



Wireless USB Golden Suite White Paper



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NTS Wireless USB Golden Suite Program

National Technical Systems, NTS, is a world leader in assisting organizations to access domestic and international markets. We are a single source for a full range of integrated engineering solutions, product testing, standards compliance, project management staffing solutions and managed services. Globally accredited by leading regulatory agencies, NTS can provide cost-effective programs to meet your requirements at one of our many U.S. or international facilities, or we can provide onsite solutions. NTS is the largest independent standards compliance and product testing company in the U.S.A serving companies within the aerospace, defense, automotive, telecommunications, electronics, power, medical device, computer, software and financial markets.

TEST OVERVIEW

In today's market, the move for pretty much every product is towards wireless. Wireless area networks (WANs based Wi-Fi) for connecting your computers to the Internet at your local coffee shop. Wireless low-powered networks (like ZigBee) to connect air conditioning units in hotel rooms to a main control server. Personnel area networks (like Bluetooth) to allow you to connect your cell phone to your computer. And, now Wireless USB to un-tether your peripherals (e.g., keyboards, mice, hard drives, etc.) from your computer.



In the real world, it's not enough for a wireless USB device or hub manufacturer to simply prove that it has correctly followed the USB-IF specification. You can never be sure what revision level of machines or subtle differences a device will have to contend with in the field. The bottom line is that you don't want to spend all of your time debugging other manufacturers' designs. But you do need to know what's out there in order to defend your own design against potential failures in the hands of real-world users, especially with an emerging technology like Wireless USB.



NTS knows from our experience that compliance does not always guarantee compatibility with other products, and you want to make you're your product is compatible with all of the USB-compliant products on the market today. To address these issues, NTS has developed the NTS Wireless USB Golden Suite that goes beyond the standard USB-IF certification. It answers the questions regarding whose fault is it, how bad is it out there, will my product perform as expected, and will it be a success or a failure.

The NTS Wireless USB Golden Suite focuses on real-world testing of your USB product with a variety of platforms, peripherals and operating systems. The testing covers various USB chipsets using up to 200 USB devices and peripherals (wired and wireless), along with supporting operating systems including Apple Mac OS X®, Microsoft Windows 2000®, Microsoft Windows XP®, Microsoft Windows Server 2003®, and Microsoft Windows Vista®. NTS's Wireless USB Golden Suite test procedures consist of six (6) major coverage areas: Installation Testing; Device Functionality Testing; Interoperability Testing; Hot Detach/Reattach Functionality Testing; Power Management Functionality Testing; and, Wireless Functionality Testing. Let NTS help make sure your product is ready for the market before you release it!

TEST PROCEDURES

Before NTS begins testing, test platforms are verified and checked for correct configuration with the assigned operating systems. Once the platforms are configured, NTS Test Engineers confirm that no errors or anomalies are listed in the Device Manager and the operating system is functioning as expected. NTS's Wireless USB Golden Suite test procedures consist of five (5) major coverage areas, as outlined in the subsections below (Note that coverage area #6 as listed below is optional). Each test area subsection includes a description of the applicable coverage as well as a high-level outline of test procedure to coincide with the device under test.

1. Installation Testing

Installation encompasses both software/driver and hardware configuration. Listed below are the major milestones that are exercised to ensure proper installation.

- Determine proper software/driver installation
- Determine proper “enumeration” of USB device under selected Operating System when attached to the USB Port on test platform and turned on (wireless device).

2. Device Functionality Testing

Basic device functionality verifies the functionality of the Wireless USB device under test to perform its basic functions. The purpose of this test is to ensure compatibility of the device under test to the operating environment, which includes other Wireless USB devices and hubs. Functionality will be determined prior to the start of testing dependent on device functionality.



3. Interoperability Testing

Interoperability testing confirms proper co-existence with multiple USB devices and/or hubs (wireless and wired). Interoperability testing performed by NTS using the USB Wireless, High Speed, Full Speed and Low Speed devices and hubs. Listed below are the major milestones that are exercised to ensure proper interoperability.

- Confirm functionality of USB Device under test with an array of USB 2.0 compliant devices (i.e., wired and wireless hubs, mice, printers, scanners, camera, etc.)
- Move wireless USB transceiver under test along USB Tree and confirm functionality of wireless USB device under test with an array of USB 2.0 (Wired & Wireless HS, FS, LS) compliant devices (i.e., hubs, mice, printers, scanners, camera, etc.)

4. Hot Detach/Reattach Functionality Testing

Hot Detach/Reattach Functionality testing verifies correct detection and functionality as the device under test is inserted and re-inserted from the same USB port and moved from port to port on the USB Tree. Listed below are major milestones that are typically exercised to ensure proper Hot Detach/Reattach Functionality.

- Hot Detach/Reattach (Scenario 1) – Change the attachment of the USB transceiver from the system’s USB Port 1 and re-attached it to the system’s USB Port 2 (if applicable). Verify that the wireless USB device re-pairs with the transceiver.
- Hot Detach/Reattach (Scenario 2) – Unplug and plug the attachment of the USB transceiver from the system’s same USB port. Verify that the wireless USB device re-pairs with the transceiver.
- Hot Detach/Reattach (Scenario 3) – Pair/unpair (turn on/off) the wireless USB device multiple times and validate that it reattaches and re-enumerates correctly.
- Hot Detach/Reattach (Scenario 4) – Move USB Device (transceiver) under test along USB tree (up and down) and confirm functionality of USB device under test with an array of USB 2.0 (HS, FS, LS) compliant devices (e.g., wireless hubs, mice, printers, scanners, camera, etc.). Verify that the wireless USB device re-pairs with the transceiver.
- “Exception Processing” Technique – Hot Detach/Reattach the USB transceiver to and from the USB ports as quickly as possible. NTS Test Engineers wait until the device is enumerated, then quickly hot detach and reattach the device.

