# Next Generation Elastomer for SLT / ATE Evaluation

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Virtual Event ● May 3 - 7, 2021

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# Overview

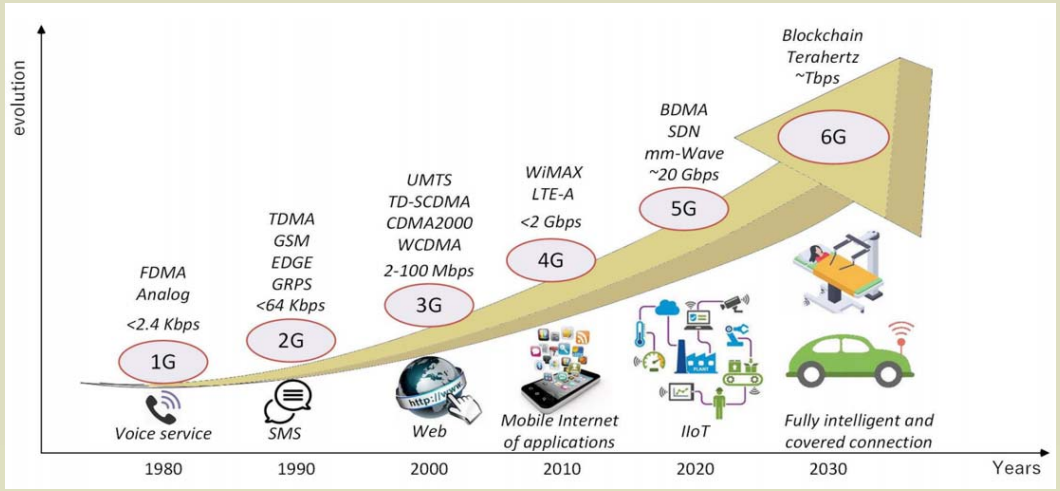
- As the Semiconductor Industry pushes to expand device performance, the I/O density, Signal Data Rates, and Electrical Performance becomes more critical. As a result, advanced test interconnects are an important component in this new test strategy.

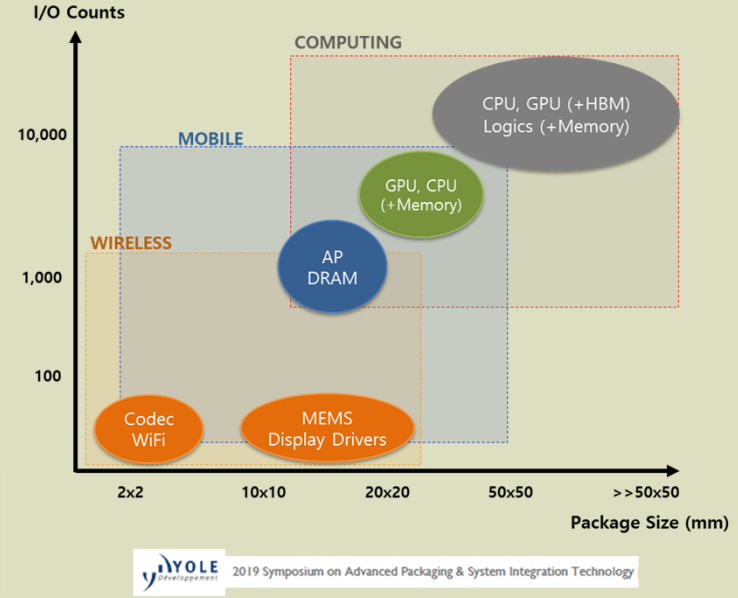
- Elastomer Sockets have been enhanced with new materials, processes and construction types. These advanced elastomer configurations continue to offer the benefits of an extremely short interconnect while expanding the range of suitable applications.

- These advances make advanced elastomers excellent solutions for ATE and SLT Testing. Presentation will share details and results from several advanced elastomer configurations to show how our latest elastomer structures solve legacy elastomer socket problems and offer an excellent solution for these new SLT/ATE Test Strategies.

# Recent Trend

- Package Trends
  - I/O Density, Signal Data Rates, and Electrical Performance becomes more critical
  - CPUs/MCUs/GPUs and the rapid expansion of 5G and Cloud infrastructure create a catalyst for new equipment and test strategies
  - Packages getting larger, SLT / ATE testing requires higher performance



# CPU / AP Test Socket Trend


**Standard Elastomer:** Comparatively weak on lifetime, thickness recovery & insufficient compliance with device warpage

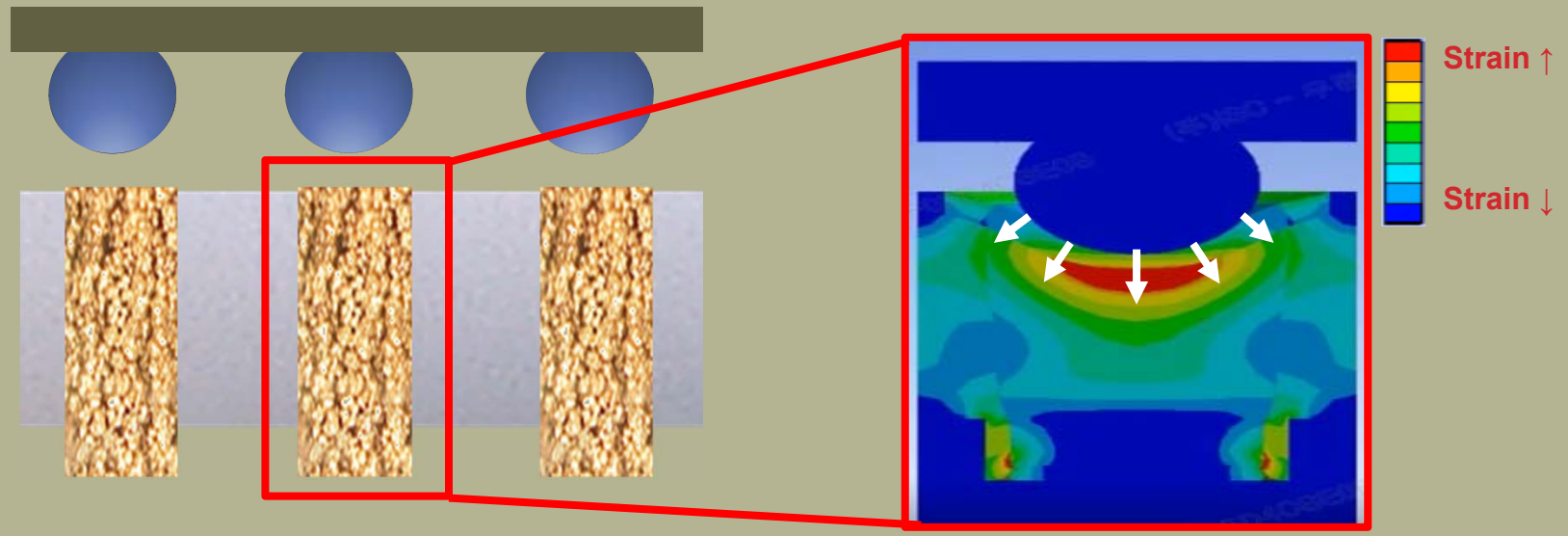
**Next Generation:** Lower Cres / Higher Current / Higher Speed / Impedance Matching / More advantage with device warpage with larger stroke working range

