
SIXTEENTH ANNUAL
BiTS
Burn-in & Test Strategies Workshop
March 15 - 18, 2015
Hilton Phoenix / Mesa Hotel
Mesa, Arizona
Archive – Session 7
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Session 7
Valts Treibergs
Session Chair

BiTS Workshop 2015 Schedule

Solutions Day

Wednesday March 18 8:00 am

All That Glitters Is Or Is Not Gold

"One piece spring probes in one piece house socket (The best cost socket solution)"

AJ Park & JD Cho - IWIN Co. Ltd.

"MEMS rubber contact for TEST socket"

Justin Yun & BoHyun Kim - TSE Co., Ltd.

Do You Believe In Leprechauns?

"Marketplace Report"

Ira Feldman - Feldman Engineering Corp.

"A Testing Time for Test Socket Suppliers"

John West - VLSI Research

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One-Piece Spring Probe In One-Piece Socket Housing

(The Best Cost Socket Solution)

AJ Park
JD Cho
IWIN Co. Ltd

2015 BiTS Workshop
March 15 - 18, 2015

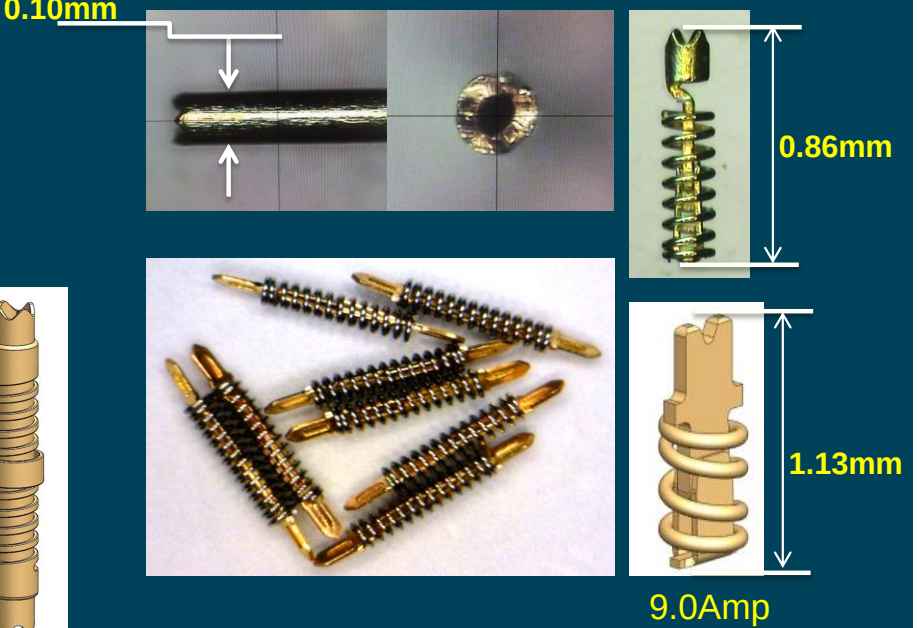
Contents

- Previous presentation updates
- One-piece housing socket
- Case study for one-piece pin (stamped)
- Test reports
- Summary and Next plan

