



Highly Accelerated Thermal Shock Reliability Report

Example Report

March 3, 2008



Test Information

Date January 24, 2008

Customer Tim Estes

Company CAT Inc.

Phone 505-797-0100

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Number of Coupons 18

Cycles Requested 500

Total Cycle Time (minutes) 11.12

High Temperature (C) + 145

Low Temperature (C) - 40

High Temperature Extended Dwell Time (minutes) 0.25

Low Temperature Extended Dwell Time (minutes) 0.25

Failure Criterion (%) 10





Coupon Design

Design Name 20 Layer Example
 Design Date January 24, 2008
 Coupon Width (inches) 2.0
 Coupon Height (inches) 0.9
 Layers 20
 Soldermask Expansion (mils) 3
 Minimum Clearance (mils) 12
 Plane Layers -
 Ground Plane Relief (mils) -

Net Number	Via Type	Hole Size (mils)	Land Size (mils)	Track Width (mils)	Grid Size (mils)	Interconnect Sequence	Vias per Net
1	through	9.0	24.0	7	50	1-20	222
2	through	9.0	24.0*	7	50	1-12-2-14-3-16-5-18-7-19-9-20	222
3	through	24.0	40.0*	7	50	1-12-2-14-3-16-5-18-7-19-9-20	114
4	blind	5.0	12.0*	7	25	1-2	228

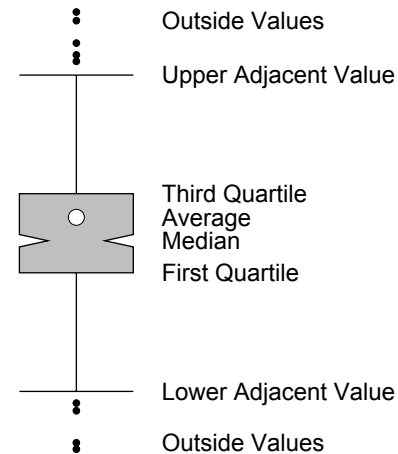
* teardrop design

Coupon Designations

Coupon Number	Designation
1	HATS_ex1
2	HATS_ex2
3	HATS_ex3
4	HATS_ex4
5	HATS_ex5
6	HATS_ex6
7	HATS_ex7
8	HATS_ex8
9	HATS_ex9
10	HATS_ex10
11	HATS_ex11
12	HATS_ex12
13	HATS_ex13
14	HATS_ex14
15	HATS_ex15
16	HATS_ex16
17	HATS_ex17
18	HATS_ex18

Notched Box Plot

Notched box plots are used to display the distribution of the data. The notch is centered at the median, and the box extends from the first quartile (25th percentile) to the third quartile (75th percentile), encompassing 50 percent of the population. A line extends from the first quartile to the lower adjacent value. This range encompasses 25 percent of the population except when there are outside values, which are plotted as individual points and reduce the population accordingly. Similarly, a line extends from the third quartile to the upper adjacent value and encompasses 25 percent of the population less any outside values at the upper bound. In some cases, the average is indicated by an open circle and is typically near the median.



