Driver Precompensation with Receiver Filtering for Ultra4

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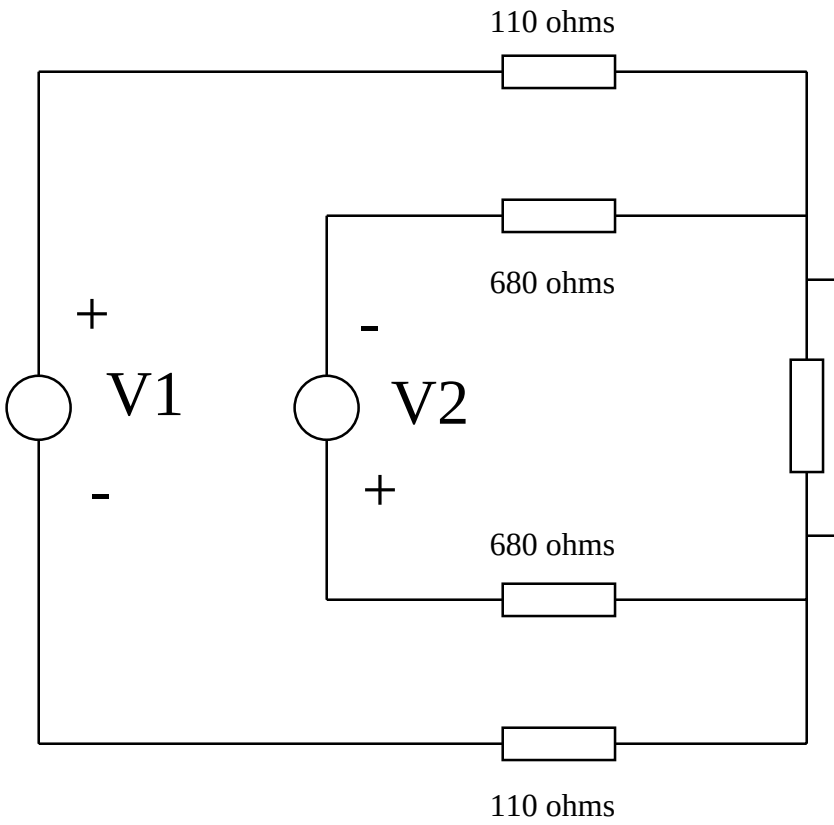
System Configurations Tested

- 12 meter Amphenol twisted-flat (#125-3096-996) w/ 4 loads @ 9.85” spacing - termination required for test equipment
- 12 meter Amphenol w/ 16 position backplane (w/ 14 drives - end slots empty) - termination required for test equipment
- 12 meter Madison round Shielded #68KCK00051 and above backplane
- 20 inch Amphenol w/ above backplane
- 1 meter twisted-flat cable with 4 loads at 10” spacing

Test Setup



1GHz differential probes placed at driver and receiver ends.

SCSI Cable

Cable terminated with a 100 ohm resistor across differential pair at far end of bus.

V1/V2 are 2 outputs from HP-81110A generator; 2.5V pk-pk; 1.6ns rise/fall; 33% boost (XOR).

Test Setup

- 80MHz, pseudo-random pattern; XOR configuration
- Tests runs:

