IEEE SW Test Workshop
Semiconductor Wafer Test Workshop
June 9 - 12, 2013 | San Diego, California

High Performance Spring Probe and 0.35mm pitch Elastomeric Contact by Stamping Process

Samuel Pak, A.J. Park

IWIN Co. Ltd.

363-883 South Korea, Choongbuk, Chungwon, Ohchang-eup Yangchung-ri, CBTP

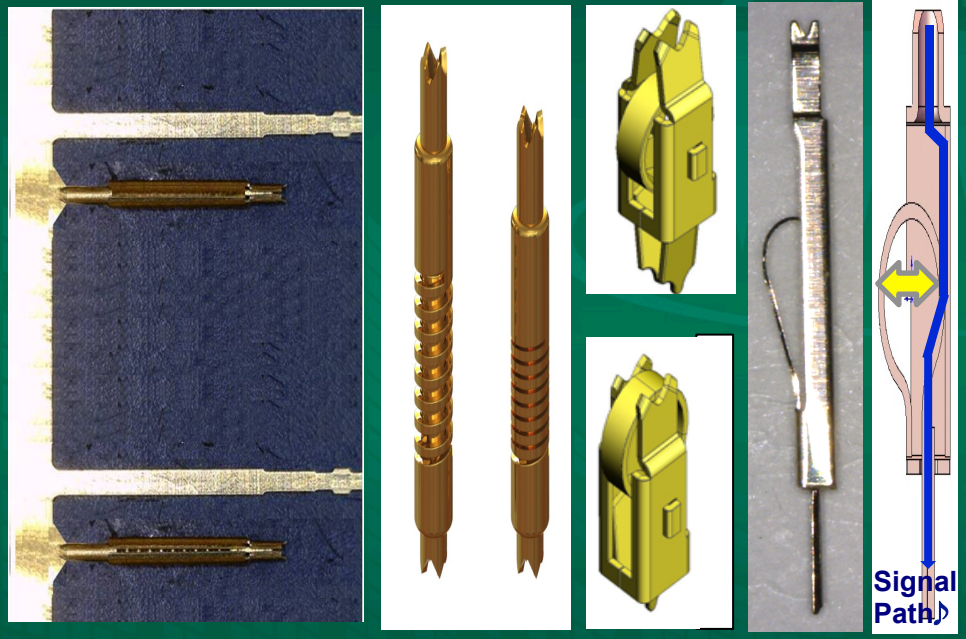
iwin@iwinsn.com www.iwinsn.com

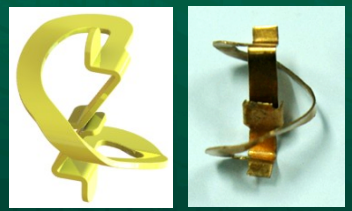
Overview

- Various spring probes by stamping
- Major strengths of stamped pin
- Case studies for HPSP2821
- Insertion loss, Cres, Current carrying
- Elastomeric contact by stamping
- Challenges and Solution
- Summary for stamped elastomeric contact

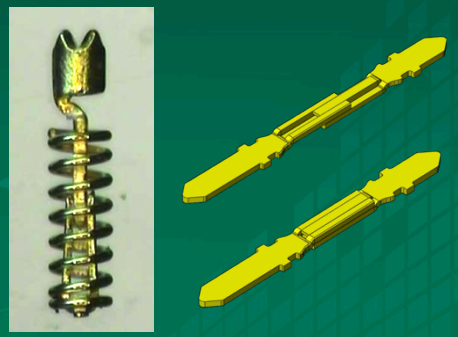
Various Spring Probes by Stamping

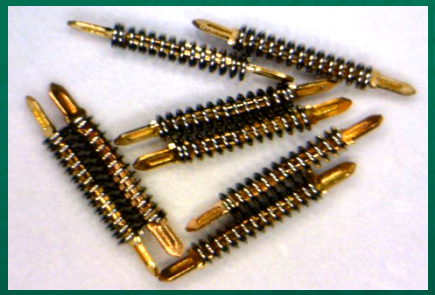
One Piece Spring Probes





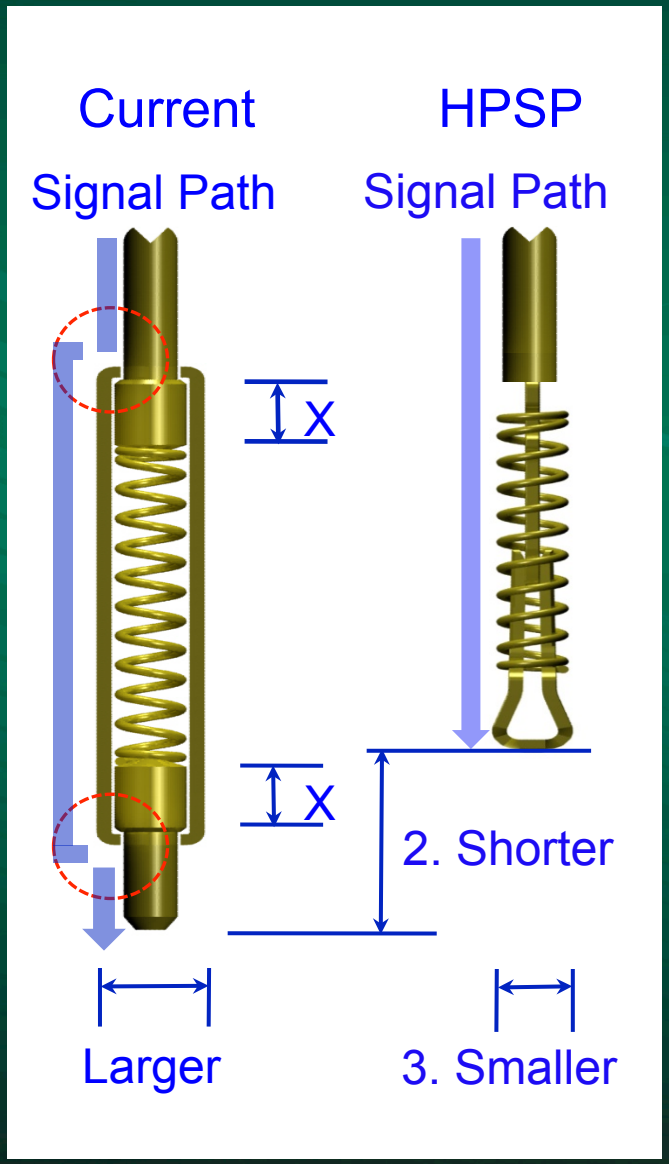
Three Pieces Spring Probes





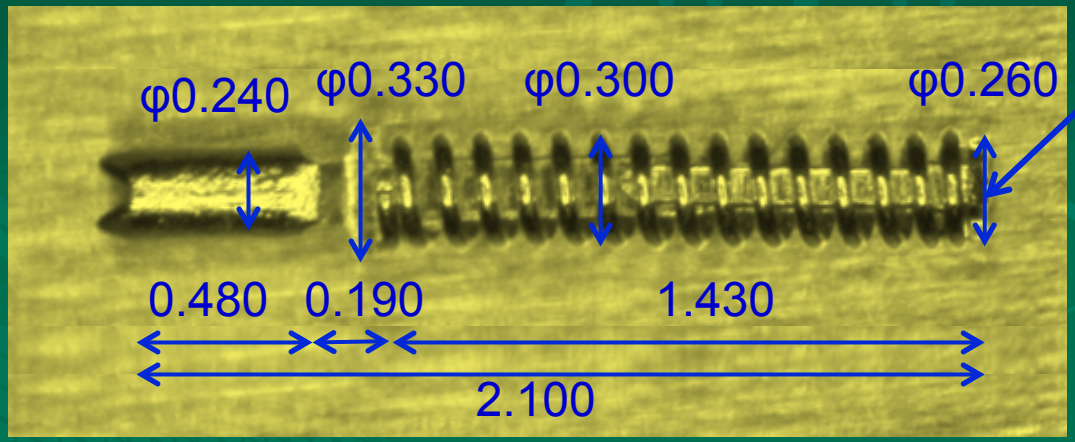
Note : Refer to SWTW 2O12 presentation for details and how to make

What are the major differences ?

