Penalty sensitivities due to Rx impairments vs. TP2 waveforms

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Objectives

- Compare the penalty sensitivities of a variety of Rx non-idealities against a variety of TP2 waveforms
  - As a measure of waveform "equalizability"
- Rx settings summary
  - Sampling offsets at slicer input
    - Timing +1/16, 0, -1/16 UI
    - Threshold 0.05, 0, -0.05 relative OMA
  - EQ lengths
    - 14,5 and 10,3
  - Rx BW (anti-aliasing filter)
    - 7.5 GHz, 5 GHz

Penalty reference

- Sensitivities are defined around a reference operating point
  - MMSE-optimized sample timing = 0
  - Linearized-mid (very close to mean) sample threshold = 0
  - 14,5 EQ length (T/2 FF, T FB)
  - Anti-aliasing filter BW =7.5 GHz
- All analysis done with Ewen pre-cursor stressor
  - #23, 4.57 dB

Rx sample offsets

- EQ length and BW at reference settings
- Grid of 3x3 penalty results from timing offset and threshold offset
  - $[-1/16, 0, 1/16]$ x $[-0.05, 0, 0.05]$
- Pick the worst result from the grid of nine values
- Sensitivity is penalty difference from the optimum
  - Optimum result is in the middle of the grid

Rx EQ length and filter BW

- EQ length
  - Sample offsets and BW at reference settings
  - Determine penalties at 14,5, 10,3 (and 100,50)
  - Sensitivity is difference between 10,3 and 14,5

- Rx bandwidth
  - Sample offsets and EQ length at reference settings
  - Determine penalties at 7.5 GHz and 5 GHz
  - Sensitivity is difference between 5 GHz and 7.5 GHz

1207-01

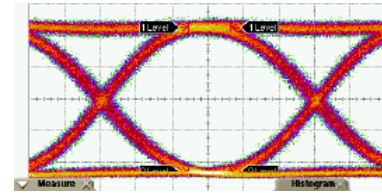115-01c

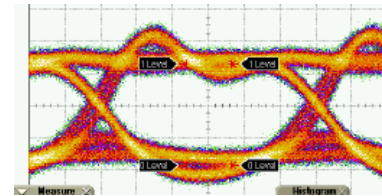**Measured waveforms for following analyses**
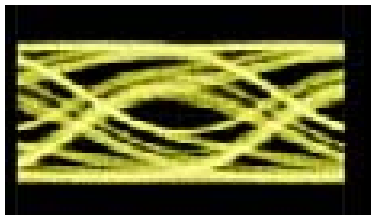
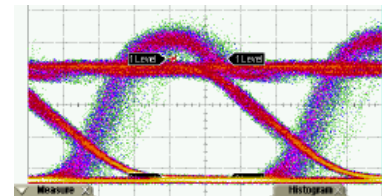1207-03
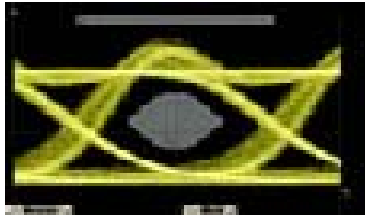
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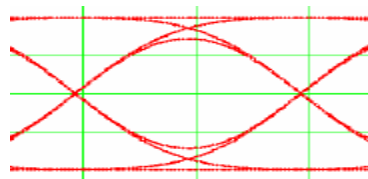115-08c