  with/without precompensation

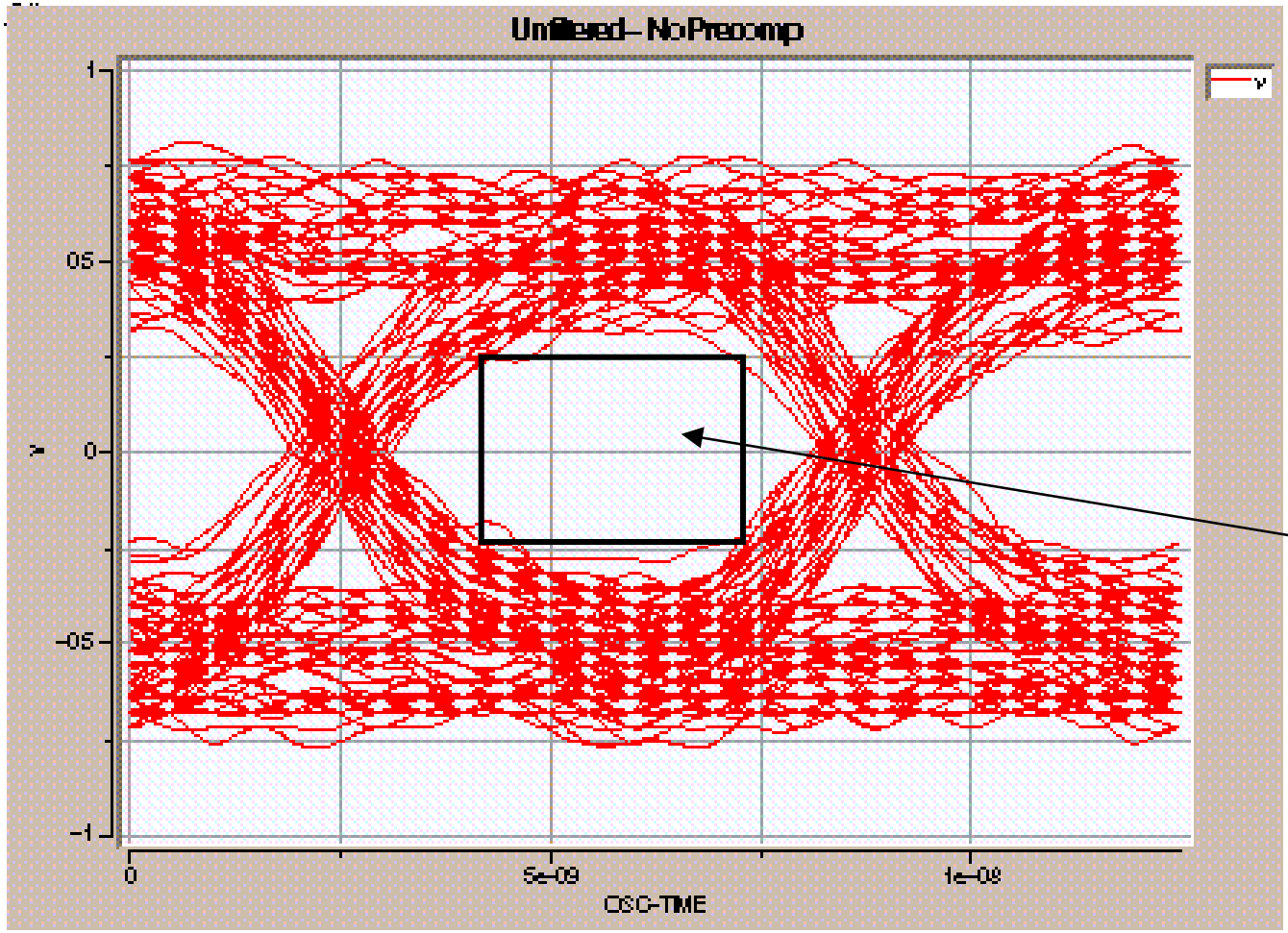
  with/without filtering

  (MatLab used for simulation of Chebyshev filter; filter gain = 1.3)
- Lab data analyzed with H-spice
  - H-spice (version 99.4) with new 'W' models used to verify behavior of physical data – further analysis with Spice is used to characterize, optimize, and validate a working solution

Data Set #1

- 12 meter Amphenol twisted-flat (#125-3096-996) w/ 4 loads @ 9.85” spacing - termination required for test equipment

