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SOCKETS: A COMPREHENSIVE, COMPREHENSIBLE GUIDE TO CONTACT TECHNOLOGY

by

Jon Diller

Director of International Sales
Interconnect Devices, Inc.

ABSTRACT

Join exciting & knowledgeable instructor, Jon Diller, of Interconnect Devices, Inc. as he helps you establish productive approaches to daily challenges with the socket interface.

This TechTalk provides a thorough survey of socket technology that benefits attendees whether their involvement with sockets is primarily commercial or technical.

Sockets are a niche within semiconductor test, yet they present veterans, outsiders and newcomers with a daunting array of jargon and assumptions. Challenged not only by the terms used to describe sockets and their functions (which any glossary might address), but they are confronted with a mythology about how sockets work and fail, which is often incomplete, inaccurate, or misleading.

The TechTalk begins with a fundamental taxonomy of sockets, separating them first by application among burn-in, characterization, and automated functional test. Next, contact technologies are surveyed and contrasted. All types of contacts are considered and compared, maintaining a context of application throughout the discussion. This TechTalk considers not only general classes of contacts (such as spring contact probes, rocking contacts, etc.) but also specific design types within those classes (e.g. three-piece spring contact probe designs versus conventional four-piece designs).

With the building blocks defined, performance parameters are then examined. The effect of contact geometry, materials, and cleaning methods is summarized, and the general industry consensus, with respect to best known practices is reviewed. The final section covers socket cost of ownership, samples of data gathered over years of process development, characterization and verification.

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Sockets

A Comprehensive, Comprehensible Guide to Contact Technology

2011 Burn-in and Test Socket Workshop
March 6, 2011



Jon Diller
Interconnect Devices, Inc.



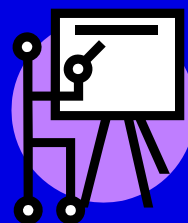
Tutorial Summary

- Introduction
- Definitions
- Applications
- Challenges



Why: Tutorial Goals

- What can I tell you?
- What do you want to know?
- Why are sockets important to you and your company?



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3

Definitions

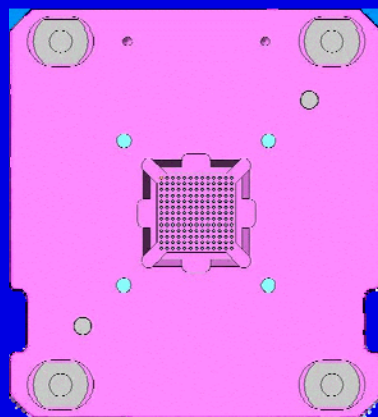
- A socket is a device which permits temporary electrical connection to a semiconductor
- A socket is part of a system
- The best sockets are electrically transparent
- The socket must solve positional uncertainty

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Positional Uncertainty

- Z-axis: compliance
- X and Y axes: alignment



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Four Elements

- Interposer: contact mechanisms
- Pocket: alignment mechanisms
- Lids: compression mechanisms
- Tester side: interface mechanisms

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The Interposer

- An array of compliant interconnects
- Axes:
 - Contact life
 - DC behavior
 - AC behavior
 - Compliance
 - Cost



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7

Interposer Constraints

- Axes:
 - Pitch
 - Contact life
 - DC behavior
 - AC behavior
 - Compliance
 - Cost

