

TWENTY-SEVENTH ANNUAL



TestConX™

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Mesa, Arizona
March 1-4, 2026

Grounded in Theory, Noisy in Practice: Hidden Weaknesses in Coaxial Socket Designs and Proposed Solutions

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Advantest Interconnect Solutions (AIS)



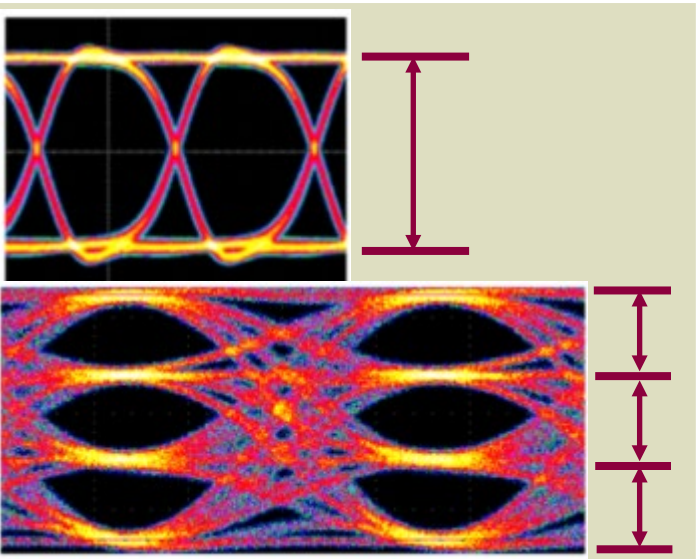
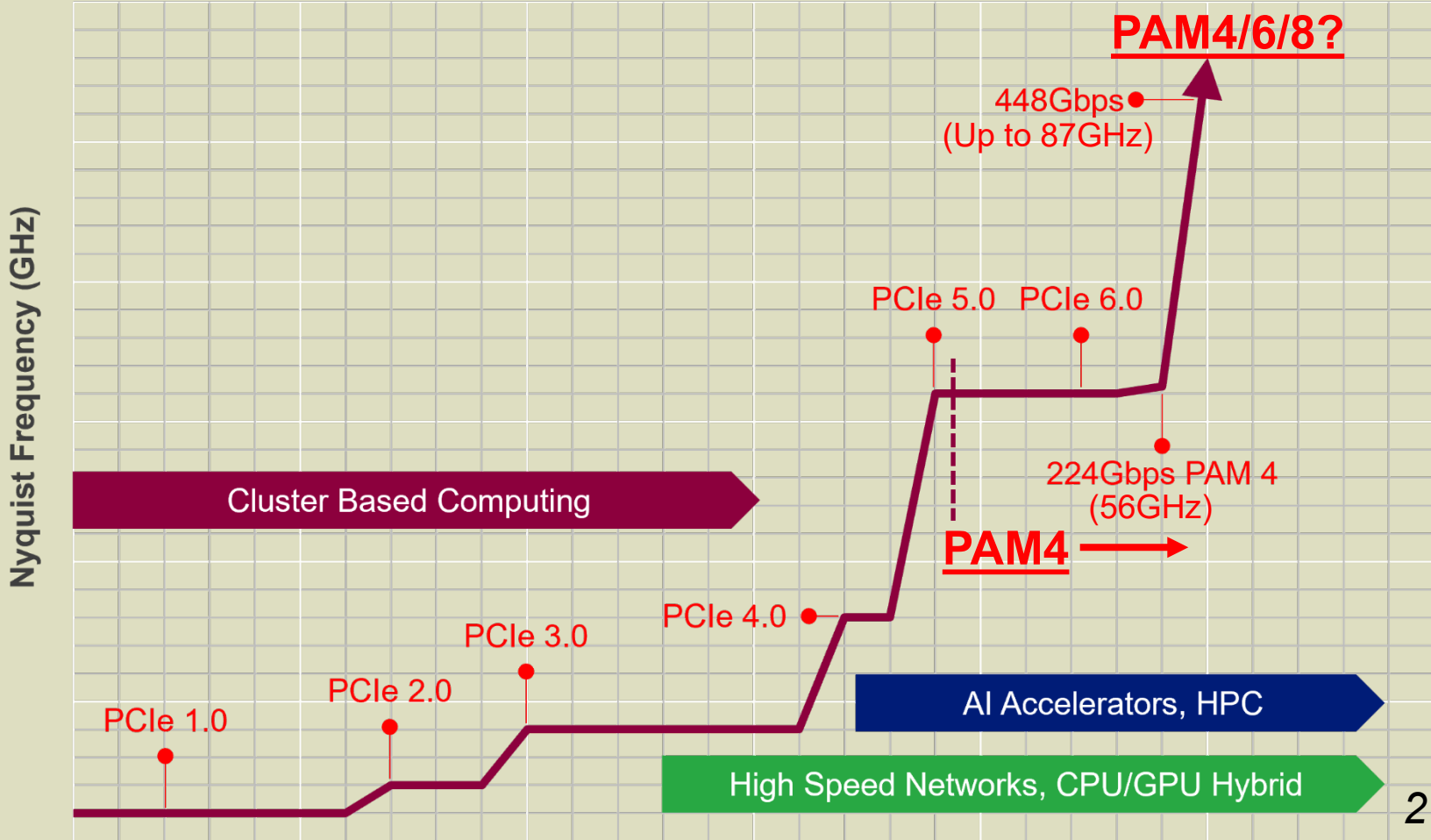
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Noise Challenges

