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.

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

0.25V/div, 2.5ns/div

(dimensions from last slide)
Unfiltered with Precomp

0.25V/div, 2.5ns/div

(dimensions from last slide)
Filtered - No Precomp

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

107MHz

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