



CATC™ UHT™

USB Hub Tester

User's Manual

Version 2.1

11 October 1999

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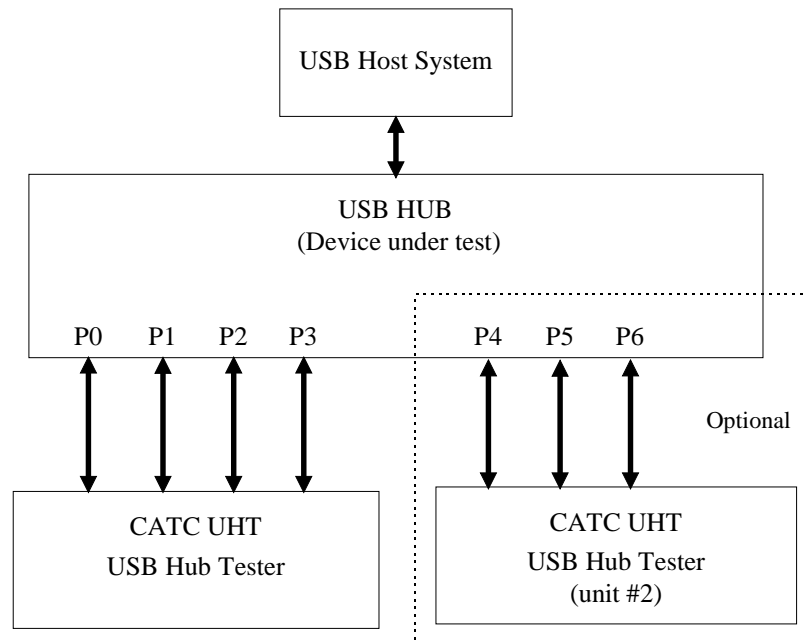
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1. INTRODUCTION

The CATC UHT USB Hub Tester is a modular unit designed for use on the production line to test USB Hubs for proper functionality according to the USB specifications. The UHT system is designed to test the one upstream port and up to 4 of the downstream ports of the hub under test. If the hub has more than 4 ports, a second UHT unit can be used. The following diagram illustrates the UHT system connection:



The UHT system includes a box (hardware) and a DOS application program (software) that controls the test process by communicating directly with the PC USB Host Controller.

At the end of the test the software provides a listing of on-screen results. If all tests were successful, the software declares the hub under test to be functional. In the case of faulty devices, the software provides a detailed description of the test results in a “.fal” file; it also accumulates the failure rate for the entire testing day in a “.sta” file.

The UHT tester performs the following tests:

1. hub enumeration
2. hub reset, suspend, and resume operation
3. connection and enumeration of a low-speed device (on each downstream port)
4. data loop-back integrity test with a low-speed device (on each downstream port)
5. connection and enumeration of a full-speed device (on each downstream port)
6. data loop-back integrity test with a full-speed device (on each downstream port)
7. individual port suspend and resume operations (on each downstream port)
8. remote wakeup detection and propagation from each of the downstream ports
9. hub-initiated remote wakeup on connect/disconnect events
10. hub overcurrent detection and reporting to the host

11. overcurrent protection (gang or per-port configuration)
12. downstream current restoration (overcurrent removed)

A complete test of a hub with four downstream ports takes about 10 seconds.

For hubs that fail these tests, a CATC Inspector™ or Detective™ USB Bus & Protocol Analyzer can be used to assist in debug and rework.

1.1 USB Overview

USB is an open industry standard, providing a simple and inexpensive way to connect up to 127 devices to a single computer port. Keyboards, mice, tablets, digitizers, scanners, bar-code readers, modems, printers, and more can all run at the same time. USB devices plug into any platform that supports the standard, from notebooks to desktop PCs to workstations.

USB is a dynamically reconfigurable serial bus with an elementary data rate of 12,000,000 bits/sec, based on off the shelf, low cost micro-controller technology. Its modular layered software protocol supports sophisticated device drivers and application programs.

