FOURTEENTH ANNUAL BiTS 2013 Burn-in & Test Strategies Workshop

Archive
Session 6

AND, AT THE WAFER LEVEL

For many in the industry, performing final test at the wafer level is still a novel idea. While providing some much needed solutions, it also comes with its own set of challenges. The four papers in this session look at wafer-level test from a number of different perspectives. The first one discusses the mechanical and electrical differences between wafer-level probe and wafer-level test using spring pins, focusing on requirements for performing final test at the wafer-level. The second presentation provides a comparison between traditional probe test for an RF wafer level chip scale package (WLCSP) and a final test socket solution. TSV issues lead our third author to share technologies that can bridge between 3D stacking and the 3D IC without TSVs. Finally, we'll gain insight into what some consider the holy grail of burn-in and test – wafer-level burn-in (WLBI). Now that WLBI is possible, it's important to understand when it's appropriate to consider WLBI versus other burn-in alternatives.

Spring Probes and Probe Cards for Wafer-Level Test
Jim Brandes—Multitest

A Comparison of Probe Solutions for an RF WLCSP Product
James Migliaccio—RF Micro Devices

Bridging Between 3D and 3D TSV Stacking Technologies
Belgacem Haba, Ph.D.—Invensas

Wafer-Level Burn-in Decision Factors
Steve Steps—Aehr Test Systems

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A Comparison of Probe Solutions for an RF WLCSP Product

James Migliaccio
RF Micro Devices

2013 BiTS Workshop
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Motivation

- Historically, use final test solutions for final test and probe solutions for probing
- For a few years, have been using spring-pin based solutions on WLCSP wafers for low frequency probing
- Been wanting to try a spring-pin solution on an RF product. Needed suitable:
  - Pitch (≥400 μm)
  - Configuration (G-S-G)
  - Suitable layout
  - Frequency range (1-6 GHz)

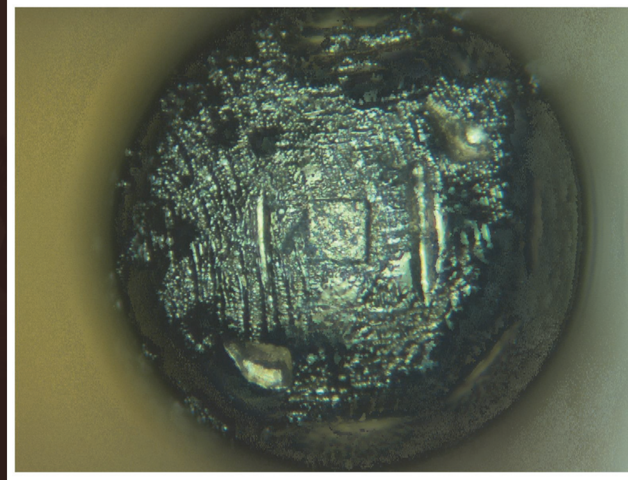
Advantage of a Socketed Probe Card

- Socket/probe interface is removable from the supporting PCB
- Need less PCBs
- Replaceable probe contact assembly or individual contacts
- PCB and contactor interface can be manufactured at the same time, shortening cycle time
- With a bolt on guide, can test loose pieces as well
- Applies force vertically to DUT
- Tend to be more robust
- Generally, greater pin force is available

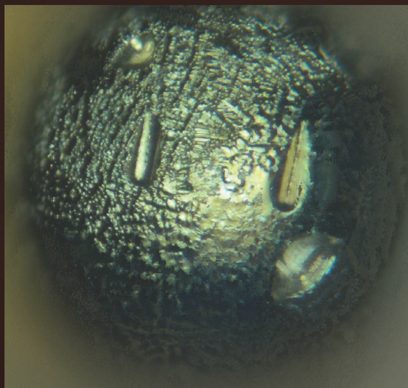
Head to Head Comparison

- High performance RF probe versus RF spring-pin sockets using two different flat spring pins
  - Spring pin results will be labeled A & B
  - RF probe results will be labeled C
- Use product with distinct sensitivity to contact quality
- Measure one 25 wafer lot with all three solutions back-to-back on same equipment
- Compare test results
- Compare whole package

