

# Assessment of Proposed Reference Package Model

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Electrical Interfaces Task Force

# Summary

- Intent: Evaluate the proposed reference package model for ability to implement in product. Specific focus on:
  - Validity of 2-segment model with PTH not located at BGA pad
  - Ability to fit within 4dB insertion loss budget
- Results:
  - We'll have to implement more aggressive PTH voiding to match the 2-segment model. Believe we need to in order to operate at 100G.
  - We can support the 4dB ref package model for a 30mm trace as long as we have the ability to trade off channel loss.
  - We also want support for 20mm reference package model.

# Outline

- Background
- Model
- PTH Voiding for 2-Segment Model
- Insertion Loss
- Validation with 112G SOC Package
- Summary

# Background

## Straw Poll #5:

I would support the package use cases

- A: 12mm and 30mm + PTH
- B: Two 30mm iterations representing trace impedance manufacturing tolerances
- C: 12mm AND two 30mm representing trace impedance manufacturing tolerances
- D: Need more information

pick one

A: 3, B: 0, C: 2, D: 33

## Straw Poll #4:

I would support the package model direction

- A: 1 segment similar to 25/50G COM (Annex 93A)
- B: 2 segment package model similar to slide 7 of mellitz\_3ck\_01b\_1118
- C: Need more information

Pick one.

A: 0 B: 19 C: 19

## Straw poll #7:

I would support the following package Loss (trace, PTH, Cp) parameter cases

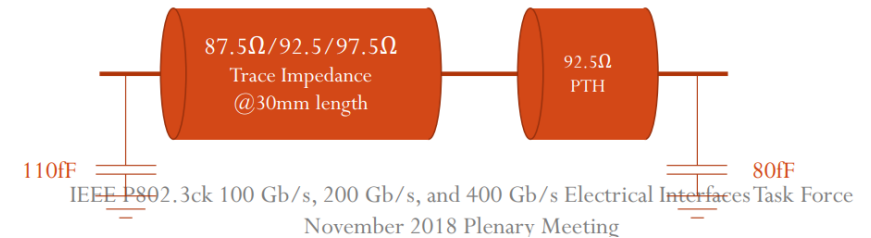
- A: Loss parameters as stated in slide #7 of mellitz\_3ck\_01b\_1118 which comes up to ~5dB of loss @26.6GHz for the 30mm PKG
- B: Updated loss parameters as supplied by Rich Mellitz and comes up to a 4dB of loss @26.6GHz for the 30mm PKG
- C: Loss parameters as stated in B for the 30mm PKG case and as stated in A above for the 12mm PKG case
- D: Need more information

A: 0, B: 1, C: 1, D: 30

Source=11/18 interim meeting minutes: [http://www.ieee802.org/3/ck/public/18\\_11/minutes\\_3ck\\_1118\\_unapproved.pdf](http://www.ieee802.org/3/ck/public/18_11/minutes_3ck_1118_unapproved.pdf)

