Universal Serial Bus Implementers Forum

EHCI and xHCI High-speed

Electrical

Test Tool Setup Instruction

Revision 0.41

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Revision History

Rev	Date	Author(s)	Comments
0.1	June 7, 2010	Martin Franke	Initial Draft
0.2	June 16, 2010	Martin Franke	Changed to EHCI/xHCI version
0.3	April 28, 2010	Martin Franke	Added Add-In Card to Legacy Free Test Method
0.4	December 9, 2011	Martin Franke	Changed to allow implementation of automatic stack switching feature, HSETT Operation and Troubleshooting

Please send comments via electronic mail to techsupp@usb.org

USB-IF High-speed Electrical Test Procedure
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Table of Contents

1   Introduction

This document provides instruction to setup the necessary test environment for performing the High-Speed USB-IF Electrical Test Procedures on EHCI or xHCI based platforms. This document describes an implementation environment utilizing the specific commercial test equipment that has been successfully used by the USB-IF electrical team. Implementation of the test environment utilizing other equivalent or better commercial test equipment is possible with adaptation and modification of the procedures and setups.

With the Loop Device Descriptor function in the Device Test menu the HS Electrical Test Tool can also be used for signal quality test of low-speed or full-speed USB peripherals.

The USB-IF Electrical Test Procedures were developed by the USB 2.0 Compliance Committee under the direction of USB-IF, Inc. All high speed supporting peripherals are required to pass the high speed electrical tests. There are three High-speed Electrical Test Procedures: The Host High-speed Electrical Test Procedure is for high speed capable host controllers, the Hub High-speed Electrical Test Procedure is for high-speed capable hubs, and the Device High-speed Electrical Test Procedure is for high-speed capable devices. The electrical tests for low-speed and full-speed peripherals, power delivery, and interoperability tests (collectively referred to as the legacy compliance tests) are documented in the USB-IF Compliance Test Procedure. All these compliance test procedures can be obtained by visiting the USB-IF website in the Compliance page in the Developers' area:

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

2   Purpose

This setup instruction is written to facilitate the installation and operation of the High-speed Electrical Test Tool on EHCI or xHCI based platforms. It is not the intent of the electrical team to endorse any specific brands and models of hardware or software. The implementation described is simply one specific instance chosen by the electrical team that met our unique set of requirements and constraints.

2.1   Windows OS Support

This document was written for testing with platforms operating Windows 7 Professional/Ultimate. In case of a Legacy-free system it may be necessary to control the platform with a remote desktop connection using a client PC operating Windows 7 Professional/Ultimate as well.

3   USB-IF Compliance Test Procedures

The USB-IF electrical compliance test procedures are not included in this installation. Please determine the versions that meet your need (with respect to your test equipment choice and your USB products) by reading this section.

3.1   USB-IF High-speed Electrical Test Procedures

The USB-IF High-speed Electrical Test Procedure documents a series of tests used to evaluate USB peripherals and systems operating at high-speed. These tests are also used to evaluate the high-speed operation of USB silicon that has been incorporated in ready-to-ship products, reference designs, proofs of concept and one of a kind prototypes of peripherals, add-in cards, motherboards, or systems.

High-speed capable systems, hosts, hubs and devices are those that support the transfer speed of 480Mbps.
There are four High-speed Electrical Test Procedures:

System High-speed Electrical Test Procedure – for systems with xHCI or EHCI host controller(s)

Host High-speed Electrical Test Procedure – for xHCI or EHCI host controllers

Hub High-speed Electrical Test Procedure – for high-speed capable hubs

Device High-speed Electrical Test Procedure – for high-speed capable devices

There are four sets of High-speed Electrical Test Procedures written for the following individual test equipment brands:

- Agilent
- Tektronix
- LeCroy
- Yokogawa

These procedures can be downloaded from the USB-IF website at this location:
http://www.usb.org/developers/docs/ .

In addition to the High-speed Electrical Test Procedures, the High-speed Electrical Test Specification is also available to be downloaded for reference from this same location.

