USB ENGINEERING CHANGE NOTICE

Title: USB 2.0 Connect Timing

Applies to: Universal Serial Bus Specification, Revision 2.0

Summary of ECN

This ECN addresses the following three issues:

- dead battery pre-connect current
- post-connect current timing
- VBUS valid to connect timing

Dead battery pre-connect current
The Battery Charging spec contains the Dead Battery Provision, which allows devices with weak or dead batteries to draw up to 100mA for the time required to power the device up, and bring it to a state where it can connect.

The USB 2.0 spec currently allows devices to draw 100mA for only 100ms before connecting. This time is not sufficient to for most portable devices with dead batteries to power up.

The USB 2.0 spec would be modified such that a device with a dead battery could draw 100mA for the time required to power up the device, and bring it to a state where it can connect.

Post-connect current timing
The Battery Charging spec allows devices to draw 100mA for 1 second after the connect event, regardless of what is happening on the bus.

The USB 2.0 spec currently requires devices to drop down to suspend current within 10ms of no bus activity, during both the attach debounce time (T_{ATTDB}) and during the reset time (T_{DRST}). In practice, no devices do this. During USB compliance testing, suspend current is not tested until several seconds after the connect event.

The USB 2.0 spec would be modified such that a device is not required to drop down to the suspend current during the 1 second immediately following the connect event.

VBUS session valid to connect time
During compliance testing, a device that is already powered up must connect within 1 second of VBUS valid. The reason for this test is to provide a user experience where something happens within a short time of a device being attached to a host.

The USB 2.0 spec is not explicit in this issue. Figure 7-29 can be interpreted to imply a VBUS valid to connect time of 100ms. But Figure 7-29 does not distinguish between the VBUS valid event and the time at which the device draws current.

The USB spec would be modified such that the VBUS valid to connect time is explicitly called out. As well, the USB spec would differentiate between the VBUS valid event and the time at which the device starts to draw current from VBUS.

Reasons for ECN

The benefits of this ECN are outlined below.

Dead battery pre-connect current
The USB 2.0 spec will align with the Dead Battery Provision, which allows a device with a dead battery to power up when attached to a USB host.

Post-connect current timing
The USB 2.0 spec will align with the fact that devices don't drop to suspend current during the attach debounce time, TATTDB. The spec will also align with the USB compliance program which doesn't check for suspend current until at least one second after the connect event.

VBUS session valid to connect time
The USB 2.0 spec will align with the USB compliance program, which requires a powered on device to connect within 1 second of VBUS valid.

Impact on Existing Peripherals and Systems:

There is no impact to existing peripherals and systems.

Hardware Implications:

No change is required of existing peripheral hardware.

Host and hub hardware must now be able to provide a unit load current for at least 1 sec (TCON_ISUSP) after a peripheral connects.

Previously, peripherals would have to drop down to suspend current several seconds after the connect event if a host suspended the bus. This several second time came from compliance testing and not from the USB 2.0 spec. The USB 2.0 spec was more even constraining, and required a peripheral to drop down to suspend current immediately after the connect event, and before start of reset. However, this was not realistic for connect to reset times of 100ms or less, and was universally ignored.

Software Implications:

There are no software changes required for either the host or peripheral. The host is still allowed to suspend the bus anytime after connect.

Compliance Testing Implications:

Existing compliance tests are not affected for self powered devices or devices with good batteries. Devices with weak or dead batteries should also be tested against the Portable Device Compliance Tests associated with the Battery Charging 1.1 specification.

Specification Changes

INSTRUCTIONS: In this section of the ECN, any paragraph starting with the word "INSTRUCTIONS" contains instructions for modifying the text of the USB specification. Any other paragraphs contain new text that should be inserted in the USB specification.

INSTRUCTIONS: In Section 7.1.7.3, replace Figure 7-29 as well as the previous one paragraph and following six paragraphs with the following.

