TDECQ Updates with Threshold Adjustment (2): EML & MZM Results*

Frank Chang, Inphi
David Leyba, Stephen Didde, David Weldon, Keysight

***** With data to support comment resolution for adding Adaptive Threshold Adj in computing TDECQ (float slicing adjustment).

IEEE802.3cd ad hoc Conference Call, 10 January 2018

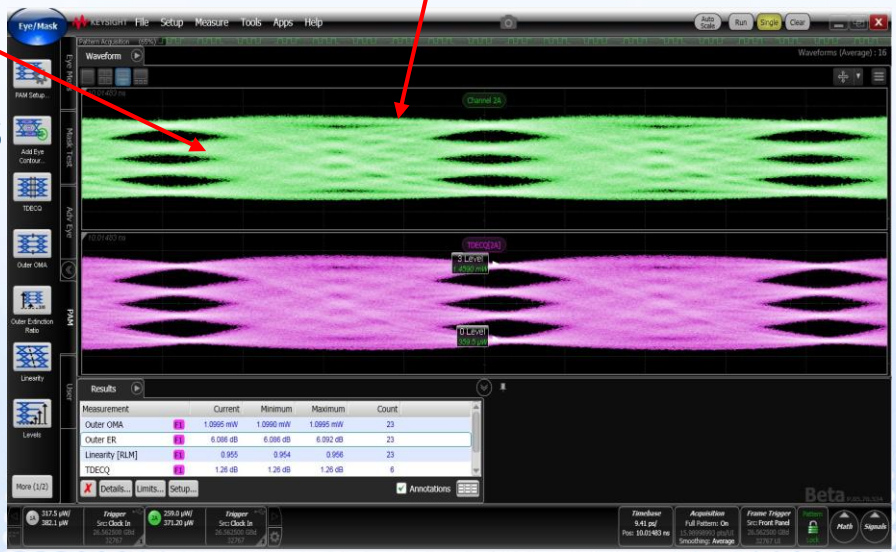
Problem Statements

- Adaptive slicing seems promising to resolve TDECQ specs dilemma
  - Precise threshold is optimized to further minimize TDECQ (Csico) (mazzini_120617_3cd_adhoc-v2)
  - TDECQ improvements have shown using DML TX (AOI).
- There exists 2 major concerns associated with TDECQ (SECQ)
  - Is TDECQ methodology robust from different testers?
  - How adaptive slicing (vertical threshold adj) work on non-DML transmitters: VCSEL, EML, and MZM (e.g. for SRS)?
- This will facilitate the PAM4 module compliance/manufacturability without throwing away good TXs (improve yield).
- This report:
  - Focus on looking into test results for **EML and MZM TX**

TDECQ Test Configurations

- Test against GOLDEN EML Tx
  - Evaluation board mounted commercial PAM4 ASIC with EML driver to test board mounted 50Gb/s EMLs (chang_3cd_01a_0917)
  - TDECQ SR tests (no test fiber)
    - PRBS 2^{15}-1
- Reasonably open eyes with symmetric timing window to start with.
- EML TX was re-tested with varying Filter BW and the # of taps
- Post-processed SRS waveforms with Threshold Adj. (chang_3cd_01_1117)
  - MZM Ref. TX. using SSPRQ
  - Full and no stress condition