**→ Applicable on Larger Packages SLT / ATE**

# Key Cause of Failure

**Standard Elastomer**

- **Structure**
- **Simulation (ANSYS Mechanical)**

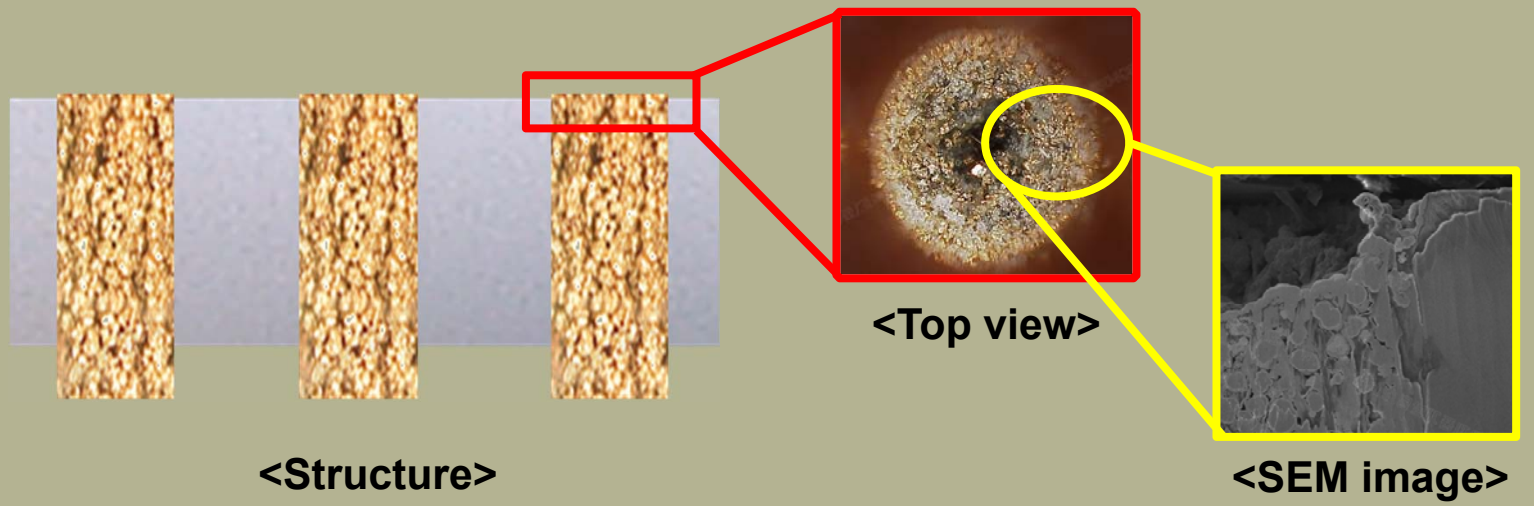



**Note.**

1. **Force is concentrated to top contact pad & not dispersing to the bottom side of the elastomer**

# Key Cause of Failure

**Standard Elastomer**

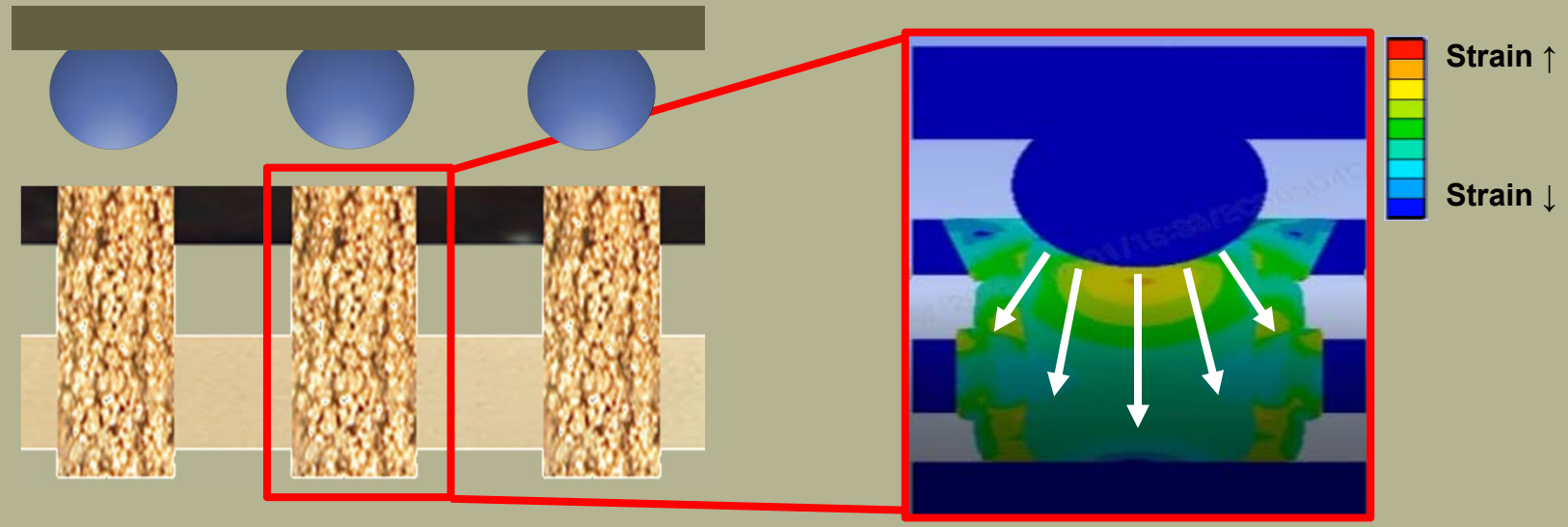



| Standard Elastomer | Key Cause of Failure |
|---|---|
| Lifespan | Force is concentrated to top elastomer pad and it's causing contact pad damage |
| | Contact pad contaminated |
| Device Warpage | Insufficient compliance caused center area open |
| Current (C.C.C) | Lower density of elastomer column |
| High speed | Nonuniform shape of column & pad size unoptimized |

