

IEEE SW Test Workshop

Semiconductor Wafer Test Workshop



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Benefits of Flip Chip Wafer Sort using MEMs Multi Site Capability

Lessons learnt



GLOBALFOUNDRIES



FORMFACTOR

June 6 to 9, 2010

San Diego, CA, USA

Outline

- **The Growing SOC Market**
- **Test Vehicle and Test Parameters**
 - Chuck Force Comparison
 - Probe Mark Comparison
- **Cleaning Considerations**
- **Yield Comparison**
- **Electrical Properties Comparison**
- **Test Performance**
- **Summary**



GLOBALFOUNDRIES – Who Are We?

Global Manufacturing Operations



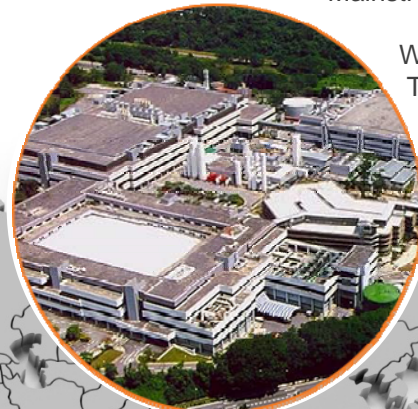
Fab 8

Future leading-edge
300mm manufacturing
Saratoga County, NY



Fab 1

Leading-edge 300mm
manufacturing campus
Dresden, Germany



Fab 2, 3, 3e, 5, 6

Mainstream 200mm manufacturing
campus
Woodlands, Singapore
Tampines, Singapore



Fab 7

Mainstream 300mm
manufacturing campus
Woodlands, Singapore



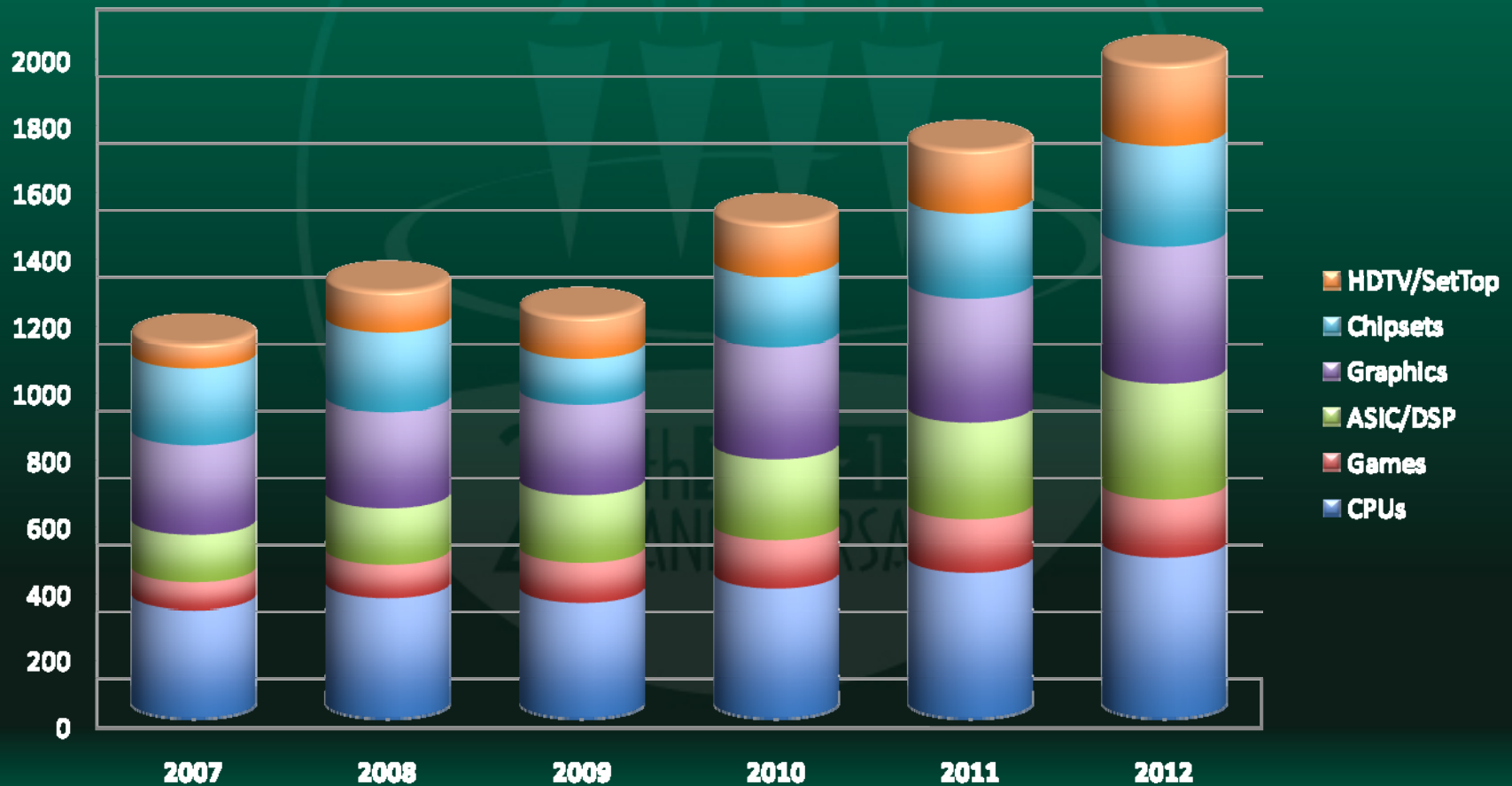
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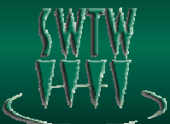
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Motivation for Vertical / MEMs Technology

Flip Chip Market Trend



Source : TechSearch International Inc.

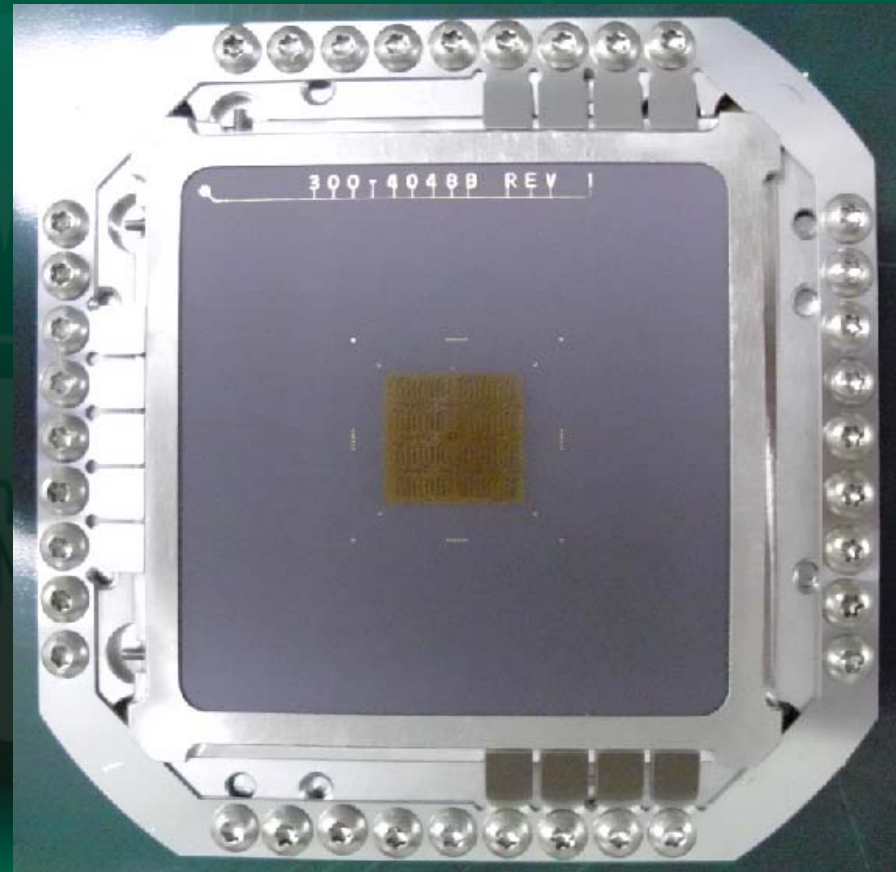
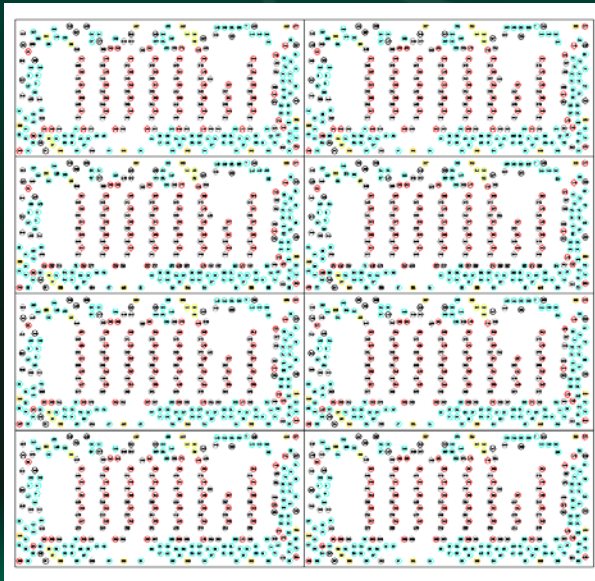


