USB Battery Charging 1.2 Compliance Plan

Revision 1.2

September 30, 2013

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Revision History

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Table of Contents

1	Introduction	7
	1.1 General	7
	1.2 Objective of the Compliance Program	7
	1.3 Scope of the Document	7
	1.4 Intended Audience	7
	1.5 Reference Document(s)	7
2	Acronyms and Terms	8
3	Scope of Tests	9
4	PET – Protocol and Electrical Tester	
	4.1 Serial Interface Engine (SIE)	
	4.2 Electrical Test Board (ETB)	
	4.3 Script Processor	
	4.4 USB Analyzer	
5	Test Cables Required	12
	5.1 Special Test Cable A	12
	5.2 Special Test Cable B	12
	5.3 Special Test Cable C	13
	5.4 Special Test Cable D	13
	5.5 Special Test Cable E	14
6	Test Setups	15
	6.1 OTG Device as Unit-Under-Test (Setup no. 1)	15
	6.2 Embedded Host as Unit-Under-Test (Setup no. 2)	16
	6.3 Peripheral Only as Unit-Under-Test (Setup no. 3)	17
	6.4 PD as Unit-Under-Test (Setup no. 4)	
	6.5 CDP (or SDP) as Unit-Under-Test (Setup no. 5)	19
	6.6 DCP as Unit-Under-Test (Setup no. 6)	20
	6.7 Micro-ACA (Separate Charger) as Unit-Under-Test (Setup no. 7)	21
	6.8 Micro-ACA (Combined Charger) as Unit-Under-Test (Setup no. 7b)	21
	6.9 Standard-ACA (Separate Charger) as Unit-Under-Test (Setup no. 8)	22
	6.10 Standard-ACA (Combined Charger) as Unit-Under-Test (Setup no. 8b)	22
	6.11 ACA-Dock as Unit-Under-Test (Setup no. 9)	23
7	Portable Device Compliance	24
	7.1 Submission Materials	24
	7.2 B-UUT Initial Power-up Test	29
	7.3 Data Contact Detect Test – With Current Source	
	7.4 Data Contact Detect Test – No Current Source	
	7.5 DCP Detection Test	
	7.6 CDP Detection Test	
	7.7 SDP Detection Test	
	7.8 ACA-Dock Detection Test	
	7.9 ACA-A Detection Test	44
	7.10 ACA-D Detection Test	45 77
	7 12 ΔCA-GND Detection Test	4747 ۸۵
	7 13 Common Mode Test - Full Sneed	49 51

	7.14 Common Mode Test - High Speed	52
	7.15 Dead Battery Provision Test	53
8	Dedicated Charging Port (DCP) Compliance	55
	8.1 Submission Materials	55
	8.2 DCP Overshoot and Undershoot Voltage Test	57
	8.3 DCP Handshaking Test	60
	8.4 DCP Resistance and Capacitance Tests	61
	8.5 DCP Voltage and Current	63
9	Charging Downstream Port (CDP) Compliance	. 65
•	9.1 Submission Materials	
	9.2 CDP Overshoot and Undershoot Voltage Test	67
	9.3 CDP Voltage and Current Test	69
	9.4 CDP Handshaking Test	70
	9.5 CDP Ground Offset Test – Full Speed	73
	9.6 CDP Ground Offset Test – High Speed	75
10	Standard Downstream Port (SDP) Compliance	77
	10.1 Submission Materials	
	10.2 SDP Handshaking Test	
11	Multiple Role Port (MRP) Compliance	70
	11.1 Submission Materials	
	11.2 MRP Functional Test	
12	Micro ACA Compliance Separate Charger	02
12	12.1 Submission Materials	03
	12.2 PET Cable Calibration	
	12.3 SDP attached to Charger Port. Nothing attached to Accessory Port	
	12.4 SDP attached to Charger Port, A-device attached to Accessory Port	94
	12.5 SDP attached to Charger Port, B-device attached to Accessory Port	
	12.6 DCP or CDP attached to Charger Port. Nothing attached to Accessory Port	
	12.7 DCP or CDP attached to Charger Port. A-device attached to Accessory Port	100
	12.8 DCP or CDP attached to Charger Port. B-device attached to Accessory Port	102
	12.9 Nothing attached to Charger Port, Nothing attached to Accessory Port	105
	12.10 Nothing attached to Charger Port, A-device attached to Accessory Port	106
	12.11 Nothing attached to Charger Port, B-device attached to Accessory Port	108
	12.12 Bypass Capacitance	110
13	Micro-ACA Compliance, Combined Charger	112
	13.1 Submission Materials	112
	13.2 PET Cable Calibration	113
	13.3 Micro-ACA Voltage, Current and Transient Test	115
	13.4 Micro-ACA Not Powered, Nothing attached to Accessory Port	118
	13.5 Micro-ACA Not Powered, A-device attached to Accessory Port	119
	13.6 Micro-ACA Not Powered, B-device attached to Accessory Port	121
	13.7 Micro-ACA Powered Up, Nothing attached to Accessory Port	123
	13.8 Micro-ACA Powered Up, A-device attached to Accessory Port	125
	13.9 Micro-ACA Powered Up, B-device attached to Accessory Port	127
	13.10 Bypass Capacitance	129
14	Standard-ACA Compliance, Separate Charger	131
	14.1 Submission Materials	131

	14.2 PET Cable Calibration	136
	14.3 SDP attached to Charger Port, Nothing attached to Accessory Port	138
	14.4 SDP attached to Charger Port, B-device attached to Accessory Port	140
	14.5 DCP or CDP attached to Charger Port, Nothing attached to Accessory Port	142
	14.6 DCP or CDP attached to Charger Port, B-device attached to Accessory Port	144
	14.7 Nothing attached to Charger Port, Nothing attached to Accessory Port	146
	14.8 Nothing attached to Charger Port, B-device attached to Accessory Port	147
	14.9 Bypass Capacitance	148
15	Standard-ACA Compliance, Combined Charger	149
	15.1 Submission Materials	149
	15.2 PET Cable Calibration	150
	15.3 Standard-ACA Voltage, Current and Transient Test	151
	15.4 Standard-ACA Not Powered, Nothing or B-device attached to Accessory Port	154
	15.5 Standard-ACA Powered Up, Nothing or B-device attached to Accessory Port	155
	15.6 Bypass Capacitance	157
16	ACA-Dock Compliance	158
	16.1 Submission Materials	158
	16.2 ACA-Dock Overshoot and Undershoot Voltage Test	160
	16.3 ACA-Dock Voltage, Current, and RID_A Test	162
	16.4 ACA-Dock not Powered.	164

Figures

Figure 4-1 ETB Block Diagram	11
Figure 6-1 Setup No 1 – OTG Device	15
Figure 6-2 Setup No 2 – Embedded Host	16
Figure 6-3 Setup No 3 – Peripheral Only	17
Figure 6-4 Setup No 4 – Portable Device	18
Figure 6-5 Setup No 5 – CDP	19
Figure 6-6 Setup No 6 – DCP	20
Figure 6-7 Setup No 7 – Micro-ACA	21
Figure 6-8 Setup No 8 – Standard-ACA	22
Figure 6-9 Setup No 9 – ACA-Dock	23

Tables

Table 5-1 Special Test Cable A	12
Table 5-2 Special Test Cable B	
Table 5-3 Special Test Cable C	
Table 5-4 Special Test Cable D	
Table 5-5 Special Test Cable E	14
Table 7-1 Device Specific Information and Materials for PDs	24
Table 7-2 Checklist for PDs	24
Table 8-1 Device Specific Information for DCPs	
Table 8-2 Checklist for DCPs	
Table 9-1 Device Specific Information for CDPs	65
Table 9-2 Checklist for CDPs	65
Table 10-1 Device Specific Information for SDPs	77
Table 10-2 Checklist for DCPs	77
Table 11-1 Device Specific Information for SDPs	79

Table 11-2 Checklist for MRPs	79
Table 12-1 Device Specific Information for Micro-ACAs with Separate Charger	
Table 12-2 Checklist for Micro-ACAs	83
Table 13-1 Device Specific Information for Micro-ACAs with Combined Charger	
Table 14-1 Device Specific Information for Standard-ACAs with Separate Charger	
Table 14-2 Checklist for Standard-ACAs	
Table 15-1 Device Specific Information for Standard-ACAs with Combined Charger	149
Table 16-1 Device Specific Information for ACA-Docks	

1 Introduction

1.1 General

This compliance plan enables test and certification of USB Portable Devices, Chargers and Charging Ports, Micro-ACAs, Standard-ACAs and ACA-Docks to USB 2.0 specification and to Battery Charging specification revision 1.2.

Charging Ports include Dedicated Charging Ports and Charging Downstream Ports as defined in the Battery Charging Specification revision 1.2. A USB Charger is a device with a Dedicated Charging Port, such as a wall adapter or car power adapter. Herein, USB Chargers are referred to as Dedicated Charging Ports as functionally they are identical.

Previously a USB Portable Device with a battery and charging capability simply took power from a USB port without any control. With BC 1.2, a Portable Device can get more power and the battery can be charged faster. It is important to verify that a Portable Device complies with the BC 1.2 specification while communicating with a Charging Downstream Port and identifying a Dedicated Charger, and ensuring that it continues to operate as a functional USB device.

Many existing dedicated chargers have offered a USB compliant physical connection but lacked a USB compliance program. This led to many chargers having characteristics incompatible with USB specifications.

As well, even though PC host ports go through an extensive certification process, future PCs that claim a USB compliant Charging Port in their feature list will be required to pass compliance checks described in this document. These checks are in addition to those required for a USB compliant Standard Downstream Port.

1.2 Objective of the Compliance Program

The overall objective of the USB Charger and Charging Port compliance program is to mirror the effectiveness of the USB-IF compliance program. The benefits of a compliance program have been proven by the USB initiative: the proliferation of knowledge, more stringent testing, and a higher standard of quality.

1.3 Scope of the Document

This document provides a compliance plan applicable to Portable Devices, USB Chargers and Charging Ports, Micro-ACAs, Standard-ACAs and ACA-Docks, as defined in the BC 1.2 specification.

1.4 Intended Audience

This plan is intended for compliance test labs and workshops. In addition, the document is intended for device manufacturers for pre-certification activities before applying for official compliance certification.

1.5 Reference Document(s)

- Battery Charging 1.2 Specification and Adopters Agreement http://www.usb.org/developers/devclass_docs/
- Universal Serial Bus Specification Revision 2.0 Specification http://www.usb.org/developers/docs/

2 Acronyms and Terms

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

ACA	Accessory Charger Adapter		
BC 1.2	USB-IF Battery Charging Specification version 1.2		
CDP	Charging Downstream Port		
CMO	Common Mode Offset		
CMV	Common Mode Voltage		
DBP	Dead Battery Provision		
DC	Direct Current		
DCD	Data Contact Detect		
DCP	Dedicated Charging Port		
ETB	Electrical Test Board		
FS	Full-speed		
HS	High-speed		
ID	Identification		
LS	Low-speed		
MRP	Multiple Role Port (CDP/DCP/SDP)		
OTG	On-The-Go		
PC	Personal Computer		
PD	Portable Device		
PET	Protocol and Electrical Tester		
PHY	Physical Layer Interface for High Speed USB		
PS2	Personal System 2		
SDP	Standard Downstream Port		
SIE	Serial Interface Engine		
SRP	Session Request Protocol		
TID	Test Identification Number		
TPL	Targeted Peripheral List		
USB	Universal Serial Bus		
USBCV	USB Command Verifier		
USB-IF	USB Implementers Forum		
UUT	Unit Under Test		
VBUS	Voltage line of the USB interface		

3 Scope of Tests

This document describes suites of tests for a number of product types. These tests only cover the additional requirements for these products, relating to the functionality of battery charging. Most of the product types will require further compliance testing to ensure their functionality in other areas, and it is beyond the scope of this document to define those tests.

For example, a Portable Device (PD) may be an OTG device and as such, require to be tested according to the appropriate OTG Supplement Compliance Plan.

The document is divided into suites of tests, each of which represents all or part of the Battery Charging test requirements for a particular product. A given product shall be tested against all the appropriate test suites. The following examples, which are not exhaustive, illustrate this principle.

<u>PD</u>

Test against both:

- 'PD, except Dead Battery Provision' tests and
- 'PD, Dead Battery Provision' tests.

Simple Charger

Test against:

DCP tests

Charging Port on Host

Test against:

CDP tests

<u>Hub</u>

Test against:

- CDP tests
- DCP tests
- SDP tests
- MRP tests

ACA or ACA-Dock

Test against the one appropriate category from:

- Micro-ACA, Separate Charger
- Micro-ACA, Combined Charger
- Standard-ACA, Separate Charger
- Standard-ACA, Combined Charger
- ACA-Dock

4 PET – Protocol and Electrical Tester

The PET is a unit, designed to perform compliance testing or assist with development work leading towards compliance testing on On-the-Go, Battery Charging and other general USB applications. It is described in detail in the document:

• Protocol and Electrical Tester Specification

A brief breakdown of its functional blocks follows.

4.1 Serial Interface Engine (SIE)

A fully functional SIE, with both host and peripheral capabilities, connected via a PHY to the UUT micro-AB receptacle on the front panel. This is under the control of the Script Processor.

4.2 Electrical Test Board (ETB)

This contains circuitry to allow control and measurement of the electrical parameters for USB, OTG and BC specifications. It includes VBUS Generator, ID pin circuitry, data line test mode circuitry, VBUS current and voltage loads, and a variety of voltage and current measuring blocks. Extra connections are provided to enable the testing of Accessory Charger Adapters (ACAs). The ETB functionality required is shown in Figure 4-1.

4.3 Script Processor

Scripts are downloaded to this processor to control the sequence of operations required for a particular test. The processor controls the SIE and ETB as required by the operator. Scripts for all the OTG and BC compliance tests would be provided by the application accompanying the PET.

4.4 USB Analyzer

The PET could also provide full USB analyzer functionality. By designing the analyzer into the PET circuitry the analyzer could be designed to have zero impact on the data line transmission quality.



Figure 4-1 ETB Block Diagram

5 Test Cables Required

The cables required by the PET tester are described below.

Each cable should be labeled, and specify the lead loop resistance value, required to be entered into the test dialog, if the lead is replaced. The tester application contains a check box to specify whether the UUT has a captive lead, as in this case the captive test cable is deemed to be part of the unit under test.

5.1 Special Test Cable A

Micro-B plug to Micro-B plug			
Micro-B plug (PET) Micro-B plug (UUT) Purpose			
1	1	VBUS	
2	2	D-	
3	3	D+	
4	4	ID	
5	5	GND	

Table 5-1 Special Test Cable A

This cable has been specified to allow control of the ID pin of the unit-under-test. It is important to use this cable when the test specifies it. The particular resistance of the cable has also been allowed for in the test suite.

5.2 Special Test Cable B

Table 5-2 Special Test Cable B

Micro-B plug to Standard-A plug			
Micro-B plug (PET) Standard-A plug (UUT) Pur		Purpose	
1	1	VBUS	
2	2	D-	
3	3	D+	
nc			
5	4	GND	

Although this is a standard cable configuration, it is important to use the specified cable, as its particular resistance has been allowed for in the test suite.

5.3 Special Test Cable C

9-pin D-type Assembly			
D-type (PET)	Standard-A Receptacle (ACA Charger Port)	Micro-B Plug (ACA Accessory Port)	Purpose
1 (linked to 4)			Cable Sense
2		1	Accessory VBUS
3		4	Accessory ID
4	4	5	GND
5	1		Charger VBUS
6	2		Charger D-
7	3		Charger D+
8			OTG VBUS
9			OTG ID

 Table 5-3 Special Test Cable C

This cable is used when testing a Micro-ACA. This is correct for a Micro-ACA with a captive charger port cable. For a Micro-ACA with a Micro-B receptacle as the charger port, connect Special Cable B to the Standard-A receptacle of Special cable C, and plug the other end into the charger port of the ACA.

5.4 Special Test Cable D

Table 5-4 Special Test Cable D

9-pin D-type Assembly			
D-type (PET)	Standard-A Receptacle (ACA Charger Port)	Standard-A Plug (ACA Accessory Port)	Purpose
1 (linked to 4)			Cable Sense
2		1	Accessory VBUS
3			Accessory ID
4	4	4	GND
5	1		Charger VBUS
6	2		Charger D-
7	3		Charger D+
8			OTG VBUS
9			OTG ID

This cable is used when testing a Standard-ACA. This is correct for a Standard-ACA with a captive charger port cable. For a Standard-ACA with a Micro-B receptacle as the charger port, connect Special Cable B to the Standard-A receptacle of Special cable C, and plug the other end into the charger port of the ACA.

5.5 Special Test Cable E

Micro-A plug to Standard-A receptacle		
Micro-A plug (PET)	Standard-A receptacle (UUT)	Purpose
1	1	VBUS
2	2	D-
3	3	D+
4 - Connected to pin 5		
5	4	GND

Table 5-5 Special Test Cable E

This is a short adapter cable, which may be used to connect a PD with a standard-A plug to the PET.

6 Test Setups

6.1 OTG Device as Unit-Under-Test (Setup no. 1)

When running a test-suite relating to an OTG device, the first test will prompt you to connect it to the PET using 'Special Cable A'. This *Micro-B plug* to *Micro-B plug* cable is provided with the PET unit and it is essential that this particular cable be used, for the following reasons:

It has 5 cores, instead of the usual 4. This allows the PET to control the ID pin of the UUT.

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.



Figure 6-1 Setup No 1 – OTG Device

6.2 Embedded Host as Unit-Under-Test (Setup no. 2)

When running a test-suite relating to an Embedded Host, the first test will prompt you to connect it to the PET using 'Special Cable B'. This *Micro-B plug* to *Standard-A plug* cable is provided with the PET unit and it is essential that this particular cable be used, for the following reason:

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.



Figure 6-2 Setup No 2 – Embedded Host

6.3 Peripheral Only as Unit-Under-Test (Setup no. 3)

When running a test-suite relating to a Peripheral-Only OTG device with a *Micro-B receptacle*, the first test will prompt you to connect it to the PET using 'Special Cable A'. This *Micro-B plug* to *Micro-B plug* cable is provided with the PET unit and it is essential that this particular cable be used, for the following reason:

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.

Another possibility is that the device has a captive cable with a *Micro-A plug*. In this case use this, and check the 'Captive Cable' check box, in the 'PET Test Suites' Dialog.

Finally, the device may have a captive cable with a *Standard-A plug*. In this case, use 'Special Cable E' to connect the *Standard-A plug* to the *Micro-AB receptacle* of the PET, and check the 'Captive Cable' check box, in the 'PET Test Suites' Dialog.



Figure 6-3 Setup No 3 – Peripheral Only

6.4 PD as Unit-Under-Test (Setup no. 4)

A Portable Device (PD) is assumed to have a *Micro-B receptacle* or a *Micro-AB receptacle*. A PD that mates with an ACA-Dock or ACA is required to have a *Micro-AB receptacle*. The PD may alternatively have a captive cable.

When running a test-suite relating to a PD having a *Micro-B receptacle* or a *Micro-AB receptacle*, the first test will prompt you to connect it to the PET using 'Special Cable A'. This *Micro-B plug* to *Micro-B plug* cable is provided with the PET unit and it is essential that this particular cable be used, for the following reason:

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.

The other possibility is that the device has a captive cable with a *micro-A plug*. In this case use this, and check the 'Captive Cable' check box, in the 'PET Test Suites' Dialog.



Figure 6-4 Setup No 4 – Portable Device

6.5 CDP (or SDP) as Unit-Under-Test (Setup no. 5)

A Charging Downstream Port (CDP) must be equipped with a Standard-A receptacle.

When running a test-suite relating to a CDP, the first test will prompt you to connect it to the PET using 'Special Cable B'. This *Micro-B plug* to *Standard-A plug* cable is provided with the PET unit and it is essential that this particular cable be used, for the following reason:

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.



Figure 6-5 Setup No 5 – CDP

6.6 DCP as Unit-Under-Test (Setup no. 6)

A Dedicated Charging Port (DCP) must be equipped with a *Standard-A receptacle*, or a captive cable terminated with a *Micro-B plug*.

When running a test-suite relating to a DCP with a **Standard-A receptacle**, the first test will prompt you to connect it to the PET using 'Special Cable B'. This **Micro-B plug** to **Standard-A plug** cable is provided with the PET unit and it is essential that this particular cable be used, for the following reason:

The resistance of this cable has been allowed for in tests involving large VBUS currents with measurements on VBUS current and voltage.

The other possibility is that the device has a captive cable with a *micro-B plug*. In this case use this, and check the 'Captive Cable' check box, in the 'USB-PET Test Suites' Dialog.



Figure 6-6 Setup No 6 – DCP

6.7 Micro-ACA (Separate Charger) as Unit-Under-Test (Setup no. 7)

An Accessory Charger Adapter having a Micro-AB receptacle for its accessory port (Micro-ACA) must be equipped with:

- a captive cable terminated with a Micro-A plug for its OTG port
- a Micro-B receptacle, or a captive cable with Standard-A plug for its charger port, and of course
- a Micro-AB receptacle for its accessory port

When running a test-suite relating to a Micro-ACA, the first test will prompt you to connect it to the PET using 'Special Cable C'.



Figure 6-7 Setup No 7 – Micro-ACA

6.8 Micro-ACA (Combined Charger) as Unit-Under-Test (Setup no. 7b)

This is the same as Setup 7 except that there is no charger cable coming from the UUT.

6.9 Standard-ACA (Separate Charger) as Unit-Under-Test (Setup no. 8)

An Accessory Charger Adapter having a Standard-A receptacle for its accessory port (Standard-ACA), must be equipped with:

- a captive cable terminated with a Micro-A plug for its OTG port
- a Micro-B receptacle, or a captive cable with Standard-A plug for its charger port, and of course
- a Standard-A receptacle for its accessory port

When running a test-suite relating to a Standard-ACA, the first test will prompt you to connect it to the PET using 'Special Cable D'.





6.10 Standard-ACA (Combined Charger) as Unit-Under-Test (Setup no. 8b)

This is the same as Setup 8 except that there is no charger cable coming from the UUT.

6.11 ACA-Dock as Unit-Under-Test (Setup no. 9)

An ACA-Dock must be equipped with a Micro-A plug, for connecting to the Micro-AB receptacle of a PD. It is represented here as a captive cable. In practice it may comprise part of a fixture, which may be difficult to connect to the PET front panel. In this case it is the responsibility of the vendor to provide a suitable means to connect the ACA-Dock to the Micro-AB receptacle of the PET.

When running a test-suite relating to an ACA-Dock, the first test will prompt you to connect it to the PET using its captive cable.



Figure 6-9 Setup No 9 – ACA-Dock

7 Portable Device Compliance

7.1 Submission Materials

7.1.1 Device Specific Information and Materials

Table 7-1	Device	Specific	Information	and	Materials for P	Ds
-----------	--------	----------	-------------	-----	-----------------	----

ltem	Function	Value/ Support
1	Captive Cable	Yes 🗆 No 🗆
2	Apply Dead Battery Provision	Yes 🗆 No 🗆
3	Weak Battery Threshold	V
4	Maximum Charging Current with Dedicated Charger	mA
5	Maximum Charging Current with Charging Downstream Port operating at LS or FS	mA
6	Maximum charging current with Charging Downstream Port operating at HS	mA
7	Typical and maximum times that UUT with a dead battery will take to connect after being attached to a Standard	Турms
	Downstream Port	Maxms
8	Typical and maximum times that UUT with a dead battery	Typms
	will take to connect after being attached to a Charging Downstream Port	Maxms
9	Maximum current that the UUT can draw from a CDP	mA
10	The USB-IF TID for the UUT USB receptacle or captive plug intended to connect the UUT to a host or OTG device.	
11	Supply 2 batteries in a dead state for the Dead Battery Provision test.	
12	Supply 2 batteries in a state just above the weak battery threshold.	
13	Supply 1 good battery.	

