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Improving Scrub Performance and Reducing Soak Time with a New Mechanism to Stabilize Probe Card Temperature

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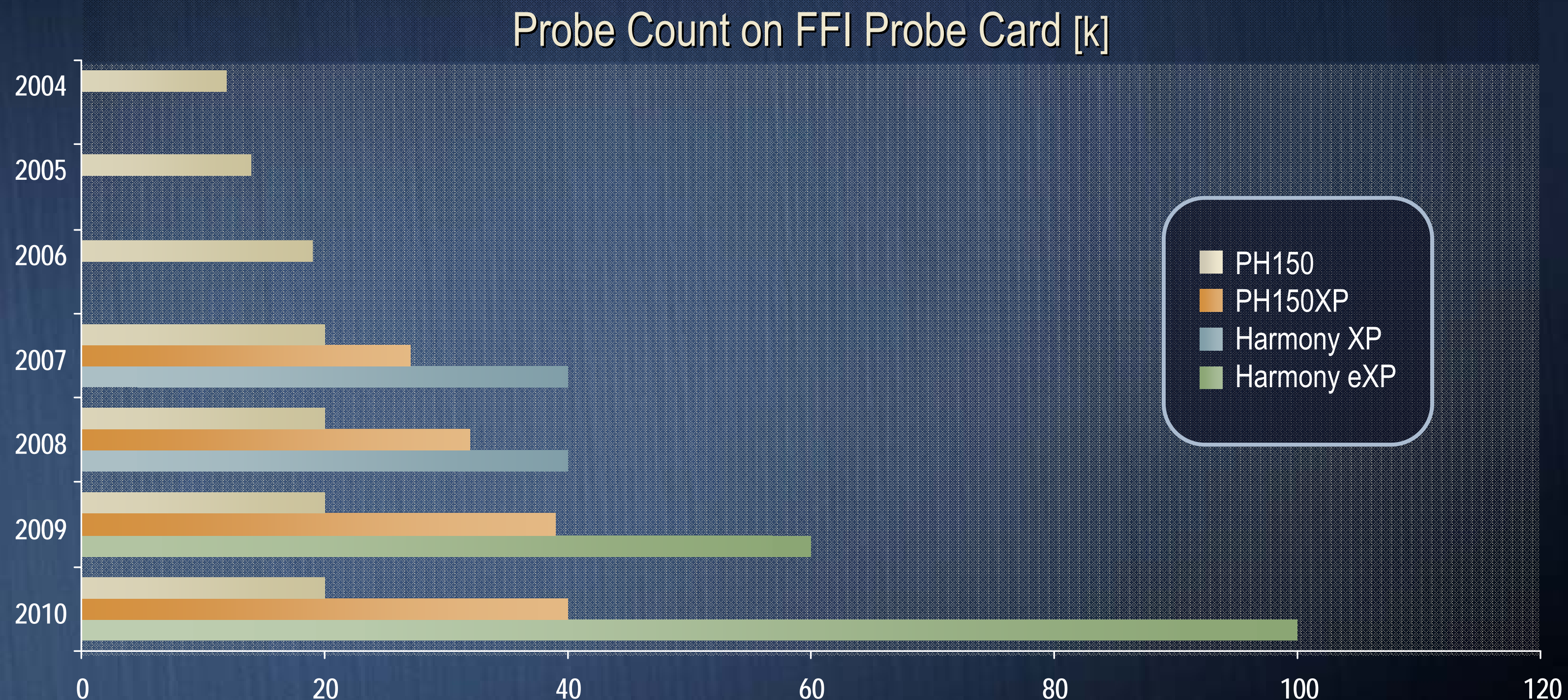
Outline

- DRAM Probing Trends
- Probe Card Thermal Stability Challenges
- Experimental Design
- Results
- Conclusions
- Acknowledgements