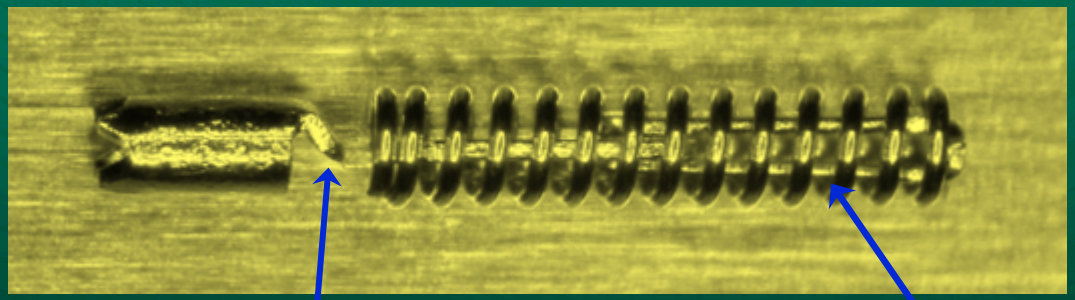


1. Stable Signal path by pinched sliding
2. Enabling Short length, 1.2mm, good for high speed application
3. Enabling Small diameter, good for finer pitch, 0.2mm pitch
4. High current carrying, 4.5 Amps in 0.4mm pitch, 3.3mm length pin
5. 0.8mm traveling in 3.3 mm length
6. Progressive stamping enabling low cost

