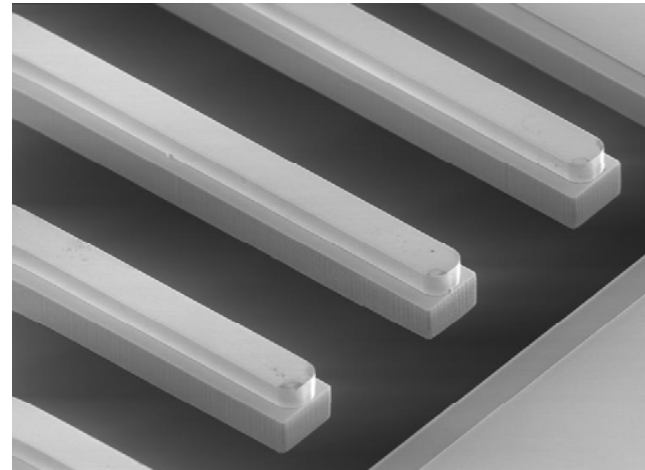
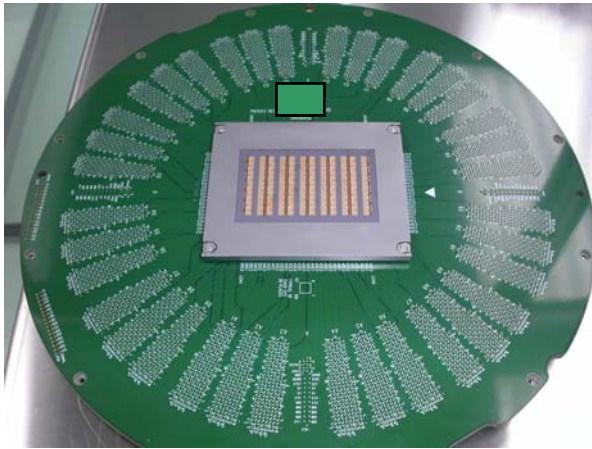


Silicon Finger 2.0

**A High Parallelism, High Bandwidth Probecard using
Silicon Finger MEMS probes**



**Presenter
Bob Aldaz**

Contributors:

**Keith Lee, Bob Aldaz, Yu Zhou, David Yu
Gert Hohenwarter, Tassos Golnas**

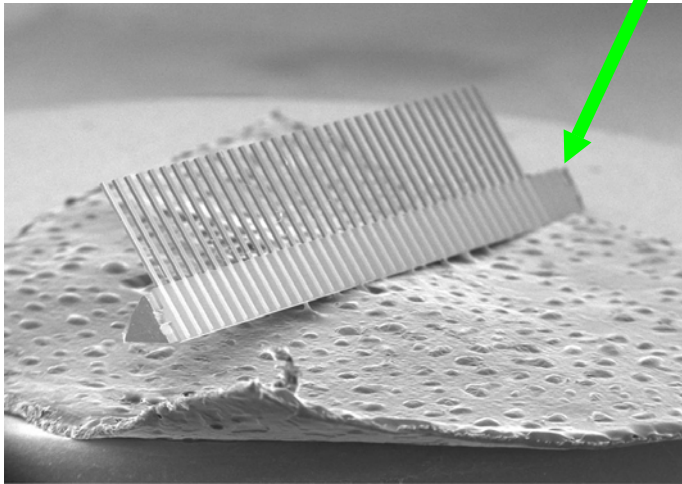
Program Outline

- **Introduction to the Silicon Finger Probe Card (SiFi 2.0)**
- **Overview of Silicon Finger probe fabrication**
- **Overview of Silicon Finger probecard manufacturing methods**
- **Overview of Silicon Finger probecard design methods**
- **Overview of probecard characteristics**

Silicon Finger Probecard Components

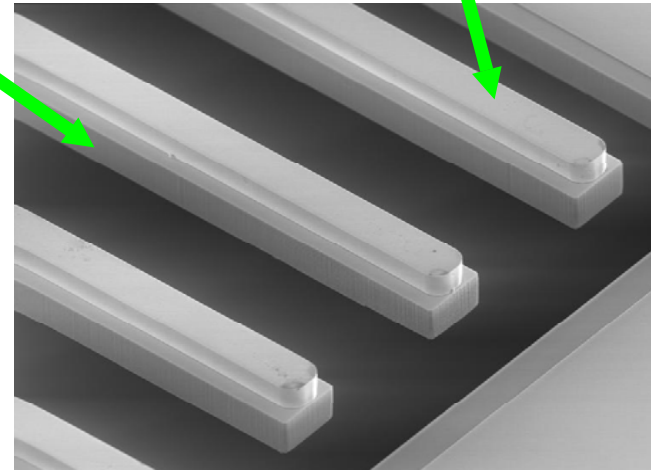
Silicon Finger Combs

**Silicon base and
underside of finger**



**SEM of whole
comb on tape**

Ni trace

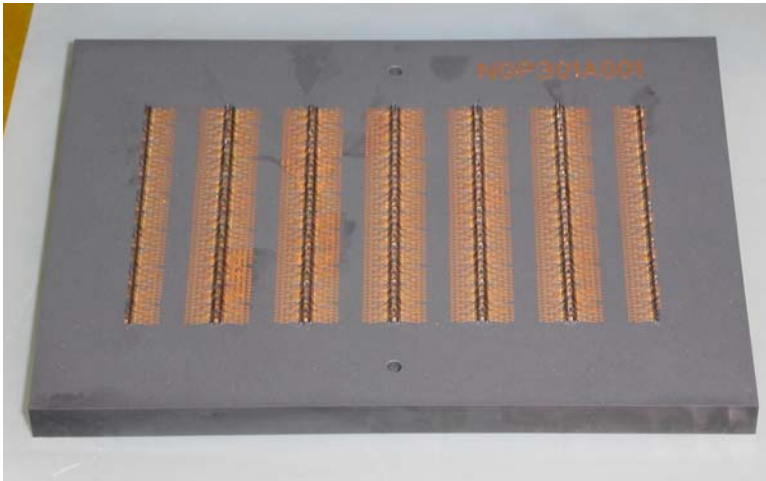


**SEM Image of
probe tips**

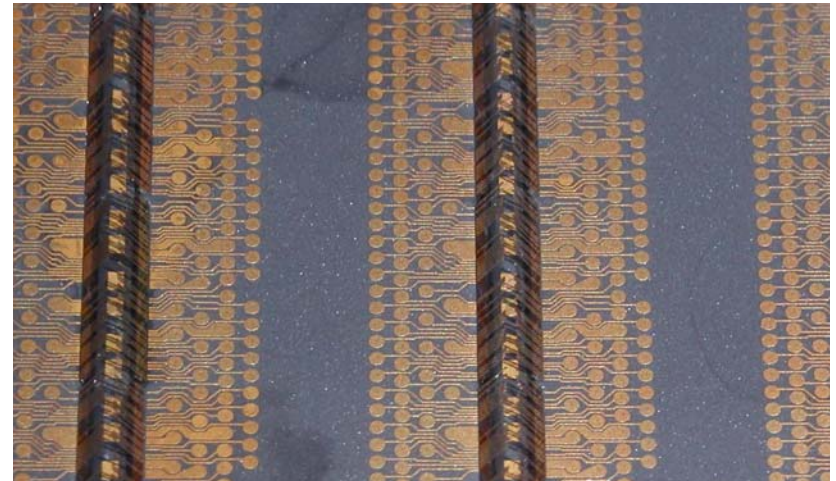
Silicon Finger Probecard Components

Example MLC

Ceramic Size	6mm x 100mm x 75mm
Ceramic Flatness	10um
-3dB Bandwidth (MLC & PCB)	1.85GHz
Routed Layer Count	19



