Proposal for 6G SAS Phy Specification

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Preview

- This presentation references T10/06-496r2, generally identifying proposal elements which differ from that presentation in red.

- Primary difference from T10/06-496r2 is in method of specifying TX compliance.

TX Spec Proposal
(ref T10/06-496r2, slide 6)

Transmitter	Min	Nominal	Max	Units
Bit Rate		6000		MBps
Differential Voltage	**(see following slide)**			mV
Transition Time (20%-80%)	0.25		**---**	UI
Tx De-Emphasis	**(not directly specified)**			
DC Differential Impedance	**(covered by SDD22)**			
DC Impedance Mismatch			5	ohm
DC Common Mode Impedance	**(covered by SCC22)**			
Dif'l Return Loss (SDD22)	(see Plot)			dB
CM Return Loss (SCC22)	(see Plot)			dB
Max. Intra-Pair Skew 15 ps				
Max. Tx Output Imbalance			10	%
**Common Mode Generation			50	mVpp
Random Jitter			0.15**??**	UI
Deterministic Jitter			0.15**??**	UI
Total Jitter			0.3 **??**	UI
AC Coupling Cap			12	nF

TX Spec Proposal: Dif'l Voltage

- ## Max amplitude to protect RX
  - **1200 mVppd**
  - Same as T10/06-496r2
- ## Min de-emphasized amplitude ("VMA")
  - **400 mVppd**
  - Same as 800 mVppd min peak voltage with 6dB de-emphasis
 - Enables low-swing mode
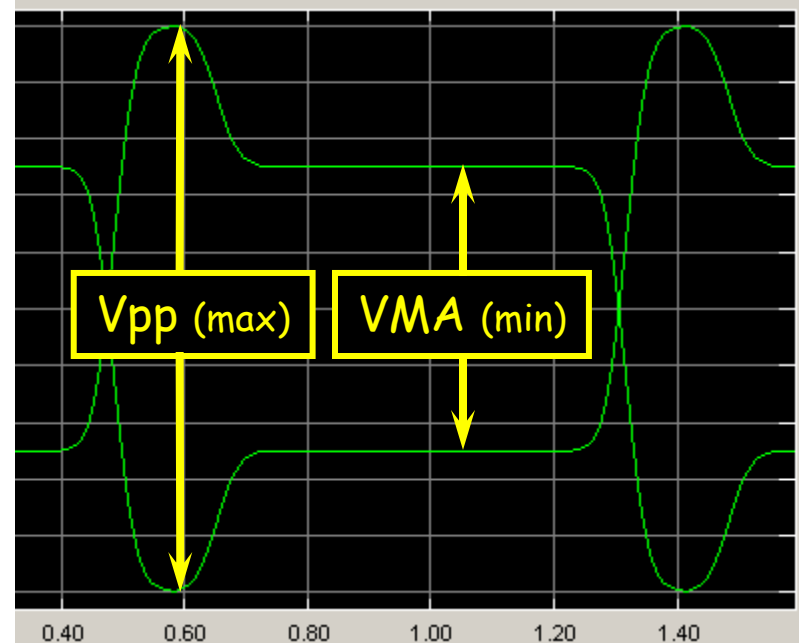
Measurement of Vpp & VMA

1. Two vertical histogram spanning an integral number of UI using a defined data pattern. 1st covers zero volts to above waveform, & 2nd covers zero to below wfm.
2. VMA is "peak position" of 1st histogram minus 2nd histogram
3. Vpp is peak-peak of 1st plus 2nd.

