High Frequency Electrical Characterization of New 3D MEMS Coaxial Socket for High Performance Package

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Why Needs High Speed Test Socket

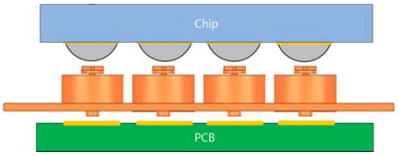
- **The 5G Generation,** a next development stage of the mobile and automotive network system, allows a significantly higher data capacity and fast response times.
- **Demands** on high-speed, and extremely small and dense package have been steadily increasing in the semiconductor or IC market.
- **Needs** for high technology test solutions to overcome signal issue such as crosstalk, signal reflection and loss, etc. have been steadily increasing as well.
- **The technology** of MEMS process is possible to make for not only accurate functions test but also high performance characterizations.

Advantage of 3D MEMS Coaxial Socket

- **3D MEMS** manufacturing process
  ✓High position accuracy, fine pitch, high pin counts available via 300mm wafer process
- **Mechanical characterizations** of 3D MEMS coaxial socket
  ✓Long durability, life cycle, low contact resistance
- **Electrical characterizations** of 3D MEMS coaxial socket
  ✓Signal integrity ensured by capability with impedance control
- **Stable contact** tip shape designed for self cleaning
  ✓High speed & performance test socket using coaxial structure

New 3D MEMS Coaxial Socket

- The coaxial socket is composed of core signal and outer conductor (GND).
- Outer GND protects the inner signal from the electric field interference.
- Impedance matching design minimizes signal loss at high frequency.



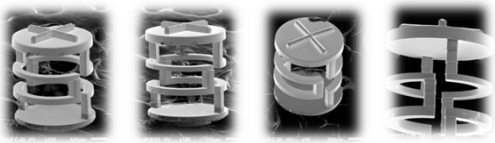


Fig. SEM images of MEMS structure

Fig. Coaxial contact

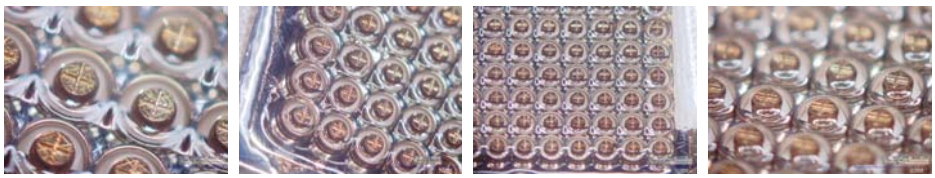


Fig. New MEMS coaxial socket - 0.8pitch, 1225 pins for 60GHz package test

Mechanical Characterizations

- Low contact resistance with life cycle test up to 200k (no cleaning)
- Cross shaped tip for better contact solution
- Pin stroke 0.2 mm, pitch 0.3 mm (coaxial)
- Test for both BGA and LGA

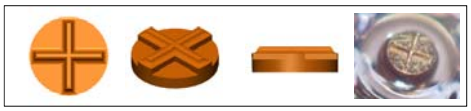


Fig. Cross tip shape designed for self-cleaning

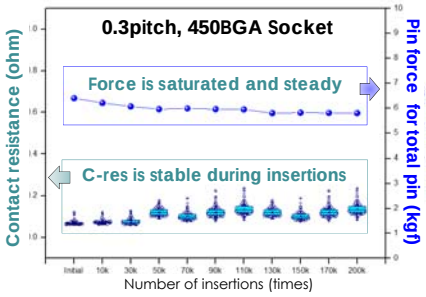


Fig. Life cycle test **vs** contact resistance

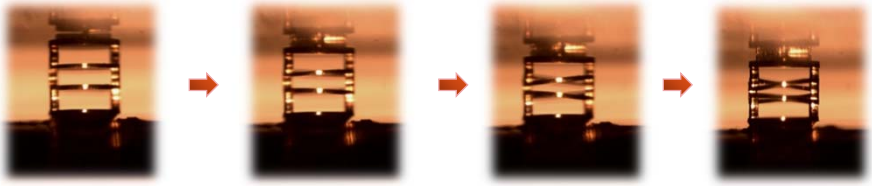


Fig. New 3D MEMS spring displacement by over drive (stroke 0.2 mm)

Electrical Characterizations

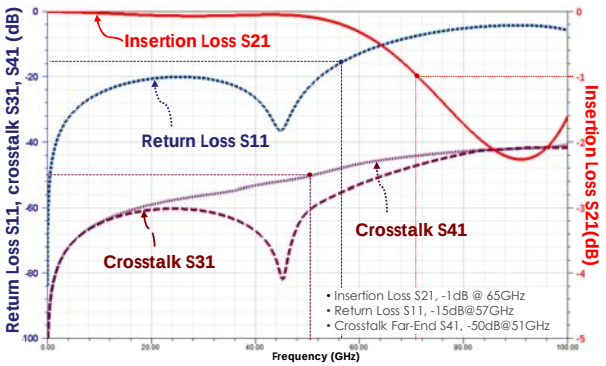


Fig. New coaxial socket (simulated data)

Fig. Socket Pin Layout

- Impedance control - the distance between core and outer conductor.
- Signal pin (Isolated) & ground pin connected to the outer conductor.
- Outer conductor merged with whole frame as return current path.

Verification of 3D MEMS Co-axial Socket

Fig. Coaxial socket measurement setup with v-type 1.85mm connector

BEAM Type

- Height 0.7 mm
- Stroke 0.15 mm
- Cres ≤ 50mΩ
- Force 35gf
- Insertions ≤ 200k

Spring Type

- Height 0.7 mm
- Stroke 0.2 mm
- Cres ≤ 50mΩ
- Force 30gf
- Insertions ≤ 200k

Fig. Test vehicle for measurement

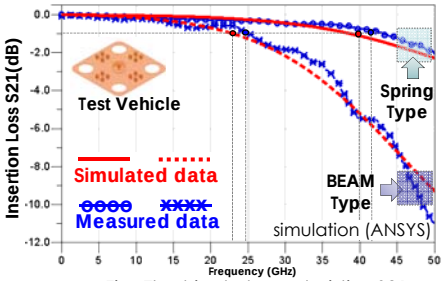


Fig. Electrical characteristics S21

- Measurement results slightly difference due to measuring contact sensitivity for high broad bandwidth.

Summary

- Proposed new design of 3D MEMS coaxial socket
  - ✓ Adjusting spring concept for better impedance matching
- Analyzed the new spring type coaxial socket
  - ✓ Mechanical and electrical characterizations
- Verified the reliability of simulation and measurement
  - ✓ Comparison data using 1.85mm connector with test vehicle

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