Probe Card Test and Repair on a Probe Card Analyzer without a Probe Card Interface

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Typical Probe Card Test Setup

- **Probe Card**
- **Probe Card Interface (PCI) (e.g. Motherboard, Fixture)**
- **Probe Card Analyzer (PCA)**
- **Measure Mechanical and Electrical Properties**
Probe Card Analyzer Basic Test Requirements

• Required Mechanical Tests
  - Planarity

• Required Electrical Tests
  - Component Testing
  - Leakage / Capacitance
  - Contact Resistance
  - Wiring – Primary Channel
  - Wiring - Shorts

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PCI Cost Impacts Cost of Probe Card Test

- **Probe Card Interface needed for each Tester Interface**
- **Probe Card Manufacturers**
  - Support multiple customers with multiple tester platforms
  - Each customer can have unique Tester Interfaces solutions
- **Tester World (only a snap shot)**
  - Advantest V93000 – 12inch tower and 9,5inch tower
  - Advantest V93000 – Direct Probe
  - Teradyne J750 – 12inch in several configurations
  - Teradyne J750HD – 12inch tower
  - Teradyne J750HD – 440J (18inch tower)
  - Teradyne µ-Flex in a lot of configurations
  - Teradyne Ultra Flex – also Ultra Probe
  - Teradyne Eagle Test Systems

………

For Digital, Analog and Mixed Signals over 200 different tester platforms!
Probe Card Interfaces Use Models

- Probe Card Manufacturing
- Probe Card Manufacturer Service and Repair Sites
- Probe Card Customers
  - Incoming QA
  - Troubleshooting
- Probe Card Manufacturing/Customer R&D

- Big investment in PCIs

- Is there a test strategy that can deliver the required test results at a lower cost?
What if we test the probe card with NO PCI?

- Can we reduce costs and maintain high test quality?
Probe Card Holder Requirements

- **Probe card holder – Mechanical Requirements**
  - Position probes planer to the Checkplate (chuck)
  - Supply minimal hold-down force – do not want card to move
  - Rework Compatible – Hold the probe card so it can be flipped

- **Probe card holder – Interconnect Requirements**
  - Single connection to probe card ground plane
What can we measure with a Probe Card Holder?

- **Required Mechanical Tests?**
  - Planarity
  - Alignment

- **Required Electrical Tests?**
  - Component Testing.
  - Leakage / Capacitance
  - Contact Resistance
  - Wiring – Primary Channel
  - Wiring - Shorts
Mechanical Properties Measured

- Planarity
- X Error
- Diameter
- Y Error
- Probe Force
- Scrub Length
- Spring Rate
- Scrub Area
- Motion Angle
Probe Card Holder Planarity Measurement Challenges

- **Cannot do electrical planarity** – No connection
- **Force Planarity (FP)** – New Feature on PRVX4
  - Determine probe contact position via *force-based contact*
  - *This enables testing without a PCI*
Probe Card Holder
Alignment Measurement Challenges

• Alignment – Requires Probe Planarity – No Electrical Connection
  – Force Planarity enables accurate alignment measurements
  – Planarity required for accurate scrub
  – Planarity required for good focus quality

• Alignment – Probe Card Holder requires low total force
  – PRVX4 the window surface is small and raised so during Alignment at overtravel, only a few probes are overtraveled at a time
Are the mechanical results valid?
PCI vs Probe Card Holder - DOE

- **J750 Probe Card Interface**

- **J750 Probe Card Holder**

- **Probe Card (ViProbe®)**
  - Active Area: 35mm X 35mm
  - Probe Count: 3508 (2484 bussed)

- **PRVX4 Probe Card Analyzer (FEINMETALL)**
  - Run P&A with PCI
  - Run P&A with Probe Card Holder

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Test Results: PCI vs. Probe Card Holder

Planarity

- Probe Card Interface - Planarity via Electrical Contact Position
- Probe Card Holder – Planarity via Force Contact Position
Test Results: PCI vs. Probe Card Holder

Planarity

- Probe Card Interface - Planarity via Electrical Contact Position
- Probe Card Holder – Planarity via Force Contact Position

Force contact is less sensitive to contamination
Test Results: PCI vs. Probe Card Holder Alignment
Summary - Mechanical test results

- Force Planarity and Low Force Alignment
  - Enables Planarity and Alignment with a Probe Card Holder

- *Probe Card Holder meets 100% of mechanical test requirements*

- Equivalent results for Planarity and Alignment

PCI VS. Probe Card Holder
Probe Card Holder
Electrical Properties Measurements?