- Increasing Nyquist frequency + PAM4 (or more) signaling
 - Harder to contain crosstalk
 - Signal channels more sensitive to crosstalk
- Certain areas of socket and interfaces are prone to issues that compromise shielding

Technology Drivers



NRZ (top) vs PAM4 (bottom)¹

PAM4 signaling more sensitive to crosstalk

Coax sockets often used to minimize X-Talk

Coax Test Socket Basics

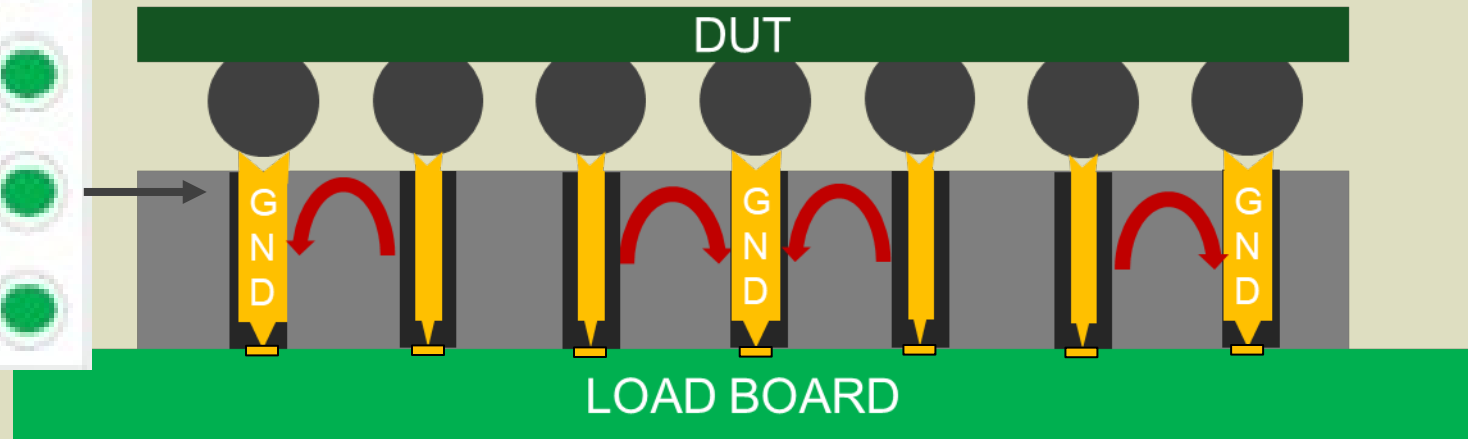
- Transmission line shield typically created by metal socket housing

