

# **PAM Simulation**

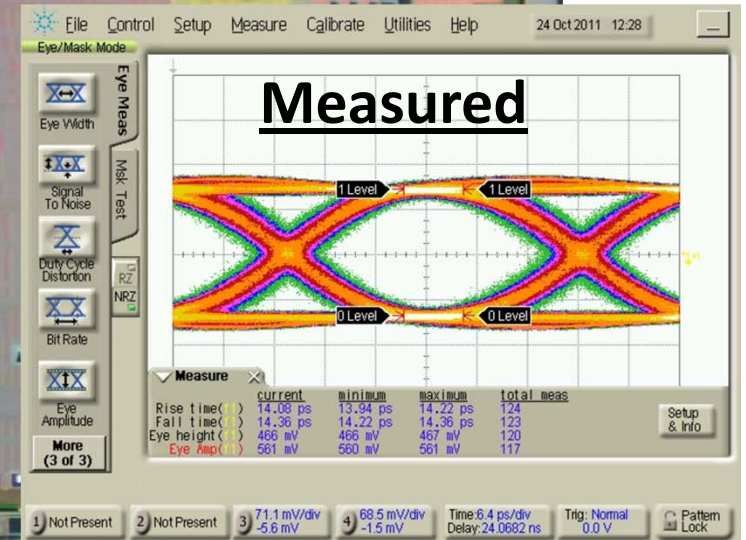
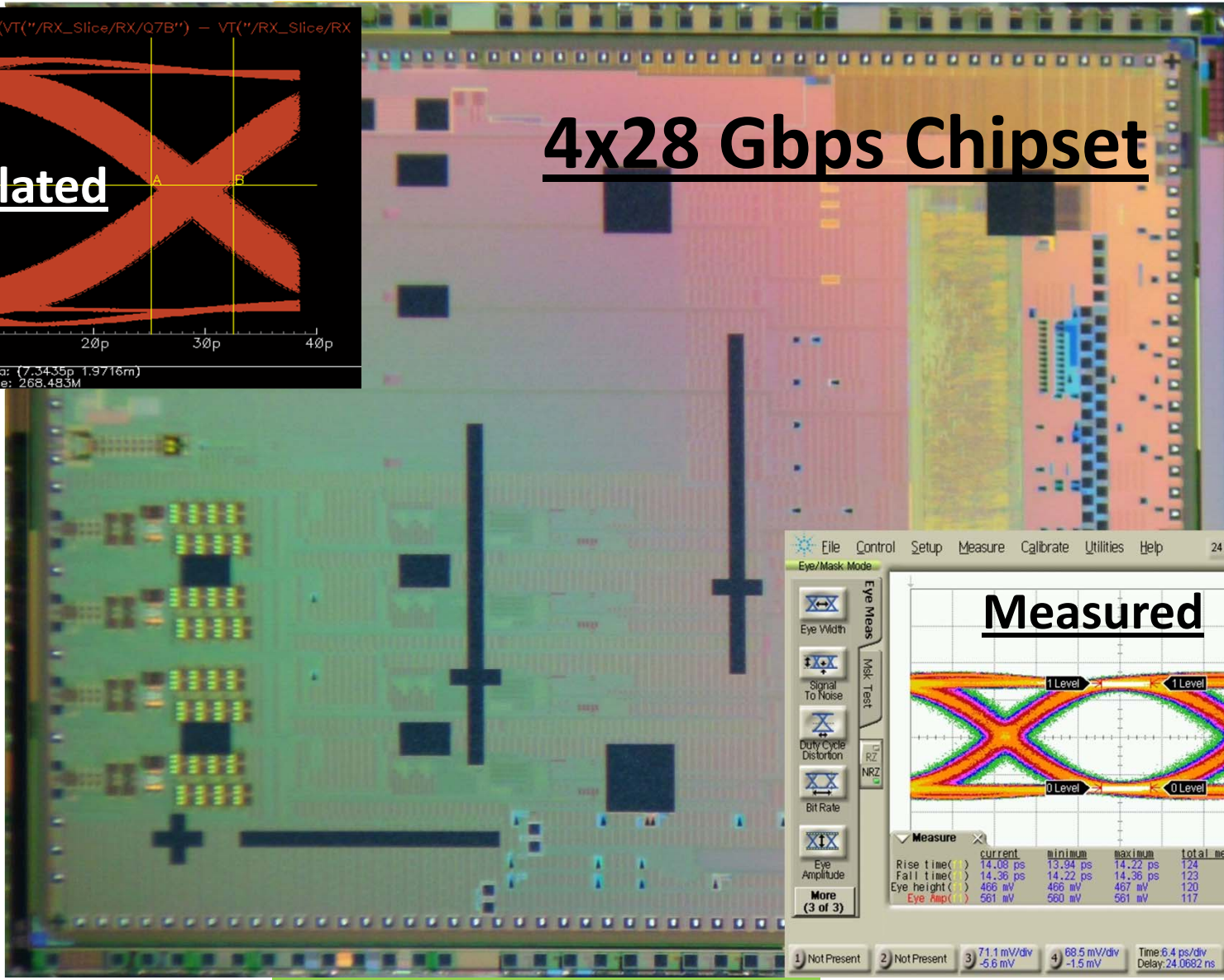
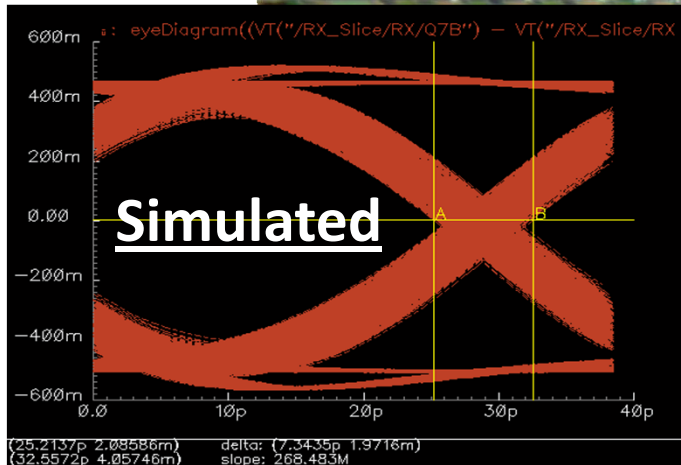
## **Palkert**

