



# Test Report

**RoHS Qualification  
FR-4 BGA Interconnect Product Family**

**Rev. 0, 8/19/05**

**By: Scott O'Connell**

**Approved: Glenn Goodman**

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## 1 Purpose:

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To ensure process compatibility with the RoHS Directive\* a design of experiments (DOE) was conducted to validate the solderability compliance of FR-4 material for BGA Interconnect product family.  
 (\*Refers to Directive 2002/95/EC “The restriction of the use of certain hazardous substances in electrical and electronic equipment.”)

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## 2 Testing Summary:

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The parts, made up of terminal assemblies and FR-4 wafers, were run through the testing listed below. Inspection, test parameters, and results are listed in Section 4.

- 1) Part Inspection
- 2) Subassembly / part assembly
- 3) Board Attachment
- 4) Analysis (x-ray / cross section)

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## 3 Components:

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SK9399-G (Gold plated PCB)  
 SK9399-TL (Tin Lead plated PCB)  
 4891-5 (Tin-Lead solder sphere)  
 8128-5 (Lead-free solder sphere)  
 FHA165-737G/FHA165-824G (adapter)  
     8157-165W - insulator  
     7654-1G – terminal  
 FHAX1156-737G/FHAX1156-824G (adapter)  
     6766-1156W - insulator  
     7654-1G – terminal  
     7654-3G – terminal  
 4FHSB256-716GG/4FHSB256-816GG (socket)  
     5987-256-1W / 2W / K - insulator  
     5990G – shell  
     5989G – contact  
 FHSB1156-716GG/ FHSB1156-816GG (socket)  
     6767-1156-1W / 2W / K – insulator  
     5990G – shell  
     5989G - contact

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## 4 Testing Requirements:

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### Material Test Matrix

The terminals are plated with Gold and attached to the 2 types of boards, Gold and Tin/Lead, using Tin/Lead solder spheres and Lead-free solder spheres. (see matrix below)

#### **Tin /Lead solder sphere (tin/lead oven profile – see section 7)**

FHA165-737G: 2 on GG PCB / 2 on TL PCB  
 FHAX1156-737G: 2 on GG PCB / 2 on TL PCB  
 4FHSB256-716GG: 2 on GG PCB / 2 on TL PCB  
 FHS1156-716GG: 1 on GG PCB / 1 on TL PCB

**Lead-free solder sphere (lead-free oven profile – see section 7)**

FHA165-824G: 2 on GG PCB / 2 on TL PCB

FHAX1156-824G: 2 on GG PCB / 2 on TL PCB

4FHSB256-816GG: 2 on GG PCB / 2 on TL PCB

FHS1156-816GG: 1 on GG PCB / 1 on TL PCB

**RoHS Survivability Test**

All non-leaded material in the DOE has passed RoHS temperature requirements of 260°C peak for 40 seconds when measured on the top surface of the part, 2°C per second ramp and decline. Run 3 times; second and third run after ambient cool down.

**Attributes monitored during-after test**

- 1) Assembly non-conformities
- 2) Wafer geometry/dimensional variation or distortion
- 3) Solder reflow
- 4) Correct interface attachment

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**5 Testing Results:**

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**Section 1: Inspection**

- 1.) Incoming Quality inspection:
  - a) Parameters: All components must pass incoming inspection (print specification)
  - b) Resultant: All parts passed Incoming Quality Inspection.

**Section 2: Measurement**

- 1) Baseline data on the flatness and hole true position of the wafers.
  - a) Parameters: All wafers must pass print specification for flatness (0.003) and true position.
  - b) Resultant: All parts passed specifications

**Section 3: Assembly**

- 1) Install terminals into wafers (per matrix)
  - a) Parameters: Per normal manufacturing process; assemble terminals and contacts into the wafer.
  - b) Resultant: The parts were assembled correctly by manufacturing.
- 2.) Inspect terminal assemblies
  - a) Parameters: The parts were visually inspected for misalignment, skiving, non-populated, contact height, wafer cracking around hole, and configuration.
  - b) Resultant: The parts passed both print and visual inspection.
- 3.) Attach solder spheres to parts (per matrix)
  - a) Parameters: Solder spheres were attached using normal manufacturing process.
  - b) Resultant: The solder spheres were attached by manufacturing.
- 4.) Inspect parts after solder sphere attach
  - a) Parameters: Solder spheres were visually inspected for reflow, sink marks, and other non-conformities.
  - b) Resultant: The solder spheres passed visual inspection.