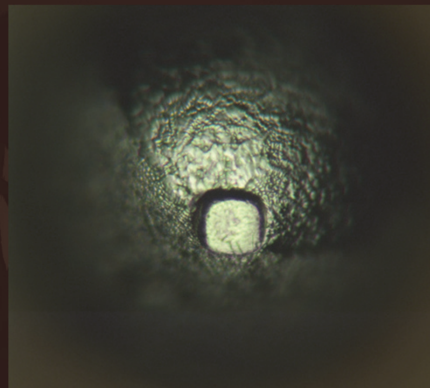
Probed Solder Bump



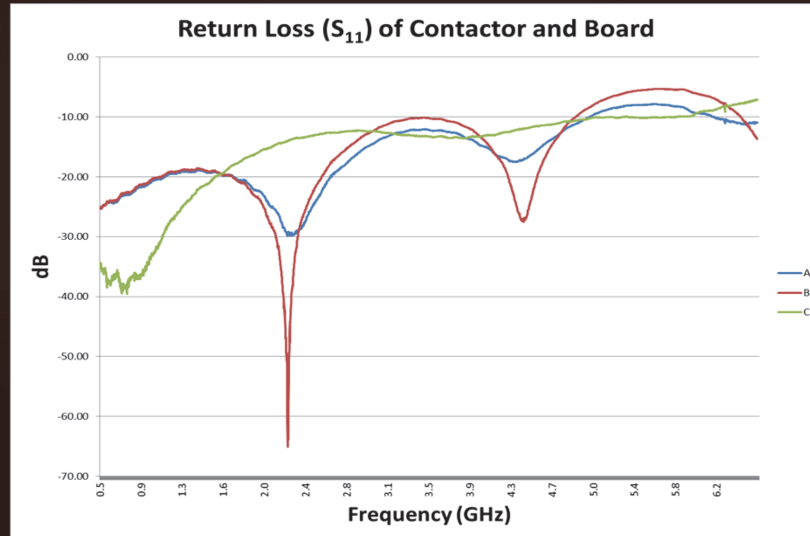
Witness Marks on Solder Balls



Contactors A & B



Contactor C


Return Loss
Return Loss (S_{11}) of Contactor and Board
0.00
-10.00
-20.00
-30.00
-40.00
-50.00
-60.00
-70.00
dB
0.5
0.9
1.3
1.6
2.0
2.4
2.8
3.1
3.5
3.9
4.3
4.7
5.0
5.4
5.8
6.2
Frequency (GHz)
A
B
C
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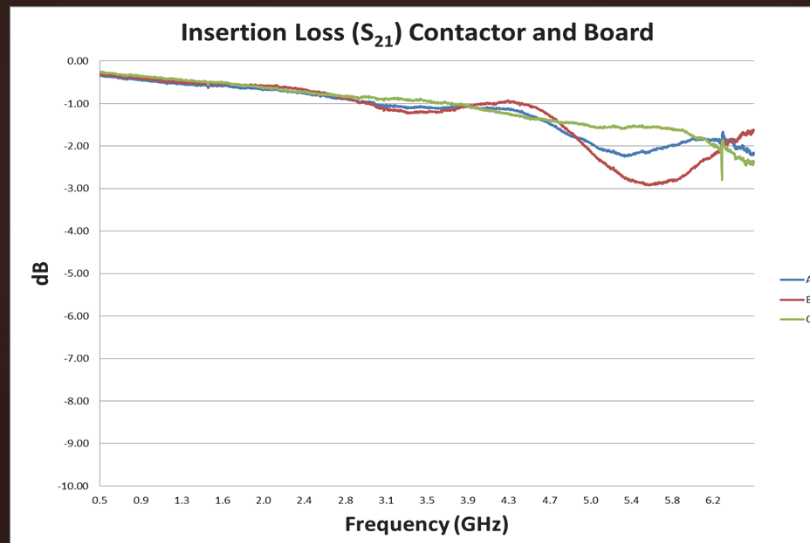
Insertion Loss
Insertion Loss (S_{21}) Contactor and Board