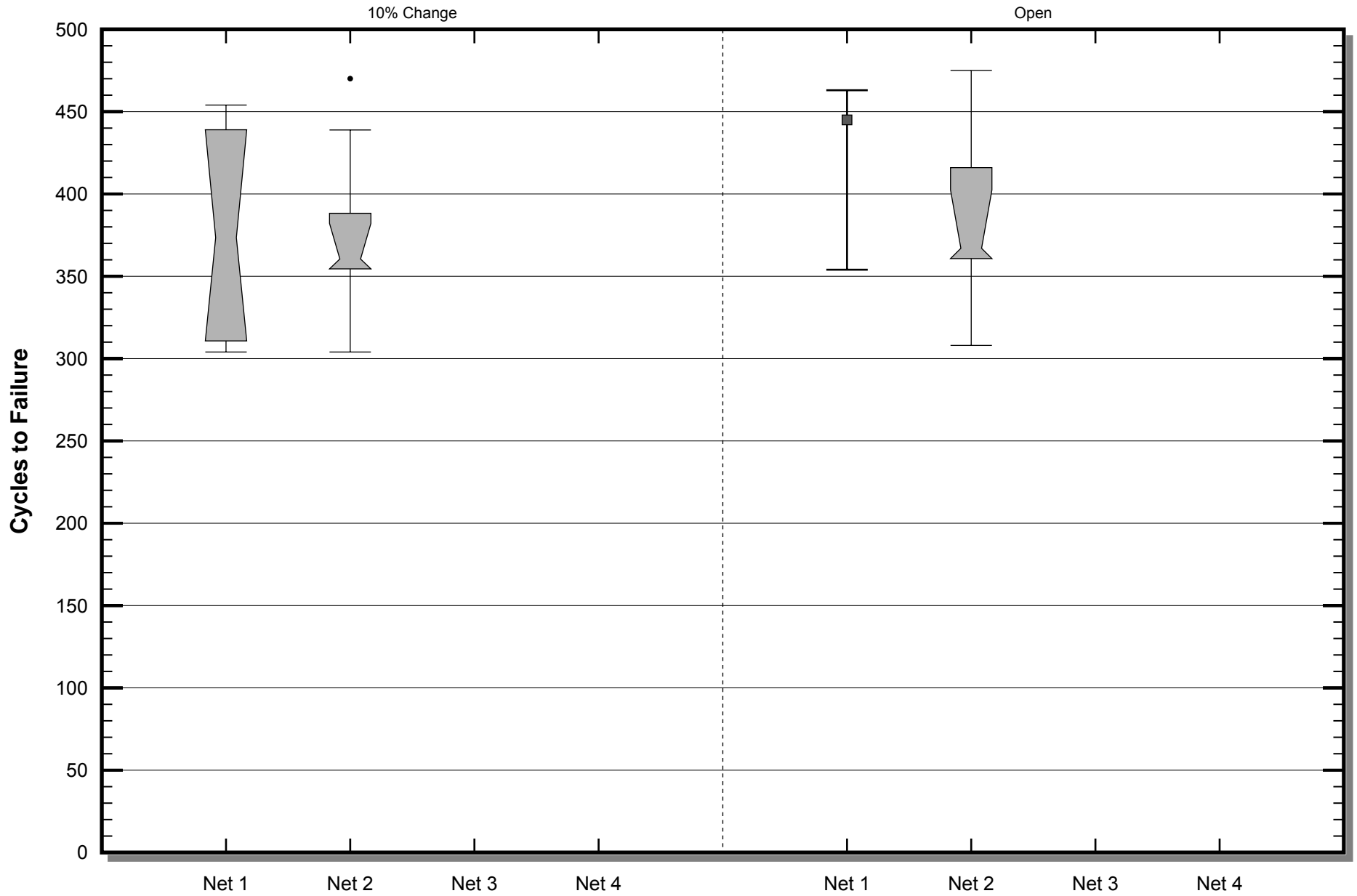
Failure Analysis

A two-parameter log-likelihood Weibull analysis is performed when a group includes four or more coupons having one or more failures. The results are presented in graphs that show "Cumulative Failure Probability" plotted vs. "Cycles to Failure" with the Weibull fit indicated by the dotted line and 90% Confidence bounds (likelihood ratio and contour plots method) indicated by red lines. The analysis is performed on both 10% failures and Open Circuit failures. Confidence bounds may be included when Beta (the slope of the data) is greater than or equal to 1.0.

