PD Communications Engine
USB PD Compliance MOI

Version 1.09

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Revision History

Date	Rev	Edited by	Changes
Feb. 25, 2016	0.90	Tim McKee	Initial Release
May 17, 2016	0.91	Pat Crowe	Last 3 sections not relevant to MOI removed
May 22,2016	1.00	Pat Crowe	End of TDA.2.3.1.1: BMC-POW-SRC-LOAD-P-PC corrected
Sept 21, 2016	1.01	Pat Crowe	Added Rev 3.0 and 'Rev 4.0' v Rev 2.0 interaction behaviour test details Added BIST Test Data message just before 'Locate EOP' tests.
Jan 25, 2017	1.02	Pat Crowe	Clarified in MSG test that UFP can't respond to SOP' or SOP''. Clarified fine detail on PR_Swap, DR_Swap and VCONN_Swap tests. Noted actual current BUSIDL test part noise omission.
Mar 22, 2017	1.03	Pat Crowe	Added TDA.2.2.9: BMC-PROT-GSC-REC, based on LeCroy's implementation. Added requirement to do E-Marker testing with VCONN at both 5V and 3V Changed note in previous version as BUSIDL noise is now performed correctly.
Mar 24, 2017	1.04	Pat Crowe	Fixed invalid parts of MSG test when testing a DFP: - Don't send Cable Reset as results are ambiguous. - Don't check response to SOP' or SOP'' as results are ambiguous. Small editorial in BMC-PROT-GSC-REC
June 6, 2017	1.05	Pat Crowe	Fixed error in TDA.1.2.1: CAB-PROT-DISCOV when checking response of Rev 3.0 cable to Rev 4.0 message. Modified checks at end of VCONN test. BMC-PROT- SEQ-PRSWAP - added mention of DRP bit. Clarified that BMC-PROT-DISCOV is only performed on a consumer (UFP).
June 10, 2017	1.06	Pat Crowe	One fail situation in TDA.2.2.6: BMC-PROT- SEQ-PRSWAP now changed to WARNING, at the request of Tech Admin.
Oct 10, 2017	1.07	Pat Crowe	Added test BMC-PROT-IGN-PPS (TDA.2.2.10) to ensure that a Rev 2.0 Sink responds correctly when seeing a PPS PDO in the Tester Rev 3.0 Source Capabilities, where this is the first SOP message from the Tester. TDA.2.2.2.1 and TDA.2.2.2.2 TDA.2.2.2.3 TDA.2.2.2.4 only apply if not captive cable. TDA.2.2.9: BMC-PROT-GSC-REC timing change
Mar 4, 2018	1.08	Pat Crowe	Added VCONN voltage range to cable testing. (See Section 2.1) Also added to each relevant test description.
Apr 30, 2018	1.09	Pat Crowe	Modified description of noise generation to match new method.

Terms and Abbreviations

This Section lists and defines terms and abbreviations used throughout this document.

Term	Description
Attached	USB Power Delivery ports which are mechanically joined with USB cable.
BIST	Built In Self Test – Power Delivery testing mechanism for the Phy Layer.
Connected	USB Power Delivery ports which are actively communicating using the USB Power Delivery protocol.
Consumer	The capability of a PD Port (typically a Device's upstream port) to sink power from the power conductor (e.g. V_{BUS}).
Consumer/Provider	A Consumer with the additional capability to act as a Provider.
Contract	An agreement on both power level and direction reached between a Port Pair. A contract may be explicitly negotiated between the Port Pair or may be an implicit power level defined by the current state. While operating in Power Delivery mode there will always be either an explicit or implicit contract in place. The agreement may only be altered in the case of a negotiation, Hard Reset or failure of the Source.
Device	When lower cased (device), it refers to any USB product, either device or host.
Downstream Port	Either a port in the Host or the ports defined in or Type-C as defined in ***[USBType-C 1.0]***. The default Host and Source.
Hard Reset	This is initiated by HardReset signaling from either Port Partner. It restores V_{BUS} to the default condition and resets the PD communications engine to its default state.
Message	The packet payload consisting of a header for control messages and a header and data for data messages as defined in Section 5.6.1.2.5 of [PowerDelivery1.1].
Packet	One entire unit of PD communication including a preamble, SOP*, payload, CRC and EOP as defined in Section 5.6 of [PowerDelivery1.1].
PD	USB Power Delivery
PD Capable	A port that supports USB Power Delivery.
PDUSB	USB Device Port or USB Host Port that is PD capable.
Phy Layer	The Physical Layer responsible for sending and receiving messages across V_{BUS} between a Port Pair.
Policy	Policy defines the behavior of PD capable parts of the system and defines the capabilities it advertises, requests made to (re)negotiate power and the responses made to requests received.
Policy Engine	The Policy Engine interprets the Device Policy Manager's input in order to implement Policy for a given port and directs the Protocol Layer to send appropriate messages.
Port	An interface typically exposed through a receptacle, or via a plug on the end of a hard-wired captive cable. USB Power Delivery defines the interaction between a Port Pair.
Port Pair	Two attached PD Ports.
Port Partner	The USB Power Delivery contract is negotiated between a Port Pair connected by a USB cable. These ports are known as Port Partners.

Term	Description
Power Conductor	The wire delivering power from the Source to Sink. For example USB's V_{BUS}.
Power Consumer	See Consumer
Power Provider	See Provider
Protocol Error	An unexpected or unknown message, that cannot be handled by a given implementation.
Protocol Layer	The entity that forms the messages used to communicate information between Port Partners.
Provider	A capability of a PD Port (typically a Host, Hub, or Wall Wart DFP) to source power over the power conductor (e.g. V_{BUS}). This corresponds to a Type-A ro a Type-C Port with R_P asserted on its CC Wire.
Provider/Consumer	A Provider with the additional capability to act as a Consumer. This corresponds to a Dual-Role Type-A Port or a Dual-Role Type-C Port with R_P asserted on its CC Wire.
Reserve	Power which is kept back by a Provider in order to ensure that it can meet total power requirements of attached Consumers on at least one port.
Sink	The port consuming power from V_{BUS}; most commonly a Device.
Soft Reset	A process that resets the PD communications engine to its default state.
Source	A role a port is currently taking to supply power over V_{BUS}; most commonly a Host or Hub downstream port.
System Policy	Overall system policy generated by the system, broken up into the policies required by each Port Pair to affect the system policy. It is programmatically fed to the individual Devices for consumption by their Policy Engines.
Tester	The Tester is assumed to be a piece of test equipment, or an assembly of pieces of test equipment, which manage(s) the testing process of a PD UUT.
Unit Under Test (UUT)	The PD device that is being tested by the Tester and responds to the initiation of a particular BIST test sequence.
Upstream Port	Typically a Type-C Port as defined in ***[USBType-C 1.0]***, starting as a default Device and Sink.
Wall Wart	A power supply or "power brick" that is plugged into an AC outlet. It supplies DC power to power a device or charge a battery.

1 COMMON TEST PROCEDURES

1.1 BMC-PROC-PD-MODE Getting into PD Mode For a PD Device

This is a routine which appears at the start of many test sequences. It differs slightly in implementation depending on whether the UUT is:

- initially a UFP (Sink) or a DRP initially connected to a Tester (Source)
- initially a DFP (Source) or a DRP initially connected to a Tester (Sink)

In any of the following procedures, the first message sent by the Tester shall have a MessageID, which is one greater than the last time this procedure was followed. This is in order to test that the UUT complies with assertion 6.6.1.2#1.

In the following the details of actually having two CC lines are taken as understood and orientation is correctly selected.

1.1.1 UUT initially a DFP (Source) or a DRP initially connected to a Tester (Sink)

In these cases, the test cable will normally already be connected, the Tester will be applying a capacitance according to USB 2.0 (as a device). As the Tester will not be applying Rp yet, the UUT will normally not be providing VBUS. However as a hot plug is permitted in the C-Specification VBUS may indeed already be present.

The Tester follows the following sequence:

1. If testing a DRP, set Tester Source Capabilities to a single PDO of Fixed 5V at 100mA. (If Get_Source_Cap is received, the Tester will respond with this automatically.)
2. Set Tester Sink Capabilities to a single PDO of Fixed 5V at 100mA. (If Get_Sink_Cap is received, the Tester will respond with this automatically.) When the Tester is forced to make a Request, it will therefore request the conditions of sink PDO#1.
3. If DFP check that Rp only is present, check that the voltage on CC is valid. If a DRP, check that it toggles between Rp and Rd at a valid rate and check that the voltages on CC are valid [BMC_PROC_PD_MODE_1].
4. Check for the presence of VBUS. Do not proceed if VBUS is present, but end the test in failure.
5. Simultaneously ensure that the Tester is applying capacitance according to USB 2.0 (as a device).
6. Turn on Rd (use 5.1kΩ to ground).

7. If VBUS was not present, wait for it to reach vSafe5V. Check that the time to achieve this from the point of turning on Rd is in a valid range (tbd) [BMC_PROC_PD_MODE_2].
8. Wait for the first message (Source Capabilities or a VDM) and, if Source Capabilities, respond to this with a GoodCRC.
9. Make a Request (for 5V at 100mA), and wait for the accompanying Accept, and PS_RDY.

Communications has now been established.

1.1.2 UUT initially a UFP (Sink) or a DRP initially connected to a Tester (Source)

For a Consumer, the test cable will normally already be connected, and the Tester will be applying vSafe0V, and not applying Rp.

The Tester follows the following sequence:

1. Set Tester Source Capabilities to a single PDO of Fixed 5V at 100mA. (If Get_Source_Cap is received, the Tester will respond with this automatically.)
2. If the UUT is a DRP, set Tester Sink Capabilities to a single PDO of Fixed 5V at 100mA. If Get_Sink_Cap is received, the Tester will respond with this automatically.
3. Turn on Rp (use 4.7kΩ to 3.3V).
4. Wait for Rd from the UUT and check that this occurs within a required time (tbd) [BMC_PROC_PD_MODE_3].
5. Wait a required time (tbd) and then apply vSafe5V to VBUS.
6. Wait a required time (tbd).
7. Send a Source Capabilities message.
8. Check that a response of GoodCRC is received from the UUT [BMC_PROC_PD_MODE_4].
9. Repeat steps 7 and 8 if required, in accordance with PD communications protocol. This requires a delay of tTypeCSendSourceCap (100 ms to 200 ms). This sequence is repeated at least 50 times.
10. Wait to receive a Request, and complete the Request sequence up to sending PS_RDY.

Communications has now been established.

1.1 CAB-PROC-PD-MODE Getting into PD Mode For a Cable Marker

This is a routine which appears at the start of most cable marker test sequences.

1. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end. The capacitive load of the tester is as close to 400pF as practical.
2. The Tester sends the first message to the cable which is specified.
3. Check that the cable responds with a GoodCRC. [CAB_PROC_PD_MODE_1].

1.2 Hard Reset Monitoring

During a sequence of automated, or semi-automated testing it is possible (and entirely legal) that a UUT would send a Hard Reset. This would generally invalidate the test being carried out and would require the test to be restarted. If such an event were to occur too often, it would not be possible to test such a UUT for compliance. It would probably also not be satisfactory from a user perspective.

Therefore:

- Each such occurrence shall be reported as part of the test results.
- If the number of Hard Resets exceeds three, during the suite of compliance tests, the UUT shall be rejected as not meeting compliance.

2 TEST OVERVIEW

For each category of UUT, there is a primary list of tests which shall be performed.

Each section following has a header entry defining the section as a Primary Test, or as a Secondary Check.

During the process of each Primary Test; as different messages and message sequences are encountered; it is required that the Tester should implement the checks described in the appropriate secondary checks section.

In addition to the unique Test Names, we have added optional Test Reference Numbers. These were added to allow an alternative method of reference for people who find numbers easier to understand than names. It is the intention that, as with the Test Names, the newly introduced test numbers will not change in future versions of the Compliance Plan.

It is a requirement that the names of the tests, and the corresponding failure names be included in any test reports. Test Reference Numbers may also be included in reports.

2.1 Cable Markers - Primary Tests

Test Conditions:

All Cable Marker tests shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end. TDA.1.1.1.1.1 (CAB-PHY-TX-EYE), and where appropriate TDA.1.1.1.1.2 (CAB-DP-PHY-TX-EYE) shall also be performed at each end of the cable with a VCONN voltage of 4.25V.

2.1.1 Physical Layer - Transmit

Test Name	Test Ref No.	Description	CAB
CAB-PHY-TX-EYE	TDA.1.1.1.1.1	Transmitter Eye Diagram Test (SOP Prime or Double Prime)	✓
CAB-DP-PHY-TX-EYE	TDA.1.1.1.1.2		✓
CAB-PHY-TX-BIT	TDA.1.1.1.2.1	Transmit Bit Rate and Bit Rate Drift (SOP Prime or Double Prime)	✓
CAB-DP-PHY-TX-BIT	TDA.1.1.1.2.2		✓

2.1.2 Physical Layer - Receive

Test Name	Test Ref No.	Description	CAB
CAB-PHY-RX-BUSIDL	TDA.1.1.2.1.1	Cable Bus Idle Detection Test (SOP Prime or Double Prime)	✓
CAB-DP-PHY-RX-BUSIDL	TDA.1.1.2.1.2		✓
CAB-PHY-RX-INT-REJ	TDA.1.1.2.2.1	Cable Receive Interference Rejection Test (SOP	✓

CAB-DP-PHY-RX-INT-REJ	TDA.1.1.2.2.2	Prime or Double Prime)	✓

2.1.3 Physical Layer - Miscellaneous

Test Name	Test Ref No.	Description	CAB
CAB-PHY-TERM	TDA.1.1.3.1.1	Cable Termination Impedance Test (SOP Prime or Double Prime)	✓
CAB-DP-PHY-TERM	TDA.1.1.3.1.2		✓
CAB-PHY-MSG	TDA.1.1.3.2.1	Cable PHY Level Message Test (SOP Prime or Double Prime)	✓
CAB-DB-PHY-MSG	TDA.1.1.3.2.2		✓

2.1.4 Protocol Specific

Test Name	Test Ref No.	Description	CAB
CAB-PROT-DISCOV	TDA.1.2.1	Cable ID Checks	✓

2.2 Power Delivery Devices - Primary Tests

2.2.1 Physical Layer - Transmit

Test Name	Test Ref No.	Description	DRP	P	C	C/P	P/C
BMC-PHY-TX-EYE	TDA.2.1.1.1	BMC Transmitter Eye Diagram Test	✓	✓	✓	✓	✓
BMC-PHY-TX-BIT	TDA.2.1.1.2	BMC Transmit Bit Rate and Bit Rate Drift	✓	✓	✓	✓	✓

2.2.2 Physical Layer - Receive

Test Name	Test Ref No.	Description	DRP	P	C	C/P	P/C
BMC-PHY-RX-BUSIDL	TDA.2.1.2.1	BMC Bus Idle Detection Test	✓	✓	✓	✓	✓
BMC-PHY-RX-INT-REJ	TDA.2.1.2.2	BMC Receive Interference Rejection Test	✓	✓	✓	✓	✓

2.2.3 Physical Layer - Miscellaneous

Test Name	Test Ref No.	Description	DRP	P	C	C/P	P/C
BMC-PHY-TERM	TDA.2.1.3.1	BMC Termination Impedance Test	✓	✓	✓	✓	✓
BMC-PHY-MSG	TDA.2.1.3.2	BMC PHY Level Message Test	✓	✓	✓	✓	✓

2.2.4 Protocol Specific

Test Name	Test Ref No.	Description	DRP	P	C	C/P	P/C
BMC-PROT-SEQ-GETCAPS	TDA.2.2.1	Get_Source_Cap and Get_Sink_Cap Test	✓	✓	✓	✓	✓
BMC-PROT-SEQ-CHKCAB-P-PC	TDA.2.2.2.1	Check Cable Capabilities (3A Marked) Test	✓[1]	✓[1]			✓[1]
BMC-PROT-SEQ-NOMRK-P-PC	TDA.2.2.2.2	Check Cable Capabilities (Unmarked) Test	✓[1]	✓[1]			✓[1]
BMC-PROT-SEQ-CHKCAB-CP-ACC	TDA.2.2.2.3	Check Cable Capabilities (3A Marked) Test - After PR_Swap	✓[1]			✓[1]	
BMC-PROT-SEQ-CHKCAB-NOMRK -CP-ACC	TDA.2.2.2.4	Check Cable Capabilities (Unmarked) Test - After PR_Swap	✓[1]			✓[1]	
BMC-PROT-SEQ-DRSWAP	TDA.2.2.3	DR_Swap Test	✓	✓	✓	✓	✓
BMC-PROT-SEQ-VCSWAP	TDA.2.2.4	VCONN_Swap Test	✓	✓	✓	✓	✓
BMC-PROT-DISCOV	TDA.2.2.5	ID Checks	✓		✓	✓	
BMC-PROT-SEQ-PRSWAP	TDA.2.2.6	PR_Swap Test	✓	✓	✓	✓	✓
BMC-PROT-BIST-NOT-5V-SRC	TDA.2.2.7	BIST Functionality at Above 5V Test	✓	✓			✓
BMC-PROT-REV-NUM	TDA.2.2.8	Revision Number Test (Not for Rev 3.0 or greater	✓		✓	✓	

		UUT)					
BMC-PROT-GSC-REC	TDA.2.2.9	Get_Source_Cap Received Test	✓	✓		✓	✓
BMC-PROT-IGN-PPS	TDA.2.2.10	Ignore PPS Test	✓		✓	✓	✓

Note 1: Only applies if not Cative Cable

2.2.1 Power Source/Sink

Test Name	**Test Ref No.**	**Description**	**DRP**	**P**	**C**	**C/P**	**P/C**
BMC-POW-SRC-LOAD-P-PC	TDA.2.3.1.1	Source Dynamic Load Test, Provider or Provider/Consumer	✓	✓			✓
BMC-POW-SRC-LOAD-CP-ACC	TDA.2.3.1.2	Source Dynamic Load Test, Consumer/Provider Accepting Swap	✓			✓	
BMC-POW-SRC-TRANS-P-PC	TDA.2.3.2.1	PDO Transition Test - Source, Provider or Provider/Consumer	✓	✓			✓
BMC-POW-SRC-TRANS-CP-ACC	TDA.2.3.2.2	PDO Transition Test - Source, Consumer/Provider Accepting Swap	✓			✓	
BMC-POW-SNK-TRANS-C-CP	TDA.2.3.3.1	PDO Transition, Current Draw and Suspend Test - Sink, Consumer or Consumer/Provider	✓		✓	✓	
BMC-POW-SNK-TRANS-PC	TDA.2.3.3.2	PDO Transition, Current Draw, and Suspend Test, Sink, Provider/Consumer	✓				✓

2.3 All Devices - Secondary Checks

2.3.1 Message Checks

The following are checks to be performed on messages, **whenever** they are encountered during a Primary Test.

Test Name	Test Ref No.	Description	CAB	DRP	P	C	C/P	P/C
PHY-MSG-GEN	TDB.1.1.1	PHY Level General Message Test (SOP*)	✓	✓	✓	✓	✓	✓
PROT-MSG-HDR	TDB.2.1.2.1	Message Header Checks - Except GoodCRC	✓	✓	✓	✓	✓	✓
PROT-MSG-HDR-GCRC	TDB.2.1.2.2	Message Header Checks - GoodCRC	✓	✓	✓	✓	✓	✓
PROT-MSG-CTRL	TDB.2.1.3	Control Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-CTRL-PING	TDB.2.1.3.1	Ping Checks		✓	✓		✓	✓
PROT-MSG-DATA-SRC-CAP	TDB.2.1.4.1.1	Source Capability Message Checks		✓	✓		✓	✓
PROT-MSG-DATA-SNK-CAP	TDB.2.1.4.1.2	Sink Capability Message Checks		✓		✓	✓	✓
PROT-MSG-DATA-REQ	TDB.2.1.4.2	Request Message Checks		✓		✓	✓	✓
PROT-MSG-DATA-VEND	TDB.2.1.4.3	Vendor Defined Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-ID-INIT	TDB.2.1.4.4.1.1	Discover ID Initiator Message Checks		✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-ID-ACK	TDB.2.1.4.4.1.2	Discover ID ACK Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-SVID-INIT	TDB.2.1.4.4.2.1	Discover SVIDs Initiator Message Checks		✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-SVID-ACK	TDB.2.1.4.4.2.2	Discover SVIDs ACK Message Checks	✓	✓	✓	✓	✓	✓

PROT-MSG-DATA-VDM-MODE-INIT	TDB.2.1.4.4.3.1	Discover Modes Initiator Message Checks		✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-MODE-ACK	TDB.2.1.4.4.3.2	Discover Modes ACK Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-ENTER-MODE	TDB.2.1.4.4.4	Enter Mode Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-EXIT-MODE	TDB.2.1.4.4.5	Exit Mode Message Checks	✓	✓	✓	✓	✓	✓
PROT-MSG-DATA-VDM-ATT	TDB.2.1.4.4.6	Attention Message Checks		✓	✓	✓	✓	✓

2.3.2 Procedures and Procedure Checks

The following are checks to be performed on procedures, **whenever** they are encountered during a Primary Test.

Test Name	**Test Ref No.**	**Description**	**CAB**	**DRP**	**P**	**C**	**C/P**	**P/C**
PROT-PROC-AMS	TDB.2.2.1.1	Procedure and Checks for any Atomic Message Sequence	✓	✓	✓	✓	✓	✓
PROT-PROC-GOODCRC-TSTR	TDB.2.2.2.1	Procedure and Checks for GoodCRC sent by Tester	✓	✓	✓	✓	✓	✓
PROT-PROC-GOODCRC-UUT	TDB.2.2.2.1	Procedure and Checks for GoodCRC sent by UUT	✓	✓	✓	✓	✓	✓
PROT-PROC-SWAP-TSTR-SNK	TDB.2.2.3.1.1	Procedure/Checks for Tester (Sink) Originated Swap		✓			✓	✓
PROT-PROC-SWAP-TSTR-SRC	TDB.2.2.3.1.2	Procedure/Checks for Tester (Source) Originated Swap		✓			✓	✓
PROT-PROC-SWAP-UUT-SNK	TDB.2.2.3.2.1	Procedure/Checks for UUT (Sink) Originated Swap		✓			✓	✓

PROT-PROC-SWAP-UUT-SRC	TDB.2.2.3.2.2	Procedure/Checks for UUT (Source) Originated Swap		✓			✓	✓
PROT-PROC-PSSOURCEOFFTIMER	TDB.2.2.4	Procedures to test PSSourceOffTimer		✓			✓	✓
PROT-PROC-PSSOURCEONTIMER	TDB.2.2.5	Procedures to test PSSourceOnTimer		✓			✓	✓
PROT-PROC-PING	TDB.2.2.6	Procedures to send Ping from Tester		✓	✓	✓	✓	✓
PROT-PROC-REQ-TSTR	TDB.2.2.7.1	Procedure and Checks for Tester Originated Request		✓	✓		✓	✓
PROT-PROC-REQ-UUT	TDB.2.2.7.2	Procedure and Checks for UUT Originated Request		✓		✓	✓	✓
PROT-PROC-SRCCAPS-TSTR	TDB.2.2.8.1	Procedure and Checks for Tester Originated Source Capabilities		✓		✓	✓	✓
PROT-PROC-SRCCAPS-UUT	TDB.2.2.8.2	Procedure and Checks for UUT Originated Source Capabilities		✓	✓		✓	✓
PROT-PROC-GETSRCCAPS-TSTR	TDB.2.2.9.1	Procedure and Checks for Tester Originated Get_Source_Cap		✓	✓	✓	✓	✓
PROT-PROC-GETSRCCAPS-UUT	TDB.2.2.9.2	Procedure and Checks for UUT Originated Get_Source_Cap		✓	✓	✓	✓	✓
PROT-PROC-GETSNKCAPS-TSTR	TDB.2.2.10.1	Procedure and Checks for Tester Originated Get_Sink_Cap		✓	✓	✓	✓	✓
PROT-PROC-GETSNKCAPS-UUT	TDB.2.2.10.2	Procedure and Checks for UUT Originated Get_Sink_Cap		✓	✓	✓	✓	✓
PROT-PROC-GOTOMIN-TSTR	TDB.2.2.11.1	Procedure and Checks for Tester Originated GotoMin		✓		✓	✓	✓

PROT-PROC-GOTOMIN-UUT	TDB.2.2.11.2	Procedure and Checks for UUT Originated GotoMin		✓	✓		✓	✓
PROT-PROC-SR-TSTR	TDB.2.2.12.1	Procedure and Checks for Tester Originated Soft Reset	✓	✓	✓	✓	✓	✓
PROT-PROC-SR-UUT	TDB.2.2.12.2	Procedure and Checks for UUT Originated Soft Reset	✓	✓	✓	✓	✓	✓
PROT-PROC-HR-TSTR	TDB.2.2.13.1	Procedure and Checks for Tester Originated Hard Reset	✓	✓	✓	✓	✓	✓
PROT-PROC-HR-UUT	TDB.2.2.13.2	Procedure and Checks for UUT Originated Hard Reset	✓	✓	✓	✓	✓	✓
PROT-PROC-BIST-TSTR	TDB.2.2.14	Procedure and Checks for Tester Originated BIST	✓	✓	✓	✓	✓	✓

3 TEST DESCRIPTIONS

3.1 CHAPTER 3 - CABLE AND CONNECTOR TESTS

Testing of Connectors and Cables are covered by separate documents published by the USB-IF.
(These are in development by the Cabcon group.)

3.2 ELECTRICAL REQUIREMENTS TESTS

One category of test may be inserted here:

- 'Revert to default after detach' tests

3.3 CABLE PHYSICAL LAYER PRIMARY TESTS - TRANSMIT

3.3.1 TDA.1.1.1.1.1: CAB-PHY-TX-EYE
TDA.1.1.1.1.2: CAB-DP-PHY-TX-EYE
Cable Transmitter Eye Diagram Test (SOP Prime or Double Prime)

Status	Primary Test
Purpose	To confirm that the transmitted data fulfills the eye diagram mask requirements in Figures 5-23 and 5-24 of the specification. Also checks that Cable UUT correctly implements BIST Carrier Mode 2. It is normally not required to repeat this test for SOP''. The results from SOP' will suffice.
Critical for Safety	
Applies to	Electronically Marked C-Cable
Description	The Protocol Tester sends a BIST request to a Cable UUT specifying 'BIST Carrier Mode 2'. The Cable UUT will then transmit a continuous string of BMC encoded alternating "1"s and “0”s in accordance with Section 5.9.4. The eye pattern is measured using the method specified below.
Test setup	Protocol Tester, plus oscilloscope function.
Preconditions	
Assertions Tested	5.8.3.2.1#1, 5.8.3.5#1, 5.9.4#1, 6.4.3#7, 6.4.3.6#1, 6.4.3.6#2 Plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V, 4.25V and 5.75V at each end.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate

sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end. The capacitive load of the tester is as close to 400pF as practical.
3. The Tester sends a BIST request to the Cable UUT, specifying 'BIST Carrier Mode 2', and checks for a valid and correctly timed protocol response [CAB_PHY_TX_EYE_1].
4. Check that the UUT is transmitting a continuous string of alternating '0' and '1' bits. This functional check shall be sufficiently accurate to ensure that the desired BIST continuous test pattern is present, and not one of the other four, nor a non-continuous transmission mode [CAB_PHY_TX_EYE_2]. The method used for this is left to the discretion of the test equipment vendor. The detailed parameters of the mode will be measured below.
5. Feed the output of the UUT into an oscilloscope type function.
6. Produce an Eye Diagram, using the method specified in section BMC-ALG-CLK-RECOV, and check that the parameters meet the requirements of Figures 5-23 and 5-24 of the Specification [CAB_PHY_TX_EYE_3].
7. Check that the continuous test pattern stops within tBISTContMode max (60ms) of starting [CAB_PHY_TX_ EYE _4].
8. Check that the rise/fall times meet the specification in Table 5-25 [CAB_PHY_TX_ EYE _5].
9. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
10. Repeat test using the other end of the cable.