Using example at right:
- VMA = 230.63 – (-230.62)
  = 461.25 mVppd
- Vpp = 427.50 + 427.50
  = 955.00 mVppd
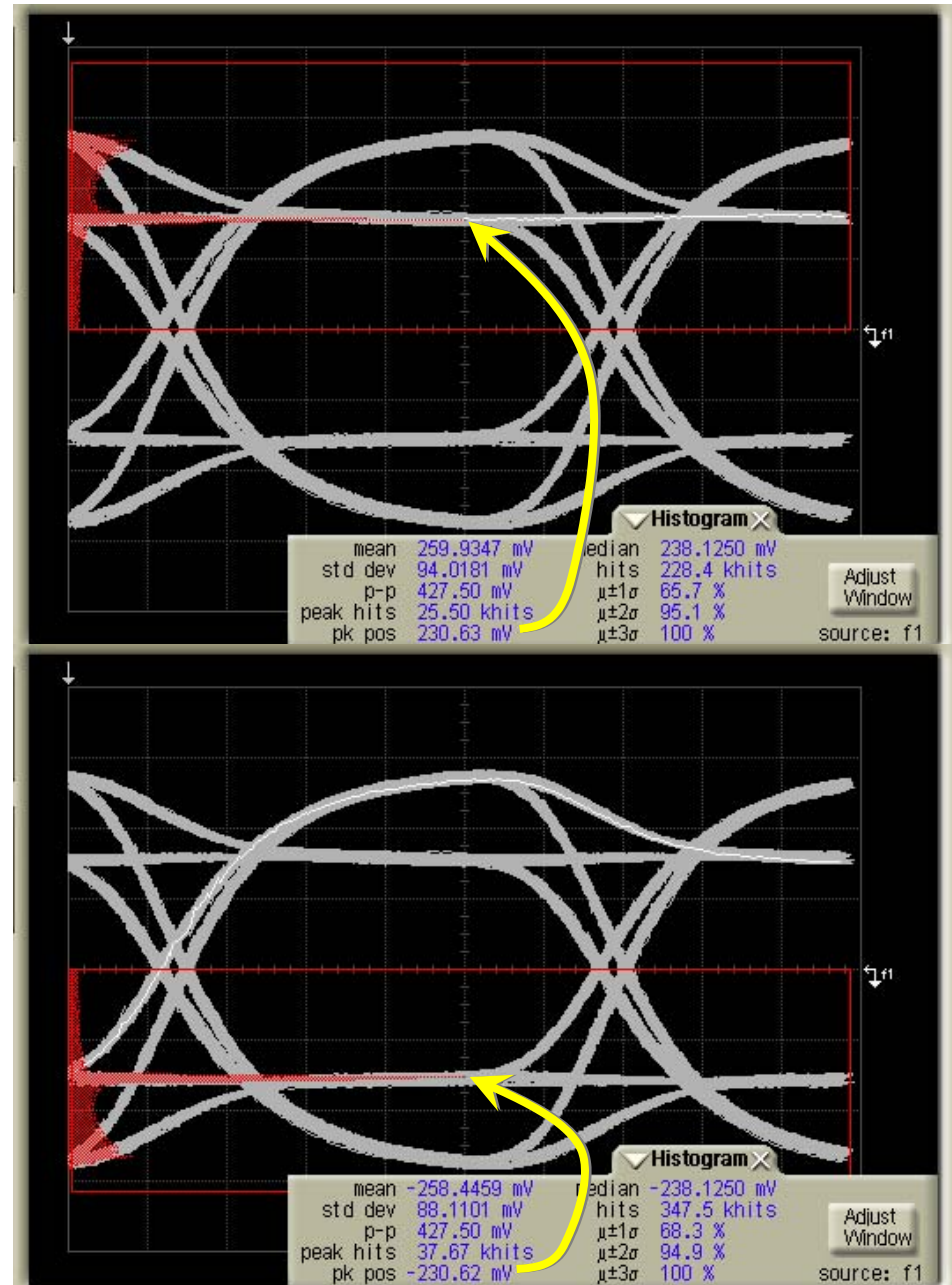
Reasons not to Specify
TX De-emphasis

- Mandates a high EMI TX waveform, even if it isn't needed

- RX equalization (DFE) is equal or better performance compared to TX emphasis

- Details of waveform depend on details of TX-to-compliance point path
  - 1dB @ 3GHz for 2-3" PCB trace, taking a compliant TX out of compliance

TX Spec Proposal: Return Loss
(same as T10/06-496r2, slide 10)

