USB Power Delivery Compliance Test Specification

Revision: *1.4   OR*

Release date: *October 3, 2021*

LIMITED COPYRIGHT LICENSE

THE USB 3.0 PROMOTERS GRANT A CONDITIONAL COPYRIGHT LICENSE UNDER THE COPYRIGHTS EMBODIED IN THE USB POWER DELIVERY SPECIFICATION TO USE AND REPRODUCE THE SPECIFICATION FOR THE SOLE PURPOSE OF, AND SOLELY TO THE EXTENT NECESSARY FOR, EVALUATING WHETHER TO IMPLEMENT THE SPECIFICATION IN PRODUCTS THAT WOULD COMPLY WITH THE SPECIFICATION. WITHOUT LIMITING THE FOREGOING, USE THE OF SPECIFICATION FOR THE PURPOSE OF FILING OR MODIFYING ANY PATENT APPLICATION TO TARGET THE SPECIFICATION OR USB COMPLIANT PRODUCTS IS NOT AUTHORIZED. EXCEPT FOR THIS EXPRESS COPYRIGHT LICENSE, NO OTHER RIGHTS OR LICENSES ARE GRANTED, INCLUDING WITHOUT LIMITATION ANY PATENT LICENSES. IN ORDER TO OBTAIN ANY ADDITIONALY INTELLECTUAL PROPERTY LICENSES OR LICENSING COMMITMENTS ASSOCIATED WITH THE SPECIFICATION A PARTY MUST EXECUTE THE USB 3.0 ADOPTERS AGREEMENT. NOTE: BY USING THE SPECIFICATION, YOU ACCEPT THESE LICENSE TERMS ON YOUR OWN BEHALF AND, IN THE CASE WHERE YOU ARE DOING THIS AS AN EMPLOYEE, ON BEHALF OF YOUR EMPLOYER.

INTELLECTUAL PROPERTY DISCLAIMER

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

Please send comments via electronic mail to techsup@usb.org

For industry information, refer to the USB Implementers Forum web page at http://www.usb.org

USB Type-C® and USB4™ are trademarks of the Universal Serial Bus Implementers Forum (USB-IF). Thunderbolt™ is a trademark of Intel Corporation.

Editors

Dmitriy Berchanskiy   Intel Corporation
Bob Dunstan   Renesas Electronics Corp.

Contributors

Abel Astley	Ellisys
Nathalie Ballot	STMicroelectronics
Dmitriy Berchanskiy	Intel Corporation
Naresh Botsa	Granite River Labs
Sten Carlsen	MQP Electronics Ltd.
Pat Crowe	MQP Electronics Ltd.
Harshavardhan Reddy Gonugunta	Granite River Labs
Tyler Joe	Teledyne LeCroy
Diane Lenox	USB Implementers Forum
Balamurugan Manialagan	Granite River Labs
Tim McKee	Intel Corporation
Mike Micheletti	Teledyne LeCroy
Prasannakumar Marikunte Nagaraju	Granite River Labs
Mahesh Nakala	Granite River Labs
Krishnamurthy Parameshwara	Granite River Labs
Mario Pasquali	Ellisys
Hao Sun	Ellisys
Chuck Trefts	Ellisys
Rajaraman Venkatachalam	Granite River Labs
Deric Waters	Texas Instruments
Biju Erayamkot Panayamthatta	Texas Instruments
Shafiuddin Mohammed	Texas Instruments
Tim Wei	Ellisys

Table of Contents

Version 1.0 Revision History

Revision	Release Date	Description
1.0	September 15, 2019	Initial release
1.0	November 22, 2019	Adds missing cover page, copyright notice and table of contents. No change to the compliance tests.
1.2	September 19, 2020	Initial Merged specification
1.2 V2	June 20, 2021	With all fixes from workshop
1.3	June 21, 2021	Adds FRS, Captive Cables, EPR SRC
1.4	October 3, 2021	Adds EPR SNK, USB4

1   Introduction

This document specifies USB-IF compliance tests for a USB PD3.0 device. This test specification covers USB-IF testing for compliance with the requirements in Chapters 5-8 and 10 in the USB PD2.0 and PD3.0 Specifications.

The following documents as well as any other tests mandated by the USB-IF may be applicable to a USB PD3.0 device:

- USB Type-C Functional Test Specification
- USB Type-C and PD Source Power Test Specification
- USB Command Verifier Compliance Test Specification
- USB 2.0 Electrical Test Specification

This document is organized as followed:

- Chapter 2 describes the common test procedures and checks that would be repeated in the tests described in the subsequent chapters.
- Chapter 3 describes tests that primarily cover Chapter 5 requirements in the USB PD2.0 and PD3.0 Specifications.
- Chapter 4 describes tests that primarily cover Chapters 6, 8 and 10 requirements in the USB PD2.0 and PD3.0 Specifications.
- Chapter 5 describes tests that primarily cover Chapter 7 requirements in the USB PD2.0 and PD3.0 Specifications.

1.1   Overview

The Tester runs tests applicable to the UUT in Chapter 3-5. The UUT applicability is determined by the VIF fields and it is provided at the beginning of each subsection e.g. "The tests in this subsection are applicable to UUT with VIF field VIF_Product_Type set to Port".

The Tester runs the common checks and procedures as described in Chapter 2 for all tests.

The applicability of common check for a given PD message is provided in Check Applicability e.g. Message Header check (COMMON.CHECK.PD.2) is applicable to "all PD messages except GoodCRC".

The applicability of common procedure is provided in Procedure Applicability e.g. unless otherwise specified, the Tester runs this procedure (COMMON.PROC.PD.2) whenever receiving Get_Source_Cap message from the UUT. The exceptions are provided either in the test steps or Test Specific Tester Behavior.

The Tester runs all the steps as described in the test (in Chapter 3-5) and the common procedure (in Section 2.3) unless the condition for "the test stops here" is satisfied. The test does not stop when a check fails.

In summary:

- Bring-up Procedures in Section 2.2 are used to start the tests in Chapter 3-5
- Common Checks in Section 2.1 are used in all the tests depending on the Check Applicability

- Common Procedures in Section 2.3 are used in all the tests depending on the <u>Procedure Applicability</u> and exceptions provided in the test.
- The test does not stop until the last step or the condition for "the test stops here" is satisfied

1.2 Terms and Abbreviations

Tester is the instrument used for running the test procedures and checks.

Unit Under Test (UUT) is the product undergoing the test procedures and checks.

1.3 Keywords

1.3.1 Check

Check is a keyword used to indicate requiring the Tester to determine whether the UUT has failed to comply the mandatory requirement in the base specification.

1.3.2 PD2 mode

The test is running in PD2 mode if the Tester as a Sink sends the first Request message with Message Header Bits 7…6 (Specification Revision) set to 01b.

The test is running in PD2 mode if the Tester as a Source sends the Source Capabilities and Discover Identity messages with Message Header Bits 7…6 (Specification Revision) set to 01b.

1.3.3 PD3 mode

The test is running in PD3 mode if the Tester as a Sink sends the first Request message with Message Header Bits 7…6 (Specification Revision) set to 10b.

The test is running in PD3 mode if the Tester as a Source sends the Source Capabilities and Discover Identity messages with Message Header Bits 7…6 (Specification Revision) set to 10b.

1.3.4 Revision Alignment

'Revision alignment' means after revision interoperability check has been done, as described in 6.2.1.5 of USB PD specification

1.4 Test Requirements

1.4.1 VCONN Levels for Testing Cable Markers or VPDs

Cable Markers and VPDs shall be tested at the highest and lowest VCONN voltages that the Type-C Specification allows. In certain tests they are also tested at the mid-level voltage. These voltages are specified in Table 1. When referring to these voltages, this Test Specification uses the names given in Table 1, rather than repeating the actual voltage values.

The values of VCONN used for VPDs are derived directly from the Type-C Specification. The values of VCONN used for Cable Markers is derived from the Type-C Specification with an additional +/- 0.25V ground offset caused by current being supplied from the source.

Table 1 - VCONN Test Voltages

	Cable Markers	VPDs
Maximum	5.75V	5.5V
Mid-level	4.25V	4.25V
Minimum	2.75V	3.0V

1.4.2 Test Condition Codes

The majority of the tests in this Test Specification are repeated more than once under different Test Conditions. A list of the applicable Test Conditions appears at the start of each test. This section defines the codes for these conditions to be used in that list and also in the XML results.

e.g: *<condition conditionID=" Rev3ChkdSrc">*

1.4.2.1 Common Test Condition

Checks that are performed as part of Common Checks, Bring-up Procedures or Common Procedures may occur during any Test Condition, but are only reported once, and are therefore not given a specific Test Condition Code. During the XML report the 'condition' element shall be defined: *<condition conditionID="">.*

1.4.2.2 Test Conditions for Ports

Test Conditions for Ports are a combination of some or all of the following:

- The PD Revision for which the Port is being tested
- Whether the Tester is set to support Unchunked Extended Messages
- Whether the Port is being tested as an initial Source or as an initial Sink
- Whether the test cable has been flipped at the UUT end

For example, the Code 'Rev3ChkdSrc' means that the Port is being tested for PD Revision 3, with the Tester set not to support Unchunked Extended Messages, and as a Source.

Table 2 shows the complete list of Test Conditions used for Ports.

Table 2 - Test Condition Codes for Ports

Test Condition Code	PD Re	Tester Supports	Source/Sink	FR_Swap Condition	Comment

	vision	Unchunked Extended messages			
Rev2Src	2	-	Source	-	
Rev2Snk	2	-	Sink	-	
Rev3ChkdSrc	3	No	Source	-	
Rev3ChkdSnk	3	No	Sink	-	
Rev3UnchkdSrc	3	Yes	Source	-	Not applicable if VIF parameter Unchunked_Extended _Messages_Supporte d is set to false
Rev3UnchkdSnk	3	Yes	Sink	-	Not applicable if VIF parameter Unchunked_Extended _Messages_Supporte d is set to false
CabFlippedSrc*	3	-	Source	-	
CabFlippedSnk*	3	-	Sink	-	
Rev3ChkdSrc5VAC	3	No	Source	Start with a 5V contract, then interrupt the AC Mains/Wall Power using Appendix B, Fig B-1	
Rev3ChkdSrc5VDC	3	No	Source	Start with a 5V contract, then interrupt the DC supply using Appendix B, Fig B-2	
Rev3ChkdSrcHiVAC	3	No	Source	Start with Highest Fixed PDO contract, then interrupt the AC Mains/Wall Power using Appendix B, Fig B-1	
Rev3ChkdSrcHiVDC	3	No	Source	Start with Highest Fixed PDO contract, then interrupt the DC supply using Appendix B, Fig B-2	

*This code is only used when checking the Eye Diagram with the cable flipped at the UUT end

1.4.2.3 Test Conditions for Cable Markers or VPDs

Test Conditions for Free Cables, Captive Cables* or VPDs are a combination of some or all of the following:

- The PD Revision for which the UUT is being tested
- The VCONN Level from Table 1 which is in use
- Which end of the cable is being tested (not for VPDs)

For example, the Code 'Rev2VcMaxEnd2' means that the Cable Marker is being tested for PD Revision 2, with VCONN set to Maximum, and End 1 of the Cable is being tested.

*Please note that the simplified term 'Captive Cable' is used in Test Conditions tables to mean 'Captive Cables Presenting Ra'.
Table 3 shows the complete list of Test Conditions used for Cable Markers or VPDs.

Table 3 - Test Conditions Codes for Cables or VPDs

Test Condition Code	PD Revision	Vconn Level	Free Cable End1	Free Cable End2	VPD, Captive Cable
Rev2VcMinEnd1	2	Minimum	✓		✓
Rev2VcMaxEnd1	2	Maximum	✓		✓
Rev2VcMinEnd2	2	Minimum		✓	
Rev2VcMaxEnd2	2	Maximum		✓	
Rev3VcMinEnd1	3	Minimum	✓		✓
Rev3VcMidEnd1	3	Mid-level	✓		✓
Rev3VcMaxEnd1	3	Maximum	✓		✓
Rev3VcMinEnd2	3	Minimum		✓	
Rev3VcMidEnd2	3	Mid-level		✓	
Rev3VcMaxEnd2	3	Maximum		✓	

1.4.3 "Supports Structured VDMs"

There are three VIF parameters that determine whether a Port UUT, using SOP signaling, supports Structured VDMs.

- Responds_To_Discov_SOP_DFP
- Responds_To_Discov_SOP_UFP
- Attempts_Discov_SOP

Throughout this document the phrase "*Supports Structured VDMs* Is YES" will be used to indicate that one of the appropriate VIF parameters is set to YES, and "*Supports Structured VDMs is NO*" if all of the appropriate VIF parameters are set to NO.

1.4.4 Error Recovery

There are a number of places in this document where a check is required as to whether Error Recovery takes place within a valid timeframe. For the sake of clarity, Error Recovery is deemed to have taken place when the CC line voltage falls outside the 'connect' range, as a result of either Rp or Rd being released by the UUT.

1.4.5 VBUS Measurement – Point of Reference

For a captive cable, VBUS shall be measured at the Tester connector, otherwise it shall be measured at the UUT connector.

2   Preparation Procedure

2.1 PD3 Mode

The preparation procedures in this subsection are applicable when the test is running in PD3 mode before all other tests on any UUT capable of being a **Source** i.e. provider only, Provider-Consumer, DRP and Consumer-Provider, to ensure that shared multiport UUTs behave correctly in their test mode. After running this once, all ports of the UUT may be tested, provided power is not removed from the UUT.

TEST.PREP.PR.1 Preparation for Bring-up Source UUT /* formerly known as COMMON.PROC.BU.6*/

Description: The Tester checks whether the UUT needs to be set into Shared Test Mode prior to all other testing.

Test Conditions:

	Provider Only, P/C, DRP, C/P
Rev3ChkdSrc	✓
Rev3ChkdSnk	

Test Specific Tester Behavior: N/A

Assumes that the Test Cable is initially connected to the Port under Test.

1. Connect the UUT to its power source.

2. If VIF field Port_Source_Power_Type is not set to Shared, then the preparation procedure is complete.

3. Otherwise, if the VIF field Master_Port is set to YES, the Tester sends a BIST Shared Test Mode Entry message to the UUT, and the preparation procedure is complete.

4. If the VIF field Master_Port is set to NO, the Tester uses the VIF to locate a component which has the VIF field Master_Port parameter is set to YES and requests the operator to connect the Test Cable to that Port on the UUT. If one is not found, the check fails [TEST.PREP.PR.1#1]

5. When this has been done, the Tester sends a BIST Shared Mode Test Entry message to the UUT.

6. The Tester requests the operator to connect the Test Cable to the Port under Test.

7. When this has been done, the preparation procedure is complete.

TEST NOTES:

- Once the UUT is placed in the test mode it is expected to remain in the test mode till it is powered down.
- The test procedure should be performed only one time per port.

3 Common Checks, Bring-up Procedures, and Common Procedures

This chapter describes the Common Checks, Bring-up Procedures, and Common Procedures that would be repeated in the tests described in the subsequent chapters.

3.1 Common Checks

3.1.1 PD2 and PD3 Modes

The common procedures in this subsection are applicable when the test is running in PD2 and PD3 modes.

COMMON.CHECK.PD.1 Check Preamble

Description: The Tester performs the physical layer checks on the Preamble sent by the UUT.

Check Applicability: All PD messages

The Tester performs the following checks on the Preamble of all PD messages
[COMMON.CHECK.PD.1#1]

- The check fails if the first bit of the Preamble does not start at least tInterFrameGap after the end of the last bit of the preceding message
- The check fails if the Preamble is not a 64-bit sequence of alternating '0's and '1's. (In practice the last 60 bits are checked as there is some uncertainty about detecting the initial bits.)
- The check fails if the Preamble does not end with a single "one".

COMMON.CHECK.PD.2 Check Message Header

Description: The Tester performs the protocol checks on the Message Header sent by the UUT.

Check Applicability: All PD messages except GoodCRC

The Tester performs the following checks on the Message Header of all PD messages except GoodCRC and Returned BIST Counters: [COMMON.CHECK.PD.2#1]

1. For Source Capabilities and Discover Identity messages before the first response from the Tester after detaching, Hard Reset or Error Recovery
   a. Bit 15 (Extended for PD3). The check fails if this field is not set to 0b

b. Bit 7…6 (Specification Revision). The check fails if this field is not set to 10b. If the message is a Discover Identity over SOP' and it is not the first time the message has been sent after the detach, Hard Reset, or Error Recovery, this check does not apply.

c. Bit 4…0 (Message Type). The check fails if the Message Type is not valid

2. All messages

a. Bits 7…6 (Specification Revision). The check fails if this field is set to either 00b or 11b.

3. Bits 14…12: Number of Data Objects

a. When the Extended field is set to zero, the check fails if Number of Data Objects field does not match the number of 32-bit Data Objects that follow the Message Header

b. When the Extended bit (in the Message Header) is set to 1b and Chunked bit (in the Extended Message Header) is set to 1b, the check fails if the size in bytes of the payload following the Message Header is not 4 times the Number of Data Objects

c. When the Extended bit (in the Message Header) is set to 1b and Chunked bit (in the Extended Message Header) is set to 0b, the check fails if Number of Data Objects field is not set to 000b

d. Data messages:

    i. Request message: Number of Data Objects = 1
    ii. Battery_Status message: Number of Data Objects = 1
    iii. Alert message: Number of Data Objects = 1
    iv. Get_Country_Info message: Number of Data Objects = 1
    v. Enter_USB message: Number of Data Objects = 1
    vi. EPR_Request message: Number of Data Objects = 2

4. Bits 11…9: MessageID. The check fails if the value is not 000b under the following conditions:

a. The first message on each SOP* type after a Hard Reset was sent or received

b. The message is a Soft_Reset

c. The first message on the same SOP* type after receiving Soft_Reset

d. The first message on SOP after a successful Power Role Swap

e. The first message on SOP after a successful Fast Role Swap

f. The first message on each SOP* type upon initial entry to Attached state

g. The first message on each SOP' and SOP" after a Cable Reset

5. Bits 11...9: MessageID. If MessageID is incremented for a valid retry scenario as described in the test procedures, fail the check. (On retry the message all fields should remain the same from the previously received message.) Else, fail the check if MessageID is not incremented.

6. Bits 11…9: MessageID. Except for conditions as mentioned above, the check fails if MessageID is incremented by three comparing to the previously received message

7. Bit 8: Port Power Role (SOP packet type only)

a. The check fails if Port Power Role does not represent the UUT port power role

b. For a Ping or GotoMin message, the check fails if Port Power Role is not Source

c. For a Request, the check fails if Port Power Role is not Sink

d. The check fails if the Port Power Role is not Sink for the first PS_RDY during a Power Role Swap

e. The check fails if the Port Power Role is not Source for the second PS_RDY during a Power Role Swap

8. Bit 8: Cable Plug (SOP' and SOP''), the Tester checks that it follows the rule:
    a. 0b Message originated from a DFP or UFP
    b. 1b Message originated from a Cable Plug or VP
9. Bit 5: Port Data Role (SOP packet type only). The check fails if Port Data Role does not represent the UUT port data role
10. Bit 5: Port Data Role (SOP' and SOP'' packet types). The check fails if Port Data Role is not set to zero

COMMON.CHECK.PD.3 Check GoodCRC

Description: The Tester performs the protocol checks on the GoodCRC message received by the Tester.

Check Applicability: All GoodCRC messages except in TEST.PD.PHY.ALL.5 Receiver Interference Rejection

The Tester performs the following checks on the reception of GoodCRC message:

1. The check fails if the GoodCRC is not received or received after tTransmit max has expired. The delay is measured between the last bit of the EOP of Tester sent message and the first bit of the Preamble of the UUT sent GoodCRC Message. [COMMON.CHECK.PD.3#1]
2. Perform the following checks on the Message Header of GoodCRC message: [COMMON.CHECK.PD.3#2]
    a. Bit 15 (Reserved for PD2, Extended for PD3). The check fails if this field is not set to 0b
    b. Bits 11…9: MessageID. The check fails if MessageID is not the same as the value in the preceding message sent by the Tester
    c. Bit 8: Port Power Role (SOP packet type only). The check fails if Port Power Role does not represent the UUT port power role.
    d. Bit 8: Cable Plug (SOP' and SOP''), the Tester checks that it follows the rule:
        i. If VIF_Product_Type is 0 (Port Product) and Captive_Cable_is_eMarked as NO, the check fails if the field is not set to 0.
        ii. If VIF_Product_Type is 1 (Cable), the check fails if the field is not set to 1.
    e. Bits 7…6 (Specification Revision). The check fails if this field is not set to 01b when the message this GoodCRC is responding to has a Specification Revision field set to 01b
    f. Bits 7…6 (Specification Revision). The check fails if this field is set to 11b.
    g. Bit 5: Port Data Role (SOP packet type only). The check fails if Port Data Role does not represent the UUT port data role
    h. Bit 5: Port Data Role (SOP' and SOP'' packet types). The check fails if Port Data Role is not set to zero
    i. Bits 4…0 (Message Type) is set to 0001b

COMMON.CHECK.PD.4 Check Atomic Message Sequence Response

Description: The Tester performs additional protocol checks on response messages as part of the Atomic Message Sequence (AMS).

Check Applicability: All PD response messages when an AMS has started

The Tester performs the following check when an AMS has started:

1.   As part of an AMS, the check fails if the UUT does not **respond to a message** (sent by the Tester) within tSenderResponse max or tVDMSenderResponse max from the last bit of the EOP of the GoodCRC message sent [COMMON.CHECK.PD.4#1]. The following are the exceptions:
     a.   PS_RDY message as part of Power Negotiation AMS
     b.   PS_RDY message as part of Power Role Swap AMS
     c.   PS_RDY message as part of VCONN Swap AMS
     d.   Security_Response message as part of Security AMS
     e.   Enter Mode command request as part Enter Mode AMS
     f.   Exit Mode command request as part Exit Mode AMS
     g.   **Not Supported message as part of chunked request**

COMMON.CHECK.PD.5 Check Unexpected Messages and Signals
Description: The Tester performs additional protocol checks on unexpected messages sent by the UUT.

Check Applicability: All PD messages

Unless specifically mentioned, the check fails if Soft_Reset message (using SOP packet) is sent by the UUT during a test [COMMON.CHECK.PD.5#1].

Unless specifically mentioned, the check fails if the UUT sends a Hard Reset or a Cable Reset signal [COMMON.CHECK.PD.5#2].

Unless specifically mentioned, the check fails if GotoMin message is sent by the UUT [COMMON.CHECK.PD.5#3]. The Tester does not set the GiveBack flag during a test.

The following messages sent by the UUT are unexpected during a test when the Tester is in *PE_SRC_Ready*, *PE_SNK_Ready* or *PE_CBL_Ready* state (Policy Engine States as described in the base specification), and the check fails. This does not apply to such messages when they are expected in these states as a normal part of the protocol (examples are Not Supported received after an Alert, Firmware_Update_Request or Security_Request). [COMMON.CHECK.PD.5#4]:

In PD2 Mode:

-   GoodCRC
-   BIST
-   Sink_Capabilities
-   Accept
-   Reject
-   Wait
-   PS_RDY
-   Structured VDM response (ACK, NAK, BUSY)
-   Ping (when the UUT is not in *PE_SRC_Ready*)

In PD3 Mode:

- GoodCRC
- BIST
- Sink_Capabilities
- Accept
- Reject
- Wait
- PS_RDY
- Structured VDM response (ACK, NAK, BUSY)
- Ping (when the UUT is not in *PE_SRC_Ready*)
- Not Supported
- Battery Status
- Source_Capabilities_Extended
- Status
- Battery_Capabilities
- Manufacturer_Info
- PPS_Status
- Country_Info
- Country_Codes
- Sink_Capabilities_Extended
- Data_Reset_Complete
- Source Info
- Revision

COMMON.CHECK.PD.6 Check Control Message

Description: The Tester performs additional protocol checks on all Control messages sent by the UUT.

Check Applicability: Control messages including GoodCRC, GoToMin, Accept, Reject, Ping, PS_RDY, Get_Source_Cap, Get_Sink_Cap, Protocol Error, DR_Swap, PR_Swap, VCONN_Swap, Wait, Soft_Reset, Get_Source_Info, Get_Revision_Message.

The Tester performs the following additional check on all Control messages [COMMON.CHECK.PD.6#1]:

1. The check fails if the Number of Data Object field in the Header is not zero
2. The check fails if the number of bytes of the payload following the header is not zero

COMMON.CHECK.PD.7 Check Source Capabilities Message

Description: The Tester performs additional protocol checks on all Source Capabilities messages sent by the UUT.

Check Applicability: Source Capabilities message

Perform the following checks on all Source Capabilities messages: [COMMON.CHECK.PD.7#1]

1. Without receiving a SOP' Discover Identity Request message from the UUT, the check fails if VIF field Captive_Cable = No and the UUT sends Source Capabilities offering currents greater than 3A and/or voltages greater than 20V
2. The Tester checks the Number of Data Objects field in the Message Header
   a. In PD3 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Src_PDOs.
   b. In PD2 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Src_PDOs minus number of PPS PDOs (count of how many Src_PDO_Supply_TypeN is set to PPS).
3. For the first PDO, the Tester check the consistency
   a. B31...30 (Fixed Supply) set to 00b
   b. B29 (Dual-Role Power) set to 1b if VIF field PD_Port_Type is set to Consumer/Provider, Provider/Consumer or DRP.
   c. B28 (USB Suspend Supported) set to 1b if VIF field USB_Suspend_May_Be_Cleared = NO
   d. B27 (Unconstrained Power) matches VIF field Unconstrained_Power
   e. B26 (USB Communications Capable) matches VIF field USB_Comms_Capable
   f. B25 (Dual-Role Data) set to 1b if VIF field DR_Swap_To_UFP_Supported or DR_Swap_To_DFP_Supported = YES
   g. For Source Capabilities message before the first response from the Tester
      i. Bit 24 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported
      ii. Bits 22 (Reserved) set to 0b
   h. For Source Capabilities message after the Tester has sent Request message
      i. Bit 24 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported if the test is running in PD3 mode
      ii. Bits 23 (EPR Mode Capable) matches VIF field EPR_Sipported_as_Src in PD3 mode
      iii. Bit 22 (Reserved) set to 0b if the test is running in PD3 mode
      iv. Bits 24...22 (Reserved) set to 000b if the test is running in PD2 mode
   i. B21...20 (Peak Current) matches VIF field Src_PDO_Peak_Current1
   j. B19...10 (Voltage) set to 5V
   k. B9...0 (Maximum Current) matches
      i. If Src_PDO_Max_current1 <= 3A, Src_PDO_Max_Current1
      ii. If Src_PDO_Max_current1 > 3A:
         1. 3A if cable emulated is not e-marked or 3A capable only
         2. Src_PDO_Max_Current1 if capable emulated is e-marked
4. If it is not the first Fixed Supply PDO, check that B29...22 is set to zero
5. If it is a Programmable Power Supply APDO, check that B26...25, B16 and B7 are set to zero
6. The Tester compares all PDOs to VIF field PD_Power_as_Source and check that they meet the requirements of the Power Rules.
7. For each PDO, the Tester checks consistency of:
   a. Src_PDO_Supply_TypeN
   b. If Fixed Supply PDO:
      i. Src_PDO_VoltageN

ii. Src_PDO_Peak_CurrentN

iii. Max_current_field:

1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN
2. If Src_PDO_Max_currentN > 3A:
   a. 3A if cable emulated is not e-marked or 3A capale only
   b. Src_PDO_Max_CurrentN if cable emulated is e-marked

c. If Variable Supply PDO:

i. Src_PDO_MinVoltageN

ii. Src_PDO_MaxVoltageN

iii. Max_current_Field:

1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN
2. If Src_PDO_Max_currentN > 3A:
   a. 3A if cable emulated is not e-marked or 3A capable only
   b. Src_PDO_Max_CurrentN if cable emulated e-marked

d. If Battery Supply PDO:

i. Src_PDO_MinVoltageN

ii. Src_PDO_MaxVoltageN

iii. Src_PDO_Max_PowerN field:

1. If (Src_PDO_Max_PowerN / Src_PDO_MinVoltageN) <= 3A, Src_PDO_Max_PowerN
2. If (Src_PDO_Max_Powern / Src_PDO_MinVoltageN) > 3A:
   a. (Src_PDO_Max_PowerN / Src_PDO_MinVoltageN) if cable emulated is not e-marked or 3A capable only
   b. Src_PDO_Max_PowerN if cable emulated is e-marked

e. If Programmable Power Supply PDO:

i. Src_PDO_MinVoltageN

ii. Src_PDO_MaxVoltageN

iii. Max_current_field:

1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN
2. If Src_PDO_Max_currentN > 3A:
   a. 3A if cable emulated is not e-marked or 3A capable only
   b. Src_PDO_Max_CurrentN if cable emulated is e-marked

8. The Tester checks PDOs following the first one, are in the correct order: Fixed PDOs in increasing Voltage sequence, Battery PDOs in increasing Minimum Voltage sequence, Variable PDOs in increasing Minimum Voltage sequence, and finally Programmable Power Supply APDOs in increasing Maximum Voltage sequence.

9. The Tester checks that no Fixed PDO has the same voltage as any other

10. The Tester checks that no Variable PDO has the same voltage range as any other

11. The Tester checks that no Battery PDO has the same voltage range as any other

COMMON.CHECK.PD.8 Check Request Message

Description: The Tester performs additional protocol checks to all Request messages sent by the UUT.

Check Applicability: Request message

The Tester performs the following additional checks on all Request messages:
[COMMON.CHECK.PD.8#1]

1. Field check for all types of Request Data Object
   a. B31…28 (Object Position) is not 000b, and the value is not greater than the number of PDOs in the last Source Capabilities message
   b. B25 (USB Communications Capable), matches VIF field USB_Comms_Capable
   c. B24 (No USB Suspend), matches VIF field No_USB_Suspend_May_Be_Set
   d. PD3 mode:
       1. Bit 23 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported
       2. Bit 22 (EPR Mode Capable), matches the VIF field "EPR_Supported_As_Snk"
       3. Bits 21 and 20 (Reserved) set to 000b if the test is running in PD3 mode

      PD2 mode:

         Bits 23…20 (Reserved) set to 0000b

2. Fixed and Variable Request Data Object
   a. B19…10 (Operating Current) does not exceed the current offered by the referenced PDO
   b. If B27 (GiveBack flag) = 0b
       i. If B9…0 (Maximum Operating Current) is greater than the current offered by the referenced PDO, then B26 (Capability Mismatch) is set to one
       ii. B19…10 (Operating Current) does not exceed B9…0 (Maximum Operating Current)
   c. If B27 (GiveBack flag) = 1b

      B9…0 (Minimum Operating Current) does not exceed B19…10 (Operating Current)

3. Battery Request Data Object
   a. B19…10 (Operating Power) does not exceed the power offered by the referenced PDO
   b. If B27 (GiveBack flag) = 0b
       i. If B9…0 (Maximum Operating Power) is greater than the power offered by the referenced PDO, then B26 (Capability Mismatch) is set to one
       i. B19…10 (Operating Power) does not exceed B9…0 (Maximum Operating Power)
   c. If B27 (GiveBack flag) = 1b

      B9…0 (Minimum Operating Power) does not exceed B19…10 (Operating Power)

4. Programmable Power Supply Request
   a. B6…0 (Operating Current) is less than or equal to the Maximum Current offered by the referenced PDO
   b. B19…9 (Output Voltage field):
       i. Greater than or equal to the Minimum Voltage field in the PPS APDO.
       ii. Less than or equal to the Maximum Voltage field in the PPS APDO.
   c. B8…7 (Reserved) set to zero
   d. Bits 27 (Reserved) set to 0b

COMMON.CHECK.PD.9 Check Structured VDM Message

Description: The Tester performs the protocol checks on the Structured VDM Message sent by the UUT.

Check Applicability: All Structured VDM messages

The Tester performs the following checks on the Structured VDM Message Header (the first Data Object): [COMMON.CHECK.PD.9#1]

1. Bits 31…16 (SVID) (does not apply if a message is a response to an invalid message from the tester)
   a. This field shall be set to 0xFF00 (PD SID) if Command (Bits 4…0) is a Discover Identity or Discover SVIDs
   b. This field shall not be set to 0xFF00 if Command (Bits 4…0) is 16-31 (SVID specific)
2. Bit 14…13 (Structured VDM Version) are set to 00b (when the test is running in PD2 mode)
3. Bit 14…13 (Structured VDM Version) are set to 01b (when the test is running in PD3 mode)
4. Bits 12…11 (reserved):
   a. Set to 00b if Command = 0…15
5. Bits 10…8 (Object Position):
   a. Set to 001b…111b if Command = Exit Mode
   b. Set to 001b…110b if Command = (Enter Mode or Attention)
   c. Set to 000b if Command = (Discover Identity, Discover SVIDs or Discover Modes)
6. Bit 5 (reserved) is set to 0b
7. Bits 4…0 (Command) shall be 1-6 or 16-31

COMMON.CHECK.PD.10 Check Extended Message Header

Description: The Tester performs the protocol checks on the Message Header and Extended Message Header sent by the UUT.

Check Applicability: All PD messages except GoodCRC

The Tester performs the following checks on the Message Header and Extended Message Header of all Extended Messages: [COMMON.CHECK.PD.10#1]

1. If both the Tester and UUT support Unchunked Extended Message (i.e. Unchunked Extended Messages Supported field set to 1b in the Tester sent Request or Source Capabilities message, and Unchunked Extended Messages Supported bit set to 1b (in UUT sent Request or Source Capabilities message)):
   a. Bit 15 Chunked bit (in Extended Message Header) = 0
2. If either the Tester or the UUT supports Chunked Extended Message (i.e. either Unchunked Extended Messages Supported field set to 0b in the Tester sent Request or Source Capabilities message, or Unchunked Extended Messages Supported bit set to 0b (in UUT sent Request or Source Capabilities message)):
   a. Bit 15 Chunked bit (in Extended Message Header) = 1
   b. The payload is padded to the next 4-byte Data Object boundary with zeros
3. Additional checks for Extended Message Header
   a. Bits 14…11 Chunk Number = 0 if Chunked flag is also set to zero

b. Bit 9 Reserved = 0
c. Bits 8…0 Data Size
     i. Source Capabilities Extended = 25
     ii. Status
          1. For SOP shall be equal to 7
          2. For SOP' shall be equal to 2
          3. For SOP" shall be equal to 2
     iii. Get_Battery_Status = 1
     iv. Battery_Capabilities = 9
     v. Manufacturer_Info
          1. Valid Get_Manufacturer_Info = 4 + vendor defined null terminated string (1…22 including null)
          2. Invalid Get_Manufacturer_Info = 18 = (PID + VID + "Not Supported" + null)

COMMON.CHECK.PD.11 Check Source Capabilities Extended Message

Description: The Tester performs additional protocol checks on all Source Capabilities Extended messages sent by the UUT.

Check Applicability: Source Capabilities Extended message

Perform the following checks on all Source Capabilities Extended:

1. For the SCEDB [COMMON.CHECK.PD.11#1]
   a. Voltage Regulation field: Bits 0..1 (Load Step) = 00b or 01b
   b. Voltage Regulation field: Bits 3..7 (Reserved) are 0
   c. Compliance field: Bits 3..7 (Reserved) are 0
   d. Touch Current field: Bits 3..7 (Reserved) are 0
   e. Touch Temp field is 0, 1 or 2
   f. Source Inputs field: If Bit 0 is 0, Bit 1 is 0
   g. Source Inputs field: Bits 3..7 (Reserved) are 0
   h. Batteries/Battery Slots field:
        i. Upper nibble (Number of Hot Swappable Battery Slots) <= 4 and matches VIF field Num_Swappable_Battery_Slots
        ii. Lower nibble (Number of Fixed Batteries) <= 4 and matches VIF field Num_Fixed_Batteries
   i. SPR Source PDP field
        i. if EPR_Support_As_Src is set
             1. Bits 0…6 (Source's rated PDP) is set to 100
        ii. if EPR_Support_As_Src is not set
             1. Bits 0…6 (Source's rated PDP) is in consistent with PD_Power_As_Source
        iii. Bit 7 (Reserved) is 0
   j. EPR Source PDP Rating
        i. If EPR_Supported_As_Src is set

1. Bits 0...7 EPR (Source's rated PDP) is in consistent with VIF field "PD_Power_As_Src"
   ii. If EPR_Supported_As_Src is not set
       1. Bit 0...7 EPR (Source's rated PDP) is set to 0.

COMMON.CHECK.PD.12 Check Sink Capabilities Message

<u>Description:</u> The Tester performs additional protocol checks on all Sink Capabilities messages sent by the UUT.

<u>Check Applicability:</u> Sink Capabilities message

Perform the following checks on all Sink Capabilities messages: [COMMON.CHECK.PD.12#1]

1. The Tester runs the following field checks on the Sink Capabilities message:
   a. The Number of Data Objects field in the Message Header:
      i. Is at least one.
      ii. In PD3 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Snk_PDOs.
      iii. In PD2 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Snk_PDOs minus number of PPS PDOs (count of how many Snk_PDO_Supply_TypeN is set to PPS).
   b. For the first PDO, the Tester checks:
      i. B31...30 (Fixed Supply) set to 00b
      ii. B29 (Dual-Role Power) set to 1b if VIF field Port_Type is DRP, Provider/Consumer or Consumer/Provider, otherwise set to 0b
      iii. B28: (Higher Capability) matches VIF field Higher_Capability_set
      iv. B27 - (Unconstrained_Power) matches VIF field Unconstrained_Power
      v. B26 (USB Communications Capable) matches VIF field USB_Comms_Capable
      vi. B25 (Dual-Role Data) set to 1b if VIF field DR_Swap_To_UFP_Supported or DR_Swap_To_DFP_Supported = YES, otherwise set to 0b if VIF field DR_Swap_To_UFP_Supported and DW_Swap_To_DFP_Supported = NO
      vii. B24...23
          1. PD3 mode (Fast Role Swap required USB Type-C Current) matches VIF field FR_Swap_Reqd_Type_C_Current_As_Initial_Source
          2. PD2 mode: set to 00b.
      viii. B22...20 (Reserved) set to 000b
      ix. B19...10 (Voltage) set to 5V
      x. B9...0 (Operational Current) matches VIF field SNK_PDO_OP_CURRENT1
   c. For each PDO, the Tester checks:
      i. The Tester checks consistency of Snk_PDO_Supply_TypeN
      ii. If Fixed Supply PDO:
          1. In PD2, B24...20 (Reserved) are set to zero
          2. In PD3, B22...20 (Reserved) are set to zero
          3. The Tester checks consistency of Snk_PDO_VoltageN
          4. The Tester checks consistency of Snk_PDO_ Op_CurrentN

  iii. If Variable Supply PDO:
    1. The Tester checks consistency of Snk_PDO_Max_VoltageN
    2. The Tester checks consistency of Snk_PDO_Min_VoltageN
    3. The Tester checks consistency of Snk_PDO_ Op_CurrentN
  iv. If Battery Supply PDO:
    1. The Tester checks consistency of Snk_PDO_Max_VoltageN
    2. The Tester checks consistency of Snk_PDO_Min_VoltageN
    3. The Tester checks consistency of Snk_PDO_ Op_PowerN
  v. If Programmable Power Supply APDO:
    1. B29…28 set to 00b
    2. B27…25 (Reserved) set to zero
    3. B16 (Reserved) set to zero
    4. B7 (Reserved) set to zero
    5. The Tester checks consistency of Snk_PDO_Max_VoltageN
    6. The Tester checks consistency of Snk_PDO_Min_VoltageN
    7. The Tester checks consistency of Snk_PDO_Max_CurrentN

d. The Tester compares all PDOs to VIF field PD_Power_as_Sink and check that they meet the requirements of the Power Rules

e. The Tester checks PDOs following the first one, are in the correct order: Fixed PDOs in increasing voltage sequence, Battery PDOs in increasing minimum voltage sequence, Variable PDOs in increasing minimum voltage sequence, and finally PPS PDOs in increasing maximum voltage sequence

f. The Tester checks that no Fixed PDO has the same voltage as any other

g. The Tester checks that no Variable PDO has the same voltage range as any other

h. The Tester checks that no Battery PDO has the same voltage range as any other

i. The Tester checks that no PPS PDO has the same voltage range as any other

COMMON.CHECK.PD.13 Check Correct Use of Rp

Description: The Tester checks whether the procedures for Collision Avoidance are correctly followed.

Check Applicability: In PD3 mode only, and explicit contract exists.

Perform the following checks on the Atomic Message Sequences: [COMMON.CHECK.PD.13#1]

1. The Source UUT starts an AMS:
  When the Source UUT sends the first message to start an AMS, check that SinkTxNG has been asserted for at least tSinkTx min before the start of the first bit of the preamble.

2. An AMS initiated by the Source UUT has ended:
  When the last message of an AMS initiated by the Source UUT has been sent, check that SinkTxNG is not asserted for more than tSrcHoldsBus. This delay is measured between the last bit of the EOP of last GoodCRC in the last AMS and the first bit of the preamble of the next AMS. (Refer to Source Port Policy Engine State Diagram in USB PD Specification)

3. The Sink UUT starts an AMS:
  When a Sink starts an AMS, one of the following must be true:
  a. SinkTxOk is asserted.

b. SinkTxNG has been asserted for less than tSinkDelay.

4. The following AMS are the exception for all the above steps
    a. Hardreset
    b. Softreset
    c. Alert

COMMON.CHECK.PD.14 Check EPR_Request Message

Description: The Tester performs additional protocol checks to all EPR_Request messages sent by the UUT.

Check Applicability: EPR_Request message

The Tester performs the following additional checks on all EPR_Request messages:
[COMMON.CHECK.PD.14#1]

1. Field check for all types of Request Data Object
    a. B31…28 (Object Position) is not 000b, and the value is not greater than the number of PDOs in the last EPR_Source_Capabilities message
    b. B25 (USB Communications Capable), matches VIF field USB_Comms_Capable
    c. B24 (No USB Suspend), matches VIF field No_USB_Suspend_May_Be_Set
    d. Bit 23 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported if the test is running in PD3 mode
    e. Bits 22 (EPR Mode Capable) set to 1b
    f. Bits 21…20 (Reserved) set to 000b if the test is running in PD3 mode
    g. Bits 23…20 (Reserved) set to 0000b if the test is running in PD2 mode
2. Fixed and Variable Request Data Object
    a. B19…10 (Operating Current) does not exceed the current offered by the referenced PDO
    b. If B27 (GiveBack flag) = 0b
        i. If B9…0 (Maximum Operating Current) is greater than the current offered by the referenced PDO, then B26 (Capability Mismatch) is set to one
        ii. B19…10 (Operating Current) does not exceed B9…0 (Maximum Operating Current)
    c. If B27 (GiveBack flag) = 1b
        B9…0 (Minimum Operating Current) does not exceed B19…10 (Operating Current)
3. Battery Request Data Object
    a. B19…10 (Operating Power) does not exceed the power offered by the referenced PDO
    b. If B27 (GiveBack flag) = 0b
        ii. If B9…0 (Maximum Operating Power) is greater than the power offered by the referenced PDO, then B26 (Capability Mismatch) is set to one
        i. B19…10 (Operating Power) does not exceed B9…0 (Maximum Operating Power)
    c. If B27 (GiveBack flag) = 1b
        B9…0 (Minimum Operating Power) does not exceed B19…10 (Operating Power)

4. SPR Programmable Power Supply RDO
    a. B6…0 (Operating Current) is less than or equal to the Maximum Current offered by the referenced PDO
    b. B19…9 (Output Voltage field):
        i. Greater than or equal to the Minimum Voltage field in the PPS APDO.
        ii. Less than or equal to the Maximum Voltage field in the PPS APDO.
    c. B8…7 (Reserved) set to zero
    d. Bits 27 (Reserved) set to 0b
5. EPR Adjustable Voltage Supply Request RDO
    a. B6…0 (Operating Current) is less than or equal to the Source PDP/Output Voltage rounded down to the nearest 50mA
    b. B20…9 (Output Voltage field):
        i. Greater than or equal to the Minimum Voltage field in the AVS APDO.
        ii. Less than or equal to the Maximum Voltage field in the AVS APDO.
    c. B8…7 (Reserved) set to zero
    d. Bits 27 (Reserved) set to 0b

6. Tester checks that the PDO(PDO2) in the EPR_Request Message exactly matches the PDO in the latest EPR_Source_Capabilities Message pointed to by the *Object Position* field in the RDO

COMMON.CHECK.PD.15 Check EPR_Mode Message

Description: The Tester performs additional protocol checks to all EPR_Request messages sent by the UUT.

Check Applicability: EPR_Mode message

The Tester performs the following additional checks on all EPR Mode messages:

[COMMON.CHECK.PD.15#1]

1. Field check for EPR Mode Data Object
    a. Bit 31…24 (Action field) shall not be equal to 0 and shall be less than 0x06
    b. Bit 23…16 (Data field):
        i. Shall be set to 0 if the action field is "Enter Acknowledged" (0x02)
        ii. Shall be set to 0 if the action field is "Enter Succeeded" (0x03)
        iii. Shall be set to 0 if the action field is "Exit" (0x05)
        iv. Shall be consistent with the "Snk_PDO_PDP_Rating" VIF field if action filed is "Enter" (0x01)
        v. Shall be less than 0x06 if the action field is "Enter Failed" (0x04)
    c. Bit 15…0 Shall be set to 0

COMMON.CHECK.PD.16 Check EPR_Source_Capabilities Message

Description: The Tester performs additional protocol checks on all EPR Source Capabilities messages sent by the UUT.

Check Applicability: EPR Source Capabilities message

Perform the following checks on all EPR Source Capabilities messages: [COMMON.CHECK.PD.16#1]

1. Check if the VIF field EPR_Support_as_Src is set to yes.
2. The Tester checks the Number of Data Objects field in the Message Header
   a. In PD3 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Src_PDOs.
   b. In PD2 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Src_PDOs minus number of PPS & AVS APDOs (count of how many Src_PDO_Supply_TypeN is set to PPS/AVS).
3. For the first PDO, the Tester check the consistency
   a. B31…30 (Fixed Supply) set to 00b
   b. B29 (Dual-Role Power) set to 1b if VIF field PD_Port_Type is set to Consumer/Provider, Provider/Consumer or DRP.
   c. B28 (USB Suspend Supported) set to 1b if VIF field USB_Suspend_May_Be_Cleared = NO
   d. B27 (Unconstrained Power) matches VIF field Unconstrained_Power
   e. B26 (USB Communications Capable) matches VIF field USB_Comms_Capable
   f. B25 (Dual-Role Data) set to 1b if VIF field DR_Swap_To_UFP_Supported or DR_Swap_To_DFP_Supported = YES
   g. For Source Capabilities message before the first response from the Tester
      i. Bit 24 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported
      ii. Bit23 (EPR Mode Capable) matches VIF field EPR_Supported_as_Src
      iii. Bits 22 (Reserved) set to 00b
   h. For Source Capabilities message after the Tester has sent Request message
      i. Bit 24 (Unchunked Extended Messages Supported) matches VIF field Unchunked_Extended_Messages_Supported if the test is running in PD3 mode
      ii. Bit23 (EPR Mode Capable) matches VIF field EPR_Supported_as_Src if the test is running in PD3 mode
      iii. Bits 22 (Reserved) set to 00b if the test is running in PD3 mode
      iv. Bits 24…22 (Reserved) set to 000b if the test is running in PD2 mode
   i. B21…20 (Peak Current) matches VIF field Src_PDO_Peak_Current1
   j. B19…10 (Voltage) set to 5V
   k. B9…0 (Maximum Current) matches
      i. If Src_PDO_Max_current1 <= 3A, Src_PDO_Max_Current1
      ii. If Src_PDO_Max_current1 > 3A:
         1. 3A if cable emulated is not e-marked or 3A capable only
         2. Src_PDO_Max_Current1 if capable emulated is e-marked
4. If it is not the first Fixed Supply PDO, check that B29…22 is set to zero
5. If it is a Programmable Power Supply APDO, check that B26…25, B16 and B7 are set to zero
6. The Tester compares all PDOs to VIF field PD_Power_as_Source and check that they meet the requirements of the Power Rules.
7. For each PDO, the Tester checks consistency of:
   a. Src_PDO_Supply_TypeN
   b. If Fixed Supply PDO:
      i. Src_PDO_VoltageN

        ii.   Src_PDO_Peak_CurrentN

        iii. Max_current_field: (When in SPR mode)

             1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN

             2. If Src_PDO_Max_currentN > 3A:

                  a. 3A if cable emulated is not e-marked or 3A capale only

                  b. Src_PDO_Max_CurrentN if cable emulated is e-marked

        iv. Max current field: (When in EPR mode)

             1. Src_PDO_Max_currentN is consistent with the VIF field "Src_PDO_Max_Current"

   c. If Variable Supply PDO:

        i.   Src_PDO_MinVoltageN

        ii. Src_PDO_MaxVoltageN

        iii. Max_current_Field:

             1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN

             2. If Src_PDO_Max_currentN > 3A:

                  a. 3A if cable emulated is not e-marked or 3A capable only

                  b. Src_PDO_Max_CurrentN if cable emulated e-marked

   d. If Battery Supply PDO:

        i.   Src_PDO_MinVoltageN

        ii. Src_PDO_MaxVoltageN

        iii. Src_PDO_Max_PowerN field:

             1. If (Src_PDO_Max_PowerN / Src_PDO_MinVoltageN) <= 3A, Src_PDO_Max_PowerN

             2. If (Src_PDO_Max_Powern / Src_PDO_MinVoltageN) > 3A:

                  a. (Src_PDO_Max_PowerN / Src_PDO_MinVoltageN) if cable emulated is not e-marked or 3A capable only

                  b. Src_PDO_Max_PowerN if cable emulated is e-marked

   e. If Programmable Power Supply PDO:

        i.   Src_PDO_MinVoltageN

        ii. Src_PDO_MaxVoltageN

        iii. Max_current_field:

             1. If Src_PDO_Max_currentN <= 3A, Src_PDO_Max_CurrentN

             2. If Src_PDO_Max_currentN > 3A:

                  a. 3A if cable emulated is not e-marked or 3A capable only

                  b. Src_PDO_Max_CurrentN if cable emulated is e-marked

   f. If EPR Adjustable Voltage Supply APDO:

        i.   Src_PDO_MinVoltageN

        ii. Src_PDO_MaxVoltageN

        iii. PDP is consistent with VIF field "PD_Power_As_Source" .

