
VIRTUAL EVENT
TestConX™
Presentation Archive
May 3-7, 2021
TestConX.org

Design Strategy for Achieving a Transparent Probe Head

Svetlana Sejas
Nidec SV TCL

TestConX

Virtual Event ● May 3 - 7, 2021

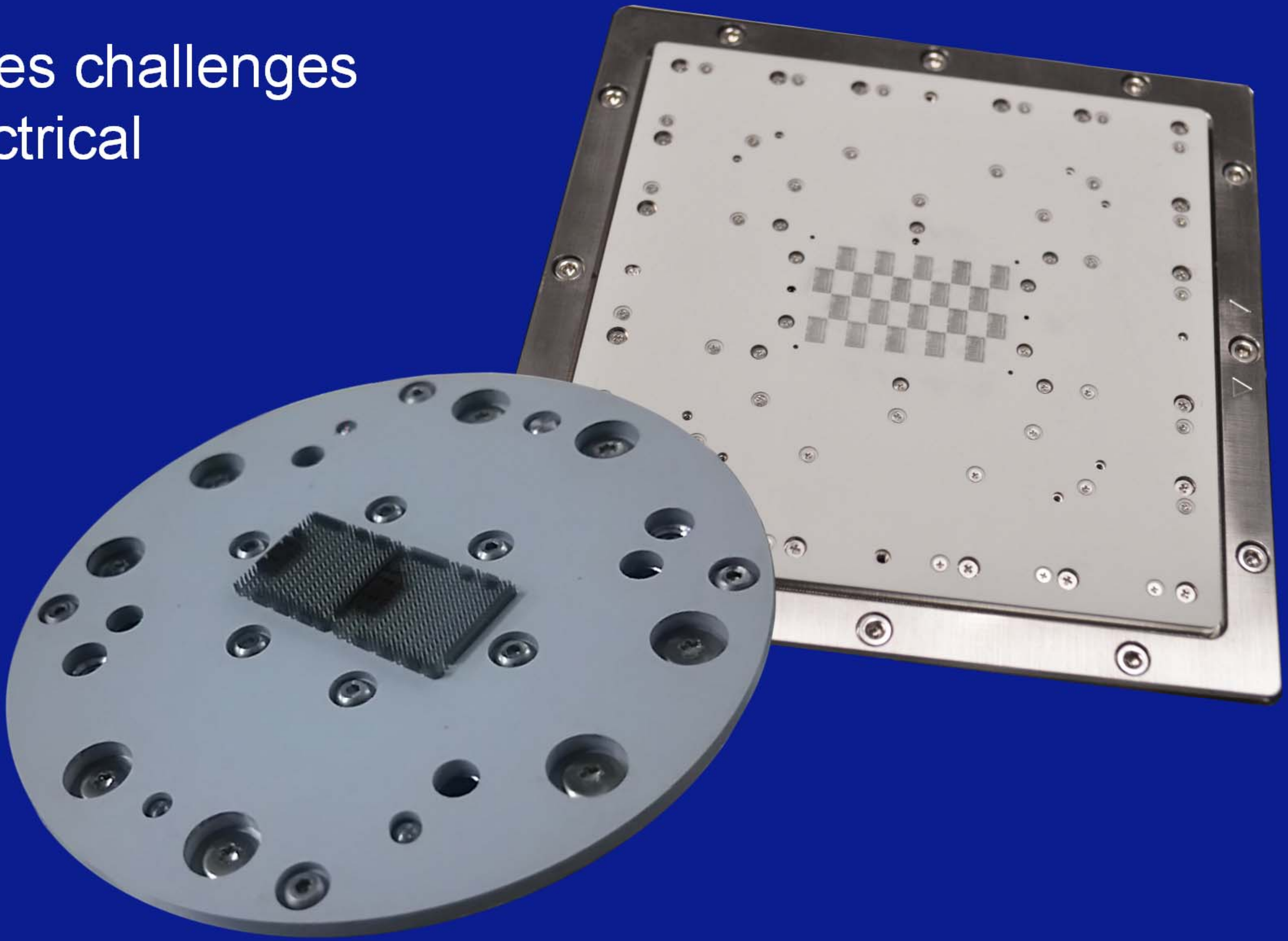
Nidec SV TCL

Introduction: Why measuring on wafer?

- Current trends in semiconductor industry trend demand for smaller, faster ICs, and denser wafers; these requirements complicate packaging and measurements.
- To validate IC designs, after-packaging measurements are required. This step, however, is expensive and introduces uncertainty when not carried out properly (for instance, when neglecting measurement parasitics).
- Probe cards serve as electromechanical interfaces providing a solution for wafer measurements and IC assessment, reducing testing time and cost since parallel testing can be performed.