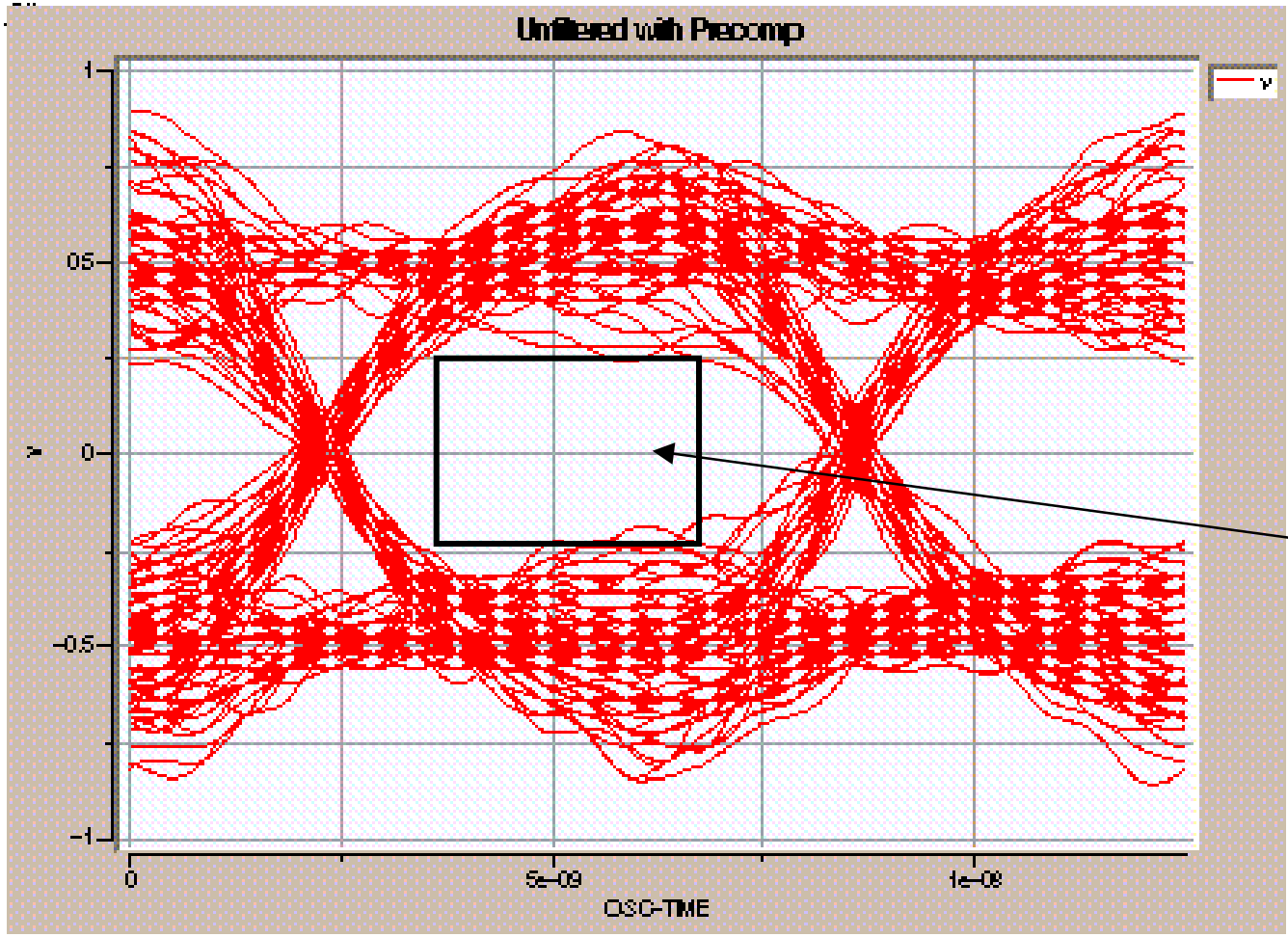
Unfiltered - No Precomp



(dimensions from last slide)