8. The Tester checks PDOs following the first one, are in the correct order: Fixed PDOs in increasing Voltage sequence, Battery PDOs in increasing Minimum Voltage sequence, Variable PDOs in increasing Minimum Voltage sequence, Programmable Power Supply APDOs in increasing Maximum Voltage sequence and finally Adjustable Voltage Supply APDOs in increasing Maximum Voltage Sequence.

9. The Tester checks that no Fixed PDO has the same voltage as any other

10. The Tester checks that no Variable PDO has the same voltage range as any other
11. The Tester checks that no Battery PDO has the same voltage range as any other

COMMON.CHECK.PD.17 Check EPR_Sink_Capabilities Message

Description: The Tester performs additional protocol checks on all EPR Sink Capabilities messages sent by the UUT.

Check Applicability: Sink Capabilities message

Perform the following checks on all Sink Capabilities messages: [COMMON.CHECK.PD.17#1]

1. The Tester runs the following field checks on the Sink Capabilities message:
   a. The Number of Data Objects field in the Message Header:
      i. Is at least one.
      ii. In PD3 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Snk_PDOs.
      iii. In PD2 mode, the check fails if the Number of Data Objects field in the Message Header is not equal to VIF field Num_Snk_PDOs minus number of PPS APDOs & AVS APDOs (count of how many Snk_PDO_Supply_TypeN is set to PPS/AVS).
   b. For the first PDO, the Tester checks:
      i. B31…30 (Fixed Supply) set to 00b
      ii. B29 (Dual-Role Power) set to 1b if VIF field Port_Type is DRP, Provider/Consumer or Consumer/Provider, otherwise set to 0b
      iii. B28: (Higher Capability) matches VIF field Higher_Capability_set
      iv. B27 - (Unconstrained_Power) matches VIF field Unconstrained_Power
      v. B26 (USB Communications Capable) matches VIF field USB_Comms_Capable
      vi. B25 (Dual-Role Data) set to 1b if VIF field DR_Swap_To_UFP_Supported or DR_Swap_To_DFP_Supported = YES, otherwise set to 0b if VIF field DR_Swap_To_UFP_Supported and DW_Swap_To_DFP_Supported = NO
      vii. B24…23
         1. PD3 mode (Fast Role Swap required USB Type-C Current) matches VIF field FR_Swap_Reqd_Type_C_Current_As_Initial_Source
         2. PD2 mode: set to 00b.
      viii. B22…20 (Reserved) set to 000b
      ix. B19…10 (Voltage) set to 5V
      x. B9…0 (Operational Current) matches VIF field SNK_PDO_OP_CURRENT1
   c. For each PDO, the Tester checks:
      i. The Tester checks consistency of Snk_PDO_Supply_TypeN
      ii. If Fixed Supply PDO:
         1. In PD2, B24…20 (Reserved) are set to zero
         2. In PD3, B22…20 (Reserved) are set to zero
         3. The Tester checks consistency of Snk_PDO_VoltageN
         4. The Tester checks consistency of Snk_PDO_ Op_CurrentN
      iii. If Variable Supply PDO:
         1. The Tester checks consistency of Snk_PDO_Max_VoltageN

2. The Tester checks consistency of Snk_PDO_Min_VoltageN
3. The Tester checks consistency of Snk_PDO_ Op_CurrentN

    iv. If Battery Supply PDO:
1. The Tester checks consistency of Snk_PDO_Max_VoltageN
2. The Tester checks consistency of Snk_PDO_Min_VoltageN
3. The Tester checks consistency of Snk_PDO_ Op_PowerN

    v. If Programmable Power Supply APDO:
1. B29…28 set to 00b
2. B27…25 (Reserved) set to zero
3. B16 (Reserved) set to zero
4. B7 (Reserved) set to zero
5. The Tester checks consistency of Snk_PDO_Max_VoltageN
6. The Tester checks consistency of Snk_PDO_Min_VoltageN
7. The Tester checks consistency of Snk_PDO_Max_CurrentN

    vi. If Adjustable Voltage Supply APDO:
1. B29…28 set to 01b
2. B26…25 (reserved) set to zero
3. B16 (Reserved) set to zero
4. The Tester checks consistency of Snk_PDO_Max_VoltageN
5. The Tester checks consistency of Snk_PDO_Min_VoltageN
6. The Tester checks if the PDP is consistent with "Snk_PDO_PDP_Rating" VIF field.

d. The Tester compares all PDOs to VIF field PD_Power_as_Sink and check that they meet the requirements of the Power Rules

e. The Tester checks PDOs following the first one, are in the correct order: Fixed PDOs in increasing voltage sequence, Battery PDOs in increasing minimum voltage sequence, Variable PDOs in increasing minimum voltage sequence, and finally PPS PDOs in increasing maximum voltage sequence

f. The Tester checks that no Fixed PDO has the same voltage as any other

g. The Tester checks that no Variable PDO has the same voltage range as any other

h. The Tester checks that no Battery PDO has the same voltage range as any other.

i. The Tester checks that no PPS/AVS PDO has the same voltage range as any other

3.2 Bring-up Procedures

3.2.1 PD2 and PD3 Modes

The common checks in this subsection are applicable when the test is running in PD2 and PD3 modes.

COMMON.PROC.BU.1 Bring-up Source UUT

1. Make sure to have run TEST.PREP.PR.1 preparation before this procedure. The test starts in a disconnected state.

2. If VIF field Captive_Cable = YES, the Tester applies Rd. Otherwise (VIF field Captive_Cable = No), the Tester applies Rd and Ra.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present (vSafe5V). [COMMON.PROC.BU.1#1]

4. The Tester responds with a GoodCRC

5. The Tester sends a Request message for 5V at 100mA.

    a. B30…B28 (Object Position) = 001b

    b. B27 (GiveBack Flag) = 0b

    c. B26 (Capability Mismatch) = 0b

    d. B25 (USB Communication Capable) = 0b

    e. B24 (No USB Suspend) = 1b

    f. B23 (PD3, Unchunked Extended Messages Supported) = 0b

    g. B22 (EPR Mode Capable) to 0b, unless it is mentioned in the test procedure

    h. B19…10 (Operating Current) = 100mA

    i. B9…0 (Maximum Operating Current) = 100mA

6. The check fails if: COMMON.PROC.BU.1#2]

    a. The UUT retries the Source Capabilities message

    b. The UUT does not respond with an Accept message

7. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.1#3]

8. An explicit contract is now established.
9. The Tester waits 500ms to respond to messages from the UUT.

COMMON.PROC.BU.2 Bring-up Sink UUT

1. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 50 ms.

5. The Tester transmits Source Capabilities message with single PDO:

    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 1b
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b

e. B26 (USB Communications Capable) set to 0b
f. B25 (Dual-Role Data) set to 0b
g. B24 (PD3, Unchunked Extended Messages Supported) set to 0b
h. B23 (EPR Mode Capable) to 0b, unless it is mentioned in the test procedure
i. B21…20 (Peak Current) set to 00b
j. B19…10 (Voltage) set to 5V
k. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

7. The check fails if the UUT does not respond with a Request message. [COMMON.PROC.BU.2#1]

8. The Tester responds with an Accept message to the Request message.

9. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.
10. An explicit contract is now established.
11. The Tester presents SinkTxOK if the test is in PD3 mode. The Tester waits 500ms to respond to messages from the UUT.

COMMON.PROC.BU.3 Bring-up Cable Plug UUT
1. The test starts in a disconnected state.

2. The Tester applies Rp to each of the CC1 and CC2 pins at one cable end. The other end of the cable is left unconnected.

3. The Tester checks that it detects Ra on one pin (from now on called the VCONN pin) and no connection on the other pin (from now on called the CC pin). [COMMON.PROC.BU.3#1]. For any other combination the test ends here.

4. The Tester performs the following:

    a. keeps Rp connected to the CC pin and also connects Rd to the CC pin,

    b. waits 150ms nominal (tCCDebounce),

    c. disconnects Rp from the VCONN pin and applies VCONN (at the voltage specified in the Test Condition) to the VCONN pin,

    d. connects vSafe5V on VBUS.

5. The Tester waits for tVCONNStable max.

Note: The Tester uses SOP' messages in Cable Plug tests except where otherwise specified.

COMMON.PROC.BU.4 Bring-up Source UUT for PPS Test

1. Make sure to have run TEST.PREP.PR.1 preparation before this procedure. The test starts in a disconnected state.

2. The Tester applies Rd.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present (vSafe5V). [COMMON.PROC.BU.4#1]

4. If there is no PPS APDO in the Source_Capabilities, the test stops here.

5. The Tester responds with a Request message for Programmable Power Supply APDO 4V 1A.

    a. B26 (Capability Mismatch) = 0b

    b. B25 (USB Communication Capable) = 0b

    c. B24 (No USB Suspend) = 1b

    d. B23 (PD3, Unchunked Extended Messages Supported) = 0b

    e. B19…9 (Output Voltage) = 4V

    f. B6…0 (Operating Current) = 1A

6. The check fails if an Accept message is not received. [COMMON.PROC.BU.4#2]

7. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.4#3]

8. An explicit contract is now established.
9. The Tester waits 500ms to respond to messages from the UUT.

COMMON.PROC.BU.5 Bring-up Sink UUT for PPS Test

1. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester transmits Source Capabilities message with two PDOs:

    a. Fixed Supply PDO
        i. B31…30 (Fixed Supply) set to 00b
        ii. B29 (Dual-Role Power) set to 1b
        iii. B28 (USB Suspend Supported) set to 0b
        iv. B27 (Unconstrained Power) set to 1b
        v. B26 (USB Communications Capable) set to 0b
        vi. B25 (Dual-Role Data) set to 0b
        vii. B24 (PD3, Unchunked Extended Messages Supported) set to 0b

<div style="margin-left: 2em;">

    viii. B21…20 (Peak Current) set to 00b

      ix. B19…10 (Voltage) set to 5V

       x. B9…0 (Maximum Current) set to 3A

b. APDO PPS

       i. B31…30 (Augmented PDO) set to 11b

      ii. B29…28 00b – Programmable Power Supply

    iii. B27 (PPS Power Limited) set to 0b

    iv. B24…17 (Maximum Voltage) set to 5.9V

     v. B15…8 (Minimum Voltage) set to 3.3V

    vi. B6…0 (Maximum Current) set to 3A

</div>

5. Repeat Step-4 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

6. The check fails if a Request message is not received. [COMMON.PROC.BU.5#1]

7. The Tester responds with an Accept message to the Request message.

8. When the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

9. An explicit contract is now established.

10. The Tester presents SinkTxOK.

11. If the Sink doesn't request the PPS APDO in 5s from the time Tester presented SinkTxOK, the test stops here. If the Request message is received, the Tester responds with an Accept message.

12. When the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

13. The Tester presents SinkTxOK. The Tester waits 500ms to respond to messages from the UUT.

COMMON.PROC.BU.6 Bring-up Sink UUT for Captive Cable Test

1. The test starts in a disconnected state.

2. The Tester applies Rp to each of the CC1 and CC2 pins at the captive cable end.

3. Tester waits for Rd to appear on at least one pin. If this does not occur within tDRP, the check fails. [COMMON.PROC.BU.6#1].

4. The Tester checks that it detects Ra on one pin (from now on called the VCONN pin) and Rd on the other pin (from now on called the CC pin). [COMMON.PROC.BU.6#2]. For any other combination the test ends here.

5. The Tester performs the following:

    a. keeps Rp connected to the CC pin,

    b. waits 150ms (tCCDebounce),

    c. disconnects Rp from the VCONN pin and applies VCONN (at the voltage specified in the Test Condition) to the VCONN pin,

d. connects vSafe5V on VBUS.

6. The Tester waits for 50 ms.

7. The Tester transmits Source Capabilities message with single PDO:

    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 1b
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b
    e. B26 (USB Communications Capable) set to 0b
    f. B25 (Dual-Role Data) set to 0b
    g. B24 (PD3, Unchunked Extended Messages Supported) set to 0b
    h. B21…20 (Peak Current) set to 00b
    i. B19…10 (Voltage) set to 5V
    j. B9…0 (Maximum Current) set to 100mA

8. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

9. The check fails if the UUT does not respond with a Request message. [COMMON.PROC.BU.6#3]

10. The Tester responds with an Accept message to the Request message.

11. When the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.
12. The Tester waits 500ms to respond to messages from the UUT.
13. The Tester sends a BIST request to the UUT using SOP, specifying BIST Test Data.

Note: The Tester uses SOP' messages in Captive Cable Plug tests except where otherwise specified.

COMMON.PROC.BU.7 Bring-up Consumer-Provider as Source UUT

1. Make sure to have run TEST.PREP.PR.1 preparation before this procedure. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 50 ms.

5. The Tester transmits Source Capabilities message with single PDO:

    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 1b
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b

e. B26 (USB Communications Capable) set to 0b

f. B25 (Dual-Role Data) set to 0b

g. B24 (PD3, Unchunked Extended Messages Supported) set to 0b

h. B21…20 (Peak Current) set to 00b

i. B19…10 (Voltage) set to 5V

j. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

7. The check fails if the UUT does not respond with a Request message. [COMMON.PROC.BU.7#1]

8. The Tester responds with an Accept message to the Request message.

9. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

10. An explicit contract is now established.

11. The Tester presents SinkTxOK if the test is in PD3 mode. The Tester waits 500ms to respond to messages from the UUT. If during this period, the UUT requests a PR_Swap, the Tester sends an Accept, and then skips to step 14.

12. The Tester sends a PR_Swap message.

13. The Tester checks the response. [COMMON.PROC.BU.7#2]

    a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.

    b. The check fails and the test ends here if the UUT responds with a Reject message.

    c. The check fails and the test ends here if the UUT response with a Not_Supported message.

14. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.

15. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.

16. The tester checks that UUT asserts Rp before the UUT has applied vSafe5V [COMMON.PROC.BU.7#3]

17. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V. [COMMON.PROC.BU.7#4]

18. The Tester checks that the PS_RDY from the UUT is within tPSSourceOn min. [COMMON.PROC.BU.7#5] This delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester.

19. The Tester checks that the UUT sends a Source Capabilities message after tSwapSourceStart and before tFirstSourceCap max. [COMMON.PROC.BU.7#6].

20. The Tester responds with a Request message for 5V at 100mA.

    a. B30 (Object Position) = 001b

    b. B27 (GiveBack Flag) = 0b

c. B26 (Capability Mismatch) = 0b

d. B25 (USB Communication Capable) = 0b

e. B24 (No USB Suspend) = 1b

f. B23 (PD3, Unchunked Extended Messages Supported) = 0b

g. B19…10 (Operating Current) = 100mA

h. B9…0 (Maximum Operating Current) = 100mA

21. The check fails if the UUT does not respond with an Accept message. [COMMON.PROC.BU.7#7]

22. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.7#8]

23. An explicit contract is now established.
24. The Tester waits 500ms to respond to messages from the UUT.
25. If the UUT is not a Vconn Source, then the Tester sends a VCONN_Swap message and completes the VCONN_Swap using common procedure COMMON.PROC.PD.17. [COMMON.PROC.BU.7#9]

COMMON.PROC.BU.8 Bring-up Provider-Consumer as Sink UUT
1. The test starts in a disconnected state.

2. If VIF field Captive_Cable = YES, the Tester applies Rd. Otherwise (VIF field Captive_Cable = No), the Tester applies Rd and Ra.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present (vSafe5V). [COMMON.PROC.BU.8#1]

4. The Tester responds with a Request message for 5V at 100mA.

a. B30…B28 (Object Position) = 001b

b. B27 (GiveBack Flag) = 0b

c. B26 (Capability Mismatch) = 0b

d. B25 (USB Communication Capable) = 0b

e. B24 (No USB Suspend) = 1b

f. B23 (PD3, Unchunked Extended Messages Supported) = 0b

g. B19…10 (Operating Current) = 100mA

h. B9…0 (Maximum Operating Current) = 100mA

5. The check fails if the UUT does not respond with an Accept message. [COMMON.PROC.BU.8#2]

6. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.8#3]

7. An explicit contract is now established.

8. The Tester waits 500ms to respond to messages from the UUT. If during this period, the UUT requests a PR_Swap, the Tester sends an Accept, and then skips to step 11.

9. The Tester sends a PR_Swap message.

10. The Tester checks the response. [COMMON.PROC.BU.8#4]
    a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.
    b. If the UUT responds with Reject or Not_Supported (PD3 mode only), the check fails, and the test ends here.
    c. If the UUT responds with an Accept messge, proceed to Step 11.

11. The Tester draws no more than iSwapStandby within tSrcTransition min after the last GoodCRC.

12. The Tester checks that the UUT asserts Rd and sends a PS_RDY message after the UUT driving VBUS voltage to vSafe0V. [COMMON.PROC.BU.8#5]

13. The Tester checks that the UUT sends PS_RDY within tPSSourceOff min after the last bit of GoodCRC was sent in response to the received Accept. [COMMON.PROC.BU.8#6]

14. The Tester presents vSafe5V on VBUS and then it sends a PS_RDY message, both within tNewSRC max of the last GoodCRC sent by the UUT.

15. The Tester transmits Source Capabilities message with single PDO (5V @ 100mA, B29 Dual-Role Power set to 1b). The Tester checks that the UUT sends a Request message. [COMMON.PROC.BU.8#7]

16. The Tester uses the common procedure COMMON.PROC.PD.10 to establish a PD contract. The Tester waits 500ms to respond to messages from the UUT.

17. If the Tester is not a Vconn Source, then the Tester sends a VCONN_Swap message and completes the VCONN_Swap using common procedure COMMON.PROC.PD.17. [COMMON.PROC.BU.8#8]

COMMON.PROC.BU.9 Bring-up Consumer-Provider as Source UUT PPS

1. Make sure to have run TEST.PREP.PR.1 preparation before this procedure. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 50 ms.

5. The Tester transmits Source Capabilities message with single PDO:
    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 1b.
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b
    e. B26 (USB Communications Capable) set to 0b
    f. B25 (Dual-Role Data) set to 0b

g. B24 (PD3, Unchunked Extended Messages Supported) set to 0b

h. B21…20 (Peak Current) set to 00b

i. B19…10 (Voltage) set to 5V

j. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

7. The check fails if the UUT does not respond with a Request message. [COMMON.PROC.BU.9#1]

8. The Tester responds with an Accept message to the Request message.

9. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

10. An explicit contract is now established.

11. The Tester presents SinkTxOK if the test is in PD3 mode. The Tester waits 500ms to respond to messages from the UUT. If during this period, the UUT requests a PR_Swap, the Tester sends an Accept, and then skips to step 14.

12. The Tester sends a PR_Swap message.

13. The Tester checks the response. [COMMON.PROC.BU.9#2]

    d. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.

    e. The check fails and the test ends here if the UUT responds with a Reject message.

    f. The check fails and the test ends here if the UUT response with a Not_Supported message.

14. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.

15. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.

16. The tester checks that UUT asserts Rp before the UUT has applied vSafe5V [COMMON.PROC.BU.9#3]

17. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V. [COMMON.PROC.BU.9#4]

18. The Tester checks that the PS_RDY from the UUT is within tPSSourceOn min. [COMMON.PROC.BU.9#5] this delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester.

19. The Tester checks that the UUT sends a Source Capabilities message after tSwapSourceStart and before tFirstSourceCap max. [COMMON.PROC.BU.9#6].

20. If there is no PPS APDO in the Source_Capabilities, the test stops here.

21. The Tester responds with a Request message for Programmable Power Supply APDO 4V 1A.

a. B26 (Capability Mismatch) = 0b

b. B25 (USB Communication Capable) = 0b

    c.   B24 (No USB Suspend) = 1b

    d.   B23 (PD3, Unchunked Extended Messages Supported) = 0b

    e.   B19…9 (Output Voltage) = 4V

    f.   B6…0 (Operating Current) = 1A

22. The check fails if an Accept message is not received. [COMMON.PROC.BU.9#7]

23. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.9#8]

24. An explicit contract is now established.

25. The Tester waits 500ms to respond to messages from the UUT.

COMMON.PROC.BU.10 Bring-up VPD

1. Before starting the test, attach the VPD UUT directly to the tester (a VPD is a Captive Cable device).

2. The test starts in a disconnected state.

3. The Tester applies Rp to each of the CC1 and CC2 pins at the tester receptacle.

4. The Tester checks that it detects Ra on one pin (from now on called the VCONN pin) and Rd on the other pin (from now on called the CC pin). [COMMON.PROC.BU.10#1]. For any other combination the test ends here.

5. The Tester (Tester is 'Sink with Accessory Support') performs the following:

    a.   keeps Rp connected to the CC pin

    b.   waits 150ms (tCCDebounce),

    c.   disconnects Rp from the VCONN pin and applies VCONN (at the voltage specified in the Test Condition) to the VCONN pin,

6. The Tester waits for tVCONNStable max from when VCONN is stable.

Note:

1. VPD tests need to be run twice, with VCONN voltage set to 3.0 V, and 5.5V. Additionally, the Eye Diagram test is run at 4.25V.
2. The Tester uses SOP' messages in VPD tests except where otherwise specified.

COMMON.PROC.BU.11 Bring-up Source UUT for Captive Cable Test

1. The test starts in a disconnected state.

2. The Tester applies Rd to each of the CC1 and CC2 pins at the captive cable end.

3. Tester waits for Rp to appear on exactly one pin. If this does not occur within tDRP, the check fails. [COMMON.PROC.BU.11#1].

4. The pin on which Rp appears from now on is called the CC pin. The other pin is referred to as the VCONN pin.

5. The Tester keeps Rd connected to the CC pin,

6. Check that VBUS is detected at vSafe5V within tCCDebounce max. COMMON.PROC.BU.11#2]

7. The Tester disconnects Rd from the VCONN pin.

8. Check that the first bit of a Source Capabilities message is received from the UUT within tFirstSourceCap max after VBUS present (vSafe5V). [COMMON.PROC.BU.11#3]

9. The Tester responds with a Request message for 5V at 100mA.

    a. B30…B28 (Object Position) = 001b

    b. B27 (GiveBack Flag) = 0b

    c. B26 (Capability Mismatch) = 0b

    d. B25 (USB Communication Capable) = 0b

    e. B24 (No USB Suspend) = 1b

    f. B23 (PD3, Unchunked Extended Messages Supported) = 0b

    g. B19…10 (Operating Current) = 100mA

    h. B9…0 (Maximum Operating Current) = 100mA

10. The check fails if the UUT does not respond with an Accept message. [COMMON.PROC.BU.11#4]

11. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.11#5]

12. The Tester waits 500ms to respond to messages from the UUT.
13. The Tester requests a VCONN_Swap. If this is not accepted the check fails. [COMMON.PROC.BU.11#6]
14. During the VCONN_Swap procedure the value of VCONN applied is determined by the Test Condition.
15. The Tester sends a BIST request to the UUT using SOP, specifying BIST Test Data.

Note: The Tester uses SOP' messages in Captive Cable Plug tests except where otherwise specified.

COMMON.PROC.BU.12 Bring-up Provider-Consumer as Sink UUT PPS

1. The test starts in a disconnected state.

2. If VIF field Captive_Cable = YES, the Tester applies Rd. Otherwise (VIF field Captive_Cable = No), the Tester applies Rd and Ra.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present (vSafe5V). [COMMON.PROC.BU.12#1]

4. The Tester responds with a Request message for 5V at 100mA.

    a. B30…B28 (Object Position) = 001b

    b. B27 (GiveBack Flag) = 0b

    c. B26 (Capability Mismatch) = 0b

    d. B25 (USB Communication Capable) = 0b

    e. B24 (No USB Suspend) = 1b

    f. B23 (PD3, Unchunked Extended Messages Supported) = 0b

    g. B19…10 (Operating Current) = 100mA

    h. B9…0 (Maximum Operating Current) = 100mA

5. The check fails if the UUT does not respond with an Accept message. [COMMON.PROC.BU.12#2]

6. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.BU.12#3]

7. An explicit contract is now established.

8. The Tester waits 500ms to respond to messages from the UUT. If during this period, the UUT requests a PR_Swap, the Tester sends an Accept, and then skips to step 11.

9. The Tester sends a PR_Swap message.

10. The Tester checks the response. [COMMON.PROC.BU.12#4]

    a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.

    b. If the UUT responds with Reject or Not_Supported (PD3 mode only), the check fails, and the test ends here.

    c. If the UUT responds with an Accept messge, proceed to Step 11.

11. The Tester draws no more than iSwapStandby within tSrcTransition min after the last GoodCRC.

12. The Tester checks that the UUT asserts Rd and sends a PS_RDY message after the UUT driving VBUS voltage to vSafe0V. [COMMON.PROC.BU.12#5]

13. The Tester checks that the UUT sends PS_RDY within tPSSourceOff min after the last bit of GoodCRC was sent in response to the received Accept. [COMMON.PROC.BU.12#6]

14. The Tester presents vSafe5V on VBUS and then it sends a PS_RDY message, both within tNewSRC max of the last GoodCRC sent by the UUT.

15. The Tester transmits Source Capabilities message with two PDOs:

    a. Fixed Supply PDO

        i. B31…30 (Fixed Supply) set to 00b

        ii. B29 (Dual-Role Power) set to 1b

        iii. B28 (USB Suspend Supported) set to 0b

        iv. B27 (Unconstrained Power) set to 1b

        v. B26 (USB Communications Capable) set to 0b

        vi. B25 (Dual-Role Data) set to 0b

        vii. B24 (PD3, Unchunked Extended Messages Supported) set to 0b

        viii. B21…20 (Peak Current) set to 00b

        ix. B19…10 (Voltage) set to 5V

        x. B9…0 (Maximum Current) set to 3A

    b. APDO PPS

        i. B31…30 (Augmented PDO) set to 11b

        ii. B29…28 00b – Programmable Power Supply

        iii. B27 (PPS Power Limited) set to 0b

        iv. B24…17 (Maximum Voltage) set to 5.9V

        v. B15…8 (Minimum Voltage) set to 3.3V

        vi. B6…0 (Maximum Current) set to 3A

16. The check fails if a Request message is not received. [COMMON.PROC.BU.12#7]

17. The Tester responds with an Accept message to the Request message.

18. When the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

19. An explicit contract is now established.

20. The Tester presents SinkTxOK.

21. If the Sink doesn't request the PPS APDO in 5s from the time Tester presented SinkTxOK, the test stops here. If the Request message is received, the Tester responds with an Accept message.

22. When the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

23. The Tester presents SinkTxOK. The Tester waits 500ms to respond to messages from the UUT.

3.3   Common Procedures

3.3.1   PD2 and PD3 Modes

The common procedures in this subsection are applicable when the test is running in PD2 and PD3 modes.

COMMON.PROC.PD.1 Tester Sends GoodCRC

Procedure Applicability: Unless otherwise specified, the Tester replies with a GoodCRC whenever receiving any PD message from the UUT.

1. The Tester sends a GoodCRC message to acknowledge messages received from the UUT. The Tester starts the preamble of GoodCRC message after tInterframeGap min of the last bit of the previously received message.

COMMON.PROC.PD.2 UUT Sent Get_Source_Cap

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Get_Source_Cap message from the UUT.

1. The Tester receives a Get_Source_Cap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.2#1]

    a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b. The check fails if the UUT sends this message within a non-interruptible AMS

    c. The check fails if the VIF field PD_Port_Type = Provider Only

2. There are three scenarios:

    a. The Tester is a Source

        i. The Tester responds with Source Capabilities message that contains single PDO

            1. B31…30 (Fixed Supply) set to 00b

            2. B29 (Dual-Role Power) set to 0b if Tester is a Source only; set to 1b if Tester is a Dual-Role Power

            3. B28 (USB Suspend Supported) set to 0b

4. B27 (Unconstrained Power) set to 1b

5. B26 (USB Communications Capable) set to 0b

6. B25 (Dual-Role Data) set to 0b

7. B24…22 (Reserved) set to 00b

8. B21…20 (Peak Current) set to 00b

9. B19…10 (Voltage) set to 5V

10. B9…0 (Maximum Current) set to 100mA

ii. The check fails if the UUT does not respond with a Request message.
[COMMON.PROC.PD.2#2]

iii. The Tester responds with an Accept message to the Request message.

iv. If the VBUS voltage is stable within the target voltage, the Tester sends a
PS_RDY message at tPSTransition min after the reception of Accept message.

b. The Tester is a Sink only

i. The Tester responds with a Reject message.

c. The Tester is a Sink with Dual-Role Power

i. The Tester responds with a Source Capabilities message for best condition for
the PR_Swap to be accepted:
1. For the first PDO:
   a. B31…30 (Fixed Supply) set to 00b
   b. B29 (Dual-Role Power) set to 1b
   c. B28 (USB Suspend Supported) set to 0b
   d. B27 (Unconstrained Power) set to 1b
   e. B26 (USB Communications Capable) matches VIF field
      USB_Comms_Capable
   f. B25 (Dual-Role Data) matches VIF field
      DR_Swap_To_UFP_Supported
   g. B24…22 (Reserved) set to 00b
   h. B21…20 (Peak Current) set to 00b
   i. B19…10 (Voltage) set to 5V
   j. B9…0 (Maximum Current) set to VIF field
      Snk_PDO_Max_Current1
2. Create the subsequent PDOs using Sink PDO values in the VIF:
   a. If Snk_PDO_Supply_TypeN = Fixed
      i. B31…30 (Fixed Supply) set to 00b
      ii. B19…10 (Voltage) set to VIF field Snk_PDO_VoltageN
      iii. B9…0 (Maximum Current) set to VIF field Snk_PDO_
         Op_CurrentN

  b. If Snk_PDO_Supply_TypeN = Variable
    i. B31…30 (Variable Supply) set to 10b
    ii. B29…20 (Maximum Voltage) set to VIF field Snk_PDO_MaxVoltageN
    iii. B19…10 (Minimum Voltage) set to VIF field Snk_PDO_MinVoltageN
    iv. B9…0 (Maximum Current) set to VIF field Snk_PDO_Op_CurrentN
  c. If Snk_PDO_Supply_TypeN = Battery
    i. B31…30 (Battery Supply) set to 01b
    ii. B29…20 (Maximum Voltage) set to VIF field Snk_PDO_MaxVoltageN
    iii. B19…10 (Minimum Voltage) set to VIF field Snk_PDO_MinVoltageN
    iv. B9…0 (Maximum Power) set to VIF field Snk_PDO_Op_PowerN

  d. If Snk_PDO_Supply_TypeN = PPS, and in Rev 3

    i. B31…28 (PPS) set to 1100b
    ii. B24…17 (Maximum Voltage) set to VIF field Snk_PDO_MaxVoltageN
    iii. B15…18 (Minimum Voltage) set to VIF field Snk_PDO_MinVoltageN
    iv. B6…0 (Maximum Current) set to VIF field Snk_PDO_Op_CurrentN

COMMON.PROC.PD.3 UUT Sent Get_Sink_Cap

<u>Procedure Applicability:</u> Unless otherwise specified, the Tester runs this procedure whenever receiving Get_Sink_Cap message from the UUT.

1. The Tester receives Get_Sink_Cap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.3#1]

 a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

 b. The check fails if the UUT sends this message within a non-interruptible AMS

 c. The check fails if the VIF field PD_Port_Type = Consumer only

2. There are three scenarios:

 a. The Tester is a Source only

        i.   The Tester responds with a Reject message

b.   The Tester is a Source with Dual Role Power

        i.   The Tester responds the following Sink Capabilities message with single PDO:
1. B31…30 (Fixed Supply) set to 00b
2. B29 (Dual-Role Power) set to 1b
3. B28 (Higher Capability) set to 0b
4. B27 (Unconstrained Power) set to 1b
5. B26 (USB Communications Capable) set to 0b
6. B25 (Dual-Role Data) set to 0b
7. B24…20 (Reserved) set to 00000b
8. B19…10 (Voltage) set to 5V
9. B9…0 (Maximum Current) set to 100mA

c.   The Tester is a Sink

        i.   The Tester responds the following Sink Capabilities message with single PDO:
1. B31…30 (Fixed Supply) set to 00b
2. B29 (Dual-Role Power) set to 0b if Tester is a Sink only; set to 1b if Tester is a Dual-Role Power
3. B28 (Higher Capability) set to 0b
4. B27 (Unconstrained Power) set to 1b
5. B26 (USB Communications Capable) set to 0b
6. B25 (Dual-Role Data) set to 0b
7. B24…23 (Fast Role Swap required USB Type-C Current) set to 00b (Fast Swap not supported)
8. B22…20 (Reserved) set to 000b
9. B19…10 (Voltage) set to 5V
10. B9…0 (Maximum Current) set to 100mA

COMMON.PROC.PD.4 UUT Sent Ping

<u>Procedure Applicability:</u> Unless otherwise specified, the Tester runs this procedure whenever receiving Ping message from the UUT.

1.   The Tester receives Ping message from the UUT and ignores it. This message is valid except the following conditions: [COMMON.PROC.PD.4#1]

    a.   The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b.   The check fails if the UUT sends this message within a non-interruptible AMS

    c.   The check fails if the UUT sends this message and the UUT is a Sink

COMMON.PROC.PD.5 UUT Sent PR_Swap

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving PR_Swap message from the UUT.

1. The Tester receives PR_Swap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.5#1]

    a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b. The check fails if the UUT sends this message within a non-interruptible AMS

2. The following are the scenarios (for rejecting a PR_Swap).

    a. The Tester is a Sink, the Tester responds with a Reject message. The check fails if the VIF field Requests_PR_Swap_As_Src = No. [COMMON.PROC.PD.5#2]

    b. The Tester is a Source, the Tester responds with a Reject message. The check fails if the VIF field Requests_PR_Swap_As_Snk = No. [COMMON.PROC.PD.5#3]

COMMON.PROC.PD.6 UUT Sent VCONN_Swap

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving VCONN_Swap message from the UUT.

1. The Tester receives VCONN_Swap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.6#1]

    a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b. The check fails if the UUT sends this message within a non-interruptible AMS

2. There are two scenarios:

    a. The Tester is the initial Vconn Source, and the Tester runs the following procedures

        i. If the VIF field VCONN_Swap_To_On_Supported = Yes and the UUT sends a VCONN_Swap message, the Tester responds with an Accept message. Otherwise (the VIF field VCONN_Swap_To_On_Supported = No and the UUT sends a VCONN_Swap message), the check fails, and the test stops here. [COMMON.PROC.PDU.6#2]

        ii. The check fails if the UUT does not respond with PS_RDY message within tVCONNSourceOn max from the last bit of the EOP of GoodCRC message corresponding to the Accept Message sent. [COMMON.PROC.PD.6#3]

        iii. The Tester stops sourcing VCONN

    b. The UUT is the initial VCONN Source, and the Tester runs the following procedures

i. If the VIF field VCONN_Swap_To_Off_Supported = Yes and the UUT sends a VCONN_Swap message, the Tester responds with an Accept message. Otherwise (VIF field VCONN_Swap_To_Off_Supported = No and the UUT sends a VCONN_Swap message), the check fails, and the test stops here. [COMMON.PROC.PD.6#4]

ii. The Tester applies VCONN and sends PS_RDY message.

COMMON.PROC.PD.7 UUT Sent Discover Identity Request

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Discover Identity Request message from the UUT.

1. The Tester receives Discover Identity Request message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.7#1]

    a. If the test is running in PD2 mode

        i. If the UUT is a UFP, the Tester checks that

            1. The message uses SOP' packet **AND**

            2. The message is sent after a PR_Swap AMS in which the UUT becomes the new Source and before an explicit contract exists **AND**

            3. UUT is VCONN source

        ii. The check fails if the UUT is a Cable Plug

    b. If the test is running in PD3 mode

        i. The check fails if message uses SOP' **AND**

            1. UUT is not supplying VCONN **OR**

            2. it is not VCONN source

        ii. the check fails if the UUT is a Cable Plug

    c. The check fails if the VIF field Attempts_Discov_SOP = NO and the UUT has sent using SOP packet.

    d. The check fails if the UUT sends this message using SOP'' packet

    e. The check fails if the UUT sends this message within a non-interruptible AMS

    f. The check fails if the UUT sends this message using SOP packet before the Tester has established an Explicit Contract

2. The Tester performs the following checks on the Structured VDM Message Header: [COMMON.PROC.PD.7#2]

    a. Bits 7…6 (Command Type) is set to 00b

b. Bits 4…0b (Command) is set to 1 (Discover Identity)

3. The Tester response depends on the SOP* Communication:

   a. If a SOP' Discover Identity Request message is received from the UUT, the Tester responds with a "Responder ACK" advertising Passive Cable with Vbus Current Handling Capability set to 5A and Maximum Vbus Voltage set to 20V.

   b. If a SOP Discover Identity Request message is received from the UUT, the Tester responds with a "Responder NAK".

4. The check fails if a message is received from the UUT before the Tester has sent "Responder ACK" or "Responder NAK". [COMMON.PROC.PD.7#3]

COMMON.PROC.PD.8 UUT Sent Discover SVIDs Request

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Discover SVIDs Request message from the UUT.

1. The Tester receives Discover SVIDs Request message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.8#1]

   a. If the test is running in PD2 mode, the check fails if the UUT is a UFP or a Cable Plug

   b. If the test is running in PD3 mode, the check fails if the UUT is a Cable Plug

   c. The check fails if the VIF field Attempts_Discov_SOP = NO

   d. The check fails if the UUT sends this message using SOP'' packet

   e. The check fails if the UUT sends this message within a non-interruptible AMS

   f. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

2. The Tester performs the following checks on the Structured VDM Message Header: [COMMON.PROC.PD.8#2]

   a. Bits 7…6 (Command Type) is set to 00b

   b. Bits 4…0 (Command) is set to 2 (Discover SVIDs)

3. The Tester responds with a "Responder NAK". The check fails if a message is received from the UUT before the Tester has sent "Responder NAK". [COMMON.PROC.PD.8#3]

COMMON.PROC.PD.9 UUT Sent Attention

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Attention Request message from the UUT.

1. The Tester receives Attention Request message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.9#1]

    a. In PD2, the check fails if the UUT is a DFP or a Cable Plug

    b. In PD3, the check fails if the UUT is a Cable Plug

    c. The check fails if VIF field Modal_Operation_Supported_SOP = NO

    d. The check fails if the UUT sends this message using SOP' or SOP'' packet

    e. The check fails if the UUT sends this message within a non-interruptible AMS

    f. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

2. The Tester performs the following checks on the Structured VDM Message Header: [COMMON.PROC.PD.9#2]

    a. Bits 7…6 (Command Type) is set to 00b

    b. Bits 4…0b (Command) is set to 6 (Attention)

3. The Tester ignores the Attention Request message and does not send a response.

COMMON.PROC.PD.10 UUT Sent Request

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Request message from the UUT.

1. The Tester receives Request message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.10#1]

    a. The check fails if an Implicit Contract is in place and the message was not in response to a Source_Capabilities message from the Tester.

    b. The check fails if the UUT sends this message within a non-interruptible AMS

    c. The check fails if the UUT is a Source

    d. The check fails if the UUT is a Sink and in the EPR mode

2. The Tester responds with an Accept message to the Request message.

3. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

COMMON.PROC.PD.11 UUT Sent Source Capabilities

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving Source Capabilities message from the UUT.

1. The Tester receives Source Capabilities message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.11#1]

    a. The check fails if the UUT is a Sink and the Tester has not previously sent Get_Source_Cap.

    b. The check fails if PD_Port_Type is set to Consumer Only

    c. The check fails if the UUT sends this message within a non-interruptible AMS

2. The procedure ends here if the UUT is a Sink. The Tester sends a Request message for 5V at 100mA.

    a. B30 (Object Position) = 001b

    b. B27 (GiveBack Flag) = 0b

    c. B26 (Capability Mismatch) = 1b

    d. B25 (USB Communication Capable) = 0b

    e. B24 (No USB Suspend) = 1b

    f. B19…10 (Operating Current) = 100mA

    g. B9…0 (Maximum Operating Current) = 100mA

3. The check fails if an Accept message is not received. [COMMON.PROC.PD.11#2]

4. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.PD.11#3]

COMMON.PROC.PD.12 UUT Sent DR_Swap

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving DR_Swap message from the UUT.

1. The Tester receives DR_Swap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.12#1]

    a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b. The check fails if the UUT sends this message within a non-interruptible AMS

    c. The check fails if the UUT is a UFP and the VIF field DR_Swap_To_DFP_Supported = No

    d. The check fails if the UUT is a DFP and the VIF field DR_Swap_To_UFP_Supported = No

COMMON.PROC.PD.13 UUT Sent EPR_Source_Cap message

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving an EPR_Source_Cap message from the UUT.

1. The Tester receives the EPR_Source_Cap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.13#1]

    a. When UUT is in SPR mode, the check fails if the Tester has not previously sent EPR_Get_Source_Cap.

    b. The check fails if PD_Port_Type is set to Consumer Only

    c. The check fails if the UUT sends this message within a non-interruptible AMS

    d. The check fails if the VIF field EPR_Supported_As_Src is set to No and the test stops here

2. The procedure ends here if the UUT is a Sink or in the SPR mode. Otherwise, the Tester sends an EPR_Request message.

    a. Object Position

        i.   For EPR_Source_Cap message with no EPR PDO, Object Position = 001b
        ii.   For EPR_Source_Cap message with EPR PDOs, Object Position = 1000b

    b. B27 (GiveBack Flag) = 0b

    c. B26 (Capability Mismatch) = 1b

    d. B25 (USB Communication Capable) = 0b

    e. B24 (No USB Suspend) = 1b

    f. B19...10 (Operating Current) = 100mA

    g. B9...0 (Maximum Operating Current) = 100mA

3. The check fails if an Accept message is not received. [COMMON.PROC.PD.13#2]

4. The check fails if PS_RDY message is not received within tPSTransition max (EPR mode) from the last bit of the EOP of Accept message. COMMON.PROC.PD.13#3

5. Tester sends EPR_KeepAlive message for every tSinkEPRKeepAlive max(500ms)

6. Tester checks that the UUT responds with EPR_KeepAlive_Ack [COMMON.PROC.PD.13#4]

The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [COMMON.PROC.PD.13#3]

COMMON.PROC.PD.14 UUT Sent EPR_Get_Source_Cap

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving an EPR_Get_Source_Cap message from the UUT.

1. The Tester receives an EPR_Get_Source_Cap message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.14#1]

    a. The check fails if the UUT sends this message before the Tester has established an Explicit Contract

    b. The check fails if the UUT sends this message within a non-interruptible AMS

    c. The check fails if the VIF field PD_Port_Type = Provider Only

    d. The check fails if the VIF field *EPR_Supported_As_Snk* is set to No and the test stops here

2. There are four scenarios:

    a. The Tester is a Source only or Sink with Dual role power, and if the "EPR cap" bit is set to 0 in the Sourcecap message (SPR mode), Tester sends Not_Supported message

    b. The Tester is a Source only or Sink with Dual role power, and if the "EPR cap" bit is set to 1 in the Sourcecap message (EPR mode),

        i. The Tester sends with EPR_ Source_Capabilities message that contains eight PDO's and one PDO (140W PDP)

            1. B31…30 (Fixed Supply) set to 00b

            2. B29 (Dual-Role Power) set to 0b if Tester is a Source only; set to 1b if Tester is a Dual-Role Power

            3. B28 (USB Suspend Supported) set to 0b

            4. B27 (Unconstrained Power) set to 1b

            5. B26 (USB Communications Capable) set to 0b

            6. B25 (Dual-Role Data) set to 0b

            7. B24 (Unchunked Extended messages Supported) set to 0b or 1b depending on test condition

            8. 23 set to 1b (EPR_Mode Capable)

            9. 22 (Reserved) set to 0b

10.   B21…20 (Peak Current) set to 00b

PDO1:   9. B19…10 (Voltage) set to 5V

10. B9…0 (Maximum Current) set to 3000mA

PDO2:   9. B19…10 (Voltage) set to 9V

10. B9…0 (Maximum Current) set to 3000mA

PDO3:   9. B19…10 (Voltage) set to 15V

10. B9…0 (Maximum Current) set to 3000mA

PDO4:   9. B19…10 (Voltage) set to 20V

10. B9…0 (Maximum Current) set to 5000mA

PDO5:   All fields set to 0

PDO6:   All fields set to 0

PDO7:   All fields set to 0

PDO8:   9. B19…10 (Voltage) set to 28V

10. B9…0 (Maximum Current) set to 5000mA

PDO9: 1. B31…B30 (Augmented) set to 11b

2. B29..B28 (EPR Ajustable Voltage Supply) 01b

3. B27..B26(reserved) set to 28V

4. B25..B17(maximum voltage) set to 28V

5. B16(reserved) set to 0b

6. B15..B8 (minimum voltage) set to 15V

7. B7..B0 (PDP) set to 140

Tester checks below steps only in EPR mode:

ii.   The check fails if the UUT does not respond with a EPR_Request message.
       [COMMON.PROC.PD.14#2]

iii.   The Tester responds with an Accept message to the Request message.

        iv.   If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition.EPRMode.min after the reception of the Accept message.

    c.   The Tester is a Sink only

        i.   The Tester responds with a Reject message.

COMMON.PROC.PD.15 UUT Sent EPR_Request

Procedure Applicability: Unless otherwise specified, the Tester runs this procedure whenever receiving an EPR_Request message from the UUT.

1. The Tester receives an EPR_Request message from the UUT. This message is valid except the following conditions: [COMMON.PROC.PD.15#1]

   a. The check fails if an Implicit Contract is in place and the message was not in response to a Source_Capabilities message from the Tester.

   b. The check fails if the UUT sends this message within a non-interruptible AMS

   c. The check fails if the UUT is a Source or if the UUT is in SPR mode

   d. The check fails if the VIF field *EPR_Supported_As_Snk* is set to No and the test stops here

2. If the Tester is in EPR mode, the Tester responds with an Accept message to the EPR_Request message, otherwise the Tester sends Not_Supported message and the test stops here

3. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition.EPRMode min after the reception of the Accept message.

COMMON.PROC.PD.16 Tester Sent EPR_Mode (Enter)

Procedure Applicability: The Tester runs this procedure wherever COMMON.PROC.PD.16 is referred in the test procedure.

1. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here. [COMMON.PROC.PD.16#1]
2. Tester performs below checks,

a. If the VIF field Captive_Cable is No **[AND]** UUT is not a Vconn source, The Tester checks that UUT sends a Vconn_Swap message and completes the Vconn Swap sequence using COMMON.PROC.PD.17. [COMMON.PROC.PD.16#2]

b. Else, the check fails if the UUT sends a Vconn_Swap message. [COMMON.PROC.PD.16#3]

3. Tester performs below checks,
   a. If the VIF field Captive_Cable is No, the check fails if the UUT does not sends a SOP' Discover Identity message. [COMMON.PROC.PD.16#4]
   b. Else, the check fails if the UUT sends a SOP' Discover Identity message. [COMMON.PROC.PD.16#5]

4. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode (Enter_Succeeded) message. [COMMON.PROC.PD.16#6]

5. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode (Enter_Succeeded) message. [COMMON.PROC.PD.16#7]

6. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13 [COMMON.PROC.PD.16#8]

COMMON.PROC.PD.17 Tester Sent Vconn_swap message

<u>Procedure Applicability:</u> The Tester runs this procedure wherever COMMON.PROC.PD.17 is referred in the test procedure.

1. There are two scenarios:

   a. The Tester is the initial Vconn Source, and the Tester runs the following procedures

      i. The Tester checks the response. [COMMON.PROC.PD.17#1]
         1. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.
         2. The check fails and the test ends here if the UUT responds with a Reject message or Not_Supported (PD3 only), and the VIF field VCONN_Swap_To_On_Supported = Yes
         3. The check fails if the UUT responds with an Accept message and the VIF field VCONN_Swap_To_On_Supported = No
         4. The test ends here if the UUT does not send an Accept message.
      ii. The check fails if the UUT does not respond with PS_RDY message within tVCONNSourceOn max from the last bit of the EOP of the received Accept Message. [COMMON.PROC.PD.17#2]
      iii. The Tester stops sourcing VCONN

b. The UUT is the initial VCONN Source, and the Tester runs the following procedures

    i. The Tester checks the response. [COMMON.PROC.PD.17#3]

        1. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.

        2. The check fails and the test ends here if the UUT responds with a Reject message or Not_Supported (PD3 only), and the VIF field VCONN_Swap_To_Off_Supported = Yes

        3. The check fails if the UUT responds with an Accept message and the VIF field VCONN_Swap_To_Off_Supported = No

        4. The test ends here if the UUT does not send an Accept message.

    ii. The Tester sends a PS_RDY message.

    iii. The Tester checks that the UUT does not present VCONN at the non-CC line within tVCONNSourceOff. [COMMON.PROC.PD.17#4]

3.3.2 PD3 Mode

The common procedures in this subsection are applicable only when the test is running in PD3.

COMMON.PROC.PD3.1 Sink Start an AMS

<u>Procedure Applicability:</u> Unless otherwise specified, the Tester runs this procedure whenever it needs to start an AMS.

1. The Tester as a Sink monitors the Rp value to start an AMS:

    If the UUT presents SinkTxOK, the Sink proceeds to send message (and start an AMS) as described in the test.

4 Physical Layer Specific Tests

This chapter describes tests that primary cover Chapters 6 and 8 requirements in the USB PD specifications.

