Next-Generation Grounding Solution for Small Leadless Packages

Blade Compliant Ground (BCG)

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TestConX™
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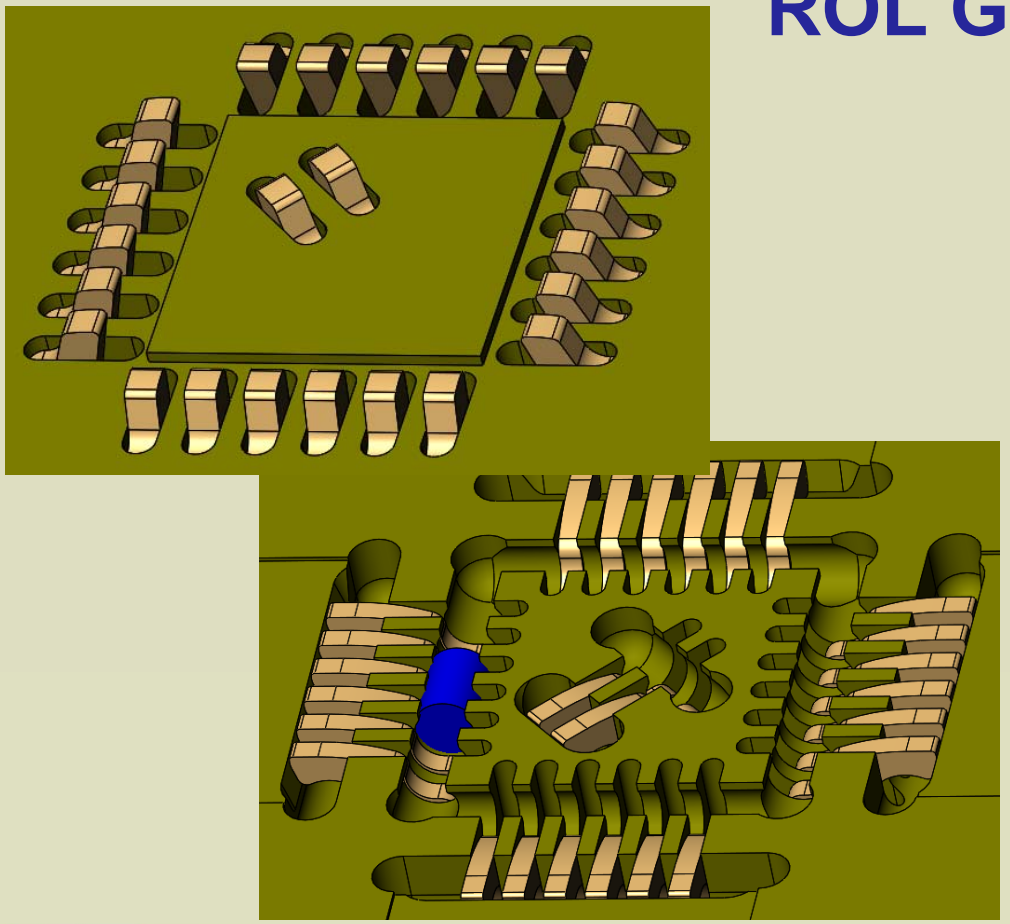
Agenda

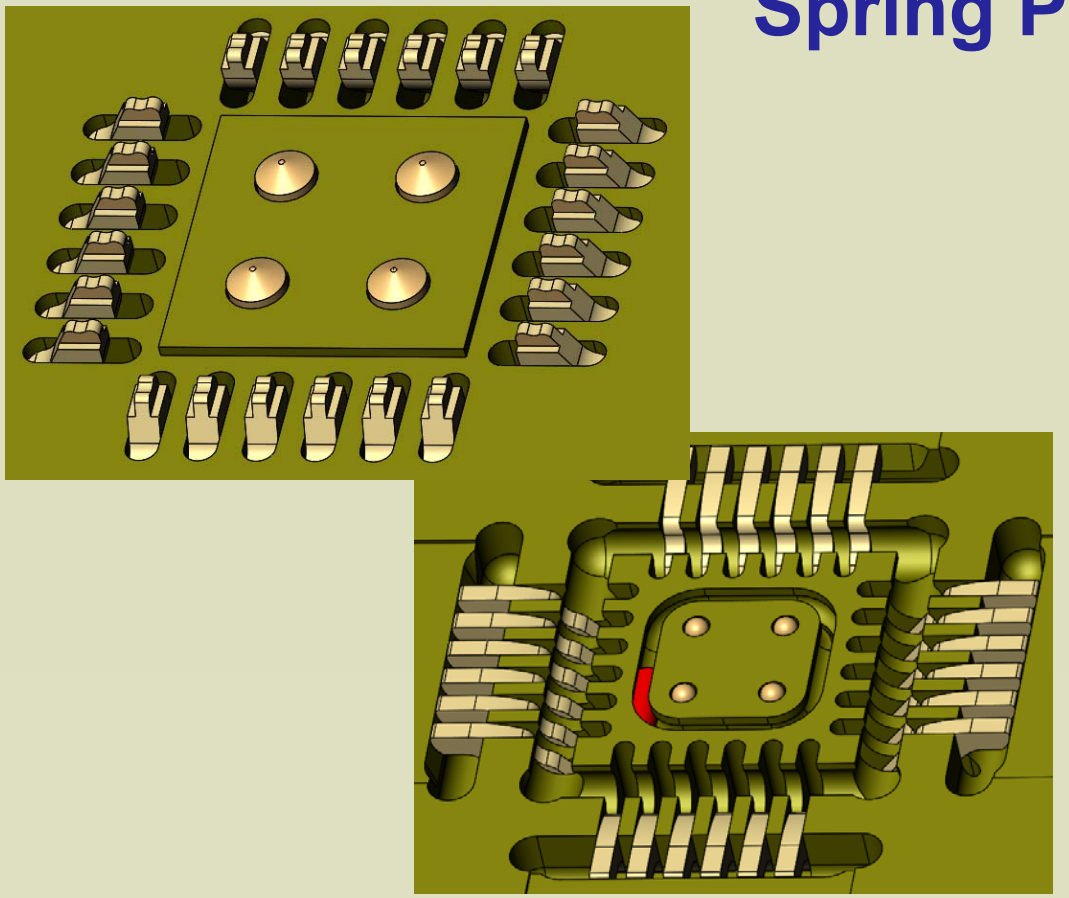
- Current Grounding Solutions
  - ROL contacts
  - Spring probes
  - Solid grounds (CI/RCI)
- Introduction to BCG
  - Concept
  - Construction
  - Simulation development
- Testing Process and Results
- Contactor Integration
  - Serviceability
  - Deployment
- Future Application of Blade Technology