3.2   USB-IF Legacy Compliance Procedure

To maintain backward compatibility with full speed host controllers, all high-speed capable devices must pass all USB-IF compliance testing for full-speed products as outlined in the USB-IF Compliance Test Procedure available at http://www.usb.org/developers/compliance.

Super or High-speed capable host controller and hub downstream ports must also pass all USB-IF

compliance testing for full-speed and low-speed. Again, these additional test requirements are provided in the USB-IF Compliance Test Procedure available at http://www.usb.org/developers/compliance.

3.3   USB Version 2.0 Specification

The USB Version 2.0 Specification defines the requirements of the high-speed USB architecture, as well as that for full- and low-speed USB architecture. The specification and the most recent update of the errata should be downloaded from the USB-IF website at http://www.usb.org/developers/docs.html

4   Computer Setup

There are two versions of the High-speed Electrical Test Tool: xHCI and EHCI. Both come in either 32 bit or 64 bit versions creating a total of four HSETT versions. Select the appropriate version based on the host controller type (xHCI or EHCI) and the computer operating system (32 bit or 64 bit).

The High-speed Electrical Test Tool serves to put the High-speed capable peripherals (device, hub or host controller) into different states allowing the High-speed signal characteristics to be measured in accordance with the High-speed Electrical Test Procedure. This requires at least one computer to perform the signal analysis and put the DUT into different signal states. However for legacy-free systems it may be necessary to use a second computer as a remote desktop controller for the test computer.

This procedure contains the steps required to perform High-speed electrical testing of a system or motherboard operating Windows 7 Professional/Ultimate as well as additional steps for the testing of Legacy-free servers and motherboards.

4.1   Hardware Requirements

The suggested minimum system features are:

- Intel Core 2 Duo or better processor, either 32 bit or 64 bit

- 1 GB or more system memory

4.2   Software Requirements

- Windows 7 Professional/Ultimate x86 (32 bit) or x64 (64 bit) for host controller as well as optional client PC in case of Legacy-free testing

5 Installation of HSETT

The high speed electrical test tool is to be loaded onto the platform that is to test the host, device or hub. It comes in both 64 bit and 32 bit forms.

The EHCI installer file can be downloaded from http://www.usb.org/developers/tools/
The xHCI installer file can be downloaded from http://www.usb.org/developers/ssusb/ssusbtools/.

5.1 Disable User Account Control

Before installing HSETT, User Account Control (UAC) should be disabled in Windows. Choose Start→Control Panel→User Accounts and Family Safety→User Accounts→Change User Account Control settings. Set the Settings Bar to "Never notify". Click "Ok" and then restart the computer.
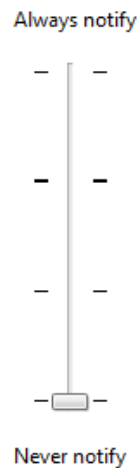
Figure 1: User Account Control Settings Bar

5.2 Install HSETT

Install the appropriate High-speed Electrical Test Tool by double clicking the installer file downloaded from the USB-IF website and following the installation instructions.

6 Operation of HSETT

WARNING: FOR LEGACY-FREE SYSTEMS (SYSTEMS WITHOUT PS/2 SUPPORT) BE SURE TO SETUP SYSTEM AS DISCUSSED IN SECTION 7 BEFORE OPENING HSETT.

The HSETT software works by putting devices, hosts and hubs into appropriate High-Speed test modes in order to test certain electrical parameters for these 2.0 and 3.0 peripherals. In order to function correctly HSETT must install its own driver in place of the standard host controller driver.

Note: HSETT does not affect SuperSpeed signaling.

6.1 Using HSETT

Open HSETT by double clicking the …HSETT logo on the desktop, or accessing it under Start→All Programs→Startup→USB-IF Test Suite→… HS Electrical Test Tool→…HSETT .

