Burn-in & Test Socket Workshop 2000

Session 2

Socket Design

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SOCKET WORKSHOP

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Presentations

“Package Tolerance Of VFQON: Effect On Socket Design”

David Pfaff, Plastronics
Marc Abelanet, Plastronics

“Aspect Of Socket Designs And Its Trends”

Lin Pong Goh
Intel

“Interconnect Solutions For ATE”

Mehdi Attaran, Oztek
Iraj Barbai, Oztek

Package Tolerance of VFQON: Effect on Socket Design

2000 Burn-in and Test Sockets Workshop

February 27-29th, 2000

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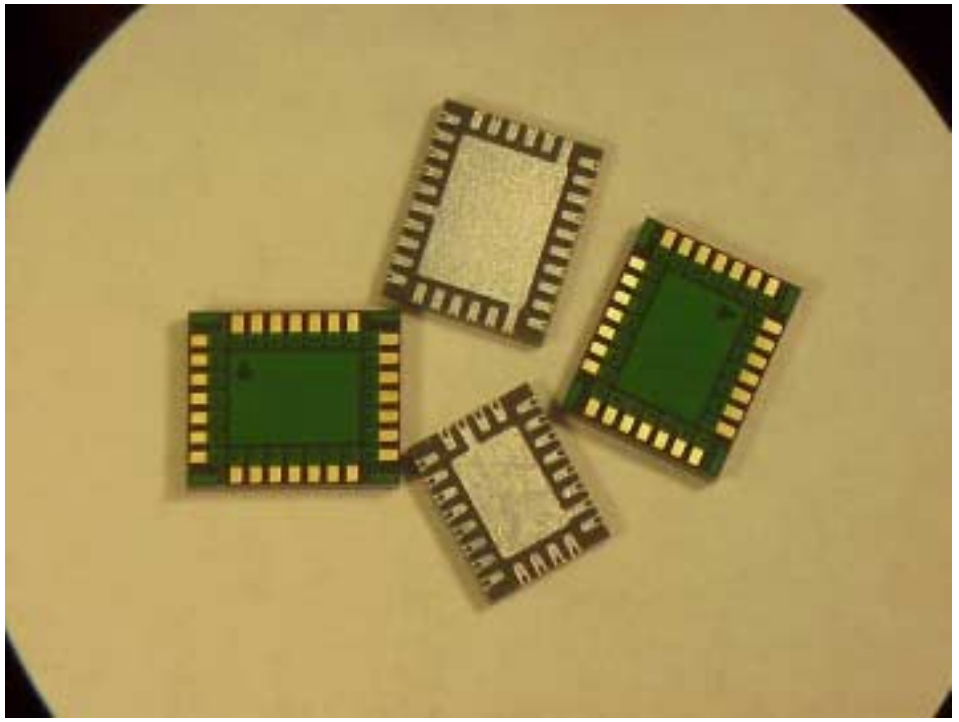
Agenda

- **New Package Family**
  - **JEDEC Proposal**
  - **Packaging Industry Versions**
- **Tolerance Study of JEDEC Proposal**
- **Effect on Socket Design - Optimal Design?**
- **Conclusion**

New JEDEC Family

- **Plastic thin fine pitch quad flat no lead package or VFQON**
- **Industry needs for package**
  - **Light weight**
  - **Small outline**
  - **Excellent electrical characteristics**
- **Similar to cross between LCC and LGA packages**



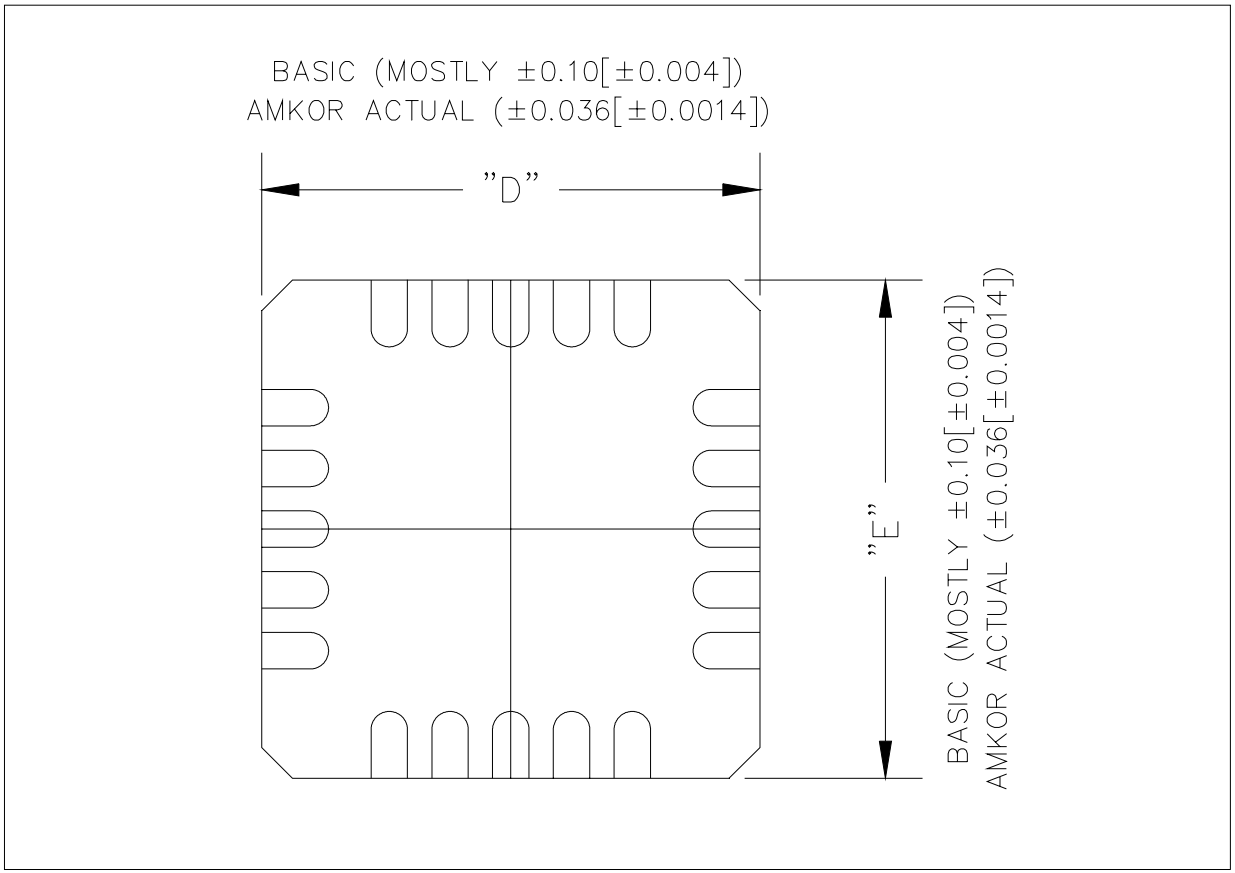
Packaging Industry Versions

- **Amkor - MLF**
- **ASAT - LPCC**
- **JEDEC MO-208 (example: Fujitsu - BCC+)**
- **JEDEC MO-209 (example: Samsung - SON)**
- **All Similar Types of Packages**
  - **Flat pad leads on peripheral of device**
  - **Leads on bottom side of package only (minimal on side)**
  - **Registration to the socket only on outside of package**
  - **Wide variety of sizes and pitches**
    - **Sizes from 3 to 10 mm**
    - **Pitches of 1, .8, .65, and .5mm**

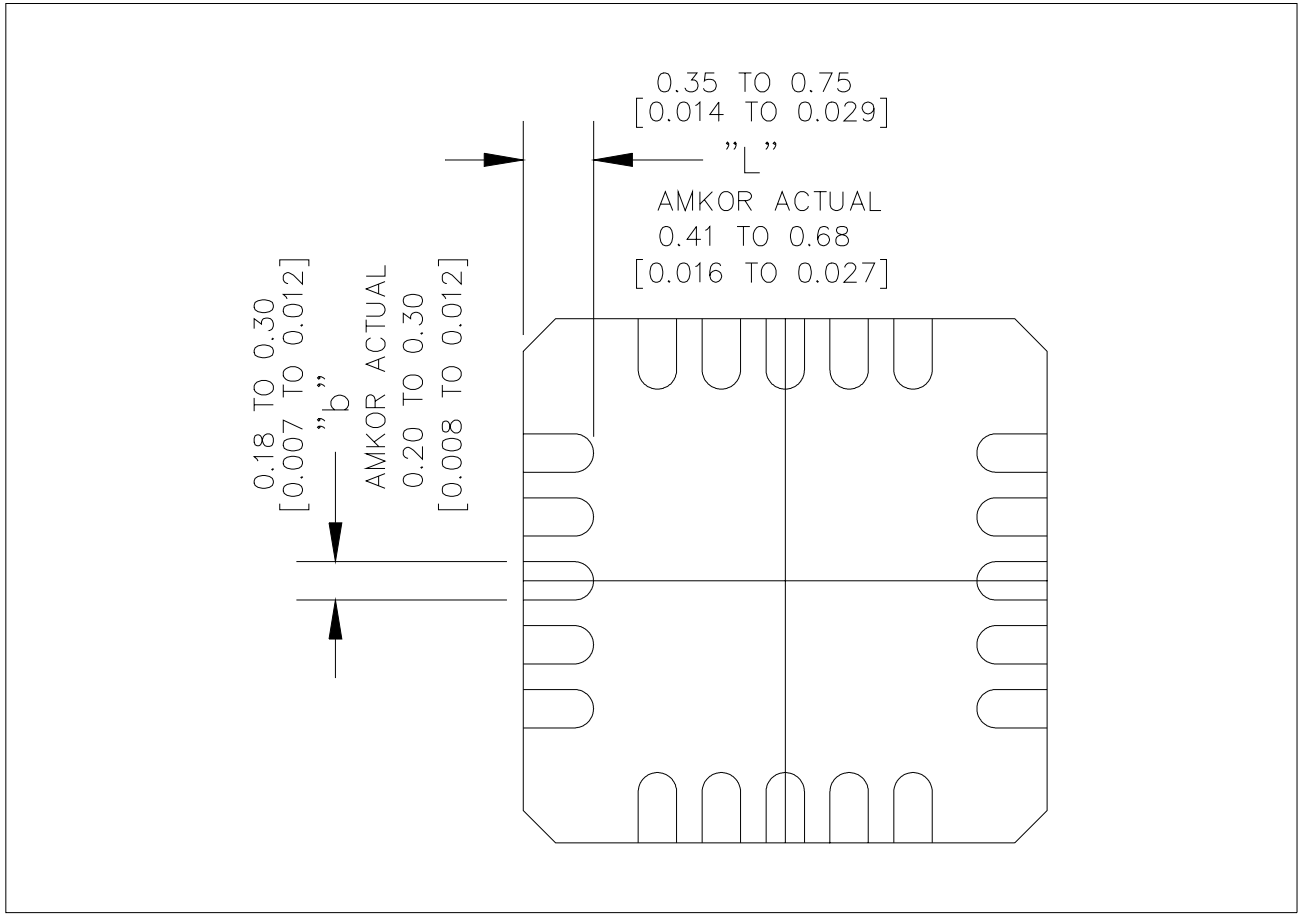
JEDEC VFQON Package Tolerances

- **Analysis of Outside Dimensions**
- **Analysis of Pad Dimensions**
- **Locational Tolerances of Pads vs. Body**
- **Finalized Tolerance Study with all Factors**
  - **Per JEDEC**
  - **Per Amkor MLF**

