



IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

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



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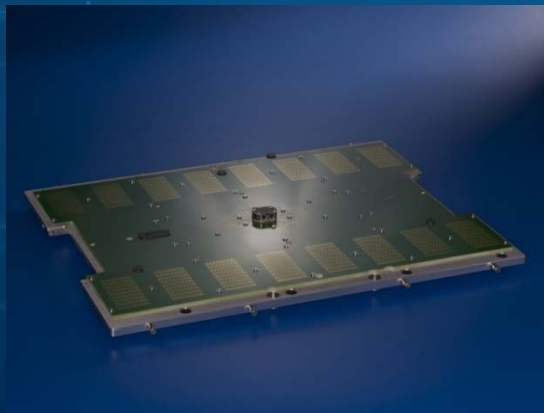
Simon Allgaier

FEINMETALL

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



PCI



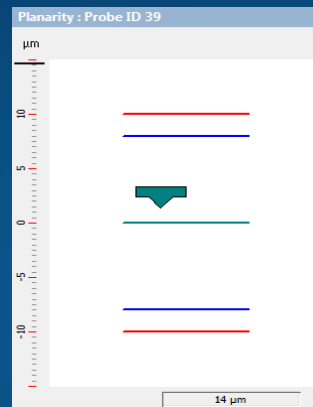
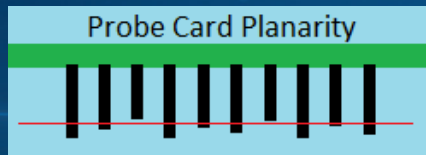
PCA



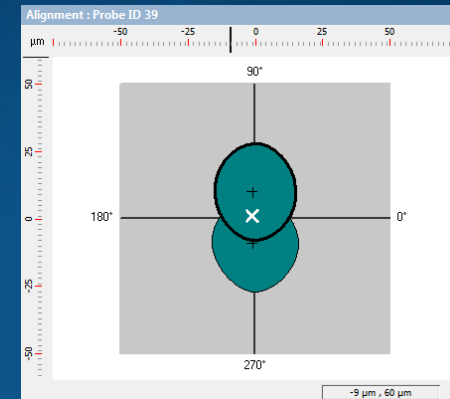
Probe Card Analyzer Basic Test Requirements

- **Required Mechanical Tests**

Planarity



Alignment

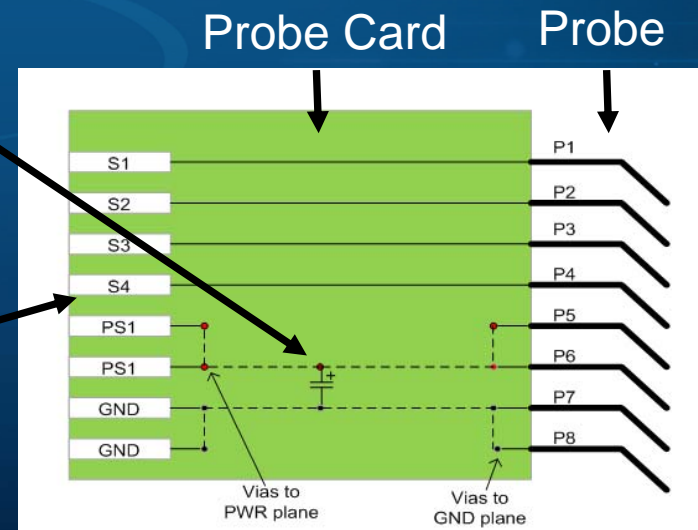


- **Required Electrical Tests**

- Component Testing
- Leakage / Capacitance
- Contact Resistance
- Wiring – Primary Channel
- Wiring - Shorts

Component

Tester Side Connections



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

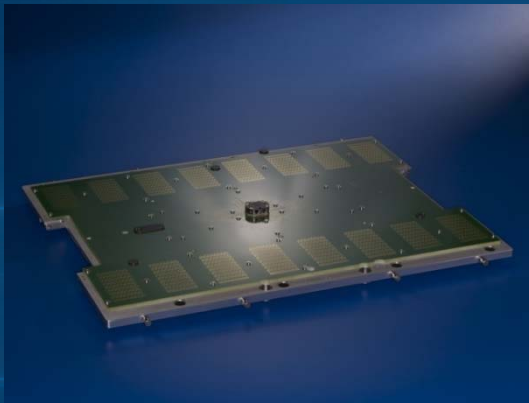


- Is there a test strategy that can deliver the required test results at a lower cost?

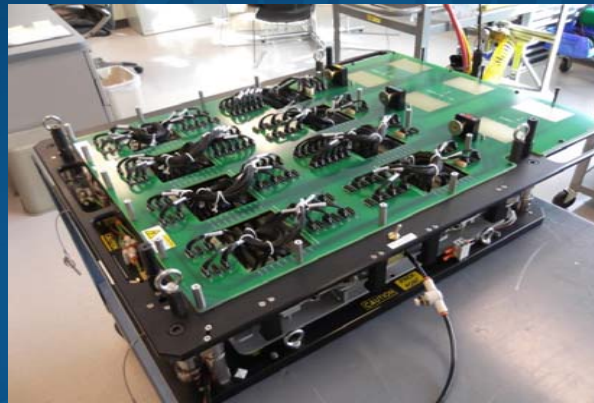
What if we test the probe card with NO PCI?

- Can we reduce costs and maintain high test quality?

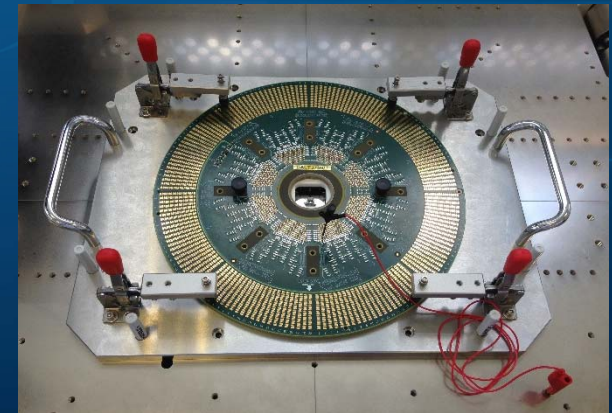
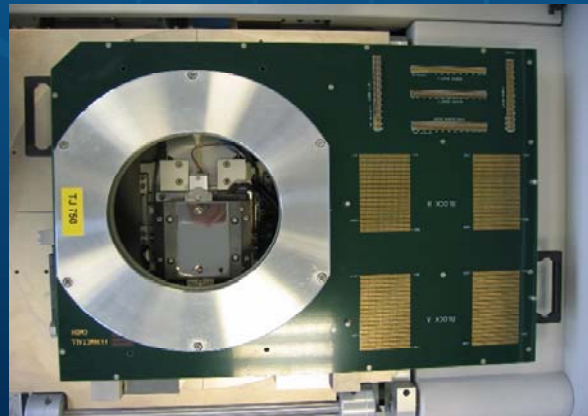
Probe Card



PCI

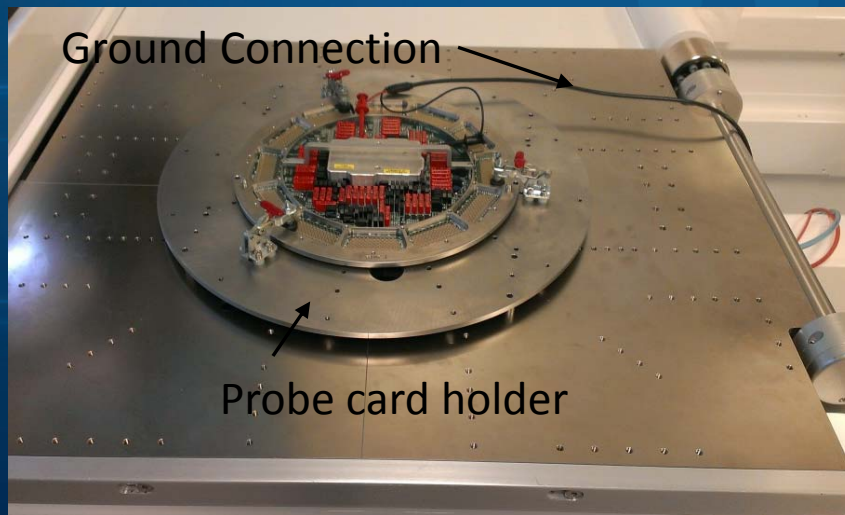


Probe Card Holder



Probe Card Holder Requirements

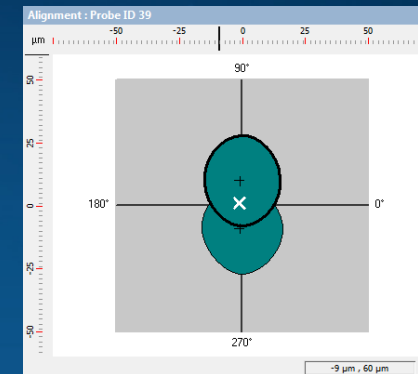
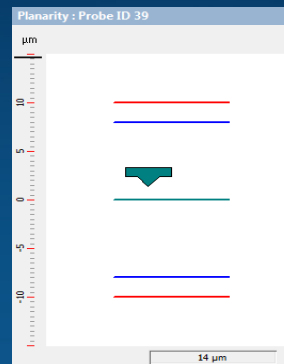
- **Probe card holder – Mechanical Requirements**
 - Position probes planer to the Checkplate (chuck)
 - Supply minimal hold-down force – do not want card to move
 - Rework Compatible – Hold the probe card so it can be flipped
- **Probe card holder – Interconnect Requirements**
 - Single connection to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



What can we measure with a Probe Card Holder?