3.3.2 TDA.1.1.1.2.1: CAB-PHY-TX-BIT
TDA.1.1.1.2.2: CAB-DP-PHY-TX-BIT
Cable Transmit Bit Rate and Bit Rate Drift (SOP Prime or Double Prime)

Status	Primary Test
Purpose	To confirm that the drift in the transmitted bit rate of a Cable UUT falls within acceptable limits. Also checks that Cable UUT correctly implements BIST Carrier Mode 2. It is normally not required to repeat this test for SOP''. The results from SOP' will suffice.
Critical for Safety	
Applies to	Electronically Marked C-Cable
Description	The Protocol Tester sends a BIST request to a Cable UUT specifying 'BIST Carrier Mode 2'. The Cable UUT will then transmit a continuous string of alternating "1"s and “0”s. The data being transmitted are fed into a clock/data recovery function, and the output of this into a frequency counter function. During one or more periods equivalent to the longest possible packet length, the bit rate is measured according to section ??? and Table ???. This is validated against pBitRate and fBitRate.
Test setup	Protocol Tester, plus clock/data recovery function, plus counter/timer function. The Cable UUT is connected by one chosen end to the tester, the other end is left unconnected. The test is repeated using the other cable end.
Preconditions	
Assertions Tested	5.8.1.2.1#1, 5.8.1.2.1#2, 5.9.4#1, 6.4.3#7, 6.4.3.6#2 Plus assertions in any appropriate secondary checks.
Parameters Tested	pBitRate, fBitRate.
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

Note: The sample data collected for this test is likely to be the same data collected during the Tx Eye Diagram test CAB-PHY-TX-EYE. Combining these tests is valid if the Tester Vendor considers this appropriate.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
3. The Tester sends a BIST request to the Cable UUT, specifying 'BIST Carrier Mode 2', and checks for a valid and correctly timed protocol response [CAB_PHY_TX_BIT_1].
4. Check that the UUT is transmitting a continuous string of alternating '0' and '1' bits. This functional check shall be sufficiently accurate to ensure that the desired BIST continuous test pattern is present, and not one of the other four, nor a non-continuous transmission mode [CAB_PHY_TX_BIT_2]. The method used for this is left to the discretion of the test equipment vendor. The detailed parameters of the mode will be measured below.
5. Use a clock/data recovery function to monitor the signal during the next step. The measurement shall be made using the positive bit edge at the start of a group of four modulated "0101" bits as the significant reference points. (The first zero is therefore a high level.) This reduces the effect of:
    a) different rise and fall wave forms
    b) different rise times dependent on value of previous bit.
6. Ensure that at least 32 bits have been detected before starting measurement. The first bit to be included starts at a reference point as defined above, and is referred to below as data bit 0.
7. Measure the bit rate during a 32 bit period. Calculate this as 32, divided by the total period between 9 reference points.
8. Do this from data bit 0 to data bit 31, then from data bit 4 to data bit 35, and repeat until there are 256 bit rate measurements.
9. The bit rate measured from data bit 0 to data bit 31 is taken as the measured fBitRate.
10. Calculate pBitRate as the largest deviation from fBitRate divided by fBitRate, expressed as a percentage.
11. Check that the lowest and highest bit rate values measured fall within fBitRate (270-330 kbps) [CAB_PHY_TX_BIT_3], and that pBitRate (less than 0.25%) is within permitted range [CAB_PHY_TX_BIT_4].
12. Check that the continuous test pattern stops within tBISTContMode max (60ms) of starting [CAB_PHY_TX_BIT_5].
13. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
14. Repeat test using the other end of the cable.

3.4 CABLE PHYSICAL LAYER PRIMARY TESTS - RECEIVE

3.4.1 TDA.1.1.2.1.1: CAB-PHY-RX-BUSIDL
TDA.1.1.2.1.2: CAB-DP-PHY-RX-BUSIDL
Cable Bus Idle Detection Test (SOP Prime or Double Prime)

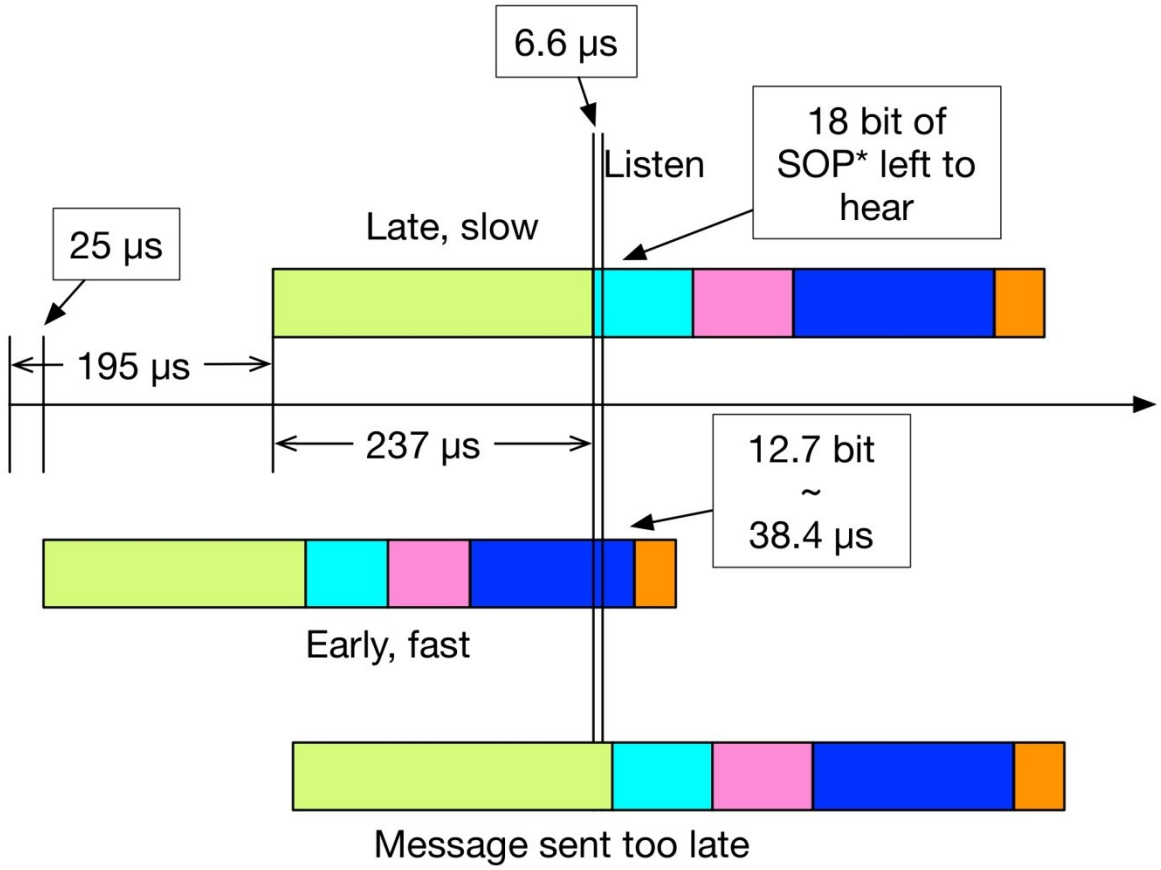
Status	Primary Test
Purpose	Confirm that the UUT accurately recognizes the Bus Idle Condition, and does not interpret valid noise interference as a false Bus Idle Condition
Critical for Safety	No
Applies to	Electronically Marked C-Cable
Description	Messages are sent to the Cable UUT under conditions which check the receiver's ability to detect Bus Idle. In steps 1-5, the tester verifies that if the bus is not idle, the UUT does not send a GoodCRC. It achieves this by sending valid transitions during the time window during which the GoodCRC is allowed to be sent. In steps 6-8, the tester verifies that expected levels of noise on the CC line do not prevent the UUT from detecting Bus Idle. It achieves this by sending noise during a time window, and ensuring that the last part of a GoodCRC is sent, but not a complete GoodCRC.
Test setup	Protocol Tester with programmable transmit signal waveform.
Preconditions	
Assertions Tested	5.8.1.4#4, 6.4.3#7, 6.4.3#10, 6.4.3.9#1, 5.7#1, 5.7#2, 5.8.3.2.2#7 Plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
3. The Protocol Tester sends a BIST request to the Cable UUT, specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [CAB_PHY_RX_BUSIDL_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
4. Send BIST Test Data message, disable Tester receiver and immediately continue sending data zeros for 195us, then open receiver. (This step prevents the UUT from sending a GoodCRC, because the CC line will not be idle during the time in which it is valid to start sending one.)
5. Listen for data from UUT. There must be nothing for 10 ms [CAB_PHY_RX_BUSIDL_2]. If we see a GoodCRC message ending, or a complete GoodCRC, the UUT is deemed to have failed the test.

   See Figure below for explanation.
6. Send BIST Test Data message, disable tester receiver and continue sending noise (see definition below) for 195+237+6.6us=438.6us, then open receiver. We are expecting the UUT to ignore the noise, and respond with a GoodCRC, so we should detect the end of an already started GoodCRC.
   The time chosen to re-enable the receiver is a point in time during which a legally timed GoodCRC will be encountered at a point after the start of its SOP and before the end of the CRC, regardless of whether this message is sent at the earliest possible opportunity at the fastest rate allowed, or at the latest opportunity at the slowest rate possible.
7. Listen for data from other end - check that we see data present, but do not receive a valid GoodCRC [CAB_PHY_RX_BUSIDL_3]. If we see a GoodCRC it means that it was started later than permitted, for whatever reason.
   If we see no data then it means that the UUT incorrectly saw the noise as an interfering signal and did not transmit the GoodCRC.
8. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
9. Repeat test using the other end of the cable.



Timing details

- 237us is the longest time required to send a preamble.
- 6.6us is a margin to ensure not seeing SOP.
- Message could be over in 25us + 149 bits at fastest speed = 472us (leaves minimum 38.4us or 12.7 bits)

Definition of Noise

- The noise signal shall be transmitted by the same transmit amplifier as the preceding signal, remaining at the same output impedance, to ensure the correct level.
- It shall be a square wave at a frequency of 600kHz.
- It shall have an amplitude of 250mV p/p, biased around 0.55V.

3.4.2 TDA.1.1.2.2.1: CAB-PHY-RX-INT-REJ
TDA.1.1.2.2.2: CAB-DP-PHY-RX-INT-REJ
Cable Receive Interference Rejection Test (SOP Prime or Double Prime)

Status	Primary Test
Purpose	Checks the ability of the receiver to correctly receive signals which are degraded by the worst case aggressor signal, and both the zero offset and worst case offset in the appropriate direction, whilst the bitrate is also set to both minimum and maximum extremes. The test applies equally to SOP' and, for cables with an SOP” controller present, to SOP''.
Critical for Safety	No
Applies to	Electronically Marked C-Cable
Description	The Protocol Tester uses BIST Test Data messages, in the presence of injected interference. The UUT is required to respond with GoodCRC messages, without missing any.
Test setup	USB PD Tester (with ability to add an aggressor signal and an offset to the data signal, while sending minimum and maximum permitted bitrates).
Preconditions	
Assertions Tested	6.4.3#10, 5.8.1.1#1, 5.8.3.4.1#1, 5.8.3.6#1 Plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

This is achieved by using a short cable, and artificially adding an aggressor signal to the transmitted signal. The tester will add voltage offset, corresponding to ground differential, artificially to the signal.

The basic signal transmitted will represent the minimum swing likely to reach the receiver.

The aggressor signal will be as defined below.

1. Test Procedure During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All

messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
3. The Protocol Tester sends a BIST request to the Cable UUT (with incremented MessageID as normal*), specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [CAB_PHY_RX_INT_REJ_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
4. Wait 15ms to ensure that the UUT understands it is in a BIST test mode, and should not initiate any message sequences*.

5. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 1 below.
6. Send the 'BIST Test Data' message (without incrementing MessageID*) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [CAB_PHY_RX_INT_REJ_2]. *n=4502*(1024/345).*
7. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 2 below.
8. Send the 'BIST Test Data' message (without incrementing MessageID) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [CAB_PHY_RX_INT_REJ_3]. *n=4502*(1024/345).*
9. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 3 below.
10. Send the 'BIST Test Data' message (without incrementing MessageID) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [CAB_PHY_RX_INT_REJ_3]. *n=4502*(1024/345).*
11. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
12. Repeat test using the other end of the cable.

Tx Group 1, Tx Group 2 and Group 3 Signal Specifications

	Nominal Signal	**Group 1 Signal**	**Group 2 Signal**	**Group 3 Signal**
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
Noise	None	One of the three noise types defined below		

The nature of this test is to send a BIST Test Data message repeatedly, with minimum delay between the GoodCRC response from the UUT and the next BIST Test Data message from the tester. There would be a potential for a UUT not to be able to deal with messages of such frequency if the test were not implemented exactly as described above. The first BIST Test Data message must have an incremented MessageID so that the UUT recognizes it as a significant message, and stops originating its own traffic. The 15ms delay before further messages ensures that the UUT has had time to recognize the message. The fact that the MessageID is then not incremented is specified so that the UUT Protocol Engine will not pass the messages up to the Policy Engine, but **will respond with GoodCRC. This behavior is specified in the PD Specification.*

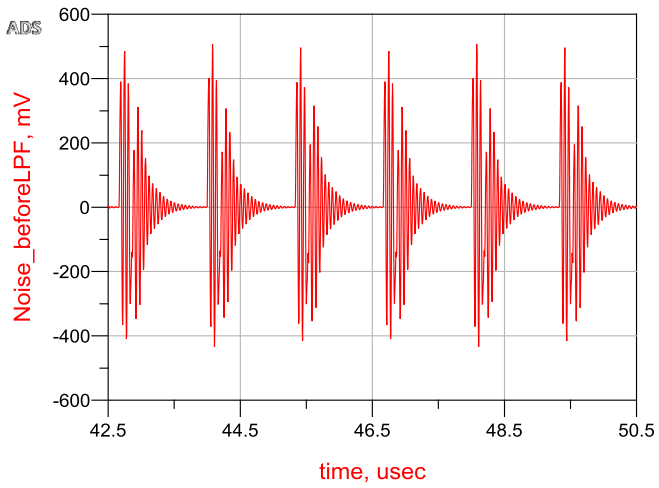
Injected Noise Specification

1. Source impedance of the tester transmitter from the combined source and noise generator shall be
    - 50 Ω ± 5 Ω
    - 400 pF ± 50 pF
2. Noise shall be generated from one of the three approaches described below.
3. The dynamic range of the noise amplitude at the input of UUT shall be less than 1V.

BMC Noise Generation Requirement

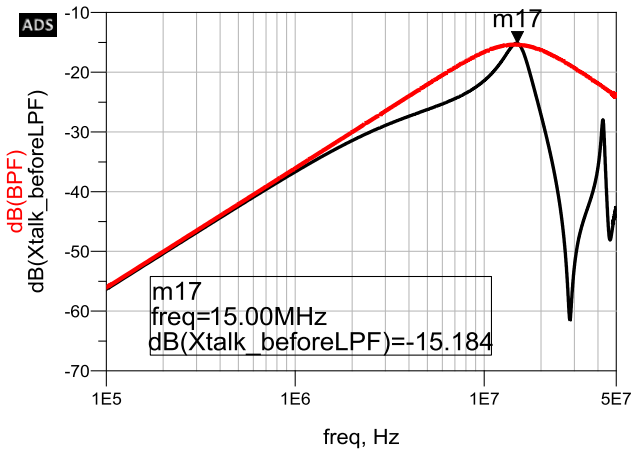
The three approaches are listed in this document for noise implementation guidance and flexibility. The noise magnitude shall be calibrated to reach the maximum level of vNoiseActive, 165mV. The noise calibration is done by connecting the test transmitter with 200pF shunt capacitive load in series with the Rx bandwidth limiting filter with the time constant tRxFilter. The Rx bandwith limiting filter shall be implemented with at least 5 kΩ load impedance to achieve a time constant of tRxFilter. The scope capacitance loading effect shall be taken into account.

1. Directly from the waveform text file using an arbitrary waveform generator (AWG). The time step shall be ≤ 15 nsec. The peak-to-peak noise magnitude shall be calibrated to 165 mV in the scope. (Note: Refer to USB.org for the waveform text file). Note that the waveform specified is what shall appear on the CC line.



USB FullSpeed SE0 Xtalk Noise Waveform at the Input of UUT

2. Using a band pass filter (BPF) circuitry with the peak frequency at 15 ± 1 MHz, 20dB/dec slope before the peak frequency and -20dB/dec slope after the peak frequency. The noise waveform at the input of the BPF has the pulse width 167 ns and the pulse period 1.33us. The peak-to-peak noise magnitude shall be calibrated to 165 mV in the scope. (Note: Refer to USB.org for the reference schematic of the BPF)



Transfer Functions of USB FullSpeed SE0 to CC Xtalk (black solid line)
and Band Pass Filter (red dash line)

3. Using two-tone sinusoidal noise waveforms simultaneously. The in-band peak-to-peak noise at 750 ± 50 kHz and the out-of-band peak-to-peak noise at 5 ± 0.5 MHz shall be calibrated to 90mV and 75 mV in the scope, respectively.

   When any of the above three approaches is used, the noise phase relative to the signal shall be advanced through the signal period so that the worst case of the interference situation can be captured.

3.5 CABLE PHYSICAL LAYER PRIMARY TESTS - MISCELLANEOUS

3.5.1 TDA.1.1.3.1.1: CAB-PHY-TERM
TDA.1.1.3.1.2: CAB-DP-PHY-TERM
Cable Termination Impedance Test (SOP Prime or Double Prime)

Status	Primary Test
Purpose	To confirm that a UUT has a valid impedance when not transmitting. The test applies equally to SOP' and, for cables with an SOP” controller present, to SOP''.
Critical for Safety	
Applies to	Electronically Marked C-Cable
Description	The Protocol Tester chooses a time when the UUT is not transmitting, and measures the impedance of the receiver using a voltage source and resistor.
Test setup	Protocol Tester with voltage generator, resistor, and voltage measurement function.
Preconditions	
Assertions Tested	6.4.3#10, 6.4.3.9#1 Plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

Note: 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 Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.

3. The Protocol Tester sends a BIST request to the Cable UUT, specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [CAB_PHY_TERM_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
4. Check that the voltage on the CC line falls within the expected range, knowing the value of these resistors [CAB_PHY_TERM_2].
5. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
   Verify that UUT does not modify voltage levels in any received message waveform when VCONN is off
6. The Tester applies VBUS, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) [but not VCONN] to one cable end.
7. 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.

8. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
   Verify that UUT does not modify voltage levels in any received message waveform when VCONN is on
9. Repeat the last 3 steps, but with VCONN applied

10. Repeat test using the other end of the cable.

3.5.2 TDA.1.1.3.2.1: CAB-PHY-MSG
TDA.1.1.3.2.2: CAB-DP-PHY-MSG
Cable PHY Level Message Test (SOP Prime or Double Prime)

Status	Primary Test
Purpose	To validate the PHY level behavior of message exchanges. To confirm the PHY level behavior of the UUT in relation to Cable Reset and Hard Reset. The test applies equally to SOP' and, for cables with an SOP” controller present, to SOP''.
Critical for Safety	
Applies to	Electronically Marked C-Cable
Description	The Protocol Tester sends a sequence of messages both correct and with deliberate errors and validates the correct behavior in each case. Protocol Tester sends Hard Reset and Cable Reset messages to the Cable UUT, and confirms correct operation by the UUT. While running the test for SOP', SOP' is referred to as the Primary SOP type and SOP'' as the alternative SOP type. While running the test for SOP'', SOP'' is referred to as the Primary SOP type and SOP' as the alternative SOP type.
Test setup	Protocol Tester with control over low level packet generation.
Preconditions	
Assertions Tested	5.6.1.2.1#2, 5.6.1.2.1#4, 5.6.1.2.2#1, 5.6.1.2.2#3, 5.6.1.2.3#3, 5.6.1.2.3#5, 5.6.1.3#1, 5.6.1.5#4, 5.6.3#1, 6.2.1.3#1, 6.2.1.3#2, 6.3.1#2, 6.4.3.9#1, 6.4.4.3.4#8, 6.6.1#4, 6.6.1#5, 6.6.1.1#1, 6.6.1.2#2, 6.8.2.3.1#2 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

   The following messages are sent using the Primary SOP type unless otherwise stated.

1. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
2. Send a BIST Test Data message to the Cable. Check that it responds with a GoodCRC [CAB_PHY_MSG_1].
3. Send a BIST Test Data message to the Cable using SOP. Check that it only responds if the vendor information states that it will [CAB_PHY_MSG_2].
4. Send a BIST Test Data message to the Cable using the alternative SOP type. Check that it only responds if the vendor information states that it will [CAB_PHY_MSG_3].
5. Send a BIST Test Data message to the Cable using Debug_SOP'. Check that it only responds if the vendor information states that it will [CAB_PHY_MSG_4].
6. Send a BIST Test Data message to the Cable using Debug_SOP''. Check that it only responds if the vendor information states that it will [CAB_PHY_MSG_5].
7. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.

   In the following the Tester will send 'Enter Mode Initiator' messages with an SVID not recognized by the UUT, and an Object position of 1. The UUT is expected to respond with GoodCRC and 'Enter Mode NAK', if the message is recognized. This particular message is used as it is equally valid for SOP' and SOP'' in a Cable.

8. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
9. In each of the following steps the Tester will send an Enter Mode Initiator message to the Cable UUT and check the cable's response is correct.
10. Send the normal error-free version of the message. Check that an Enter Mode NAK is received [CAB_PHY_MSG_6].
11. Check that GoodCRC is not received and that no Enter Mode NAK is received, from the Cable if a message is sent, with the CRC deliberately corrupted before 4b5b encoding [CAB_PHY_MSG_7].
12. Check that GoodCRC is not received and that no Enter Mode NAK is received, from the Cable if a message is sent, with the CRC deliberately corrupted after 4b5b encoding [CAB_PHY_MSG_8].
13. Check that GoodCRC is not received and that no Enter Mode NAK is received, from the Cable if a message is sent with the payload, deliberately corrupted before 4b5b encoding but after being used for the CRC generation [CAB_PHY_MSG_9].

14. Check that GoodCRC is not received and that no Enter Mode NAK is received, from the Cable if a message is sent with the payload, deliberately corrupted after 4b5b encoding [CAB_PHY_MSG_10].
15. Check that GoodCRC is not received and that no Enter Mode NAK is received, from the Cable if a message is sent containing a reserved 5-bit code used in place of a valid hex code [CAB_PHY_MSG_11].
16. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.

Procedure for Determining if the Cable UUT Recognizes Hard Reset, Cable Reset and Soft Reset, and acts on them correctly

17. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
    Confirm that out-going Message ID is initialized correctly
18. Send an Enter Mode Initiator message to the UUT (using MessageID = 000b). Check that UUT sends an Enter Mode NAK message, and check that the MessageID in that message header is 000b [CAB_PHY_MSG_12].
    Confirm that out-going Message ID is incremented correctly
19. Send an Enter Mode Initiator message to the UUT (using an incremented MessageID). Check that UUT sends an Enter Mode NAK message, and check that the MessageID in that message header is also incremented [CAB_PHY_MSG_13].
20. Repeat previous step until MessageIDs (sent and received) reach 001b for the second time.
21. - For the first pass through this test, send a Cable Reset message.
    - For the second pass through this test, send a Hard Reset message.
    - For the third pass through this test, send a Soft Reset Message. Check that an Accept message is received with MessageID = 000b [CAB_PHY_MSG_14].
    Confirm that out-going Message ID is reset correctly
22. Send an Enter Mode Initiator message to the UUT (using MessageID = 000b), or 001b in the case of Soft Reset). Check that UUT sends an Enter Mode NAK message, and check that the MessageID in that message header is 000b, or 001b in the case of Soft Reset.
    Cable Reset: [CAB_PHY_MSG_15],
    Hard Reset: [CAB_PHY_MSG_16],
    Soft Reset: [CAB_PHY_MSG_17].
    Confirm that repeated incoming Message ID is ignored
23. Send an Enter Mode Initiator message to the UUT (using MessageID = 000b). Check that UUT does not send a response (other than GoodCRC) [CAB_PHY_MSG_18].
24. Send an Enter Mode Initiator message to the UUT (using an incremented MessageID). Check that UUT sends an Enter Mode NAK message, and check that the MessageID in that message header is also incremented [CAB_PHY_MSG_19].
25. Repeat previous step until MessageID (sent) reaches 000b for the second time.
    - For the first pass through this test, send a Cable Reset message.
    - For the second pass through this test, send a Hard Reset message.
    Confirm that repeated incoming Message ID is not ignored for Soft Reset
    - For the third pass through this test, send a Soft Reset Message. Check that an Accept message is received with MessageID = 000b [CAB_PHY_MSG_20].
    Confirm that incoming Message ID is reset correctly

26. Send an Enter Mode Initiator message to the UUT (using MessageID = 000b, or 001b in the case of Soft Reset). Check that UUT sends an Enter Mode NAK message, and check that the MessageID in that message header is 000b, or 001b in the case of Soft Reset.
    Cable Reset: [CAB_PHY_MSG_21],
    Hard Reset: [CAB_PHY_MSG_22],
    Soft Reset: [CAB_PHY_MSG_23].

27. Reset Cable UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
28. Repeat the test using the appropriate versions of steps 22 and 26.

Confirm that the CRC is correctly verified according to the rules in Chapter 5 of the PD Specification

29. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
30. The Tester constructs and sends a message consisting of:
    a. preamble
    b. SOP
    c. header, indicating anything BUT Soft Reset or Ping
    d. payload, consisting of a number of bytes not being a multiple of 4, and not being related to the number of PDOs specified in the header
    e. CRC
    f. EOP
31. Check that the message is acknowledged by a GoodCRC message.
32. Reset Cable UUT by simulating a tester end cable detach.
33. Repeat test using the other end of the cable. Check that both ends respond with the same information.

3.6 CABLE PROTOCOL SPECIFIC PRIMARY TESTS

3.6.1 TDA.1.2.1: CAB-PROT-DISCOV Cable ID Checks

Status	Primary Test
Purpose	To perform the appropriate protocol checks relating a Cable Discovery sequence.
Critical for Safety	
Applies to	Electronically Marked C-Cable
Description	This test performs a Discovery procedure for a cable, using SOP' and then if necessary SOP'' messages.
Test setup	The Cable UUT is connected by one chosen end to the tester, the other end is left unconnected.
Preconditions	
Assertions Tested	5.6.1.2.2#1, 6.2.1.7#2, 6.4.4.2#1, 6.4.4.3#1, 6.4.4.3.4#8, 6.4.4.3.4#15, 6.4.4.4#3, 6.5.13#1plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This test shall be performed at both ends of the cable, and with a VCONN of 2.75V and 5.75V at each end.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The Tester applies VBUS, VCONN, Rp (4.7kΩ to 3.3V) and Rd (5.1kΩ to 0V) to one cable end.
3. Wait for tVCONNStable max (100ms) before sending any messages.
4. During the following, respond to any messages received and behave accordingly. Check the appropriateness of such messages.

If the VIF claims that this is a Rev 2.0 cable

5. Send a Discover ID Initiator to the Cable UUT, using SOP', with the Specification Revision set to Rev 3.0.

6. Check that the Cable UUT responds with a valid Discover ID ACK message, using SOP' , and with the Specification Revision set to Rev 2.0. [CAB_PROT_DISCOV_1].

7. Send a Discover ID Initiator to the Cable UUT, using SOP', with the Specification Revision set to reserved value 11b.
8. Check that the Cable UUT responds with a valid Discover ID ACK message, using SOP' , and with the Specification Revision set to Rev 2.0. [CAB_PROT_DISCOV_1].

If the VIF claims that this is a Rev 3.0 cable

9. Send a Discover ID Initiator to the Cable UUT, using SOP', with the Specification Revision set to reserved value 11b.
10. Check that the Cable UUT responds with a valid Discover ID ACK message, using SOP' , and with the Specification Revision set to Rev 3.0. [CAB_PROT_DISCOV_1].

