Future Technology Devices International Ltd.

Technical Note

TN_128

Preparing an FTDI-based Peripheral for USB-IF Certification

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This technical note will guide the reader through preparing an FTDI-based product for USB Implementers Forum certification.

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1 Introduction

The Universal Serial Bus (USB) has become a *de-facto* standard among not only personal computers, but also many types of computing devices throughout the electronics industry. One primary reason for this wide acceptance is the strict adherence to a set of specifications set out by the Universal Serial Bus Implementers Forum (USB-IF).

In order to ensure that devices follow the specification, the USB-IF created and maintains a specific suite of tests that cover both electrical specifications and interoperability. This technical note is intended to help the designer of an FTDI-based peripheral prepare for submitting their device for USB-IF certification testing.

After a device is certified and the appropriate agreements with the USB-IF executed, the official USB logos can be used in conjunction with the product.

1.1 Vendor ID, Product ID and Test ID

All products intended for USB-IF are identified by two values and assigned a third when tested for certification:

- **Vendor ID (VID)** – This is a unique number between 1 and 65535 issued by the USB-IF when a company joins the USB-IF or purchases the VID in order to obtain certification. A company may not "borrow" another VID for certification purposes. This number is commonly denoted as a 4-digit, hexadecimal value. For example, the FTDI VID is 0x0403.
- **Product ID (PID)** – This is a number between 1 and 65535 issued by the company that obtained a VID. It is not necessary for each product created by a company to have a unique PID; however, the functionality of all devices with a given PID should be similar. It is also commonly denoted as a 4-digit, hexadecimal value. For example, the FTDI-assigned default PID for all single-port USB-UART ICs is 0x6001.
- **Test ID (TID)** – This is an 8-digit number assigned by the USB-IF when a product is first submitted for testing. Any subsequent testing of the same product would use the same TID.

The host operating system uses the VID/PID pair to match the peripheral with a specific set of device drivers. The USB-IF also records the VID, PID and TID in their list of compliant products.

Upon successful test completion and review by the USB-IF, the official USB logos may be used with the product. The USB-IF requires additional agreements to be in place, such as the logo trademark agreement. Refer to the compliance section USB-IF web site for the latest requirements.

At the time of this writing, the USB-IF allows the use of the "Trident" symbol on cables and near port connectors regardless whether the product has been certified with the USB-IF.

1.2 FTDI-issued PIDs

Any product using PID values issued by FTDI for use with the FTDI VID (0x0403) is *not eligible* for USB-IF certification. Official USB logos *cannot* be associated with the product.

Any product using the default VID/PID combination from FTDI is *not eligible* for USB-IF certification. Official USB logos *cannot* be associated with the product.

Please refer to TN_100, USB Vendor ID/Product ID Guidelines for guidelines regarding the choice of which identification method to use.

2 Requirements

There are several steps to preparing a FTDI-based peripheral for USB-IF certification.

2.1 Hardware design

As technologies become faster, it is important to follow best practices when designing the circuit and PCB layout for a USB product. USB signalling is accomplished over a matched, differential pair both in the cabling and on the PCB. The integrity of the USB signals is measured in the USB-IF electrical tests. Refer to AN_146, USB Hardware Design Guidelines for FTDI ICs from FTDI and "High Speed USB Platform Design Guidelines" from the USB-IF for circuit design best practices.

Refer to the USB2.0 Specification, Chapter 7 for electrical details and Chapter 9 for details surrounding the framework that defines the various USB states that determine when the product should be operational, in low power mode, etc. While FTDI's goal is "USB Made Easy", where detailed knowledge of USB is not necessary, it is prudent for the designer to be at least familiar with the USB specification, especially these two chapters.

All products tested by the USB-IF require certified USB connectors. Ensure that the chosen connector is on the USB-IF Product List and is assigned a TID.

Environmental noise, shielding and EMI compatibility must also be considered. Depending on the target customer of the product, other industry certifications of the product may be necessary, such as FCC, CE, RoHS, UL, etc. Discussion of these certifications is beyond the scope of this document.

2.2 EEPROM settings

Any FTDI-based product destined for USB-IF certification will require an EEPROM to store the USB configuration descriptors. Some FTDI ICs, such as the FT232R and FT245R, contain an internal EEPROM. Refer to the datasheet of the selected IC for USB configuration descriptor storage requirements.There are several key USB descriptors that require a unique configuration:

Value	Description
USB Vendor ID (VID)	Assigned by the USB-IF
USB Product ID (PID)	Chosen by the product manufacturer, unique to a product type or family
Serial Number Enabled	Yes or No – determines whether a serial number is present
Serial Number	Chosen by the product manufacturer, unique to an individual device
Manufacturer Name	Name of the company obtaining USB-IF certification
Product Description	Descriptive string indicating the product name or type
Power Source	Bus- or Self-powered, depends on hardware design
Max Bus Current	If bus-powered, the amount of current required by the product (500mA max). If self-powered, this value should be set to zero
Remote Wake-Up	Enabled or disabled, depends on hardware design

Table 2.1 – Key USB Configuration Descriptors

These descriptors determine how the electrical and interoperability tests will be performed. For example, if remote wake-up is enabled, there must be a means of stimulating the product (e.g. switch closure) to cause the host system to wake-up.

