

Infineon

On the way to 30 μ m pads - a new generation of kerf probe cards

Frank Pietzschmann

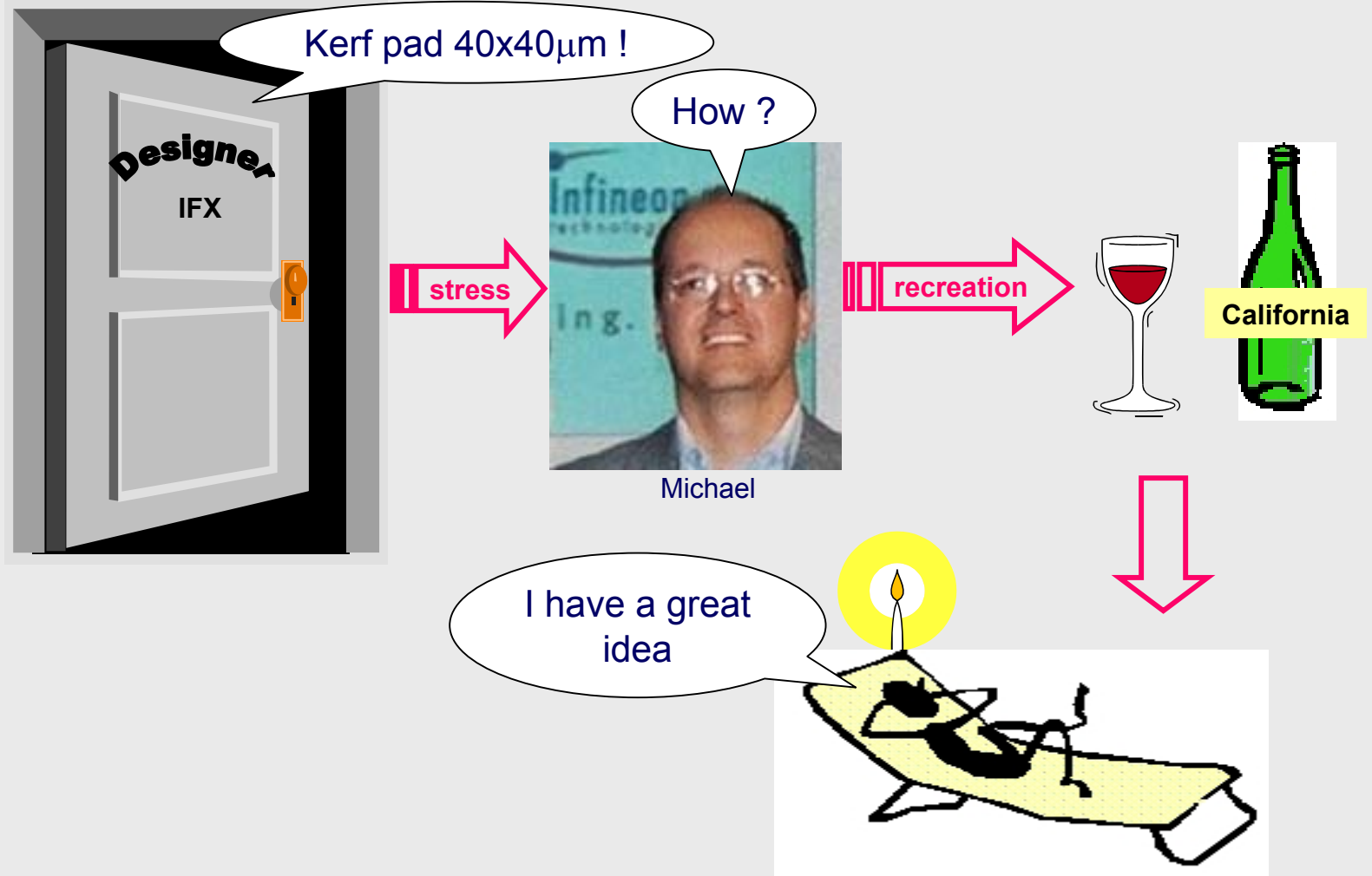
SWTW June 2003



Never stop thinking.

On the way to 30 μ m pads - a new generation of kerf probe cards

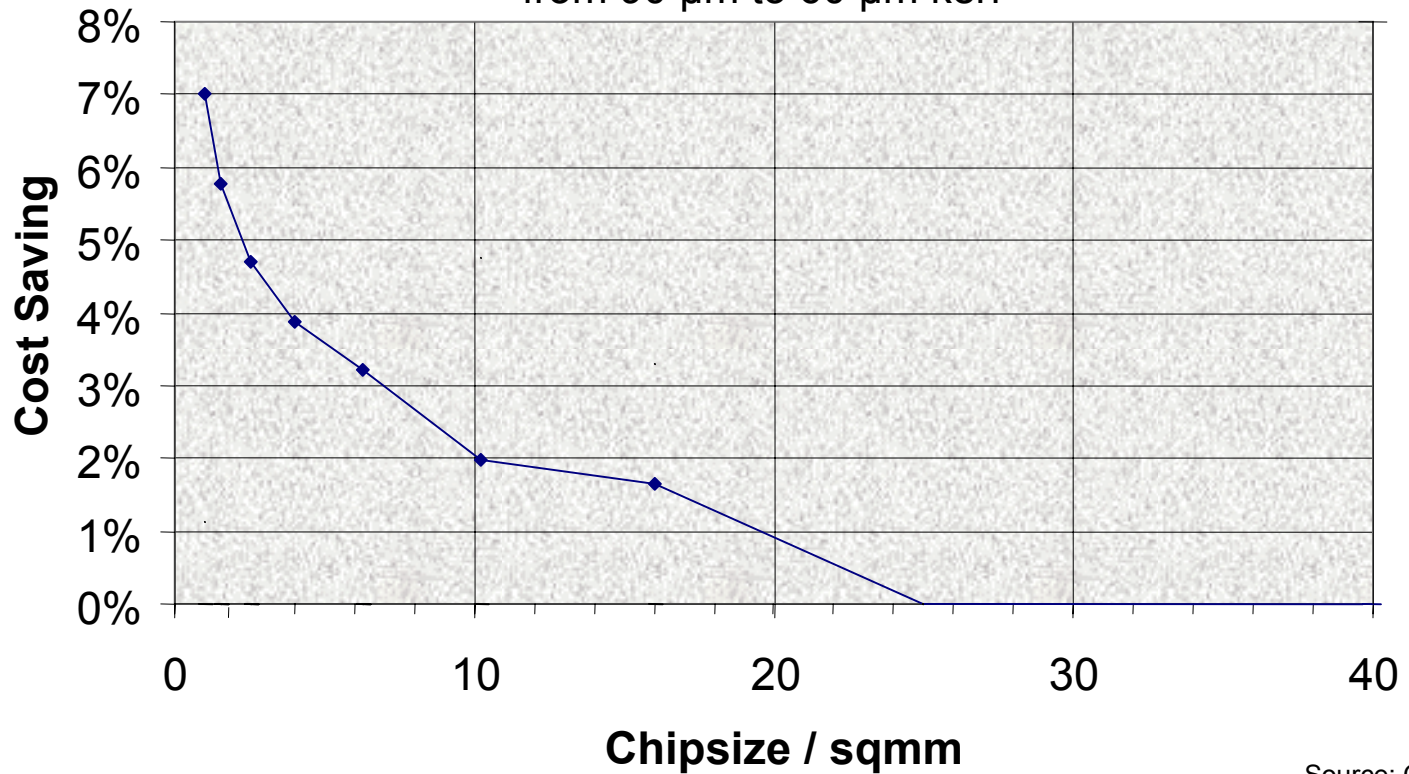
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On the way to 30 μ m pads - a new generation of kerf probe cards

