



International Electronics Manufacturing Initiative

SnPb BGA Availability for High Rel
Applications

Supplier Perspective



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September 28th, 2006*



- On January 27, 2003, the European Union passed the "Restriction on Use of Hazardous Substances in Electrical and Electronic Equipment," or "RoHS" directive 2002/95/EC, which had an implementation date of July 1, 2006.
- Texas Instruments completed the conversion of all its components roughly a year ahead of this deadline and will continue to monitor and respond to other environmental directive developments to ensure our customer needs are met in a timely manner.
- NiPdAu is Texas Instruments primary Pb-free finish for leadframe base packages
- The solder ball in our Pb-Free BGA packages are based on the industry Standard Tin-Silver-Copper (SAC) process (lead solder ball versions will continue to be available)
- After June 1, 2004, TI began shipping Pb-Free capable integrated circuit (IC) components using packing labels that align with JEDEC standards.

- The conversion to Lead-Free has resulted in an increase in package cost. Sourcing the two solder finishes increases package cost further more
- Dual sourcing of lead and lead-free components has substantially complicated the manufacturing process
- Customer requirements are getting more complicated:
 - Customer wants a Pb-free package
 - Customer wants a Pb-free and green package
 - Customer wants a package that is high temp reflow capable
 - Customer wants a package that is high temp reflow capable and green
 - Customer only wants a low alpha solder
- **Net effect is substantial increase in package cost and more complex manufacturing and logistics**

- BGA packages with Pb-free solder balls are designed to be soldered to the circuit board with a complimentary Pb-free solder.
- Mismatch of BGA solder ball finish and the composition of the solder used on the circuit board can compromise board level performance:

Solder Ball Finish	Circuit Board Solder Paste Composition	
	SnPb	Pb-free
SnPb	OK	Not recommended or guaranteed. See Note B.
SnAgCu Pb-free	Not recommended or guaranteed. See Note A.	OK

Note A: When the BGA ball is Pb-free and is soldered with SnPb on the circuit board, the resulting intermetallic is brittle and performs poorly when exposed to board level temperature cycling. Additionally, the BGA ball does not melt due to low soldering temperature used on the circuit board. Pb is dispersed unevenly in the solder joint leading to poor quality joints and low yield. This combination is not recommended and performance is not guaranteed.

Note B: Brittle intermetallics also form in this combination and performance to board level tests for mechanical fatigue may degrade. This combination is not recommended and performance is not guaranteed.

- Lead-free and SnPb solder ball packages require different manufacturing parameters. The options are either use dual lines or reduce equipment utilization (set up time during conversions)
 - Different solder ball tools (screen printing, stencils, pick and place tools, etc)
 - IR reflow settings
 - Test contacts
- Lead-free BGA require different material set
 - Substrate design and finish
 - New Solder composition and in some cases supplier
 - Flux or paste
- Increase in process controls
 - Prevention of mixing up and cross contamination
- Dual Bill Of Material (BOM) inventory
- Lower Equipment utilization of dual lines (capital increase)
- Inventory control and material obsolescence
- Dual Product samples
- Compliance testing
- New systems for part information and dissemination
- New Organizations to manage conversions, customer notification and legal oversight

- Component suppliers want to avoid litigation associated with unintentional contamination of "RoHS-compliant" material that may come in contact with manufacturing tools that are used for Pb-bearing products.
- Component suppliers are reluctant to assume liability for board level reliability (or subsequent customer returns) when customers use mixed alloys.
- Market conversion to lead-free is increasing. Demand for SnPb products is declining
- Low demand for SnPb components will have a major impact in:
 - equipment utilization
 - efficiency of manufacturing space
 - Procurement of raw materials
 - Increase in manufacturing complexity
 - Longer manufacturing cycle times
 - **Net Result will be an increase in SnPb Product Cost!**

Back-up Information

**Lead-Free and SnPb Product
Identification at Texas Instruments**

For BGA based parts ... YES.

For Leadframe based parts ... YES.
(Pb-Free PN added after TI leaded inventory is depleted)

Ball Grid Array (BGA) Parts



Industry Standard Pb-Free Solution ...

