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Measuring Transmitter Compliance Parameters at a varying TP0a

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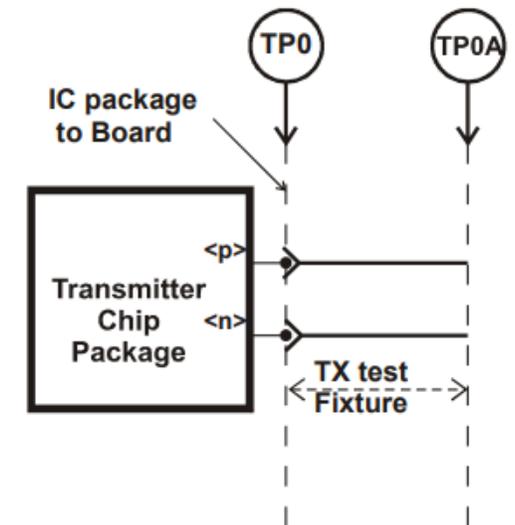
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Problem Statement

- Transmitter (Tx) parameters were historically defined in electrical specifications at the device package ball – referred to as TP0
- TP0 is usually inaccessible for direct measurement nor is it a TEM point → Measuring device transmitter compliancy @TP0 required one of the following solutions:
 1. Physically accessing the measurement point @TP0 by means of “pico-probing”, or other “creative” structure
 2. Connecting TP0 (the device ball/pin) to a “distant” location (TP0a) with a transmission line and vias according to what is “structurally” required. Measuring the Tx @TP0a and performing mathematical de-embedding to check compliance of parameters vs. those defined @TP0. De-embedding is an extremely challenging mathematical task which easily introduces measurement inaccuracies threatening the validity of the whole compliance measurement

Problem Statement – Cont.

- To address challenges of measuring Tx parameters @ TP0, the measurement structure connecting TP0 with TP0a was defined within a range of loss, loss variance and return loss/effective return loss (originally done in 802.3bj).
The Tx compliance parameters were redefined @ TP0a according to the Tx test fixture parameters
- Definition of Tx parameters @ TP0a was followed by 802.3by, 802.3bs, 802.3cd
- 802.3ck introduced higher signal BW due to the increased lane rate of 100Gbps @ PAM4, thus making TP0-TP0a test fixture definition challenging



Problem Statement – Cont.

- TP0 to TP0a loss @ ~26GHz has increased x2 compared to former standards which Fb/2 was ~13GHz
- The fixture achievable manufacturable variance also increased dramatically, **making the possible definition of Tx measurements @TP0a questionable**
- Measuring @TP0a according to a predefined fixture limitations is not practical in real high-radix products, making it impossible to qualify all lanes, and maybe even one
- suggestions were heard to re-define Tx parameters @TP0, or at (the very limited, tightly defined) TP0a
(http://www.ieee802.org/3/ck/public/20_01/mellitz_3ck_01a_0120.pdf)
And difference according to implementation to be accounted for at time of measurement – Suggested way to proceed to be described...

Suggested Remedy

- Tx parameters are to be defined @TP0
- Tx parameters will be measured at a specific TP0a as implemented per measurement point

The “extension” of Tx parameters from TP0 to TP0a is to be done by:

- A “COM-like” set of equations that need to be defined and provide:
 - TP0 defined parameters when run with a null board
 - TP0a adjusted parameters according to every specific TP0 to TP0a test fixture

Suggested Remedy – Cont.

- A reasonable test fixture implementation “region” limit is to be introduced / defined –
 - Initial suggestion:
 - Loss @ 26GHz < 6dB
 - Allowed ILD? - ± 0.5 ÷ ± 1 dB
 - ERL (probably need to be defined at a strict TP0a)?
- The idea allows each board implementor to define their own (reasonable) TP0-TP0a test fixture which varies according to specific implementation challenges
- Gaining “an adjusted” set of Tx parameters allows measuring at a variety of TP0a

Suggested Remedy – Cont.

- Fixture S-parameter representation is needed and can be obtained by replica, or extraction (or even “Pico probed on a non assembled board)
- Since the path used is embedding (rather than de-embedding), the Fixture S-param model accuracy may be mediocre and still obtain the appropriate pass criteria @TP0a
- May be integrated into oscilloscope test suites and directly adjust Tx parameters to a variance of TP0a points
- Allow multiple lanes to be measured as long as replica traces are provided
- Why not still specify @ TP0a? – Because one will have to de-embed to TP0 and re extrapolate to the new TP0a
- Call for action: Form a brain storming group to tailor the required mathematics

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Back-up Slides

Parameter Extrapolation Example – Vf & linear fit

Transmitter steady-state voltage, v_f (min.)	162.9.3.1.2	0.4	V
Transmitter steady-state voltage, v_f (max.)		0.6	
Linear fit pulse peak (min.)	162.9.3.1.2	TBD $\times v_f$	V

- Create a PAM4 stream and pass it through the COM package using the characteristic transmitter
- Simulate the PRBS13Q stream through the sampled or simulated TP0 to the specific TP0a
- Use the below procedure to extract the adjusted Tx characteristic
 - 162.9.3.1.2 Steady-state voltage and linear fit pulse peak
 - Compute Vf per 136.9.3.1.2 using: $N_v = 200$ & Tx equalizer with no emphasis
 - Compute $Vf = \frac{\sum_1^{M \times N_v} P(k)}{M}$
 - Follow the procedure of 136.9.3.1.2 /85.8.3.3.5 to obtain adjusted linear fit pulse peak parameter

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