# Model to Hardware Correlation

- Silicon Photonics has been designed to the same standard as conventional CMOS technologies
- High level of Simulation to Hardware correlation necessary
- Demonstrated over several product iterations
  - 10 Gbps, 14 Gbps, and 28 Gbps
- System Characteristics described by electronic capabilities
  - Optics very high bandwidth relative to contemporary electronic signaling rates

# Model to Hardware Correlation

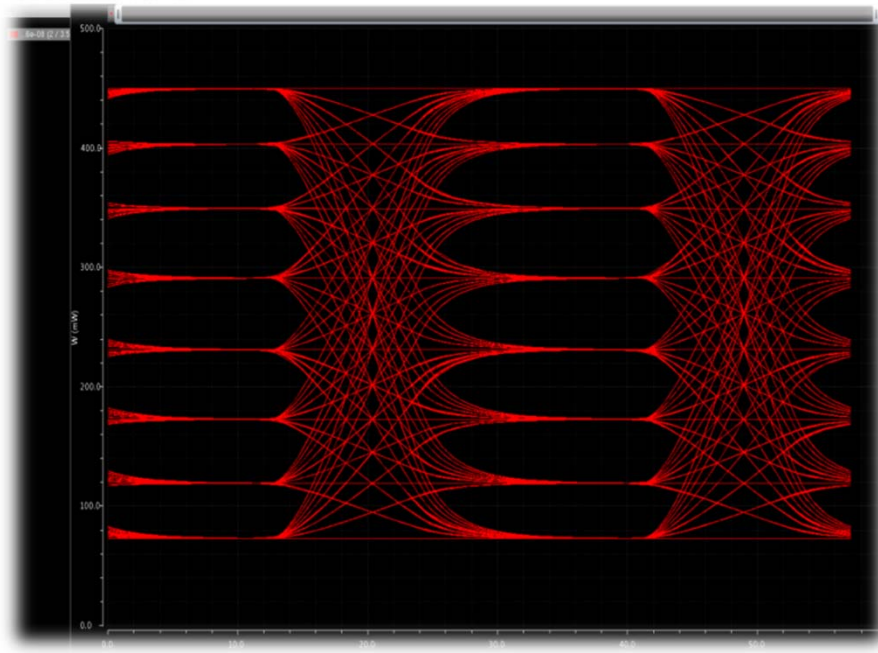
## 4x28 Gbps Chipset



# Silicon Photonics for PAM

- Silicon Photonics potential medium PAM solutions
- Current Modulators can be easily modified to act as PAM encoders
  - Requires minimal design alterations, no technology changes
  - Very low power compared to conventional PAM architectures
- Integrated photonics library allows novel chipset architectures
  - Optical linearity control on PAM receiver
- Integrated systems enable performance/power/size optimizations
  - Entire functionality can be integrated into a single transceiver chipset

