USB Compliance Checklist
Hubs (Excluding Root Hubs)

For the 2.0 USB Specification
Checklist Version 1.06
October 5, 2001

USB Device Product Information

field	**—all fields must be filled in—**
Date	
Vendor Name	
Vendor Street Address	
Vendor City, State, Postal Code	
Vendor Country	
Vendor Phone Number	
Vendor Contact, Title	
Vendor Contact Email Address	
Product Name	
Product Model Number	
Product Revision Level	
Test ID Number	
Manufacture, Model, & TID of Receptacles used	
Manufacture, Model, & TID of Connectors and/or Cable Assemblies used	
Manufacture & Model Identifier of the USB Hub Silicon used in this hub	
Signature of Preparer	

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Revision History

version	changes	date
1.06	Changes for 2.0	2001.10.5
1.05	added test ID field, SP8 section ref	1999.8.16
1.04	added H3, revised H2, H4	1999.7.15
1.03	added E1, test description pointers	1999.4.9
1.02	revised checklist 3.2 to fully cover spec 7.1.7.5, 11.4.4, and 11.9 revised introduction and clarified bus current draw ownership revised M12, H1, H11, P7, inserted new H12, M13, fixed Δ, μ, Ω, typos	1999.2.5
1.01	added preparer's signature and changed checklist contact info	1999.1.4
1.00	initial release: numerous clarifications/bug fixes, added contact info	1998.11.20
.75	first public review draft, released for Taipei USB Plugfest	1998.10.26

1 Introduction

This checklist helps designers of USB hubs (not including root hubs) to asses their products' compliance with the Universal Serial Bus Specification, Revision 2.0. Unless explicitly stated otherwise, all references to the USB Specification refer to Revision 2.0.

This checklist is also used, in part, to qualify a USB hub for the USB-IF Integrators List. This document and other USB compliance tools, including USB Check, are available in the developers section of the USB-IF's website, http://www.usb.org/developers/. The compliance checklists and other tools are updated periodically, so developers should check for updates when starting new projects.

Section 5, Recommended Questions, contains questions covering areas not required by the USB Specification. Answering these questions is not a requirement for compliance with the Specification or acceptance to the Integrators List. However, vendors are strongly encouraged to take these questions into consideration when designing their products.

Questions or comments regarding the Integrators List, Compliance Workshop testing results, or checklist submissions should be sent to admin@usb.org. If you have questions regarding the checklist itself, feel it fails to adequately cover an aspect of the USB specification, have found an error, or would like to propose a question, please contact the USB-IF at checklists@usb.org.

1.1 General Notes

- All voltages are referenced to the hub's USB ground.
- Active extension cables violate the USB Specification since they do not allow for proper bus topology management. A one-port hub integrated into the end of a 26ns cable is legal, and fulfils the same role without raising the possibility of violating power distribution and turnaround time requirements. The hub must be a bus-powered hub unless a power supply is used to meet the requirements for a self powered USB port.

2 Mechanical Design and Layout

ID	question
M1	What is the manufacture and model identifier of the connectors or cables used with this hub? Manufacturer: _____ Model: _____ If the connectors or cables used in this peripheral are **NOT** listed on the USB Integrators List attach a Connector and Cable Assembly checklists covering this hub's connectors and cable assemblies.
M2	What is the manufacture and model identifier of the USB silicon used in this hub? Manufacturer: _____ Model: _____ If the silicon used in this peripheral is **NOT** listed on the USB Integrators List attach a Hub Silicon checklist covering this hub's USB silicon.
M3	If the hub includes permanently attached devices, attach the appropriate checklists for those devices.

Hub vendors are strongly encouraged to review the Connector and Cable Assembly and Hub Silicon checklists regardless of whether or not their device's cabling, connectors, and silicon appear on the Integrators List.

