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Draft**

**Serial ATA
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Title : Tx AC Common Mode Voltage Change for
Gen3**

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Document History

Version	Date	Comments
0	07-Sep-2011	Initial release.
1	12-Oct-2011	Text changes from PHY WG discussion to improve understanding and clarity of the wording. Changes to Table 38 were added to support UHost Transmitted Signal Requirements.
2	4-Nov-2011	Fixed further typos. Added official ECN number.
3	16-Nov-2011	Changed formula to use $3 \cdot F_{\text{baud}}/2$ for mathematical clarity.
4	6-Dec-2011	Changed "Fbaud" to "bitrate" to remain compatible with current 3.1 spec. Changed TX AC CMV sections to reflect 'Susceptibility' for Gen2 and 'Emissions' for Gen3. Changed text sections for Gen3 to reflect time domain rather than frequency domain technique and to update the bandwidth requirements.
5	14-Dec-2011	Changed the word 'Emission' or 'Emissions' to 'Generated', to remove confusion with FCC requirements or EMI, which is not the intention. The Gen3 change is with reference to an output or 'generation' requirement. The filtering requirement in section 7.4.22 removed the wording about HBWS, as that is not needed.
6	22-Feb-2012	Removed all previous changes due to on-going discussions except: For Gen3 column of Tx AC Common Mode Voltage, changed the word 'Emission' or 'Emissions' to 'Generated', to remove confusion with FCC requirements or EMI, which is not the intention. The Gen3 change is with All Gen3 text in this regard is changed to reflect 'generation', not 'emission'. The frequency domain measurement for this parameter is changed to use the same time domain techniques used for Gen2.
7	29-Feb-2012	Removed all extraneous notes for clarity.
8	14-Mar-2012	Fixed final cross references in the text sections. Removed the word 'Generation' – it's implied by the change itself.

1 Introduction

1.1 Problem Statement

In the SATA Logo activities, a recommendation has been proposed to reduce the number of tests. The following proposal will change the Tx AC Common Mode Voltage testing required for Gen3, in the frequency-domain, to the time domain technique used for Gen2.

The current SATA specification (revision 3.1) Gen3 requires a frequency-domain technique for measuring the 'Tx AC Common Mode Voltage' parameter, or equivalent. The SATA Logo testing has proven that the Gen1/2 testing of this parameter, using the time-domain technique on a real-time scope, has been sufficient to prove pass/fail conditions of this quantity. The additional complication of a frequency domain technique is not required to effectively accomplish this measurement.

Additionally, the current 3.1 specification has the Gen3 definition of Tx AC Common Mode Voltage as an emissions requirement. This proposal changes all references for Gen3 to catch generated CMV, as was intended for Gen2.

Gen1i is presently not measured for Tx AC Common Mode Voltage because of the possibility of DC coupling on legacy products.

Also, the Logo test data has shown that the Gen3 minimum for this parameter needs to be increased to reflect additional losses and noise at 6 Gbps.

1.2 Solution Summary

Even though the Gen3 technique *allows* a time-domain equivalent test, the Logo testing will be simplified by doing both Gen3 and Gen2 with a singular, time-domain technique, eliminating a test equipment requirement for the frequency-domain test.

This can be accomplished by changing the current Gen3, frequency-domain measuring technique to the time-domain technique, as used for Gen2 testing.

The wording in section 7.2.2.3.5 was found to be incorrect with regard to *amplitude* vs. *peak-to-peak*, and will be changed to *peak-to-peak*, as shown below.

Because of Gen3, higher frequency sensitivities occur during common mode testing, the HFTP pattern is added to section 7.4.22. Additional rewording was deemed necessary to bring this section up to date, in relation to current test results and Gen3 needs.

During the process of discussing this ECN, it was found that the Gen2 'Tx AC Common Mode Voltage' parameter was meant to be a susceptibility requirement that needed to be changed to a generated Tx CMV limit requirement. The Gen3 requirement is also a generated Tx CMV limit requirement. The intention is for all Tx AC Common Mode Voltage requirements to use a time domain measurement technique and check for a maximum of common mode voltage being generated by transmitters.

2 Technical Specification Changes

The changes marked in **red**, underline or ~~strike-through~~, shall be incorporated in the following section/s, as shown. Notes shown in *italic* are meant as instructions for these changes.

2.1 Transmitted Signal Requirement Changes

Delete the following section of Table 37 shown as crossed out in red below. This eliminates the previous test at Gen3 that was intended to catch EMI, which has since been determined to be an unnecessary requirement in the specification.

Table 37 – Transmitted Signal Requirements

Parameter	Units	Limit	Electrical Specification					Detail Cross-Ref Section	Measurement Cross-Ref Section
			Gen1i	Gen1m	Gen2i	Gen2m	Gen3i		
$V_{cm,acTX}$, TX AC Common Mode Voltage	dBmV (rms)	3 GHz	-	-	-	-	26	7.2.2.3.6	7.4.22
		Max	-	-	-	-	-		
		6 GHz	-	-	-	-	30		
		Max	-	-	-	-	-		

Additionally, in Table 37 below, add a line for the Gen3i parameter, with different references to the text containing the additional requirement of using HFTP during the test, which is different from the Gen2 text section.