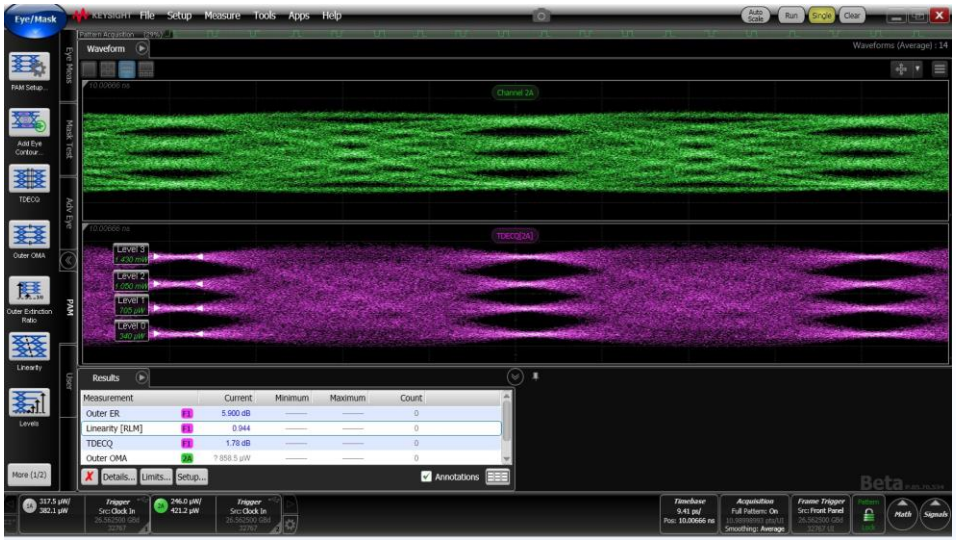
Raw eye with 19.3GHz RX filter BW



EML TX Under different # of Taps - 1

- W.r.t 13.28GHz filter BW

5 Taps, TDECQ=1.78dB



7 Taps, TDECQ=1.71dB

9 Taps, TDECQ=1.69dB

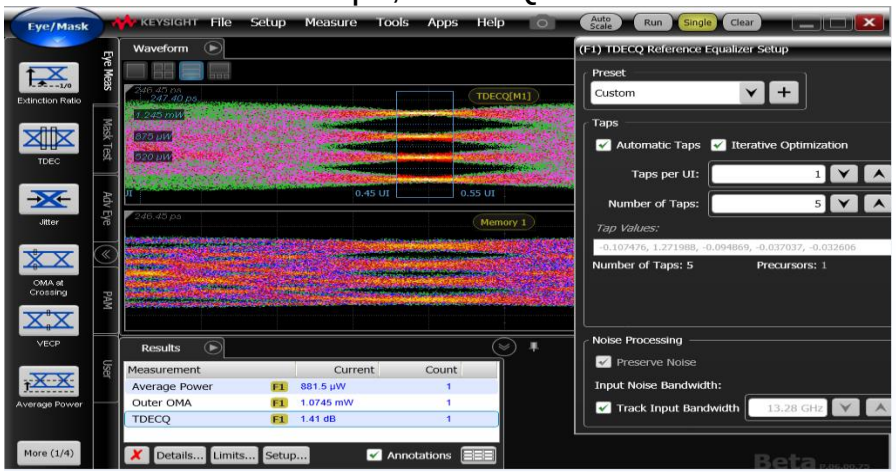
11 Taps, TDECQ=1.73dB

EML TX Under different # of Taps - 2

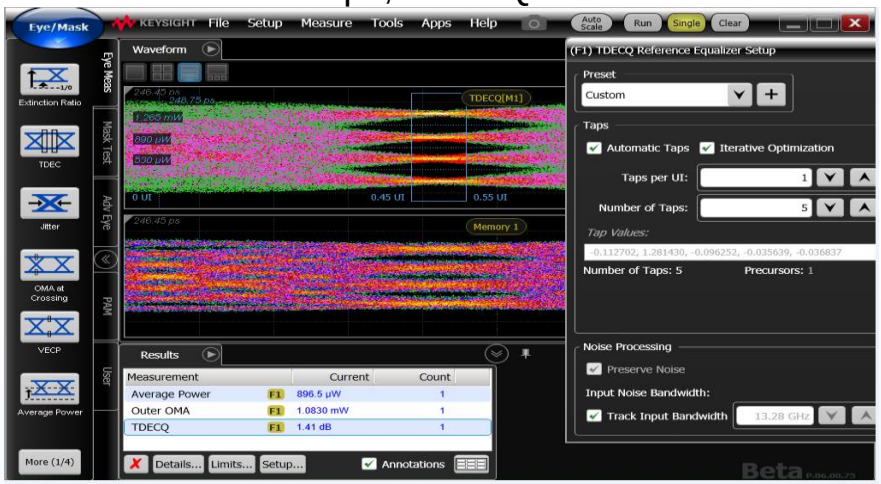
Note: the post-processed data were actually done in 5 taps only using threshold adj. so somewhat pessimistic for larger number of taps. This has no impact to the conclusion we are making.