0.25V/div, 2.5ns/div

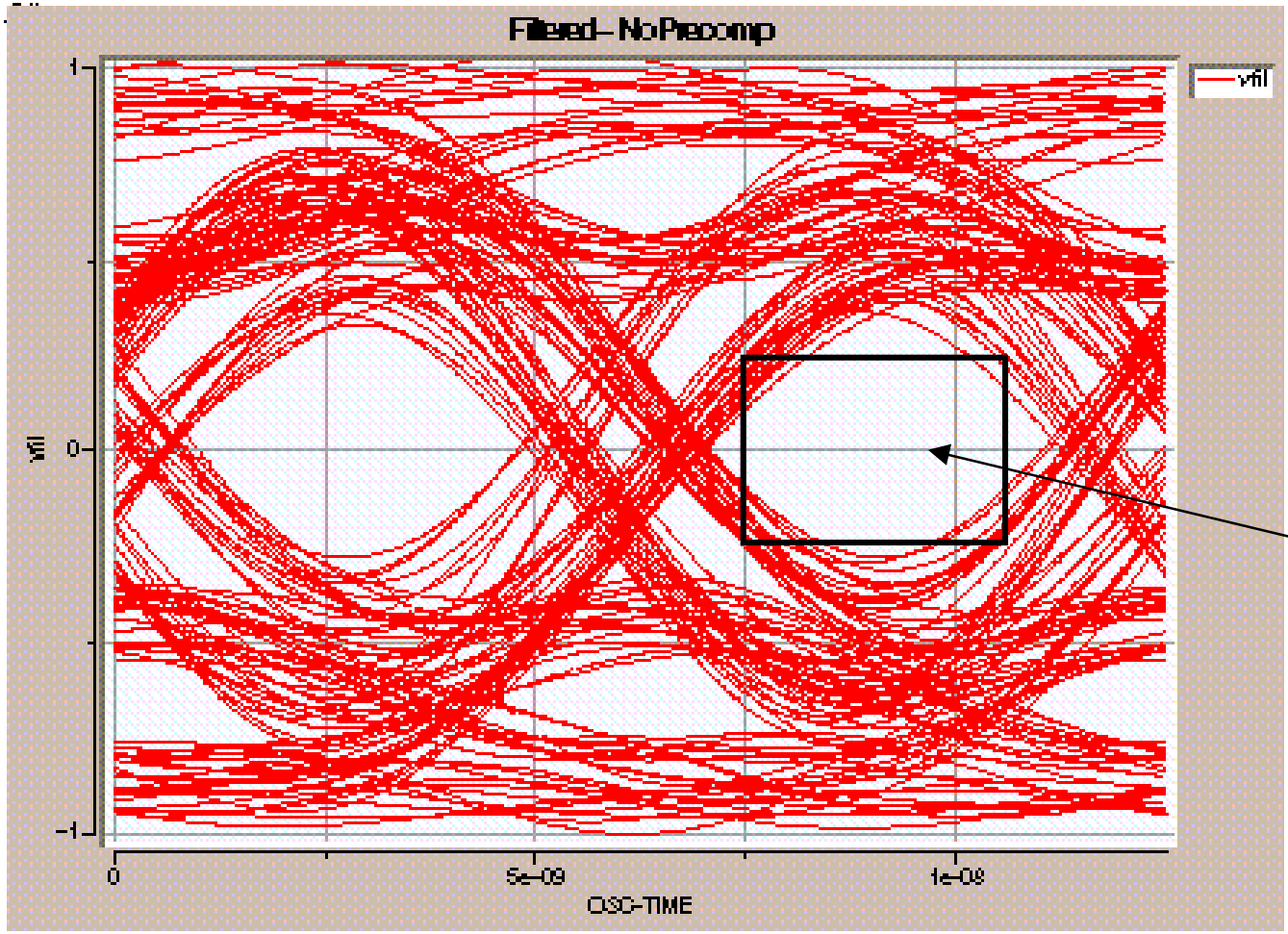
Unfiltered with Precomp



(dimensions from last slide)

