

## TEST TOOLING MADE EASY

Whether you're testing conventional packages like QFNs and BGAs, or emerging 2.5D and 3D packages, you're only as successful as your test floor equipment. This session's presenters span the spectrum of tooling issues beginning with a method for 3D package handling through the integration of complex technologies. Next, you'll learn how to prevent semiconductor test system coolant leakage by implementing a hazardous warning system. Operator error in manual test handlers comes under scrutiny thanks to a failure analysis investigation in QFN packages. Lastly, we take a look at cost saving through homogenous spring pin tip implementation in a high volume manufacturing (HVM) environment.

### **3D Package Handling: A Simple Case of Integrating Complex Technologies**

Zain Abadin—Advantest America, Inc.

### **Innovative Way to Prevent Semiconductor Test Tester Coolant Leakage with Hazardous Warning System**

Yee Wei Tiang—Intel (Malaysia)

### **Die-Cracking Failure Analysis of QFN Packages in Manual Test Handler**

M.P. Divakar, PhD—Stack Design Automation

### **Cost Saving Through Homogenous Spring Loaded Pin Tip Implementation in High Volume Manufacturing (HVM) Environment**

Chin Siang (David) Chew, Nithya Nandhan Subramaniam—Intel Technology  
Chin Chien Tee—Interconnect Devices, Inc.



This Paper

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## Cost Saving Through Homogenous Spring Loaded Pin Tip Implementation in High Volume Manufacturing (HVM) Environment

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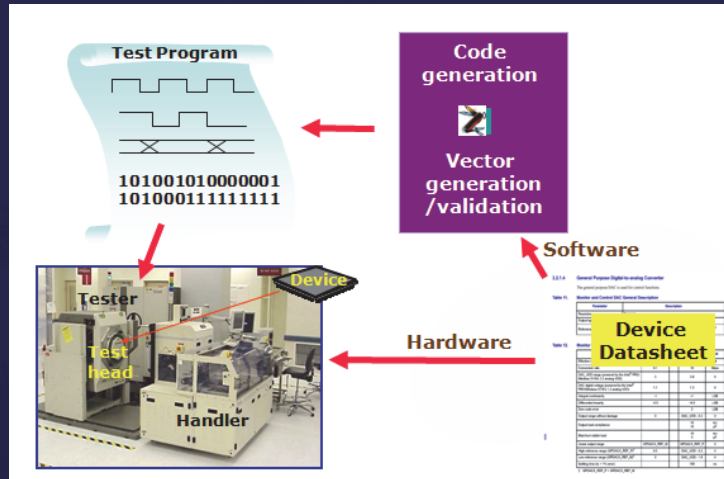
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### Content

- Introduction
- Current State of Spring Loaded Pin
- Future State of Spring Loaded Pin
- Methodology & DOE
- Results in Cost & Others
- Conclusion
- Future Works
- Acknowledgement

## Test – The Concept

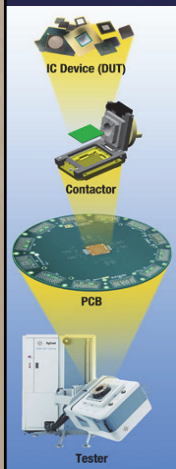


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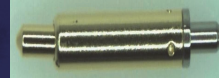
## What is Spring Loaded Pin?



Test Socket



Spring Loaded Pin



- Spring loaded pin is a device commonly used in electronics to:
  - Establish a temporarily connection between 2 PCBs
  - Transmission of electrical signals
- Land Grid Array (LGA), Ball Grid Array (BGA) and Pin Grid Array (PGA) are pin types commonly found
- Spring loaded pin technology is widely used in semiconductor industry