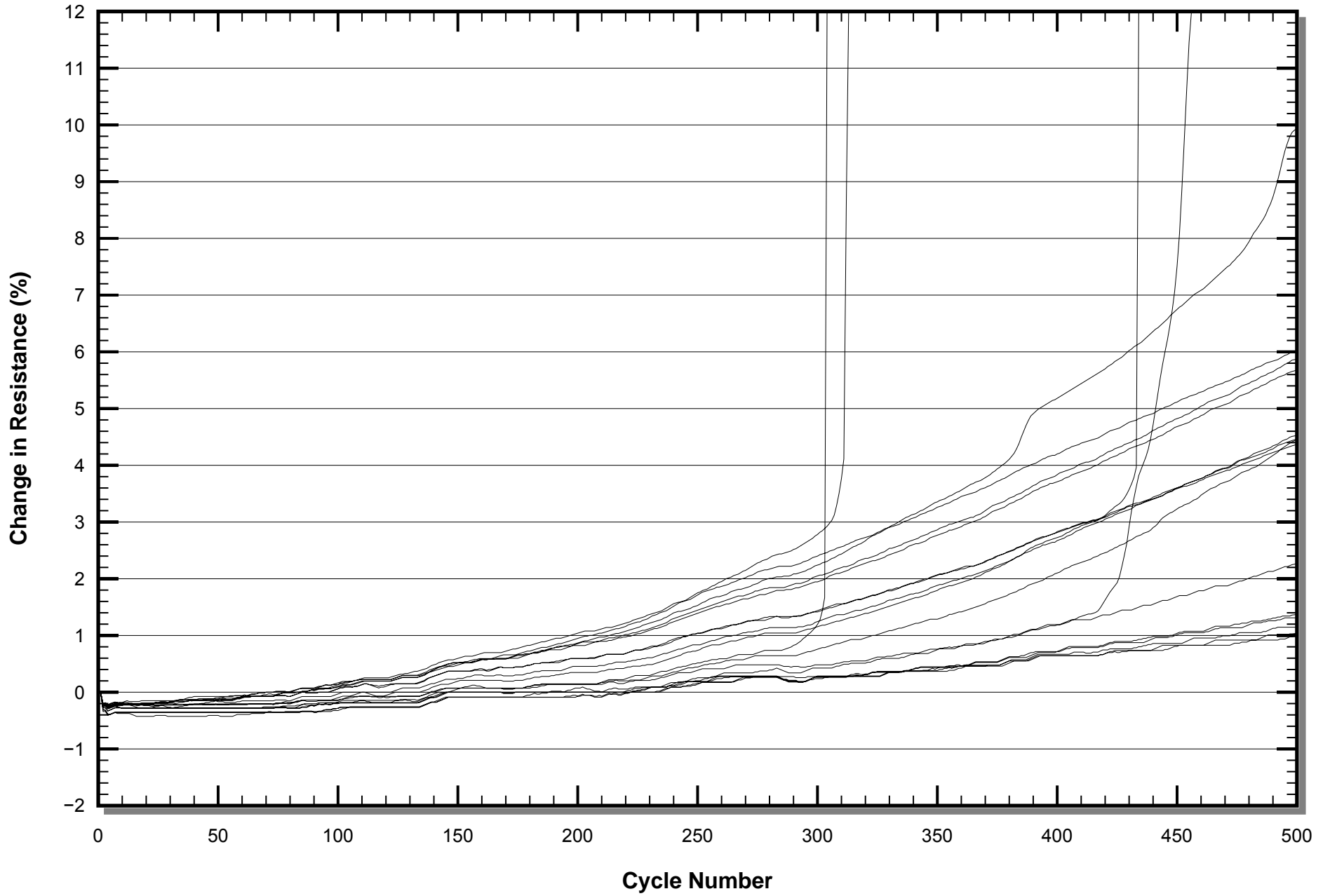
Reliability

Statistics	Cycles to 10% Change				Cycles to Open Circuit (20 ohms)			
	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4
Number Failed	4	6	0	0	3	6	0	0
Minimum	304	304	-	-	354	308	-	-
First Quartile	311	354	-	-	-	361	-	-
Median	374	360	-	-	445	367	-	-
Third Quartile	439	388	-	-	-	416	-	-
Maximum	454	470	-	-	463	475	-	-
Mean	376	374	-	-	421	385	-	-
Range	150	166	-	-	109	167	-	-
Number Passed	14	12	18	18	15	12	18	18