- W.r.t 13.28GHz filter BW with Threshold Adj. (post-processed)

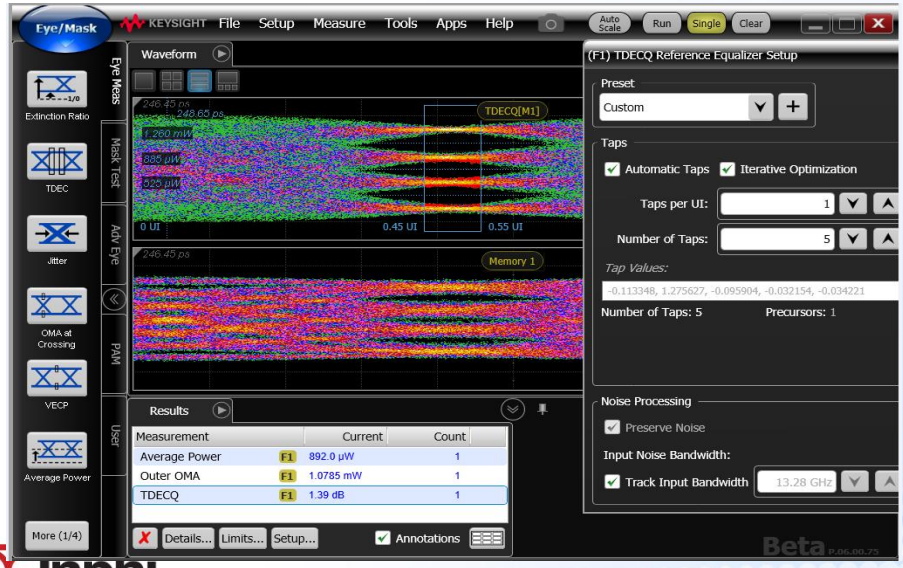
5 Taps, TDECQ=1.41dB



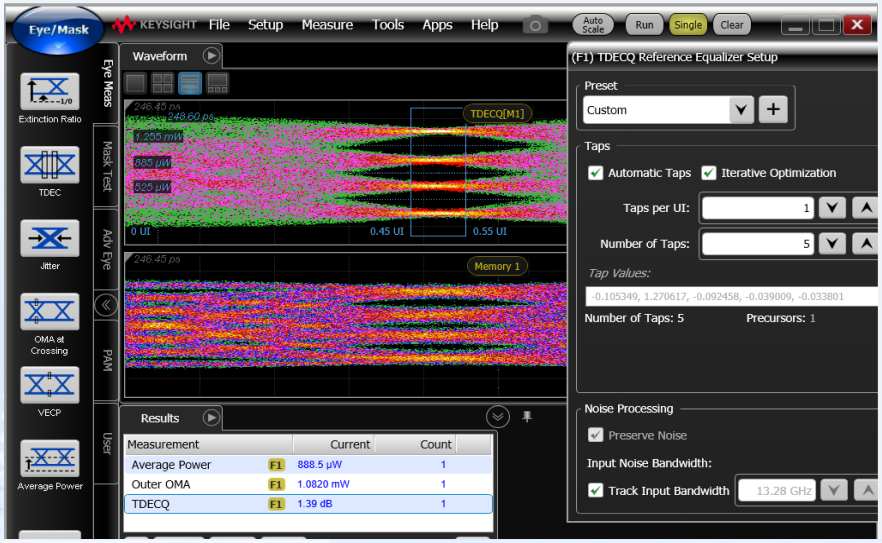
7 Taps, TDECQ=1.41dB



