NINETEENTH ANNUAL

# BiTS

Burn-in & Test Strategies Workshop™

**March 4 - 7, 2018**

**Hilton Phoenix / Mesa Hotel**
**Mesa, Arizona**

# Archive

# Improved contact solutions for WLCSP RF applications

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**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.

Total Capacity= B X η X N

Bandwidth

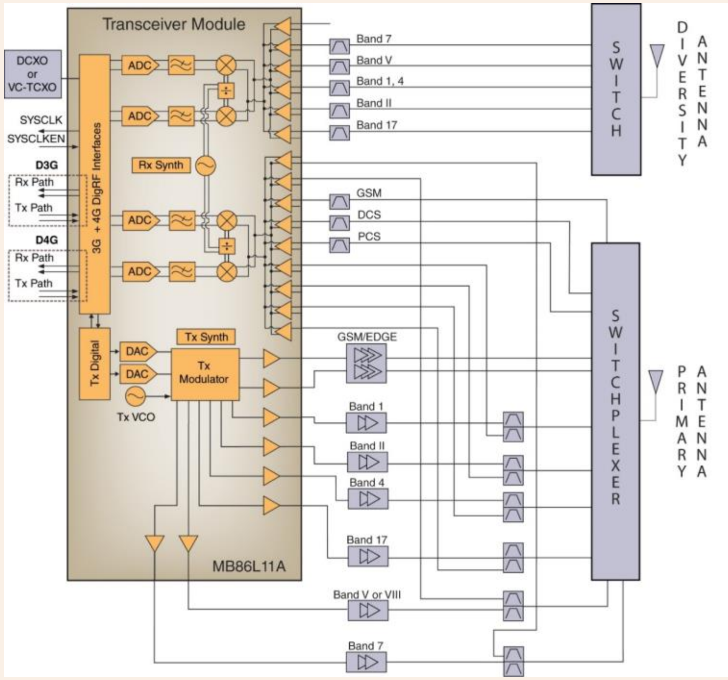
spectrum effectiveness

No of stations

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

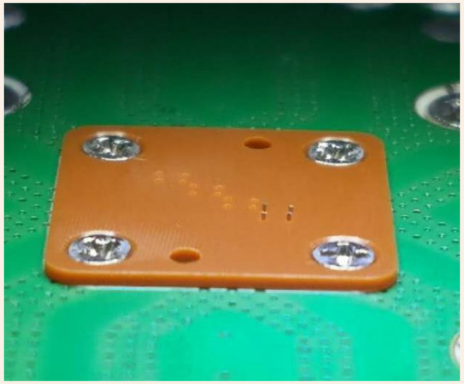


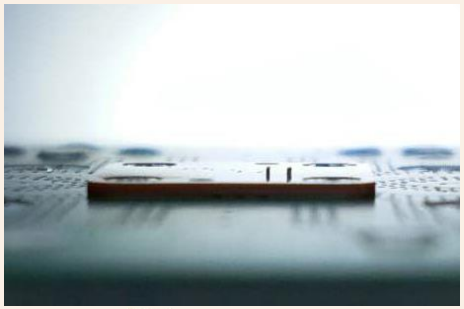

- 5 Mode/ 13 Band
- 2G
  - GSM：850/900/1800/1900
- 3G (WCDMA /TD)
  - WCDMA：2100MHz/1900MHz/850MHz
  - TD-SCDMA:1880-1920MHz/2010-2025MHz
  - CDMA2000：1920-1935MHz/2110-2125MHz
- 4G
  - TDD-LTE：1900MHz/2300MHz/2600MHz
  - FDD-LTE：1800MHz/2600MHz

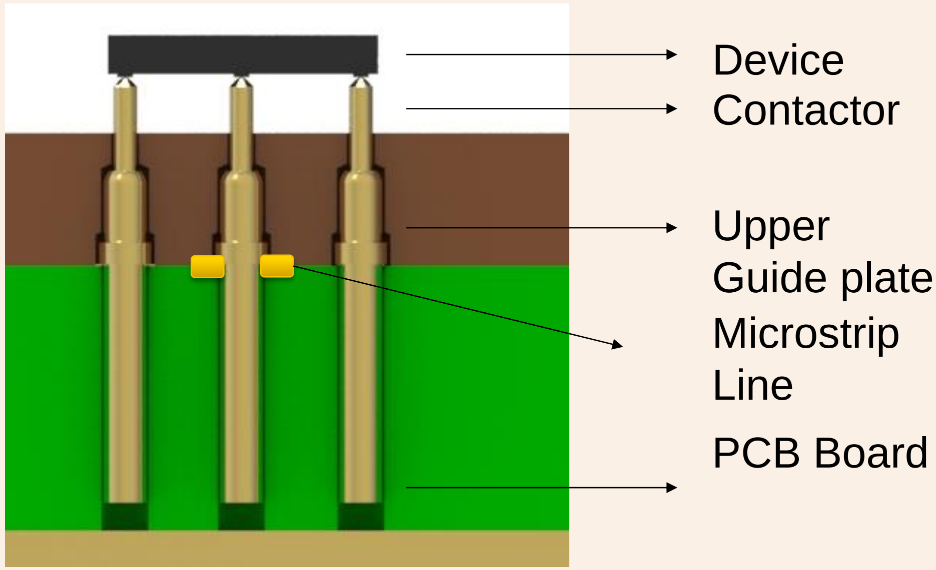
http://eecatalog.com/bindra/wp-content/uploads/2012/03/RF-Microwave-Tracker-March-3-Fujitsu-MB86L11A_block-diagram.jpg