0.25V/div, 2.5ns/div

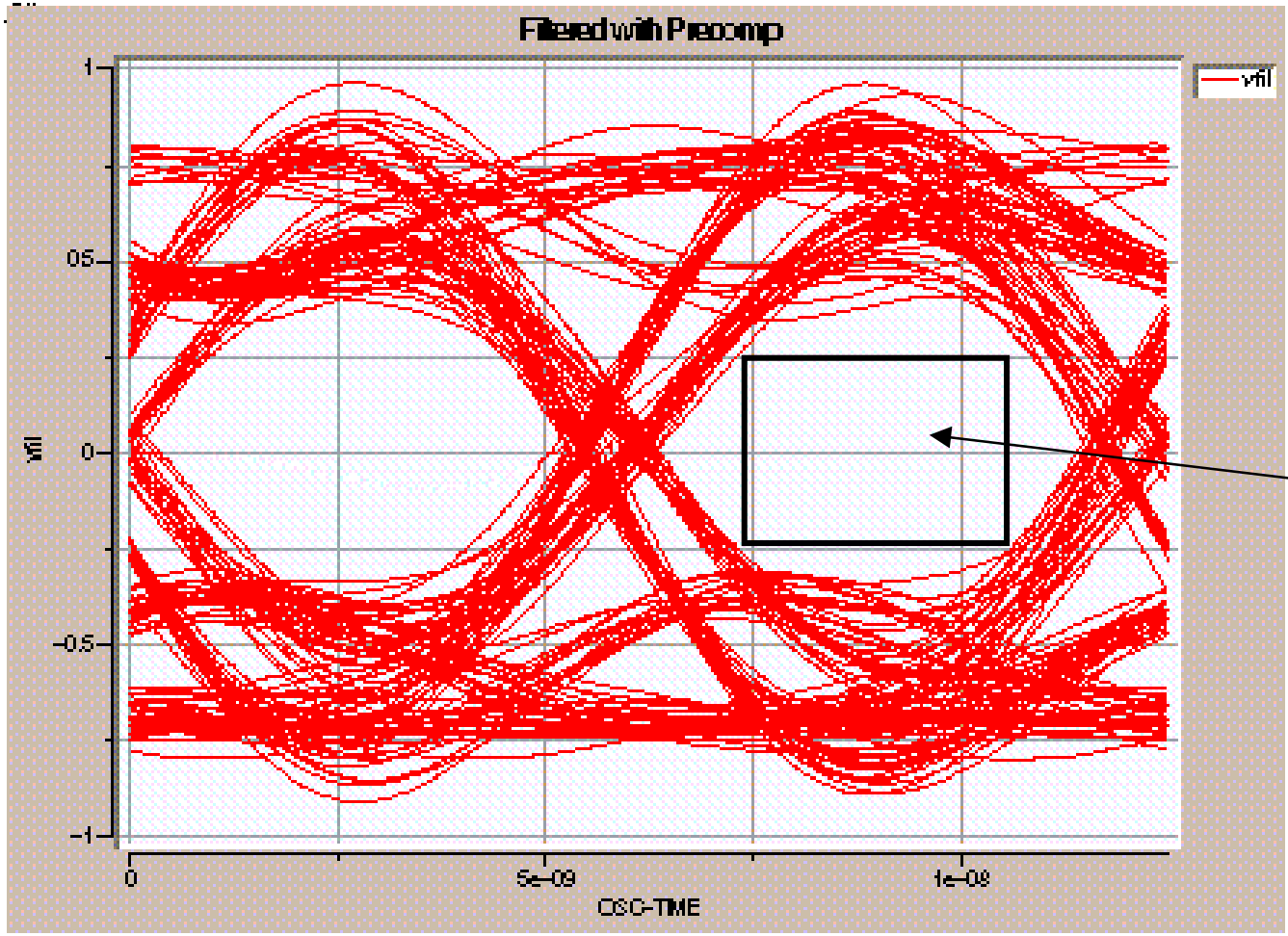
Filtered - No Precomp



(dimensions from last slide)