Receiver Test Signaling Table

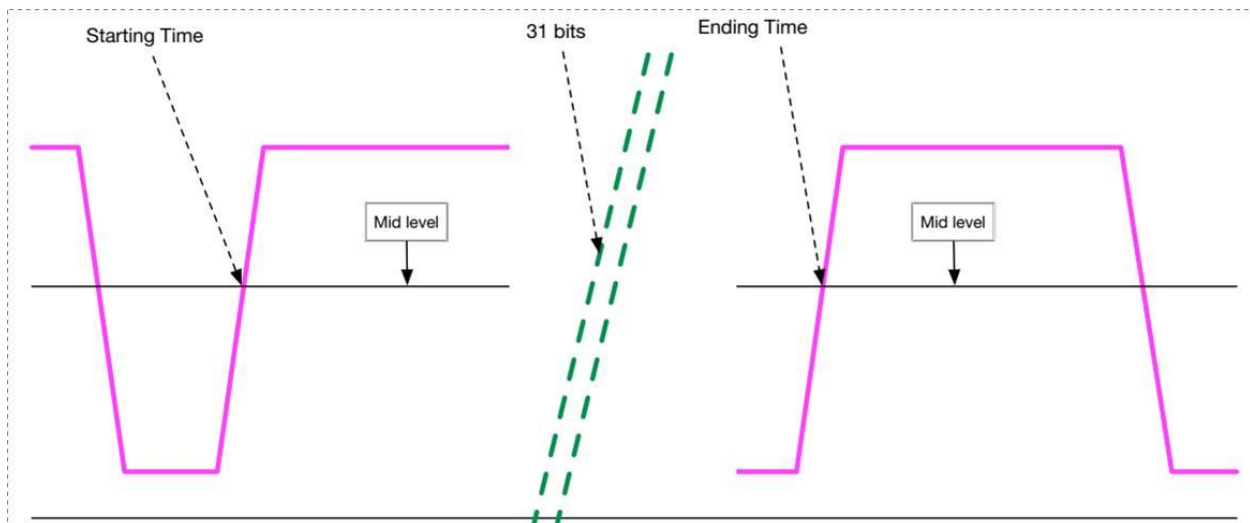|	TX_NORMAL	TX_GROUP_1	TX_GROUP_2	TX_GROUP_3
High Level (nom)	1100 mV	1200 mV	790 mV	1290 mV
Low Level (nom)	25mV	0 mV	-250mV	250mV
Bit Rate	300 kb/s	270 kb/s	330 kb/s	330 kb/s
Rise/Fall Time	735 ns	735 ns	735 ns	735 ns

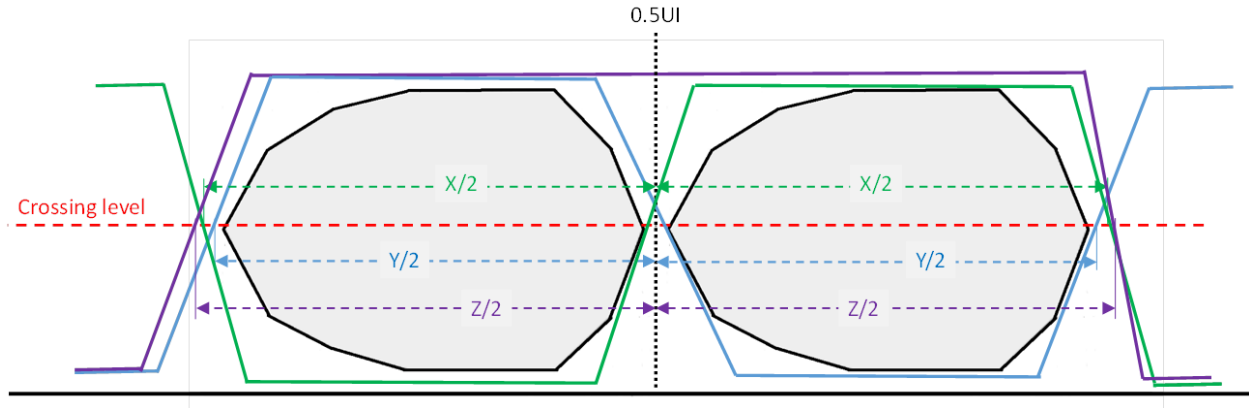*Figure 1: using mid-level to find the reference unit interval*

Figure 2: Example of producing eye diagram
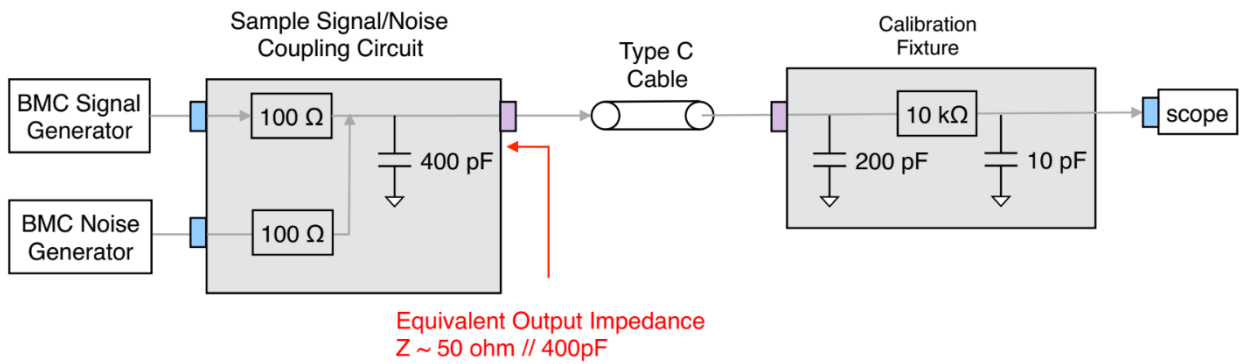
Figure 3: Noise injection generator and calibration fixture setup
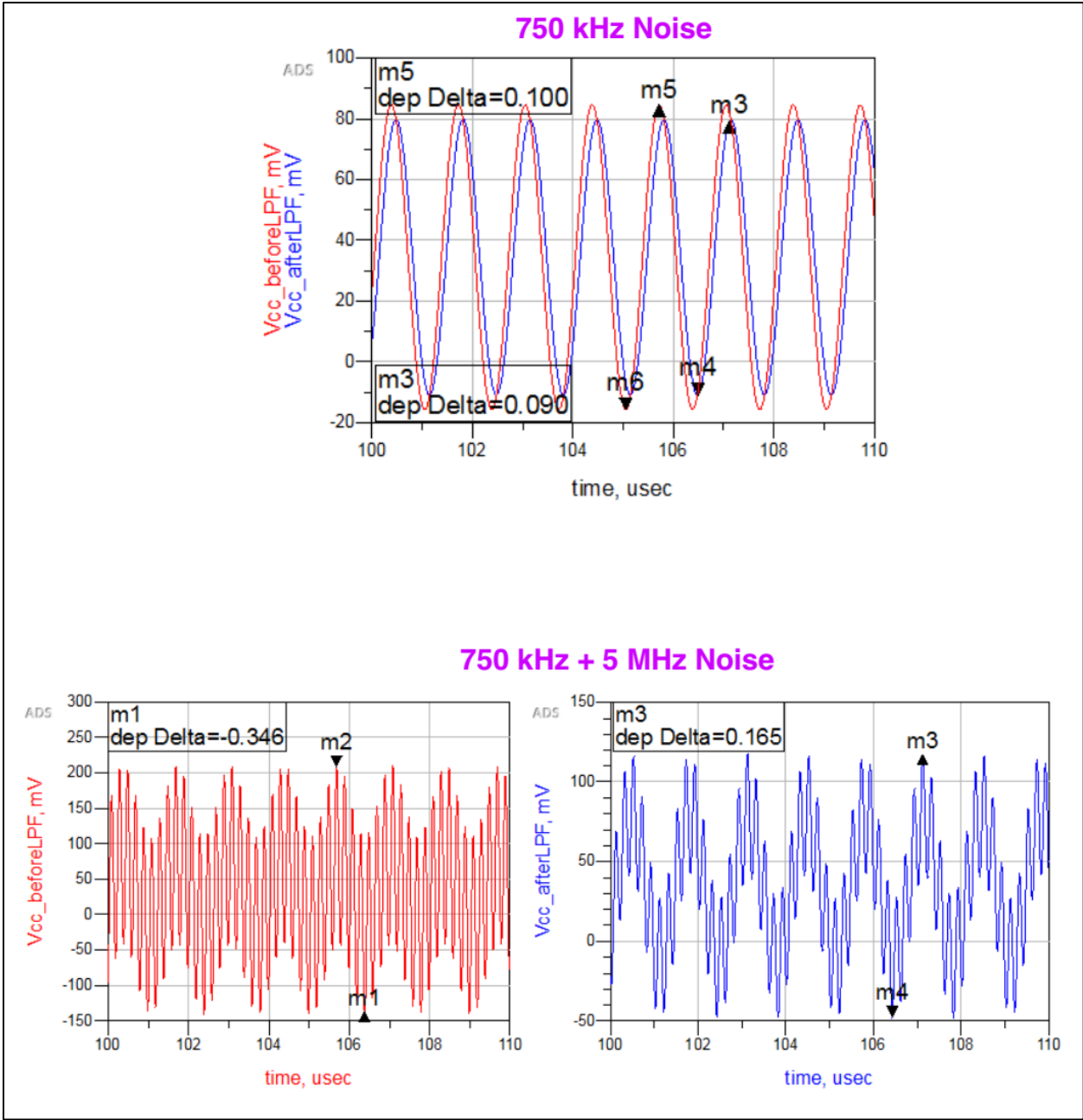
Figure 4: Two-tone noise calibration
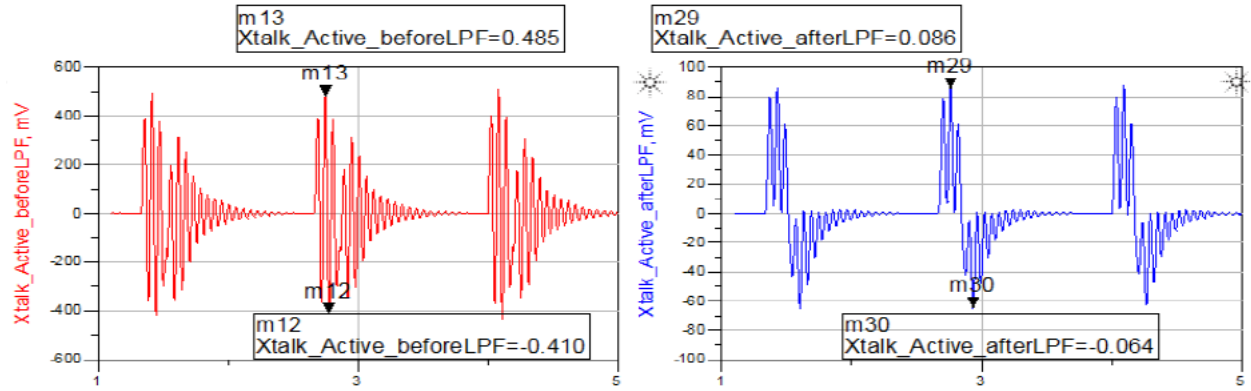
Figure 5: AWG measurement waveforms

4.1 Test Procedures for All UUTs

4.1.1 PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to all UUTs.

- This section uses the following behavior, except where defined in <u>Test Specific Tester Behavior</u> or a <u>Test Procedure</u>:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PHY.ALL.1 Transmit Bit Rate and the Drift

<u>Description:</u> The Tester checks that the UUT transmitted data meets the bit rate requirements and it correctly implements BIST Carrier Mode 2.

<u>Test Specific Tester Behavior:</u> N/A

<u>Test Conditions:</u>

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

<u>Test Procedures:</u>

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a BIST request to the UUT, specifying "BIST Carrier Mode".

3. The Tester creates a histogram with at least 100 bins of the total voltage swing for the bit stream collected from the BIST request. For example, 100 bins, the voltage absolute max is 1.1V and absolute min is 0V; then the top bin is count of voltages between 1.089V and 1.1V; bottom bin is count of voltages between 0V and 0.011V

4. The Tester searches for the bin with highest count between Y5TX (0.5625V) and the maximum; and the middle voltage of the bin is "high level"

5. The Tester searches for the bin with highest count between Y5TX (0.5625V) and the minimum; and the middle voltage of the bin is "low level"

6. The average between "high level" and "low level" is the mid-level

7. The Tester uses the mid-level to find fBitRateRef (refer to *Figure 1*)

   a. Locate the first rising edge of a "0" bit.
   b. Count 32 bits.
   c. Locate the rising edge of a "0" bit, this is the **start** of the measured time.
   d. Count 32 bits
   e. Locate the rising edge of a "0" bit, this is the **end** of the measured time.
   f. The reference bit length fBitRateRef equals 32 divided by the measured time

8. The Tester finds a rising edge of a "0" bit and then it locates a 1024 bits long packet, where the first bit is identified as B0, and the last bit is identified as B1023. The Tester repeats the following 256 times with _num = 0 (the first run starts from B0 through B32, the second runs start from B4 through B36 etc.)

   a. Locate the rising edge of B(_num) (a "0" bit), this is the **start** of the measured time.
   b. Locate the rising edge of B(_num + 32) (a "0" bit), this is the **end** of the measured time.
   c. Calculate fBitRateMeas as 32 divided by the measured time
   d. The Tester checks fBitRateMeas: [TEST.PD.PHY.ALL.1#1]
      i. The check fails if fBitRateMeas is less than or equal to fBitRate min
      ii. The check fails if fBitRateMeas is more than or equal to fBitRate max
   e. Compute pBitRateMeas = (| fBitRateMeas – fBitRateRef |) / fBitRateRef.
   f. The Tester checks that pBitRateMeas is less than 0.25% [TEST.PD.PHY.ALL.1#2]
   g. Set _num = _num + 4

9. The Tester checks that the bit stream collected meets tBISTContMode limits. [TEST.PD.PHY.ALL.1#3]

10. If it is a Cable Plug UUT, repeat the test on the other end of the cable.

TEST.PD.PHY.ALL.2 Transmitter Eye Diagram

Description: The Tester checks that the UUT transmitted data meets the eye diagram mask requirements.

Test Specific Tester Behavior:

If bring-up will result in the UUT being a Sink:

- The Tester shall implement Rp as a 4.7kΩ resistor pull up to 3.3V. The capacitive load of the tester is as close to 400pF as practical.

If bring-up will result in the UUT being a Source:

- The Tester shall implement Rd as a 5.1kΩ resistor to ground. The capacitive load of the tester is as close to 400pF as practical.

If UUT is a Cable:

- The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ) to one cable end. The capacitive load of the tester is as close to 400pF as practical.

Test Conditions: (check email)

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
CabFlippedSrc		✓			
CabFlippedSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMidEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMidEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a BIST request to the UUT, specifying "BIST Carrier Mode". If the UUT is acting as a Sink, do not follow the normal Rp Collision Avoidance but maintain the specified 4.7kΩ resistor pull up to 3.3V

3. The Tester creates a histogram with at least 100 bins of the total voltage swing for the bit stream collected from the BIST request. For example, 100 bins, the voltage absolute max is 1.1V and absolute min is 0V; then the top bin is count of voltages between 1.089V and 1.1V; bottom bin is count of voltages between 0V and 0.011V

4. The Tester searches for the bin with highest count between Y5TX (0.5625V) and the maximum; and the middle voltage of the bin is "high level"

5. The Tester searches for the bin with highest count between Y5TX (0.5625V) and the minimum; and the middle voltage of the bin is "low level"

6. The average between "high level" and "low level" is the mid-level

7. Use the mid-level to find 1 UI (refer to *Figure 1*)
    a. Locate the rising edge of a "0" bit. This is the start of the measured time.
    b. Count 32 bits.
    c. Locate the rising edge of a "0" bit. This is the end of the measured time.
    d. The reference bit length 1 UI equals the measured time divided by 32

8. The Tester uses the mid-level as the initial crossing level of the Eye Diagram, refer to *Figure 2*.

9. The Tester produces an Eye Diagram and checks that the parameters meet the requirements of Figures 5-22 and 5-23 of the USB PD2.0 specification.
    a. The Eye Diagram shall use 2640 bits placed on the TX-Mask.
    b. 1UI and crossing level is used for plotting the Eye Diagram. For each bit, the first and last crossings are separated equally from 0.5UI. Refer to *Figure 2*.
    c. The Eye Diagram check fails if the signals violate the TX-Mask.

10. If the Eye Diagram check fails in the previous step, the crossing level is shifted as follows and the Eye Diagram check is repeated for each sub-step below. For example, a given bit may shift left or right when the crossing level is adjusted.
    a. Add 10mv to the initial crossing level to the mid-level, run Step-9
    b. Subtract 10mv from the initial crossing level, run Step-9
    c. Add 20mv to the initial crossing level, run Step-9
    d. Subtract 20mv from the initial crossing level, run Step-9

e. Add 30mv to the initial crossing level, run Step-9

f. Subtract 30mv from the initial crossing level, run Step-9

g. Add 40mv to the initial crossing level, run Step-9

h. Subtract 40mv from the initial crossing level, run Step-9

i. Add 50mv to the initial crossing level, run Step-9

j. Subtract 50mv from the initial crossing level, run Step-9

11. The check fails if the Eye Diagram check fails in Steps 9 and for all the crossing levels in 10. [TEST.PD.PHY.ALL.2#1]

12. The check fails if the rise time and fall time check fails. [TEST.PD.PHY.ALL.2#2]

a. A "10%-Level" is defined as "low level" + ("high level" - "low level") *10/100

b. A "90%-Level" is defined as "low level" + ("high level" - "low level") *90/100

c. For each rising edge of the 2640 bits, find the rise-time as the time from crossing the "10%-Level" until crossing the "90%-Level". The final measured rise time is the average of these measurements. Check that this is not less than tRise.

d. For each falling edge of the 2640 bits, find the fall time as the time from crossing the "90%-Level" until crossing the "10%-Level". The final measured fall time is the average of these measurements. Check that this is not less than tFall.

13. If the connected UUT is a port without a captive cable, repeat the test on the other CC connection by flipping the test cable plug at the UUT end.

TEST.PD.PHY.ALL.3 Collision Avoidance

Description: The Tester checks that the UUT properly implements collision avoidance requirements.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3eVcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
3. The Tester waits 15ms.
4. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
5. Exactly 17us after the end of the previous packet, the Tester transmits a bit stream sequence (alternating 0s and 1s simulating a preamble) for a duration of 200 us. *Editorial note: it takes 2 UI (3.7us tUnitInterval max) to generate 3 transitions (nTransitionCount). So that is 25us (tInterFrameGap) minus 7.4us.*
6. The Tester waits for 10ms and the check fails if the UUT sends a GoodCRC. The check also fails if the Tester detects the tail end of the GoodCRC message immediate after it has stopped transmitting in the previous step. [TEST.PD.PHY.ALL.3#1]
7. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
8. Immediately after the end of the previous packet, the Tester transmit a continuous stream of 0s for a duration of 195us.
9. The Tester waits for 10ms and the check fails if the UUT sends a GoodCRC. The check also fails if the Tester detects the tail end of the GoodCRC message immediate after it has stopped transmitting in the previous step. [TEST.PD.PHY.ALL.3#2]
10. If it is a Cable Plug UUT, repeat the test on the other end of the cable.

TEST.PD.PHY.ALL.4 Bus Idle Detection

Description: The Tester checks that the expected levels of noise on the CC line do not prevent the UUT from detecting a bus idle condition.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable

Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
3. The Tester waits 15ms.
4. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
5. Immediately after the end of the previous packet, the Tester either transmits simulated noise waveforms using an Arbitrary Waveform Generator (AWG) or transmits the two-tone noise waveforms for 438us.
6. The check fails if the UUT does not respond with a GoodCRC within tReceive. [TEST.PD.PHY.ALL.4#1]
7. If it is a Cable Plug UUT, repeat the test on the other end of the cable.

The two-tone sinusoidal noise waveform is generated as followed:

1. The noise calibration setup is as shown in *Figure 3*:
   a. The equivalent impedance of the Tester BMC transmitter and the noise generator is 50 Ohm +/- 10% and 400pF +/-15%
   b. The calibration fixture consists of a bandwidth limiting filter as shown in *Figure 3*. The probe capacitance loading effect shall be considered.

2. The noise generator provides a superimposed two-tone sinusoidal waveform. One at 750 ± 50 kHz and another at 5 ± 0.5 MHz.
3. The noise magnitude is calibrated using a scope connected to the calibration fixture (refer to *Figure 4*):
   a. First, inject 750 kHz sinusoidal waveform and adjust the magnitude until the scope (attached to the calibration fixture) measures 90mV peak-to-peak.
   b. Next, superimpose 5 MHz sinusoidal waveform on the 750 kHz waveform, adjust the magnitude of the 5 MHz sinusoidal waveform until the scope measures 300mV peak-to-peak.

The Arbitrary Waveform Generator (AWG) waveform is generated as followed:

1. The noise calibration setup is as shown in *Figure 3*:
   a. The equivalent impedance of the Tester BMC transmitter and the noise generator is 50 Ohm +/- 10% and 400pF +/-15%
   b. The calibration fixture consists of a bandwidth limiting filter as shown in *Figure 3*. The probe capacitance loading effect shall be considered.
2. Program the AWG to output the simulated noise using the generated waveform file. This should be summed with the CC signal during the transmission of a BIST Tester Data message.
3. In *Figure 5*, the left-hand waveform m13 is both the content of the AWG-waveform data file, and exactly what should appear on the CC line of the test cable. The waveform data file is not what should be applied to the noise insertion point in *Figure 3*. This point requires a pre-emphasized version of the waveform data file, which compensates for the filtering effect of the noise insertion circuit comprising the two 100Ω resistors, the 400pF and 200pF capacitors and the nominal capacitance of the cable type used by the test equipment.

TEST.PD.PHY.ALL.5 Receiver Interference Rejection

Description: The Tester checks that the UUT correctly receives signals under boundary conditions.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
3. The Tester waits 15ms.
4. Using TX_GROUP_1 parameters in the **Receiver Test Signaling Table**, the Tester sends "BIST Test Data" message (without incrementing MessageID) for 13362 times. The noise generator transmits two-tone noise or AWG waveforms when the Tester sends the BIST Tester Data message, and the two-tone noise or AWG waveforms are not transmitted when the Tester stops sending BIST Tester Data message. The check fails if UUT does not respond with a GoodCRC for each of the "BIST Test Data" message. [TEST.PD.PHY.ALL.5#1]
5. The Tester runs the following procedures depending on the power role:
   a. If it is a Sink UUT, using TX_GROUP_2 parameters in the **Receiver Test Signaling Table**, the Tester sends "BIST Test Data" message (without incrementing MessageID) for 13362

times. The check fails if UUT does not respond with a GoodCRC for each of the "BIST Test Data" message. [TEST.PD.PHY.ALL.5#2]

    b. If it is a Source UUT, using TX_GROUP_3 parameters in the **Receiver Test Signaling Table**, the Tester sends "BIST Test Data" message (without incrementing MessageID) for 13362 times. The check fails if UUT does not respond with a GoodCRC for each of the "BIST Test Data" message. [TEST.PD.PHY.ALL.5#3]

    c. If it is a Cable Plug UUT, the Tester performs the following checks [TEST.PD.PHY.ALL.5#4]:

        i. Using TX_GROUP_2 parameters in the **Receiver Test Signaling Table**, the Tester sends "BIST Test Data" message (without incrementing MessageID) for 13362 times. The check fails if UUT does not respond with a GoodCRC for each of the "BIST Test Data" message.

        ii. Using TX_GROUP_3 parameters in the **Receiver Test Signaling Table**, the Tester sends "BIST Test Data" message (without incrementing MessageID) for 13362 times. The check fails if UUT does not respond with a GoodCRC for each of the "BIST Test Data" message.

8. If UUT is a Dual-Role Power device (and it has been running this test first time as a Sink), repeat the test with the UUT as a Source. If it is a Cable Plug UUT, repeat the test on the other end of the cable.

The two-tone sinusoidal noise waveform is generated as followed:

1. The noise calibration setup is as shown in *Figure 3*:
    a. The equivalent impedance of the Tester BMC transmitter and the noise generator is 50 Ohm +/- 10% and 400pF +/-15%
    b. The calibration fixture consists of a bandwidth limiting filter as shown in *Figure 3*. The probe capacitance loading effect shall be considered.
2. The noise generator provides a superimposed two-tone sinusoidal waveform. One at 750 ± 50 kHz and another at 5 ± 0.5 MHz.
3. The noise magnitude is calibrated using a scope connected to the calibration fixture (refer to *Figure 4*):
    a. First, inject 750 kHz sinusoidal waveform and adjust the magnitude until the scope (attached to the calibration fixture) measures 90mV peak-to-peak. The offset is at 0V.
    b. Next, superimpose 5 MHz sinusoidal waveform on the 750 kHz waveform, adjust the magnitude of the 5 MHz sinusoidal waveform until the scope measures 165mV peak-to-peak. The offset is at 0V.

The Arbitrary Waveform Generator (AWG) waveform is generated as followed:

1. The noise calibration setup is as shown in *Figure 3*:
    a. The equivalent impedance of the Tester BMC transmitter and the noise generator is 50 Ohm +/- 10% and 400pF +/-15%
    b. The calibration fixture consists of a bandwidth limiting filter as shown in *Figure 3*. The probe capacitance loading effect shall be considered.
2. Program the AWG to output the simulated noise using the generated waveform file. This should be summed with the CC signal during the transmission of a BIST Tester Data message.

3. In *Figure 5*, the left-hand waveform m13 is both the content of the AWG-waveform data file, and exactly what should appear on the CC line of the test cable. The waveform data file is not what should be applied to the noise insertion point in *Figure 3*. This point requires a pre-emphasized version of the waveform data file, which compensates for the filtering effect of the noise insertion circuit comprising the two 100Ω resistors, the 400pF and 200pF capacitors and the nominal capacitance of the cable type used by the test equipment.

TEST.PD.PHY.ALL.6 Invalid SOP*

Description: The Tester checks that the UUT responds correctly to invalid SOP*.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
3. The Tester waits 15ms to respond to messages from the UUT.
4. Transmit a BIST message with BIST Test Data object using SOP packet
5. Transmit 10 BIST Test Data messages flipping Bit 0 of the first two symbols (number 1&2) of the SOP. The check fails if the UUT responds with a GoodCRC. [TEST.PD.PHY.ALL.6#1]
6. Repeat Step-5 with all combinations of flipping Bit 0 of two symbols of the SOP (number 1&3, 1&4, 2&3, 2&4, 3&4).
7. Additionally, for Cable Plug, repeat the test using SOP' packet (if SOP_P_Capable = Yes) and SOP'' packet (if SOP_PP_Capable = Yes).

TEST.PD.PHY.ALL.7 Valid SOP*

Description: The Tester checks that the UUT responds correctly to valid SOP*.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends 10 BIST Test Data messages using SOP packet.
   a. If SOP_Capable = NO, the check fails if the UUT respond with a GoodCRC [TEST.PD.PHY.ALL.7#1]
   b. If SOP_Capable = YES, the check fails if the UUT does not respond with a GoodRCR. [TEST.PD.PHY.ALL.7#2]

3. The Tester sends 10 BIST Test Data messages using SOP'.
   a. If SOP_P_Capable = NO, the check fails if the UUT responds with a GoodCRC. [TEST.PD.PHY.ALL.7#3]
   b. The check fails if
      i. VIF_Product_Type = Port **and**
      ii. PD_Port_Type != eMarker **and**
      iii. (UUT is not the Vconn Source or UUT is not actively sourcing Vconn)

      and UUT does not respond with a GoodCRC. [TEST.PD.PHY.ALL.7#9]

   c. The check fails if
      i. VIF_Product_Type = Cable or
      ii. PD_Port_Type = eMarker or
      iii. Captive_Cable_Is_eMarked = YES

   the UUT does not respond with a GoodCRC [TEST.PD.PHY.ALL.7#4]

4. The Tester sends 10 BIST Test Data messages using SOP''.
   a. If SOP_PP_Capable = NO, the check fails if the UUT responds with a GoodCRC. [TEST.PD.PHY.ALL.7#5]
   b. The check fails if
      i. VIF_Product_Type = Port **and**
      ii. PD_Port_Tyoe != eMarker **and**
      iii. Captive_Cable_Is_eMarked = NO **and**
      iv. (UUT is not the Vconn Source or UUT is not actively sourcing Vconn)

   and UUT responds with a GoodCRC. [TEST.PD.PHY.ALL.7#9]

   c. The check fails if
      i. (VIF_Product_Type = Cable or Captive_Cable_Is_eMarked = YES) and
      ii. SOP_PP_Capable = YES

      and the UUT does not respond with a GoodCRC. [TEST.PD.PHY.ALL.7#6]

5. The Tester sends 10 BIST Test Data messages using SOP'_Debug.
   a. The check fails if SOP_P_Debug_Capable = NO and the UUT responds with a GoodCRC [TEST.PD.PHY.ALL.7#7]

6. The Tester sends 10 BIST Test Data messages using SOP''_Debug.

a. The check fails if SOP_PP_Debug_Capable = NO and the UUT responds with a GoodCRC [TEST.PD.PHY.ALL.7#8]

TEST.PD.PHY.ALL.8 Incorrect CRC

Description: The Tester checks that the UUT does not provides a GoodCRC to an intentionally corrupted message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a message depending on the UUT type/role (note that this test is first run sending uncorrupted message followed by corrupted messages):
    a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
    b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
3. The Tester checks the response message depending on the UUT type/role:
    a. The UUT is a Cable Plug: [TEST.PD.PHY.ALL.8#1]
        i. If the Tester has sent an uncorrupted message, the check fails if the UUT does not send a Discover Identity ACK message.
        ii. If the Tester has sent a corrupted message, the check fails if the UUT responds with a GoodCRC or a Discover Identity ACK message.
    b. The UUT is a Sink: [TEST.PD.PHY.ALL.8#2]
        i. If the Tester has sent an uncorrupted message, the check fails if the UUT does not send a Sink Capabilities message.
        ii. If the Tester has sent a corrupted message, the check fails if the UUT responds with a GoodCRC or a Sink Capabilities message.
    c. The UUT is a Source: [TEST.PD.PHY.ALL.8#3]
        i. If the Tester has sent an uncorrupted message, the check fails if the UUT does not send Sink Capabilities, Not Supported or Reject message.
        ii. If the Tester has sent a corrupted message, the check fails if the UUT responds with a GoodCRC or Sink Capabilities, Not Supported or Reject message.
4. The Tester repeats Step-2 and Step-3 but implements modifications to the messages in Step-2 as followed:
    a. Flip Bit 0 in the CRC before 4b5b encoding
    b. Flip Bit 0 in the CRC after 4b5b encoding
    c. After generating the CRC, flip Bit 0 of the packet payload before 4b5b encoding
    d. After generating the CRC and the 4b5b encoding, flip Bit 0 of the packet payload
    e. After the 4b5b encoding, replace the third 5b symbol of the Message Header with 11111b (a reserved 5b symbol).

TEST.PD.PHY.ALL.9 Receiver Input Impedance

Description: The Tester checks that the UUT receiver input impedance is not excessively low. It also checks that UUT does not modify voltage levels in any received message waveform.
It is not practical to directly measure the input impedance of the receiver in the UUT (required to be >= 1 MΩ), as it is masked by the Rp / Rd resistors. Instead, we will assume the presence of these resistors and measure that the resulting resistance falls within a valid range.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓			

Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

9. There are 4 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   d. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   e. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   f. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
10. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".
11. Depending on the UUT
    a. For Sink: Check that the voltage on the CC line falls within the expected range, knowing the values of the Rp and Rd resistors [TEST.PD.PHY.ALL.9#1]
    b. For Source: Check that the voltage on the CC line falls within one of the two expected ranges, knowing the possible values of the Rp and Rd resistors [TEST.PD.PHY.ALL.9#2]
    c. For Cable Plug: Check that the voltage on the CC line falls within the expected range, knowing the value of these resistors [TEST.PD.PHY.ALL.9#3]
12. Reset UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
13. Depending on the UUT
    a. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer/Provider or DRP. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Provider Only or Provider/Consumer. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

    c. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

14. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".

15. Check that signal voltages on the CC line of -300mV and 1500mV are not modified at the receiver input by more than the tester tolerances may produce. The actual test method is left to the discretion of the implementer. [TEST.PD.PHY.ALL.9#4]

    Except for cable plug, end test here.

16. For Cable Plug only:

    The Tester applies Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V), but not VCONN or VBUS to one cable end.

17. Check that signal voltages on the CC line of -300mV and 1500mV are not modified at the receiver input by more than the tester tolerances may produce. The actual test method is left to the discretion of the implementer. [TEST.PD.PHY.ALL.9#5]

18. Repeat last two steps at other end of Cable.

4.2 Test Procedures for Source and Sink Capable UUTs

4.2.1 PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field VIF_Product_Type set to Port.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PHY.PORT.1 Invalid Reset Signals

Description: The Tester checks that the UUT responds correctly to invalid reset signals. Also, the Tester checks that the UUT ignores messages upon reception of a BIST Test Data BIST data Object.

Test Specific Tester Behavior: N/A

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).

c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

2. The Tester sends a BIST request to the UUT, specifying "BIST Test Data".

3. The Tester waits 15ms to respond to messages from the UUT.

4. The Tester sends a Cable Reset signal.

5. The Tester waits 1.5 second, and the check fails if the UUT sends any message or removes VBUS. [TEST.PD.PHY.PORT.1#1]

6. The Tester transmits Hard Reset flipping Bit 0 of the first two symbols (number 1&2).

7. The Tester waits 1.5 second and checks that the UUT does not send any message or removing VBUS.

8. The Tester sends a Get_Sink_Cap message to the UUT.

9. The Tester waits for tSenderResponse and the check fails if the UUT sends a response to Get_Sink_Cap message. [TEST.PD.PHY.PORT.1#2]

10. The Tester repeats Step-6 through Step-9 and uses all combinations of flipping Bit 0 of two symbols (number 1&3, 1&4, 2&3, 2&4, 3&4) in Step-6.

5 Protocol Specific Tests

This chapter describes tests that primary cover Chapters 6 and 8 requirements in the USB PD2 specifications.

5.1 Test Procedures for All UUTs

5.1.1 PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to all UUTs.

- This section uses the following behavior, except where defined in <u>Test Specific Tester Behavior</u> or a <u>Test Procedure</u>: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.ALL.1 Corrupted GoodCRC

<u>Description:</u> The Tester checks that the UUT retransmits the PD message if it does not receive a correct GoodCRC.

<u>Test Specific Tester Behavior:</u> N/A

<u>*Test Conditions:*</u>

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2Src		✓	✓		
Rev3ChkdSrc		✓	✓		
Rev2Snk	✓		✓		
Rev3ChkdSnk	✓		✓		
Rev2VcMinEnd1				✓	✓
Rev3VcMinEnd1				✓	✓
Rev2VcMaxEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev2VcMinEnd2				✓	
Rev3VcMinEnd2				✓	
Rev2VcMaxEnd2				✓	
Rev3VcMaxEnd2				✓	

<u>Test Procedures:</u>

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a message depending on the UUT type/role (first time):
   a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
   b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
3. The Tester checks the response message depending on the UUT type/role:
   a. If the UUT is a Cable Plug, the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.1#1]
   b. If the UUT is a Sink, the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.1#2]
   c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.1#3]

   i. If the VIF field PD_Port_Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.

   ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Reject message.

   iii. In PD3 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Not_Supported message.

4. The Tester sends a GoodCRC with an incorrect CRC (flip bit 0 of the CRC before 4b5b encoding).
5. The Tester checks the behavior:
   a. For Cable Plug UUT, the check fails if the UUT retransmits [TEST.PD.PROT.ALL.1#4]
   b. For Sink or Source UUT, the check fails if the UUT does not retransmit (Sink Capabilities, Not Supported or Reject message) with the same MessageID (within tRetry of the CRCReceiveTimer expiring), and the Tester responds with a valid GoodCRC. [TEST.PD.PROT.ALL.1#5]
6. The Tester sends a message depending on the UUT type/role (second time):
   a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
   b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
7. The Tester checks the response message depending on the UUT type/role:
   a. If the UUT is a Cable Plug, the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.1#6]
   b. If the UUT is a Sink, the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.1#7]
   c. If the UUT is a Source, the check fails if the UUT does not send Sink Capabilities, Not Supported or Reject message. [TEST.PD.PROT.ALL.1#8]
8. The Tester sends a GoodCRC with an incorrect MessageID (increment by one from the received message).
9. The Tester checks the behavior:
   a. For Cable Plug UUT, the check fails if the UUT retransmits [TEST.PD.PROT.ALL.1#9]
   b. For Sink or Source UUT, the check fails if the UUT does not retransmit (Sink Capabilities, Not Supported or Reject message) with the same MessageID (within tRetry of the CRCReceiveTimer expiring). [TEST.PD.PROT.ALL.1#10]
10. For Cable Plug UUT, the test ends here. For Sink or Source UUT, the Tester repeats the previous 2 steps until the UUT has retransmitted the same MessageID for nRetryCount times.

TEST.PD.PROT.ALL.2 Soft Reset and Hard Reset

Description: The Tester checks that the UUT uses Soft Reset and Hard Reset correctly.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2Src		✓	✓		

Rev3ChkdSrc			✓	✓		
Rev2Snk	✓			✓		
Rev3ChkdSnk	✓			✓		
Rev2VcMinEnd1					✓	✓
Rev3VcMinEnd1					✓	✓
Rev2VcMaxEnd1					✓	✓
Rev3VcMaxEnd1					✓	✓
Rev2VcMinEnd2					✓	
Rev3VcMinEnd2					✓	
Rev2VcMaxEnd2					✓	
Rev3VcMaxEnd2					✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter `SOP_P_Capable is set to YES*`. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a message depending on the UUT type/role (first time):
   a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
   b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.

3. The Tester checks the response message depending on the UUT type/role:
   a. If the UUT is a Cable Plug, the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.2#1]
   b. If the UUT is a Sink, the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.2#2]
   c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.2#3]
      i. If the VIF field PD_Port_Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.
      ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Reject message.
      iii. In PD3 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Not_Supported message.

4. The Tester does not send a GoodCRC.

5. The Tester checks the response message depending on the UUT type/role:
   a. For Cable Plug UUT, the check fails if the UUT retransmits [TEST.PD.PROT.ALL.2#4]
   b. For Sink or Source UUT, the check fails if the UUT does not retransmit (Sink Capabilities, Not Supported or Reject message) with the same MessageID (within tRetry of the CRCReceiveTimer expiring) for nRetryCount times. [TEST.PD.PROT.ALL.2#5]

6. The Tester checks the behavior depending on the UUT type/role:
   a. If the UUT is a Cable Plug, the Tester waits 35ms and the check fails if the UUT sends a Soft_Reset message or a Hard Reset signal. [TEST.PD.PROT.ALL.2#6]
   b. If the UUT is a Sink
      i. The check fails if the UUT does not transmit a Soft_Reset message. [TEST.PD.PROT.ALL.2#7] The Tester responds with a valid GoodCRC.
      ii. The Tester sends an Accept message.
      iii. The Tester transmits Source Capabilities message with single PDO (5V @ 100mA, Source only). The check fails if the UUT does not send a Request message. [TEST.PD.PROT.ALL.2#8] The Tester establishes a PD contract using common procedure COMMON.PROC.PD.10.
   c. If the UUT is a Source
      i. The check fails if the UUT does not transmit a Soft_Reset message. [TEST.PD.PROT.ALL.2#9] The Tester responds with a valid GoodCRC.
      ii. The Tester sends an Accept message.
      iii. The check fails if the UUT does not send a Source Capabilities message. [TEST.PD.PROT.ALL.2#10] The Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

7. The Tester sends a message depending on the UUT type/role (second time):
    a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
    b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
8. The Tester checks the behavior depending on the UUT type/role:
    a. For Cable Plug UUT: the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.2#11]
    b. For Sink UUT: the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.2#12]
    c. For Source UUT: the check fails if the UUT does not send Sink Capabilities, Not Supported or Reject message. [TEST.PD.PROT.ALL.2#13]
9. The Tester does not send a GoodCRC.
10. The Tester checks the response message depending on the UUT type/role:
    a. For Cable Plug UUT, the check fails if the UUT retransmits [TEST.PD.PROT.ALL.2#14]
    b. For Sink or Source UUT, the check fails if the UUT does not retransmit (Sink Capabilities, Not Supported or Reject message) with the same MessageID (within tRetry of the CRCReceiveTimer expiring) for nRetryCount times. [TEST.PD.PROT.ALL.2#15]
11. The Tester checks the behavior depending on the UUT type/role:
    a. If the UUT is a Cable Plug, check that the UUT does not send a Soft_Reset message or a Hard Reset signal [TEST.PD.PROT.ALL.2#16]
    b. If the UUT is a Sink or Source
        i. The check fails if the UUT does not transmit a Soft_Reset message [TEST.PD.PROT.ALL.2#17]
        ii. The Tester does not send a GoodCRC to the Soft_Reset message.
        iii. The check fails if the UUT does not retransmit (Soft_Reset message) with the same MessageID (within tRetry of the CRCReceiveTimer expiring) for nRetryCount times [TEST.PD.PROT.ALL.2#18].
        iv. The check fails if the UUT does not transmit a Hard Reset [TEST.PD.PROT.ALL.2#19].

TEST.PD.PROT.ALL.3 Soft Reset Response

Description: The Tester checks that the UUT responds correctly to Soft Reset message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2Src		✓	✓		
Rev3ChkdSrc		✓	✓		
Rev2Snk	✓		✓		
Rev3ChkdSnk	✓		✓		
Rev2VcMinEnd1				✓	✓

Rev3VcMinEnd1				✓	✓
Rev2VcMaxEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev2VcMinEnd2				✓	
Rev3VcMinEnd2				✓	
Rev2VcMaxEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a message depending on the UUT type/role (using an incremented MessageID):
    a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
    b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
3. The Tester checks the response message (with an incremented MessageID) based on the UUT type/role:
    a. If the UUT is a Cable Plug, the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.3#1]
    b. If the UUT is a Sink, the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.3#2]
    c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.3#3]
        i. If the VIF field PD_Port_Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.
        ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Reject message.
    d. In PD3 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Not_Supported message.
4. If MessageID in the last sent message is not 000b, the Tester repeats the previous 2 steps (i.e. sending Discover Identity REQ or Get_Sink_cap and receiving response) until the MessageID in the last sent message is 000b.
5. Immediately after sending GoodCRC (to the Discover ID ACK, Sink Capabilities or Reject), the Tester sends a Soft Reset message after tInterframeGap. The check fails if the UUT does not send an Accept message with MessageID 000b. [TEST.PD.PROT.ALL.3#4]
6. The Tester checks the response message depending on the UUT type/role:
    a. For Sink UUT, the Tester transmits Source Capabilities message with single PDO (5V @ 100mA, Source only). The check fails if the UUT does not send a Request message. [TEST.PD.PROT.ALL.3#5] The Tester establishes a PD using common procedure COMMON.PROC.PD.10.
    b. For Source UUT, the check fails if the UUT does not send a Source Capabilities. [TEST.PD.PROT.ALL.3#6] Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.
7. The Tester sends a message depending on the UUT type/role:
    a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
    b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.
8. The Tester checks the response message depending on the UUT type/role:
    a. For Cable Plug UUT: the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.3#7]
    b. For Sink UUT: the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.3#8]
    c. For Source UUT: the check fails if the UUT does not send Sink Capabilities, Not Supported or Reject message. [TEST.PD.PROT.ALL.3#9]

TEST.PD.PROT.ALL.4 Reset Signals and MessageID

Description: The Tester checks that the UUT responds correctly to Hard Reset and Cable Reset signals.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2Src		✓	✓		
Rev3ChkdSrc		✓	✓		
Rev2Snk	✓		✓		
Rev3ChkdSnk	✓		✓		
Rev2VcMinEnd1				✓	✓
Rev3VcMinEnd1				✓	✓
Rev2VcMaxEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev2VcMinEnd2				✓	
Rev3VcMinEnd2				✓	
Rev2VcMaxEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink

only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

  f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

  g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

  h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

  i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a message depending on the UUT type/role (using an incremented MessageID):

  a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.

  b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.

3. The Tester checks the response message (with an incremented MessageID) based on the UUT type/role:

  a. If the UUT is a Cable Plug, check that the UUT sends a Discover Identity ACK message. [TEST.PD.PROT.ALL.4#1]

  b. If the UUT is a Sink, check that the UUT sends a Sink Capabilities message. [TEST.PD.PROT.ALL.4#2]

  c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.4#3]

      i. If the VIF field PD_Port_Type is set to Provider/Consumer or DRP, check that the UUT sends a Sink Capabilities message.

      ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Reject message.

      iii. In PD3 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Not_Supported message.

4. If MessageID in the last sent message is not 000b, the Tester repeats the previous 2 steps (i.e. sending Discover Identity REQ or Get_Sink_cap and receiving response) until the MessageID in the last sent message is 000b.

5. Immediately after sending GoodCRC (to the Discover ID ACK, Sink Capabilities or Reject), the Tester sends a Hard-Reset signal after tInterframeGap (note that the second run through is a Cable Reset signal for a Cable Plug UUT).

6. The test proceeds depending on the UUT type/role:

  a. If the UUT is a Sink, the Tester drives VBUS to vSafe0V and then restores VBUS to vSafe5V. The Tester transmits Source Capabilities messages with single PDO (5V @ 100mA, Source only) immediately after VBus reaches vSafe0V min. The Tester checks

that the UUT sends a Request message. [TEST.PD.PROT.ALL.4#4] Once it receives a Request message, it proceeds using common procedure COMMON.PROC.PD.10.

b. If the UUT is a Source:
  i. The Tester checks that the UUT drives VBUS to vSafe0V and then restores VBUS to vSafe5V. [TEST.PD.PROT.ALL.4#5]
  ii. The check fails if Source Capabilities is not sent by the UUT within tFirstSourceCap. [TEST.PD.PROT.ALL.4#6] Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

c. If the UUT is a Cable Plug, the Tester checks the response depending on the **run number**. [TEST.PD.PROT.ALL.4#7]
  i. If the Tester has sent a Hard Reset (**first run**), the Tester drives VBUS to vSafe0V and then restores VBUS to vSafe5V. The Tester run VCONN power cycles process. The Tester transmits Discover Identity REQ every tDiscoverIdentity until either it receives a GoodCRC followed by a Discover Identity ACK or it has transmitted Discover Identity REQ 3 times. The check fails when the Tester has transmitted Discover Identity REQ for 3 times.
  ii. If the Tester has sent a Cable Reset (**second run**), the Tester transmits Discover Identity REQ every tDiscoverIdentity. The check fails if the UUT does not sends a GoodCRC followed by a Discover Identity ACK.

7. The Tester sends a message depending on the UUT type/role (using an incremented MessageID):
  a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.
  b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.

8. The Tester checks the response message (with an incremented MessageID) based on the UUT type/role:
  a. If the UUT is a Cable Plug, check that the UUT sends a Discover Identity ACK message. [TEST.PD.PROT.ALL.4#8]
  b. If the UUT is a Sink, check that the UUT sends a Sink Capabilities message. [TEST.PD.PROT.ALL.4#9]
  c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.4#10]
    i. If the VIF field PD_Port_Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.
    ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Reject message.
    iii. In PD3 mode, if the VIF field PD_Port_Type is set to Provider Only, check that the UUT sends a Not_Supported message.

9. The Tester repeats Step-7 with the same MessageID.

10. The check fails if the UUT has sent a response message (either Discover Identity ACK, NAK or BUSY, or Sink Capabilities or Reject) when the MessageID has been repeated. [TEST.PD.PROT.ALL.4#11]

11. The Tester sends a message depending on the UUT type/role (using an incremented MessageID):

a. If the UUT is a Cable Plug, the Tester sends a Discover Identity Request message.

b. If the UUT is a Source or Sink, the Tester sends a Get_Sink_Cap message.

12. The Tester checks the response message (with an incremented MessageID) based on the UUT type/role:

a. For Cable Plug UUT: the check fails if the UUT does not send a Discover Identity ACK message. [TEST.PD.PROT.ALL.4#12]

b. For Sink UUT: the check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.PROT.ALL.4#13]

c. If the UUT is a Source, the Tester checks the response as follows: [TEST.PD.PROT.ALL.4#14]

    i. If the VIF field PD_Port_Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.

    ii. In PD2 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Reject message.

    iii. In PD3 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Not_Supported message.

13. If the UUT is a Cable Plug, the Tester repeats the test using Cable Reset (in lieu of Hard Reset).

TEST.PD.PROT.ALL.5 Unrecognized Message

Description: The Tester checks that the UUT responds correctly to unrecognized message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2Src		✓	✓		
Rev3ChkdSrc		✓	✓		
Rev2Snk	✓		✓		
Rev3ChkdSnk	✓		✓		
Rev2VcMinEnd1				✓	✓
Rev3VcMinEnd1				✓	✓
Rev2VcMaxEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev2VcMinEnd2				✓	
Rev3VcMinEnd2				✓	
Rev2VcMaxEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
    f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
    g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
    h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
    i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends the following message, depending on the UUT type/role:
    a. If the UUT is a Cable Plug, the Tester sends an Extended Message:
        i. Chunked bit = 1
        ii. Data Size field set to 26
        iii. Message Type field set to 1110b (Reserved, in PD2 mode) or 11111b (Reserved, in PD3 mode).
        iv. Bytes 0 to 25 of data block contain incrementing values starting at 0x00
    b. If the UUT is a Source or Sink, the Tester sends a Control Message with Message Type field set to 1110b (Reserved, in PD2 mode) or 11111b (Reserved, in PD3 mode).
3. The Tester checks the response message (with an incremented MessageID) based on the UUT type/role:

a. For Cable Plug UUT, the check fails if the UUT does not ignore the message i.e. message is received within tChunkReceiverRequest max. [TEST.PD.PROT.ALL.5#1]

b. For Source or Sink UUT, the check fails if the UUT does not send Reject message if in PD2 mode and Not_Supported message if in PD3 mode. [TEST.PD.PROT.ALL.5#2]

5.1.2   PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to all UUTs.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.ALL3.1 Get_Status Response

Description: The Tester verifies that the UUT responds correctly to Get_Status message.

