

IEEE SW Test Workshop

Semiconductor Wafer Test Workshop

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MicroProbe Vx-RF Probe Card Technology



Outline

- Vx-RF Technology Overview
 - Problem Statement and Requirements
 - Approach
 - Characterization Data
- Wafer-Test Results
 - Bump-probe interaction
 - Cleaning
 - Qualification Methodology and Results
- Summary and Conclusions

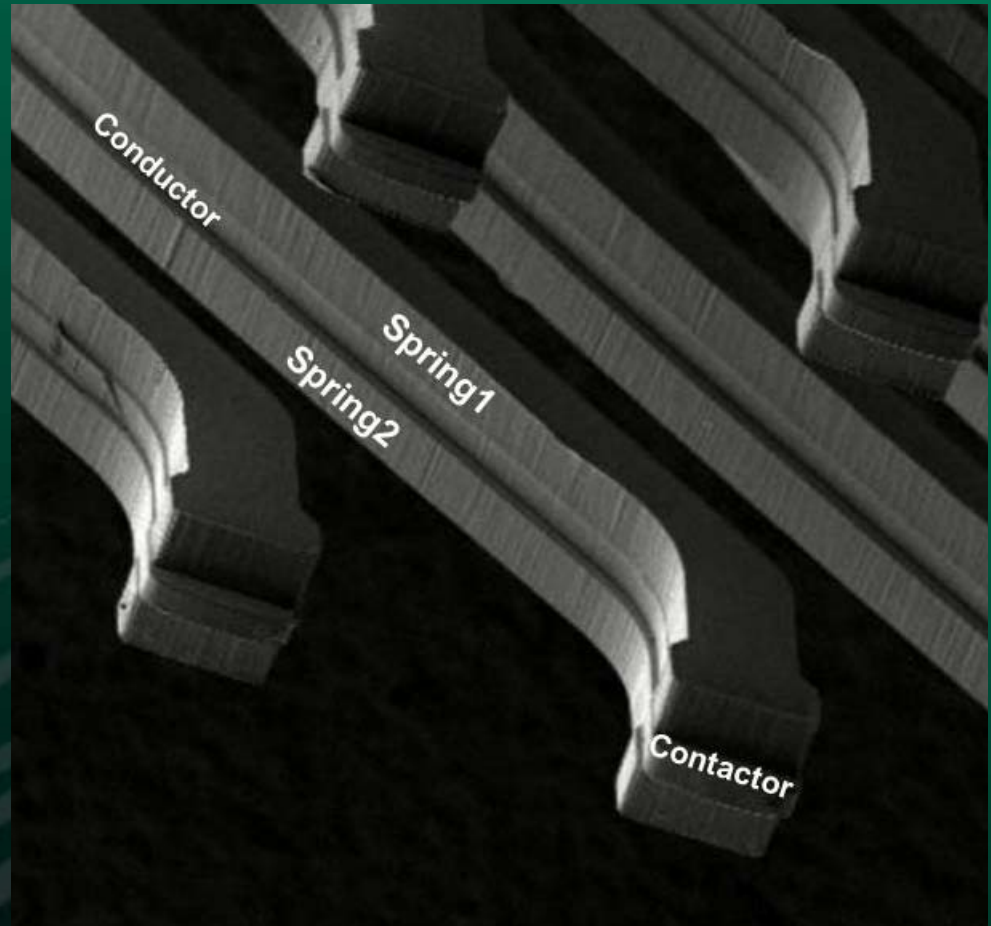
Problem Statement

- Infineon Technologies required a RF probe-card technology to provide:
 - Probing of Pb-free bumps and Al pads with same technology
 - Minimal pad/bump damage for KGD apps
 - Pitch scalability to 80um; corresponding planarity and alignment
 - Moderate pin count (< 500)
 - Moderate RF bandwidth (<6GHz)
 - Reliable and robust
- Collaboration with MicroProbe produced a production-worthy probe-card that meets all requirements

