Disconnect Supplement to High Speed Inter Chip Specification

Revision 1.0

Sep 18, 2013

Revision History

Revision	Issue Date	Comment
1.0	Sep 18, 2013	Initial v1.0 for release

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1 Introduction

Standard USB uses signaling on the D+ line to enable a device to connect, disconnect and subsequently re-connect. Standard USB also uses Vbus to enable a host to disconnect a device.

Support for disconnect and re-connect is also desirable in HSIC to support power management goals such as powering down of HSIC circuitry or for a device to present an alternate configuration. To this end, this supplement specifies a mechanism that can be used to support:

- Host initiated disconnect (also applicable to downstream facing hub ports)
- Host initiated reconnect (also applicable to downstream facing hub ports)
- Device initiated disconnect (also applicable to upstream facing hub ports)
- Device initiated reconnect (also applicable to upstream facing hub ports)

A method for determining if a host, device or hub implementation supports this optional mechanism is out of scope of this supplement.

1.1 Related Documents

This is not a stand-alone document. It is a supplement to [HSIC].

The following referenced documents can be found on the USB-IF website www.usb.org:

[USB 2.0]	*Universal Serial Bus Revision 2.0 Specification including ECNs*
[HSIC]	*High Speed Inter-Chip USB Electrical Specification including ECN*

2 Functional Description

This supplement defines an additional single ***optional*** sideband signal named AUX. The functional requirements of the AUX signal during disconnect and reconnect processes are described in Section 2.1 and Section 2.2 respectively.

It is intended to use a 1.8V Hi-Z capable general purpose I/O to realize the AUX connection. The electrical requirements are formally defined in Table 2. The AUX signal is asserted by the host or device/hub by driving a high value. When not asserting the AUX signal, the host or device/hub shall maintain a low value by implementing a pull-down resistor of value R_{PD-AUX}.

2.1 Disconnect

The operational model of the AUX signal during the disconnect process is described below in reference to Figure 1.

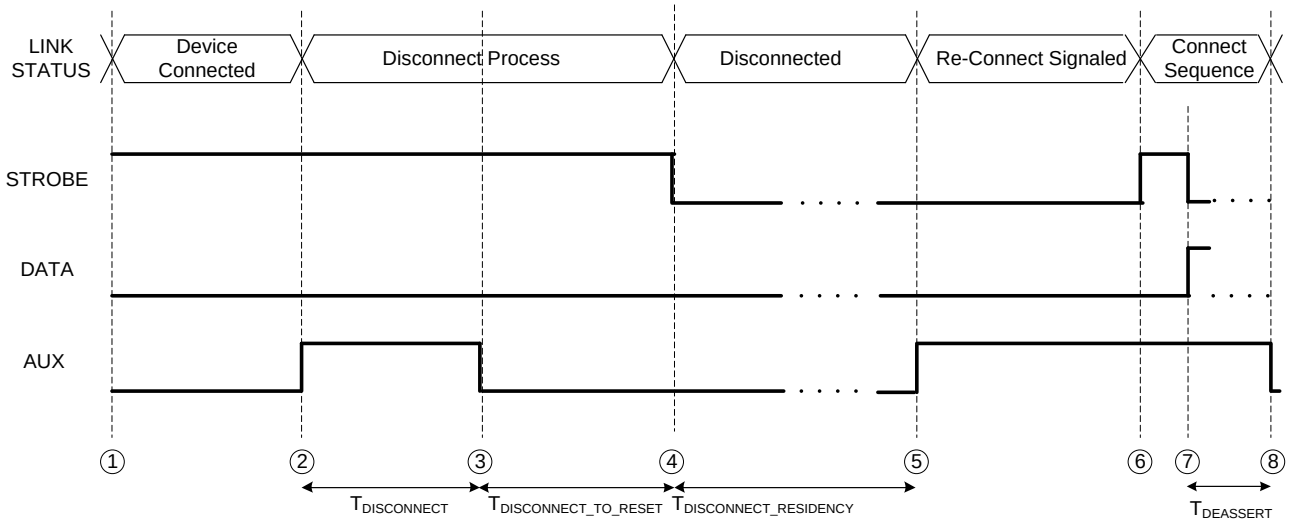

Figure 1 Disconnect and Re-Connect Signaling

The AUX signal must remain de-asserted during initial power-on-reset until a CONNECT is signaled on the link.

Disconnect by Host (or downstream facing hub port):

1. Until a CONNECT is signaled on the link the AUX must remain deasserted.
2. Host must assert AUX to signal a disconnect to the device.
3. Minimum of $T_{DISCONNECT}$ time after (2) Host must deassert AUX.
4. After deassertion of AUX, Host must wait until $T_{DISCONNECT\_TO\_RESET}$ before signaling a RESET state

Disconnect by Device (or upstream facing hub port):

1. Until a CONNECT is signaled on the link the AUX must remain deasserted.
2. Device must assert AUX to request a disconnect.
3. Minimum of $T_{DISCONNECT}$ time after (2) Device must deassert AUX
4. After deassertion of AUX, Host must wait until $T_{DISCONNECT\_TO\_RESET}$ before signaling a RESET state

Host and Device are now disconnected.