5. Power Management Functionality Testing

Power Management functionality testing assures that the USB Device under test continues to operate normally after “resuming” from a selected power management state. Listed below are the major milestones that are exercised to ensure proper Power Management Functionality.

- With USB Device under test attached, place test platform in “Standby” mode. Upon test platform dropping to “standby” mode, “resume” from the power management state.



- With the USB Device under test attached, place test platform in “hibernation” mode. Upon test platform dropping to “hibernation” mode, “resume” from the power management state.
- “Exception Processing” Technique - With USB Device under test attached on the USB Tree, place test platform in “Standby” mode. Upon test platform dropping to “Standby” mode, move the USB Device to a different USB port along the USB Tree. “Resume” from the power management state.
- “Exception Processing” Technique - With USB Device under test attached on the USB Tree, place test platform in “hibernation” mode. Upon test platform dropping to “hibernation” mode, move the USB Device under test to a different USB port. “Resume” from the power management state.
- Verify that power management modes can be entered into and out of by wireless USB devices (e.g., does a wireless mouse wake a system?, etc.).
- Low Battery Testing – Allow the batteries in the wireless device to run down. Verify that the device responds with appropriate “low battery” warnings (via operating system, device itself, wireless connection, etc.)

Note: Power Management testing will be performed on one (1) test platform only and each of the above tests will only be executed once.

6. Wireless Functionality Testing – OPTIONAL

Wireless functionality testing assures that the Wireless USB Device under test continues to operate normally as defined by the wireless USB specification. Listed below are the major milestones that are exercised to ensure proper Wireless Functionality.

- Interference Testing – Test with other wireless products that might adversely affect performance (e.g., cordless phones, audio/video transmitters, wireless cameras, wireless networks [802.11a, b, g, n], other wireless protocols [ZigBee, Bluetooth], etc.).
- Range & Angle Testing – Test at distances from one (1) foot to twenty (20) feet (as supported by the product-under-test) in increments. Also perform testing at various angles off of the main line of communications between the wireless connection and the wireless device (e.g., 0, ±45°, ±90°).
- Obstruction Testing – Test with select objects blocking the direct line-of-sight communications between the wireless connection and the wireless device (e.g., wood, metal, fabric, glass, liquid, etc.) to simulate real-world usage.

Note: Wireless Functionality testing will be performed on one (1) test platform only and each of the above tests will only be executed once.

TEST OPTIONS

NTS provides several options to meet your testing needs and budget:

NTS Project Costs	
Service	Description
Option 1	Ten (10) Test Platforms Thirty (30) USB Devices Total (Wired & Wireless)
Option 2	Fifteen (15) Test Platforms Forty-five (45) USB Devices Total (Wired & Wireless)
Option 3	Twenty (20) Test Platforms Sixty (60) USB Devices Total (Wired & Wireless)
Option 4	Coverage area #6 (Wireless Functionality Testing) as outlined above.



TEST ENVIRONMENT

For testing, NTS will use a variety of current and legacy platforms configured with appropriate operating systems available over the last five (5) years. Upon completion of testing, the client will receive a Test Matrix detailing the test environment, the test procedures, the errors encountered and the test report reference numbers, if any were created.

OPERATING SYSTEMS

Each PC platform is configured with one of the operating systems listed below. The specific operating systems used by NTS for Wireless USB Golden Suite testing are:

- Microsoft Windows 2000 Professional (Retail, SP2, SP3, SP4)
- Microsoft Windows XP Home & Professional (SP1 & SP2)
- Microsoft Windows Vista Home Basic, Home Premium, Business & Ultimate
- Apple Mac OS X (10.3 Panther & 10.4 Tiger) – *Upon request*

TEST PLATFORMS & USB CHIPSETS

Below is the listing of test platforms, operating systems and USB controller chipsets deployed by NTS for its USB Golden Suite testing. NTS will select ten (10), fifteen (15) or twenty (20) test configurations depending on test option selected. NTS deploys the platforms listed below specifically to cover the various USB chipsets (i.e. a combination of USB 2.0 compliant and non-USB 2.0 compliant) to verify compatibility and interoperability of the customer's product. Note that NTS may substitute one or more platforms with Apple Macintosh platforms depending on the customer's request.

PC Test Platforms

	Test Platform	USB Chipset	USB Chipset Speed
1.	Dell Dimension 4500S	Intel 82801DB/DBM USB 2.0 EHCI	EHCI
2.	Dell Inspiron 600M	Intel 82801DB/DBM USB 2.0 EHCI	EHCI
3.	Comaq S6300NX	Via SouthBridge VT8237	EHCI
4.	Sony VAIO PCV-RS410	Intel 82801DB/DBM USB 2.0 EHCI	EHCI
5.	EMachine C2685	Intel 82801DB/DBM USB 2.0 EHCI	EHCI
6.	HP Pavillion a300n	Intel 82801 DB/DBM USB 2.0 EHCI	EHCI
7.	Generic	Intel 82801E USB 2.0 EHCI	EHCI
8.	HP Vectra LV8 Pentium II/450	Intel 82371 AB/EB	EHCI
9.	HP Media Center PC m260n	Intel P4 2.6GHz	EHCI
10.	Compaq Presario 1286 Cxrix MII-333 MMX	SIS7001	OHCI
11.	Gateway G6-400C Intel Celeron/400	Intel 82371AB/EB	UHCI
12.	IBM Aptiva K7 650Mhz	AMD 756AC	OHCI
13.	Hewlett-Packard Vectra VL8 Pentium II/450	Intel 82371 AB/EB	UHCI
14.	Hewlett-Packard Pavillion 4430 AMD K6-2/300	SIS 7001 PCI	OHCI
15.	AST Bravo 500A-1 Pentium III/500MHz	Intel 82371AB/EB	EHCI
16.	Compaq Prosignia 310 Celeron 400Mhz	Intel 82371 AB/EB	EHCI
17.	Compaq: Presario 1275 AMD K6-2 366MHz	OPTi 82C861	OHCI
18.	Compaq Presario 5900Z AMD Athlon/700Mhz	VIA Tech 3038	UHCI
19.	Hewlett-Packard Pavillion 9695C AMD Athlon/850	VIA 3036	UHCI
20.	Compaq Presario 7998 AMD Athlon/1GHz	VIA 82C686A	UHCI
21.	Hewlett-Packard Pavillion 8650 Celeron/533	Intel 82801 AB	UHCI
22.	Hewlett-Packard Omnibook 7150 PII/300	Intel 82371AB/EB	UHCI
23.	Acer AcerPower 8600 Pentium III/800	Intel 82801AA	UHCI
24.	Acer Aspire 3230 AMD K62/366 MicroTower	Ali M1543C	OHCI
25.	Dell Dimension 4500S Intel P4/2GHz	Intel 845G	UHCI
26.	MicronPC 910a Millennia Professional	NVIDIA nFORCE2	OHCI
27.	Screwdriver Box #1	VIA VT6202	UHCI
28.	Screwdriver Box #2	SIS 963	OHCI



