Component Vendor Perspective on PMDs for 100G/λ

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kimber_3cd_01A_ 0916.pdf

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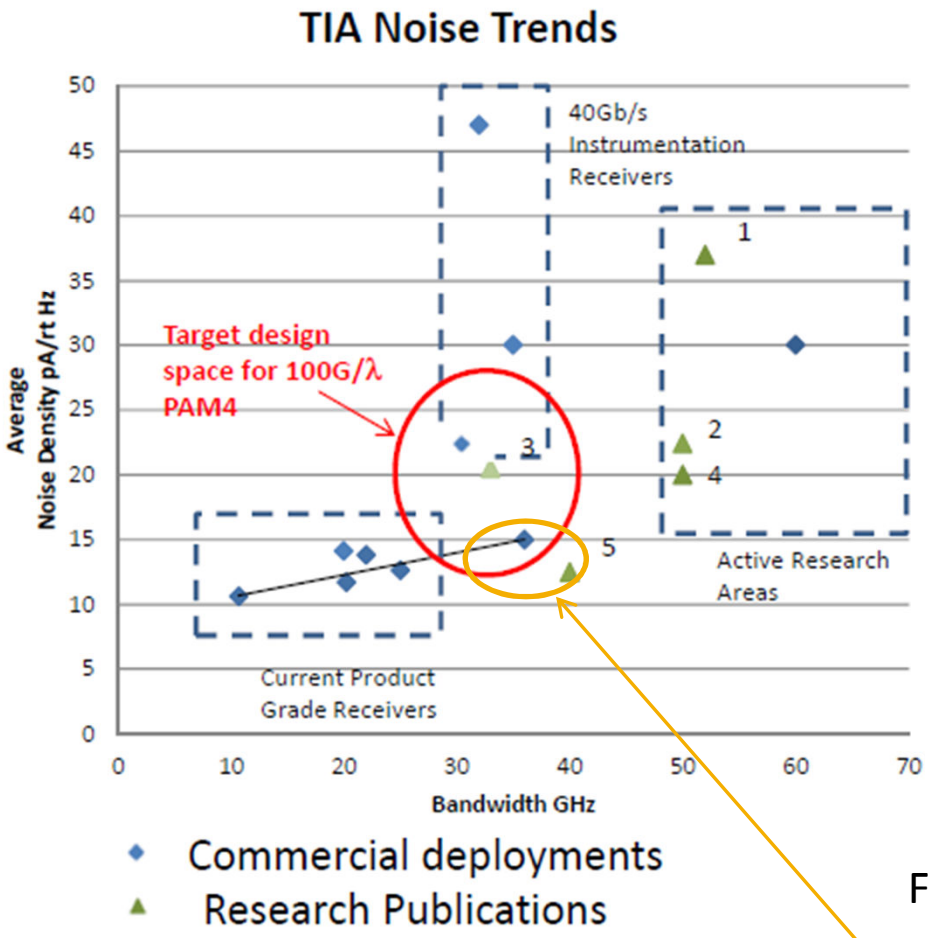
Background

- Availability of PMD components critical to deployment of 100G/λ modules and systems
  - TIAs
  - EML Drivers
  - MZ Drivers
- Earlier generation components had performance but had high power dissipation, larger size and higher noise

TIAs

- Key parameter requirements for link budgets
  - Typically 4k transimpedance
  - Typically 30-35GHz bandwidth (with PD)
  - Typically 15pA/√Hz noise
  - Typically 2mApp max input current
  - Low power dissipation to enable

TIAs



1. Monolithic Photorecievers for 60 Gbits/s and Beyond
H.-G. Bach
OFC 2003 ThZ1

2. A 50-Gb/s Differential Transimpedance Amplifier in 65nm CMOS Technology
Sang Gyun Kim, Seung Hwan Jung, Yun Seong
Taiwan Asian Solid-State Circuits Conference
IEEE November 10 - 12, 2014/Kaohsiung,

3. A 40-Gb/s Optical Transceiver Front-End in 45 nm SOI CMOS
Joohwa Kim, and James F. Buckwalter
IEEE JOURNAL OF SOLID-STATE CIRCUITS,
VOL. 47, NO. 3, MARCH 2012