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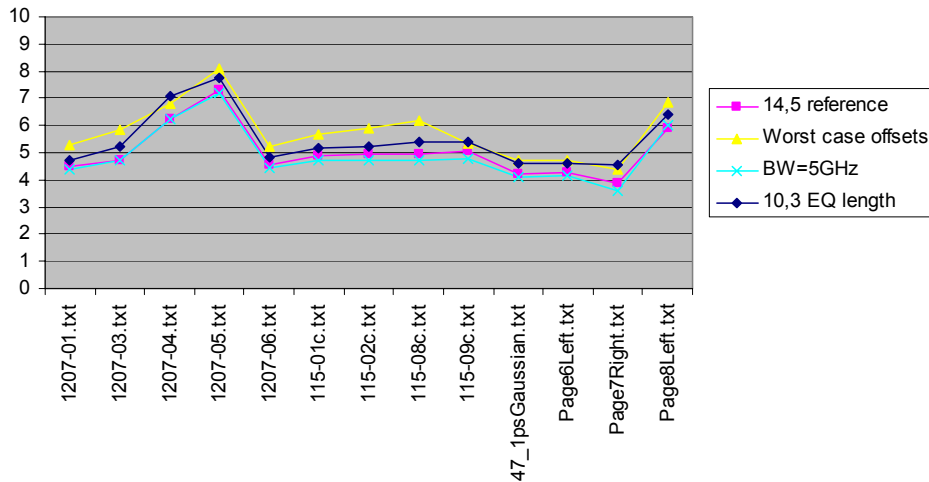
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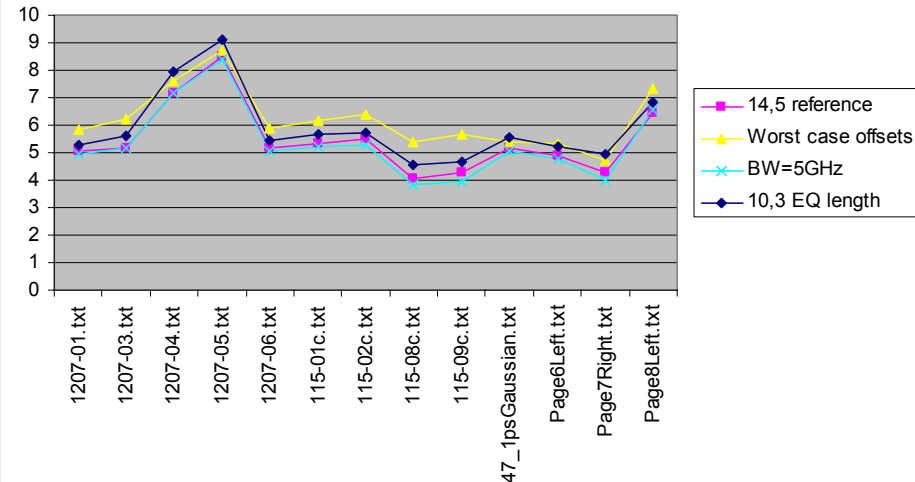
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47.1 psec Gaussian