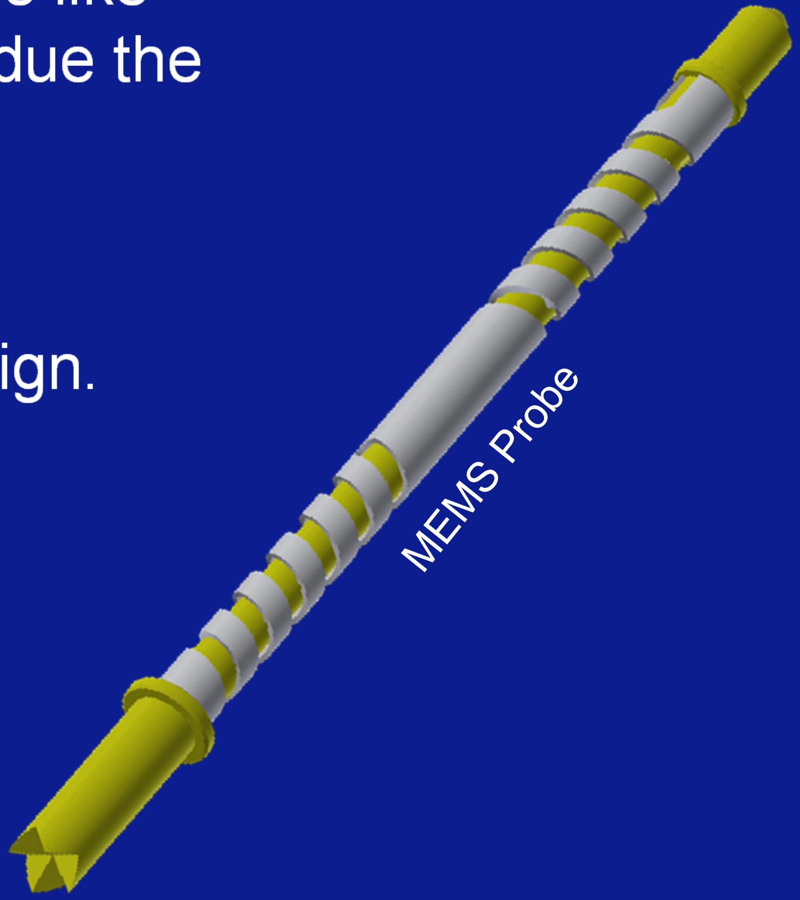
Probe Head Challenges

- Advanced wafer testing involves challenges from both mechanical and electrical perspectives:
  - Contact Force
  - Current Capability
  - Planarity
  - Alignment
  - Thermal Dissipation
  - <u>*Frequency bandwidth*</u>
  - Lifetime
  - Pitch

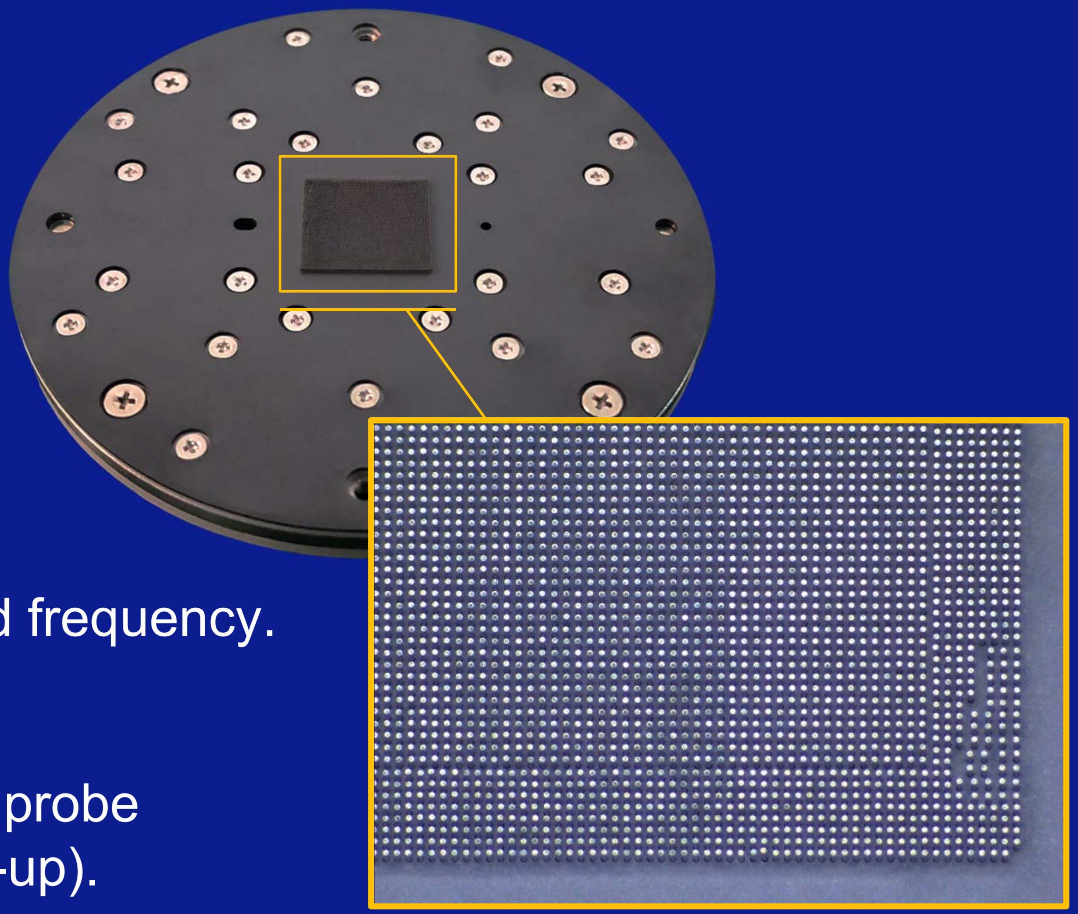


High Frequency – Probe Head Design

- For high frequency applications, vertical probes like MEMS are currently the most suitable option, due the following advantages:
  - Control of the probe path.
  - Flexibility in the probe head stack-up design.
  - Reduced probe length.
  - Small probe pitch.
  - Diameter probe options
  - Repeatable landing.



