

Wafer Probe Technology & Application Overview

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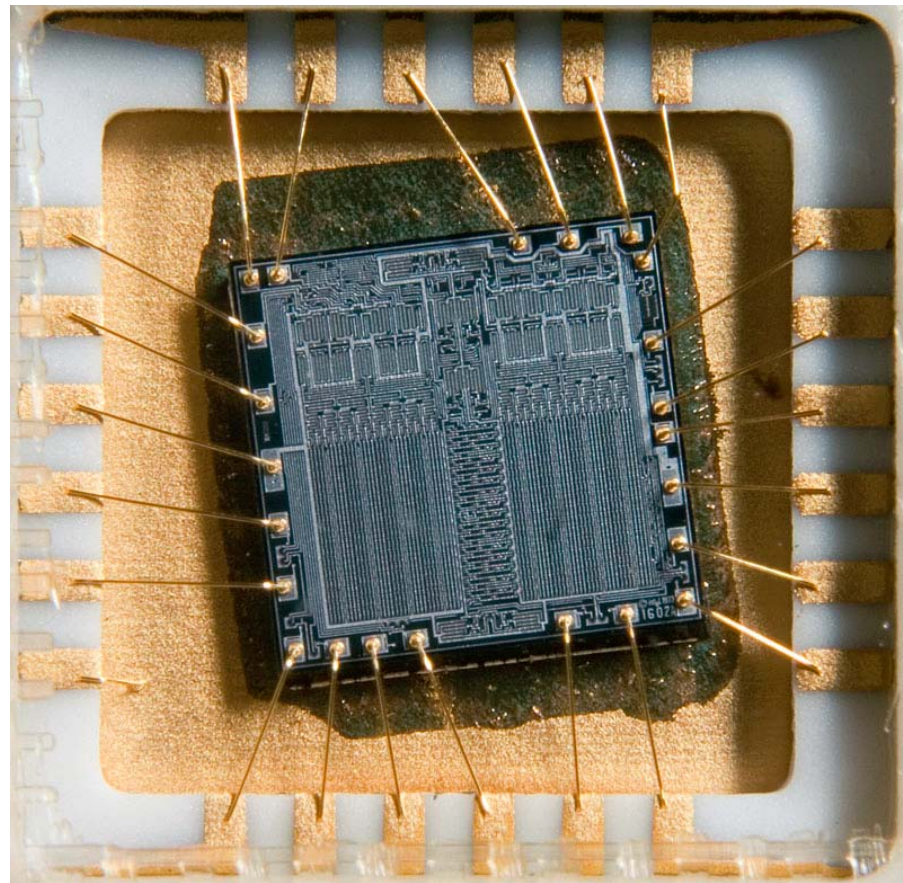
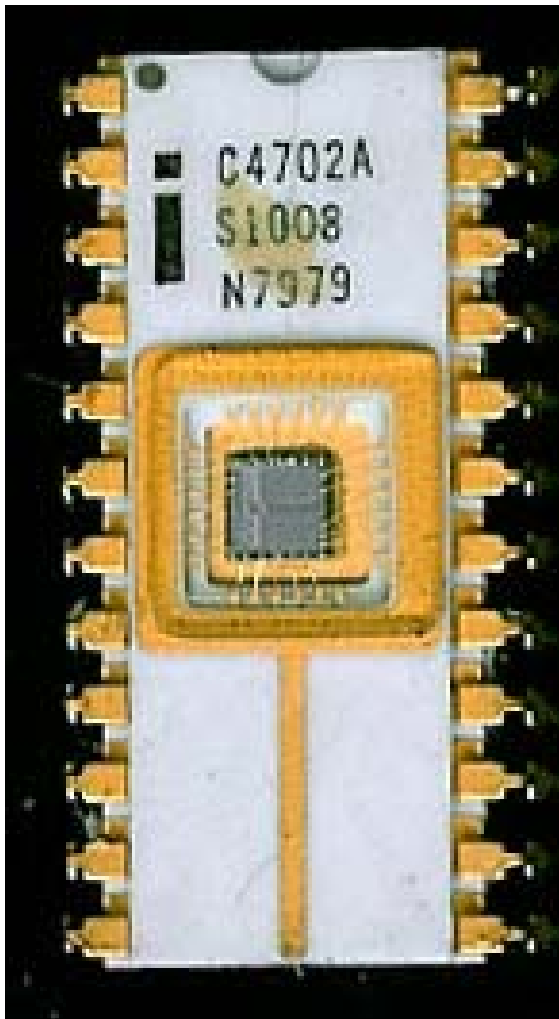
iradave@gmail.com

Agenda



- Introduction
- Application Examples
- Contact Technologies / Probe Types
- Top Vendors
- Hot Topics
- Summary
- Resources

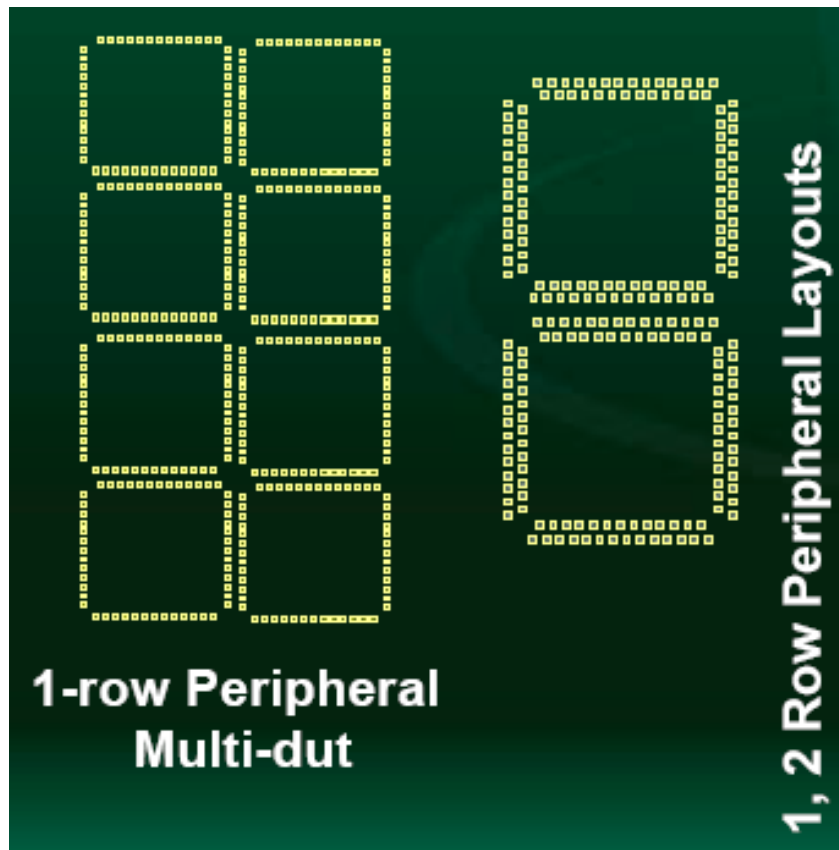
Devices & Packages – Have Evolved!



