BiTS Burn-in & Test Socket Workshop 2008

Poster Session 1

ARCHIVE 2008

"Complete Z_o=50 Ohm Coaxial Spring Probe IC Socket"

Tatsumi Watabe
S.E.R. Corporation

"High Frequency Wafer Level Test Approach With Coaxial Socket"

Takuto Yoshida, Craig Hudson, Takahiro Nagata, Atushi Sato, Satoshi Kakegawa
Yokowo Co., Ltd.

"Signal and Power Integrity Analysis of ATE Loadboard, Socket, and Package"

James Zhou, Hongjun Yao
Antares Advanced Test Technologies
Wei Wang
Sigrity, Inc.

"Fine Pitch Socket Solution"

Shunji Abe
Yamaichi Electronics

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ELECTRONICS PARTS SER CUSTOMIZED SOCKETS & CONNECTORS

Complete Zo=50 ohm Coaxial Spring Probe IC Socket

Tatsumi Watabe
S.E.R. Corporation : Managing Director

1. Overview

IC Test Socket for SHF best performance, SER has realized Complete 50 ohm Characteristic Impedance Coaxial Probe to use for FBGA and CSP Testing. Complete Zo Coaxial Probe, the concept is to do careful design for every portion detail on plungers, barrel, dielectric in coaxial to fit Zo=50 ohm and consider keeping totally stable GND design for PCB, IC and Socket GND. The **Complete Zo Coaxial Probe** has been confirmed **the frequency performance** exceeded **20GHz on S21** Transmission Performance. **The socket is available for** 1.0, 0.8 and **0.5mm pitch.**

The base socket is composed of 3 featured concept. (Photo.1)

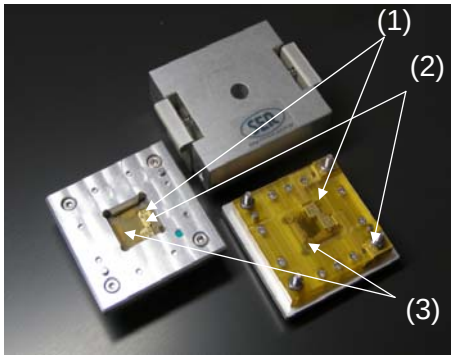

Photo. 1 Complete Zo=50 ohm Coaxial Spring probe IC Socket (0.5mm pitch)

(1) Complete Zo=50 ohm Coaxial Spring Probe Contacts.

(2) Socket GND organize block.

(3) Regular composed Spring Probe block.

Best performance was brought from a combination of combining (1) and (2). It was confirmed by S parameter loop measurement by specialized board and Network Analyzer using like Fig. 3. And total cost saving comes from composing of (3).

Poster #1

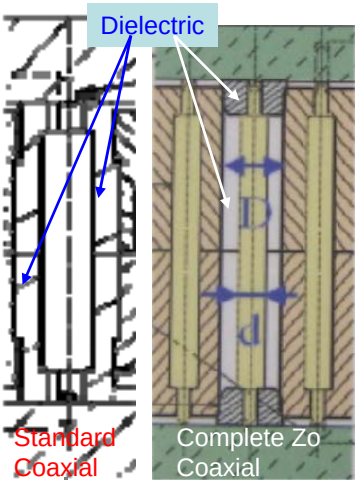

Fig. 1 Coaxial probe

2. Complete Zo Coaxial Probe (1).

Because Characteristic impedance is decided by the equation.

Zo=log(D/d) *138 / √ ε (Epsilon) (ohm)

All Coaxial probe portion from PCB side (bottom) to IC terminal side (top) is designed to fit in Zo=50 ohm by choosing and adjust Dielectric(Epsilon) and diameter of plunger and barrel.

This example : **Coaxial GND diameter** is 0.9mm for 1.0mm matrix pitch and **0.41mm for 0.5mm matrix pitch**.

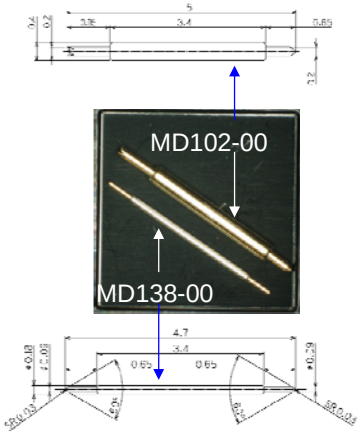

Fig 2. Coaxial core probe.