Socket housing grounded by spring probe lateral contact

RF energy propagation blocked by nearby GND return path

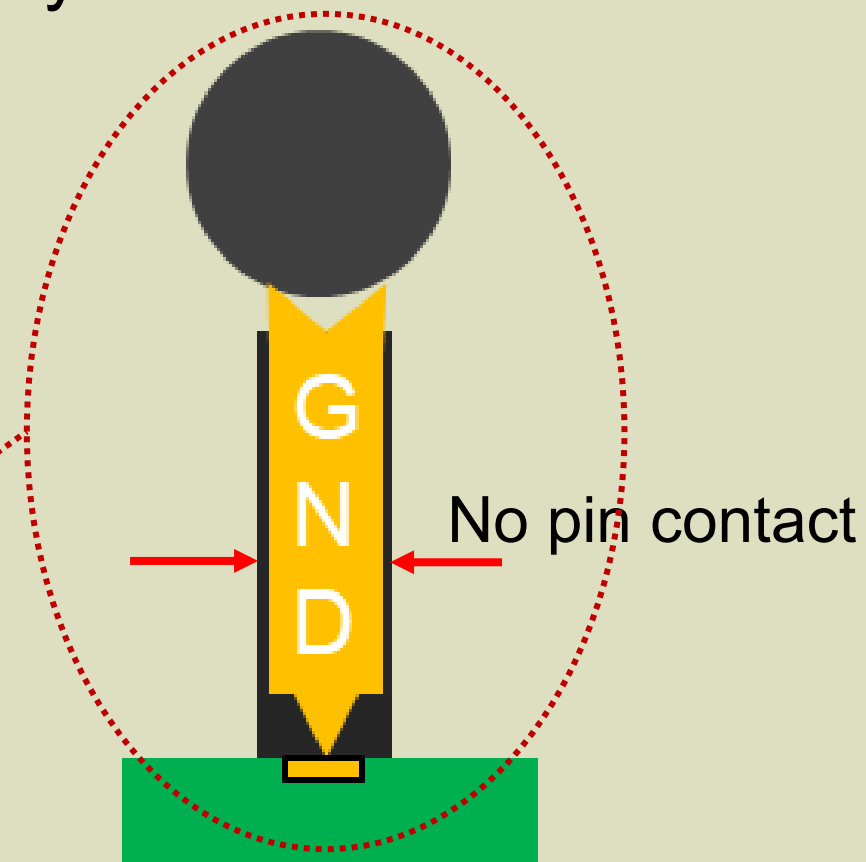
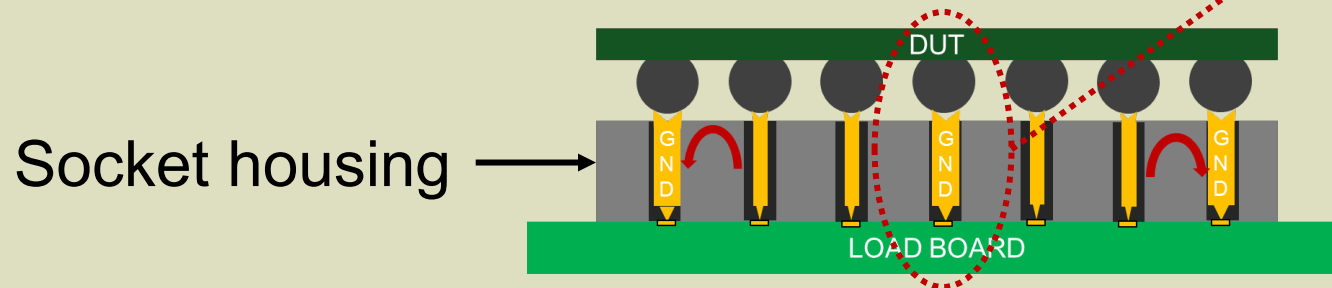
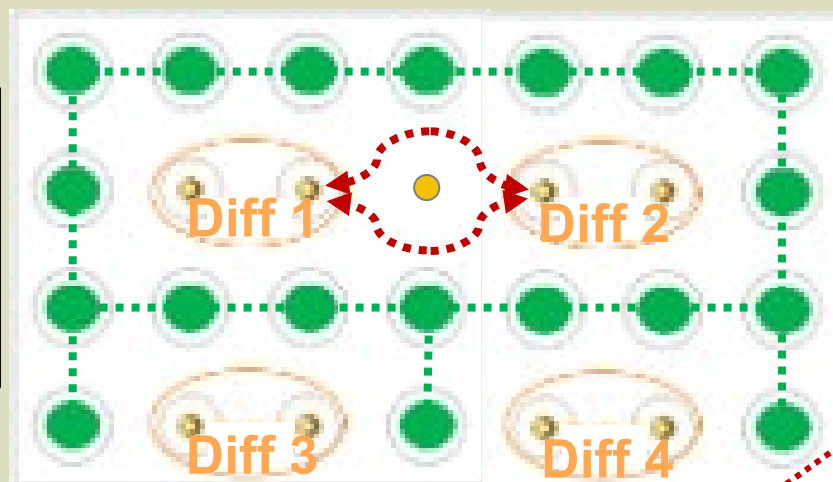
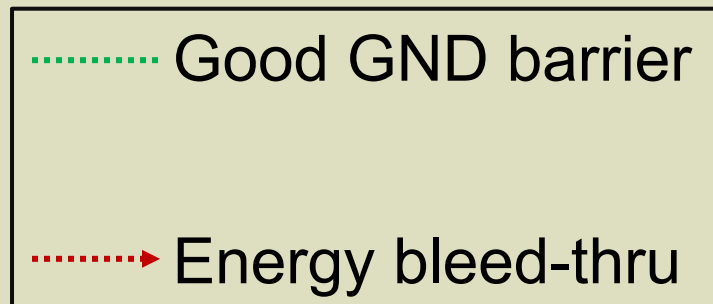


