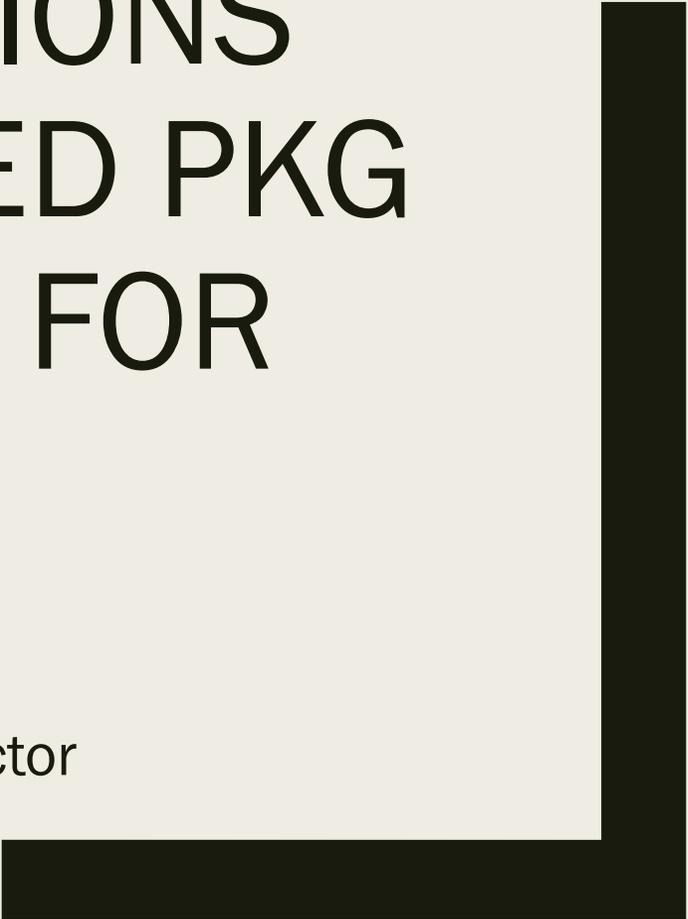




PACKAGE DISCUSSIONS UPDATE & SUGGESTED PKG MODEL BASE-LINE FOR 802.3CK COM

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Executive Summary

- Multiple discussions held to exchange package model related thoughts – Multiple participants
- Taking on Inputs from the group during Bangkok plenary - PKG trace loss was updated - Slide #3
- Inputs stated that the trace length in a 70mm² PKG will exceed 30mm (can be as long as 36mm-40mm)
 - *It is assumed that in a long trace case PKG trace characteristics can not follow 5dB @30mm (as was presented in Bangkok)*
 - *What is the appropriate trace length to be used in COM? (many options were brought up)*
- A suggested path forward will be shared including a PKG baseline

PKG Extracted Trace Change Highlights

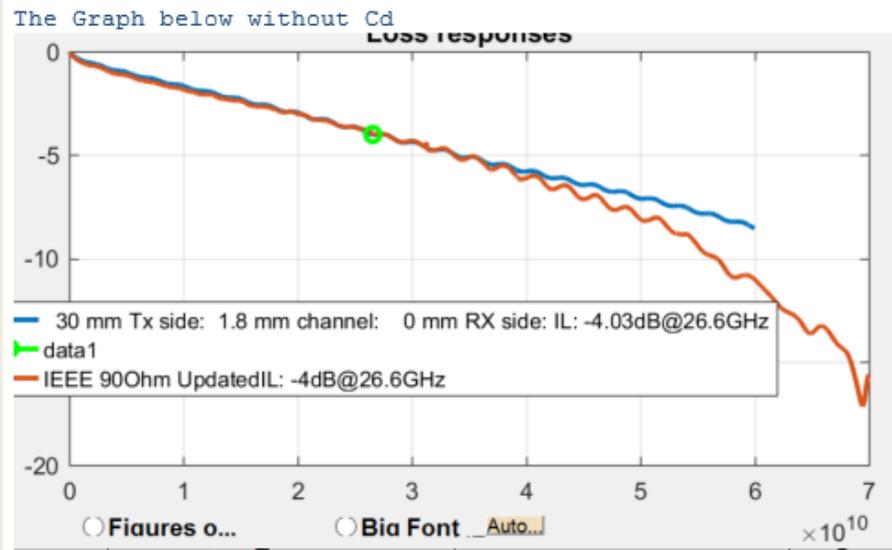
- Surface Roughness to follow best case of surface roughness technology
- Dielectric material characteristics taken @ room temperature (0.004)
- **Resulting loss \approx 4dB @ Nyquist – Correlated to inputs**
- Ball side equivalent capacitance taken closer to the higher end. i.e. 90fF (actual is 87fF)
- Impedance used was a bit higher (closer to the 92.5 Ω target)
- Matched to a model by Rich (Thanks!)
- There is a notion to proceed with this trace loss (and the model that goes with it) to the next phase
- Used 110fF for die side capacitance in runs
- Running with Zambel orthogonal 28.6dB orthogonal BP result >3.5dB COM

