Development of a Scalable Spring Contact for Probe Cards

Southwest Test Workshop 2000

Robert C. Martin
FormFactor Inc.
2140 Research Drive
Livermore CA, 94550

www.formfactor.com

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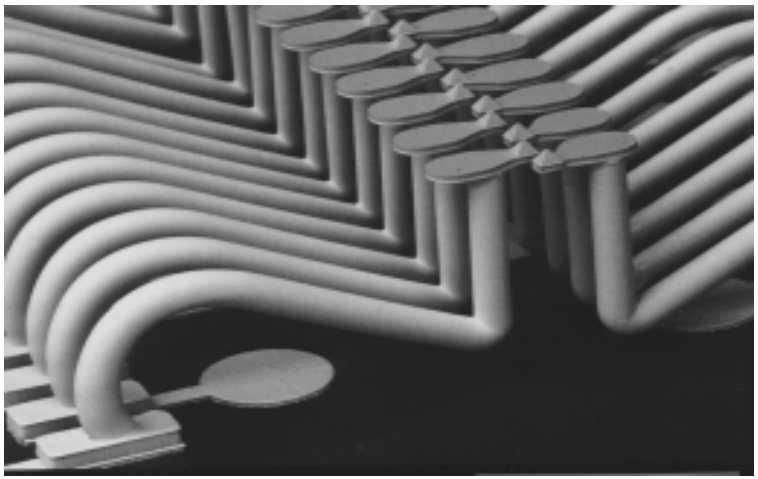
Agenda

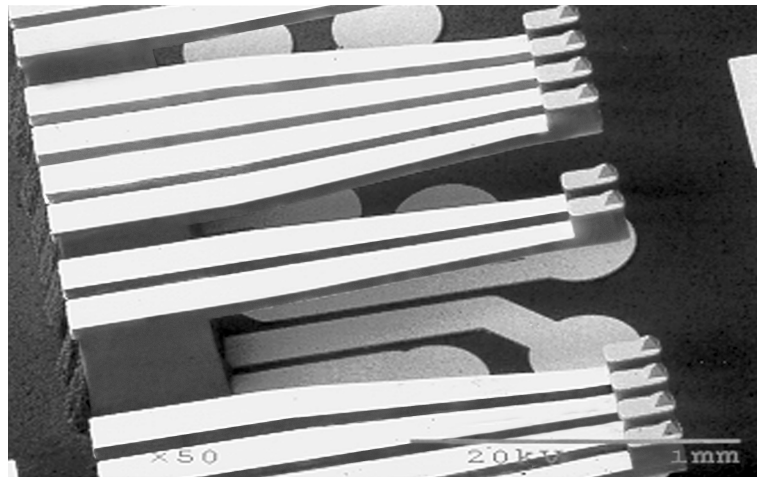
- Probe Card Requirements
- FormFactor Current Status
- Introducing MicroSpringsII™ contact
- MicroSpringsII technology characterization
- Beta test results
- Conclusions

Probe Card Requirements

	MicroSpring™ Contact	MicroSpringsII Contact
■ Fine pitch capability ➔ Down to 60um and below	☐	☑
■ Layout flexibility ➔ LOC, peripheral pads, staggered peripheral	☐	☑
■ Low TCOO ➔ Improved yield, low maintenance	☑	☑
■ Scalable for multi-DUT array capability ➔ 64DUT memory and beyond, >4 DUT logic	☑	☑
■ Low probe force ➔ Mean spring force < 1.5 gm/mil	☑	☑

MicroSpring vs. MicroSpringsII Contact





What is the **SAME**

- Truncated pyramid contact
  - ProbeAlloy™ contact metallurgy
- Probe card construction
  - PCB
  - Interposer
  - Ceramic space transformer
- Electrical characteristics

What is **NEW**

- Cantilever type spring
- Better pitch capability
  - 90µm **NOW** – 60µm **2001**
- Increased layout flexibility
- Better control of spring force

MicroSpringsII
Production Proven Contact Technology

- FormFactor ProbeAlloy™ contacts
- Truncated pyramid contact
- Low contact resistance
- Minimal cleaning
- Long lifetime
- Production proven over millions of touchdowns at over 20 customer sites

MicroSpringsII Characterization

- 200,000 touchdowns reliability test
- 100,000 touchdowns Cres test
- Cres vs overtravel
- Scrub mark characteristics
- Spring force

