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25 Gbd/s Stressed RX Sensitivity (SRS) in 802.3ca

- Notes on D2.0 Cmt. 418 on SRS

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802.3ca TF meeting, Geneva

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D2.0 - Comment #418 on SRS
SC 141.5.2

From powell_3ca_2a_0719

Submitter Comment:
If these PMDs use FEC, probably the stressed receive signal should be defined by SEC, J2 and J4, as 25GBASE-SR, LR and ER, rather than VECP, J2 and J9 as 40GBASE-SR4.

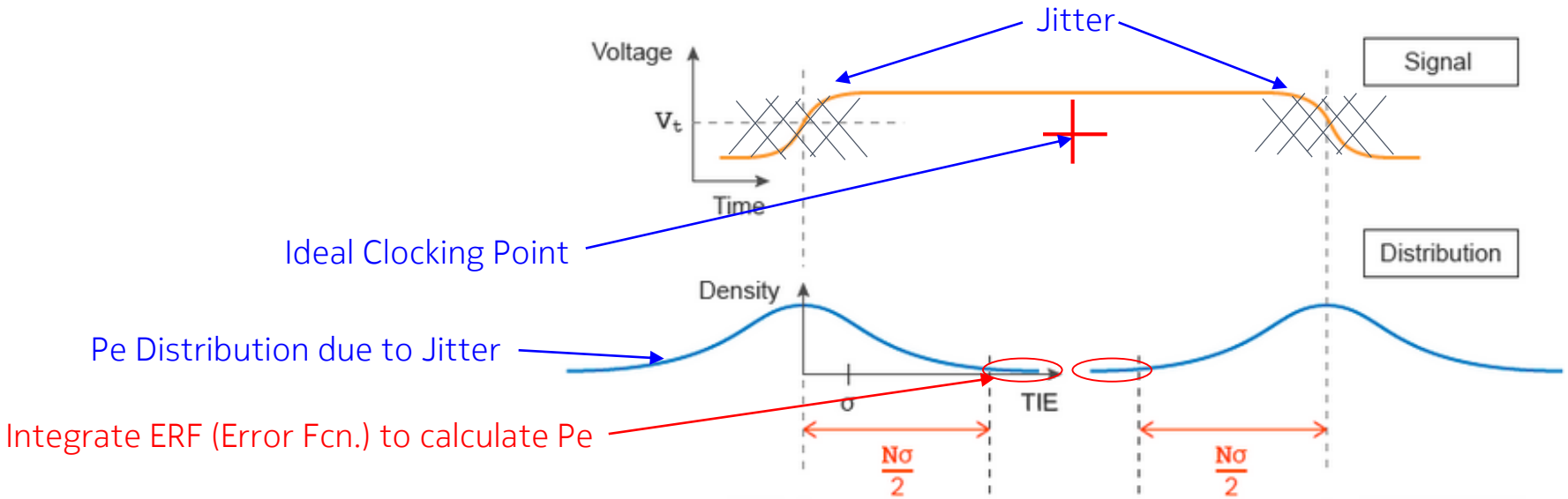
Submitter Suggested Remedy:
But as the pre-BER is 1e-2, even J4 is wrong. Maybe Jrms and J3 would be suitable. SEC can easily be defined for a BER of 1e-2.

Our Current 25G SRS Spec – J2, J9, VECP (from Table 141-17, D3.0)

	25G	10G	
Stressed receiver sensitivity (OMA), each channel[e] (max)	–21.2		dBm
Receiver settling time (max)	800		ns
Conditions of stressed receiver sensitivity test			
Vertical eye closure penalty,[f] each channel	2	See Table 75-6[a]	dB
Stressed eye J2 Jitter,[e,f] each channel	0.3	—	UI
Stressed eye J9 Jitter,[e,f] each channel	0.47	—	UI

[a] Individual 10G-EPON PMD parameters are reused without change at a higher pre-FEC bit error ratio shown in Table 141–17.
[b] The BER of 10^{-12} is achieved by the utilization of FEC as described in 142.2.4.1.
[c] The receiver tolerates, without damage, continuous exposure to an optical input signal having this average power level.
[d] Receiver sensitivity (OMA), each channel (max) is informative and is defined for a transmitter with VECP = 0.5 dB. For reference, this implies that the maximum average power unstressed receiver sensitivity measured with an ideal transmitter signal at minimum extinction ratio is –22 dBm. This value is informative only.
[e] Measured with conformance test signal at TP3 (see 141.7.11) for BER = 10^{-2}.
[f] Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Jitter vs. Pe (Probability of Error)



