

# Gel-Pak®

*Protecting the World's Valuable Devices*

## LCS2® Lid-Clip Super System

**Darby Davis**

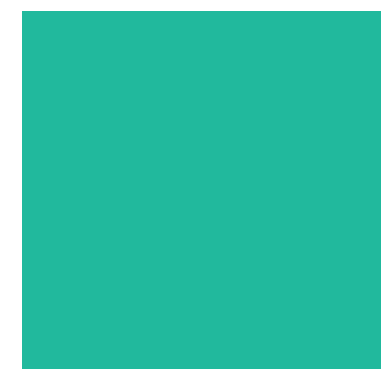
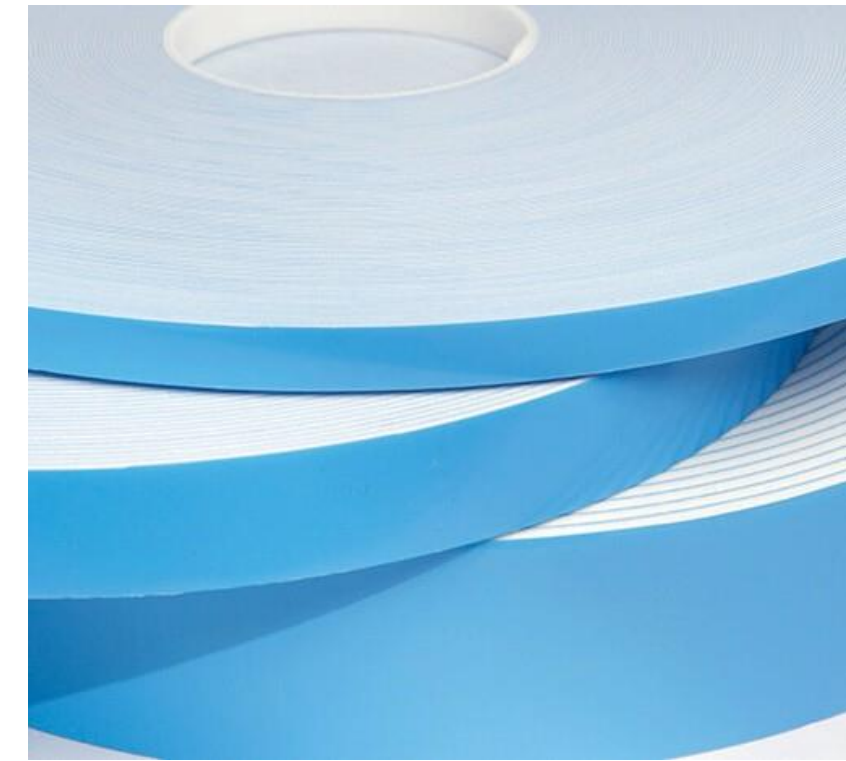
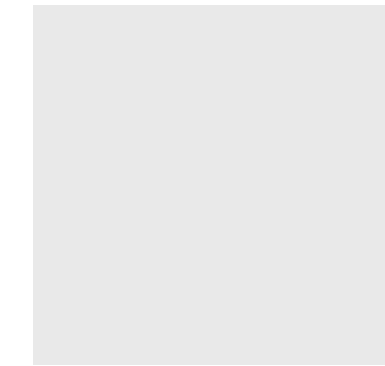
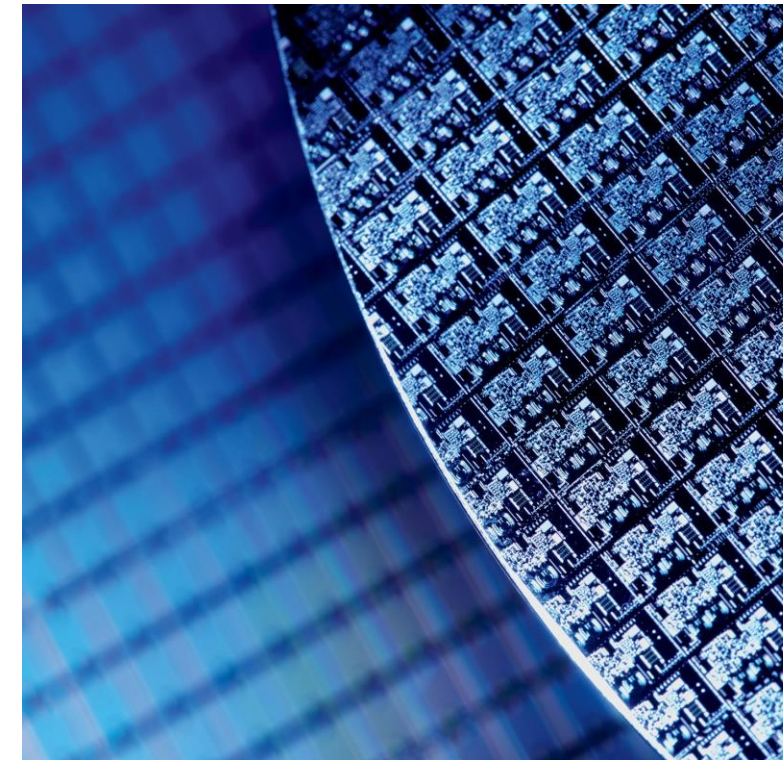
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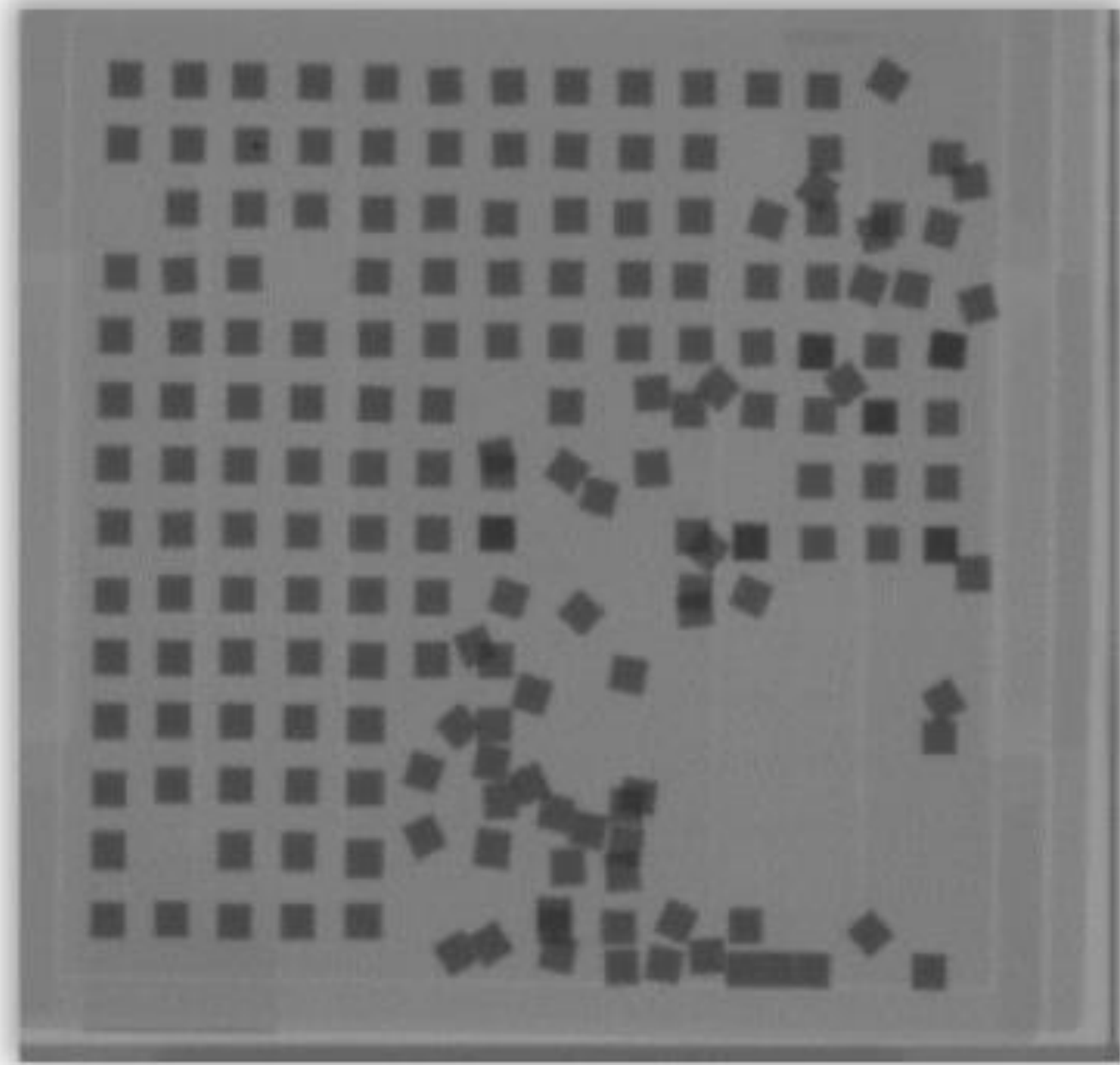