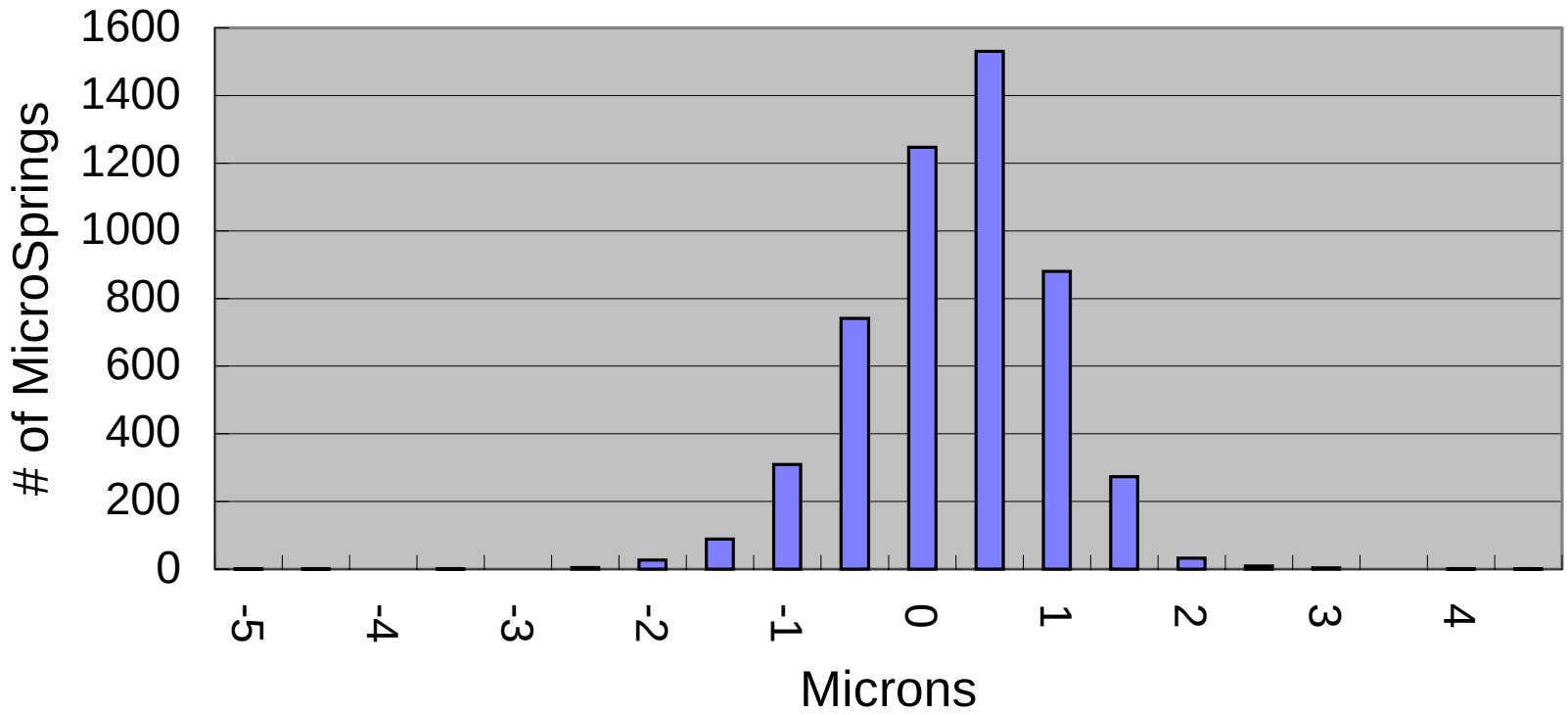
200,000 Touchdown Reliability Test

- 732 spring probe card
- Performed touchdowns on TSK UF-200
  - ➔ Average 87um overtravel from first contact
  - ➔ Used FFI wafer – non-abrasive contact surface
- Measured probe tip x, y, and planarity on API PRVX1
  - ➔ Measured at:

0	25,000
1,000	50,000
5,000	100,000
10,000	200,000

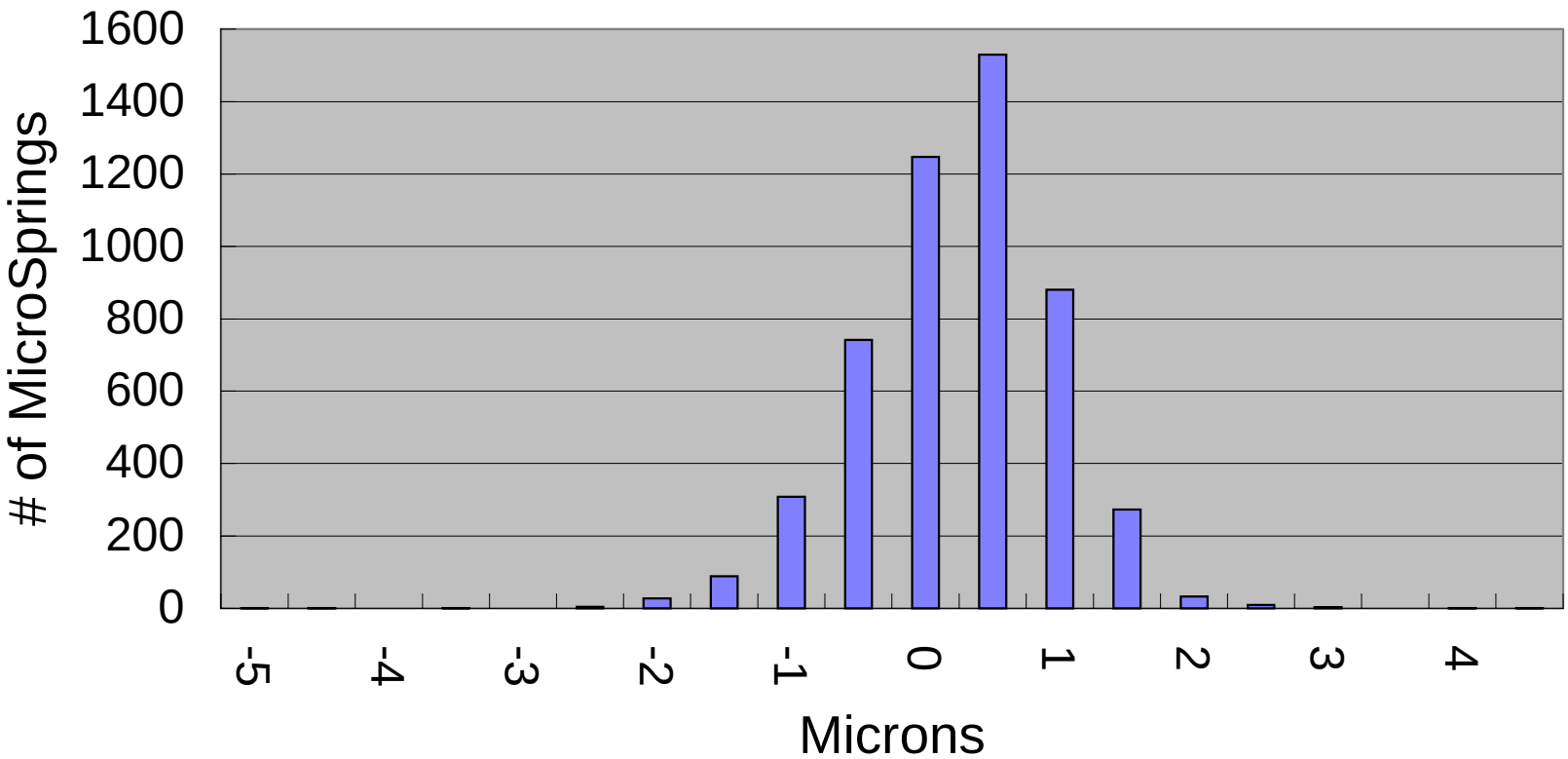
touchdowns

Change in X Alignment After 200,000 Touchdowns



- 736 probes x 7 measurements = 5152 data points
- Maximum deviation from initial position over 200k touchdowns
- Measured on API PRVX – specified measurement error ±1.3um

