Product Change Notifications

Preparing for PCNs in Harsh Environment Applications

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IPC/ECIA/JEDEC J-STD-046 Customer Notification Standard for Product/Process Changes by Electronic Product Suppliers

3.2.2

a) Identify affected customers

b) Determine notification requirements (for review or awareness only) per special customer or, supplier-agreed-to customer profile. If a customer expresses no unique attributes, the supplier's standard PCN system shall apply.

c) Customer will be notified a minimum of 90 days before the proposed first ship date of the identified in the PCN. Shipment of changed product may occur prior to stated ship in the 90 day review period is the time necessary for an authorized distributor to forward the notice to its customers of the affected product.

d) …..

3.2.3

3.2.3.1 Customer acknowledgement response

a) Customers should acknowledge receipt of the PCN within 30 days of delivery of the PCN. Any concerns, sample order response, or a request for further information should be provided within the acknowledgement period. If additional time is required to determine if samples or additional data is required, the customer must submit this request along with the acknowledgement response and state when they expect to complete their review.

b) Lack of acknowledgement of the PCN within 30 days constitutes acceptance of the change.

Preparation for Change

- Universal PCN statement:
  - “No impact on Fit, Form, Function”
    - Statement may add “Quality & Reliability”
- Typical PCNs
  - Manufacturing site changes – new or additional sites
  - Die shrink
  - Material changes
    - Wire bond
    - Die attach
    - Molding compound
    - Lead frame finish
    - …. many more
- Changes are not Trivial when exposed to Harsh Environments
  - Especially when given 30 days to respond
  - Change implemented regardless of objections
    - 90 days is not enough time to thoroughly test for harsh environments

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PCN – Cu Wire Bonds

- Industry Marketed Potential Positive Benefits:
  - "Cu wire is a superior conductor", "eliminates Kirkendall voiding bond failures", …
- Not included in the PCNs:
  - Cu Properties require processing & design changes
    - Wire diameter = larger ball diameter, limits on spacing
    - Force / energy increase required for acceptable bond
    - Forming gas to prevent oxidation
    - New Bonders and tooling (capillaries)
  - Interaction with "green" molding compounds
    - Compounds with lower CTE introduced during shift to Cu
  - Manufacturer test data is not board level reliability
    - Cycling on trays only
    - Testing to 150°C or above is too often unlikely

PCN – Preparation for Change

- Prepare as an organization
  - Qualification testing and analysis
    - Board level reliability in your environments
      - PWB Attachment effects – Board Level Reliability
    - Non destructive and Destructive analysis
  - Database – Documentation of
    - failure modes and mechanisms
      - material properties in relation to failure
      - Molding Compounds or die attach adhesives
  - Modeling and Simulation
    - Using database of material properties
    - Look for material interactions / potential weak points

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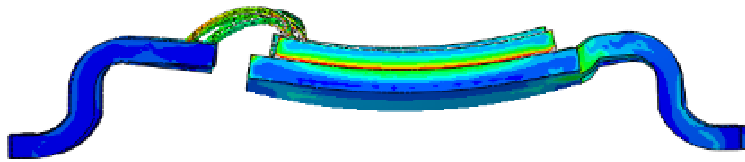
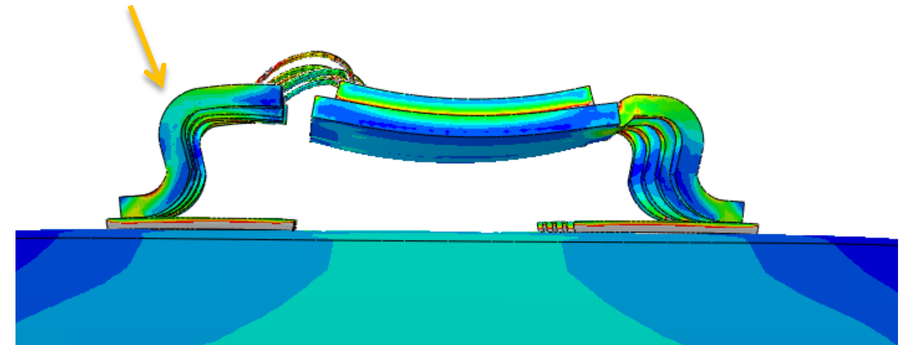
PWB attchment effect