DRAM Industry Probe Count Trend 2009

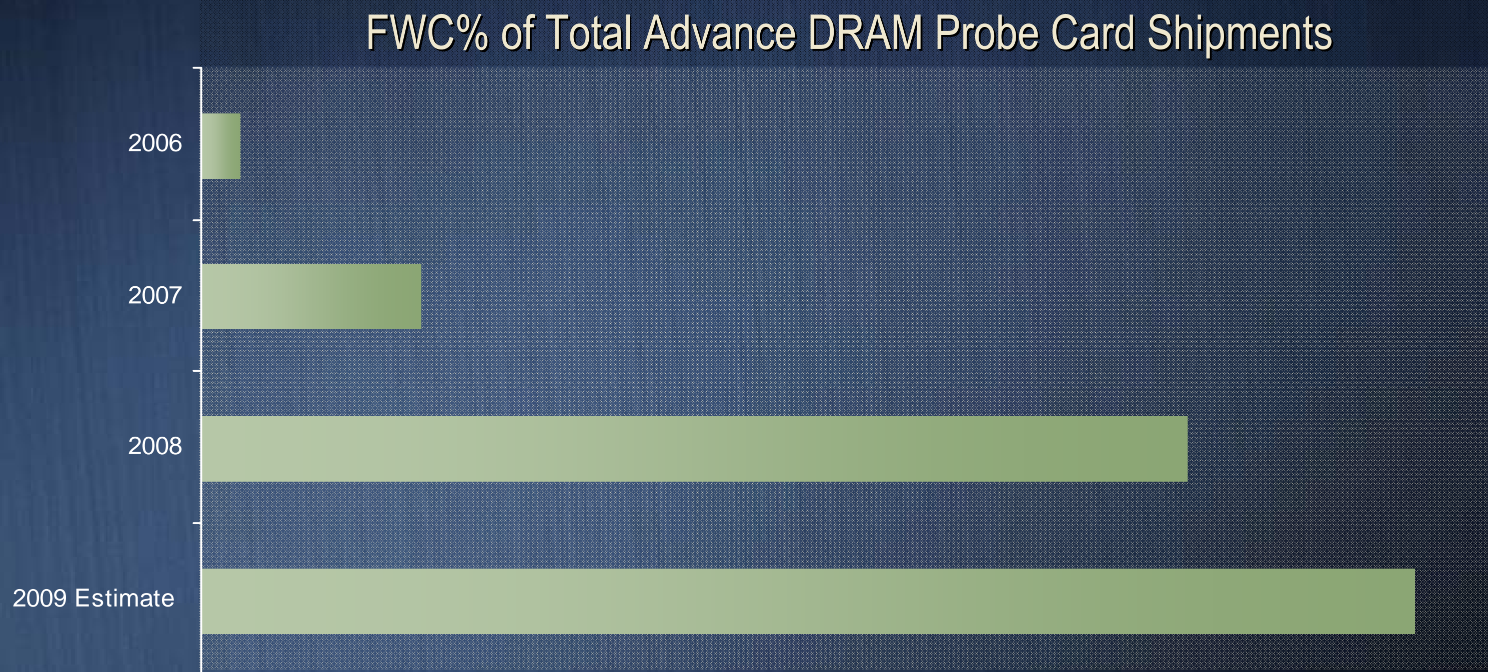
- DRAM cost of test reduction requirements are driving increased probe card parallelism and increased probe counts
  - Achieving 512 DUT parallel testing for DRAM SORT
  - PH150XP and Harmony eXP full wafer contactor
- Overall probe count will continue to increase



Probing Trends

Transition to Full Wafer Contactors

- Transition to full wafer contactors (FWC) driven by need to achieve lowest TD count
  - For some die sizes, FWC enables reduced TD count to accommodate increased parallelism