Patent Pending

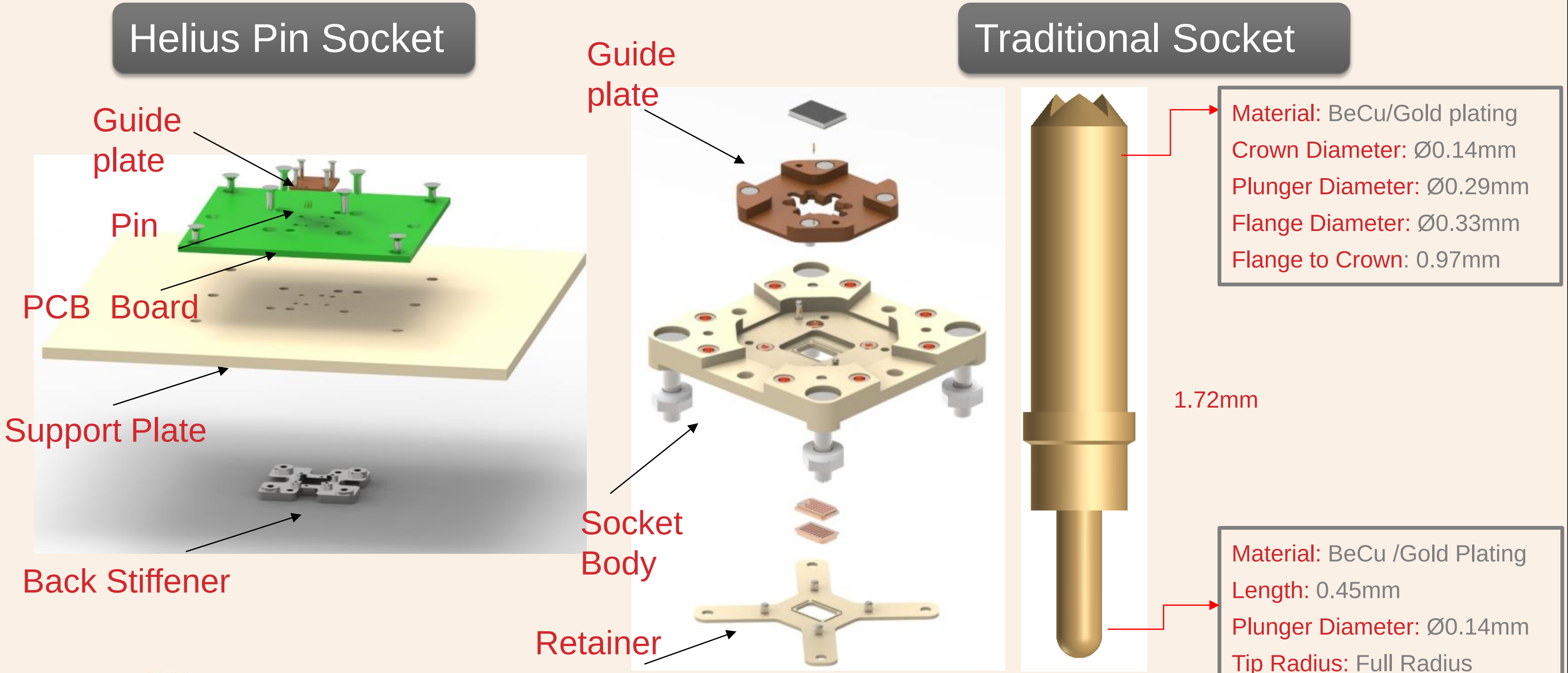
# 1st Generation Socket Structure







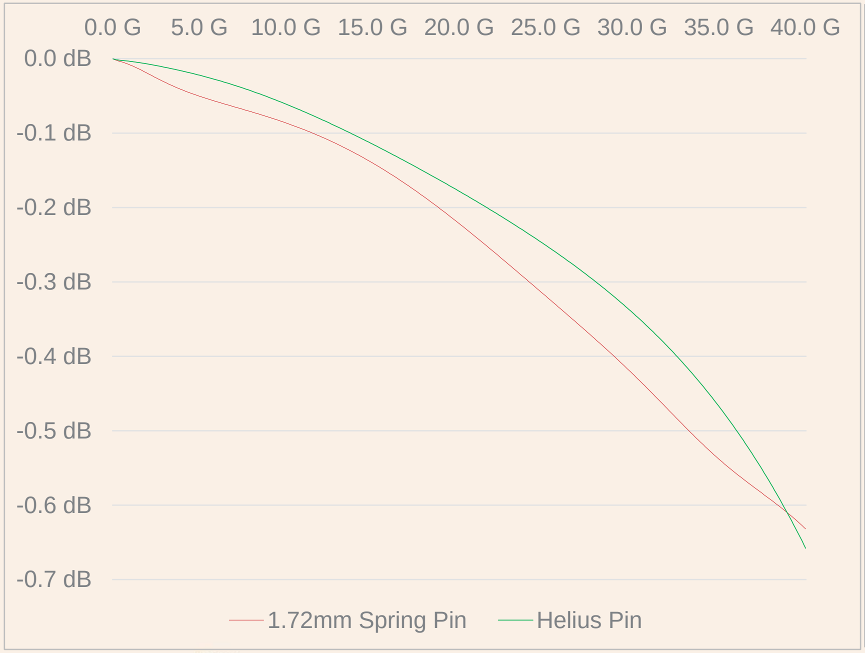
# Helius Pin Socket Vs. Traditional Socket