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3UnChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3UnChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the

Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).

c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. If VIF field Product_Type = Active Cable, the Tester sends a Discover Identity message to the UUT, the checks fails if the UUT doesn't respond with a Discover Identity ACK message. [TEST.PD.PROT.ALL.3.1#1]

3. The Tester sends a Get_Status message to the UUT.

4. The Tester checks the response message depending on the UUT type/role:

   a. If the UUT is a Cable Plug [TEST.PD.PROT.ALL3.1#2]

      i. If the VIF field Product_Type = Active Cable, the Tester checks that the UUT sends a Status message

      ii. Otherwise, the Tester checks that the UUT sends either Ignore or Status message

   b. If the UUT is a Source or Sink, the check fails if the UUT does not respond with either Not_Supported or Status message. [TEST.PD.PROT.ALL3.1#3]

5. The Tester runs additional check for the Status message: [TEST.PD.PROT.ALL3.1#4]

   a. For the SOP SDB

      i. Present Input field: Bit 0 = 0 (Reserved)

      ii. Present Input field: Bit 0 and Bits 5…7 (Reserved) are 0s

iii. If Bit 3 (Internal Power from Battery) is 0 in Present Input field, then Present Battery Input field shall be 0

iv. Event Flags field: Bit 0 and Bits 5...7 (Reserved) are 0s

v. Temperature Status field: Bit 0, Bits 3…7 (Reserved) are 0s

vi. Power Status field: Bit 0, Bits 6…7 (Reserved) are 0s

- Bit1 = 1 if one or more Src_PDO_Max_Current > 3A, and emulated cable is not e-marked
- Bit1 = 0 if emulated cable is e-marked at 5A
- Bit1 = 0 if DUT has captive cable
- Bit1 = 0 if all SRC_PDO_Max_Current <= 3A

vii. If Bit 5 (OTP event) is 1 in Event Flags field, then Temperature Status field shall be set to 11b (Over Temperature)

viii. Power State Change:

- bits 6..7(reserved) are 0s
- bits 0..2: values must be less than 7
- Bit5 (reserved) is 0.

b. For the SOP'/SOP'' SDB

i. Flags field: Bits 1…7 = 0 (Reserved)

ii. Flags field Bit 0 (not in Thermal Shutdown)

iii. VIF field Product_Type = Active Cable, the number reported in Internal Temp field is less than the Shutdown Temperature reported in Active Cable VDO 2

iv. The number reported in Internal Temp field is either 0, or between 1 and 100

TEST.PD.PROT.ALL3.2 Get_Manufacturer_Info Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Manufacturer_Info message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3UnChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3UnChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a Get_Manufacturer_Info message with Manufacturer Info Target set to 0.
3. The Tester checks the response message depending on the UUT type/role:
   a. If the UUT is a Cable Plug: [TEST.PD.PROT.ALL3.2#1]
      i. If VIF field Manufacturer_Info_Supported = Yes, then the Tester checks that the UUT responds with a Manufacturer_Info message.
      ii. Otherwise, the Tester checks that the UUT responds with an Ignore.
   b. If the UUT is a Source or Sink: [TEST.PD.PROT.ALL3.2#2]
      i. If VIF field Manufacturer_Info_Supported_Port = Yes, then the Tester checks that the UUT responds with a Manufacturer_Info message.

ii. Otherwise, the Tester checks that the UUT responds with a Not_Supported message.
4. The Tester runs the following VIF field checks for Manufacturer_Info message: [TEST.PD.PROT.ALL3.2#3]
    a. Manufacturer_Info_VID(_SOP)
    b. Manufacturer_Info_PID(_SOP)

TEST.PD.PROT.ALL3.3 Invalid Manufacturer Info Target

Description: The Tester sends a Get_Manufacturer message with an invalid target and verifies correct field values in the response message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3UnChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3UnChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a Get_Manufacturer_Info message with Manufacturer Info Target set to 2 and Manufacturer Info Ref set to 0.

3. The Tester checks the response message depending on the UUT type/role:
   a. If the UUT is a Cable Plug, the check fails if the UUT does not respond with either Ignore or Manufacturer_Info message [TEST.PD.PROT.ALL3.3#1]
   b. If the UUT is a Source or Sink, the check fails if the UUT does not respond with either Not_Supported or Manufacturer_Info message. [TEST.PD.PROT.ALL3.3#2]

4. The Tester verifies Manufacturer_Info message: the check fails if
   a. Manufacturer String in Manufacturer Info Data Block is not null terminated ASCII text string "Not Supported"
   b. VID field is not 0xFFFF

   [TEST.PD.PROT.ALL3.3#3]

TEST.PD.PROT.ALL3.4 Invalid Manufacturer Info Ref

Description: The Tester sends a Get_Manufacturer message with an invalid reference and verifies correct field values in the response message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3UnChkdSrc		✓	✓		

Rev3ChkdSnk	✓		✓		
Rev3UnChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
    f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
    g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
    h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
    i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a Get_Manufacturer_Info message with Manufacturer Info Target set to 1 and Manufacturer Info Ref set to 8.

3. The Tester checks the response message depending on the UUT type/role:
    a. If the UUT is a Cable Plug, the check fails if the UUT does not respond with either Ignore or Manufacturer_Info message. [TEST.PD.PROT.ALL3.4#1]
    b. If the UUT is a Source or Sink, the check fails if the UUT does not respond with either Not_Supported or Manufacturer_Info message. [TEST.PD.PROT.ALL3.4#2]
4. The Tester veries Manufacturer_Info message: the check fails if:
    a. Manufacturer String in Manufacturer Info Data Block is not null terminated ASCII text string "Not Supported"
    b. VID field is not 0xFFFF

    [TEST.PD.PROT.ALL3.4#3]

TEST.PD.PROT.ALL3.5 Chunked Extended Message Response

Description: The Tester verifies that the UUT receives a chunked extended message correctly by sending messages to request chunks.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and

it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends the first chunk of a chunked extended message to the UUT
   a. Chunked bit = 1
   b. Data Size field set to 260
   c. Message Type set to 11111b
   d. Bytes 0 to 259 of data block contain incrementing values (mod 256) starting at 0x00

3. The tester checks the response
   a. If the UUT is a Cable Plug, the Tester check the response: [TEST.PD.PROT.ALL3.5#1]
      i. The check fails if the UUT does not respond with either Ignore or a request for a Chunk of Data Block message.
      ii. If the message is ignored, the test ends here.
            The check fails if VIF field Chunking_Implemented = YES
      iii. If a request for a Chunk of a Data Block is received
            1. The check fails if the request for a Chunk of a Data Block is not received within tChunkReceiverRequest max
            2. The check fails if VIF field Chunking_Implemented = NO
   b. If the UUT is a Source or Sink, the Tester check the response: [TEST.PD.PROT.ALL3.5#2]
      i. The check fails if Sink or Source UUT does not respond with either Not_Supported or a request for a Chunk of Data Block message.
      ii. If a Not_Supported message is received, the test ends here.
            1. The check fails if VIF field Chunking_Implemented_SOP = YES
            2. The check fails if Not_Supported message is not received between tChunkingNotSupported min and tChunkingNotSupported max
      iii. If a request for a Chunk of the Data Block is received

1. The check fails if a request for a Chunk of a Data Block is not received within tChunkReceiverRequest max
2. The check fails if VIF field Chunking_Implemented_SOP = NO

c. The check fails if this is not the first chunk and the UUT does not respond with a request for chunk message. If the UUT does not respond with a request for chunk message, the test stops here. Else, upon receipt of a request response from the UUT, the Tester sends the requested chunk to the UUT. This step is repeated until the Tester has sent all 10 chunk messages. The Tester runs the following additional checks on the request chunk message: [TEST.PD.PROT.ALL3.5#3]

    i. For Message Header
1. Bit 15 Extended bit = 1
2. Bits 14…12 Number of Data Objects = 1
3. Bits 4…0 Message Type = 11111b

    ii. For Extended Message Header
1. Bits 14…11 Chunk Number = next chunk in the series
2. Bit 10 Request Chunk = 1
3. Bits 8…0 Data Size = 0

4. The Tester check fails if:
a. The UUT is a Source or Sink, and it does not send a Not Supported message within tReceiverResponse after it has requested the 10 chunk messages.
b. The UUT is a Cable Marker, and it does not ignore the completed Extended message

[TEST.PD.PROT.ALL3.5#4]

TEST.PD.PROT.ALL3.6 ChunkSenderResponseTimer Timeout

Description: The Tester verifies that the UUT recovers correctly after the Tester stops sending chunked messages in the middle.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section need to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section need to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
    f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
    g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
    h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
    i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends the first chunk of a chunked extended message to the UUT
    a. Chunked bit = 1
    b. Data Size field set to 260
    c. Message Type set to 11111b
    d. Bytes 0 to 259 of data block contain incrementing values (mod 256) starting at 0x00
3. The tester checks the response
    a. If the UUT is a Cable Plug, the check fails if the UUT does not respond with either Ignore or a request for a Chunk of Data Block message. [TEST.PD.PROT.ALL3.6#1]
    b. If the UUT is a Source or Sink, the Tester checks response: [TEST.PD.PROT.ALL3.6#2]
        i. The check fails if Sink or Source UUT does not respond with either Not_Supported or a request for a Chunk of Data Block message.

ii. The check fails if a Not_Supported message received, and it is not received between tChunkingNotSupported min and tChunkingNotSupported max

iii. The check fails if a request for a Chunk of a Data Block is received, and it is not received within tChunkReceiverRequest max.

c. The test stops here if the UUT does not respond with a request for chunk message. Upon receipt of a request response from the UUT, the Tester sends the requested chunk to the UUT. This step is repeated until the Tester has sent 4 chunk messages and it intentionally does not send the 5th chunk message to the UUT.

d. The Tester runs the following additional checks the request chunk message: [TEST.PD.PROT.ALL3.6#3]

   i. For Message Header
      1. Number of Data Objects = 1
      2. Message Type = 11111b

   ii. For Extended Message Header
      1. Bits 14…11 Chunk Number = next chunk in the series
      2. Bit 10 Request Chunk = 1
      3. Bits 8…0 Data Size = 0

4. The Tester waits for tChunkSenderResponse max + 5 ms and then it sends the first chunk message to the UUT.

5. The tester checks the response

   a. If the UUT is a Cable Plug, the check fails if the UUT does not respond with either Ignore or a request for a Chunk of Data Block message. [TEST.PD.PROT.ALL3.6#4]

   b. If the UUT is a Source or Sink, the Tester checks the response [TEST.PD.PROT.ALL3.6#5]

      i. The check fails if Sink or Source UUT does not respond with either Not_Supported or a request for a Chunk of Data Block message.

      ii. The check fails if a Not_Supported message received, it is not received between tChunkingNotSupported min and tChunkingNotSupported max

      iii. The check fails if a request for a Chunk of a Data Block is received, it is not received within tChunkReceiverRequest max.

   c. Upon receipt of the response from the UUT, the Tester sends the requested chunk to the UUT.

   d. The Tester runs the following additional checks on the request chunk message: [TEST.PD.PROT.ALL3.6#6]

      i. For Message Header
         1. Number of Data Objects = 1
         2. Message Type = 11111b

      ii. For Extended Message Header
         1. Bits 14…11 Chunk Number = next chunk in the series
         2. Bit 10 Request Chunk = 1
         3. Bits 8…0 Data Size = 0

TEST.PD.PROT.ALL3.7 Security Messages Supported

Description: The Tester verifies the support of security messages is as specified in the VIF.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3ChkdSrc		✓	✓		
Rev3UnChkdSrc		✓	✓		
Rev3ChkdSnk	✓		✓		
Rev3UnChkdSnk	✓		✓		
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 7 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
   f. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   g. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

h. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

i. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a Security_Request message, in which SRQDB is set to {0x01, 0x81, 0x00, 0x00}, to the UUT.

3. The Tester checks the response:

a. If VIF field Security_Msgs_Supported(_SOP) is set to NO, the Tester checks that the UUT replies Not_Supported (if VIF field VIF_Product_Type not set to Cable) or Ignored (if VIF field VIF_Product_Type set to Cable). The test stops here. [TEST.PD.PROT.ALL3.7#1]

b. If VIF field Security_Msgs_Supported(_SOP) is set to YES, the Tester checks a Security_Response message is received within tDigestSent (different values for **Unchunked** and **Chunked**). [TEST.PD.PROT.ALL3.7#2]. In this case, the UUT shall also run Authentication Compliance tests in CV.

5.2   Test Procedures for Source and Sink Capable UUTs

5.2.1   PD2 and PD3 Modes
None

5.2.2   PD3 Mode
The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field VIF_Product_Type set to Port.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.PORT3.1 Get_Battery_Status Response
Description: The Tester verifies that the Source UUT responds correctly to Get_Battery_Status message

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C

Rev3ChkdSrc		✓	✓
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Source_Cap_Extended message to the UUT.
3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.PORT3.1#1]
4. The Tester sends a Get_Battery_Status message to the UUT, with Battery Status Ref field set to 0.
5. The check fails if the UUT does not send either Not_Supported or Battery_Status message. [TEST.PD.PROT.PORT3.1#2]
6. If the UUT has sent Not_Supported as a response to Get_Battery_Status, the Tester checks the response: [TEST.PD.PROT.PORT3.1#3]
   a. The check fails if the UUT has sent Source_Capabilities_Extended message as a response to Get_Source_Cap_Extended and the Number of Batteries/Battery Slots field in the message has non-zero value
   b. The check fails if the UUT has sent Not_Supported message as a response to Get_Source_Cap_Extended and the values of VIF fields Num_Fixed_Batteries and Num_Swappable_Battery_Slots are non-zero.

7. The Tester runs the following additional field checks for Battery_Status message:
   [TEST.PD.PROT.PORT3.1#4]
   a. Bits 7…0 of the BSDO are 0
   b. Battery Info field:
      i. Bits 7...4 (Reserved) are 0
      ii. Bit 0 (Invalid Battery Reference field):
         1. If Source_Capabilities_Extended is received as a response to Get_Source_Cap_Extended, check against Number of Batteries/Battery Slots field in the message
         2. Check against VIF fields Num_Fixed_Batteries and Num_Swappable_Battery_Slots
      iii. If Bit 0 (Invalid Battery Reference bit) is 0b and Battery Status Ref field (in the Get_Battery_Status Message) has a value between 0 and 3, then check that the Bit 1 (Battery is Present bit) is set to 1b
      iv. If Bit 0 (Invalid Battery Reference bit) is 1b, then check that the Bit 1 (Battery is Present bit) is set to 0b
      v. If Bit 1 (Battery is Present bit) is set to 1b, then check that Bits 3…2 (Battery Charging Status field) is not 11b
      vi. If Bit 1 (Battery is Present bit) is set to 0b, then check that Bits 3…2 (Battery Charging Status field) is 00b
8. Rerun steps 6 and 7 with Battery Status Ref (in the Get_Battery_Status message) set to 1 – 7

TEST.PD.PROT.PORT3.2 Invalid Battery Status Reference

Description: The Tester sends a Get_Battery_Status message with an invalid battery reference to the UUT and verifies correct field values in the response message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the

Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).

 c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

 d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

 e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Source_Cap_Extended message to the UUT.

3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.PORT3.2#1]

4. The Tester sends a Get_Battery_Status message with Battery Status Ref field set to 8.

5. The check fails if the UUT does not send either Not_Supported or Battery_Status message. [TEST.PD.PROT.PORT3.2#2]

6. If the UUT has sent Not_Supported as a response to Get_Battery_Status, the Tester check the response: [TEST.PD.PROT.PORT3.2#3]

 a. The check fails if the UUT has sent Source_Capabilities_Extended message as a response to Get_Source_Cap_Extended and the Number of Batteries/Battery Slots field in the message has non-zero value

 b. The check fails if the UUT has sent Not_Supported message as a response to Get_Source_Cap_Extended and the values of VIF fields Num_Fixed_Batteries and Num_Swappable_Battery_Slots are non-zero.

7. The Tester runs the following additional field checks for Battery_Status message: [TEST.PD.PROT.PORT3.2#4]

 a. Bits 7..0 of the BSDO are 0

 b. Battery Info field:

  i. Check that Bit 0 (Invalid Battery Reference field) is 1b

  ii. Check that Bits 7..1 are 0

TEST.PD.PROT.PORT3.3 Get_Battery_Cap Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Battery_Cap message

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
   e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Source_Cap_Extended message to the UUT.
3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.PORT3.3#1]
4. The Tester sends a Get_Battery_Cap message to the UUT, with Battery Cap Ref field set to 0.
5. The Tester checks the response [TEST.PD.PROT.PORT3.3#2]
   a. If either Num_Fixed_Batteries is not set to 0 or Num_Swappable_Battery_Slots is not set to 0, the Tester checks that the UUT sends Battery_Capabilities message
   b. Otherwise, the Tester checks that the UUT sends either:
      i. Not_Supported, or

      ii.   A Battery_Capabilities message with:
1. VID field set to FFFF
2. The Invalid Reference bit set to 1.
3. The reserved bits set to 0.
6. The Tester runs the following additional field checks for Battery_Capabilities message:
[TEST.PD.PROT.PORT3.3#3]
    a. Battery Type field:
      i. Check that Bit 0 (Invalid Battery Reference field) matches:
1. If Source_Capabilities_Extended is received as a response to Get_Source_Cap_Extended, check against Number of Batteries/Battery Slots field in the message
2. If Not_Supported message is received as a response to Get_Source_Cap_Extended, check against VIF fields Num_Fixed_Batteries and Num_Swappable_Battery_Slots
      ii. Check that Bits 1…7 are 0
7. Rerun steps 6 and 7 with Battery Cap Ref (in the Get_Battery_Capabilities message) set to 1 – 7

TEST.PD.PROT.PORT3.4 Invalid Battery Capabilities Reference

Description: The Tester sends a Get_Battery_Capabilities message with an invalid battery reference to the UUT and verifies correct field values in the response message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Source_Cap_Extended message to the UUT.

3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.PORT3.4#1]

4. The Tester sends a Get_Battery_Cap message to the UUT, with Battery Cap Ref field set to 8.

5. The check fails if the UUT does not send either Not_Supported or Battery_Capabilities message. [TEST.PD.PROT.PORT3.4#2]

6. The Tester runs the following additional field checks for Battery_Capabilities message: [TEST.PD.PROT.PORT3.4#3]
   i. VID field set to FFFF
   ii. The Invalid Reference bit set to 1.
   iii. The reserved bits set to 0.

TEST.PD.PROT.PORT3.5 Get_Country_Codes Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Country_Codes message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).

c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Country_Codes message to the UUT.

3. The check fails if the UUT does not send either Not_Supported or Country_Codes message. [TEST.PD.PROT.PORT3.5#1]

4. The Tester runs the following additional field checks for CCDB: [TEST.PD.PROT.PORT3.5#2]
   a. Length = (Data Size) / 2 - 1
   b. All other bytes are ascii codes of capital letters (65 - 90 inclusive)

TEST.PD.PROT.PORT3.6 Get_Country_Info Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Country_Info message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).

c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).

e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).

2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends a Get_Country_Codes message to the UUT.

3. The check fails if the UUT does not send either Not_Supported or Country_Codes message. [TEST.PD.PROT.PORT3.6#1]

4. If a Not_Supported message is received, the test stops here. Otherwise, the Tester sends a Get_Country_Info message to the UUT.

5. The check fails if the UUT does not send Country_Info message. [TEST.PD.PROT.PORT3.6#2]

6. The Tester runs the following additional field checks for CIDB: [TEST.PD.PROT.PORT3.6#3]

    a. Country Code field (Byte 0 and Byte 1) is the same as that in the Get_Country_Info message sent by the Tester

    b. Byte 2 and Byte 3 (Reserved) are 0

7. Rerun the test with the bring-up procedures in Step-1 with the Unchunked Extended Messages Supported field set to 1b in the Tester sent Request (RDO) or Source Capabilities PDO.

TEST.PD.PROT.PORT3.7 Unchunked_Extended_Messages_Supported

Description: The Tester verifies that that if Unchunked_Extended_Messages_Supported is set to yes, the UUT can receive Extended Messages with Data Size > MaxExtendedMsgLegacyLen bytes in a single, Unchunked Message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 5 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer Only. The Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    c. The UUT has VIF field PD_Port_Type set to Provider Only. The Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
    d. The UUT has VIF field PD_Port_Type set to Provider/Consumer, each test under this section needs to be run twice, first time the Tester behaves as a Consumer/Provider and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8; second time the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 1b).
    e. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (Dual-Role Power bit B29 in the single PDO is set to 0b).
2. The UUT has VIF field PD_Port_Type set to DRP, each test under this section needs to be run twice, first time the Tester behaves as a Source only and it runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2; second time the Tester behaves as a Sink only and it runs bring-up procedure with the The Tester sends an extended message to the UUT, with Data Size set to 260 and Message Type set to 11111b. Bytes 0 to 259 of data block contain incrementing values (mod 256) starting at 0x00.
3. If a GoodCRC is not received, the check fails. [TEST.PD.PROT.PORT3.7#1]
4. If a Not_Supported message is not received within tReceiverResponse max, the check fails. This delay is measured from the time the last bit of the extended message EOP has been transmitted to the time the first bit of the Not_Supported message preamble has been received. [TEST.PD.PROT.PORT3.7#2]

5.3   Test Procedures for Source Capable UUT

5.3.1   PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Provider Only, Provider/Consumer and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.SRC.1 Get_Source_Cap Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Source_Cap message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, DRP, P/C
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a Get_Source_Cap message to the UUT.
3. The check fails if the Tester does not receive Source Capabilities message.
   [TEST.PD.PROT.SRC.1#1]

4. Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

TEST.PD.PROT.SRC.2 Get_Source_Cap No Request

Description: The Tester sends a Get_Source_Cap message to the UUT. After receiving a Source_Capabilities message, the Tester intentionally does not send the Request message to force a SenderResponseTimer timeout on the Source UUT. The Tester verifies correct implementation of this timer.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a Get_Source_Cap message to the UUT.
3. The check fails if the Tester does not receive Source Capabilities message. [TEST.PD.PROT.SRC.2#1]
4. The Tester does not send a Request message after receiving Source Capabilities message.
5. The Tester checks that a Hard Reset is detected between tSenderResponse min and max, the delay is between the last bit of the GoodCRC message EOP has been sent and the first bit of Hard Reset SOP has been received. [TEST.PD.PROT.SRC.2#2]

TEST.PD.PROT.SRC.3 SenderResponseTimer Deadline

Description: As a Sink, the Tester checks that the UUT accepts a Request message sent at the deadline limit of tSenderResponse min in reply to a Source Capabilities message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS for tNoResponse max.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC.3#1]

4. The Tester responds with a Request message at the deadline limit of tSenderResponse min after the GoodCRC message.

5. The Tester checks the response [TEST.PD.PROT.SRC.3#2]

    a. The check fails if the UUT does not send an Accept message

    b. The check fails if the UUT sent a Hard Reset

TEST.PD.PROT.SRC.4 Reject Request

Description: As a Sink, the Tester requests 200% of the offered current or power under the terms of each PDO on the UUT, and verifies the request is rejected by the UUT.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS for tNoResponse max.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC.4#1]

4. The Tester sends a Request (starting from the first PDO), requesting 200% of the current or power offered.

5. The check fails if a Reject message is not received. [TEST.PD.PROT.SRC.4#2]

6. Restart the test from Step 1 by sending Request to the next PDO.

TEST.PD.PROT.SRC.5 Reject Request Invalid Object Position

Description: As a Sink, the Tester sends a Request with an invalid object position, and verifies the request is rejected by the UUT.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev2Src		✓

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS present.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC.5#1]

4. The Tester sends a Request message using the VIF field Num_Src_PDOs:

    a. If Num_Src_PDOs = 7, then set Object Position field to 0

    b. Otherwise, set Object Position field to 1 + Num_Src_PDOs

5. The check fails if the UUT does not respond with a Reject message. [TEST.PD.PROT.SRC.5#2]

TEST.PD.PROT.SRC.6 Atomic Message Sequence – Request

Description: As a Sink, the Tester sends a Get_Sink_Cap message instead of a Request message and verifies that the UUT correctly sends a Soft Reset to recover from this error.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS present.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC.6#1]

4. The Tester sends a Get_Sink_Cap message instead of a Request message.

5. The check fails if a Soft_Reset message is not received within tProtErrSoftReset. [TEST.PD.PROT.SRC.6#2]

6. The Tester sends an Accept message to the UUT (as a response to Soft_Reset message).

7. The check fails if a Source Capabilities message with a MessageID = 1 is not received within tTypeCSinkWaitCap max from the last bit of the EOP of the GoodCRC message. [TEST.PD.PROT.SRC.6#3]

TEST.PD.PROT.SRC.7 DR_Swap

Description: As a Sink, the Tester sends a DR_Swap message, and verifies that the UUT responds correctly.

Test Specific Tester Behavior:

- The Tester always replies with a Reject message to a DR_Swap message

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester instead sends Request message with B25 (USB Communication Capable) set to 1b.
3. The Tester sends a DR_Swap message.
4. The Tester checks the response. [TEST.PD.PROT.SRC.7#1]
   a. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times.
   b. The check fails if
      i. In PD2, the UUT responds with a Reject message and the VIF field DR_Swap_To_UFP_Supported = Yes.
      ii. In PD3, the UUT responds with either:
         1. Not_Supported **and (**VIF field DR_Swap_To_UFP_Supported = Yes **or** VIF field DR_Swap_To_DFP_Supported = Yes**) or**
         2. Reject **and** the VIF fields DR_Swap_To_UFP_Supported = Yes

      If the check fails, the test ends here.

   c. The check fails if the UUT responds with an Accept message and the VIF field DR_Swap_To_UFP_Supported = No.

5. If VIF DR_SWAP_To_UFP_Supported=N, test ends here. Otherwise, the Tester requests a further DR_Swap.
6. The Tester checks the response. [TEST.PD.PROT.SRC.7#2]
    a. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times.
    b. The check fails if
        i. In PD2, the UUT responds with a Reject message and the VIF field DR_Swap_To_DFP_Supported = Yes.
        ii. In PD3, the UUT responds with either
            1. Not_Supported **and (**the VIF fields DR_Swap_To_DFP_Supported = Yes or the VIF fields DR_Swap_To_UFP_Supported = Yes) **or**
            2. Reject **and** the VIF fields DR_Swap_To_DFP_Supported = Yes
    c. The check fails if the UUT responds with an Accept message and the VIF field DR_Swap_To_DFP_Supported = No.

TEST.PD.PROT.SRC.8 VCONN_Swap Response

Description: As a Sink, the Tester sends a VCONN_Swap message, and verifies that the UUT responds correctly.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

    The Tester keeps monitoring the VConn voltage throughout this test.

2. If VIF field Captive_Cable = No, the Tester presents Ra to the non-CC line (of the UUT). If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 5A and Maximum Vbus Voltage set to 50V.
3. The Tester sends a VCONN_Swap message.
4. The Tester checks the response. [TEST.PD.PROT.SRC.8#1]

a. If the UUT responds with a Wait message:
   i. The check fails if the UUT responds with a Wait message in PD3 mode and the Test stops here.
   ii. If the UUT responds with a Wait message in PD2 mode, the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times in PD2 mode.
b. If the UUT responds with an Accept message, the Tester checks that VCONN_Swap_To_Off_Supported = YES
c. If the UUT responds with a Reject message:
   i. The check fails in PD3 mode
   ii. The Tester checks VCONN_Swap_To_Off_Supported = NO
   iii. The test stops here
d. If the UUT responds with a Not_Supported message:
   i. The check fails in PD2 mode
   ii. The Tester checks VCONN_Swap_To_Off_Supported = NO
   iii. The check fails if the UUT ever sourced VConn
   iv. The Test stops here
5. The Tester sends a PS_RDY message.
6. The Tester checks that the UUT does not present VCONN at the non-CC line within *tVCONNSourceOff*. [TEST.PD.PROT.SRC.8#2]
7. The Tester sends another VCONN_Swap.
8. The Tester checks the response. [TEST.PD.PROT.SRC.8#3]
   a. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.
   b. The check fails if the UUT responds with Reject message and the VIF field VCONN_Swap_To_On_Supported = Yes. The test ends here.
   c. The check fails if the UUT responds with Not_Supported. The test ends here.
   d. The check fails if the UUT responds with an Accept message and the VIF field VCONN_Swap_To_On_Supported = No. The test ends here.
9. The Tester checks that the UUT sends a PS_RDY message within tVCONNSourceOn. [TEST.PD.PROT.SRC.8#4]
10. If the VIF field Type_C_Sources_VCONN = NO, the Tester checks that VCONN is not present at the non-CC line. [TEST.PD.PROT.SRC.8#5]

TEST.PD.PROT.SRC.9 PR_Swap Response

Description: The Tester verifies that the initial Source UUT responds correctly to the PR_Swap message.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Sink
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 1b COMMON.PROC.PD.3

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

2. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
3. The Tester sends a PR_Swap message.
4. The Tester checks the response. [TEST.PD.PROT.SRC.9#1]
    a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.
    b. If the UUT responds with Reject or Not_Supported (PD3 mode only), check that the VIF field PD_Port_Type is set to "Provider Only" or VIF field Accepts_PR_Swap_As_Src = No. The test ends here.
    c. The check fails if the UUT responds with an Accept message and the VIF field PD_Port_Type is not set to either "Provider/Consumer", "Consumer/Provider", or "DRP". The test ends here.
    d. The check fails if the UUT responds with an Accept message and the VIF field Accept_PR_Swap_As_Src = No
5. The Tester draws no more than iSwapStandby within tSrcTransition min after it has sent the last GoodCRC.
6. The Tester checks that the UUT asserts Rd and sends a PS_RDY message after the UUT driving VBUS voltage to vSafe0V. [TEST.PD.PROT.SRC.9#2]
7. The Tester checks that the UUT sends PS_RDY within tPSSourceOff min after the last bit of GoodCRC was sent in response to the received Accept. [TEST.PD.PROT.SRC.9#3]
8. The Tester presents vSafe5V on VBUS and then it sends a PS_RDY message, both within tNewSRC max of the last GoodCRC sent by the UUT.
9. The Tester transmits Source Capabilities message with single PDO (5V @ 100mA, B29 Dual-Role Power set to 1b). The Tester checks that the UUT sends a Request message. [TEST.PD.PROT.SRC.9#4] The Tester uses the common procedure COMMON.PROC.PD.10 to establish a PD contract.
10. The UUT is now a Sink and the Tester is a Source.
11. The Tester sends a PR_Swap message.
12. The Tester checks the response. [TEST.PD.PROT.SRC.9#5]

a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.

　　　　b. The check fails if the UUT responds with a Reject message and that the VIF field Accept_PR_Swap_As_Snk = Yes.

　　　　c. The check fails if the UUT responds with an Accept message and that the VIF field Accept_PR_Swap_As_Snk = No.

　　　　d. The check fails if the UUT response with a Not_Supported message.

13. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.

14. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.

15. The tester checks that UUT asserts Rp before the UUT has applied vSafe5V
[TEST.PD.PROT.SRC.9#6]

16. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V.
[TEST.PD.PROT.SRC.9#7]

17. The Tester checks that the PS_RDY from the UUT is within tPSSourceOn min.
[TEST.PD.PROT.SRC.9#8] This delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester.

18. The Tester checks that the UUT sends a Source Capabilities message after tSwapSourceStart and before tFirstSourceCap max. [TEST.PD.PROT.SRC.9#9].

19. The Tester waits for 5 second period to check correct usage of Rp, and the Tester replies any message sent from the UUT with a proper response.

TEST.PD.PROT.SRC.10 PR_Swap – PSSourceOnTimer Timeout

Description: As a new Source, the Tester intentionally does not send a PS_RDY message after a PR_Swap in order to force a PSSourceOnTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Sink
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 1b
  COMMON.PROC.PD.3

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.

b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

2. The Tester sends a PR_Swap message.

3. The Tester checks the response. [TEST.PD.PROT.SRC.10#1]

a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.

b. If the UUT responds with Reject or Not_Supported (PD3 mode only), check that the VIF field PD_Port_Type is set to "Provider only" or VIF field Accepts_PR_Swap_As_Src is set to No. The test ends here.

c. The check fails if the UUT responds with an Accept message and the VIF field PD_Port_Type is not set to either "Provider/Consumer" , "Consumer/Provider", or "DRP". The test ends here.

4. The Tester draws no more than iSwapStandby within tSrcTransition min after it has sent the last GoodCRC.

5. The Tester checks the response: [TEST.PD.PROT.SRC.10#2]

a. The check fails if the UUT does not send a PS_RDY message after the UUT driving VBUS voltage to vSafe0V

b. The check fails if the UUT does not send PS_RDY within tSrcTransition max plus tSrcSwapStdby max after the last bit of GoodCRC was sent in response to the received Accept.

6. The Tester presents vSafe5V on VBUS but does not send a PS_RDY message, in order to force a PSSourceOnTimer timeout on the UUT.

7. A USB Type-C Error Recovery is expected from the UUT. The Tester checks the response: [TEST.PD.PROT.SRC.10#3]

a. The check fails if a USB Type-C Error Recovery is detected before tPSSourceOn min after the time the last bit of the EOP of the GoodCRC Message corresponding to the received PS_RDY message.

b. The check fails if a USB Type-C Error Recovery is not detected within tPSSourceOn max after the last bit of the EOP of the GoodCRC Message corresponding to the received PS_RDY message.

TEST.PD.PROT.SRC.11 Unexpected Message Received in Ready State

Description: As a Sink, the Tester sends an unexpected message to the UUT after setting up a contract with the UUT and verifies the UUT does Soft Reset.

Test Specific Tester Behavior: N/A

Test Conditions:

Consumer Only	Provider Only, C/P, P/C, DRP

Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends an Accept message to the UUT.
3. The check fails if a Soft Reset message is not received within tProtErrSoftReset max. [TEST.PD.PROT.SRC.11#1] This delay is measured from the EOP of the GoodCRC corresponding to the Accept message has been received to the time the EOP the Soft Reset message has been received.

TEST.PD.PROT.SRC.12 Get_Sink_Cap Response

Description: The Tester verifies that the Source UUT responds correctly to Get_Sink_Cap message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a Get_Sink_Cap message to the UUT.
3. The Tester checks the response. [TEST.PD.PROT.SRC.12#1] /*same as TEST.PD.PROT.ALL.4 12.c */
   a. If the VIF field PD_Port__Type is set to Provider/Consumer, check that the UUT sends a Sink Capabilities message.
   b. In PD2 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Reject message.

c. In PD3 mode, if the VIF field PD_Port_Type is set to Provider only, check that the UUT sends a Not_Supported message.

TEST.PD.PROT.SRC.13 PR_Swap – GoodCRC not sent in Response to PS_RDY

Description: As a new Source, the Tester intentionally does not reply GoodCRC message to the PS_RDY message after a PR_Swap in order to force the UUT to do an Error Recovery and verifies it is correctly implemented.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Sink
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 1b COMMON.PROC.PD.3

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a PR_Swap message.
3. The Tester checks the response. [TEST.PD.PROT.SRC.13#1]
   a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.
   b. If the UUT responds with Reject or Not_Supported (PD3 mode only), check that the VIF field PD_Port_Type is set to "Provider Only" or VIF field Accepts_PR_Swap_As_Src is set to No. The test ends here.
   c. The check fails if the UUT responds with an Accept message and the VIF field PD_Port_Type is not set to either "Provider/Consumer" , "Consumer/Provider", or "DRP". The test ends here.
4. The Tester draws no more than iSwapStandby within tSrcTransition min after it has sent the last GoodCRC.
5. The Tester checks the response: [TEST.PD.PROT.SRC.13#2]
   a. The check fails if the UUT does not send a PS_RDY message after the UUT driving VBUS voltage to vSafe0V

b. The check fails if the UUT does not send PS_RDY within tSrcTransition max plus tSrcSwapStdby max after the last bit of GoodCRC was sent in response to the received Accept.

6. Upon receipt of the PS_RDY message, the Tester:
   a. Intentionally does not respond with GoodCRC.
   b. Applies Rp in place of Rd
   c. Does not Send further messages.

7. A USB Type-C Error Recovery is expected from the UUT. The check fails if a USB Type-C Error Recovery is not detected within 15ms after the last bit of the EOP of the last retried PS_RDY Message. [TEST.PD.PROT.SRC.13#3]

5.3.2 PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to Source capable UUT with VIF field PD_Port_Type set to Provider Only, Provider/Consumer and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider) The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.SRC3.1 SourceCapabilityTimer Timeout

Description: The Tester waits for a Source Capabilities message from the Source UUT. The Tester intentionally does not reply with a GoodCRC in order to force a SourceCapabilityTimer timeout, then verifies it is correctly implemented.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS present.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC3.1#1]

4. Upon receipt of the first Source Capabilities message from the Source UUT, the Tester intentionally does not reply with a GoodCRC message and waits for the next Source Capabilities message. **The Tester does not reply with a GoodCRC message for the duration of this test.**

5. **In the following steps** the Tester measures the delay from the last bit of a Source Capabilities message EOP to the first bit of the preamble of the following Source Capabilities message received. [TEST.PD.PROT.SRC3.1#2]

   a. The Tester checks that the time between the first Source Capabilities received and the second Source Capabilities received is within tReceive max + tRetry.

   b. The Tester checks that the time between the second Source Capabilities received and the third Source Capabilities received is within tReceive max + tRetry.

   c. The Tester measures the time between the third Source Capabilities received and the fourth Source Capabilities received.

      i. The check fails if this time is larger than 201.1 ms (tTypeCSendSourceCap max + tReceive max)

      ii. The check fails if this time is smaller than 100.9 ms (tTypeCSendSourceCap min + tReceive min)

   d. The Tester checks that the time between the fourth Source Capabilities received and the fifth Source Capabilities received is within tReceive max + tRetry.

TEST.PD.PROT.SRC3.2 SenderResponseTimer Timeout

Description: As a Sink, the Tester intentionally does not send the Request message to force a SenderResponseTimer timeout on the Source UUT. The Tester verifies correct implementation of this timer.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS for tNoResponse max.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC3.2#1]

4. The Tester intentionally does not send a Request message and waits for a Hard Reset.

5. The Tester checks that a Hard Reset is detected between tSenderResponse min and max, the delay is between the last bit of the GoodCRC message EOP has been sent and the first bit of Hard Reset SOP has been received. [TEST.PD.PROT.SRC3.2#2]

TEST.PD.PROT.SRC3.3 Get_Source_Cap_Extended Response

Description: As a Sink, the Tester verifies that the Source UUT responds correctly to Get_Source_Cap_Extended message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓
Rev3UnchkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a Get_Source_Cap_Extended message to the UUT.
3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.SRC3.3#1]

TEST.PD.PROT.SRC3.4 Alert Response Source Input Change

Description: As a Sink, the Tester sends Alert message indicating Source Input Change and verifies the response messages. Note that there isn't any specific failure condition for this test, however, failure as a side effect of this will be captured as part of the COMMON checks and procedures.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓
Rev3UnchkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends an Alert message to the UUT with Type of Alert field = Source Input Change Event (Bit 5).
3. The test stops here when one of the following conditions happens:
    a. A Not_Supported message is received as a response to the last Alert message.
    b. A Get_ Status message is not received within 500 ms after the last Alert message was sent

TEST.PD.PROT.SRC3.5 Alert Response Battery Status Change

Description: As a Sink, the Tester sends Alert message indicating Battery Status Change and verifies the response messages.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓
Rev3UnchkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends an Alert message to the UUT
    a. Type of Alert field = Battery Status Change Event (Bit 1)
    b. Fixed Batteries = Battery 0 (B20)
3. Upon receiving the Get_Battery_Status message, the Tester checks Battery Status Ref = 0. [TEST.PD.PROT.SRC3.5#1]
4. The test stops here when one of the following conditions happens:

a. A Not_Supported message is received as a response to the last Alert message.
b. A Get_Battery_Status message is not received within 500 ms after the last Alert message was sent

TEST.PD.PROT.SRC3.6 Soft_Reset Sent when SinkTxOK

Description: As a Sink, the Tester forces the UUT to send Soft_Reset and verifies Soft_Reset is sent when the Rp value is SinkTxOK.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends a Get_Source_Cap message to the UUT.
3. Upon receipt of the Source_Capabilities Message, the Tester doesn't reply with GoodCRC.
4. The check fails if a Soft_Reset message is not sent by the UUT within tReceive max + tSoftReset max, the delay is measured from the time the last bit of the last retransmitted Source_Capabilities Message EOP has been received to the time the last bit of the Soft_Reset message EOP has been received. [TEST.PD.PROT.SRC3.6#1]

TEST.PD.PROT.SRC3.7 Get_PPS_Status Response

Description: The Tester verifies that the Source UUT responds correctly to Get_PPS_Status message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓
Rev3UnchkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the Consumer-Provider as Source UUT PPS COMMON.PROC.BU.9.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source for PPS test COMMON.PROC.BU.4.
2. The Tester sends a Get_PPS_Status message to the UUT.
3. The check fails if the Tester does not receive PPS_Status message. [TEST.PD.PROT.SRC3.7#1]
4. The Tester runs the following additional field checks for the PPSSDB: [TEST.PD.PROT.SRC3.7#2]

    a. Output Voltage field shall be within ±3% of the actual output voltage rounded to the nearest 20mV or 0xFFFF

    b. Output Current field shall be 0x00 to 0x03(inclusive) or 0xFF

    c. For Real Time Flags field

    d. Bit 0 shall be 0

    e. PTF shall be 0x00 (Not Supported) or 0x01 (Normal)

    f. OMF shall be 0 (Constant Voltage mode)

    g. Bits 4..7 shall be 0

TEST.PD.PROT.SRC3.8 SourcePPSCommTimer Deadline

Description: As a Sink, the Tester sends the second Request message after tPPSRequest max, verifies SourcePPSCommTimer is not timeout at the UUT and the timer is correctly reinitialized.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the Consumer-Provider as Source UUT PPS COMMON.PROC.BU.9.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source for PPS test COMMON.PROC.BU.4.
2. The check fails if a Hard Reset is received within tPPSRequest max. [TEST.PD.PROT.SRC3.8#1]
    The delay is measured from the time the last bit of the EOP of the GoodCRC Message sent by

the UUT in response to the previous Request message to the time the first bit of the Hard Reset is received.

3. The Tester sends the second Request message to request the Programmable Power Supply APDO at 4V 1A, tPPSRequest max after the previous Request message. The check fails if the Tester cannot send the second Request message at tPPSRequest max because the UUT has presented SinkTxNG. [TEST.PD.PROT.SRC3.8#2]

4. The check fails if the UUT does not respond with an Accept message and then a PS_RDY message. [TEST.PD.PROT.SRC3.8#3]

5. The check fails if a Hard Reset is received within tPPSRequest max. [TEST.PD.PROT.SRC3.8#4] The delay is measured from the time the last bit of the EOP of the GoodCRC Message sent by the UUT in response to the second Request Message to the time the first bit of the Hard Reset is received.

TEST.PD.PROT.SRC3.9 SourcePPSCommTimer Timeout

Description: As a Sink PPS, the Tester intentionally stops resending Request message, in order to force a SourcePPSCommTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the Consumer-Provider as Source UUT PPS COMMON.PROC.BU.9.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source for PPS test COMMON.PROC.BU.4.
2. The Tester repeats the following steps 3 times:
   a. At tPPSRequest max after the previously sent Request Message, the Tester sends a Request Message requesting Programmable Power Supply APDO 4V 1A. The check fails if the Tester cannot send the Request message at tPPSRequest max because the UUT has presented SinkTxNG. [TEST.PD.PROT.SRC3.9#1]
3. The Tester intentionally stops sending Request message.
4. The check fails if a Hard Reset is received before tPPSTimeout min, or not received within tPPSTimeout max. [TEST.PD.PROT.SRC3.9#2] The delay is measured from the time the last bit of the EOP of the GoodCRC Message sent by the UUT in response to the previous Request Message to the time the first bit of the preamble of the Hard Reset is received.

TEST.PD.PROT.SRC3.10 SourcePPSCommTimer Stopped

Description: As a Sink, the Tester request a PPS APDO first and then request a fixed PDO, verifies SourcePPSCommTimer is stopped at the UUT.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the Consumer-Provider as Source UUT PPS COMMON.PROC.BU.9.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source for PPS test COMMON.PROC.BU.4.
2. The check fails if a Hard Reset is received within tPPSRequest max. [TEST.PD.PROT.SRC3.10#1] The delay is measured from the time the last bit of the EOP of the GoodCRC message sent by the UUT in response to the previous Request message to the time the first bit of the Hard Reset is received.
3. The Tester sends the second Request message to request the Fixed Supply PDO at 5V 0.1A, tPPSRequest max after the previous Request message. The check fails if the Tester cannot send the second Request message at tPPSRequest max because the UUT has presented SinkTxNG. [TEST.PD.PROT.SRC3.10#2]
4. The check fails if the UUT does not respond with an Accept message and then a PS_RDY message. [TEST.PD.PROT.SRC3.10#3]
5. The check fails if a Hard Reset is received within tPPSTimeout max + 15ms. [TEST.PD.PROT.SRC3.10#4] The delay is measured from the time the last bit of the EOP of the GoodCRC message sent by the UUT in response to the second Request message to the time the first bit of the Hard Reset is received.

TEST.PD.PROT.SRC3.11 GoodCRC Specification Revision Compatibility

Description: As a Sink, the Tester verifies the UUT accepts GoodCRC with Specification Revision set to 00b, 01b, or 10b.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, DRP, P/C

Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and it waits for VBUS for tNoResponse max.

3. The check fails if the first bit of a Source Capabilities message is not received from the UUT within tFirstSourceCap max after VBUS present. [TEST.PD.PROT.SRC3.11#1]

4. The Tester sends a GoodCRC (acknowledging the Source Capabilities message) with Specification Revision set to 00b. The check fails if the UUT retransmits the Source Capabilities message. [TEST.PD.PROT.SRC3.11#2]

5. Repeat the test with Specification Revision in GoodCRC set to 01b and 10b.

TEST.PD.PROT.SRC3.12 FR_Swap Without Signaling

Description: The tester checks the UUT response to an invalid FR_Swap message

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, DRP, P/C, C/P
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the Consumer-Provider as Source UUT PPS COMMON.PROC.BU.9.
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source for PPS test COMMON.PROC.BU.4.

2. The Tester sends a FR_Swap message to the UUT.

3. The Tester checks the response: [TEST.PD.PROT.SRC3.12#1]

    a. If FR_Swap_Reqd_Type_C_Current_As_Initial_Source field (in the VIF) is zero value, the Tester checks that the UUT sends Not_Supported.

    b. If FR_Swap_Reqd_Type_C_Current_As_Initial_Source field (in the VIF) is nonzero value, the Tester checks that that PD_Port_Type field (in the VIF) is not set to Provider Only. The check fails if a Hard Reset is not received within tProtErrHardReset max. The delay is measured from the time the last bit of the EOP of the GoodCRC message sent by the

UUT in response to the FR_Swap message to the time the first bit of the Hard Reset is received.

TEST.PD.PROT.SRC3.13 Cable Type Detection

Description: As a Sink, the Tester verifies that the UUT does cable detection if it offers currents in excess of 3A, voltages in excess of 20V or both.

Test Specific Tester Behavior: N/A

Test Conditions:

The test is applicable if VIF field Captive_Cable = NO

	Consumer Only, C/P	Provider Only, DRP, P/C
Rev3ChkdSrc		✓

Test Procedures:

1. The test starts in a disconnected state.

2. The Tester applies Rd and Ra, and it waits for VBUS present.
3. The Tester checks the response:

    a. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 5A and Maximum Vbus Voltage set to 50V.

    b. Without receiving a SOP' Discover Identity message from the UUT, the check fails if the UUT sends Source Capabilities offering currents in excess of 3A and/or voltages in excess of 20V. The test stops here. [TEST.PD.PROT.SRC3.13#1]

4. The Tester removes all terminations and simulates a disconnection

5. The Tester applies Rd and Ra, and it waits for VBUS present.
6. The Tester checks the response:

    a. If a SOP' Discover Identity message is received, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 3A and Maximum Vbus Voltage set to 20V.

    b. The check fails if the UUT sends Source Capabilities offering currents in excess of 3A and/or voltages in excess of 20V. [TEST.PD.PROT.SRC3.13#2]

7. The Tester removes all terminations and simulates a disconnection

8. The Tester applies Rd but does not present Ra, and it waits for VBUS present.

9. The Tester shall disregard Discover ID SOP'messages if any.

USB Power Delivery Compliance Test Specification, Revision 1.4   Page 138

10. The Tester checks the UUT Source Capability response. The check fails if the UUT sends Source Capabilities offering currents in excess of 3A and/or voltages in excess of 20V [TEST.PD.PROT.SRC3.13#3].

5.4 Test Procedures for Sink Capable UUT

5.4.1 PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Consumer Only, Consumer/Provider and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.SNK.1 Get_Sink_Cap Response

Description: The Tester verifies that the Sink UUT responds correctly to the Get_Sink_Cap message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, DRP, P/C, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Sink_Cap message to the UUT. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.
3. The check fails if the UUT does not send Sink Capabilities message. [TEST.PD.PROT.SNK.1#1]

TEST.PD.PROT.SNK.2 Get_Source_Cap Response

Description: The Tester verifies that the Sink UUT responds correctly to the Get_Source_Cap message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Source_Cap message to the UUT. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.
3. The Tester checks the response. [TEST.PD.PROT.SNK.2#1]
    a. The check fails if VIF field PD_Port_Type = Consumer Only and the UUT does not send a Reject message (in PD2 mode) or Not_Supported (in PD3 mode).
    b. The check fails if VIF field PD_Port_Type != Consumer Only and the UUT does not send a Source Capabilities message

TEST.PD.PROT.SNK.3 SinkWaitCapTimer Deadline

Description: The Tester verifies that the UUT provides a Request to a Source Capabilities message sent at the deadline limit of tTypeCSinkWaitCap after a Hard Reset.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester sends a Hard Reset. It drives VBUS to vSafe0V and then restores VBUS to vSafe5V.

3. The Tester transmits Source Capabilities message with single PDO immediately prior to tTypeCSinkWaitCap min (the delay is from the time VBUS present vSafe5V min to the last bit of Source Capabilities message EOP):

a. B31…30 (Fixed Supply) set to 00b

b. B29 (Dual-Role Power) set to 0b, Tester is a Source only

c. B28 (USB Suspend Supported) set to 0b

d. B26 (USB Communications Capable) set to 0b

e. B25 (Dual-Role Data) set to 0b

f. B24…22 (Reserved) set to 00b

g. B21…20 (Peak Current) set to 00b

h. B19…10 (Voltage) set to 5V

i. B9…0 (Maximum Current) set to 100mA

4. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The Tester checks that the UUT responds with a Request message.
[TEST.PD.PROT.SNK.3#1]

TEST.PD.PROT.SNK.4 SinkWaitCapTimer Timeout

Description: The Tester does not send Source Capabilities message after cycling VBUS to force a SinkWaitCapTimer timeout on the UUT, then verifies it is correctly implemented.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Hard Reset. It drives VBUS to vSafe0V and then restores VBUS to vSafe5V.