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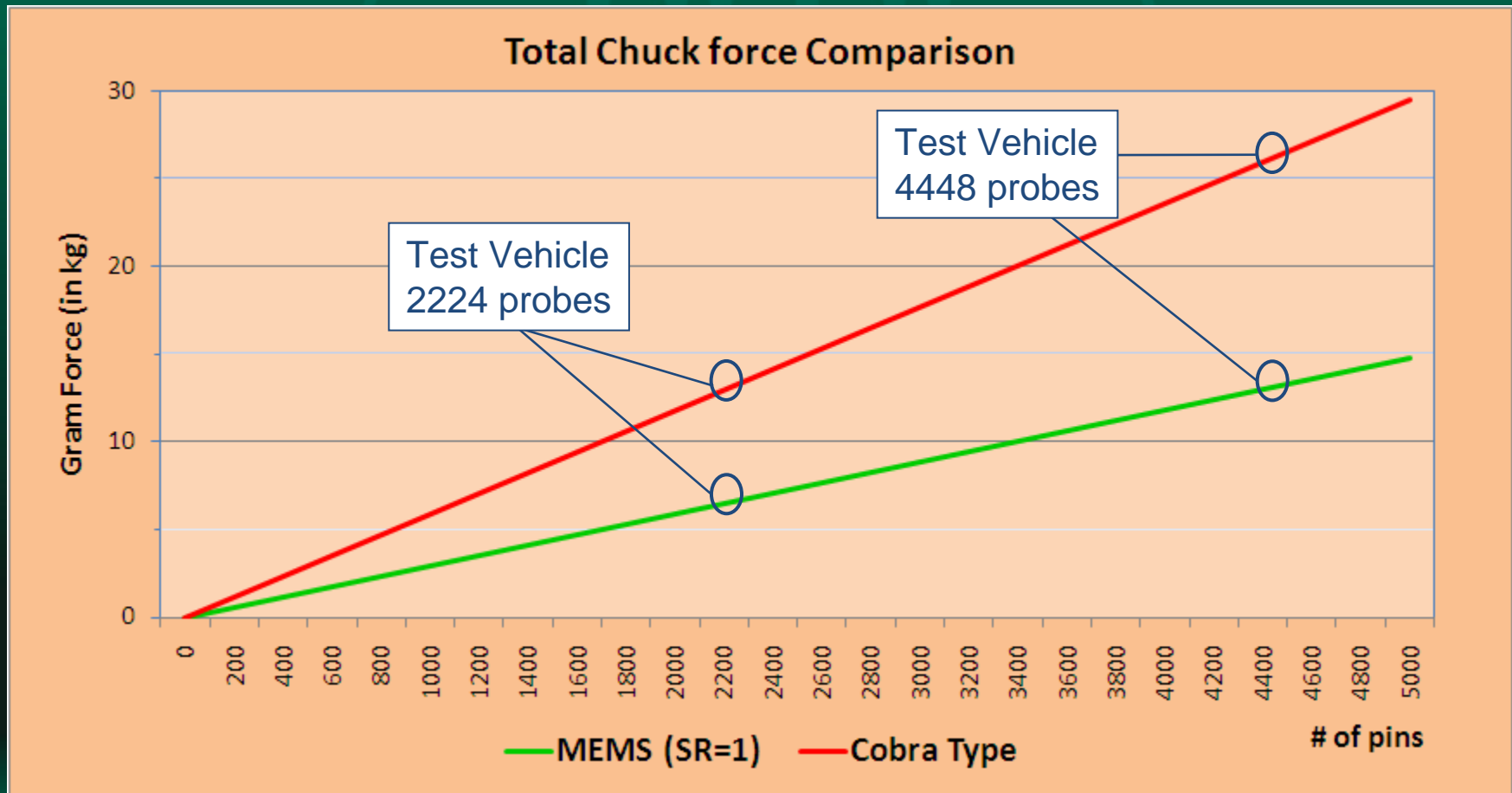
Test Vehicle Information

- **Application: Universal Mobile Telecommunication Chip**
- **Technology Node: 65nm**
- **Die Size: 3.4mm x 7.1mm**
- **Pitch: 180um**
- **Bump Material: Eutectic**
- **Probe Count per Die: 278**
- **Multi-Site: 2 x 4 Solid Array**



Probe-card Chuck Force Comparison

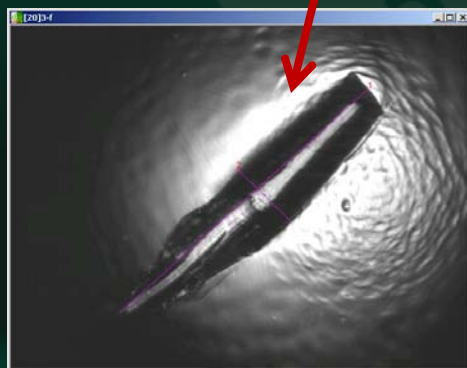
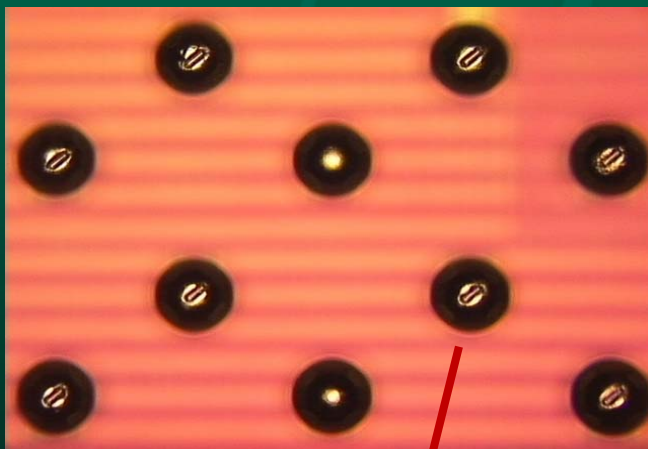
- Significant increase in chuck force needed for Vertical probe with higher pin count