Change in Y Alignment After 200,000 Touchdowns

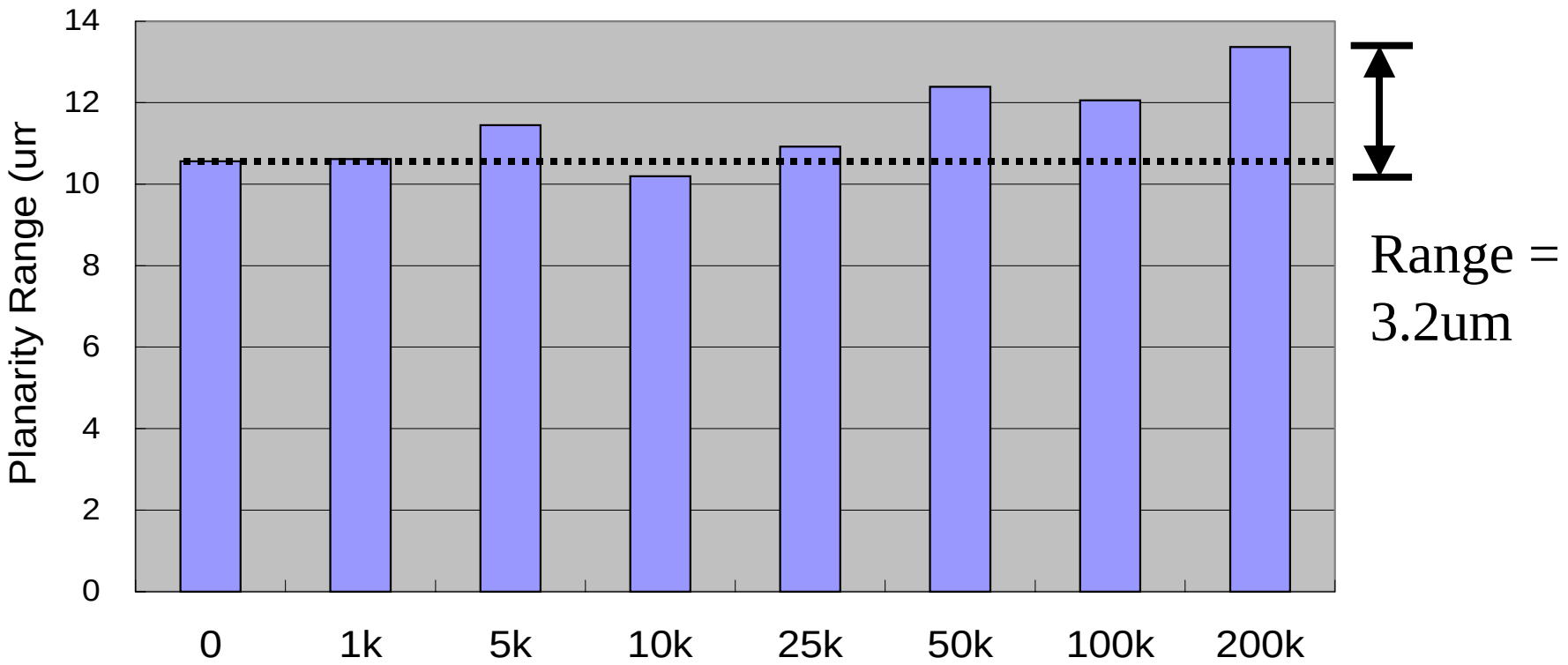


736 probes x 7 measurements = 5152 data points

Maximum deviation from initial position over 200k touchdowns

- Measured on API PRVX – specified measurement error ±1.3um

