Use of Advance Scope for Measurement of TP2/ TP4 and Calibration of TP4 Stressor

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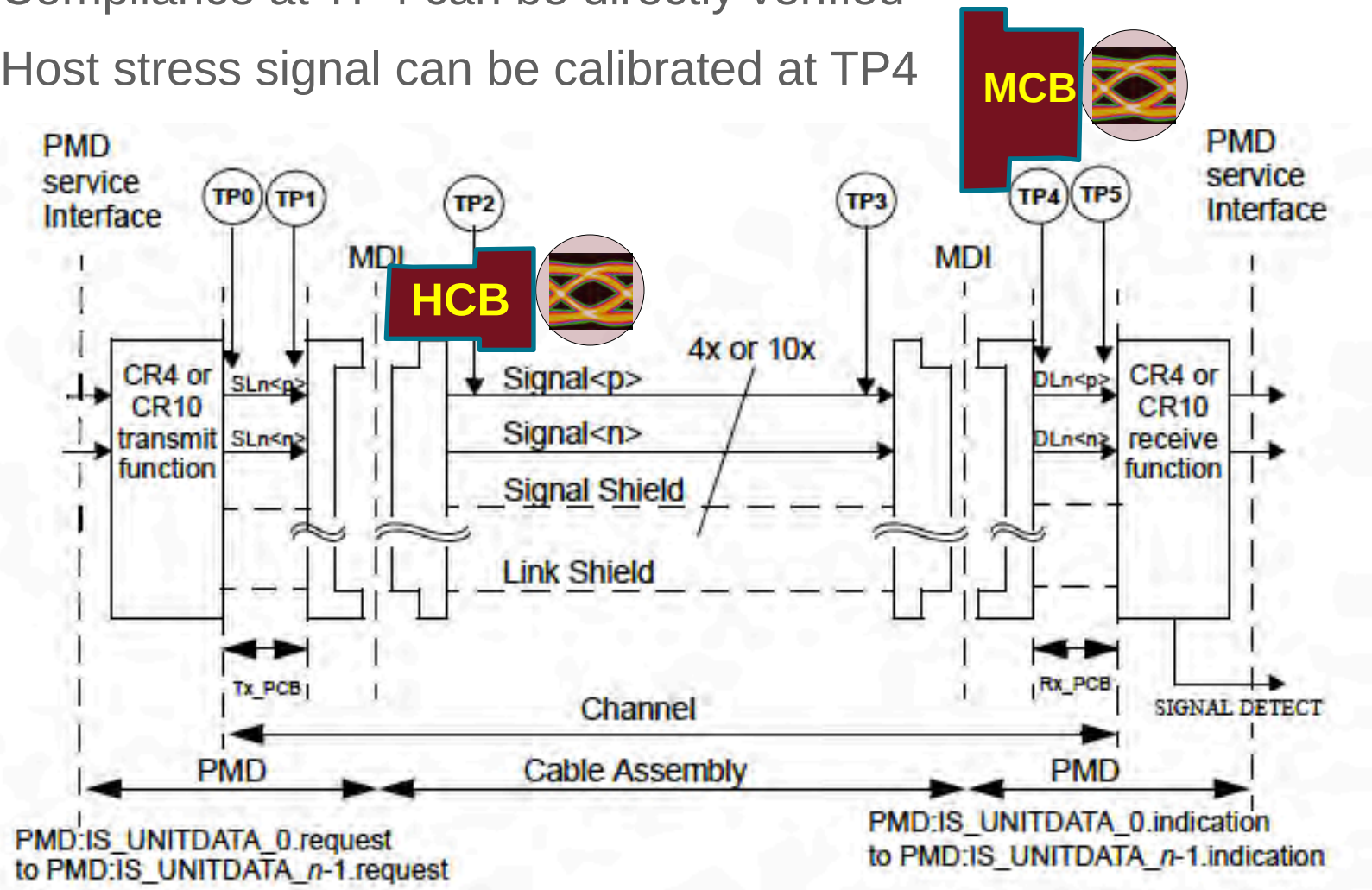
Overview

- To show feasibility of OIF VSR test specifications these measurement were presented during OIF Q4 2011 meeting
  - Specific measurements here were made on Agilent DSO-90000 real time scope but similar measurements can also be made on sampling scope
- The advantage of time domain statistical method is capability to measure TP2 and TP4 compliance on an operating system instead of limited post processing of the channel S-parameters for compliance
  - The same method can also be used for calibration of the CR4 host stress signal
- Time domain statistical simulator based on the same principle currently is in use by all SI engineer involved in high speed deigns
  - The best proof is just looking at contribution given in this group, nearly all show feasibility with statistical time domain eyes!