Appearance & size measurement



Projection
・φ0.081mm
・Height 0.01mm

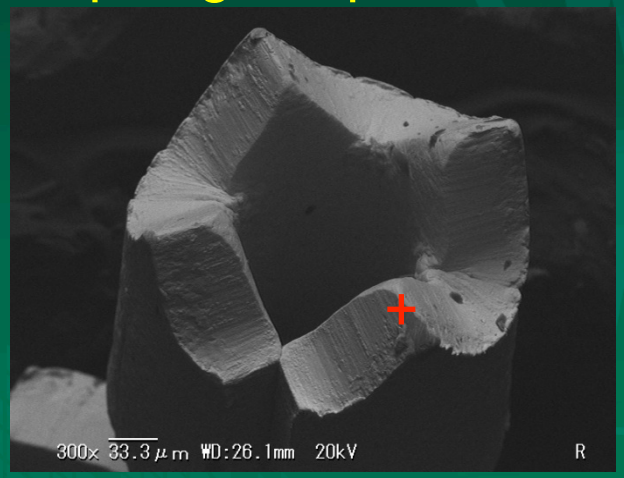


Thickness : 0.050

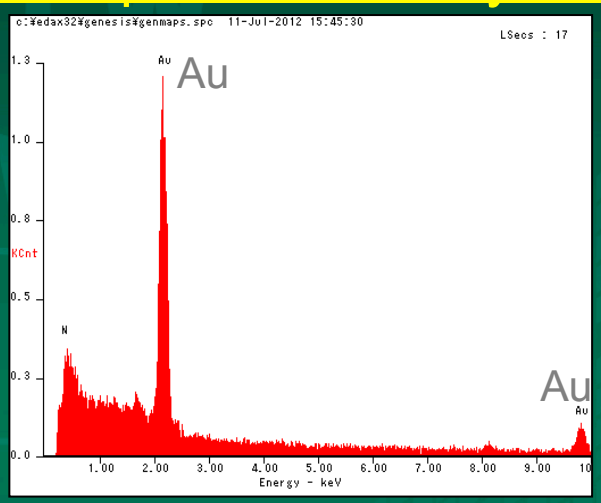
Thickness: 0.040

SEM & Componential Analysis Result

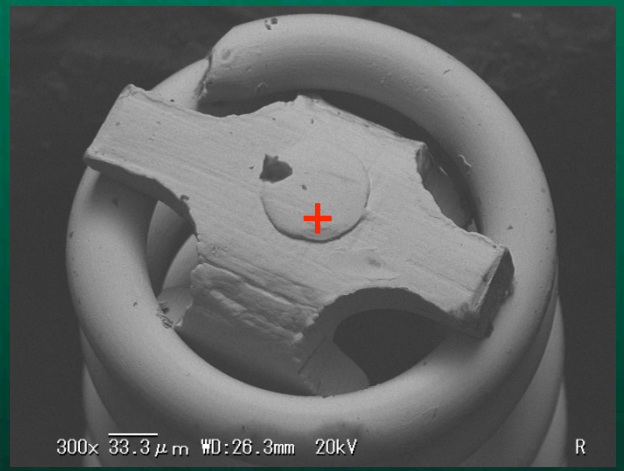
A-plunger Tip



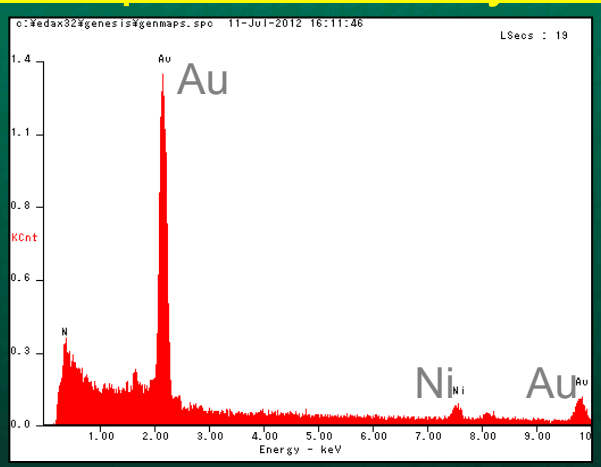
Componential analysis result



B-plunger Tip

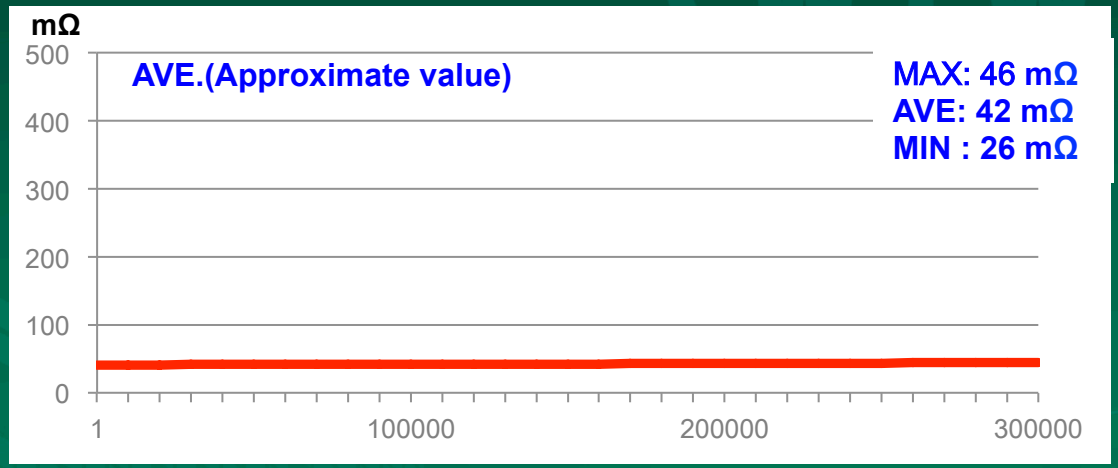


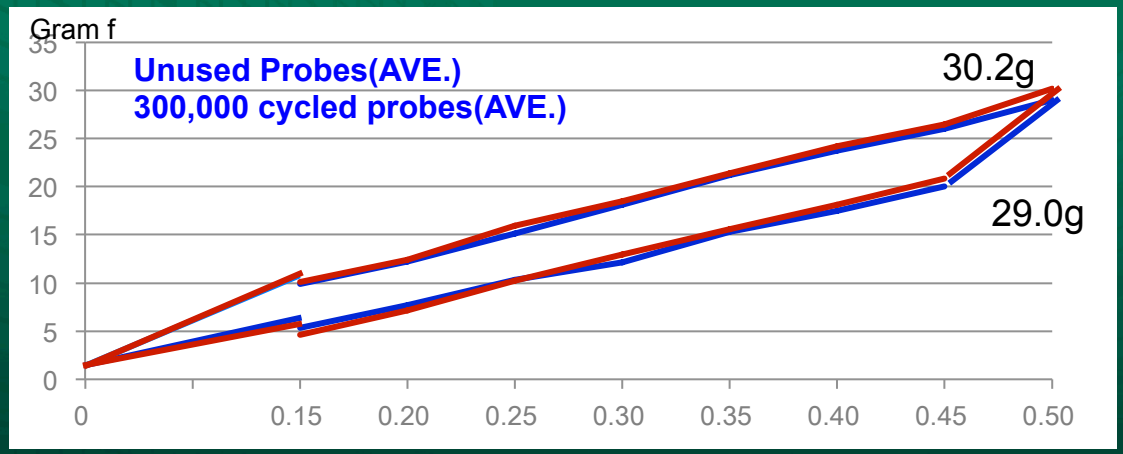
Componential analysis result



Durability test – 300k cycles

Spring force vs Stroke (n=20)



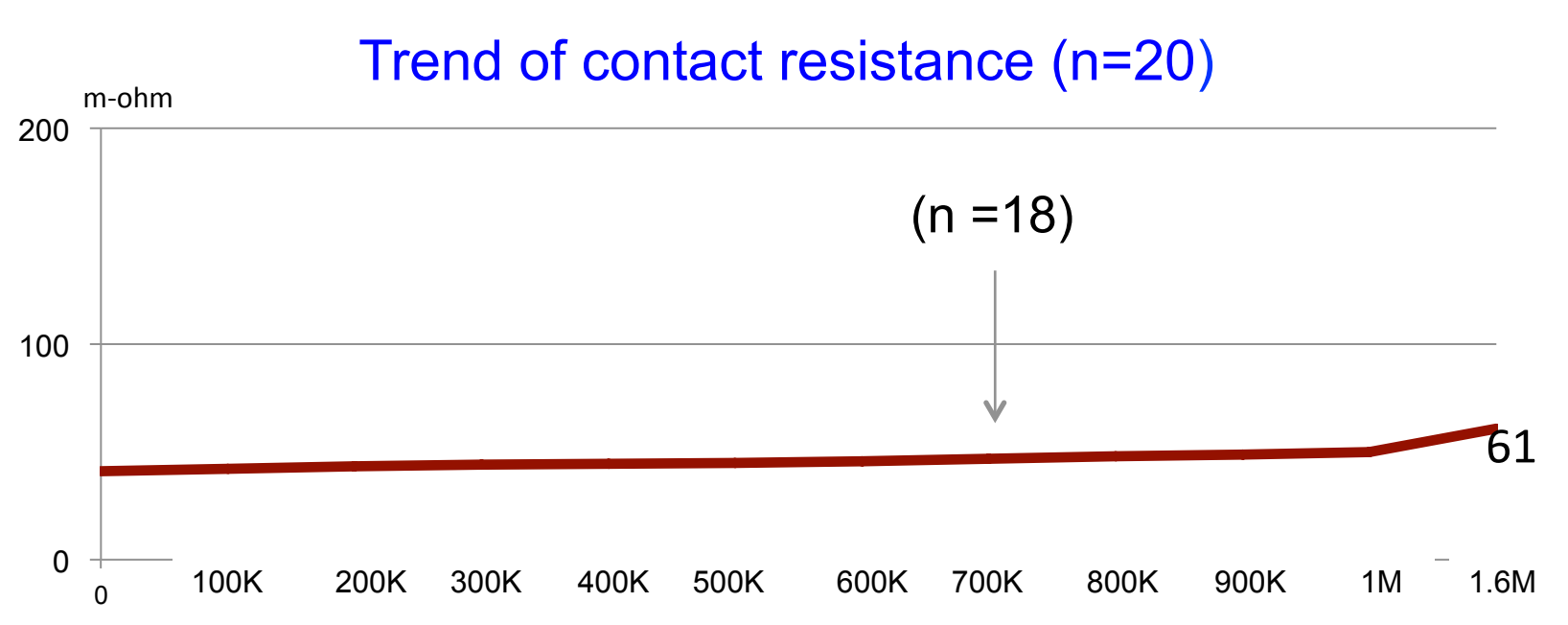


Test condition

- Cycles: 300,000 times
- Contacted electrode: Au plate
- Measure Resistance: Every 10,000 times
- Stroke: 0.50mm (Pre-stroke: 0.15mm)

Pre-stroke; 0.15mm

Destructive test

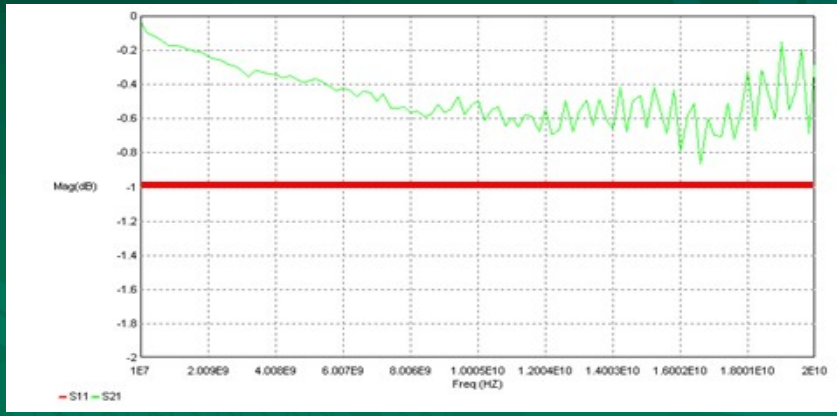


Cycles	Condition	To improve
700 k	Deflection of spring	Safety ratio shall be increased
>1 M	Erosion of gold plating	Material shall be changed to special alloy, not requiring gold plating

