

Fine Pitch P4 Probe Cards

P*hotolithographic*

P*attern*

P*lating*

P*rocess*

June 1998

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 **MITSUBISHI MATERIALS CORPORATION**

Sanda Plant

Contents

- What is a P4 probe card?
- Specification
- Some test results
- Tip cleaning
- RF performance

SANDA PLANT SUMMARY

Employees 311 (As of Feb. 1st 1998)

Site Area 33,000m²

Products

Probe Cards

Gold Bonding Wire

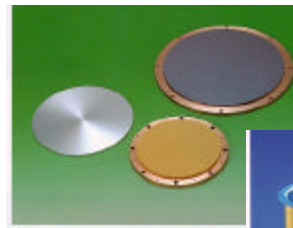
Sputtering Targets

Precious Metal

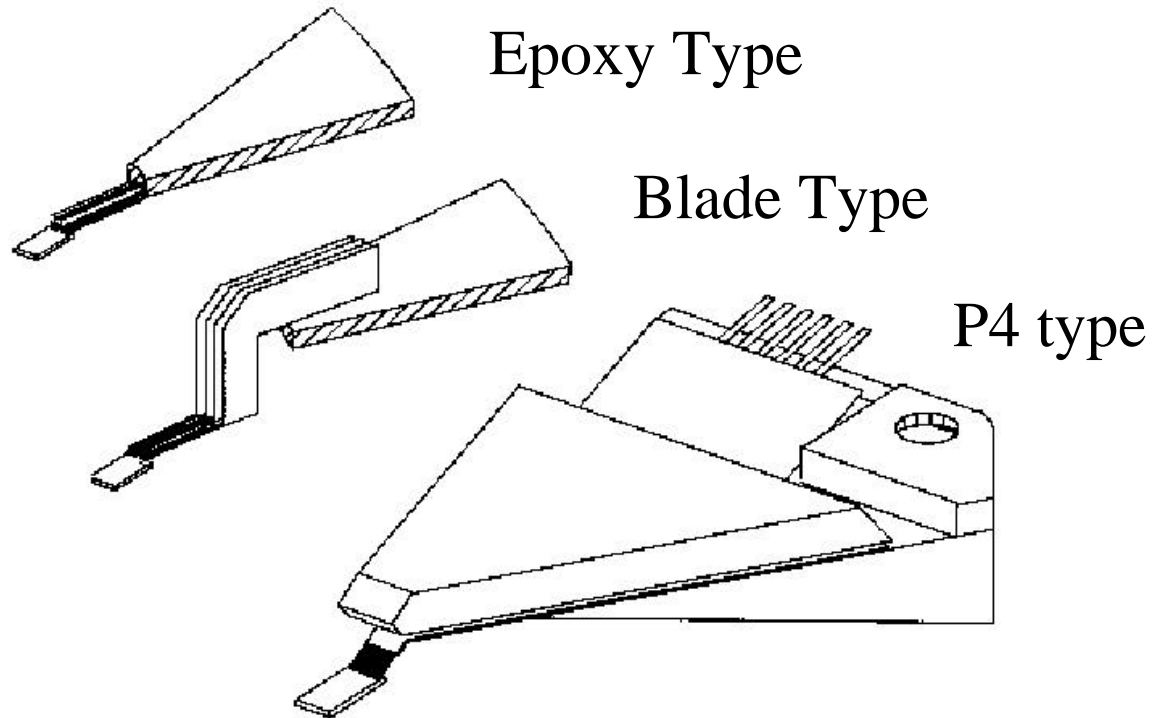
Fine Rolled Materials

Precious Metals Clay

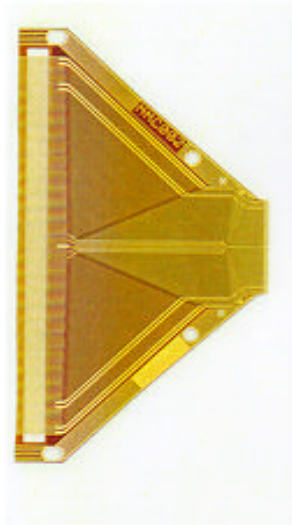
Ornament Materials



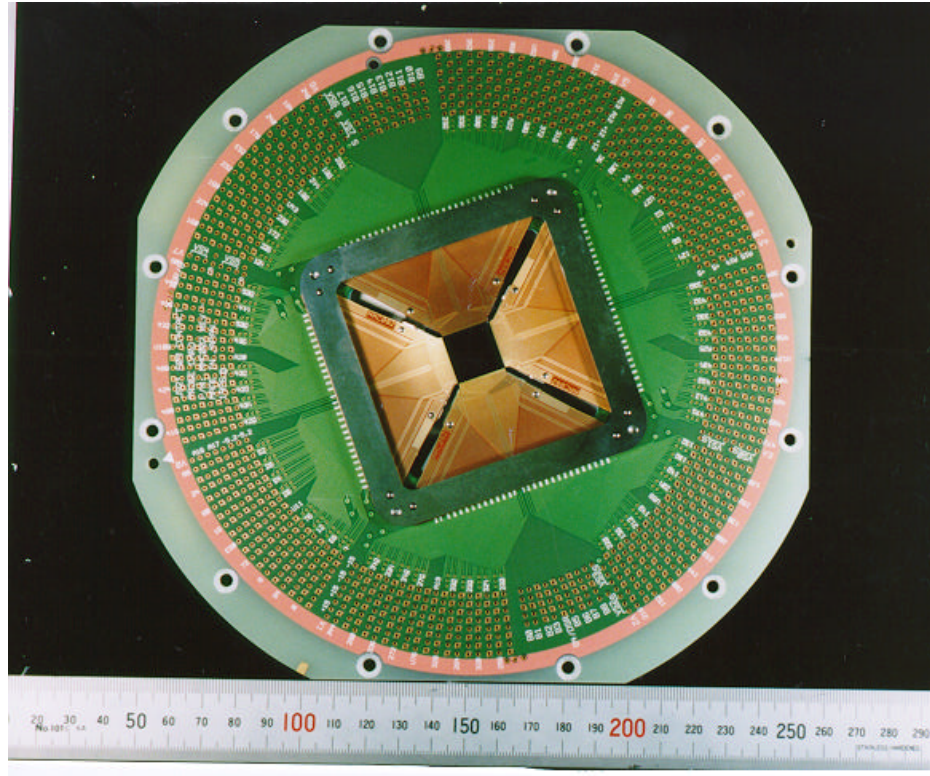
Drawing of each Contact Method



Picture of P4 Flex and P4 Probe Card



P4 Flex



P4 Probe Card

P4 Probe Card Properties

(Photolithographic Pattern Plating Process)

1. **Ni Alloy** probe by Plating Process
2. For Fine Pitch (<50 micron **Min. 40 micron**)
and High Pin Counts (>1000 pins)
3. Scrub Contact
4. Impedance Matching by **Microstrip Structure**
5. High RF Performance
6. Easy Maintenance