MicroProbe's MEMs-enabled Probe Architecture

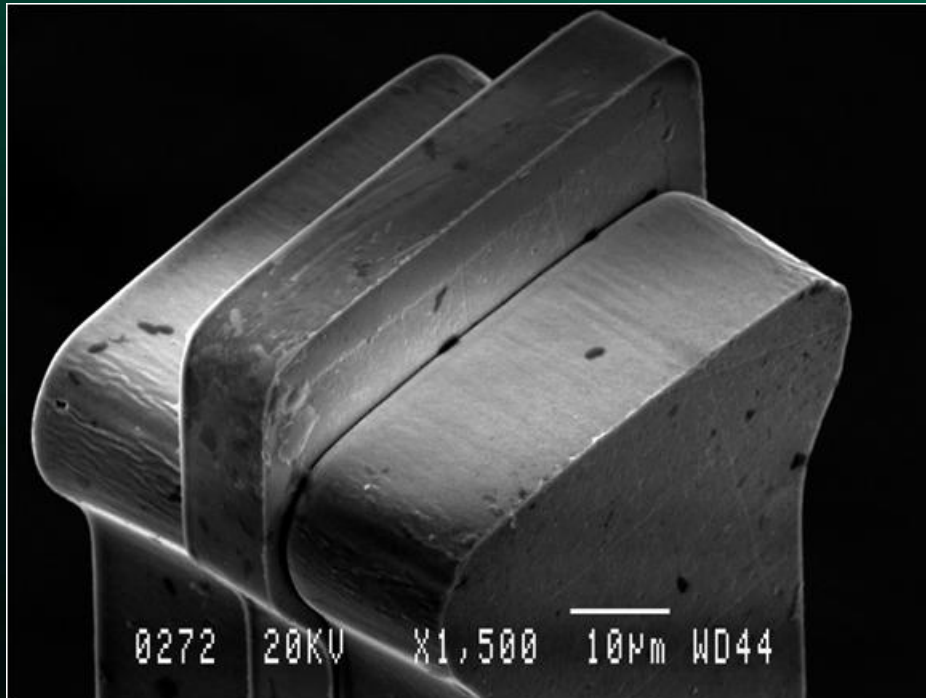
Composite structure allows optimization of both mechanical and electrical properties

- Technical approach
 - Multiple materials
 - Photolithographically defined
- Material/geometry flexibility to provide optimal mechanical and electrical performance



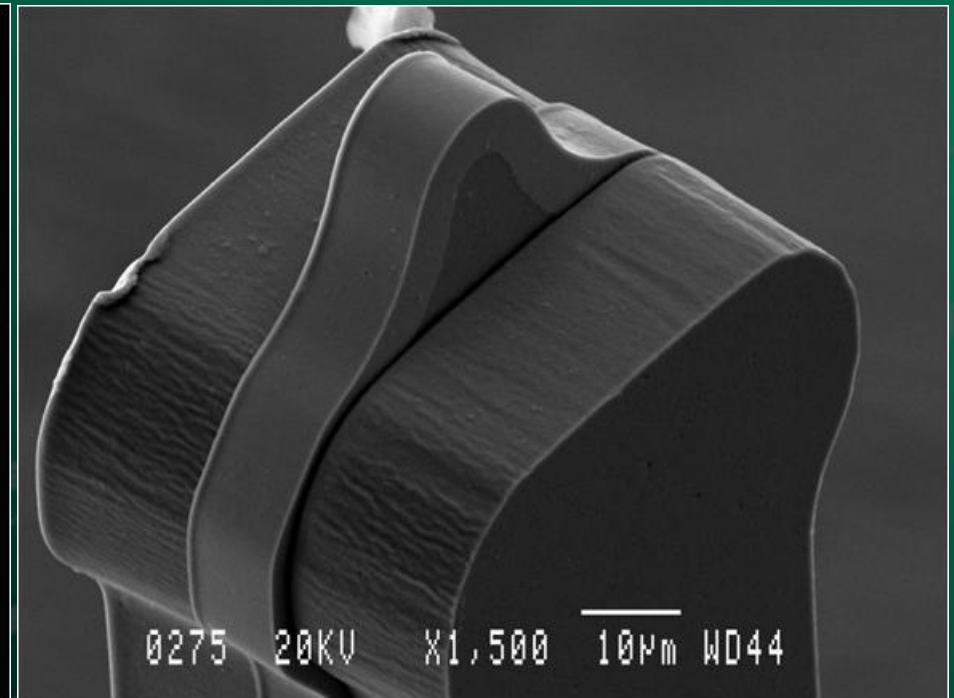
Probes selectively etched to highlight structure