Without PWB – unrestricted movement

Fixed to PWB – restricted movement



Higher stress at leads

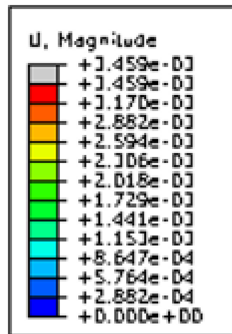


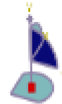
- Leads absorb the relative disablement induced by the thermal expansion mismatch between PCB and component, hence higher in-plane relative displacement …

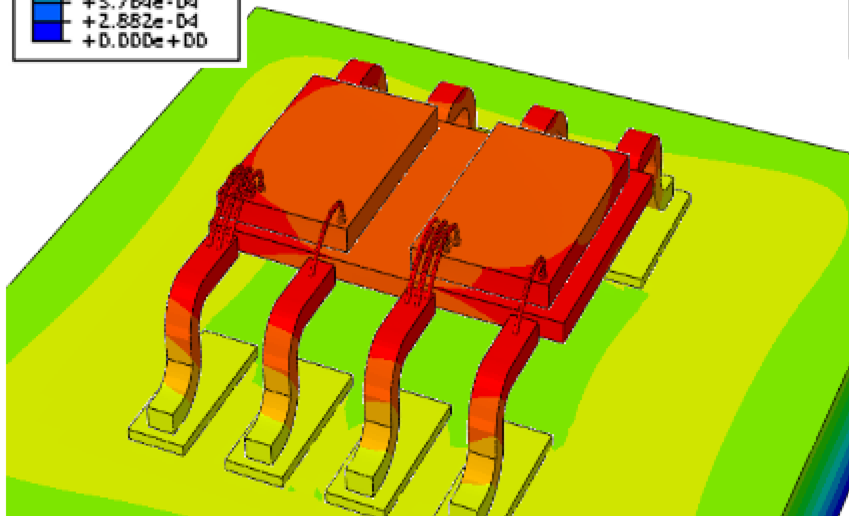
Molding compound is omitted for clarity
Assumption – consistent molding compound bond – no delamination. Residual stress from die bond not considered.
Used with permission – A. Battentier

