HRPPD Meeting Update

2025-12-16

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U.S. DEPARTMENT of ENERGY

Current Status

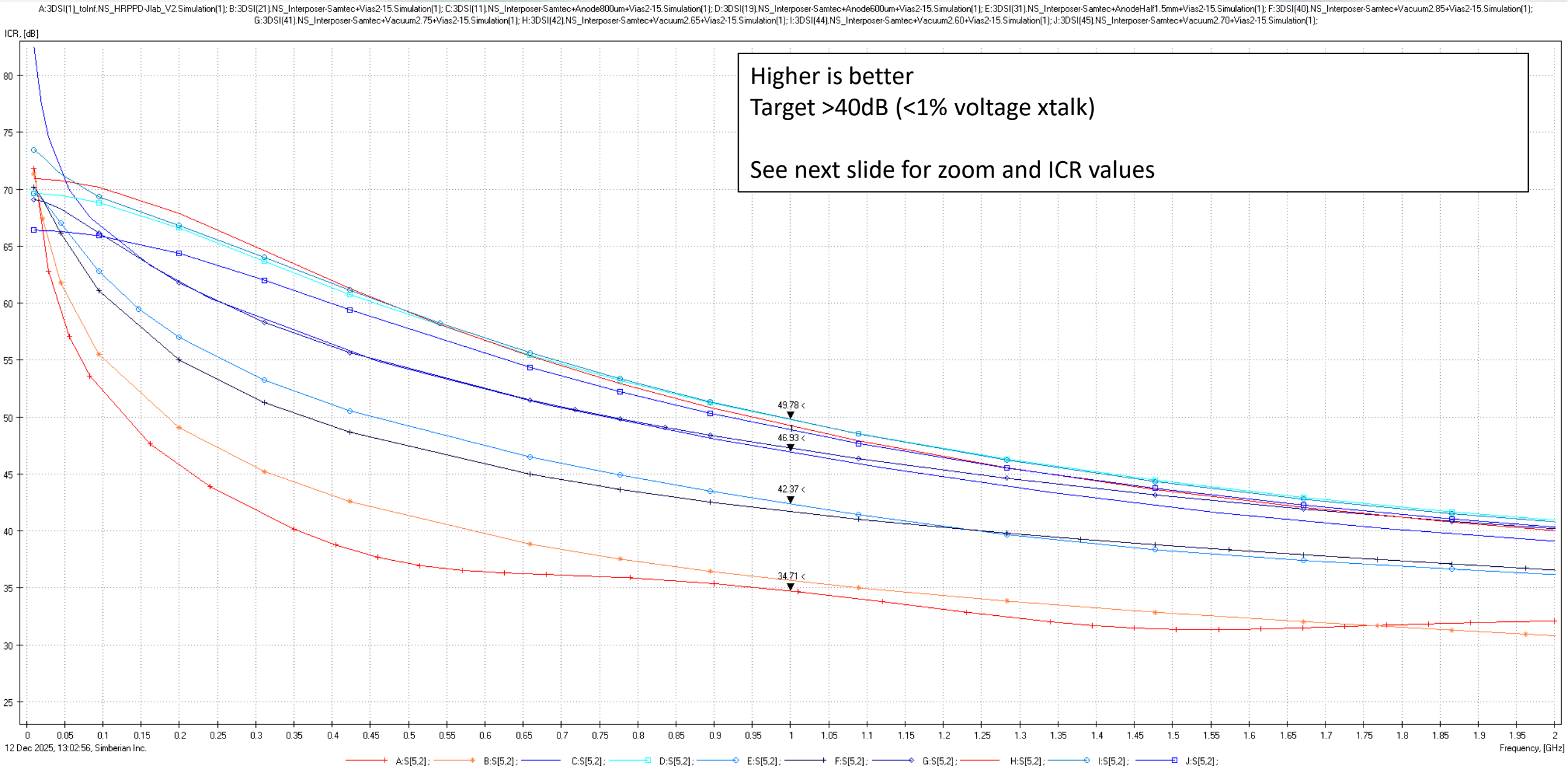
HRPPD Tasks: Due by 01/12/2026

- Simulations
  - Complete - stitching vias, air side interposer pad reduction, GND planes
  - Complete 12/16 - Vacuum side pad size selection
  - TBD
    - Interposer downselection (in progress)
    - Interposer Ground pour
- High Voltage (HV) Design
  - Complete - preliminary pogo pins selected, HV spacing determined
  - TBD
    - Location of ground and power connections to MCPs
    - Optimization of number of vias (in progress)
