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BiTS

TM

Burn-in & Test Strategies Workshop

March 4 - 7, 2018

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Archive

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Improved contact solutions for WLCSP RF applications

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Twinsolution & GTransi



BiTS Workshop
March 4 - 7, 2018



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Background

RF Test Contactor Type

- Short spring pin
 - Elastomer
 - S-Contactor
 - Membrane Pin
- In order to get a lower inductance, we need the contactor as short as possible.
 - Different technology using different material as the spring, but with a lower compress height.
 - A longer compress travel is needed for RF testing.

5G Vision

Quote from Star Trek:

To boldly go where
no man has gone
before.

$$\text{Total Capacity} = B \times \eta \times N$$

Bandwidth

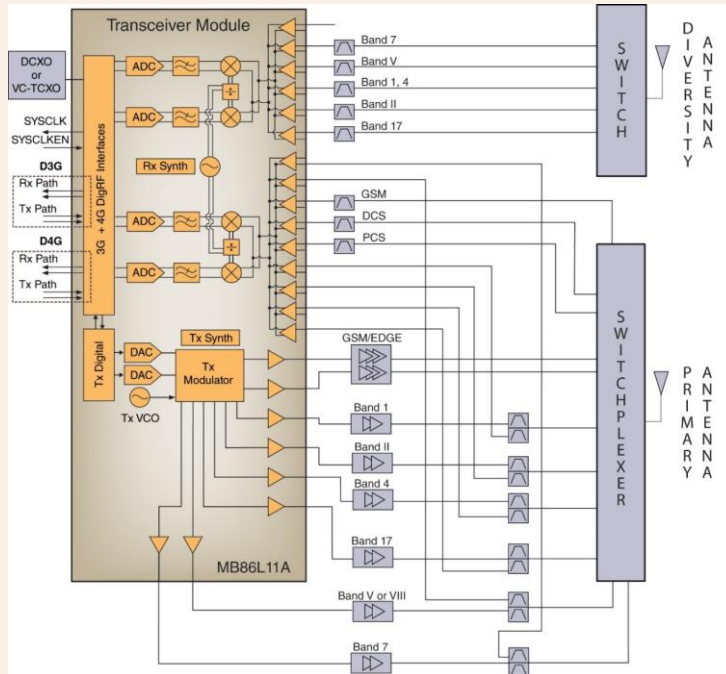
No of stations

spectrum effectiveness

5G NR Standard

Catergeory	Frequency Range
Consideration	TDD Band(3.3GHz -4.6GHz) (Time Division Duplexing)
Researching	24.25-27.5 31.8-33.4 37-43.5 45.4-50.2 50.4-52.6 66-76 81-86
North America	27.5-28.35 37-38.6 38.6-40 64-71

An Typical Diagram of Mobile Phone

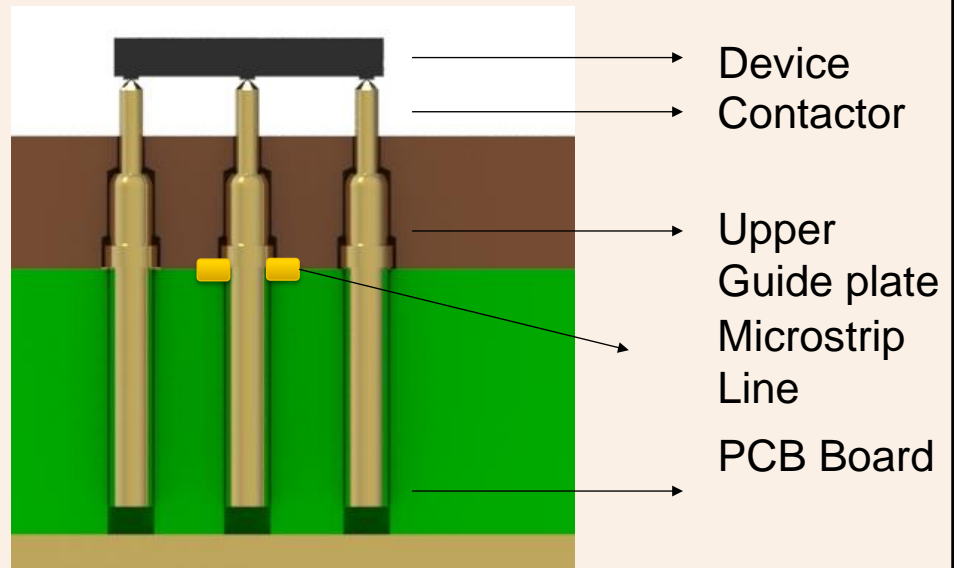
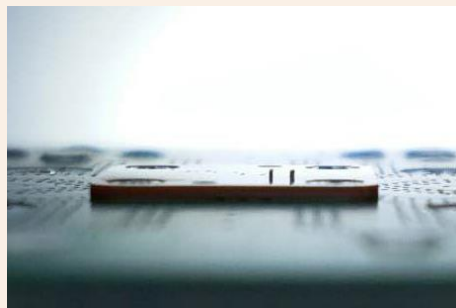


