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BiTS

Burn-in & Test Strategies Workshop

March 4 - 7, 2018

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Life Cycles of Sockets; Specification vs Reality and Setting Standards – Contact Resistance

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Xcerra Cycling for C_{res} Characterization

OFF-LINE CYCLING

- Mainly used for spring probe qualification
- 256 pin socket **(LARGE SAMPLE SIZE)**
- Hardstop to set probe overdrive
- Gold / Gold cycling surfaces – checked often for wear
- Force – Resistance – Deflection evaluated at prescribed cycle intervals: 0, 10k, 50k, 100k, 250k, 500k, 1M, +
  - MAP – Cres and Force at contact nominal test height
  - FReD – Contact consistency over entire stroke – window of consistency, hysteresis

DYNAMIC CYCLING

- Used primarily for elastomer and cantilever contact qualification
- 28-56 contact points in socket configuration
- Hardstop to set probe overdrive
- Gold / Gold cycling surfaces – checked often for wear
- Automated C_{res} data collection in programmable tri-temp chamber
- Off-line Force / Resistance / Deflection test also done at 250k intervals

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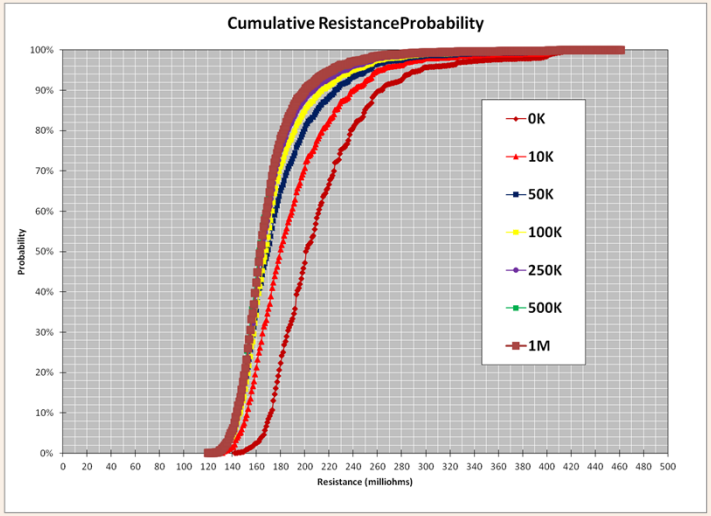
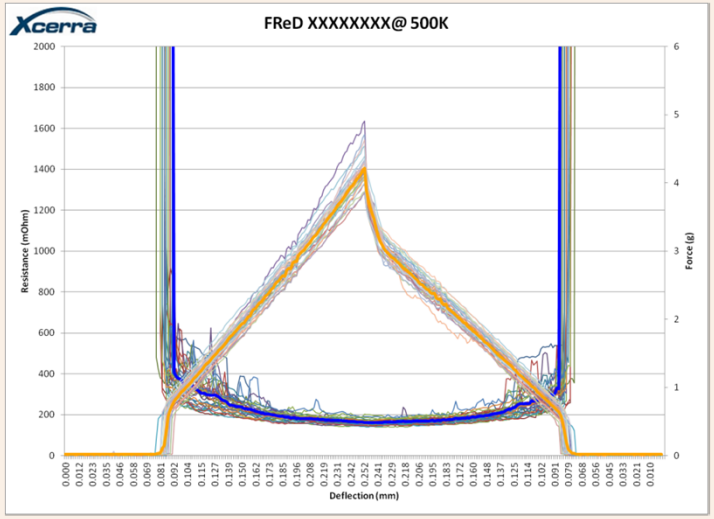
Xcerra Off-Line Cycling Data

MAP test shows statistical trends in performance – probability plots – statistical trends in force and resistance





Cycle Count	0	10,000	50,000	100,000	250,000	500,000	1,000,000
Average Resistance (milliohms):	89.3	90.0	92.1	105.5	96.1	106.4	106.9
Std Dev Resistance (milliohms):	8.9	8.2	9.6	14.7	12.5	18.0	21.4
Max Resistance (milliohms):	118.1	107.2	132.9	144.7	153.1	189.9	217.4
Min Resistance (milliohms):	73.1	71.9	75.0	80.2	75.8	82.1	76.5
Average Force (g):	13.6	14.0	14.0	13.8	13.8	13.7	13.6
Std Dev Force (g):	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Max Force (g):	14.4	14.7	15.4	14.4	14.6	14.8	14.7
Min Force (g):	12.9	13.3	13.1	13.0	13.3	13.0	13.0

FReD plots display internal frictional/Cres effects over time – hysteresis and potential mechanical and plating problems

