TWENTY THIRD ANNUAL

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Simplifying and Standardizing Semiconductor Test

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Cohu

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Overview

- Introduction
- Challenge and Opportunity
- Design Methodology
- Analysis and Design Validation
- Results
- Conclusion

Introduction

- Reducing Cost of Test (CoT) will always play a significant role in our industry
- This presentation will guide you through the methodology of analyzing and testing spring probes in order to generate the latest line of improved probes
- We'll review the design improvements, outcome and implementation

Challenge: Legacy Spring Probes

- Numerous probes created for customer-specific applications
- Portfolio created over several years
- Resulted in:
  - Random assortment of probe offerings: different pitches, heights, compositions
    - Difficult for customers to change probes
    - Volume spread over multiple part numbers
    - Manufacturing inefficiencies
    - Longer lead times
  - Many established probes that could be further optimized

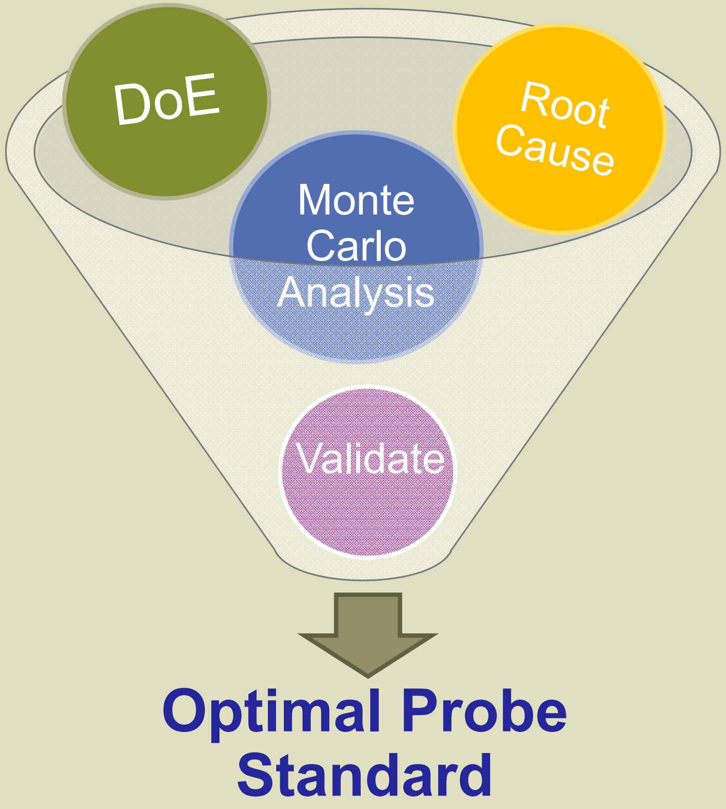
Opportunity / Project Objective

- Create a new line of standard probes with desired outcome:
  - Lower average cost
  - Reduce standard lead time
  - Higher performance (contact resistance, number of cycles)
  - Standardization for customer use, resulting in reduced CoT
- We would achieve that by using:
  - Latest design standards
  - Common pitch
  - Common test heights
  - Standard options for DUT probe metal and platings
  - Standard options for DUT probe shape

Defining the Best Probe Standard

Analysis and improvement process:

1. Analyze poor performing probes for root cause
2. Perform Design of Experiments (DoE) to identify the correct value of design variables
3. Perform Monte Carlo analysis to confirm design tolerance
4. Improve existing probe to validate the design "recipe"
5. Carry this perfected recipe into new family of standard probes