- Mechanical Changes
  - TBD
    - Interposer positional tolerance
    - Pogo pin placement
    - Plastic connectors for HV connections
    - Check backplane fit for pogo pins and connectors
    - Match outline to mechanical changes
- Other
  - Complete - Break in ground ring placed
  - TBD
    - Test file import with Kyocera
    - Update HRPPD with final design changes

Non-HRPPD Tasks: Due after

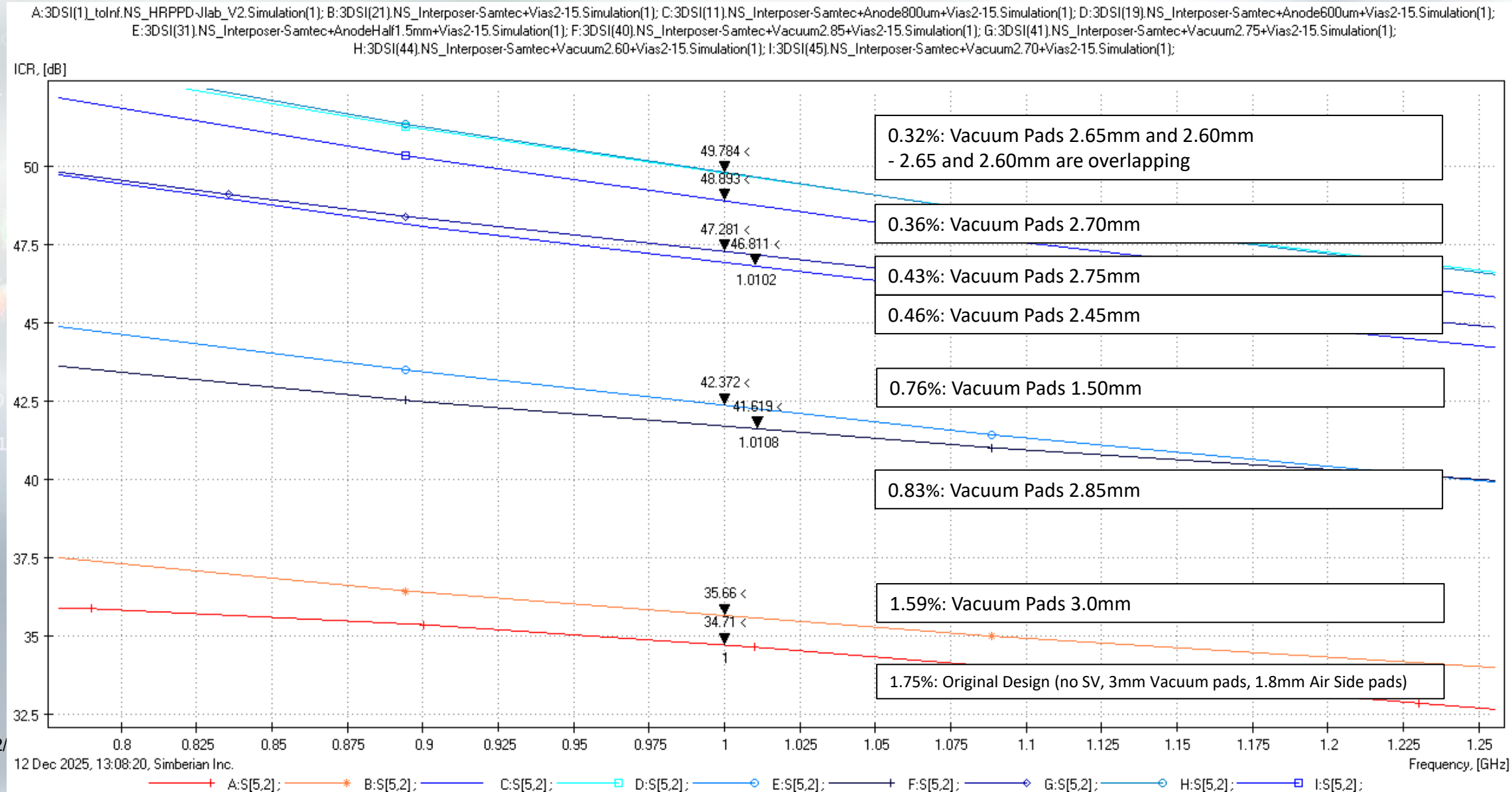
- Backplane Changes
  - Cables
  - Safety resistors
  - Bypass capacitors + ringing resistors
- FCFD Test Board
  - Board design complete
  - Final quote received, ETA 20 days ARO

