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Archive
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Bridging The Gap, Part 2

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HiCon
NXP
HighRel, Inc.

Contents

- Technology Drivers & Tooling Challenges
- Bridging The Gap, Part 1 Review
- The “HSRR” Solution – Building a Better Bridge
- Technology Comparison & Test Data
- Full System Measurement Results
- Conclusions & Next Steps

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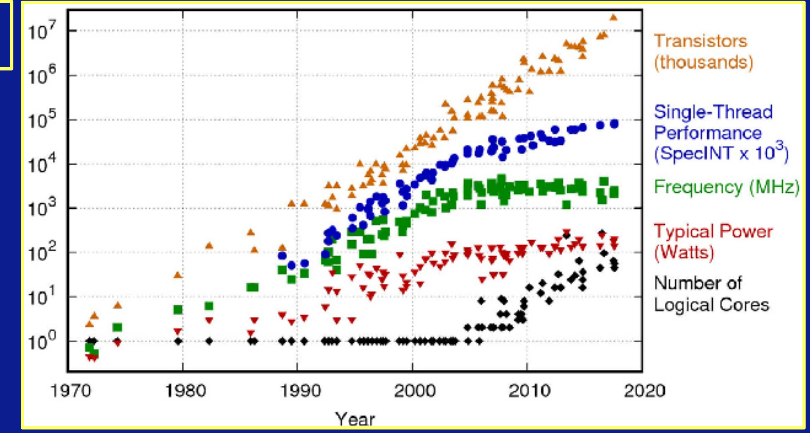
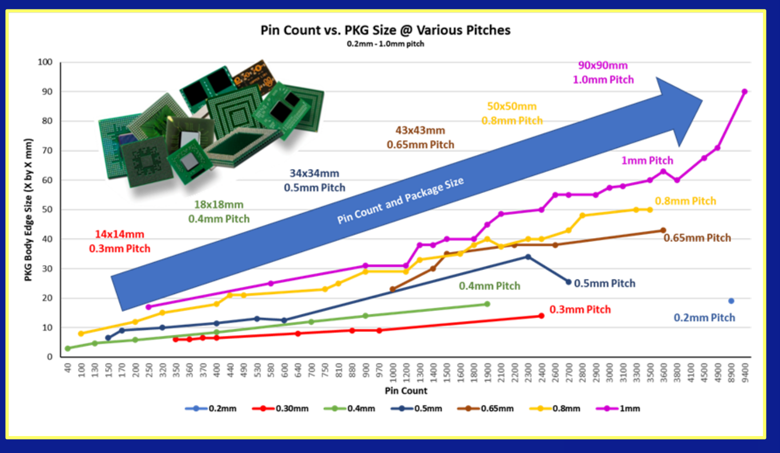
Technology Drivers and Tooling Challenges

Device Trends[1]



Technology treadmill never slows

- Mining, AI, Streaming, Self-Driving, Mobility, Smart Home, Health, etc...
- Higher data rates
- More transistors / More cores
- Higher power
- Both larger and smaller packages
- Finer pitch / Higher pin counts



Packaging Trends

The Test Gap for Fine Pitch / High Speed

Spring Probes:

- Typically, machined pin
- High mechanical cycle life
- Wide temperature range
- Good electrical performance
- Machined pin cost is high and rapidly increases for very fine pitch & high-speed applications, especially as pin height is less than 3mm

Elastomer Contacts:

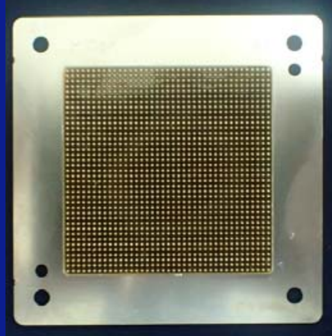
- Excellent electrical performance
- Typically used for validation / characterization applications
- Lower life cycle expectancy compared to spring probes
- Lower temperature range compared to spring pins
- Free height is generally 1mm maximum

Elastomer Contact

Solution Goal: A cost-effective solution contact that provides the electrical capabilities of elastomer contacts and mechanical benefits of spring probes, especially in 1-2mm test height applications

Bridging the Gap, Part 1 – The ‘HyBrid’ Solution

- HiCon has developed an entire product family devoted to addressing ‘The Gap’
- HiCon’s HyBrid Contact was the 1st product developed and was introduced at TestConX 202
  - Initially developed as a way to break through < 0.3mm pitch barrier with a high-performance, cost- effective solution
  - Available at 0.2mm minimum pitch
- The HyBrid contact system combines a mechanical pin with traditional elastomer
  - Contact system benefits from excellent electrical performance
  - Mechanical performance that meets long life and tri-temp temperature range requirements



1mm 1521-pin HyBrid Socket

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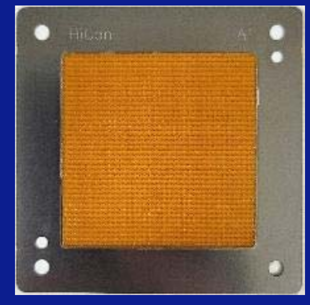
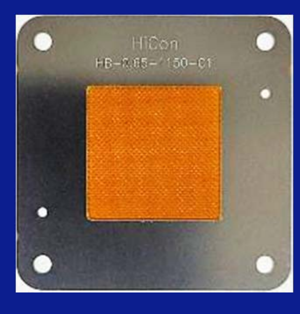
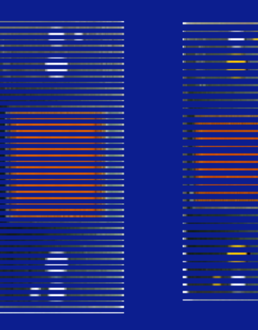
Bridging the Gap, Part 2: HSRR


1mm Pitch

0.65mm Pitch

0.4mm Pitch
0.3mm Pitch

HSRR (High-Speed Round/Round Tip Pin):

- Shortest Spring Probe for High-Speed Test
- High Volume, Stamped Pin
- Wide temperature range: -50°C to 150°C**
- Long Mechanical Life
- Low and Consistent Contact Resistance & excellent S-Parameter performance
- Available in 0.5mm to 1.2mm free heights