Add-In Cards

	Card Vendor	USB Chipset	USB Chipset Speed
1.	Adaptec Duoconnect FireWire & USB 2.0 AVA-3020	NEC D720100AGM 0316KX009	EHCI
2.	Adaptec USB 2 connect 6-port USB 2.0 AVA-5100	NEC D720100GM 0109KK006	EHCI
3.	Adaptec USB 2.0 2-port CardBus AVA-1420	NEC (either uPD720100 or uPD720101)	EHCI
4.	Adaptec USB 2.0 CONN4000 AVA-5100b	NEC D720101GJ 0244EPA15	EHCI
5.	Adaptec USB2Connect 4 port USB 2.0 card AVA-4000b	NEC 720101GJ 033EPA18	EHCI
6.	ADS dual link USB 2.0 dlx-180	NEC D720100AGM 0307EPA02	EHCI
7.	ADS PCMCIA USB 2.0 dlx-181/ usbx-2001	NEC (either uPD720100 or uPD720101)	EHCI
8.	ADS USB PCI card 2.0 usbx-2000	NEC D720100AGM 0309KP123	EHCI
9.	Belkin 2pt USB 2.0 CardBus f5u222	NEC (either uPD720100 or uPD720101)	EHCI
10.	Belkin 2pt USB 2.0 INT PCI card f5u219	NEC D720101GJ 0307EPA16	EHCI
11.	Belkin FireWire /USB 2.0 PCI ca f5u508	NEC D720100AGM 0326KX020	EHCI
12.	Belkin High-Speed USB 2.0 upgrade kit f5u219	NEC D7201000AGM 0213KP048	EHCI
13.	Belkin USB 2.0 PCI card 5pt f5u220	NEC D720101GJ 0324EPA25	EHCI
14.	Centon USB 2.0 usb2pcmcia	NEC (either uPD720100 or uPD720101)	EHCI
15.	CompUSA High Speed 5 port USB card, v2.0 FS-MEG-ALI	ALI M5273 A1 0336 TS05 CK38503100B	EHCI
16.	CompUSA USB 2.0 - i333 1394 Combo PC Card	ALI (either M5239, M5271, or M5273)	EHCI
17.	CompUSA USB v2.0 CardBus pc card FS-MEG-ALI	ALI (either M5239, M5271, or M5273)	EHCI
18.	DLink 2 port USB 2.0 PCI adapter card DUB-A2CDW	VIA VT6202 0325CD TAIWAN 23A5015700	EHCI
19.	DLink 2port USB 2.0 CardBus Ad DUB-C2	NEC (either uPD720100 or uPD720101)	EHCI
20.	DLink 3pt FireWire 1394/2pt USB-2 DFB-A5	NEC D720100AGM 0322KX010	EHCI
21.	DLink High-speed USB 2.0 2pt PCI DUB-A2 CDW	VIA VT6202 0325CD TAIWAN 23A5015700	EHCI
22.	D-link USB 2.0 ADA 5pt PCI du-520	NEC D720100AGM 0323KX045	EHCI
23.	Hawking 2pt USB 2.0 PCI card uh202p	VIA VT6202 0244CD TAIWAN 23A5012600	EHCI
24.	I/O Flex hi-speed 5-port PCI host controller ioflex-2580n4	NEC D702101GJ 0325EPA06	EHCI
25.	I/O Flex hi-speed USB 2.0 2-port CardBus PC Card	NEC (either uPD720100 or uPD720101)	EHCI
26.	IBM TP USB 2.0 CardBus Adapter 33I3245	NEC (either uPD720100 or uPD720101)	EHCI
27.	Inland USB 2.0 PCI 2port 8335	VIA VT6202 0248CD TAIWAN 23A5017600	EHCI
28.	Intek21 USB 2.0 PCI Card tk9910	NEC D720100AGM 0309KP030	EHCI
29.	logear 2pt USB 2.0 CardBus PC GPU202	NEC (either uPD720100 or uPD720101)	EHCI
30.	logear 5pt USB 2.0 PCI Adapter GIC250U	NEC D720100AGM 0315KX029	EHCI
31.	Kanguru Combo Internal USB 2.0 hub & PCI Card	NEC D720100AGM 0207KX050	EHCI
32.	Kanguru USB 2.0 PCI Card KPCI-USB2	NEC D720100AGM 0315KX091	EHCI
33.	Keyspan 5pt PCI USB 2.0 Card M U2PCI-5	NEC D720100AGM 0317KX104	EHCI
34.	Kingwin USB 2.0 PCI Adapter 2ext+1int U2PCI-3	VIA VT6202 0245CD TAIWAN 23A5011900	EHCI
35.	Kingwin USB 2.0 PCI Adapter 4ext+1int U2PCI-5	VIA VT6202 0245CD TAIWAN 23A5011900	EHCI
36.	Micro Inn 2.0 PCI 2 port USB640A	VIA VT6202 0211CD TAIWAN 23A5008900	EHCI
37.	Micro Inn USB 2.0 5 port USB650A	NEC D720100AGM 0329KX021	EHCI
38.	Orange Micro FireWire/USB 2.0 70htI00110	NEC D720100AGM 0326EPA02	EHCI
39.	Pacific Digital USB 2.0 PCI 1897-01-US-3	VIA VT6202 0212CD TAIWAN 23A5009100	EHCI
40.	PPA 5 port PCI/USB Card 1066	ALI M5273 A1 0313 TS05 CK357281000B	EHCI
41.	PPA USB 2.0+1394 FireWire Combo 1509	ALI M5271 A1 0331 TS05 EK345661000C	EHCI
42.	Ratoc USB 2.0 PCMCIA cbu2u	NEC (either uPD720100 or uPD720101)	EHCI
43.	Siig USB 2.0 High-speed 2pt PCI US2286	NEC D720100AGM 0315KX106	EHCI
44.	Siig USB 2.0 PCI 5pt adapter US2245	NEC D720100AGM 0318KP002	EHCI
45.	Siig USB 2.0 PCMCIA dual port US2246	NEC UPD720101	EHCI
46.	Siig USB 2.0+FireWire Combo DV-KIT US2254	NEC D720100AGM 0221KXA11	EHCI
47.	Siig USB 2.0+FireWire+10/100 Combo US2275	NEC D720100AGM 0304KP005	EHCI
48.	Startech 5pt USB 2.0 PCI Adapt PCI4USBV2	NEC D720100AGM 0302EPA16	EHCI
49.	Syba SD-VIA-5U PCI 4ext+1int Ports SD-U2VIA6202-4I	VIA VT6202 0332CD TAIWAN 23A5011200	EHCI
50.	Generic viavt6202 USB 2.0 host controller	VT6202	EHCI
51.	Orange micro USB host controller	NEC uPD720100A	EHCI
52.	Adaptec USB 2.0 host controller	NEC uPD720100A	EHCI
53.	Siig USB 1.1 host controller	Opti Firelink 82C861	OHCI