If multiple controllers exist HSETT will prompt the user to select the appropriate controller for testing. Choose the correct controller based on the information provided.
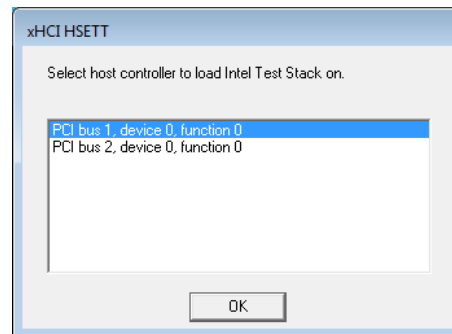

Figure 2: Choose Controller

The first time HSETT is opened the user will be asked if they would like to install the compliance driver. Click "Install".
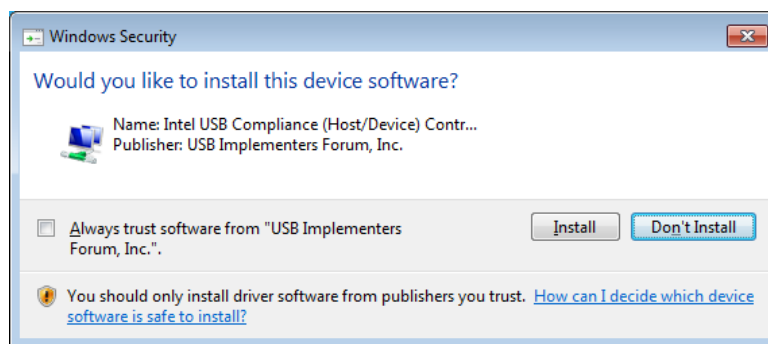

Figure 3: Select "Install" from Windows Security Window

Figure 4 shows the Main Menu. The left hand side provides options for testing devices, hubs or hosts. The right side shows the available host controllers for use during testing (Note: only controllers with the compliance driver installed are displayed here). Select the appropriate test type; confirm the host controller being used is correct; then click "Test" to open the applicable test menu.
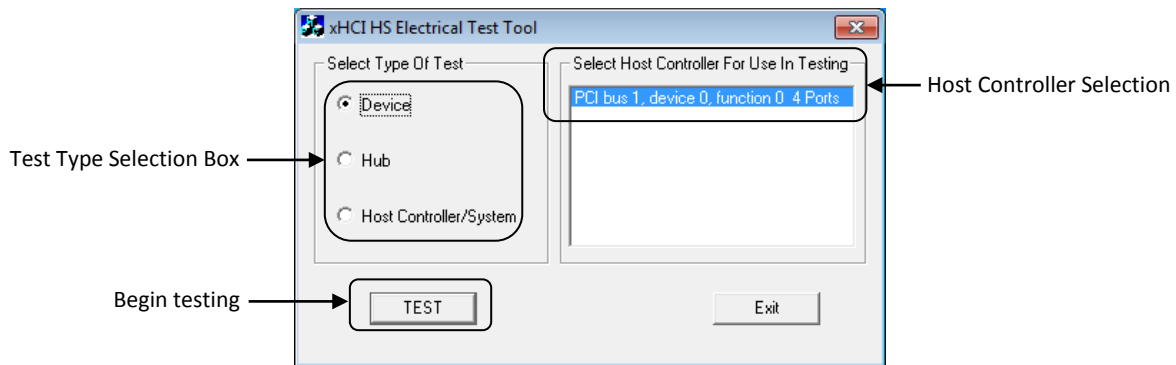

Figure 4: HSETT Main Menu

6.1.1   Device Test Menu

The Device Test Menu provides options to put a device into an electrical test mode through the host controller selected for use in testing. Select the correct device to test from the Device Selection Box by observing the PID/VID. Next choose the appropriate command from the Device Command drop-down menu. Then select "EXECUTE".