• Required Mechanical Tests?

- Planarity
- Alignment



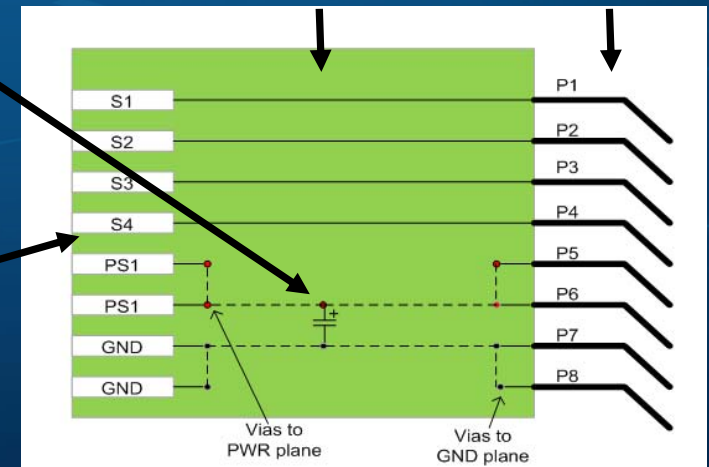
• Required Electrical Tests?

- Component Testing.
- Leakage / Capacitance
- Contact Resistance
- Wiring – Primary Channel
- Wiring - Shorts

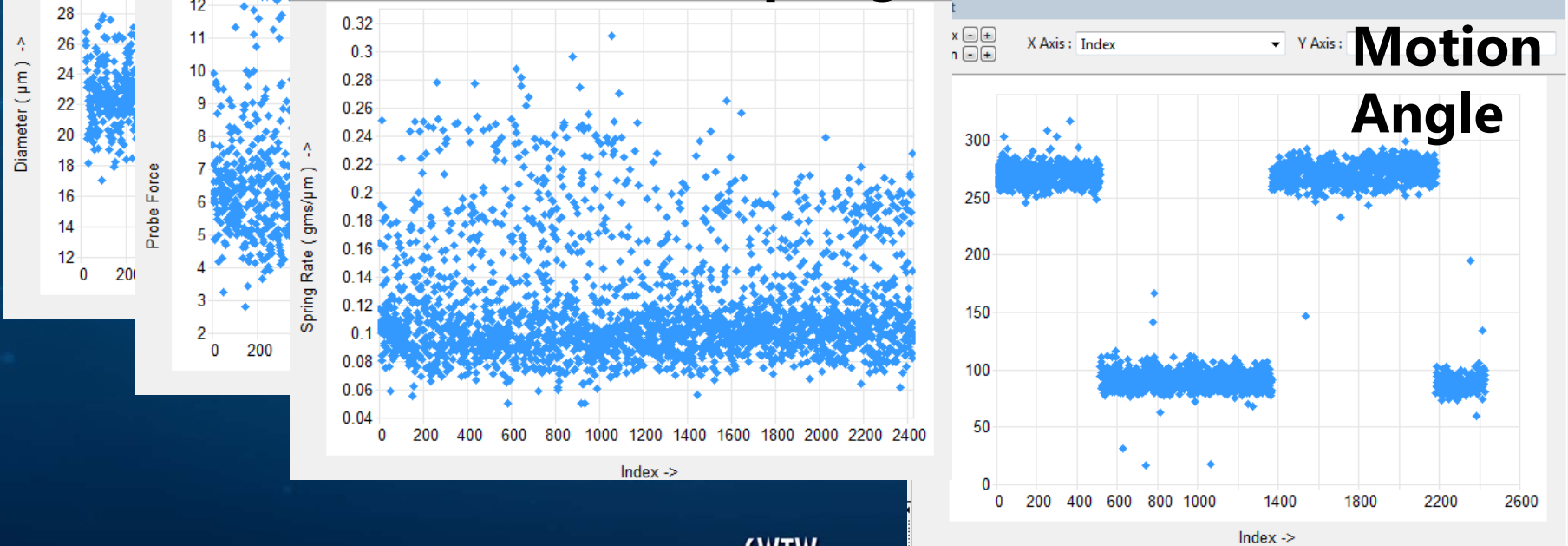
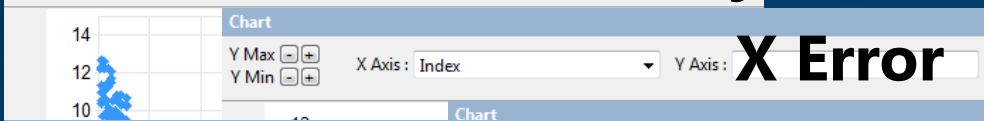
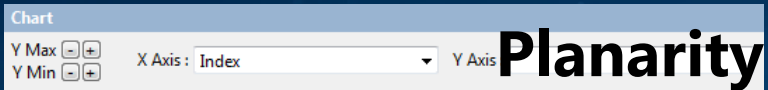
Component

Tester Side Connections

Probe Card Probes



Mechanical Properties Measured



Probe Card Holder

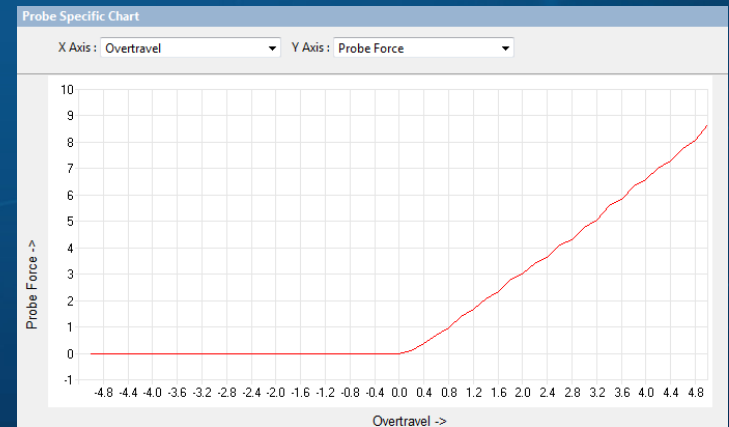
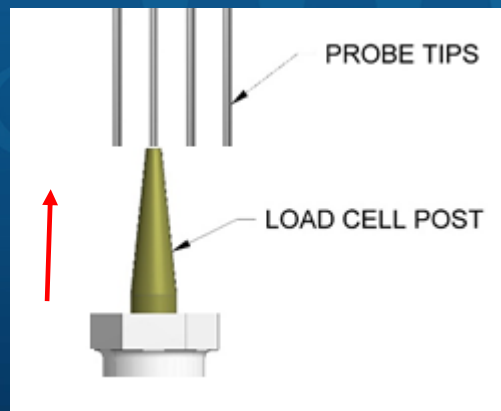
Planarity Measurement Challenges

- 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*

Load Cell

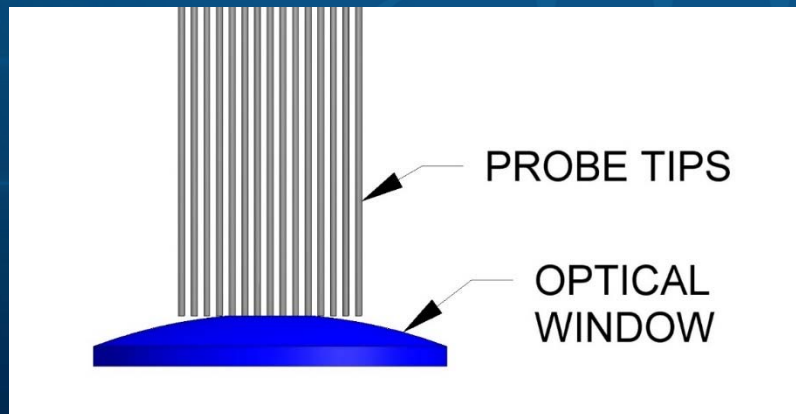
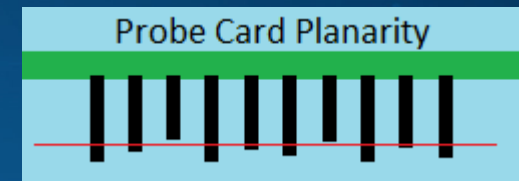


Load Cell Post



Probe Card Holder Alignment Measurement Challenges

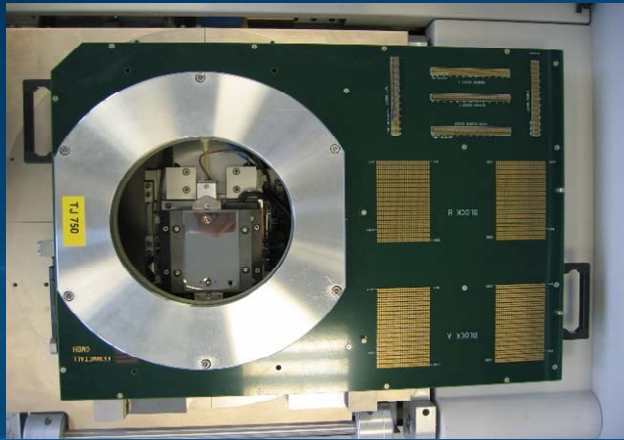
- **Alignment – Requires Probe Planarity – No Electrical Connection**
 - Force Planarity enables accurate alignment measurements
 - Planarity required for accurate scrub
 - Planarity required for good focus quality
- **Alignment – Probe Card Holder requires low total force**
 - PRVX4 the window surface is small and raised so during Alignment at overtravel, only a few probes are overtraveled at a time



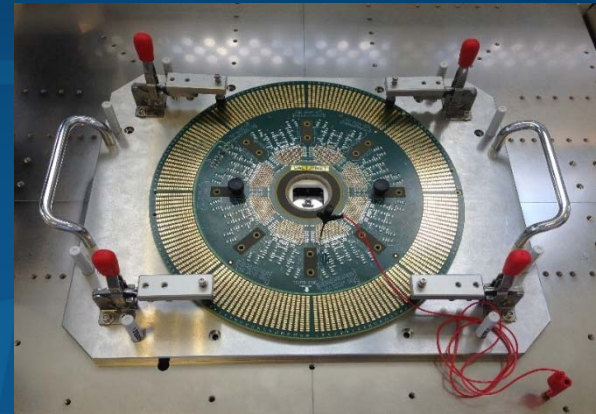
Are the mechanical results valid?

