SW Test Workshop
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Review of New, Flexible MEMS Technology to Reduce Cost of Test for Multi-site Wire Bond Applications

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Overview

- **Project Background & Objective**
- **Probe spec - FFI**
- **Data Results - TI**
  - Planarity
  - Thermal agility
  - Pad damage
  - Cres performance
  - Yield performance
  - Life time data
- **Summary**

Background

- **Previously evaluated and released to production a new MEMS vertical technology for flip chip bumps**
  - Results presented at SWTW 2014 (S07_01_Stillman_5-28-2014)
- **For wire bond applications, wanted to combine the strong operational performance of MEMS cantilever technology with the pad layout flexibility and repair – ability of MEMS vertical technology**
- **Leverage success of production worthiness of flip chip applications to expand design coverage for wire bond applications**

Motivation From Previous Work

- **Conclusion from 2014 SWTW presentation**
  - Low-force MEMS Probe Card Technology, such as FormFactor's K-Probe, demonstrated several advantages for solder flip-chip probing in high-volume production
    - Production stability for high pin counts, > 20,000 pins
    - Scalability for multi-DUTs probing, >= 8 DUTs
    - Long life-time, >2M touchdowns demonstrated
    - Controlled Cres in production
  - As flip-chip pitch continues to shrink, requiring finer vertical probes, MEMS probe technology is proven to be a viable path to continue lowering cost of test
- **Extend the MEMS vertical spring technology to Al pad probing for wire bond applications**

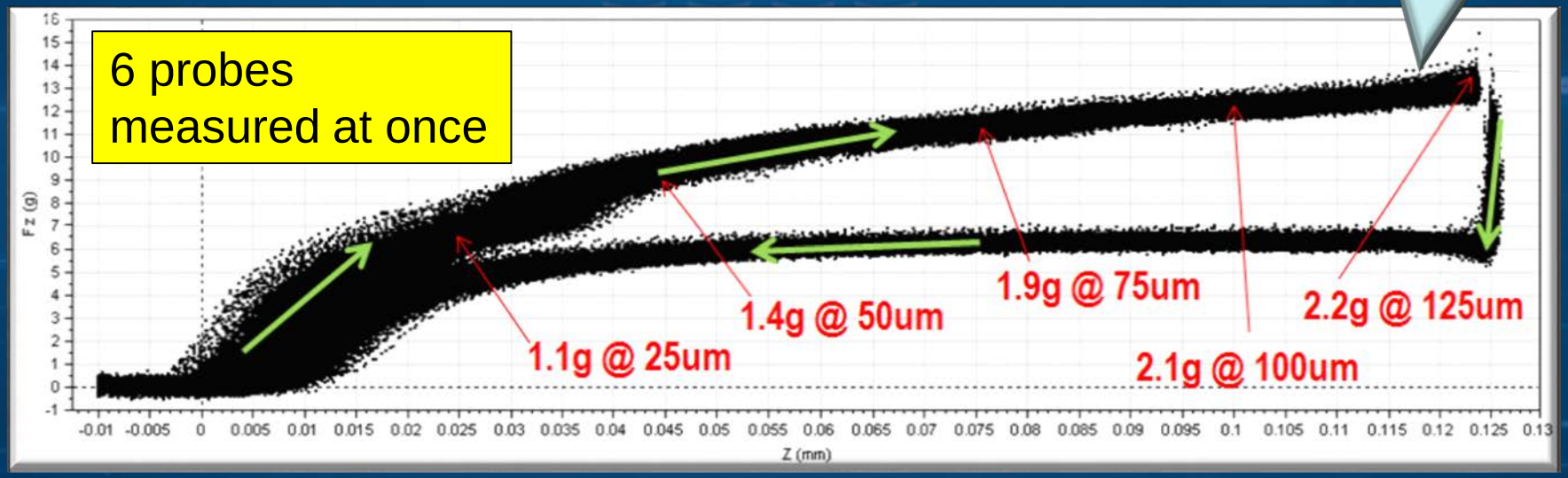
Project Objective

- **Evaluate, then release to production a new MEMS vertical probe technology for Al pads**
  - Low force probe without sacrificing CCC
  - Contact stability – tight planarity and CRES
  - Thermal Agility –probe card stability with wide temperature range of -40°C to 140°C
  - Minimal pad damage and ILD cracking
  - Production support with field replaceable probes