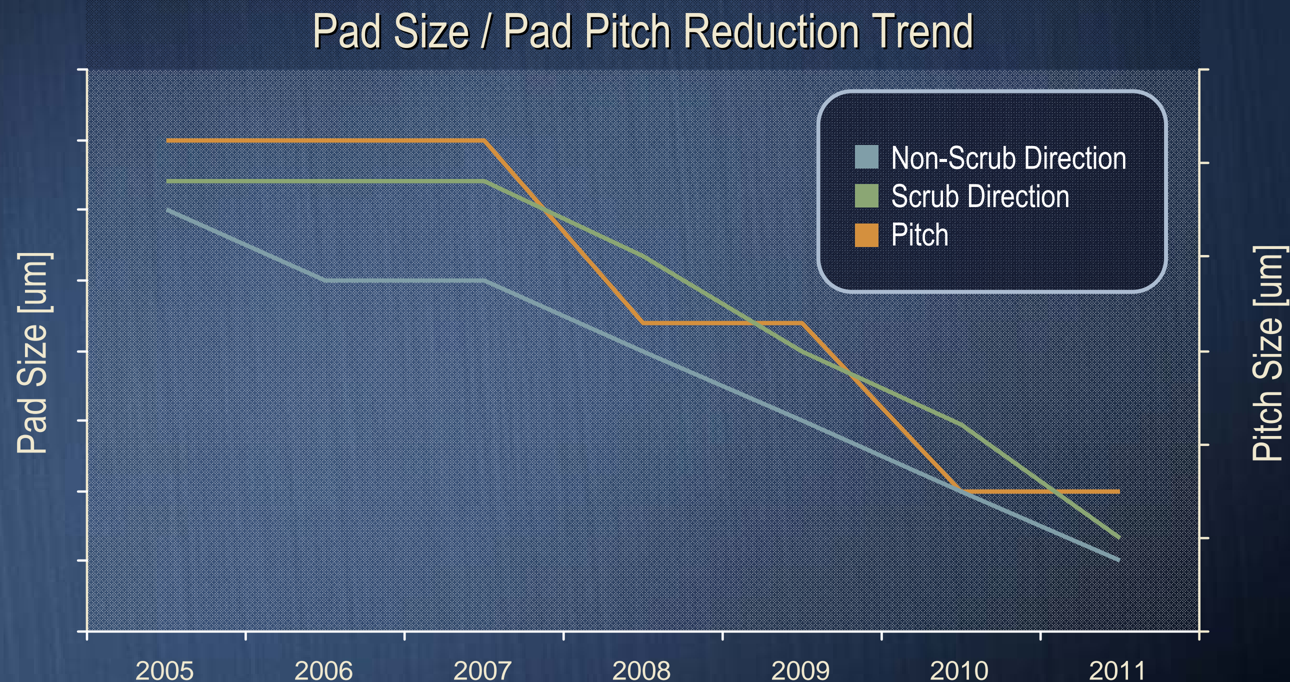


Data based on FFI's market analysis

Probing Trends

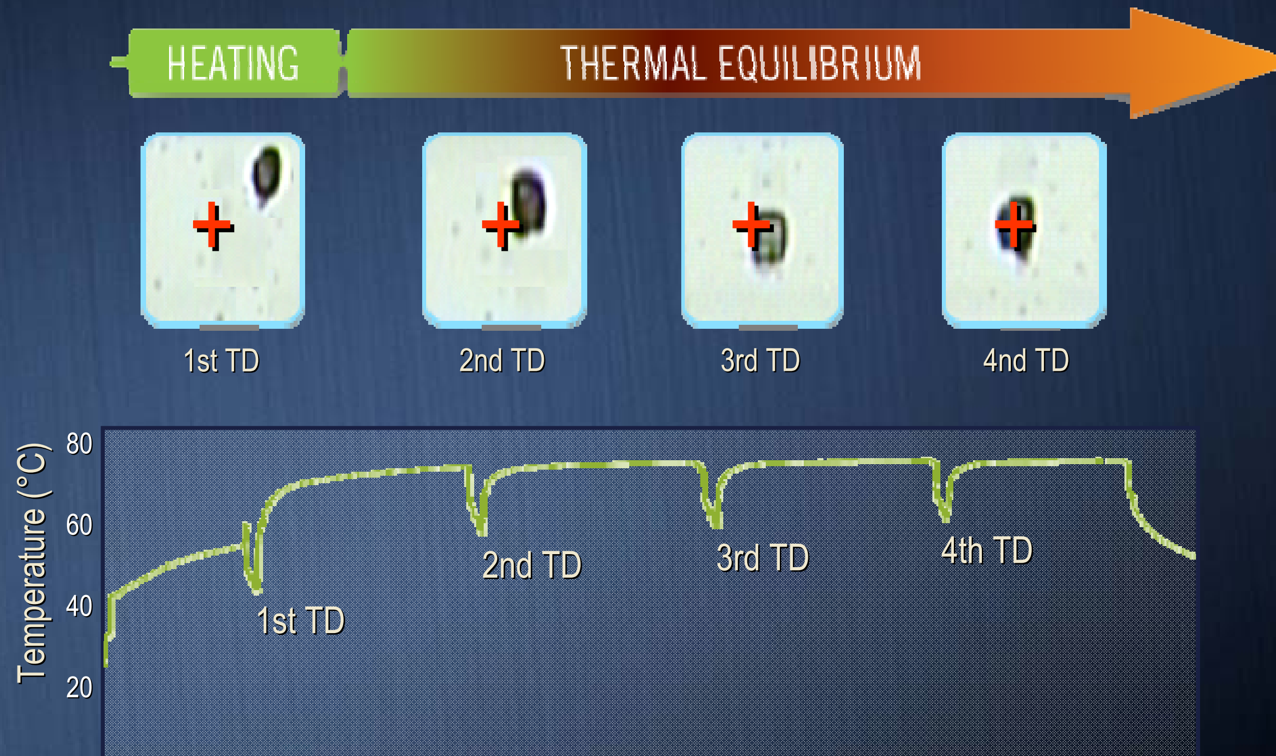
Pad Size / Pad Pitch Reduction

- DRAM pad size/pad pitch reduction – approximately 10%-15% per year going forward
  - Minimum pad size / pad pitch per year
- Overall probing budget is being reduced



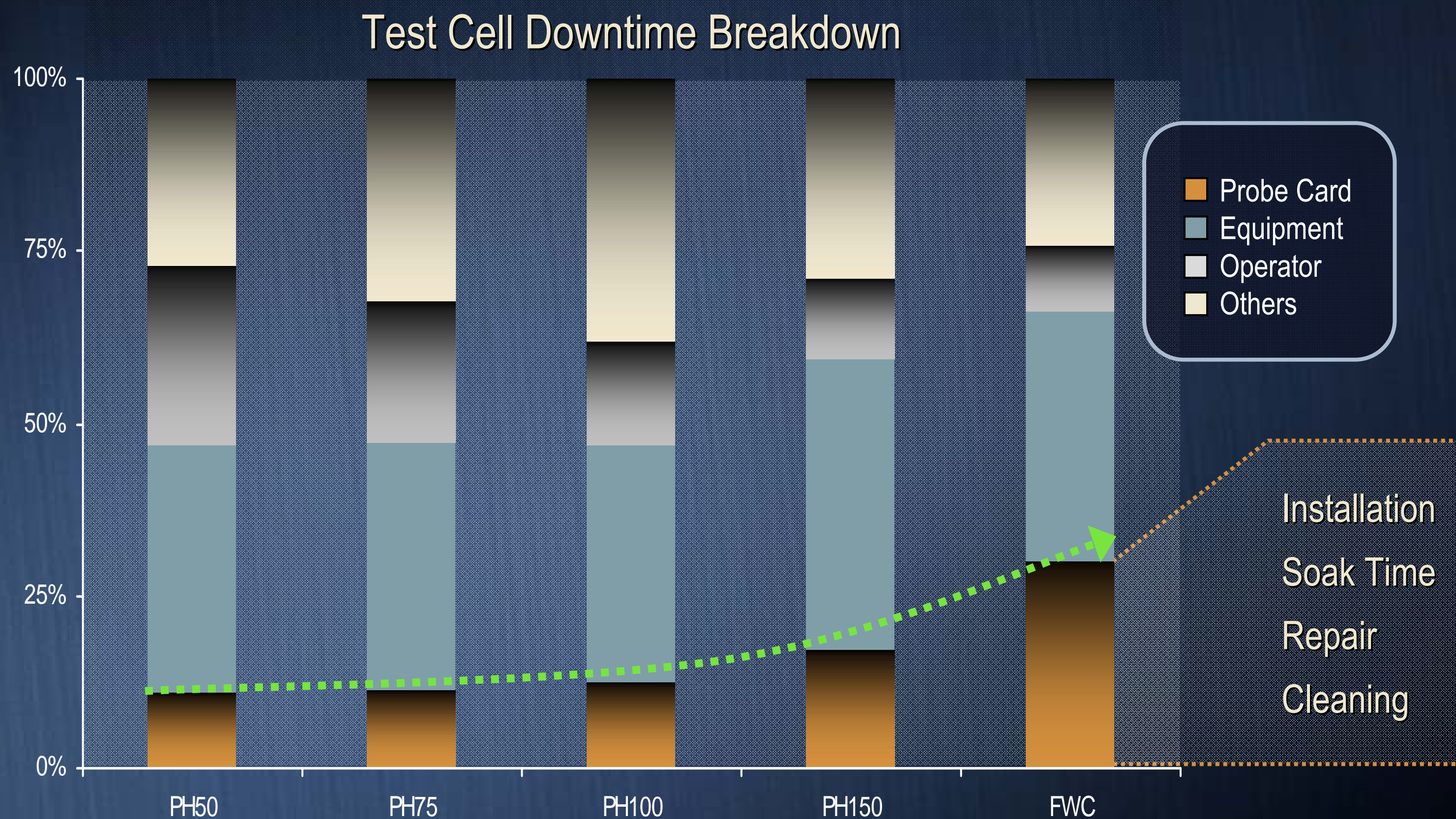
Inconsistent Scrub on Full Wafer Contactor