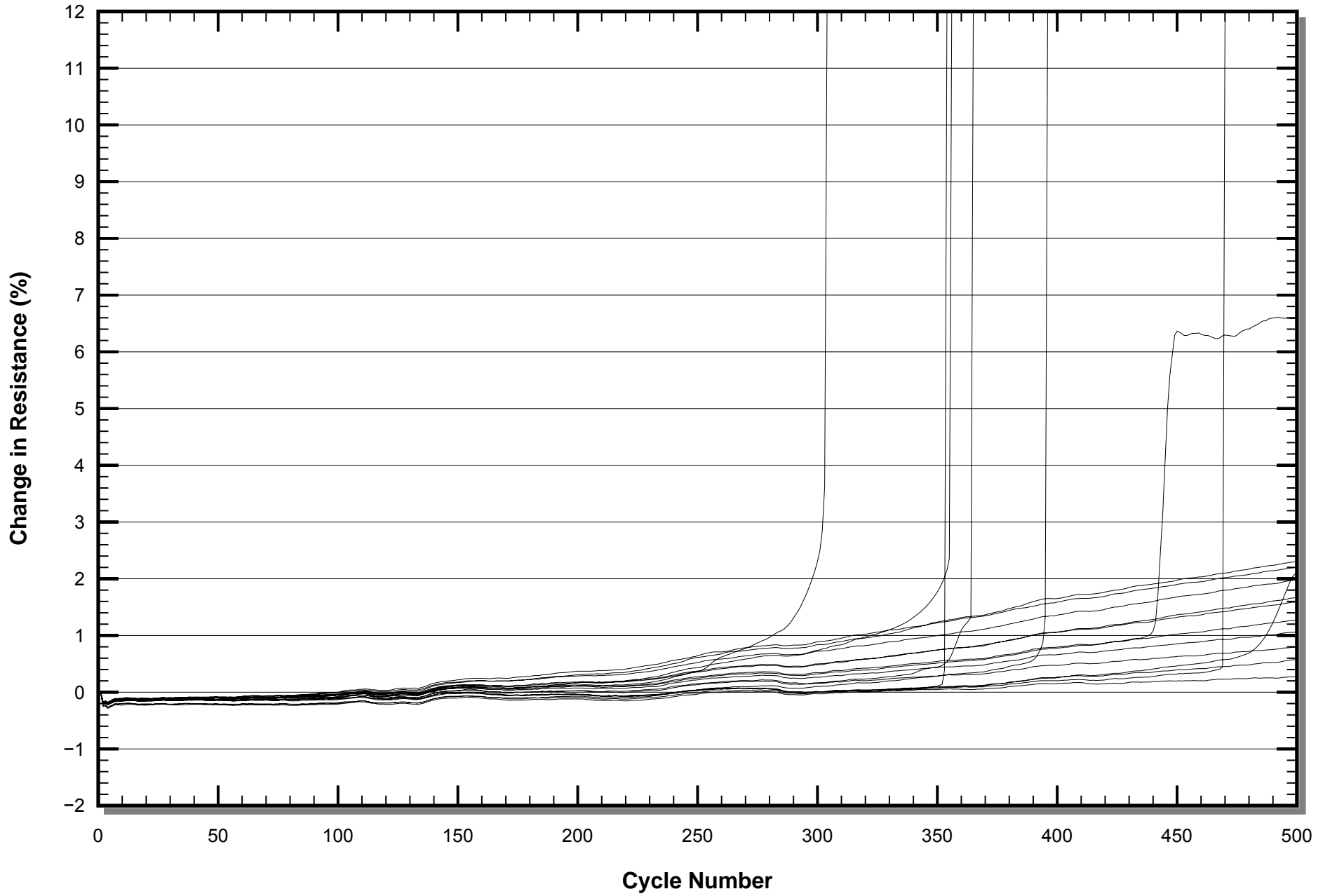
Reliability



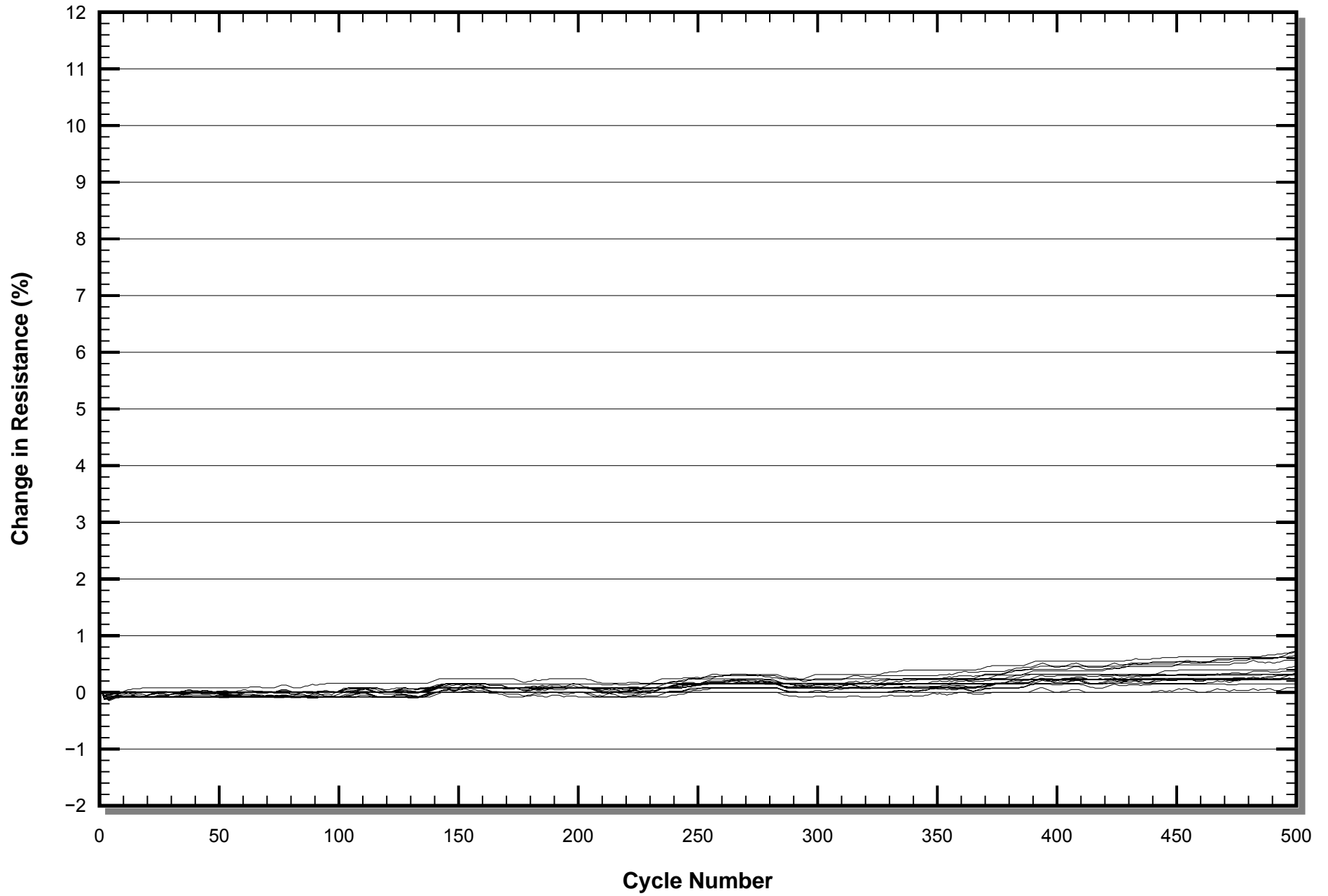
Net 1 Resistance by Cycle



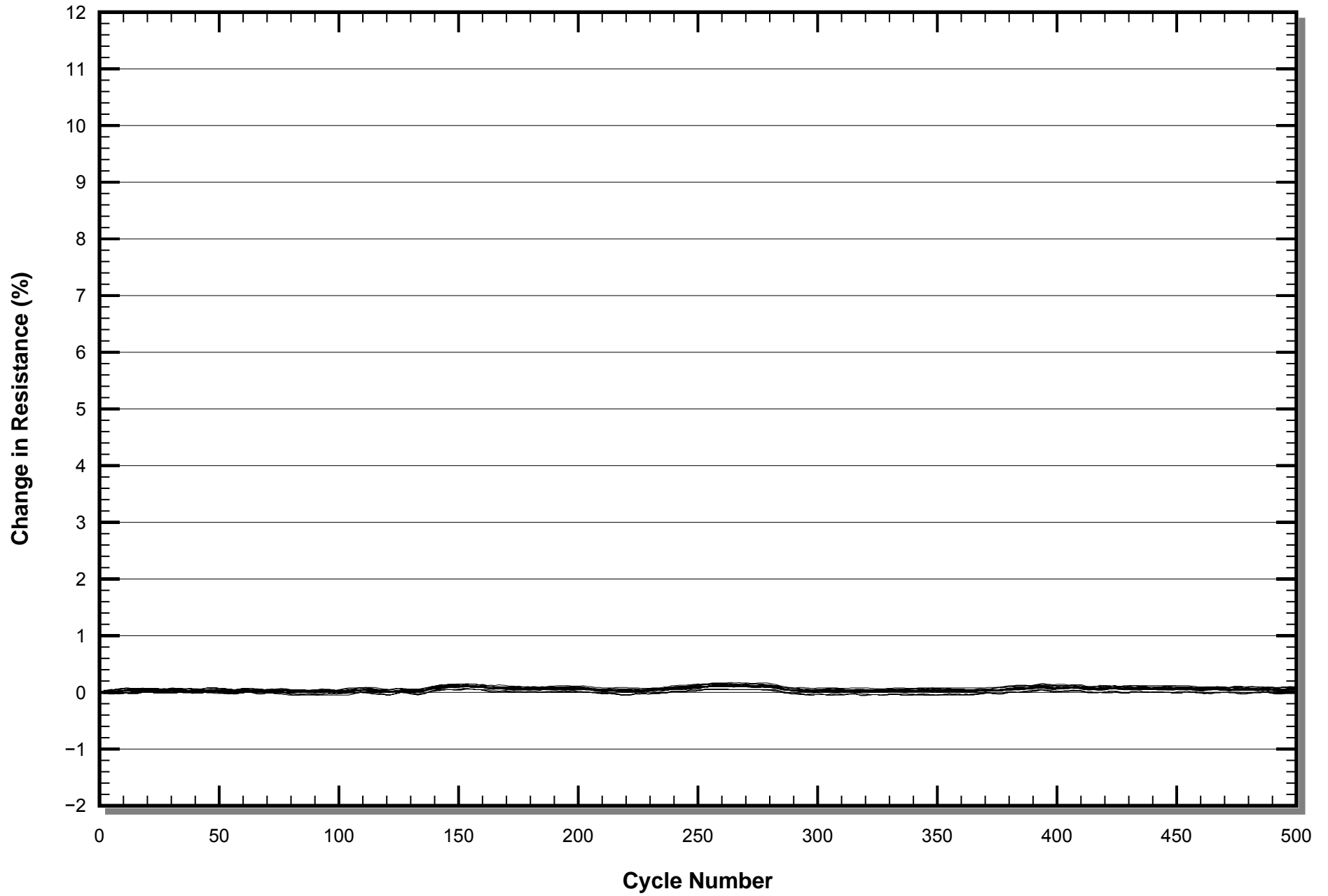
Net 2 Resistance by Cycle



Net 3 Resistance by Cycle



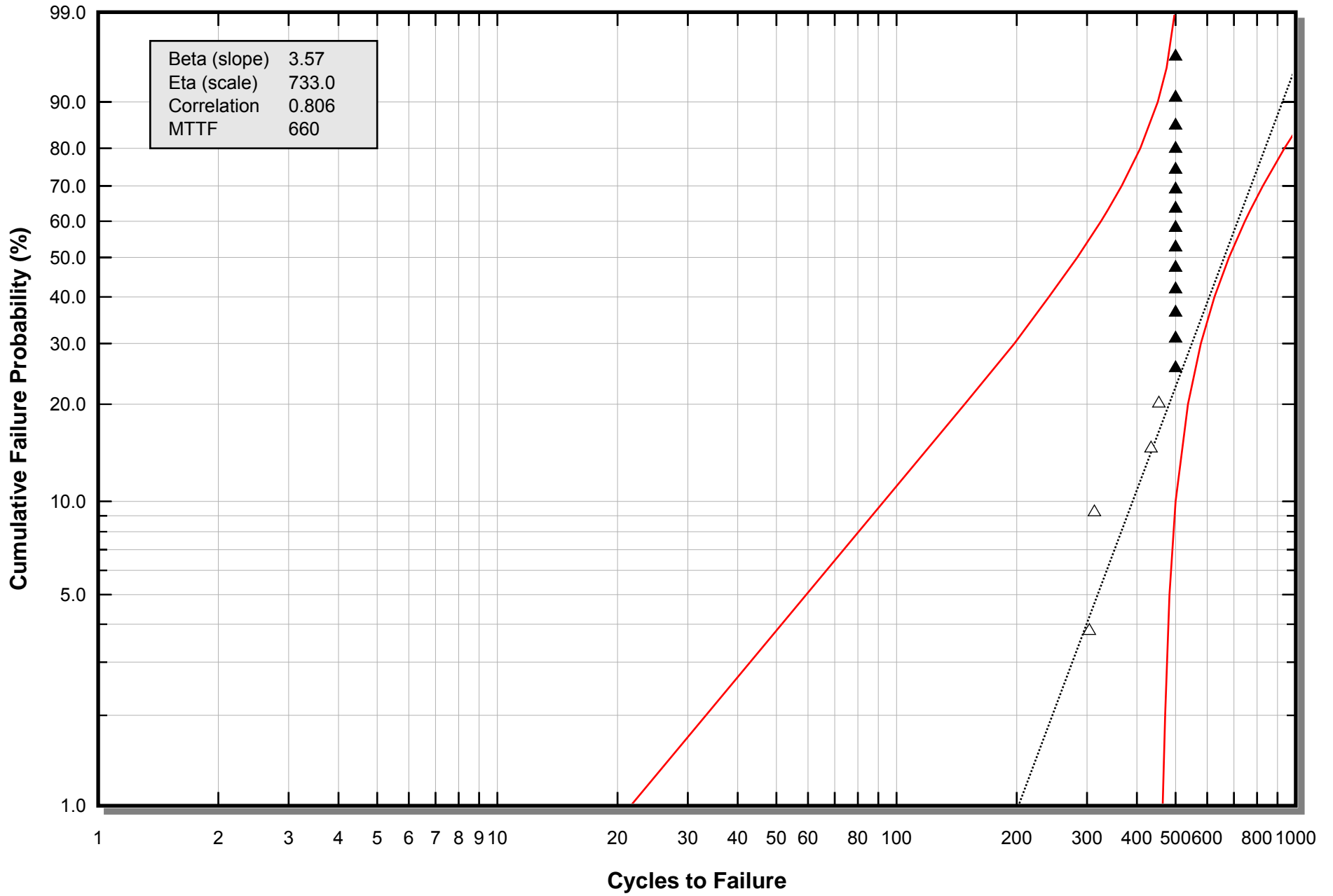
Net 4 Resistance by Cycle



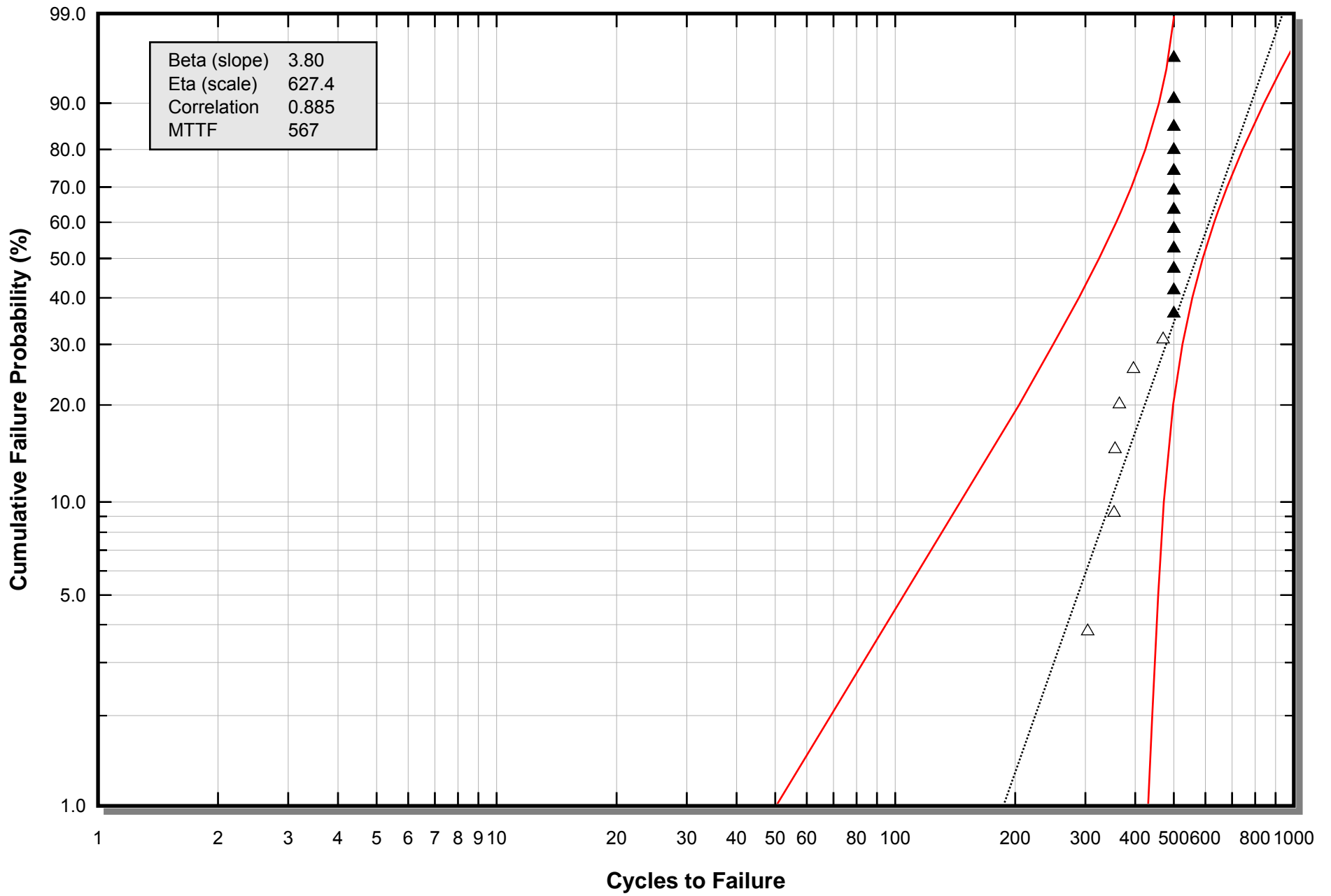
Reliability by Coupon

Coupon Number	Initial Resistance at 25C (ohms)				Reference Resistance at 145C (ohms)				Cycles to 10% Change				Cycles to Open Circuit (20 ohms)				Percent Change at 500 Cycles			
	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4	Net 1	Net 2	Net 3	Net 4
