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The Implementation of RC Springprobe™ Technology into Massively Parallel, Discrete Node, Low Force Space Transformers

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Overview

- **What is a Space Transformer (with respect to this work)**
  - Current Needs in Space Transformer Interconnect Technology
- **New Compliant Contact Technology adapted to Space Transformers**
- **Field and Lab Testing of the New Technology**
- **New Technology Incorporated into Space Transformer Designs**
- **Summary**
- **Future Experimentation**

Space Transformer

- **Interface required to change pitch and/or stack height within a vertical electric sub-system such as a probe card assembly.**
  - Comprised of at least one compliant Interposer and a pitch reducing interface board such as a substrate or PCB
- **Interposer also known as:**
  - Probe Ring, Probe Tower, Interface Block, Compliant connector
- **Presentation focuses on the Interposer**

Space Transformer Interconnect Desired Characteristics (need)

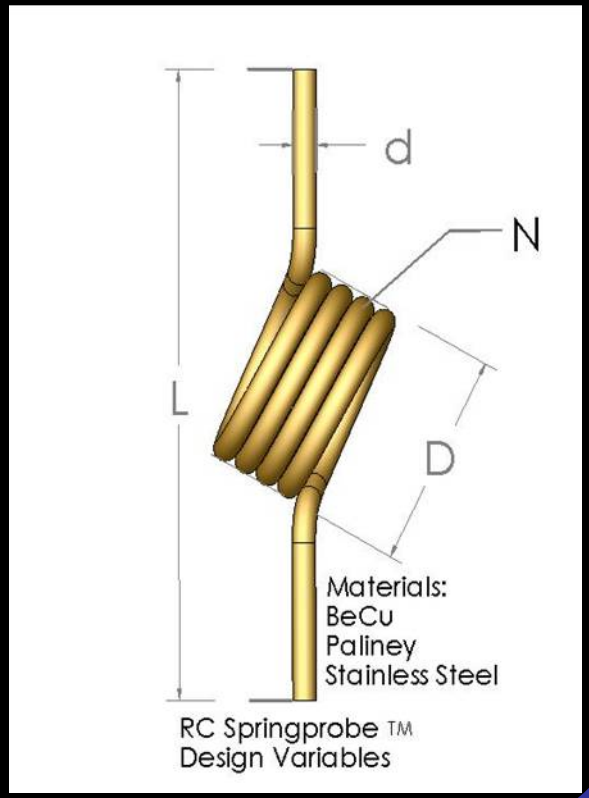
- Ultra high node count capability, >20000
- Low contact force, <10 grams/node
- Low and Consistent Contact Resistance
- Stable Resistance at Elevated Temperature
- Low cost per node
- High Bandwidth, >20GHz @ -1db S21
- Easy/No Maintenance
- Design Flexibility

Contact Force and Spacetransformer Interconnect Technologies

- **With large node count space transformers, high compression forces are required from current interconnect technologies**
  - In a 10000 node Space transformer with a 1oz (28.4g) spring probe, 625 pounds total force is applied to system
- **These large forces have tendency to warp probe cards, load boards and vertical interface stacking planes**
- **Warping requires larger amounts of probe card overdrive to make consistent contact with the wafer in probe**

RC Springprobe™

L = Free Length
D = Coil Diameter
N = Number of Coils
d = Wire Diameter

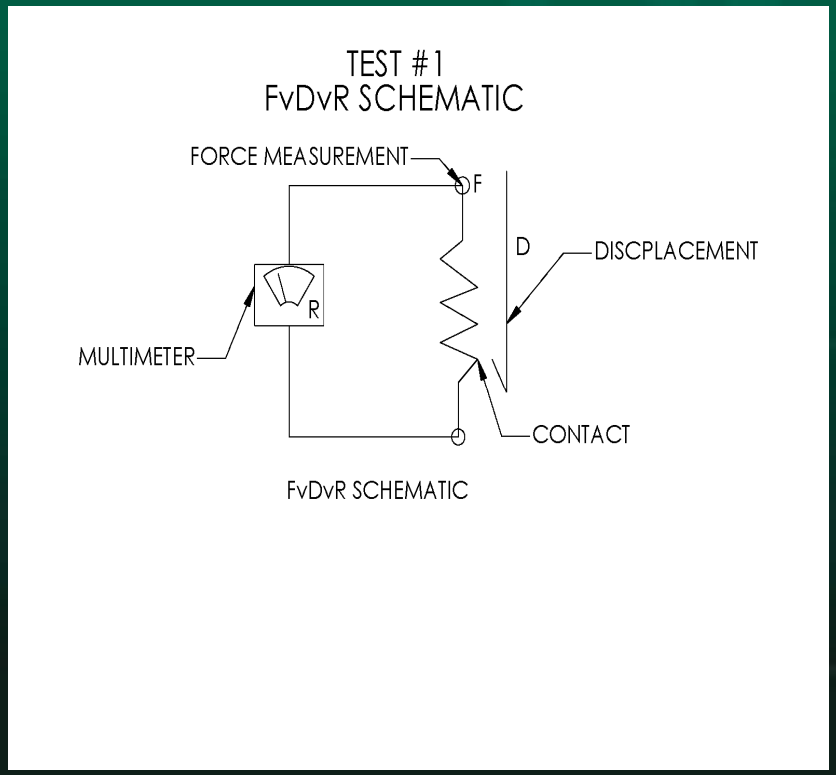


Tests to Confirm Compatibility with Space Transformers

- Test #1: Force vs Deflection vs Resistance of several low force contacts
- Test #2: Deflection vs Resistance for Several Contacts within one Compression Stroke
- Test #3: Resistance vs Time at an Elevated Temperature (100C)
- Test #4: Current Carrying Capacity and the Associated Thermal offset
- Test #5: Insertion Loss (S21) of an Interposer modeled and measured

