CEI-56G –
Signal Integrity to the Forefront: Testing Considerations

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New testing needs for 56G links

Evolutionary versus Revolutionary

- 56G NRZ – evolutionary shift from 28G NRZ

    - Tighter jitter budgets, better loss management, totally closed eyes

- Multi-Level signaling changes all the rules – in place for 50+ years!

    - Packing 4 levels into amplitude swing of 2 – lose 9.6 dB SNR
        - Better management of noise and return loss

    - Finite rise time creates inherent DDJ

    - How to implement clock recovery?

    - Closed eyes with lower SNR
        - FEC often required

0 – 1 crossing

0 – 3 crossing
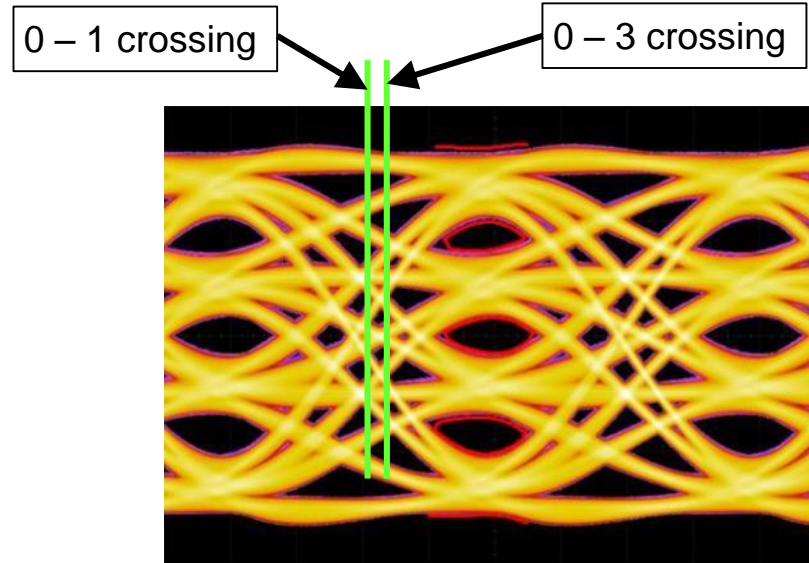
New impairments that challenge PAM-4 receivers

It's not just timing jitter anymore!

- Non-linearity - Amplitude compression in lower eyes
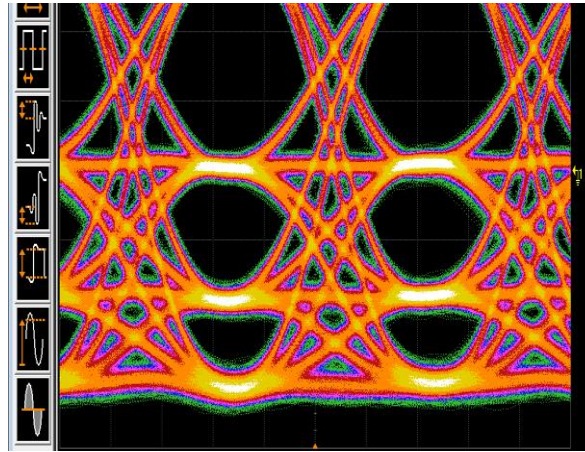
- FEC is more susceptible to burst errors than evenly distributed errors
  - Traditional BERTs do not measure burst counts

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Ensuring PAM-4 link integrity

- As PAM-4 receivers are susceptible to more than just timing jitter....

- The CEI-56G-xx-PAM Implementation Agreements are responding to assure data link integrity

- New measurements <u>ARE</u> being defined for Tx Outputs

- New stress tests <u>ARE</u> being defined for Rx Input testing

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Example: Linearity included in Input Stress Tests

- Included in CEI-56G-xx-PAM4 Implementation Agreements

- Compliance is static pass/fail test, combined with jitter or interference stress.

