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Application of Coaxial Structure on Micro Pitch Sockets

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Virtual ▪ November 1-4, 2022



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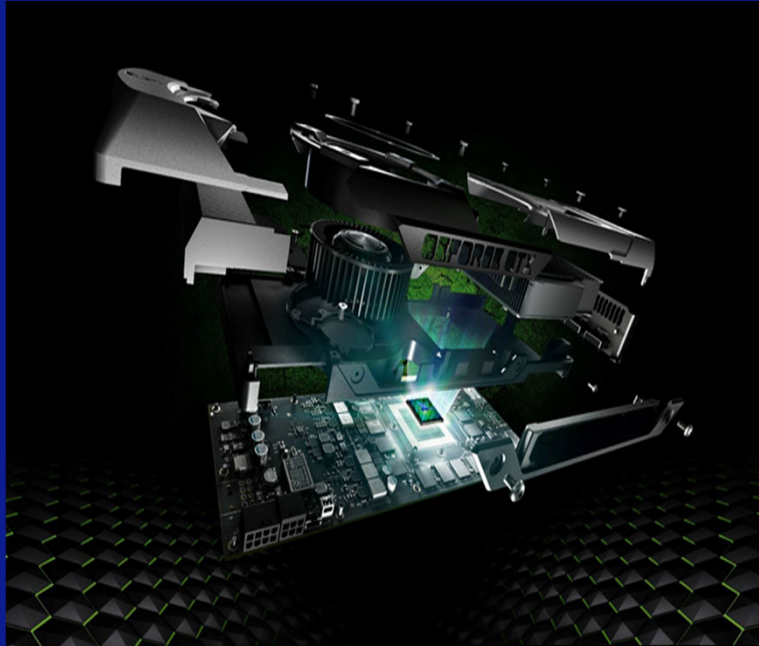


Application of Coaxial Structure on Micro Pitch Sockets

2022

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Background

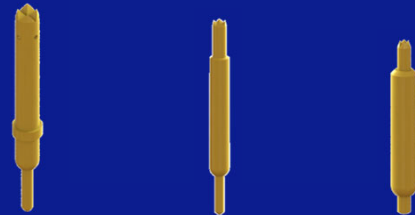


- Sophisticated Systems-on-Chip(SoCs)
 - Functionality increased
 - Smallest outline footprint
 - IC pitch below 500um
- High-speed chip development trend
- Limitations of existing high speed test sockets

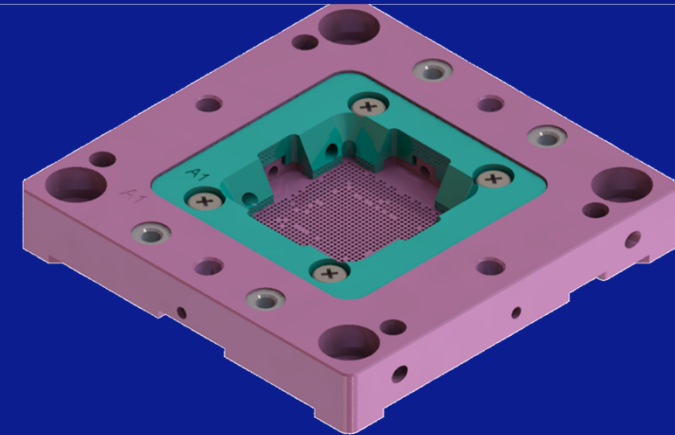
Objective: Develop coaxial structure socket for IC pitch $\leq 500\mu\text{m}$
high-speed test to meet technology trends & market needs.

Common Solutions for Fine Pitch Device High-Speed Test

- Normal plastic socket with short spring probes
 - Limited compliance
 - Insufficient spring force
 - Un-perfect RF performance



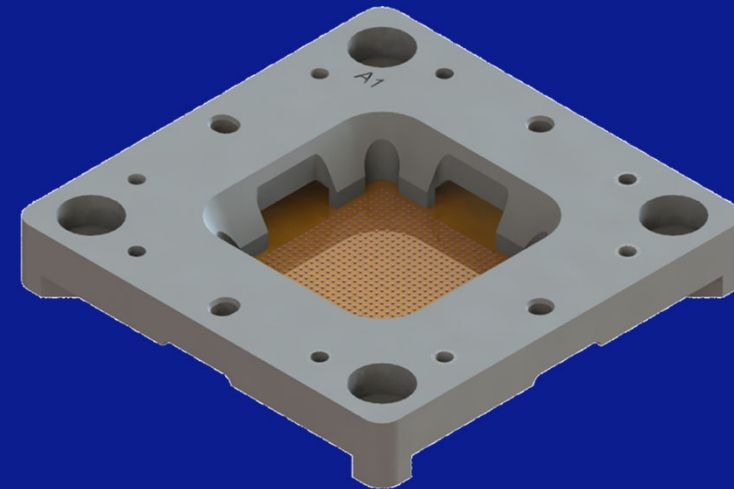
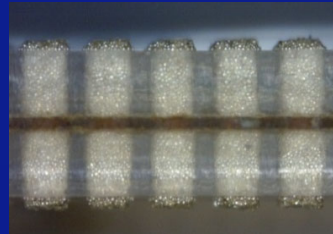
Test Length : $\geq 1.3\text{mm}$;
Pitch: $\geq 0.35\text{mm}$



