Micro Rework
Al Cabral
April 24, 2012
SMTA – Tempe, AZ
World Electronics Production

World production per application sector, 2009

- Home Appliances: 6%
- Industrial & Medical: 17%
- Automotive: 8%
- Aero/Defense & Security: 10%
- Audio & Video: 15%
- Data Processing: 24%
- Telecoms: 20%

World production per region, 2009

- ROW: 3%
- Europe: 20%
- Other Asia Pacific: 15%
- North America: 17%
- Japan: 15%
- China: 30%

Source: DECISION, October 2010

Worldwide Production - $1.5B

Because Performance Matters!
Smartphone Growth

Smartphone Marketshare Trends

- Smartphone Unit Sales (M)
- Smartphone Share of Total Cellphone Shipments

Source: Nokia, IC Insights

Because Performance Matters!
Tablet Growth

Media Tablet Shipments World

Digitimes 7/11, updated values through 2Q'11 on 8/4/11
Micro Rework Applications

- Smartphones
- GPS / Auto Modules
- Netbooks / Tablets / eReaders
- Digital Video Recorders
- Portable Medical Devices
- Set Top Boxes / Game Consoles
- Audio / Video Players
- Other small form factor products
Micro Rework Products
Device Packaging Evolution

Driven by the need for more I/Os and/or high performance

Sizes:
- DIP
- PGA
- QFP
- BGA
- SiP
- LCC
- SOP
- TQFP / FQFP
- FBGA / CSP
- SSOP / TSOP
- S-CSP / PoP
- LLCC / QFN
- WLP
- 3D IC (TSV)

Source: IC Insights

Because Performance Matters!
Smartphone Revealed

65mm

100mm
Smartphone Components

RF Shields

micro Actives & Passives

Because Performance Matters!
Micro Passives

Courtesy of ITM

Because Performance Matters!
Chip Scale Packages (uBGAs)
Micro Rework Process

1. **Coplanar PCB Support**
2. **Thermal Characterization**
3. **Device Removal**
4. **Site Preparation**
5. **Device Replacement**

*Because Performance Matters!*
RF Shield Specific

- Rapid Removal Profile / Top Heat Only
- Minimize Device Temperature Beneath
- Discard RF Shield Due to Warpage & Discolor
- Asymmetrical Scavenging with Tight Spacing
- Level Residual, Dispense or Solder Preforms
- Rapid Replacement Profile / Top Heat Only
Typical RF Shield Profile

Because Performance Matters!

VJ ELECTRONIX

Because Performance Matters!
RF Shield Removal

Concentrate heat on the perimeter of the shield

Because Performance Matters!
RF Shield Nozzle
RF Shield Rework

RF Shield

Because Performance Matters!
RF Shield Site Dressing
01005 Specific

- Rapid Removal of 01005 via Micro Scavenger
- Solder Replenishment Remains Industry Challenge
  - micro Scavenging followed by Dispensing
  - hot Air Leveling followed by Flux Dip of Passive
  - micro Scavenging followed by Pin Dip Transfer
- Rapid Replacement Profile / Top Heat Only
- 01005 benefits from use of N2
  - improves wetting
  - minimizes shorts
  - improves alignment
Typical 01005 Profile

Because Performance Matters!
Conductive Vacuum Tip

Because Performance Matters!
Micro Passive Replacement

01005 Placement onto Dispensed Solderpaste
Micro Passives (01005)
Micro BGA Specific

- Top & Bottom Gradual Heating
- Micro Scavenging with Tight Spacing
  - N2 requires NO flux
  - Air typically requires flux
- Solder Replenishment
  - dispense solder
  - solder paste or flux component dipping
  - component printing of solder paste or flux
- 0.3mm pitch benefits from use of N2
  - improves wetting
  - minimizes shorts
  - improves alignment

Because Performance Matters!
Typical uBGA RSS Profile

- 150°C: <2°C/s
- 220°C: ~1°C/s, <60s
- 240°C: <5s
- Below 240°C: <2°C/s

Because Performance Matters!
Typical uBGA Linear Profile

*Some specific solder paste / flux formulations require a pre-reflow soak and specific heating & cooling rates.*
Micro Scavenging
Micro Scavenging

Chip Scale Package

CSP Pads Unleveled

Because Performance Matters!
Micro Scavenging
Micro Scavenging
Micro Scavenging

Air with No Flux  N2 with No Flux

Because Performance Matters!