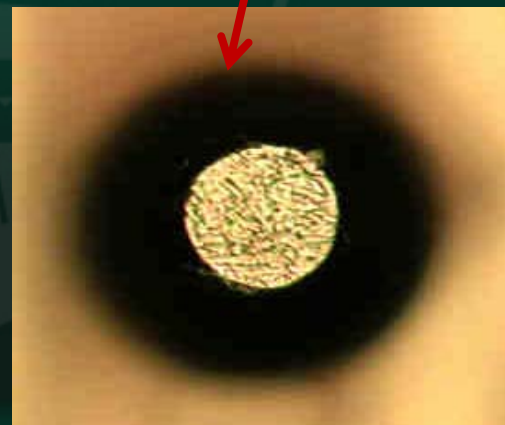
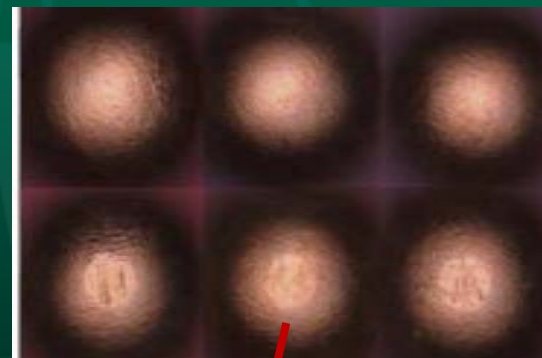
Probe Mark Comparison (MEMS vs Vertical)

- Characteristics of the probe marks

MEMS probe marks

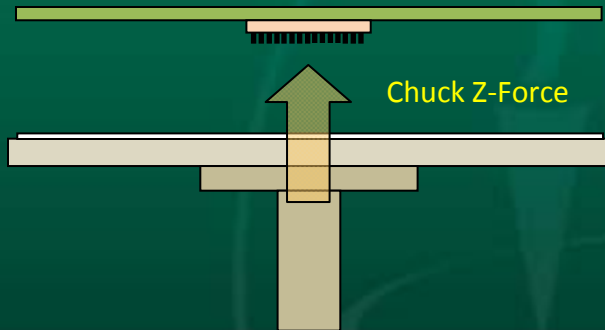


Vertical probe marks



Impact of Higher Chuck Force on Higher Parallelism

Pressure of probe head at center of check



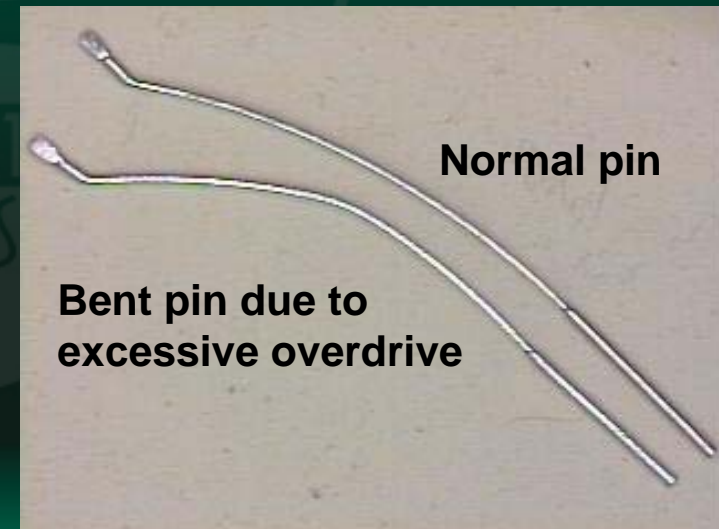
Improper overdrive with excessive chuck force



Pressure of probe head at edge of check

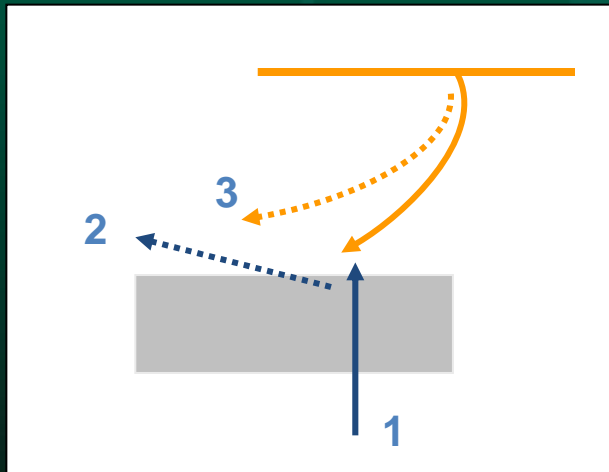


Note : Need to change to a stronger chuck

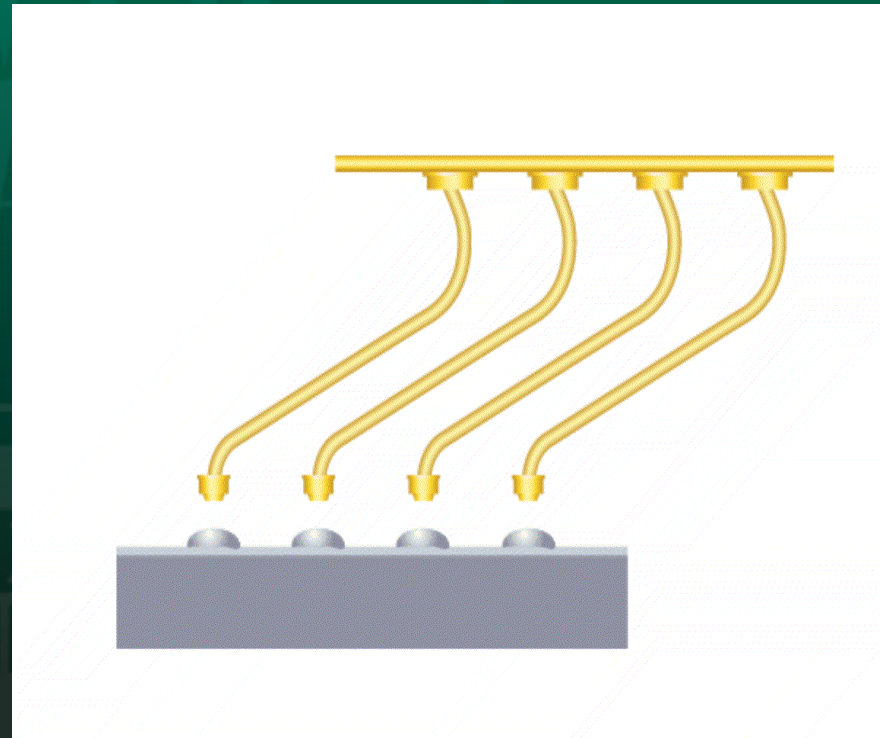


Overcoming the Impact : MicroForce™ Probing

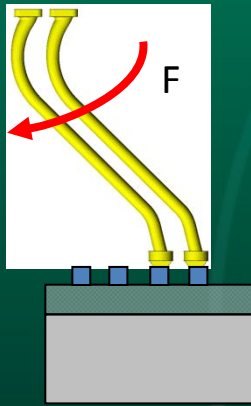
- What is MicroForce™ probing?
 - It is a coordinated X-Y-Z probing motion



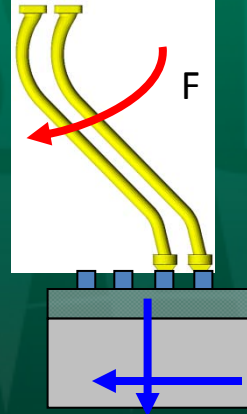
- 1 – Prober Chuck Moves in Z-axis
- 2 – Contact with Flip Chip Bump
- 3 – Chuck moves in X-Y-Z