7.1.2 Checklist

Table 7-2 Checklist for PDs

ID - Que	estion	Response	Test Number	BC 1.2 Reference
PD1	Can the PD detect when VBUS is	Yes 🗆 No 🗆	Vendor	3.2.2
	greater than a threshold in the range VOTG_SESS_VLD ?		Declaration	3.3.1
PD2	Can the PD detect when D+ is greater than a threshold in the range VDAT_REF ?	Yes 🗆 No 🗆	Vendor Declaration	3.3.1
PD3	Can the PD detect when D- is greater than a threshold in the range VDAT_REF ?	Yes 🗆 No 🗆	Vendor Declaration	3.3.1

r				
PD4	Can the PD detect when D- is greater than a threshold in the range VLGC ?	Yes 🗆 No 🗆	Vendor Declaration	3.3.1
PD5	[Optional] Does PD use a current source IDP_SRC and pull-down resistor RDM_DWN to detect when the data pins have made contact during an attach event?	Yes 🗆 No 🗆	7.3	3.2.3.1 3.4.1 4.6.2
PD6	If yes, does PD commence Primary Detection within TDCD_TIMEOUT max after VBUS rises above VOTG_SESS_VLD, if pin contact has not been detected on D+ or ID pins?	Yes 🗆 No 🗆	7.3	3.2.3.1 3.3.2 4.6.2
PD7	If no, does PD wait a time of TDCD_TIMEOUT after the attach event before starting Primary Detection?	Yes 🗆 No 🗆	7.4	3.2.3.1 3.3.2 4.6.2
PD8	Does PD connect within TsvLD_CON_PWD of the attach event?	Yes 🗆 No 🗆	7.6, 7.7, 7.10, 7.11	3.2.3.1
PD9	Does PD wait for D+ to stay below VLGC_LOW for TDCD_DBNC min before disconnecting IDP_SRC and RDM_DWN?	Yes 🗆 No 🗆	7.3	3.3.2 3.4.1
PD10	Does PD turn on VDP_SRC and IDM_SINK and maintain them for TVDPSRC_ON during Primary Detection?	Yes □ No □	7.6, 7.7	3.2.4.1 3.2.4.2 3.2.4.3 3.3.2 3.4.2
PD11	Is the design of VDP_SRC such that an external device is able to pull D+ to 2.2V through RDP_UP?	Yes 🗆 No 🗆	7.8	3.2.4.4 5
PD12	Does PD compare D- with VDAT_REF during Primary Detection to distinguish between an SDP and a Charging Port?	Yes □ No □	7.7	3.2.4.1 3.2.4.2 3.2.4.3 3.3.2 4.6.2
PD13	[Optional] Does PD compare D- with VLGC during Primary Detection?	Yes 🗆 No 🗆	Vendor Declaration	3.2.4.1 3.2.4.2 3.2.4.3 3.3.2 4.6.2
PD14	[Optional] Does PD implement Secondary Detection?	Yes 🗆 No 🗆	7.5, 7.6	4.6.2
PD15	If the PD supports Secondary Detection, does the PD turn on VDM_SRC and IDP_SINK and maintain them for TVDMSRC_ON during Secondary Detection?	Yes □ No □ N/A □	7.5, 7.6	3.2.5.1 3.2.5.2 3.3.2 3.4.2
PD16	If the PD supports Secondary Detection, does the PD compare D+ with VDAT_REF during Secondary Detection to distinguish between a DCP and a CDP?	Yes □ No □ N/A □	Vendor Declaration	3.2.5.1 3.2.5.2 3.3.2 3.4.2

PD17	If the PD supports Secondary Detection, and during this detects that it is attached to a DCP, does it disable VDM_SRC and IDP_SINK, and either enable VDP_SRC or pull D+ up to VDP_UP through RDP_UP, within TSVLD_CON_PWD of attach, and maintain this for as long as it draws more than ISUSP? If the PD does not support Secondary Detection, and during Primary Detection has detected that it is connected to a DCP or to a CDP, does it pull D+ up to VDP_UP through RDP_UP, within TSVLD_CON_PWD of attach, and maintain this for as long as it draws more than ISUSP?	Yes 🗆 No 🗆	7.5	3.2.5.1 3.3.2
PD18	If the PD supports Secondary Detection, and during this detects that it is attached to a CDP, does it turn off VDP_SRC, VDM_SRC and IDP_SINK, and connect within TSVLD_CON_PWD of attach?	Yes □ No □ N/A □	7.6	3.2.5.2 3.3.2 3.4.2
PD19	[Optional] Does PD implement ACA Detection?	Yes 🗆 No 🗆	Vendor Declaration	3.2.6 4.6.2
PD20	If the PD supports ACA detection, does PD have a Micro-AB receptacle?	Yes □ No □ N/A □	Inspection	3.2.6 4.6.4
PD21	If the PD supports ACA detection, is it able to detect being attached to an ACA-Dock when it sees the following conditions: • VBUS > VOTG_SESS_VLD	Yes □ No □ N/A □	7.8	3.2.4.4 3.3.2 3.2.6
	ID at RID_A			
	D+ at VLGC_HI			
	• VDAT_REF < D- < VLGC			
PD22	If the PD supports ACA detection, is it able to detect being attached to an ACA with a FS B-device on its accessory port and a charging port attached, when it sees the following conditions:	Yes	7.9	3.2.4.5 3.3.2 3.2.6
	• ID at RID_A			
	• D- < VDAT_REF			
PD23	If the PD supports ACA detection, is it able to detect being attached to an ACA with a LS B-device on its accessory port and a charging port attached, when it sees the following conditions:	Yes □ No □ N/A □	Vendor Declaration	3.2.4.5 3.2.6
	ID at RID_A			
	• D- > VLGC			

• ID at RID_B PD25 If the PD supports ACA detection, is it able to detect being attached to an ACA with an A-device on its accessory port and a charging port Yes □ No □ 7.11 3.2.4.5 N/A □ N/A □ 7.11 3.2.6	
PD25If the PD supports ACA detection, is it able to detect being attached to an ACA with an A-device on its accessory port and a charging portYes □ No □ N/A □7.113.2.4.5 3.2.6	
attached, when it sees the following condition:	
ID at RID_C	
PD26 If the PD supports ACA detection, is it able to detect being attached to an ACA with an B-device on its accessory port and no charging port attached, when it sees the following condition: Yes □ No □ 7.12 3.2.6	
PD27 If the PD supports ACA detection, does it continue to monitor the ID line after doing Primary detection, and respond correctly to resistance changes? Yes □ No □ Vendor 3.2.4.5 N/A □ N/A □ 0eclaration 3.2.6	
PD28 Does PD discharge VBUS to less than VBUS_LKG within TVLD_VLKG whenever VBUS is removed? Yes □ No □ 7.7 4.6.3	
PD29Does PD wait at least TCP_VDM_EN after disconnecting, before restarting the charger detection process?Yes □ No □ DeclarationVendor Declaration4.6.3	
PD30 Does PD draw no more than IDEV_CHG max from a Charging Port? Yes □ No □ 7.5, 7.6, 7.8, 7.9, 7.10, 7.11 4.6.1 What is the value of IMAX_BC, the actual maximum current drawn? mA mA mA Note: IMAX_BC is the maximum current that the PD can draw from a CDP. mA mA mA	
PD31Does PD draw no more than ICFG_MAX from a SDP?Yes □ No □7.72.1	
PD32Does PD pull output voltage of a Charging Port no lower than VDCP_SHTDWN?Yes □ No □ DeclarationVendor Declaration4.6.1	
PD33 Does the PD correctly support LS, FS, HS and chirp signaling when the local ground is (IMAX_BC x 0.25Ω + 5mV)* higher than the remote ground, where IMAX_BC is the maximum current that the PD can draw from a CDP? Yes □ No □ 7.13, 7.14 3.5 *maximum of 0.375V Yes □ No □ 7.13, 7.14 3.5	
DBP1 Does PD draw no more than IUNIT Yes D No D 7.15 2.2	

DBP2	Does PD reduce current drawn to ISUSP within TSVLD_CON_WKB after attach if it is unable to connect and be enumerated?	Yes 🗆 No 🗆	Vendor Declaration	2.2
DBP3	Does PD enable VDP_SRC within TDBP_ATT_VDPSRC of attach and maintain it if it is unable to connect?	Yes 🗆 No 🗆	7.15	2.2
DBP4	Does PD connect within TDBP_ VDPSRC_CON of disabling VDP_SRC?	Yes 🗆 No 🗆	Vendor Declaration	2.2
DBP5	Does PD prevent the use of DBP current to perform tasks unrelated to battery charging?	Yes 🗆 No 🗆	Vendor Declaration	2.2
DBP6	If the PD uses the DBP, can the	Yes 🗆 No 🗆	Vendor	2.2
	device normally operate stand-alone from internal battery power?	N/A □	Declaration	
DBP7	Can the PD, with a dead battery, pass the inrush test?	Yes 🗆 No 🗆	Vendor Declaration	2.2

7.2 B-UUT Initial Power-up Test

Test Setup	Test Setup 4. UUT is a PD, PET simulates a downstream port.
Purpose	To prepare the PD for the following tests.
Preconditions	To ensure that the PD has been powered up and is ready for the subsequent tests. All following PD tests assume that this test has been run first.
	In the case of an ADP capable device, this test also confirms functional startup sequence.
Parameters	TB_SRP_FAIL, TB_ADP_PRB, TPWRUP_RDY
Description	The test operator is then instructed to connect up the PD in preparation for the tests, and to perform any actions required to power it up.

7.2.1 Test Procedure

Part 1 – Common to All B-UUT Types

- 1. The user enters into the PET:
 - whether the UUT is capable of ADP

The test sequence followed depends on the UUT type

- PD capable of ADP
- PD not capable of ADP

Part 2 – For PD UUT capable of ADP

- 2. Operator: Ensure UUT connected using special cable A or, where the device does not have a micro-AB or micro-B receptacle, a suitable alternative.
- 3. UUT is either powered or is not powered. PET is not applying VBUS, and not applying capacitance between VBUS and ground, ID pin is not connected to ground.
- 4. Operator: Turn UUT off, if not already off.
- 5. Operator: Turn UUT on.
- 6. Check that UUT performs an ADP probe within TPWRUP_RDY (30 sec or as specified by vendor).
- 7. To check probe, check that VBUS goes below 0.3V and then rises above 0.5V within 10ms.
- 8. After the first probe check that either a further probe (or probes) is performed, or that D+ goes high. Wait here till D+ goes high or TPWRUP_RDY times out.
- 9. Check that D+ stays high for at least 5ms.
- 10. Check that D+ goes low within 10ms of start of pulse.

- 11. Check ADP probe is not performed for TB_SRP_FAIL min (5 sec) after start of D+ (SRP) pulse.
- 12. Check that ADP probe is performed within TB_SRP_FAIL max plus TB_ADP_PRB max (6.0 + 2.6 = 8.6 sec) after start of D+ (SRP) pulse.
- 13. Now ready for any other B_UUT test.

Part 2 – For PD UUT not capable of ADP

- 2. Operator: Ensure UUT connected using special cable A or, where the device does not have a micro-AB or micro-B receptacle, a suitable alternative
- 3. UUT is either powered or is not powered. PET is not applying VBUS, and not applying capacitance between VBUS and ground, ID pin is not connected to ground.
- 4. Operator: Turn UUT on, if not already on.
- 5. PET applies CADP_VBUS max (6.5 μ F) and a pull-down resistor of ROTG_VBUS min (10k Ω) to VBUS and turns on VBUS.
- 6. Check that D+ goes high within TPWRUP_RDY (30 sec).
- 7. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 8. Wait 5 seconds to allow disconnection to be detected.
- 9. Now ready for any other B_UUT test.

Following Tests

From now on all test sequences must start and finish with the PET holding VBUS off, and no capacitance or pull-down resistance connected to VBUS. This allows the tests to be performed in any sequence. In between tests, the ID pin is not connected to ground.

Test Setup	Test Setup 4. UUT is a PD, PET simulates a downstream port.
Pre-conditions	Only required if UUT supports DCD using IDP_SRC. The charge state of the battery is not critical in this test, provided it is above the Weak Battery Threshold.
Purpose	To validate a correct data contact detection procedure when the UUT supports DCD using IDP_SRC.
Description	Check that IDP_SRC is maintained for TDCD_DBNC after D+ is pulled low and that TDCD_TIMEOUT is complied with.
Parameters	RDM_DWN or IDM_SINK, TDCD_DBNC, IDP_SRC
Checklist	PD5, PD6, PD9
Pass Criteria	Step 3: D+ to rises above 2V
	Step 6: D- does not exceed 0.498V
	Step 10: D+ is less than 0.375V.

7.3 Data Contact Detect Test – With Current Source

7.3.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

DCD using IDP_SRC

- 1. PET applies CADP_VBUS max (6.5μF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V.
- 2. Start timer when VBUS reaches 0.8V.
- 3. Wait for D+ to rise above 2V. (If it doesn't within 0.9 second test fails.) This proves that IDP_SRC is sufficiently large to overcome the UUT's own leakage current. [PD5]
- 4. Measure and report time till it does.
- 5. After 1ms of D+ exceeding 2V, measure and report voltage on D+.
- 6. Connect 0.8V via 15k Ω to D-. Check voltage at D- is in correct range for a pull-down value meeting the specification (i.e. that voltage is not greater than 0.498V and not less than 0.390V). [PD5]

Note: For worst case max RDM_DWN of 24.8K we need a max voltage at D- of 0.498V. For worst case min RDM_DWN of 14.25K we need a min voltage at D- of 0.390V.

- 7. Disconnect components in previous step.
- 8. Connect $15k\Omega$ from D+ to 0V.
- 9. Wait just less than TDCD_DBNC min (<10ms = 9.5ms). [PD9]
- 10. Check voltage on D+ is less than 0.375V. This proves that IDP_SRC and leakage, together, are low enough to provide a low logic level on D+, even after nearly

TDCD_DBNC min (10ms). (Voltage to be adjusted in actual test script to allow for small tester leakage.)

Note: Highest current sourced by UUT should be IDP_SRC max (13 μ A) plus VDAT_LKG max (3.6V) across RDAT_LKG min (300K), equals 13 + 12 μ A = 25 μ A. 25 μ A x 15K = 0.375V.

- 11. Disconnect everything from VBUS, and switch VBUS off.
- 12. Wait 2 seconds for disconnect to be detected.

DCD using Timeout

- 13. PET applies CADP_VBUS max (6.5μF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V.
- 14. Start timer when VBUS reaches 0.8V.
- 15. Wait for D+ to rise above 2V. (If it doesn't within 0.9 second test fails.).
- Check that D+ goes down to voltage in the range VDP_SRC (0.5 to 0.7V) within TDCD_TIMEOUT (0.3 to 0.9 sec) of D+ going high and within 1 second of VBUS reaching 0.8V. [PD6]
- 17. Turn off VBUS.
- 18. Wait 8 seconds, ignoring SRP pulse, for disconnect to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates.
Pre-conditions	Only required if UUT does not support DCD using IDP_SRC. The charge state of the battery is not critical in this test, provided it is above the Weak Battery Threshold.
Purpose	To validate a correct data contact detection procedure when the UUT does not support DCD using IDP_SRC.
Description	Check that Primary Detection commences within TDCD_TIMEOUT max of VBUS turning on.
Parameters	RDM_DWN or IDM_SINK, TDCD_DBNC, IDP_SRC
Checklist	PD5, PD7
Pass Criteria	Step 3: Time for D+ to go to VDP_SRC is 0.3 to 0.9 sec.

7.4 Data Contact Detect Test – No Current Source

7.4.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

DCD using Timeout

- 1. PET applies CADP_VBUS max (6.5μF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V.
- 2. Start timer when VBUS reaches 0.8V.
- 3. Connect 15k resistors from 0V to D+, and from 0V to D-.
- 4. Check that D+ goes up to voltage in the range VDP_SRC (0.5 to 0.7V) within TDCD_TIMEOUT (0.3 to 0.9 sec) of VBUS going on. [PD7]
- 5. Disconnect 15k pull-down resistors from D+ and D-.
- 6. Disconnect capacitance and pull-down resistor from VBUS and switch VBUS off.
- 7. Wait 8 seconds, ignoring SRP pulse, for disconnect to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates a DCP.
Pre-conditions	Vendor has declared whether secondary detection is implemented. This test should be performed with a battery just above the Weak Battery Threshold, as this provides the best check on the maximum current drawn.
Purpose	To validate a correct detection procedure when the UUT encounters a DCP.
Description	PET simulates a DCP and monitors activity on D+ and D-, and current drawn.
Parameters	VDP_SRC, VDM_SRC, TVDPSRC_ON, TVDMSRC_ON,
Checklist	PD14, PD15, PD17, PD30
Pass Criteria	See below

7.5 DCP Detection Test

7.5.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

DCD

- 1. PET connects 200R between D+ and D-.
- PET connects voltage source of 0V via 100k to D-, to prevent false detection of voltage on D+ etc.
- 3. PET applies CADP_VBUS max (6.5µF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to VB_BUS nom (5V). ID pin is left floating.

Primary Detection

- 4. Wait for D+ to rise above 0.5V
- 5. Wait 1ms for D+ to settle.
- 6. Measure D+ and check voltage is VDP_SRC (0.5 to 0.7V).
- 7. Wait for slightly less than TVDPSRC_ON min (38ms).
- 8. Check that D+ voltage is still VDP_SRC (0.5 to 0.7V)
- 9. Wait for D+ to go below 0.5V, or above 0.8V, or for TSVLD_CON_PWD (1 sec) from VBUS going on to expire.

TSVLD_CON_PWD expires:

Implication is that change between driving VDP_SRC, then driving VDM_SRC and then driving VDP_SRC was not seen by the tester, as no gaps were inserted. We can only assume that this is not a failure. Skip to 'Checking Current Draw'.

D+ goes below 0.5V:

If secondary detection is declared not to be implemented, skip to 'Checking Current Draw'.

If secondary detection is declared to be implemented, proceed with 'Secondary Detection'.

D+ rises above 0.8V:

If D+ rises instead above 0.8V, it will be regarded as a 'device connect'.

If secondary detection is declared not to be implemented, this is a valid procedure, and the tester will report that this sequence has occurred, and skip to 'Checking Current Draw'.

If secondary detection is declared to be implemented, and less than 80ms has passed since D+ first rose above 0.5V, this constitutes a failure because the specified periods TVDPSRC_ON plus TVDMSRC_ON have not been completed. [PD14]

If secondary detection is declared to be implemented, and more than 80ms has passed since D+ first rose above 0.5V, this implies that the change between driving VDP_SRC and then driving VDM_SRC was not seen by the tester. The only possible conclusion here is to assume a pass at this stage, and to skip to 'Checking Current Draw'.

Secondary Detection

10. Wait for D- to rise above 0.5V, or above 0.8V, or for expiration of TSVLD_CON_PWD (1 sec) from VBUS going on.

TSVLD_CON_PWD expires:

This constitutes a failure because neither VDP_SRC nor a pullup to VDP_UP through RDP_UP occurred.

D- goes above 0.5V:

First check if it goes between 0.7V and 0.8V within 1ms. If so this is an error.

Also check if it goes above 0.8V within 1ms. If so go to 'D- goes above 0.8V'.

If voltage stays within VDM_SRC (0.5 to 0.7V), assume this is secondary detection and go to Step 11.

D- goes above 0.8V:

This will be regarded as a 'device connect'. (D+ and D- are connected via 200R.)

If less than 80ms has passed since D+ first rose above 0.5V, this constitutes a failure because the specified periods TVDPSRC_ON plus TVDMSRC_ON have not been completed. [PD14]

Otherwise, proceed to 'Checking Current Draw'.

(In practice we may have missed gap between VDP_SRC and VDM_SRC, and be seeing a gap between VDM_SRC and connect. However this will not invalidate the next steps.)

- 11. Wait for slightly less than TVDMSRC_ON min (38ms).
- 12. Check that D- voltage is still VDM_SRC (0.5 to 0.7V). [PD14], [PD15]
- 13. Wait for D- to go below 0.5V, or above 0.8V, or for TSVLD_CON_PWD max (1 sec) from VBUS going on to expire.
Checking Current Draw

- 14. If secondary detection is declared to be implemented, display message to test operator 'PD under test should now have detected DCP'.
 If secondary detection is declared not to be implemented, display message to test operator 'PD under test should now have detected DCP or CDP'. (This is a development aid.)
- 15. Check current drawn does not exceed 1.5A from now on. [PD30]
- Check D+ is held at or above VDP_SRC min (0.5V) for the entire period, starting TSVLD_CON_PWD max (1 sec) after VBUS was applied, that current drawn exceeds ISUSP max (2.5mA). Note that the voltage drop in the cable ground will raise the apparent voltage on D+. [PD17]
- 17. Maintain session for 30 seconds from step 14.
- 18. Disconnect 200R resistor between D+ and D-.
- 19. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 20. Disconnect voltage source and 100k resistor from D-.
- 21. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates.
Pre-conditions	Vendor has declared whether secondary detection is implemented. This test must be performed with a battery just above the Weak Battery Threshold, as this provides the best check on the maximum current drawn.
Purpose	To validate a correct detection procedure when the UUT encounters a CDP. Also to check correct renegotiation behavior.
Description	PET simulates a CDP and monitors activity on D+ and D- , and current drawn.
Parameters	VDP_SRC, TVDPSRC_ON, TSVLD_CON_PWD, IMAX_BC
Checklist	PD8, PD10, PD14, PD15, PD18, PD28, PD30
Pass Criteria	See below

7.6 CDP Detection Test

7.6.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

DCD

- 1. Switch data lines to PET test circuit. PET applies a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V. ID pin is left floating.
- 2. Connect 0V via 15k resistor to D+. Connect 0V via15k resistor to D-.

Primary Detection

- 3. Wait for D+ to rise above 0.5V
- 4. Wait 1ms for D+ to settle.
- 5. Measure D+ and check voltage is VDP_SRC (0.5 to 0.7V). [PD10]
- Check value of IDM_SINK, as follows: Change voltage on 15k resistor to D- to 0.6V. Wait 1ms, then check voltage at D- is in correct range for a worst case IDM_SINK of 25µA (i.e. that voltage is not greater than 0.225V). [PD10]
- 7. Change voltage on 15k resistor to D- to 0V.
- 8. Wait for 17ms (together with 2ms delay above, this is less than TVDMSRC_EN max).
- 9. Disconnect 15K resistor from D- and replace with 1K5 from 0.7V.
- 10. Wait 1ms for D- to settle.
- 11. Measure voltage on D-. This must be above 0.4V, to prove that IDM_SINK max (175µA) is not exceeded.
- 12. Wait 19ms (together with 20ms delay above, this is less than TVDPSRC_ON min).
- 13. Check that D+ voltage is still VDP_SRC (0.5 to 0.7V). [PD10]

14. Wait for D+ to go below 0.5V, or above 0.8V, or for TSVLD_CON_PWD (1 sec) from VBUS going on to expire.

TsvLD_CON_PWD expires:

This is a failure, as the UUT failed to connect within TSVLD_CON_PWD (1 sec). [PD8]

D+ goes below 0.5V:

End of primary detection, proceed from step 15.

D+ rises above 0.8V:

If D+ rises instead above 0.8V, it will be regarded as a 'device connect'. [PD8]

If secondary detection is declared not to be implemented, this is a valid procedure, and the tester will report that this sequence has occurred, perform steps 13 and 14, and then skip to 'Checking Current Draw'.

If secondary detection is declared to be implemented, this is a failure, secondary detection was not attempted. [PD14]

15. Disconnect 1K5 resistor from D- and replace with 15K from 0V.

16. Wait 100us (for D- to fall).

If secondary detection is declared not to be implemented, skip to Checking Current Draw.

Secondary Detection

- 17. Wait for D- to rise above 0.5V
- 18. Wait 1ms for D- to settle.
- 19. Measure D- and check voltage is VDM_SRC (0.5 to 0.7V). [PD15]
- 20. Check value of IDP_SINK, as follows: Change voltage on 15k resistor to D+ to 0.6V. Wait 20ms, then check voltage at D+ is in correct range for a worst case IDP_SINK of 25μA (i.e. that voltage is not greater than 0.225V). [PD15]
- 21. Change voltage on 15k resistor to D+ to 0V.
- 22. Wait for 18ms (together with 21ms delays above, this is less than TVDMSRC_ON min).
- 23. Check that D- voltage is still VDM_SRC (0.5 to 0.7V). [PD14] [PD15]
- 24. DO NOT Connect 0.6V to D+.
- 25. Wait for D- to go below 0.5V.

Checking Current Draw

26. If secondary detection is declared to be implemented, display message to test operator 'PD under test should now have detected CDP'. If secondary detection is declared not to be implemented, display message to test operator 'PD under test should now have detected DCP or CDP'. (This is a development aid.)

- 27. Switch data lines to transceiver.
- 28. Check current drawn does not exceed IMAX_BC from now on until end of step 31. [PD30]
- 29. Check D+ goes high within TSVLD_CON_PWD (1 sec) from VBUS turning on. [PD8] [If secondary detection supported: PD18]
- 30. Enumerate UUT (at HS if possible), and Set Configuration 1.
- 31. Maintain session for 30 seconds from configuration.

Checking Renegotiation

- 32. Switch data lines to PET test circuit. Turn off VBUS and disconnect pull-down resistance from VBUS.
- Check that the PD discharges VBUS to less than VBUS_LKG max (0.7V) within TVLD_VLKG max (500ms). [PD28]
- 34. Wait for TVBUS_REAPP min (100ms).
- 35. Apply a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turn on VBUS to 5V.
- 36. Connect 0V via 15k resistor to D+. Connect 0V via15k resistor to D-.

Note: We will emulate an SDP this time to demonstrate that renegotiation was successful.

Renegotiation - Primary Detection

- 37. Wait for D+ to rise above 0.5V.
- 38. Wait 1ms for D+ to settle.
- 39. Measure D+ and check voltage is VDP_SRC (0.5 to 0.7V). [PD10]

Renegotiation - Checking Current Draw

- 40. Switch data lines to transceiver.
- 41. Check D+ goes high within TSVLD_CON_PWD (1 sec) from VBUS turning on.
- 42. Display message to test operator 'PD under test should now have detected SDP'.
- 43. Wait for 150ms (D+ debounce time plus 50ms).
- 44. Check that current drawn from VBUS does not exceed IUNIT (100mA).
- 45. Turn off VBUS and disconnect pull-down resistance from VBUS.
- 46. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates a SDP.			
Pre-conditions	Vendor has declared whether secondary detection is implemented. This test should be performed with a battery just above the Weak Battery Threshold, as this provides the best check on the maximum current drawn.			
Purpose	To validate a correct detection procedure when the UUT encounters a SDP.			
Description	PET simulates a SDP and monitors activity on D+, and current drawn.			
Parameters	VDP_SRC, TVDPSRC_ON, TSVLD_CON_PWD			
Checklist	PD8, PD10, PD12, PD28, PD31			
Pass Criteria	See below			

7.7 SDP Detection Test

7.7.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

DCD

- 1. PET applies a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V. ID pin is left floating.
- 2. Connect 0V via15k resistor to D+. Connect 0V via15k resistor to D-.

