Careful Planning for Interface Compliance Testing

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October 28, 2008

Abstract

This paper provides information about how careful planning for interface compliance testing is an essential part in connecting devices. The planning should anticipate forced changes in applicable standards and specifications, and careful planning should be incorporated in compliance tests at required hardware, software, and system implementation levels. This paper discusses incorporation of such planning and closely examines evolving USB connectivity requirements as one of the most common ways to connect a very broad range of devices.

References and resources are listed at the end of this paper.

For the latest information, see:   
 <http://www.microsoft.com/whdc/>

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# Planning for All Levels of Development

Careful planning for interface compliance testing is an essential part in a device product plan in the present connected world.

In the present connected world, a device has multiple connections to the outside world and must work flawlessly. The device must comply with different standards and real-life environments.

When planning the development of a device, it is essential to consider the forced changes in the applicable standards (such as USB to USB 3.0, Wi-Fi, W-USB, and DLNA) and also changes in the compliance program associated with these technologies.

When developing a device, development will be required at the following levels:

* Hardware
* Software components
* System integration

As a project manager, be aware of the consequences of compliance testing within these different levels.

# Compliance Testing vs. Internal Testing 1

In the approach to verifying your device, there is a difference between testing your device internally versus verifying it against a set of specifications / test specifications.

## Compliance Testing

When discussing compliance testing, consider it a more generic testing methodology that is defined by an independent organization. In a compliance test program, a product will be tested against the test specifications of a technical organization. The goal of such testing is to ensure interoperability in an interconnected environment. The testing sets a bar high enough to promote the technology yet low enough to encourage vendors to obtain a logo.

Consider the example of USB. The Universal Serial Bus specification defines the product-design targets at the level of interfaces and mechanisms. To complement the specification and enable measurement of compliance in real products, the USB-IF has instituted a Compliance Program that provides reasonable measures of acceptability. Products that pass this level of acceptability are added to the Integrators List and have the right to license the USB-IF Logo. Information about how you can get your product on the Integrators List is provided below. Please reference the [Compliance FAQ](http://www.usb.org/developers/usbfaq/) section if you have further questions.

## Internal Testing

The basic difference between compliance testing and internal testing is that internal testing is a specific testing methodology that you define and depends on the stage of development. Herein the product will be tested against test specifications at the appropriate stage. The most ideal situation is that the internal test specification will consist of parts needed for the compliance testing programs.

## Advantages of Compliance with the Programs

The most important reason for obtaining a logo or complying with the different compliance programs is that it provides a basic level of interoperability assurance across other products.

An important benefit of compliance is that most compliance programs are related to a trademarked logo. This provides the advantage of receiving a basic level of interoperability for your devices together with considerable marketing power. You may use the certified logo only after you pass the certification program. This logo can give the vendor (B2B) and customer (B2C) the confidence that the product is compliant with the specification.

# Changing Standards and Compliance Plans

How can you be ready for the next specifications and ensure your design will be compliant in the future? Preparation is key.

## Specifications

Work with the most recent and appropriate specifications. When the specifications are not final, it is necessary to work together with the appropriate workgroup to stay up to date concerning the changes.

When the Design Specifications are final, make sure that your design is compliant with the specification and compliance program (in which backwards compatibility is needed).

## Tools

For internal testing, the most important thing is to update your test bench,

whether it is in the case of electrical/PHY layer testing, or in software test tools.

For the different electrical test and measurement manufacturers, there are specific testing procedures.

For the best software test tools, use the most recent available.

## Workshops

Workshops have two main functions:

1. To test designs against other manufacturers in the market.
2. To obtain the logo for your device.

Most technologies give their attendees the opportunity to test their prototypes in a real-world environment with other prototypes. Workshops are organized quarterly and are only open to attendees.

## Independent Certification Vendor

Most compliance programs will work with a number of Independent Certification Vendors (ICV). These test labs are accredited by the Implementers Forum and are able to pretest and certify your device at their site. The advantage of using an ICV is that there is no need to travel to workshops: ICVs are able to give you support and guarantee a high degree of confidentiality.

# Verification in the Development Lifecycle

When defining where verification fits in the development phase, the use of the V-model as a concept is a wide spread way of working and provides the base what testing needs to be associated with which phases.