Note: If the customer selects an add-in card instead of a platform with built-in USB for one of the test configurations, NTS will select a test platform (TBD) outside of the platforms listed above. NTS will notify the customer of the exact test configuration prior to the start of testing.



PERIPHERALS

NTS will provide thirty (30), forty-five (45) or sixty (60) device for testing depending on the option selected. All hardware utilized during testing will be recorded within the NTS Project Documentation Report

The following is a sample list of peripherals, which were available for testing at the time of proposal creation. NTS will recommend the best set of available products from mixed vendors during the test matrix creation phase at the start of the project. The customer may request substitutions however these substitutions could affect the actual project cost.

Wireless USB Peripheral Devices

Description	Model/version	Vendor
1. TBD – Dependent on release schedules		

USB Peripheral Devices

Description	Model/version	Vendor
2. USB Ethernet Network Interface Device 1.1	3C19250	3Com Corporation
3. PalmConnect USB Kit 1.1	90201U	3Com Corporation
4. HomeConnect Cable Modem External with USB 1.1	3CR29223	3Com Corporation
5. OfficeConnect Cable Modem External with USB 1.1	3CR29210	3Com Corporation
6. OfficeConnect Cable Modem External with USB 1.1	3CR29210	3Com Corporation
7. USB 2.0 Port Expander Hub	UH-102	ABL Electronics
8. USB Mouse 1.1	MUSXT	Acer America Corporation
9. USB Keyboard 1.1	6511-HA	Acer America Corporation
10. Mouse: USB Style 1.1	M-U48A	Acer America Corporation
11. 6x4x6 USB External CD-RW Drive	6406EU-002	Acer America Corporation
12. Firewire/USB 2.0 60GB External Hard Drive	HD060U2FE	Acom Data
13. 4 Port USB 2.0 XHub 4	1933300	Adaptec Incorporated
14. USB2.0 Connect PCI Adapter Card	AUA-5100	Adaptec Incorporated
15. XHUB4 USB 2.0 Hub	4000	Adaptec Incorporated
16. XHUB7 Plus USB 2.0 Hub	AUH-7000Plus	Adaptec Incorporated
17. PocketDVD2K 8x DVD-ROM/24x CD-ROM Ext. USB 1.1	AD-285	Addonics Incorporated
18. USB 2.0 4 Port Hub	AHUSB2/4	Addonics Incorporated
19. USB 1.1 Powered Hub	USBH-600	ADS Technology
20. USB 1.1 Ultra Hub 4	USBH-604	ADS Technology
21. Gamepad Pro USB 1.1	4211	Advanced Gravis
22. SnapScan 1212U USB 1.0 Color Scanner	SnapScan 1212u	AGFA Corporation
23. Speed Touch USB 1.1 ADSL Modem	12/12/01	Alcatel
24. CopperJet 800 USB ADSL Modem	CJ8MO EU	Allied DataTechnologies
25. USB 1.0 Speakers	FMW0214942	Altec Lansing
26. Digital Powercube USB 1.0 Speakers	ADA70	Altec Lansing
27. Flip2disk 10GB USB Hard Drive	10GB-F2D10000	Amacom Technologies
28. USB Keyboard	M2452	Apple Computer Corporation
29. USB Mouse	M4848	Apple Computer Corporation
30. USB Keyboard	M2452	Apple Computer Corporation
31. USB Mouse	M4848	Apple Computer Corporation
32. USB Keyboard	M2452	Apple Computer Corporation
33. USB Mouse	M4848	Apple Computer Corporation
34. USB Keyboard	M2452	Apple Computer Corporation
35. USB Mouse	M4848	Apple Computer Corporation
36. Pro Mouse USB	M5769	Apple Computer Corporation
37. 16x10x24x USB 2.0 External MiniCD-RW Drive	XS2-2	Archos
38. Iconnect PCI to 2 USB 1.1 Port Adapter Card	AUPCI1010	Ariston Technologies
39. USB Flatbed Scanner for Macintosh	1236 USB	Artec
40. FriendlyNET USB Hub-4 Port	61-20568-00	Asante Technologies
41. TV Wonder USB External Tuner Pod	100-703115	ATI Technology
42. External USB 1.1 TV Tuner	AVerTV USB	AverMedia Technology
43. 40GB USB 2.0 External Hard Drive	1202	Bason Computer
44. 5GB USB 2.0 External Hard Drive	Me-910	Bason Computer
45. USB Serial Adapter	F5U103	Belkin Components
46. USB BusStation Hub	F5U100	Belkin Components