Length	1.2mm	1.0mm	0.8mm	0.6mm	0.5mm
Model					
Diameter	0.38mm	0.32mm	0.27mm	0.20mm	0.155mm
Minimum Pitch	0.6mm	0.5mm pitch	0.4mm pitch	0.3mm pitch	0.25mm pitch

** Up to 180°C Solutions Available

High Speed Interconnect Comparison

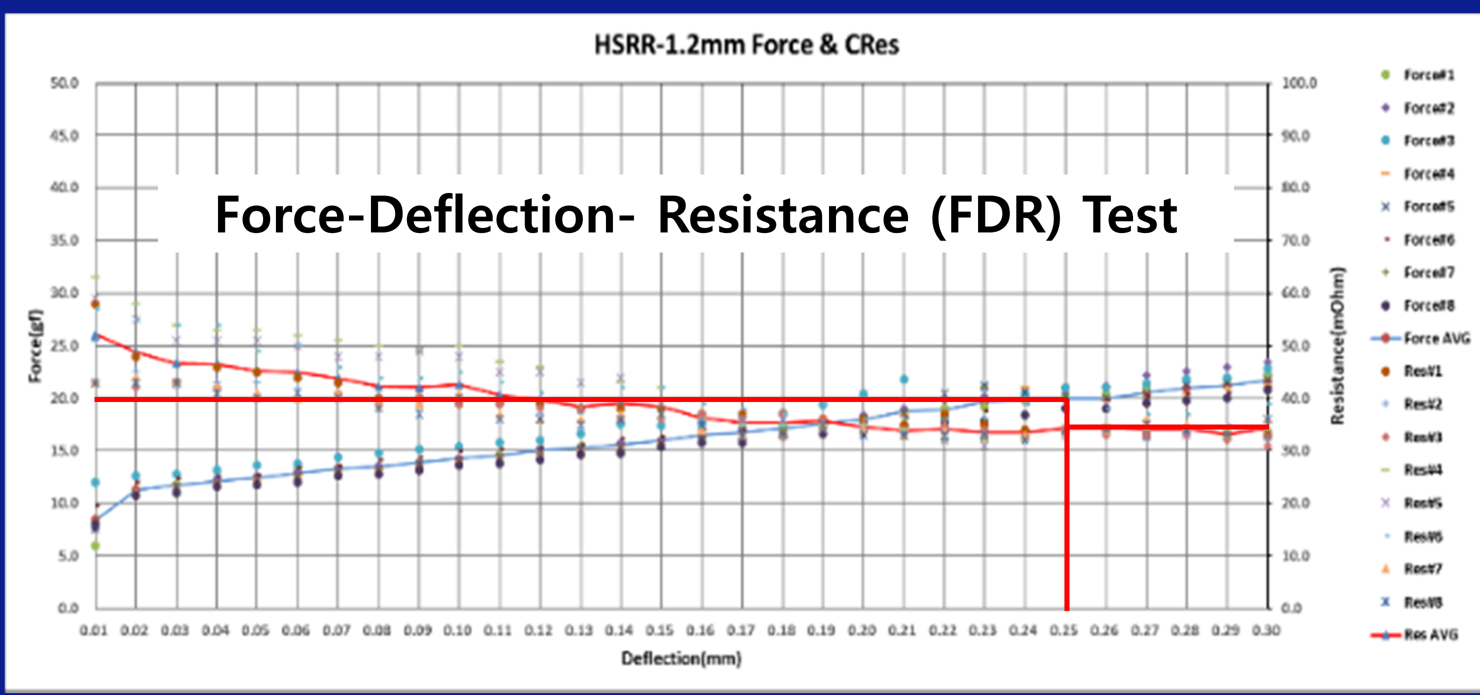
	HiCon HyBrid pin (HB)	HiCon Stamped Pin (HSRR)
Image		
DC Resistance	≤ 80mΩ	≤ 80mΩ
Force	≤ 40g (@0.8p)	Variable (@0.8p) (Available in 16~26g)
Band width (@-1dB)	30~40 GHz	30~40 GHz
Pitch Capability	>1mm ~ 0.20mm	> 1mm ~ 0.25mm
Mechanical Cycles	~ 100K	≥ 100K
Temperature Range	-35°~125℃	-50°~150℃
C.C.C	> 3A	> 3A
Key Features	Short (1.2mm↓). Stamped Pin + Powder	Short (1.2mm↓). Fully stamped (Robust & Economical)

HSRR Benefits:

- Fully stamped solution
- Same electrical performance
- Greater mechanical stroke
- Greater temperature range (150°C and higher)
- High current
- Increased mechanical life
- Test height as low as 0.36mm
- 1-2mm test height solutions available

Data based on 0.8mm pitch

HSRR Validation Data



DEF(mm)	Force(gf)	Resistance(mΩ)
0.25	20.0gf/pin	34.3mΩ/pin
0.30	21.7gf/pin	34.3mΩ/pin