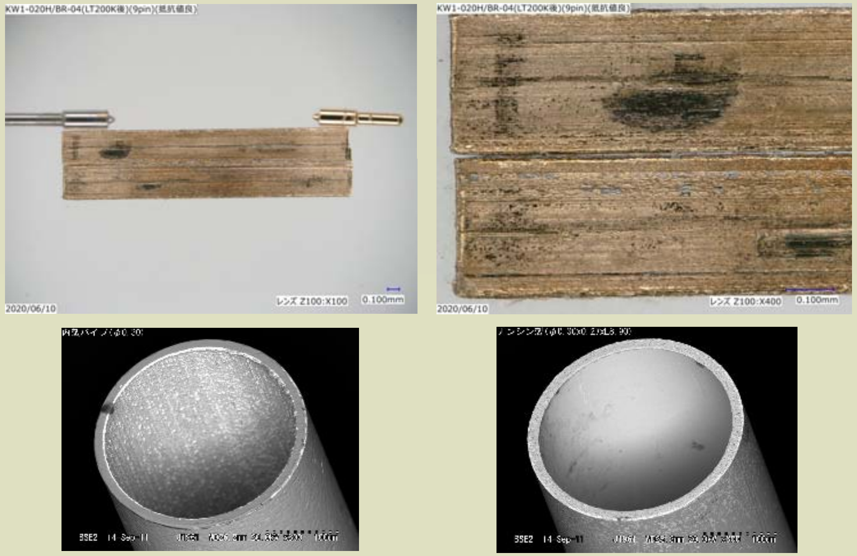
Identifying Root Cause

- MFG data was reviewed to correlate probe failures to measurements taken
- Probes were dissected to determine failing features and cause

Validation of build dimensions

	Wire O.D	Free Length
Standard	0.168mm +0.005/-0.01	2.2mm +/-0.1
1	0.166	2.19
2	0.166	2.19
3	0.165	2.18
4	0.166	2.19
5	0.165	2.19
6	0.165	2.19
7	0.166	2.18
8	0.165	2.19
9	0.165	2.18
10	0.164	2.18
Min	**0.164**	**2.18**
Max	**0.166**	**2.19**
AVERAGE	**0.165**	**2.19**

Inspection of failed probes



DoE's Performed to Test Hypothesis

- DoE's specific for:
  - Barrel geometries
  - Spring geometries
  - Plunger geometries
  - Plating materials
  - Contactor cross sections

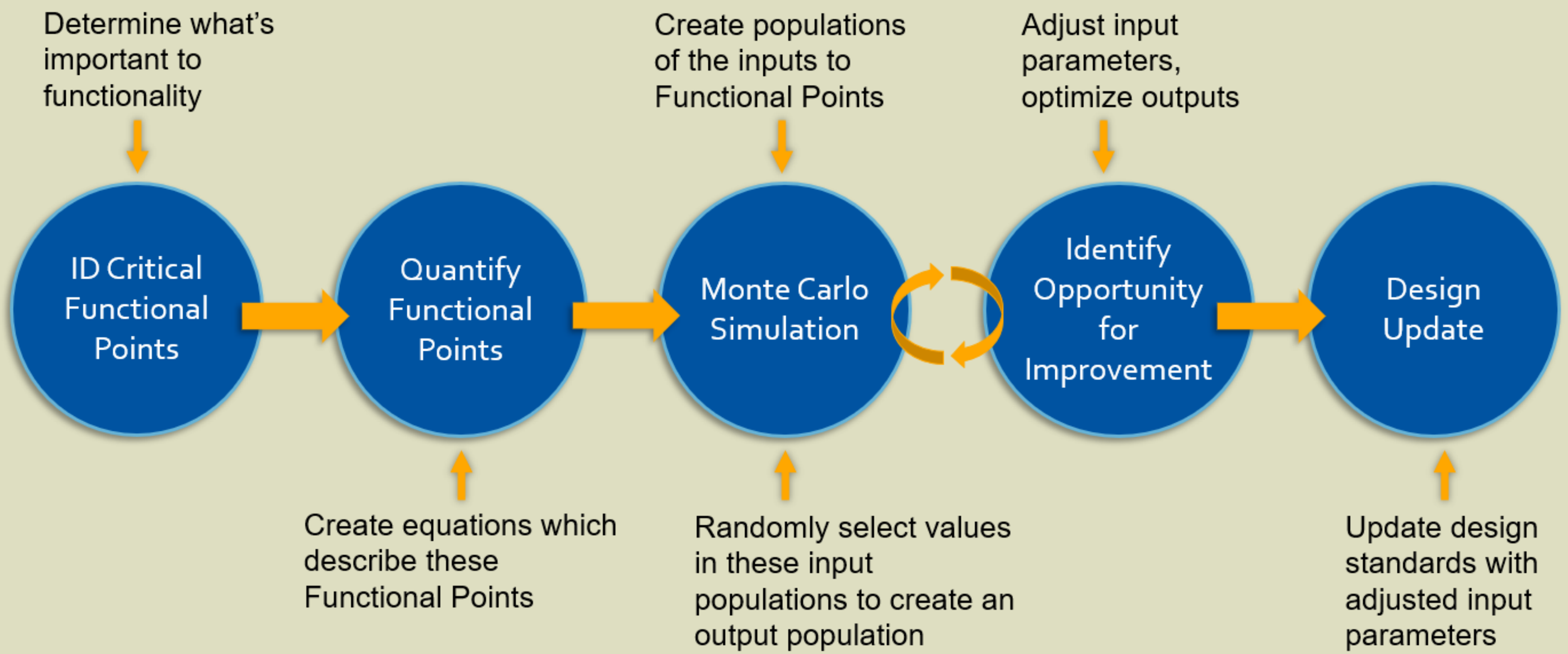
Proposed Improvements
- DoE's
- Field Data