3. Core probe for coaxial probe(1).

1.0mm pitch (MD102-00) : diameters

Barrel 0.40mm Plunger 0.20mm,

0.5mm pitch (MD138-00) : diameters

Barrel 0.18mm, **Plunger 0.09mm**

are used (Fig.2). And deferent dielectric are used for plunger portion and barrel portion individually.

4. Coaxial GND is equate PCB GND(2).

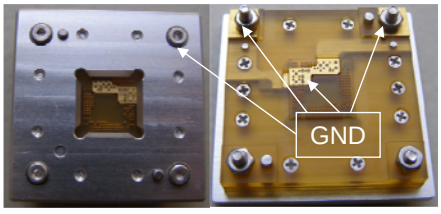

Photo 2. Socket GND organize

It is distinguished high frequency GND (analog GND on this IC socket) to other GND. **Metal base is used for the Coaxial GND partially as Socket GND organized to PCB GND .** Then IC GND was equalized to PCB GND by this composing.

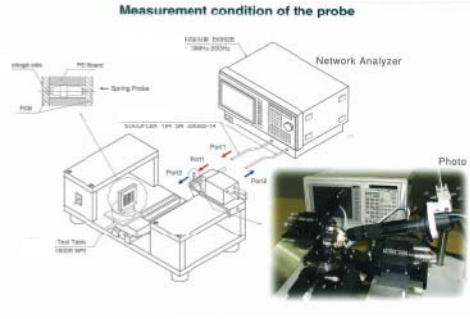

Fig 3. Measurement condition

5. Measurement Condition.

High frequency signal source through a Pico Probe touching to the specialized board (characterized to Zo=50 ohm) holding Probe or Coaxial Probe be assembled as same condition of IC base socket. And the signal return to Network Analyzer by **loop test condition. (Fig 3**.)

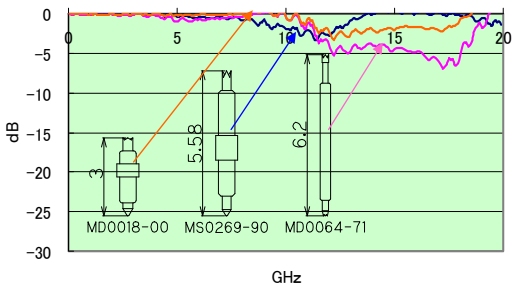

Fig 4. Probe performance restriction

6. Probe S21 performance.

A probe is designed with flung or resistive belting on its surface has a transmission performance 5 through 7 GHz only (Fig 4.). It is not restricted by probe length like Fig 4. For achieving max. frequency performance, a core probe for coaxial must be more efficient design for SHF performance.

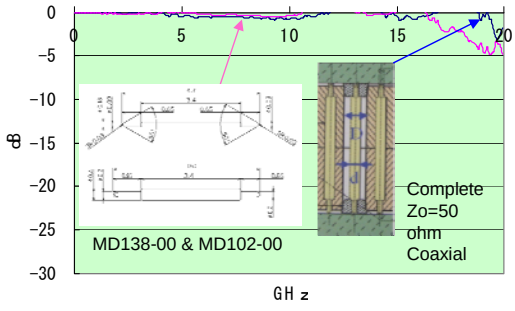

Fig 5. Complete Coaxial Probe Performance

7. Complete Zo=50 ohm Coaxial probe performance.

20 GHz transmission performance was measured. A conditioning of complete Zo coaxial technique with, Socket GND equate technique brought this achievement for both of 1.0 mm and 0.5 mm coaxial probe socket by using MD102-00 and MD138-00 core probe. (Fig 5.)

Best design concept for IC Socket's Probe and GND location is required to be best fitting to IC contact terminal matrix. I think It will be needed more cooperated relationship enhancement between 'socket makers' and user 'IC users' together.