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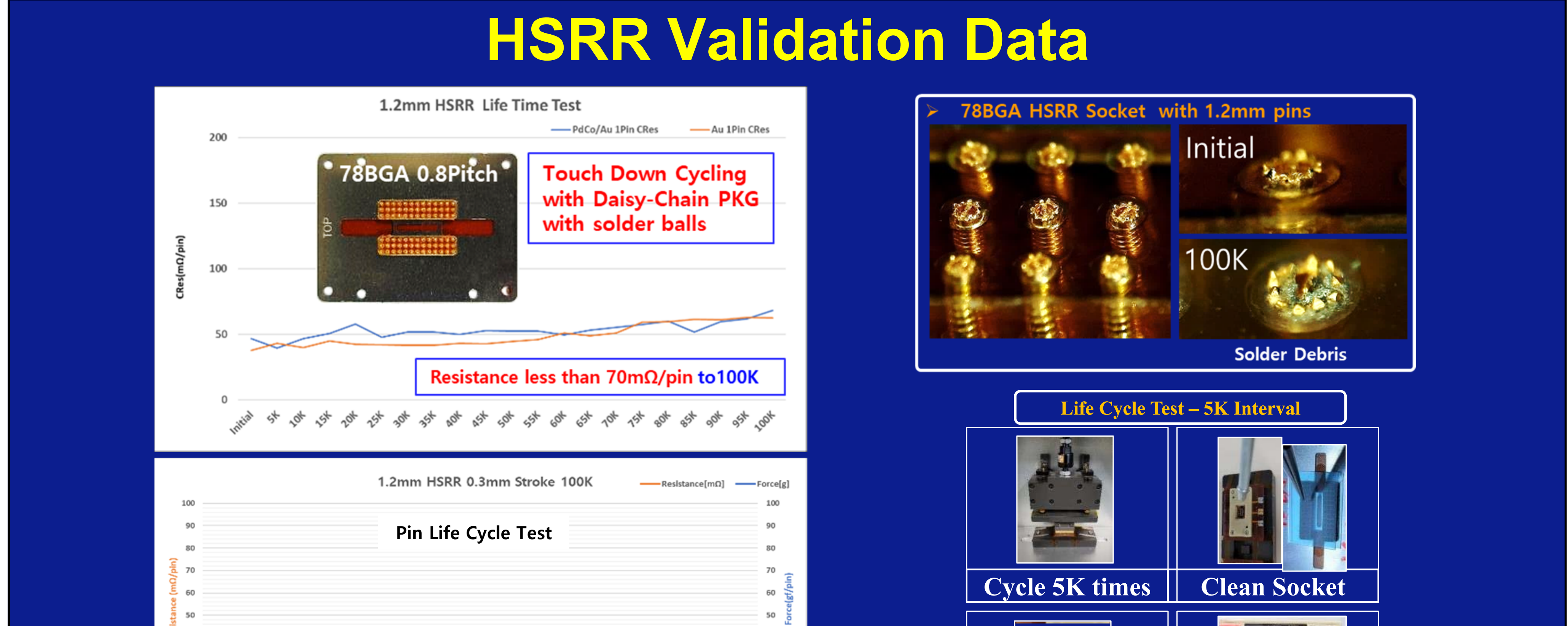

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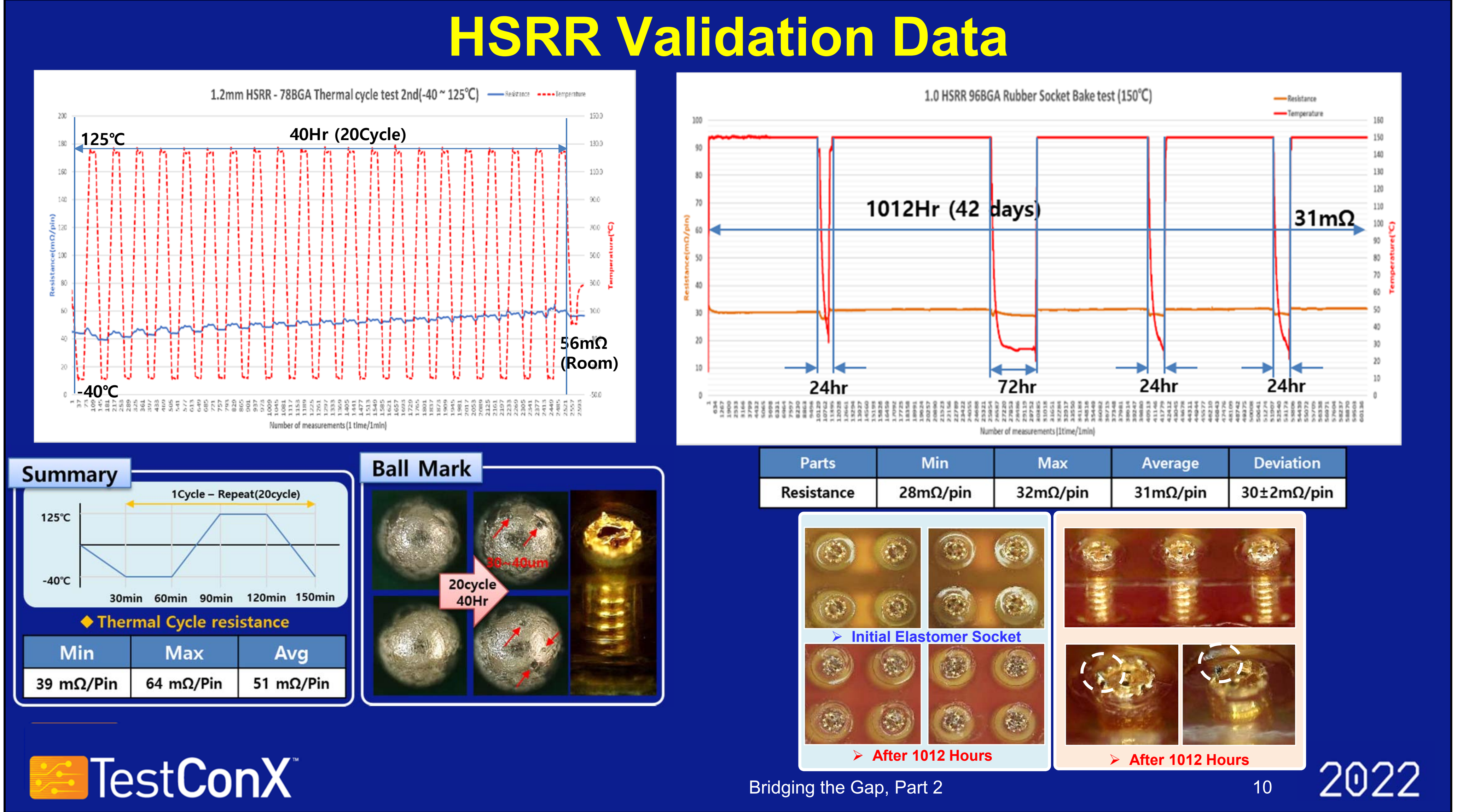
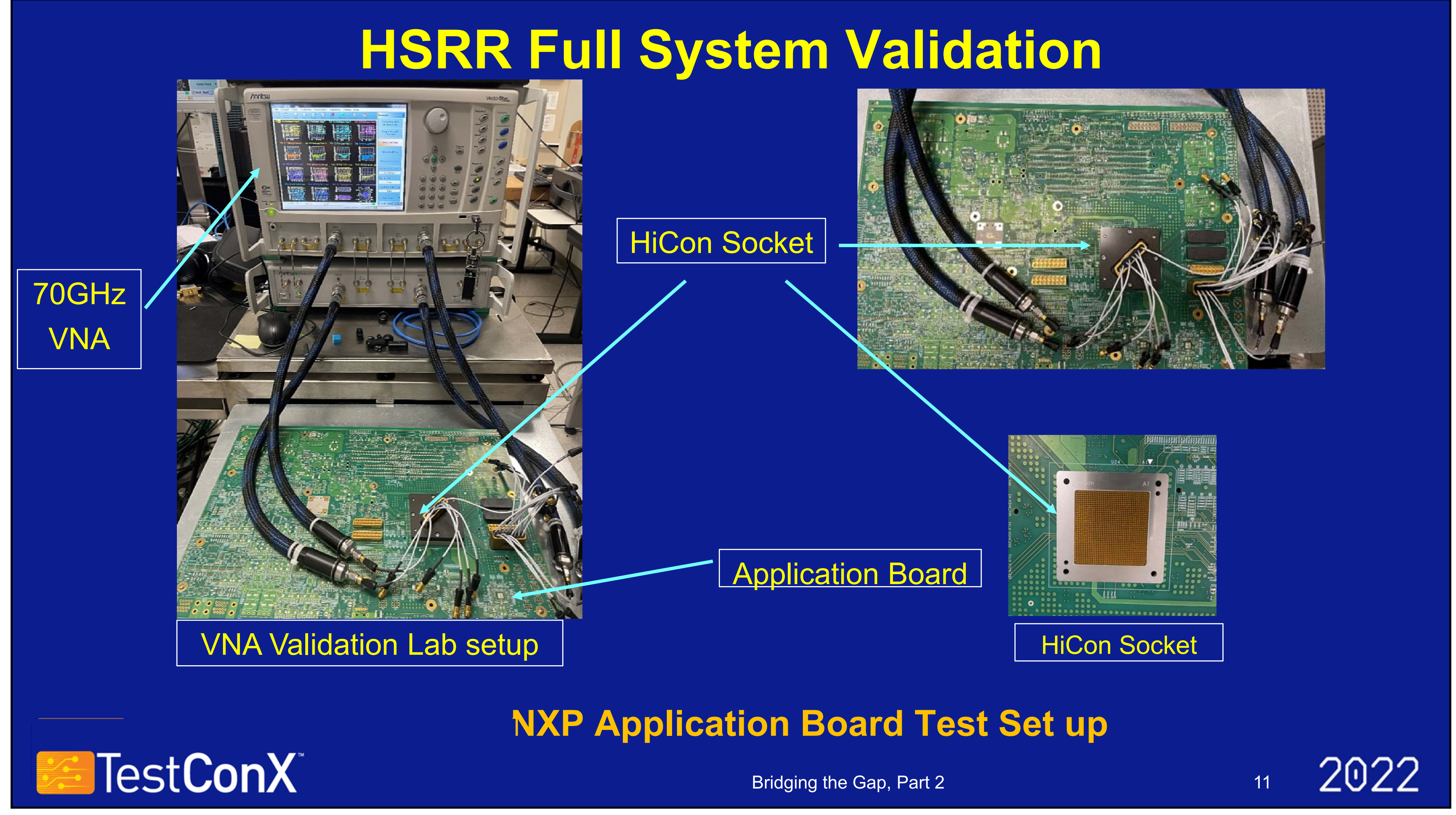