50 MHz < f < 4.5 GHz:

$$\text{SCC22} = \max\{-6, -\textcolor{green}{3.0}+13.3*\log10(f/4.25 \text{ GHz})\}$$
$$= \max\{-6, -\textcolor{green}{5.0}+13.3*\log10(f/3.0 \text{ GHz})\}$$

$$\text{SDD22} = \max\{-10, -5.9+13.3*\log10(f/4.25 \text{ GHz})\}$$
$$= \max\{-10, -7.9+13.3*\log10(f/3.0 \text{ GHz})\}$$

TX Spec Proposal: Interoperability
(from OIF CEI 2.0, "Method D")

> ### 2.4.3 Transmitter Interoperability
>
> The following step shall be made to identify which transmitters are to be considered compliant.
>
> 1. It shall be verified that the measured eye is equal or better than the calculated eye for the given measurement probability Q (see Appendix 2.E.3 for a suggested method of calculating Q given a measurement population), given:
>
>   — A "compliance" channel as per 2.4.2 that required at least half the maximum transmit emphasis with no receiver filtering to give an open eye.
>
>   — Using this channel the transmitter shall be then optimally adjusted and the resulting eye measured (see Appendix 2.D.7 for a suggested method).
>
>   — Using this channel the statistical eye shall then be calculated, as per Annex 2.C.5, using the maximum defined transmit jitter and the actual transmitter's amplitude and emphasis.

- 10 meter iPass cable (possibly plus 1-2 dB of fixture loss) satisfies this "compliance" channel definition.

- Proposed TX eye mask after compliance channel and simulated DFE equalization is 100mVppd x 0.4UI (R_Y1=50mV and R_X1=0.3)

100mVppd

0.4 UI
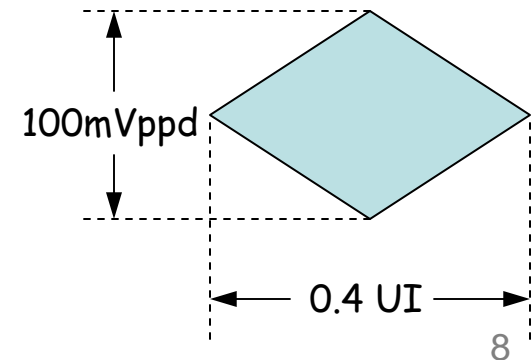
RX Spec Proposal
(ref T10/06-496r2, slide 11)

Receiver	Min	Nom	Max	Units
DC Differential Impedance	**(covered by SDD11)**			
DC Common Mode Impedance	**(covered by SCC11)**			
Dif'l Return Loss (SDD11)	(same as SDD22)			
CM Return Loss (SCC11)	**(same as SCC22)**			
DC Impedance Mismatch			**5**	**ohm**
CM Tolerance (2-200MHz)	150			mVpp
Max Operational Input	1200			mVpp
Max Non-Operational Input	2000			mVpp

Reference Devices

- Reference TX & RX are used primarily to set requirements for compliant channels.

- Numerous presentations have shown that the following reference TX (one post cursor tap) & RX (two DFE taps) establish all the submitted channels as compliant.

- More elaborate reference TX and/or RX will declare more difficult (but yet unknown) channels as compliant.

Reference Devices: TX
(ref T10/06-496r2, slide 5)

Ref TX		Units
Ref Tx # of taps	**2 (note 1)**	
Ref Tx de-emphasis	**0 to 6**	dB
Ref Tx swing ("VMA")	**400**	mVpp
Ref Tx dif'l resistance	**100**	ohms
Ref Tx dif'l capacitance	**0.47**	pF

Note 1: If more accuracy is required, one additional TX tap (precursor) provides far more margin than adding a 3rd RX tap. (Ref: T10/06-049r1)

Reference Devices: RX
(ref T10/06-496r2, slide 5)

Ref RX		Units
Ref RX # of taps	2	
Ref RX tap spacing	1	UI
Ref RX tap weight limit	(see below)	
Ref Tx dif'l resistance	100	ohms
Ref Tx dif'l capacitance	0.47	pF

Note: DFE tap weights are constrained to be positive (in the sense defined in OIF CEI 2.0, so that fractions of preceding decisions are *subtracted* from the present input). This precludes DFE supplying a low pass characteristic to compensate for excess de-emphasis.