Figure 7-29 shows the timing associated with a peripheral connecting to a host or hub port.

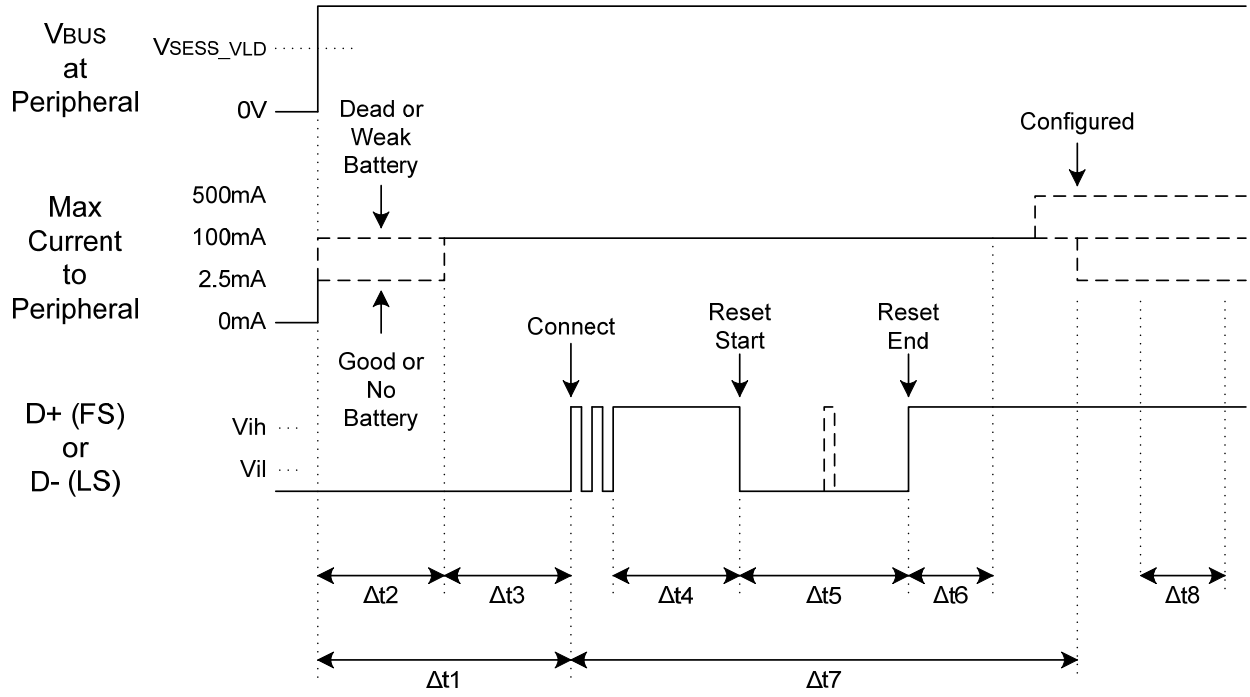

Figure 7-29 Connect Event Timing

Δt1 (TSVLD_CON_PWD, TSVLD_CON_WKB) This is the maximum time from when VBUS crosses VSESS_VLD to when the peripheral is required to connect (pull D+ or D- high) and be ready for enumeration. For bus powered peripherals and peripherals that are already powered up, this time is TSVLD_CON_PWD. For portable devices with dead or weak batteries, this time is TSVLD_CON_WKB. During TSVLD_CON_WKB, a portable device with a dead or weak battery that is drawing up to IUNIT is required to signal the upstream port by driving D+ to VDP_SRC. If a portable device with a dead or weak battery cannot connect and be enumerated after drawing IUNIT for TSVLD_CON_WKB, then it shall reduce its current draw to ISUSP.

Δt2 (TSVLD_UNIT) This time starts when VBUS crosses the VSESS_VLD threshold, and ends 100ms before the connect event. During this time, portable devices with dead or weak

batteries are allowed to draw up to I_{UNIT} from V_{BUS}. All other peripherals are only allowed to draw up to I_{SUSP} during this time.