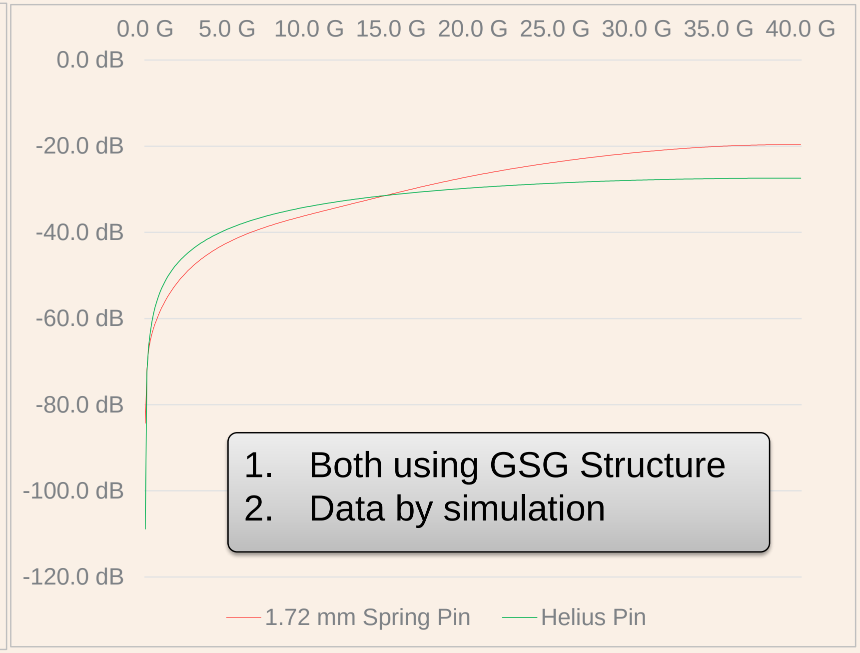

Improved contact solutions for WLCSP RF applications

# Study of S-Parameter

Insertion Loss




Return Loss

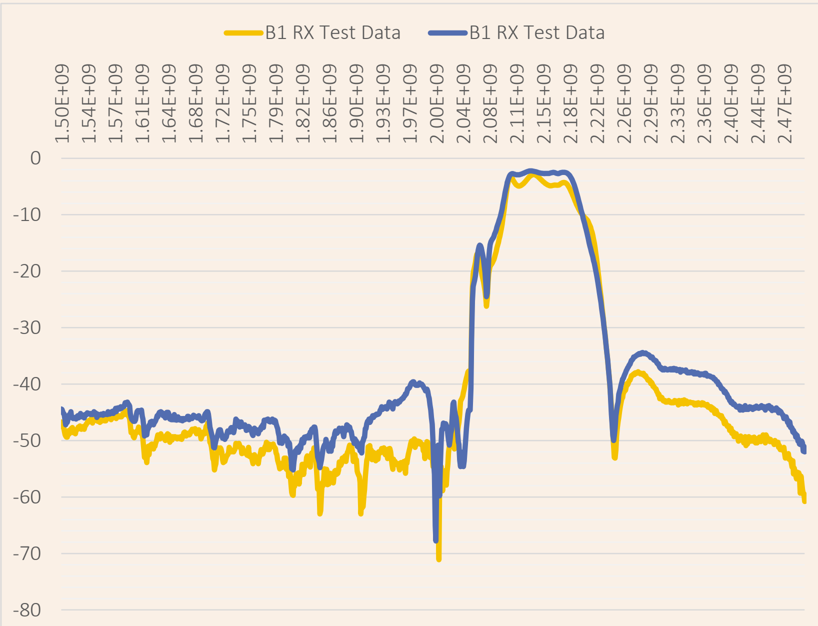


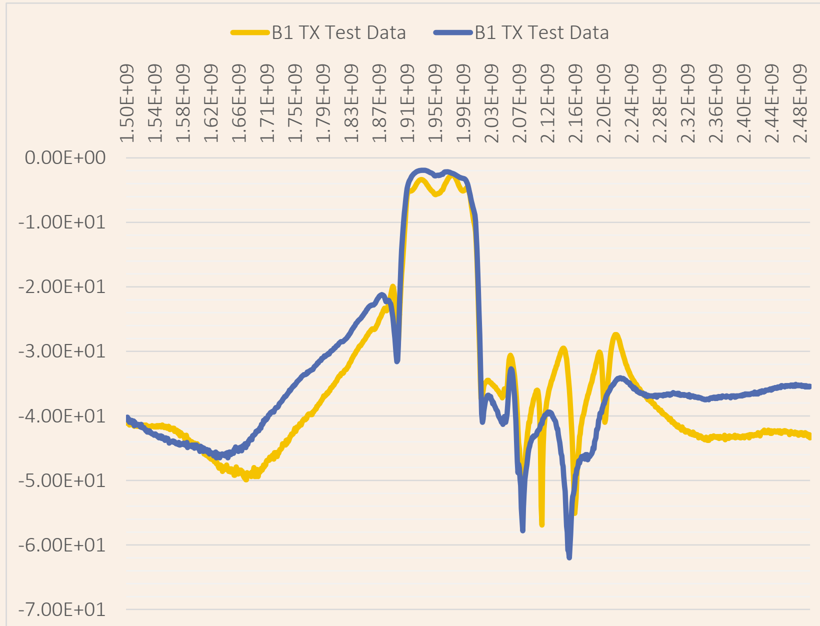

1. Both using GSG Structure
2. Data by simulation

## Production Test Data

By using same device different socket structure to measure.