Please refer to the USB Specifications for details on the USB protocol. The USB specifications are available from the USB Implementers Forum at:

USB IF

M/S JF2-51
2111 NE 25th Avenue
Hillsboro, OR 97124

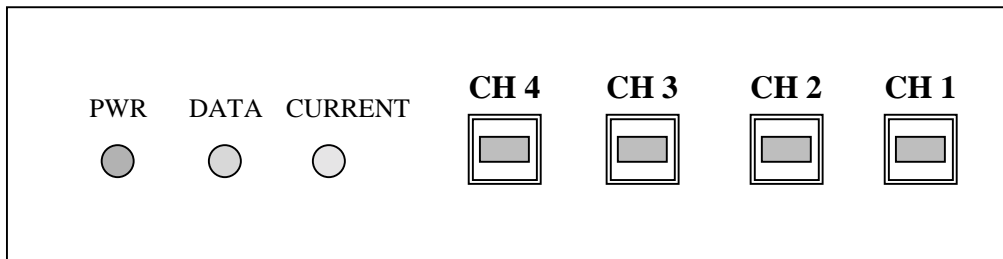
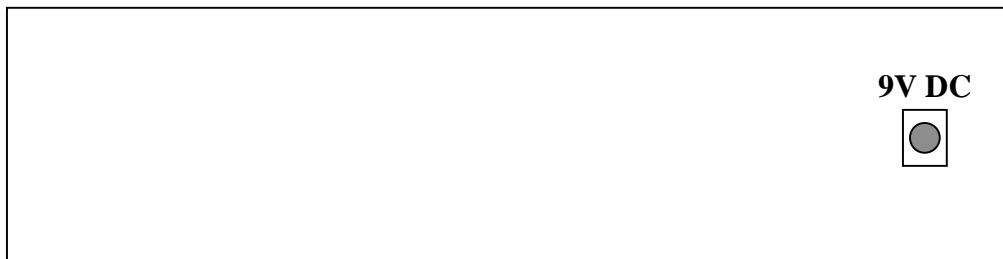
Tel: +1/ 503 264 0590
Fax: +1/ 503 693 7975
Web: <http://www.usb.org/>

2. CATC UHT SYSTEM

The CATC UHT package includes the following components:

- a sturdy metal box housing the UHT electronic test circuitry, based on the Intel 8x930 USB controller
- an AC to DC power converter
- four USB cables
- a diskette with the CATC UHT DOS software program
- this user's manual

The UHT box is an intelligent USB device. It has four female B-type USB connectors and three LEDs on the front of the unit and a +9V DC @ 500mA power connector on the rear. The USB connectors (marked "CH 4" through "CH 1") are used to connect the UHT box to the hub under test. The power connector is used to power the box from the AC to DC power converter; when power is applied, the red LED (marked "PWR") is illuminated. The yellow LED (marked "DATA") is a status indicator; it blinks at a high rate to indicate that the on-board microcontroller is functioning properly, and at a low rate when the box is performing a test sequence. The green LED (marked "CURRENT") illuminates briefly when an overcurrent test is being performed.

Front Panel**Rear Panel**

The DOS-based UHT software runs on the USB host; it communicates with the UHT box via the USB host controller (on the motherboard) and the USB hub under test. For each USB port, the software program checks for proper operation in both full- and low-speed modes. When all tests are successful, the software declares the USB hub to be functional; any failures are reported on the computer display screen, and saved on the hard disk as a text file.

3. SYSTEM SETUP

Position the CATC UHT box on the test bench, near the USB hub to be evaluated. If a hub with more than four ports is to be tested, position a second UHT test box nearby.

Connect the DC plug(s) of the AC to 9V DC @ 500mA power converter(s) to the +9V power receptacle(s) of the CATC UHT box(es). To activate the unit, plug the AC to DC converter(s) into appropriate AC power outlet(s).

In the USB test system, connect the CATC UHT box(es) as follows:

- A) Connect a USB cable between the upstream port of the USB hub under test and the USB port of the host PC.
- B) Connect a USB cable between the first downstream port (of the USB Hub) to be tested and the USB connector labeled "CH 1" on the (first) CATC UHT box.
- C) Repeat step B for the next (and any additional) ports to be tested, connecting to "CH 2", "CH 3", and "CH 4" in sequence. For hubs with more than four ports, continue connecting them to "CH 1" through "CH 4" of the second UHT box, as required.