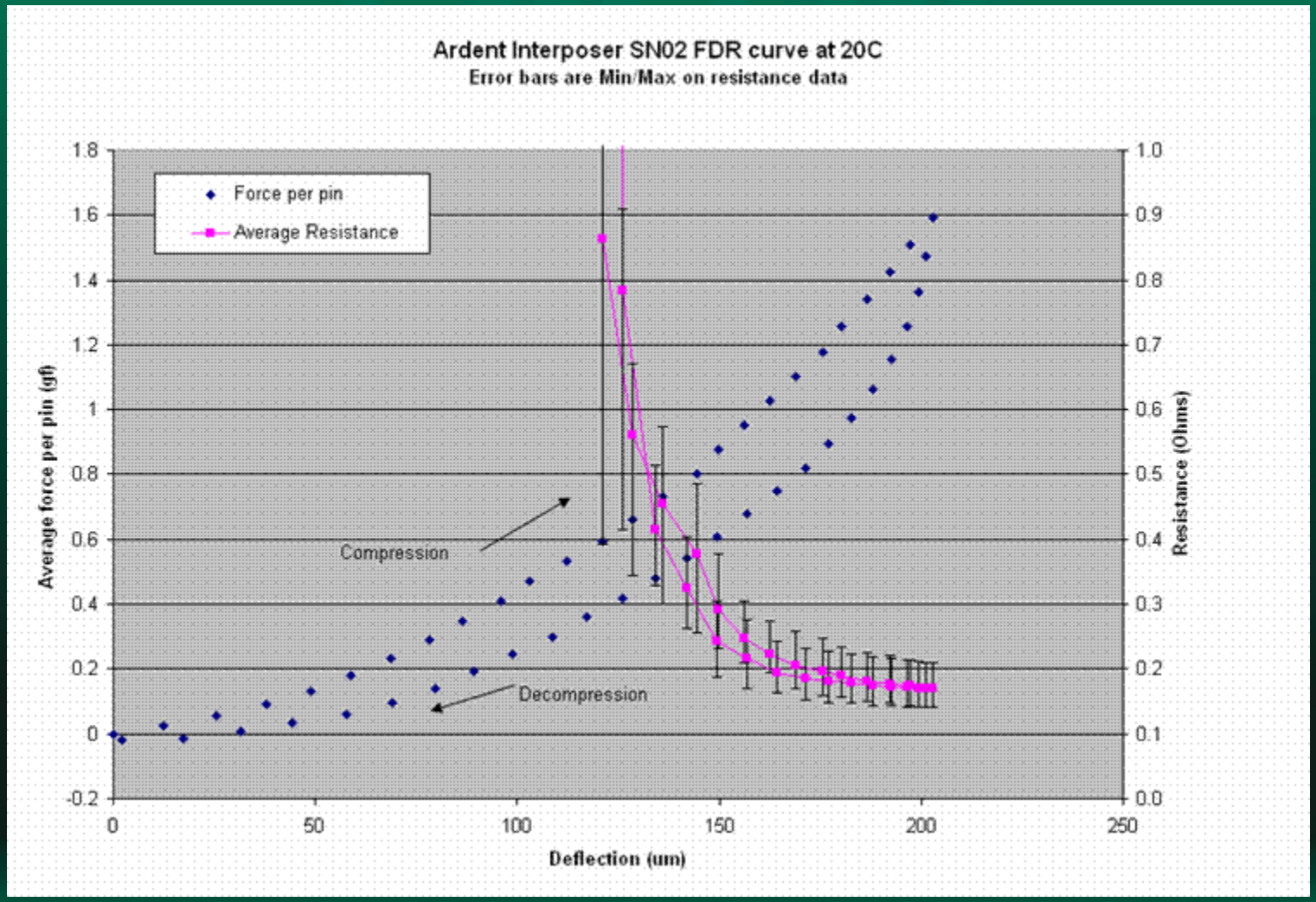
Test #1&2 Set-up for Force vs. Deflection vs. Resistance