- 5 Mode/ 13 Band
- 2G
 - GSM: 850/900/1800/1900
- 3G (WCDMA /TD)
 - WCDMA: 2100MHz/1900MHz/850MHz
 - TD-SCDMA: 1880-1920MHz/2010-2025MHz
 - CDMA2000: 1920-1935MHz/2110-2125MHz
- 4G
 - TDD-LTE: 1900MHz/2300MHz/2600MHz
 - FDD-LTE: 1800MHz/2600MHz

http://eecatalog.com/bindra/wp-content/uploads/2012/03/RF-Microwave-Tracker-March-3-Fujitsu-MB86L11A_block-diagram.jpg

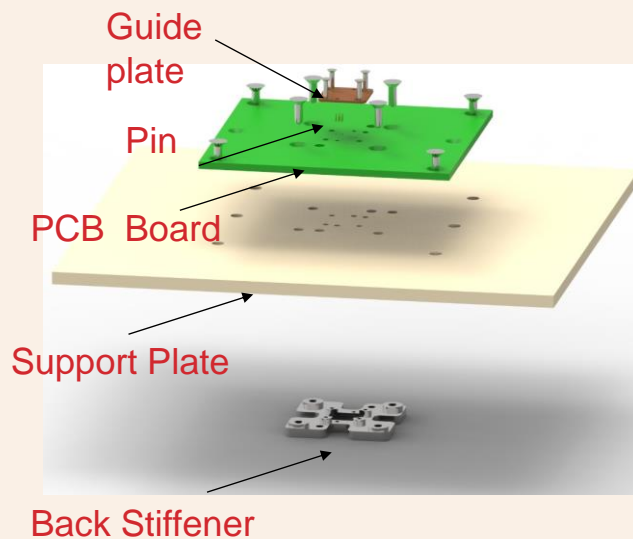
1st Generation Socket Structure

Patent Pending

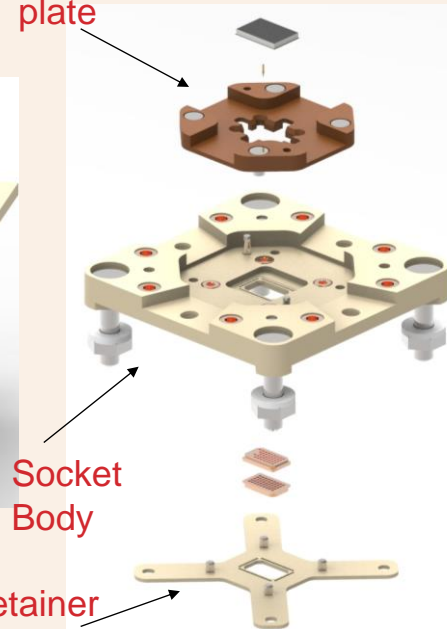


Helius Pin Socket Vs. Traditional Socket

Helius Pin Socket



Guide plate



Traditional Socket

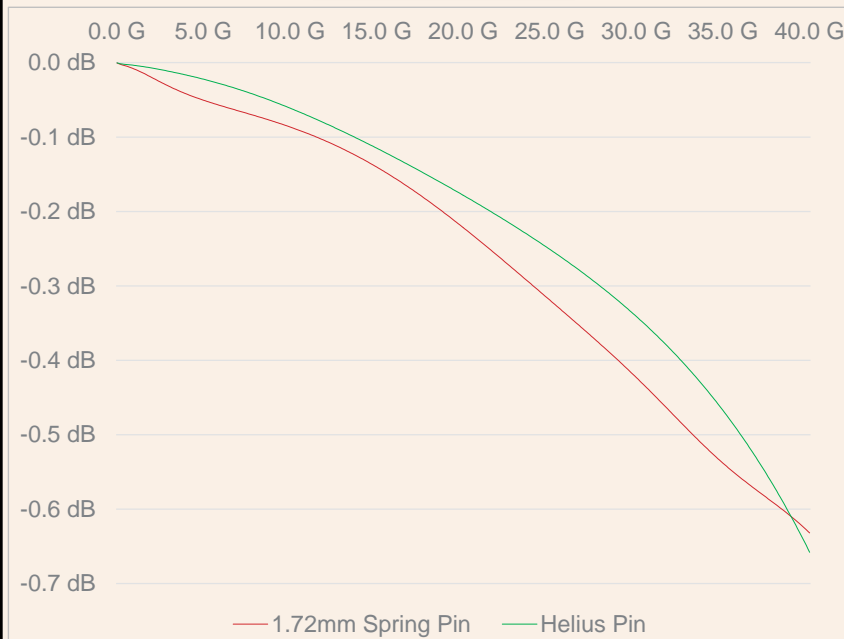


Material: BeCu/Gold plating
Crown Diameter: $\varnothing 0.14\text{mm}$
Plunger Diameter: $\varnothing 0.29\text{mm}$
Flange Diameter: $\varnothing 0.33\text{mm}$
Flange to Crown: 0.97mm