3. The Tester does not send a Source Capabilities message after cycling the VBUS to force a SinkWaitCaptTimer timeout on the UUT.
4. The check fails if the UUT does not send a Hard Reset between tTypeCSinkWaitCap min and max. [TEST.PD.PROT.SNK.4#1] The delay is between the VBUS present vSafe5V min and the time of the first bit of Preamble of the Hard Reset sent by the UUT.

TEST.PD.PROT.SNK.5 SenderResponseTimer Deadline

Description: The Tester verifies that the UUT accepts an Accept message sent at the deadline limit of tSenderResponse min.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:
1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester transmits Source Capabilities message with single PDO
    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 0b, Tester is a Source only
    c. B28 (USB Suspend Supported) set to 0b
    d. B26 (USB Communications Capable) set to 0b
    e. B25 (Dual-Role Data) set to 0b
    f. B24…22 (Reserved) set to 00b
    g. B21…20 (Peak Current) set to 00b
    h. B19…10 (Voltage) set to 5V
    i. B9…0 (Maximum Current) set to 100mA
3. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The check fails if the UUT does not respond with a Request message.
4. The Tester sends an Accept message at the deadline limit of tSenderResponse min after the GoodCRC message. This delay is measured from the time the last bit of the GoodCRC message has been transmitted to the time the last bit of the Accept message has been transmitted.
5. The check fails if a Hard Reset is detected before tSenderResponse max after the GoodCRC message sent in respond to the Request message. [TEST.PD.PROT.SNK.5#1]

TEST.PD.PROT.SNK.6 SenderResponseTimer Timeout

Description: The Tester does not respond to the Request message from the UUT, in order to force a SenderResponseTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:
1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester transmits Source Capabilities message with single
    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 0b, Tester is a Source only
    c. B28 (USB Suspend Supported) set to 0b
    d. B26 (USB Communications Capable) set to 0b
    e. B25 (Dual-Role Data) set to 0b
    f. B24…22 (Reserved) set to 00b
    g. B21…20 (Peak Current) set to 00b
    h. B19…10 (Voltage) set to 5V
    i. B9…0 (Maximum Current) set to 100mA
3. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The check fails if a Request message is not received from the UUT.
4. The Tester does not send an Accept (as a response to the Request message) in order to force a SenderResponseTimer timeout on the UUT.
5. The Tester checks that a Hard Reset is detected between tSenderResponse min and max, the delay is between the last bit of the GoodCRC message EOP has been sent and the first bit of Hard Reset SOP has been received. [TEST.PD.PROT.SNK.6#1]

TEST.PD.PROT.SNK.7 PSTransitionTimer Timeout

Description: The Tester does not send the PS_RDY message after the Accept message is sent to the UUT, in order to force a PSTransitionTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester transmits Source Capabilities message with single PDO (5V @ 100mA, Source only).

3. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The check fails if a Request message is not received from the UUT.
[TEST.PD.PROT.SNK.7#1]

4. The Tester responds with an Accept message to the Request message.

5. The Tester does not send a PS_RDY message.

6. The check fails if a Hard Reset is not detected within tPStransition min and tPStransition max.
[TEST.PD.PROT.SNK.7#2] The delay is between the last bit of the Accept message EOP and the first bit of Preamble of the Hard Reset sent by the UUT.

TEST.PD.PROT.SNK.8 Atomic Message Sequence – Accept

Description: The Tester sends a GetSinkCap message in place of Accept message and verifies the UUT will send a SoftReset and recover from the error.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester sends a Hard Reset. It drives VBUS to vSafe0V and then restores VBUS to vSafe5V.

3. The Tester transmits Source Capabilities message with single PDO immediately prior to tTypeCSinkWaitCap min

   a. B31…30 (Fixed Supply) set to 00b
   b. B29 (Dual-Role Power) set to 0b, Tester is a Source only
   c. B28 (USB Suspend Supported) set to 0b
   d. B26 (USB Communications Capable) set to 0b
   e. B25 (Dual-Role Data) set to 0b
   f. B24…22 (Reserved) set to 00b
   g. B21…20 (Peak Current) set to 00b
   h. B19…10 (Voltage) set to 5V
   i. B9…0 (Maximum Current) set to 100mA

4. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The check fails if the UUT does not respond with a Request message. [TEST.PD.PROT.SNK.8#1]

5. The Tester sends a Get_Sink_Cap message at the limit of tReceiverResponse max after the reception of Request message. The delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Request message.

6. The check fails if a Soft_Reset message is not received within tProtErrSoftReset max. [TEST.PD.PROT.SNK.8#2]

7. The Tester responds with an Accept message to the Soft_Reset message.

8. The Tester sends Source Capabilities message to the UUT repeatedly until nCapsCount is reached or a GoodCRC is received. The check fails if nCapsCount is reached.

9. The check fails if the UUT does not respond with a Request message. [TEST.PD.PROT.SNK.8#3]

TEST.PD.PROT.SNK.9 Atomic Message Sequence – PS_RDY

Description: The Tester sends a GetSinkCap message in place of PS_RDY message and verifies the UUT will send a Hard Reset.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Hard Reset.
3. The Tester drives VBUS to vSafe0V and then restores VBUS to vSafe5V. The Tester transmits Source Capabilities message with single PDO (5V @ 100mA, Source only) immediately prior to tTypeCSinkWaitCap min.
4. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode. The check fails if a Request message is not received from the UUT.
    [TEST.PD.PROT.SNK.9#1]
5. The Tester responds with an Accept message to the Request message.
6. The Tester sends a Get_Sink_Cap message at tPSTransition min after the last bit of the EOP of the Accept message sent.
7. The check fails if a Hard Reset is not received within 15ms after the last bit of the EOP of the GoodCRC message received. [TEST.PD.PROT.SNK.9#2]

TEST.PD.PROT.SNK.10 DR_Swap Request

Description: As a Sink, the Tester sends a DR_Swap message, and verifies that the UUT responds correctly.

Test Specific Tester Behavior:

- The Tester always replies with a Reject message to a DR_Swap message

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester requests a DR_Swap. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.

3. The Tester checks the response. [TEST.PD.PROT.SNK.10#1]
   a. If the UUT responds with a Wait message, the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails if the Tester has resent DR_Swap for 10 times and the test ends here.
   b. The check fails if
      i. In PD2, the UUT responds with a Reject message and the VIF field DR_Swap_To_DFP_Supported = Yes.
      ii. In PD3, the UUT responds with either
         1. Not_Supported and (the VIF field DR_Swap_To_DFP_Supported = Yes **or** the VIF field DR_Swap_To_UFP_Supported = Yes) **or**
         2. Reject **and** the VIF field DR_Swap_To_DFP_Supported = Yes

      If the check fails, the test ends here.

   c. The check fails if the UUT responds with an Accept message and the VIF field DR_Swap_To_DFP_Supported = No.
4. If VIF field DR_Swap_To_DFP_Supportd=N, the test ends here. Otherwise, the Tester requests a further DR_Swap.
5. The Tester checks the response. [TEST.PD.PROT.SNK.10#2]
   a. If the UUT responds with a Wait message, the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails if the Tester has resent DR_Swap for 10 times.
   b. The check fails if
      i. In PD2, the UUT responds with a Reject message and the VIF field DR_Swap_To_UFP_Supported = Yes.
      ii. In PD3, the UUT responds with either
         1. Not_Supported **and** (the VIF fields DR_Swap_To_UFP_Supported = Yes **or** the VIF fields DR_Swap_To_DFP_Supported = Yes) or
         2. Reject **and** the VIF fields DR_Swap_To_UFP_Supported = Yes
   c. The UUT responds with an Accept message and the VIF field DR_Swap_To_UFP_Supported = No.

TEST.PD.PROT.SNK.11 VCONN_Swap Request
Description: As a Source, the Tester sends a VCONN_Swap message, and verifies that the UUT responds correctly.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester presents Ra to the non-CC line (of the UUT). The Tester checks that VCONN is not present at the non-CC line. [TEST.PD.PROT.SNK.11#1]
3. The Tester requests a VCONN_Swap. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.
4. The Tester checks the response. [TEST.PD.PROT.SNK.11#2]
    a. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.
    b. The check fails and the test ends here if the UUT responds with a Reject message or Not_Supported (PD3 only), and the VIF field VCONN_Swap_To_On_Supported = Yes
    c. The check fails if the UUT responds with an Accept message and the VIF field VCONN_Swap_To_On_Supported = No
    d. The test ends here if the UUT does not send an Accept message.
5. The Tester checks that the UUT sends a PS_RDY message. [TEST.PD.PROT.SNK.11#3]
6. The Tester checks that VCONN is present at the non-CC line. [TEST.PD.PROT.SNK.11#4]
7. The Tester requests a further VCONN_Swap.
8. The Tester checks the response. [TEST.PD.PROT.SNK.11#5]
    a. If the UUT's response is a Wait, the Tester waits tVCONNSwapWait + 15ms seconds to resend VCONN_Swap. The Tester sends VCONN_Swap up to 10 times, and the test ends here if the UUT does not respond with an Accept or Reject message.
        i. In PD3 mode and the UUT responds with a Reject message, the check fails.
        ii. In PD2 mode and the UUT responds with a Reject message, the check fails if VCONN_Swap_To_Off_Supported = YES.
9. The Tester sends a PS_RDY message.
10. The Tester checks that the UUT does not present VCONN at the non-CC line within *tVCONNSourceOff*. [TEST.PD.PROT.SNK.11#6]

TEST.PD.PROT.SNK.12 PR_Swap – PSSourceOffTimer Timeout

Description: As a new Sink, the Tester intentionally does not send a PS_RDY message after a PR_Swap in order to force a PSSourceOffTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Source
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 0b COMMON.PROC.PD.3

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a PR_Swap message. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.
3. The Tester checks the response. [TEST.PD.PROT.SNK.12#1]
    a. If the UUT responds with a Wait message, the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent PR_Swap for 10 times.
    b. If the VIF field Accept_PR_Swap_As_Snk = No, the check fails if the UUT responds with an Accept message.
    c. If the VIF field Accept_PR_Swap_As_Snk = Yes, the check fails if the UUT responds with a Reject message or Not Supported (PD3 only).
    d. If the VIF field PD_Port_Type is set to "Consumer Only", the Tester checks that the UUT responds with a Reject message or Not Supported (PD3 only). The test ends here.
4. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.
5. The Tester continues to assert Rp (i.e., the Tester does not assert Rd so that Tester can detect the UUT entering Error Recovery). The Tester does not send a PS_RDY message, in order to force a PSSourceOffTimer timeout on the UUT.
6. A USB Type-C Error Recovery is expected from the UUT. The Tester checks the response: [TEST.PD.PROT.SNK.12#2]
    a. The check fails if a USB Type-C Error Recovery is not detected after tPSSourceOff max after the time the last bit of the EOP of the GoodCRC Message corresponding to the received Accept message.
    b. The check fails if a USB Type-C Error Recovery is detected within tPSSourceOff min after the last bit of the EOP of the GoodCRC Message corresponding to the received Accept message.

TEST.PD.PROT.SNK.13 PR_Swap – Request SenderResponseTimer Timeout

Description: As a new Sink, the Tester intentionally does not send a Request message after a PR_Swap in order to force a SenderResponseTimer timeout on the UUT and verifies it is correctly implemented.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Source
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 0b COMMON.PROC.PD.3

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a PR_Swap message. The Tester continues to present SinkTxNG while waiting for a response if the test is running in PD3 mode.
3. The Tester checks the response. [TEST.PD.PROT.SNK.13#1]
    a. If the UUT responds with a Wait message, the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent PR_Swap for 10 times.
    b. If the VIF field Accept_PR_Swap_As_Snk = No, the check fails if the UUT responds with an Accept message.
    c. If the VIF field Accept_PR_Swap_As_Snk = Yes, the check fails if the UUT responds with a Reject message or Not Supported (PD3 only).
    d. If the VIF field PD_Port_Type is set to "Consumer Only", the Tester checks that the UUT responds with a Reject message or Not Supported (PD3 only). The test ends here.
4. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.
5. The Tester presents Rd on the CC wire. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.
6. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V. [TEST.PD.PROT.SNK.13#2]

7. The check fails if the PS_RDY from the UUT is not sent within tPSSourceOn min. [TEST.PD.PROT.SNK.13#3] This delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester.

8. The Tester checks that the UUT sends a Source Capabilities message after tSwapSourceStart min. [TEST.PD.PROT.SNK.13#4]

9. Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

10. The Tester waits 500ms to respond to messages from the UUT.

11. The Tester sends a Get_Source_Cap message to the UUT.

12. The check fails if the Tester does not receive Source Capabilities message. [TEST.PD.PROT.SNK.13#5]

13. The Tester intentionally does not send a Request message and waits for a Hard Reset.

14. The Tester checks that a Hard Reset is detected between tSenderResponse min and max, the delay is between the last bit of the GoodCRC message EOP has been sent and the first bit of Hard Reset SOP has been received. [TEST.PD.PROT.SNK.13#6]

TEST.PD.PROT.SNK.14 Valid Use of GoodCRC on Power up

Description: The Tester send Source_Capabilities at the earliest opportunity, and checks that the UUT does not send GoodCRC before it is completely ready for operation.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, DRP, C/P	Provider Only, P/C
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 1 ms.

5. The Tester transmits Source Capabilities message with single PDO:

    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 0b
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b
    e. B26 (USB Communications Capable) set to 0b
    f. B25 (Dual-Role Data) set to 0b
    g. B24 (PD3, Unchunked Extended Messages Supported) set to 0b
    h. B23 (EPR Mode Capable) to 0b, unless it is mentioned in the test procedure
    i. B21…20 (Peak Current) set to 00b
    j. B19…10 (Voltage) set to 5V
    k. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.

7. The check fails if the UUT does not respond with a Request message, within tReceiverResponse of the UUT sending the **first** GoodCRC. [TEST.PD.PROT.SNK.14#1]

8. The Tester responds with an Accept message to the Request message.

9. If the VBUS voltage is stable within the target voltage, the Tester sends a PS_RDY message at tPSTransition min after the reception of Accept message.

10. An explicit contract is now established.

5.4.2   PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Consumer Only, Consumer/Provider and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PROT.SNK3.1 Get_Source_Cap_Extended

Description: The Tester verifies that the Sink UUT responds correctly to Get_Source_Cap_Extended message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev3ChkdSnk	✓	
Rev3UnchkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Source_Cap_Extended message to the UUT and continues to present SinkTxNG while waiting for a response.
3. The check fails if the UUT does not send either Not_Supported or Source_Capabilities_Extended message. [TEST.PD.PROT.SNK3.1#1]

TEST.PD.PROT.SNK3.2 Alert Response Source Input Change

Description: As a Source, the Tester sends Alert message indicating OTP event and verifies that the response messages are correct.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The Tester sends an Alert message to the UUT with Type of Alert field = OTP event (Bit 3).
3. The Tester presents SinkTxOK.
4. The test stops here when one of the following conditions happens:
   a. A Not_Supported message is received as a response to the last Alert message
   b. A Get_ Status message is received as a response to the last Alert message
   c. No Get_ Status message is received within 500 ms after the last Alert message was sent

TEST.PD.PROT.SNK3.3 Alert Response Battery Status Change

Description: As a Source, the Tester sends Alert message indicating Battery Status Change and verifies that the response messages are correct.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev3ChkdSnk	✓	
Rev3UnchkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends an Alert message to the UUT
   a. Type of Alert field = Battery Status Change Event (Bit 1)
   b. Fixed Batteries = Battery 0 (B20)
3. The Tester presents SinkTxOK.
4. The test stops here when one of the following conditions happens:
   a. A Not_Supported message is received as a response to the last Alert message
   b. A Get_Battery_Status message is received; the Tester checks that Battery Status Ref = 0. [TEST.PD.PROT.SNK3.3#1]
   c. No Get_Battery_Status message is not received within 500 ms after the last Alert message was sent.

TEST.PD.PROT.SNK3.4 Soft_Reset Sent Regardless of Rp Value

Description: The Tester verifies that the Sink UUT responds correctly to a missing GoodCRC.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Sink_Cap message to the UUT and continues to present SinkTxNG while waiting for a response.
3. Upon receipt of the Sink_Capabilities Message, the Tester doesn't reply with GoodCRC.
4. The check fails if a Soft_Reset message is not sent by the UUT within tReceive max + tSoftReset max. [TEST.PD.PROT.SNK3.4#1] The delay is measured from the time the last bit of the last retransmitted Sink_Capabilities Message EOP has been received to the time the last bit of the Soft_Reset message EOP has been received.

TEST.PD.PROT.SNK3.5 Sink PPS Normal Operation

Description: The Tester verifies that the Sink UUT verifies the UUT periodically re-request the PPS APDO.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, DRP, C/P	Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.12
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.5
2. The Tester presents SinkTxOk.
3. The check fails if a Request message is not received within tPPSRequest max.
    [TEST.PD.PROT.SNK3.5#1] The delay is measured from the time the last bit of the EOP of the

GoodCRC Message sent by the Tester in response to the previous Request Message to the time the first bit of the Preamble of the new Request Message is received.

4. The Tester runs the following additional field checks on the Request Data Object: [TEST.PD.PROT.SNK3.5#2]
   a. Object Position field is 2.

TEST.PD.PROT.SNK3.6 Revision Number Test

Description: As a Source, the Tester sends Source Capabilities message with the Message Header containing a higher revision number than that supported and the UUT responds using the highest supported revision number.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
Rev3ChkdSnk	✓	

Test Procedures:

1. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 50 ms.

5. The Tester sets the Specification Revision (in the Message Header) to 11b and transmits Source Capabilities message with single PDO:

   a. B31…30 (Fixed Supply) set to 00b
   b. B29 (Dual-Role Power) set to 0b
   c. B28 (USB Suspend Supported) set to 0b
   d. B27 (Unconstrained Power) set to 1b
   e. B26 (USB Communications Capable) set to 0b
   f. B25 (Dual-Role Data) set to 0b
   g. B24…22 (Reserved) set to 00b
   h. B21…20 (Peak Current) set to 00b
   i. B19…10 (Voltage) set to 5V
   j. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least nCapsCount times.

7. The check fails if a Request message is not received from the UUT. [TEST.PD.PROT.SNK3.7#1]

TEST.PD.PROT.SNK3.7 GoodCRC Specification Revision Compatibility

Description: As a Source, the Tester verifies the UUT accepts GoodCRC with Specification Revision set to 00b, 01b, or 10b.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
Rev3ChkdSnk	✓	

Test Procedures:

1. The test starts in a disconnected state.

2. The tester applies Rp.

3. If the UUT attachment is detected, the Tester applies VCONN (if Ra is detected) and vSafe5V on VBUS.

4. The Tester waits for 50 ms.

5. The Tester transmits Source Capabilities message with single PDO:

    a. B31…30 (Fixed Supply) set to 00b
    b. B29 (Dual-Role Power) set to 0b
    c. B28 (USB Suspend Supported) set to 0b
    d. B27 (Unconstrained Power) set to 1b
    e. B26 (USB Communications Capable) set to 0b
    f. B25 (Dual-Role Data) set to 0b
    g. B24…22 (Reserved) set to 00b
    h. B21…20 (Peak Current) set to 00b
    i. B19…10 (Voltage) set to 5V
    j. B9…0 (Maximum Current) set to 100mA

6. Repeat Step-5 if the Tester does not receive a GoodCRC from the UUT in response to Source Capabilities message. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least nCapsCount times.

7. The check fails if the UUT does not respond with a Request message. [TEST.PD.PROT.SNK3.8#1]

8. The Tester sends a GoodCRC (acknowledging the Request message) with Specification Revision set to 00b. The check fails if the UUT retransmits the Request message.
[TEST.PD.PROT.SNK3.8#2]

9. Repeat the test with Specification Revision in GoodCRC set to 01b and 10b.

5.5 Structured VDM Test Procedures for Source Capable UUT

5.5.1 PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Provider Only, Provider/Consumer and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.VDM.SRC.1 Discovery Process and Enter Mode

Description: The Tester verifies that the UUT responds appropriately to VDM messages.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends Request message with B25 (USB Communication Capable) set to 1b.
3. The Tester sends a Discover Identity Request to the UUT, using SOP. The Tester checks the response:
   a. In PD2 mode, the Tester checks the response as follow: [TEST.PD.VDM.SRC.1#1]

        i. The check fails If Supports Structured VDM is NO and the UUT responds with Responder NAK

        ii. The check fails If Supports Structured VDM is YES and the UUT Ignores the Discover Identity Request and

        iii.

b. The check fails If the UUT responds with Responder ACK or Responder BUSYIn PD3 mode, the Tester checks the response as follow: [TEST.PD.VDM.SRC.1#2]

        i. The check fails if the UUT responds with anything but a Discover ID Response message or Not_Supported, and the Tester has resent Discover ID Request tVDMBusy min after it is in PE_SRC_RDY for 10 times.

        ii. The check fails if the UUT responds with a "Responder BUSY" message, and the Tester has resent Discover ID Request for 10 times every tVDMBusy min

        iii. The check fails If Supports Structured VDMs is NO and the UUT responds with Responder ACK

        iv. The check fails if Responds_To_Discov_SOP_DFP is NO and the UUT responds with Responder ACK

        v. The check fails If Responds_To_Discov_SOP_DFP is YES and the UUT responds with Responder NAK

        vi. The check fails If Supports Structured VDMs is NO and the UUT responds with Responder NAK.

        vii.

c. The check fails If Supports Structured VDMs is YES and the UUT responds with Not Supported, If the UUT sends a "Responder ACK" message, the Tester performs the following check on the "Responder ACK" message: [TEST.PD.VDM.SRC.1#3]

        i. ID Header VDO:

           1. The check fails if B31 does not match VIF field Data_Capable_as_USB_Host_SOP

           2. The check fails if B30 does not match VIF field Data_Capable_as_USB_Device_SOP

           3. Check fails if B29..27 if:

               a. In PD2 Mode:

                    i. Field is not set to Undefined if VIF Product_Type_UFP_SOP is PSD

                    ii. Does not match VIF Product_Type_UFP_SOP otherwise

               b. In PD3 Mode:

                   Does not match VIF Product_Type_UFP_SOP

           4. The check fails if B26 does not match VIF field Modal_Operation_Supported_SOP

           5. In PD3, the check fails if B25…23 does not match VIF field Product_Type_DFP_SOP

           6. In PD3, the check fails if B22…21 does not match VIF field ID_Header_Connector_Type

           7. In PD3, the check fails if B20…16 is not set to zero

           8. In PD2, the check fails if B25…16 is not set to zero

        9.   The check fails if B15…0 does not match VIF field USB_VID_SOP

      ii.   The check fails if Cert Stat VDO does not match VIF field XID_SOP

     iii.   The check fails if Product VDO does not match VIF fields PID_SOP and bcdDevice_SOP

4. The Tester sends an Attention Request message to the UUT.
5. The Tester waits for tSenderResponse and the check fails if the UUT sends an Attention Response message (ACK, NAK or BUSY). [TEST.PD.VDM.SRC.1#4]

TEST.PD.VDM.SRC.2 Invalid Fields – Discover Identity

Description: The Tester verifies that the UUT responds correctly to a Discover Identity Request sent with invalid fields.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only	Provider Only, C/P, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester instead sends Request message with B25 (USB Communication Capable) set to 1b.
3. The Tester sends Discover Identity Request message with SVID = 0xEEEE. The Tester checks the response. [TEST.PD.VDM.SRC.2#1]
   a. If VIF fields Responds_To_Discov_SOP_UFP and Responds_To_Discov_SOP_DFP are set to NO, then the UUT response shall be Ignore in PD2 and Not_Supported in PD3.
   b. Otherwise, the check fails if the UUT does not reply with a "Responder NAK". The check fails if the SVID is not set to 0xEEEE in the "Responder NAK" message.

5.6   Structured VDM Test Procedures for Sink Capable UUT

5.6.1   PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Consumer Only, Consumer/Provider and DRP.

- This section uses the following behavior, except where defined in <u>Test Specific Tester Behavior</u> or a <u>Test Procedure</u>:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.VDM.SNK.1 Discovery Process and Enter Mode

Description: The Tester verifies that the UUT responds correctly to the Discovery Process and the Enter Mode message.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover Identity Request to the UUT, using SOP. The Tester checks the response. [TEST.PD.VDM.SNK.1#1]
   a. If the UUT responds with a "Responder NAK, the Tester checks that VIF fields Responds_To_Discov_SOP_UFP = NO and Responds_To_Discov_SOP_DFP = YES.
   b. If the UUT responds with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the Tester checks that VIF fields Responds_To_Discov_SOP_UFP = NO and Responds_To_Discov_SOP_DFP = NO.
   c. If the UUT interrupts the Discovery Process (by sending anything but a Discover ID Response message), the Tester resends Discover ID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover ID Request for 10 times.
   d. The check fails if the UUT responds with a "Responder BUSY" message and the Tester has resent Discover ID Request for 10 times every tVDMBusy min.
   e. The check fails if the UUT responds with a "Responder ACK" message and VIF field Responds_To_Discov_SOP_UFP= No.
3. The test ends here if the UUT does not send "Responder ACK" message.
4. Perform the following check on "Responder ACK" message: [TEST.PD.VDM.SNK.1#2]

a. Number of VDOs:
   i. The check fails if the number of VDOs in the message does not match the value stated in the Tables 4-1, 4-2, 4-3, 4-4 below, as appropriate, based on the Product Type(s) found in the message.
   ii. The check fails if the number of VDOs is 7, and the 6th VDO (Pad) is not all 0's.
b. ID Header VDO:
   i. The check fails if B31 does not match VIF field Data_Capable_as_USB_Host_SOP
   ii. The check fails if B30 does not match VIF field Data_Capable_as_USB_Device_SOP
   iii. The check fails if B29…27 if
        a. In PD2 Mode:
           i. Field is not set to Undefined if VIF Product_Type_UFP_SOP is PSD
           ii. Field is set to AMA and VIF Product_Type_UFP_SOP is not set to peripheral
           iii. Does not match VIF Product_Type_UFP_SOP otherwise
        b. In PD3:
           Does not match VIF Product_Type_UFP_SOP
   iv. The check fails if B26 does not match VIF field Modal_Operation_Supported_SOP
   v. In PD3 mode, the check fails if B25…23 does not match VIF field Product_Type_DFP_SOP
   vi. In PD3, the check fails if B22…21 does not match VIF field ID_Header_Connector_Type
   vii. In PD3 mode, the check fails if B20…16 is not set to zero
   viii. In PD2 mode, the check fails if B25…16 is not set to zero
   ix. The check fails if B15…0 does not match VIF field USB_VID_SOP
c. The check fails if Cert Stat VDO does not match VIF field XID_SOP
d. The check fails if Product VDO does not match VIF fields PID_SOP and bcdDevice_SOP

5. The Tester sends a Discover SVIDs Request to the UUT, using SOP. The Tester checks the response. [TEST.PD.VDM.SNK.1#3]
   a. The check fails if the UUT responds with either Not_Supported or Ignore. The test stops here.
   b. If the UUT interrupts the Discovery Process (by responding with anything but a Discover SVIDs Response message), the Tester resends Discover SVID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover ID Request for 10 times.
   c. If the UUT responds a "Responder BUSY" message, the Tester resends Discover SVIDs Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover SVIDs for 10 times, the check fails, and test stops here.
   d. If the UUT responds with a "Responder NAK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = No.
   e. If the UUT responds with a "Responder ACK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = Yes.

6. The Tester evaluates the number of SVIDs in the Discover SVIDs ACK message and checks the following: [TEST.PD.VDM.SNK.1#4]
    a. Each discovered SVID appears in VIF list SVID<X>_SOP. SVID's position in the VDO is checked according to SVID_Fixed_SOP value in VIF.
        i.   If SVID_Fixed_SOP is set to YES, the order of SVIDs in the VDO matches the order of SVID<X>_SOP in VIF.
        ii. If SVID_Fixed_SOP is set to NO, each SVID in the VDO list can be in any position in the VIF's SVID<X>_SOP list.
    b. The number of SVIDs discovered lies between Num_SVIDs_min_SOP and Num_SVIDs_max_SOP.
    c. For each VDO, the Tester checks if B15…0 (SVID n+1) are set to zeros, this marks the last VDO.
    d. For each VDO, the Tester checks if B31…16 (SVID n) are set to zeros, then B15…0 shall also be zeros and this marks the last VDO.
    e. If the Discover SVIDs ACK message has 6 VDOs, and B15…0 in VDO 6 is non-zero, then repeat Step-3 until the Tester finds the last VDO.
7. For each SVID:
    a. The Tester sends a Discover Modes Request to the UUT, using SOP.
    b. The Tester checks the response: [TEST.PD.VDM.SNK.1#5]
        i.   The check fails if the UUT responds with either Not_Supported or Ignore. The test stops here.
        ii. If the UUT interrupts the Discovery Process (by responding with anything but a Discover Modes Response message), the Tester resends Discover SVID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover ID Request for 10 times.
        iii. If the UUT responds a "Responder BUSY" message, the Tester resends Discover Modes Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover SVIDs for 10 times, the check fails, and test stops here.
        iv. If the UUT responds with a "Responder NAK" message, the Tester checks that Modal_Operation_Supported_SOP = No.
        v.   If the UUT responds with a "Responder ACK" message, the Tester checks that Modal_Operation_Supported_SOP = Yes.
        vi. The number of Modes discovered lies between SVID<X>_Num_Modes_Min_SOP and SVID<X>_Num_Modes_Max_SOP.
        vii. Check that each Mode discovered matches one of the VIF list SVID<X>_Mode<Y>_SOP. The procedure for matching them is as follows:
            1. If SVID<X>_Modes_Fixed_SOP is set to YES, the match is done by simply comparing the value in the VDO with the corresponding value in the SVID<X>_Mode<Y>_Recog_Value_SOP. Both lists should be in the same sequence.
            2. If SVID<X>_Modes_Fixed_SOP is set to NO, the value in the VDO is bitwise ANDed with each SVID<X>_mode<Y>_Recog_Mask_SOP and the result is compared with the corresponding SVID<X>_Mode<Y>_Recog_Value_SOP in turn until a match is found.

8. For every Mode in each SVID:
   a. The Tester sends Enter Mode to the UUT, using SOP.
   b. The Tester checks the response. [TEST.PD.VDM.SNK.1#6]
      i. If the UUT responds with "Responder BUSY", the check fails.
      ii. The check fails if the UUT responds with "Responder NAK" to the corresponding SVID<X>_mode<Y>_enter_SOP = Yes.
      iii. If the UUT responds with "Responder ACK" to Enter Mode, the Tester then sends an Exit Mode Request to the UUT using SOP. The check fails if the UUT does not respond with "Responder ACK" to Exit Mode.
9. The Tester sends an Attention Request message to the UUT.
10. The Tester waits for tSenderResponse and the check fails if the UUT sends an Attention Response message (ACK, NAK or BUSY). [TEST.PD.VDM.SNK.1#7]

Table 4-1 Rev 2 Port - Number of VDOs Expected

Product	Undefined	4
Type	PD USB Hub	4
(UFP)	PD USB Peripheral	4
	AMA	5

Table 4-2 Rev 2 Cable - Number of VDOs Expected

Product	PassiveCable	5
Type	Active Cable	5

Table 4-3 Rev 3 Port Number of VDOs Expected

		Product Type (DFP)			
		Undefined	PD USB Hub	PD USB Host	Power Brick
Product Type (UFP)	Undefined	4	5	5	5
	PD USB Hub	5	7*	7*	7*
	PD USB Peripheral	5	7*	7*	7*
	PSD	4	5	5	5

*The 6th VDO (Pad) must be all 0's

Table 4-4 Rev 3 Cable - Number of VDOs Expected

Product	PassiveCable	5
Type	Active Cable	6
	VPD	5

TEST.PD.VDM.SNK.2 Exit Mode without Entering

Description: The Tester verifies that the UUT responds with a correctly formed message to an Exit Mode command from the Tester.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover SVIDs Request to the UUT, using SOP.
3. The Tester checks the response: [TEST.PD.VDM.SNK.2#1]
    a. If the UUT responds with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the Tester checks that the UUT does not Support Structured VDMs. The test ends here.
    b. If the UUT interrupts the Discovery Process (by responding with anything but a Discover SVIDs Response message), the Tester resends Discover SVID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover ID Request for 10 times.
    c. If the UUT responds with a BUSY message, the Tester resends Discover SVIDs Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover SVIDs Request for 10 times, the check fails, and the test ends here.
    d. If the UUT responds with a "Responder NAK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = No. The test ends here.
    e. If the UUT responds with a "Responder ACK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = Yes.
4. The Tester sends Exit Mode to the UUT using SOP, set to the first SVID and the first Mode.
5. The Tester checks that Exit Mode NAK as a response is sent before tVDMExitMode max. [TEST.PD.VDM.SNK.2#2] This delay is from the last bit of the EOP of the GoodCRC.

TEST.PD.VDM.SNK.3 Interruption by PD Message

Description: The Tester verifies that the UUT correctly supports PD message interruption during VDM exchanges.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover ID Request to the UUT, using SOP.
3. The Tester sends a Get_Sink_Cap using SOP packet immediately after tInterFrameGap has expired, the delay is from the last bit of the EOP of the UUT sent GoodCRC.
4. The check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.VDM.SNK.3#1]
5. The Tester sends a Discover SVIDs Request to the UUT, using SOP.
6. The Tester sends a Get_Sink_Cap using SOP packet immediately after tInterFrameGap has expired, the delay is from the last bit of the EOP of the UUT sent GoodCRC.
7. The check fails if the UUT does not send a Sink Capabilities message. [TEST.PD.VDM.SNK.3#2]

TEST.PD.VDM.SNK.4 Interruption by VDM Message

Description: The Tester verifies that the UUT correctly aborts an ongoing VDM exchange if it is interrupted by other VDM command.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover ID Request to the UUT, using SOP.
3. The Tester sends a Discover SVIDs Request using SOP packet immediately after tInterFrameGap has expired, the delay is from the last bit of the EOP of the UUT sent GoodCRC.
4. The Tester checks the response: [TEST.PD.VDM.SNK.4#1]
a. If the UUT responds with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the Tester checks that the UUT does not support Structured VDMs. The test ends here.
b. If the UUT interrupts the Discovery Process (by responding with anything but a Discover SVIDs Response message), the Tester responds with appropriate response message and then resends Discover SVID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover SVID Request for 10 times.
c. If the UUT does not respond with a "Discover SVID Responder ACK/NAK/BUSY", the check fails.
d. If the UUT responds with a "Discover ID Responder ACK/NAK/BUSY" message, the check fails.

TEST.PD.VDM.SNK.5 DR Swap in Modal Operation

Description: The Tester verifies that the UUT issues a Hard Reset within tDRSwapHardReset if DR_Swap is sent by during a modal operation.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover SVIDs Request to the UUT, using SOP.
3. The Tester checks the response: [TEST.PD.VDM.SNK.5#1]
a. If the UUT responds with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the Tester checks that the UUT does not Support Structured VDMs. The test ends here.

b. If the UUT interrupts the Discovery Process (by responding with anything but a Discover SVIDs Response message), the Tester resends Discover SVID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails and the test ends here if the Tester has resent Discover ID Request for 10 times.

c. If the UUT responds with a BUSY message, the Tester resends Discover SVIDs Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover SVIDs Request for 10 times, the check fails, and the test ends here.

d. If the UUT responds with a "Responder NAK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = No. The test ends here.

e. If the UUT responds with a "Responder ACK" message, the Tester checks that VIF field Modal_Operation_Supported_SOP = Yes.

4. The test ends here if the UUT does not send Discover SVIDs ACK message.

5. For each SVID
   a. The Tester sends a Discover Modes Request to the UUT, using SOP.
   b. The Tester checks the response: [TEST.PD.VDM.SNK.5#2]
      i. The check fails if a response message (ACK, NAK or BUSY) is not sent.
      ii. If the UUT responds with a BUSY message, the Tester resends Discover Modes Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover Modes Request for 10 times, the check fails.
      iii. The check fails if the UUT does not responds with a Discover Modes ACK message using SOP.

6. For any first found Mode<Y> in the SVID<X> where SVID<X>_mode<Y>_enter = Yes in the VIF file:
   a. The Tester sends Enter Mode to the UUT, using SOP.
   b. The Tester checks the response: [TEST.PD.VDM.SNK.5#3]
      i. The check fails if a response message (ACK or NAK) is not sent.
      ii. If the UUT responds with an Enter Mode NAK, the test ends here
   c. If the UUT responds with an Enter Mode ACK, the Tester sends a DR_Swap using SOP packet. The check fails if Hard Reset is not received within tDRSwapHardReset. [TEST.PD.VDM.SNK.5#4]

TEST.PD.VDM.SNK.6 Structured VDM Revision Number Test

Description: The Tester verifies that the UUT correctly handles Structured VDM Version higher than supported.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, P/C, C/P, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Discover ID Request to the UUT, using SOP. The Structured VDM Version field in the VDM Header is set to 3.
3. The Tester checks the response [TEST.PD.VDM.SNK.6#1]
    a. If the UUT responds with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the Tester checks that VIF fields Responds_To_Discov_SOP_UFP = NO and Responds_To_Discov_SOP_DFP = NO.
    b. Otherwise (either VIF fields Responds_To_Discov_SOP_UFP = Yes or Responds_To_Discov_SOP_DFP = Yes), the Tester checks that a response message (ACK, NAK or BUSY) is sent.

TEST.PD.VDM.SNK.7 Unrecognized VID in Unstructured VDM

Description: As a DFP, the Tester verifies that the UUT responds a Not_Supported message to an unstructured VDM message with an unrecognized VID.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P , P/C, DRP	Provider Only
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
    b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends an unstructured VMD message to the UUT, in which VID in the Unstructured VDM Header is set to the Tester manufacture's VID.
3. If the UUT does not respond with either Not_Supported (in PD3 mode) or Ignore (in PD2 mode), the check fails. [TEST.PD.VDM.SNK.7#1]

5.7 Structured VDM Test Procedures for Cable Plug UUT

5.7.1 PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF fields:

 VIF_Product_Type = Cable OR

VIF_Product_Type = 0 (Port Product) AND **PD_Port_Type = 5** (eMarker) AND **Product_Type = 6** (Vconn Powered Device).

TEST.PD.VDM.CBL.1 Discovery Process and Enter Mode

Description: The Tester verifies that the UUT responds correctly to the Discovery Process and the Enter Mode message.

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev2VcMinEnd1				✓	✓
Rev3VcMinEnd1				✓	✓
Rev2VcMaxEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev2VcMinEnd2				✓	
Rev3VcMinEnd2				✓	
Rev2VcMaxEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   b. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10
   c. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   d. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.
2. The Tester sends a Discover ID Request to the UUT, using SOP'.

3. The Tester checks the response message: [TEST.PD.VDM.CBL.1#1]
   a. The check fails if the UUT responds anything but a Discover ID Response message.
   b. If the UUT responds with "Responder BUSY" message, the Tester resends Discover ID Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover ID for 10 times, the check fails.
   c. If the UUT responds with a "Responder NAK", the check fails.
   d. Check the "Responder ACK" message:
      i. In PD2 mode
         The check fails if the Number of Data Objects is not 5.
      ii. In PD3 mode
         If Product Type (ID Header B29…27) = **Passive Cable**, the check fails if the Number of Data Objects is not 5.
         If Product Type (ID Header B29…27) = **Active Cable**, the check fails if the Number of Data Objects is not 6.
         If Product Type (ID Header B29…27) = **VPD**, the check fails if the Number of Data Objects is not 5.
      iii. ID Header VDO:
         1. The check fails if B31 does not match VIF field Data_Capable_as_USB_Host
         2. The check fails if B30 does not match VIF field Data_Capable_as_USB_Device
         3. The check fails if B29…27 does not match VIF field Product_Type
         4. The check fails if B26 does not match VIF field Modal_Operation_Supported
         5. In PD2, the check fails if B25…16 is not set to zero
         6. In PD3, the check fails if B25…23 is not set to zero
         7. In PD3, the check fails if B22…21 does not match VIF field ID_Header_Connector_Type
         8. In PD3, the check fails if B20…16 is not set to zero
         9. The check fails if B15…0 does not match VIF field USB_VID
      iv. The check fails if Cert Stat VDO does not match VIF field XID
      v. The check fails if Product VDO does not match VIF fields PID and bcdDevice
      vi. Passive Cable VDO consistency with respective VIF fields:
         1. B31…28: Cable_HW_Vers
         2. B27…24: Cable_FW_Vers
         3. B23…21:
            a. In PD2 mode: Reserved 000b
            b. In PD3 mode: VDO Version is 000b
         4. B20: Reserved 0b
         5. B19…18:
            a. In PD2 mode: Type_C_To_Type_A_B_C
            b. In PD3 mode: Type_C_To_Type_C_Capt_Vdm_V2
         6. B17:
            a. In PD2 mode: (Reserved) 0b

b. In PD3 mode: EPR Mode Capable

7. B16…13 Cable_Latency
8. B12…11 Cable_Termination_Type
9. In PD2 mode: B10…7: Any Value Permitted
10. In PD3 mode
    a. B10…9: Max_VBUS_Voltage
    b. B10…9: If EPR Mode Capable is set to 1b, check that Max_VBUS_Voltage is set to 11b(50V)
    c. B8…7: Reserved 00b
11. B6…5
    a. In PD2: VBUS_through_cable is YES: Cable_VBUS_Current
    b. In PD2: VBUS_through_cable is NO: (Reserved) 00b
    c. In PD3: Cable_VBUS_Current
    d. In PD3: If EPR Mode Capable is set to 1b, check that Cable_VBUS_Current is set to 10b(5A)
12. B4
    a. In PD2: VBUS_through_cable
    b. In PD3: (Reserved) 0b
13. B3 (Reserved) 0b
14. B2…0 Cable_Superspeed_Support (in PD2 only)
15. B2…0 Cable_USB_Highest_Speed (in PD3 only)

vii. Active Cable VDO consistency (in PD2) or Active Cable VDO 1 consistency (in PD3) with respective VIF fields

1. B31…28: Cable_HW_Vers
2. B27…24: Cable_FW_Vers
3. B23…21:
   a. In PD2: Reserved 000b
   b. In PD3: VDO Version is 011b
4. B20: Reserved 0b
5. B19…18:
   a. In PD2: Type_C_To_Type_A_B_C
   b. In PD3: Type_C_To_Type_C_Capt_Vdm_V2
6. B17:
   a. In PD2 mode: (Reserved) 0b
   b. In PD3 mode: EPR Mode Capable
7. B16…13 Cable_Latency
8. B12…11 Cable_Termination_Type
9. In PD2: B10…7: Any Value Permitted
10. In PD3:
    a. B10…9: Max_VBUS_Voltage
    b. B10..9: If EPR Mode Capable is set to 1b, check that Max_VBUS_Voltage is set to 11b(50V)
    c. B8: SBU_Supported
    d. B7: SBU Active

11. B6…5
    a. If VBUS_Through_ Cable is NO, Reserved 00b
    b. If VBUS_Through_ Cable is YES, Cable_VBUS_Current
    c. In PD3: If EPR Mode Capable is set to 1b, check that Cable_VBUS_Current is seto to 10b(5A)
12. B4 VBUS_through_cable
13. B3 Cable_SOP''_controller
14. B2…0 Cable_Superspeed_Support (in PD2 only)
15. B2…0 Cable_USB_Highest_Speed (in PD3 only)

viii. Active Cable VDO 2 consistency in PD3
1. B31…24 Act_Cab_Max_Op_Temp
2. B23…16 Act_Cab_ShutDn_Temp
3. B15 Reserved 0b
4. B14…12 Act_Cab_U3_CLd_Power
5. B11 Act_Cab_U3_U0_Trans_Mode
6. B10 Act_Cab_Phys_Connect
7. B9 Act_Cab_Active_Elem
8. B8 Act_Cab_USB4_Supp
9. B7…6 Act_Cab_USB_2_0_Hub_Hops
10. B5 Act_Cab_USB_2_0_Supp
11. B4 Act_Cab_USB_3_2_Supp
12. B3 Act_Cab_USB_Lanes
13. B2 Act_Cab_Opt_Isol
14. B1 Reserved 0b
15. B0 Act_Cab_USB_Gen

ix. VPD consistency in PD3
1. B31…28 VPD_HW_Vers
2. B27…24 VPD_FW_Vers
3. B23…21 VDO Version is 000b
4. B20…17 Reserved 0000b
5. B16…15 VPD_Max_VBUS_Voltage
6. B14
    a. VPD_Charge_Through_Support = 1: VPD_Charge_Through_Current
    b. VPD_Charge_Through_Support = 0: Reserved 0b
7. B13 Reserved 0b
8. B12…7
    a. VPD_Charge_Through_Support = 1: VPD_VBUS_Impedance
    b. VPD_Charge_Through_Support = 0: Reserved 000000b
9. B6…1
    a. VPD_Charge_Through_Support = 1: VPD_Ground_Impedance
    b. VPD_Charge_Through_Support = 0: Reserved 000000b
10. B0 VPD_Charge_Through_Support

4. The Tester sends a Discover SVIDs Request to the UUT, using SOP'. The Tester checks the response message: [TEST.PD.VDM.CBL.1#2]
   e. The check fails if the UUT responds anything but a Discover SVIDs Response message.
   f. If the UUT responds with "Responder BUSY" message, the Tester resends Discover SVIDs Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover SVIDs for 10 times, the check fails, and the test ends here.
   g. If the UUT responds with a "Responder NAK" message, the check fails if VIF field Modal_Operation_Supported = YES. The test ends here.
   h. If the UUT responds with a "Responder ACK" message, the check fails if VIF field Modal_Operation_Supported = NO.
5. The Tester evaluates the number of SVIDs in the Discover SVIDs ACK message and checks the following: [TEST.PD.VDM.CBL.1#3]
   i. Each discovered SVID appears in VIF list SVID<X>. SVID's position in the VDO is checked according to SVID_Fixed value in VIF.
      i. If SVID_Fixed is set to YES, the order of SVIDs in the VDO matches the order of SVID<X> in VIF.
      ii. If SVID_Fixed is set to NO, each SVID in the VDO list can be in any position in the VIF's SVID<X> list.
   j. The number of SVIDs discovered lies between Num_SVIDs_min and Num_SVIDs_max.
   k. For each VDO, the Tester checks if B15…0 (SVID n+1) are set to zeros, this marks the last VDO.
   l. For each VDO, the Tester checks if B31…16 (SVID n) are set to zeros, then B15…0 shall also be zeros, and this marks the last VDO.
   m. If the Discover SVIDs ACK message has 6 VDOs, and B15…0 in VDO 6 is non-zero, then repeat Step-4 until the Tester finds the last VDO.
6. For each SVID:
   n. The Tester sends a Discover Modes Request to the UUT, using SOP'.
   o. The Tester checks the response: [TEST.PD.VDM.CBL.1#4]
      i. The check fails if the UUT responds anything but a Discover Modes Response message.
      ii. If the UUT responds with "Responder BUSY" message, the Tester resends Discover Modes Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover Modes for 10 times, the check fails, and the test ends here.
      iii. If the UUT responds with a "Responder ACK" message, the check fails if VIF field Modal_Operation_Supported = NO.
      iv. The number of Modes discovered lies between SVID<X>_Num_Modes_Min and SVID<X>_Num_Modes_Max.
      v. If the UUT responds with a "Responder NAK" message, the check fails if VIF field Modal_Operation_Supported = YES. The test ends here.
      vi. Check that each Mode discovered matches one of the VIF list SVID<X>_Mode<Y>. The procedure for matching them is as follows:
         1. If SVID<X>_Modes_Fixed is set to YES, the match is done by simply comparing the value in the VDO with the corresponding value in the

SVID<X>_Mode<Y>_Recog_Value. Both lists should be in the same sequence.

2. If SVID<X>_Modes_Fixed is set to NO, the value in the VDO is bitwise ANDed with each SVID<X>_mode<Y>_Recog_Mask and the result is compared with the corresponding SVID<X>_Mode<Y>_Recog_Value in turn until a match is found.

7. For every Mode in each SVID:
    p. The Tester sends Enter Mode to the UUT, using SOP'.
    q. The Tester checks the response: [TEST.PD.VDM.CBL.1#5]
        i. If the UUT responds with "Responder BUSY", the check fails.
        ii. The check fails if the UUT responds with "Responder NAK" to the corresponding SVID<X>_mode<Y>_enter = Yes. If the UUT responds with "Responder ACK" to Enter Mode, the Tester then sends an Exit Mode Request to the UUT. The check fails if the UUT does not respond with "Responder ACK" to Exit Mode.

8. The Tester sends Attention to the UUT. The check fails if the UUT does not ignore the message. [TEST.PD.VDM.CBL.1#6]

5.7.2 PD3 Mode

The tests in this subsection are run only in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field VIF_Product_Type set to Cable.

TEST.PD.VDM.CBL3.1 Revision Number Test

Description: As a Source, the Tester sends Discover ID REQ message with the Message Header containing a higher revision number than that supported and the UUT responds using the highest supported revision number.

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	VPD, Captive Cable
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

b. The UUT has VIF field VIF_Product_type set to Port Product and PD_Port_type set to eMarker. The Tester runs bring-up procedure with the UUT as a VPD COMMON.PROC.BU.10

c. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

d. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sets the Specification Revision (in the Message Header) to 11b and transmits a Discover ID Request to the UUT, using SOP'.

3. The Tester checks the response: [TEST.PD.VDM.CBL3.1#1]
    a. The check fails if either "Responder ACK" or "Responder BUSY" message is not sent before tVDMReceiverResponse. This delay is from the last bit of the EOP of the Discover ID Request to the first bit of the response.
    b. The Tester checks that the Specification Revision (in the Message Header) is set consistent with VIF field PD_Specification_Revision.
    c. If the UUT responds with a BUSY message, the Tester resends Discover ID Request for 10 times every tVDMBusy min. Once the Tester has repeated Discover ID for 10 times, the check fails if the UUT does not respond with a "Responder ACK" message.