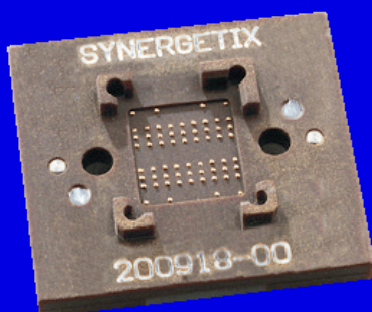


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Alignment Mechanisms

- X- and y- axis boundaries
- Fiducial elements for vision systems



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Compression Mechanisms

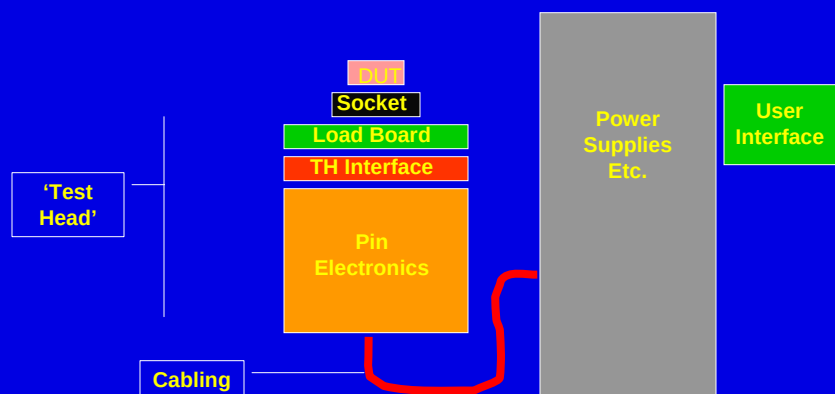
- 'Lids' – hinged, open-top, compression plates
- Can add thermal functions



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10

Interfacing: the Tester Stack



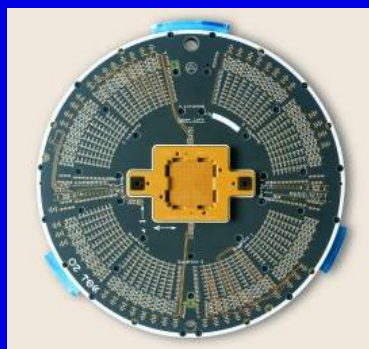
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Interface to Tester

- PCB
 - Solder
 - Compression
 - Receptacle



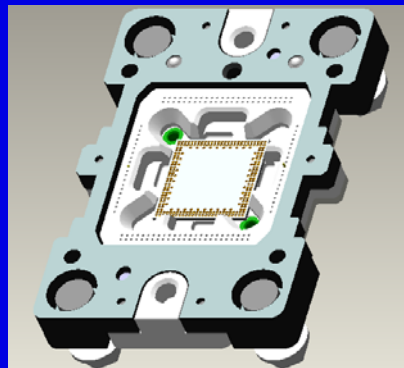
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12

Socket Types by Application

- Test
 - Characterization
 - Burn-in
 - Functional / System Level
- Other (out of scope)
 - Product Sockets
 - Fusing
 - Programming



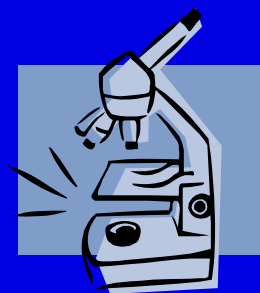
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Types of Test, Types of Sockets

- Characterization:
 - Singular
 - SI demanding
 - Self-contained
 - Low throughput



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14

Characterization Sockets

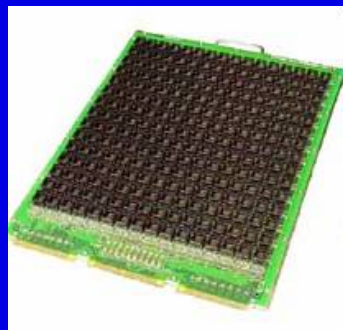
- High performance interconnects
- Varying mounting methods
- Self-contained compression (sometimes thermal)
- Often custom



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Types of Test, Types of Sockets

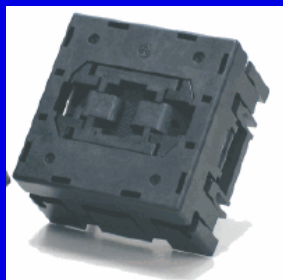
- Burn-in
 - Massively parallel
 - Thermal and current demands
 - DC only
 - Low throughput



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Burn-in Sockets

- Hard mounted
- Lidded (open or hinged)
- Standardized or tooled
- Iteratively inexpensive
- Less durable



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17

Types of Test, Types of Sockets

- Functional Test
 - AKA 'Sort' or 'Final' or 'Production' test
 - Automated – high throughput
 - Moderately to significantly parallel
 - 'At speed' – interconnect must be solder-like