ID	question	response	sections in spec
M4	Does the hub have type A receptacles on all user-accessible downstream ports?	yes ☐ no ☐	6.2
M5	Can the hub's data lines withstand voltages between –1.0 and 4.6V applied with a source impedance of 39Ω ±2% for up to 100ns?	yes ☐ no ☐	7.1.1
M6	When tri-stated, can any data line be continuously shorted to V_{BUS}, GND, the other data line, or the connector's shield without damage occurring?	yes ☐ no ☐	7.1.1
M7	When driving 50% of the time, can any data line be shorted to V_{BUS}, GND, the other data line, or the connector's shield without damage occurring?	yes ☐ no ☐	7.1.1
M8	Do all downstream ports have 15kΩ ±5% pull down resistors on D+ and D- ?	yes ☐ no ☐	7.1.5
M9	Do all D+ and D- traces present a characteristic impedance of 45Ω ±15% to GND and a differential impedance of 90Ω ±15%, between the hub's cable connections and termination resistors?	yes ☐ no ☐	7.1.6
M10	Do all downstream ports present 150pF or less capacitance on D+ and D-?	yes ☐ no ☐	7.1.6
M11	If edge rate control capacitors are used: Are they located between the transceiver pins and the hub's termination resistors? Is their capacitance less than 75pF and balanced within 10%?	 yes ☐ no ☐ yes ☐ no ☐	7.1.6
M12	For full-speed signals originating at the hub, is the signaling rate 12.000Mb/s ±.25%, even if the hub uses spread spectrum clocking?	yes ☐ no ☐	7.1.11
M13	For low-speed signals originating at the hub, is the signaling rate 1.50Mb/s ±1.5%, even if the hub uses spread spectrum clocking?	yes ☐ no ☐	7.1.11
M13	Is the maximum propagation delay for a signal with full- speed edges on any route through the hub (including up to 1ns of propagation time from the hub's upstream to the hub silicon and up to 3ns of propagation time from the hub silicon to any downstream port): 44ns or less if the hub has a detachable cable? 70ns or less if the hub has a fixed cable?	 yes ☐ no ☐ yes ☐ no ☐	7.1.14
M14	Is the maximum propagation delay on any route through the hub for a signal to, or from, a low- speed device connected directly to the hub (including up to 1ns of propagation time from the hub's upstream port to the hub silicon and up to 3ns of propagation time from the hub silicon to any downstream port): 274ns or less if the hub has a detachable cable? 300ns or less if the hub has a fixed cable?	 yes ☐ no ☐ yes ☐ no ☐	7.1.14
M15	Are the hub's upstream receivers and transmitters within 1ns of its upstream cable connection?	yes ☐ no ☐	7.1.16
M16	Are the hub's downstream receivers and transmitters within 3ns of its downstream cable connections?	yes ☐ no ☐	7.1.16
M17	Does the hub present sufficient capacitance between V_{BUS} and GND on its upstream and downstream ports to prevent adverse effects from flyback voltages when a cable is disconnected? (A minimum of 1.0µF is recommended for the upstream port.)	yes ☐ no ☐	7.2.4.2
M18	Does the hub have only one upstream port?	yes ☐ no ☐	11.1.1

2.1 Tethered Hubs

(not applicable to untethered hubs)

Tethered hubs are hubs with a captive upstream cable.

MT1	Does the captive cable have a series A plug?	yes ☐ no ☐	6.2
MT2	Does the hub pull up D+ with a 1.5kΩ ±5% resistor attached to a voltage source between 3.0 and 3.6V or with a Thevénin source of at least 900Ω?	yes ☐ no ☐	7.1.5

2.2 Untethered Hubs

(not applicable to tethered hubs)

Untethered hubs are hubs with a detachable upstream cable.

MUT1	Does the have a series B receptacle?	yes ☐ no ☐	6.2
MUT2	Does the hub pull up D+ with a 1.5kΩ ±5% resistor attached to a voltage source between 3.0 and 3.6V?	yes ☐ no ☐	7.1.5
MUT3	Does the hub's upstream port present 100pF or less on D+ and D-?	yes ☐ no ☐	7.1.6

3 Hub States and Signals

E1	Are the hub's differential *and* single-ended USB signals within spec? Note: This test is especially important if ferrite beads or a common mode choke is used on the USB data lines, as these components often pose a significant signal integrity hazard.	yes ☐ no ☐	7.1.6

For details on testing USB signals, consult the USB-IF's signal quality test description, which can be downloaded from the USB-IF Compliance Program webpage.

