USB ENGINEERING CHANGE NOTICE

Title: USB 2.0 VBUS Max Limit

Applies to: Universal Serial Bus Specification, Revision 2.0

Summary of ECN

Update the USB2.0 specification to align with the expanded VBUS voltage definition in the USB-IF Type-C specification which defines VBUS as having a Max supply voltage of 5.50 V DC.

The Type-C cable and connector definition specifies a minimal current carrying capacity of 3A. This increased capacity creates a situation where losses in cables, connectors, PCB traces and power supply components will result in the VBUS level available at the consumer end of the cable that is below the minimum acceptable level for operation. As a result, in order to have an implementable Type-C specification it is necessary to boost the upper limit for VBUS at the supply side to 5.5V DC from the present spec value of 5.25 V DC.

Reasons for ECN

OEM's can design products that support the higher power levels of the Type-C connector and provide VBUS levels at or above 5.25V to ensure that the VBUS voltage that is available at the far-side connection is within a suitable working range for USB products, and is also at a high enough level to charge batteries in as short a time interval as possible to ensure customer satisfaction.

Impact on Existing Peripherals and Systems:

The impact is difficult to assess as there is a wide range of component vendors supporting USB, and also a wide variation of design methodologies.

As a result, there are certainly going to be a subset of existing USB products that may be sensitive to operation at VBUS levels of up to 5.5V. The sensitivity will be mitigated in many cases by cable losses, so the devices themselves may never experience the 5.5V.

Hardware Implications:

New designs adhering to this ECN will need to consider the new 5.5V VBUS max level during the component selection process.

Software Implications:

There are no known software implications.

Compliance Testing Implications:

Compliance will need to make the small modifications necessary to accommodate the new upper limit.

USB Engineering Change Notice

Specification Changes

(a) Section 7.1.1 USB Driver Characteristics

From Text:

Short Circuit Withstand

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).

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.

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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.

(b)Section 7.2.2 Voltage Drop Budget

From Text:

The voltage drop budget is determined from the following:

- The voltage supplied by high-powered hub ports is 4.75 V to 5.25 V.
- The voltage supplied by low-powered hub ports is 4.4 V to 5.25 V.
- Bus-powered hubs can have a maximum drop of 350 mV from their cable plug (where they attach to a source of power) to their output port connectors (where they supply power).
- The maximum voltage drop (for detachable cables) between the A-series plug and B-series plug on VBUS is 125 mV (VBUSD).
- The maximum voltage drop for all cables between upstream and downstream on GND is 125 mV (VGNDD).
- All hubs and functions must be able to provide configuration information with as little as 4.40 V at the connector end of their upstream cables. Only low-power functions need to be operational with this minimum voltage.
- Functions drawing more than one unit load must operate with a 4.75 V minimum input voltage at the connector end of their upstream cables.

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- The maximum voltage drop for all cables between upstream and downstream on GND is 125 mV (VGNDD).
- All hubs and functions must be able to provide configuration information with as little as 4.40 V at the connector end of their upstream cables. Only low-power functions need to be operational with this minimum voltage.
- Functions drawing more than one unit load must operate with a 4.75 V minimum input voltage at the connector end of their upstream cables.

c) Section 7.3.2 Bus Timing/Electrical Characteristics

From Text/Table:

Table 7-1. DC Electrical Characteristics

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage:					
High-power Port	V_{BUS}	Note 2, Section 7.2.1	4.75	5.25	V
Low-power Port	V_{BUS}	Note 2, Section 7.2.1	4.40	5.25	V
Supply Current:					
High-power Hub Port (out)	I_{CCPRT}	Section 7.2.1	500		mA
Low-power Hub Port (out)	I_{CCUPT}	Section 7.2.1	100		mA
High-power Function (in)	I_{CCHPF}	Section 7.2.1		500	mA
Low-power Function (in)	I_{CCLPF}	Section 7.2.1		100	mA
Unconfigured Function/Hub (in)	I_{CCINIT}	Section 7.2.1.4		100	mA
Suspended High-power Device	I_{CCSH}	Section 7.2.3; Note 15		2.5	mA
Suspended Low-power Device	I_{CCSL}	Section 7.2.3		500	µA
Input Levels for Low-/full-speed:					
High (driven)	V_{IH}	Note 4, Section 7.1.4	2.0		V
High (floating)	V_{IHZ}	Note 4, Section 7.1.4	2.7	3.6	V
Low	V_{IL}	Note 4, Section 7.1.4		0.8	V
Differential Input Sensitivity	V_{DI}	|(D+)-(D-)|; Figure 7-19; Note 4	0.2		V
Differential Common Mode Range	V_{CM}	Includes V_{DI} range; Figure 7-19; Note 4	0.8	2.5	V
Input Levels for High-speed:					
High-speed squelch detection threshold (differential signal amplitude)	V_{HSSQ}	Section 7.1.7.2 (specification refers to differential signal amplitude)	100	150	mV

To Text/Table:

Table 7-2. DC Electrical Characteristics

Parameter	Symbol	Conditions	Min.	Max.	Units
Supply Voltage:					
High-power Port	V_{BUS}	Note 2, Section 7.2.1	4.75	5.50	V
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High-power Function (in)	I_{CCHPF}	Section 7.2.1		500	mA
Low-power Function (in)	I_{CCLPF}	Section 7.2.1		100	mA
Unconfigured Function/Hub (in)	I_{CCINIT}	Section 7.2.1.4		100	mA
Suspended High-power Device	I_{CCSH}	Section 7.2.3; Note 15		2.5	mA

Parameter	Symbol	Conditions	Min.	Max.	Units
Suspended Low-power Device	I_{CCSL}	Section 7.2.3		500	µA
Input Levels for Low-/full-speed:					
High (driven)	V_{IH}	Note 4, Section 7.1.4	2.0		V
High (floating)	V_{IHZ}	Note 4, Section 7.1.4	2.7	3.6	V
Low	V_{IL}	Note 4, Section 7.1.4		0.8	V
Differential Input Sensitivity	V_{DI}	|(D+)-(D-)|; Figure 7-19; Note 4	0.2		V
Differential Common Mode Range	V_{CM}	Includes V_{DI} range; Figure 7-19; Note 4	0.8	2.5	V
Input Levels for High-speed:					
High-speed squelch detection threshold (differential signal amplitude)	V_{HSSQ}	Section 7.1.7.2 (specification refers to differential signal amplitude)	100	150	mV