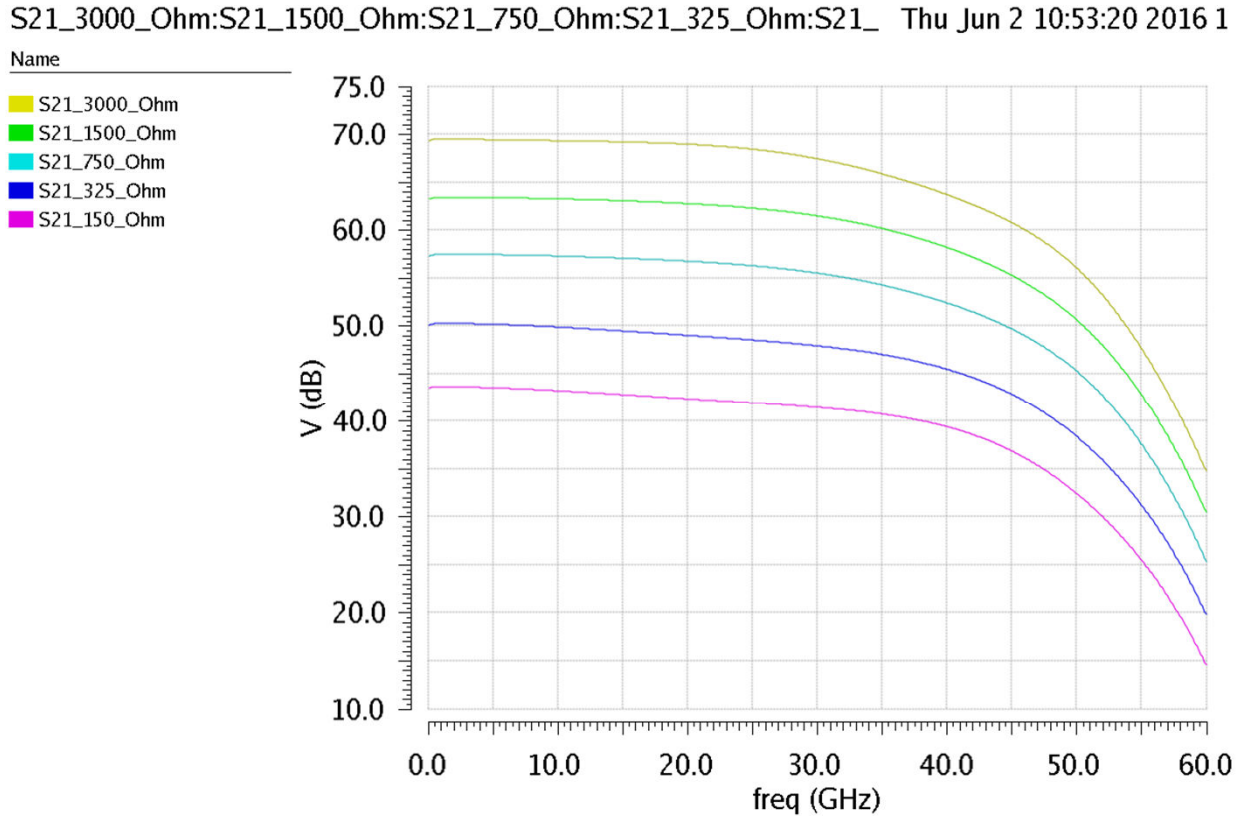
4. SiGe Differential Transimpedance Amplifier With 50-GHz Bandwidth Joseph S. Weiner, Andreas Leven, Vincent Houtsma, Yves Baeyens, Young-Kai Chen, Peter Paschke, Yang Yang, John Frackoviak, Wei-Jer Sung, Alaric Tate, Roberto Reyes, Rose F. Kopf, and Nils G. Weimann
IEEE JOURNAL OF SOLID-STATE CIRCUITS,
VOL. 38, NO. 9, SEPTEMBER 2003

5. A 40-GHz Bandwidth Transimpedance Amplifier with Adjustable Gain-Peaking in 65-nm CMOS
Ran Ding,y Zhe Xuan, Tom Baehr-Jones, Michael Hochberg
2014 IEEE 57th International Midwest Symposium on Circuits and Systems (MWSCAS),

From tipper_01a_3bs_0315

Current (2016) product developments

Current simulated performance



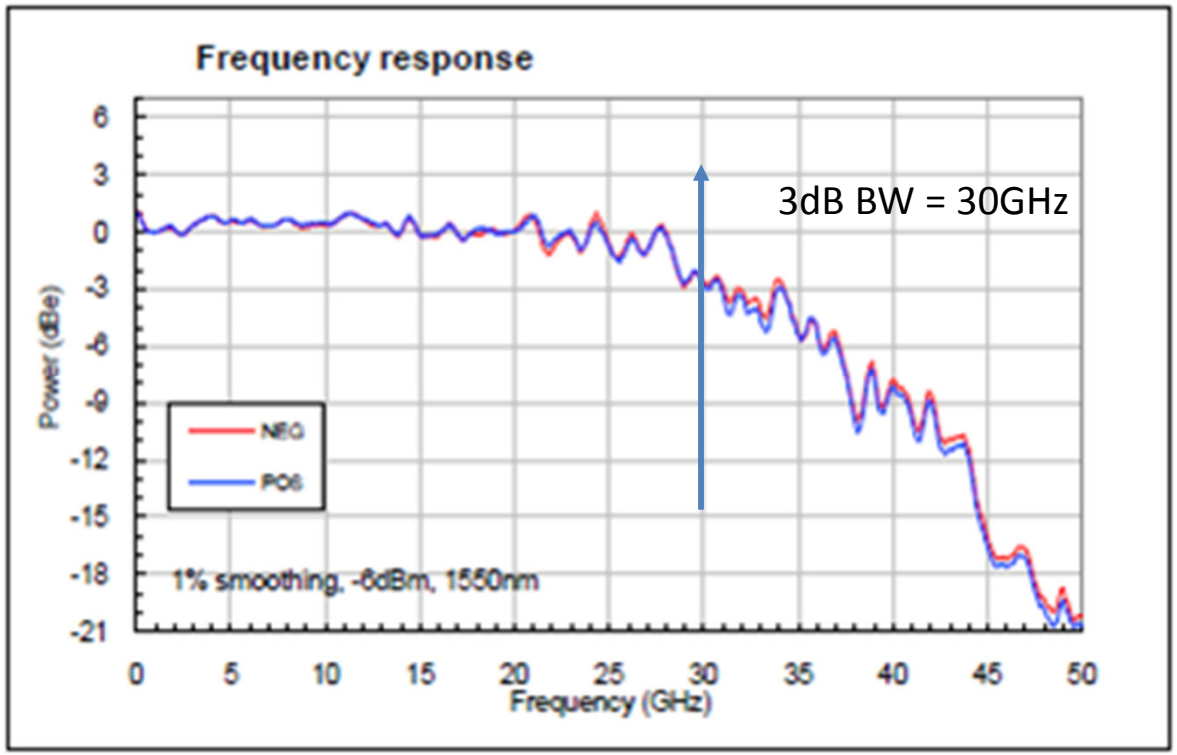
PIN capacitance = 70fF

Transit time = 14ps

Input bondwire loop inductance (including PIN parasitics)= 220pH

Output bondwire inductances = 200pH

Current TIA measured performance: Bandwidth



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Current TIA measured performance Noise