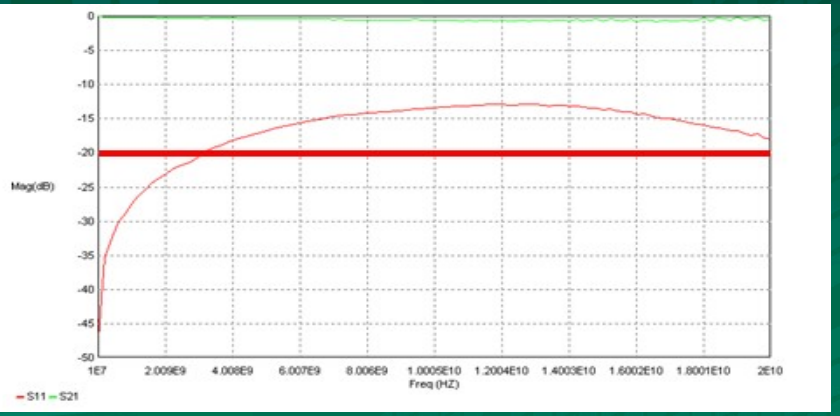
Insertion Loss Test Data

Sample #1

Transmission 22.4GHz @-1 db

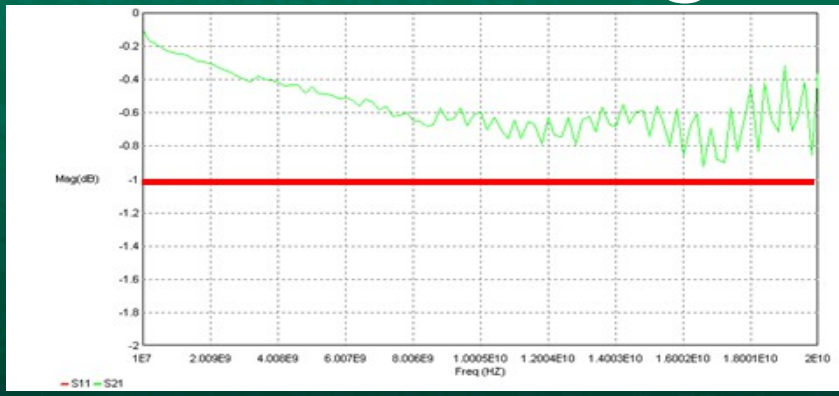


Reflection 3.2GHz @-20db

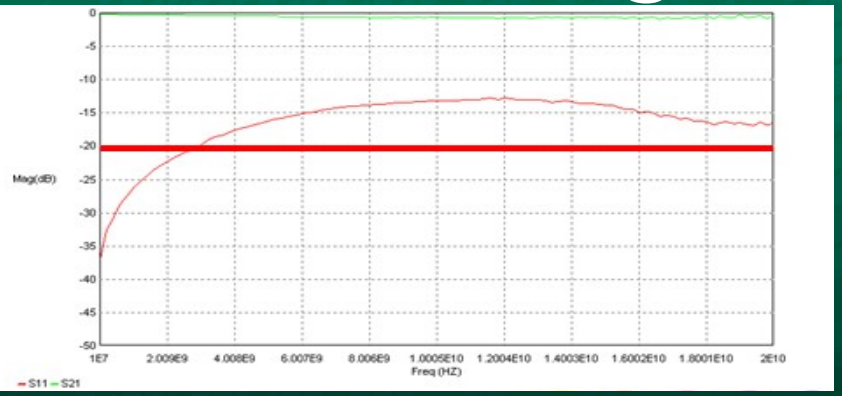


Sample #2

Transmission 21.3GHz @-1 db

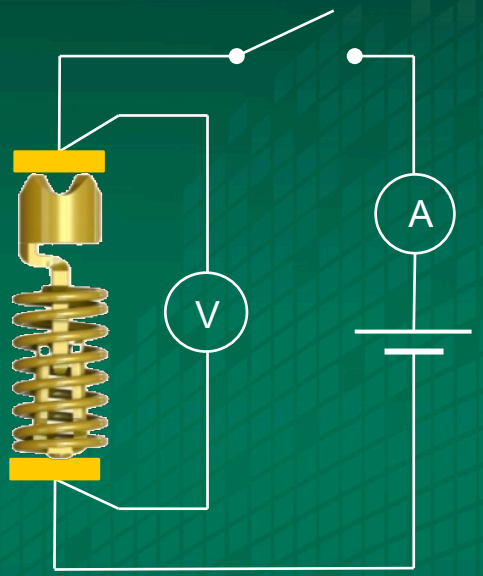


Reflection 3.0GHz @-20db



Current Carrying Capacity Measuring

* Test condition: Ambient temp (25°C)
* Test method: Started from 1Amp and increase 1 Amp by every one minute
* Measure allowable current carrying:
  - Any change in contact force
  - Burn
  - Permanent deflection
* Result
  - Contact force was changed at 5.0Amp
* Conclusion
  - Acceptable for 3.5A of current carrying