Short Pin Socket

Common Solutions for Fine Pitch Device High-Speed Test

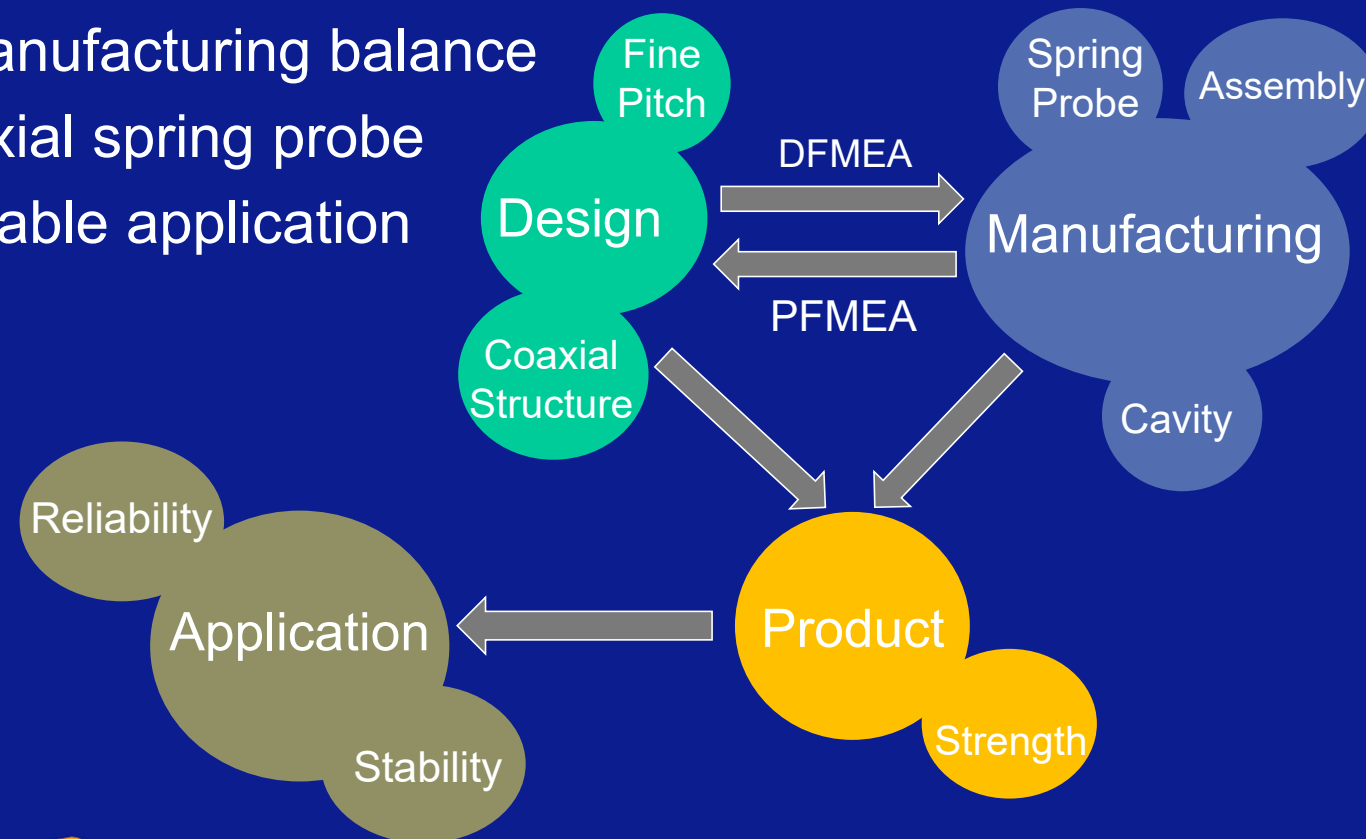
- Conductive elastomer socket
 - Limited compliance
 - Relative higher test force
 - Maintainability
 - Life



Elastomer Socket

Challenges of Fine Pitch Coaxial Structure

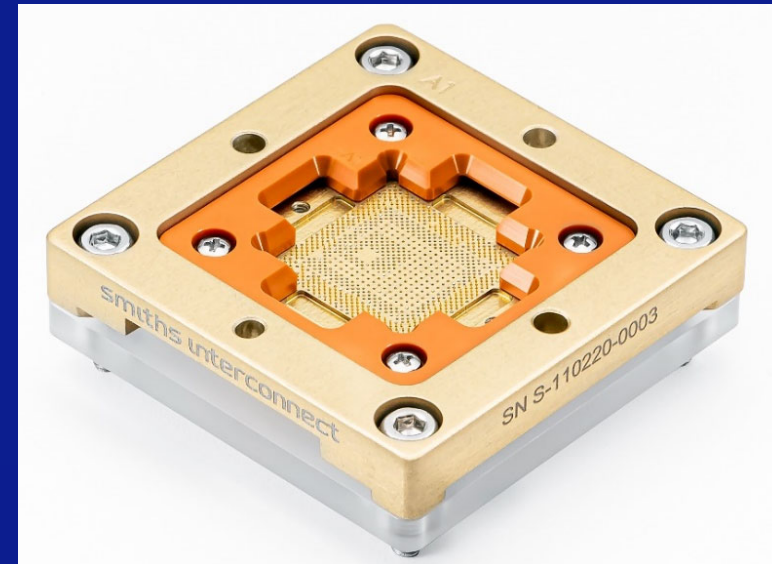
- Design and manufacturing balance
- Fine pitch coaxial spring probe
- Stable and reliable application



