

QuadraMAX USB Type-C and PD Tests

Testing Manual

Introduction

The USB-IF Compliance Program uses the QuadraMAX hardware unit for USB Type-C and PD Source Power Tests (Source Tests), USB Type-C End Product Cable tests (Cable Tests), and USB PD Sink PDO and VDO checks (Sink Tests).

These tests are defined in the following specifications, available on usb.org.

Tests	Specification
Source Tests	USB Type-C and PD Source Power Test Specification
Cable Tests	USB Type-C End Product Cable Test Specification
Sink Tests	(not defined) USB PD Sink PDO and VDO Check Plan

This document provides instructions to run these tests using the QuadraMAX and its software. The required software is bundled in the QuadDraw.msi. It includes the QuadDraw application, used to execute tests and view the results log, and the QuadraView application used to view Source Test graph results in addition to the log.

Terms and Abbreviations

The following definitions are used throughout this document.

Term	Definition
Cable IR Drop	The sum of the voltage drop across Vbus and ground in a cable.
Consumer/Provider	A USB PD term used to describe a PD port that "defaults" to the Sink role in one of two ways: <ul style="list-style-type: none"> • Port is a USB Type-C SNK • Port is a USB Type-C DRP. Possible DR_Swap to transition to UFP data role

DUT	Device under test. In this document a DUT can refer to: <ul style="list-style-type: none"> • A product with a USB Host, Hub, Peripheral, Charger port that is Source-capable. Used for Source Tests. • A USB Type-C Cable with a USB Type-C connector on both ends. Used for Cable Tests.
EPC	Abbreviation for the USB Type-C End Product Cable Tests.
Source-capable	A Source-capable port is a USB port that is capable of operating as a Vbus power source.
SPT	Abbreviation for the USB Type-C and PD Source Power Tests
Total Power Capability	The Wattage rating on the power supply for the DUT.
USB Type-C SNK	Abbreviation for a USB Type-C Port that implements the Sink Connection state machine as defined in the USB Type-C Cable and Connector Specification. The port starts as a Sink on connect.
USB Type-C DRP	Abbreviation for a USB Type-C Port that implements the DRP Connection state machine as defined in the USB Type-C Cable and Connector Specification. The port may start as Sink or Source on connect.
VIF	Abbreviation for Vendor Info File. A File generated with all the USB Type-C port characteristics as reflected in the product firmware.

Source Tests

This section describes how to select, run tests and view results.

Every USB Type-C and USB Type-A port on the DUT that is capable of sourcing Vbus must be tested.

These are referred to as “Source-capable” ports.

DUTs using the Consumer/Provider scheme and that default as USB Type-C SNK are not testable at this time but are scheduled to be tested in the future. To discover if the DUT is a Consumer/Provider, look in the VIF file. If during the test run QuadraMAX does not detect a port that looks correctly connected, double check with the Vendor whether the port is a Consumer/Provider and USB Type-C SNK.

Test Applicability

If the DUT includes a Type-A and/or Type-C only (no USB PD) source-capable port, run the following test with every source-capable port connected (including USB PD source-capable ports):

- SPT.1 Load Test

If such a product includes USB PD source-capable ports, then unplug all Type-A and Type-C only ports to run the rest of the applicable tests.

DUTs with only one USB PD Source-capable port select the following tests:

- SPT.1 Load Test
- SPT.3 Hard Reset Test
- SPT.5 Overcurrent Test

DUTs with multiple USB PD Source-capable ports select the following tests:

- SPT.1 Load Test
- SPT.2 Capabilities Test
- SPT.3 Hard Reset Test
- SPT.4 Give Back Test
- SPT.5 Over Current Test

Note: At this time SPT.4 Giveback Test is in development so leave it out.

DUTs with USB PD PPS capability also select the following tests:

- SPT.6 PPS Voltage Step Test
- SPT.7 PPS Current Foldback Test

Test Setup

Be careful when choosing a cable to connect a DUT port to a QuadraMAX Port. If the DUT port has a Source PDO with a Max Current greater than 3 Amps, then the cable used for testing must advertise 5 Amp capability in its Cable VDO.