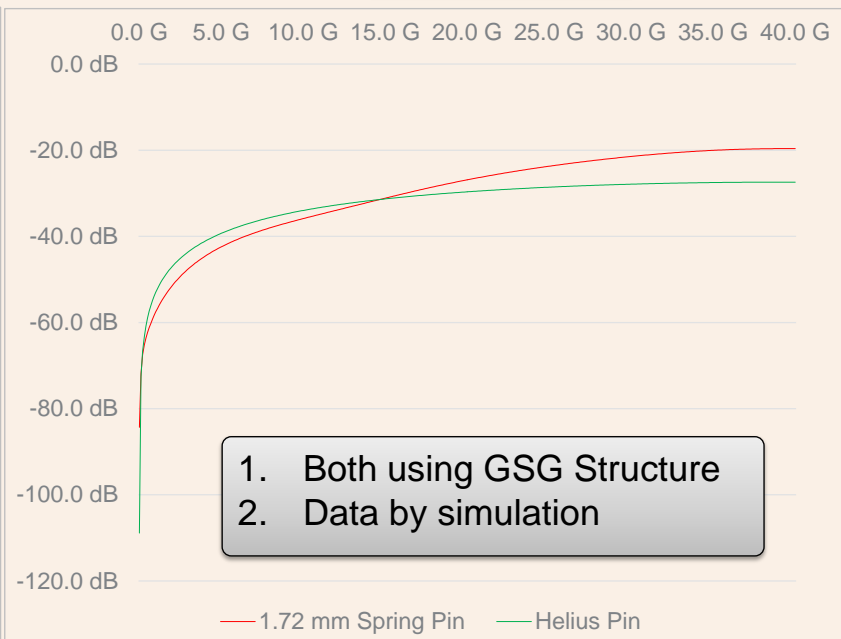
Material: BeCu /Gold Plating
Length: 0.45mm
Plunger Diameter: $\varnothing 0.14\text{mm}$
Tip Radius: Full Radius

Study of S-Parameter

Insertion Loss



Return Loss

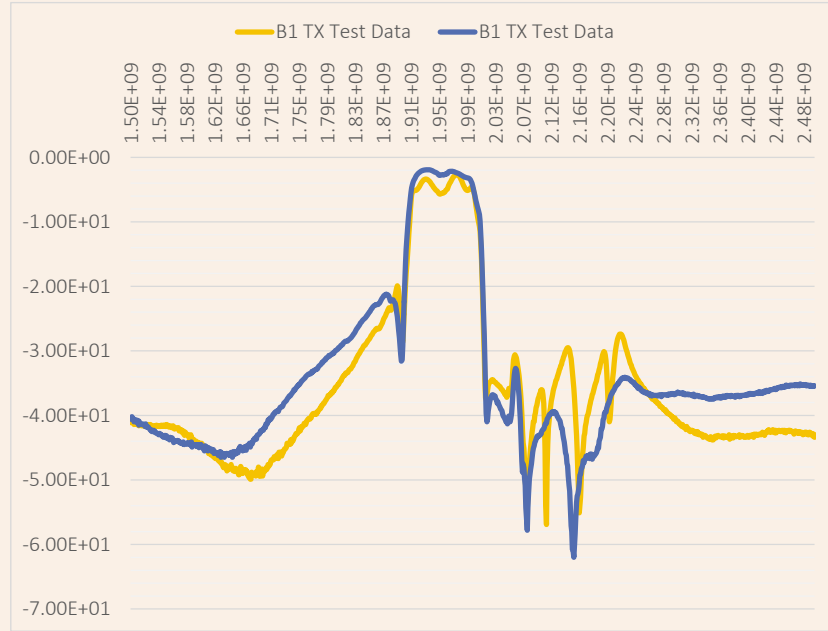
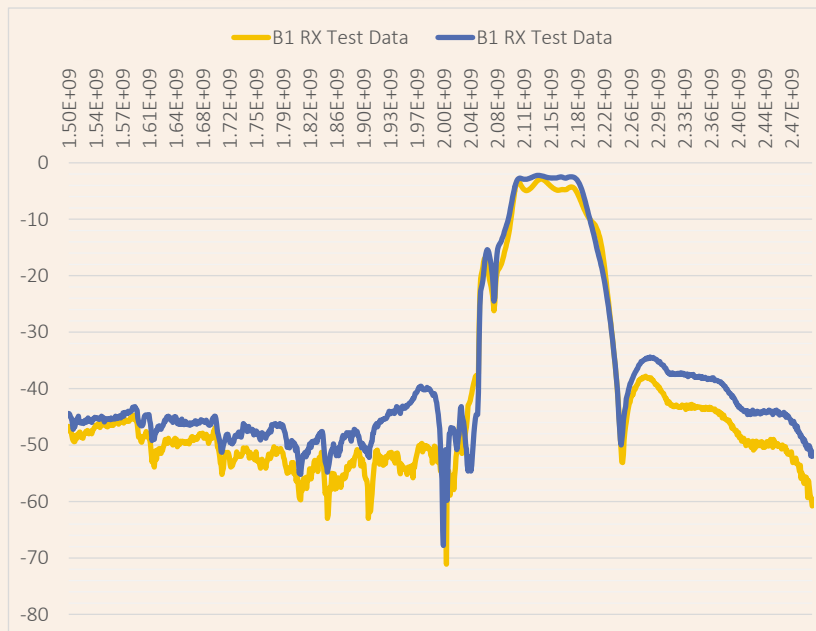