Note: If a device does not show in the Device Selection Box or if the command fails try power cycling device and clicking "Enumerate Bus"; then try the command again.
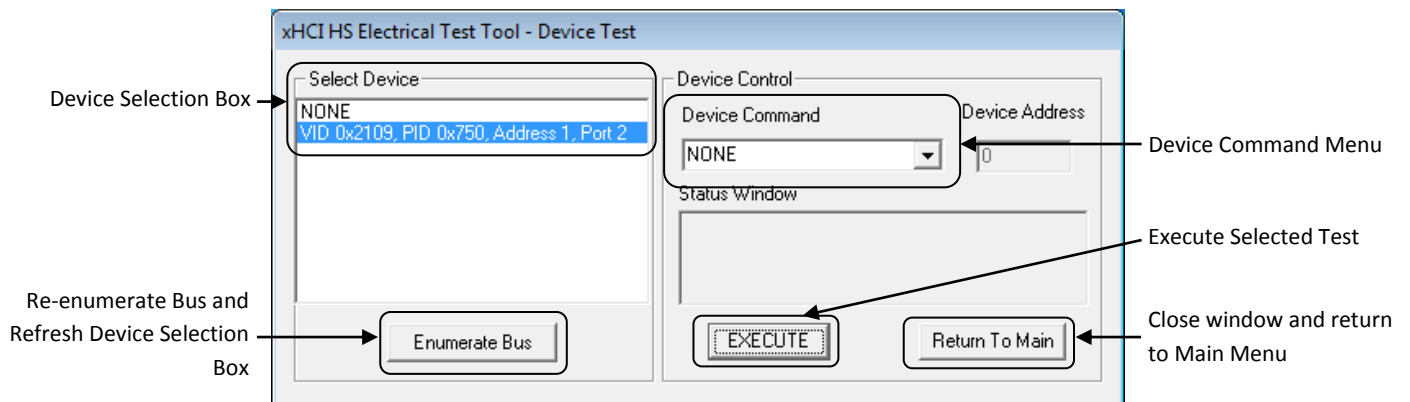

Figure 5: Device Test Menu

6.1.2   Hub Test Menu

The Hub Test Menu provides options to put a hub or a device attached to a hub's downstream port into an electrical test mode through the host controller selected for use in testing. Select the correct hub to test

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from the Hub Selection Box by observing the PID/VID. Next choose the appropriate command from either the Upstream, Downstream or Downstream Device Command drop-down menu (for downstream hub port tests user must also select port number of port under test). Then select "EXECUTE".

Note: If a hub or device does not show in the Hub or Device Selection Box or if the command fails try power cycling hub and/or device and clicking "Enumerate Bus"; then try the command again.
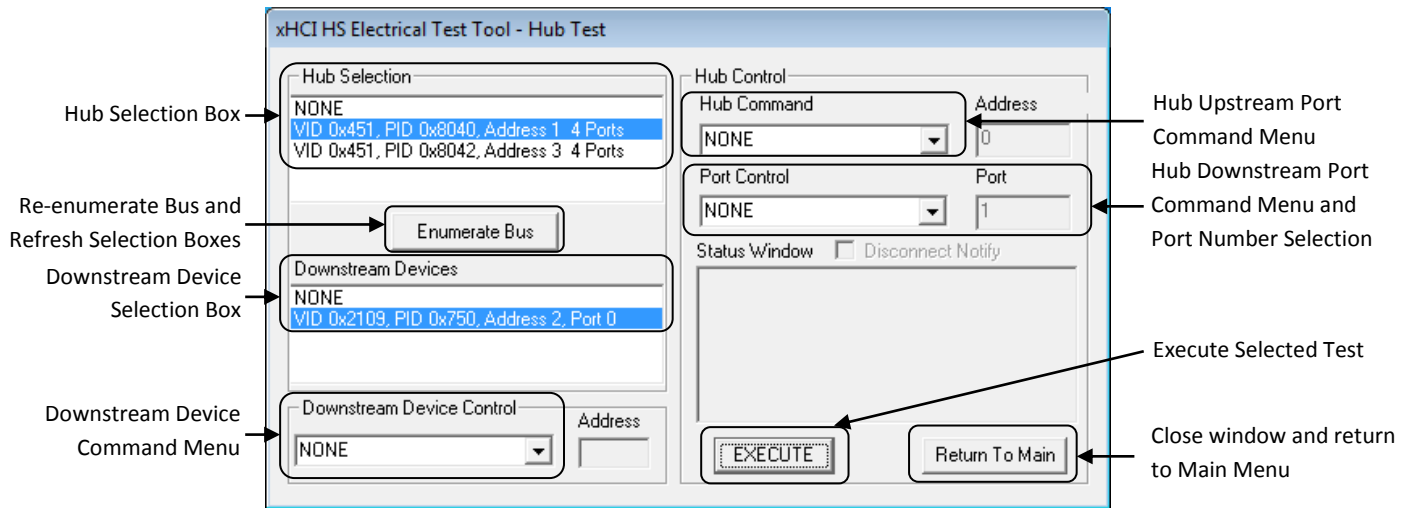