If less than four downstream ports are being tested, the unconnected test channels on the UHT box should be the higher numbered ones (e.g., if only two hub ports are being tested, they should be connected to "CH 1" and "CH 2"). Similarly, if more than four ports are being tested, all channels of the first UHT box must be filled, and unconnected channels on the second box should be the higher numbered ones.

With one exception, downstream ports on the hub under test can be connected to the UHT box in any order; this will only affect the sequence in which the ports are tested (the software will first test the port connected to "CH 1", then that connected to "CH 2", and so on for any remaining ports, continuing to the second box when appropriate). The exception is when a hub with 5, 6, or 7 ports is being tested: in this case it is important for the UHT software to know which is the "second" UHT box (so it can tell the difference between unused connections and hub ports that are not working). This is accomplished by requiring that the hub port connected to "CH 1" of the first box be numbered lower than the hub port connected to "CH 1" of the second box.

The CATC UHT Hub Tester hardware is now ready for operation.

Note: To observe bus traffic, a CATC Inspector or Detective USB Bus & Protocol Analyzer can be connected between the CATC UHT box and the hub under test, or between the hub and the USB Host PC.

3.1 Connectors and Cables

All connectors have a limited life (i.e., number of connect/disconnects before failure). When testing multiple hubs, be sure to **plug and unplug cables at the hub only, not at the UHT box** (or the USB host). *There is generally no need to disconnect the B-type USB connectors from the UHT box (or the A-type connector from the host PC).* There is also no need to power down the UHT box between tests.

Additionally, forceful or otherwise improper connection and disconnection of USB cables can damage the cables and connectors on the CATC UHT box, the USB host PC, and the hub under test.

*Note that the CATC Warranty (see "Warranty and License") specifically **excludes** damage caused by this kind of product misuse.*

4. SOFTWARE INSTALLATION

4.1 Software Components

The CATC UHT software consists of the following files, included on the supplied diskette:

- USB_UHT.EXE executable code of the CATC UHT program
- USB_UHT.CFG configuration text file for the USB host controller
(used only for Intel PIIX3 UHCI systems)

4.2 Installing the Software

Make a copy of the CATC diskette for backup, then copy its contents to the hard drive of the USB-capable PC to be used as the test system host.

4.3 Running the Software

The UHT software program (**usb_uht.exe**) is a DOS application, and must be run under the DOS operating system. It supports both UHCI and OHCI USB host controller implementations; the latter, however, requires use of the "/O" command line option (see the table below for further details).

The program scans the PC's PCI devices and locates the USB host controller by class code. It uses the first host controller it finds as the test target. *On some systems with a USB-aware BIOS, the software may fail to communicate with the USB host controller; should this occur, contact CATC technical support (see "How to Contact CATC").*

To run the program, type **USB_UHT** at the DOS prompt and press the "Enter" key. The program will clear the monitor screen and begin execution. During the test, the program displays the test results on the monitor screen. The tests conclude in less than 10 seconds, leaving the test results on the screen. To terminate the program and get back to the DOS prompt, press any key.

4.3.1 Setting the PIIX4 Interrupt Line Number

In some computers the BIOS does not set the PIIX4 interrupt line, and as a result, the USB host controller interrupt line remains disabled.

The UHT software allows setting of the PIIX4 interrupt line number, using the /I:N option, where N is the IRQ number of the USB host controller (in the range 3–F).

If the IRQ setting is done by the BIOS, the /I option is not required.

When thus directed, the UHT software reads the Interrupt Line Register contents (function 2). If a valid interrupt line number (3–F) is found, it uses this interrupt number *even if the /I option specifies a different IRQ number*. If an invalid interrupt value is found (not 3–F) the driver alerts the user with a screen message, stating that an invalid interrupt number was found, and requests the use of the /I option to specify a valid IRQ value.

Ignoring the /I option when a valid IRQ number is detected allows the user to use the same software configuration to run the UHT tester on different systems (where some need this option and some do not).

