XLAUI/CAUI TP4 VMA specification issue (Clause 83B)

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Background

- During the development of the XLAUI/CAUI specifications for clause 83B, assumptions about the speed of internal module design components were made that resulted in an over-estimate of the transition times possible for the module high speed electrical outputs.
- As a result, simulations of the trade off between minimum Voltage Modulation Amplitude (VMA) of the module high speed outputs, and the de-emphasis and transition time of the outputs, did not extend to short enough transition times.
- The unforeseen consequence is that equation 83B-6, which was a second order fit to the simulations, allows unreasonably low VMA values for short transition time module outputs.

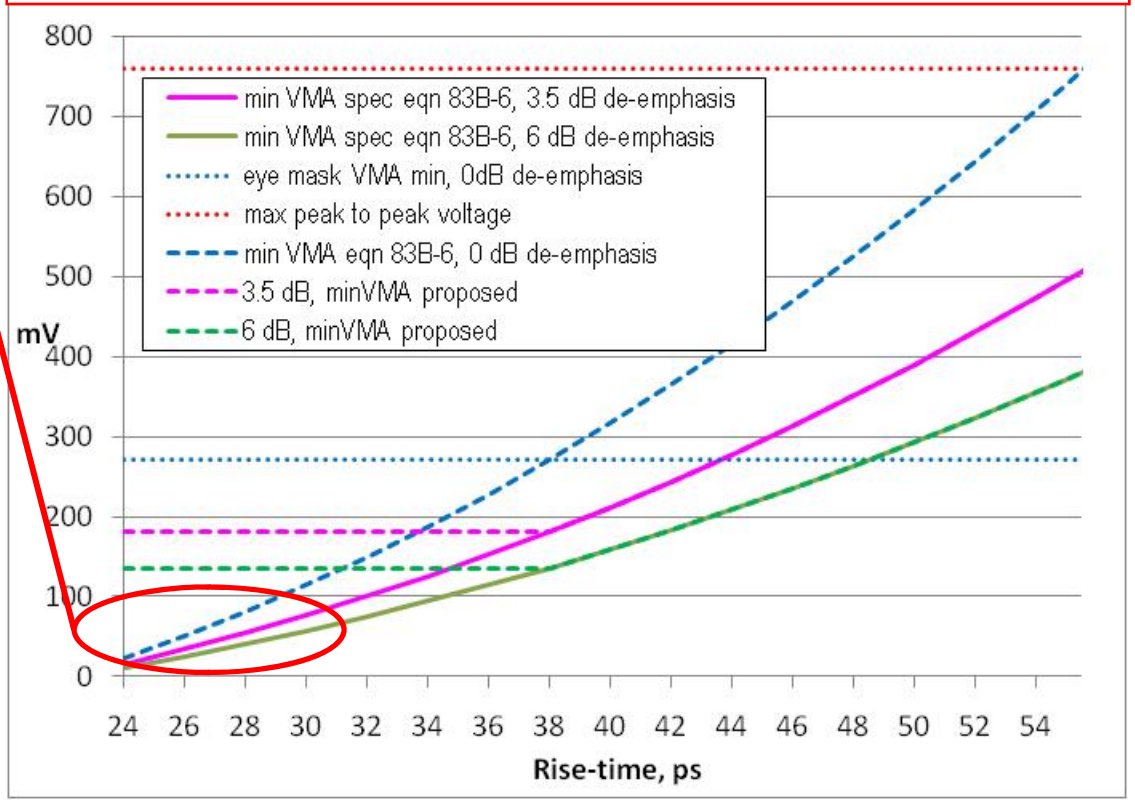
Minimum VMA spec in Clause 83B: the issue

- The Minimum VMA spec in table 83B-3 refers to equation 83B-6
- … it leads to unreasonably small values of VMA for fast rise-time (but 83B compliant) module XLAUI outputs.