Basic Spring Performance

Probe Force vs. Over Travel

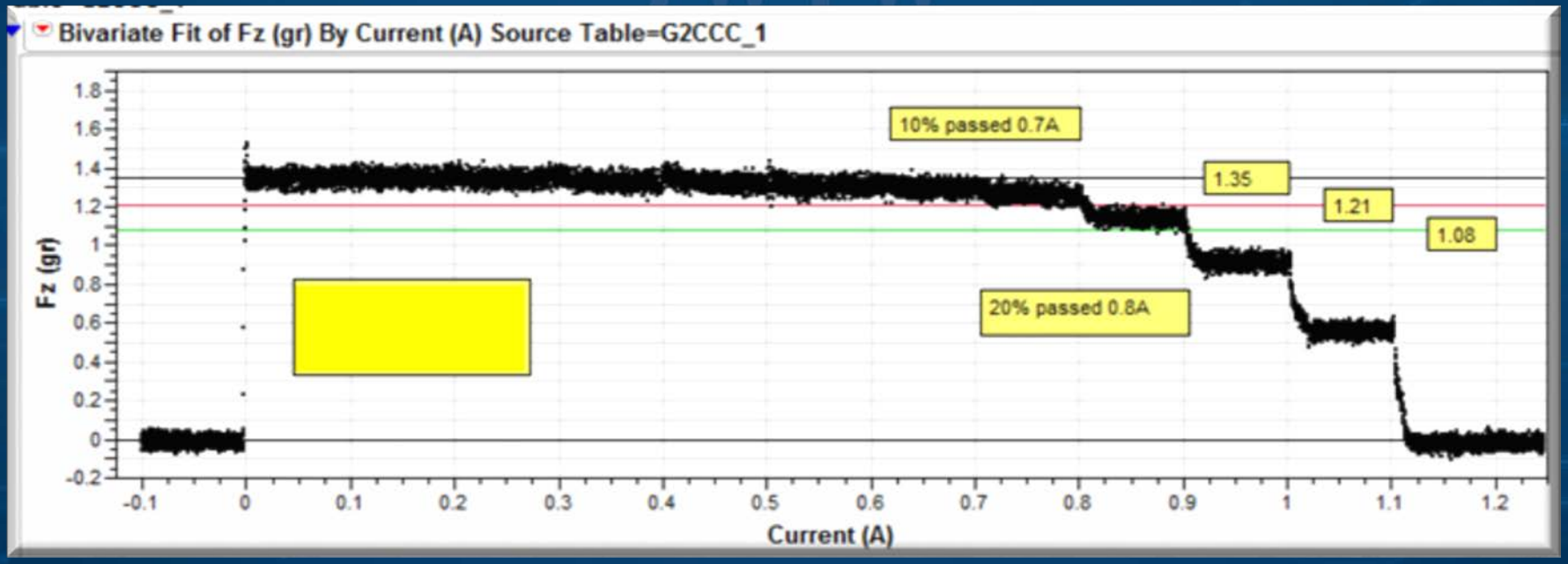
Full Probe cycle of being compressed and released



Data after 1.5M cycles

Basic Spring Performance

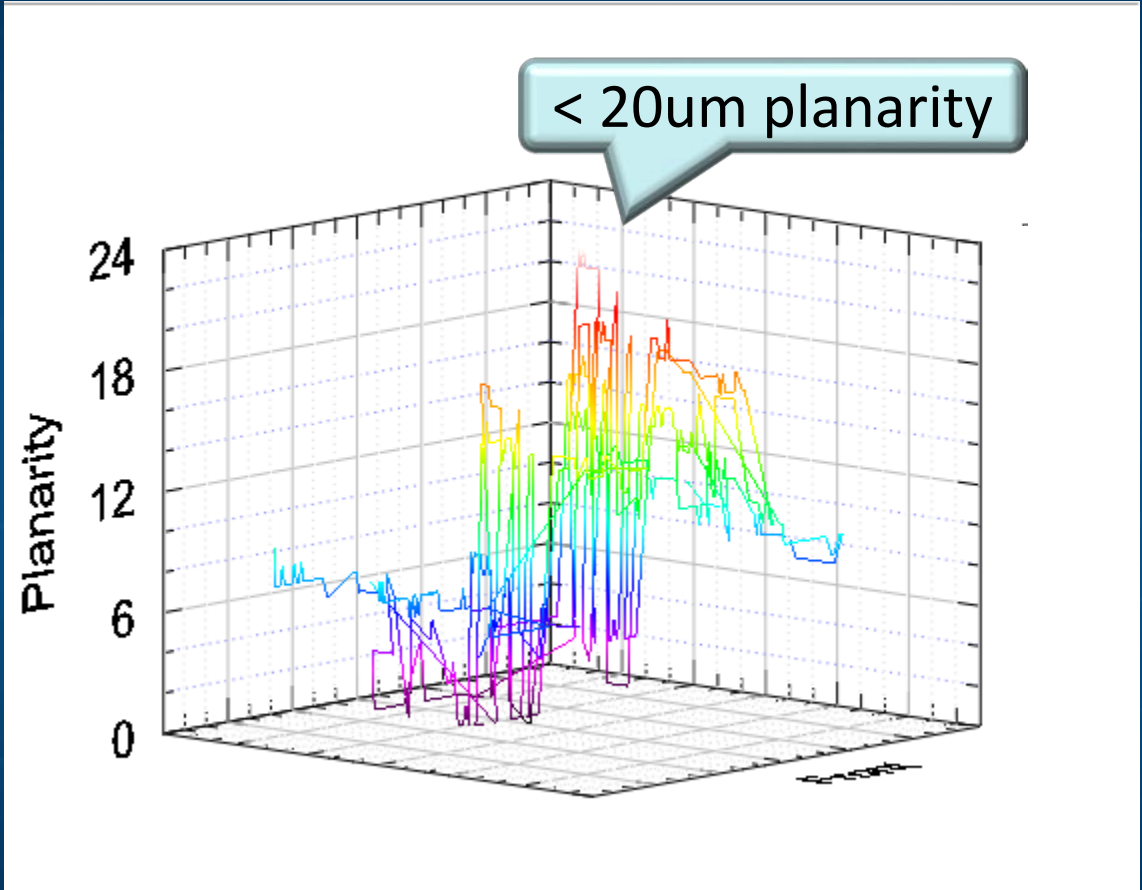
ISMI Current Carrying Capacity
performance of low force vertical spring



