TWENTY-SEVENTH ANNUAL

TestConX™

Archive

DoubleTree by Hilton
Mesa, Arizona
March 1-4, 2026

Probing Sockets at 224 Gbps

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Mesa, Arizona • March 1–4, 2026

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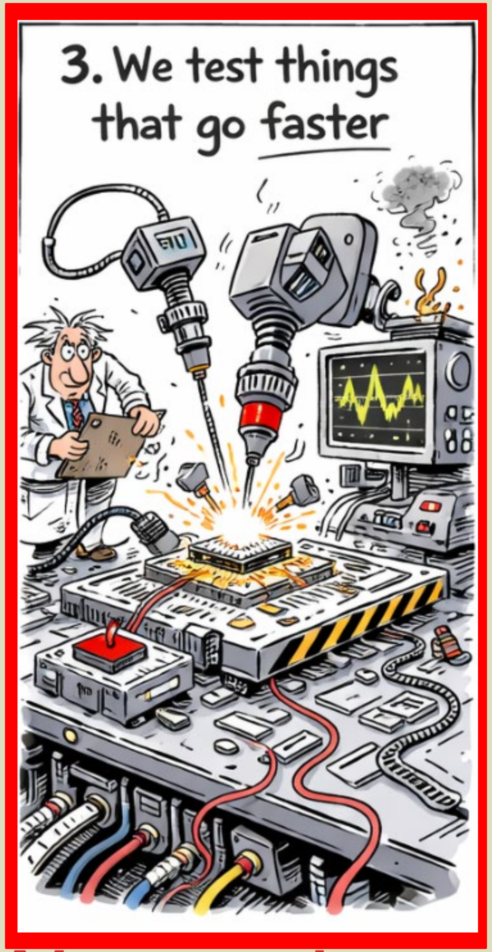
The Big Picture



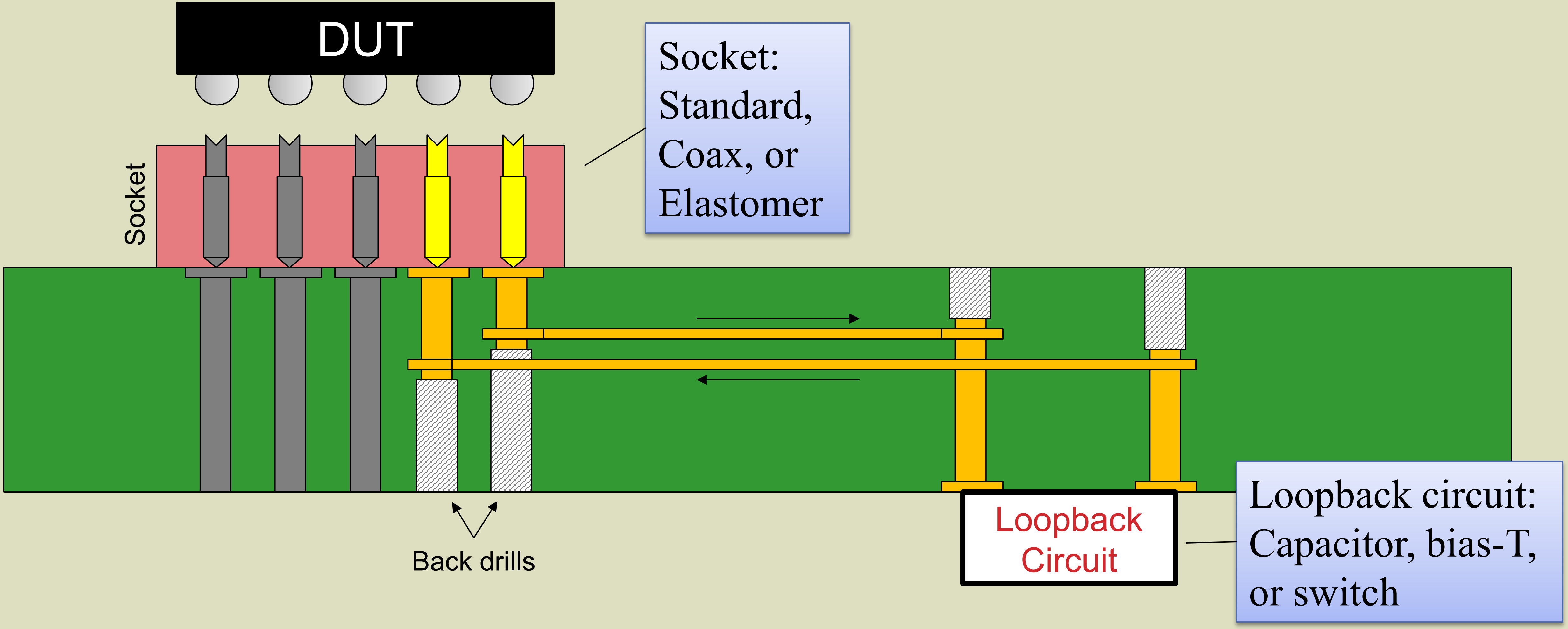
We are here

224 Gbps – Testing More Important than Ever

- Design does not equal reality
- Simulations follow the rule of “garbage in, garbage out”
- Components often do not match simulations
- Part models aren’t always accurate – even when provided by the manufacturer
- Tolerances affect results

Most important: Many things can and do go wrong in a 224 Gbps design. You must be able to quickly identify and fix any issue discovered.

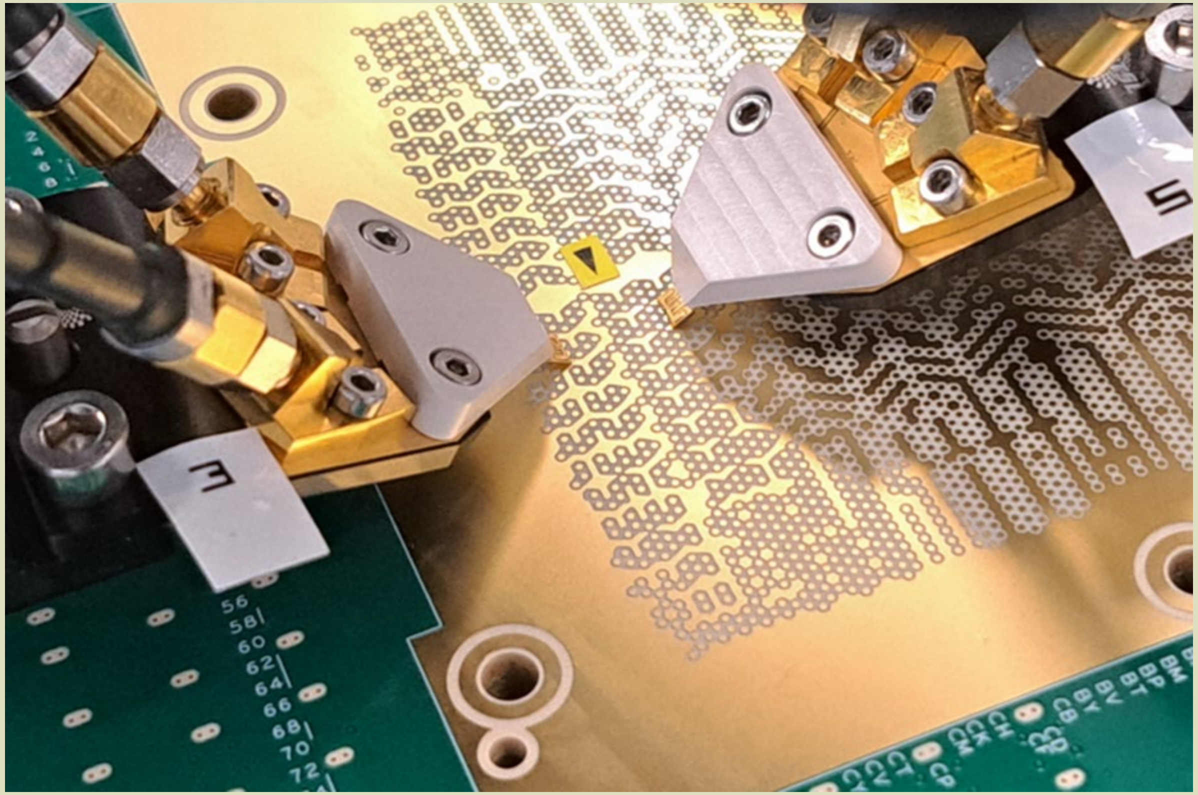
For Reference: A Standard SerDes Test Structure