PCI vs Probe Card Holder - DOE

- J750 Probe Card Interface

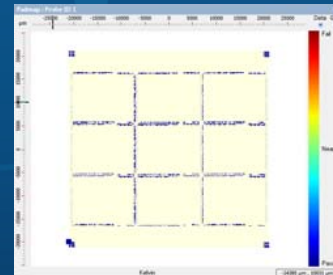


- J750 Probe Card Holder



- Probe Card (ViProbe®)

- Active Area: 35mm X 35mm
- Probe Count: 3508 (2484 bussed)



- PRVX4 Probe Card Analyzer (FEINMETALL)

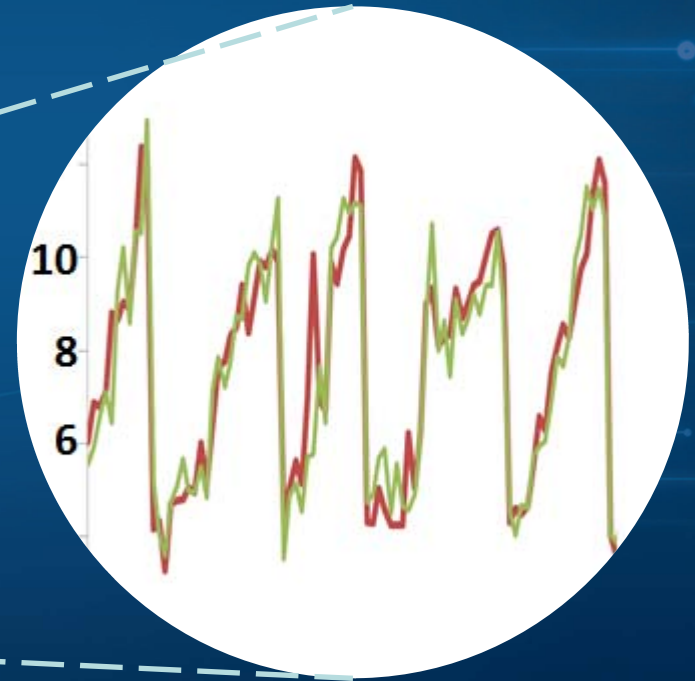
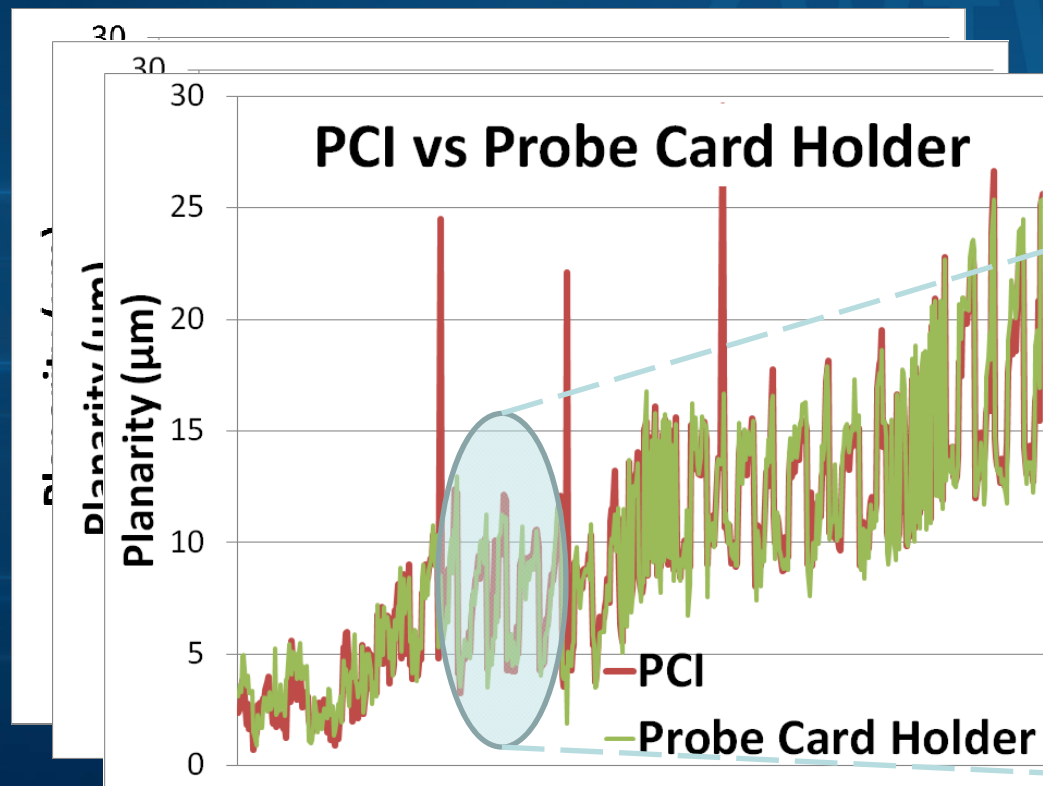
- Run P&A with PCI
- Run P&A with Probe Card Holder



Test Results: PCI vs. Probe Card Holder

Planarity

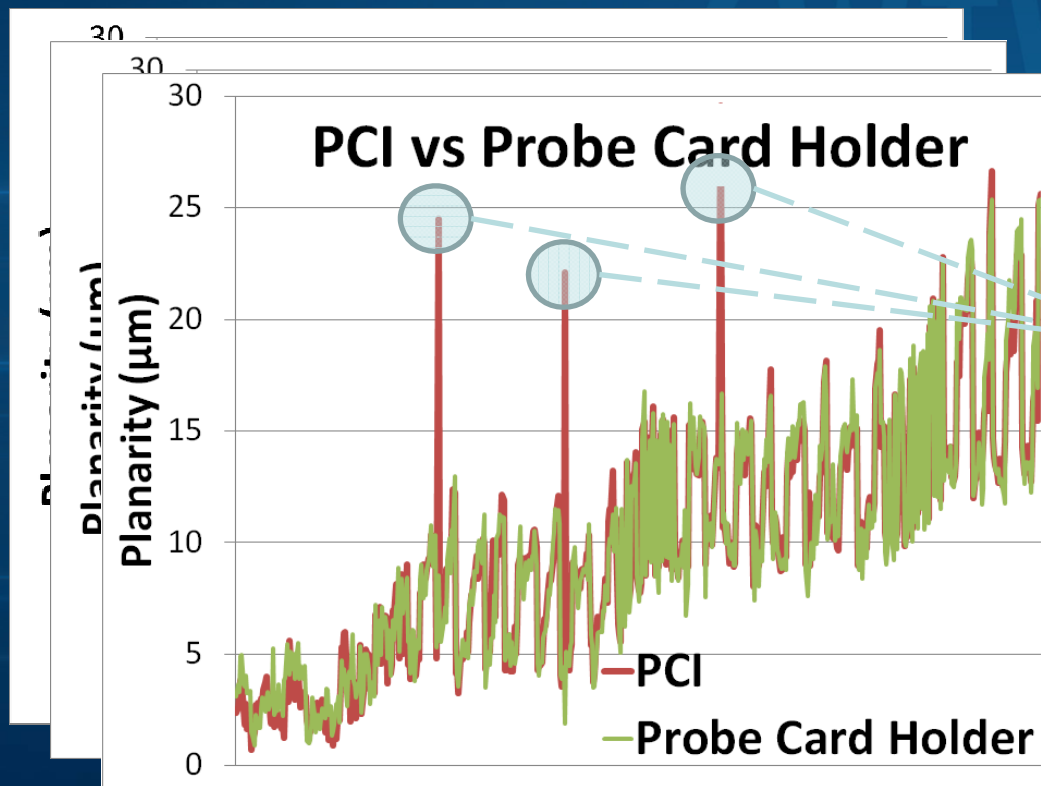
- Probe Card Interface - Planarity via Electrical Contact Position
- Probe Card Holder – Planarity via Force Contact Position