Multi Layer Ceramic



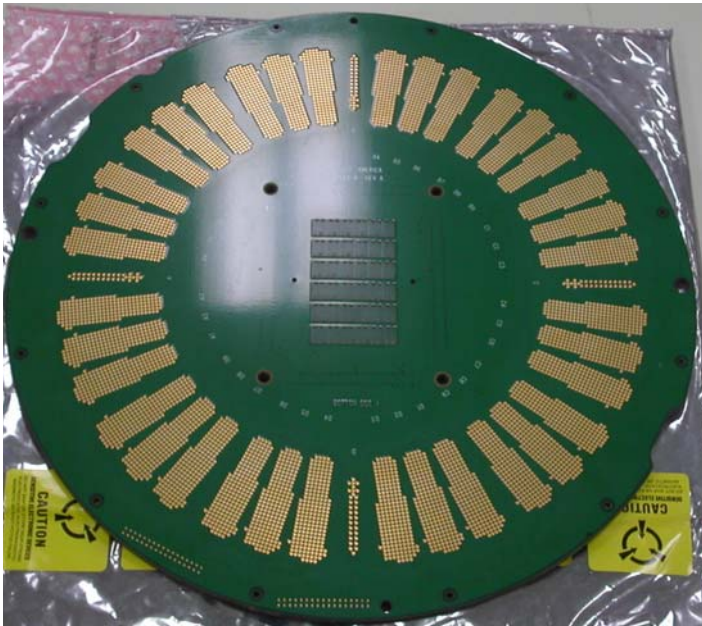
Combs on MLC

Silicon Finger Probecard Components

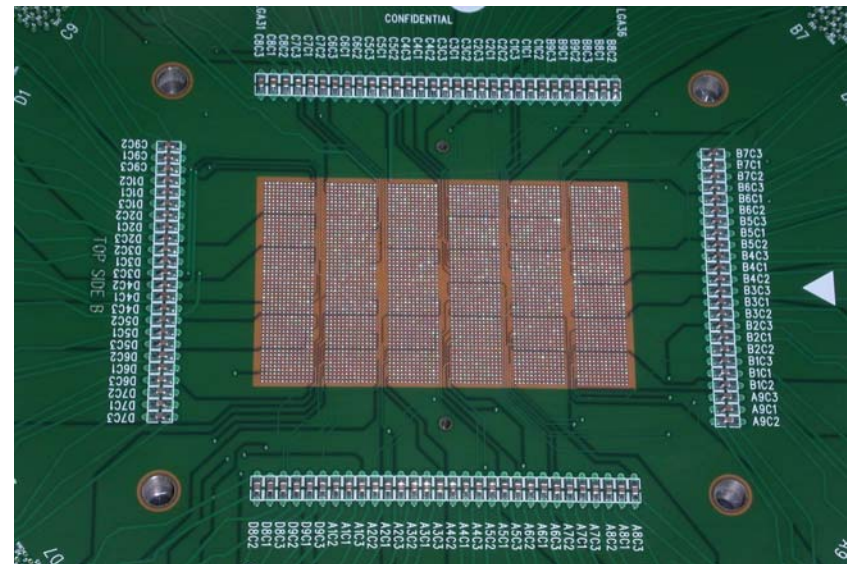
PCB

PCB Layers: 44
Signal Count: 2052
PCB Thickness: 6.35mm
PCB Diameter 355mm

PCB Impedance $50\Omega \pm 3\Omega$
PCB Flatness 0.005in/1in



PCB

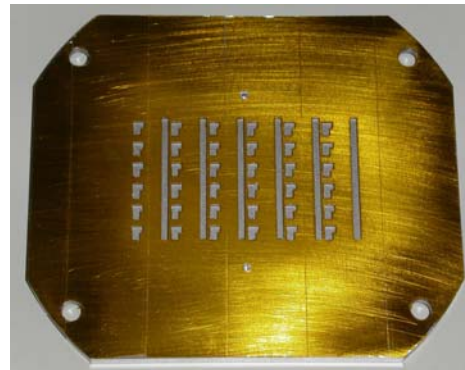


LGA region of PCB for connection to MLC

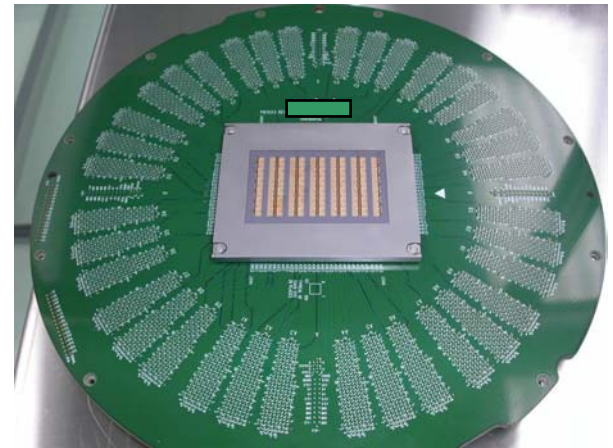
Silicon Finger Probecard Assembled



MLC Frame



**PCB Backing
Support Plate**

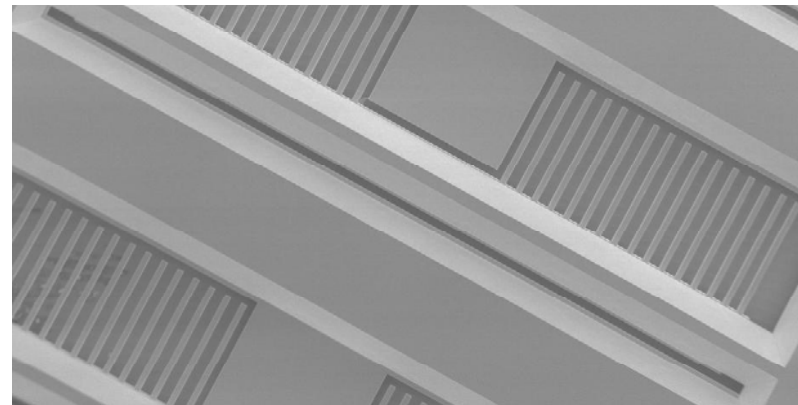
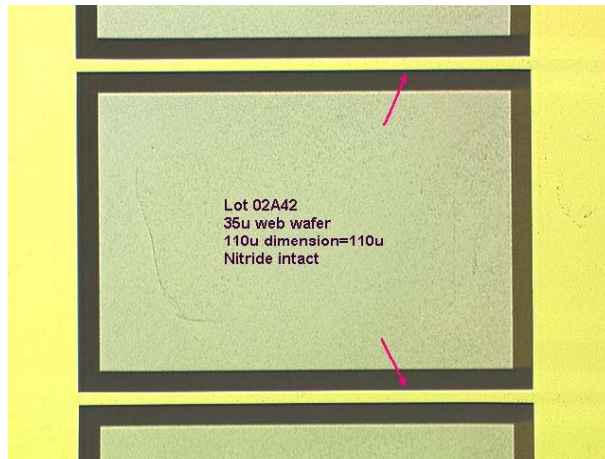


**Assembled
Probecard**

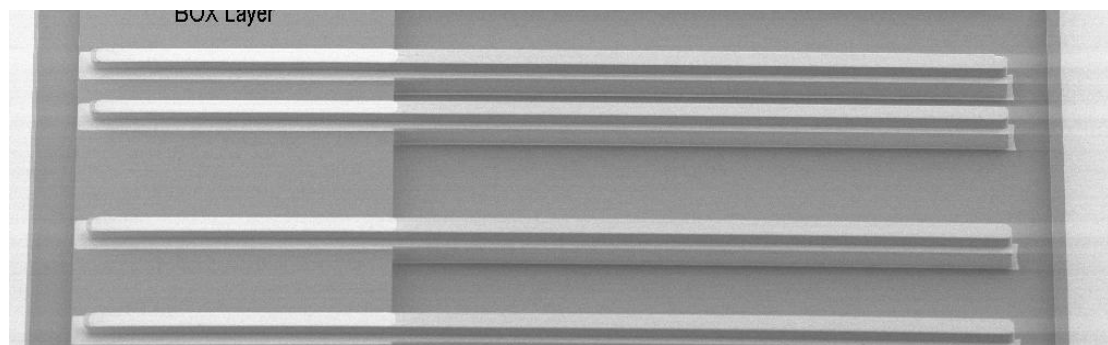
Not Shown - Fasteners, Spacers and elastomer