FvDvR Schematic

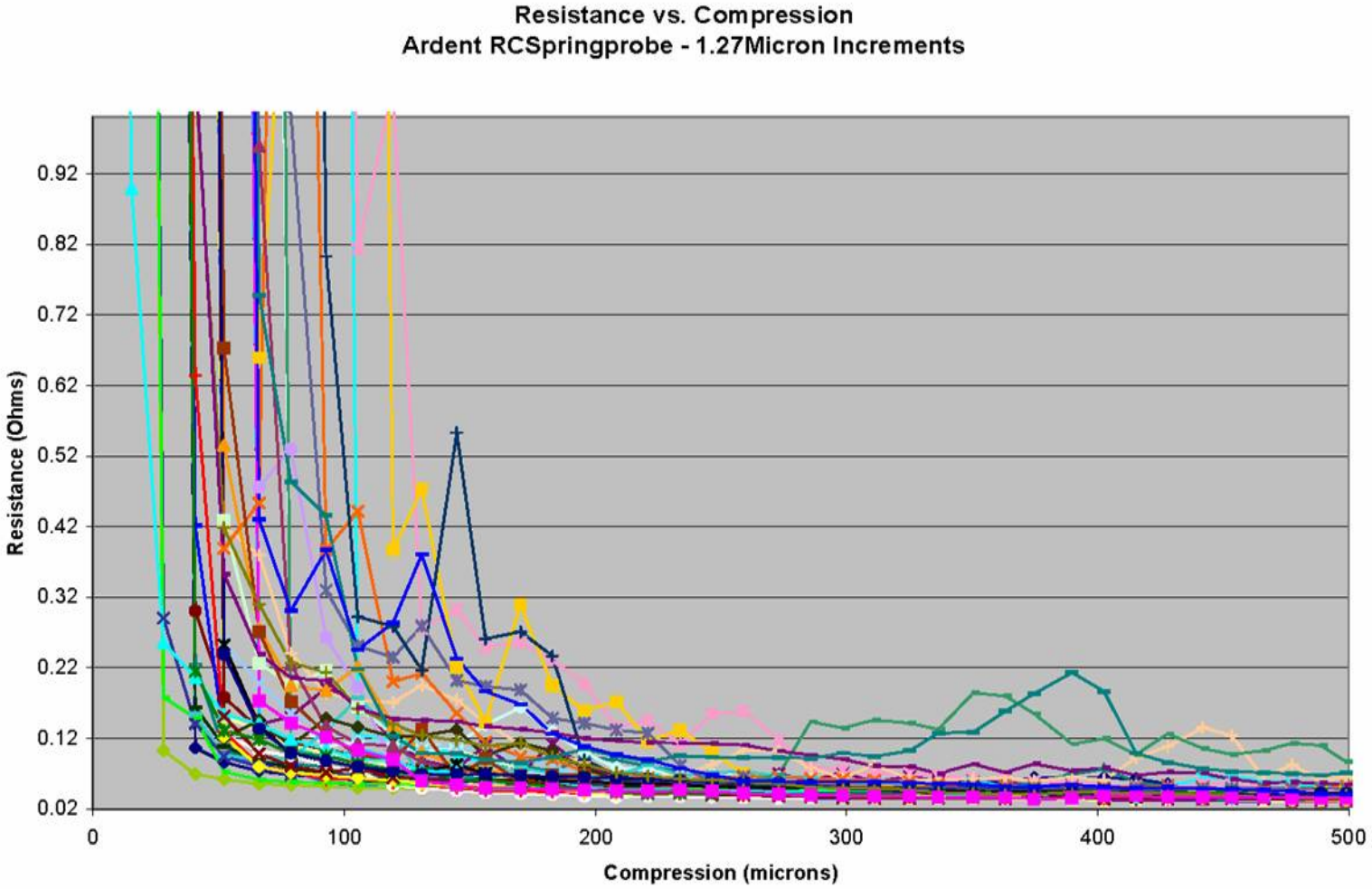


FvDvR Equipment setup

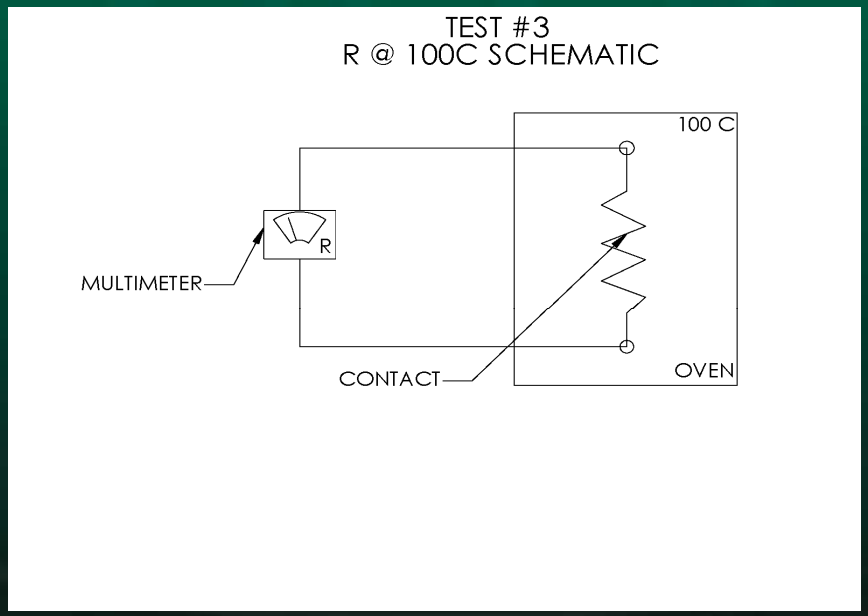
Test #1 FvDvR for Several Low Force Contacts



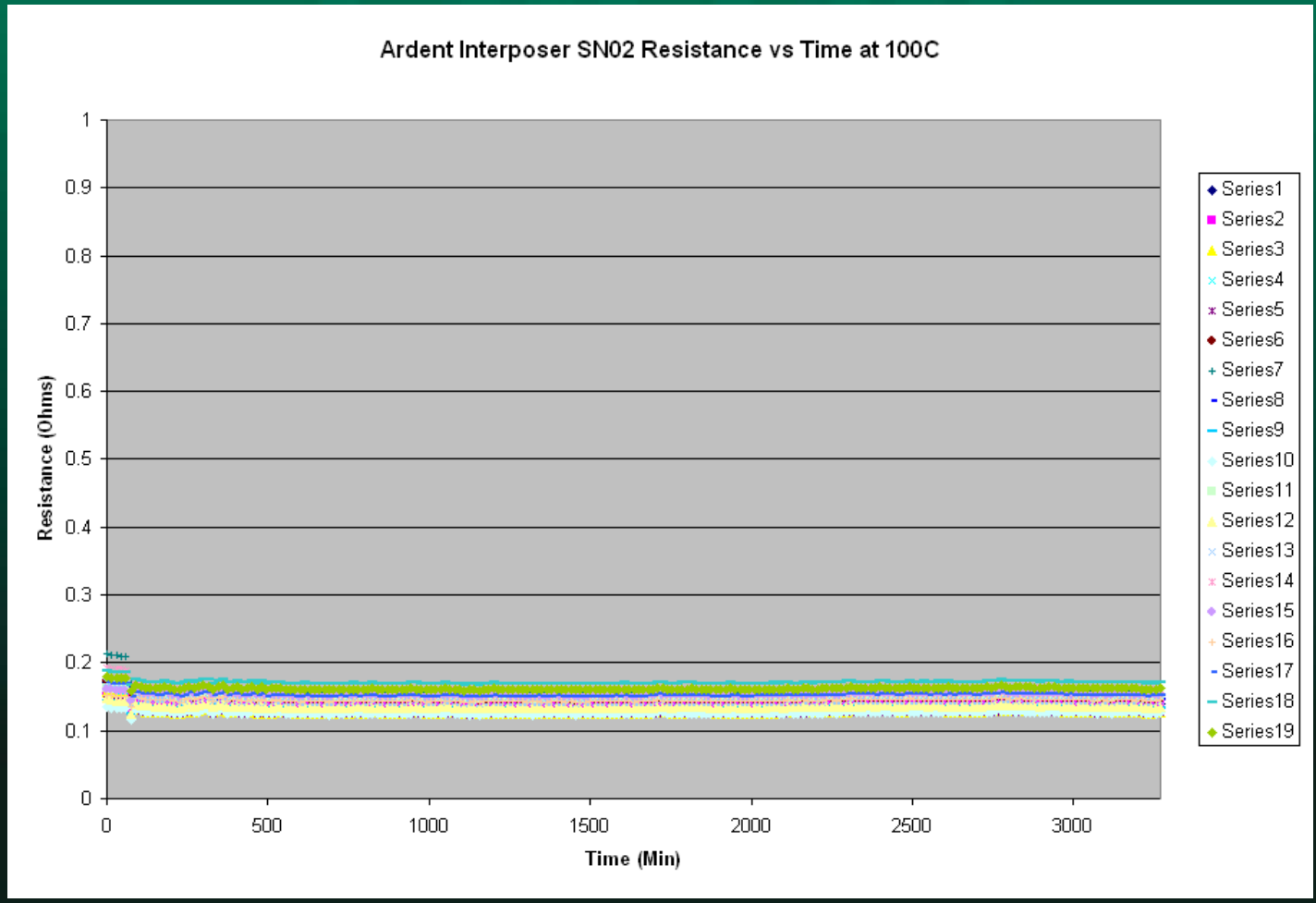
Test #2 Resistance vs Displacement for 50 nodes