Photo courtesy of
Multitest GmbH

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18

Functional Test Sockets

- Durable
- Made to suit equipment, device – customized
- Cost of use significant
- Often share roles

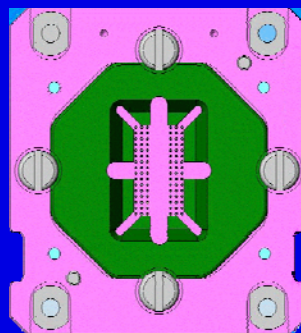


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Detail: Alignment Techniques

- Edge alignment (fixed feature)
- Edge alignment (replaceable, compliant features)
- Lead alignment
- Handler alignment
- Vision

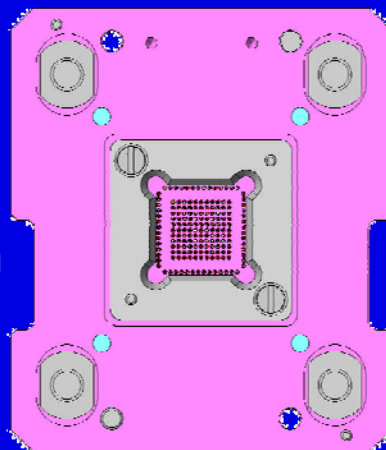


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Alignment Considerations

- Wear
- Sticking
- Tolerance stacks
- Hygroscopic growth
- Contact patch

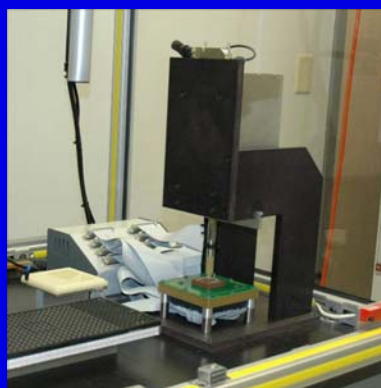


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Detail: Compression Techniques

- Compression plate
- Hinged lid
(compliant plunger)
- Open-top lid
- Test handler

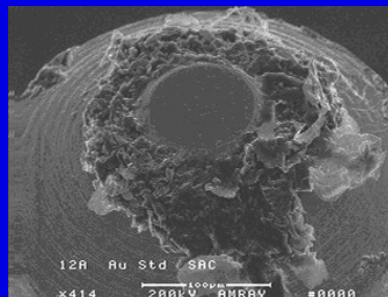


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22

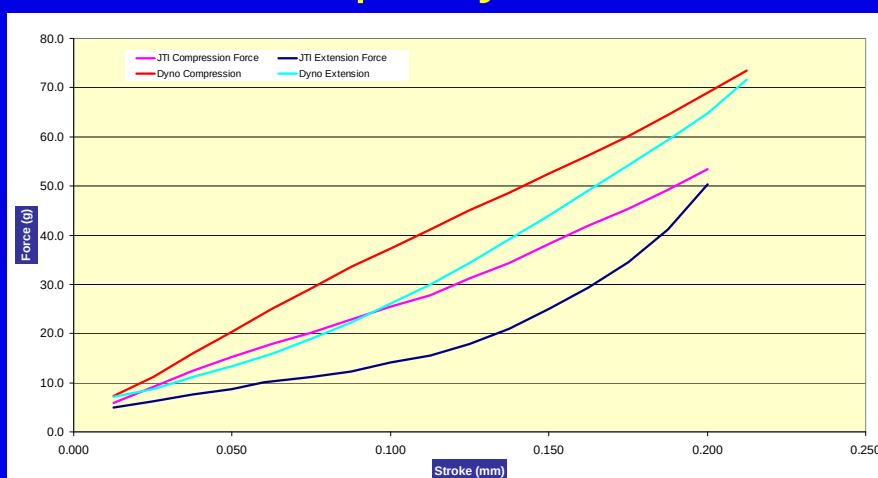
Compression Considerations

- Hard stop
- Contact damage
 - Force
 - Energy
- Contact compliance
- Required contact force
- Thermal requirements



