USB Type-C

End Product Cable Test Plan

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Introduction

USB Type-C cables may be Electronically Marked and support an array of USB and Vendor Defined functionalities. A cable may support USB Data 3.1 and 2.0 Specifications, USB PD Alternate Modes, negotiate power contracts with USB Type-C and USB PD to carry up to 5 A, and may support several modes of traffic running concurrently.

The USB-IF Compliance Program is designed to ensure these functions are working as expected and for functions that aren't supported, that they fail gracefully.

Electronically Marked cable silicon must meet requirements for the USB Power Delivery Test Suites and all Type-C Cables must meet requirements for the USB Cable Assembly and Connector tests.

This End Product Cable Test Specification is for Type-C Cable End Products seeking USB-IF Certification. Its tests cover the following:

- Electronically Marked cables implementing PD Structured VDM Messaging
- IR drop across Vbus and ground for all Type-C Cables
- Stressing an Electronically Marked cable by concurrently signaling SBU traffic, USB HS Data, and PD messaging.

For questions about this test spec please email ssusbcompliance@usb.org

Pre-Required and Co-Required Testing

Electronically Marked cables must be using certified silicon before being eligible to run the tests defined here. The following test suites are required for silicon certification:

- USB PD Test Suites
- USB Type-C Cable and Connector Test Suites

Other USB Type-C Cables have no pre-requisite certification.

For USB-IF Certification, End Product cables must complete the following tests suites:

- USB Type-C Cable Assembly and Connector Test Suites
- UST Type-C End Product Cable Tests

Terminology

The following table describes the terms used in this document.

Electronically Marked	USB Type-C Cable capable of USB PD communication
CabCon	USB Type-C Cable Assembly and Connector Tests
Cable Fixture	USB-IF Multi-Source and Cable Fixture
CF_DFP	The tester DFP on the Cable Fixture (Port 4)
CF_UFP	The tester UFP on the Cable Fixture (Port 1)
CUT	USB Type-C Cable Under Test
DFP	Downstream Facing Port – A USB Type-C port that supports the USB 3.1 Link State Machine or USB 2.0 data as a downstream facing port.
PD	USB Power Delivery
UFP	Upstream Facing Port – A USB Type-C port that supports the USB 3.1 Link State Machine or USB 2.0 data as an upstream facing port.

Tests

The verifications in these tests refer to Assertions defined in the USB PD Test Plan document and the USB Type-C Function Test Specification document.

Every test begins with the following assumptions:

1) The Cable Fixture is plugged into a computer running Cable Fixture Test software
2) The CUT is plugged into the Cable Fixture with one plug attached to the CF_DFP and the other to CF_UFP
3) The CF_DFP and CF_UFP are in the USB Type-C Disabled Connection State
4) The CF_UFP terminates SBU1 and SBU2 to 1 M

EPC.1. Structured VDM Test (Electronically Marked cables only)

A) Purpose
   1) To perform VDM message value checks relating to a Cable Discovery and Enter Modes sequences for Electronically Marked cables.
   2) To provide an abbreviated USB PD Test 12.9.1 CAB-PROT-DISCOV: Cable ID Checks for End Product USB PD Cables.

B) Assertions Covered
   1) USB Type-C (USB Type-C Functional Test Specification)
      a) 4.9#2
      b) 5.2#1
      c) 5.2.3#1
      d) 5.2.3.1#1
      e) 5.2.3.2#1
      f) 5.2.3.3#1
      g) 5.2.3.4#1
   2) USB PD (USB PD Test Plan)
      a) See Test 12.9.1 CAB-PROT-DISCOV

C) Procedure
   1) The CF_DFP and CF_UFP progress through the USB Type-C Connection State Machines to Attached.DFP and Attached.UFP.
   2) The CF_DFP sends a Discover Identity SOP'
   3) The Cable Fixture performs the following verifications:
      a) The CUT responds with Responder ACK within 500ms
      b) CUT Response contains the following VDM Header values:
         (i) SVID == 0xFF00
         (ii) VDM Type == 1
         (iii) Structured VDM Version == 00b
         (iv) Object Position == 0
         (v) Command Type == 01b
         (vi) Command == 1
      c) CUT Response contains the following ID Header values:
         (i) USB Data Host Capable == 0
         (ii) USB Data Device Capable == 0
         (iii) Product Type == 011b || 100b (Passive Cable or Active Cable)
         (iv) VID == Valid Cable VID
      d) CUT Response contains a Cert Stat VDO with a valid USB-IF TID
      e) CUT Response contains a Cable VDO
      f) CUT Response Cable VDO contains the following values:
         (i) Connector Body Type (B19..18) == 10b
         (ii) Connector Plug or Receptacle(B17) == 0b
   4) Retry = 5;
   5) The CF_DFP sends a Discovery SVIDS SOP'
   6) The Cable Fixture performs the following verifications:
      a) The CUT responds within 100ms

b) The CUT response contains the following VDM Header values:
    (i) SVID == 0xFF00
    (ii) VDM Type == 1
    (iii) Structured VDM Version == 00b
    (iv) Object Position == 0
    (v) Command == 2

