

## Gold Suite Summary Test Procedure

The following procedures are used at USB sponsored compliance workshops and are tailored for the Interoperability Gold-tree system.

### Device Information

1. Locate device ID number in database. Verify that the database information matches the Device Under Test [DUT] (vendor, model number)
2. Disconnect tree from [HubHS#1]
3. Run USB20CV
4. If [DUT] is self-powered, apply external power
5. Attach [DUT] to [HubHS#1]
6. Run “Device Summary” test.
7. Enter the summary data about the [DUT] into the database
8. Examine [DUT] for all USB connectors.

### Device Framework (USB20CV) Tests:

1. Disconnect tree from [HubHS#1]
2. Connect [HubHS#1] to [Onboard System Port]
3. If [DUT] is self-powered, apply external power
4. Attach [DUT] to [HubHS#1]
5. Run USB20CV and select “Chapter 9 Tests”. Record result in database
6. Examine the Configuration Descriptor Test results
7. Run all appropriate class tests (HID, HUB, MSC, UVC, PHDC, etc...)
8. Repeat above on each embedded device (compound devices only)
9. Repeat above at each supported operating speeds
10. If [DUT] is self-powered, remove external power; otherwise, test ends
11. Run USB20CV and select “Chapter 9 Tests”
12. If bus-powered [DUT] is found within USB20CV, run “Chapter 9 Tests”; otherwise, tests end
13. Examine the Configuration Descriptor Tests results

### Device Framework (USB30CV) Tests:

1. Disconnect tree from host system
2. If [DUT] is self-powered, apply external power
3. Attach [DUT] to [SuperSpeed Root Port]
4. Run USB30CV and select “Chapter 9 Tests”. Record result in database
5. Run all appropriate class tests (HID, HUB, MSC, UVC, PHDC, etc...)
6. Repeat above on each embedded device (compound devices only)
7. Repeat above at each supported operating speeds

### Current Measurement Tests:

1. Disconnect tree from [HubHS#1]
2. Connect [HubHS#1] to [Onboard System Port]
3. Attach<sup>(see note)</sup> [DUT] to [Current Dongle]
4. Attach [Current Dongle] with [DUT] to [HubHS#1]
5. Run USB20CV
6. Obtain un-configured current (must be  $\leq 100\text{mA}$ )
7. Obtain configured current (must be  $\leq \text{MaxPower value}$ )
8. Exit USB20CV
9. Load [DUT] device driver and run associated application

10. Operate all features of the [DUT] concurrently and measure “Operating Current.”
11. Enable [DUT] as wake device, if supported
12. Suspend the system and measure “Suspend Current.”
13. Disconnect the [HubHS#1] from the [Onboard System Port]
14. Disconnect the [DUT] from [HubHS#1]
15. Reconnect the [DUT] to [HubHS#1]
16. Measure the “‘Powered’ State Suspend Current”

## **Test Attachment Points**

### **Interoperability**

#### **1. EHCI test:**

- A. Connect the high-speed tree to [motherboard USB root port] through [HSHub#1] and connect the full-speed tree (HubFS#1) to [motherboard USB root port]
  - B. Check operation of entire gold-tree
  - C. Examine and verify all connectors on [DUT]
  - D. If [DUT] is self-powered, attempt to enumerate [DUT] under bus-power
  - E. Enumeration Test
  - F. Check operation of device
  - G. Interoperability Test:
  - H. Hot plug test:
  - I. Warm Boot test:
  - J. Remote Wake-up Tests:
  - K. S3 Active Standby Tests:
  - L. Root port test:
  - M. S4 Active Hibernate Test:
2. **UHCI Full-speed Operation Test:**
  3. **OHCI Full-speed Operation Test:**
  4. **xHCI Classic-Speed Operation Test:**

### **Battery Powered Devices**

#### **Battery Test Procedures:**

1. Attach the DUT to an average current draw test fixture
2. Select a known good device and attach it to a root port of an EHCI system
3. Using HSET, suspend the known good device.
4. Replace the known good device with the with the average current draw test fixture that has the DUT attached.
5. Ensure that VBus is valid on the suspended port.
6. The measured current must not exceed ICCINIT (100mA) while attached to a suspended port.
7. Attempt to power-on the DUT and measure current drawn.