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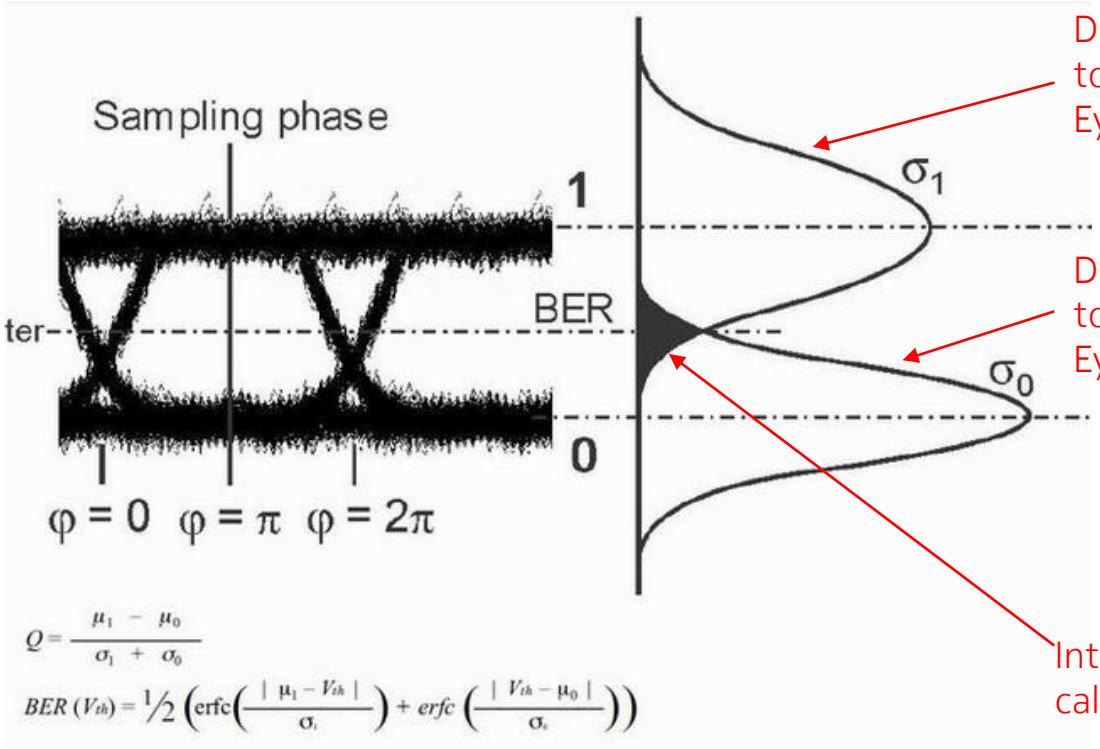
Probability of Error due to Vertical Eye Closure



Distribution of “1” signal level due to additive noise, causing Vertical Eye Closure

Distribution of “0” signal level due to additive noise, causing Vertical Eye Closure

Integrate ERF (Error Fcn.) to calculate Pe

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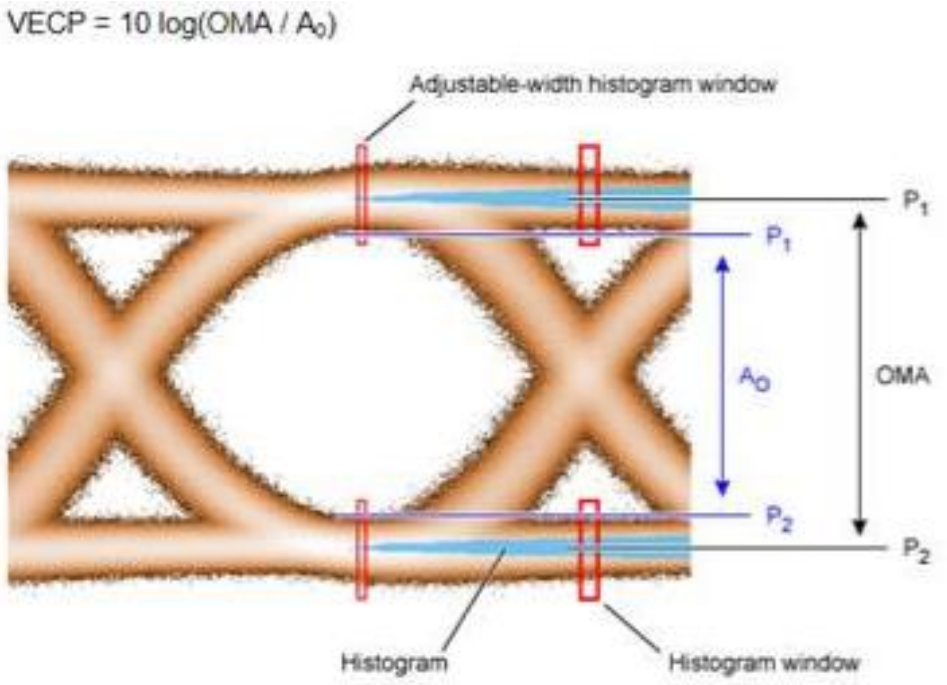
Keysight VECP/OMA measurement eye diagram