Pad Size Comparison – Overall View



Pad Size Comparison – Zoomed View

All simulations have smaller air side pads (0.8mm) and and stitching via span layers 2-15



Vaccum Side Pad Size Summary

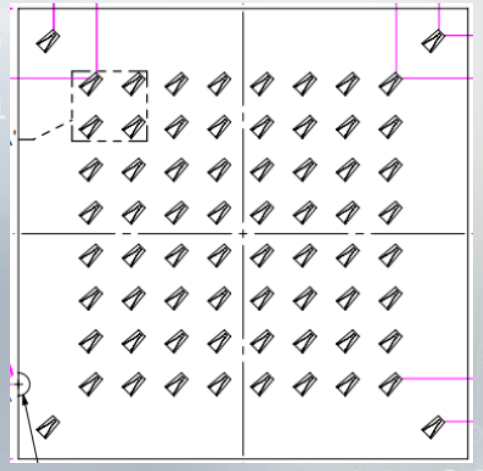
- Tested pad sizes:
  - 3.0, (2.85), (2.75), (2.7), 2.65, (2.6), 2.45, 1.5
    - ( ) Indicating new simulations
- “Knee” for ICR is 2.65-2.60mm
  - 2.60 performs very **slightly** better in IL and RL
- Suggested Vacuum Side Pad Size:
  - 2.75mm (108mil) to maximize detection area without major impacts to crosstalk, IL, and RL
  - Gives pad-pad spacing of 0.5mm / 20mil
    - This is double the current spacing with 3mm pads (0.25mm / 10mil)

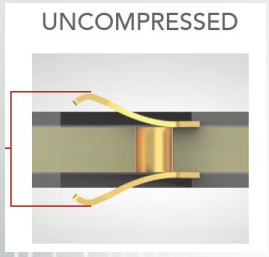
Test Case	ICR	IL	RL
Vacuum Pads 2.60mm	0.32%	1.87%	3.08%
Vacuum Pads 2.65mm	0.32%	2.05%	3.46%
Vacuum Pads 2.70mm	0.36%	2.15%	3.62%
Vacuum Pads 2.75mm	0.43%	2.22%	3.74%
Vacuum Pads 2.45mm	0.46%	1.38%	2.02%
Vacuum Pads 1.5mm	0.76%	0.51%	0.57%
Vacuum Pads 2.85mm	0.83%	2.80%	4.82%
Vacuum Pads 3.0mm	1.59%	3.47%	6.04%
Original (no SV, 3mm Vacuum pads, 1.8mm Air Side pads)	1.75%	4.83%	8.15%