Probes Optimized For Individual Applications



Flat probe

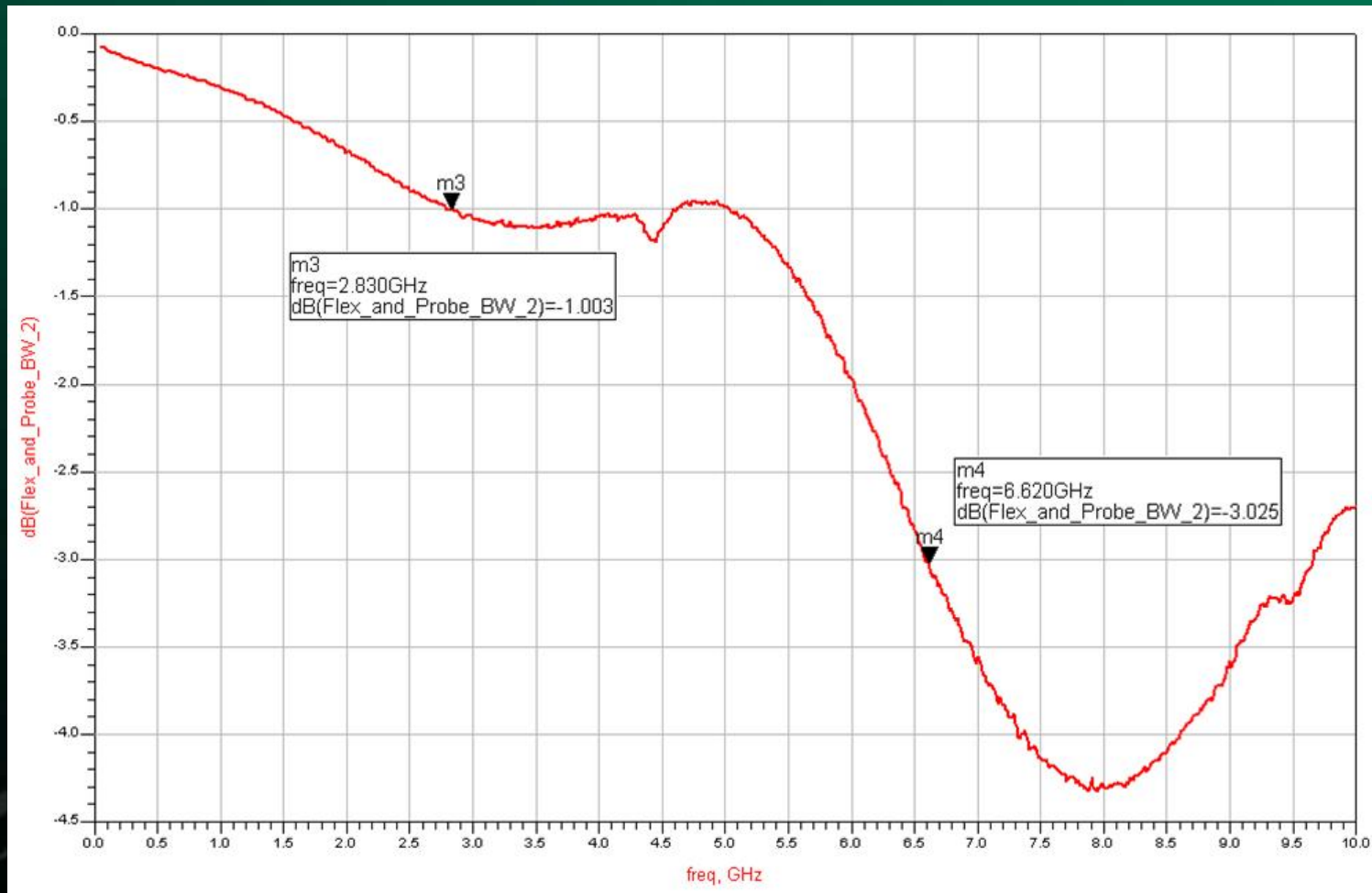
Cu Pillars, bumps, large pads



Pointed probe

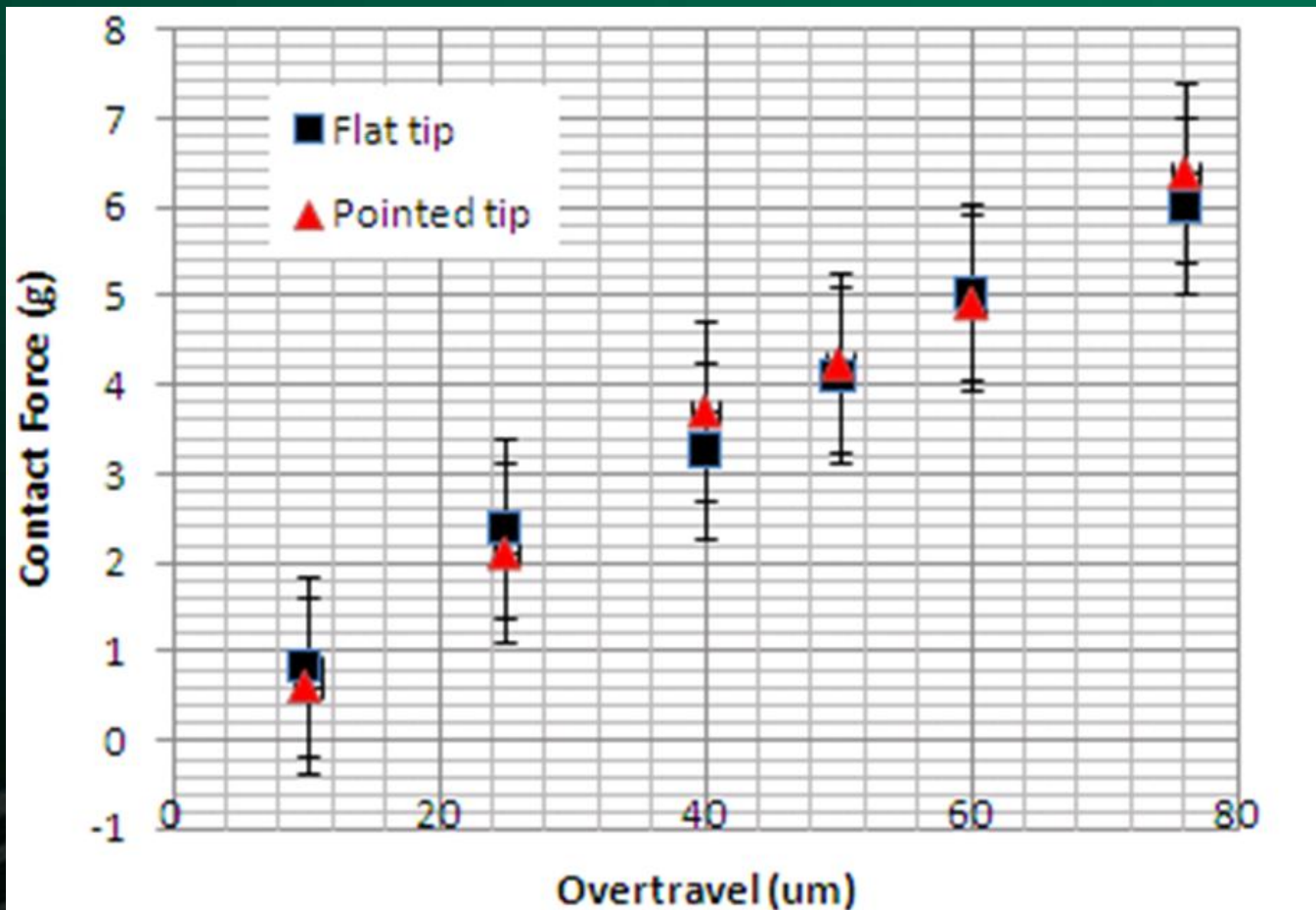
Small Pads

Vx-RF-80 Probe Head Bandwidth



-3dB @ 6.6GHz Frequency Response

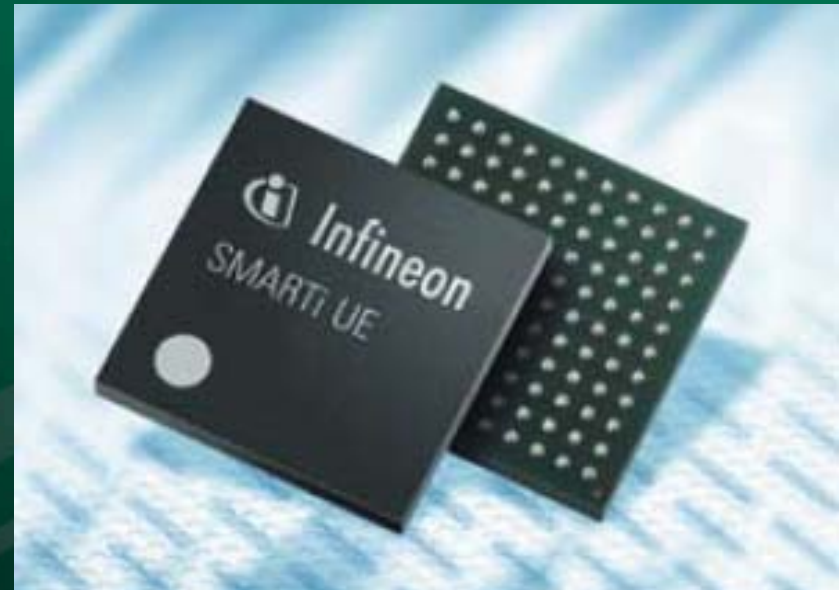
Vx-RF-80 Contact Force



Wide overtravel range with low contact force

SMARTi-UE Product Outline

- SMARTi® family - single chip CMOS transceivers Infineon is the leading supplier of standard GSM/GPRS, EDGE, and 3G/UMTS transceiver solutions.
- Applications:
 - Worldwide 3GPP UMTS / EDGE (W-EDGE) mobile handsets
 - HSDPA / HSUPA (H-EDGE) mobile data devices