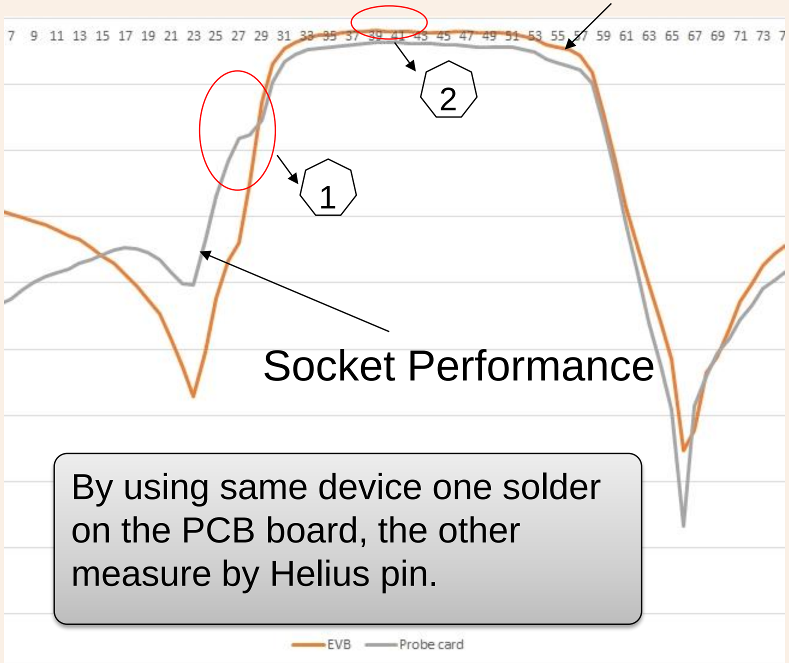
1.72mm Pin Vs Helius Pin



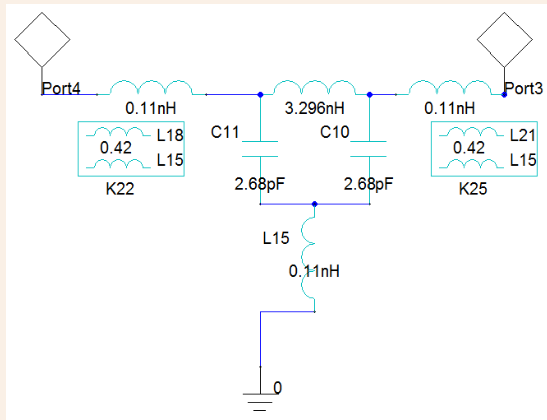
# Further Discussion

Soldering on Evaluation Board



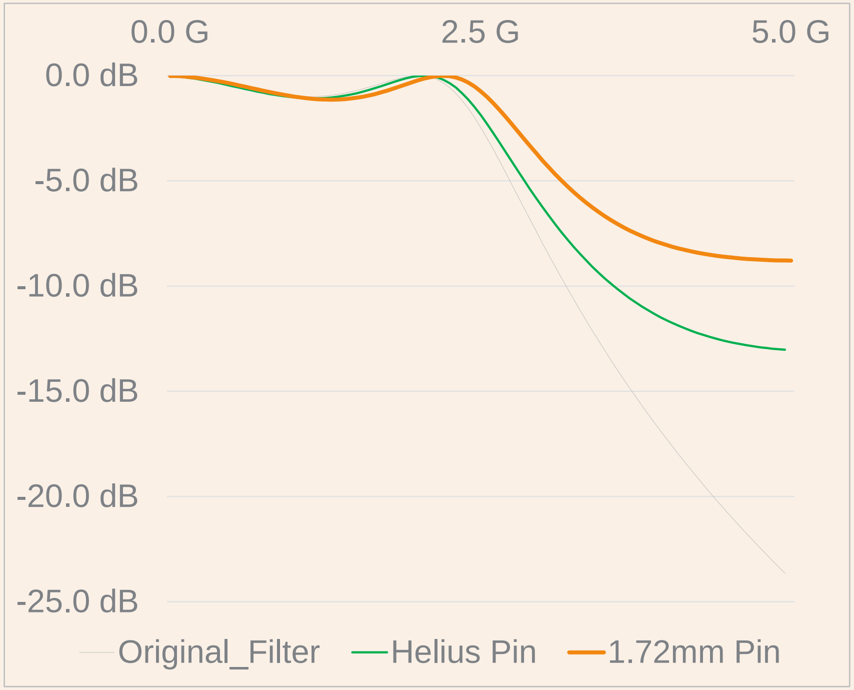

By using same device one solder on the PCB board, the other measure by Helius pin.

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



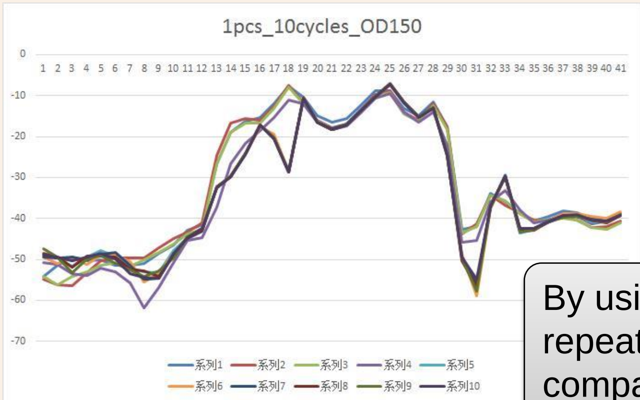

| | 1.72mm Pin | Helius Pin |
|---|---|---|
| Self Inductance | 0.31nH | 0.11nH |
| Mutual Inductance | 0.124nH | 0.042nH |

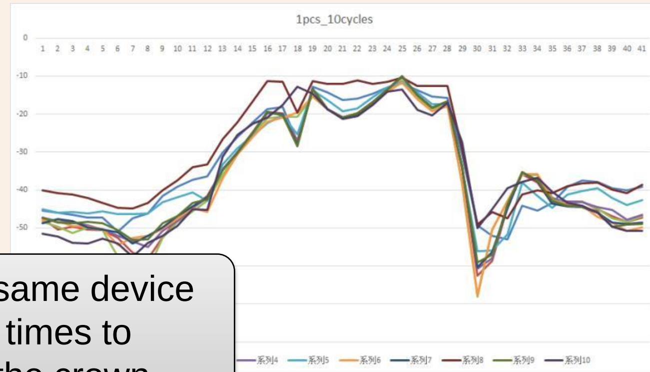
1. The lower grounding inductance, the lower Out-band suppression
2. High contact resistance significantly related to gain loss.