**BAE SYSTEMS**





# ELIMINATING COSTLY DIE MIGRATION ISSUES



Eliminate Costly Die Migration  
Defect Condition  
During Semiconductor IC  
Packaging/Transport/Handling

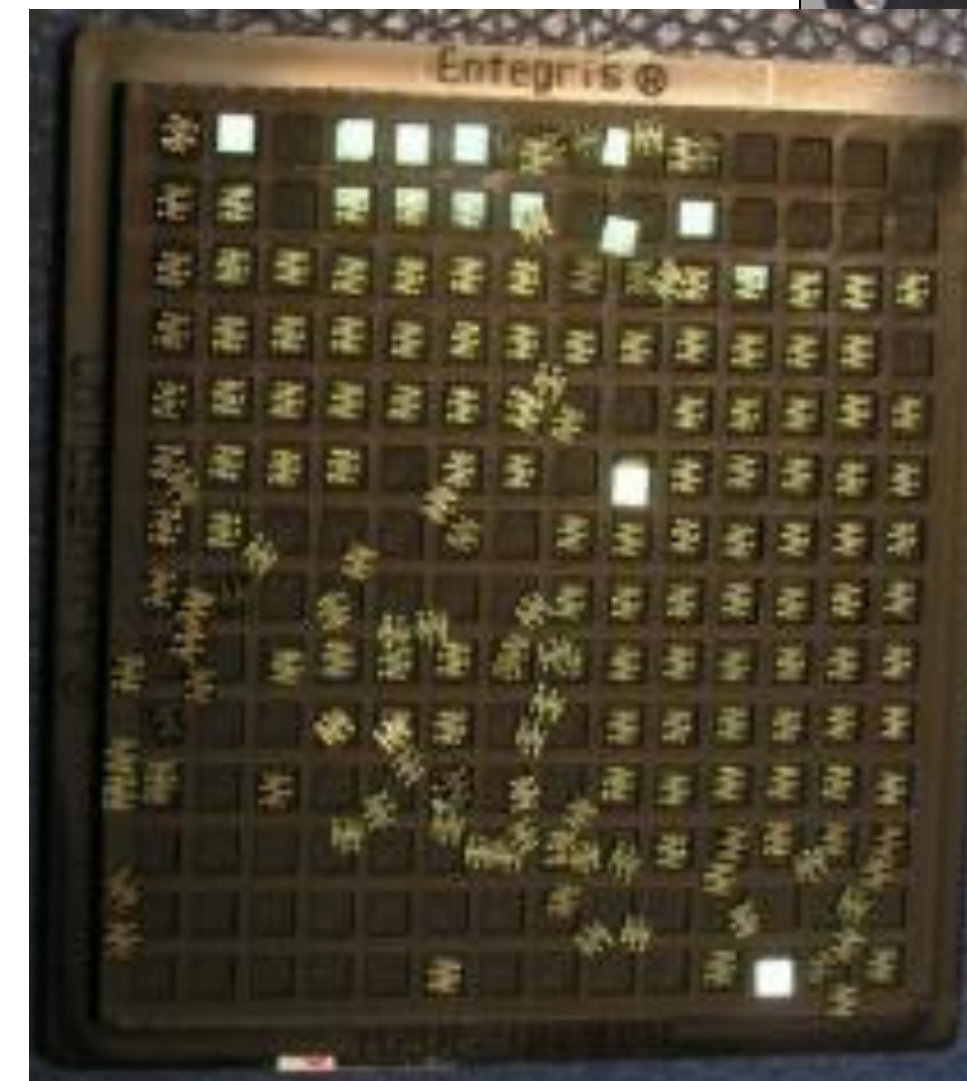
- Packaging, shipping and handling of thin devices using waffle packs with traditional lid and clip can cause die migration as shown in x-ray above
- BAE Systems partnered with Gel-Pak to solve this costly industry wide Component-Out-Of-Pocket (COOP) issue for thin  $\leq 0.010$ " devices shipped in waffle packs
- Novel Lid & Clip System developed by **BAE Systems** and **Gel-Pak**

# WAFFLE PACK DIE MIGRATION COST DRIVERS

For decades die migration for thin devices ( $\leq 0.010$ -inch,  $\leq 250\mu\text{m}$ ) has occurred at **suppliers, during transit, and in end user stockrooms/factories**, driving up costs in the business.

**Cost of Poor Quality due to Die Migration =  
Millions \$\$ Across Industry**

- Military aerospace and commercial manufacturers **worldwide** are incurring these unnecessary costs in the form of:
- Component damage and scrap
- Non-value added labor to inspect and re-order components
- Quality Management System administration labor
- Production interruptions
- Decreased pick and place machine utilization



**COOP IS INCOMPATIBLE WITH  
AUTOMATED ASSEMBLY**

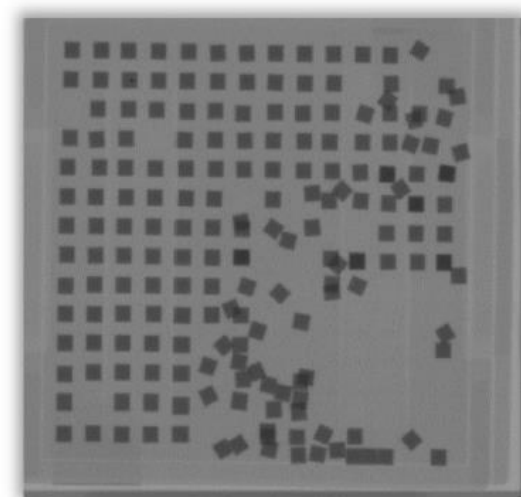
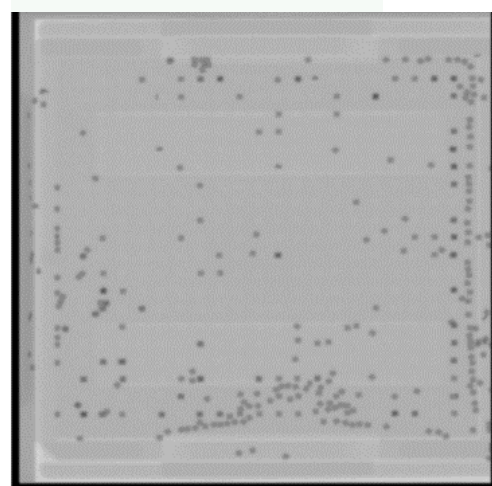