	Description	Model/version	Vendor
47.	USB Serial Adapter for the Macintosh	F5U103-MAC	Belkin Components
48.	4 Port USB 2.0 Hub	F5U221	Belkin Components
49.	4 Port USB Hub	F5U101	Belkin Components
50.	USB BusStation 7-Port Hub	F5U100	Belkin Components
51.	USB 2.0 Upgrade Kit-Internal/External Hub	F5U900	Belkin Components
52.	Nostromo USB Game Pad	n40	Belkin Components
53.	3 Port USB 2.0 Pocket Hub	F5U217	Belkin Components
54.	4 Port USB 2.0 Hub (Office Essentials)	F5U214-OE	Belkin Components
55.	USB 2-Port PCI Card	F5U005	Belkin Components
56.	24x10x32 USB 2.0 Portable CD-RW Drive	2410MR-102	Benq
57.	SmartOne External 56k v.90 USB Modem	56USB-Sp/56USB	Best Data
58.	USB Pocket Size 20GB Hard Drive	D-20-UI	Buslink
59.	USB 60GB External Hard Drive	L60/60GB	Buslink
60.	USB 2.0 Slim CD-Rom Drive	D-RM24-U2	Buslink
61.	USB 2.0 External CD-RW Drive	UII-RW32E	Buslink
62.	52x24x52 USB 2.0 External CD-RW Drive	UII-RW52E	Buslink
63.	PowerShot A200 USB Digital Camera	A200	Canon Computer Systems
64.	BubbleJet i320 USB 2.0 InkJet Printer	K10217	Canon Computer Systems
65.	BubbleJet i550 USB 2.0 InkJet Printer	i550	Canon Computer Systems
66.	BubbleJet i850 USB 2.0 InkJet Printer	i850	Canon Computer Systems
67.	52x24x52 USB 2.0 External CD-RW Drive	CRW-5224A	CenDyne
68.	USB Fighterstick	FTRUSB	CH Products
69.	Pro Throttle USB Joystick	300-122IL2	CH Products
70.	DOXport 1110 External USB Cable Modem	DP1110	COM21, Inc.
71.	Keyboard: 101 Key USB Style	SDM4540UL	Compaq Computer
72.	Mouse: USB Style	M-U48A	Compaq Computer
73.	Mouse: USB Style	M-U48A	Compaq Computer
74.	Andromeda USB Hub	U-HUB-AN1	Computer Access Technology
75.	USB Host Production Tester	U-HPT-001	Computer Access Technology
76.	USB Hub Tester	UHT	Computer Access Technology
77.	Chief Plus USB 1.1 Protocol Analyzer	U-CHF-128	Computer Access Technology
78.	QuickCam VC USB for Windows version 1.0	LKD5	Connectix Corporation
79.	USB 1.1 WebCam	PD1001	Creative Labs Incorporated
80.	eFilm USB CompactFlash Reader 12	DDReader-12	Delkin Devices
81.	Keyboard: USB	RT7D10	Dell Computer Corporation
82.	SupraMax 56K External USB Modem	SUP2920	Diamond Multimedia Systems
83.	External USB Ethernet Cable Modem	DCM-200	D-Link
84.	USB 1.1 TV Tuner	DSB-T100	D-Link
85.	USB 3 Port Hub 1 Parallel 1 Serial	DSB-H3SP	D-Link Systems Incorporated
86.	56k USB Modem	DSB-560	D-Link Systems Incorporated
87.	2 Port USB 2.0 PCI Adapter Card	DUB-A2	D-Link Systems Incorporated
88.	USB 2.0 4 Port Hub	DUB-H4	D-Link Systems Incorporated
89.	USB 1.1 64MB Portable Storage Unit	ED1064	Easy Disk
90.	USB Hub	Hub4U	Entrega Technology
91.	USB to Serial 9 Pin Converter	CON-USB-S9	Entrega Technology
92.	2 Port USB PCI Card	UPG-PCI-2U	Entrega Technology
93.	Stylus 740 Color USB InkJet Printer	P110A	Epson America Incorporated
94.	Perfection USB Photo Scanner	1600	Epson America Incorporated
95.	Perfection 2400 USB Photo Scanner	J111A	Epson America Incorporated
96.	Stylus Photo 820 USB InkJet Printer	B163A	Epson America Incorporated
97.	Perfection 1600 USB Photo Scanner	J112A	Epson America Incorporated
98.	24x10x40x USB 2.0 External CD-RW Drive	CRW2400PU	EXP Computer Incorporated
99.	16.8GB USB 1.0 Hard Disk Drive	260616-USB	Fantom Drives
100.	80GB USB 2.0 External Hard Drive	FDU8072	Fantom Drives
101.	16x USB 2.0 External DVD-Rom Drive	FDR0MU16PG	Fantom Drives
102.	USB 2.0 4 Port Hub	99467	Fellowes
103.	IQ USB Cable	IQUSB	Freecom
104.	Paragon PCI to 2 Port USB 1.1 Upgrade Card	BG-3800-00	Global Paragon
105.	USB Gamepad Pro	42111	Gravis
106.	WinTV USB 1.1 TV Tuner	40211	Hauppauge
107.	External 56K USB Modem	PN580U	Hawking
108.	ScanJet 6200C USB/SCSI Color Scanner	C6270	Hewlett-Packard