High Frequency – Probe Head Design



Probe-Head Design Parameters:
- Fixed X and Y coordinates
- Frequency band target
- Transmission type

Design Goal:
- Achieving a reflection loss as low as -20 dB.
- Transmission loss close to -1 dB at the highest required frequency.

Design Variables:
- Reflection loss → matching through careful definition of probe **impedance** (optimizing probe-head structure and stack-up).
- Attenuation/Loss→ length of the probe

Why is impedance so important?

The impedance is fundamental for preserving the signal integrity through the probe or any other interconnection; impedance mismatch may lead to significant reflections that distort signals (e.g., loss and crosstalk is originated).

The impedance is **linked to:**

- Stack-up material (Capacitance)
- Shape of the probe (Inductance)
- Pitch and ground configuration (inductance loop and capacitance)

$$Z_{C\_LossLess} = \sqrt{\frac{L}{C}}$$

Characteristic Impedance

The impedance is linked to:

- Stack-up material (Capacitance)

$$Z_{CLoss\ Less} = \sqrt{\frac{L}{C}}$$

Dielectric loss: Defined
by
Dk and Df

The impedance is inversely proportional to the <u>square root of capacitance</u> (Dk).

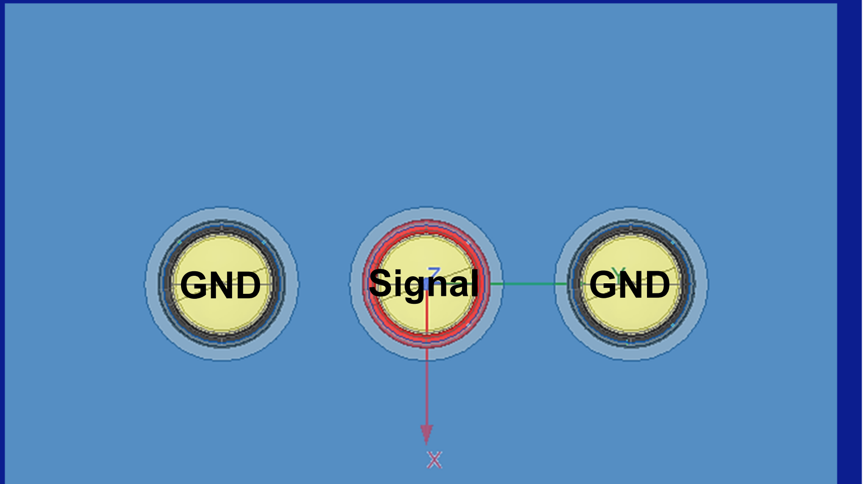
- Shape of the probe (Inductance)

The inductance is linked to the current loop, geometric parameters of the conductor (probe), and frequency.

$$Z_{CLoss\ Less} = \sqrt{\frac{L}{C}}$$

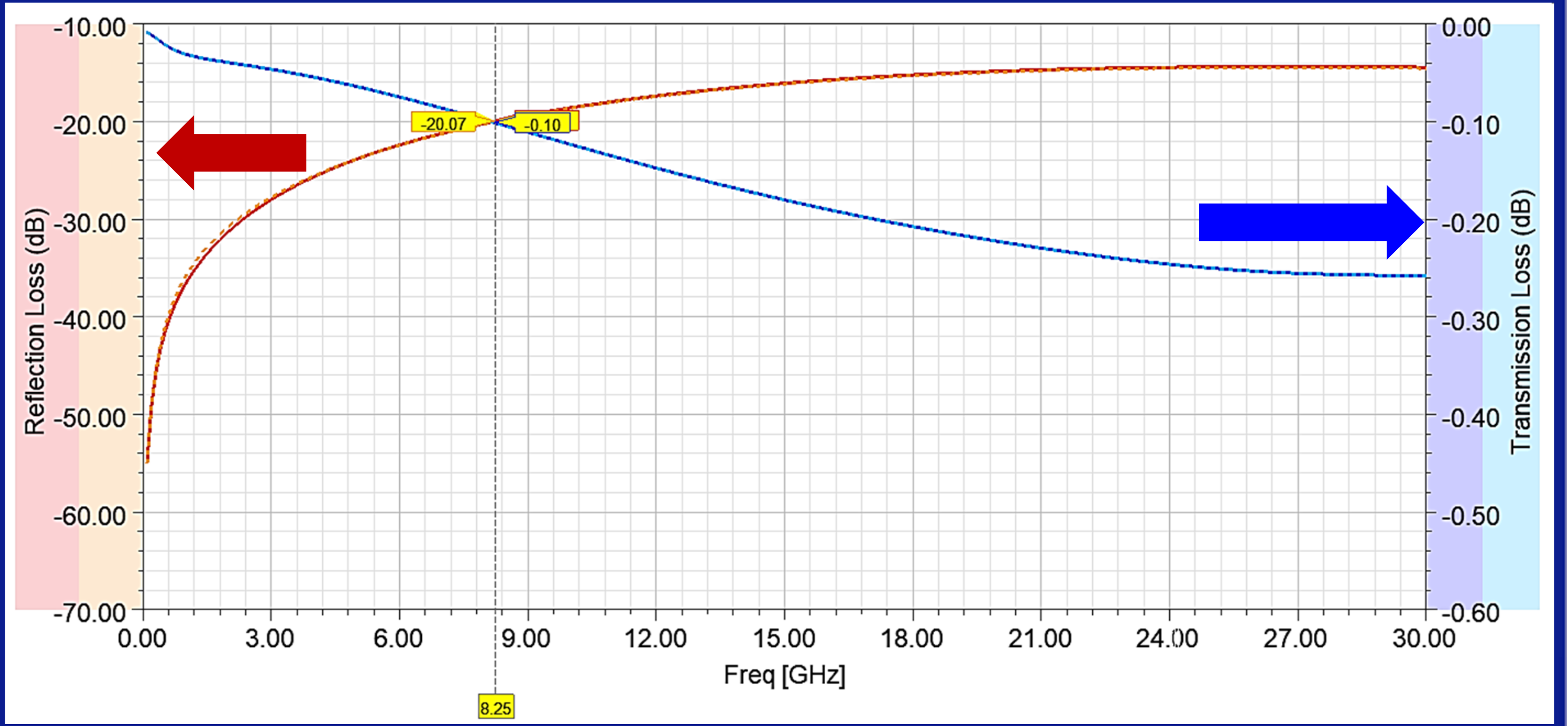
The impedance is proportional to the <u>square root of inductance</u>.

