USB Type-C ENGINEERING CHANGE NOTICE

Title: Low Speed Signal Coupling Requirements Change Applied to: USB Type-C Specification Release 1.0, August 11, 2014

Brief description of the functional changes:
This ECN is for updates to the SI specifications for the Type-C Plug to Type-A receptacle adaptor. This ECN extends this adaptor specified pulse period range to include SuperSpeed GEN2 direct attach coverage. The original SI specs are tighter than is achievable in some cases for SuperSpeed usage. The ECN adds Differential to common mode conversion limits to the Adaptor.

Benefits as a result of the changes:
Type-C plug to Type-A receptacle Adaptor designs can be achieved with connectors design points that are available, while being robust in the defined signal usage scenario. GEN1 usage and GEN2 direct attach usage was examined in a system model to verify proposed specifications. Compliant prototypes have been demonstrated.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
No products have completed compliance. Design points that meet original SI spec, are very likely to also pass the GEN 2 requirements (though none are known to exist).

An analysis of the hardware implications:
The signal path must adhere to the proposed adaptor SI specs using the GEN1 and GEN2 pulse width's respectively (200 psec and 100psec), and GEN1 and Gen2 Nyquist frequencies respectively for insertion loss limits. This implies the structures geometries is designed to assure appropriate Zo control through the assembly as well as proximity between signal paths is controlled to meet the suite of SI requirements.

An analysis of the software implications:
None.

An analysis of the compliance testing implications:
Testing frequency range needs to be extended for the insertion loss measurement to 5 Ghz. The integration range for SI parameters in compliance is unchanged. The pulse width used in the integrated integrals for GEN2 terms is 100 psec. This is a software edit in reporting results. Test equipment types are unchanged.

Actual Change

Section 3.7.5.2, Table 3-29

From Table 3-29:

Table 3-29 Design Targets for USB Type-C to USB 3.1 Standard-A Adapter Assemblies (Informative)

Items	Design Targets
Differential Return Loss	≤ −15 dB to 2.5 GHz Normalized with 85 ohms.
Differential Insertion Loss	≥ −2 dB to 2.5 GHz
Differential NEXT between SuperSpeed Pairs	≤ −40 dB to 2.5 GHz
Differential NEXT and FEXT between D+/D− and SuperSpeed Pairs	≤ −30 dB to 2.5 GHz

To Table 3-29:

Table 3-29 Design Targets for USB Type-C to USB 3.1 Standard-A Adapter Assemblies (Informative)

Items	Design Targets
Differential Return Loss	≤ −15 dB to 5 GHz Normalized with 85 ohms.
Differential Insertion Loss	≥ −2.4 dB at 2.5 GHz, ≥ -3.5 dB at 5 Ghz
Differential NEXT between SuperSpeed Pairs	≤ −40 dB to 2.5 GHz ≤ -34 dB at 5 Ghz
Differential NEXT and FEXT between D+/D− and SuperSpeed Pairs	≤ −30 dB to 2.5 GHz

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Section 3.7.5.2, Table 3-30

From table 3-30:

Table 3-30 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly Signal Integrity Requirements (Normative)