6 Power Supply Specific Tests

PDO Sequence Table

Number of PDOs	1	2	3	4	5	6	7
Transition #1	1 to 1	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2	1 to 2
Transition #2		2 to 1	2 to 1	2 to 1	2 to 1	2 to 1	2 to 1
Transition #3			1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Transition #4			3 to 2	3 to 2	3 to 2	3 to 2	3 to 2
Transition #5			2 to 3	2 to 3	2 to 3	2 to 3	2 to 3
Transition #6			3 to 1	3 to 1	3 to 1	3 to 1	3 to 1
Transition #7				1 to 4	1 to 4	1 to 4	1 to 4
Transition #8				4 to 3	4 to 3	4 to 3	4 to 3
Transition #9				3 to 4	3 to 4	3 to 4	3 to 4
Transition #10				4 to 2	4 to 2	4 to 2	4 to 2
Transition #11				2 to 4	2 to 4	2 to 4	2 to 4
Transition #12				4 to 1	4 to 1	4 to 1	4 to 1
Transition #13					1 to 5	1 to 5	1 to 5
Transition #14					5 to 4	5 to 4	5 to 4
Transition #15					4 to 5	4 to 5	4 to 5
Transition #16					5 to 3	5 to 3	5 to 3
Transition #17					3 to 5	3 to 5	3 to 5
Transition #18					5 to 2	5 to 2	5 to 2
Transition #19					2 to 5	2 to 5	2 to 5
Transition #20					5 to 1	5 to 1	5 to 1
Transition #21						1 to 6	1 to 6
Transition #22						6 to 5	6 to 5
Transition #23						5 to 6	5 to 6
Transition #24						6 to 4	6 to 4
Transition #25						4 to 6	4 to 6
Transition #26						6 to 3	6 to 3
Transition #27						3 to 6	3 to 6
Transition #28						6 to 2	6 to 2
Transition #29						2 to 6	2 to 6
Transition #30						6 to 1	6 to 1
Transition #31							1 to 7
Transition #32							7 to 6
Transition #33							6 to 7
Transition #34							7 to 5
Transition #35							5 to 7
Transition #36							7 to 4
Transition #37							4 to 7
Transition #38							7 to 3
Transition #39							3 to 7
Transition #40							7 to 2
Transition #41							2 to 7
Transition #42							7 to 1

EPR PDO Sequence Table

Number of PDOs	8	9	10	11
Transition #1	1 to 8	1 to 8	1 to 8	1 to 8
Transition #2	8 to 7	8 to 7	8 to 7	8 to 7

Transition #3	7 to 8	7 to 8	7 to 8	7 to 8
Transition #4	8 to 6	8 to 6	8 to 6	8 to 6
Transition #5	6 to 8	6 to 8	6 to 8	6 to 8
Transition #6	8 to 5	8 to 5	8 to 5	8 to 5
Transition #7	5 to 8	5 to 8	5 to 8	5 to 8
Transition #8	8 to 4	8 to 4	8 to 4	8 to 4
Transition #9	4 to 8	4 to 8	4 to 8	4 to 8
Transition #10	8 to 3	8 to 3	8 to 3	8 to 3
Transition #11	3 to 8	3 to 8	3 to 8	3 to 8
Transition #12	8 to 2	8 to 2	8 to 2	8 to 2
Transition #13	2 to 8	2 to 8	2 to 8	2 to 8
Transition #14	8 to 1	8 to 1	8 to 1	8 to 1
Transition #15		1 to 9	1 to 9	1 to 9
Transition #16		9 to 8	9 to 8	9 to 8
Transition #17		8 to 9	8 to 9	8 to 9
Transition #18		9 to 7	9 to 7	9 to 7
Transition #19		7 to 9	7 to 9	7 to 9
Transition #20		9 to 6	9 to 6	9 to 6
Transition #21		6 to 9	6 to 9	6 to 9
Transition #22		9 to 5	9 to 5	9 to 5
Transition #23		5 to 9	5 to 9	5 to 9
Transition #24		9 to 4	9 to 4	9 to 4
Transition #25		4 to 9	4 to 9	4 to 9
Transition #26		9 to 3	9 to 3	9 to 3
Transition #27		3 to 9	3 to 9	3 to 9
Transition #28		9 to 2	9 to 2	9 to 2
Transition #29		2 to 9	2 to 9	2 to 9
Transition #30		9 to 1	9 to 1	9 to 1
Transition #31			1 to 10	1 to 10
Transition #32			10 to 9	10 to 9
Transition #33			9 to 10	9 to 10
Transition #34			10 to 8	10 to 8
Transition #35			8 to 10	8 to 10
Transition #36			10 to 7	10 to 7
Transition #37			7 to 10	7 to 10
Transition #38			10 to 6	10 to 6
Transition #39			6 to 10	6 to 10
Transition #40			10 to 5	10 to 5
Transition #41			5 to 10	5 to 10
Transition #42			10 to 4	10 to 4
Transition #43			4 to 10	4 to 10
Transition #44			10 to 3	10 to 3
Transition #45			3 to 10	3 to 10
Transition #46			10 to 2	10 to 2
Transition #47			2 to 10	2 to 10
Transition #48			10 to 1	10 to 1
Transition #49				1 to 11
Transition #50				11 to 10
Transition #51				10 to 11
Transition #52				11 to 9
Transition #53				9 to 11
Transition #54				11 to 8
Transition #55				8 to 11
Transition #56				11 to 7
Transition #57				7 to 11
Transition #58				11 to 6

Transition #59				6 to 11
Transition #60				11 to 5
Transition #61				5 to 11
Transition #62				11 to 4
Transition #63				4 to 11
Transition #64				11 to 3
Transition #65				3 to 11
Transition #66				11 to 2
Transition #67				2 to 11
Transition #68				11 to 1

6.1   Test Procedures for Source Capable UUT

6.1.1   PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Provider Only, Provider/Consumer and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider) The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PS.SRC.1 Multiple Request Load Test

Description: As a Sink only, the Tester verifies that the Source UUT responds correctly to various Request messages.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Requirements: If Captive_Cable = YES, **vSrcNew min** or **vPpsNew min** limit shall be (vSrcNew min) - (0.75*I/X) or (vPpsNew min) - (0.75*I/X), where I is the actual current being drawn, and X=3 if the sourced PDO contract is within the range (0, 3A], or X=5 if the sourced PDO contract is within the range (3A, 5A)

Test Procedures:

7. The Tester runs bring-up procedure with the UUT as a Source COMMON.BU.PD.1.

8. The Tester repeats the following steps for each of the PDOs (in the Source Capabilities message), starting with the first PDO:

    a. If the next Request will be for a PPS transition involving a current decrease (but no PDO change), the Tester reduces its current draw to the new level required, before sending the Request. (This avoids the current limit in the UUT shutting off VBUS.) The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per μs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of PpsNew. [TEST.PD.PS.SRC.1#9]

    b. The Tester sends a Request message.

        i. B27 (GiveBack Flag) = 0b

        ii. B26 (Capability Mismatch) = 0b

        iii. B25 (USB Communication Capable) = 0b

        iv. B24 (No USB Suspend) = 1b

        v. For Fixed, Battery or Variable PDO:

            1. B19…10 (Operating Current / Power):

                a. For first Request: 0mA/0mW

                b. For subsequent Request: As defined in Step 2.f.i

            2. B9…0 (Maximum Operating Current / Power) = Maximum Current / Power in the Source PDO.

        vi. For PPS:

            1. B19…9 (Output Voltage) = Maximum Voltage offered in Source APDO

            2. B6…0 (Operating Current):

                a. For first Request: 1A

                b. For subsequent Request: As defined in Step 2.f.II

        The initial Request is for PDO #1 (5V Fixed) at 0mA. The complete list of Requests is defined in step 2.f.

    c. The check fails if an Accept message is not received. [TEST.PD.PS.SRC.1#10]
    d. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.SRC.1#11]
    e. The Tester performs the following checks:

i. If the transition involves a current decrease (but no PDO change) [TEST.PD.PS.SRC.1#1]

    1. **For Fixed, Battery or Variable PDOs**:
The Tester decreases current to the new value within tSnkNewPower min of the last bit of the GoodCRC sent in response to the Accept message. The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per μs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew.

    2. **For PPS**:
The current was already reduced in step 2.a.

ii. If the transition involves a current increase (but no PDO change), the Tester increases current to the new value after the last bit of the GoodCRC sent in response to the PS_RDY message. The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per μs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew or vPpsNew. [TEST.PD.PS.SRC.1#2]

iii. If the transition involves a change of PDO, decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

    1. The Tester checks that VBUS remains within vSrcNew or vPpsNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.SRC.1#3]

    2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.SRC.1#4]

    3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits from the time of crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.SRC.1#5]

    4. The Tester checks that the VBUS voltage remains within vSrcNew or vPpsNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.SRC.1#6]

    5. The Tester checks that the UUT does not send PS_RDY before VBUS is within vSrcNew or vPpsNew. [TEST.PD.PS.SRC.1#7]

    6. After having sent GoodCRC in response to PS_RDY, the Tester increases its current draw to:

        a. For Fixed, Battery and Variable PDOs:

            The current or power requested.

  b. For PPS PDO:

      80% of the current requested (except that for the last step 0mA will be drawn.

    The Tester checks that the VBUS voltage remains within vSrcNew or vPpsNew limits for 100ms after receivingPS_RDY[TEST.PD.PS.SRC.1#8]

 f. The Tester repeats Step-2a to Step-2e, replacing the appropriate fields with the next value from the following list. The Tester sends 9 separate Request messages for each PDO (7 separate Request messages for PPS):

  i. For Fixed, Battery and Variable PDOs, replace B19…10 (Operating Current / Power):

    1. 0mA / 0mW [performed in Step 2.b; listed here for reference only]

    2. 25% of Maximum Current / Power in the Source PDO

    3. 50% of Maximum Current / Power in the Source PDO

    4. 75% of Maximum Current / Power in the Source PDO

    5. 100% of Maximum Current / Power in the Source PDO

    6. 75% of Maximum Current / Power in the Source PDO

    7. 50% of Maximum Current / Power in the Source PDO

    8. 25% of Maximum Current / Power in the Source PDO

    9. 0mA / 0mW

  ii. For PPS PDO, replace B19..9 (Output Voltage) and B6…0 (Operating Current):

    1. Maximum Voltage offered in Source APDO @ 1A (Tester will draw 0mA) [performed in Step 2.b; listed here for reference only]
    2. Maximum Voltage offered in Source APDO @ 1A (Tester will draw 80% of this.)
    3. Maximum Voltage offered in Source APDO @ (1A + Maximum Current offered in Source APDO)/2. (Tester will draw 80% of this.)
    4. Maximum Voltage offered in Source APDO @ Maximum Current offered in Source APDO. (Tester will draw 80% of this.)
    5. Maximum Voltage offered in Source APDO @ (1A + Maximum Current offered in Source APDO)/2. (Tester will draw 80% of this.)
    6. Maximum Voltage offered in Source APDO @ 1A (Tester will draw 80% of this)
    7. Maximum Voltage offered in Source APDO @ 1A (Tester will draw 0mA)

TEST.PD.PS.SRC.2 PDO Transitions

Description: As a Sink only, the Tester enumerates all possible transitions among the PDOs of the UUT and verifies the UUT performs PDO transitions correctly.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P	Provider Only, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Source COMMON.BU.PD.1.

2. The Tester repeats the following steps using the PDO as provided in the **PDO Sequence Table**:

    a. The Tester sends a Request message:

        i. B27 (GiveBack Flag) = 0b

        ii. B26 (Capability Mismatch) = 0b

        iii. B25 (USB Communication Capable) = 0b

        iv. B24 (No USB Suspend) = 1b

        v. For Fixed, Battery or Variable PDO:

            B19…10 (Operating Current / Power) = 100mA / 0.5W

            B9…0 (Maximum Operating Current / Power) = 100mA / 0.5W

        For PPS PDO:

            B19…9 (Output Voltage) = Maximum Voltage offered in Source APDO

            B7…0 (Operating Current) = 1A

    b. The check fails if an Accept message is not received. [TEST.PD.PS.SRC.2#1]

    c. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.SRC.2#2]

    d. The Tester performs the following checks:

    Decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby min of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

        1. The Tester checks the VBUS is within vSrcNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.SRC.2#3]

2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.SRC.2#4]

3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits from the time of crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.SRC.2#5]

4. The Tester checks that the VBUS voltage is within vSrcNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.SRC.2#6]

5. The Tester checks that the UUT does not send PS_RDY before the VBUS is within vSrcNew. [TEST.PD.PS.SRC.2#7]

TEST.PD.PS.SRC.3 Initial Source PDO Transition Post PR Swap

<u>Description:</u> The Tester verifies that after a PR_Swap, the new Sink UUT responds correctly to a new Source Capabilities messages

<u>Test Specific Tester Behavior:</u>

- The Tester is a Dual-Role Power, initially a Sink
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 1b COMMON.PROC.PD.3

<u>Test Conditions:</u>

	Consumer Only, C/P	Provider Only, P/C, DRP
Rev2Src		✓
Rev3ChkdSrc		✓

<u>Test Procedures:</u>

1. The Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. After this point the tester should reject any PR_swap request.
3. The Tester sends a PR_Swap message.
4. The Tester checks the response. [TEST.PD.PS.SRC.3#1]
   a. If the UUT responds with a Wait message and the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has resent PR_Swap for 10 times, the check fails, and the test ends here.
      i. If the UUT responds with Reject or Not_Supported (PD3 mode only) checkVIF field PD_Port_Type is set to "Provider Only" or
      ii. VIF field Accepts_PR_Swap_As_Src = No
         The test ends here.
   b. If the UUT responds with an Accept message, check that the VIF field PD_Port_Type is not set to "Provider Only" and VIF field Accepts_PR_Swap_As_Src = Yes.
5. After this point the Tester shall Reject any PR_Swap request.
6. The Tester draws no more than iSwapStandby within tSrcTransition min after it has sent the last GoodCRC.
7. The Tester checks that the UUT sends a PS_RDY message after the UUT driving VBUS voltage to vSafe0V. [TEST.PD.PS.SRC.3#2]
8. The Tester checks that the UUT sends PS_RDY within tSrcTransition max plus tSrcSwapStdby max after the last bit of GoodCRC was sent in response to the received Accept. [TEST.PD.PS.SRC.3#3]
9. The Tester presents vSafe5V on VBUS and then it sends a PS_RDY message, both within tNewSRC max of the last GoodCRC sent by the UUT.
10. The Tester transmits a Source Capabilities message with the Capabilities as defined in COMMON.PROC.PD.2 Paragraph 2c. (as these will have been the Source Capabilities

returned if the UUT has requested them during the PR_Swap. The Tester checks that the UUT sends a Request message. [TEST.PD.PS.SRC.3#4]

11. The UUT is now a Sink and the Tester is a Source.
12. The Tester sends an Accept message.
    a. If a new PDO has been requested:
        i. After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SRC.3#5]
        ii. Wait tSrcTransition from the GoodCRC message, and then change VBUS voltage requested to the new value and/or be prepared to supply more or less current within tSrcTransition max plus tSrcReady max as appropriate.
        iii. Check that the average power drawn by the UUT, measured in the 1ms before sending PS_RDY, does not exceed pSnkStdby max. [TEST.PD.PS.SRC.3#6]
        iv. The Tester sends a PS_RDY message to the UUT
    b. If no new PDO requested,
        i. After 315ms time period, (tSrcTransition max + tSrcReady max) check that the current drawn from VBUS does not exceed the previously contracted current (100mA). [TEST.PD.PS.SRC.3#7]
        ii. The Tester sends a PS_RDY message to the UUT.

13. The Tester performs the following check [TEST.PD.PS.SRC.3#8]
    a. For Fixed, Battery or Variable PDO:

       The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds.

    b. For PPS PDO:
       N/A
14. The UUT is now a Sink and the Tester is a Source.
15. The Tester presents SinkTxOK if the test is in PD3 mode. The Tester waits 500ms to respond to messages from the UUT.
16. The Tester sends a new Source Capabilities message with a single PDO
    The PDO:
        i. B31…30 (Fixed Supply) set to 00b
        ii. B29 (Dual-Role Power) set to 1b
        iii. B28 (USB Suspend Supported) set to 0b
        iv. B26 (USB Communications Capable) set to 0b
        v. B25 (Dual-Role Data) set to 1b
        vi. B24…22 (Reserved) set to 00b
        vii. B21…20 (Peak Current) set to 00b
        viii. B19…10 (Voltage) set to 5V
        ix. B9…0 (Maximum Current) set to the full requested current as provided in the 1st PDO of the Sink Capabilities from the UUT
17. The check fails if the UUT does not responds with a Request message.
    [TEST.PD.PS.SRC.3#9]
18. The Tester sends an Accept message.
        a. If a new PDO has been Requested:

i. After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SRC.3#10]

ii. Wait tSrcTransition from the GoodCRC message, and then change VBUS voltage requested to the new value and/or be prepared to supply more or less current within tSrcTransition max plus tSrcReady max as appropriate.

Check that the average power drawn by the UUT, measured in the 1ms before sending PS_RDY, does not exceed pSnkStdby max. [TEST.PD.PS.SRC.3#11]

iii. The Tester sends a PS_RDY message to the UUT

b. If no new PDO Requested,

i. After 315ms time period, (tSrcTransition max + tSrcReady max) check that the current drawn from VBUS does not exceed the contracted current. [TEST.PD.PS.SRC.3#12]

ii. The Tester sends a PS_RDY message to the UUT.

19. The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds. [TEST.PD.PS.SRC.3#13]

20. The Tester sends a new Source Capabilities message with a single PDO
    a. The PDO:
        i. B31…30 (Fixed Supply) set to 00b
        ii. B29 (Dual-Role Power) set to 1b
        iii. B28 (USB Suspend Supported) set to 0b
        iv. B26 (USB Communications Capable) set to 0b
        v. B25 (Dual-Role Data) set to 1b
        vi. B24…22 (Reserved) set to 00b
        vii. B21…20 (Peak Current) set to 00b
        viii. B19…10 (Voltage) set to 5V
        ix. B9…0 (Maximum Current) set to 0mA
21. The Tester checks that it receives a Request message [TEST.PD.PS.SRC.3#14]
22. The Tester sends an Accept message.
    a. After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkSusp max. [TEST.PD.PS.SRC.3#17]
    b. The Tester a PS_RDY message to the UUT.
23. The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds. [TEST.PD.PS.SRC.3#18]

6.2 Test Procedures for Sink Capable UUT

6.2.1 PD2 and PD3 Modes

The tests in this subsection are run firstly in PD2 mode and secondly in PD3 mode.

The tests in this subsection are applicable only to UUT with VIF field PD_Port_Type set to Consumer Only, Consumer/Provider and DRP.

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PS.SNK.1 PDO Transitions As Sink

Description: The Tester verifies that the UUT responds correctly to a new Source Capabilities messages.

Test Specific Tester Behavior: N/A

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a Get_Sink_Cap message to the UUT.
3. The check fails if the UUT does not send Sink Capabilities message. [TEST.PD.PS.SNK.1#1]
4. The Tester sends a new Source Capabilities message with PDOs, mirroring the VIF definition of the UUT Sink requirements (for Rev 3 include any PPS PDOs)
    a. The first PDO:
        i. B31…30 (Fixed Supply) set to 00b
        ii. B29 (Dual-Role Power) set to 0b
        iii. B28 (USB Suspend Supported) set to 0b
        iv. B26 (USB Communications Capable) set to 0b
        v. B25 (Dual-Role Data) set to 0b
        vi. B24…22 (Reserved) set to 00b
        vii. B21…20 (Peak Current) set to 00b
        viii. B19…10 (Voltage) set to 5V
        ix. B9…0 (Maximum Current) set to the full requested current as provided in the 1st PDO of the Sink Capabilities from the UUT

      b.   The remaining PDOs mirror the VIF definition of the UUT Sink requirements (for Rev 3 include any PPS PDOs) If the Sink Capabilities consists of only one PDO, the Tester provides only 1 PDO in the Source Capabilities.

5. The check fails if the UUT does not responds with a Request message. [TEST.PD.PS.SNK.1#2]

6. The Tester sends an Accept message.
      a.   If a new PDO has been requested:
           i.   After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SNK.1#3]
          ii.   Wait a nominal tSrcTransition from the GoodCRC message, and then change VBUS voltage requested to the new value and/or be prepared to supply more or less current within tSrcTransition max plus tSrcReady max as appropriate.
         iii.   As soon as the voltage on VBUS has stopped changing, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SNK.1#4]
         iv.   The Tester sends a PS_RDY message to the UUT
      b.   If no new PDO requested,
           i.   After 315ms time period, (tSrcTransition max + tSrcReady max) check that the current drawn from VBUS does not exceed the previously contracted current (100mA). [TEST.PD.PS.SNK.1#5]
         ii.   The Tester sends a PS_RDY message to the UUT.

7. The Tester performs the following check [TEST.PD.PS.SNK.1#6]

      a.   For Fixed, Battery or Variable PDO:

         The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds.

      b.   For PPS PDO:

         N/A

8. The Tester sends another new Source Capabilities message with single PDO
      a.   The PDO:
           i.   B31…30 (Fixed Supply) set to 00b
         ii.   B29 (Dual-Role Power) set to 0b
         iii.   B28 (USB Suspend Supported) set to 0b
         iv.   B26 (USB Communications Capable) set to 0b
         v.   B25 (Dual-Role Data) set to 0b
         vi.   B24…22 (Reserved) set to 00b
         vii.   B21…20 (Peak Current) set to 00b
         viii.   B19…10 (Voltage) set to 5V
         ix.   B9…0 (Maximum Current) set to 0mA

9. The check fails and the test ends here if the UUT does not respond with a Request message [TEST.PD.PS.SNK.1#7]

10. The Tester sends an Accept message.
      a.   If a new PDO has been requested:

i.   After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SNK.1#8]

ii. Wait a nominal tSrcTransition from the GoodCRC message, and then change VBUS voltage requested to the new value and/or be prepared to supply more or less current within tSrcTransition max plus tSrcReady max as appropriate.

iii. As soon as the voltage on VBUS has stopped changing, check that power drawn by the UUT does not exceed pSnkStdby max. [TEST.PD.PS.SNK.1#9]

iv. The Tester sends a PS_RDY message to the UUT

b. If no new PDO requested,

i.   After a total of tSrcTransition min, check that power drawn by the UUT does not exceed pSnkSusp max. [TEST.PD.PS.SNK.1#10]

ii. The Tester sends a PS_RDY message to the UUT.

11. The Tester checks that the current drawn by the UUT does not exceed the level specified in the current PDO over the next 5 seconds. [TEST.PD.PS.SNK.1#11]

TEST.PD.PS.SNK.2 Initial Sink PDO Transitions Post PR Swap

Description: The Tester verifies that the new Source UUT performs PDO transitions correctly.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Source
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 0b COMMON.PROC.PD.3

Test Conditions:

	Consumer Only, C/P, DRP	Provider Only, P/C
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. After this point the tester should reject any PR_swap request.
3. The Tester sends a PR_Swap message.
4. The Tester checks the response: [TEST.PD.PS.SNK.2#1]
   a. The check fails if the UUT responds with a Reject message or Not_Supported (PD3 only), and the VIF field Accepts_PR_Swap_As_Snk is "Yes".
   b. The test ends here if the UUT responds with a Reject message or Not_Supported (PD3 only).
   c. If the UUT responds with a Wait message, the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has repeated for 10 times, the check fails, and the test ends here.

d. If the UUT responds with an Accept message, the Tester checks that the VIF field PD_Port_Type is set to either "Consumer/Provider" or "DRP".

e. If the UUT responds with an Accept message, the Tester checks that the VIF field Accepts_PR_Swap_As_Snk is "Yes".

5. At tSrcTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.

6. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.

7. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V. [TEST.PD.PS.SNK.2#2]

8. The Tester checks that the PS_RDY from the UUT is within tNewSrc max, this delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester. [TEST.PD.PS.SNK.2#3]

9. Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

10. After this point the Tester shall Reject any PR_Swap request received.

11. The Tester repeats the following steps using the PDO as provided in the **PDO Sequence Table**:

a. The Tester sends a Request message:

i. B27 (GiveBack Flag) = 0b

ii. B26 (Capability Mismatch) = 0b

iii. B25 (USB Communication Capable) = 0b

iv. B24 (No USB Suspend) = 1b

v. B19…10 (Operating Current / Power) = 100mA / 0.5W

vi. B9…0 (Maximum Operating Current / Power) = Maximum Current / Power in the Source PDO.

b. The check fails if the UUT does not respond with an Accept message. [TEST.PD.PS.SNK.2#4]

c. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.SNK.2#5]

d. The Tester performs the following checks:

Decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby min of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

1. The Tester checks the VBUS is within vSrcNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.SNK.2#6]

2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.SNK.2#7]

3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits upon crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.SNK.2#8]

4. The Tester checks that the VBUS voltage is within vSrcNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.SNK.2#9]

5. The Tester checks that the UUT does not send PS_RDY before the VBUS is within vSrcNew. [TEST.PD.PS.SNK.2#10]

TEST.PD.PS.SNK.3 *Multiple Request Load Test Post PR Swap*

Description: The Tester verifies that the new Source UUT responds correctly to various Request messages.

Test Specific Tester Behavior:

- The Tester is a Dual-Role Power, initially a Source
- The Tester sends Sink Capabilities setting B27 (Unconstrained Power) to 0b COMMON.PROC.PD.3

Test Conditions:

	C/P, DRP	Consumer Only, Provider Only, P/C
Rev2Snk	✓	
Rev3ChkdSnk	✓	

Test Requirements: If Captive_Cable = YES, **vSrcNew min** or **vPpsNew min** limit shall be (vSrcNew min) - (0.75*I/X) or (vPpsNew min) - (0.75*I/X), where I is the actual current being drawn, and X=3 if the sourced PDO contract is within the range (0, 3A], or X=5 if the sourced PDO contract is within the range (3A, 5A)

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
2. The Tester sends a PR_Swap message.
3. The Tester checks the response: [TEST.PD.PS.SNK.3#1]
   a. The check fails if the UUT responds with a Reject message or Not_Supported (PD3 only), and the VIF field Accepts_PR_Swap_As_Snk is "Yes".

b. The test ends here if the UUT responds with a Reject message or Not_Supported (PD3 only).

c. If the UUT responds with a Wait message, the Tester resends PR_Swap every tPRSwapWait + 15ms for 10 times. Once the Tester has repeated for 10 times, the check fails, and the test ends here.

d. If the UUT responds with an Accept message, the Tester checks that the VIF field PD_Port_Type is set to either "Consumer/Provider" or "DRP".

e. If the UUT responds with an Accept message, the Tester checks that the VIF field Accepts_PR_Swap_As_Snk is "Yes".

4. At tSinkTransition max (this delay is from the last bit of GoodCRC sent in response to the Accept), the Tester drives the VBUS voltage to vSafe0V within tSrcSwapStdby max.

5. The Tester sends a PS_RDY at the deadline limit of tPSSourceOff min, the delay is from the time the last bit of the EOP of the GoodCRC corresponding to the Accept message.

6. The Tester checks that the UUT sends PS_RDY only after the UUT has applied vSafe5V. [TEST.PD.PS.SNK.3#2]

7. The Tester checks that the PS_RDY from the UUT is within tNewSrc max, this delay is from the GoodCRC sent by the UUT in response to the PS_RDY sent by the Tester. [TEST.PD.PS.SNK.3#3]

8. Once the Tester receives Source Capabilities message, the Tester establishes a PD contract using common procedure COMMON.PROC.PD.11.

9. After this point the Tester shall Reject any PR_Swap request received.

10. The Tester repeats the following steps for each of the PDOs (in the Source Capabilities message), starting with the first PDO:

a. If the next Request will be for a PPS transition involving a current decrease (but no PDO change), the Tester reduces its current draw to the new level required, before sending the Request. (This avoids the current limit in the UUT shutting off VBUS.) The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per μs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of PpsNew. [TEST.PD.PS.SNK.3#4]

b. The Tester sends a Request message:

   i. B27 (GiveBack Flag) = 0b

   ii. B26 (Capability Mismatch) = 0b

   iii. B25 (USB Communication Capable) = 0b

   iv. B24 (No USB Suspend) = 1b

   v. For Fixed, Battery or Variable PDO:

      1. B19…10 (Operating Current / Power) :

         a. For first Request: 0mA/0mW

         b. For subsequent Requests: As defined in Step 10.f.i

2. B9…0 (Maximum Operating Current / Power) = Maximum Current / Power in the Source PDO.

    vi. For PPS:

1. B19…9 (Output Voltage) = Maximum Voltage offered in Source APDO

2. B6…0 (Operating Current):

    a. For first Request: 1A

    b. For subsequent Requests: As defined in Step 10.f.ii.

The initial Request is for PDO #1 (5V Fixed) at 0mA. Further requests are defined in step 10f.

c. The check fails if an Accept message is not received. [TEST.PD.PS.SNK.3#12]
d. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.SNK.3#13]
e. The Tester performs the following checks:

    i. If the transition involves a current decrease (but no PDO change) [TEST.PD.PS.SNK.3#4]

1. **For Fixed, Battery or Variable PDOs**:
The Tester decreases current to the new value within tSnkNewPower min of the last bit of the GoodCRC sent in response to the Accept message. The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per µs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew.

2. **For PPS**:
The current was already reduced in step 10a.

    ii. If the transition involves a current increase (but no PDO change), the Tester increase current to the new value after the last bit of the GoodCRC sent in response to the PS_RDY message. The Tester draws the requested Operating Current / Power with a current transition slew rate of 100mA per µs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew or vPpsNew. [TEST.PD.PS.SNK.3#5]

    iii. If the transition involves a change of PDO, decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby min of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

1. The Tester checks that VBUS remains within vSrcNew or vPpsNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.SNK.3#6]

2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.SNK.3#7]

3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits from the time of crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.SNK.3#8]

4. The Tester checks that the VBUS voltage remains within vSrcNew or vPpsNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.SNK.3#9]

5. The Tester checks that the UUT does not send PS_RDY before the VBUS is within vSrcNew or vPpsNew. [TEST.PD.PS.SNK.3#10]

6. After having sent GoodCRC in response to PS_RDY, the Tester increases its current draw to:

   a. For Fixed, Battery and Variable PDOs: the current or power requested

   b. For PPS PDO: 80% of the current requested (except that for the last step 0mA will be drawn)

7. The Tester checks that the VBUS voltage remains within vSrcNew or vPpsNew limits for 100ms after receiving PS_RDY.

   [TEST.PD.PS.SNK.3#11]

f. The Tester repeats Step-10a through Step-10d, **replacing** The appropriate fields with the next value from the following list. The Tester sends 9 separate Request messages for each PDO (6 separate Request messages for PPS):

   i. For Fixed, Battery and Variable PDOs, replace B19…10 (Operating Current / Power):

      1. 0mA / 0mW [performed in Step 10.b; listed here for reference only]

      2. 25% of Maximum Current / Power in the Source PDO

      3. 50% of Maximum Current / Power in the Source PDO

      4. 75% of Maximum Current / Power in the Source PDO

      5. 100% of Maximum Current / Power in the Source PDO

      6. 75% of Maximum Current / Power in the Source PDO

      7. 50% of Maximum Current / Power in the Source PDO

      8. 25% of Maximum Current / Power in the Source PDO

      9. 0mA / 0mW

ii. For PPS PDO, replace B19…9 (Output Voltage) and B6…0 (Operating Current):

1. Maximum Voltage offered in Source APDO @ 1A (Tester will draw 0mA) [performed in Step 10.b; listed here for reference only]

2. Maximum Voltage offered in Source APDO @ 1A. (Tester draws 80% load)

3. Maximum Voltage offered in Source APDO @ (1A + Maximum Current offered in Source APDO)/2. (Tester draws 80% load)

4. Maximum Voltage offered in Source APDO @ Maximum Current offered in Source APDO. (Tester draws 80% load)

5. Maximum Voltage offered in Source APDO @ (1A + Maximum Current offered in Source APDO)/2. (Tester draws 80% load)

6. Maximum Voltage offered in Source APDO @ 1A (Tester draws 80% load)

7. Maximum Voltage offered in Source APDO @ 1A (Tester draws 0mA)

7 Extended Power Range Tests

7.1 Test Procedure for EPR Source Capable UUT

7.1.1 PD3 Mode

The tests in this subsection are run in PD3 mode.

- This section uses the following behavior, except where defined in <u>Test Specific Tester Behavior</u> or a <u>Test Procedure</u>: The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider) The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6, unless mentioned otherwise in the test procedure
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8
- The Tester sets the *EPR_Mode_Capable* bit to 1 in the Request and EPR_Request message, unless mentioned otherwise in the test procedure
- If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable), unless mentioned otherwise in the test procedure
- Configure Tester's Sink_Capabilities_Extended message as follows:
    - B21 (EPR Sink Minimum PDP): 140
    - B22 (EPR Sink Operational PDP): 140
    - B23 (EPR Sink Maximum PDP): 140

TEST.PD.EPR.SRC3.1 EPR Entry Process - UUT as VCONN Source

Description: The Tester as a sink verifies the successful EPR negotiation when UUT acts as a VCONN source.

Test Specific Tester Behavior:

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1

   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check that the "EPR mode capable" field in the Source Capabilities message sent by UUT matches with VIF parameter EPR_Supported_As_Src during the bring up procedure [TEST.PD.EPR.SRC3.1#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester performs below [TEST.PD.EPR.SRC3.1#2]

   a) If the VIF field EPR_Supported_As_Src is Yes, The Tester checks that UUT responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x00.

   b) If the VIF field EPR_Supported_As_Src is No, The Tester checks that UUT responds with Not_Supported message and the test stops here.

5. If the VIF field *Captive_Cable* is No, Tester performs below checks

   a. Tester checks that UUT does not sends a Vconn_Swap message [TEST.PD.EPR.SRC3.1#3]

   b. The check fails if the UUT does not send SOP' Discover Identity message [TEST.PD.EPR.SRC3.1#4]

6. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.1#5]

7. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.1#6]

8. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13 [TEST.PD.EPR.SRC3.1#10]

9. Tester waits for 2 seconds, If UUT sends EPR_Source_Capabilities message with no EPR PDOs, Tester checks that UUT completes the contract negotiation using common procedure COMMON.PROC.PD.13, otherwise, the Tester performs below steps

    a. Tester sends EPR_Request message with Object Position set to 1, Operating Current and Maximum Operating Current set to 100mA

    b. The check fails if an Accept message is not received. [TEST.PD.EPR.SRC3.1#7]

    c. The check fails if PS_RDY message is not received within tPSTransition max(EPR mode) from the last bit of the EOP of Accept message. [TEST.PD.EPR.SRC3.1#8]

10. Tester waits for 100ms for UUT to initiate the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0, else the Tester sends the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0

11. Tester checks that the UUT sends Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Exit) message [TEST.PD.EPR.SRC3.1#9]

12. Tester checks that the UUT completes the contract negotiation using common procedure COMMON.PROC.PD.10 [TEST.PD.EPR.SRC3.1#11]

TEST.PD.EPR.SRC3.2 EPR Entry Process - Tester as VCONN Source

Description: The Tester as a sink verifies the successful EPR negotiation when Tester acts as a VCONN source.

Test Specific Tester Behavior: Tester rejects the VCONN Swap message initiated by UUT unless mentioned in the test procedure

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_As_Src is set to No or if the Captive_Cable field in the VIF is set to Yes

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.2#1]

3. The Tester sends a VCONN_Swap message.

4. The Tester checks the Accept message response from the UUT. [TEST.PD.EPR.SRC3.2#2]

5. The Tester sends a PS_RDY message.

6. The Tester checks that the UUT does not present VCONN at the non-CC line within *tVCONNSourceOff*. [TEST.PD.EPR.SRC3.2#3]

7. Configure the Tester to accept the VCONN_Swap message and then Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

8. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.2#4]

9. The Tester checks that UUT sends a Vconn_Swap message [TEST.PD.EPR.SRC3.2#5], else the check fails and test stops here

10. The Tester checks that UUT completes the Vconn swap sequence using COMMON.PROC.PD.6

11. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

12. The check fails if the UUT does not send a SOP' Discover Identity message. [TEST.PD.EPR.SRC3.2#6]

13. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.2#7]

14. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.2#8]

15. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13 [TEST.PD.EPR.SRC3.2#9]

16. Tester waits for 2 seconds, If UUT sends EPR_Source_Capabilities message with no EPR PDOs, Tester checks that UUT completes the contract negotiation using common procedure COMMON.PROC.PD.13, otherwise, the Tester performs below steps

    a. Tester sends EPR_Request message with Object Position set to 1, Operating Current and Maximum Operating Current set to 100mA

    b. The check fails if an Accept message is not received. [TEST.PD.EPR.SRC3.2#10]

    c. The check fails if PS_RDY message is not received within tPSTransition max(EPR mode) from the last bit of the EOP of Accept message. [TEST.PD.EPR.SRC3.2#11]

17. Tester waits for 100ms for UUT to initiate the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0, else the Tester sends the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0

18. Tester checks that the UUT sends Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Exit) message [TEST.PD.EPR.SRC3.2#12]

19. Tester checks that the UUT completes the contract negotiation using common procedure COMMON.PROC.PD.11 [TEST.PD.EPR.SRC3.2#13]

TEST.PD.EPR.SRC3.3 EPR Entry failed - EPR Mode Capable bit not set in RDO

Description: As a Sink, the Tester verifies that the Source UUT fails the EPR entry process when the EPR Mode Capable bit was not set in the most recent RDO.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.3#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds with EPR_Mode message with the Action field set to 0x04(Enter Failed) and Data field set to 0x03(EPR Mode Capable bit not set in RDO). [TEST.PD.EPR.SRC3.3#2]

5. Tester sends the SoftReset message and checks the UUT sends the Accept message followed by Source_Caps message [TEST.PD.EPR.SRC3.3#3]

6. Tester checks that the UUT establishes a SPR contract negotiation using COMMON.PROC.PD.11 [TEST.PD.EPR.SRC3.3#5]

7. Tester waits for 2 seconds and checks that the UUT does not initiate EPR_Source_Caps message [TEST.PD.EPR.SRC3.3#4]

TEST.PD.EPR.SRC3.4 EPR Entry failed – Tester as VCONN source

Description: The Tester as a sink, verifies the UUT fails the EPR entry process while Tester is acting as the VCONN source.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No or if the or Captive_Cable field in the VIF is set to Yes

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.4#1]

3. The Tester sends a VCONN_Swap message.

4. The Tester checks the Accept message response from the UUT. [TEST.PD.EPR.SRC3.4#2]

5. The Tester sends a PS_RDY message.

6. The Tester checks that the UUT does not present VCONN at the non-CC line within tVCONNSourceOff. [TEST.PD.EPR.SRC3.4#3]

7. Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

8. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.4#4]

9. The Tester checks that UUT sends a Vconn_Swap message [TEST.PD.EPR.SRC3.4#5], else the check fails, and test stops here

10. If the UUT initiates the Vconn_Swap message, Tester responds with Reject message

11. Tester checks that the UUT sends EPR_Mode with Action field set to 0x4(Enter Failed) and Data field set to 0x02(Source failed to become VCONN source). [TEST.PD.EPR.SRC3.4#6]

12. If the EPR entry process does not exit within tEnterEPR(500ms) (this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Failed) message), the check fails [TEST.PD.EPR.SRC3.4#7]

TEST.PD.EPR.SRC3.5 EPR Entry Failed - EPR_Mode(Reserved) message

Description: As a Sink, the Tester verifies that the Source UUT responds with SoftReset to the EPR_Mode Reserved message.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.5#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x00(Reserved) and Data field set to 140 (140W).

4. The Tester checks that UUT sends a SoftReset message within tProtErrSoftReset (this timing is measured from the last bit of the GoodCRC of EPR_Mode(Enter) message to the last bit of the SoftReset message) [TEST.PD.EPR.SRC3.5#2]

TEST.PD.EPR.SRC3.6 EPR Entry Failed - Cable not EPR capable

Description: As a Sink, the Tester emulates as a non EPR cable and verifies the UUT fails the EPR entry process

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No or Captive_Cable field is set to Yes

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

b.   The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.6#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.6#2]

5. If a SOP' Discover Identity message is received from the UUT, the Tester replies as a Passive Cable with

   a.   Vbus Current Handling Capability set to 10b(5A),

   b.   Maximum Vbus Voltage set to 11b(50V),

   c.   EPR Mode Capable field set to 0b (EPR Mode Capable)

6. The check fails if the UUT does not send SOP' Discover Identity message[TEST.PD.EPR.SRC3.6#3]

7. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x04(Enter Failed) and Data field set to 0x01(Cable not EPR capable). [TEST.PD.EPR.SRC3.6#4]

8. If the EPR entry process does not exit within tEnterEPR(500ms) (this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Failed) message), the check fails [TEST.PD.EPR.SRC3.6#5]

9. Repeat this test by Tester emulating as a Passive Cable

   a.   Vbus Current Handling Capability set to 10b(5A),
   b.   Maximum Vbus Voltage set to 00b(20V),
   c.   EPR Mode Capable field set to 1b (EPR Mode Capable)

10. Repeat this test by Tester emulating as a Passive Cable

   a.   Vbus Current Handling Capability set to 01b(3A),
   b.   Maximum Vbus Voltage set to 11b(50V),
   c.   EPR Mode Capable field set to 1b (EPR Mode Capable)

TEST.PD.EPR.SRC3.7 EPR Entry Failed - Interrupted by EPR_Get_Sink_Cap message

Description: As a Sink, the Tester verifies that the Source UUT responds with SoftReset when EPR Mode entry process Interrupted by EPR_Get_Sink_Cap message

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_As_Src is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 3 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.7#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.7#2]

5. Tester sends a EPR_Get_Sink_Cap message just after 25us from the GoodCRC of the EPR_Mode(Enter Acknowledged) message.

6. The check fails if the UUT responds with EPR_Sink_Cap or any message other than Soft_Reset message within tProtErrSoftReset (this timing is measured from the last bit of the GoodCRC

of EPR_Get_Sink_Cap message to the last bit of the SoftReset message)
[TEST.PD.EPR.SRC3.7#3]

TEST.PD.EPR.SRC3.8 EPR mode - Request message response

Description: As a Sink, the Tester verifies that the Source UUT responds with HardReset to the Request message received in the EPR_Mode.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.8#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.8#2]

5. If VIF field Captive_Cable = Yes, skip to step 8, else Tester checks that UUT does not sends a Vconn_Swap message [TEST.PD.EPR.SRC3.8#3]

6. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

7. The check fails if the UUT does not send SOP' Discover Identity message[TEST.PD.EPR.SRC3.8#4]

8. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.8#5]

9. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.8#6]

10. Tester responds with a Request message with Object Position set to 1 and other fields set to values mentioned in bring-up procedure BU1.

11. Tester checks that the UUT sends a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of Request message to the last bit of the HardReset signal)[TEST.PD.EPR.SRC3.8#7]

TEST.PD.EPR.SRC3.9 EPR mode - EPR_Get_Source_Cap message

Description: As a Sink, the Tester verifies that the Source UUT responds correctly for EPR_Get_Source_Cap message in the EPR_Mode.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓

Test Procedures:

1. If EPR_Supported is set to no in the vendor file, this test passes and stops here.

2. There are 3 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

3. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.9#1]

4. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

5. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.9#2]

6. If VIF field Captive_Cable is Yes, skip to step 10, else Tester checks that UUT does not sends a Vconn_Swap message [TEST.PD.EPR.SRC3.9#3]

7. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

8. The check fails if the UUT does not send SOP' Discover Identity message [TEST.PD.EPR.SRC3.9#4]

9. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.9#5]

10. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.9#6]

11. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13

12. Tester sends a EPR_Get_Source_Cap message.

13. The check fails if the UUT does not send a EPR_Source_Cap message [TEST.PD.EPR.SRC3.9#7]

14. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13

15. Tester waits for 2 seconds, If UUT sends EPR_Source_Capabilities message with no EPR PDOs, Tester checks that UUT completes the contract negotiation using common procedure COMMON.PROC.PD.13, otherwise, the Tester performs below steps

    a. Tester sends EPR_Request message with Object Position set to 1, Operating Current and Maximum Operating Current set to 100mA

    b. The check fails if an Accept message is not received. [TEST.PD.EPR.SRC3.9#8]

    c. The check fails if PS_RDY message is not received within tPSTransition max(EPR mode) from the last bit of the EOP of Accept message. [TEST.PD.EPR.SRC3.9#9]

16. Tester waits for 100ms for UUT to initiate the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0, else the Tester sends the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0

17. Tester checks that the UUT sends Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Exit) message [TEST.PD.EPR.SRC3.9#10]

18. Tester checks that the UUT completes the SPR contract negotiation using common procedure COMMON.PROC.PD.11

TEST.PD.EPR.SRC3.10 SPR mode - EPR_Get_Source_Cap message

Description: As a Sink, the Tester verifies that the Source UUT responds with HardReset to the EPR Request message received in the SPR_Mode.

Test Specific Tester Behavior:

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. Tester sends a EPR_Get_Source_Cap message.

3. The Tester checks the response. [TEST.PD.EPR.SRC3.10#1]

    a. The check fails if the VIF field *EPR_Supported_As_Src* is set to Yes and the UUT does not respond with a EPR_Source_Cap message.

    b. The check fails if the VIF field *EPR_Supported_As_Src* is set to No and the UUT does not respond with a Not_Supported message and the tests stops here.

4. Tester sends an EPR_Request with Object Position set to 1.

5. The Tester checks the response. [TEST.PD.EPR.SRC3.10#2]

    a. The check fails if the UUT does not send a HardReset message within tProtErrHardReset, this timing is measured from the last bit of the GoodCRC of EPR_Request to the last bit of the HardReset signal

TEST.PD.EPR.SRC3.11 EPR Mode Exit by EPR_Mode_Exit message

Description: As a Sink, the Tester verifies that the Source UUT responds with HardReset to the EPR_Mode(Exit).

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

_	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 (set EPR mode bit in RDO to 1).

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.11#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W).

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.11#2]

5. If VIF field Captive_Cable = Yes, skip to step 8, else Tester checks that UUT does not sends a Vconn_Swap message [TEST.PD.EPR.SRC3.11#3]

6. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

7. The check fails if the UUT does not send SOP' Discover Identity message [TEST.PD.EPR.SRC3.11#4]

8. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.11#5]

9. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.11#6]

10. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13

11. Tester sends a EPR_Mode message with the Action field set to 0x05(Exit) and Data field set to 0x00

12. The check fails if the UUT does not send a HardReset message within tProtErrHardReset, this timing is measured from the last bit of the GoodCRC of EPR_Mode(Exit) message to the last bit of the Hard_Reset signal [TEST.PD.EPR.SRC3.11#7]

TEST.PD.EPR.SRC3.12 EPR mode - Get_Source_Cap message and Request message response

Description: As a Sink, the Tester verifies that the Source UUT responds with HardReset to the Request message in the EPR mode.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

_	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1

    b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.12#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.12#2]

5. If VIF field Captive_Cable = Yes, skip to step 8, else Tester checks that UUT does not send a Vconn_Swap message [TEST.PD.EPR.SRC3.12#3]

6. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

7. The check fails if the UUT does not send SOP' Discover Identity message [TEST.PD.EPR.SRC3.12#4]

8. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.12#5]

9. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.12#6]

10. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13

11. Tester sends a Get_Source_Cap message.

12. The check fails if UUT doesn't send a Source_Capabilities message [TEST.PD.EPR.SRC3.12#7]

13. Tester responds with a Request message with Object Position set to 1 and other fields set to   values mentioned in bring-up procedure BU1.

14. Tester checks that the UUT sends a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of Request message to the last bit of the HardReset signal)[TEST.PD.EPR.SRC3.12#8]

TEST.PD.EPR.SRC3.13 EPR mode - tSourceEPRKeepAlive Timeout

Description: The Tester as a sink does not send EPRKeepAlive message in EPR mode and verifies that the UUT sends HardReset message within *tSourceEPRKeepAlive* timer

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

_	Consumer Only	Provider Only	DRP, C/P, P/C

Rev3ChkdSrc		✓	✓
Rev3UnchkdSrc		✓	✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider Only, Provider/Consumer or DRP, the Tester behaves as a Sink Only and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1

   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester behaves as a Provider/Consumer and it runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SRC3.13#1]

3. The Tester sends an EPR_Mode(Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W)

4. The Tester checks that UUT responds EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0, otherwise the check fails and stops here [TEST.PD.EPR.SRC3.13#2]

5. If VIF field Captive_Cable = Yes, skip to step 8, Tester checks that UUT does not sends a Vconn_Swap message [TEST.PD.EPR.SRC3.13#3]

6. If a SOP' Discover Identity message is received from the UUT, the Tester replies as Passive Cable with Vbus Current Handling Capability set to 10b(5A), Maximum Vbus Voltage set to 11b(50V) and EPR Mode Capable field set to 1b (EPR Mode Capable)

7. The check fails if the UUT does not send SOP' Discover Identity message [TEST.PD.EPR.SRC3.13#4]

8. Tester checks that UUT completes the EPR entry process by sending EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR (500ms), this timing is measured from the last bit of the Good_CRC in response to the EPR_Mode (Enter) message to the last bit of the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.13#5]

9. Tester checks that the UUT sends EPR_Source_Capabilities message within tFirstSourceCap of the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message [TEST.PD.EPR.SRC3.13#6]

10. Tester checks that the UUT establishes EPR contract using common procedure COMMON.PROC.PD.13

11. Tester doesn't send EPRKeepAlive message and checks that the UUT sends HardReset message between *tSourceEPRKeepAlive* min(0.75sec) and max(1sec)), this timing is measured from the last bit of the Good_CRC in response to the last message in the last AMS sequence to the first bit of the HardReset message [TEST.PD.EPR.SRC3.13#7

7.1.2   PD3 Mode – EPR_Power_Supply Specific Tests

The tests in this subsection are run in PD3 mode.