Figure 6: Hub Test Menu

6.1.3   Host Test Menu

The Host Test Menu provides options to put a host controller or a device attached to that controller into an electrical test mode. Choose the appropriate command from either the Root Port or Downstream Device Command drop-down menu (for root port tests user must also select port number of port under test). If a device is attached select the correct device to test from the Device Selection Box by observing the PID/VID. Then select "EXECUTE".

Note: If a device is connected to one of the host's downstream ports but does not show in the Device Selection Box or if the command fails try power cycling that device and clicking "Enumerate Bus"; then try the command again.
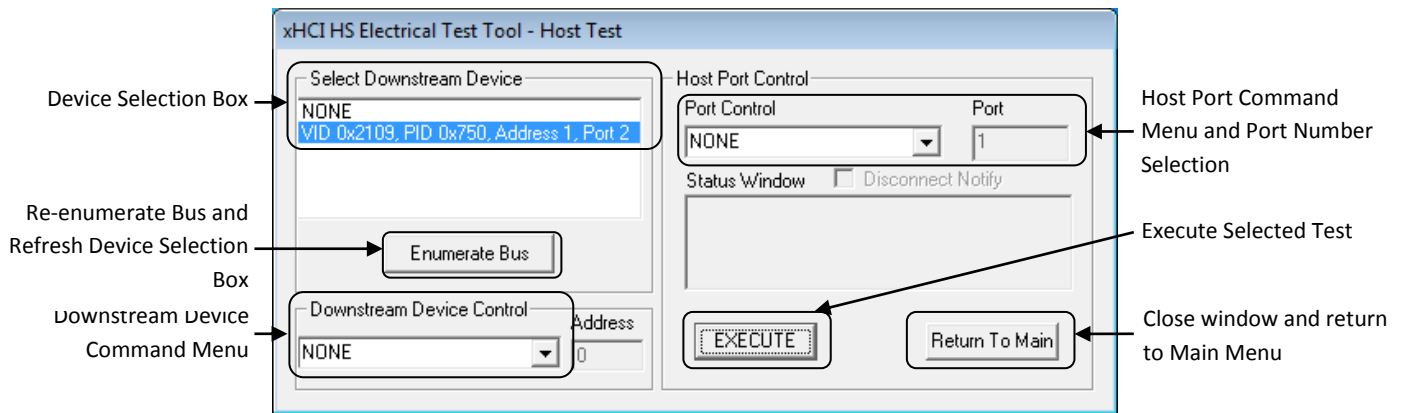
Figure 7: Host Test Menu

6.2   Electrical Testing

Information regarding which commands to execute and how to perform actual electrical testing can be found in electrical test procedures for Agilent, LeCroy, Tektronix and Yokogawa. See Section 3.1 for more details.

7   Legacy-free Systems

If the test system is Legacy-free (does not have PS/2 controller ports) it may be necessary to control it either from an add-in card or from a client PC on a remote desktop.

- The Add-In card method requires the test computer to have either a PCI or PCIe slot on the motherboard. While the computer is off, insert the respective USB add-in card into the PCI/PCIe slot. Once the card is in place turn the test computer back on and load the vendor provided driver. Use this card to operate the human interface devices to control the computer.

- The Remote Desktop method requires that the client PC should match the specifications listed in section 4.1 and 4.2. The remote desktop client PC allows the user to completely control the host PC through a network connection between the two. Remote desktop connections can be done multiple ways; for simplicity this document only covers one method. For more information on remote desktop connections with Windows 7 see http://windows.microsoft.com/en-US/windows7/Connect-to-another-computer-using-Remote-Desktop-Connection .