 - Multi-Band UMTS
 - Quad-Band EDGE
- Test Requirements:
- Probe-after-Bump, 200µm min. pitch , full array, room temperature
- 5.0 GHz@-3.0dB, LTX Fusion-CX
- Ca. 80 pins , 1-DUT



Infineon's Probe Card Qualification Process

- Significant PC-qualification milestones
 - **PC6.1**: Probe card acceptance and verification
 - incoming check, mechanical check, heating behavior, first TD, manual stepping
 - **PC7**: Probe card engineering release
 - online cleaning, correlation (**AMSA**, see next page)
 - **PC8**: Early production release
 - early yield stability and repeatability for 5 wafers (300 dice min)
 - **PC9**: Production release
 - yield stability for 10 lots
 - **PC10**: Manufacturing release
 - yield stability for 3 months or 50 lots, 2 probe cards minimum

Advanced Measurement System Analysis

„**AMSA** is a fast and efficient tool based on Gage r&R methodology to analyze and assess test performance, identifying test instabilities (Gr&R and Bin Flips) and focusing on the impact on yield of the measurement process (C_{gk}) vs manufacturing process (C_{pk})“

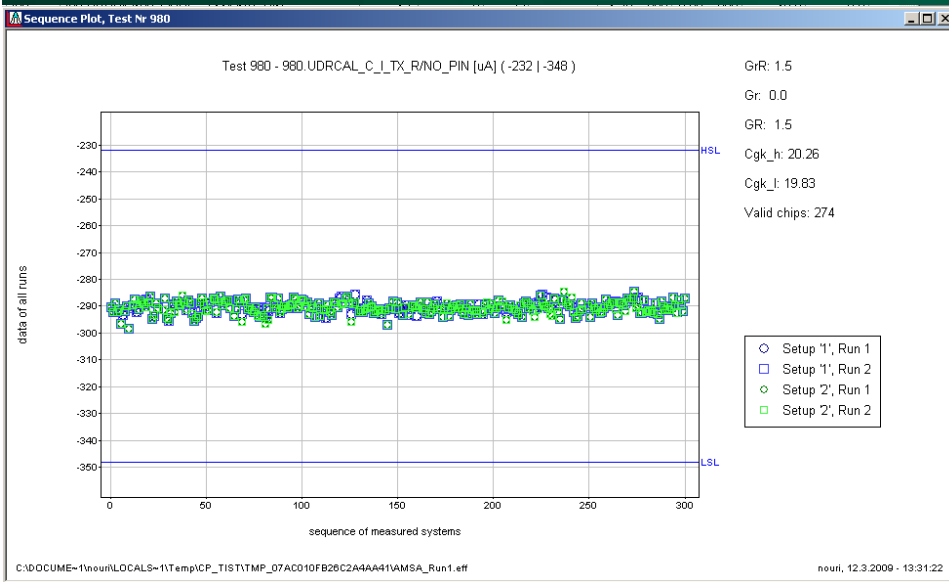
- **When to use AMSA:**

A regular Gr&R, whenever ...

- the product is transferred into production (test package transfer)
- **a novel test equipment (e.g. probe cards) is introduced**
- a transfer from existing to new test site location