Typical Pattern



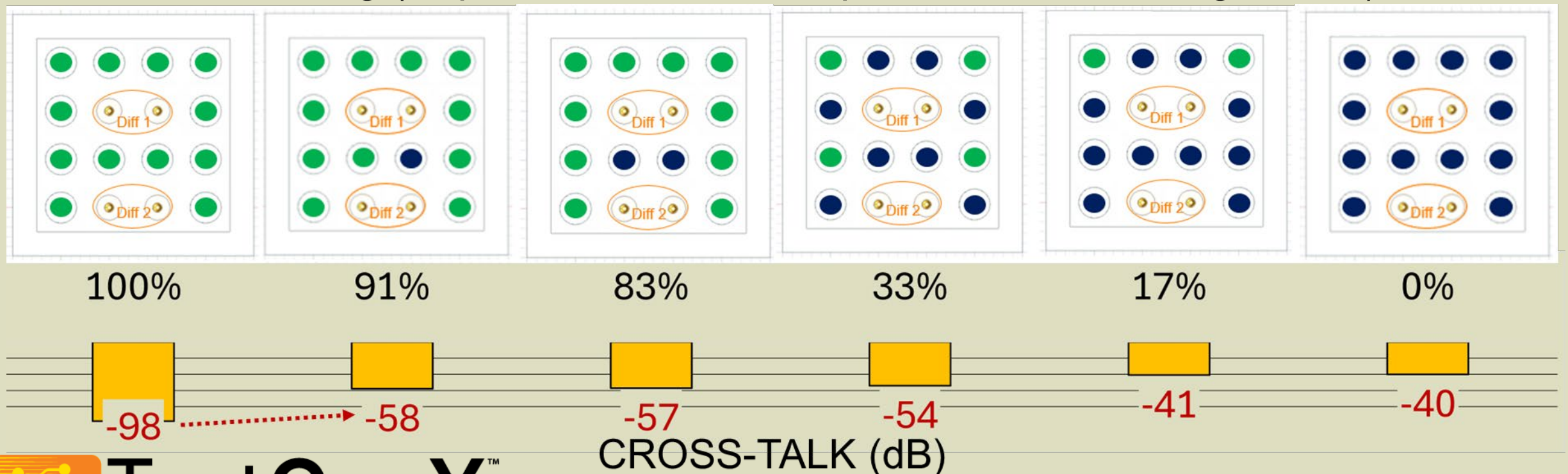
PROBLEM – Poor Ground Pin Contact

- Pin motion, oxidation, etc. affect contact to socket housing
- RF energy not returned to GND as effectively