Interposers

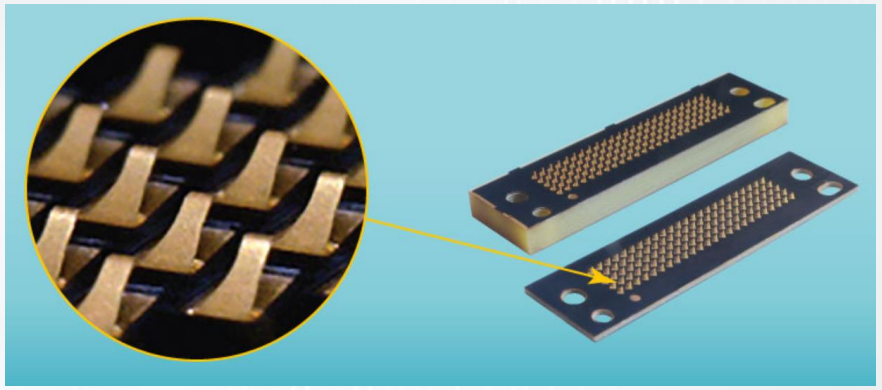
- Current Samtec interposer has no ground pins within signal pin field, just in corners
  - SI concern - no grounds between adjacent pins allows crosstalk through capacitive coupling and return current
- In order to add ground pins but not significantly affect footprint (increase size or change routing), considering a 1mm pitch interposer instead of a 2mm pitch one
- Added pins will be used for ground, but increased number of pins significantly affects force
  - Interposer company can selectively (de)populate interposer to alleviate this

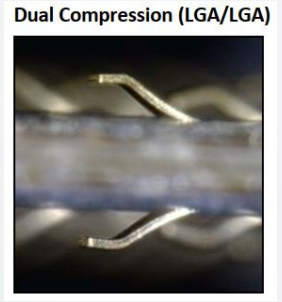
Samtec, 2mm pitch





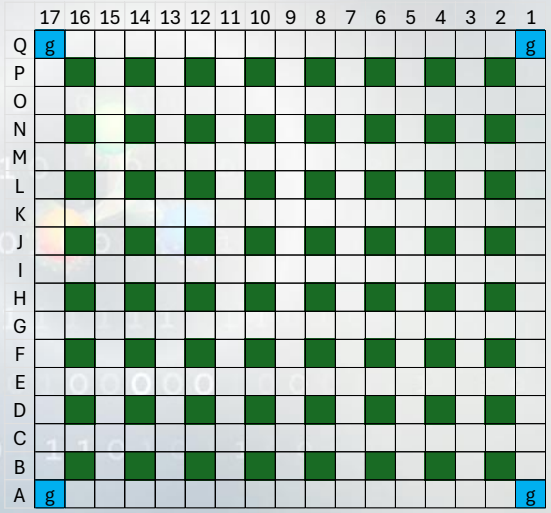
Neoconix, 1mm pitch





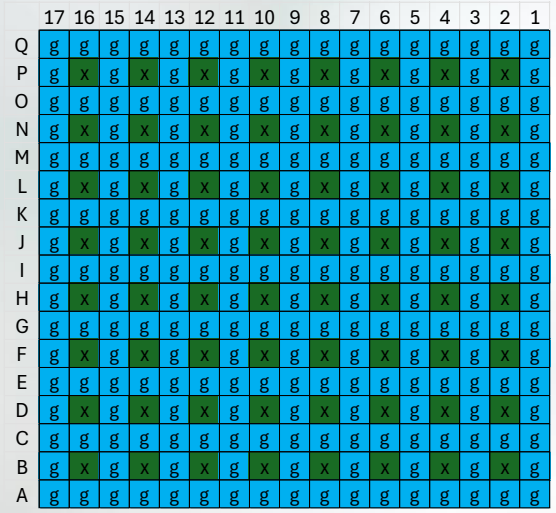
Interposer Configurations

- 2mm pitch interposer force per pin: 30g (0.07 lbs)
- 1mm pitch interposer force per pin: 30g
  - Note: Interposer force is per interposer, overall force is force per HRPPD (x16 interposer)
  - Grounds were removed from outer rings of “by2” and “by4” to reduce force