3.1 Hub Controller

H1	Can the hub pull up D+ on its upstream port from 0V to at least 2.0V within 2.5μs?	yes ☐ no ☐	7.1.5
H2	Is the hub's pullup active only when V_{BUS} is high?	yes ☐ no ☐	7.1.5
H3	Is the V_{BUS} switching threshold for the hub's pullup control between 1.0V and 4.0V?	yes ☐ no ☐	7.1.5
H4	If the hub is bus powered, or uses bus power to run any of its components, does it pullup its upstream D+ line within 100ms of V_{BUS} exceeding 4.01V?	yes ☐ no ☐	7.1.5
H5	When the hub is plugged into the bus, does it meet all power-on and connection timing requirements, as illustrated in Figure 7-19?	yes ☐ no ☐	7.1.7.1 7.3.2
H6	Does the hub respond to a reset no sooner than 2.5μs and no later than 10ms after the SE0 begins?	yes ☐ no ☐	7.1.7.3
H7	Is the hub's reset recovery time less than 10ms?	yes ☐ no ☐	7.1.7.3

H8	At the end of the reset recovery time: Is the hub's controller in the default state? The frame timer unlocked? Is an SE0 driven on all downstream ports? Are all port status bits set to their default values?	 yes ☐ no ☐ yes ☐ no ☐ yes ☐ no ☐ yes ☐ no ☐	7.1.7.3 9.1.1 11.2.1 11.5.1 11.16.2.6
H9	Can the hub correctly handle more than one USB RESET with no intervening packets?	yes ☐ no ☐	7.1.7.3
H10	Does the hub begin the transition to its suspend state after its upstream bus segment has been idle for 3ms, regardless of the hub's state?	yes ☐ no ☐	7.1.7.4
H11	Has the hub's power consumption dropped to its suspended value after the hub's upstream bus segment has been idle for 10ms?	yes ☐ no ☐	7.1.7.4
H12	When suspended, does the hub recognize any non-idle state on the bus, excluding a reset, as a resume signal?	yes ☐ no ☐	7.1.7.5
H13	When suspended, does the hub recognize a reset and act on the signal so that it enters the default state?	yes ☐ no ☐	7.1.7.5 7.1.7.3 9.1
H14	Does the hub recognize a K→low- speed EOP→J transition on its upstream port as the end of resume signaling?	yes ☐ no ☐	7.1.7.5
H15	Is the hub able to accept a SetAddress() request 10ms after resume is signaled?	yes ☐ no ☐	7.1.7.5
H16	Does the hub complete its wakeup within 20ms?	yes ☐ no ☐	7.1.7.5
H17	Can the hub function correctly with frame lengths between 995 and 1005µs?	yes ☐ no ☐	7.1.12
H18	Does the hub enumerate correctly on tier 6, when subjected to worst-case hub bit skews and delay times?	yes ☐ no ☐	7.1.14 7.1.19
H19	Does the hub controller allow an interpacket delay of at least two full- speed bit times?	yes ☐ no ☐	7.1.18
H20	Is the hub's controller transaction timeout 16–18 full-speed bit times?	yes ☐ no ☐	7.1.19
H21	Does the combination of the hub's pullup and the 15kΩ ±5% pulldown resistor at the port above the hub yield a voltage between 2.7 and 3.6V when the bus is idle?	yes ☐ no ☐	7.3.2
H22	Does the hub complete SetAddress() or a standard request with no data in less than 50ms?	yes ☐ no ☐	7.3.2 9.2.6.3
H23	Does the hub pass a full Chapter 9 test, as performed by USB Check?	yes ☐ no ☐	Chapters 8 and 9
H24	Does the hub controller implement a default control endpoint 0 for all addresses?	yes ☐ no ☐	9.1.1.4
H25	Does the hub pass a full Chapter 11 test, as performed by USB Check?	yes ☐ no ☐	Chapter 11
H26	Does the hub complete a standard request with no data stage within 50ms?	yes ☐ no ☐	11.16.1
H27	Does the hub deliver the first and all subsequent data packets, except for the last data packet, for a standard request with a data stage within 50ms?	yes ☐ no ☐	11.16.1
H28	Does the hub deliver the last data packet for a standard request with a data within 50ms?	yes ☐ no ☐	11.16.1

Hub vendors are strongly encouraged to complete all bus transactions as quickly as is practical. See section 9.2.6.1 for details.

