

***Requirements and Recommendations
for USB Products with
Embedded Hosts
and/or
Multiple Receptacles***

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Revision History

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1. Introduction

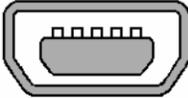
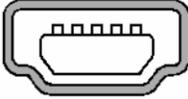
The Universal Serial Bus (USB) interface is the most successful interface in personal computing. There are more products using this interface than any other interface in the history of personal computing. This success is due in large part to the low cost and ease-of-use of USB. The message is simple: plug in cables that match the receptacles, and the PC identifies the peripheral, asks for the correct drivers, and the peripheral works.

The success of USB has also led to a number of applications that are beyond the original vision of the specification and existing certification requirements. The ease of incorporating inexpensive host and peripheral controllers has led to a wide range of peripherals that have more than one USB receptacle, and are not classified as conventional hosts or hubs. Some of these are vendor specific applications that do not impact the overall USB community, and so are of less concern to the USB-IF. However, an ever increasing number of Embedded Hosts and Multiple Receptacle Products interoperate with one or more broad classes of USB peripherals.

Some of these products are not eligible for certification because a test does not exist that covers them. Other products are being certified based on the compliance of only part of the functionality because there is not a procedure to address the entire product. In order to preserve the reliability and ease-of-use of USB products, USB-IF is expanding the test coverage of the compliance tests to include the most common cases.

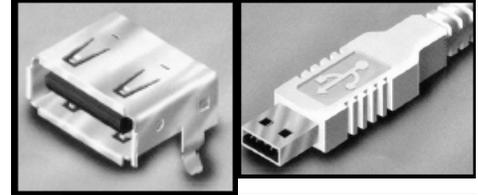
This document offers guidelines for creating complex products that preserve our most valuable asset: the simplicity, reliability, and ease-of-use of USB products. We acknowledge that individual product needs vary widely, and there will be exceptions to nearly every rule. To that end, some principles are offered as recommendations whereas others are listed as requirements for logo certification.

2. Terms

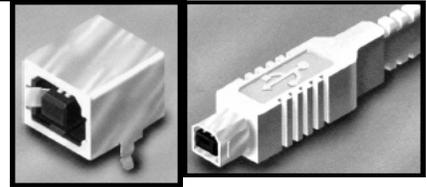
A-device	A product with a Type-A plug inserted into its receptacle.
B-device	A product with a Type-B plug inserted into its receptacle.
Embedded Host	A product that has a Host Controller, but is a closed system, meaning that the user cannot install general purpose software and drivers. Embedded Hosts have a limited set of peripherals with which they will function.
Host Negotiation Protocol (HNP)	A protocol introduced in the USB On-The-Go Supplement that allows an A-device to relinquish control of the bus to a B-device to provide symmetrical behavior to the customer no matter which way a Mini-A to Mini-B cable is connected between two OTG devices.
Host	A general purpose computing device that supports a wide variety of USB peripherals, and to which a user can add drivers and software.
Host Controller	Logic within a device that is capable of providing host functionality.
Icon	The USB trident icon is placed on products adjacent to plugs and receptacles to indicate USB functionality. 
Mini-A, Mini-B, Mini-AB	<div style="display: flex; align-items: center;">  <div style="display: flex; flex-direction: column; gap: 10px;"> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">Mini-B Receptacle</div>  </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">Mini-AB Receptacle</div>  </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">Mini-A Receptacle</div>  </div> </div> </div>
OTG	On-The-Go
Peripheral Controller	Logic within a peripheral that provides endpoints and responds to host enumeration, and transfers data to and from the peripheral according to its function.
Session Request Protocol (SRP)	A protocol introduced in the USB On-The-Go Supplement that allows a B-device to prompt a sleeping A-device to supply V-Bus power.

Standard-A

Another term for Series “A”, when referencing a connector, plug, receptacle or port.

**Standard-B**

Another term for Series “B”, when referencing a connector, plug, receptacle or port.

**Targeted Peripheral List (TPL)**

A list of products supported by an Embedded Host or by an OTG device when acting as a host.

Type-A

A term that indicates either Standard-A or Mini-A, when referencing a connector, plug, receptacle or port.

Type-B

A term that indicates either Standard-B or Mini-B, when referencing a connector, plug, receptacle or port.

3. Conventional USB products

This section describes traditional USB product categories. These product types are well established and well understood by customers. Compliance testing for each category includes a set of Electrical, Interoperability and Functional tests specific to that particular category. Refer to the USB-IF web site at <http://www.usb.org/developers/compliance> for details.