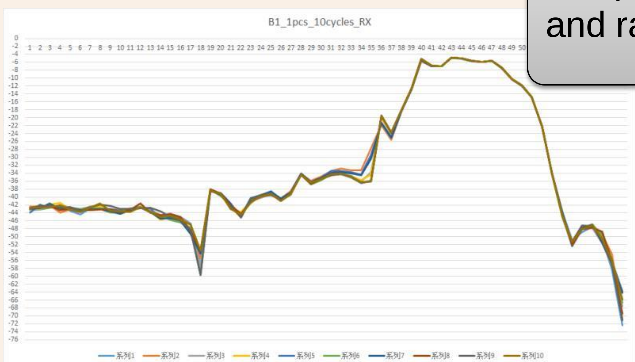
# Contact Tip Study

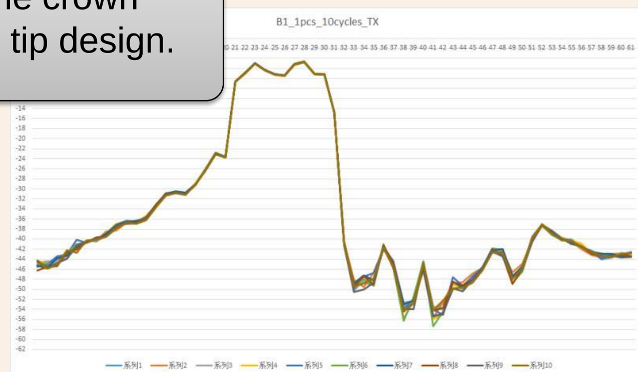
Radius

Crown



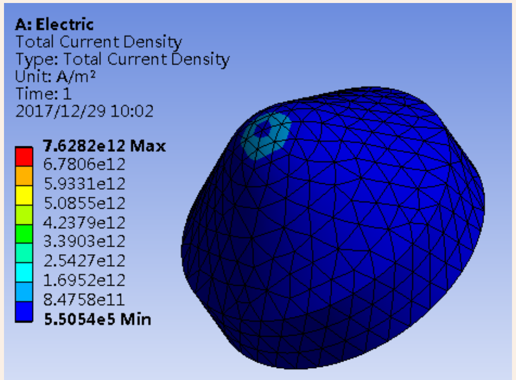



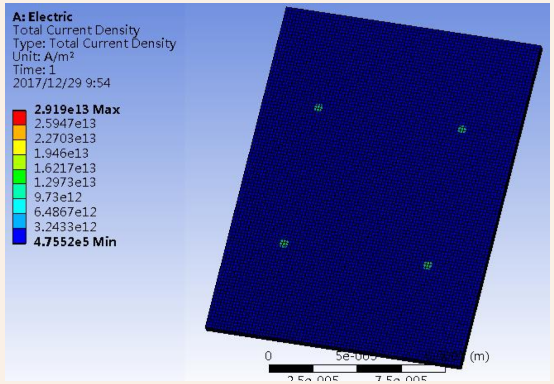



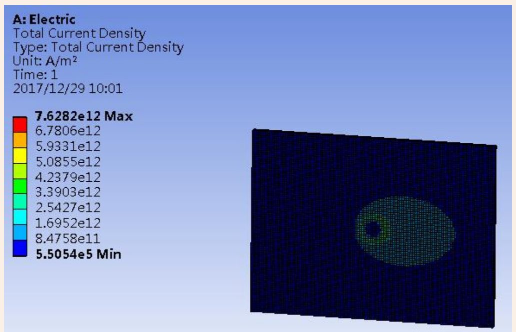



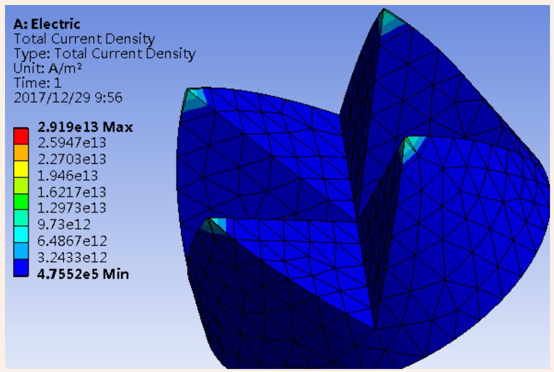

By using same device repeat 10 times to compare the crown and radius tip design.

# Contact Current Density Analysis



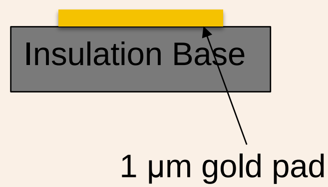



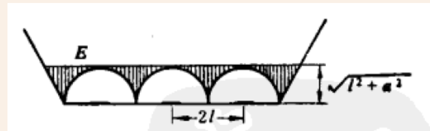

1. Crown has a better current path compare with radius point, the four constriction point, utilize the space optimized.
2. Radius contact has 3 times current density when we look at the constriction area.