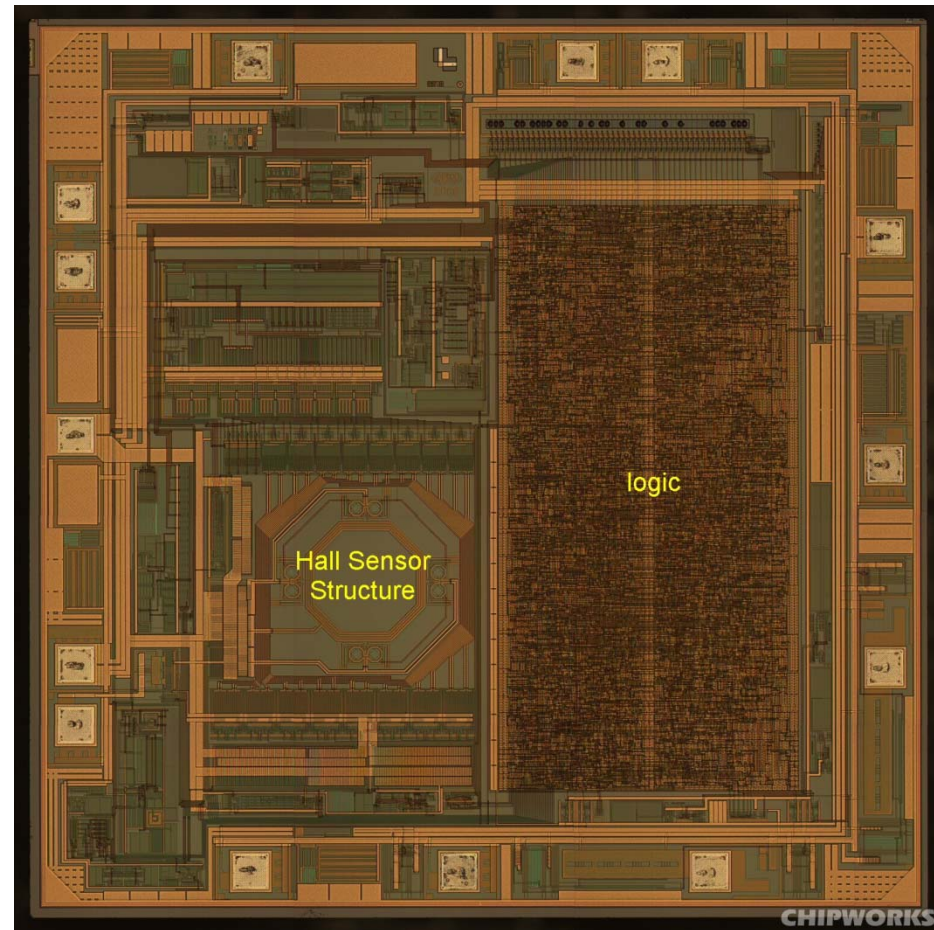
UV EPROM circa 1974

<http://www.cpushack.com/EPROM.html>

Peripheral Pads - Logic

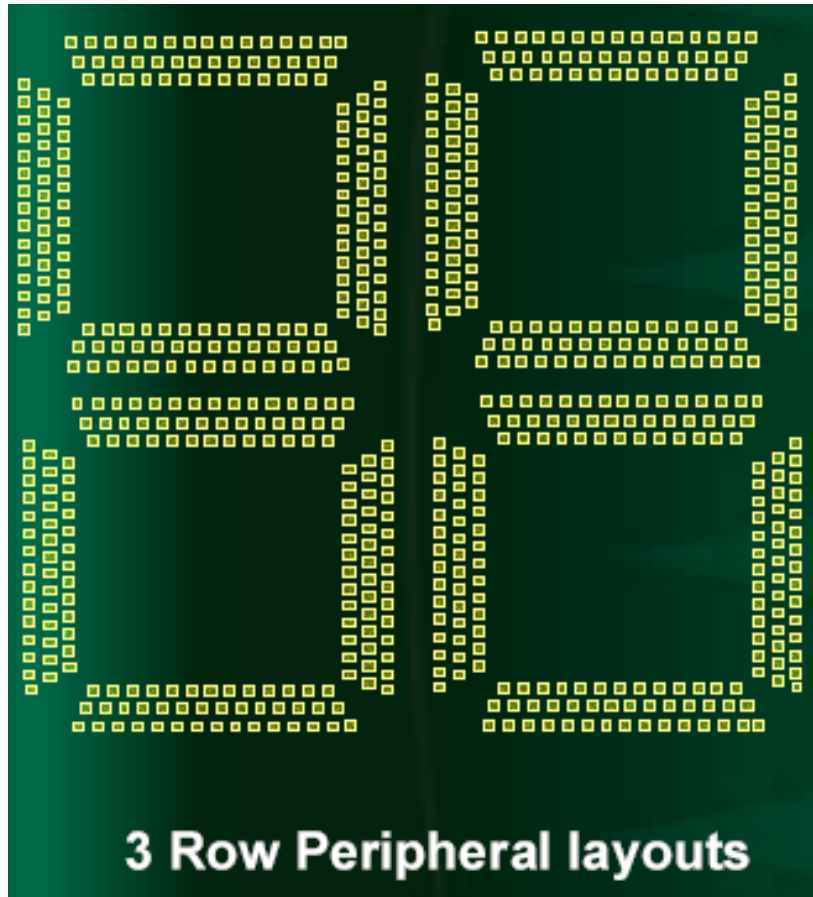


SWTW 2009: MEMS Technology – Enabling Design
Flexibility for Fine Pitch Probing
Bahadır Tunaboylu, SV Probe

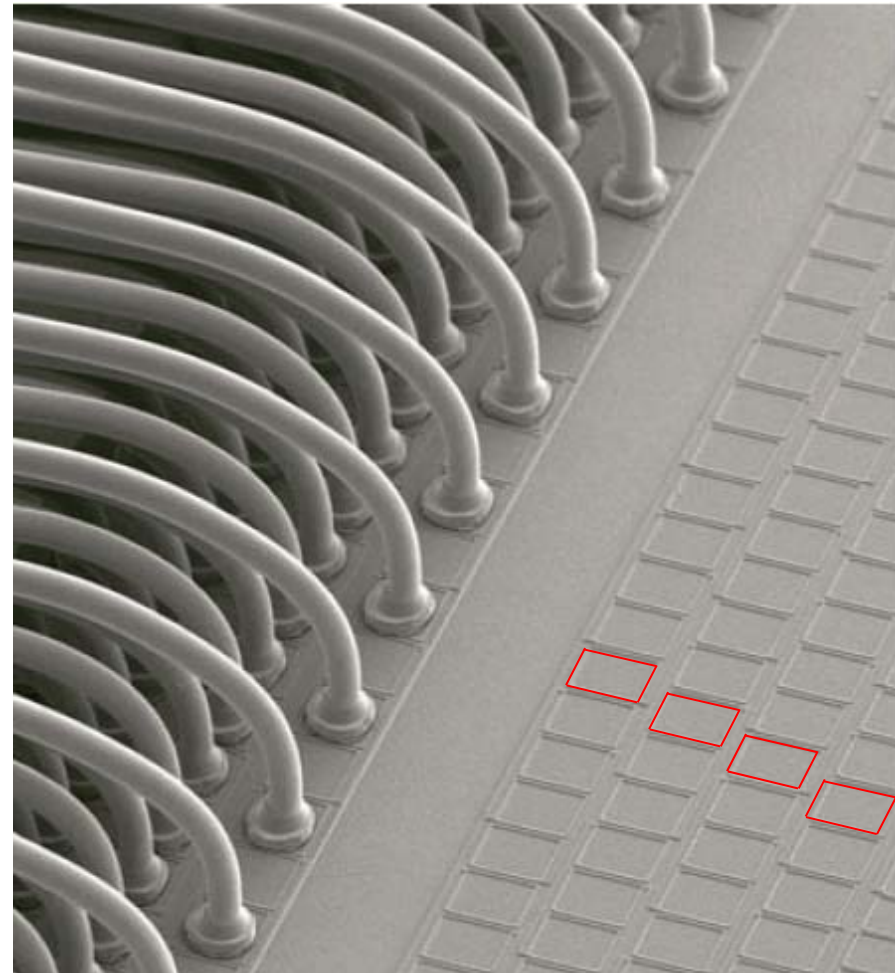


http://www.chipworks.com/uploadedImages/Blog/blogimagesq310/AKM8975_6210_cal_branded.JPG