ROL Ground Contacts

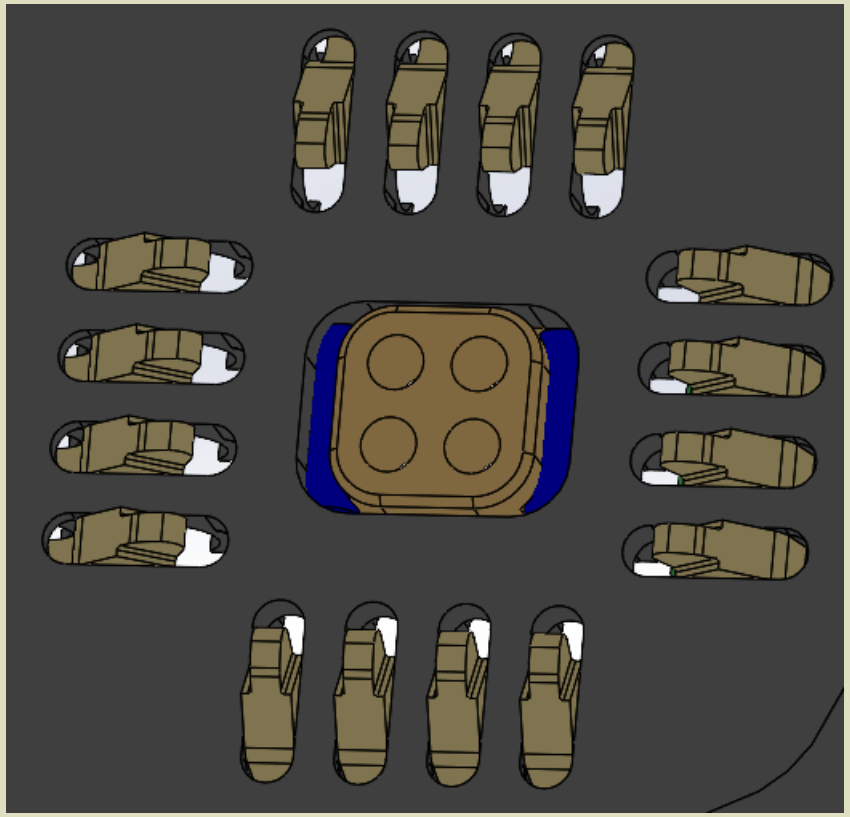
- ROL is a contact that “rolls” on the LDBD and scrubs the DUT pads
- Self cleaning contacts
- Ground matches perimeter compliance
- Precise force for excellent contact resistance
- Easy to clean and replace
- Limited configuration positions

Spring Probe Grounding



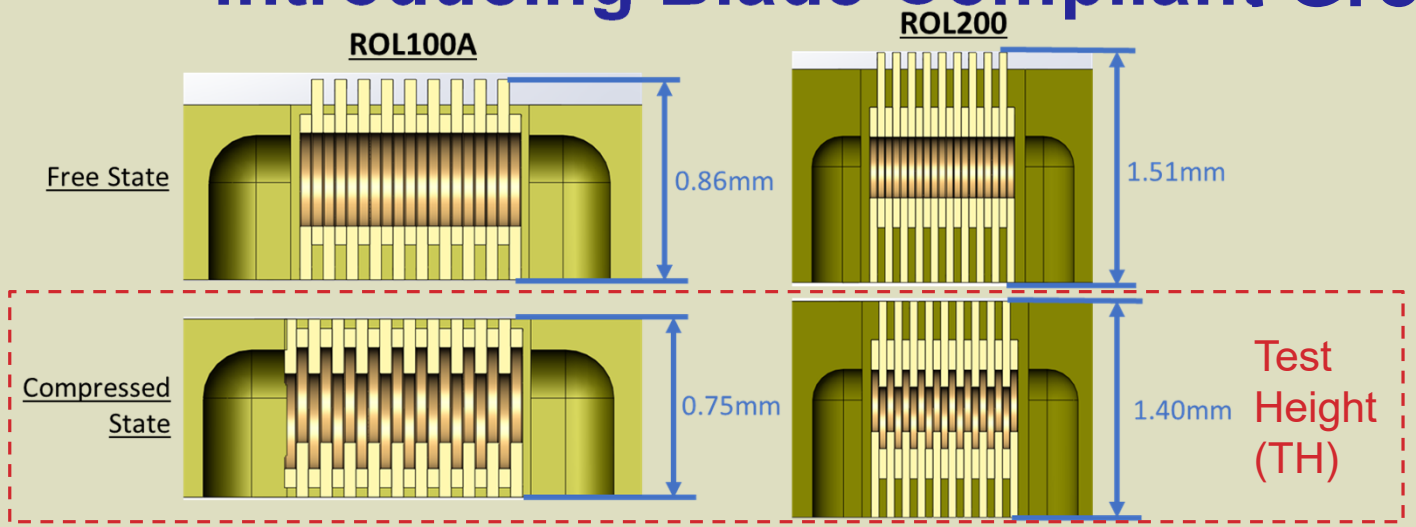
- Ground matches perimeter compliance
- Small footprint for number of contacts and configuration flexibility
- Precise force for good contact resistance
- Ground contacts are easy to clean
- No self cleaning
- Limited test heights available (1.4mm)
- Extra components needed to retain the contacts
- More difficult to replace than ROL contacts

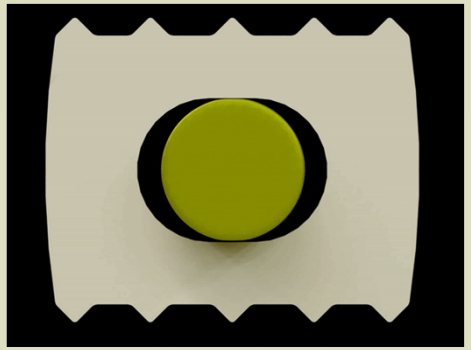
Solid Contacts (CI)