For clarity in this section the Server platform will be referred to as the *Host* Computer while the controller PC will be referred to as the *Client* Computer.

7.1   Remote Desktop Hardware Setup

Using an Ethernet cable, connect the host computer directly to the client computer. This will create a basic LAN connection between the two computers.
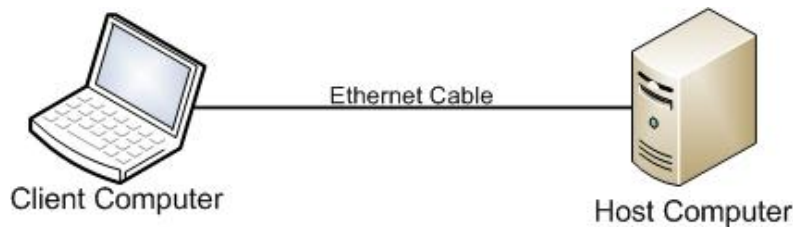

Figure 8: Network Connection for Remote Desktop

7.1.1   Host Side Setup

On the host side click "Start" and right click on "Computer", select "Properties". This will bring up the system properties window. In the upper left hand corner of the screen select "Remote Settings", when the window appears check the option "Allow connections from computers running any version of Remote Desktop", click "ok".
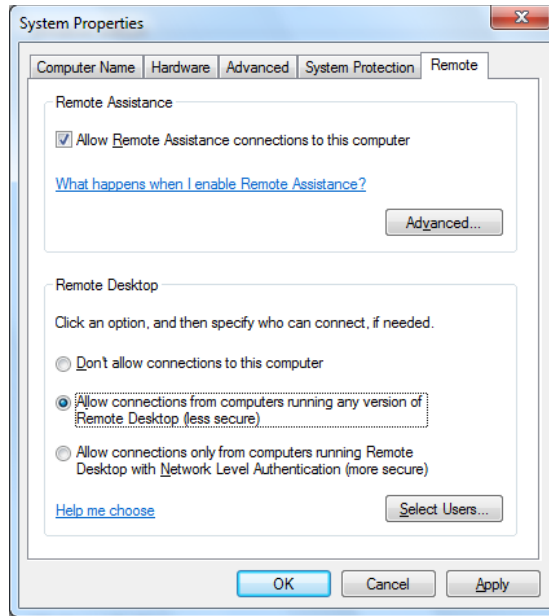
Figure 9: Allow Remote Connections

In the properties window (should already be open) note the *full computer name* as shown in Figure 10. This will be needed later for connecting to the host with the client computer. In this example the full computer name is USB-Test-PC.
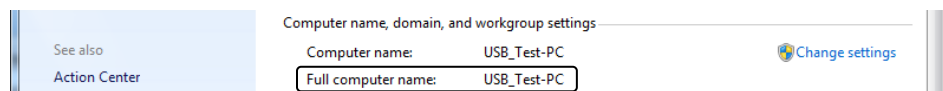

Figure 10: Full Computer Name

Click "Start→Control Panel→System and Security→Allow a Program through Windows Firewall", scroll through the exceptions and check "Remote Administration" and "Remote Desktop" if not already checked. Click "Ok".
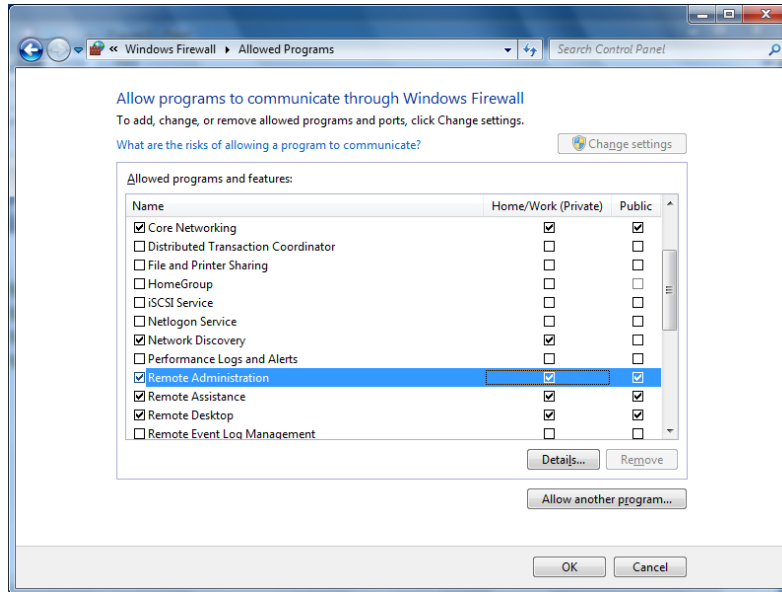
Figure 11: Enable Exceptions in Windows Firewall