## How Many Trace Segments Do We Need?

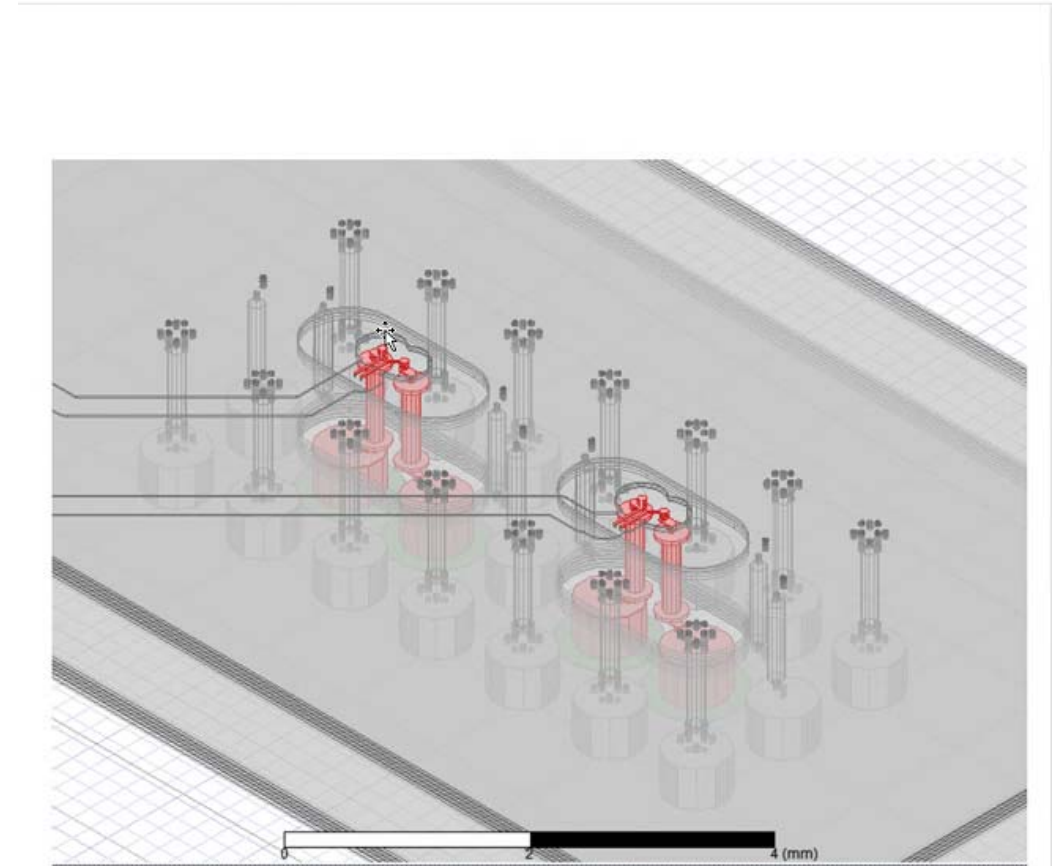
- It was shown that one segment that will represent the trace and a short one at the ball location (to represent the PTH) comes “close enough” to represent the PKG trace, therefore....
- **Recommend using only up to two of the flexible PKG model segments**
- **Former projects used only one (in our case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



This work addresses the straw poll questions shown here.