Statistical Time Domain Measurements

- Compliance at TP2 can be directly verified
- Compliance at TP4 can be directly verified
- Host stress signal can be calibrated at TP4

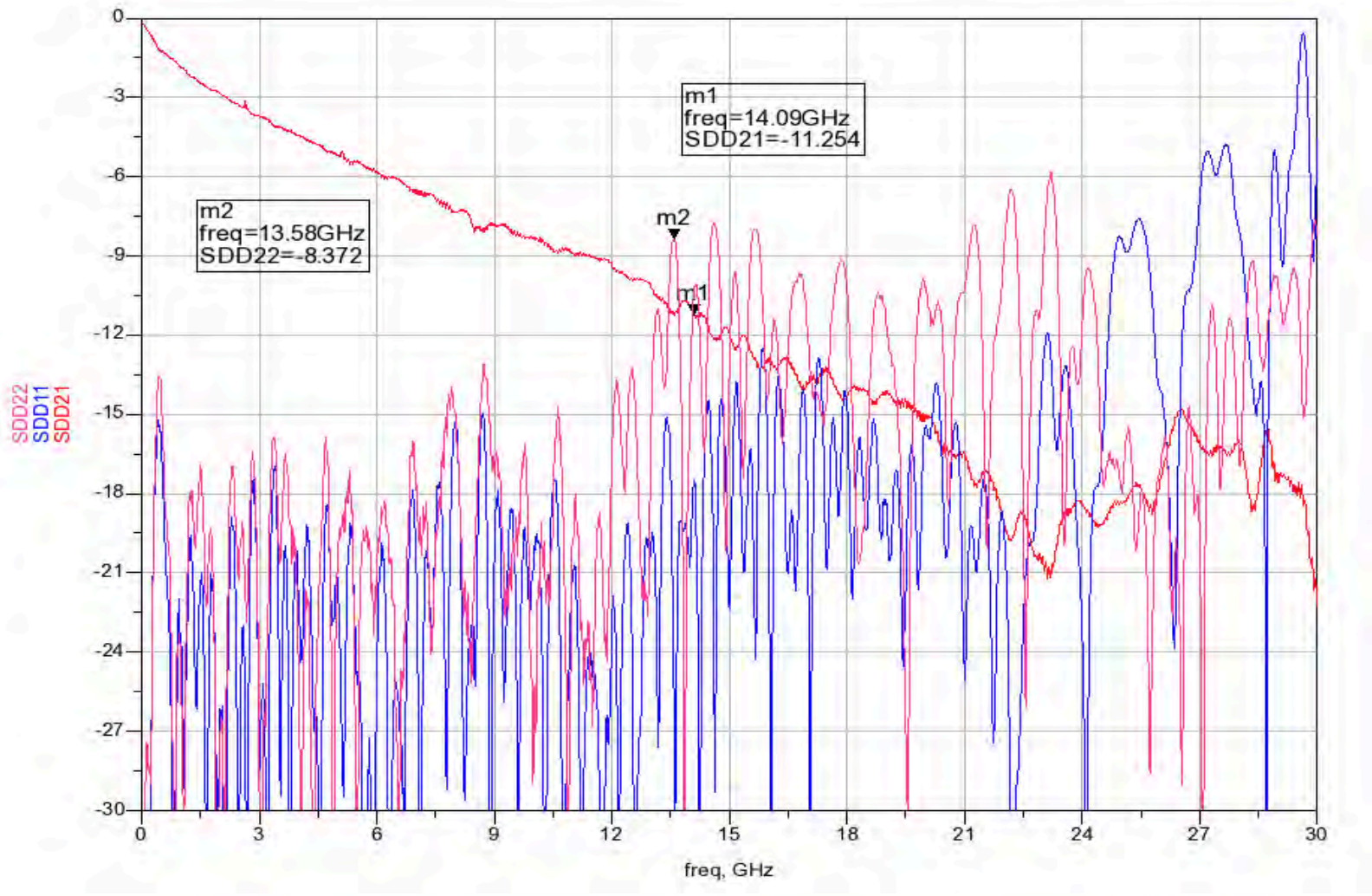


Constructing VSR Channel and Host

- Based on availability zQSFP MCB was used instead of Quattro based channel
- The channel was build of
  - Microstrip cal trace with loss of 6.5 dB + zQSFP MCB-HCB with loss of 5 dB at 14 GHz
  - Total loss including additional cables was estimated to be 12.25 dB at 14 GHz
- The transmitter output was set to ~640 mV differential p-p
- Transmit FFE post was set to about 2 dB and the CTLE was doing most of the work
  - If the FFE was doing most of the work the output eye opening was about 30% lower
- To excite worst case crosstalk TX1 and TX3 were excited in the zQSFP connector

