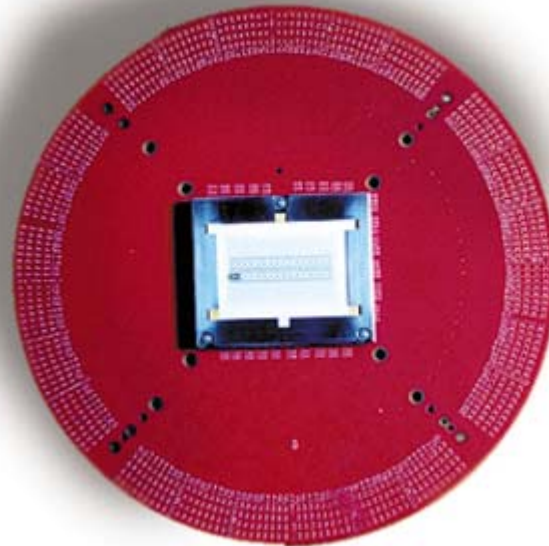


Advanprobe™ Technology

An Introduction to the Next Generation Probe Program



Ted Khoury

Program Manager, Research & Development, Advantest America Inc.

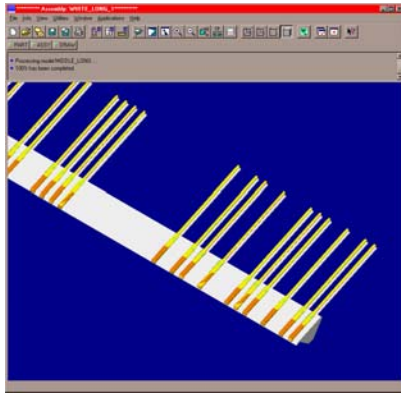
Co-Authors:

Robert Aldaz, Dr. David Yu, Dr. Gert Hohenwarter

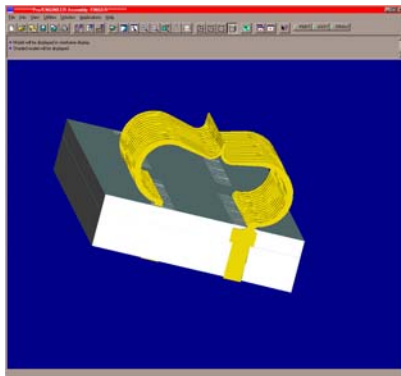
Program Outline

- ◆ **Advanprobe™ Core Memory/Periphery Probecard Design**
- ◆ **The Silicon Finger™ (SiFi™) and Photo Finger™ Designs**
- ◆ **Evaluation/Modeling Equipment/Methods**
- ◆ **Performance Data Collected To Date**
 - ◆ **Electrical / RF Data**
 - ◆ **Mechanical / Physical Data**
- ◆ **Variations of the Photo Finger™ Technologies**
- ◆ **Concurrent Technologies Now In Alpha & Beta Development**
- ◆ **Distinguished Acknowledgements**