Test Results: PCI vs. Probe Card Holder

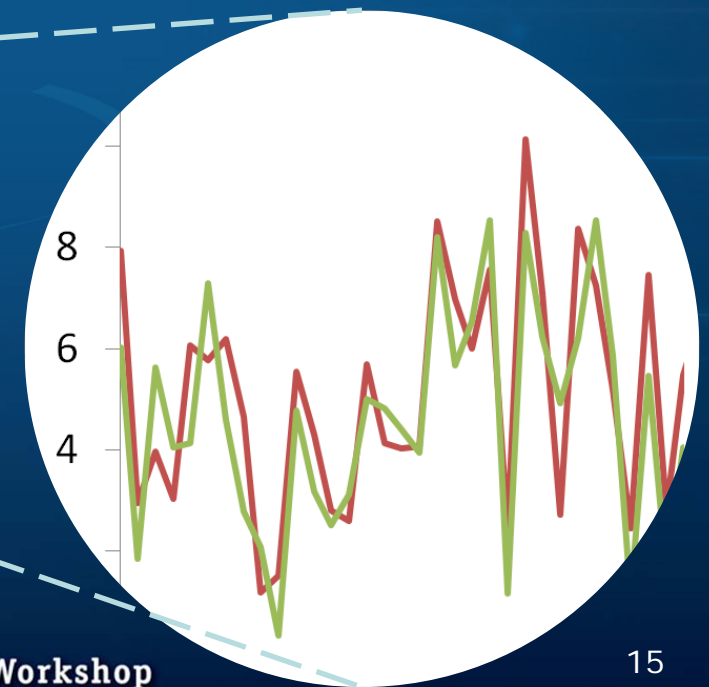
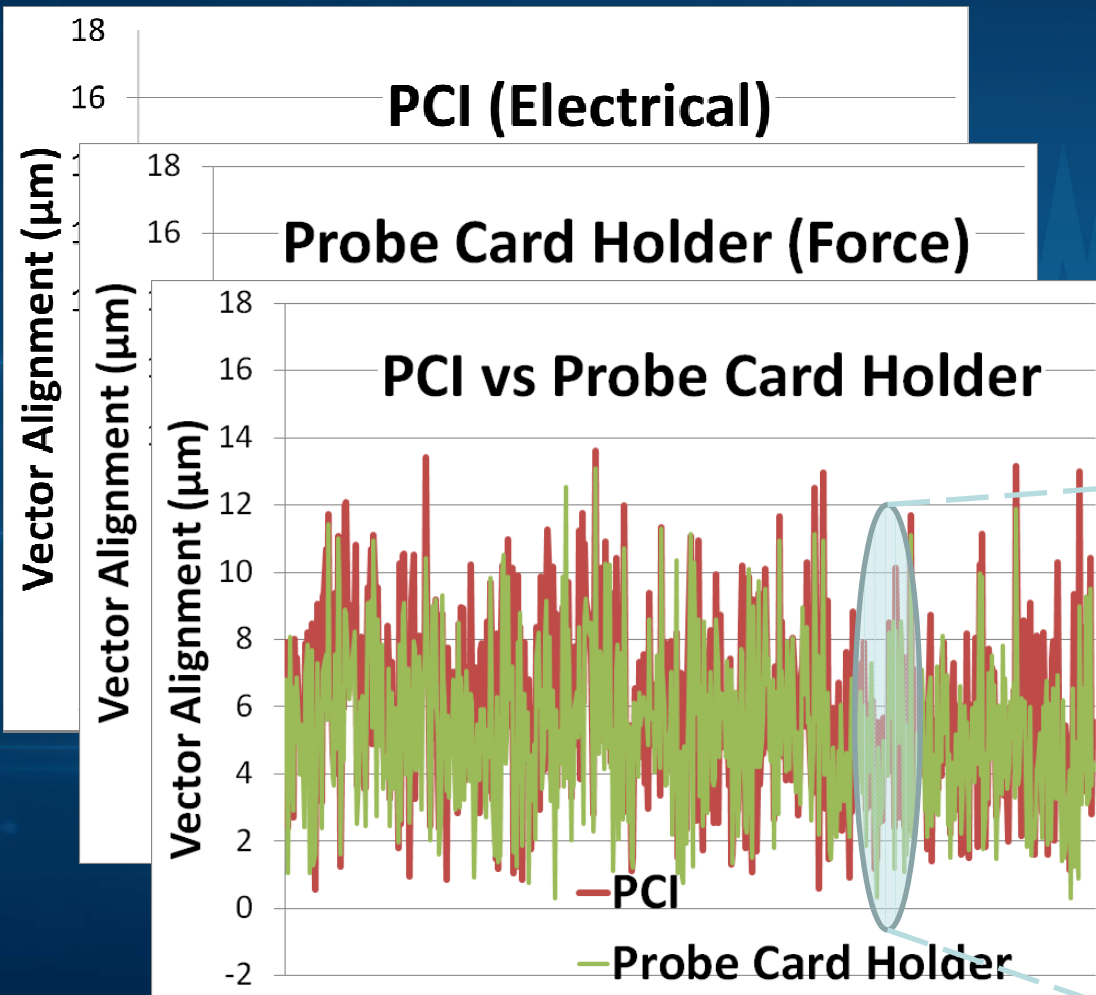
Planarity

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



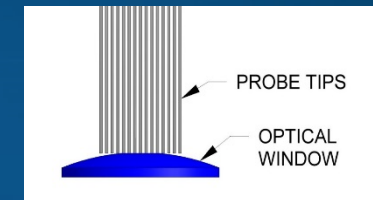
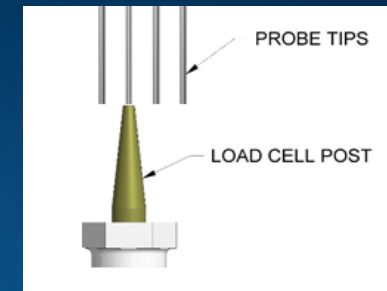
Force contact is less sensitive to contamination

Test Results: PCI vs. Probe Card Holder Alignment



Summary - Mechanical test results

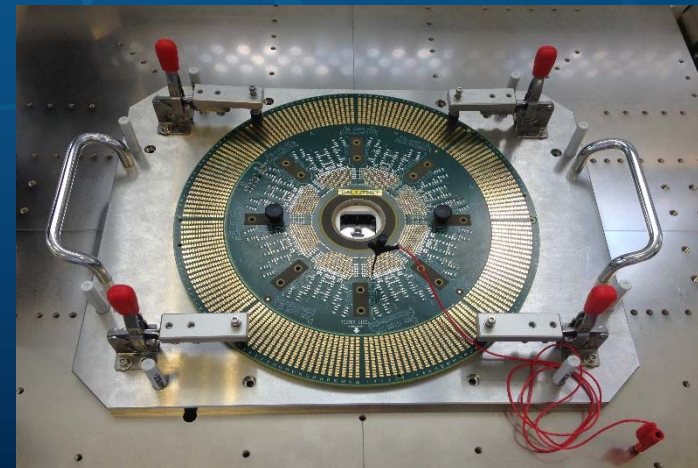
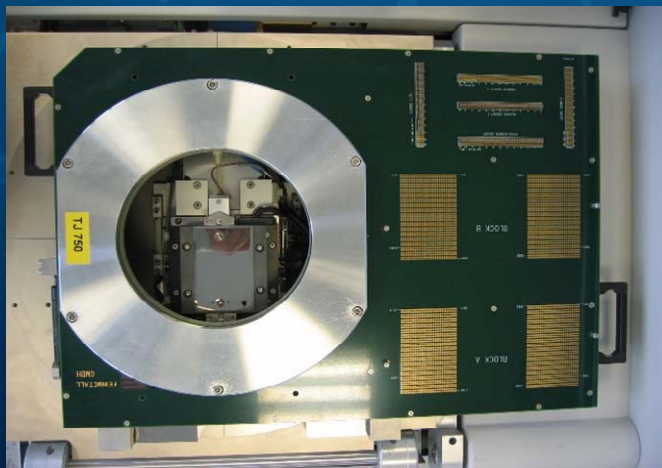
- **Force Planarity and Low Force Alignment**
 - Enables Planarity and Alignment with a Probe Card Holder
- ***Probe Card Holder meets 100% of mechanical test requirements***
- **Equivalent results for Planarity and Alignment**



PCI

VS.

Probe Card Holder

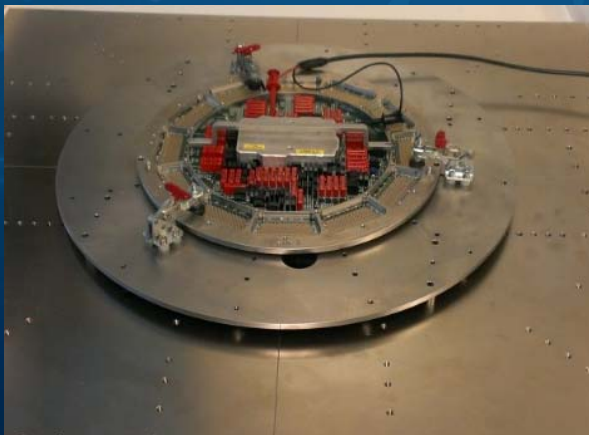


Probe Card Holder

Electrical Properties Measurements?

