

Towards Package Baseline Proposal for 802.3ck

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Executive Summary

- An Optimized initial PKG model was supplied during the September interim
- The supplied package model is claimed to use best practice and manufacturing techniques
- A mathematical model was matched vs. the extracted model (thanks Rich!)
- The PKG parameters were updated according to inputs received during the interim
- COM Simulation results will be shared
- **Possible directions going forward will be presented and followed by straw polls to come up with initial base-line**

Best Practice Package Limitations

A **best case package model** was provided and shared during the September interim

Characteristics:

- Best next generation (not in production yet) manufacturing package metal surface roughness treatment
- Best next generation dielectric loss material characteristics
- Optimized PTH via and ball area construction
- Some parameters were assumed to have very limited manufacturing tolerance and some had no tolerance taken into account at all
- Wide traces topology was used to lower loss as much as possible



- Gamma & Tau parameters provided by Rich represent a best case loss

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PKG Suggested Parameters

- Following September interim nominal PKG impedance was voted to be 92.5Ω
- Ball and PTH discontinuities were optimized and rated @ 75-90fF
➔ **recommend using 80fF @ the COM excel**
- COM mathematical model was matched to the extracted package
– The mathematical representation gives slightly better results compared to actual concatenated PKG extraction

Table 93A-3 parameters		
Parameter	Setting	Units
package_tl_gamma0_a1_a2	[0 0.0007901838 0.00050925]	
package_tl_tau	6.325E-03	ns/mm

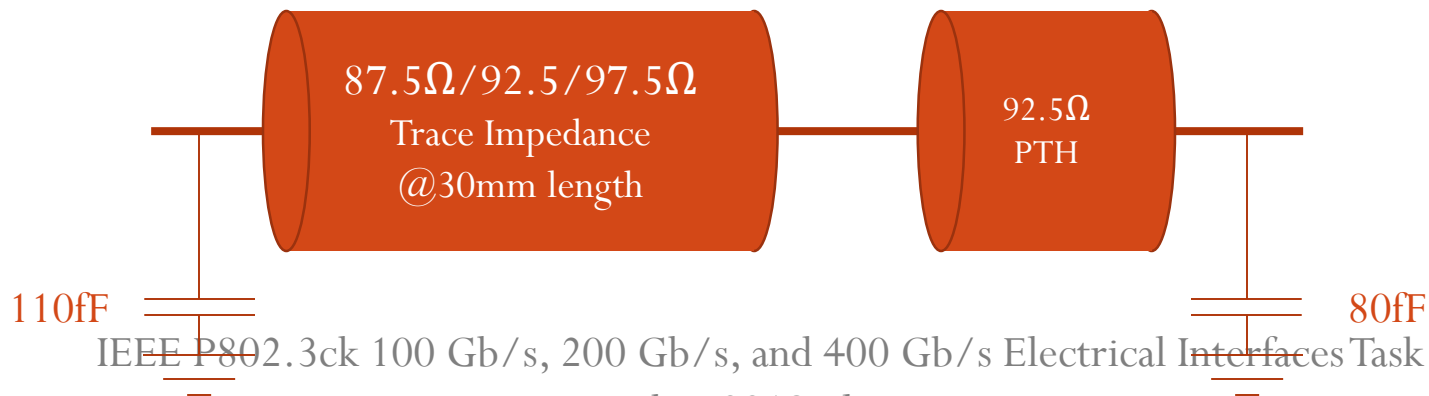
- Former projects have used 14Taps of DFE @ half rate ➔ doubling the rate direct us towards extending compensation depth above 16Taps ➔ Used 20-24 taps depth (Done in the COM runs for this presentation, but not a part of this baseline)

Which Cases Should We Examine in COM (for Long Reach cases)?

- 30mm 87.5Ω PKG trace + 92.5Ω PTH [Trace includes - 5ohm manufacturing tolerance] – **Recommend including**
- 30mm 97.5Ω PKG trace + 92.5Ω PTH [Trace includes +5ohm manufacturing tolerance] – **Recommend including**
- Backplane cases that were run with 12mm 87.5Ω PKG trace + 92.5Ω PTH resulted in $\sim 2\text{dB}$ higher COM compared to 30mm PKG. Shorter c2c and c2m higher reflections interconnects may show higher importance to this PKG length

How Many Trace Segments Do We Need?

- It was shown that one segment that will represent the trace and a short one at the ball location (to represent the PTH) comes “close enough” to represent the PKG trace, therefore....
- **Recommend using only up to two of the flexible PKG model segments**
- **Former projects used only one (in our case 92.5ohm) segment with 30mm trace length which ignores the loss and delay of the PTH**



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COM Simulation Results Summary

Trace	PTH	Compensation Depth	Zambel Orthogonal BP (28.5dB @ 26.6GHz)	Tracy Orthogonal BP (~22dB @26.6GHz)	MellitzBP including vias Case2 (~22dB @26.6GHz)
87.5Ω	92.5Ω	24	2.829dB		
92.5Ω	92.5Ω	24	2.853dB		
92.5Ω	-----	24	2.95dB		
97.5Ω	92.5Ω	24	2.853dB		
97.5Ω	92.5Ω	20		3.466dB	3.07dB
87.5Ω	92.5Ω	20		3.622dB	3.21dB
92.5Ω	92.5Ω	20		3.504dB	3.135dB
92.5Ω	-----	20		4dB	3.557dB

Summary

- Best Case PKG was formerly presented and matched
- Two sections of the “flexible package model” are enough to fit the extracted PKG model
- Recommend to use **trace parameters (gamma & Tau)** according to Mellitz_ck_01_1118 and as described on slide #4
- Based on “Zambel’s BP” (it is 28.5dB loss and has almost 2dBs of ILD) COM results it is assumed that high quality BP can meet COM if compensation depth is increased – Method and depth of COM compensation should be discussed perpendicular to this presentation

Summary – Cont.

- Recommend having $C_{die}=110\text{fF}$ (as agreed before) and $C_{ball}=80\text{fF}$ (as indicated by optimized PKG extraction model matching)
- Recommend to have the 30mm trace length with two cases of “manufacturing tolerance” trace impedance (actual tolerance values are higher)

Thank you

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Backup & COM Runs

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Orthogonal BP (Tracy)

- 20 taps of Rx compensation

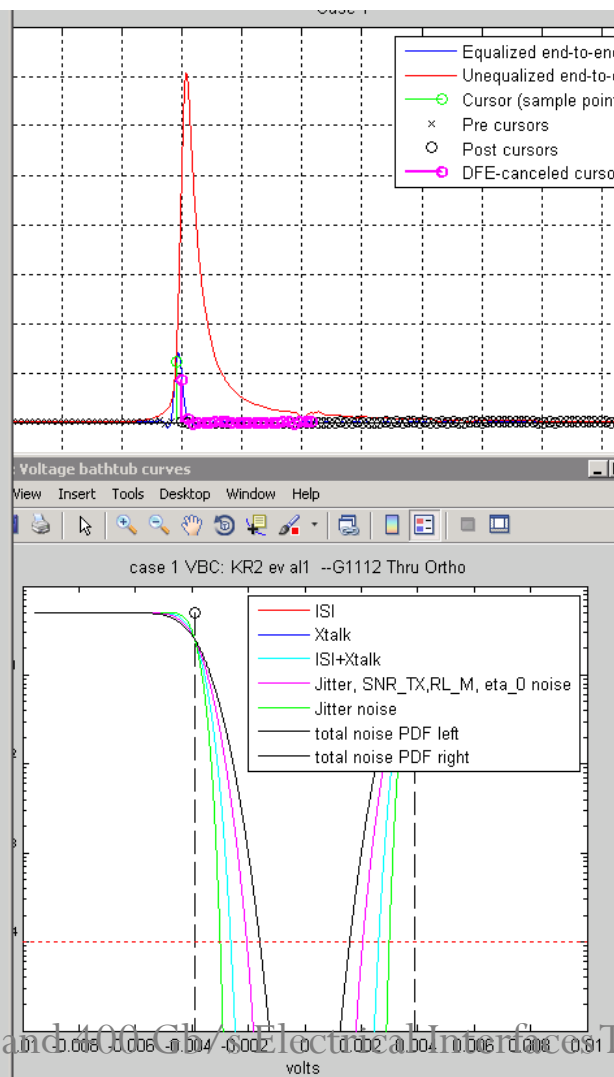
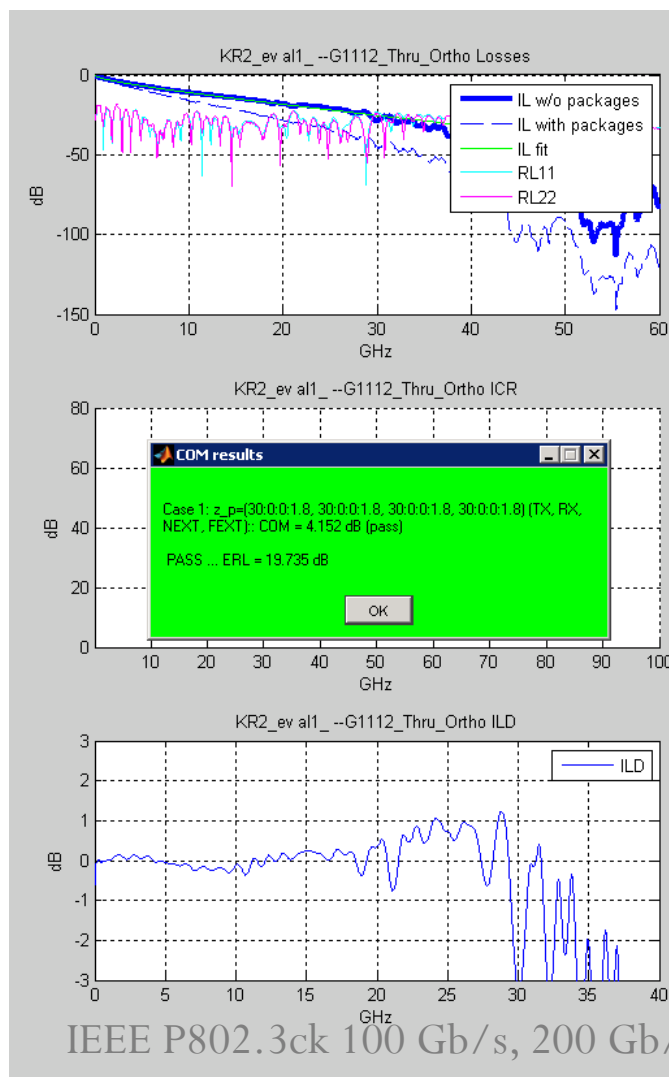
- $\sim 22\text{dB}$ Loss @ 26.6GHz