Items	Descriptions and Procedures	Requirements
Differential Insertion Loss Fit at Nyquist Frequency (ILfitatNq)	ILfitatNq is evaluated at the SuperSpeed Gen 1 Nyquist frequency.	≥ −2 dB at 2.5 GHz
Integrated Differential Multi-reflection (IMR)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}\lvert ILD(f)\rvert^2\lvert Vin(f)\rvert^2 df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$	≤ −38 dB
Integrated Differential Crosstalk on SuperSpeed (ISSXT)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}(\lvert Vin(f)\rvert^2\lvert NEXTs(f)\rvert^2+\lvert Vdd(f)\rvert^2\lvert NEXTd(f)\rvert^2)df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$ where: *NEXTs* = NEXT between SuperSpeed pairs *NEXTd* = NEXT between D+/D− and SuperSpeed pairs *Vdd(f)* = Input pulse spectrum on D+/D− pair, evaluated using equation shown in Figure 3-44 with Tb (UI) = 2.08 ns.	≤ −38 dB
Integrated Differential Crosstalk on D+/D- (IDDXT)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}(\lvert Vin(f)\rvert^2\lvert NEXT(f)\rvert^2+\lvert Vin(f)\rvert^2\lvert FEXT(f)\rvert^2)df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$ where: *NEXT* = Near-end crosstalk from SuperSpeed to D+/D− *FEXT* = Far-end crosstalk from SuperSpeed to D+/D− f_{max} = 7.5 GHz	≤ −32 dB
Integrated Return Loss (IRL)	$dB\left(\sqrt{\frac{\int_0^{fmax}\lvert Vin(f)\rvert^2\lvert SDD21(f)\rvert^2(\lvert SDD11(f)\rvert^2+\lvert SDD22(f)\rvert^2)df}{\int_0^{fmax}\lvert Vin(f)\rvert^2 df}}\right)$,	≤ −24 dB

Note: *fmax* = 7.5 GHz; *Vin(f)* is defined Figure 3-44 with Tb (UI) = 200 ps; and *Vdd(f)* is also specified in Figure 3-44 with Tb (UI) = 2.08 ns.

To Table 3-30:

Table 3-30 USB Type-C to USB 3.1 Standard-A Receptacle Adapter Assembly Signal Integrity Requirements (Normative)

Items	Descriptions and Procedures	Requirements
Differential Insertion Loss Fit at Nyquist Frequency (ILfitatNq)	ILfitatNq is evaluated at the SuperSpeed Gen 1 Nyquist frequency and at GEN2 Nyquist Frequency.	≥ –2.4 dB at 2.5 GHz ≥ -3.5 dB at 5.0 Ghz
Integrated Differential Multi-reflection (IMR)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}\lvert ILD(f)\rvert^2\lvert Vin(f)\rvert^2 df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$	≤ -34 dB, Tb = 200 ps ≤ -27 dB, Tb = 100 ps
Integrated Differential Crosstalk on SuperSpeed (ISSXT)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}(\lvert Vin(f)\rvert^2\lvert NEXTs(f)\rvert^2 + \lvert Vdd(f)\rvert^2\lvert NEXTd(f)\rvert^2)df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$ where: *NEXTs* = NEXT between SuperSpeed pairs *NEXTd* = NEXT between D+/D– and SuperSpeed pairs *Vdd(f)* = Input pulse spectrum on D+/D– pair, evaluated using equation shown in Figure 3-44 with Tb (UI) = 2.08 ns.	≤ –37 dB
Integrated Differential Crosstalk on D+/D- (IDDXT)	$dB\left(\sqrt{\frac{\int_0^{f_{max}}(\lvert Vin(f)\rvert^2\lvert NEXT(f)\rvert^2 + \lvert Vin(f)\rvert^2\lvert FEXT(f)\rvert^2)df}{\int_0^{f_{max}}\lvert Vin(f)\rvert^2 df}}\right)$ where: *NEXT* = Near-end crosstalk from SuperSpeed to D+/D– *FEXT* = Far-end crosstalk from SuperSpeed to D+/D– f_{max} = 7.5 GHz	≤ –23 dB
Integrated Return Loss (IRL)	$dB\left(\sqrt{\frac{\int_0^{fmax}\lvert Vin(f)\rvert^2\lvert SDD21(f)\rvert^2(\lvert SDD11(f)\rvert^2+\lvert SDD22(f)\rvert^2)df}{\int_0^{fmax}\lvert Vin(f)\rvert^2 df}}\right)$,	≤ –14.5 dB, Tb=200ps ≤ -12.0 dB, Tb=100ps
Diff to Comm mode	Differential to Common mode conversion (SCD21, SCD12)	≤ -15 dB

Note: *fmax* = 7.5 GHz; *Vin(f)* is defined in Figure 3-44 with Tb (UI) = 100 ps; and *Vdd(f)* is also specified Figure 3-44 with Tb (UI) = 2.08 ns.