Advanprobe™ Core Technologies

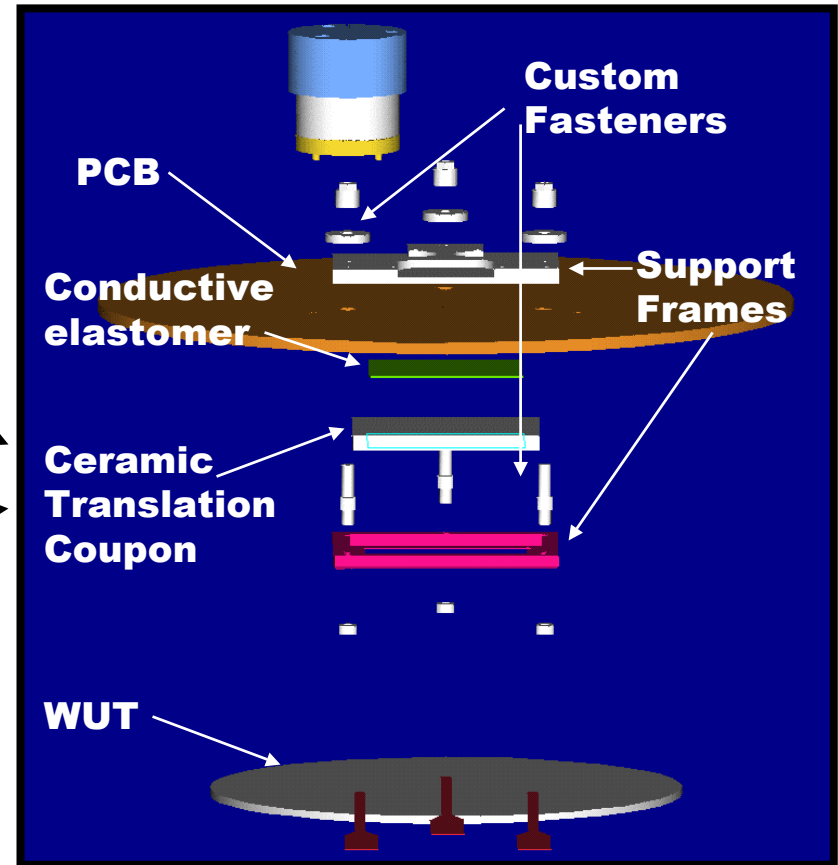


**Silicon Finger™
(SiFi™) Structure**



**Photo Finger™
Structure**

**Contactors Are
Assembled Onto
Ceramic Via
Advantest-
Proprietary
Micro-Robotic
Positioning
Equipment**



Shaded View Stack-up of Generic

Silicon Finger™ Contact Technology

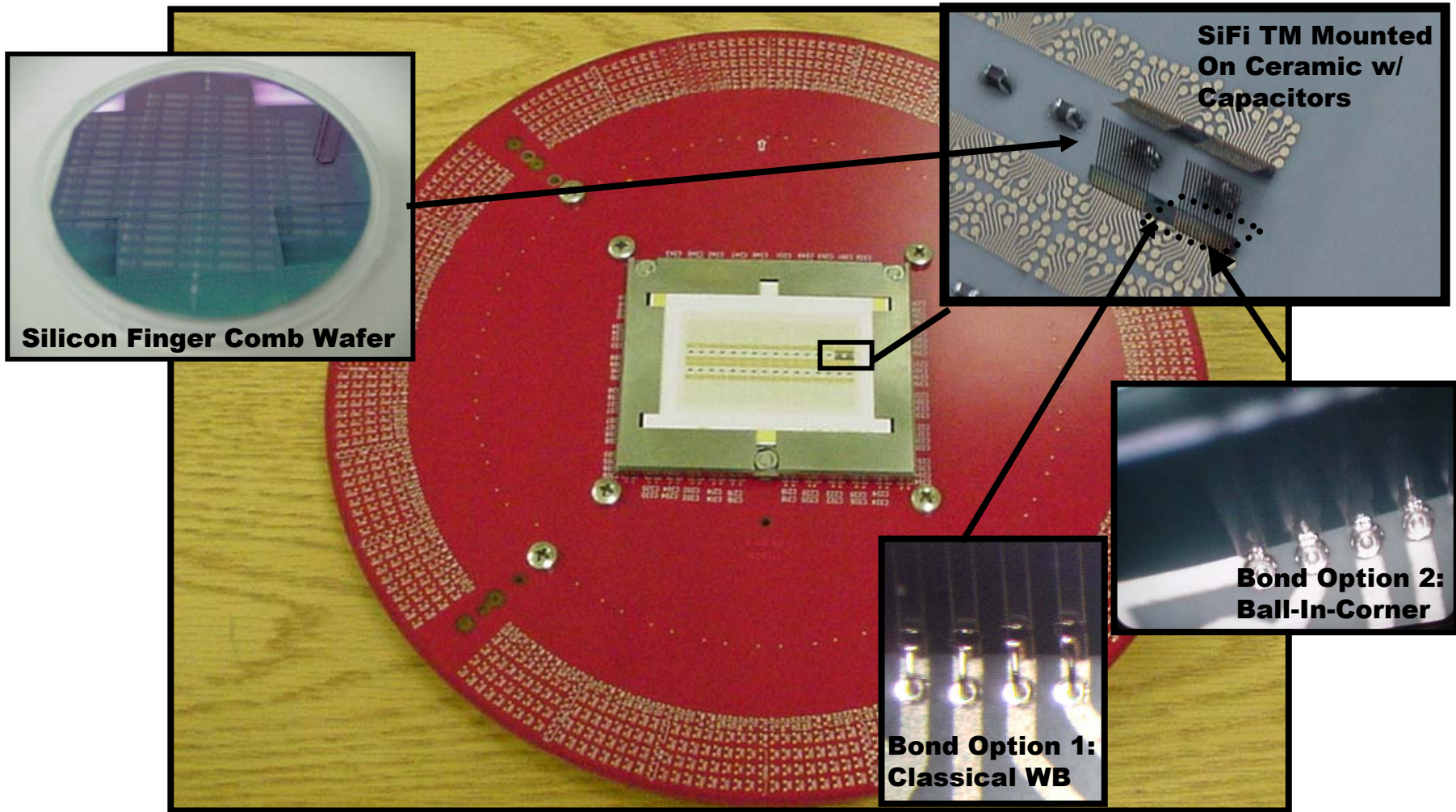
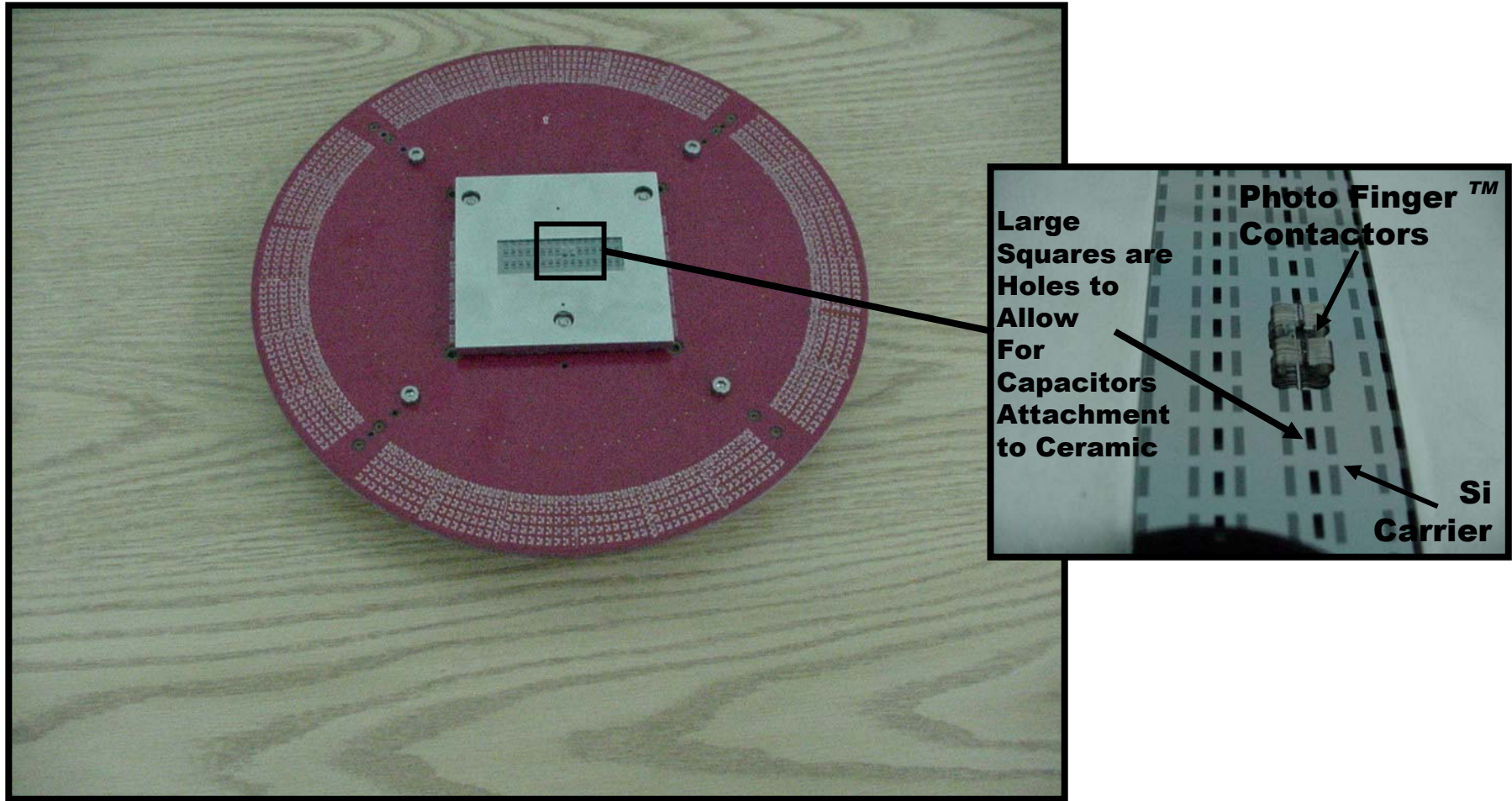


Photo Finger™ Contact Technology



Evaluation Methods & Equipment

RF Measurements:

SPICE Modeler Simulation

2 1/2 D field modeling with Ansoft *Maxwell Field Solver*

TDT / TDR: Tektronix CSA803 (w/ SD24) sampler with digital data acquisition system

VNA: HP 8720C Network Analyzer

Contact Resistance & AC & DC Current-Handling Measurements:

Advantest Resistance meter R8340, TSK UF-200 prober, HP E3631A power supply

Dimensional / Tip Accuracy Measurements:

Vision Engineering Dynascope & Custom Integrated Equipment

Force / Spring Rate Measurements:

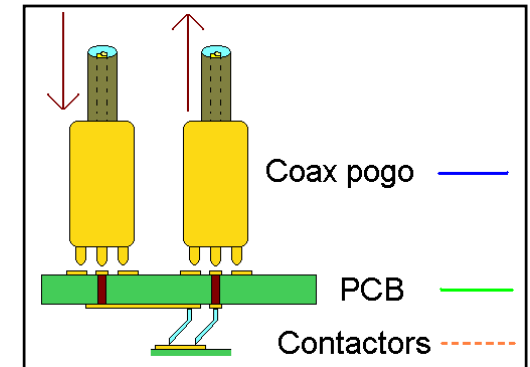
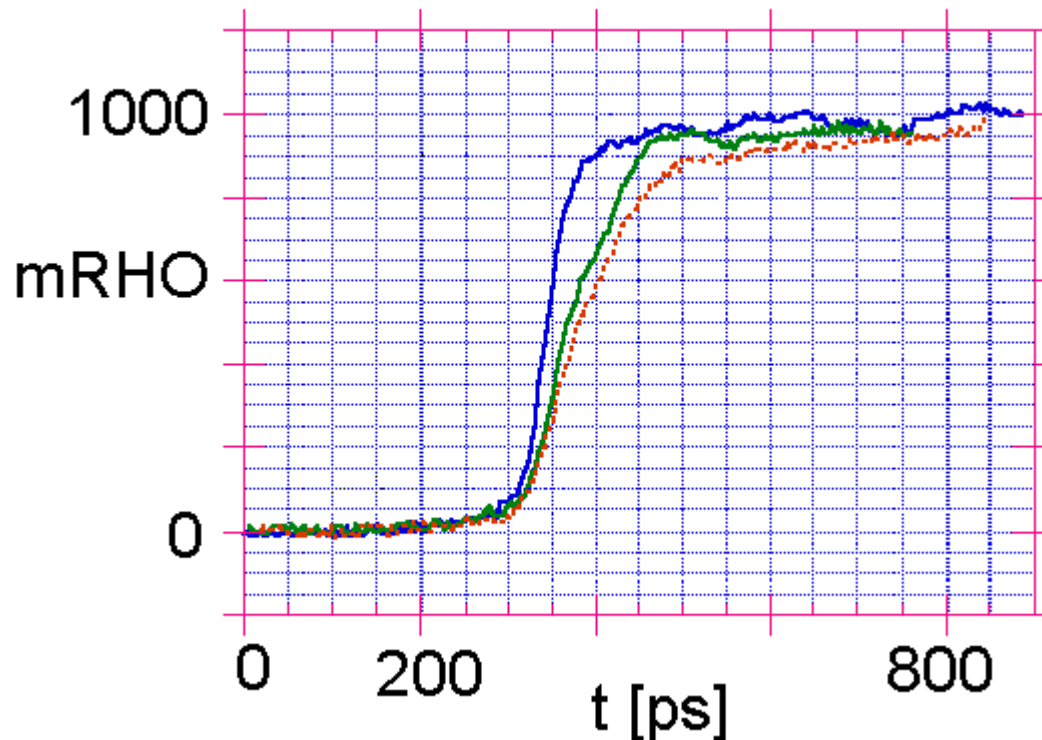
Futek Strain-gage & Kistler Piezo-based custom designed Force sensors, TSK UF-200

Stress, Failure, Spring Force Simulation: Cosmos / *Design Star*

3D Modeling: PTC's *ProEngineer*

3D Element Meshing / Pre & Post Processing: *FEMAP*

TDT Response Measurement: PCB+ SiFi™



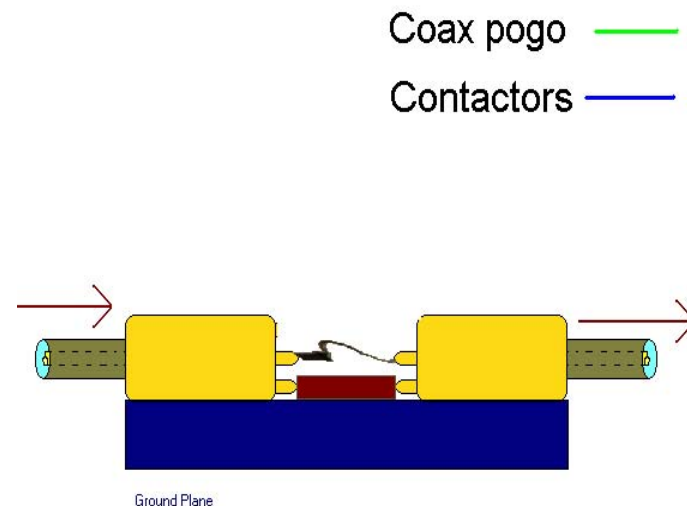
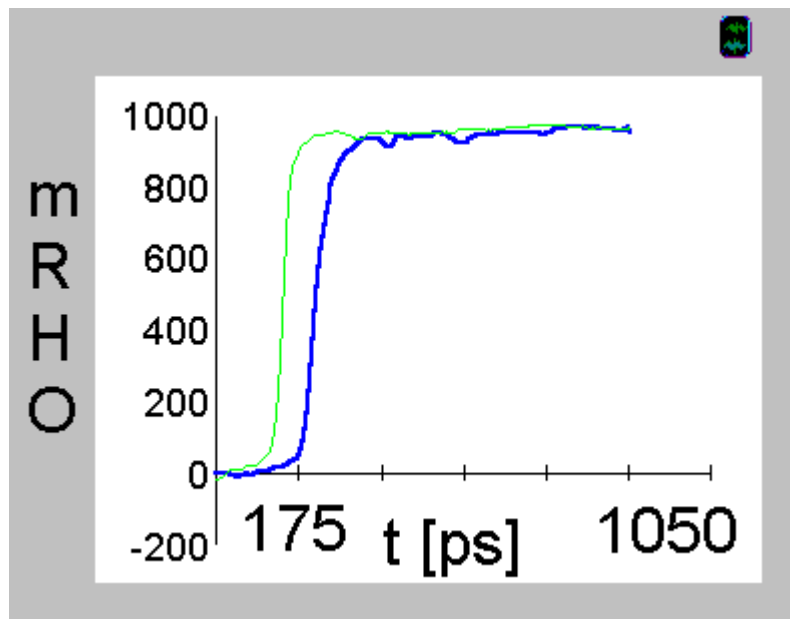
**Equivalent -3dB
BW = 3 GHz**

Blue: Coax pogo to coax pogo (w/o PCB and contactors)

Green: Coax-PCB-coax (w/o contactors)

Orange-Dash: Through response; 116 ps RMS contribution (10/90%)
from complete signal path

TDT Response Measurement: *Photo Finger™*



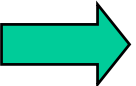
Green: Through connection w/o contactor

Blue: Step excitation through

Photo Finger™ contactor - 54 ps RMS risetime contribution (10/90%)