1.) More chips per wafer or 2.) More PCM's per kerf

from 90 μ m to 60 μ m kerf

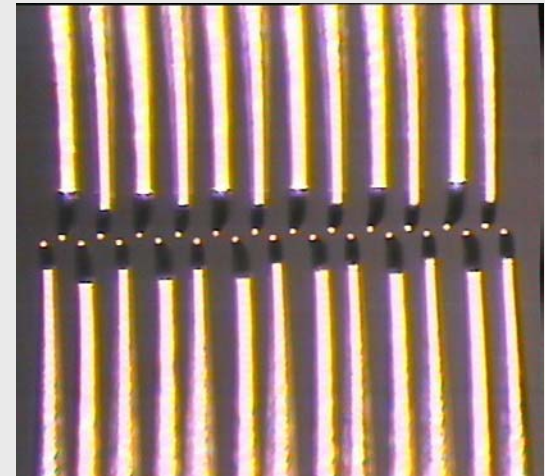


Source: O. Gehring

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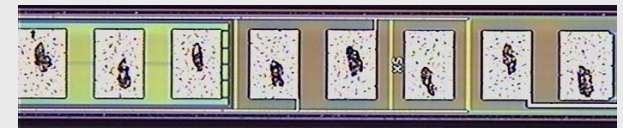
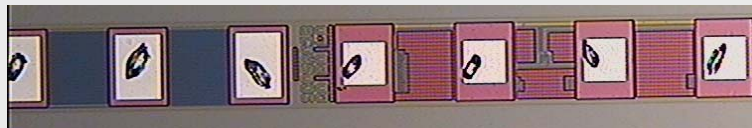


single layer cantilever



dual layer cantilever

40x40 μ m pad size simulation

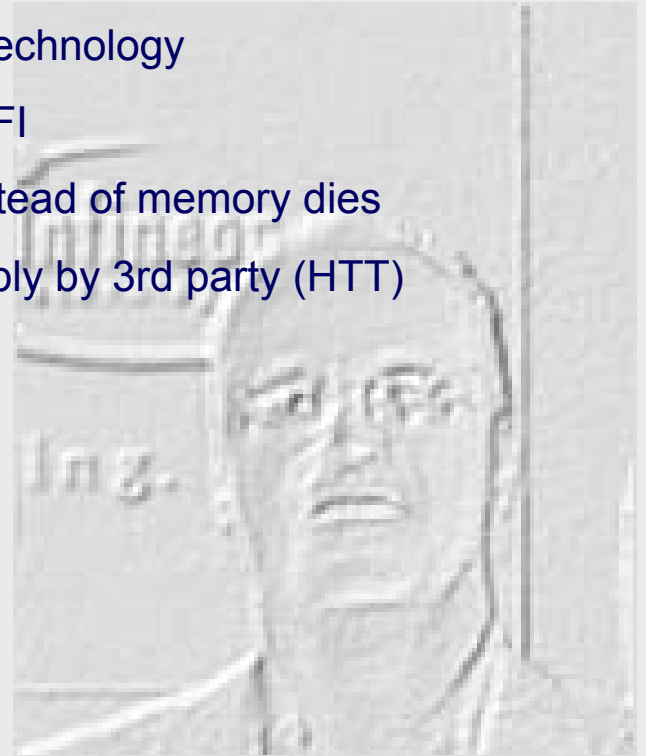
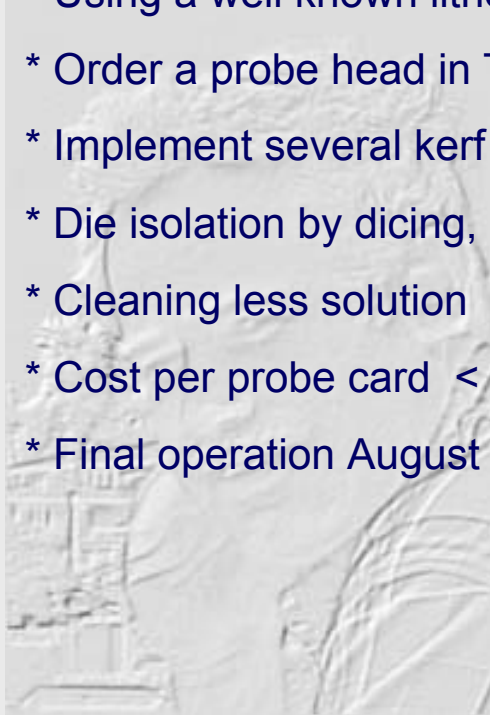


Both solutions are not suitable for 40x40 μ m pad size and pitch 80 μ m

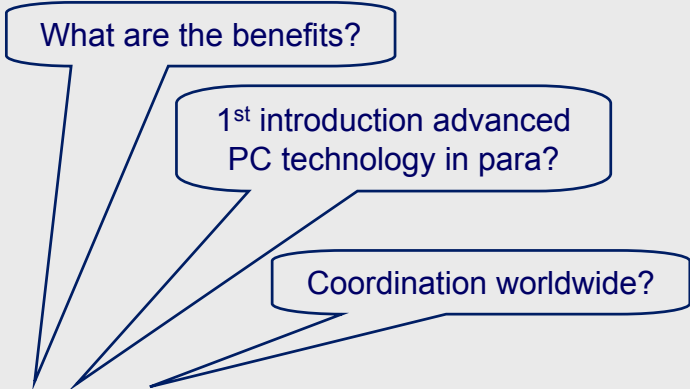
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The smart solution