- 5) Measure flatness and true position on the assembly with solder spheres.
  - a) Parameters: All wafers must pass print specification for flatness (0.006) and true position.
  - b) Resultant: All parts passed specifications.

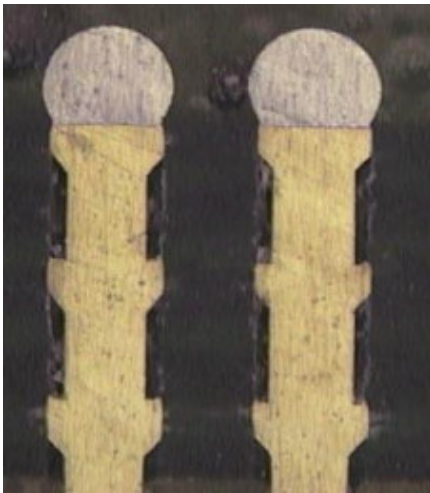
#### **Section 4: Cross Section (see Figures 1-2 below)**

- 1) Cross section 1 part from each group
  - a) Parameters: Cross section parts through center of terminal.
  - b) Resultant: The parts were cross-sectioned correctly.
- 2) Inspect cross-sectioned parts
  - a) Parameters: The parts were visually inspected under a scope looking for solder non-conformities (wicking, poor attach, grain structure, voids, etc.).
  - b) Resultant: The parts passed inspection.

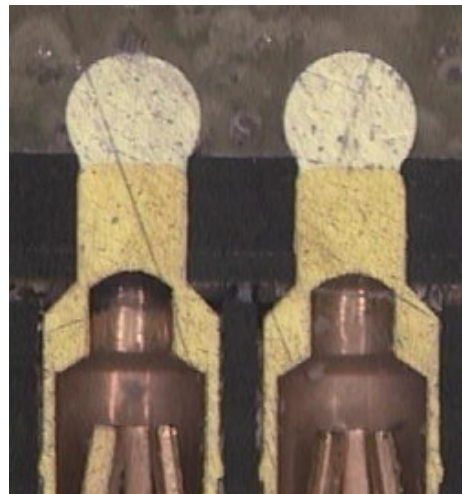
#### **Fig. 1-2 Cross Section Assembly**

- (1) FHAX1156-737G with Tin/Lead solder sphere
- (2) 4FHSB256-816GG with Lead-free solder sphere

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#### **Section 5: Board Attach**

- 1) Board assembly: Attach parts to PCBs
  - a) Parameters: The parts were attached per the test matrix. (Section 7 for profile)
  - b) Resultant: The parts were attached by manufacturing.
- 2) Inspection of board attachment
  - a) Parameters: The parts were visually inspected for correct attachment looking at placement and solder reflow.
  - b) Resultant: The parts passed visual inspection.