	Description	Model/version	Vendor
109.	ScanJet 4100C USB Color Scanner	C6290A	Hewlett-Packard
110.	ScanJet 5200C USB Color Scanner	C7190A	Hewlett-Packard
111.	DeskJet 895CXI Color InkJet Printer USB 1.0	C6410A	Hewlett-Packard
112.	ScanJet 3300C USB Color Scanner	C7680A	Hewlett-Packard
113.	ScanJet 6300C USB/SCSI Color Scanner	C7670A	Hewlett-Packard
114.	PhotoSmart S20 USB Scanner	C5101A	Hewlett-Packard
115.	CD-Writer Plus 8200e External USB Drive	C4453A	Hewlett-Packard
116.	DeskJet 895CXI Color InkJet Printer USB 1.0	C6410A	Hewlett-Packard
117.	USB Keyboard	SK-2502U	Hewlett-Packard
118.	USB Mouse	M-UB48	Hewlett-Packard
119.	USB Keyboard	SK-2502U	Hewlett-Packard
120.	USB Mouse	M-UB48	Hewlett-Packard
121.	Keyboard: 101 Key USB Style	5184-4708	Hewlett-Packard
122.	Mouse: USB Style	M-UB48	Hewlett-Packard
123.	DeskJet 970Cxi USB InkJet Printer	C6429A	Hewlett-Packard
124.	ScanJet 4400C USB Color Scanner	C9870A	Hewlett-Packard
125.	DeskJet 850C USB InkJet Printer	C8934A	Hewlett-Packard
126.	ScanJet 4570C USB Scanner	4570c	Hewlett-Packard
127.	ScanJet 3570C USB Scanner	3570C	Hewlett-Packard
128.	ScanJet 3500C USB Scanner	3500C	Hewlett-Packard
129.	DeskJet 5550 USB Inkjet Printer	5550	Hewlett-Packard
130.	Color PhotoSmart 7350 USB 2.0 Inkjet Printer	7350	Hewlett-Packard
131.	56K V.90 External USB e-Modem	p1979b	Hewlett-Packard
132.	Photosmart 1315 USB Inkjet Printer	C8634A	Hewlett-Packard
133.	4x4x6 USB External CD-RW Drive	8220e	Hewlett-Packard
134.	USB External CD-RW Drive	8200	Hewlett-Packard
135.	USB Keyboard Device	KU-9958	IBM Corporation
136.	USB Mouse	MO09KZ	IBM Corporation
137.	Optical Navigator USB Mouse	MO27FO	IBM Corporation
138.	40x12x48x USB 2.0 External CD-RW Drive	ME-320U2	ICUE
139.	Super Disk External 120MB USB Port Disk Drive (Mac)	SD-USB-M2	Imation
140.	Super Disk External 120MB USB Port Disk Drive (Mac)	SD-USB-U2	Imation
141.	Super Disk External 120MB USB Port Disk Drive (Mac)	SD USB U3	Imation
142.	USB External Floppy Drive for Mac & PC	D353FUE	Imation
143.	Any Point Phoneline USB Home Network Device	USB 1 Mbps	Intel Corporation
144.	USB Customer Hub	8x931HA	Intel Corporation
145.	USB High Speed Test Fixture	01/08	Intel Corporation
146.	USB High Speed Test Fixture	01/08	Intel Corporation
147.	Kanguru 60GB USB 2.0 External Hard Drive	U2-HD35-60	Interactive Media
148.	Kanguru Combo Internal USB 2.0 Hub & PCI Card	Combo Pack	Interactive Media
149.	Black USB Scrolling Mouse	MOSXU	Interex
150.	USB 4 Port Hub (Strawberry)	G-UH124	IOGear
151.	MiniHub USB 2.0 4 Port Hub	GUH204	IOGear
152.	2 Port USB 2.0 Cardbus PCMCIA Card	GPU202	IOGear
153.	MicroHub 4 Port USB Hub	GUHX104	IOGear
154.	16x10x40x USB 2.0 External CD-RW Drive	GCD16140-OB	IOGear
155.	100 MB USB External Zip Drive	Z100USB	lomega Corporation
156.	Zip 250MB USB Drive	Z250USBPCM	lomega Corporation
157.	Peerless 10GB USB Storage Drive version 1.1	PRLSUSB	lomega Corporation
158.	Predator USB 2.0 External CD-RW Drive	CDRW9602EXT-B	lomega Corporation
159.	External 16x10x40 USB CD-RW Drive	CDRW6402EXT-B	lomega Corporation
160.	USB 2.0 40GB External Hard Drive	HDD040	lomega Corporation
161.	USB 2.0 80GB External Hard Drive	HDD080	lomega Corporation
162.	48x24x48x USB 2.0 External CD-RW Drive	CDRW5529EXT	lomega Corporation
163.	USB 2.0 20GB External Hard Drive	IPHD20	lomega Corporation
164.	Predator USB 2.0 External CD-RW Drive	CDRW38402EXT2-B	lomega Corporation
165.	16x10x40 USB 2.0 External CD-RW Drive	CDRW6402EXT-B	lomega Corporation
166.	Evolution MOUSE-TRAK USB Trackball	X-6XUSB	ITAC Systems Incorporated
167.	External 56K USB Modem	01496612	Jaton
168.	Orbit Trackball 2 Button USB/PS2 Mouse	HTB114	Kensington Microware Limited
169.	Orbit Trackball 2 Button USB/PS2 Mouse	HTB114	Kensington Microware Limited
170.	USB 4 Port Hub	UH-4ABK	Keyspan