Silicon Finger Comb Fabrication

Silicon Etching



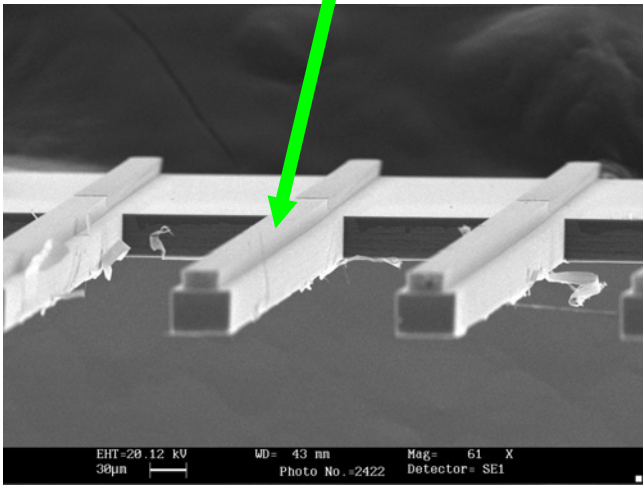
Comb back side



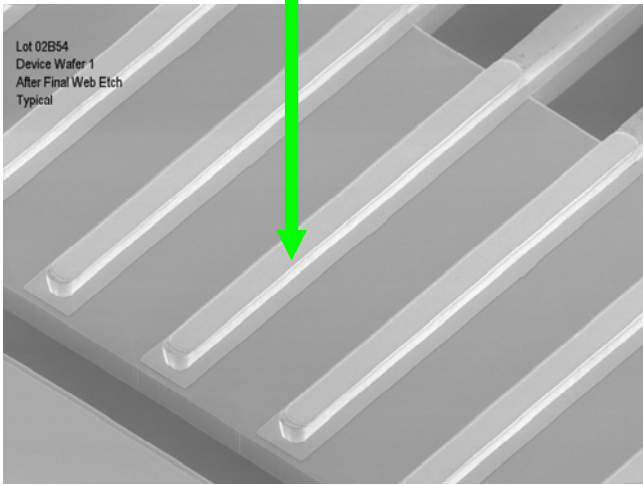
Probes

Silicon Finger Comb Fabrication Metal Plating

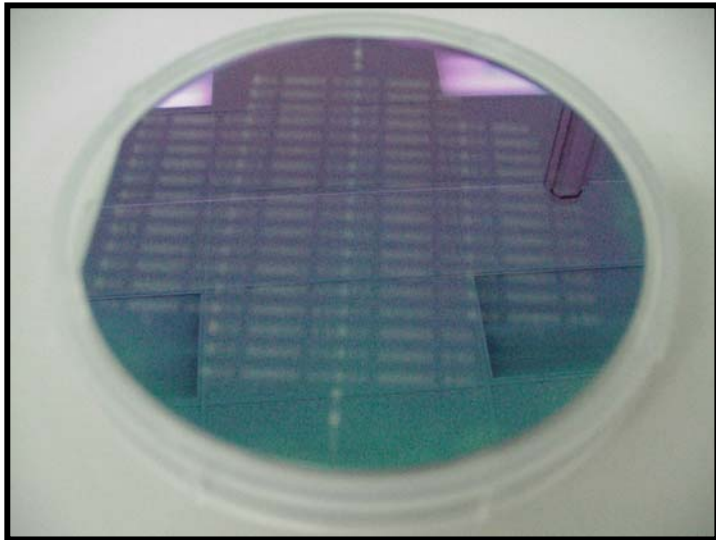
Ni Trace



Au Wire Bond Pad



Silicon Finger Comb Fabrication Finished Wafer



**Completed wafer
diced and combs
removed from
tape.**

Full Q/A

- **Isolation**
- **Dimensional**
- **Visual**

Silicon Finger Probecard Assembly Cleanroom

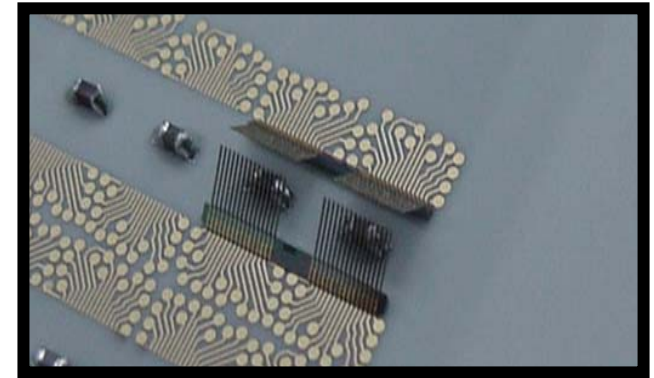
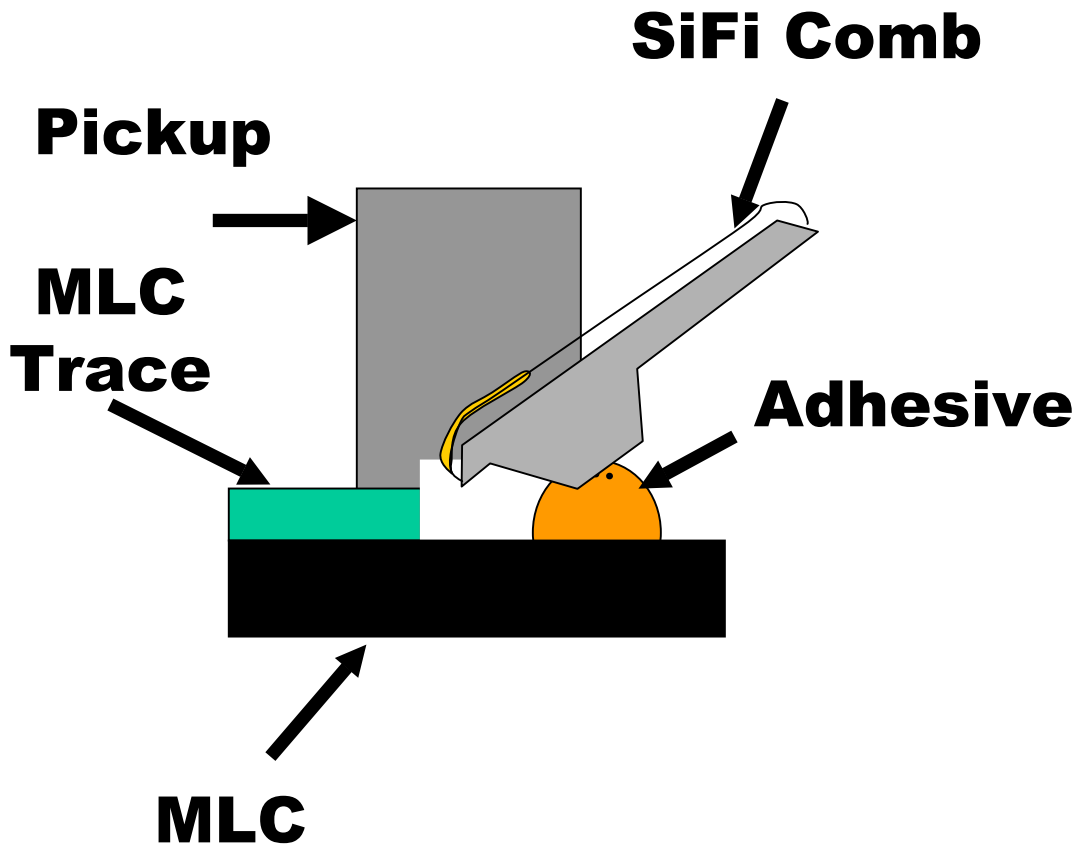