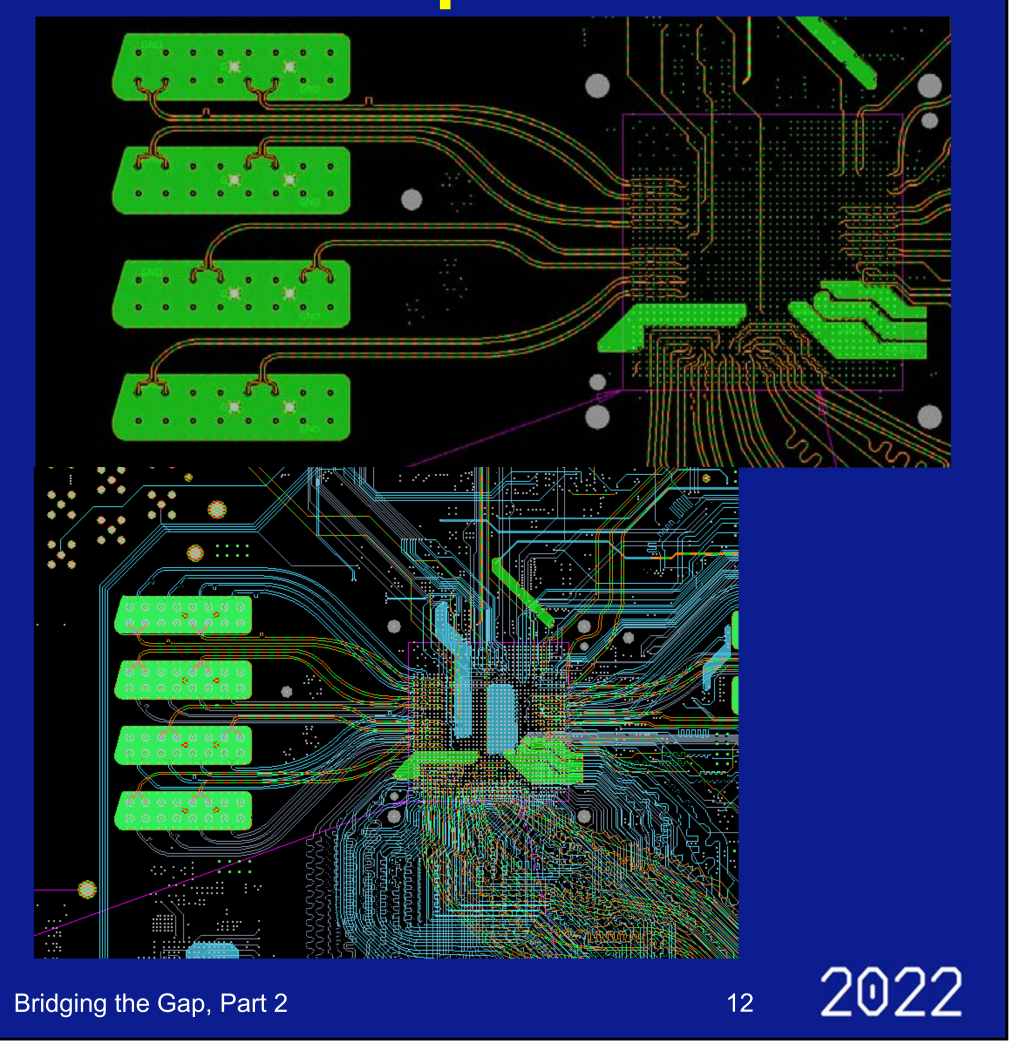
Min	Max	Avg
39 mΩ/Pin	64 mΩ/Pin	51 mΩ/Pin