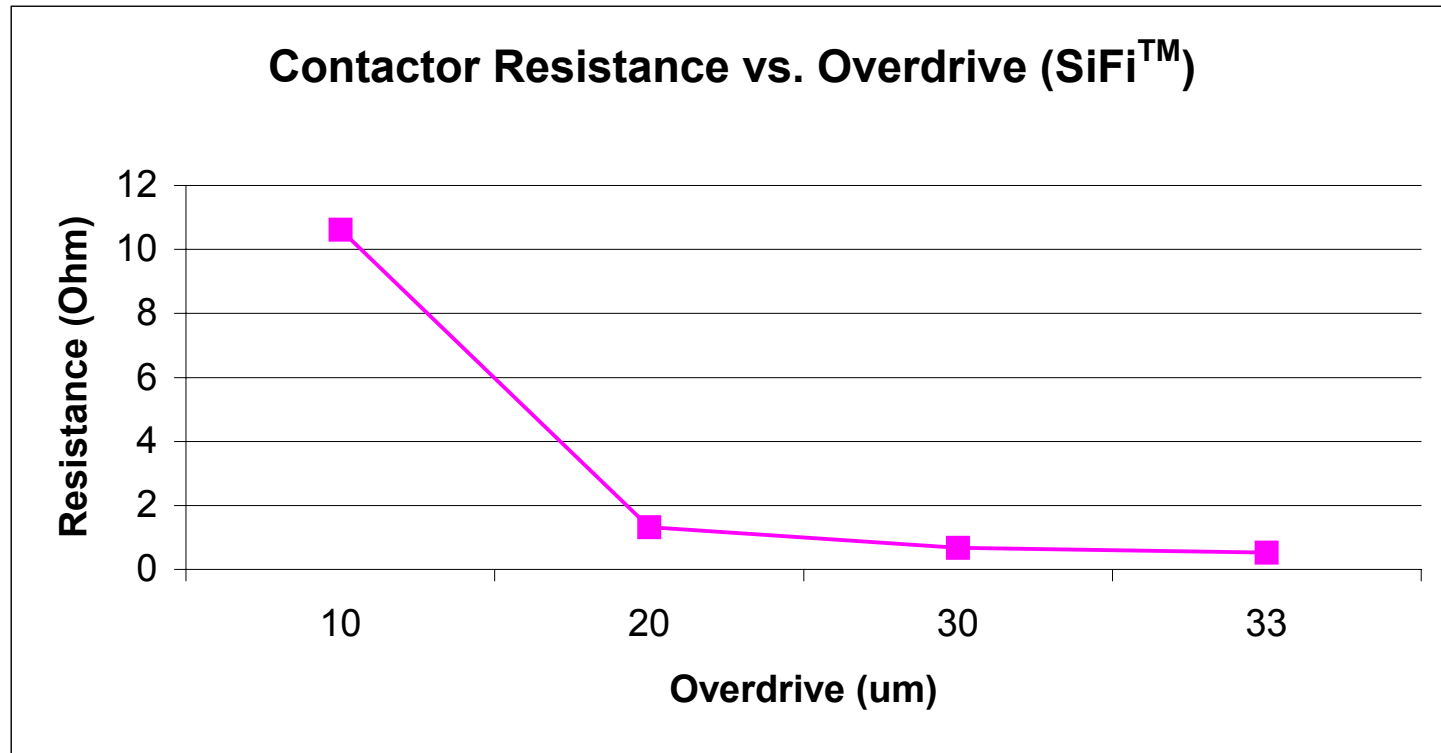
*** Note: Data shows ultimate performance of Contactor only (w/o Si or Glass Carrier).**

Contactor RF Property Summary

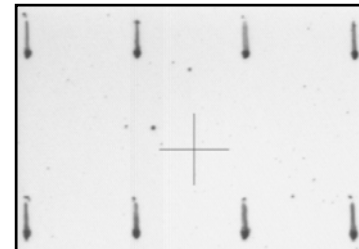
Type	Measurement 		Models From L/C Measurements	
	L [nH]	C [pF]	S21 (-3dB) 50 Ohm load [GHz] Results From Freq. Domain Modeling	f Clock [GHz] Derived From S21 Models
SiFi (TM)	1.05	0.5	6.9	2.4
Photo Finger (TM)	2.23	0.15	3.6	1.26

*** Note: L & C measurements performed on Vector Network Analyzer**

Contactor Resistance Vs. Z-OD: SiFi™

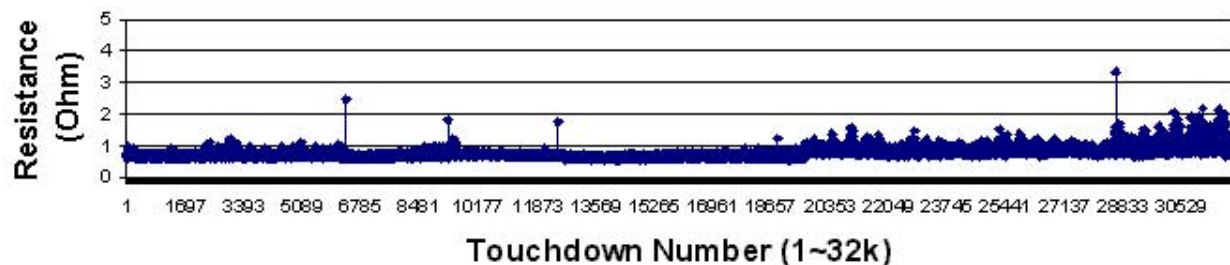


Scrub Mark at 45um Z-OD = 43 x 9 um
Z-deformation at 450 nano-meters

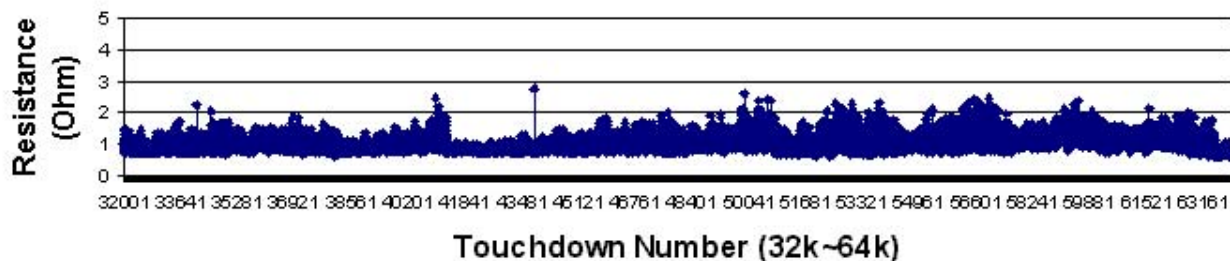


Contactor Resistance Vs. Touchdown: SiFi™

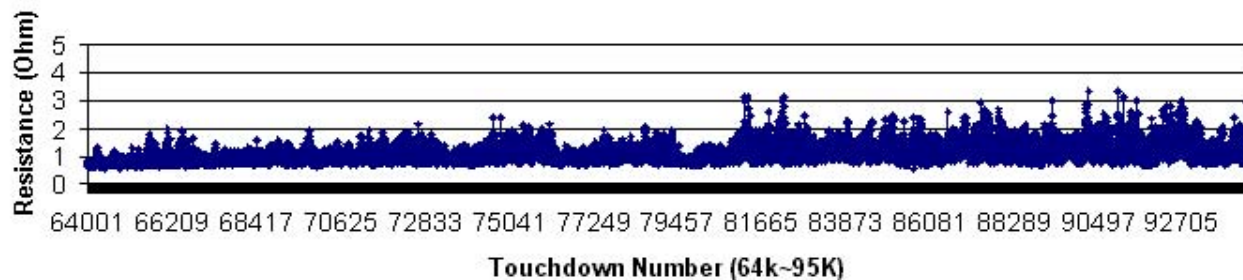
Contactor Resistance vs. Touchdown (SiFi™@85deg)