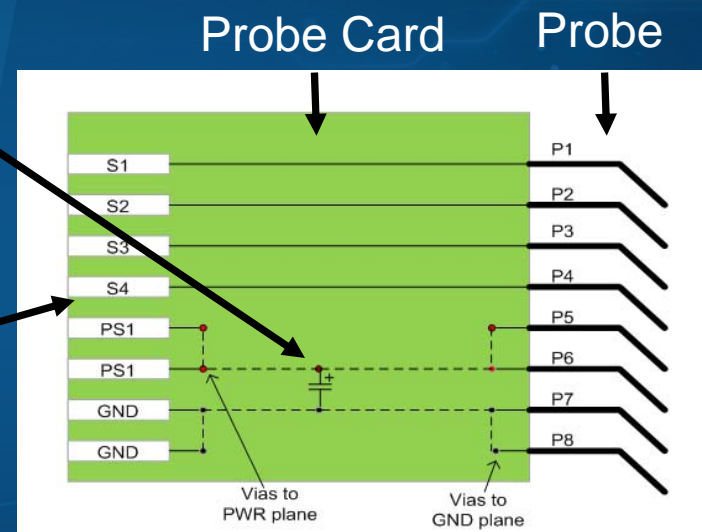
- **Required Electrical Tests?**

- Component Testing
- Leakage / Capacitance
- Contact Resistance
- Wiring – Primary Channel
- Wiring – Shorts / Opens



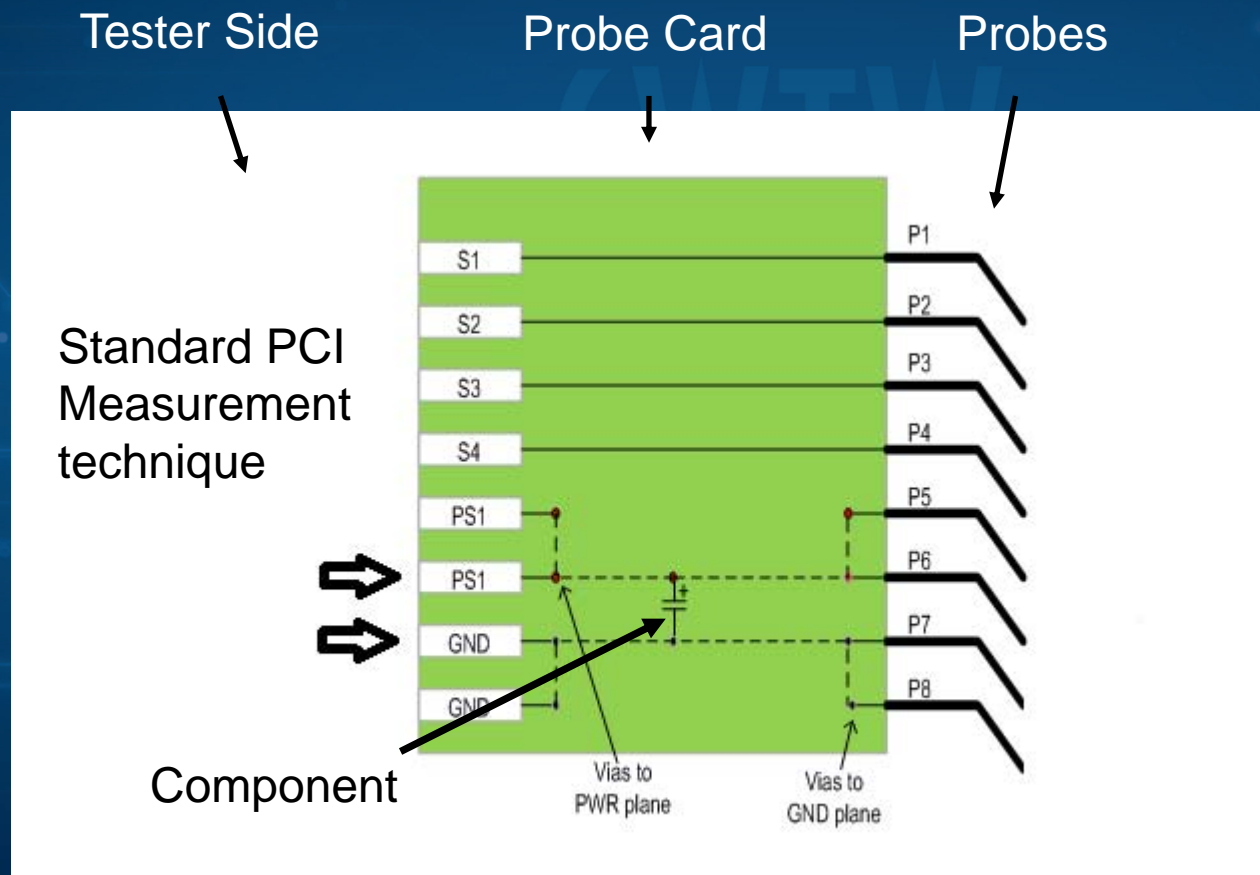
Component

Tester Side Connections



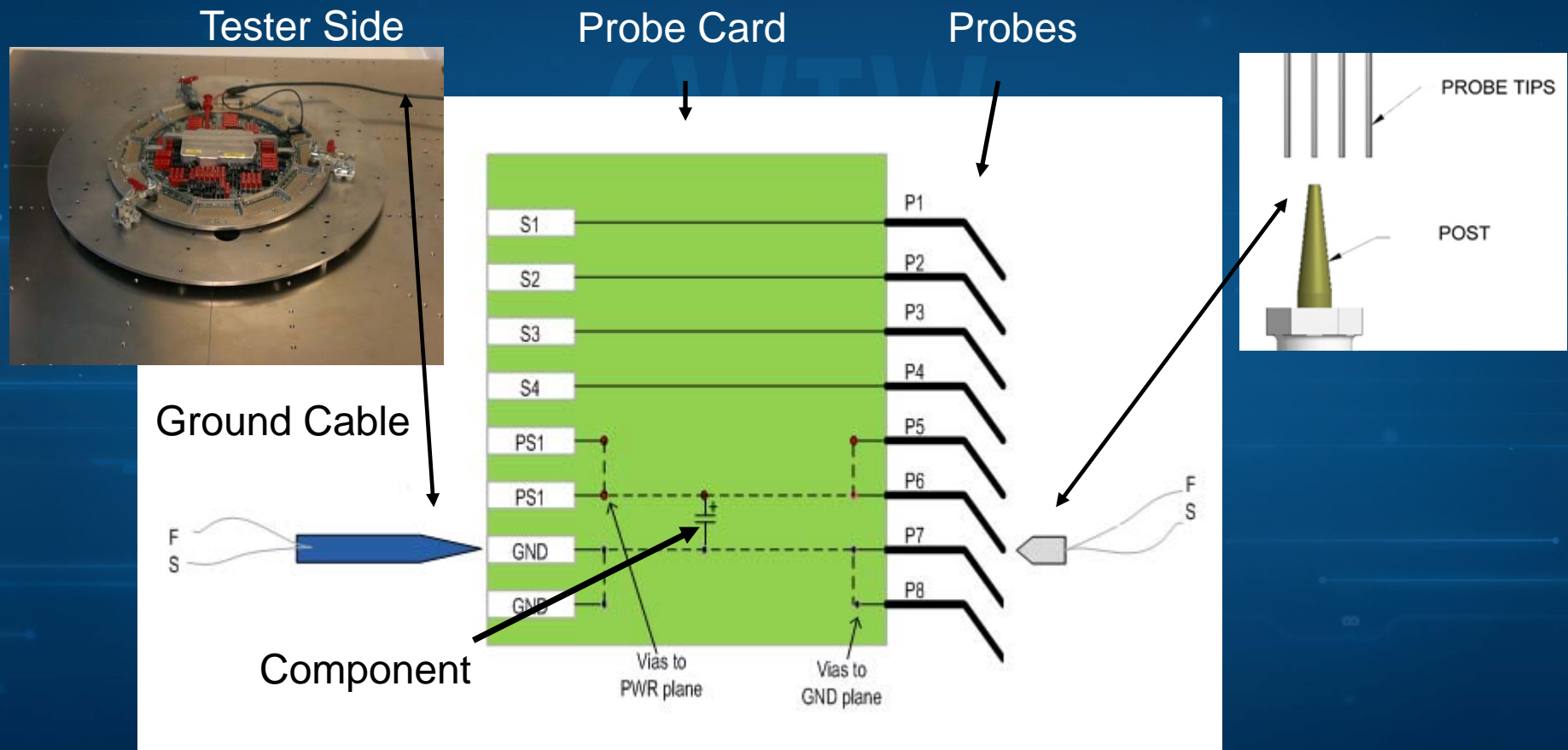
Probe Card Holder : Component Testing

- Component testing – PCI Technique



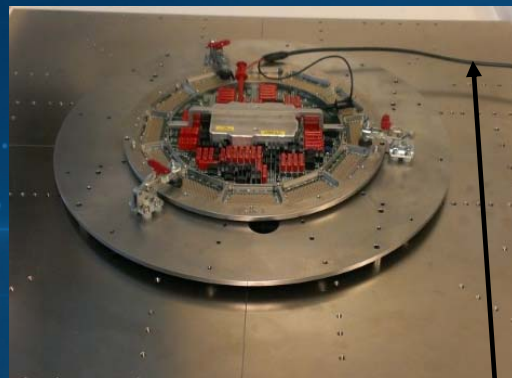
Probe Card Holder : Component Testing

- Component testing – Probe Card Holder Technique



Probe Card Holder : Component Testing

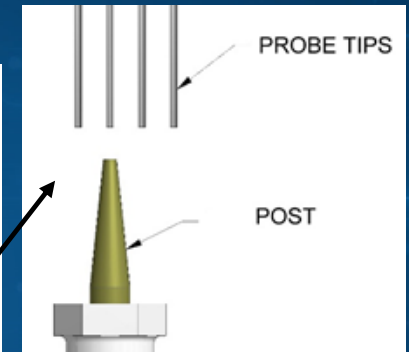
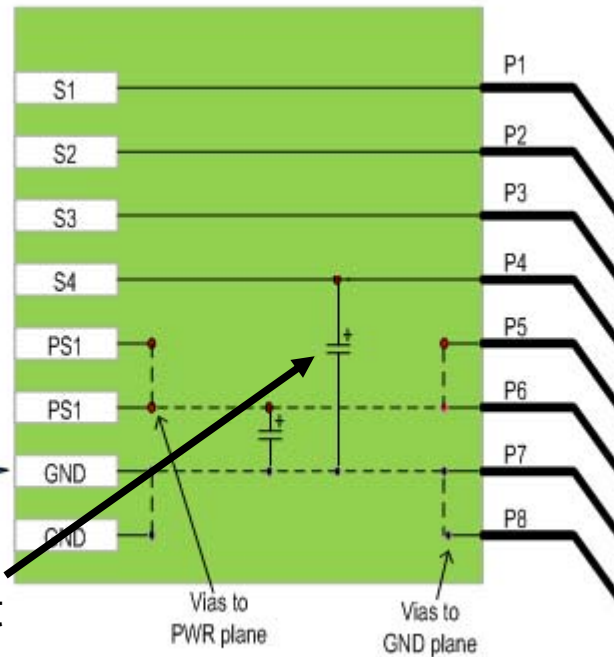
- **Component testing – Probe Card Holder Technique**
 - Automatically measure all components connected to ground plane