Design/Build/Test Improved Probe

Confirmation of Probe Standard

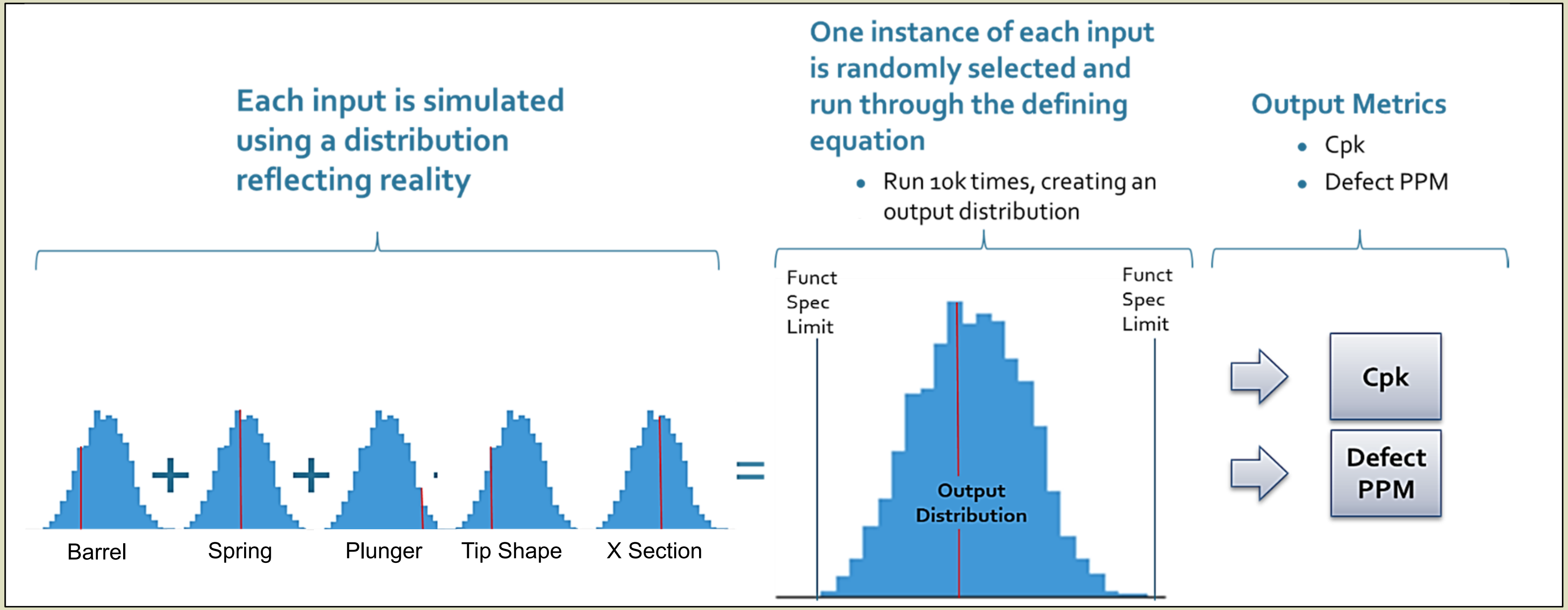
DOE	Process	Run	Positions	spring	DUT plunger Lot Number	Cycle Count	Outputs	cRes - average - discrete	cRes - std dev - discrete	cRes - Min - discrete	cRes - Max - discrete	cRes - average - cumulative	cRes - std dev - cumulative	cRes - Min - cumulative	cRes - Max - cumulative
Test 19	B	2	17 to 32	Lot 1	Lot 1	500000	Test 19	90.3	90.3	31	283	48.8	46.8	28	383

