(Technoprobe TPEG™ MEMS T4 OPM) Eliminates Challenges faced with Cobra-like Solutions

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OBJECTIVE

The objective of this project is to improve quality, machine utilization and repair-maintenance cost of probe card by converting present technology to best known technology available locally.

BACKGROUND

When the Probe product was initially transferred, the team was tasked with using existing technology being used by AML. Even with experience using this technology, manufacturing experienced quality issues (specifically hitting glass), poor up time and machine utilization, long repair lead-time due to overseas repair and high costs associated with the probe card price and overseas shipping cost.

Due to the negative impact as stated above, the team decided to initially to convert two problematic devices using a locally supplied and supported probe card.
ISSUES PRIOR QUALIFYING T4_OPM

- Frequent hitting glass / probe mark misalignment
- High occurrence of misaligned pins, bent pins, sunken pins and broken pins
- Low mean touch down before repair
- Long probe card repair lead time
TARGETS

- To improve the utilization from 58% to 70%.
- To reduce misaligned probe marks and hitting glass issues by 90%.
- To remove the 100% wafer inspection step.
- To improve repair lead time of probe cards from 8 weeks to 1 week.
- To improve mean touchdown before repair from 25,000 to 350,000.
- To have a probe card vendor with local capability that can accommodate new and challenging designs.
Hitting glass Images using Cobra-like Technology
# Technoprobe TPEG T4 OPM specs

## Mems TPEG T4 OPM

- **TPEG™ MEMS T4 OPM**: Technology applied in addressing ultra high current testing

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>TPEG™ MEMS T4 OPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle diameter</td>
<td>Less than 3 mils equivalent</td>
</tr>
<tr>
<td>Max pin count</td>
<td>&gt; 20,000 pins</td>
</tr>
<tr>
<td>X, Y alignment accuracy and Z planarity</td>
<td>X,Y: ± 8 μm; Z plan: Δ 20 μm</td>
</tr>
<tr>
<td>Min pitch and configuration</td>
<td>78 μm Full Array</td>
</tr>
<tr>
<td>Pin Current (CCC)</td>
<td>850mA (LCR2), 1150mA (HCS alloy)</td>
</tr>
<tr>
<td>Force (at 3 mils OT)</td>
<td>4.5g at working 3mils working OD</td>
</tr>
</tbody>
</table>
Probe Mark Comparison of Vendor A (Cobra-like Technology) and T4_OPM

T4_OPM - small probe mark even at 75um OD
Cobra-like Technology - large mark with less OD applied (<20 um)
Cobra-like Technology Card has high BCF
Multiple Test 1X / 5X / 10X using T4 TPEG Technology

NORTH

1X TD
PM Measurement = 12um

5X TD
PM Measurement = 15um

10X TD
PM Measurement = 16um
Multiple Test 1X / 5X / 10X using T4 TPEG Technology

1X TD
PM Measurement = 11µm

5X TD
PM Measurement = 14µm

10X TD
PM Measurement = 16µm

SOUTH
Multiple Test 1X / 5X / 10X using T4 TPEG Technology

EAST

1X TD
PM Measurement = 12um

5X TD
PM Measurement = 14um

10X TD
PM Measurement = 14um
Multiple Test 1X / 5X / 10X using T4 TPEG Technology

1X TD
PM Measurement = 12um

5X TD
PM Measurement = 14um

10X TD
PM Measurement = 16um
TEST TIME COMPARISON

Cobra-like Technology Probe Card = 8.29861 secs
T4_OPM = 7.68754 secs
Advantages using TP Probe Card

• Repair Lead Time

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Repair Lead Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP</td>
<td>&lt; 1 Week</td>
</tr>
<tr>
<td>Competitor Probe Card</td>
<td>1 month</td>
</tr>
</tbody>
</table>

