A CAUI-4 Specification Method Supporting 15-20 dB Chip-to-Chip Channels

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Purposes

- Propose a self-contained and complete spec/parameters for CAUI4 c2c RX interference tolerance and channel in supporting 15-20 dB channels

Proposed RX Interference Tolerance Test: Option (I)

Table 83D-3 Receiver interference tolerance test parameters

Parameter	Test Value	Unit
Max BER	1e-15	
Applied peak-to-peak sinusoidal jitter	5 UI at 1 MHz, 0.05 UI at 10 MHz	UI
Applied broad-band noise	Adjusted to meet the EH and EW	mv (rms)
Applied random jitter	Adjusted to meet the EH and EW	ps (rms)
Min Eye-Height (EH) after ref RX	30	mv
Min Eye-Width (EW) after ref RX	0.35	UI
Channel Insertion loss at 12.89 GHz	15, 20	dB

Proposed Reference Receiver Definition: Option (I) cont…

- Reference RX is composed of behavior models of
  - Rx package
  - CTLE/DFE
- For up to 15, 20 dB channels, CTLE + (0-10)-tap DFE is enabled for ref RX
- Reference RX is defined and provided by the updated COM

Updated Behavioral CTLE Definition: Option (I) cont...

- CTLE behavioral model is defined with the following equation and related parameters, comprehending both AC and DC gains

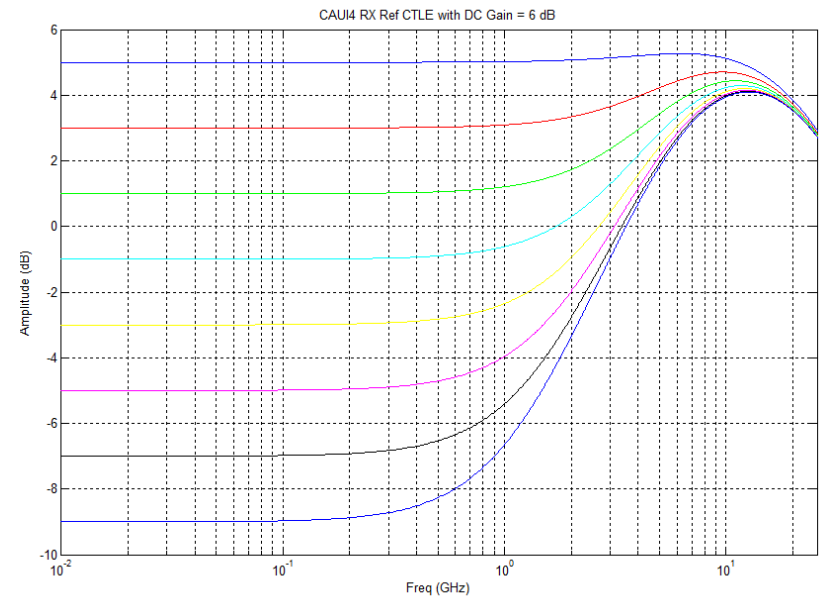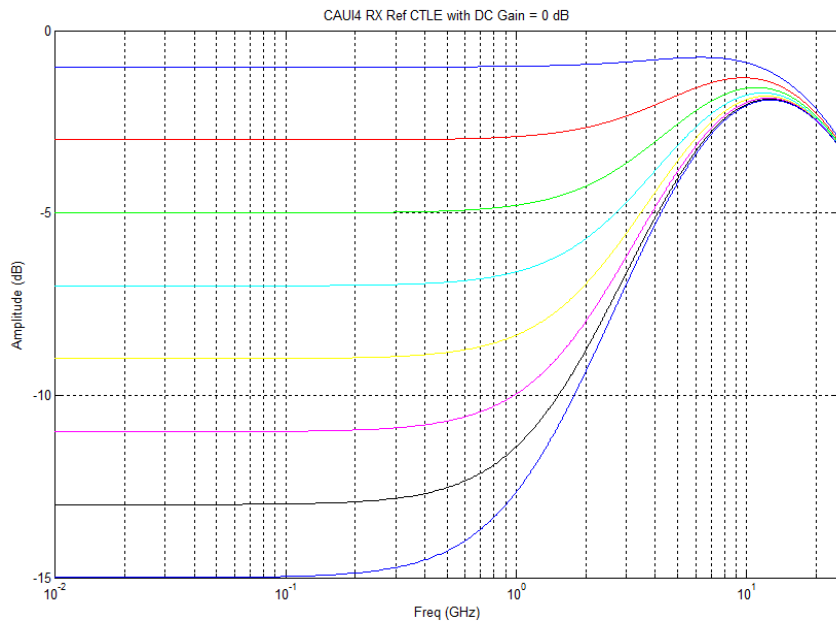$$H_{CTLE}(s) = A_{DC}\omega_{p2}\frac{(s + \omega_{p1}A_{AC})}{(s + \omega_{p1})(s + \omega_{p2})}$$