Previous Presentation Updates

One-Piece Spring Probe

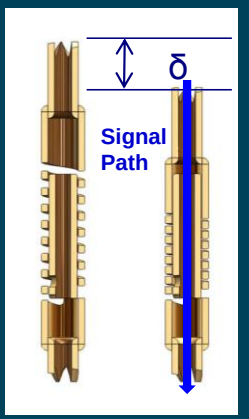
Three-Piece Spring Probes

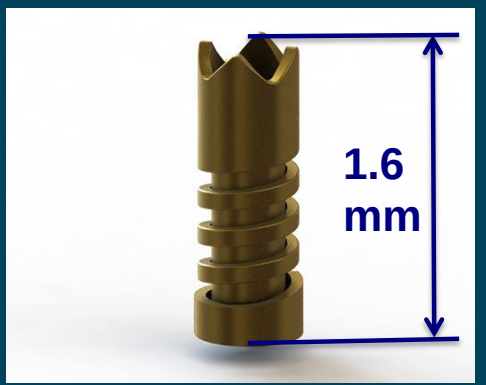


Note : Refer to BiTS 2014 presentation for details and how to make

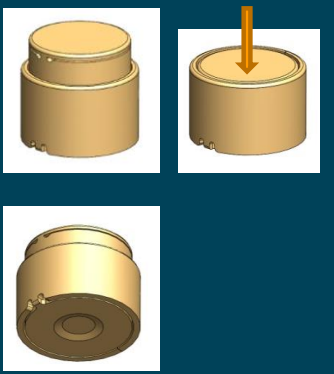
Previous Presentation Update

One-Piece Spring Probe

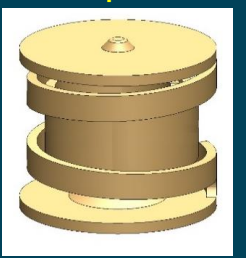




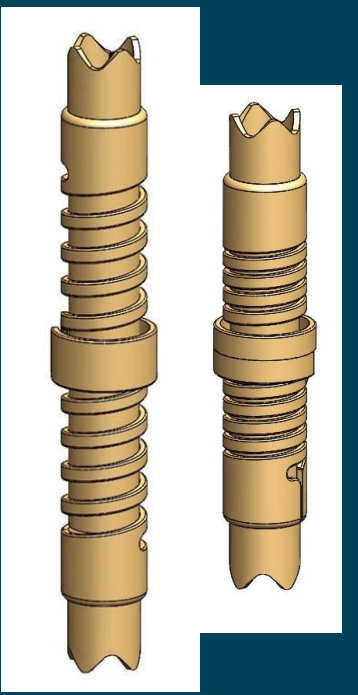
Low Cost Version



Button shape
One-piece



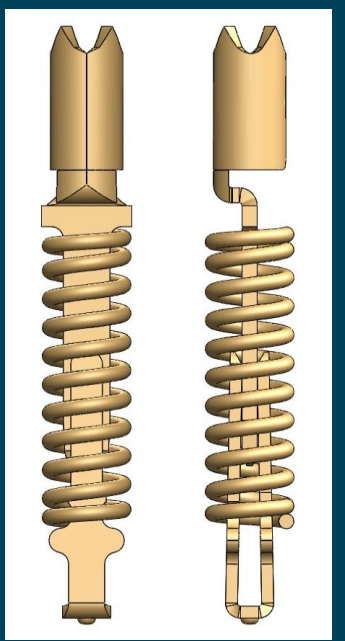
Drum shape
One-piece



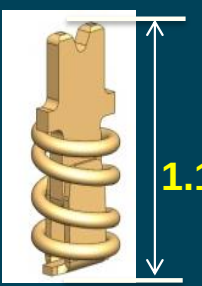
Double acting 0.4mm pitch
One-piece pin

Previous Presentation Update

Three-Piece Spring Probe



0.4 mm pitch
Signal pin high performance



9.0 Amp
High Current carrying
Ground pin

One-Piece Spring Probe In One-Piece Socket Housing (The Best Cost Socket Solution) 5

One-Piece Socket And Pin Introduction-1

Objectives

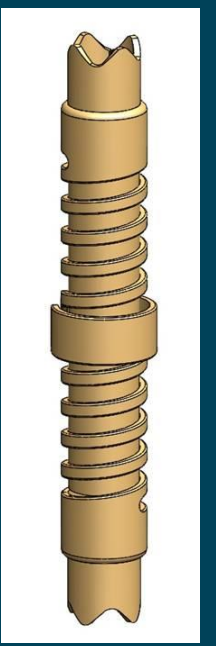
- Best cost
- High performance
- Cycle time management

Merit of one piece pin

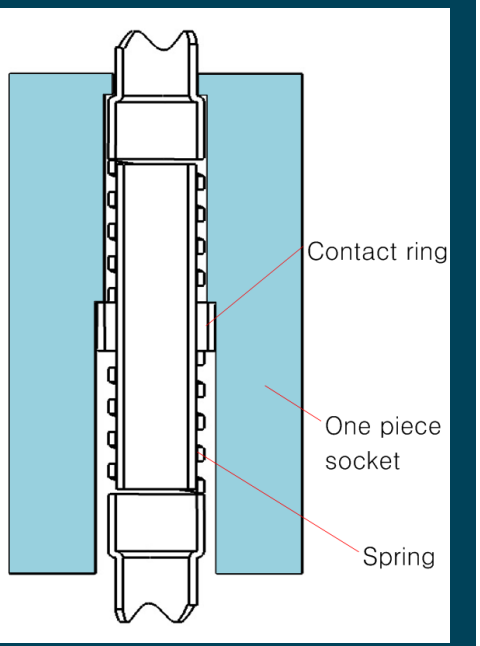
- Low cost
- Better electrical performance

Merit of one piece socket

- Simpler and thinner socket
- Ability to accommodate shorter pins
- Low cost
- Easy pin insertion and automation