Change in Planarity Over 200,000 Touchdowns



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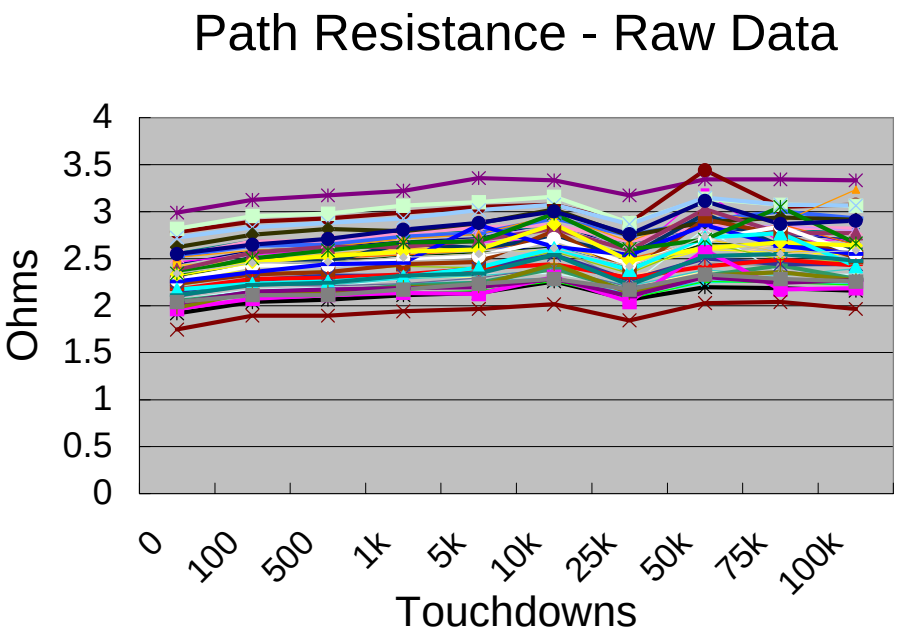
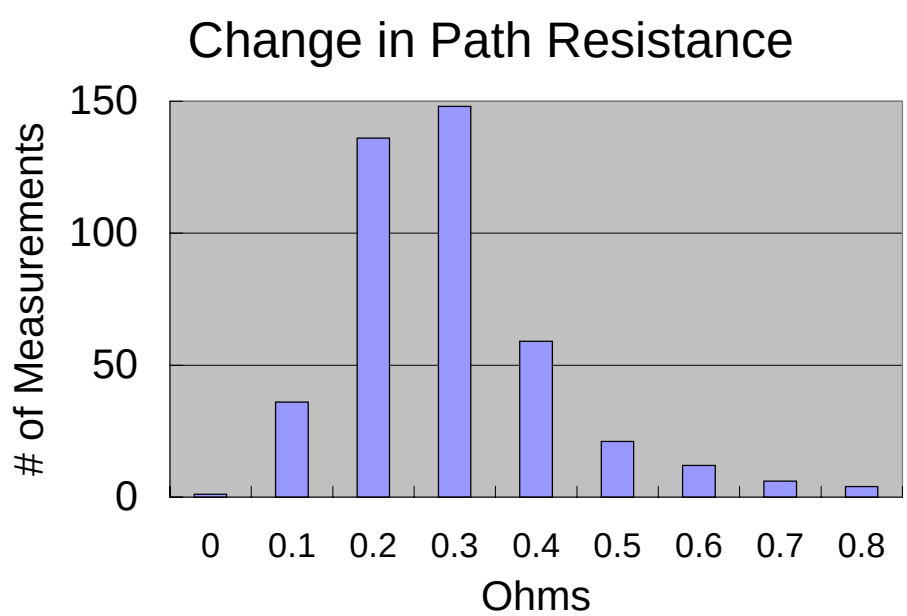
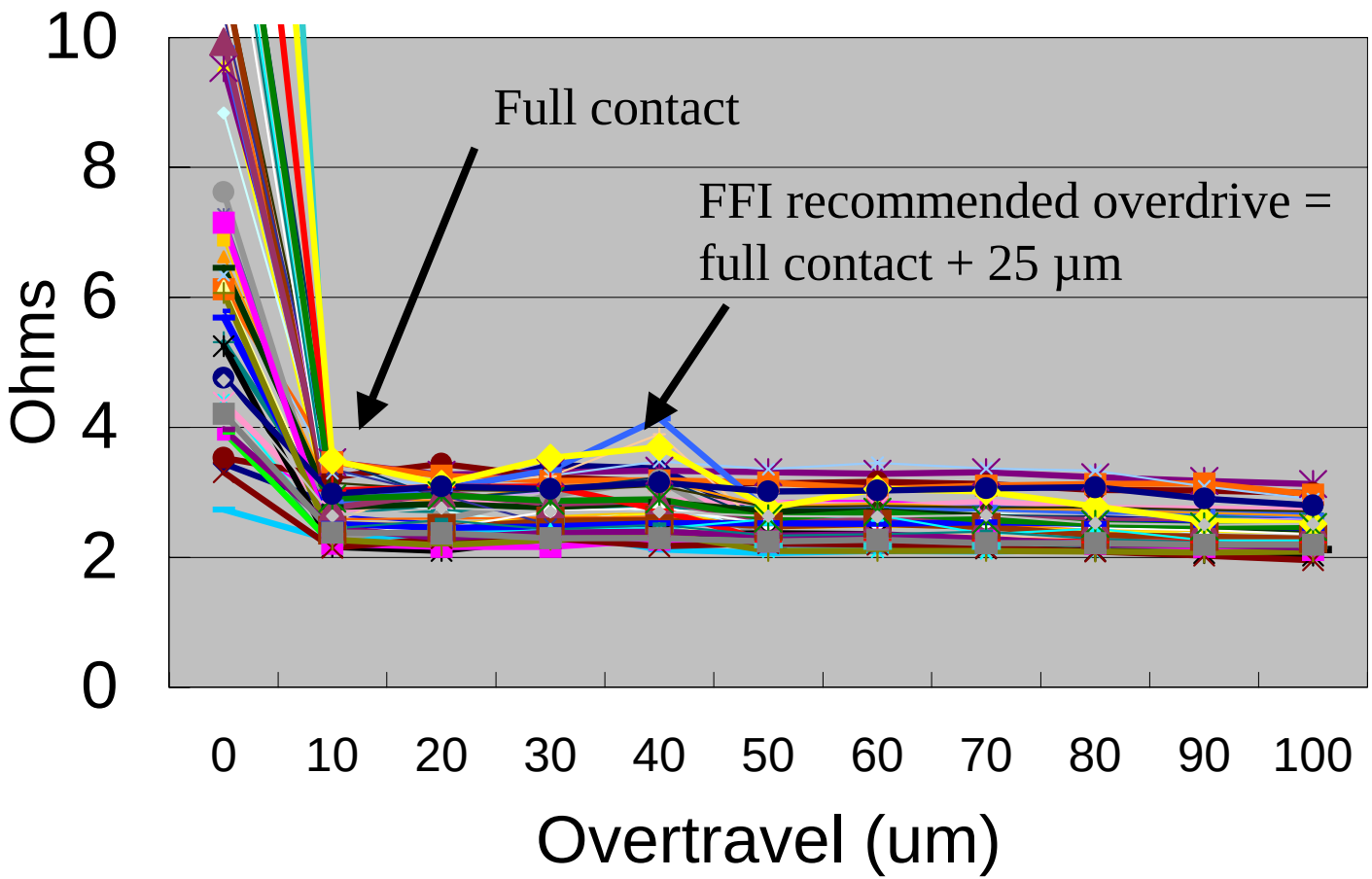
100,000 Touchdowns vs. Path Resistance