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Concept: Hysteresis



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Detail: Interconnect Types

- Cantilever contact
- Spring contact probe
- Conductive elastomer
- Rocking contact
- Microcompliant interconnect
- Torsional contact

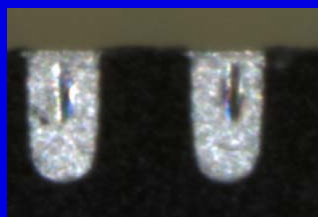
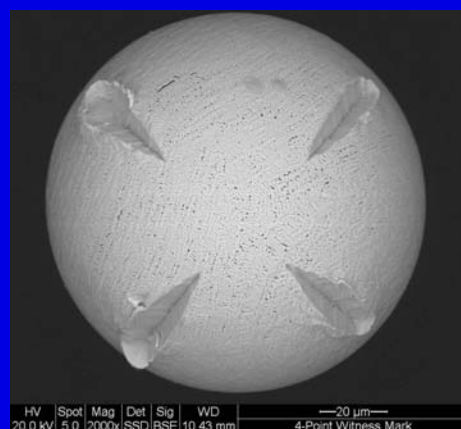


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25

Concept: Microcontact



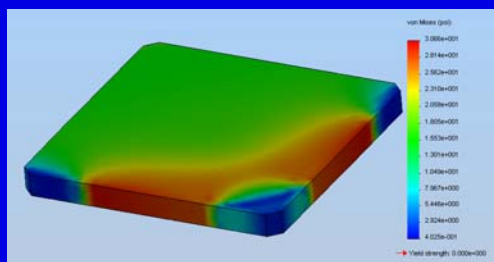
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Challenges: Contactor Force

- Preload
- Interposer warp
- DUT damage
 - Leads
 - Die crack



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Cantilever Contacts

- Compliance by bending
- Metal fatigue
- Force curve
- Contact wear
- Contact length



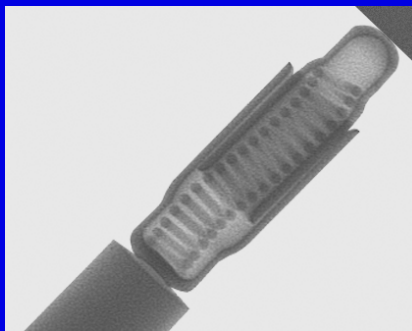
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Spring Contact Probes

- Direct geometry translation
- Durable
- Pitch limited
- High SI
- Maintainable
- No wipe



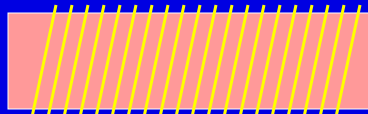
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Elastomer