9 Taps, TDECQ=1.39dB

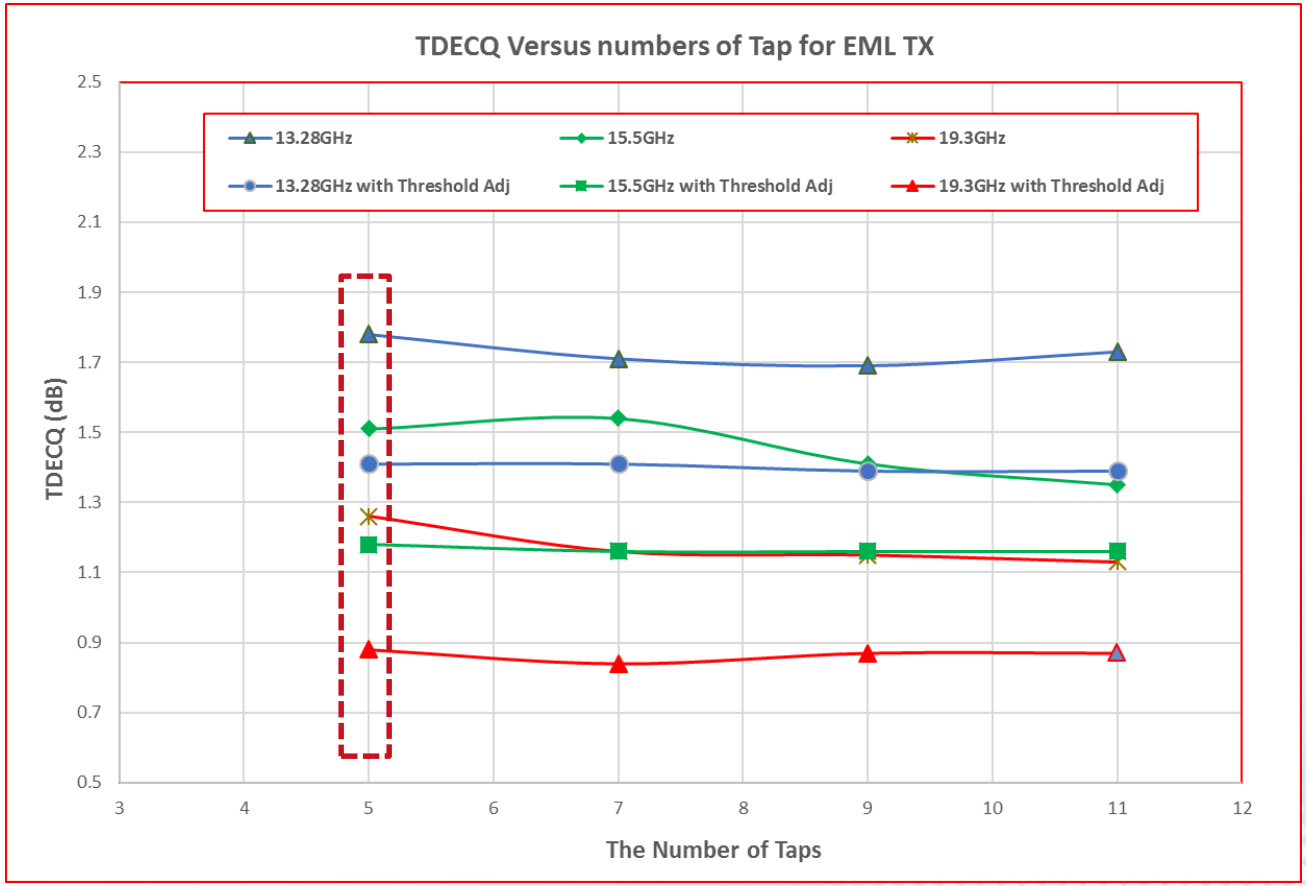


11 Taps, TDECQ=1.39dB



EML TX Under different # of Taps - 3

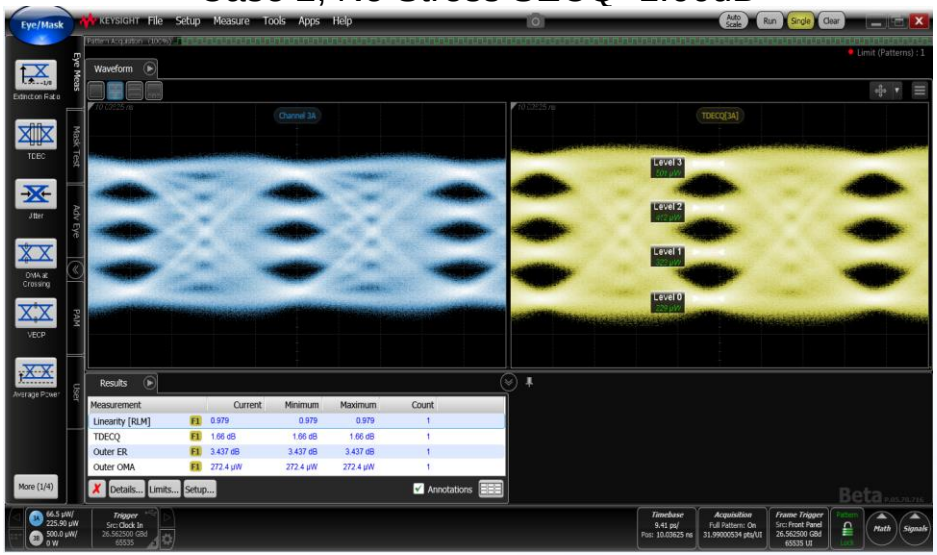
- With Threshold Adj (post-processed)