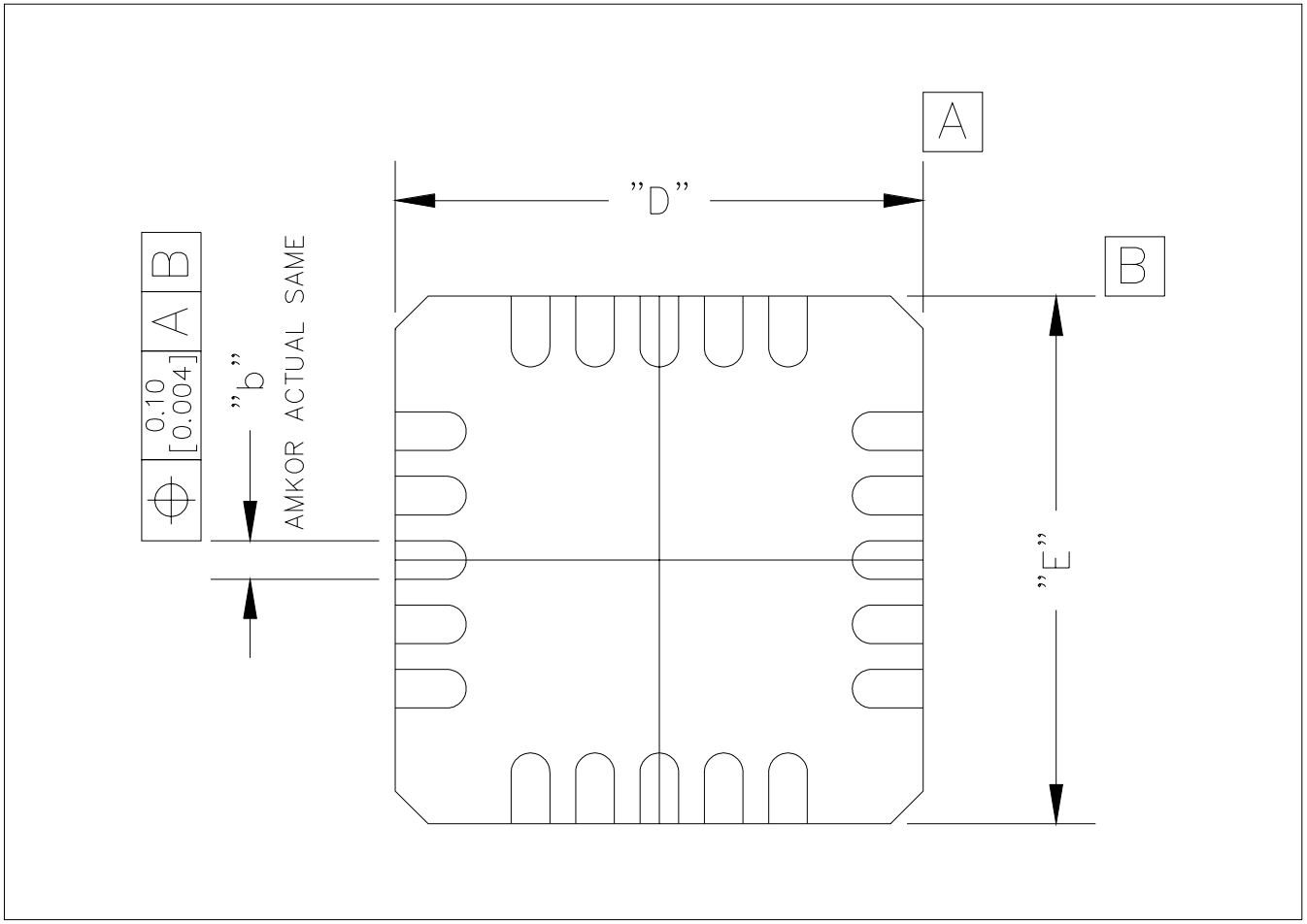
Outside Dimensional Tolerances



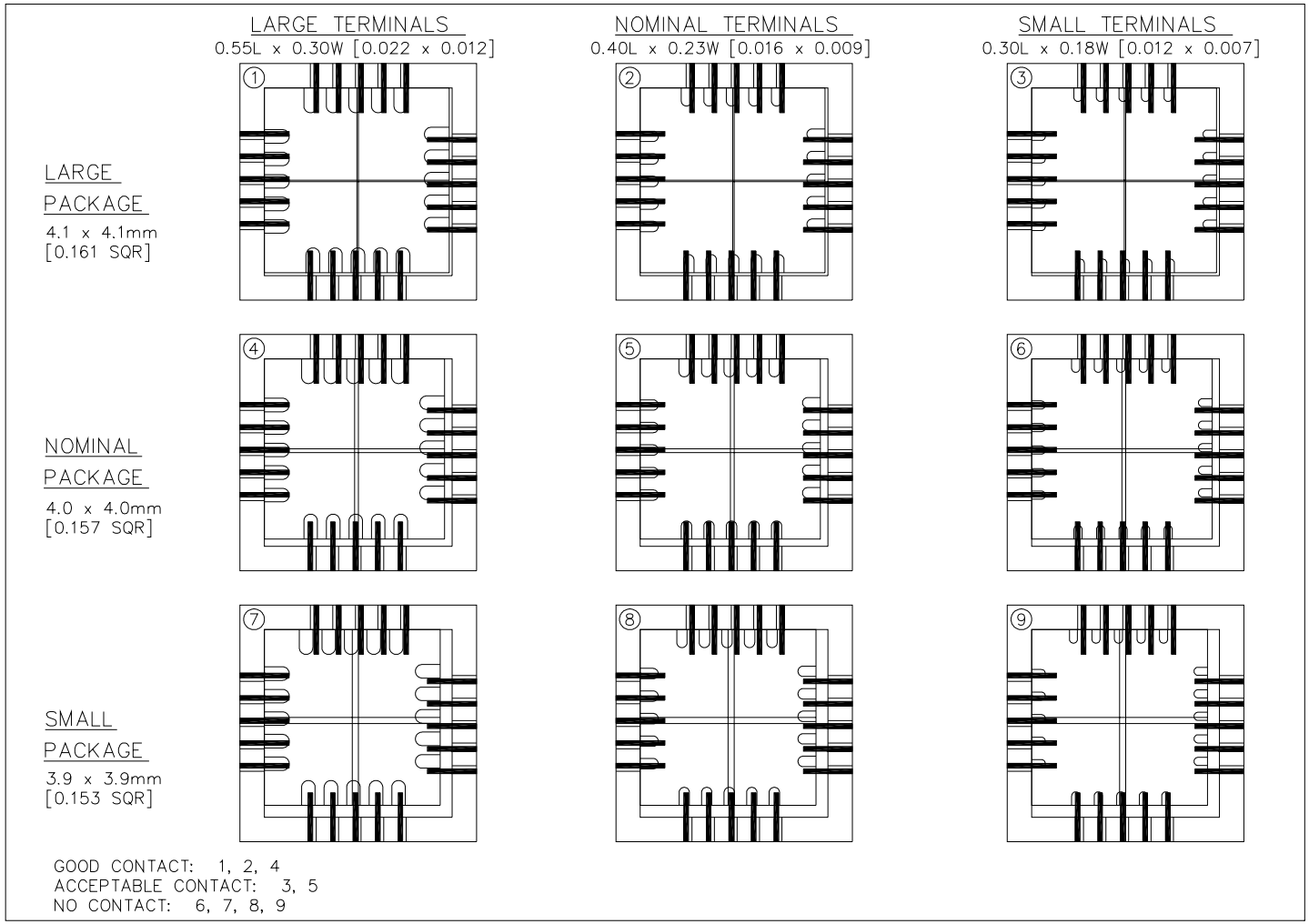
Pad Dimensional Tolerance



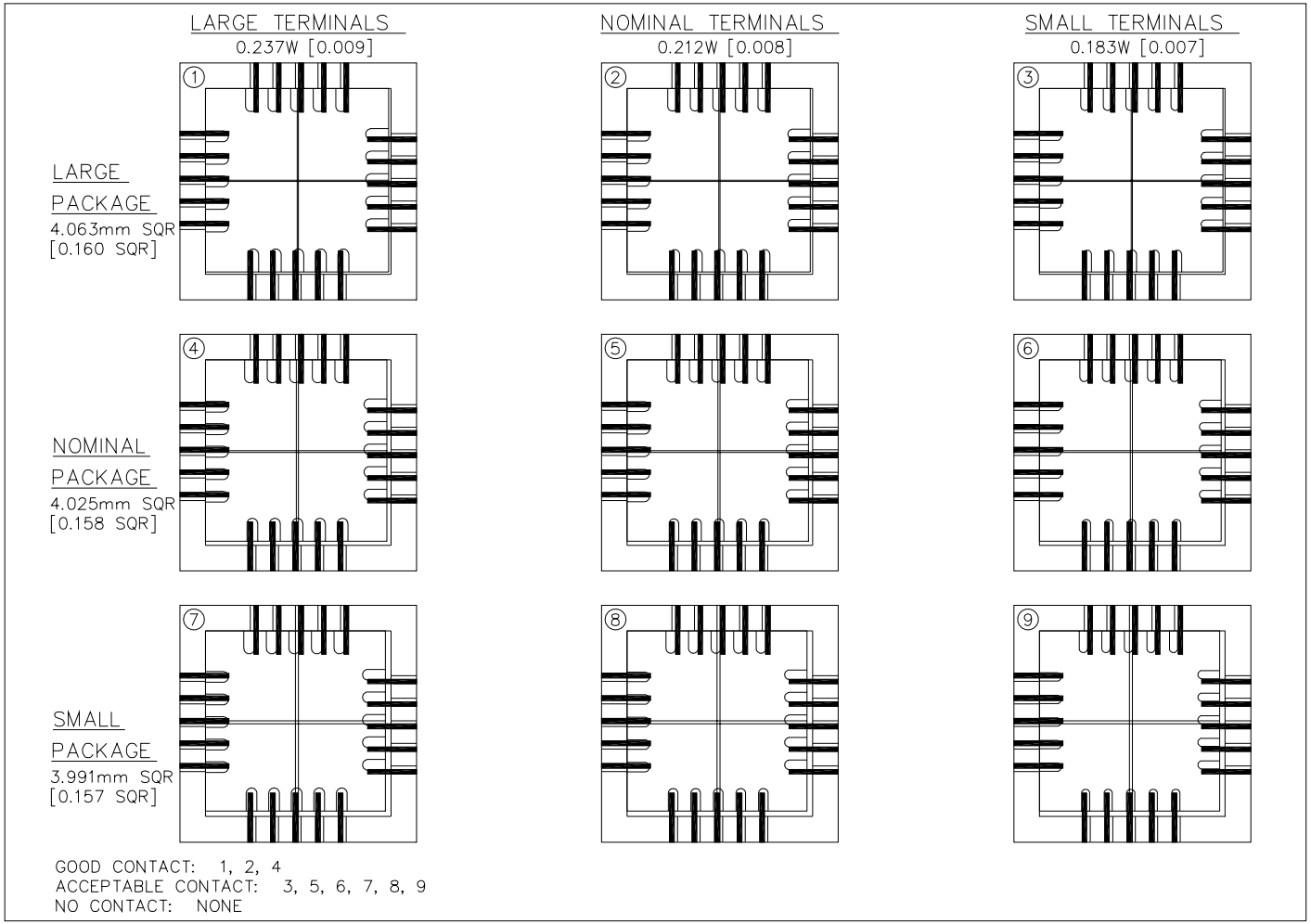
Locational Tolerances of Pads



Full Tolerance Analysis Per JEDEC



Full Tolerance Analysis Per Amkor

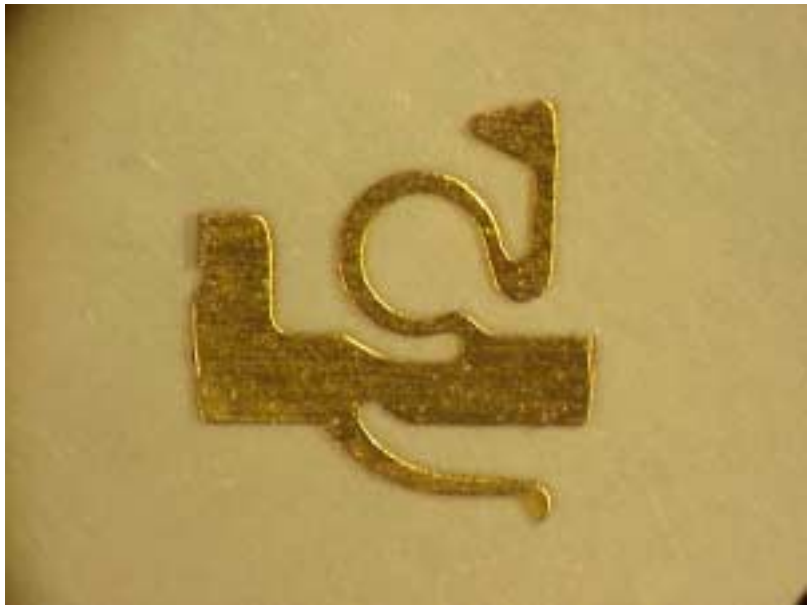


Socketing Issues Topics

- Electrical Considerations of Contact Element
- Size of Contact
  - Ability to Mold Components
  - Ability to Assembly Socket
- Inexpensive Method of Providing Sockets for Different Variations of VFQON
- Ability (Difficulty) to Meet Tolerances of Package

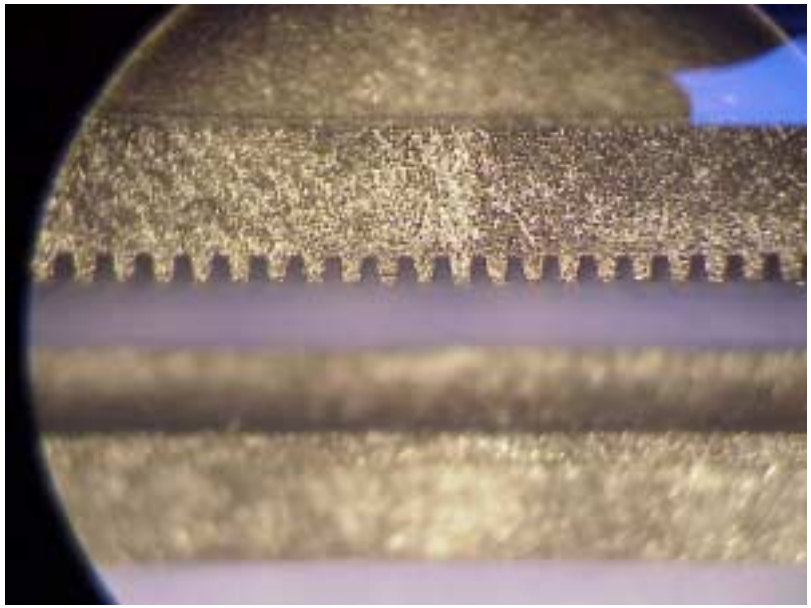
Electrical Characteristics

- Package is built for high frequency, telecommunications devices
- Contact for burn-in use, but good electrical specs.
- Inductance ~3nH
- Resistance <30 mOhms
- Surface Compression Mount or Through-Hole
- Size - .150”x.150”x.004”



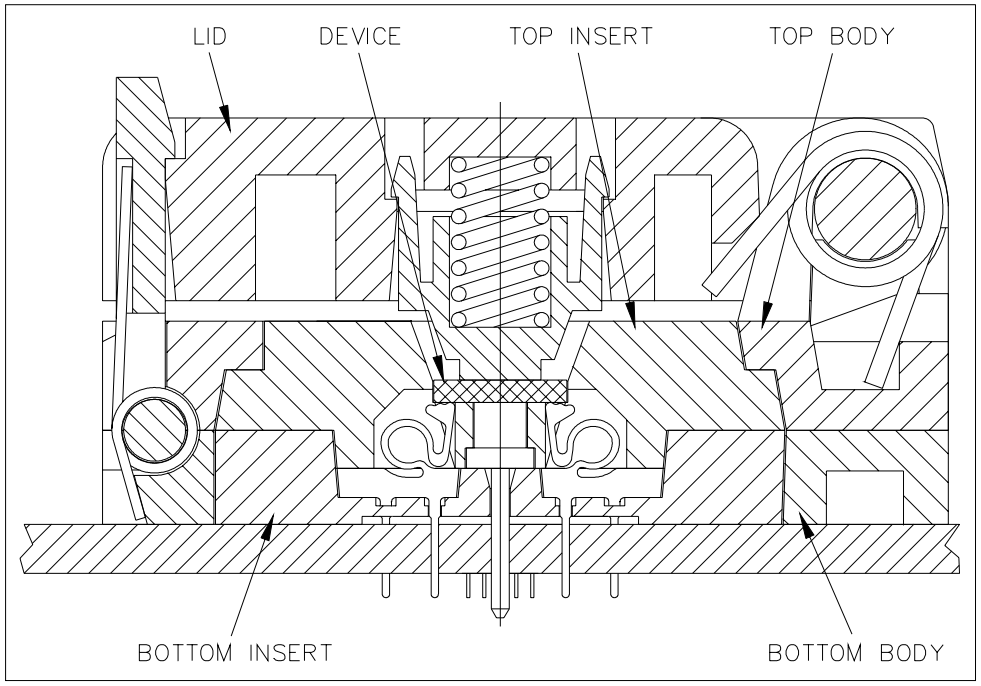
Mold and Assembly of Socket

- Size of contact .004”
- Molding gate allowance of .006” for slots
- Autoloader machine size tolerance .001”



Different Size Packages

- Must be inexpensive to tool
- One master socket
  - Lid with interchangeable pressure plates
  - Base
- **Two piece modular inserts**
  - Option of surface mount or through-hole



Meeting the Tolerance of the Package

- **Difficulty to make reliable contact with JEDEC design specifications**
  - **Alignment to the contact pads**
- **Location of package in plastic guides to be within +/- .001”**
- **Contact size limited to .004” per force curve considerations**
- **Contact size also limited to .006” for space between maximum size package terminal**
- **Tolerances of package critical to build functional socket - mainly OD variation**

Conclusion

- **Large variety of packages creates requirement for easily adaptable sockets**
- **Electrical characteristics of new package type create requirement for high-performance contact**
- **Volume nature of connector creates requirement for low-cost stamped or formed contact**
- **Tolerance is based on specific packaging house, not wide JEDEC tolerances**

Aspect of Socket Designs and its Trends

by
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Agenda:

- Objective
- Introduction
- Comparison of various types of BIS features
- Current design trend
- Common issues during development
- Future trend
- Conclusion

Objective

- Elaborate current socket trends from assembly (BIB interface), cost, automation and performance point of view
- Address common BIS development issues
- Future BIS cost and performance requirement trends

Introduction:

- BI: to screen device infant mortality.
- BIS: interface hardware between DUT and BIB
- Socket's functionality, cost, delivery, maintainability are critical items for product delivery.