Parts	Min	Max	Average	Deviation
Resistance	28mΩ/pin	32mΩ/pin	31mΩ/pin	30±2mΩ/pin


HSRR Full System Validation
70GHz
VNA
HiCon Socket
Application Board
VNA Validation Lab setup
HiCon Socket
NXP Application Board Test Set up
TestConX
Bridging the Gap, Part 2
11
2022

HSRR Measurement Set-up

1. VNA DC to 30Ghz @ 3Mhz resolution or steps
2. HiCon LX2 Test Socket
3. 1mm pitch / 1517BGA Surrogate Package
4. Differential Measurements
5. Eight Serdes Lanes Measured (RX2, TX2, RX3, TX3)
6. Room Temperature using 70Ghz VNA
7. No LX2 functional test
8. HyperLynx simulator on one lane, PRBS31 at 25 data rate



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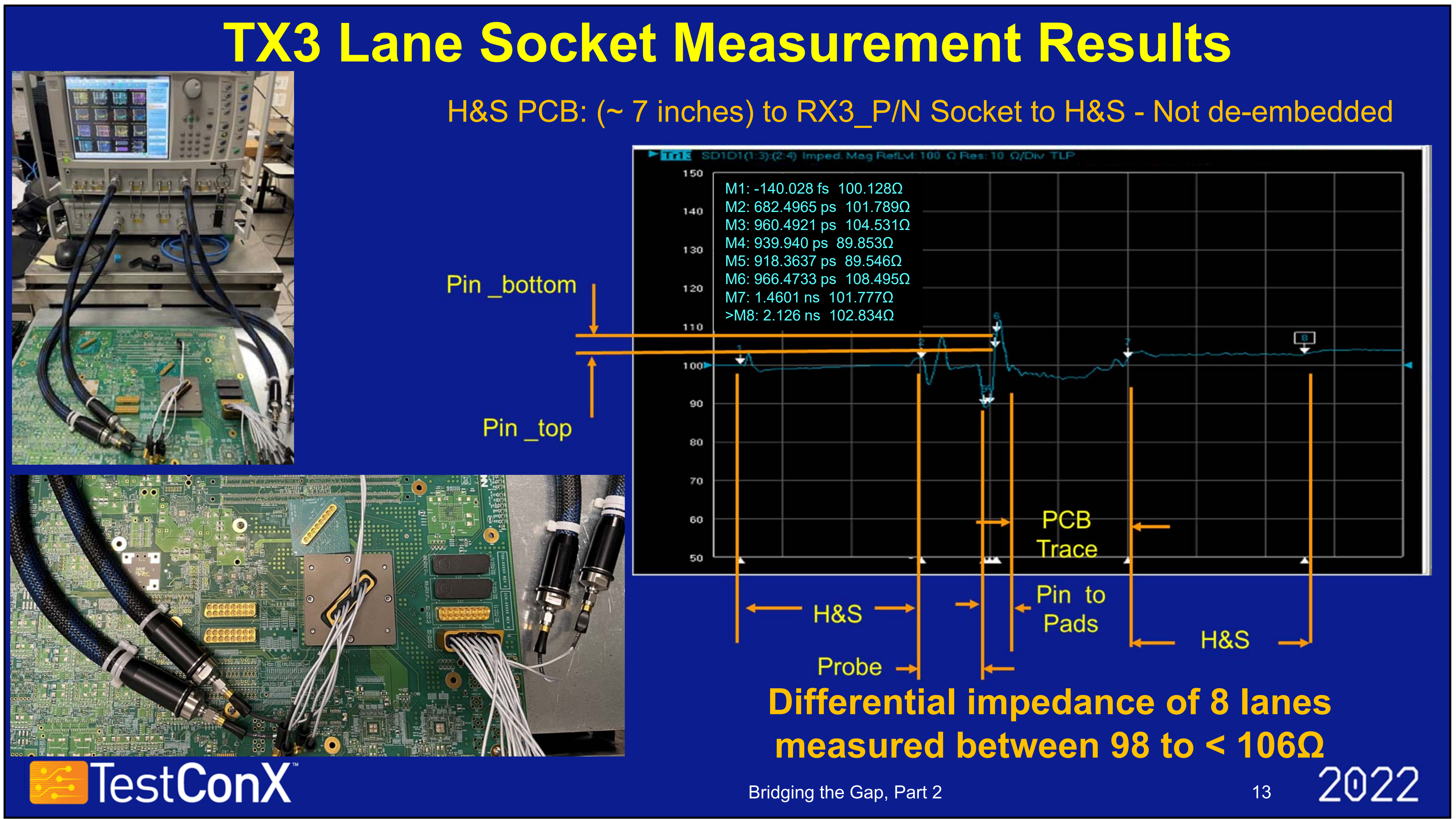
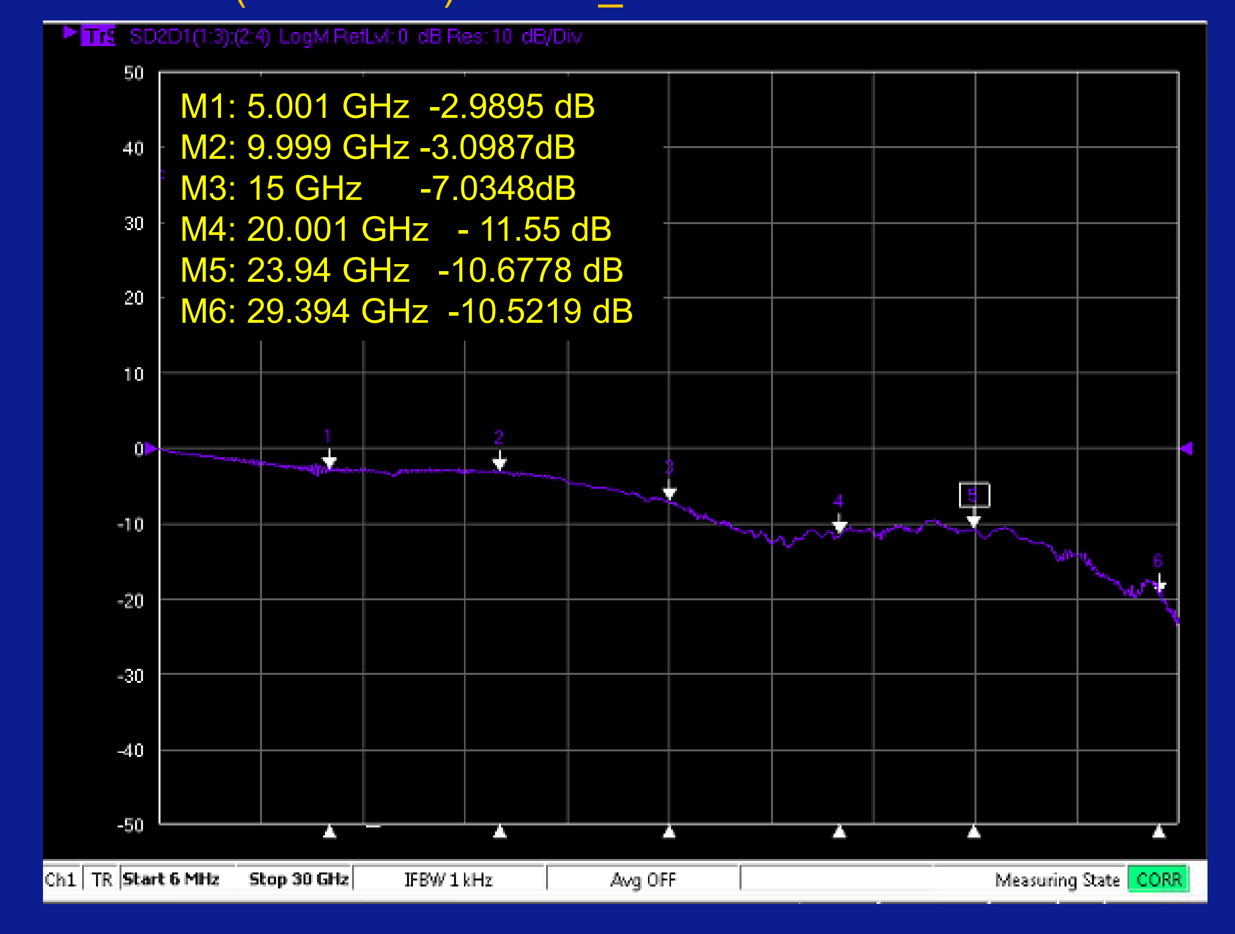