3.2 Remote Wakeup

W1	Does the hub wait at least 5.0ms after its bus segment enters the idle state before sending a remote wakeup?	yes ☐ no ☐	7.1.7.5
W2	Does the hub signal remote wakeup by driving K upstream for at least 1ms,	yes ☐ no ☐	7.1.7.5

	but not more than 15ms?		
W3	After driving K, does the hub immediately tri-state its buffers without driving the bus to any non-K state?	yes ☐ no ☐	7.1.7.5
W4	When acting as an intermediate hub, does the hub repeat a remote wakeup on its upstream port within 100µs of receiving the remote wakeup at any downstream port?	yes ☐ no ☐	7.1.7.5
W5	When acting as an intermediate hub, does the hub drive resume on its upstream port for at least 1ms?	yes ☐ no ☐	7.1.7.5
W6	When acting as an intermediate hub, does the hub stop driving resume on its upstream port and reverse connectivity no more than 15ms after it began driving resume?	yes ☐ no ☐	7.1.7.5
W7	When acting as the controlling hub, does the hub drive resume on only the downstream port which received the resume signal?	yes ☐ no ☐	7.1.7.5 11.9
W8	When acting as the controlling hub, does the hub drive resume within 100µs of receiving the resume signal?	yes ☐ no ☐	7.1.7.5 11.9
W9	When acting as the controlling hub, does the hub drive resume on the resumed downstream port for at least 20ms?	yes ☐ no ☐	7.1.7.5 11.9
W10	Does the hub generate a remote wakeup when any C_PORT_SUSPEND bit is set, regardless of whether or not remote wakeup is enabled?	yes ☐ no ☐	11.4.4 9.6.2
W11	If remote wakeup is enabled, does the hub generate a remote wakeup when any bit is set in the hub change field or a port change field?	yes ☐ no ☐	11.4.4 9.6.2

4 Operating Voltages and Power

P1	Is the port power rail stabilization time (Δt2) less than 100ms?	yes ☐ no ☐	7.1.7.1
P2	Does the hub source no current to V_{BUS} under any circumstance?	yes ☐ no ☐	7.2.1
P3	When the hub is suspended, is average current drawn from V_{BUS} 500µA or less, excluding current drawn by devices attached downstream from the hub but including devices included in the hub's unit load?	yes ☐ no ☐	7.2.3
P4	If the hub's current draw spikes during suspend, is the maximum spike height less than 100mA and is the spike's edge rate less than 100mA/µs for V_{BUS} between 4.02 and 5.25V? (Excluding current drawn by devices attached downstream from the hub but including devices included in the hub's unit load.)	yes ☐ no ☐	7.2.3
P5	When the hub wakes up from suspend, does it limit any inrush currents drawn from V_{BUS} to 100mA or less, excluding current drawn by devices attached downstream from the hub but including devices included in the hub's unit load?	yes ☐ no ☐	7.2.3
P6	Does the hub limit the inrush current drawn from V_{BUS}, either by using capacitors smaller than 10µF or by using soft-start circuits, such that no more than 10µF of capacitance is charged by currents higher than 100mA when the hub is hot plugged?	yes ☐ no ☐	7.2.4.1 7.2.3
P7	Does the hub draw no inrush current from the bus at configuration time?	yes ☐ no ☐	7.2.4.1
P8	Does the hub have at a total of at least 120µF of low ESR bypass capacitance at its downstream ports?	yes ☐ no ☐	7.2.4.1

P9	Does the hub's port bypassing limit the maximum voltage droop at any of its downstream ports to 330mV, even when subjected to hot-plug inrush currents with peaks of 7.5A or more? (As of this writing, the highest inrush current the USB-IF has observed from a within spec configuration is 7.40A.)	yes ☐ no ☐	7.2.4.1
P10	Does the hub's descriptor include the port power turn on time? (bPwrOn2PwrGood should be zero for a hub without power switching.)	yes ☐ no ☐	11.15.2.1 11.11
P11	If the hub implements ganged power switching, does it conform to the requirements of section 11.11.1?	yes ☐ no ☐	11.11.1

4.1 Self Power

(applicable to **any** hub capable of operating as a self powered device)

SP1	Can the hub supply 0 to 500mA on each of its downstream ports when using self power?	yes ☐ no ☐	7.2.1
SP2	Does the hub implement overcurrent protection to prevent more than 5A from being drawn from any downstream port?	yes ☐ no ☐	7.2.1.2.1
SP3	Is the hub's overcurrent protection resettable without user mechanical intervention, such as replacing a fuse?	yes ☐ no ☐	7.2.1.2.1
SP4	Does the hub draw the amount of current specified in its MaxPower field or less from the bus at all times, **including** when powering up a downstream port, provided its V_{BUS} is between 4.02 and 5.25V?	yes ☐ no ☐	7.2.1.3
SP5	Can the hub operate in all states with a steady-state upstream V_{BUS} of 4.35–5.25V when using self power?	yes ☐ no ☐	7.2.2
SP6	Can the hub operate in all states with a transient upstream V_{BUS} as low as 4.02V when using self power?	yes ☐ no ☐	7.2.2
SP7	Can the hub maintain V_{BUS} between 4.75 at 5.25V at all of its downstream connectors for DC loads between 0 and 500mA per downstream port when using self power?	yes ☐ no ☐	7.2.2
SP8	If an overcurrent condition occurs, does the hub report the event to the host?	yes ☐ no ☐	11.13.5