- Differential output referred PD+TIA noise which includes loading of the PD and any dark current noise of the PD = 6.4mVrms
- TIA gain = 2.5K ohm
- TIA BW = 30GHz
- Input referred noise =

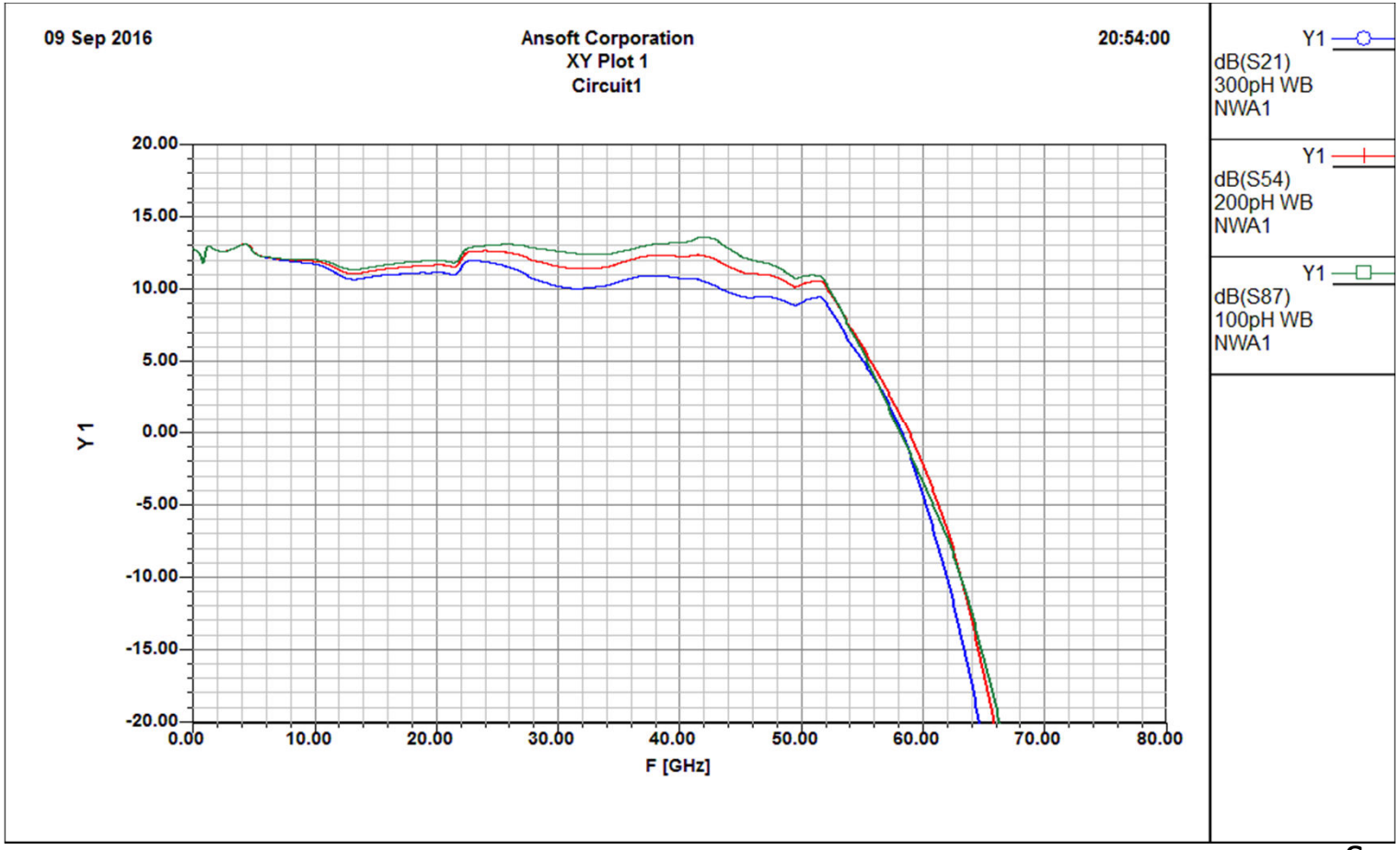
  6.4E-3 / (2.5k * sqrt(30G))

  = 14.78pA/sqrt(Hz)

EML Drivers – Single-ended

- Key parameter requirements to enable link budgets
  - Typically 10-15dB gain
  - Typically 30-35GHz bandwidth
  - Typically <10dB noise figure
  - Typically <5% THD
  - Low power dissipation for 2VppSE output swing