Impedance Control – through the Probe Head Stack-up

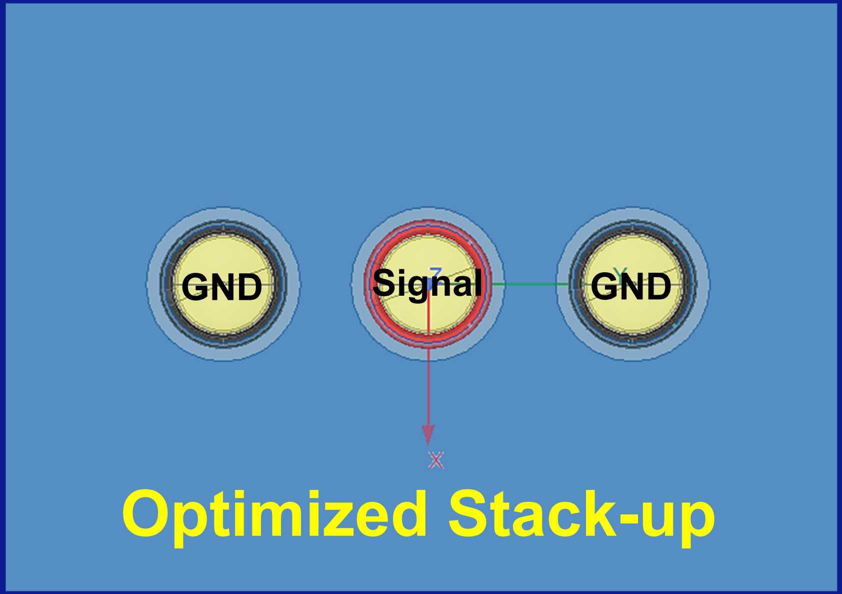


Non-optimized Stack-up