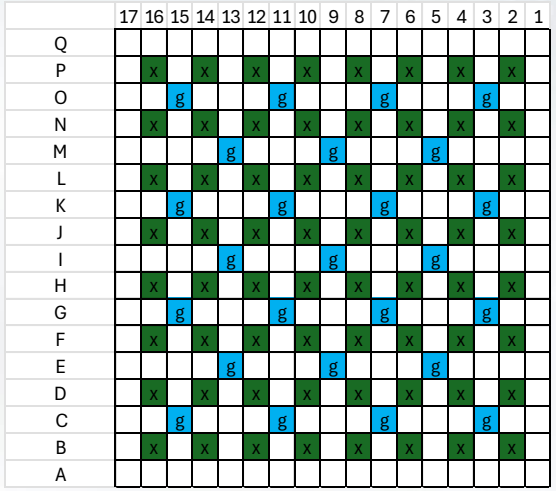
Samtec (Current 2mm)
No Isolation

Total pins: 68
Interposer force: 4.5 lbs
Overall force: 72 lbs



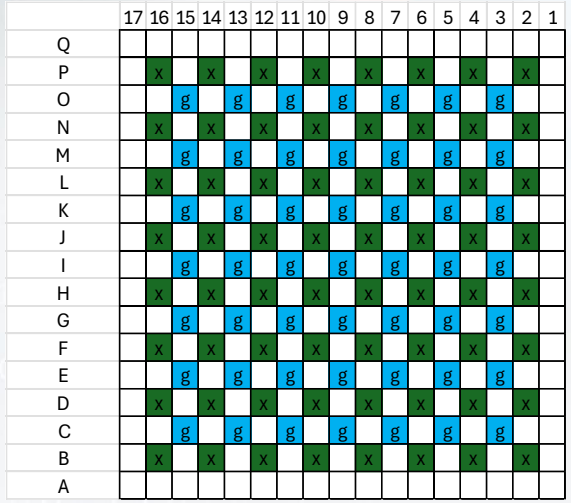
Neoconix (1mm)
Fully Isolated

Total pins: 289
Interposer force: 19.1 lbs
Overall force: 305 lbs



Neoconix (1mm)
Partial Isolation – each signal adjacent to 2 ground (“by2”)

Total pins: 89
Interposer force: 5.87 lbs
Overall force: 94 lbs



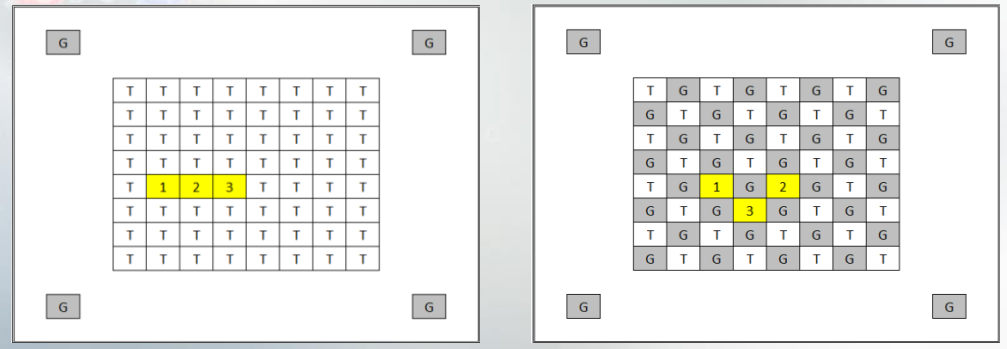
Neoconix (1mm)
Partial Isolation – each signal adjacent to 4 grounds (“by4”)