Current simulated EML Driver performance

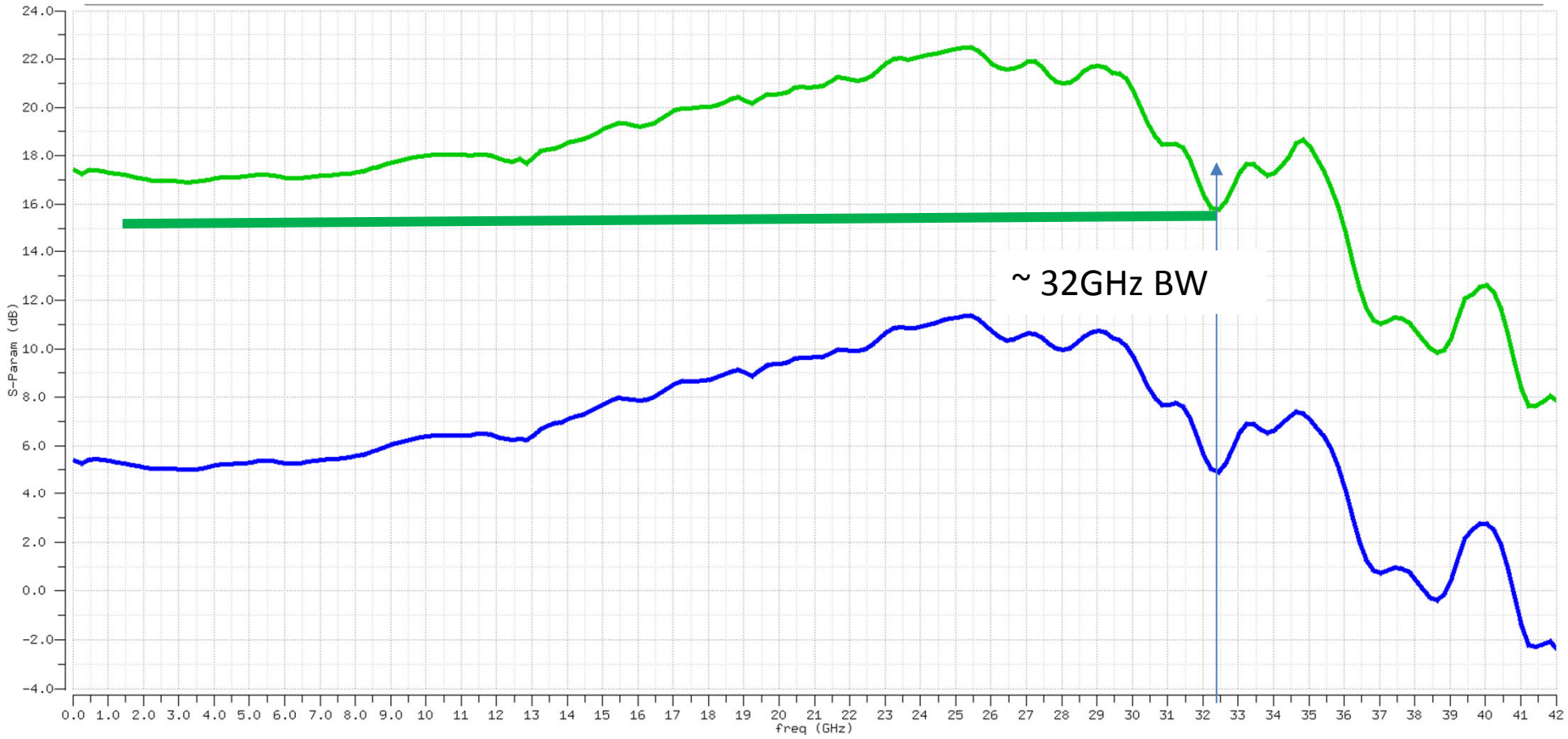


Semtech

MZ Drivers – Differential

- Key parameter requirements to enable link budgets
  - Typically 10-15dB gain
  - Typically 30-35GHz bandwidth
  - Typically <10dB noise figure
  - Typically <5% THD
  - Low power dissipation for 2Vppd output swing

Current MZ Driver measured performance: BW



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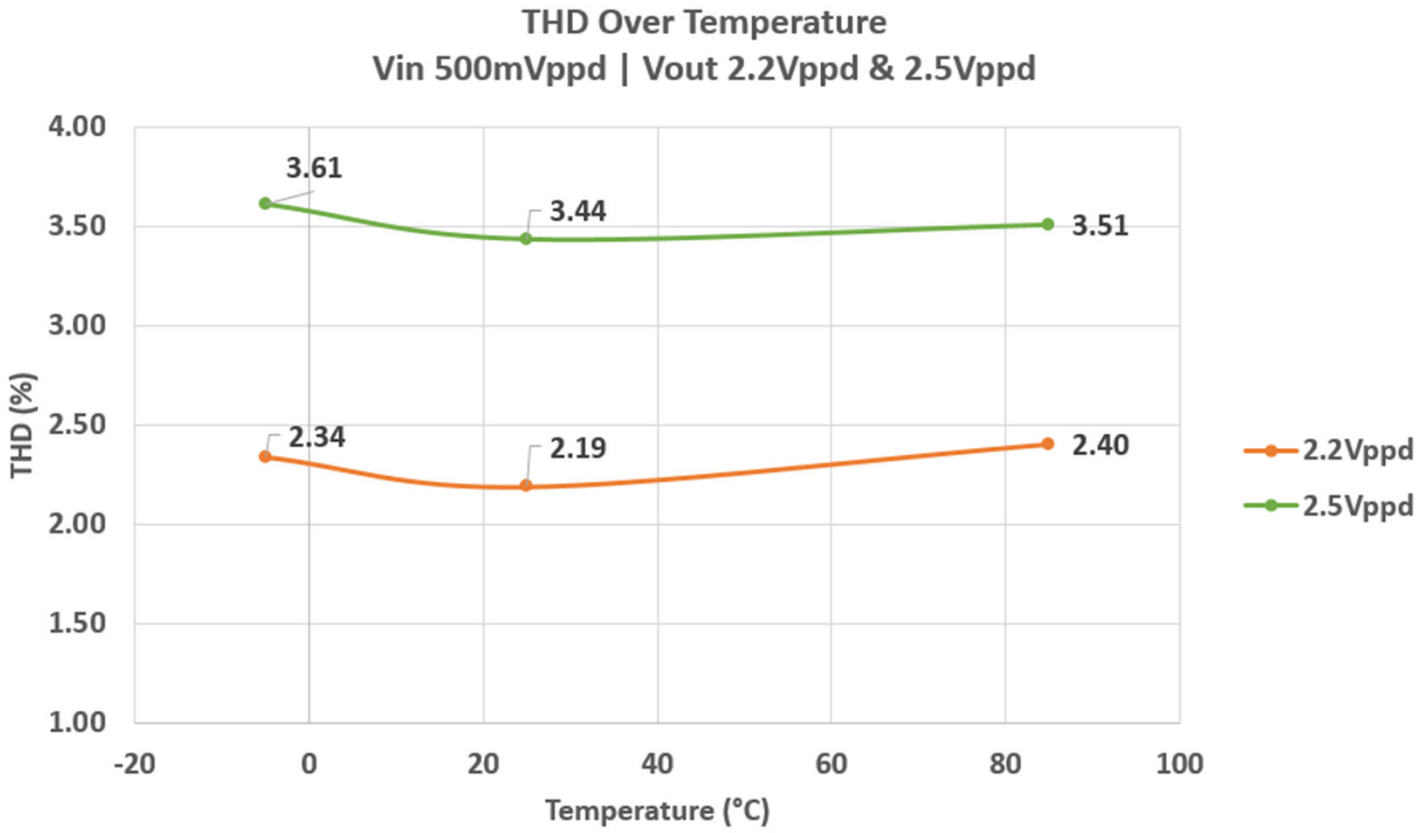
Linearity Measurement of MZ Driver