# IDENTIFICATION OF DIE MIGRATION USING X-RAY SYSTEM

**Gel-Pak**

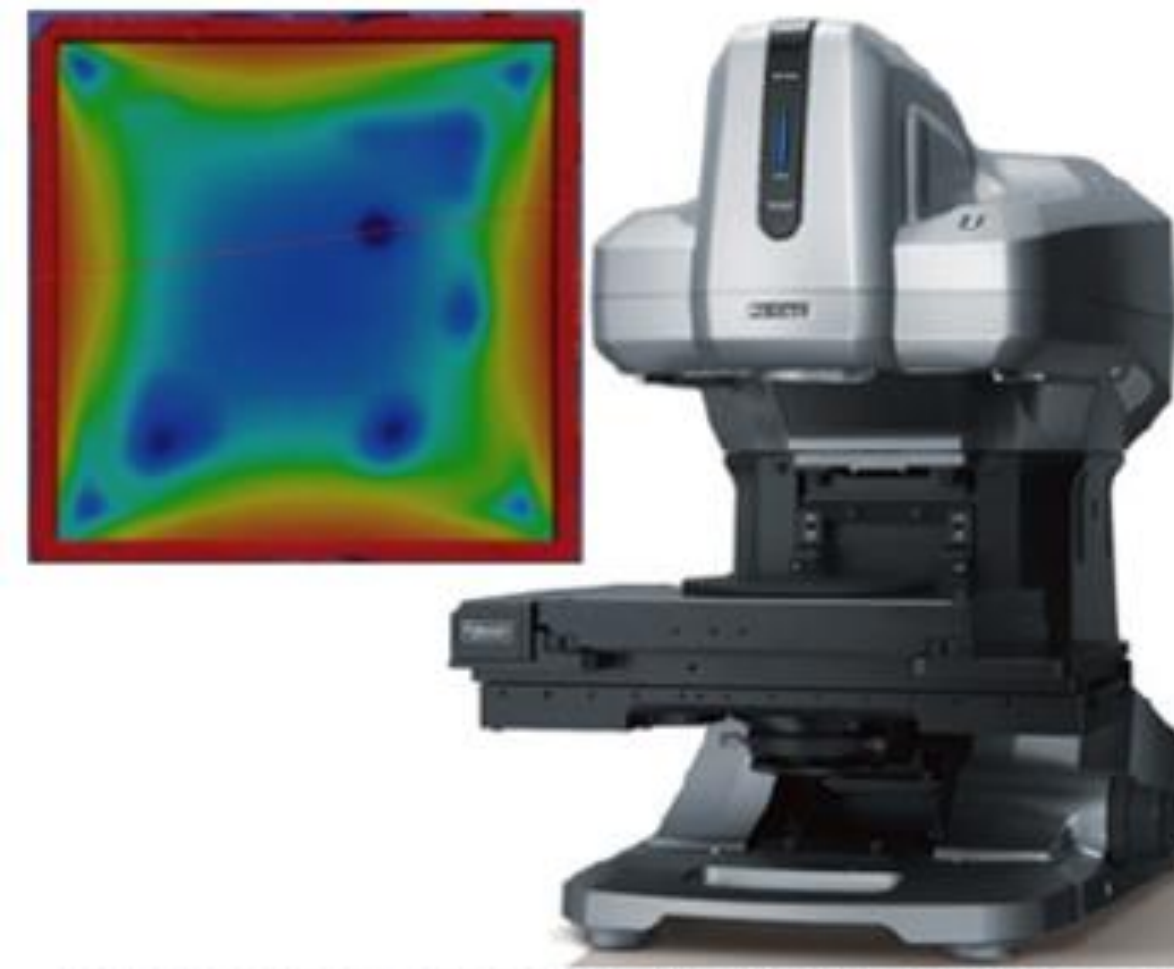


VJ ELECTRONIX MODEL X-QUIK II PLUS X-RAY 2017



Technologies Key to Understanding Root Causes of Component Die Migration

X-ray and 3D measurement

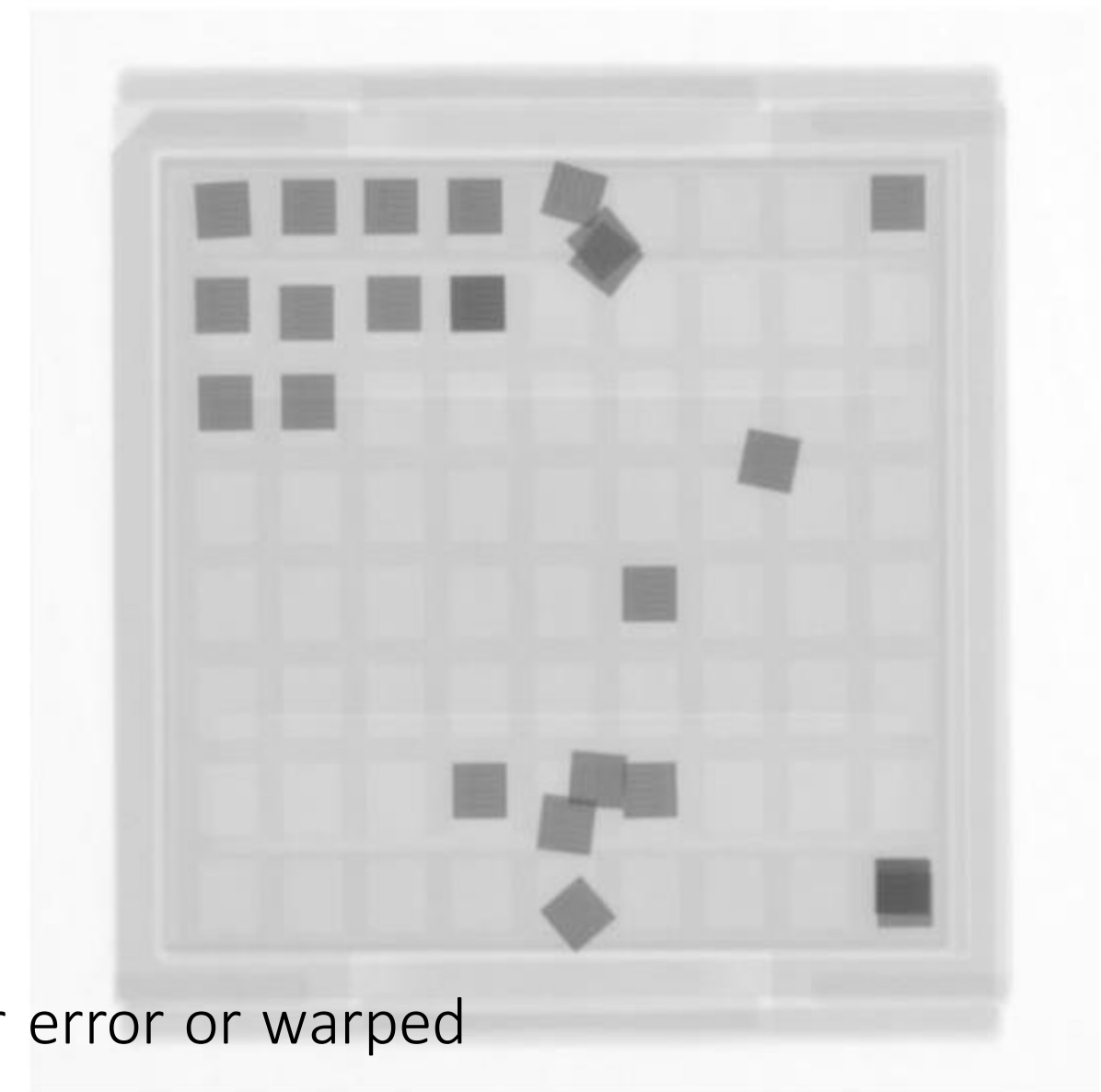


KEYENCE VR-3200 3D MEASUREMENT SYSTEM, 2018

# ROOT CAUSES OF DIE MIGRATION

**Gel-Pak®**

- Warped injection molded waffle pack trays and lids
- Misaligned and pinched non-woven polyethylene inserts (Tyvek paper)
- Deformation of lids and trays using industry standard one-piece clip
- Components not sitting flat in chip tray before lidding
- Stacked components (2 or more components in 1 pocket) caused by operator error or warped lids
- Residual adhesives on lid from tamper label allowing lid to fall on top of tray
- Operator dependent assembly process involving industry standard materials
- Removing clip to apply bottom side label to waffle pack
- The unlimited reuse of clips which may be worn or broken
- Bump lid failures as demonstrated with thin components