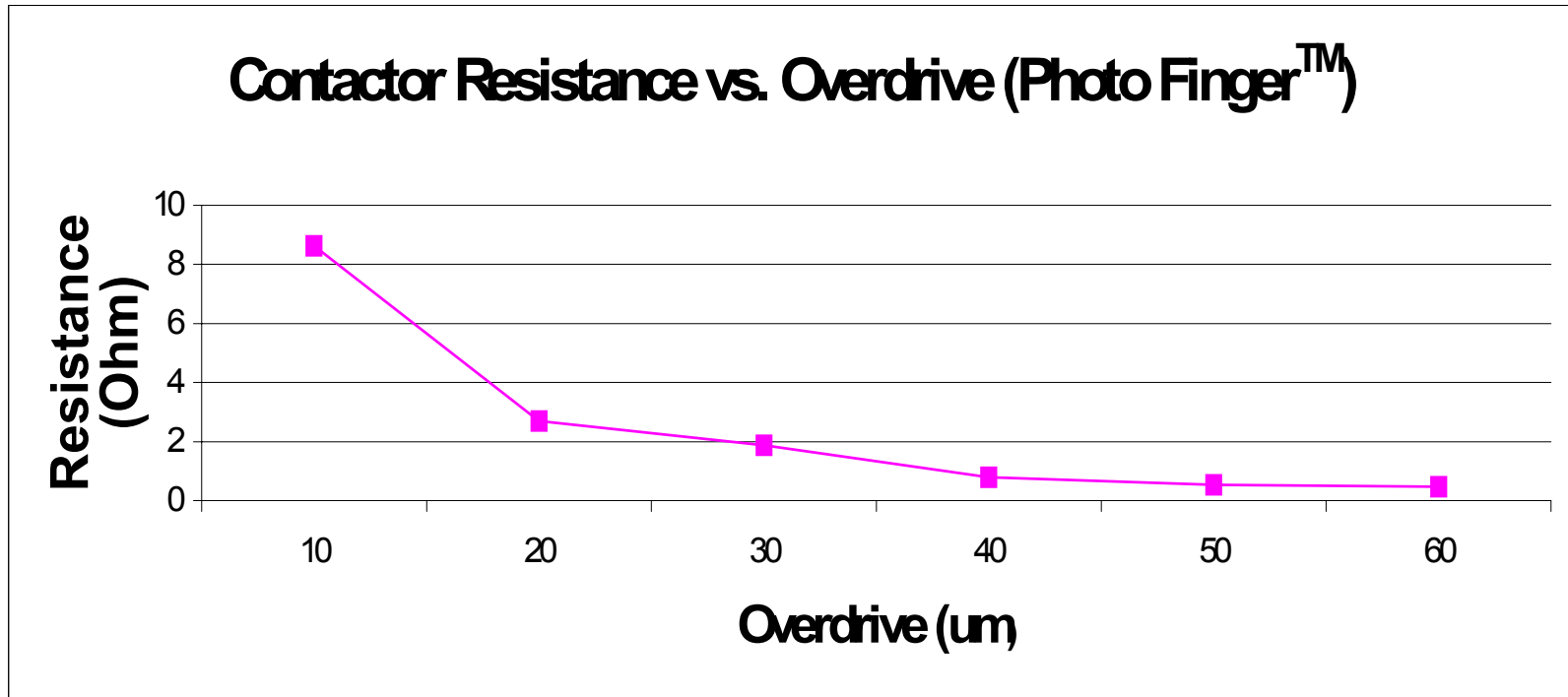
Contactor Resistance vs. Touchdown (SiFi™@85deg)



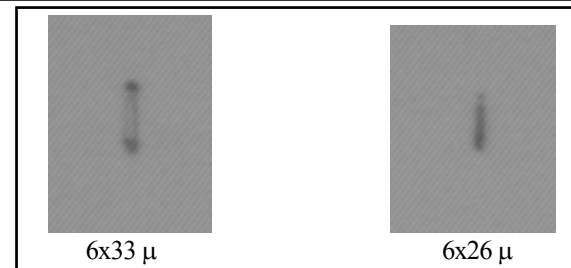
Contactor resistance vs. Touchdown (SiFi™@85deg)