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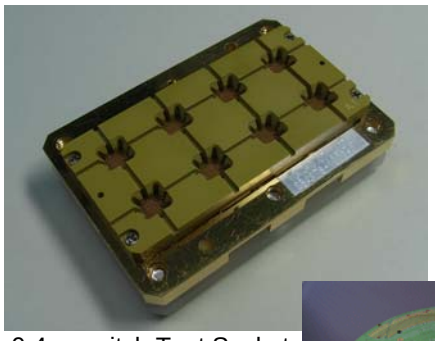
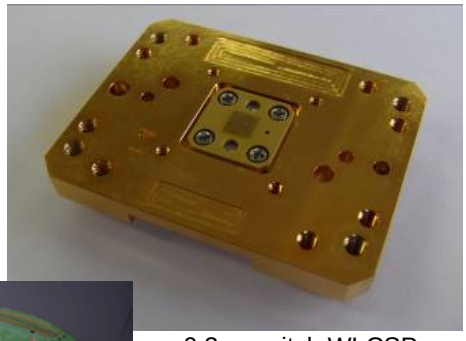
High Frequency Wafer Level Test Approach with Coaxial Socket

By: Takuto Yoshida[1)], Craig Hudson[2)], Takahiro Nagata[3)], Atsushi Sato[3)], Satoshi Kakegawa[3)]
[1)]: Yokowo CTC Business Division, [2)]: Yokowo America, [3)]: Yokowo CTC Technical Division

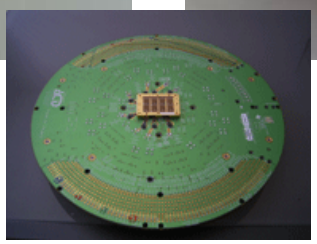
Prober equipment enables coaxial BGA test socket to become a probe card for 0.3mm, 0.4mm & 0.5mm pitch WLCSP devices…flexibility and yield improvement at minimum cost.



0.4mm pitch Test Socket with Alignment Plate



0.3mm pitch WLCSP Test Socket



0.4mm pitch WLCSP Test Socket on DUT Board

- **Multisite throughput** on prober or pick-and-place handler
- **Same socket** for bench, handler and or prober
- >250 microns of **mechanical compliance**
- Outstanding Signal Integrity (**6 GHz** for 0.3mm pitch)
- High **spring force** for Pb Free solder or pad

Poster #2

Same Socket Crossover Flexibility

Characterization (Hand Test)

Characterization of diced WLCSP devices is accomplished on bench using traditional test socket set-up comprised of socket body, fixed or floating alignment plate, and lid. (0.3mm to 0.5mm pitch)

Socket with Alignment Plate

Hand Socket Lid

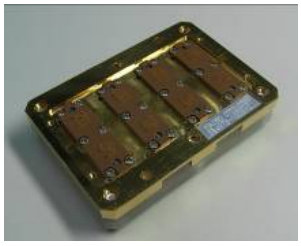
Pick & Place Handler Test

Limited volume production testing of WLCSP products can be implemented using a Pick & Place handler can be used for small preproduction runs. (0.3mm to 0.5mm pitch)

Socket with Alignment Plate

Prober Test

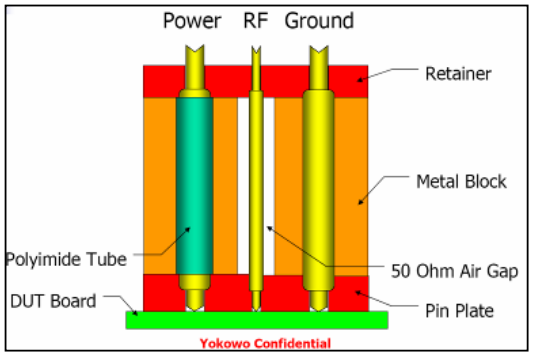
Mass volume production testing of WLCSP products can be implemented using a prober. Multi-site testing is possible, such as 4, 8 and 16 site configurations. (0.3mm to 0.5mm pitch)