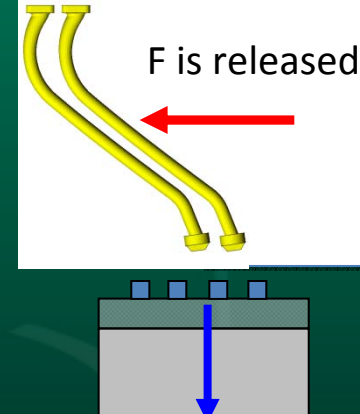
Improvements on MEMS PC : Enhanced Self-Cleaning MicroForce™ Recipe



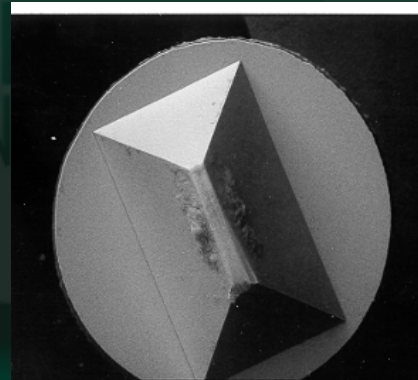
- F has been created during the XYZ Up motion



- Start XYZ Down motion
- Self Cleaning Phase 1

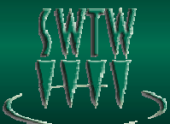


- Start Z only Down motion
- Self Cleaning Phase 2



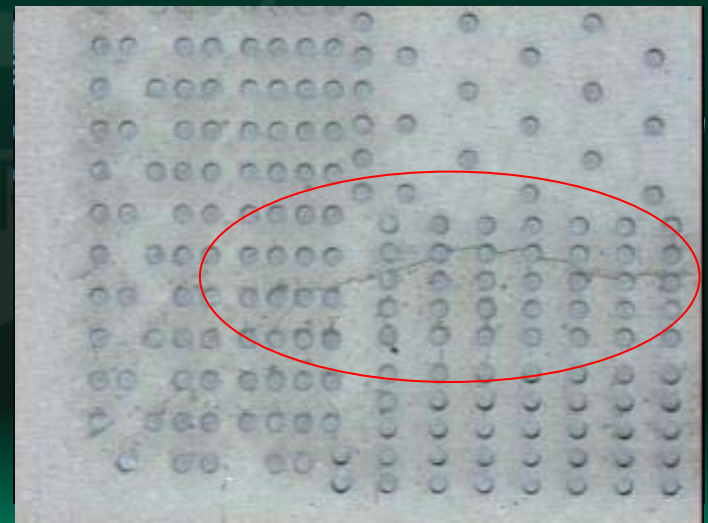
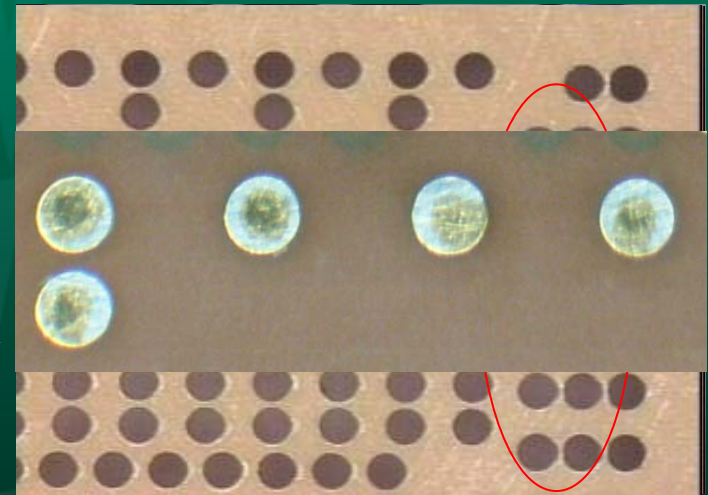
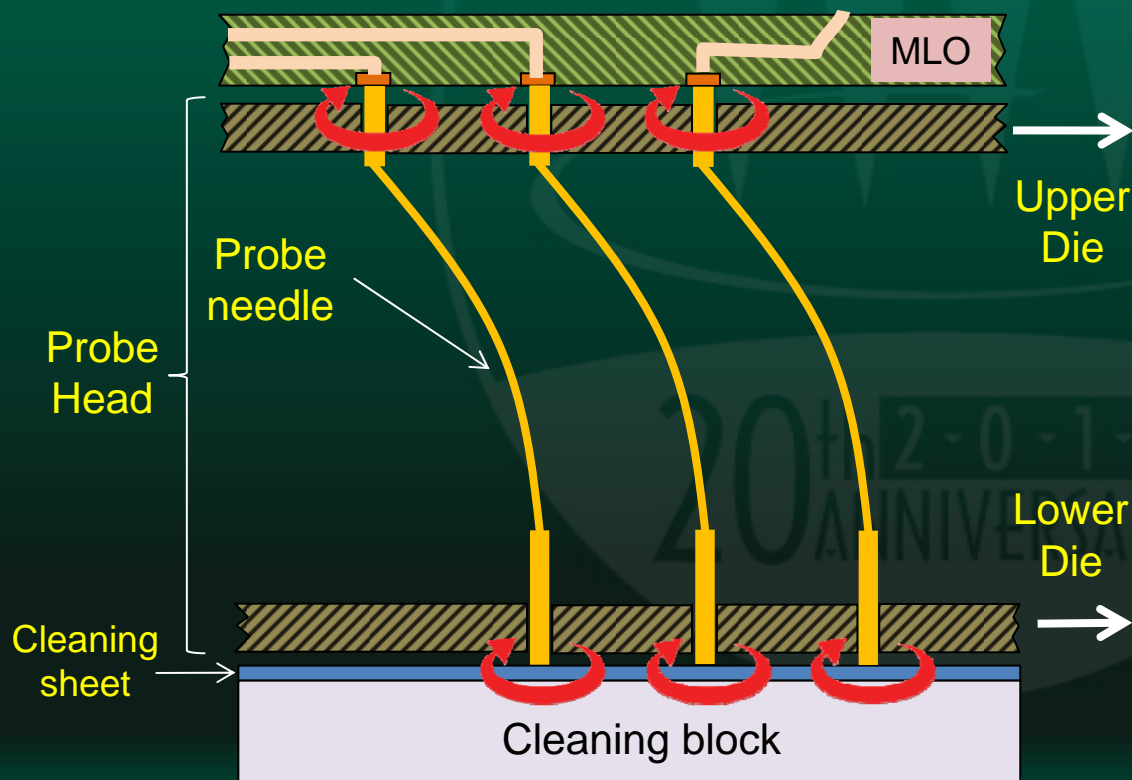
Impact:
With self cleaning option, online cleaning frequency lowered by 16X!!