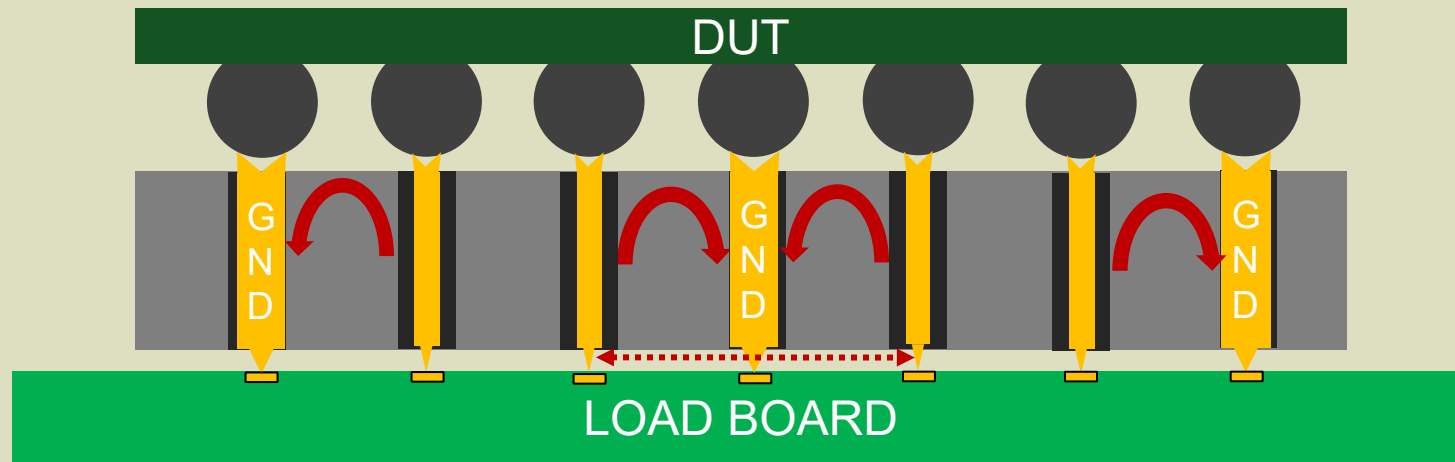
EFFECT – RF Shielding Less Effective

- Poor contact between GND pin and socket housing greatly reduces shielding effectiveness – 40dB worse if one GND between signals is lost!
- In simulation results below, darker dots indicate no GND pin contact to socket housing (all pins connect to PCB pad and BGA ball regardless)



