose definition is outside the scope of USB-IF specifications. Entry to and exit from the Mode uses the Enter Mode and Exit Mode Processes. Modes are equivalent to "Alternate Modes" as described in ***[USB Type-C 1.2]***.
Multi-Drop	Refers to a Power Delivery system with one or more Cable Plugs where communication is to the Cable Plugs rather than the Port Partner. Multi-Drop systems share the Power Delivery communication channel with the Port Partners.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Negotiation	This is the PD process whereby: 1. The Source advertises its capabilities. 2. The Sink requests one of the advertised capabilities. 3. The Source acknowledges the request and alters its output to satisfy the request. The result of the negotiation is a Contract for power delivery/consumption between the Port Pair.
Non-interruptible	An AMS that, on receiving a Protocol Error, generates either a Soft Reset or Hard Reset. Any power related AMS is Non-interruptible once the first Message in the AMS has been sent (a ***GoodCRC*** Message has been received).
OCP	Over-Current Protection
OTP	Over-Temperature Protection
OVP	Over-Voltage Protection
Packet	One entire unit of PD communication including a Preamble, ***SOP****, payload, CRC and ***EOP*** as defined in Section 5.6.
Passive Cable	Cable with a USB Plug on each end at least one of which is a Cable Plug supporting SOP' that does not incorporate data bus signal conditioning circuits. Supports the Structured VDM ***Discover Identity*** to determine its characteristics (Electronically Marked Cable see ***[USB Type-C 1.2]***). Note this specification does not discuss Passive Cables which are not Electronically Marked Cables.
PD	USB Power Delivery
PD Capable	A Port that supports USB Power Delivery.
PD Connection	See Connected.
PD Power (PDP)	The output power of a Source, as specified by the manufacturer and expressed in Fixed Supply PDOs as defined in Section 10.
PDUSB	USB Device Port or USB Host Port that is both PD capable and capable of USB Communication. See also PDUSB Host, PDUSB Device and PDUSB Hub.
PDUSB Device	A USB Device with a PD Capable UFP. A PDUSB Device is only addressed by SOP Packets.
PDUSB Host	A USB Host which is PD Capable on at least one of its DFPs. A PDUSB Host is only addressed by SOP Packets.
PDUSB Hub	A port expander USB Device with a UFP and one or more DFPs which is PD Capable on at least one of its Ports. A PDUSB Hub is only addressed by SOP Packets.
PDUSB Peripheral	A USB Device with a PD Capable UFP which is not a PDUSB Hub. A PDUSB Peripheral is only addressed by SOP Packets.
PHY Layer	The Physical Layer responsible for sending and receiving Messages across the USB Type-C CC wire between a Port Pair.
Policy	Policy defines the behavior of PD capable parts of the system and defines the capabilities it advertises, requests made to (re)negotiate power and the responses made to requests received.
Policy Engine (PE)	The Policy Engine interprets the Device Policy Manager's input in order to implement Policy for a given Port and directs the Protocol Layer to send appropriate Messages.
Port	An interface typically exposed through a receptacle, or via a plug on the end of a hard-wired captive cable. USB Power Delivery defines the interaction between a Port Pair.
Port Pair	Two Attached PD Capable Ports.
Port Partner	A Contract is negotiated between a Port Pair connected by a USB cable. These ports are known as Port Partners.
Power Conductor	The wire delivering power from the Source to Sink. For example USB's V_{BUS}.
Power Consumer	See Consumer