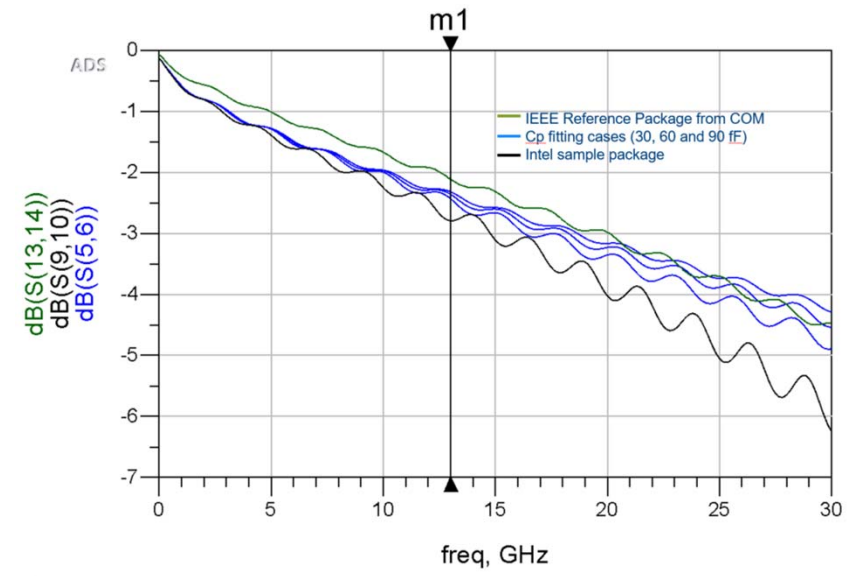
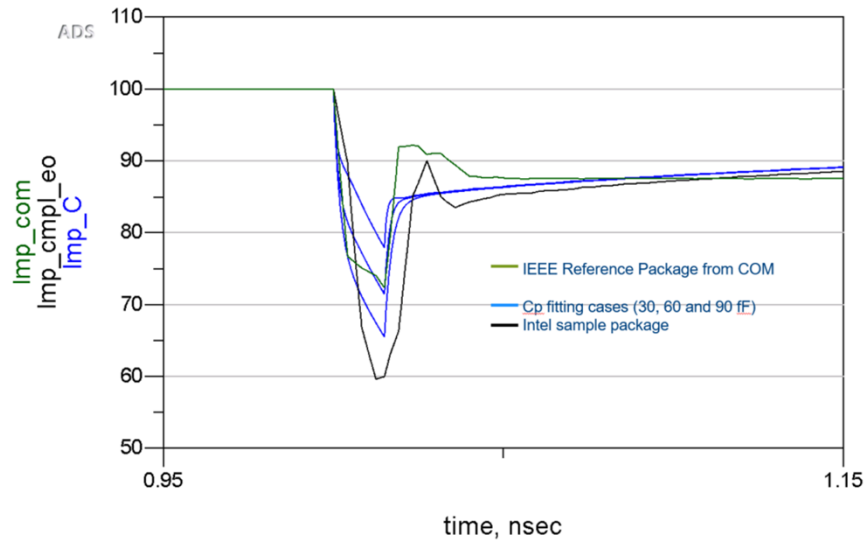
# Model

- Based on existing server package design
- 3D extraction of two diff pairs
- Next gen dielectric
- Focused on optimizing PTH voiding for matched impedance
- Design points studied:
  - Existing voiding rules
  - “middle ground” voiding
  - “aggressive” voiding
- Temp = 25C

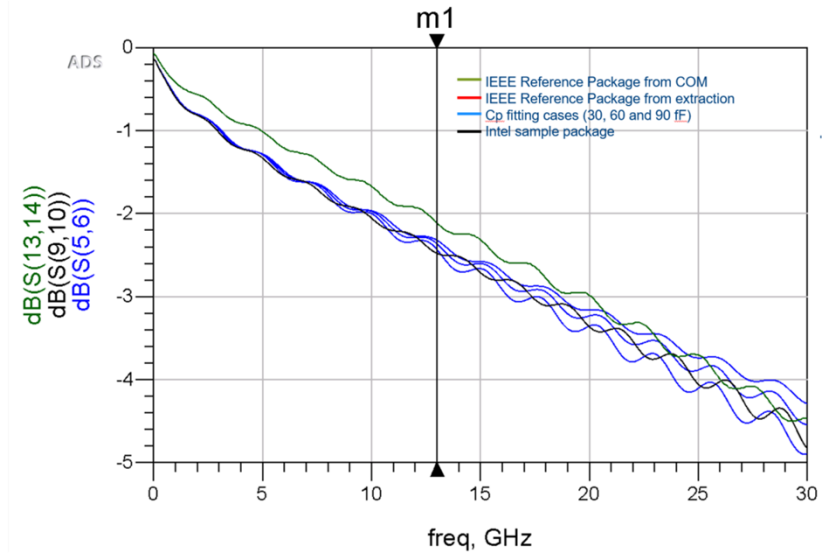
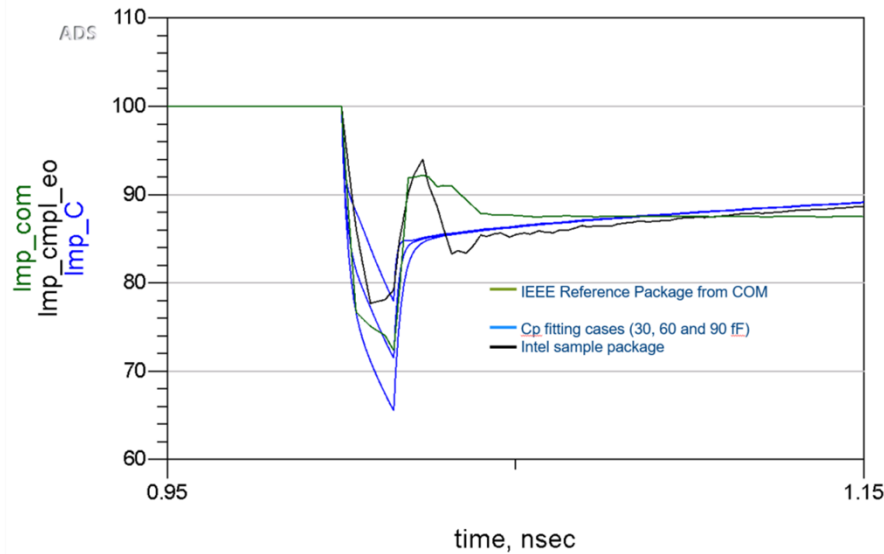