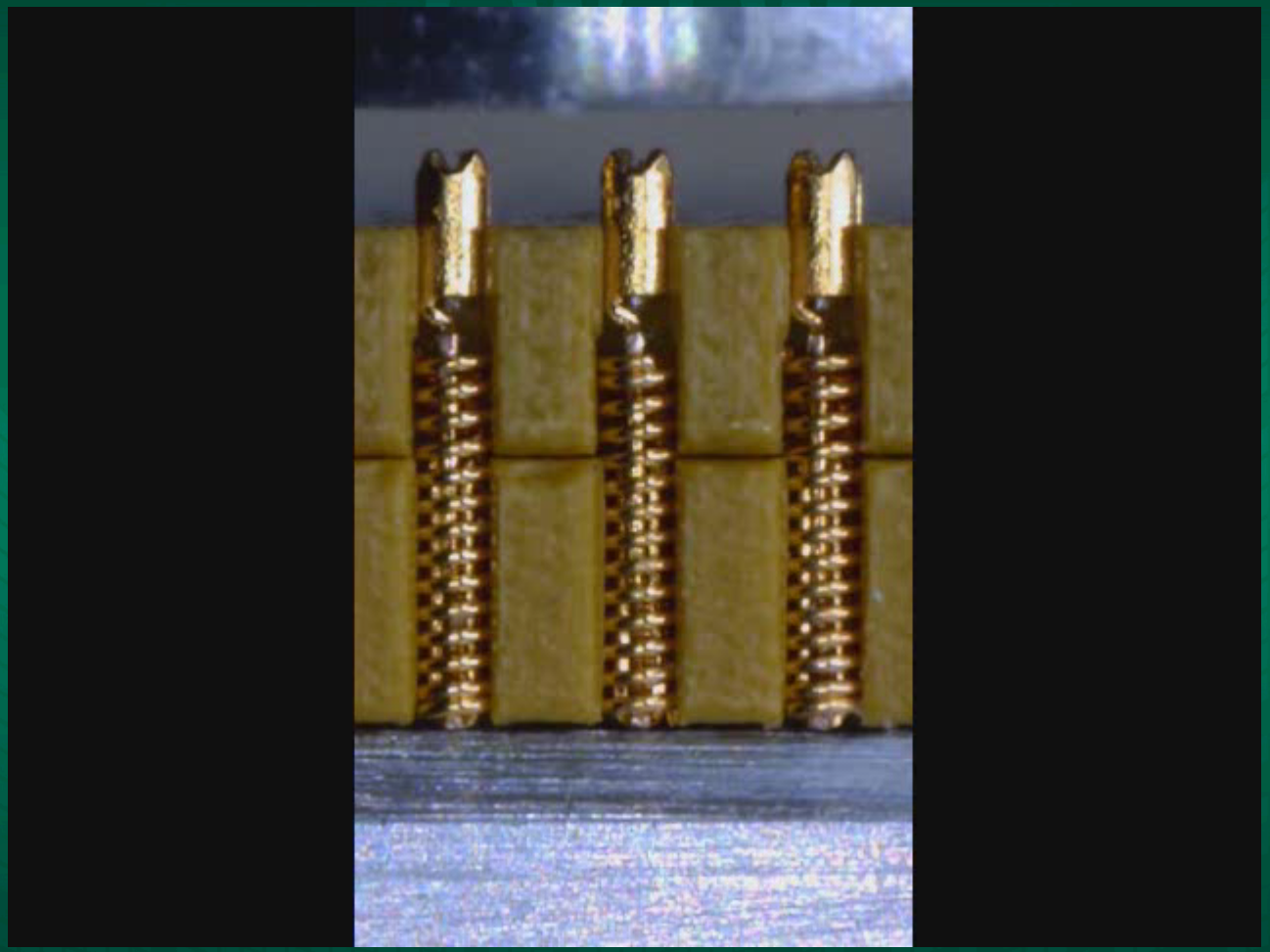


Current Carrying Capacity Measuring

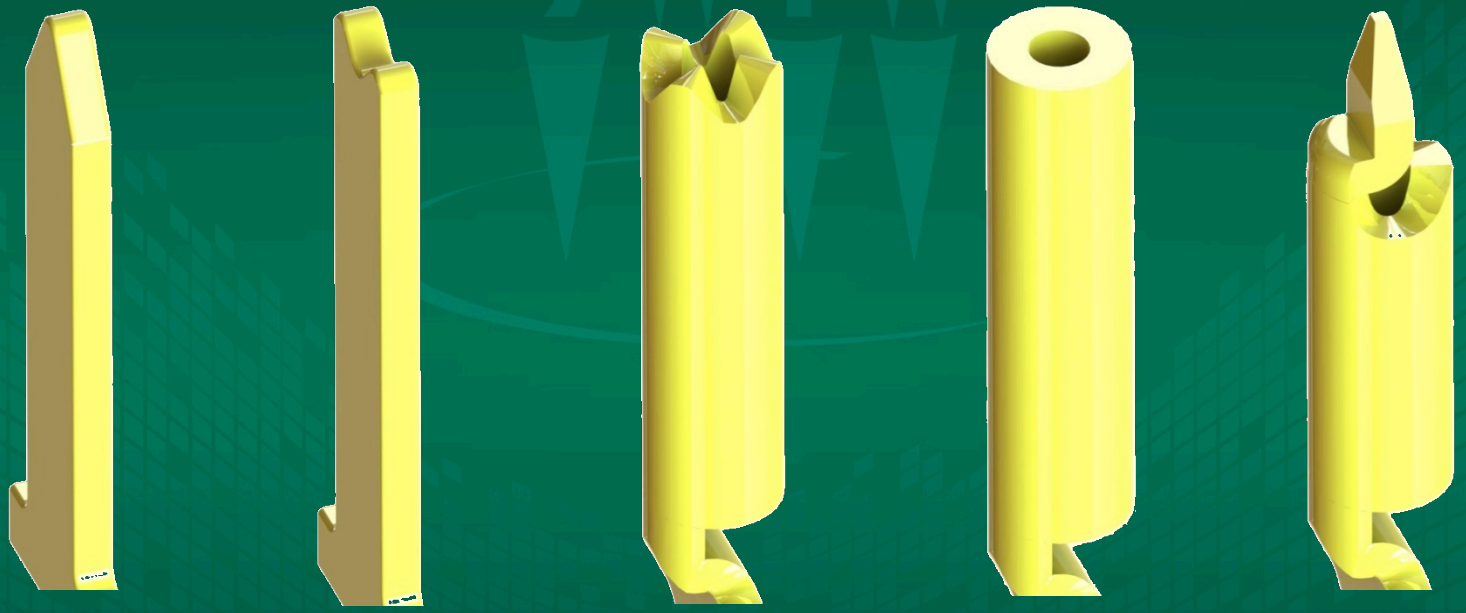
* Result
  - in 4.5~5.0 Amp, contact force was changed

Current	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
1.0A	OK	OK	OK	OK	OK
1.5A	OK	OK	OK	OK	OK
2.0A	OK	OK	OK	OK	OK
2.5A	OK	OK	OK	OK	OK
3.0A	OK	OK	OK	OK	OK
3.5A	OK	OK	OK	OK	OK
4.0A	OK	OK	OK	OK	OK
4.5A	OK	C/F Changed	OK	OK	OK
5.0A	C/F Changed		C/F Changed	C/F Changed	C/F Changed

HPSP2821 in motion

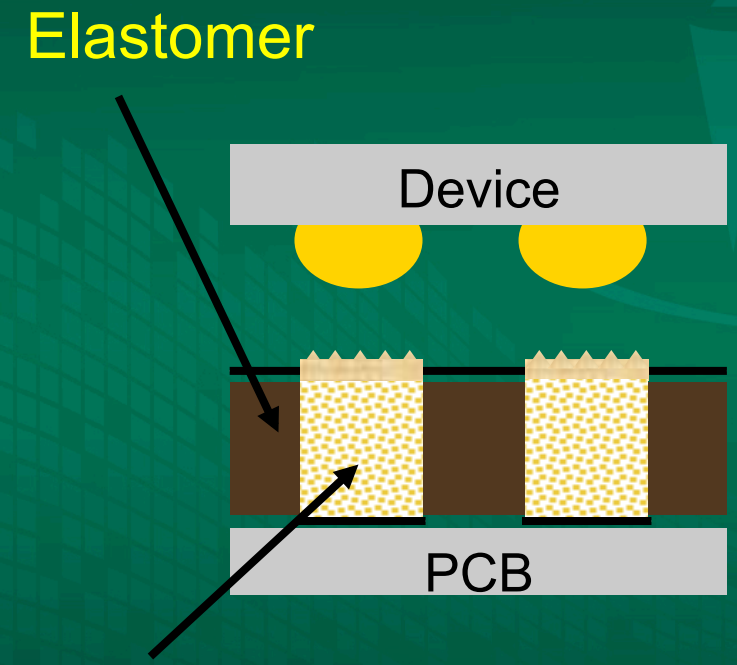


Available Tip Shape



Single Double Cylindrical Crown Cylindrical Flat Cylindrical Sharpen

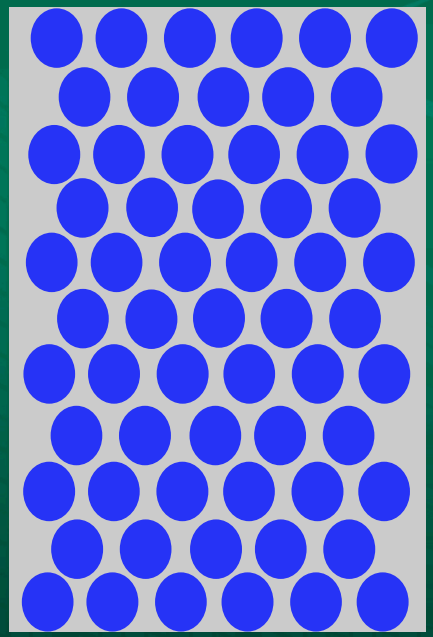
Previous concept of elastomer socket



- Simple socket structure
- Good for high frequency
- Wider contact area
- Least ball damage
- Less contamination