Contact Resistance Vs. Z-OD: Photo Finger™

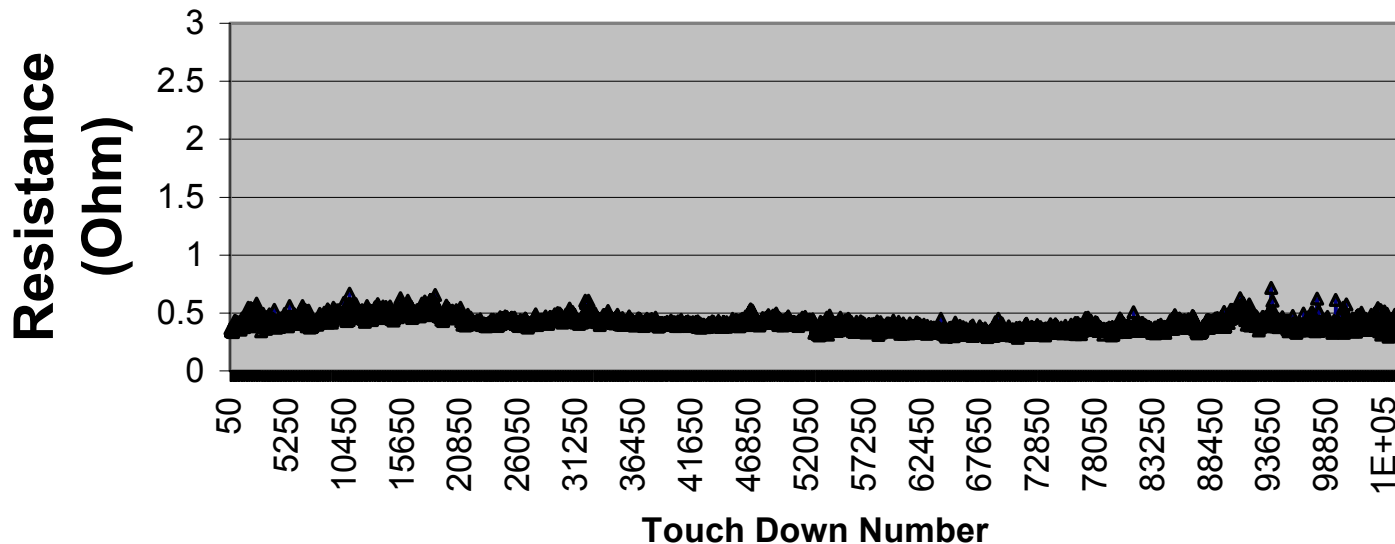


**Scrub Marks at
45 um Z-OD**

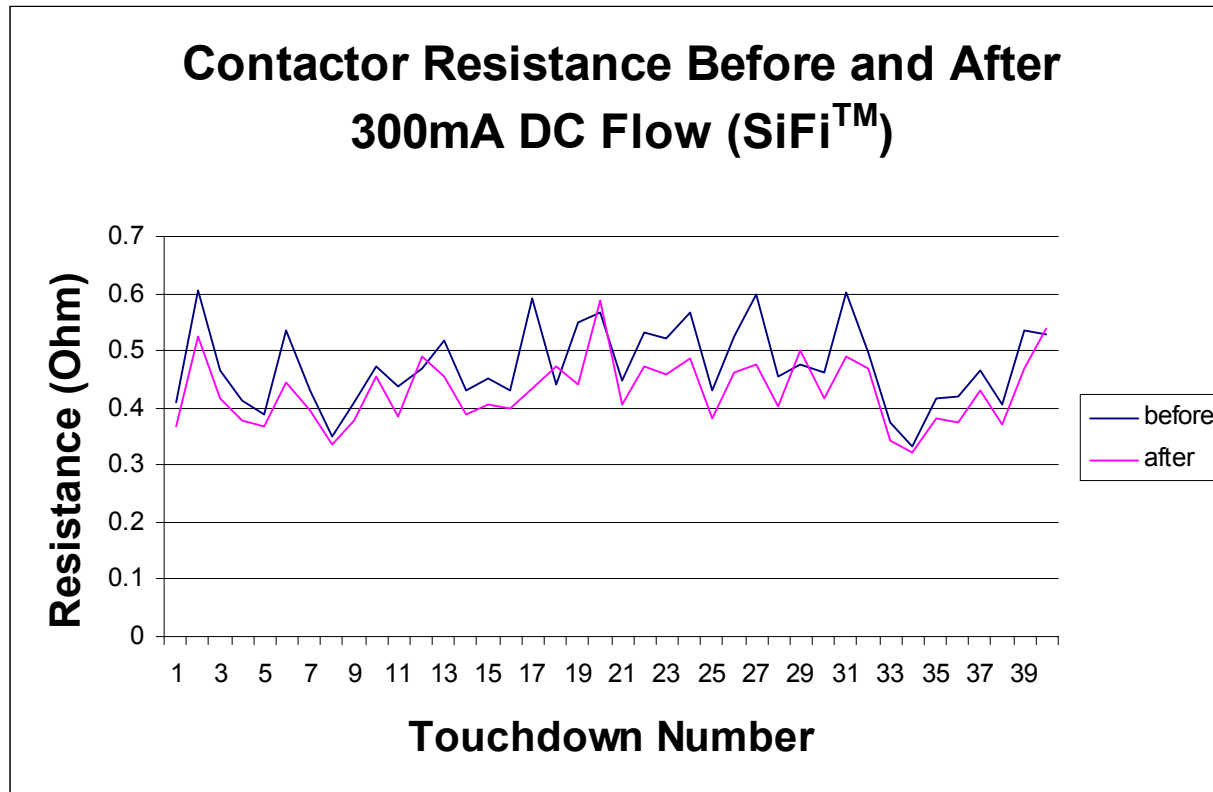


Contactors Resistance Vs. Touchdown: Photo Finger™

Contactors Resistance vs. Touchdown (Photo Finger™)