Measuring the Board

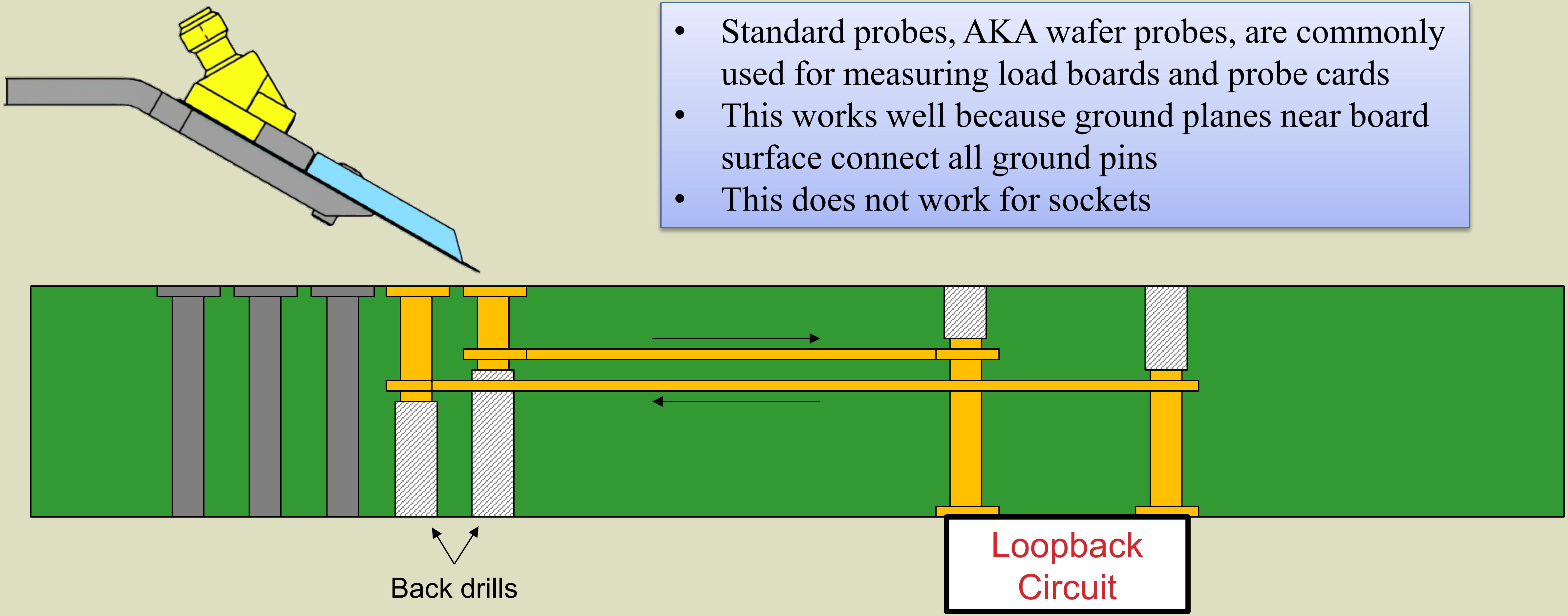
Today if testing is done, it is done by probing the board with “wafer probes”

- Probe pitches from wafer-scale to PCB-scale
- Standard configurations
  GSG, GSSG, GSGSG, etc.
- Smaller pitches are used for wafer testing; larger pitches for PCB testing
- Probes are removed from measurements with calibration substrates



The Standard SerDes Test Structure

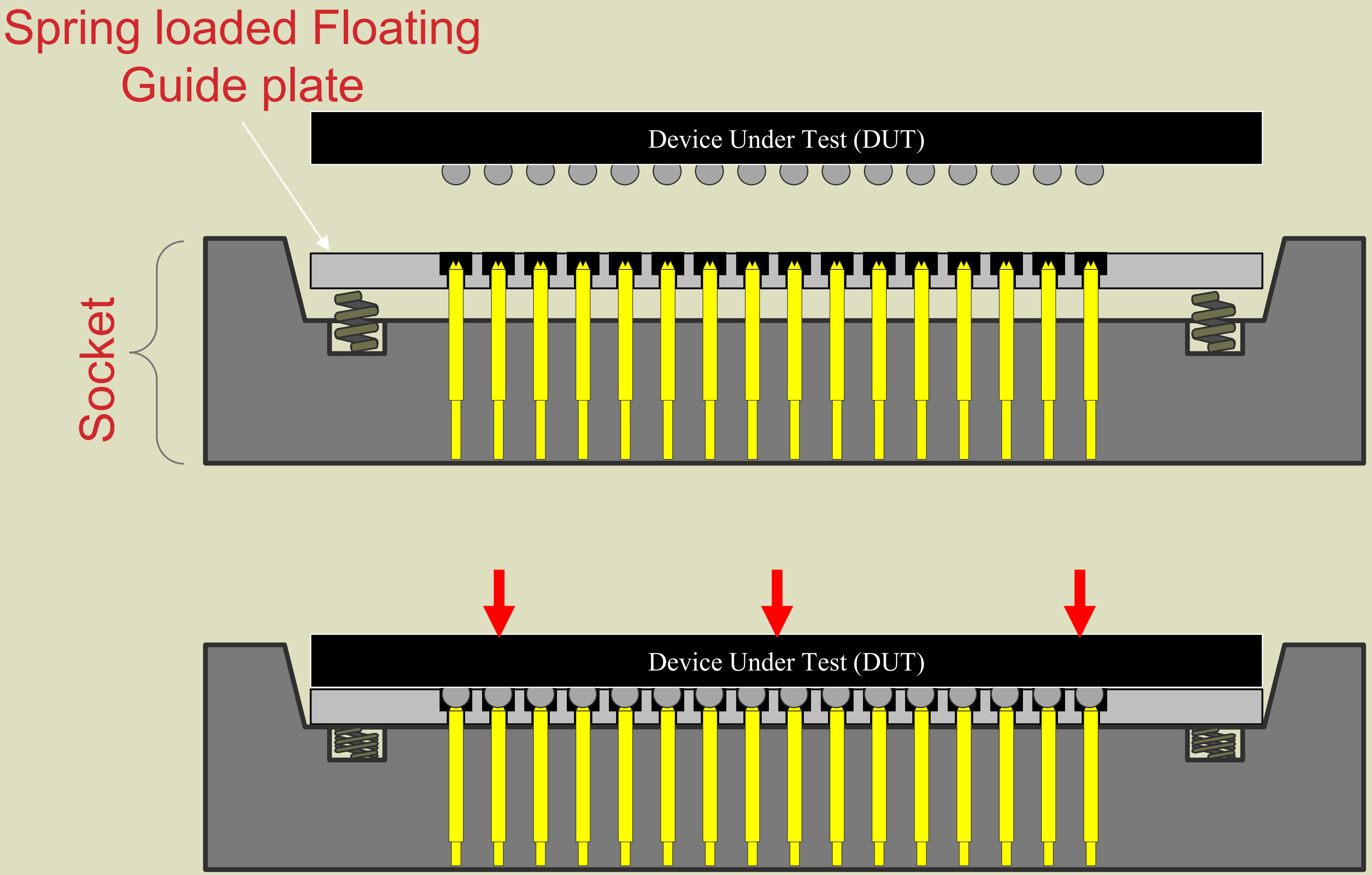
- Standard probes, AKA wafer probes, are commonly used for measuring load boards and probe cards
- This works well because ground planes near board surface connect all ground pins
- This does not work for sockets



The only thing worse than no test is a confident but incorrect test…

(We need to test the socket too!)