# Suggested Solutions

**XF Type Elastomer**

- **Structure**
- **Simulation (ANSYS Mechanical)**

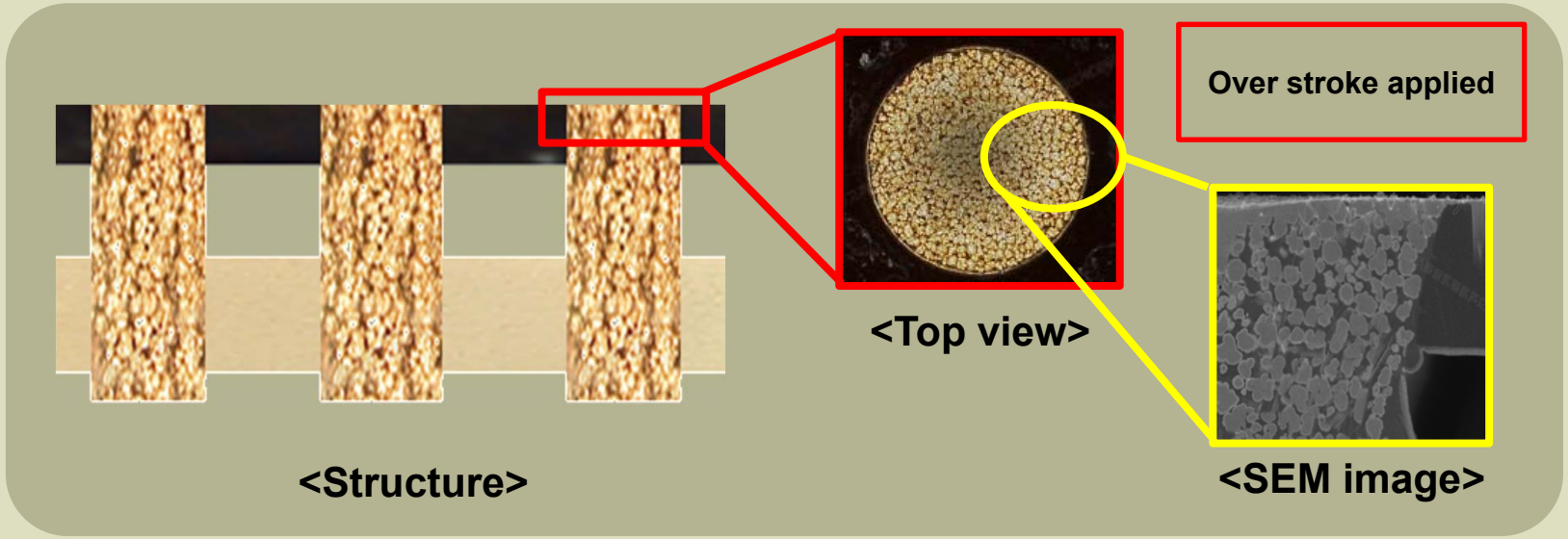



**Note.**

1. **Force dispersed from top to bottom side of the elastomer**
2. **More advantage on lifetime perspective with force disperse**
3. **With higher density columns, resistance is lower and STDEV is stable**

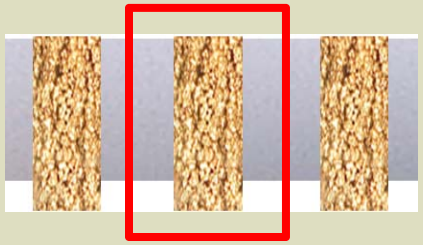
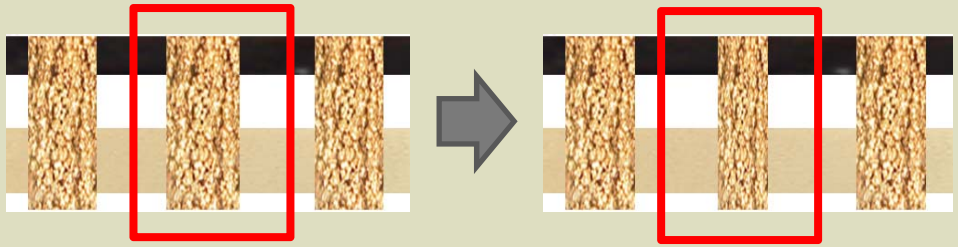
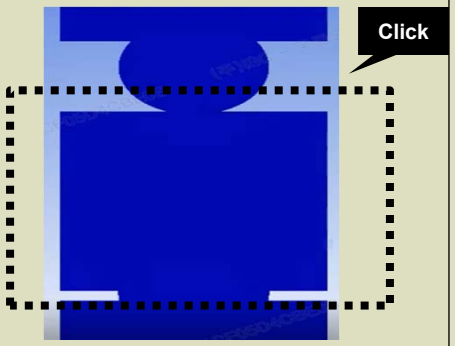
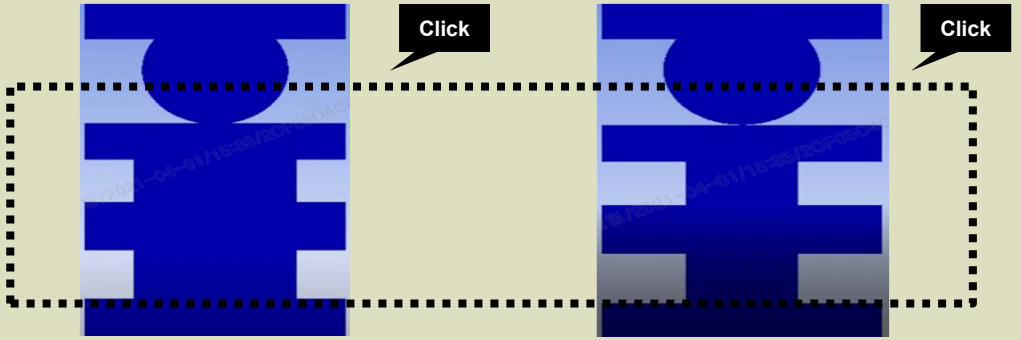
# Suggested Solutions

**XF Type Elastomer**




| XF Type Elastomer | ISC Solutions | Expectation |
|---|---|---|
| Lifespan | Force dispersing to the middle & bottom side of the elastomer | Lifespan increase |
| | Contamination can be minimized with higher density of contact pads | |
| Device Warpage | Air pocket in the elastomer column enables individual compliance | Warped devices applicable |
| Current (C.C.C) | Higher density of elastomer column enables more durable with higher current | Higher current applicable |
| High speed | Optimized column size + contact pad diameter | Higher speed applicable |

# Elastomer Comparison: Standard vs Next Generation

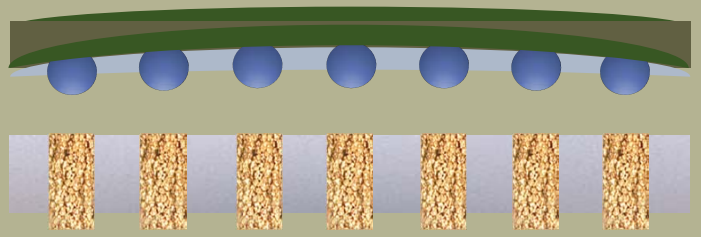
| | Standard Elastomer | XF Type Elastomer |
|---|---|---|
| **Concept** |  |  |
| **Ball Contact Mechanism** |  |  |
| **Note** | 1. Larger contact surface<br>2. No Ball Damage<br>3. **Force is concentrated on upper elastomer area**<br>4. Weak on warped device & large device | 1. Larger contact surface<br>2. Gap on middle area helps elastomers recover its height after compression<br>3. **Force is dispersing from top to bottom side of the elastomer**<br>4. No Ball Damage<br>5. Robust top pad<br>6. More advantage with device warpage with larger stroke working range<br>7. **Impedance matching for better RF & S-parameter** |