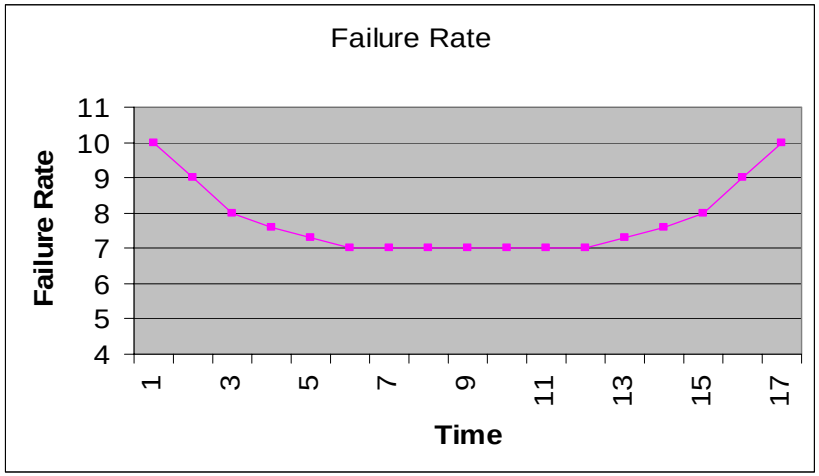

Figure 1: Bath Tub curve

Comparison of various types of BIS features:

1. BIB-interface type of socket.

	Through hole	SMT
Cost per unit socket	Low	High
Maintenance	Difficult (soldered)	Easy (screw mounted)
BIB interface	Reliable	Not reliable (BIB warpage)

2. Operation-mode type of socket

	Open top	Clamp shell
Automation	Excellent	Poor
Manual operation	Not ergonomic	Recommended
Dimensional tolerance	Tight (automate)	Loose (manual)
Actuation	High force	Low force
Cost per socketing	Low	High

Current Design trend

1. Design for BIB assembly process

A. Through-hole type socket

- **Through-hole type needs to accommodate two challenges:**
  - **Pitch of device lead is getting finer (2.54mm, 1.27mm, 1mm, 0.8mm); as a result, solder bridging (shorted condition between solder tail after wave solder) worsen**
  - **(b) through hole type burn-in socket is not reusable after it has been soldered**

B. Surface Mount Socket

- **Challenges faced by surface mount socket:**
  - **(a) high contact-pin-to-pad force induced high warpage on BIB. Extra components are required to minimize warpage.**
  - **(b) Higher cost**

Impact of solder bridge

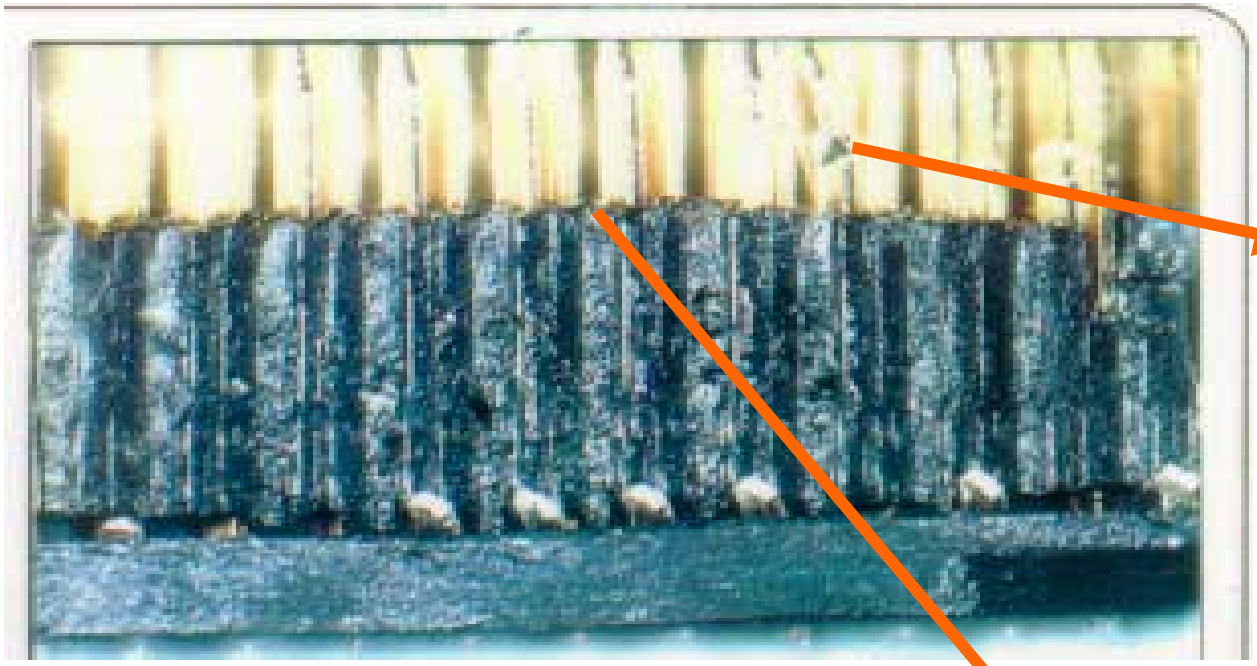

Figure 2: Impact of solder bridge

Current Design trend ctd…

2. Design for real estate management and cost

- higher socket density per board (minimum X & Y)
- higher board density per burn-in oven (minimum Z height), trade off between power, heat sink height and BIS density requirement.
- increasing number of passive component required per board.
- Sharing mold tool
- re-use socket for close form factor package

Current Design trend ctd…

3. Design for automation

- Tight dimensional tolerance is required for precision alignment between socket and package.
- Open top socket for ease of package loading
- Long lasting with appropriate material, PES, PEI
- Actuated type to capture and release package easily
- Robust contact pin design for repetitive process
- Increasing in pin count, increasing in actuation force

Current Design trend ctd…

4. Design for performance

- Contact pin to carry high current and low inductance
- High performance heat sink for heat dissipation .
- Maintain contact pin force while pin count is increasing

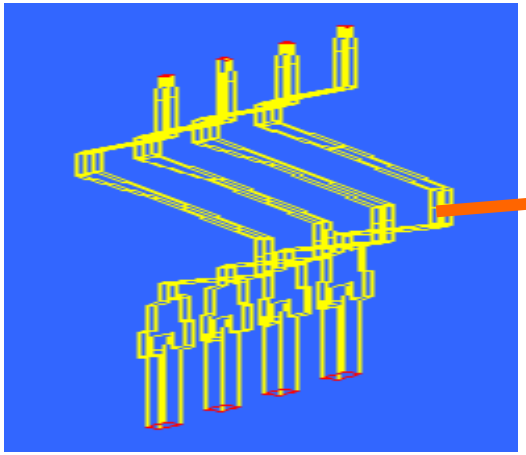

Figure 3: Contact pin design for performance

Common Issues during development

- **1. Project management/ coordination**
  - Tool modification lead time impacting project schedule.
- **2. Prediction tool capabilities**
  - Thermal, mechanical and electrical simulation reduces the design modification iteration. Fine tuning on tooling is still required.
  - Prototype socket in early discovery work is costly.

Common issues during development ctd……

3. Component Design

- Efficient heat sink requires for high power product occupies invaluable space.
- Low inductance contact needed for high frequency testing

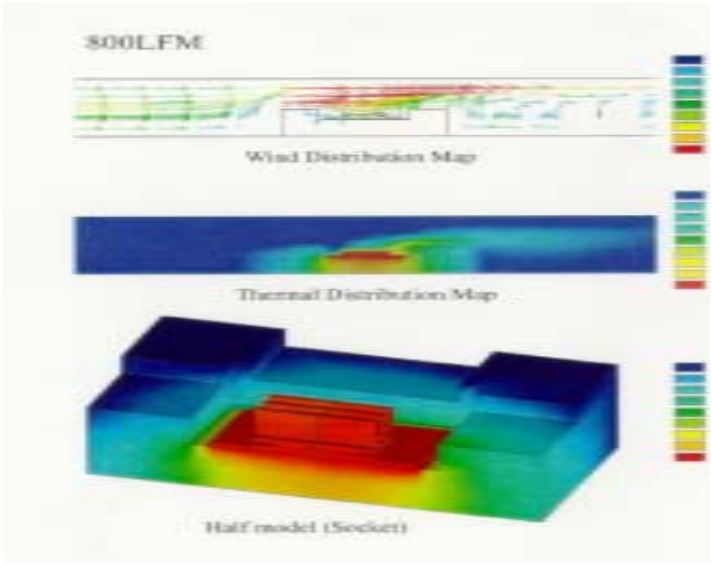

Figure 4: Simulation to optimize heat sink geometry

Future trends

1. Cost and time to market

- Replaceable/ reusable socket for next generation burn-in socket.
- Viability of flexible socket tooling
- Concept of test during burn in

2. Socket technology

- Device package is evolving --- smaller in size, more pins. Socket needs to have more pins while maintaining its minimum contact force.
- Socket contact pin performance in high current environment.

Conclusion

- Burn-in socket is a critical item to enable product to meet the competitive market needs. The socket design, cost, delivery schedule and volume capacity will come under intense scrutiny in this competitive semiconductor industry.

- The total solution for future burn-in requires re-usable, long lasting, easy to produce, low cost (burn-in per device) and high performance socket. User needs to balance between cost versus performance requirement.

Interconnect Solutions for ATE

Iraj Barabi / Mehdi Attaran

OZ Technologies Inc.

February 26th 2000

Industry Trends

- Miniaturization
- Reduced Pitch , Increased Pin Count
- Increased Performance Requirements
- Multi-site testing
- Integrated solution
- Speed & flexibility

Contactor Design Considerations

- Electrical Performance
- Mechanical Performance
- Dimensional Variations
- Design Reuse\Modularity
- Manual and Automated Test Capability
- Field Serviceable
- Cost Effective

Electrical Requirements

AC

- < 1nH contact Inductance
- Low cross-talk
- Low capacitance
- Simulation

DC

- <40 m Ohm contact Resistance
- Current carrying capacity

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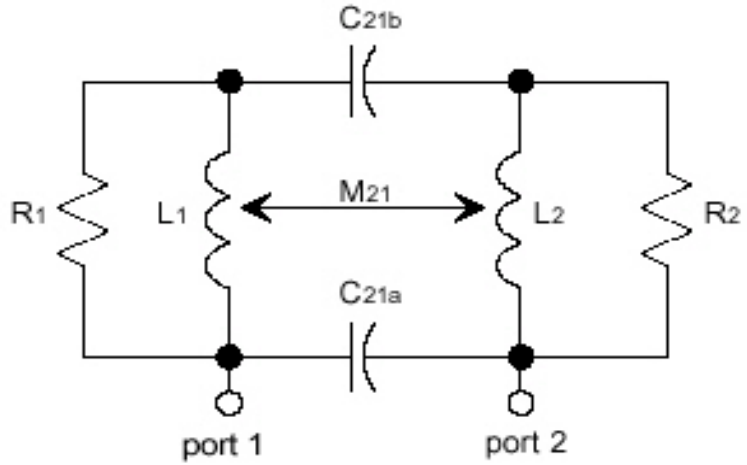
Electrical Modeling



Equivalent Circuit Diagram

Pins	L_1 & L_2 (nH)	M_{21} (nH)	R_1 & R_2 (Ω)	C_{21a} (pF)	C_{21b} (pF)
Field adjacent	0.58	0.12	200	0.020	0.025
Edge adjacent	0.65	0.13	200	0.030	0.030
Corner adjacent	0.75	0.15	200	0.030[1]	0.040[1]