- $87.5\Omega + 92.5\Omega \rightarrow 4.15\text{dB COM}$ excluding XTalk

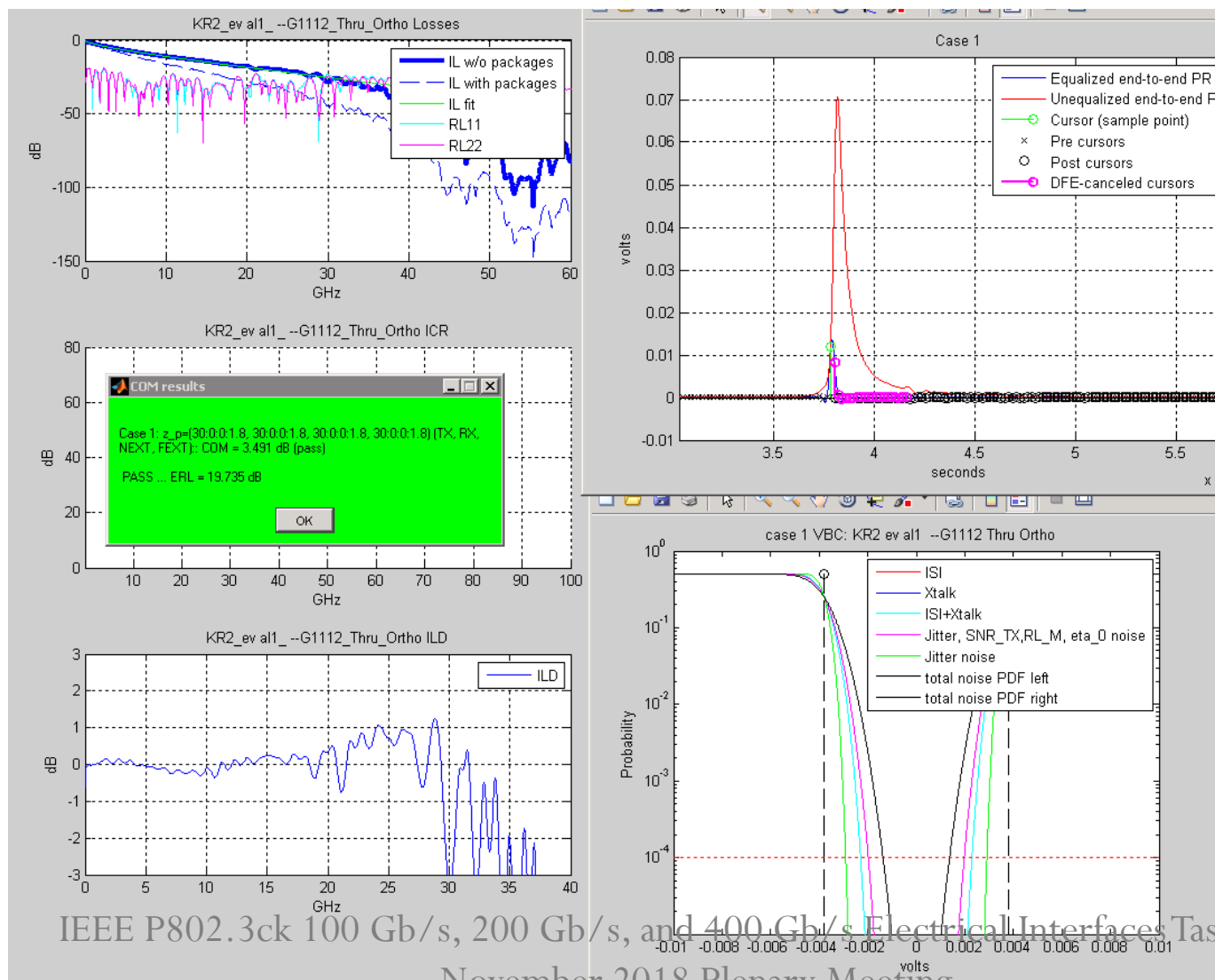
- $87.5\Omega + 92.5\Omega \rightarrow 3.622\text{dB COM}$ including XTalk

- $97.5\Omega + 92.5\Omega \rightarrow 3.491\text{dB COM}$ Excluding XTalk

Orthogonal BP results (Tracy)



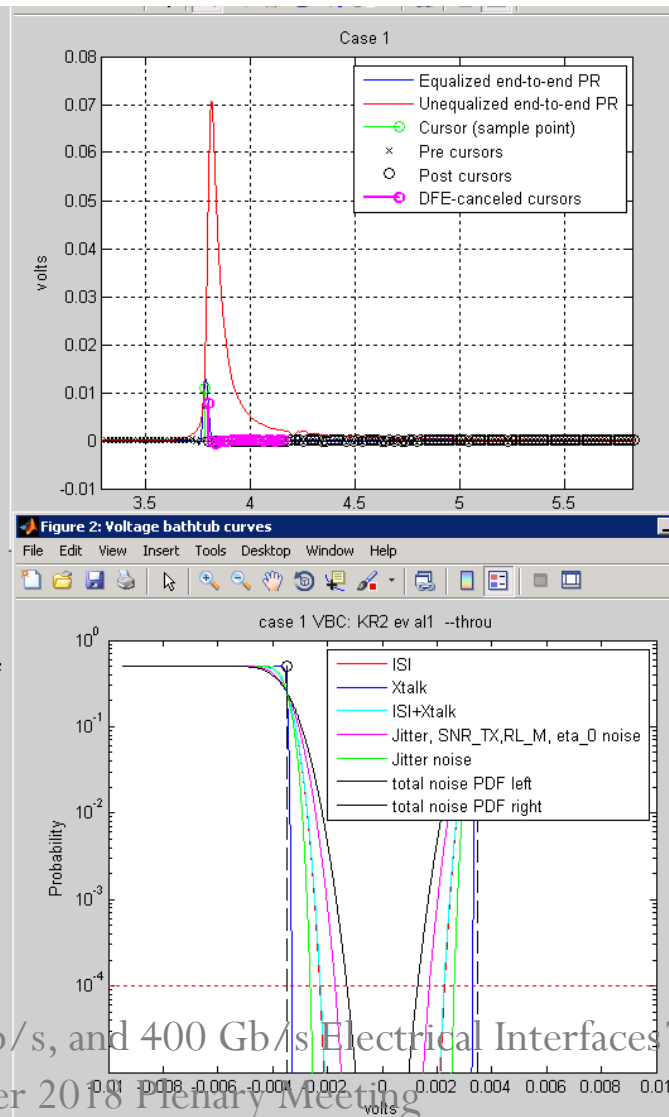
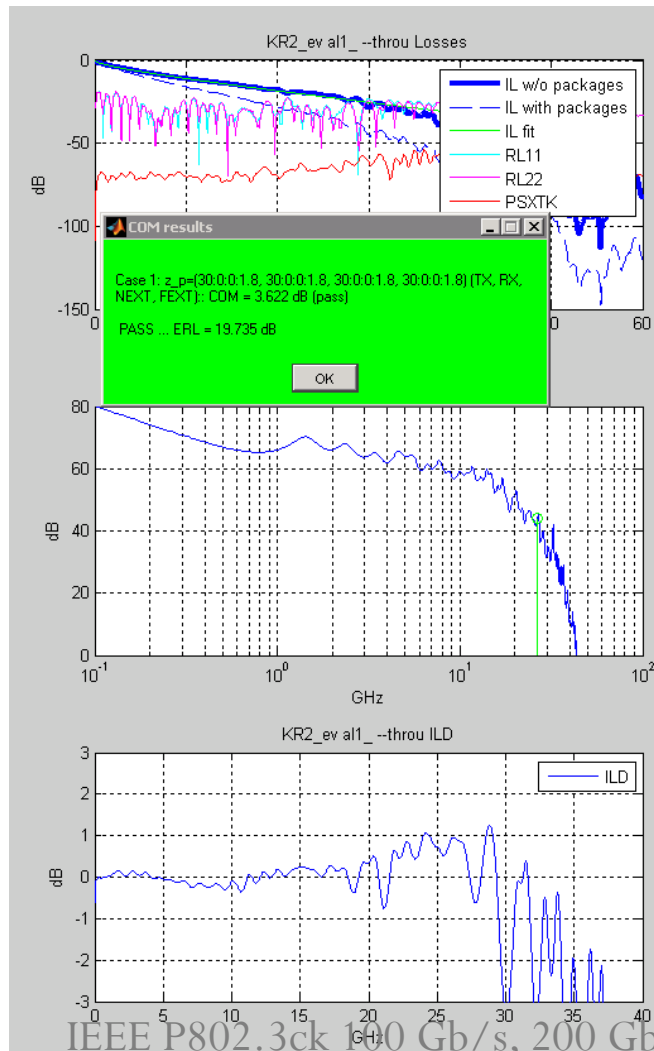
97.5&92.5 Orthogonal (Tracy)



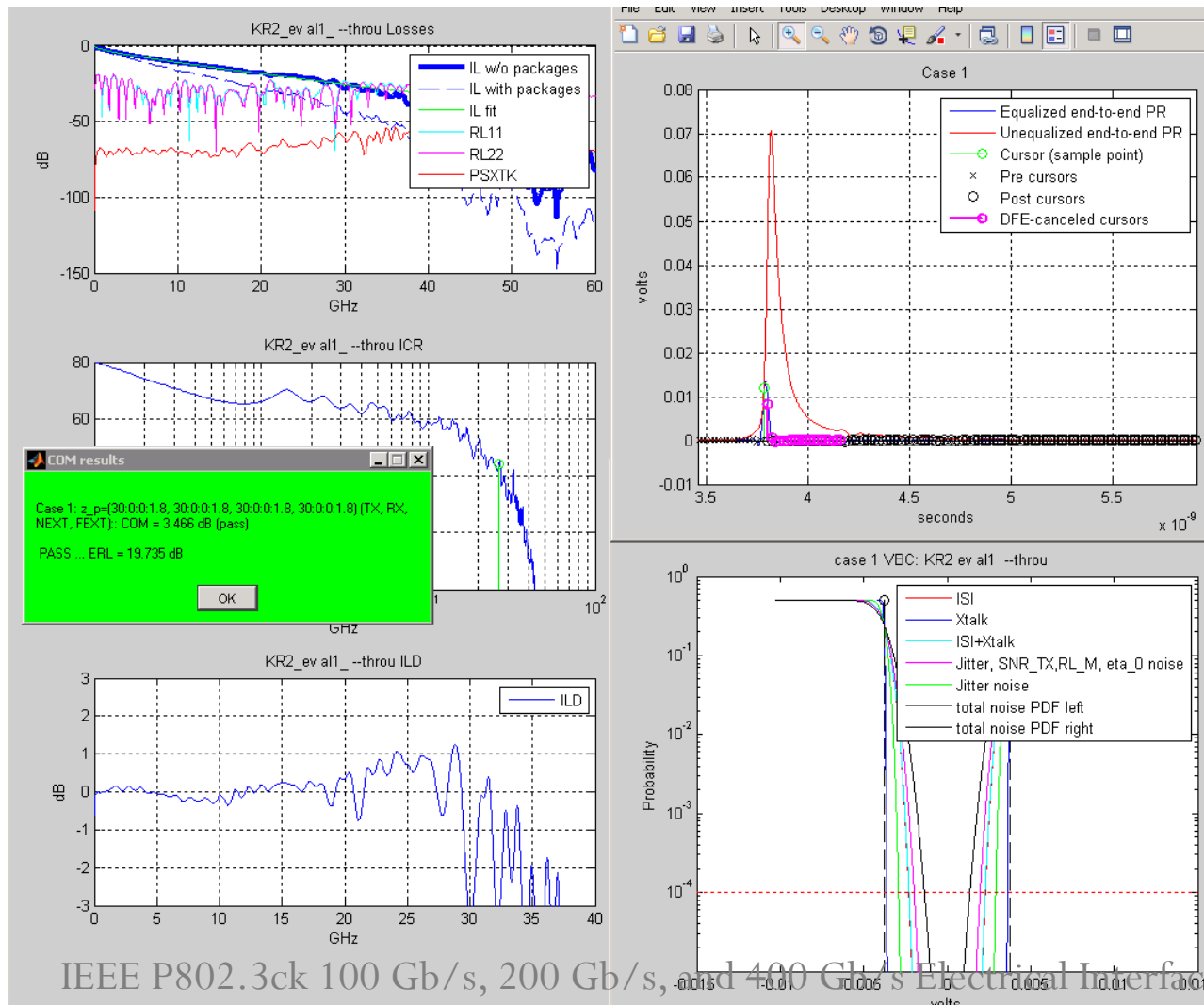
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87.5&92.5 Orthogonal (tracy) + XTalk