The tests in this subsection are applicable to UUT with VIF field PD_Port_Type set to Provider Only, Provider/Consumer, Consumer/Provider and DRP.

Unless a <u>Test Specific Tester Behavior</u> is specified, this section uses the following behavior:

- The Tester is a Sink
- The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

TEST.PD.PS.EPR.SRC3.1 Multiple EPR Request Load Test

<u>Description:</u> As a Sink only, the Tester verifies that the Source UUT responds correctly to various EPR_Request messages.

<u>Test Specific Tester Behavior:</u>

<u>Test Conditions:</u>

This test is applicable if the VIF parameter EPR_Supported_*As_Src* is set to Yes.

	Consumer Only	Provider Only, P/C, C/P, DRP
Rev3ChkdSrc		✓

<u>Test Requirements:</u> If Captive_Cable = YES, **vSrcNew min** or **vAvsNew min** limit shall be (vSrcNew min) - (0.75*I/X) or (vAvsNew min) - (0.75*I/X), where I is the actual current being drawn, and X=3 if the sourced PDO contract is within the range (0, 3A], or X=5 if the sourced PDO contract is within the range (3A, 5A)

<u>Test Procedures:</u>

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.

b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.

2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here. [TEST.PD.PS.EPR.SRC3.1#1]

3. The Tester sends an EPR_Mode (Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W) and enters EPR mode using common procedure COMMON.PROC.PD.16. [TEST.PD.PS.EPR.SRC3.1#2]

4. The Tester repeats the following steps for each of the EPR_PDOs only (in the EPR_Source Capabilities message), starting with the 8th PDO:

   a. The Tester sends an EPR_Request message.

      i. B27 (GiveBack Flag) = 0b

      ii. B26 (Capability Mismatch) = 0b

      iii. B25 (USB Communication Capable) = 0b

      iv. B24 (No USB Suspend) = 1b

      v. B22 (EPR Mode Capable) = 1b

      vi. For Fixed PDO:

          1. B19…10 (Operating Current):

             a. For first EPR_Request: 0mA

             b. For subsequent Request: As defined in Step 4.f.i

          2. B9…0 (Maximum Operating Current) = Maximum Current in the Source PDO.

      vii. For EPR AVS APDO:

          1. B20…9 (Output Voltage) = Maximum Voltage offered in Source APDO

          2. B6…0 (Operating Current):

             a. For first EPR_Request: 0mA

             b. For subsequent Request: As defined in Step 4.e.i

      The initial EPR_Request is for PDO #8 (28V Fixed) at 0mA. The complete list of EPR_Request is defined in step 4.e.

   b. The check fails if an Accept message is not received. [TEST.PD.PS.SRC.1#11]

   c. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.SRC.1#12]

   d. The Tester performs the following checks:

      i. If the transition involves a current decrease (but no PDO change), the Tester decreases current to the new value within tSnkNewPower min of the last bit of

the GoodCRC sent in response to the Accept message. The Tester draws the requested Operating Current with a current transition slew rate of 100mA per µs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew or vAvsNew. [TEST.PD.PS.EPR.SRC3.1#3]

ii. If the transition involves a current increase (but no PDO change), the Tester increases current to the new value after the last bit of the GoodCRC sent in response to the PS_RDY message. The Tester draws the requested Operating Current with a current transition slew rate of 100mA per µs. The Tester monitors VBUS voltage and the check fails if VBUS voltage is not within the limits of vSrcNew or vAvsNew. [TEST.PD.PS.EPR.SRC3.1#4]

iii. If the transition involves a change of PDO, decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

1. The Tester checks that VBUS remains within vSrcNew or vAvsNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.EPR.SRC3.1#5]

2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.EPR.SRC3.1#6]

3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits from the time of crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.EPR.SRC3.1#7]

4. The Tester checks that the VBUS voltage remains within vSrcNew or vAvsNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.EPR.SRC3.1#8]

5. The Tester checks that the UUT does not send PS_RDY before VBUS is within vSrcNew or vAvsNew. [TEST.PD.PS.EPR.SRC3.1#9]

6. After having sent GoodCRC in response to PS_RDY, the Tester increases its current draw to the current requested and The Tester checks that the VBUS voltage remains within vSrcNew or vAvsNew limits for 100ms after receiving PS_RDY [TEST.PD.PS.EPR.SRC3.1#10]

e. The Tester repeats Step-4a to Step-4d, replacing the appropriate fields with the next value from the following list. The Tester sends 9 separate EPR_Request messages for each EPR_PDO.

i. For Fixed PDOs, replace B19…10 (Operating Current) and For EPR AVS APDO, replace B6…0 (Operating Current):

1. 0mA [performed in Step 4.b; listed here for reference only]

2. 25% of Maximum Current

3. 50% of Maximum Current

4. 75% of Maximum Current

5. 100% of Maximum Current

6. 75% of Maximum Current

7. 50% of Maximum Current

8. 25% of Maximum Current

9. 0mA

TEST.PD.PS.EPR.SRC3.2 PDO Transitions in EPR Mode

Description: As a Sink only, the Tester enumerates all possible transitions among the PDOs of the UUT and verifies the UUT performs PDO transitions correctly in EPR Mode.

Test Specific Tester Behavior: N/A

Test Conditions:

This test is not applicable if the VIF parameter EPR_Supported_*As_Src* is set to No

	Consumer Only	Provider Only, P/C, C/P, DRP
Rev3ChkdSrc		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to anything else, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The check fails if the "EPR mode capable" field is set to 0 in the Source Capabilities message sent by UUT during the bring up procedure and the test stops here. [TEST.PD.PS.EPR.SRC3.2#1]
3. The Tester sends an EPR_Mode (Enter) message with the Action field set to 0x01(Enter) and Data field set to 140 (140W) and enters EPR mode using common procedure COMMON.PROC.PD.16[TEST.PD.PS.EPR.SRC3.2#2]

4. The Tester repeats the following steps using the PDO as provided in the **EPR_PDO Sequence Table**: Note, PDO Transitions only applicable for valid PDOs in the EPR_Source_Capabilities. Ignore the unused PDOs.

   a. The Tester sends an EPR_Request message:

      i. B27 (GiveBack Flag) = 0b

ii. B26 (Capability Mismatch) = 0b

iii. B25 (USB Communication Capable) = 0b

iv. B24 (No USB Suspend) = 1b

v. B22 (EPR Mode Capable) = 1b

vi. For Fixed PDO:

B19…10 (Operating Current) = 100mA

B9…0 (Maximum Operating Current) = 100mA

For EPR AVS PDO:

B20…9 (Output Voltage) = Maximum Voltage offered in Source APDO

B7…0 (Operating Current) = 100mA

b. The check fails if an Accept message is not received. [TEST.PD.PS.EPR.SRC3.2#3]
c. The check fails if PS_RDY message is not received within tPSTransition max from the last bit of the EOP of Accept message. [TEST.PD.PS.EPR.SRC3.2#4]
d. The Tester performs the following checks:

Decrease the power drawn by the Tester to less than pSnkStdby within tSnkStdby min of the last bit of the GoodCRC sent in response to the Accept message. The Tester performs the following checks:

1. The Tester checks the VBUS is within vSrcNew or vAvsNew of the starting voltage within tSrcTransition min after the end of the GoodCRC sent in response to the Accept message. [TEST.PD.PS.EPR.SRC3.2#5]

2. The Tester checks that the VBUS transition meets vSrcSlewPos and vSrcSlewNeg. [TEST.PD.PS.EPR.SRC3.2#6]

3. During the voltage transition, the Tester checks that the VBUS voltage remains within vSrcValid limits from the time of crossing into the vSrcValid limits until tSrcSettle max. [TEST.PD.PS.EPR.SRC3.2#7]

4. The Tester checks that the VBUS voltage is within vSrcNew or vAvsNew limits between tSrcSettle max and 100ms after tSrcSettle max. [TEST.PD.PS.EPR.SRC3.2#8]

5. The Tester checks that the UUT does not send PS_RDY before the VBUS is within vSrcNew or vAvsNew. [TEST.PD.PS.EPR.SRC3.2#9]

7.2 Test Procedure for EPR Sink Capable UUT

7.2.1 PD3 Mode

The tests in this subsection are run in PD3 mode.

Cable Discovery message sequences are not explicitly mentioned in all the tests in this subsection, as it can be varied based on the test tool implementation and test cable used in the test setup.

Ensure the testing environment favors the UUT to initiate the EPR_Mode (Enter) message after the SPR contract negotiation to successfully validate the EPR negotiation

- This section uses the following behavior, except where defined in Test Specific Tester Behavior or a Test Procedure:The Tester supports both Power Roles but does not toggle (ie, a Provider/Consumer or Consumer/Provider)The Tester always replies with an Accept message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6, unless mentioned otherwise in the test procedure
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8
- The Tester sets the *EPR_Mode_Capable* bit to 1 in the Source_Caps and EPR_Source_Caps message, unless mentioned otherwise in the test procedure

TEST.PD.EPR.SNK3.1 EPR Entry Process - Success

Description: The Tester as a source verifies the successful EPR negotiation

Test Specific Tester Behavior:

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8
   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. Tester checks that the "EPR mode capable" field in the Request message sent by UUT matches with VIF parameter EPR_Supported_As_Snk during the bring upprocedure [TEST.PD.EPR.SNK3.1#1]

3. Tester waits for 5 second and performes below checks, [TEST.PD.EPR.SNK3.1#2]

   a. If the VIF field EPR_Supported_As_Snk is No, Then the check fails if the UUT sends an EPR_Mode message

   b. Else, Tester checks that UUT sends an EPR_Mode(Enter) message with the Action field set to 0x01, otherwise make this check as warning and the test stops here.

4. If VIF field Captive_Cable = Yes, the Tester sends SOP' Discover Identity message and checks the below fields in the response message, [TEST.PD.EPR.SNK3.1#3]

   a. Vbus Current Handling Capability set to 10b(5A)
   b. Maximum Vbus Voltage set to 11b(50V)
   c. EPR Mode Capable field set to 1b (EPR Mode Capable)

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) and Data field set to 0x0 within tEnterEPR from the EPR_Mode(Enter) message.

6. Tester sends EPR_Source_Capabilities message after 50ms from the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message and establishes EPR contract using common procedure COMMON.PROC.PD.14 from Step2.

7. Tester waits for 10 seconds and if there are no messages initiated by the UUT for more than *tSinkEPRKeepAlive*.max (500ms), then the check fails [TEST.PD.EPR.SNK3.1#4]

8. If the UUT does not send even single EPR_KeepAlive message in above step, make this check as warning [TEST.PD.EPR.SNK3.1#5]

9. Tester waits for 1 second and if the UUT sends EPR_Request message with SPR RDO, else the Tester sends EPR_SourceCaps message with no EPR PDO's and checks that the UUT responds with EPR_Request message [TEST.PD.EPR.SNK3.1#6]

10. Tester checks that the UUT establishes the EPR contract negotiation using COMMON.PROC.PD.15 [TEST.PD.EPR.SNK3.1#8]

11. Tester waits for 100ms for UUT to initiate the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0, else the Tester sends the EPR_Mode message with Action field set 0x5(Exit) and Data field set to 0

12. Tester sends SourceCaps message and checks that the UUT responds with Request message [TEST.PD.EPR.SNK3.1#7]

13. Tester checks that the UUT establishes the SPR contract negotiation using COMMON.PROC.PD.10 [TEST.PD.EPR.SNK3.1#9]

TEST.PD.EPR.SNK3.2 EPR Entry Failed - tEnterEPR timeout

Description: The Tester as a source does not send EPR_Mode Enter Succeeded message in the EPR mode sequence and verifies that the UUT sends Soft Reset message.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

    b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.2#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here.[TEST.PD.EPR.SNK3.2#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. If VIF field Captive_Cable = Yes, the Tester sends SOP' Discover Identity message and checks the below fields in the response message [TEST.PD.EPR.SNK3.2#3]

    a. Vbus Current Handling Capability set to 10b(5A)
    b. Maximum Vbus Voltage set to 11b(50V)
    c. EPR Mode Capable field set to 1b (EPR Mode Capable)

6. Tester doesn't send EPR_Mode(Enter_Succeeded) message.

7. Tester checks that UUT sends SoftReset within the tEnterEPR(500ms) from the EOP of GoodCRC message of the EPR_Mode(Enter) message.[TEST.PD.EPR.SNK3.2#4]

TEST.PD.EPR.SNK3.3 EPR Entry Failed by EPR_Mode(Enter failed) message

Description: :As a Source, the Tester verifies that the UUT responds with a SoftReset message to the EPR_Mode Failed message.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.3#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter), otherwise the test passes and stops here [TEST.PD.EPR.SNK3.3#2]

4. Tester responds with the EPR_Mode message with Action field set to 0x04(Enter Failed) and Data field set to 0x03(EPR Mode Capable bit not set in RDO).

5. Tester checks that UUT sends a SoftReset message within tProtErrSoftReset, this timing is measured from the last bit of the GoodCRC of EPR_Mode(Enter Failed) message to the last bit of the SoftReset message). [TEST.PD.EPR.SNK3.3#3]

6. If UUT initiates EPR_Mode(Enter) message in step3, then repeat this test for all conditions in the Data field and include 1 reserved value (6), otherwise the test stops here.

TEST.PD.EPR.SNK3.4 EPR Fail due to tFirstSourceCap timeout

Description: The Tester as a source verifies the UUT responds with HardReset for Source Capability timeout by Tester

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓
Rev3UnchkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.4#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.4#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message.

6. Tester doesn't send an EPR_Source_Capabilites message

7. The check fails if the UUT doesn't sends a HardReset message within tTypeCSinkWaitCap (this timing is measured from the last bit of the GoodCRC of EPR_Mode(Enter_succeeded) to the last bit of the HardReset signal)[TEST.PD.EPR.SNK3.4#3]

TEST.PD.EPR.SNK3.5 EPR Exit due to incorrect EPR Source Cap

Description: The Tester as a source verifies the EPR Exit due to the incorrect EPR Source Capability

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.5#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.5#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message

6. Tester sends a EPR_Source_Capabilites message with PDO1 set to 5V 3A, PD02- 9V/3A, PDO3-15V/3A, PDO4-20V/5A, PDO5 set to 28V 5A, PDO6 to PDO7 set to 0 and PDO8 set to 28V 5A

7. The check fails if the UUT doesn't send a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of EPR_Source _Capabilites message to the last bit of the HardReset signal)[TEST.PD.EPR.SNK3.5#3]

TEST.PD.EPR.SNK3.6 EPR Exit due to EPR_Mode Exit message

Description: The Tester as a source verifies the UUT responds with HardReset for EPR_Exit message(In the EPR PD Negotiation)

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

    a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

    b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.6#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.6#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message.

6. Tester sends EPR_Source_Capabilities message after 50ms from the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message and establishes EPR contract using common procedure COMMON.PROC.PD.14 from Step2.

7. Tester waits for 1 second and checks that UUT sends EPR_KeepAlive message within tSinkEPRKeepAlive max(500ms) from the EOP of the last message of the last AMS sequence [TEST.PD.EPR.SNK3.6#3]

8. Tester sends EPR_Mode Exit message.

9. The check fails if the UUT doesn't sent a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of EPR_Mode Exit message to the last bit of the HardReset signal) [TEST.PD.EPR.SNK3.6#4]

TEST.PD.EPR.SNK3.7 EPR_Fail_by_Wait_Message

Description: The Tester as a source verifies the UUT responds with HardReset for the Wait message.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.7#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.7#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message.

6. Tester initiates the EPR_SourceCaps message after 50ms from the EPR_Mode (Enter_Succeeded) message

7. Tester checks that the UUT sends EPR_Request message for which the Tester responds with Wait message [TEST.PD.EPR.SNK3.7#3]

8. Tester checks that the UUT sends a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of Wait message to the last bit of the HardReset signal) [TEST.PD.EPR.SNK3.7#4]

TEST.PD.EPR.SNK3.8 EPR Exit due to Source Cap

Description: The Tester as a source verifies the UUT responds with HardReset for the Source Capability message after the EPR PD negotiation.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.8#1]

3. Tester waits for 5 seconds for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.8#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message.

6. Tester sends EPR_Source_Capabilities message after 50ms from the last bit of the GoodCRC message acknowledging the EPR_Mode(Enter_Succeeded) message and establishes EPR contract using common procedure COMMON.PROC.PD.14 from Step2.

7. Tester waits for 1 second and checks that UUT sends EPR_KeepAlive message within tSinkEPRKeepAlive max(500ms) from the EOP of the last message of the last AMS sequence [TEST.PD.EPR.SNK3.8#3]

8. Tester sends the Source Cap message.

9. Tester checks that the UUT sends a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of Source Cap message to the last bit of the HardReset signal) [TEST.PD.EPR.SNK3.8#4]

TEST.PD.EPR.SNK3.9 EPR Entry failed due to SourceCap

Description: The Tester as a source verifies the UUT responds with HardReset for the Source Capability message during the EPR PD negotiation.

Test Specific Tester Behavior:

Test Conditions:

This test is not applicable if the VIF parameter *EPR_Supported_As_Snk* is set to No

	Consumer Only	Provider Only	DRP, C/P, P/C
Rev3ChkdSnk	✓		✓

Test Procedures:

1. There are 2 possible bring-up procedures:

   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8

   b. The UUT has VIF field PD_Port_Type set to Consumer Only, Consumer /Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

2. The check fails if the "EPR mode capable" field is set to 0 in the Request message sent by UUT during the bring up procedure and the test stops here [TEST.PD.EPR.SNK3.9#1]

3. Tester waits for 5 second for the UUT to initiate EPR_Mode(Enter) message with the Action field set to 0x01(Enter) , otherwise the test passes and stops here [TEST.PD.EPR.SNK3.9#2]

4. Tester responds with EPR_Mode message with the Action field set to 0x02(Enter Acknowledged) and Data field set to 0x0.

5. Tester sends EPR_Mode message with Action field set to 0x03(Enter_Succeeded) after 100ms from the EPR_Mode(Enter) message.

6. Tester initiates the SourceCaps message after 50ms from the EPR_Mode (Enter_Succeeded) message

7. Tester checks that the UUT sends a HardReset message within tProtErrHardReset(this timing is measured from the last bit of the GoodCRC of Wait message to the last bit of the HardReset signal) [TEST.PD.EPR.SNK3.9#4]

8 Fast Role Swap Tests

8.1 Fast Role Swap Tests – Initial Source

8.1.1 PD3 Mode

The tests in this subsection are run in PD3 mode.

The tests are based on the model of the UUT shown in Figure 7-1.
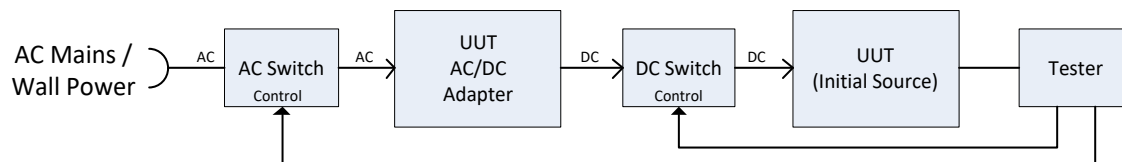
Figure 7-1: FRS Testing Concept

The assumption is that power to the Initial Source can be lost for either of two reasons:

1. The connection to the AC mains/wall power is broken (or the AC supply itself fails).
2. The connection from the UUT to its AC/DC Adapter is broken.

Either of these two events can be the cause of a Fast Role Swap request from the Initial Source. However, reason 2 is potentially more onerous on the UUT as the loss of usable power occurs with no chance of early warning. For some UUTs one or other of these interruptions may not be possible, so related testing need not take place.

During FRS testing, up to two switches, controlled by the tester (one AC and one DC), are connected up as part of the test setup. These are able to simulate the loss of power in the two distinct locations.

Please note that FRS tests apply whether or not FRS is supported, and the VIF parameter Power_Interruption_Available will be expected to be present in all cases.

The other factor which may affect the FRS performance is the voltage of the contract at the time of the power interruption. The main Initial Source test TEST.PD.FRS.SRC.1 will attempt to test both a 5V contract, and also the highest voltage contract achievable.

Test Conditions Rev3ChkdSrc5VAC, Rev3ChkdSrc5VDC, Rev3ChkdSrcHiVAC and Rev3ChkdSrcHiVDC are used to describe the combination of the position of the power interruption (AC or DC) and the contract voltage in force (See Table 2 - Test Condition Codes for Ports.)

TEST.PD.FRS.SRC3.1 Normal Conditions

Description: Starting with the UUT as an initial Source, the Tester verifies that the UUT does Fast Role Swap correctly under normal conditions.

Test Specific Tester Behavior: N/A

Test Conditions:

This test is not applicable if VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

	Consumer Only, Provider Only,	C/P, P/C, DRP
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓
Rev3ChkdSrcHiVAC		✓
Rev3ChkdSrcHiVDC		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to Provider/Consumer, or DRP, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. *For Test Conditions Rev3ChkdSrcHiVAC or Rev3ChkdSrcHiVDC*: The Tester makes a Request for the the highest fixed PDO number, and checks that the contract is made. [TEST.PD.FRS.SRC.1#1]
3. The Tester sends Get_Sink_Caps to the UUT
4. If a Sink_Capabilities message is not received, the test ends here, and the check fails. [TEST.PD.FRS.SRC.1#2]
5. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition.
6. The Tester verifies the following: [TEST.PD.FRS.SRC.1#3]
   a. If Fast Role Swap USB Type-C Current field is 00b (in the Sink_Capabilities message), check that no Fast Role Swap signal is received. The test ends here.
   b. If Fast Role Swap USB Type-C Current field is not 00b (in the Sink_Capabilities message), check that Fast Role Swap signal is received within 60 seconds after power disconnection. Also, check that the Fast Role Swap signal meets tFRSwapTx. The receiver detection level used to detect the Fast Role Swap signal shall be the mid-range value of vFrSwapCableTx (i.e.520mV). For Test Conditions Rev3ChkdSrcHiVAC or Rev3ChkdSrcHiVDC: The check fails if the FRS Signal starts after tFRSwapRx max before the time VBUS falls to 90% of the nominal value.
7. After receiving the Fast Role Swap signal, the VBUS electrical and PD messaging test sub-steps are performed separately. In the following sub-steps, the sequences of the VBUS electrical behavior and PD messaging are only bounded at the operating point referred to as Stage 1.
   a. VBUS electrical sub-steps:

i. The Tester immediately stops sinking current through VBUS after detecting Fast Role Swap signal

ii. The Tester waits for VBUS to be below vSafe5V max and this operating point is referred to as Stage 1

iii. The Tester applies vSafe5V on VBUS at tSrcFRSwap max after receiving the Fast Role Swap signal and VBUS has dropped below vSafe5V min. After the start of Fast Role Swap signal, the Tester checks that the UUT does not draw more than pSnkStdby, either while VBUS is below vSafe5V (min) or tSnkFRSwap has elapsed, whichever comes first. [TEST.PD.FRS.SRC.1#4]

iv. After tSnkFRSwap, check that the UUT does not draw more current than it declared it would in the Fast Role Swap USB Type-C Current field [TEST.PD.FRS.SRC.1#5].

b. PD messaging sub-steps:

i. The Tester checks that the UUT presents SinkTxOK within 1 millisecond after receiving Fast Role Swap signal [TEST.PD.FRS.SRC.1#6].

ii. The Tester sends an FR_Swap message at tFRSwapInit max after receiving the Fast Role Swap signal. If the Tester cannot send the FR_Swap message because it cannot start an AMS, the check fails [TEST.PD.FRS.SRC.1#7].

iii. Check that the UUT sends an Accept message within tReceiverResponse max from the last bit of the EOP of the FR_Swap message, and check that the Port Power Role field = 1b (Source) in this message [TEST.PD.FRS.SRC.1#8].

iv. Check that the UUT presents Rd after the operating point has reached Stage 1, and after the UUT has sent the Accept message [TEST.PD.FRS.SRC.1#9].

v. Check that the UUT sends a PS_RDY message after presenting Rd, and within tFRSwap5V of Stage 1 or of the last bit of the EOP of Accept message if that is later. Check that the Port Power Role field = 0b (Sink) in the PS_RDY message. [TEST.PD.FRS.SRC.1#10]

vi. The Tester changes the presented CC-line termination from Rd to Rp at a time tFRSwapComplete minus 1 millisecond after receiving the last bit of the EOP of the PS_RDY message. The Rp value the Tester presents shall match FR_Swap_Reqd_Type_C_Current_As_Initial_Source parameter as specified in the VIF.

vii. The Tester starts sending a PS_RDY message at a time tFRSwapComplete minus 1 millisecond after the Tester is providing power.

viii. As the new Source, the Tester sends a Source_Capabilities message that matches the UUT sink requirements, and checks that the UUT follows COMMON.PROC.PD.10 to establish a new contract [TEST.PD.FRS.SRC.1#11].

8. Repeat the test for every test condition based on *Power_Interruption_Available VIF field.*

TEST.PD.FRS.SRC3.2 Provider Only Checks

Description: Starting with the UUT as an initial Source, the Tester verifies that the UUT does not attempt Fast Role Swap under under any conditions.

Test Specific Tester Behavior: N/A

Test Conditions:

This test is not applicable if VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

If VIF Parameter *Power_Interruption_Available* is *AC mains/wall power Only* or *AC mains/wall power and DC Power* then the first test only shall be run, otherwise the second test only shall be run.

	Consumer Only C/P, P/C, DRP	Provider Only
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester sends Get_Sink_Caps to the UUT
3. Check that a Not Supported message is received. [TEST.PD.FRS.SRC3.2#1]
4. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition.
5. Check that no Fast Role Swap signal is received. The test ends here. [TEST.PD.FRS.SRC3.2#2]

TEST.PD.FRS.SRC3.3   GoodCRC Not Sent In Response To Accept

Description: Starting with the UUT as an initial Source, after the receipt of the Accept message for FR_Swap, the Tester intentionally does not reply GoodCRC in order to force a Hard Reset on the UUT and verifies it is correctly implemented.

Test Conditions:

This test is not applicable if VIF parameter *FR_Swap_Reqd_Type_C_Current_As_Initial_Source* is 00b, or VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

If VIF Parameter *Power_Interruption_Available* is *AC mains/wall power Only* or *AC mains/wall power and DC Power* then the first test only shall be run, otherwise the second test only shall be run.

	Consumer Only, Provider Only,	C/P, P/C, DRP
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up
   b. procedure with the UUT as a Source COMMON.PROC.BU.7. The UUT has VIF field PD_Port_Type set to Provider/Consumer, or DRP, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition. If the Fast Swap Signal is not detected within 60 second time period, the test stops here.
3. After receiving the Fast Role Swap signal, the VBUS electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately stops sinking current through VBUS after detecting Fast Role Swap signal
      ii. The Tester waits for VBUS to be below vSafe5V max
      iii. The Tester applies vSafe5V on VBUS at tSrcFRSwap max after receiving the Fast Role Swap signal and VBUS has dropped below vSafe5V min.

   b. PD messaging sub-steps:
      i. The Tester sends an FR_Swap message. If the Tester cannot send the FR_Swap message because it cannot start an AMS, the check fails, and the test ends here [TEST.PD.FRS.SRC3.3#1].
      ii. Upon receipt of the Accept message, the Tester intentionally does not reply with a GoodCRC message.
      iii. After nRetryCount retries of the Accept message, the check fails if Hard Reset is not detected within tReceive max + tProtErrHardReset max, the delay is measured from the time the last bit of the last retransmitted Accept Message EOP has been received to the time the first bit of the Hard Reset is received [TEST.PD.FRS.SRC3.3#2].

TEST.PD.FRS.SRC3.4   GoodCRC Not Sent In Response To PS_RDY

Description: Starting with the UUT as an initial Source, after the receipt of the PS_RDY message during the Fast Role Swap process, the Tester intentionally does not reply GoodCRC in order to force an Error Recovery on the UUT and verifies it is correctly implemented.

Test Conditions:

This test is not applicable if VIF parameter *FR_Swap_Reqd_Type_C_Current_As_Initial_Source* is 00b, or VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

If VIF Parameter *Power_Interruption_Available* is *AC mains/wall power Only* or *AC mains/wall power and DC Power* then the first test only shall be run, otherwise the second test only shall be run.

Consumer Only,	C/P, P/C, DRP

	Provider Only,	
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to Provider/Consumer, or DRP, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition.If the Fast Swap Signal is not detected within 60 second time period, the test stops here.
3. After receiving the Fast Role Swap signal, the VBUS electrical and PD messaging test sub-steps are performed separately.
   b. VBUS electrical sub-steps:
      iv. The Tester immediately stops sinking current through VBUS after detecting Fast Role Swap signal
      v. The Tester waits for VBUS to be below vSafe5V max
      vi. The Tester applies vSafe5V on VBUS at tSrcFRSwap max after receiving the Fast Role Swap signal and VBUS has dropped below vSafe5V min.

   a. PD messaging sub-steps:
      i. The Tester sends a FR_Swap message. If the Tester cannot send the FR_Swap message because it cannot start an AMS, the check fails, and the test ends here [TEST.PD.FRS.SRC3.4#1].
      ii. Upon receipt of the Accept message, the Tester replies with a GoodCRC message.
      iii. The check fails and the test ends here if PS_RDY is not received within tPSSourceOff min. The delay is measured from the time the last bit of the EOP of the GoodCRC message sent by the Tester in response to the Accept message to the time the last bit of the EOP of the PS_RDY message is received. [TEST.PD.FRS.SRC3.4#2]
      iv. Upon receipt of the PS_RDY message, the Tester intentionally does not reply with a GoodCRC message.
      v. The check fails if a USB Type-C Error Recovery is not detected within 15ms after the last bit of the EOP of the last retried PS_RDY Message. [TEST.PD.FRS.SRC3.4#3]

Description: Starting with the UUT as an initial Source, after a FR_Swap accepted, the Tester sends PS_RDY at the deadline limit of tPSSourceOn min and verifies the UUT accepts this message.

Test Conditions:

This test is not applicable if VIF parameter *FR_Swap_Reqd_Type_C_Current_As_Initial_Source* is 00b, or VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

If VIF Parameter *Power_Interruption_Available* is *AC mains/wall power Only* or *AC mains/wall power and DC Power* then the first test only shall be run, otherwise the second test only shall be run.

	Consumer Only, Provider Only,	C/P, P/C, DRP
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
    a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
    b. The UUT has VIF field PD_Port_Type set to Provider/Consumer, or DRP, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition.If the Fast Swap Signal is not detected within 60 second time period, the test stops here.
3. After receiving the Fast Role Swap signal, the VBUS electrical and PD messaging test sub-steps are performed separately.
    a. VBUS electrical sub-steps:
        vii. The Tester immediately stops sinking current through VBUS after detecting Fast Role Swap signal
        viii. The Tester waits for VBUS to be below vSafe5V max
        ix. The Tester applies vSafe5V on VBUS at tSrcFRSwap max after receiving the Fast Role Swap signal and VBUS has dropped below vSafe5V min.

    b. PD messaging sub-steps:
        i. The Tester sends a FR_Swap message. If the Tester cannot send the FR_Swap message because it cannot start an AMS, the check fails, and the test ends here. [TEST.PD.FRS.SRC3.5#1]
        ii. Upon receipt of the Accept message, the Tester replies with a GoodCRC message.

      iii.   Upon receipt of the PS_RDY message, the Tester replies with a GoodCRC message.

      iv.   The Tester sends a PS_RDY at the deadline limit of tPSSourceOn min after the time the last bit of the EOP of the GoodCRC message corresponding to the received PS_RDY message was sent.

      v.   The test passes if a GoodCRC is received. [TEST.PD.FRS.SRC3.5#2]

      vi.   The test fails if Error Recovery is detected when waiting the GoodCRC message or before sending the PS_RDY. [TEST.PD.FRS.SRC3.5#3]

TEST.PD.FRS.SRC3.6 PSSourceOnTimer Timeout

Description: Starting with the UUT as an initial Source, after a FR_Swap accepted, the Tester intentionally does not send PS_RDY, in order to force a PSSourceOnTimer timeout on the UUT and verifies it is correctly implemented.

Test Conditions:

This test is not applicable if VIF parameter *FR_Swap_Reqd_Type_C_Current_As_Initial_Source* is 00b, or VIF Parameter *Power_Interruption_Available* is *No Interruption Possible*.

If VIF Parameter *Power_Interruption_Available* is *AC mains/wall power Only* or *AC mains/wall power and DC Power* then the first test only shall be run, otherwise the second test only shall be run.

	Consumer Only, Provider Only,	C/P, P/C, DRP
Rev3ChkdSrc5VAC		✓
Rev3ChkdSrc5VDC		✓

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Consumer/Provider, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.7.
   b. The UUT has VIF field PD_Port_Type set to Provider/Consumer, or DRP, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1.
2. The Tester operates the appropriate power disconnection switch (see Appendix B) depending on the Test Condition.If the Fast Swap Signal is not detected within 60 second time period, the test stops here.
3. After receiving the Fast Role Swap signal, the VBUS electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately stops sinking current through VBUS after detecting Fast Role Swap signal
      ii. The Tester waits for VBUS to be below vSafe5V max

      iii.   The Tester applies vSafe5V on VBUS at tSrcFRSwap max after receiving the Fast Role Swap signal and VBUS has dropped below vSafe5V min.

  b. PD messaging sub-steps:

      i.   The Tester sends a FR_Swap message. If the Tester cannot send the FR_Swap message because it cannot start an AMS, the check fails, and the test ends here. [TEST.PD.FRS.SRC3.6#1]

      ii.   Upon receipt of the Accept message, the Tester replies with a GoodCRC message.

      iii.   Upon receipt of the PS_RDY message, the Tester replies with a GoodCRC message.

      iv.   The Tester intentionally does not send PS_RDY, in order to force a PSSourceOnTimer timeout on the UUT.

      v.   Check that Error Recovery is detected in the range tPSSourceOn min to tPSSourceOn max after the time the last bit of the EOP of the GoodCRC message corresponding to the received PS_RDY message was sent. [TEST.PD.FRS.SRC.6#2]

8.2 Fast Role Swap Tests – Initial Sink

8.2.1 PD3 Mode

The tests in this subsection are run in PD3 mode.

TEST.PD.FRS.SNK3.1 Normal Conditions

Description: Starting with the UUT as an initial Sink, the Tester verifies that the UUT does Fast Role Swap correctly under normal conditions.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)

2. Tester waits 500ms to allow UUT to request Sink Caps.
   a. If it does, the Tester replies with a single PDO set to what the VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink says the UUT will support as a Source (i.e. 5V @ 500mA, 1.5A or 3A).
   b. If no Get Sink Caps message received then check that the VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink is 00b. [TEST.PD.FRS.SNK3.1#1]
3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min. The signal is applied via a resistance of rFRSwapTx (5Ω) to ground.
4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.
      ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink. After the Tester has turned off Vbus, the operating point when Vbus is below vSafe5V max is referred to as *Stage 1*.
      iii. The Tester makes the following check on VBUS:
         1. If the VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink is 00b, the Tester checks that the UUT does not supply VBUS within 1s. This branch of the test ends here. [TEST.PD.FRS.SNK3.1#1]
         2. In any other case, it verifies that the UUT as a new Source supplies Vbus and it reaches vSafe5V min within tSrcFRSwap of both the Fast Role Swap signal having had time to be detected, and Vbus being below vSafe5V min (due to Tester turning off Vbus). [TEST.PD.FRS.SNK3.1#2]
   b. PD messaging sub-steps:
      i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.
      ii. The Tester makes the following message check:
         1. If the VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink is 00b, the Tester checks that the UUT does not send an FR_Swap message. [TEST.PD.FRS.SNK3.1#3] This branch of the test ends here.
         2. In any other case, it checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.1#4]
      iii. The Tester sends an Accept message at the boundary of tReceiverResponse max from the last bit of the EOP of the FR_Swap message
      iv. The Tester changes from presenting Rp to Rd as soon as the operating point has reached *Stage 1*.
      v. The Tester sends PS_RDY message immediately after changing from presenting Rp to Rd (in sub-step d)

vi. The Tester checks that UUT changes from presenting Rd to Rp within tFRSwapComplete of having sent PS_RDY message (in sub-step e) [TEST.PD.FRS.SNK3.1#5]

vii. The Tester checks that it starts receiving PS_RDY message from the UUT within tFRSwapComplete of having sent PS_RDY message (in sub-step e). [TEST.PD.FRS.SNK3.1#6]

viii. The Tester checks that the UUT sends a Source Capabilities message after tSwapSourceStart and before tFirstSourceCap max. [TEST.PD.FRS.SNK3.1#7]

5. The Tester runs the test again, but in step 1 the Tester sends a Source_Capabilities message with two PDOs:

   a. a Fixed Supply PDO 5V at the corresponding current specified in the UUT's Sink_Capabilities message, plus

   b. a Fixed Supply PDO with the highest voltage in the UUT's Sink_Capabilities message at the corresponding current.

   This may result in establishing a contract at the highest voltage in the UUT's Sink_Capabilities message. If instead the 5V contract is made by the UUT this pass ends immediately.

TEST.PD.FRS.SNK3.2 Normal Conditions, Consumer Only

Description: Starting with the UUT as an initial Sink, the Tester verifies that the Consumer Only UUT correctly ignores Fast Role Swap.

Test Conditions:

	Consumer Only	Provider Only, P/C, C/P, DRP
Rev3ChkdSnk	✓	

Test Procedures:

1. The Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)

2. Tester waits 500ms to allow UUT the opportunity to request Sink Caps.

3. Check that the UUT does not send a Get Sink Caps message. [TEST.PD.FRS.SNK3.2#1]

4. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min. The signal is applied via a resistance of rFRSwapTx (5Ω) to ground.

5. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.

   a. VBUS electrical sub-steps:

      i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.

      ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester attempts to draw 100mA. (This is necessary in order to detect whether VBUS is being applied by UUT.)

iii. The Tester checks that the UUT does not supply VBUS within 1s of the Tester VBUS falling below vSafe5V min. [TEST.PD.FRS.SNK3.2#2]

b. PD messaging sub-steps:

i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.

ii. The Tester checks that the UUT does not send an FR_Swap message within 1s. [TEST.PD.FRS.SNK3.2#3]

TEST.PD.FRS.SNK3.3 FR_Swap Not Sent

Description: Starting with the UUT as an initial Sink, after the receipt of the FR_Swap message, the Tester intentionally does not reply GoodCRC in order to force an Error Recovery on the UUT and verifies it is correctly implemented.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. If VIF field FR_Swap_Type_C_Current_Capability_As_Initial_Sink is set in the vendor file to 00b, this test passes and stops here.
2. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)
3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min.
4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.
      ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink.
   b. PD messaging sub-steps:
      i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.

ii. The Tester checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.3#1]

iii. Upon receipt of the FR_Swap message, the Tester intentionally does not reply with a GoodCRC message

iv. The check fails if Error Recovery is not detected within 15ms after the last bit of the EOP of the last retried PS_RDY message. [TEST.PD.FRS.SNK3.3#2]

TEST.PD.FRS.SNK3.4   SendResponseTimer Timeout

Description: Starting with the UUT as an initial Sink, after the receipt of the FR_Swap message, the Tester intentionally does not reply with Accept in order to force a SenderResponseTimer time out on the UUT and verifies it is correctly implemented.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. If VIF field FR_Swap_Type_C_Current_Capability_As_Initial_Sink is set in the vendor file to 00b, this test passes and stops here.

2. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)

3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min.

4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.
      ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink.
   b. PD messaging sub-steps:

i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.
ii. The Tester checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.4#1]
iii. Upon receipt of the FR_Swap message, the Tester replies with a GoodCRC message but intentionally does not reply with Accept message to the UUT.
iv. Check that Error Recovery is detected between tSenderResponse min, and tSenderResponse max. The delay is measured from the time the last bit of the GoodCRC Message EOP has been sent to the time the Error Recovery starts. [TEST.PD.FRS.SNK3.4#2]

TEST.PD.FRS.SNK3.5   PSSourceOffTimer Deadline

Description: Starting with the UUT as an initial Sink, after accepting a FR_Swap, the Tester sends PS_RDY at the deadline limit of tPSSourceOff min and verifies the UUT accepts this message.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. If VIF field FR_Swap_Type_C_Current_Capability_As_Initial_Sink is set in the vendor file to 00b, this test passes and stops here.
2. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)
3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min.
4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:
      i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.
      i. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink. After the Tester has turned off Vbus, the operating point when Vbus is below vSafe5V max is referred to as *Stage 1*.

b. PD messaging sub-steps:
   i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.
   ii. The Tester checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.5#1]
   iii. Upon receipt of the FR_Swap message, the Tester replies with a GoodCRC and sends an Accept message to the UUT.
   iv. The Tester changes from presenting Rp to Rd as soon as the operating point has reached Stage 1.
   v. The Tester sends PS_RDY at the deadline limit of tPSSourceOff min. The delay is measured from the time the last bit of the EOP of the GoodCRC message corresponding to the Accept message was sent to the time the last bit of the EOP of the PS_RDY was sent.
   vi. The check fails if Error Recovery is detected when waiting the GoodCRC message or before the PS_RDY is sent. [TEST.PD.FRS.SNK3.5#2]

TEST.PD.FRS.SNK3.6 PSSourceOffTimer Timeout

Description: Starting with the UUT as an initial Sink, after accepting a FR_Swap, the Tester intentionally does not send PS_RDY, to force a PSSourceOffTimer timeout on the UUT and verifies it is correctly implemented.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. If VIF field FR_Swap_Type_C_Current_Capability_As_Initial_Sink is set in the vendor file to 00b, this test passes and stops here.
2. There are 2 possible bring-up procedures:
   a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)
   b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)
3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min.
4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.
   a. VBUS electrical sub-steps:

i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.

ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink. After the Tester has turned off Vbus, the operating point when Vbus is below vSafe5V max is referred to as *Stage 1*.

b. PD messaging sub-steps:

i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.

ii. The Tester checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.6#1]

iii. Upon receipt of the FR_Swap message, the Tester replies with a GoodCRC and sends an Accept message to the UUT.

iv. The Tester changes from presenting Rp to Rd as soon as the operating point has reached Stage 1.

v. The Tester intentionally does not send PS_RDY, to force a PSSourceOffTimer timeout on the UUT.

vi. Check that Error Recovery is detected between tPSSourceOff min, and tPSSourceOff max. The delay is measured from the time the last bit of the GoodCRC Message EOP corresponding to the Accept message has been sent to the time the Error Recovery starts. [TEST.PD.FRS.SNK3.6#1]

TEST.PD.FRS.SNK3.7 PS_RDY Not Sent

Description: Starting with the UUT as an initial Sink, after the receipt of the PS_RDY message, the Tester intentionally does not reply GoodCRC in order to force an Error Recovery on the UUT and verifies it is correctly implemented.

Test Conditions:

	P/C, C/P, DRP	Consumer Only, Provider Only
Rev3ChkdSnk	✓	

Test Procedures:

1. If VIF field FR_Swap_Type_C_Current_Capability_As_Initial_Sink is set in the vendor file to 00b, this test passes and stops here.

2. There are 2 possible bring-up procedures:

a. The UUT has VIF field PD_Port_Type set to Provider/Consumer, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.8 (Dual-Role Power bit B29 in the single PDO is set to 1b)

b. The UUT has VIF field PD_Port_Type set to Consumer/Provider or DRP, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2 (Dual-Role Power bit B29 in the single PDO is set to 1b)

3. The Tester sends a Fast Role Swap signal to the UUT, with a duration of tFRSwapTx min.

4. After sending the Fast Role Swap signal, the Vbus electrical and PD messaging test sub-steps are performed separately.

    a. VBUS electrical sub-steps:

        i. The Tester immediately turns off the Vbus at the end of Fast Role Swap signal. The Tester as a Source shall present a capacitance of 10uF on the Vbus line.

        ii. The Tester draws no current until tSnkFRSwap has passed, since the start of the Fast Role Swap signal or since when the Vbus falls below vSafe5V min, whichever comes later. After that, the Tester draws the current specified in VIF parameter FR_Swap_Type_C_Current_Capability_As_Initial_Sink. After the Tester has turned off Vbus, the operating point when Vbus is below vSafe5V max is referred to as *Stage 1*.

    b. PD messaging sub-steps:

        i. The Tester presents SinkTxOK immediately after sending Fast Role Swap signal.

        ii. The Tester checks that FR_Swap message starts to be sent by the UUT within tFRSwapRx max plus tFRSwapInit max of the start of the Fast Role Swap signal. [TEST.PD.FRS.SNK3.7#1]

        iii. Upon receipt of the FR_Swap message, the Tester replies with a GoodCRC and sends an Accept message to the UUT.

        iv. The Tester changes from presenting Rp to Rd as soon as the operating point has reached Stage 1.

        v. The Tester sends PS_RDY with the Port Power Role field = 0b (Sink).

        vi. The check fails if the PS_RDY is not received within tPSSourceOn min. The delay is measured from the time the last bit of the EOP of the GoodCRC message corresponding to the transmitted PS_RDY message to the time the last bit of the EOP of the PS_RDY is received. [TEST.PD.FRS.SNK3.7#2]

        vii. Upon receipt of the PS_RDY message, the Tester intentionally does not reply with a GoodCRC message.

        viii. The check fails if Error Recovery is not detected within 15ms after the last bit of the EOP of the last retried PS_RDY message EOP has been received to the time the Error Recovery is detected. [TEST.PD.FRS.SNK3.7#3]

9. USB4

TEST.PD.USB4.DRST.1 –Data_Reset command response of UFP UUT

Description:

Tester verifies the UFP UUT provides proper response for the Data_Reset command from DFP.

Test Specific Tester Behavior:

- The Tester is a Source and DFP
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6

Test Conditions:

	Consumer Only	Provider Only, P/C	DRP, C/P
Rev3Snk	✓		✓

Test Procedures:

1. Bring up the UUT with bring-up procedure COMMON.PROC.BU2

2. The Tester sends "Data_Reset" message to UUT

3. The Tester checks for response.

   a. If the tester receives message 'Not_Supported" and the VIF field 'Data_Reset_Supported=No', the check passes and test ends here. [TEST.PD.USB4.DRST.1#1]
   b. If the tester doesn't receive "Not_Supported" and the VIF field 'Data_Reset_Supported=No", the check fails and test ends here. [TEST.PD.USB4.DRST.1#2]
   c. If the tester doesn't receive "Accept" in tSenderResponse (30mS) and the VIF Field Data_Reset_Supported= Yes. The check fails and test end here [TEST.PD.USB4.DRST.1#3]
   d. If the tester receives "Accept' in tSenderResponse (30mS), tester perform below step
      a. Tester Power Cycle Vconn in accordance with requirements

4. The Tester sends the message 'Data_Reset_Complete' and verify the below checks upon the goodcrc from UUT [TEST.PD.USB4.DRST.1#4]

   a. No disconnect seen in CC termination.
   b. UFP is not presenting Vconn

5. The Tester sends the message 'Get_Sink_Cap and verify the below checks upon the goodcrc from UUT [TEST.PD.USB4.DRST.1#5]

   a. Data_role is same as before data reset (Tester is DFP, UUT is UFP)

TEST.PD.USB4.DRST.2 –Data_Reset command response of UFP UUT, Invalid Sequence

Description:

The Tester verifies UFP UUT initiates the error recovery upon failure of data_reset process.

Test Specific Tester Behavior:

- The Tester is a Source and DFP
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6

Test Conditions:

This test is applicable if the VIF parameter "Data_Reset_Supported" is set to Yes

	Consumer Only	Provider Only, P/C	DRP, C/P
Rev3Snk	✓		✓

Test Procedures:

1. Bring up the UUT with bring-up procedure COMMON.PROC.BU.2

2. The Tester sends "Data_reset" message to UUT

3. The Tester checks for response.

    a. If the tester doesn't receive "Accept" in tSenderResponse (30mS), the check fails.
    [TEST.PD.USB4.DRST.2#1]

    b. If the tester receives "Accept' in tSenderResponse (30mS), tester perform below steps
    [TEST.PD.USB4.DRST.2#2]
        a. Power Cycle Vconn in accordance with requirements

4. The Tester skips sending "DataResetComplete" and sends the message "Get Sink cap" after tdataresetfail (300mS). Tester verifies that the UUT does error recovery in 315mS.
[TEST.PD.USB4.DRST.2#3]

TEST.PD.USB4.DRST.3 –Data_Reset command response of UFP UUT Sourcing Vconn

Description:

Verify the Vconn power cycling of UFP upon accepting data_reset command from DFP

Test Specific Tester Behavior:

- The Tester is a Source and DFP
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6

Test Conditions:

This test is applicable if the VIF parameter "Data_Reset_Supported" is set to Yes and "VCONN_Swap_To_On_Supported= Yes" on Vendor information file

	Consumer Only	Provider Only, P/C	DRP, C/P
Rev3Snk	✓		✓

Test Procedures:

1. Bring up the UUT with bring-up procedure COMMON.PROC.BU.2

2. Tester sends Vconn_Swap message to bring UFP UUT as Vconn provider. Tester check the response. [TEST.PD.USB4.DRST.3#1]

   a. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.
   b. The check fails and test ends here if the UUT does not send an Accept message.

3. Tester send message "Data_Reset" message to UUT

4. The Tester checks for response.

   a. If the tester doesn't receive "Accept" in tSenderResponse (30mS), the check fails. [TEST.PD.USB4.DRST.3#2]
   b. If the tester receives "Accept' in tSenderResponse (30mS), tester perform below steps
      I. Check fails if the Vconn voltage is not below VRaReconnect (800mV) in tVconnzero (125mS) [TEST.PD.USB4.DRST.3#3]
      II. Check fails if the PS_RDY Message is not received in tVCONNSourceDischarge [160 to 240mS]. [TEST.PD.USB4.DRST.3#4]

5. The Tester sends the message Data_Reset_Complete and verify the below checks upon the GOODCRC from UUT

a. No disconnect seen in CC termination. [TEST.PD.USB4.DRST.3#5]

b. UFP not presenting Vconn. [TEST.PD.USB4.DRST.3#6]

TEST.PD.USB4.DRST.4 –DataReset command response of UFP UUT Sourcing Vconn – Invalid Sequence

Description:

Verify that UFP initiates the error recovery upon invalid sequence of UFP Vconn power cycle.

