SECQ and its sensitivity to measurement bandwidth

Pavel Zivny

zivny_3cd_01c_0518
Pittsburgh, PA

Supporters

Marco Mazzini, Cisco

Mark Kimber, Semtech

Greg LeCheminant, Keysight

Piers Dawe, Mellanox

John Calvin, VTM

Hai-Feng Liu, Intel

Situation

- In 802.3cd, the measurement and the calculation of SECQ requires a calibrated signal. This signal is calibrated by an oscilloscope
- Calibration by an oscilloscope which has uneven and/or early and sharply rolled-off 4th order Bessel-Thomson roll off causes the stresses in the calibrated signal to be over-reported.
- This improperly under-stressed ‘calibrated’ signal is easier for the DUT RX to pass – leading to false passes (of some bad devices)
- The reference receiver is defined only as an ideal curve; since a practical realization can not be ideal, the standard today is open to earnest misinterpretation.
  - Example: a oscilloscope with a correct 3-dB bandwidth (which initially *does* follow the B-T curve) but with a sharp roll-off soon afterwards will cause false passes in SECQ

Proposed solution

- We propose that in order to limit the variability of the SECQ result between different measurement tools, the Bessel-Thomson definition should be more explicit - specifying the B-T and its -3dB point, but also the to what fraction of the symbol rate does the B-T need to be compliant.
  (next page)

Example: Specification of the Optical Reference Receiver in IEEE 802.3 138.8.8

Current 802.3cd language (138.8.8)

"The SECQ of the stressed receiver conformance test signal is measured according to 138.8.5, except that the combination of the O/E and the oscilloscope has a fourth-order Bessel-Thomson filter response with a bandwidth of approximately 13.28125 GHz, and the optical splitter and variable reflector shown in Figure 121–4 are not used. "

"The SECQ of the stressed receiver conformance test signal is measured according to 138.8.5, except that the combination of the O/E and the oscilloscope has a bandwidth of approximately 13.28125 GHz and a fourth-order Bessel-Thomson filter response to no less than 0.9 * 26.5625 GHz. The optical splitter and variable reflector shown in Figure 121–4 are not used."

Specification of the Optical Reference Receiver in IEEE 802.3

- Other clauses specifying SECQ should implement this at their relative rates (implemented by the editorial team).
- We recommend but do not insist that for the TDECQ measurement same changes are implemented.

Backup information

-

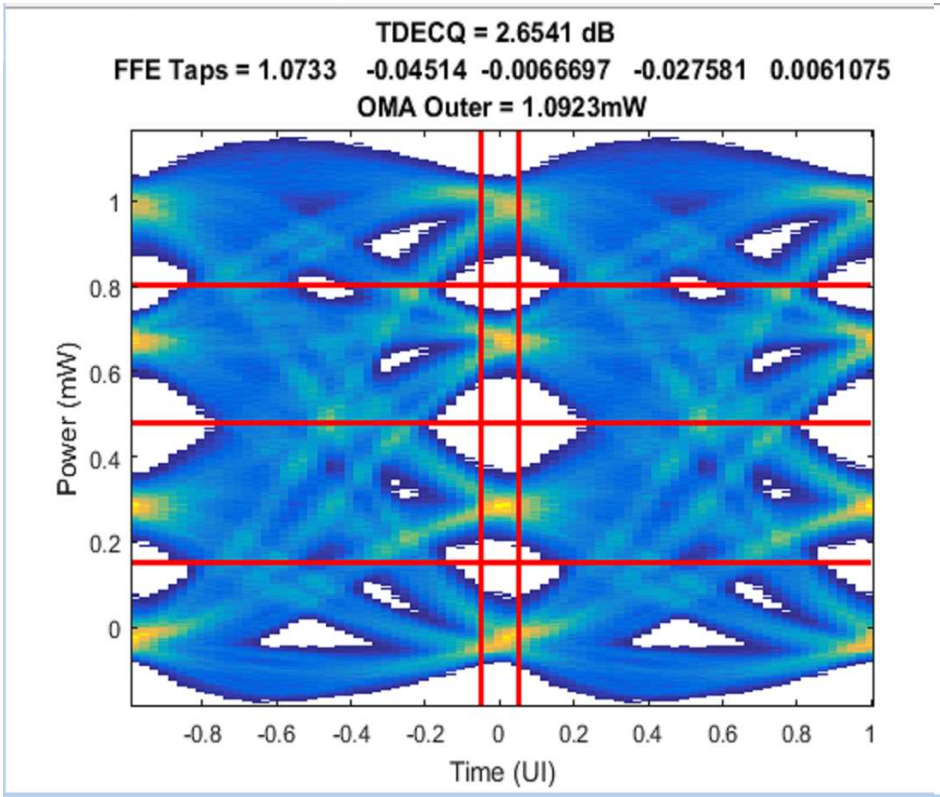
Example of the SECQ sensitivity to B-T roll-off problem