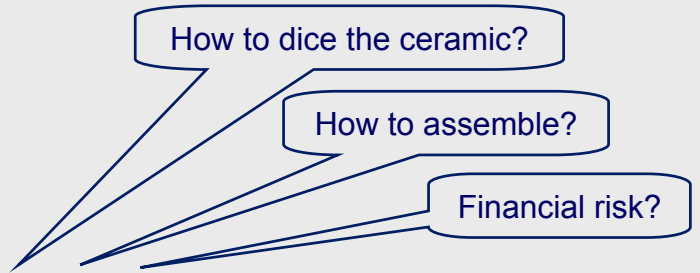
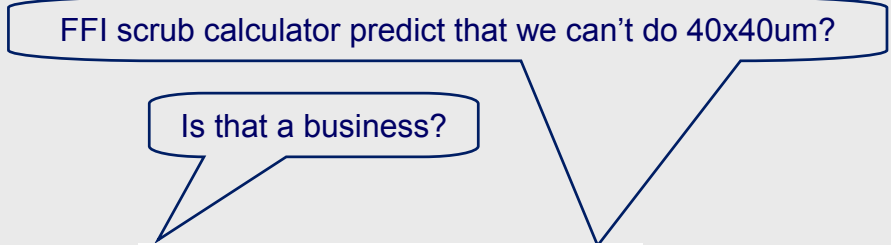
- * Develop a PCM card for 40x40 mm pad size, 80 mm pitch, 25 needles
- * Using a well known lithographic probe card technology
- * Order a probe head in T2 technology from FFI
- * Implement several kerf needle structures instead of memory dies
- * Die isolation by dicing, mounting and assembly by 3rd party (HTT)
- * Cleaning less solution
- * Cost per probe card < \$4000
- * Final operation August 2002



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Challenges for other affected areas:
PCM design; different alignment marks; dicing; picking; reliability tests;



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stop thinking
Never

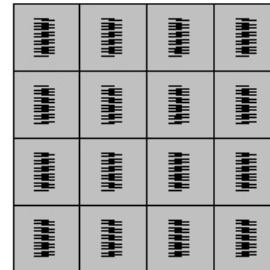


Confidential

Technical Documentation of a probe card for parameter test

This probe card is for testing 1DUT with 25 pads (probe set).
16 probe sets with 25 probes each should be processed on a 57mm x 57mm ceramic substrate in such a way that it is possible to cut the ceramic in approximately 14mm x 14mm pieces each having 25 probes (see figure).

Wafer side



After sawing each of the probe sets should be mounted on a PCB for HP 4071. Electrical connection should be done by cables soldered to the backside of the ceramic on the LGA8 (all the assembly work will be done by HTT Dresden, FFI only has to deliver the ceramics with the probes on).

Front of prober must be marked using an arrow and the text "Front of prober" on both sides of the probe card board.

Following text must be printed on the PCB: HP 4071 80µm Pitch

Mechanical requirements

- ▶ 25 probes at 80µm regular pitch
- ▶ Planarity over a set of 25 probes: better than 10µm
- ▶ XY accuracy: better +/- 10µm over a set of 25 probes
- ▶ Tip size: 5µm x 5µm to 10µm x 10µm
- ▶ Probe force: 0.5 - 3.0 gr/25µm
- ▶ Scrub length: 0.1 - 0.25 x DT
- ▶ Probing temperature: 25 - 120 degree Celsius
- ▶ Probe Height: 9,2 mm (will be adjusted by HTT)

Electrical requirements

- ▶ Leakage between channels: less than 100pA at 100V
- ▶ Contact resistance: less than 10hm

Specification

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Designed precision

- Tip size 10 μ m
- Position 0 \pm 2 μ m
- Planarity <10 μ m

Applied accuracy

Technology behind the limits

NOTES:
LAYOUTS VIEWED LOOKING AT THE PROBE SIDE OF THE CERAMIC

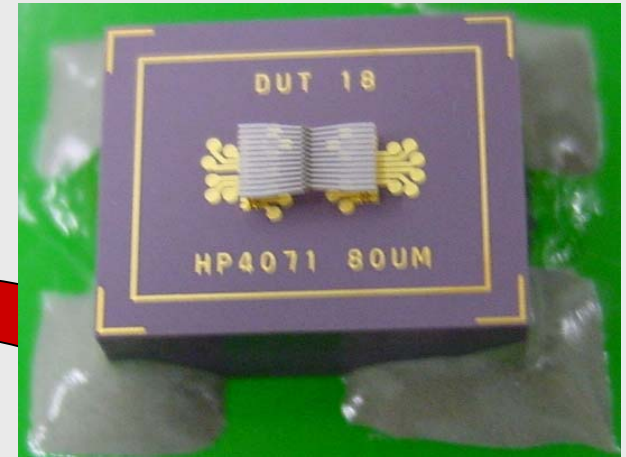
FormFactor ML0507M TEST DEBUK DRAWING		1 OF 1	
TOLERANCES DIMS = 0.125MM HOLES = 0.125MM FINISHES = 0.1/0.08	DIMS HOLES FINISHES	ML0507M TDM0507M	1 OF 1

Head design

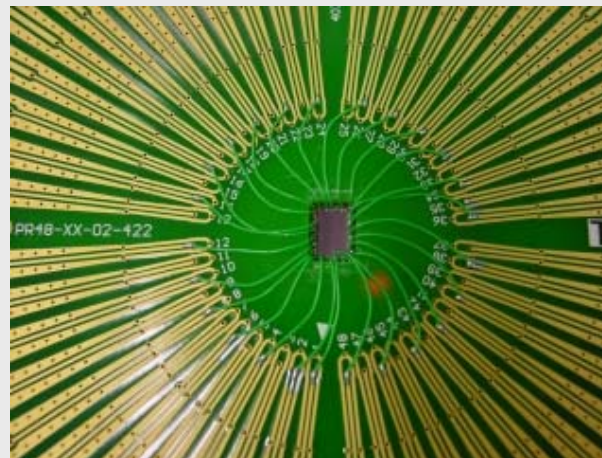
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dicing



