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Spec No: 001-65455

Spec Title: USB COMPLIANCE TESTING OVERVIEW - AN023

Sunset Owner: Prajith Cheerakkoda (PRJI)

Replaced by: None

USB Compliance Testing Overview

Associated Project: No
Related Application Notes: None

Abstract

One of the secrets to USB's success is the compliance-testing program. This program verifies that your device meets the specification and works well with other USB devices.

Introduction

Devices that have passed compliance testing can wear the USB logo. Compliance testing is performed in two ways: USB Compliance Workshops (Plugfests) and Independent Test Lab testing. Both methods get your device on the Integrators List, USB's list of compliant devices.

Figure 1. USB Logos

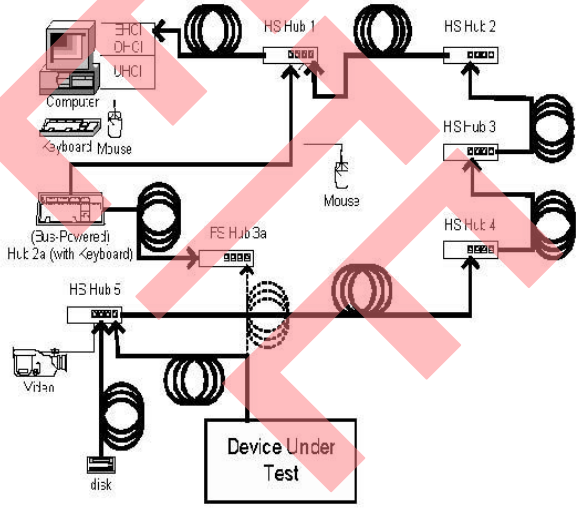
Why is Testing Done?

The USB IF performs compliance testing to insure that all of our customers have a good experience with USB. This is important because all USB vendors are relying on each other to generate goodwill with the public. If a customer has a bad experience with one USB device, he will be much less willing to invest his time and effort in another one.

What is tested?

Compliance testing verifies that your device operates at several different levels. The gold tree test checks driver behavior under Windows and verifies that your device works in a 'real world' scenario without interfering with other devices. The USB Command Verifier checks that your devices correctly implement the SETUP commands required by Chapter 9 of the USB spec. The electrical suites verify that your USB signaling and power are correct. The gold tree consists of a 'known good' PC, an EHCI and UHCI host controller, a five-deep hub stack, a USB video camera, a USB mass-storage device and two HID (Human Interface) devices. The gold tree test checks that your device works well in this tree by hot-plugging your device into many locations in the tree. The gold tree test also verifies device operation at both high-speed and full-speed, during S3 suspend (where VBUS is still present), during Hibernate (where VBUS is removed), and during warm and cold boot of the host. The details of the gold tree test are in the USB test procedure document, available at http://www.usb.org/developers/compliance.

Figure 2. USB Gold Tree



The USB Command Verifier (USBCV) is a Windows program that is available at http://www.usb.org/developers/developers/tools/. The current version runs under Windows 2000 or XP. USBCV installs a special host stack that enables it to directly access the host controller. This program exercises

SETUP commands that may not be seen in normal OS operation. If your device is processing SETUP commands under firmware control, this program is sure to turn up a few bugs.

The electrical suites check your device's compliance to the spec for signaling and power. The current consumption test checks suspend current, unconfigured current and configured current at both high and full speeds. The signal quality tests measure your device's transmit eye diagram. The receiver sensitivity tests verify your high-speed squelch and receiver sensitivity at the spec boundaries.

Since most designs are created with qualified transceivers, most of the electrical problems found at Plugfest are current draw issues. The strict 500 uA suspend current limit can be blown by a few floating pins on your device. Bus-powered devices often fail the 100 mA unconfigured current limit or the 500 mA configured current limit. Self-powered devices often fail to check VBUS before connecting their pull-ups to D+ or D-.