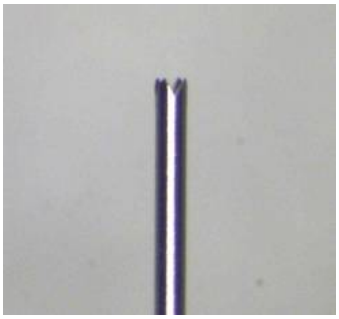
Socket without Alignment Plate

Poster #2

Coaxial Socket Structure

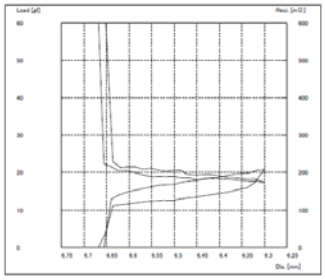


Coaxial Socket Structure

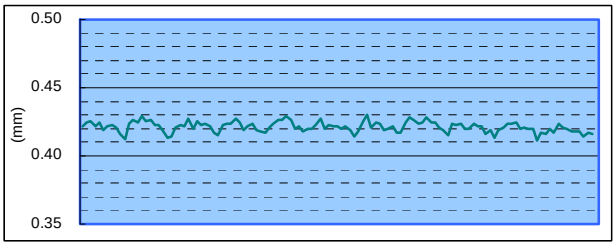


Crown Tip Shape of 0.3mm Pitch Probe

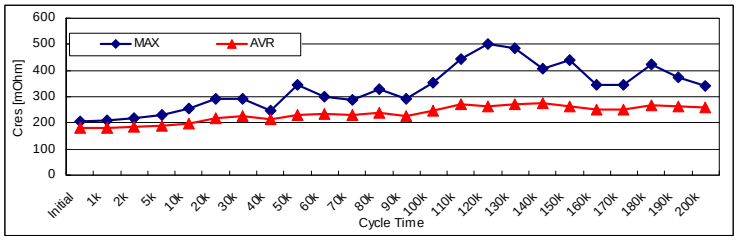
Probe Mechanical Performances



Rc-s/P-s

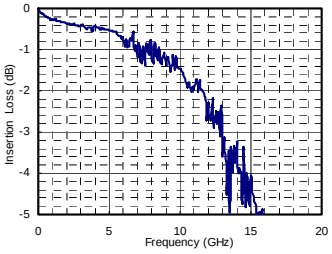


Probe Tip Planarity

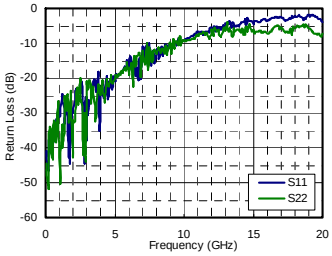


Probe Cres Life Cycle

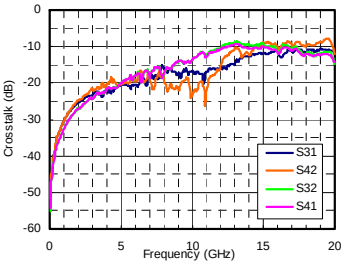
0.3mm pitch RF Performances



Insertion Loss



Return Loss



Crosstalk

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Poster #2

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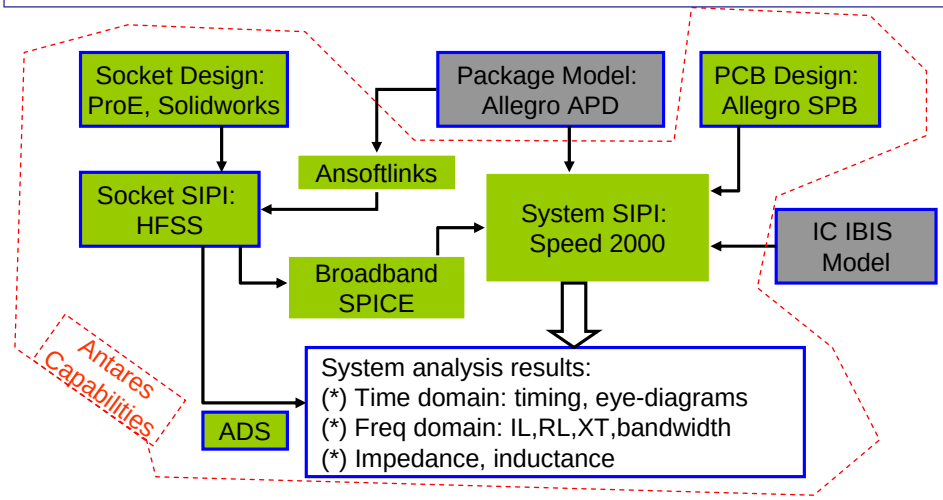
Signal and Power Integrity Analysis of ATE Loadboard, Socket and Package

James Zhou[1], Hongjun Yao[1], Wei Wang[2]
[1]Antares Advanced Test Technologies, [2]Sigrity Inc.