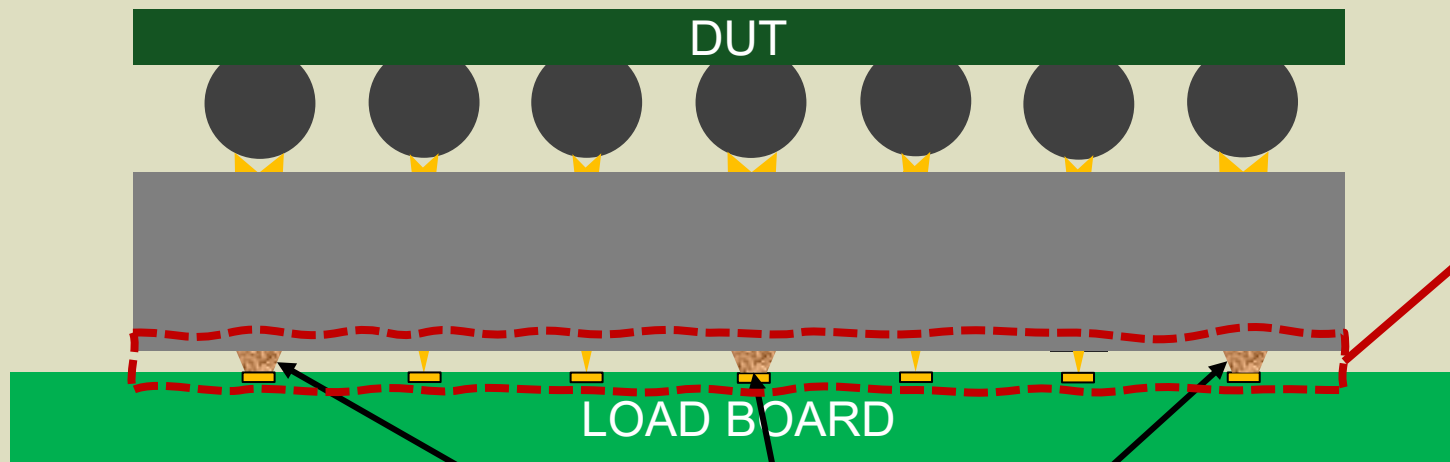
PROBLEM – Insulator or Air Gap Leakage Path

- Warpage of socket or PCB also causes gap / leakage path
 - Spring probe bottom plungers are relatively small, gap between them allows more RF leakage
 - Dielectric insulation on bottom of socket also allows leakage



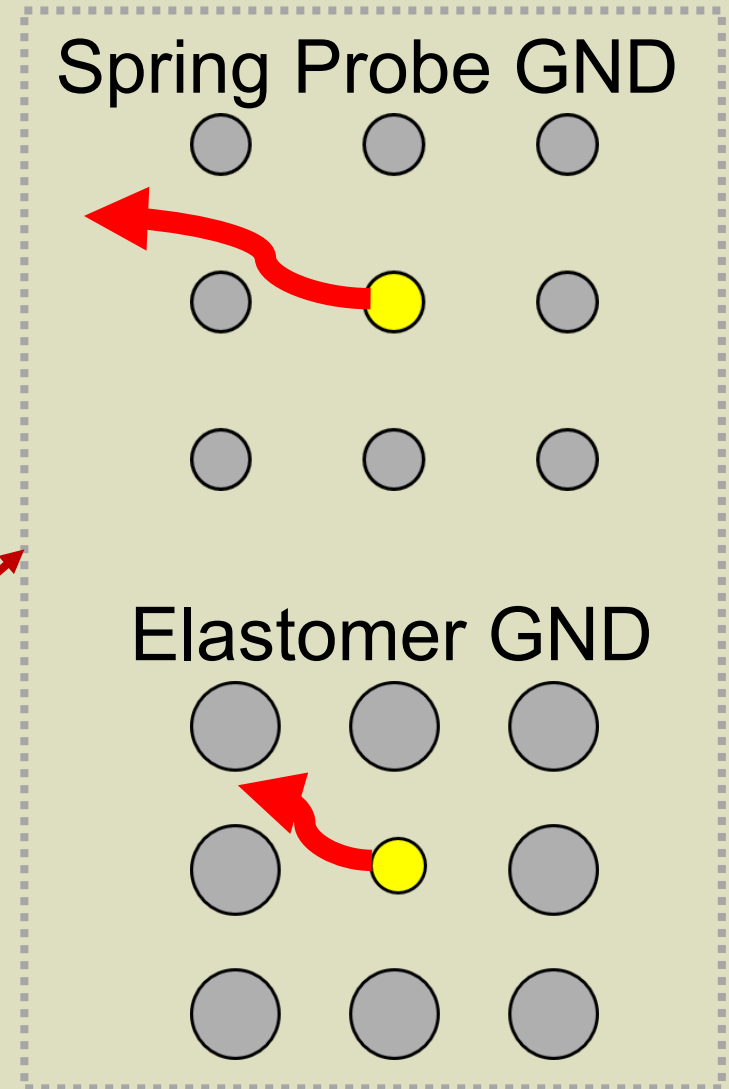
IMPROVEMENT IDEA – Compliant Housing

- Conductive elastomer buttons on bottom of socket housing more reliable than sliding contact
- Buttons are larger diameter, provide better shielding in air-gap/insulator area