Electrical Conductivity vs Flexibility

High density
Conductive particle



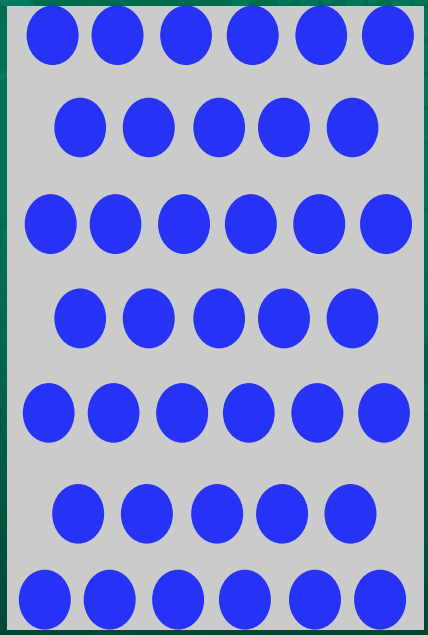
Electrical Conductivity

>

Flexibility

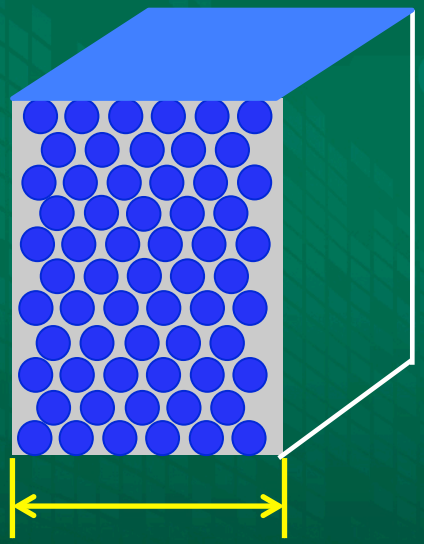
<

Low density
Conductive particle



Resistance at fine pitch

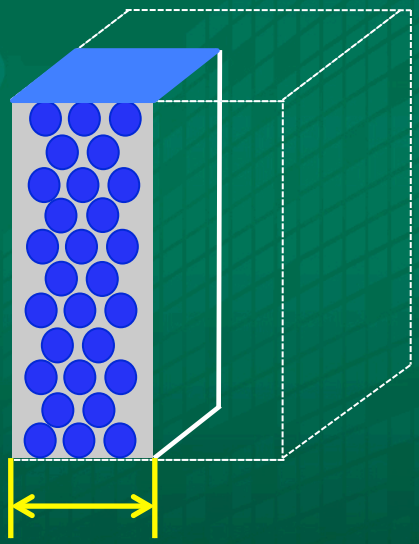
Pitch 0.5㎜→0.4㎜, Pad size 0.38 mm→ 0.28 mm
Electrical resistance increased by two times