**Spring loaded pin is widely used as interconnect device**

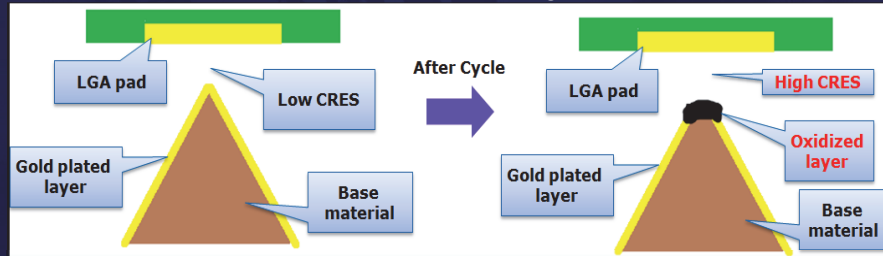
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## The Current State of Spring Loaded Pin

- Base material is made of Beryllium Copper (BeCU) plated by gold layer for better electrical conductivity and low Contactor Resistance (CRES)
- Oxidized layer built up when base material is exposed
- Spring loaded pin is replaced after reaching its defined lifespan
- CRES is unstable even before reaching defined lifespan



**Gold plated Spring loaded pin lifespan is short & CRES is unstable**

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## The Current State of Spring Loaded Pins

- Approximately 15% of equipment spare part spending is from spring loaded pin
- Spring loaded pin is consumed through:
  - Full socket pins replacement for its defined lifespan
  - Individual pin replacement per failure within its defined cycle lifespan

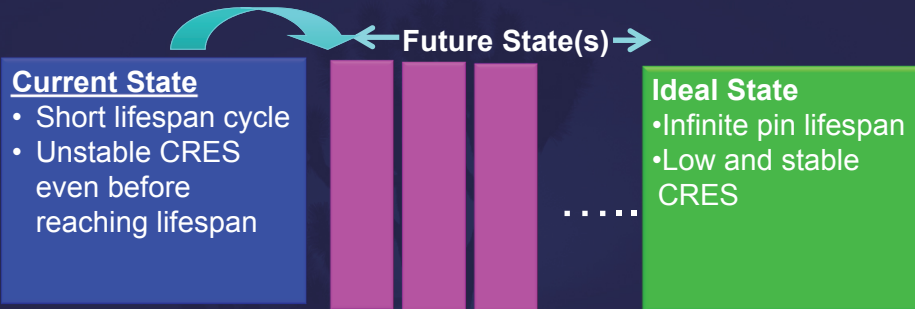
**Spring loaded pin consumed ~15% of overall spare part spending**

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## Way To Ideal State



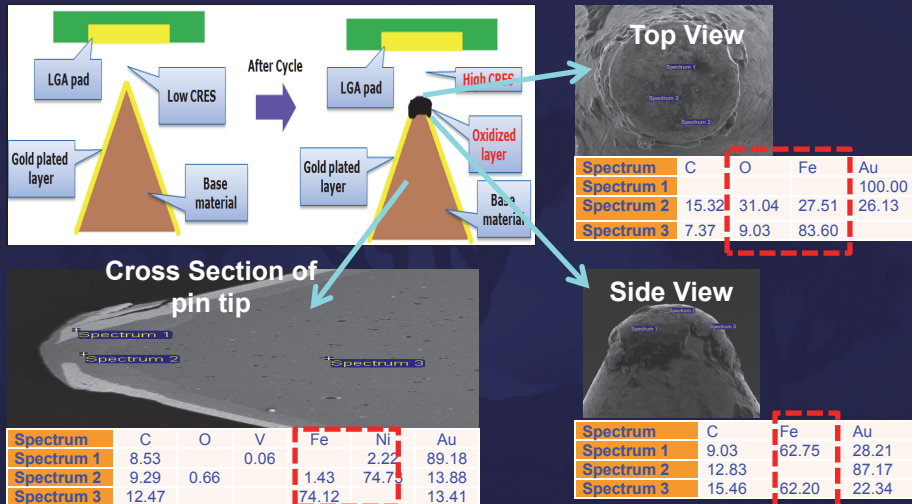
Ideal state of the pin is infinite lifespan

