BiTS™ Burn-in & Test Socket Workshop 2010 **Poster Session**

ARCHIVE 2010

New Polyarylketone Polymer for Use in the Manufacturing of Test Sockets: OXPEKK®

Tim Spahr—Oxford Performance Materials, Inc.

Shortest Spring Pin (so far) – Practical Implication

Jay Kim—Western Specialty Tech., LLC
M. G. Seo—OKins Electronics, Co. Ltd.

PoP Solutions Configurations and Challenges

Jim Spooner—Interconnect Devices Inc.

Hybrid BK Elastomer Socket

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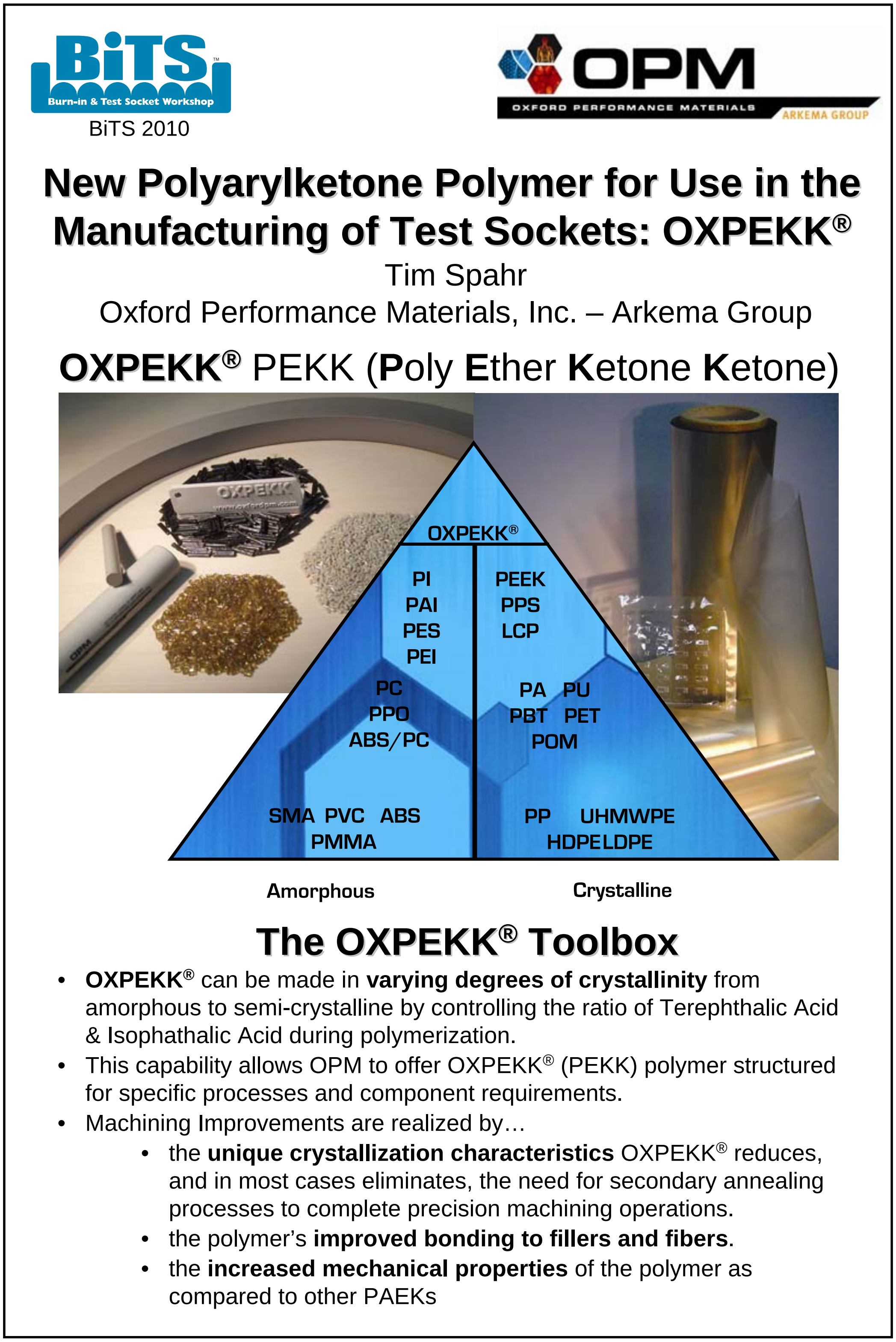
Byung-Gi Kim—Leeno Industrial Inc.

BGA Spring Probe for Final Test – Multipoint Contact to BGA Solder

Eichi Osato—Micronics Japan Co., Ltd.
Fred Megna—MJC Electronics Corporation



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New Polyarylketone Polymer for Use in the Manufacturing of Test Sockets: OXPEKK®

Tim Spahr
Oxford Performance Materials, Inc. – Arkema Group

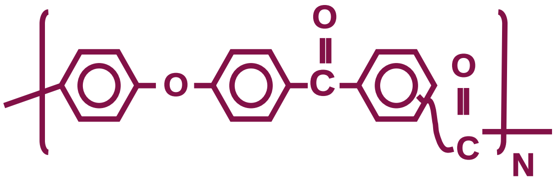
OXPEKK® PEKK (**P**oly **E**ther **K**etone **K**etone)

The OXPEKK® Toolbox

- **OXPEKK®** can be made in **varying degrees of crystallinity** from amorphous to semi-crystalline by controlling the ratio of Terephthalic Acid & Isophathalic Acid during polymerization.
- This capability allows OPM to offer OXPEKK® (PEKK) polymer structured for specific processes and component requirements.
- Machining Improvements are realized by…
    - the **unique crystallization characteristics** OXPEKK® reduces, and in most cases eliminates, the need for secondary annealing processes to complete precision machining operations.
    - the polymer's **improved bonding to fillers and fibers**.
    - the **increased mechanical properties** of the polymer as compared to other PAEKs