Δt3 (T_{UNIT_CON}) This is the maximum time that a bus powered peripheral or a portable device with a good battery can draw up to I_{UNIT} from V_{BUS} before connecting.

Δt4 (T_{CON_RST}) This is a debounce interval with a minimum duration of 100 ms that is provided by USB System Software. It ensures that the electrical and mechanical connection is stable before software attempts to reset the attached device. The interval starts when the USB System Software is notified of a connect event (D+ or D- pulled high). The interval restarts if there is a disconnect event. The debounce interval ensures that power is stable at the device for at least 100 ms before resetting the peripheral.

Δt5 (T_{DRST}) This is the period of time hubs drive reset to a peripheral. Refer to Section 7.1.7.5 and Section 11.5.1.5 for details.

Δt6 (T_{RSTRCY}) The USB System Software guarantees a minimum of 10 ms for reset recovery. Peripheral response to any bus transactions addressed to the default device address during the reset recovery time is undefined.

Δt7 (T_{CON_ISUSP}) After connecting, a peripheral is allowed to draw up to one unit load current for a time of T_{CON_ISUSP}, before having to obey the rules of dropping down to suspend current. If, during this time, a peripheral becomes configured, it is then allowed to draw its configured current.

Δt8 (T_{2SUSP}) After a time of T_{CON_ISUSP} from the connect event, a peripheral must obey the rules of going into suspend (see Section 7.1.7.6).

Figure 7-29 shows the connect event timing from the perspective of peripheral. From a hub perspective, there is delay between the time that the hub is requested to switch on a port, to the time that the hub outputs a valid voltage on VBUS. This delay is a function of the type of hub port switch. Hubs report this time in the hub descriptor (see Section 11.15.2.1), which can be read via a request to the Hub Controller (see Section 11.16.2.4).

INSTRUCTIONS: Globally replace I_{CCS} with I_{SUSP}.

INSTRUCTIONS: In Table 7-7 below the row for Low-power port, add a row for the parameter V_{SESS_VLD}. In the Parameter box, add the text “Peripheral session valid threshold”. The min and max values are 0.8V and 4.0V respectively.

INSTRUCTIONS: In Table 7-14, replace T_{ATTDB} with T_{CON_RST}. In the Parameter box, replace the existing text with “Debounce interval provided by USB System Software after peripheral connects.”

INSTRUCTIONS: In Table 7-14, replace T_{SIGATT} with $T_{SVLD\_CON\_PWD}$. In the Parameter box, replace the existing text with “Time from V_{BUS} crossing V_{SESS_VLD} to a powered up peripheral connecting (pull D+ or D- above V_{IH}).” Replace the max value of 100ms with 1sec.

INSTRUCTIONS: In Table 7-14, add the parameter $T_{SVLD\_CON\_WKB}$, with a maximum value of 45 minutes. In the Conditions box put “Section 7.1.7.3”. In the Parameter box put “Time from V_{BUS} crossing V_{SESS_VLD} to a peripheral with a dead or weak battery connecting and being ready to enumerate.”

INSTRUCTIONS: In Table 7-14, add the parameter T_{UNIT_CON}, with a maximum value of 100 msec. In the Conditions box put “Section 7.1.7.3”. In the Parameter box put “Time a peripheral can draw unit load from V_{BUS} before connecting.”

INSTRUCTIONS: In Table 7-14, add the parameter T_{CON_ISUSP}, with a maximum value of 1 sec. In the Conditions box put “Section 7.1.7.3”. In the parameter box put “Time after connect when peripheral must obey rules of suspend.”

INSTRUCTIONS: In Table 7-7, under the heading “Output levels for low/full-speed”, add the parameter V_{DP_SRC} with a minimum value of 0.5V and a maximum value of 0.7V.