Fine Pitch Logic

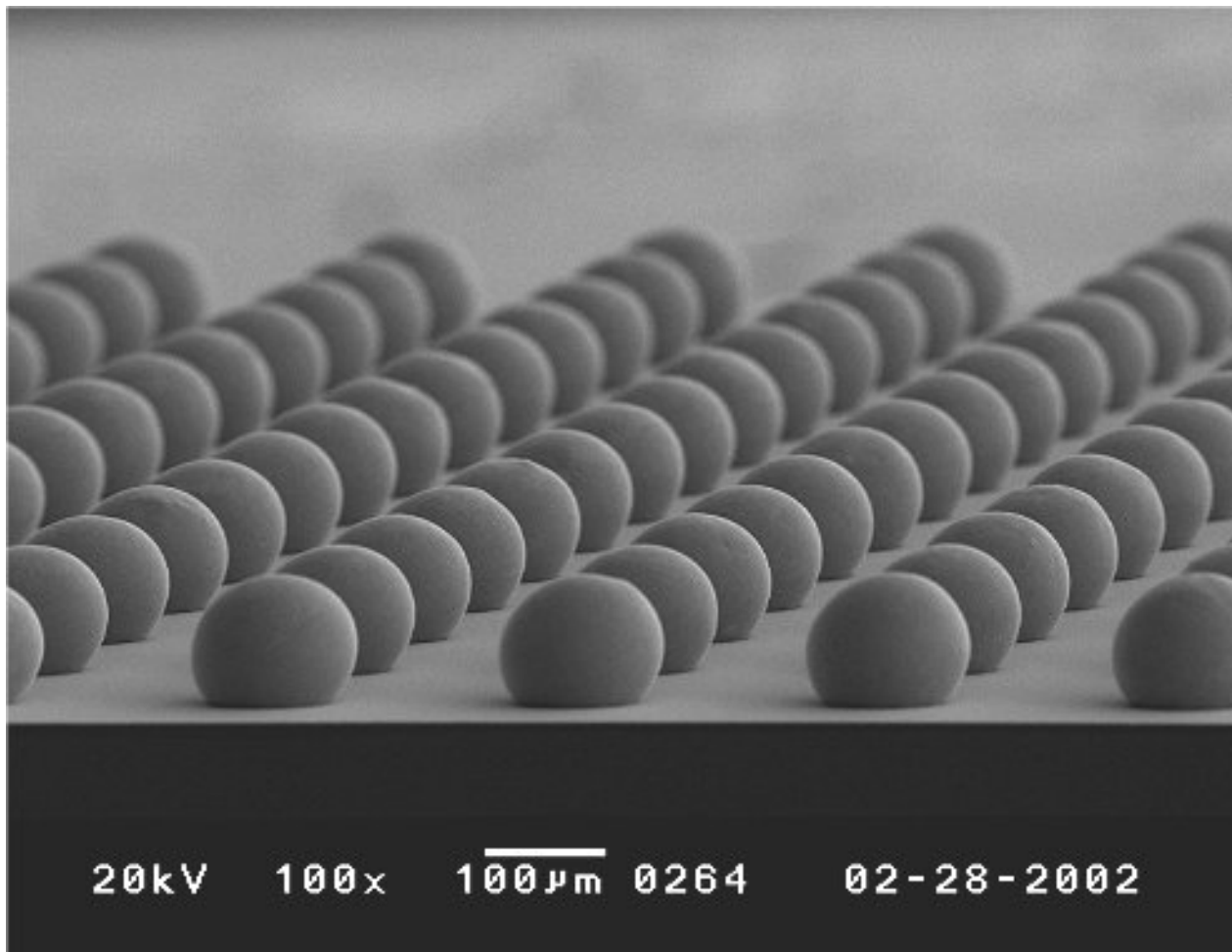


SWTW 2009: MEMS Technology – Enabling Design
Flexibility for Fine Pitch Probing
Bahadir Tunaboylu, SV Probe



Kulicke & Soffa: <http://www.imaps.org/imaps2005/keynote.pdf>

Area Array – Logic, μ P, etc.

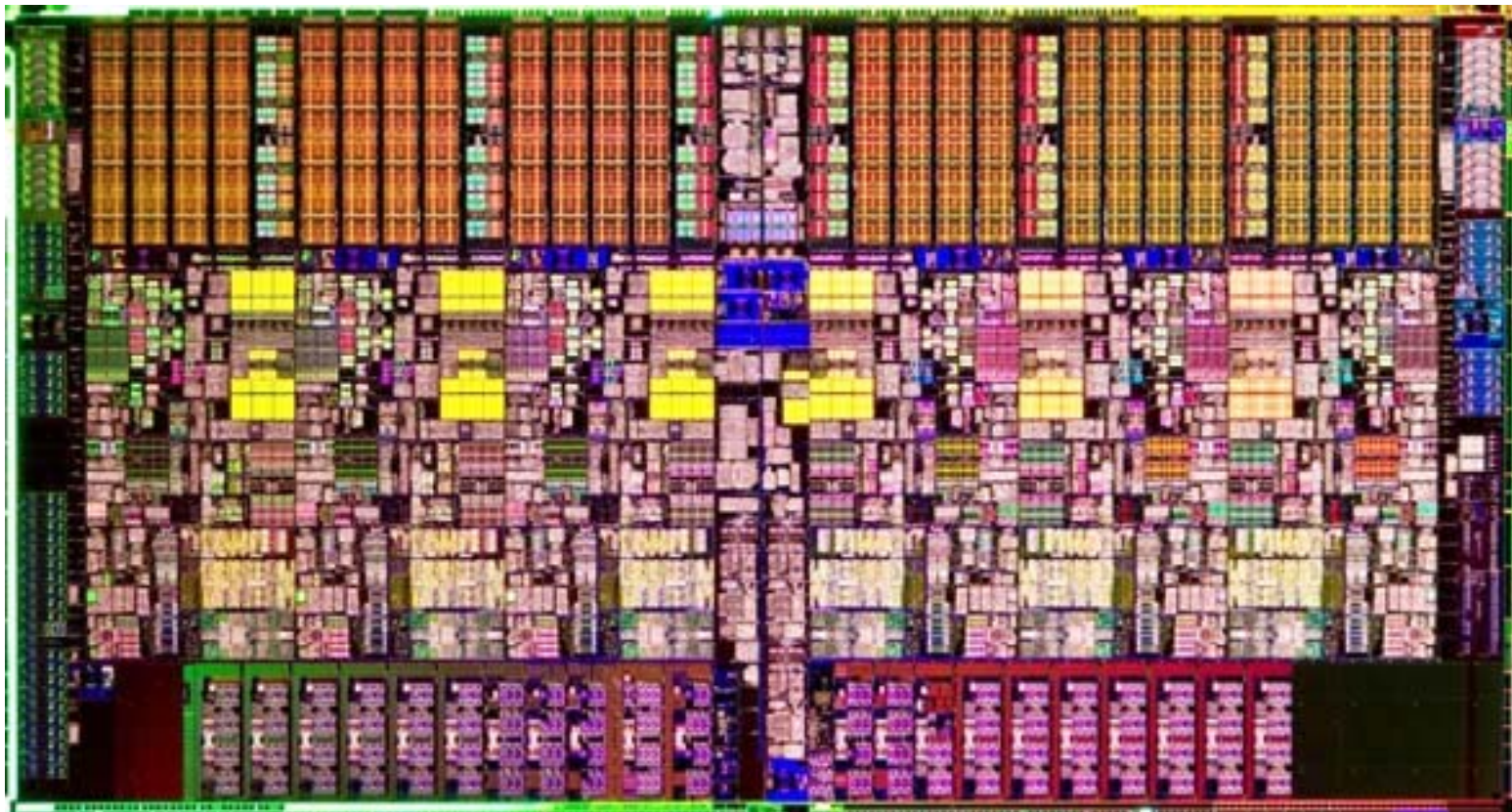


http://www.tradekorea.com/product-detail/P00032217/Solder_Bump.html

Silicon Valley Test Conference 2010



Marketing Version of a CPU...



Intel Core i7-980X Extreme 6-Core Processor (32nm Q1 '10)
<http://hothardware.com/News/Intel-Core-i7980X-Extreme-6Core-Processor-Review/>