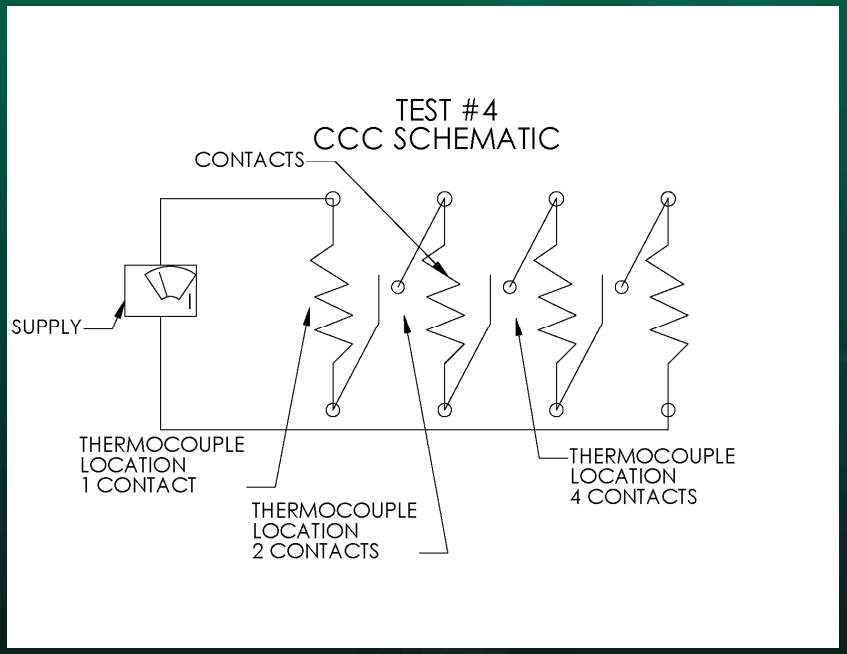
Test #3 Schematic for Resistance vs. Time @ Temperature