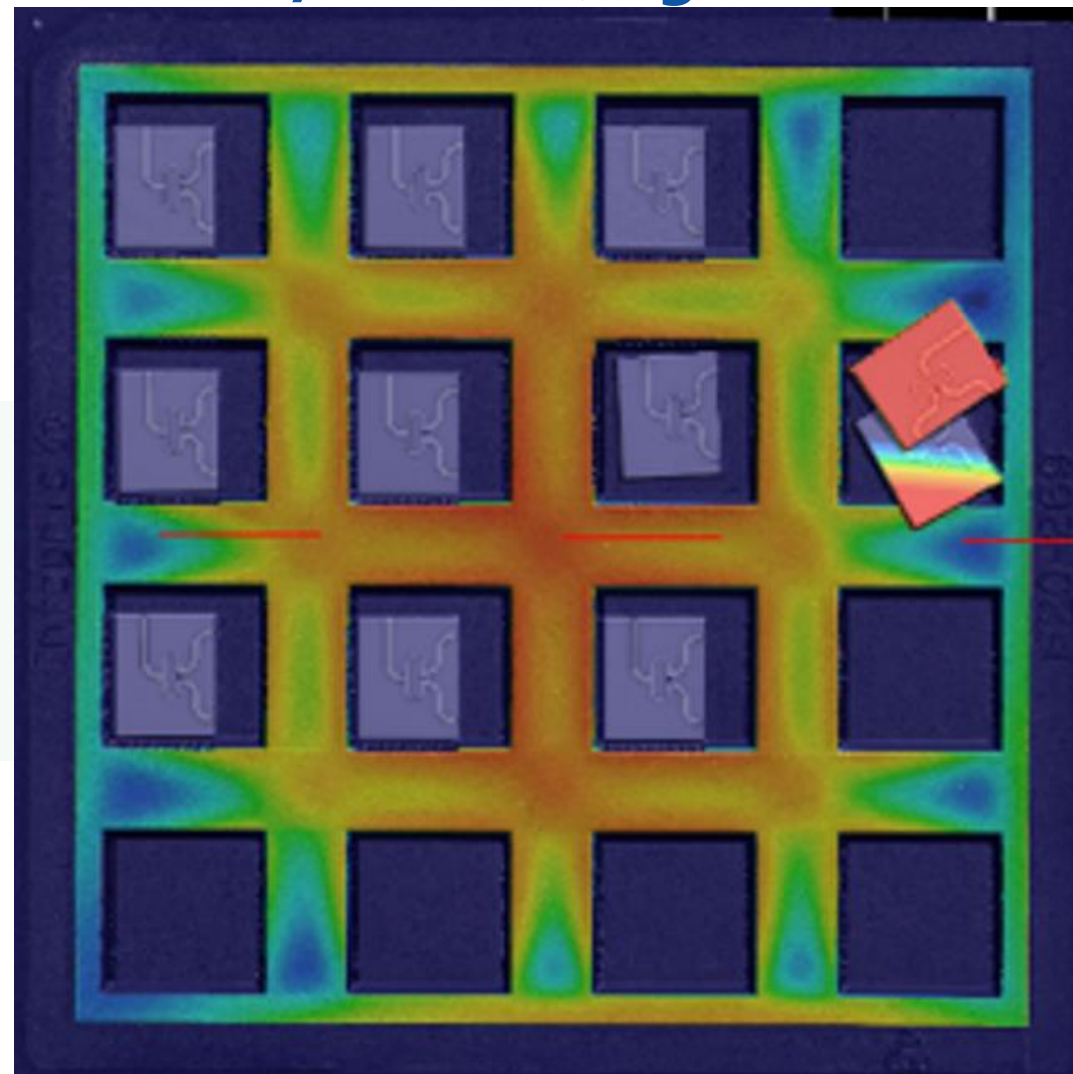
# THE ROLE OF TRAY AND LID WARPAGE



- Combined warpage of carbon loaded PP lid/tray stack: up to 0.024"
- Combined warpage of ABS and carbon loaded PC lid/tray stack: up to 0.008"