OXPEKK®'s Toolbox allows OPM to vary the polymer's:

- Melt Point (Tm)
- Glass Transition (Tg)
- Mechanical Properties
- Crystallization Kinetics
- Adhesion Performance
- Electrical Properties
- Chemical Resistance
- Molecular Weight
- Rheology



Available OXPEKK polymer structures:

OXPEKK-SP Grades:	Amorphous
OXPEKK-D Grades:	Semi-Crystalline
OXPEKK-C Grades:	Semi-Crystalline

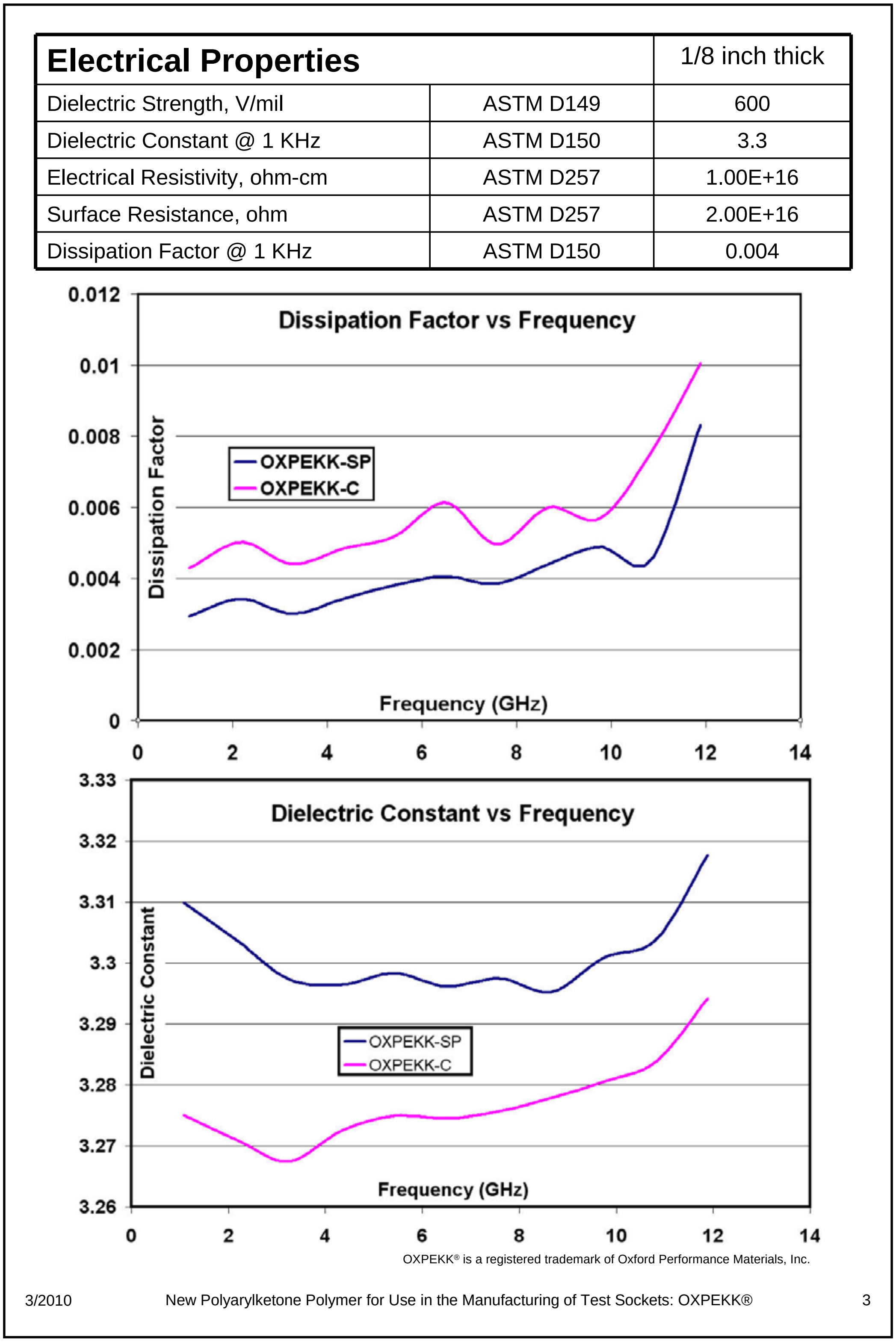
	OXPEKK-SP	OXPEKK-D	OXPEKK-C
Crystallinity	Amorphous	Semi-crystalline	Semi-crystalline
Melt Point (Tm)	307 °C	340 °C	360 °C
Glass Transition (Tg)	155 °C	159 °C	163 °C
Mechanical Properties	High	Higher	Highest
Crystallization Kinetics	Slow	Medium	Faster
Adhesion Performance	Excellent	Good	Average
Electrical Properties	Excellent	Excellent	Excellent
Chemical Resistance	Good	High	Highest
Viscosity	Low Medium High	Low Medium High	Low Medium High

Ultra Low Ionic Content (<0.1 ppm of Na)

Higher Temperature Performance than PEEK

Unfilled Polymer Tg = 163°C

Unfilled Polymer HDT = 175°C



Electrical Properties		1/8 inch thick
Dielectric Strength, V/mil	ASTM D149	600
Dielectric Constant @ 1 KHz	ASTM D150	3.3
Electrical Resistivity, ohm-cm	ASTM D257	1.00E+16
Surface Resistance, ohm	ASTM D257	2.00E+16
Dissipation Factor @ 1 KHz	ASTM D150	0.004

OXPEKK® is a registered trademark of Oxford Performance Materials, Inc.