DaVinci Micro Sockets

- Solution for BGA, LGA, QFN, DFN and other variants
- Mechanical specification
 - Minimum pitch: 0.35mm
 - Short test height: 2.85mm
 - Compliance: 0.40mm
 - Contact force: 10~16Grams
 - Signal ended impedance: 40, 45, 50Ohm
 - Operating temperature: -40°C to +125°C

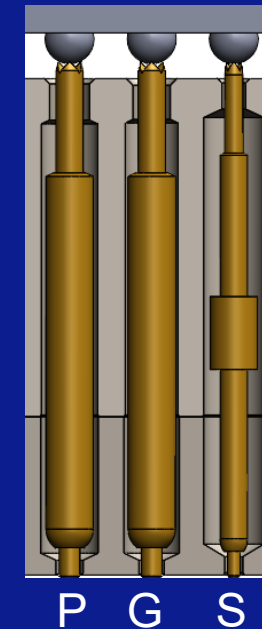
SINT Patented Technology



DaVinci Micro Sockets

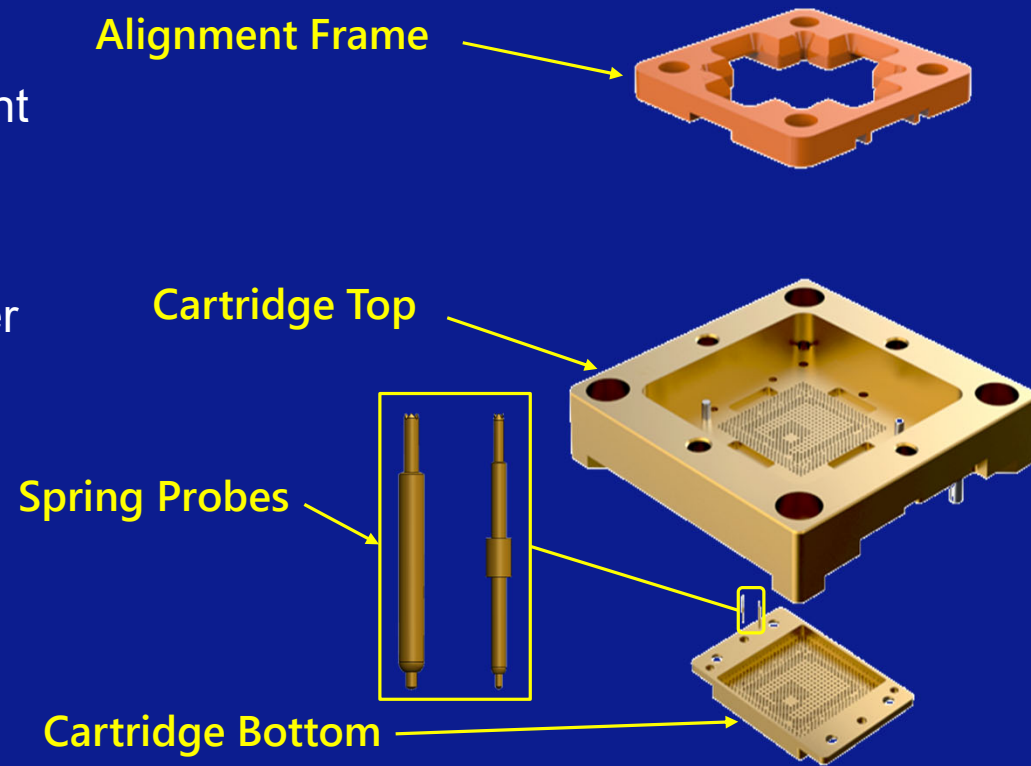
- Electrical specifications
 - Contact resistance: $< 150\text{m}\Omega$
 - Current carrying capacity: 1.1Amps
 - RF bandwidth up to 30GHz @ -1dB IL
 - Reduction in pin-to-pin noise (Cross-Talk)

SINT Patented Technology



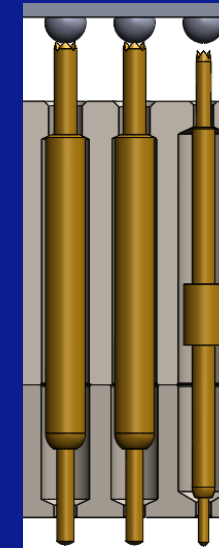
DaVinci Micro Socket Structure

- Simple structure
 - Apply to existing socket footprint easily
- Two types probes
 - Signal pin with smaller diameter to match impedance