- **Required Electrical Tests?**
  - Component Testing
  - Leakage / Capacitance
  - Contact Resistance
  - Wiring – Primary Channel
  - Wiring – Shorts / Opens
Probe Card Holder: Component Testing

- Component testing – PCI Technique

Tester Side  | Probe Card  | Probes

Standard PCI Measurement technique

Component

Vias to PWR plane  | Vias to GND plane
Probe Card Holder: Component Testing

- Component testing – Probe Card Holder Technique

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Probe Card Holder: Component Testing

- Component testing – Probe Card Holder Technique
  - Automatically measure all components connected to ground plane
Probe Card Holder: Leakage/Capacitance

- Leakage / Capacitance – PCI Technique
Probe Card Holder: Leakage/Capacitance

- Leakage / Capacitance – Probe Card Holder
  - Can measure all probes to ground automatically
Probe Card Holder

Contact Resistance & Wiring: Primary channel

- Contact resistance / Wire checker - Primary channel method
Probe Card Holder
Contact Resistance & Wiring: Primary channel

- Contact resistance / Wire checker - Primary channel method
- New User Assist Testing Feature
- 100% test coverage with User Assist
New User Assist Testing

- New feature guides user to each location to contact with probe
- Bussed probes typically large % of probe card (semi-automatic)
- Roughly 20-30 probes/minute for non-bussed probes
Probe Card Holder
Wiring: Short/Opens

- Where do I move the ground probe?
- Not currently viable: Area for future work
### Summary: Electrical Measurements With Probe Card Holder

<table>
<thead>
<tr>
<th>Valid Electrical Tests</th>
<th>Results</th>
<th>Trade Offs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component Testing (100%)</td>
<td>YES</td>
<td>Auto – Gnd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Semi – Non Gnd</td>
</tr>
<tr>
<td>Leakage / Capacitance (100%)</td>
<td>YES</td>
<td>To Ground only</td>
</tr>
<tr>
<td>Contact Resistance (100%)</td>
<td>YES</td>
<td>Semi-Automatic</td>
</tr>
<tr>
<td>Wiring – Primary Channel (100%)</td>
<td>YES</td>
<td>Semi-Automatic</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Not viable Tests</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiring – Short / Opens</td>
<td>No</td>
</tr>
</tbody>
</table>
Probe Card Holder Additional Benefits

- **Easy to Make**
  - Can be manufactured in-house
  - Very short lead times

- **Allows simplified probe card definitions**

- **No PCB required for Planarity and Alignment**

- **Very low cost compared to PCI**

- **Does not require PCA with Pogo blocks – Low Cost PCA option**

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# Summary: PCI vs Probe Card Holder

<table>
<thead>
<tr>
<th>Test</th>
<th>PCI</th>
<th>Probe Card Holder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planarity</td>
<td>Yes - Electrical</td>
<td>Yes: Force</td>
</tr>
<tr>
<td>Alignment</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Components</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Leakage/Capacitance</td>
<td>Yes</td>
<td>Yes: To ground plane</td>
</tr>
<tr>
<td>Contact Resistance</td>
<td>Yes</td>
<td>Yes: Semi-Automatic</td>
</tr>
<tr>
<td>Wiring: Primary Channel</td>
<td>Yes</td>
<td>Yes: Semi-Automatic</td>
</tr>
<tr>
<td>Wiring: Shorts/Opens</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Cost</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>
Summary

- New VX4 test capabilities provide options for reducing cost of probe card test by using a Probe Card Holder instead of a PCI
  - Force based planarity
  - Low force Alignment measurement
  - User assisted electrical test

- Use models for lower cost Probe Card Holder testing
  - *Probe Card manufacturer production*: new tester interface introduction and other low volume manufacturing
  - *Probe Card manufacturer service center*: probe card repair
  - *Probe Card customer*: incoming QA, troubleshooting
  - *Probe Card manufacturer/customer*: R&D testing

- Use model for traditional Probe Card Interface testing
  - Volume manufacturing
  - 100% test coverage
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