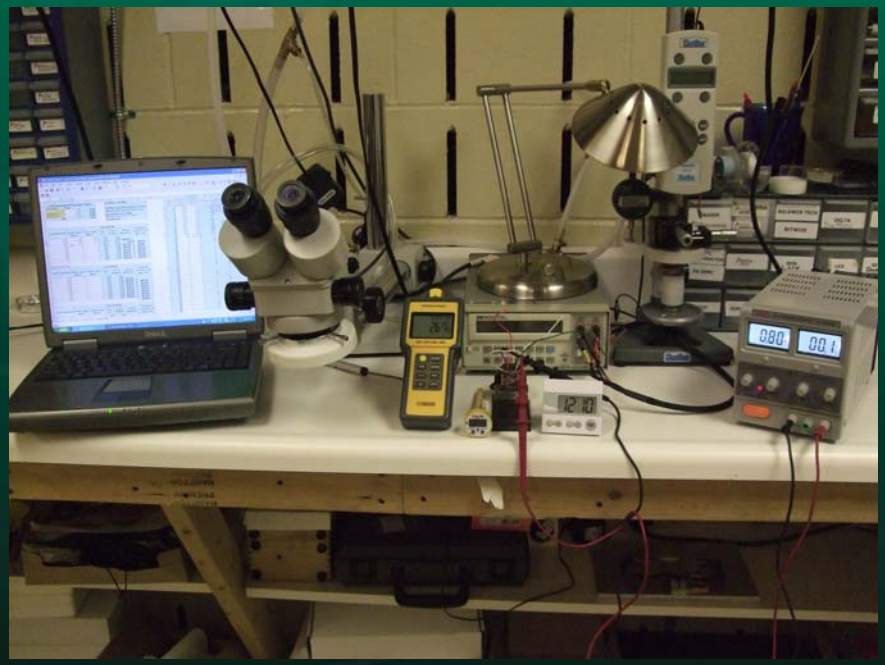


Test #3 Resistance vs. Time at 100C

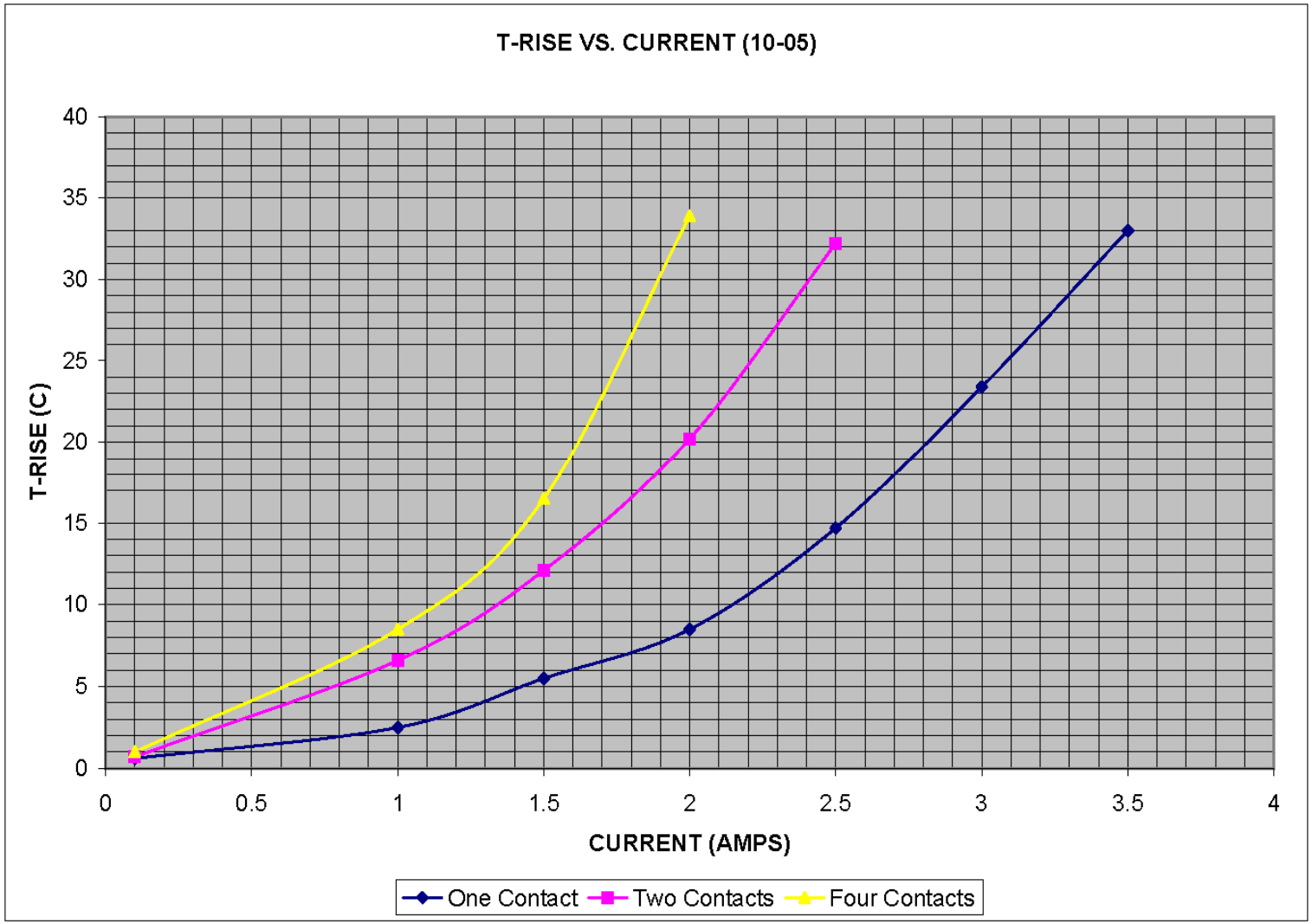


Test #4 Set-up and Schematic for Current Carrying Capability

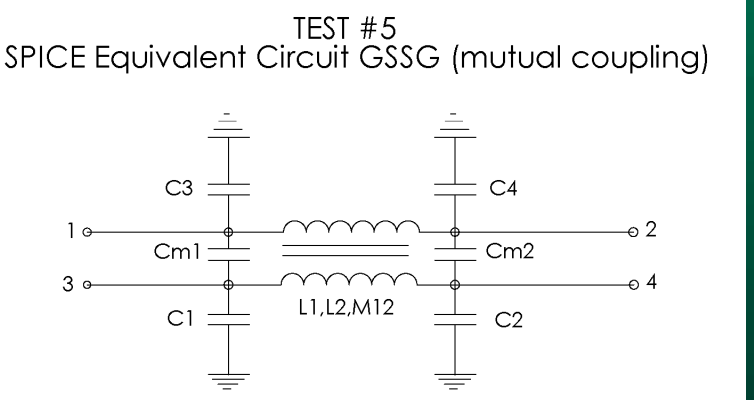


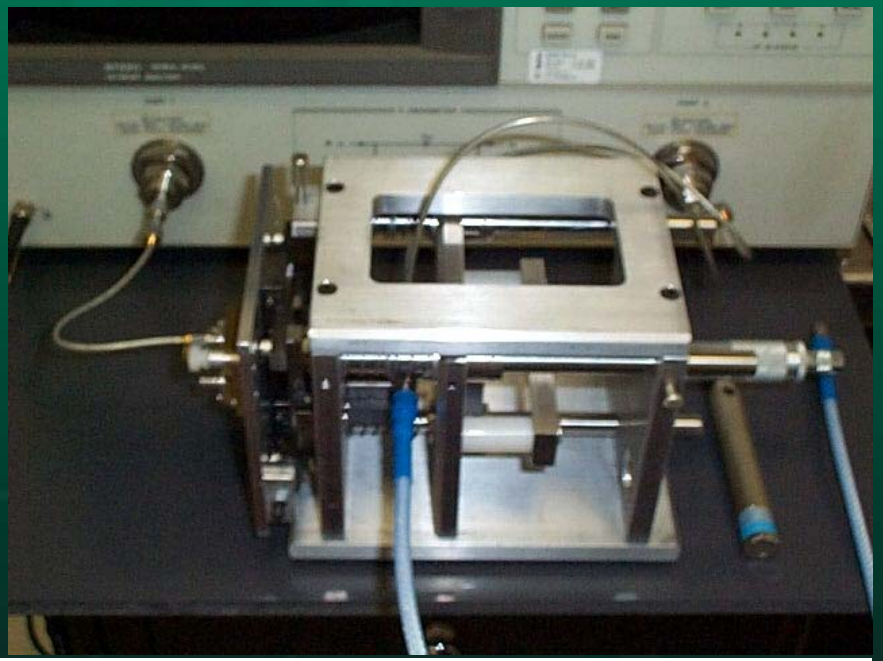


Test #4 Current Carrying Capability