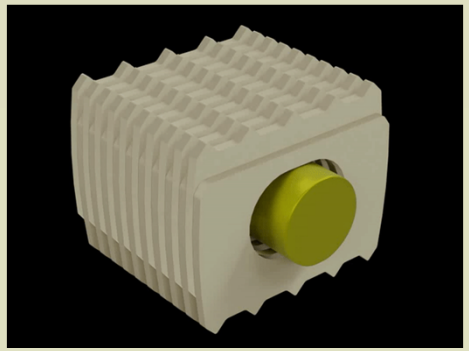


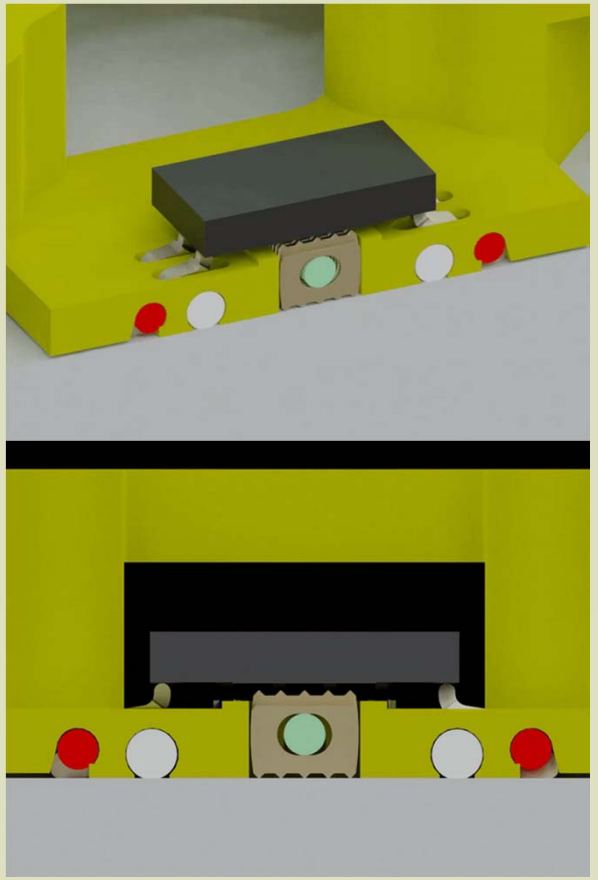
- Small package capable
- Very easy to replace
- Zero compliance
- Forces vary depending on the handler and plunge depth
- Very difficult to clean
- No self cleaning
- Contact resistance and RF performance depends on contact area

Introducing Blade Compliant Ground (BCG)









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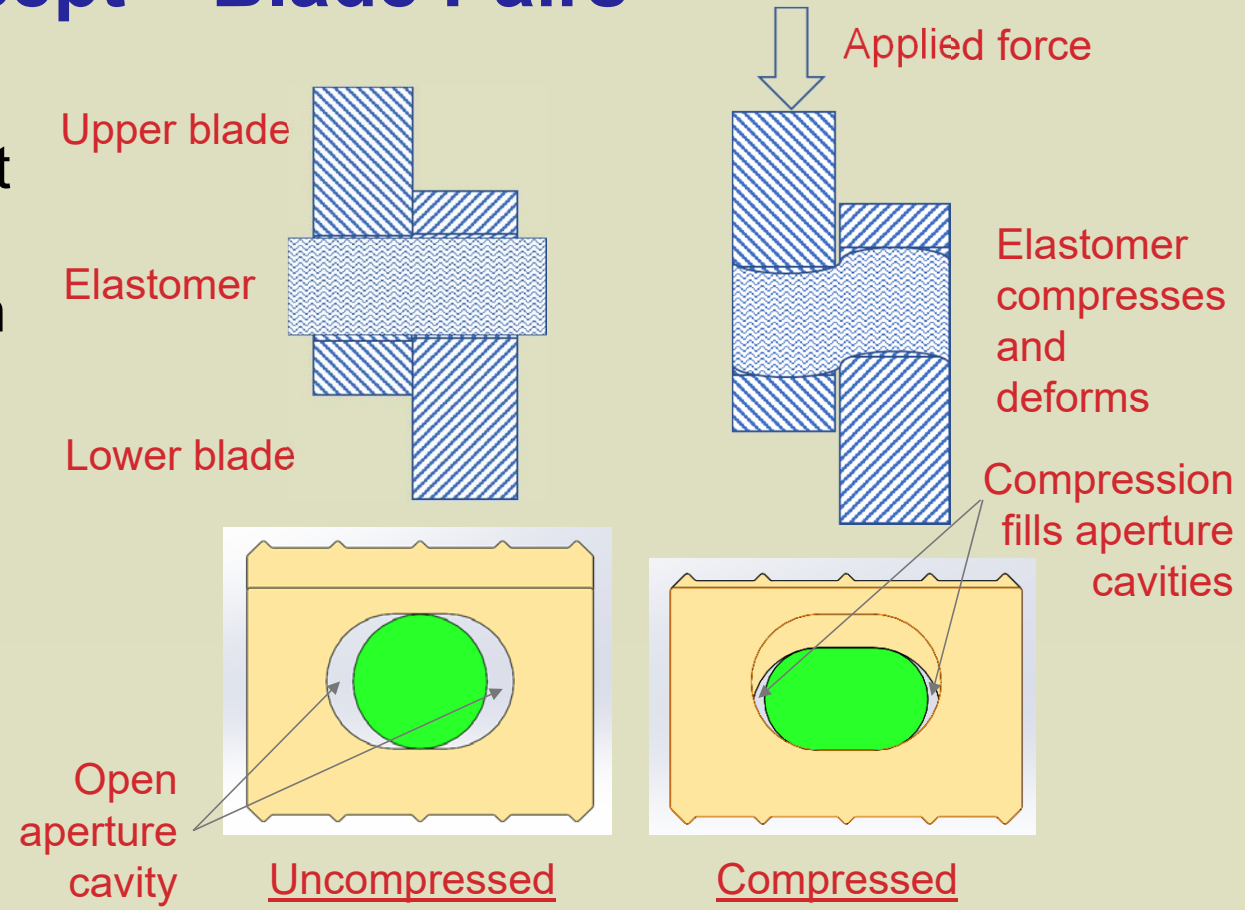
Concept – Blade Pairs

- Upper and lower plates slide up and down against each other making electrical contact between the DUT and loadboard.
- Elastomer installed in hole compresses and deforms.
- Elastomer compression and elasticity applies the contact force.