Each FTDI IC has other EEPROM settings based on the features of the chosen IC. All of these settings are configured with the FTDI utility FT_Prog, or through a custom application using the FTDI D2XX API.

2.3 Device driver requirements

The USB-IF tests are done with the Microsoft® Windows® operating system. Contact the USB-IF for test procedures if the product only operates with Mac OS®. The USB-IF does not offer testing with the Linux® operating system.

FTDI provide a combined Microsoft Windows device driver with base USB functionality (D2XX) and Virtual COM Port (VCP) capability. The VCP driver provides a USB Serial Port which is assigned a COM port number by the operating system. Application programs originally written for native COM ports can be used with the VCP COM port. The D2XX driver provides additional capability and modes for use with applications that utilize the FTDI D2XX API. Products that *only* use D2XX are not required to use the VCP driver; however, the choice whether to expose the COM port is up to the designer. Note that with the combined driver model (CDM), the same driver files cover both D2XX only and combined D2XX/VCP installations.

With the EEPROM settings chosen as noted above, matching updates must be made in the Device Driver configuration files. These updates are done by editing the FTDIBUS.INF and FTDIPORT.INF files contained within the device driver files downloaded from the FTDI Website. More information regarding the required changes can be found in TN_100 USB Vendor ID/Product ID Guidelines. Additional device driver settings, such as aliased baud rates, timers, etc. are found in AN_107, Advanced Driver Options.

FTDI provide a utility called FT_INF to assist in editing the INF files.

64-bit Microsoft Windows Vista and 64-bit Windows 7 operating systems require device drivers certified and signed by the Windows Hardware Quality Labs (WHQL). Other varieties of Windows operating systems will allow installation of unsigned drivers after accepting a warning indicating the lack of a signature. At the time of this writing, the USB-IF does not require WHQL-signed device drivers as part of the test requirement.

It is important to note that while the USB-IF does not require them, the end-user experience will be enhanced by providing WHQL-certified device drivers. Details on obtaining WHQL-certification of the modified FTDI device drivers can be found in AN_101, Using Microsoft's WHQL Process for Certifying Customer Modified FTDI Driver Files.

2.4 Interoperability Test Program

The Interoperability test program is an application program that runs on the host system and exercises the product under test. There are no specific requirements as to how the product is exercised except that some output must be either displayed on the product or feedback from the port on the host screen. It depends on the complexity of the product under test and can be as simple as a serial port loopback or flashing an LED.

3 USB-IF tests

3.1 Procedures

The USB-IF website provides the latest information regarding the USB-IF Compliance Program. The Product Test Requirements section of the compliance page has links to the various test requirements and test methods. These methods are updated on a regular basis. Since operating systems and test hardware are continually being introduced into the market, this document may not reflect the very latest test procedures published by the USB-IF. The designer must contact the USB-IF prior to starting a design to ensure it is compliant with the latest requirements.

3.1.1 Checklist

A completed "Peripheral Checklist", obtained from the USB-IF website. is required prior to any test session. This document gives the USB-IF basic information such as company name, contact, product name, revision, etc. There are several fields that ask for TID and manufacturer information. As noted above, all USB cables and connectors used in conjunction with the product will require a TID for certification. The same checklist is used for Full- and Hi-Speed peripherals.

One of the fields is titled "Manufacture & Model Identifier of the USB Silicon used in this peripheral". Enter the full FTDI company name and model of the IC in use, for example:

Field	Entry
Manufacture & Model Identifier of the USB Silicon used in this peripheral	Future Technology Devices International Ltd. FT2232H (TID=40720019)

Table 3.1 - Sample Silicon Vendor TID Entry for FT2232H

Nearly all FTDI USB peripheral ICs have been certified to USB-IF specifications and issued a Test ID (TID) number as noted in the respective IC Datasheet.

The remainder of the checklist contains a questionnaire surrounding the design and operation of the product. In particular, the TID questions are repeated in Section 2, Mechanical Design and Layout. Be sure to include the same information as the example above.

With respect to the FTDI ICs, all applicable questions can be answered "yes". Note, however, that the final answer is dependent on the design of the overall product over which FTDI has no control. The checklist has references to the applicable section of the USB 2.0 specification if there are any questions. *Final responsibility of the checklist answers lies with the product designer.*

3.1.2 Electrical

Detailed electrical requirements for a USB peripheral are covered the USB 2.0 specification, Chapter 7. The test procedure measures various signal integrity and power values in a mostly automated test session.