From now on set the Specification Revision set to Rev 2.0

11. Send a Discover ID Initiator to the Cable UUT, using SOP'.
12. Check that the Cable UUT responds with a valid Discover ID ACK message, using SOP' [CAB_PROT_DISCOV_1].
    If the Cable UUT responds with NAK it is deemed to have failed. If the Cable UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the Cable UUT does not respond with ACK after one of these attempts, it is deemed to have failed, and is concluded by proceeding to the last step.
13. Check that the first bit of the preamble of this message is sent after tCableMessage min (750us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [CAB_PROT_DISCOV_2]. Check that the values in the Discover ID ACK message meet the requirements of PROT-MSG-DATA-VDM-ID-ACK.
14. Send a Discover SVIDs Initiator to the Cable UUT, using SOP'.
15. Check that the Cable UUT responds with a valid Discover SVIDs ACK message or NAK message, using SOP' [CAB_PROT_DISCOV_3]. If the response is NAK, the test is concluded by proceeding to the last step. In the case of a NAK, if the UUT has indicated in its response to 'Discover ID' that it supports Modal Operation, then it is deemed to have failed. If the response is ACK, and the UUT has indicated in its response to 'Discover ID' that it does not support Modal Operation, then it is deemed to have failed.
    If the Cable UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the Cable UUT does not respond with ACK after one of these attempts, it is deemed to have failed.
16. Check that the first bit of the preamble of this message is sent after tCableMessage min (750us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [CAB_PROT_DISCOV_4]. Check that the values in the Discover SVID ACK message meet the requirements of PROT-MSG-DATA-VDM-SVID-ACK.
17. If the Discover SVID ACK message indicates that there are further SVIDs to fetch, the sequence is repeated from [7] until there are no further SVIDs.

For each SVID:

18. Send a Discover Modes Initiator to the Cable UUT, using SOP'.
19. Check that the Cable UUT responds with a valid Discover Modes ACK message or NAK message, using SOP' [CAB_PROT_DISCOV_5].
    If the Cable UUT responds with NAK it is deemed to have failed. If the Cable UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the Cable UUT does not respond with ACK after one of these attempts, it is deemed to have failed.
20. Check that the first bit of the preamble of this message is sent after tCableMessage min (750us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [CAB_PROT_DISCOV_6]. Check that the values in the Discover MODES ACK message meet the requirements of PROT-MSG-DATA-VDM-MODES-ACK.

For each of these Modes:
In the following we attempt to enter, then exit each mode advertised. Some modes may not be enterable without first entering some other mode. It must be possible to enter at least one mode.

21. Send an Enter Mode Initiator to the Cable UUT, using SOP'.
22. Check that the Cable UUT responds with a valid Enter Mode ACK message or NAK message, using SOP' [CAB_PROT_DISCOV_7].
    If the Cable UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the Cable UUT does not respond with ACK or NAK after one of these attempts, it is deemed to have failed.
23. If the Enter Mode response was an ACK, send an Exit Modes Initiator to the Cable UUT, using SOP'.
24. Check that the Cable UUT responds with a valid Exit Modes ACK message, using SOP' [CAB_PROT_DISCOV_8]. If the response is NAK or BUSY, the test is deemed to have failed.

If the cable has an SOP'' Controller Present, then for each of these same Modes:
In the following we attempt to enter, then exit each mode advertised. Some modes may not be enterable without first entering some other mode. It must be possible to enter at least one mode.

25. Send an Enter Mode Initiator to the Cable UUT, using SOP''.
26. Check that the Cable UUT responds with a valid Enter Mode ACK message or NAK message, using SOP' [CAB_PROT_DISCOV_7].
    If the Cable UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the Cable UUT does not respond with ACK or NAK after one of these attempts, it is deemed to have failed.
27. If the Enter Mode response was an ACK, send an Exit Modes Initiator to the Cable UUT, using SOP'.
28. Check that the Cable UUT responds with a valid Exit Modes ACK message, using SOP'' [CAB_PROT_DISCOV_8]. If the response is NAK or BUSY, the test is deemed to have failed.

29. Reset Cable UUT by removing VCONN.
30. Repeat test using the other end of the cable.

3.7 BMC PHYSICAL LAYER PRIMARY TESTS - TRANSMIT

3.7.1 TDA.2.1.1.1: BMC-PHY-TX-EYE
BMC Transmitter Eye Diagram Test

Status	Primary Test
Purpose	To confirm that the transmitted data fulfills the eye diagram mask requirements in Figures 5-23 and 5-24 of the specification. Also checks that UUT correctly implements BIST Carrier Mode 2.
Critical for Safety	
Applies to	Any PD Capable UUT except Cable
Description	The Protocol Tester sends a BIST request to a UUT specifying 'BIST Carrier Mode 2'. The UUT will then transmit a continuous string of BMC encoded alternating "1"s and “0”s in accordance with Section 5.9.4. The eye pattern is measured using the method specified below.
Test setup	Protocol Tester, plus oscilloscope function.
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	5.8.2.5.2#1, 5.8.3.2.1#2, 5.8.3.2.1#3, 5.9.4#1, 6.4.3#7, 6.4.3.6#1, 6.4.3.6#2 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. The Tester gets the UUT into PD Mode (BMC-PROC-PD-MODE). Note that for a UUT behaving as a Sink, Rp is implemented as a 4.7kΩ resistor to 3.3V, to give the worst case pullup. The role chosen for the UUT is Sink whenever possible. The capacitive load of the tester is as close to 400pF as practical.
4. The Tester sends a BIST request to the UUT, specifying 'BIST Carrier Mode 2', and checks for a valid and correctly timed protocol response [BMC_PHY_TX_EYE_1].
5. Check that the UUT is transmitting a continuous string of alternating '0' and '1' bits. This functional check shall be sufficiently accurate to ensure that the desired BIST continuous test pattern is present, and not one of the other four, nor a non-continuous transmission mode [BMC_PHY_TX_EYE_2]. The method used for this is left to the discretion of the test equipment vendor. The detailed parameters of the mode will be measured below.
6. Feed the output of the UUT into an oscilloscope type function.
7. Produce an Eye Diagram, using the method specified in section BMC-ALG-CLK-RECOV, and check that the parameters meet the requirements of Figures 5-23 and 5-24 of the Specification [BMC_PHY_TX_EYE_3].
8. Check that the continuous test pattern stops within tBISTContMode max (60ms) of starting [BMC_PHY_TX_ EYE _4].
9. Check that the rise/fall times meet the specification in Table 5-25 [BMC_PHY_TX_ EYE _5].
10. Reset UUT by simulating a tester end cable detach in order to guarantee exiting the BIST Mode.

3.7.2 TDA.2.1.1.2: BMC-PHY-TX-BIT: BMC Transmit Bit Rate and Bit Rate Drift

Status	Primary Test
Purpose	To confirm that the drift in the transmitted bit rate of a UUT falls within acceptable limits. Also checks that UUT correctly implements BIST Carrier Mode 2.
Critical for Safety	
Applies to	Any PD Capable UUT except Cable
Description	The Protocol Tester sends a BIST request to a UUT specifying 'BIST Carrier Mode 2'. The UUT will then transmit a continuous string of alternating "1"s and “0”s. The data being transmitted are fed into a clock/data recovery function, and the output of this into a frequency counter function. During one or more periods equivalent to the longest possible packet length, the bit rate is measured according to section ??? and Table ???. This is validated against pBitRate and fBitRate.
Test setup	Protocol Tester, plus clock/data recovery function, plus counter/timer function. The UUT is connected by one chosen end to the tester, the other end is left unconnected. The test is repeated using the other cable end.
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	5.8.1.2.1#1, 5.8.1.2.1#2, 5.9.4#1, 6.4.3#7, 6.4.3.1#3, 6.4.3.9#1, 6.5.8.4#1 plus assertions in any appropriate secondary checks.
Parameters Tested	pBitRate, fBitRate.
Checklist References	

Note: The sample data collected for this test is likely to be the same data collected during the Tx Eye Diagram test BMC-PHY-TX-EYE. Combining these tests is valid if the Tester Vendor considers this appropriate.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (BMC-PROC-PD-MODE).
4. The Tester sends a BIST request to the UUT, specifying 'BIST Carrier Mode 2', and checks for a valid and correctly timed protocol response [BMC_PHY_TX_BIT_1].
5. Check that the UUT is transmitting a continuous string of alternating '0' and '1' bits. This functional check shall be sufficiently accurate to ensure that the desired BIST continuous test pattern is present, and not one of the other four, nor a non-continuous transmission mode [BMC_PHY_TX_BIT_2]. The method used for this is left to the discretion of the test equipment vendor. The detailed parameters of the mode will be measured below.
6. Use a clock/data recovery function to monitor the signal during the next step. The measurement shall be made using the positive bit edge at the start of a group of four modulated "0101" bits as the significant reference points. (The first zero is therefore a high level.) This reduces the effect of:
    a) different rise and fall wave forms
    b) different rise times dependent on value of previous bit.
7. Ensure that at least 32 bits have been detected before starting measurement. The first bit to be included starts at a reference point as defined above, and is referred to below as data bit 0.
8. Measure the bit rate during a 32 bit period. Calculate this as 32, divided by the total period between 9 reference points.
9. Do this from data bit 0 to data bit 31, then from data bit 4 to data bit 35, and repeat until there are 256 bit rate measurements.
10. The bit rate measured from data bit 0 to data bit 31 is taken as the measured fBitRate.
11. Calculate pBitRate as the largest deviation from fBitRate divided by fBitRate, expressed as a percentage.
12. Check that the lowest and highest bit rate values measured fall within fBitRate (270-330 kbps) [BMC_PHY_TX_BIT_3], and that pBitRate (less than 0.25%) is within permitted range [BMC_PHY_TX_BIT_4].
13. Check that the continuous test pattern stops within tBISTContMode max (60ms) of starting [BMC_PHY_TX_BIT_5].
14. Reset UUT by simulating a tester end cable detach in order to guarantee exiting the BIST Mode.

3.8 BMC PHYSICAL LAYER PRIMARY TESTS - RECEIVE

3.8.1 TDA.2.1.2.1: BMC-PHY-RX-BUSIDL BMC Bus Idle Detection Test

Status	Primary Test
Purpose	Confirm that the UUT accurately recognizes the Bus Idle Condition, and does not interpret valid noise interference as a false Bus Idle Condition
Critical for Safety	No
Applies to	Any PD Capable UUT except Cable
Description	Messages are sent to the UUT under conditions which check the receiver's ability to detect Bus Idle. In steps 1-5, the tester verifies that if the bus is not idle, the UUT does not send a GoodCRC. It achieves this by sending valid transitions during the time window during which the GoodCRC is allowed to be sent. In steps 6-8, the tester verifies that expected levels of noise on the CC line do not prevent the UUT from detecting Bus Idle. It achieves this by sending noise during a time window, and ensuring that the last part of a GoodCRC is sent, but not a complete GoodCRC.
Test setup	Protocol Tester with programmable transmit signal waveform.
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	6.4.3#10, 6.4.3.9#1 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

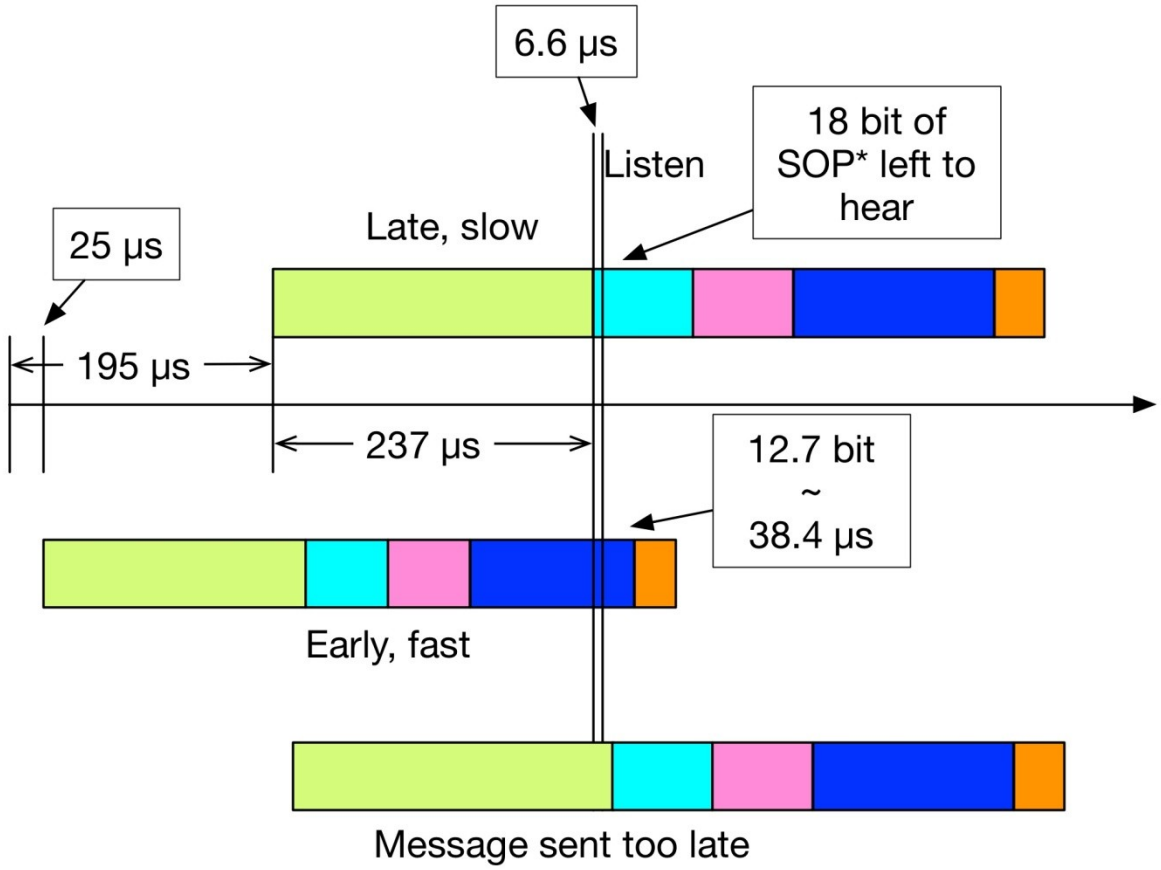
Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between

messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (BMC-PROC-PD-MODE).
4. The Protocol Tester sends a BIST request to the UUT, specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [BMC_PHY_RX_BUSIDL_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
5. Send BIST Test Data message; immediately disable tester receiver, and continue sending data zeros for 195us, then open receiver. (This step prevents the UUT from sending a GoodCRC, because the CC line will not be idle during the time in which it is valid to start sending one.)
6. Listen for data from UUT. There must be nothing for 10 ms [BMC_PHY_RX_BUSIDL_2]. If we see a GoodCRC message ending, or a complete GoodCRC, the UUT is deemed to have failed the test.

7. *See Figure below for explanation.*
   Send BIST Test Data message; disable tester receiver, and continue sending noise (see definition below) for 195+237+6.6us=438.6us, then open receiver. We are expecting the UUT to ignore the noise, and respond with a GoodCRC, so we should detect the end of an already started GoodCRC.
   The time chosen to re-enable the receiver is a point in time during which a legally timed GoodCRC will be encountered at a point after the start of its SOP and before the end of the CRC, regardless of whether this message is sent at the earliest possible opportunity at the fastest rate allowed, or at the latest opportunity at the slowest rate possible.
8. Listen for data from other end - check that we see data present, but do not receive a valid GoodCRC [BMC_PHY_RX_BUSIDL_3]. If we see a GoodCRC it means that it was started later than permitted, for whatever reason.
   If we see no data then it means that the UUT incorrectly saw the noise as an interfering signal and did not transmit the GoodCRC.
9. Reset UUT by simulating a tester end cable detach in order to guarantee exiting the BIST Mode.



Timing details

- 237us is the longest time required to send a preamble.
- 6.6us is a margin to ensure not seeing SOP.
- Message could be over in 25us + 149 bits at fastest speed = 472us (leaves minimum 38.4us or 12.7 bits)

Definition of Noise

- The noise signal shall be transmitted by the same transmit amplifier as the preceding signal, remaining at the same output impedance, to ensure the correct level.
- It shall be a square wave at a frequency of 600kHz.
- It shall have an amplitude of 250mV p/p, biased around 0.55V.

3.8.2 TDA.2.1.2.2: BMC-PHY-RX-INT-REJ BMC Receive Interference Rejection Test

Status	Primary Test
Purpose	Checks the ability of the receiver to correctly receive signals which are degraded by the worst case aggressor signal, and both the zero offset and worst case offset in the appropriate direction, whilst the bitrate is also set to both minimum and maximum extremes.
Critical for Safety	No
Applies to	Any PD Capable UUT except Cable
Description	The Protocol Tester uses BIST Test Data messages, in the presence of injected interference. The UUT is required to respond with GoodCRC messages, without missing any.
Test setup	USB PD Tester (with ability to add an aggressor signal and an offset to the data signal, while sending minimum and maximum permitted bitrates).
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	5.8.2.6.4#2, 6.4.3#10plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

This is achieved by using a short cable, and artificially adding an aggressor signal to the transmitted signal. The tester will add voltage offset, corresponding to ground differential, artificially to the signal.

The basic signal transmitted will represent the minimum swing likely to reach the receiver.

The aggressor signal will be as defined below.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive

cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

For a UUT which can be a Sink

3. The Tester gets the UUT into PD Mode as a Sink (BMC-PROC-PD-MODE).
4. The Protocol Tester sends a BIST request to the UUT (with incremented MessageID as normal*), specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [BMC_PHY_RX_INT_REJ_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
5. Wait 15ms to ensure that the UUT understands it is in a BIST test mode, and should not initiate any message sequences*.

6. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 1 below.
7. Send the 'BIST Test Data' message (without incrementing MessageID*) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [BMC_PHY_RX_INT_REJ_2]. *n=4502*(1024/345).*

8. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 2 below.
9. Send the 'BIST Test Data' message (without incrementing MessageID*) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [BMC_PHY_RX_INT_REJ_3]. *n=4502*(1024/345).*
10. Reset UUT by simulating a tester end cable detach in order to guarantee exiting the BIST Mode.

For a UUT which can be a Source

11. The Tester gets the UUT into PD Mode as a Source (BMC-PROC-PD-MODE).
12. The Protocol Tester sends a BIST request to the UUT (with incremented MessageID as normal*), specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [BMC_PHY_RX_INT_REJ_4]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
13. Wait 15ms to ensure that the UUT understands it is in a BIST test mode, and should not initiate any message sequences*.

14. In the following step, send BIST Test Data message using signal, plus the distortions defined in Tx Group 1 below.
15. Send the 'BIST Test Data' message (without incrementing MessageID*) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [BMC_PHY_RX_INT_REJ_2]. *n=4502*(1024/345).*

16. In the following step, send BIST Test Data message using the signal and the distortions defined in Tx Group 3 below.

17. Send the 'BIST Test Data' message (without incrementing MessageID*) 13362 times to validate BER, and check that the UUT fails to respond with GoodCRC no more 0 times [BMC_PHY_RX_INT_REJ_5]. *n=4502*(1024/345).*
18. Reset UUT by simulating a tester end cable detach in order to guarantee exiting the BIST Mode.

Tx Group 1, Tx Group 2 and Tx Group 3 Signal Specifications

	Nominal Signal	Group 1 Signal	Group 2 Signal	Group 3Signal
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
Noise	None	One of the three noise types defined below		

The nature of this test is to send a BIST Test Data message repeatedly, with minimum delay between the GoodCRC response from the UUT and the next BIST Test Data message from the tester. There would be a potential for a UUT not to be able to deal with messages of such frequency if the test were not implemented exactly as described above. The first BIST Test Data message must have an incremented MessageID so that the UUT recognizes it as a significant message, and stops originating its own traffic. The 15ms delay before further messages ensures that the UUT has had time to recognize the message. The fact that the MessageID is then not incremented is specified so that the UUT Protocol Engine will not pass the messages up to the Policy Engine, but **will respond with GoodCRC. This behavior is specified in the PD Specification.*

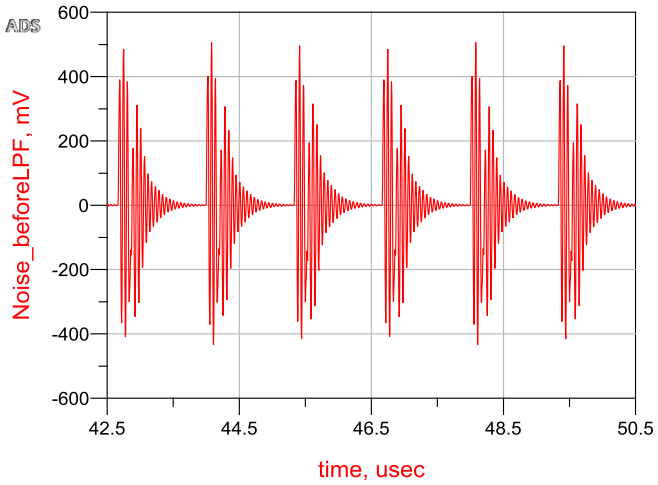
Injected Noise Specification

1. Source impedance of the tester transmitter from the combined source and noise generator shall be
   - 50 Ω ± 5 Ω
   - 400 pF ± 50 pF
2. Noise shall be generated from one of the three approaches described below.
3. The dynamic range of the noise amplitude at the input of UUT shall be less than 1V.

BMC Noise Generation Requirement

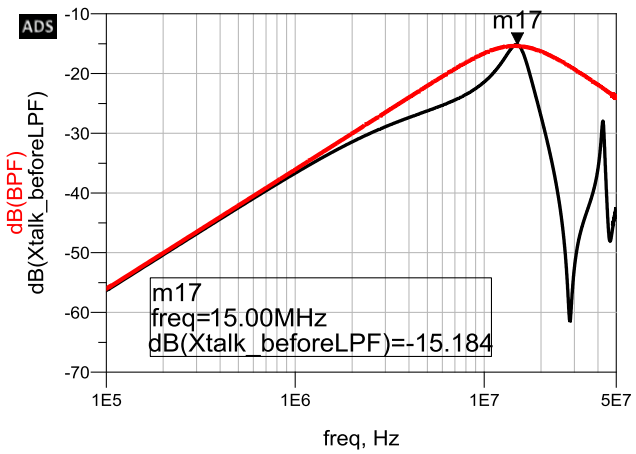
The three approaches are listed in this document for noise implementation guidance and flexibility. The noise magnitude shall be calibrated to reach the maximum level of vNoiseActive, 165mV. The noise calibration is done by connecting the test transmitter with 200pF shunt capacitive load in series with the Rx bandwidth limiting filter with the time constant tRxFilter. The Rx bandwith limiting filter shall be implemented with at least 5 kΩ load impedance to achieve a time constant of tRxFilter. The scope capacitance loading effect shall be taken into account.

1. Directly from the waveform text file using an arbitrary waveform generator (AWG). The time step shall be ≤ 15 nsec. The peak-to-peak noise magnitude shall be calibrated to 165 mV in the scope. (Note: Refer to USB.org for the waveform text file). Note that the waveform specified is what shall appear on the CC line.



USB FullSpeed SE0 Xtalk Noise Waveform at the Input of UUT

2. Using a band pass filter (BPF) circuitry with the peak frequency at 15 ± 1 MHz, 20dB/dec slope before the peak frequency and -20dB/dec slope after the peak frequency. The noise waveform at the input of the BPF has the pulse width 167 ns and the pulse period 1.33us. The peak-to-peak noise magnitude shall be calibrated to 165 mV in the scope. (Note: Refer to USB.org for the reference schematic of the BPF)



Transfer Functions of USB FullSpeed SE0 to CC Xtalk (black solid line)
and Band Pass Filter (red dash line)

3. Using two-tone sinusoidal noise waveforms simultaneously. The in-band peak-to-peak noise at 750 ± 50 kHz and the out-of-band peak-to-peak noise at 5 ± 0.5 MHz shall be calibrated to 90mV and 75 mV in the scope, respectively.

   When any of the above three approaches is used, the noise phase relative to the signal shall be advanced through the signal period so that the worst case of the interference situation can be captured.

3.9 BMC PHYSICAL LAYER PRIMARY TESTS - MISCELLANEOUS

3.9.1 BMC-PHY-TERM: BMC-PHY-TERM BMC Termination Impedance Test

Status	Primary Test
Purpose	To confirm that a UUT has a valid impedance when not transmitting.
Critical for Safety	
Applies to	Any PD Capable UUT except Cable
Description	The Protocol Tester chooses a time when the UUT is not transmitting, and measures the impedance of the receiver using a voltage source and resistor.
Test setup	Protocol Tester with voltage generator, resistor, and voltage measurement function.
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	6.4.3#10, 6.4.3.9#1 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Note: 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 Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (BMC-PROC-PD-MODE).

4. The Tester sends a BIST request to the UUT, specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [BMC_PHY_TERM_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
5. Check that the voltage on the CC line falls within the expected range, knowing the range of values of the Rp and Rd resistors [BMC_PHY_TERM_2].
6. Reset UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.
   Verify that UUT does not modify voltage levels in any received message waveform.
7. The Tester gets the UUT into PD Mode (BMC-PROC-PD-MODE).
8. The Tester sends a BIST request to the UUT, specifying 'BIST Test Data', and checks for a valid and correctly timed protocol response [BMC_PHY_TERM_1]. *This shows that the basic test mechanism is working and prevents the UUT from sending any other messages during the following steps.*
9. 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.

10. Reset UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.

3.9.2 TDA.2.1.3.2: BMC-PHY-MSG BMC PHY Level Message Test

Status	Primary Test
Purpose	To validate the PHY level behavior of message exchanges. To confirm the PHY level behavior of the UUT in relation to Cable Reset and Hard Reset.
Critical for Safety	
Applies to	Any PD Capable UUT except Cable
Description	The Protocol Tester sends a sequence of messages both correct and with deliberate errors and validates the correct behavior in each case. Protocol Tester sends Hard Reset, Soft Reset and Cable Reset messages to the UUT, and confirms correct operation by the UUT.
Test setup	Protocol Tester with control over low level packet generation.
Ping Policy	Send no Pings
Preconditions	
Assertions Tested	5.3#1, 5.3#2, 5.5#1, 5.5#2, 5.6#1, 5.6.1.1#2, 5.6.1.1#3, 5.6.1.1#4, 5.6.1.2.2#5, 5.6.1.2.2#6, 5.6.1.2.3#7, 5.6.1.3#1, 5.6.1.5#4, 5.6.1.5#5, 5.6.3#1, 6.2.1.3#1,1.3#2, 6.3.1#2, 6.4.3.9#1, 6.6.1.1#1, 6.8.2.3.1#1, 8.3.3.8.1.2#1, 8.3.3.8.1.2#2, 8.3.3.9.1.1#2, 8.3.3.10.2.2#1, 8.3.3.10.2.2#2, 8.3.3.10.2.3#1, 8.3.3.10.2.3#2, 8.3.3.10.11.1#5 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a

cable marker.
The following messages are sent using SOP unless otherwise stated.

3. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE).
4. Send a BIST Test Data message to the UUT. Check that it responds with a GoodCRC [BMC_PHY_MSG_1].
5. If the UUT is a DFP, and vendor specifies that it will not respond to SOP', send a BIST Test Data message to the UUT using SOP' and check that it does not respond.
   If the UUT is a UFP, send a BIST Test Data message to the UUT using SOP' and check that it does not respond. If the UUT is a DFP, and vendor specifies that it will respond to SOP' skip this step. [BMC_PHY_MSG_2].
6. If the UUT is a DFP, and vendor specifies that it will not respond to SOP'', send a BIST Test Data message to the UUT using SOP'' and check that it does not respond.
   If the UUT is a UFP, send a BIST Test Data message to the UUT using SOP' and check that it does not respond. If the UUT is a DFP, and vendor specifies that it will respond to SOP'' skip this step. [BMC_PHY_MSG_3].
7. Send a BIST Test Data message to the UUT using Debug_SOP'. Check that it does not respond, unless specified by vendor that it will [BMC_PHY_MSG_4].
8. Send a BIST Test Data message to the UUT using Debug_SOP''. Check that it does not respond, unless specified by vendor that it will [BMC_PHY_MSG_5].
9. Reset UUT by simulating a tester end cable detach, in order to guarantee exiting the BIST Mode.

In each of the following steps referring to 'the message', the Tester will send a Get_Source_Cap message to the UUT if it is being tested as a Sink, or a Get_Sink_Cap message to the UUT if it is being tested as a Source, UUT and check the UUT's response is correct. We expect either a Reject message or an appropriate Capabilities message, if the message is recognized, otherwise no related response.

10. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE).
11. Send the normal error-free version of the message. Check that a valid response message is received [BMC_PHY_MSG_6].
12. Check that GoodCRC is not received and that no response message is received, from the UUT if a message is sent, with the CRC deliberately corrupted before 4b5b encoding [BMC_PHY_MSG_7].
13. Check that GoodCRC is not received and that no response message is received, from the UUT if a message is sent, with the CRC deliberately corrupted after 4b5b encoding [BMC_PHY_MSG_8].
14. Check that GoodCRC is not received and that no response message is received, from the UUT if a message is sent with the payload, deliberately corrupted before 4b5b encoding but after being used for the CRC generation [BMC_PHY_MSG_9].
15. Check that GoodCRC is not received and that no response message is received, from the UUT if a message is sent with the payload, deliberately corrupted after 4b5b encoding [BMC_PHY_MSG_10].

16. Check that GoodCRC is not received and that no response message is received, from the UUT if a message is sent containing a reserved 5-bit code used in place of a valid hex code [BMC_PHY_MSG_11]. [Note exactly which code]
17. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

Confirm that out-going Message ID is initialized correctly (on establish PD-Mode)
Confirm that out-going Message ID is incremented correctly (on any message)

18. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
19. Send an appropriate Get Capabilities message to the UUT. Check that UUT sends an appropriate response message.
20. During the previous two steps check that the MessageID contained in the messages from the UUT follow the rules about initial value [BMC_PHY_MSG_12] and incrementing [BMC_PHY_MSG_13].

Confirm that the UUT ignores Cable Reset (Skip to Step 27 if UUT can only behave as a Source)

21. Send an appropriate Get Capabilities message to the UUT. Check that UUT sends an appropriate response message.
22. Send a Cable Reset to the UUT.
23. Send an appropriate Get Capabilities message to the UUT. Check that UUT sends an appropriate response message.
24. Send a Cable Reset to the UUT.
25. Send an appropriate Get Capabilities message to the UUT. Check that UUT sends an appropriate response message.
26. Check that the MessageID in any messages received from the UUT (including unexpected ones) starting at step 20 are always incrementing [BMC_PHY_MSG_15].
27. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

Confirm that repeated incoming Message ID is ignored

28. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
29. Send appropriate Get Capabilities message to the UUT with NO MessageID increment. Check that UUT does not send a response (other than GoodCRC). [BMC_PHY_MSG_18].
30. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

Confirm that out-going Message ID is reset correctly on Hard Reset

31. The Tester gets the UUT into PD Mode(as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
32. The Tester sends Hard Reset to UUT.
33. Check that the UUT performs the correct steps to re-enter PD-MODE (whether it is a source or a sink). The tester automatically performs its role in this. [BMC_PHY_MSG_16]

34. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

Confirm that out-going Message ID is reset correctly on Soft Reset

35. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
36. The Tester sends Soft Reset to UUT.
37. Check that the UUT sends an Accept message [BMC_PHY_MSG_14], and then performs the correct steps to re-cover from Soft Reset (whether it is a source or a sink). The tester automatically performs its role in this.
38. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

Confirm that the CRC is correctly verified according to the rules in Chapter 5 of the PD Specification

39. The Tester gets the UUT into PD Mode (as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
40. The Tester sends a BIST Test Data message to the UUT. Check that it responds with a GoodCRC [BMC_PHY_MSG_1].
41. The Tester constructs and sends a message consisting of:

    a. preamble
    b. SOP
    c. header, indicating anything BUT Soft Reset or Ping
    d. payload, consisting of a number of bytes not being a multiple of 4, and not being related to the number of PDOs specified in the header
    e. CRC
    f. EOP

42. Check that the message is acknowledged by a GoodCRC message.
43. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

(Only if Testing to Rev 2.0)
Confirm that a Rev 3.0 Extended Message is responded to with a GoodCRC

44. The Tester gets the UUT into PD Mode(as a Sink if possible, otherwise as a Source) (BMC-PROC-PD-MODE].
45. The Tester sends a Get_Manufacturer_Info Extended message (with Rev 3.0)
46. Check that the message is acknowledged by a GoodCRC message.
47. Reset UUT by simulating a tester end cable detach, in order to start again from a known state.

3.10 PHYSICAL LAYER SECONDARY CHECKS

3.10.1 TDB.1.1.1: PHY-MSG-GEN PHY Level General Message Test (SOP*)

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To validate the PHY level behavior of message format.
Critical for Safety	
Applies to	Any UUT
Description	This section is a list of specific checks to be made in the course of any other test when a message from the UUT is seen.
Test setup	Depends on test being carried out.
Preconditions	
Assertions Tested	5.6.1.1#3, 5.6.1.1#4
Parameters Tested	
Checklist References	

Test Procedure

1. Check that Preamble is 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.) [PHY_MSG_GEN_1]
2. Check that Preamble ends with '1'. [PHY_MSG_GEN_2]

3.11 PROTOCOL SPECIFIC SECONDARY CHECKS

3.11.1 TDB.2.1.2.1: PROT-MSG-HDR Message Header Checks - Except GoodCRC

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any Message Header sent by the UUT (except GoodCRC).
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1#1, 6.2.1.1#1, 6.2.1.1#2, 6.2.1.2#1, 6.2.1.3#1, 6.2.1.3#2, 6.2.1.4#1, 6.2.1.4#2, 6.2.1.4#3, 6.2.1.4#4, 6.2.1.4#5, 6.2.1.4#7, 6.2.1.5#1, 6.2.1.6#1, 6.2.1.6#2, 6.2.1.8#1, 6.3#1, 6.3#2
Parameters Tested	nMessageIDCount
Checklist References	

Test Procedure - Message Header Checks

During any test which refers to this section, ensure that the following checks are carried out:

1. That bit 15 (reserved) of the Message Header is set to 0. [PROT_MSG_HDR_1]
2. That the size in bytes of the message following the Message Header is 4 times the Number of Data Objects represented by the value in bits 14:12. [PROT_MSG_HDR_2]
3. That the MessageID represented by the value in bits 11:9 of the Message Header is the expected value, i.e.
    - if this is first message after a Hard Reset was sent or received by the sender of this message, or after attachment, or after a Swap, or (in the case of a cable plug or DFP or UFP talking to a Cable Plug) after a Cable Reset, the value shall be 000b. [PROT_MSG_HDR_3]
    - if the message is a Soft Reset, the value shall be 000b. [PROT_MSG_HDR_4]
    - if the message is the first message after a Soft Reset was received by the sender of the message, the value shall be 000b. [PROT_MSG_HDR_5]
    - that it is incremented by one compared with the previously received message (modulo-[nMessageIDCount+1]), with the following exceptions:
        - during 'Discovery', when the Source Capabilities message shall have the MessageID value 000b until after a GoodCRC is received, and

- if the message is an exact repeat of the previous message then it is valid for the MessageID to be the same as for that previous message, on the assumption that the re-sender of this message did not see a GoodCRC. [PROT_MSG_HDR_6]

- if the message is Returned BIST Counters, then No check is performed on MessageID.

4. That the Port Power Role represented by the value in bit 8 of the Message Header for an SOP Packet Type is the expected value, based on the tester's knowledge of the UUT port role. Additionally, confirm that for a Ping or GotoMin, the Port Power Role is Source (bit 8 = '1'), and for a Request, the Port Power Role is Sink (bit 8 = '0'). The Port Power Role bit in the first PS_RDY during a Swap shall to set to Sink.
   [PROT_MSG_HDR_11]
5. That the Cable Plug role represented by the value in bit 8 of the Message Header for any packet type other than an SOP Type is the expected value, based on the tester's knowledge of the UUT. [PROT_MSG_HDR_12]
6. That the Specification Revision represented by the value in bits 7:6 of the Message Header is 01b. [PROT_MSG_HDR_13]
   That if BMC is in use, the Specification Revision represented by the value in bits 7:6 of the Message Header is not 00b. [PROT_MSG_HDR_18]
7. That the Port Data Role represented by the value in bit 5 of the Message Header for an SOP Packet Type is the expected value, based on the tester's knowledge of the UUT port role. [PROT_MSG_HDR_14]
8. That the reserved field represented by the value in bit 5 of the Message Header for any packet type other than an SOP is zero. [PROT_MSG_HDR_15]
9. That the reserved field represented by the value in bit 4 of the Message is zero. [PROT_MSG_HDR_16]
10. That the MessageType represented by the value in bits 3:0 of the Message Header is not a reserved value. [PROT_MSG_HDR_17]
    a. Reserved values for Control Messages (defined by Number of Data Objects = 0) for an SOP packet type are 0000b, 1110b and 1111b.
       Additional reserved values for BMC are 1001b and 1011b.
    b. Reserved values for Control Messages (defined by Number of Data Objects = 0) for any packet type other than an SOP Type are 0000b, 0010b, 0100b, 0110b, 0111b, 1000b, 1001b, 1010b, 1011b, 1100b, 1110b and 1111b.
    c. Reserved values for Data Messages (defined by Number of Data Objects > 0) for an SOP packet type are 0000b and 0101 to 1110b.
    d. Reserved values for Data Messages (defined by Number of Data Objects > 0) for any packet type other than an SOP Type are 0000b to 0010b, and 0100 to 1110b.

Following tables for information only:

Valid Control MessageTypes (V1.3) are:

MessageType	Message Name

0000b	(reserved)
0001b	GoodCRC
0010b	GotoMin
0011b	Accept
0100b	Reject
0101b	Ping
0110b	PS_RDY
0111b	Get_Source_Cap
1000b	Get_Sink_Cap
1001b	Protocol Error (deprecated)
1010b	Swap
1011b	(reserved)
1100b	Wait
1101b	Soft Reset
1110b-1111b	(reserved)

Valid Data MessageTypes (V1.3) are:

MessageType	Number of Data Objects	Message Name
0000b	-	(reserved)
0001b	1 to 7	Source Capabilities
0010b	1	Request
0011b	1	BIST
0100b	1 to 7	Sink Capabilities
0101b-1110b	-	(reserved)
1111b	1 to 7	Vendor Defined

Valid Control MessageTypes (SOP - V2.0) are:

MessageType	Message Name
0000b	(reserved)
0001b	GoodCRC
0010b	GotoMin
0011b	Accept
0100b	Reject
0101b	Ping
0110b	PS_RDY
0111b	Get_Source_Cap
1000b	Get_Sink_Cap
1001b	DR_Swap
1010b	Swap
1011b	VCONN_Swap
1100b	Wait
1101b	Soft Reset
1110b-1111b	(reserved)

Valid Control MessageTypes (not SOP V2.0) are:

MessageType	Message Name
0000b	(reserved)
0001b	GoodCRC
0010b	(reserved)
0011b	Accept
0100b-1100b	(reserved)
1101b	Soft Reset

1110b-1111b	(reserved)

Valid Data MessageTypes (SOP - V2.0) are:

MessageType	Number of Data Objects	Message Name
0000b	-	(reserved)
0001b	1 to 7	Source Capabilities
0010b	1	Request
0011b	1	BIST
0100b	1 to 7	Sink Capabilities
0101b-1110b	-	(reserved)
1111b	1 to 7	Vendor Defined

Valid Data MessageTypes (not SOP - V2.0) are:

MessageType	Number of Data Objects	Message Name
0000b-0010b	-	(reserved)
0011b	1	BIST
0100b-1110b	-	(reserved)
1111b	1 to 7	Vendor Defined

3.11.2 TDB.2.1.2.2: PROT-MSG-HDR-GCRC Message Header Checks - GoodCRC

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the GoodCRC message is received by the Tester.
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the GoodCRC message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.1#2, 6.2.1.2#1, 6.2.1.3#1, 6.2.1.4#1, 6.2.1.4#7, 6.2.1.5#1, 6.2.1.6#1, 6.2.1.6#3, 6.2.1.7#1, 6.2.1.7#2, 6.3.1#1, 6.3.1#2, 6.3.1#3
Parameters Tested	
Checklist References	

Test Procedure - GoodCRC Checks

During any test which refers to this section, ensure that the following checks are carried out:
This set of checks assumes that the message in which the header appears has already been identified as GoodCRC, because it has the correct value of 000b for the Number of Data Objects in bits 14:12, and the correct MessageType of 0001b in bits 3:0.

1. That bit 15 (reserved) of the Message Header is set to 0. [PROT_MSG_HDR_GCRC_1]
2. That the size in bytes of the message following the Message Header is zero. [PROT_MSG_HDR_GCRC_2]
3. That the MessageID represented by the value in bits 11:9 of the Message Header is the expected value, i.e. the same as the value in the preceding message from the tester. [PROT_MSG_HDR_GCRC_3]
4. That the Port Power Role represented by the value in bit 8 of the Message Header for an SOP Packet Type is the expected value, based on the tester's knowledge of the UUT port role. There is an ambiguous case in the GoodCRC responding to the first PS_RDY during a Swap. The PS_RDY is sent by the new Sink, but the GoodCRC will, in most implementations, be from the old Sink. In practice we will **not** check this during Compliance. [PROT_MSG_HDR_GCRC_7]

5. That the Cable Plug role represented by the value in bit 8 of the Message Header for any packet type other than an SOP Type is the expected value, based on the tester's knowledge of the UUT. [PROT_MSG_HDR_GCRC_8]
6. That the Specification Revision represented by the value in bits 7:6 of the Message Header is 01b. [PROT_MSG_HDR_GCRC_9]
7. That if BMC is in use, the Specification Revision represented by the value in bits 7:6 of the Message Header is not 00b. [PROT_MSG_HDR_GCRC_14]
8. That the Port Data Role represented by the value in bit 5 of the Message Header for an SOP Packet Type is the expected value, based on the tester's knowledge of the UUT port role. [PROT_MSG_HDR_GCRC_10]
9. That the reserved field represented by the value in bit 5 of the Message Header for any packet type other than an SOP is zero. [PROT_MSG_HDR_GCRC_11]
10. That the reserved field represented by the value in bit 4 of the Message is zero. [PROT_MSG_HDR_GCRC_12]
11. That the first bit of the GoodCRC is returned within tTransmit max (195µs) of the last bit of the previous message. [PROT_MSG_HDR_GCRC_13]

3.11.3 TDB.2.1.3: PROT-MSG-CTRL Control Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which one of the following Control messages is sent by the UUT: GoodCRC, GoToMin, Accept, Reject, Ping, PS_RDY, Get_Source_Cap, Get_Sink_Cap, Protocol Error, DR_Swap, PR_Swap, VCONN_Swap, Wait, Soft Reset
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the GoodCRC message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.5.1#6, 6.5.1#7, 6.5.2#6, 6.6.1.1#1, 6.6.1.1#2, 6.6.1.1#3, 6.6.1.2#1, 6.6.1.2#2, 6.6.1.2#3plus assertions in checks: PROT-HDR PROT-HDR-GCRC
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:
This set of checks assumes that the message has already been identified as the one being tested, because it has the correct value of 000b for the Number of Data Objects in bits 14:12, and the correct MessageType in bits 3:0.

1. All the Message Header Checks detailed in PROT-HDR or PROT-HDR-GCRC.
2. That the number of bytes of the payload, following the header, is zero. [PROT_MSG_CTRL_1]

3.11.4 TDB.2.1.3.1: PROT-MSG-CTRL-PING Ping Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Ping message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer or Consumer/Provider
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Ping message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.5.1#1, 6.5.3.1#2, 6.5.3.1#3plus assertions in checks: PROT-MSG-CTRL
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:
This set of checks assumes that the message has already been identified as the one being tested, because it has the correct value of 000b for the Number of Data Objects in bits 14:12, and the correct MessageType 0101b in bits 3:0.

1. That the Control Message Checks (PROT-MSG-CTRL) are correct.
2. That the partnered devices currently have a contract. [PROT_MSG_CTRL_PING_1]
3. That Pings are sent periodically when a Source is operating at a voltage other than vSafe5V, or if the Source is in a Swapped state. [PROT_MSG_CTRL_PING_2]

3.11.5 TDB.2.1.4.4.1.1: PROT-MSG-DATA-SRC-CAP Source Capability Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the (Source) Capabilities message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Source Capabilities message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.1#1, 6.4.1#3, 6.4.1.2#2, 6.4.1.2.3#1, 6.4.1.2.3#2, 6.4.1.2.3#3, 6.4.1.2.3.1#1, 6.4.1.2.3.1#2, 6.4.1.2.3.2#2, 6.4.1.2.3.3#1, 6.4.1.2.3.4#1, 6.4.1.2.3.5#1, 6.4.1.2.3.5#2, 6.4.1.2.3.6#2, 6.4.1.2.3.6#3, 6.4.1.2.3.6#4, 6.4.1.2.4#1, 6.4.1.2.4#2, 6.4.1.2.5#1, 6.4.1.2.5#2plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is at least 1 [PROT_MSG_DATA_SRC_CAP_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 0001b [PROT_MSG_DATA_SRC_CAP_2].
4. That for the first PDO in a Source Capabilities message, bits B31:B30 are set to 00b (representing a Fixed supply) [PROT_MSG_DATA_SRC_CAP_3].
5. That for the first PDO in a Source Capabilities message, the state of bit B29 matches the vendor supplied information as to whether the UUT is a dual role PD device [PROT_MSG_DATA_SRC_CAP_4].
6. That for the first PDO in a Source Capabilities message, the state of bit B28 matches the vendor supplied information as to whether the UUT supports USB Suspend [PROT_MSG_DATA_SRC_CAP_5].

7. That for the first PDO in a Source Capabilities message, the state of bit B27 matches the current known state of whether the UUT is Externally Powered, in tests where this information is known [PROT_MSG_DATA_SRC_CAP_6].
8. That for the first PDO in a Source Capabilities message, the state of bit B26 matches the vendor supplied information as to whether the UUT is USB Communications capable [PROT_MSG_DATA_SRC_CAP_7].
9. That for the first PDO in a Source Capabilities message, the state of bit B25 matches the vendor supplied information as to whether the UUT is Type-C and performs DR_Swap [PROT_MSG_DATA_SRC_CAP_8].
10. That for the first PDO in a Source Capabilities message, bits B24:B22 are set to 0 [PROT_MSG_DATA_SRC_CAP_9].
11. That for the first PDO in a Source Capabilities message, the value bit B21:B20 contain a value for Peak Power equal to the one declared for this PDO by the vendor [PROT_MSG_DATA_SRC_CAP_10].
12. That for the first PDO in a Source Capabilities message, the voltage represented by bits B19:B10 is 5V [PROT_MSG_DATA_SRC_CAP_11].
13. That for the first PDO in a Source Capabilities message, bits B9:B0 contains a value equal to the one declared for this PDO by the vendor [PROT_MSG_DATA_SRC_CAP_12].
14. That a PDO in a Source Capabilities message has a value in B31:B30 of 00b (referred to as a Fixed PDO), 01b (referred to as a Battery PDO) or 10b (referred to as a Variable PDO), but never 11b [PROT_MSG_DATA_SRC_CAP_13].
15. That any PDOs following the first one, are in the correct order: Fixed PDOs in increasing voltage sequence, Battery PDOs in increasing minimum voltage sequence and finally Variable PDOs in increasing minimum voltage sequence [PROT_MSG_DATA_SRC_CAP_14].
16. That for any Fixed PDO in a Source Capabilities message, other than the first, bits B29:B22 are set to 0 [PROT_MSG_DATA_SRC_CAP_15].
17. That for any Fixed PDO in a Source Capabilities message, bits B21:B20 contain a value for Peak Power equal to the one declared for this PDO by the vendor [PROT_MSG_DATA_SRC_CAP_16].
18. That for any Fixed PDO in a Source Capabilities message, other than the first, the voltage represented by bits B19:B10 equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_17].
19. That for any Fixed PDO in a Source Capabilities message, the current represented by bits B9:B0 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_18].
20. That for any Variable PDO in a Source Capabilities message, the Maximum Voltage represented by bits B29:B20 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_19].
21. That for any Variable PDO in a Source Capabilities message, the Minimum Voltage represented by bits B19:B10 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_20].
22. That for any Variable PDO in a Source Capabilities message, the current represented by bits B9:B0 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_21].
23. That for any Battery PDO in a Source Capabilities message, the Maximum Voltage represented by bits B29:B20 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_22].

24. That for any Battery PDO in a Source Capabilities message, the Minimum Voltage represented by bits B19:B10 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_23].
25. That for any Battery PDO in a Source Capabilities message, the current represented by bits B9:B0 is equal to that declared by the vendor [PROT_MSG_DATA_SRC_CAP_24].
26. That no Fixed PDO has the same voltage as any other [PROT_MSG_DATA_SRC_CAP_25].
27. That no Variable PDO has the same voltage range as any other [PROT_MSG_DATA_SRC_CAP_26].
28. That no Battery PDO has the same voltage as any other [PROT_MSG_DATA_SRC_CAP_27].
29. That the Source Capabilities offered are consistent with the PD Power As Source specified by the vendor [PROT_MSG_DATA_SRC_CAP_28]. This means that the Source Capabilities shall meet the Power Rules in the latest specification 2.x version.
30. That the Source Capabilities message differs from the previously sent one, unless it is sent in response to from a Get_Source_Cap message, or during 'Discovery' [PROT_MSG_DATA_SRC_CAP_29].

End of List of Checks

3.11.6 TDB.2.1.4.1.2: PROT-MSG-DATA-SNK-CAP Sink Capability Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the (Sink) Capabilities message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider/Consumer, Consumer/Provider or Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Sink Capabilities message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.1#1, 6.4.1#3, 6.4.1.2.3#4, 6.4.1.2.3.1#1, 6.4.1.2.3.1#2, 6.4.1.2.3.3#1, 6.4.1.2.3.4#1, 6.4.1.2.3.5#1, 6.4.1.2.3.5#2, 6.4.1.2.4#1, 6.4.1.2.4#2, 6.4.1.2.5#1, 6.4.1.2.5#2, 6.4.1.3#1, 6.4.1.3#2, 6.4.1.3#3, 6.4.1.3#4, 6.4.1.3#6, 6.4.1.3#7, 6.4.1.3.1#1, 6.4.1.3.1#2, 6.4.1.3.1#3, 6.4.1.3.1#4, 6.4.1.3.1.1#1, 6.4.1.3.1.1#2, 6.4.1.3.1.2#1, 6.4.1.3.1.4#1, 6.4.1.3.2#1, 6.4.1.3.2#2, 6.4.1.3.3#1, 6.4.1.3.3#2plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is at least 1 [PROT_MSG_DATA_SNK_CAP_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 0100b [PROT_MSG_DATA_SNK_CAP_2].
4. That for the first PDO in a Sink Capabilities message, bits B31:B30 are set to 00b (representing a Fixed supply) [PROT_MSG_DATA_SNK_CAP_3].

5. That for the first PDO in a Sink Capabilities message, the state of bit B29 matches the vendor supplied information as to whether the UUT is a dual role PD device [PROT_MSG_DATA_SNK_CAP_4].
6. That for the first PDO in a Sink Capabilities message, the state of bit B28 (Higher Capability) matches the vendor supplied information as to whether the UUT needs more than vSafe5V to provide full functionality [PROT_MSG_DATA_SNK_CAP_5].
7. That for the first PDO in a Sink Capabilities message, the state of bit B27 matches the current known state of whether the UUT is Externally Powered, in tests where this information is known [PROT_MSG_DATA_SNK_CAP_6].
8. That for the first PDO in a Sink Capabilities message, the state of bit B26 matches the vendor supplied information as to whether the UUT is USB Communications capable [PROT_MSG_DATA_SNK_CAP_7].
9. That for the first PDO in a Source Capabilities message, the state of bit B25 (Data Role Swap) matches the vendor supplied information as to whether the UUT is Type-C and performs DR_Swap [PROT_MSG_DATA_SNK_CAP_8].
10. That for the first PDO in a Sink Capabilities message, bit B24:B20 (reserved) are set to 0 [PROT_MSG_DATA_SNK_CAP_9].
11. That for the first PDO in a Sink Capabilities message, the voltage represented by bits B19:B10 is 5V [PROT_MSG_DATA_SNK_CAP_10].
12. That for the first PDO in a Sink Capabilities message, bits B9:B0 contains a value no larger than the one declared for this PDO by the vendor [PROT_MSG_DATA_SNK_CAP_11].
13. That a PDO in a Sink Capabilities message has a value in B31:B30 of 00b (referred to as a Fixed PDO), 01b (referred to as a Battery PDO) or 10b (referred to as a Variable PDO), but never 11b [PROT_MSG_DATA_SNK_CAP_12].
14. That any PDOs following the first one, are in the correct order: Fixed PDOs in increasing voltage sequence, Battery PDOs in increasing minimum voltage sequence and finally Variable PDOs in increasing minimum voltage sequence [PROT_MSG_DATA_SNK_CAP_13].
15. That for any Fixed PDO in a Sink Capabilities message, other than the first, bits B29:B20 are set to 0 [PROT_MSG_DATA_SNK_CAP_14].
16. That for any Fixed PDO in a Sink Capabilities message, other than the first, the voltage represented by bits B19:B10 is the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_15].
17. That for any Fixed PDO in a Sink Capabilities message, the current represented by bits B9:B0 does not exceed the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_16].
18. That for any Variable PDO in a Sink Capabilities message, the Maximum Voltage represented by bits B29:B20 is the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_17].
19. That for any Variable PDO in a Sink Capabilities message, the Minimum Voltage represented by bits B19:B10 is the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_18].
20. That for any Variable PDO in a Sink Capabilities message, the current represented by bits B9:B0 does not exceed the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_19].
21. That for any Battery PDO in a Sink Capabilities message, the Maximum Voltage represented by bits B29:B20 is the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_20].
22. That for any Battery PDO in a Sink Capabilities message, the Minimum Voltage represented by bits B19:B10 is the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_21].

23. That for any Battery PDO in a Sink Capabilities message, the current represented by bits B9:B0 does not exceed the value declared by the vendor [PROT_MSG_DATA_SNK_CAP_22].
24. That no Fixed PDO has the same voltage as any other [PROT_MSG_DATA_ SNK _CAP_23].
25. That no Variable PDO has the same voltage range as any other [PROT_MSG_DATA_ SNK _CAP_24].
26. That no Battery PDO has the same voltage as any other [PROT_MSG_DATA_ SNK _CAP_25].
27. That the Sink Capabilities specified are consistent with the PD Power As Sink specified by the vendor [PROT_MSG_DATA_ SNK _CAP_26]. This means that the Sink Capabilities shall meet the Power Rules in the latest specification 2.x version.

End of List of Checks

3.11.7 TDB.2.1.4.2: PROT-MSG-DATA-REQ Request Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Request message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider/Consumer, Consumer/Provider or Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Source Capabilities message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.2#3, 6.4.2#4, 6.4.2#5, 6.4.2.1#1, 6.4.2.2#1, 6.4.2.3#3, 6.4.2.3#4, 6.4.2.3#5, 6.4.2.4#1, 6.4.2.6#1, 6.4.2.6#3, 6.4.2.7#1, 6.4.2.7#2, 6.4.2.7#3, 6.4.2.8#1, 6.4.2.8#2, 6.4.2.8#3, 6.4.2.9#1, 6.4.2.9#2, 6.4.2.10#1, 6.4.2.10#2, 6.4.2.10#3, 6.4.2.10#4, 6.4.2.11#1, 6.4.2.11#2plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in section 3.10.1 .
2. That the Number of Data Objects represented by the value in bits 14:12 is exactly 1 [PROT_MSG_DATA_REQ_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 0010b [PROT_MSG_DATA_REQ_2].
4. That B31 of the Request Data Object (RDO) is set to 0b [PROT_MSG_DATA_REQ_3].
5. That the Object Position represented by B30:28 is not 000b [PROT_MSG_DATA_REQ_4], and is not greater than the number of PDOs offered in the Source Capabilities message most recently received by the UUT[PROT_MSG_DATA_REQ_5].
6. That B25, the USB Communications Capable bit, matches the statement provided by the Vendor as to whether the UUT is USB Communications capable [PROT_MSG_DATA_REQ_6].
7. That B24, the No USB Suspend bit, matches the statement provided by the Vendor as to whether the UUT sets this bit [PROT_MSG_DATA_REQ_7].
8. That B23:20 are set to 0000b [PROT_MSG_DATA_REQ_8].