Ground Cable

F
S

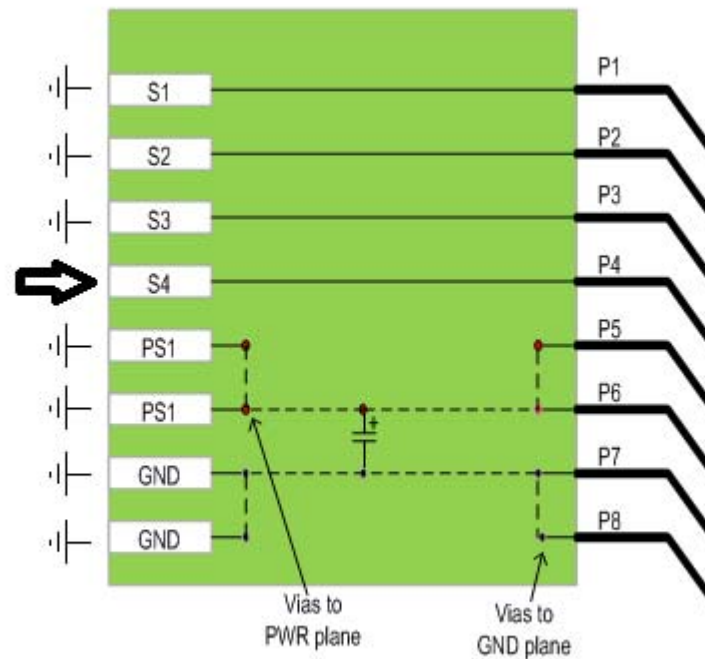
Component



F
S

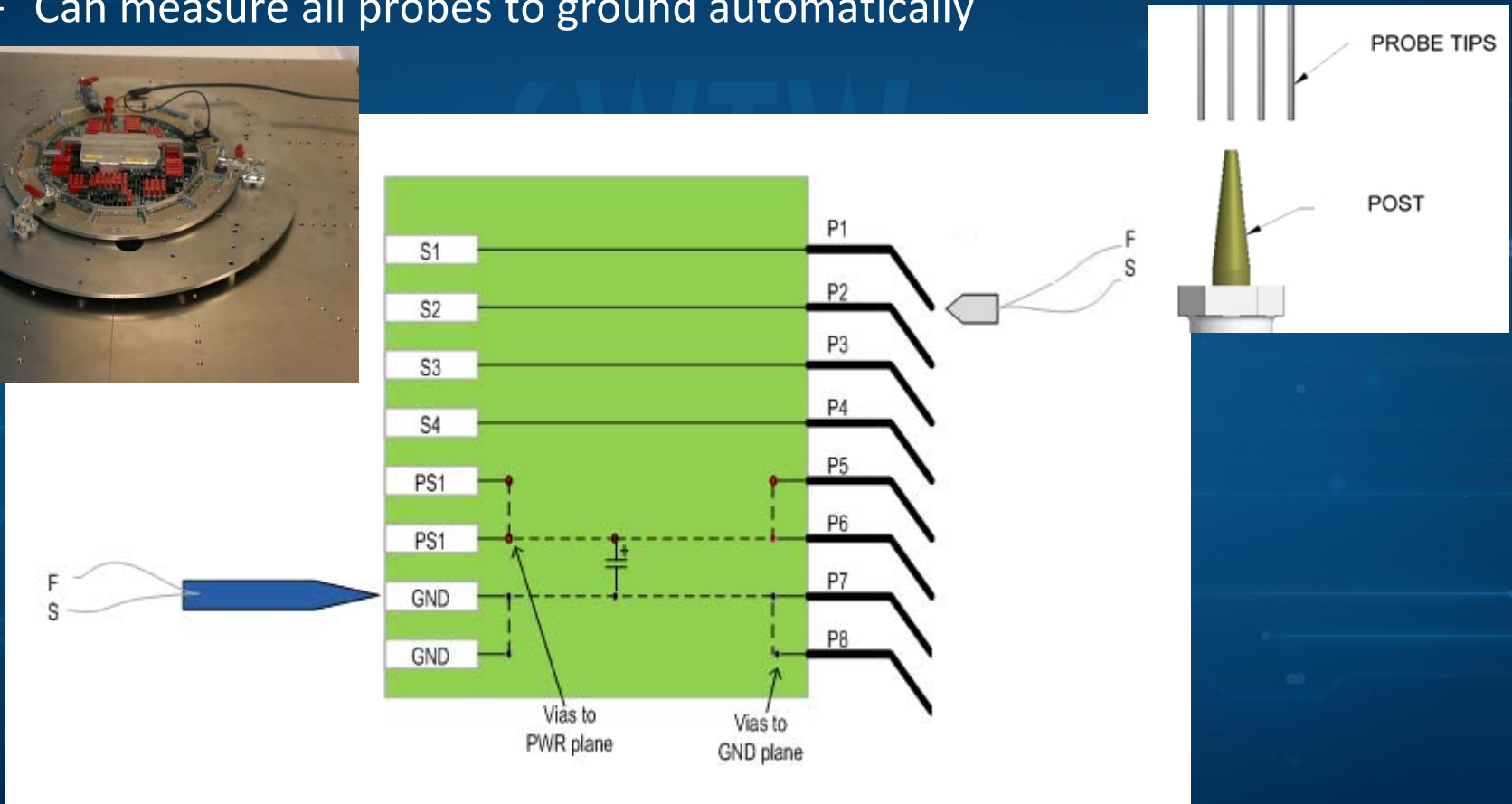
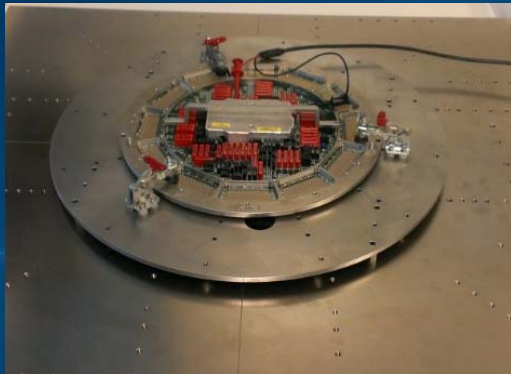
Probe Card Holder: Leakage/Capacitance

- Leakage / Capacitance – PCI Technique



Probe Card Holder: Leakage/Capacitance

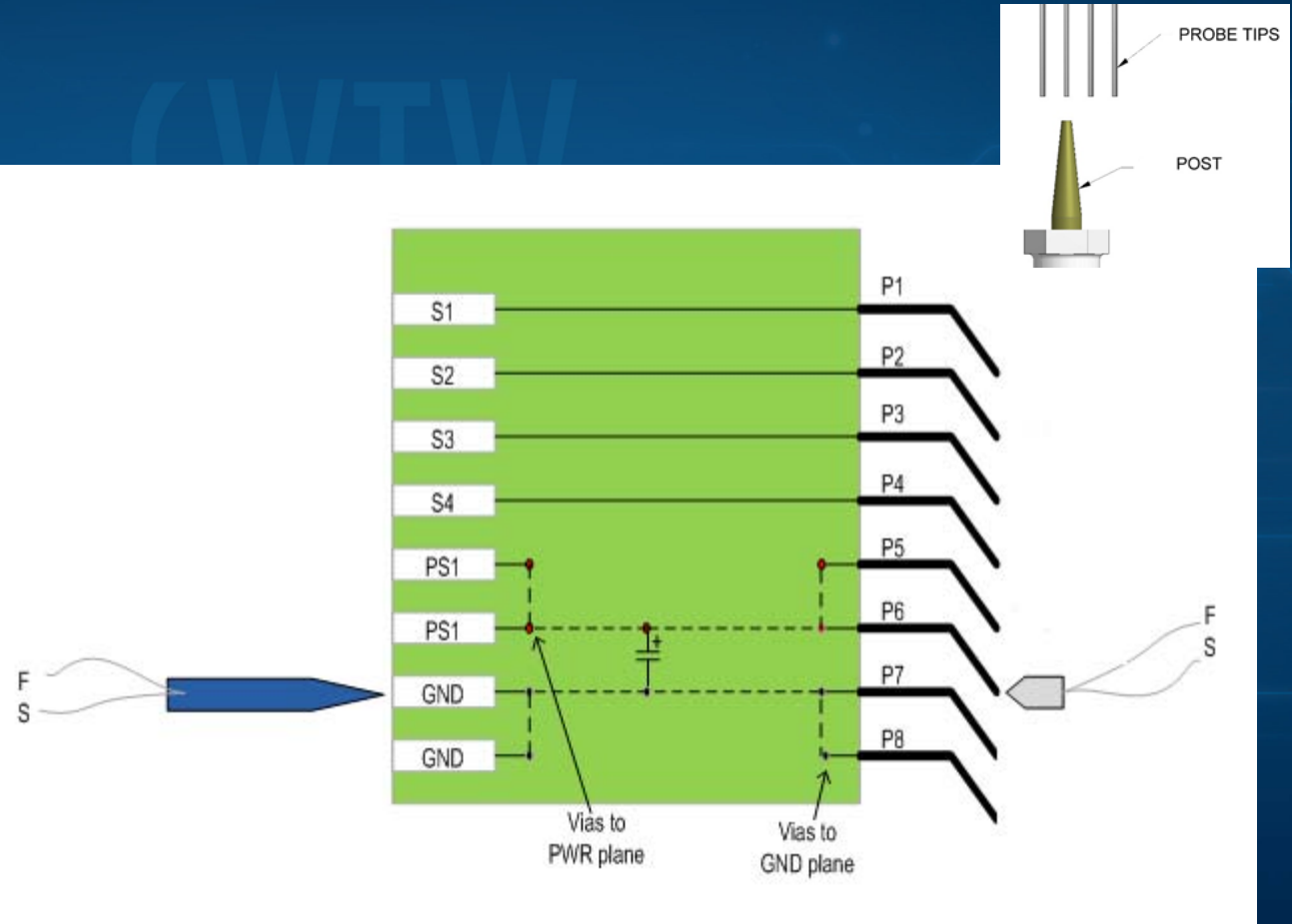
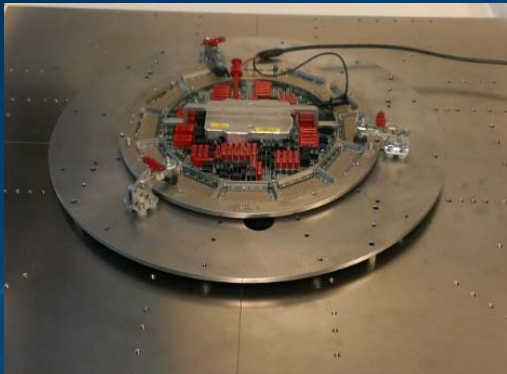
- Leakage / Capacitance – Probe Card Holder
 - Can measure all probes to ground automatically