...What Probe Really Sees

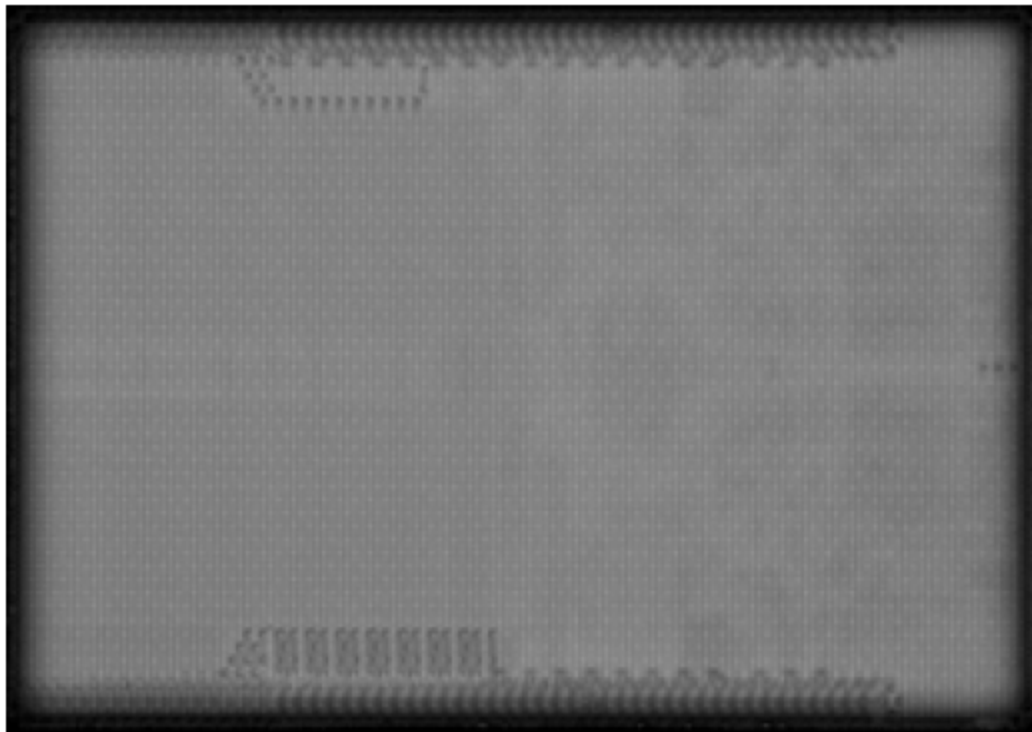
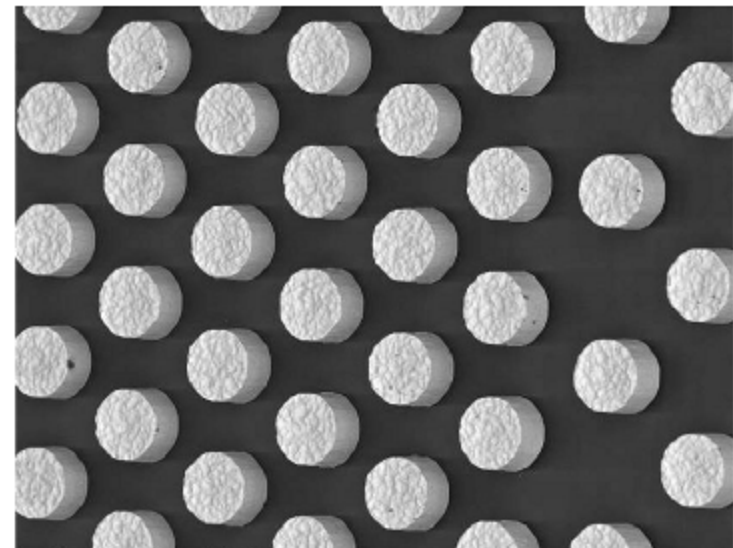
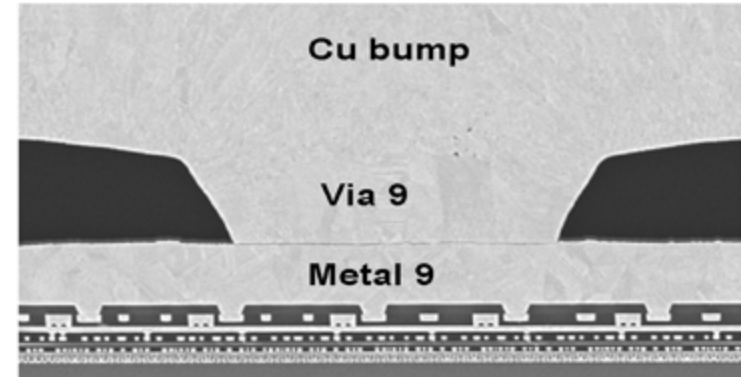
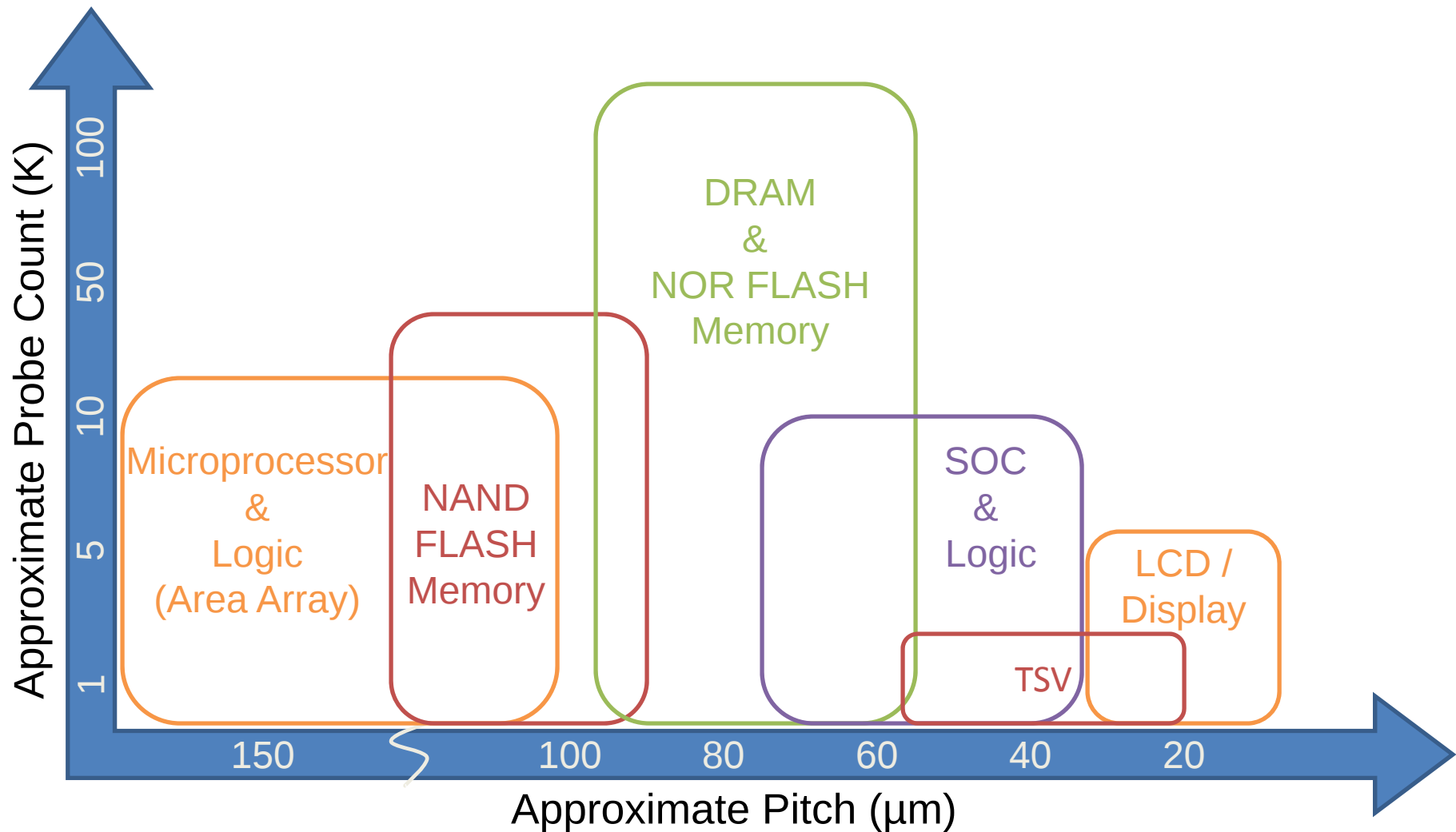


Figure 9: CSAM image of a production unit post packaging

Intel Technology Journal (6/2008):
45 nm process ~50 μm tall Cu bumps



No One Solution Fits All



Many Other Parameters

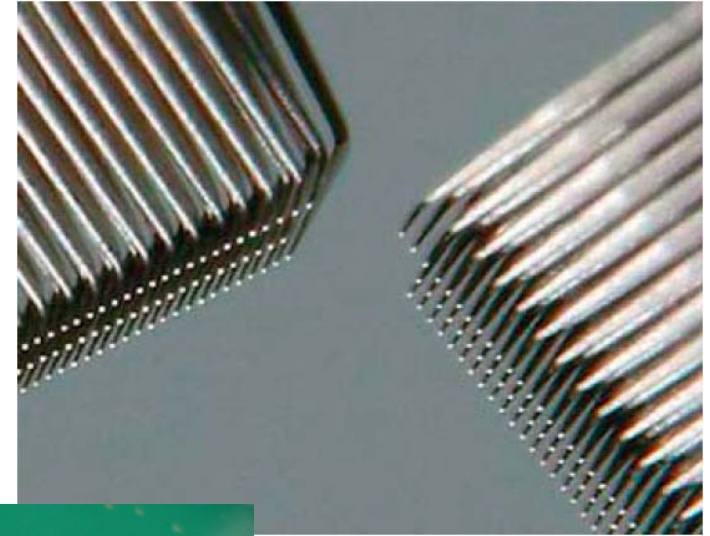
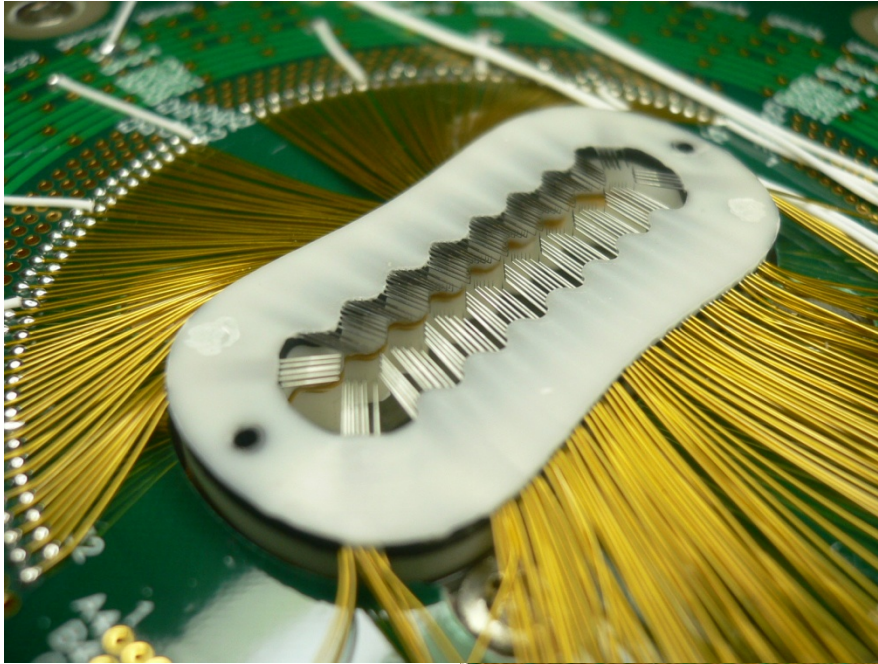
- “Pad” type – bond pad, BGA, column, bump
- Pad Configuration – peripheral, LOC, DLOC, array
- Die Size
- Pad Size - passivation opening & keep away
- Pad Metal – Al, Cu, Au, solder, etc.
- Force Requirements
- Scrub Depth
- Frequency / Bandwidth
- Pad Density (probes / mm²)
- Active Area (size of probe array)
- Temperature