# PTH Voiding Results

Middle Ground Voiding



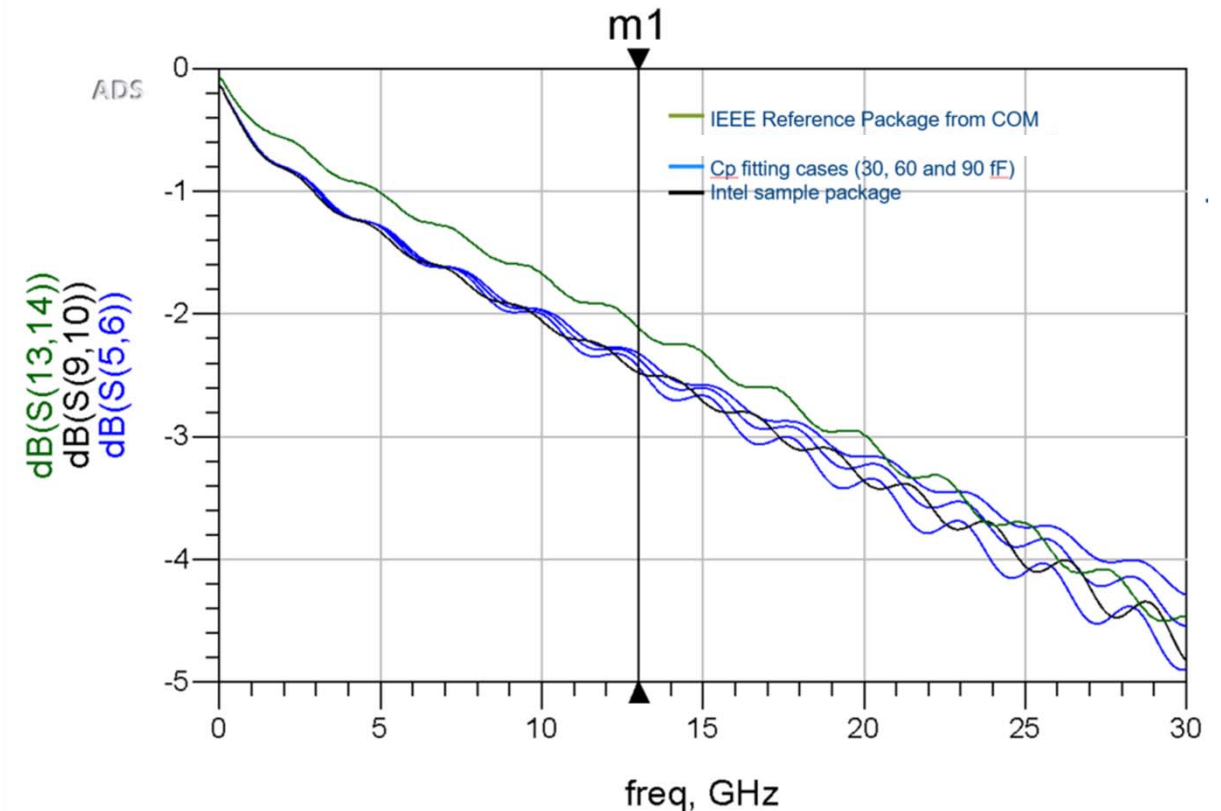
Aggressive Voiding



Aggressive voiding gives reasonable match to the 2-segment model. Expect 100G operation to require it.

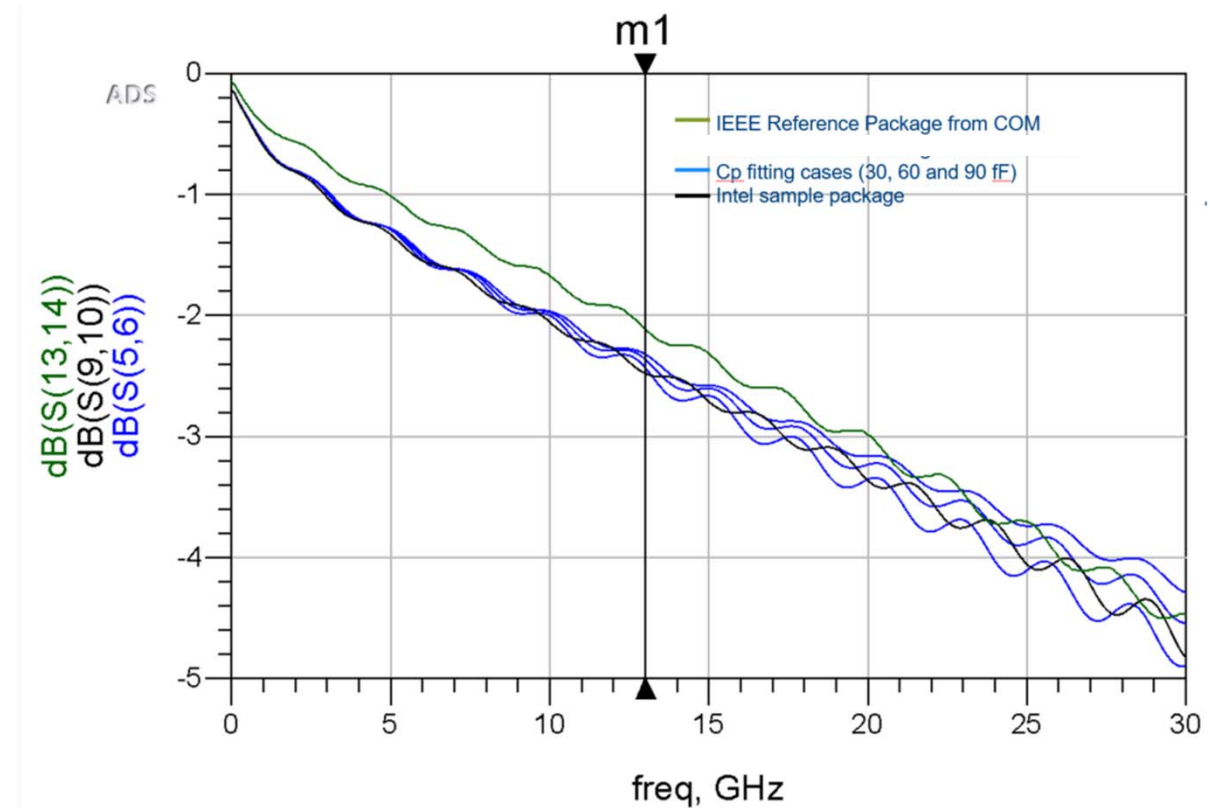
# Insertion Loss

- Analysis: multiple combinations for dielectric thickness, trace width, trace spacing (impedance constrained).
- Best case:  $\sim 0.13\text{dB/mm}$  @ 28GHz @ 25C.
  - 30mm transmission line barely fits within 4dB
  - expect  $\sim 1\text{dB}$  degradation @ 90C
- Expect some impedance mismatch in die breakout region.
- We don't expect to meet 4dB for a 30mm package
  - though we may get close @ 25C