Typical Socket Construction



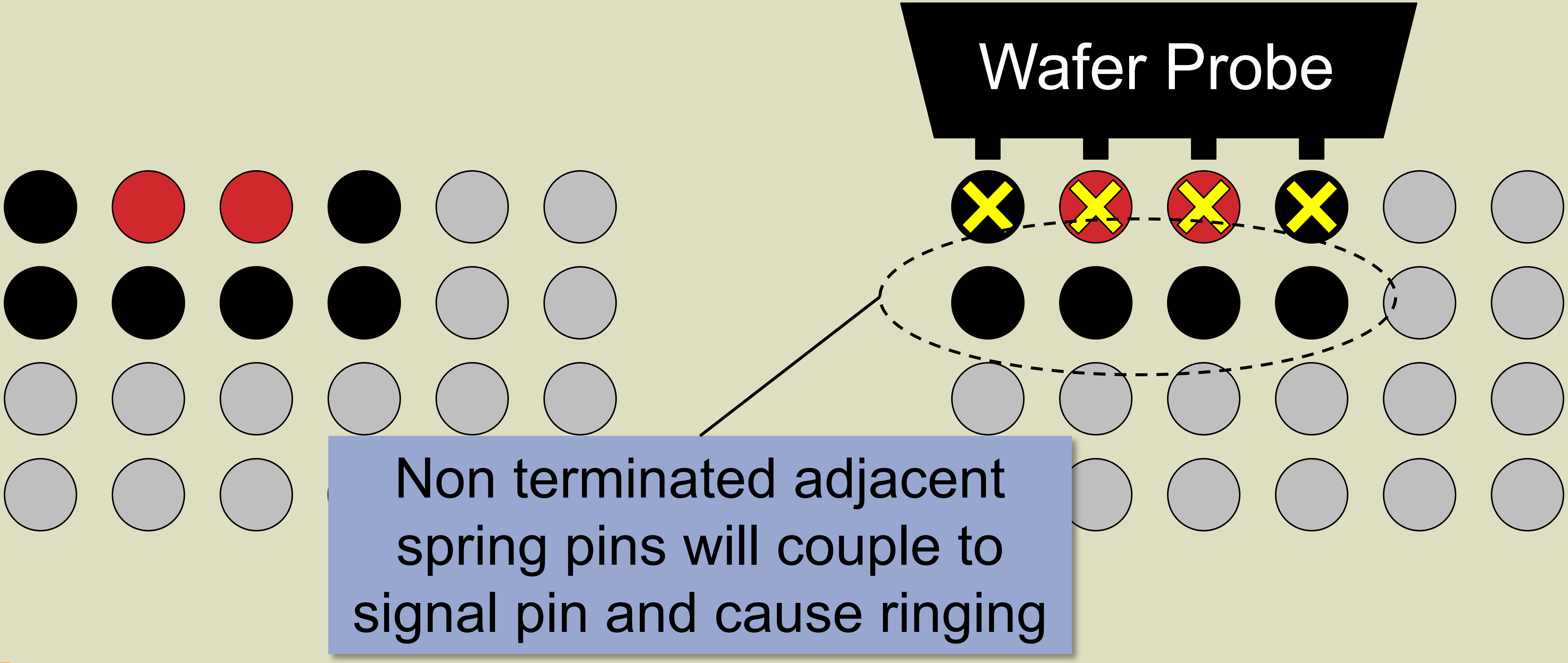
The DUT is aligned to the floating plate as it's inserted into the socket

The floating plate aligns the spring pin to the center of the solder ball as it's compressed

A handler typically pushes the DUT into the socket until it bottoms out; this defines the test position