Properties of Each Probe Material

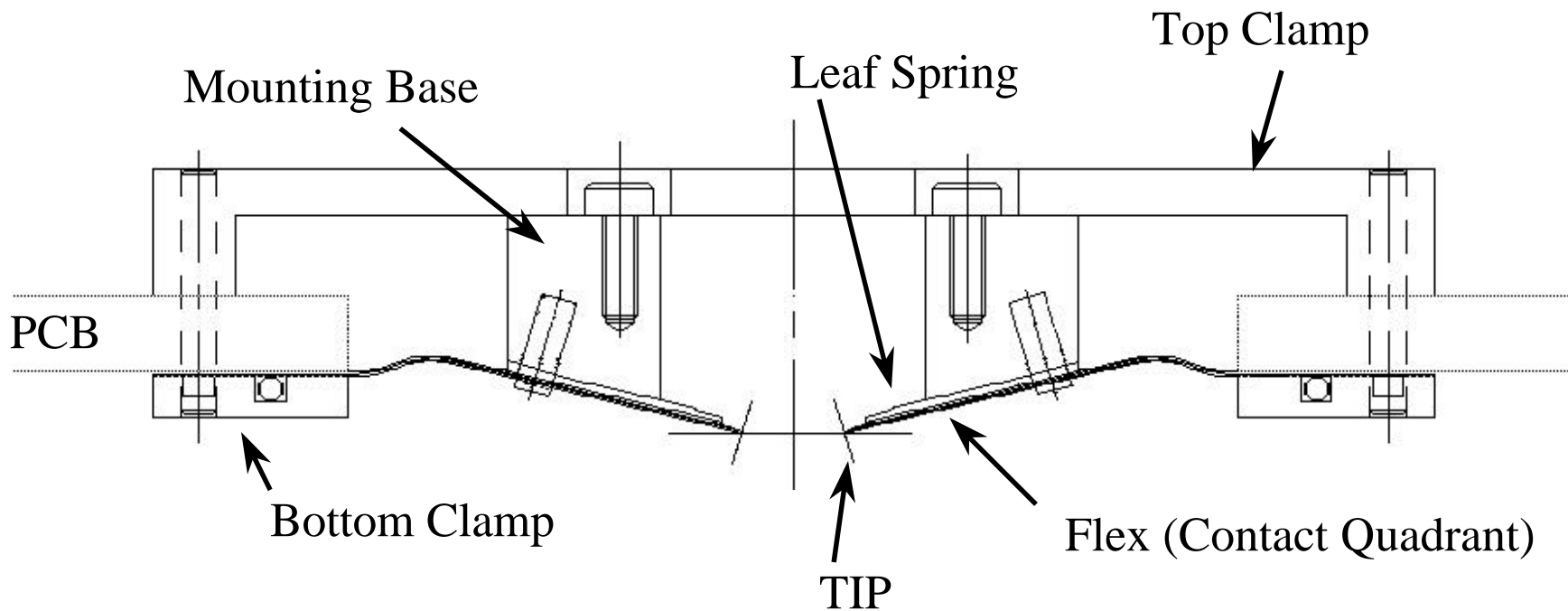
	Ni	W	Cu-Be(C17200)
Electrical Resistance $\mu \Omega * \text{cm}$	6.844	5.4	9.85
Heat Conductivity $\text{W m}^{-1} * \text{K}^{-1}$	88	167	84
Specific Heat $\text{J/Kg} * \text{K}$	435	134	419
Density g/ cm^3	8.9	19.3	8.25
Young Modulus $\times 10^{11} \text{Pa}$	2.05	4.03	1.27
Poisson's Ratio	0.3	0.284	0.345
Heat Expansion Coefficient $10^{-6} / \text{K}$	13.3	4.5	17
Hardness Hv	280-350	550-700	250-400

Fine Pitch Probing

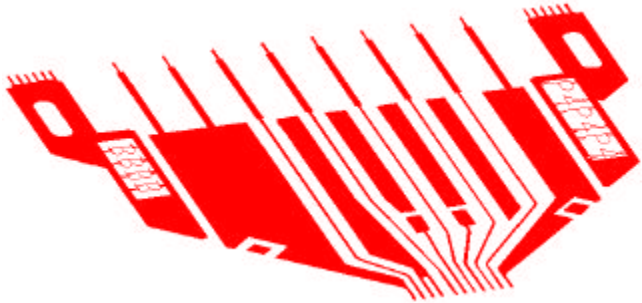
*What are some of the difficulties
to achieve a pitch of 45 microns?*