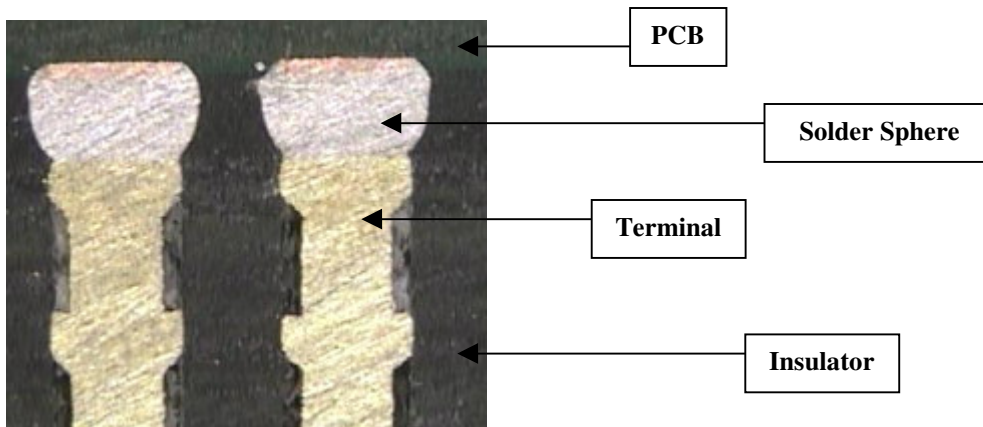
#### **Section 6: Board Attach Inspection:**

- 1) X-ray the attached parts.
  - a) Parameters: X-ray 1 part from each group, visually inspecting for any solder non-conformities .
  - b) Resultant: The parts were x-rayed correctly and no defects were found.

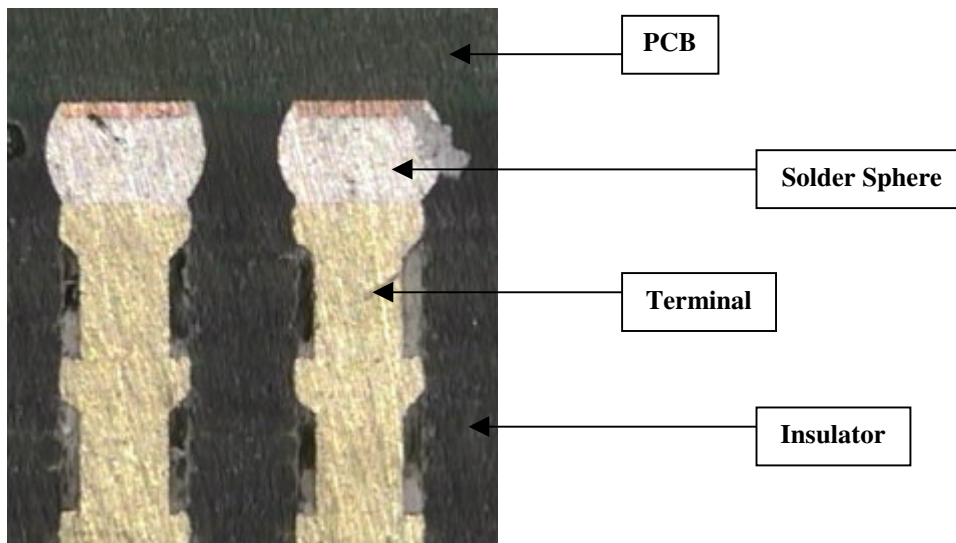
- 2) Cross section parts: (see **Figures 3-6 below**)
  - a) Parameters: Cross-section parts from each group. Section through the middle of the terminal.
  - b) Resultant: The parts were sectioned correctly.
  
- 3) Inspection of cross-sectioned parts
  - a) Parameters: Visual inspection of the cross-sectioned parts, looking for correct solder reflow (attachment).
  - b) Resultant: The parts show a good attach between the terminal and board. All the plating variations showed good attachment. Example; Gold terminal on a Tin/Lead board with Tin/Lead solderball vs. Gold terminal on a Tin/Lead board with lead-free solderball show the same characteristics.