Primary Detection

- 3. Wait for D+ to rise above 0.5V
- 4. Wait 1ms for D+ to settle.
- 5. Measure D+ and check voltage is VDP_SRC (0.5 to 0.7V). [PD10]
- Check value of IDM_SINK, as follows: Change voltage on 15k resistor to D- to 0.6V. Wait 20ms, then check voltage at D- is in correct range for a worst case IDM_SINK of 25µA (i.e. that voltage is not greater than 0.225V). [PD10]
- 7. Change voltage on 15k resistor to D- to 0V.
- 8. Wait for 18ms (together with 21ms delay above, this is less than TVDPSRC_ON min).
- 9. Check that D+ voltage is still VDP_SRC (0.5 to 0.7V) [PD10]
- 10. Do not connect 0.6V to D-.
- 11. Wait for D+ to go below 0.5V, or above 0.8V, or for TSVLD_CON_PWD (1 sec) from VBUS going on to expire.

TSVLD_CON_PWD expires:

This is a failure, as the UUT failed to connect within TSVLD_CON_PWD (1 sec). [PD8]

D+ goes below 0.5V:

If secondary detection is declared not to be implemented, skip to 'Checking Current Draw'.

If secondary detection is declared to be implemented, proceed with 'Secondary Detection'.

D+ rises above 0.8V:

If D+ rises instead above 0.8V, it will be regarded as a legitimate 'device connect'. Skip to 'Checking Current Draw'. [PD8]

Secondary Detection

12. Note: If the primary detection identifies an SDP, then Secondary Detection may not occur. In this case there is no purpose in looking for Secondary Detection, even if it does occur. So we will go straight to 'Checking Current Draw'.

Checking Current Draw

- 13. Display message to test operator 'PD under test should now have detected SDP. (This is a development aid.)
- 14. Check current drawn does not exceed ICFG_MAX (500mA) from now on. [PD12], [PD31]
- 15. Check D+ goes high within TSVLD_CON_PWD (1 sec) from VBUS turning on. [PD8]
- 16. Enumerate UUT (at HS if possible), and Set Configuration 1.
- 17. Maintain session for 30 seconds from configuration.
- 18. Turn off VBUS and disconnect pull-down resistance from VBUS.
- 19. Check that VBUS falls below VBUS_LKG max (0.7V) within TVLD_VLKG max (500ms). [PD28]
- 20. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates ACA-Dock.		
Pre-conditions	Only required if UUT supports ACA detection. This test should be performed with a battery just above the Weak Battery Threshold, as this provides the greatest stress on the measurement of RID_A, owing to the current flowing in the cable ground.		
Purpose	Demonstrate that PD UUT responds to RID_A on ID pin. i.e. The PD is attached to an ACA-Dock that is driving VBUS.		
Description	Connect RID_A to ID pin and check that PD behaves correctly.		
Parameters	RID_A		
Checklist	PD11, PD21, PD30		
Pass Criteria	Step 9: UUT enumerates the PET.		

7.8 ACA-Dock Detection Test

7.8.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

- 1. Switch data lines to PET test circuit. Set up transceiver (now not connected) to peripheral mode with 1k5 pull-up to 3.3V on D+, and 15k pull-down on D-.
- 2. PET applies CADP_VBUS max (6.5µF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V.
- 3. Wait 10ms.
- 4. Simultaneously
 - Connect ID pin to ground via RID_A min (122k).
 - Connect 0.6V via 200R to D-.
 - Connect 3.3V via 1K5 to D+.
- 5. Check that D+ remains above VLGC_HI min (2.0V) for TDCD_TIMEOUT min (0.3 sec). [PD11]

Note: DCD using current source is not available in this case.

- 6. Display message to test operator 'PD under test should now have detected ACA-Dock'. (This is a development aid, and may appear up to 0.4sec before actual detection.)
- 7. Check that SE0 occurs within TA_BCON_ARST max (30 sec).
- 8. On detecting SE0, switch data lines to transceiver. This has the effect of disconnecting the 0.6V from D-, and replaces the test circuit pull-up with the transceiver pull-up.
- 9. Check that UUT enumerates the PET within 30 seconds. PET responds as test device 0x1A0A/0x0200. [PD21]

- 10. From now on check current drawn and report. Check that this current does not exceed IMAX_BC. (If current exceeds 1.5A test will terminate to protect tester connectors.) [PD30]
- 11. Wait 10 seconds.
- 12. Simulate a detach as follows:
 - Switch off transceiver D+ pullup
 - Switch off transceiver pull-down from D-.
 - Disconnect RID_A from ID pin
 - Disconnect 0.6V via 200R from D-.
 - Disconnect data line test circuit 3.3V via 1K5 from D+
 - Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 13. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.
- 14. Repeat steps 1-13 using RID_A max (126k).

Test Setup	Test Setup 4. UUT is a PD, PET simulates.		
Pre-conditions	Only required if UUT supports ACA detection.		
Purpose	Demonstrate that PD UUT responds to RID_A on ID pin (i.e. the PD is attached to an ACA that has a charger on its Charger Port, and a B-device on its Accessory Port). This test should be performed with a battery just above the Weak Battery Threshold, as this provides the greatest stress on the measurement of RID_A, owing to the current flowing in the cable ground.		
Description	Connect RID_A to ID pin and check that PD behaves correctly.		
Parameters	RID_A		
Checklist	PD22, PD30		
Pass Criteria	Step 6: UUT enumerates the PET.		

7.9 ACA-A Detection Test

7.9.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on. ID pin not connected.

- 1. PET applies CADP_VBUS max (6.5 μ F) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V
- 2. Wait 10ms to simulate plug insertion.
- 3. Connect ID pin to ground via RID_A min (122k).
- 4. Display message to test operator 'PD under test should now have detected ACA-A'. (This is a development aid, and may appear slightly before actual detection.)
- 5. Connect using D+.
- 6. Check that UUT resets and enumerates the PET within 30 seconds. PET responds as test device 0x1A0A/0x0200. [PD22]
- 7. From now on check current drawn and report. Check that this current does not exceed IMAX_BC. (If current exceeds 1.5A test will terminate to protect tester connectors.) [PD30]
- 8. Wait 10 seconds.
- 9. Disconnect using D+.
- 10. Disconnect resistor from ID pin.
- 11. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 12. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.
- 13. Repeat steps 1-12 using RID_A max (126k).

Test Setup	Test Setup 4. UUT is a PD, PET simulates ACA-B.	
Pre-conditions	Only required if UUT supports ACA detection.	
Purpose	To validate a correct detection procedure when the UUT encounters an ACA-B (i.e. the PD is attached to an ACA that has a charger on its Charger Port, and does not have an accessory on its Accessory Port).	
Description	PET simulates an ACA-B and monitors activity on D+, and current drawn.	
Parameters	RID_B	
Checklist	PD8, PD24, PD30	
Pass Criteria	Step 97: UUT does not connect	

7.10 ACA-B Detection Test

7.10.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on. ID pin not connected.

DCD

- 1. Switch data lines to PET test circuit.
- PET applies CADP_VBUS max (6.5µF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V.
- 3. Wait 10ms to simulate plug insertion.
- 4. Connect ID pin to ground via RID_B min (67k).
- 5. Connect 0V via 15k resistor to D+. Connect 0V via 15k resistor to D-.
- 6. Start timer of TSVLD_CON_PWD (1 sec).
- 7. Wait for D+ to exceed VLGC min, or timer to expire.

Timer TsvLD_CON_PWD expires:

Proceed to ' Checking Current Draw'

D+ rises above 0.8V:

Check that D+ goes below 0.8V within no more than TB_DATA_PLS max (10ms). This represents a valid SRP pulse, which we will ignore. Proceed to ' Checking Current Draw'

Else UUT has attempted to connect - FAIL. [PD8]

Primary Detection

Primary detection is optional, and its parameters are measured elsewhere, so we will ignore it during this test.

Checking Current Draw

- 8. Display message to test operator 'PD under test should now have detected RID_B'. (This is a development aid.)
- 9. From now on check current drawn and report. Check that this current does not exceed IMAX_BC. (If current exceeds 1.5A test will terminate to protect tester connectors.) [PD30]
- Check D+ is held below VDAT_REF min (0.25V) from now on. It is possible that SRP pulses are attempted, these should be ignored if they do not exceed TB_DATA_PLS max (10ms). [PD24]
- 11. Maintain session for 15 seconds from step 6.
- 12. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 13. Disconnect 15k pulldown resistor from D+ and D-.
- 14. Disconnect ID pin resistor.
- 15. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.
- 16. Repeat steps 1-15 using RID_B max (69K).
- 17. Disconnect data lines from PET test circuit.

Test Setup	Test Setup 4. UUT is a PD, PET simulates ACA-C.		
Pre-conditions	Only required if UUT supports ACA detection.		
Purpose	To validate a correct detection procedure when the UUT encounters an ACA-C. i.e. The PD is attached to an ACA that has a charger on its Charger Port, and an A- device on its Accessory Port. This test should be performed with a battery just above the Weak Battery Threshold, as this provides the greatest stress on the measurement of RID_C, owing to the current flowing in the cable ground.		
Description	PET simulates an ACA-C and monitors activity on D+, enumerates the PD UUT and monitors current drawn.		
Parameters	RID_C		
Checklist	PD8, PD25, PD30		
Pass Criteria	Step 8: UUT does connect		

7.11 ACA-C Detection Test

7.11.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on. ID pin not connected.

DCD

- 1. Switch data lines to PET test circuit.
- PET applies CADP_VBUS max (6.5µF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V
- 3. Wait 10ms to simulate plug insertion.
- 4. Connect ID pin to ground via RID_C min (36k).
- 5. Connect 0V via15k resistor to D+. Connect 0V via15k resistor to D-.
- 6. Start timer of TSVLD_CON_PWD (1 sec).
- 7. Wait for D+ to exceed VLGC min, or timer to expire.

Timer TsvLD_CON_PWD expires:

UUT failed to connect - FAIL [PD8] [PD25]

D+ rises above 0.8V:

Check that D+ is high for more than 10ms. If not this is a failure (SRP not allowed). [PD25]

Else UUT has connected - proceed to ' Checking Current Draw'.

Primary Detection

Primary detection is optional, and its parameters are measured elsewhere, so we will ignore it during this test.

Checking Current Draw

- 8. Switch data lines back to transceiver.
- 9. Display message to test operator 'PD under test should now have detected RID_C'. (This is a development aid.)
- 10. From now on check current drawn and report. Check that this current does not exceed IMAX_BC. (If current exceeds 1.5A test will terminate to protect tester connectors.) [PD30]
- 11. Enumerate UUT and Set Configuration 1. [PD25]
- 12. Maintain session for 10 seconds from step 8.
- 13. Disconnect 15k pulldown resistor from D+ and D-.
- 14. Disconnect ID pin resistor.
- 15. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 16. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.
- 17. Repeat steps 1-15 using RID_C max (37K)

7.12 ACA-GND Detection Test

Test Setup	Test Setup 4. UUT is a PD, PET simulates.		
Pre-conditions	Only required if UUT supports ACA detection. This test should be performed with a battery just above the Weak Battery Threshold, as this provides the greatest stress on the measurement of RID_GND, owing to the current flowing in the cable ground.		
Purpose	Demonstrate that PD UUT responds to RID_GND max on ID pin. i.e. the PD is attached to a B-device, or to an ACA that has a B-device on its Accessory Port, but no charger.		
Description	Connect RID_GND max to ID pin and check that PD behaves as A-device.		
Parameters	RID_GND		
Checklist	PD26		
Pass Criteria	For UUT with session support:		
	Step 6: VBUS turns on in response to SRP.		
	For UUT with no session support:		
	Step 3: VBUS turns on in response to ID low.		

7.12.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. PD is switched on.

For UUT with session support:

- 1. Connect 6.5μ F from VBUS to ground.
- 2. Connect ID pin to ground via RID_GND max (1k).
- 3. Wait 3 seconds.
- 4. If VBUS is on, wait for it to go off, and stay off for 5 seconds.

This deals with ADP and any initial test for a peripheral.

- 5. Perform SRP for 7.5ms pulse.
- Check that VBUS rises above VOTG_SESS_VLD within TA_SRP_RSPNS of rising edge of SRP pulse. [PD26]
- 7. Disconnect RID_GND, and capacitance and resistance from VBUS.
- 8. Wait for VBUS to go off, and stay off for 5 seconds.

End of Test

For UUT with no session support:

- 1. Connect 6.5μ F from VBUS to ground.
- 2. Connect ID pin to ground via RID_GND max (1k).

- 3. Check that VBUS rises above VOTG_SESS_VLD within TA_VBUS_ATT (200ms) of ID pin going low. [PD26]
- 4. Disconnect RID_GND, and capacitance and resistance from VBUS.
- 5. Wait for VBUS to go off, and stay off for 5 seconds.

7.13 Common Mode Test - Full Speed

Test Setup	Test Setup 4. UUT is a PD, PET simulates a SDP.			
Pre-conditions	This test should be performed with a good battery in order to minimize extra current flowing in the cable ground, as the PET provides the ground offset itself.			
Purpose	This test verifies that a UUT is able to communicate with a charging downstream port at full-speed when cable ground is dropping $IMAX_BC \ge 0.25\Omega + 5mV$.			
Description	This test will apply a maximum of 375mV offset to UUT ground, and then verify UUT will enumerate and work successfully.			
	PET simulates an SDP to reduce the risk that the UUT itself draws a significant current.			
Parameters				
Checklist	PD33			
Pass Criteria	Step 5: UUT enumerates successfully			
	Step 6: UUT functions as expected			

7.13.1 Test procedure

Initial State. Special Test Cable A is connected to PD. VBUS is off, capacitance of 6.5μ F is connected to VBUS, data lines switched to PET transceiver.

- Apply a common mode offset of IMAX_BC x 0.25 Ω + 5mV (a maximum of VGND_OFFSET [0.375V] if IMAX_BC is declared as 1500mA) with PET test socket higher than PET transceiver ground.
- 2. Turn VBUS on to 5V.
- 3. Wait for UUT to connect
- 4. Wait 100ms.
- 5. Reset and enumerate at Full Speed. Check that enumeration was successful.
- Continue for 10 seconds, without configuring, to perform a number of standard requests, (e.g. Get Device Descriptor) checking again for failure to respond to transactions. This is achieved by counting the number of failures to respond to transactions, and comparing this to an arbitrary ceiling. (A good device would never fail to respond in practice.) [PD33]
- 7. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 8. Remove common mode offset.
- 9. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.

7.14 Common Mode Test - High Speed

Test Setup	Test Setup 4. UUT is a PD, PET simulates a SDP.			
Pre-conditions	This test should be performed with a good battery in order to minimize extra current flowing in the cable ground, as the PET provides the ground offset itself.			
Purpose	This test verifies that a UUT is able to communicate with a charging downstream port at high-speed when cable ground is dropping $IMAX_BC \times 0.25\Omega + 5mV$.			
Description	This test will apply a maximum of 375mV offset to UUT ground, and then verify UUT will enumerate and work successfully.			
	PET simulates an SDP to reduce the risk that the UUT itself draws a significant current.			
Parameters				
Checklist	PD33			
Pass Criteria	Step 5: UUT enumerates successfully			
	Step 6: UUT functions as expected			

7.14.1 Test procedure

Initial State. Special Test Cable A is connected to PD. VBUS is off, capacitance of 6.5µF is connected to VBUS, data lines switched to PET transceiver.

- Apply a common mode offset of IMAX_BC x 0.25 Ω + 5mV (a maximum of VGND_OFFSET [0.375V] if IMAX_BC is declared as 1500mA) with PET test socket higher than PET transceiver ground.
- 2. Turn VBUS on to 5V.
- 3. Wait for UUT to connect
- 4. Wait 100ms.
- 5. Reset and enumerate at High Speed. Check that enumeration was successful.
- 6. Continue for 10 seconds, without configuring, to perform a number of standard requests, (e.g. Get Device Descriptor) checking again for failure to respond to transactions. This is achieved by counting the number of failures to respond to transactions, and comparing this to an arbitrary ceiling. (A good device would never fail to respond in practice.) [PD33
- 7. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 8. Remove common mode offset.
- 9. Wait 8 seconds, ignoring SRP pulse, for detachment to be detected.

Test Setup	Test Setup 4. UUT is a PD, PET simulates an SDP.	
Pre-conditions	UUT has been fitted with a 'Dead Battery'. Assumption is that this remains dead for 30 second duration of test.	
Purpose	To verify that the UUT complies with requirements of the 'Dead Battery Provision – Unconfigured Clause'	
Description	This test is performed separately from the other PD tests, as it requires a dead battery to be fitted. VBUS is applied to the device, and the current drawn and D+ voltage are monitored.	
Parameters	IUNIT, VDP_SRC	
Checklist	DBP1, DBP3	
Pass Criteria	Step 4: D+ is below VLGC min	
	Step 9: D+ is at VDP_SRC	
	Step 10: Watch-block has not been triggered.	

7.15 Dead Battery Provision Test

7.15.1 Test procedure

Initial State: Special Test Cable A is connected to PD. No VBUS voltage applied. Any mechanical switches on the PD required for it to be able to power up have been operated.

- 1. PET applies CADP_VBUS max (6.5µF) and a pull-down resistor of ROTG_VBUS min (10k) to VBUS and turns on VBUS to 5V. ID pin is left floating.
- 2. Connect 0V via 15k resistor to D+. Connect 0V via 15k resistor to D-.
- 3. Wait TSVLD_CON_PWD max plus a margin (1 sec + .5 sec = 1.5 sec).
- 4. Set up a watch-block to monitor the current drawn from VBUS, and be triggered if this current exceeds IUNIT (100mA).
- 5. Check that D+ is below VLGC min (0.8v). If UUT connects at any time during the remainder of the test, skip to Step15. We must assume that the dead battery provision is no longer required by the UUT.
- 6. Display message to test operator 'PD under test should now have detected SDP'. (This is a development aid.)
- 7. For the next 30 seconds, follow the procedure in steps 8-10
- 8. Measure the average current drawn from VBUS, sampling every 1ms for a period of 1 second. Record whether this value exceeds ISUSP (2.5mA).
- If the value does exceed ISUSP for two consecutive averages, then check that D+ is at VDP_SRC (0.5V-0.7V).
- 10. Check that the watch-block has not been triggered.
- 11. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 12. Disconnect 15k pull-down resistors.

13. Wait 5 seconds for detachment to be recognized.

14. Skip to End of Test

Enumerating

- 15. Wait TA_BCON_LDB min (100ms) then issue a bus reset to the B-UUT.
- 16. Check that PET can enumerate UUT (at HS if possible), and Set Configuration 1.
- 17. For the next 30 seconds, check current drawn does not exceed bMaxPower.
- 18. Turn off VBUS and disconnect capacitance and pull-down resistance from VBUS.
- 19. Disconnect 15k pull-down resistors.
- 20. Wait 5 seconds for detachment to be recognized.

End of Test

Note: Parameters and behavior such as TSVLD_CON_WKB, TDBP_VDPSRC_CON are verified by vendor declaration.

8 Dedicated Charging Port (DCP) Compliance

8.1 Submission Materials

8.1.1 Device Specific Information

The following items are required to be submitted along with the UUT:

Table 8-1 Device Specific Information for DCPs

Item	Function	Value/ Support
1	Evidence the UUT contains on its nameplate and/or end-user	
	documentation, the continuous current rating at which output voltage of	
	4.75V to 5.25V is provided	
2	Schematics or other proof that UUT output current cannot exceed 5.0	
	amperes	
3	The USB-IF TID for the UUT standard-A receptacle(s) or micro-B plug(s)	
	(via captive cable)	
4	Schematics or other proof that a single UUT failure will not cause the	
	output voltage on VBUS to exceed VCHG_FAIL?	
5	UUT Charging Port identification label drawing (If additional Charging or	
	non Charging Ports are included in UUT)	
6	Description of UUT output or Charging Port operation and availability	
	when multiple outputs or Charging Ports are present (if applicable)	
7	Description of UUT output or Charging Port operation and availability	
	during Device power states (if applicable)	

8.1.2 Checklist

Table 8-2 Checklist for DCPs

Question		Response	Test Number	BC 1.2 Reference
DCP1	Is the output voltage of the UUT less than VCHG_OVRSHT max for any step change in load current, and also when powering on of off?	Yes 🗆 No 🗆	8.2	4.1.1
DCP2	Is the output current of the UUT prevented from exceeding ICDP max under any condition?	Yes 🗆 No 🗆	Vendor Declaration	4.1.2
DCP3	If the UUT switches roles among SDP, CDP and DCP, does it allow VBUS to drop to less than VBUS_LKG and wait for a time TVBUS_REAPP before driving VBUS again?	Yes 🗆 No 🗆	Vendor Declaration	4.1.3
DCP4	Has it has been shown, using schematics or by some other explanation, that in the case of a single failure in the UUT, the output voltage on VBUS will not exceed VCHG_FAIL?	Yes □ No □	Vendor Declaration	4.1.5
DCP5	As per provided UUT description: if the UUT provides multiple USB Charging Ports, the active UUT USB Charging Port does not affect operation of any other Charging Port.	Yes □ No □	Vendor Declaration	4.1.6

DCP6	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) for all currents less than IDCP min?	Yes 🗆 No 🗆	8.5	4.4.1
DCP7	Does the UUT output a voltage less than VCHG max (averaged over TVBUS_AVG) for all currents between IDCP min and IDEV_CHG max?	Yes 🗆 No 🗆	8.5	4.4.1
DCP8	Is the output voltage of the UUT greater than VCHG_UNDSHT min for any step change in load current from IDCP_LOW to IDCP_MID?	Yes 🗆 No 🗆	8.2	4.4.2
DCP9	Is the output voltage of the UUT greater than VCHG_UNDSHT min for any step change in load current from IDCP_MID to IDCP_HI, including steps that occur TDCP_LD_STP after a transition from IDCP_LOW to IDCP_MID?	Yes □ No □	8.2	4.4.2
DCP10	Is the duration of any undershoot less than TDCP_UNDSHT ?	Yes 🗆 No 🗆	8.2	4.4.2
DCP11	Does the output voltage of the UUT drop below VCHG min for less than TDCP_UNDSHT, any step change in load current from IDCP_LOW to IDCP_HI provided the load current is less than IDCP min ?	Yes □ No □	8.2	4.4.2
DCP12	Does the UUT have a resistance between D+ and D- of RDCP_DAT ?	Yes 🗆 No 🗆	8.3	4.4.3
DCP13	Does the UUT have a leakage current from D+/D- less than or equal to RDAT_LKG tied to a voltage of VDAT_LKG ?	Yes 🗆 No 🗆	8.3	4.4.3
DCP14	Does the UUT have a capacitance from D+/D- of CDCP_PWR ?	Yes □ No □	8.3	4.4.3
DCP15	Does the UUT have a Standard-A receptacle, or a captive cable terminated with a Micro-B plug?	Standard-A Captive No	Inspection	4.4.4
DCP16	Does the UUT provide VBUS discharge functionality?	Yes 🗆 No 🗆	Vendor Declaration	4.1.3

8.2 DCP	Overshoot and	Undershoot	Voltage	Test
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Test Setup	Test Setup 6. UUT is a DCP, PET simulates a PD.
Pre-conditions	This test must be run before any of the other DCP tests.
Purpose	To verify the DCP meets overshoot and undershoot voltage specifications, for any specified step change in load.
Description	This test changes the VBUS current abruptly, and measures the resulting voltage overshoot and undershoot levels.
	Note: The DCP can have a Standard-A receptacle or a captive cable. In the case of a captive cable, the BC specification requires voltage measurements to be taken at the Micro-B plug of the captive cable.
Parameters	VCHG_OVERSHT, VCHG_UNDSHT, TDCP_UNDSHT
Checklist	DCP1, DCP6, DCP8, DCP9, DCP10, DCP11, DCP12
Pass Criteria	Step 7 – Maximum voltage during overshoot is less than 6.0V.
	Step 19 – VBUS is in range 4.75V to 5.25V
	Step 20 – Minimum voltage during undershoot is above 4.1V.
	Step 20 – Maximum voltage during overshoot is less than 6.0V.
	Step 24 – VBUS is in range 4.75V to 5.25V
	Step 25 – Minimum voltage during undershoot is above 4.1V.
	Step 25 – Maximum voltage during overshoot is less than 6.0V.
	Step 28 – Minimum voltage during undershoot is above 4.1V.
	Step 28 – Maximum voltage during overshoot is less than 6.0V.
	Step 31 – VBUS is in range 4.75V to 5.25V
	Step 32 – VBUS is in range 4.75V to 5.25V

8.2.1 Test procedure

Initial State: No load applied. If captive cable equipped, check the 'Captive Cable' box in the test dialog.