Probe Card Holder

Contact Resistance & Wiring: Primary channel

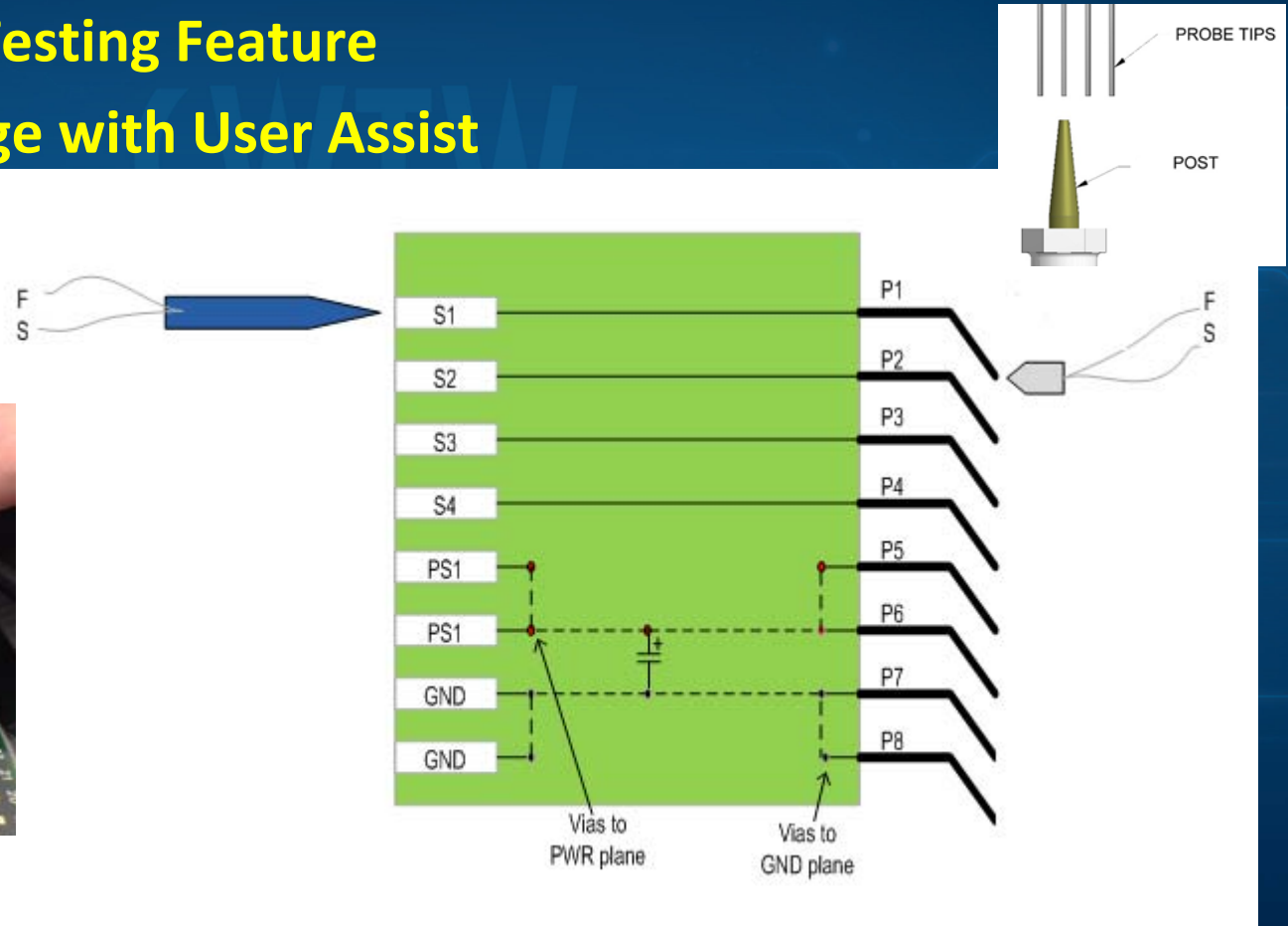
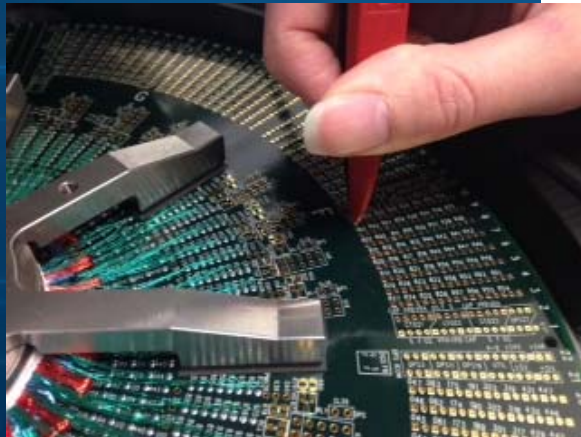
- Contact resistance / Wire checker - Primary channel method



Probe Card Holder

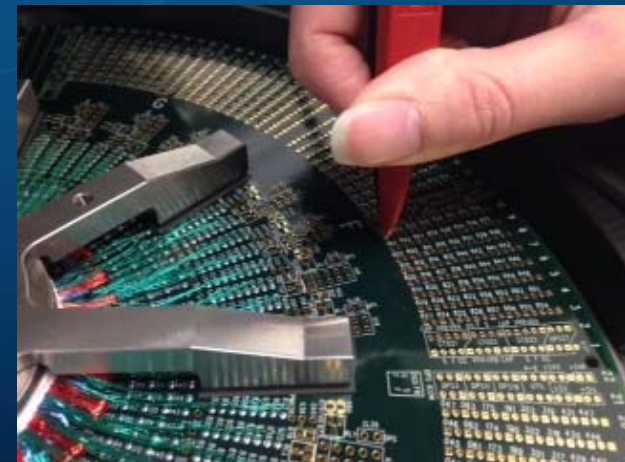
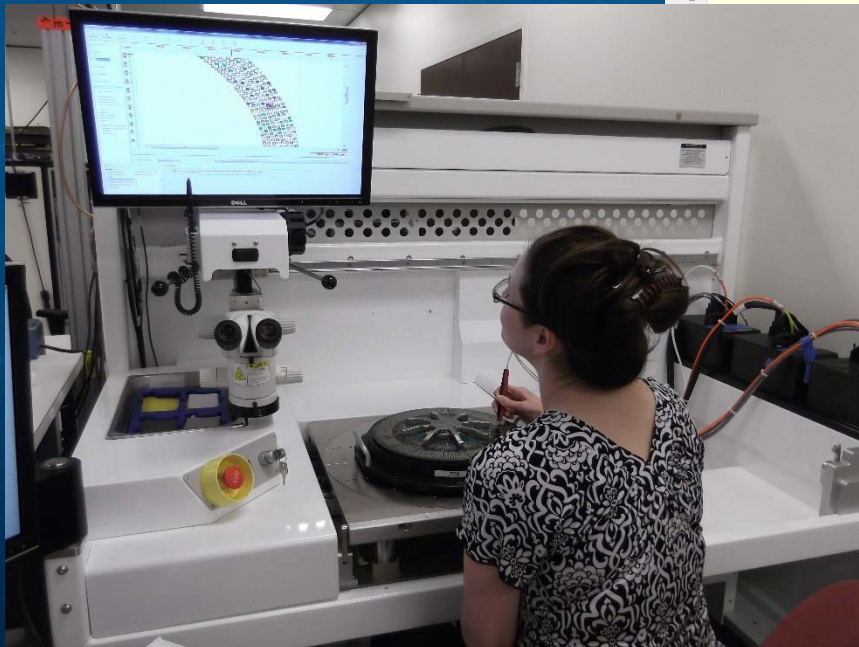
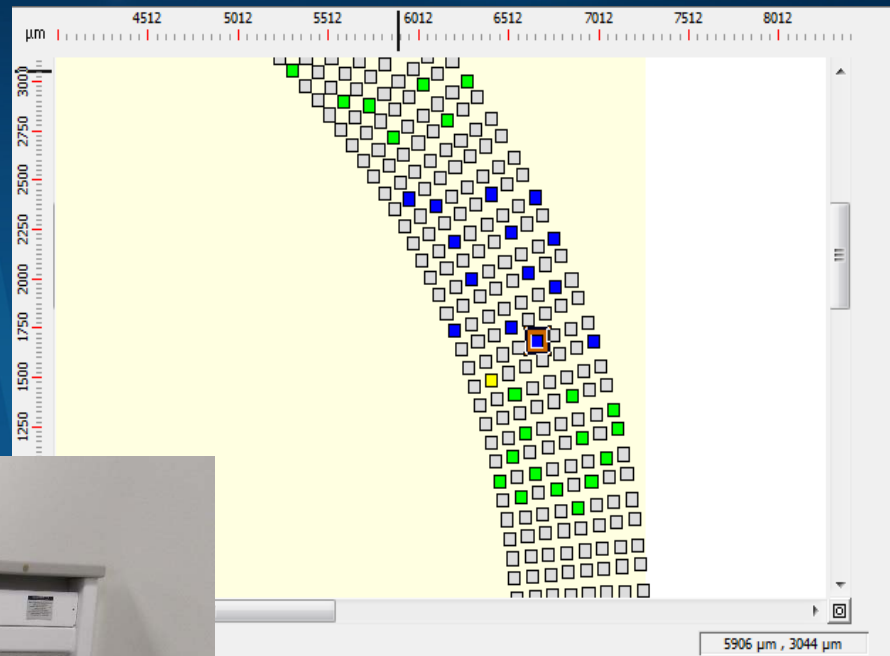
Contact Resistance & Wiring: Primary channel