Design Verification: Monte Carlo Process



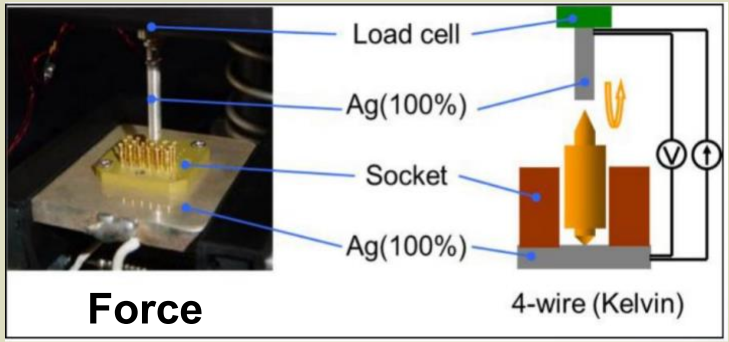
Design Verification: Monte Carlo Analysis

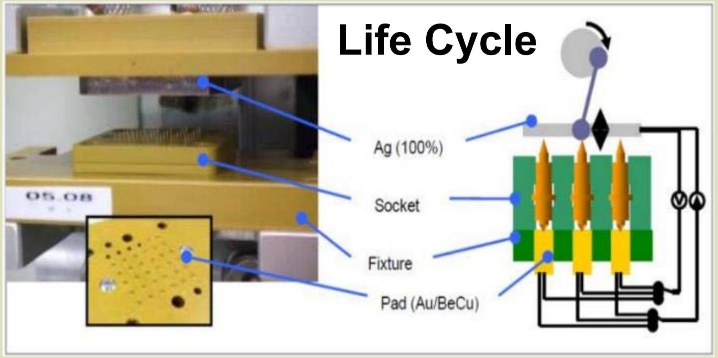
- Used to estimate the designs resulting Cpk and PPM
- Variable inputs based on actual measured distributions



Test Methods: Analyze and Validate Design

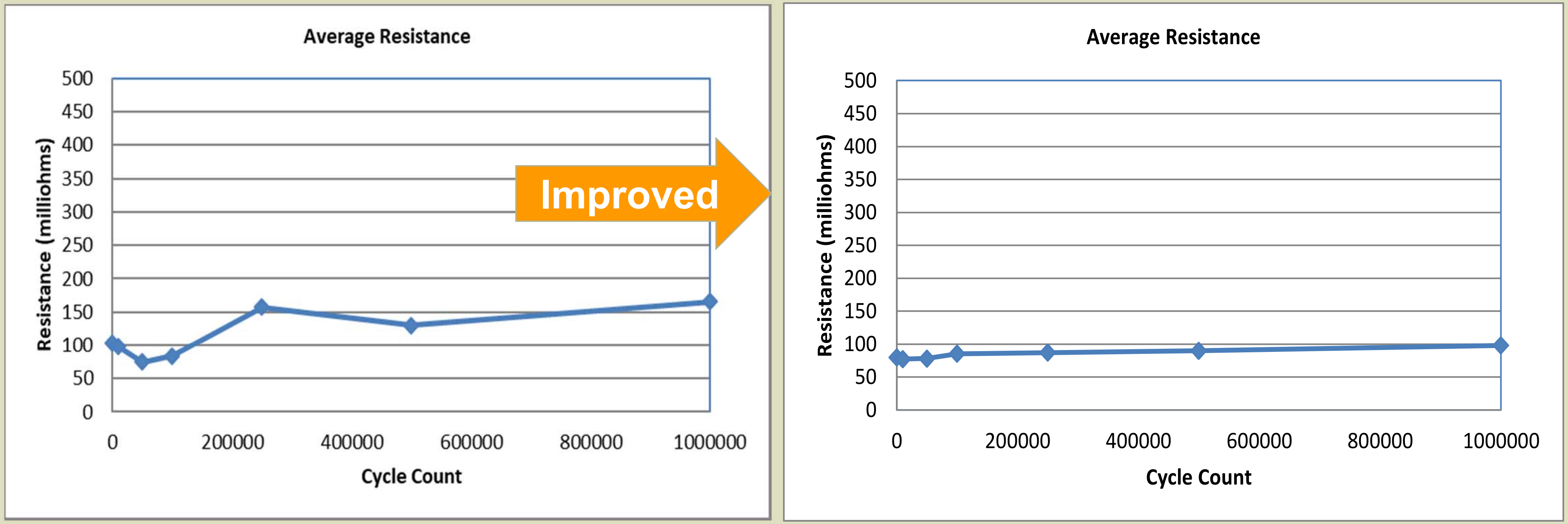
- Probes were tested using correlated, validated test systems
- Initial prototype batch tested
- First production run also tested
- Tests performed
  - Resistance and stability
    - Life Cycle up to 1,000,000 cycles
  - Probe Force through compression
  - Continuous Current Carrying Capacity (CCC)
  - Radio Frequency (RF)