- 1. Ensure that UUT is connected via Special Test Cable B, or its captive cable, to the PET.
- 2. Ensure that DCP is in an unpowered state.
- 3. Wait for DCP voltage to fall below 0.5V, in case it has just been switched off. (Speed up fall using current load.)
- 4. Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on VBUS.
- 5. Instruct test operator to plug DCP into 'wall-socket', or to perform steps required to bring the DCP from an un-powered state to a powered one.
- 6. Wait for operator to click 'OK'.
- 7. Check watch-block overshoot detector latch was not triggered. [DCP1]

- 8. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on VBUS.
- With an applied current load of IDCP_LOW min (0mA), check that VBUS average is within appropriate range VCHG (4.75V to 5.25V) over the next TVBUS_AVG max (0.25 sec). [DCP6]
- 10. Check watch-block overshoot and undershoot detector latches were not triggered. [DCP1][DCP8]
- 11. Re-program watch-block to allow for voltage drop in cable.

Emulate attaching PD

- 12. Apply voltage source (0.535V) via 200R resistor to D+. Apply voltage source (0.15V) via 15k resistor to D-.
- 13. Wait TVDMSRC_EN max + 1 ms (= 21ms)
- 14. Check D- > VDAT_REF min (0.25V). [DCP12]
- 15. Wait for 1ms more than the remainder of TVDPSRC_ON (40ms 20ms = 20ms).
- 16. Disconnect voltage source via 200R resistor from D+. Disconnect voltage source via 15k resistor from D-.

Load Testing

- 17. Apply load of IDCP_MID max (100mA) to VBUS.
- 18. Wait TDCP_UNDSHT max (10ms).
- 19. Check VBUS, at DCP connector, is in range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable (spot check voltage). [DCP6][DCP10]
- 20. Check watch-block overshoot and undershoot detector latches were not triggered. [DCP1][DCP8]
- 21. Re-program watch-block to allow for voltage drop in cable.
- 22. Increase load on VBUS to IDCP min (500mA), 20ms after rise to IDCP mid.
- 23. Wait TDCP_UNDSHT max (10ms).
- Check VBUS average, at DCP connector, is in range VCHG (4.75V to 5.25V), over the next TVBUS_AVG max (0.25 sec), making due allowance for voltage drop in cable. [DCP6]
- 25. Check watch-block overshoot and undershoot detector latches were not triggered. [DCP1] [DCP9]
- 26. Remove Current Load.
- 27. Wait 100ms

- 28. Check watch-block overshoot and undershoot detector latches were not triggered.
- 29. Apply load of IDCP min (500mA) to VBUS.
- 30. Wait TDCP_UNDSHT max (10ms).
- 31. Check VBUS, at DCP connector, is in range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable (spot check voltage). [DCP1] [DCP1] [DCP1]
- Check VBUS average, at DCP connector, is in range VCHG (4.75V to 5.25V), over the next TVBUS_AVG max (0.25 sec), making due allowance for voltage drop in cable. [DCP6]
- 33. Remove Current Load.
- 34. Wait 100ms
- 35. Check watch-block overshoot and undershoot detector latches were not triggered. [DCP1] [DCP9]

Test Setup	Test Setup 6. UUT is a DCP, PET simulates a PD.
Pre-conditions	DCP Overshoot and Undershoot Voltage Test has been run, and DCP is now switched on.
Purpose	To verify the parameters of detection handshake. This test is particularly designed to verify the behavior of UUTs which switch roles among DCP, CDP and SDP, and may therefore have more complex circuitry on D+ and D- than a simple resistive connection.
Description	Test confirms correct handshake behavior.
Parameters	
Checklist	DCP6
Pass Criteria	Step 5 – Voltage is in range
	Step 10 - Voltage is in range

8.3 DCP Handshaking Test

8.3.1 Test procedure

Initial State: UUT is connected via Special Test Cable B, or its captive cable, to the PET. No load applied. DCP is switched on. Data lines switched to data measurement circuit.

- 1. Check VBUS is above VOTG_SESS_VLD max (4V). [DCP6]
- 2. Wait 200ms

Primary Detection

- 3. Apply voltage source (0.535V) via 200R resistor to D+. Apply voltage source (0.15V) via 15k resistor to D-.
- 4. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).
- 5. Check D- voltage is in range VDM_SRC (0.5V 0.7V). [DCP12, DCP13]
- 6. Wait 20ms to complete TVDPSRC_ON.
- 7. Disconnect voltage source via 200R resistor from D+. Disconnect voltage source via 15k resistor from D-.

Secondary Detection

- Apply voltage source (0.535V) via 200R resistor to D-. Apply voltage source (0.15V) via 15k resistor to D+.
- 9. Wait 21ms.
- 10. Check D+ voltage is in range VDM_SRC (0.5V 0.7V). [DCP12, DCP13]
- 11. Wait 20ms to complete TVDMSRC_ON.
- 12. Disconnect voltage source via 200R resistor from D-. Disconnect voltage source via 15k resistor from D+.
- 13. Wait 5 seconds for UUT to recover.

Test Setup	Test Setup 6. UUT is a DCP, PET simulates a PD.
Pre-conditions	
Purpose	To verify that the resistance between D+/D- and data line resistance and capacitance to VBUS/GND is in valid range.
Description	This test measures the resistance of data lines (D+/D-) and then the resistance/capacitance from D+/D- to VBUS and to GND. Also, ID pin resistance is checked for sanity.
Parameters	RDCP_DAT, CDCP_PWR, RDAT_LKG
Checklist	DCP12, DCP13, DCP14
Pass Criteria	Step 6 - Resistance between D+ and D- is less than 200Ω .
	Step 12 - Resistances between D+/- and GND/VOH are greater than 150kΩ. (RDAT_LKG / 2).
	Step 15 - Capacitances between D+/- and GND are less than 1nF.

8.4 DCP Resistance and Capacitance Tests

8.4.1 Test procedure

Initial State: UUT is connected via Special Test Cable B, or its captive cable, to the PET. No load applied. DCP is switched on. Data lines switched to data measurement circuit.

Emulate attaching PD

- 1. Apply voltage source (0.535V) via 200R resistor to D+. Apply voltage source (0.15V) via 15k resistor to D-.
- 2. Wait TVDMSRC_EN max + 1 ms (= 21ms)
- 3. Check D- > VDAT_REF min (0.25V).
- 4. Wait for 1ms more than the remainder of TVDPSRC_ON (40ms 20ms = 20ms).
- 5. Disconnect voltage source via 200R resistor from D+. Disconnect voltage source via 15k resistor from D-.

Checking Resistance between D+ and D-

 Check that resistance from D+ to D- is less than RDCP_DAT max (200R). i.e. Connect 2.0V via 200R resistor to D+, connect 0.05V via 200R resistor to D-. Measure voltages at D+ and D-. The difference must be less than 0.67V. [DCP12]

Checking leakage from D+ or D-

- 7. Connect D+ via 100k to 0V
- 8. Wait 2 seconds to eliminate capacitive effects.
- Check that voltage at D+ is below 1.44V (Two RDAT_LKG (300k) in parallel, VDAT_LKG = 3.6V).
- 10. Connect D+ via 100K to 3.6V. Connect D- via 100K to 3.6V.
- 11. Wait 2 seconds

12. Check that D+ is not less than 2.65V (Two RDAT_LKG (300k) in parallel, VDAT_LKG = 0V).

This shows that leakage resistance is greater than RDAT_LKG / 2. [DCP13]

Checking Capacitance of D+ or D-

- Discharge Standard 1nF capacitor and Capacitance under Test Connect 0V to D+ via 1nF test capacitor. Connect 0V to D- via 200R resistor. There is a tested, <200R, resistor between D- and D+. This will discharge the standard 1nF capacitor and the capacitance under test to 0V. Wait 10ms.
- 14. <u>Isolate Capacitances</u> Disconnect 0V from test capacitor to isolate it. Disconnect 0V from 200R resistor.

Note: We will now use the D+ voltage watch-block to determine whether, during the chargesharing process, D+ rises above 1.65V. The watch-block amplifier has a limited band-width by design, so that the watch-block voltage set is lower than 1.65V. The actual value can be found in the test script.

- Share Charge Between Capacitances Set D+ watch-block to be testing for voltage less than the value required. Connect 3.3V to D+ via 1nF test capacitor. Wait 1ms. This allows for charge sharing between standard 1nF capacitor and capacitance under test.
- 16. Read watch-block to see if voltage on D+ went above 1.65V. If it did, then the capacitance under test is less than 1nF and therefore in specification. [DCP14]

Test Setup	Test Setup 6. UUT is a DCP, PET simulates a PD.
Pre-conditions	
Purpose	To verify that the VBUS voltage / current load characteristic meets the specified requirements. These are steady-state tests, hence the 1 second delay in step 3.
	The test may result in shutdown of the DCP, so this test is placed last in the test sequence, as no recovery time is specified by the Battery Charging 1.2 Specification.
Description	This test measures the voltage at various current loads, in order to confirm correct behavior.
Parameters	VCHG, VDCP_SHTDWN
Checklist	DCP6, DCP7
Pass Criteria	Step 1 - VBUS voltage is in correct range.
	Step 9 - VBUS voltage is in correct range.
	Step 12 - VBUS voltage is in correct range.

8.5 DCP Voltage and Current

8.5.1 Test procedure

Initial State: UUT is connected via Special Test Cable B, or its captive cable, to the PET. No load applied. DCP is switched on.

1. IDCP is initially 0mA. Check that VBUS voltage, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), from DCP is within VCHG (4.75 – 5.25V). [DCP6]

Emulate attaching PD

- 2. Apply voltage source (0.535V) via 200R resistor to D+. Apply voltage source (0.15V) via 15k resistor to D-.
- 3. Wait TVDMSRC_EN max + 1 ms (= 21ms)
- 4. Check $D \rightarrow VDAT_REF min (0.25V)$.
- 5. Wait for 1ms more than the remainder of TVDPSRC_ON (40ms 20ms = 20ms).
- 6. Disconnect voltage source via 200R resistor from D+. Disconnect voltage source via 15k resistor from D-.
- 7. Apply load of IDCP min (500 mA) to VBUS.
- 8. Wait 1 sec to avoid possible transient period (overshoot and undershoot are measured separately).
- Check that VBUS voltage from DCP, at DCP connector, with samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within VCHG (4.75 – 5.25V), making due allowance for voltage drop in cable. [DCP6]
- 10. Increase load to IDEV_CHG max (1.5A).
- 11. Wait 1 sec to avoid possible overshoot.

- 12. Check that VBUS voltage from DCP, at DCP connector, with samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is below VCHG max (5.25V), making due allowance for voltage drop in cable. The PET reports the voltage measured. [DCP7]
- 13. Disconnect the current load.

9 Charging Downstream Port (CDP) Compliance

9.1 Submission Materials

The following items are required to be submitted along with the UUT:

9.1.1 Device Specific Information

Table 9-1 Device Specific Information for CDPs

Item	Function	Value/ Support
1	Evidence the UUT contains on its nameplate and/or end-user	
	documentation, the continuous current rating at which output voltage of	
	4.75V to 5.25V is provided	
2	Schematics or other proof that UUT output current cannot exceed 5.0	
	amperes	
3	The USB-IF TID for the UUT standard-A receptacle(s) or micro-B plug(s)	
	(via captive cable)	
4	Schematics or other proof that a single UUT failure will not cause the	
	output voltage on VBUS to exceed VCHG_FAIL?	
5	UUT Charging Port identification label drawing (If additional Charging or	
	non Charging Ports are included in UUT)	
6	Description of UUT output or Charging Port operation and availability	
	when multiple outputs or Charging Ports are present (if applicable)	
7	Description of UUT output or Charging Port operation and availability	
	during Device power states (if applicable)	

9.1.2 Checklist

ID Question **Test Number** Response BC 1.2 Section Number $\mathsf{Yes} \Box \mathsf{No} \Box$ CDP1 Is the output voltage of the 9.2 4.1.1 UUT less than VCHG_OVRSHT max for any step change in load current, and also when powering on of off? CDP2 Is the output current of the $\mathsf{Yes} \Box \mathsf{No} \Box$ Vendor 4.1.2 UUT prevented from Declaration exceeding ICDP max under any condition? CDP3 If the UUT switches roles Yes 🗆 No 🗆 Vendor 4.1.3 among SDP, CDP and DCP, Declaration does it allow VBUS to drop to less than VBUS LKG and wait for a time TVBUS_REAPP before driving VBUS again? CDP4 Has it has been shown, using Yes □ No □ Vendor 4.1.5 schematics or by some other Declaration explanation, that in the case of a single failure in the UUT, the output voltage on VBUS will not exceed VCHG FAIL?

Table 9-2 Checklist for CDPs

CDP5	As per provided UUT description: if the UUT provides multiple USB Charging Ports, the active UUT USB Charging Port does not affect operation of any other Charging Port.	Yes □ No □	Vendor Declaration	4.1.6
CDP6	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) for all currents less than ICDP min?	Yes 🗆 No 🗆	9.3	4.2.1
CDP7	Is the output voltage of the UUT greater than VCHG_UNDSHT min for any step change in load current where current is less than ICDP min?	Yes □ No □	9.2	4.2.3
CDP8	Does the CDP either: A.) Enable VDM_SRC within TCP_VDM_EN of a disconnect and disable VDM_SRC within TCP_VDM_DIS of a connect,	Yes □ (A □ B □) No □	9.4	3.4.2 4.2.4
	or			
	B.) Enable VDM_SRC, whenever D+ is greater than VDAT_REF and less than VLGC, and disable VDM_SRC, whenever D+ is less than VDAT_REF or greater than VLGC?			
CDP9	If the first option of CDP8 is implemented, is the design of VDM_SRC such that an external device is able to pull D- to 2.2V through RDM_UP?	Yes □ No □ N/A □	9.4	5.
CDP10	If before connecting, a device applies VDM_SRC to D-, does the CDP maintain a voltage of less than VDAT_REF min on D+?	Yes □ No □	8.4	3.2.5.2
CDP11	If a PD draws more than ICFG_MAX from the CDP, does the CDP correctly support LS, FS, HS and chirp signaling when the local ground is VGND_OFFSET max lower than the remote ground.	Yes □ No □	9.5, 9.6	3.5
CDP12	Does the UUT have a Standard-A receptacle?	Yes 🗆 No 🗆	Inspection	4.2.5
CDP13	If the CDP goes into shutdown during a current overload condition, does it recover and output a voltage of VCHG within a time of TSHTDWN_REC when the current overload condition has been removed.	Yes □ No □	Vendor Declaration	4.2.2
CDP14	Does the UUT provide VBUS discharge functionality?	Yes 🗆 No 🗆	Vendor Declaration	4.1.3

Test Setup	Test Setup 5. UUT is a CDP, PET simulates a PD.
Pre-conditions	This must be performed as the first test in the CDP suite.
Purpose	To verify the CDP meets overshoot and undershoot voltage specifications, for any specified step change in load.
Description	This test changes the VBUS current abruptly, and measures the resulting voltage overshoot and undershoot levels.
Parameters	VCHG_OVERSHT, VCHG_UNDSHT
Checklist	CDP1, CDP7
Pass Criteria	Step 8 – Maximum voltage during overshoot is less than 6.0V.
	Step 10 – VBUS is in range 4.75V to 5.25V
	Step 18 – VBUS is in range 4.75V to 5.25V
	Step 19 – Minimum voltage during undershoot is above 4.1V.
	Step 19 – Maximum voltage during overshoot is less than 6.0V.
	Step 22 – Minimum voltage during undershoot is above 4.1V.
	Step 22 – Maximum voltage during overshoot is less than 6.0V.

9.2 CDP Overshoot and Undershoot Voltage Test

9.2.1 Test procedure

Initial State: No load applied.

- 1. Ensure that UUT is connected via Special Test Cable B to the PET.
- 2. Ensure that CDP is in an un-powered state.
- 3. Wait for CDP voltage to fall below VBUS_LKG max (0.7V), in case it has just been switched off. (Speed up fall using 100mA current load.)
- 4. Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on VBUS.
- 5. Instruct test operator to perform steps required to bring the CDP from an un-powered state to a powered one.
- 6. Wait for operator to click 'OK'.
- 7. Wait for VBUS to rise above VCHG min (4.75V).
- 8. Check watch-block overshoot detector latch was not triggered. [CDP1]
- 9. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on VBUS, allowing for voltage drop in cable.
- 10. With no current load applied, check that VBUS is within appropriate range VCHG (4.75V to 5.25V). [CDP6]

Emulate attaching PD

- 11. Apply VDP_SRC nom. (0.6V) to D+.
- 12. Wait TVDMSRC_EN max + 1 ms (= 21ms)
- 13. Check D- > VDAT_REF min (0.25V).
- 14. Wait for 1ms more than the remainder of TVDPSRC_ON (40ms 20ms = 20ms).
- 15. Take D+ back to 0V.

Load Testing

- 16. Apply load of ICDP min (1.5A) to VBUS.
- 17. Wait 10ms.
- 18. Check that VBUS voltage from CDP, at CDP connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable.
- 19. Check watch-block overshoot and undershoot detector latches were not triggered. [CDP1] [CDP7]
- 20. Remove Current Load.
- 21. Wait 10ms
- 22. Check that VBUS voltage from CDP, at CDP connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V).[CDP6]
- 23. Check watch-block overshoot and undershoot detector latches were not triggered. [CDP1] [CDP7]

Test Setup	Test Setup 5. UUT is a CDP, PET simulates a PD.
Pre-conditions	CDP Overshoot and Undershoot Voltage Test has been run, and CDP is now switched on.
Purpose	To verify that the VBUS voltage / current load characteristic meets the specified requirements.
Description	This test measures the voltage at various current loads, in order to confirm correct behavior.
Parameters	VCHG
Checklist	CDP6
Pass Criteria	Step 1 - VBUS voltage is in correct range.
	Step 9 - VBUS voltage is in correct range.

9.3 CDP Voltage and Current Test

9.3.1 Test procedure

Initial State: Special Cable B is connected to CDP. CDP is switched on.

1. Check that VBUS voltage, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), from CDP is within VCHG (4.75 – 5.25V). [CDP6]

Emulate attaching PD

- 2. Apply VDP_SRC nom. (0.6V) to D+.
- 3. Wait TVDMSRC_EN max + 1 ms (= 21ms)
- 4. Check D- > VDAT_REF min (0.25V).
- 5. Wait for 1ms more than the remainder of TVDPSRC_ON (40ms 20ms = 20ms).
- 6. Take D+ back to 0V.

Load Testing

- 7. Apply load of ICDP min (1.5A) to VBUS.
- 8. Wait 1 sec to avoid possible transient period (overshoot and undershoot are measured separately).
- Check that VBUS voltage from CDP, at CDP connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable. [CDP6]
- 10. Disconnect the current load.

Note: In order that the test should not damage the tester connectors, no recovery time test is performed. A special test configuration is detailed elsewhere to provide a means of performing this test safely, if required.

Test Setup	Test Setup 5. UUT is an CDP, PET simulates a PD.
Pre-conditions	CDP Overshoot and Undershoot Voltage Test has been run, and CDP is now switched on.
Purpose	To verify the parameters of detection handshake.
Description	Test determines which of the two permissible behaviors is implemented, and confirms correct behavior.
Parameters	RDP_DWN, RDM_DWN, VDM_SRC, VDAT_REF, TVDMSRC_DIS, TVDMSRC_EN, TCP_VDM_DIS, TCP_VDM_EN, TVDMSRC_ON, RDAT_LKG, VDAT_LKG
Checklist	CDP8, CDP9, CDP10
Pass Criteria	Step 8: D- voltage is still in range VDM_SRC min (0.5V – 0.7V).
	Step 15: Voltage on D- is greater than 2V.
	Step 28: Voltage on D- is below VDAT_REF min (0.25V).
	or
	Step 35. D- voltage is still in range VDM_SRC min (0.5V – 0.7V).
	Step 43. Voltage on D- is below VDAT_REF min (0.25V).

9.4 CDP Handshaking Test

9.4.1 Test procedure

Initial State: Special Cable B is connected to CDP. CDP is switched on.

- 1. Check VBUS is above VOTG_SESS_VLD max (4V). [CDP6]
- 2. Wait 200ms
- 3. Examine voltage on D-. If this is less than VDAT_REF min (0.25V), skip to step 31.

Behavior 1 – CDP maintains VDM_SRC while device not connected.

Primary Detection

- 4. Connect voltage source (0.6V) via 200R resistor to D+.
- 5. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).

Check VDM_SRC Gets Connected

- 6. Connect voltage source (0.5V) via 200R resistor to D-.
- While voltage across 200R is less than 50mV, decrement the D- voltage source in steps of 2mV. Stop if D- voltage falls below VDM_SRC min (0.5V) - FAIL. Else we will now be drawing the required 250µA from VDM_SRC.
- 8. Check D- voltage is still in range VDM_SRC (0.5V 0.7V). [CDP8]
- 9. Disconnect voltage source and 200R from D-.
- 10. Wait 20ms to complete TVDPSRC_ON
- 11. Disconnect voltage source (0.6V) via 200R resistor from D+.

- 12. Wait 100ms.
- 13. Check if D- is still at VDM_SRC (0.5V 0.7V). If not FAIL owing to inconsistent behavior.

D- Pull-up Test

- 14. Connect 3.3V via 1K5 to D-.
- 15. Check that D- is greater than 2.2V. [CDP9]
- 16. Disconnect 3.3V via 1K5 from D-.
- 17. Wait 5 seconds for UUT to recognize disconnect.

Primary Detection

- 18. Connect voltage source (0.6V) via 200R resistor to D+.
- 19. Wait TVDPSRC_ON min (40ms)
- 20. Disconnect voltage source via 200R resistor from D+.

Secondary Detection

- 21. Connect voltage source (0.6V) via 200R resistor to D-.
- 22. Wait 21ms.
- 23. Check that D+ is below VDAT_REF min (0.25V)
- 24. Wait 20ms to complete TVDMSRC_ON.
- 25. Disconnect voltage source via 200R resistor from D-.

Check VDM_SRC Gets Disconnected

- 26. Connect 3.3V via 1k5 resistor to D+.
- 27. Wait slightly more than TVDMSRC_DIS max (20ms +1 ms = 21ms)
- 28. Check that D- voltage is below VDAT_REF min (0.25V). [CDP8]
- 29. Disconnect 3.3V via 1k5 resistor from D+
- 30. Wait 5 seconds for UUT to recognize disconnect.

End of Test – Behavior 1

Behavior 2 – CDP only connects VDM_SRC in response to Primary detection.

Primary Detection

- 31. Connect voltage source (0.6V) via 200R resistor to D+.
- 32. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).
Check VDM_SRC Gets Connected

- 33. Connect voltage source (0.5V) via 200R resistor to D-.
- 34. While voltage across 200R is less than 50mV, decrement the D- voltage source in steps of 2mV. Stop if D- voltage falls below VDM_SRC min (0.5V) - FAIL. Else we will now be drawing the required 250µA from VDM_SRC.
- 35. Check D- voltage is still in range VDM_SRC (0.5V 0.7V). [CDP8]
- 36. Disconnect voltage source and 200R from D-.
- 37. Wait 20ms to complete TVDPSRC_ON
- 38. Disconnect voltage source (0.6V) via 200R resistor from D+.
- 39. Wait 100ms.
- 40. Check if D- is still at VDM_SRC (0.5V 0.7V). If so FAIL owing to inconsistent behavior.

Secondary Detection

- 41. Connect voltage source (0.6V) via 200R resistor to D-.
- 42. Wait 21ms.
- 43. Check that D+ is below VDAT_REF min (0.25V). [CDP10]
- 44. Wait 20ms to complete TVDMSRC_ON.
- 45. Disconnect voltage source via 200R resistor from D-.
- 46. Wait 5 seconds for UUT to recover.

End of Test - Behavior 2

9.5 CDP Ground Offset Test – Full Speed

Test Setup	Test Setup 5. UUT is an CDP, PET simulates a PD.
Pre-conditions	When running this test, ensure that an isolated computer is used for the tester host (e.g. Laptop).
Purpose	To verify that charging downstream port fulfills USB2.0 specification common mode voltage requirements at full speed.
Description	Insert specified command voltage offset and check UUT can enumerate reference device and operate well.
Parameters	
Checklist	CDP11
Pass Criteria	Step 9: Enumeration is successful.

9.5.1 Test procedure

- 1. Check VBUS is above VOTG_SESS_VLD max (4V).
- 2. Wait 200ms.

Primary Detection

- 3. Connect voltage source (0.6V) via 200R resistor to D+.
- 4. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).
- 5. Check D- voltage is in range VDM_SRC (0.5V-0.7V).
- 6. Switch data lines to transceiver.

CMO Test

- 7. Apply common mode offset of VGND_OFFSET (0.375 V) with test socket lower than PET transceiver ground.
- 8. Connect using D+.
- 9. Allow PET to be reset and enumerated, responding as a Full Speed device. Check that communication is reliable. [CDP11] This is achieved as follows:
 - If we do not receive a Get Device Descriptor request within 30 seconds communication is deemed to have failed.
 - After the Get Device Descriptor setup transaction we NAK the IN transactions for 250 frames duration (mid-frame to mid-frame).
 - During this period we count the successfully received SOF packets; less than 100% success is considered a failure.
 - Assuming success, we now allow enumeration to continue, in whatever form the CDP chooses (we have no way to control the CDP).