1. Both using GSG Structure
2. Data by simulation

Production Test Data

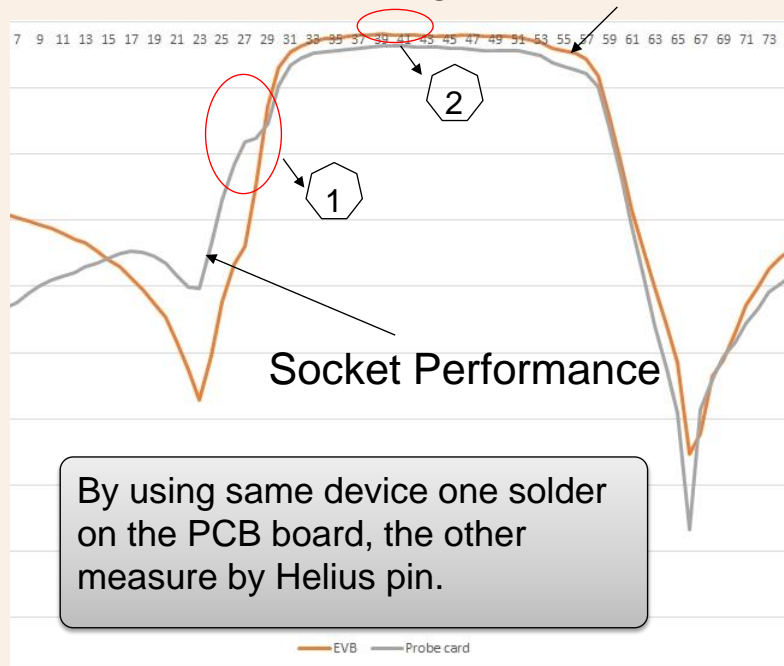
1.72mm Pin Vs Helius Pin

By using same device
different socket structure
to measure.