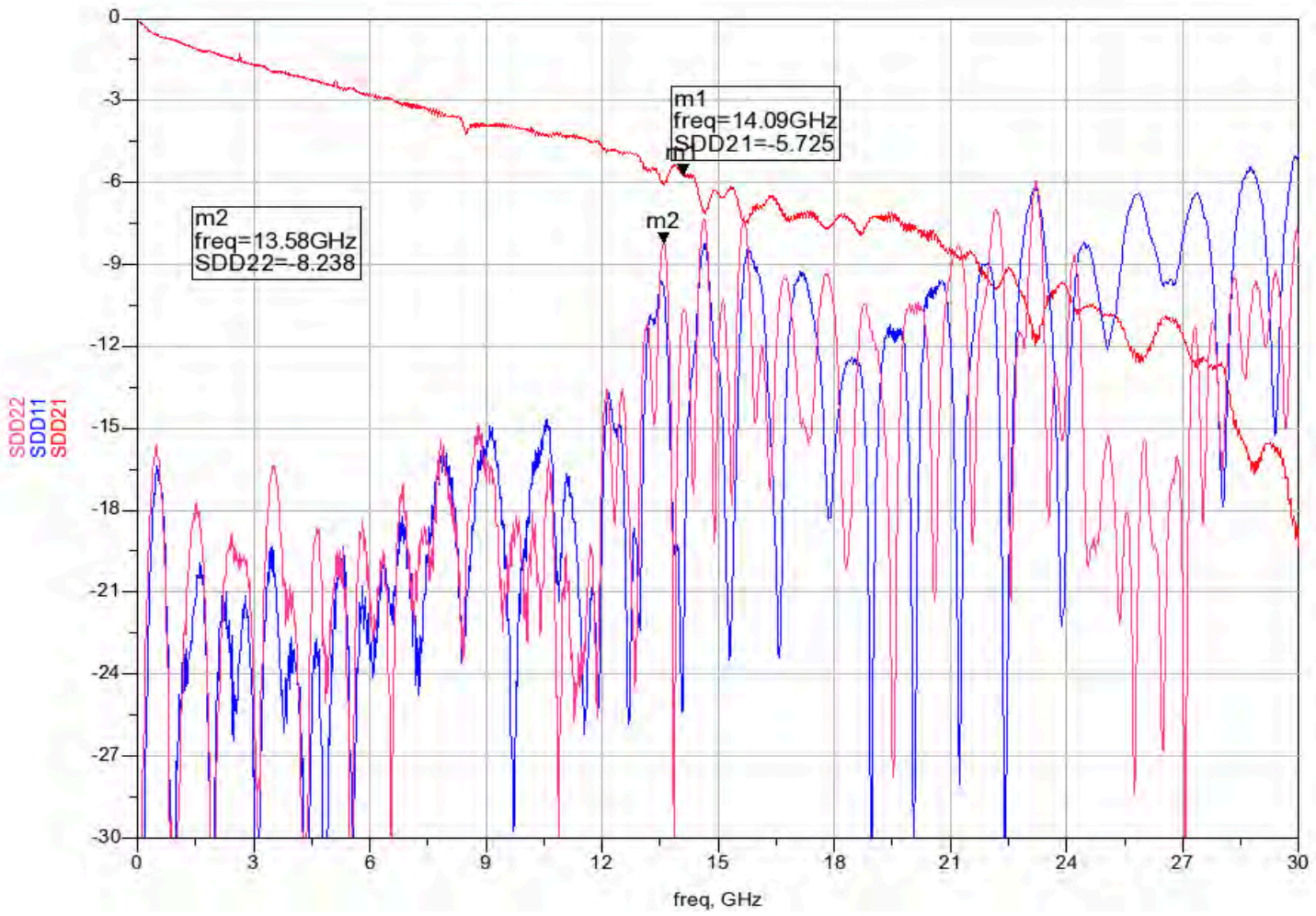
TP0-TP1a End to End Channel

- Channel does not include additional ~1dB cable loss