Note: we are now confident that we can receive IN packets, and need to check whether the CDP reliably receives packets we send to it.

- We monitor whether any IN transactions timeout when expecting ACK. This would indicate a failure of the CDP to have received our Data0/1 packet. Continue this monitoring until we get suspended, or for a chosen maximum period. A 'pass' requires 100% success in receiving ACKs to IN transactions.
- 10. Disconnect using D+
- 11. Remove common mode offset.

9.6 CDP Ground Offset	: Test – High Speed
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Test Setup	Test Setup 5. UUT is an CDP, PET simulates a PD.
Pre-conditions	When running this test, ensure that an isolated computer is used for the tester host (e.g. Laptop).
Purpose	To verify that charging downstream port fulfills USB2.0 specification common mode voltage requirements at high speed.
Description	Insert specified command voltage offset and check UUT can enumerate reference device and operate well.
Parameters	
Checklist	CDP11
Pass Criteria	Step 9: Enumeration is successful.

9.6.1 Test procedure

- 1. Check VBUS is above VOTG_SESS_VLD max (4V).
- 2. Wait 200ms.

Primary Detection

- 3. Connect voltage source (0.6V) via 200R resistor to D+.
- 4. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).
- 5. Check D- voltage is in range VDM_SRC (0.5V-0.7V).
- 6. Switch data lines to transceiver.

CMO Test

- 7. Apply common mode offset of VGND_OFFSET (0.375 V) with test socket lower than PET transceiver ground.
- 8. Connect using D+.
- 9. Allow PET to be reset and enumerated, responding as a High Speed device. Check that communication is reliable. [CDP11] This is achieved as follows:
 - If we do not receive a Get Device Descriptor request within 30 seconds communication is deemed to have failed.
 - After the Get Device Descriptor setup transaction we NAK the IN transactions for 250 frames duration (mid-frame to mid-frame).
 - During this period we count the successfully received SOF packets; less than 100% success is considered a failure.
 - Assuming success, we now allow enumeration to continue, in whatever form the CDP chooses (we have no way to control the CDP).

Note: we are now confident that we can receive IN packets, and need to check whether the CDP reliably receives packets we send to it.

- We monitor whether any IN transactions timeout when expecting ACK. This would indicate a failure of the CDP to have received our Data0/1 packet. Continue this monitoring until we get suspended, or for a chosen maximum period. A 'pass' requires 100% success in receiving ACKs to IN transactions.
- 10. Disconnect using D+
- 11. Remove common mode offset.

10 Standard Downstream Port (SDP) Compliance

This section is included in order to allow the testing of a Multiple Role Port, which may behave as a CDP, a DCP or an SDP, depending on circumstances. Its purpose is to check the additional BC requirement placed on an MRP acting as an SDP, namely to take part in detection handshaking correctly.

10.1 Submission Materials

10.1.1 Device Specific Information

The following items are required to be submitted along with the UUT:

Table 10-1 Device Specific Information for SDPs

ltem	Function	Value/ Support
1	The USB-IF TID for the UUT standard-A receptacle(s).	

10.1.2 Checklist

Table 10-2 Checklist for DCPs

Question		Response	Test Number	BC 1.2 Reference
SDP1	If before connecting, a device applies VDP_SRC to D+, does the SDP maintain a voltage of less than VDAT_REF min on D-?	Yes 🗆 No 🗆	10.2	3.2.4.3
SDP2	If before connecting, a device applies VDM_SRC to D-, does the SDP maintain a voltage of less than VDAT_REF min on D+?	Yes 🗆 No 🗆	10.2	3.2.4.3
SDP3	Does the UUT provide VBUS discharge functionality?	Yes 🗆 No 🗆	Vendor Declaration	4.1.3

Test Setup	Test Setup 5. UUT is a SDP, PET simulates a PD.
Pre-conditions	SDP is switched on.
Purpose	To verify the parameters of detection handshake. This test is particularly designed to verify the behavior of UUTs which switch roles among DCP, CDP and SDP, and may therefore have more complex circuitry on D+ and D- than a standard downstream port.
Description	Test confirms correct handshake behavior.
Parameters	-
Checklist	SDP1, SDP2
Pass Criteria	Step 5. D- is below 0.25V.
	Step 10. D+ is below 0.25V.

10.2 SDP Handshaking Test

10.2.1 Test procedure

Initial State: UUT is connected via Special Test Cable B to the PET. No load applied. SDP is switched on. Data lines switched to data measurement circuit.

- 1. Check VBUS is above VOTG_SESS_VLD max (4V).
- 2. Wait 200ms

Primary Detection

- 3. Connect voltage source (0.6V) via 200R resistor to D+.
- 4. Wait slightly more than TVDMSRC_EN max (20ms +1 ms = 21ms).
- 5. Check that D- is below VDAT_REF min (0.25V). [SDP1]
- 6. Wait 20ms to complete TVDPSRC_ON.
- 7. Disconnect voltage source via 200R resistor from D+.

Secondary Detection

- 8. Connect voltage source (0.6V) via 200R resistor to D-.
- 9. Wait 21ms.
- 10. Check that D+ is below VDAT_REF min (0.25V). [SDP2]
- 11. Wait 20ms to complete TVDMSRC_ON.
- 12. Disconnect voltage source via 200R resistor from D-.
- 13. Wait 5 seconds for UUT to recover.

11 Multiple Role Port (MRP) Compliance

This section is included in order to allow the testing of a Multiple Role Port, which may behave as a CDP, a DCP or an SDP, depending on circumstances. Its purpose is to check that the MRP port behaves correctly when switching between its roles.

11.1 Submission Materials

11.1.1 Device Specific Information

Table 11-1 Device Specific Information for SDPs

Item	Function	Value/ Support
1	Description of how to bring the UUT from an un-powered state to a state	
	where it is acting as a CDP.	
2	Description of how to bring the UUT from a state where it is acting as a	
	CDP, to a state where it is acting as an SDP, if applicable.	
3	Description of how to bring the UUT from a state where it is acting as an	
	SDP, to a state where it is acting as a CDP, if applicable.	
4	Description of how to bring the UUT from a state where it is acting as a	
	CDP, to a state where it is acting as a DCP, if applicable.	
5	Description of how to bring the UUT from a state where it is acting as a	
	DCP, to a state where it is acting as a CDP, if applicable.	

11.1.2 Checklists

Table 11-2 Checklist for MRPs

Question		Response	BC 1.2 Section Number
Informati	on		
MRPI1	Can the MRP act as a CDP? *	Yes 🗆 No 🗆	4.1.3
MRPI2	Can the MRP act as a SDP?	Yes 🗆 No 🗆	4.1.3
MRPI3	Can the MRP act as a DCP?	Yes 🗆 No 🗆	4.1.3
MRPI4	Does the MRP force detection	Yes 🗆 No 🗆	4.1.3
	renegotiation when changing from a CDP to an SDP role?	N/A □	
MRPI5	Does the MRP force detection	Yes 🗆 No 🗆	4.1.3
	renegotiation when changing from an SDP to a CDP role?	N/A □	
MRPI6	Does the MRP force detection	Yes 🗆 No 🗆	4.1.3
	renegotiation when changing from a CDP to a DCP role?	N/A □	
MRPI7	Does the MRP force detection	Yes 🗆 No 🗆	4.1.3
	renegotiation when changing from a DCP to a CDP role?	N/A □	

* The Multiple Role Port compliance test assumes that the MRP can act as a CDP.

Questio	n	Response	Test Number	BC 1.2 Section Number
Requiren	nents			
MRP1	If the MRP forces detection renegotiation when changing from an CDP to a SDP role, does it stop driving VBUS, allow VBUS to drop to less than VBUS_LKG, wait for a time of TVBUS_REAPP and then start driving VBUS?	Yes □ No □ N/A □		4.1.3
MRP2	If the MRP forces detection renegotiation when changing from an SDP to a CDP role, does it stop driving VBUS, allow VBUS to drop to less than VBUS_LKG, wait for a time of TVBUS_REAPP and then start driving VBUS?	Yes □ No □ N/A □		4.1.3
MRP3	If the MRP forces detection renegotiation when changing from an CDP to a DCP role, does it stop driving VBUS, allow VBUS to drop to less than VBUS_LKG, wait for a time of TVBUS_REAPP and then start driving VBUS?	Yes □ No □ N/A □		4.1.3
MRP4	If the MRP forces detection renegotiation when changing from an DCP to a CDP role, does it stop driving VBUS, allow VBUS to drop to less than VBUS_LKG, wait for a time of TVBUS_REAPP and then start driving VBUS?	Yes □ No □ N/A □		4.1.3

Test Setup	Test Setup 5. UUT is an MRP, PET simulates a PD.		
Pre-conditions	MRP is switched on.		
Purpose	To verify the parameters of detection renegotiation. This test is designed to verify the behavior of UUTs which switch roles among DCP, CDP and SDP.		
Description	Test confirms correct detection renegotiation behavior, where implemented.		
Parameters	VBUS_LKG, TVBUS_REAPP		
Checklist	MRP1, MRP2, MRP3, MRP4		
Pass Criteria	Step 19. If implemented, VBUS goes below 0.7V for at least 100ms.		
	Step 22. If implemented, VBUS goes below 0.7V for at least 100ms.		
	Step 25. If implemented, VBUS goes below 0.7V for at least 100ms.		
	Step 27. If implemented, VBUS goes below 0.7V for at least 100ms.		

11.2 MRP Functional Test

11.2.1 Test procedure

Initial State: No load applied.

- 1. Ensure that UUT is connected via Special Test Cable B to the PET.
- 2. Ensure that UUT is in an un-powered state.
- 3. Wait for UUT voltage to fall below VBUS_LKG max (0.7V), in case it has just been switched off. (Speed up fall using 100mA current load.)
- 4. Ask the test operator whether the MRP can act as a CDP. Record the answer. [MRPI1] If answer is 'No', then abandon test.
- 5. Ask the test operator whether the MRP can act as a SDP. Record the answer. [MRPI2]
- 6. Ask the test operator whether the MRP can act as a DCP. Record the answer. [MRPI3]
- 7. If neither MRPI2 nor MRPI3 were answered 'Yes', then abandon test.
- 8. If MRPI2 was answered 'No', skip to step 11.
- 9. Ask the test operator whether the MRP forces detection renegotiation when changing from a CDP to an SDP role. Record the answer. [MRPI4]
- 10. Ask the test operator whether the MRP forces detection renegotiation when changing from an SDP to a CDP role. Record the answer. [MRPI5]
- 11. If MRPI3 was answered 'No', skip to step 14.
- 12. Ask the test operator whether the MRP forces detection renegotiation when changing from a CDP to a DCP role. Record the answer. [MRPI6]
- 13. Ask the test operator whether the MRP forces detection renegotiation when changing from a DCP to a CDP role. Record the answer. [MRPI7]

- 14. If none of MRPI4, MRPI5, MRPI6, MRPI7 were answered 'Yes', then abandon test.
- 15. Instruct test operator to perform steps required to bring the UUT from an un-powered state to a powered one, such that it will be acting in a CDP role, and then to indicate that this has occurred.
- 16. Wait for operator to click 'OK'.
- 17. Wait for VBUS to rise above VCHG min (4.75V).
- 18. If the answer to MRPI2 is 'No', skip to Step 24.
- 19. Instruct test operator to perform steps required to change the role of the UUT from a CDP to an SDP, and then to click 'OK' to indicate that this has been done.
- If the answer to MRPI4 was 'No' skip to next step; else monitor VBUS to check whether it went below VBUS_LKG max (0.7V) for TVBUS_REAPP min (100ms), before the operator clicked 'OK' in the previous step. [MRP1]
- 21. Instruct test operator to perform steps required to change the role of the UUT from an SDP to an CDP, and then to click 'OK' to indicate that this has been done.
- 22. If the answer to MRPI5 was 'No' skip to next step; else monitor VBUS to check whether it went below VBUS_LKG max (0.7V) for TVBUS_REAPP min (100ms), before the operator clicked 'OK' in the previous step.. [MRP2]
- 23. If the answer to MRPI3 is 'No', skip to 'End of Test'.
- 24. Instruct test operator to perform steps required to change the role of the UUT from a CDP to a DCP, and then to click 'OK' to indicate that this has been done.
- If the answer to MRPI6 was 'No' skip to next step; else monitor VBUS to check whether it went below VBUS_LKG max (0.7V) for TVBUS_REAPP min (100ms), before the operator clicked 'OK' in the previous step. [MRP3]
- 26. Instruct test operator to perform steps required to change the role of the UUT from an DCP to an CDP, and then to click 'OK' to indicate that this has been done.
- 27. If the answer to MRPI7 was 'No' skip to 'End of Test'; else monitor VBUS to check whether it went below VBUS_LKG max (0.7V) for TVBUS_REAPP min (100ms), before the operator clicked 'OK' in the previous step. [MRP4]

12 Micro-ACA Compliance, Separate Charger

12.1 Submission Materials

12.1.1 Device Specific Information

Table 12-1 Device Specific Information for Micro-ACAs with Separate Charger

ltem	Function	Value/ Support
1	The USB-IF TID for the UUT micro-AB receptacle used for the accessory port	
2	The USB-IF TID for the UUT micro-A plug used for the OTG port captive cable	
3	The USB-IF TID for the UUT standard-A plug or micro-B receptacle used for the charger port	

12.1.2 Checklists

Question		Response	Test Number	BC 1.2 Section Number
Questions	relating to all Micro-ACAs			
MACA1	Does the UUT have a capacitance from VBUS to ground of CMACA_VBUS on its OTG port?	Yes 🗆 No 🗆	12.12	6.2.6
MACA2	Does the UUT have a capacitance from VBUS to ground of CMACA_VBUS on its accessory port?	Yes 🗆 No 🗆	12.12	6.2.6
MACA3	Does the ACA have an indicator showing when the charger port is able to supply power to the other ports?	Yes 🗆 No 🗆	12.3 - 012.11	6.1
MACA4	Is the Charger Port on the UUT clearly labeled 'Charger Only'? This does not apply to a UUT with a combined charger.	Yes □ No □ N/A □	Inspection	6.1
MACA5	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_GND when nothing is connected to its charger port, and a B-device is connected to its accessory port?	Yes 🗆 No 🗆	012.11	4.5.3
	If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_GND when the unit is not connected to a power source and a B-device is connected to its accessory port?			

Table 12-2 Checklist for Micro-ACAs

MACA6	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_GND when an SDP is connected to its charger port, and a B-device is connected to its accessory port? This does not apply to a UUT with a	Yes 🗆 No 🗆	12.5	4.5.3
MACA7	combined charger. If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_A when a DCP or a CDP is connected to its charger port, and a B-device is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_A when the unit is connected to a power source, and a B-device is connected to its	Yes 🗆 No 🗆	12.8	4.5.3
MACA8	Accessory port? If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_B when a DCP or a CDP is connected to its charger port, and nothing is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_B when the unit is connected to a power source, and nothing is connected to its accessory port?	Yes 🗆 No 🗆	12.6	4.5.3
MACA9	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_B when a DCP or a CDP is connected to its charger port, and an A-device not providing VBUS is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_B when the unit is connected to a power source, and an A-device not providing VBUS is connected to its accessory port?	Yes 🗆 No 🗆	12.7	4.5.3

MACA10	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_C when a DCP or a CDP is connected to its charger port, and an A-device providing VBUS is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_C when the unit is connected to a power source, and an A-device providing VBUS is connected to its accessory port?	Yes 🗆 No 🗆	12.7	4.5.3
MACA11	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when nothing is connected to its charger port, and nothing is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_FLOAT when the unit is not connected to a power source, and nothing is connected to its accessory port?	Yes 🗆 No 🗆	12.9	4.5.3
MACA12	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when an SDP is connected to its charger port, and nothing is connected to its accessory port? This does not apply to a UUT with a combined charger.	Yes 🗆 No 🗆 N/A 🗆	12.3	4.5.3
MACA13	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when nothing is connected to its charger port, and an A-device not supplying VBUS is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_FLOAT when the unit is not connected to a power source, and an A-device not supplying VBUS is connected to its accessory port?	Yes 🗆 No 🗆	12.10	4.5.3
MACA14	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when an SDP is connected to its charger port, and an A-device not supplying VBUS is connected to its accessory port?		12.4	4.5.3
	I his does not apply to a UUT with a combined charger.	N/A ∐		

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MACA15	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when nothing is connected to its charger port, and an A-device supplying VBUS is connected to its accessory port?	Yes 🗆 No 🗆	12.10	4.5.3
	If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_FLOAT when the unit is not connected to a power source, and an A-device supplying VBUS is connected to its accessory port?			
MACA16	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_FLOAT when an SDP is connected to its charger port, and an A-device supplying VBUS is connected to its accessory port?	Yes 🗆 No 🗆	12.4	4.5.3
	This does not apply to a UUT with a combined charger.	N/A □		
MACA17	Does the UUT directly connect the data pins of the OTG port directly to the data pins of the accessory port?	Yes 🗆 No 🗆	Vendor Declaration	4.5.3
MACA18	Does the UUT have a captive cable terminated with a Micro-A plug on its OTG port?	Yes 🗆 No 🗆	Inspection	4.5.4
MACA19	Does the Micro-A plug have a valid TID?	Yes 🗆 No 🗆	Vendor Declaration	
MACA20	Does the UUT have a Micro-AB receptacle on its OTG port?	Yes 🗆 No 🗆	Inspection	6.1
MACA21	Does the Micro-AB receptacle have a valid TID?		Vendor Declaration	
MACA22	Does the UUT Charger Port have a Micro-B receptacle, a captive cable terminated with a Standard-A plug, or a captive cable terminated with a Charger?	Micro-B Standard-A Charger No	Inspection	6.2.1
MACA23	If the Charger Port has a Micro-B receptacle or a Standard-A plug, does this have a valid TID?	Yes □ No □ N/A □	Vendor Declaration	
MACA24	Does the UUT charger port draw less than ISUSP when anything other than a charging port is attached to it?	Yes 🗆 No 🗆	12.3, 12.4, 12.5	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		

MACA25	Does the UUT charger port draw less than ISUSP when a charging port is attached to it, and nothing is attached to the OTG port or accessory port?	Yes 🗆 No 🗆	12.6	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
MACA26	Is the resistance between the VBUS_CHG and VBUS_OTG pins of the UUT, RACA_CHG_OTG when the charger switch is closed, and the voltage on VBUS_CHG is VACA_OPR?	Yes 🗆 No 🗆	12.6	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
MACA27	Is the resistance between the VBUS_CHG and VBUS_ACC pins of the UUT, RACA_CHG_ACC when the accessory switch is closed, and the voltage on VBUS_CHG is VACA_OPR?	Yes 🗆 No 🗆	12.8	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
MACA28	Is the resistance between the VBUS_OTG and VBUS_ACC pins of the UUT, RACA_OTG_ACC when the accessory switch is closed, and the voltage on VBUS_CHG, VBUS_ACC or VBUS_OTG, is VACA_OPR?	Yes 🗆 No 🗆	12.5, 13.6	6.2.6
MACA29	Is the resistance between the internal ground of the UUT and the ground pin of the Micro-AB receptacle attached to the OTG port of the UUT, ROTG_ACA_GND?	Yes 🗆 No 🗆	Vendor Declaration	6.2.6
MACA30	Does the UUT output VDP_SRC on DP_CHG when it detects VBUS_CHG?	Yes 🗆 No 🗆	12.8	6.2.6
	This does not apply to a UUT with a combined charger.	N/A □		
MACA31	Does the UUT close its charger switch when it detects DN_CHG greater than VDAT_REF and VBUS_CHG remains above VOTG_SESS_VLD?	Yes 🗆 No 🗆	12.8	6.2.6
MACA31	Does the UUT close its charger switch when it detects DN_CHG greater than VDAT_REF and VBUS_CHG remains above VOTG_SESS_VLD? This does not apply to a UUT with a combined charger.	Yes □ No □ N/A □	12.8	6.2.6

Questions specific to Micro-ACAs with Combined Charger				
MACC1	Is the output voltage of the UUT less than VCHG_OVRSHT max for any step change in load current, and also when powering on or off?	Yes 🗆 No 🗆		4.1.1
	This does not apply to a UUT with a separate charger.	N/A 🗆		
MACC2	Is the output current of the UUT prevented from exceeding ICDP max under any condition?	Yes 🗆 No 🗆	Vendor Declaration	4.1.2
	This does not apply to a UUT with a separate charger.	N/A □		
MACC3	Has it has been shown, using schematics or by some other explanation, that in the case of a single failure in the UUT, the output voltage on VBUS will not exceed VCHG_FAIL?	Yes 🗆 No 🗆	Vendor Declaration	4.1.5
	This does not apply to a UUT with a separate charger.	N/A 🗆		
MACC4	Is the output voltage of the UUT OTG port greater than VCHG_UNDSHT min for any step change in load current where current is less than ICDP min?	Yes 🗆 No 🗆		4.5.2
	This does not apply to a UUT with a separate charger.	N/A □		
MACC5	Is the output voltage of the UUT Accessory port greater than VCHG_UNDSHT min for any step change in load current where current is less than ICFG_MAX?	Yes 🗆 No 🗆		4.5.2
	This does not apply to a UUT with a separate charger.			
		N/A 🗆		
MACC6	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) for all currents less than ICDP min on its OTG port?	Yes 🗆 No 🗆		4
	This does not apply to a UUT with a separate charger.	N/A 🗆		
MACC7	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) allowing for a drop across RACA_OTG_ACC for all currents less than 500mA on its ACC port?	Yes 🗆 No 🗆		4
	This does not apply to a UUT with a separate charger.	N/A 🗆		

USB Battery Charging 1.2 Compliance Plan Revision 1.2

MACC8	If the UUT goes into shutdown during a current overload condition, does it recover and output a voltage of VCHG within a time of TSHTDWN_REC when the current overload condition has been removed.	Yes 🗆 No 🗆	Vendor Declaration	4.2.2
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Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	This is the first procedure in the Micro-ACA Test Suite.
Purpose	To calibrate the Test Cables, and to prepare the Micro-ACA for the following tests.
Description	The test operator is instructed to connect the test cables in turn, and these are calibrated. The test operator is then instructed to connect up the Micro-ACA in preparation for the tests.

12.2 PET Cable Calibration

12.2.1 Test procedure

- 1. Instruct test operator to plug Special Cable C into PET D-type connector, and the Micro-B plug of the Special Cable C into the PET Micro-AB receptacle, and then click on 'OK'.
- 2. PET passes a current of 500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 3. Instruct test operator to unplug the Micro-B plug of the Special Cable C from the PET Micro-AB receptacle, and then click on 'OK'.
- 4. If 'Captive Cable' checkbox is checked, skip to step 8.
- 5. Instruct test operator to plug Special Cable B into the Standard-A receptacle of Special Cable C, and the Micro-B plug of the Special Cable B into the PET Micro-AB receptacle, and then click on 'OK'.
- 6. PET passes a current of 1500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 7. PET passes a current of 2000mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 8. Instruct test operator to unplug the Micro-B plug of the Special Cable B from the PET Micro-AB receptacle, and then click on 'OK'.
- 9. Instruct test operator to plug the Micro-B plug of Special Cable C into the Accessory Port of the Micro-ACA under test, and then click on 'OK'.
- 10. Instruct test operator to plug the Micro-B plug of the captive OTG cable of the Micro-ACA under test into the PET Micro-AB receptacle, and then click on 'OK'.

11. With Captive Charger Cable

Instruct test operator to plug the Standard-A plug of the captive Charger cable of the Micro-ACA under test into the Standard-A receptacle of Special Cable C, and then click on 'OK'.

With No Captive Charger Cable

Instruct test operator to plug the Micro-B plug of Special Cable B into the Charger port of the Micro-ACA under test, and then click on 'OK'.