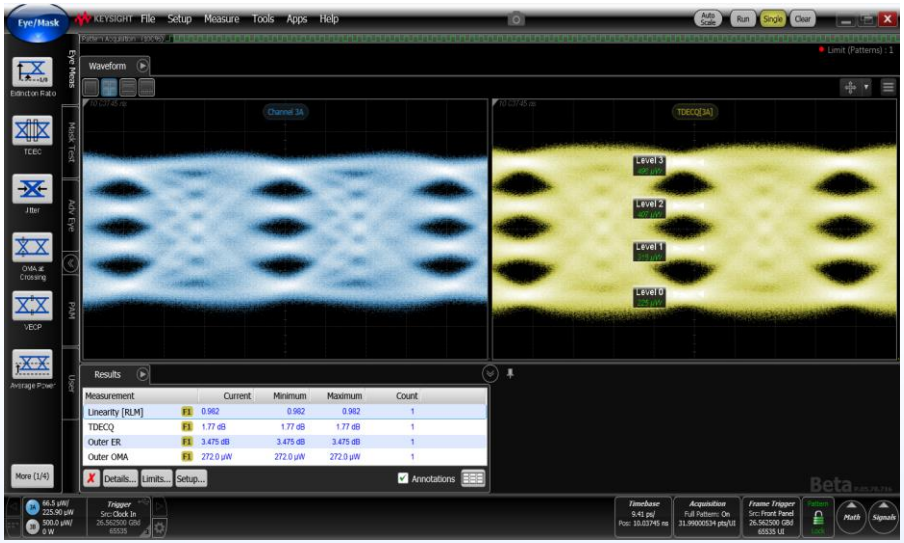
MZM TX Under SRS Stressed Condition - 1

- 13.28GHz filter BW, 5T Equalizers, SSPRQ (chang_3cd_01_1117)