Test #5 Schematic with Elemental Values for SPICE Model and Set up for Insertion Loss GSSG Measurement





Site	C1,2,3,4	Cm1,Cm2		L1,L2	M12	
Corner	0.073	0.008	pF	1.17	0.217	nH
Edge	0.069	0.009	pF	0.99	0.198	nH
Field	0.069	0.006	pF	0.92	0.117	nH
Diagonal	0.069	0.003	pF	0.98	0.066	nH

Test 5 Insertion Loss

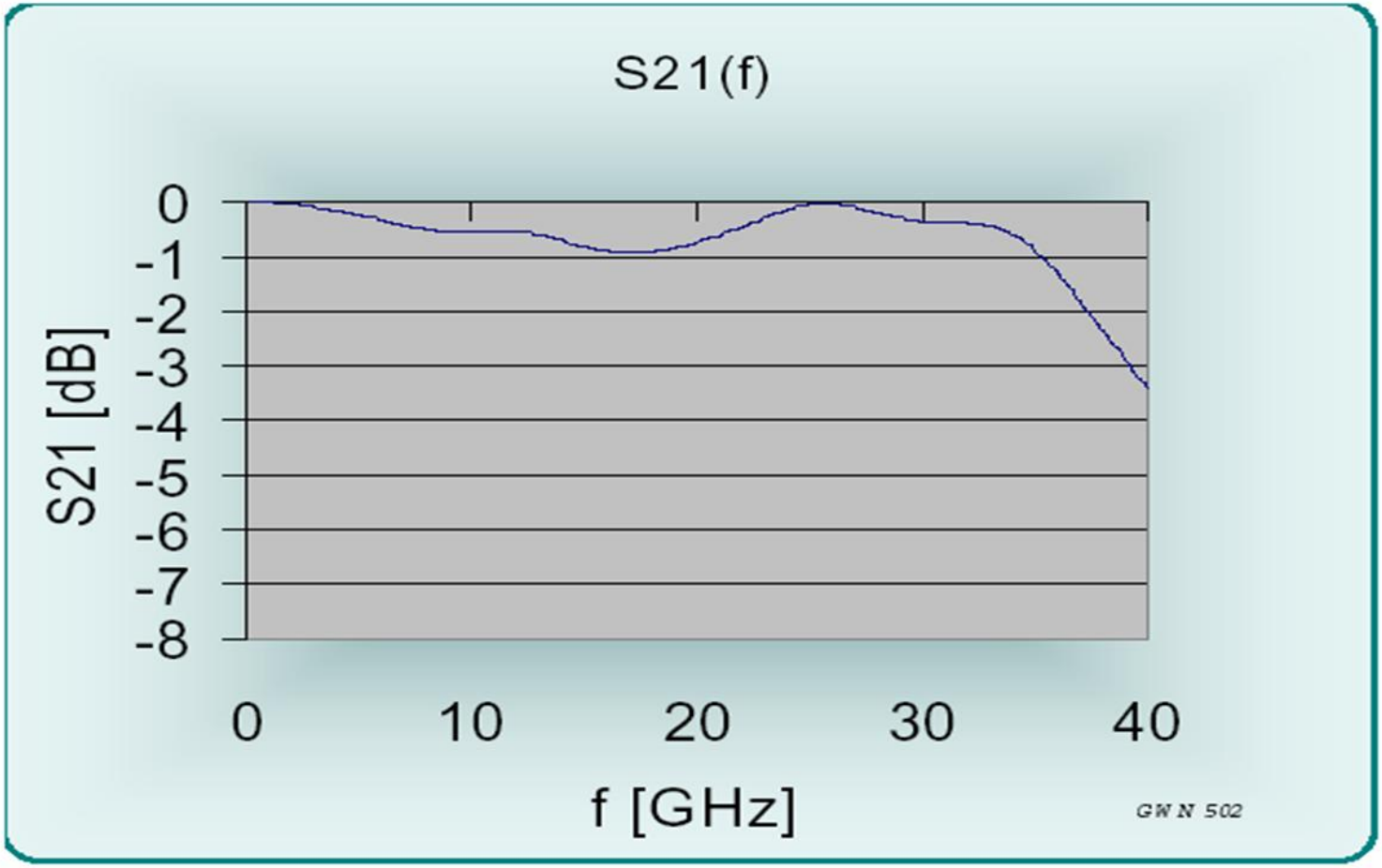
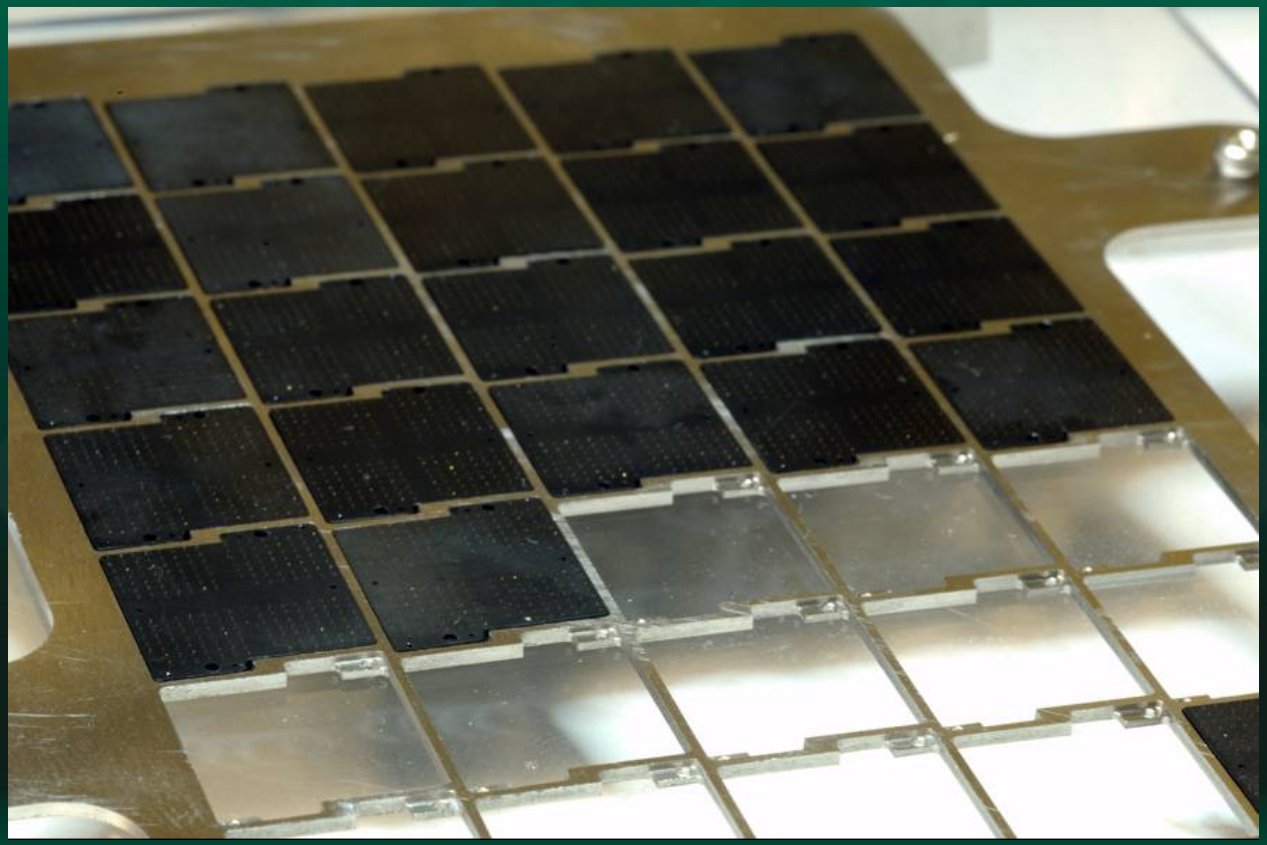