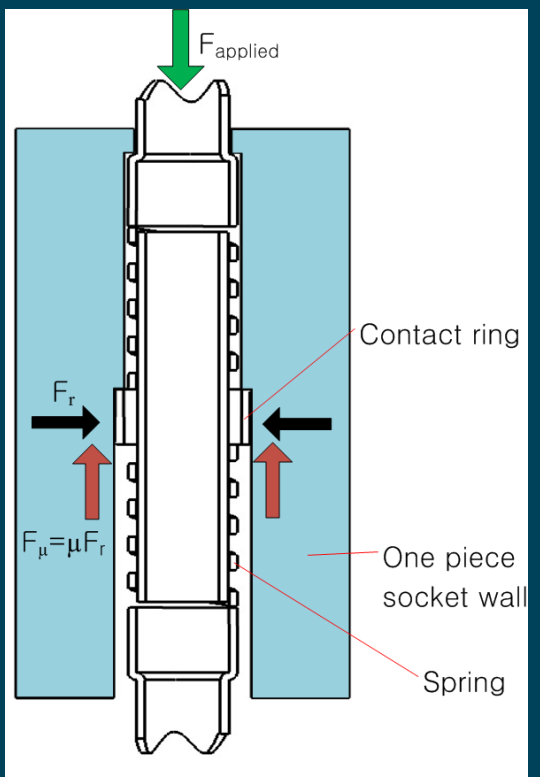
One-piece pin



Socket assembly Sectional view

One-Piece Socket And Pin Introduction-2

Mechanical Concept



Criterion on contact interface

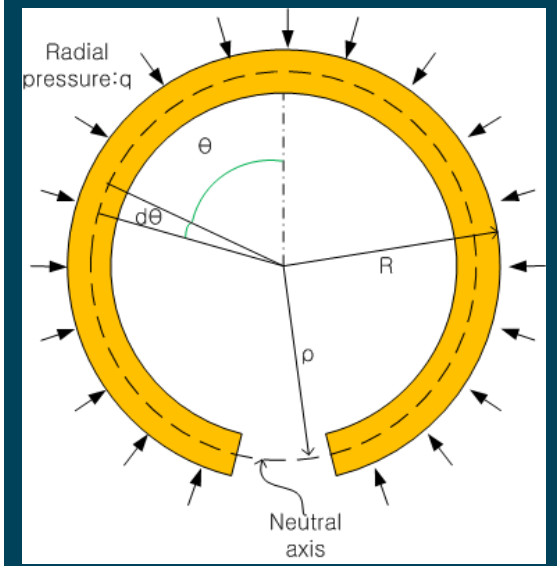
First, to prevent the pin being detached from the socket,
$F_{\mu} > F_{impact}$ … (1)
where F_{impact} *is an impact force by handling.*

Second, to gurantee the contact between pin and PCB,
$F_{\mu} < F_{applied}$ … (2)
where $F_{applied}$ *is an force applied to provide its pin stroke.*

In addition, F_{impact}*= Pin mass x Acceleration where the criterion of acceleration can be experimentally obtained.*

One-Piece Socket Introduction-3

The relation between friction force and contact ring deformation



Assumption:

1. *The neutral axis passes through the centroid of rectangular section.* $\rho \approx R - t/2$ *since* $t \ll R$.
2. *The radial pressure (q) acting on outside surface is uniform.*
3. *The outside shape is always circular.*

$$M = \int_0^{\pi} qh(\rho_2 \sin\theta)\,\rho_2 d\theta = 2qh\rho_2^2$$

$$\frac{M}{I} = E\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right) \quad \text{where } I = \frac{ht^3}{12}$$

$$\therefore q = \frac{EI}{2h\rho_2^2}\left(\frac{1}{\rho_2} - \frac{1}{\rho_1}\right)$$

Finally, Friction force $F_\mu = \mu(2\pi Rqh)$

where

R: the outer radius.
ρ: the radius of curvature to its neutral axis.
t: the thickness of the contact ring.
q: radial pressure
h: ring height
μ: friction coefficient

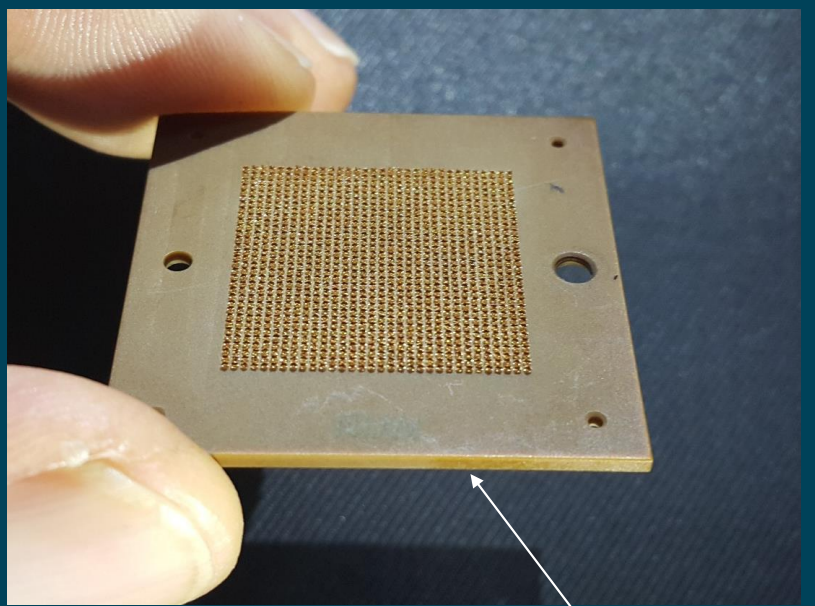
$F_\mu \leftrightarrow R_1 \& R_2$

R_1: contact ring radius before deformation

R_2: contact ring radius after deformation ($R_2 \approx$ socket hole radius)

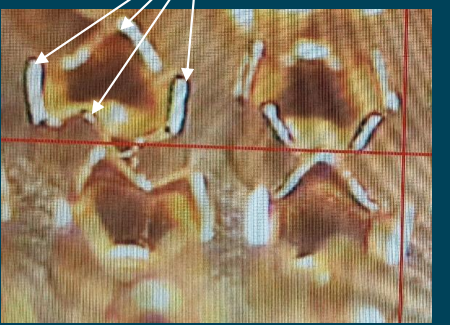
Friction force can be estimated by both radius of socket hole and contact ring.
Pin separating force can be controlled by the friction force.