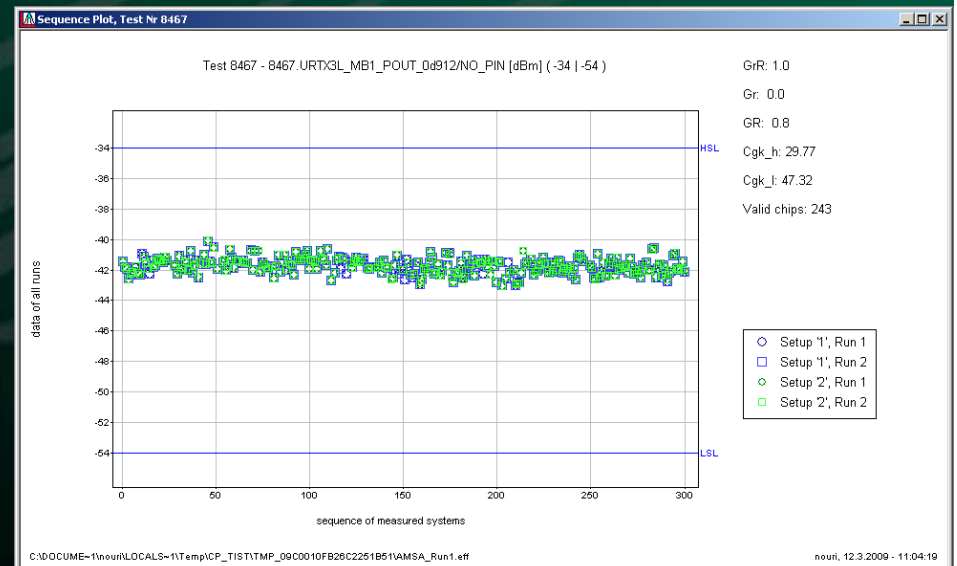
Smarti UE

Critical Tests vs. 300 samples



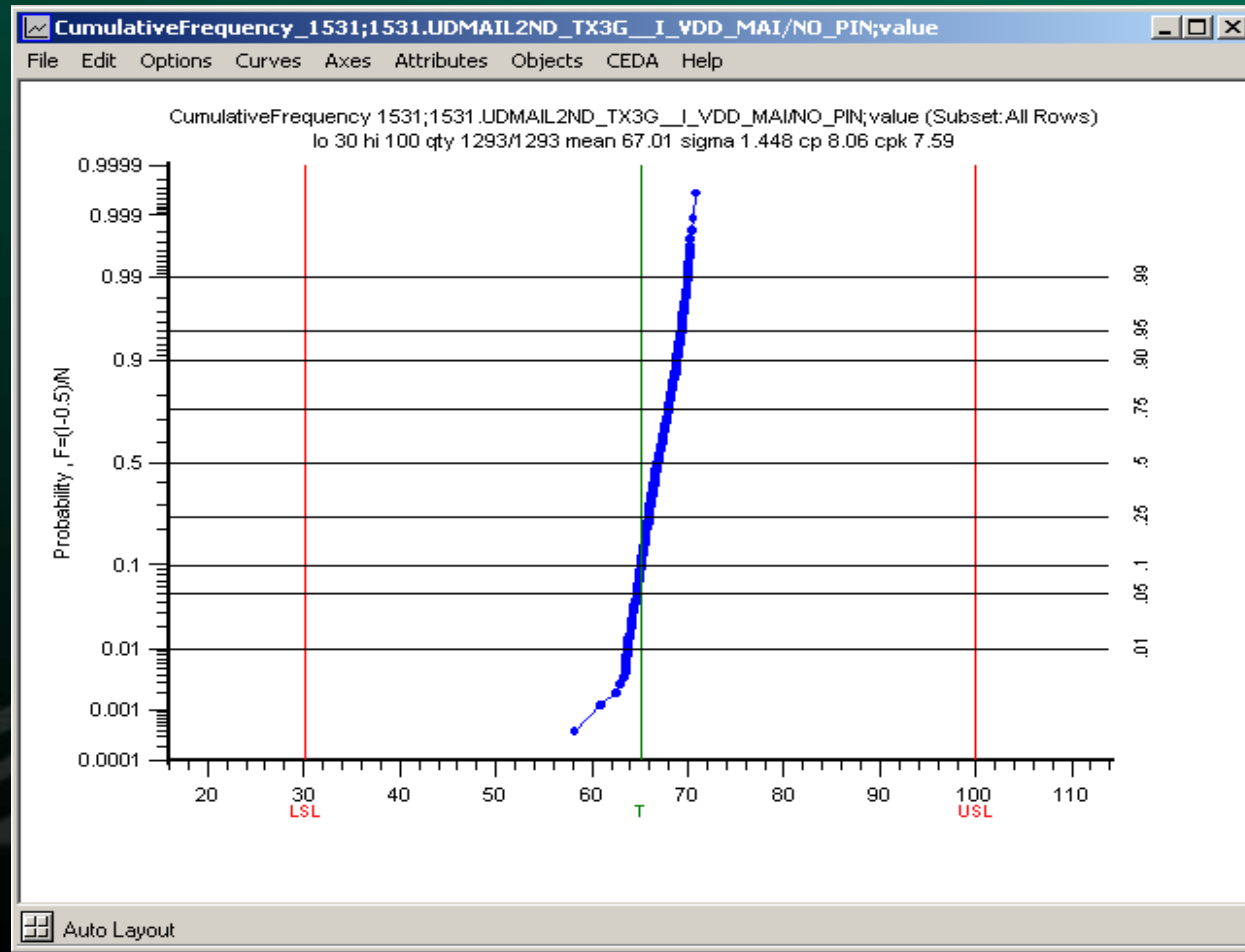
Tx - Pout

Cres Sensitivity



Smarti UE