Total pins: 113
Interposer force: 7.46 lbs
Overall force: 119 lbs

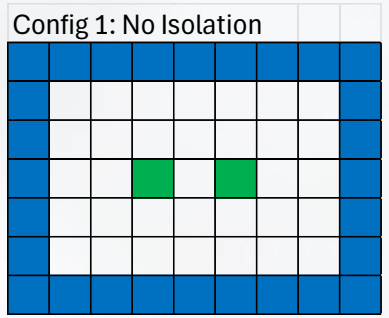
Interposer Models

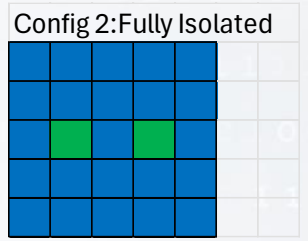
- Received touchstone models from Samtec and Neoconix
- Only modeled a portion of the connector as a full grid (8x8 or 17x17) would be too large and have too many ports
  - Created equivalent models for Neoconix interposers:

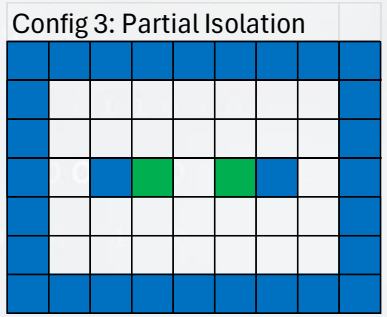
Samtec models



Neoconix models

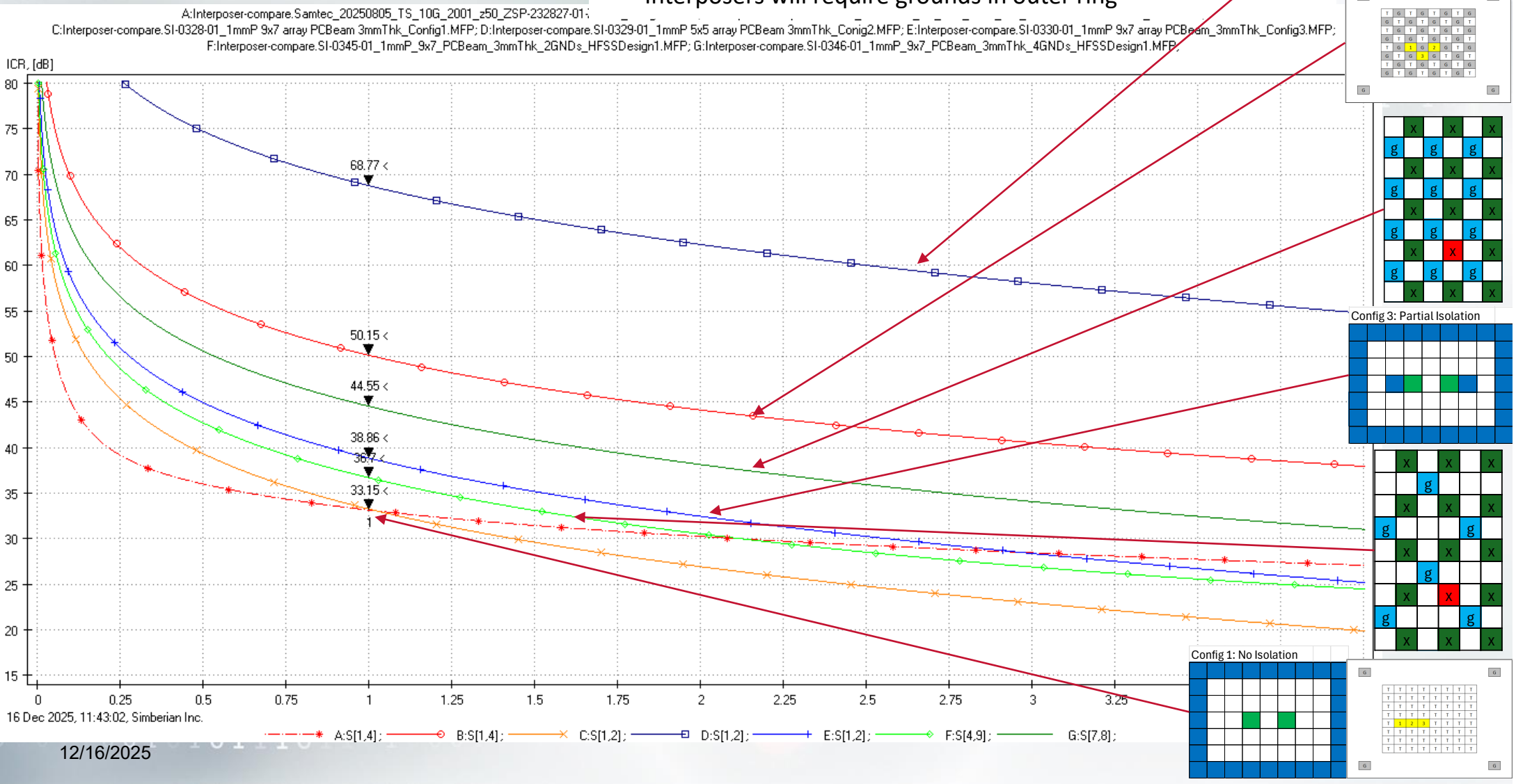


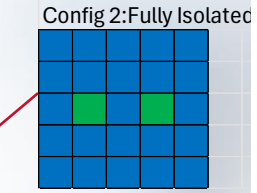


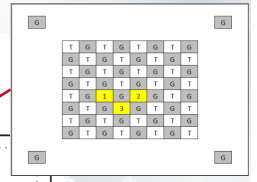


Interposers - ICR

Higher is better
Target: >40dB (1%)
Values in % voltage
Takeaway:
- By 4 configuration performs within 1%
- Interposers will require grounds in outer ring