Contact Technologies / Probe Types



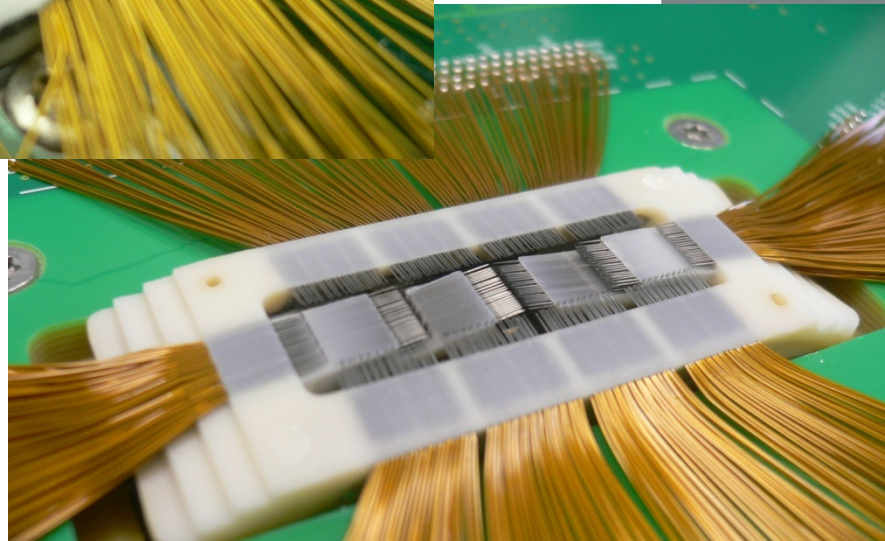
- Cantilever
- Blade
- Vertical
- MEMS
 - Vertical
 - Micro Cantilever
 - Torsional
- Spring
- Membrane

Cantilever

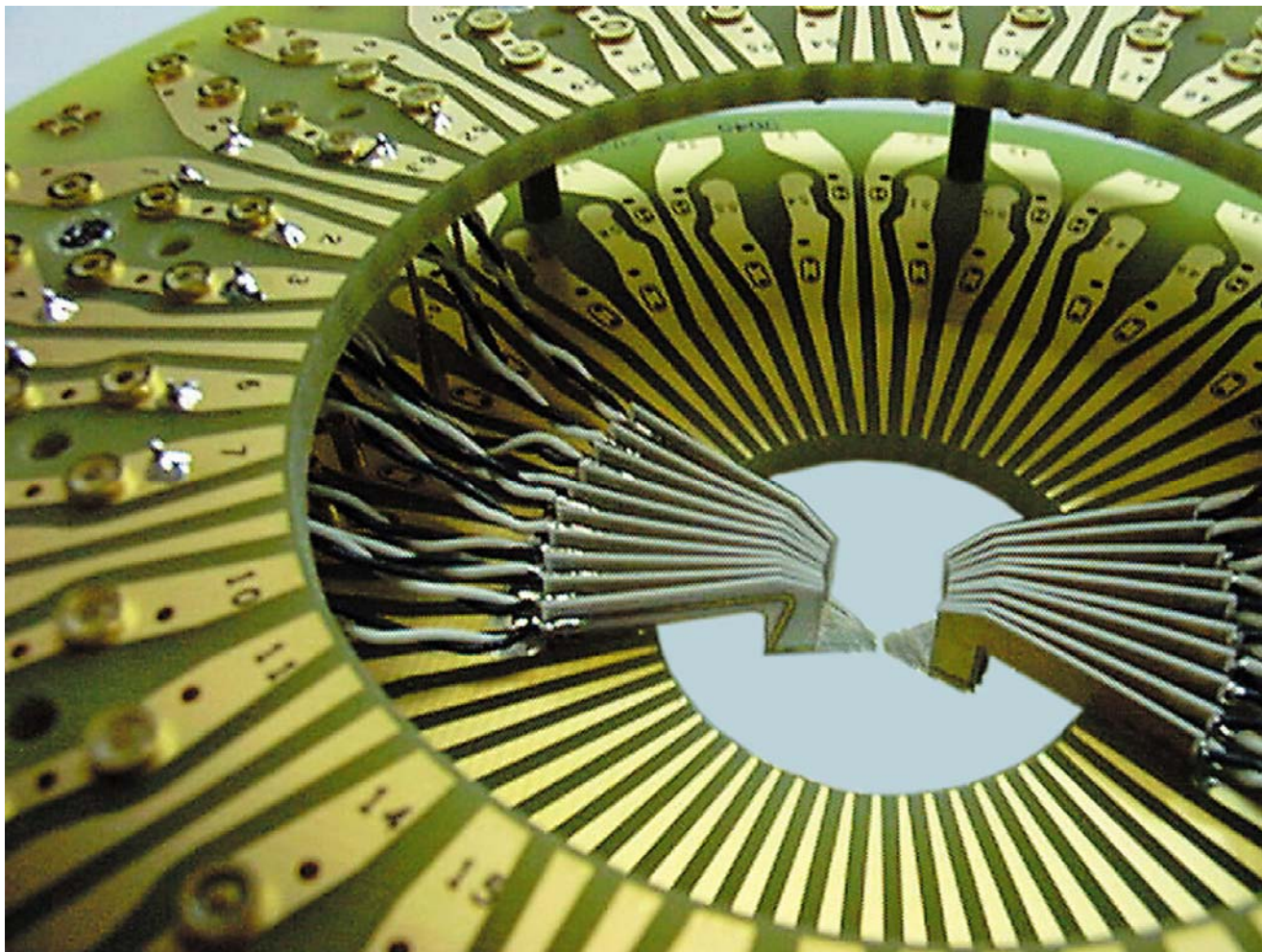


K&S: <http://www.imaps.org/imaps2005/keynote.pdf>

Technoprobe

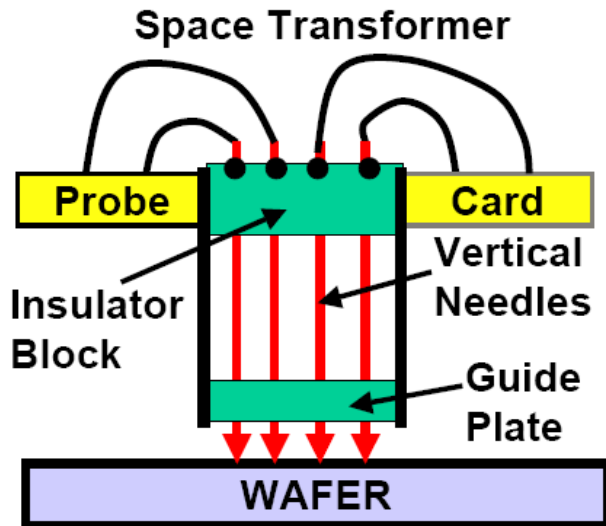


Blade



SV Probe

Vertical- Buckling Beam

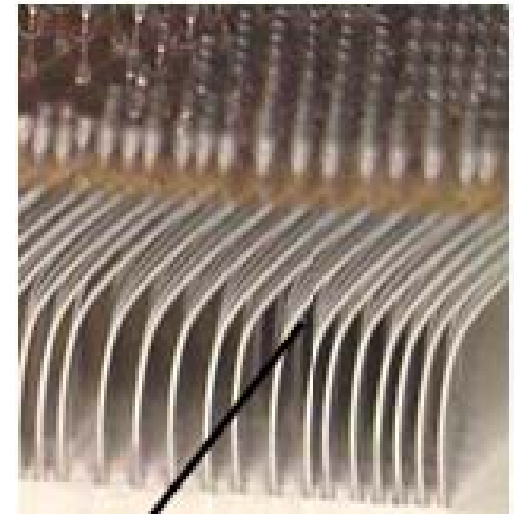


Cobra "Buckling Beam" Card
Patented by IBM in June 1977

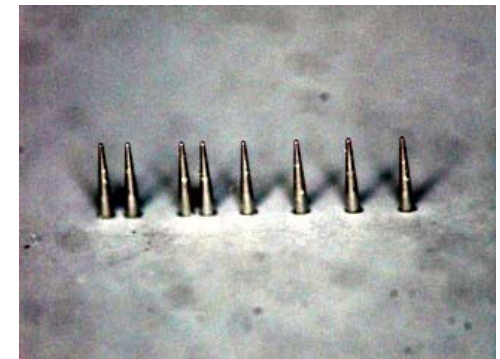
Mann: SWTW Tutorial 2004



SV Probe "Trio"