What Do I Need to Pass?

To pass compliance testing, devices must pass ALL of the USB electrical and Gold Tree suites and pass 80% of the compatibility testing. You must also turn in a completed compliance checklist. The compliance checklist is filled out by the board designer. It is a list of common errors in USB designs that cause test failures. It is also the place where the designer lists the Test IDs (TIDs) of qualified connectors, cables and silicon used in the design. These IDs are available in the member's area of the http://www.usb.org website or from your vendor. A list of Cypress' TIDs appears at the end of this application note.

How Do I Get My Device Tested?

Independent labs test your device for a fee. They provide a quick compliance test any time one is needed without waiting for a Plugfest. Sending your device to a test lab keeps your engineering resources free for other tasks. Some independent labs provide debug support for an additional fee.

Plugfests are held every two to three months. They generally start on Tuesday afternoon and run until Friday morning, allowing time for most people to travel on Tuesday and Friday. Plugfests offer an opportunity to examine the cause of any test failures on the spot. Many people can fix their failures and retest during the same Plugfest.

At Plugfest, each system and hub vendor has a fixed test area, called a test suite. Devices and hubs travel from test suite to test suite, performing compatibility tests. Since hub vendors are both a system and a device, they must operate a test suite and travel as a device.

Table 1. Test Labs versus Plugfests

Test Labs	Plugfest
No personnel needed	3–4 days of engineers' or technicians' time. Hubs require two people: one person runs a system suite, and the other person does device testing
$2–5K cost per item	Free to USB I/F members (except for time, travel, etc.)
Unlimited consulting available (for a fee)	USB experts available to help debug, but you're sharing them with 50 other people who are also desperate to pass
Test any time	Only held 4–5 times per year
Exposed to less prototype hardware	Exposed to prototype hosts, hubs and drivers
More secrecy	Less secrecy

What do I do next?

Join the USB I/F or License the USB Logo

There are two preferred options for obtaining a Vendor ID, which is required to identify your device. Joining the USB I/F costs $2500 per year. Purchasing a license for the USB logo without joining the USB I/F costs $1500 for a two-year period. Joining the USB I/F provides a number of benefits (from the USB.org website):

- Free Compliance Workshops (Plugfests)
- Waived logo license administration fee
- Free Vendor ID (if one has not been previously assigned).
- Discounts on developer conferences, products in the e-store, and so on.
- Opportunities to participate in USB-IF industry activities, such as IDF and WinHEC booths, and so on.
- Opportunities to participate in USB-IF marketing programs, such as retail newsletters, store end caps, featured products, and so on.
- Opportunities to participate in USB-IF committees, such as DWG, marketing, and compliance.
- Five free copies of the specification.

Decide on a Test House or Plugfest

If you decide to go to Plugfest, be aware that they often fill up within a few days after registration opens. Check the web site often and sign up well in advance for Plugfest. Remember that you must be a USB I/F member to attend Plugfest.

Complete Your Compliance Checklist

Many of the common design problems seen in USB devices can be avoided if you read the compliance checklist during the design phase of your device. If you have not yet completed the checklist, it is a compliance requirement.

Pre-test Your Device

Pre-testing your device is crucial to success in either testing scenario. After all, you would not stage a demo of your device without making sure the demo will succeed. Compliance testing is a demonstration of how your device works in a typical user environment. To pre-test your device, download the compliance testing procedure for your device from http://www.usb.org/developers/docs#comp test procedures and run through all of the tests. One third of all devices fail at Plugfest. Many of these failures are for simple tests like back-drive of D+ or inrush current.

Qualification by Similarity

(From the USB.org website)

When products are very similar, testing of one product may also allow other products to be added to the Integrators List. Many OEMs buy USB interface boards that are already on the Integrators List and qualify by similarity.