**Fig #3-6 Cross Section of board assembly**

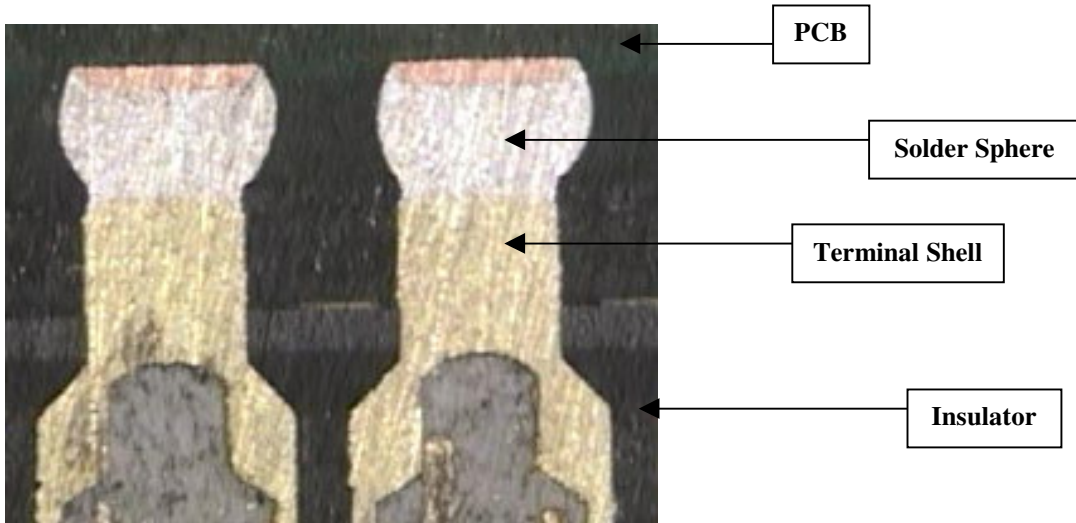
(3) FHA165-737G with Tin/Lead solder sphere on a Tin/Lead plated PCB



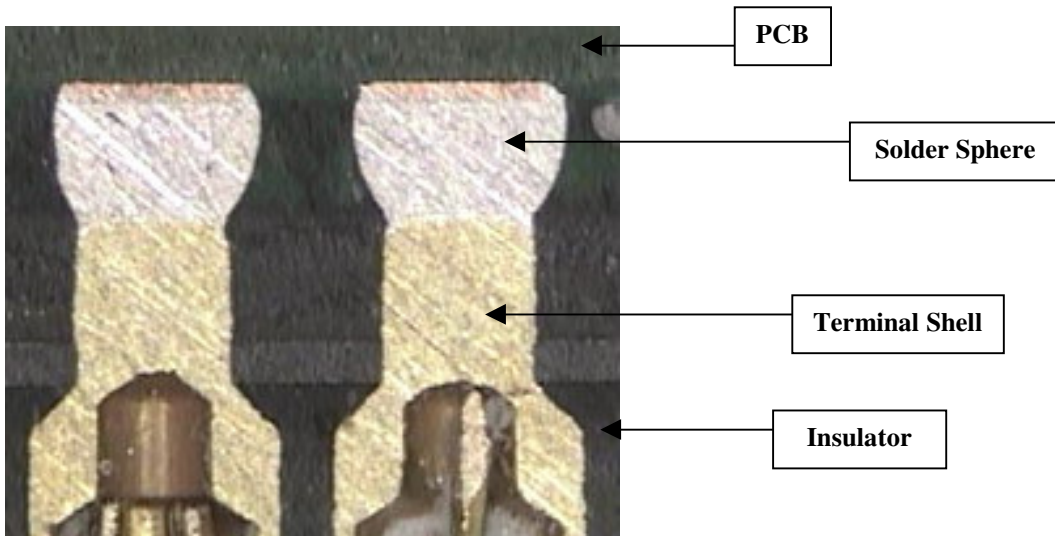
(4) FHA165-824G with Lead-free solder sphere on a Tin/Lead plated PCB