Wire Bonding



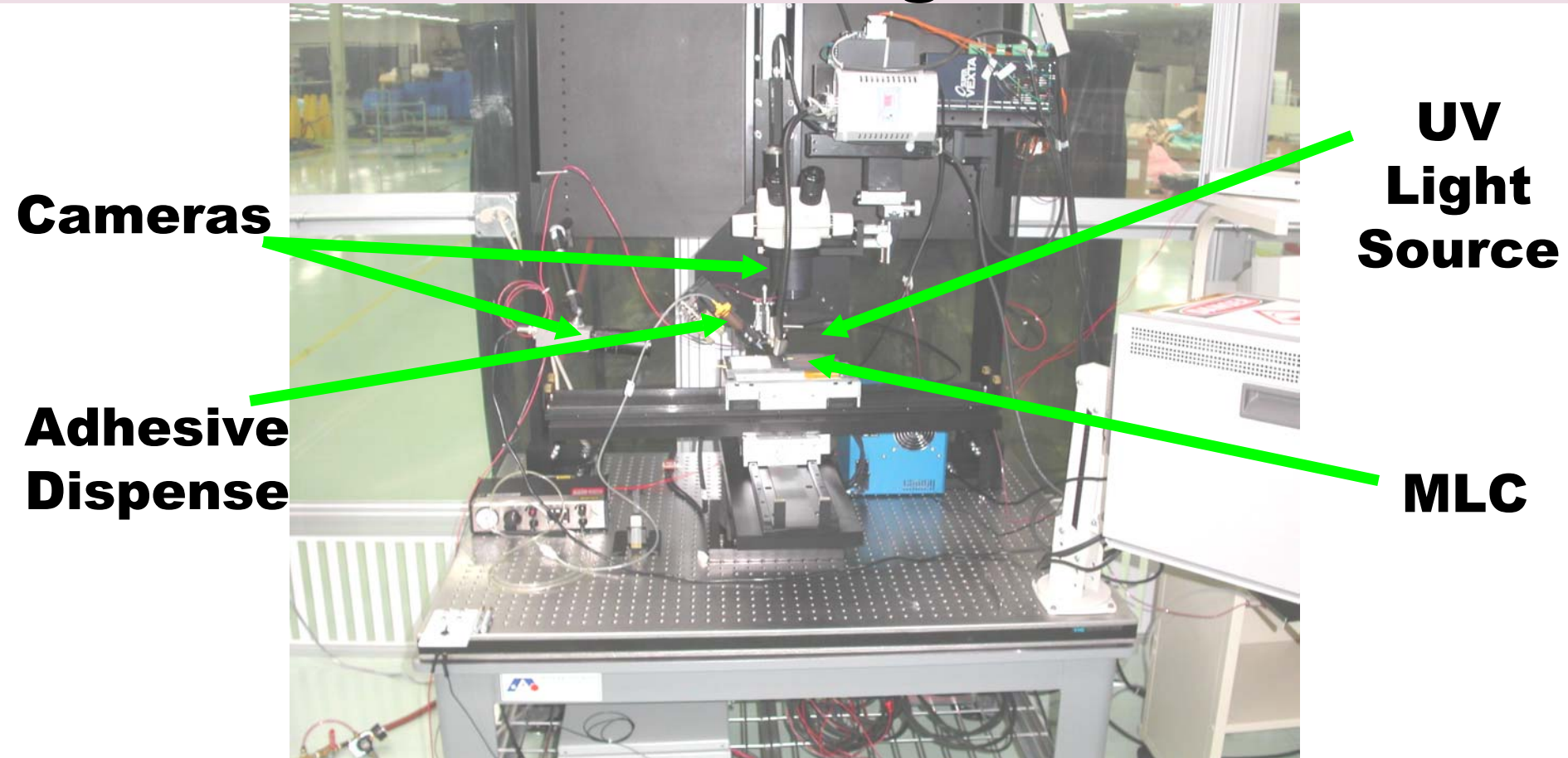
Comb Mounting

Silicon Finger Probecard Assembly Comb Mounting

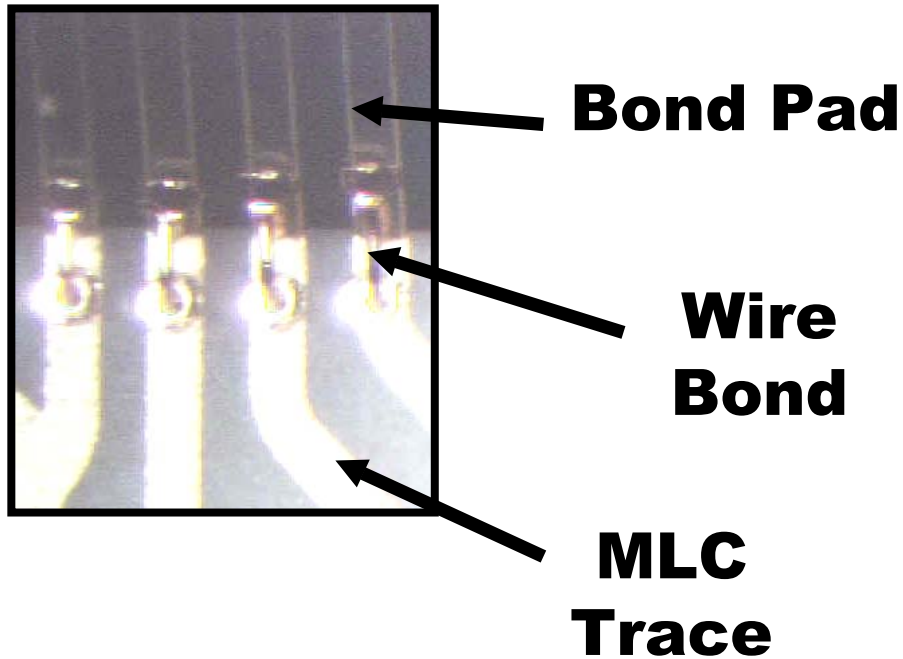


**Alignment and
Mounting to
Ceramic
Substrate**

Silicon Finger Probecard Assembly Comb Mounting Station



Silicon Finger Probecard Assembly Wire Bonding

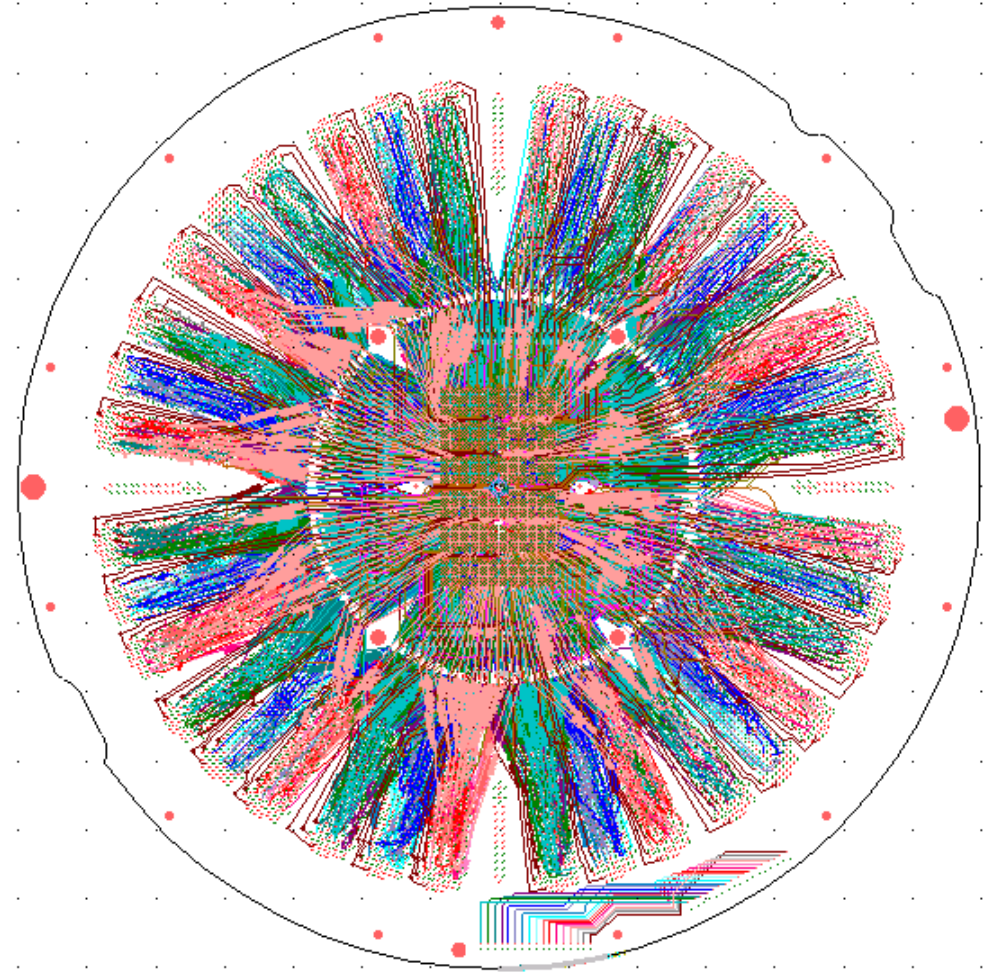


Wire bonding system



Silicon Finger Probecard Design

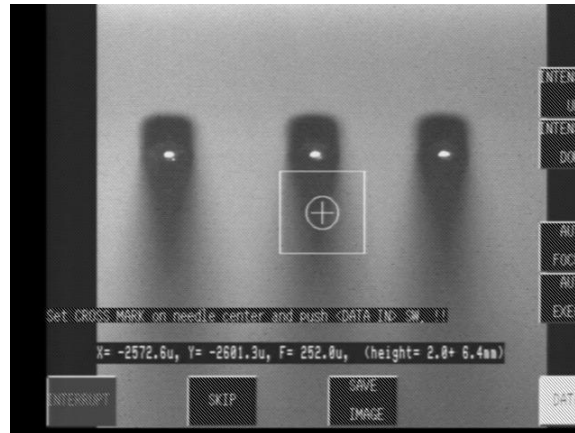