If the PDO requested is a Fixed or Variable supply and B27 (Giveback flag) is 0:

9. That the Operating Current represented by B19:10 (10mA units) does not exceed the current offered by the referenced PDO [PROT_MSG_DATA_REQ_9].
10. That, if the Maximum Operating Current represented by B9:0 (10mA units) exceeds the current offered by the referenced PDO, then B26 (the Capability Mismatch bit) is also set [PROT_MSG_DATA_REQ_10].
11. That the Operating Current represented by B19:10 (10mA units) does not exceed the Maximum Operating Current represented by B9:0 (10mA units) [PROT_MSG_DATA_REQ_11].

If the PDO requested is a Fixed or Variable supply and B27 (Giveback flag) is 1:

12. That the Operating Current represented by B19:10 (10mA units) does not exceed the current offered by the referenced PDO [PROT_MSG_DATA_REQ_12].
13. That the Minimum Operating Current represented by B9:0 (10mA units) does not exceed the current offered by the referenced PDO [PROT_MSG_DATA_REQ_13].
14. That the Minimum Operating Current represented by B9:0 (10mA units) is less than does not exceed the Operating Current represented by B19:10 (10mA units) [PROT_MSG_DATA_REQ_14].

If the PDO requested is a Battery supply and B27 (Giveback flag) is 0:

15. That the Operating Power represented by B19:10 (250mW units) does not exceed the current offered by the referenced PDO [PROT_MSG_DATA_REQ_15].
16. That, if the Maximum Operating Power represented by B9:0 (250mW units) exceeds the power offered by the referenced PDO, then B26 (the Capability Mismatch bit) is also set [PROT_MSG_DATA_REQ_16].
17. That the Operating Power represented by B19:10 (250mW units) does not exceed the Maximum Operating Power represented by B9:0 (250mW units) [PROT_MSG_DATA_REQ_17].

If the PDO requested is a Battery supply and B27 (Giveback flag) is 1:

18. That the Operating Power represented by B19:10 (250mW units) does not exceed the current offered by the referenced PDO [PROT_MSG_DATA_REQ_18].
19. That the Minimum Operating Power represented by B9:0 (250mW units) does not exceed the power offered by the referenced PDO [PROT_MSG_DATA_REQ_19].
20. That the Minimum Operating Power represented by B9:0 (250mW units) is less than does not exceed the Operating Power represented by B19:10 (250mW units) [PROT_MSG_DATA_REQ_20].

End of List of Checks

3.11.8 TDB.2.1.4.3: PROT-MSG-DATA-VEND Vendor Defined Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which an Unstructured Vendor Defined message is sent by the UUT.
Critical for Safety	No
Applies to	Any UUT
Description	Checks the validity of formatting of a Vendor message to ensure that it will not cause problems to PD devices which do not recognize it.
Test setup	
Preconditions	The checks will be performed on any occasion when a Vendor message is encountered.
Assertions Tested	6.2.1.8#1, 6.4.4#1, 6.4.4#2 plus assertions in checks: PROT-HDR
Parameters Tested	-
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VEND_1]
3. That B31:16 of the Data Object contains the Vendor ID (VID) value, as specified by the Vendor. [PROT_MSG_DATA_VEND_2]

End of List of Checks

3.11.9 TDB.2.1.4.4.1.1: PROT-MSG-DATA-VDM-ID-INIT Discover ID Initiator Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover ID Initiator message is sent by the UUT. Also used for the Discover ID NAK, and Discover ID Busy messages.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Discover ID Initiator message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.2.5#2, 6.4.4.3.1#5 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1 [PROT_MSG_DATA_VDM_ID_INIT_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_ID_INIT_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B31:B16 are set to 0xFF00 (defining PD SID) [PROT_MSG_DATA_VDM_ID_INIT_3].
5. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_ID_INIT_4].

6. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_ID_INIT_5].
7. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_ID_INIT_6].
8. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_ID_INIT_7].
9. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B7:B6 (Command Type) is set to 00b (Initiator), 10b (NAK) or 11b (BUSY) [PROT_MSG_DATA_VDM_ID_INIT_8].
10. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_ID_INIT_9].
11. That, for the first VDO in a Discover ID Initiator, NAK or BUSY message, bits B4:B0 are set to 00001b (Discover Identity) [PROT_MSG_DATA_VDM_ID_INIT_10].

End of List of Checks

3.11.10 TDB.2.1.4.4.1.2: PROT-MSG-DATA-VDM-ID-ACK Discover ID ACK Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover ID ACK message is sent by the UUT.
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Discover ID ACK message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.3.1#5, 6.4.4.3.1#6, 6.4.4.3.1.1#2, 6.4.4.3.1.1#3, 6.4.4.3.1.1#4, 6.4.4.3.1.1#5, 6.4.4.3.1.4#1, 6.4.4.3.1.6#1, 6.4.4.3.1.7#1, 6.4.4.3.1.7#2, 6.4.4.3.1.8#1, 6.4.4.3.1.9#1, 6.4.4.3.1.9#2, 6.4.4.3.1.9#3, 6.4.4.3.1.10#1, 6.4.4.3.1.10#2, 6.4.4.3.1.10#3 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 4 or 5 [PROT_MSG_DATA_VDM_ID_ACK_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_ID_ACK_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover ID ACK message, bits B31:B16 are set to 0xFF00 (defining PD SID) [PROT_MSG_DATA_VDM_ID_ACK_3].
5. That, for the first VDO in a Discover ID ACK message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_ID_ACK_4].
6. That, for the first VDO in a Discover ID ACK message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_ID_ACK_5].

7. That, for the first VDO in a Discover ID ACK message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_ID_ACK_6].
8. That, for the first VDO in a Discover ID ACK message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_ID_ACK_7].
9. That, for the first VDO in a Discover ID ACK message, bits B7:B6 (Command Type) is set to 01b (ACK) [PROT_MSG_DATA_VDM_ID_ACK_8].
10. That, for the first VDO in a Discover ID ACK message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_ID_ACK_9].
11. That, for the first VDO in a Discover ID ACK message, bits B4:B0 are set to 00001b (Discover Identity) [PROT_MSG_DATA_VDM_ID_ACK_10].

VDO #2 (ID Header)

12. That, for the second VDO in a Discover ID ACK message, bit B31 (Data Capable as USB Host) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_11].
13. That, for the second VDO in a Discover ID ACK message, bit B30 (Data Capable as USB Device) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_12].
14. That, for the second VDO in a Discover ID ACK message, bits B29:B27 (Product Type) are set to the expected value based on the vendor supplied information, and not to a reserved value (110b or 111b) [PROT_MSG_DATA_VDM_ID_ACK_13].
15. That, for the second VDO in a Discover ID ACK message, bit B26 (Modal Operation supported) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_14].
16. That, for the second VDO in a Discover ID ACK message, bits B25:B16 (reserved) are set to 0000000000b [PROT_MSG_DATA_VDM_ID_ACK_15].
17. That, for the second VDO in a Discover ID ACK message, bits B15:B0 (Vendor ID) are set to the expected value based on the vendor supplied information. The value Vendor ID Unassigned (0000h) is permitted if the vendor does not have an assigned Vendor ID [PROT_MSG_DATA_VDM_ID_ACK_16].

VDO #3 (Cert Stat VDO)

18. That, for the third VDO in a Discover ID ACK message, bits B31:B0 (Test ID) are set to the XID allocated (in decimal) by USB-IF before certification [PROT_MSG_DATA_VDM_ID_ACK_18].

VDO #4 (Product VDO)

19. That, for the fourth VDO in a Discover ID ACK message, bits B31:B16 (USB Product ID) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_19].
20. That, for the fourth VDO in a Discover ID ACK message, bits B15:B0 (USB bcdDevice) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_20].

21. That if the Product Type in the ID Header is 'Undefined', 'Hub' or 'Peripheral', there are exactly 4 VDOs, and this is the end of this check list [PROT_MSG_DATA_VDM_ID_ACK_21].

22. That if the Product Type in the ID Header is 'Active Cable' or 'Passive Cable' the checks in 'VDO #5 (Cable VDO)' are satisfied. [PROT_MSG_DATA_VDM_ID_ACK_49]
23. That if the Product Type in the ID Header is 'Alternate Mode Adapter' the checks in 'VDO #5 (AMA VDO)' are satisfied. [PROT_MSG_DATA_VDM_ID_ACK_50]

VDO #5 (Cable VDO)

24. That, for the fifth VDO in a Discover ID ACK message, bits B31:B28 (HW Version) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_22].
25. That, for the fifth VDO in a Discover ID ACK message, bits B27:B24 (Firmware Version) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_23].
26. That, for the fifth VDO in a Discover ID ACK message, bits B23:B20 (reserved) are set to 0000b [PROT_MSG_DATA_VDM_ID_ACK_24].
27. That, for the fifth VDO in a Discover ID ACK message, bits B19:B18 (Type-C to Type-A/B/C) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_25].
28. That, for the fifth VDO in a Discover ID ACK message, bit B17 (Type-C to Plug/Receptacle) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_26].
29. That, for the fifth VDO in a Discover ID ACK message, bits B16:B13 (Cable Latency) are set to the expected value based on the vendor supplied information. Check that the value is not a reserved value (0000b, 1011b, 1100b, 1101b, 1110b or 1111b) [PROT_MSG_DATA_VDM_ID_ACK_27].
30. That, for the fifth VDO in a Discover ID ACK message, bits B12:B11 (Cable Termination type) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_28].
31. That, for the fifth VDO in a Discover ID ACK message, bits B10:B7 (Reserved) are set zero [PROT_MSG_DATA_VDM_ID_ACK_51].
32. That, for the fifth VDO in a Discover ID ACK message, bits B6:B5 (VBUS Current Handling Capability) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_33].
33. That, for the fifth VDO in a Discover ID ACK message from an Active Cable, bit B4 (VBUS through cable) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_34].
34. That, for the fifth VDO in a Discover ID ACK message from a Passive Cable, bit B4 (Reserved) is set to zero [PROT_MSG_DATA_VDM_ID_ACK_52].
35. That, for the fifth VDO in a Discover ID ACK message from an Active Cable, bit B3 (SOP” controller present) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_35].
36. That, for the fifth VDO in a Discover ID ACK message from a Passive Cable, bit B3 (Reserved) is set to zero [PROT_MSG_DATA_VDM_ID_ACK_53].

37. That, for the fifth VDO in a Discover ID ACK message, bits B2:B0 (USB Superspeed Signaling Support) are set to the expected value based on the vendor supplied information. Check that

the value is not a reserved value (011b, 100b, 101b, 110b or 111b) [PROT_MSG_DATA_VDM_ID_ACK_36].

38. That there are no following VDOs [PROT_MSG_DATA_VDM_ID_ACK_48].

VDO #5 (AMA VDO)

39. That, for the fifth VDO in a Discover ID ACK message, bits B31:B28 (HW Version) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_37].
40. That, for the fifth VDO in a Discover ID ACK message, bits B27:B24 (Firmware Version) are set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_38].
41. That, for the fifth VDO in a Discover ID ACK message, bits B23:B12 (reserved) are set to 000000000000b [PROT_MSG_DATA_VDM_ID_ACK_39].
42. That, for the fifth VDO in a Discover ID ACK message, bit B11:B8 (Reserved) is set to zero [PROT_MSG_DATA_VDM_ID_ACK_54].
43. That, for the fifth VDO in a Discover ID ACK message, bits B7:B5 (VCONN power) are set to the expected value based on the vendor supplied information. Check that the value is not a reserved value (111b) [PROT_MSG_DATA_VDM_ID_ACK_44].
44. That, for the fifth VDO in a Discover ID ACK message, bit B4 (VCONN required) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_45].
45. That, for the fifth VDO in a Discover ID ACK message, bit B3 (VBUS required) is set to the expected value based on the vendor supplied information [PROT_MSG_DATA_VDM_ID_ACK_46].
46. That, for the fifth VDO in a Discover ID ACK message, bits B2:B0 (USB Superspeed Signaling Support) are set to the expected value based on the vendor supplied information. Check that the value is not a reserved value (100b, 101b, 110b or 111b) [PROT_MSG_DATA_VDM_ID_ACK_47].
47. That there are no following VDOs [PROT_MSG_DATA_VDM_ID_ACK_48].

End of List of Checks

3.11.11 TDB.2.1.4.4.2.1: PROT-MSG-DATA-VDM-SVID-INIT Discover SVIDs Initiator Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover SVIDs Initiator message is sent by the UUT. Also used for the Discover SVIDs NAK, and Discover SVIDs Busy messages.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Discover SVIDs Initiator message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.2.5#2, 6.4.4.3.2#4 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1 [PROT_MSG_DATA_VDM_SVID_INIT_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_SVID_INIT_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B31:B16 are set to 0xFF00 (defining PD SID) [PROT_MSG_DATA_VDM_SVID_INIT_3].
5. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_SVID_INIT_4].

6. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_SVID_INIT_5].
7. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_SVID_INIT_6].
8. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_SVID_INIT_7].
9. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B7:B6 (Command Type) is set to 00b (Initiator), 10b (NAK) or 11b (BUSY) [PROT_MSG_DATA_VDM_SVID_INIT_8].
10. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_SVID_INIT_9].
11. That, for the first VDO in a Discover SVIDs Initiator, NAK or BUSY message, bits B4:B0 are set to 00010b (Discover SVIDs) [PROT_MSG_DATA_VDM_SVID_INIT_10].

End of List of Checks

3.11.12 TDB.2.1.4.4.2.2: PROT-MSG-DATA-VDM-SVID-ACK Discover SVIDs ACK Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover SVIDs ACK message is sent by the UUT.
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.3.2#4 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is at least 2 [PROT_MSG_DATA_VDM_SVID_ACK_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_SVID_ACK_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover SVIDs ACK message, bits B31:B16 are set to 0xFF00 (defining PD SID) [PROT_MSG_DATA_VDM_SVID_ACK_3].
5. That, for the first VDO in a Discover SVIDs ACK message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_SVID_ACK_4].
6. That, for the first VDO in a Discover SVIDs ACK message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_SVID_ACK_5].
7. That, for the first VDO in a Discover SVIDs ACK message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_SVID_ACK_6].

8. That, for the first VDO in a Discover SVIDs ACK message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_SVID_ACK_7].
9. That, for the first VDO in a Discover SVIDs ACK message, bits B7:B6 (Command Type) is set to 01b (ACK) [PROT_MSG_DATA_VDM_SVID_ACK_8].
10. That, for the first VDO in a Discover SVIDs ACK message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_SVID_ACK_9].
11. That, for the first VDO in a Discover SVIDs ACK message, bits B4:B0 are set to 00010b (Discover SVIDs) [PROT_MSG_DATA_VDM_SVID_ACK_10].

Each following VDO (Discover SVIDs Responder VDO)

12. That, for this VDO in a Discover SVIDs ACK message, bits B31:B16 (SVID n) are set to the expected value based on the vendor supplied information. This means either a valid SID or VID, or the value zero. If zero, this marks the end of the list; in this case check that the next value is zero [PROT_MSG_DATA_VDM_SVID_ACK_11].
13. Check that the first Discover SVIDs ACK VDO, in the first Discover SVIDs ACK message received, contains at least one (non-zero) SVID [PROT_MSG_DATA_VDM_SVID_ACK_12].
14. That, for this VDO in a Discover SVIDs ACK message, bits B15:B0 (SVID n+1) are set to the expected value based on the vendor supplied information. This means either a valid SID or VID, or the value zero. If zero, this marks the end of the list; in this case check that no further VDOs are present [PROT_MSG_DATA_VDM_SVID_ACK_13].

End of List of Checks

3.11.13 TDB.2.1.4.4.3.1: PROT-MSG-DATA-VDM-MODE-INIT Discover Modes Initiator Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover Modes Initiator message is sent by the UUT. Also used for the Discover Modes NAK, and Discover Modes Busy messages.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section. The correct formatting of the Discover Modes Initiator, NAK or Busy message is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.2.5#2 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1 [PROT_MSG_DATA_VDM_MODE_INIT_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_MODE_INIT_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B31:B16 are set to 0xFF00 (defining PD SID) [PROT_MSG_DATA_VDM_MODE_INIT_3].
5. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_MODE_INIT_4].

6. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_MODE_INIT_5].
7. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_MODE_INIT_6].
8. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_MODE_INIT_7].
9. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B7:B6 (Command Type) is set to 00b (Initiator), 10b (NAK) or 11b (BUSY) [PROT_MSG_DATA_VDM_MODE_INIT_8].
10. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_MODE_INIT_9].
11. That, for the first VDO in a Discover Modes Initiator, NAK or BUSY message, bits B4:B0 are set to 00011b (Discover Modes) [PROT_MSG_DATA_VDM_MODE_INIT_10].

End of List of Checks

3.11.14 TDB.2.1.4.4.3.2: PROT-MSG-DATA-VDM-MODE-ACK Discover Modes ACK Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Discover Modes ACK message is sent by the UUT.
Critical for Safety	
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2#10, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.3.3#1 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is at least 2 [PROT_MSG_DATA_VDM_MODE_ACK_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_MODE_ACK_2].

VDO #1 (VDM Header)

4. That, for the first VDO in a Discover Modes ACK message, bits B31:B16 are set to the SVID specified in the preceding Discover Modes initiator message [PROT_MSG_DATA_VDM_MODE_ACK_3].
5. That, for the first VDO in a Discover Modes ACK message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_MODE_ACK_4].
6. That, for the first VDO in a Discover Modes ACK message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_MODE_ACK_5].

7. That, for the first VDO in a Discover Modes ACK message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_MODE_ACK_6].
8. That, for the first VDO in a Discover Modes ACK message, bits B10:B8 (Object Position) are set to 000b [PROT_MSG_DATA_VDM_MODE_ACK_7].
9. That, for the first VDO in a Discover Modes ACK message, bits B7:B6 (Command Type) is set to 01b (ACK) [PROT_MSG_DATA_VDM_MODE_ACK_8].
10. That, for the first VDO in a Discover Modes ACK message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_MODE_ACK_9].
11. That, for the first VDO in a Discover Modes ACK message, bits B4:B0 are set to 00011b (Discover Modes) [PROT_MSG_DATA_VDM_MODE_ACK_10].

Each following VDO (Discover Modes Responder VDO)

12. The content of the Discover Modes Responder VDO is currently not checked.
    End of List of Checks

3.11.15 TDB.2.1.4.4.4: PROT-MSG-DATA-VDM-ENTER-MODE Enter Mode Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Enter Mode message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer or Cable
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.2.5#2, 6.4.4.3.4#1, 6.4.4.3.4#4 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1. [PROT_MSG_DATA_VDM_ENTER_MODE_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_ENTER_MODE_2].

VDO #1 (VDM Header)

4. That, for the first VDO in an Enter Mode message, bits B31:B16 are set to an SVID specified in a preceding Discover SVIDs ACK message and, if the current message is not an initiator, that the SVID matches the one specified in the corresponding previous initiator [PROT_MSG_DATA_VDM_ENTER_MODE_3].
5. That, for the first VDO in an Enter Mode message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_ENTER_MODE_4].
6. That, for the first VDO in an Enter Mode message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_ENTER_MODE_5].

7. That, for the first VDO in an Enter Mode message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_ENTER_MODE_6].
8. That, for the first VDO in a Enter Mode message, bits B10:B8 (Object Position) are set to an Object Position specified in a preceding Discover Modes ACK message and, if the current message is not an initiator, that the Object Position matches the one specified in the corresponding previous initiator [PROT_MSG_DATA_VDM_ENTER_MODE_7].
9. That, for the first VDO in an Enter Mode message, bits B7:B6 (Command Type) is set to 00b (Initiator), 01b (ACK) or 10b (NAK) [PROT_MSG_DATA_VDM_ENTER_MODE_8].
10. That, for the first VDO in an Enter Mode message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_ENTER_MODE_9].
11. That, for the first VDO in an Enter Mode message, bits B4:B0 are set to 00100b (Enter Mode) [PROT_MSG_DATA_VDM_ENTER_MODE_10].

Following VDOs

12. Check that there are no further VDOs [PROT_MSG_DATA_VDM_ENTER_MODE_11].

End of List of Checks

3.11.16 TDB.2.1.4.4.5: PROT-MSG-DATA-VDM-EXIT-MODE Exit Mode Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Exit Mode message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer or Cable
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#8, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.4#5, 6.4.4.2.5#1, 6.4.4.2.5#2, 6.4.4.3.5#1, 6.4.4.3.5#3 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1. [PROT_MSG_DATA_VDM_EXIT_MODE_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_EXIT_MODE_2].

VDO #1 (VDM Header)

4. That, for the first VDO in an Exit Mode ACK message, bits B31:B16 are set to the SVID specified in the preceding Exit Mode initiator message [PROT_MSG_DATA_VDM_EXIT_MODE_3].
5. That, for the first VDO in an Exit Mode ACK message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_EXIT_MODE_4].
6. That, for the first VDO in an Exit Mode ACK message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_EXIT_MODE_5].
7. That, for the first VDO in an Exit Mode ACK message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_EXIT_MODE_6].

8. That, for the first VDO in an Exit Mode ACK message, bits B10:B8 (Object Position) are set to the value specified in the preceding EXIT Mode initiator message [PROT_MSG_DATA_VDM_EXIT_MODE_7].
9. That, for the first VDO in an EXIT Mode ACK message, bits B7:B6 (Command Type) is set to 00b (Initiator) or 01b (ACK) [PROT_MSG_DATA_VDM_EXIT_MODE_8].
10. That, for the first VDO in an EXIT Mode ACK message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_EXIT_MODE_9].
11. That, for the first VDO in an EXIT Mode ACK message, bits B4:B0 are set to 00100b (Exit Mode) [PROT_MSG_DATA_VDM_EXIT_MODE_10].

Following VDOs

12. Check that there are no further VDOs [PROT_MSG_DATA_VDM_EXIT_MODE_11].

End of List of Checks

3.11.17 TDB.2.1.4.4.6: PROT-MSG-DATA-VDM-ATT Attention Message Checks

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Attention message is sent by the UUT.
Critical for Safety	
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider, Consumer
Description	This section is a list of specific checks to be made in the course of any other test in this document which refers to this section.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.2.1.2#1, 6.2.1.8#1, 6.4.4#7, 6.4.4.2#2, 6.4.4.2#8, 6.4.4.2.1#1, 6.4.4.2.3#1, 6.4.4.2.5#1, 6.4.4.2.5#2, 6.4.4.3.6#1, 6.4.4.3.6#3 plus assertions in checks: PROT-HDR
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, ensure that the following checks are carried out:

1. All the Message Header Checks detailed in PROT-HDR.
2. That the Number of Data Objects represented by the value in bits 14:12 is 1 [PROT_MSG_DATA_VDM_ATT_1].
3. That the MessageType represented by the value in bits 3:0 of the Message Header is 1111b [PROT_MSG_DATA_VDM_ATT_2].
4. That this message was not sent by a Cable Marker, and was not sent using SOP' or SOP'' [PROT_MSG_DATA_VDM_ATT_12].

VDO #1 (VDM Header)

5. That, for the first VDO in an Attention message, bits B31:B16 are set to the SVID specified in the preceding Enter Mode initiator message [PROT_MSG_DATA_VDM_ATT_3].
6. That, for the first VDO in an Attention message, bit B15 is 1b (defining a structured VDM) [PROT_MSG_DATA_VDM_ATT_4].
7. That, for the first VDO in an Attention message, bits B14:B13 (Structured VDM Version) are 00b (representing Structured VDM V1.0) [PROT_MSG_DATA_VDM_ATT_5].

8. That, for the first VDO in an Attention message, bits B12:B11 (reserved) are set to 00b [PROT_MSG_DATA_VDM_ATT_6].
9. That, for the first VDO in an Attention message, bits B10:B8 (Object Position) are set to the value specified in the preceding Enter Mode initiator message [PROT_MSG_DATA_VDM_ATT_7].
10. That, for the first VDO in an Attention message, bits B7:B6 (Command Type) is set to 00b (Initiator - no other value is allowed) [PROT_MSG_DATA_VDM_ATT_8].
11. That, for the first VDO in an Attention message, bit B5 (reserved) is set to 0b [PROT_MSG_DATA_VDM_ATT_9].
12. That, for the first VDO in an Attention message, bits B4:B0 are set to 00100b (Exit Mode) [PROT_MSG_DATA_VDM_ATT_10].

Following VDOs

13. Check that there are no further VDOs [PROT_MSG_DATA_VDM_ATT_11].

End of List of Checks

3.11.18 TDB.2.2.1.1: PROT-PROC-AMS Procedure and Checks for any Atomic Message Sequence

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which a message is sent in response to another message as part of an Atomic Message Sequence.
Critical for Safety	No
Applies to	Any
Description	The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	-
Assertions Tested	6.5.2#5 Plus assertions in checks: PROT-MSG-CTRL
Parameters Tested	-
Checklist References	

Test Procedure

During any test in which a message from the UUT is in response to a message from the Tester as part of an Atomic Message Sequence:

1. Check that the time from the last bit of the message sent by the Tester until the start of the response does not exceed 15ms (except in cases where another criterion is specified e.g. power transition timings). [PROT_PROC_AMS_1]

3.11.19 TDB.2.2.2.1: PROT-PROC-GOODCRC-TSTR Procedure and Checks for GoodCRC sent by Tester

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which a GoodCRC is sent by the Tester in response to any other message.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Consumer , Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated GoodCRC message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	-
Assertions Tested	assertions in checks: PROT-MSG-CTRL
Parameters Tested	-
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. Send a GoodCRC message, alternately starting the preamble after tInterframeGap min (25µs) and tTransmit max (195 µs) of the last bit of the previously received message.

3.11.20 TDB.2.2.2.1: PROT-PROC-GOODCRC-UUT Procedure and Checks for GoodCRC sent by UUT

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which a GoodCRC is sent by the UUT in response to any other message.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Consumer , Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a UUT originated GoodCRC message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.1#3, 6.5.1#6, 6.5.1#7 plus assertions in checks: PROT-MSG-CTRL
Parameters Tested	tBusIdle, tTransmit
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. Check that the first bit of the preamble of a GoodCRC is received after tInterframeGap min (25µs) to tTransmit max (195 µs) of the last bit of the previously sent message. [PROT_PROC_GOODCRC_UUT_1]
2. Check that this GoodCRC message meets the requirements of PROT-MSG-CTRL. [PROT_PROC_GOODCRC_UUT_2]

3.11.21 TDB.2.2.3.1.1: PROT-PROC-SWAP-TSTR-SNK Procedure/Checks for Tester (Sink) Originated Swap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Swap message is sent by the Tester acting as a Sink.
Critical for Safety	No
Applies to	DRP, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Swap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.3#2, 6.3.3#6, 6.3.6#1, 6.3.10#1, 6.3.10#2, 6.5.2#5, 6.5.3.1#1, 6.5.3.1#2, 6.5.3.1#3, 6.5.6.2#2, 7.1.11#1, 7.1.11#2, 7.1.11#3, 7.2.4#2, 7.2.4#4, 7.3.9#1, 7.3.9#2, 7.3.9#3, 7.3.9#4, 7.3.9#6 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tReceiverResponse, tTypeCSinkWaitCap, tSourceActivity,
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

Checks for Sink Requested Swap - UUT starts as Source

1. Send a Swap message to the UUT (Source).
2. Check that an Accept message is received from UUT within tReceiverResponse max (15ms) of the last bit of the Request message. [PROT_PROC_SWAP_TSTR_SNK_1]
3. Check that this Accept message meets the requirements of PROT-MSG-CTRL.

4. Ensure that we are drawing no more than iSwapStandby within tSrcTransition min (25ms) after we sent the last GoodCRC.
5. Check that the UUT reduces its VBUS voltage to vSafe0V max (0.8V) within tSrcTransition max (35ms) plus tSrcSwapStdby max (650ms) after the last bit of GoodCRC was sent in response to the received Accept. [PROT_PROC_SWAP_TSTR_SNK_3] We do not check that the UUT stops driving VBUS.
6. The UUT may sends Ping(s) if it is attempting to meet the timing tSourceActivity (40ms to 50ms). However this is optional, so not checked.
7. Check that we receive a PS_RDY message after VBUS reaches vSafe0V, and by no later than tSrcTransition max (35ms) plus tSrcSwapStdby max (650ms) after the last bit of GoodCRC was sent in response to the received Accept. [PROT_PROC_SWAP_TSTR_SNK_5]
8. Check that this PS_RDY message meets the requirements of PROT-MSG-CTRL.