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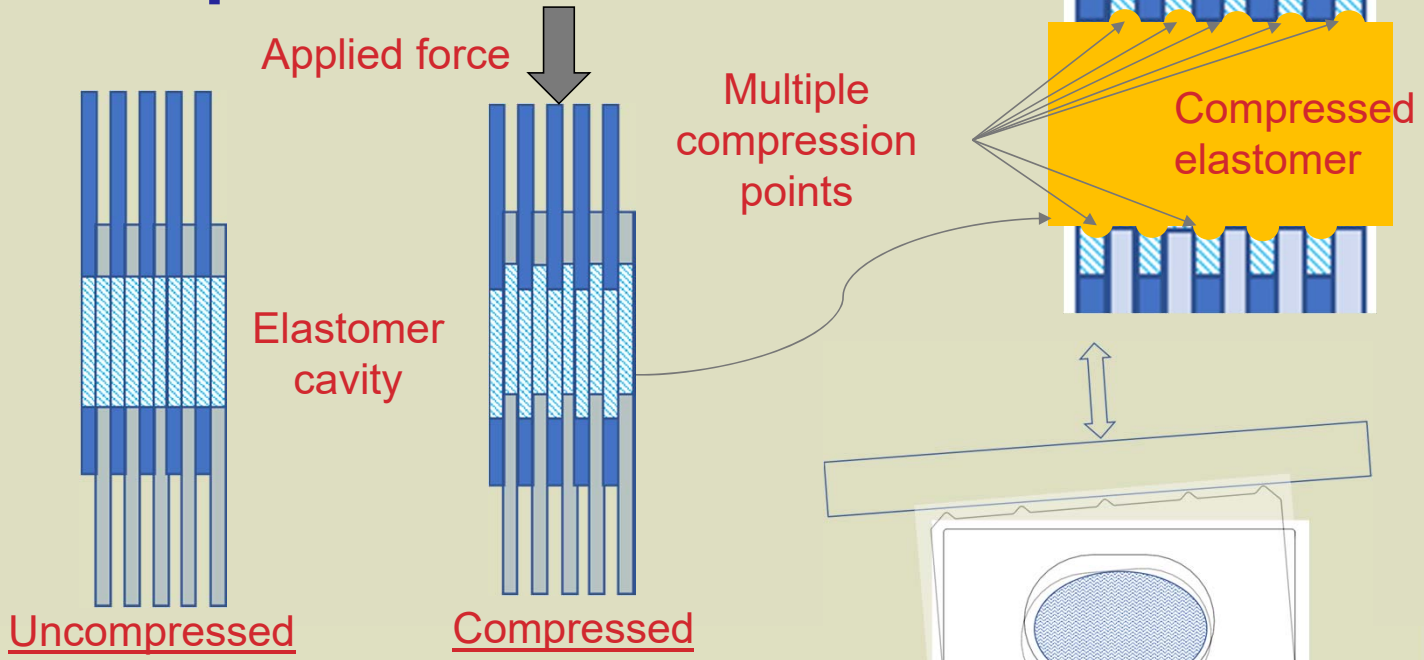
Concept – Blade Stacks

- Multiple blades distribute load over elastomer length.
  - This causes the elastomer to expand into open aperture cavities.
- This design allows for a gimbaling motion.
  - Accommodates devices that are not inserted flat.
  - Allows for pads that are not flat.



BCG compliance allows for non-planar DUT presentation

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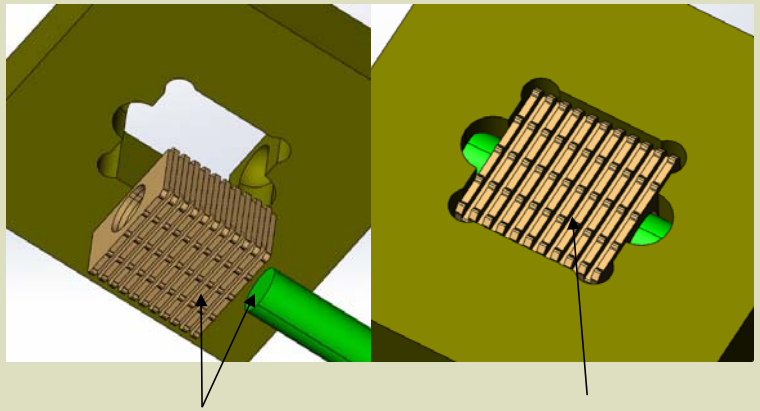
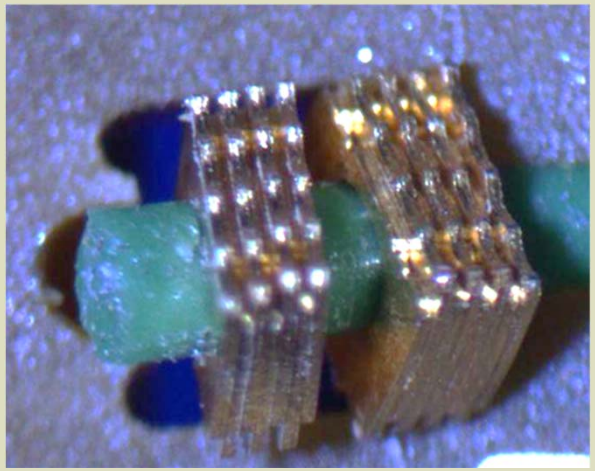
Construction



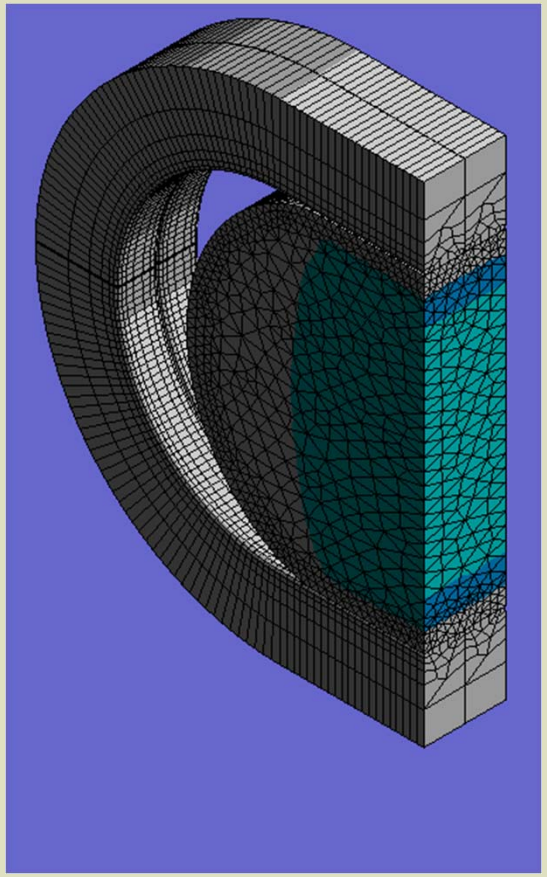
Blades are stacked onto elastomer.