Results

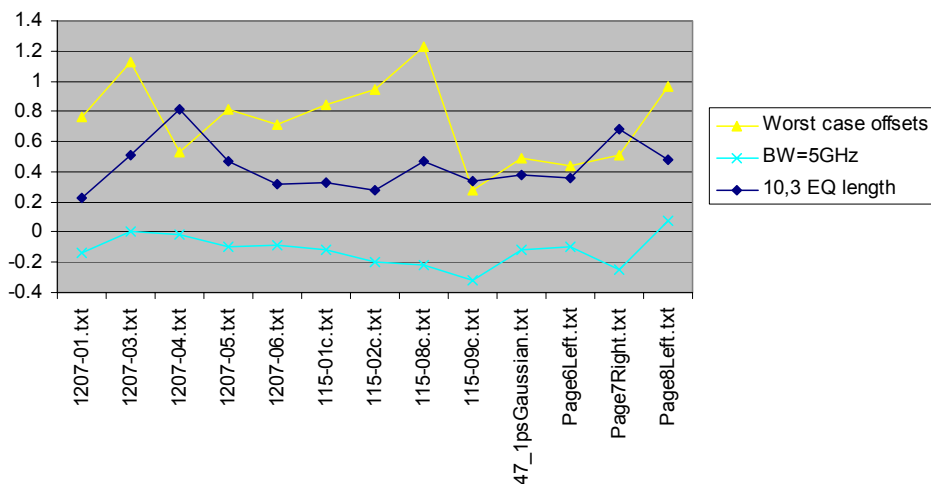# Overall penalties

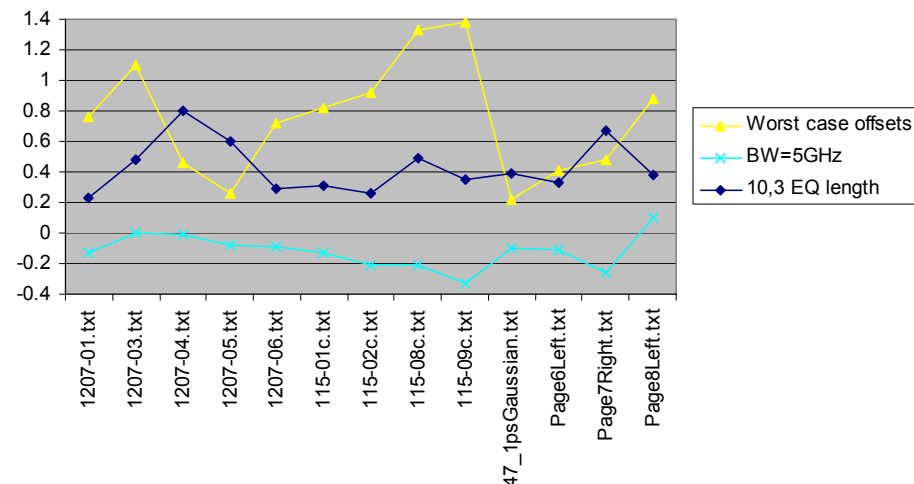

OMSD referenced penalties

OMA referenced penalties

- Note penalty decrease with OMA referencing for 2 pre-emphasized waveforms
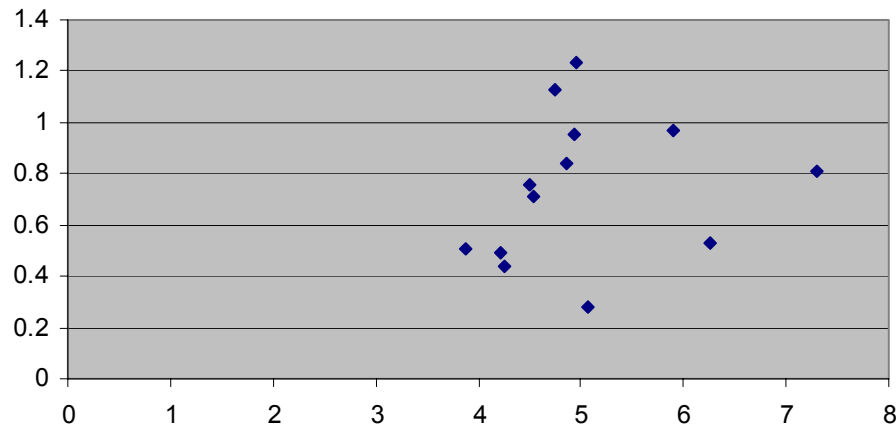
Summary of sensitivities

- Note that for offsets, worst case sensitivities align with lowest penalties and vice versa
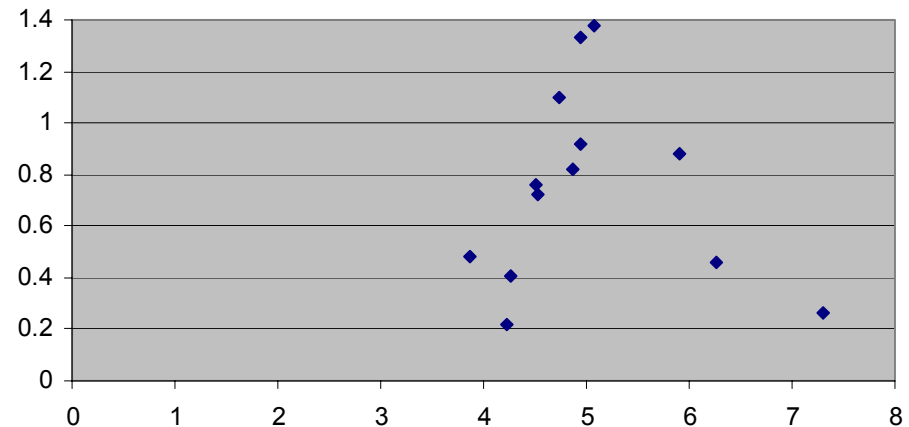 - Somewhat better with OMSD referencing?

Sample offset scatter plots

- X axis is reference penalty value
- Y axis is Δ due to change from centered to worst-case sample offset
- Correlation is weak

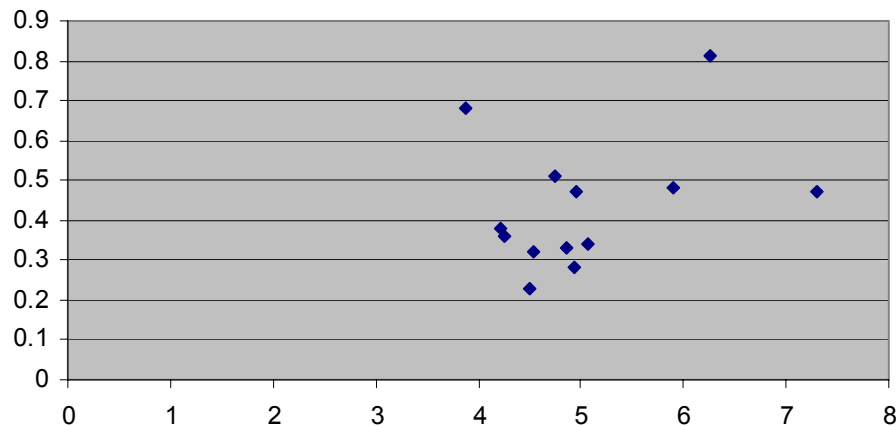Sample offset sensitivity, OMSD referenced