9. If the Tester Ping Policy is currently to send Pings, from now on send Ping messages if required to meet the timing tSourceActivity (40ms to 50ms). If the Ping Policy for the test is not to send Pings, then do not send Pings.
10. Turn on VBUS drive and take it to vSafe5V completing the transition before sending PS_RDY, both within tNewSRC max (275ms) of the GoodCRC we sent in response to the PS_RDY from the UUT.
11. If we are in a 'PSSourceOnTimer Test', then go to PROT-PROC-PSSOURCEONTIMER or PROT-PROC-PSSOURCEONTIMER-SWPD as appropriate, and complete test there.
12. Send this PS_RDY.
13. Wait 300ms from the time when VBUS rose above vSafe0V (so just under tTypeCSinkWaitCap min) and then send Source Capabilities. This is deliberate 'out of spec' behavior to test the tTypeCSinkWaitCap parameter.
14. Check that we receive a Request and that the UUT draws no more than pSnkSusp max/5 (25/5 = 5mA) until we Accept the Request. [PROT_PROC_SWAP_TSTR_SNK_6]
15. Continue using procedure PROT-PROC-REQ-UUT.

3.11.22 TDB.2.2.3.1.2: PROT-PROC-SWAP-TSTR-SRC Procedure/Checks for Tester (Source) Originated Swap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Swap message is sent by the Tester acting as a Source.
Critical for Safety	No
Applies to	DRP, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Swap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.3#2, 6.3.3#6, 6.3.6#1, 6.3.10#1, 6.3.10#2, 6.5.3.1#1, 6.5.3.1#2, 6.5.3.1#3, 6.5.6.3#1, 6.5.9.2#1, 7.1.2#4, 7.1.11#1, 7.1.11#2, 7.1.11#3, 7.1.11#4, 7.2.2#5, 7.2.7#1, 7.2.7#2, 7.2.7#3, 7.2.7#4 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tTypeCSinkWaitCap, tSourceActivity
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

Checks for Source Requested Swap - UUT starts as Sink

1. Send a Swap message to the UUT (Sink).
2. Check that an Accept message is received from UUT within tReceiverResponse max (15ms) of the last bit of the Request message. [PROT_PROC_SWAP_TSTR_SRC_1]
3. Check this message (PROT-MSG-CTRL).
4. If the Tester Ping Policy is currently to send Pings, from now on send Ping messages if required to meet the timing tSourceActivity (40ms to 50ms). If the Ping Policy for the test is not to send Pings, then do not send Pings.

5. Check that UUT is not drawing more than iSwapStandby after a time tSourceTransition min (25ms) after the last bit of GoodCRC is sent in response to the Accept we received. [PROT_PROC_SWAP_TSTR_SRC_2]
6. Starting at tSinkTransition max (35ms) after the last bit of GoodCRC was sent in response to the Accept we received, reduce the VBUS voltage to less than vSafe0V max (0.8V) within tSrcSwapStdby max (650ms) and stop driving VBUS.
7. If we are in a 'PSSourceOffTimer Test', then go to PROT-PROC-PSSOURCEOFFTIMER or PROT-PROC-PSSOURCEOFFTIMER-SWPD as appropriate, and complete test there.
8. Send PS_RDY immediately following this tSrcSwapStdby period.
9. Check that the UUT takes VBUS to vSafe5V (4.75V to 5.5V) and only once it is in this range that it sends PS_RDY [PROT_PROC_SWAP_TSTR_SRC_4]
10. Check this message (PROT-MSG-CTRL).
11. Check that this PS_RDY was started within tNewSrc max (275ms) of the GoodCRC we sent in response to the PS_RDY from the UUT [PROT_PROC_SWAP_TSTR_SRC_6]
12. Check that the UUT sends a Source Capabilities message within tFirstSourceCap max (250ms). [PROT_PROC_SWAP_TSTR_SRC_7]

3.11.23 TDB.2.2.3.2.1: PROT-PROC-SWAP-UUT-SNK Procedure/Checks for UUT (Sink) Originated Swap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Swap message is sent by the UUT acting as a Sink.
Critical for Safety	No
Applies to	DRP, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Swap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.6#1, 6.5.3.1#1, 6.5.3.1#2, 6.5.3.1#3, 7.1.2#4, 7.1.11#1, 7.1.11#2, 7.1.11#3, 7.1.11#4, 7.1.11#5, 7.2.2#5, 7.2.7#1, 7.2.7#2, 7.2.7#3, 7.2.7#4, 7.2.7#5, 7.3.9#1, 7.3.9#2, 7.3.9#3, 7.3.9#4, 7.3.9#6 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tSinkWaitCap, tSourceActivity
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

Checks for Sink Requested Swap - UUT starts as Sink

1. The Tester receives a PR_Swap message from the UUT. Check that the details of this message are valid, and as expected (PROT-MSG-CTRL).
2. Send an Accept message after slightly less than tSenderResponse min (24-1=23ms) from the last bit of the GoodCRC message sent (this is out of spec, in order to test the parameter tSenderResponse, but should not cause misoperation). [PROT_PROC_SWAP_UUT_SNK_1]

3. If the Tester Ping Policy is currently to send Pings, from now on send Ping messages if required to meet the timing tSourceActivity (40ms to 50ms). If the Ping Policy for the test is not to send Pings, then do not send Pings.
4. Check that UUT is not drawing more than iSnkSwapStdby after a time tSrcTransition max (35ms) after the last bit of GoodCRC is received in response to the Accept we sent. [PROT_PROC_SWAP_UUT_SNK_3]
5. Starting at tSrcTransition max (35ms) after the last bit of GoodCRC is received in response to the Accept we sent, reduce the VBUS voltage to less than vSafe0V max (0.8V) within tSrcSwapStdby max (650ms) and stop driving VBUS [PROT_PROC_SWAP_UUT_SNK_4]
6. If we are in a 'PSSourceOffTimer Test', then go to PROT-PROC-PSSOURCEOFFTIMER or PROT-PROC-PSSOURCEOFFTIMER-SWPD as appropriate, and complete test there.
7. Send PS_RDY immediately following this tSrcSwapStdby period. [PROT_PROC_SWAP_UUT_SNK_5]
8. Check that the UUT takes VBUS to vSafe5V (4.75V to 5.50V) and only once it is in this range that it sends PS_RDY [PROT_PROC_SWAP_UUT_SNK_6]
9. Check that this PS_RDY was finished within tPSSourceOn max (480ms) of the GoodCRC we sent in response to the PS_RDY from the UUT [PROT_PROC_SWAP_UUT_SNK_8]
10. Check this PS_RDY message (PROT-MSG-CTRL)
11. Check that the UUT sends a Source Capabilities message within tFirstSourceCap max (250ms). [PROT_PROC_SWAP_UUT_SNK_9]

3.11.24 TDB.2.2.3.2.2: PROT-PROC-SWAP-UUT-SRC Procedure/Checks for UUT (Source) Originated Swap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Swap message is sent by the UUT acting as a Source.
Critical for Safety	No
Applies to	DRP, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Swap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.6#1, 6.5.3.1#1, 6.5.3.1#2, 6.5.3.1#3, 7.1.11#1, 7.3.10#4, 7.3.10#6, 7.3.10#7plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tTypeCSinkWaitCap, tSourceActivity
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

Checks for Source Requested Swap - UUT starts as Source

1. The Tester receives a Swap message from the UUT. Check that the details of this message are valid, and as expected (PROT-MSG-CTRL).
2. Send an Accept message after slightly less than tSenderResponse min (24-1=23ms) from the last bit of the GoodCRC message sent (this is out of spec, in order to test the parameter tSenderResponse, but should not cause misoperation).

3. Ensure that we are drawing no more than iSwapStandby within tSrcTransition max (35ms) after we sent the last GoodCRC.
4. Check that the UUT reduces its VBUS voltage to vSafe0V max (0.8V) within tSrcTransition max (35ms) plus tSrcSwapStdby max (650ms) after the last bit of GoodCRC was sent in response to the received Accept. We do not check that the UUT stops driving VBUS. [PROT_PROC_SWAP_UUT_SRC_1]
5. Check that we receive a PS_RDY message after VBUS reaches vSafe0V and by no later than tPSSourceOff max (920ms) after the last bit of GoodCRC was sent in response to the received Accept. [PROT_PROC_SWAP_UUT_SRC_2]
6. Check this message (PROT-MSG-CTRL).
7. If the Tester Ping Policy is currently to send Pings, from now on send Ping messages if required to meet the timing tSourceActivity (40ms to 50ms). If the Ping Policy for the test is not to send Pings, then do not send Pings.
8. Turn on VBUS drive and take it to vSafe5V, with a rise time within tNewSRC max (275ms), and completing the transition in time to send PS_RDY timed to arrive at just under tPSSourceOn max (480ms) of the GoodCRC we sent in response to the PS_RDY from the UUT. [PROT_PROC_SWAP_UUT_SRC_3]
9. If we are in a 'PSSourceOnTimer Test', then go to PROT-PROC-PSSOURCEONTIMER or PROT-PROC-PSSOURCEONTIMER-SWPD as appropriate, and complete test there.
10. Send this PS_RDY
11. Wait just under tTypeCSinkWaitCap min (310ms - 10ms = 300ms) and then send Source Capabilities. This is deliberate 'out of spec' behavior to test the tTypeCSinkWaitCap parameter.
12. Check that we receive a Request and that the UUT draws no more than pSnkSusp max/5 (25/5 = 5mA) until we Accept the Request. [PROT_PROC_SWAP_UUT_SRC_4]

3.11.25 TDB.2.2.4: PROT-PROC-PSSOURCEOFFTIMER Procedures to test PSSourceOffTimer

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the PSSourceOffTimer test, as an alternative to completing the appropriate Swap test.
Critical for Safety	No
Applies to	DRP, Provider /Consumer, Consumer/Provider
Description	This section describes the procedure to test PSSourceOffTimer. The main element is the failure to send the first PS_RDY when expected by the UUT. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.5.6.2#1, 6.5.6.2#2, 6.5.6.2#3, 6.5.6.2#4, 7.1.1#4 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	vSafe0V, tPSSourceOff, tSwapRecover
Checklist References	

Test Procedure for Not Sending First PS_RDY

During any test which refers to this section, follow this procedure:

Note: We are testing PSSourceOffTimer by failing to send PS_RDY, so we were the Source and have just turned off VBUS.

1. Do not send this (1st) PS_RDY (also stop sending Pings if we were sending them). Maintain Rp at 4k7 to 3.3V.
2. Check that within tPSSourceOff max (920ms) of the last bit of the EOP that we sent in response to receiving the Accept from the UUT, the UUT transitions to Error Recovery. [PROT_PROC_PSSOURCEOFFTIMER_1]
3. The test which contains this sequence ends at this point, by simulating a tester end cable detach.

3.11.26 TDB.2.2.5: PROT-PROC-PSSOURCEONTIMER Procedures to test PSSourceOnTimer

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the PSSourceOnTimer test, as an alternative to completing the appropriate Swap test.
Critical for Safety	No
Applies to	DRP, Provider /Consumer, Consumer/Provider
Description	This section describes the procedure to test PSSourceOnTimer. The main element is the failure to send the second PS_RDY when expected by the UUT. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.5.6.3#1, 6.5.6.3#2, 6.5.9.1#1, 7.1.1#4 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	vSafe0V, vSafe5V, tPSSourceOn, tSwapRecover
Checklist References	

Test Procedure for Not Sending Second PS_RDY

During any test which refers to this section, follow this procedure:

Note: We are testing PSSourceOnTimer by failing to send PS_RDY, so we have become Source, connected Rp and just turned on vSafe5V; UUT has connected Rd.

1. Do not send this (2nd) PS_RDY (also do not send any Pings).
2. Check that within tPSSourceOn max (480ms) of receiving the PS_RDY from the UUT, the UUT transitions to Error Recovery. [PROT_PROC_PSSOURCEONTIMER_1]
3. The test which contains this sequence ends at this point, by simulating a tester end cable detach.

3.11.27 TDB.2.2.6: PROT-PROC-PING
Procedures to test Pings sent by Tester

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To check that the timing of any Ping sent by the UUT is appropriate.
Critical for Safety	No
Applies to	DRP, Consumer/Provider, Provider/Consumer, Provider, Consumer
Description	This section describes the procedure to test Pings sent by a UUT The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.5.3.1#2, 6.3.5.1#1, 6.2.1.4#2plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	
Checklist References	

Test Procedure

Assumption is that a Ping has been received from the UUT

1. Check that the UUT is acting as a Source at the time. [PROT_PROC_PING_1]
2. Check that at least tSourceActivity min (40ms) has elapsed since the previous message on the bus, and that no more than tSourceActivity min (50ms) has elapsed since the previous message on the bus. [PROT_PROC_PING_2]

3.11.28 TDB.2.2.7.1: PROT-PROC-REQ-TSTR Procedure and Checks for Tester Originated Request

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Request message is sent by the Tester.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Request message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.3#1, 6.3.3#6, 6.3.4#1, 6.3.6#1, 6.5.2#5, 6.5.3.1#1, 6.5.3.1#2, 6.5.3.1#3, 6.5.6.1#2, 7.1.4#4, 7.1.4#5, 7.1.5#2, 7.1.5#4, 7.3.2#2, 7.3.2#3, 7.3.6#3plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tReceiverResponse , tSourceActivity, tPSTransition
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure. If this is a test requiring VBUS voltage transition measurement, perform the appropriate measurements specified below at the same time:

1. Send a Request for the Power Data Object in question at a specified power not exceeding that offered.
2. Check that an Accept message is received from UUT within tReceiverResponse max (15ms) of the last bit of the Request message. [PROT_PROC_REQ_TSTR_1].

3. If Reject or Wait is received from the UUT instead of the Accept, check that it is received within tReceiverResponse max (15ms) of the last bit of the Request message. Retry the Request from step 1, three times and then abandon the test as a failure. [PROT_PROC_REQ_TSTR_2]
4. • If the transition involves a current decrease, decrease it to the new value within tSinkTransition min (20ms) of the last bit of the GoodCRC we sent in response to the Accept message we received.

   • If the transition involves a voltage change, decrease the current drawn by the Tester to less than pSnkStdby/VBUS mA within tSinkTransition min (20ms) of the last bit of the GoodCRC we sent in response to the Accept message we received.
5. Check that the last bit of a PS_RDY message is received from UUT by tPSTransition min (450ms) from the receipt of the last bit of the Accept message. [PROT_PROC_REQ_TSTR_3]

Voltage Measurement Checks for a Rise in Voltage

Check:

1. that from the end of the GoodCRC we sent in response to the Accept till the voltage leaves its initially valid range was not less than tSrcTransition min (25ms). [PROT_PROC_REQ_TSTR_4]
2. that the voltage was within its target range of nominal voltage ±5%, by tSrcSettlePos from time voltage started to rise, and remained in range for the next 80ms from that time. [PROT_PROC_REQ_TSTR_5]
3. that the slew rate was not greater than 30mV/µs. [PROT_PROC_REQ_TSTR_6]
4. that VBUS does not exceed nominal + 10% of the target voltage during the tSrcSettlePos period from time voltage started to rise. [PROT_PROC_REQ_TSTR_7]
5. that once VBUS has crossed nominal - 20% of the target voltage, it does not fall below this value again during the tSrcSettlePos period from time voltage started to rise. [PROT_PROC_REQ_TSTR_8]
6. that PS_RDY was not received from the UUT before the voltage was within its target range. [PROT_PROC_REQ_TSTR_9]
7. that the last bit of a PS_RDY message is received from UUT by tPSTransition min (450ms) from the end of the Accept message. [PROT_PROC_REQ_TSTR_10]

Voltage Measurement Checks for a Fall in Voltage

Check:

1. that from the end of the GoodCRC we sent in response to the Accept till the voltage leaves its initially valid range was not less than tSrcTransition min (25ms). [PROT_PROC_REQ_TSTR_11]
2. that the voltage was within its target range of nominal voltage ±5%, by tSrcSettleNeg from time voltage started to fall, and remained in range for the next 80ms from that time. [PROT_PROC_REQ_TSTR_12]
3. that the slew rate was not greater than 30mV/µs. [PROT_PROC_REQ_TSTR_13]
4. that VBUS does not go lower than nominal - 10% of the target voltage during the tSrcSettlePos period from time voltage started to fall. [PROT_PROC_REQ_TSTR_14]

5. that once VBUS has crossed nominal +20% of the target voltage, it does not rise above this value again during the tSrcSettlePos period from time voltage started to fall. [PROT_PROC_REQ_TSTR_15]
6. that PS_RDY was not received from the UUT before the voltage was within its target range. [PROT_PROC_REQ_TSTR_16]
7. that the last bit of a PS_RDY message is received from UUT by tPSTransition min (450ms) from the end of the Accept message. [PROT_PROC_REQ_TSTR_17]

3.11.29 TDB.2.2.7.2: PROT-PROC-REQ-UUT Procedure and Checks for UUT Originated Request

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Request message is sent by the UUT.
Critical for Safety	No
Applies to	DRP, Consumer, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a UUT originated Request message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.4.1#5, 6.4.1.2#7, 6.4.2#1, 6.5.3.1#2, 6.5.3.1#3, 7.2.3#2, 7.3.2#4, 7.3.3#4, 7.3.4#4, 7.3.5#4, 7.3.6#5, 7.3.7#4 plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	tSourceActivity,
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. Check that a Request message is sent by the UUT. Check that the details of this Request are valid, and as expected. [PROT_PROC_REQ_UUT_1]
2. Send an Accept message after slightly less than ~~tSenderResponse min (24-1=23ms)~~ (this is out of spec, in order to test the parameter tSenderResponse, but should not cause misoperation) tReceiverResponse min (15-1=14ms) from the last bit of the GoodCRC message sent.

For voltage change (with or without current change)

3. After a total of tSrcTransition min (25 ms), check that current drawn by the UUT does not exceed pSnkStdby max / VBUS (150 mW / VBUS) mA. [PROT_PROC_REQ_UUT_2]
4. Wait a nominal tSrcTransition (30 ms) 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 (35ms) plus tSrcReady max (285ms) as appropriate (total 315ms).
5. As soon as the voltage on VBUS has stopped changing, check that current drawn by the UUT does not exceed pSnkStdby max / VBUS (150 mW / VBUS) mA. [PROT_PROC_REQ_UUT_3]
6. The Protocol Tester sends a PS_RDY message to the UUT, and checks for receipt of a GoodCRC message. [PROT_PROC_REQ_UUT_4]
7. The Protocol Tester checks that the current drawn by the UUT is not in excess of the level specified in the current PDO over the next 5 seconds. [PROT_PROC_REQ_UUT_5]
8. Over the same 5 seconds, if the test in question requires it, the Tester sends a Ping message every tSourceActivity max (50ms) and checks for receipt of a GoodCRC message. [PROT_PROC_REQ_UUT_6]

For current change only

3. Wait a nominal tSrcTransition (30 ms) from the GoodCRC message, and then be prepared to supply more or less current as appropriate, within tSrcTransition max (35ms) plus tSrcReady max (285ms) (total 315ms).
4. After this 315ms, check that the current drawn from VBUS does not exceed the previously contracted current [PROT_PROC_REQ_UUT_7]
5. The Protocol Tester sends a PS_RDY message to the UUT, and checks for receipt of a GoodCRC message. [PROT_PROC_REQ_UUT_8]
6. The Protocol Tester checks that the current drawn by the UUT is not in excess of the level specified in the current PDO over the next 5 seconds. [PROT_PROC_REQ_UUT_9]
7. Over the same 5 seconds, if the test in question requires it, the Tester sends a Ping message every tSourceActivity max (50ms) and checks for receipt of a GoodCRC message. [PROT_PROC_REQ_UUT_10]

3.11.30 TDB.2.2.8.1: PROT-PROC-SRCCAPS-TSTR Procedure and Checks for Tester Originated Source Capabilities

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Source Capabilities message is sent by the Tester. The assumption is that this has occurred while the Tester is acting as a Source.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated Source Capabilities message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a Source Capabilities message containing the pre-determined information required.
2. If the UUT is acting as a Sink, now continue to the procedure PROT-PROC-REQ-UUT, ensuring that the Request message is received by the Tester within tReceiverResponse max (15ms), from the last bit of the GoodCRC message.

3.11.31 TDB.2.2.8.2: PROT-PROC-SRCCAPS-UUT Procedure and Checks for UUT Originated Source Capabilities

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Source Capabilities message is sent by the UUT. The assumption is that this has occurred while the Tester is acting as a Sink.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer or Consumer/Provider
Description	This section describes the procedure which starts with a Tester originated Source Capabilities message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.4.1#1, 6.4.1#2, 6.4.1#3, 6.4.1.2#1, 6.4.1.2#2, 6.4.1.2#3, plus assertions in checks: PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-CTRL
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester receives a Source Capabilities message.

2. If the UUT is acting as a Source, now continue to the procedure PROT-PROC-REQ-TSTR, sending the Request message ~~tSenderResponse max (30ms)~~ tReceiverResponse max (15ms) from the last bit of the GoodCRC message received.

3.11.32 TDB.2.2.9.1: PROT-PROC-GETSRCCAPS-TSTR Procedure and Checks for Tester Originated Get_Source_Cap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Get_Source_Cap message is sent by the Tester.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated Get_Source_Cap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.7#1, 6.3.7#2 plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SRC-CAP
Parameters Tested	tBusIdle, tTransmit, tSenderResponse tReceiverResponse
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a Get_Source_Cap message to the UUT.
2. Check that for a Provider, Provider/Consumer, or Consumer/Provider UUT, a Source Capabilities message is received by the Tester within tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_GETSRCCAPS_TSTR_1]
3. Check that this message meets all the requirements detailed in PROT-MSG-DATA-SRC-CAP. [PROT_PROC_GETSRCCAPS_TSTR_2]

4. Check that for a Consumer UUT, a Reject message is received by the Tester within tReceiverResponse max (15ms) from the last bit of the GoodCRC message. [PROT_PROC_GETSRCCAPS_TSTR_3]
5. Check that this message meets all the requirements detailed in PROT-MSG-CTRL. [PROT_PROC_GETSRCCAPS_TSTR_4]
6. If the Tester is acting as a Sink, now continue to the procedure PROT-PROC-REQ-TSTR, ensuring that the Request is sent within tReceiverResponse max (15ms), from the last bit of the GoodCRC message.

3.11.33 TDB.2.2.9.2: PROT-PROC-GETSRCCAPS-UUT Procedure and Checks for UUT Originated Get_Source_Cap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Get_Source_Cap message is sent by the UUT.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a UUT originated Get_Source_Cap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.8#1, 6.3.8#2plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SRC-CAP
Parameters Tested	tBusIdle, tTransmit, tSenderResponse
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester receives a Get_Source_Cap message from the UUT.
2. If the tester is emulating a Provider, Provider/Consumer, or Consumer/Provider, send a valid Source Capabilities message to the UUT after tReceiverResponse max (15ms), from the last bit of the GoodCRC message.
3. If the tester is emulating a Consumer, send a valid Reject message to the UUT after tSenderResponse max (30ms), from the last bit of the GoodCRC message.

4. If the UUT is acting as a Sink, now continue to the procedure PROT-PROC-REQ-UUT, ensuring that the Request message is received by the Tester within tReceiverResponse max (15ms) of the last bit of the GoodCRC message.

3.11.34 TDB.2.2.10.1: PROT-PROC-GETSNKCAPS-TSTR: Procedure and Checks for Tester Originated Get_Sink_Cap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Get_Sink_Cap message is sent by the Tester.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated Get_Sink_Cap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.8#1, 6.3.8#2plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SNK-CAP
Parameters Tested	tBusIdle, tTransmit, tSenderResponse
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a Get_Sink_Cap message to the UUT.
2. Check that for a Consumer, Consumer/Provider, or Provider/Consumer UUT, a Sink Capabilities message is received by the Tester within tReceiverResponse max (15ms) of the last bit of the GoodCRC message. [PROT_PROC_GETSNKCAPS_TSTR_1]
3. Check that this message meets all the requirements detailed in PROT-MSG-DATA-SNK-CAP. [PROT_PROC_GETSNKCAPS_TSTR_2]

4. Check that for a Provider UUT, a Reject message is received by the Tester within tReceiverResponse max (15ms) of the last bit of the GoodCRC message. [PROT_PROC_GETSNKCAPS_TSTR_3]
5. Check that this message meets all the requirements detailed in PROT-MSG-CTRL. [PROT_PROC_GETSNKCAPS_TSTR_4]

3.11.35 TDB.2.2.10.2: PROT-PROC-GETSNKCAPS-UUT Procedure and Checks for UUT Originated Get_Sink_Cap

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Get_Sink_Cap message is sent by the UUT.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a UUT originated Get_Sink_Cap message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.8#1, 6.3.8#2 plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SRC-CAP
Parameters Tested	tBusIdle, tTransmit, tSenderResponse tReceiverResponse
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester receives a Get_Sink_Cap message from the UUT.
2. Check that this message meets all the Control Message Checks detailed in PROT-MSG-CTRL. [PROT_PROC_GETSNKCAPS_UUT_1]

3. If the tester is emulating a Consumer, Consumer/Provider, or Provider/Consumer, send a valid Sink Capabilities message to the UUT after tReceiverResponse max (15ms), from the last bit of the GoodCRC message.
4. If the tester is emulating a Provider, send a valid Reject message to the UUT after tReceiverResponse max (15ms), from the last bit of the GoodCRC message.

3.11.36 TDB.2.2.11.1: PROT-PROC-GOTOMIN-TSTR Procedure and Checks for Tester Originated GotoMin

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the GotoMin message is sent by the Tester.
Critical for Safety	No
Applies to	DRP, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated GotoMin message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	7.3.11#1, 7.3.11#2, 7.3.11#3, 7.3.11#4plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SNK-CAP
Parameters Tested	tSrcTransition
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a GotoMin message to the UUT.
2. Check that the Sink current is reduced to the Minimum Operating Current specified by the previous UUT Request, within tSrcTransition max (35ms) from the last bit of the GoodCRC message received in response to the GoToMin message. [PROT_PROC_GOTOMIN_TSTR_1]
3. From the last bit of the GoToMin message wait for tSrcTransition min plus tSnkNewPower max (25+15 = 40ms), then send PS_RDY.

3.11.37 TDB.2.2.11.2: PROT-PROC-GOTOMIN-UUT Procedure and Checks for UUT Originated GotoMin

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the GotoMin message is sent by the UUT.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider
Description	This section describes the procedure which starts with a UUT originated GotoMin message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	7.3.11#1, 7.3.11#2, 7.3.11#3, 7.3.11#4 plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SNK-CAP
Parameters Tested	tSrcTransition, tSnkNewPower,
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester receives a GotoMin message from the UUT.
2. Check that the UUT is not behaving as a Sink. . [PROT_PROC_GOTOMIN_UUT_2]
3. The Tester ensures that Sink current it is drawing is reduced to the Minimum Operating Current specified by the previous Request within tSrcTransition max (35ms) from the last bit of the GoToMin message.

4. Check that a PS_RDY message is received by the Tester within tSrcTransition min plus tSnkNewPower max (25+15 = 40ms) from the last bit of the GoodCRC message received in response to the GotoMin message. [PROT_PROC_GOTOMIN_UUT_1]

3.11.38 TDB.2.2.12.1: PROT-PROC-SR-TSTR Procedure and Checks for Tester Originated Soft Reset

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Soft Reset message is sent by the Tester.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated Soft Reset message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.3.3#5, 6.3.3#6 plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a Soft Reset message to the UUT.
2. Check that an Accept message is received by the Tester within tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_SR_TSTR_1]
3. Check that this message meets all the requirements detailed in PROT-MSG-CTRL. [PROT_PROC_SR_TSTR_2]

If UUT is currently acting as a Source:

4. Continue to the procedure PROT-PROC-SRCCAPS-UUT ensuring that the Source Capabilities message is received within tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_SR_TSTR_3]

If UUT is currently acting as a Sink:

5. Continue to the procedure PROT-PROC-SRCCAPS-TSTR ensuring that the Source Capabilities message is sent at a time slightly less than tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_SR_TSTR_4]

3.11.39 TDB.2.2.12.2: PROT-PROC-SR-UUT Procedure and Checks for UUT Originated Soft Reset

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Soft Reset message is sent by the UUT.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a UUT originated Soft Reset message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT
Parameters Tested	
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester receives a Soft Reset message from the UUT.
2. Check that the UUT is not a Cable. [PROT_PROC_SR_UUT_4]
3. Check that this message meets all the Control Message Checks detailed in PROT-MSG-CTRL. [PROT_PROC_SR_UUT_1]
4. The Tester sends an Accept message to the UUT after tReceiverResponse max (15ms) from the last bit of the GoodCRC message received.