### **Gold-tree Device List**

#### **Hubs and compound devices:**

## Gold Suite Detail Test Procedure

### ***Device Information***

1. Locate device ID number in database.  
Verify that the database information matches the Device Under Test [DUT] (vendor, model number)
2. Disconnect tree from [HubHS#1]
  - i. Connect [HubHS#1] to [Onboard System Port]
3. Run USB20CV
4. If [DUT] is self-powered, apply external power
5. Attach [DUT] to [HubHS#1]
  - Attaching the [DUT] after loading USB20CV prevents device driver complications
6. Run “Device Summary” test.
7. Enter the summary data about the [DUT] into the database
  - i. Record the [DUT] VID and PID. The VID must match the manufacturer of the product.
  - ii. Enter the operating speed
  - iii. Enter MaxPower value
  - iv. Record whether the device is tested self- or bus-powered in “Power Source”
  - v. Check if the [DUT] has a battery
  - vi. Check if remote wakeup is supported
  - vii. Enter the number of Interfaces (each interface must be tested)
  - viii. Record if the [DUT] is compound in “Peripheral Type” (each embedded function must be tested)
8. Examine [DUT] for all USB connectors.
  - Each and every USB connector must be tested
  - Mini A-connectors and mini AB-receptacles are prohibited
  - Micro AB receptacles require full OTG compliance tests to be performed – no exceptions

### **Device Framework (USB20CV) Tests:**

USB20CV is to be executed at *each* supported speed and against each embedded USB peripheral of compound devices. Record suspicious results and note the operating speed in comments box

1. Disconnect tree from [HubHS#1]
2. Connect [HubHS#1] to [Onboard System Port]
3. If [DUT] is self-powered, apply external power
4. Attach [DUT] to [HubHS#1]
5. Run USB20CV and select “Chapter 9 Tests”. Record result in database
6. Examine the Configuration Descriptor Test results
  - Verify that “Currently remote wakeup is DISABLED”
  - For self-powered devices, verify that the “Device is currently SELF POWERED”
  - For bus-powered devices, verify that the “Device is currently BUS POWERED”
7. Run all appropriate class tests (HID, HUB, MSC, UVC, PHDC, etc...)
8. Repeat above on each embedded device (compound devices only)

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9. Repeat above at each supported operating speeds
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10. If [DUT] is self-powered, remove external power; otherwise, test ends
11. Run USB20CV and select “Chapter 9 Tests”
12. If bus-powered [DUT] is found within USB20CV, run “Chapter 9 Tests”; otherwise, tests end
13. Examine the Configuration Descriptor Tests results
  - Verify that the “Device is currently BUS POWERED”

### **Device Framework (USB30CV) Tests:**

USB30CV is to be executed on all USB 2.0 devices at *each* supported speed and against each embedded USB peripheral of compound devices. Record suspicious results and note the operating speed in comments box