[1] estimated values

Electrical Modeling

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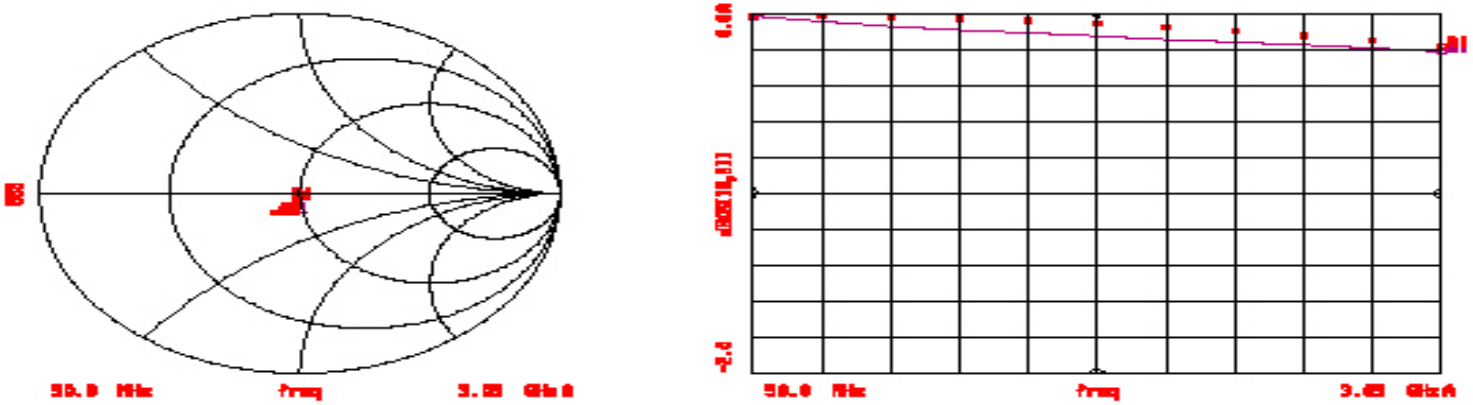
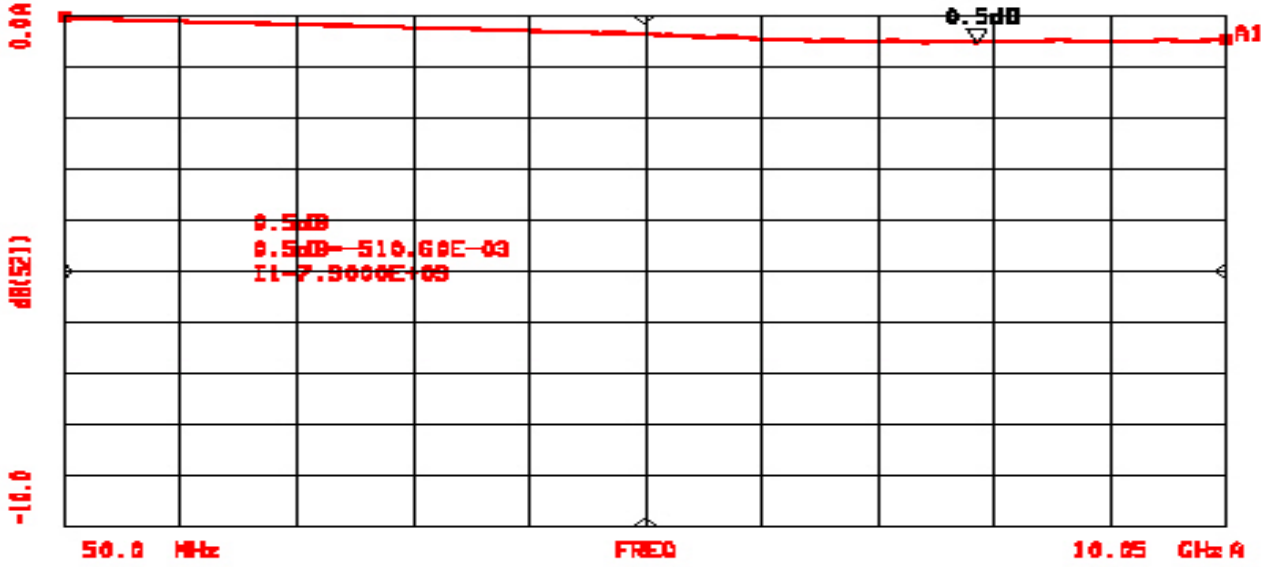
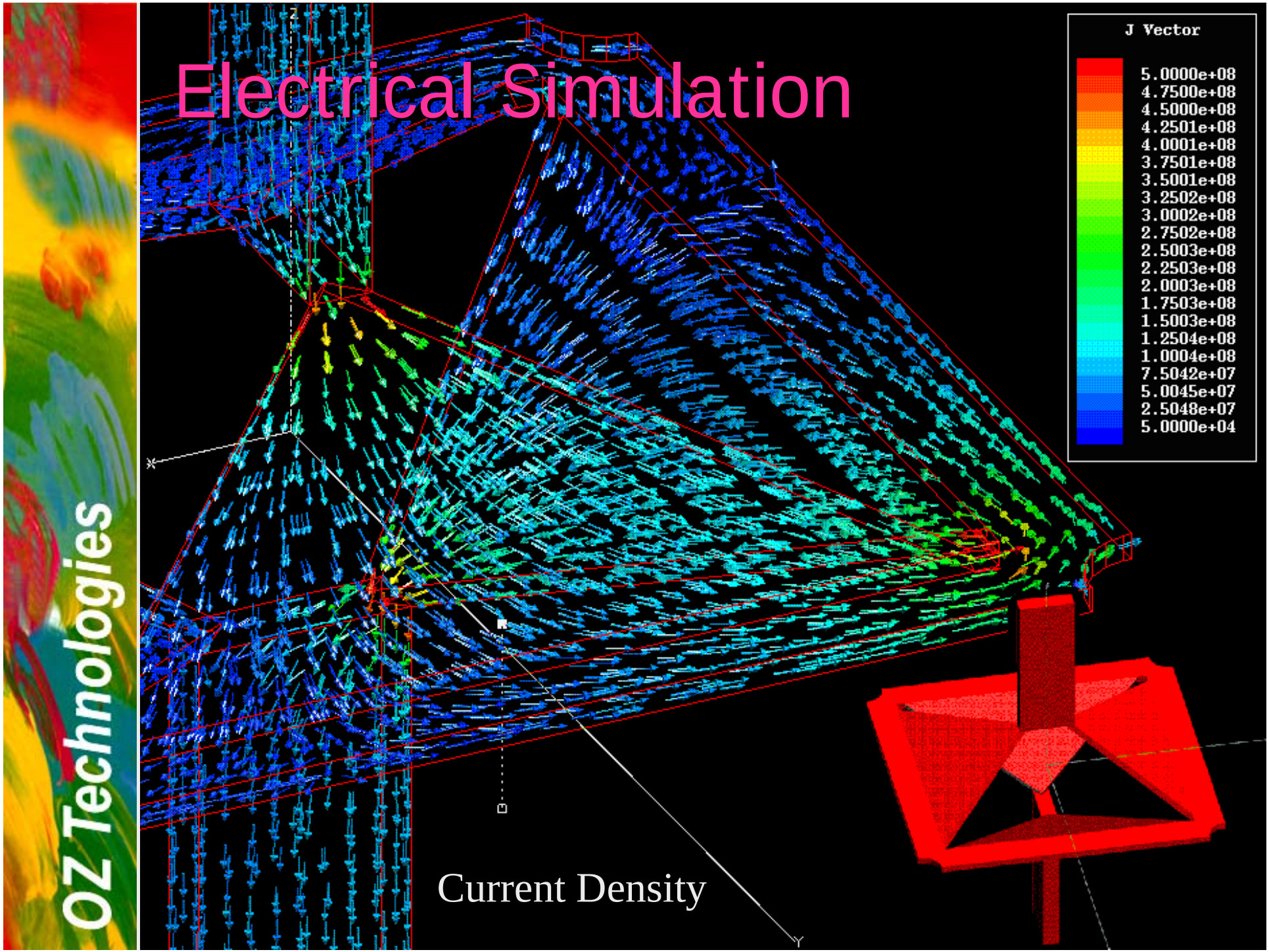
Thru measurement, measured vs. simulated response



Loop-thru measurement (10 GHz)



Electrical Simulation



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Mechanical Requirements

- High level of accuracy
- Simulation & Modeling
- large window of operation
- Modular design
- long Life
- Reduced mechanical cross-talk
- Controlled contact point
- Thermal consideration

Accuracy

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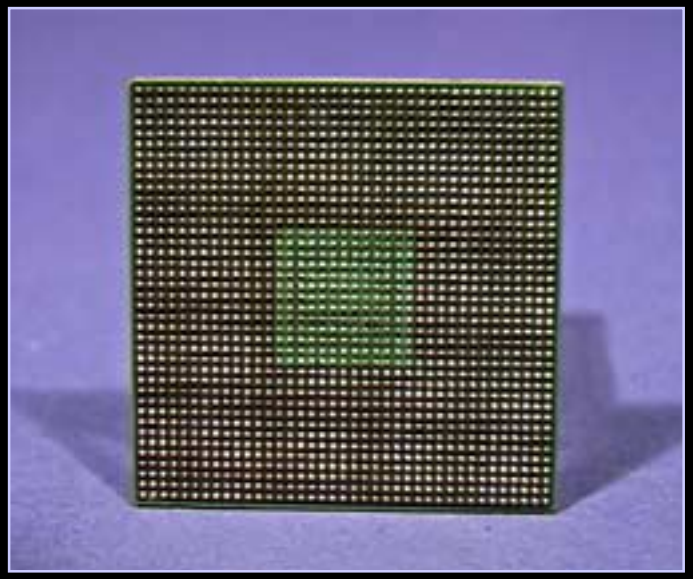
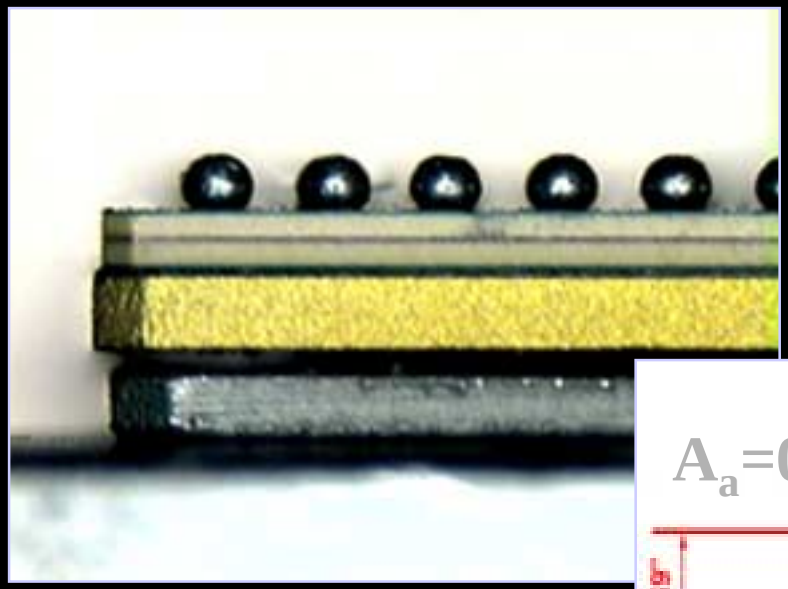
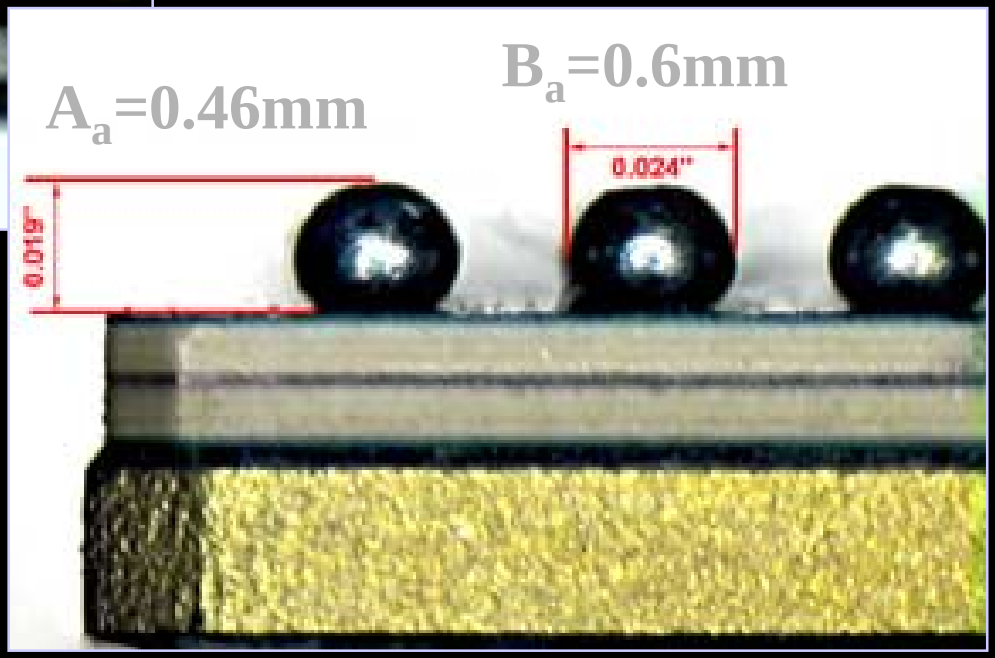




A_s= 0.4mm-0.6mm
B_s= 0.5mm-0.7mm



Accuracy Of Design

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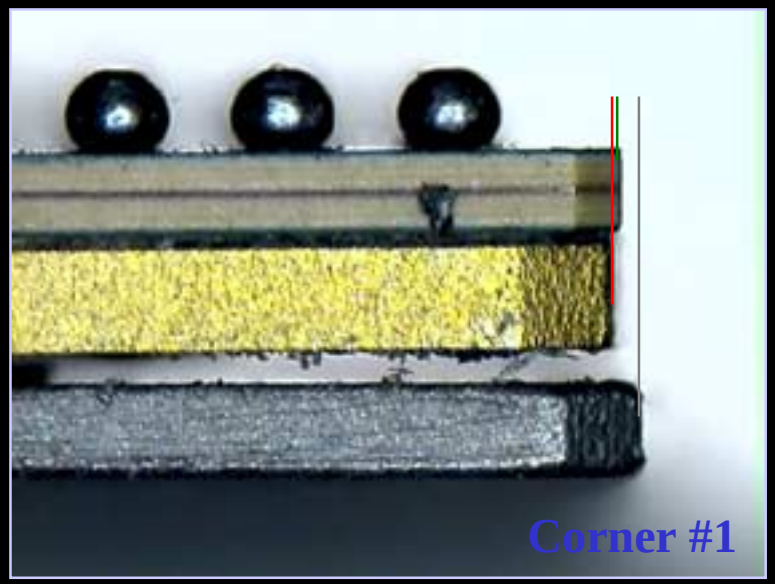
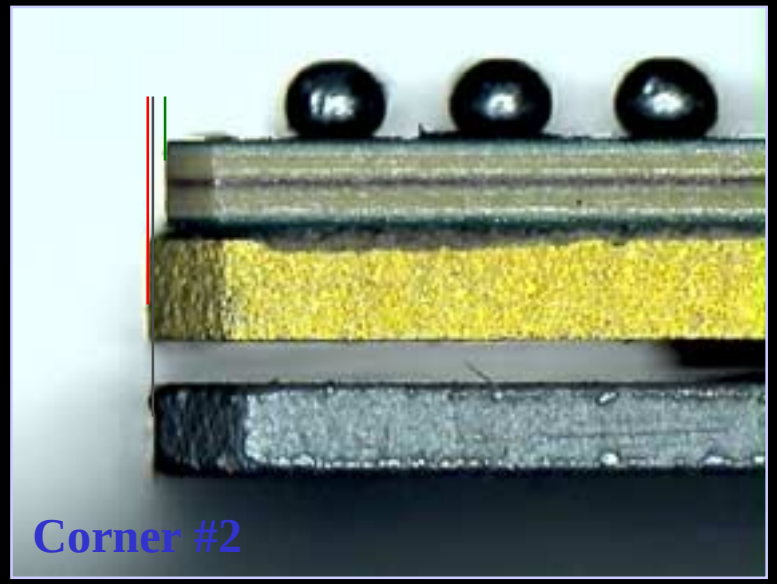
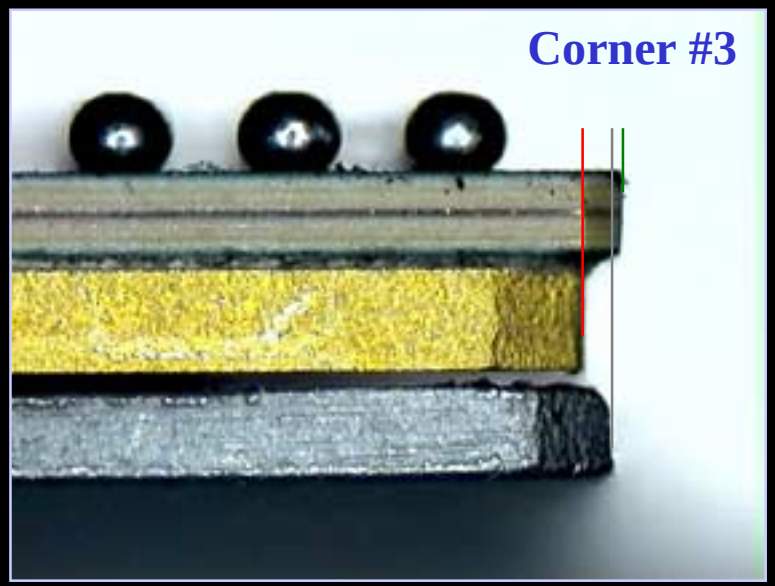
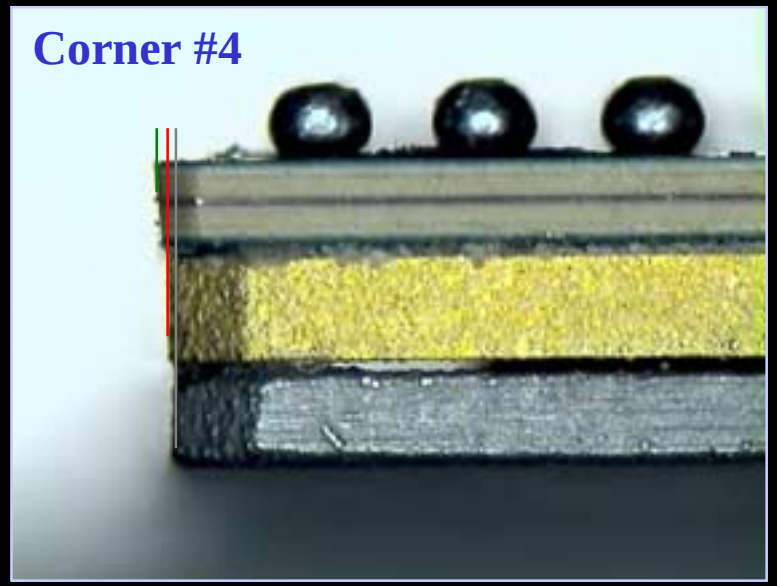
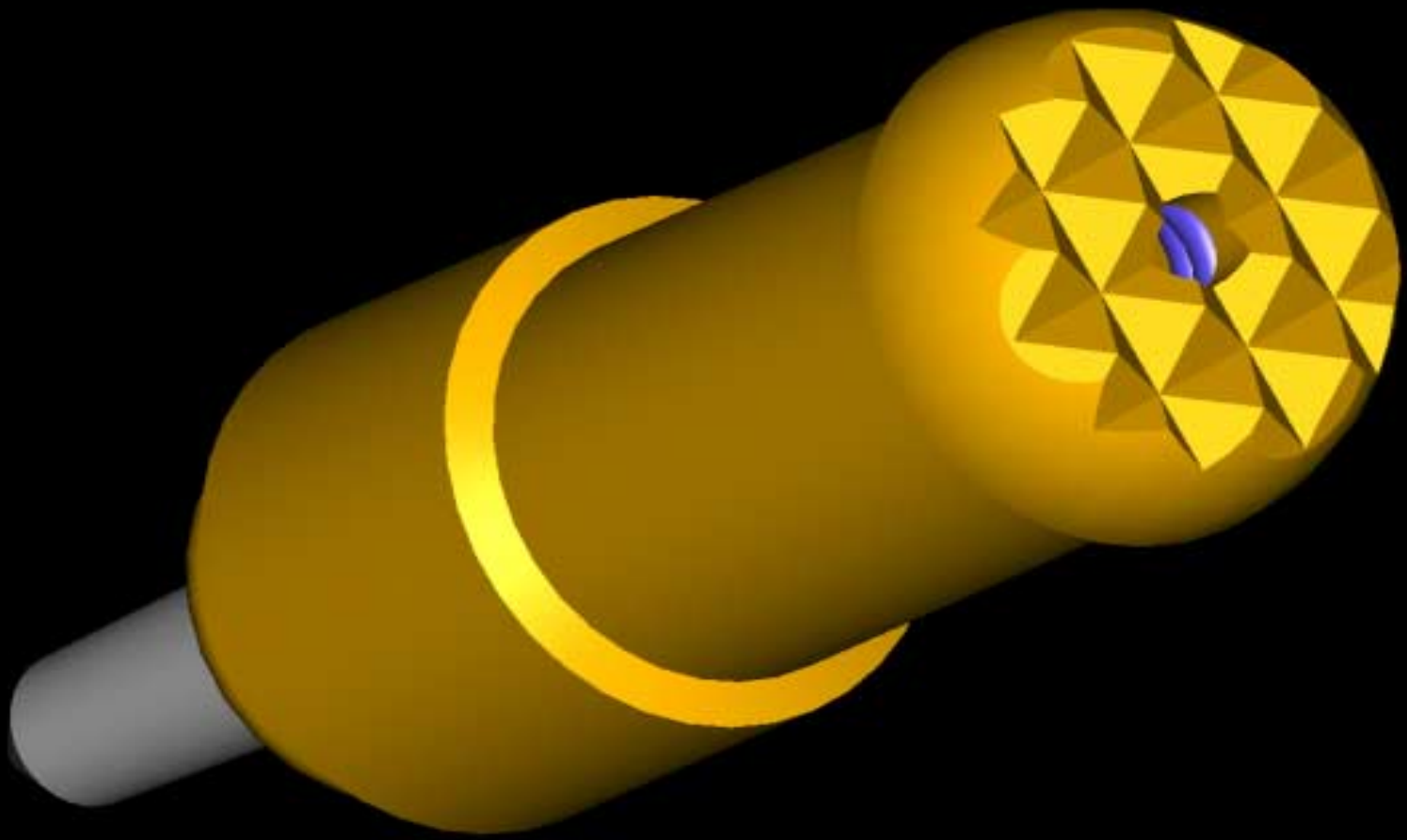