1	0.927	2.892	0.869	1.391	1.356	4.224	1.271	2.030	304	>500	>500	>500	354	>500	>500	>500	-	0.8	0.7	0.1
2	0.983	2.948	0.871	1.415	1.438	4.308	1.276	2.066	434	356	>500	>500	463	360	>500	>500	-	-	0.2	0.0
3	0.955	2.958	0.887	1.464	1.399	4.322	1.298	2.137	>500	>500	>500	>500	>500	>500	>500	>500	4.5	1.1	0.6	0.0
4	0.918	3.135	0.893	1.669	1.343	4.580	1.307	2.435	>500	>500	>500	>500	>500	>500	>500	>500	4.5	1.3	0.2	0.1
5	0.921	3.124	0.896	1.632	1.349	4.564	1.312	2.381	>500	304	>500	>500	>500	308	>500	>500	4.4	-	0.2	0.1
6	0.926	3.208	0.904	1.732	1.356	4.688	1.323	2.528	>500	>500	>500	>500	>500	>500	>500	>500	5.9	1.7	0.3	0.1
7	0.899	3.225	0.919	1.795	1.317	4.714	1.346	2.619	>500	>500	>500	>500	>500	>500	>500	>500	4.5	6.6	0.1	0.1
8	0.912	3.211	0.903	1.751	1.337	4.696	1.324	2.558	>500	>500	>500	>500	>500	>500	>500	>500	5.7	1.6	0.3	0.1
9	0.714	3.020	0.861	1.534	1.047	4.415	1.261	2.239	>500	354	>500	>500	>500	363	>500	>500	1.1	-	0.5	0.0
10	0.743	3.033	0.865	1.600	1.088	4.431	1.267	2.335	>500	470	>500	>500	>500	475	>500	>500	1.0	-	0.2	0.1
11	0.743	2.980	0.851	1.512	1.088	4.353	1.248	2.205	>500	>500	>500	>500	>500	>500	>500	>500	1.0	0.3	0.3	0.0
12	0.782	2.925	0.845	1.415	1.144	4.273	1.237	2.064	>500	>500	>500	>500	>500	>500	>500	>500	1.3	0.6	0.6	0.0
13	0.763	2.871	0.825	1.429	1.117	4.195	1.209	2.086	>500	>500	>500	>500	>500	>500	>500	>500	1.4	2.1	0.3	0.0
14	0.801	2.850	0.829	1.379	1.174	4.164	1.216	2.015	>500	396	>500	>500	>500	431	>500	>500	2.3	-	0.1	0.0
15	1.054	3.144	0.907	1.796	1.544	4.594	1.329	2.619	>500	>500	>500	>500	>500	>500	>500	>500	9.9	2.0	0.3	0.1
16	1.077	3.178	0.917	1.782	1.576	4.643	1.341	2.599	>500	>500	>500	>500	>500	>500	>500	>500	6.0	2.2	0.4	0.1
17	1.037	3.201	0.925	1.855	1.518	4.675	1.353	2.705	313	>500	>500	>500	445	>500	>500	>500	-	2.3	0.7	0.1
18	0.990	3.125	0.900	1.634	1.451	4.569	1.320	2.386	454	365	>500	>500	>500	371	>500	>500	219.2	-	0.7	0.0