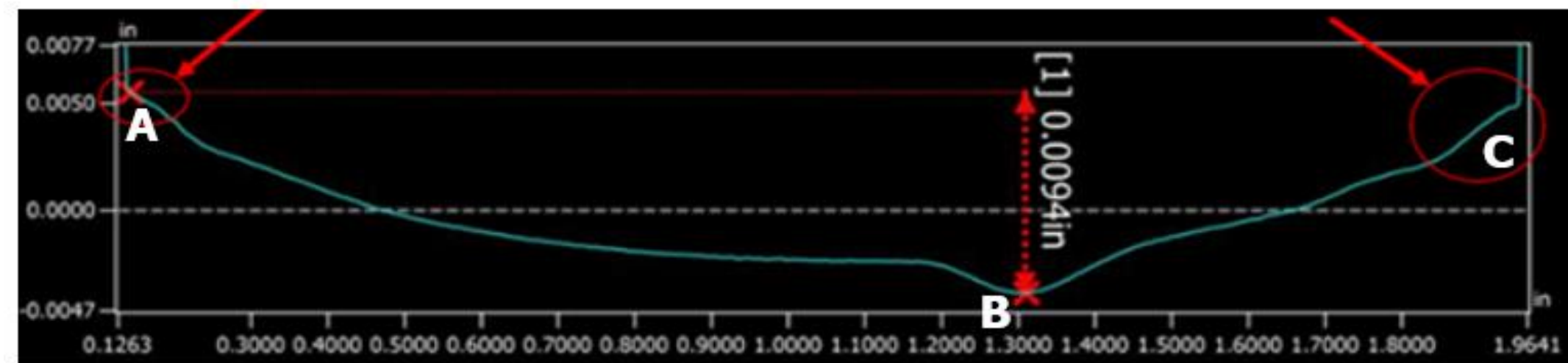
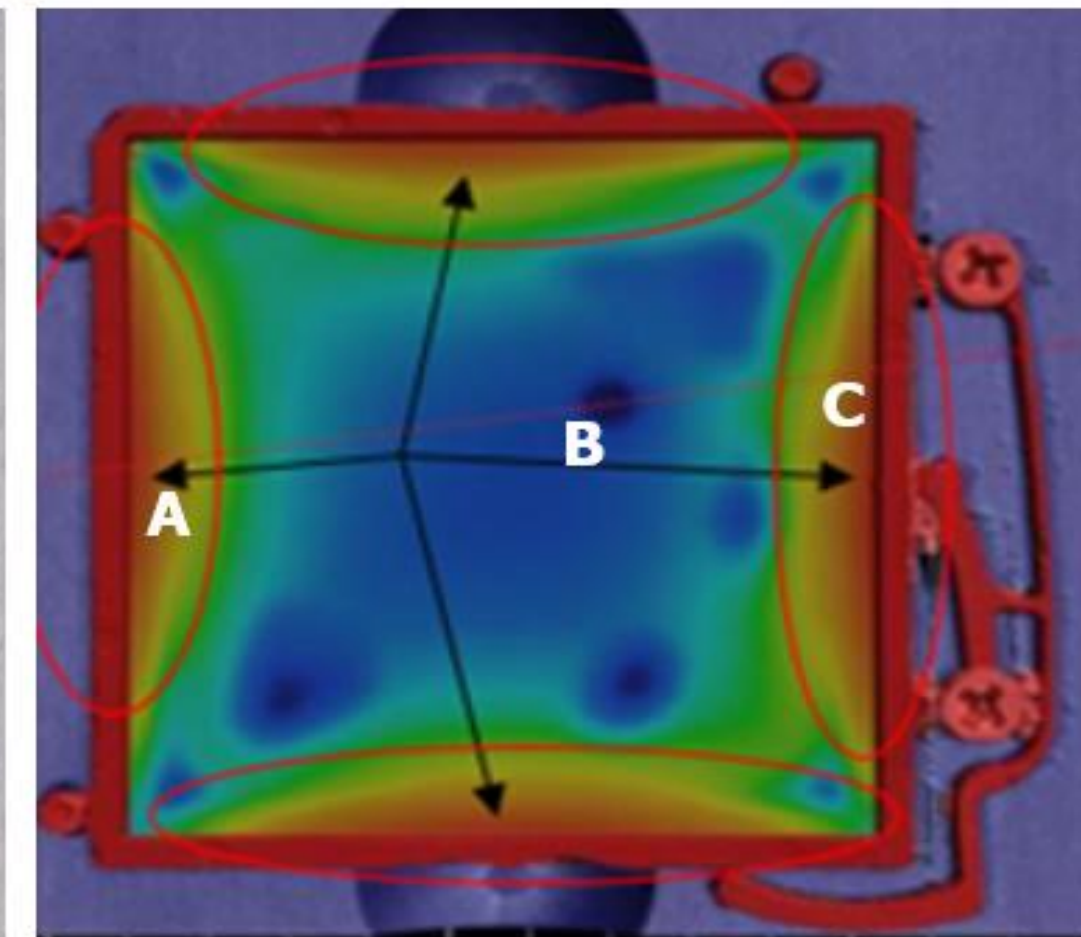
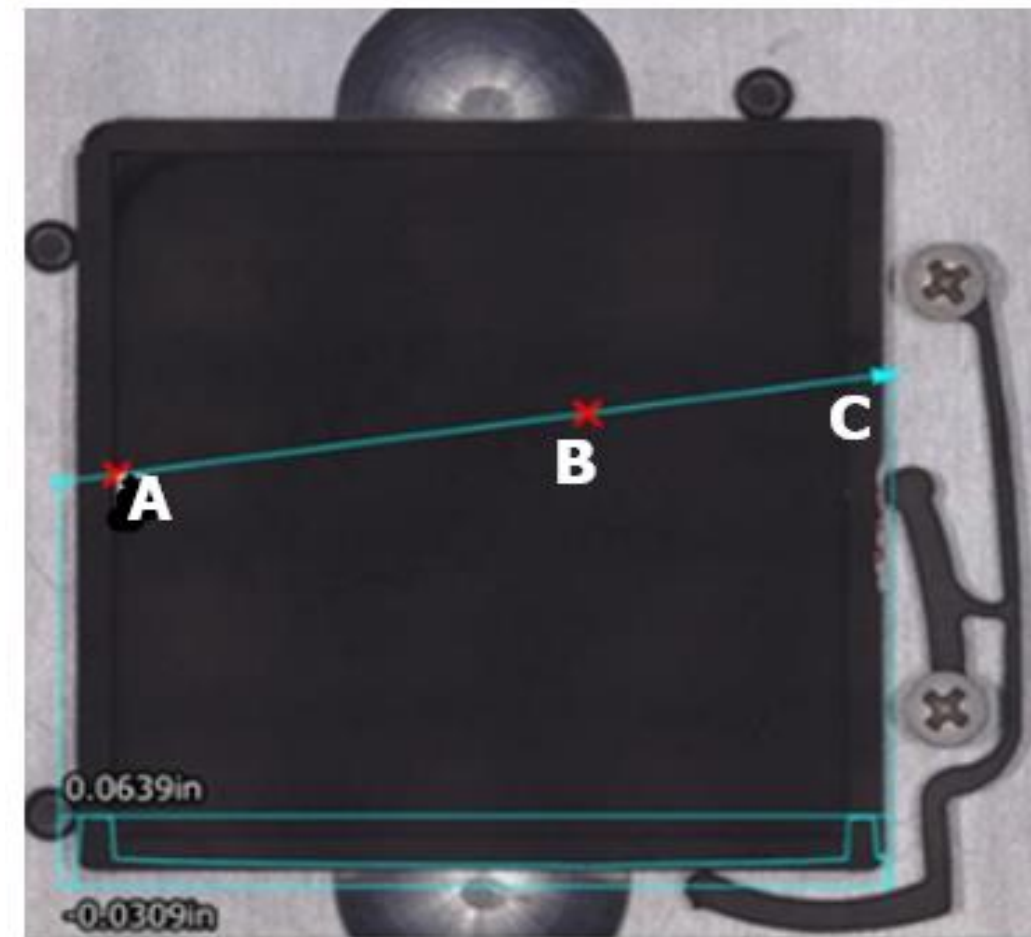
0.0087" Delta (High to Low)

Device is 0.010"



Plenty of gap for a thin die to escape!

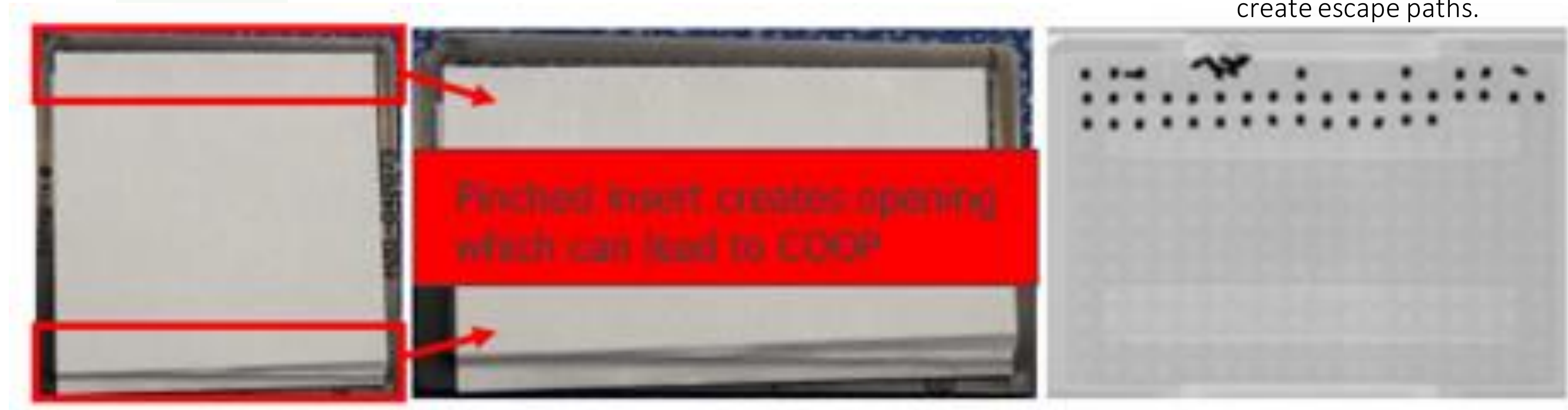
0.0094" Delta (High to Low)



Polypropylene Lid Shown

# MISALIGNMENT AND PINCHING OF INSERTS

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- The intended function is to create a softer surface for sensitive components during shipment.
- Misaligned & pinched non-woven polyethylene inserts during assembly create escape paths.