Mechanical Modeling



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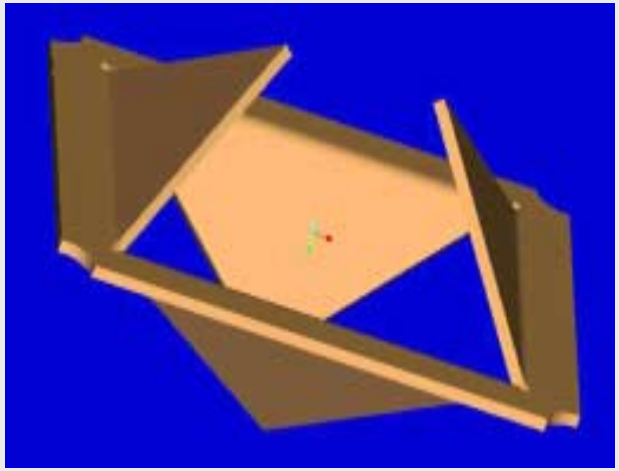
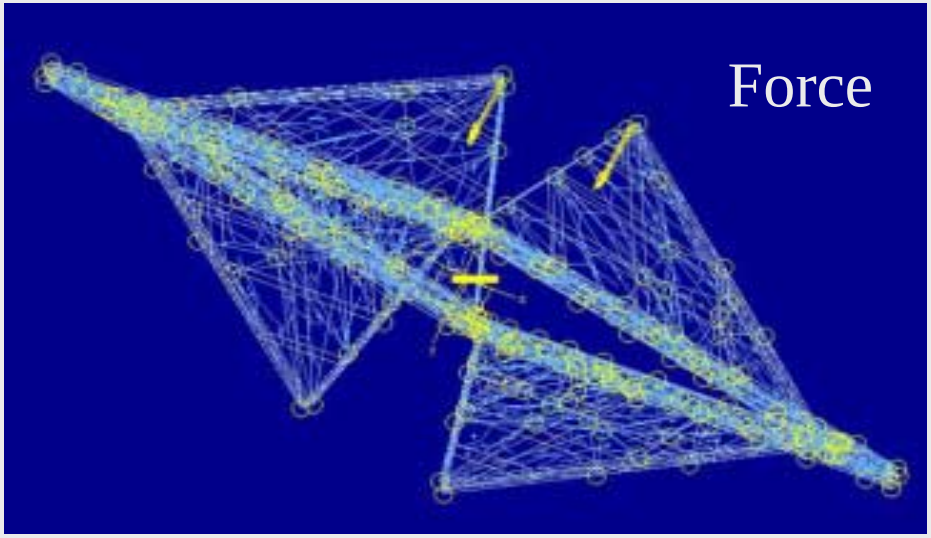
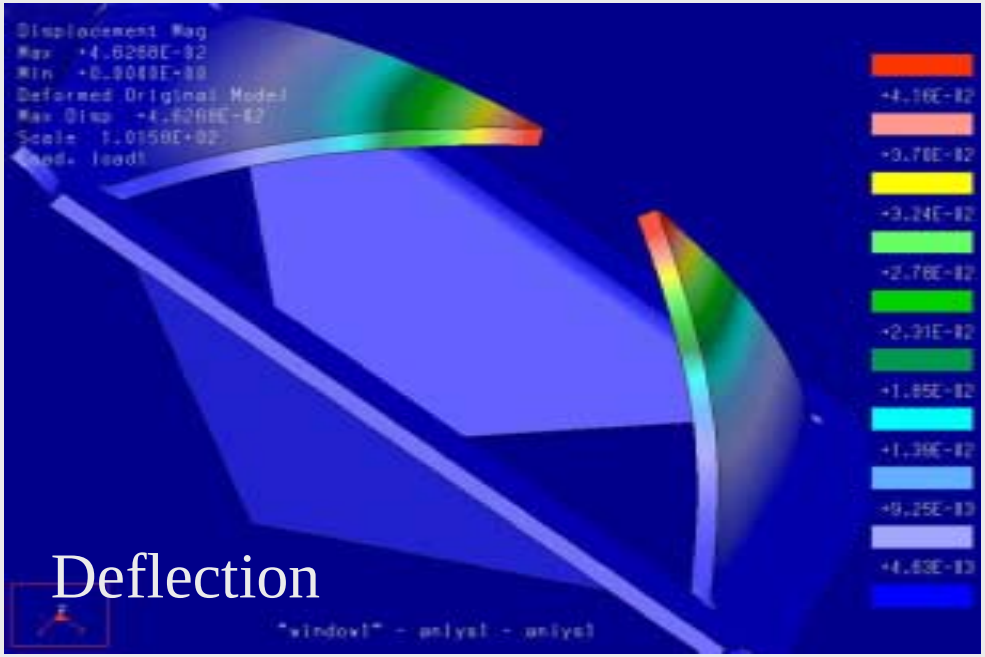
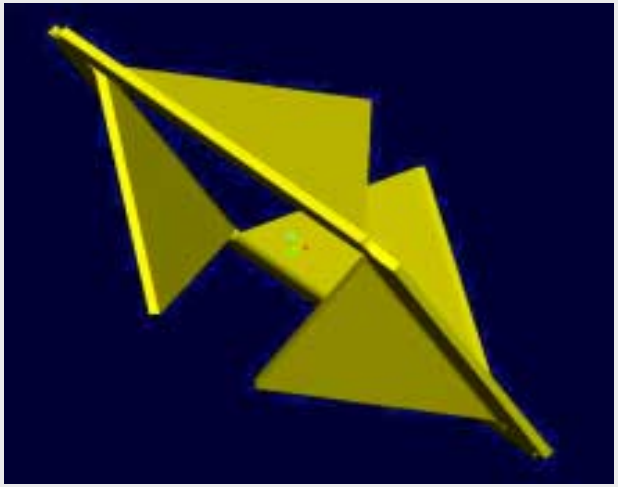
Mechanical Modeling









Structural Simulations

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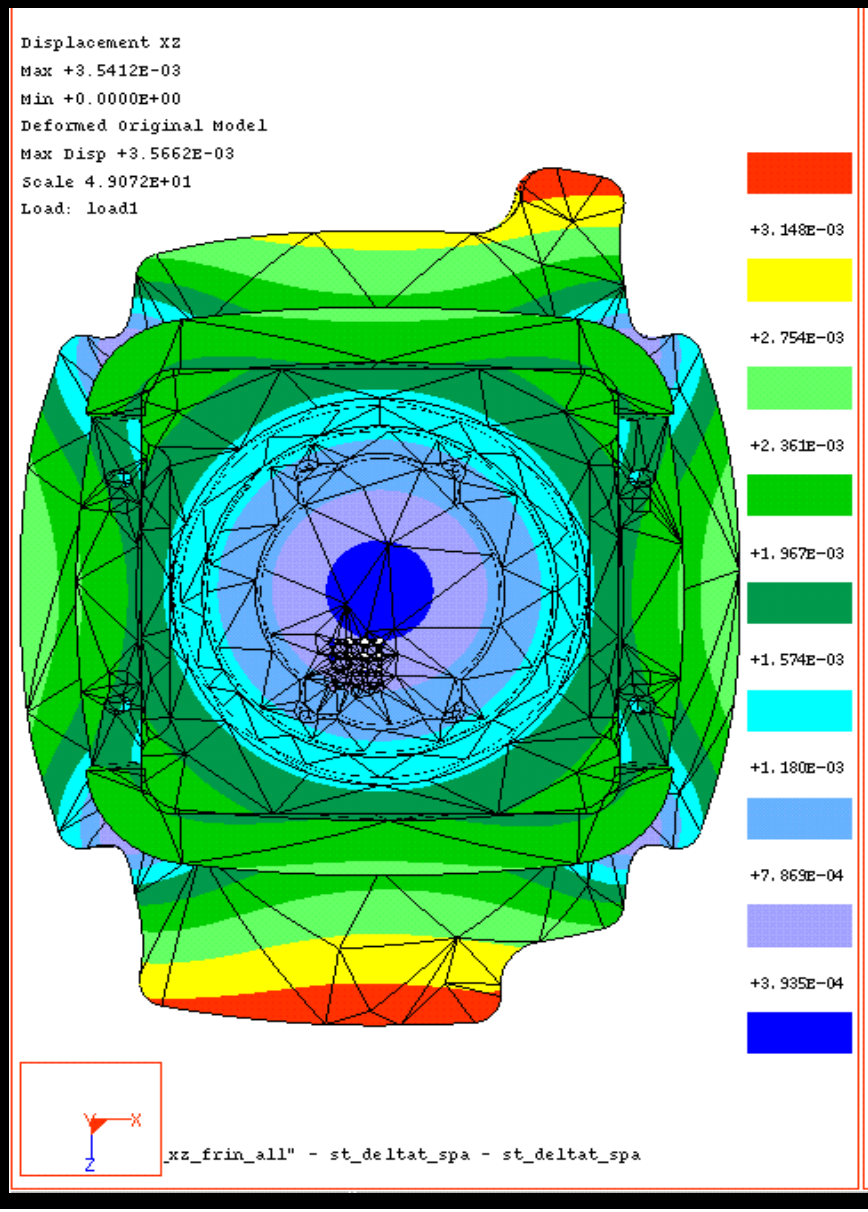