Data after 1.5M cycles

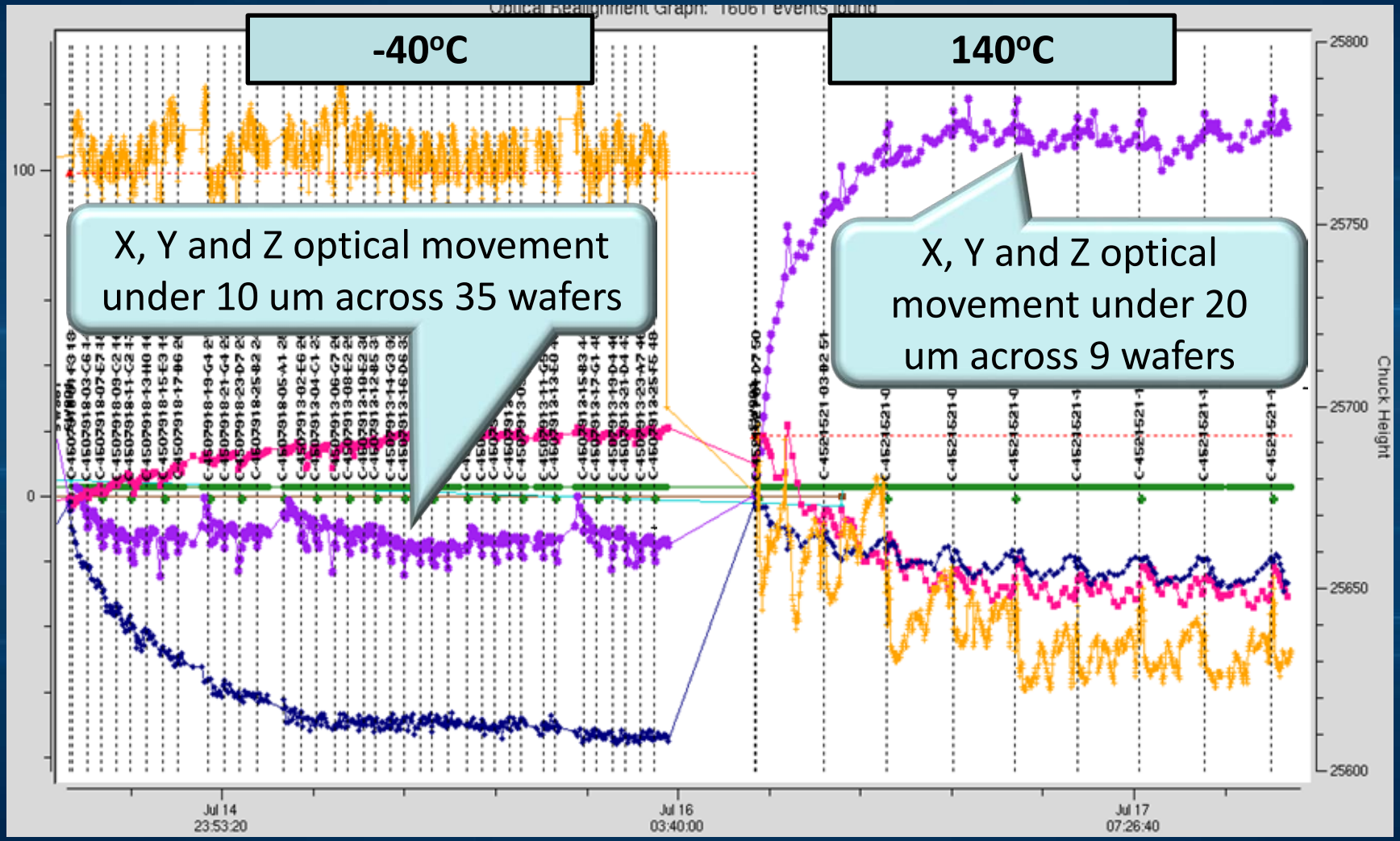
Qualification Results

Auto Z Performance



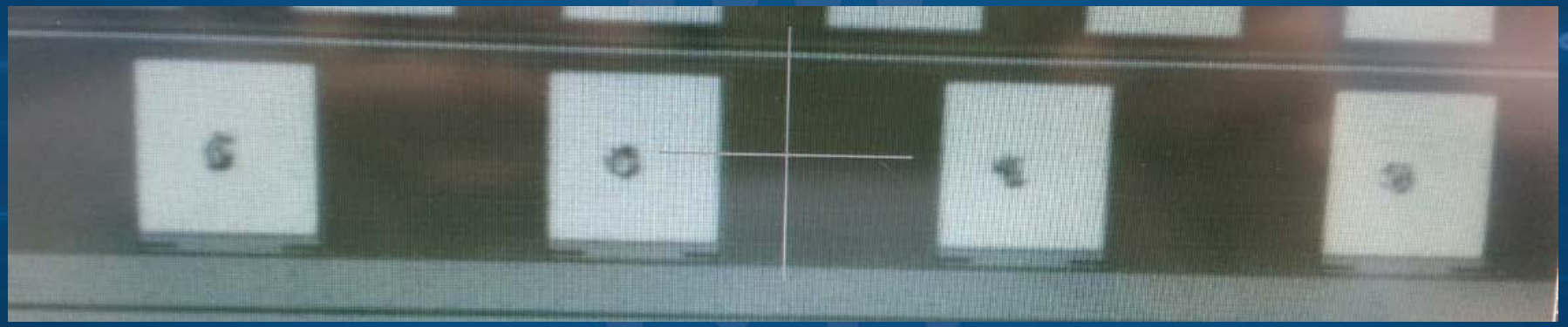