- 1) Tin-Silver-Copper Alloy Solder Balls

Leadframe Based Parts



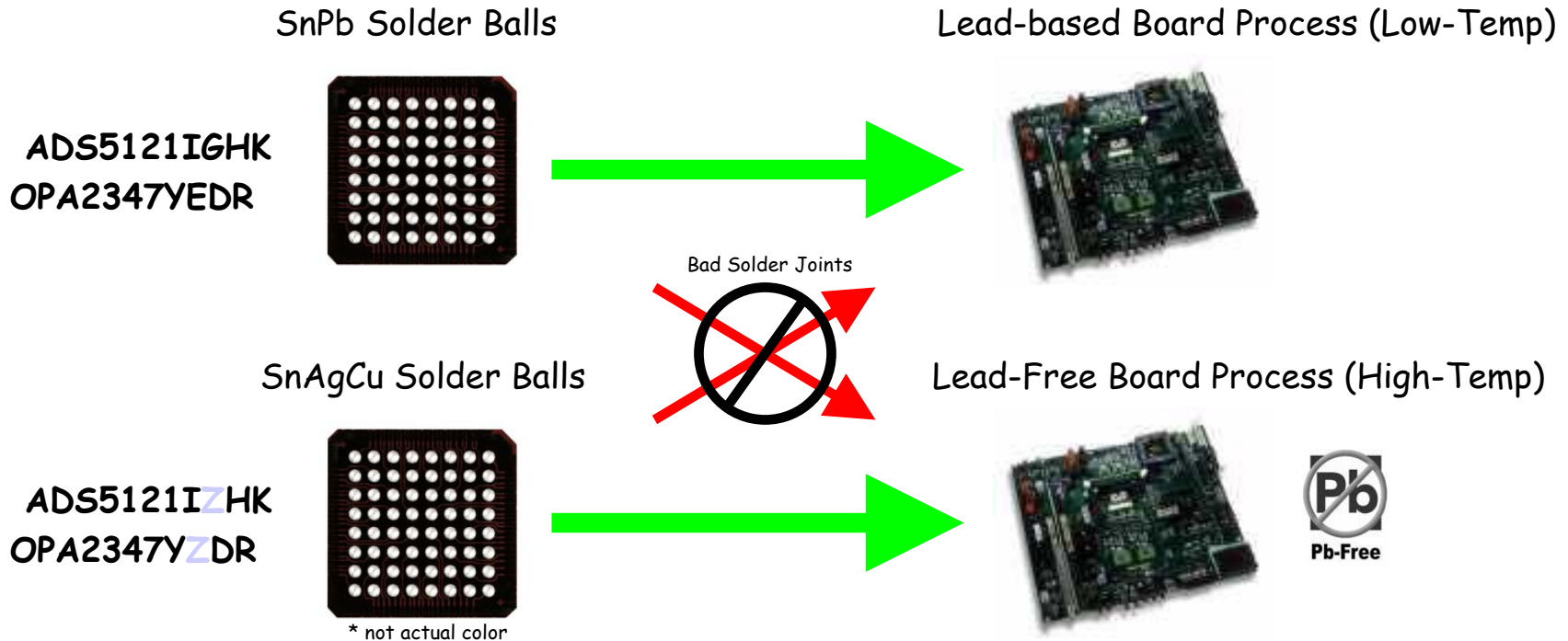
Common Pb-Free Solutions ...

- 1) Nickel-Palladium-Gold Plating
- 2) Tin Plating (risk of "Tin Whiskers")