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Shortest Spring Pin (so far) – Practical Implication

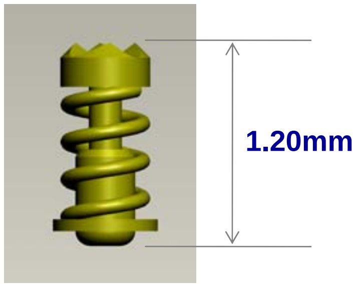
Jay Kim, Western Specialty Technologies, LLC
MG Seo, OKins Electronics Co. LTD

Shortest spring pin (so far): 1.2mm

- Compressed length: 0.95mm
- 2009 theoretical limit (BiTS): 1.6mm

Advantages of *short* spring pin

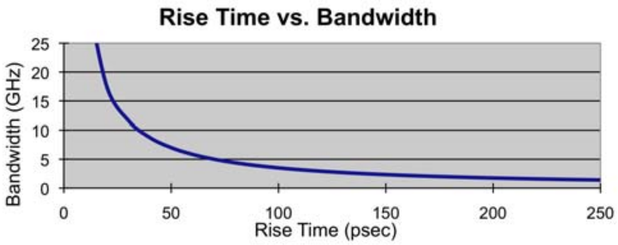
- Better signal integrity
- Higher frequency



Shortest Spring Pin, SSC

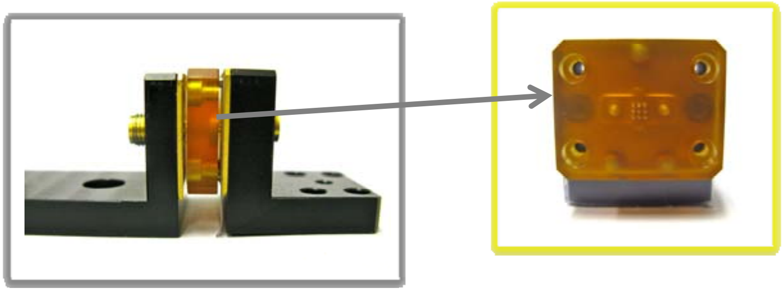
Fast rise time requires high bandwidth

- Typical Bandwidth = 0.35 / (Rise Time)
- Bandwidth for measurement = 0.5 / (Rise Time)



Test Setup

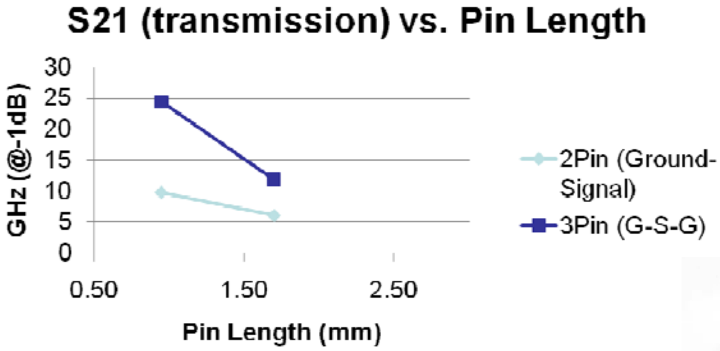
- Custom fixture, for consistent measurement

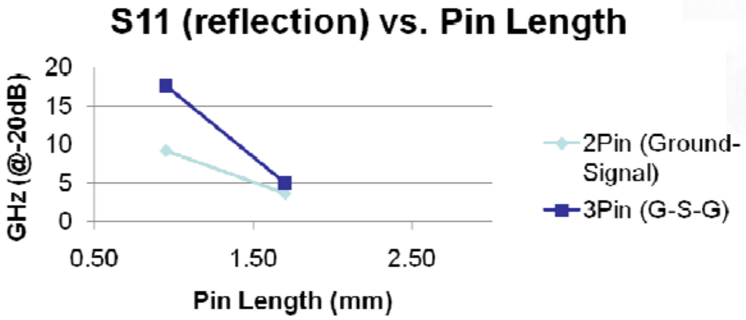


Spring Pin Length vs. Frequency

- S21: Transmission – measures insertion loss
- S11: Reflections – measures return loss

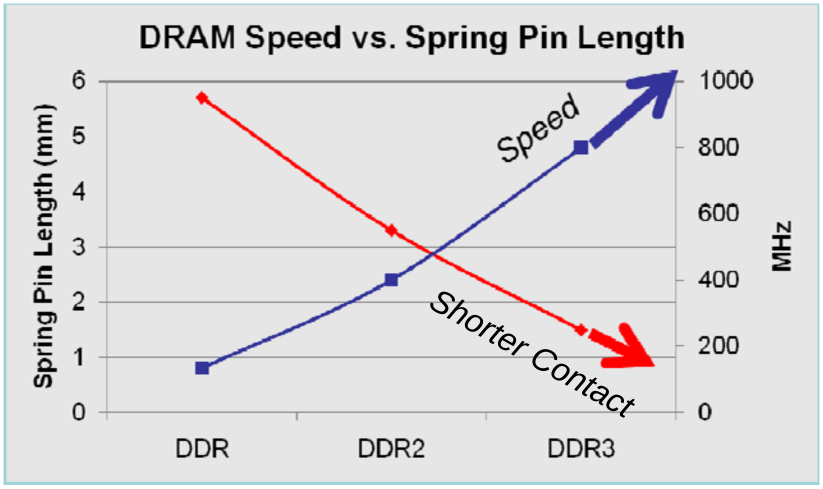
Shorter pin = Higher Frequency





Customer Experience – Production test socket

- Shorter contacts are needed to test faster devices



Advantages of external spring pin design

- Higher reliability
  - Larger spring diameter / more materials for a given diameter
    - Better spring force control
  - Extended lifetime (1 million++ cycle)
- High Bandwidth
  - Enables shorter spring pin design
  - Shorter pin -> better signal integrity at high frequency

Summary

- Shorter spring pin of 1.2mm (0.95mm during use) is viable
- Higher bandwidth devices can be tested with shorter spring pins
- External spring pin design increases reliability.