One-Piece Socket
1024 Pin Count



One-piece housing
(No bottom cover)

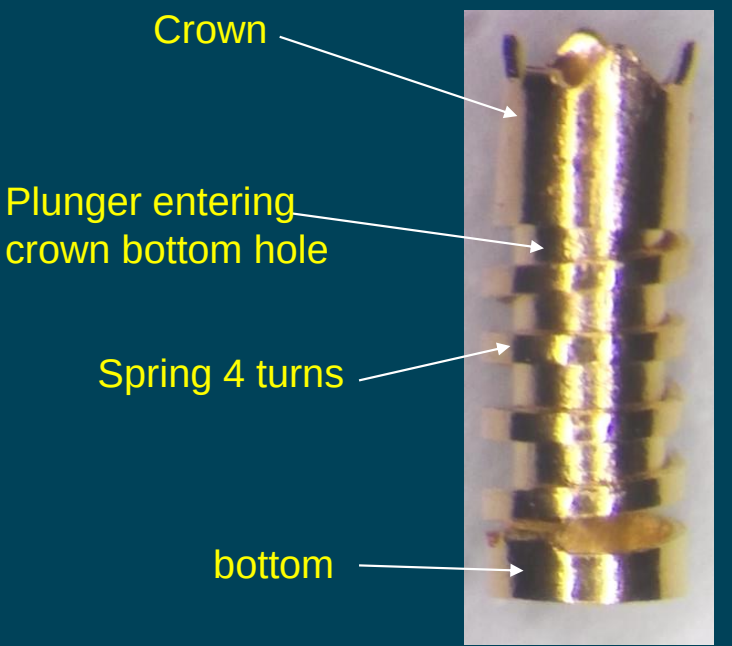
Four tips crown



Case Study For One-Piece Spring Probe Pin

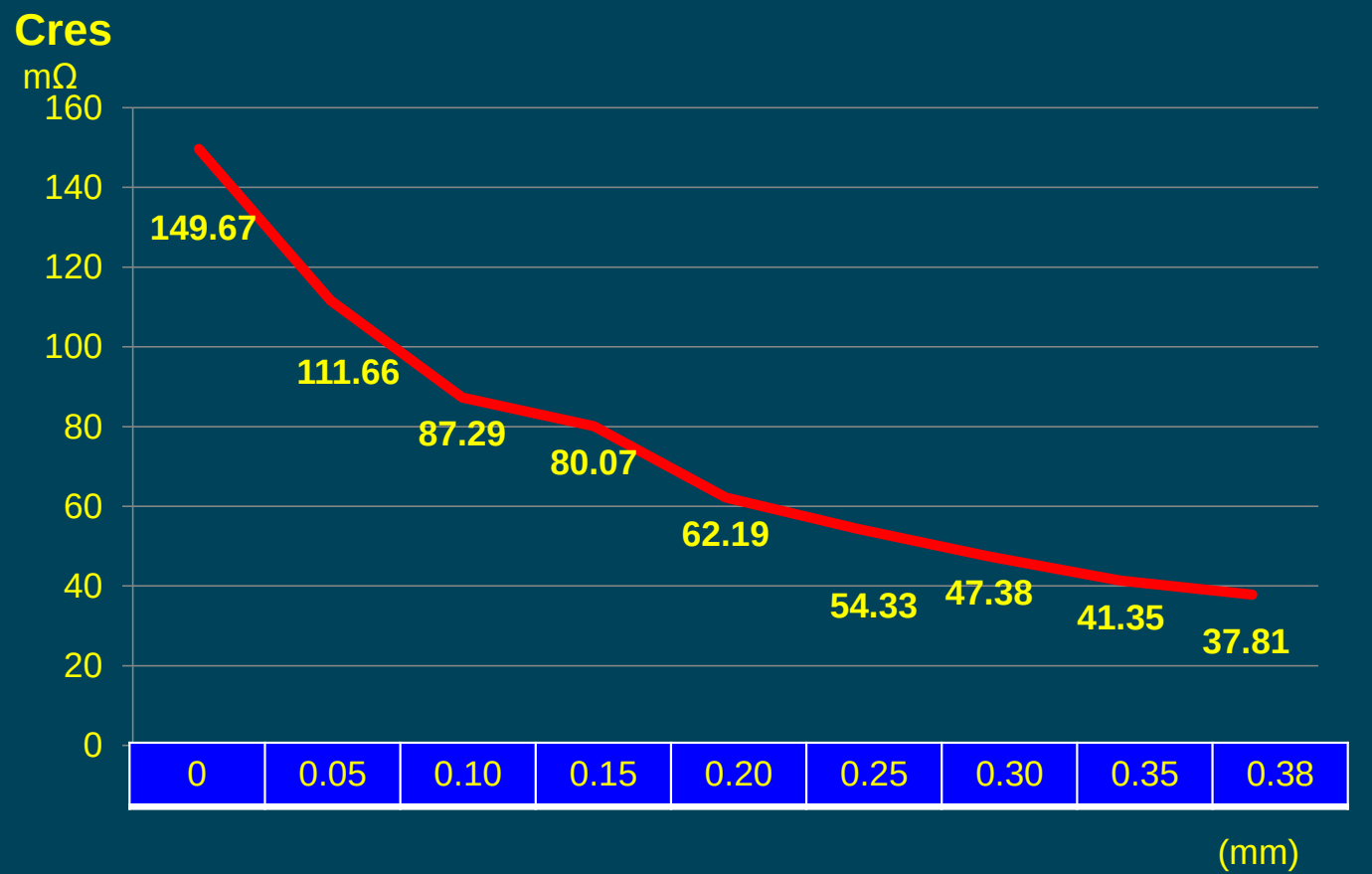
Performance Test

- Spring Probe tested
  - Configuration ; One Piece Pin by stamping
  - Part name ; PPSP55160C4-01
- Tested parameters
  - Spring force/Travelling distance Curve
  - CRES/Spring force
  - Insertion Loss/Return loss
  - Capacitance and Inductance
  - Impedance