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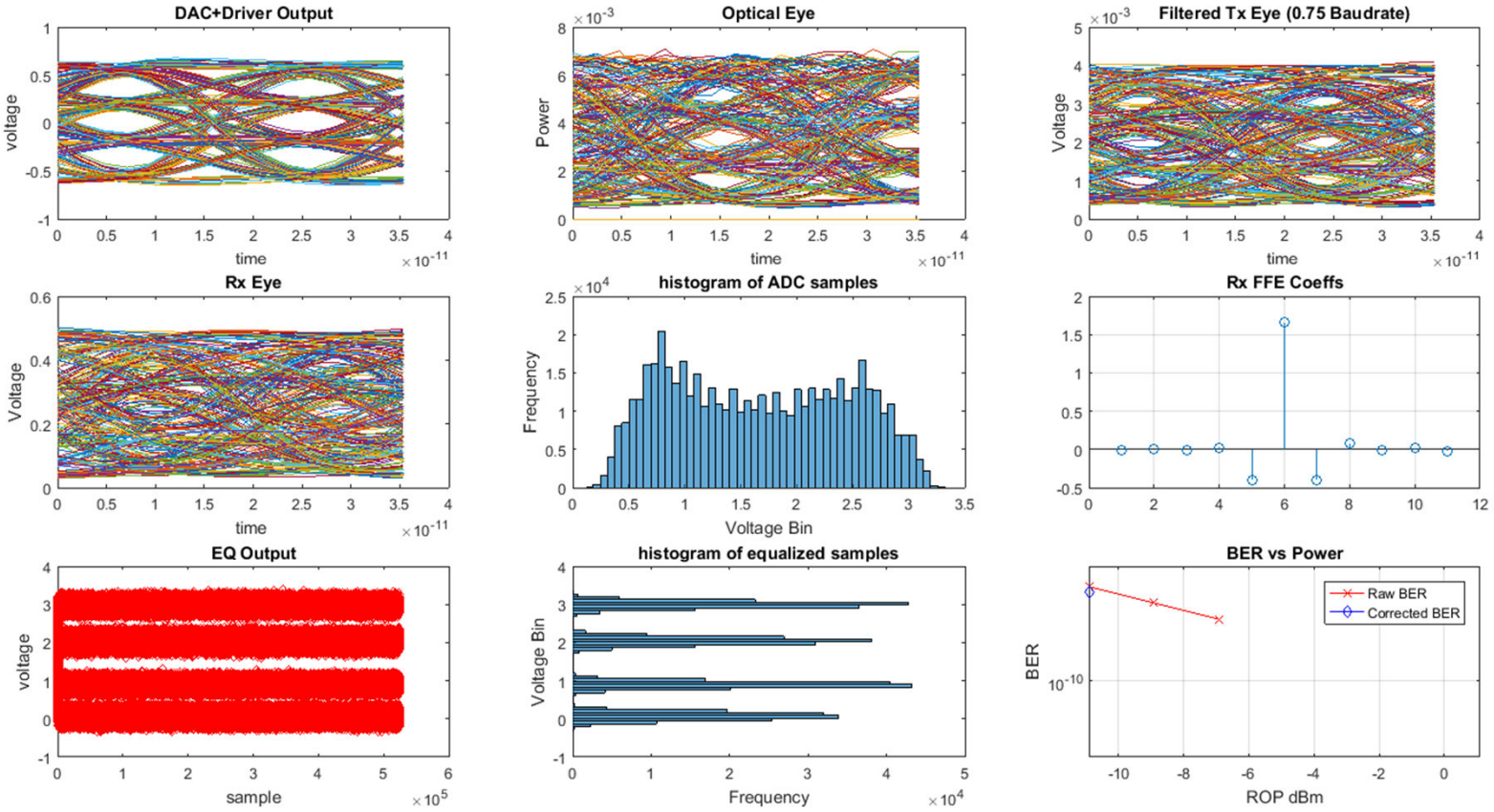
Simulated DR Link