- Automatic netlist creation and verification.
- Automatic PCB layout routing.



Silicon Finger Probecard Specifications Overview

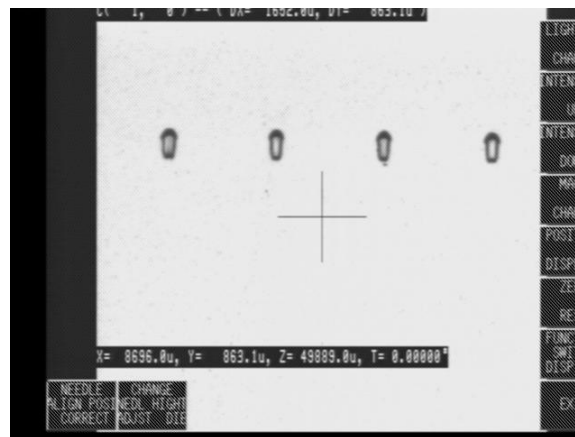
Tip accuracy	+/- 10 microns
Minimum Pitch	80 microns
Minimum Overdrive	10 microns
Spring rate	1 gm/mil
-3dB Bandwidth (Probecard)	1.30 GHz
Cres	0.5 Ω
Inductance (SiFi probe only)	1 nH
Length	1.585 mm
DUTs in Parallel	X63 full pin count, X512 Design for Test
TD life	500,000 cycles