# Test condition / Agenda

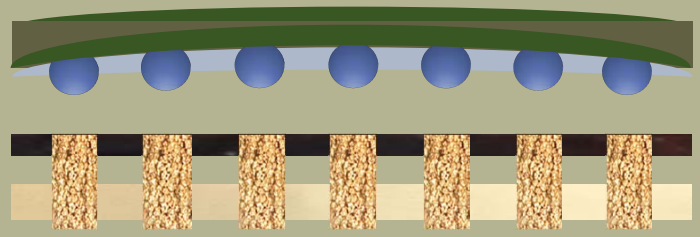
| | Test item | Test condition |
|---|---|---|
| Warpage | Warpage Compression Test | • Warpage: 250um<br>• Force : 30g/pin<br>• Temperature : 25℃<br>• Test Time : 180s |
| Structural Characteristics | Contact mechanism | • ANSYS mechanical |
| Electrical Characteristics | Thermal Cycle | • Operation Temperature : -5~125℃<br>• 1 cycle : 180min |
| | Lifetime Test | • Temperature : 90℃ |
| | S-parameter | • ANSYS Electronics 2020 R1 |

# Warpage Compression Test

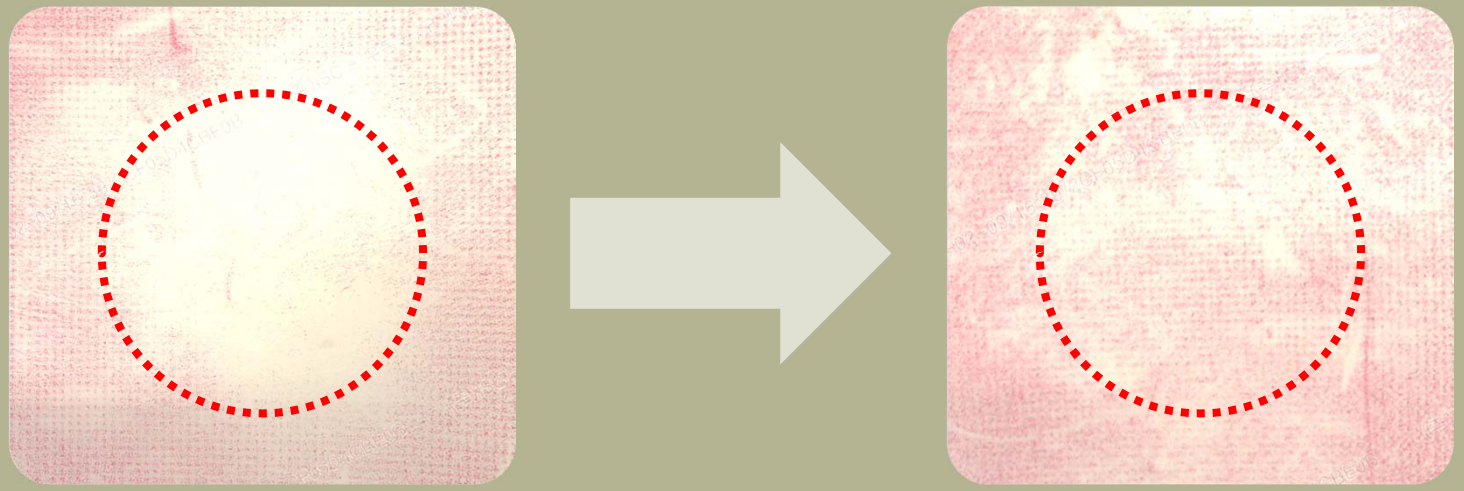
**Standard Elastomer**



**XF Type Elastomer**

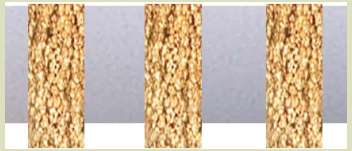


**Test condition**
- Warpage: 250um
- Force : 30g/pin
- Temp. : 25℃
- Test time : 180s



# Specification Comparison

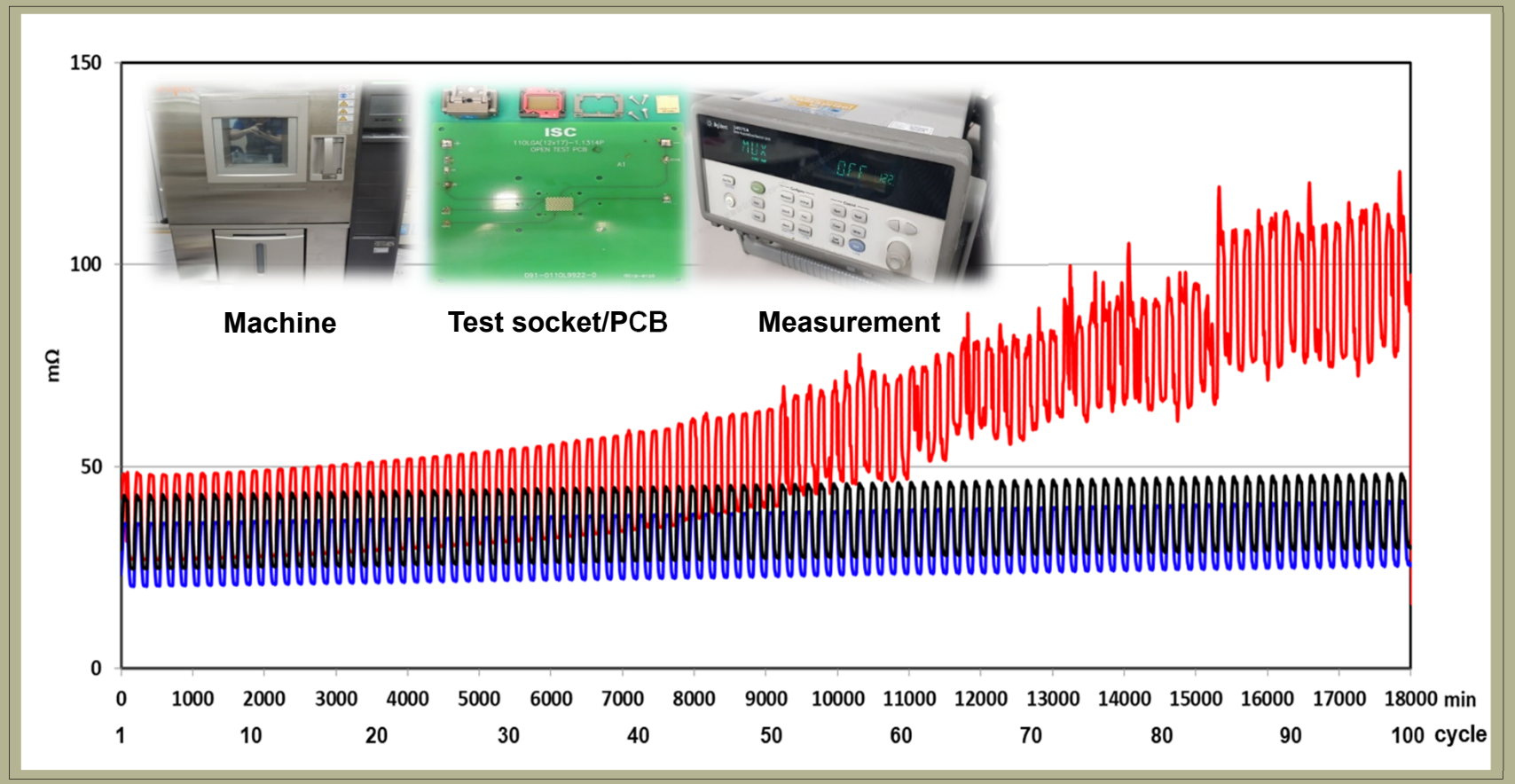
* Specification Based on 0.9mm Pitch

| | | Specification | | | | | | Note |
|---|---|---|---|---|---|---|---|---|
| Type | | Standard Elastomer | | XF Type Elastomer | | XF Type Elastomer (Optimized Column Size) | | |