- **Probe card layout – x8, 1256 springs, 608 mm^2 array**

Thermal Agility



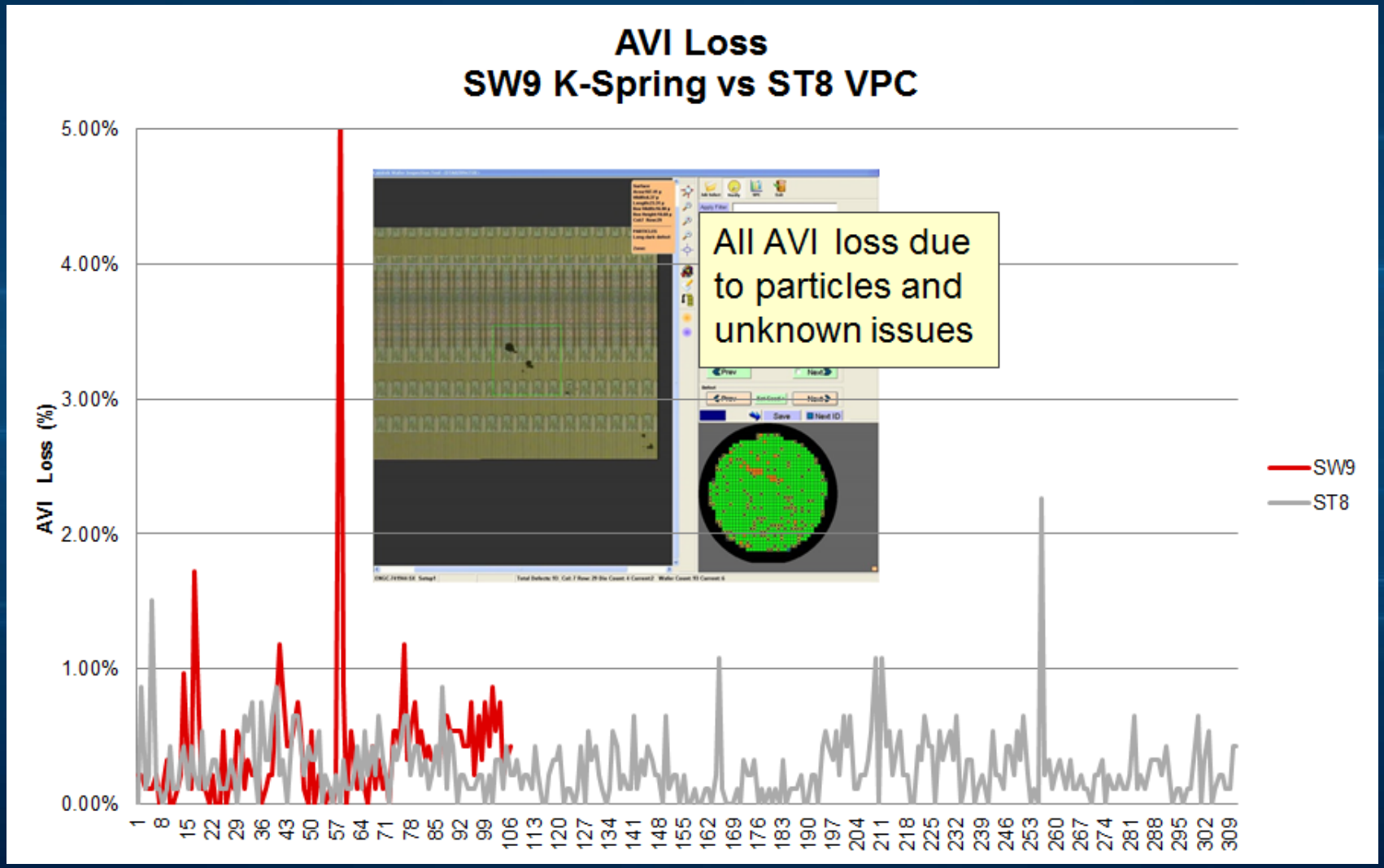
- **Once the card gets to temp, thermal movement is very stable**