Silicon Finger Probecard Characteristics; Probe Tips



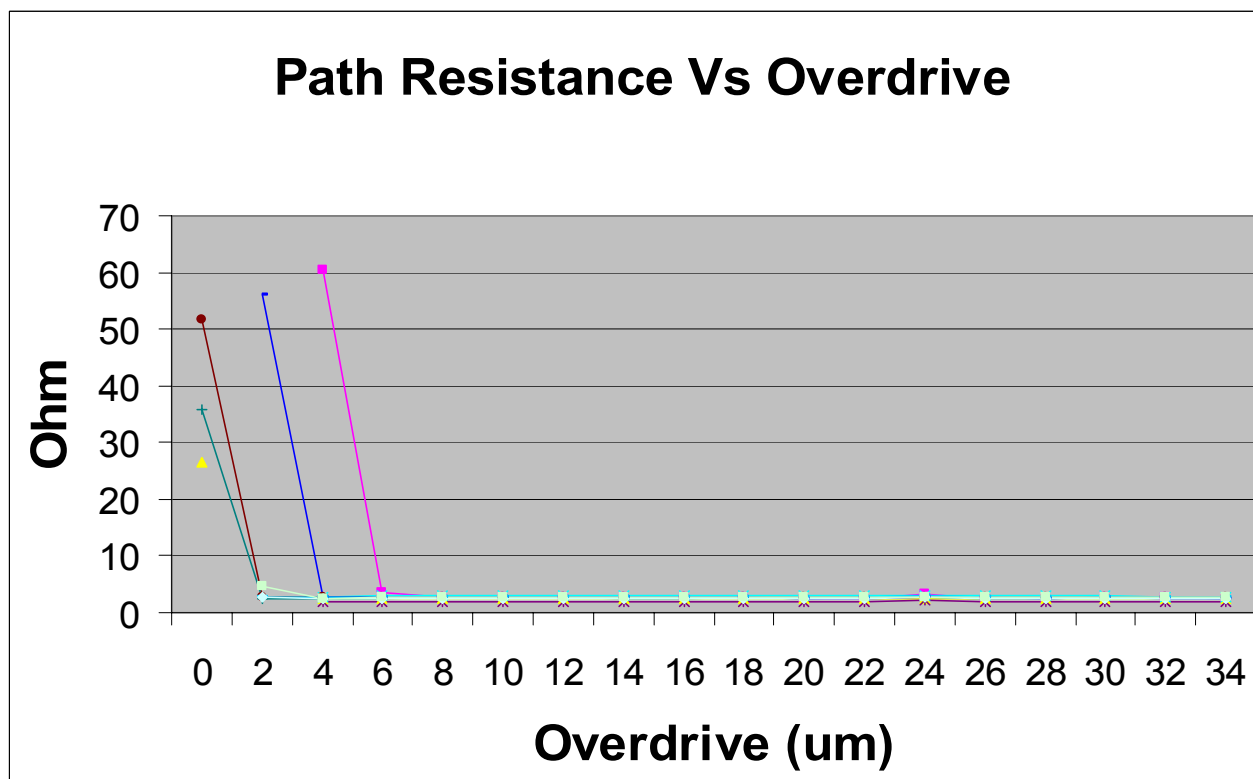
Optical view of
probe tips via prober

Width 12 to 18 um
Length depends upon
overdrive



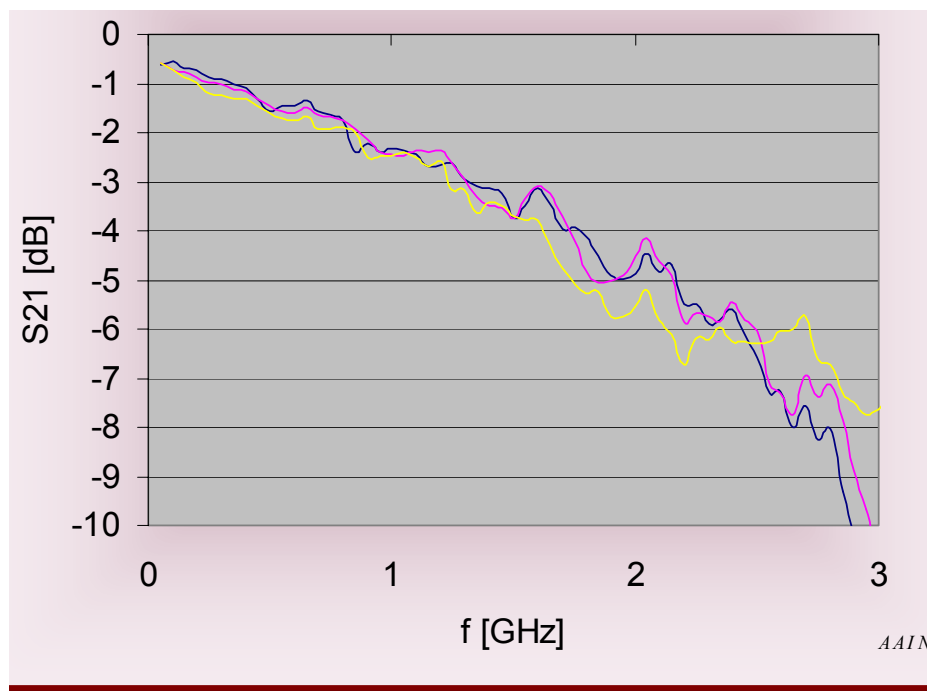
Optical view of
scrub marks via
prober

Silicon Finger Probecard Characteristics; Cres Vs Overdrive



Silicon Finger Probecard Characteristics; Insertion Loss

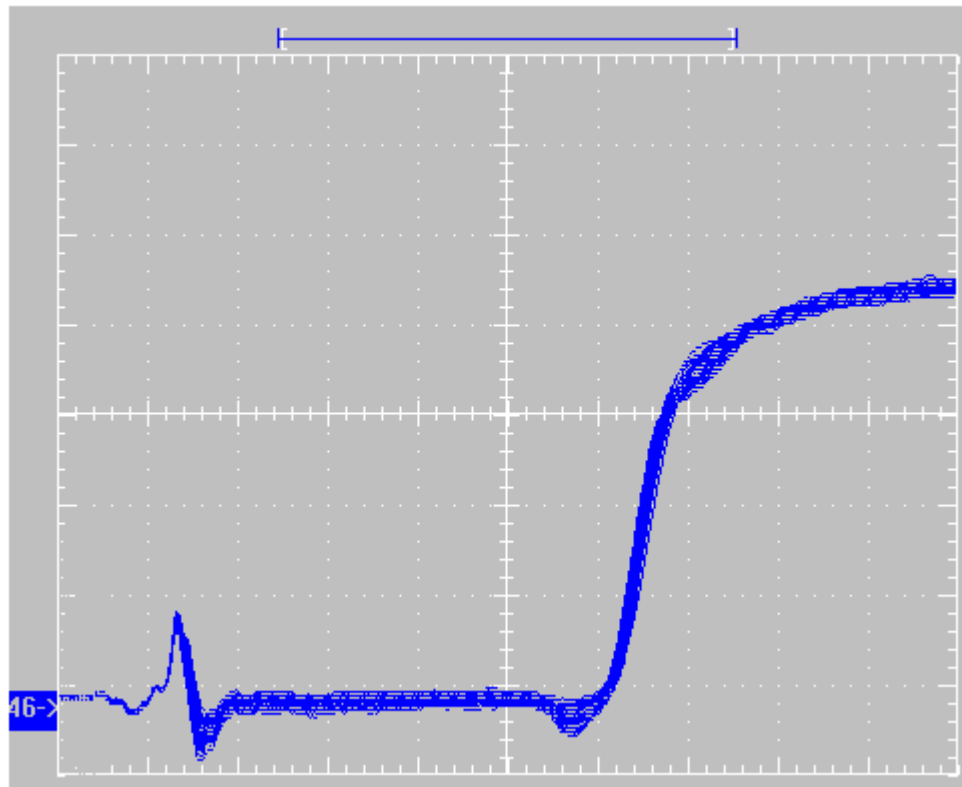
Insertion loss S21 (f)
whole probecard



The -3dB point is reached at 1.3 GHz.

Silicon Finger Probecard Characteristics; Timing Error

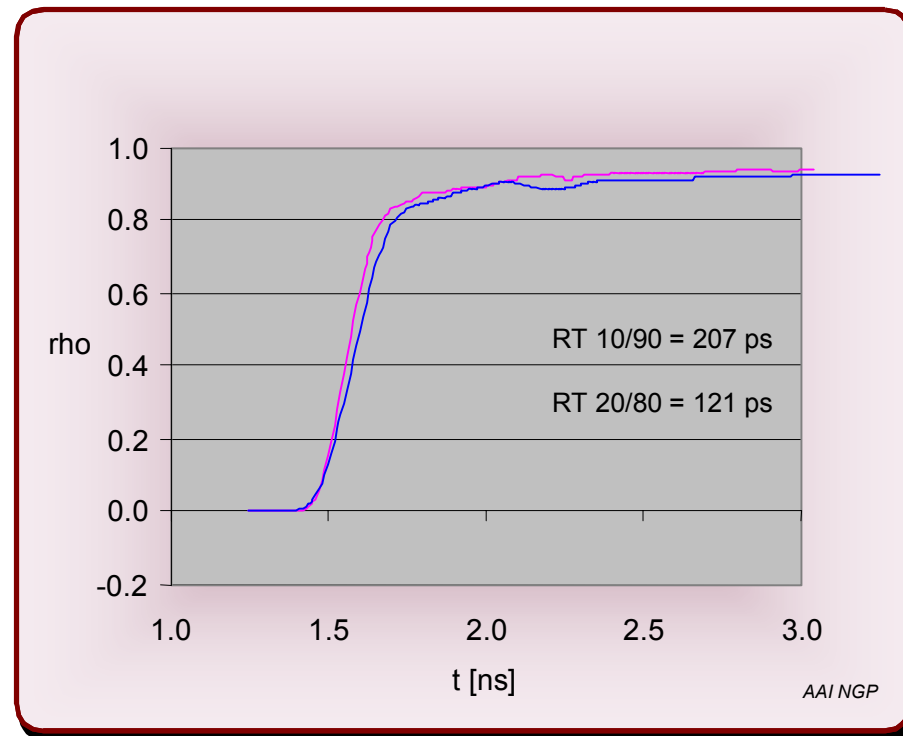
Typical Reflections from 40 Randomly selected traces



Timing errors <70 ps and impedance at 50 ± 3 Ohms.