VJ ELECTRONIX
Package on Package Assembly

Top PoP Layer

PoP Layer 1

PCB PoP Site

Because Performance Matters!
PoP Device
Package on Package Example
PoP Specific

• Decide to Remove Layers or Entire Stack

• Stack Removal Requires Tooling or Epoxy for Layers
• Site Scavenged, Treated Like Typical BGA Rework
• Replacement PoP Soldered as Assembly

• Layer Removal Typ. when Bottom Layer Underfilled
• Top Layer Usually Memory Device, Bottom Processor
• Remaining Bottom Layer Requires Micro Scavenging
• Replacement of Top Layer(s) Like Typical BGA
Layer PoP Rework Process

1. Remove Top Layer PoP
2. Prepare Sub-layer PoP
   - Remove Residual Solder
3. Prepare New Top Layer PoP
   - PoP Apply Paste or Flux
4. Place New Top PoP Layer
5. Reflow Entire PoP Stack

Because Performance Matters!
Stack PoP Rework Process

1. Remove PoP Stack
2. Prepare PCB Site
3. Remove Residual Solder
4. Prepare PCB Site
5. Apply Solder Paste or Flux
6. Place PoP Layer 1
7. Prepare PoP Layer 2
8. Apply Solder Paste or Flux
9. Place PoP Top Layer
10. Reflow Entire PoP Stack

or

1. Prepare PoP Layer 1
2. Apply Solder Paste or Flux
3. Prepare PoP Layer 2
4. Apply Solder Paste or Flux
5. Place PoP Top Layer
6. Reflow Entire PoP Stack
PoP Layer Separation

- Important Feature – Zero Force Removal
- Prevents displacing solder in lower layer(s)
PoP Stack Removal

- PoP Mechanical Clips - Requires adjacent space > 1.0 mm
- Bonding between layers

Because Performance Matters!
PoP Stack Removal
PoP Scavenging

Micro Scavenging – non-contact solder removal
- Low board/substrate temperature
- Scavenge speed (approx 1 mm/sec)
PoP Stack Replacement

- Two step placement - Flux dip recommended
- Single reflow step for entire stack preferred
Solder Re-deposition

Paste or Flux Dip Tray

Pin Dip Transfer

Because Performance Matters!
Solder Re-deposition

Component Printing

Because Performance Matters!
Solder Re-deposition

Solder Paste and Flux Dispensing
Solder Re-deposition

Several viable methods of replenishing solder exist today for Rework, however replenishment of solder for Micro Passive components and 0.3mm pitch Active devices remains an industry challenge.
QFN Rework

- Requires application of Solder Paste
- Typically includes Thermal Pad
- Leads often extend up the sides of the package
QFN Rework

- **Solder Paste application**
  - Apply to the PCB
  - Apply directly to the QFN Package
QFN Stencil Design

Overprint Lead Frame Pads

Underprint Thermal Pads by 40 – 60 %
Underfill Challenges

- Very Material Dependent
- Component Removal via:
  - thermal
  - mechanical (torque)
  - chemical
- Residue Removal via:
  - chemical
  - abrasion
  - remain
- Real Estate Limited (rotate)
- Heat Cycle Limited
Micro Rework Equipment Capabilities

- Micro BGAs / CSPs / QFNs
- Micro Passives / 01005s
- RF Shields
- Asymmetrical Scavenging Patterns
- High Resolution Vision & Lighting
- High Efficiency Heating
- 0.3mm Pitch Accuracy
- High I/O Rework
- Top & Bottom Heating Control
Top & Bottom Heating
Questions and Discussion