Minimal Pad Damage



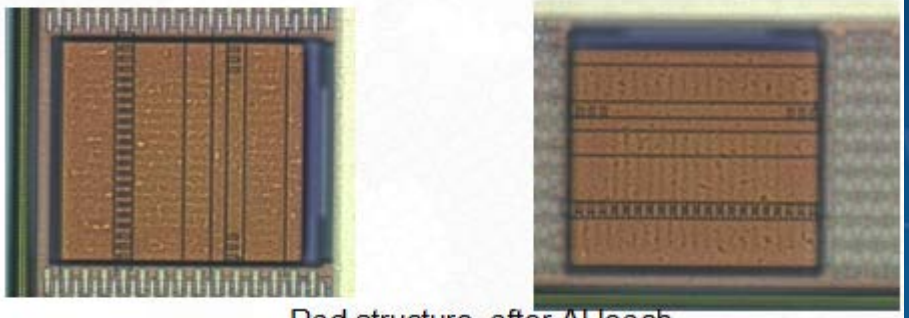
- **Probing at 80um OT**

AVI Performance
(Automated Visual Inspection of Pad Damage)



Dielectric Cracking & Punch Through

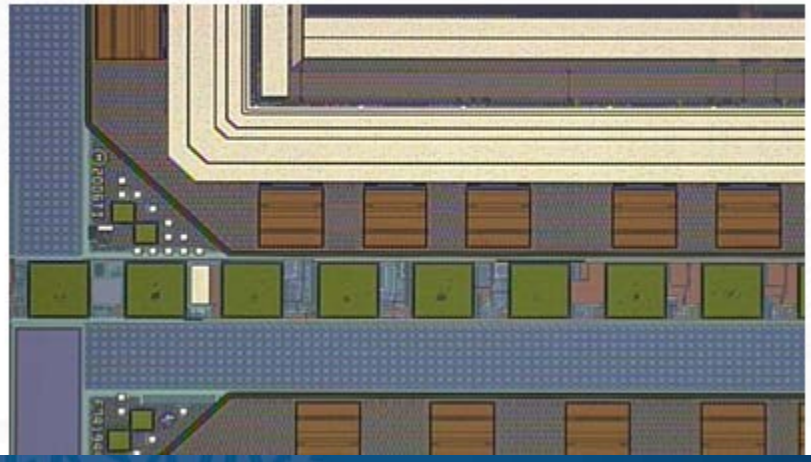
11x Touchdowns at 100um OT



Pad structure after Al leach

No dielectric cracking found

Parametric cracks found during wafer de-processing.