Minimum VMA (mV) = $(-110 - 2.13x + 0.32x^2) \times (10^{-y/20})$ (83B–6)

where

x is the rise or fall time (whichever is larger) in ps
y is de-emphasis value in dB



83B Module electrical output eye mask

Table 83B–3—Module electrical output

Parameter	Subclause reference	Value	Unit
Maximum differential output voltage, peak-to-peak	83A.3.3.1	760	mV
Minimum de-emphasis	83A.3.3.1	3.5	dB
Maximum de-emphasis	83A.3.3.1	6	dB
Minimum VMA	83A.3.3.1	See Equation (83B–6)	mV
Maximum termination mismatch at 1 MHz	86A.5.3.2	5	%
Maximum output AC common-mode voltage, RMS	86A.5.3.1	15	mV
Minimum output rise and fall time (20% to 80%)	83A.3.3.2	24	ps
Maximum Total Jitter	83A.3.3.5	0.4	UI
Maximum Deterministic Jitter	83A.3.3.5	0.25	UI
Module electrical output eye mask definition X1	83A.3.3.5	0.2	UI
Module electrical output eye mask definition X2	83A.3.3.5	0.5	UI
Module electrical output eye mask definition Y1	83A.3.3.5	136	mV
Module electrical output eye mask definition Y2	83A.3.3.5	380	mV