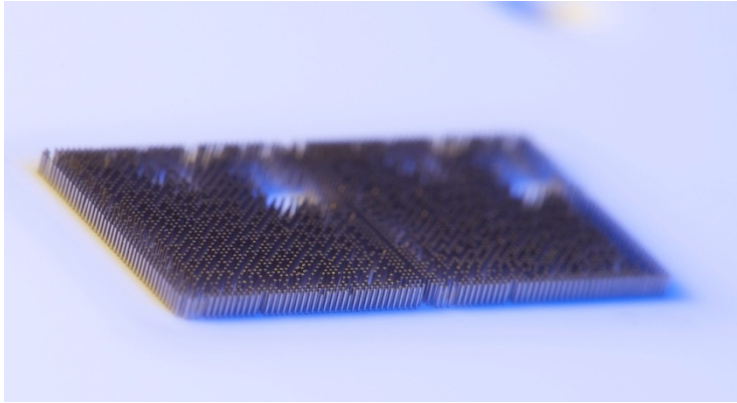


FormFactor: "MEMS for ProbeCard Applications"
Chong Chan Pin – Semicon Singapore 2010

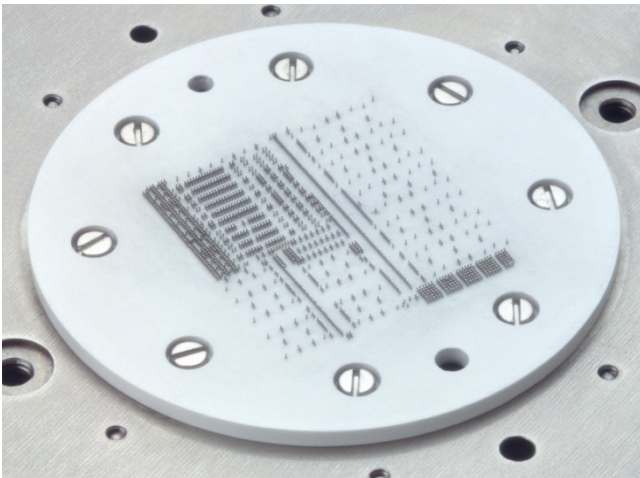


JEM "VC"

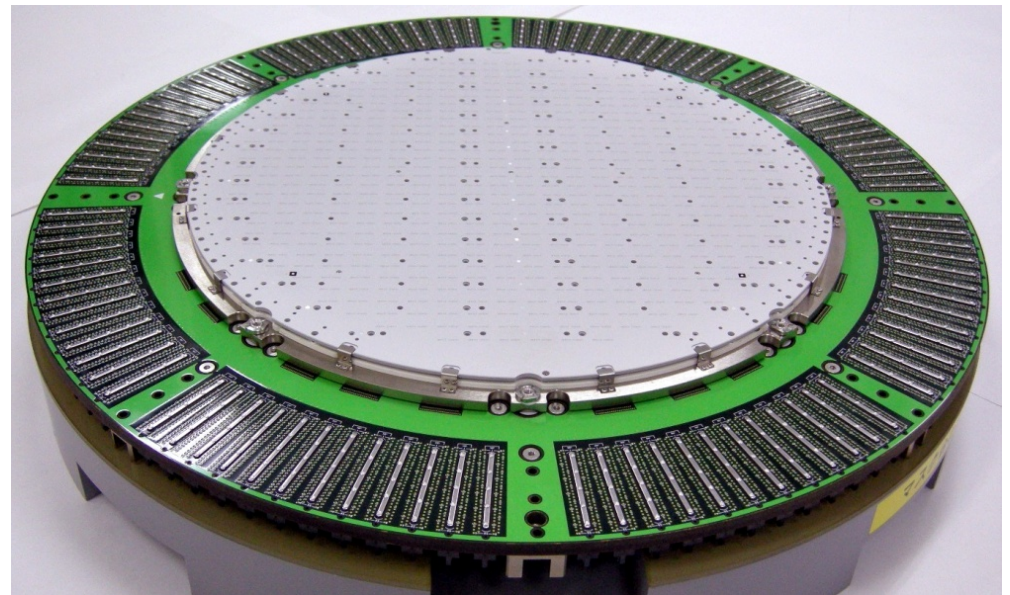
Vertical- Buckling Beam



MicroProbe: Apollo Vertical

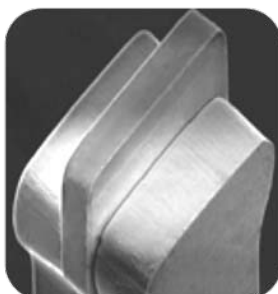


SV Probe: Trio

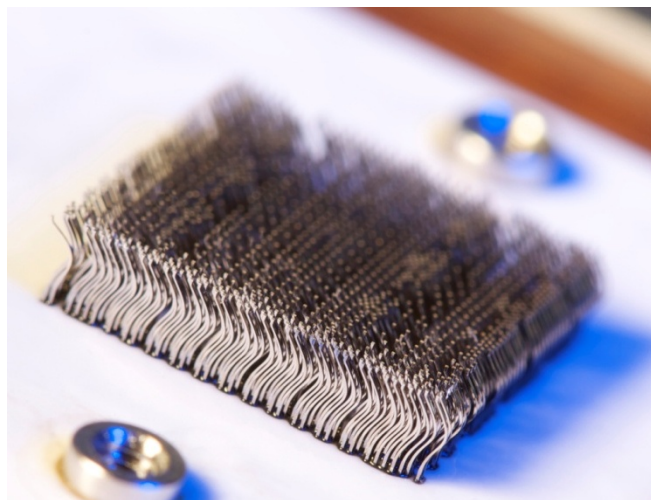


JEM: VC

MEMS - Vertical

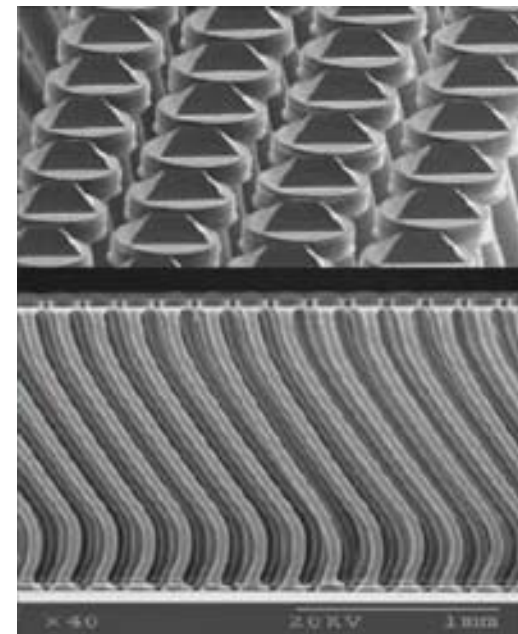


Microfabrica MicroProbe



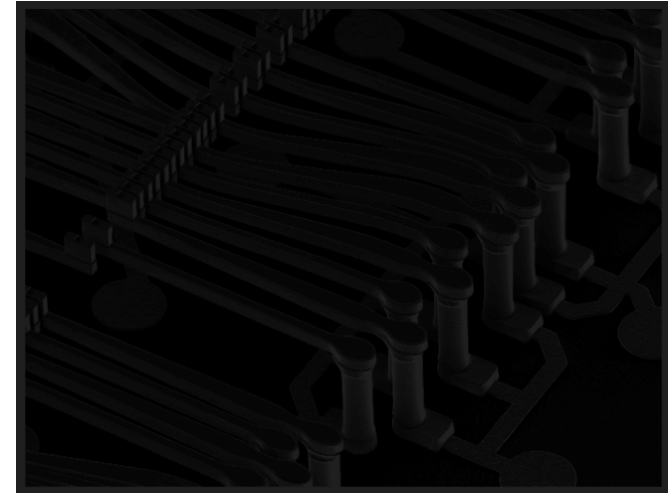
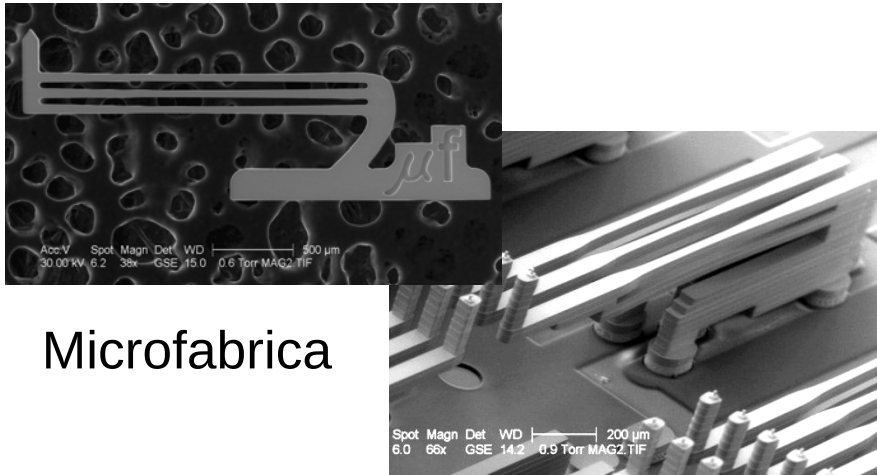
MicroProbe (Vx-MP)