Antares SIPI Flow and Tools



Signal Integrity Power Integrity (SIPI) Tools

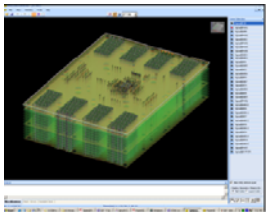
Planer EM: Speed2000: Analyze very large problems of entire package and loadboard; Include RLC circuits (i.e. bypass caps) in hybrid engine with FDTD planar EM

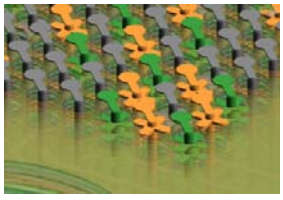
3D EM: **HFSS/CST**:captures full-wave electromagnetic interactions in the structure and its surrounding environments, valid up to very high frequencies of multi- 10s of GHz

Suitable for general 3D structures which cannot be analyzed by planar EM tools: such as sockets, contactor arrays, via arrays of boards and other interconnects

•Circuit: ADS, Broadband SPICE (Sigrity): RLC(or broadband) model extraction by optimization

•CAD converters: Ansoftlinks, Sigrity PCB converters, ADS layout extractor for Allegro





Poster #3

Test Boards and Interposers

•Interfaces between embedded interposers and test sockets are highly discontinuous even when blind vias are used

•Analyzing these structures at mechanical boundaries of socket and board is not the best choice for 3D analysis; in many cases mechanical boundary locations are among the worst choices for ports

•By incorporating the entire structure in one integrated model, the discontinuities between sockets and boards are truly represented in the model and, their fullwave electromagnetic effects are accurately simulated

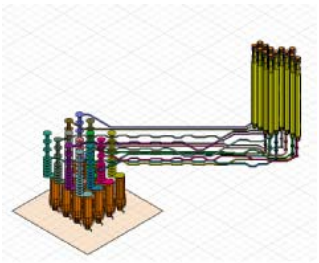
•Fullwave EM analysis is the best way to fully characterize these highly complex 3D structures at high frequencies

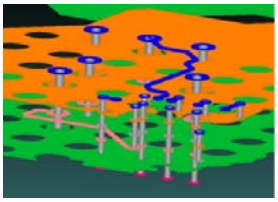
•What-if analysis of socket/interposer structure provide engineering guidelines at early stage to avoid costly mistakes

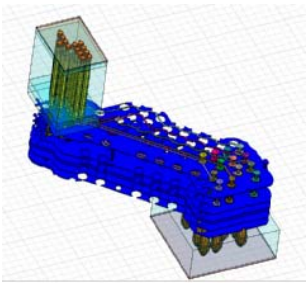
•Quantitative data enables objective PCB layout strategy decisions and identify potential PCB layout issues

•Enable data-driven decision making for project managers

•Simulated data can be generated at much lower cost within short time frame comparing to lab measurement







Sockets and Contactors

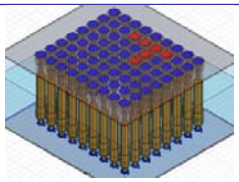
•3D EM fullwave analysis using HFSS or CST

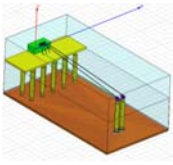
•Simulate LGA, BGA, PGA, QFN and all types of socket contactors with accuracy and speed

•Fullwave analysis takes into account electromagnetic interactions in the structure and its surrounding environments

•Unlike quasi-static methods which are inherently inaccurate at high frequencies, fullwave analysis maintains its accuracy at all frequencies for general 3D structures, valid up to very high frequencies of 10s of GHz

•Absorbing boundary conditions simulate wave propagation along horizontal directions where socket structure extends

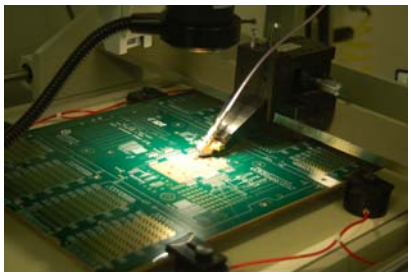


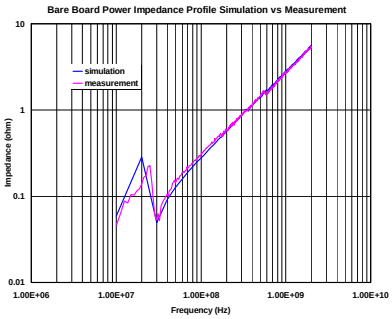


Poster #3

Power Integrity : Simulation

- Sigrity Speed2000 FDTD (Finite Difference Time Domain)
- Import entire loadboard model into Speed2000
- Simulated with and without caps
- Gaussian pulse excitation
- Selected one pair of VDD/VSS for comparison with measurement
- Results converted from time domain waveforms to frequency domain impedance