- Challenge: Inconsistent scrub mark are often observed after lot change, wafer change, probe mark inspection and long idle time
  - Issue occurs regardless of probe card technology
  - With smaller pad sizes, a few microns of change is a real issue



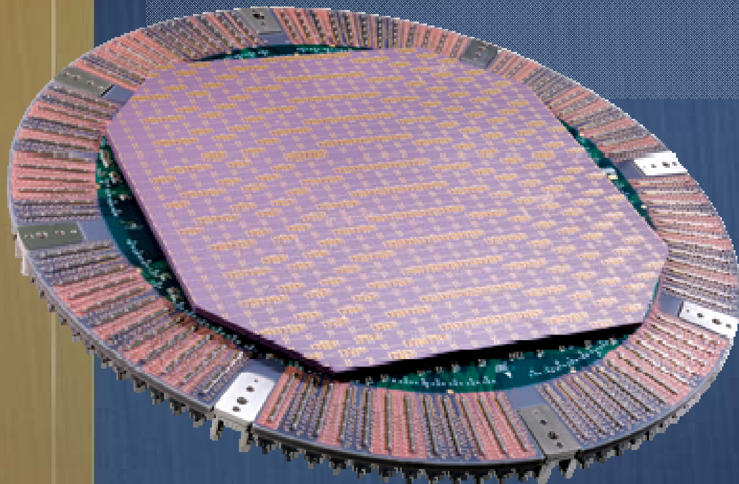
Productivity Reduction by Probe Card Size