mounting

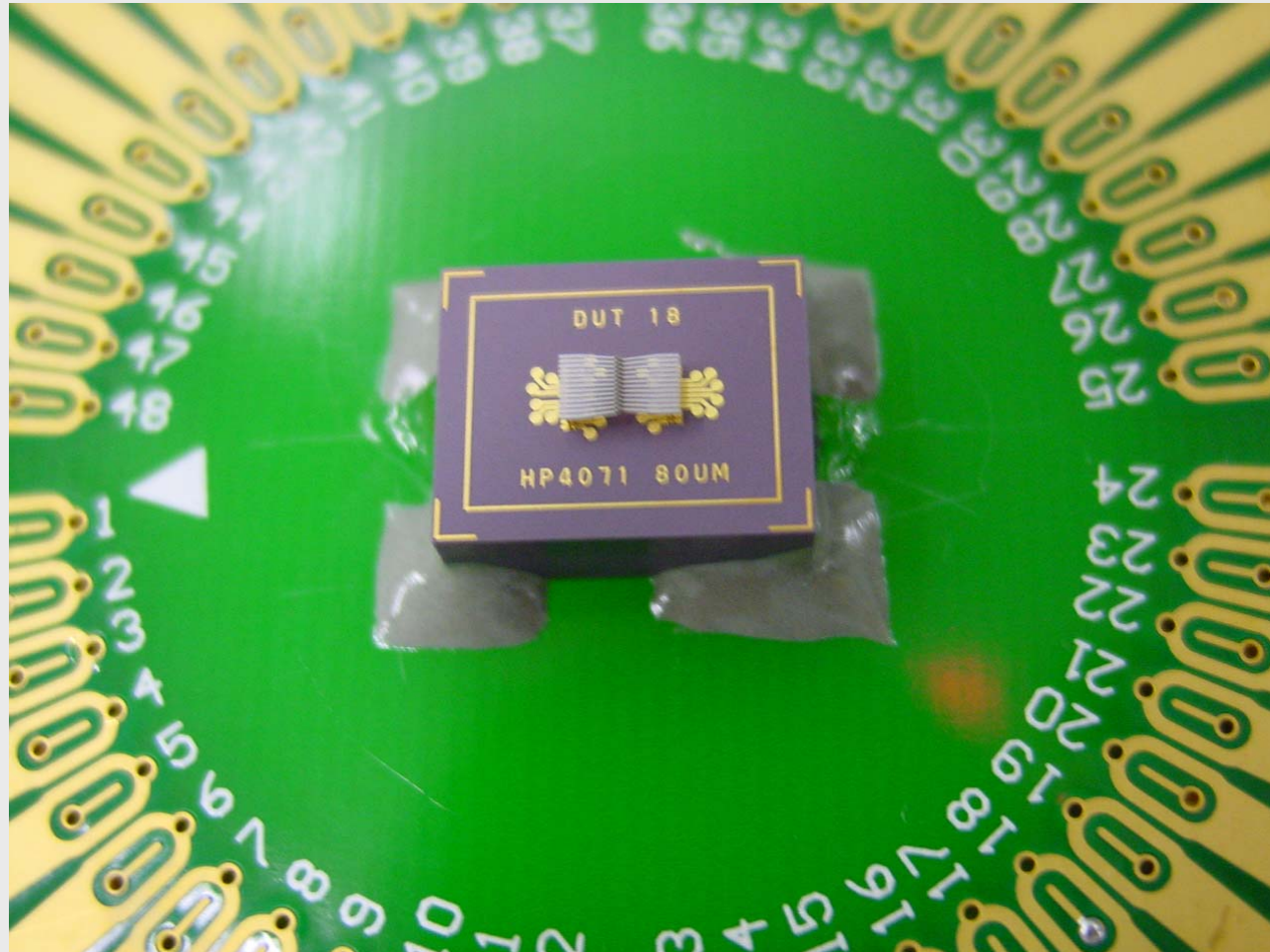


assembly

Card assembly

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Evaluation flow:

first 2 samples E/2001 ✓

2 month delay due to
"scheduled" para bottle
neck situation and wrong
wiring

TV- and M0-correlation 03/02 ✓

production run pad size 50x70mm over one month 04/02 ✓

TV- and M0-correlation 05/02 ✓

Process **C**hange **R**elease **B**oard # IFDD.PCRB.FU.02.1302 16.05.2002 ✓

production since 16.05.02 on SPF3PA-02 and 26.07.02 SPF3PA-10 ✓

first product with pad size 40x40 μ m 08/02 ✓

A few test chips lots w/
40x40 μ m; 1st product came
surprising w/ 40x50 μ m

final release 40x40 μ m 09/02 ✓

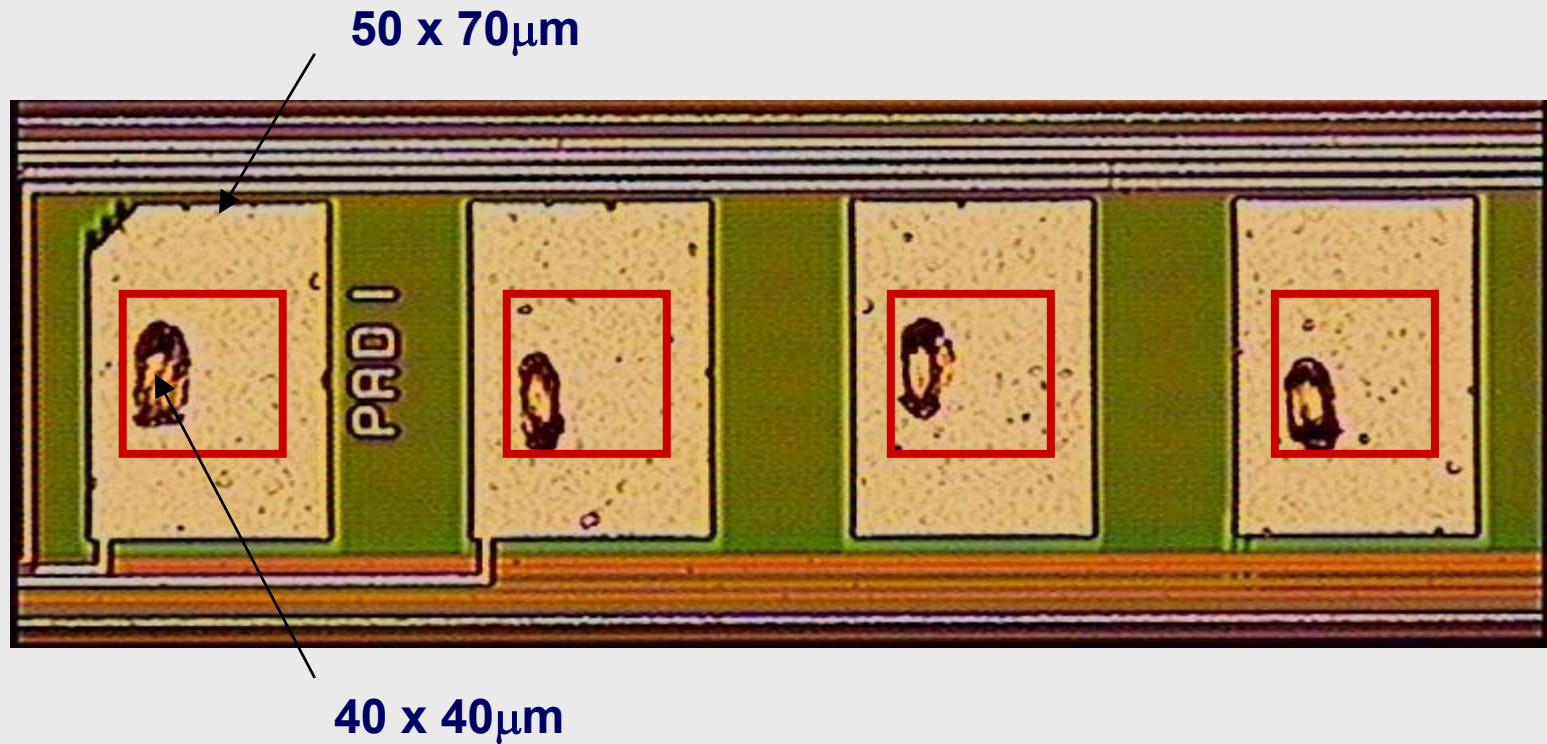
first evaluation pad size 30x30 μ m 05/03 ✓

