PAM-8 Eyes at 32 Gsym (96 Gbps)

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IEEE P802.3bm – 40 Gb/s and 100 Gb/s Fiber Optic Task Force
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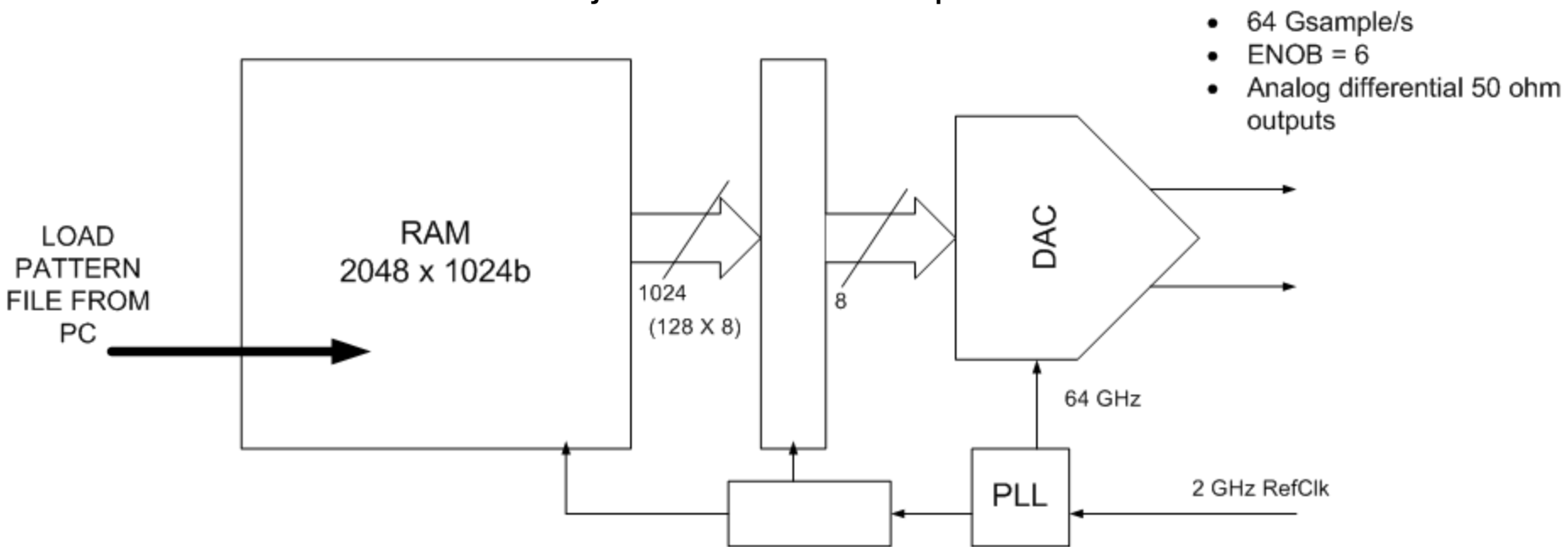
DAC Test Chip Block Diagram & Experimental Method