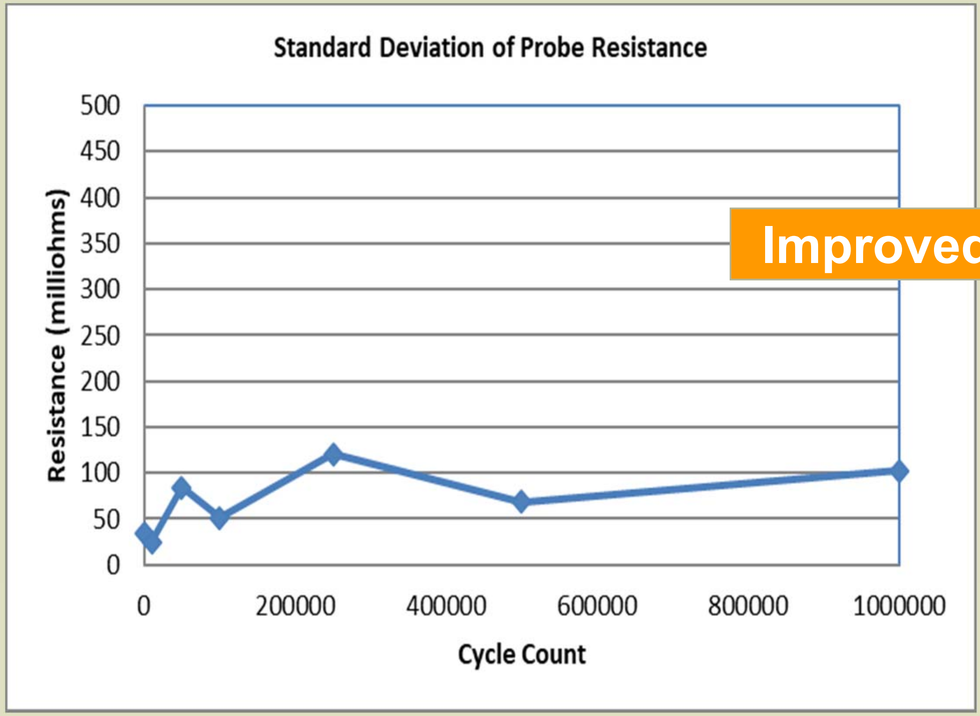


Validate Probe cRes - AVG

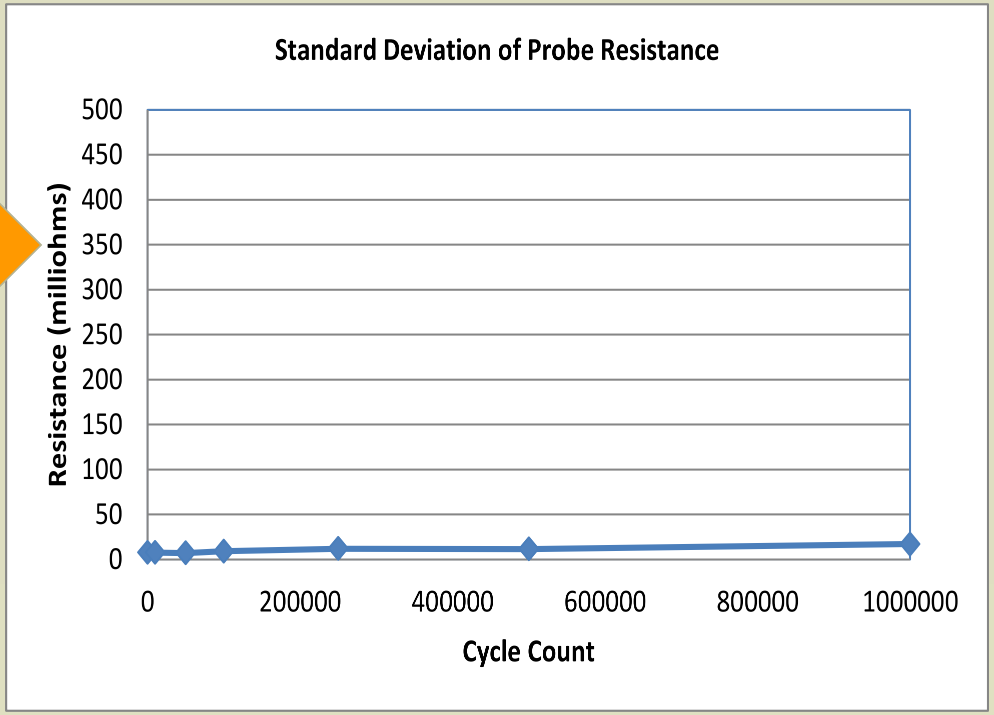
- Measured improvements after changing barrel, spring and plunger geometries and plating



Validate Probe cRes – Std Dev



Improved