	Description	Model/version	Vendor
171.	Internal Front Panel 4 Port USB 1.1 Hub	KW-591	Kouwell
172.	10GB USB External Hard Drive	10GBIDE IBM	La Cie
173.	4/2/8X CD-RW USB	Mite	La Cie
174.	Limited 30GB PocketDrive Ext. FireWire & USB Hard Drive	MHL2300AT	La Cie
175.	24x10x40 Firewire/USB 2.0 External CD-RW Drive	U&I	La Cie
176.	24x12x40 Fusion USB 2.0 External CD-RW Drive	LC241240	La Cie
177.	USB 1.1 WebCam	961206-0403	Labtec Enterprises Incorporated
178.	Headset for PC Voice Access USB	Axis-711	Labtec Enterprises Incorporated
179.	USB Color Jetprinter	Z35	Lexmark International
180.	E320 USB Laser Printer	4500-001	Lexmark International
181.	USB Color Jetprinter	Z25	Lexmark International
182.	ADSL USB 1.1 Modem	USBDSL1	LinkSys
183.	Wireless USB2.0 Network Adapter(802.11b)	WUSB11	LinkSys
184.	40x12x40 USB 2.0 External CD-RW Drive	LXR-40122C	Liteon
185.	PageScan USB Color Scanner	S-UA1	Logitech Incorporated
186.	First Mouse Wheel - USB1.0/PS2	M-BB48	Logitech Incorporated
187.	Keyboard: USB 1.0 Internet Navigator Keyboard	Y-BE22	Logitech Incorporated
188.	Wingman Rumblepad Vibration USB 1.1 Gamepad	G-UA3	Logitech Incorporated
189.	Mx500 Optical USB Mouse	Mx500	Logitech Incorporated
190.	USB 4 Port Hub	UH-Mini4i	MacSense Connectivity
191.	52x24x52 USB 2.0 External CD-RW Drive	BCE 5224UI	MagicSpin
192.	52x24x52 USB 2.0 External CD-RW Drive	BCE 5224UI	MagicSpin
193.	USB1.1 Micro Webcam Basic	IC50C	Micro Innovations
194.	Advantage 60GB External Firewire/USB 2.0 Hard Drive	HD6072U2F	MicroNet
195.	Advantage 100GB External Firewire/USB 2.0 Hard Drive	HD10072U2F	MicroNet
196.	Advantage 80GB External Firewire/USB 2.0 Hard Drive	HD8072U2F	MicroNet
197.	Intellimouse USB	1.1USB	Microsoft Corporation
198.	SideWinder Precision Pro USB Joystick	X03-57540	Microsoft Corporation
199.	Digital Sound System 80 USB Speakers	76923-01117200	Microsoft Corporation
200.	Natural USB and PS/2 Elite 2.0 Keyboard	E06401COMB	Microsoft Corporation
201.	Intellimouse USB Optical Mouse	X04-91790	Microsoft Corporation
202.	Internet Keyboard Pro USB Keyboard	RT9420 V 5FTW	Microsoft Corporation
203.	Internet Keyboard Pro USB Keyboard	RT9420 V 5FTW	Microsoft Corporation
204.	SideWinder Strategic Commander USB Game Controller	X05-92630	Microsoft Corporation
205.	Intellimouse Explorer USB Optical Mouse	B75-00057	Microsoft Corporation
206.	Sidewinder Precision USB Racing Wheel	X04-74734	Microsoft Corporation
207.	Backpack 40GB External USB 2.0 & Parallel Port Hard Drive	155010	MicroSolutions Incorporated
208.	Backpack External Parallel Port/USB 2.0 DVD/CD Drive	210010	MicroSolutions Incorporated
209.	Backpack 48x24x48 USB 2.0 External CD-RW Drive	232010	MicroSolutions Incorporated
210.	Backpack 32x10x40 USB 2.0 External CD-RW Drive	194200R	MicroSolutions Incorporated
211.	ScanMaker X6 USB Flatbed Scanner	MRS-1200X6J	Microtek
212.	Scanmaker USB Scanner	V6UPL	Microtek
213.	Scanmaker USB Scanner	5900	Microtek
214.	2x/4x/8x CD-RW USB External Drive	CR-4802TU	Mitsumi Electronics Corporation
215.	MultiModem ZBA 56k v.90 External USB 1.0 Fax/Modem	MT5634ZBA-USB	MultiTech Systems
216.	PAKit Pro 4.0GB External USB 1.1 Storage Drive	PKP04	myPAKit.com
217.	GPIB-USB Measurement Device	NI-488.2	National Instruments
218.	Mouse: USB Style 1.1	NEC J	NEC Corporation
219.	Storix Fusion USB 2.0/Firewire 30GB Mobile Hard Drive	STXFU25	NewAge International
220.	USB Hub Clear Lime 4 Port	BT6AT01	Newnex Technology Corporation
221.	USB 2.0 PCI Card	2.0	Orange Micro
222.	iBot2 USB 2.0 Web Cam w/PCI Card	70USB90051	Orange Micro
223.	48x12x48 USB 2.0 External CD-RW Drive	USB 1930-48	Pacific Digital Corporation
224.	32x12x48 USB 2.0 External CD-RW Drive	32x12x48-USB-2	Pacific Digital Corporation
225.	USB 2.0 PCI Card	7/10/03	Pacific Digital Corporation
226.	16x10x40 USB 2.0 External CD-RW Drive	1930-16	Pacific Digital Corporation
227.	USB 2.0 PCI Card	7/10/03	Pacific Digital Corporation
228.	QUADHUB USB Hub	UH4100-K	Peracom Networks
229.	17" Color USB 1.0 Monitor	PA7588 T001	Philips
230.	USB Speakers version 1.0	DSS 350	Philips
231.	USB Speakers version 1.0	DSS 370	Philips
232.	JackRabbit USB 2.0 External 24x12x40 CD-RW Drive	JR24CWRW	Philips