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Power Data Object (PDO)	Data Object used to expose a Source Port's power capabilities or a Sink's power requirements as part of a ***Source_Capabilities*** or ***Sink_Capabilities*** Message respectively. Fixed, Variable and Battery Power Data Objects are defined.
Power Delivery Mode	Operation after a Contract has initially been established between a Port pair. This mode persists during normal Power Delivery operation, including after a Power Role Swap. Power Delivery mode can only be exited by Detaching the ports, applying a Hard Reset or by the Source removing power (except when power is removed during the Power Role Swap procedure).
Power Provider	See Provider
Power Reserve	Power which is kept back by a Source in order to ensure that it can meet total power requirements of Attached Sinks on at least one Port.
Power Role Swap	Process of exchanging the Source and Sink roles between Port Partners.
Preamble	Start of a transmission which is used to enable the receiver to lock onto the carrier. The Preamble consists of a 64-bit sequence of alternating 0s and 1s starting with a "0" and ending with a "1" which is not 4b5b encoded.
Product Type	Product categorization returned as part of the ***Discover Identity*** Command.
Product Type VDO	VDO identifying a certain Product Type in the ID Header VDO of a ***Discover Identity*** Command.
Programmable Power Supply (PPS)	A power supply whose output voltage can be programmatically adjusted in small increments over its advertised range. The PPS also has a programmable output current fold back. The capabilities of the PPS are exposed by the Programmable Power Supply APDO (see Section 6.4.1.2.5).
Protocol Error	An unexpected Message during an Atomic Message Sequence. A Protocol Error during a Non-interruptible AMS will result in either a Soft Reset or a Hard Reset. A Protocol Error during an Interruptible AMS will result in a return to the appropriate ready state where the Message will be handled.
Protocol Layer	The entity that forms the Messages used to communicate information between Port Partners.
Provider	A capability of a PD Port (typically a Host, Hub, or Wall Wart DFP) to source power over the power conductor (e.g. V_{BUS}). This corresponds to a USB Type-C Port with Rp asserted on its CC Wire.
Provider/Consumer	A Provider with the additional capability to act as a Consumer. This corresponds to a Dual-Role Power Port with Rp asserted on its CC Wire.
PS1, PS2	Classification of electrical power as defined in ***[IEC 62368-1].***
Rd	Pull-down resistor on the USB Type-C CC wire used to indicate that the Port is a Sink (see ***[USB Type-C 1.2]***).
Reattach	Attach of the Port Pair by a cable after a previous Detach.
Re-negotiation	A process wherein one of the Port Partners wants to alter the negotiated Contract.
Request Data Object (RDO)	Data Object used by a Sink Port to negotiate a Contact as a part of a ***Request*** Message.
Re-run	Start an Interruptible AMS again from the beginning after a Protocol Error.
Responder	The receiver of a Command request sent by an Initiator that replies with a Command response.
Rp	Pull-up resistor on the USB Type-C CC wire used to indicate that the Port is a Source (see ***[USB Type-C 1.2]***).
Safe Operation	Sources must have the ability to tolerate ***vSafe5V*** applied by both Port Partners.
Signaling	A Preamble followed by an ordered set of four K-codes used to indicate a particular line symbol e.g. ***Hard Reset*** as defined in Section 5.6.4.
Signaling Scheme	Physical mechanism used to transmit bits. Only the BMC Signaling Scheme is defined in this specification. Note: the BFSK Signaling Scheme supported in previous Revisions of this specification has been ***Deprecated***.
Single-Role Port	A Port that is a Port only capable of operating as a Source or Sink, but not both.
Sink	The Port consuming power from V_{BUS}; most commonly a Device.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Sink Directed Charge	A charging scheme whereby the Sink connects the Source to its battery through safety and other circuitry. Sink Directed Charge has two different modes of operation: • When the Current Foldback feature is not activated, the Sink controls the Source's output current by adjusting the Source's output voltage • When the Current Foldback feature is activated, the Source automatically controls its output current by adjusting its output voltage. The Sink is responsible for managing the current so as not to exceed the advertised capability of the Source and to protect itself from over-current events.
Soft Reset	A process that resets the PD communications engine to its default state.
SOP Communication	Communication using SOP Packets also implies that a Message sequence is being followed.
SOP Packet	Any Power Delivery Packet which starts with an ***SOP***.
SOP* Communication	Communication with a Cable Plug using SOP* Packets, also implies a Message sequence is being followed.
SOP* Packet	A term referring to any Power Delivery Packet starting with either ***SOP***, ***SOP'*** or ***SOP''***.
SOP' Communication	Communication with a Cable Plug using SOP' Packets, also implies that a Message sequence is being followed.
SOP' Packet	Any Power Delivery Packet which starts with an ***SOP'*** used to communicate with a Cable Plug.
SOP'' Communication	Communication with a Cable Plug using SOP'' Packets, also implies that a Message sequence is being followed.
SOP'' Packet	Any Power Delivery Packet which starts with an ***SOP''*** used to communicate with a Cable Plug when SOP' Packets are being used to communicate with the other Cable Plug.
Source	A role a Port is currently taking to supply power over V_{BUS}; most commonly a Host or Hub downstream port.
Standard ID (SID)	16-bit unsigned value assigned by the USB-IF to a given industry standard.
Standard or Vendor ID (SVID)	Generic term referring to either a VID or a SID. SVID is used in place of the phrase "Standard or Vendor ID".
Start of Packet (SOP)	K-code marker used to delineate the start of a packet. Three start of packet sequences are defined: ***SOP, SOP'*** and ***SOP''***, with ***SOP**** used to refer to all three in place of ***SOP***/***SOP'***/***SOP''.***
System Policy	Overall system policy generated by the system, broken up into the policies required by each Port Pair to affect the system policy. It is programmatically fed to the individual devices for consumption by their Policy Engines.
System Policy Manager (SPM)	Module running on the USB Host. It applies the System Policy through communication with PD capable Consumers and Providers that are also connected to the Host via USB.
Test Frame	Frame consisting of a Preamble, ***SOP****, followed by test data (See Section 5.9).
Test Pattern	Continuous stream of test data in a given sequence (See Section 5.9)
Tester	The Tester is assumed to be a piece of test equipment that manages the BIST testing process of a PD UUT.
Unexpected Message	Message that a Port supports but has been received in an incorrect state.
Unit Interval (UI)	The time to transmit a single data bit on the wire.
Unit Under Test (UUT)	The PD device that is being tested by the Tester and responds to the initiation of a particular BIST test sequence.
Unrecognized Message	Message that a Port does not understand e.g. a Message using a ReservedMessage type, a Message defined by a higher specification Revision than the Revision this Port supports, or an Unstructured Message for which the VID is not recognized.
Unsupported Message	Message that a Port recognizes but does not support. This is a Message defined by the specification but which is not supported by this Port.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018