| Concept | |  | |  | |  | | |
| Resistance (Initial) | Avg. | 45.6mΩ | | 26.4mΩ | | 29.4mΩ | | |
| | STDEV | 16.8 | | 2.8 | | 2.7 | | |
| Resistance (100K) | Avg. | 73.6mΩ | | 43.8mΩ | | 46.9mΩ | | |
| | STDEV | 23.2 | | 11.6 | | 12.3 | | |
| Device Warpage Coverage | | <150um | | <350um | | <350um | | |
| Current (C.C.C) | | 3.2A | | 4.7A | | 4.5A | | Force 20%↓ or Temp. 125℃ |
| Thermal cycle (Initial : 100 cycle) | | 42.4 : 122.9mΩ | | 23.3 : 41.5mΩ | | 29.5 : 48.5mΩ | | 0 ~ 100 cycle |
| S-parameter | | IL | RL | IL | RL | IL | RL | |
| Differential pair | 8GHz | -0.08 | -19.51 | -0.02 | -25.56 | -0.02 | -26.02 | |
| | 16GHz | -0.14 | -17.06 | -0.03 | -27.72 | -0.03 | -29.49 | |
| | 32GHz | -0.51 | -12.49 | -0.09 | -19.36 | -0.07 | -21.82 | |

# Thermal cycling test

※ Test condition
Temp. : -5~125℃
1 cycle : 180min

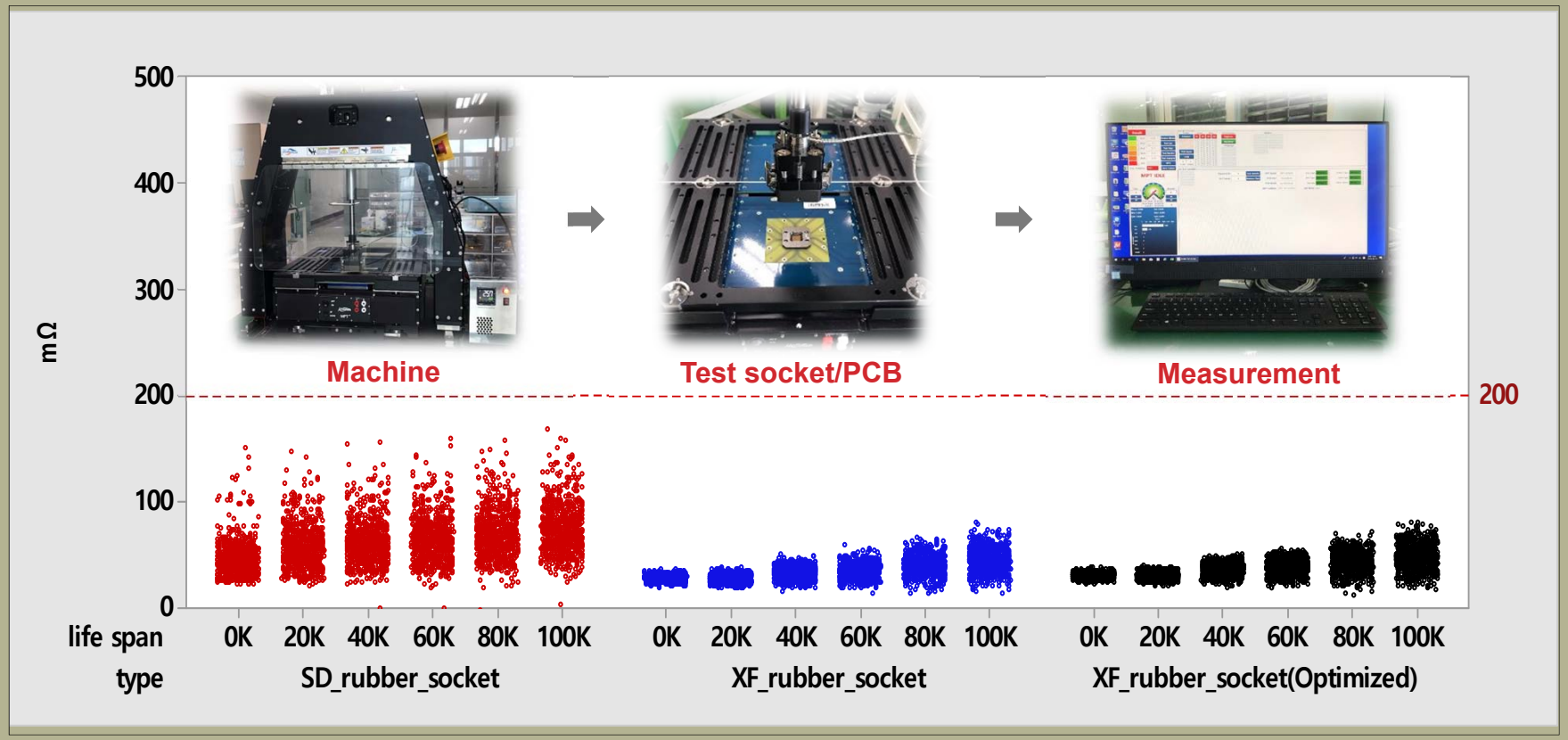
Standard Elastomer
XF Type Elastomer
XF Type Elastomer (Optimized)