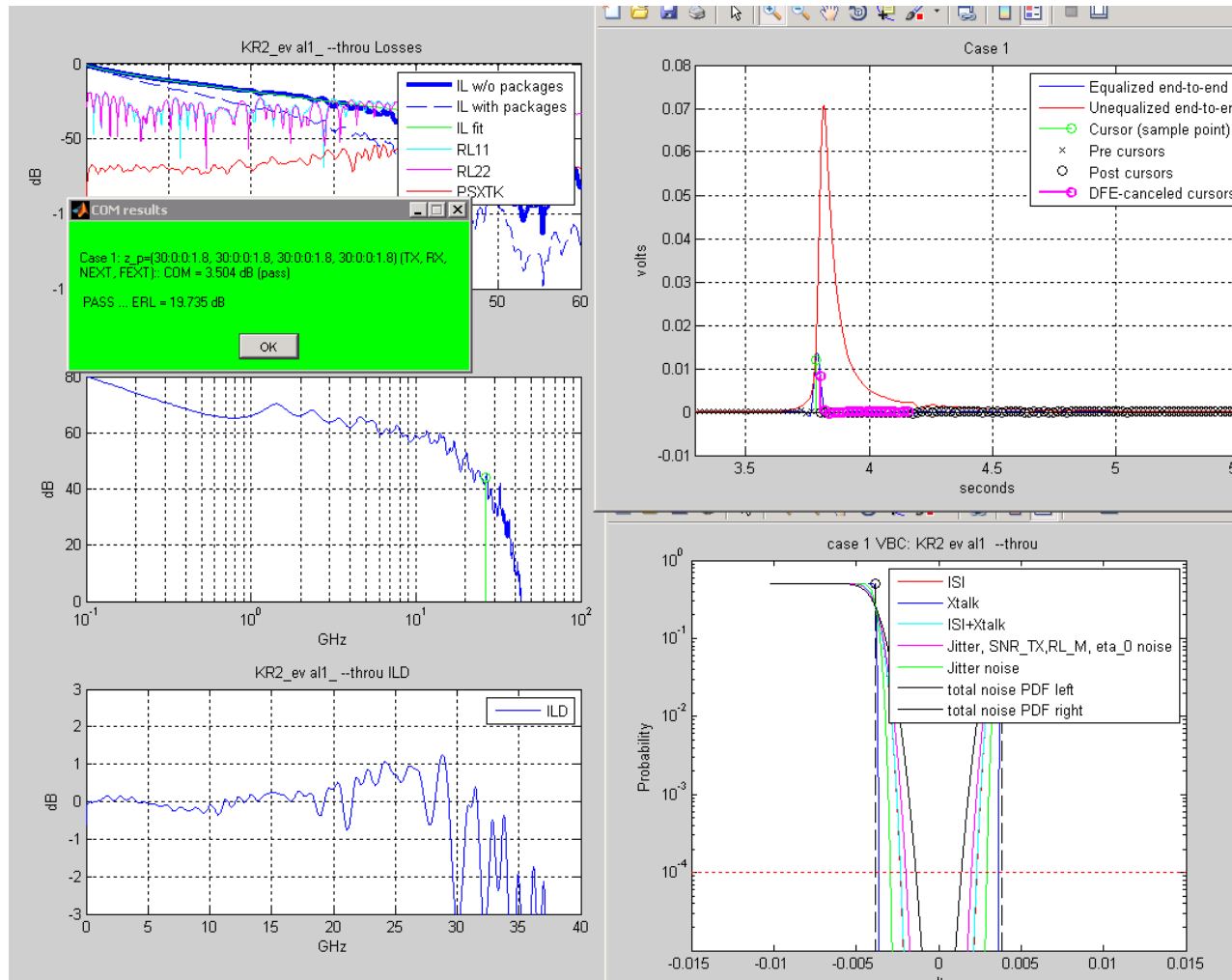
97.5Ω+92.5 Orthogonal (tracy) + XTalk



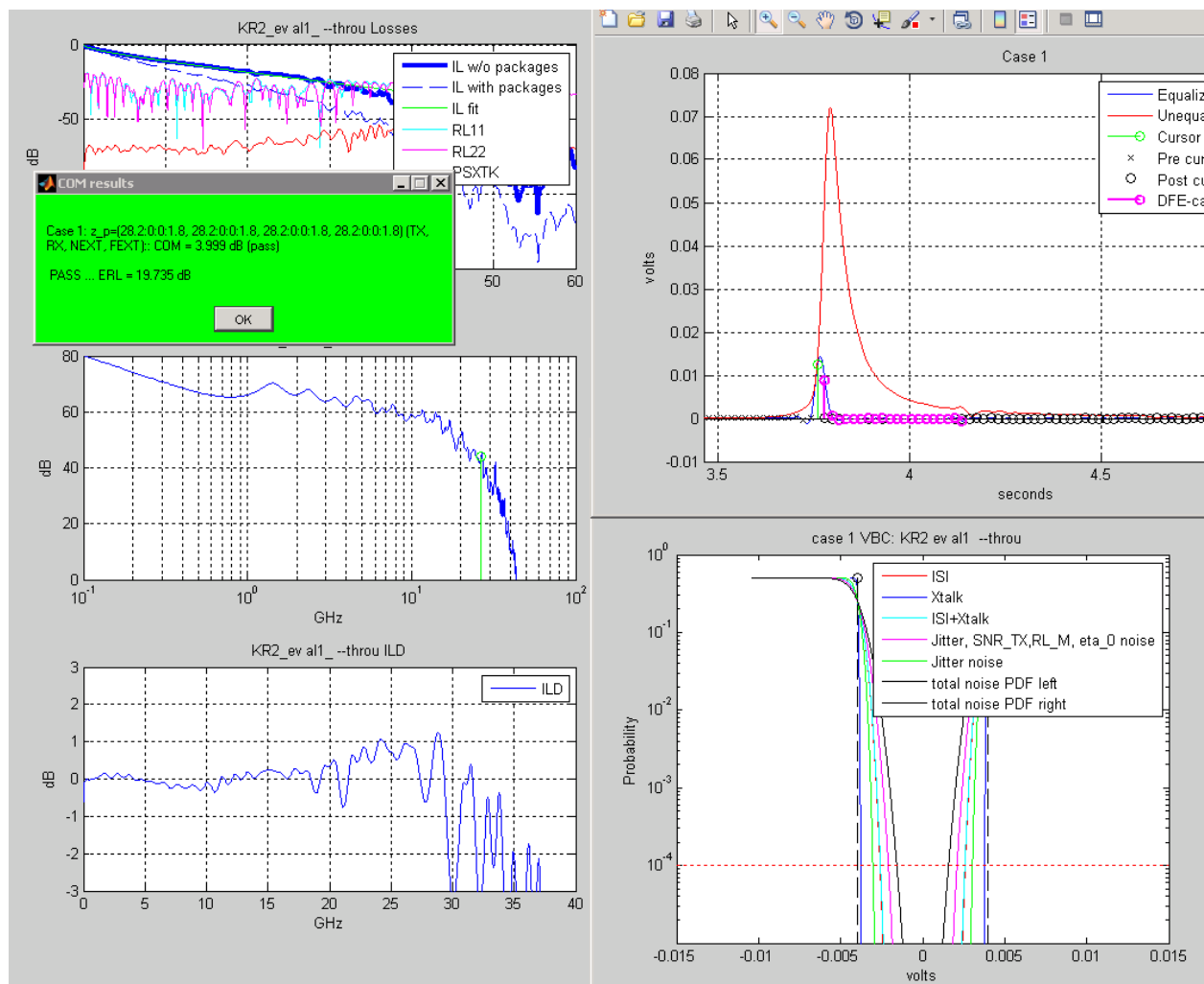
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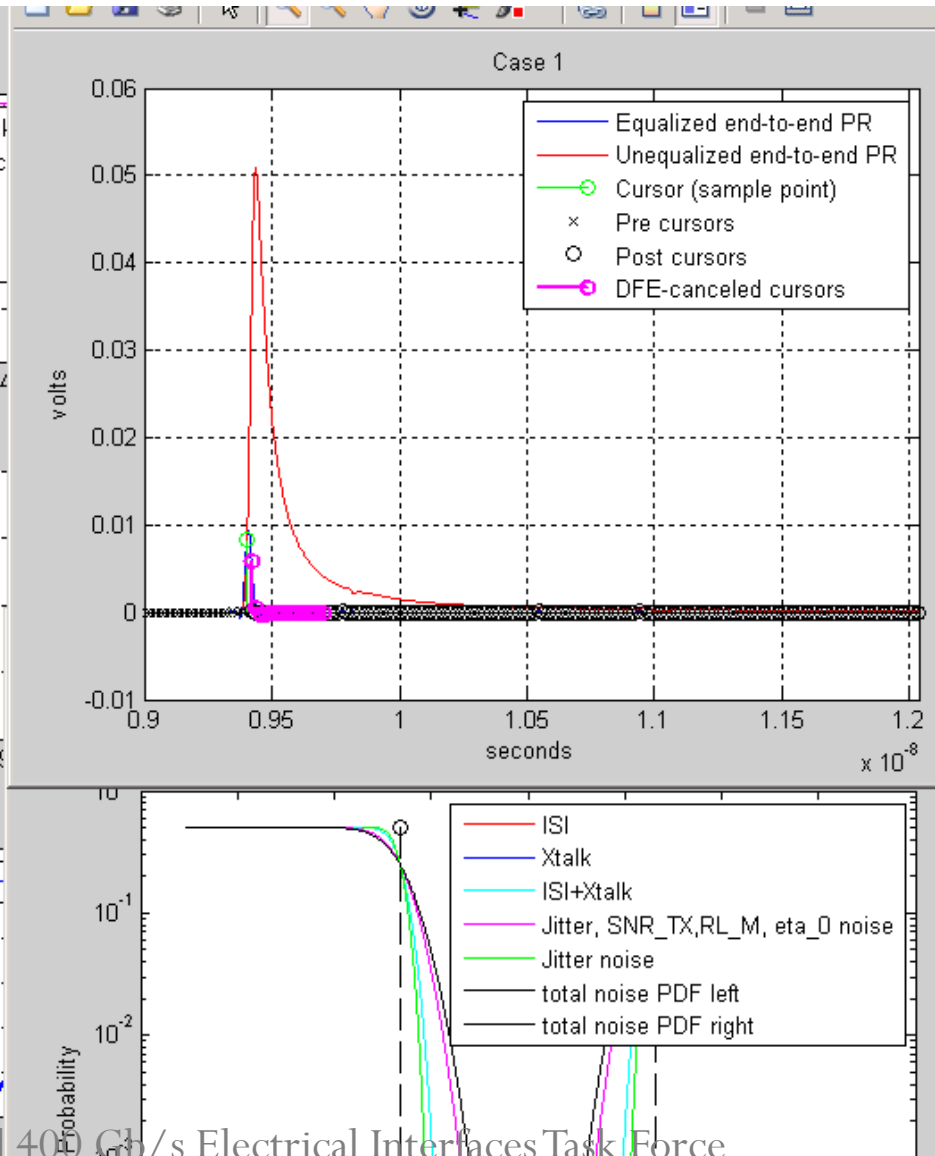
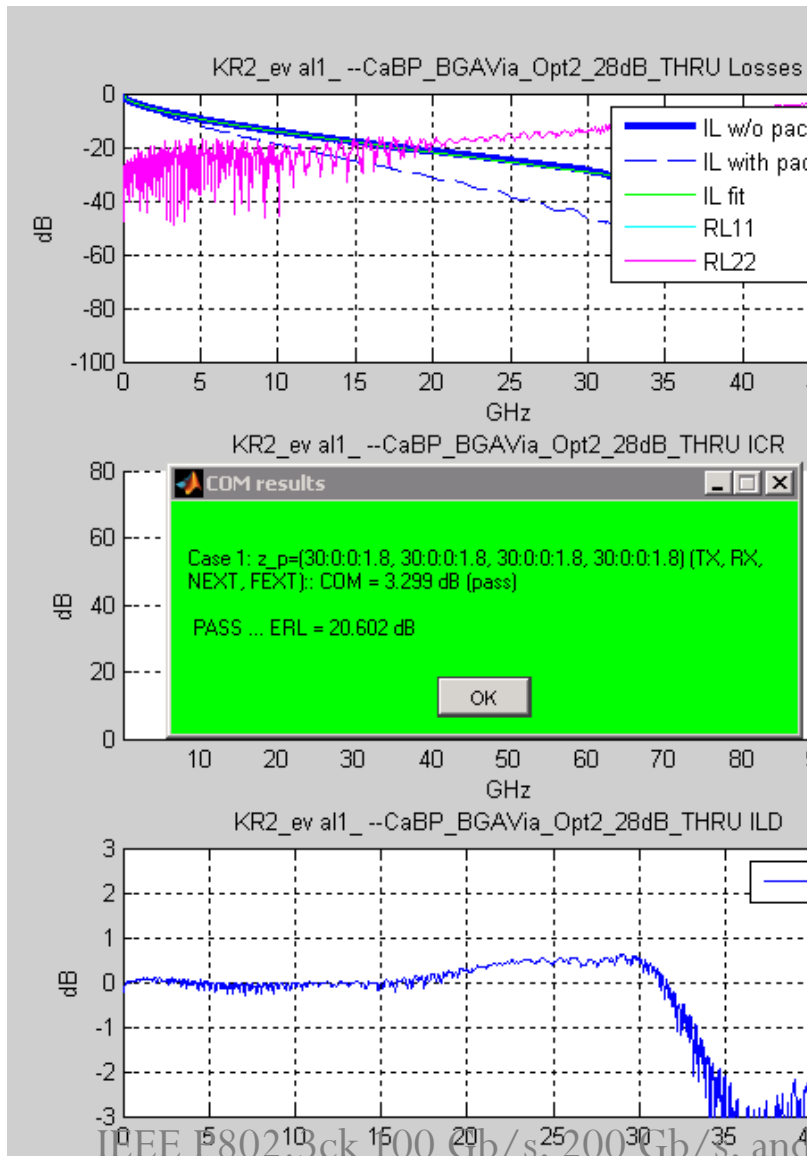
Trace and PTH 92.5Ω + Orthogonal (Tracy)