Term	Description
Upstream Facing Port (UFP)	Indicates the Port's position in the USB topology typically a Port on a Device as defined in ***[USB Type-C 1.2]***. At connection the Port defaults to operation as a USB Device (when USB Communication is supported) and Sink.
USB Attached State	Synonymous with the ***[USB 2.0]***] and ***[USB 3.1]*** definition of the Attached state
USB Default Operation	Operation of a Port at Attach or after a Hard Reset where the DFP Source applies ***vSafe0V*** or ***vSafe5V*** on V_{BUS} and the UFP Sink is operating at ***vSafe5V*** as defined in ***[USB 2.0]***, ***[USB 3.1]***, ***[USB Type-C 1.2]*** or ***[USBBC 1.2]***.
USB Device	Either a hub or a peripheral device as defined in ***[USB 2.0]*** and ***[USB 3.1]***.
USB Host	The host computer system where the USB host controller is installed as defined in ***[USB 2.0]*** and ***[USB 3.1]***.
USB Powered State	Synonymous with the ***[USB 2.0]*** and ***[USB 3.1]*** definition of the powered state.
USB Safe State	State of the USB Type-C connector when there are pins to be re-purposed (see ***[USB Type-C 1.2]***) so they are not damaged by and do not cause damage to their Port Partner.
USB Type-A	Term used to refer to any A plug or receptacle including Micro-A plugs and Standard-A plugs and receptacles. Micro-AB receptacles are assumed to be a combination of USB Type-A and USB Type-B.
USB Type-B	Terms used to refer to any B-plug or receptacle including Micro-B plugs and Standard-B plugs and receptacles, including the PD and non-PD versions. Micro-AB receptacles are assumed to be a combination of USB Type-A and USB Type-B.
USB Type-C	Term used to refer to the USB Type-C connector plug or receptacle as defined in ***[USB Type-C 1.2]***.
USB-IF PD SID (PD SID)	Standard ID allocated to this specification by the USB Implementer's Forum.
Variable Supply	A very poorly regulated power supply that is not a Battery. This is exposed by the Variable Supply PDO (see Section 6.4.1.2.3).
V_{CONN} Powered Accessory	An accessory that is powered from V_{CONN} to operate in a Mode (see ***[USB Type-C 1.2]***).
V_{CONN} Powered USB Device (VPD)	A captive cable USB Device that may be powered by either V_{CONN} or V_{BUS} as defined in ***[USB Type-C 1.2]***. Note a VPD is only addressable by SOP' Packets.
V_{CONN} Source	The USB Type-C Port responsible for sourcing V_{CONN}.
V_{CONN} Swap	Process of exchanging the V_{CONN} Source between Port Partners.
VDM Header	The first Data Object following the Message Header in a Vendor Defined Message. The VDM Header contains the SVID relating to the VDM being sent and provides information relating to the Command in the case of a Structured VDM (see Section 6.4.4).
Vendor Data Object (VDO)	Data Object used to send Vendor specific information as part of a ***Vendor_Defined*** Message.
Vendor Defined Message (VDM)	PD Data Message defined for vendor/standards usage. These are further partitioned into Structured VDM Messages, where Commands are defined in this specification, and Unstructured VDM Messages which are entirely Vendor Defined (see Section 6.4.4).
Vendor ID (VID)	16-bit unsigned value assigned by the USB-IF to a given Vendor.
VI	Same as power (i.e. voltage * current = power)
Wall Wart	A power supply or "power brick" that is plugged into an AC outlet. It supplies DC power to power a device or charge a Battery.

1.7 Parameter Values

The parameters in this specification are expressed in terms of absolute values. For details of how each parameter is measured in compliance please see ***[USBPDCompliance]***.

Documents
Document Sharing Hub
Full document details: BS EN IEC 62680-1-2:2018