Challenge: Minimize test cell downtime with increasing probe card size



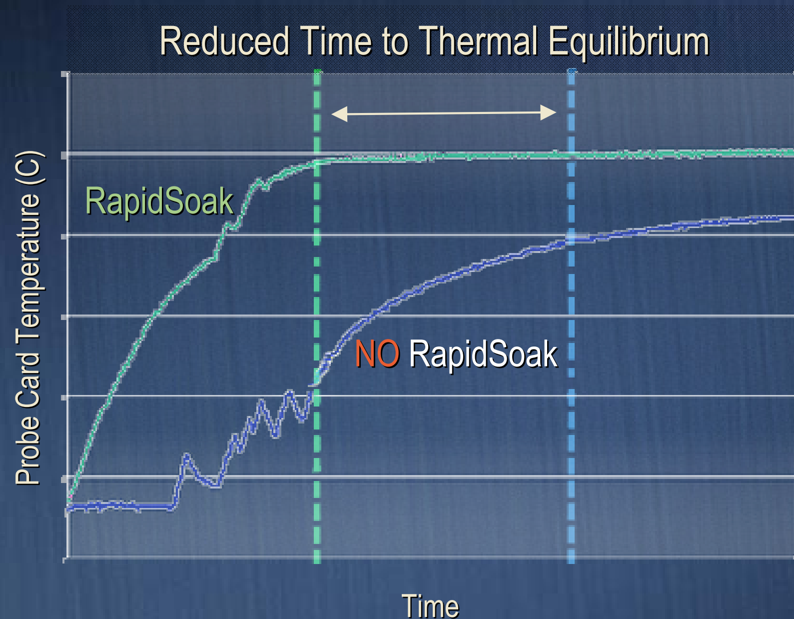
Industry Trends / Challenge Summary

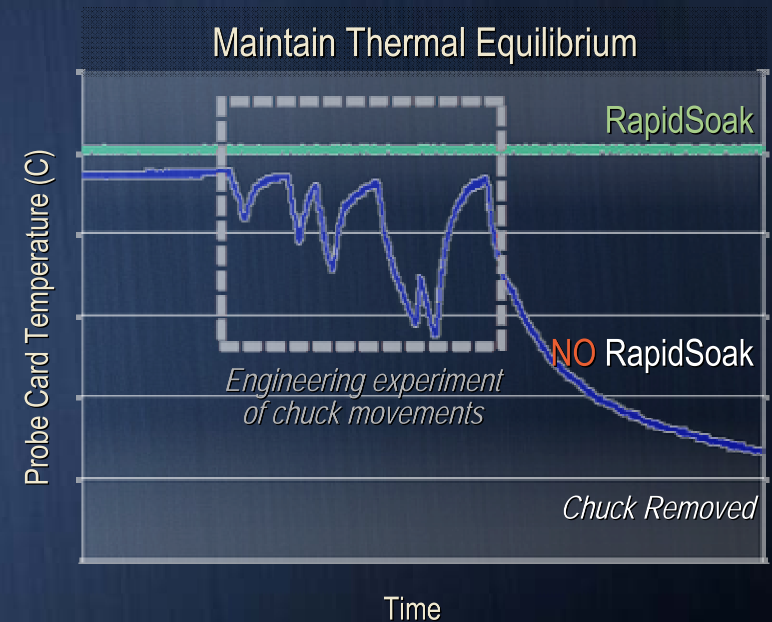
Trend / Challenge	Impact to Wafer Probing	Requirement
FWC adoption resulting in larger probe cards Increasing probe card design complexity - Higher pin counts / higher parallelism Negative productivity impact with increased probe card size	Increased probe card mass resulting in longer soak time and additional soak insertions	Minimize time to reach thermal stability due to increased complexity of probe card and test conditions
Reduced pad size and pad pitch	Decreased probing area / reduced error budgets	Improve scrub accuracy, consistency due to thermal variations



RapidSoak™ Technology

- FFI's patented RapidSoak technology enables probe cards to reach thermal equilibrium faster and maintain thermal stability
  - Integrated in the probe card for active, real time thermal control