3.1 Host System

A conventional USB Host has multiple Standard-A receptacles, and no Standard-B receptacles. The Host will contain one or more Host Controllers and a root Hub function for connection to these receptacles.

Each Type-A receptacle connects to the dedicated downstream port of a root hub in the Host. Each root hub connects to a Host Controller that is responsible for scheduling and controlling the transactions on the root hub ports. Some hosts will have one Host Controller servicing all Type-A receptacles while others will have multiple Host Controllers.

Each port on a Host System must be capable of supplying 100mA for enumeration, and 500mA for operation.

3.2 Hub

A conventional hub device will provide a single upstream port for connection to a USB Host. This port will consist of either a captive cable with an A-plug or a Type-B receptacle. In addition it will provide a number of downstream Standard-A receptacles for connection of peripherals.

3.3 Peripheral

A conventional USB peripheral contains one Type-B receptacle or a captive cable containing a Standard-A plug. All peripherals whether self-powered or bus-powered must enumerate while only drawing 100mA on VBUS and may consume additional current up to the 500mA limit only when enabled by the Host.

3.4 On-The-Go Device

An On-The-Go (OTG) device contains a single Mini-AB receptacle that will function either as a host or a peripheral. An OTG device defaults to acting as host when a Mini-A plug is inserted, and defaults to acting as peripheral when a Mini-B plug is inserted. The Host Negotiation Protocol (HNP) allows these roles to be changed.

When a Mini-A plug is inserted, OTG products must be capable of supplying at least 8mA on VBUS.

4. Embedded Host Ports

Type-A ports on a product that do not operate either as a hub or as a full host are referred to as Embedded Host ports. Embedded Hosts are not general purpose PC hosts. Generally their system resources are more limited, and users are not expected to be able to install general purpose software or drivers on these products.

Products with Embedded Host ports may or may not contain Type-B ports.

4.1 Examples

Products with Embedded Host Ports can come in many flavors. They may be very PC-like as in Set-Top Boxes that use a PC motherboard, but are closed systems running an embedded operating system. At the other extreme, they may be simple devices with light weight processors that support only one peripheral.

4.2 Certification Requirements

Products with an Embedded Host are eligible for the USB logo based on their compliance with the requirements listed in this section.

4.2.1 Host System Electrical Tests

The Type-A port must pass host system electrical compliance tests.

4.2.2 Targeted Peripheral List

An Embedded Host is required to have a Targeted Peripheral List (TPL). The TPL has two functions: it tells the testers what to test, and it tells customers which peripherals are supported. Therefore the list is required to be available in two forms: 1) a technical version is required for certification testing, giving testers sufficient information to properly test the host capability, and 2) a user oriented version that communicates to customers the products that are tested as compatible peripherals to the host. The former will have VID/PID identifiers, and the latter will simply have Manufacturer and Model numbers.

Entries in a Targeted Peripheral list may refer to specific products (Make/Model & VID/PID) or may refer to a class of products (HID, Mass Storage, etc).

Table 4-1 is an example of a Targeted Peripheral List containing specific products, and is provided here for informational purposes only.

Table 4-1. Example Targeted Peripheral List

Manufacturer	Model	VendorID	ProductID	Description	Speed
Logitech	M-BJ58	0x046D	0xC00E	USB Wheel Mouse	LS

Embedded Hosts and Multiple Receptacles

Yamaha	YST-MS35D	0x0499	0x3002	USB Speakers	FS
TEAC Corporation	FD-05PUB	0x0644	0x0000	USB Floppy Drive	FS
Hewlett Packard	D125X1	0x03F0	0x2311	All-In-One Printer, Scanner, Copier	HS

Table 4-2 is an example of a TPL listing supported device classes as an alternative to listing every Make/Model & VID/PID supported.

Table 4-2. Alternative Example for Targeted Peripheral List.

Class Name	Description	Class Code	Sub Class Code	Protocol	Speeds supported
Mass Storage	Support for USB Floppy drives.	08h	04h	50h	HS,FS
Devices Tested					
Manufacturer	Model	VendorID	ProductID	Description	
TEAC Corporation	FD-05PUB	0x0644	0x0000	USB Floppy Drive	HS

Embedded Hosts using this form of TPL must support any peripheral that complies with the listed class. This includes supplying sufficient power for any and all peripherals covered on the list, as described in section 4.2.3.