L

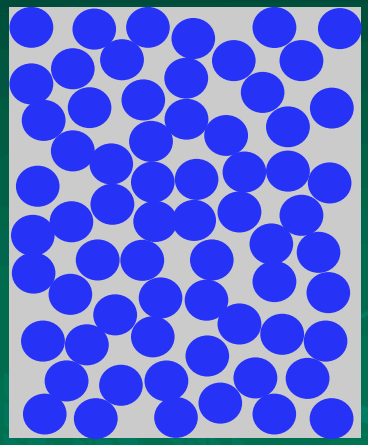
L→½L,

electrical conductive
reduce to ¼

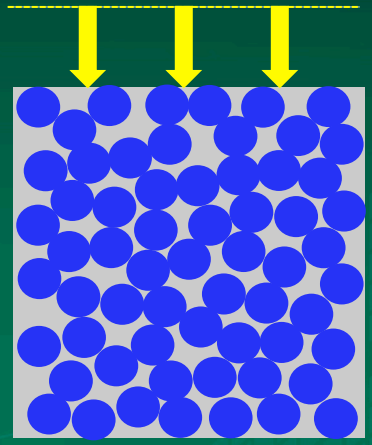


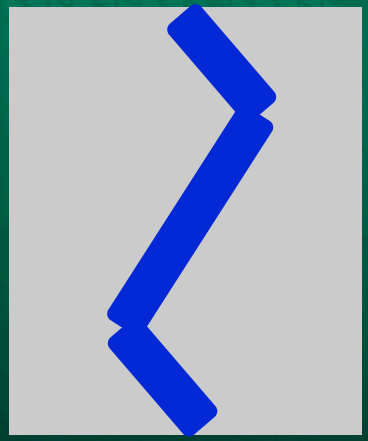
½L

New Idea

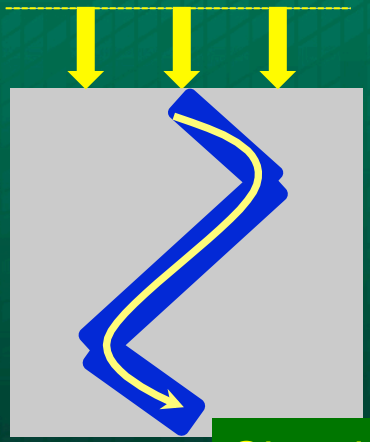


Conductive particle

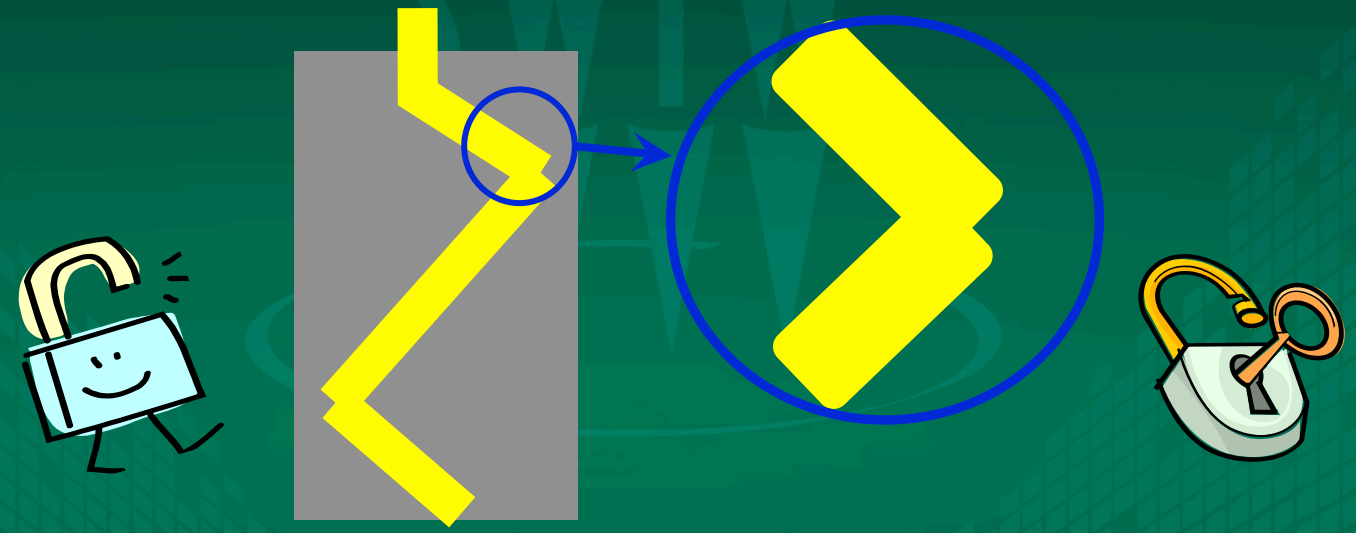




Metal Strip



How to eliminate rigidity of metal structure



Progressive Stamping of metal strip → Heat treatment

→ Rubber injection (Coating) → metal parts separate in pieces by pressure from the top at v-notches → rigidity of metal parts eliminated

Rubber providing Spring force

Metal parts providing Signal path

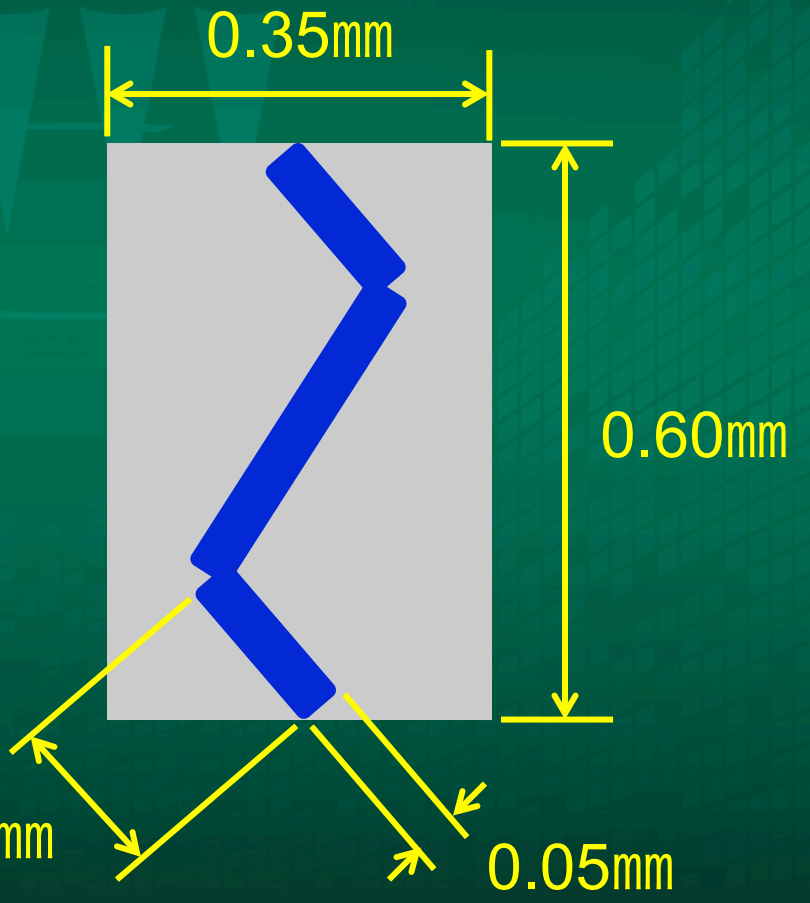
What's the challenge ?

length 0.16mm x width 0.22mm

Numerous tiny metal pieces to be aligned in rubber

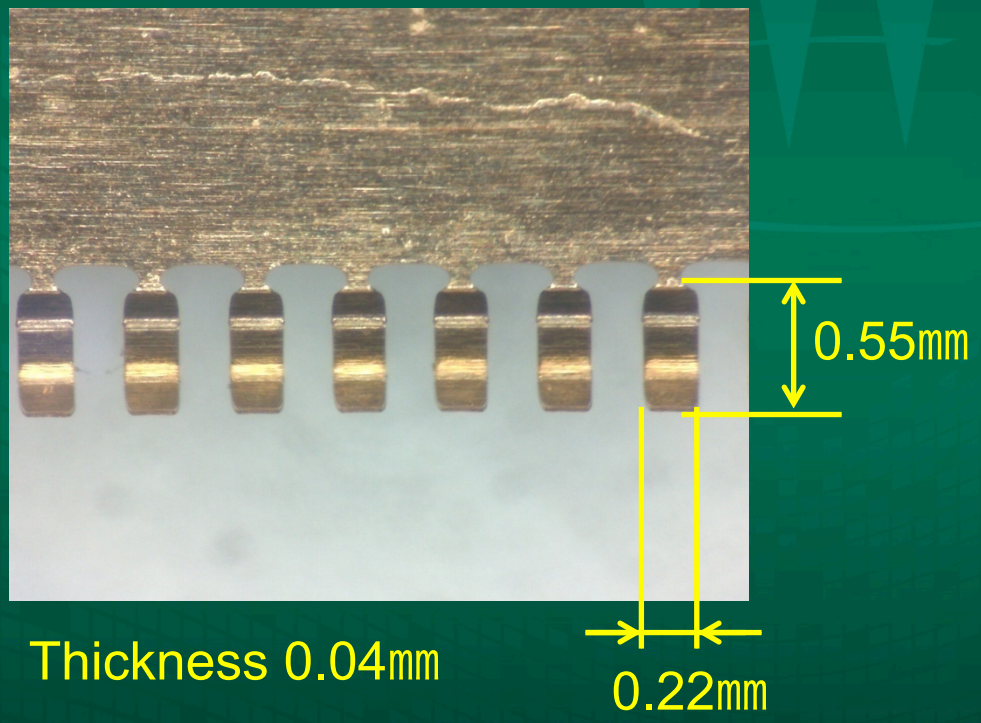
Possible ?

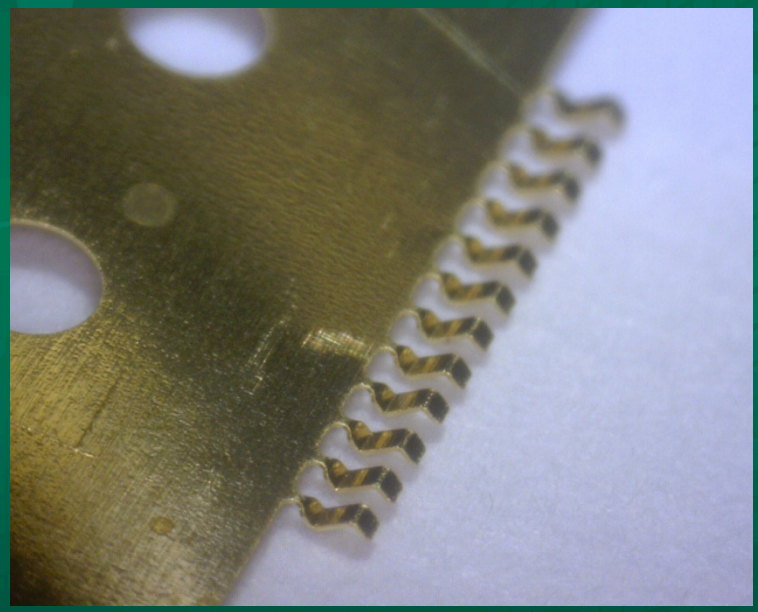
How ?