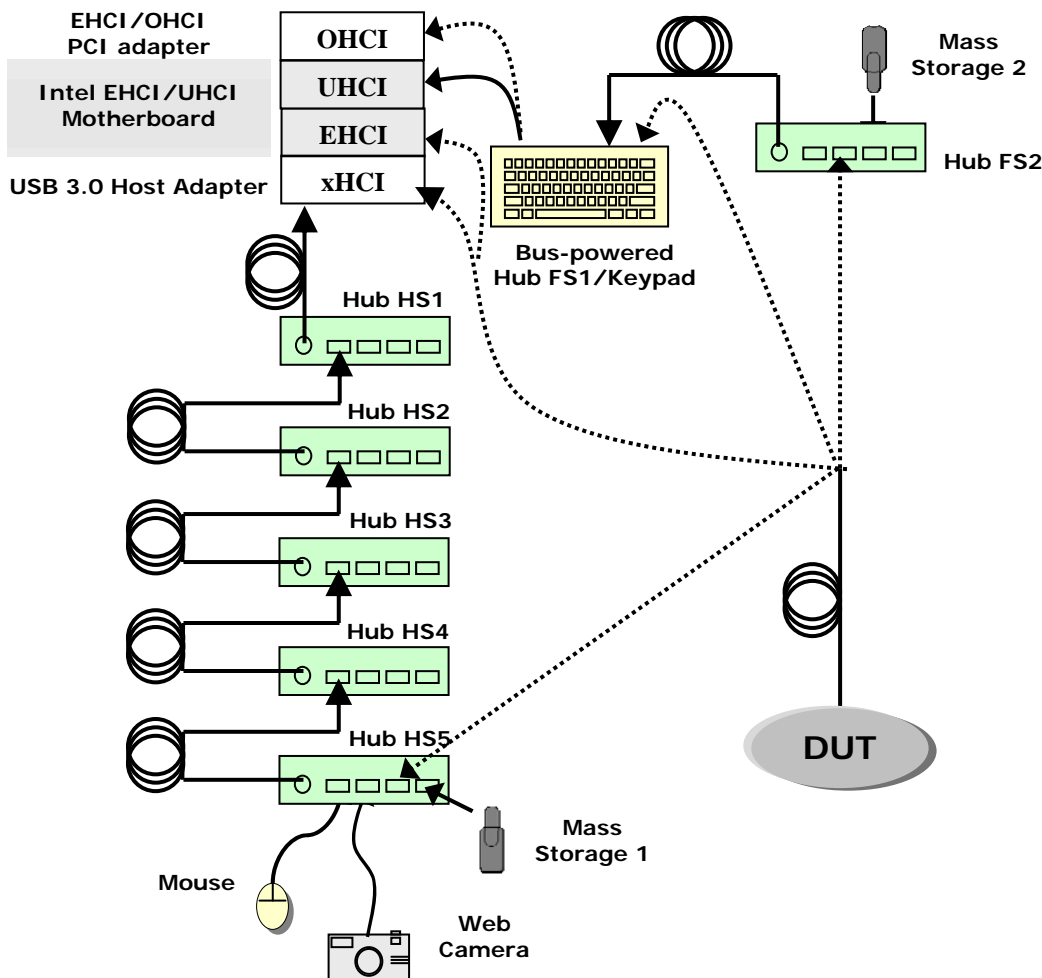
1. Disconnect tree from host system
2. If [DUT] is self-powered, apply external power
3. Attach [DUT] to [SuperSpeed Root Port]
4. Run USB30CV and select “Chapter 9 Tests”. Record result in database
5. Run all appropriate class tests (HID, HUB, MSC, UVC, PHDC, etc...)
6. Repeat above on each embedded device (compound devices only)
7. Repeat above at each supported operating speeds

### **Current Measurement Tests:**

1. Disconnect tree from [HubHS#1]
2. Connect [HubHS#1] to [Onboard System Port]
3. Attach<sup>(see note)</sup> [DUT] to [Current Dongle]
4. Attach [Current Dongle] with [DUT] to [HubHS#1]
5. Run USB20CV
6. Obtain un-configured current (must be  $\leq 100\text{mA}$ )
  - i. If the [DUT] is self-powered, test again under bus power. Pull the power plug from the device.
7. Obtain configured current (must be  $\leq \text{MaxPower}$  value)
  - i. If the [DUT] is self-powered, test again under bus power. Pull the power plug from the device.
8. Exit USB20CV
9. Load [DUT] device driver and run associated application
10. Operate all features of the [DUT] concurrently and measure "Operating Current."
  - Verify that the current is less than the MaxPower value
11. Enable [DUT] as wake device, if supported
12. Suspend the system and measure "Suspend Current."
  - Verify that the current is  $\leq 2.5\text{mA}$
13. Disconnect the [HubHS#1] from the [Onboard System Port]
  - Make sure VBus is still powered on the downstream ports of [HubHS#1]
14. Disconnect the [DUT] from [HubHS#1]
15. Reconnect the [DUT] to [HubHS#1]
  - [DUT] should suspend due to bus inactivity
16. Measure the "'Powered' State Suspend Current"
  - Verify that the current is  $\leq 2.5\text{mA}$

NOTE: Use a 1 meter (or shorter) cable to attach the DUT to the current dongle.