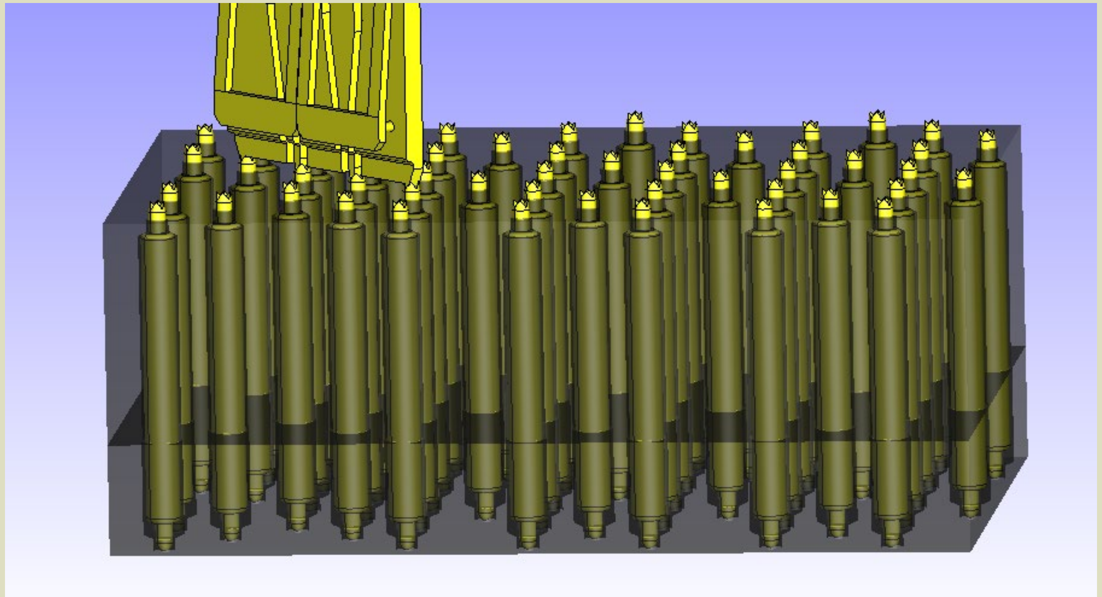
Option #1: Standard Probes

- Standard probes only touch down on a line of probes

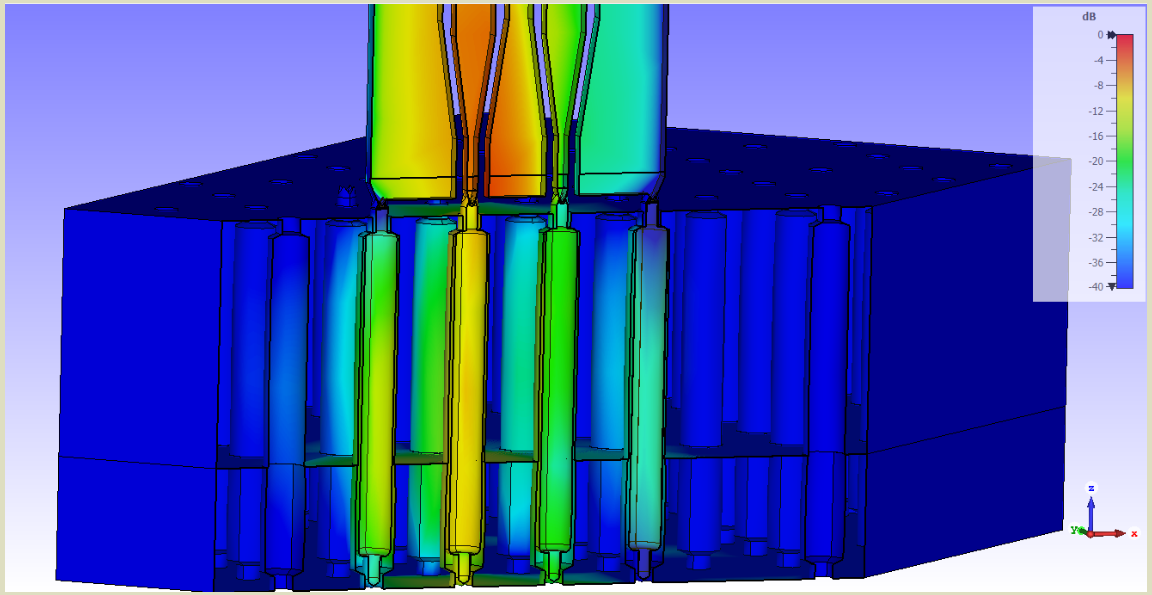


Unconnected Pogo Pins in Measurement

Standard probe mounted vertically



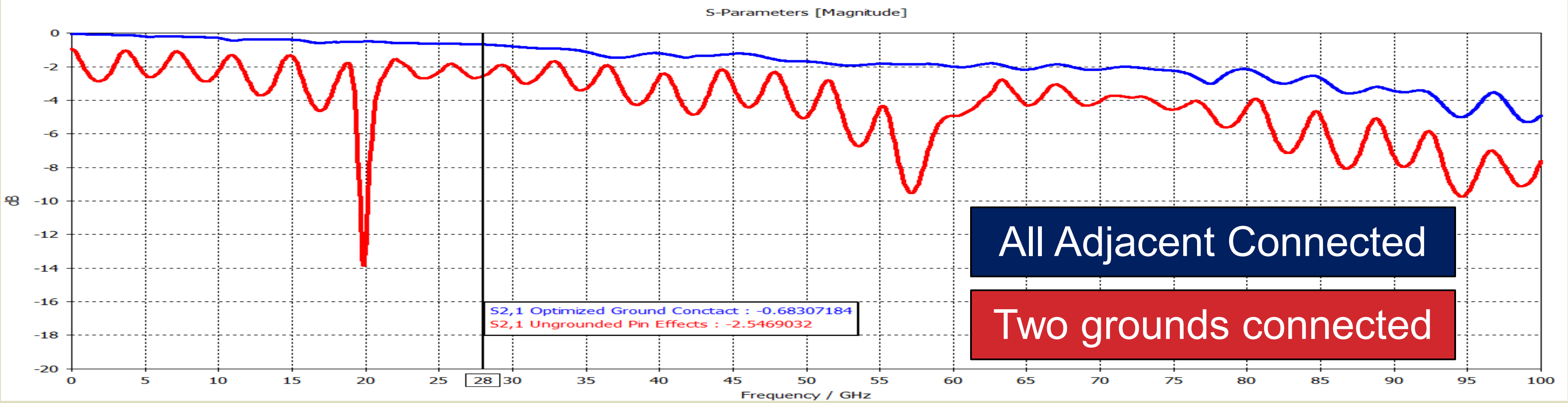
Coupling to adjacent probes

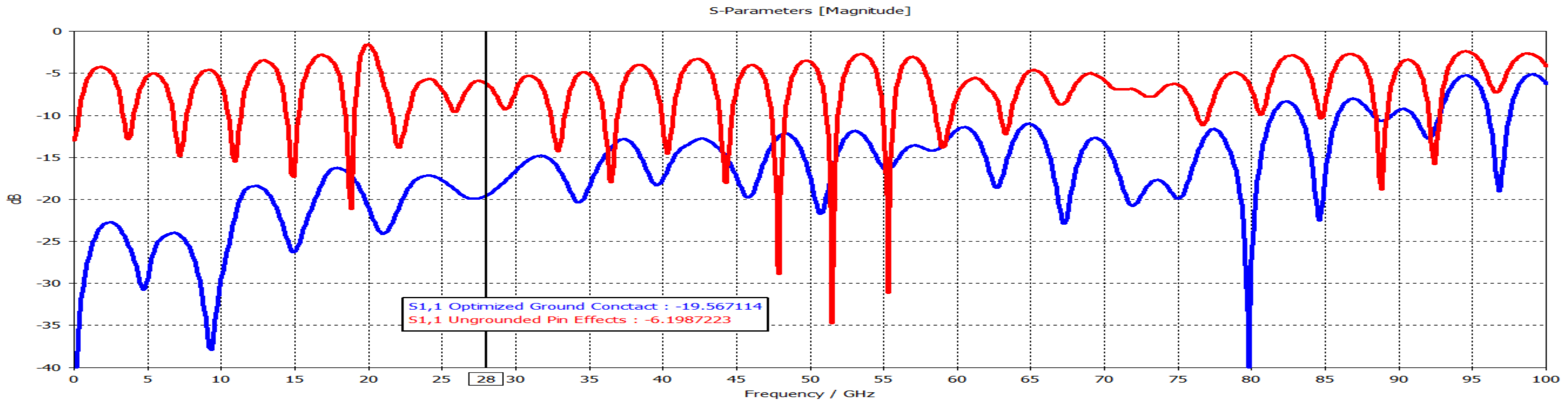


Energy on floating (non-grounded) pins does not propagate downstream

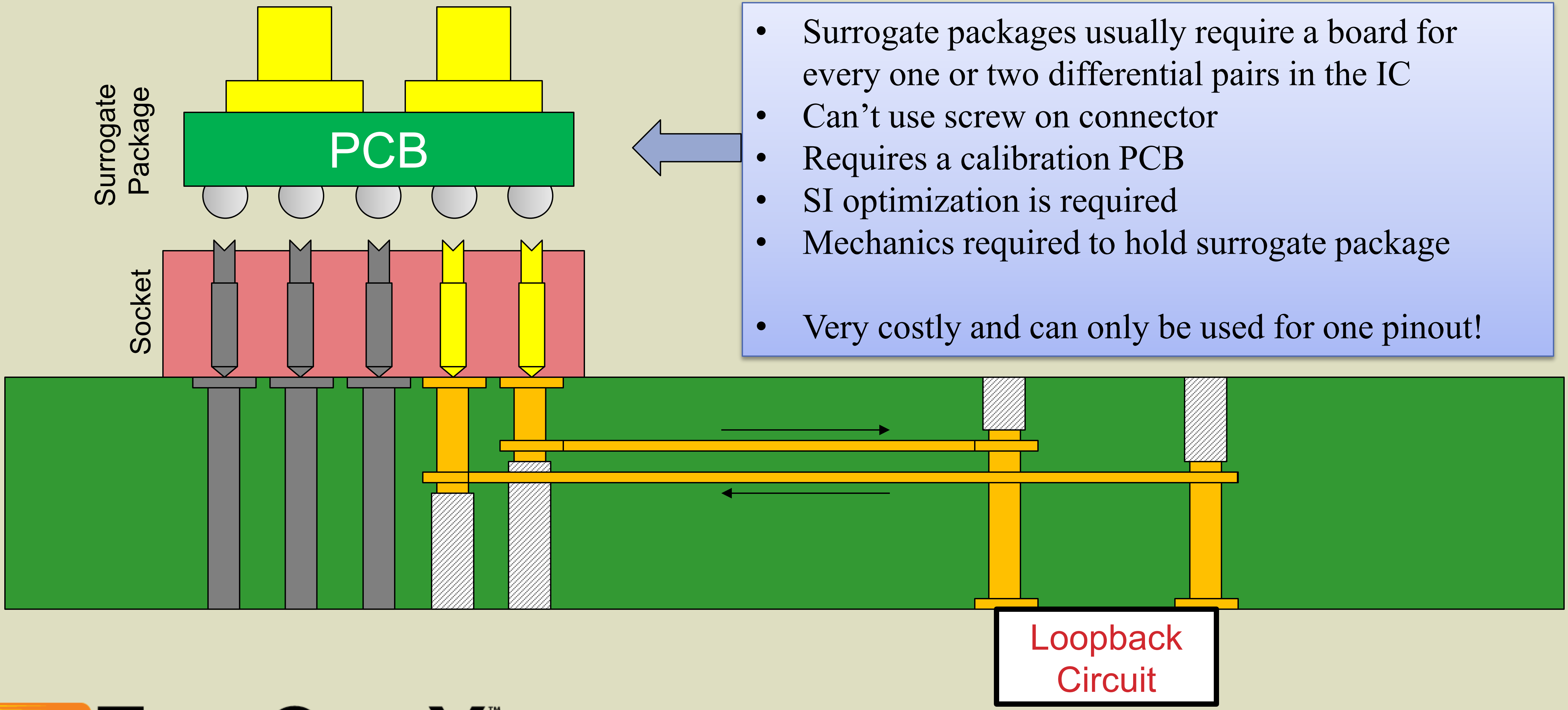
Standard Probe Simulated Measurement

- Unconnected grounds in socket causes ringing
- Using a standard probe gives inaccurate results





Option #2: Surrogate Packages



- Surrogate packages usually require a board for every one or two differential pairs in the IC
- Can't use screw on connector
- Requires a calibration PCB
- SI optimization is required
- Mechanics required to hold surrogate package
- Very costly and can only be used for one pinout!

Option #3: Build Your Own Probe

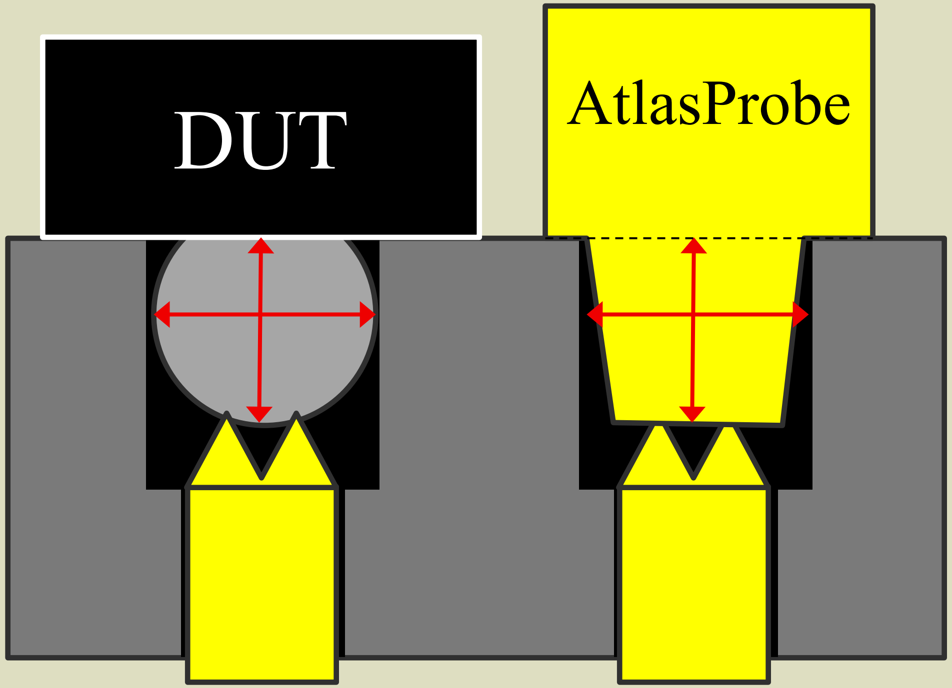
<u>Problem Statement</u>

- We need a probe that touches down on multiple pins in a 4x3 array
- It must be higher performance than the PCB we're measuring (>60 GHz for 224 Gbps PAM4)
- Must be able to calibrate it out of the measurements
- At least two must work at the same time for loopback measurements
- Must allow line-of-sight for probe alignment
- Must be reusable