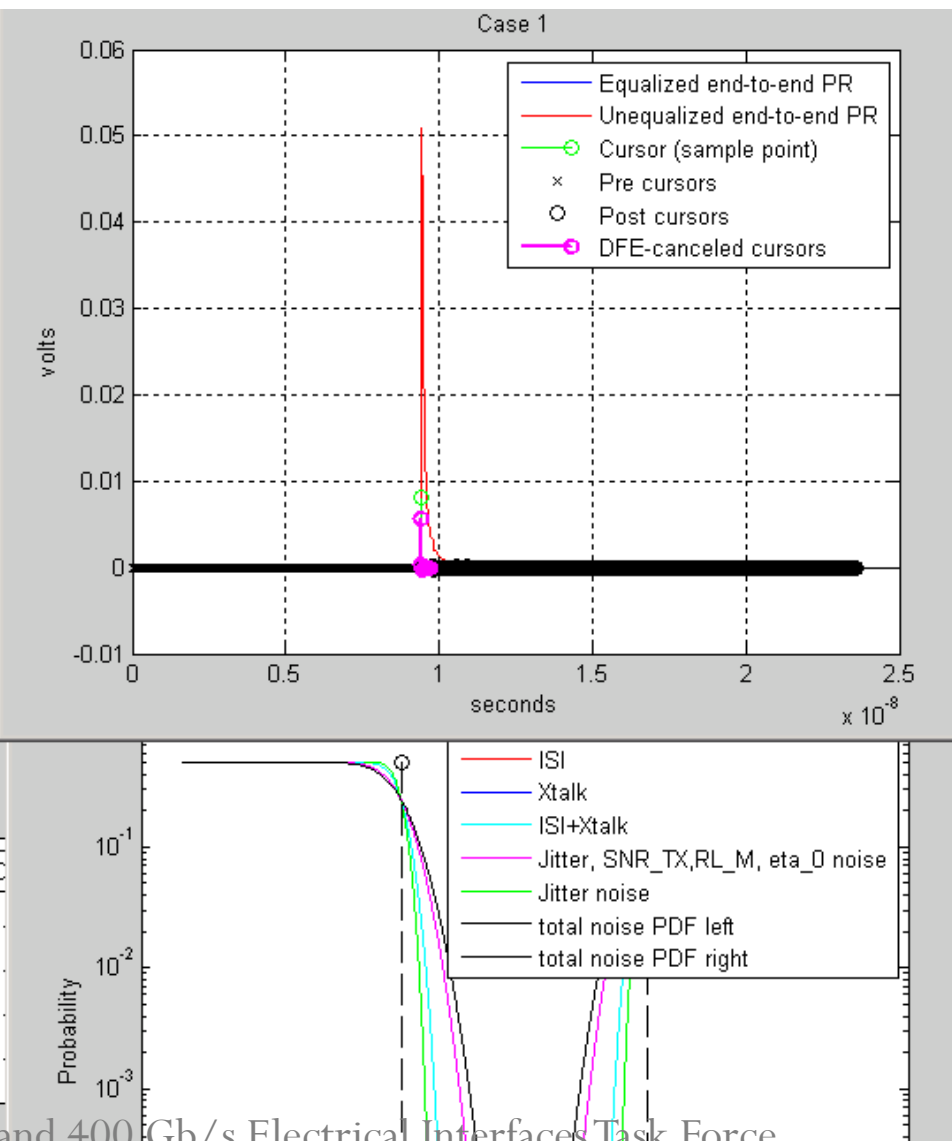
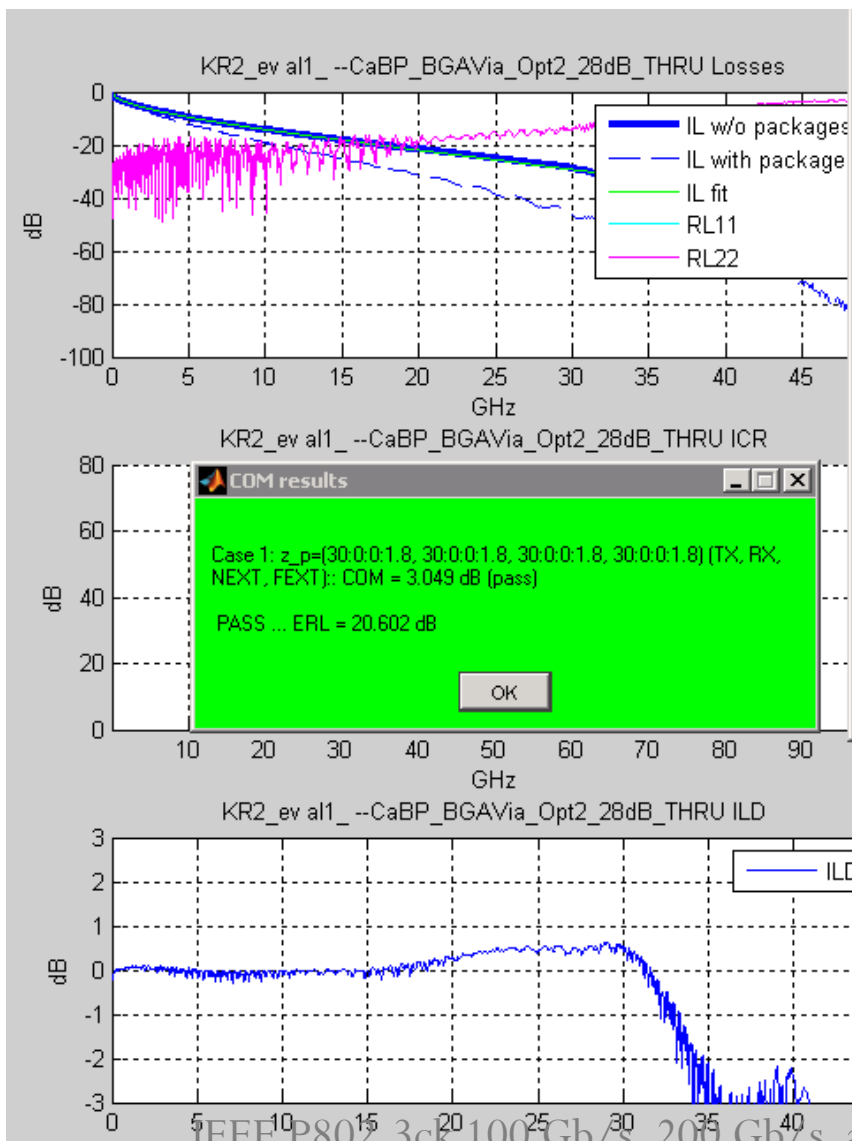
92.5Ω 30mm +Orthogonal (tracy)



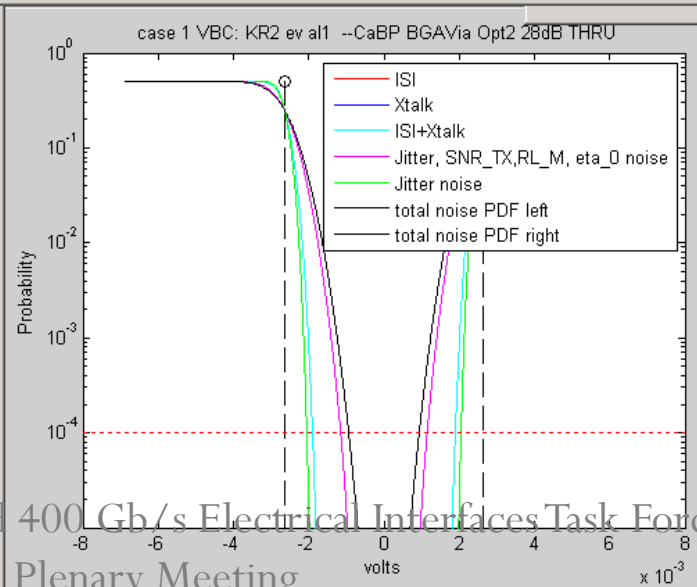
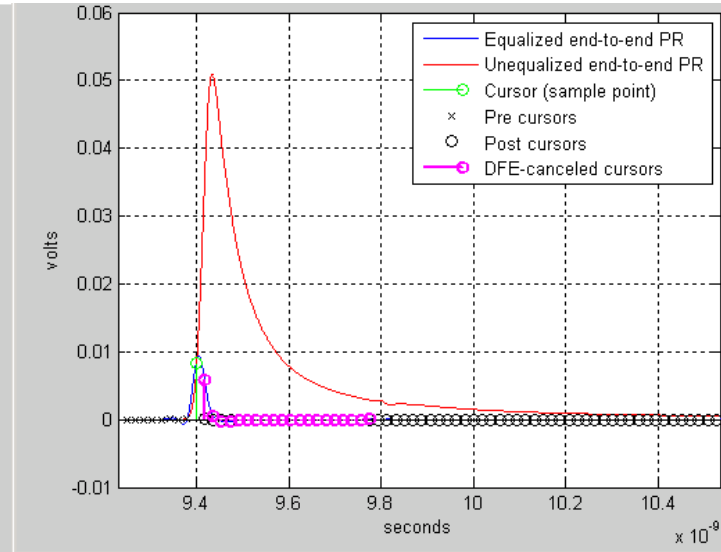
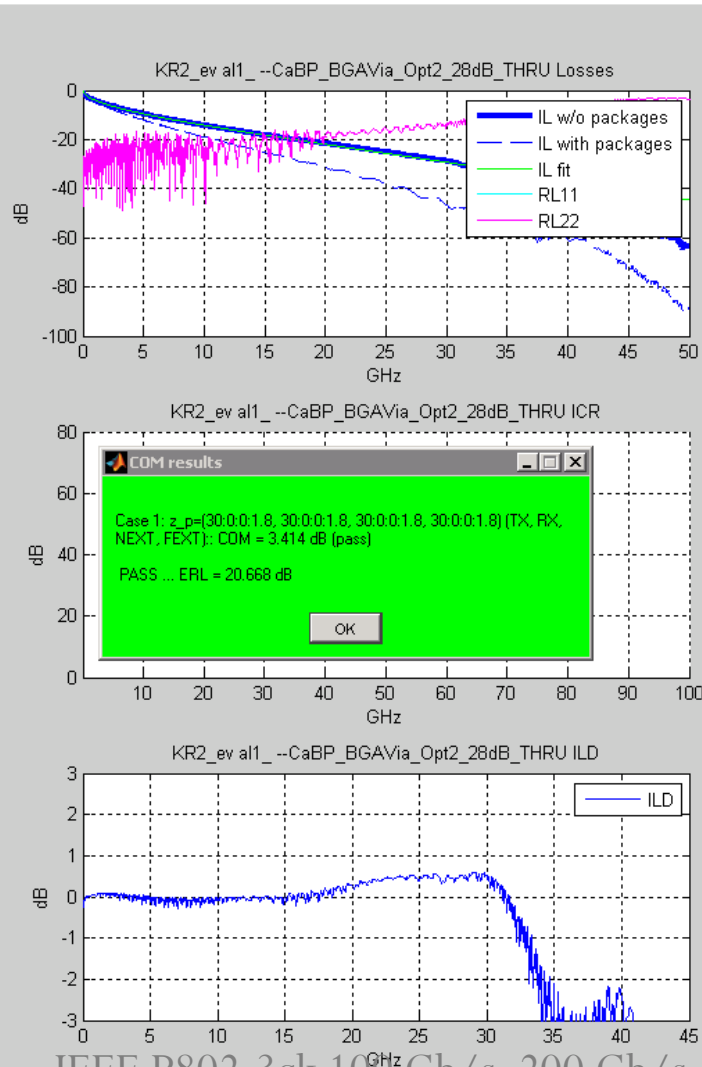
87.5 & 92.5