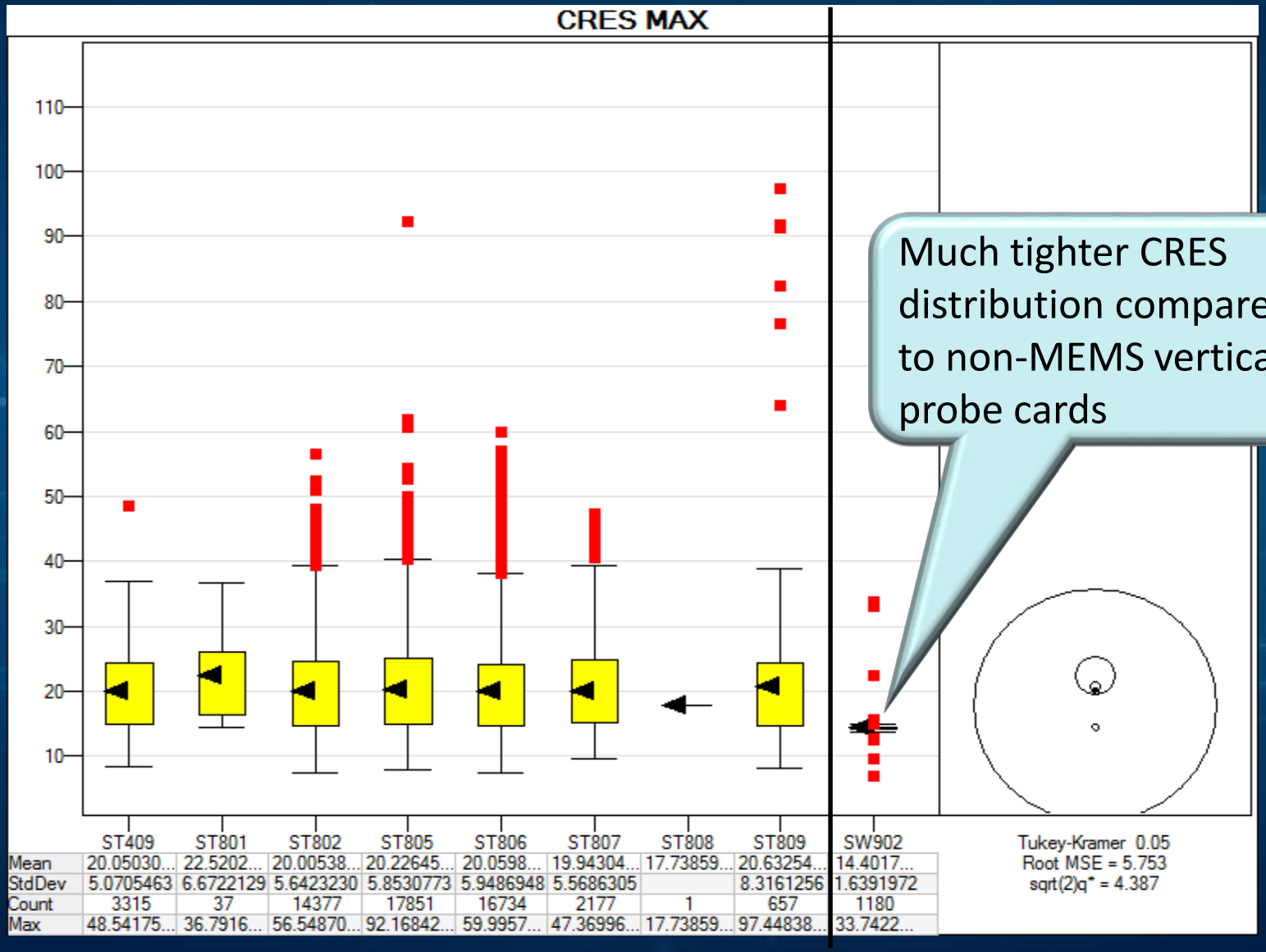


Punch Through per TD count

TD Count	Punch through found	Raw punch through per parts per million
3x – 10x	NA	NA
11x	0	0

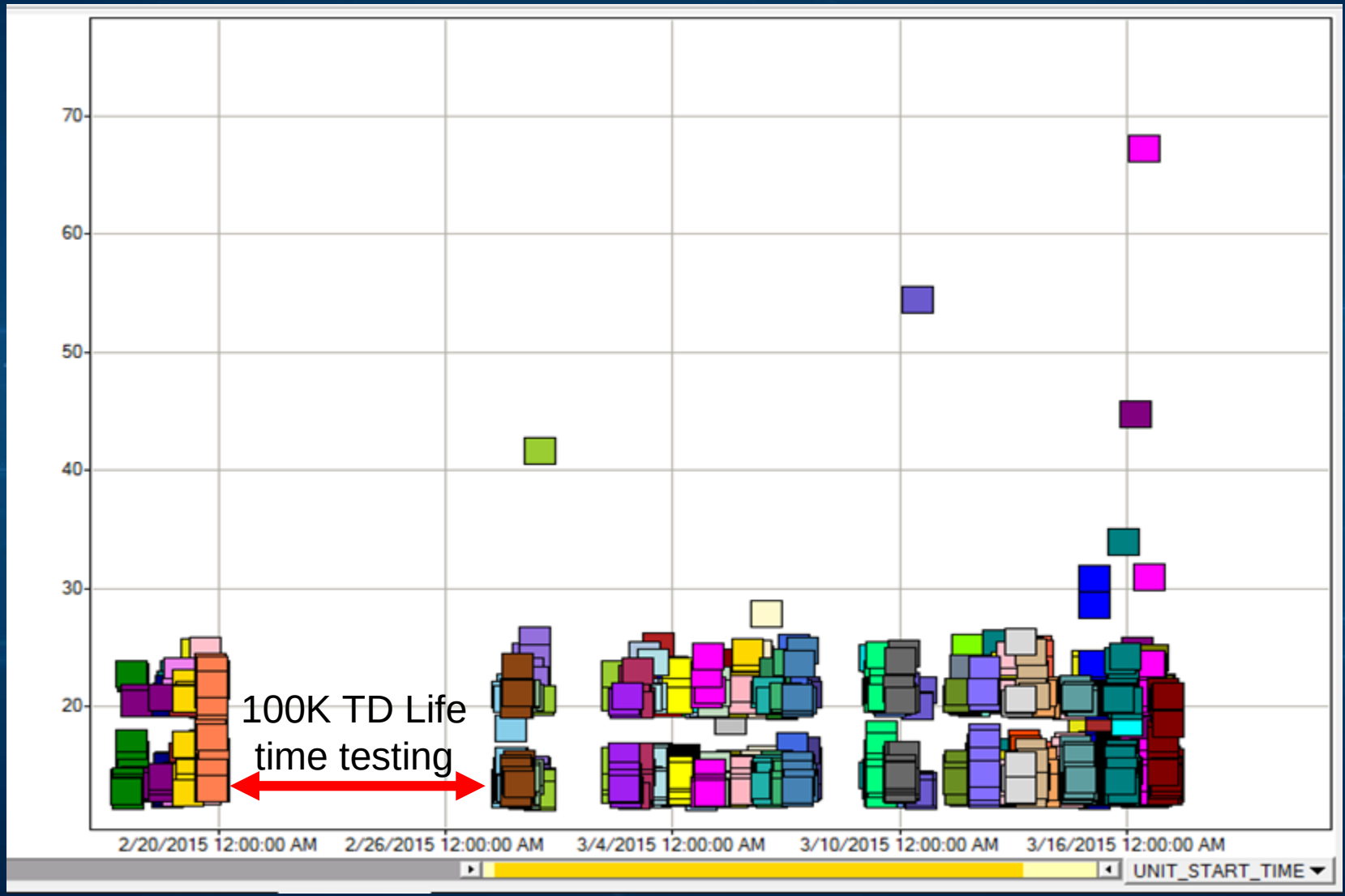
Results: No dielectric cracking found with 100um OT on F05 Saturn 60 wafers - Pass