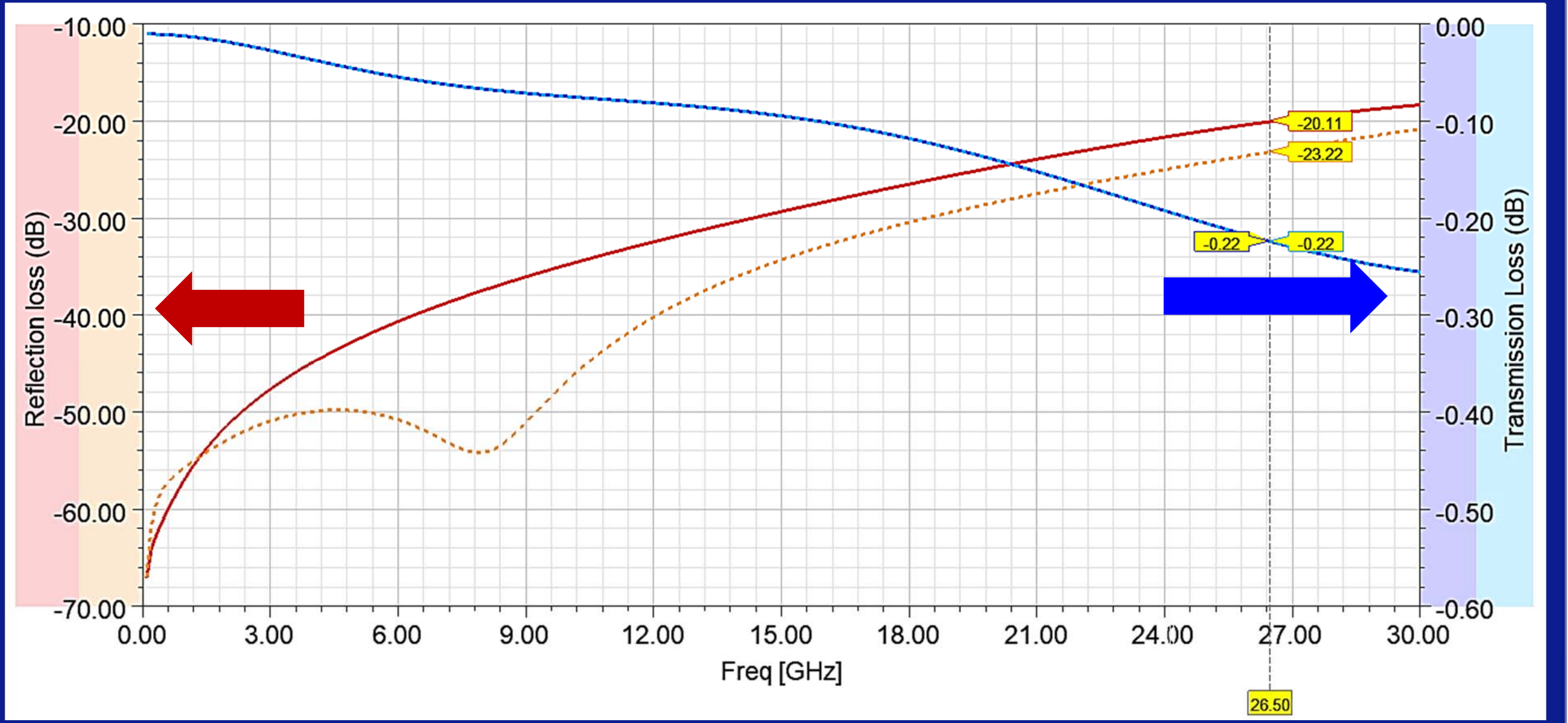
S-Parameters



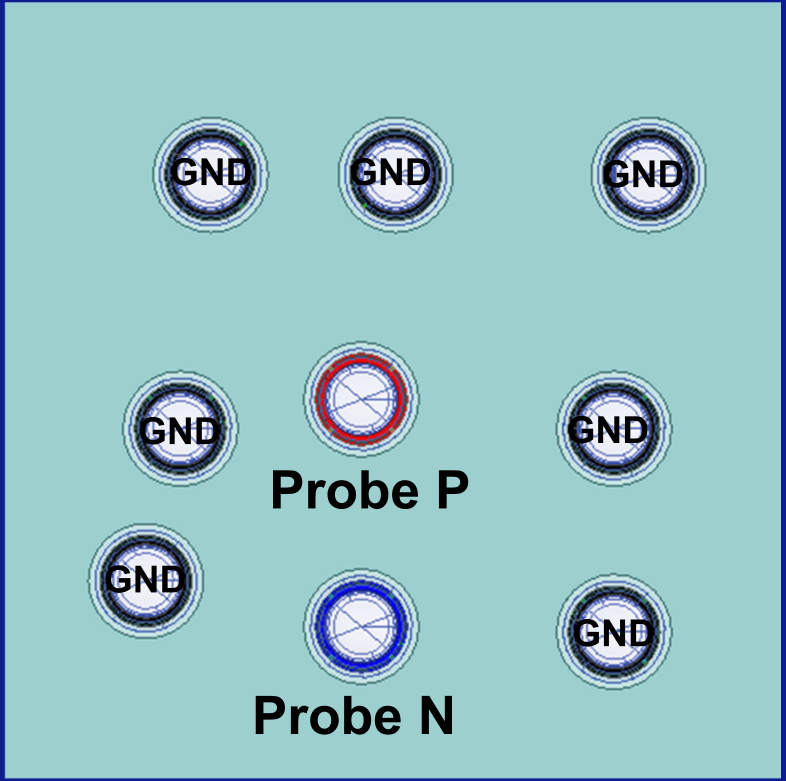
Impedance control – through the Probe Head Stack-up