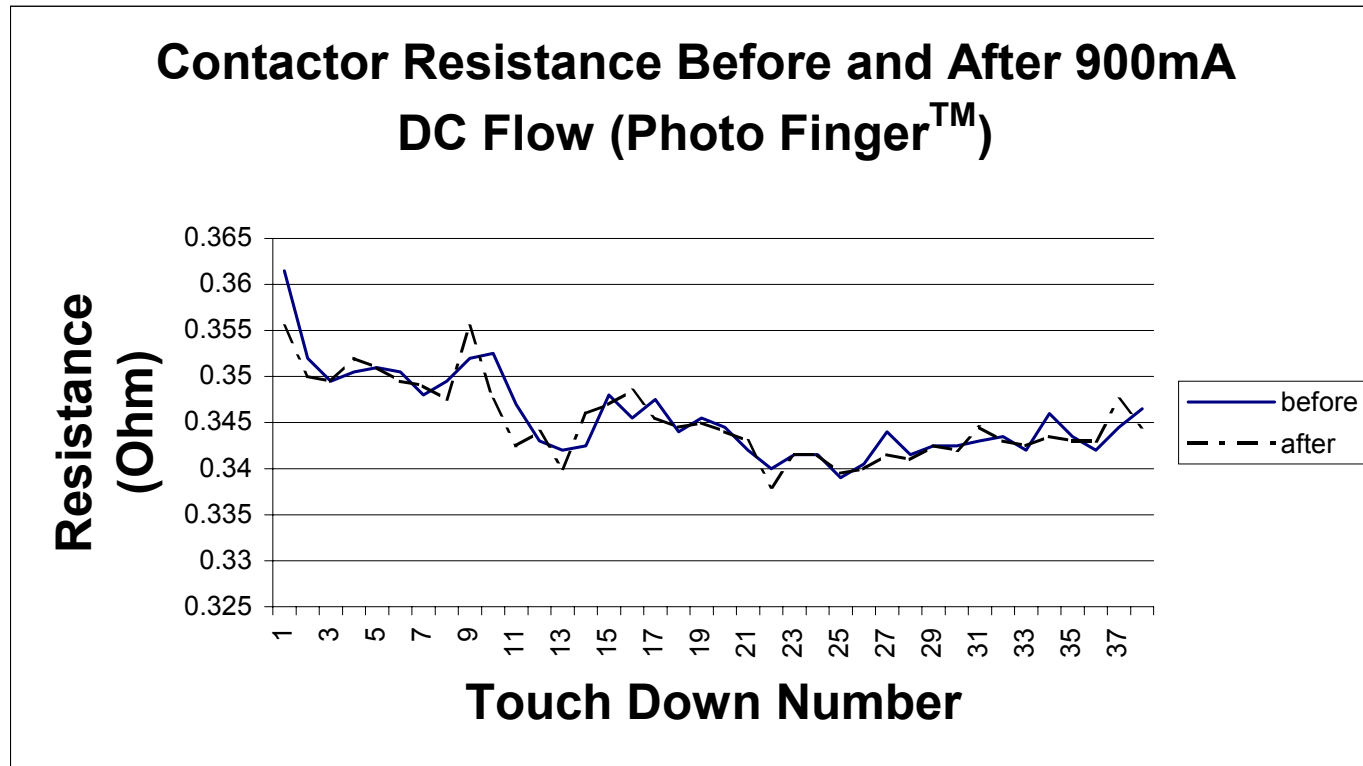


Contactor Resistance Vs. Current DC: SiFi™

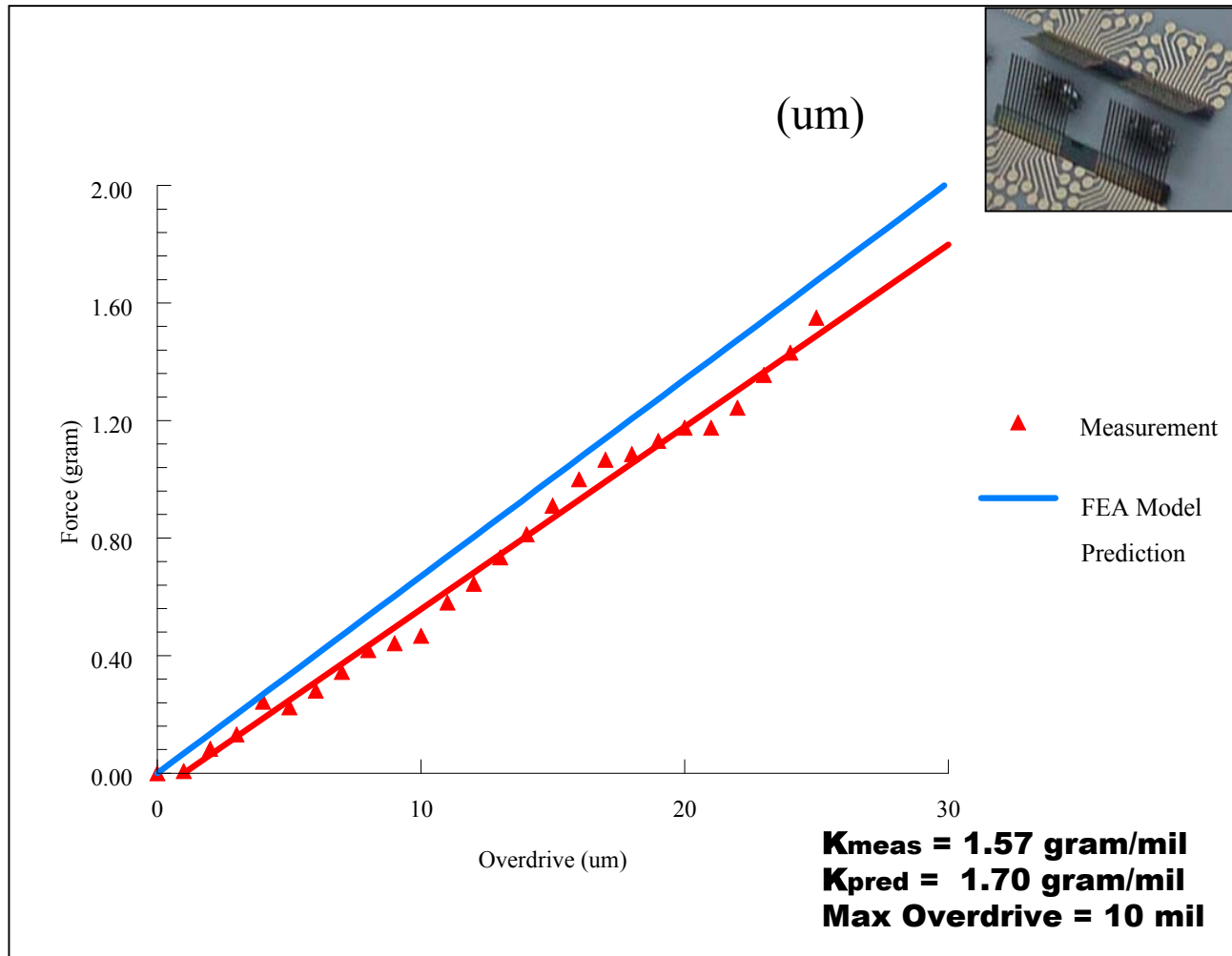


**Separately, AC Current was also measured:
Contactor Resistance Before/After 2.5 A Pulses for 5 u-sec was unchanged.**

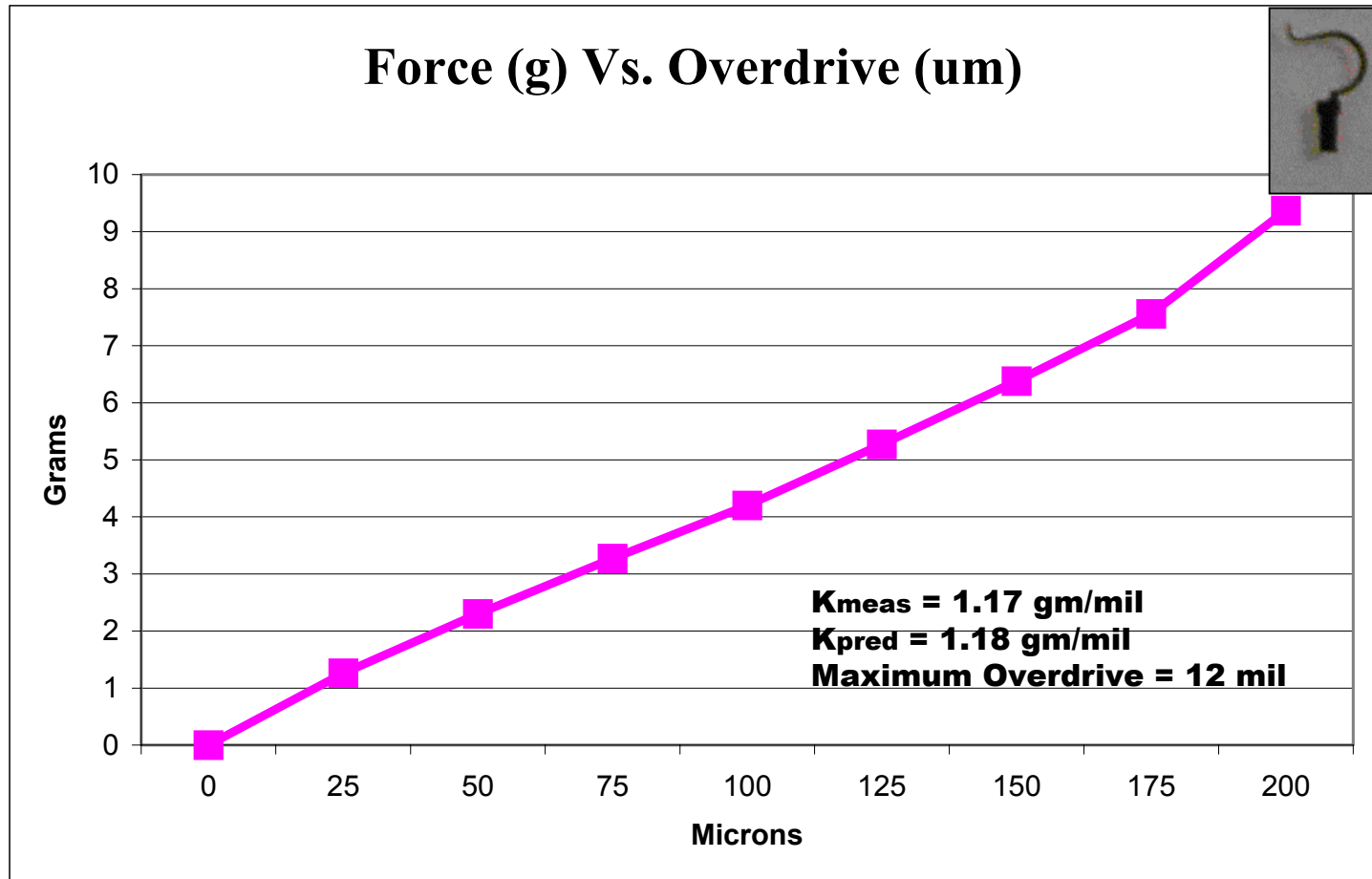
Contactor Resistance Vs. Current DC: Photo Finger™