- Manufacturing
- Alignment
- Contact Force

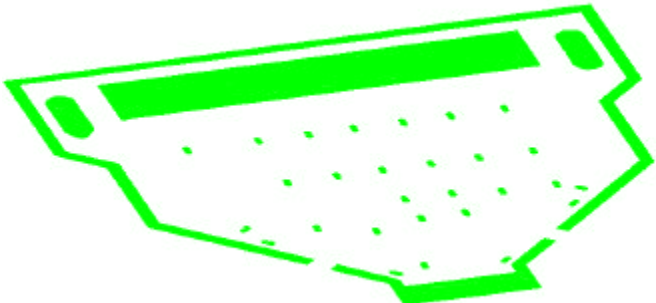
Mechanical Structure of a P4 Probe Card



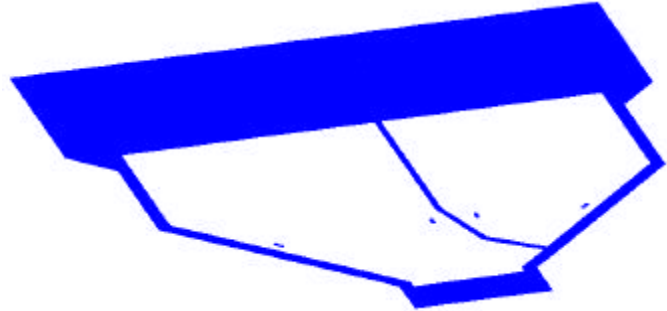
Assembly Drawing of a 3 Layer Flex



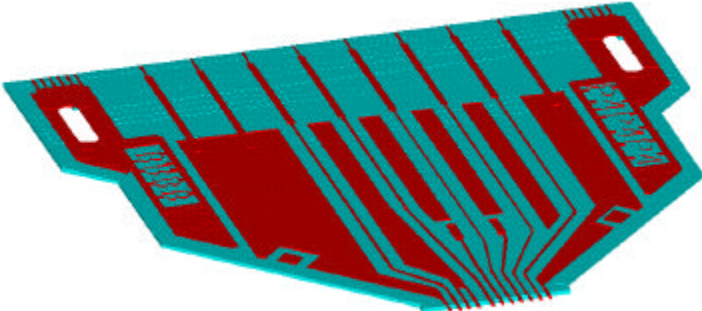
CONTACT LAYER
(Pattern Plated)
Ni Alloy



GROUND LAYER WITH DIELECTRIC
(Print and Etch)
Cu

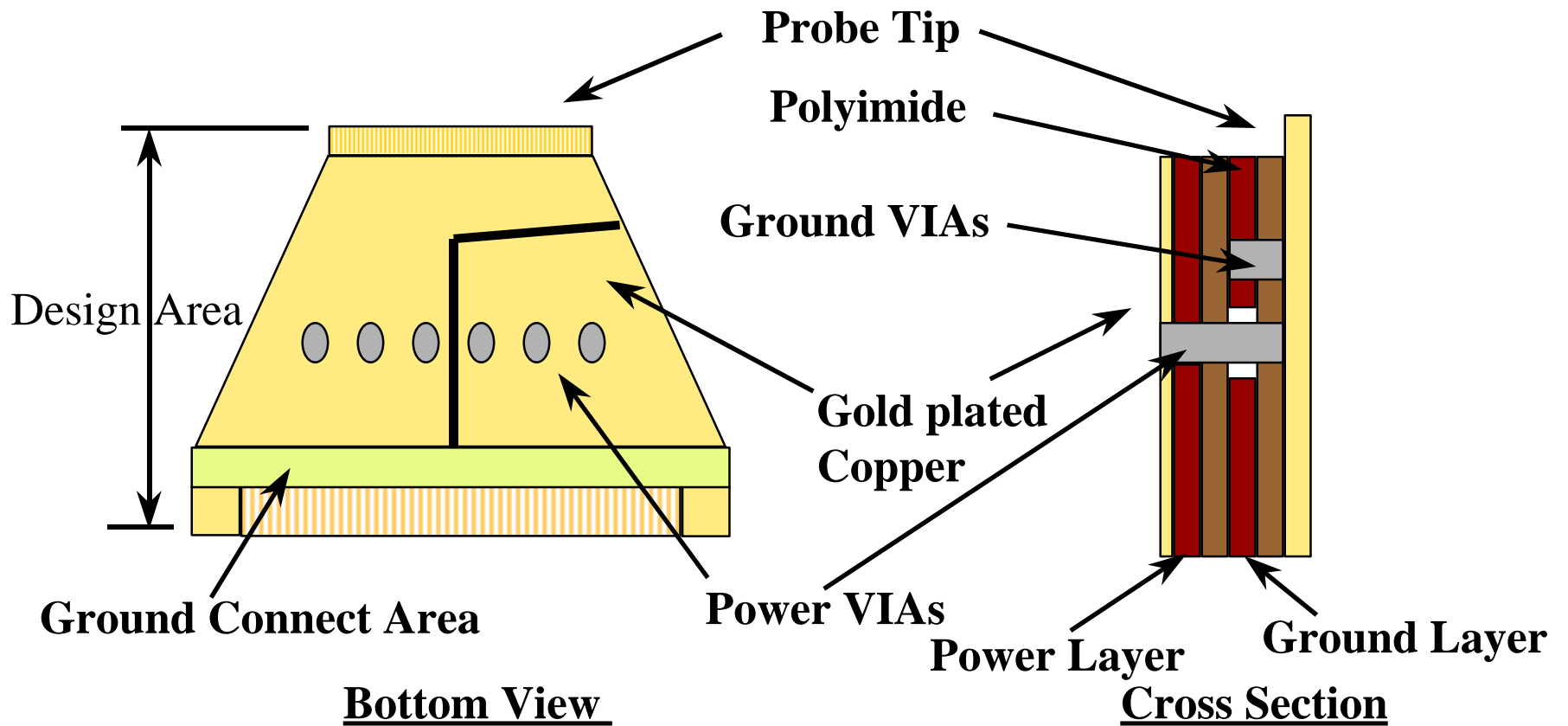


POWER LAYER WITH DIELECTRIC
(Print and Etch)
Cu / Ni + Au

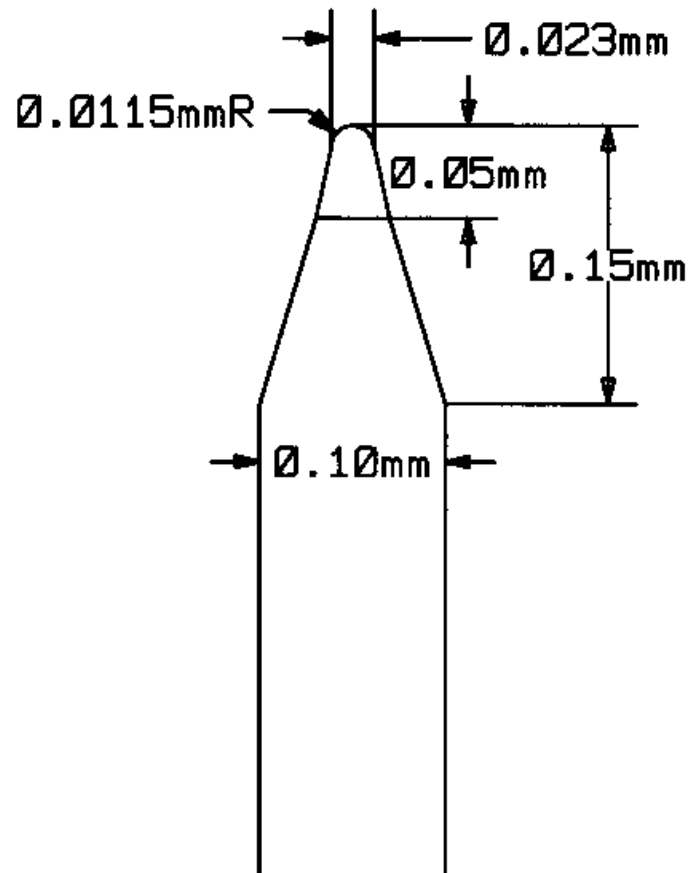


LAMINATED CONTACT SET

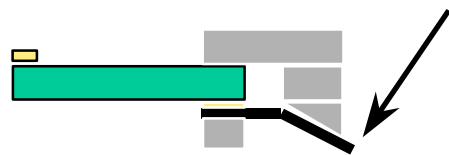
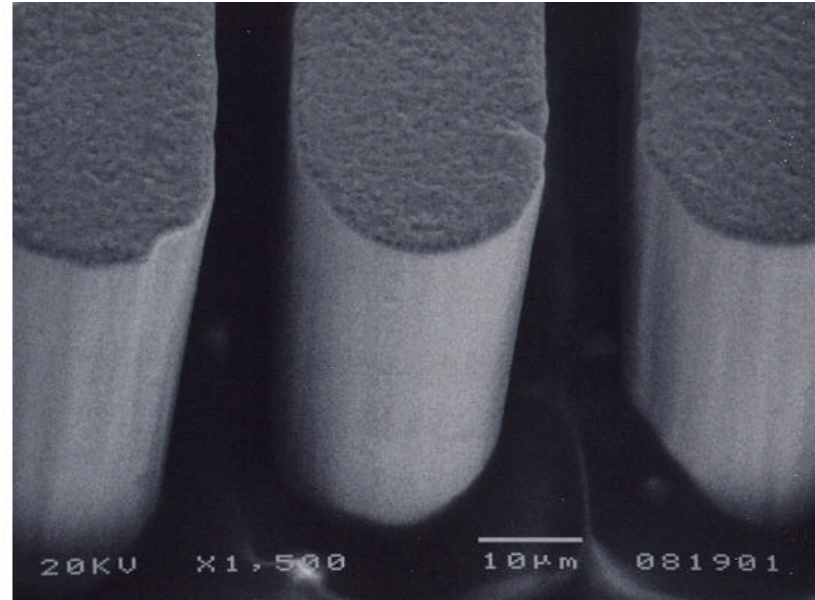
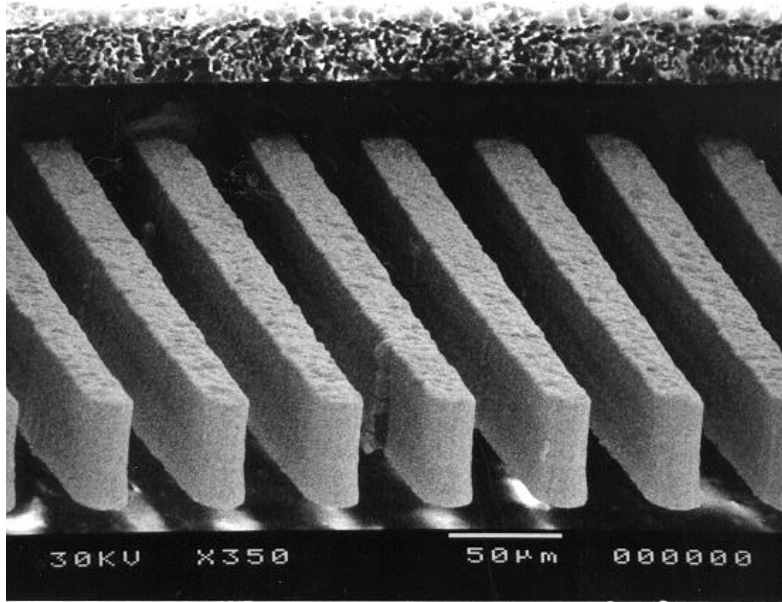
The structure of a P4 probe (Flex)