RX3 Lane Measurement Results

DIFFERENTIAL INSERTION LOSS

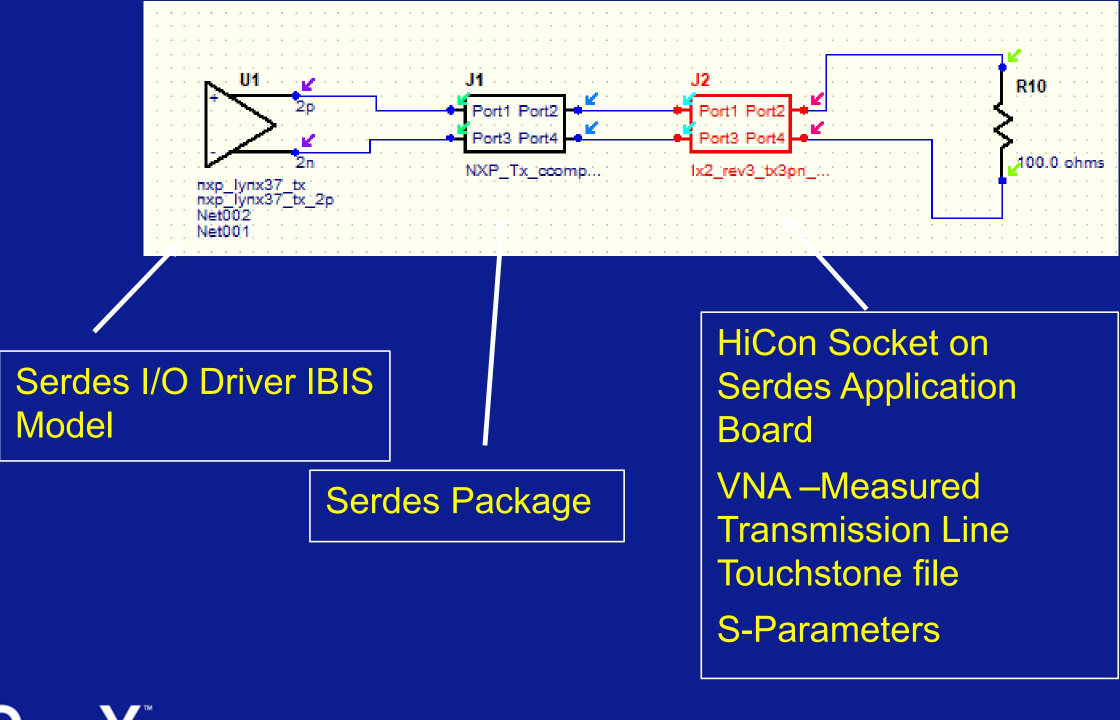
- DC to 30 GHz
- TRANSMISSION LINE (SIGNAL PATH)
  - HICON Socket
  - APPS board
  - H&S Connector X2
  - Surrogate Package