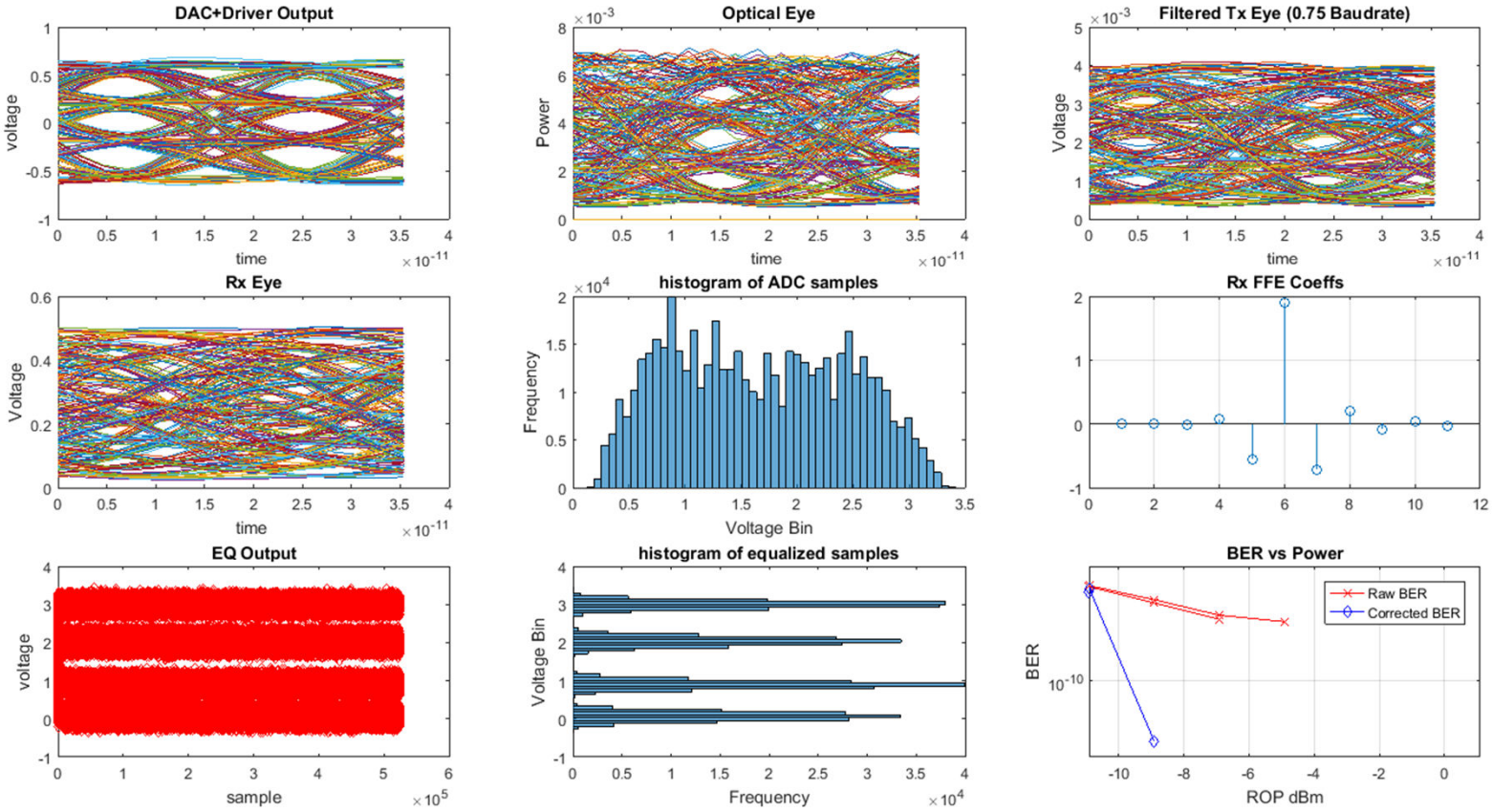
- 53GBd PAM4 (Gray coded) over 500m SMF
- -26dB ORL for Tx, Rx, -45dB ORL for connectors
- 30GHz ADC and DAC bandwidths modelled
- Simulated EML response with level offsetting
- ~7-8dB Tx ER
- 3dB Tx CTLE
- -142dB/Hz RIN
- Simulated Rx response + 3% THD
- 0.6A/W coupled responsivity
- 20pA/rtHz Rx noise
- -40dB electrical crosstalk
- Simple interconnect included
- 11 tap FFE equaliser