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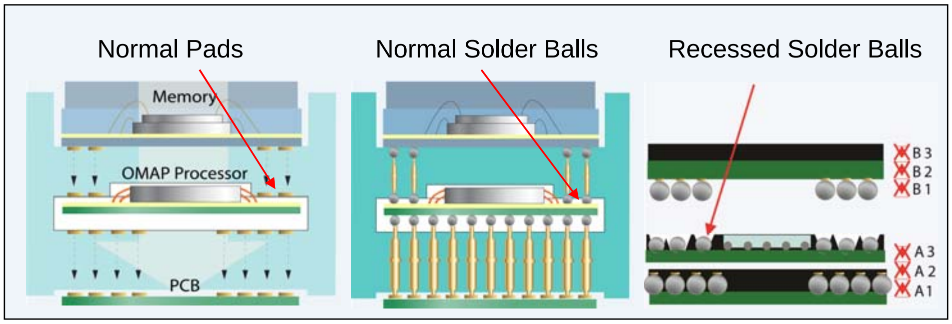
PoP Solutions Configurations and Challenges

Jim Spooner
Interconnect Devices, Inc.

PoP Bottom Device to Memory Interface Variations

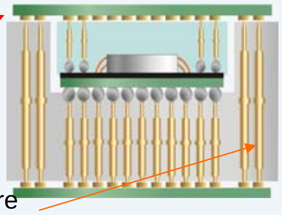


Challenges and Solutions

- XY alignment of entire setup
- Gimbal lid
- Controlling thin package bowing/warping and Z stack tolerances

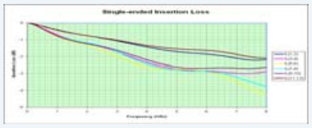
Major considerations in Signal Integrity

- Topside contactor return path is much longer than normal contactor
- Topside PCB affects SI performance significantly
- Coaxial structure is recommended for return path



Top side PCB can be impedance controlled

Coaxial structure at long return pin

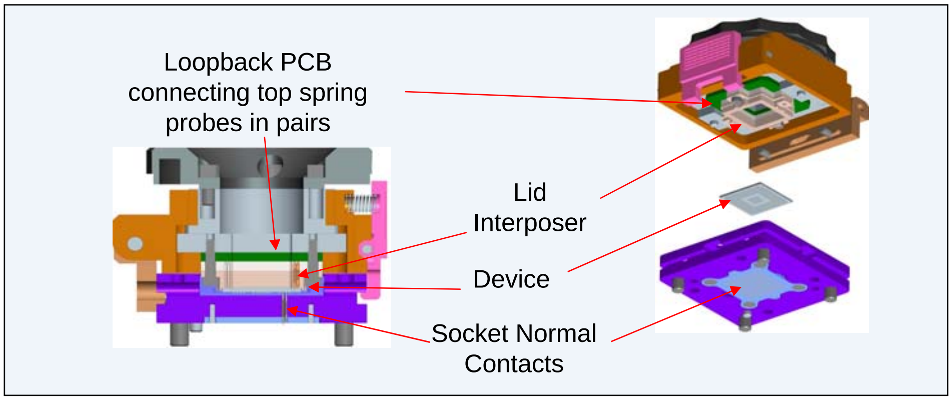


IL(7,8) = 2.8dB @ 5.00 GHz
IL(5,6) = 1.0dB @ 1.30 GHz

Poster #3

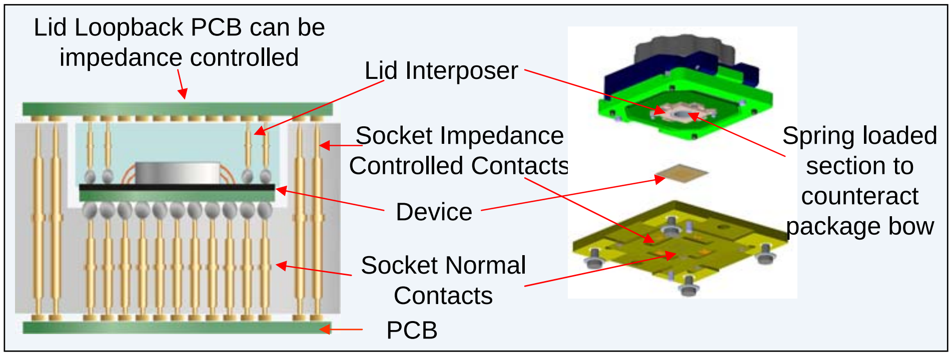
Memory-Less (ML) Option 1

- Bottom access to leads on devices with memory information supplied via Loopback on top of device thru the socket assembly
- Same Lid Interposer used in change kit



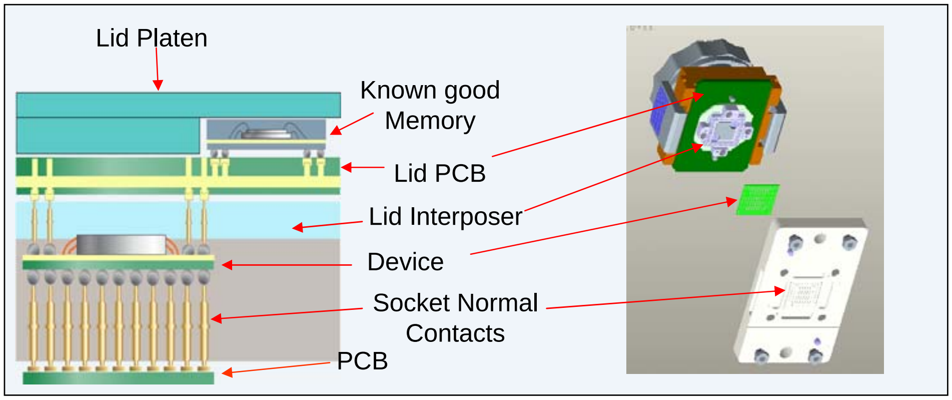
Memory-Less (ML) Option 2

- Top and bottom access to leads on devices with memory information supplied from the tester to the top of the device thru the socket assembly
- Same Lid Loopback PCB and Lid Interposer used in change kit
- Cable Loopback system in development as alternate to impedance controlled contacts