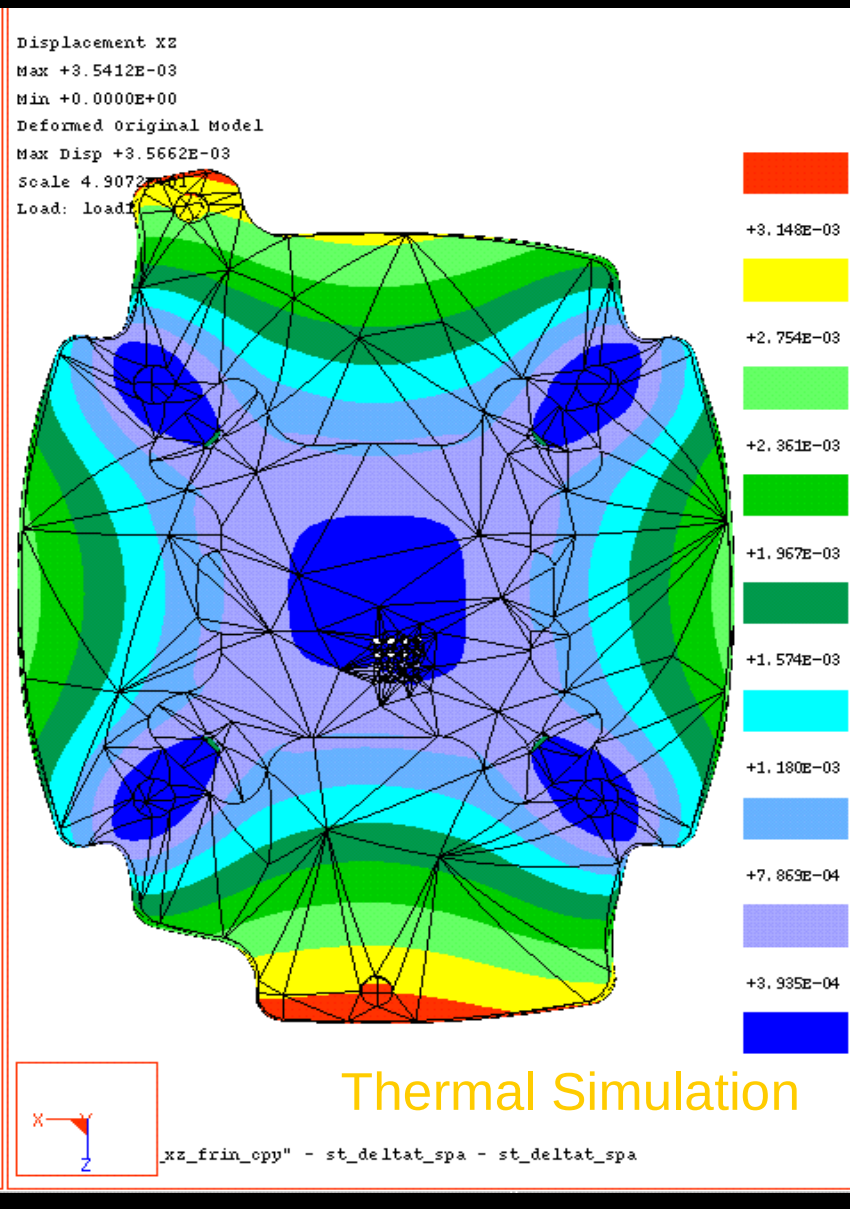

Thermal Simulation

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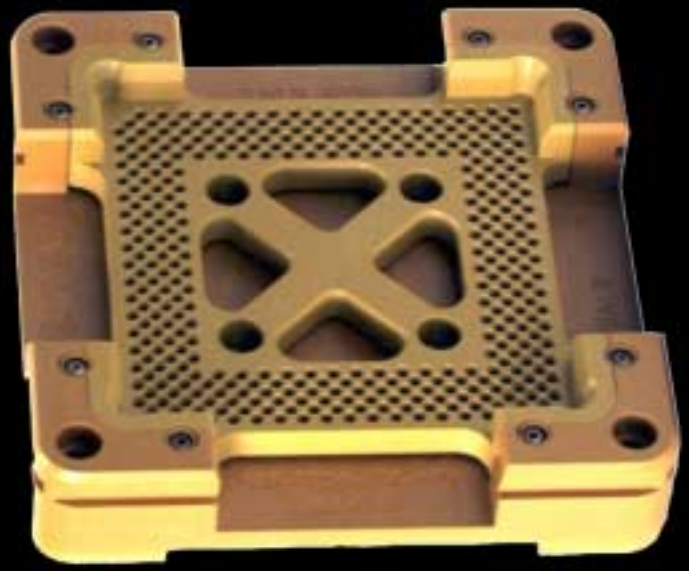
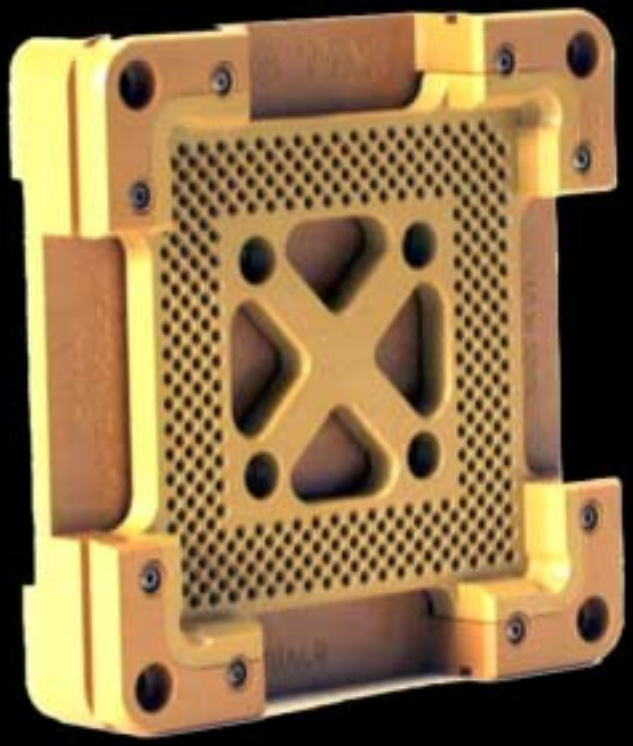
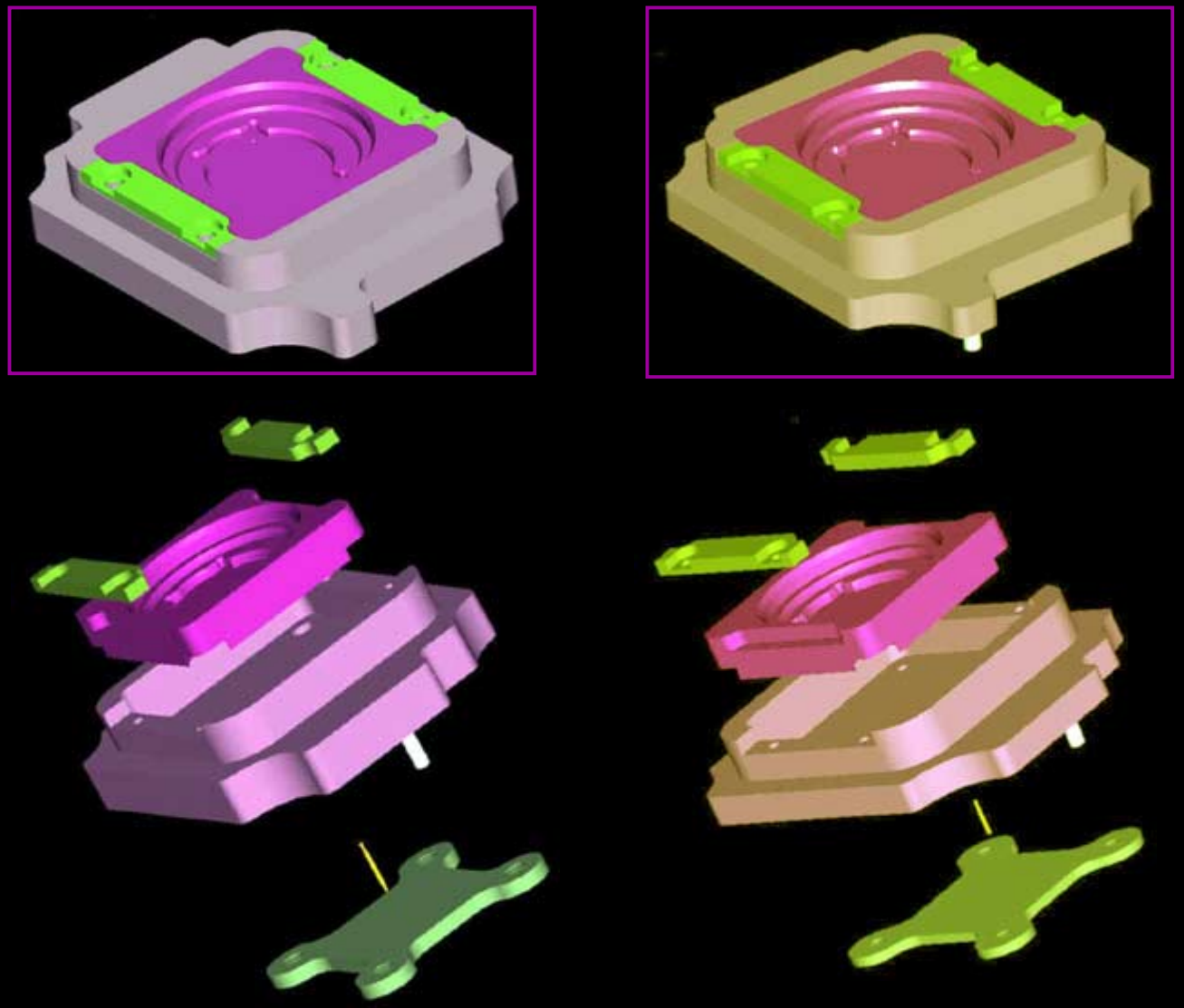
Large Window Of Operation





Modular Design



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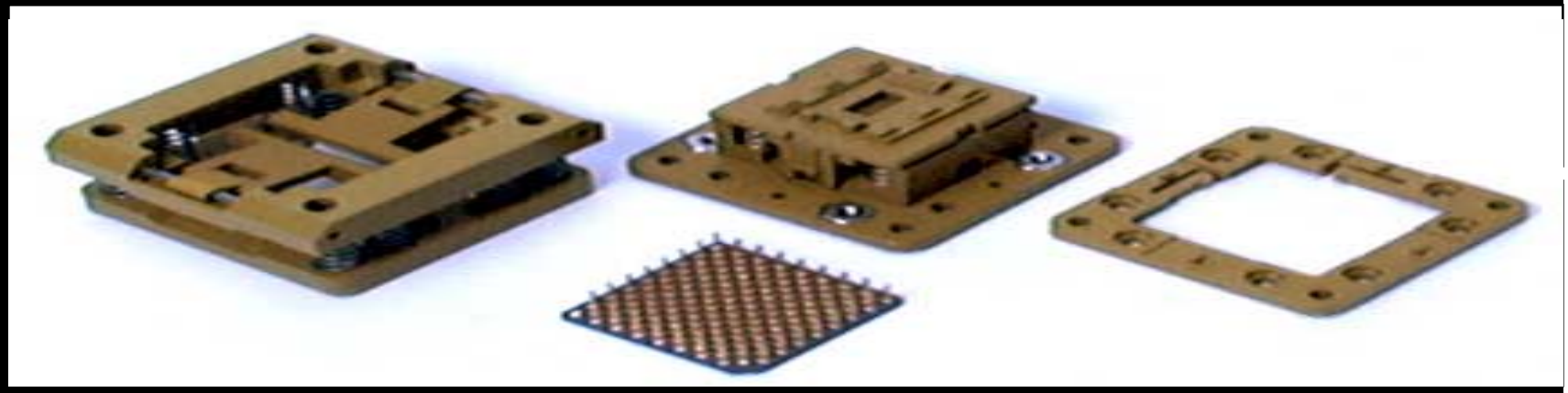
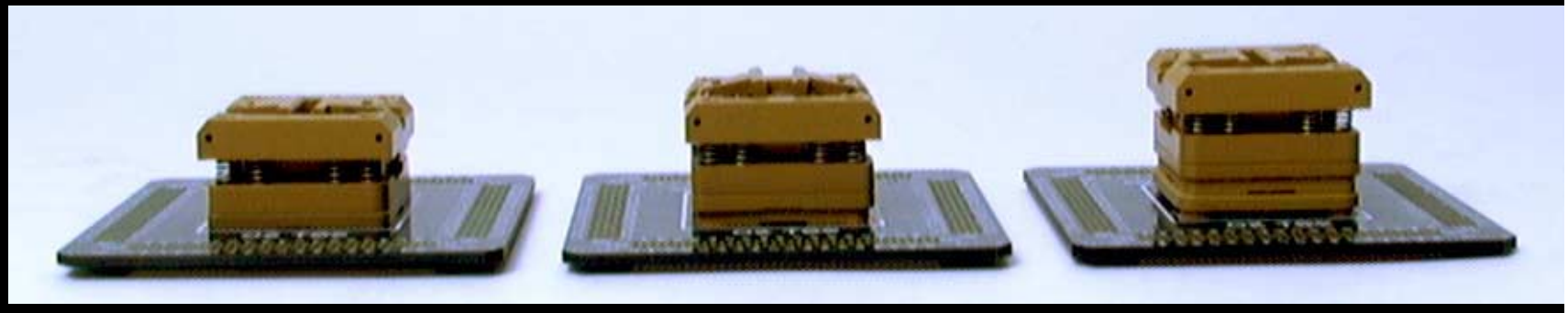
Modularity





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Life Cycle Testing

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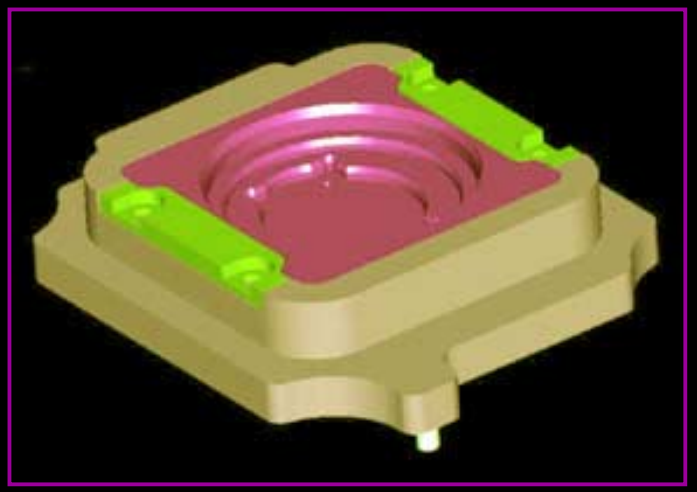