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



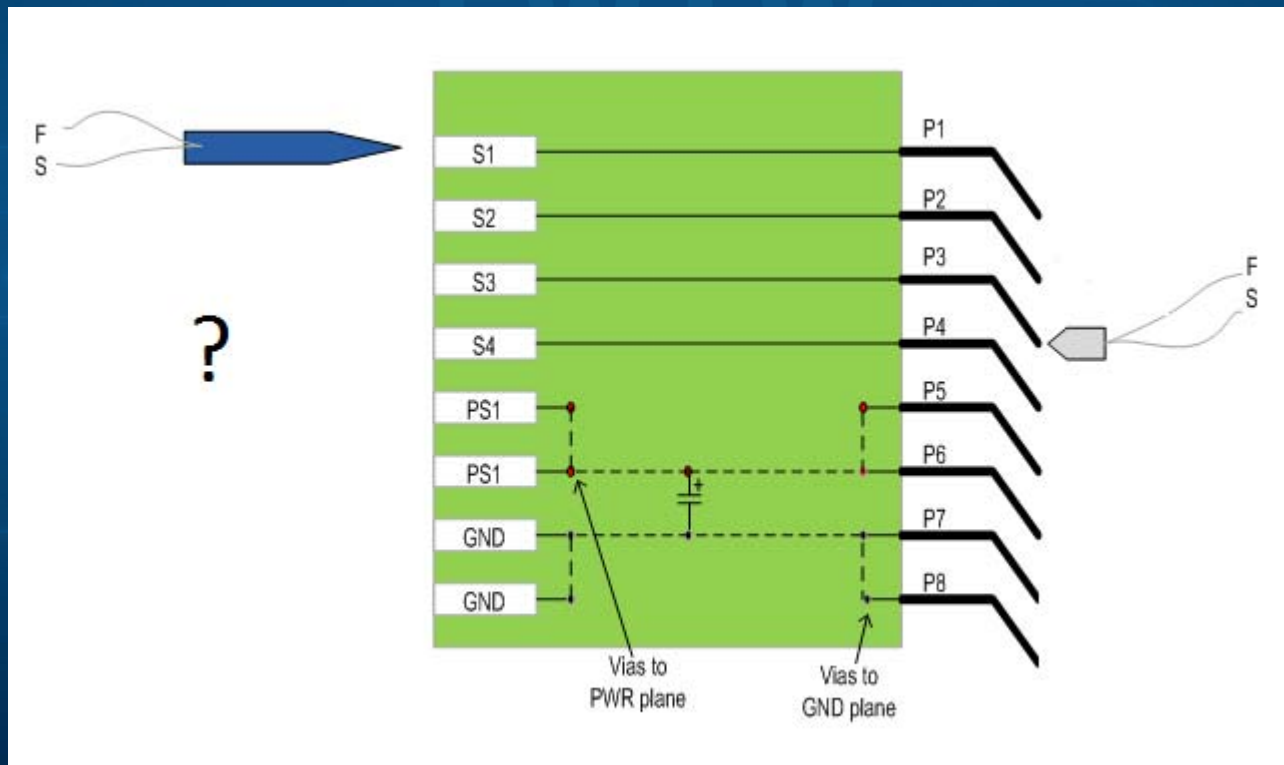
New User Assist Testing

- 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

Valid Electrical Tests

Results

Trade Offs?

- | | | |
|-----------------------------------|-----|------------------------------|
| • Component Testing (100%) | YES | Auto – Gnd
Semi – Non Gnd |
| • Leakage / Capacitance (100%) | YES | To Ground only |
| • Contact Resistance (100%) | YES | Semi-Automatic |
| • Wiring – Primary Channel (100%) | YES | Semi-Automatic |

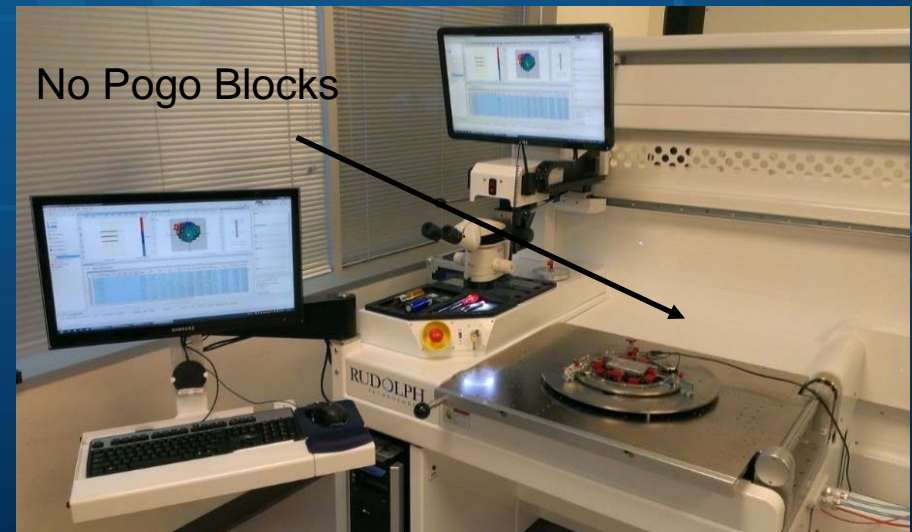
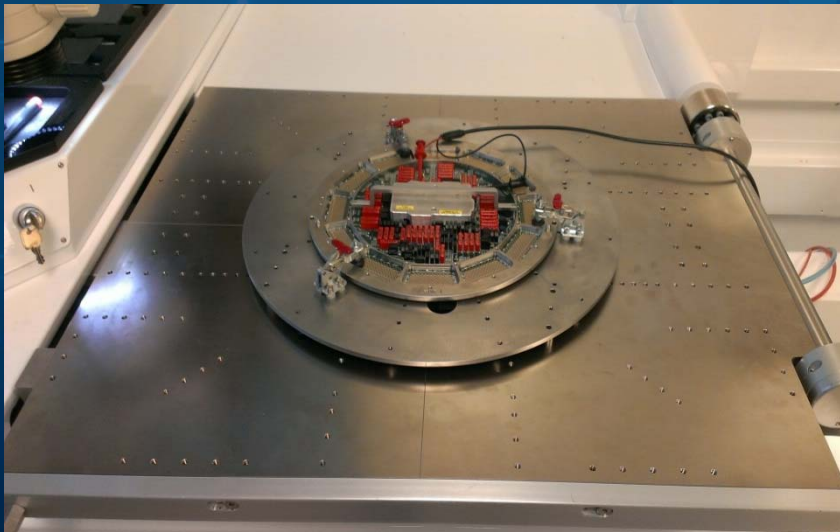
Not viable Tests

Results

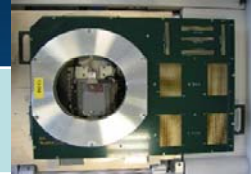
- | | |
|--------------------------|----|
| • Wiring – Short / Opens | No |
|--------------------------|----|

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**



Summary: PCI vs Probe Card Holder



Test	PCI	Probe Card Holder
Planarity	Yes -Electrical	Yes: Force
Alignment	Yes	Yes
Components	Yes	Yes
Leakage/Capacitance	Yes	Yes: To ground plane
Contact Resistance	Yes	Yes: Semi-Automatic
Wiring: Primary Channel	Yes	Yes: Semi-Automatic
Wiring: Shorts/Opens	Yes	No
Cost	High	Low

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

Thank You : Acknowledgements

- **Sam Waggoner – JP Kummer**
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- **Foster Lin – Rudolph Technologies**
- **Brett Strong – Rudolph Technologies**
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- **Aleksandar Markovski – FEINMETALL**