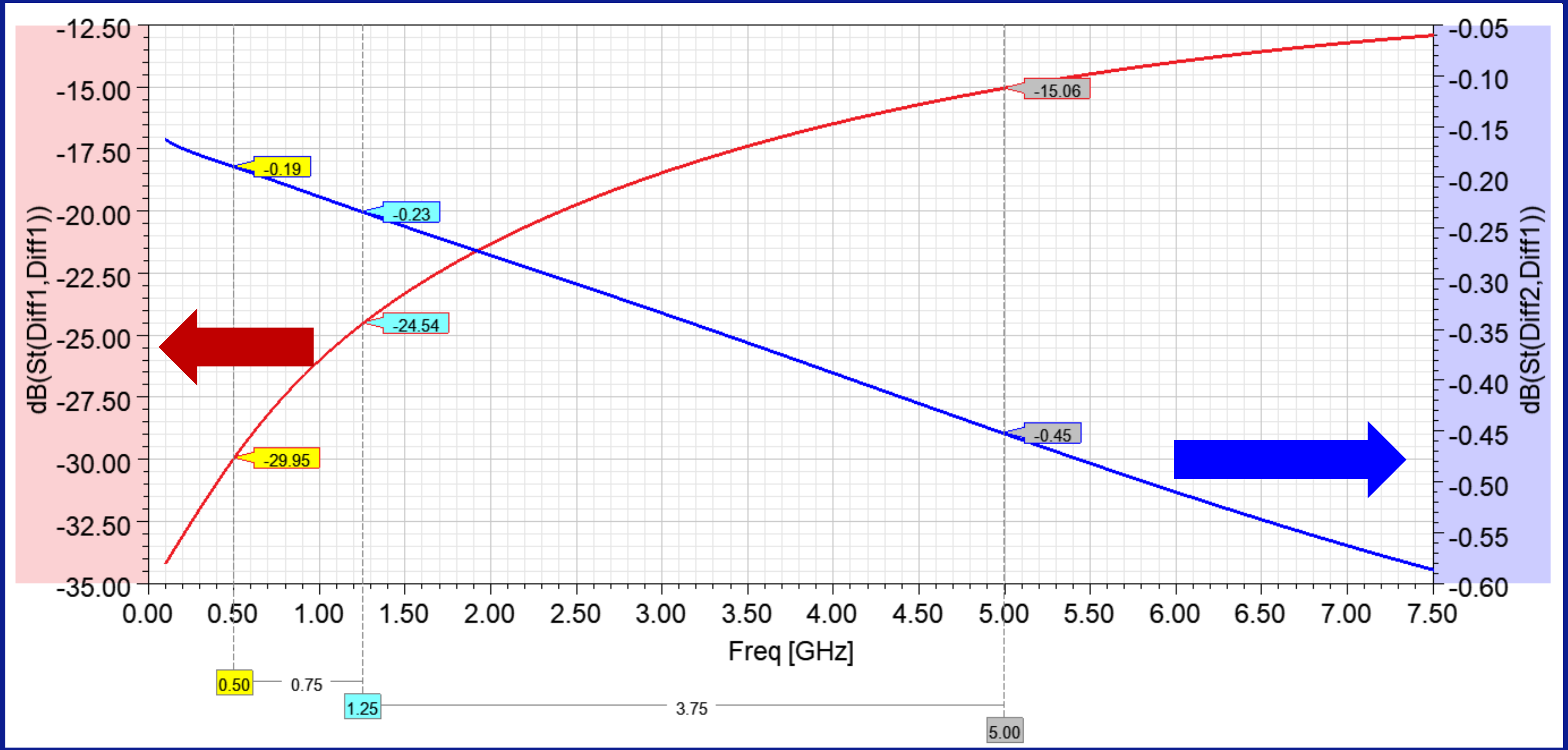
S-Parameters



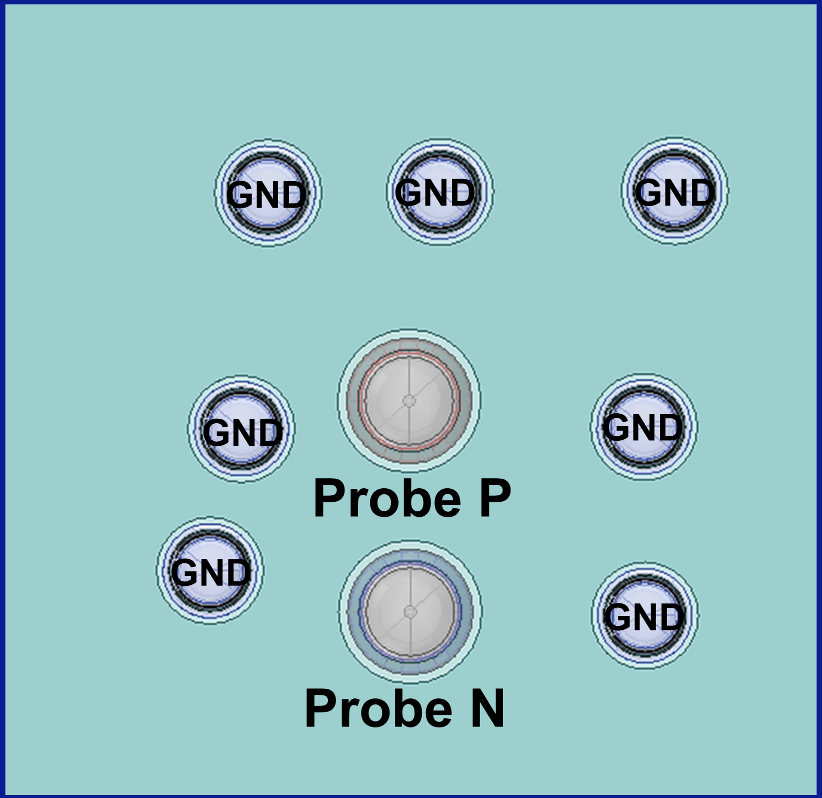
Impedance Control – through Selection of Probe Diameters