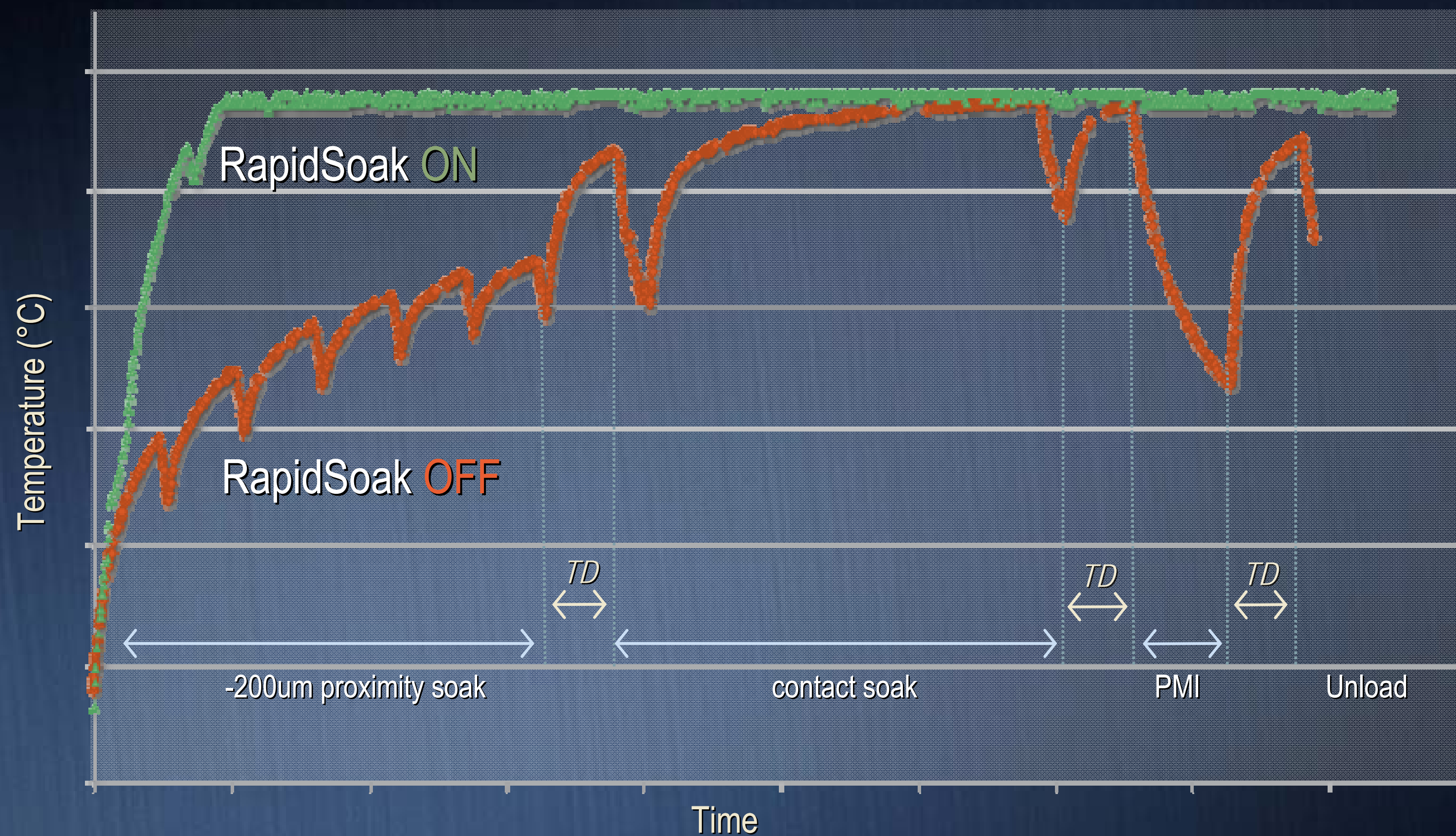
SHORTER SET-UPS → FASTER THERMAL EQUILIBRIUM → HIGHER TEST CELL EFFICIENCY

RapidSoak Characterization Overview

- Characterization Objectives
  - Study RapidSoak's impact on soak time reduction and scrub mark consistency
  - Determine if RapidSoak provides opportunities to improve test cell throughput / efficiency
- Initial data collected using two customer production probe cards
  - Customer A – Harmony eXP, Accretech UF3000EX prober, Advantest T5383 tester
  - Customer B – Harmony eXP, Accretech UF3000EX prober, Advantest T5377 tester
- Data Collection Plan
  - Load probe card in room temperature prober – RapidSoak Off
  - Ramp chuck temperature to desired temperature
  - Load wafer and align probe card
  - Perform proximity soak and TD
  - Perform contact soak and TD
  - Perform PMI and TD
  - Repeat steps a) –f) with RapidSoak On

Thermal Stability Data

Customer "A"



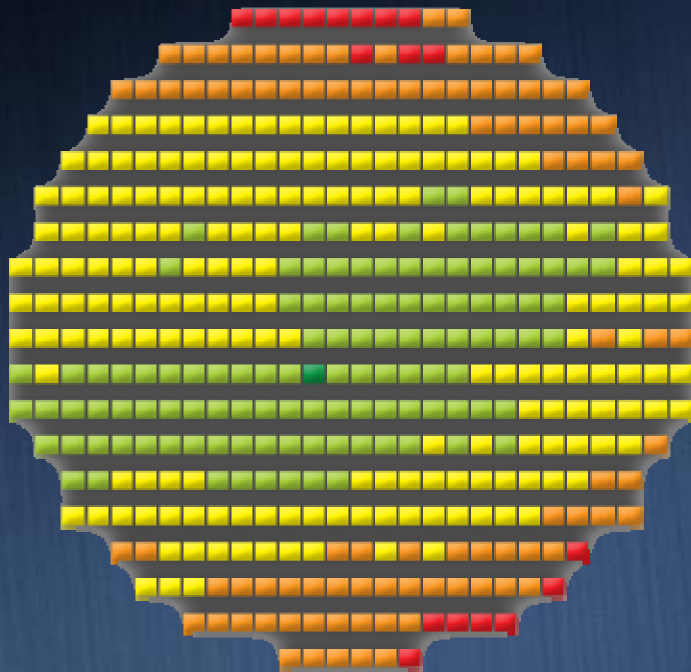
- Thermal stability achieved up to 80% faster with RapidSoak
- Contact soak and additional alignments for thermal instability can be eliminated with RapidSoak on

Scrub Mark Consistency Data

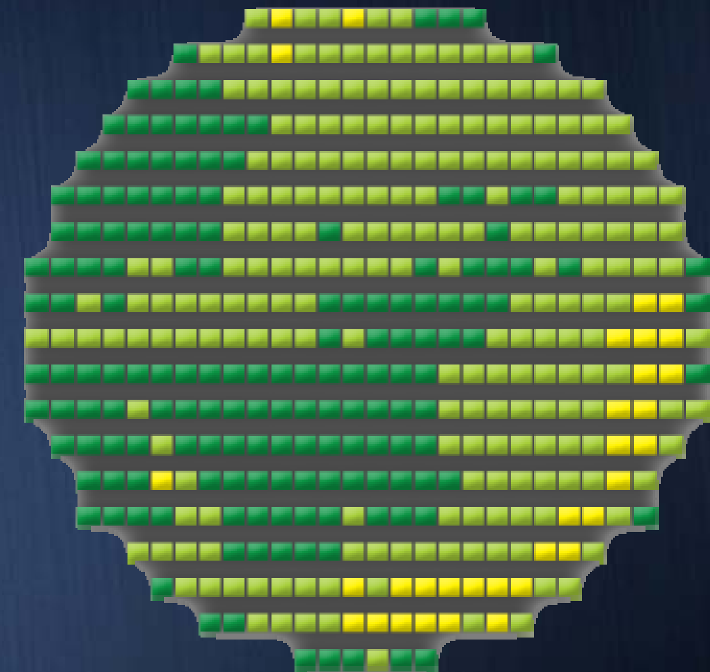
Customer "A"