4.2.3 Power

Embedded Hosts must be capable of supplying at least 8mA on VBUS. In addition, they must be capable of supplying the maximum amount of current that any device in the Targeted Peripheral List will consume while operating. If the devices on the Targeted Peripheral List are not known to have limited power consumption then the Embedded Host ports must be able to supply 500mA of current.

Embedded Hosts that support a class of peripherals will be required to supply 500mA since the class specifications do not limit the power consumption of the devices in their class.

Embedded Hosts must be capable of providing the maximum amount of power required above on all of its Type-A receptacles simultaneously.

Embedded Hosts must report a failure to the user when peripherals are connected that consume more power than the device supplies.

4.2.4 Speed

An end-user product with an Embedded Host only needs to support the speeds required by the devices on its Targeted Peripheral List. High-, Full-, and Low-Speed may be supported in any combination as dictated by the TPL. The TPL must list the supported speeds at which it operates with each device or class as shown in the tables above.

Silicon or IP designs must support either: A) all three speeds, or B) Full- and Low-Speeds, in order to be eligible for certification.

An Embedded Host must report a warning message to the user when an unsupported peripheral is connected, no matter what speed the peripheral requires.

4.2.5 Transfer Types

The USB specification defines four transfer types: Control, Isochronous, Bulk, and Interrupt.

All Embedded Hosts must support Control transfers in order to be able to enumerate the connected peripherals. Products with Embedded Hosts may support one or more of the three remaining transfer types as required by the peripherals on the product's Targeted Peripheral List.

4.2.6 Hub support

Hub support is not required for Embedded Host ports. If an Embedded Host port does support hubs, it may support only a single hub or it may support any number of hubs within the limits set by the USB Specification. The Embedded Host must provide an indication to the user of any unsupported hub configuration.

Products that offer hub support must report an "Excessive Power" message to the user when a hub is connected which consumes more power than the Embedded Host can supply, just as it would with any other peripheral.

4.2.7 Interoperability

The Embedded Host must be able to demonstrate interoperability with any and all of the devices on its Targeted Peripheral List. Products that list a device class on their Targeted Peripheral List must be able to demonstrate interoperability with a variety of devices in this class.

4.2.8 Indications to the User

On connection of a peripheral, an Embedded Host must indicate to the user whether the peripheral is supported. The indication may be as simple as an LED labeled to convey success or failure. Textual messages are preferred for products that have such a display.

4.2.9 Compliance Tester Recognition

When an Embedded Host enumerates a device with a VID of 0x1A0A, then it shall recognize this device as a Compliance Tester, and follow the behavior defined in the OTG Supplement.

4.2.10 Session Request Protocol

Embedded Hosts may optionally support the SRP. Embedded Hosts that do support SRP must comply with the requirements for SRP as outlined in the OTG supplement, including section 5.1.4 VBus Capacitance.

4.2.11 Host Negotiation Protocol

HNP only applies to ports that use the Mini-AB receptacle, as described in section 5.4 (VBus Capacitance) of the OTG supplement. HNP must not be implemented on Type-A ports.

4.3 Recommendations

To avoid giving the impression that the Type-A port offers standard USB host or hub functionality, the product should have some graphical or textual label adjacent to the receptacle that in some way indicates the limited functionality (e.g., a camera icon). The port may or may not display the USB icon, at the manufacturer's discretion.

5. Multiple Receptacles

This section covers products with Multiple Receptacles other than the conventional products listed in Section 3.

5.1 Products with Multiple Type-B Receptacles

Both the Standard-B and Mini-B receptacles are Type-B receptacles used for upstream ports on a USB device. The Mini-B receptacle is commonly used only on small devices that do not have room for a Standard-B receptacle. The functions and behaviors associated with both types of Type-B receptacles are identical. Nominally, a device will only have a single Type-B receptacle.

5.1.1 Example

A printer that supports multiple hosts might have a Standard-B receptacle for connection to a PC, and an additional Type-B for 'walk-up and print' operations from a laptop, PDA, camera, etc. While the PC receptacle is typically on the rear of the product, the additional receptacle(s) may be located elsewhere on the product.

5.1.2 Certification Requirements

USB-IF certification is available for products with multiple Type-B ports.

- The device must pass all Peripheral Compliance tests on each port.
- The device must provide an independent Peripheral Controller connected to each of the Type-B receptacles and each port must be capable of operating independently from any activity on the other Peripheral Controllers on that device.
- The device must support enumeration and control on all of the Type-B receptacles simultaneously.
- All Type-B ports must support the same speeds.