* Must work with a floating guide plate

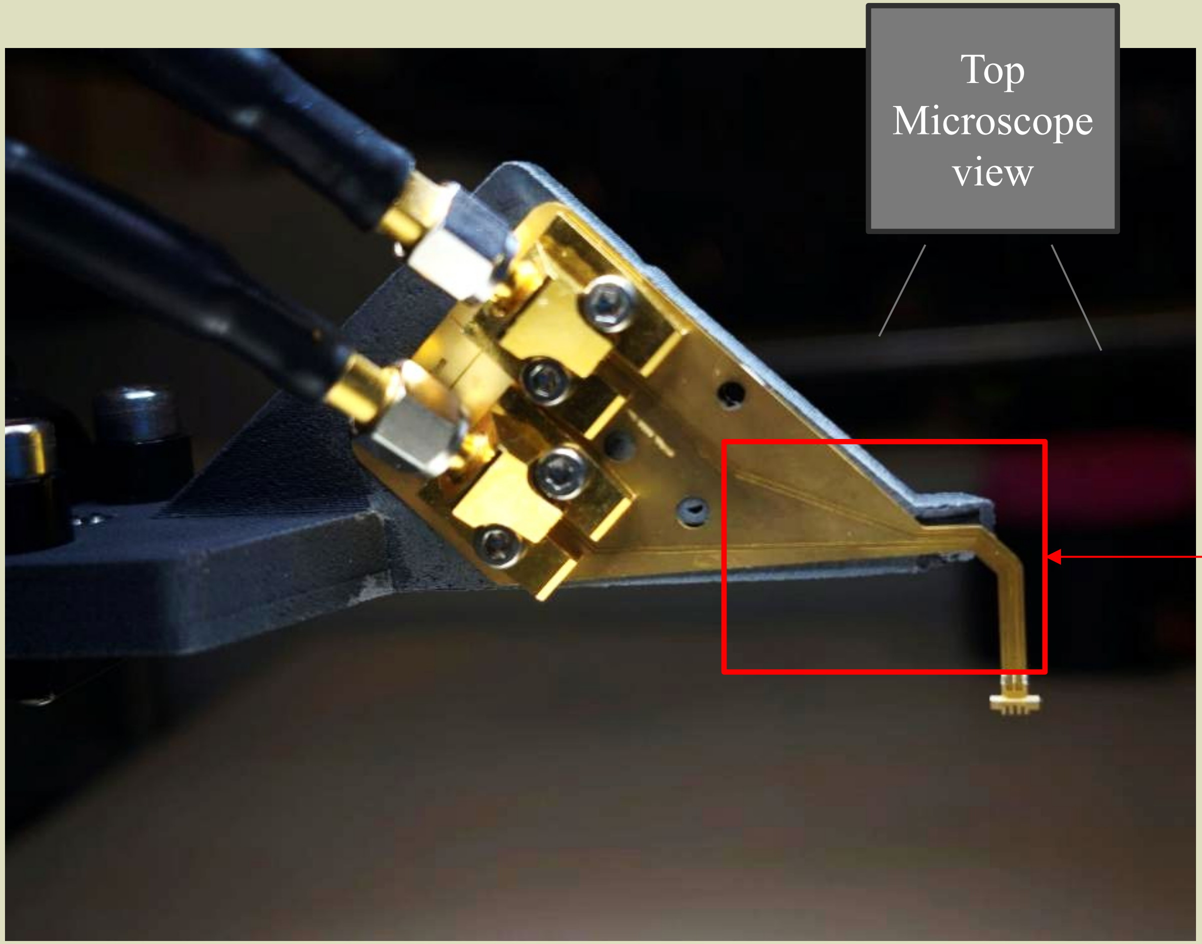
Probe Mimics the Solder Ball

The section of the probe that reaches into floating plate is sized to exactly match the nominal solder ball depth. This gives the most realistic measurement of the socket's performance.



Similar width and height

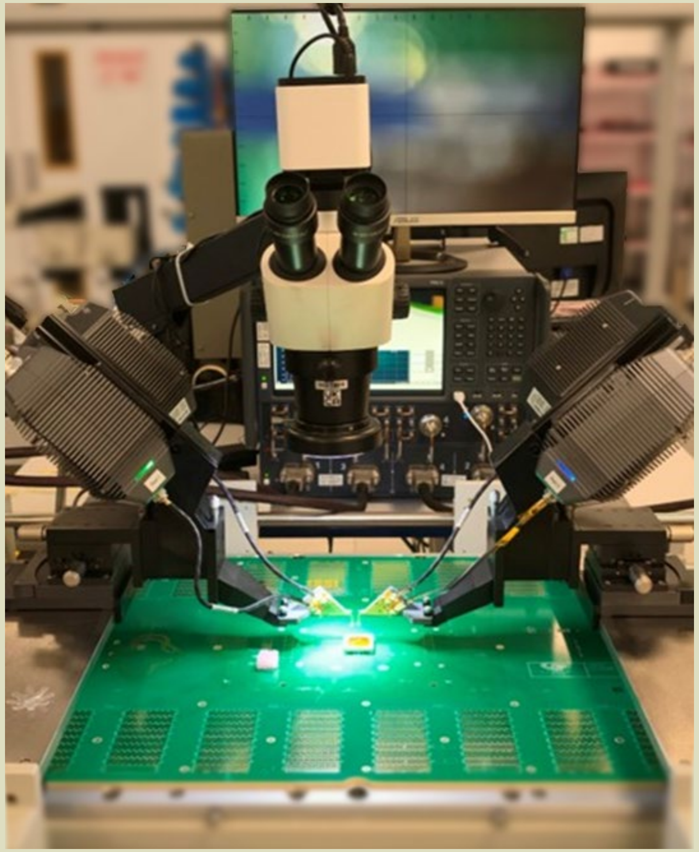
The AtlasProbe

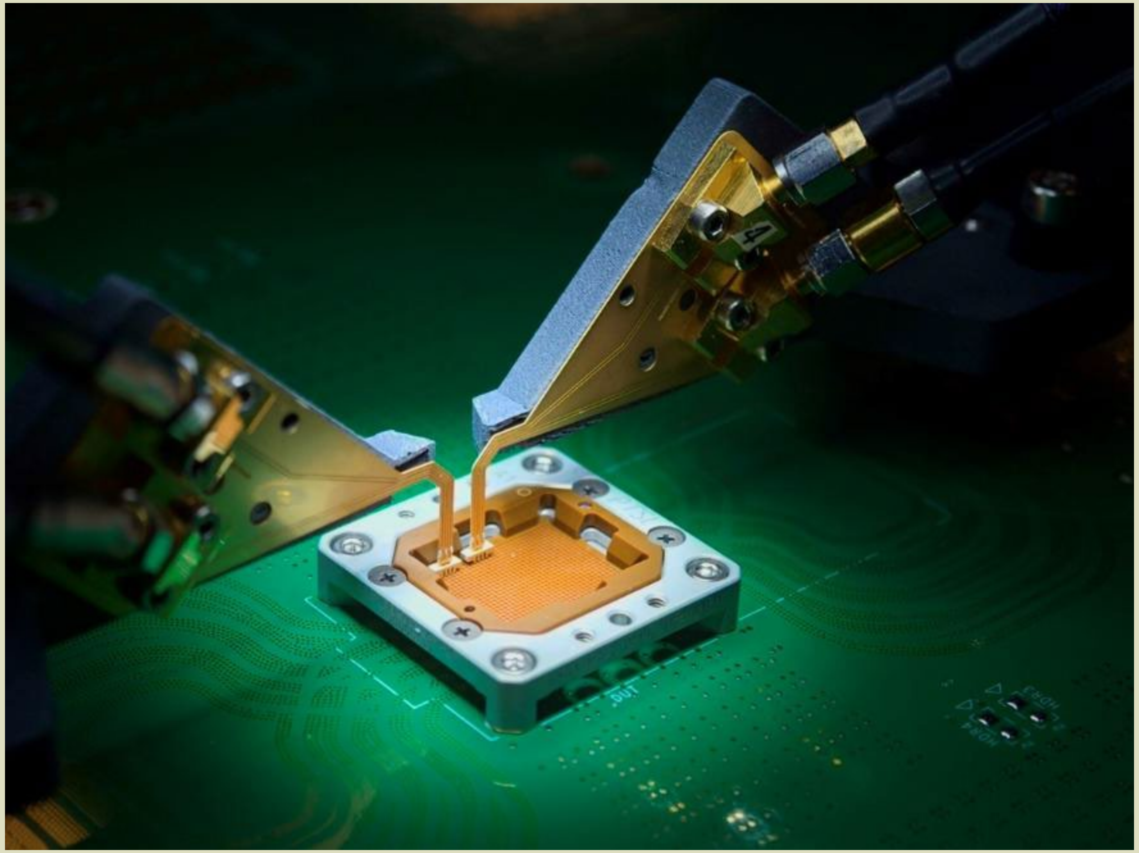


CPW jog allows for better viewability from above for aligning probe and allows for reaching over socket walls