- Very high SI
- No wipe
- Low CTL
- Environmental limitations



BallWire™ photos courtesy of
Dr. Weiss at Paricon

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Rocking Contact

- Good wipe
- Elastomer fatigue
- Short, high SI
- Maintainable

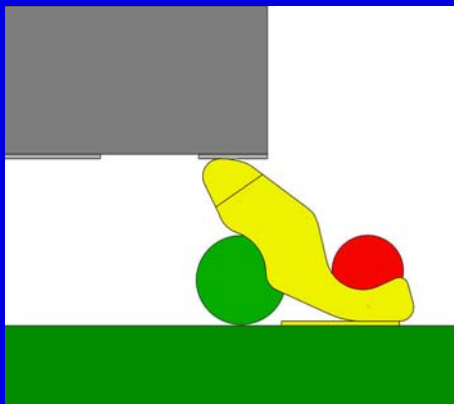


Illustration courtesy Johnstech International Corporation

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Microcompliance

- Best SI
- Rapid contamination
- No maintainability



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32

Torsional Interconnects

- Excellent SI
- Stable CRES
- Limited compliance
- Some wipe

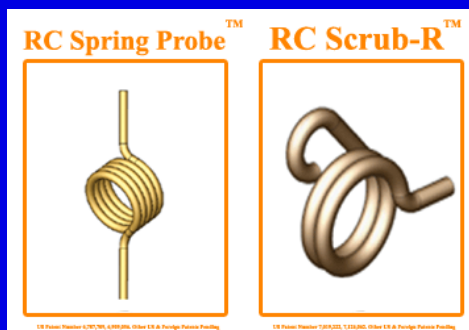


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Challenges: Plastic

- Hygroscopic growth
- Pocket wear and detritus
- Stiffness
- Precision
- ESD



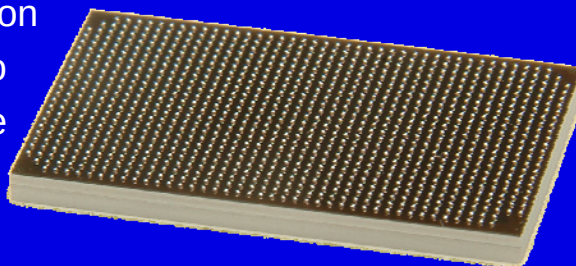
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Challenges: Pitch

- Contact barriers
 - Cross-section
 - Aspect ratio
 - Compliance
- Alignment
- Geometry transformation



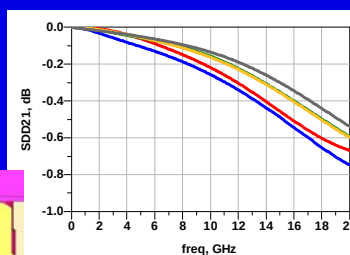
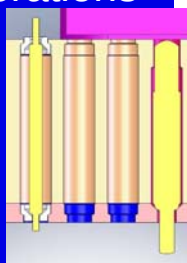
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Challenges: SI

- The high cost of CTL
- Differential issues
- Power considerations
- Defining requirements



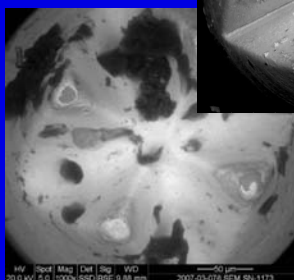
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Challenges: Durability

- R1 versus R2
- Contamination
 - Organic
 - Inorganic
 - Adhesion
- Failure to penetrate
- Wiping alternatives

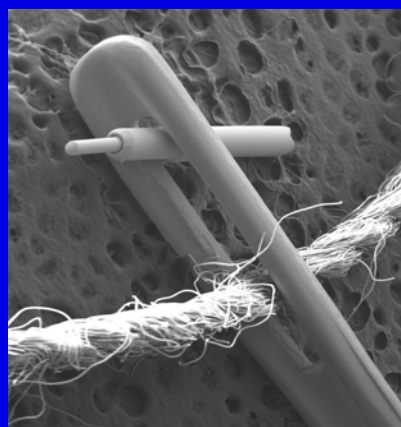


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Challenges: Compliance

- Limitations on contact design
 - Aspect ratios
 - Lateral displacement
- SI sometimes wins the battle
- Production disconnect
- Parallelism

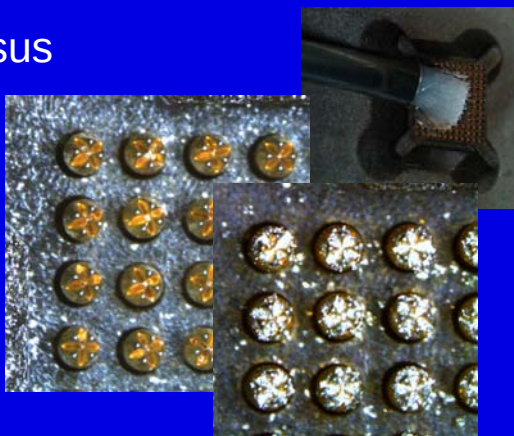


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Challenges: Maintenance

- Off-line versus in-line
- Plating integrity
- Solvents
- Immersion



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Challenges: Cost

- Economies of scale
- Cost of uniqueness
- Hidden costs
- Cost of ownership calculations

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40