Silicon Valley Test Conference 2010

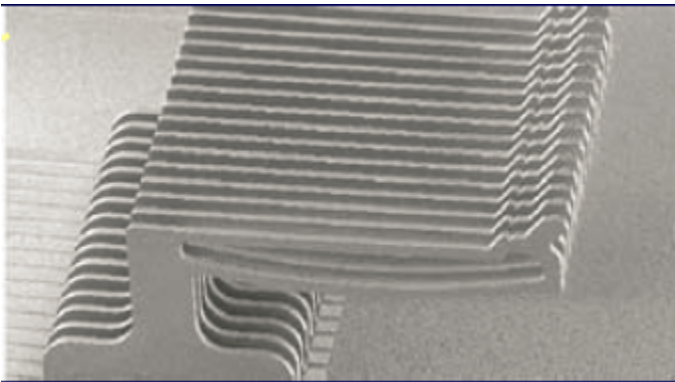


FormFactor (T1)

MEMS - Micro Cantilever

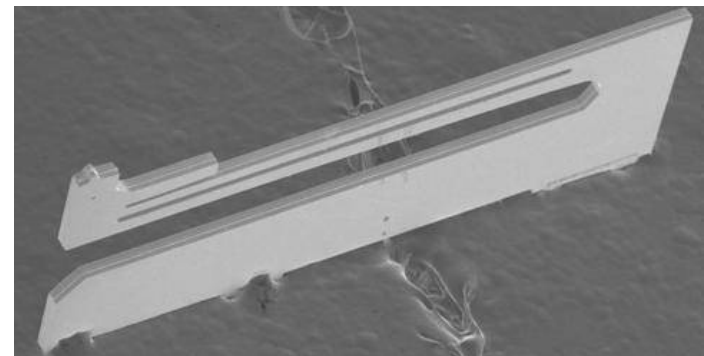


FormFactor (T3)



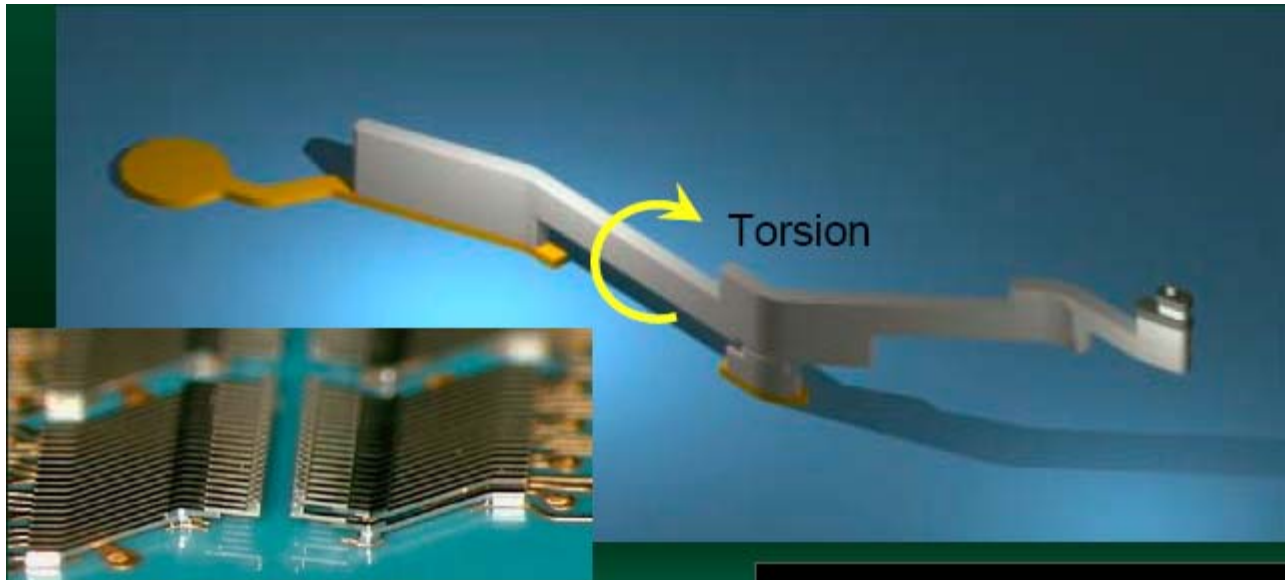
MJC (U Probe)

<http://www.mjc.co.jp/eng/ir/pdf/MJC070226-s.pdf>



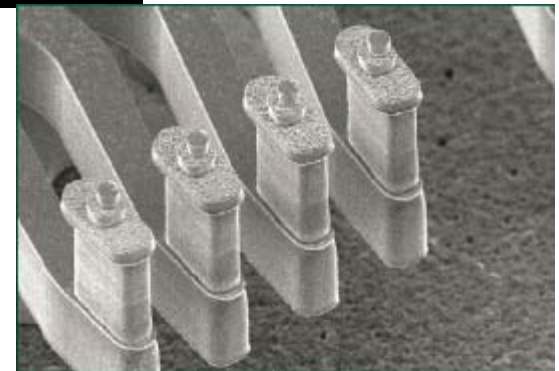
JEM

MEMS - Torsional

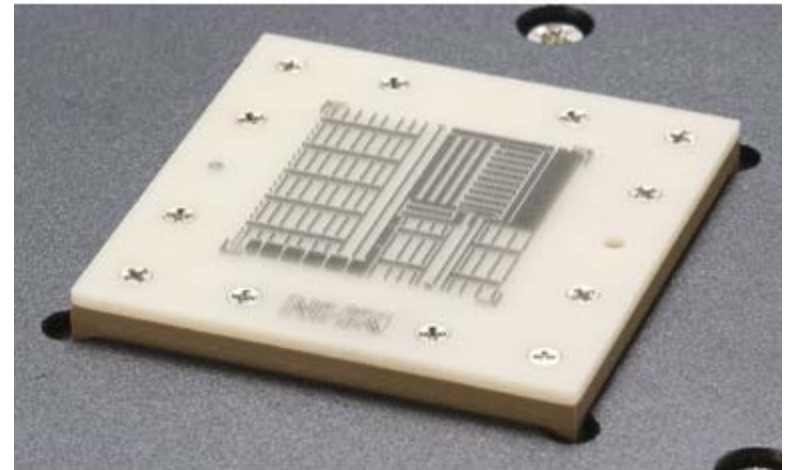
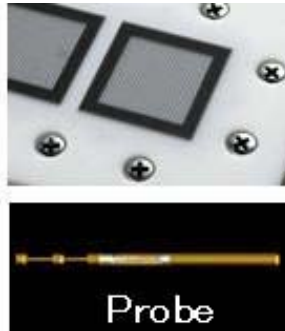
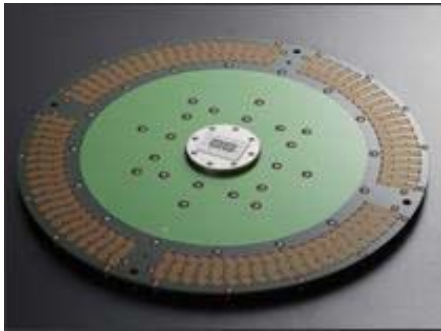


Touchdown Technologies (ACCU-TORQ)

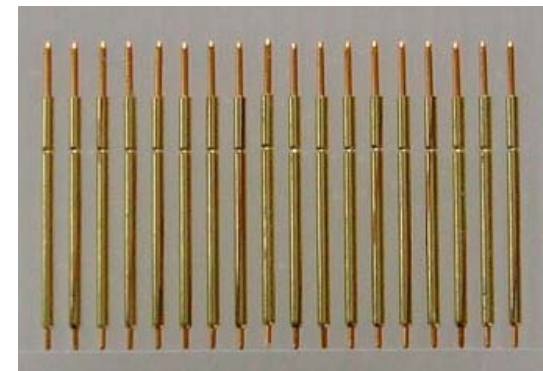
SWTW 2010: "Low-Force MEMS Probe Solution for Full Wafer
Single Touch Test" Matt Losey