Coplanar wave guide construction – Used effectively to 110 GHz+

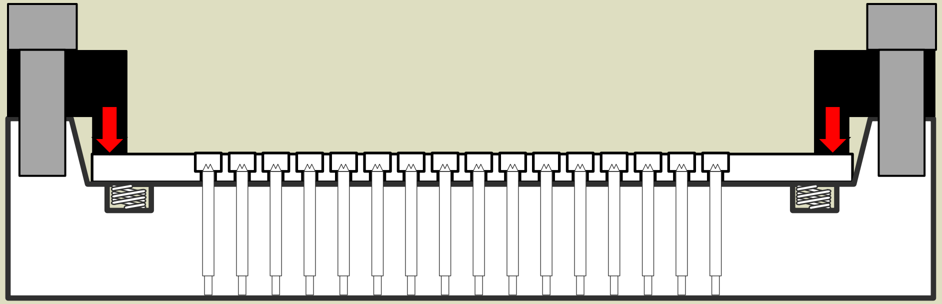
AtlasProbe in Action

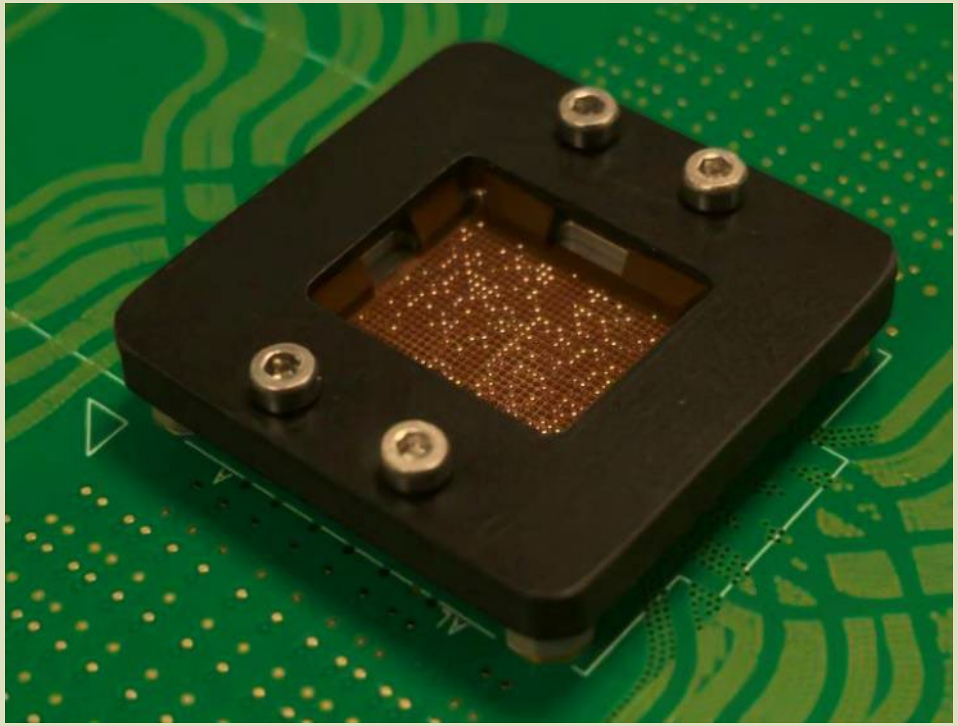




Compressing the Floating Guide Plate

- A simple 3D printed compression plate is used to depress the floating guide plate during testing
- This must be done to put the socket in the correct configuration for measurements. If skipped, additional inductance will appear at probe tips.



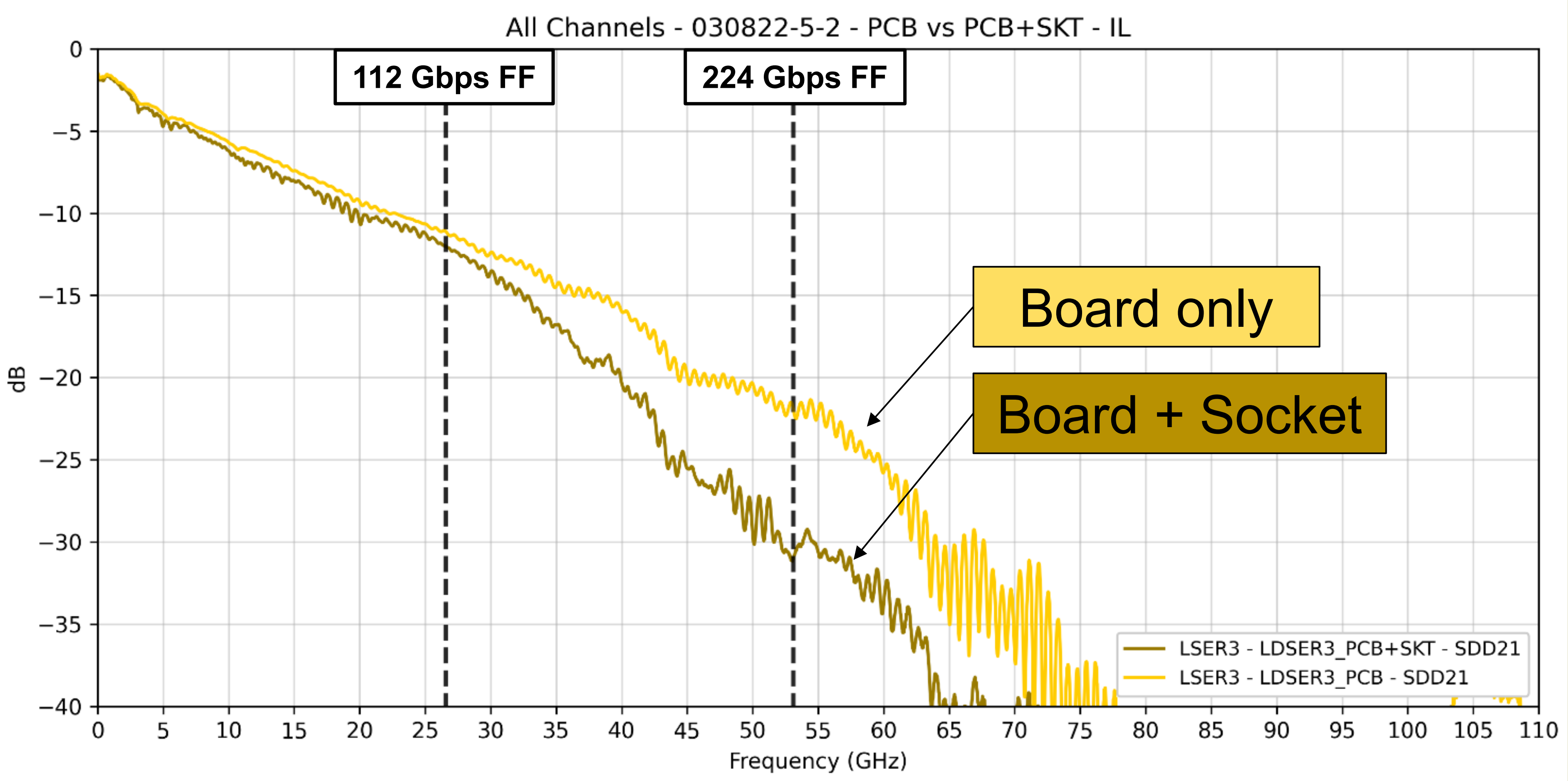


Measuring with NuvoRF and AtlasProbe

- The evaluation board was first measured using NuvoRF wafer probes
- Socket was installed, floating plate was compressed, and the board was measured with an AtlasProbe
- Several calibration options were tried for the AtlasProbe