- 48 probes monitored – 20 mA forcing current
- Customer supplied Al/Cu wafers
- Tested at 85°C

Path Resistance vs Overtravel



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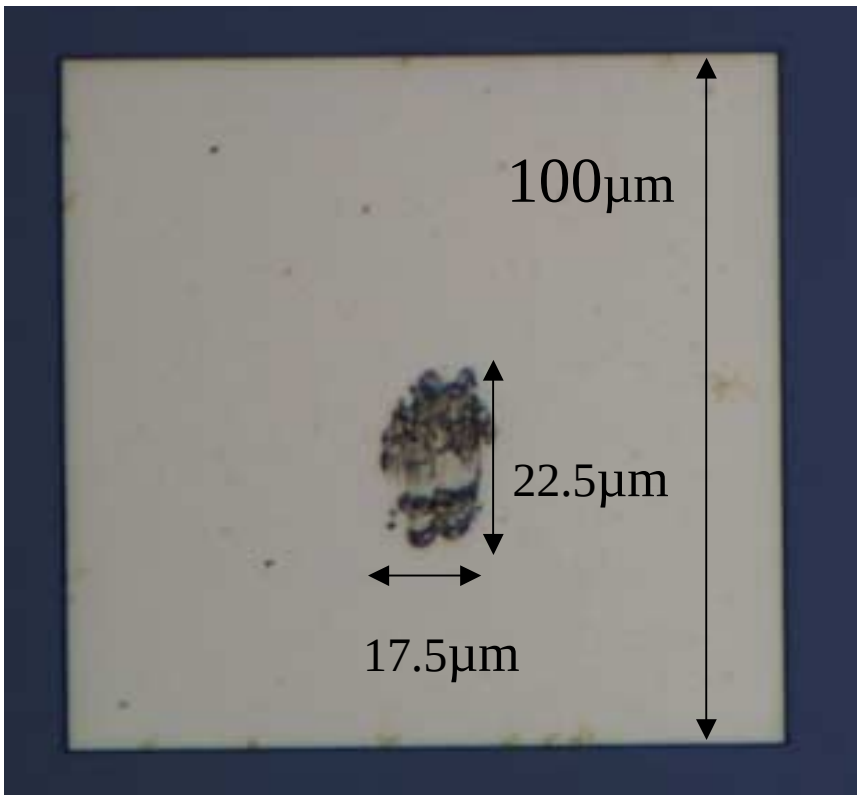
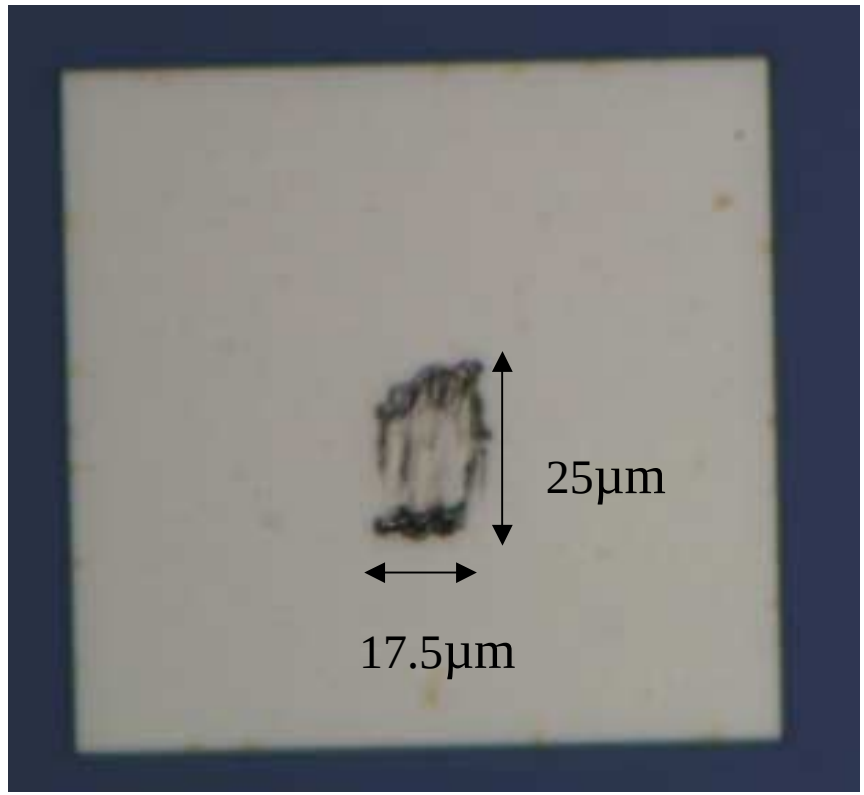
Scrub Mark