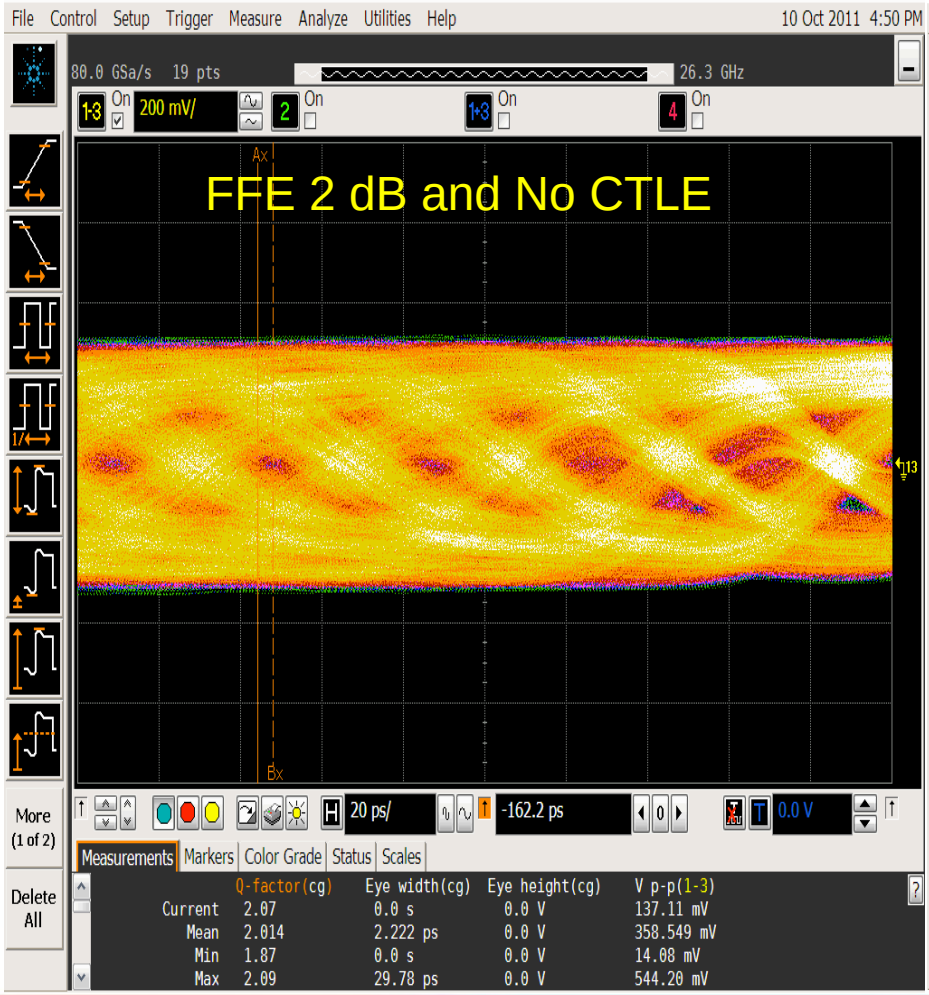
TP0-TP4 Channel

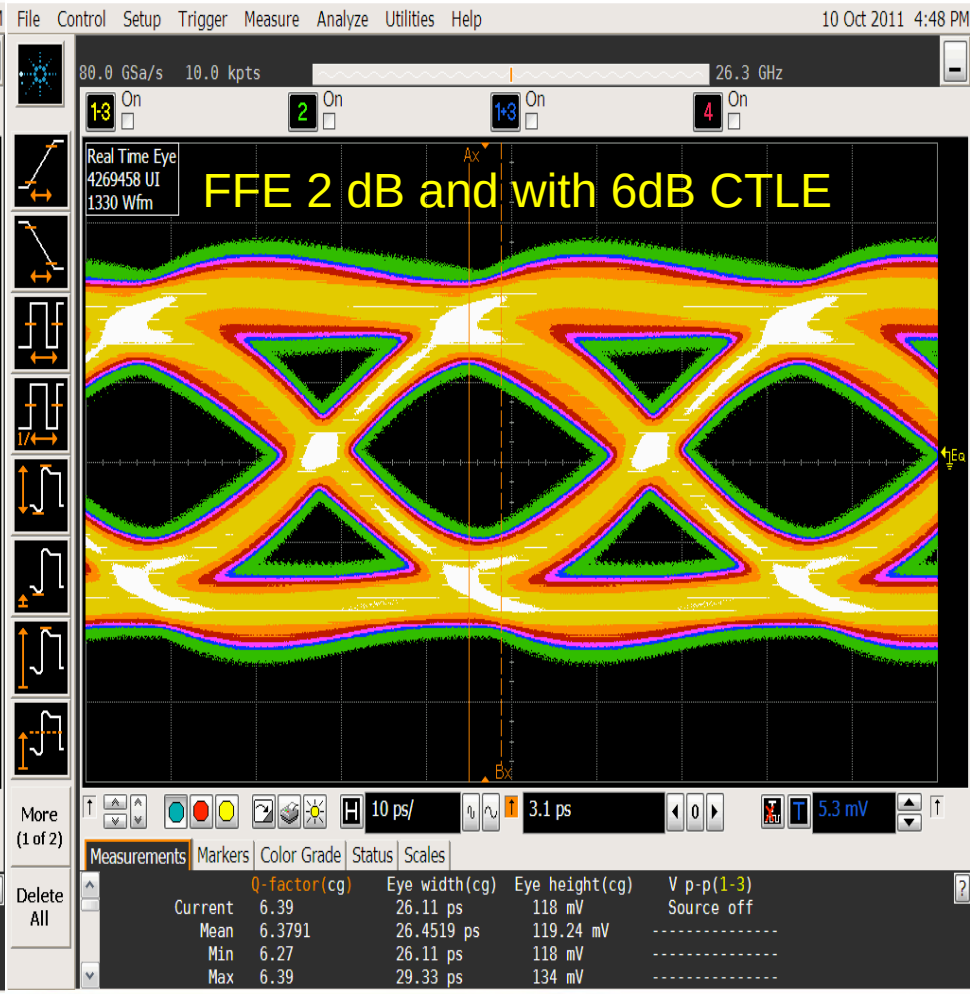
- This board has about ~1dB higher loss than matted MCB-HCB