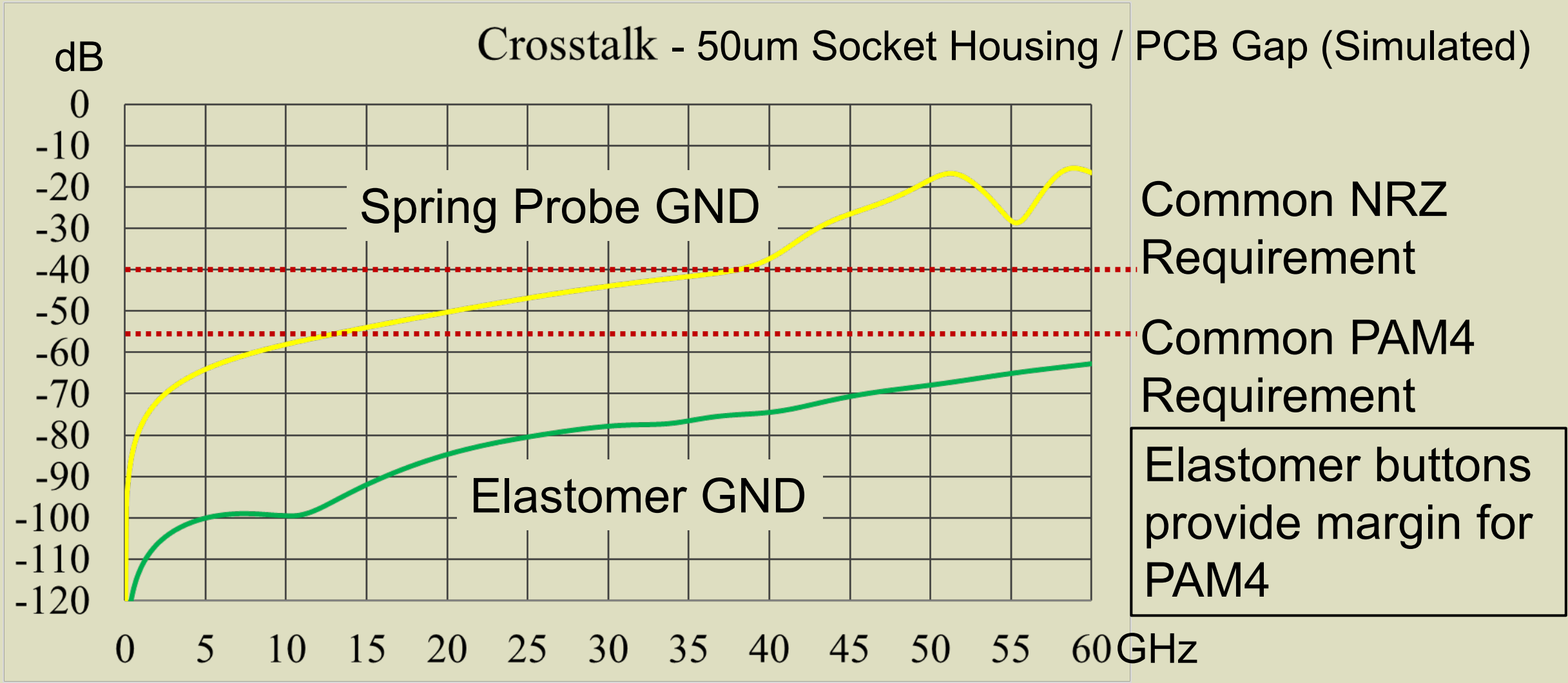


Elastomer GND buttons

Patent Pending

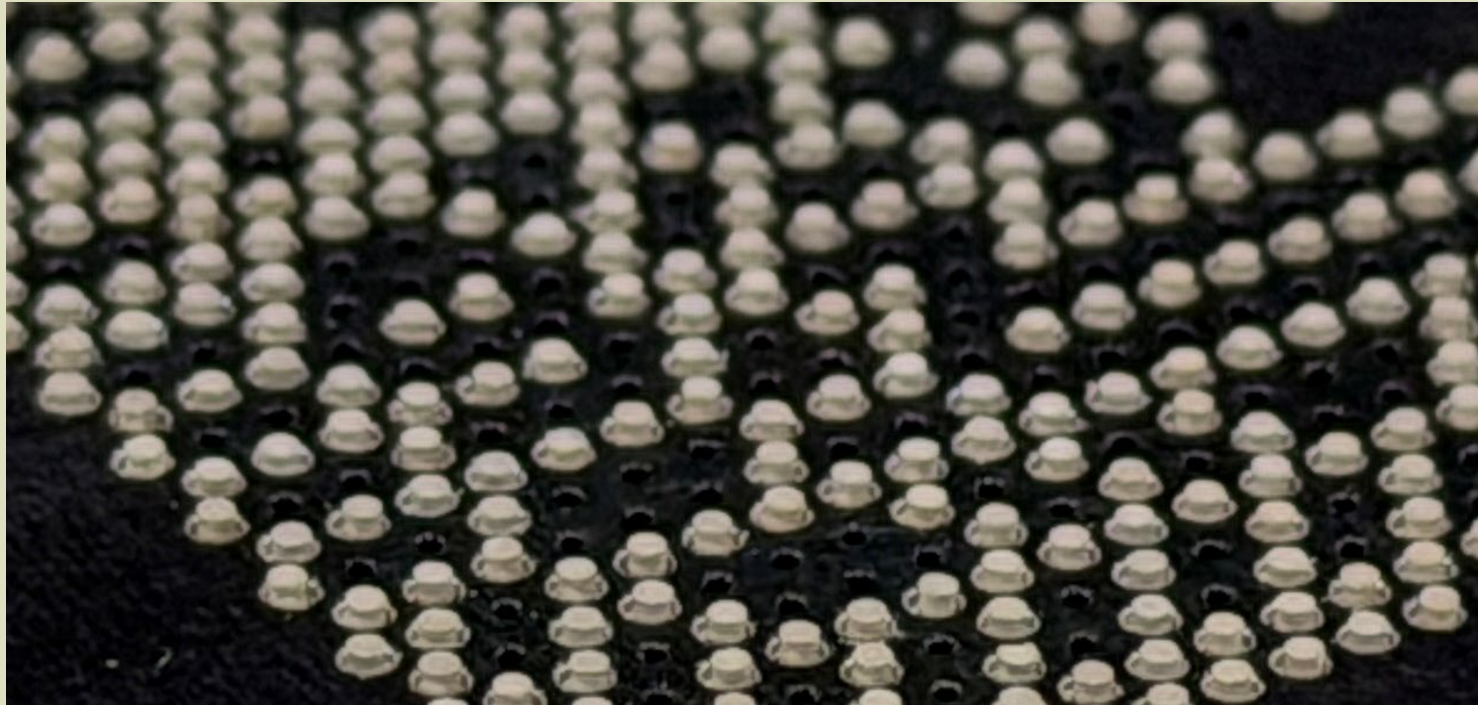


IMPROVEMENT EFFECT – 50um Air Gap



Concept Realized

Socket Bottom Cover with Compliant GND Buttons



CONCLUSION

- Standard socket designs challenged for the high-speed interface requirements now common
- A key limiter is grounding, both socket housing and interface to PCB
- The proposed concept overcomes these challenges while still using conventional spring probes
 - Robust for engineering characterization and HVM package test across -40°C to 150°C
 - No impact expected to socket durability/cycle life



Acknowledgements

- ¹ NRZ and PAM4 Eye Diagrams:
<https://blog.samtec.com/post/understanding-nrz-and-pam4-signaling/>
- ² (Untitled) Nyquist frequency progression chart, Quaid Furniturewala, Advantest Interconnect Solutions (AIS)

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