When the /I option is used, the driver writes the specified IRQ number to both the Interrupt Line Register and the PIRQD Route Control Register (function 0), and clears the Interrupt Routing Enable bit of the latter.

4.3.2 Command Line Options

The test program supports a variety of command line options. To use these options, type **USB_UHT** (at the DOS prompt) followed by one or more of the following options, and press the “Enter” key. Note that option switches may be either upper- or lowercase.

Command Line Options

Options	Purpose	Default
/A:n (n from 0–32768)	Specifies an integer value representing the number of milliseconds to wait at the end of the test before terminating (without waiting for the operator to press a key). The maximum value of “n” is 32,768 (approximately 32.8 seconds).	Wait for operator to press a key. Default value of “n” is 1000.
/C	Sends all screen output to the console (so it can be redirected to a file or communication port).	Display screen output only.

/D:n1[,n2,...] (n from 0–7)	<p>Disables one or more of the following test stages:</p> <ul style="list-style-type: none"> 0 – basic power test 1 – port Suspend/Resume 2 – Get Bus State request 3 – propagation of Remote Wakeup from the downstream device 4 – Remote Wakeup from suspended port on awake hub 5 – hub-generated Remote Wakeup 6 – Overcurrent Protection 7 – individual port power switching <p>Note: Stages 3, 4, & 5 are individual parts of the Remote Wakeup test; to disable the entire test, disable all three stages. Similarly, stages 0 & 7 are components of the downstream power test; to disable the full test, disable both stages.</p>	All test stages are enabled.												
/E:n1[,n2,...] (n = any valid port #)	Specifies number(s) of one or more embedded ports (i.e., ports assigned to permanently attached devices—such as a monitor—that will not be included in the hub test operations)	No embedded ports are assumed.												
/G:n (n from 0-120)	Provides a configurable delay for the “per port” power switching test. Max. delay is 120 msec	Default delay is 72 msec.												
/H:n (n from 0–10)	<p>Selects one of the following current value ranges for the overcurrent test:</p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">0) 100–200mA</td> <td style="width: 50%;">1) 250–450mA</td> </tr> <tr> <td>2) 650–850mA</td> <td>3) 1.3–1.5A</td> </tr> <tr> <td>4) 2.0–2.2A</td> <td>5) 2.3–2.5A</td> </tr> <tr> <td>6) 3.0–3.2A</td> <td>7) 3.8–4.0A</td> </tr> <tr> <td>8) 4.4–4.6A</td> <td>9) 4.6–4.8A</td> </tr> <tr> <td>10) 4.7–5.0A</td> <td></td> </tr> </table> <p>Note: these current ranges are approximate, and may vary $\pm 10\%$ due to temperature, individual components, etc.</p>	0) 100–200mA	1) 250–450mA	2) 650–850mA	3) 1.3–1.5A	4) 2.0–2.2A	5) 2.3–2.5A	6) 3.0–3.2A	7) 3.8–4.0A	8) 4.4–4.6A	9) 4.6–4.8A	10) 4.7–5.0A		See “Default Overcurrent Test Levels” table.
0) 100–200mA	1) 250–450mA													
2) 650–850mA	3) 1.3–1.5A													
4) 2.0–2.2A	5) 2.3–2.5A													
6) 3.0–3.2A	7) 3.8–4.0A													
8) 4.4–4.6A	9) 4.6–4.8A													
10) 4.7–5.0A														
/I:n (n from 3–F)	Set PIIX4 interrupt line in USB host controller to specified IRQ number, unless already set by the BIOS (see “Setting the PIIX4 Interrupt Line Number”, above).	Use IRQ as set by BIOS.												