TP1a Far End Eye without and With CTLE

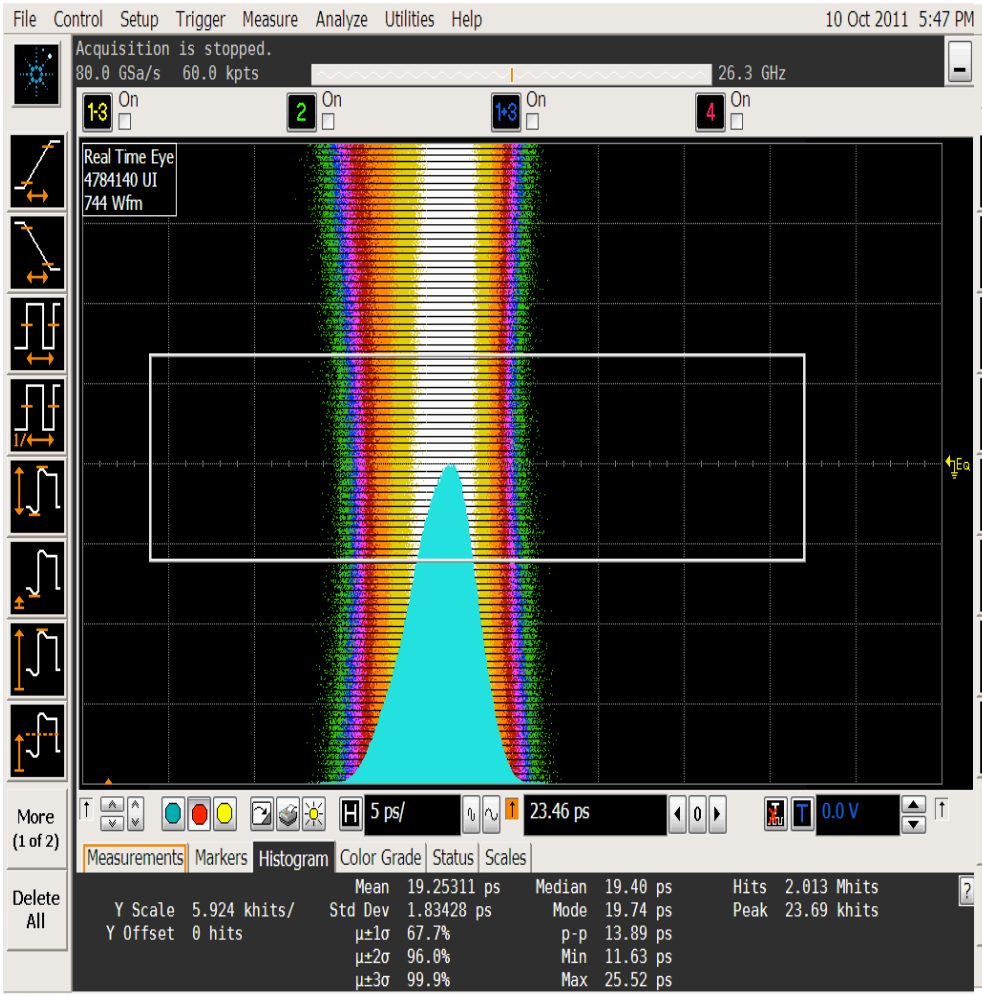
- Crosstalk reduced the eye opening from 118 to 112 mV