Full Wafer, Tx_current



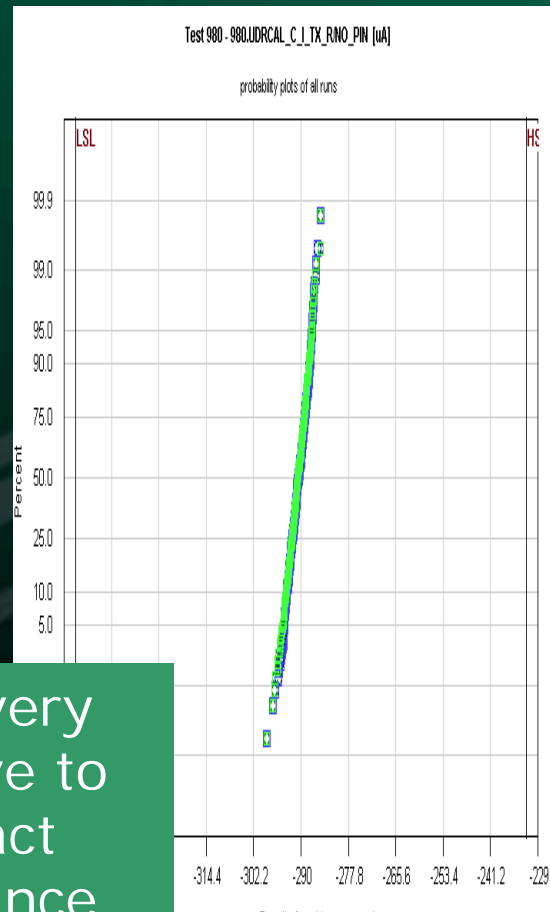
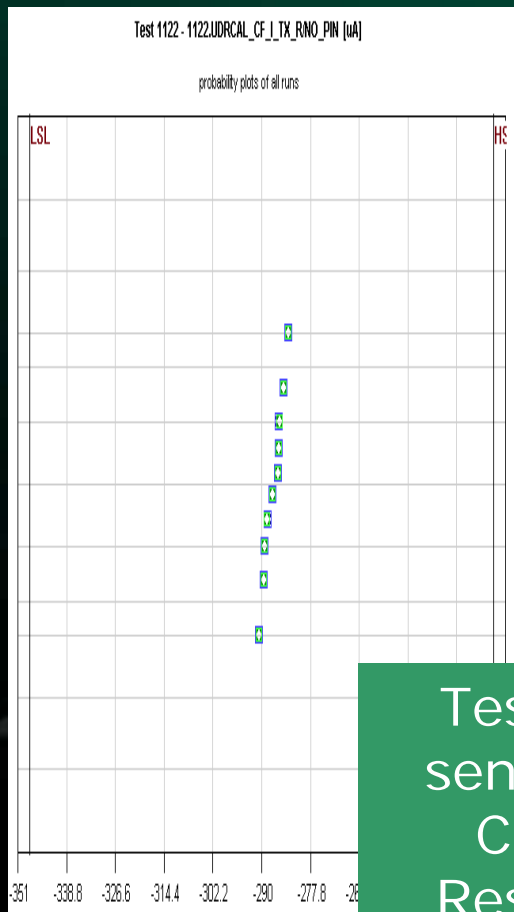
June 7 to 10, 2009

IEEE SW Test Workshop

Smarti UE Comparison (I_TX)

