SCT Barrel "PC" Hybrid Status

Japanese SCT group

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1. Assembly and QA Procedure

i) Cu/Polyimide flexible PC
   - Visual inspection
   - Integrity test

ii) Carbon-carbon bridge gluing
   - Visual inspection

iii) Passive components stuffing
   - Visual inspection

iv) Pitch adapter gluing
   - Visual inspection
   - Mechanical tests
   - Electrical tests

v) Temperature cycling
   (-25 to 40 deg. C times 5 cycles; 10 hours)
   - Visual inspection
   - Mechanical tests
   - Electrical tests

vi) Barcode and Data sheet entry
2. QA items

i) Electrical tests (before and after TC)

<table>
<thead>
<tr>
<th>Items</th>
<th>Nominal</th>
<th>Tolerances</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_{cc}$</td>
<td>11.88 µF</td>
<td>± 10 %</td>
<td>AG bypath C at 1kHz</td>
</tr>
<tr>
<td>$C_{dd}$</td>
<td>11.88 µF</td>
<td>± 10 %</td>
<td>DG bypath C at 1kHz</td>
</tr>
<tr>
<td>$Z_{hv}$ at 0.1kHz</td>
<td>33 kΩ</td>
<td>± 10 %</td>
<td>HV net. at 0.1kHz</td>
</tr>
<tr>
<td>$Z_{hv}$ at 1kHz</td>
<td>10 kΩ</td>
<td>± 10 %</td>
<td>HV net. at 1kHz</td>
</tr>
<tr>
<td>$Z_{hv}$ at 10kHz</td>
<td>6.7 kΩ</td>
<td>± 10 %</td>
<td>HV net. at 10kHz</td>
</tr>
<tr>
<td>$Z_{hv}$ at 100kHz</td>
<td>6.1 kΩ</td>
<td>± 10 %</td>
<td>HV net. at 100kHz</td>
</tr>
<tr>
<td>$R_{27}$</td>
<td>100 Ω</td>
<td>± 2 Ω</td>
<td>Termination R</td>
</tr>
<tr>
<td>$R_{28}$</td>
<td>100 Ω</td>
<td>± 2 Ω</td>
<td>Termination R</td>
</tr>
<tr>
<td>$R_{29}$</td>
<td>100 Ω</td>
<td>± 2 Ω</td>
<td>Termination R</td>
</tr>
<tr>
<td>$R_{30}$</td>
<td>100 Ω</td>
<td>± 2 Ω</td>
<td>Termination R</td>
</tr>
<tr>
<td>$TM_0$</td>
<td>10 kΩ</td>
<td>± 2 %</td>
<td>Thermistor R at 25°</td>
</tr>
<tr>
<td>$TM_1$</td>
<td>10 kΩ</td>
<td>± 2 %</td>
<td>Thermistor R at 25°</td>
</tr>
<tr>
<td>$I_{cc}$</td>
<td>-</td>
<td>&lt; 50 nA</td>
<td>Leakage at 10V</td>
</tr>
<tr>
<td>$I_{dd}$</td>
<td>-</td>
<td>&lt; 50 nA</td>
<td>Leakage at 10V</td>
</tr>
<tr>
<td>$I_{hv}$</td>
<td>-</td>
<td>&lt; 10 nA</td>
<td>Leakage at 500V</td>
</tr>
</tbody>
</table>
ii) Mechanical tests (before and after TC)

- Thickness; 620 ± 50 µm

- Flatness
  - Bow (long); < 75 µm
  - Bow (short); < 75 µm
  - Twist; < 100 µm

- Height of the critical components (after TC only)
  < 2.63 mm

iii) Wire bonding pull tests (after TC)

- Flex. PC bond test
  - Four test pads (one wire/pad) /FPC;
  - > 6 gr

- Pitch adapter bond test
  - 10 places/lot ;
  - > 6 gr
  - (25 PAs'/sheet, 10 sheets/lot)
before TC: $I_{cc}$ (nA) at 10V

before TC: $I_{dd}$ (nA) at 10V

before TC: $I_{hv}$ (nA) at 500V

after TC: $I_{cc}$ (nA) at 10V

after TC: $I_{dd}$ (nA) at 10V

after TC: $I_{hv}$ (nA) at 500V
3. Pitch adapter problem

"White PA" problem;

We have recently encountered the "white PA" problem. The PAs' in the sixth lot (about 200 pcs') were found to have an Al layer of slightly whiter and rougher surface. They had such a poor bonding quality as reported by Hamamatsu that the failure rate of the bonding between the PA and Si-sensor (mostly 1st bond) was about 2 %. Since then the company seems to have lost control over the PA production process.

After elaborated studies and trials with not only this company but also the other companies, we found that the critical conditions to be maintained and controlled were i) cleanliness of the glass surface, ii) contamination free environment, iii) temperature of the glass during the Al deposition and vi) growth rate of the Al layer.

Concerning the above four conditions, we have
instructed as in the followings;
i) Thorough baking and bombarding at high temperature in high vacuum should be required to achieve a clean glass surface.
ii) The camber for the Al deposition process should be purged with Ar and kept at sufficiently high vacuum during the operation.
iii) The glass should be kept at high temperature, e.g. 150 deg. C, during the Al deposition. In fact, depositing at room temperature in a poor vacuum, the Al layer became too hard for the wire bonding.
vi) High rate of the Al layer deposition, e.g. 20 Å/sec, makes the Al surface too smooth like a mirror, and on such surface the wire bonding quality was generally poor.
We found that the Al layer growth rate of 5 Å/sec seemed to be optimum.

Now we feel we have sufficient understandings to control the process. We expect we could resume the PA production soon.
4. Production and Delivery  
(as of 30 Apr. 2003)

So far produced;

1214 pcs' of good "PC" hybrids  
(incl. the ones with old PA and "white" PA(159))

So far delivered to;

<table>
<thead>
<tr>
<th>UK</th>
<th>US</th>
<th>Nordic</th>
<th>Japan</th>
</tr>
</thead>
<tbody>
<tr>
<td>194 (47)</td>
<td>161 (9)</td>
<td>69 (4)</td>
<td>555 (57) pcs'</td>
</tr>
</tbody>
</table>

(with "white" PA)

Delivery schedule update;

<table>
<thead>
<tr>
<th>Month</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>May. 2003</td>
<td>400</td>
</tr>
<tr>
<td>Jun. 2003</td>
<td>400</td>
</tr>
<tr>
<td>Jul. 2003</td>
<td>400</td>
</tr>
<tr>
<td>Aug. 2003</td>
<td>86</td>
</tr>
</tbody>
</table>

Total 2,500
"ASIC" Hybrid

So far delivered to;

Nordic Japan

69 (4) 555 (57) pcs'
(with "white" PA)

5. Summary

- The SCT barrel "PC" hybrid production has been carried on under the rigorous QA procedure.
- We have finished half of the "PC" hybrid production successfully.
- The "White PA" problem has been understood and is expected to be overcome without halting the production.
- The production will be completed in Aug. '03.