5.1.3 Recommendations

All Peripheral Controllers on a device should have the same capabilities, and have access to the same resources. In the unusual case where non-equivalent ports are the best solution for the customer, vendors should make the difference obvious by physically separating the ports on the product and by labeling the product in a way that highlights the differences.

Each Type-B port should use the USB icon to identify its functionality.

5.2 Products with Multiple Type-A Receptacles

5.2.1 Examples

A product such as a Set-Top Box or gaming device that is a closed system and supports more than one peripheral simultaneously would fall into this category.

5.2.2 Certification Requirements

- All ports using Type-A receptacles must comply with all of the Embedded Host recommendations listed in Section 4.2.
- If simultaneously accessible, then all Type-A ports must operate concurrently, independent of the activity on the other ports.
- The product must be able to supply the required current to all Type-A ports simultaneously.
- All Type-A ports must support the same speeds.
- All Type-A ports must support the same devices.

5.2.3 Recommendations

See Section 6 for recommendations on equivalency and labeling.

5.3 Products with both Type-B and Type-A receptacles

This category refers to products that act as PC peripherals via their Type-B port(s), and in addition provide an Embedded Host controller function via their Standard-A port(s). OTG products are not included in this category.

5.3.1 Example

Printers conforming to the Camera & Imaging Product Association (**CIPA**) DC-001-2003 (PictBridge) specification will fall into this category. In addition to the Type-B port used for PC connect, they add a Standard-A port on the front of a printer for camera connection only.

Such a configuration benefits the camera owner by requiring only one cable, a Mini-B to Standard-A, for both PC & printer connections.

5.3.2 Certification Requirements

USB-IF certification is available for products in this category that meet the following requirements:

- All Type-B ports must pass all peripheral compliance tests.

- All Type-A ports must comply with all of the Embedded Host recommendations listed in Section 4.2.
- If simultaneously accessible, then Type-A and Type-B ports must operate concurrently, independent of the activity on the other ports.
- The speeds supported on Type-A receptacles and on Type-B receptacles need not be the same. For instance, it is acceptable for a product to support High-Speed over Type-B ports, but only support Full- and Low-Speed on Type-A ports.
- Products with a Type-B and multiple Type-A receptacles may not have a mixture of A-ports that only offer limited Embedded Host capability and A-ports that offer full-function hub capability. All Type-A receptacles must either be served by an Embedded Host controller or all Type-A receptacles must be connected to a hub controller that serves the Type-B port.

Products in this category are eligible for the standard USB logo, not the OTG logo, and may use the High-Speed banner if the Type-B port(s) is(are) High-Speed compliant.

5.3.3 Recommendations

To avoid giving the impression that the Type-A port offers standard USB host or hub functionality, the product should have some graphical or textual label adjacent to the receptacle that in some way indicates the limited functionality (e.g., a camera icon). The port may or may not display the USB icon, at the manufacturer's discretion.

Products in this category that operate at High-Speed as a device are encouraged but not required to provide High-Speed in their Embedded Host Controller. This avoids sending a potentially confusing message by the use of the High-Speed logo.

5.4 Products with Mini-AB receptacles

5.4.1 Certification Requirements

The Mini-AB receptacle is not certified for use on products with multiple receptacles, with the exception noted in Section 5.5.1.

All products using the Mini-AB receptacle will be tested using the On-The-Go test procedures.

If an OTG device meets the following requirements, then it is allowed not to support HNP and SRP as a B-device:

- uses VID/PID to identify devices on TPL, and does not use class descriptors
- TPL does not include any OTG devices

If an OTG device does not support HNP and SRP as a B-device, then it must not report HNP and SRP in their configuration descriptors when being enumerated as a peripheral. All products using the Mini-AB receptacle are required to support HNP as an A-device. All products using the Mini-AB receptacle

are required to either support SRP as an A-device or supply a valid VBUS continually when a mini-A plug is inserted.

5.4.2 Recommendations

Full support of all OTG features is recommended in order to prepare for the future possibility that a supported device category will add OTG capability.

5.5 The Mini-A receptacle

The use of the Mini-A receptacle is strongly discouraged. The USB-IF feels that it is vital that we preserve the Standard-A as the primary downstream-facing receptacle in order to maintain the simplicity and ease-of-use of USB

5.5.1 Certification Requirements

Notwithstanding, OTG devices that have one Mini-AB receptacle and one Mini-A receptacle, and no other receptacles will be eligible for the logo. This is to accommodate those portable products that require connection to two USB products simultaneously.