$$\omega_{p1} = 2\pi \times (0.25 \times 25.78 \text{ GHz})$$
$$\omega_{p2} = 2\pi \times 25.78 \text{ GHz}$$
$$A_{DC} = 0, to\ 10\ dB, with\ 1\ dB\ step\ size$$
$$A_{AC} = -1\ to - 15\ dB, with\ 1\ dB\ step\ size$$

Updated Behavioral CTLE Definition: Option (I) cont…

Proposed RX Interference Tolerance Test: Option (II)

Table 83D-3 Receiver interference tolerance test parameters

Parameter	Test Value	Unit
Max BER	1e-15	
Applied peak-to-peak sinusoidal jitter	5 UI at 1 MHz, 0.05 UI at 10 MHz	UI
Applied broad-band noise	5.6 (15 dB IL), 3.4 (20 dB IL)	mv (rms)
Applied random jitter	0.364	ps (rms)
Channel Insertion loss at 12.89 GHz	15, 20	dB

Proposed CAUI4 Channel Characteristics Option (I)

- Use updated COM as the channel compliance tool
- EW(1e-15) of 0.35 UI, and EH (1e-15) of 30 mv are the passing/fail thresholds

Proposed CAUI4 Channel Characteristics Option (I), 2/2

Table 83D–5—Channel operating margin parameters

Parameter	Symbol	Value	Units
Signaling rate	f_b	25.78125	GBd
Maximum start frequency	f_{min}	0.05	GHz
Maximum frequency step	Δf	0.01	GHz

Device package model
  Single-ended device capacitance
  Transmission line length
  Single-ended board capacitance
	C_d
	z_p
	C_b
		1e-4
		3
		1e-4
			nF
			mm
			nF

Single-ended reference resistance	R_o	50	ohms
Single-ended termination resistance	R_d	55	ohms
Receiver 3 dB bandwidth	f_r	$0.75 \times f_b$	GHz
Transmitter equalizer, pre-cursor coefficient	$c(-1)$	0 -0.07 -0.14	— — —
Transmitter equalizer, post-cursor coefficient	$c(1)$	0 -0.09 -0.18	— — —

Continuous time filter,   DC and AC Gains
  Minimum value
  Maximum value
  Step size
	A_{DC}
	
	A_{AC}
		A_{DC} 0, 10, 1
		
		A_{AC} -1, -15, 1
			dB
			dB
			dB

Transmitter differential peak output voltage
  Victim
  Far-end aggressor
  Near-end aggressor
	Av
	A_f
	A_n
		0.4
		0.4
		0.6
			V
			V
			V

Number of signal levels	L	2	—
Number of samples per unit interval	M	32	—
Decision feedback equalizer (DFE) length	N_b	0-10	UI
Normalized DFE coefficient magnitude limit	b_{max}	1	—
Random jitter, RMS	σ_{RJ}	0.009375	UI
Dual-Dirac jitter, peak	A_{DD}	0.07	UI
One-sided noise spectral density	η_o	5.2e-8	V^2/GHz
Target detector error ratio	DER_0	10^{-15}	—

Proposed CAUI4 Channel Characteristics Option (II)

- Define the channel impairment limits and use them to define the channel characteristics w/o the use of Ref TX and RX

Table 83D-5 Channel characteristic parameters

Parameter	Test Value	Unit
IL at Nyquist (12.89 GHz)	15, 20	dB
Peak_MDXTK_interference	25.8	mv
Peak_MDNEXT_interference	24.8	mv
Peak_MDFEXT_interference	2.7	mv
ICN	5.6 (15 dB) 3.4 (20 dB)	mv (rms)
ILD	0.3	mv (rms)
ILD_peak	+-1.2	dB (f <=Nyquist)
ICR (dB, at Nyquist)	17	dB

References

[1]: http://www.ieee802.org/3/bm/public/jan13/li_01_0113_optx.pdf

[2]: http://www.ieee802.org/3/bm/public/mar13/li_01_0313_optx.pdf

[3]:http://www.ieee802.org/3/bm/public/may13/li_01a_0513_optx.pdf

[4]:http://www.ieee802.org/3/bm/public/jul13/mli_01_0713_optx.pdf

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