Suggested Matched Parameters

C_d	[1.1e-4 1.1e-4]	nF	[TX RX]
z_p select	[1 2]		[test cases to run]
z_p (TX)	[12 30; 1.8 1.8; 0 0; 0 0]	mm	[test cases]
z_p (NEXT)	[12 30; 1.8 1.8; 0 0; 0 0]	mm	[test cases]
z_p (FEXT)	[12 30; 1.8 1.8; 0 0; 0 0]	mm	[test cases]
z_p (RX)	[12 30; 1.8 1.8; 0 0; 0 0]	mm	[test cases]
C_p	[0.87e-4 0.87e-4]	nF	[TX RX]

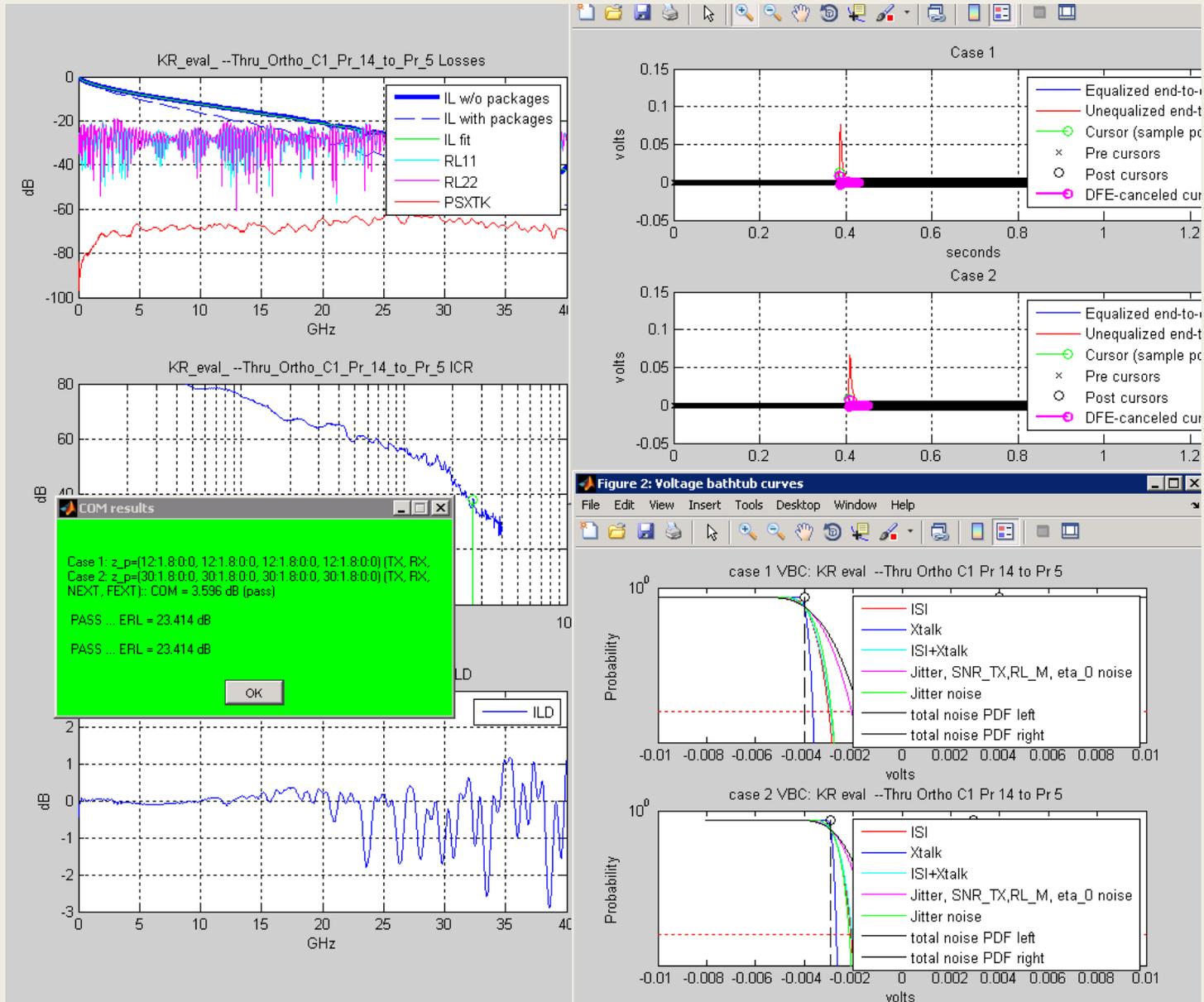
package_tl_gamma0_a1_a2	[0 0.0009909 0.0002772]	
package_tl_tau	6.14E-03	ns/mm
package_Z_c	[87.5 87.5 ; 92.5 92.5; 100 100 ; 100 100]	Ohm (tdr sel)