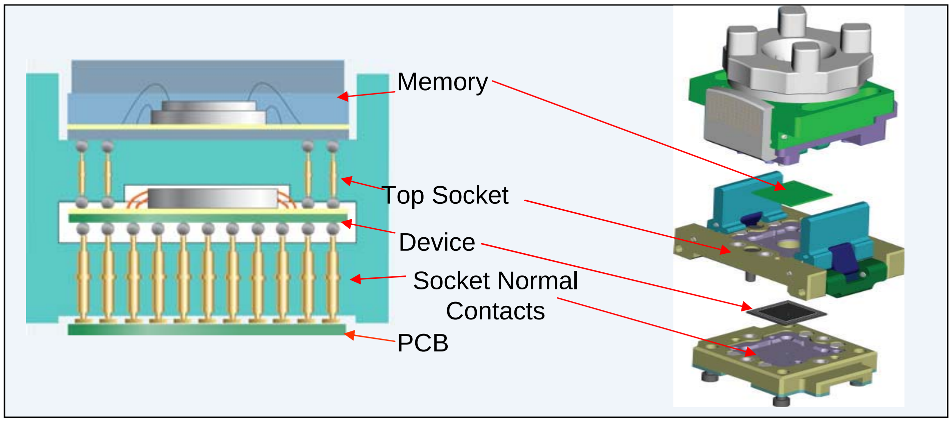
Memory-Bearing (MB)

- Top and bottom access to leads on devices with a known good memory contained within the lid assembly providing a temporary connection to the PoP device under test
- PCB can also be used as breakout board for access points for external instrumentation



Manual-Test (MT)

- Top and bottom access to leads on devices with a known good memory contained within the top socket assembly providing a temporary connection to the PoP device under test



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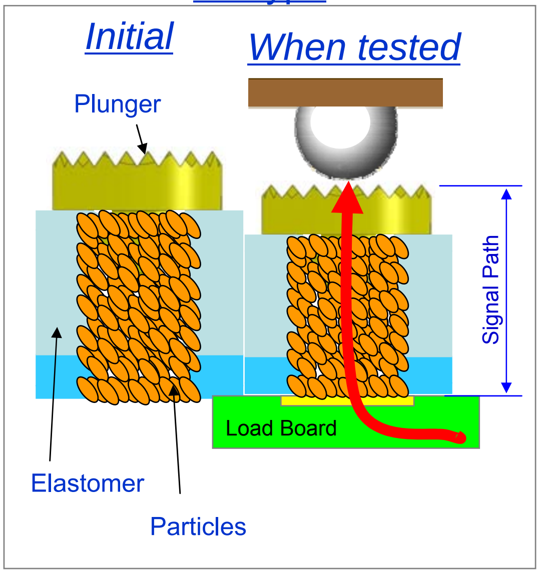
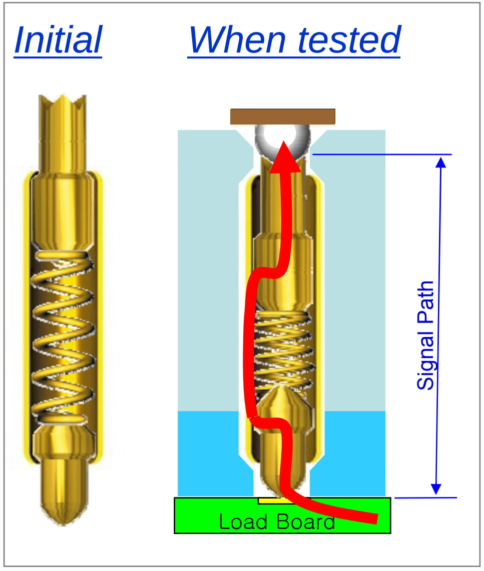
"Hybrid BK Elastomer Socket"

Behrouz Sadrabadi, Rani Awale, Qualmax America. Inc.
Byung-Gi Kim, Leeno Industrial Inc.