	Description	Model/version	Vendor
233.	USB External CD-RW Drive	PCRW464K47	Philips
234.	Dual Slot Flash Card Reader (USB 1.1 Port)	PNYUSA-MDCFSM	PNY Technologies
235.	USB Flash Card Reader version1.0	.	PNY Technologies
236.	ColorShot USB 1.0 Photo Printer	COLORSHOT	Polaroid Corp
237.	Que! USB 2.0/1.1 CD-RW Drive	2.0/1.1	QPS Incorporated
238.	Que! 32x10x40 USB 2.0/1.1 External CD-RW Drive	QPS-525	QPS Incorporated
239.	USB 2.0 CardBus PC Card	CBU2	Ratoc Systems Incorporated
240.	USB 1.0 Studio Monitor Speaker Set	MA-150U	Roland Corporation
241.	Cyborg 3D Force USB Joystick	J45	Saitek
242.	USB Hub version 1.0	JU-H40012	SiG Incorporated
243.	USB Dual Port PCI Adapter version 1.0	US2204	SiG Incorporated
244.	USB 1.1 Dual Port PCI Adapter	US2203	SiG Incorporated
245.	4-Port USB 2.0 SlimHub w/Power Adapter	4000P	SiG Incorporated
246.	SimpleDrive USB 20GB External Hard Drive	STI-USB2032	Simple Technologies
247.	Bonzai USB 1.1 32MB Mini-Drive	STI-USBMD/32	Simple Technologies
248.	USB 2.0 80GB External Hard Drive	USBFP80P	SmartDisk
249.	EZ Connect USB 1.1 Cable Modem	SMC8002CM	SMC Networks, Inc.
250.	USB Keyboard Device 1.0	KU-9855	Sony Corporation
251.	Spessa 6x/4x/2x External USB 1.1 CD-ReWritable Drive	CRX100E/X	Sony Corporation
252.	64MB USB Storage Media	USM64	Sony Corporation
253.	48x12x48 USB 2.0 External CD-RW Drive	CRX2100U	Sony Corporation
254.	40x12x48 USB 2.0 External CD-RW Drive	CRX1950U	Sony Corporation
255.	Cute USB 1.1 TV Tuner	USBTVTuner	StarTech.com
256.	Slim-Line USB 1.1 External CD-RW Drive	ECW-043	Targus
257.	USB 2.0 48x16x48 External CD-RW Drive	UE-481648D	TDK U.S.A. Corporation
258.	External USB 1.1 CD-ROM Drive	CD-210PU	TEAC Corporation
259.	External USB 1.1 CD-RW Drive	CDWE24E	TEAC Corporation
260.	4x4x8 USB 1.1 External CD-RW Drive	CDWF58E	TEAC Corporation
261.	Top Gun USB Joystick 1.1	USB	Thrustmaster Incorporated
262.	USB Bus Powered 4 Port Hub 2.0	UH-9126Z	Tripplite
263.	56k v.90 Pro External USB Voice/Fax Modem usb 1.1	0525	U.S. Robotics
264.	56k v.90 Pro External USB Voice/Fax Modem usb 1.1	3C5605	U.S. Robotics
265.	Wireless USB 1.1 Adapter (802.11b)	1120	U.S. Robotics
266.	Astro 2100U USB Flatbed Scanner 1.1 compatible	2100U/UTI	UMAX
267.	Astra 4450 USB Flatbed Scanner 1.1	4450	UMAX
268.	USB Scanner usb 2.0	4800	Visioneer
269.	USB 2.0 40GB External Hard Drive	WD800B005-RNN	Western Digital Corporation
270.	Spyder 12x8x24 USB 2.0 External CD-RW Drive	CRW-70	Yamaha
271.	24x10x40 USB 2.0 External CD-RW Drive	CRW3200UX	Yamaha
272.	44x24x44 USB 2.0 External CD-RW Drive	CRW-F1UX	Yamaha
273.	56k USB 1.0 Modem	2986	Zoom Telephonics Incorporated
274.	Omni 56KPlus USB1.0 Modem Desk	Omni 56K Plus	ZyXEL Communications

ADDITIONAL TEST SERVICES

Regression Testing

For maximum flexibility and cost benefits to our customers, NTS does not incorporate regression testing into the test suite by default. However, if you are interested in additional regression testing after the completion of your project, NTS will be happy to work with you to address your specific needs. When the client is ready for regression testing, here's what we do:

- Client contacts NTS Account Manager indicating that they are ready for regression testing.
- NTS estimates how long it will take to perform regression testing. This is normally estimated in 8 hour blocks.
- An addendum is generated and sent to the client.
- The client signs off on addendum.
- Regression testing begins.

The goal is NTS's goal to be flexible, just like an extension to your internal testing capabilities, and to keep testing as cost effective as possible and yet give our clients exactly what they need.



USB Certification Testing

During testing, issues that are encountered may be due to a suspect USB physical layer of the product-under-test. Because of NTS's ability to perform USB 2.0 compliance testing and having all of the necessary equipment, NTS can perform validation of the product to the USB certification standards. Testing typically includes electrical test (e.g., signal quality, inrush current, etc.) as well as interoperability testing.

CONCLUSION

Thank you for giving NTS the opportunity to provide you more information about the computer testing services that we provide. If you have any questions or comments, please feel free to contact me at the phone number or e-mail address listed below. Thank you again for your time, and we look forward to working with you in the future.

Thank You,

A handwritten signature in black ink that reads 'Raymond Chung' in a cursive style.

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