4.2 Bus Power

(applicable to **any** hub that can use bus power)

BP1	Can the hub supply 0 to 100mA to each of its downstream ports when using only bus power?	yes ☐ no ☐	7.2.1
BP2	Does the hub allow host controlled power switching of its downstream ports?	yes ☐ no ☐	7.2.1.1 11.11
BP3	When reset, does the hub turn off power to all downstream ports?	yes ☐ no ☐	7.2.1.1
BP4	Does the hub draw the amount of current specified in its MaxPower field or less at all times, excluding current provided to downstream ports, provided its V_{BUS} is between 4.02 and 5.25V?	yes ☐ no ☐	7.2.1.3
BP5	Can the hub operate in its unconfigured state with a steady-state V_{BUS} of 4.35–5.25V?	yes ☐ no ☐	7.2.2
BP6	Can the hub operate in its unconfigured state with a transient V_{BUS} as low as 4.02V?	yes ☐ no ☐	7.2.2
BP7	Can the hub operate in its configured state with a steady-state V_{BUS} of 4.50–5.25V?	yes ☐ no ☐	7.2.2
BP8	Can the hub operate in its configured state with a transient V_{BUS} as low as 4.17V?	yes ☐ no ☐	7.2.2

BP9	Is the maximum DC voltage drop between the hub's cable connections 100mV?	yes ☐ no ☐	7.2.2
BP10	When the hub wakes up from suspend, does it limit any inrush currents to 100mA or less, excluding current delivered to its downstream ports?	yes ☐ no ☐	7.2.3
BP11	Does the hub limit the inrush current when one or more of its downstream ports is turned on?	yes ☐ no ☐	7.2.4.1

Note: the 100mA current draw allowed for a bus powered hub includes all current drawn by the hub **except** current passed to downstream USB ports via V_{BUS}, GND, D+, D-, or cable EMI shields. Thus, the 100mA includes the power required to drive the hub's upstream port but does not include the power supplied to downstream devices or required to drive downstream data lines—since the hub and any device connected directly to the hub will not drive signals simultaneously, the hub can "borrow" the downstream devices' signaling current.

In the case of a self-powered hub which uses a bus powered upstream interface, no current from upstream is allocated for the hub's downstream ports. Thus, the current used to drive the downstream ports must be drawn from the hub's power supply, not from upstream. In this case, a USB controller with split supplies or external USB transcievers must be used to isolate the downstream drivers from upstream power.

For details on testing USB power provision, consult the USB-IF's drop and droop test description, which can be downloaded from the USB-IF Compliance Program webpage.

5 Recommended Questions

R1	Are the hub's signal swings matched as closely as possible?	yes ☐ no ☐	7.1.2
R2	If ferrite beads are used in the hub's USB connections, are they present on only the V_{BUS} and GND lines?	yes ☐ no ☐	7.1.6
R3	Does the hub limit its total current consumption to 500mA or less when one or more of its downstream ports is turned on?	yes☐ no☐	7.2 7.2.4.1
R4	Does the hub complete all commands as quickly as is practical?	yes ☐ no ☐	9.2.6.1
R5	If the hub is self-powered and does not operate any of its components from bus power, does it only signal an attach when both bus power and external power are available?	yes ☐ no ☐	
R6	Can a bus powered hub withstand a short on its downstream port either until the upstream hub current limits or until the bus powered hub's optional overcurrent limiting trips?	yes ☐ no ☐	
R7	Is a downstream port fully powered on before connect detection and bus speed evaluation is performed?	yes☐ no☐	
R8	Is the hub's average response time less than 5ms for all requests?	yes☐ no☐	11.16.1

6 Explanations

This section should be used to explain any "no" answers or clarify any answers on checklist items above. Please key entries to the appropriate checklist question.