Validate Probe CCC Performance

DC Specifications

20°C T-Rise Current:	1.3 Amps
40°C T-Rise Current:	1.6 Amps
60°C T-Rise Current:	1.9 Amps

Pulsed Current Specification

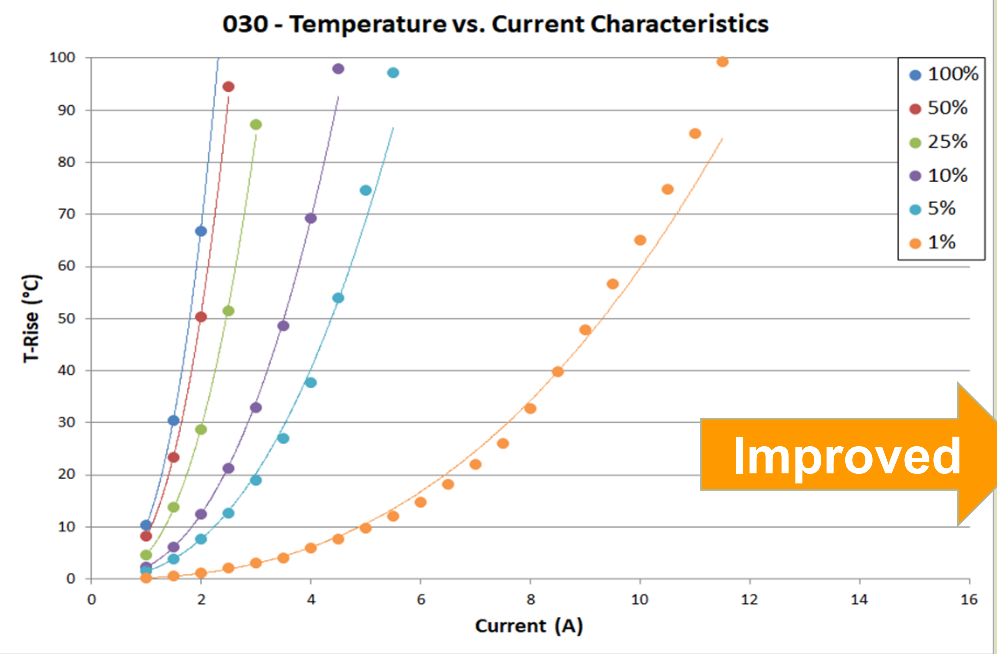
1% duty cycle, 20°C T-Rise Current:	6.4 Amps