If UUT is currently acting as a Source:

5. Continue to the procedure PROT-PROC-SRCCAPS-UUT ensuring that the Source Capabilities message is received within tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_SR_TSTR_2]

If UUT is currently acting as a Sink:

6. Continue to the procedure PROT-PROC-SRCCAPS-TSTR ensuring that the Source Capabilities message is sent at a time slightly less than tReceiverResponse max (15ms), from the last bit of the GoodCRC message. [PROT_PROC_SR_TSTR_3]

3.11.40 TDB.2.2.13.1: PROT-PROC-HR-TSTR Procedure and Checks for Tester Originated Hard Reset

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Hard Reset signal is sent by the Tester.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a Tester originated Hard Reset message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages and VBUS voltage involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.5.4.3#1, 6.5.10.2#1, 7.1.6#1, 7.1.6#2, 7.1.6#4, 7.1.6#5, 7.3.12#5, 7.3.12#6 plus assertions in checks:
Parameters Tested	
Checklist References	

UUT is behaving as source

The Tester sends a Hard Reset signal.

1. Check VBUS stays within present valid voltage range for tPSHardReset min (25ms) after last bit of Hard Reset signal. [PROT_PROC_HR_TSTR_1]
2. Check that VBUS starts to fall below present valid voltage range by tPSHardReset max (35ms). [PROT_PROC_HR_TSTR_2]
3. Check that VBUS reaches vSafe0V within tSafe0v max (650 ms). [PROT_PROC_HR_TSTR_3]
4. Check that VBUS starts rising to vSafe5V after a delay of tSrcRecover (0.66s - 1s) from reaching vSafe0V. [PROT_PROC_HR_TSTR_4]
5. Check that VBUS reaches vSafe5V within tSrcTurnOn max (275ms) of rising above vSafe0v max (0.8V). [PROT_PROC_HR_TSTR_5]

6. Check that Source Capabilities are finished sending within tFirstSourceCap max (250ms) of VBUS reaching vSafe5v min. [PROT_PROC_HR_TSTR_6]

UUT is behaving as sink

The Tester sends a Hard Reset signal.

1. Keep VBUS within present valid voltage range for tPSHardReset nom (30ms) after last bit of Hard Reset signal.
2. Take VBUS to vSafe0V within tSafe0v max (650 ms).
3. Keep VBUS at vSafe0V for tSrcRecover (0.66s - 1s).
4. Take VBUS to vSafe5V within tSrcTurnOn max (275ms) of rising above vSafe0v max (0.8V).
5. Send Source Capabilities within tFirstSourceCap max (250ms) of VBUS reaching vSafe5v min.

3.11.41 TDB.2.2.13.2: PROT-PROC-HR-UUT: Procedure and Checks for UUT Originated Hard Reset

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the Hard Reset signal is sent by the UUT.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a UUT originated Hard Reset message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages and VBUS voltage involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.5.4.3#1, 6.5.10.2#1, 7.1.6#1, 7.1.6#2, 7.1.6#4, 7.1.6#5, 7.3.12#5, 7.3.12#6 plus assertions in checks:
Parameters Tested	
Checklist References	

UUT is behaving as source

The UUT receives a Hard Reset signal from the UUT.

1. Check that the UUT is not a Cable. [PROT_PROC_HR_UUT_1]
2. Check VBUS stays within present valid voltage range for tPSHardReset min (25ms) after last bit of Hard Reset signal. [PROT_PROC_HR_UUT_2]
3. Check that VBUS starts to fall below present valid voltage range by tPSHardReset max (35ms). [PROT_PROC_HR_UUT_3]
4. Check that VBUS reaches vSafe0V within tSafe0v max (650 ms). [PROT_PROC_HR_UUT_4]
5. Check that VBUS starts rising to vSafe5V after a delay of tSrcRecover (0.66s - 1s) from reaching vSafe0V. [PROT_PROC_HR_UUT_5]

6. Check that VBUS reaches vSafe5V within tSrcTurnOn max (275ms) of rising above vSafe0v max (0.8V). [PROT_PROC_HR_UUT_6]
7. Check that Source Capabilities are finished sending within tFirstSourceCap max (250ms) of VBUS reaching vSafe5v min. [PROT_PROC_HR_UUT_7]

UUT is behaving as sink

The UUT receives a Hard Reset signal from the UUT.

1. Keep VBUS within present valid voltage range for tPSHardReset nom (30ms) after last bit of Hard Reset signal.
2. Take VBUS to vSafe0V within tSafe0v max (650 ms).
3. Keep VBUS at vSafe0V for tSrcRecover (0.66s - 1s).
4. Take VBUS to vSafe5V within tSrcTurnOn max (275ms) of rising above vSafe0v max (0.8V).
5. Send Source Capabilities within tFirstSourceCap max (250ms) of VBUS reaching vSafe5v min.

3.11.42 TDB.2.2.14: PROT-PROC-BIST-TSTR Procedure and Checks for Tester Originated BIST

Status	Secondary Checks performed during any Primary Test where the specified situation is encountered
Purpose	To perform the appropriate protocol checks relating to any circumstance in which the BIST message is sent by the Tester.
Critical for Safety	No
Applies to	Cable, DRP, Provider, Provider/Consumer, Consumer/Provider or Consumer
Description	This section describes the procedure which starts with a UUT originated BIST message. The checks described are made any time the sequence is encountered during testing. The correct formatting, sequence and timing of the messages involved is checked.
Test setup	Depends on test referring to this section.
Preconditions	
Assertions Tested	6.4.3#7, 6.4.3#10, 6.4.3.6#1, 6.4.3.6#2, 6.4.3.9#1, 6.4.3.9#2 plus assertions in checks: PROT-MSG-CTRL PROT-PROC-GOODCRC-TSTR PROT-PROC-GOODCRC-UUT PROT-MSG-DATA-SNK-CAP
Parameters Tested	tBusIdle, tTransmit, tSenderResponse tReceiverResponse
Checklist References	

Test Procedure

During any test which refers to this section, follow this procedure:

1. The Tester sends a BIST message to the UUT.
2. Check that the requesting operation is performed. [PROT_PROC_BIST_TSTR_1]

Two commands are relevant:

- BIST Carrier Mode 2: Check that the pattern starts within tBISTMode max (300ms) and continues for tBISTContMode (40-60ms).

- BIST Test Data: Check that the UUT does not originate any traffic, before a Hard Reset or detachment.

3.12 PROTOCOL SPECIFIC PRIMARY TESTS

3.12.1 TDA.2.2.1: BMC-PROT-SEQ-GETCAPS Get_Source_Cap and Get_Sink_Cap Test

Status	Primary Test
Purpose	To confirm that a UUT responds correctly to a Get_Source_Cap and Get_Sink_Cap request.
Critical for Safety	No
Applies to	Any PD Capable UUT except Cable
Description	A Get_Source_Cap message is sent to the UUT, to verify that it responds correctly. A Get_Sink_Cap message is sent to the UUT, to verify that it responds correctly.
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	6.3.7#1, 6.3.7#2, 6.3.8#1, 6.3.8#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

For UUT capable of being a provider

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).
4. Send Get_Source_Cap.
5. Check that a Reject message is received if the UUT is a Consumer only [BMC_PROT_SEQ_GETCAPS_1]. Else check that valid Source Capabilities are received. (If the

UUT is currently a Source, a Request will be sent by the Tester.)
[BMC_PROT_SEQ_GETCAPS_2]

6. Send Get_Sink_Cap.
7. Check that a Reject message is received if the UUT is a Provider only [BMC_PROT_SEQ_GETCAPS _3]. Else check that valid Sink Capabilities are received. [BMC_PROT_SEQ_GETCAPS _4]
8. Emulate a tester-end detach.

For UUT capable of being a consumer

9. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
10. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
11. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).
12. Send Get_Source_Cap.
13. Check that a Reject message is received if the UUT is a Consumer only [BMC_PROT_SEQ_GETCAPS_1]. Else check that valid Source Capabilities are received. (If the UUT is currently a Source, a Request will be sent by the Tester.)
[BMC_PROT_SEQ_GETCAPS_2]
14. Send Get_Sink_Cap.
15. Check that a Reject message is received if the UUT is a Provider only [BMC_PROT_SEQ_GETCAPS _3]. Else check that valid Sink Capabilities are received. [BMC_PROT_SEQ_GETCAPS _4]
16. Emulate a tester-end detach.

3.12.2 TDA.2.2.2.1: BMC-PROT-SEQ-CHKCAB-P-PC Check Cable Capabilities (3A Marked) Test -

Status	Primary Test
Purpose	To confirm that a UUT does not offer more than 3A, on a 3A-only cable.
Critical for Safety	No
Applies to	DRP, Provider, or Provider/Consumer not having a captive cable.
Description	The Source Capabilities from the UUT are checked to ensure that the UUT does not offer more current than the connecting cable is capable of supporting. The UUT is also checked to confirm that it sends Discover ID to the cable (using SOP').
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	3.3.2#1, 6.4.4.2#1, 6.4.4.3.1#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

If the vendor declared source capabilities never exceed 3A, then the test is for information only. The following test is performed, either with an E-marked cable of supporting 3A only, or by using a special unmarked test cable, and simulating an E-marker in the Tester, supporting 3A only.

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 3A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 3A cable responses. If the UUT has a captive

cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).
4. Check that the UUT sends a DiscoverID message to the cable, using SOP'. [BMC_PROT_SEQ_CHKCAB_P_PC_1]
5. For a 'Fixed' or 'Variable' supply, check that none of the Source Capabilities offered exceeds 3A. For a 'Battery' supply check that the power offered does not exceed the max Voltage offered times 3A. [BMC_PROT_SEQ_CHKCAB_ P_PC _2]
6. Emulate a tester-end detach.

3.12.3 TDA.2.2.2.2: BMC-PROT-SEQ-NOMRK-P-PC Check Cable Capabilities (Unmarked) Test -

Status	Primary Test
Purpose	To confirm that a UUT does not offer more than 3A, on an unmarked cable.
Critical for Safety	No
Applies to	DRP, Provider, or Provider/Consumer not having a captive cable.
Description	The Source Capabilities from the UUT are checked to ensure that the UUT does not offer more current than the connecting cable is capable of supporting. The UUT is also checked to confirm that it sends Discover ID to the cable (using SOP').
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	3.3.2#1, 6.4.4.2#1, 6.4.4.3.1#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

If the vendor declared source capabilities never exceed 3A, then the test is for information only. The following test is performed using a special unmarked test cable, and NOT simulating an E-marker in the Tester.

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 3A or 5A unmarked cable. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).

4. For a 'Fixed' or 'Variable' supply, check that none of the Source Capabilities offered exceeds 3A. For a 'Battery' supply check that the power offered does not exceed the max Voltage offered times 3A. [BMC_PROT_SEQ_NOMRK_P_PC _2]
5. Emulate a tester-end detach.

3.12.4 TDA.2.2.2.3: BMC-PROT-SEQ-CHKCAB-CP-ACC Check Cable Capabilities (3A Marked) Test -

Status	Primary Test
Purpose	To confirm that a UUT does not offer more than 3A, on a 3A-only cable, in a power swapped state.
Critical for Safety	No
Applies to	DRP, Consumer / Provider not having a captive cable.
Description	The Source Capabilities from the UUT are checked to ensure that the UUT does not offer more current than the connecting cable is capable of supporting. The UUT is also checked to confirm that it sends Discover ID to the cable (using SOP').
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	3.3.2#1, 6.4.4.2#1, 6.4.4.3.1#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

If the vendor declared source capabilities never exceed 3A, then the test is for information only. The following test is performed, either with an E-marked cable of supporting 3A only, or by using a special unmarked test cable, and simulating an E-marker in the Tester, supporting 3A only.

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 3A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 3A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).

   Change Tester from being a Source to being a Sink as follows:

4. The Tester requests a power role swap (PROT-PROC-SWAP-TSTR), which may initially be declined with a Wait, while the UUT establishes what the Tester sink requirements are. After having been asked for and then having sent the Sink Capabilities, the Tester once again requests a role swap (PROT-PROC-SWAP-TSTR). As the vendor has stated that the PR_Swap will be accepted, and the correct condition are met, a failure to role swap at this point is deemed a test failure. [BMC_PROT_SEQ_CHKCAB_ CP_ACC _1]
5. Check that the UUT sends a DiscoverID message to the cable, using SOP'. [BMC_PROT_SEQ_CHKCAB_CP_ACC_2]
6. For a 'Fixed' or 'Variable' supply, check that none of the Source Capabilities offered exceeds 3A. For a 'Battery' supply check that the power offered does not exceed the max Voltage offered times 3A. [BMC_PROT_SEQ_CHKCAB_ CP_ACC _3]
7. Emulate a tester-end detach.

3.12.5 TDA.2.2.2.4: BMC-PROT-SEQ-NOMRK-CP-ACC Check Cable Capabilities (Unmarked) Test -

Status	Primary Test
Purpose	To confirm that a UUT does not offer more than 3A, on an unmarked cable, in a power swapped state.
Critical for Safety	No
Applies to	DRP, Consumer / Provider not having a captive cable.
Description	The Source Capabilities from the UUT are checked to ensure that the UUT does not offer more current than the connecting cable is capable of supporting. The UUT is also checked to confirm that it sends Discover ID to the cable (using SOP').
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	3.3.2#1, 6.4.4.2#1, 6.4.4.3.1#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

If the vendor declared source capabilities never exceed 3A, then the test is for information only. The following test is performed using a special unmarked test cable, and NOT simulating an E-marker in the Tester.

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 3A or 5A unmarked cable. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).

   Change Tester from being a Source to being a Sink as follows:

4. The Tester requests a power role swap (PROT-PROC-SWAP-TSTR), which may initially be declined with a Wait, while the UUT establishes what the Tester sink requirements are. After having been asked for and then having sent the Sink Capabilities, the Tester once again requests a role swap (PROT-PROC-SWAP-TSTR). As the vendor has stated that the PR_Swap will be accepted, and the correct condition are met, a failure to role swap at this point is deemed a test failure. [BMC_PROT_SEQ_NOMRK_CP_ACC _1]
5. For a 'Fixed' or 'Variable' supply, check that none of the Source Capabilities offered exceeds 3A. For a 'Battery' supply check that the power offered does not exceed the max Voltage offered times 3A. [BMC_PROT_SEQ_NOMRK_CP_ACC _3]
6. Emulate a tester-end detach.

3.12.6 TDA.2.2.3: BMC-PROT-SEQ-DRSWAP DR_Swap Test

Status	Primary Test
Purpose	To confirm that a UUT responds correctly to a DR_Swap request.
Critical for Safety	No
Applies to	Any PD Capable UUT except Cable
Description	A DR_Swap message is sent to the UUT, to verify that it responds correctly.
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	4.4.1#4, 6.3.10#6, 6.4.4.2#1 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. Set default tester response to PR_Swap to **Reject**.
   Set default tester response to DR_Swap to **Reject**.
   Set default tester response to VCONN_Swap to **Reject**.

If UUT is able to start as Source

4. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).

5. At the earliest possible stage the Tester requests a DR_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a DR_Swap, until either Reject or Accept is received.
6. Check that a Reject message is received from the UUT, if DR_Swap_to_UFP is not supported [BMC_PROT_SEQ_DRSWAP_1].
   Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ DRSWAP_2]
7. If the DR_Swap was Rejected, then skip to step 10.
8. At the earliest possible stage the Tester requests a further DR_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a DR_Swap, until either Reject or Accept is received.
9. Check that a Reject message is received from the UUT, if DR_Swap_to_DFP is not supported [BMC_PROT_SEQ_DRSWAP_3].
   Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ DRSWAP_4]
10. Emulate a tester-end detach.

If UUT is able to start as Sink

11. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).
12. At the earliest possible stage the Tester requests a DR_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a DR_Swap, until either Reject or Accept is received.
13. Check that a Reject message is received from the UUT, if DR_Swap_to_DFP is not supported [BMC_PROT_SEQ_DRSWAP_5].
    Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ DRSWAP_6]
14. If the DR_Swap was Rejected, then skip to step 17.
15. At the earliest possible stage the Tester requests a further DR_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a DR_Swap, until either Reject or Accept is received.
16. Check that a Reject message is received from the UUT, if DR_Swap_to_UFP is not supported [BMC_PROT_SEQ_DRSWAP_7].
    Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ DRSWAP_8]
17. Emulate a tester-end detach.

3.12.7 TDA.2.2.4: BMC-PROT-SEQ-VCSWAP VCONN_Swap Test

Status	Primary Test
Purpose	To confirm that a UUT responds correctly to a VCONN_Swap request.
Critical for Safety	No
Applies to	Any PD Capable UUT except Cable
Description	VCONN_Swap messages are sent to the UUT, to verify that it responds correctly.
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	-
Assertions Tested	4.4.1#4, 6.3.10#6, 6.4.4.2#1 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. Set default tester response to PR_Swap to **Reject**.
   Set default tester response to DR_Swap to **Accept**.
   Set default tester response to VCONN_Swap to **Reject**.

   If UUT is able to start as Source

4. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE), applying Ra to the remote end of the non-CC line.
5. Check that, if Type_C_Sources_VCONN is YES, then VCONN is present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_6]. Check that, if Type_C_Sources_VCONN is

NO, then VCONN is not present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_6].

6. At the earliest possible stage the Tester requests a VCONN_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a VCONN_Swap, until either Reject or Accept is received.
7. Check that a Reject message is received from the UUT, if VCONN_Swap_to_Off is not supported [BMC_PROT_SEQ_ VCSWAP _1].
   Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ VCSWAP _2]
8. If the VCONN_Swap was Rejected, then skip to step 15.
9. Send a PS_RDY message.
10. Check that VCONN is not present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_7].
11. At the earliest possible stage the Tester requests a further VCONN _Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a VCONN _Swap, until either Reject or Accept is received.
12. Check that a Reject message is received from the UUT, if VCONN_Swap_to_On is not supported [BMC_PROT_SEQ_ VCSWAP _3].
    Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ VCSWAP _4]
13. Check that a PS_RDY message is received from the UUT [BMC_PROT_SEQ_VCSWAP_5].
14. Check that VCONN is present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_6].
15. Emulate a tester-end detach.

If UUT is able to start as Sink

16. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE), applying Ra to the remote end of the non-CC line.
17. Check that VCONN is not present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_7].
18. At the earliest possible stage the Tester requests a VCONN _Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a VCONN _Swap, until either Reject or Accept is received.
19. Check that a Reject message is received from the UUT, if VCONN_Swap_to_On is not supported [BMC_PROT_SEQ_ VCSWAP _8].
    Else check that an Accept message is received from the UUT. [BMC_PROT_SEQ_ VCSWAP _9]
20. If the VCONN_Swap was Rejected, then skip to step 28.
21. Check that a PS_RDY message is received from the UUT [BMC_PROT_SEQ_VCSWAP_10].
22. Check that VCONN is present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_11].
23. At the earliest possible stage the Tester requests a further VCONN_Swap. The UUT may initially send a Wait and then perform other operations. The Tester continues, for up to 10 seconds, to request a VCONN_Swap, until either Reject or Accept is received.
24. Check that a Reject message is received from the UUT, if VCONN_Swap_to_Off is not supported [BMC_PROT_SEQ_ VCSWAP _12].
    Else check that an Accept message is received from the UUT.
    [BMC_PROT_SEQ_VCSWAP_13]

25. If the VCONN _Swap was Rejected, then skip to step 11.
26. Send a PS_RDY message.
27. Check that VCONN is not present at the remote end of the non-CC line [BMC_PROT_SEQ_VCSWAP_14].
28. Emulate a tester-end detach.

3.12.8 TDA.2.2.5: BMC-PROT-DISCOV ID Checks

Status	Primary Test
Purpose	To perform the appropriate protocol checks relating a Cable Discovery sequence.
Critical for Safety	
Applies to	DRP, Consumer, Consumer/Provider
Description	This test performs a Discovery procedure for a UUT, using SOP messages.
Test setup	The UUT is connected to the tester.
Ping Policy	Send Pings where possible
Preconditions	
Assertions Tested	6.3.3#3, 6.3.4#3, 6.3.9#6, 6.3.9#7, 6.3.9#8, 6.3.9#9, 6.3.12#3 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (PROC-PD-MODE) as a Consumer.
4. During the following, respond to any messages received and behave accordingly. Check the appropriateness of such messages.
5. Send a Discover ID Initiator to the UUT, using SOP.
6. Check that the UUT responds with a valid Discover ID ACK message, using SOP [BMC_PROT_DISCOV_1].
   If the UUT responds with NAK it is deemed to have failed. If the UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the UUT does not respond with ACK after one of these attempts, it is deemed to have failed, and is concluded by proceeding to the last step.

7. Check that the first bit of the preamble of this message is sent after tInterFrameGap min (25us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [BMC_PROT_DISCOV_2]. Check that the values in the Discover ID ACK message meet the requirements of PROT-MSG-DATA-VDM-ID-ACK.
8. Send a Discover SVIDs Initiator to the UUT, using SOP.
9. Check that the UUT responds with a valid Discover SVIDs ACK message or NAK message, using SOP [BMC_PROT_DISCOV_3]. If the response is NAK, the test is concluded by proceeding to the last step. In the case of a NAK, if the UUT has indicated in its response to 'Discover ID' that it supports Modal Operation, then it is deemed to have failed. If the response is ACK, and the UUT has indicated in its response to 'Discover ID' that it does not support Modal Operation, then it is deemed to have failed.
   If the UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the UUT does not respond with ACK after one of these attempts, it is deemed to have failed.
10. Check that the first bit of the preamble of this message is sent after tInterFrameGap min (25us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [BMC_PROT_DISCOV_4]. Check that the values in the Discover SVID ACK message meet the requirements of PROT-MSG-DATA-VDM-SVID-ACK.
11. If the Discover SVID ACK message indicates that there are further SVIDs to fetch, the sequence is repeated from [7] until there are no further SVIDs.

For each SVID:

12. Send a Discover Modes Initiator to the UUT, using SOP.
13. Check that the UUT responds with a valid Discover Modes ACK message or NAK message, using SOP [BMC_PROT_DISCOV_5].
    If the UUT responds with NAK it is deemed to have failed. If the UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the UUT does not respond with ACK after one of these attempts, it is deemed to have failed.
14. Check that the first bit of the preamble of this message is sent after tInterFrameGap min (25us) but before tVDMReceiverResponse max (15ms), after the last bit of the EOP of the GoodCRC [BMC_PROT_DISCOV_6]. Check that the values in the Discover MODES ACK message meet the requirements of PROT-MSG-DATA-VDM-MODES-ACK.

For each of these Modes:

In the following we attempt to enter, then exit each mode advertised. Some modes may not be enterable without first entering some other mode. It must be possible to enter at least one mode.

15. Send an Enter Mode Initiator to the UUT, using SOP.
16. Check that the UUT responds with a valid Enter Mode ACK message or NAK message, using SOP [BMC_PROT_DISCOV_7].
    If the UUT responds with BUSY, then the Tester will make four further attempts, with a delay in between of tVDMBusy min (100ms) between each attempt. If the UUT does not respond with ACK or NAK after one of these attempts, it is deemed to have failed.
17. If the Enter Mode response was an ACK, send an Exit Modes Initiator to the UUT, using SOP.

18. Check that the UUT responds with a valid Exit Modes ACK message, using SOP [BMC_PROT_DISCOV_8]. If the response is NAK or BUSY, the test is deemed to have failed.
19. Emulate a tester-end detach.

3.12.9 TDA.2.2.6: BMC-PROT- SEQ-PRSWAP PR_Swap Test

Status	Primary Test
Purpose	To confirm that a UUT always reponds appropriately to PR_Swap requests.
Critical for Safety	No
Applies to	Any UUT
Description	The UUT is requested to do a Power Role Swap, under conditions favourable to such a swap. We confirm that the PR_Swap is responded to in the way specified in the Vendor Information File.
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	
Assertions Tested	6.3.3#4, 6.3.4#4, 6.3.11#3, 6.3.11#5, 6.3.11#7, 6.3.11#8, 6.3.12#4 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Test Procedure

For any UUT cabable of being a Source (else proceed to the second half of the test description)

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. Set default tester response to PR_Swap to **Reject**.
   Set default tester response to DR_Swap to **Accept**.
   Set default tester response to VCONN_Swap to **Accept**.
   Set the Tester Unconstrained Power bit to **1**.

Set Tester Dual-Role Power to **1**.

4. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).
5. The Tester gets the UUT Sink Capabilities, and changes its own Source Capabilities to match the UUT Sink Capabilities, and changes its Unconstrained Power bit to 1, giving the best conditions for the PR_Swap to be accepted.
6. At the earliest possible stage the Tester requests a PR_Swap. The UUT may initially send a Wait and then fetch the Tester Source Capabilities. The Tester continues, for up to 10 seconds, to request a PR_Swap.
7. By the end of this time, check that the response from the UUT matches the VIF declared response (Accepts_PR_Swap_as_Source: YES/NO) [BMC_PROT_SEQ_SWAP_REJ_1]. Accept and Reject are the only options to be considered for a PASS. Continued Wait response after 10 seconds is considered to be a FAIL.
8. If the UUT has sent a Reject message then skip to step 12.
9. (The UUT is now a Sink, the tester is Source; has just completed a PR_Swap and has a contract.) The Tester gets the UUT Source Capabilities, and changes its own Sink Capabilities to match the first PDO of the UUT Source Capabilities, and changes its Unconstrained Power bit to 0, giving the best conditions for the PR_Swap to be accepted. Send these new Capabilities to the UUT, and allow it to request a new contract.
10. Now request a PR_Swap. The UUT may initially send a Wait and then fetch the Tester Sink Capabilities. The Tester continues, for up to 10 seconds, to request a PR_Swap.
11. By the end of this time, check that the response from the UUT matches the VIF declared response (Accepts_PR_Swap_as_Sink: YES/NO) [BMC_PROT_SEQ_SWAP_REJ_2]. Accept and Reject are the only options to be considered for a PASS. Continued Wait response after 10 seconds is considered to be a FAIL.
12. Emulate a tester-end detach.

For any UUT cabable of being a Sink (if not, test is complete)

13. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
14. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

15. Set default tester response to PR_Swap to **Reject**.
    Set default tester response to DR_Swap to **Accept**.
    Set default tester response to VCONN_Swap to **Accept**.
    Set the Tester Unconstrained Power bit to **0**.

Set Tester Dual-Role Power to **1**.

16. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).
17. The Tester gets the UUT Source Capabilities, and changes its own Sink Capabilities to match the first PDO of the UUT Source Capabilities, and to state that the Tester does not have Unconstrained Power, giving the best conditions for the PR_Swap to be accepted.
18. At the earliest possible stage the Tester requests a PR_Swap. The UUT may initially send a Wait and then fetch the Tester Sink Capabilities. The Tester continues, for up to 10 seconds, to request a PR_Swap.
19. By the end of this time, check that the response from the UUT matches the VIF declared response (Accepts_PR_Swap_as_Sink: YES/NO) [BMC_PROT_SEQ_SWAP_REJ_3]. Accept and Reject are the only options to be considered for a PASS. Continued Wait response after 10 seconds is considered to be a FAIL.
20. If the UUT has sent a Reject message then skip to step 24.
21. (The UUT is now a Source, the tester is Sink; has just completed a PR_Swap and has a contract.) The Tester gets the UUT Sink Capabilities, and changes its own Source Capabilities to match the UUT Sink Capabilities, and changes its Unconstrained Power bit to 1, giving the best conditions for the PR_Swap to be accepted.
22. Now request a PR_Swap. The UUT may initially send a Wait and then fetch the Tester Sink Capabilities. The Tester continues, for up to 10 seconds, to request a PR_Swap.
23. By the end of this time, check that the response from the UUT matches the VIF declared response (Accepts_PR_Swap_as_Source: YES/NO) [BMC_PROT_SEQ_SWAP_REJ_4]. Accept and Reject are the only options to be considered for a PASS. Continued Wait response after 10 seconds is considered to be a FAIL. Sending Reject when parameter Accepts_PR_Swap_as_Source is YES, is deemed to only attract a WARNING.