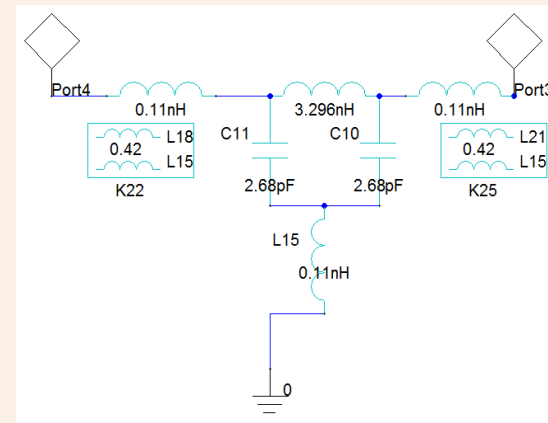


Further Discussion

Soldering on Evaluation Board

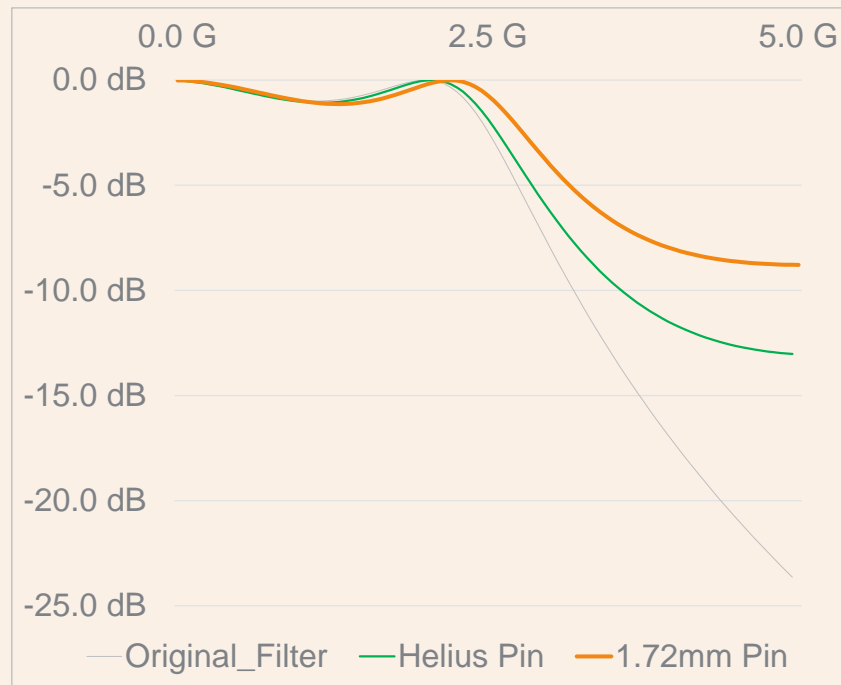


1. Out-band suppression
2. Gain loss



In order to study the impact of contactors to the device, we create a pi type low pass filter, and insert the pin into the filter to compare.

Further Discussion



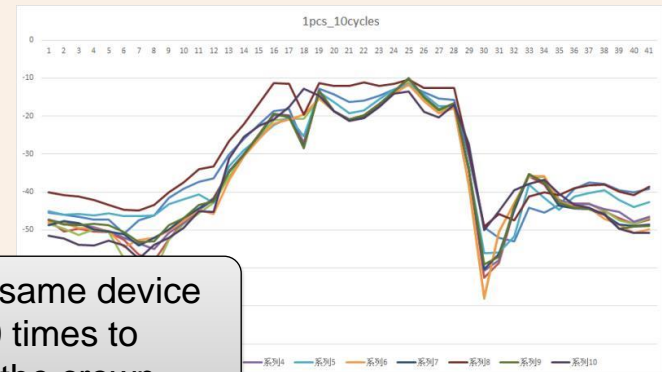
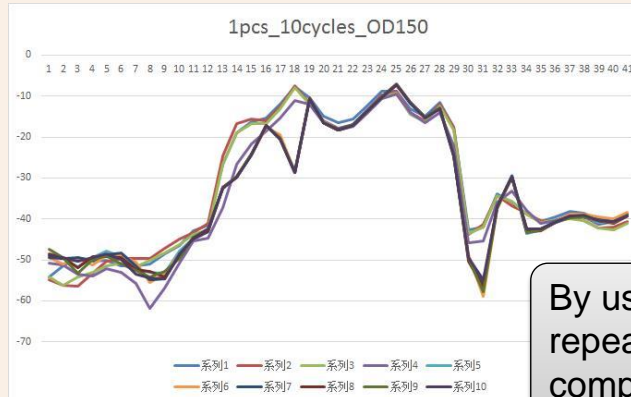
	1.72mm Pin	Helius Pin
Self Inductance	0.31nH	0.11nH
Mutual Inductance	0.124nH	0.042nH

1. The lower grounding inductance, the lower Out-band suppression
2. High contact resistance significantly related to gain loss.

Contact Tip Study



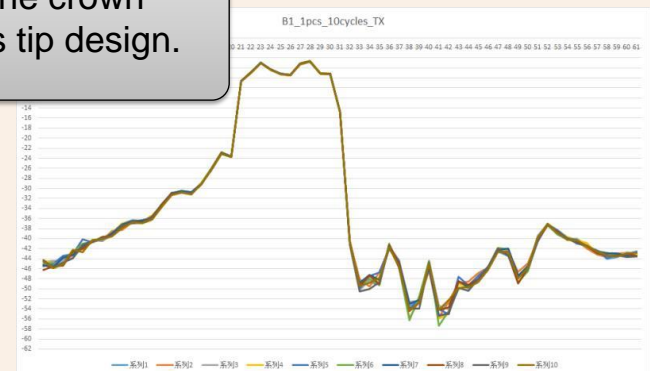
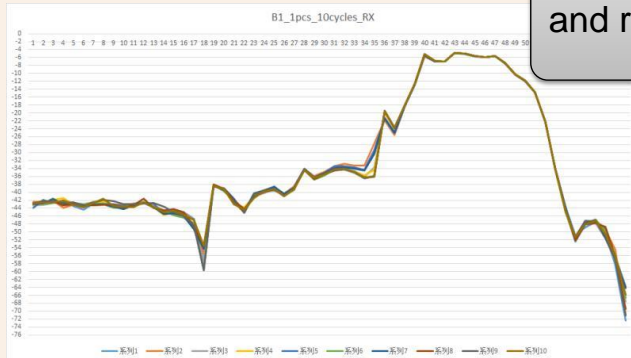
Radius