* First section impedance may vary to 92.5Ω/97.5Ω



Updated Run

- Former runs resulted in ~2.8-2.9dB of COM
- Current parameters result in 3.6dB COM



Decision Tree – Shared during Ad-hoc

- Assumption: Trace parameters and ball discontinuity to follow written in slide #4
 - *Recommendation is that these parameters will be used for future analysis (excluding length)*
- **Decision #1:** Topology options (main open item to be defined before putting PKG model stake in the ground):
Lengths below exclude 1.8mm designated for PTH+lower laser via+ball delay and loss
 - **Symmetric**
 - 30mm, 32mm, 34mm, 36mm per side
 - **Asymmetric (36mm & 30mm)**
 - Tx Longer (may pose a challenge on ITol Rx testing)
 - Rx Longer (May pose a challenge on Tx qual @ TPO in longer packages)
- **Decision #2:** Cd = 130fF / 110fF (10fF assumed to be related to PKG side bump pad parasitic capacitance)
- **Recommendation:**
 - *Use data provided to analyze and come up with recommendation(s) as to appropriate decision(s) in the above decision tree*

Package Trace Length

70x70mm PKG

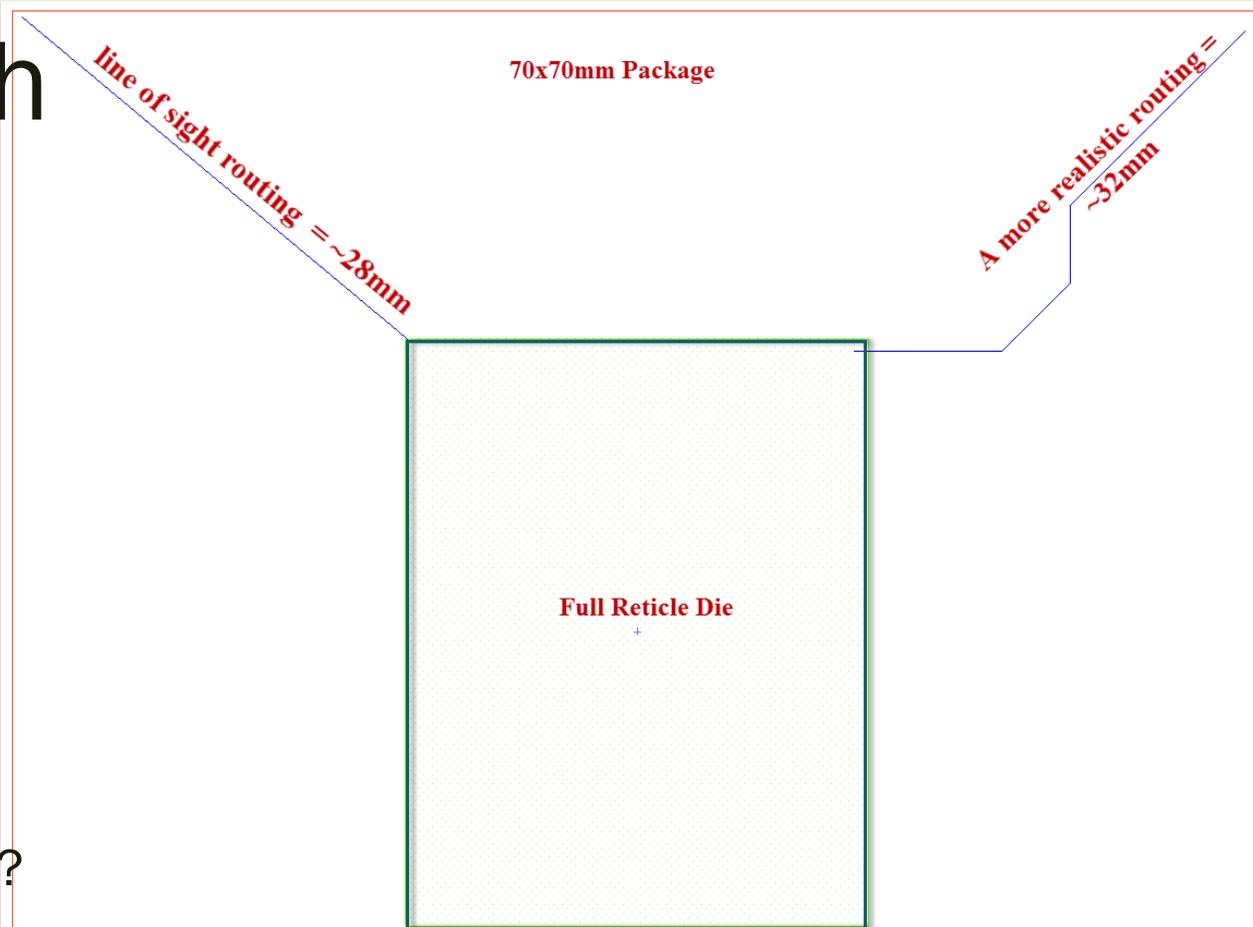
“Full Reticle” silicon size



- Direct “line of sight” → 28mm length
- A “more realistic routing” translates to ≥ 32 mm trace length

Asymmetric? Which side should be the longer?

- Rx length ≥ 30 mm → Tx model causes Tx TPOA definition to pose a challenge on IPs implemented the other way around
- Rx model should be short → Pose a challenge on Rx IPs if actual PKG loss is above COM models’ or if reflections reside outside compensated area
- A Symmetric approach gives an answer to both concerns as long as DFE/FFE length is shorter than Rx package delay → Suggest using 32mm on both sides (excluding PTH)



Suggested Package Base-Line

- Use the an updated flexible PKG model with two sections (based on the one described in http://www.ieee802.org/3/ck/public/18_09/mellitz_3ck_01_0918.pdf) – Allows accounting for PTH @ different impedance as well as for its (+ lower buildup + ball) delay
- Follow trace parameters as in slide #4
- Two symmetric COM package cases (32mm, 1.8mm) and (12mm, 1.8mm) on Tx and Rx sides + DFE/FFE length \leq 24 taps
- Use $C_d=110\text{fF}$; $C_p=87\text{fF}$

Thanks!