Spring Pins



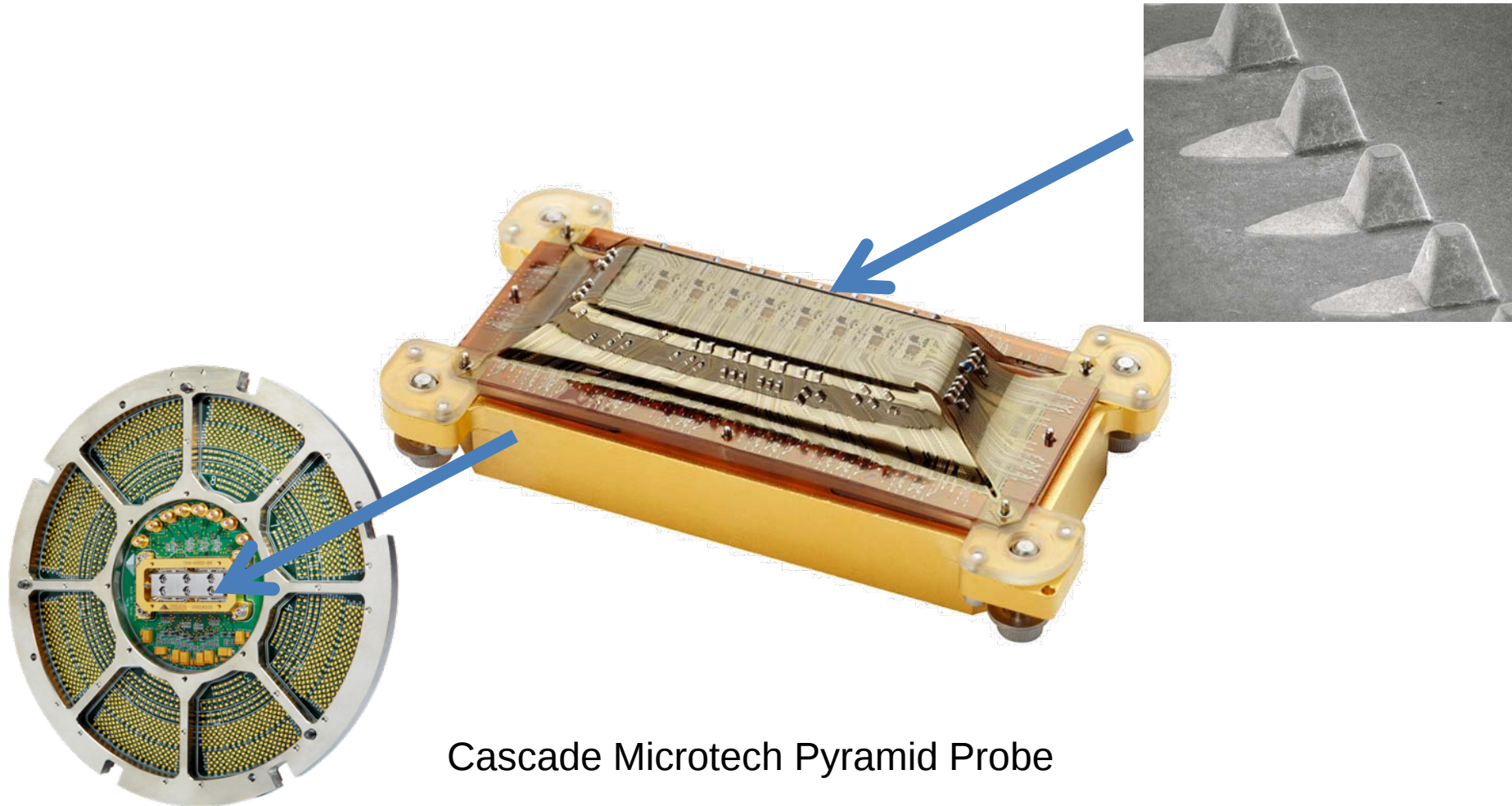
<http://www.nhkspg.co.jp/eng/mc/products/wlt.html>



JEM VS

<http://www.ksdk.co.jp/eng/spring-probes.html>

Membrane



Cascade Microtech Pyramid Probe

Top Vendors - Technology



Rank	Company	09 Revenue (\$M)						
			Cantilever	Blade	Vertical	MEMS	Spring	Membrane
1	FormFactor	135				X		
2	Micronics Japan Co. (MJC)	118	X		X	X		
3	Japan Electronic Materials (JEM)	90	X	X	X	X	X	
4	Technoprobe	36	X		X			
5	MicroProbe	35	X		X	X		
	SV Probe		X	X	X	X		
	Cascade Microtech							X

Revenue per VLSI Research press release

https://vlsiwebserver.vlsiresearch.com/public/cms_pdf_upload/458310.pdf

Based upon website and company responses to marketing inquiries.

Top Vendors - Applications

Rank	Company							
		Peripheral Fine Pitch Logic	Area Array Logic/uP/SOC	DRAM/NOR Memory	NAND Memory	RF	DC Parametric	LCD / Display
1	FormFactor	X	X	X	X	X	X	
2	Micronics Japan Co. (MJC)	X	X	X	X	X	X	X
3	Japan Electronic Materials (JEM)	X	X	X	X	X	X	X
4	Technoprobe	X	X		X	X		X
5	MicroProbe	X	X		X	X		X
	SV Probe	X	X				X	X
	Cascade Microtech		X			X	X	

Based upon website and company responses to marketing inquiries.

Hot Topics (1)

IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

Senthil Theppakuttal, PhD
Bahadır Tunaboylu, PhD
Jeff Hicklin
SV Probe, Inc.

**Probing Assessment on Fine Pitch
Copper Pillar Solder Bumps**

Most
Inspirational

IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

Rehan Kazmi, PhD
Habib Kilicaslan
Jeffrey Hicklin
Bahadır Tunaboylu, PhD
SV Probe, Inc.

**Measuring Current Carrying
Capability (CCC) of Vertical Probes**

Most
Inspirational

IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

Matthew C Zeman
Intel Corporation

**A New Methodology for Assessing the
Current Carrying Capability of Probes
used at Sort**

June 6 to 9, 2010
San Diego, CA USA

20th ANNIVERSARY



- Bump / ball damage
- Cu probing
- High current

Hot Topics (2)

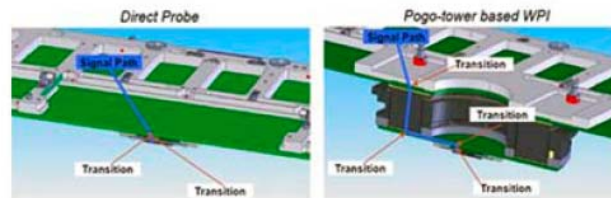
- High Frequency / high bandwidth
 - Advanced space transformers
 - Modeling
 - Direct Dock

Method

Verigy 93k Direct Probe™ with MicroProbe Apollo

Application Signal Bandwidth

HIGHER BANDWIDTH – Direct Probe reduces the number of signal path transitions between the tester to the probes



Hot Topics (3)

- Operational – lower cost, quicker cycle time

IEEE SW Test Workshop
Semiconductor Wafer Test Workshop

E Boyd Daniels & Martin Gao
Texas Instruments
Mitch Baumann
Millennium Circuits

Very Low Cost Probe Cards
A Two Piece Approach

June 6 to 9, 2010
San Diego, CA USA

TEXAS INSTRUMENTS



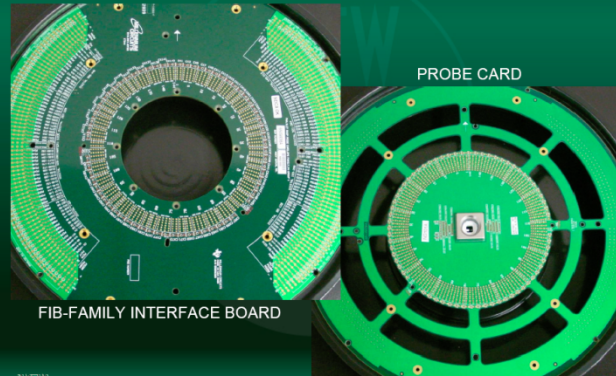
Enhanced 2P PC Solution

- Concept was reorganized and redesigned with Millennium Circuits.
- Result: A drop-in solution for the TI's VLCT tester setup using a 2 PCB methodology.



June 6 to 9, 2010 IEEE SW Test Workshop

Enhanced 2P PC Solution



FIB-FAMILY INTERFACE BOARD

PROBE CARD

June 6 to 9, 2010 IEEE SW Test Workshop

Summary



- Device product requirements drive both packaging and test complexity
 - Essential to partner with suppliers from day one
- Careful selection of probe card vendors
 - Know strengths & weaknesses for your devices
 - Technology may limit performance & impact cost
 - No one solution fits all

Resources



- IEEE Semiconductor Wafer Test Workshop
www.swtest.org
- International Test Conference
www.itctestweek.org
- My blogs
www.hightechbizdev.com
www.ateforum.com/tothepoint

Credits



Thank you to the vendors who provided photos!

- FormFactor
- Technoprobe
- MicroProbe
- JEM
- SV Probe
- Cascade Microtech