/M: n (n from 1–4)	<p>Specifies a particular mode of overcurrent testing:</p> <ul style="list-style-type: none"> 1 – test per-port (individual) overcurrent protection 2 – test global (ganged) overcurrent protection 3 – test both per-port & global overcurrent protection 4 – special mode, used only with hubs that <i>implement</i> per-port overcurrent protection, but <i>report</i> overcurrent events as global (i.e., as hub—rather than port—overcurrent conditions) 6 – special mode, provides per port OverCurrent test for hubs that shut down power to all downstream ports when an OverCurrent event is detected 	Use mode as specified by hub descriptor.
/O	<p>Enables operation of the UHT software with an OHCI USB controller. Important Note: there has been widespread distribution of early OHCI host controllers that do not properly implement the USB protocol standard with respect to hub functionality. In particular, it is quite common for suspend/resume operations to malfunction. If disabling test stages 3 and 5 (with /D:3,5) allows the test to run with no other errors, this is likely the cause. Contact the silicon vendor (or CATC) for further information on this issue.</p>	Test as UHCI USB controller.
/P: n (n from 1–8)	<p>Specifies the number of USB ports to be tested. If /P:1 is specified, the software omits those test stages that require the connection of a second device (Get Bus State request and both types of Remote Wakeup).</p>	/P:4 (four ports)
/S:ON OFF	<p>Turns the “end of test” indicator sound on or off.</p>	/S:ON (sound on)
/T:n (n from 0–20000)	<p>Specifies the time (in milliseconds) for which current will be applied during the overcurrent test. This time will be rounded <i>up</i> to the nearest integer multiple of 40ms.</p>	/T:40 (40ms)
/V	<p>Interrogates the UHT box and reports version numbers of the UHT software and firmware.</p>	N/A

/W:n (n from 1–2000)	Specifies the time (in microseconds, with an accuracy of $\pm 10\mu\text{s}$) that the UHT box will wait for a Remote Wake-Up signal to be propagated to a downstream port (in Port Test Sequence #6, described below). <i>Note that the USB standard specifies $50\mu\text{s}$ or less for this operation.</i>	/W:100 (100 μs)
/X:n (n from 0–10000)	Specifies the time (in milliseconds) for which a heavy USB traffic load will be generated during the test of the final port in the sequence (both low- and full-speed); used to test some hubs that monitor bandwidth.	/X:0 (no traffic)
?	Displays this help information.	N/A

Examples:

1. **USB_UHT /s:off /p:3** Test three ports without activating the indicator sound.
2. **USB_UHT /a /c > test.res** Terminate automatically one second after the test, and send the output to a file named “test.res”.
3. **USB_UHT /d:2,6 /e:1** Omit tests for Get Bus State request & overcurrent protection, and exclude testing of port #1.

5. UHT SOFTWARE FUNCTIONALITY

The DOS-based UHT software runs on the USB host; it communicates with the UHT box via the USB host controller (on the motherboard) and the USB hub under test. For each USB port, the software program checks for proper operation in both full- and low-speed modes. When all tests are successful, the software declares the USB hub to be functional; any failures are reported on the computer display screen, and saved on the hard disk as a text file.

Initially, the test program attempts to determine (using the PCI protocol) whether or not the host system is equipped with a USB Host Controller; if such a controller is not found, the program aborts with an explanatory error message.

5.1 Hub Test Initialization

Once a USB host controller is identified, the UHT application proceeds to:

1. find a hub attached to one of the host USB ports;
2. initialize the hub and assign it an address;
3. read its general device & configuration descriptors, and set the configuration to the hub;
4. read the hub-specific (device class) descriptor and decode it (determining hub type);
5. instruct the hub to provide power to the downstream ports; and
6. begin polling the hub Status Change endpoint, in order to get the connect notification.

The program then tests each hub port, using the following functional test sequence.

5.2 Port Test Sequence

Each of the following functions is tested, in sequence (in both full- and low-speed modes), for each downstream hub port:

1. Connect event (processed as done by a USB-enabled operating system)
2. initialization of the USB device (incorporated in the UHT box) and data loopback sequence [During data loopback, a set of 75 random data bytes is sent to the UHT box on its OUT bulk endpoint, and then read back on one of its IN bulk endpoints; this procedure is repeated twice.]
3. verification that power is provided to the USB port, and—for hubs with per-port power control—that power can be turned on and off [using SetPortFeature(PORT_POWER)]
4. individual port suspend/resume [The hub port to which the UHT box is currently connected is suspended for 50ms, and the UHT box verifies the presence of both Suspend and Resume events.]
5. optional Get Bus State diagnostic request (state is returned or STALL)
6. propagation of the device-generated Remote Wakeup signaling upstream and to enabled USB ports during suspend [The hub under test is suspended, while two ports on it have devices connected and enabled. Then, after approximately 50ms, the UHT box sends a Remote Wakeup signal on one of those ports. The hub is supposed to propagate this signal upstream to the host, and downstream to the other enabled port. This behavior is verified by host software in cooperation with the UHT box.]
7. handling of Remote Wakeup from a suspended port on an awake hub [The software suspends the hub port to which the UHT box is currently connected. Then, after approximately 50ms, the UHT box sends a Remote Wakeup signal on this port. The hub is supposed to complete the Resume signaling on this port and notify the host about the change, which it does by sending the Hub Bitmap (with the corresponding port bit set) from the Status Change interrupt endpoint, and also by setting the C_PORT_SUSPEND bit in the Hub Status. This functionality is verified by the UHT system.]
8. generation of the upstream Remote Wakeup signal upon connect/disconnect event during suspend [The hub under test is suspended, while two ports on it have devices connected and enabled. Then, after approximately 50–100ms, the UHT box creates a disconnect event on one of these ports. The hub is supposed to respond to this by sending a Remote Wakeup signal to the host. The software verifies this functionality. After the Resume signaling is completed by the host, the disconnect event is processed.]
9. optional port overcurrent reporting [This function is executed for each port only if the software determines (from the Hub Descriptor) that the hub implements per-port (individual) overcurrent protection. For this test the software instructs the UHT box to create an overcurrent condition on the port under test, and expects the hub to shut down the power to this port and report the condition, which the hub does by sending the Hub Bitmap (with the corresponding port bit set) from the Status Change interrupt endpoint, and also by setting the C_PORT_OVER_CURRENT bit in the Hub Status. Then, after about 50ms, the software instructs the hub to restore power to the port, and processes the UHT device connection on this port in order to proceed with the test. If the hub supports

global (ganged) overcurrent protection, the testing is done in a similar fashion, but at the end of the test (i.e., after completing the set of individual port tests).]

10. Disconnect event [The UHT box is instructed to disconnect itself from the current port (Channel), and reconnect after some time at a different port and/or speed.]

During the test of each port, the system connects (between functions 4 and 5, above) and disconnects (between functions 9 and 10) a full-speed device on some other hub port (the port connected to the “next” channel on the UHT box). This is required for testing the Get Bus State request (function 5) and both aspects of Remote Wakeup (functions 6 and 8). If only one downstream port is being tested, these tests are necessarily omitted.

5.3 Overcurrent Protection Testing

The UHT box tests overcurrent protection by drawing a predetermined amount of current (from a variety of available values) for a brief (<100ms) period of time. The amount drawn depends on how the test hub is powered (from the bus or its own local supply), and whether it implements global (ganged) or per-port (individual) overcurrent protection.

Further, a hub may have a designed current trip point that differs from that normally tested by the UHT device; for this reason, the /H switch enables the specification of a variety of current draws, ranging up to a full 5 Amperes. The following table enumerates the standard (default) test levels:

Default Overcurrent Test Levels

Hub Overcurrent Protection Type	Hub Power Type	Approximate Current Draw
global (ganged)	bus-powered	650–850mA
	self-powered	2.3–2.5A
per-port (individual)	bus-powered	250–450mA
	self-powered	650–850mA

Note: the above current ranges are approximate, and may vary $\pm 10\%$ due to temperature, individual components, etc.

5.4 Test Results

5.4.1 Test Results: Monitor Display

Results of the tests are displayed on the computer monitor screen (a color monitor is preferred, as results are color-coded). If all test functions succeed, the overall test is declared “passed”; otherwise, it is reported as “failed”.