Results : Self Cleaning Effect



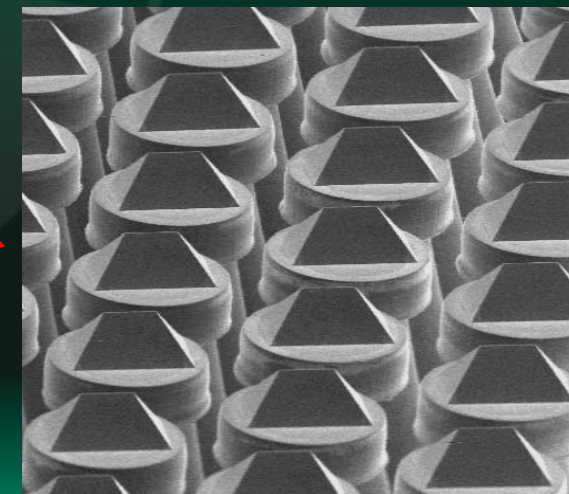
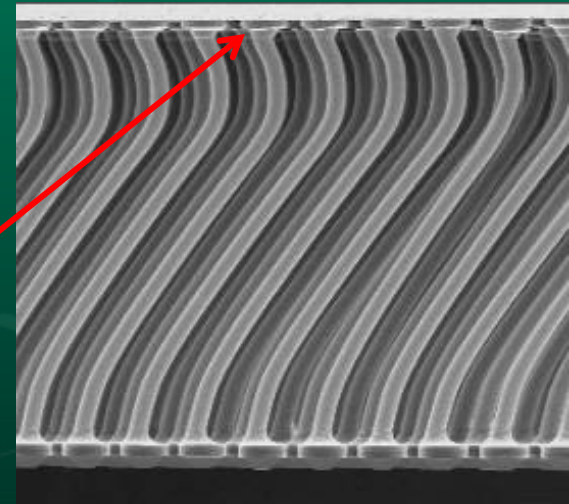
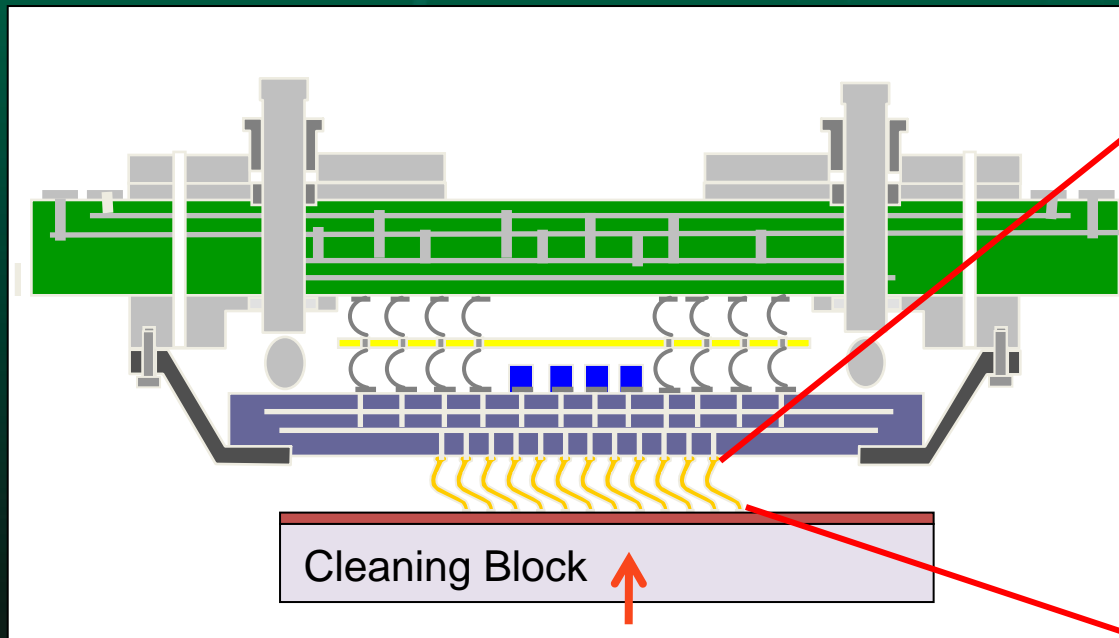
Impact of High Chuck Force on Online Cleaning (Vertical)

- Vertical Probe Head Construct



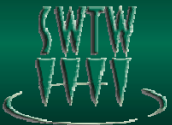
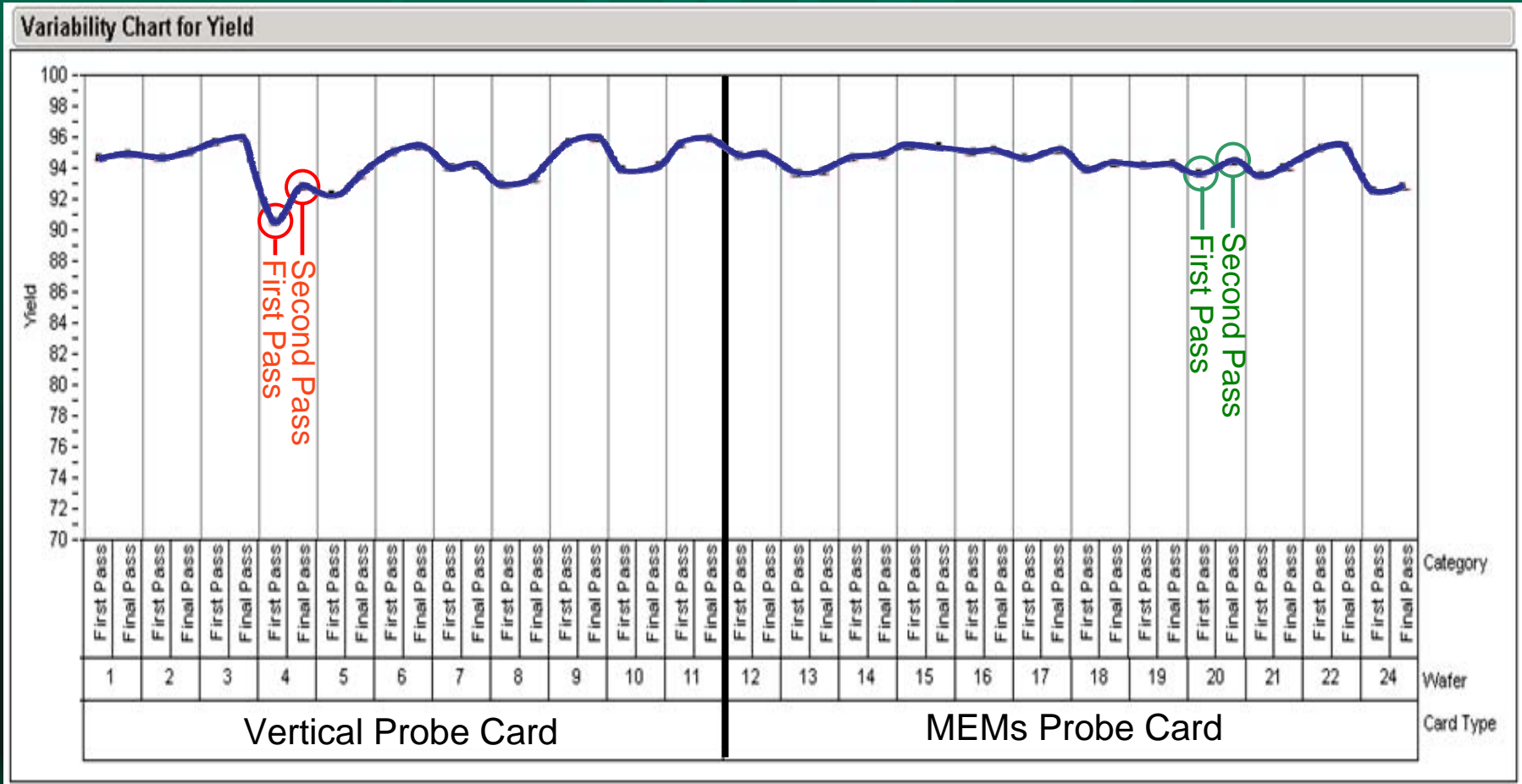
Impact of High Chuck Force on Online Cleaning