Pad Structure

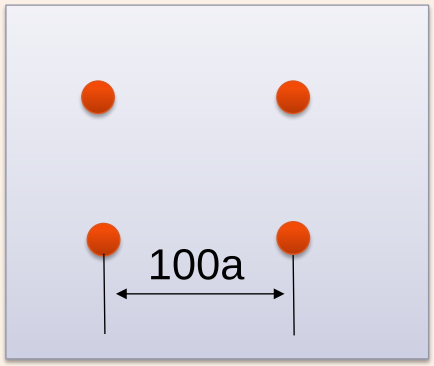


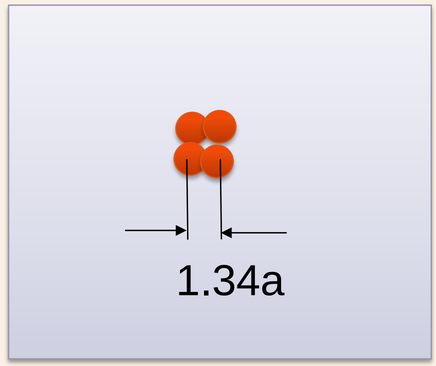
## n Spot Constriction Discussion

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

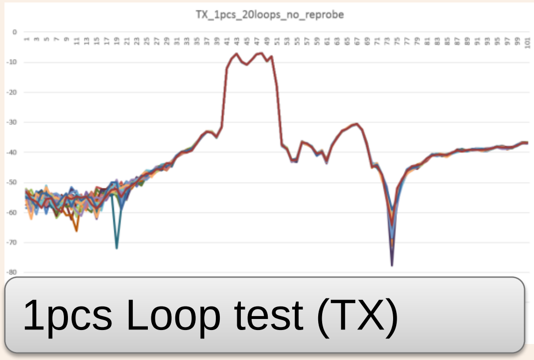


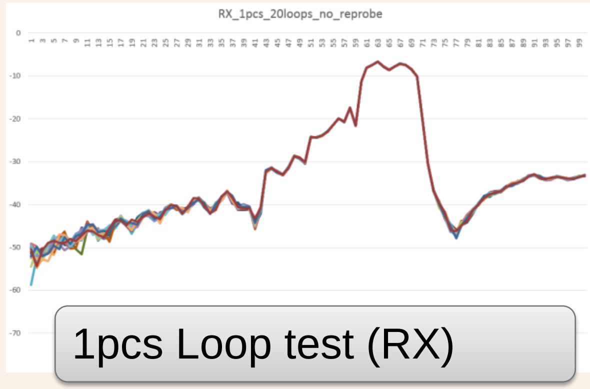
R: Constriction Resistance
n: 4
L: Distance between different constriction point
a: Constriction radius