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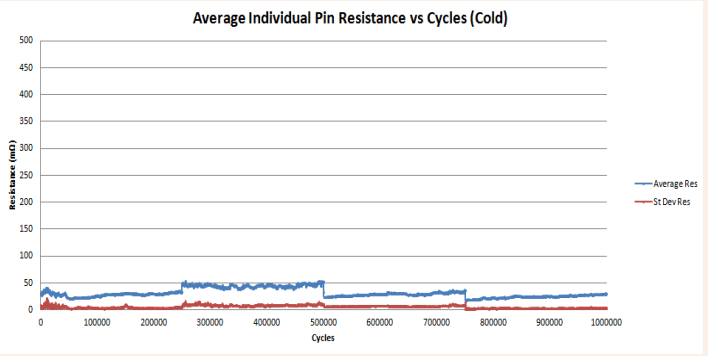
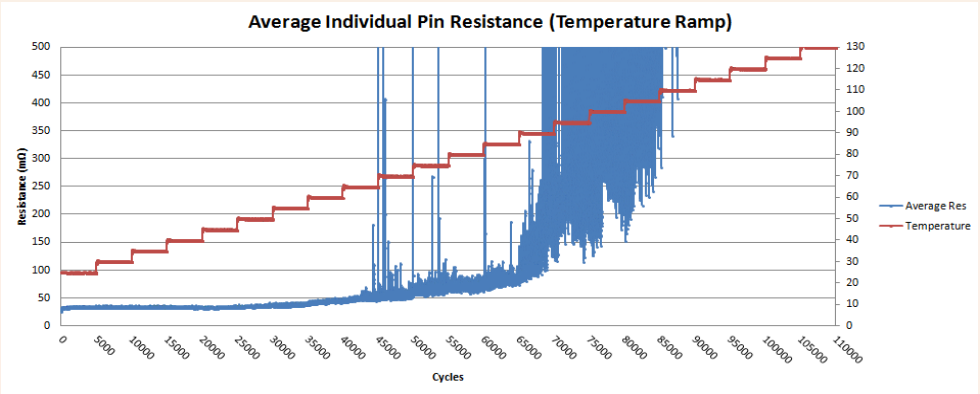
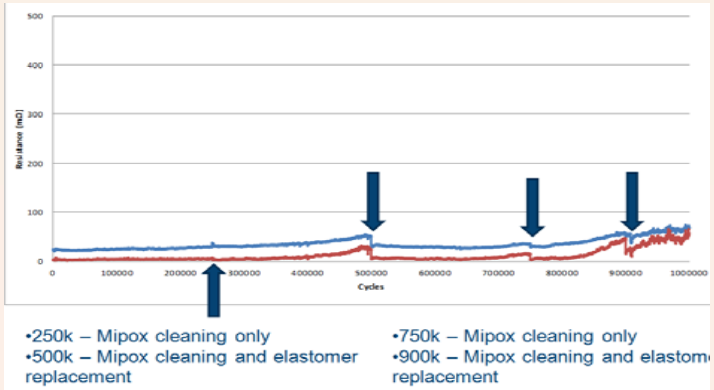
Xcerra Dynamic Cycling Data

Dynamic cycle plots show statistical trends in C_{res} performance over various conditions

Pin State	Cycles	Ravg (mΩ)	Rstdev (mΩ)	Favg (g)	Fstdev (g)	% Force Reduction
Initial	0	24.6	2.5	29.3	2.8	-
Pre-Clean	250,000	36.2	9.4	28.0	2.8	4.5
Post-Clean	250,000	34.0	7.2	27.6	2.7	5.8
Pre-Clean	500,000	38.1	6.1	27.8	2.7	5.2
Post-Clean	500,000	33.3	5.7	27.6	2.7	6.0
Pre-Clean	750,000	42.3	4.7	26.9	2.5	8.4
Post-Clean	750,000	36.5	6.1	27.0	2.3	7.8
Pre-Clean	1,000,000	41.1	10.8	27.4	2.3	6.5
Post-Clean	1,000,000	35.3	11.2	27.0	2.2	8.0







•250k – Mipox cleaning only
•500k – Mipox cleaning and elastomer replacement

•750k – Mipox cleaning only
•900k – Mipox cleaning and elastom replacement

Key Parameters & Assumption

- Off-line Cycling
  - Very defined procedure – automated data collection – relatively quick
  - Large sample size – can keep retains for post-mortem analysis (SEM/other)
  - Best for spring probe applications
  - **END OF LIFE:** any mechanical failures (breakage or sticking), C_{res} standard deviation exceeds 20% of average Cres value
- Dynamic Cycling
  - Best for elastomer/cantilever contacts, because elastomer performance is very specific to environment. Scrub amount influences lifetime/performance
  - **END OF LIFE:** any mechanical failures (breakage or sticking), C_{res} standard deviation exceeds 20% of average Cres value
- Variables captured
  - Forcing current during C_{res} measurement, contact interface metallurgy conditions, temperature

Lab vs. Real Test-Floor Performance Data

- Lab data is only useful to define a data-sheet baseline set of performance parameters – **The best case scenario – ignoring everything else**
- Socket suppliers interact with hundreds of customers, DUT types, handlers/probers, and test conditions. **This makes it impossible to test for every possible combination and scenario**
- How does production yield data relate to contact resistance? It depends. The onion must be peeled back carefully to rule out environment, device or setup related problems

Supplier Standards

- **What is Critical:** Define a standard force and Cres baseline (at what current and under what conditions)
- **What I want to see:**
  - From Customers: What statistics and under what conditions shall we provide data? How do you want this data presented? A standard template would be quite nice!
  - From Xcerra and other Socket Suppliers: **Complete test reports** that include equipment, test conditions, methods, results with complete statistics

DATA SHEETS ARE WORTHLESS

(unless supported by test methods & statistics)