The following requirements apply to the disconnect process:

- Upon a disconnect, the status of any ongoing data transfers that have not completed is not defined.
- Once the initiator of a disconnect completes step (2), it must ignore subsequent changes in the HSIC link state during the disconnect process.
- Once the recipient of a disconnect detects step (2), it must complete the disconnect process regardless of the current link state of the HSIC interface and must terminate any other HSIC link state activities in progress.
- Specifically a remote wake signaled by the device after step (2) must be ignored since a disconnect signaled by the host shall take priority. In such a case, the device cannot resume the link and will have to initiate a re-connect to communicate with the host.

Implementation Note: Keeping AUX asserted for a value larger than the minimum $T_{DISCONNECT}$ time may delay the entry of the device into the disconnected state.

2.2 Reconnect

The operational model of the AUX signal when a subsequent re-connect is initiated by the Host is described below in reference to Figure 1.

Re-connect by Host (or downstream facing hub port):

5. Minimum of $T_{DISCONNECT\_RESIDENCY}$ time after (3) Host asserts AUX to signal link bring up
6. At same time or after (5), Host signals IDLE as per Peripheral Discovery sequence (Sec 3.1.3)
7. Upon detection of IDLE state, the device signals a CONNECT state (Sec 3.1.4)
8. Maximum of $T_{DEASSERT}$ time after (6) Host must deassert AUX. This ensures AUX is deasserted to enable a subsequent disconnect to be signaled.

The operational model of the AUX signal when a subsequent re-connect is initiated by the Device is described below ***also*** in reference to Figure 1.

Reconnect by Device (or upstream facing hub port):

5. Minimum of $T_{DISCONNECT\_RESIDENCY}$ time after (3) Device asserts AUX to signal link bring up
6. Host detects AUX assertion and signals IDLE as per Peripheral Discovery sequence (Sec 3.1.3)
7. Upon detection of IDLE state, the device signals a CONNECT state (Sec 3.1.4)
8. Maximum of $T_{DEASSERT}$ time after (6) Device must deassert AUX. This ensures AUX is deasserted to enable a subsequent disconnect to be signaled.

Implementation Note: Systems that choose to skip Step (5) in the re-connect process have to note that the supplement does not define a maximum time for $T_{DISCONNECT\_TO\_RESET}$. In such cases, implementation-specific methods must be used (for example using implementation-specific timers) to ensure devices don't prematurely enable IDLE state detection for step (7).

2.3 Disconnect requirements for a HSIC hub

Following a disconnect at the upstream port of the hub, the downstream ports are in an implementation-specific state. This supplement does not define any actions for a hub to modify the downstream port states.

Following a disconnect at the downstream port of the hub, the hub must show the disconnect status as per rules defined in [USB 2.0] for hubs.

If a remote wake event at a downstream port and a disconnect at the upstream port is simultaneously received, the disconnect must take precedence and any wake event generation on the upstream port must be halted. The signaling on the affected downstream port or ports is implementation specific.

2.4 Reconnect requirements for a HSIC hub

There are no additional requirements for a hub during a reconnect. The hub must follow the requirements outlined in Section 2.2.

Implementation Note: There may be system level implementation requirements to ensure that devices downstream of the hub are prepared to reconnect at the proper time as per [HSIC].

2.5 Timing Parameters

Table 1 Disconnect & Re-Connect Timing Parameters

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
Time AUX is asserted by host to signal disconnect	$T_{DISCONNECT}$	1			ms	
Time elapsed after deassertion of AUX before the host maintains RESET state on lines	$T_{DISCONNECT\_TO\_RESET}$	1			ms	Mandating a minimum time ensures devices have sufficient time to disconnect A maximum time is not defined and is implementation-specific.
Time spent in disconnected state before a re-connect is requested either by host or device	$T_{DISCONNECT\_RESIDENCY}$	5			ms	Mandating a minimum time in disconnect ensures devices have sufficient time to disconnect and prepare for re-connect detection.
Time AUX remains asserted during a re-connect either by host or device after device has signaled	$T_{DEASSERT}$			3	ms	

CONNECT.						

2.6 AUX Electrical Parameters

Table 2 AUX Electrical Parameters

PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS	COMMENTS
AUX Pull-Down Resistor Strength	R_{PD-AUX}	10		50	KΩ	
AUX I/O Voltage Input Low	V_{IL-AUX}	-0.2		0.26	V	Max is 20% of 1.8V
AUX I/O Voltage Input High	V_{IH-AUX}	1.26		2.0V	V	Min is 70% of 1.8V