- MEMS Probe Head Construct



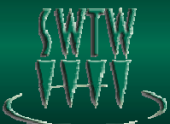
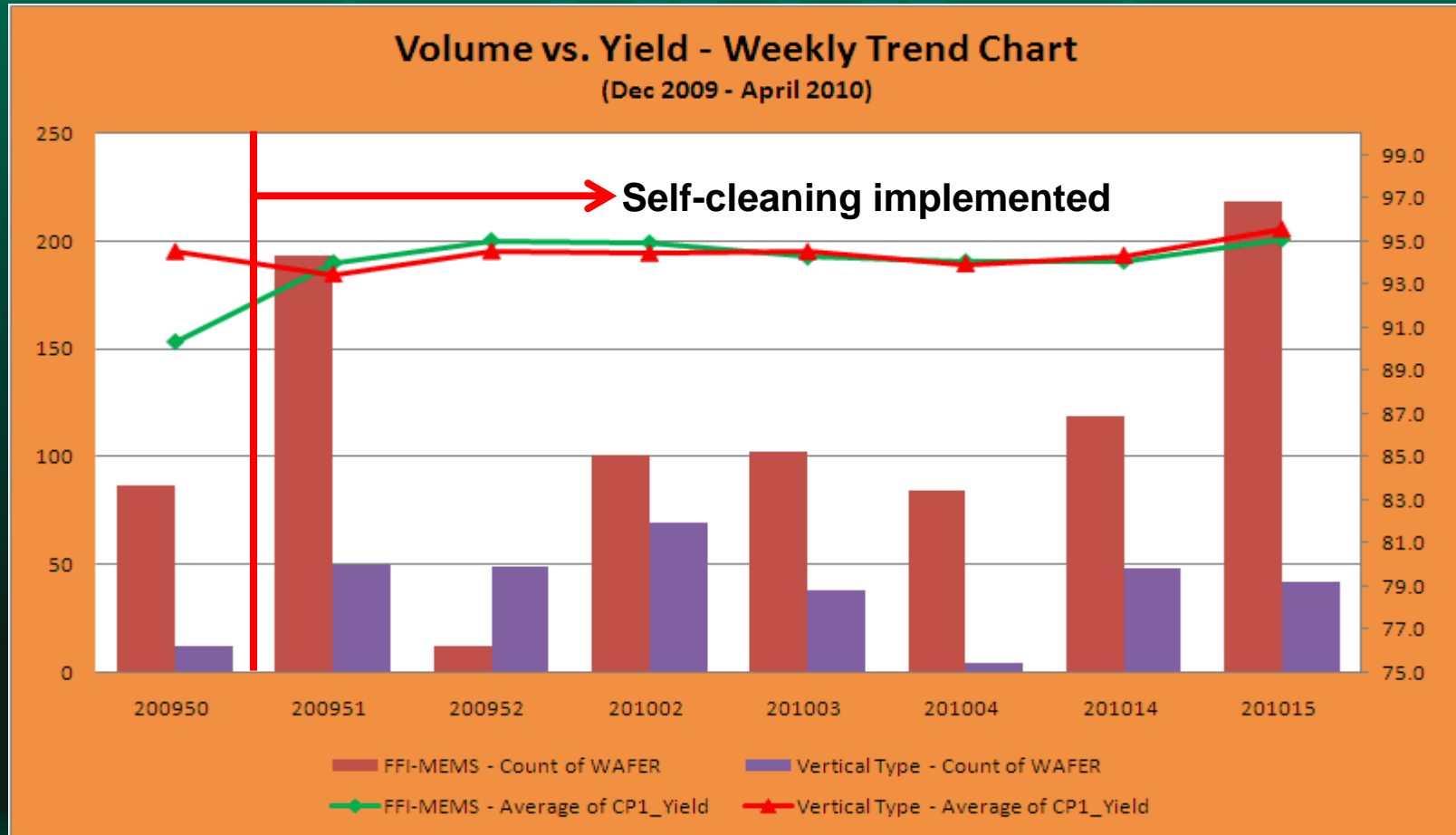
MEMs vs Vertical Probe Cards

- Yield Comparison



Impact of Self Cleaning : Yield

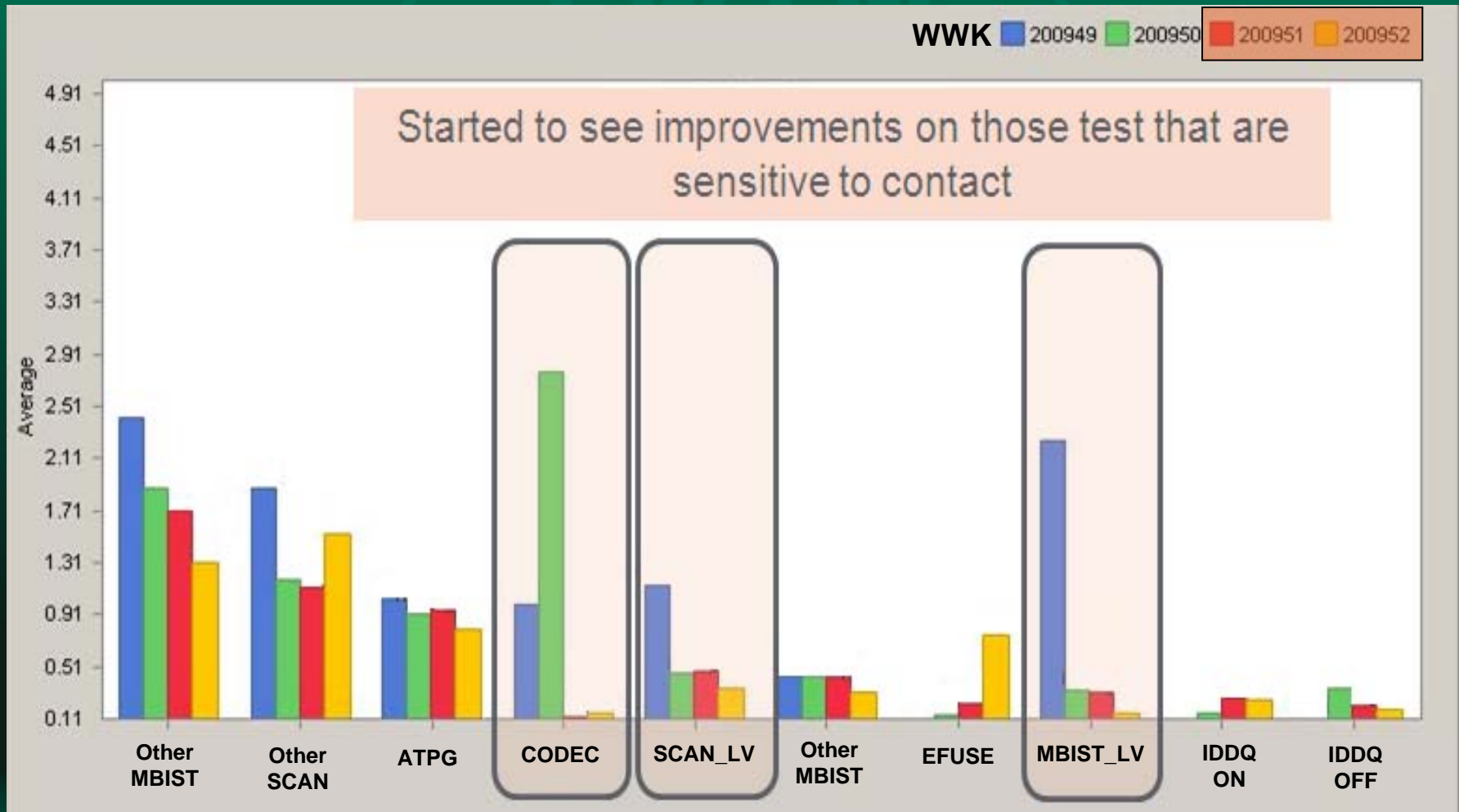
- Significant improvement in yield after implementing self-cleaning