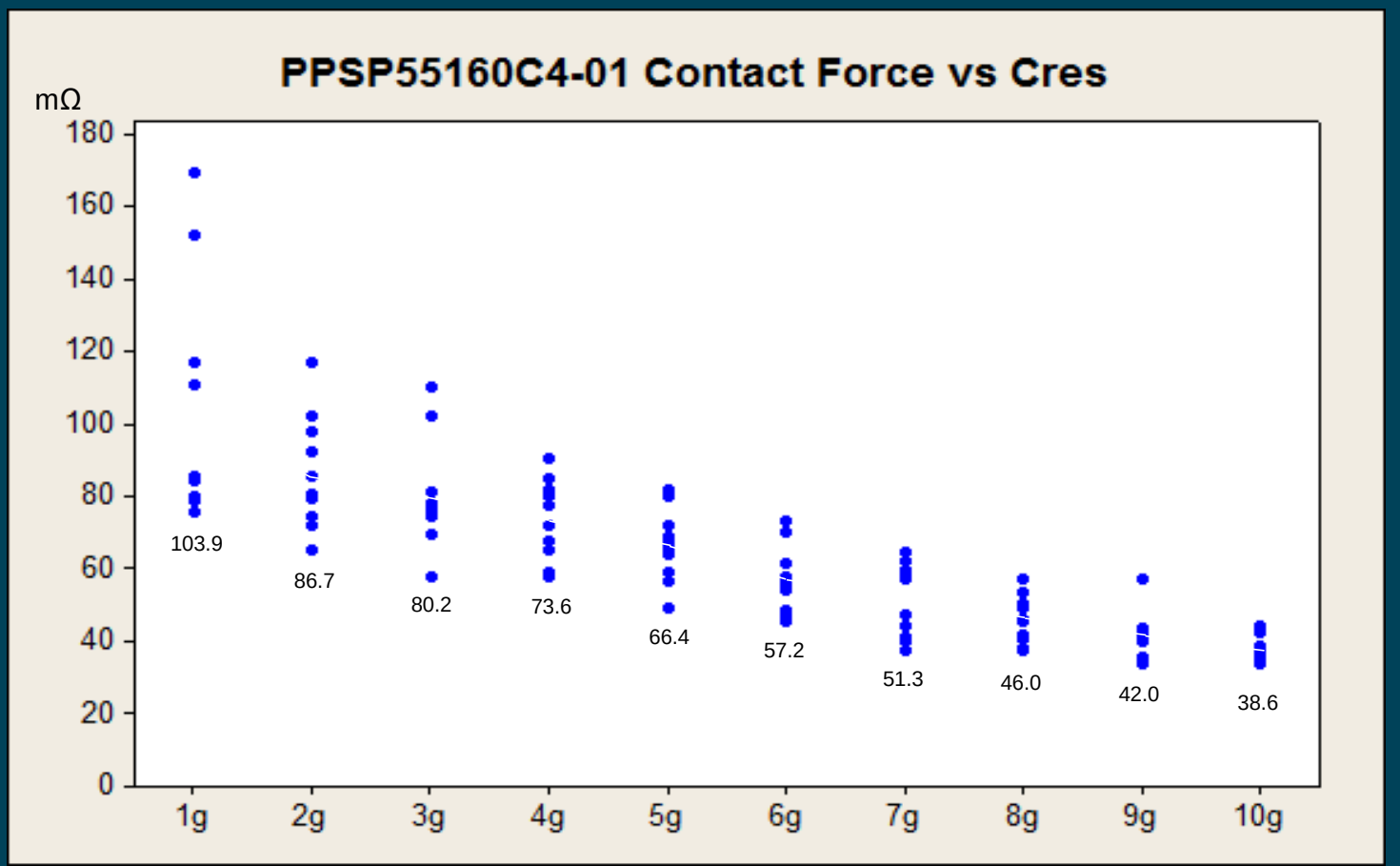


Spring Force / Traveling Distance

Cres Versus Traveling Distance

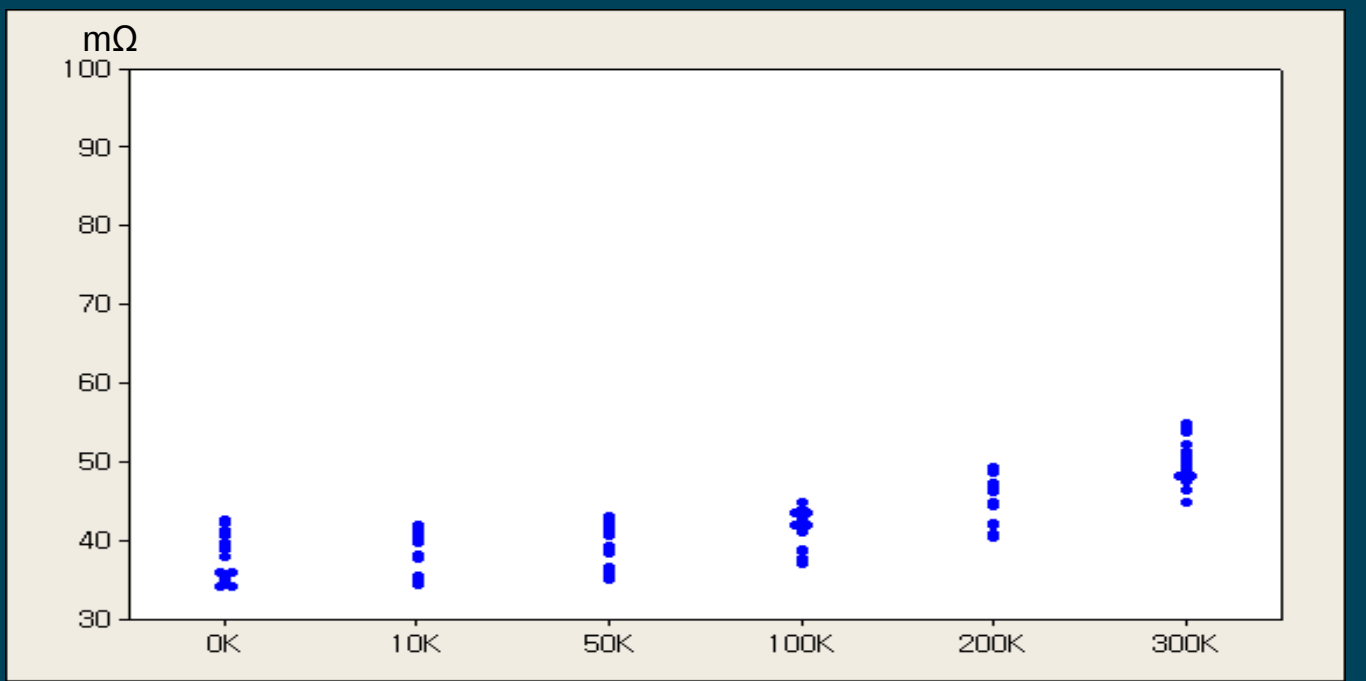


Contact Force / Cres

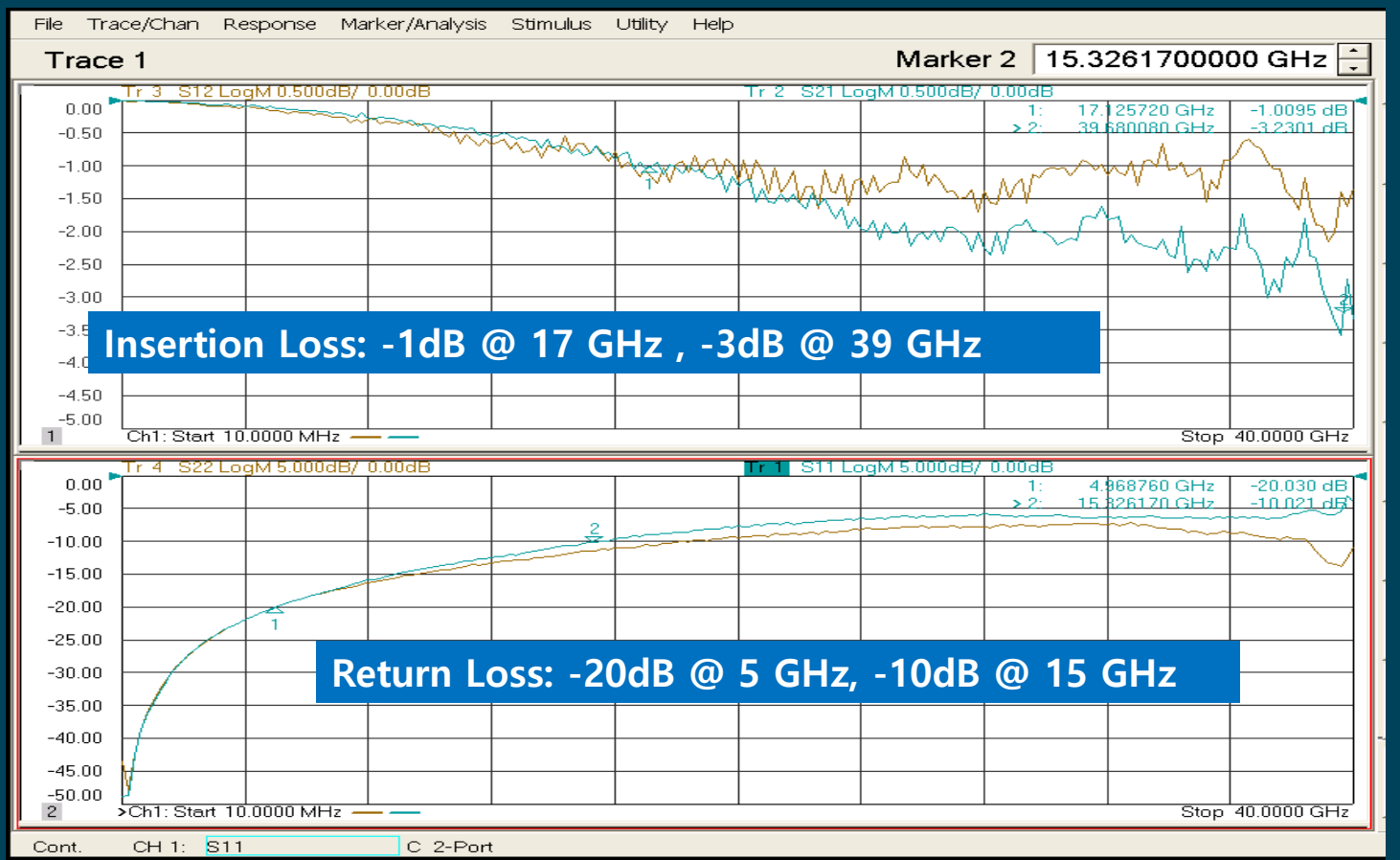