Fujitsu 40nm Test Chip



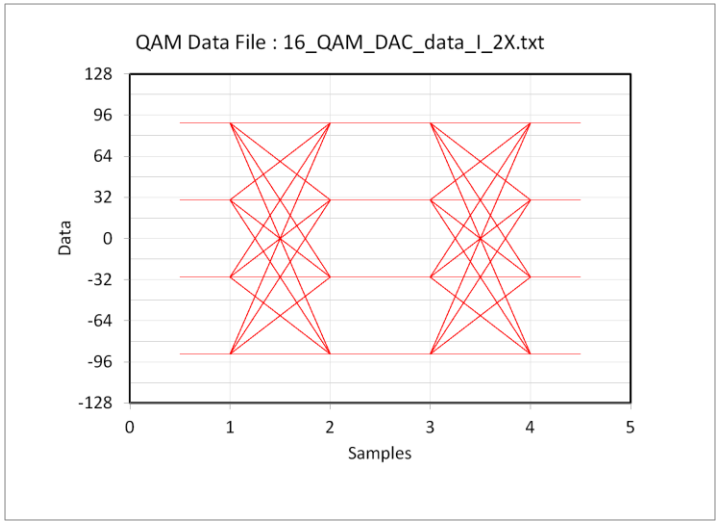
Experimental Method

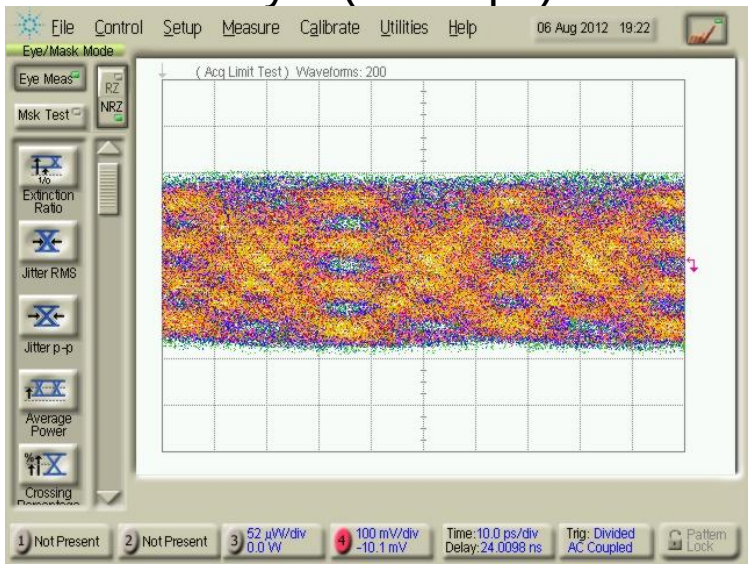
1. Run uncorrected PAM data file from RAM
2. Analyze results and apply corrections to PAM data file
3. Run corrected PAM data files from RAM

PAM-4 DAC Output with Sample Correction

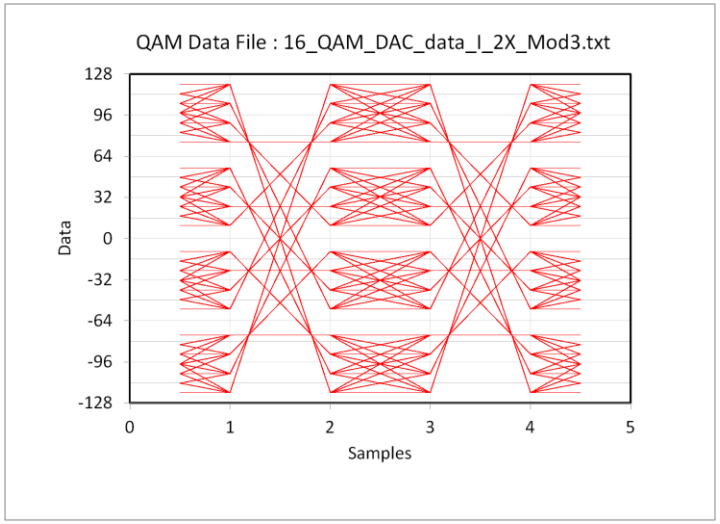
32 Gsym (64 Gbps)

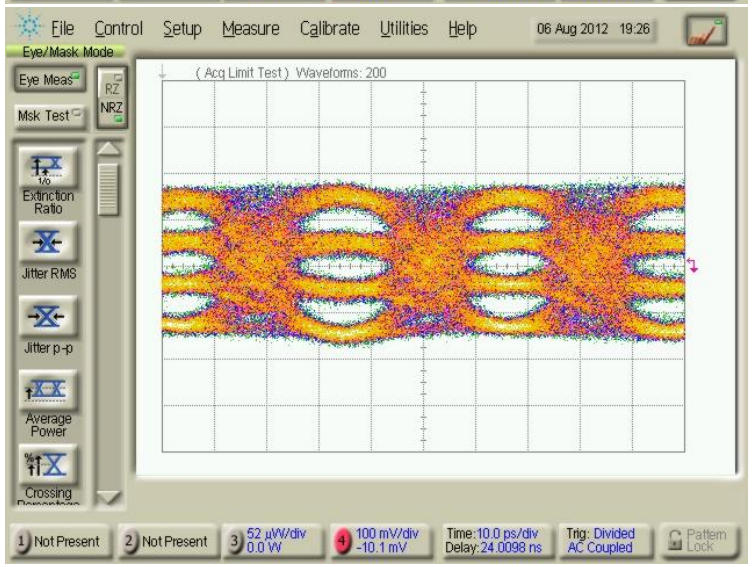
Uncorrected





Pre-emphasis using 3-tap filter (level 3)