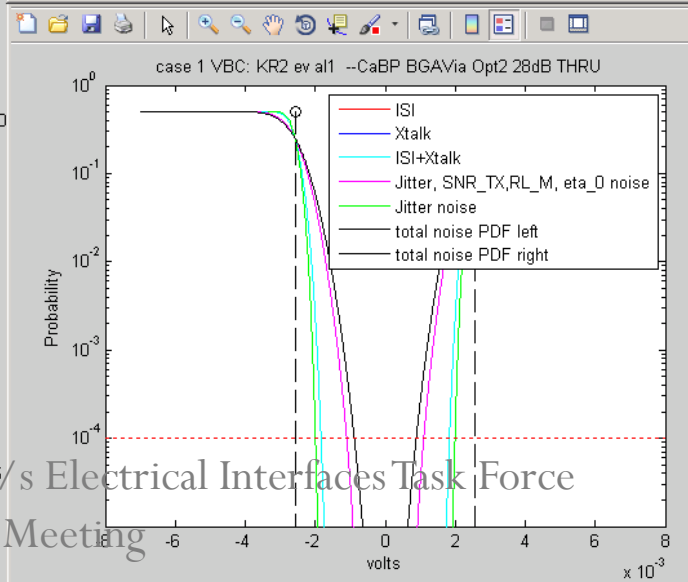
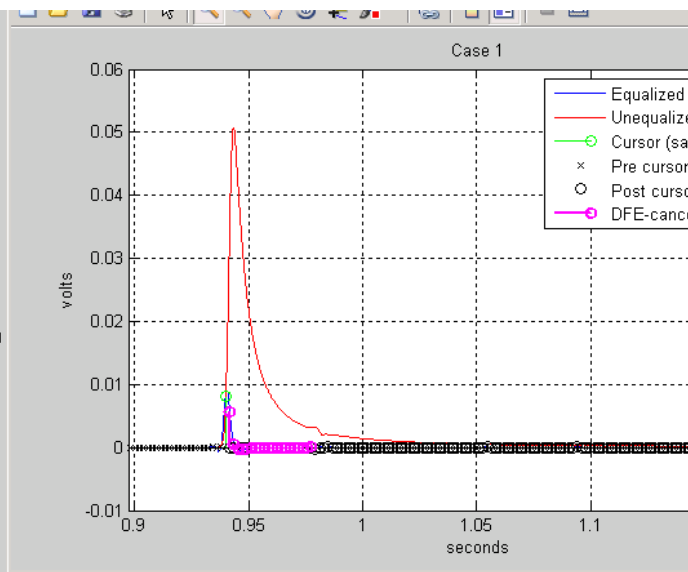
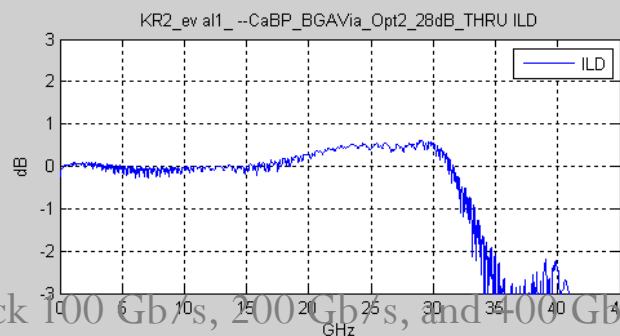
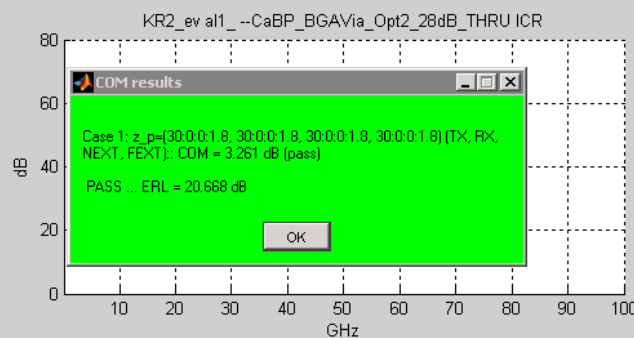
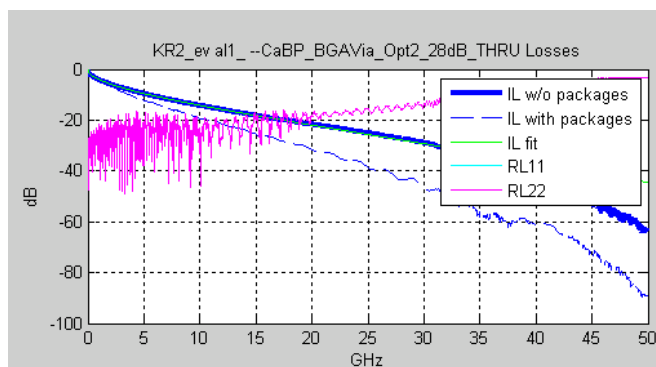
97.5 & 92.5 (3.07dB with 20taps)