Silicon Finger Probecard Characteristics; Rise Time

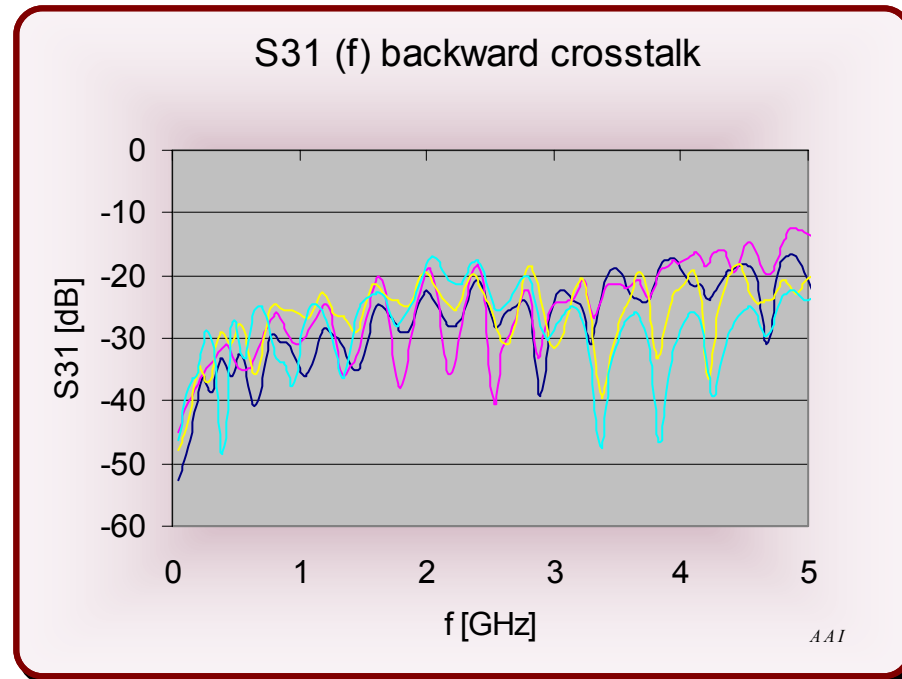
Time domain transmission - whole probecard



20%-80% risetime = 121 ps

10%-90% risetime = 207 ps

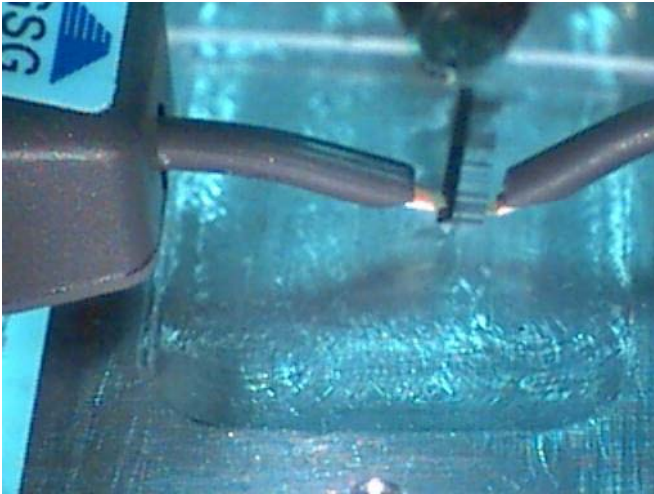
Silicon Finger Probecard Characteristics; Cross Talk



Crosstalk for the probecard is well within typical specs.

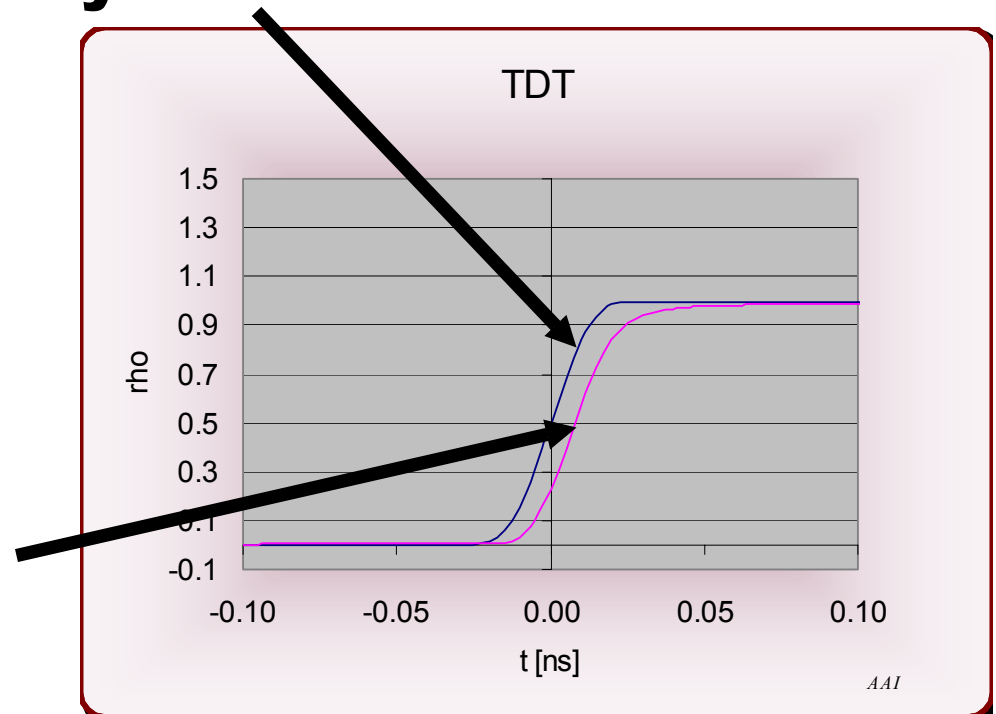
Silicon Finger

Probe only Characteristics; Risetime

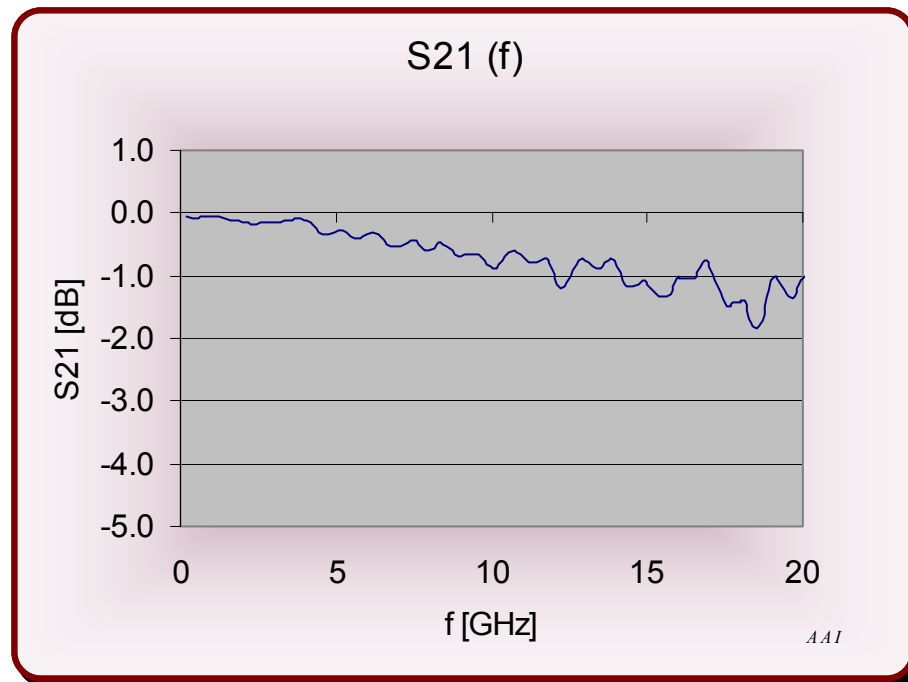
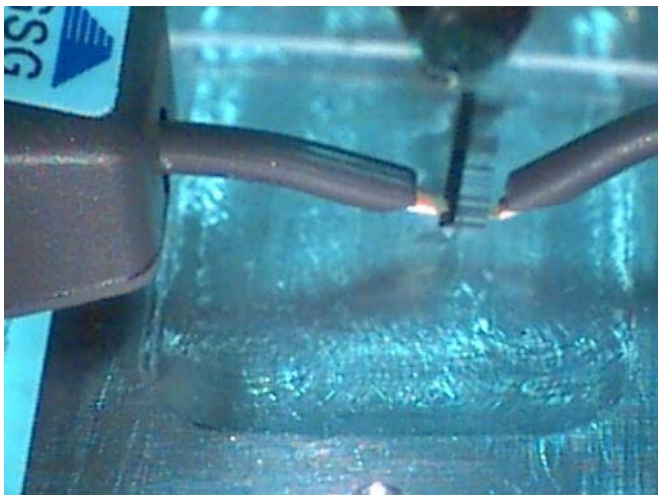