Check that cables are connected:

- 12. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 13. Apply 5V to VBUS on charger port.
- 14. Connect together D+ and D- on charger port via 200R.
- 15. Apply ground to ID pin on accessory port.
- 16. Check that we can sense 5V on VBUS on OTG port.
- 17. Check that we can sense 5V on VBUS on accessory port.
- 18. Remove 5V from VBUS on charger port.
- 19. Disconnect D+ from D- on charger port.
- 20. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 21. Remove ground from ID pin on accessory port.
- 22. If test fails report 'Either cables not correctly connected or accessory port ID pin not functioning'.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with SDP attached to the Charger Port and Nothing attached to accessory port
Description	The PET simulates an SDP being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT. Check whether VBUS comes from the OTG port or the Accessory Port. Check the resistance to ground of ID pin on OTG port. Check the current drawn by the Charger Port. Check correct functioning of the Indicator.
Parameters	RID_FLOAT, ISUSP
Checklist	MACA3, MACA12, MACA24
Pass Criteria	Step 3. VBUS is not coming from the Accessory port.
	Step 4. VBUS is not coming from the OTG port.
	Step 5. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 7. Indicator is off.
	Step 8. UUT is drawing less than ISUSP from the charger port

12.3 SDP attached to Charger Port, Nothing attached to Accessory Port

12.3.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Check that VBUS is not coming from the Accessory port. i.e. Check that Accessory port VBUS is less than VOTG_VBUS_LKG (0.7V)
- 4. Check that VBUS is not coming from the OTG port. i.e. Check that OTG port VBUS is less than VOTG_VBUS_LKG (0.7V)

Check RID_FLOAT

5. Check that resistance to ground of ID pin on OTG port is RID_FLOAT (> 220 k Ω). [MACA12]

Check Indicator

- 6. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 7. Wait for response, if 'Yes', test fails. If 'No' it passes. [MACA3]

Check Current Drawn by UUT Charger Port

- 8. Check that the UUT is drawing less than ISUSP (2.5mA) from the charger port. [MACA24]
- 9. Remove 5V from VBUS on charger port.
- 10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with SDP attached to the Charger Port and A-device attached to accessory port
Description	The PET simulates an SDP being attached to the Charger Port of the UUT, and an A- device to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG Port. Check the resistance to ground of ID pin on OTG port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check the current drawn by the Charger Port. Check correct functioning of the Indicator.
Parameters	RID_FLOAT, ISUSP
Checklist	MACA3, MACA9, MACA10, MACA24
Pass Criteria	Step 5. VBUS is coming from the OTG port.
	Step 8. Indicator is off.
	Step 9. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 12. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 14. Voltage is less than 100mV
	Step 19. UUT is drawing less than ISUSP from the charger port

12.4 SDP attached to Charger Port, A-device attached to Accessory Port

12.4.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Connect 5V to VBUS on charger port.
- 3. Connect OV to VBUS on accessory port.
- 4. Check that voltage on VBUS from OTG is less than VOTG_VBUS_LKG (0.7V)
- 5. Connect 5V to VBUS on accessory port.
- 6. Check that voltage on VBUS from OTG port is >= 4.75V.

Check Indicator

- 7. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 8. Wait for response, if 'Yes', test fails. If 'No' it passes. [MACA3]

Check RID_FLOAT

9. Connect OV to VBUS on accessory port.

- 10. Check that resistance to ground of ID pin on OTG port is RID_FLOAT (> 220 k Ω). [MACA9]
- 11. Connect 5V to VBUS on accessory port.
- 12. Check that resistance to ground of ID pin on OTG port is RID_FLOAT (> 220 k Ω). [MACA10]

Check RACA_OTG_ACC

- 13. Set OTG Port VBUS current load to 500mA.
- 14. Check that voltage on Accessory Port VBUS minus OTG VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ).
- 15. Set OTG Port VBUS current load to 0mA.

Check Current Drawn by UUT Charger Port

- 16. Set OTG Port VBUS current load to 10mA.
- 17. Measure current drawn from VBUS generator.
- 18. Disconnect VBUS from Charger Port.
- 19. Check that current drops by less than ISUSP (2.5mA) [MACA24]
- 20. Remove 5V from VBUS on OTG port.
- 21. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 22. Set OTG Port VBUS current load to 0mA.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with SDP attached to the Charger Port and B-device attached to accessory port
Description	The PET simulates an SDP being attached to the Charger Port of the UUT, and a B- device to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG port or the Accessory Port. Check the resistance to ground of the ID pin on OTG port. Check the current drawn by the Charger Port. Check correct functioning of the Indicator.
Parameters	RID_GND, RACA_OTG_ACC, ISUSP
Checklist	MACA3, MACA6, MACA24, MACA28
Pass Criteria	Step 4. VBUS is not coming from the Accessory port.
	Step 5. VBUS is not coming from the OTG port.
	Step 6. Resistance to ground of ID pin on OTG port is RID_GND.
	Step 8. Indicator is off.
	Step 11. Voltage is less than 100mV
	Step 16. UUT is drawing less than ISUSP from the charger port

12.5 SDP attached to Charger Port, B-device attached to Accessory Port

12.5.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Apply ground to ID pin on accessory port.
- 4. Check that VBUS is not coming from the Accessory port. i.e. Check that Accessory port VBUS is less than VOTG_VBUS_LKG (0.7V).
- 5. Check that VBUS is not coming from the OTG port. i.e. Check that OTG port VBUS is less than VOTG_VBUS_LKG (0.7V)

Check RID_GND

6. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1k Ω). [MACA6]

Check Indicator

- 7. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 8. Wait for response, if 'Yes', test fails. If 'No' it passes. [MACA3]

Check RACA_OTG_ACC

- 9. Apply VBUS to OTG port
- 10. Connect 10Ω load to Accessory Port VBUS line
- Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ). [MACA28]
- 12. Remove 10Ω load from accessory port VBUS line

Check Current Drawn by UUT Charger Port

- 13. Connect 625Ω load to Accessory Port VBUS line.
- 14. Measure current drawn from VBUS generator.
- 15. Disconnect VBUS from Charger Port.
- 16. Check that current drops by less than ISUSP (2.5mA) [MACA24]
- 17. Remove 5V from VBUS on OTG port.
- 18. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 19. Disconnect 625Ω load from Accessory Port VBUS line.
- 20. Disconnect ground from ID pin on accessory port.

12.6 DCP or CDP attached to Charger Port, Nothing attached to Accessory Port

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with Charger attached to the Charger Port and Nothing attached to accessory port
Description	The PET simulates a DCP or CDP being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG Port or the Accessory Port. Check the resistance to ground of the ID pin on OTG Port. Check the resistance between VBUS on the Charger Port, and on the OTG Port. Check correct functioning of the Indicator. Check UUT outputs VDP_SRC on Charger Port D+.
Parameters	RID_B, RACA_CHG_OTG, VDP_SRC
Checklist	MACA3, MACA8, MACA24, MACA26
Pass Criteria	Step 4. VBUS is not coming from the Accessory port.
	Step 5. VBUS is coming from the OTG port.
	Step 6. Less than 2.5mA is being drawn by the charger port.
	Step 8. Voltage is less than 300mV
	Step 10. Resistance to ground of ID pin on OTG port is RID_B.
	Step 12. Indicator is on.
	Step 13. Voltage is 0.5V-0.7V.

12.6.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Connect together D+ and D- on charger port via 200R.
- 4. Check that VBUS is not coming from the Accessory port. i.e. Check that Accessory port VBUS is less than VOTG_VBUS_LKG (0.7V)
- 5. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.
- 6. Check that less than ISUSP max (2.5mA) is being drawn by charger port. [MACA24]

Check RACA_CHG_OTG

7. Set OTG Port VBUS current load to 1500mA.

- Check that voltage on Charger VBUS minus OTG Port VBUS is less than 300mV, allowing for the voltage drop in the test cables. This confirms RACA_CHG_OTG (200mΩ). [MACA26]
- 9. Set OTG Port VBUS current load to 0mA.

Check RID_B

10. Check that resistance to ground of ID pin on OTG port is RID_B (67-69 kΩ). [MACA8]

Check Indicator

- 11. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 12. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]

Check VDP_SRC

- 13. Check that voltage on D+ of charger port is VDP_SRC (0.5V-0.7V).
- 14. Remove 5V from VBUS on charger port.
- 15. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 16. Disconnect D+ from D- on charger port.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with DCP or CDP attached to the Charger Port and A-device attached to accessory port
Description	The PET simulates a DCP or CDP being attached to the Charger Port of the UUT, and an A-device to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG. Check the resistance to ground of ID pin on OTG Port. Check correct functioning of the Indicator. Check UUT outputs VDP_SRC on Charger Port D+.
Parameters	RID_C, ISUSP, VDP_SRC
Checklist	MACA3, MACA9, MACA10
Pass Criteria	Step 5. VBUS is coming from the OTG port.
	Step 6. Resistance to ground of ID pin on OTG port is RID_B.
	Step 8. Resistance to ground of ID pin on OTG port is RID_C.
	Step 10. Indicator is on.
	Step 15. Current is < 2.5mA
	Step 17. Voltage is 0.5V-0.7V.

12.7 DCP or CDP attached to Charger Port, A-device attached to Accessory Port

12.7.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 0V to VBUS on Accessory Port.
- 3. Apply 5V to VBUS on Charger Port.
- 4. Connect together D+ and D- on charger port via 200Ω .
- 5. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_B and RID_C

- 6. Check that resistance to ground of ID pin on OTG port is RID_B (67-69 kΩ). [MACA9]
- 7. Apply 5V to VBUS on Accessory Port.
- 8. Check that resistance to ground of ID pin on OTG port is RID_C (36-37 kΩ). [MACA10]

Check Indicator

- 9. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 10. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]

Check Current From Accessory Port

- 11. Set OTG Port VBUS current load to 10 mA.
- 12. Measure current from VBUS generator.
- 13. Disconnect VBUS from Accessory Port.
- 14. Measure current from VBUS generator and subtract from previous measurement.
- 15. Check that difference is less than ISUSP (2.5mA).
- 16. Set OTG Port VBUS current load to zero.

Check VDP_SRC

- 17. Check that voltage on D+ of charger port is VDP_SRC (0.5V-0.7V).
- 18. Remove 5V from VBUS on Charger Port.
- 19. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 20. Disconnect D+ from D- on charger port.

12.8 DCP or CDP attached to 0	Charger Port,	B-device attached to
Accessory Port		

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports	
Pre-conditions		
Purpose	Check ACA behavior with DCP or CDP attached to the Charger Port and B-device attached to accessory port	
Description	The PET simulates a DCP or CDP being attached to the Charger Port of the UUT, and a B-device to the Accessory Port of the UUT.	
	Check whether VBUS comes from the OTG Port or the Accessory Port. Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the Charger Port, and on the OTG Port. Check the resistance between VBUS on the Charger Port, and on the Accessory Port. Check correct functioning of the Indicator. Check UUT outputs VDP_SRC on Charger Port D+.	
Parameters	RID_A, VACA_OPR, VACA_DIS, RACA_CHG_ACC, RACA_CHG_OTG, VDP_SRC	
Checklist	MACA3, MACA7, MACA26, MACA27, MACA30	
Pass Criteria	Step 6. VBUS is coming from the Accessory port.	
	Step 7. VBUS is coming from the OTG port.	
	Step 8. Resistance to ground of ID pin on OTG port is RID_A.	
	Steo 10. VBUS is coming from the Accessory port.	
	Step 11. VBUS is coming from the OTG port.	
	Step 15. Voltage is less than 500mV	
	Step 17. Voltage is less than 300mV	
	Step 20. Indicator is on.	
	Step 21. Voltage is 0.5V-0.7V.	

12.8.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Connect Accessory Port ID pin to ground.
- 3. Apply 5V to VBUS on charger port.
- 4. Connect together D+ and D- on charger port via 200R.
- 5. Connect 625Ω load on Accessory Port VBUS
- 6. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 4.75V.
- 7. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_A

8. Check that resistance to ground of ID pin on OTG port is RID_A (122-126 kΩ). [MACA7]

Check VACA_OPR

- 9. Change VBUS generator voltage to VACA_OPR min (4.1V).
- 10. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 3.85V.
- 11. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 3.85V. [MACA27]

Check RACA_CHG_ACC

- 12. Disconnect 625Ω load from Accessory Port VBUS
- 13. Set OTG Port VBUS current load to 1500mA.
- 14. Connect 10Ω load to Accessory Port VBUS line.
- Check that voltage on Charger VBUS minus Accessory Port VBUS is less than 500mV, allowing for the voltage drop in the test cables. This confirms RACA_CHG_ACC (400mΩ). [MACA27]

Note: The 500mV comprises 400mV across the Charger Switch (2A x 200m Ω), plus 100mV across the Accessory Switch (0.5A x 200m Ω).

Check RACA_CHG_OTG

- 16. Disconnect 10Ω load from Accessory Port VBUS line.
- Check that voltage on Charger VBUS minus OTG Port VBUS is less than 300mV, allowing for the voltage drop in the test cables. This confirms RACA_CHG_OTG (200mΩ). [MACA26]
- 18. Set OTG Port VBUS current load to 0mA.

Check Indicator

- 19. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 20. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]

Check VDP_SRC

- 21. Check that voltage on D+ of charger port is VDP_SRC (0.5V-0.7V). [MACA30]
- 22. Remove 5V from VBUS on charger port.
- 23. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 24. Disconnect Accessory Port ID pin from ground.

25. Disconnect D+ from D- on charger port.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with Nothing attached to the Charger Port and an A-device attached to accessory port
Description	The PET simulates nothing being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT.
	Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.
Parameters	RADP_OTG_ACC, RID_FLOAT
Checklist	MACA3, MACA11, MACA32
Pass Criteria	Step 2. Voltage is less than 20mV.
	Step 4. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 6. Indicator is off.

12.9 Nothing attached to Charger Port, Nothing attached to Accessory Port

12.9.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

Check RADP_OTG_ACC

- 1. Apply 0.75V to VBUS on OTG Port.
- Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes [MACA32].
- 3. Disconnect VBUS from OTG port.

Check RID_FLOAT

4. Check that resistance to ground of ID pin on OTG port is RID_FLOAT (> 220 k Ω). [MACA11]

Check Indicator

- 5. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 6. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with Nothing attached to the Charger Port and A-device attached to accessory port
Description	The PET simulates nothing being attached to the Charger Port of the UUT, and an A- device to the Accessory Port of the UUT.
	Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.
Parameters	RADP_OTG_ACC, RID_FLOAT, RACA_OTG_ACC
Checklist	MACA3, MACA14, MACA15, MACA32
Pass Criteria	Step 2: Voltage difference is less than 20mV
	Step 5. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 7. Voltage is less than 100mV.
	Step 12. Indicator is not on.

12.10 Nothing attached to Charger Port, A-device attached to Accessory Port

12.10.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

Check RADP_OTG_ACC

- 1. Apply 0.75V to VBUS on OTG Port.
- 2. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes. [MACA32]
- 3. Disconnect VBUS from OTG port.

Check RID_ FLOAT

- 4. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 5. Check that resistance to ground of ID pin on OTG port is RID_ FLOAT (> 220k Ω). [MACA14]
- 6. Connect 5V VBUS to Accessory port.
- 7. Check that resistance to ground of ID pin on OTG port is RID_ FLOAT (> 220k Ω). [MACA15]

Check RACA_OTG_ACC

- 8. Set OTG Port current load to 500mA.
- 9. Check that voltage on Accessory VBUS minus OTG Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ)
- 10. Set OTG Port current load to 0mA.

Check Indicator

- 11. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 12. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]
- 13. Disconnect VBUS from Accessory port.
- 14. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
12.11 Nothing attached to Charger Port, B-device attached to Accessory Port

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with Nothing attached to the Charger Port and a B-device attached to accessory port
Description	The PET simulates nothing being attached to the Charger Port of the UUT, and a B- device to the Accessory Port of the UUT.
	Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.
Parameters	RADP_OTG_ACC , RID_GND, RACA_OTG_ACC
Checklist	MACA3, MACA5, MACA32
Pass Criteria	Step 3: Voltage difference is less than 20mV
	Step 5. Resistance to ground of ID pin on OTG port is RID_ GND.
	Step 8. Voltage is less than 100mV
	Step 11. Indicator is off.

12.11.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

Check RADP_OTG_ACC

- 1. Apply ground to ID pin on accessory port.
- 2. Apply 0.75V to VBUS on OTG Port.
- 3. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes. [MACA32]
- 4. Disconnect VBUS from OTG port.

Check RID_GND

5. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1kΩ). [MACA5]

Check RACA_OTG_ACC

- 6. Connect 5V VBUS to OTG port.
- 7. Connect Accessory Port 10Ω load.
- 8. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ)
- 9. Disconnect Accessory Port 10Ω load.

Check Indicator

- 10. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 11. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]
- 12. Disconnect VBUS from OTG port.
- 13. Disconnect ground from ID pin on accessory port.

Test Setup	UUT is a Micro-ACA, PET simulates devices on the three ports	
Pre-conditions		
Purpose	Check presence and values of bypass capacitors CMACA_VBUS.	
	Note: The capacitance at the OTG port will be seen as a combined capacitance. Therefore the range of capacitance at the OTG port is valid if it lies between 20nF and 200nF (2 x CMACA_VBUS max).	
Description	The PET simulates necessary conditions for measuring the bypass capacitors on the OTG port and the Accessory port.	
Parameters	CMACA_VBUS	
Checklist	MACA1, MACA2	
Pass Criteria	Step 7. Capacitance is 10-100nF	
	Step 12. Capacitance is 20-200nF	

12.12 Bypass Capacitance

12.12.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Accessory Port Bypass Capacitance:

- 1. Apply 5V to VBUS on charger port.
- 2. Connect together D+ and D- on charger port via 200Ω .
- 3. Check that Accessory port VBUS is less than 0.25V
- 4. Connect 625R resistor from Accessory port VBUS to ground.
- 5. Connect 5V to VBUS on Accessory port.
- 6. Disconnect it and measure fall time as it discharges through the 625R pull-down resistor.
- 7. Evaluate capacitance from fall time and check it lies within CMACA_VBUS (10-100nF). [MACA2]
- 8. Disconnect 5V from VBUS on charger port.
- 9. Disconnect 625R resistor from Accessory port VBUS to ground.
- 10. Disconnect D+ from D- on charger port.

Check OTG Port Bypass Capacitance:

11. Use ADP circuit components in PET to evaluate OTG port capacitance.

12. Check that this capacitance lies within 2 x CMACA_VBUS min and 2 x CMACA_VBUS max (20 - 200nF). [MACA1]

13 Micro-ACA Compliance, Combined Charger

13.1 Submission Materials

13.1.1 Device Specific Information

Table 13-1 Device Specific Information for Micro-ACAs with Combined Charger

Item	Function	Value/ Support
1	Schematics or other proof that UUT output current cannot exceed 5.0 amperes	
2	The USB-IF TID for the UUT micro-AB receptacle used for the accessory port	
3	The USB-IF TID for the UUT micro-A plug used for the OTG port captive cable	
4	Schematics or other proof that a single UUT failure will not cause the output voltage on VBUS to exceed VCHG_FAIL?	

13.1.2 Checklists

See previous section for Checklist

Test Setup	Test Setup 7b. UUT is a Micro-ACA, with combined charger, PET simulates devices on the two ports.
Pre-conditions	This is the first procedure in the Micro-ACA, Combined Charger Test Suite.
Purpose	To calibrate the Test Cables, and to prepare the Micro-ACA for the following tests.
Description	The test operator is instructed to connect the test cables in turn, and these are calibrated. The test operator is then instructed to connect up the Micro-ACA in preparation for the tests.

13.2 PET Cable Calibration

13.2.1 Test procedure

- 1. Instruct test operator to plug Special Cable C into PET D-type connector, and the Micro-B plug of the Special Cable C into the PET Micro-AB receptacle, and then click on 'OK'.
- 2. PET passes a current of 500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 3. Instruct test operator to unplug the Micro-B plug of the Special Cable C from the PET Micro-AB receptacle, and then click on 'OK'.
- 4. Instruct test operator to plug the Micro-B plug of Special Cable C into the Accessory Port of the Micro-ACA under test, and then click on 'OK'.
- 5. Instruct test operator to plug the Micro-B plug of the captive OTG cable of the Micro-ACA under test into the PET Micro-AB receptacle, and then click on 'OK'.

Check that cables are connected:

- 6. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 7. Instruct test operator to power up the Micro-ACA under test, and then click on 'OK'.
- 8. Apply ground to ID pin on accessory port.
- 9. Check that we can sense 5V on VBUS on OTG port.
- 10. Check that we can sense 5V on VBUS on accessory port.
- 11. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 12. Remove ground from ID pin on accessory port.
- 13. If test fails report 'Either cables not correctly connected or UUT is not functioning'.
- 14. Instruct test operator to perform steps required to bring the Micro-ACA from a powered state to an un-powered one.
- 15. Wait for operator to click 'OK'.

13.3 Mi	cro-ACA	Voltage,	Current and	Transient	Test
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Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	PET Cable Calibration test has been run.
Purpose	To verify the Micro-ACA meets voltage, current, voltage overshoot and undershoot specifications, for any specified step change in load.
Description	This test measures the VBUS voltage at extremes of load current. It also changes the VBUS current abruptly, and measures the resulting voltage overshoot and undershoot levels.
Parameters	VCHG_OVERSHT, VCHG_UNDSHT, VCHG
Checklist	MACC1, MACC4, MACC5, MACC6, MACC7
Pass Criteria	Step 8 – Latch not triggered
	Step 10 – Voltage in range
	Step 14 – Latches not triggered
	Step 17 – Voltage in range
	Step 18 – Latches not triggered
	Step 26 – Latch not triggered
	Step 28 – Voltage in range
	Step 32 – Latches not triggered
	Step 35 – Voltage in range
	Step 36 – Latches not triggered

13.3.1 Test procedure

Initial State: No load applied.

OTG Port

- 1. Ensure that Micro-ACA is in an un-powered state.
- 2. Wait for Micro-ACA OTG port VBUS to fall below VBUS_LKG max (0.7V), in case it has just been switched off. (Speed up fall using 100mA current load.)
- 3. Connect accessory port ID pin to ground.
- Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on OTG port VBUS.
- 5. Instruct test operator to perform steps required to bring the Micro-ACA from an unpowered state to a powered one.
- 6. Wait for operator to click 'OK'.
- 7. Wait for Micro-ACA OTG port VBUS to rise above VCHG min (4.75V).
- 8. Check watch-block overshoot detector latch was not triggered. [MACC1]

- 9. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on Micro-ACA OTG port VBUS.
- 10. With no current load applied, check that Micro-ACA OTG port VBUS is within appropriate range VCHG (4.75V to 5.25V). [MACC6]

Load Testing OTG port

- 11. Apply load of ICDP min (1.5A) to Micro-ACA OTG port VBUS.
- 12. Wait 10ms.
- Check that Micro-ACA OTG port VBUS, at Micro-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V).
- 14. Check watch-block overshoot and undershoot detector latches were not triggered. [MACC1] [MACC4]
- 15. Remove Current Load.
- 16. Wait 10ms
- 17. Check that VBUS voltage from Micro-ACA accessory port VBUS, at Micro-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V). [MACC6]
- 18. Check watch-block overshoot and undershoot detector latches were not triggered. [MACC1] [MACC4]
- 19. Instruct test operator to perform steps required to bring the Micro-ACA from a powered state to an un-powered one.
- 20. Wait for operator to click 'OK'.

Accessory Port

- 21. Wait for Micro-ACA accessory port VBUS to fall below VBUS_LKG max (0.7V). (Speed up fall using 10R resistive load.)
- 22. Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on accessory port VBUS.
- 23. Instruct test operator to perform steps required to bring the Micro-ACA from an unpowered state to a powered one.
- 24. Wait for operator to click 'OK'.
- 25. Wait for Micro-ACA OTG port VBUS to rise above VCHG min (4.75V).
- 26. Check watch-block overshoot detector latch was not triggered. [MACC1]
- 27. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on Micro-ACA accessory port VBUS, allowing for voltage drop in cable.

28. With no current load applied, check that Micro-ACA accessory port VBUS is within appropriate range VCHG (4.75V to 5.25V). [MACC7]

Load Testing Accessory port

- 29. Apply load of ICFG_MAX (500mA) to Micro-ACA accessory port VBUS.
- 30. Wait 10ms.
- Check that Micro-ACA accessory port VBUS, at Micro-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable.
- 32. Check watch-block overshoot and undershoot detector latches were not triggered. [MACC1] [MACC5]
- 33. Remove Current Load.
- 34. Wait 10ms
- 35. Check that VBUS voltage from Micro-ACA accessory port VBUS, at Micro-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG RACA_OTG_ACC x ICFG_MAX (4.65V to 5.25V). [MACC7]
- 36. Check watch-block overshoot and undershoot detector latches were not triggered. [MACC1] [MACC5]
- 37. Instruct test operator to perform steps required to bring the Micro-ACA from a powered state to an un-powered one.
- 38. Wait for operator to click 'OK'.

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Check ACA behavior with ACA not powered and nothing attached to accessory port
Description	The PET simulates nothing being attached to the Accessory Port of the UUT.
	Checks the resistance to ground of ID pin on OTG Port. Checks the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.
Parameters	RADP_OTG_ACC , RID_FLOAT
Checklist	MACA3, MACA11, MACA32
Pass Criteria	Step 3. Voltage is less than 20mV. (Not mandatory)
	Step 6. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 8. Indicator is off.

13.4 Micro-ACA Not Powered, Nothing attached to Accessory Port

13.4.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is not powered. Accessory port ID pin is floating. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

1. Ensure that Micro-ACA is in an un-powered state.

Check RADP_OTG_ACC

- 2. Apply 0.75V to VBUS on OTG Port.
- 3. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes. [MACA32]
- 4. Disconnect VBUS from OTG port.

Check RID_FLOAT

5. Check that resistance to ground of ID pin on OTG port is RID_FLOAT (> 220 k Ω). [MACA11]

Check Indicator

- 6. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 7. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Check ACA behavior with ACA not powered and A-device attached to accessory port
Description	The PET simulates an A-device being attached to the Accessory Port of the UUT.
	Checks the resistance to ground of ID pin on OTG Port. Checks the resistance between VBUS on the OTG Port, and on the Accessory Port. Checks correct functioning of the Indicator.
Parameters	RADP_OTG_ACC, RID_FLOAT, RACA_OTG_ACC
Checklist	MACA3, MACA13, MACA14, MACA32
Pass Criteria	Step 3. Voltage difference is less than 20mV
	Step 6. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 8. Resistance to ground of ID pin on OTG port is RID_FLOAT.
	Step 10. Voltage is less than 100mV.
	Step 13. Indicator is not on.