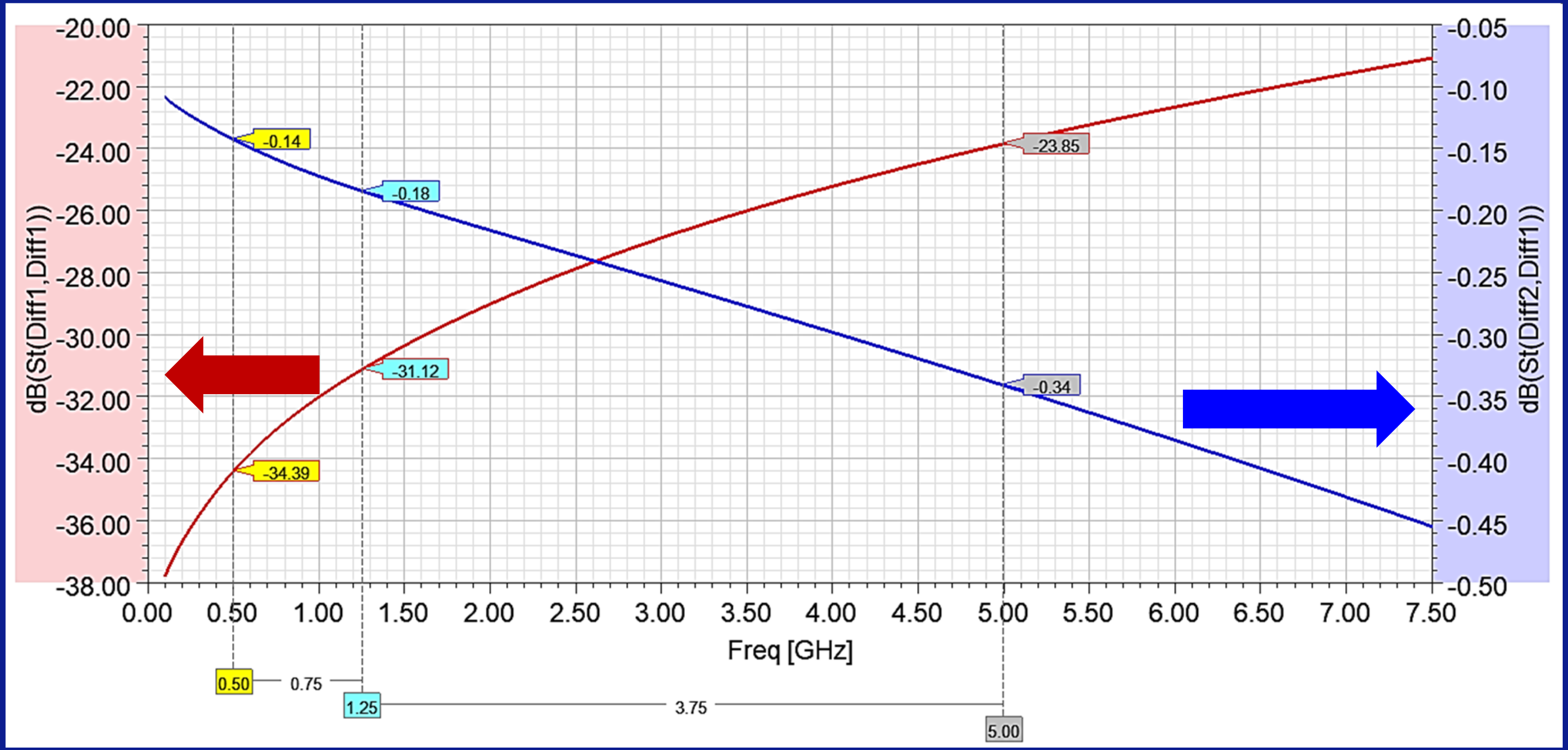
Differential S-Parameters



Impedance control – through Selection of Probe Diameters



Differential S-Parameters



Conclusions

- The probe head is only one part of a complete system; it should be as efficient as possible so that the rest of the elements composing a link such as space transformers and PCB are allowed to exhibit a larger tolerance.
- Impedance control is an important aspect to be considered for maintaining signal integrity transmission.
- Inductance and capacitance can be tuned by the conductor geometry and dielectric materials.

Future Work

- Evaluate the concept of impedance control for higher frequency and complex configuration.
- Evaluate the probe head performance with the space transformer.

With Thanks to Our Sponsors!

Premier

Cohu

Emeritus

Johnstech®

Honored

GLOBAL INNOVATION ISC

WIN SOLUTION

TSE

With Thanks to Our Sponsors!

Distinguished

BACKER HOTWATT

Innovative Circuits Engineering, INC

JMT

Nidec SV TCL

R&D Altanova®

UIGreen 和林科技

Exhibitor

ELES

MJC

PHOENIX TEST ARRAYS
High Performance Contacts

smiths interconnect
bringing technology to life

With Thanks to Our Sponsors!

Industry Partners

MEPTEC
THE NEXT GENERATION

SWTEST
PROBE TODAY, FOR TOMORROW

Publication Sponsor

Chip Scale Review
ChipScaleReview.com
The Future of Semiconductor Packaging

Cohu

The Market Leader in Test Interface Solutions for the Most Challenging Applications

Mobility	Precision Analog & Sensors	RF	High End Digital	Automotive & Power

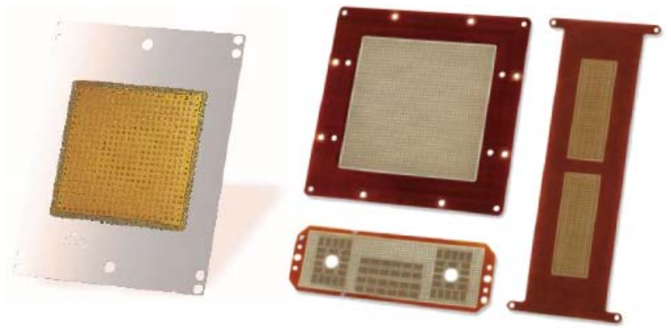
TestConX™ **Premier Sponsor**

GLOBAL INNOVATION

ISC Global No.1! Total Test Solution Provider!