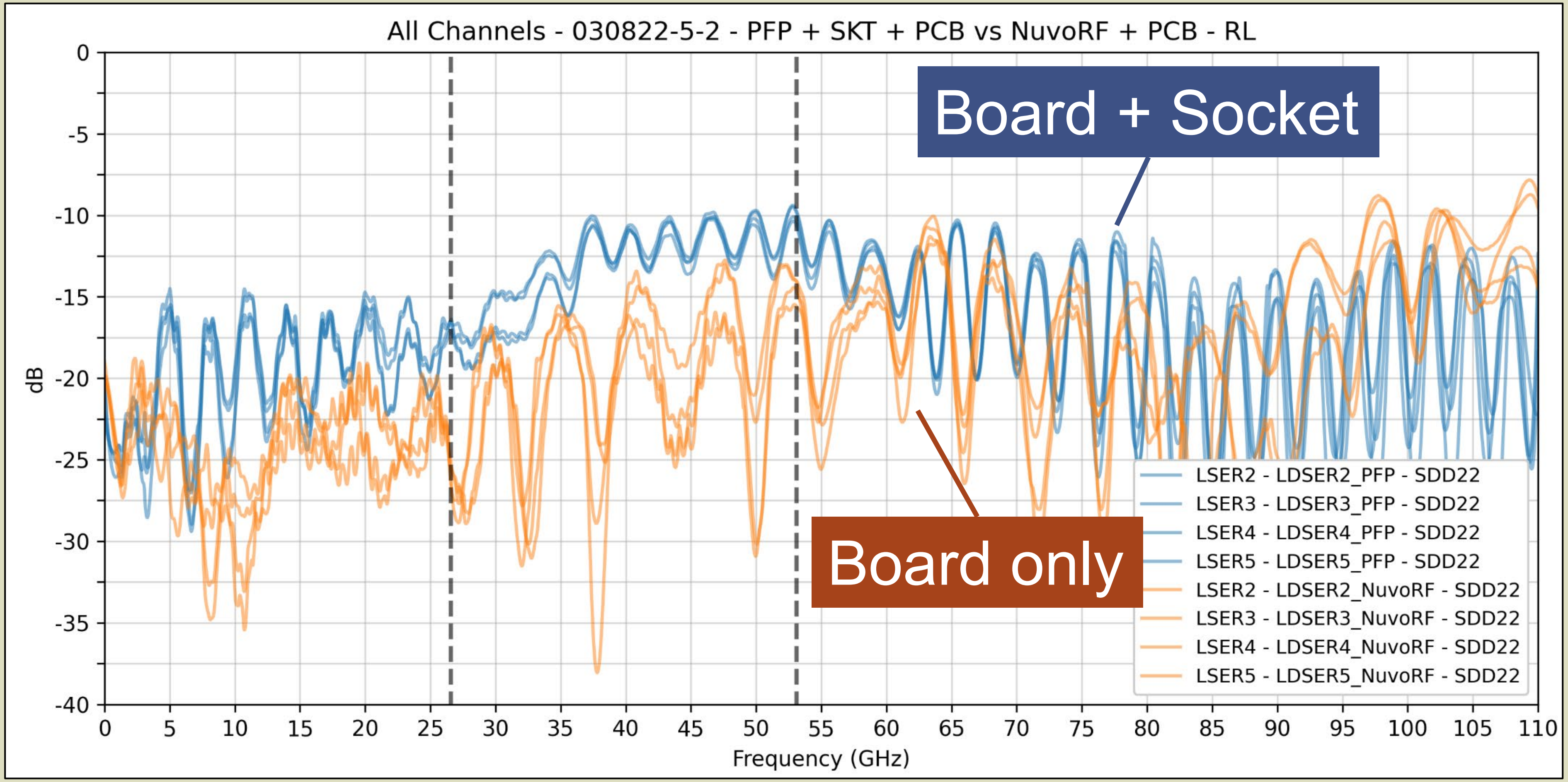
Board vs. Socket Measurements: Insertion Loss

- Board has design target of 26dB loss +/- 4dB (loss was added to hit this target)
- This is a loopback measurement, so the delta shown is two trips through socket



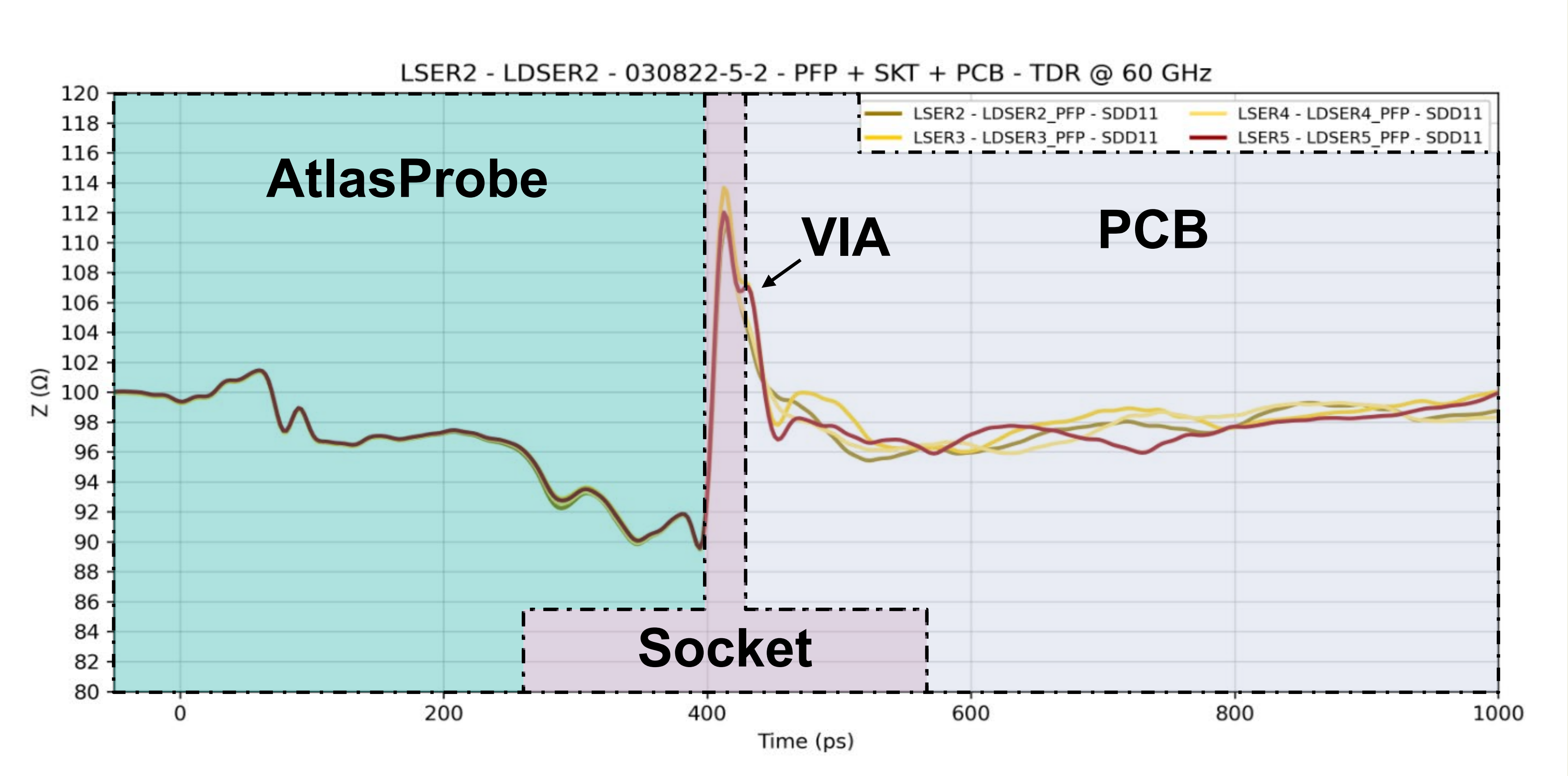
Board vs. Socket Measurements: Return Loss

- Socket discontinuity significantly degrades return loss
- This is especially visible due to the high loss loopback circuit. High board loss masks reflections from the loopback circuit.