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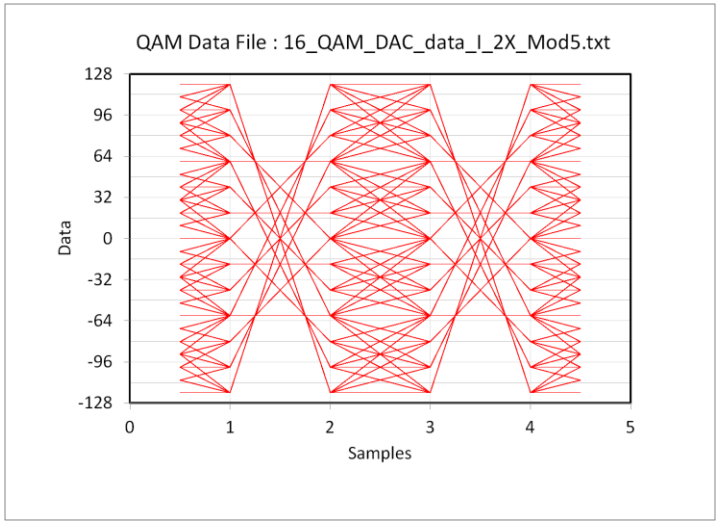
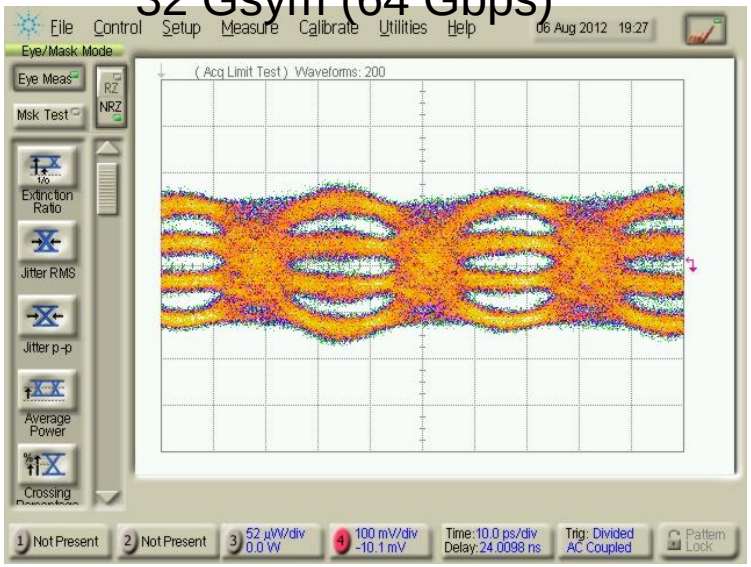
PAM-4 DAC Output with sample correction

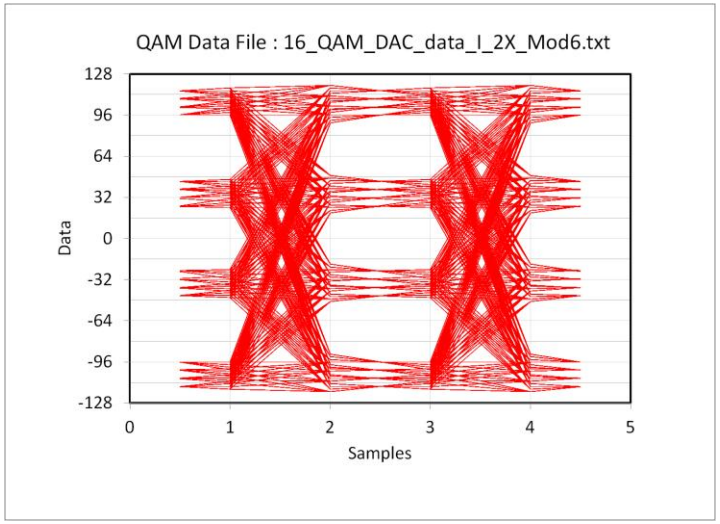
32 Gsym (64 Gbps)