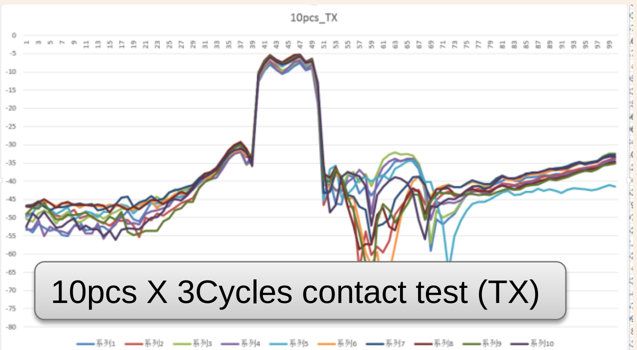


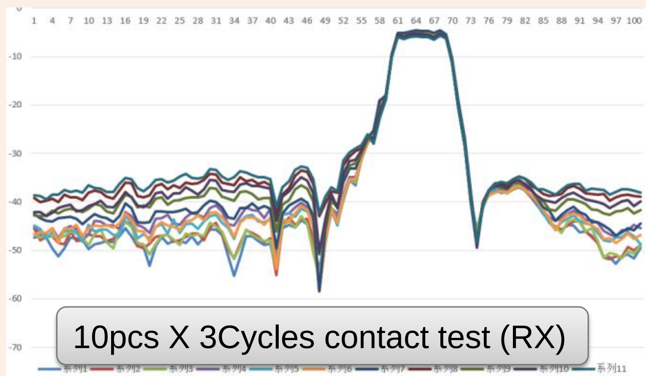



# Contactor Performance Test



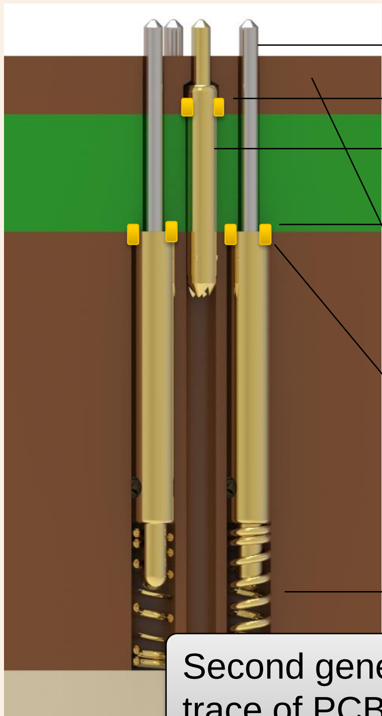



Patent Pending

## 2nd Generation Proto Type



Grounding or logic pin

Micro Strip

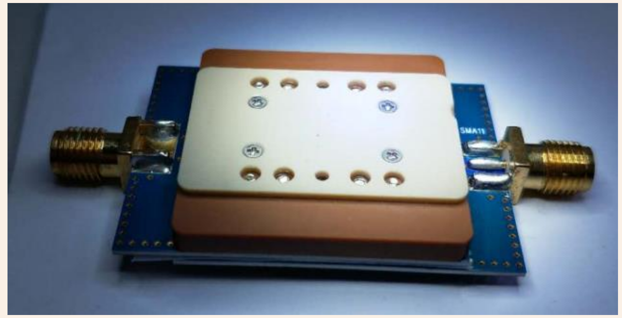
Signal Pin

PCB Board

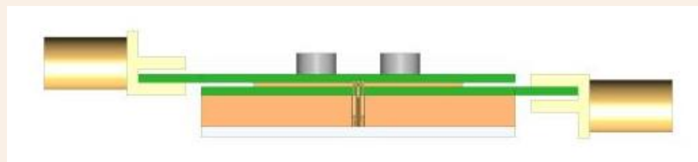
Top Guide Plate

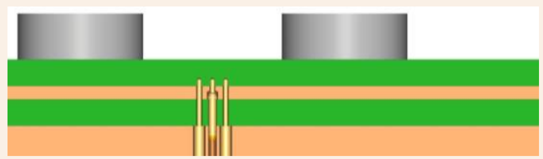