## V-Model

A typical device development lifecycle begins with the documentation of the requirements. The system is designed at a high and low level and finally coded. All of these phases are accompanied with a well-defined approach to internal testing plans.

Commonly the main testing focus is on acceptance testing in the final stages of the product development cycle. Postponing testing to the last stages is a very dangerous way of working. As when a failure occurs, it will delay time to market (TOM) and force you to return to your hardware/silicon vendor to resolve issues.

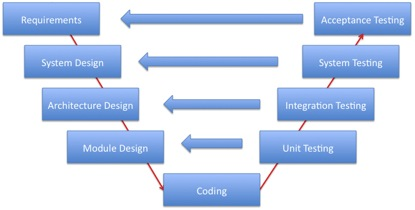


Figure . V-Model

## Example of Compliance Tests for USB-IF

The following are some of the requirements that a product must meet to comply with USB specifications:

* Electrical
  + High Speed electrical
  + Legacy electrical
  + Power measurements
  + Optional TDR
* Protocol
  + USB Framework (USBCV)
* Functionality
  + Interoperability (Goldtree)

## Requirement Stage

At the requirement stage, it is vital to include the different interface technologies your design supports.

At this stage, you need to ask the following questions:

* Will your company obtain compliance or compliance and logo?
* Do you only want to use the testing plans to validate compliance?
* Which technologies are we using?
* Re-use / buy in of components (are they certified and for which technology)
  + Cables and connectors
  + PHY
  + Reference designs

Depending on the answers to these questions, you need to prepare yourself. If you want to go for the compliance program, you need to:

* Be a member of the appropriate Implementers’ Forum
* Use the latest design specification

Use the latest compliance test specification.

## Design Stage

When you are starting to design, use the latest specifications and limitations set in the compliance testing plans. Some compliance programs will work with checklists; these lists consist of tests that cannot be measured in the end device. Hence make sure you have the tests measured in the design phase.

Necessary steps:

* Assure that the used cables and connectors are certified for the latest compliance requirements.
* Assure that the used silicon and or reference designs are certified for the latest compliance requirements.
* Incorporate the appropriate compliance requirements in your internal quality assurance process.

## Coding Hardware

When coding hardware and firmware, the developer must verify their design versus the electrical compliance testing procedures on Full Speed and High Speed (if applicable). These tests consist of: signal quality; inrush current; device packet parameters; timing measurements; Device test J/K, SEO\_NAK; Receiver Sensitivity.

Necessary steps:

* Internal testing.
  + Test and measurement setup.
  + Specific testing procedures for your in house test and measurement setup. Assure that your device is compliant towards the power save modes.
* External testing.
  + Be sure that you approach an ICV in order to schedule a pretesting timeslot.

## System Integration

After the completion of the hardware coding, you can then verify the firmware, driver, and the application. To reach USB compliance, verify:

* Hardware/firmware integration versus the compliance of the device framework.
* Hardware/firmware/driver integration versus the power measurements in difference states and back voltage.
* Hardware/firmware/driver/software versus a real live functionality (Goldtree interoperability).

Necessary steps:

* Internal testing.
  + Device framework: hardware/firmware.
    - Specific testing procedures.
    - Download the latest USB Compliance Verifier tool.
  + Power measurement: hardware/firmware/driver.
    - Specific testing procedures.
    - Download the latest USB Compliance Verifier tool.
  + Goldtree interoperability: hardware/firmware/driver/software.
    - Specific testing procedures Acquire all needed gold tree setup.
* External testing.
  + Be sure that you approach an ICV to schedule a pretesting timeslot.
  + Plan your visit to get your product certified through a workshop or ICV.

# Call to Action

* Be a member of applicable technology forums.
* Integrate testing and compliance in your development cycle.
* Work with testing specialists and Independent Certification Vendors.
* Always work with the latest design specifications, testing specifications, test and measurements tools, and equipment.

# Resources

Generic: <http://www.usb.org/>

Specs: <http://www.usb.org/developers/docs/>

Compliance: <http://www.usb.org/developers/compliance/>

Procedures: <http://www.usb.org/developers/docs#comp_test_procedures>

ICV: <http://www.usb.org/developers/compliance/labs/>

Whitepapers: <http://www.testroniclabs.com>

Contact information: [usb@testroniclabs.com](mailto:usb@testroniclabs.com)