# Lifetime Test

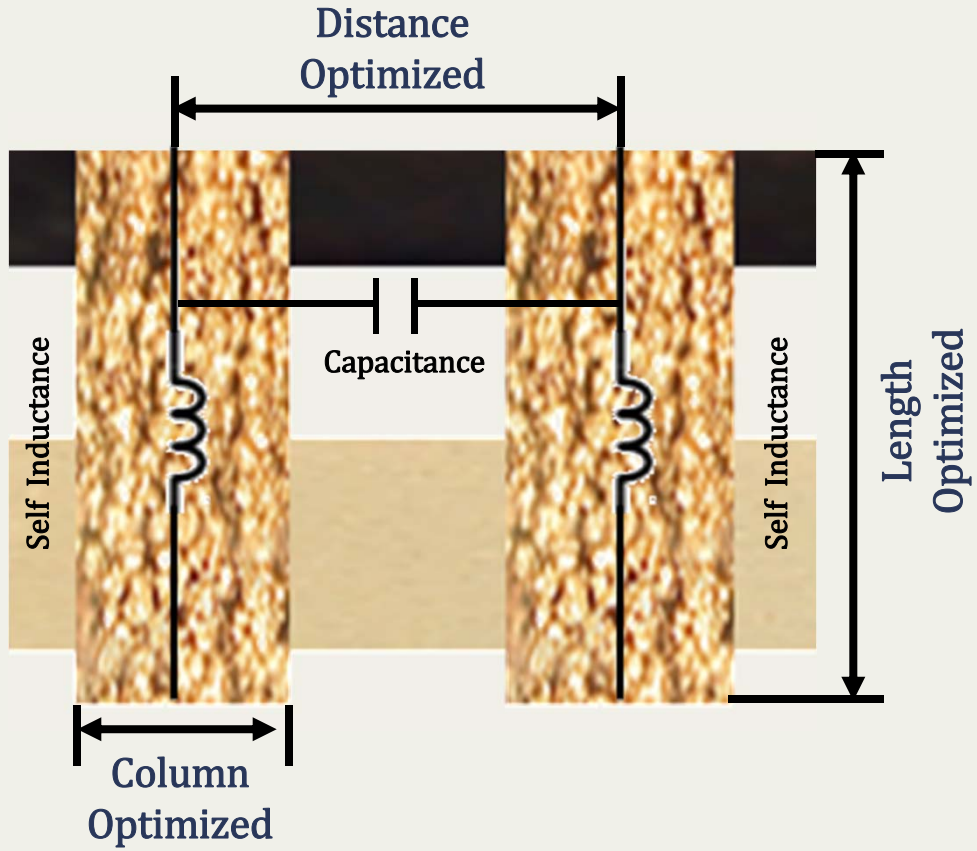
※ Test condition
Test type : Touch down
Temp. : 90℃

Standard Elastomer
XF Type Elastomer
XF Type Elastomer (Optimized)



# S-parameter

## RF optimized (Length, Column, Distance optimized)

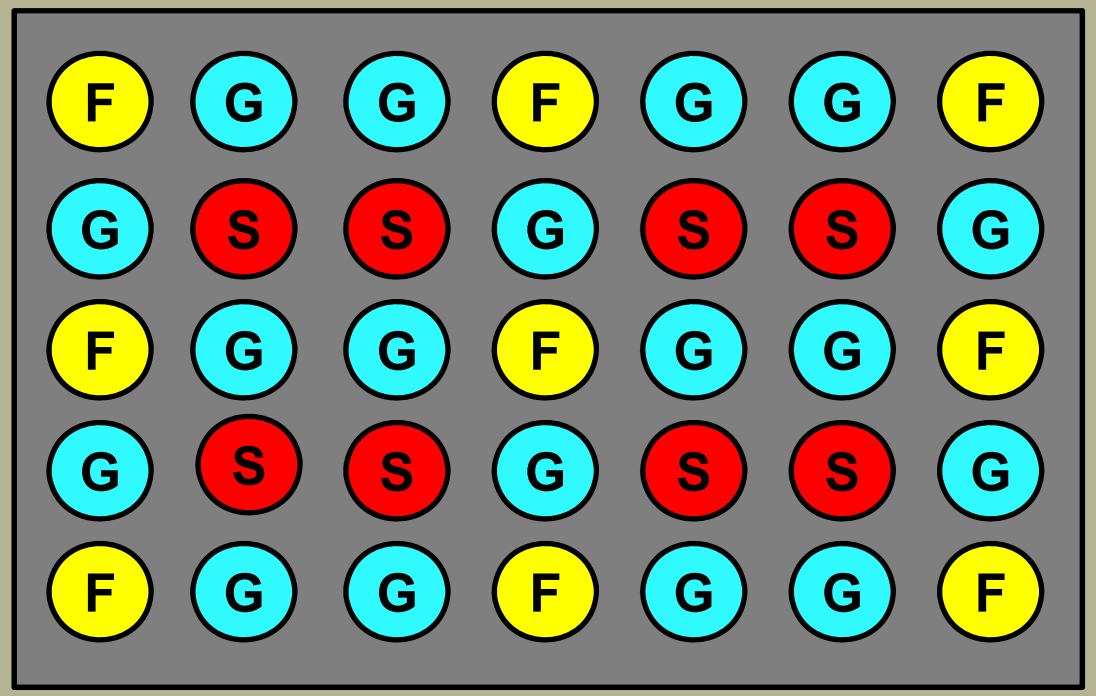



$$Zo = \sqrt{\frac{L}{C}}$$

- Impedance (Zo)
- Inductance (L)
- Capacitance (C)