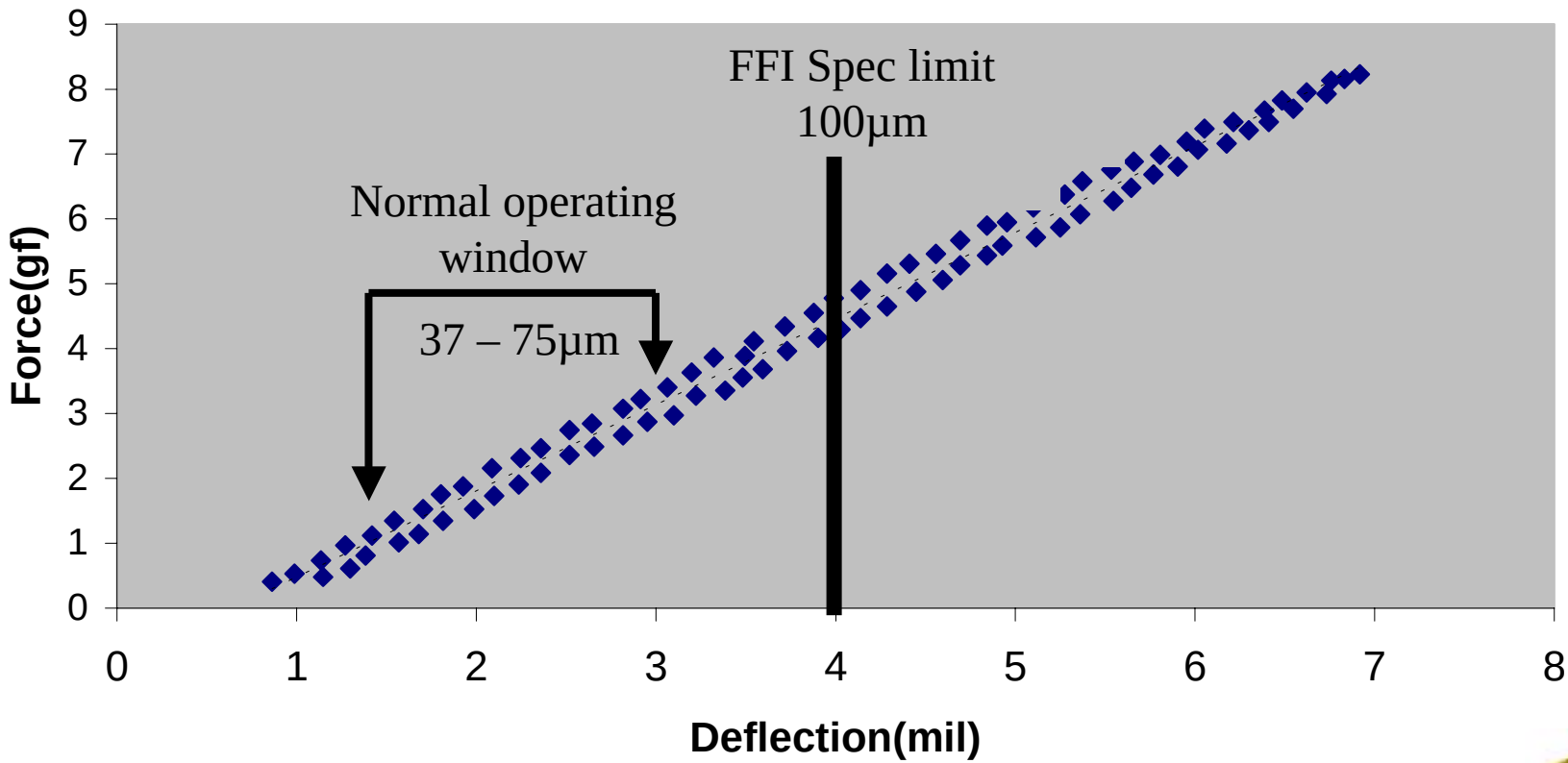
Scrub Mark at 40µm overtravel
17.5 x 22.5µm scrub in 100µm pad