DUT Ave. Scrub Area | RapidSoak OFF

DUT Ave. Scrub Area | RapidSoak ON



RapidSoak OFF

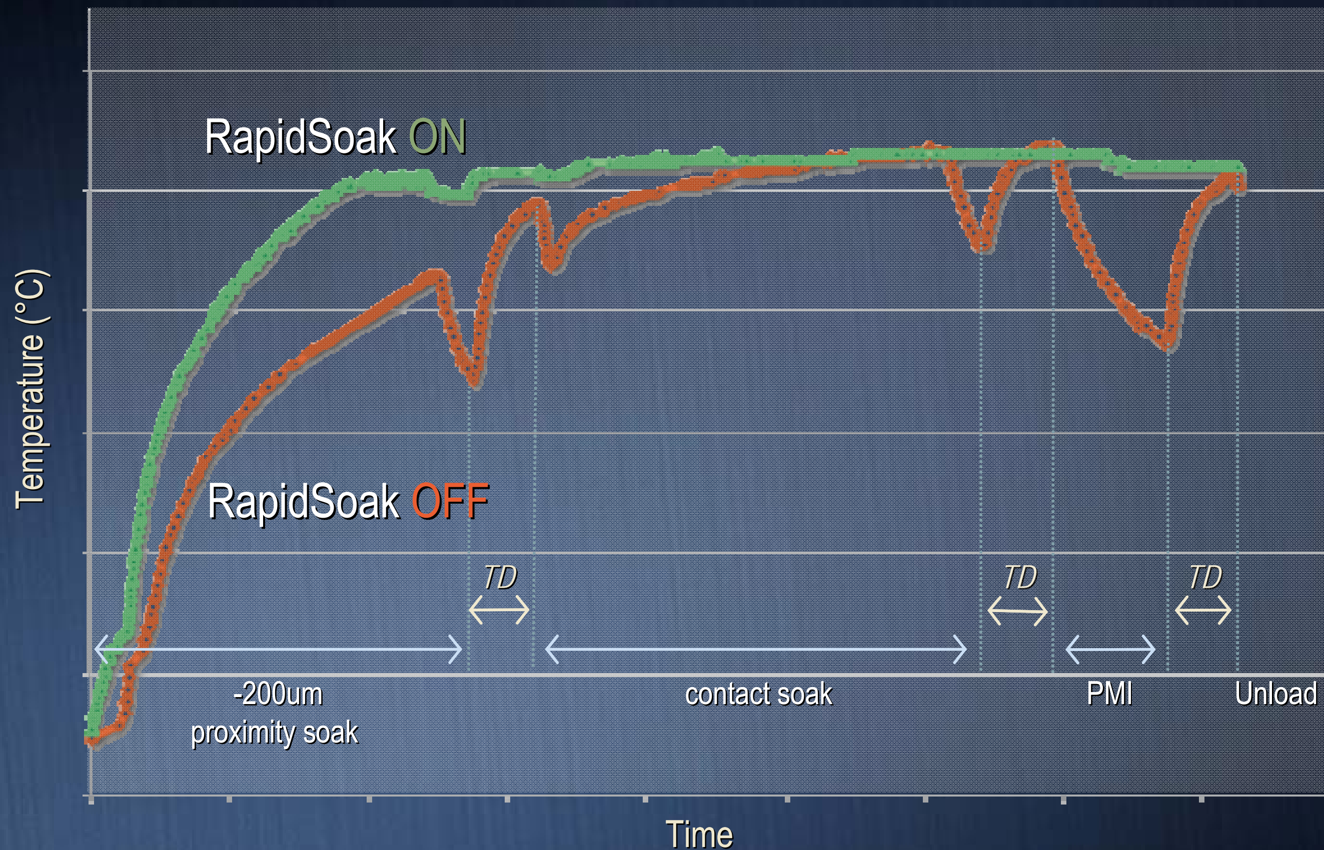


RapidSoak ON

- Average scrub area reduced by 24% with RapidSoak
- Scrub area standard deviation reduced by 37% with RapidSoak

Thermal Stability Data

Customer "B"



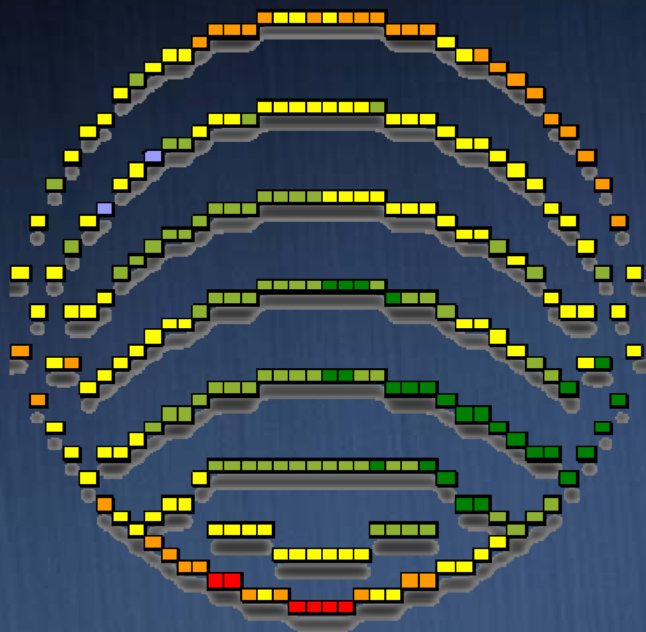
- Thermal stability achieved up to 60% faster with RapidSoak

