IMAPS-Korea

Application of Circuit Tape in Low Cost IC Package

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B.Y. Min
Anam Semiconductor Inc.
Enabling Effective Performance
The Changing Role of Packaging

<table>
<thead>
<tr>
<th></th>
<th>Yesterday</th>
<th>Today</th>
<th>Tomorrow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component</td>
<td>XXX</td>
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</tr>
<tr>
<td>Material</td>
<td>XXX</td>
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<tr>
<td>Technology</td>
<td>XXX</td>
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<tr>
<td>System</td>
<td>XXX</td>
<td>XXX</td>
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<tr>
<td>Function</td>
<td>XXX</td>
<td>XXX</td>
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<tr>
<td>Product</td>
<td>XXX</td>
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</tbody>
</table>

Product Trends

- Lower voltage circuits for increased battery life
- Smaller devices that are portable and light
- Shrinking motherboards but with tighter metal trace density as well as increased layer density
- Increased use of modules for speed improvement by placing ICs physically close
- Increased integration of memory functions on semiconductor devices - Rambus, Neomagic
- Increased use of DSP and mixed digital/analog systems - modems, cameras, phones
Package Trend Drivers

- Cost of the die
- Cost of the package
- Cost of the motherboard
- Size
- Thickness
- I/O Count
- Thermal
- Electrical

Package Design Options

House
- mold
- gold top
- underfill

Interposer
- ceramic
- laminate
- flex circuit

CTE
- Wire bond
- TAB lead
- flip lead
- Au bump

Solder Bump

~ 3 ppm

~ 17 ppm
Thickness Trends

1.7
- CABGA
1.2
- TSOP
- TQFP
1.0
- flexBGA
- TSSOP/EPTSSOP
0.8
- μBGA
- BLP
- BCC
0.5
- UltraCSA
- ShellCASE

Package Size Shrinkage

1.7
- Ball Dia 0.3 mm
- Ball Pitch 0.5 mm
- 0.8 mm
1.2
- 0.5 mm
0.8 mm
0.5 mm
1.0 mm

* Contact solder ball diameter of BGA varying with their pitch

<table>
<thead>
<tr>
<th>Lead Pitch</th>
<th>0.62</th>
<th>0.5</th>
<th>0.4</th>
<th>0.8 (3 rows)</th>
<th>0.5 (2 rows)</th>
<th>0.65 (full)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package</td>
<td>MQFP</td>
<td>TQFP</td>
<td>TQFP</td>
<td>FPBGA</td>
<td>FPBGA</td>
<td>Bare Die</td>
</tr>
<tr>
<td>Pin Count</td>
<td>160</td>
<td>128</td>
<td>128</td>
<td>132</td>
<td>136</td>
<td>144</td>
</tr>
<tr>
<td>Pin Array</td>
<td>(14 x 14)</td>
<td>(19 x 19)</td>
<td>(17 x 12)</td>
<td></td>
<td></td>
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<tr>
<td>Package Thickness (mm)</td>
<td>3.37</td>
<td>1.4</td>
<td>1.4</td>
<td>1.25</td>
<td>1.2</td>
<td>0.5</td>
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<tr>
<td>Package Size</td>
<td>Body</td>
<td>28 x 28</td>
<td>20 x 20</td>
<td>14 x 14</td>
<td>12 x 12</td>
<td>10 x 10</td>
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<tr>
<td>Mount area</td>
<td>31.2 x 31.2</td>
<td>22.8 x 22.8</td>
<td>16.8 x 16.8</td>
<td>12 x 12</td>
<td>10 x 10</td>
<td>8.5 x 8.5</td>
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<tr>
<td>Relative mounting area</td>
<td>3.45</td>
<td>1.84</td>
<td>1</td>
<td>0.51</td>
<td>0.36</td>
<td>0.26</td>
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<tr>
<td></td>
<td>6.76</td>
<td>3.61</td>
<td>1.96</td>
<td>1</td>
<td>0.98</td>
<td>0.51</td>
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</table>
The Emergence of Film-based Interconnect

- Finer lines and spaces than PCBs
- Finer pitch accommodates high density silicon
- Several vendors building the tape infrastructure
- Enables thinner packages
- Improved via density
- Several film packages qualified by OEMs
  - Anam/Amkor/\textsc{flex}BGA
  - μBGA
  - T.I. μStar
  - Sharp CSP, etc

The Emergence of Film-based Interconnect

- Industry moving to wider web reel-to-reel processing:
  - Casio - 156 mm wide
  - 3M - 350 mm wide
  - Sheldahl - 350 mm wide
- Two metal layer film will extend the technology
Low Pin Count ASIC CSP

High Pin Count Thermal Enhanced BGA
Memory IC CSP

Wafer Scale CSP Structure

(Wafer Scale CSP Structure)
Single Metal Tape Construction

2-Layer Tape
Without Adhesive
(Wet Etched Holes)

3-Layer Tape
With Adhesive
(Punched Holes)

Tape Production Process Flow

2 Layer Tape
1. Metallize polyimide substrate
2. Laminate photoresist to both sides
3. Expose both simultaneously and develop
4. Electrodeposit copper
5. Chemically etch polyimide substrate
6. Strip photoresist, etch seed layer
7. Ni, Au plating

3 Layer Tape
1. Polyimide substrate with adhesive layer
2. Punching
3. Cu foil lamination
4. Photoresist
5. Expose and develop
6. Chemically etch Cu foil
7. Strip photoresist & Ni, Au plating
2 Layer Tape VS 3 Layer Tape
(Conductor Layer)

2 Layer Tape

3 Layer Tape

2 Layer Tape VS 3 Layer Tape
(Interfacial Surface)
2002 CSP Demand by Substrate

- LeadFrame 9%
- Ceramic 3%
- Laminate 31%
- Flex 57%

Total 5339 million units

Advanced Tape Substrate

- Two metal layer tape substrate

- Multiple layer Tape Substrate
Closing Statements

- Package technology driven by personal application; migrated from military, and from commercial application.

- Endless demands of increasing level of integration on devices; smaller, thinner and lighter

- FlexCircuit has been a natural solution to meet both performance and cost driven requirements of many applications; existing industry infrastructure and material characteristics.