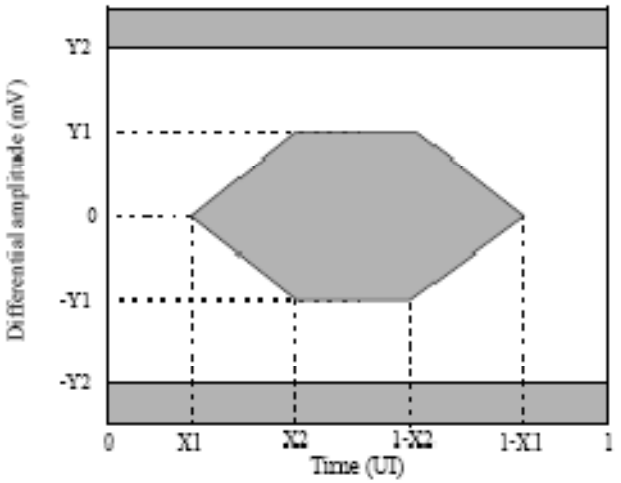


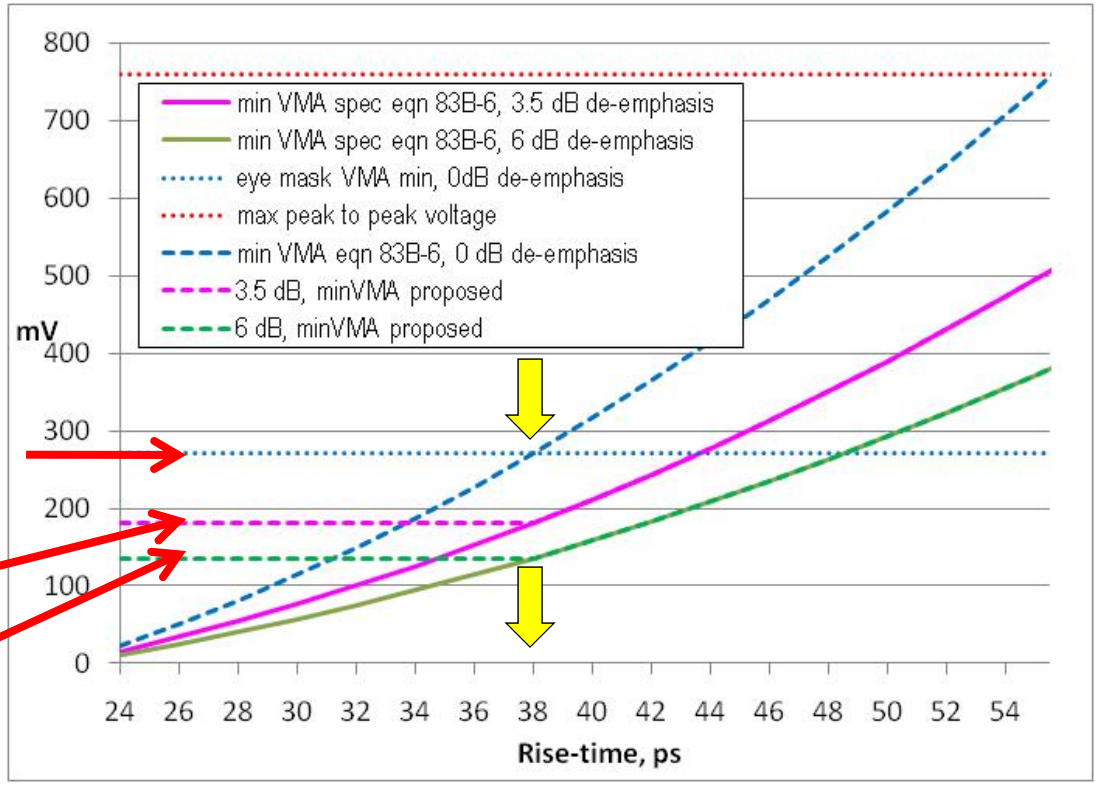
Figure 83A–8—Transmitter eye mask

Eye-mask for module TP4 electrical output (note that the eye mask is a diamond shape , since X2=0.5)

- There is a minimum 272 mV VMA implied by the electrical eye mask definition, which is for a 0 dB de-emphasis signal and any rise time.
- During the development of 83B, a Finite Impulse Response (FIR) implementation with constant main tap setting was assumed for adding de-emphasis; the intent was that the minimum VMA specified in 83B-6 should be consistent with an FIR implementation of de-emphasis for the 0dB de-emphasis transmitter eye mask test value, and over the operating range of 3.5 to 6 dB de-emphasis range.

Minimum VMA spec in Clause 83B: the issue

- For a FIR with constant main tap, a 0 dB de-emphasis eye with 272 mV VMA would be equivalent to
  - a 3.5 dB de-emphasis eye with 181.2 mV VMA, and
  - a 6 dB de-emphasis eye with 135.9 mV VMA.



- However, a FIR implementation cannot be assumed – it is not a normative requirement of clause 83B (there are many other methods of implementing 'de-emphasis'), so there's a missing normative link between the minimum VMA at 0 dB de-emphasis and the minimum VMA for the 3.5 to 6 dB de-emphasis range for very fast module output rise-times.
- The intent here is modify 83B-6 to make the minimum VMA implied by an assumed FIR characteristic explicit.

Minimum VMA spec: proposed remedy

- Change equation 83B-6 from

Minimum VMA (mV) = $(-110 - 2.13x + 0.32x^2) \times 10^{-y/20}$)

where

x is the rise or fall time (whichever is larger) in ps

y is de-emphasis value in dB

- to

Minimum VMA (mV) = $(-110 - 2.13x + 0.32x^2) \times 10^{-y/20}$)