Test Specific Tester Behavior:

- The Tester is a Source and DFP
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6

Test Conditions:

This test is applicable if the VIF parameter "Data_Reset_Supported" is set to Yes and "VCONN_Swap_To_On_Supported= Yes" on Vendor information file

	Consumer Only	Provider Only, P/C	DRP, C/P
Rev3Snk	✓		✓

Test Procedures:

1. Bring up the UUT with bring-up procedure COMMON.PROC.BU.2

2. Tester sends Vconn_Swap message to bring UFP UUT as Vconn provider. Tester check the response. [TEST.PD.USB4.DRST.4#1]

   a. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.

   b. The check fails and test ends here if the UUT does not send an Accept message.

3. Tester send message "Data_Reset" message to UUT

4. The Tester checks for response.

    c.   If the tester doesn't receive "Accept" in tSenderResponse (30mS), the check fails. [TEST.PD. USB4.DRST.4#2]

5. The Tester sends message Vconn_Swap without waiting (in less than 160mS after accept) for PS_RDY from UUT and verify that the UUT does the error recovery in 15mS. The check fails if the error recovery is not seen from UUT. [TEST.PD. USB4.DRST.4#3]

TEST.PD. USB4.DRST.5 –Data_Reset command response of DFP UUT Sourcing Vconn

Description:

The Tester verifies DFP UUT accepts data_reset command and provides the proper response.

Verify the Vconn power cycle sequence and DFP becomes the Vconn source after completion of data_reset

Test Specific Tester Behavior:

- The Tester is a Sink and UFP
- Tester emulates active cable
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

If the parameter "Data_Reset_Supported = YES" on the vendor file, this test is applicable.

	Consumer Only, C/P	Provider Only	DRP, P/C
Rev3Src		✓	✓

Test Procedures:

1. Bring-up the UUT with bring-up procedure COMMON.PROC.BU.1.

2. The Tester send message "Data_Reset" message to UUT. The Tester checks for response.

    a.   If the tester doesn't receive "Accept" the check fail. Test end here. [TEST.PD. USB4.DRST.5#1]

    b.   If the tester receives "Accept', the tester performs below steps

I.   Tester verifies the UUT Power Cycle the Vconn properly. The UUT should stop sourcing Vconn and the VCONN should be below vRaReconnect (800mV) within tVconnzero(125mS]. [TEST.PD. USB4.DRST.5#2]. The tVconnzero is measured from last bit of GoodCRC acknowledging Accept.

II. Tester verify the UUT keeps the Vconn below vRaReconnect (800mV) for tVconnReapplied (minimum of 10ms and max of 20mS]. [TEST.PD. USB4.DRST.5#3]

III. Tester verifies that the UUT starts sourcing the Vconn (Vconn voltage rising above vRaReconnect by end of tVconnReapplied. [TEST.PD. USB4.DRST.5#4]

IV. The tester verifies the Vconn voltage is reaching in valid range in Max of tVconnvalid [5mS].[TEST.PD. USB4.DRST.5#5]. The time is measured between Vconn voltage crossing vRaReconnect(800mV) to min of vVconnValid(3V).

3. The Tester expects the Data_Reset_Complete message from UUT. If the Data_Reset_Complete message is received and the tester considers the data_reset process is completed. Tester verifies the below checks

a.   UUT not initiated any other message after accepting data_reset. [TEST.PD. USB4.DRST.5#6]
b.   VBUS is not changed and it is in valid range throughout the data_reset process. [TEST.PD. USB4.DRST.5#7]

4. If the tester doesn't receive the Data_Reset_Complete in tDataResetFail(300mS) time, the check fails. [TEST.PD. USB4.DRST.5#8].

5. If the tester doesn't receive the Data_Reset_Complete in tDataResetFail(300mS) time, tester verifies that the UUT enters error recovery. Check fails if UUT not entered error recovery [TEST.PD. USB4.DRST.5#9]

6. If the VIF "USB4_Supported= Yes", Tester expects the UUT to initiate the device discovery process from the UUT. Tester expects DiscoverID REQ from UUT on SOP [TEST.PD. USB4.DRST.5#10]

7. If the VIF "USB4_Supported= Yes", Tester expects the UUT to initiate the cable discovery process from the UUT. Tester expects DiscoverID REQ from UUT on SOP' [TEST.PD. USB4.DRST.5#11]

TEST.PD. USB4.DRST.6 –Data_Reset command response of DFP UUT, UFP Sourcing Vconn

Description:

The Tester verifies DFP UUT accepts data_reset command and provides the proper response when UFP sourcing Vconn.

Verify the Vconn power cycle sequence and DFP becomes the Vconn source after completion of data_reset

Test Specific Tester Behavior:

- The Tester is a Sink and UFP
- The tester emulates active cable
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

This test is applicable if the VIF parameter "Data_Reset_Supported" is set to Yes and "VCONN_Swap_To_OFF_Supported= Yes" on Vendor information file

	Consumer Only, C/P	Provider Only	DRP, P/C
Rev3Src		✓	✓

Test Procedures:

1. Bring-up the UUT with bring-up procedure COMMON.PROC.BU.1.

2. Tester sends Vconn_Swap message to become Vconn provider. Tester check the response. [TEST.PD.USB4.DRST.6#1]

a. If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.
b. The check fails and test ends here if the UUT does not send an 'Accept' message.
c. Tester sends PS_RDY upon accept of VconnSwap

4. The Tester send message "Data_reset" message to UUT. The Tester checks for response.

a. If the tester doesn't receive "Accept", the check fails. [TEST.PD. USB4.DRST.6#2]
b. If the tester receives "Accept' message, the tester performs below steps
    I. Tester sends PS_RDY after tVconnZero. The tVconnzero is measured from last bit of goodcrc acknowledging Accept.
    II. Tester verifies that the Vconn is below vRaReconnect for minimum of tVconnReapplied(10ms). The time is measured from the last bit of GoodCRC acknowledging PS_RDY to Vconn voltage rising above vRaReconnect.[TEST.PD. USB4.DRST.6#3]
    III. Tester verifies that the UUT starts sourcing the Vconn (Vconn voltage rising above vRaReconnect by maximum of tVconnReapplied. [TEST.PD. USB4.DRST.6#4]

IV. The tester verifies the Vconn voltage is reaching in valid range in Max of tVconnvalid [5mS]. [TEST.PD. USB4.DRST.6#5]. The time is measured between Vconn voltage crossing vRaReconnect(800mV) to min of vVconnValid(3V).

3. The Tester expects the Data_Reset_Complete message from UUT. If the Data_Reset_Complete message is received, and the tester considers the data_reset process is completed. Tester verifies the below checks

   a. UUT not initiated any other message after accepting data_reset. [TEST.PD. USB4.DRST.6#6]
   b. VBUS is not changed, and it is in valid range throughout the data_reset process. [TEST.PD. USB4.DRST.6#7]

4. If the tester doesn't receive the Data_Reset_Complete in tDataResetFail(300mS) time, the check fails. [TEST.PD. USB4.DRST.6#8].

6. If the VIF "USB4_Supported= Yes", Tester expects the UUT to initiate the device discovery process from the UUT. Tester expects DiscoverID REQ from UUT on SOP [TEST.PD. USB4.DRST.6#9]

7. If the VIF "USB4_Supported= Yes", Tester expects the UUT to initiate the cable discovery process from the UUT. Tester expects DiscoverID REQ from UUT on SOP' [TEST.PD. USB4.DRST.6#10]

TEST.PD. USB4.DRST.7 –Data_reset command response of DFP UUT, UFP Sourcing Vconn-VCONNDischargeTimer expiry check

Description:

The Tester verifies DFP UUT accepts data_reset command and provides the proper response when UFP sourcing vconn. Tester verifies implementation of Vconn Discharge Timer on DFP.

Test Specific Tester Behavior:

- The Tester is a Sink and UFP
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always rejects VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

This test is applicable if the VIF parameter "Data_Reset_Supported" is set to Yes and "VCONN_Swap_To_Off_Supported= Yes" on Vendor information file

	Consumer Only, C/P	Provider Only	DRP, P/C
Rev3Src		✓	✓

Test Procedures:

1. Bring-up the UUT with bring-up procedure COMMON.PROC.BU.1.

2. Tester sends Vconn_Swap message to become Vconn provider. Tester check the response. [TEST.PD.USB4.DRST.7#1]

    a.   If the UUT responds with a Wait message and the Tester resends VCONN_Swap every tVCONNSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent VCONN_Swap for 10 times.

    b.   The check fails and test ends here if the UUT does not send an 'Accept' message.

    c.   Tester sends PS_RDY upon accept of VconnSwap

4. The Tester send message "Data_reset" message to UUT. The Tester checks for response.

    a.   If the tester doesn't receive "Accept", the check fails. [TEST.PD. USB4.DRST.7#2]

    b.   If the tester receives "Accept' message, the tester performs below steps

        I.   Tester sends PS_RDY after tVconnZero. The tVconnzero is measured from last bit of goodcrc acknowledging Accept.

       II.   Tester intentionally do not send PS_RDY after dropping the Vconn. Tester checks for UUT going error recovery upon expiry of Vconndischargetimer. The check fails if the error recovery is not seen in tVCONNSourceDischarge max (240mS). [TEST.PD. USB4.DRST.7#3] The tVCONNSourceDischarge is measured from the last bit of the GoodCRC acknowledging the Accept message in response to the Data_Reset Message.

TEST.PD. USB4.EUSB.1 – Enter_USB command response of UFP UUT-Valid Mode

Description:

The Tester as USB4 DFP verifies that the USB4 capable UFP accepts Enter_USB command and provides the proper response.

Test Specific Tester Behavior:

Unless a Test Specific Tester Behavior is specified, this section uses the following behavior:

- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

If parameter "USB4_UFP_Supported" is set to Yes in the vendor file, this test is applicable.

	Consumer Only, C/P	Provider Only, P/C	DRP
Rev3Snk	✓		✓
Rev3Src		✓	

Test Procedures:

1. The tester starts with two possible bring-up procedures.

   a. The UUT has VIF field PD_Port_Type set to Consumer Only / DRP or C/P, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 and does the below steps to bring the UUT as UFP.
      a. Tester sends a DR_Swap message and check response
      b. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times. [TEST.PD. USB4.EUSB.1#1]
      c. If the UUT not responded with "Accept". The check fails and test end here. [TEST.PD. USB4.EUSB.1#2]

2. The Tester sends a Discover Identity Request to the UUT, using SOP. The Tester checks the response. [TEST.PD. USB4.EUSB.1#3]

   a. The check fails if the UUT responds with a "Responder NAK"
   b. The check fails if the UUT responds with "Not_Supported "
   c. If the UUT interrupts the Discovery Process (by sending anything but a Discover ID Response message), the Tester resends Discover ID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails if the Tester has resent Discover ID Request for 10 times.
   d. The check fails if the UUT responds with a "Responder BUSY" message and the Tester has resent Discover ID Request for 10 times every tVDMBusy min.
   e. The check fails if the UUT does not send "Responder ACK"

3. The Tester formulates the EUDO with information received from UFP1 VDO of Discover ID ACK response from UUT. The Tester sends an Enter_USB message to the UUT using SOP with host present bit = 0 to make speculative connection.

   a. USB Mode: USB4, Cable speed: USB3.2 Gen2, Cable type: Passive, Cable current: 3A. Host Present = 0, Set everything else to 0.

4. The Tester checks the response from UFP. Testers checks the below

   a. The check fails if the tester receives any message other than Accept. [TEST.PD. USB4.EUSB.1#4].
   b. The tester issues a warning if UUT initiated any AMS in tEnterUSB(500mS). For Consumer Only/C/P and the DRP the tEnter USB is measured from last bit of goodcrc acknowledging source cap from tester. For Provider only, P/C, It is measured from goodcrc for the accept response of DR_SWAP

5. The Tester sends an Enter_USB message to the UUT using SOP with EUDO set with below parameters to make USB4PDhost connection.

   a. USB Mode: USB4, Cable speed: USB3.2 Gen2, Cable type: Passive, Cable current: 3A. Host Present = 1, Set everything else to 0.

6. The Tester checks the response from UFP. Testers checks the below

   a. The check fails if the tester receives any message other than Accept. [TEST.PD. USB4.EUSB.1#5].

TEST.PD. USB4.EUSB.2 – Enter_USB command response of UFP UUT-Invalid Mode

Description:

The Tester as USB4 DFP verifies that the USB4 capable UFP Rejects invalid Enter_USB request and provides the proper response.

Test Specific Tester Behavior:

Unless a Test Specific Tester Behavior is specified, this section uses the following behavior:

- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- The Tester always provides a NAK response for Discover Identity COMMON.PROC.PD.7
- The Tester always provides a NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

If parameter "USB4_UFP_Supported" is set to Yes in the vendor file, this test is applicable.

	Consumer Only, C/P	Provider Only, P/C	DRP
Rev3Snk	✓		✓
Rev3Src		✓	

Test Procedures:

1. The tester starts with two possible bring-up procedures.

   c.   The UUT has VIF field PD_Port_Type set to Consumer Only / DRP or C/P, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2

   d.   The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 and does the below steps to bring the UUT as UFP.

        a.   Tester sends a DR_Swap message and check response

        b.   If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times. [TEST.PD. USB4.EUSB.2#1]

        c.   If the UUT not responded with "Accept". The check fails and test end here. [TEST.PD. USB4.EUSB.2#2]

2. The Tester sends a Discover Identity Request to the UUT, using SOP. The Tester checks the response. [TEST.PD. USB4.EUSB.2#3]

   f.   The check fails if the UUT responds with a "Responder NAK"

   g.   The check fails if the UUT responds with "Not_Supported "

   h.   If the UUT interrupts the Discovery Process (by sending anything but a Discover ID Response message), the Tester resends Discover ID Request tVDMBusy min after it is in PE_SNK_RDY for 10 times. The check fails if the Tester has resent Discover ID Request for 10 times.

   i.   The check fails if the UUT responds with a "Responder BUSY" message and the Tester has resent Discover ID Request for 10 times every tVDMBusy min.

   j.   The check fails if the UUT does not send "Responder ACK"

3. The Tester sends an Enter_USB message to the UUT using SOP. The Tester formulates the EUDO with information received from Discover ID ACK response from UUT

        b.   USB Mode: USB4, Cable speed: USB2, Cable type: Passive, Cable current: 3A. Host Present = 0, Set everything else to 0.

4. The Tester checks the response from UFP. Testers checks the below

c. The check fails if the tester receives any message other than Reject. [TEST.PD. USB4.EUSB.2#4].

d. The tester issues a warning if UUT initiated any AMS in tEnterUSB(500mS). For Consumer Only/C/P and the DRP the tEnter USB is measured from last bit of goodcrc acknowledging source cap from tester. For Provider only, P/C, It is measured from EOP of goodcrc for the accept response of DR_SWAP

TEST.PD. USB4.EUSB.3–Enter_USB Flow-USB4 DFP Connected to USB4 UFP using an Active Cable

Description: The Tester verifies the Enter_USB flow of USB4 Capable DFP UUT when it is connected to a USB4 capable UFP using a USB4 Capable Active cable.

Test Specific Tester Behavior:

- Tester emulates USB4 capable UFP, PD Peripheral device
- Tester emulates USB4 Gen3 Active cable. Highest Speed USB4Gen3, Current – 3A, VBus Max-20V, Cable Latency -0001b, SOP" Controller Present=1.
- The Tester always accepts DR_SWAP_to_UFP and rejects DR_Swap_to_DFP
- The tester always accepts the Vconn_Swap
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always provides ACK response with below settings for Discover Identity Request as in COMMON.PROC.PD.7.
  - On the SOP'
    - ID header VDO-> Product Type UFP: Active Cable, Connector Type: USB TypeC plug, Modal operation supported = No, USB VendorID= Tester Vendor ID. All other values are 0
    - Active Cable VDO 1-> Connector: USB TypeC, Max Current 3A, Max Voltage=20V, Max Speed= USB4 Gen3. Cable termination = 11b. Cable latency=0001b, SOP" Controller Present=1, Remaining all field are 0
    - Active Cable VDO 2-> Max Temp=70, Shutdown Temp=80, USB Gen=1, remaining all fields are 0

  - On the SOP
    - ID header VDO->Product Type UFP: PDUSB Peripheral, Connector Type: USB TypeC Receptacle
    - UFP VDO->Device capability: USB4 Device capable, Highest Speed: USB4 Gen3

- The Tester always provides NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

If USB4_DFP_Supported is set to Yes in the vendor file, this test is applicable.

	Consumer Only, C/P	Provider Only	DRP, P/C
Rev3Src		✓	✓
Rev3Snk	✓		

Test Procedures:

1. There are two possible bring-up procedures

    a.   For Provider Only, DRP, P/C, bring-up the UUT with bring-up procedure COMMON.PROC.BU.1.

    b.   For Consumer Only, C/P bring-up the UUT with be UUT with COMMON.PROC.BU.2 and perform below steps

        i.   Tester sends DR_Swap message to bring the UUT as DFP. Tester check the response. [TEST.PD.USB4.EUSB.3#1]

            a.   If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times.

            b.   The check fails if the UUT not accepted the DR_SWAP, the test ends here.

2. If the tester receives the 'Enter_USB' message on SOP', the tester performs the below checks.

    a.   Verify the USB mode on EUDO is set to USB4[TEST.PD.USB4.EUSB.3#2]

    b.   Verifies the reserved fields on EUDO(b31, b27,b24,b12-0) are set to 0. [TEST.PD. USB4.EUSB.3#3]

    c.   Tester send "Accept" response on SOP'

3. If the tester receives the 'Enter_USB' message on SOP'', the tester performs the below checks.

    a.   Verify the USB mode on EUDO is set to USB4[TEST.PD.USB4.EUSB.3#4]

    b.   Verifies the reserved fields on EUDO(b31, b27,b24,b12-0) are set to 0[TEST.PD. USB4.EUSB.3#5]

    c.   Tester send 'Accept" response on SOP''

4. If the tester receives the 'Enter_USB' message on SOP, the tester performs the below checks.

    a.   The Enter_USB command is received with in tEnterUSB(500mS) [TEST.PD. USB4.EUSB.3#6] For Provider, DRP, P/C UUTs , the tEnter USB is measured from last bit of goodcrc acknowledging source cap from the UUT. For C, C/P UUTs, the tEnter USB is measured from last bit of goodcrc acknowledging Accept message in response for DR_SWAP

    b.   Tester verifies below parameters of EUDO matching to the tester's UFP VDO and Cable VDOs. Tester send 'Accept' response if the checks are true. Tester send 'Reject' response if any of the below checks are false. [TEST.PD. USB4.EUSB.3#7]

        a.   USB Mode = USB4

        b.   Cable Speed = USB4 Gen3,

        c.   Cable Type =Active,

        d.   Current=3A

e.   Reserved fields are set to 0 (b31, b27, b24, b12-0)

c.   Tester checks the consistency of EUDO fields against the VIF. The check fails if any of the fields are not matching.

      a.   USB4 DRD should set to 1 if USB4_UFP_Supported =YES. USB4 DRD should set to 0 if USB4_UFP_Supported =No.

      b.   USB3 DRD should set to 1, if Type_C_Can_Act_As_Device is set to 1 and Device Speed is USB 3 Gen 1 or above,

      c.   PCIe Support field setting matches to the VIF field USB4_**PCIe_Tunneling_Supported**

      d.   DP Support field setting matches to the VIF field **USB4_DP_Tunneling_Supported**

      e.   TBT Support field setting matches to the VIF field **USB4_TBT3_Tunneling_Supported = Yes**

      f.   If UUTs ProductType DFP = PDUSBHost, verify that the Host Connected bit set to 1

5. Test waits for tUSB4Timeout (1000mS). The test fails if the tester doesn't receive the Enter_USB on SOP. The tUSB4Timeout is measured from sink(tester) attach for Provider,DRP,P/C. For C, C/P it is measured from last bit of GoodCRC acknowledging accept response for the DR_Swap. [TEST.PD. USB4.EUSB.3#8]

TEST.PD. USB4.EUSB.4 – DR_Swap after Entering USB4 Mode entry

Description:

Verify the USB4 capable DRD accepting DR_SWAP after entering USB4 mode. Verify the UUT perform the USB4 device discovery and mode entry to USB4 after DR_SWAP

Test Specific Tester Behavior:

Unless a Test Specific Tester Behavior is specified, this section uses the following behavior:

- Tester emulates as USB4 Host and USB4 Peripheral with DRD Capable
- The Tester always replies with a Reject message to a DR_Swap message
- The Tester always rejects PR_Swap COMMON.PROC.PD.5
- The Tester always accepts VCONN_Swap COMMON.PROC.PD.6
- When acting as DFP, Tester emulates USB4 Host and send Enter_USB with below setting EUDO
  - USB Mode: USB4, Cable speed: USB3.2 Gen2, Cable type: Passive, Cable current: 3A. Host Present = 1, Set everything else to 0.
- The Tester always provides ACK response with below settings for Discover Identity Request as in COMMON.PROC.PD.7.
  - On the SOP'
    - ID header VDO-> Product Type UFP: Active Cable, Connector Type: USB TypeC plug, Modal operation supported = No
    - Active Cable VDO 1-> Connector: USB TypeC, Max Current 3A, Max Voltage=20V, Max Speed= USB4 Gen3. Remaining all field are 0
    - Active Cable VDO 2-> Max Temp=70, Shutdown Temp=80, USB Gen=1, remaining all fields are 0

- o On the SOP
  - ▪ ID header VDO->Product Type UFP: PDUSB Peripheral, Connector Type: USB TypeC Receptacle
  - ▪ UFP VDO->Device capability: USB4 Device capable, Connector Type: USB TypeC Receptacle, Highest Speed: USB4 Gen3

- The Tester always provides NAK response for Discover SVIDs COMMON.PROC.PD.8

Test Conditions:

If parameter "USB4_UFP_Supported" and USB4_DFP_Supported" is set to Yes in the vendor file, this test is applicable.

	Consumer Only, C/P	Provider Only, P/C	DRP
Rev3Snk	✓		✓
Rev3Src		✓	

Test Procedures:

1. The tester starts with two possible bring-up procedures.

   a. The UUT has VIF field PD_Port_Type set to Consumer Only / DRP or C/P, the Tester runs bring-up procedure with the UUT as a Sink COMMON.PROC.BU.2
   b. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, the Tester runs bring-up procedure with the UUT as a Source COMMON.PROC.BU.1 and does the below steps to bring the UUT as UFP.
      a. Tester sends a DR_Swap message and check response
      b. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times. [TEST.PD. USB4.EUSB.4#1]
      c. If the UUT not responded with "Accept". The check fails and test end here. [TEST.PD. USB4.EUSB.4#2]

2. The Tester sends an Enter_USB message to the UUT using SOP and check the response from UUT.

   a. The check fails if the tester receives any message other than Accept. [TEST.PD. USB4.EUSB.4#3].

3. Tester send DR_Swap message to bring the UUT as DFP. Tester checks the response. [TEST.PD.USB4.EUSB.4#4]

a. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times.

b. The check fails if the UUT not accepted the DR_SWAP, the test ends here.

4. If the tester receives the 'Enter_USB' message on SOP', the tester performs the below checks. [TEST.PD.USB4.EUSB.4#5]

a. Verify the USB mode on EUDO is set to USB4

b. Tester send "Accept" response on SOP'

5. If the tester receives the 'Enter_USB' message on SOP'', the tester performs the below checks. [TEST.PD.USB4.EUSB.4#6]

a. Verify the USB mode on EUDO is set to USB4

b. Tester sends 'Accept" response on SOP''

8. If the tester receives the 'Enter_USB' message on SOP, the tester performs the below checks and send Accept response if checks are true. Otherwise send Reject response. [TEST.PD.USB4.EUSB.4#7]

a. The Enter_USB command is received with in tEnterUSB(500mS). The tEnter USB is measured from last bit of goodcrc acknowledging Accept message in response for DR_SWAP

b. Verify the USB mode on EUDO is set to USB4

c. USB4 DRD on EUDO set to 1

9. Tester waits for tUSB4Timeout (1000mS). The check fails if the tester doesn't receive the Enter_USB on SOP. The tUSB4Timeout is measured GoodCRC of Accept for DR_Swap. [TEST.PD. USB4.EUSB.4#8]

10. Tester send DR_Swap message to bring the UUT as UFP. Tester check the response. [TEST.PD.USB4.EUSB.4#9]

a. If the UUT responds with a Wait message and the Tester resends DR_Swap every tDRSwapWait + 15ms for 10 times. The check fails and the test ends here if the Tester has resent DR_Swap for 10 times.

b. The check fails if the UUT not accepted the DR_SWAP, the test ends here.

11. The Tester sends an Enter_USB message to the UUT using SOP and check the response from UUT.

a. The check fails if the tester receives any message other than Accept. [TEST.PD. USB4.EUSB.4#10].

TEST.PD.USB4.CBL.1 – Enter_USB command response of cable UUT-Valid Mode

Description:

The Tester as USB4 DFP verifies the Enter_USB command response from the cable.

Test Conditions:

	Consumer Only	Provider Only, DRP, C/P, P/C	VPD	Free Cable	Captive Cable
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 3 possible bring-up procedures

   a. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3
   b. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.
   c. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a Discover Identity Request to the UUT, using SOP'. The tester checks the response to know the cable information. If the UUT responds with "Responder BUSY" message, the Tester resends Discover ID Request for 10 times every tVDMBusy min.

3. The Tester formulates the EUDO with USB Mode = USB4 and other fields set to 0. Tester sends Enter_USB on SOP' and check the response.

   a. If the VIF Field 'Enter_USB_Supported = No', the check fails if the tester receives any response message. [TEST.PD. USB4.CBL.1#1]
   b. If the VIF Fields 'Enter_USB_Supported = Yes' and 'USB4_Supported = No', the check fails if the tester receives any message other than 'Reject'. [TEST.PD. USB4.CBL.1#2]
   c. If the VIF Fields 'Enter_USB_Supported = Yes' and 'USB4_Supported = Yes', the check fails if the tester receives any message other than "Accept". [TEST.PD. USB4.CBL.1#3]

4. If the tester received an Active Cable VDO in response to DiscoverID request and 'SOP" Controller Present' bit is set to 1 on Active cable VDO, the tester sends Enter_USB message on SOP" with USB Mode on EUDO set to USB4 and other fields set to 0. Tester checks the response from UUT

   a. If the VIF Field 'Enter_USB_Supported = No', the check fails if the tester receives any response message. [TEST.PD. USB4.CBL.1#4]

b. If the VIF Fields 'Enter_USB_Supported = Yes' and 'USB4_Supported = No', the check fails if the tester receives any message other than 'Reject' [TEST.PD. USB4.CBL.1#5]

c. If the VIF Fields 'Enter_USB_Supported = Yes' and 'USB4_Supported = Yes', the check fails if the tester receives any message other than "Accept" [TEST.PD. USB4.CBL.1#6]

TEST.PD. USB4.CBL.2 – Enter_USB command response of Cable UUT-Invalid Mode

Description:

The Tester as USB4 DFP verifies the Enter_USB command response of cables for an invalid request.

Test Conditions:

	Consumer Only	Provider Only	DRP, C/P, P/C	Free Cable	Captive Cable
Rev3VcMinEnd1				✓	✓
Rev3VcMaxEnd1				✓	✓
Rev3VcMinEnd2				✓	
Rev3VcMaxEnd2				✓	

Test Procedures:

1. There are 3 possible bring-up procedures

a. The UUT has VIF field VIF_Product_Type set to Cable. The Tester runs bring-up procedure with the UUT as a Cable Plug COMMON.PROC.BU.3

b. The UUT has VIF field PD_Port_Type set to DRP, Consumer/Provider or Consumer only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Sink UUT for Captive Cable Test COMMON.PROC.BU.6.

c. The UUT has VIF field PD_Port_Type set to Provider/Consumer or Provider only, and VIF parameter Captive_Cable is set to YES, and VIF parameter SOP_P_Capable is set to YES*. The Tester runs bring-up procedure with the UUT as a Source UUT for Captive Cable Test COMMON.PROC.BU.11.

2. The Tester sends a Discover Identity Request to the UUT, using SOP'. The tester checks the response to know the cable information. If the UUT responds with "Responder BUSY" message, the Tester resends Discover ID Request for 10 times every tVDMBusy min.

3. The Tester formulates the EUDO with USB Mode = "Reserved" and other fields set to 0. Tester sends Enter_USB on SOP' and check the response.

a. If the VIF Field 'Enter_USB_Supported = No', the check fails if the tester receives any response message. [TEST.PD. USB4.CBL.2#1]

b. If the VIF Fields 'Enter_USB_Supported = Yes', the check fails if the tester receives any message other than 'Reject' [TEST.PD. USB4.CBL.2#2]

4. If the tester received Active Cable VDO in response to DiscoverID request and 'SOP" Controller Present' bit is set to 1 on Active cable VDO, the tester sends Enter_USB message on SOP" with USB Mode on EUDO set to "Reserved" and other fields set to 0. Tester checks the response from UUT.

     a. If the VIF Field 'Enter_USB_Supported = No', the check fails if the tester receives any response message. [TEST.PD. USB4.CBL.2#3]

     b. If the VIF Fields 'Enter_USB_Supported = Yes', the check fails if the tester receives any message other than 'Reject' [TEST.PD. USB4.CBL.2#4]

Appendix A: Requirements for Compliance Test Results

The Compliance Test Results **Shall** be output in XML format, compliant with the official USB-IF documentation and schema

Documentation:

Schema: https://compliance.usb.org/xsd/USB/DataCollection.xsd

- In the *testRun* element:
  - The following values **Shall** be set within the *spec* element:
    - title: "USB Power Delivery Compliance Test Specification"
    - version: "1.0"
    - revision: "1.2"
  - Inside *tests*, a *test* element **Shall** be created for each Common Check, Common Procedure, and Test
  - If any tests fail, the *score* element **Shall** be set to "fail". Otherwise, it **Shall** be set to "pass".

- In each *test* element:
  - The *tcID* attribute **Shall** match the test number (e.g. "TEST.PD.PROT.SRC.1")
  - Inside *conditions*, a *condition* element **Shall** be created for each Test Condition identifier
  - If any conditions fail, the *score* element **Shall** be set to "fail". Otherwise, it **Shall** be set to "pass". For Common Checks and Common procedures, the absence of any failing instances Shall result in a pass regardless of whether the check was ever performed.

- In each *condition* element:
  - The *conditionID* attribute **Shall** match the test condition (e.g. "Rev2Src")
  - An element called *checks* **Shall** be created. Within *checks*, a *check* element **Shall** be created for every check identifier. Checks from within any Bring-up Procedure that is references during the test Shall be included.
  - If any checks fail, the *score* element **Shall** be set to "fail". Otherwise, it **Shall** be set to "pass".
    - If any check element score results in warning, still the *condition score* element **Shall** be set to "pass"

- In each *check* element:
  - A *checkID* attribute **Shall** match the check identifier (e.g. "TEST.PD.PROT.SRC.1#1")
  - If the check fails, the *score* element **Shall** be set to "fail". Otherwise, it **Shall** be set to "pass" or "warning".
    NOTE: "warning" is a variant of "pass" informing the device vendor that the device is compliant with the current specification, however its behavior is marginal and may need to change for better interoperability with other devices.
  - A *comment* element **Shall** be used to provide detail on the nature of each failure. The format in which this is done may be determined by the test vendor.
    - In Common Checks and Procedures, the *comment* element **Shall** indicate both the number of failures and total number of times the check was performed. The format in which this is done may be determined by the test vendor.

Appendix B: XML Output Example

```xml
<?xml version="1.0"?>
<testReport>
  <product>
    <deviceID>0</deviceID>
    <nameVendor>Product Vendor</nameVendor>
    <nameProduct>Product Name</nameProduct>
    <nameModel>0</nameModel>
    <productInfo>
      <vif>
        <![CDATA[
        <?xml version="1.0" encoding="utf-8"?>
        <VIF xmlns="http://usb.org/VendorInfoFile.xsd">
          <VIF_Specification>3.01</VIF_Specification>
          <VIF_App>
            <Vendor>USB-IF</Vendor>
            <Name>Vendor Info File Editor</Name>
            <Version>3.0.0.1</Version>
          </VIF_App>
          <Vendor_Name>Product Vendor</Vendor_Name>
          <Model_Part_Number>Product Name</Model_Part_Number>
          <Product_Revision>0</Product_Revision>
          <TID>0</TID>
          <VIF_Product_Type value="1">Cable</VIF_Product_Type>
          <Certification_Type value="2">Silicon</Certification_Type>
          <Product/>
          <Component>
            <USB4_Supported value="false"/>
            <USB_PD_Support value="true"/>
            <PD_Specification_Revision value="1">Revision
2.0</PD_Specification_Revision>
            <SOP_Capable value="false"/>
```

```xml
            <SOP_P_Capable value="true"/>
            <SOP_PP_Capable value="false"/>
            <SOP_P_Debug_Capable value="false"/>
            <SOP_PP_Debug_Capable value="false"/>
            <XID value="0"/>
            <Data_Capable_As_USB_Host value="false"/>
            <Data_Capable_As_USB_Device value="false"/>
            <Product_Type value="3">passive Cable</Product_Type>
            <Modal_Operation_Supported value="false"/>
            <USB_VID value="0">0000</USB_VID>
            <PID value="0">0000</PID>
            <bcdDevice value="0">0000</bcdDevice>
            <Cable_HW_Vers value="0">0</Cable_HW_Vers>
            <Cable_FW_Vers value="0">0</Cable_FW_Vers>
            <Type_C_To_Type_A_B_C value="2">Type-C®</Type_C_To_Type_A_B_C>
            <Type_C_To_Plug_Receptacle
value="0">Plug</Type_C_To_Plug_Receptacle>
            <Cable_Latency value="1">&lt;10ns</Cable_Latency>
            <Cable_Termination_Type value="0">Both ends passive, VCONN not
required</Cable_Termination_Type>
            <VBUS_Through_Cable value="true"/>
            <Cable_VBUS_Current value="2">5A</Cable_VBUS_Current>
            <Cable_SOP_PP_Controller value="false"/>
            <Cable_Superspeed_Support value="2">USB 3.1 Gen
2</Cable_Superspeed_Support>
          </Component>
        </VIF>
        ]]>
      </vif>
    </productInfo>
  </product>
  <components>
    <component>
      <technology/>
      <subject/>
      <value>1</value>
      <testTool>
        <deviceID/>
        <nameVendor>Test Vendor</nameVendor>
        <nameProduct>Test Product</nameProduct>
        <nameModel>XYZ</nameModel>
        <versionHW>1.23</versionHW>
        <versionSW>1.23 b456</versionSW>
        <versionFW>1.23</versionFW>
        <serialNumber>12345</serialNumber>
        <dateCalibration/>
        <configuration/>
        <description/>
        <comments/>
        <testRuns>
          <testRun timestamp="2020-08-30T12:34:56">
            <spec>
              <title>USB Power Delivery Compliance Test Specification</title>
              <revision>1.3</revision>
              <version>1.0</version>
            </spec>
            <score value="fail"/>
```

```xml
<test tcID="TEST.PD.PHY.ALL.5">
  <title>Unrecognized Message</title>
  <score value="pass"/>
  <conditions>
    <condition conditionID="Rev2VcMinEnd1">
      <score value="pass"/>
      <checks>
        <check checkID="TEST.PD.PHY.ALL.5#1">
          <score value="pass"/>
          <comment/>
        </check>
        <check checkID="TEST.PD.PHY.ALL.5#2">
          <score value="n/a"/>
          <comment/>
        </check>
      </checks>
    </condition>
    <condition conditionID="Rev2VcMaxEnd1">
      <score value="pass"/>
      <checks>
        <check checkID="TEST.PD.PHY.ALL.5#1">
          <score value="pass"/>
          <comment/>
        </check>
        <check checkID="TEST.PD.PHY.ALL.5#2">
          <score value="n/a"/>
          <comment/>
        </check>
      </checks>
    </condition>
    <condition conditionID="Rev3VcMinEnd1">
      <score value="pass"/>
      <checks>
        <check checkID="TEST.PD.PHY.ALL.5#1">
          <score value="pass"/>
          <comment/>
        </check>
        <check checkID="TEST.PD.PHY.ALL.5#2">
          <score value="n/a"/>
          <comment/>
        </check>
      </checks>
    </condition>
    <condition conditionID="Rev3VcMaxEnd1">
      <score value="pass"/>
      <checks>
        <check checkID="TEST.PD.PHY.ALL.5#1">
          <score value="pass"/>
          <comment/>
        </check>
        <check checkID="TEST.PD.PHY.ALL.5#2">
          <score value="n/a"/>
          <comment/>
        </check>
      </checks>
    </condition>
  </conditions>
```

```xml
        </test>
        <test tcID="COMMON.CHECK.PD.3">
          <title>Check Request Message</title>
          <score value="fail"/>
          <conditions>
            <condition conditionID="">
              <score value="fail"/>
              <checks>
                <check checkID="TEST.PD.PHY.ALL.5#1">
                  <score value="fail"/>
                  <comment>Failed in 1 of 3 instances. Failures occurred
during: TEST.PD.PHY.ALL.5</comment>
                </check>
                <check checkID="TEST.PD.PHY.ALL.5#1">
                  <score value="pass"/>
                  <comment/>
                </check>
              </checks>
            </condition>
          </conditions>
        </test>
      </testRun>
    </testRuns>
  </testTool>
  </component>
  </components>
</testReport>
```

Appendix C: Power Disconnection for FRS Initial Source Testing

The initial Source testing requires the ability to trigger the Source to send a Fast Role Swap signal. Two methods of performing this are required:

1. Interrupting the AC mains / wall power to the UUT.
2. Interrupting the DC power between the UUT and its power supply. This method is important because it is more likely to cause issues during testing, as there is less possibility of early warning of the interruption.

The Tester Vendor shall provide Switch Boxes to accomplish these switching requirements.

The circuitry of these boxes is at the discretion of the Test Equipment Vendor, except that the interface from the Tester shall be as described below, including connector type, electrical levels and logical sense of the input.

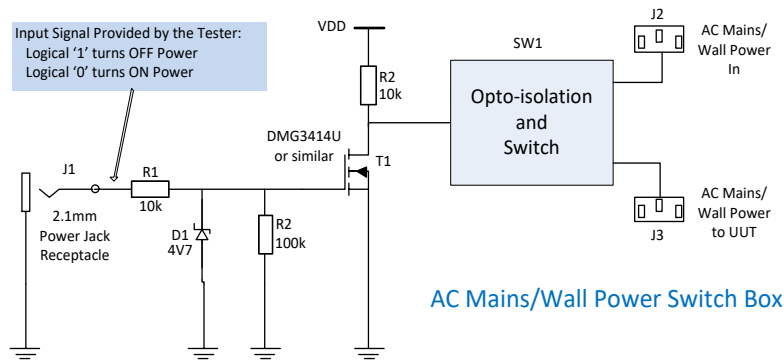## AC Mains / Wall Power Switch Box

Figure C-1: Schematic of the Switch Box for disconnecting AC Mains / Wall Power

Figure C-1 shows the schematic of the Switch Box. The switch box has an AC connector (J2) to plug into the AC mains / wall power, and 2 additional receptacles:

- J1 is a 2.1mm barrel jack connector for receiving input signal from the Tester
- J3 is an AC receptacle providing the UUT as its power supply

The AC mains / wall power (the UUT's power supply) is allowed to pass if the Tester provides a logical "0" input to the switch box. Conversely, the AC mains / wall power is disconnected if the Tester provides a logical "1" as the input of the switch box, or if the cable from the Tester is not connected. The function of each components in the schematic as shown in Figure B-1:

- R1 is a 10 kOhm resistor, providing current limitation
- R2 is a 100 kOhm resistor, providing high impedance termination
- R3 is a 10 kOhm pull up resistor
- D1 is a Zener diode for protecting the T1 N-channel MOSFET gate-to-source against any high voltage inadvertently applied to J1.
- SW1 represents a voltage-controlled switch circuit that is capable of switching AC voltage from 90 to 265V AC. Please note that this switch must contain suitable isolation circuitry to provide isolation of 2500V AC between the input and the switched AC voltage for safety purposes.
- T1 is an N-channel MOSFET that provides input signal to the switch SW1.

When the input signal is higher than 1.26V, the switch box is presented with a logical "1":

- The T1 transistor is turned on
- This in turn pulls the drain terminal of T1 transistor to zero and turns off the switch SW1

When the input signal is lower than 0.54V or J1 is not connected, the switch box is presented with a logical "0":

- The T1 transistor is turned off
- This in turn pulls up the drain terminal of T1 transistor to VDD voltage and turns on the switch SW1.

- This allows the AC power to pass through the switch box.
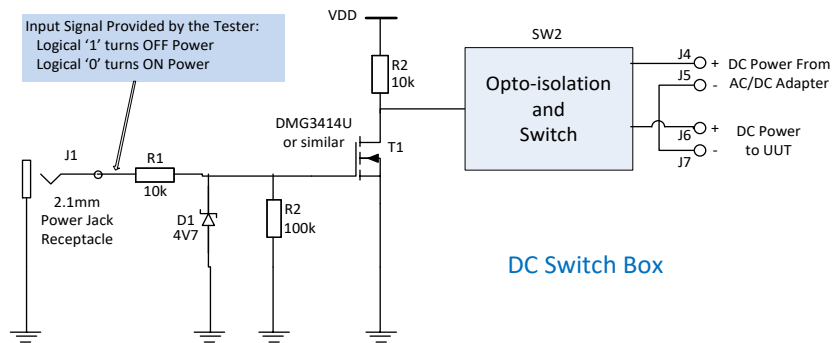
DC Switch Box

Figure C-2: schematic of the standard switch box for disconnecting DC power

Most of the operation of the DC Switch Box (Figure C-2) duplicates the AC mains / wall power Switch Box, however connectors J4 to J7 are provided to switch DC power between the UUT and its AC/DC Adapter. To accommodate different connectivity the connectors are 4mm test terminals, which will accept either 4mm test plugs or bare-ended wires. During Compliance Testing, the UUT Vendor is expected to provide suitable cables connected to the UUT and to its AC/DC Adapter.

A box for interrupting the DC power will need to be able to switch 15A. The connectors would have to carry this current too and be widely available. The 4mm test socket proposed will carry 15A, and the mating plugs are available in a shrouded version to protect the UUT Vendor's AC/DC Adapter from accidental shorting.

Figure C-3: Plug and Socket for disconnecting DC power

If the UUT Vendor prefers bare ended cables, they will also be compatible and able to provide up to 15A.

Operating the DC Switch shall have the effect of disconnecting any normally user-accessible plugged DC supply connection.
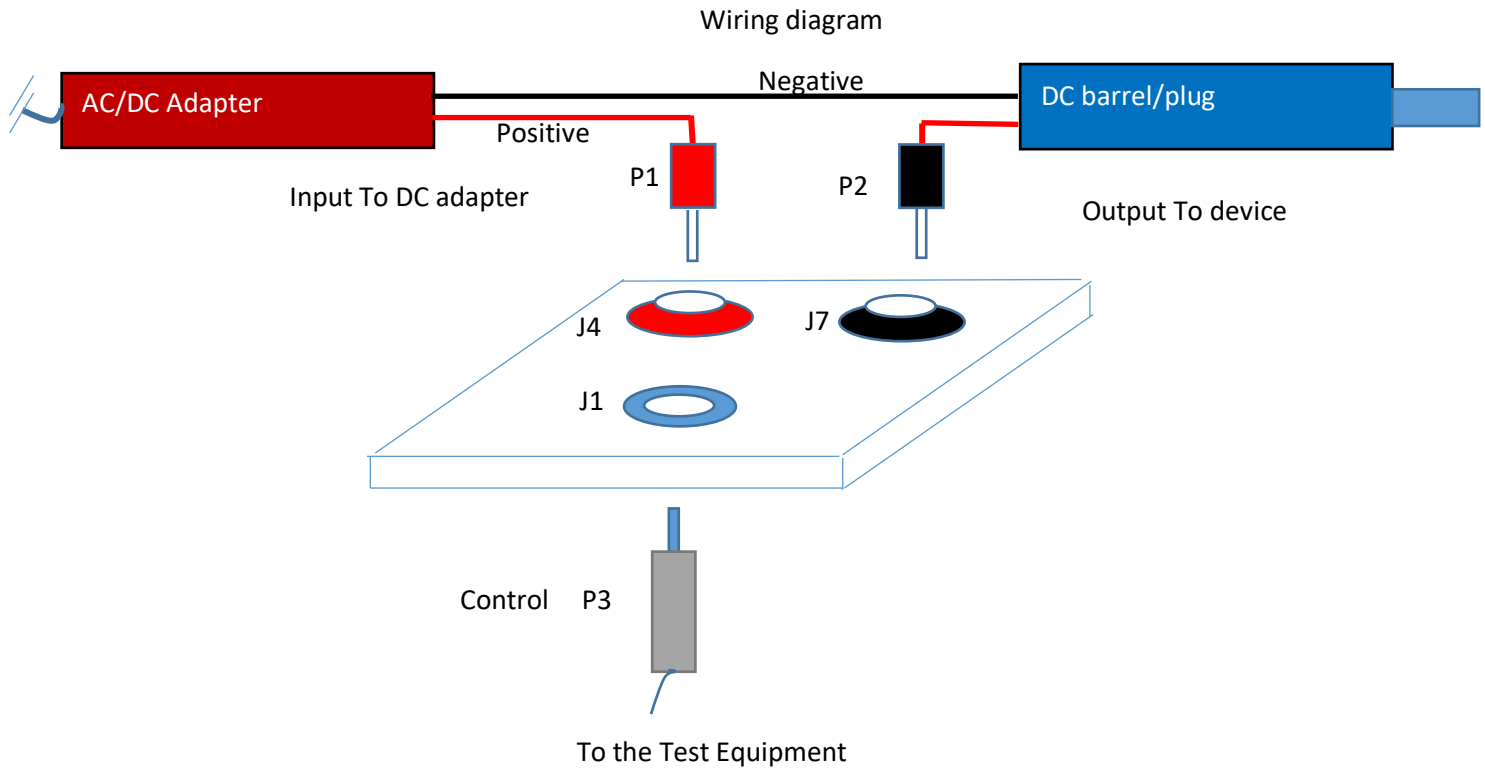
Cable interfaces and BOM

Figure C-4 Wiring diagram

Table 2 Components

Component	Manufact.	Part Number	Newark #	Description
P1	Pomona	1325-2	30F1407	Conn banana Plug 15A, 60V Red
P2	Pomona	1325-0	30F1430	Conn banana Plug, 15A, 60V Black
P3	Switchcraft conxall	762Z	80AH1412	DC Power Connector
J1	Switchcraft Conxall	721A	49AC1396	DC Power Connector, 2.1mm Jack
J4, J7	2269-0	2269-0	30F1419	Banana Test Connector, 15A 25kV

Appendix D: VBUS measurements

In order to give consistent results on measurements of VBUS voltage it has been decided that all compliance test equipments *Shall* use the same filtering when evaluating the voltage vs. the test spec.

This filter has been agreed to be a second order Butterworth low pass filter with a 3 dB cut off frequency of 15kHz. This is compatible with the parameters of all current testers.

The CTS proposes an implementation of the filter, first the function is listed, after that the coefficients are given.

D.1 Filter Function

The below function is used with the coefficients listed in the Coefficients section to calculate the filtered VBUS voltage.

When called with a sample value, the function returns the filtered sample value. It is intended to be called for all samples in the capture from the first to the last sample.

```
float Iir(float newSample)
{
      define nCoef 2

      static double y[nCoef + 1]; //output samples
      static double x[nCoef + 1]; //input samples
      int n;

      //shift the old samples
      for (n = nCoef; n > 0; n--) {
            x[n] = x[n - 1];
            y[n] = y[n - 1];
      }

      //Calculate the new output
      x[0] = newSample;
      y[0] = m_aCoef[0] * x[0];
      for (n = 1; n <= nCoef; n++)
            y[0] += m_aCoef[n] * x[n] + m_bCoef[n] * y[n];

      return (float) y[0];

}
```

D.2 Coefficients

Coefficients have been calculated for a number of sample rates.

Please note that these are informational and implementors are required to verify their implementations against the specification of the filter.

1.2.1 20µs sample interval

aCoef[0] = 0.39133577250176854178675966977607

aCoef[1] = 0.78267154500353708357351933955215

aCoef[2] = 0.39133577250176854178675966977607

bCoef[0] = 1.00000000000000000000000000000000

bCoef[1] = -0.36952737735124108198192516283598

bCoef[2] = -0.19581571265583302965396228501049

1.2.2 15µs sample interval

aCoef[0] = 0.24833913797217702090769364531297

aCoef[1] = 0.49667827594435404181538729062595

aCoef[2] = 0.24833913797217702090769364531297

bCoef[0] = 1.00000000000000000000000000000000

bCoef[1] = 0.18422210917344900016345832227671

bCoef[2] = -0.17757866106215708379423290352861

1.2.3 10µs sample interval

aCoef[0] = 0.13110643991662596086200665013166

aCoef[1] = 0.26221287983325192172401330026332

aCoef[2] = 0.13110643991662596086200665013166

bCoef[0] = 1.00000000000000000000000000000000

bCoef[1] = 0.74778917825850343970017775063752

bCoef[2] = -0.27221493792500722763705311990634

1.2.4 2µs sample interval

aCoef[0] = 0.00782020803349719149932806061543

aCoef[1] = 0.01564041606699438299865612123085

aCoef[2] = 0.00782020803349719149932806061543

bCoef[0] = 1.00000000000000000000000000000000

bCoef[1] = 1.73472576880927498166329314699396

bCoef[2] = -0.76600660094326389337737737150746

1.2.5 1µs sample interval

aCoef[0] = 0.00208056713549229247914307272538

aCoef[1] = 0.00416113427098458495828614545076

aCoef[2] = 0.0020805671354922924791430727 2538

bCoef[0] = 1.000000000000000000000000000000 00

bCoef[1] = 1.8668922797117144529 72159961063 88

bCoef[2] = -0.8752145482536837217 6797038264 340