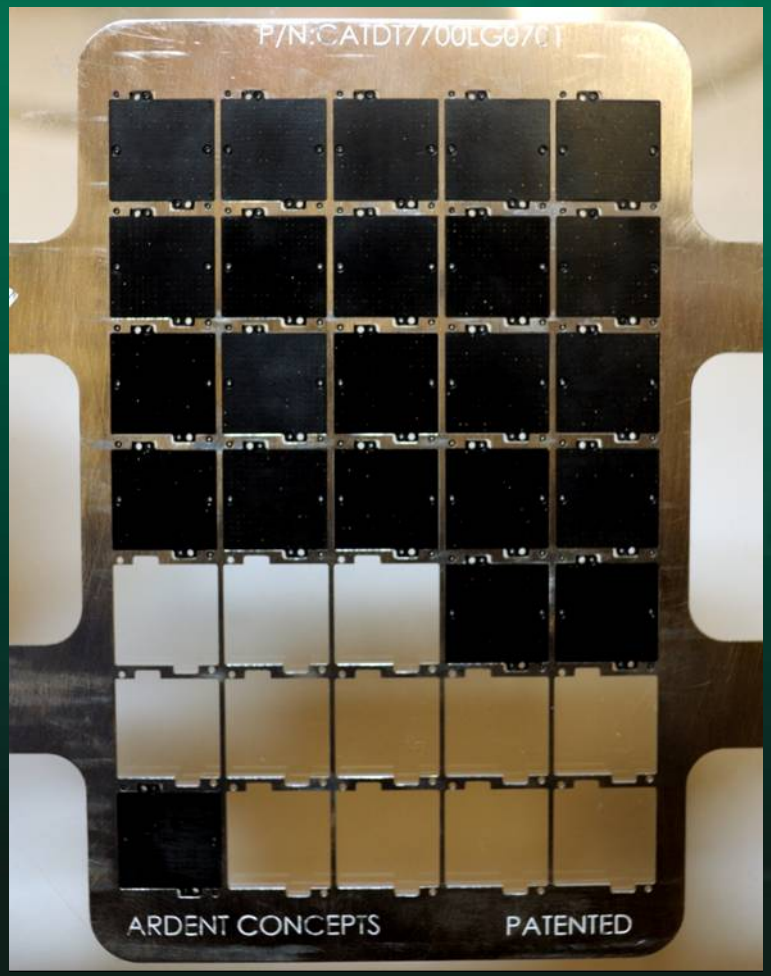
Figure 23 Insertion loss S21 (f) and S12 (f)