Fight against the "wind
mills" for the world wide IFX
introduction

first product pad size 30x30 μ m 09/03

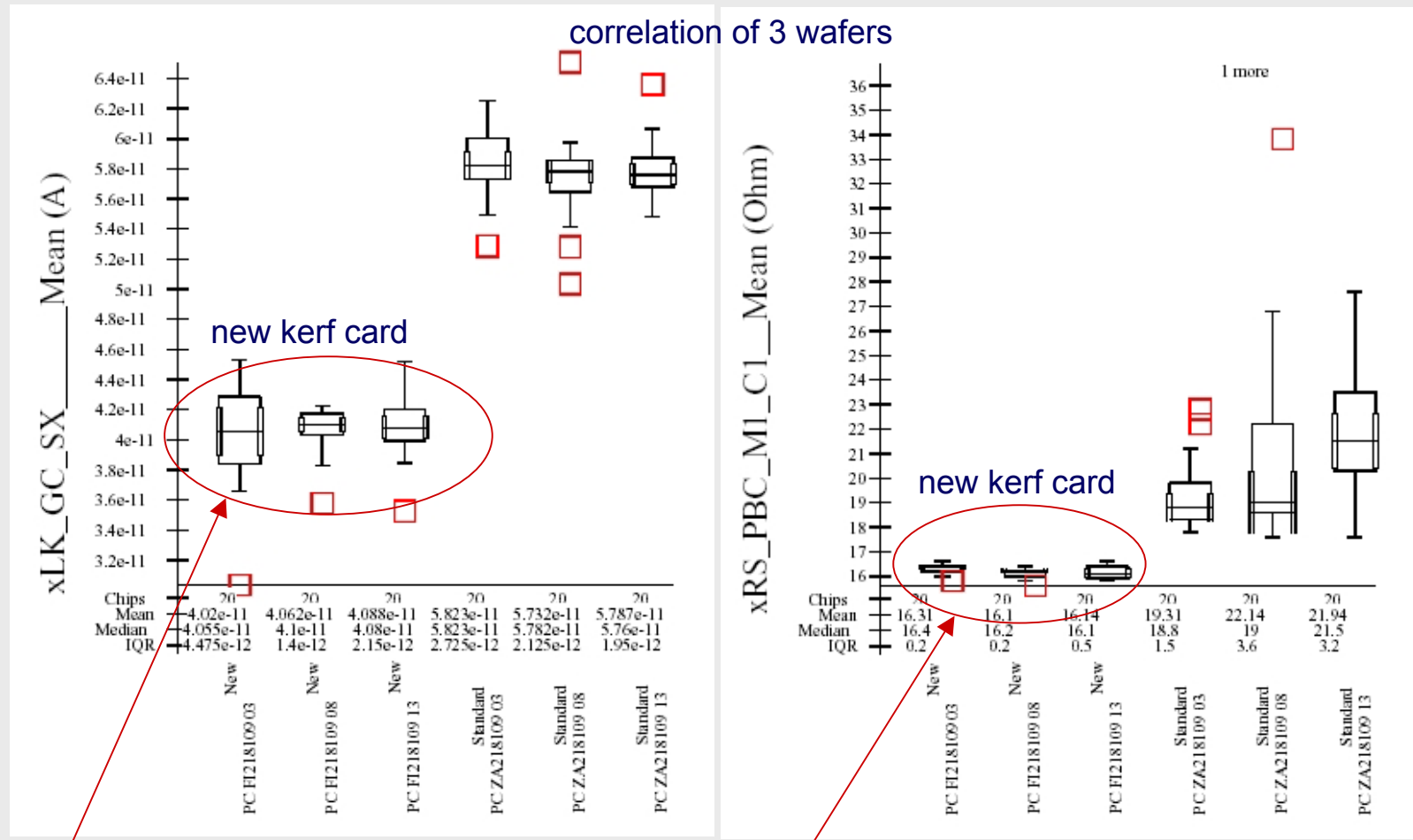
final release 30x30 μ m E/03

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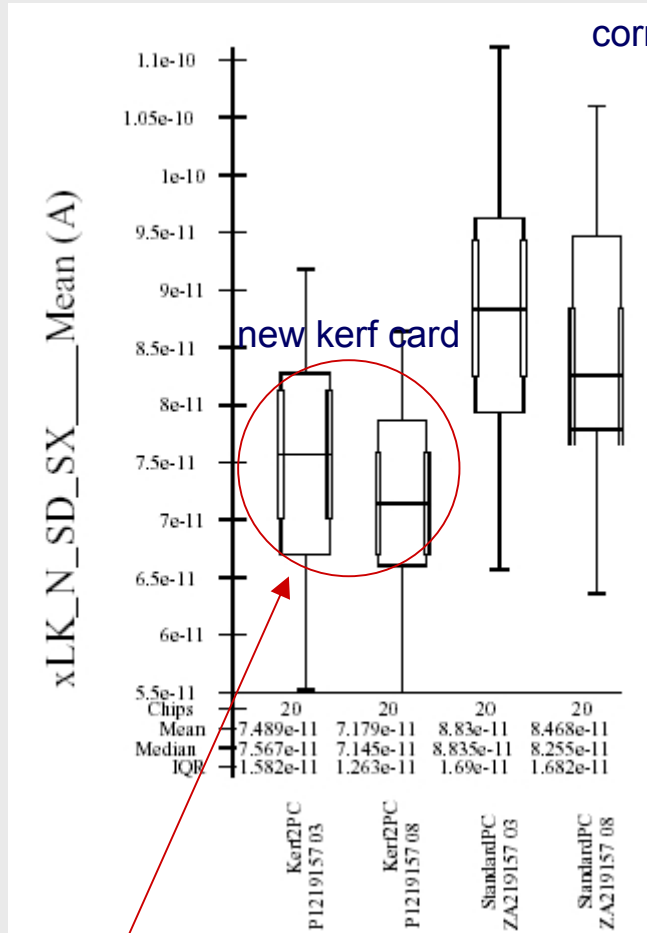


Leakage-values: lower, smaller range

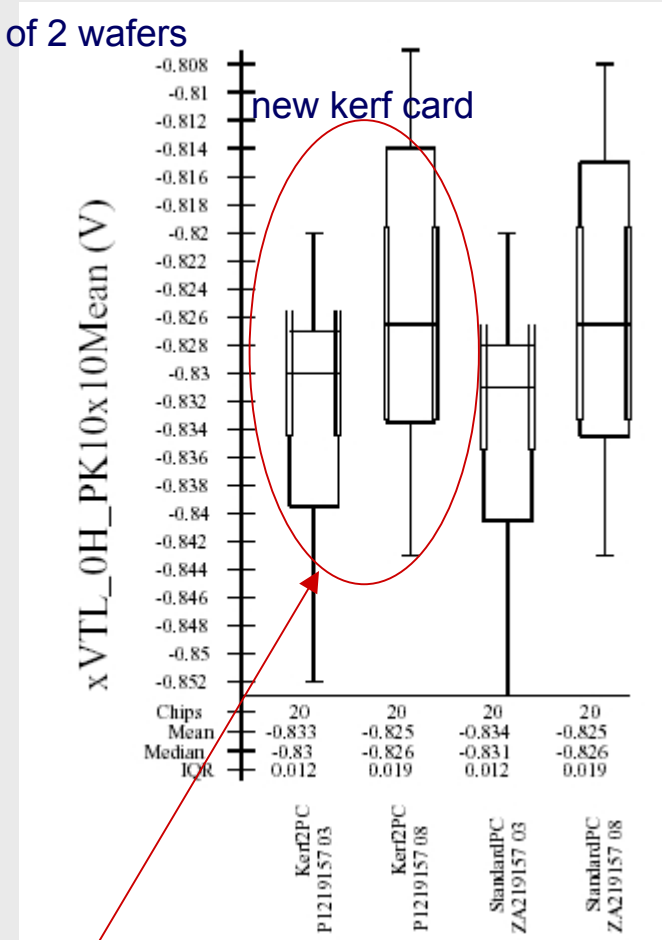