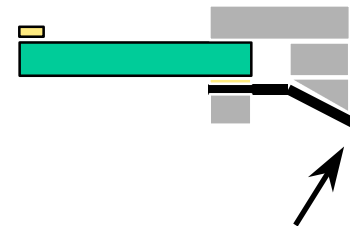
Example Shape of a P4 probe Tip



SEM Photograph of P4 Tips



Top View



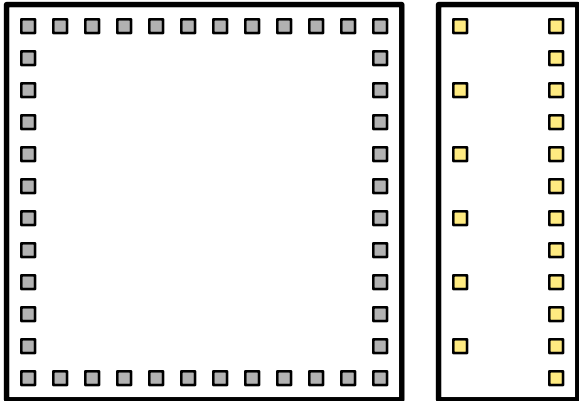
Contact Side

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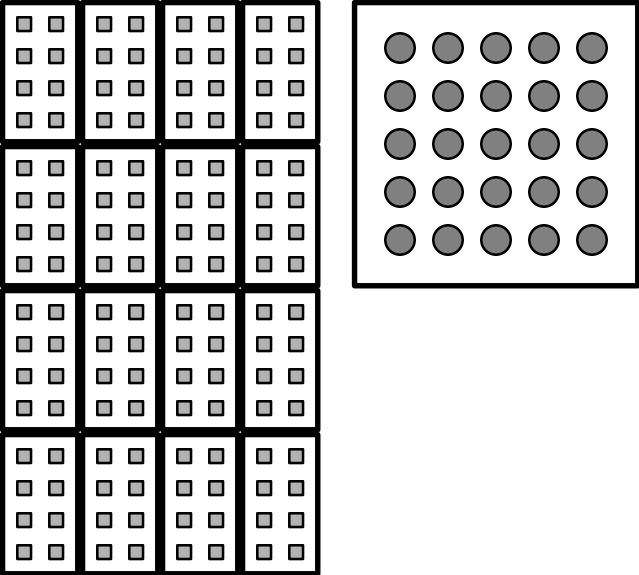
Applications for P4 Probe Cards

• *P4 is available for:*



Fine Pitch LOGIC
Fine Pitch LDI (LCD Driver IC)
For Al Pads, Au Bumps

• *P4 started on*



Multi Chip Memory
Area Bump (Solder Bumps)

Standard Specifications of P4 Probe Cards

- Mechanical Properties

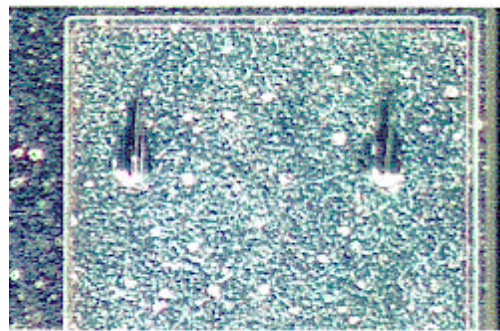
- 1) **Overdrive : 50 - 100 micron (2.0-4.0mil)**
(Max. 150 micron (6.0mil))
- 2) **Scrub Length : 20 - 25 micron (0.8-1.0 mil)**
- 3) **Flex Precision : +/- 5 micron (0.2mil)**
- 4) **XY Position : +/- 10 micron (0.4mil)**
- 5) **Z Position : < 20 micron (0.8mil)**
- 6) **Distance between Tip and PCB : >3.0mm (0.12inch)**
- 7) **Thickness of PC : PCB Thickness +15mm(0.6 inch)**

Standard Specifications of P4 Probe Cards-2

Electrical Properties

- 1) **Contact Resistance** : **< 0.5 Ohm**
(Circuit Resistance Not Included)
- 2) **Isolated Resistance** : **> 100M Ohm**
- 3) **Maximum Current** : **250 mA**
(100 micron pitch, 20sec.)
- 4) **High Frequency** : **50 Ohm Impedance Matching**
by Microstrip Structure

The Scrub Marks on Al Pad



Scrub
Direction



20 μ m



Scrub
Direction

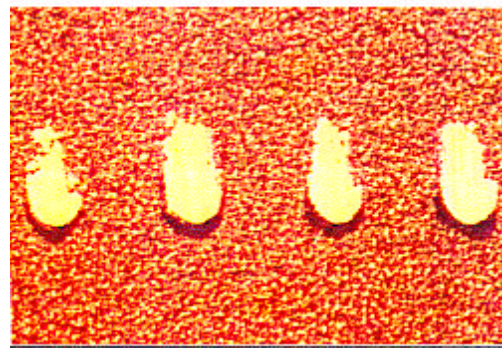


10 μ m

The Scrub Marks on Al Pad (70 micron pitch probe)

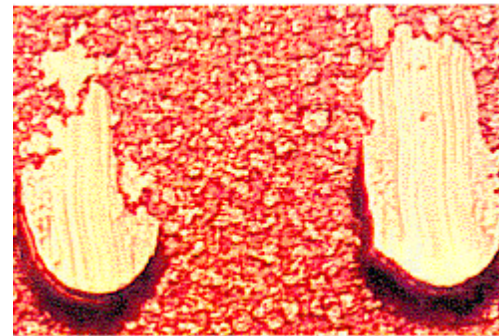
- Overdrive 100 micron
- Probe Angle 20°

The Scrub Marks on Au Pad



25 μ m

Scrub
Direction



10 μ m

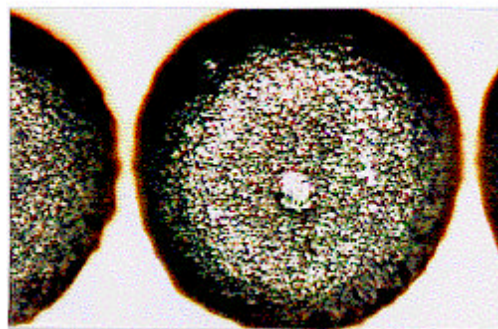
Scrub
Direction



The Scrub Marks on Au Pad (45 micron pitch probe)

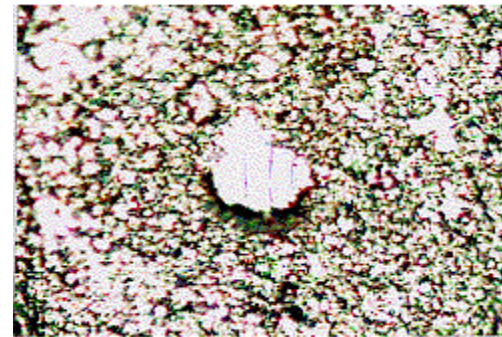
- Overdrive 100 micron
- Probe Angle 20°