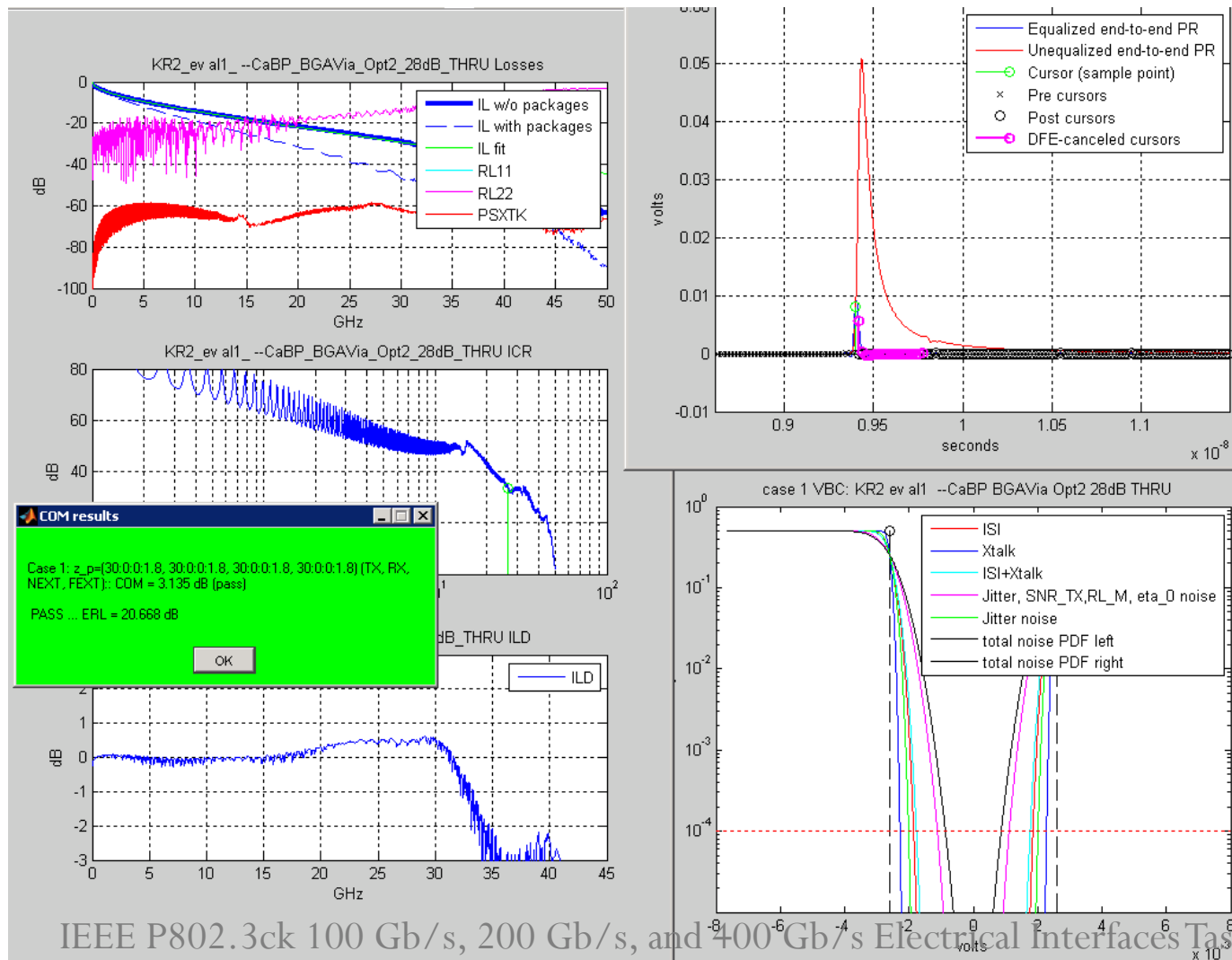
87.5; 92.5 20tap DFE



97.5; 92.5; 20Tap DFE



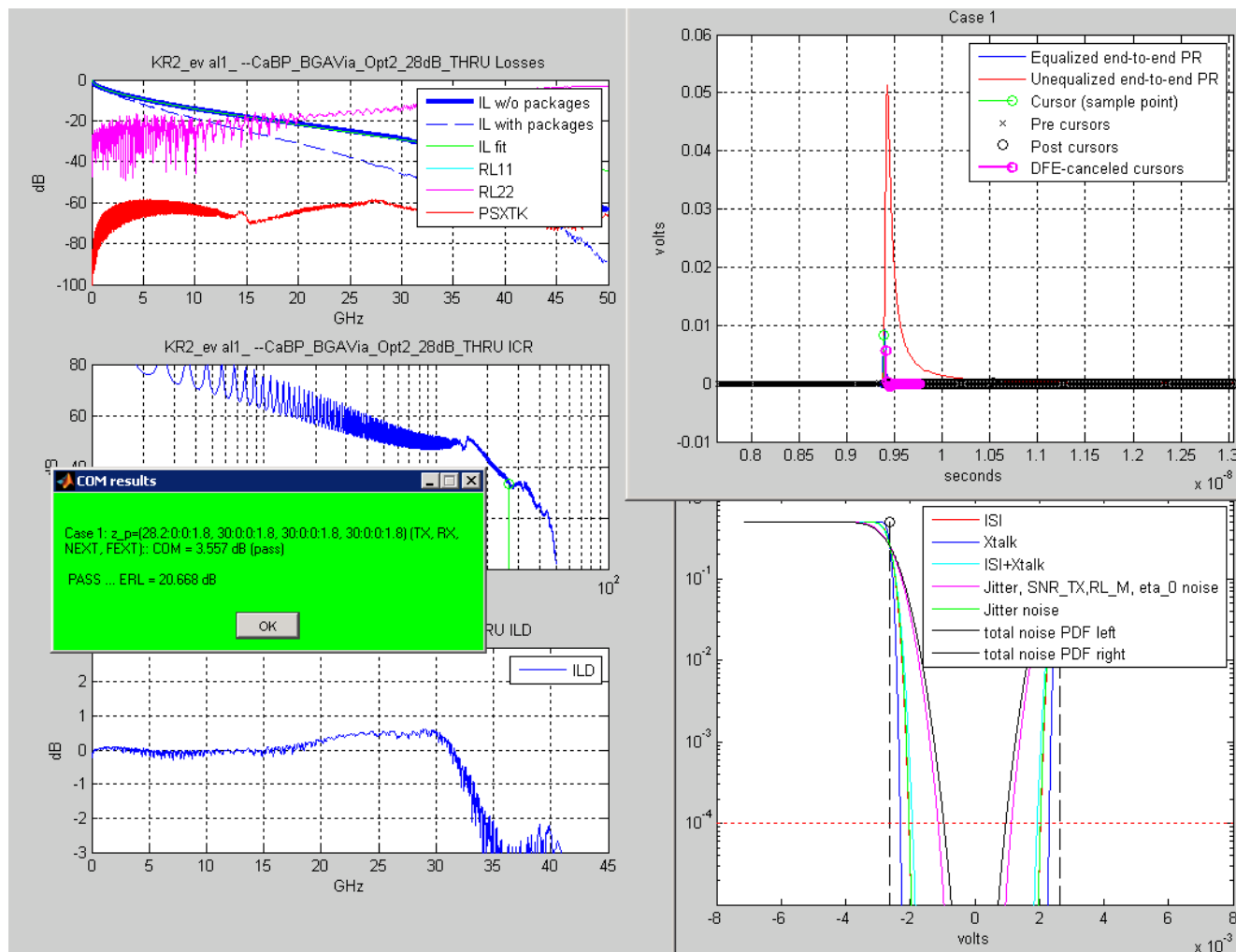
92.5; 92.5; 20Tap DFE



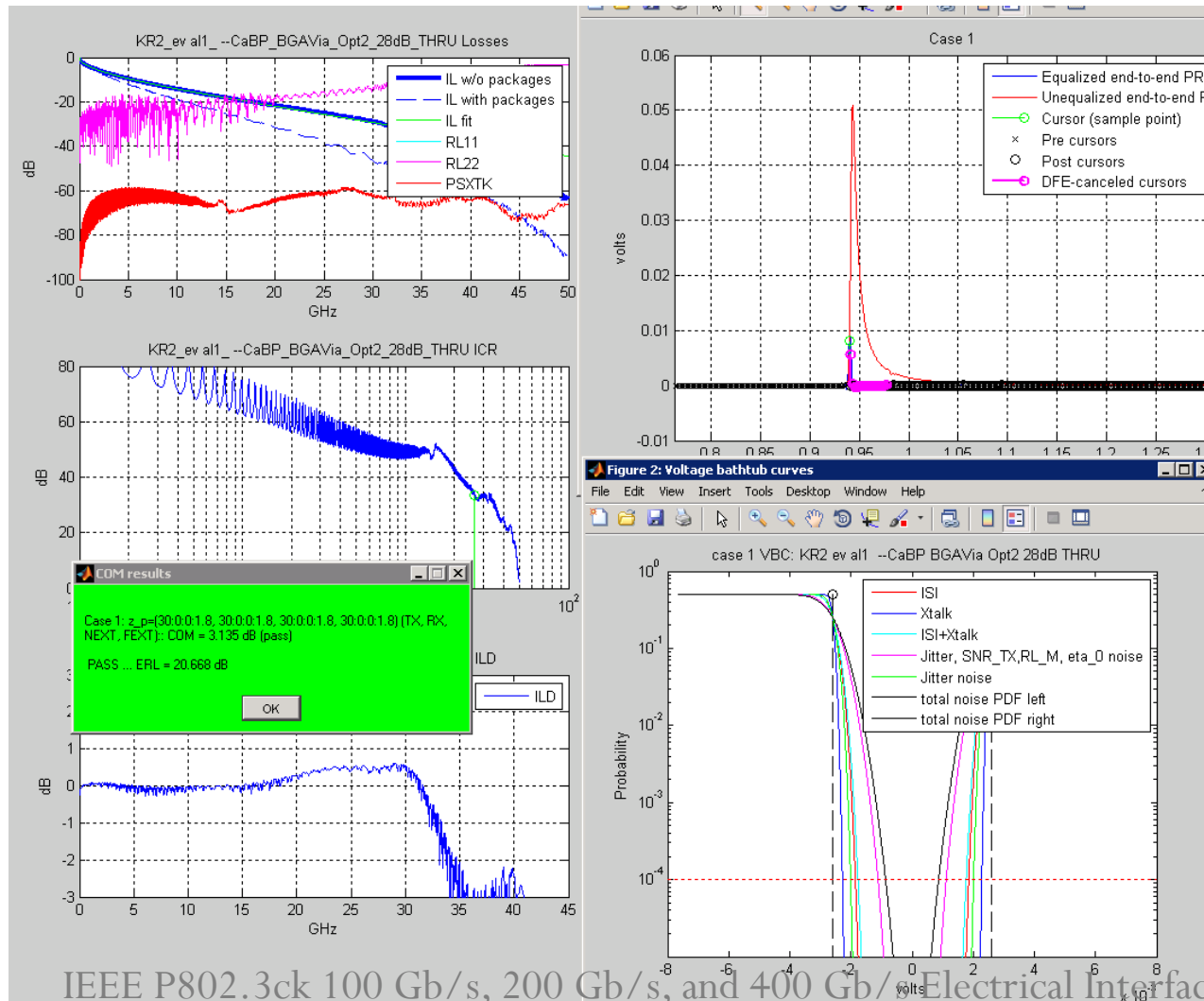
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92.5; No PTH; 20Tap DFE