The Mini-A receptacle on products of this sort must comply with all Embedded Host Requirements, and must support all devices that are supported by the Mini-AB receptacle when operating as a Host.

The Mini-A receptacle is not endorsed in any other topologies. No other product configurations, including Standard Hosts, Embedded Hosts, Hubs or any other products, will be eligible for a logo if they use the Mini-A receptacle on their product.

6. Logo Eligibility Overview

- Certification and logo eligibility is reviewed on a product basis, not on a port basis.
- Product certification is granted only when all ports are compliant with the relevant tests.
- Products are only eligible to use a single USB logo. Products may not use multiple USB logos.
- Products with Type-B ports are eligible for the High-Speed banner if all Type-B ports are High-Speed compliant. Any Type-A ports on such a product are encouraged but not required to be High-Speed capable for the device to be eligible for the High-Speed logo.
- Products with one or more Standard-A ports and no Type-B ports are eligible to use the High-Speed banner if all ports are High-Speed compliant.
- Products with a Type-AB receptacle are only eligible for one of the OTG logos. They are not eligible for the standard USB logo or the High-Speed USB logo.
- Products with Type-AB receptacles are eligible for the High-Speed OTG logo if the product is High-Speed compliant when acting as a peripheral. The Host controller does not need to offer High-Speed capability for the product to be eligible for the High-Speed logo.
- If a product uses the High-Speed logo (based on its Type-B capability) and its Type-A port has a High-Speed certified peripheral on its TPL that is not supported in High-Speed mode, then any packaging, documentation or advertisement that contains the High-Speed logo and mentions support for this peripheral must include a disclaimer stating that the peripheral is not supported at its highest speed.
- Product upgrades that may change the peripherals supported on the TPL shall not violate any of the provisions in this document and related specifications. Product upgrades that would expand the test requirements for the product (adding a transfer type, adding HS host support, adding an OTG peripheral, etc) require that the device be recertified.

7. Recommendations and Best Practices

The following are a list of principles to be considered when designing Embedded Hosts and Multiple Receptacle Devices.

7.1 Equivalency

Products with multiple USB ports of the same type should provide the same functionality and behavior on all such ports (this is the equivalency principle). Using any one of these ports should not affect the functionality of any of the other equivalent ports.

In some product configurations there are compelling business or technical reasons that prevent compliance with the principle of equivalency. In these cases, care should be taken to avoid potential user confusion by clearly communicating the difference in functionality. Suggestions include: 1) Label the non-equivalent ports in a manner that makes their different functionalities more apparent. 2) Physically separate the offending ports, placing them on different surfaces of the product, if possible. 3) Provide user documentation that clearly explains the differences between the non-equivalent ports.

Ports must never be shared (or daisy chained) between connectors. USB is a point to point interface with no more than one attachment point allowed per port.

7.2 Consistency & Familiarity

Products should avoid mixing Standard- and Mini- receptacles wherever possible. In general, Mini-B receptacles should only be used on products without sufficient space for standard receptacles. The best user experience is one where the product operates as the customer expects. Care should be taken to ensure that the behavior is consistent when connected to a PC and when not connected to a PC.

7.3 Labeling

Where possible, labeling should be used on Embedded Hosts and products with Multiple Receptacles to help instruct customers in proper use of the ports. The trident icon should be placed adjacent to any Type-B ports to indicate their USB functionality.

Type-A ports that offer full hub or host functionality should also be labeled with the trident icon. Type-A ports that offer Embedded Host functionality may or may not use the icon, but should also consider some other form of labeling, either iconic or textual, to communicate their specific functionality. For instance, a Standard-A port that only supports a camera might be labeled with a camera icon.

7.4 False Hubs

The term 'False Hub' refers to a device with both Type-B and Type-A receptacles but which does not support the direct routing of data between the Type-B receptacle and the Type-A receptacle(s) as with a standard hub. An example of a False Hub would be a printer that has a Type-B receptacle to connect to a PC, and a Standard-A receptacle used only for connecting to cameras for printing pictures. In this case the Standard-A port, likely on the front of the product, could easily lead to the impression that the printer contains a hub, and that this port could be used for connection to the PC.

Great care should be taken in the industrial design, port labeling and product literature of such a product to communicate to the user the unique nature of the Embedded Host port.