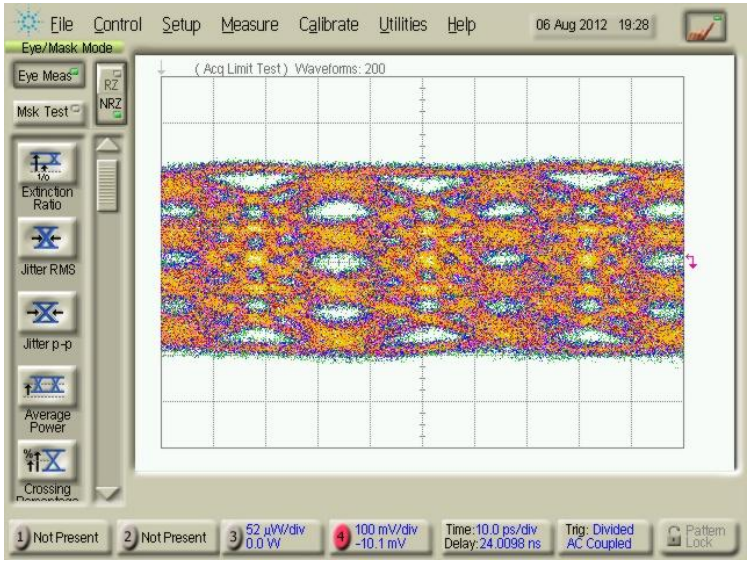
Pre-emphasis using 3-tap filter (level 5)





Reflection correction using 8-tap filter





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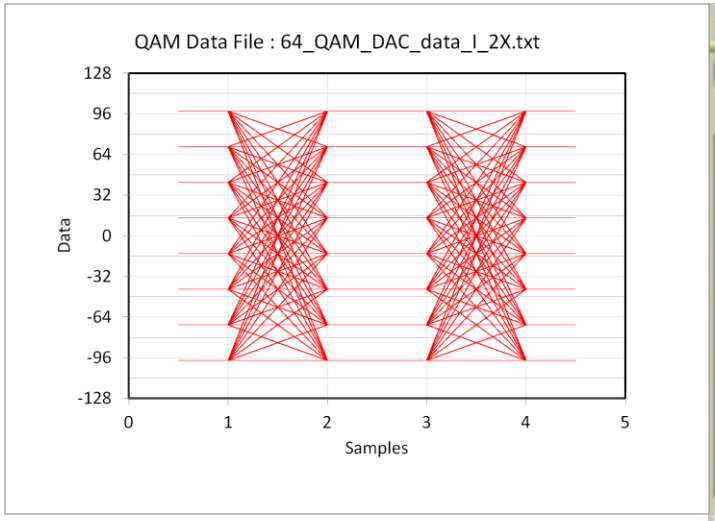
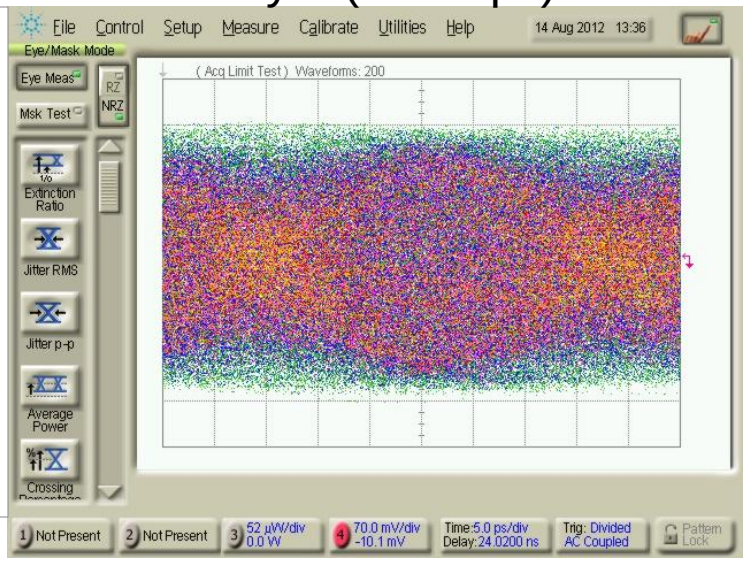
PAM-8 DAC Output with Sample Correction