H&S PCB: (~ 7 inches) to RX3_P/N socket to H&S - Not De-Embedded



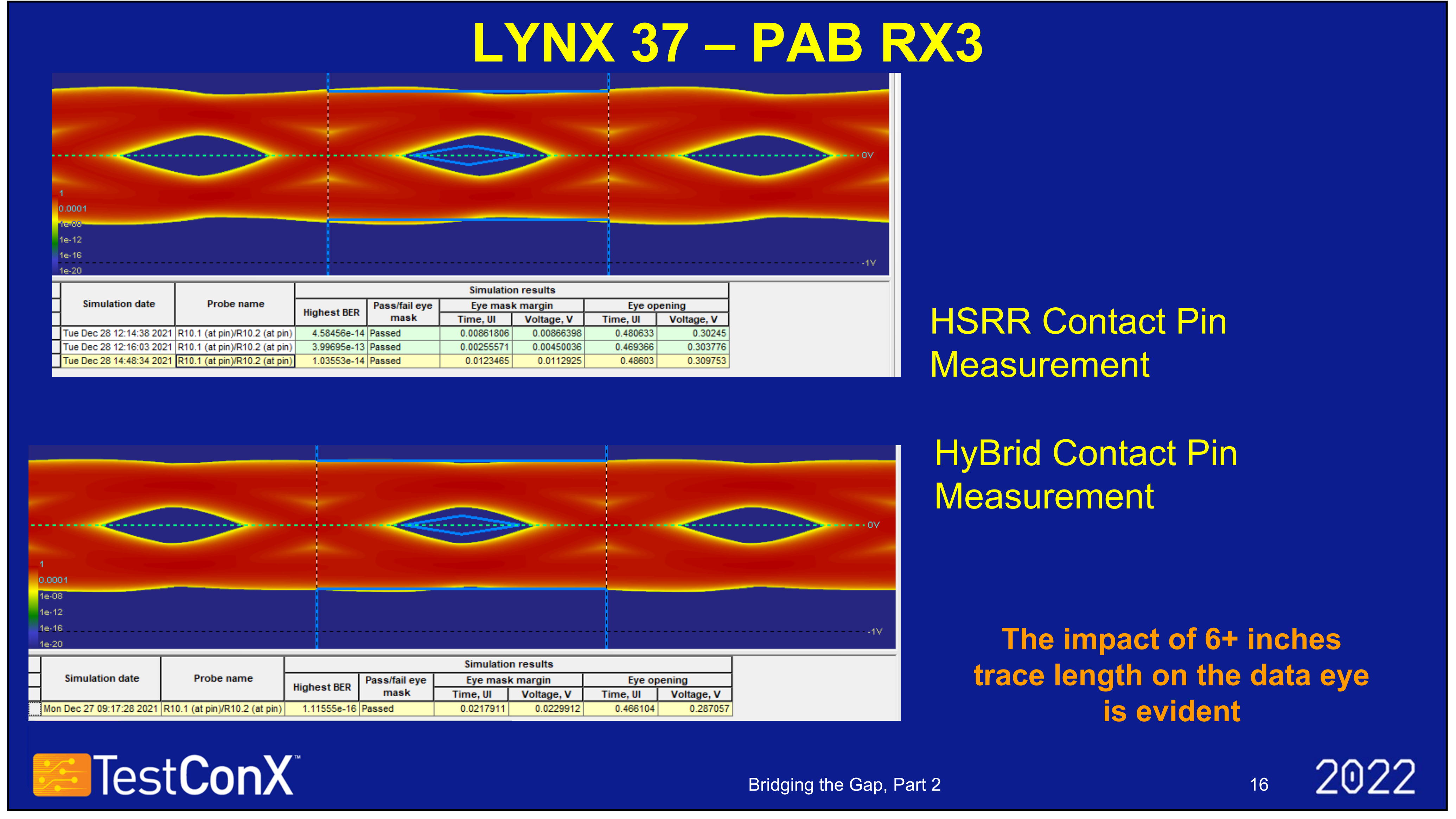
LYNX37: Package – Application Board (PAB)