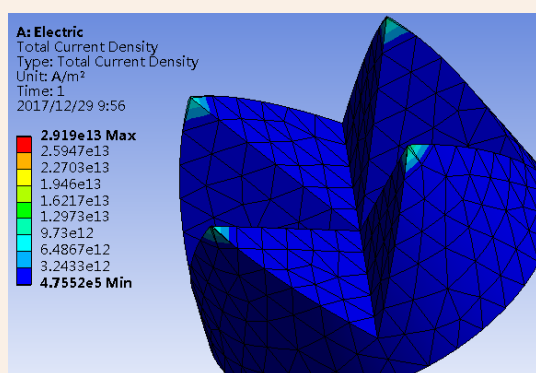
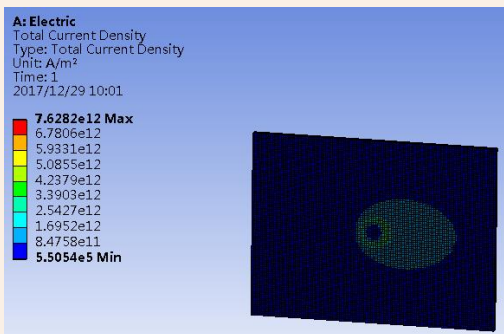
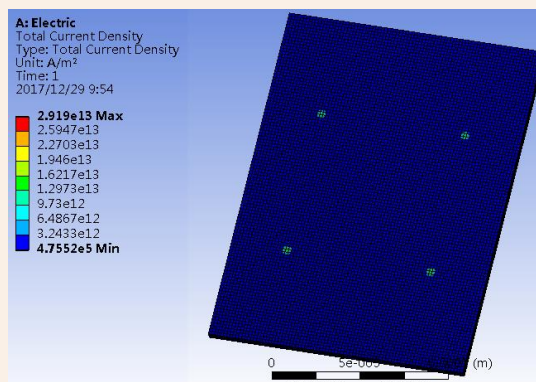
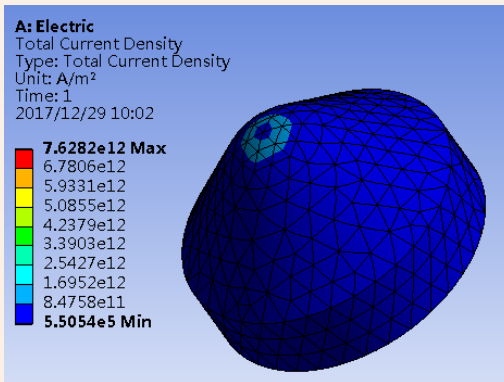
By using same device repeat 10 times to compare the crown and radius tip design.



Crown

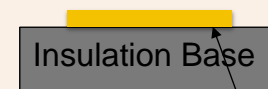


Contact Current Density Analysis



1. Crown has a better current path compare with radius point, the four constriction point, utilize the space optimized.
2. Radius contact has 3 times current density when we look at the constriction area.

Pad Structure

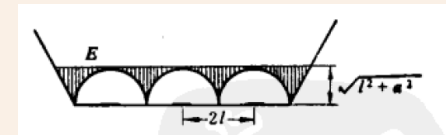


1 μ m gold pad

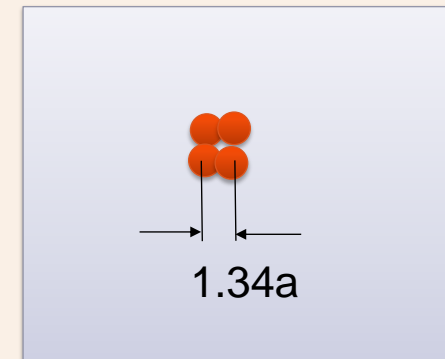
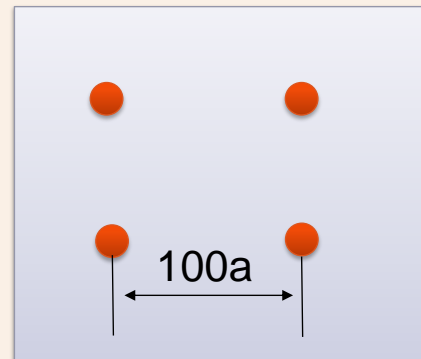
Improved contact solutions for WLCSP RF applications