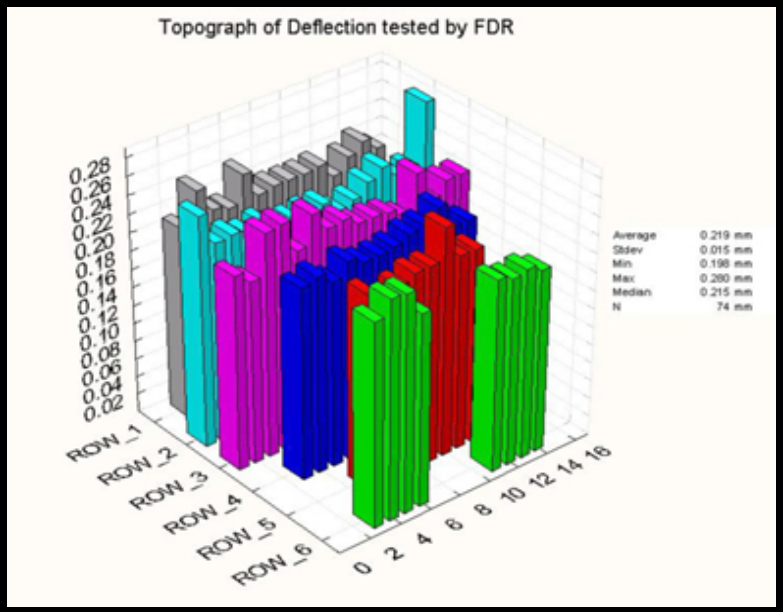

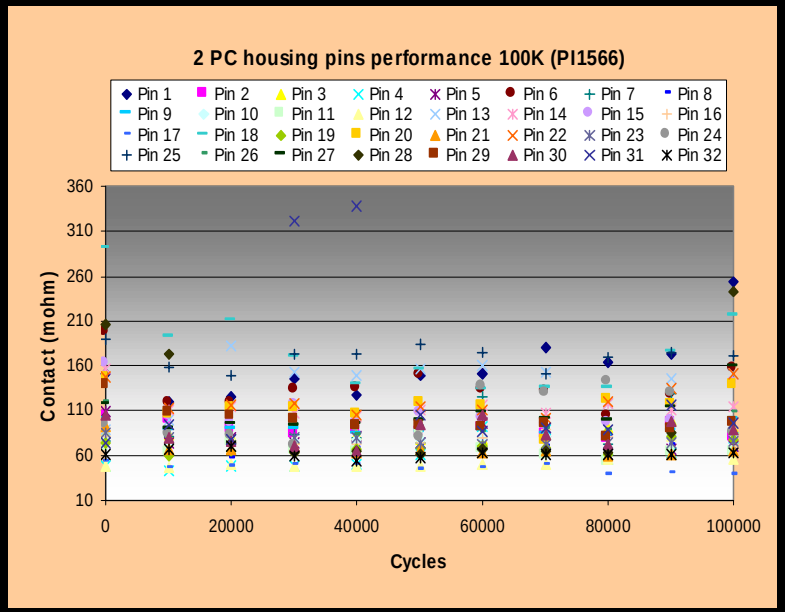

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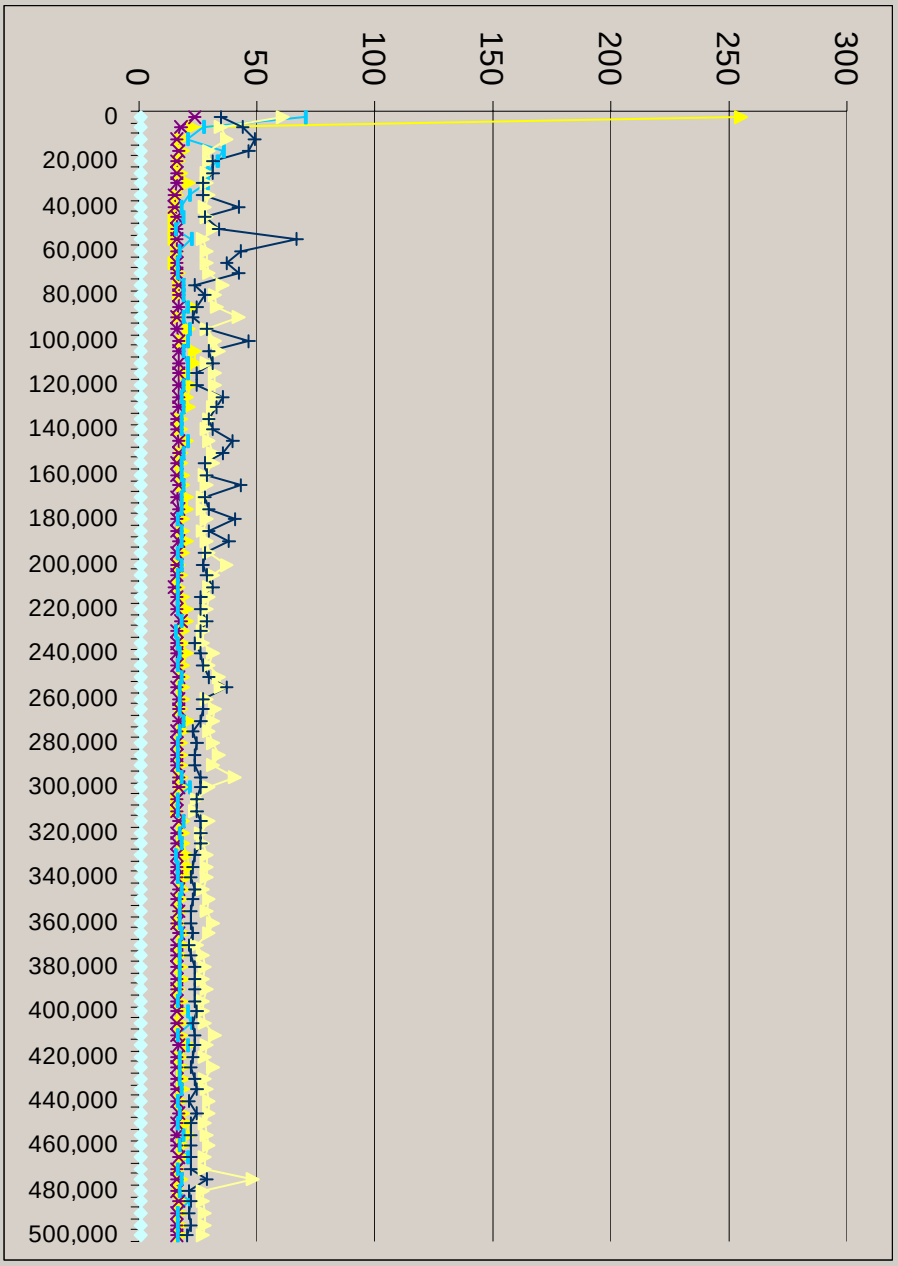
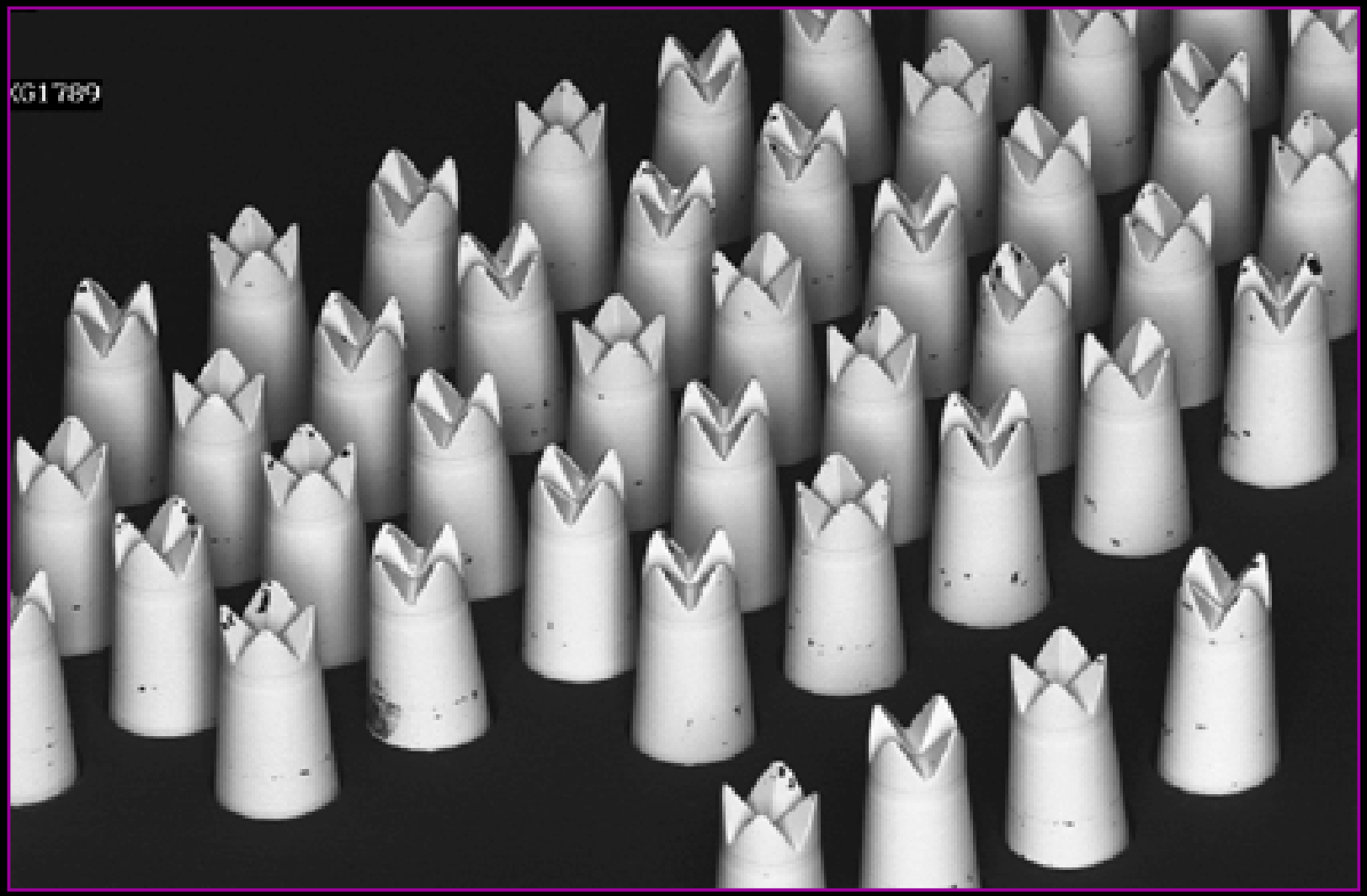
Life cycle vs. Resistance

Resistance mΩ



Number of Insertions

Mechanical Cross-Talk



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Controlled Contact

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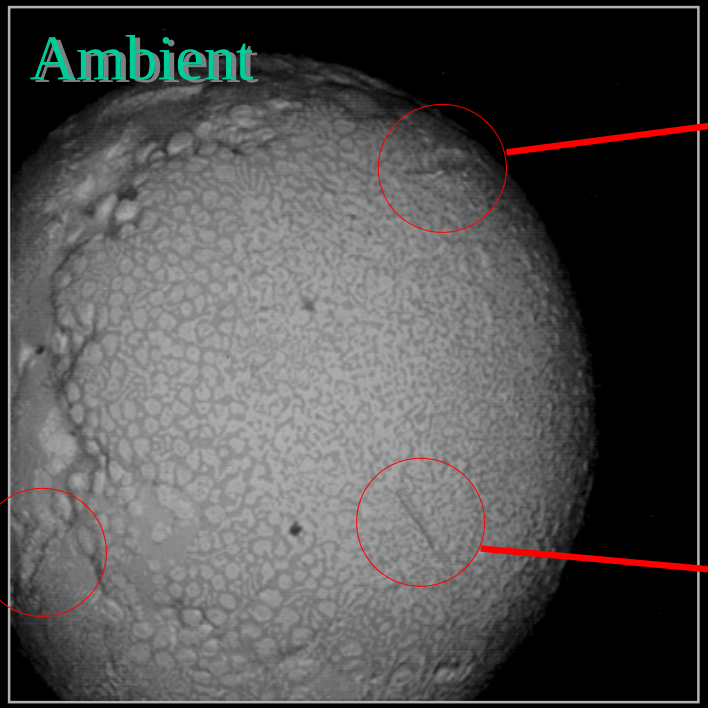

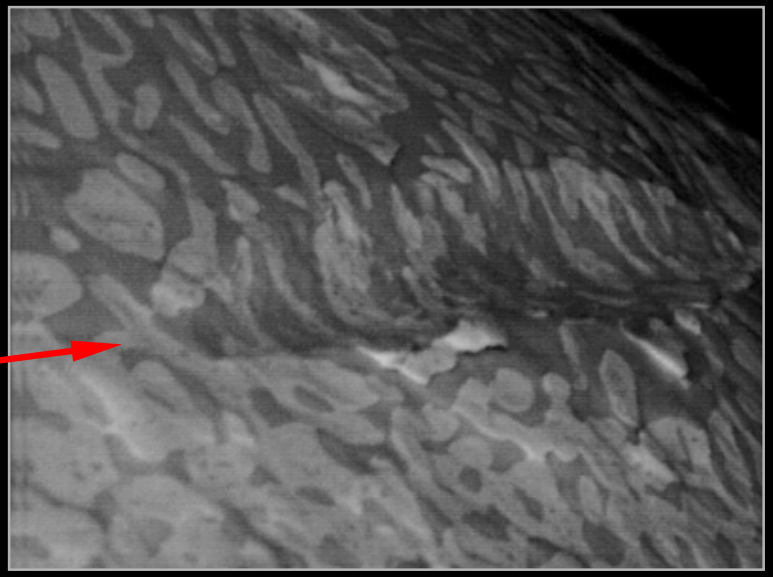

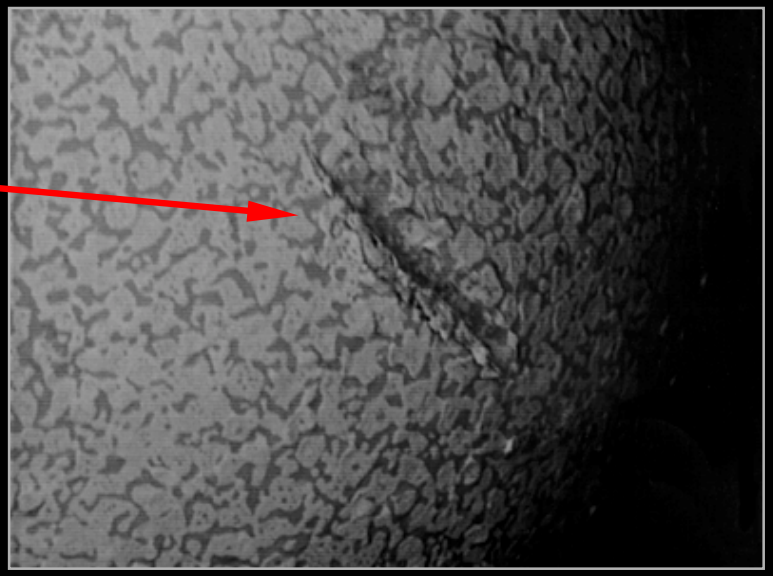

Deflection = ~0.010”
Force = ~ 10gf

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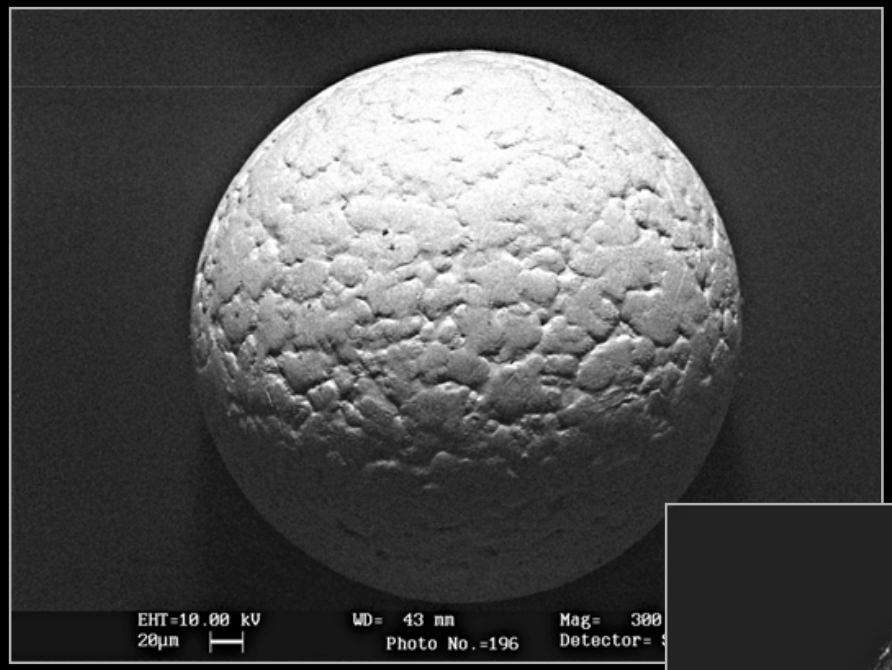
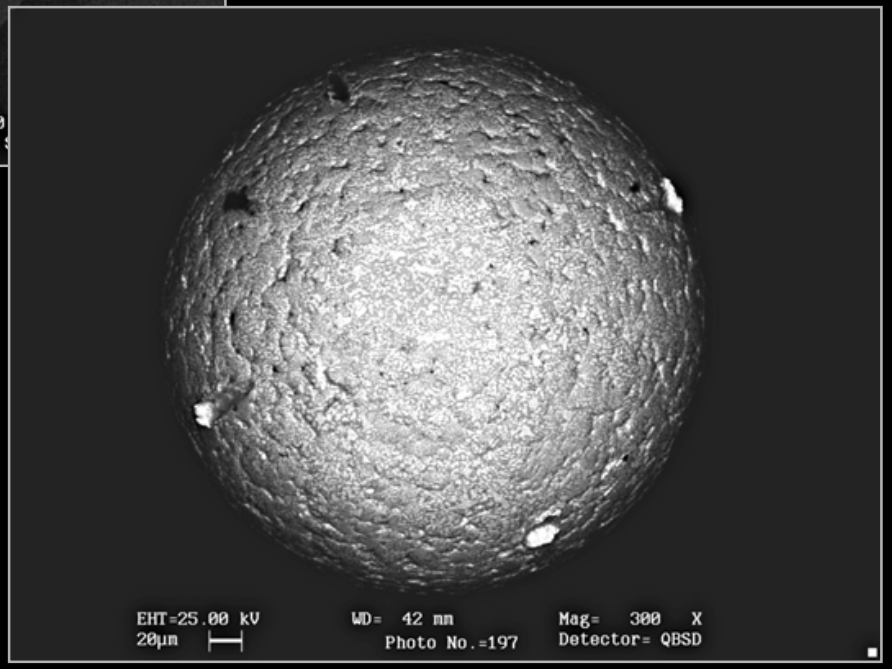
Controlled Contact