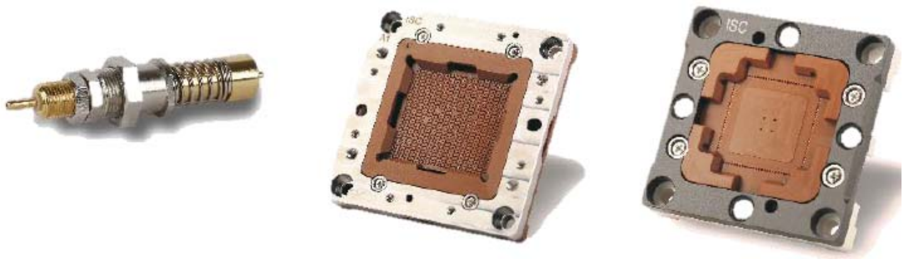
ELASTOMET SOCKET & INTERPOSERS

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



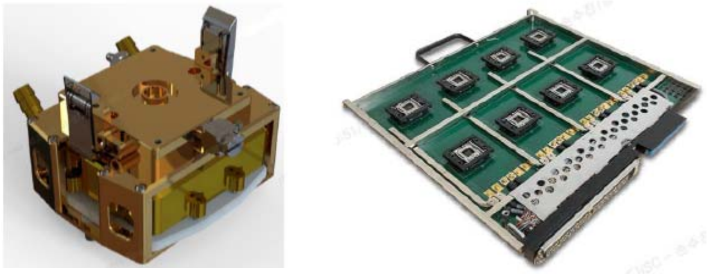
POGO SOCKET SOLUTIONS

- 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



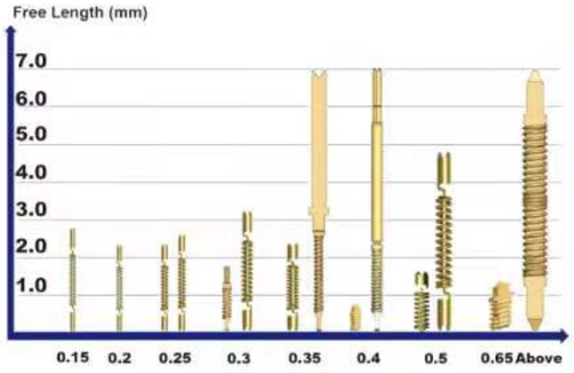
BURN-IN SOLUTIONS

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

CONTACT ISC CO., LTD	ISC HQ Seong-nam, Korea	ISC International Silicon-valley, CA	Tel: +82-31-777-7675 / Fax: +82-31-777-7699 Email: sales@isc21.kr / Web: www.isc21.kr

The test probe for high signal integrity at extremely high speed test

Spring probe by stamping



250 kinds of spring probe pin

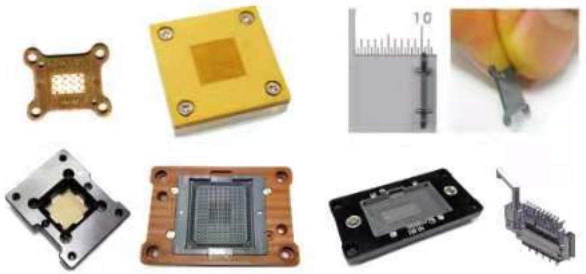
300 kinds of test socket (44,000 Pin count socket possible)

One piece spring probe

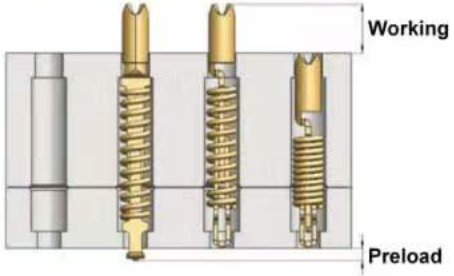
Three piece spring probe

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

Finest Pitch → 0.15mm Pitch



Spring probe by stamping

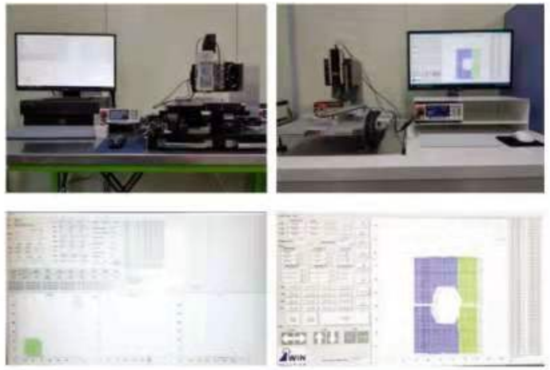


Patented

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



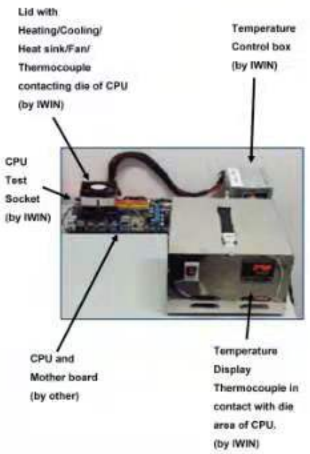
Top Figure: Socket CRES, Force, Stroke test

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.

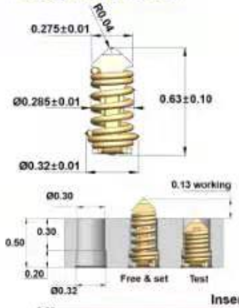
Spring probe pins for High speed

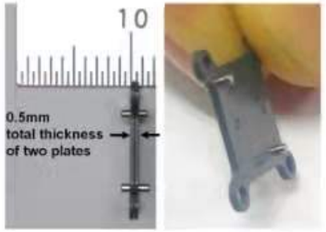
Extremely short spring probes by stamping

One piece spring probe

Three piece spring probe

Design approach





Homepage. www.iwinsn.com Tel. +82-10-6417-7580 E-mail. aj@iwinsn.com

High Performance Probe solution

COPYRIGHT NOTICE

www.testconx.org