Normal Trace

Bottom Guide Plate



Test Board





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

Improved contact solutions for WLCSP RF applications

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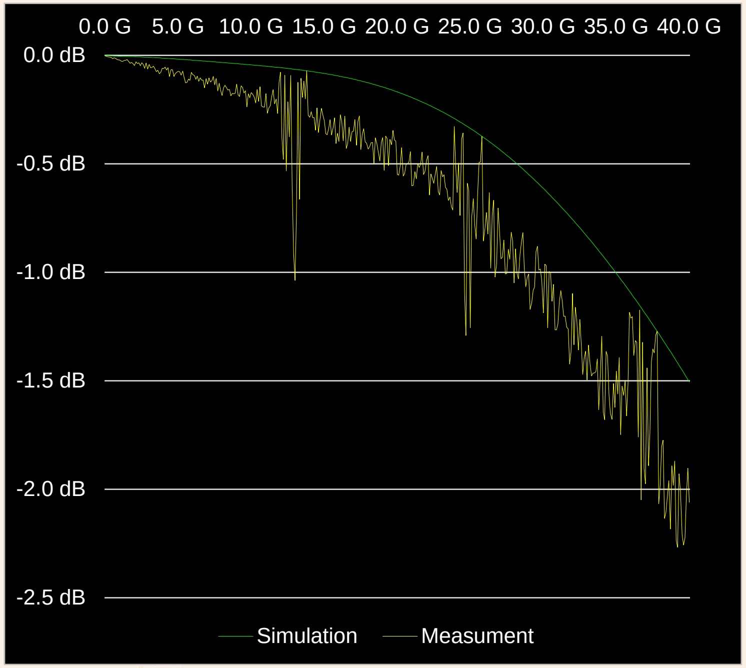
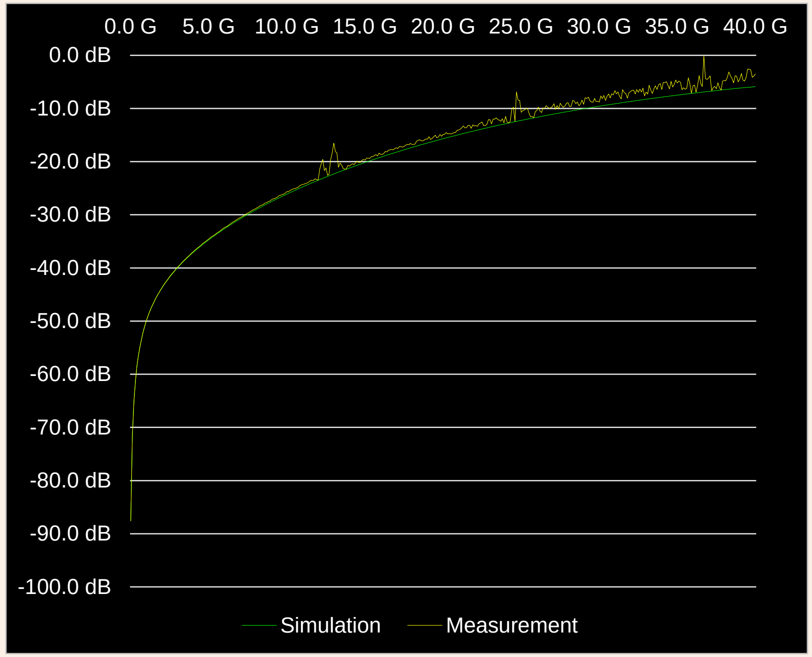
## S-Parameter Simulation and Measurement



## 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.