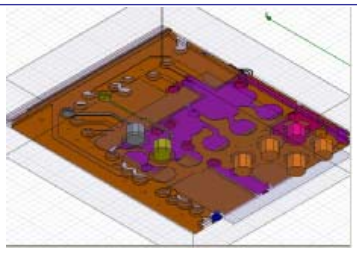


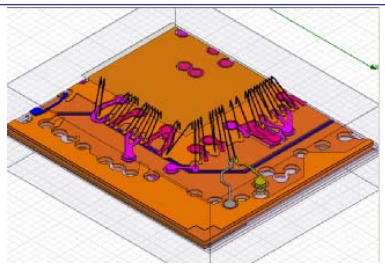
Power Integrity : Measurement

- Agilent PNA 8363E 40GHz Vector Network Analyzer
- Cascade ACP40 probes
- Measured both short and open VDD-VSS at power connector
- Power integrity can only be analyzed using the entire structure of interest; a divide-and-conquer approach cannot work for power analysis
- Resonant modes exist in power/ground planes and propagate to the entire board in all directions
- Resonant modes starts at as low as 10MHz

Package SI Analysis

- Package substrates usually made of 4~8 layers of organic material
- Comparing to PCB structures, package substrates contains bond wires and solder balls
- Sigrity Speed2000 can directly import package layout models
- Power impedance analysis including lumped element models





Poster #3

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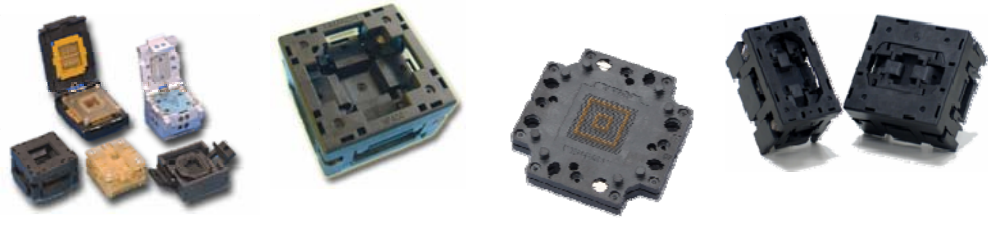
Author:
Shunji Abe

Fine Pitch Socket Solution

The evolution of IC manufacturing technology has led to a decrease in package sizes. This necessitated a simultaneous decrease in the distance of the individual contact pads (pitch), decreasing from a moderate 0.5mm to the current CSP 0.4mm, and below 0.2mm in the near future.

The current solutions are the use of spring probes and other basic technology. However, it is very difficult to control contact force, cost effectiveness, and manufacturability.

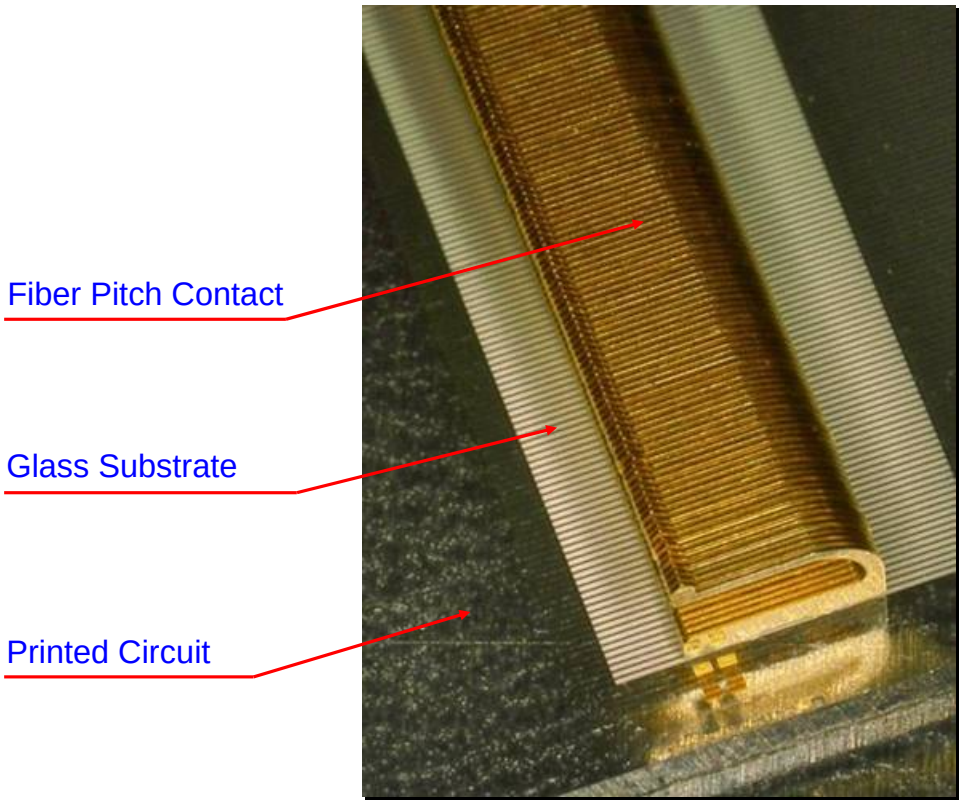
“Fiber Pitch” solution for Test and Burn-In sockets to utilize current stamping and etched contacts to achieve cost effectiveness and manufacturability.