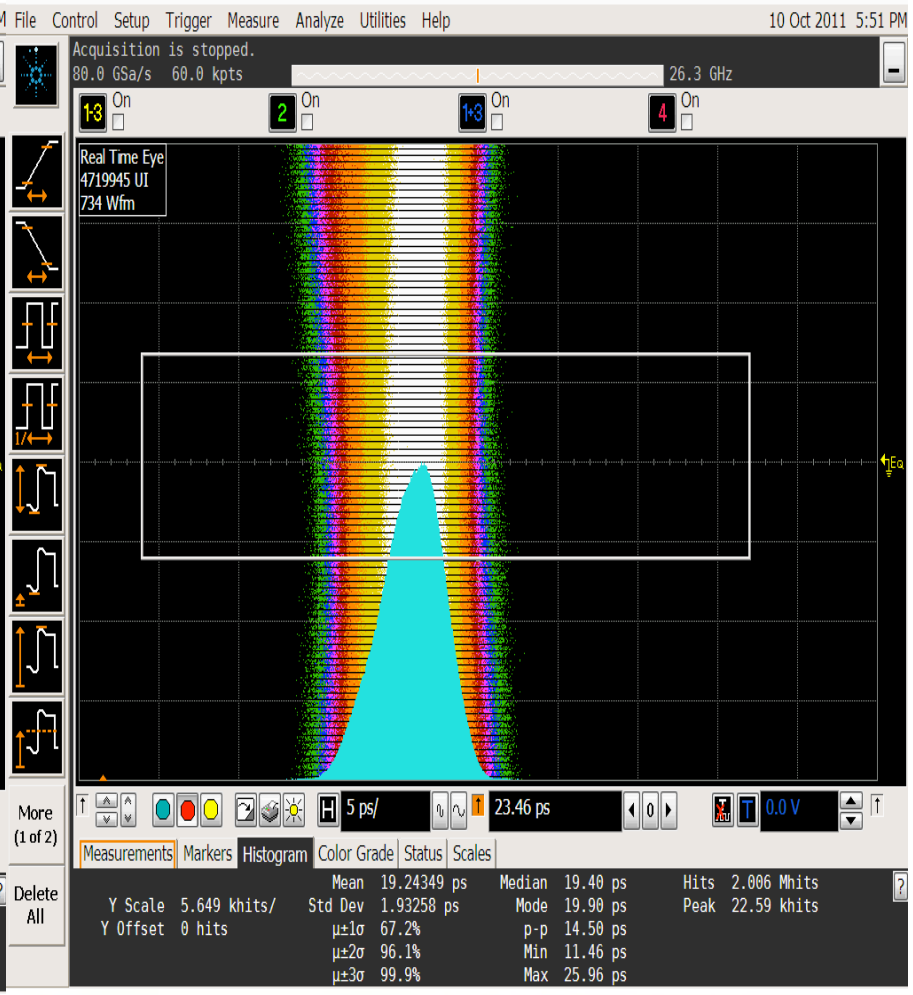




Far End Histogram with CTLE Without and with Crosstalk

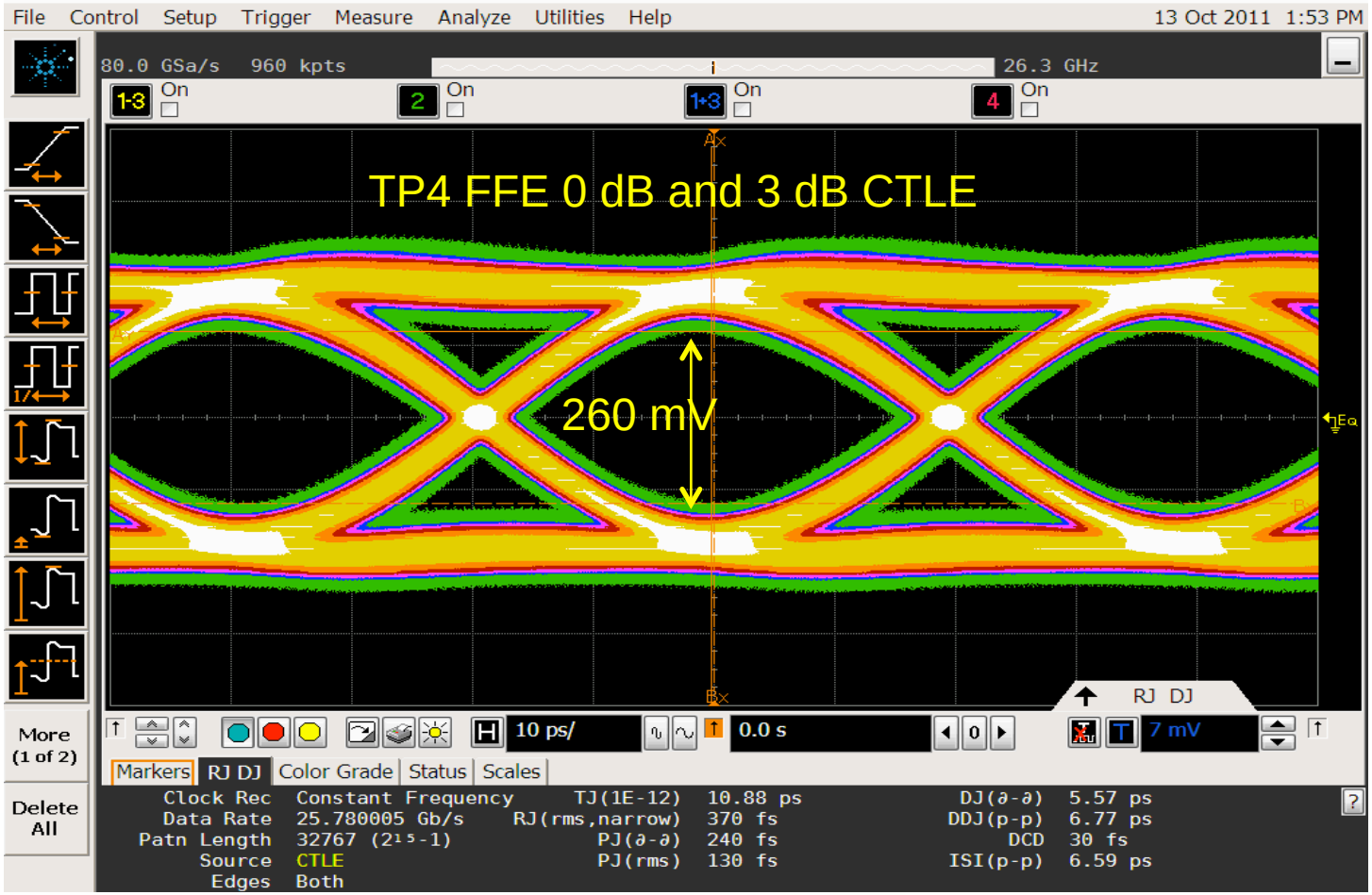
- Crosstalk increased the 1σ RMS jitter by 0.1 ps





