

USB 3.2 ENGINEERING CHANGE NOTICE

Title: Gen1 SSC_{df/dt} Limit

Applied to: USB 3.2 Revision 1.0

Brief description of the functional changes proposed:

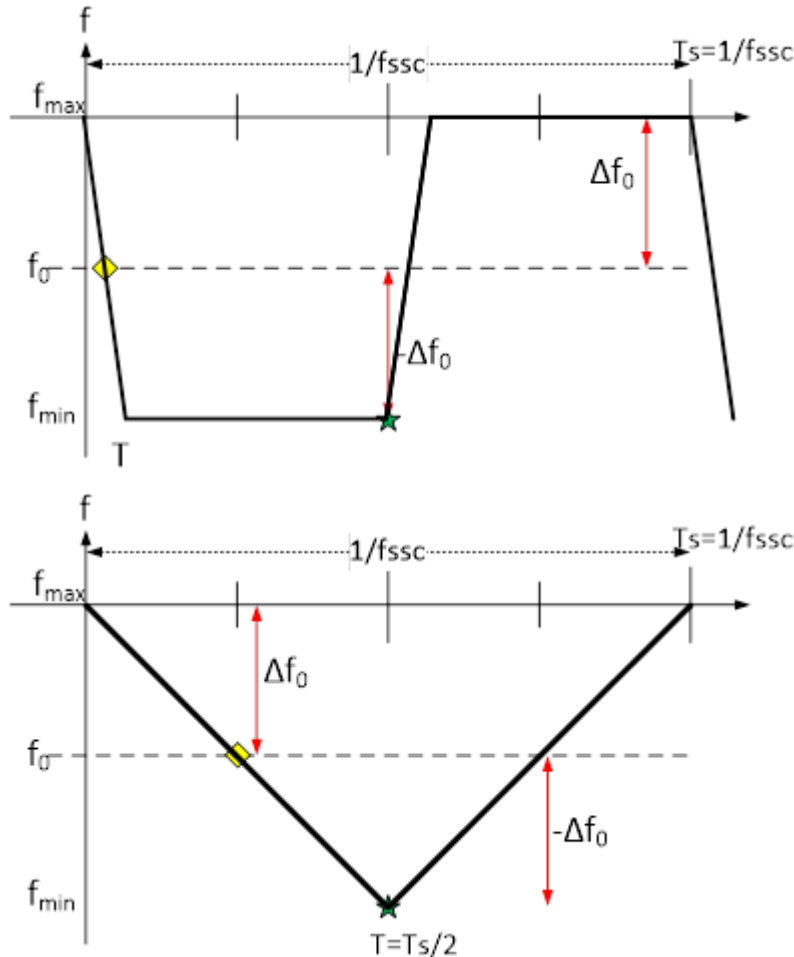
Currently USB Table 6-18 contains the following two requirements:

- Symbol period tolerance +/-300ppm
- Gen1- $t_{CDR_SLEW_MAX}$ 10mS/S max slew rate
- Gen2 - Maximal frequency slope 1250 ppm/uSec

The current requirement SSC_{df/dt} in Gen1 does not bound the steady state frequency change slope.

Present Gen1 $t_{CDR_SLEW_MAX}$ 10mS/S requirement by itself does not bound max the frequency change slope:

The examples below has the same $t_{CDR_SLEW_MAX}$, but differ in SSC_{df/dt}



This ECN aligns Gen1 SSC_{df/dt} requirement with Gen2 of 1250ppm/us.

Benefits as a result of the changes:

- Ensuring Gen1 operating Transmitters will not present a steep frequency change towards link partner Rx CDR
- Alignment with present USB3.1 Electrical Compliance Test Specification Rev 1.0 (FEB 14 2017)

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An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
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Present certified designs which passed interoperability testing will retain their certification

An analysis of the hardware implications:
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New designs will need to comply with this ECR.
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An analysis of the software implications:
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None.

An analysis of the compliance testing implications:
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Compliance testing will be augmented to accommodate this change.
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Actual Change

(a)Table 6-18

From Text:

Table 6-18. Transmitter Normative Electrical Parameters

Symbol	Parameter	Gen 1 (5.0 GT/s)	Gen 2 (10 GT/s)	Units	Comments
UI	Unit Interval	199.94 (min) 200.06 (max)	99.97 (min) 100.03 (max)	ps	The specified UI is equivalent to a tolerance of ± 300 ppm for each device. Period does not account for SSC induced variations.
		200.34 (min) 200.46 (max)	100.17 (min) 100.23 (max)	ps	Alternate limits apply to "radio friendly" clocking mode which employs a clock whose center frequency is downshifted by 2000ppm. This mode is to be used with a ± 3000 ppm spread.
V _{TX-DIFF-PP}	Differential p-p Tx voltage swing	0.8 (min) 1.2 (max)	0.8 (min) 1.2 (max)	V	Nominal is 1 V p-p
V _{TX-DIFF-PP-LOW}	Low-Power Differential p-p Tx voltage swing	0.4 (min) 1.2 (max)	0.4 (min) 1.2 (max)	V	Refer to Section 6.7.2. There is no de-emphasis requirement in this mode. De-emphasis is implementation specific for this mode.
V _{TX-DE-RATIO}	Tx de-emphasis	3.0 (min) 4.0 (max)	See section 6.7.5.2.	dB	Nominal is 3.5 dB for Gen 1 operation. Gen 2 transmitter equalization requirements are described in section 6.7.5.2.
R _{TX-DIFF-DC}	DC differential impedance	72 (min) 120 (max)	72 (min) 120 (max)	Ω	
V _{TX-RCV-DETECT}	The amount of voltage change allowed during Receiver Detection	0.6 (max)	0.6 (max)	V	Detect voltage transition should be an increase in voltage on the pin looking at the detect signal to avoid a high impedance requirement when an "off" receiver's input goes below ground.
C _{AC-COUPLING}	AC Coupling Capacitor	75 (min) 265 (max)	75 (min) 265 (max)	nF	All Transmitters shall be AC coupled. The AC coupling is required either within the media or within the transmitting component itself.
t _{CDR_SLEW_MAX}	Maximum slew rate	10	Not applicable	ms/s	See the jitter white paper for details on this measurement. This is a df/ft specification; refer to Section 6.5.4 for details.
SSC _{dfdt}	SSC df/dt	Not applicable	1250 (max)	ppm/ μ s	See note 1.
V _{TX-CM-IDLE-DELTA}	Transmitter idle common-mode voltage change	+600 (max) -600 (min)	+600 (max) -600 (min)	mV	The maximum allowed instantaneous common-mode voltage at TP2 while the transmitter is in U2 or U3 and not actively transmitting LFPS. Note that this is an absolute voltage spec referenced to the receive-side termination ground but serves the purpose of limiting the magnitude and/or slew rate of Tx common mode changes.

Note 1: Measured over a 0.5 μ s interval using CP10. The measurements shall be low pass filtered using a filter with 3 dB cutoff frequency that is 60 times the modulation rate. The filter stopband rejection shall be greater or equal to a second order low-pass of 20 dB per decade. Evaluation of the maximum df/dt is achieved by inspection of the low-pass filtered waveform.

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To Text:

Table 6-18. Transmitter Normative Electrical Parameters

Symbol	Parameter	Gen 1 (5.0 GT/s)	Gen 2 (10 GT/s)	Units	Comments
UI	Unit Interval	199.94 (min) 200.06 (max)	99.97 (min) 100.03 (max)	ps	The specified UI is equivalent to a tolerance of ± 300 ppm for each device. Period does not account for SSC induced variations.
		200.34 (min) 200.46 (max)	100.17 (min) 100.23 (max)	ps	Alternate limits apply to "radio friendly" clocking mode which employs a clock whose center frequency is downshifted by 2000ppm. This mode is to be used with a $\pm 0/-3000$ ppm spread.
V _{TX-DIFF-PP}	Differential p-p Tx voltage swing	0.8 (min) 1.2 (max)	0.8 (min) 1.2 (max)	V	Nominal is 1 V p-p
V _{TX-DIFF-PP-LOW}	Low-Power Differential p-p Tx voltage swing	0.4 (min) 1.2 (max)	0.4 (min) 1.2 (max)	V	Refer to Section 6.7.2. There is no de-emphasis requirement in this mode. De-emphasis is implementation specific for this mode.
V _{TX-DE-RATIO}	Tx de-emphasis	3.0 (min) 4.0 (max)	See section 6.7.5.2.	dB	Nominal is 3.5 dB for Gen 1 operation. Gen 2 transmitter equalization requirements are described in section 6.7.5.2.
R _{TX-DIFF-DC}	DC differential impedance	72 (min) 120 (max)	72 (min) 120 (max)	Ω	
V _{TX-RCV-DETECT}	The amount of voltage change allowed during Receiver Detection	0.6 (max)	0.6 (max)	V	Detect voltage transition should be an increase in voltage on the pin looking at the detect signal to avoid a high impedance requirement when an "off" receiver's input goes below ground.
C _{AC-COUPLING}	AC Coupling Capacitor	75 (min) 265 (max)	75 (min) 265 (max)	nF	All Transmitters shall be AC coupled. The AC coupling is required either within the media or within the transmitting component itself.
t _{CDR_SLEW_MAX}	Maximum slew rate	10	Not applicable	ms/s	See the jitter white paper for details on this measurement. This is a df/ft specification; refer to Section 6.5.4 for details.
SSC _{data}	SSC df/dt	1250 (max)	1250 (max)	ppm/ μ s	See note 1.
V _{TX-CM-IDLE-DELTA}	Transmitter idle common-mode voltage change	+600 (max) -600 (min)	+600 (max) -600 (min)	mV	The maximum allowed instantaneous common-mode voltage at TP2 while the transmitter is in U2 or U3 and not actively transmitting LFPS. Note that this is an absolute voltage spec referenced to the receive-side termination ground but serves the purpose of limiting the magnitude and/or slew rate of Tx common mode changes.

Note 1: Measured over a 0.5 μ s interval using CP10. The measurements shall be low pass filtered using a filter with 3 dB cutoff frequency that is 60 times the modulation rate. The filter stopband rejection shall be greater or equal to a second order low-pass of 20 dB per decade. Evaluation of the maximum df/dt is achieved by inspection of the low-pass filtered waveform.