n Spot Constriction Discussion

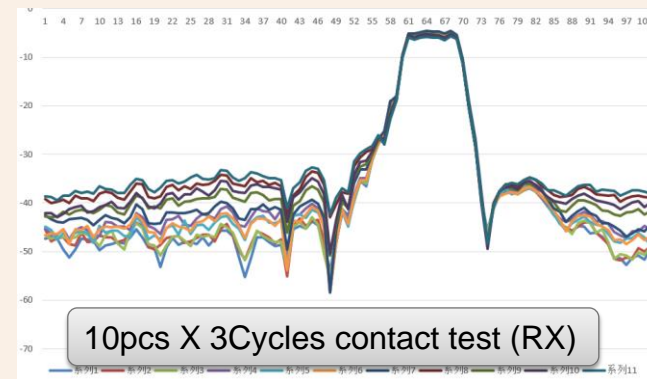
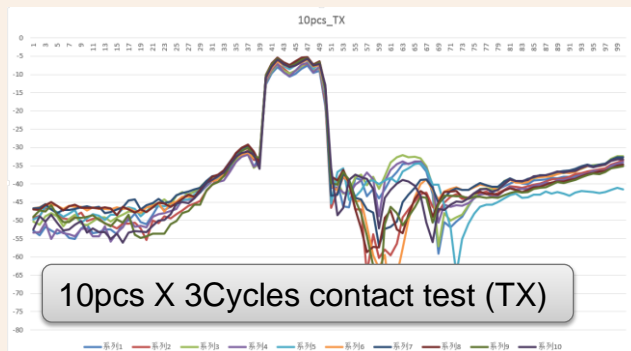
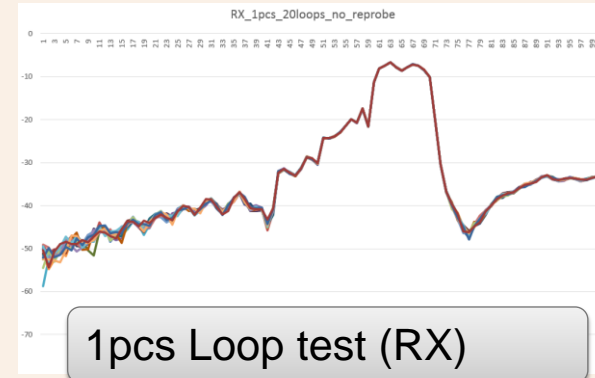
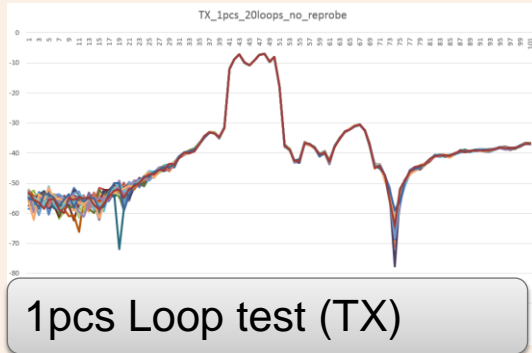
$$R(n, l, a) = \frac{\rho}{2\pi na} \arctan \frac{\sqrt{l^2 - a^2}}{a}$$



R: Constriction Resistance
 n: 4
 L: Distance between different
 constriction point
 a: Constriction radius