Max CRES – Production Data

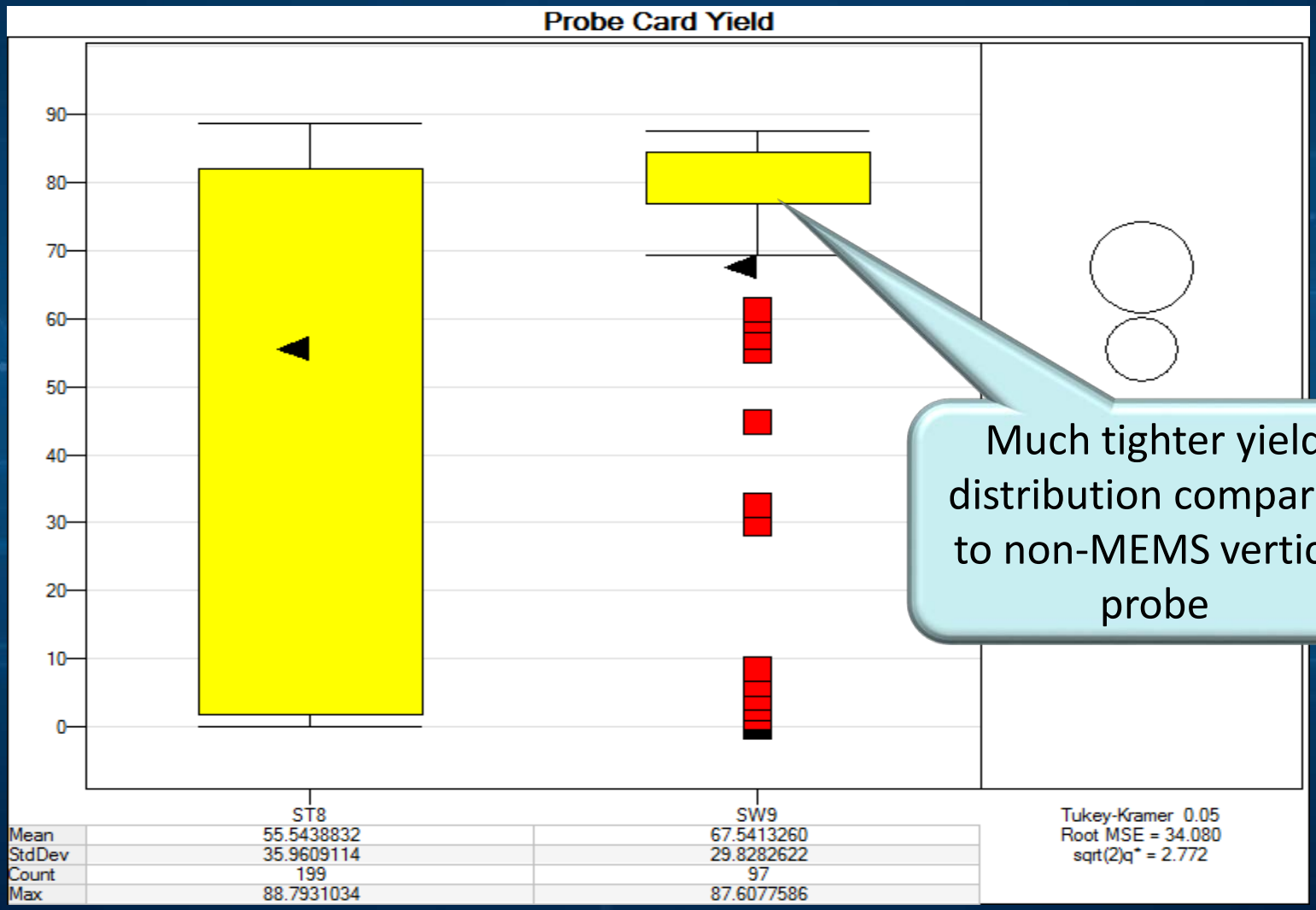


	ST409	ST801	ST802	ST805	ST806	ST807	ST808	ST809	SW902
Mean	20.05030...	22.5202...	20.00538...	20.22645...	20.0598...	19.94304...	17.73859...	20.63254...	14.4017...
StdDev	5.0705463	6.6722129	5.6423230	5.8530773	5.9486948	5.5686305		8.3161256	1.6391972
Count	3315	37	14377	17851	16734	2177	1	657	1180
Max	48.54175...	36.7916...	56.54870...	92.16842...	59.9957...	47.36996...	17.73859...	97.44838...	33.7422...