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
-7.00
-8.00
-9.00
-10.00
dB
0.5
0.9
1.3
1.6
2.0
2.4
2.8
3.1
3.5
3.9
4.3
4.7
5.0
5.4
5.8
6.2
Frequency (GHz)
A
B
C
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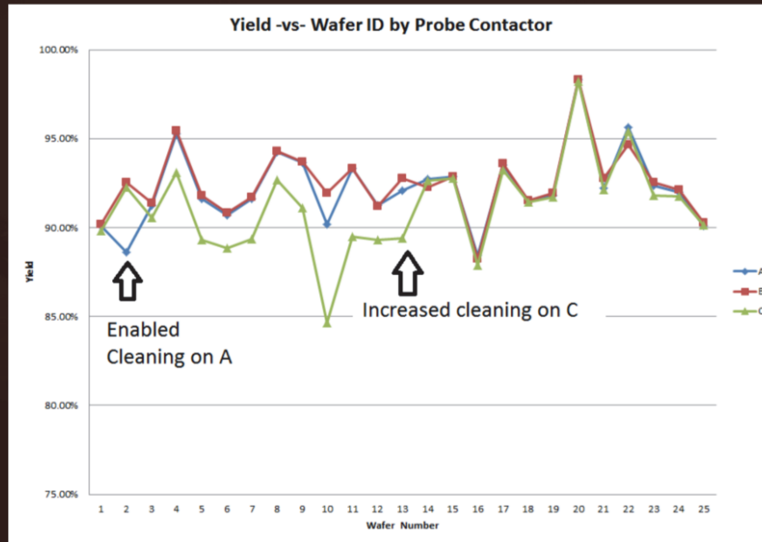
Yield by Contactor



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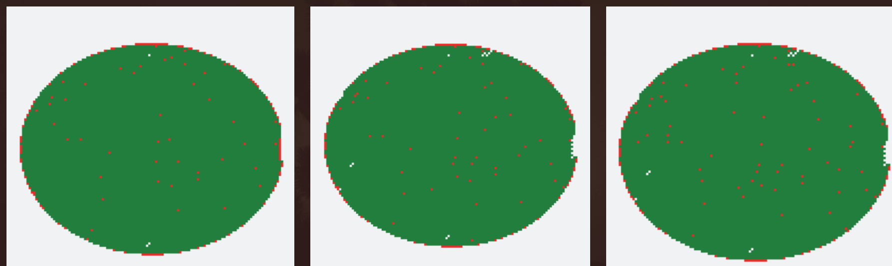
Same Wafer - Three Maps



A B C

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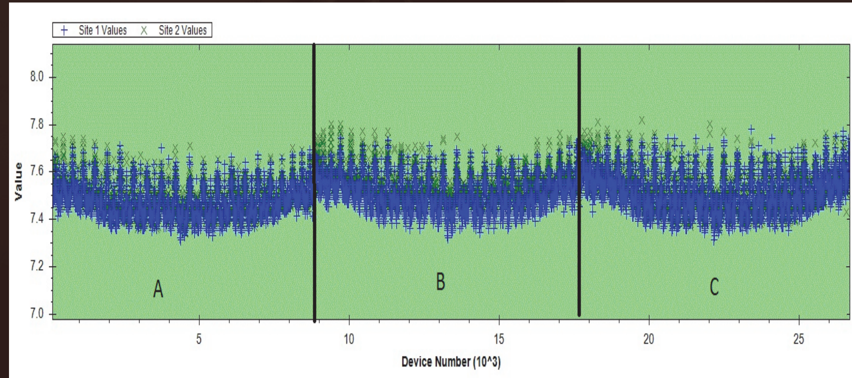
Typical Parameter for the Same Wafer Tested 3x