7) If the CUT Discover SVIDS Response includes VDM Command Type == 11b:
    a) Retry--;
    b) If Retry > 0:
        (i) Continue to Step 5
    c) The Cable Fixture has failed to receive a valid response and the test fails.
8) If the CUT Discover SVIDS Response includes VDM Command Type == 01b:
    a) The Cable Fixture verifies the Discover ID ACK ID Header field Modal Operation Supported == 1
    b) For each SVID returned:
        (i) CF_DFP sends Discover Modes SOP'
        (ii) The Cable Fixture performs the following verifications:
            (1) The CUT response contains the following VDM Header values:
                (a) VDM Type == 1
                (b) Structured VDM Version == 00b
                (c) Object Position == 0
                (d) Command Type == 01b
                (e) Command == 3
        (iii) For each Mode returned:
            (1) X is Mode number where X = {1,..,6}
            (2) CF_DFP sends Enter Mode SOP'
            (3) The Cable Fixture performs the following verifications:
                (a) The CUT responds within 500ms
                (b) The CUT response contains the following VDM Header values:
                    1. VDM Type == 1
                    2. Structured VDM Version == 00b
                    3. Object Position == X
                    4. Command == 4
            (4) If the response Command Type == 01b
                (a) CF_DFP sends Exit Mode SOP' for Mode X
                (b) The Cable Fixture verifies that the CUT responds with an ACK
9) If the CUT Discover SVIDS Response includes a VDM Command Type == 10b:
    a) Cable Fixture verifies Discover ID ACK ID Header field Modal Operation Supported == 0
10) If the Discover ID ACK responded with a Cable VDO and indicated SOP" Controller Present == 1
    a) Cable Fixture prompts tester to unplug CUT, switch ends around and plug back in
    b) Continue to Step 1
11) Verify with vendor all values returned for SVIDs and Alternate Modes are correct and describe the CUT functionality

EPC.2. IR Drop Test

A) Purpose
   1) To check IR drop requirements for USB Type-C Cables
   2) To check IR drop requirements for Electronically Marked cables.
B) Assertions Covered
   1) USB Type-C (USB Type-C Functional Test Specification):
      a) 4.4.1#1
      b) 4.4.1#2
   2) USB PD (USB PD Test Plan):
      a) TBD
C) Procedure
   1) The CF_DFP and CF_UFP progress through the USB Type-C Connection State Machines to Attached.DFP and Attached.UFP.
   2) The CF_DFP Rp advertises 3A Source capability.
   3) The CF_DFP sources Vconn at 5 V
   4) The CF_DFP sends a Discover Identity SOP'
      a) If the CUT responds with an ACK AND Vbus Current Handling Capacity == 10b:
         (1) CF_UFP draws 5 A at 5 V
      b) Else:
         (1) CF_UFP draws 3 A at 5 V
   5) The Cable Fixture verifies:
      a) Ground voltage drop is less than 250mV between CF_DFP and CF_UFP
      b) Vbus voltage drop is less than 500mV between CF_DFP and CF_UFP

EPC.3. Stress Test

A) Purpose
   1) To perform a functionality check when traffic is flowing concurrently across several communication modes.
   2) This test is only applicable to Electronically Marked cables.
B) Assertions Covered
   1) USB Type-C (USB Type-C Functional Test Specification):
      a) 5.2.1#4
   2) USB PD (USB PD Test Plan):
      a) TBD
C) SBU Test Patterns
   1) 0000000001000010
   2) 1111111110111101
   3) 0101010101010101
   4) 1111010100001010
D) Procedure
   1) The CF_DFP and CF_UFP progress through the USB Type-C Connection State Machines to Attached.DFP and Attached.UFP.

2) The CF_DFP contracts a 5V PDO with the CF_UFP
3) The CF_UFP terminates its Dp/Dn lines to device
4) The CF_DFP begins connects to device at far end and begins looping Device Descriptor requests
5) The CF_DFP SPU1 transmits SBU Test Pattern 1 above at 10 kHz
6) The CF_DFP SBU2 transmits SBU Test Pattern 1 above at 12.5 kHz
7) The CF_UFP Begins to loop the following:
    a) Enable a load in 25% increments to 3A or 5A depending on the cable capabilities
    b) Disable load
8) The CF_DFP sends a Discover Identity SOP'
9) The Cable Fixture verifies:
    a) The CUT responds with ACK
10) Continue to step 4 using the next SBU Test Pattern from section C above