FEXT @ 1GHz

Neoconix full iso

19.1lbs per interposer

68.77 dB = 0.04%

Samtec SGS

50.15 dB = 0.31%

Neoconix By4

7.46lbs per interposer

44.55 dB = 0.59%

Neoconix partial iso

38.86 dB = 1.14%

Neoconix By2

5.87lbs per interposer

36.7 dB = 1.46%

Samtec/Neoconix no iso

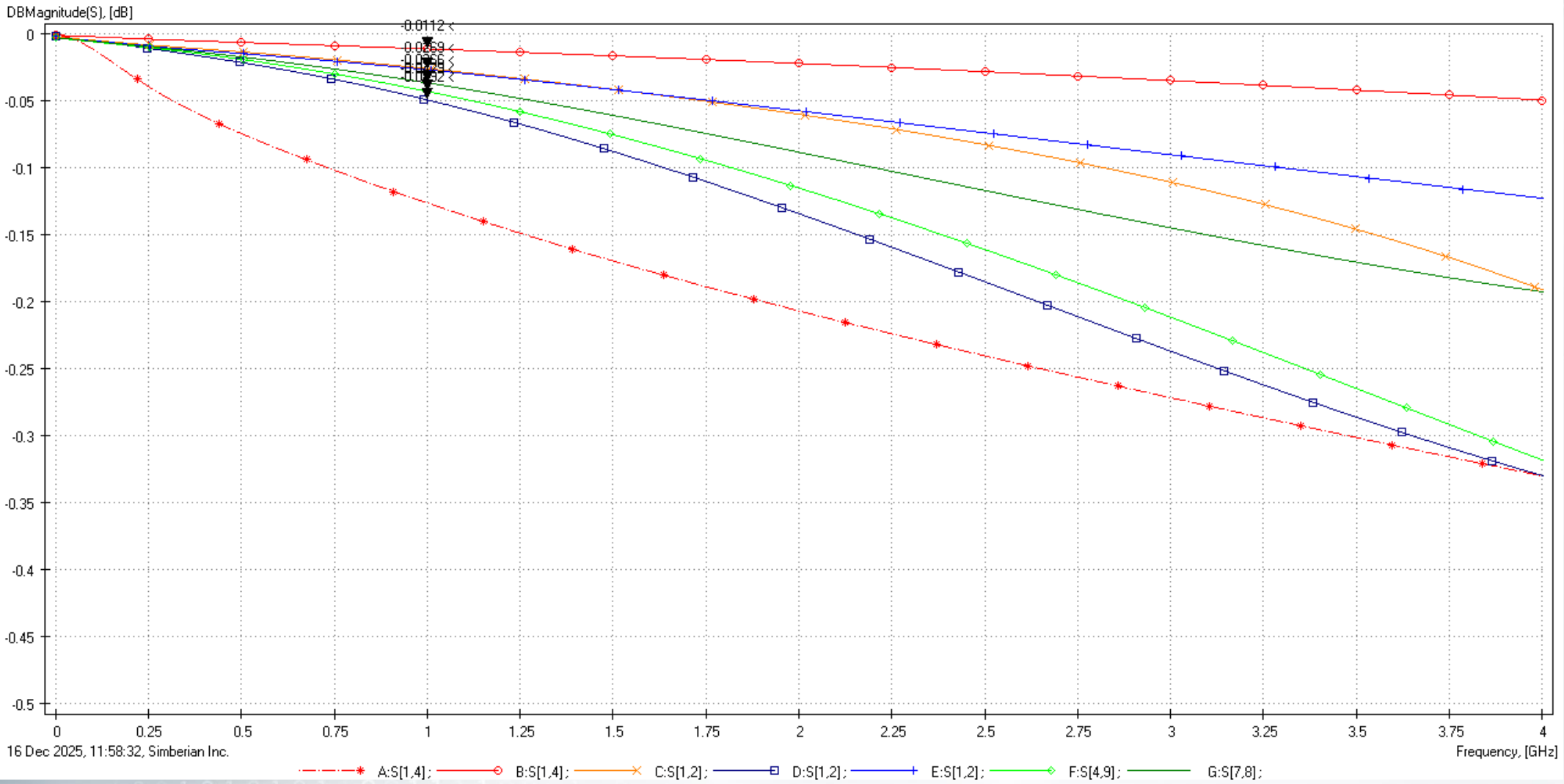
Current design

4.49lbs per interposer

33.15 dB = 2.2%

Interposers - IL

Higher is better
Target: >-1dB (10% loss)
Values in % voltage
Takeaway:
- All configurations are <0.57% loss



Suggested Interposer

- Suggest “by4” configuration with grounds re-added to the outer ring
- 1mm pitch interposer force per pin: 30g
  - Note: Interposer force is per interposer, overall force is force per HRPPD (x16 interposer)
  - Grounds are required in outer ring

	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Q	g		g		g		g		g		g		g		g		g
P		x		x		x		x		x		x		x		x	
O	g		g		g		g		g		g		g		g		g
N		x		x		x		x		x		x		x		x	
M	g		g		g		g		g		g		g		g		g
L		x		x		x		x		x		x		x		x	
K	g		g		g		g		g		g		g		g		g
J		x		x		x		x		x		x		x		x	
I	g		g		g		g		g		g		g		g		g
H		x		x		x		x		x		x		x		x	
G	g		g		g		g		g		g		g		g		g
F		x		x		x		x		x		x		x		x	
E	g		g		g		g		g		g		g		g		g
D		x		x		x		x		x		x		x		x	
C	g		g		g		g		g		g		g		g		g
B		x		x		x		x		x		x		x		x	
A	g		g		g		g		g		g		g		g		g

Neoconix (1mm)
Partial Isolation – each signal adjacent to 4 grounds (“by4”)

Total pins: 145
Interposer force: 9.57 lbs
Overall force: 153 lbs