Package Test

Vx-RF-80



Tests very
sensitive to
Contact
Resistance

Same
performance
for wafer and
package test

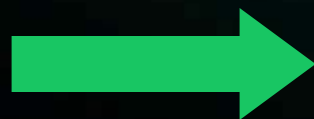
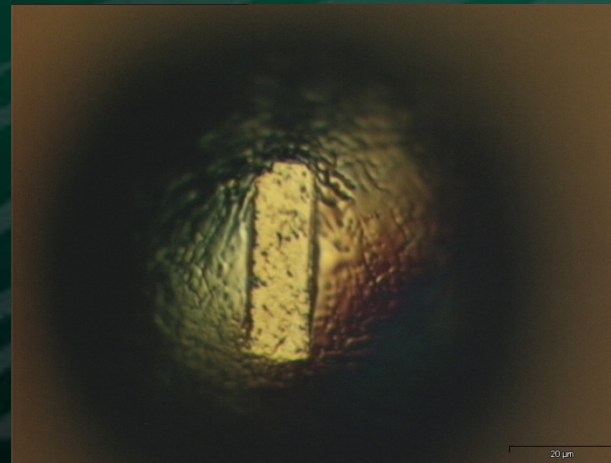
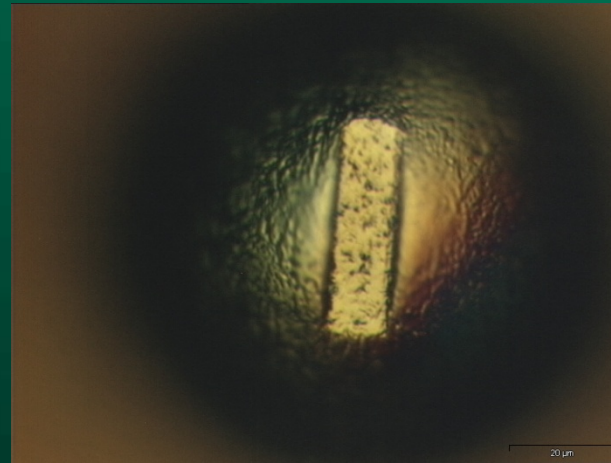
AMSA Qualification Results

- Excellent performance
 - RF-characteristics up to 6GHz
 - High repeatability (GrR > 98%)
 - Stable contact quality
 - Low contact resistance

Minimal Bump Damage



65 μ m OD
No xy-offset
5x multiple-TD

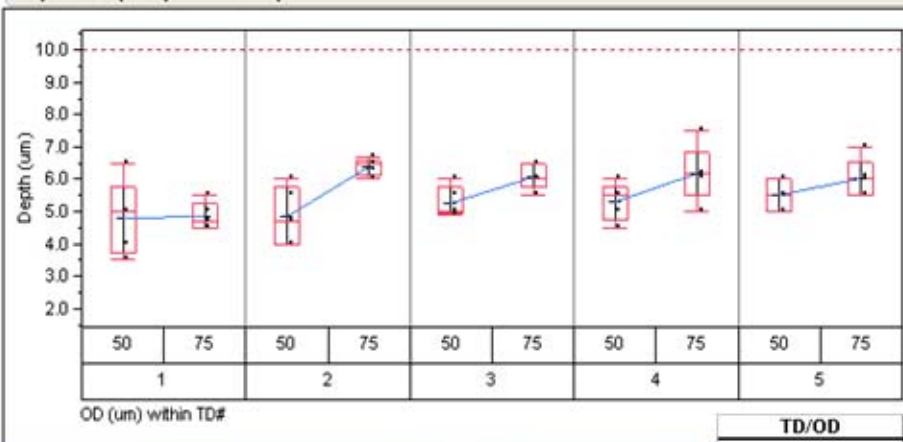


Bump imprint depth < 10 μ m

Qualification Results Bump Imprint Depth

Scrub Depth on Bump

Imprint Gap Depth on Bump



Depth

TD/OD	Mean	Std Dev	Min	Max	Range
TD#1 OD (um)[50]	4.8	1.151086	3.5	6.5	3
TD#1 OD (um)[75]	4.84	0.4219	4.5	5.5	1
TD#2 OD (um)[50]	4.84	0.896103	4	6	2
TD#2 OD (um)[75]	6.4	0.264575	6	6.7	0.7
TD#3 OD (um)[50]	5.28	0.465833	4.9	6	1.1
TD#3 OD (um)[75]	6.1	0.41833	5.5	6.5	1
TD#4 OD (um)[50]	5.3	0.570088	4.5	6	1.5
TD#4 OD (um)[75]	6.18	0.889944	5	7.5	2.5
TD#5 OD (um)[50]	5.5	0.5	5	6	1
TD#5 OD (um)[75]	6.02	0.614003	5.5	7	1.5

- For touchdown 4 and OD 50um, the depth is about 5.3um

Meets Infineon's bump damage requirements

Cleaning

- Media: ITS 1um AlO2 lapping Film
- Frequency every 1/250 - 1/750 TD
- Deflection during Cleaning = 20um
- Cleaning TD's = 10

Summary

- Vx-RF-80 uses MicroProbe's MEMs technology to provide a robust probe card for RF at-speed wafer sort
- Infineon Qualification Results:
 - Electrical performance: pass
 - Repeatability: pass
 - Bump damage: pass
- Next steps: Transfer to volume production