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## Unstable CRES Root Cause



Oxide built up on the base material is the root cause to high & stable CRES

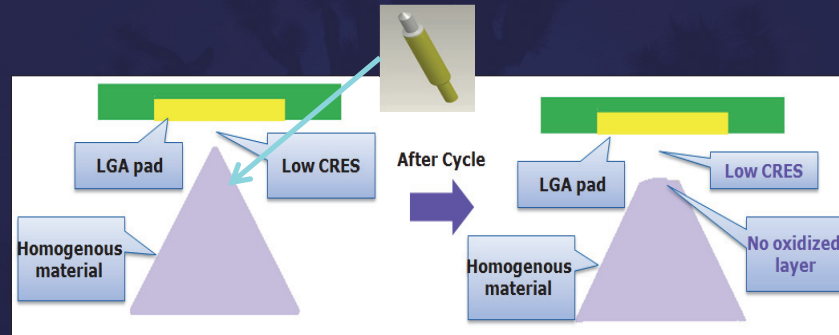
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## The Future State of Spring Loaded Pin

- Eliminate any pin tip design with plated layer through Homogenous (HG) material implementation
- Low and stable CRES with long lifespan



**Homogenous material pin tip without plating layer is the future state!**

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## Roadblocks to Future State

- More than 2 quarters lead time to achieve the lifespan qualification with HVM material
- Current lab test is not representative to HVM condition
- Lifespan extension qualification methodology is critical

**The longer lifespan, the more challenging for the qualification**

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## Lab Test Versus HVM

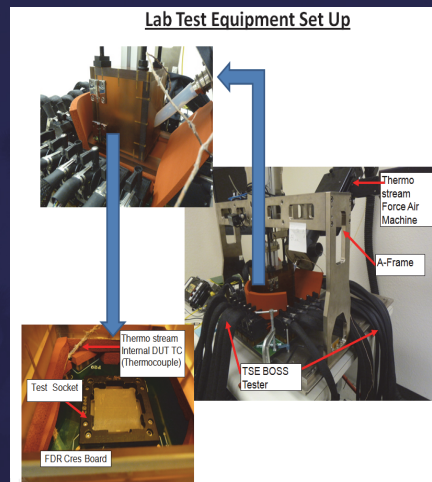
- HVM pin is 3x worse than lab test cycled pin
- 4 potential variables are found based on preliminary study:
  - Testing temperature
  - Testing current
  - Actuator velocity
  - Test time

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## HVM Matching Lab Test Set up



**Lab test set up is based on actual testing temperature & actuator velocity**

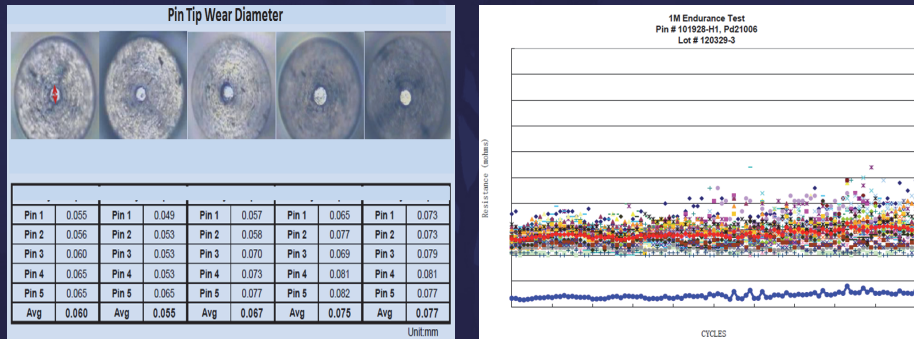
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## Design of Experiment

- Several Design of Experiments (DOE) carried out including Force Displacement Resistance (FDR), yield analysis, pin tip wear and etc.