$V_{cm,acTX}$, TX AC Common Mode Voltage	mVp-p	Max	-	50	-	7.2.2.3.5	7.4.21
$V_{cm,acTX}$, TX AC Common Mode Voltage	mVp-p	Max	-	--	120	7.2.2.3.6	7.4.22

2.2 UHost Transmitted Signal Requirement Changes

Change the Gen3U parametric value to the following entry in Table 38, as shown in the red changes below. Eliminate the 7.2.2.3.5 and 7.4.21 Gen2 references. The 7.2.2.3.6 and 7.4.22 references remain, although those sections will change to show a time domain measurement rather than a frequency domain measurement.

Table 38 – UHost Transmitted Signal Requirements

Parameter ¹	Units	Limit	Electrical Specification			Detail Cross-Ref Section ^{2,3}	Measurement Cross-Ref Section ^{2,3}
			Gen1u	Gen2u	Gen3u ³		
$V_{cm,acTX}$, TX AC Common Mode Voltage	mVp-p	Max	100	100	120	7.2.2.3.5 7.2.2.3.6	7.4.21 7.4.22

2.3 TX AC Common Mode Voltage - Text Section Changes

Add Gen1u, Gen2u, Gen3i and Gen3u to the header text as shown in red.

References to 'sinusoidal' are changed to 'peak-to-peak' to more accurately represent how the actual test is performed and evaluated. Gen2i and Gen2m were originally shown as a 'susceptibility' test. It has since been noted that this was an error and will be changed to deal with generated CMV. Section 7.2.2.3.5 is being changed to require a measurement of any generated Tx Common Mode Voltage.

References to any susceptibility requirement for Gen2u are being removed, as it is intended to be measured as generated CMV for USM requirements. (See strikeout in Table 38 above.)

7.2.2.3.5 TX AC Common Mode Voltage (Gen2i, Gen2m)

Maximum ~~sinusoidal~~ peak-to-peak amplitude of common mode signal measured at the transmitter connector.

~~The Transmitter shall comply to the electrical specifications of section 7.2, when subjected to a sinusoidal interfering signal with peak-to-peak voltage, and swept from the frequency range extremes, at a sweep rate period no shorter than 33.33 us.~~

Add the paragraph below, from section 7.2.2.3.6, to further define the need to limit maximum amplitude during this test.

The Transmitter shall not deliver more output voltage than that specified in Table 37 and Table 38 using the common mode voltage measuring technique defined in section 7.4.21.

7.2.2.3.6 TX AC Common Mode Voltage (Gen1u, Gen2u, Gen3i, Gen3u)

Maximum ~~sinusoidal~~ peak-to-peak amplitude of common mode signal measured at the transmitter connector.

Cross reference error corrected: Table 41 should be Table 38.

The Transmitter shall not deliver more output voltage than that specified in Table 37 and Table 4138 using the common mode voltage measuring technique defined in section 7.4.22.

Replace the following section with the new text below it, as shown in red. Add Gen1u and Gen2u to the header.

~~7.4.22 Tx AC Common Mode Voltage (Gen3i, Gen3u)~~

~~A method to measure the common mode voltage is attaching a metrology-grade power combiner between the Tx+ and Tx- outputs of the transmitter, at the Device or Host transmit connector. Both outputs shall be joined to the combiner with phase matched cables having $\leq \pm 3$ ps of mismatch, diminishing phase distortion during the measurement. The power combiner's output is connected to a spectrum analyzer having sufficient bandwidth to measure the fundamental and 2nd harmonic frequencies of the data speed. (Example: 6.0 Gbps, fundamental = 3 GHz.) The measurement shall be made using a 1 MHz resolution bandwidth. The transmitter shall output the HFTP (D10.2) pattern during the test. Equivalent methods may be used. The dBmV level is understood to be: 0 dBmV = 1mV into 50 ohms.~~

7.4.22 TX AC Common Mode Voltage (Gen1u, Gen2u, Gen3i, Gen3u)

This parameter is a measure of common mode noise other than the CM spikes during transitions due to TX+/TX- mismatch and skews which are limited by the rise/fall mismatch and other requirements. Measurement of this parameter is achieved by transmitting through a mated

connector into a Lab-Load such as shown in Figure 163. The transmitter shall use an MFTP (mid-frequency test pattern) and an HFTP (high frequency test pattern) during a data transfer only, not involving OOB transmissions. The measurement instrument may be a HBWS or other instrument. The measurement bandwidth shall be limited on the low end at 200 MHz and on the high end at $3 * \text{bitrate}/2$ (third harmonic), using first order filters. Separate channels shall be used for TX+ and TX- and the common mode is $(\text{TX+} + \text{TX-}) / 2$. The peak-to-peak voltage of the AC Common Mode Voltage and shall remain below the specified limit.