Impact of Self Cleaning : Contact Sensitive Failures

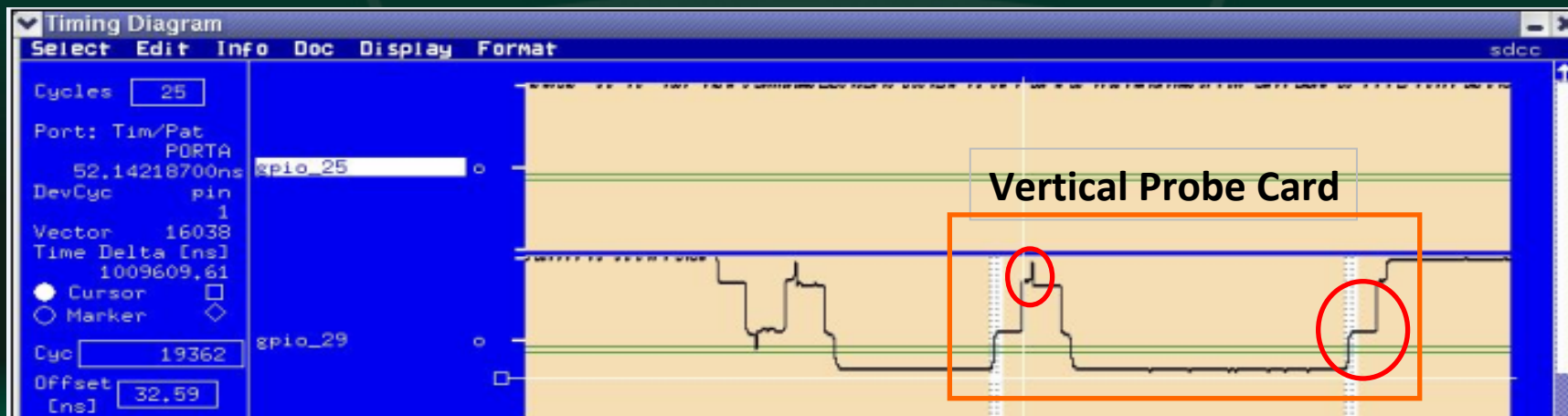
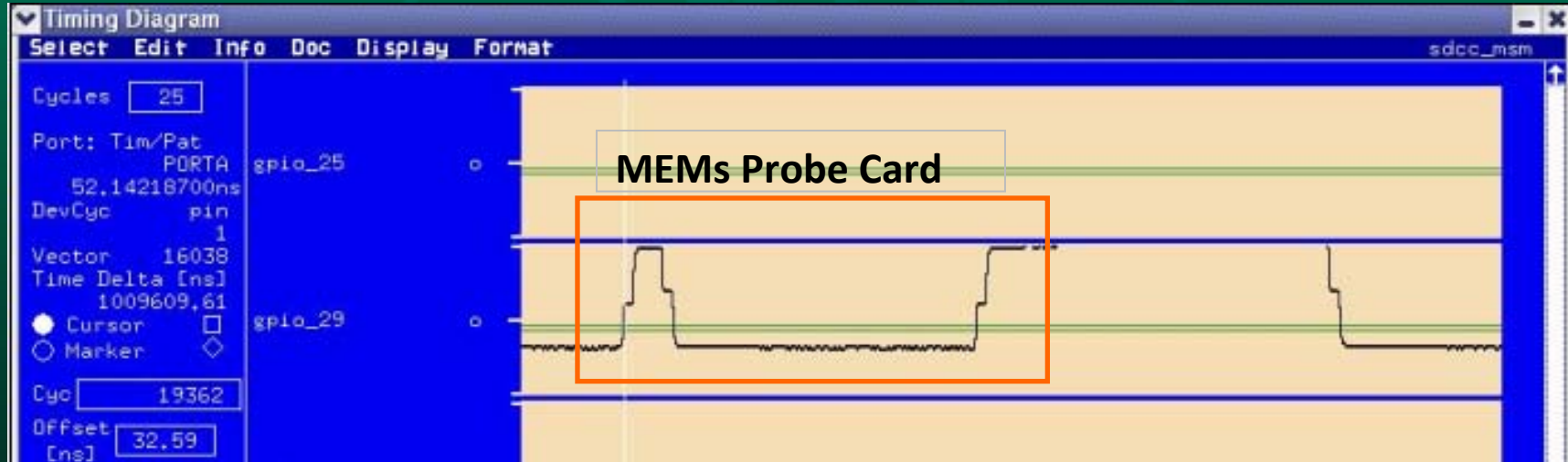
- Reduction in contact related failures