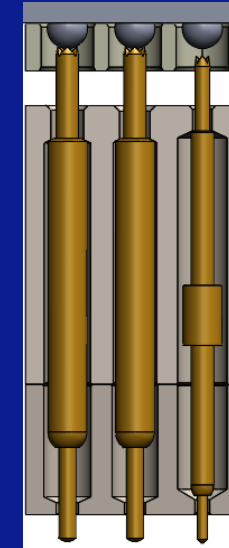


DaVinci Micro Socket Features

- Spring probe strength
 - Double moving structure
 - High strength material
 - Optimized assembly process
- Test reliability & stability
 - High-Lower concept
 - Floating base concept
 - Proprietary insulated metal material
 - Lower deflection
 - High heat dissipation



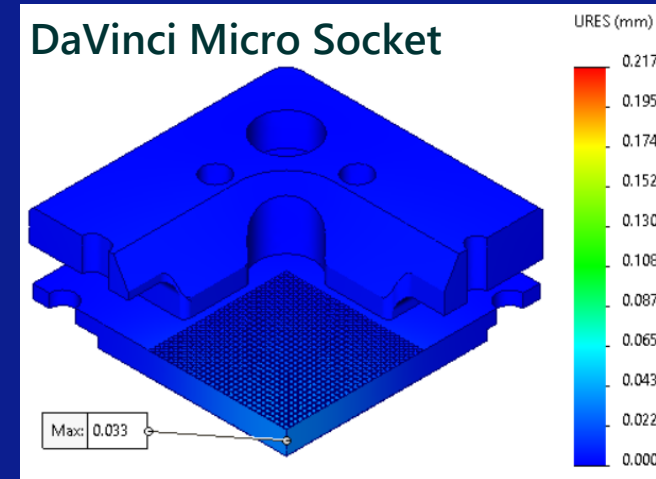
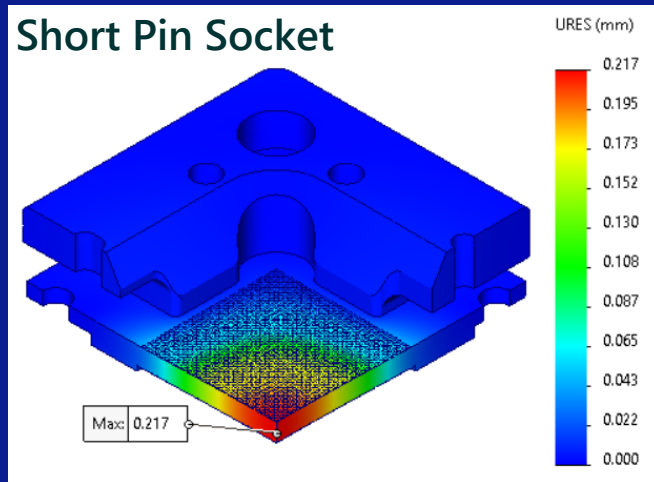
Hi-Low
Configuration



Floating Base
Configuration

Internal Evaluation – Mechanical

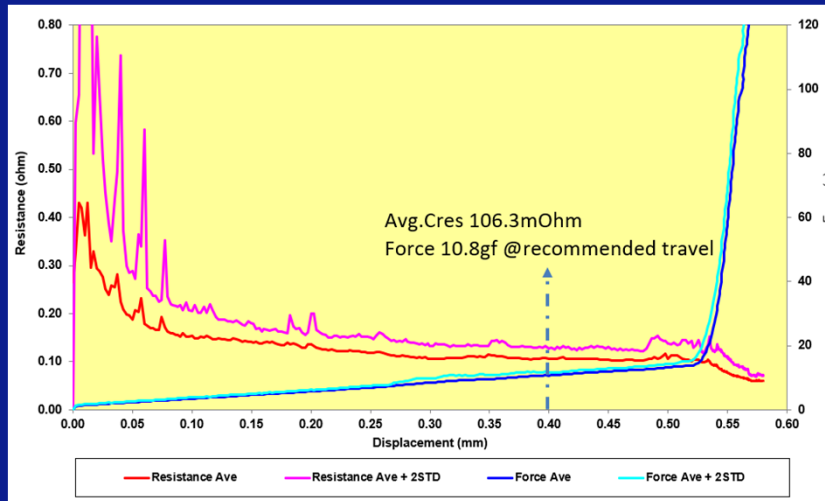
FEA analysis & measurement : Max. deflection



Socket Type	Preload(mm)	Pitch(mm)	Pin Count	Analysis Max. Deflection(mm)	Actual Max. Deflection(mm)
Short Pin	0.15	0.35	3600	0.22	~0.20
DaVinci Micro	0.15	0.35	3600	0.03	~0.03