- Test with stressed PAM-4 eye, with inner levels offset to spec limit

- Linearity expressed as "Eye Linearity" (spec limit 0.67)

  - Set rail voltages with AWG, or individual output amplitudes with 2 channel BERT

$0.67\ A_{Max}$
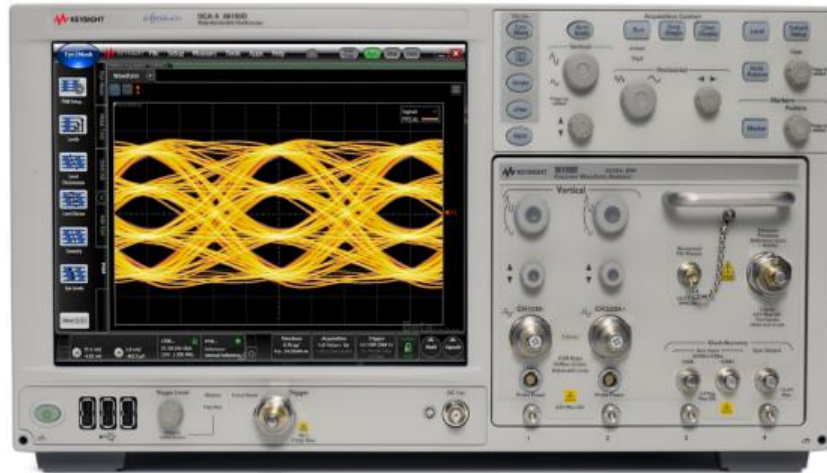
A_{Max}

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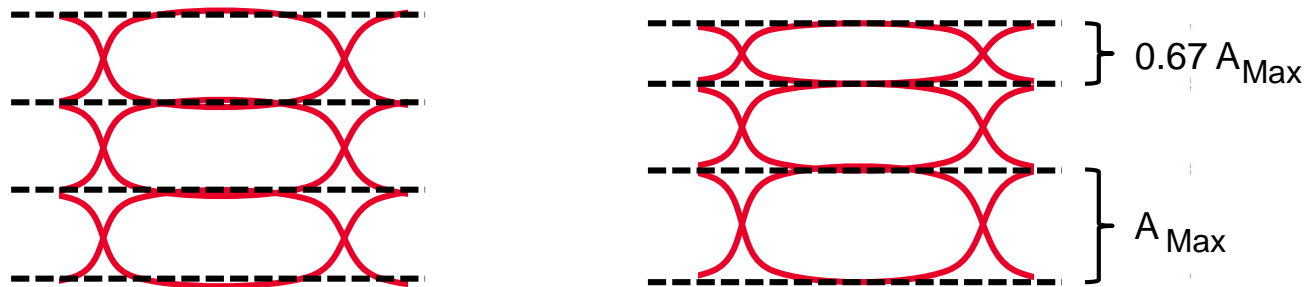
Upgrading measurement tools for PAM-4

- A "well equipped lab" for characterizing and testing compliance of NRZ will require some new tools for PAM-4

- Good news - All IAs using PAM-4 have similar test requirements
  - Same tool set works for all

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Output (Tx) Measurement Tools
Oscilloscope remains the primary tool

- Many test instruments for Output (Tx) measurements can be upgraded from NRZ to PAM-4

  - Sampling and Real Time Oscilloscopes can add new PAM-4 measurements with optional software packages

  - Direct measurements for eye parameters, skew, linearity, noise, etc.

  - PAM-4 capable clock recovery

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Tools for Input (Rx) measurement – a different story

- Some NRZ BERTs can be upgraded to PAM-4 with added hardware

  - Analog combining or PAM – DACs

    - Use 2 NRZ channels to create single PAM-4 pattern generator channel

  - Expensive – pattern aligned channels needed to create 1 PAM-4 signal

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Native PAM-4 capable BERTs
Just starting to appear on the market

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BERT – do you need an error detector?

Many transceiver ICs have internal error counters

- High speed Arbitrary Waveform Analyzers (AWG) can generate PAM-4 directly

- Flexible to create any impairment type

- When considering, check for:
    - Adequate memory depth for long patterns
    - Ability to make changes on the fly (needed for Jitter Tolerance testing)

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Test solutions vendors

Here to help with your CEI-56G testing needs

- Test equipment and compliance test board vendors are active members contributing to CEI-56 Implementation Agreements

- Use their application support teams to help you with your testing needs