Durability Test

Test condition: 300,000 times of mechanical touch downs
Contacted electrode: Au plated BeCu
Travelling distance: 0.38mm
Sample size: Touched down 20 pins, CRES measured 10 pins only

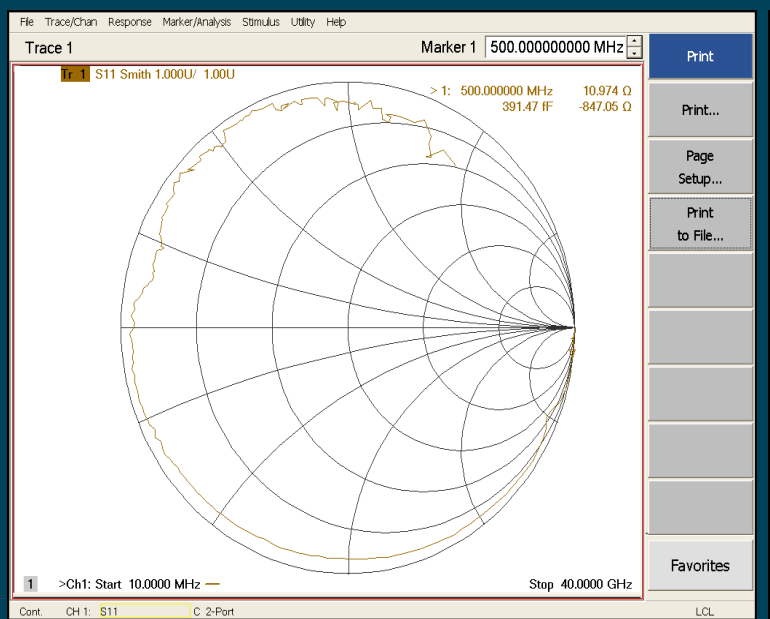


Insertion And Return Loss (GSG Thru)



Capacitance

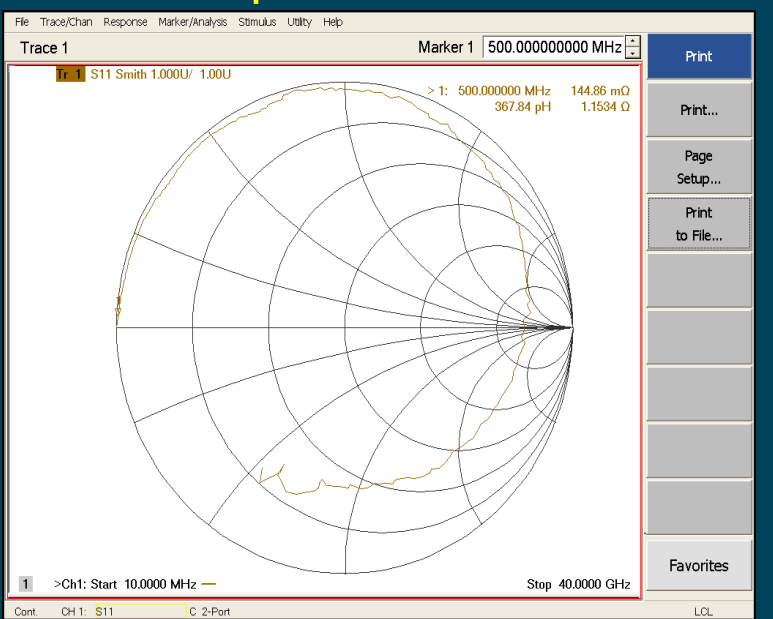
0.391pF @ 500 MHz
GSG open circuit
0.65mm pitch