The Scrub Mark on Solder Bump



50 μm

Scrub
Direction



20 μm

Scrub
Direction



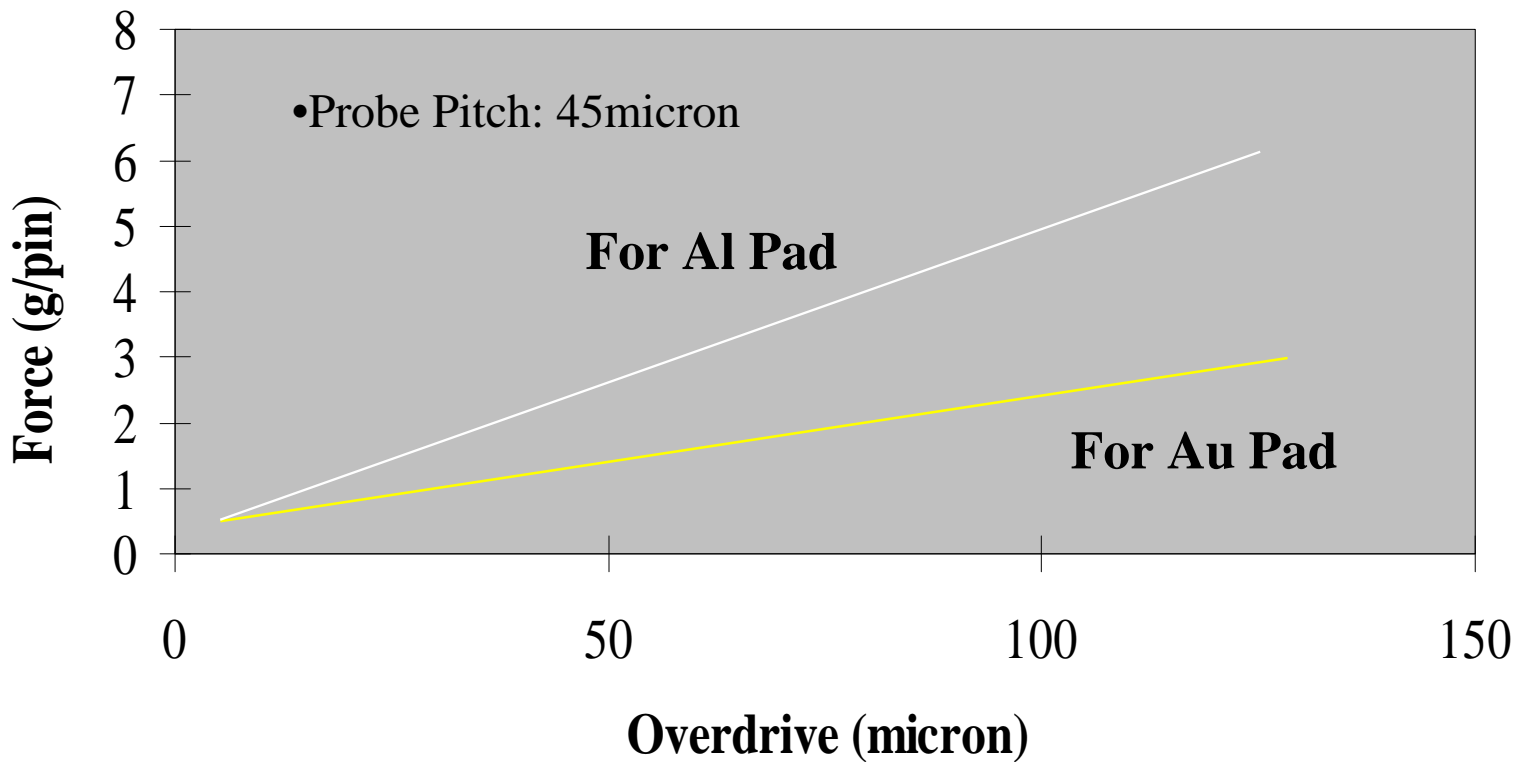
The Scrub Mark on Solder Bump (65 micron pitch probe)
(Sn:63% ; Pb37%)

- Overdrive 100 micron
- Probe Angle 20°

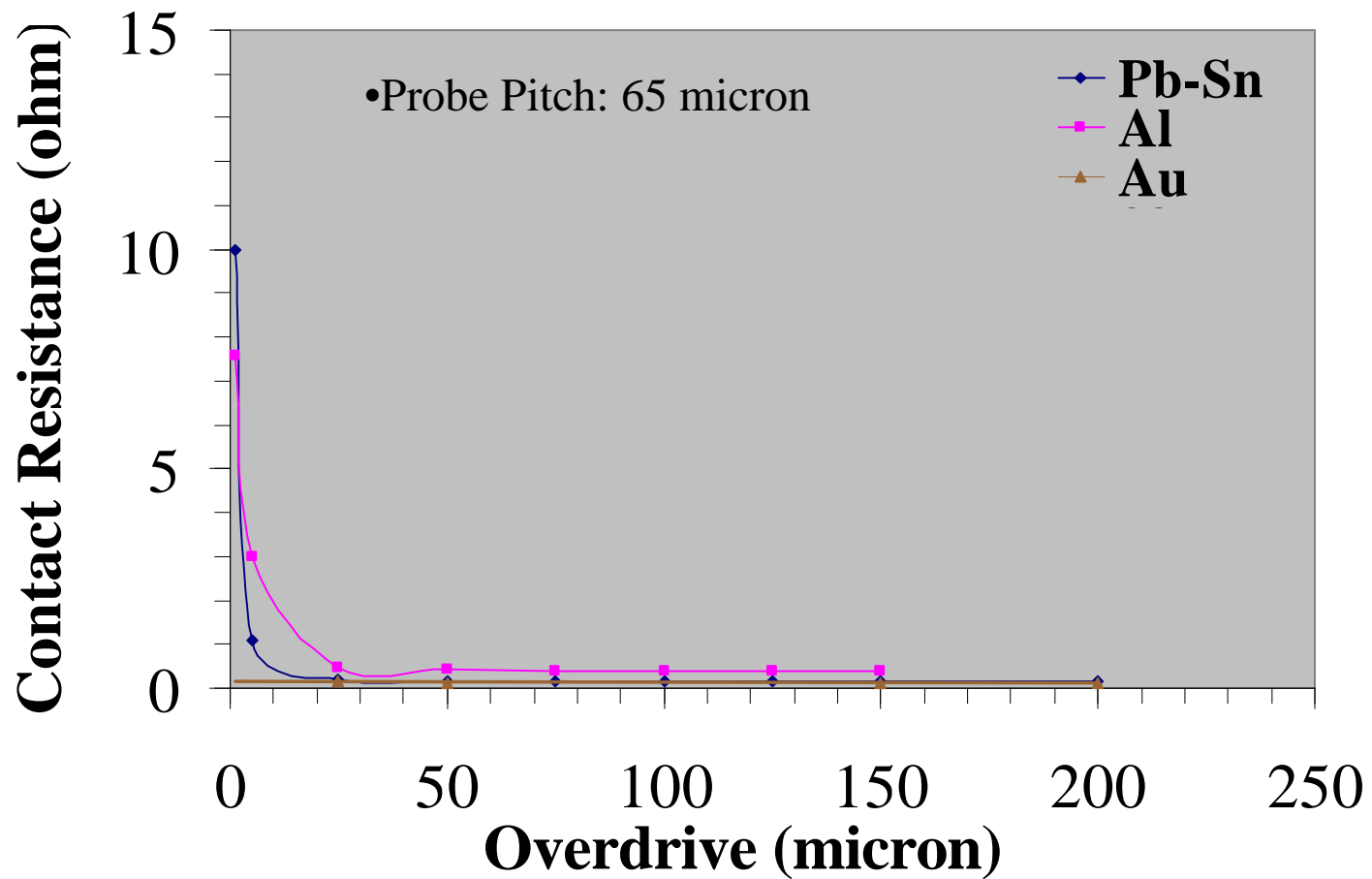
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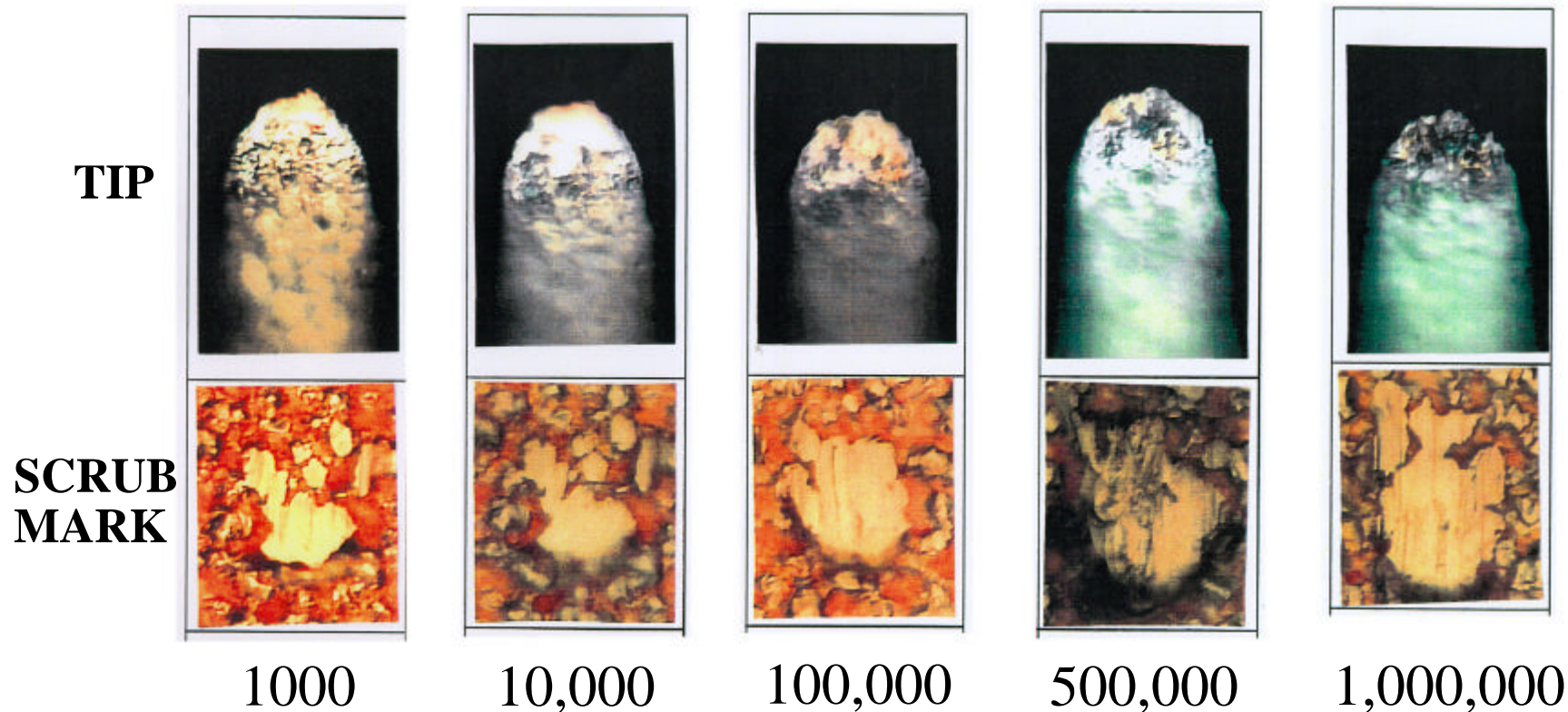
The Relationship between Force and Overdrive



