Pyramid Probe Cards

Pyramid Probe Technology Benefits

Design for Test
• Internal pads, bumps, and arrays
• High signal integrity
• RF and DC on same probe card
• Small pad, tight pitch
• Multi-DUT
• More useable real estate

Device Testing
• Parametric and RF
• High speed digital
• DC and mixed signal
• All probers and testers

Assembly & Packaging
• Positional stability of probes
• Minimal pad damage
• Minimal particle generation
• Known good die (KGD)

Cost of Ownership
• Increased number of touchdowns
• Decreased cleaning frequency
• Increased die yields
• Increased package yields
• Field replaceable core

Application Specific Pyramid Probe Tips

Aluminum and Copper
• 15 micron diameter, 60 micron tall
• 50 micron pitch released, 45 micron pitch capability
• Others available

Probe Tip Size and Scrub Control

• 3 µm scrub (Different probe tip geometries apply when probing different metallurgies.)
Membrane Model

- Membrane supported at DUT contact
- Chip cap close to DUT
- Optically clear plunger
- Coax and circuit trace interface to membrane
- Nickel alloy contact bump
- Edge (contact) sense

Mechanical Core Assembly

- Two metal layers, top is signal, bottom is ground
- GSG, 20 GHz micro strip, 40 microns over 250 micron solid ground
- 80 micron line over mesh exhibits approximately 80 Ohm impedance
- Power line is a 14 Ohm transmission line up to the bypass cap, ground inductance usually 0.2 nH or less depending on layout
- Bypass capacitors usually within 30 psec of DUT
- Unusual grounds on DUT can be probed
15X Less Pad Damage

Comparison of Pyramid vs Epoxy ring

Pyramid Probe marks | Epoxy ring marks
---|---
15 x 20 microns | 40 x 70 microns

Pyramid damage | Epoxy ring damage
---|---
85 cubic microns | 1447 cubic microns

One Cantilever and two Pyramid Probe scrub marks from Sandia Labs test wafer

*slide complements of Fred Tabor of IBM and Infineon*
**Probe Mark Budget**

- Maximum mark size 15 x 20 µm
- Positional accuracy +/- 5 µm
- Mark budget 25 x 30 µm
- Typical marks on 30 x 50 µm pads

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**Actual CRES Results from a Customer**

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Needle card switched to membrane card over 73 lots. Contact resistance of cantilever and Pyramid Probe technology.
**Pyramid Core Shape**

The pyramid probe card uses a replaceable core wherein the polyimide membrane is attached to a transparent plunger and the connections are brought away from the device under test up through the hole in the interface board. This minimizes the length of the signal lines, thus decreasing their loss, and allows space to attach bypass capacitors very near the device under test. Each polyimide membrane is customized to the device under test. Extremely low ground and power inductances are possible—the circuitry has capabilities similar to flip-chip on MCM-D technology.

- Low inductance bypass capacitors close to DUT
- Short, low-loss lines for high frequency signals
- Cost effective use of membrane real estate
- Controllable microscrub
- Field replaceable
- Excellent mechanical support
- Modular
- Standard board interface
- Robust
- Easy to handle
- Core to board alignment pins

**Case Study: Multi-Die Testing of Mixed Signal Devices**

- Customer challenges
  - Need to test advanced devices on new silicon process utilizing low-K dielectric and/or pads over active circuitry resulting in lower test cost through parallel testing
- Approach
  - Use Pyramid Probe card: quad site
- Results
  - In qualification; passed pad damage and functional correlation, moving into production