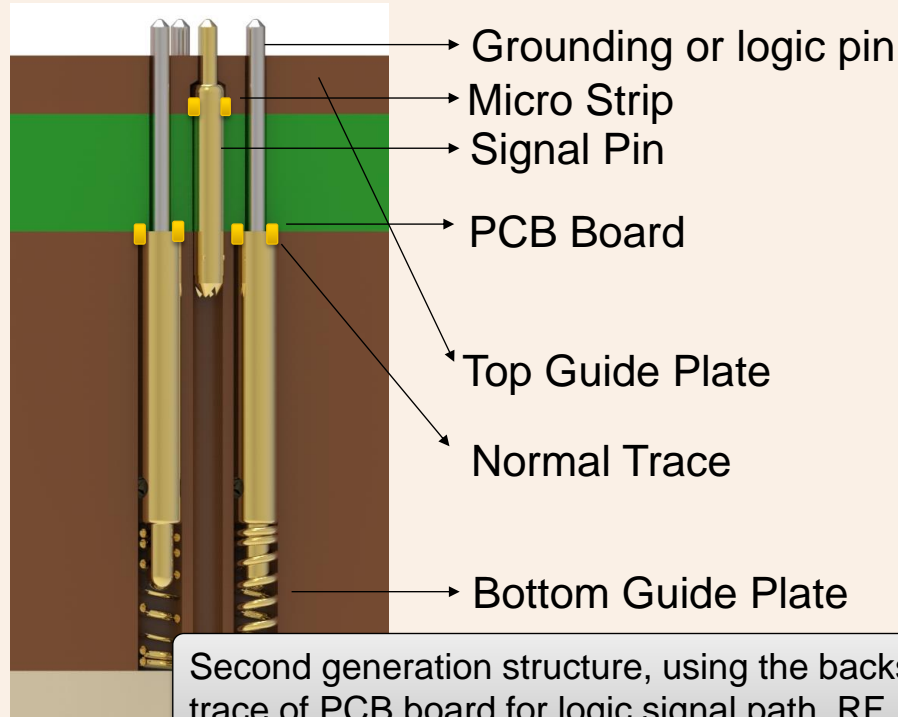


Contactor Performance Test

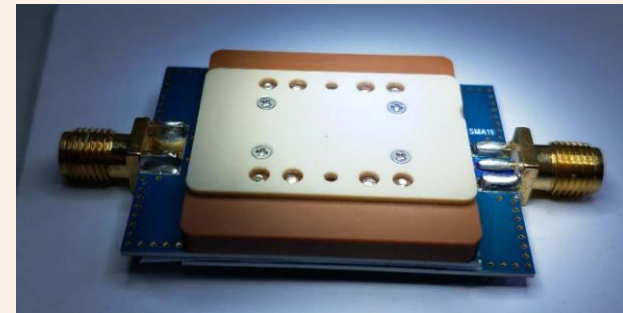


Patent Pending

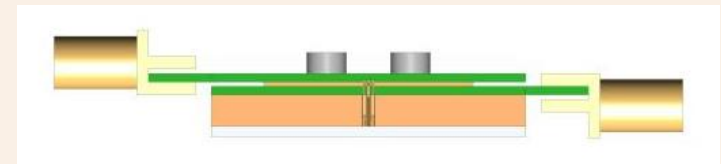
2nd Generation Proto Type



Second generation structure, using the backside trace of PCB board for logic signal path, RF signal still go with the top layer trace.

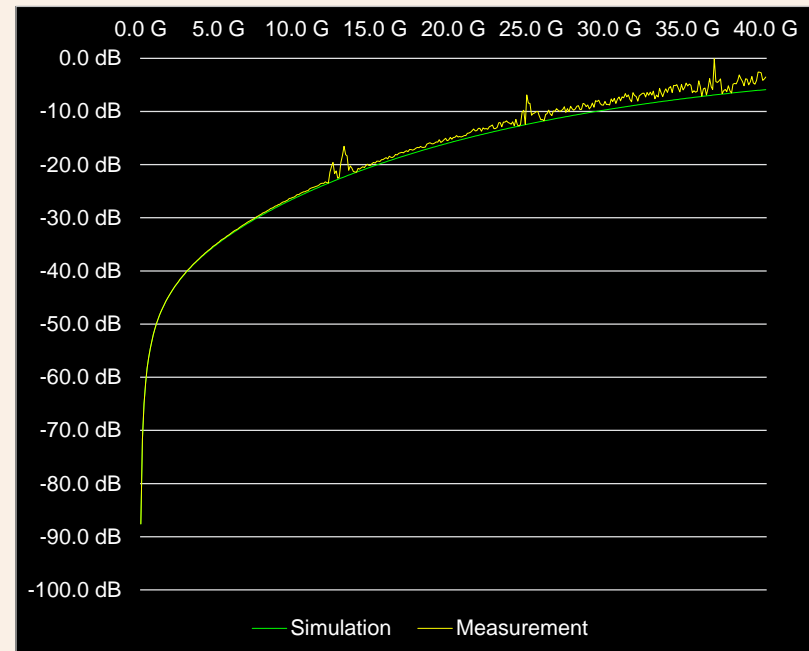
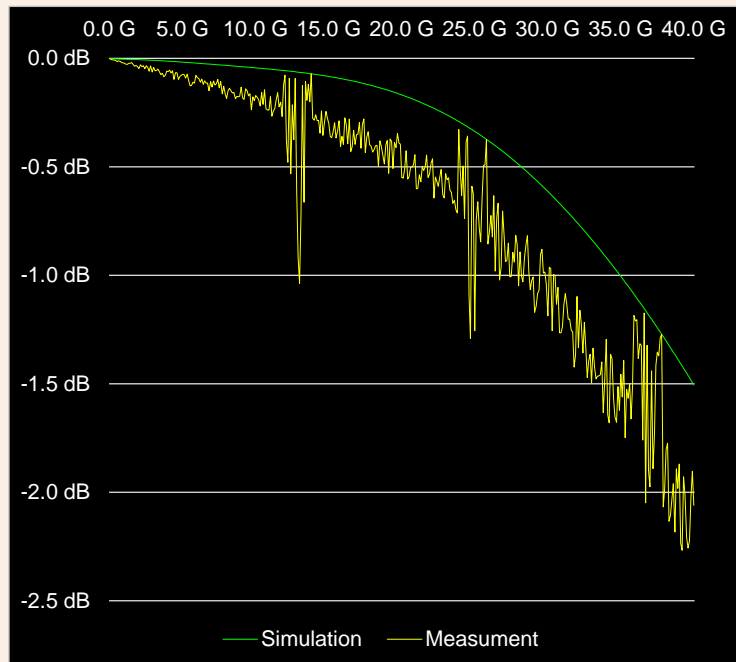


Test Board



Improved contact solutions for WLCSP RF applications

S-Parameter Simulation and Measurement



Summary & Discussion

- Introduce a new design concept for integrated with PCB board in order to reduce contactor inductance, and signal to signal isolation
- Discuss the pin contact performance and inductance impact to filter application.
- Introduce 2nd generation of the design in order to improve the socket pin count to around 100 pieces.