One Touch 300 mm wafer probing

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Synopsis

The problems encountered with 1 TD 300 mm wafer probing are unique enough that an approach that simply scales up traditional probe card architecture and industry practice is not sufficient.

To resolve the specific setup and throughput issues associated with 1 TD requires a systems level approach where probe card, prober and tester vendors work collaboratively to solve customer problems.
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300mm 1TD challenges – Planarity & Tilt

\[ \delta_{300} = 2 \times \delta_{150} \]

Long Scrubs (more damage)
Low Cres, Higher Probing Force

Short Scrubs (less damage)
High Cres, Lower Probing Force

To maintain spec, we have to be
2 x better than we have been before
Problems impacted by planarity and tilt

Planarity correlation between customer and supplier.
Test floor to test floor correlation – cards are shipped between sites.
Test system to test system correlation – on a single test floor

300 mm 1 TD predicted to be at least 2 x adjustment rate of PH150
How to address planarity and tilt

- **System to system correlation**
  - Usually carried out using a “standard” that is measured across the floor.
    - Glass mask
    - Golden probe card.
    - Ceramic probe card.
- **Issues with correlation**
  - Extensive Time and work required.
  - System downtime.
  - Repeatability and accuracy.

- **In-situ tilt control**
  - Issues with this method
    - Automation has not traditionally been available
    - Card often has to be pulled out of the prober to adjust, while measurement is done inside the prober.
Results of System Level tilt control on a 1 TD card

Tilt + pin-to-pin variation

Card left factory with 20 um planarity

Adjusted at customer using one leveling point

Will be automated in the future
### 1TD Probing Process Challenges

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300mm 1TD challenges – High Probe Force
This is a big jump in force over current products

<table>
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<tr>
<th>Product Type</th>
<th>Springs /DUT</th>
<th># of DUTs</th>
<th>Springs</th>
<th>Low Force Spring Kg</th>
<th>High Force Spring Kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nand Flash</td>
<td>25</td>
<td>500</td>
<td>12,500</td>
<td>63</td>
<td>125</td>
</tr>
<tr>
<td>NOR Flash</td>
<td>40</td>
<td>800</td>
<td>32,000</td>
<td>160</td>
<td>320</td>
</tr>
<tr>
<td>DRAM #1</td>
<td>75</td>
<td>500</td>
<td>37,500</td>
<td>188</td>
<td>375</td>
</tr>
<tr>
<td>DRAM #2</td>
<td>75</td>
<td>1000</td>
<td>75,000</td>
<td>375</td>
<td>750</td>
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* Low spring force is 5 grams per contact
300mm 1TD challenges – High Probe Force

System deflection results in 35% loss of effective spring compression
300mm 1TD challenges – High Probe Force

Unbalanced loading leads to horizontal system compliance

Compliance Contributions

- Head Plate: 68%
- Chuck: 27%
- Probe Card: 5%

Measured using split photodiode

Short scrub

Long scrub
Methods for adjusting for system z compliance

Engineering studies on cards with different probe counts
- Platform dependent
- Issues with resolution, accuracy

Add stiffeners to the probe cards
- Adds mass (approaching ergonomic limits)
- The high CTE of the stiffener can cause thermal bending.
- Adds thermal mass, which increases setup times.
- May not fit in space allocated for probe card.
- Adds cost

The most effective approach is to look at the structural rigidity of the system
Results of minimizing system compliance

Rigid element attached to tester motherboard

Force = 200 kgms

Max Deflection = 3.4 um

Vertical Z Deflection

No Tilt
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300mm 1TD challenges – Uptime

- Baseline – no thermal soak (5 minutes for lot change).
- 30 minute thermal soak
- Realign every 10 minutes for 4 hours – setup only
- Realign every 10 minutes for 4 hours – every lot
Slow system thermal response impacts probe position

System continues drifting after probe card reaches thermal equilibrium
One Touch 300 mm Wafer Probing

Tester – Probe Card – Prober Thermal Loop

- TEST HEAD
- INSERT RING
- HEAD PLATE
- CH
- WAFFER
- CHUCK
- GND
- PROBER CAVITY
- FAN

Conduction
Convection
Radiation
Thermal Stability Results

One TD card designed to minimize system thermal response

At all times, total deflection within a 20um range

This card carries the potential to remove thermal soak and realignment times
Other elements of uptime

Alignment failures
- Special alignment features.
- Minimize thermal realignment.

Cleaning /PM
- Process improvements discussed earlier are all designed to provide a consistent probing process which minimizes cleaning.

Repair
- Minimize repair through improved contactor design.
- Service close to customer (fast turn times)
Conclusion

1 TD probing is more than a scale up of previous technologies
System Level approaches are needed to overcome key probing process and throughput issues.