13.5 Micro-ACA Not Powered, A-device attached to Accessory Port

13.5.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is not powered. Accessory port ID pin is floating. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

1. Ensure that Micro-ACA is in an un-powered state.

Check RADP_OTG_ACC

- 2. Apply 0.75V to VBUS on OTG Port.
- 3. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes. [MACA32]
- 4. Disconnect VBUS from OTG port.

Check RID_FLOAT

- 5. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 6. Check that resistance to ground of ID pin on OTG port is RID_ FLOAT (> 220k Ω). [MACA13]
- 7. Connect 5V VBUS to Accessory port.
- 8. Check that resistance to ground of ID pin on OTG port is RID_ FLOAT (> 220k Ω). [MACA14]

Check RACA_OTG_ACC

- 9. Set OTG Port current load to 500mA.
- 10. Check that voltage on Accessory VBUS minus OTG Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ)
- 11. Set OTG Port current load to 0mA.

Check Indicator

- 12. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 13. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]
- 14. Disconnect VBUS from Accessory port.
- 15. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.	
Pre-conditions		
Purpose	Check ACA behavior with ACA not powered and a B-device attached to accessory port	
Description	The PET simulates a B-device being attached to the Accessory Port of the UUT.	
	Checks the resistance to ground of ID pin on OTG Port. Checks the resistance between VBUS on the OTG Port, and on the Accessory Port. Checks correct functioning of the Indicator.	
Parameters	RADP_OTG_ACC , RID_GND, RACA_OTG_ACC	
Checklist	MACA3, MACA5, MACA28	
Pass Criteria	Step 4. Voltage difference is less than 20mV	
	Step 6. Resistance to ground of ID pin on OTG port is RID_ GND.	
	Step 9. Voltage is less than 100mV	
	Step 12. Indicator is off.	

13.6 Micro-ACA Not Powered, B-device attached to Accessory Port

13.6.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is not powered. Accessory port ID pin is floating. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

- 1. Ensure that Micro-ACA is in an un-powered state.
- 2. Apply ground to ID pin on accessory port.

Check RADP_OTG_ACC

- 3. Apply 0.75V to VBUS on OTG Port.
- 4. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes.
- 5. Disconnect VBUS from OTG port.

Check RID_GND

6. Check that resistance to ground of ID pin on OTG port is RID_GND (< $1k\Omega$). [MACA5]

Check RACA_OTG_ACC

- 7. Connect 5V VBUS to OTG port.
- 8. Connect Accessory Port 10Ω load.
- Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_OTG_ACC (200mΩ). [MACA28]

10. Disconnect Accessory Port 10Ω load.

Check Indicator

- 11. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 12. Wait for response, if 'No', test passes. If 'Yes' it fails. [MACA3]
- 13. Disconnect VBUS from OTG port.
- 14. Disconnect ground from ID pin on accessory port.

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Check ACA behavior with ACA powered and Nothing attached to accessory port
Description	The PET simulates nothing being attached to the Accessory Port of the UUT.
	Checks whether VBUS comes from the OTG Port or the Accessory Port. Checks the resistance to ground of ID pin on OTG Port. Checks correct functioning of the Indicator.
Parameters	RID_B, RACA_CHG_OTG
Checklist	MACA3, MACA8
Pass Criteria	Step. VBUS is not coming from the Accessory port.
	Step. VBUS is coming from the OTG port.
	Step. Less than 2.5mA is being drawn by the charger port.
	Step. Voltage is less than 300mV
	Step. Resistance to ground of ID pin on OTG port is RID_B.
	Step. Indicator is on.
	Step. Voltage is 0.5V-0.7V.

13.7 Micro-ACA Powered Up, Nothing attached to Accessory Port

13.7.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is not powered. Accessory port ID pin is floating.

- 1. Instruct test operator to perform steps required to bring the Micro-ACA from an unpowered state to a powered one.
- 2. Wait for operator to click 'OK'.
- 3. Ensure that Micro-ACA is in a powered state.

Check Switching Functionality:

- 4. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 5. Check that VBUS is not coming from the accessory port. i.e. Check that accessory port VBUS is less than VOTG_VBUS_LKG (0.7V)
- 6. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_B

7. Check that resistance to ground of ID pin on OTG port is RID_B (67-69 kΩ). [MACA8]

Check Indicator

8. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.

- 9. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]
- 10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.	
Pre-conditions		
Purpose	Check ACA behavior with ACA powered and A-device attached to accessory port	
Description	The PET simulates an A-device being attached to the Accessory Port of the UUT.	
	Checks whether VBUS comes from the OTG port. Checks the resistance to ground of ID pin on OTG Port. Checks correct functioning of the Indicator.	
Parameters	RID_C, ISUSP	
Checklist	MACA3, MACA9, MACA10	
Pass Criteria	Step 4. VBUS is coming from the OTG port.	
	Step 5. Resistance to ground of ID pin on OTG port is RID_B.	
	Step 7. Resistance to ground of ID pin on OTG port is RID_C.	
	Step 9. Indicator is on.	
	Step 14. Current is < 2.5mA	

13.8 Micro-ACA Powered Up, A-device attached to Accessory Port

13.8.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is powered. Accessory port ID pin is floating.

1. Ensure that Micro-ACA is in a powered state.

Check Switching Functionality:

- 2. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 3. Apply 0V to VBUS on Accessory Port.
- 4. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_B and RID_C

- 5. Check that resistance to ground of ID pin on OTG port is RID_B (67-69 k Ω). [MACA9]
- 6. Apply 5V to VBUS on Accessory Port.
- 7. Check that resistance to ground of ID pin on OTG port is RID_C (36-37 kΩ). [MACA10]

Check Indicator

- 8. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 9. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]

Check Current From Accessory Port

- 10. Set OTG Port VBUS current load to 10 mA.
- 11. Measure current from VBUS generator.
- 12. Disconnect VBUS from Accessory Port.
- 13. Measure current from VBUS generator and subtract from previous measurement.
- 14. Check that difference is less than ISUSP (2.5mA).
- 15. Set OTG Port VBUS current load to zero.
- 16. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Check ACA behavior with ACA powered and B-device attached to accessory port
Description	The PET simulates a B-device being attached to the Accessory Port of the UUT.
	Checks whether VBUS comes from the OTG Port or the Accessory Port. Checks the resistance to ground of ID pin on OTG Port. Checks correct functioning of the Indicator.
Parameters	RID_A, VACA_OPR, VACA_DIS, RACA_CHG_ACC, RACA_CHG_OTG
Checklist	MACA3, MACA7
Pass Criteria	Step 5. VBUS is coming from the Accessory port.
	Step 6. VBUS is coming from the OTG port.
	Step 7. Resistance to ground of ID pin on OTG port is RID_A.
	Step 9. Indicator is on.

13.9 Micro-ACA Powered Up, B-device attached to Accessory Port

13.9.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is powered. Accessory port ID pin is floating.

1. Ensure that Micro-ACA is in a powered state.

Check Switching Functionality:

- 2. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 3. Connect Accessory Port ID pin to ground.
- 4. Connect 625Ω load on Accessory Port VBUS
- 5. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 4.75V.
- 6. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_A

7. Check that resistance to ground of ID pin on OTG port is RID_A (122-126 kΩ). [MACA7]

Check Indicator

- 8. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 9. Wait for response, if 'Yes', test passes. If 'No' it fails. [MACA3]
- 10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 11. Disconnect Accessory Port ID pin from ground.

13.10	Bypass	Capacitance
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Test Setup	Test Setup 7b. UUT is a Micro-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Checks presence and values of bypass capacitors CMACA_VBUS.
	Note: If the ACA is capable of passing ADP probes from the OTG port to the accessory port when not powered, the capacitance at the OTG port will be seen as a combined capacitance. Therefore the range of capacitance at the OTG port is valid if it lies between 1 μ F and 4 μ F (2 x CMACA_VBUS max).
Description	The PET simulates necessary conditions for measuring the bypass capacitors on the OTG port and the Accessory port.
Parameters	CMACA_VBUS
Checklist	MACA1, MACA2
Pass Criteria	Step 6. Capacitance is 10-100nF
	Step 11. Capacitance is 20-200nF

13.10.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to any port. ACA is powered. Accessory port ID pin is floating.

1. Ensure that Micro-ACA is in a powered state.

Check Accessory Port Bypass Capacitance:

- 2. Check that Accessory port VBUS is less than 0.25V
- 3. Connect 625R resistor from Accessory port VBUS to ground.
- 4. Connect 5V to VBUS on Accessory port.
- 5. Disconnect it and measure fall time as it discharges through the 625R pull-down resistor.
- 6. Evaluate capacitance from fall time and check it lies within CMACA_VBUS (10-100nF). [MACA2]
- 7. Disconnect 625R resistor from Accessory port VBUS to ground.

Check OTG Port Bypass Capacitance:

- 8. Instruct test operator to perform steps required to bring the Micro-ACA from a powered state to an un-powered one.
- 9. Wait for operator to click 'OK'.
- 10. Use ADP circuit components in PET to evaluate OTG port capacitance.

11. Check that this capacitance lies within 2 x CMACA_VBUS min and 2 x CMACA_VBUS max (20– 200nF). [MACA1]

14 Standard-ACA Compliance, Separate Charger

14.1 Submission Materials

14.1.1 Device Specific Information

Table 14-1 Device Specific Information for Standard-ACAs with Separate Charger

ltem	Function	Value/ Support
1	The USB-IF TID for the UUT standard-A receptacle used for the accessory port	
2	The USB-IF TID for the UUT micro-A plug used for the OTG port captive cable	
3	The USB-IF TID for the UUT standard-A plug or micro-B receptacle used for the charger port	

14.1.2 Checklists

Question		Response	Test Number	BC 1.2 Section Number
Questions r	elating to all Standard-ACAs			
SACA1	Does the UUT have a capacitance from VBUS to ground of CMACA_VBUS on its OTG or accessory port?	Yes 🗆 No 🗆	12.12	6.2.6
SACA2	Does the ACA have an indicator showing when the charger port is able to supply power to the other ports?	Yes 🗆 No 🗆	12.3 - 012.11	6.1
SACA3	Is the Charger Port on the UUT clearly labeled 'Charger Only'? This does not apply to a UUT with a combined charger	Yes □ No □ N/A □	Inspection	6.1
SACA4	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_GND when nothing is connected to its charger port, and a B-device is connected to its accessory port? If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_GND when the unit is not connected to a power source and a B-device is connected to its accessory port?	Yes 🗆 No 🗆	012.11	4.5.3

Table 14-2 Checklist for Standard-ACAs

SACA5	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_GND when an SDP is connected to its charger port, and a B-device is connected to its accessory port?	Yes 🗆 No 🗆	12.5	4.5.3
	This does not apply to a UUT with a combined charger.	N/A 🗆		
SACA6	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_A when a DCP or a CDP is connected to its charger port, and a B-device is connected to its accessory port?	Yes □ No □	12.8	4.5.3
	If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_A when the unit is connected to a power source, and a B-device is connected to its accessory port?			
SACA7	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_A when a DCP or a CDP is connected to its charger port, and nothing is connected to its accessory port?	Yes □ No □	12.6	4.5.3
	If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_A when the unit is connected to a power source, and nothing is connected to its accessory port?			
SACA8	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_GND when nothing is connected to its charger port, and nothing is connected to its accessory port?	Yes 🗆 No 🗆	12.9	4.5.3
	If the UUT has a combined charger, does the UUT pull the ID pin to ground through RID_GND when the unit is not connected to a power source, and nothing is connected to its accessory port?			

SACA9	If the UUT uses a separate charger, does the UUT pull the ID pin to ground through RID_ GND when an SDP is connected to its charger port, and nothing is connected to its accessory port? This does not apply to a UUT with a combined charger.	Yes □ No □ N/A □	12.3	4.5.3
SACA10	Does the UUT directly connect the data pins of the OTG port directly to the data pins of the accessory port?	Yes 🗆 No 🗆	Vendor Declaration	4.5.3
SACA11	Does the UUT directly connect VBUS of the OTG port directly to VBUS of the accessory port?	Yes 🗆 No 🗆	Vendor Declaration	6.3.3
SACA12	Does the UUT have a captive cable terminated with a Micro-A plug on its OTG port?	Yes 🗆 No 🗆	Inspection	4.5.4
SACA13	Does the Micro-A plug have a valid TID?	Yes 🗆 No 🗆	Vendor Declaration	
SACA14	Does the UUT have a Standard-A receptacle on its accessory port?	Yes 🗆 No 🗆	Inspection	6.1
SACA15	Does the Standard-A receptacle have a valid TID?		Vendor Declaration	
SACA16	Does the UUT Charger Port have a Micro-B receptacle, a captive cable terminated with a Standard-A plug, or a captive cable terminated with a Charger (or combined Charger)?	Micro-B	Inspection	6.2.1
SACA17	If the Charger Port has a Micro-B receptacle or a Standard-A plug, does this have a valid TID? This does not apply to a UUT with a combined charger.	Yes 🗆 No 🗆 N/A 🗆	Vendor Declaration	
SACA18	Does the UUT charger port draw less than ISUSP when anything other than a charging port is attached to it? This does not apply to a UUT with a	Yes 🗆 No 🗆 N/A 🗆	12.3, 12.4, 12.5	6.2.6

				1
SACA19	Does the UUT charger port draw less than ISUSP when a charging port is attached to it, and nothing is attached to the OTG port or accessory port?	Yes 🗆 No 🗆	12.6	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
SACA20	Is the resistance between VBUS_CHG and either VBUS_OTG pins or VBUS_ACC of the UUT, RACA_CHG_OTG when the charger switch is closed, and the voltage on VBUS_CHG is VACA_OPR ?	Yes □ No □	12.6	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
SACA21	Is the resistance between the internal ground of the UUT and the ground pin of the Micro-AB receptacle attached to the OTG port of the UUT, ROTG_ACA_GND ?	Yes 🗆 No 🗆	Vendor Declaration	6.2.6
SACA22	Does the UUT output VDP_SRC on DP_CHG when it detects VBUS_CHG?	Yes 🗆 No 🗆	12.8	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
SACA23	Does the UUT close its charger switch when it detects DN_CHG greater than VDAT_REF and VBUS_CHG remains above VOTG_SESS_VLD ?	Yes 🗆 No 🗆	12.8	6.2.6
	This does not apply to a UUT with a combined charger.	N/A 🗆		
Questions s	specific to Standard-ACAs with Combin	ned Charger		
SACC1	Is the output voltage of the UUT less than VCHG_OVRSHT max for any step change in load current, and also when powering on or off?	Yes 🗆 No 🗆		4.1.1
	This does not apply to a UUT with a separate charger.	N/A 🗆		
SACC2	Is the output current of the UUT prevented from exceeding ICDP max under any condition?	Yes 🗆 No 🗆	Vendor Declaration	4.1.2
	This does not apply to a UUT with a separate charger.	N/A 🗆		

SACC3	Has it has been shown, using schematics or by some other explanation, that in the case of a single failure in the UUT, the output voltage on VBUS will not exceed VCHG FAIL?	Yes 🗆 No 🗆	Vendor Declaration	4.1.5
	This does not apply to a UUT with a separate charger.	N/A 🗆		
SACC4	Is the output voltage of the UUT OTG port greater than VCHG_UNDSHT min for any step change in load current where current is less than ICDP min?	Yes 🗆 No 🗆		4.5.2
	This does not apply to a UUT with a separate charger.	N/A 🗆		
SACC5	Is the output voltage of the UUT Accessory port greater than VCHG_UNDSHT min for any step change in load current where current is less than ICFG_MAX?	Yes 🗆 No 🗆		4.5.2
	This does not apply to a UUT with a separate charger.	N/A 🗆		
SACC6	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) for all currents less than ICDP min on its OTG port?	Yes 🗆 No 🗆		4
	This does not apply to a UUT with a separate charger.	N/A 🗆		
SACC7	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) allowing for a drop across RACA_OTG_ACC for all currents less than 500mA on its ACC port?	Yes 🗆 No 🗆		4
	This does not apply to a UUT with a separate charger.	N/A □		
SACC8	If the UUT goes into shutdown during a current overload condition, does it recover and output a voltage of VCHG within a time of TSHTDWN_REC when the current overload condition has been removed.	Yes 🗆 No 🗆	Vendor Declaration	4.2.2

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports
Pre-conditions	This is the first procedure in the Standard-ACA Test Suite.
Purpose	To calibrate the Test Cables, and to prepare the Standard-ACA for the following tests.
Description	The test operator is instructed to connect the test cables in turn, and these are calibrated. The test operator is then instructed to connect up the Standard-ACA in preparation for the tests.

14.2 PET Cable Calibration

14.2.1 Test procedure

- 1. Instruct test operator to plug Special Cable D into PET D-type connector, and the Standard-A plug of the Special Cable D into the Standard-A receptacle of the Special Cable D, and then click on 'OK'.
- 2. PET passes a current of 500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 3. Instruct test operator to unplug Standard-A plug of the Special Cable D from the Standard-A receptacle of the Special Cable D, and then click on 'OK'.
- 4. If 'Captive Cable' checkbox is checked, skip to step 9.
- 5. Instruct test operator to plug Special Cable B into the Standard-A receptacle of Special Cable D, and the Micro-B plug of the Special Cable B into the PET Micro-AB receptacle, and then click on 'OK'.
- 6. PET passes a current of 500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 7. PET passes a current of 1500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 8. Instruct test operator to unplug the Micro-B plug of the Special Cable B from the PET Micro-AB receptacle, and then click on 'OK'.
- 9. Instruct test operator to plug the Standard-A plug of Special Cable D into the Accessory Port of the Standard-ACA under test, and then click on 'OK'.
- 10. Instruct test operator to plug the Micro-B plug of the captive OTG cable of the Standard-ACA under test into the PET Micro-AB receptacle, and then click on 'OK'.

11. With Captive Charger Cable

Instruct test operator to plug the Standard-A plug of the captive Charger cable of the Standard-ACA under test into the Standard-A receptacle of Special Cable D, and then click on 'OK'.

With No Captive Charger Cable

Instruct test operator to plug the Micro-B plug of Special Cable B into the Charger port of the Standard-ACA under test, and then click on 'OK'.

Check that cables are connected:

- 12. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 13. Apply 5V to VBUS on charger port.
- 14. Connect together D+ and D- on charger port via 200R.
- 15. Check that we can sense 5V on VBUS on OTG port.
- 16. Check that we can sense 5V on VBUS on accessory port.
- 17. Remove 5V from VBUS on charger port.
- 18. Disconnect D+ from D- on charger port.
- 19. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 20. If test fails report 'Either cables not correctly connected or accessory port ID pin not functioning'.

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with SDP attached to the Charger Port and Nothing attached to accessory port
Description	The PET simulates an SDP being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT. Check whether VBUS comes from the OTG port or the Accessory Port. Check the resistance to ground of ID pin on OTG port. Check the current drawn by the Charger Port. Check correct functioning of the Indicator.
Parameters	RID_GND, ISUSP
Checklist	SACA2, SACA9, SACA18
Pass Criteria	Step 3. VBUS is not coming from the Accessory port.
	Step 4. VBUS is not coming from the OTG port.
	Step 5. Resistance to ground of ID pin on OTG port is RID_GND.
	Step 7. Indicator is off.
	Step 8. UUT is drawing less than ISUSP from the charger port

14.3 SDP attached to Charger Port, Nothing attached to Accessory Port

14.3.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- Check that VBUS is not coming from the Accessory port. i.e. Check that Accessory port VBUS is less than VOTG_VBUS_LKG (0.7V)
- 4. Check that VBUS is not coming from the OTG port. i.e. Check that OTG port VBUS is less than VOTG_VBUS_LKG (0.7V)

Check RID_GND

5. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1 k Ω). [SACA9]

Check Indicator

- 6. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 7. Wait for response, if 'Yes', test fails. If 'No' it passes. [SACA2]

Check Current Drawn by UUT Charger Port

- 8. Check that the UUT is drawing less than ISUSP (2.5mA) from the charger port. [SACA18]
- 9. Remove 5V from VBUS on charger port.

10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with SDP attached to the Charger Port and B-device attached to accessory port
Description	The PET simulates an SDP being attached to the Charger Port of the UUT, and a B- device to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG port or the Accessory Port. Check the resistance to ground of ID pin on OTG port. Check the current drawn by the Charger Port. Check correct functioning of the Indicator.
Parameters	RID_GND, ISUSP
Checklist	SACA2, SACA5
Pass Criteria	Step 4. VBUS is not coming from the Accessory port.
	Step 5. VBUS is not coming from the OTG port.
	Step 6. Resistance to ground of ID pin on OTG port is RID_GND.
	Step 8. Indicator is off.
	Step 11. Voltage is less than 100mV
	Step 16. UUT is drawing less than ISUSP from the charger port

14.4 SDP attached to Charger Port, B-device attached to Accessory Port

14.4.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Check that VBUS is not coming from the Accessory port. i.e. Check that Accessory port VBUS is less than VOTG_VBUS_LKG (0.7V).
- 4. Check that VBUS is not coming from the OTG port. i.e. Check that OTG port VBUS is less than VOTG_VBUS_LKG (0.7V)

Check RID_GND

5. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1kΩ). [SACA5]

Check Indicator

- 6. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 7. Wait for response, if 'Yes', test fails. If 'No' it passes. [SACA2]

Check RACA_OTG_ACC

- 8. Apply 5V VBUS to OTG port
- 9. Connect 10Ω load to Accessory port VBUS line
- 10. Check that voltage on OTG VBUS minus Accessory port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms that a VBUS path exists from OTG port to Accessory port.
- 11. Remove 10Ω load from accessory port VBUS line.

Check Current Drawn by UUT Charger Port

- 12. Connect 625Ω load to Accessory Port VBUS line.
- 13. Measure current drawn from VBUS generator.
- 14. Disconnect VBUS from Charger Port.
- 15. Check that current drops by less than ISUSP (2.5mA)
- 16. Remove 5V from VBUS on OTG port.
- 17. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 18. Disconnect 625Ω load from Accessory Port VBUS line.

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check ACA behavior with Charger attached to the Charger Port and Nothing attached to accessory port
Description	The PET simulates a Charger being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT.
	Check whether VBUS comes from the OTG Port or the Accessory Port. Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the Charger Port, and on the OTG Port. Check correct functioning of the Indicator. Check UUT outputs VDP_SRC on Charger Port D+.
Parameters	RID_A, RACA_CHG_OTG, VDP_SRC
Checklist	SACA2, SACA7, SACA19, SACA20, SACA22, SACA23
Pass Criteria	Step 4. VBUS is coming from the Accessory port.
	Step 5. VBUS is coming from the OTG port.
	Step 6. Less than 2.5mA is being drawn by the charger port.
	Step 8. Voltage is less than 300mV
	Step 10. Resistance to ground of ID pin on OTG port is RID_A.
	Step 12. Indicator is on.
	Step 13. Voltage is 0.5V-0.7V.

14.5 DCP or CDP attached to Charger Port, Nothing attached to Accessory Port

14.5.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Connect together D+ and D- on charger port via 200R.
- 4. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 4.75V.
- 5. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V. [SACA23]
- 6. Check that less than ISUSP max (2.5mA) is being drawn by charger port. [SACA19]

Check RACA_CHG_OTG

7. Set OTG Port VBUS current load to 1500mA.

- Check that voltage on Charger VBUS minus OTG Port VBUS is less than 300mV, allowing for the voltage drop in the test cables. This confirms RACA_CHG_OTG (200mΩ). [SACA20]
- 9. Set OTG Port VBUS current load to 0mA.

Check RID_A

10. Check that resistance to ground of ID pin on OTG port is RID_A (122-126 kΩ). [SACA7]

Check Indicator

- 11. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 12. Wait for response, if 'Yes', test passes. If 'No' it fails. [SACA2]

Check VDP_SRC

- 13. Check that voltage on D+ of charger port is VDP_SRC (0.5V-0.7V). [SACA22]
- 14. Remove 5V from VBUS on charger port.
- 15. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 16. Disconnect D+ from D- on charger port.
| Test Setup | UUT is a Standard-ACA, PET simulates devices on the three ports | | |
|---|---|--|--|
| Pre-conditions | | | |
| Purpose | Check ACA behavior with Charger attached to the Charger Port and B-device attached to accessory port | | |
| Description | The PET simulates a Charger being attached to the Charger Port of the UUT, and a B-
device to the Accessory Port of the UUT. | | |
| | Check whether VBUS comes from the OTG Port or the Accessory Port. Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the Charger Port, and on the OTG Port. Check the resistance between VBUS on the Charger Port, and on the Accessory Port. Check correct functioning of the Indicator. Check UUT outputs VDP_SRC on Charger Port D+. | | |
| Parameters | RID_A, VACA_OPR, VACA_DIS, RACA_CHG_ACC, RACA_CHG_OTG, VDP_SRC | | |
| Checklist | SACA2, SACA6 | | |
| Pass Criteria Step 5. VBUS is coming from the Accessory port. | | | |
| | Step 6. VBUS is coming from the OTG port. | | |
| | Step 7. Resistance to ground of ID pin on OTG port is RID_A. | | |
| | Steo 9. VBUS is coming from the Accessory port. | | |
| | Step 10. VBUS is coming from the OTG port. | | |
| | Step 13. Voltage is less than 100mV | | |
| | Step 16. Indicator is on. | | |
| | Step 17. Voltage is > 0.5V-0.7V. | | |

14.6 DCP or CDP attached to Charger Port, B-device attached to Accessory Port

14.6.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check Switching Functionality:

- 1. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 2. Apply 5V to VBUS on charger port.
- 3. Connect together D+ and D- on charger port via 200R.
- 4. Connect 625Ω load on Accessory Port VBUS
- 5. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 4.75V.
- 6. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_A

7. Check that resistance to ground of ID pin on OTG port is RID_A (122-126 kΩ). [SACA6]

Check VACA_OPR

- 8. Change VBUS generator voltage to VACA_OPR min (4.1V).
- 9. Check that VBUS is coming from the Accessory port. i.e. Check that Accessory port VBUS is greater than 3.85V.
- 10. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 3.85V.