    Note: this WARNING would result from the UUT assuming the state of the Unconstrained Power bit, rather than the logically correct behaviour of sending a Wait, and then fetching the Tester Sink Capabilities to determine the up-to-date state of this bit.

24. Emulate a tester-end detach.

3.12.10 TDA.2.2.7: BMC-PROT-BIST-NOT-5V-SRC BIST Functionality at Above 5V Test

Status	Primary Test
Purpose	To confirm that the UUT ignores BIST messages if VBUS is above 5V.
Critical for Safety	Yes
Applies to	DRP, Provider, Provider/Consumer (capable of supplying a voltage above 5V).
Description	The Source is made to supply a voltage above 5V, and then a BIST message is sent to it. It is confirmed that the message is ignored.
Test setup	Protocol Tester.
Ping Policy	Send Pings where possible
Preconditions	
Assertions Tested	5.8.1.4#2, 5.8.1.4#3, 6.4.4.3.1#4, 6.4.4.3.2#4, 6.4.4.3.3#2, 6.4.4.3.4#4, 6.4.4.4#1, 6.5.11.1#6, 6.5.11.1#7 plus assertions in any appropriate secondary checks.
Parameters Tested	
Checklist References	

Test Procedure for Provider or Provider/Consumer

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (PROC-PD-MODE).
4. The Tester makes a Request for a voltage above 5V (PROT-PROC-REQ-TSTR).
5. The Tester sends a BIST request for Mode 2.
6. Check that the UUT does not start sending BIST Mode 2 data. [BMC_PROT_BIST_NOT_5V_SRC_1]

3.12.11 TDA.2.2.8: BMC-PROT-REV-NUM Revision Number Test

Status	Primary Test
Purpose	To confirm that on receipt of a message header with a higher revision number than that supported, a port responds using the highest revision number it supports.
Critical for Safety	No
Applies to	DRP, Consumer, Consumer / Provider for UUT supporting no version above Rev 2.0
Description	A message containing a revision number higher than the current revision is sent to the UUT. The UUT is checked to see that it responds correctly by returning the correct current revision number in a Request message.
Test setup	Protocol Tester.
Ping Policy	Send Pings where possible
Preconditions	
Assertions Tested	6.3.4#2, 6.3.4#7, 8.2.6.2#2 plus assertions in any appropriate secondary checks.
Parameters Tested	-
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode (PROC-PD-MODE). During this procedure, the Tester sends the Source Capabilities message to the UUT using the value 10b for its Specification Revision field.
4. Check that the UUT responds with a Request, and that this contains the Specification Revision value 01b [BMC_PROT_REV_NUM_1].

Test is now repeated, using reserved value 11b for the Source Capability message Specification Revision field.

3.12.12 TDA.2.2.9: BMC-PROT-GSC-REC Get_Source_Cap Received Test

Status	Primary Test
Purpose	To confirm that on receipt of a Get_Source_Cap message in the PE_SRC_Ready state, the port properly transitions to the PE_SRC_Send_Capabilities state.
Critical for Safety	No
Applies to	DRP, Provider, Provider/Consumer, Consumer/Provider
Description	A Get_Source_Cap message is sent to a UUT that is in the PE_SRC_Ready state. After sending a Source_Capabilities message, the UUT should then expect a Request message in response. When one is not received, the UUT should timeout to PE_SRC_Hard_Reset.
Test setup	Protocol Tester
Ping Policy	Send Pings where possible
Preconditions	
Assertions Tested	
Parameters Tested	
Checklist References	

Test Procedure

For UUTs that can be started as Source

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered, except as explicitly described. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode as a Source (PROC-PD-MODE).

4. The Tester sends a Get_Source_Cap message to the UUT.
5. Check that a Source_Capabilities message is received from the UUT. [BMC_PROT_GSC_REC_1]
6. The Tester does not send a Request message.
7. Check that after tSenderResponse timeout min (24 ms), the UUT issues a Hard Reset. [BMC_PROT_GSC_REC_2]

For UUTs that are Consumer/Providers

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered, except as explicitly described. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode as a Sink (PROC-PD-MODE).
4. Request a PR_Swap to make the UUT a Source (offering the most favourable conditions to allow a PR_Swap to take place). Wait till there is an explicit contract in place.
5. The Tester sends a Get_Source_Cap message to the UUT.
6. Check that a Source_Capabilities message is received from the UUT. [BMC_PROT_GSC_REC_1]
7. The Tester does not send a Request message.
8. Check that after tSenderResponse timeout (30 ms), the UUT issues a Hard Reset. [BMC_PROT_GSC_REC_2]

3.12.13 TDA.2.2.10: BMC-PROT-IGN-PPS Ignore PPS Test

Status	Primary Test
Purpose	To confirm that a Rev 2.0 Sink responds correctly when seeing a PPS PDO in the Tester Rev 3.0 Source Capabilities, where this is the first SOP message from the Tester.
Critical for Safety	No
Applies to	Rev 2.0 DRP, Consumer, Consumer/Provider
Description	A Rev 3.0 Source Capabilities containing a PPS PDO is sent to a UUT Sink (which does not support Rev 3.0). The UUT is expected to ignore the PPS PDO and select the only Fixed PDO offered.
Test setup	Protocol Tester
Ping Policy	Not required
Preconditions	
Assertions Tested	
Parameters Tested	
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. The Tester gets the UUT into PD Mode as a Sink(PROC-PD-MODE), initially offering a Rev 3.0 Source Capabilities message with :
    - PDO#1 (5V Fixed at 3A) and
    - PDO#2 (9V Fixed at 3A) and

- PDO#2 (5V PPS at 3A) and
- PDO#2 (9V PPS at 3A)

4. Check that a Request is received from the UUT [BMC_PROT_IGN_PPS_1], and that it specifies PDO#1 or PDO#2 [BMC_PROT_IGN_PPS_2].
5. Continue to monitor any further Request from the UUT for 5 sec, and check that no Request for any PDO other than PDO#1 or PDO#2 occurs[BMC_PROT_IGN_PPS_3].
6. The Tester simulates a cable detach.

3.13 POWER SOURCE/SINK PRIMARY TESTS

3.13.1 TDA.2.3.1.1: BMC-POW-SRC-LOAD-P-PC Source Dynamic Load Test, Provider or Provider/Consumer

Status	Primary Test
Purpose	To verify that the static and dynamic electrical capabilities of a Source UUT meet the requirements for each PDO offered, and that the procedure for requesting a change in current functions correctly. Also verifies the behavior when a Hard Reset is sent to the UUT.
Critical for Safety	
Applies to	DRP, Provider or Provider/Consumer
Description	The Tester requests power under the terms of each available PDO, and checks the static voltage provided at five equally spaced current loads, and that the voltage remains in specification while the current is increased or decreased at a rate of 100mA per µs, from one specified level to another.
Test setup	Dynamic voltage measurement equipment, protocol Tester, adjustable load.
Ping Policy	n/a
Preconditions	The UUT vendor is assumed to have provided a list of source PDOs, to be the list offered by the UUT.
Assertions Tested	6.4.1#4, 7.1.3#2, 7.1.3#3, 7.1.3#4 plus assertions in any appropriate secondary checks.
Parameters Tested	tPSTransition, tSinkRequest, tSourceActivity
Checklist References	

Note: All VBUS voltage measurements are required to relate to the UUT connector.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate

sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. During the following, if Ping messages are received from the UUT, check that Ping messages timing meets requirements in PROT-PROC-PING.
4. The Tester gets the UUT into PD Mode (PROC-PD-MODE), initially requesting PDO#1 at 100mA.
5. Wait until a Source Capabilities message is received, note the number of Power Data Objects, and record their contents. Check that they are identical to the list provided by the vendor [BMC_POW_SRC_LOAD_P_PC_1]. If at any time during the following steps a further Capabilities message is received, the PDOs shall be compared to the previous ones. If they differ, report the details, and the test ends as a failure.

Repeat the following steps for each of these Power Data Objects, starting with PDO#1:

6. Repeat the next 4 steps at no load, 25% full load, 50% full load, 75% full load, 100% full load, 75% full load, 50% full load, 25% full load and no load (9 separate Requests per PDO).
7. Monitor the voltage during the next step from just before the Request until a time sufficiently later to capture any significant perturbation in the voltage caused by the applied current change.
8. Send a Request for power under the conditions of the current Power Data Object requesting the appropriate current (or power) (use checks in PROT-PROC-REQ-TSTR).
9. Set the Tester to draw the requested current, changing the current drawn at a rate of 100mA per µs.
10. Check that the extremes of the voltage measured remain within the required limits of vSrcNew (for fixed supplies) or within the limits specified for the battery or variable supply, and confirm that the timing of the VBUS waveform versus the messages meets the requirements defined in PROT-PROC-REQ-TSTR. [BMC_POW_SRC_LOAD_P_PC_2]

After doing this for each of these Power Data Objects:

11. Start to monitor the voltage on VBUS; send a Hard Reset and confirm that the timing of the VBUS waveform versus the messages meets the requirements for Hard Reset defined in PROT-PROC-HR-TSTR. [BMC_POW_SRC_LOAD_P_PC_3]
12. Emulate a tester-end detach.
13. The Tester follows the procedure to get the UUT into PD Mode (PROC-PD-MODE), however it makes its first request for the highest voltage advertised, but requests 10ma (or 250mW if it is a battery supply)) more than was offered.
14. Check that the UUT Rejects the Request-[BMC_POW_SRC_LOAD_P_PC_4]

3.13.2 TDA.2.3.1.2: BMC-POW-SRC-LOAD-CP-ACC Source Dynamic Load Test, Consumer/Provider Accepting Swap

Status	Primary Test
Purpose	To verify that the static and dynamic electrical capabilities of a Source meet the requirements for each PDO offered, and that the procedure for requesting an increase in current functions correctly.
Critical for Safety	
Applies to	DRP or Consumer/Provider which is able to accept a Swap
Description	The Tester requests power under the terms of each available PDO, initially 25% of the offered power, and then requesting an increase to 100%. It then checks the static voltage provided at five equally spaced current loads, and that the voltage remains in specification while the current is increased or decreased at a rate of 100mA per µs, from one specified level to another.
Test setup	Dynamic voltage measurement equipment, protocol Tester, adjustable load.
Ping Policy	Send Pings where possible
Preconditions	The UUT vendor is assumed to have provided a list of source PDOs, to be the list offered by the UUT; and to have stated that the UUT will accept a Power Role Swap request under the test conditions.
Assertions Tested	6.4.1#4, 7.1.3#2, 7.1.3#3, 7.1.3#4 plus assertions in any appropriate secondary checks.
Parameters Tested	tPSTransition, tSinkRequest, tSourceActivity
Checklist References	

Note: All VBUS voltage measurements are required to relate to the UUT connector.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive

cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. During the following, whenever the UUT is acting as a Source, if Ping messages are received from the UUT, check that Ping messages timing meets requirements in PROT-PROC-PING.
4. The Tester gets the UUT into PD Mode (PROC-PD-MODE).
5. Get the UUT Source Capabilities.
6. Set the Tester Sink Capabilities to match this, and set 'Not Externally Powered'.

Change Tester from being a Source to being a Sink as follows:

7. The Tester requests a power role swap (PROT-PROC-SWAP-TSTR), which may initially be declined with a Wait, while the UUT establishes what the Tester sink requirements are. After having been asked for and then having sent the Sink Capabilities, the Tester once again requests a role swap (PROT-PROC-SWAP-TSTR). As the vendor has stated that the PR_Swap will be accepted, and the correct condition are met, a failure to role swap at this point is deemed a test failure. [BMC_POW_SRC_LOAD_CP_ACC_1]
8. On receiving Source Capabilities from the UUT, after the Swap, the Tester initially requests PDO#1 at 100mA.
9. In this Source Capabilities message, note the number of Power Data Objects, and record their contents. Check that they are identical to the list provided by the vendor [BMC_POW_SRC_LOAD_CP_ACC_2]. If at any time during the following steps a further Capabilities message is received, the PDOs shall be compared to the previous ones. If they differ, report the details, and the test ends as a failure.

Repeat the following steps for each of these Power Data Objects, starting with PDO#1:

10. Repeat the next 4 steps at no load, 25% full load, 50% full load, 75% full load, 100% full load, 75% full load, 50% full load, 25% full load and no load (9 separate Requests per PDO).
11. Monitor the voltage during the next step from just before the Request until a time sufficiently later to capture any significant perturbation in the voltage caused by the applied current change.
12. Send a Request for power under the conditions of the current Power Data Object requesting the appropriate current (or power) (use checks in PROT-PROC-REQ-TSTR).
13. Set the Tester to draw the requested current, changing the current drawn at a rate of 100mA per µs.
14. Check that the extremes of the voltage measured remain within the required limits of vSrcNew (for fixed supplies) or within the limits specified for the battery or variable supply, and confirm that the timing of the VBUS waveform versus the messages meets the requirements defined in PROT-PROC-REQ-TSTR. [BMC_POW_SRC_LOAD_CP_ACC_3]

After doing this for each of these Power Data Objects:

15. Start to monitor the voltage on VBUS; send a Hard Reset and confirm that the timing of the VBUS waveform versus the messages meets the requirements for Hard Reset defined in PROT-PROC-HR-TSTR. [BMC_POW_SRC_LOAD_P_PC_4]

3.13.3 TDA.2.3.2.1: BMC-POW-SRC-TRANS-P-PC PDO Transition Test - Source, Provider or Provider/Consumer

Status	Primary Test
Purpose	To verify the timing, electrical and protocol compliance of a positive or negative voltage or current transition from a Source.
Critical for Safety	
Applies to	DRP, Provider or Provider/Consumer
Description	The Tester causes the UUT to perform each possible transition between sourcing different voltages, and by monitoring VBUS and the protocol messages, verifies that the appropriate conditions are met.
Test setup	Voltage measurement equipment, protocol Tester, adjustable load.
Preconditions	The UUT vendor is assumed to have provided a list of source PDOs, to be the list offered by the UUT.
Ping Policy	n/a
Assertions Tested	5.2.1#1, 5.2.3#1, 7.1.4#1-8, 7.1.5#1-8, 7.1.7#1, plus assertions in any appropriate secondary checks.
Parameters Tested	tSinkRequest
Checklist References	

Note: All VBUS voltage measurements are required to relate to the UUT connector.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive

cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

3. During the following, if Ping messages are received from the UUT, check that Ping messages timing meets requirements in PROT-PROC-PING.
4. The Tester gets the UUT into PD Mode (PROC-PD-MODE), initially requesting PDO#1 at 100mA.
5. Wait until a Source Capabilities message is received, note the number of Power Data Objects, and record their contents. Check that they are identical to the list provided by the vendor [BMC_POW_SRC_TRANS_P_PC_1]. If at any time during the following steps a further Capabilities message is received, the PDOs shall be compared to the previous ones. If they differ, report the details, and the test ends as a failure.

Choose a sequence of Requests which, starting from PDO #1 will, by their completion, have demonstrated every transition between two different available PDOs, and end back at PDO #1. (A table of such sequences is given in PD Compliance Plan Section 5.7.) For each of these transitions, and starting with the Tester applying a nominal capacitance of cSnkBulk min (1uF) across VBUS:

6. Send a Request for power under the conditions of the next PDO in question, with a current of 100mA (or a power of 500mW if Battery) or less if less is offered (use the checks in PROT-PROC-REQ-TSTR). Start monitoring VBUS continuously.
7. Check that the VBUS trace measured and the message timing satisfy the requirements in PROT-PROC-REQ-TSTR. [POW_SRC_TRANS_P_PC_2]
8. If not all PDO voltage transitions have been tested, repeat from step 5.
9. Repeat all transition tests from step 5 while the Tester loads VBUS with a nominal cSnkBulk max (10µF).

3.13.4 TDA.2.3.2.2: BMC-POW-SRC-TRANS-CP-ACC PDO Transition Test - Source, Consumer/Provider Accepting Swap

Status	Primary Test
Purpose	To verify the timing, electrical and protocol compliance of a positive or negative voltage or current transition from a Source.
Critical for Safety	No
Applies to	DRP or Consumer/Provider, able to accept a Swap request
Description	The Tester causes the UUT to perform each possible transition between sourcing different voltages for available sets of Source Capabilities, and by monitoring VBUS and the protocol messages, verifies that the appropriate conditions are met.
Test setup	Voltage measurement equipment, protocol Tester, adjustable load.
Ping Policy	Send Pings where possible
Preconditions	The UUT vendor is assumed to have provided a list of source PDOs, to be the list offered by the UUT; and to have stated that the UUT will accept a Power Role Swap request under the test conditions.
Assertions Tested	5.2.1#1, 5.2.3#1, 7.1.4#1, 7.1.4#2, 7.1.4#3, 7.1.4#4, 7.1.4#5, 7.1.4#6, 7.1.4#7, 7.1.4#8, 7.1.5#1, 7.1.5#2, 7.1.5#3, 7.1.5#4, 7.1.5#5, 7.1.5#6, 7.1.5#7, 7.1.5#8, 7.1.7#1, 7.1.12#1, 7.1.12#2, 7.1.12#1, 7.1.12#2, plus assertions in any appropriate secondary checks.
Parameters Tested	tSinkRequest
Checklist References	

Note: All VBUS voltage measurements are required to relate to the UUT connector.

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.

2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. During the following, whenever the UUT is acting as a Source, if Ping messages are received from the UUT, check that Ping messages timing meets requirements in PROT-PROC-PING.
4. The Tester gets the UUT into PD Mode (PROC-PD-MODE).
5. Get the UUT Source Capabilities.
6. Set the Tester Sink Capabilities to match this, and set 'Not Externally Powered'.

Change Tester from being a Source to being a Sink as follows:

7. The Tester requests a power role swap (PROT-PROC-SWAP-TSTR), which may initially be declined with a Wait, while the UUT establishes what the Tester sink requirements are. After having been asked for and then having sent the Sink Capabilities, the Tester once again requests a role swap (PROT-PROC-SWAP-TSTR). As the vendor has stated that the PR_Swap will be accepted, and the correct condition are met, a failure to role swap at this point is deemed a test failure. [BMC_POW_SRC_TRANS_CP_ACC_1]
8. On receiving Source Capabilities from the UUT, after the Swap, the Tester initially requests PDO#1 at 100mA.
9. In this Source Capabilities message, note the number of Power Data Objects, and record their contents. Check that they are identical to the list provided by the vendor [BMC_POW_SRC_ TRANS _CP_ACC_2]. If at any time during the following steps a further Capabilities message is received, the PDOs shall be compared to the previous ones. If they differ, report the details, and the test ends as a failure.

Choose a sequence of Requests which, starting from PDO #1 will, by their completion, have demonstrated every transition between two different available PDOs, and end back at PDO #1. (A table of such sequences is given in PD Compliance Plan Section 5.7.) For each of these transitions, and starting with the Tester applying a nominal capacitance of cSnkBulk min (1uF) across VBUS:

10. Send a Request for power under the conditions of the next PDO in question, requesting the largest current offered (use checks in PROT-PROC-REQ-TSTR). Start monitoring VBUS continuously.
11. Check that the VBUS trace measured and the message timing satisfy the requirements in PROT-PROC-REQ-TSTR. [BMC_POW_SRC_ TRANS _CP_ACC_3]
12. If not all PDO voltage transitions have been tested, repeat from step 9.
13. Repeat all transition tests from step 9 while the Tester loads VBUS with a nominal cSnkBulk max (10µF).

3.13.5 TDA.2.3.3.1: BMC-POW-SNK-TRANS-C-CP PDO Transition, Current Draw and Suspend Test - Sink, Consumer or Consumer/Provider

Status	Primary Test
Purpose	To verify the timing, electrical and protocol compliance of a voltage or current transition for a Sink, and that the Sink does not draw more current than contracted for.
Critical for Safety	No
Applies to	Consumer or Consumer/Provider
Description	The Tester causes the UUT to make a request for power under the terms of a new PDO, selected at the discretion of the test operator. It then checks that the UUT meets the protocol and protocol timing requirements and does not draw more current than permitted at any time during or after the transition. Finally the Sink is suspended and its current draw checked against permitted suspend current.
Test setup	Current measurement equipment, protocol Tester, adjustable supply.
Ping Policy	Send Pings where possible
Preconditions	The Tester attempts to encourage the UUT to make a request for a transition from 5V to the highest voltage it can make use of. If no better alternative is available, a transition from 5V/100mA to 5V at a higher current may be used as the test example. Except for this case we will be testing a voltage and a current increase type transition.
Assertions Tested	5.2.1#1, 5.2.3#1, 7.2.3#1-5, 7.3.1#1-5, 7.3.2#1-6, 7.3.3#1-6, 7.3.4#1-6, 7.3.5#1-6, 7.3.6#1-6, 7.3.7#1-6, 7.3.8#1-6, 7.3.19#1-3, plus assertions in any appropriate secondary checks.
Parameters Tested	tSourceActivity, tNewSnk
Checklist References	

Test Procedure

1. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
2. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.
3. During the following, Ping messages are sent by the Tester, as specified in PROT-PROC-PING. (Although optional, it is desirable to check that Ping does not cause any misbehavior.)
4. The Tester gets the UUT into PD Mode (PROC-PD-MODE), initially offering only PDO#1 at 100mA.
5. After a contract has been established, fetch the UUT Sink Capabilities.
6. The Tester sends a Get_Sink_Cap message to the UUT (use checks in PROT-PROC-GETSNKCAPS-TSTR).
7. Check this Sink Capabilities message to ensure that it matches the PDOs specified by the vendor. [POW_SNK_TRANS_C_CP_1] Note the PDO# with the highest voltage for subsequent tests.
8. The Tester changes its capabilities to offer 0mA for PDO#1, and the full requested current (power) at PDO#2 corresponding to the sink PDO# noted above, and sends out a new Source Capabilities message as a result (use checks in PROT-PROC-SRCCAPS-TSTR). (If only 5V is specified in the Sink Capabilities, offer only PDO#1 at the full current required.)
9. Check that we receive a request from the UUT for PDO#2 (or PDO#1 if 5V only), starting to monitor VBUS voltage and current at this point. Check that the transition timing is correct according to [specify appropriate proc section here].
10. Change the Tester Source Capabilities to 0mA at each of the offered PDOs.
11. Check that we receive a valid request for 0mA from the UUT, and Accept that Request. [POW_SNK_TRANS_C_CP_2]
12. Check that the current draw after the transition corresponds to a power draw of 25mW. [POW_SNK_TRANS_C_CP_3]
13. The Tester simulates a cable detach.

3.13.6 TDA.2.3.3.2: BMC-POW-SNK-TRANS-PC PDO Transition, Current Draw, and Suspend Test, Sink, Provider/Consumer

Status	Primary Test
Purpose	To verify the timing, electrical and protocol compliance of a voltage or current transition for a Sink, after a Role Swap, and that the Sink does not draw more current than contracted for.
Critical for Safety	No
Applies to	DRP, Provider/Consumer
Description	The Tester performs a Power Role Swap to make the UUT into a Sink. It then attempts to encourage the UUT to make a request for a transition from 5V to the highest voltage it can make use of. If no better alternative is available, a transition from 5V/100mA to 5V at a higher current may be used as the test example. Except for this case we will be testing a voltage and a current increase type transition. Finally the Sink is suspended and its current draw checked against permitted suspend current.
Test setup	Current measurement equipment, protocol Tester, adjustable supply.
Ping Policy	Send Pings where possible

Preconditions	The UUT vendor is assumed to have provided instructions, and any special equipment required, to force the UUT to accept a role swap, and then request and use a particular Sink PDO, preferably a voltage higher than vSafe5V. If no better alternative is available, a transition from 5V/100mA to 5Vat a higher may be used as the test example. Except for this case we will be testing a voltage and a current increase type transition. For each PDO the vendor is assumed to have specified how long the Tester should wait before the maximum expected load will be drawn. This period has a default minimum of 5 seconds.
Assertions Tested	5.2.1#1, 5.2.3#1, 7.2.3#1-5, 7.3.1#1-5, 7.3.2#1-6, 7.3.3#1-6, 7.3.4#1-6, 7.3.5#1-6, 7.3.6#1-6, 7.3.7#1-6, 7.3.8#1-6, 7.3.19#1-3, plus assertions in any appropriate secondary checks.
Parameters Tested	tSourceActivity, tNewSnk
Checklist References	

Note: A Provider/Consumer is guaranteed to accept a swap request, under defined conditions.

Test Procedure

The following procedure make use of a configuration which will guarantee a Swap will be accepted. Essentially this means that the Provider/Consumer UUT will not be externally powered, and that the Tester will be pre-programmed with the Source Capabilities matching the vendor specified Sink Capabilities are considered to satisfy its condition to accept a Role Swap.

Note: As this is a sink and also as it is role swapped we limit the test to one or two transitions, depending on the circumstances.

1. Follow the appropriate instructions supplied by the vendor to guarantee that the Role Swap will occur.
2. During the following, the Tester is assumed to be running a PD Communications engine, which interacts correctly with all communications encountered. All messages are assumed to be checked in detail against the appropriate sections of this Plan, and the timing between messages and significant power supply events is also checked against the appropriate sections of this Plan. Specific Compliance Plan sections which will be checked in this test are shown above in 'Assertions Tested'.
3. The connection to the UUT is via a short 5A cable with a cable e-marker, or the e-marker may be absent, and the tester may simulate the 5A cable responses. If the UUT has a captive cable then it shall be connected directly to the tester, and the tester shall not simulate a cable marker.

4. The Tester gets the UUT into PD Mode (PROC-PD-MODE). By default its Source Capabilities will only offer PDO#1 at 100mA, and its Sink Capabilities will only require PDO#1 at 100mA. [BMC_POW_SNK_TRANS_PC_1]
5. Change the Source Capabilities offered to a list which matches the vendor Sink Capabilities.

Change Tester from being a Sink to being a Source as follows:

6. The Tester requests a role swap (use checks in PROT-PROC-SWAP-TSTR-SNK), which may initially be declined with a Wait, while the UUT establishes what the Tester Source Capabilities are. After having been asked for and then having sent the Source Capabilities, the Tester once again requests a role swap (use checks in PROT-PROC-SWAP-TSTR-SNK). As the Tester is meeting the vendor description which guarantees a swap will be accepted, a failure to role swap at this point is deemed a test failure. [BMC_POW_SNK_TRANS_PC_2]
7. The Tester sends the Source Capabilities specified by the vendor (use checks in PROT-PROC-SRCCAPS-TSTR) (not to offer these capabilities would result in the possibility of the UUT requesting a further role swap.)
8. The Sink is obliged to make a request at this point (use checks in PROT-PROC-REQ-UUT). This may be for the target PDO or for an intermediate one. Perform the Transition Checks specified below in PROT-PROC-REQ-UUT.
9. Send a Get_Sink_Cap message (use checks in PROT-PROC-REQ-UUT).
10. Check this Sink Capabilities message to ensure that it matches the PDOs specified by the vendor. [BMC_POW_SNK_TRANS_PC_3] Note the PDO# with the highest voltage for subsequent tests.
11. The Tester changes its capabilities to offer 0mA for PDO#1, and the full requested current (power) at PDO#2 corresponding to the sink PDO# noted above, and sends out a new Source Capabilities message as a result (use checks in PROT-PROC-SRCCAPS-TSTR). (If only 5V is specified in the Sink Capabilities, offer only PDO#1 at the full current required.)
12. Check that we receive a request from the UUT for PDO#2 (or PDO#1 if 5V only), starting to monitor VBUS voltage and current at this point. [BMC_POW_SNK_TRANS_PC_4] Check that the transition timing is correct according to [specify appropriate proc section here].
13. The Tester changes its capabilities to offer 0mA at each of the previously offered voltages, and sends out a new Source Capabilities message as a result (use checks in PROT-PROC-SRCCAPS-TSTR).
14. Check that we receive a valid request for 0mA from the UUT (use checks in PROT-PROC-REQ-UUT), and Accept that Request. [BMC_POW_SNK_TRANS_PC_5]
15. Check that the current draw after the transition corresponds to a power draw of 25mW. [BMC_POW_SNK_TRANS_PC_6]
16. The Tester simulates a cable detach.