# S-parameter

## SI Performance Comparison



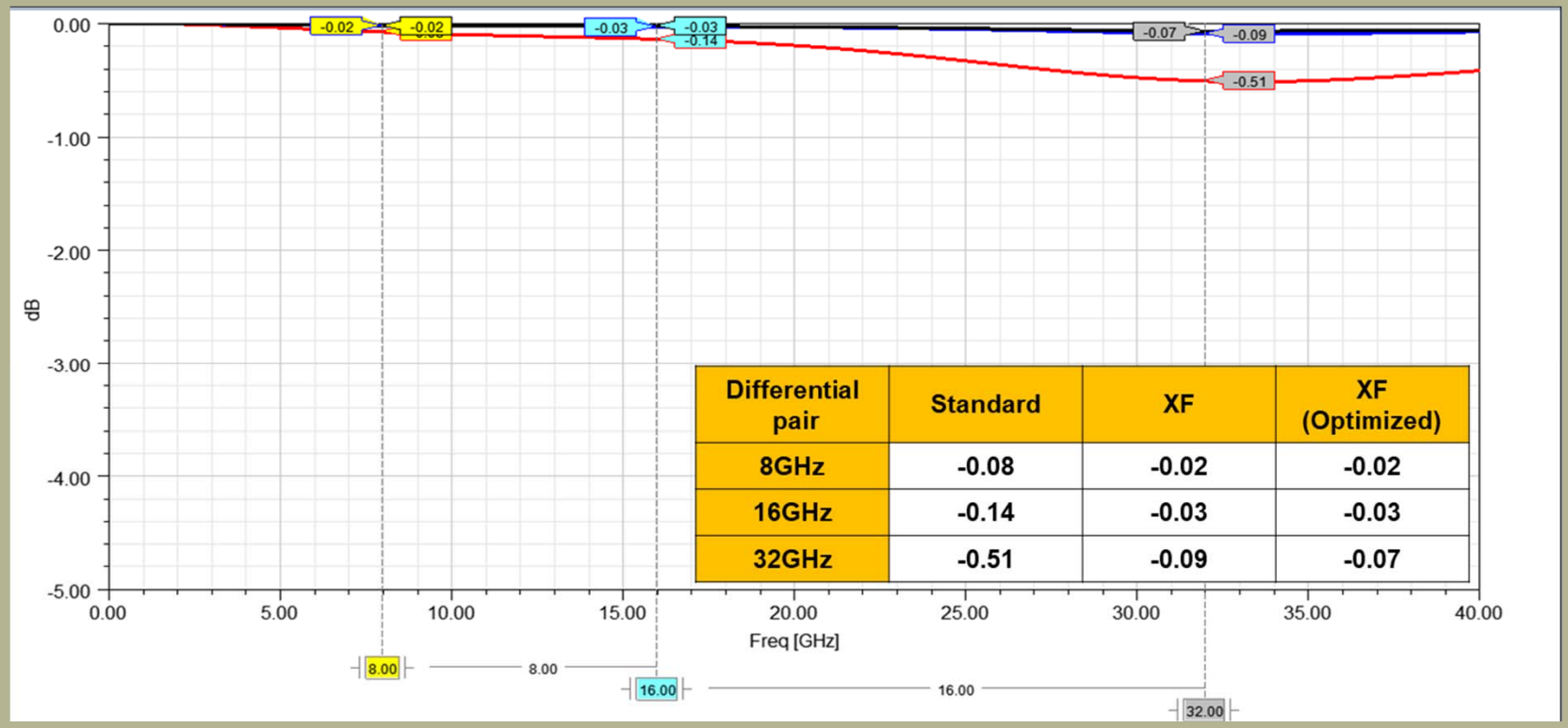

Differential Pair

S Signal
G GND
F Floating

# S-parameter

* Specification Based on 0.9mm Pitch

## Differential pair

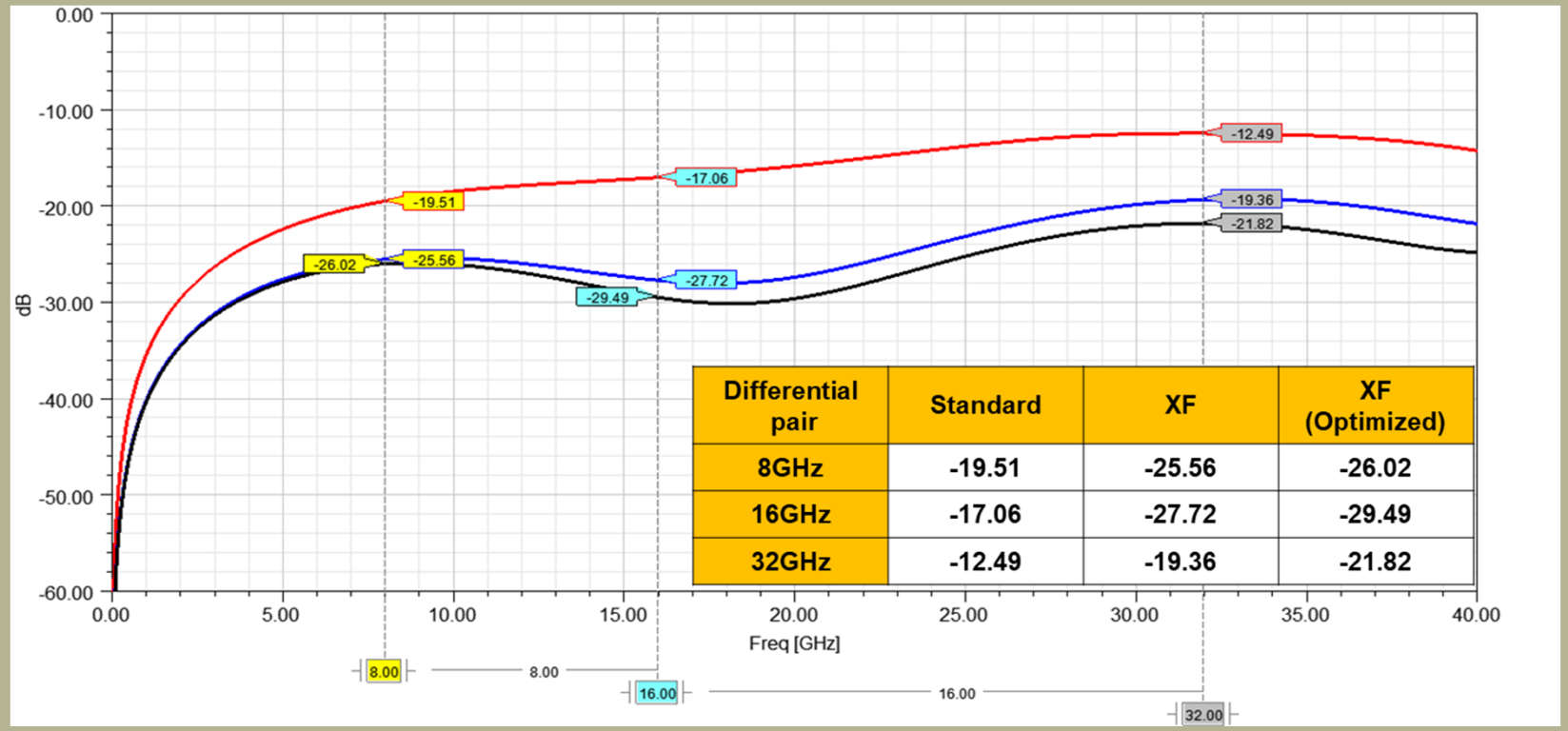



| Differential pair | Standard | XF | XF (Optimized) |
|---|---|---|---|
| 8GHz | -0.08 | -0.02 | -0.02 |
| 16GHz | -0.14 | -0.03 | -0.03 |
| 32GHz | -0.51 | -0.09 | -0.07 |

# S-parameter

* Specification Based on 0.9mm Pitch

## Differential pair




| Differential pair | Standard | XF | XF (Optimized) |
|---|---|---|---|
| 8GHz | -19.51 | -25.56 | -26.02 |
| 16GHz | -17.06 | -27.72 | -29.49 |
| 32GHz | -12.49 | -19.36 | -21.82 |

# Conclusion

- As semiconductor technologies develop, such as 5G / CPU / GPU / MCU packages, these development requires higher performance on test sockets
- Especially for a higher frequency packages, Coaxial sockets are normally used in current market, whereas so far the elastomer socket is comparatively weak for these special cases due to limited stroke working range and weakness on reflection
- Next Generation Elastomer is covering the weak points from the existing elastomers and it's now ready to replace Coaxial socket, so considering cost perspective, next generation elastomer is going to be very attractive for these test markets
- Advanced Elastomer enables impedance matching & maximize electrical characteristic with optimized elastomer column, and also enables to accommodate larger packages, especially for warped device, with new elastomer structure as it allows flexible compliance

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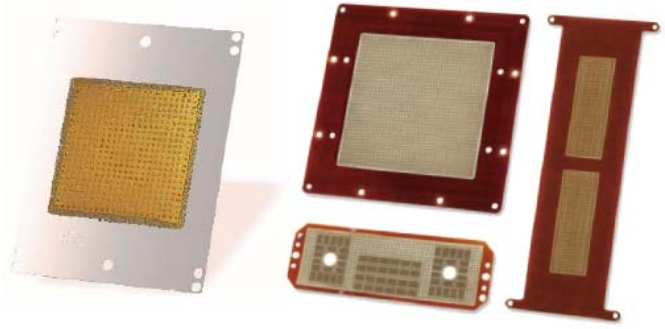
# ISC Global No.1! Total Test Solution Provider!