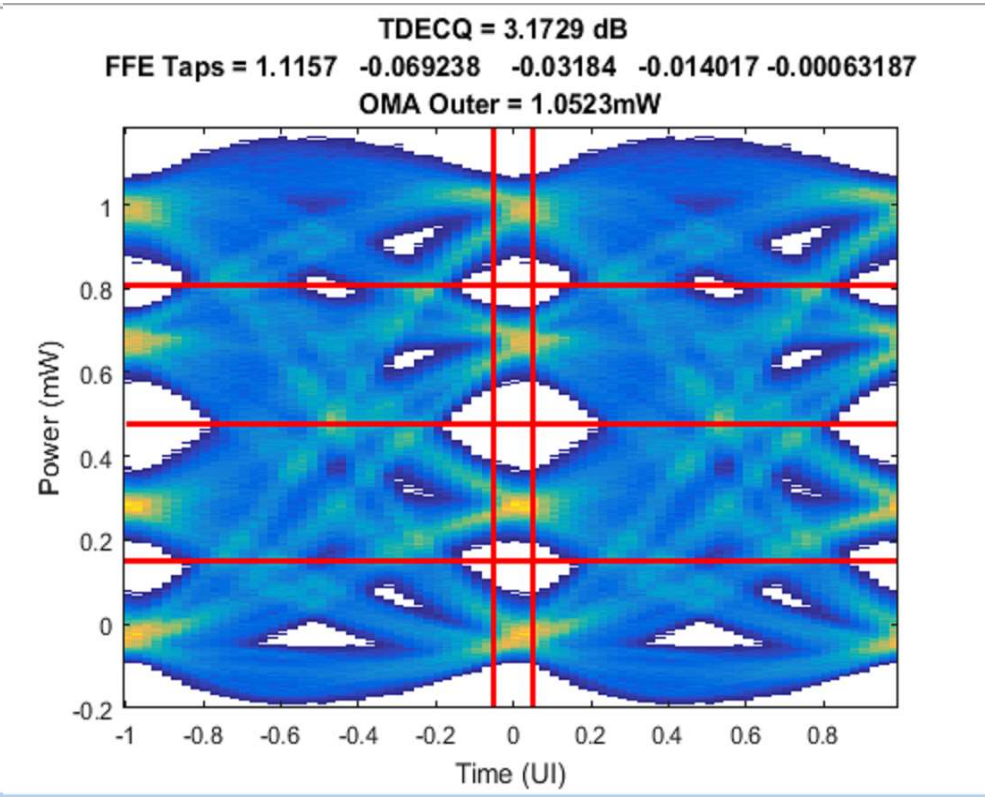
- In the following the problem is demonstrated by capturing a clean 26.56 GBd signal with an oscilloscope with same bandwidth, but two different roll-offs.

Using a 13.28 GHz B-T

SMALL DECREASE OF ROLL-OFF FREQUENCY INCREASES THE MEASURED SECQ.

- 18 GHz roll-off of the B-T: SECQ=2.65 dB
- 17.2 GHz roll-off of the B-T: SECQ=3.17 dB





SECQ sensitivity to the B-T roll-off

- As shown in previous slide, a small change of roll-off bandwidth from 18 GHz to 17.2 GHz added 0.51 dB of penalty to SECQ. (This all with a soft roll-off).
- That is, the same receiver measured with the 2nd signal will show 0.5 dB higher sensitivity.
- This example can be carried further; the point is, an earnest implementer can follow the standard to a ‘t’, yet under-stress their receivers, and pass bad products.

Conclusion

- We show the sensitivity of the SECQ calibration process to the oscilloscope's roll-off can cause false passes RXs
- Solution: As per comment TBD, insert the language proposed here to limit this sensitivity.