Contact resistance: lower, smaller range

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Saturation current-values: lower



measurement variation to cantilever < 1%

Results - M0 correlation

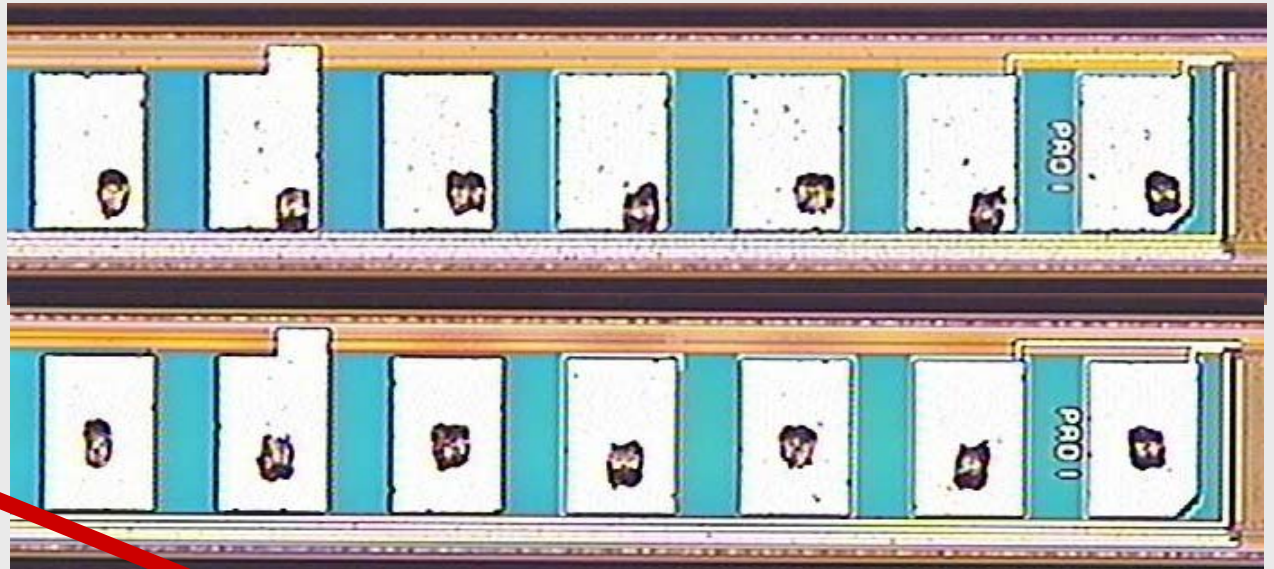
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Upgrades

hardware UF200 “cognex board”

software UF200 “pattern matching for single DUT”