Check RACA_CHG_ACC

- 11. Disconnect 625Ω load from Accessory Port VBUS
- 12. Connect 10Ω load to Accessory Port VBUS line.
- 13. Check that voltage on Charger VBUS minus Accessory Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms RACA_CHG_ACC (200m Ω).
- 14. Disconnect 10Ω load from Accessory Port VBUS line.

Check Indicator

- 15. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated. [SACA2]
- 16. Wait for response, if 'Yes', test passes. If 'No' it fails.

Check VDP_SRC

- 17. Check that voltage on D+ of charger port is VDP_SRC (0.5V-0.7V).
- 18. Remove 5V from VBUS on charger port.
- 19. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 20. Disconnect D+ from D- on charger port.

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports		
Pre-conditions			
Purpose	Check ACA behavior with Nothing attached to the Charger Port and an nothing attached to accessory port		
Description	The PET simulates nothing being attached to the Charger Port of the UUT, and nothing to the Accessory Port of the UUT.		
	Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.		
Parameters	RID_GND		
Checklist	SACA2, SACA8		
Pass Criteria	Step 2. Voltage is less than 20mV.		
	Step 4. Resistance to ground of ID pin on OTG port is RID_GND.		
	Step 6. Indicator is off.		

14.7 Nothing attached to Charger Port, Nothing attached to Accessory Port

14.7.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open. Accessory port has $100k\Omega$ to ground on VBUS to prevent floating pin.

Check RACA_OTG_ACC

- 1. Apply 0.75V to VBUS on OTG Port.
- 2. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 20mV. This confirms ability to transmit ADP probes.
- 3. Disconnect VBUS from OTG port.

Check RID_GND

4. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1k Ω). [SACA8]

Check Indicator

- 5. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 6. Wait for response, if 'No', test passes. If 'Yes' it fails. [SACA2]

14.8 Nothing attached to Charger Port, B-device attached to Accessory Port

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports		
Pre-conditions			
Purpose	Check ACA behavior with Nothing attached to the Charger Port and a B-device attached to accessory port		
Description	The PET simulates nothing being attached to the Charger Port of the UUT, and a B- device to the Accessory Port of the UUT.		
	Check the resistance to ground of ID pin on OTG Port. Check the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.		
Parameters	RID_GND		
Checklist	SACA2, SACA4		
Pass Criteria	Step 1. Resistance to ground of ID pin on OTG port is RID_GND.		
	Step 4. Voltage is less than 100mV		
	Step 7. Indicator is off.		

14.8.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check RID_GND

1. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1k Ω). [SACA4]

Check RACA_OTG_ACC

- 2. Connect 5V VBUS to OTG port.
- 3. Connect Accessory Port 10Ω load.
- 4. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 100mV, allowing for the voltage drop in the test cables. This confirms that a VBUS path exists from OTG port to Accessory port.
- 5. Disconnect Accessory Port 10Ω load.

Check Indicator

- 6. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 7. Wait for response, if 'No', test passes. If 'Yes' it fails. [SACA2]
- 8. Disconnect VBUS from OTG port.

Test Setup	UUT is a Standard-ACA, PET simulates devices on the three ports
Pre-conditions	
Purpose	Check presence and values of bypass capacitor CSACA_VBUS.
Description	The PET simulates necessary conditions for measuring the bypass capacitor on the OTG / Accessory port.
Parameters	CSACA_VBUS
Checklist	SACA1
Pass Criteria	Step 4. Capacitance is 10-100nF

14.9 Bypass Capacitance

14.9.1 Test procedure

Initial State: The PET is connected to all three ports of ACA. No VBUS voltage applied to any port. Switch between D+ and D- to charger port is open.

Check OTG Port Bypass Capacitance:

- 1. Use ADP circuit components in PET to evaluate capacitance on OTG port VBUS.
- 2. Check that this capacitance lies within CSACA_VBUS min and CSACA_VBUS max (10 100 nF). [SACA1]

15 Standard-ACA Compliance, Combined Charger

15.1 Submission Materials

15.1.1 Device Specific Information

Table 15-1 Device Specific Information for Standard-ACAs with Combined Charger

ltem	Function	Value/ Support
1	Schematics or other proof that UUT output current cannot exceed 5.0 amperes	
2	The USB-IF TID for the UUT standard-A receptacle used for the accessory port	
3	The USB-IF TID for the UUT micro-A plug used for the OTG port captive cable	
4	Schematics or other proof that a single UUT failure will not cause the output voltage on VBUS to exceed VCHG_FAIL?	

15.1.2 Checklists

See previous section for submission Materials.

Test Setup	Test Setup 8b. UUT is a Standard-ACA, with combined charger, PET simulates devices on the two ports.
Pre-conditions	This is the first procedure in the Standard-ACA, Combined Charger Test Suite.
Purpose	To calibrate the Test Cables, and to prepare the Standard-ACA for the following tests.
Description	The test operator is instructed to connect the test cables in turn, and these are calibrated. The test operator is then instructed to connect up the Standard-ACA in preparation for the tests.

15.2 PET Cable Calibration

15.2.1 Test procedure

- 1. Instruct test operator to plug Special Cable D into PET D-type connector, and the Standard-A plug of the Special Cable D into the Standard-A receptacle of the Special Cable D, and then click on 'OK'.
- 2. PET passes a current of 500mA through the VBUS conductor of the cable, and measures and records the voltage drop.
- 3. Instruct test operator to unplug Standard-A plug of the Special Cable D from the Standard-A receptacle of the Special Cable D, and then click on 'OK'.
- 4. Instruct test operator to plug the Standard-A plug of Special Cable D into the Accessory Port of the Standard-ACA under test, and then click on 'OK'.
- 5. Instruct test operator to plug the Micro-B plug of the captive OTG cable of the Standard-ACA under test into the PET Micro-AB receptacle, and then click on 'OK'.

Check that cables are connected:

- 6. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 7. Instruct test operator to power up the Standard-ACA under test, and then click on 'OK'.
- 8. Check that we can sense 5V on VBUS on OTG port.
- 9. Check that we can sense 5V on VBUS on accessory port.
- 10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.
- 11. If test fails report 'Either cables not correctly connected or UUT is not functioning'.
- 12. Instruct test operator to perform steps required to bring the Standard-ACA from a powered state to an un-powered one.
- 13. Wait for operator to click 'OK'.

15.3 Standard-ACA Voltage, Current and Transient Test

Test Setup	Test Setup 8b. UUT is a Standard-ACA with combined charger, PET simulates devices on the two ports.			
Pre-conditions	PET Cable Calibration test has been run.			
Purpose	To verify the Standard-ACA meets voltage, current, voltage overshoot and undershoot specifications, for any specified step change in load.			
Description	This test measures the VBUS voltage at extremes of load current. It also changes the VBUS current abruptly, and measures the resulting voltage overshoot and undershoot levels.			
Parameters	VCHG_OVERSHT, VCHG_UNDSHT, VCHG			
Checklist	SACC1, SACC4, SACC5, SACC6, SACC7			
Pass Criteria Step 7 – Latch not triggered				
	Step 9 – Voltage in range			
	Step 13 – Latches not triggered			
	Step 16 – Voltage in range			
	Step 17 – Latches not triggered			
	Step 25 – Latch not triggered			
	Step 27 – Voltage in range			
	Step 31 – Latches not triggered			
	Step 35 – Latches not triggered			

15.3.1 Test procedure

Initial State: No load applied.

OTG Port

- 1. Ensure that Standard-ACA is in an un-powered state.
- 2. Wait for Standard-ACA OTG port VBUS to fall below VBUS_LKG max (0.7V), in case it has just been switched off. (Speed up fall using 100mA current load.)
- Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on OTG port VBUS.
- 4. Instruct test operator to perform steps required to bring the Standard-ACA from an unpowered state to a powered one.
- 5. Wait for operator to click 'OK'.
- 6. Wait for Standard-ACA OTG port VBUS to rise above VCHG min (4.75V).
- 7. Check watch-block overshoot detector latch was not triggered. [SACC1]
- 8. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on Standard-ACA OTG port VBUS.

9. With no current load applied, check that Standard-ACA OTG port VBUS is within appropriate range VCHG (4.75V to 5.25V). [SACC6]

Load Testing OTG port

- 10. Apply load of ICDP min (1.5A) to Standard-ACA OTG port VBUS.
- 11. Wait 10ms.
- Check that Standard-ACA OTG port VBUS, at Standard-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V).
- 13. Check watch-block overshoot and undershoot detector latches were not triggered. [SACC1] [SACC4]
- 14. Remove Current Load.
- 15. Wait 10ms
- Check that VBUS voltage from Standard-ACA OTG port VBUS, at Standard-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V). [SACC6]
- 17. Check watch-block overshoot and undershoot detector latches were not triggered. [SACC1] [SACC4]
- 18. Instruct test operator to perform steps required to bring the Standard-ACA from a powered state to an un-powered one.
- 19. Wait for operator to click 'OK'.

Accessory Port

- 20. Wait for Standard-ACA accessory port VBUS to fall below VBUS_LKG max (0.7V). (Speed up fall using 10R resistive load.)
- 21. Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on accessory port VBUS.
- 22. Instruct test operator to perform steps required to bring the Standard-ACA from an unpowered state to a powered one.
- 23. Wait for operator to click 'OK'.
- 24. Wait for Standard-ACA accessory port VBUS to rise above VCHG min (4.75V).
- 25. Check watch-block overshoot detector latch was not triggered. [SACC1]
- 26. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on Standard-ACA accessory port VBUS, allowing for voltage drop in cable.
- 27. With no current load applied, check that Standard-ACA accessory port VBUS is within appropriate range VCHG (4.75V to 5.25V). [SACC7]

Load Testing Accessory port

- 28. Apply load of ICFG_MAX (500mA) to Standard-ACA accessory port VBUS.
- 29. Wait 10ms.
- 30. Check that Standard-ACA accessory port VBUS, at Standard-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V), making due allowance for voltage drop in cable.
- 31. Check watch-block overshoot and undershoot detector latches were not triggered. [SACC1] [SACC5]
- 32. Remove Current Load.
- 33. Wait 10ms
- 34. Check that VBUS voltage from Standard-ACA accessory port VBUS, at Standard-ACA connector, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG RACA_OTG_ACC x ICFG_MAX (4.65V to 5.25V). [SACC7]
- 35. Check watch-block overshoot and undershoot detector latches were not triggered. [SACC1] [SACC5]
- 36. Instruct test operator to perform steps required to bring the Standard-ACA from a powered state to an un-powered one.
- 37. Wait for operator to click 'OK'.

Test Setup	Test Setup 8b. UUT is a Standard-ACA with combined charger, PET simulates devices on the two ports.			
Pre-conditions				
Purpose	Check ACA behavior with ACA not powered and nothing or a B-device attached to accessory port			
Description	The PET simulates nothing being attached to the Accessory Port of the UUT.			
	Checks the resistance to ground of ID pin on OTG Port. Checks the resistance between VBUS on the OTG Port, and on the Accessory Port. Check correct functioning of the Indicator.			
Parameters	RID_FLOAT			
Checklist	SACA2, SACA4, SACA8			
Pass Criteria	Step 4. Voltage is less than 125mV.			
	Step 7. Resistance to ground of ID pin on OTG port is RID_GND.			
	Step 9. Indicator is off.			

15.4 Standard-ACA Not Powered, Nothing or B-device attached to Accessory Port

15.4.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to either port. ACA is not powered. Accessory port ID pin is floating.

1. Ensure that Standard-ACA is in an un-powered state.

Check VBUS Continuity

- 2. Apply 5V to VBUS on OTG Port.
- 3. Connect 10R load on accessory port VBUS.
- 4. Check that voltage on OTG VBUS minus Accessory Port VBUS is less than 125mV. (This value matches the drop allowed by OTG 2.0 in a detachable cable).
- 5. Disconnect 10R load from accessory port VBUS.
- 6. Disconnect VBUS from OTG port.

Check RID_GND

7. Check that resistance to ground of ID pin on OTG port is RID_GND (< 1 k Ω). [SACA4] [SACA8]

Check Indicator

- 8. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 9. Wait for response, if 'No', test passes. If 'Yes' it fails. [SACA2]

Test Setup	Test Setup 8b. UUT is a Standard-ACA with combined charger, PET simulates devices on the two ports.	
Pre-conditions		
Purpose	Check ACA behavior with ACA powered and Nothing or a B-device attached to accessory port	
Description	The PET simulates nothing being attached to the Accessory Port of the UUT.	
	Checks whether VBUS comes from the OTG Port or the Accessory Port. Checks the resistance to ground of ID pin on OTG Port. Checks correct functioning of the Indicator.	
Parameters	RID_A	
Checklist	SACA2, SACA6, SACA7	
Pass Criteria	Step 5. VBUS is coming from the Accessory port.	
	Step 6. VBUS is coming from the OTG port.	
	Step 7. Resistance to ground of ID pin on OTG port is RID_A.	
	Step 9. Indicator is on.	

15.5 Standard-ACA Powered Up, Nothing or B-device attached to Accessory Port

15.5.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to either port. ACA is not powered. Accessory port ID pin is floating.

- 1. Instruct test operator to perform steps required to bring the Standard-ACA from an unpowered state to a powered one.
- 2. Wait for operator to click 'OK'.
- 3. Ensure that Standard-ACA is in a powered state.

Check Switching Functionality:

- 4. Connect $10k\Omega$ pull-down resistor to OTG port VBUS.
- 5. Check that VBUS is coming from the accessory port. i.e. Check that accessory port VBUS is greater than 4.75V.
- 6. Check that VBUS is coming from the OTG port. i.e. Check that OTG port VBUS is greater than 4.75V.

Check RID_A

7. Check that resistance to ground of ID pin on OTG port is RID_A (122-126 k Ω). [SACA6] [SACA7]

Check Indicator

- 8. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 9. Wait for response, if 'Yes', test passes. If 'No' it fails. [SACA2]
- 10. Disconnect $10k\Omega$ pull-down resistor from OTG port VBUS.

Test Setup	Test Setup 8b. UUT is a Standard-ACA with combined charger, PET simulates devices on the two ports.
Pre-conditions	
Purpose	Check presence and values of bypass capacitor CSACA_VBUS.
Description	The PET simulates necessary conditions for measuring the bypass capacitor on the OTG / Accessory port.
Parameters	CSACA_VBUS
Checklist	SACA1
Pass Criteria	Step 4. Capacitance is 10-100nF

15.6 Bypass Capacitance

15.6.1 Test procedure

Initial State: The PET is connected to both ports of ACA. No VBUS voltage applied to either port.

Check OTG Port Bypass Capacitance:

- 1. Ensure that Standard-ACA is in an un-powered state.
- 2. Use ADP circuit components in PET to evaluate capacitance on OTG port VBUS.
- 3. Check that this capacitance lies within CSACA_VBUS min and CSACA_VBUS max (10 100 nF). [SACA1]

16 ACA-Dock Compliance

Note: USB2.0 tests are to be run separately, using appropriate equipment.

16.1 Submission Materials

16.1.1 Device Specific Information

Table 16-1 Device Specific Information for ACA-Docks

ltem	Function	Value/ Support
1	Schematics or other proof that UUT output current cannot exceed 5.0 amperes	
2	The USB-IF TID for the UUT micro-A plug used for connecting the PD	
3	Schematics or other proof that a single UUT failure will not cause the output voltage on VBUS to exceed VCHG_FAIL?	
4	If it is not possible to plug the ACA-Dock into the PET Micr0-AB receptacle, a means of achieving this	

16.1.2 Checklists

ID and Question		Response	Test Number	BC 1.2 Section Number
ACAD1	Is the output voltage of the UUT less than VCHG_OVRSHT max for any step change in load current, and also when powering on of off?	Yes 🗆 No 🗆	16.2	4.1.1
ACAD2	Is the output current of the UUT prevented from exceeding ICDP max under any condition?	Yes 🗆 No 🗆	Vendor Declaration	4.1.2
ACAD3	Has it has been shown, using schematics or by some other explanation, that in the case of a single failure in the UUT, the output voltage on VBUS will not exceed VCHG_FAIL?	Yes 🗆 No 🗆	Vendor Declaration	4.1.5
ACAD4	As per provided UUT description: if the UUT provides multiple USB Charging Ports, the active UUT USB Charging Port does not affect operation of any other Charging Port.	Yes 🗆 No 🗆	Vendor Declaration	4.1.6
ACAD5	Does the UUT output a voltage of VCHG (averaged over TVBUS_AVG) for all currents less than ICDP min?	Yes 🗆 No 🗆	16.3	4.3.1

Table 16-2 Checklist for ACA-Docks

ACAD6	Is the output voltage of the UUT greater than VCHG_UNDSHT min for any step change in load current where current is less than ICDP min?	Yes 🗆 No 🗆	16.2	4.3.2
ACAD7	Does the UUT enable VDM_SRC within TCP_VDM_EN if D+/- are at idle, and disable VDM_SRC within TCP_VDM_DIS of any USB activity on D+/-?	Yes 🗆 No 🗆	16.3	4.3.3
ACAD8	Does the UUT pull the ID pin to ground through a resistance of RID_A, whenever the connected PD is allowed to act as host and to draw current, and through RID_FLOAT at all other times?	Yes 🗆 No 🗆	16.3	4.3.3
ACAD9	Does the UUT have a captive cable with a Micro-A plug?	Yes 🗆 No 🗆	Inspection	4.3.4
ACAD10	Does the Micro-A plug have a valid TID?	Yes 🗆 No 🗆	Vendor Declaration	
ACAD11	Does the UUT have a captive (non-removable) USB hub?	Yes 🗆 No 🗆	Vendor Declaration	
ACAD12	If the hub has exposed downstream-facing ports, are they exposed via Standard-A receptacle(s) with valid TID(s)?	Yes □ No □ N/A □	Vendor Declaration	
ACAD13	Does the hub silicon have a valid TID?	Yes 🗆 No 🗆	Vendor Declaration	
ACAD14	Does the UUT have an indicator showing when it is able to supply power to the OTG port?	Yes 🗆 No 🗆	16.3, 16.4	
ACAD15	If the UUT goes into shutdown during a current overload condition, does it recover and output a voltage of VCHG within a time of TSHTDWN_REC when the current overload condition has been removed.	Yes 🗆 No 🗆	Vendor Declaration	4.2.2

Test Setup	Test Setup 9. UUT is an ACA-Dock, PET simulates a PD.	
Pre-conditions	This must be performed as the first test in the ACA-Dock suite.	
Purpose	To verify the ACA-Dock meets overshoot and undershoot voltage specifications, for any specified step change in load.	
Description	This test changes the VBUS current abruptly, and measures the resulting voltage overshoot and undershoot levels.	
Parameters	VCHG_OVERSHT, VCHG_UNDSHT	
Checklist	ACAD1, ACAD6	
Pass Criteria	Step 4 – Maximum voltage during overshoot is less than 6.0V.	
	Step 6 – VBUS is in range 4.75V to 5.25V	
	Step 9 – VBUS is in range 4.75V to 5.25V	
	Step 10 – Minimum voltage during undershoot is above 4.1V.	
	Step 10 – Maximum voltage during overshoot is less than 6.0V.	
	Step 13 – VBUS is in range 4.75V to 5.25V	
	Step 14 – Minimum voltage during undershoot is above 4.1V.	
	Step 14 – Maximum voltage during overshoot is less than 6.0V.	

16.2 ACA-Dock Overshoot and Undershoot Voltage Test

16.2.1 Test procedure

Initial State: No VBUS voltage applied. ACA-Dock is not powered.

1. Instruct test operator to plug captive cable of the ACA-Dock into the Micro-AB receptacle of the PET, and then click on 'OK'.

Note: If this is not physically possible, then make use of the alternative arrangement provided by the vendor.

- 2. Ask test operator to ensure that power is disconnected from the ACA-Dock, and then click on 'OK'. Check that VBUS is off.
- 3. Set up voltage watch-block ready to capture overshoot of VCHG_OVRSHT (6.0V) on VBUS.
- 4. Instruct test operator to perform steps required to bring the ACA-Dock from an unpowered state to a powered one.
- 5. Wait for operator to click 'OK'.
- 6. Wait for ACA-Dock OTG port VBUS to rise above VCHG min (4.75V).
- 7. Check watch-block overshoot detector latch was not triggered. [ACAD1]
- 8. Set up voltage watch-block ready to capture undershoot of VCHG_UNDSHT (4.1V), or overshoot of VCHG_OVRSHT (6.0V) on VBUS, allowing for voltage drop in cable.
- 9. With an applied current load of 0mA, check that VBUS is within appropriate range VCHG (4.75V to 5.25V).

- 10. Apply load of ICDP min (1.5A) to VBUS.
- 11. Wait 10ms.
- 12. Check that VBUS voltage from ACA-Dock, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V).
- 13. Check watch-block overshoot and undershoot detector latches were not triggered. [ACAD1] [ACAD6]
- 14. Remove Current Load.
- 15. Wait 10ms
- Check that VBUS voltage from ACA-Dock, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within appropriate range VCHG (4.75V to 5.25V). [ACAD1] [ACAD6]
- 17. Check watch-block overshoot and undershoot detector latches were not triggered.

Test Setup	Test Setup 9. UUT is an ACA-Dock, PET simulates a PD.
Pre-conditions	ACA-Dock Overshoot and Undershoot Voltage Test has been run, and ACA-Dock is now switched on.
Purpose	To verify that the VBUS voltage / current load characteristic meets the specified requirements.
Description	This test measures the voltage at various current loads, in order to confirm correct behavior.
Parameters	VCHG, RID_A, VDM_SRC
Checklist	ACAD5, ACAD7, ACAD8, ACAD14
Pass Criteria	Step1 - VBUS voltage is in correct range.
	Step 4 - VBUS voltage is in correct range.
	Step 7 - Voltage on ID pin is in correct range.
	Step 9 – Response was 'Yes'.
	Step 10 - VDM_SRC is in correct range.

16.3.1 Test procedure

Initial State: The captive cable of the ACA-Dock is connected to the Micro-AB receptacle of the PET. No VBUS voltage applied. ACA-Dock is powered.

Check Voltage under load

- 1. Confirm that power has been connected to ACA-Dock, asking test operator to connect it, if not.
- 2. Check that VBUS voltage, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), from ACA-Dock is within VCHG (4.75 5.25V). [ACAD5]
- 3. Apply load of ICDP min (1.5A) to VBUS.
- 4. Wait 1 sec to avoid possible overshoot period (overshoot and undershoot are measured separately).
- 5. Check that VBUS voltage from ACA-Dock, samples taken every 1 ms and averaged over TVBUS_AVG max (250ms), is within VCHG (4.75 5.25V). [ACAD5]
- 6. Disconnect the current load.

Check ID pin

- 7. Connect voltage source (3.3V) via 82k resistor to ID pin.
- 8. Check voltage on ID pin is in the range 1.970V 2.002V. [ACAD8]

Note: This shows that the RID_A value from the ACA-Dock lies in the range 122k – 126k.

Check Indicator

- 9. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 10. Wait for response, if 'Yes', test passes. If 'No' it fails. [ACAD14]

Check VDM_SRC

11. Check that voltage on D- is in range VDM_SRC (0.5 to 0.7V). [ACAD7]

Test Setup	Test Setup 9. UUT is an ACA-Dock, PET simulates a PD.
Pre-conditions	ACA-Dock Overshoot and Undershoot Voltage Test has been run, and ACA-Dock is now switched on.
Purpose	To verify that the ID pin and the indicator meets the specified requirements under no power conditions.
Description	This test measures the ID pin, and checks the indicator, after the power has been removed.
Parameters	RID_FLOAT
Checklist	ACAD8, ACAD14
Pass Criteria	Step 3 - Voltage on ID pin is 2.40V or above.
	Step 5 – Response was 'No'.

16.4 ACA-Dock not Powered

16.4.1 Test procedure

Initial State: ACA-Dock Micro-A plug is connected to Micro-AB receptacle on PET. No VBUS voltage applied. ACA-Dock is powered.

Check ID pin

- 1. Ask test operator to disconnect power from ACA-Dock, and then to confirm that this has been done.
- 2. Connect voltage source (3.3V) via 82k resistor to ID pin.
- 3. Check voltage on ID pin is 2.40V or above. [ACAD8]

Note: This shows that the RID_FLOAT value from the ACA-Dock lies above 220k.

Check Indicator

- 4. Ask test operator to confirm 'Yes' or 'No' whether indicator lamp on UUT is illuminated.
- 5. Wait for response, if 'No', test passes. If 'Yes' it fails. [ACAD14]