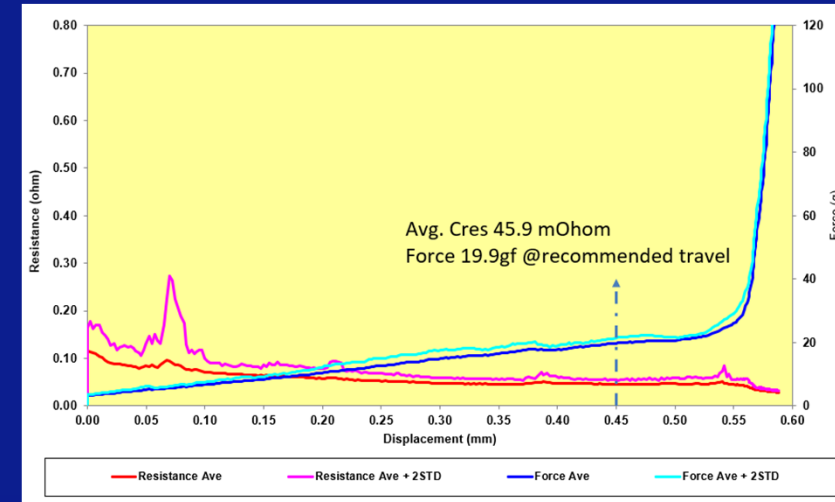
Internal Evaluation – FDR

Force, deformation & resistance: Avg. Cres, force & compliance



Signal spring probes

- Avg. Cres: 106mOhm
- Force: 10.8gf

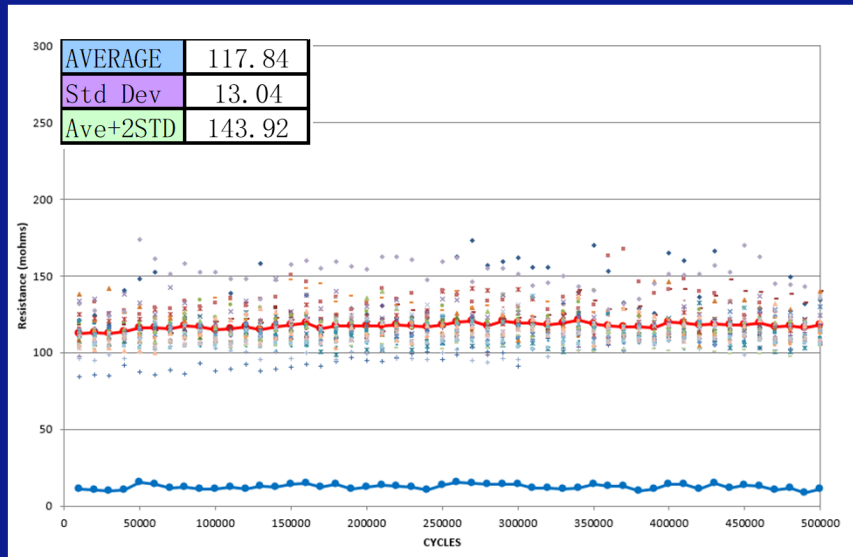


Power & ground spring probes

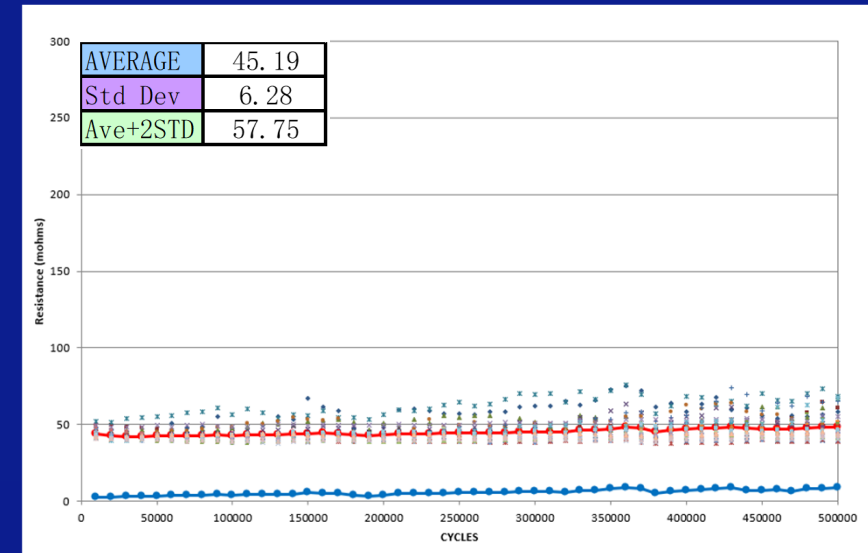
- Avg. Cres: 46mOhm
- Force: 19.9gf

Internal Evaluation - Life