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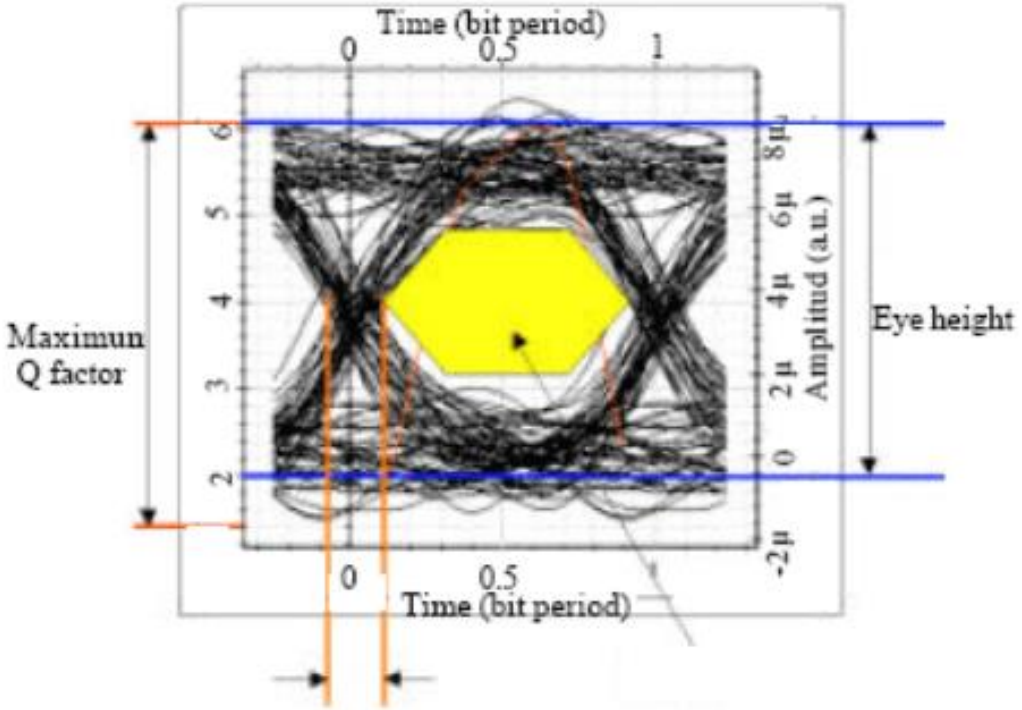
Keysight Jn Jitter vs. BER selections

Jn roughly tracks measurement BER level

Measurement BER Selections

Argument	Measurement BER Associated with TJ
J1	2.5×10^{-2}
J2	2.5×10^{-3}
J3	2.5×10^{-4}
J4	2.5×10^{-5}
J5	2.5×10^{-6}
J6	2.5×10^{-7}
J7	2.5×10^{-8}
J8	2.5×10^{-9}
J9	2.5×10^{-10}

Eye Diagram with Jitter and Vertical Eye Closure



- With Vertical Eye Closure, Jitter, and reduced signal levels, data eye becomes more closed
- Stressed RX Sensitivity (SRS) measured with Vertical Eye Closure and at different Jitter/BER Levels (J2, J9)

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Comments on our current 25G SRS spec from our .3ca optical experts

- Emails discussing our SRS spec were sent to a number of our .3ca optical experts – John Johnson (Broadcom), Daisuke Umeda (Sumitomo), Hanhyub Lee (ETRI), and Dora Van Veen & Vincent Houtsma (both Nokia Bell Labs)
- Comments from John Johnson (Broadcom) – 17Jan2020 email

  The RX stress parameters were indeed copied from 100GBASE-LR4 as a reasonable starting point to enable the draft to move forward. I personally don't have the background to derive them from first principles for the 802.3ca PMDs, so it will be up to someone else with the knowledge and interest to do so. In the end it likely doesn't matter much since I'm not aware of any PON module vendor using stressed receiver testing in manufacturing.
  Regards,
  John

- Comments from Umeda-San (Sumitomo) – Jan. 19, 2020 email:

  I agree with your recommendation. I think it's still OK to keep our current J2/J9 and VECP levels. I think Tamura-san's SRS BER measurement data is nearly equal to 802.3ca spec if the receiver were APD. I think our current levels are reasonable.
  Regards,
  Daisuke.

Conclusions

- Our .3ca optical experts have considered the concerns raised in comment #418 from D2.0 on our 25 Gbd .3ca SRS specification in our draft

- They don’t think our current VECP, J2, J9 SRS specs are an issue as stressed receiver tests are not normally used by PON module vendors in manufacturing and that our SRS specifications are at reasonable levels

- We have considered the concerns raised in D2.0 comment #418, and in the absence of a specific proposed change, propose to keep our current 25 Gbd SRS requirements


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