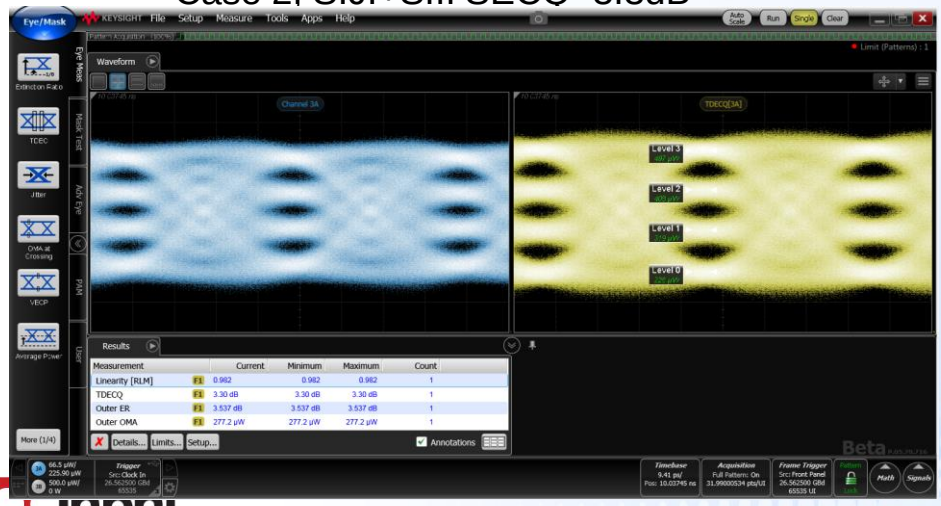
Case 2, No Stress SECQ=1.66dB



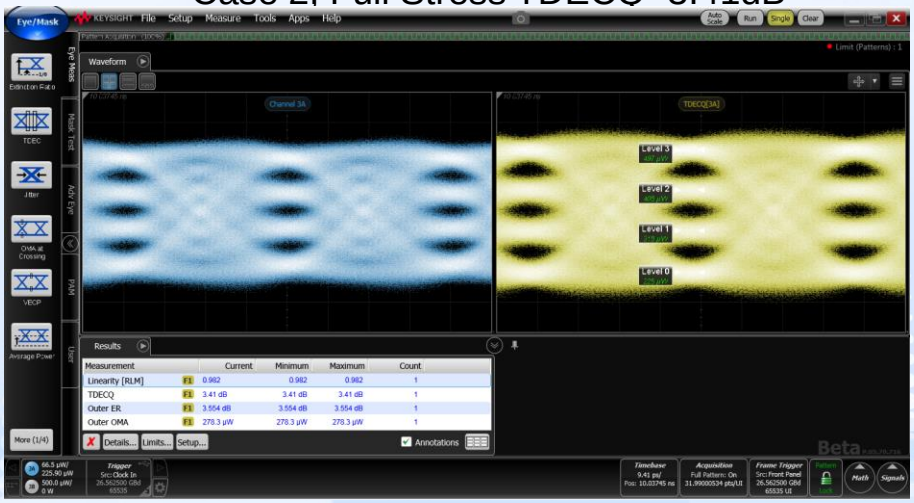
Case 2, S.J. + G.N. SECQ=1.77dB



Case 2, S.J.+S.I. SECQ=3.3dB



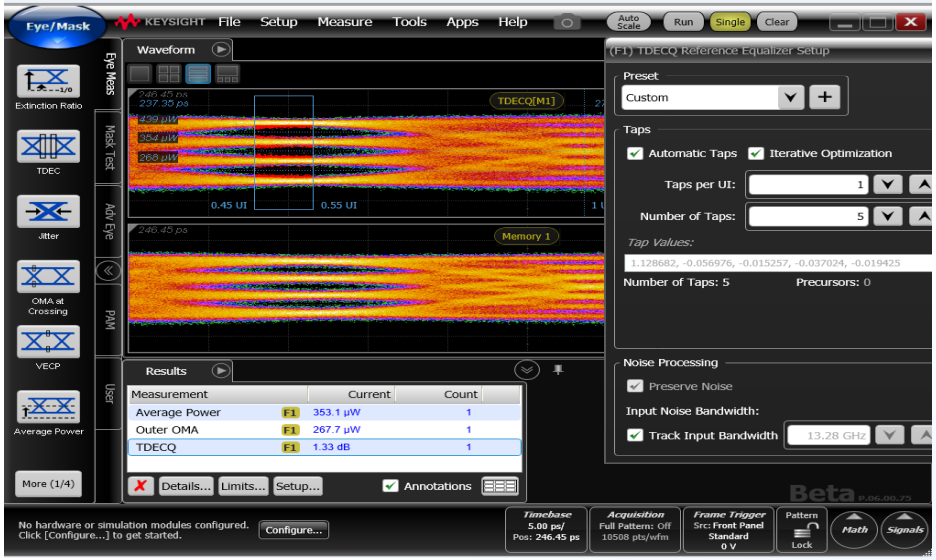
Case 2, Full Stress TDECQ=3.41dB



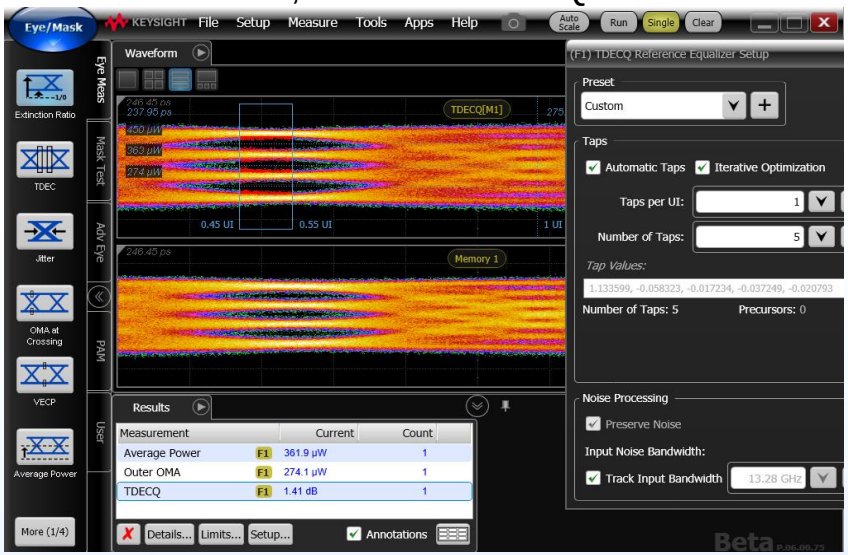
MZM TX Under SRS Stressed Condition - 2

- 13.28GHz filter BW, 5T Equalizers with Threshold Adj (post-processed)