Board Level Global Displacement

Displacement @ 43°C

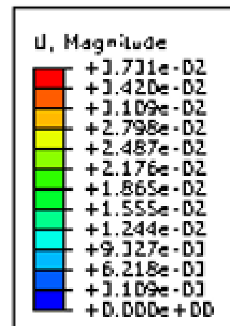




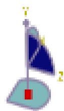


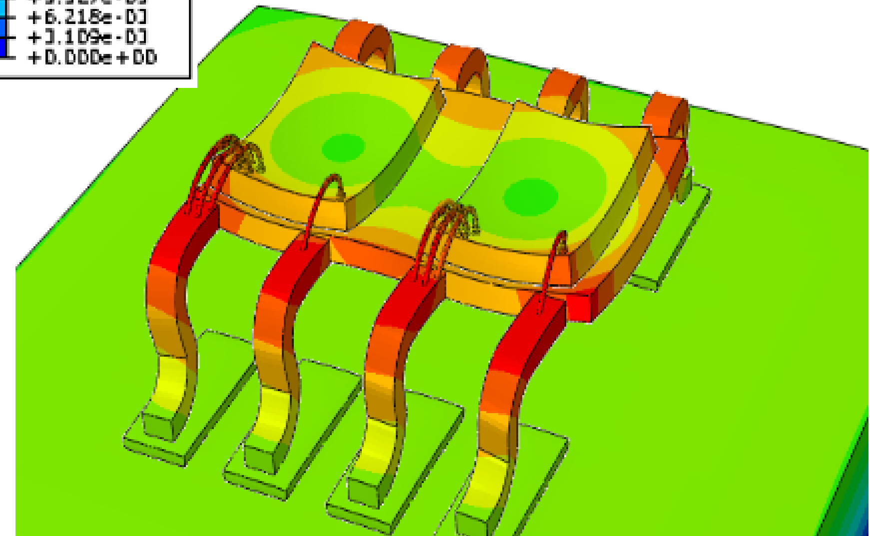
deformation scale factor=x30

Displacement @ - reflow



Molding Compound Tg = 125 ° C





deformation scale factor=x30

Above Tg, the flexural modulus of the molding compound drops, allowing for greater deformation of the package and internal stresses

Molding compound is omitted for clarity

Assumption – consistent molding compound bond – no delamination. Residual stress from die bond not considered.

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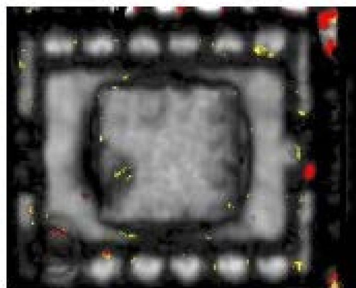
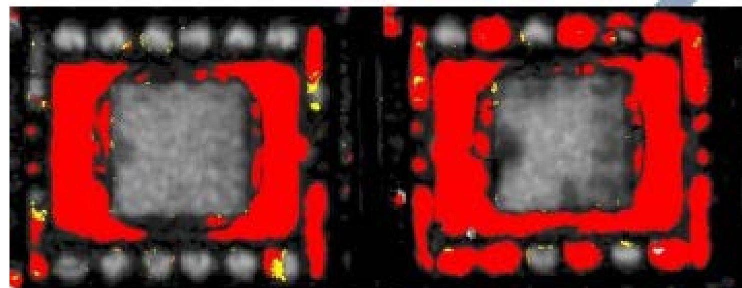
Failure Analysis – Board Level Reliability

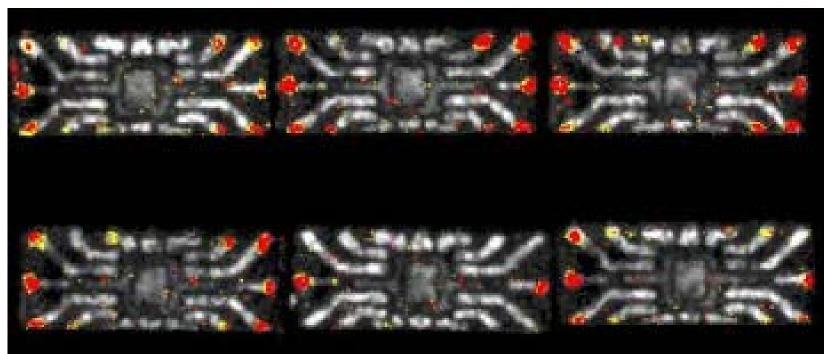
Delamination of SMT packages after reflow