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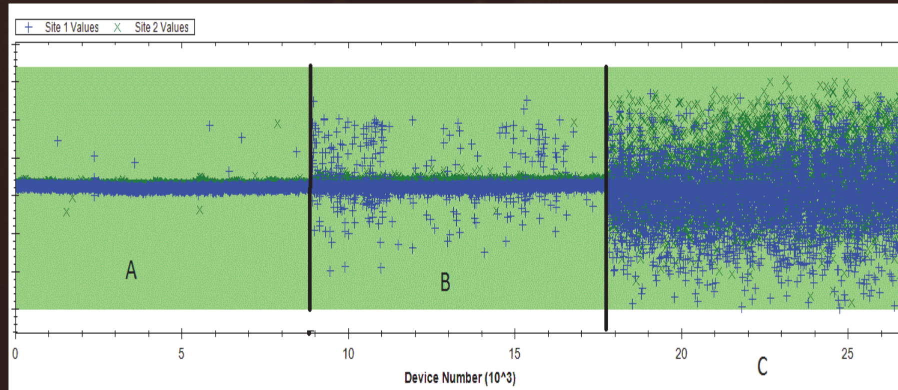
Sensitive Parameter for the Same Wafer Tested 3x



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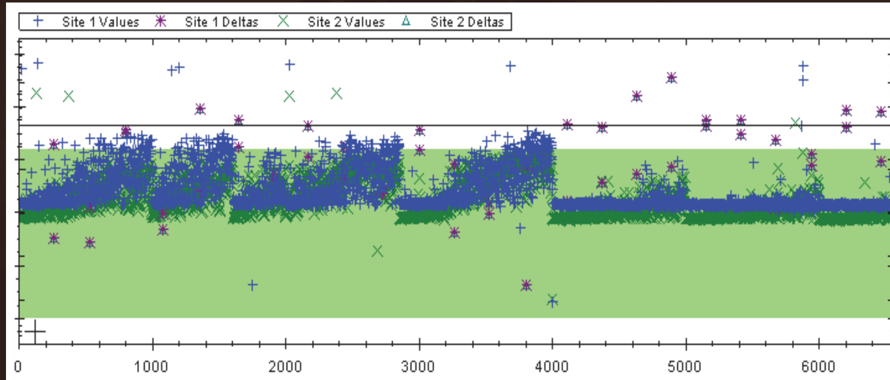
Example of Cleaning Adjustment