Cartridge is installed into housing



- The blades are stacked together, alternating up and down until the length of the contact needed is met.
- The blades are then stacked onto the elastomer using special tooling.
- The assembled blade cartridge is then inserted into the housing.
  - The pocket walls keep the blade stack together.
  - The elastomer slot keeps the elastomer in place and applies the contact preload to the loadboard.

Simulation – Mechanical

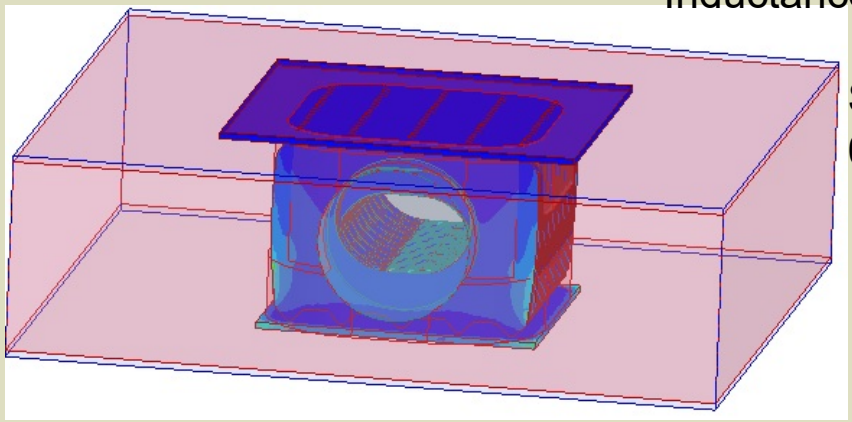


Nonlinear hyperelastic simulations:

- We've been able to successfully model how our elastomers behave between the blades of the BCG.
- Using ANSYS we can simulate the stress within the elastomer and the force it exerts on the blades.
- With these stress and force values, we can predict:
  - How to maximize the life of the elastomer and blades.
  - What the force of the contact on the DUT and loadboard will be.
- Simulated forces were approximately 120g per cartridge of 19 blades or 6.3g per blade. During testing, measured forces were within 10-15% of these values.