The Relationship between Contact Resistance and Overdrive



Tip and Scrub Mark after Contact Test to Au



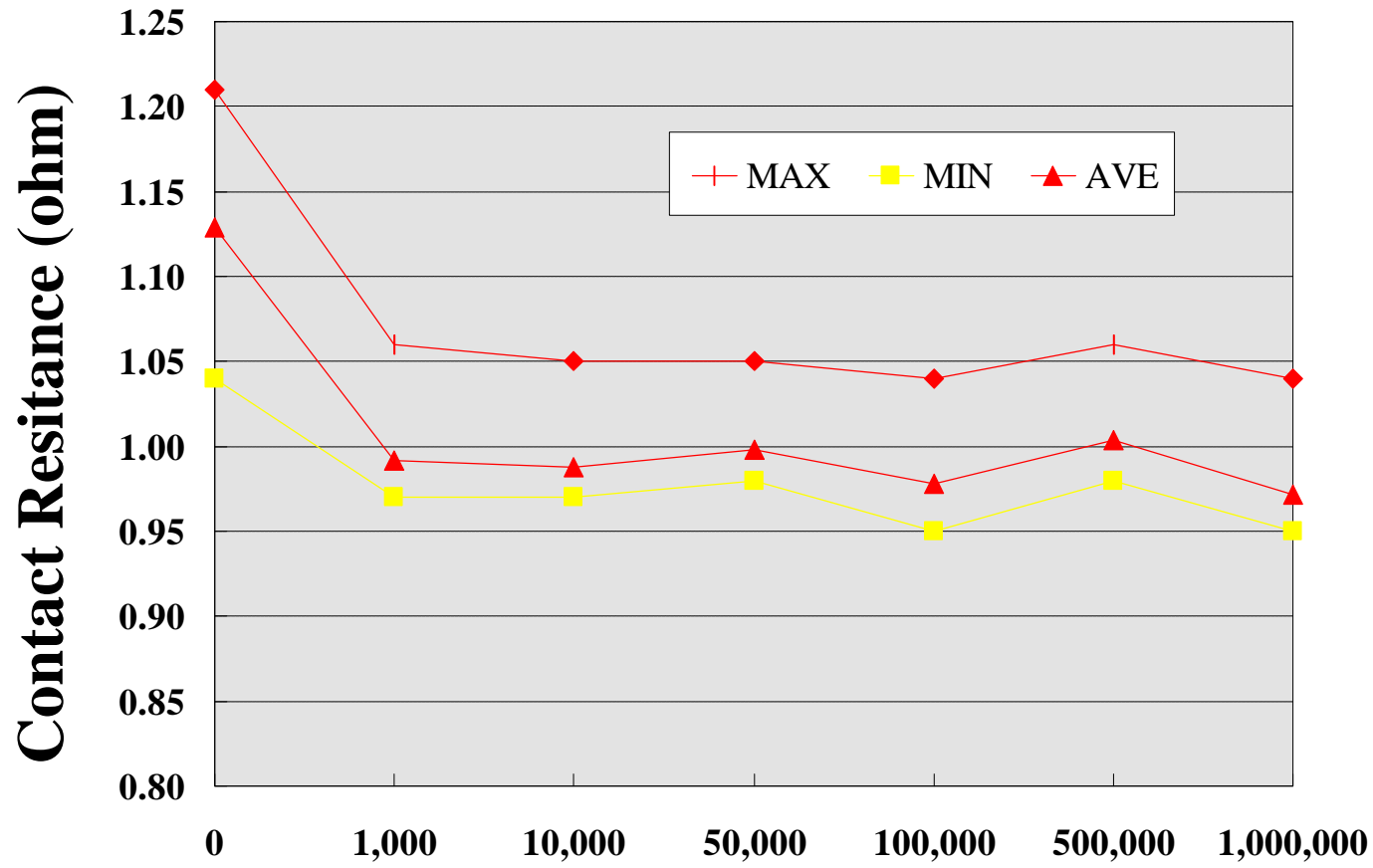
OD : 100 Micron
Pitch : 45 Micron

Probe Angle : 15 degree

Temp. : 125C

10 micron
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The Variation of Contact Resistance (Au)