The items listed below are common points of failure for the electrical tests:

Item	Discussion
Signal integrity	Follow the guidelines in AN_146, USB Hardware Design Guidelines for FTDI ICs from FTDI and "High Speed USB Platform Design Guidelines" from the USB-IF. Ensure cables and connectors are terminated properly and have

	USB TID numbers.
Power – Inrush Current (both initial plug-in and switching to high-power)	In general, the maximum bulk capacitance on VBUS should be no more than 10uF with an equivalent 44-ohm load. Slow start switching techniques help if higher bulk capacitance is needed.
Power – attached	Until the product is enumerated, ensure the circuit draws no more than 100mA from VBUS if bus-powered.
Power – configured (enumerated)	Ensure the product draws no more than the amount of current requested by the USB descriptor (500mA maximum) from VBUS if bus-powered
Power – Sleep / Hibernate	Ensure the product draws no more than 2.5mA.
Power – back-feed	Ensure the product does not source any current toward an upstream USB host or hub port.

Table 3.2 - USB-IF Electrical Test Summary

3.1.3 Interoperability

The Interoperability test ensures the product behaves well with a moderately loaded computer and a complex "Gold Tree" of USB hubs and peripherals.

The designer is responsible for supplying both the device drivers and an application program to exercise the product under test.

A few key components of the test are:

Item	Discussion
Device Driver	Ensure the device driver loads without error or requiring a reboot
Application Program	Provides an indication that the peripheral under test is functioning
Power States	Check rebooting, suspend/hibernate, resume of the system while exercising the Gold Tree peripherals both with and without the Application Program running.
Remote Wake-up	If enabled, ensure the product can initiate a system resume from suspend.

Table 3.3 - USB-IF Interoperability Test Summary

3.2 Test opportunities

3.2.1 USB-IF Events

The USB-IF holds several Compliance Workshops (formerly known as "PlugFests") throughout the world each year. Members of the USB-IF can participate in these test sessions for at no charge as a benefit of membership. In addition to providing the compliance test sessions, other vendor and/or technology sessions are included in the test schedule. These additional sessions give opportunities for the USB-IF and members to test hardware with emerging technologies and evaluate new test equipment and procedures. See the USB-IF website for a list of events.

3.2.2 Independent Test Labs

As with other industry standards, numerous independent test labs around the world are certified by the USB to carry out the compliance tests. See the USB-IF website for a list of approved sites. Both USB-IF members and non-members can have products tested at independent labs.

4 Disclaimers

This technical note is intended for use with FTDI USB2.0 Full- and Hi-Speed products. At the time of this writing, official peripheral tests for USB2.0 require testing with 32-bit Microsoft Windows 7 operating system.

USB3.0 (Super-Speed) is beyond the scope of this document.

If this technical note is in conflict with USB-IF documentation, the USB-IF documentation takes precedence. Check with the USB-IF for current testing requirements.

FTDI is not responsible for any design failing to meet USB-IF requirements.

5 Contact Information

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Distributor and Sales Representatives

Please visit the Sales Network page of the FTDI Web site for the contact details of our distributor(s) and sales representative(s) in your country.

Appendix A – References

Document and Website References

Description	Website
FTDI Ltd.	www.ftdichip.com
FTDI Products	http://www.ftdichip.com/FTProducts.htm
FTDI AN_101, Using Microsoft's WHQL Process for Certifying Customer Modified FTDI Driver Files	http://www.ftdichip.com/Support/Documents/AppNotes/AN_101_WHQL_Certified_Driver_Process.pdf
FTDI AN_107, Advanced Driver Options	http://www.ftdichip.com/Support/Documents/AppNotes/AN_107_AdvancedDriverOptions_AN_000073.pdf
FTDI AN_146, USB Hardware Design Guidelines for FTDI ICs	http://www.ftdichip.com/Support/Documents/AppNotes/AN_146_USB_Hardware_Design_Guidelines_for_FTDI_ICs.pdf
FTDI TN_100, USB Vendor ID/Product ID Guidelines	http://www.ftdichip.com/Support/Documents/TechnicalNotes/TN_100_USB_VID-PID_Guidelines.pdf
FTDI D2XX API	http://www.ftdichip.com/Support/Documents/ProgramGuides/D2XX_Programmer's_Guide(FT_000071).pdf
FTDI Device Drivers	http://www.ftdichip.com/Drivers/VCP.htm
FTDI FT_Inf	http://www.ftdichip.com/Support/Utilities.htm#FT_Inf
FTDI FT_Prog	http://www.ftdichip.com/Support/Utilities.htm#FT_Prog
USB Implementers Forum (USB-IF)	www.usb.org
USB-IF Compliance Program	http://www.usb.org/developers/compliance/
USB-IF Product List	http://www.usb.org/kcompliance/view
USB-IF USB2.0 Specification	http://www.usb.org/developers/docs/
USB-IF High Speed USB Platform Design Guidelines	http://www.usb.org/developers/docs/hs_usb_pdg_r1_0.pdf
USB-IF Events	http://www.usb.org/developers/events/
USB-IF Approved Independent Test Labs	http://www.usb.org/developers/compliance/labs/

Appendix B – List of Tables

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Appendix C – Revision History

Revision	Changes	Date
1.0	Initial Release	2011-01-17