The host computer should now be ready for remote login from the client computer.

7.1.2   Client Side Setup

On the client side click "Start→All Programs→Accessories→Remote Desktop Connection". The remote desktop window will appear, type the *full computer name* of the host computer as was noted in section 7.1.1 in the text box and click "connect".
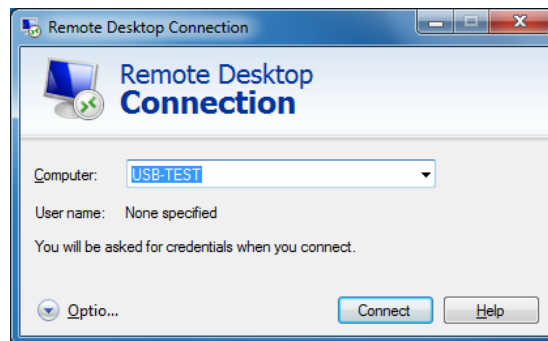

Figure 12: Remote Desktop Connection Window

Once the system has connected to the host computer a Windows Security box will open, type the username and password for the host computer's account you wish to log on to and click "Ok". If another security window appears asking about the system certificate click "Yes" to connect anyway.
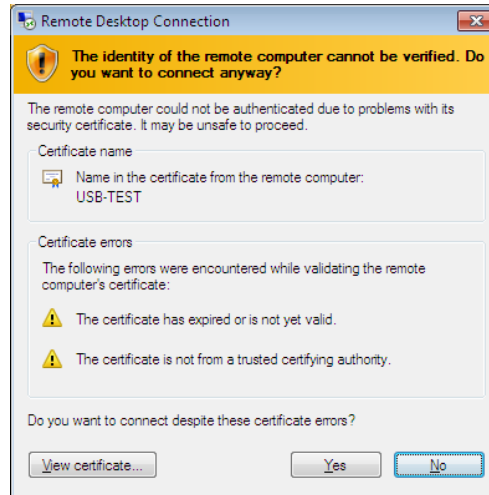
Figure 13: Possible Security Error

The system should now connect to the host computer and bring up the remote desktop window. From this window it should be possible to control the host computer and load the compliance driver.

7.2   Troubleshooting Remote Desktop

In the case that the client computer does not connect to the host computer, below is a list of possible fixes for certain errors:

- The firewall of the host computer may be blocking the connection. Try disabling the firewall by clicking "Start→Control Panel→Windows Firewall" Under the general tab turn off the firewall and click "ok". Try connecting again. – *Note: It is not recommended to have the firewall OFF if connected to the internet, be sure to turn it back on once the testing is complete, also disable any internet connections while the firewall is off.*
- Username and/or password are incorrect, check the username and password typed into the Remote Desktop Security Window.
- The Ethernet port on either the host or client is disabled. Click "Start→Control Panel→Network and Sharing Center" and choose "Change adapter settings" in the upper left corner of the screen. Confirm that the connection is enabled and configured correctly.

More information on remote desktop connections can be found from Microsoft at
http://technet.microsoft.com/en-us/library/bb457106.aspx .