before



after

temperature compensation

automatic prober alignment

prober position accuracy

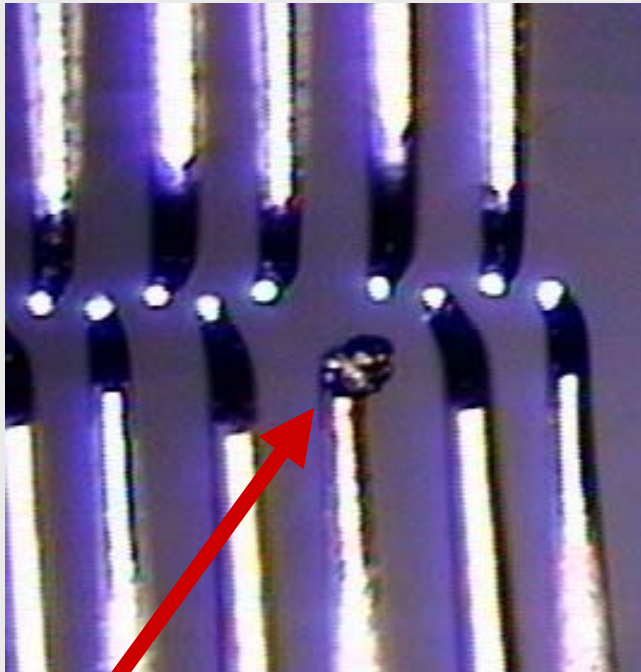
parallelism check plate to chuck

Control

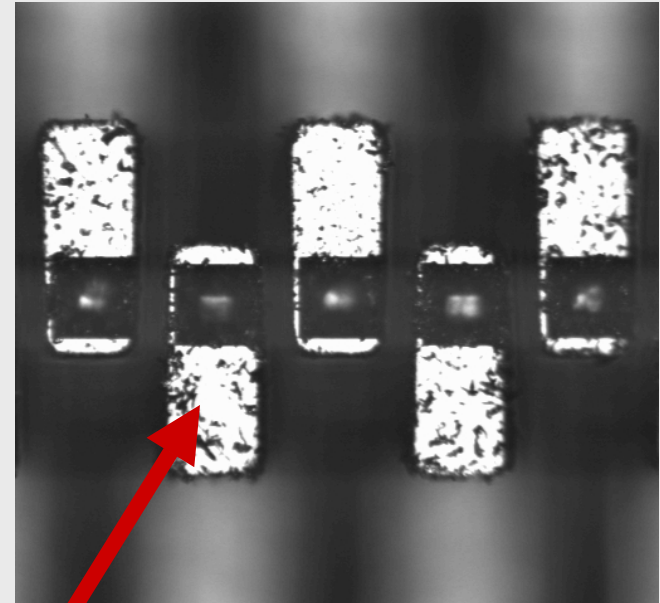
Prober issues

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Avoid burning due to hot stepping and over current!



Avoid this kind of tip contamination with cleaning optimization

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**Standardization
is a must !**



> 40 cards are running in IFX production very well

„Die Korrelation ist OK. Wie schon bei der Korrelation vor Start der FU zu sehen war, zeigt die Kerf2-NK bei einigen Leckströmen geringere Werte und hat geringeren Übergangswiderstand - ist also eher etwas besser.“

stefan.kuelbel@infineon.com

„We have been started our evaluation of our 80 μ m pitch FFI (25 springs) that we bought from HTT. The first results are quite good...“

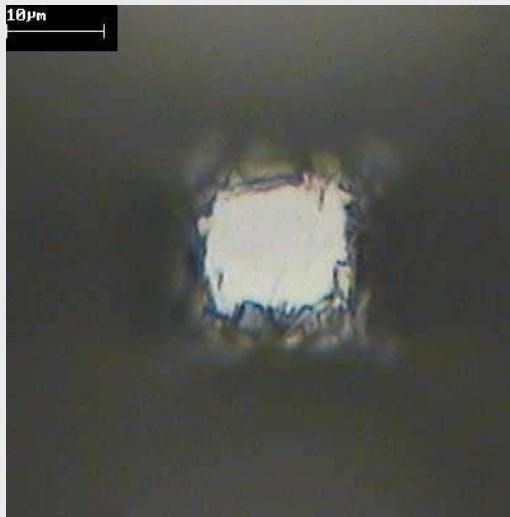
dominique.langlois@altissemiconductor.com

„I like the HTT cards much better than cantilever cards - we get fewer contact and alignment problems than in the past.“

david.lacy@infineon.com

Feedback

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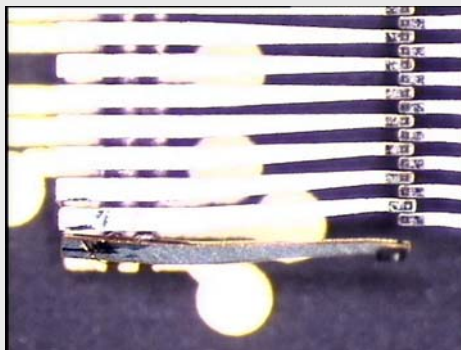
1st card is running since 16.05.2002

>200.000 Touchdowns

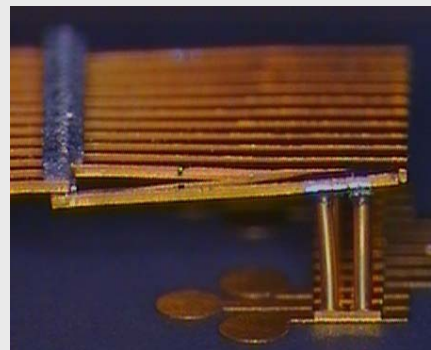
50.000 TD's on tungsten pad (M0)

=> very clean tip

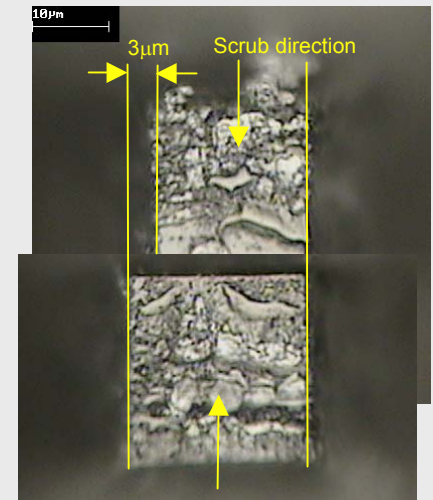
=> no changes in tip size



crash



crash

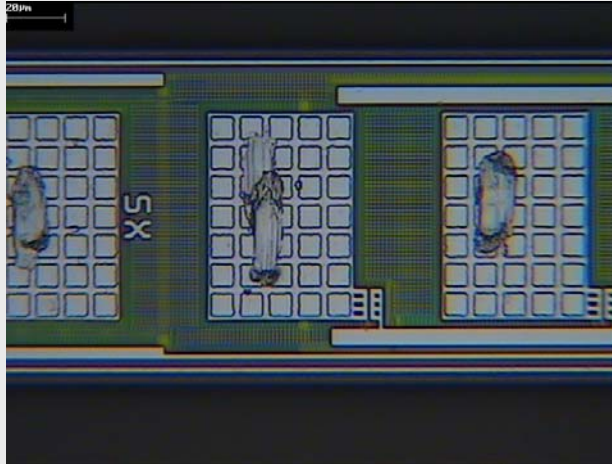


wrong cleaning

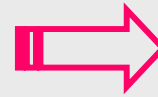
We lost 3 cards due to mishandling

Live time

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50x70 μ m



30x30 μ m

Identified challenges:

- alignment improvements
- maximum tips size for end of live
- maximum overdrive
- prober accuracy +/- 4 μ m
- start/end of scrub

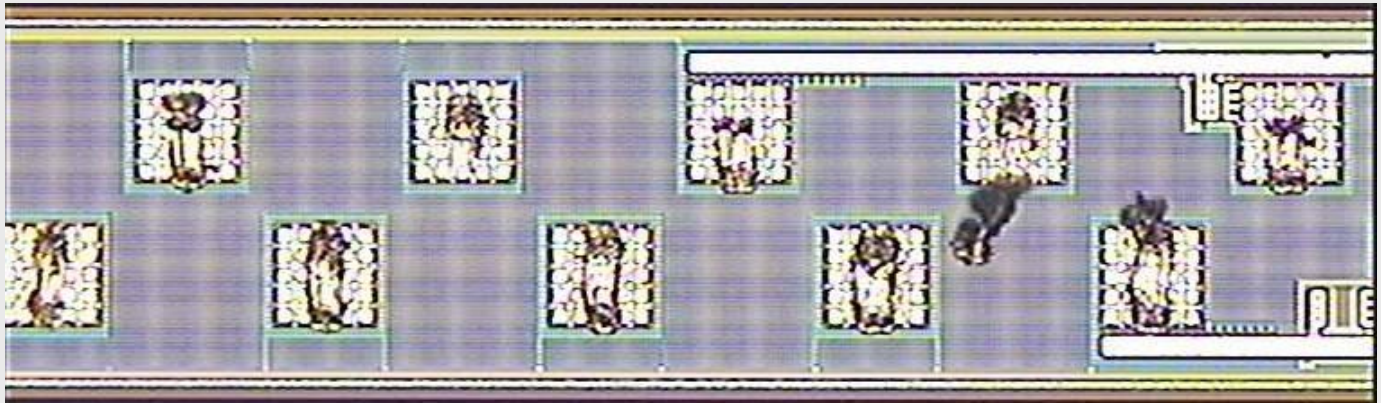
No issues:

- planarity < 10 μ m
- X/Y position accuracy
- temperature effect RT/120 $^{\circ}$ C < 0,5 μ m

**We can do 30x30 μ m pads =>
3 μ m distance to the pad edge**

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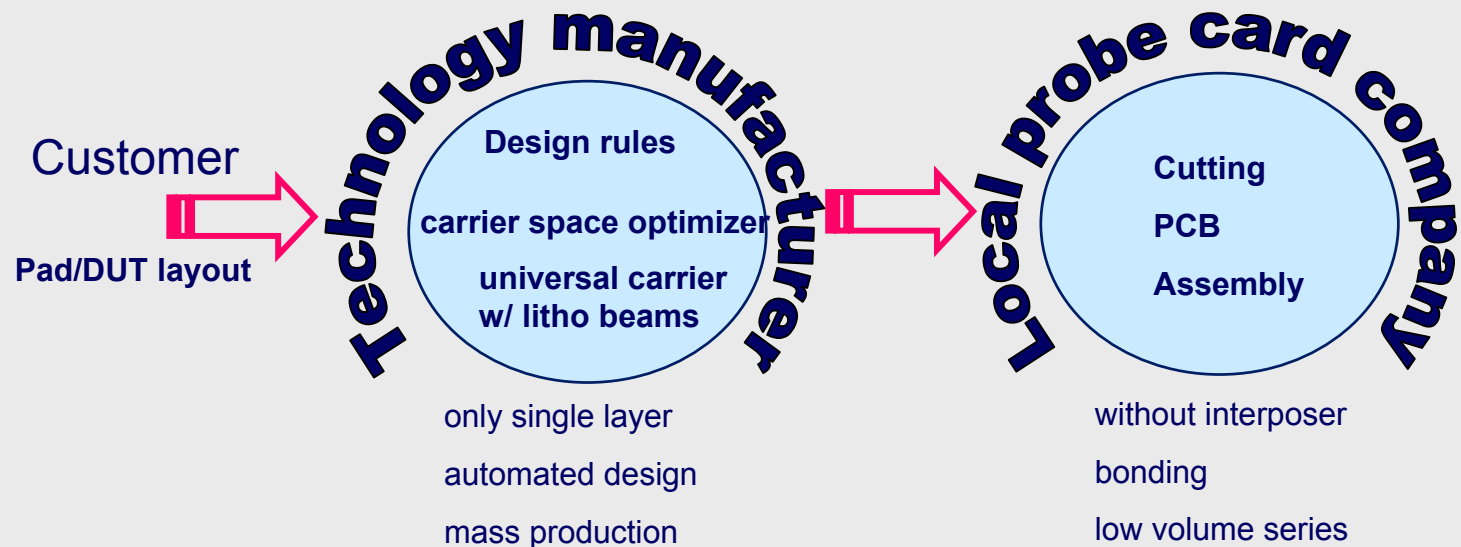
85% of the electrical parameters are correct with “Kerf card I”



Next step: improved generation “Kerf card II”

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Combine lithographic technology with handwork



Goals:

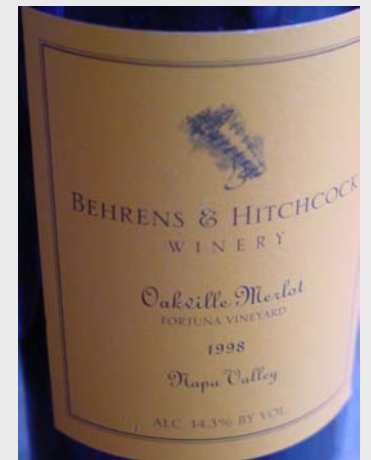
Use the benefits from the lithographic probe cards for lower pin count

Solution for 1...8 DUT probe cards

Cost reduction for design, ceramic carrier, (benchmark cantilever cost)

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- 1.) California wine-growers! Pls. create more delicious red wine for getting more great ideas.
- 2.) We are close on the way to measure 30x30 μ m pads inside the kerf in production.
- 3.) Making “advanced tech” probe cards with low pin count and acceptable costs is not a fiction
- 4.) Joint projects between vendor & costumer gives synergies and a higher development speed



presented by Swen Harder (FFI)

Conclusion



„Never stop thinking“