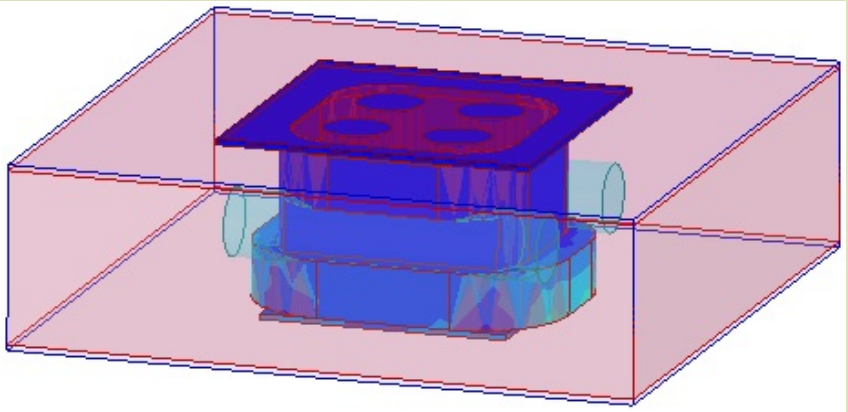
Simulation – HFSS Electrical

Inductance of a 3mm X 3mm device

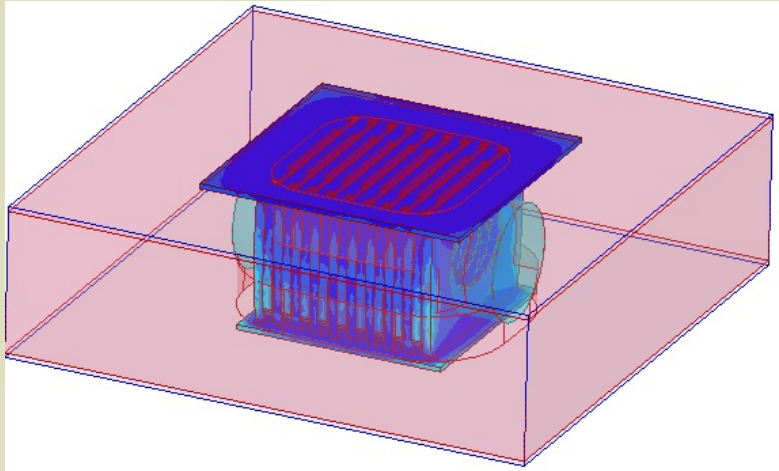


Standard tip design blade BCG
0.75mm TH – 0.046 nH

0.75mm TH =
ROL100A test height



Blades are configurable to meet customers electrical specifications and needs

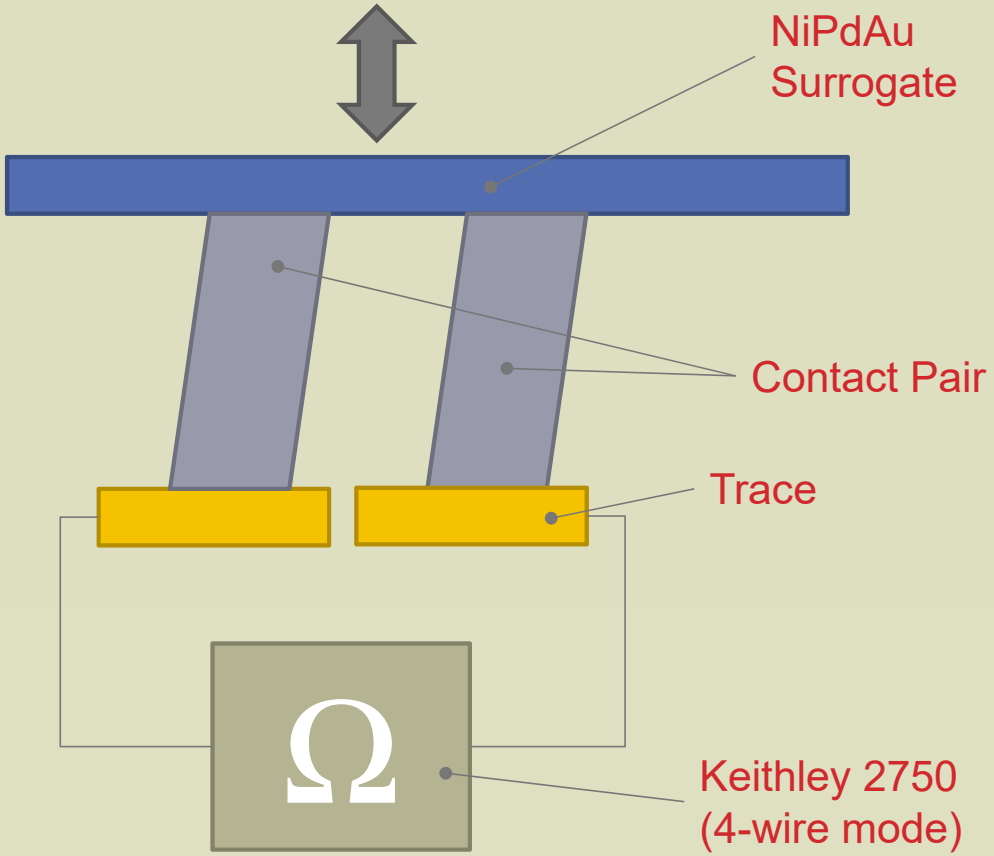


Solid ground CI
0.75mm TH - 0.0356 nH

Alternate tip design blade BCG
0.75mm TH – 0.034 nH

Testing – Contact Resistance Method

- NiPdAu fresh/unused surrogate is cycled on the contact array.
- Provides a CRES vs. Cycle plot comparing the BCG at different temperatures.
  - Customers require operation at ambient, hot, and cold.
  - Materials need to be validated at all operating temperatures.
- The “Average CRES” is defined as follows:
  - Every 100th insertion, the CRES was measured through each of 4 sets of 2 pin/pairs.
  - The average is taken of the 4 data points and reported.
  - The graphs report a moving averaged trendline of the data described above.