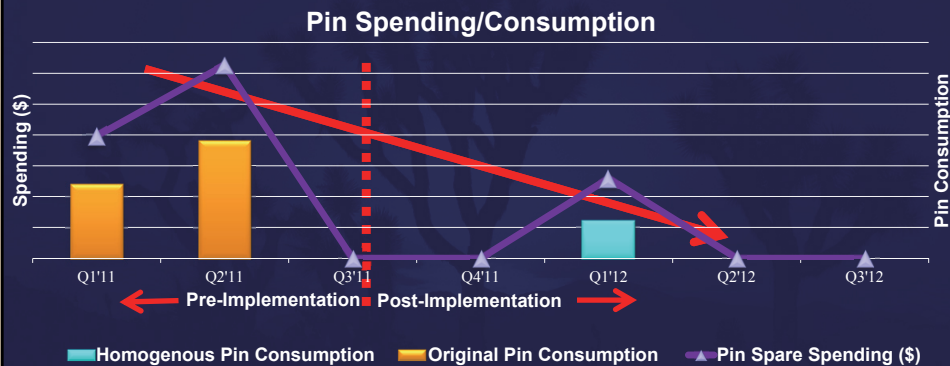
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## Result in HVM - Cost

- Success story: Product A pin spending and consumption were reduced by 5X with 5X longer lifespan



**5X spare consumption reduction achieved**

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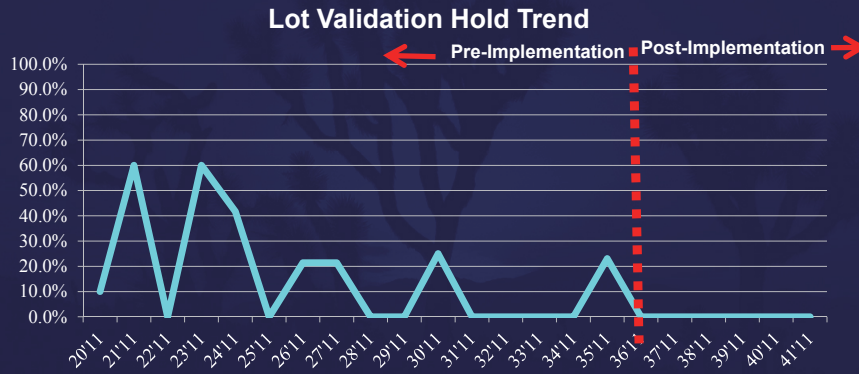
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## Yield – Invalid Lot Validation Hold

- HG pin CRES is low and stable before reaching its defined lifespan
- Lot validation on hold has achieved significant improvement



**Lot on hold improved due to low and stable CRES**

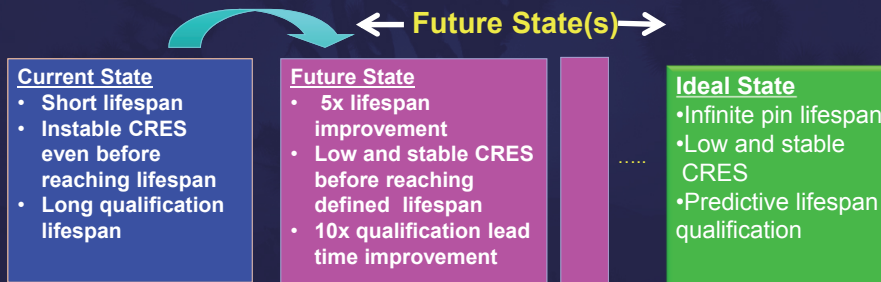
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## Conclusion

- 5x spare spending improvement is possible through the implementation of the 5X longer lifespan Homogenous pin
- Better yield, faster cycle time, Great Place To Work can be achieved with lower manufacturing cost



**We are one step closer to ideal state !**

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## Future Works

- The future works and researches include:
  - Effective cleaning material to homogenous pin to prolong existing lifespan
  - Gap analysis of lab test vs. HVM
  - A predictive qualification methodology for longer lifespan pin test

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## Acknowledgement

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