By adjusting cleaning, data spread can be managed



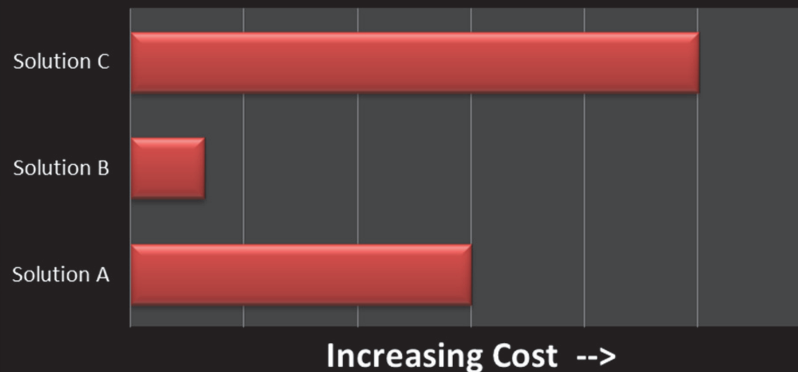
Test Result Review

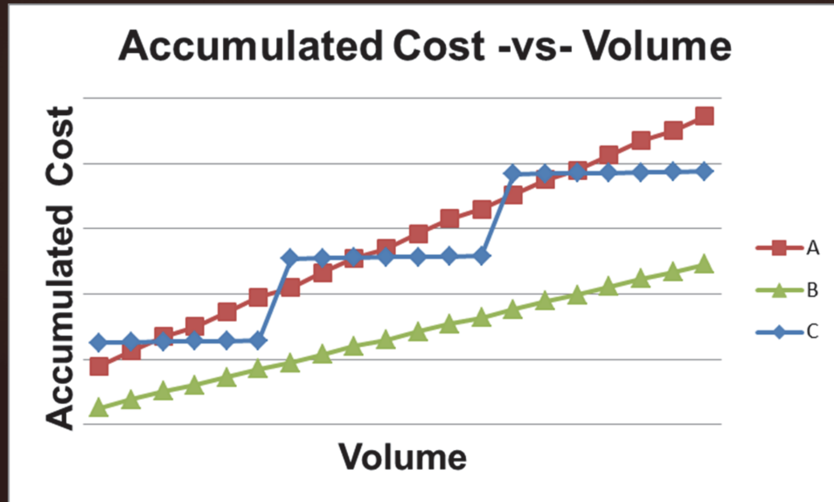
- Data looks good in all cases
- No significant yield difference by solution
- Most parameters have similar distributions
- A few extra sensitive parameters show differences in data spread
- Data spread can be managed by changing cleaning regiment and/or over travel

Operating Costs

- Contactors A & B have replaceable spring pins
- Contactor C is cannot be repaired
- For contactor C use historical data for costing – lifetime & cleaning
- For contactors A & B use historical data for data for spring replacement from package parts
  - Estimate of cleaning cycles based on limited data from this experiment
- Cleaning for contactor C is lapping film
- Cleaning media for spring pins is abrasive loaded polymer ~ 20x cost of lapping film

Relative Cost for One Probe Card




Relative Cost for One Probe Card
Accumulated Cost -vs- Volume
Accumulated Cost
Volume
A
B
C
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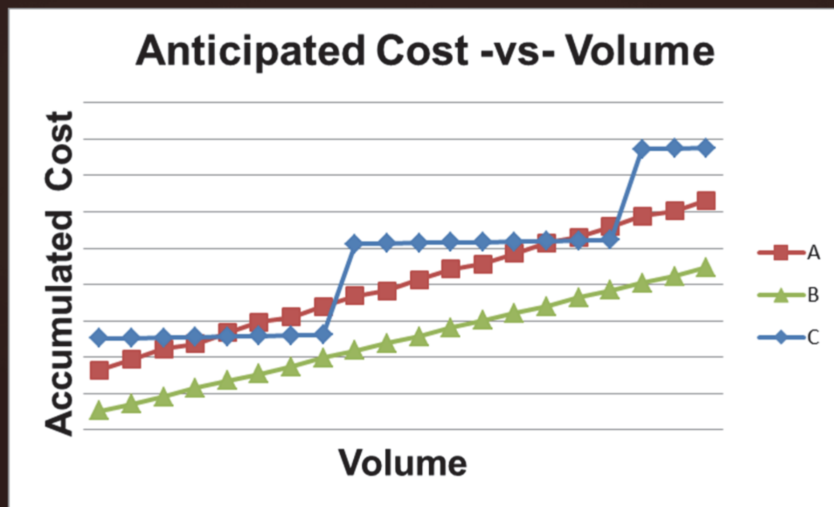
Anticipated Cost for One Probe Card
Anticipated Cost -vs- Volume
Accumulated Cost
Volume
A
B
C
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RF Probe Pros/Cons

Pros:
- Well defined in situ cleaning for the probes and manufacture
- Long life with minimal intervention
- Prober support
- Great frequency response
- Top-side board mounting – see through
- Controlled impedance to base of tip

Cons:
- Tips are not independent
- Too much over travel not tolerated
- Higher initial cost
- This particular design is not repairable
- Unique construction

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Spring Pin Pros/Cons

Pros:
- Pins will bottom out in the housing
- Each pin can move independently – overhang allowed
- Higher contact pressure possible
- Spring pins have greater usable contact range

Cons:
- Prober alignment for different spring tip geometry can be a challenge
- Cleaning regiment not as clear
- Will need more downtime for rework
- Not a clear cut cost advantage

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Summary

- No dominant solution for this product
- All solutions worked very well
- Small variation in performance for the flat pins
- Higher contact pressure achieved by flat pins is advantageous

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