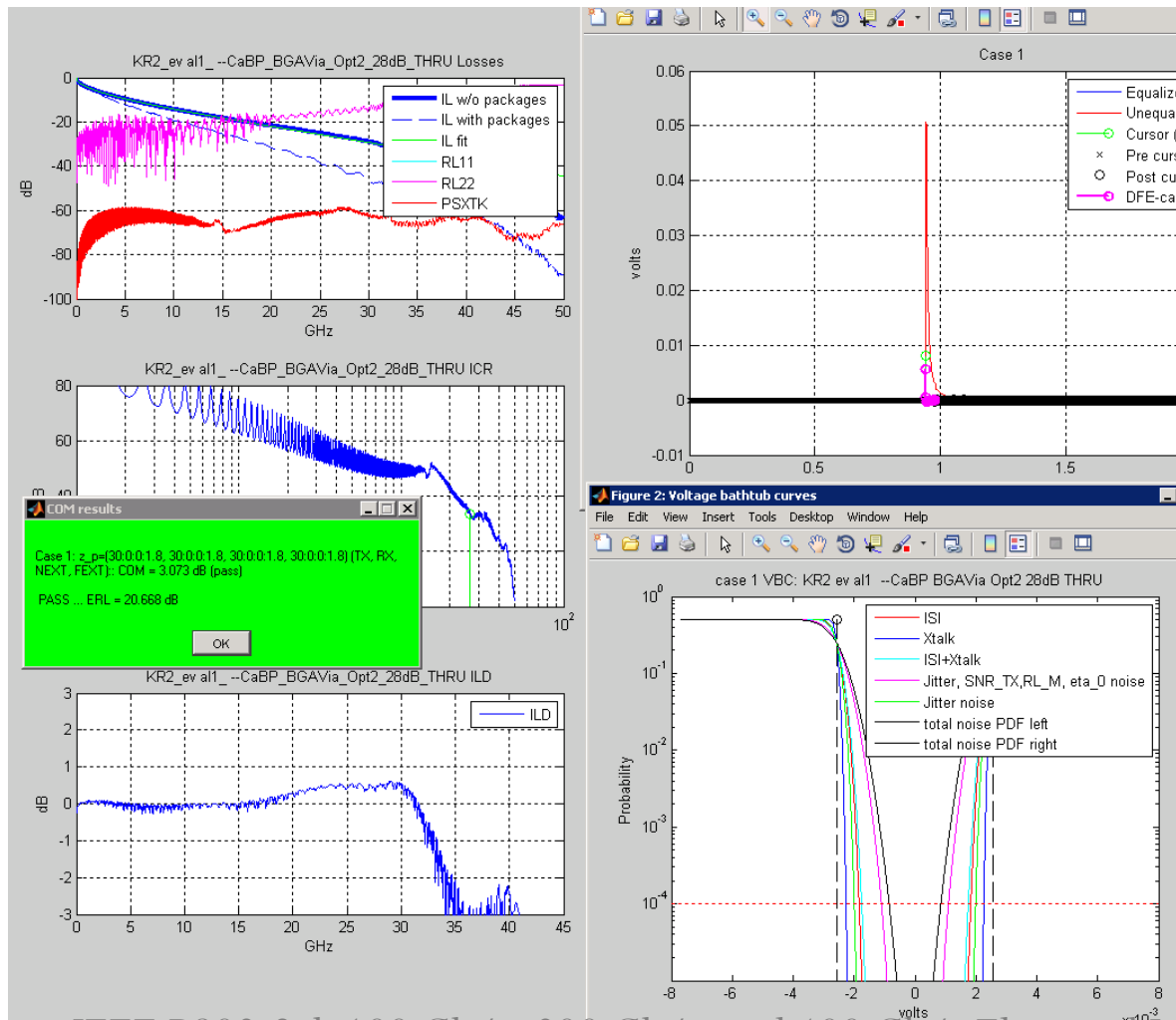
92.5; 92.5; 20Tap DFE including XTalk



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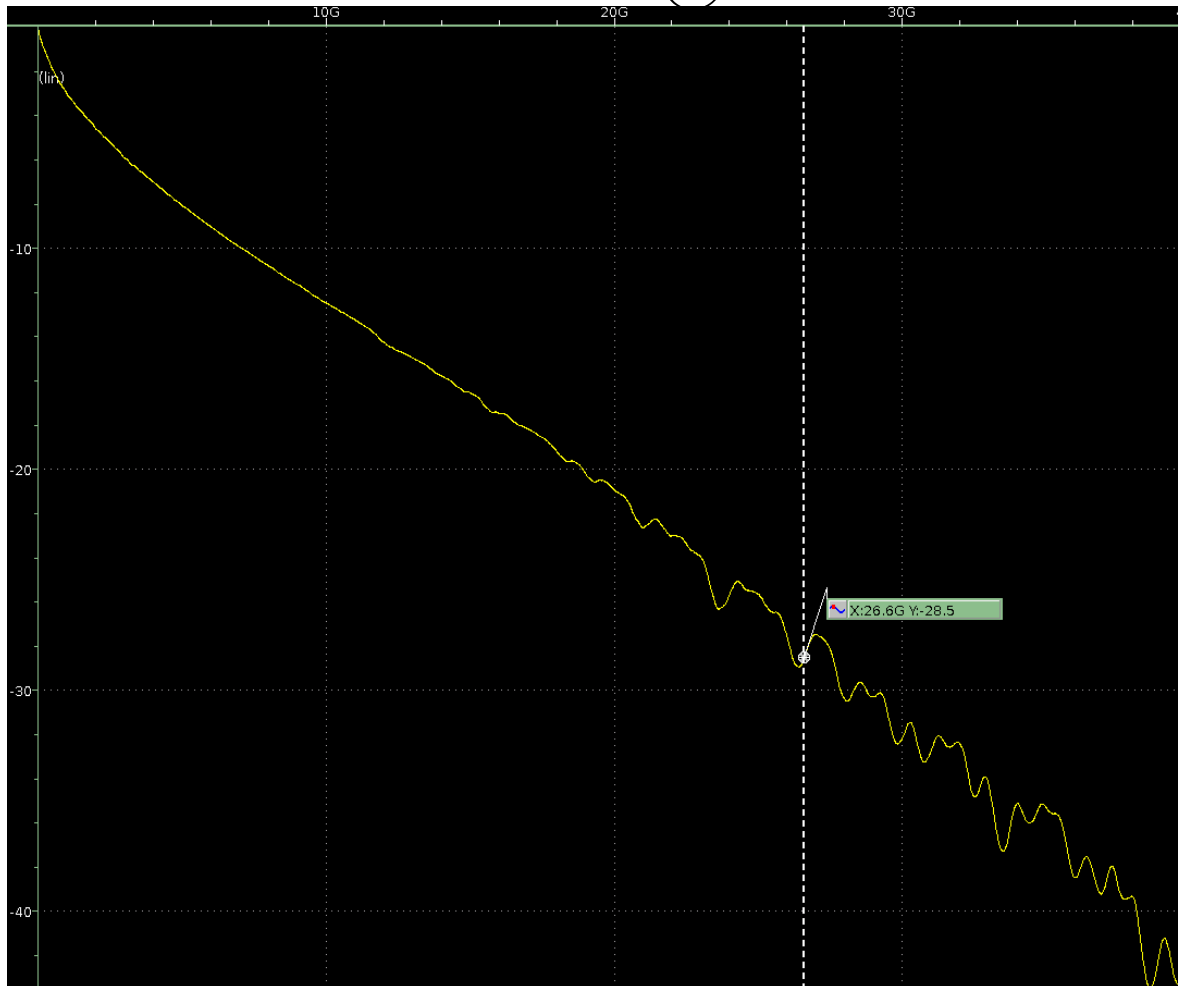
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97.5; 92.5; 20Tap DFE including XTalk



Orthogonal – Zambel

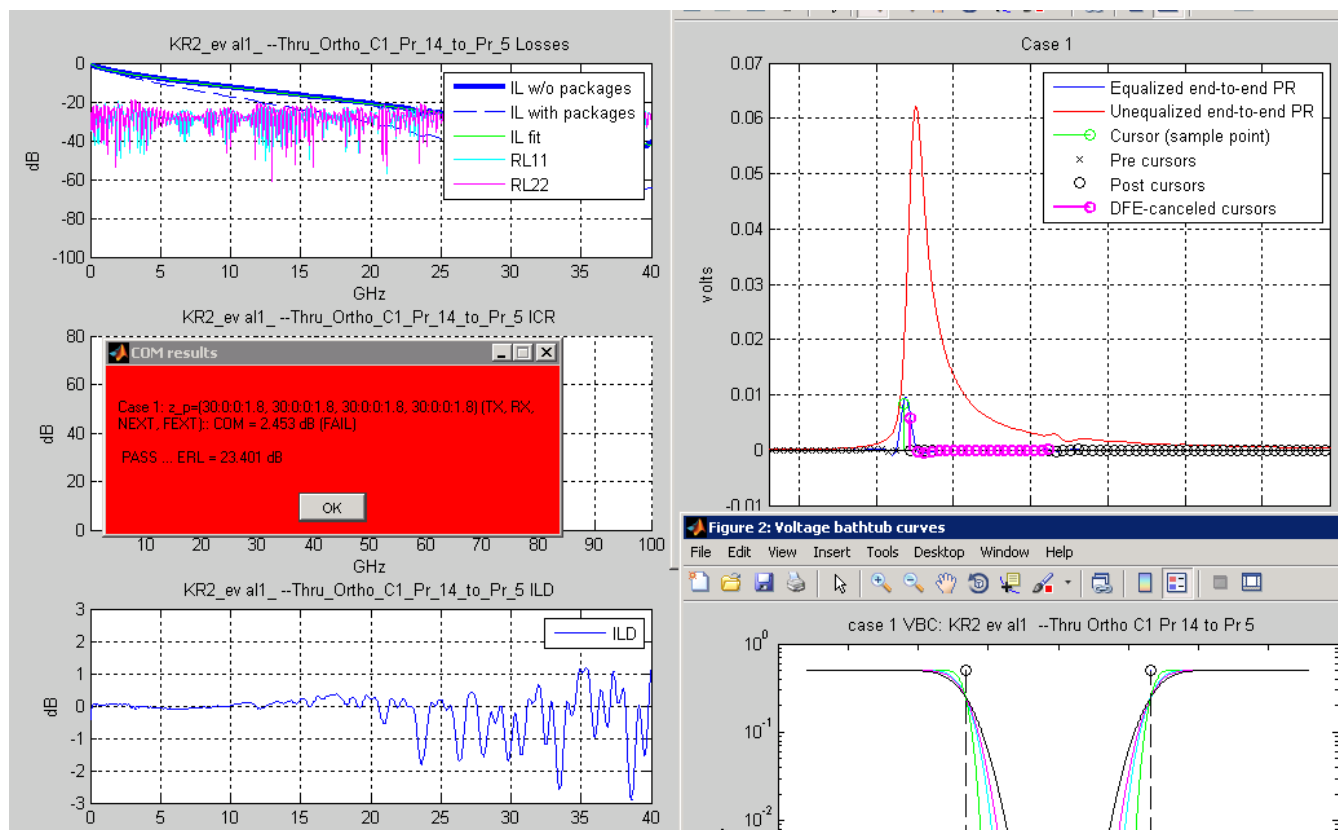
- ~28.5dB Channel Loss (@ 26.6GHz including ILD)



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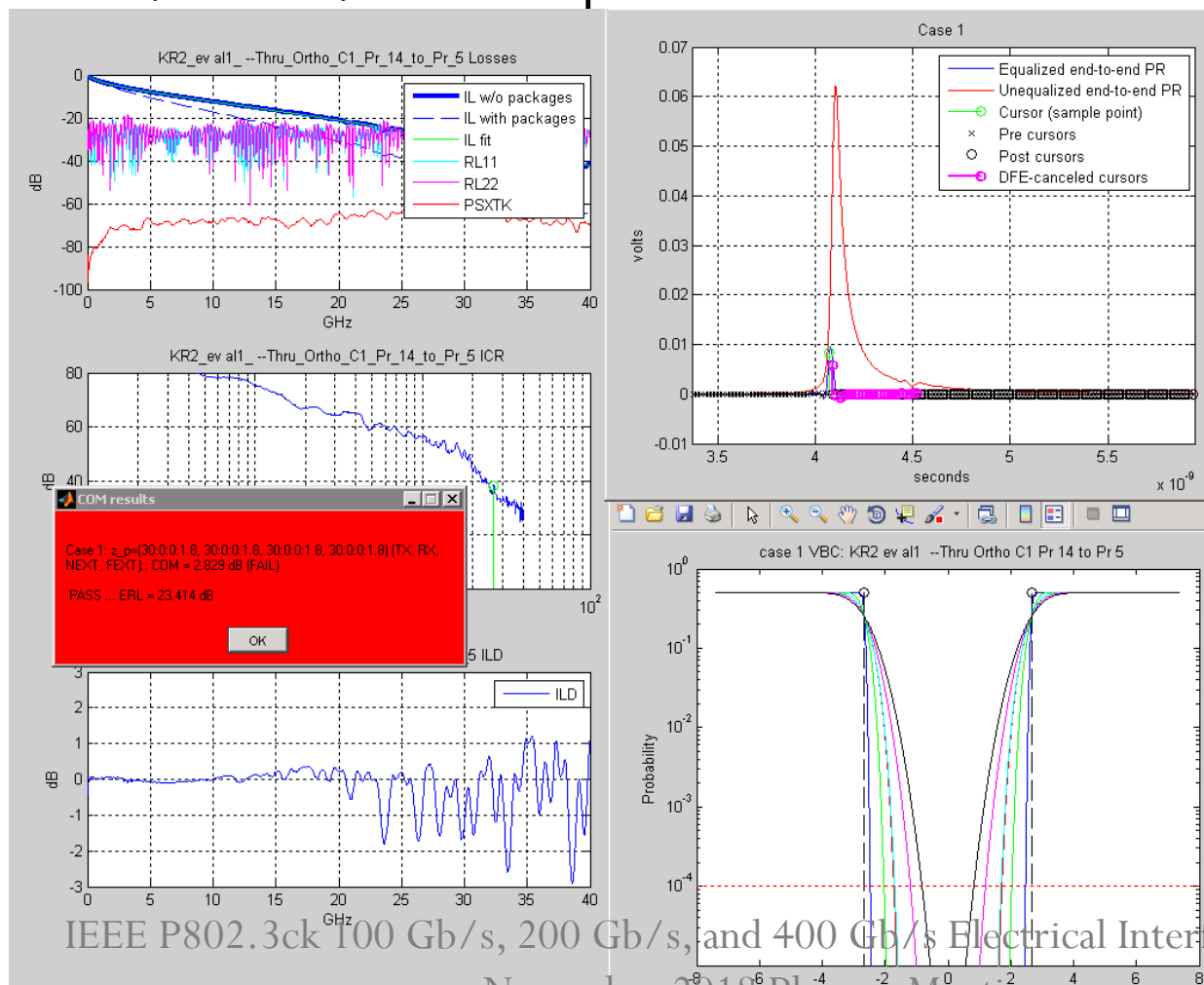
Orthogonal – Zambel W/O XTalk