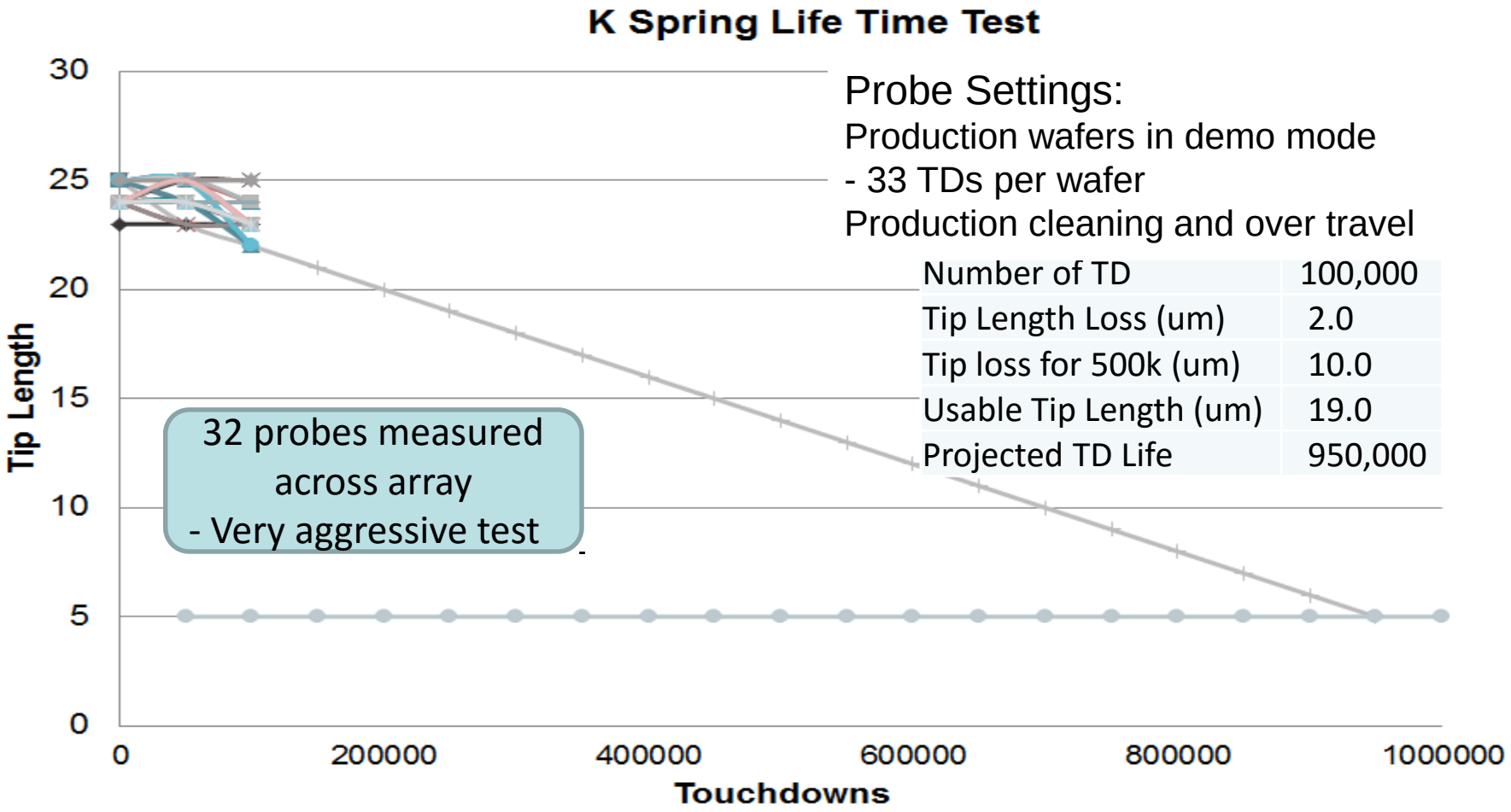
CRES Over Time



Yield Comparison



Life Time Data



- **Initial projects of ~1M TD lifetime in production**

Summary

- **Production performance stand out**
  - Production performance
    - Planarity
    - Thermal agility over wide temperature range
    - Minimal pad damage, stable AVI and no ILD cracking
    - CRES and Yield
    - Lifetime
- **Compelling new technology to replace existing high volume technologies**
- **Flexible MEMS Technology to Reduce Cost of Test for Multi-site Wire Bond Applications**

Acknowledgement

- Al Wegleitner, Texas Instruments
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- Doug Shuey, FormFactor
- Kevin Hughes, FormFactor