8   Miscellaneous

HSETT is a test program used to put USB peripherals into various compliance modes from which there is sometimes no specified method of recovery. Occasionally this leads to program crashes or other inconveniences. This chapter is here to help with various issues that may arise.

8.1   HSETT Known Issues

The following are known issues/bugs that exist in the latest release of HSETT.

- If the user enters an illegal port number, HSETT crashes. An illegal port number is any port number that does not exist on the host controller (e.g., 0). There is no workaround for this bug.
- As of the writing of this document no more than 1 version of HSETT can be installed on a single system at a time. This issue should be fixed at a later time.
- For xHCI HSETT only: as of the writing of this document, under hub tests: PARENT_TEST_PACKET after TEST_FORCE_ENABLE is currently not functioning correctly. This issue is being looked into. Workaround: do this step with EHCI HSETT for now.

8.2   Loading Compliance Driver Manually

If the compliance driver does not install automatically it may be necessary to manually install it.

Click "start" and then right click on "Computer" and select "Manage"; in the pane on the left select "Device Manager". Under "Universal Serial Bus controllers" choose the correct USB controller and right click on it and select "Update Driver Software…" then click "Browse my computer for driver software"→"Let me pick from a list of device drivers on my computer"→"Have Disk…"→"Browse" and navigate to folder labeled "x/EHCI Host Drivers" (This is likely located at C:Program Files/USB-IF Test Suite/Drivers and Firmware). Choose a driver and click "Ok". Now select the compliance driver from the "Update Driver Software" screen and click "Next". Figure 14 demonstrates a correctly loaded driver for xHCI.
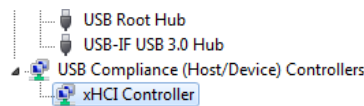

Figure 14: xHCI Compliance Driver successfully loaded

Open HSETT and verify driver loaded correctly.

8.3 Troubleshooting HSETT

Issue	Possible Cause	Solution
HSETT does not see my device	Device is in compliance mode	Power cycle device and click "Enumerate Bus"
	Test fixture is in "Test" mode	Set test fixture back to "Initialize"; power cycle device; click "Enumerate Bus"
My HSETT version is correct but I have to manually install/uninstall the compliance driver every time	USB…CV is installed on the system and "Enable Stack Switcher" is unselected	Open CV Settings. Under the "Drivers & Firmware" tab check "Enable Stack Switcher"
My USB mouse/keyboard quit functioning when I open HSETT	The compliance driver installed on the USB controller your keyboard/mouse were attached to	If your system has multiple USB controllers plug your mouse/keyboard into another controller -OR- Boot into safe mode and uninstall compliance driver (see Section 8.2 for assistance with driver changing). Use one of the methods described in Section 7 to run HSETT on a Legacy-Free machine
"No Host Controller Found" Error when opening HSETT	User Account Control is not disabled	Disable User Account Control (see Section 5.1)
	Compliance driver did not load correctly	Manually install compliance driver (see Section 8.2)
	32 bit HSETT loaded on a 64 bit system	Uninstall 32 bit HSETT and load 64 bit HSETT
	x/EHCI HSETT installed on a machine that only has the opposite USB controller	Uninstall HSETT and install the correct x/EHCI version for your USB controller
"Unable to set Config Flag" Error when opening HSETT	User Account Control is not disabled	Disable User Account Control (see Section 5.1)

Appendix A: Abbreviations

Term	Definition
Client Computer	Controller computer networked to host PC for remote control desktop connection
DUT	Device Under Test
EHCI	Enhanced Host Controller Interface
xHCI	Extensible Host Controller Interface
Host Computer	Server platform operated by Client PC through remote desktop connection
HSETT	High Speed Electrical Test Tool
LAN	Local Area Network
Legacy-free	Any system that does not have PS/2 and other legacy ports
PCI	Peripheral Component Interconnect Bus
PCIe	Peripheral Component Interconnect Express Bus
PID	Product Identification Number
PS/2 port	A legacy mouse or keyboard port located on some motherboards
UAC	User Account Control
USB	Universal Serial Bus
VID	Vendor Identification Number

Appendix B: List of Figures