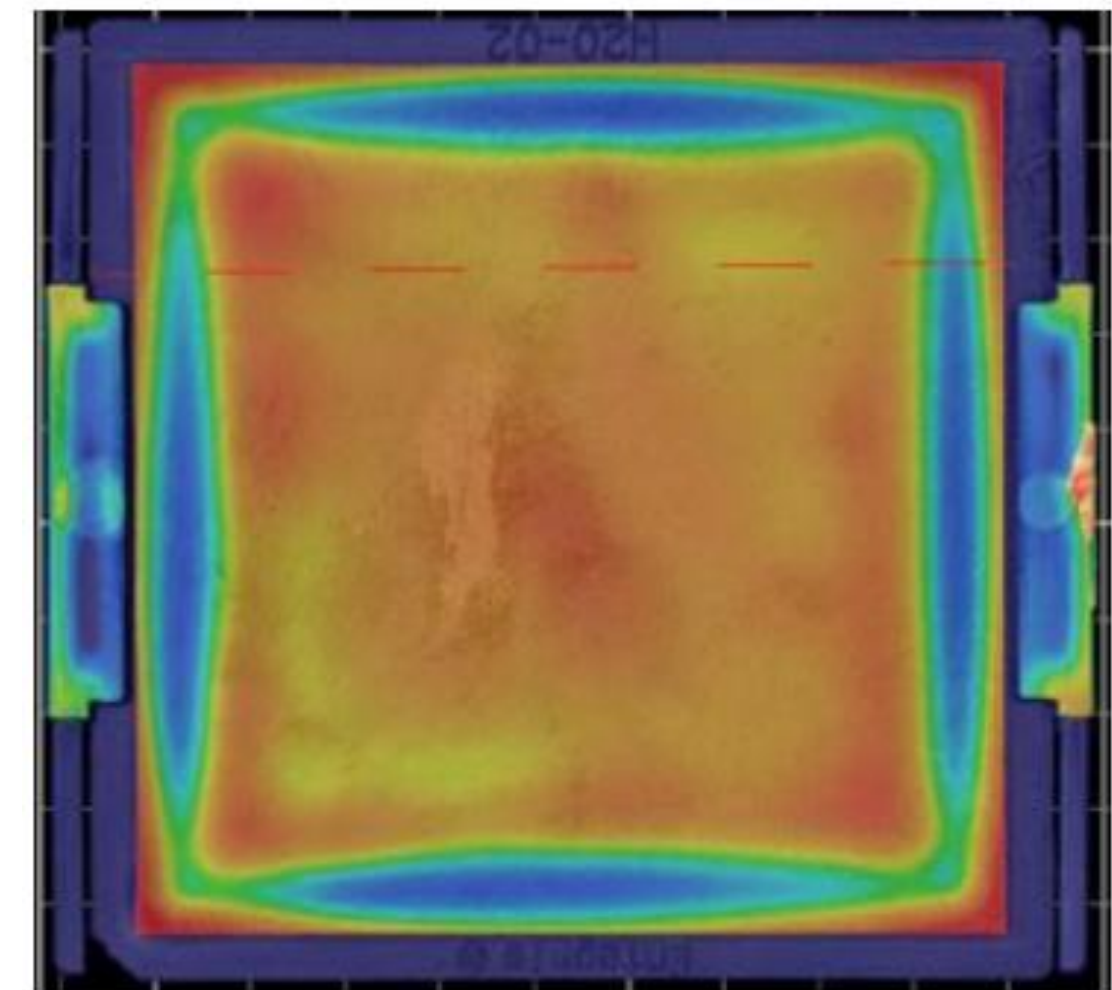
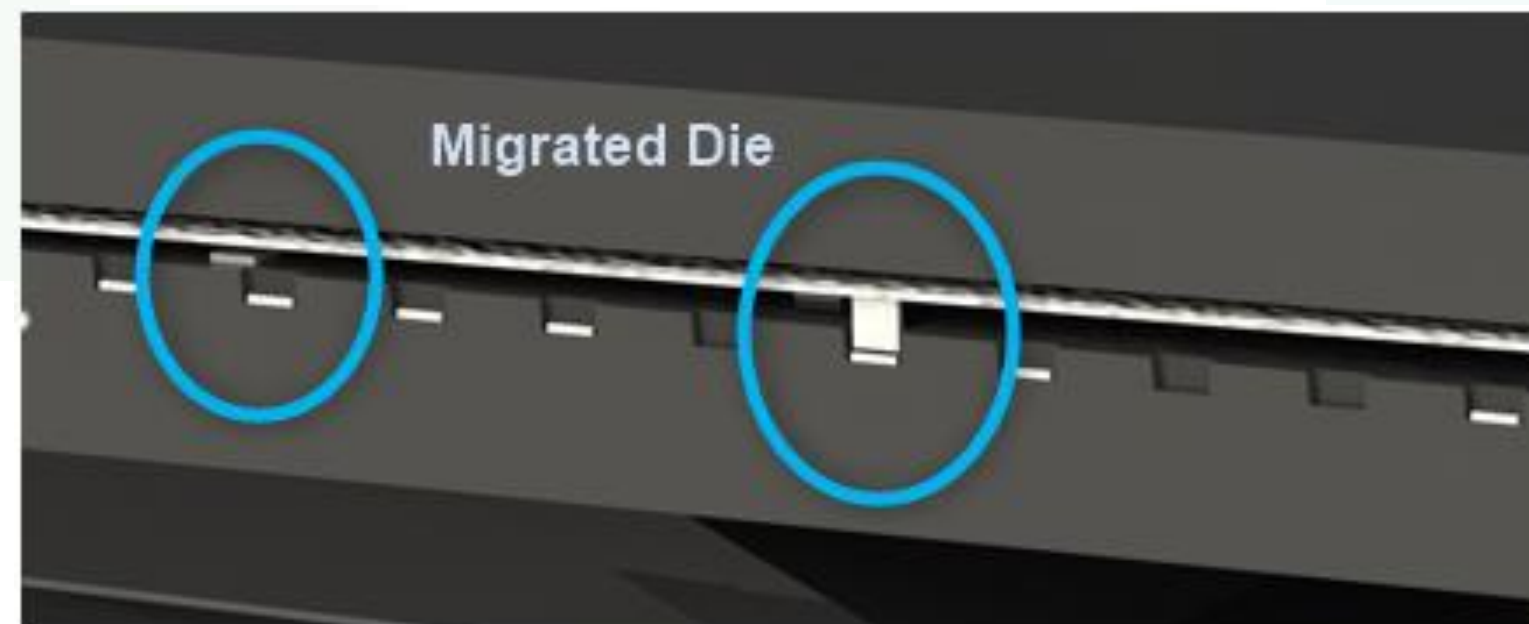
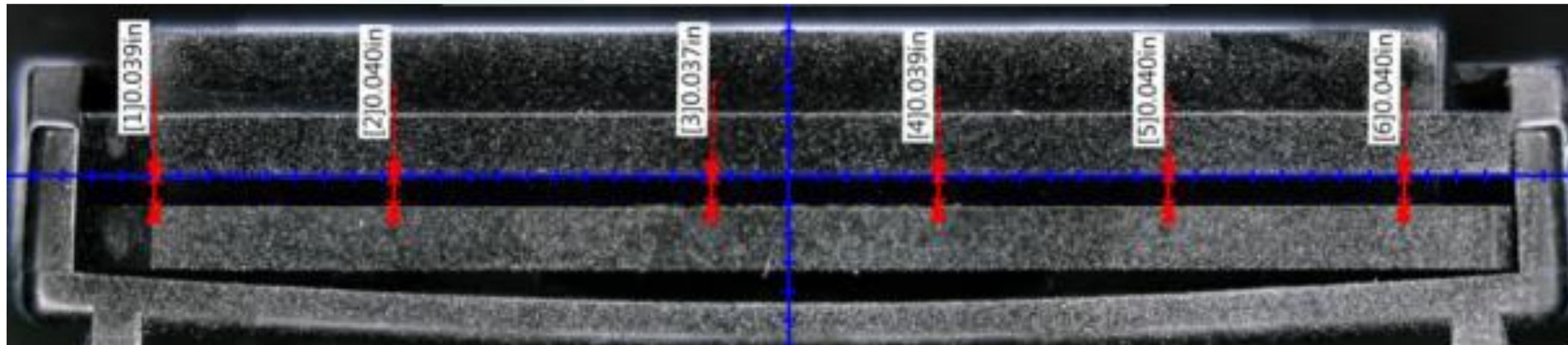
- Common misconception is that inserts prevent die migration – **NOT TRUE**
- Challenging and time-consuming process for operators