where

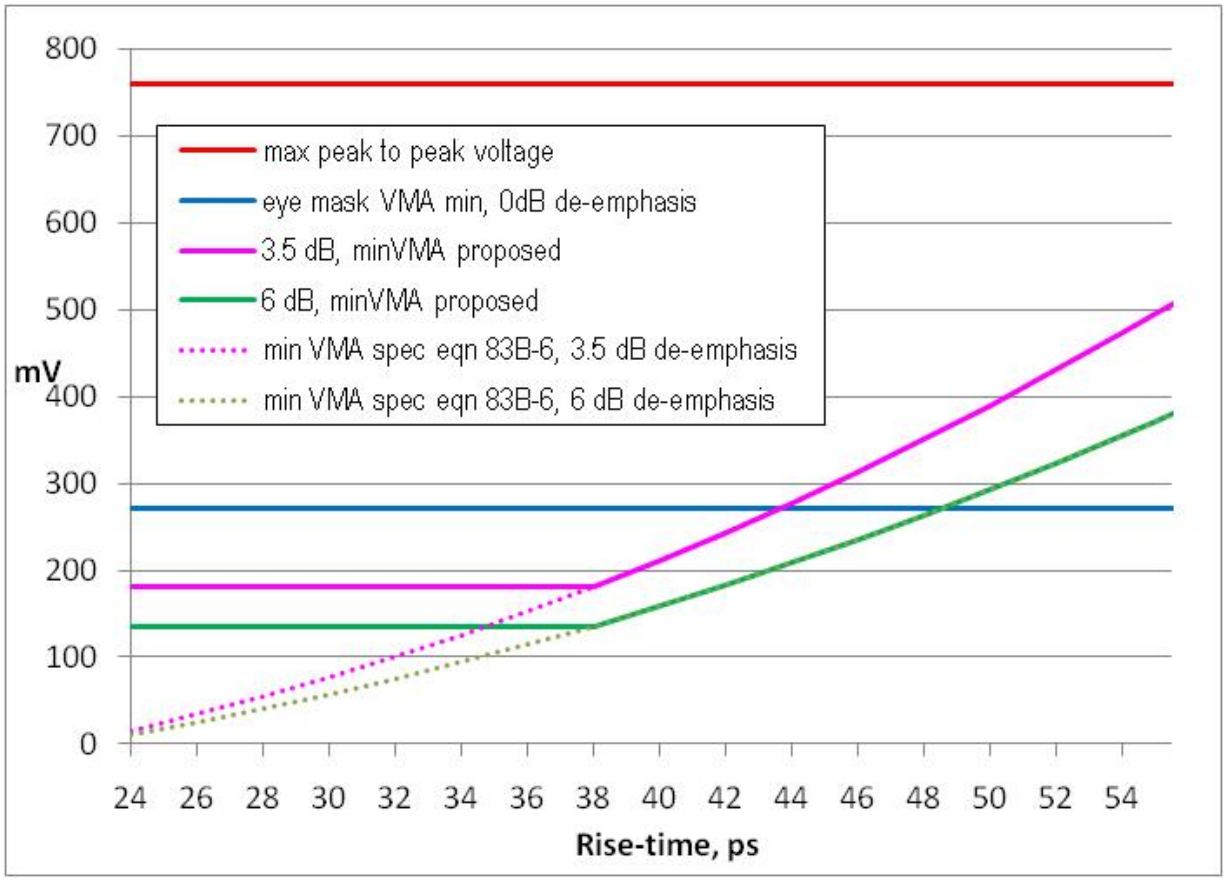
x is the rise or fall time, or 38, (whichever is larger) in ps

y is de-emphasis value in dB

38 is based on the module XLAUI Tx eye mask spec and an assumed FIR implementation, as was the original intent of the experts developing 83B.

Illustration of the proposed remedy

The effect of setting a minimum allowed value of 38 ps transition time in equation 83B-6 is to set a minimum VMA of 181.2mV for 3.5dB de-emphasis, and 135.9 mV for 6dB de-emphasis.



Back up

Host XLAUI electrical specifications in 83B and 83A

Table 83B–5—Host electrical output

Parameter	Subclause reference	Value	Units
Maximum output AC common-mode voltage, RMS	86A.5.3.1	20	mV
Minimum output rise and fall time (20% to 80%)	83A.3.3.2	24	ps
Maximum Total Jitter	83A.3.3.5	0.62	UI
Maximum Deterministic Jitter	83A.3.3.5	0.42	UI
Host electrical output eye mask definition X1	83A.3.3.5	0.31	UI
Host electrical output eye mask definition X2	83A.3.3.5	0.5	UI
Host electrical output eye mask definition Y1	83A.3.3.5	42.5	mV
Host electrical output eye mask definition Y2	83A.3.3.5	425	mV

- Host output: minimum VMA is 85 mV p-p
- Host input sensitivity is 85 mV p-p (at XLAUI chip input, see 802.3ba, figure 83A-2)

Table 83A–2—Receiver characteristics

Parameter	Subclause reference	Value	Units
Signaling rate per lane (range)	—	10.3125 ± 100 ppm	GBd
Minimum input AC common-mode voltage tolerance, RMS	86A.5.3.1	20	mV
Minimum input rise and fall time tolerance (20% to 80%)	83A.3.3.2	24	ps
Differential input return loss	83A.3.4.3	See Equation (83A–7)	dB
Differential to common-mode input return loss	83A.3.4.4	See Equation (83A–8)	dB
Stressed receiver tolerance			
Minimum Total Input Jitter Tolerance	83A.3.4.2	0.62	UI
Minimum Deterministic Input Jitter Tolerance	83A.3.4.2	0.42	UI
Receiver eye mask definition X1	83A.3.4.2	0.31	UI
Receiver eye mask definition X2	83A.3.4.2	0.5	UI
Receiver eye mask definition Y1	83A.3.4.2	42.5	mV
Receiver eye mask definition Y2	83A.3.4.2	425	mV