Following is a typical UHT displayed result for a passed test:

Found Hub with VENDOR_ID = XXXX , PRODUCT_ID = XXXX				Data	Connect/ Disconnect	Power	Remote Wakeup	Over- Current
Full Speed Port	1	OK	OK	OK	OK	OK	OK	
Low Speed Port	1	OK	OK	OK	OK	OK	OK	
Full Speed Port	2	OK	OK	OK	OK	OK	OK	
Low Speed Port	2	OK	OK	OK	OK	OK	OK	
Full Speed Port	3	OK	OK	OK	OK	OK	OK	
Low Speed Port	3	OK	OK	OK	OK	OK	OK	
Full Speed Port	4	OK	OK	OK	OK	OK	OK	
Low Speed Port	4	OK	OK	OK	OK	OK	OK	

T E S T P A S S E D

Note: Port numbers are displayed in the order tested, which may not be in strict numerical sequence as shown in the above example.

For failed tests, the results may differ as follows:

- The Data test result will be changed to BAD if initialization of the UHT box failed, or data received during the data loopback test doesn't match the expected data, or suspend/resume of an individual port doesn't work, or the Get Bus State request failed.
- The Connect/Disconnect test result will be changed to BAD if there was an error or time-out during processing of Connect or Disconnect events.
- The Power test result will be changed to BAD if the UHT doesn't sense the power provided on the hub port, or fails the power switching test on per-port power controlled hubs.
- The Remote Wakeup test result will be changed to BAD if the device- or hub-generated Remote Wakeup wasn't properly propagated or sent, or to N/A if connection of the second device failed (see “Port Test Sequence”, above).

- The Overcurrent test result will be changed to BAD if the hub reported an overcurrent event and then failed in subsequent processing, or to *** if the overcurrent event was created, but the hub didn't report it. In the latter case the following message (as appropriate to the overcurrent test in question) will appear at the bottom of the test screen:

*** - Didn't trip on ... (*test current value*)

Note: If, at the beginning of a test, the UHT software senses that the UHT box is not connected to any of the hub's USB ports, the program declares a test failure, displaying the message:

```
Found Hub with VENDOR_ID = XXXX, PRODUCT_ID = XXXX
```

```
The Hub Tester Device is not connected to the hub!
```

T E S T F A I L E D

5.4.2 Test Results: Disk Files

The UHT application always generates two text files: one with the extension “.sta”, another with the extension “.fal”. The root name of both files is constructed from the current date, as “yy_mm_dd”. For example, on July 3rd, 1998 the file names would be:

98_07_03.sta and 98_07_03.fal

In the “.sta” file, the program records production statistics for the current day: the number of units passed and the number of units failed.

In the “.fal” file is recorded a failure description for each failed unit, as follows:

Failure #n, Unit #m

 Before failure, passed for ports: n1, n2, ... (*or NONE*)

 Failed for Port #n at ... speed. Failed items:

followed by one or more of:

 Bad connect handling.

 Error initializing Hub Tester device.

 Wrong data on data loopback.

 Power is not provided to the port.

 Bad handling of port Suspend/Resume commands.

 Bad connection of the second device.

 Get Bus State request failed.

 Bad propagation of device-generated Remote Wakeup upstream.

 Remote Wakeup wasn't propagated downstream.

 Bad handling of Remote Wakeup from suspended port on awake hub.

 Hub didn't send Remote Wakeup on disconnect event.

 Bad disconnection of the second device.

Bad individual overcurrent protection.
Bad disconnect handling.

5.4.3 Test Results: Error Levels

Upon termination, the UHT application sets the DOS error level according to the test results. If the test passed, it exits with error level 0; otherwise it exits with a corresponding error level. This feature allows processing of the test results in a batch file, or when the program is spawned as a child process by another application.

The error level (**result_code**) is calculated as the sum of two components:

$$\text{result_code} = \text{passed_ports_code} + \text{failed_port_code}$$

The **passed_ports_code** portion allows determination of which ports completely passed the test before the failure occurred; the **failed_port_code** portion allows determination of which port failed, at what speed, and at which test stage.

Five test stages are specified (per the test results screen): Data (DT), Connect/Disconnect (CD), Power (PW), Remote Wakeup (RW), and Overcurrent (OC).