# DEFORMATION CAUSED BY USING INDUSTRY STANDARD CLIPS

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- Uneven bending stresses caused by standard clip can cause deformation to the waffle pack lid/clip – which can create gaps
- Clip reuse can magnify the problem





# NEW LID & CLIP REQUIREMENTS TO ELIMINATE DIE MIGRATION

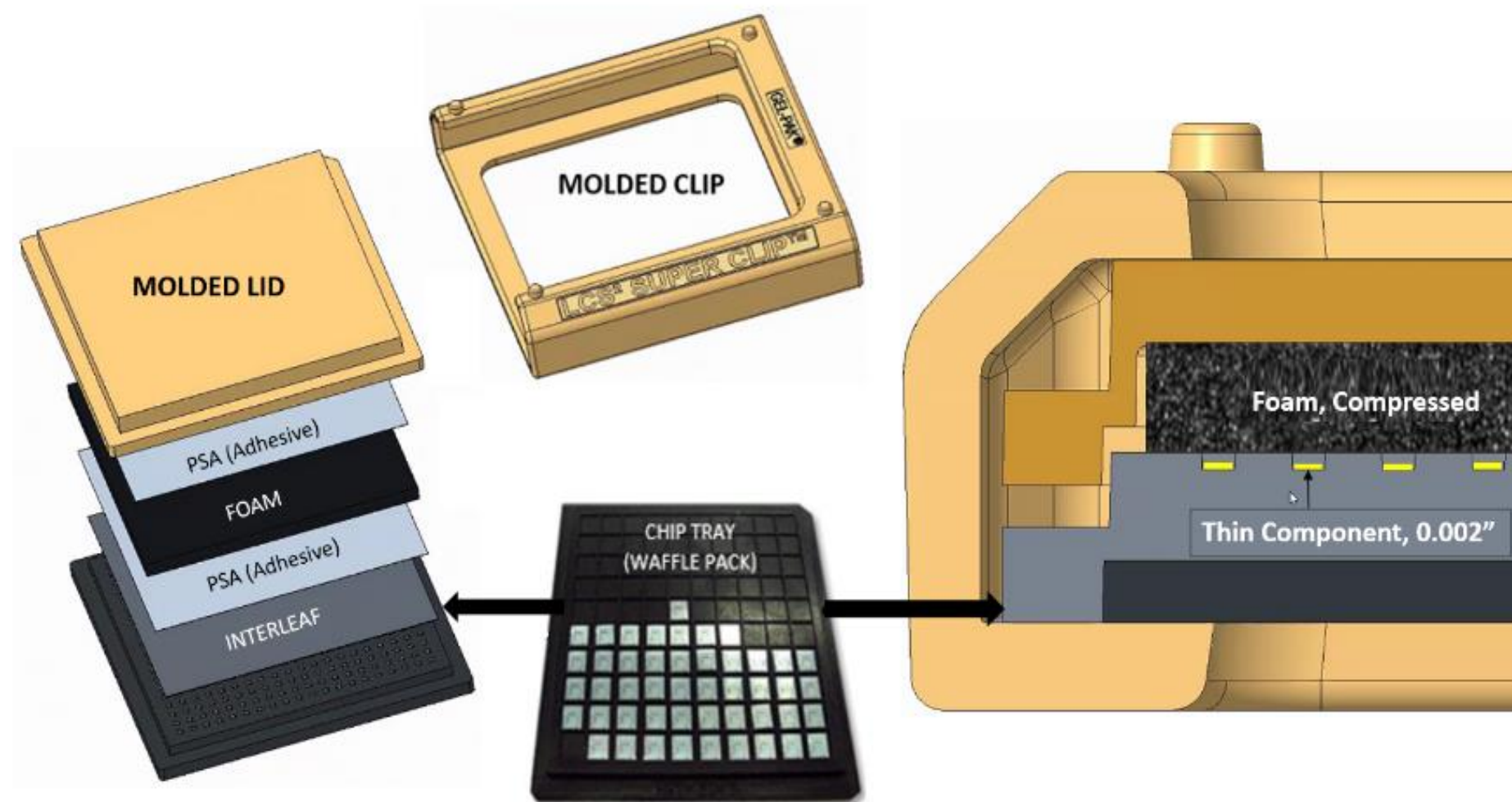
**Gel-Pak**

- Uniformly seal each individual tray pocket
  - ✓ Compensate for waffle pack tray and lid warpage issues
- Be compatible with existing pick & place equipment infrastructure
- Use static dissipative, low outgassing, non-silicone, FOD-free materials that are prevalent in the semiconductor industry
- Develop a methodology to validate that the solution eliminates COOP

# LCS<sub>2</sub><sup>®</sup> LID/CLIP SUPER SYSTEM

**Gel-Pak**

Patented Lid/Clip Super System (LCS2) compatible with standard waffle pack trays designed to seal every pocket in order to establish a COOP-free carrier solution for thin die



- Compatible with standard waffle packs
- No manual placement of inserts
- Labels can be applied to tray or lid without removing clip
- Barcodes can be scanned with clip in place
- Fingers keep constant pressure on lid during removal
- Unique gold color for easy identification
- Stackable

Static dissipative material for the lid and clip was selected and tested per ANSI/ESD S11.11 to provide ESD Class 000 protection for high value devices with the lowest voltage susceptibility thresholds.