Scrub Mark at 80µm overtravel
17.5 x 25µm scrub in 100µm pad

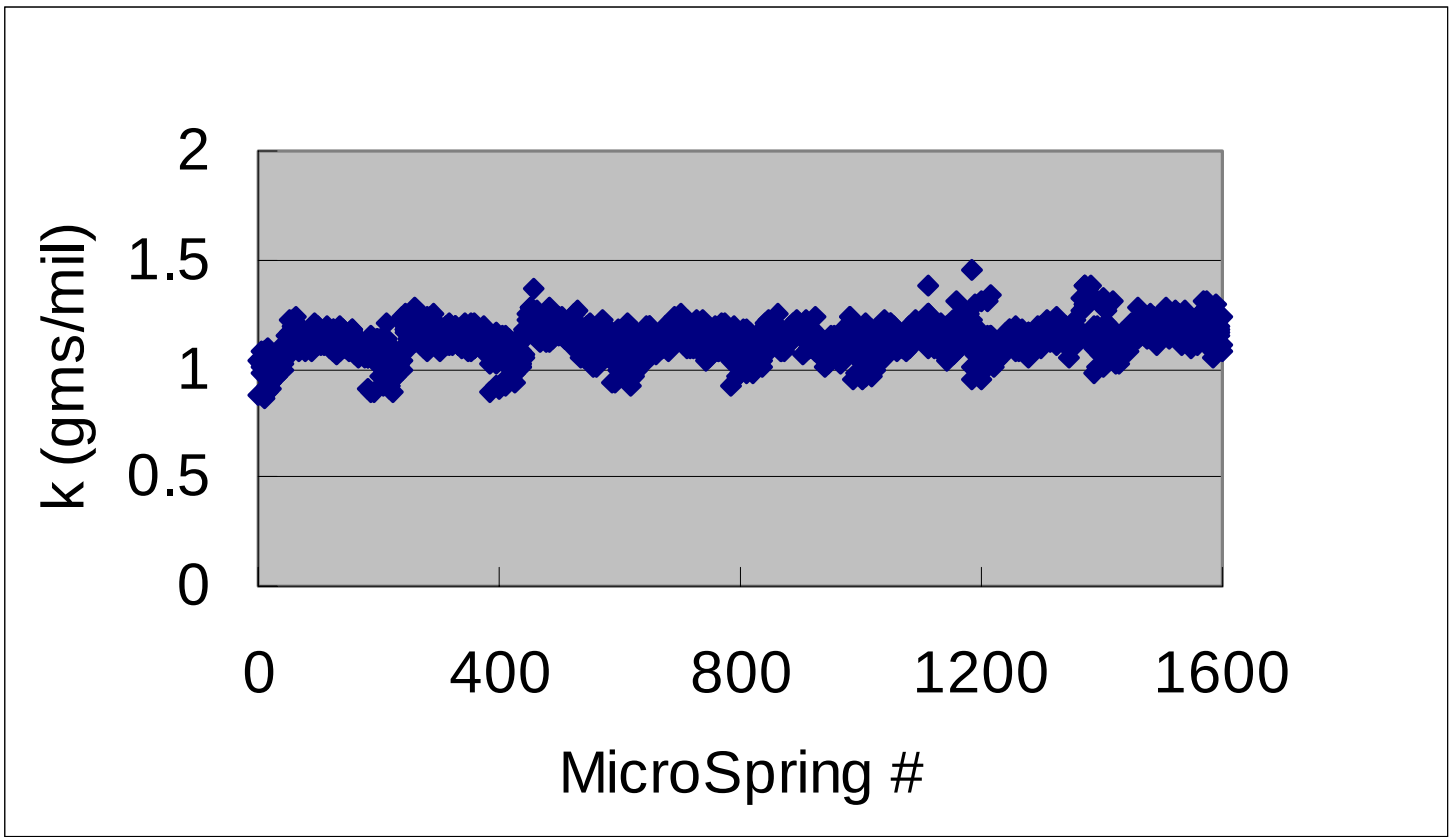
Spring Characteristics

Force vs Deflection Curve



Measured on FFI spring force metrology tool

Spring Constant – k



MicroSprings – 1600 springs, Mean k = 1.13, Range = 0.57

Measured on FFI spring force metrology tool

MicroSpringsII Beta Testing – Customer #1

- 32DUT card passed correlation with existing MicroSpring probe card – equivalent yield
- > 50,000 production touchdowns with no cleaning
- Card examined @ FFI after 30,000 touchdowns – no change

	X Error (µm)	Y Error (µm)	Planarity (µm)
Initial*	13.8	18.9	19.7
After 30K Touchdowns**	18.9	16.7	24.9
Change	+5.1	-2.2	+5.2

*Total Range of data (max – min), 32DUT probe card, 1472 Microsprings

** API Motherboard was NOT fine leveled for the "Initial" measurement

MicroSpring™ Beta Testing – Customer #2

- 4 DUT logic probe card
- 4 DUT probe card correlated to single DUT cantilever probe card
- MicroSpring™ advantages:
  - ➔ 1 space transformer can be used for single, dual or 4 DUT probing
  - ➔ Better decoupling
  - ➔ Low cleaning frequency
  - ➔ Smaller scrub marks

Conclusions

- Characterization shows robust new MicroSpring contact
- Beta results confirm characterization results
- MicroSpring™ technology is in production in parallel memory and logic applications
- FFI MicroSpring™ technology is now available for fine pitch probing