Cres vs 500K cycles, ambient temperature



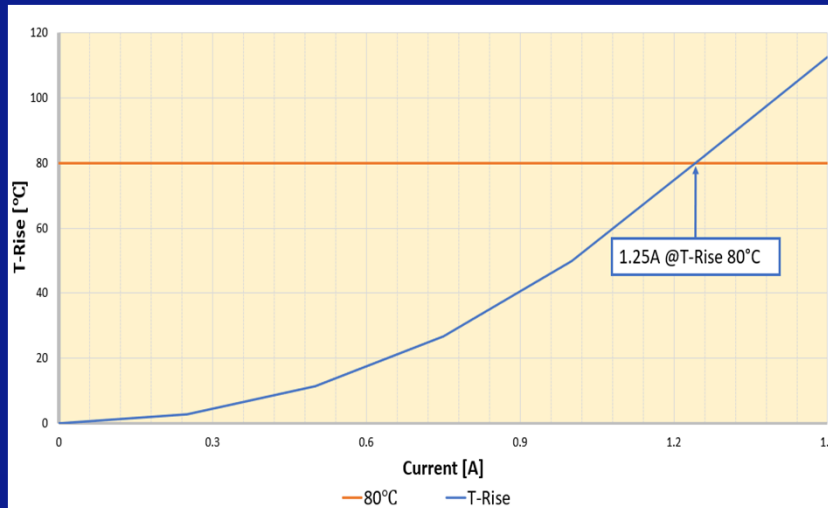
Signal spring probes



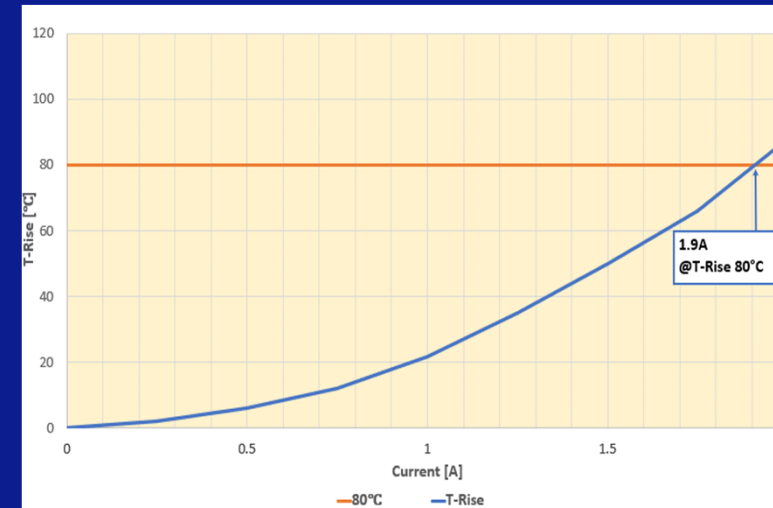
Power & ground spring probes

Internal Evaluation - CCC

Current Carrying Capability

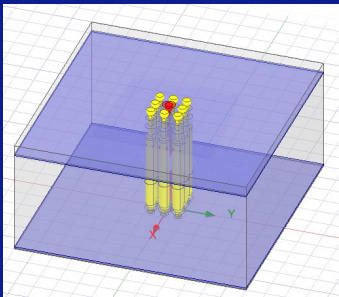
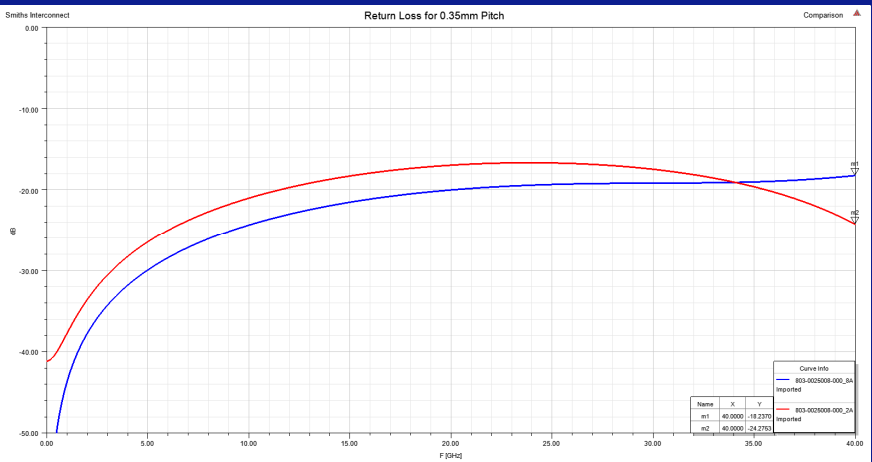
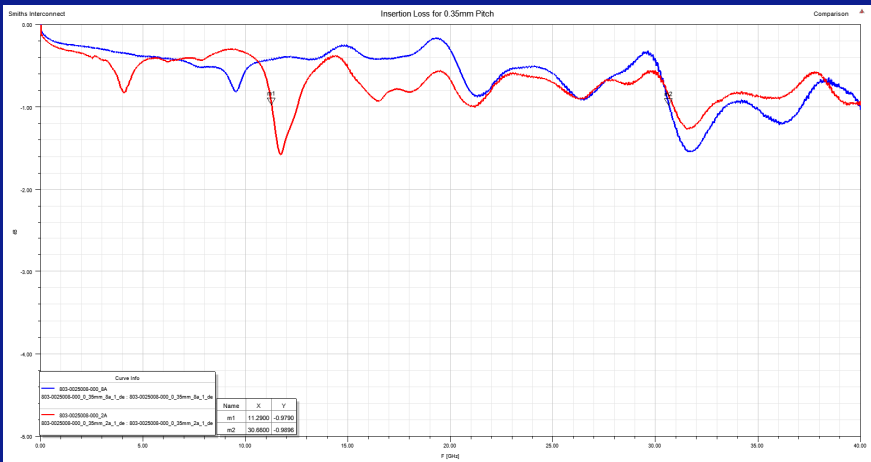