DC Specifications

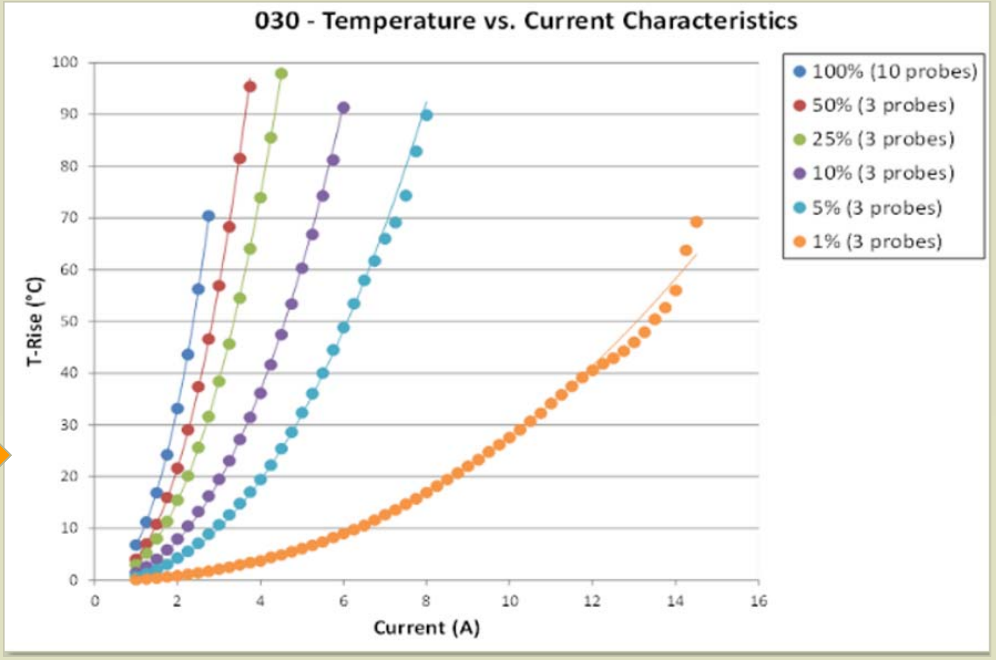
20°C T-Rise Current:	1.6 Amps
40°C T-Rise Current:	2.2 Amps
60°C T-Rise Current:	2.6 Amps

Pulsed Current Specification

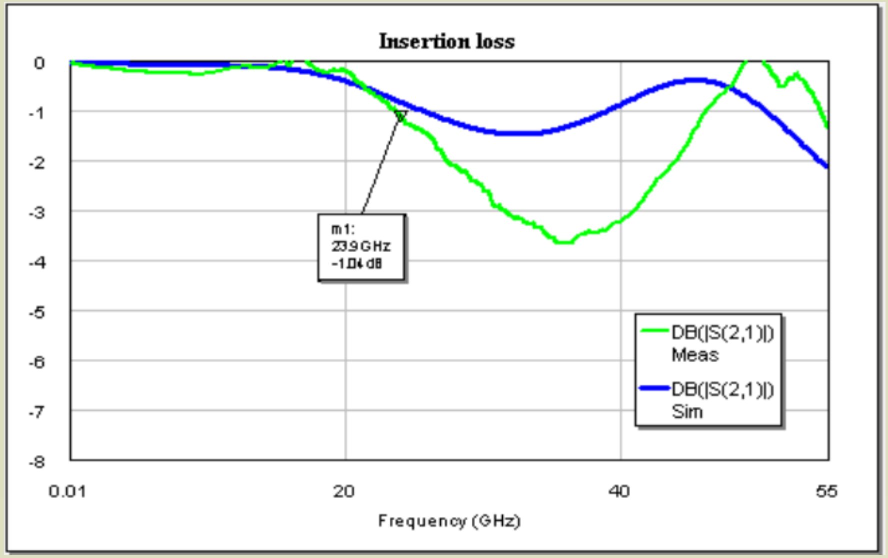
1% duty cycle, 20°C T-Rise Current:	8.6 Amps