Simulated DR Link Performance



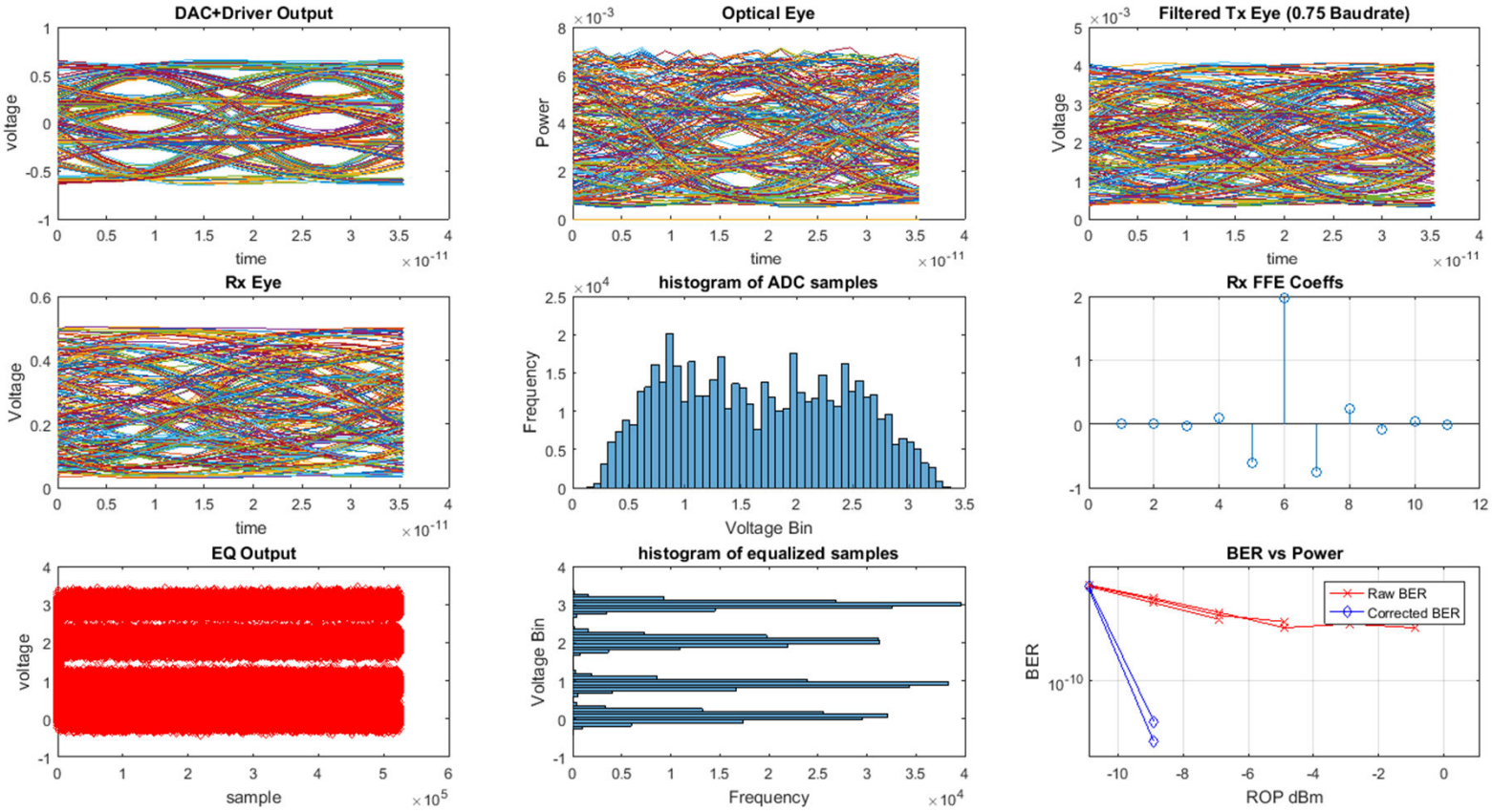
35GHz Ideal Driver, 30GHz Ideal Rx

Simulated DR Link Performance



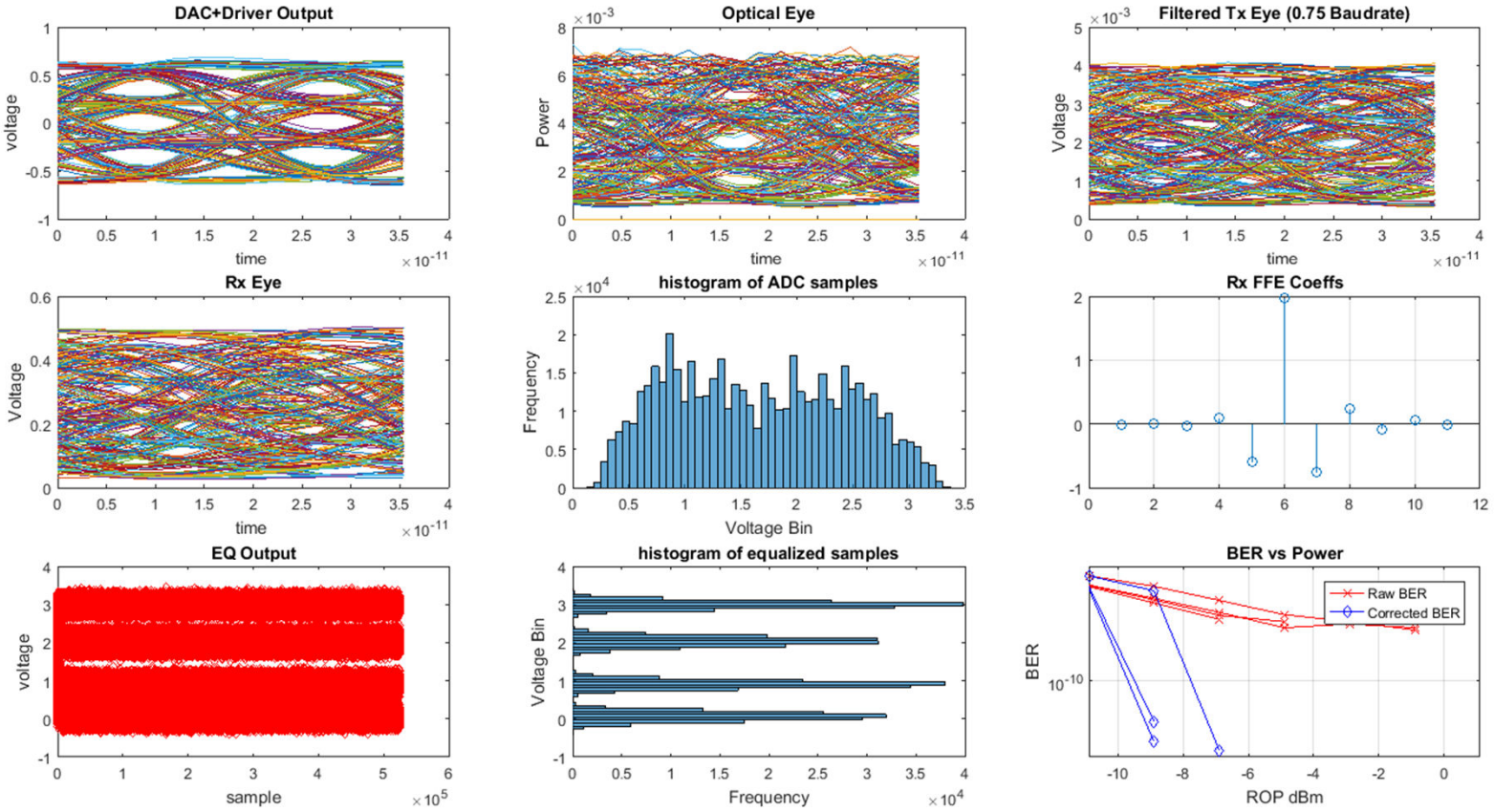
35GHz Ideal Driver, 26GHz simulated wc Rx (slow)