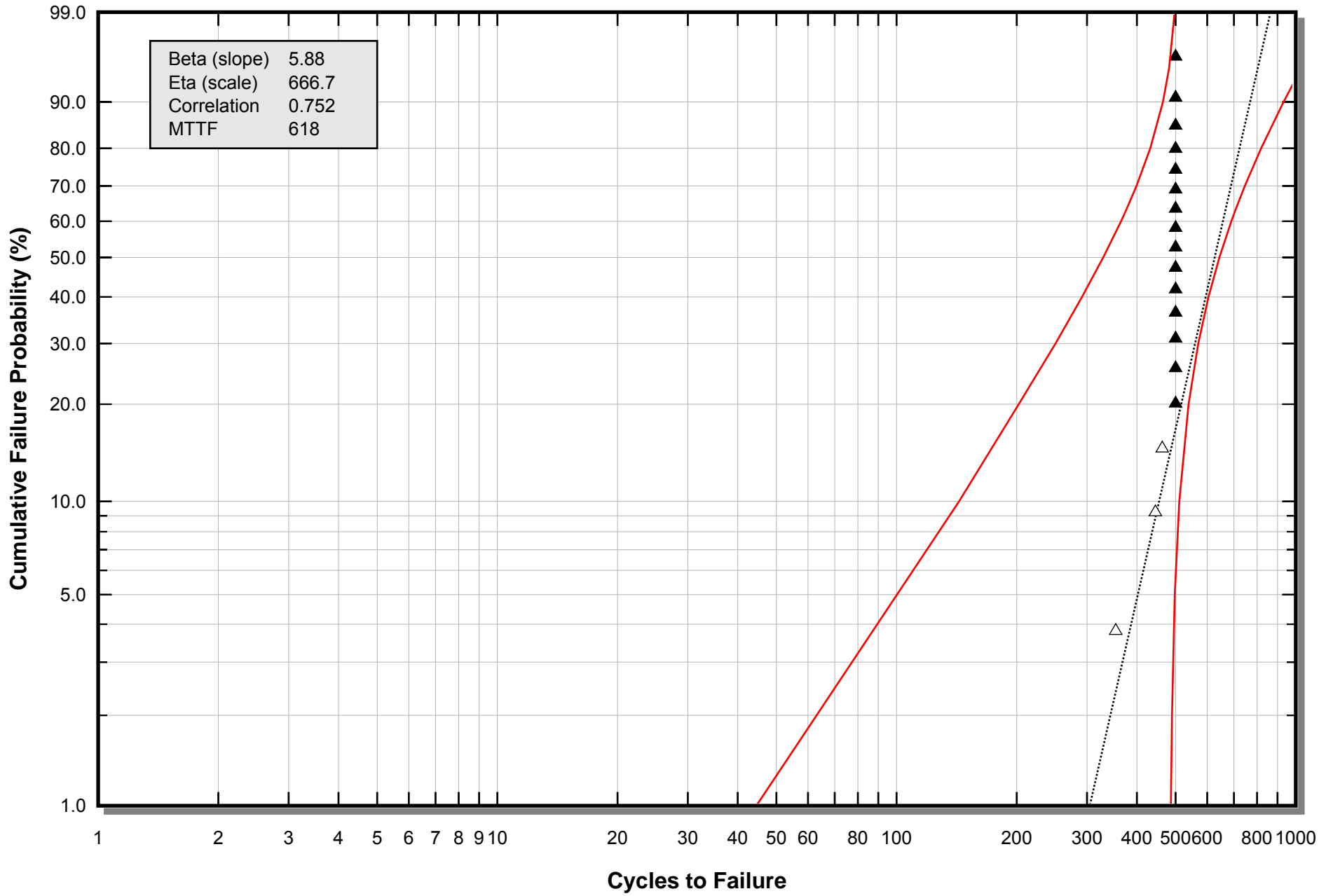
Net 1 Reliability (10% Change)



Net 2 Reliability (10% Change)



Net 1 Reliability (Open Circuit)



Net 2 Reliability (Open Circuit)