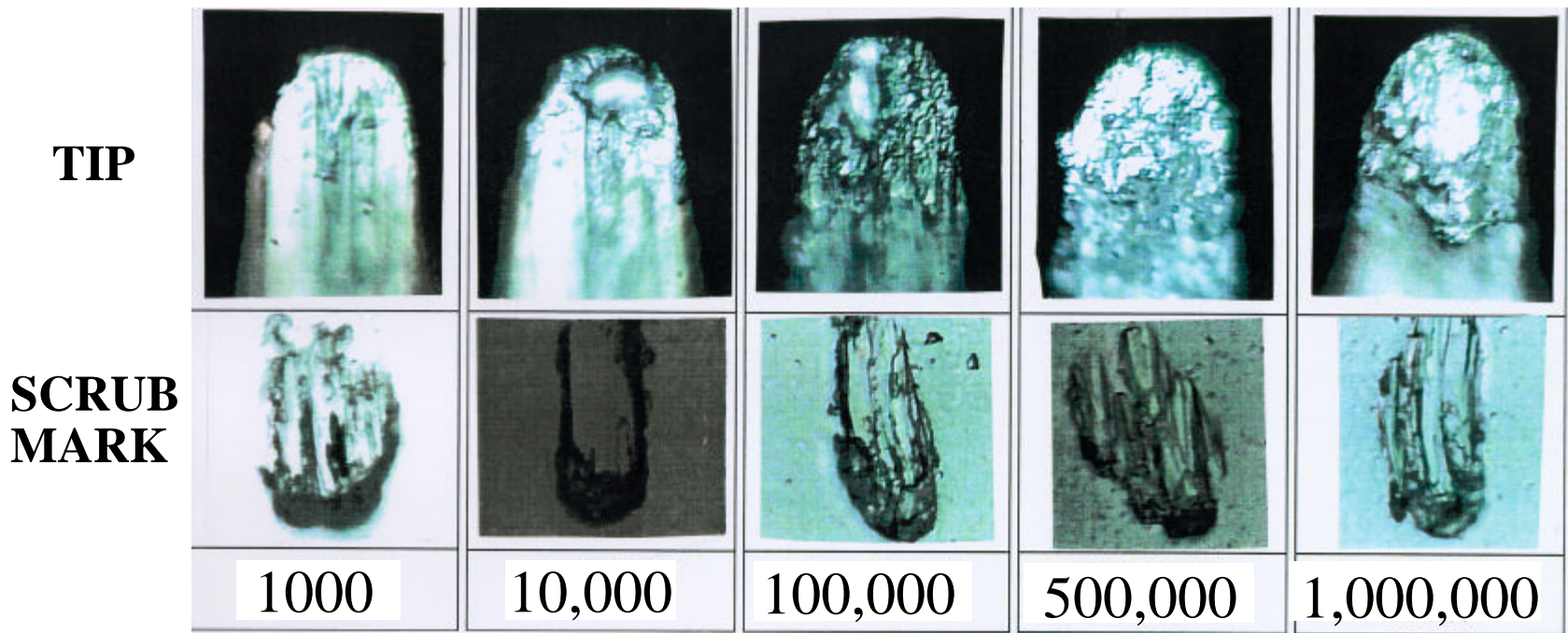
Left Side Flex : Measured 10 pins

Touch Down

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Tip and Scrub Mark after Contact Test to Al

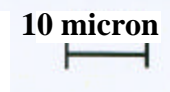


OD : 100 Micron

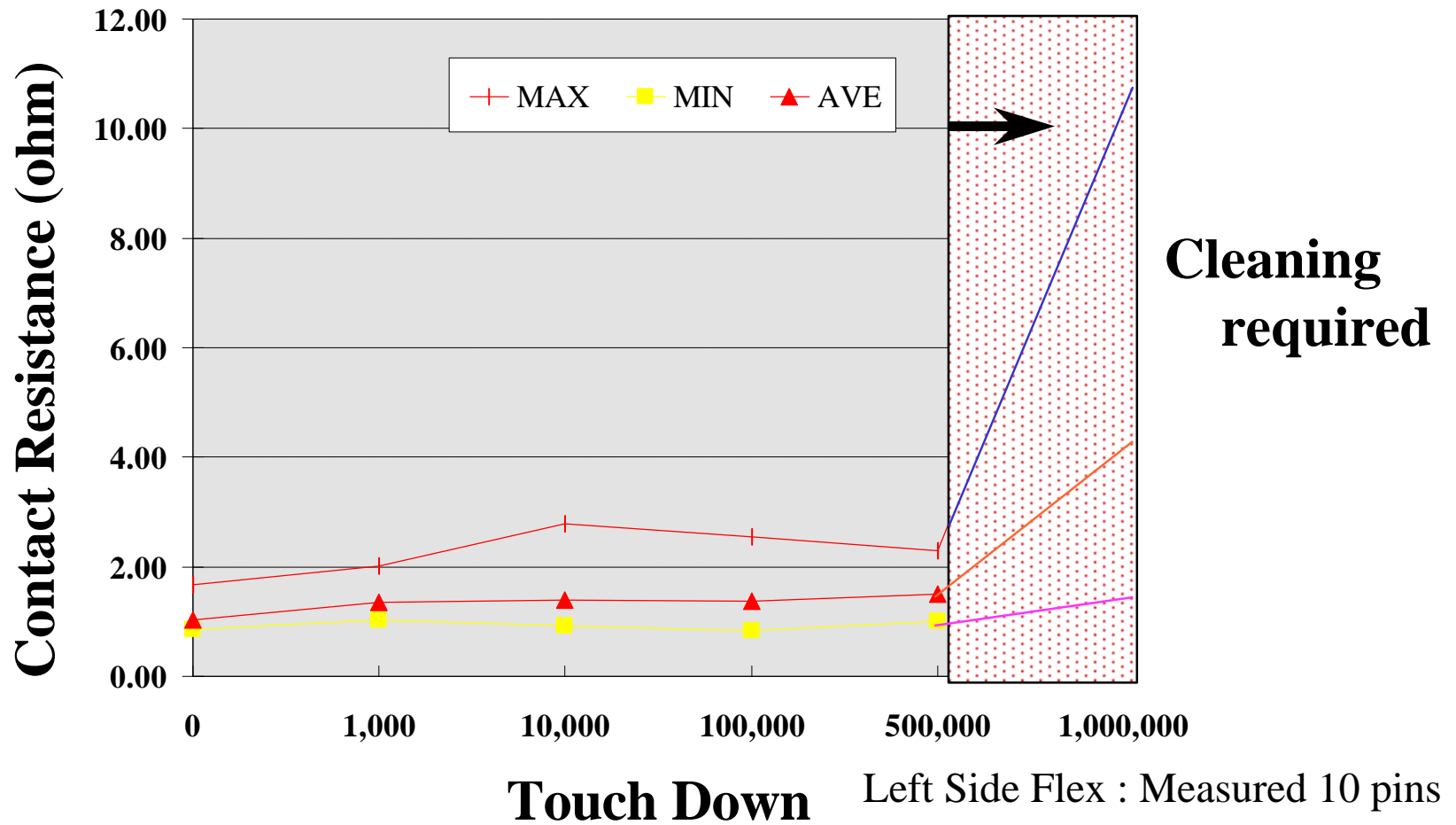
Probe Angle : 20 degree

Temp : 125C

Pitch : 100 Micron



The Variation of Contact Resistance (Al)



Evaluation Results of Fine Pitch P4 by Customer

- Probe Card

Pitch : 45 micron

Pin Counts : Around 500

Pad materials : Au Bump

- Contact condition

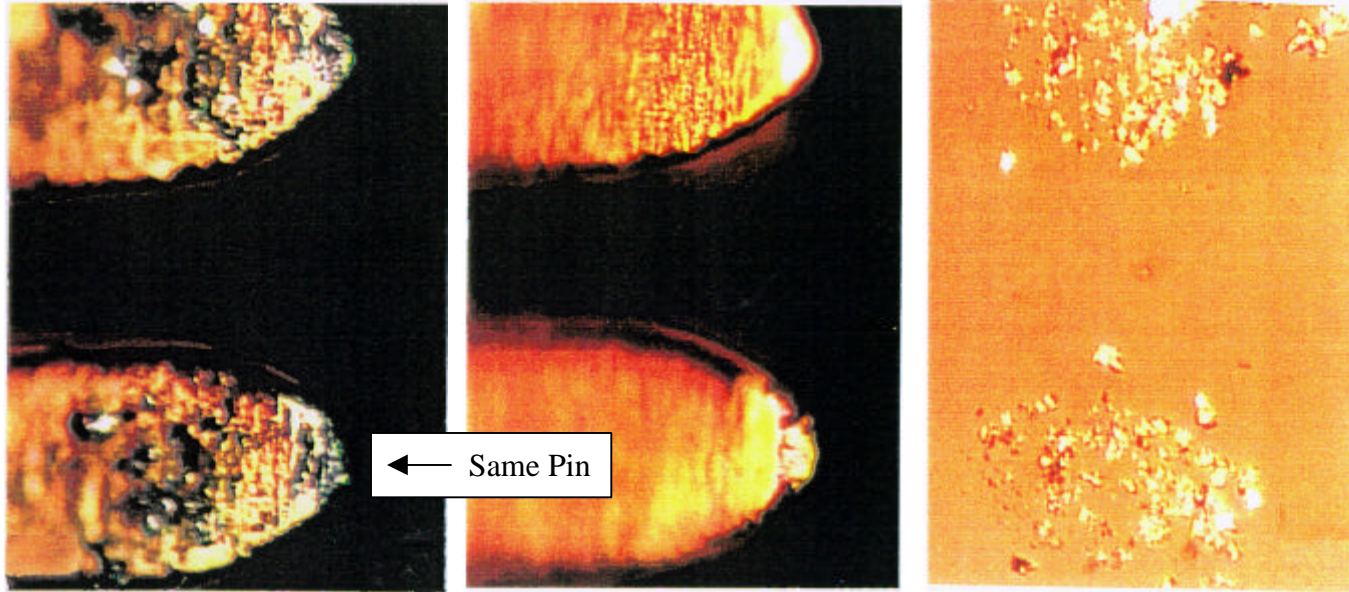
100,000 (at room temp.) + 30,000 (at 90 C)