## Test Attachment Points



### Attachment Notes:

- All hi-speed hubs are self-powered
- On Hub HS5, position the gold-tree devices and the DUT as shown. In other words, attach the DUT between ports that are occupied on the hub. The device is not allowed to interfere with adjacent ports.
- Low-power devices are to be tested on the bus-powered Hub FS1
- The hub identified as FS2 is a hi-speed, self-powered hub. This hub will operate at full-speed because it is downstream of a full-speed hub.
- The purpose of FS2 is to test the operation of high-powered devices on the full-speed branch (FS1 is bus-powered and unable to support high-powered devices).
- High-power devices are to be tested on the bus-powered Hub FS1 (enumeration only) and the self-powered Hub FS2
- Five meter cable assemblies must be used between hubs and between the hi-speed tree and the host.
- For peripherals that do not use a captive cable, a standard detachable USB cable assembly of maximum length that is appropriate for the peripheral must be used. For example, if the peripheral implements a micro B-receptacle, then a 2 meter standard A-plug to micro B-plug cable assembly must be used. Use of SuperSpeed cable assemblies are not allowed for USB 2.0 compliance testing.

## **Interoperability**

For Windows XP, it is necessary to have the following registry entry in order to enable S3 remote wakeup via USB. (This is not necessary for Windows 7.)

HKLM\SYSTEM\CurrentControlSet\Services\usb\USBBIOSx=DWORD:00000000

At no time may the [DUT] fail to operate

At no time may the [DUT] have an error in Device Manager

At no time may the [DUT] require detach and reattach in order to continue operation

At no time may a Gold-tree device be removed from the tree in order to test the DUT

At no time may any of the Gold-tree devices cease working

At no time may the operating system hang or blue screen

### **1. EHCI test:**

- A.** Connect the high-speed tree to [motherboard USB root port] through [HSHub#1] and connect the full-speed tree (HubFS#1) to [motherboard USB root port]
- B.** Check operation of entire gold-tree
- C.** Examine and verify all connectors on [DUT]
  - i.** Ensure USB connectors are not proprietary (extra pins, unusual shape, etc.)
  - ii.** Verify all non-USB receptacles do not accept a standard, mini and micro USB plugs
  - iii.** Verify all non-USB plugs do not insert into standard, mini and micro USB receptacles
  - iv.** Each and every USB connection must be tested
- D.** If [DUT] is self-powered, attempt to enumerate [DUT] under bus-power
  - i.** **If enumeration occurs under bus-power, the device must be tested, henceforth, as bus-powered.** Otherwise, test the device under its self-powered mode.
- E.** Enumeration Test
  - i.** Plug the [DUT] in [HS#5]. **DO NOT PRELOAD VENDOR'S SOFTWARE OR DRIVER**
  - ii.** If OS does not possess a native driver, follow OS instructions for installing driver
    - 1. If driver still does not load – install software as directed by vendor
      - a. If driver loads, PASS with waiver and recommend the driver load via .INF file
    - 2. If reboot is requested or required as a result of driver (or application) installation – PASS with waiver and recommend removing reboot requirement
- F.** Check operation of device
- G.** Interoperability Test:
  - i.** Operate all devices simultaneously
    - 1. Operate [DUT]
    - 2. Transfer a large file between the Mass Storage Drive 1 and Mass Storage Drive 2
    - 3. View live video from the USB camera
    - 4. Strike keys on the USB keyboard
    - 5. Move mouse
    - 6. Hot plug the mouse
- H.** Hot plug test:
  - i.** Stop operation of [DUT]
  - ii.** Disconnect and re-connect cable at the downstream port [DUT]
  - iii.** Check operation of all USB devices including [DUT]
  - iv.** Stop operation of [DUT]