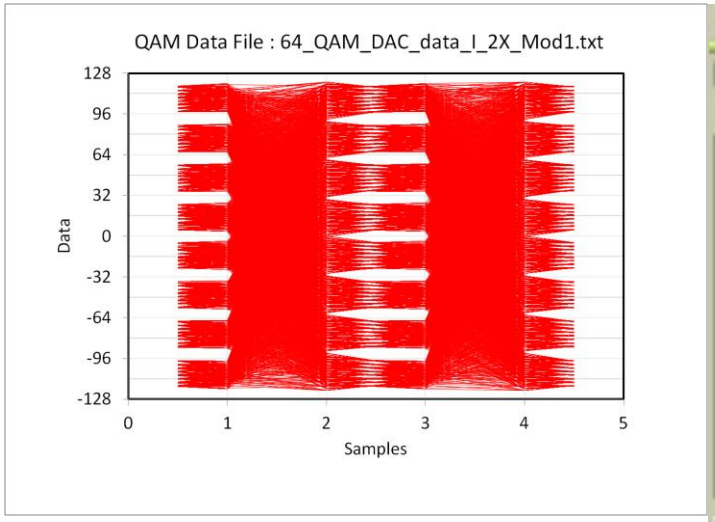
32 Gsym (96 Gbps)

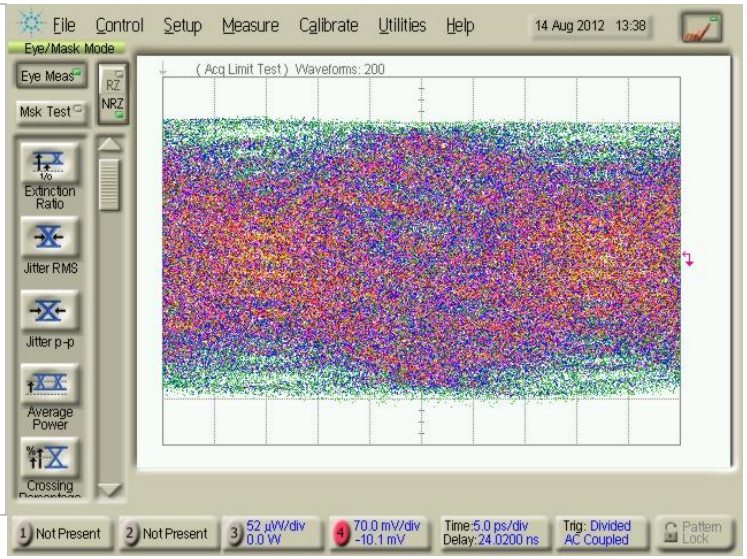
Uncorrected





Reflection correction using 8-tap filter





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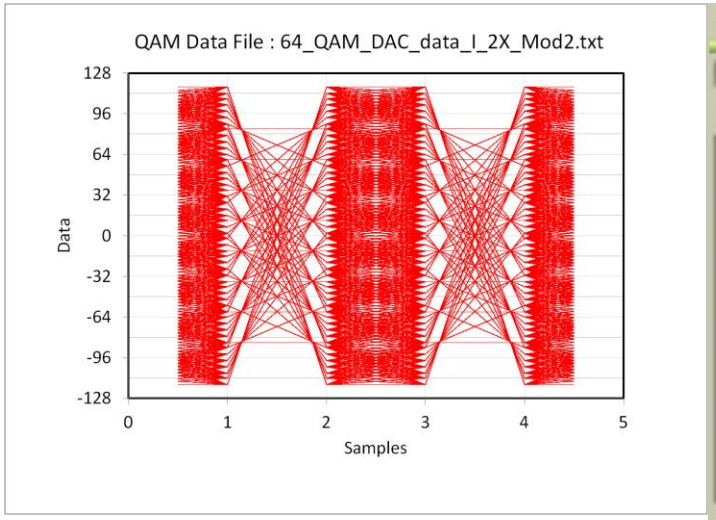
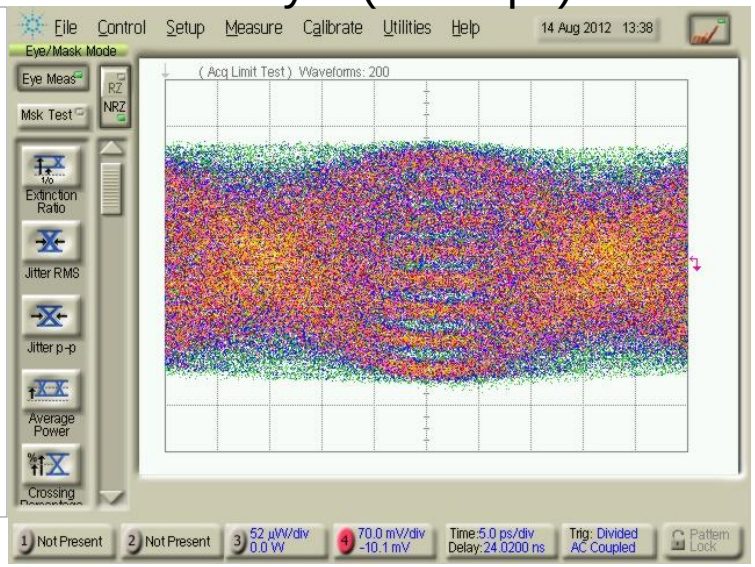
PAM-8 DAC Output with Sample Correction – Cont'd