Implementation of self-cleaning



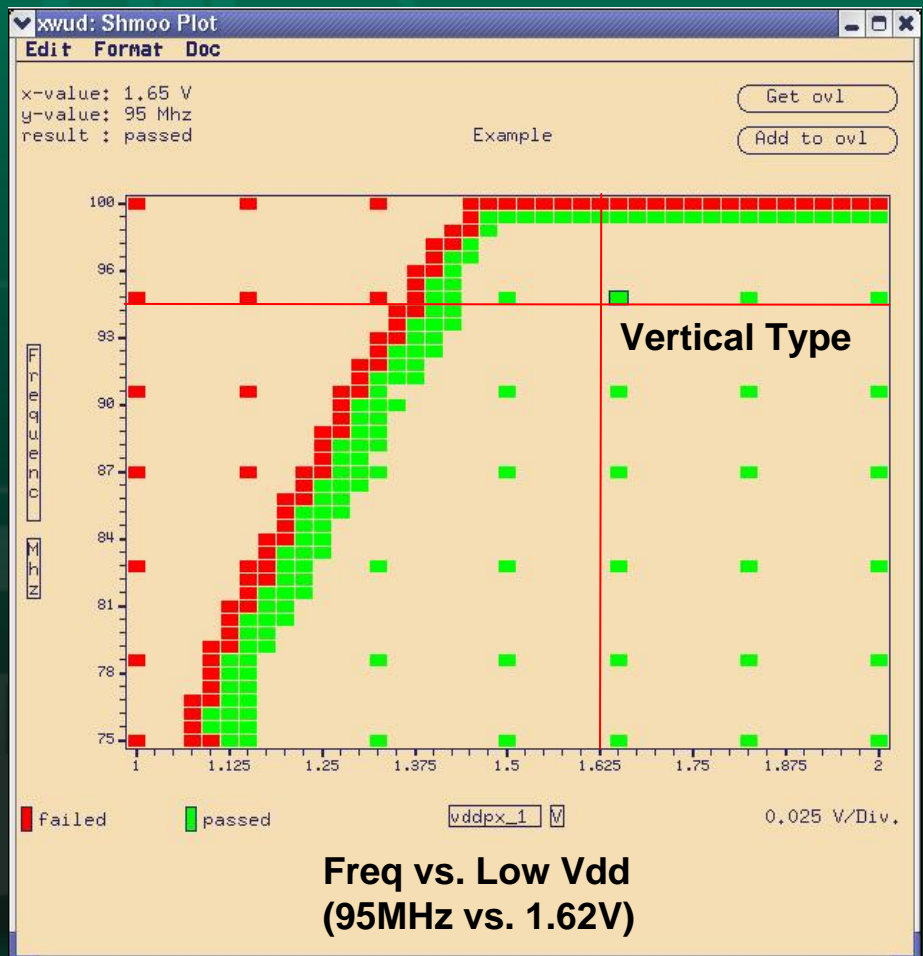
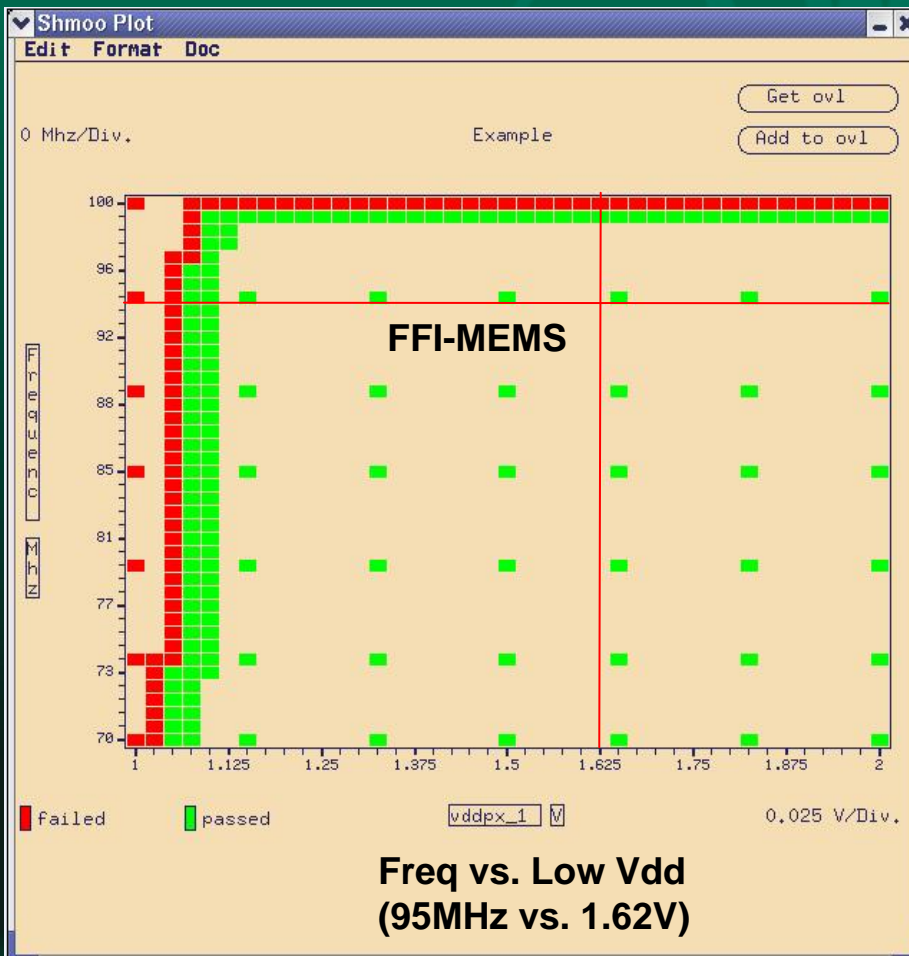
Electrical Properties Comparison

- Experienced timing delay for some functional test block (~15ns)



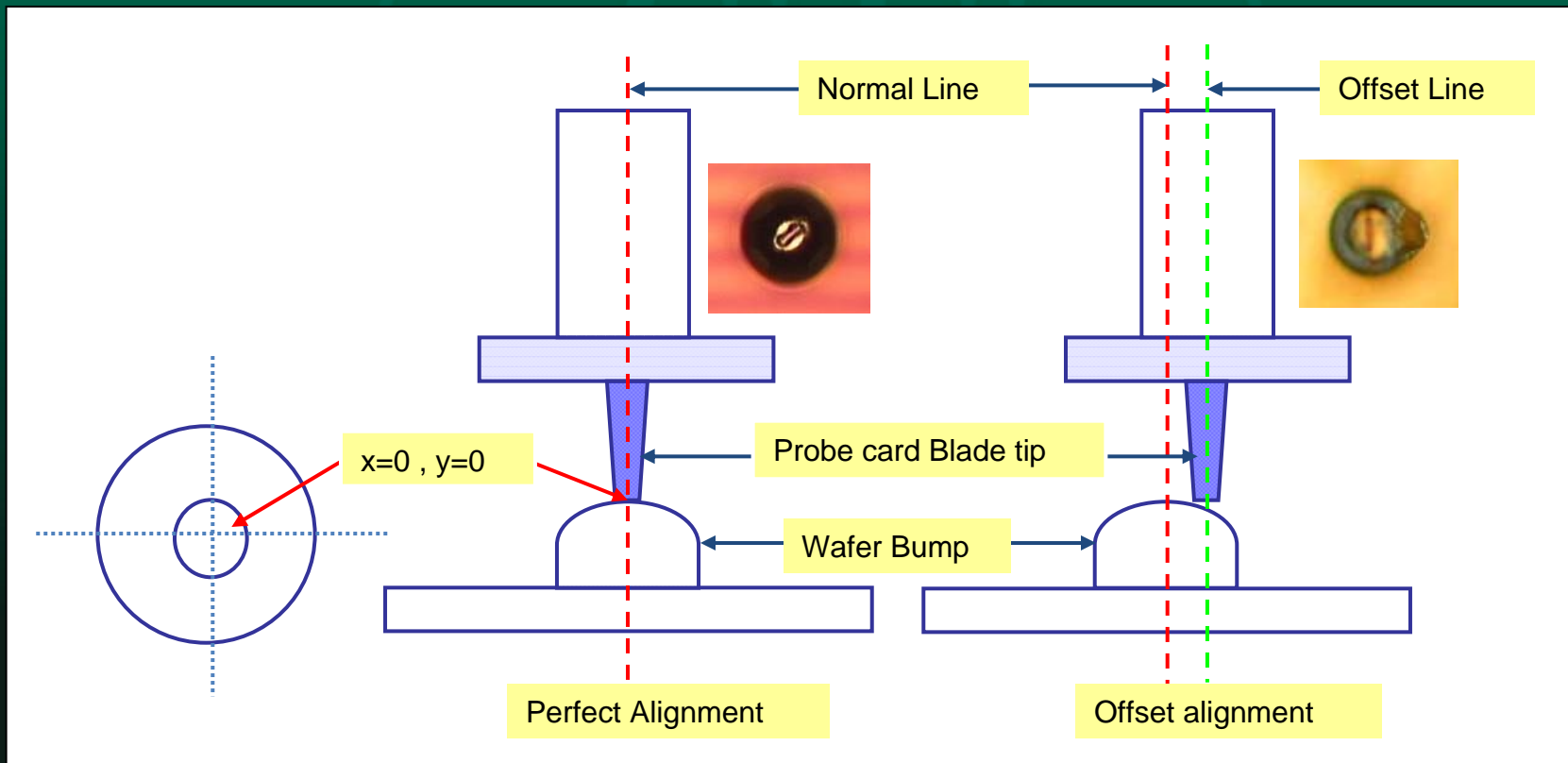
Test Performance Comparison

- Experienced better margin in some functional test block



MEMS PC : Caveats

- A tool is only as good as the skills of the user
 - Improper setup leading to quality issue



Summary

■ Positive learning

- Better Yield stability over time
- Better Electrical performances
- Lower down time with implementation of online self-cleaning
- Experienced lower Z-force with MicroForce™ (ease into higher parallelism)
- MEMs architecture allows easy migration to higher multi sites test
- Presence of probe mark to help with the setup and troubleshooting
- No MLC damage with MEMs technology

■ Caveats

- Need to ensure Microforce™ option is installed on prober prior to using.
- Susceptible to probe mark issue if not setup properly
- Limited pin replacement capability



Acknowledgements

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Ralph Yang, Kai Yoon, Paul Shin



THANK YOU

Q & A

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