However, if 'significant differences' exist between products, testing of each is required. The definition of 'significant differences' is debatable and the final judgment is the responsibility of the compliance review board which reports to the USB-IF board of directors. As decisions are made on what are 'significant differences', rules of thumb are listed at http://www.usb.org/developers/compliance/. The ultimate responsibility for making sure that various production product models do not have 'significant differences' from the product samples tested lies with each vendor. Audits by USB-IF that reveal discrepancies between shipping product and samples tested are cause for retest. The effect on rights to use the USB-I/F logo is covered in the standard logo license agreement.

Retest required:

- Microcontroller design change (new architecture, or new product family).
- Connector footprint on PCB.

Retest not required:

- Product packaging changes (color, shape etc.).
- Microcontroller vendor change (no board layout change, no firmware change). Retest not required only if new micro-controller is on Integrators List.
- Microcontroller firmware change (changes in fully modular code not associated with USB functions).
- Connector color and aesthetics.

Requirements for retest

After your device is on the Integrator's List, you are required to keep the USB circuits the same. The retest rules for modified devices are the same as for similar devices specified earlier.

Waivers

Waivers allow devices to qualify for the Integrator's List when they are slightly out of spec. For example, the current high-speed test procedure allows devices to pass the high-speed electrical test if they fail in the fifth hub tier. Waivers are temporary agreements between the device manufacturer and the USB I/F. As the current practices of USB design improve, waivers are removed. Waiver decisions are made by the Compliance Review Board (crb@usb.org).

More Information

There is a wealth of information available about the testing process at the USB.org website.

http://www.usb.org/developers/compliance

- Compliance home page

http://www.usb.org/developers/docs#comp_test_procedures

- Links to all of the test procedures for either Tektronics or Agilent equipment

http://www.usb.org/developers/presentations/pres0602/vincent_so.pdf

- Pages 28 and 29 of this presentation contain a comprehensive list of common electrical failures.

Table 2. Cypress Test ID List

Product	TID	Test Date
Antioch-SP CYWB0124ABX-FDXI	40000409	8/14/2007
CY16 Series (CS5954AM) USB NAND Flash Drive Controller	40350250	8/30/2002
CY16 Series (SL1148C) Full-Speed USB Microcontroller	40000776	4/20/2002
CY3280 - 20X66 Universal Capsense Controller	10005114	2/16/2009
CY3660 - enCoRe V Development Board	10005449	9/4/2009
CY3663 EZ-Host	50380381	5/29/2003
CY3686	10003310	6/17/2006
CY4616 Full-Speed USB NAND Flash Drive	10350250	8/30/2002
CY4617 Compact Flash Reader	10380266	5/2/2003
CY4632	10410431	2/12/2004
CY4632 wireless USB LS 2.4GHz Keyboard/Mouse	10360171	10/29/2002
CY7C637XX	40240586	8/20/2000
CY7C64713/14 FX1	40000125	3/8/2006
CY7C67200	40390424	8/20/2003
CY7C68310-80AC	40001426	6/28/2003
Cypress 4-port bus powered	20260113	11/10/2000
Cypress 4-port hub ref. Design	20250106	8/29/2000
Cypress Combi KB Hub Ref	20260112	11/10/2000
CYWB0224AB	40610003	2/15/2008
enCoRe II	40000005	4/8/2005
enCoRe II/ CY7C63310, CY7C638xx	40000085	10/11/2005
enCoRe III	40000110	1/16/2006
enCoRe USB (CY7C632xx)	40260169	11/10/2000
enCoRe USB (CY7C632xx) Mouse Reference Design	10260169	11/10/2000
enCoRe USB (CY7C637xx) Low-Speed Microcontroller	40230188	5/12/2001
enCoRe USB (CY7C637xx) Mouse Reference Design	10240586	8/20/2000
enCoRe V / CY7C64356	40000893	9/4/2009
EZ-HOST	90390448	8/22/2003
EZ-Host CY7C67300	40380381	5/29/2003
EZ-Host/CY7C67300	100390448	9/2/2003
EZ-OTG	90390449	8/22/2003
EZ-OTG/CY7C67200	100390449	9/2/2003
EZ-USB	40240631	9/18/2000
EZ-USB (AN2122/26)	10220287	3/3/2000
EZ-USB AT2 (CY7C68300) USB 2.0-to-ATA	40340244	6/6/2002
EZ-USB AT2 (CY7C68300A) USB 2.0-to-ATA	41340244	6/6/2002
EZ-USB AT2LP	40490119	9/30/2005
EZ-USB AT2LP/CY7C68300B	40440196	9/11/2004
EZ-USB AT2LP/ CY7C68300B	40460273	3/7/2005
EZ-USB FX	40240630	8/23/2000
EZ-USB FX (CY7C646xx) USB-to-ATA Reference Design	10240630	8/23/2000
EZ-USB FX2 (CY7C68013) USB 2.0 Microcontroller	41000229	11/9/2001