Signal spring probes: 1.25A



Power & ground spring probes: 1.9A

Internal Evaluation – RF Single Ended



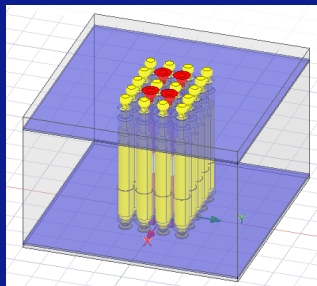
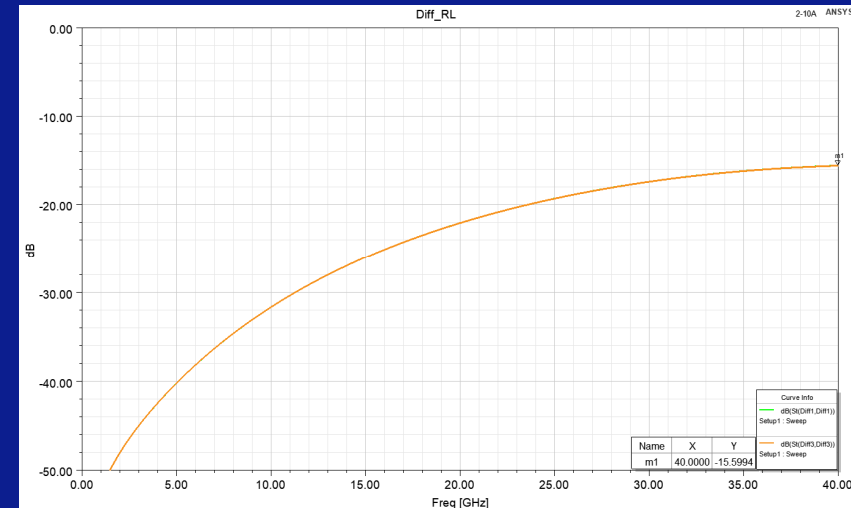
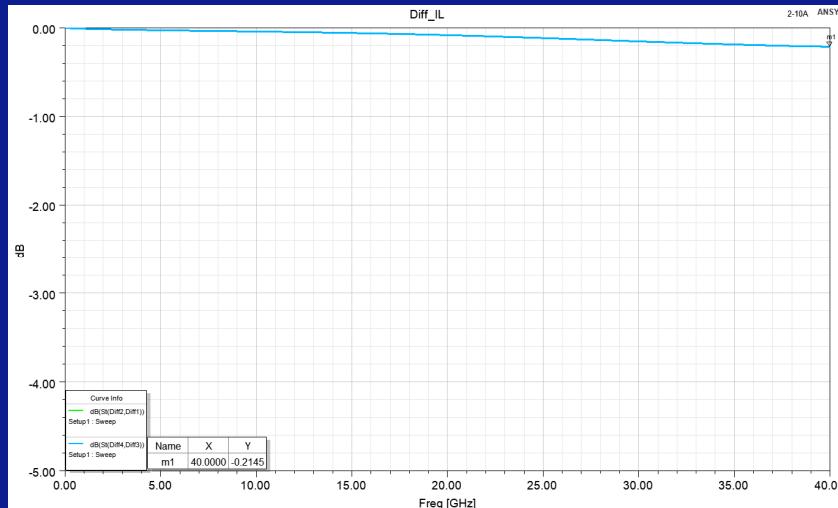
- Conditions:
- 8A pattern
 - Impedance 40Ohm