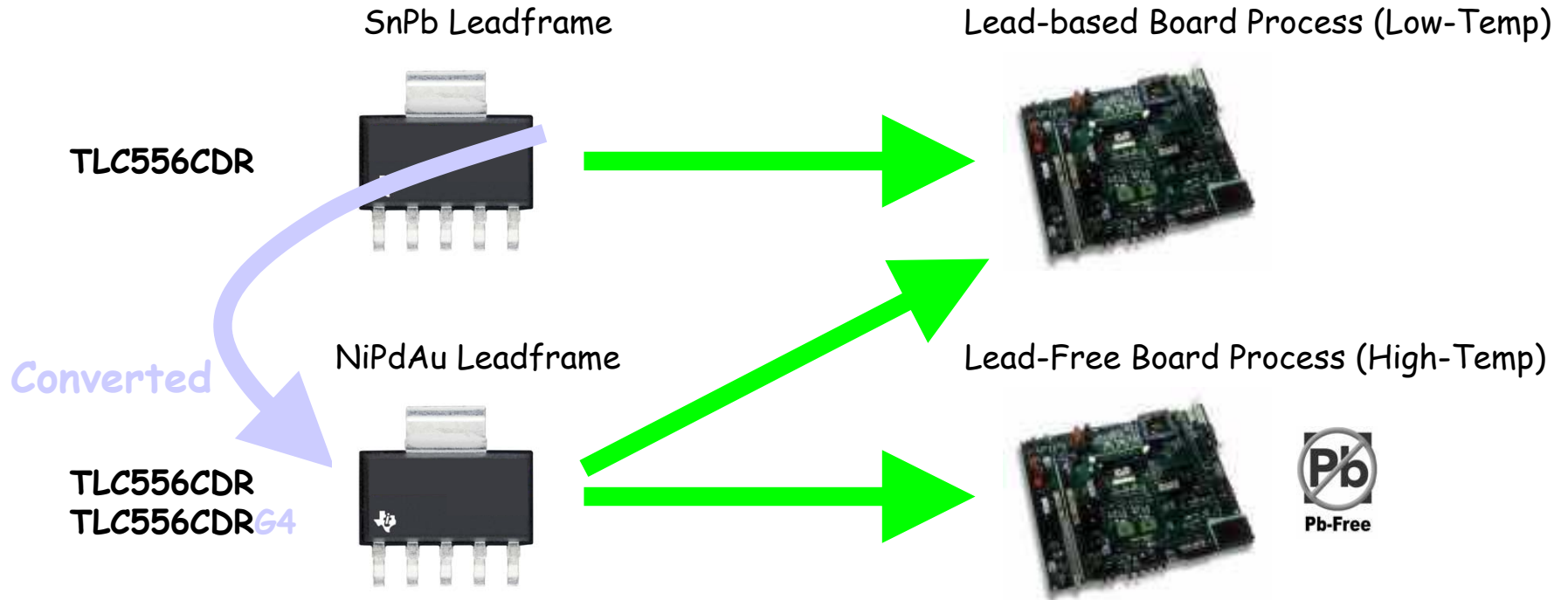
iNEMI - Recommendations on Lead-Free Finishes for Components Used in High-Reliability Products
(May2005)

Recommendation #1 - "Use a Non-Tin plating: Nickel-Palladium-Gold should be strongly considered for lead-frame applications."

INEMI Part Numbering, BGAs



- BGA Parts are not interchangeable, so two part numbers are required.
- Support for both versions will be driven by customer/market demand.
- New part numbers substitute a "Z" into the package suffix ($G_{xx} \rightarrow Z_{xx}$, $YEx \rightarrow YZx$).
- For Flip-Chip BGAs, RoHS-Exempt PN = Z_{xx} and 100% RoHS PN = C_{xx} .



- TI's primary Pb-Free solution is Nickel-Palladium-Gold (NiPdAu).
- TI's Pb-Free leadframe products are backward compatible with SnPb processes.
- A Pb-Free PN is being added using JEDEC/IPC based Pb-Free codes.
- Both the Standard PN & the Pb-Free PN will be orderable part numbers.

Outer Box Shipping Labels displays the ordered part number (Pb-Free PN or Std PN) and also contain the Pb-Free logo and Pb-Free/Green Finish Code.

Inner Box/Reel Labels



MSL
Caution
Label

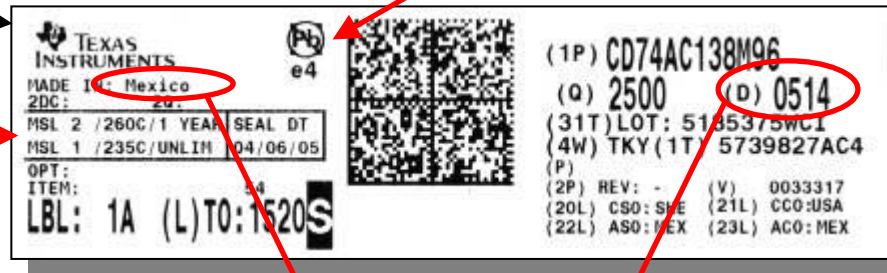


High-Temp
& Low-Temp
MSL Ratings

Ordered PN



JEDEC Pb-Free Logo & Finish Code



Assembly Site & Assembly Date Code (YYWW)

Comparing the Assembly Site & Date Code to the Search Tool info will always identify "Pb-Free" parts.

Self-Serve ...

- General Info – www.ti.com/ecoinfo
- Product Content/Sch – www.ti.com/productcontent
- Pb-Free Certificate – www.ti.com/leadfree

TI Help ...

- TI Tech Support – support.ti.com
- Questionnaires – ezSurveys@list.ti.com
- TI-authorized Sales Representative



Helping you connect with and strengthen your supply chain

www.inemi.org

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