Inductance

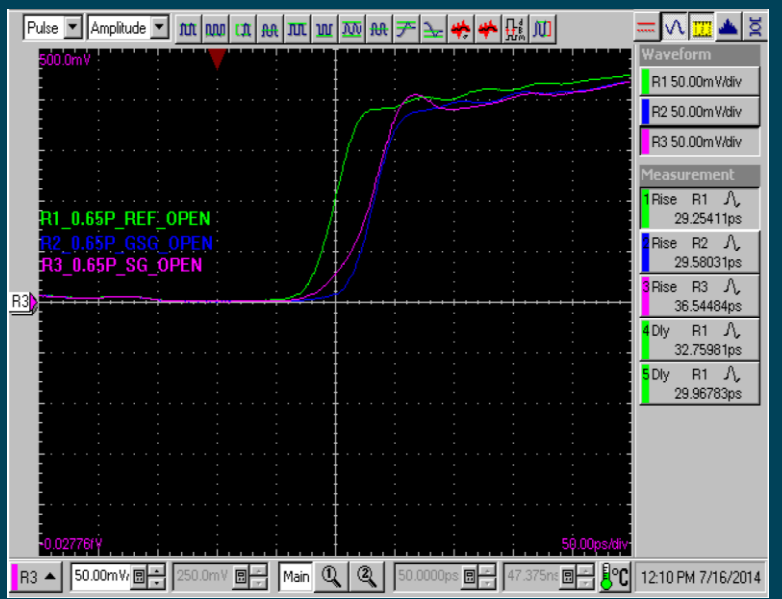
0.368nH @ 500 MHz

GSG Short Circuit
0.65mm pitch



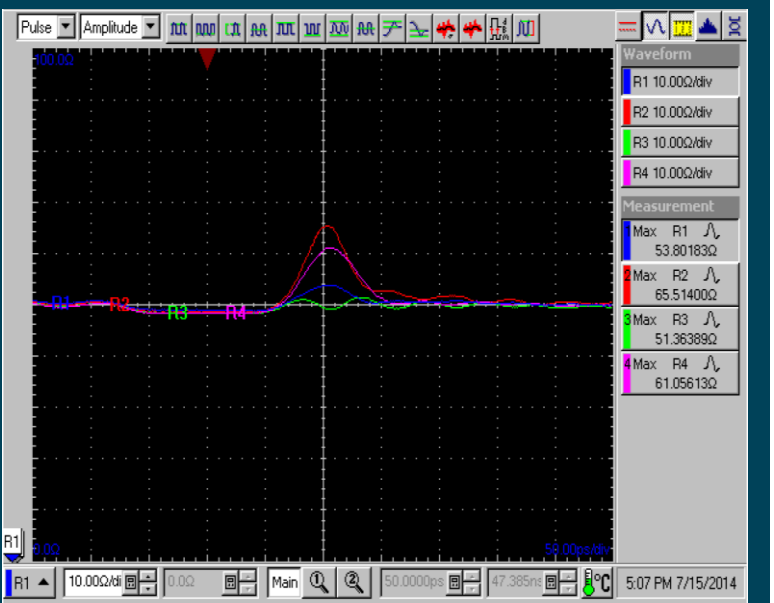
TDR Open Circuit

Ref Rise time : 29.25ps
GSG Rise time : 29.25ps
SG Rise time : 36.54ps
GSG Time delay : 16.38ps



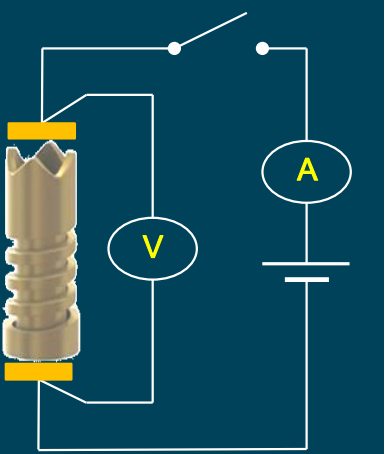
TDR Thru Impedance

0.65P GSG Impedance(max) : 53.80Ω
0.65P SG Impedance(max) : 65.51Ω



Current Carrying Capacity

* Test condition : Ambient temp (25 Degree C)
* Test method : Started from 1Amp and increase 1 Amp by every one minute
* Measure allowable current carrying :
  - Any change in mechanical condition, Contact force
  - Burn
  - Permanent deflection
* Result
  - in 4.0~4.5Amp, contact force was changed
* Conclusion
  - Acceptable 3.0A for one minutes



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	C/F Changed	C/F Changed	C/F Changed	OK	C/F Changed
4.5A				C/F Changed	

Summary And Next Step

- One-piece pin
  - A state of the art stamping technology.
  - Good performance test results.
  - Low manufacturing cost.
- One-piece socket
  - Good structure stiffness even for thinner socket thickness
  - Easy automation for pin insertion
  - Low manufacturing cost
  - Pin separation from socket can be prevented by the friction force against socket wall.
- Next step
  - Smaller sized pin and thinner socket will be developed.
  - One-piece pin and socket technology will replace multi-piece pin and socket applications.