Force & Spring Rate Vs. Z-OD: SiFi™

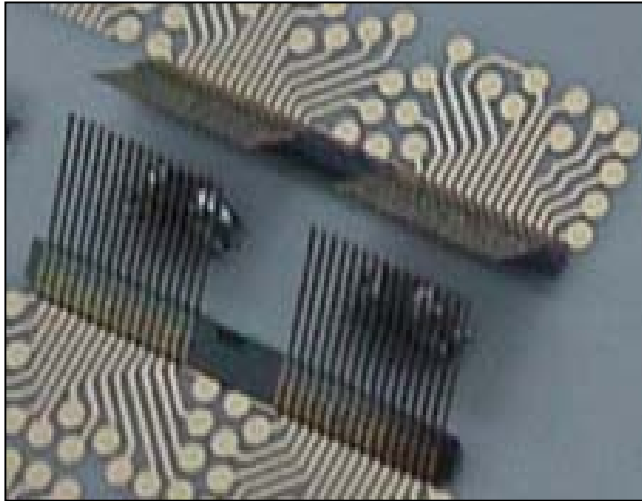


Force & Spring Rate Vs. Z-OD: Photo Finger™



Physical Density & Accuracy Specs

SiFi™

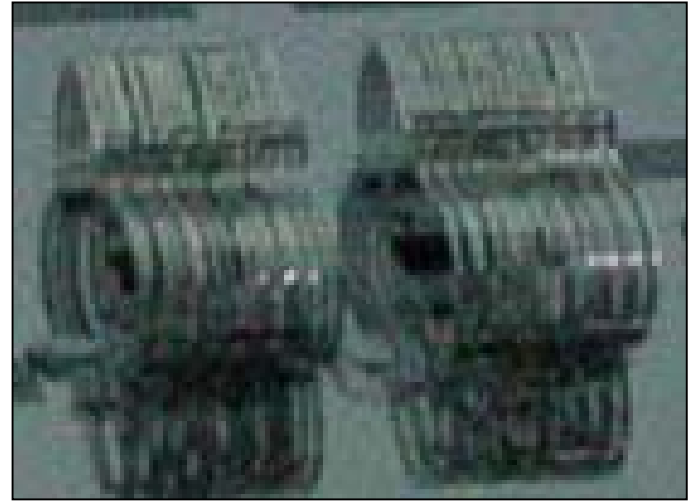


X,Y & Z +/- 10 microns

**Theoretical Pitch Limit = 80 um
(technology is scalable)**

**Theoretical Parallelism = x128
(limited by ceramic design rules)**

Photo Finger™



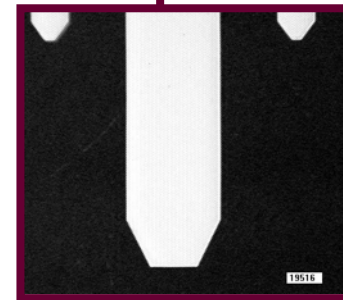
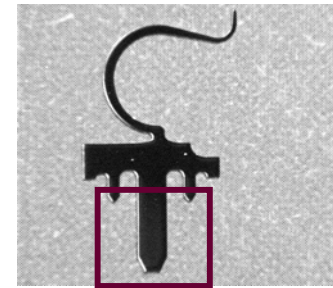
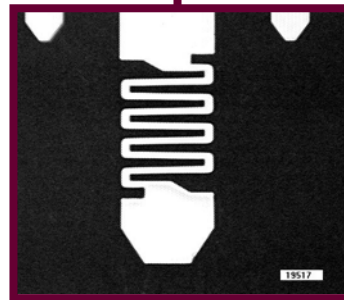
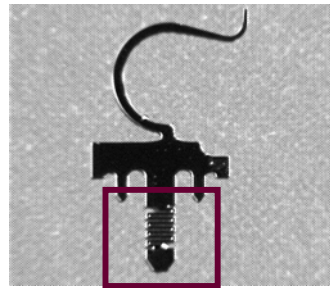
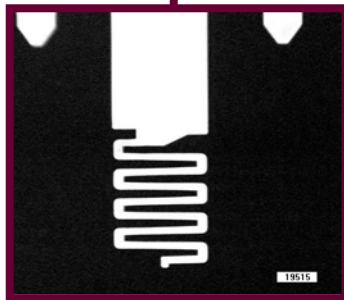
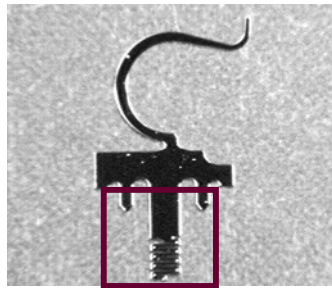
X,Y & Z +/- 15 microns

**Theoretical Pitch Limit = 80 um
(technology is scalable)**

**Theoretical Parallelism = x128
(limited by ceramic design rules)**

Possible Variations of the Photo Finger™ Technology

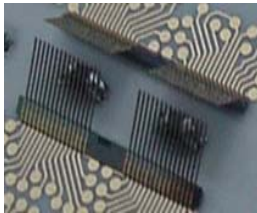
Now in Beta Investigation



Technology Portfolio

Currently In Alpha & Beta Development

Beta Evaluation



Silicon Finger (SiFi™)
Technology



Photo Finger™
Hook-Shape Technology

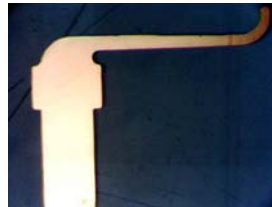


Photo Finger™
Cantilever Technology

Periphery / Memory
Technologies

Alpha Evaluation

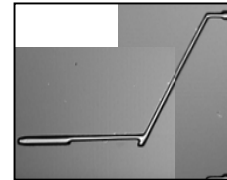


Photo Finger™
Vertical-Cantilever
Technology



Photo Finger™
Vertical
Technology

Vertical / Array
Technologies

Photos are Not to Scale

Further Data To Investigate

- **Total Touchdown Life**

So far, each technology has been taken to 350K touchdowns; no physical or electrical breakdown has been seen.

- **Cleaning Necessity**

Adhesive Tape-Touch may be required at a very minimal cleaning frequency.

- **Confirm Prober Optics Compatibility**

So far only TSK UF 200 has been used for testing; further studies need to be explored with TEL and EG probers.

- **More Real Device Testing**

Currently, we are engaged with a key high performance memory supplier to study high-parallelism at-speed testing. We will also be using the technologies to measure high-performance IC's that we produce for Advantest test equipment.

Distinguished Acknowledgements

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Ben Preis / Advantest America Inc.

Dr. James Frame / Advantest America Inc.

Keith Lee / Advantest America Inc.

Nick Konidaris / Advantest America Inc.

Hiroshi Tsukahara / Advantest Corporation

Hiroji Agata / Advantest Corporation

Tadao Saito / Advantest Corporation

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CDE Design Group, Advantest Europe & Advantest Japan