Product	TID	Test Date
EZ-USB FX2LP/ CY7C68013A	40440111	9/10/2004
EZ-USB FX2LP/ CY7C68013A, EZ-USB FX2LP CY7C68014A/15A/16A	40460272	3/7/2005
EZ-USB HX2LP CY7C656205	30000038	9/18/2009
EZ-USB HX2LP(TM) CY7C656305	30000039	9/18/2009
EZ-USB NX2LP-Flex	40490118	9/30/2005
EZ-USB NX2LP/ CY7C68023	40460274	3/7/2005
EZ-USB SX2 (CY7C68001) USB 2.0 SIE	40000713	3/1/2002
EZ-USB SX2 (CY7C68001) USB 2.0 SIE	10000713	8/21/2002
EZ-USB TX2 (CY7C68000) USB 2.0 PHY	40350107	8/30/2002
Full Speed USB Hub Controller/ CY7C65013, CY7C65113	30250106	6/13/2005
HX1TT CY7C65620, CY7C65630	30000009	8/28/2006
HX2VL / CY7C65632	30000060	8/9/2011
HX2VL / CY7C65634	30000059	8/9/2011
ISD-300LP/CY7C68013-80AC	40380266	5/2/2003
Krypton	40000768	2/27/2009
M8 Series (CY7C63000A) Mouse Reference Design	10230247	4/20/2000
M8 Series (CY7C634xx) Combi Keyboard	10230189	8/23/2000
M8 Series (CY7C634xx/635xx/636xx)	40230189	8/23/2000
M8 Series (CY7C64013) Full-Speed Microcontroller	40000152	5/22/2001
M8 Series (CY7C66013) Full-Speed Hub + Peripheral Controller	30220230	9/1/2000
MoBL-USB FX2LP18 USB Microcontroller	40000188	6/7/2006
PRoC LP/CYRF69213	40000552	4/2/2008
PSoC 3 CY8C3866AXI-040	40770053	4/29/2011
Radon	40000124	1/16/2006
SL811HS USB Host/Peripheral Controller	40000689	1/22/2002
TetraHub (CY7C65640) USB 2.0 Multi-TT Hub Controller	30000089	8/9/2002
West Bridge Antioch	40000348	4/12/2007
West Bridge Antioch - CYWB0124AB	40000325	3/14/2007
West Bridge Astoria	40000676	9/3/2008
WirelessUSB LS DVK Gamepad	10410474	2/19/2004
WirelessUSB LS DVK Keyboard/Mouse Combo	10410430	2/19/2004

Document History

Document Title: USB Compliance Testing Overview

Document Number: 001-65455

Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	3092405	AASI	12/08/2010	Created spec number for the application note to be added to spec system.
*A	3135270	AASI	01/12/2011	Updated Cypress Test ID (TID) list
*B	3450469	AASI	11/29/2011	Updated Cypress Test ID (TID) list. Updated template according to current Cypress standards.
*C	4108854	RSKV	08/30/2013	Obsolete application note

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