USB Type-C ENGINEERING CHANGE NOTICE

Title: High Speed Cross Coupling
Applied to: USB Type-C Specification Release 1.1, April 3, 2015

Brief description of the functional changes:

1. Define and clarify that the integrated crosstalk is required between the USB SuperSpeed pairs Tx1-Rx1 and Tx2-Rx2, as well as Tx1-Tx2, Tx1-Rx2, Tx2-Rx1 and Rx1-Rx2.
2. Add a paddle-card design guideline to avoid the scenario of placing the SuperSpeed pairs right next to each other without isolation.

Benefits as a result of the changes:

The current USB Type-C specification only defines the crosstalk between the USB SuperSpeed pairs Tx1-Rx1 and Tx2-Rx2. It has no limit on the crosstalk between the other SuperSpeed pairs, for example Tx1-Tx2, Tx1-Rx2, etc. Such unlimited crosstalk can cause serious link margin issues for systems or protocols that use multiple transmitters or receivers.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

Some of the Type-C cables that meet the current crosstalk spec may violate the added crosstalk limits for Tx1-Tx2, Tx1-Rx2, Tx2-Rx1 and Rx1-Rx2. But not limiting the crosstalk between Tx1-Tx2, Tx1-Rx2, Tx2-Rx1 and Rx1-Rx2 is not something the ecosystem can live with and must be fixed.

An analysis of the hardware implications:

Cables need to be tested to check more crosstalk items. Some cable vendors may have to change their paddle-card designs.

An analysis of the software implications:

No software implications.

An analysis of the compliance testing implications:

The proposal results in more measurements needing to be performed at cable certification.

USB Type-C ENGINEERING CHANGE NOTICE

Actual Change

(a). From, Section 3.1.2, page 24

3.1.2 Compliant Cable Assemblies

Error! Reference source not found. summarizes the USB Type-C standard cable assemblies along with the primary differentiating characteristics. The cable lengths listed in the table are informative and represents the practical length based on cable performance requirements. All cables that are either full-featured and/or are rated at more than 3 A current are Electronically Marked Cables.

(a). To, Section 3.1.2

3.1.2 Compliant Cable Assemblies

Error! Reference source not found. summarizes the USB Type-C standard cable assemblies along with the primary differentiating characteristics. All USB full-featured Type-C cables shall support simultaneous, independent signal transmission on both *USB 3.1* (TX and RX pairs) data buses. The cable lengths listed in the table are informative and represents the practical length based on cable performance requirements. All cables that are either full-featured and/or are rated at more than 3 A current are Electronically Marked Cables.

(b). From, Section 3.2.2.5, page 49

3.2.2.5 USB Full-Featured Type-C Plug Paddle Card (Informative)

The use of a paddle card is expected in the USB Full-Featured Type-C Plug. **Error! Reference source not found.** illustrates the paddle card pin assignment and contact spring connection location for a USB Full-Featured Type-C plug. The following guidelines are provided for the paddle card design:

- The paddle card should use high performance substrate material. The recommended paddle card thickness should have a tolerance less than or equal to ± 10%.
- The USB SuperSpeed traces should be as short as possible and have a nominal differential characteristic impedance of 85 Ω.
- The differential pairs should have a minimum pair-to pair separation of 0.5 mm.
- It is recommended that a grounded coplanar waveguide (CPWG) system be selected as a transmission line method.
- Use of vias should be minimized.
- V_{BUS} pins should be bussed together on the paddle card.
- GND pins should be bussed together on the paddle card.

(b). To, Section 3.2.2.5

3.2.2.5 USB Full-Featured Type-C Plug Paddle Card (Informative)

The use of a paddle card is expected in the USB Full-Featured Type-C Plug. **Error! Reference source not found.** illustrates the paddle card pin assignment and contact spring connection location for a USB Full-Featured Type-C plug. The following guidelines are provided for the paddle card design:

- The paddle card should use high performance substrate material. The recommended paddle card thickness should have a tolerance less than or equal to ± 10%.
- The USB SuperSpeed traces should be as short as possible and have a nominal differential characteristic impedance of 85 Ω.
- The wire attach should have two high speed differential pairs on one side and two other high speed differential pairs on the other side, separated as far as practically allowed.
- It is recommended that a grounded coplanar waveguide (CPWG) system be selected as a transmission line method.
- Use of vias should be minimized.
- V_{BUS} pins should be bussed together on the paddle card.
- GND pins should be bussed together on the paddle card.

(c). From, Section 3.7.3.2.3, page 80

The integration shall be done for each NEXT and FEXT between USB SuperSpeed pairs located at A2, A3 to B10, B11 and B2, B3 to A10, A11 (See **Error! Reference source not found.**). Coupling between other combinations of USB SuperSpeed pairs is comparatively lower. The largest values of INEXT and IFEXT shall meet the following requirements:

- INEXT ≤ −40 dB
- IFEXT ≤ −40 dB

(c). To, Section 3.7.3.2.3

The integration shall be done for each NEXT and FEXT between all differential pairs. The largest values of INEXT and IFEXT shall meet the following requirements:

- INEXT ≤ −40 dB to 12.5GHz, for Tx1 to Rx1, Tx2 to Rx2, TX1 to RX2, TX2 to RX1, TX1 to TX2, and RX1 to RX2.
- IFEXT ≤ −40 dB to 12.5GHz, for Tx1 to Rx1, Tx2 to Rx2, TX1 to RX2, TX2 to RX1, TX1 to TX2, and RX1 to RX2.

The port-to-port crosstalk (TX1 to RX2, TX2 to RX1, TX1 to TX2, and RX1 to RX2) is specified to support the usages in which all the four SuperSpeed pairs transmit or receive signals simultaneously, for example in an Alternate Mode.