Simulated DR Link Performance



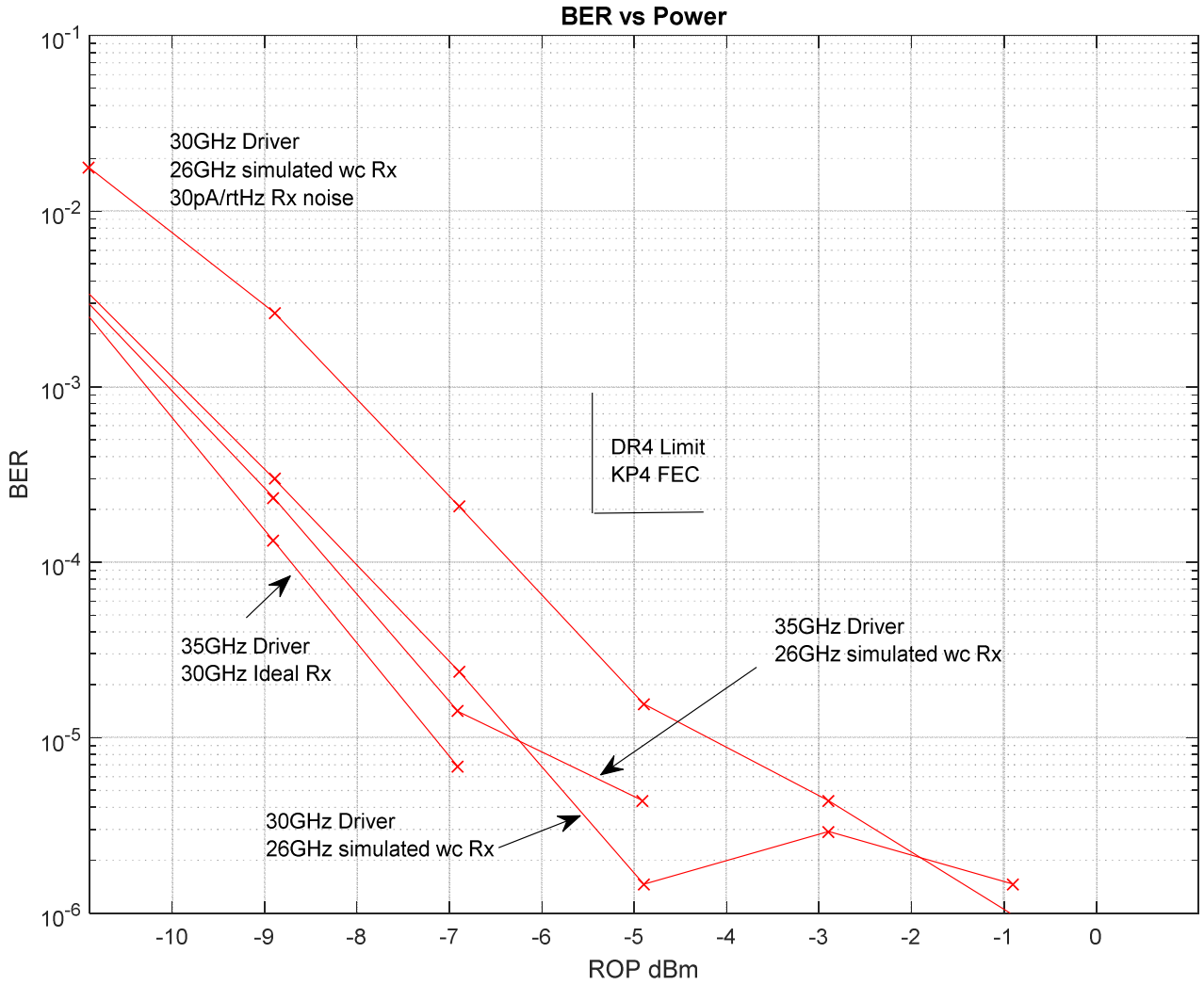
30GHz Ideal Driver, 26GHz simulated wc Rx (slow)

Simulated DR Link Performance



30GHz Ideal Driver, 26GHz simulated wc Rx (slow), 30pA/rtHz

Simulated DR Link Performance



Expected availability

- Several vendors indicate product availability within the next 6 months
  - Some companies have prototypes available

Summary

- PMD performance to support the link budgets for 100G/λ are in development
  - Some prototypes are already available
- PMD component availability to support the link budgets for 100G/λ is expected within 6 months
- Multiple vendors supporting this