The **failed_port_code** is computed as follows:

$$\text{failed_port_code} = (\text{failed_port_number}-1) * 10 + \text{failure_code}$$

where **failure_code** is chosen according to this table:

	DT	CD	PW	RW	OC
Full Speed	0	1	2	3	4
Low Speed	5	6	7	8	9

The **passed_ports_code** is computed as the sum of

$$(2^{(\text{passed_port_number}-1)}) * 100$$

for all ports successfully passing the test..

There are also four special cases:

- Initialization of the hub failed (**result_code** = 30000);
- The software doesn't detect a hub connected to the host when the test begins (**result_code** = 30001);
- The software doesn't detect a UHT box connected to the hub under test when the test begins (**result_code** = 30002);
- The individual ports passed, but the Global Overcurrent protection test failed (**result_code** = 30003).

The following code fragment demonstrates how the **result_code** returned by the UHT application might be interpreted in software. This "C" language function takes **result_code** as a parameter, and prints out the decoded test results:

```
void Decode_UHT_test_results ( int result_code )
{
    int i,
        temp_value,
        passed_ports_base = result_code/100,
        failed_port_value = result_code - passed_ports_base * 100;

    if (result_code >= 30000){
        switch(result_code){
            case 30000:
                printf("\n Problem initializing hub.\n"); break;

            case 30001:
                printf("\n Hub under test not connected to host.\n"); break;

            case 30002:
                printf("\n Hub Tester Device not connected to hub.\n"); break;

            case 30003:
                printf("\n Bad global overcurrent protection.\n"); break;
        }
        return;
    }

    if( passed_ports_base != 0 ) // zero means no ports fully passed
    {
        printf(" Passed at ports: ");

        temp_value = passed_ports_base;

        for(i=1; i<=8; i++)
        {
            if( (temp_value / 2) * 2 < temp_value ) // odd number
                printf(" %d", i);

            if(temp_value == 1)
                break;

            temp_value = temp_value/2;
        }
        printf(".\n");
    }

    temp_value = failed_port_value/10;
    printf("\n Failed on port %d at ", temp_value + 1);

    temp_value = failed_port_value - temp_value * 10;
    if( temp_value > 4 ) {

        printf("low speed.\n");
        temp_value -= 5;

    }else
        printf("full speed.\n");

    printf("\n Failed stage: ");
}
```

```
switch(temp_value){
    case 0: printf(" Data\n"); break;
    case 1: printf(" Connect/Disconnect\n"); break;
    case 2: printf(" Power\n"); break;
    case 3: printf(" Remote Wakeup\n"); break;
    case 4: printf(" Overcurrent Protection\n"); break;
}
```

5.5 Configuration File (for Intel PIIX3 UHCI systems only)

If the system under test has a BIOS that disables the USB portion of the Intel PIIX3 Host Controller, the UHT software will enable it for the duration of the test, and then restore the previous settings.

In order to run the test, the software needs certain information about the controller configuration: the I/O base address for PIIX3 function 2 (USB portion), the IRQ assigned to the host controller, and the USB Clock Selector (if host controller runs at 24 or 48 MHz).

In order to provide this input, a configuration text file (**usb_uht.cfg**) is included with the UHT software, containing two lines, as in the following example:

```
; I/O Space   IRQ   Clock
0xF300      11    48
```

This file should be used to provide input for the above cases. If the “.cfg” file is not present, the program will use the default values as shown above (0xF300 11 48). For the clock input, only two values are accepted: 24 and 48; any other values are ignored, and 48 used as a default. The I/O base address should be entered in hexadecimal, IRQ as an integer.

The values in **usb_uht.cfg** are used by the program only when the USB (Function 2 in PIIX3) is disabled by the BIOS.

6. HOW TO CONTACT CATC

Type of Service	Contact
Call for technical support...	US and Canada: +1/ 800 909 2282 Worldwide: +1/ 408 727 6600
Fax your questions...	Worldwide: +1/ 408 727 6622
Write a letter...	Computer Access Technology Corp. Customer Support 2403 Walsh Avenue Santa Clara, CA 95051-1302
Send e-mail...	support@catc.com
Visit CATC's Website...	http://www.catc.com/

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