• Prober and Cleaning setup Comparison

<table>
<thead>
<tr>
<th>Category</th>
<th>Competitor Probe Card</th>
<th>Technoprobe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probing OD</td>
<td>100 um</td>
<td>40 um</td>
</tr>
<tr>
<td>Soak Time</td>
<td>2 Hrs.</td>
<td>2 Hrs.</td>
</tr>
<tr>
<td>Preheat Setting</td>
<td>Same</td>
<td>Same</td>
</tr>
<tr>
<td>Cleaning settings:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cleaning Media</td>
<td>ITS PP-300</td>
<td>WA6000</td>
</tr>
<tr>
<td>Cleaning OD</td>
<td>75 um</td>
<td>35um</td>
</tr>
<tr>
<td>Cleaning Frequency</td>
<td>125 TD</td>
<td>125 TD</td>
</tr>
</tbody>
</table>

Use less expensive polishing media in comparison with competitor card.
Advantages using TP Probe Card

Improved Machine Index Time due to 4X1 or 1X4 configuration

Competitor Cards

TechnoProbe Card
YIELD DATA COMPARISON (XXXX Device)

- Average Probe Yield of 93.62% using Cobra-like Technology Probe card.
- Average Probe Yield of 94.78% using T4_OPM Probe card.
- Significant Probe yield improvement, increased Good Die quantity.
• Average Probe Yield of 90.23% using Cobra-like Technology Probe card.
• Average Probe Yield of 93.55% using T4_OPM Probe card.
• Significant Probe yield improvement, increased Good Die quantity.
Hitting Glass Occurrence Comparison (XXXX Device)
Hitting Glass Occurrence Comparison (YYYY Device)

**YYYY - Hitting Glass Occurrence - Wafer per Lot**
Comparison of Old and New Probe Card

**YYYY - Hitting Glass Occurrence - Dice per Lot**
Comparison of Old and New Probe Card
Contact Resistance Measurements

C_RES on Al blank wafer
Cleaning frequency: 10/250 PTDs
Cleaning media: MIPOX WA6000
STANDARD ALLOY – LCR2
BCF Comparison of TP and Vertical Cobra-like Probe Cards @ 25um OD

Competitor Card (Cobra-like) @ 25 microns Overdrive
- BCF reading: 2.9 - 4.1

Technoprobe Card (TPEG T4 OPM) @ 25 microns Overdrive
- BCF reading: 2.7 - 4.0

Conclusion
- Technoprobe Card and Competitor card BCF performance at 25microns overdrive are almost the same.
BCF Comparison of TP and Vertical Cobra Probe Cards @ 75um OD

Competitor Card (Cobra Like) @ 75 microns Overdrive
- BCF reading: 9.7 - 12.9

Technoprobe Card (TPEG T4 OPM) @ 75 microns Overdrive
- BCF reading: 3.7 - 4.6

CONCLUSION:
- Competitor Card (Cobra Like)
  - BCF reading increases as the overdrive increases
- Technoprobe Card (TPEG T4 OPM)
  - BCF reading was consistent ranging up to 4.5g even though the overdrive applied has different values.
CONCLUSIONS

- Utilization was improved from 58% to 80%.
- Test yield for T4_OPM is significantly improved and increased meeting the target device yield.
- Misaligned probe marks and hitting glass issues are significantly reduced from 40% to 0%.
- 100% wafer inspection was removed, and normal inspection requirement is done on affected devices, thus lot cycle time is improved.
- Rebuild lead time of probe cards was reduced from 6-8 weeks to less than 1 week.
- Cobra like technology BCF reading increases as overdrive increases, while T4 BCF reading was consistent ranging up to 4.5g even though overdrive applied has different values.
- Improvement on test time from 8.29 to 7.68 seconds/touch down.
FUTURE PLANS

- Our Team plans to convert more devices that have similar quality and productivity issues to Technoprobe design.
- Considering Technoprobe card as an option for new product designs.
- Follow on activities include collaborating with and evaluating Technoprobe for Hot Probe.
Thank You

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Jim Tan – Allegro Phils. Test Eng’g. Department Manager
Jack Sadie- Allegro Phils. Test and Probe Operation Director

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