With SiFi
Added Delay 7.5 ps

Measurement System w/o SiFi

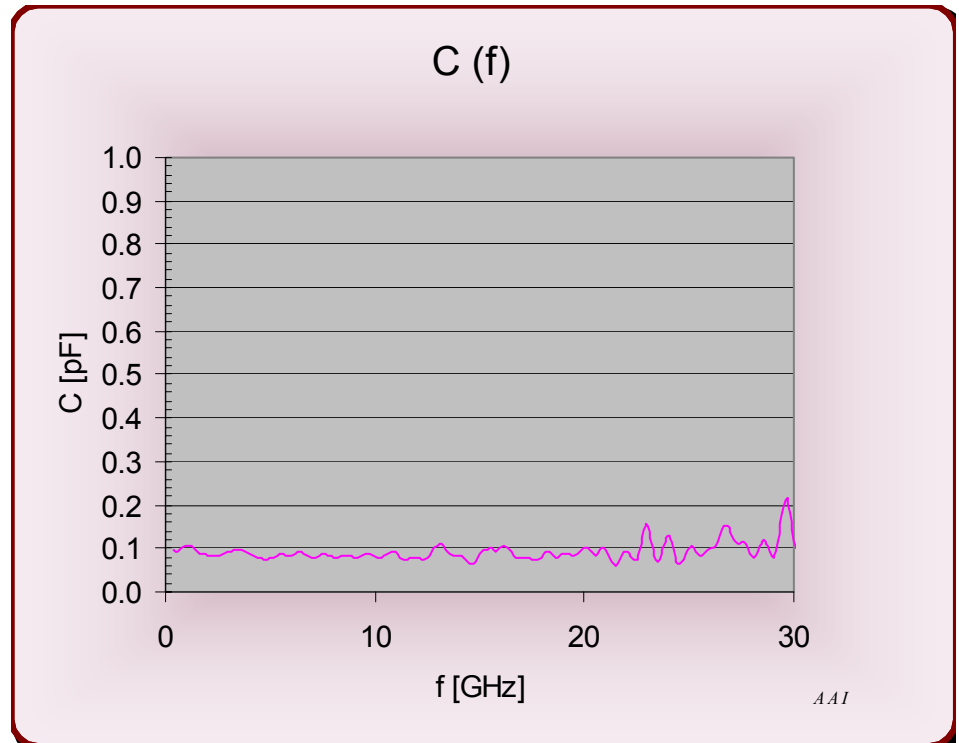
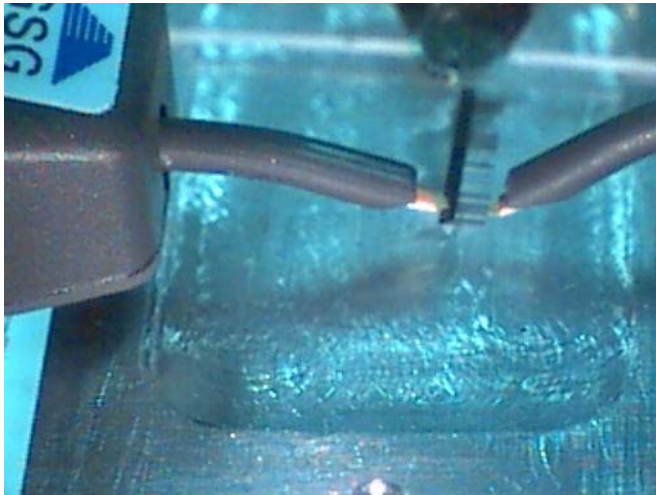


Silicon Finger Probe only Characteristics; Insertion Loss



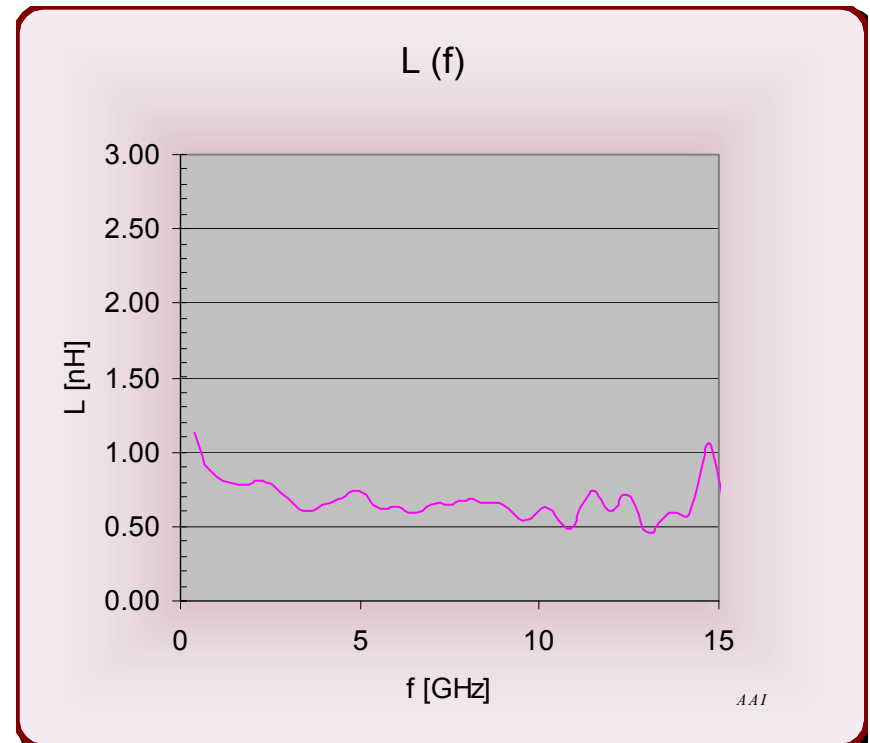
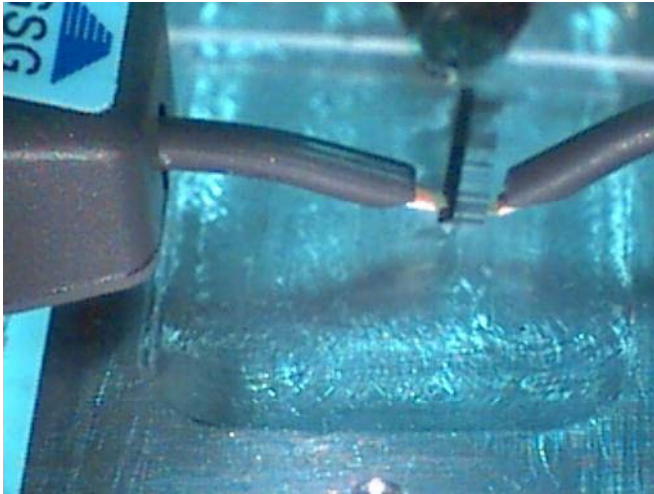
Less than 3db insertion loss to 30 GHz

Silicon Finger Probe only Characteristics; Capacitance



0.1 pF to above 20 GHz

Probe only Characteristics; Inductance



**Less than 1nH up to 15 Ghz
in G-S-G arrangement**