To discover a Cable's Vbus Current Capability, use the QuadraMAX to run the EPC 1 Test on the Cable and read its Cable VDO "VBUS Current Capability" field.

To discover the Source Capability PDOs for a port:

1. Connect the port to the QuadraMAX using its captive cable or an Emarker cable with a 5A Vbus Current Capability.
2. Open the QuadDraw software
3. Open the Reins window
4. In the Reins window, find the Port dropdown and Select the Port # that is connected to the port in question.
5. Click Connect Port.
6. Click Get Source Capabilities.
7. Read the Capabilities from the Results pane.

Alternatively, to discover Source PDOs for a port, look in its VIF file if that is available.

Run Source Tests

When it is clear what tests are applicable and how to connect the ports for the tests, run the source tests.

To run Source Tests:

- 1) Plug every Source-capable port on the DUT into the QuadraMAX. (note 1)
- 2) Open QuadDraw software and navigate to Source Tests tab.
- 3) Enter Cable IR Drop for the cable attached to each port. (note 2)
- 4) Enter the Total Power Capability for the DUT. This is the rating on the DUT power supply.
- 5) Open the VIF file for the DUT. (note 3)
- 6) Select the applicable tests.
- 7) Click "Run".

Test Results will appear in the Results scrolling pane. To view and analyze the graph results open the result directory using QuadraView application. Follow the next section for more information.

Notes:

1. For many products there will only be one Source-capable port. A Hub or Host is likely to have multiple Source-capable USB Type-C Ports. A Hub UFP will likely be Source-capable, and its DFP ports are required to be Source-capable.
2. If the product has a captive cable, enter 750mV to this field. Otherwise enter the IRDrop of the cable used for testing. To get the Cable IR Drop, use the QuadraMAX to run EPC 2. Cable IR Drop Test on the cable. View the results in the Results pane, and add the Vbus IR Drop and the Ground drop together to enter the total Cable IR Drop in millivolts.
3. Not yet incorporated – unnecessary at this time

View Source Test Results

To understand results, please see the USB Type-C and PD Source Power Test Specification.

To open results:

- 1) Open QuadraView.exe
- 2) Click the File menu and select Open.
- 3) Navigate to the Source Test results directory for the DUT and select OK.
- 4) Any failures are listed with Graph # in the Test Results log. Check the graph number for the failure, then select that graph on the list to review.
- 5) Manipulate the graphs by zooming and measuring to get a good understanding of the failure

Cable Tests

This section describes how to run Cable Tests and read the results.

Every USB Type-C Cable with USB Type-C connectors on both ends must be tested.

If the DUT does not have an Emarker chip run the following test only:

- EPC 2. Cable IR Drop Test

Cable With Emarker Requirements

Run all three tests.

Tests must be run twice, with cable switched end for end before rerun. The cable has two plugs. If plug 1 was connected to port 1 and plug 2 was connected to port 4 for the first test run, then for the rerun connect plug 2 to port 1 and connect plug 1 to port 4.

The cable does not need to be flipped in the connector orientation. Every orientation would be testing the same CC line on the cable. There are also Vbus and ground pins on both top and bottom of the connector that are used regardless of connector orientation. In the end, if the cable fails CC communication or Vbus requirements, it will do so in all orientations. There are other test suites that cover USB Data pin verifications.

Run Cable Tests

When it is clear what tests are applicable and how to connect and flip the cable, run the tests.

To run tests on a cable:

- 1) Connect a USB Type-C Cable plug to Port 1, and plug the other end into Port 4 of the QuadraMAX unit.
- 2) Open the QuadDraw software and navigate to Cable Tests tab.
- 3) Open the VIF file for the DUT if applicable (note 1)
- 4) Select the applicable tests.
- 5) Click "Run".

Test Results will appear in the Results scrolling pane.

Please see the USB Type-C End Product Cable Test Specification to understand results.

Note 1: VIF File is Applicable if the DUT contains a PD Emarker. Not yet incorporated – unnecessary at this time.

Sink Tests

These tests are not yet defined. They are intended to check that the PDOs and VDOs described in a product's VIF are equivalent to the ones returned from the DUT when queried through firmware.