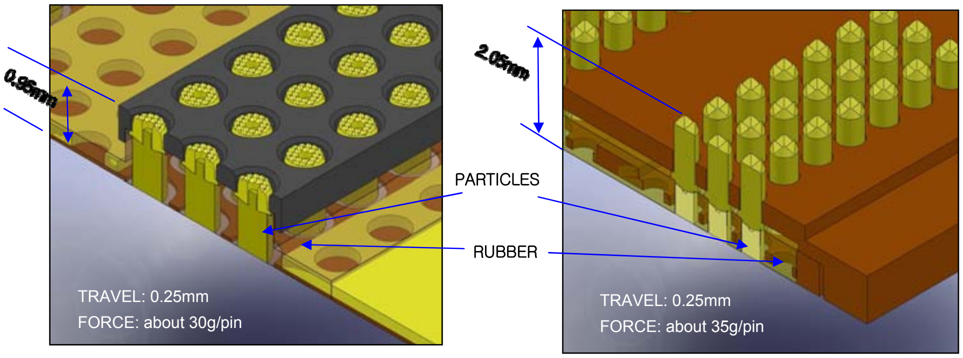
BK type



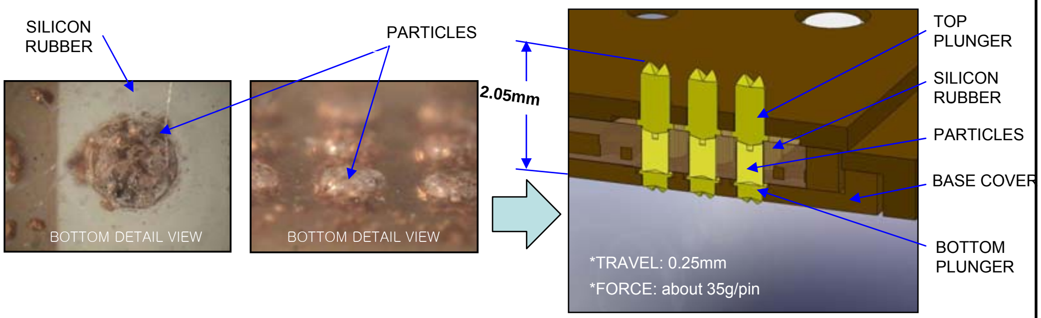
Probe type



- Creates a shorter signal path; greatly improved AC/RF parametric.
- CRES becomes more stable.



- Signal path length can be controlled by plunger height.
- Using plunger guarantees better contact with DUT

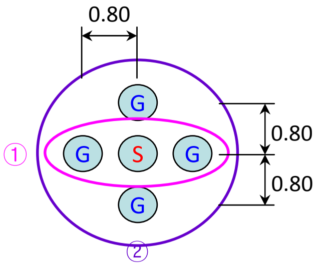


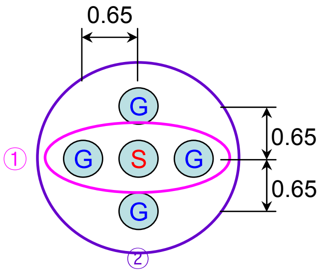
-Particles coming out of the capsules after 200K is one of the failure modes on elastomer products.

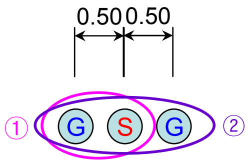
- Adding bottom plunger will increase the product life and improve the performance.

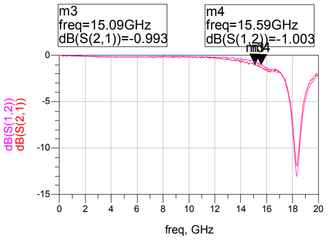
RF measurements on the actual BGA sockets

1) SIG#1 + GND#2
2) SIG#1 + GND#4



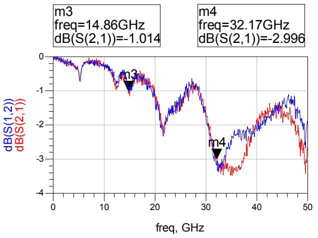






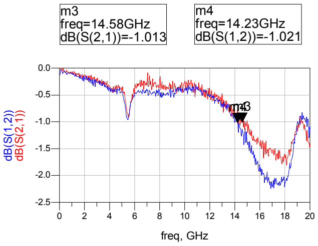
② S-Parameter : SIG#1 + GND#4

Insertion Loss : -0.993dB @ 15.09GHz



① S-Parameter : SIG#1 + GND#2

Insertion Loss : -1.014dB @ 14.86GHz

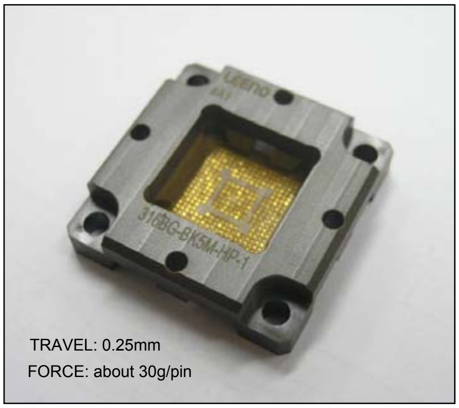


② S-Parameter : SIG#1 + GND#4

Insertion Loss : -1.013dB @ 14.58GHz

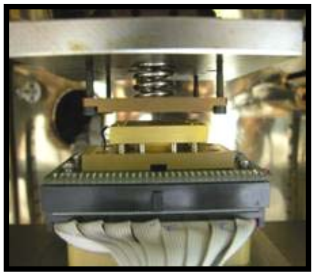

TRAVEL: 0.25mm
FORCE: about 30g/pin

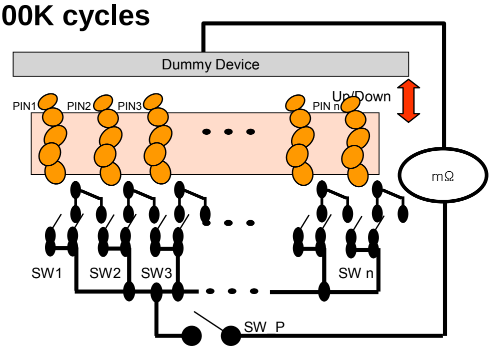
316BGA (Pitch: 0.50mm
Signal Path : 2.80mm)

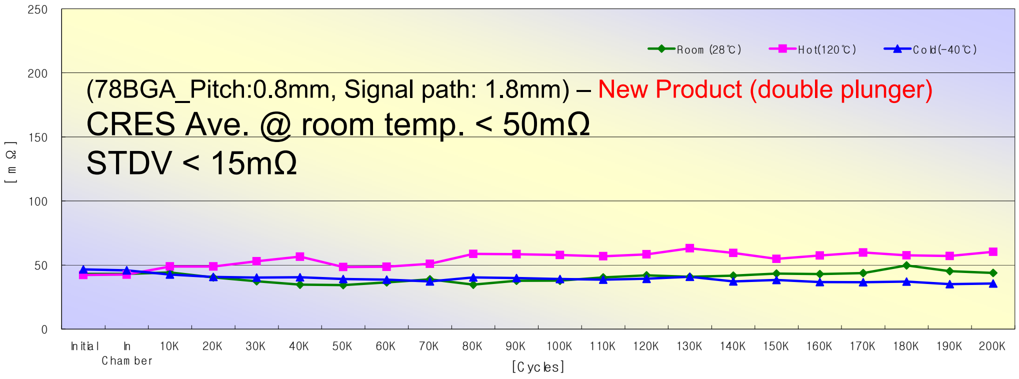

TRAVEL: 0.25mm
FORCE: about 30g/pin

316BGA (Pitch: 0.65mm
Signal Path : 1.05mm)