Poster #4

High Accuracy Contact Module Spec

-Contact Shape: Buckling Beam
-Applicable Pitches: 80-100um (50um minimum)
-Contact Positional Tolerance X,Y: <+/-10um Target
(Component Tolerance +/-5um, Mounting Tolerance +/-5um)
-Other Features;
Wide Freedom on PWB Lay Out
Module (Block) Form Mounting
Low Cost Contact Pin Used
Optimum Wiping Distance Achievable



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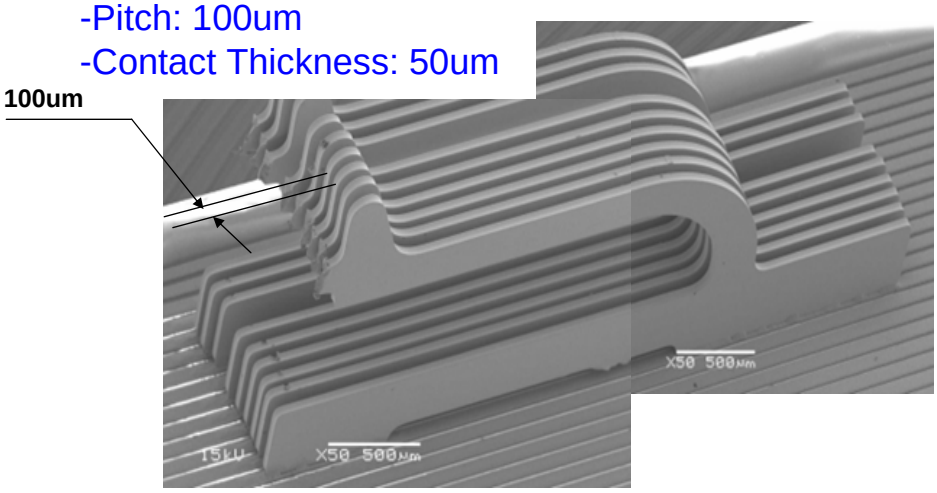
Poster #4

High Accuracy Contact Module Model

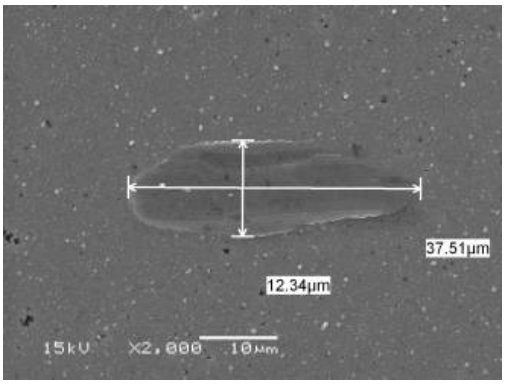
Actual Product (Example)

-Contact Manufacturing Method: Etching
-Base Material: BeCu
-Plating: Ni-Au
-Pitch: 100um
-Contact Thickness: 50um



Actual Contact Mark (Example)

-Contact Pin Displacement: 100um
-Material: Si Wafer + Al Pad
-Al Pad Thickness: 0.8-1.0um
-Contact Force: 0.05N (5gf)



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Poster #4