Scrub Mark Consistency Data

Customer "B"

DUT Ave. Scrub Area | RapidSoak OFF

DUT Ave. Scrub Area | RapidSoak ON



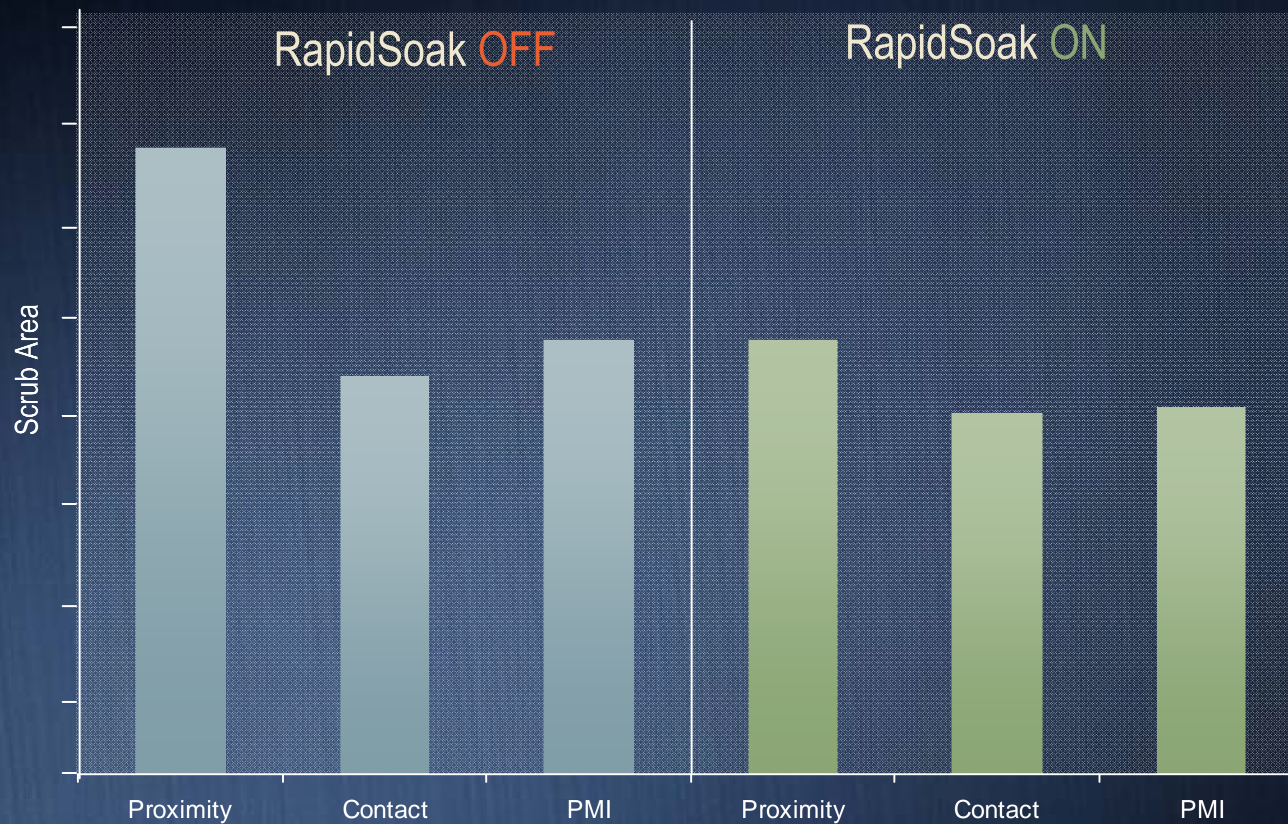
RapidSoak OFF

RapidSoak ON

- Average scrub area reduced by 25% with RapidSoak
- Scrub area standard deviation reduced by 26% with RapidSoak

Scrub Mark Consistency Data

Customer "B"



- Three TD wafer composite scrub area reduced by 15% utilizing RapidSoak

Soak Time Reduction Summary Utilizing RapidSoak

Customer	Probe Card Type	Tester Platform	Soak Time Reduction
"A"	FWC	Advantest T5383	80%
"B"	FWC	Advantest T5377	56%
"C"	FWC	Advantest T5377	54%
"D"	FWC	Advantest T5383	67%
"E"	PH150	Advantest T5377	55%
"F"	FWC	Advantest T5377S	0 soak time achieved

- Soak time reductions achieved in each customer qualification utilizing RapidSoak technology
- RapidSoak currently running in production at multiple customers

Summary and Conclusions

- Summary:
  - Probe card designs are increasing in complexity and size
  - Overall probing budgets are being reduced with shrinking pad size and pad pitch
  - Probe card thermal instability from TD to TD, wafer to wafer results in loss of scrub margin and scrub consistency
  - Negative impact to productivity with increased probe card size
  - On probe card thermal management needed to enable current probe card trends
- Conclusions:
  - Demonstrated RapidSoak enables soak time reduction
    - Contact soak can be eliminated, proximity soak can be reduced
    - Additional soak after PMI not required
    - Enables faster set-up time and production flow efficiencies
  - Probe card thermal equilibrium is maintained with RapidSoak during production operations
    - Enables improved scrub margin and consistency from TD to TD, wafer to wafer
- RapidSoak being used in wafer test production at multiple customers

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Thank You