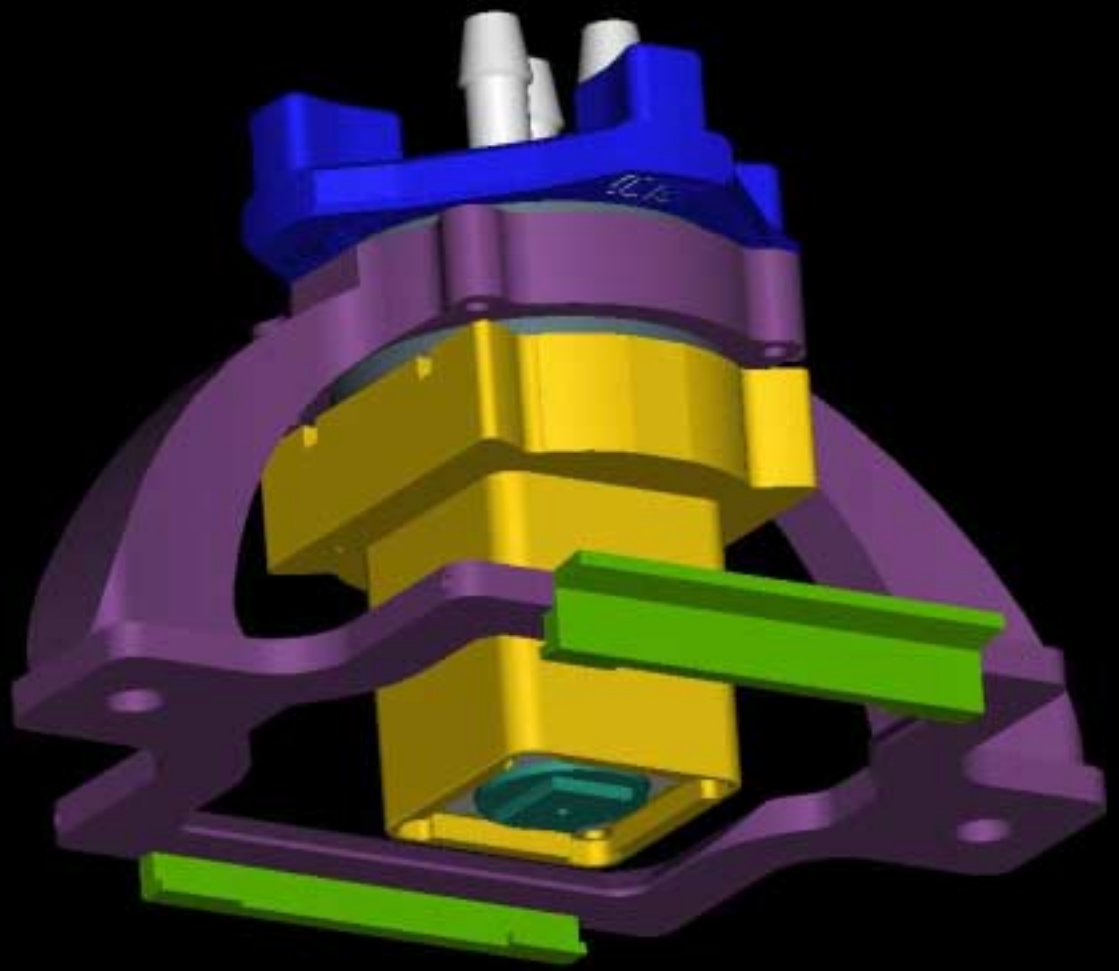
Before

Ambient



After

Thermal Considerations



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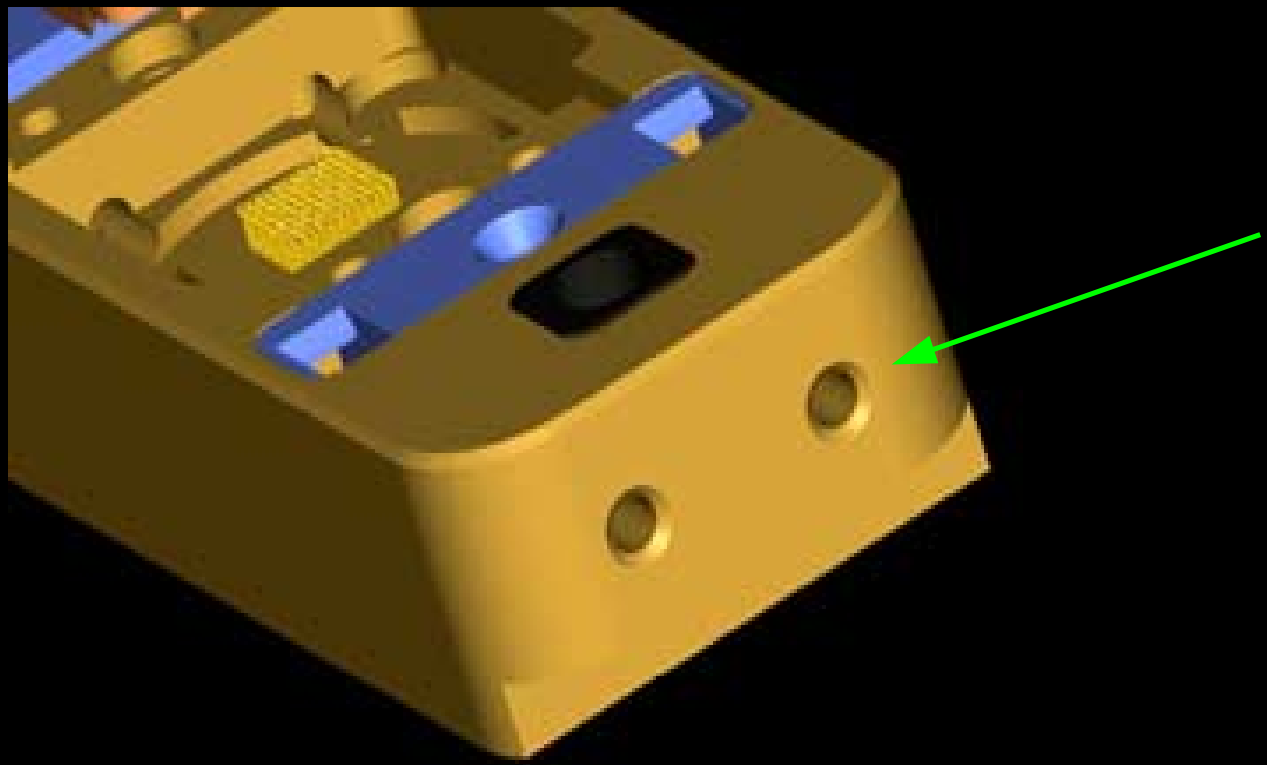
Thermal Considerations



Thermal Simulations

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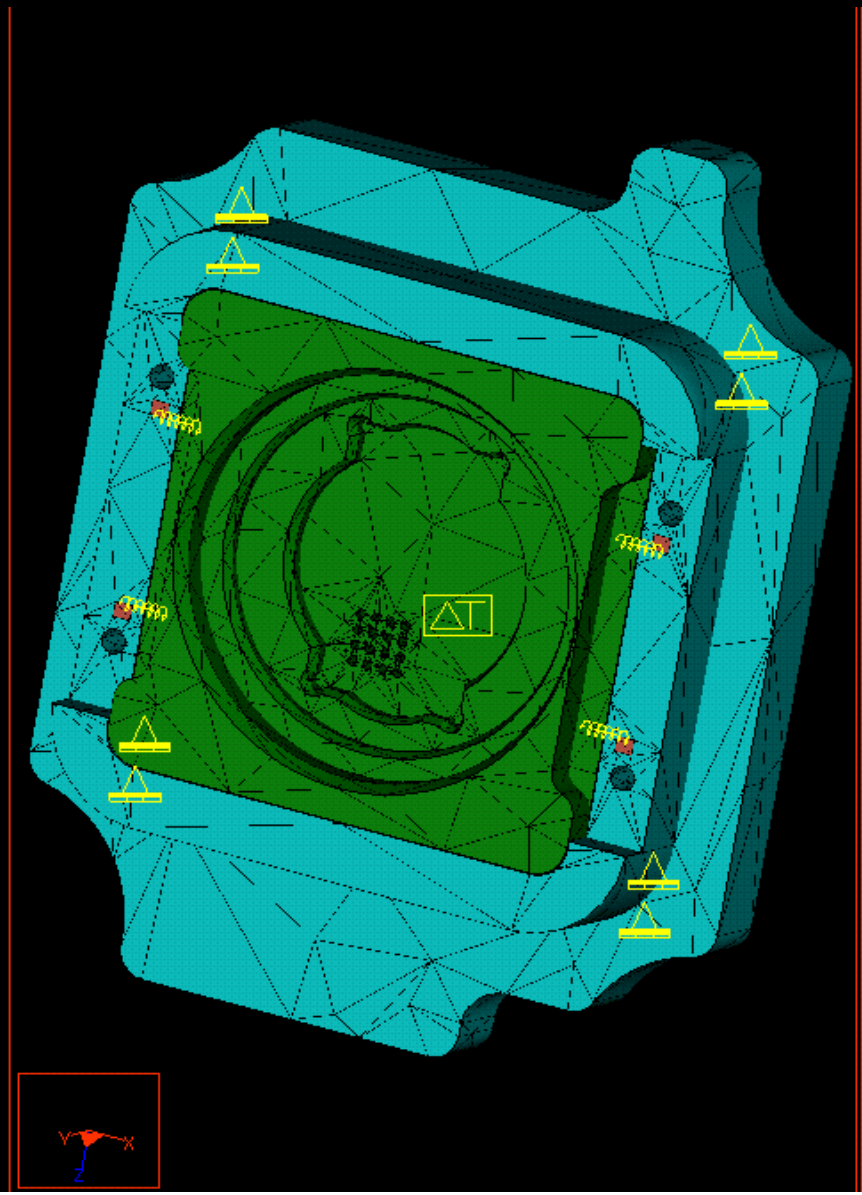

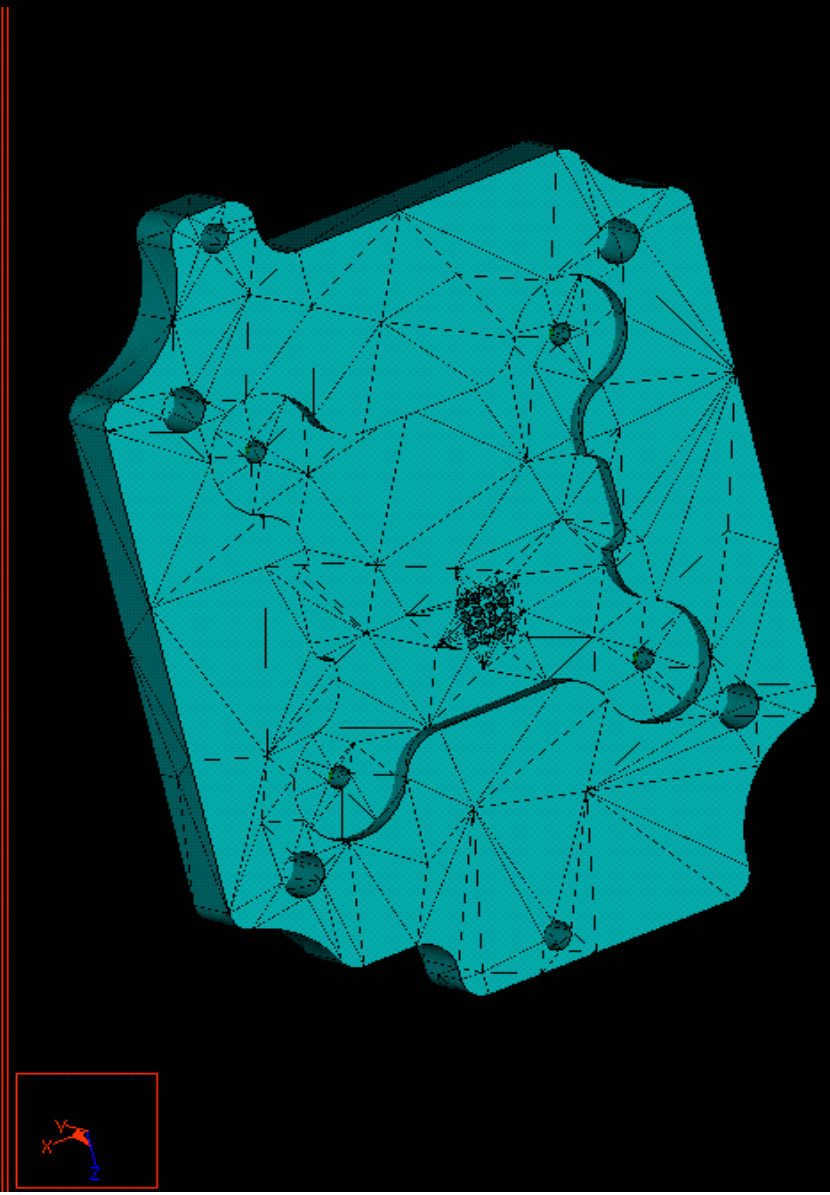

Conclusion

- Design and validation of ATE test contactors requires a vast array of discipline and technologies.
- Mechanical, Electrical, Thermal and functional requirements must be optimized in a concurrent and interlinked process to yield necessary performance requirements.