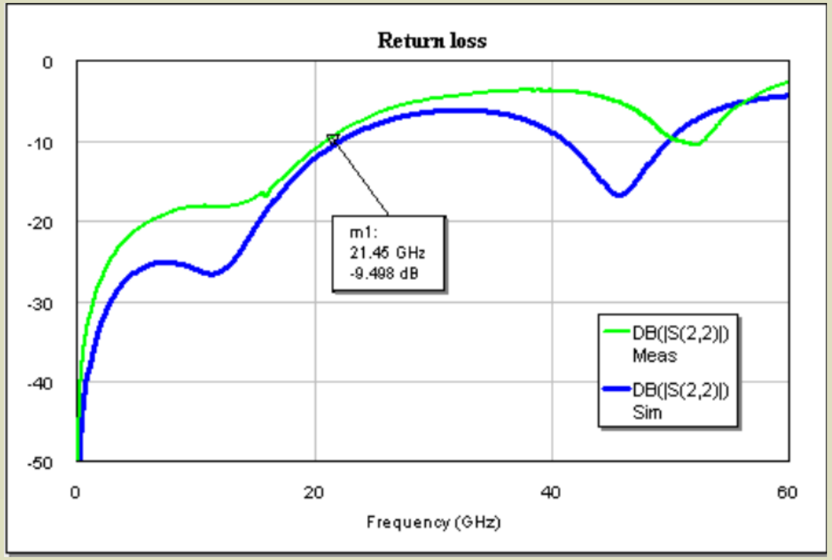


Improved



Validate Probe RF Performance

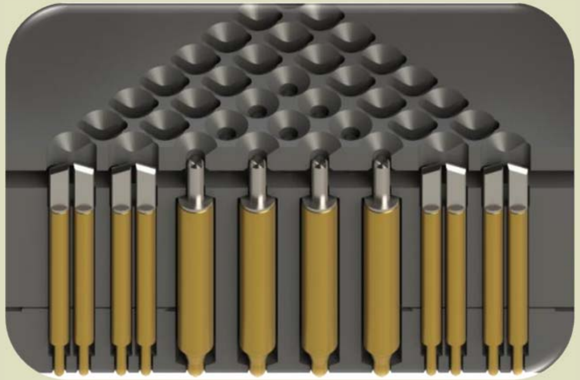


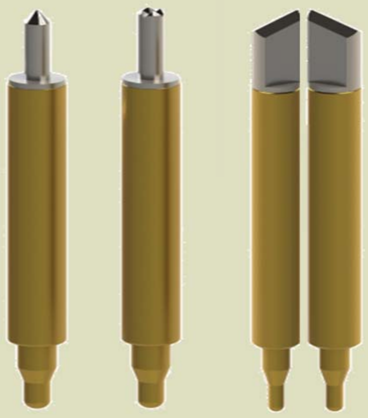


BANDWIDTH	FREQUENCY
GSG INSERTION LOSS (-1 dB)	24 GHz
GSG RETURN LOSS (-10 dB)	21 GHz

Outcome: Hydra – Probe Tip Styles and Plating

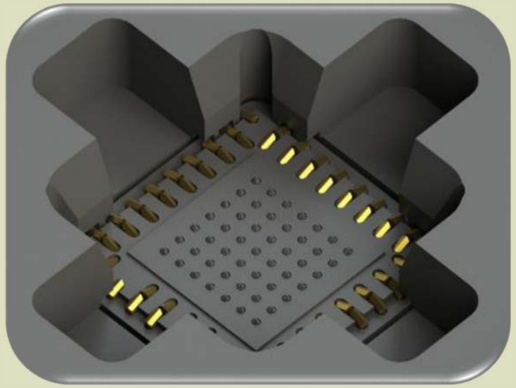
- Portfolio
  - 3 Test heights
- Plating options
  - Gold, 2-2H, N01, Pd Alloy
- Probe tip styles for all package types
  - 3 Tip styles: single point, 4-point crown, Kelvin
- Probe interchangeability

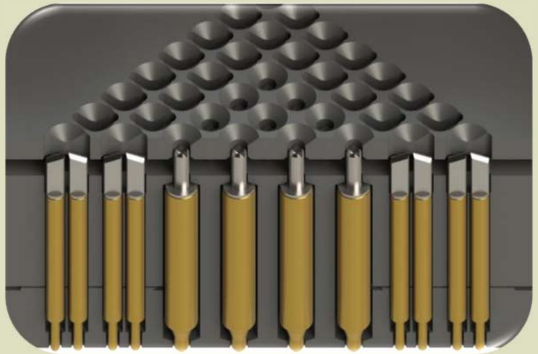




Conclusion

- Performance – probe family optimized for best-in-class performance
- Standardization – ability to standardize tester/handler change kits and hardware
- Interchangeability – mix-and-match power, RF and Kelvin in same socket housing
- Efficiency – reduced part management and customer spares inventory
- Reduced cost and lead time





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