- v. Disconnect and re-connect cable at the device (if not hardwired)
- vi. Check operation of [DUT]
- I. Warm Boot test:
  - i. Stop operation of all devices
  - ii. Start→Turn Off Computer→Restart
  - iii. Check operation of all USB devices including [DUT]
- J. Remote Wake-up Tests:
  - i. If the [DUT] supports remote wake-up, enable the [DUT] to wake the system; otherwise, go to step K - S3 Active Standby Tests
  - ii. Do not operate [DUT]
  - iii. Place the system in standby (wait 5 – 10 seconds after monitor is dark)
  - iv. Use the device under test to wake the system
  - v. Check operation of all USB devices including [DUT]
- K. S3 Active Standby Tests:
  - i. Disable remote wake-up on all USB devices, including DUT
  - ii. Operate the [DUT] *while* placing the system in standby (wait 5 – 10 seconds after monitor is dark)
  - iii. Wake the system
  - iv. Check operation of all USB devices including [DUT]
- L. Root port test:
  - i. Stop operation of [DUT]
  - ii. Plug [DUT] into a root port of the system's motherboard
  - iii. Check operation of all USB devices including [DUT]
- M. S4 Active Hibernate Test:
  - i. Stop operation of all devices
  - ii. Plug DUT into a root port of the system's motherboard
  - iii. Operate the [DUT] while the system enters hibernation (wait 5 – 10 seconds after monitor is dark)
  - iv. Turn-on the system
  - v. Check operation of all USB devices including [DUT]
- 2. UHCI Full-speed Operation Test:**
  - i. Stop operation of [DUT]
  - ii. Attach [DUT] to the Keyboard [HubFS#1];  
**High-power [DUT's] must enumerate (not necessarily be configured) without an overcurrent error --** A "power exceeded" message is expected and acceptable.
  - iii. Operation of self-powered and low-powered devices must be tested behind [HubFS#1]
  - iv. Move high-power [DUT] to self-powered [HubFS#2]
  - v. Check operation of all USB devices including [DUT]
  - vi. Suspend/resume host system and check operation of [DUT]
  - vii. Warm boot host system and check operation of [DUT]
- 3. OHCI Full-speed Operation Test:**
  - i. Stop operation of all devices
  - ii. Connect the Keyboard [Hub#FS1] test tree to a root port on the [PCI Card Port]
  - iii. Check operation of all USB devices including [DUT]
  - iv. Suspend/resume host system and check operation of [DUT]
  - v. Warm boot host system and check operation of [DUT]

**4. xHCI Classic-Speed Operation Test:**

- i. At this time, only USB30CV is required at the root port of the xHCI
  - a. Execute USB30CV Chapter 9 at the root port of the xHCI
  - b. Execute all applicable class tests of USB30CV at the root port of the xHCI

## ***Battery Powered Devices***

1. All battery powered devices must test with a dead battery. A dead battery is defined by a device that is unable to successfully power on when not attached to an external power supply (such as USB or an AC adapter).
2. Once the device has asserted its pull-up, it must fully comply with the USB 2.0 Specification.
3. When unconfigured, the upstream port must never consume more than ICCINIT (100mA)
4. When configured, the upstream port must never consume more current than its active bMaxPower value. If current draw exceeds 100mA, the device must report itself as bus-powered during enumeration.
5. If a peripheral is unable to connect (assert its pull-up) due to a dead battery, it must never consume more than ICCINIT (100mA) including when attached to a suspended downstream port.
6. If a peripheral is able to connect (assert its pull-up) with a dead battery, it must fully abide by the USB 2.0 Specification and the USB-IF Compliance Program rules in regards to power draw.
7. The peripheral must pass Inrush tests with a dead battery.
8. If the peripheral is not able to charge its batteries from USB with a dead battery, then the battery is permitted to be charged to the point where it is able to power on using its battery. The peripheral is permitted to be tested from a low battery state, but with the peripheral turned off.
9. If the peripheral is not able to charge its batteries from USB with a low battery while in an off state, then the peripheral is permitted to be tested with a low battery while turned on.
10. A device that uses USB to charge its batteries must enumerate as a USB device on the host system.