CRES and Force measurement, 200K cycles



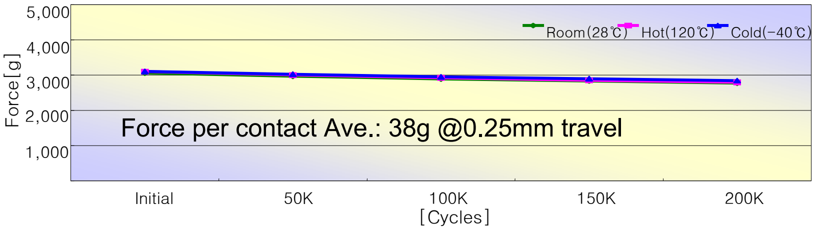




(78BGA_Pitch:0.8mm, Signal path: 1.8mm) – New Product (double plunger)

CRES Ave. @ room temp. < 50mΩ

STDV < 15mΩ



Force per contact Ave.: 38g @0.25mm travel

Poster #4

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BGA Spring Probe for Final Test

Multipoint Contact to BGA Solder

Presenter : Eichi Osato, Micronics Japan Co., Ltd.
Co-Author: Fred Megna, MJC Electronics Corp.

1.Challenges of Spring probe

Spring probes that have 4 point crown tips are designed to contact the solder ball at 4 locations simultaneously. However, in reality, the 4 points cannot make contact to the ball all the time due to inaccuracy of the ball location. Most likely the points that contact the ball is one or two. Because it is unlikely that all 4 of the crown tips will make contact perfectly to the ball, many spring probe manufacturers have been trying to change tip shape, materials or surface treatment such as plating. However, MJC took a different approach to solving this problem. We changed the spring probe structure to enable the crown tip (4 points) to contact the ball at all times. Fig. 1 shows the contact between a spring probe crown and the ball. You can see that some points of the crown miss contact to the solder ball when we use standard spring probes. Fig. 2 shows that contact gets worse when there is contamination present at the interface.

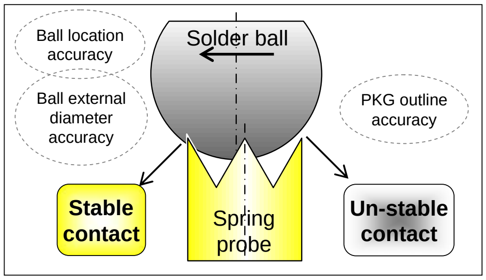

Fig 1 Contact condition: Spring probe (1)

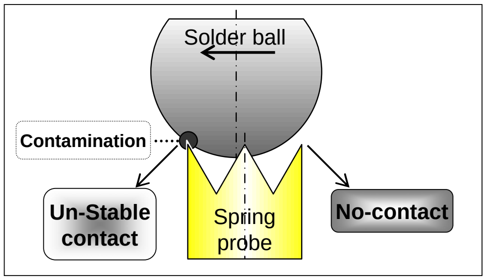

Fig 2 Contact condition: Spring probe (2)

2.Contact to BGA solder ball at multipoints

We envisioned, if the tips of the crown could move independently, it could self adjust according to the shape of the solder ball, which would result in an improved, more robust contact. With this concept MJC successfully manufactured a new structure of spring probe. Fig.3, the crown is made of two independent parts which can move along with shape and position of the solder ball. This allows the tips to adjust to misalignment and contour of the solder ball.

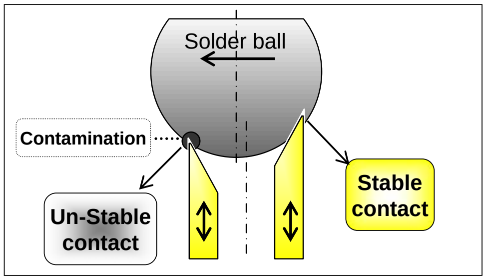

Fig 3 Contact condition: ideal contact

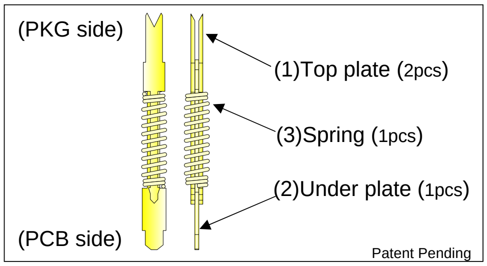

Fig 4 Structure of new probe

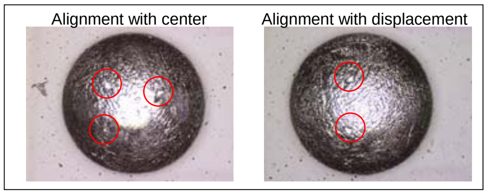

Photo 1 Contact marks (Spring probe)

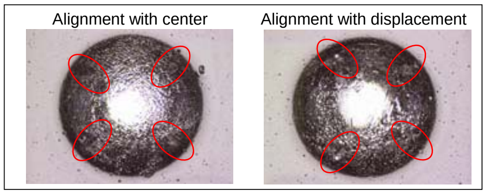

Photo 2 Contact marks (New contactor)