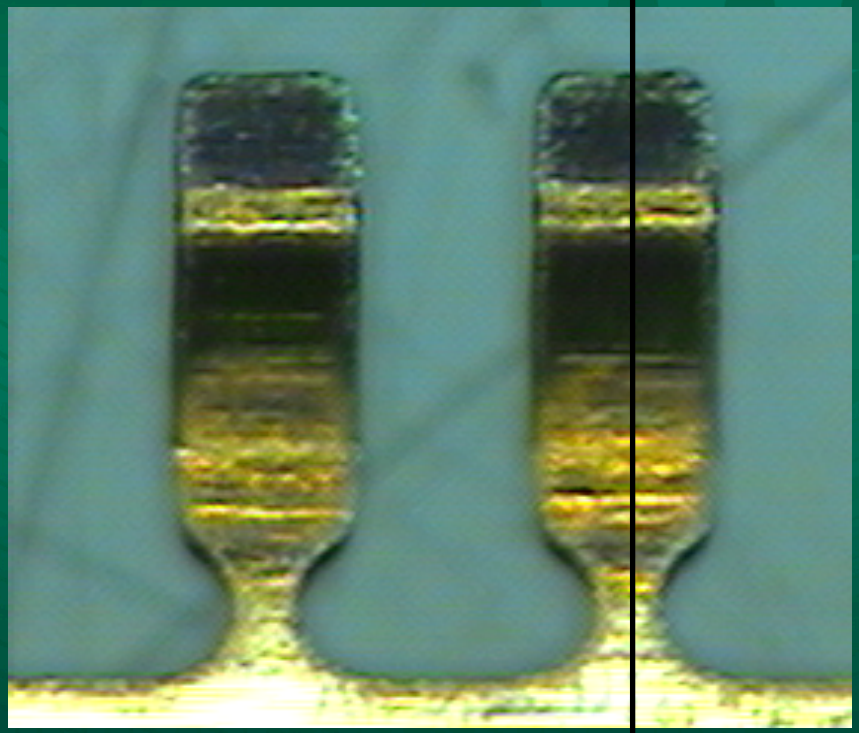
Stamped metal strip for a core metal

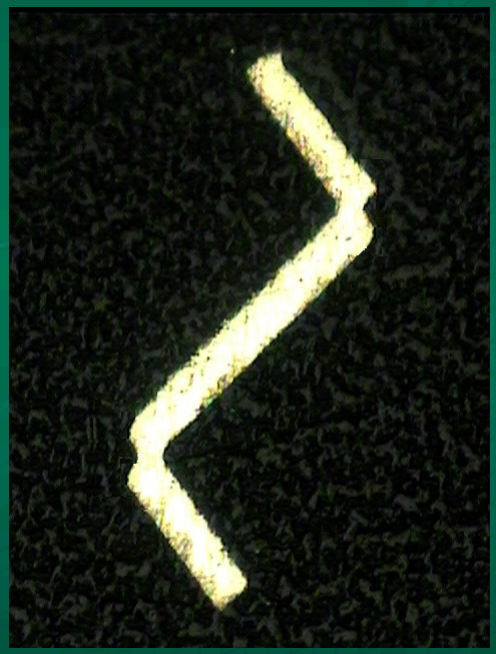
0.35㎜ pitch





V-notches at core metal piece

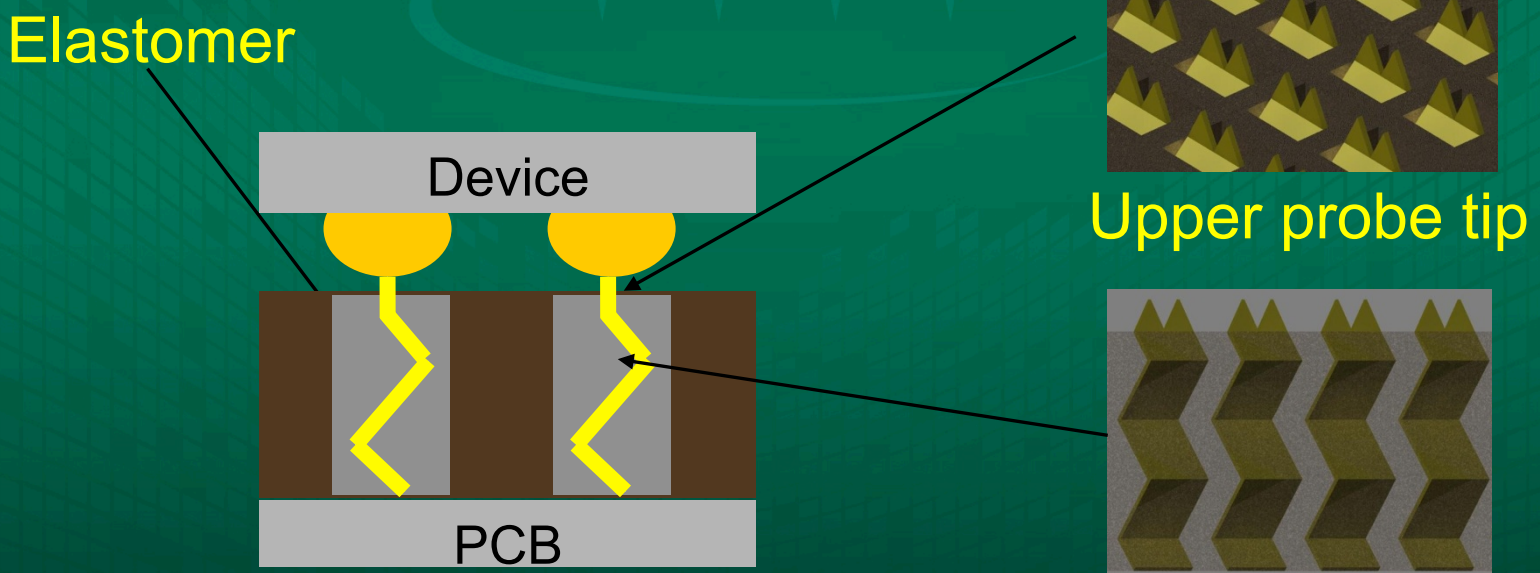




A-A Cross Section

New design by core metal

- Signal path thru metal pieces
  → Better electrical performance
- Spring force by elastomeric
  → Good travelling



Summaries for elastomeric contact by stamping

- Development expense funded by Korean Government
- Challenged 0.35 mm pitch and 0.6mm in thickness, providing 0.25mm travel
- Contact resistance 32 milii-ohm
- Insertion loss tested only up to -1db@40 GHz
- Need to find better rubber for improving low temperature performance