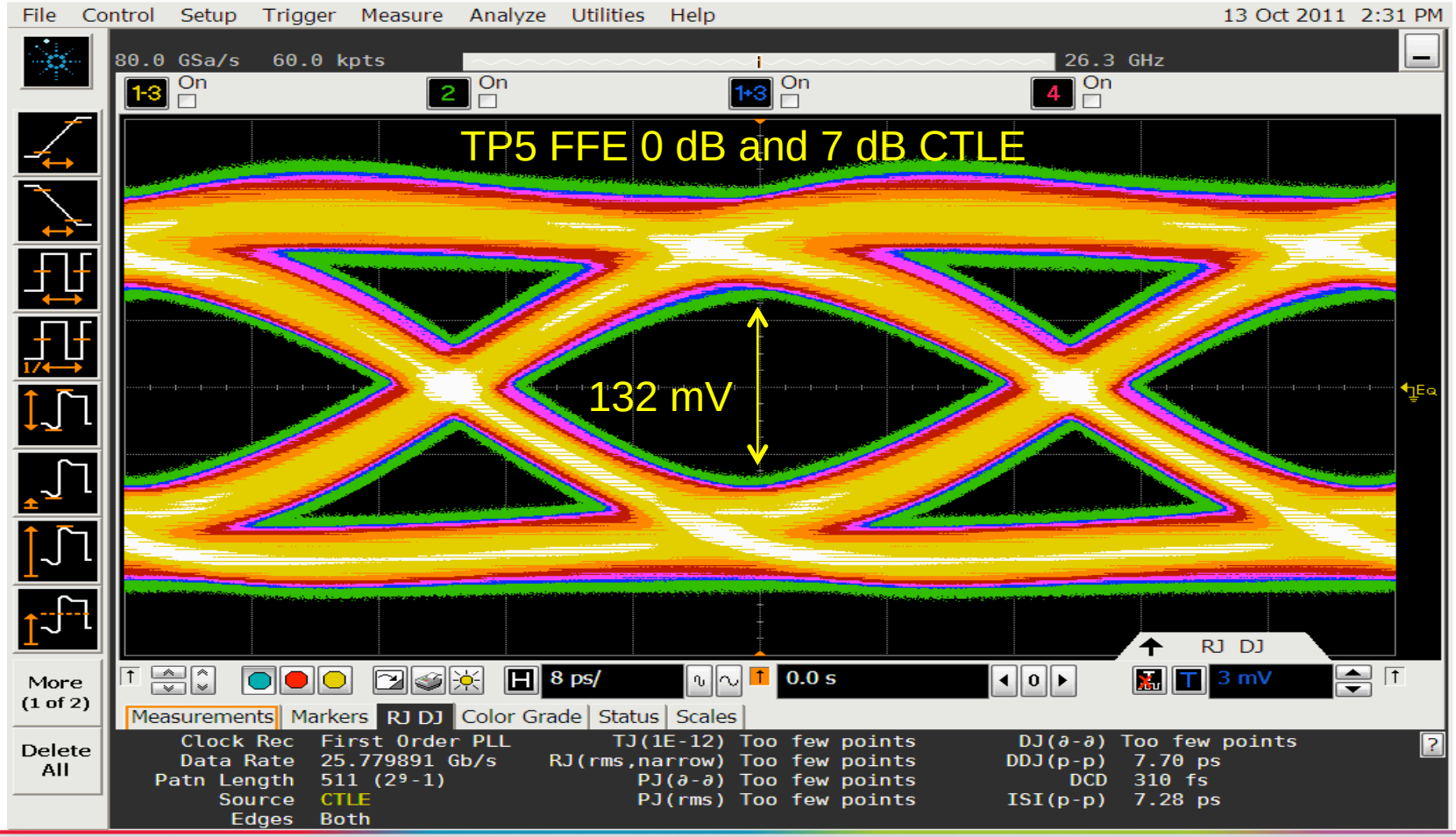
TP4 Eyes

- With 640 mv P-P transmitter in the module and no pre-emphasis
  - TP4 eye without CTLE 220 mV with 3 dB CTLE 270 mV
  - Next will show that this eye passes TP5 with 7 dB CTLE