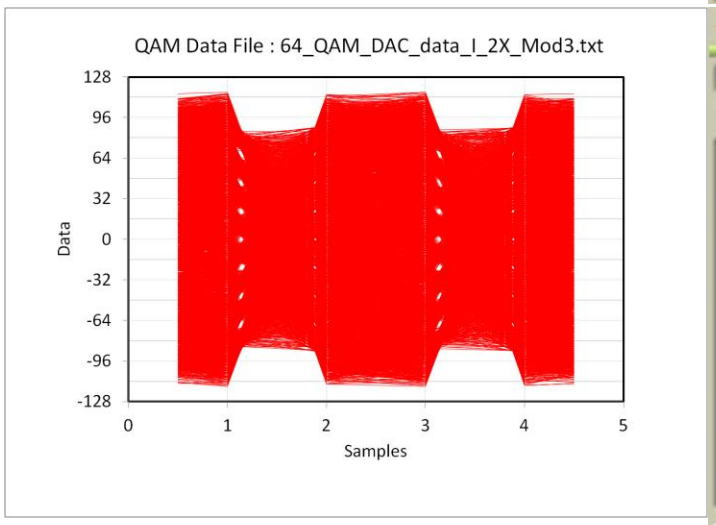
32 Gsym (96 Gbps)

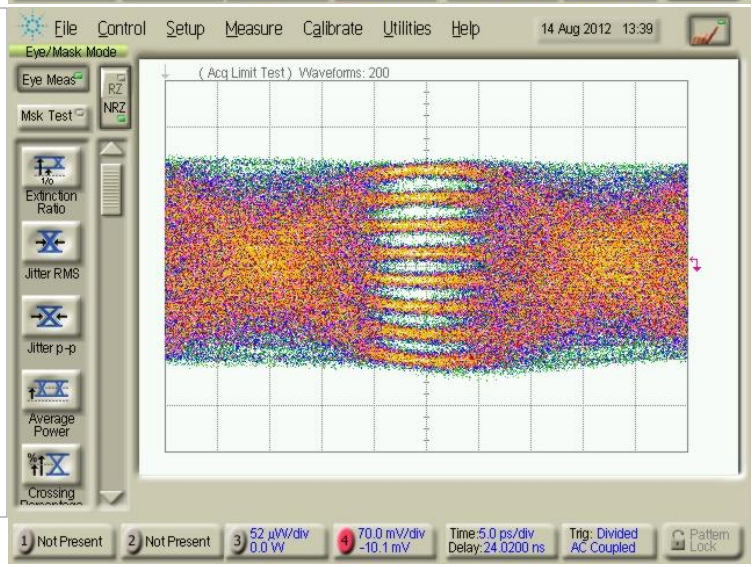
Pre-emphasis correction using 3-tap filter





Pre-emphasis and reflection correction





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Summary

- 3-point digital filter to pre-distort the data gives very clear PAM-4 eyes where the corresponding non-pre-distorted data gives barely visible eyes
- 2X oversampling corresponds to 32 Gbaud and a PAM-4 data rate of 64 Gb/s
  - It also corresponds to operating the DAC in its RF roll-off region around 16 GHz. Pre-distortion helps compensate for the roll-off.
- 2X oversampling corresponds to 32 Gbaud and a PAM-8 data rate of 96 Gb/s
  - Pre-distortion also helps in this case.
- 8-point digital filter corrects the reflection found in previous 4X and 8X oversampled data and this has the effect of bringing out the detail of the crossover region
  - A combination of these filters can be used to improve the eye diagrams further