USB ENGINEERING CHANGE NOTICE

Title: 5V Short Circuit Withstand Requirement Change
Applies to: Universal Serial Bus Specification, Revision 2.0

Summary of ECN:
This ECN proposes to remove the 5V short circuit withstand requirement for the USB D+ and/or D- bus traces.

NOTE: This ECN affects the core USB 2.0 specification.

Reasons for ECN:
1. The 5V short circuit requirement limits the scalability of silicon fabrication processes moving forward. The advanced processes do not easily support this voltage level, which is 5X or more of the native process voltage.

2. The proposed change also provides an opportunity in reducing the silicon area and average power. Analysis shows a ~16% transceiver silicon area reduction and a ~3x standby idle power saving can be achieved on a silicon process which does not support a 3.3 volt tolerant transistor.

3. The original intent of this requirement was to protect the ports against degradation if the USB cable was damaged resulting in a VBUS short to only to one or both of the data signal lines (Dp or Dm). Research into the likelihood of this condition occurring has resulted in zero reports of this fail condition. (Source: USB IF database)

Lab tests were also conducted to comprehend the probability of a VBUS short to Dp or Dm when the cables were crushed or cut. No failures were seen under "normal," unintentional, damage circumstance like rolling a chair across a cable, shutting it in a metal cabinet, or a cable cut with scissors. In order to see what shorts could occur, more extreme (though improbable) tests were conducted. Fifty High Speed cables were crushed in a vise until a short occurred. In every case, VBUS shorted to ground first. This is protected by the over-current mechanism. Any short that might have occurred to a data signal line would be masked by a short to ground. Another extreme test condition used diagonal cutters or a utility knife to cut the cable. In this case, when a short was observed, 713 out of 713 High Speed cable cut shorted VBUS to ground.

Low Speed cable almost exhibits similar characteristics when going through the cable cutting and crushing experiment. 0.4% probability of getting data wire shorted to VBUS was observed when a particular type of Low Speed mouse cable was crushed at the exact same location by > 260 lbs force, which was exerted by a galvanized pipe against the concrete floor. However the shorts were intermittent. There was no continuous short that may cause long term reliability issue (more detailed experiment results can be found in the attachment, Cable Test Report.doc). In summary, the probability of a damaged cable which causes VBUS shorted to data bus is very low.

4. Some devices may have connected their pull-up resistor to VBUS, as described in USB ECN titled "Pull-up/pull-down resistors". The voltage divider formed by the device pull-up and host pull-down will guarantee the data wire park at a safe voltage level, which is below the VBUS value. In summary, the host/hub will not see 5V at the wire when interoperating with these devices.

5. A final argument for removing the 5 volt tolerance requirement from USB is that other external interconnect standards like 1394 do not protect against the power short to the data wires.

Impact on existing peripherals and systems:
None

Hardware Implications:
OEMs that require short circuit withstand to VBUS can implement the requirement with an external hub or other external protection circuitry.

Software Implications:
None

Compliance Testing Implications:
Compliance to this requirement has never been tested so removal of the VBUS short condition will have no effect on compliance testing.

Specification Changes:

Change section 7.1.1 USB Driver Characteristic, 6th paragraph as follows:

A USB transceiver is required to withstand a continuous short circuit of D+ and/or D- to ~~VBUS,~~ GND, other data line, or the cable shield at the connector, for a minimum of 24 hours without degradation. It is recommended that transceivers be designed so as to withstand such short circuits indefinitely. The device must not be damaged under this short circuit condition when transmitting 50% of the time and receiving 50% of the time (in all supported speeds). The transmit phase consists of a symmetrical signal that toggles between drive high and drive low. ~~This requirement must be met for max value of VBUS (5.25 V).~~ A USB transceiver is recommended, but not required, to withstand a continuous short of D+ and/or D- to VBUS for a minimum of 24 hours without degradation.

It is recommended that these AC and short circuit stresses be used as qualification criteria against which the long-term reliability of each device is evaluated.