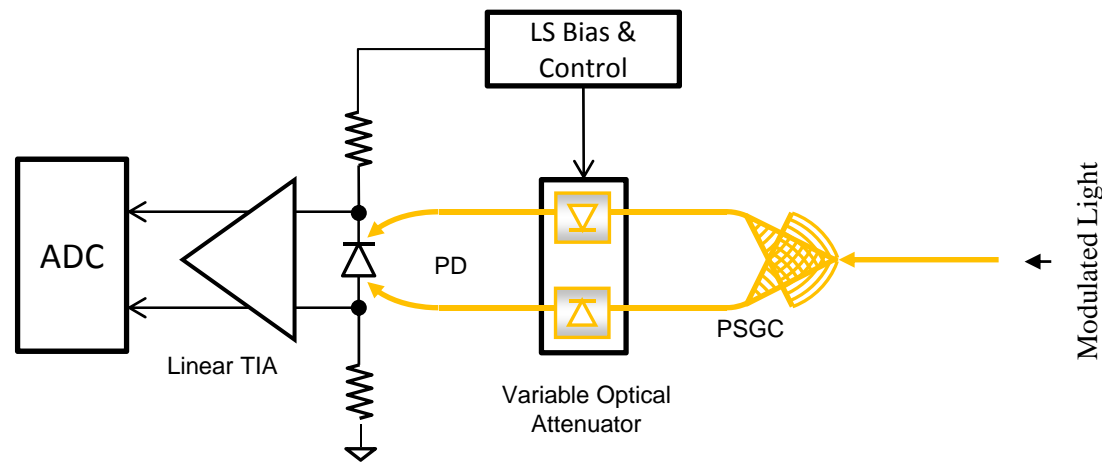
# Luxtera Approach: PAM-8 Modulator



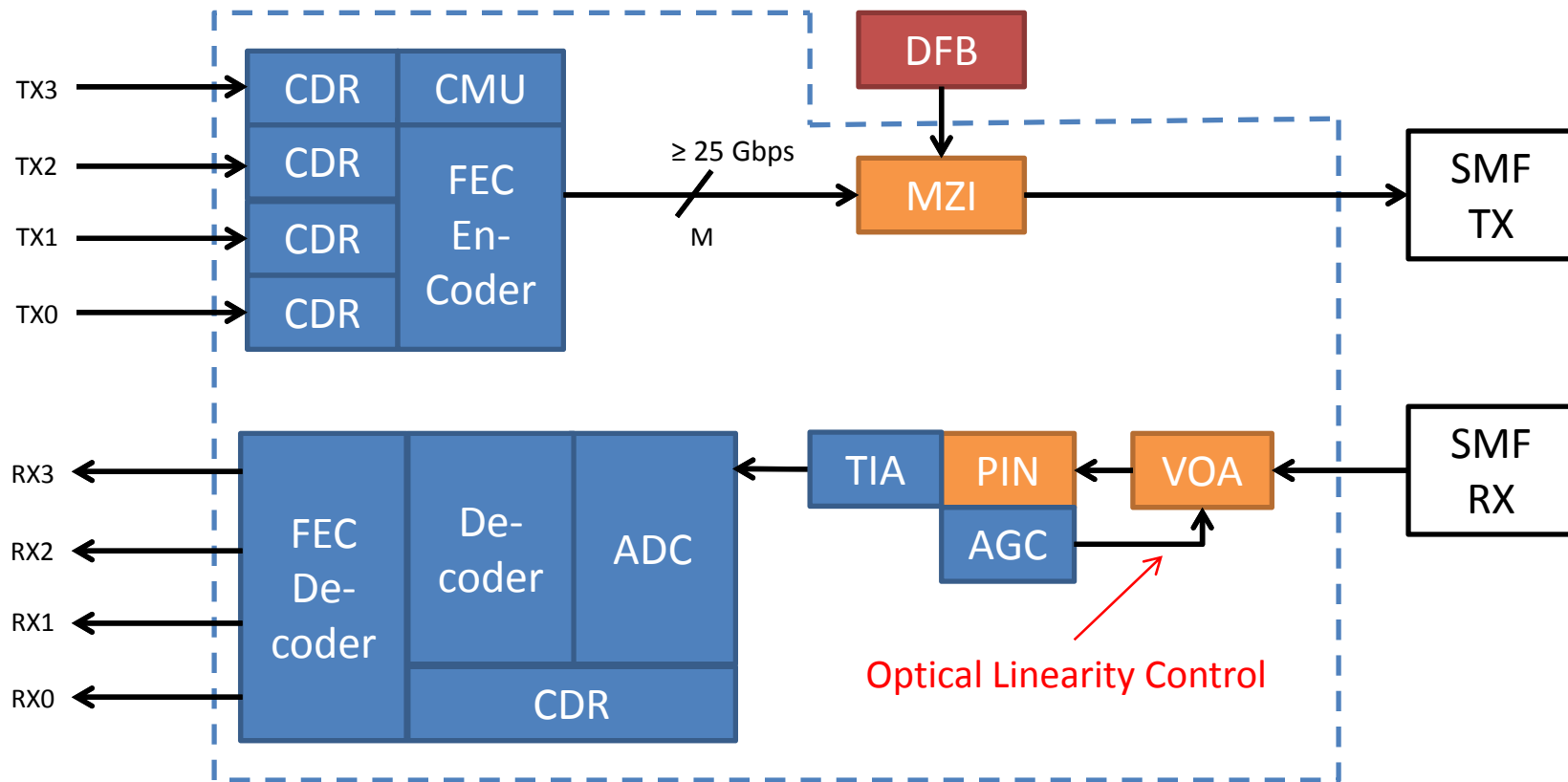
- Modulator Optical Eye Diagram
  - 12 ps Rise/Fall Time
  - 8 dB Extinction Ratio

# Luxtera Approach: Pam-8 Receiver

- Optical AGC
  - Alternate/supplement to electronic AGC
  - Tracks bias point and varies optical attenuator
  - Simple opto-electronic control loop drives integrated silicon photonics VOA (PIN diode)
  - Approximately 40 dB of dynamic range



# Luxtera Approach: Pam-8 System



100G PAM-N Silicon Photonics Transceiver Chipset

# Luxtera Approach: Component Maturity

- ✓ Modulator > 25 Gbps Bandwidth
- ✓ PIN Photodiode > 25 Gbps Bandwidth
- ✓ Discrete Low Cost DFB
- ✓ Variable Optical Attenuator
- ✓ Opto-Electronic Control Systems
- ✓ 25 Gbps CDR
- ✓ High resolution ADC
- ✓ FEC Encoder/Decoder
- **All Components Proven Independently**
- **PAM-N Transceiver is primarily an integration activity**
  - No new technologies need to be developed!