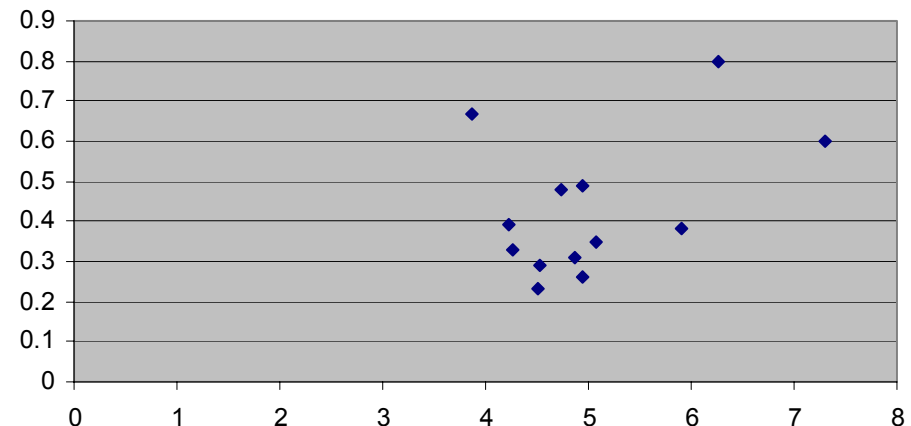Sample offset sensitivity, OMA referenced

- X axis is reference penalty value
- Y axis is Δ due to change from 14,5 to 10,3
- Correlation is weak

EQ length sensitivity, OMSD referenced
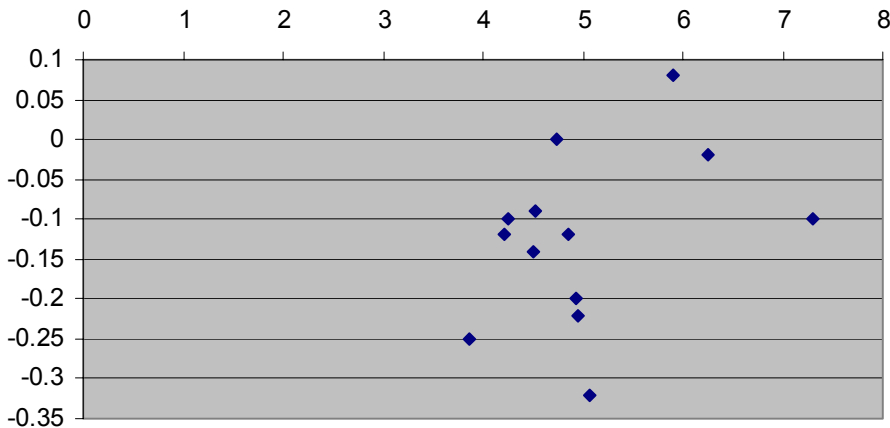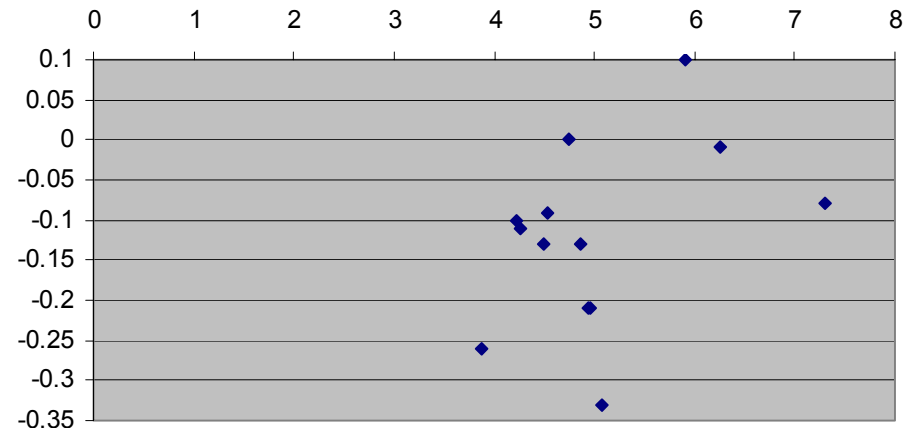
EQ length sensitivity, OMA referenced

Rx filter BW scatter plots

- X axis is reference penalty value
- Y axis is Δ due to change from 7.5 GHz to 5 GHz
- Correlation is weak

BW sensitivity, OMSD referenced

BW sensitivity, OMA referenced

Observations

- Relatively poor ability to predict implementation sensitivities (equalizability) from reference penalty result

- Penalties resulting from timing offset and threshold offset are almost orthogonal
  – They add up to the combined offset penalty
- BW = 5GHz typically has better performance than 7.5GHz
  – Noise power is less with BW = 5GHz
  – Filter has less effect on combined ISI than rest of channel