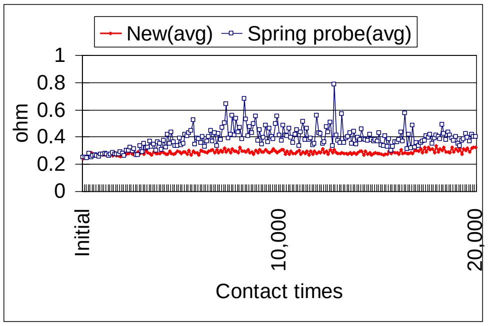

Fig 5 Contact resistance (Solder plate)

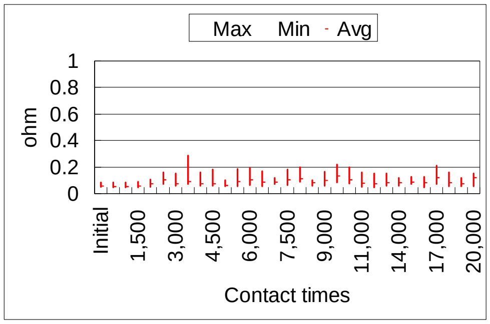

Fig 6 Contact resistance (BGA pkg)

3.Overview

Item	Note
Material (Plating)	BeCu (Ni-Au)
Pin height	5.8 mm (PCB set)
Pitch	0.8 mm (Min. 0.5mm)
S21	1.7GHz @ -1dB
S11	5.0GHz @ -20dB

4.Contact marks

We performed a contact experiment using an actual device to verify multipoint contact. Photo 1 shows the result with standard spring probe. Even though the alignment is centered, there are some cases that all 4 points of the crown will not make contact. Photo 2 shows the result with our new spring probe structure. We can see all 4 points made contact marks clearly even if the alignment is off.

5.Contact resistance

Fig.5 is a comparison of contact resistance between a standard spring probe and our new spring probe on a Sn plate. The data shows that multi-contact achieves low, stable contact resistance.

(1)Cres (Spring probe): Avg 0.39 ohm
(2)Cres (New contactor): Avg 0.28 ohm
* including wire/pattern line
**Contact force: 0.35N
***Impressed current: 0.2A

Fig. 6 shows contact resistance when our new spring probe is used for an actual BGA package (BGA 484 pin, P1.0). The data shows that the contact resistance is low and stable for an actual device solder ball.

(1)C/R (New contactor): Avg 0.083 ohm
*including wire/pattern line
**Contact force: 0.35N
***Impressed current: 0.1A

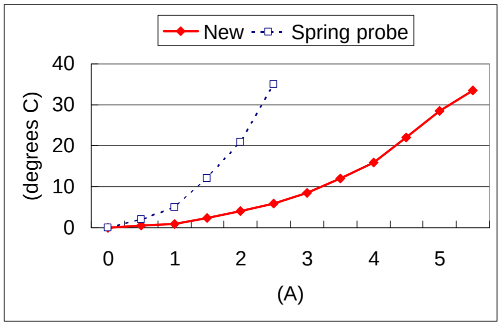

Fig 7 Pin temperature rise

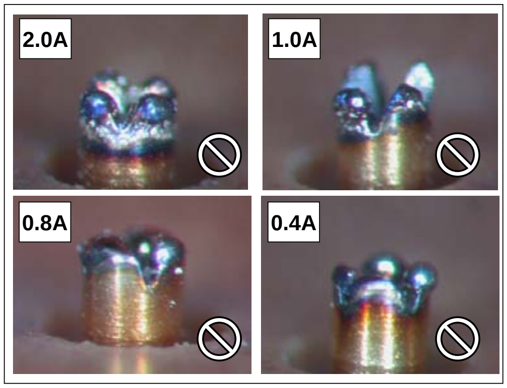

Photo 3 Hot switch (Spring probe)

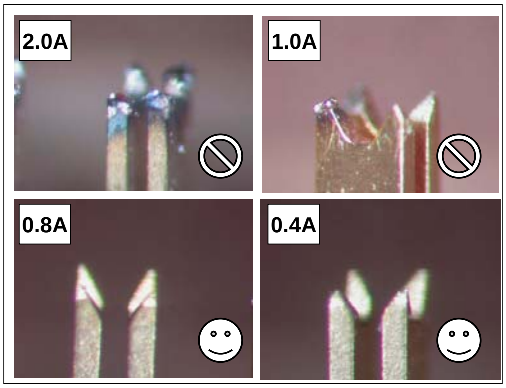

Photo 4 Hot switch (New contactor)

6.Pin temperature rise

Our new spring pin has a unique structure which enhances the contact area of the plunger's internal parts. The contact area of a standard spring probe is defined by the plunger and the inner surface of the outer tube, which makes a very small contact area. The contact area of our new spring probe is different. Because it is an assembly of 3 plates surrounded by a spring. The contact surface area is greatly increased which increases current carrying capacity as well.

Fig.7 is CCC data comparison between standard spring pin and our new spring probe.

7.Hot switch

We performed an evaluation at extreme conditions using constant current power supply. As the photos show, our new spring probe has higher durability than a standard spring probe.

(1)Spring probe (Photo 3)
2.0A: The pin melted
1.0A: The pin melted
0.8A: The pin melted
0.4A: The pin melted

(2)New contactor (Photo 4)
2.0A: The pin melted
1.0A: The pin melted
0.8A: The pin was unchanged
0.4A: The pin was unchanged

*Constant-current power supply: Kikusui

8.Conclusion

Through our BGA contactor development, we recognized that trying to improve the existing spring probe was not a good idea. The question; "What is essential for quality, robust, low resistance BGA contact?"-we focused on this point and we asked ourselves about this over and over. As a result of our study, we developed the idea of -a new structure of spring probe that achieves contact at multiple points simultaneously. We will continue developing test socket technology by always asking "What is the proper contact mechanism?"