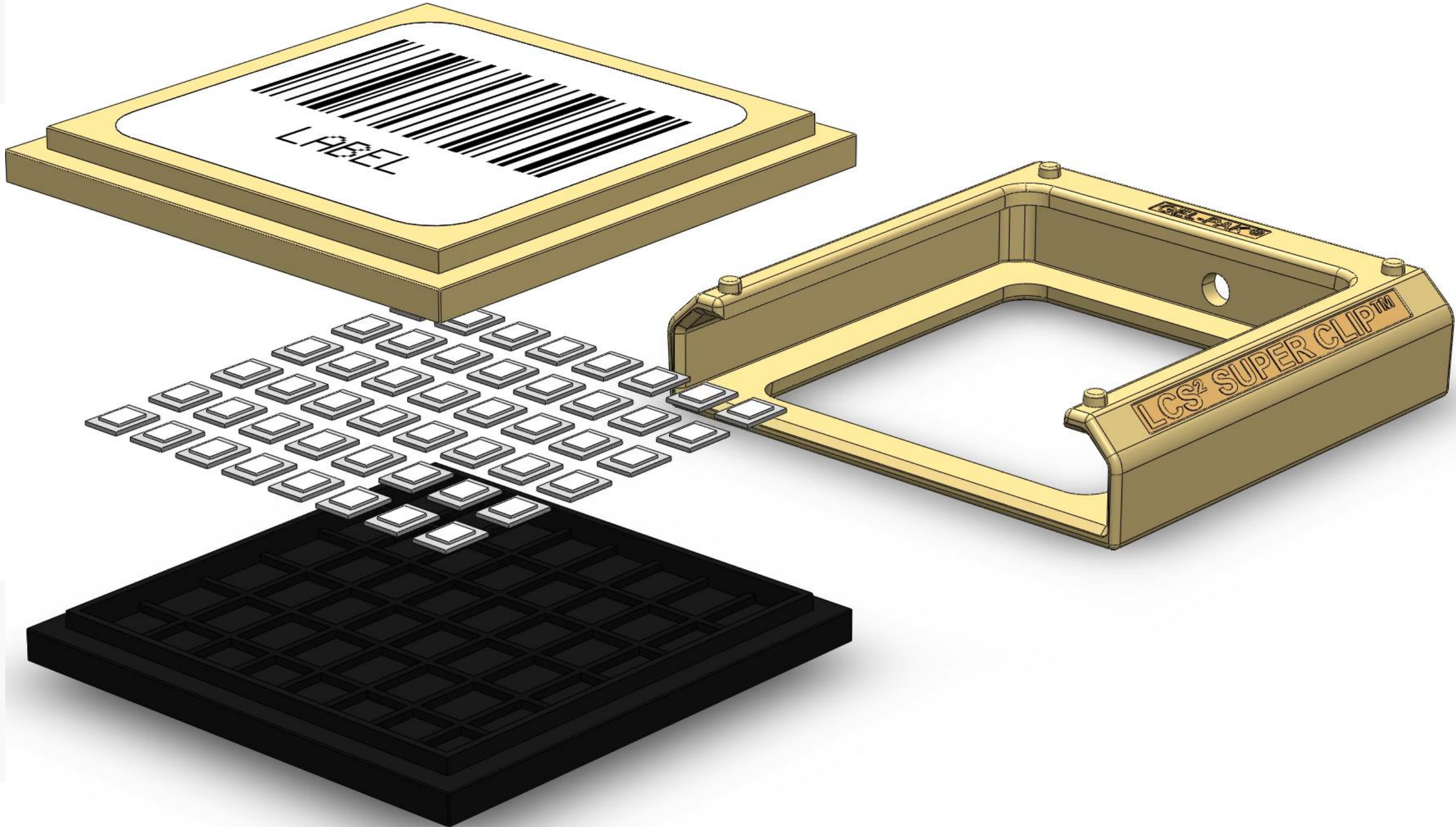
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# LCS<sub>2</sub> ASSEMBLY WITH WAFFLE PACK

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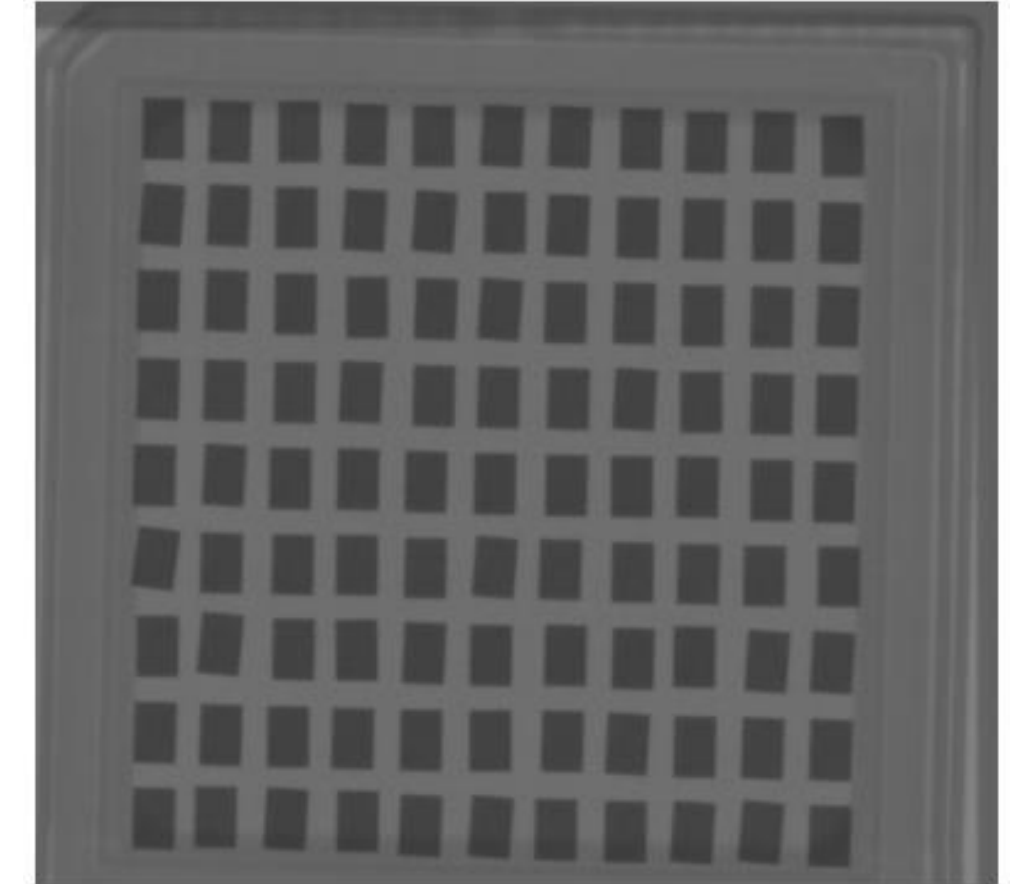


# LCS<sub>2</sub><sup>®</sup> PERFORMANCE VALIDATION

**Gel-Pak<sup>®</sup>**

## Qualification

- BAE Systems conducted rigorous 34" drop testing of 50µm GaN die loaded in Stat-Pro 500 Chip Sentry waffle trays
- X-Ray imaging confirmed ZERO die migration after 100 drop tests (10 trays X 10 drops) when using the LCS2
- Significant die migration was detected when performing same drop tests using industry standard waffle pack lid and clip solution
- The LCS2 is proven to solve the issue of COOP for all sized components that are < 250µm or thinner
- Potential to prevent millions of dollars in waste and improve process efficiencies



X-Ray image after 10 drop tests



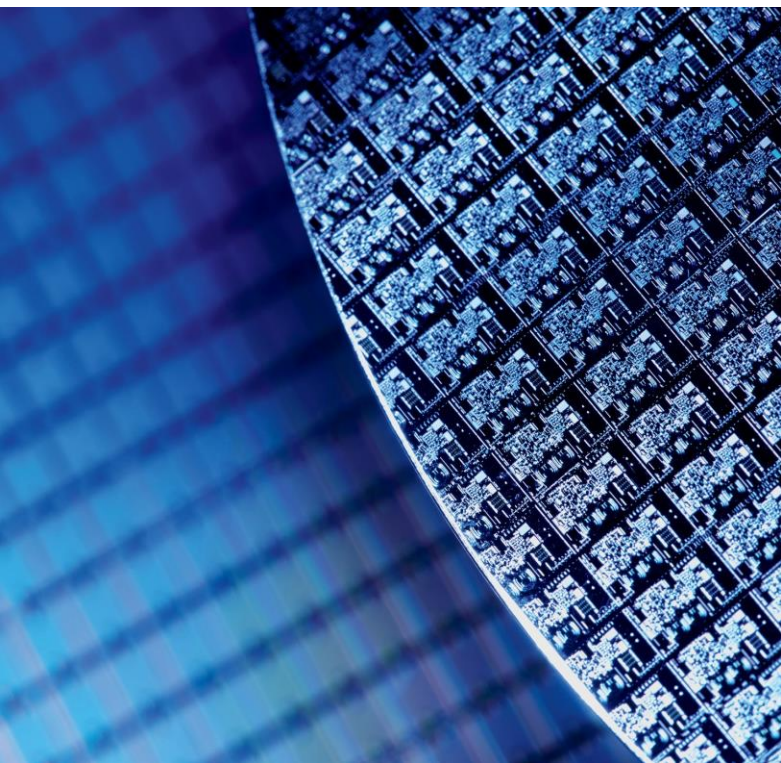


## ACKNOWLEDGEMENTS

**Gel-Pak**

- Richard Rochford - BAE Systems
- Craig Blanchette – BAE Systems





# DELPHON

MERGING INNOVATIVE TECHNOLOGIES