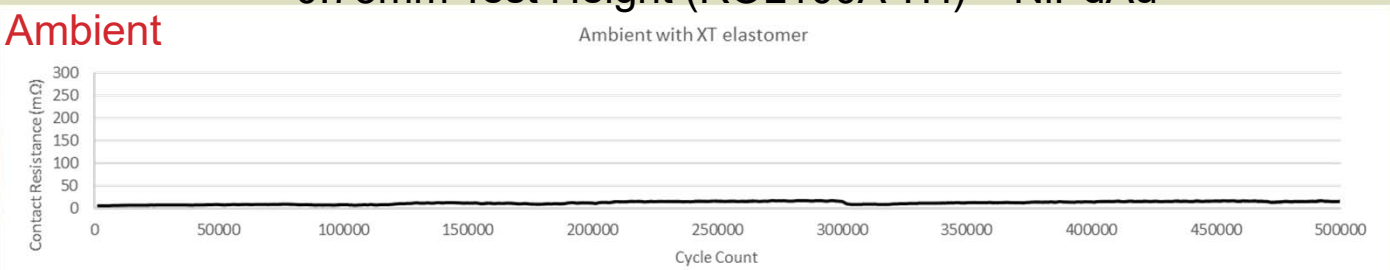


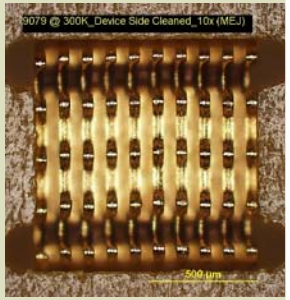
Testing – Contact Resistance

0.75mm Test Height (ROL100A TH) – NiPdAu

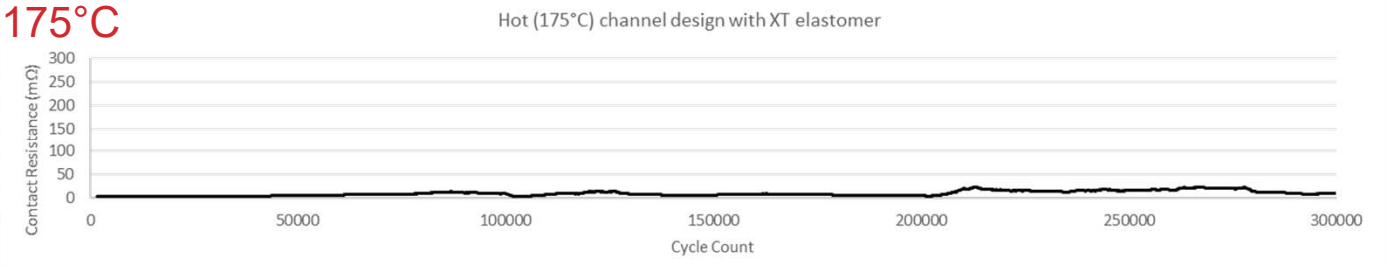
End of life wear images

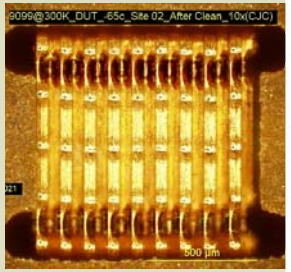
Ambient



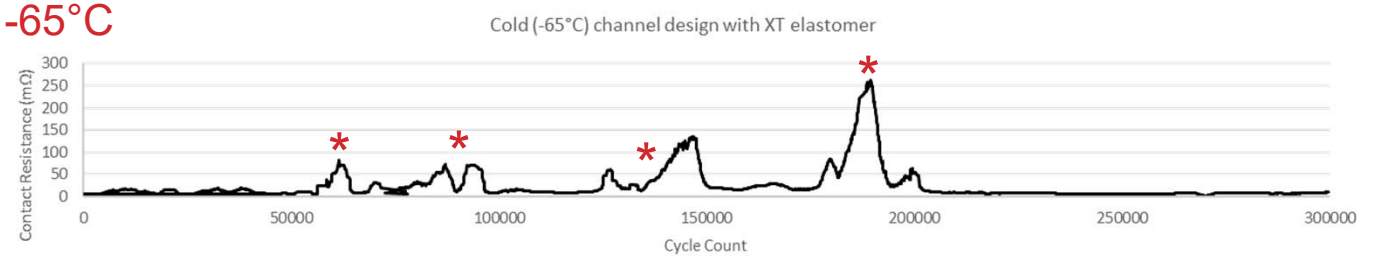


175°C





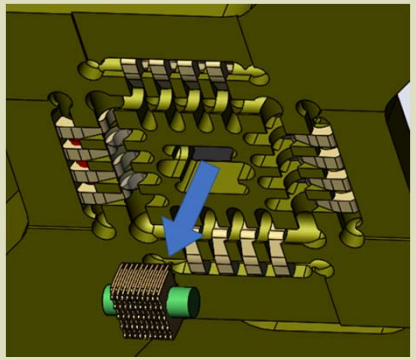
-65°C



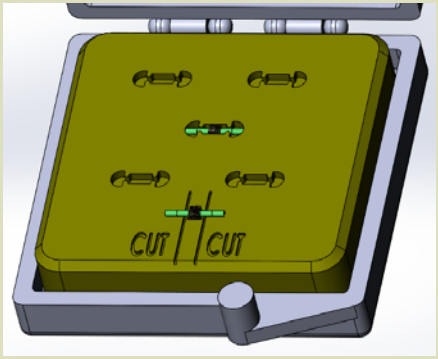
*Spikes in data are caused by test apparatus freezing in a humid environment

Serviceability

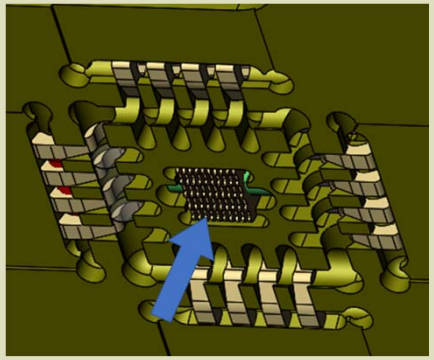
Replacement



Remove used cartridge

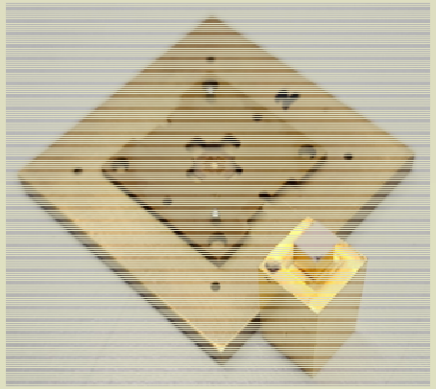


Trim elastomer of new cartridge using shipping container

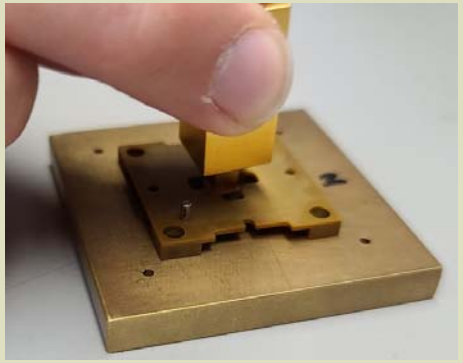


Install new cartridge

Manual Cleaning

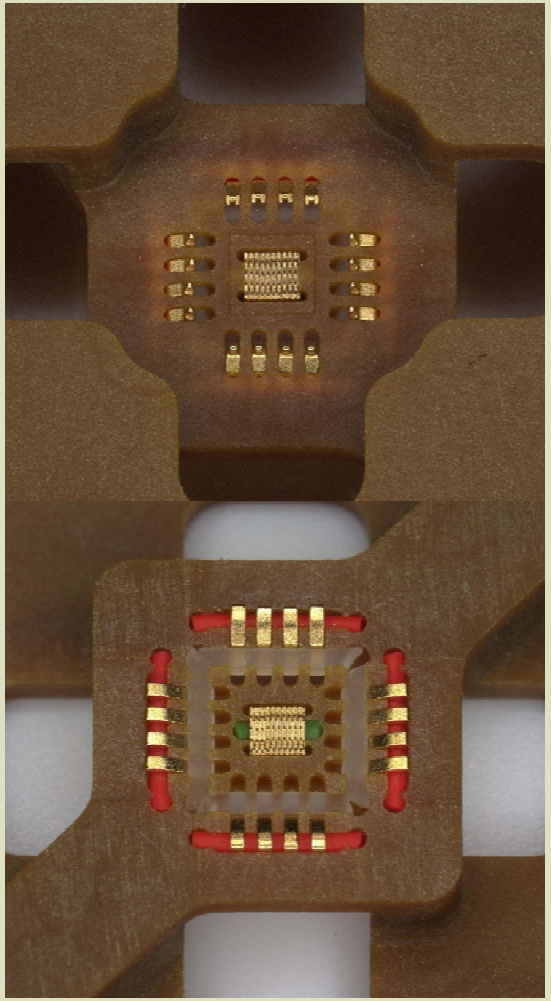


Cut a small piece of Mipox abrasive foam



Actuate the ground contact approx. 10 times

Automated surrogate cleaners in handlers will work as well



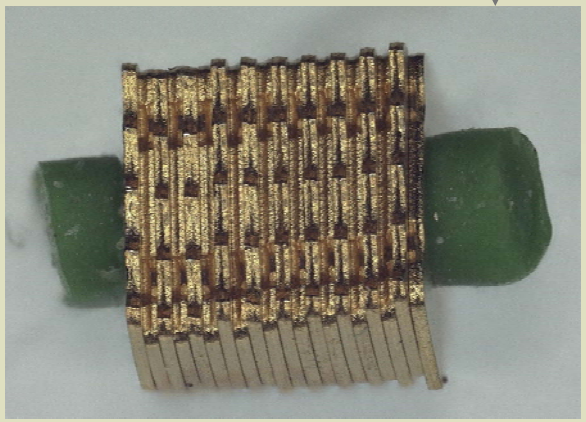
Deployment

The BCG was built into a customer contactor and is currently being evaluated:

- QFN
- 3mm X 3mm
- 16 pad
- 0.5mm pitch
- 1.4mm X 1.4mm gnd pad
- NiPdAu

This was just *one* application; the BCG cartridge is customizable in length and number of contacts.

…just to get an idea of the size!