### Battery Test Procedures:

Suspend: The average suspend current draw test is performed by attaching the device with a dead battery to an already suspended downstream port that has VBus powered.

1. Attach the DUT to an average current draw test fixture
2. Select a known good device and attach it to a root port of an EHCI system
3. Using HSET, suspend the known good device.
4. Replace the known good device with the with the average current draw test fixture that has the DUT attached.
5. Ensure that VBus is valid on the suspended port.
6. The measured current must not exceed ICCINIT (100mA) while attached to a suspended port.
7. Attempt to power-on the DUT and measure current drawn.

## Gold-tree Device List

The gold-tree is supposed to consist of USB-IF certified consumer devices that are widely available in the market. Unfortunately, the shelf-life of consumer products is limited and some items become difficult to find as time goes by. As a result, the USB-IF will no longer identify specific makes and models of products for the gold-tree. The shelf life and availability of consumer products is just too short and is difficult to maintain. Because there is nothing special about the peripherals and hubs, except being USB Certified, product classes and types are specified.

Item	Class	Description	Example Product	Qty
USB Host System		Multicore processor Certified USB EHCI with embedded UHCI PCI slots	Intel DG965SS motherboard	1
EHCI / OHCI		PCI Host Adapter using certified USB EHCI with embedded OHCI	Adaptec, model AUA 4000 PCI adapter	1
xHCI (SuperSpeed host adapter)		PCI Host Adapter using certified USB xHCI	USB-IF SuperSpeed PDK	1
HS Hub (Self-powered)	Hub	Hi-speed hub. Minimum of 4 exposed downstream ports	Belkin F5U233	6
FS Hub (bus-powered)	Hub	Full-speed hub. Minimum of 2 exposed downstream ports (Likely to be a compound device)	Targus Numeric Keypad with 2-port Hub, model PAUK10U	1
USB mouse	HID	Low-speed using interrupt transport	Microsoft Basic Optical Mouse	1
HS Mass Storage	MSC	Hi-speed using bulk transport	Memorex TravelDrive model 32509051	2
PC Camera	UVC	Hi-speed using isochronous transport	Logitech QuickCam Ultra Vision P/N: 961471-0403	1
average current draw test jig		Fixture to measure current consumed from VBus	<a href="http://www.usb.org/developers/adapters/">http://www.usb.org/developers/adapters/</a>	1
one meter (or shorter) USB cables		any listed on USB-IF Cables and Connectors Integrators List		1
4.5 meter USB cable with mini B-plug		any listed on USB-IF Cables and Connectors Integrators List		1
2 meter USB cable with micro B-plug		any listed on USB-IF Cables and Connectors Integrators List		1
five meter USB cables		any listed on USB-IF Cables and Connectors Integrators List		8

### ***Hubs and compound devices:***

Hubs or compound devices are added to the highest operational tier level at the start of the test. Typically, that will be tier level 4. If the compound device contains nested hubs, then attach to tier level 3. Move gold tree devices on the branch to the exposed downstream ports on the hub or compound device. Then follow the procedure for peripherals.

- Hubs with no embedded devices:
  - Run USBCV chap 9 and 11 on the hub
  - Run interoperability with gold device(s) attached.
- Hubs with embedded devices (compound):
  - Run USBCV on the hub and on each embedded device
  - Concurrently run interoperability run on all embedded devices
- Isochronous Devices:
  - High-speed isochronous DUTs are simply added to the tree.

Vendors are encouraged to test their devices against a variety of hosts and peripherals and not rely solely on the USB-IF Gold-tree for validation.