— Measurement

— Simulation

Pitch (mm)	IL @ -1dB (GHz)	RL @ -10dB (GHz)
0.35	31.5	40.0
0.40	56.7	81.0

Internal Evaluation – RF Differential Pair, IL & RL

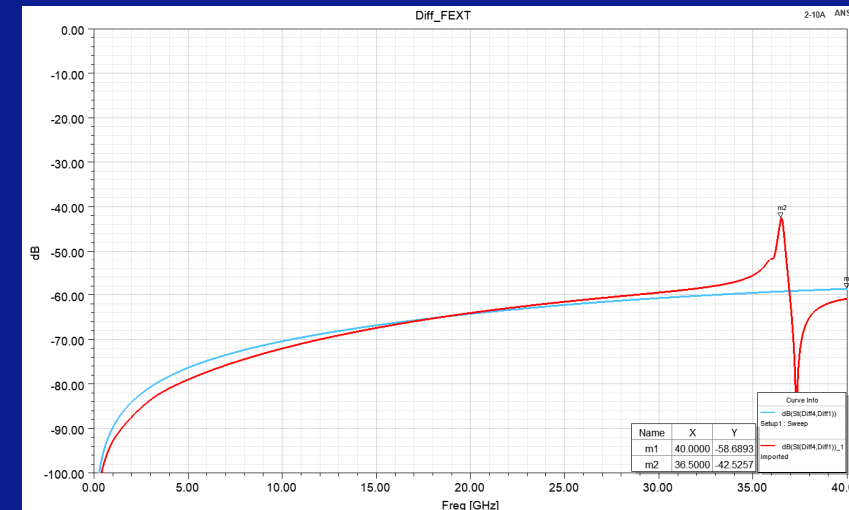
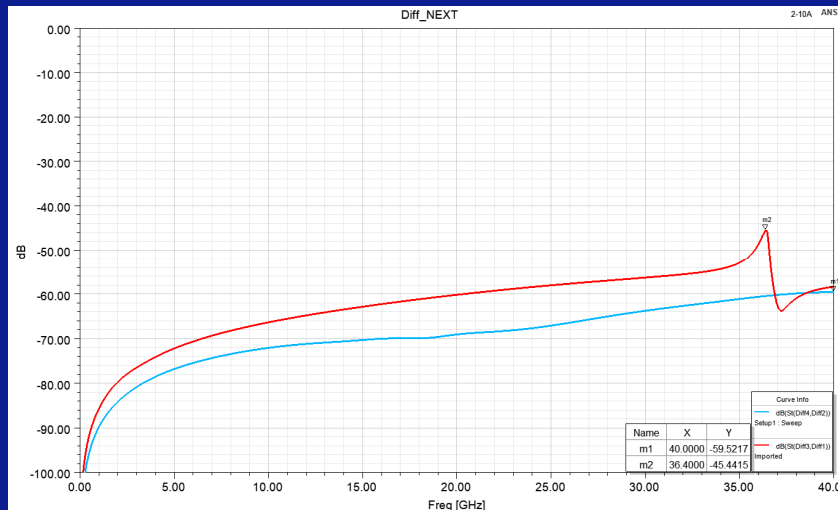


Conditions:

- 2-10A pattern
- Diff. impedance 80Ohm

Pitch (mm)	IL @ -1dB (GHz)	RL @ -10dB (GHz)
0.35	>40.0	>40.0

Internal Evaluation – RF Differential Pair, XT



— DaVinci Micro
— Short Probe

Socket	Pitch (mm)	NEXT (Worst, DC ~ 40GHz)	FEXT (Worst, DC ~ 40GHz)
DaVinci Micro	0.35	-59.5dB	-58.7dB
Short Probe		-45.4dB	-2.5dB

Fine pitch & High-Speed Test Socket Performance Comparison

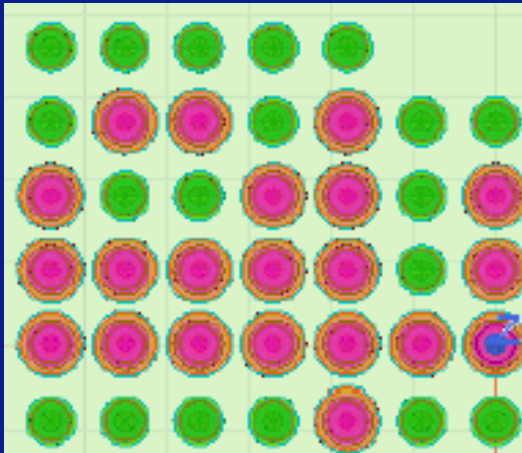
Socket Type	Compliance	Proper Test Force	RF Performance	User Friendly	Application		
					Pkg Size	Test Type	Test Environment
Normal with Short Probes	**	**	*	***	Mid-size	Wide	**
Elastomer	*	*	***	*	Small size	Limited	*
DaVinci Micro	***	***	***	***	Various	Wide	***

Notes: Excellent: ***; Good: **; Average: *

- DaVinci micro socket has excellent overall performance.

Real Customer Application

- Package size: 22 x 22mm
- Pin count: ~1700
- Pitch: 0.45mm
- Signal pin (Port Number): **S** Return/GND: **G**



Requirement	SE	Diff.
RL (DC ~ 20Ghz)	-14.8dB	-16.5dB
IL (DC ~ 20Ghz)	-0.44dB	-0.17dB
NEXT (DC ~ 20Ghz)	-28.4dB	-38.9dB
FEXT (DC ~ 20Ghz)	-21.4dB	-33.1dB
TDR	43.7Ω	86.5Ω

Summary

- Coaxial structure successful development on fine pitch application, met market trends and customer needs.
- DaVinci micro socket properties
 - Pitch $\geq 0.35\text{mm}$
 - Insertion loss: 31 GHz @ -1dB
 - Return loss: 40 GHz @ -10dB
 - Cross talk: 40 GHz @ -40dB
 - Current carrying capability: Up to 1.25Amps
 - Patented insulated metal socket housing
 - Field easily repairable
- DaVinci micro sockets have been qualified in customer site with good performance in high volume IC chip testing at various customer sites.

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