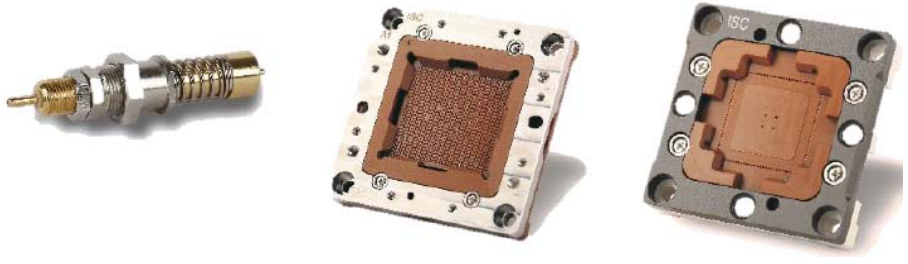
## ELASTOMET SOCKET & INTERPOSERS

- High performance and competitive price
- High speed & RF device capability
- Various customized design to meet challenge requirement



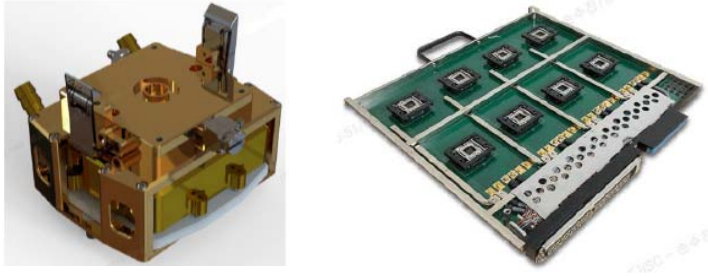
## POGO SOCKET SOLUTIONS

- Excellent gap control & long lifespan
- High bandwidth & low contact resistance



## THERMAL CONTROL UNIT

- Extreme active temperature control
- Safety auto shut-down temperature monitoring of the device & thermal control unit
- Full FEA analysis & Price competitiveness



## BURN-IN SOLUTIONS

- Direct inserting on the board without soldering
- Higher performance BIB solution


**CONTACT**
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Silicon-valley, CA

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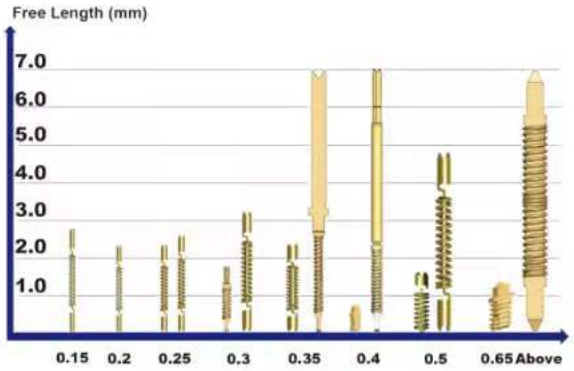
**Email**: sales@isc21.kr / **Web**: www.isc21.kr

# IWIN Co., Ltd. The test probe for high signal integrity at extremely high speed test

## Spring probe by stamping




250 kinds of spring probe pin

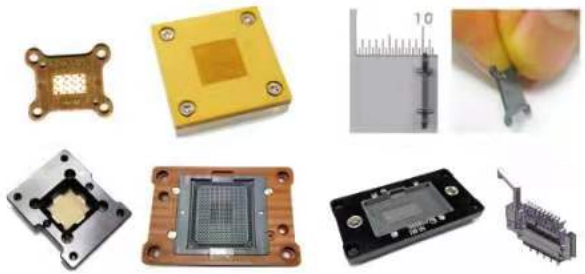
300 kinds of test socket (44,000 Pin count socket possible)

One piece spring probe

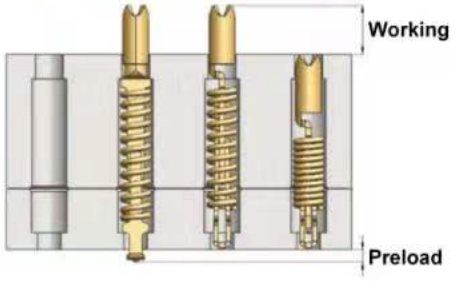
Three piece spring probe

High speed product → 0.63mm free length spring probe pin available

Finest Pitch → 0.15mm Pitch



## Spring probe by stamping

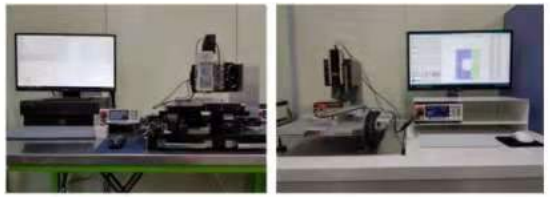



Patented

| Pitch(mm) | Free Length(mm) | Current Carrying(Amps) |
|---|---|---|
| 0.15/0.2/0.25 | 2.17~ | 0.5~ |
| 0.3 | 1.5~ | 1.5~ |
| 0.35 | 2.08~ | 1.8~ |
| 0.4 | 0.8~ | 2.5~ |
| 0.5 | 1.5~ | 3.0~ |
| 0.65 | 1.13~ | 9.0~ |
| 0.8 | 3.14~ | 3.0~ |

## Automation

Pin assembly and Quality control



Top Figure: Socket CRES, Force, Stroke test

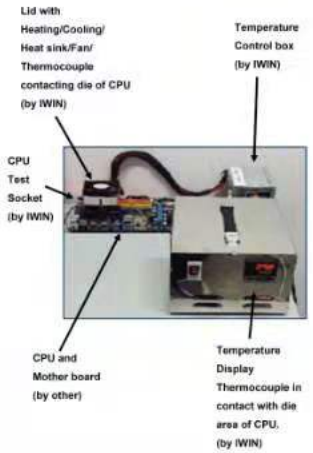
Bottom Figure: Data displayed



Top Figure: Socket CRES test

Bottom Figure: Data display 5,903 pins socket

### Socket and Lid




### Pin assembly

(Fully automated machines)

- Stamped piece parts attached to a reel fed into the assembly machine

- Assembled pins can be attached to a reel, or, supply in separate for socket assembly.

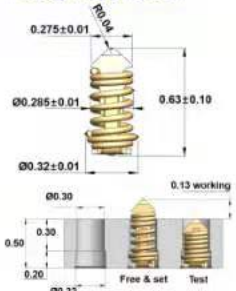
## Spring probe pins for High speed

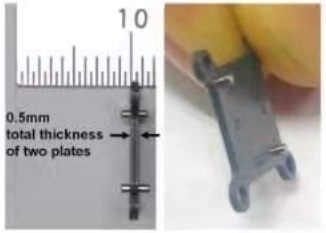
Extremely short spring probes by stamping

One piece spring probe

Three piece spring probe

### Design approach





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