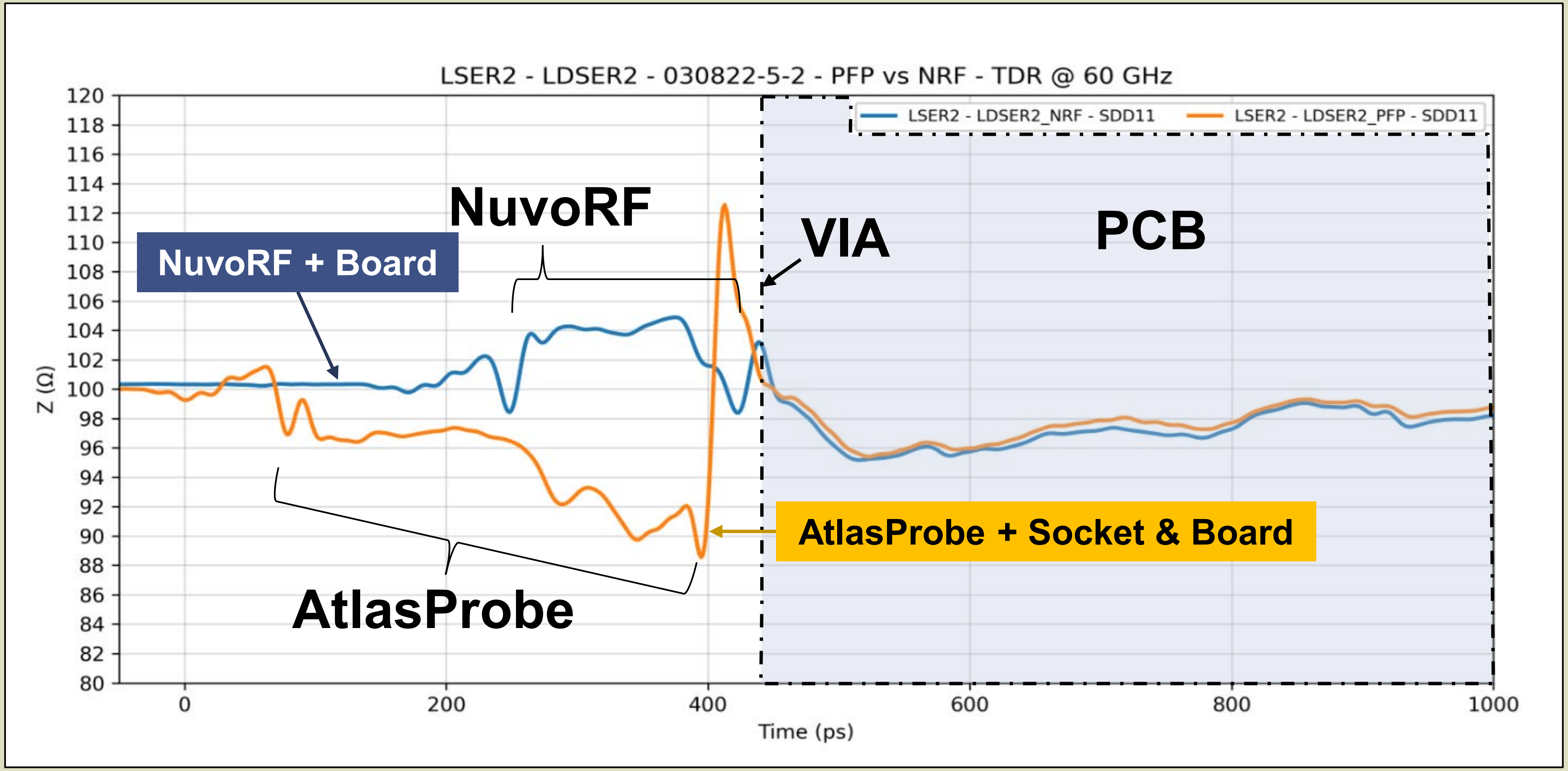
Board + Socket TDR (*Using AtlasProbe*)

- Inductive spike seen at Socket which was not present on PCB only
- This shows the reason for the large return loss from adding in the socket



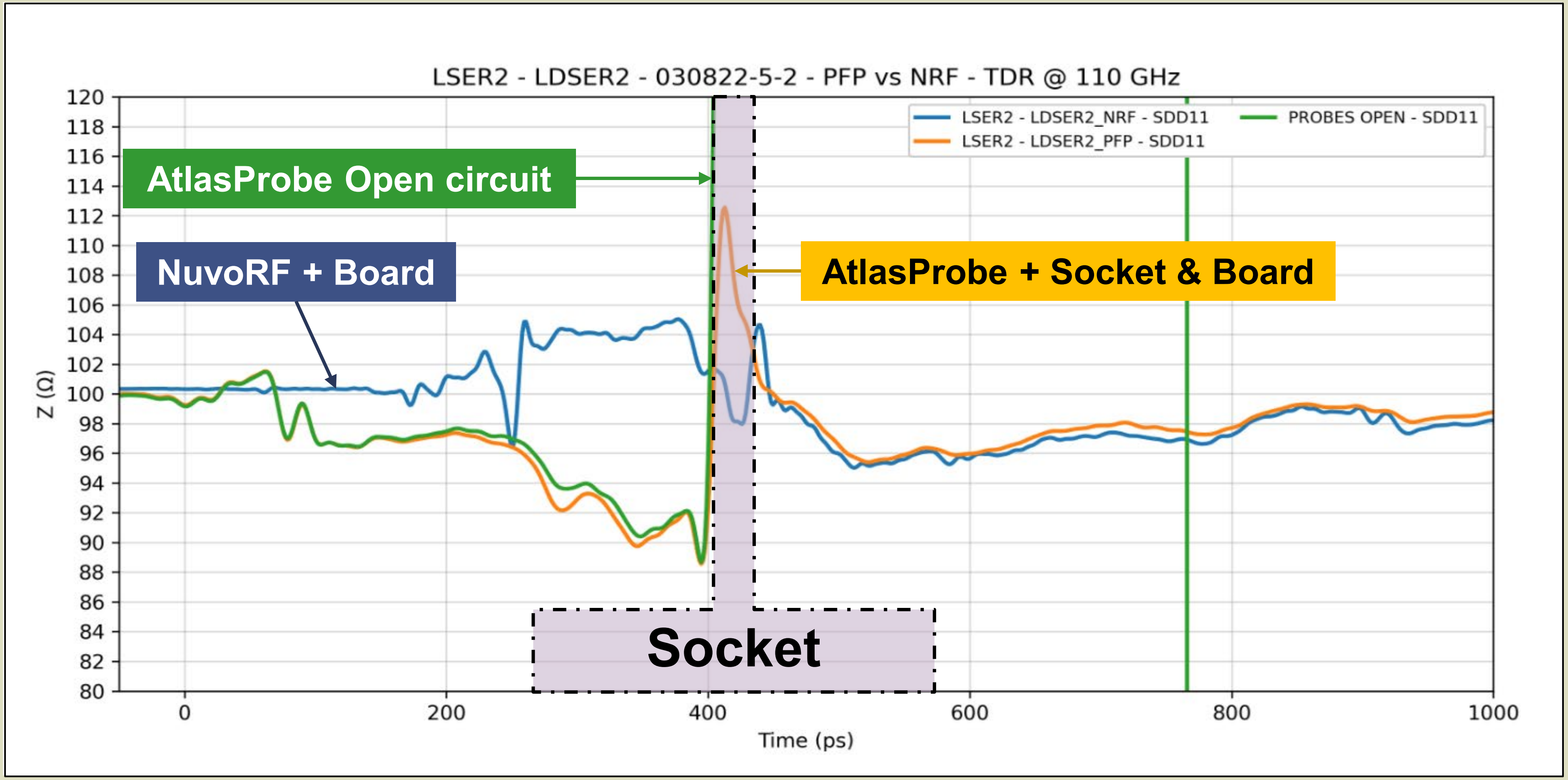
Board + Socket TDR

- The inductive spike only shows up on the Probe and socket measurement



Double Checking Our Work

- We know exactly where the socket is with an open circuit AtlasProbe (socket start) and seeing where NuvoRF and AtlasProbe measurements line up (socket end)
- This verifies the socket, not AtlasProbe, is causing the impedance spike



Conclusion

- The socket is a critical piece of test circuitry and must be included in validation of high-speed test equipment
- The AtlasProbe is a successful tool for measuring sockets that is accurate up to 224 Gbps and a useful piece of metrology equipment
- This probe solution is reusable across projects, reducing overall cost and improving ROI for the probe

Special Thanks

- Tim Rey
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- Robin Cedeno
- PTSL’s MEMs Fabrication Team