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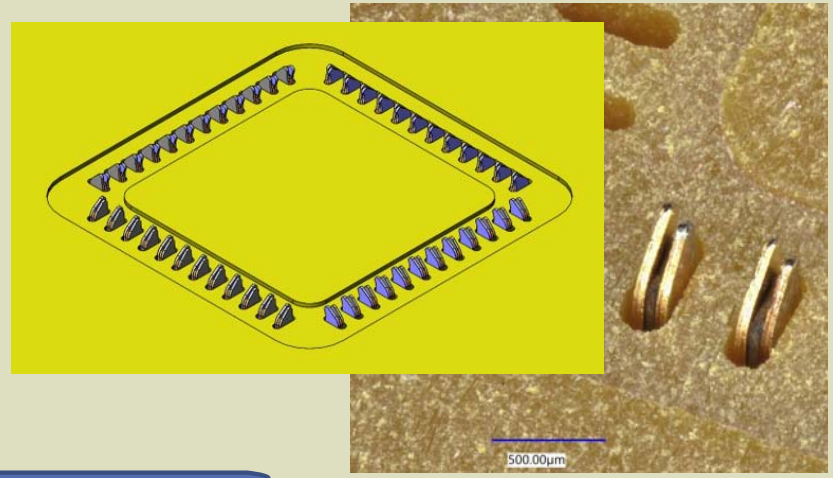
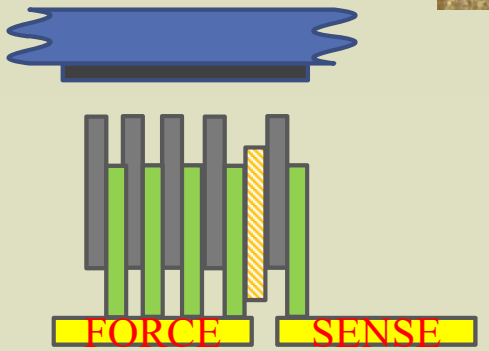
Future Blade Application – Blade Touch Kelvin

- Blades are stacked to match high-power module power pads and grounds.
  - Force pins can be stacked for high power while sense pins can be a single blade pair.
- Insulative layer insures isolation between force and sense stacks.





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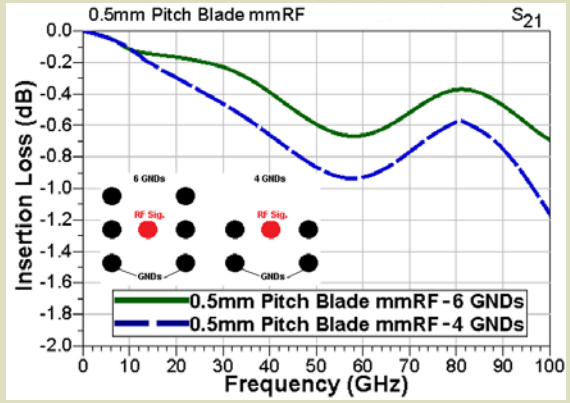
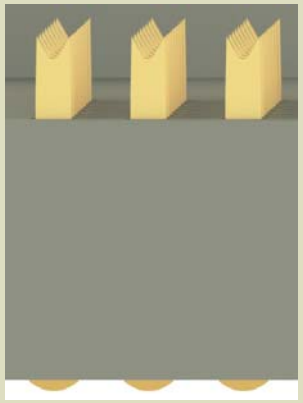
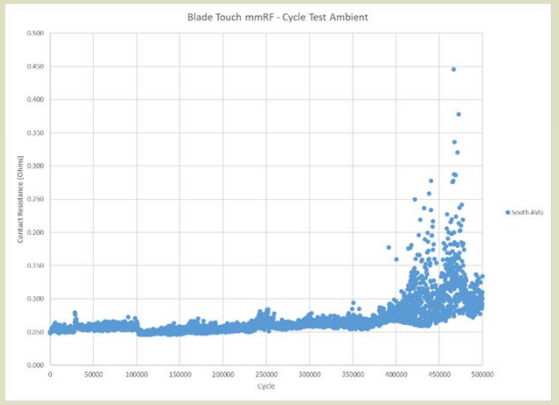
Future Blade Application – Blade Touch mmRF

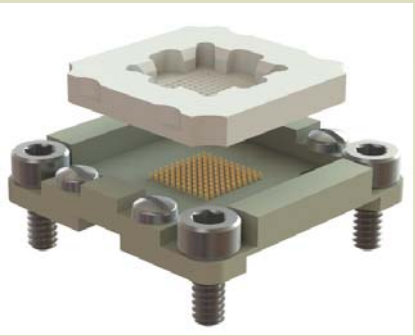
Ultra Short Contacts for High-Speed Contacting

- Ideal fit for 5G and ADAS applications for BGA/LGA and peripheral packages.
  - Extremely short contact heights ≈ 1.0mm
  - Spring probe comparable compliance.
  - 100 GHz + insertion loss.
  - Low and stable contact resistance.









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Summary

- The Blade Compliant Ground (BCG) is designed for small package devices and is available in both 0.75mm and 1.4mm test heights.
- The technology works by electrical connection through blade pairs and force distribution along the elastomer with the blade stack.
- The blades are thread onto the elastomer, alternating up and down. Then the assembled “cartridge” is pressed into an opening in the contactor housing.
- We can accurately simulate elastomer forces and inductance for a given grounding solution.
- The BCG exhibits excellent life at ambient, hot, and cold temperatures.
- The ground cartridge is easy to clean and replace.
- The BCG is highly customizable to fit both customers electrical and size specifications.

Thank You!

Johnstech Teams:

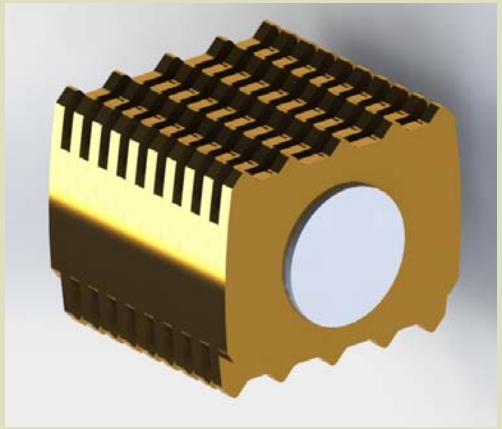
Custom Products Engineering

Standard Products Engineering

Test Lab

Design and Drafting

Field Service



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