RC Space Transform-R

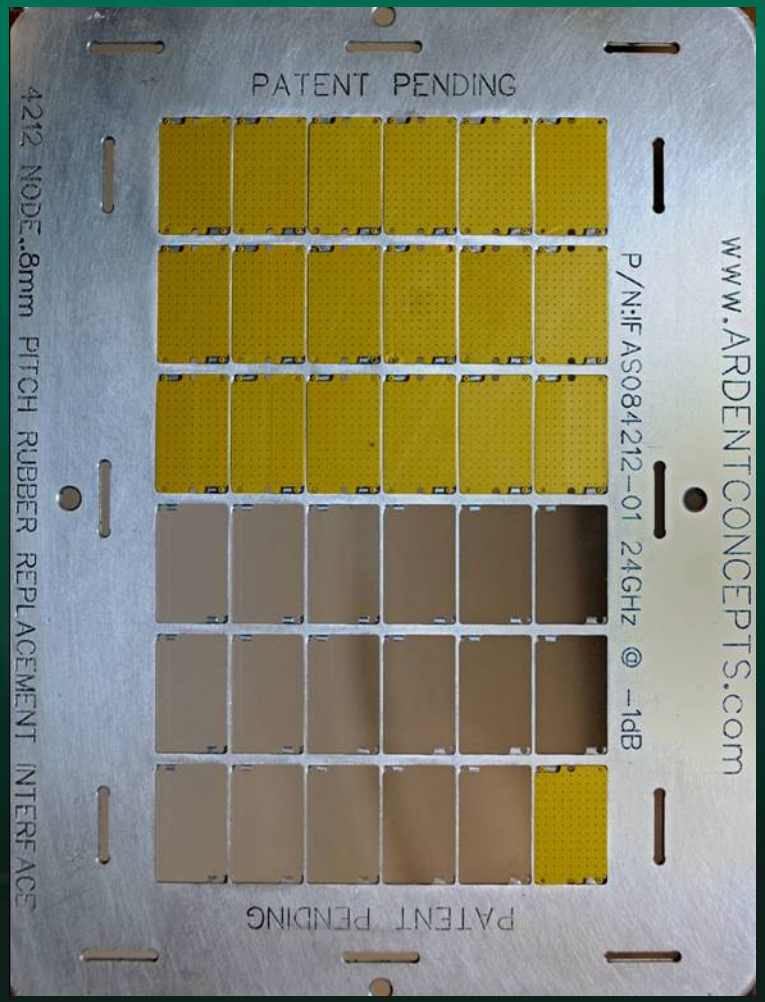
RC Space Transform-R™ uses a lower force version of the RC Springprobe™ installed into individually replaceable interposer modules tooled within an interface frame.



Space Transform-R Modular Design

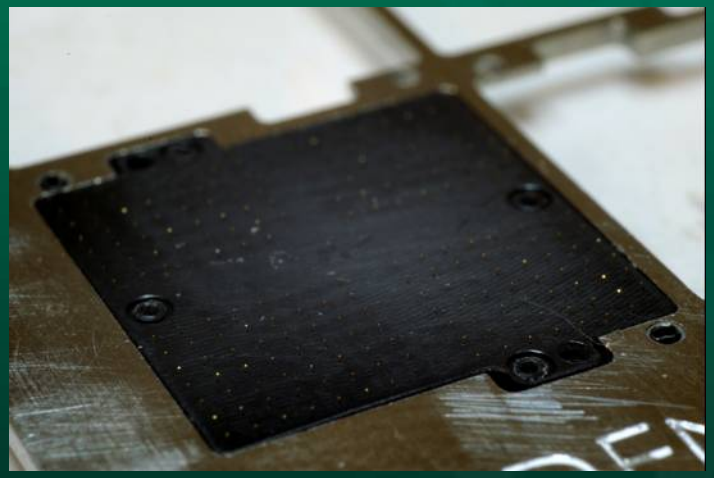


7700 Node, .7mm Pitch
35 Modules with 220 Nodes

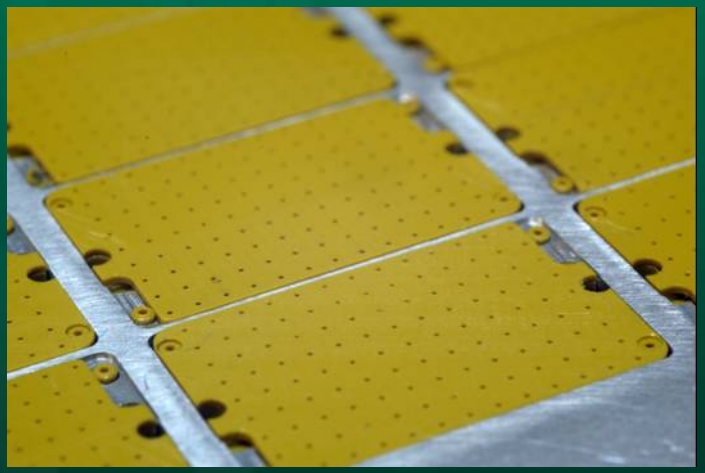


4212 Node, .8mm Pitch
36 Modules with 117 Nodes

RC Spacetransform-R Modules



220 Node Module



117 Node Module

Modular Design Advantages:

1. Scalable Interposers and Interfaces
2. Easily Replaceable Modules
3. Inexpensive and Easy to Maintain
4. Great Positional Accuracy

RC Springprobe™ in RC Spacetransform-R™ Summary

- Consistent C-Res thru Compression and at Temperature Excursions
- Inexpensive, Discrete Node Solution
- Infinitely Scalable (currently 400 Micron Pitch)
- Good Current Carrying Capacity
- High Bandwidth
- Long Cycle life

Further Experimentation

- **Massively Parallel (1000 node +) C-Res Measurement thru all channels**
  - Static, full compression measurement
  - C-Res as a function of displacement
  - C-Res over time at temperature
- **Design a 50ohm GSG system for 1mm, .8mm, and .5mm pitch**

Thank You