0.25V/div, 2.5ns/div

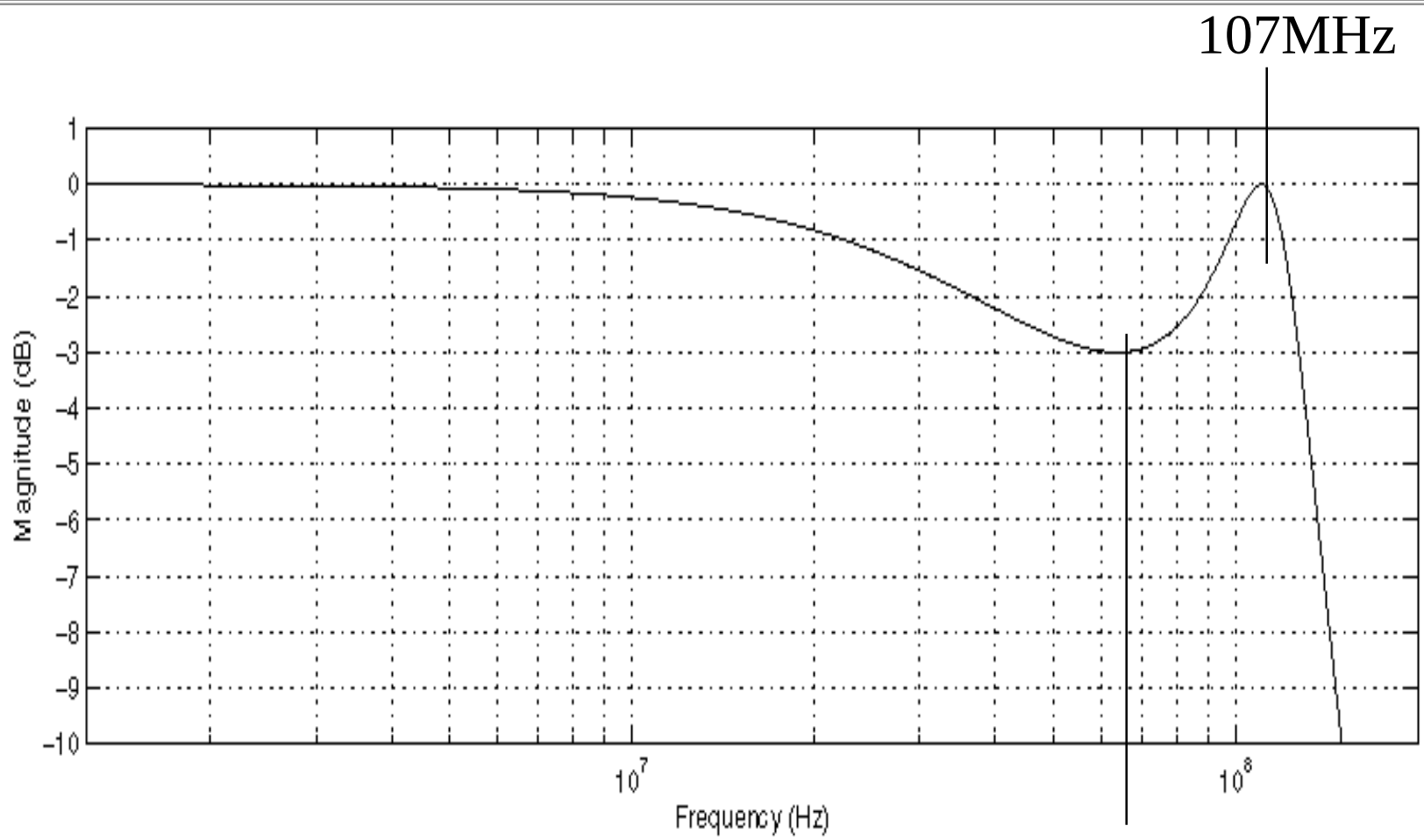
Filtered with Precomp



Approx:
3.1ns wide
500mVp-p tall

0.25V/div, 2.5ns/div

3-Pole Chebyshev Filter Response



*Not optimized for 80MHz

64MHz

Precompensation with Filtering

- Observations
  - Works At 20% to 30% precomp without a large increase in pad area (approximately 5% to 12% increase)
  - Better margin with low-pass filter
  - 20% to 30% precomp has less impact than current practice of raising amplitude to improve margins (required by some implementations of Ultra3)

Conclusions

- Additional margin is gained through:
  - 20% to 30% amplitude precomp
  - 3-pole, Chebyshev filter at the receiver (filter not optimized)
- Precomp with filtering is a low cost solution for Ultra4 transceivers
  - Driver requires less than 15% increase in area
  - 2 or 3 pole filter is smaller and simpler than an adaptive equalizer
  - No training pattern required

What's Next

- **Collect more data**
  - Further research to prove 2-pole Chebyshev has sufficient margin
  - More test cases – various backplanes and cables
  - Multiple lines - crosstalk tests
  - Verify common mode shift is not a problem
  - Optimize precomp value – validate with models and lab tests
- **Additional simulations**
  - More models of cable configurations and types – help identify system requirements/restrictions
- **Actual circuit implementations**
  - Design driver/receiver circuits from optimized models
  - Develop test silicon to validate conclusions