- Results

XYZ position : No problem (too small to measure)

Contact Resistance : No problem (without any cleaning)

Tip Cleaning for P4

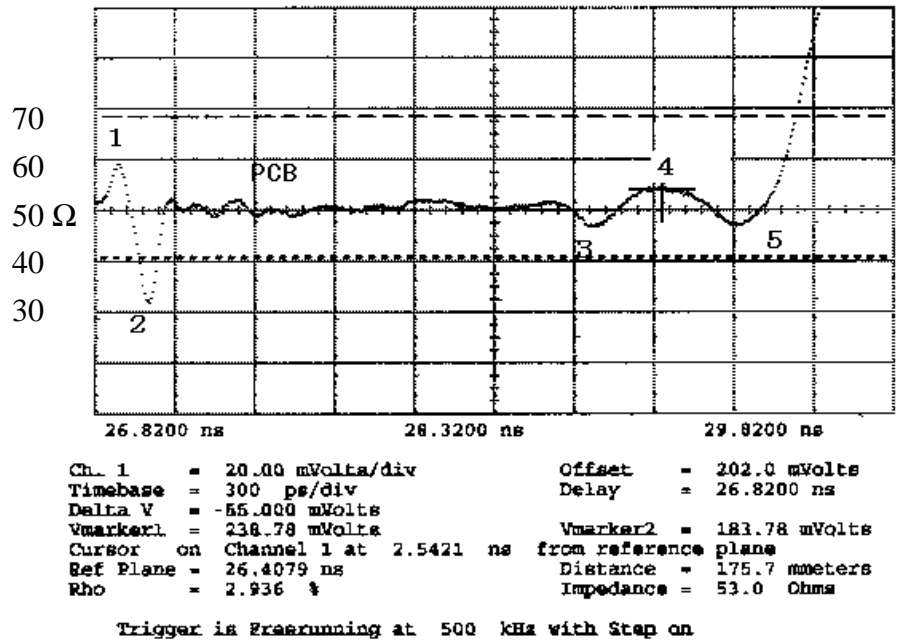


25micron
└───┘

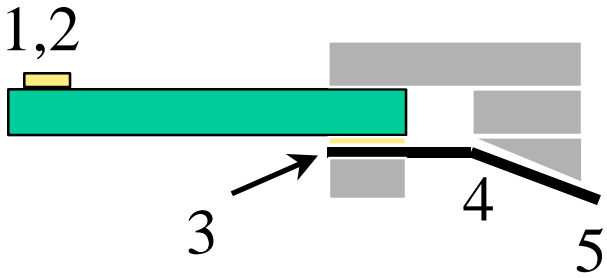
Before Cleaning After Cleaning

Sticking Tape
After Cleaning

TDR Results of P4 Flex

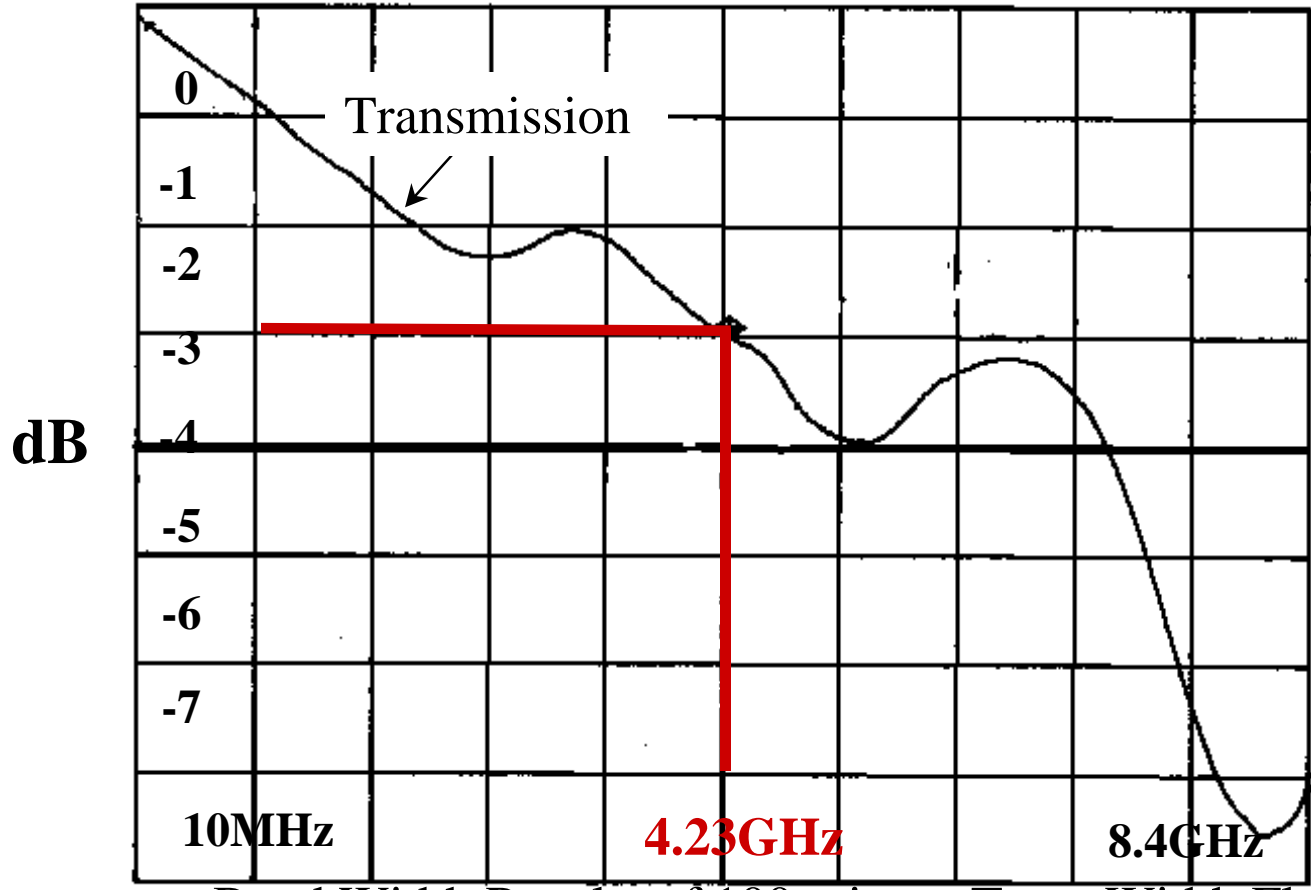


- 1,2 Probing Point
- 3. Contact Point
(PCB and P4 Flex)
- 4. Max. Point in P4 Flex
- 5. Min. Point in P4 Flex



TDR Results of 100 micron Trace Width P4 Flex

Example of Band Width Result of P4 Flex



Band Width Results of 100 micron Trace Width Flex

End of Presentation

- P4 Probe Cards are developed jointly between Cerprobe Corporation and Mitsubishi Materials Corporation.
- P4 Probe Cards are available in Japan from Mitsubishi Materials Corporation through Innotech Corporation (Sales)
- P4 Probe Cards are available elsewhere from Cerprobe Corporation