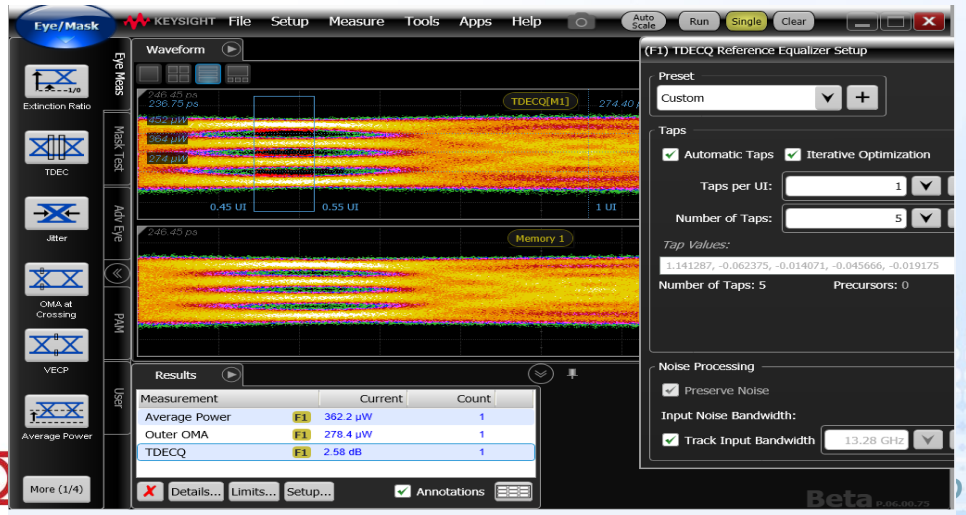
Case 2, No Stress SECQ=1.33dB



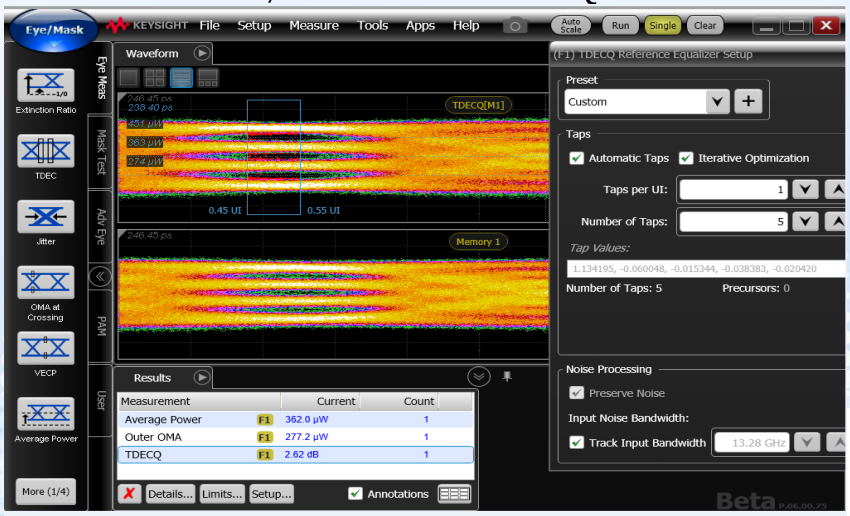
Case 2, S.J.+G.N. SECQ=1.41dB



Case 2, S.J.+S.I. SECQ=2.58dB



Case 2, Full Stress TDECQ=2.62dB



MZM TX Under SRS Stressed Condition - 3

- 13.28GHz filter BW, 5T Equalizers with Threshold Adj (post-processed)

MZM TX SRS TX			SECQ(dB)	
SSPRQ			SECQ Cal.	With threshold adj
Default	no stress:		1.7	1.35
	full stress		3.5	2.75
Case 2	Full stress		3.4	2.62
	No stress		1.66	1.33
	SJ Only		1.74	1.37
	SJ+GN		1.77	1.41
	SJ+SI		3.3	2.58
Case 1	Full stress		3.72	2.76
	No stress		1.7	1.34

Concluding Remarks

- EML and MZM consistently shown improvement of over 0.3dB due to threshold adjustment. And it could be higher under stressed condition.
  - The data support to implement threshold adjustment into computing TDECQ.
- EML and MZM normally show much higher RLM than directly modulated type of lasers such like DML and VCSEL.
  - RLM ≥ 0.9 seems good strawman proposal to start with.