Serdes Circuit Simulator, HyperLynx SI



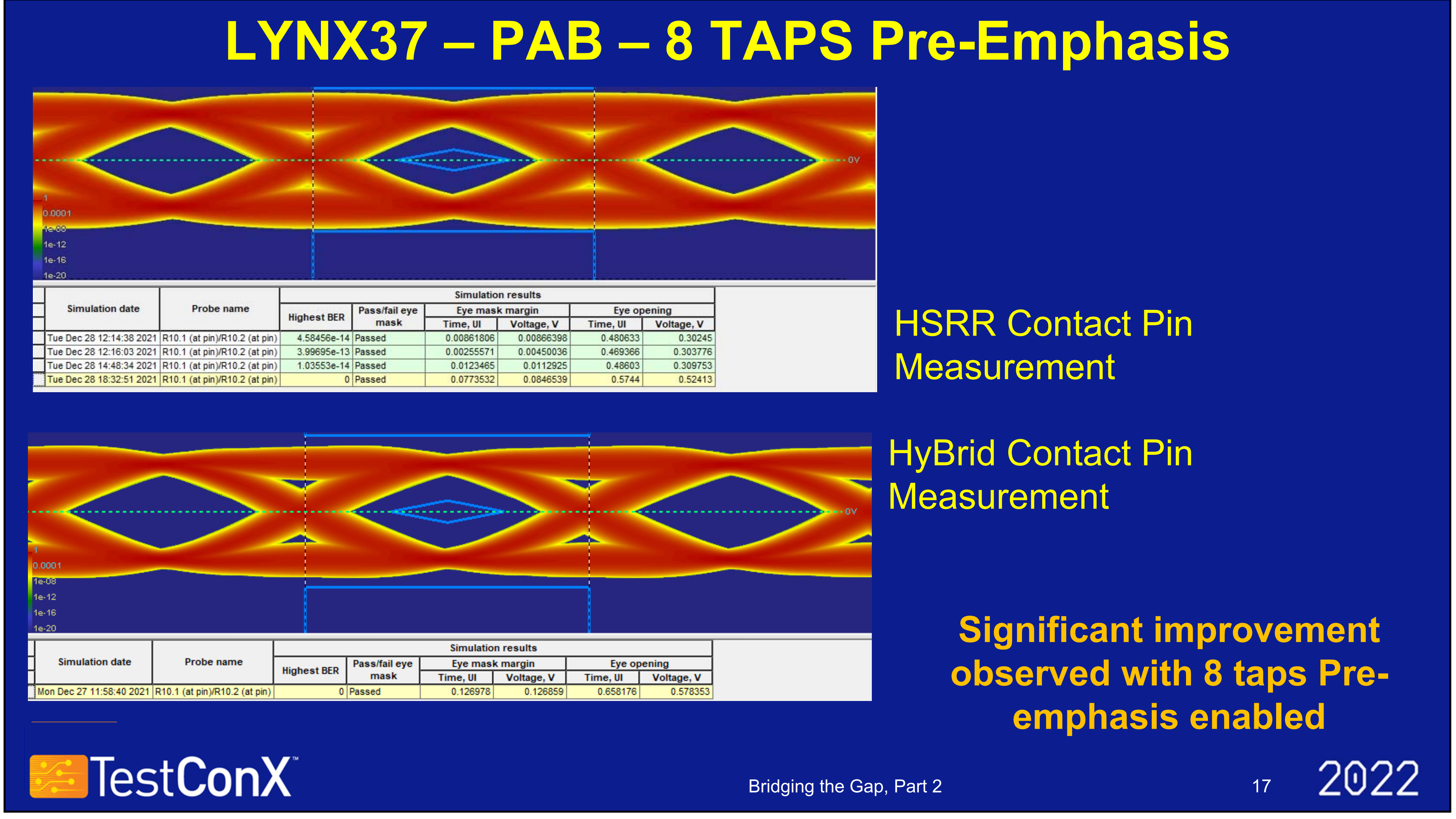
Serdes Circuit Simulator

- Mentor Graphics HyperLynx
- PRBS31 Test Pattern
- 25G Data Rate



Simulation date	Probe name	Highest BER	Pass/fail eye mask	Eye mask margin Time, UI	Eye mask margin Voltage, V	Eye opening Time, UI	Eye opening Voltage, V
Tue Dec 28 12:14:38 2021	R10.1 (at pin)/R10.2 (at pin)	4.58456e-14	Passed	0.00861806	0.00866398	0.480633	0.30245
Tue Dec 28 12:16:03 2021	R10.1 (at pin)/R10.2 (at pin)	3.99695e-13	Passed	0.00255571	0.00450036	0.469366	0.303776
Tue Dec 28 14:48:34 2021	R10.1 (at pin)/R10.2 (at pin)	1.03553e-14	Passed	0.0123465	0.0112925	0.48603	0.309753

Simulation date	Probe name	Highest BER	Pass/fail eye mask	Eye mask margin Time, UI	Eye mask margin Voltage, V	Eye opening Time, UI	Eye opening Voltage, V
Mon Dec 27 09:17:28 2021	R10.1 (at pin)/R10.2 (at pin)	1.11555e-16	Passed	0.0217911	0.0229912	0.466104	0.287057



Simulation date	Probe name	Simulation results					
		Highest BER	Pass/fail eye mask	Eye mask margin		Eye opening	
				Time, UI	Voltage, V	Time, UI	Voltage, V
Tue Dec 28 12:14:38 2021	R10.1 (at pin)/R10.2 (at pin)	4.58456e-14	Passed	0.00861806	0.00866398	0.480633	0.30245
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Tue Dec 28 14:48:34 2021	R10.1 (at pin)/R10.2 (at pin)	1.03553e-14	Passed	0.0123465	0.0112925	0.48603	0.309753
Tue Dec 28 18:32:51 2021	R10.1 (at pin)/R10.2 (at pin)	0	Passed	0.0773532	0.0846539	0.5744	0.52413

Simulation date	Probe name	Simulation results					
		Highest BER	Pass/fail eye mask	Eye mask margin		Eye opening	
				Time, UI	Voltage, V	Time, UI	Voltage, V
Mon Dec 27 11:58:40 2021	R10.1 (at pin)/R10.2 (at pin)	0	Passed	0.126978	0.126859	0.658176	0.578353

Summary & Conclusions

	HiCon Hs Product Solution Family
DC Resistance	≤ 80mΩ
Force	≤ 40g (@0.8p)
Band width (@-1dB)	> 40 GHz
Pitch Capability	0.25mm minimum
Mechanical Cycles	> 100K
Temperature Range	-35°~150℃ (Up to 180°C)
Current Carrying Capacity	> 3A
Test Height Range	0.36mm – 1.7mm
Key Features	Fully Stamped / Scalable and Economic Solution

- Spring Pins and Elastomer Contact Solutions offer seemingly mutually exclusive benefits suitable for different applications
- HiCon's High-speed (Hs) product family combines the best attributes of both into a single solution
- The HSRR contact builds upon the HyBrid contact by increasing the pin stroke, temperature range, and mechanical life cycles
- Fully stamped pin is a cost-effective solution for applications as low as 0.25mm pitch
- HSRR provides consistent quality and C-res

References

1\. DOI: 10.1109/JPROC.2019.2948554 • Corpus ID: 208882381

High-Density Power Conversion and Wide-Bandgap Semiconductor Power Electronics Switching Devices

K. Shenai • Published 5 November 2019 • Materials Science, Computer Science • Proceedings of the IEEE

From page 3

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