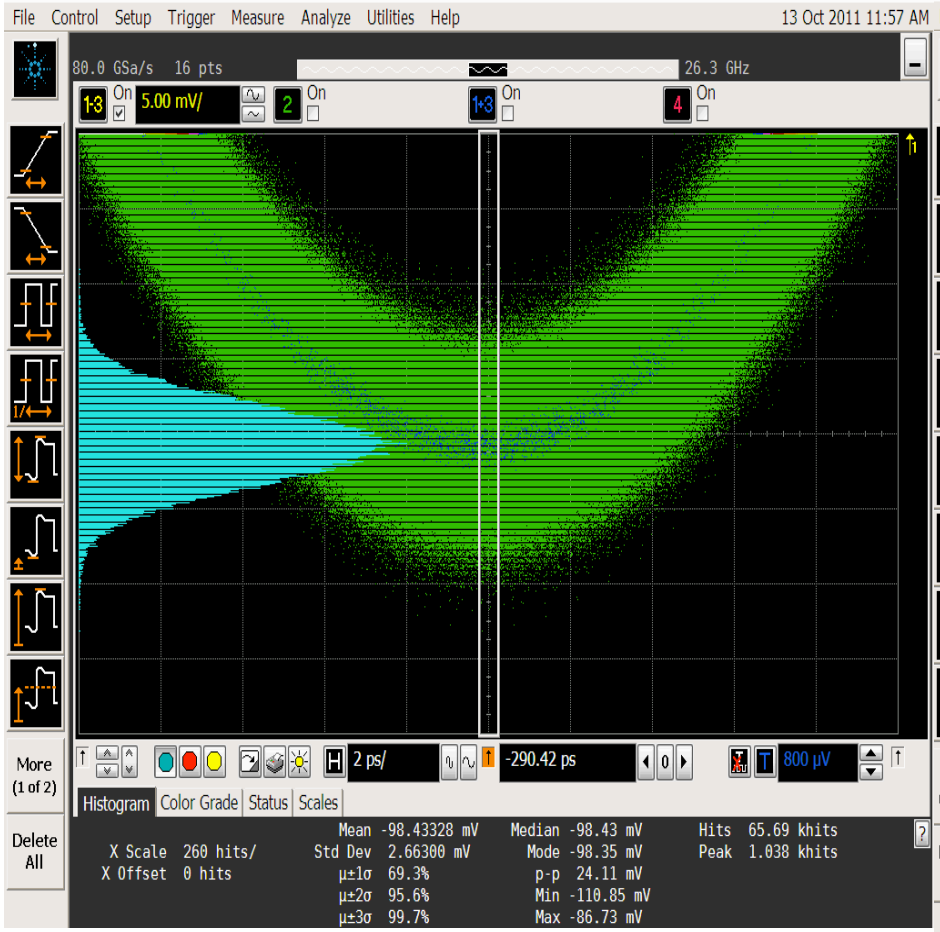
TP5 Eyes

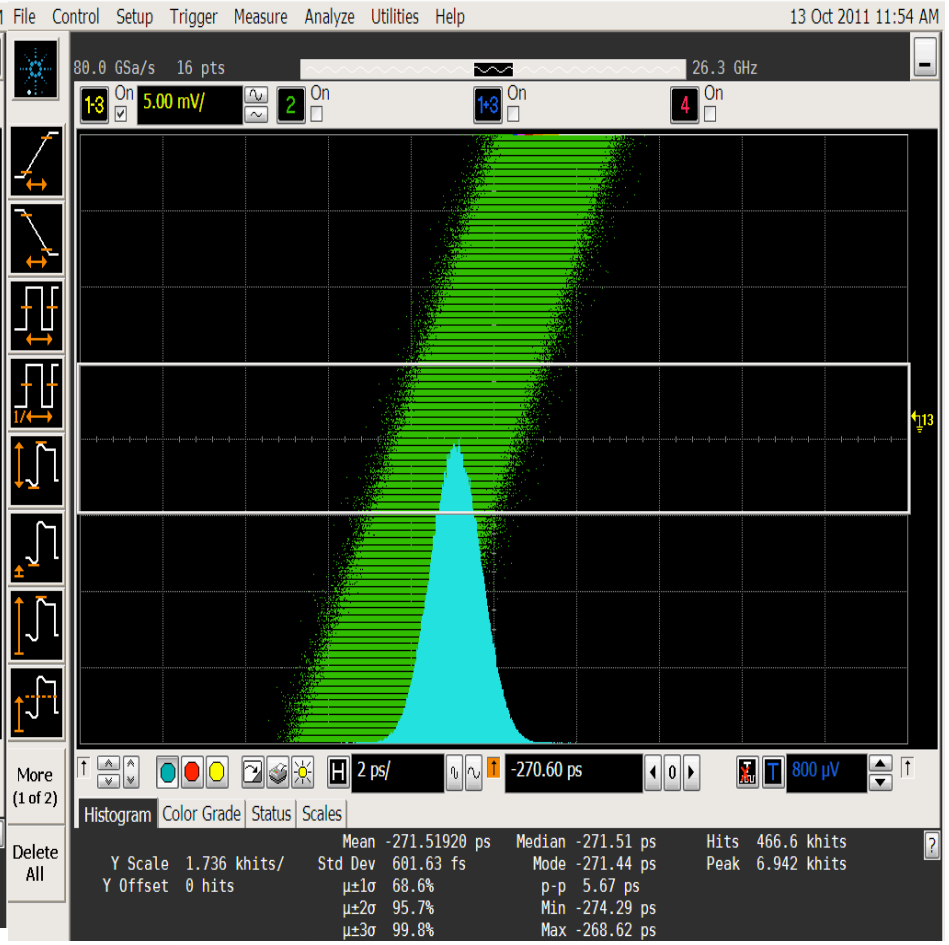
- With 640 mv P-P transmitter in the module and no pre-emphasis
  - TP4 eye passing 3 dB CTLE also passes far end TP5 with margin
  - If CTLE was not applied to TP4 some passing module would fail!



Looking at TP5 Voltage and Timing Histogram

- Histogram are the TP1a/TP5 without CTLE
  - With 6 dB CTLE V=2.3 mV and T=599 fs





Summary

- These results showed that reference receiver model when combined with statistical time domain measurement provide the most accurate compliance methodology
- Even with one of fastest scope DSO 90000 with 80 GS/s BER 1E-12 or 1E-15 can not be observed directly
  - OIF VSR directly measures 10M samples or equivalent number of edges in case of sampling scope
  - Then the equivalent eye opening is extrapolate to BER 1E-15
  - These scopes are very fast with measurement taking 10's sec
  - Scopes do have build in software and/or hardware CDRs
- In OIF VSR a family of CTLE's were define with specific poles and zeros
  - Actual receiver implementation might be different but still the minimum requirement can be traced back to the reference receiver
  - 100 GCU group would have to agree to an specific reference receiver to allow taking advantage of the most accurate simulation and measurement capability.

Thank You