- 28.6dB Channel Loss $87.5 + 92.5 + 20$ taps



Orthogonal – Zambel Inc. XTalk

- 87.5 + 92.5 + 24 taps

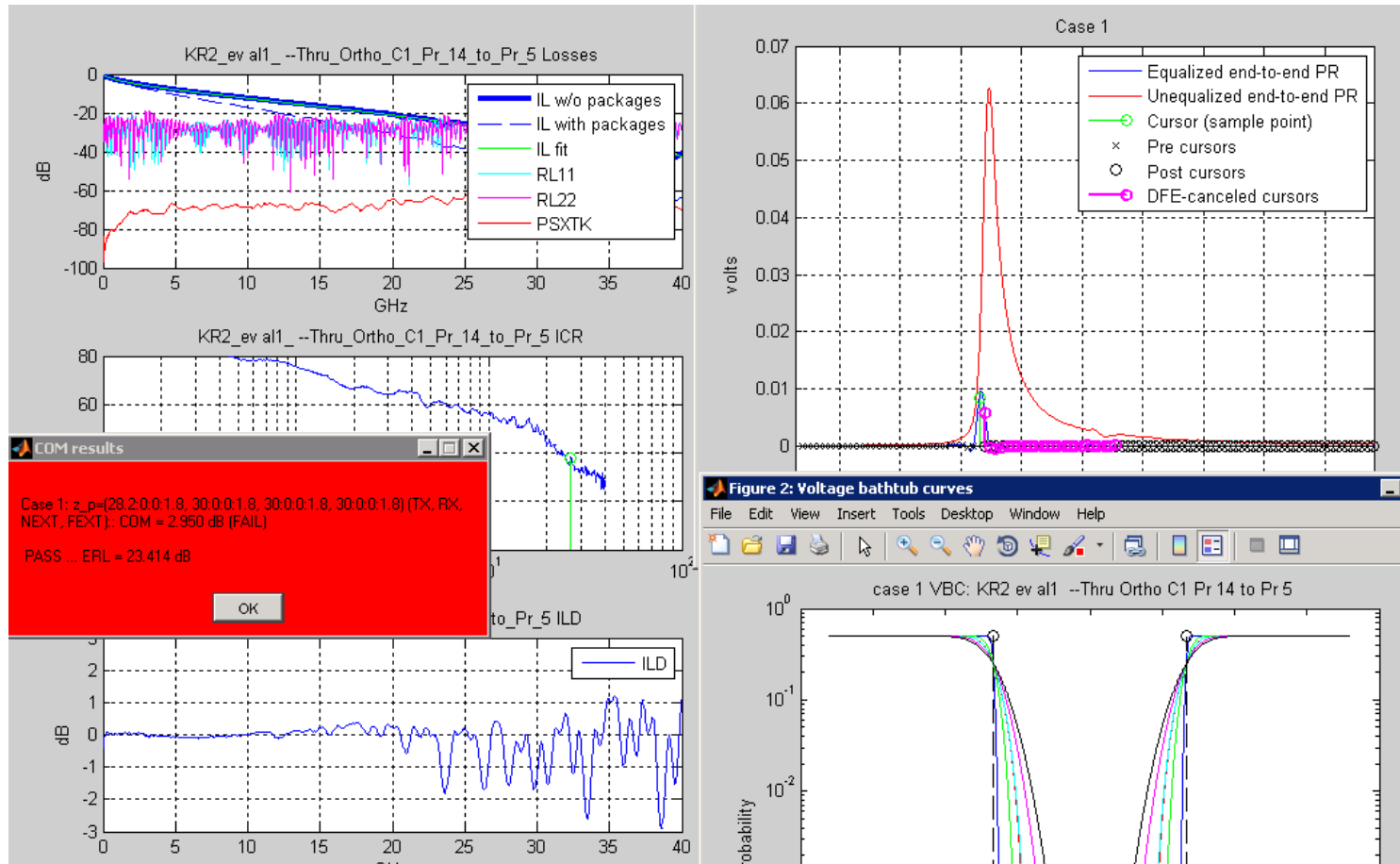


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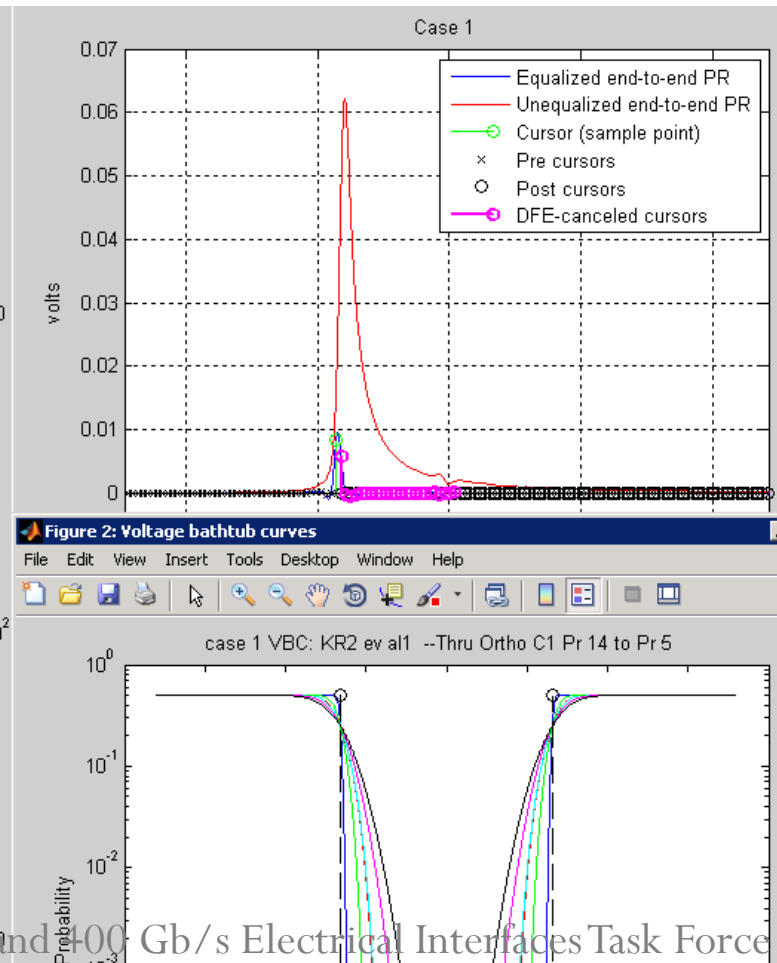
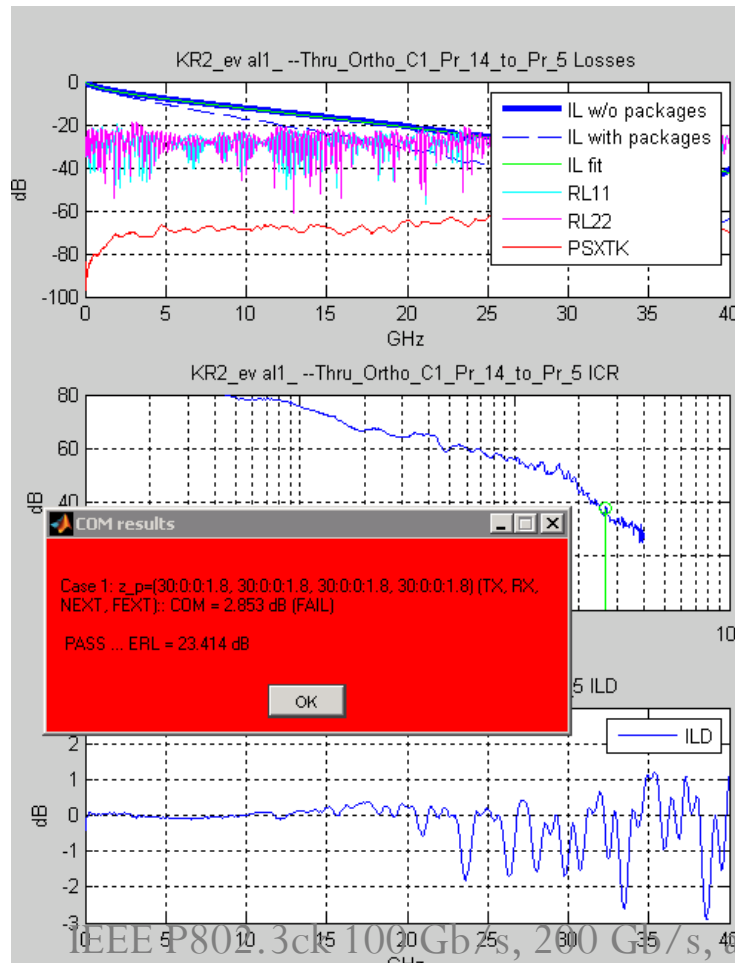
Orthogonal – Zambel Inc. XTalk

- 92.5 total 30mm + 24 taps



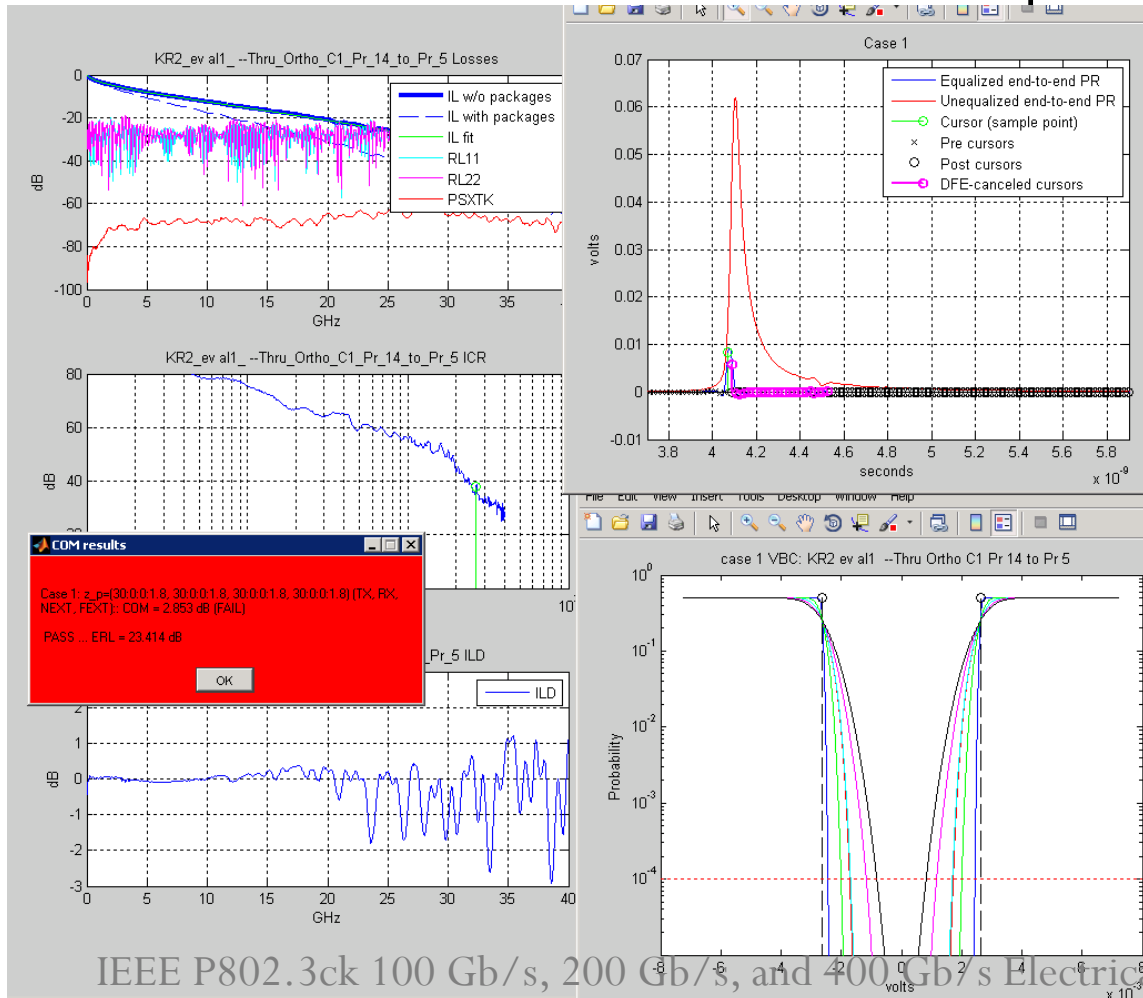
Orthogonal – Zambel Inc. XTalk

- 92.5 total 30mm + 92.5PTH + 24 taps



Orthogonal – Zambel Inc. XTalk

- 97.5 total 30mm + 92.5PTH + 24 taps



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