(5) FHS1156-716GG with Tin/Lead solder sphere on a Gold plated PCB



(6) FHS1156-816GG with Lead-free solder sphere on a Gold plated PCB



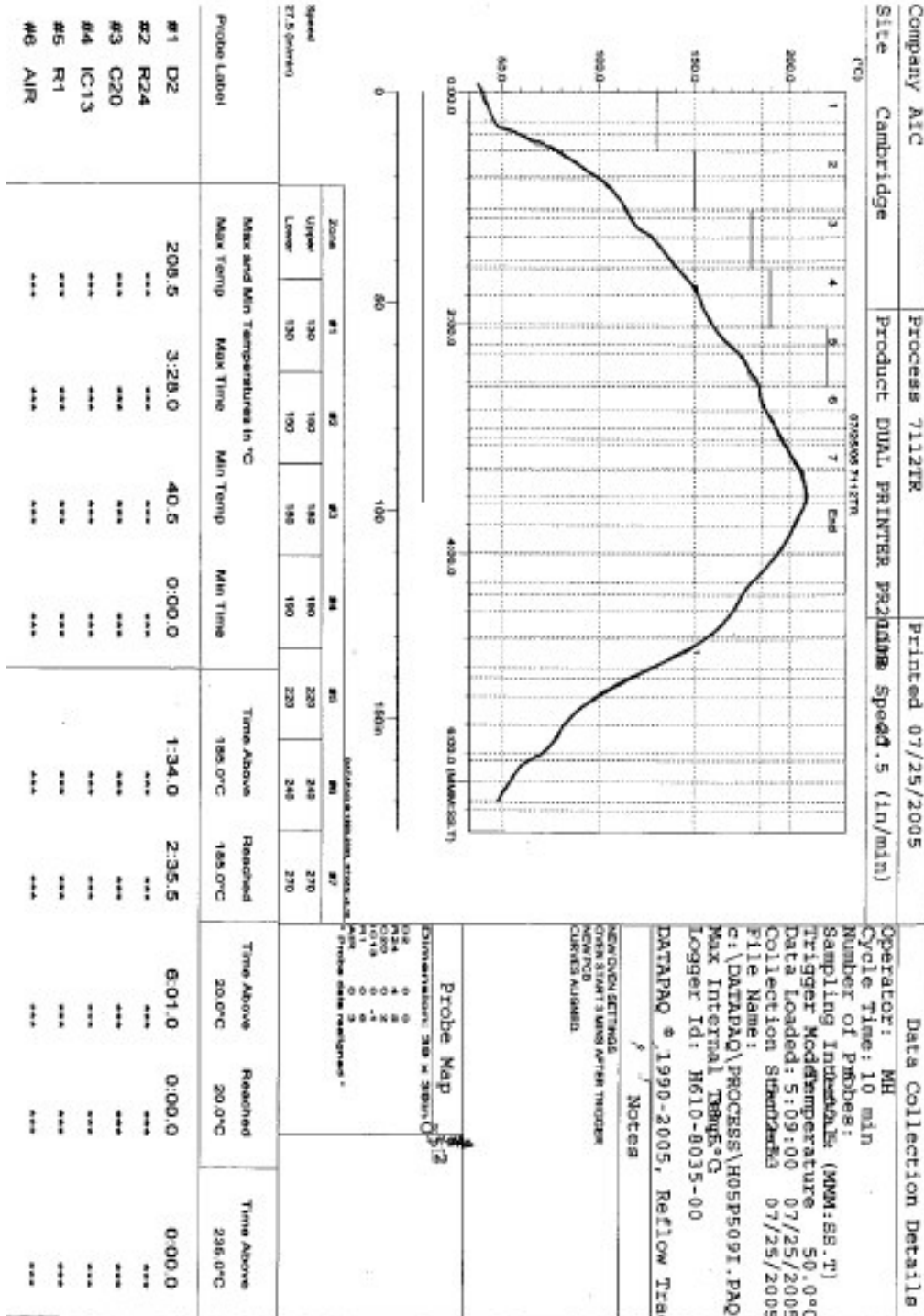
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**6 Conclusion:**

The FR-4 material used in the BGA Interconnect product family has been approved by engineering for use in lead-free applications meeting RoHS standards.

**7 Oven Profile:**

**Tin/Lead Profile**



**Lead-Free Profile**