# Insertion Loss

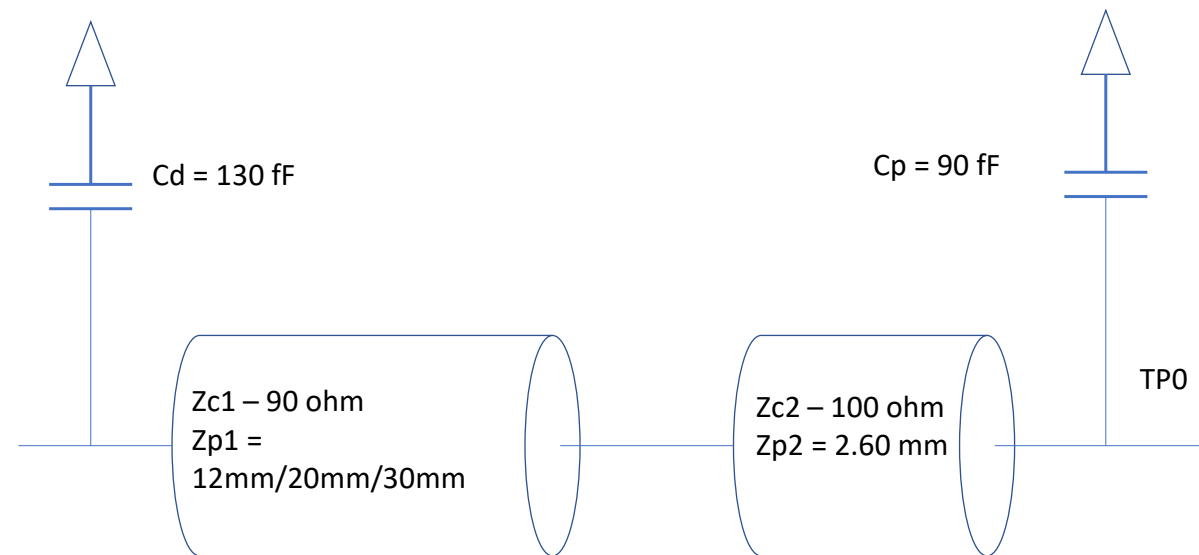
- We can support the 4dB ref package model as long as we have the ability to trade off channel loss in meeting COM.
  - i.e. if I have 4.5dB package loss, then keep channel loss  $\leq 27.5$ dB.
  - assuming 30mm max trace length
  - as long as spec assumes 25C
- We also want support for the 20mm reference package model.





# 112G SOC Package Validation of the Two Segment Model

- Two segment ref package model matches actual design better than one-segment ref package model.
- The two model parameters derived from an actual 112G SOC post-layout package are on the following slide.



# 112G SOC Package Validation of the Two Segment Model

| Ref PKG Transmission Line Model<br>Parameters and Values (T = 90 C) |                         |                       |
|---|-------------------------|-----------------------|
| Parameters  | Value                   | Units                 |
| $\gamma_0$  | 0                       | 1/mm                  |
| $a_1$   | $0.7945 \times 10^{-3}$ | ns <sup>1/2</sup> /mm |
| $a_2$   | $1.902 \times 10^{-4}$  | ns/mm                 |
| $\tau$  | $6.141 \times 10^{-3}$  | ns/mm                 |

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- Results:
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  - We can support the 4dB ref package model for a 30mm trace as long as we have the ability to trade off channel loss & the spec is based on 25C temperature.
  - We also want support for the 20dB reference package model.

Thank you!