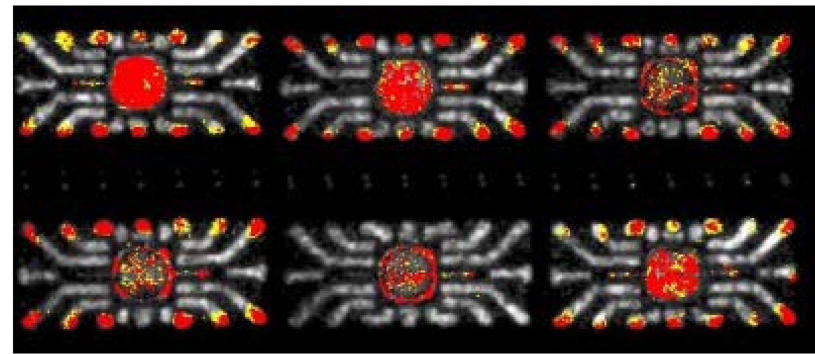


SAM pre-reflow



SAM post reflow

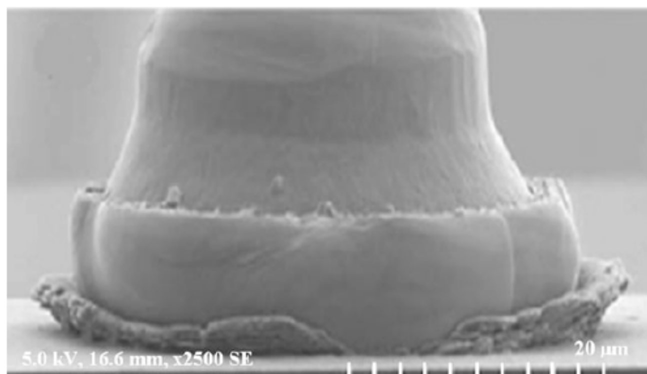




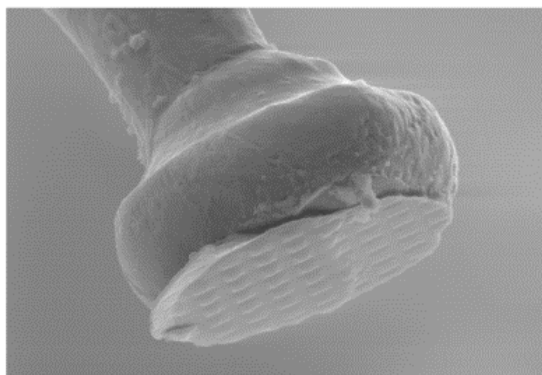
Changes included Cu WB and molding compound

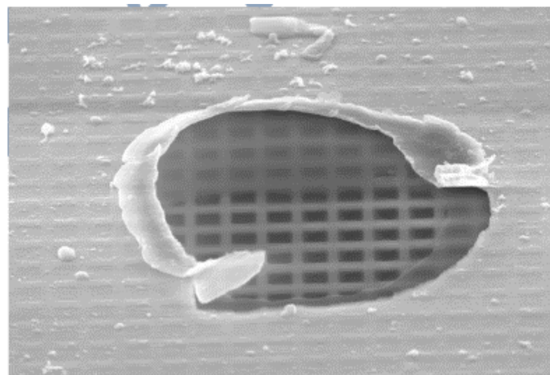
Failure Analysis – Board Level Reliability

- Board level testing results of wire bond and molding compound changes

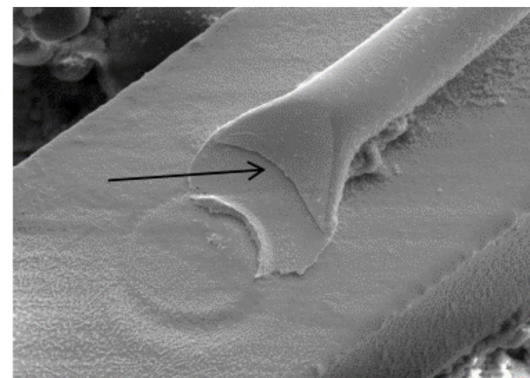


Aluminum Splash on bond pad





Early failure of ball bond



Stitch bond failure

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Summary Recommendations

Prepare as an organization

- Plan for Quick Review and PCN Response
- Complete construction analysis
  - Essential for major changes (ex: Cu wire bond)
  - Don't be hesitant to order samples offered
- Qualification testing and analysis
  - Identify tests that reveal problems quickly in your environments
  - Long Term - Board level reliability in your environments
- Build a Reference Database of material properties
  - Molding compounds, Die attach adhesives, …
  - Interposers, Lead frame, wire bond, …..
  - Surface finishes,

Summary Recommendations

Prepare as an organization – continued …

- Document failure modes and mechanisms
  - material properties in relation to failure
  - Add to material property Reference Database
    - Molding Compounds, die attach adhesives …
  - Compare results with simulations to improve models
- Modeling and Simulation
  - Models to predict effects of material property changes
  - Using database of material properties
  - Look for material interactions / potential weak points

This effort will lead to a timely response to PCNs