



NIC COMPONENTS CORP.

70 Maxess Road • Melville, New York 11747
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NTC SERIES

TANTALUM CHIP CAPACITORS

- FAILURE RATE ESTIMATION
- DE-RATED OPERATION
- LIST OF RELIABILITY TESTS
- LIFE TEST SUMMARY

FAILURE RATE ESTIMATION

Introduction

This report contains reliability test results of various surface mount tantalum chip capacitors subjected to routine Monitoring Reliability Testing (MRT). The products used in this testing are all representative of manufacturing process for tantalum chip capacitors.

Estimation Of Failure Rate

There are various methods used to estimate the field failure rate of tantalum chip capacitors. NIC uses the following equation to estimate the field failure rate:

$$\lambda = \lambda_0 (V/V_0)^3 \times 2^{(T-T_0)/10}$$

λ : failure rate at operating condition (V = applied voltage, T = environmental temperature)

λ_0 : failure rate at rated condition (V₀ = rated voltage, T₀ = rated temperature)

Example, for a capacitor:

Rated: V₀ = 20V DC, T₀ = 85°C

Operated: V = 5V DC, T = 45°C

Failure Rate: NTC-T / NTC-L / NTC-P : 1%/1000 hours at +85°C with 1.0Ω/V circuit resistance

If λ_0 is equal to 1%/1000 hrs., the estimated failure rate is as follows:

$$\lambda = \lambda_0 (5/20)^3 \times 2^{(45-85)/10}$$

$$\lambda = \lambda_0 \times (1/64) \times (1/16)$$

$$\lambda = 0.001\% / 1000 \text{ hrs.}$$

$$\lambda = 10 \text{ FIT}$$



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DE-RATED OPERATION

Recommended Operations (**Standard Applications**)

Circuit Resistance: $\geq 3.0\Omega/V$

Voltage Derating: 70% of Rated Working Voltage

<i>Rated Voltage</i>	<i>Recommend Maximum Operating Voltage</i>
4.0VDC	2.8VDC
6.3VDC	4.4VDC
10VDC	7VDC
16VDC	11.2VDC
20VDC	14VDC
25VDC	17.5VDC
35VDC	24.5VDC
50VDC	35VDC

Recommended Operations (**Low Impedance Circuit Applications**)

Circuit Resistance: $< 3.0\Omega/V$

Voltage Derating: 33% of Rated Working Voltage

<i>Rated Voltage</i>	<i>Recommend Maximum Operating Voltage</i>
4.0VDC	1.3VDC
6.3VDC	2.1VDC
10VDC	3.3VDC
16VDC	5.3VDC
20VDC	6.6VDC
25VDC	8.3VDC
35VDC	11.6VDC
50VDC	16.5VDC



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LIST OF RELIABILITY TESTS

TEST ITEM	SAMPLE SIZE
Visual & Mechanical Examination	8
DC Leakage (Initial)	20
Capacitance (Initial)	20
Dissipation Factor (Initial)	20
Impedance (Initial)	5
Solderability	5
Resistance To Solder Heat	12
Bond Strength Of The End Face Plating	12
Mounting	78/66/24
Adhesion	18
Rapid Change Of Temperature	18
Climatic Sequence	18
Damp Heat, Steady Heat	9
Endurance: 1. @ 85°C, Rated Voltage 2. @ 125°C, Derated Voltage	24
Characteristics At High & Low Temperatures	15
Surge: 1. @ 85°C, R.V. x 1.15 2. @125°C, D.V. x 1.15	6
Reverse Voltage (R.V. x -0.1, or - 3V)	6



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LIFE TEST SUMMARY

High Temperature Operating Life (Endurance) Test Summary

This section summarizes the reliability test results for tantalum chip capacitors.. The failure rate prediction is based on 85°C high temperature life (endurance) test results.

Failure Rate Prediction Based Upon Endurance Test Results

Period	Lot No	No. Of Devices	No. Of Failures	Accumulated Device Hours	Acceleration Factor	Equivalent Device Hours	Failure Rate 85°C
6/89 9/89	9F	72	0	144,000	1	144,000	
12/89 1/90	9J	72	0	144,000	1	144,000	
1/90 4/90	9M	72	0	144,000	1	144,000	
4/90 7/90	0C	72	0	144,000	1	144,000	
6/90 9/90	0F	72	0	144,000	1	144,000	
8/90 12/90	0J	72	0	144,000	1	144,000	
1/91 4/91	0M	72	0	144,000	1	144,000	
4/91 7/91	1C	72	0	144,000	1	144,000	
6/91 9/91	1F	72	0	144,000	1	144,000	
9/91 12/91	1J	72	0	144,000	1	144,000	
1/92 4/92	1M	72	0	144,000	1	144,000	
4/92 9/92	2C	72	0	144,000	1	144,000	
8/92 10/92	2F	72	0	144,000	1	144,000	
10/92 12/92	2J	72	0	144,000	1	144,000	
1/93 4/93	2M	72	0	144,000	1	144,000	
4/93 7/93	3C	72	0	144,000	1	144,000	
7/93 10/93	3F	72	0	144,000	1	144,000	



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Failure Rate Prediction Based Upon Endurance Test Results (continued)

Period	Lot No	No. Of Devices	No. Of Failures	Accumulated Device Hours	Acceleration Factor	Equivalent Device Hours	Failure Rate 85°C
10/93 12/93	3J	72	0	144,000	1	144,000	
1/94 4/94	3M	72	0	144,000	1	144,000	
4/94 7/94	4C	72	0	144,000	1	144,000	
7/94 10/94	4F	72	0	144,000	1	144,000	
10/94 12/94	4J	72	0	144,000	1	144,000	
1/95 4/95	4M	72	0	144,000	1	144,000	
5/95 7/95	5C	72	0	144,000	1	144,000	
7/95 10/95	5F	72	0	144,000	1	144,000	
10/95 12/95	5J	72	0	144,000	1	144,000	
11/95 1/96	5K	72	0	144,000	1	144,000	
2/96 4/96	6A	72	0	144,000	1	144,000	
2/96 4/96	6B	72	0	144,000	1	144,000	
4/96 8/96	6C	72	0	144,000	1	144,000	
5/96 8/96	6D	72	0	144,000	1	144,000	
8/96 10/96	6f	72	0	144,000	1	144,000	
8/96 10/96	6G	72	0	144,000	1	144,000	
11/96 2/97	6K	72	0	144,000	1	144,000	
11/96 3/97	6L	72	0	144,000	1	144,000	
2/97 4/97	7A	72	0	144,000	1	144,000	
2/97 5/97	7A	72	0	144,000	1	144,000	
4/97 7/97	7D	72	0	144,000	1	144,000	
5/97 8/97	7E	72	0	144,000	1	144,000	



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Failure Rate Prediction Based Upon Endurance Test Results (continued)

Period	Lot No	No. Of Devices	No. Of Failures	Accumulated Device Hours	Acceleration Factor	Equivalent Device Hours	Failure Rate 85°C
8/97 10/97	7G	72	0	144,000	1	144,000	
8/97 10/97	7H	72	0	144,000	1	144,000	
11/97– 2/98	7K	72	0	144,000	1	144,000	
12/97– 3/98	7M	72	0	144,000	1	144,000	
4/98– 6/98	8E	72	0	144,000	1	144,000	
10/98 – 12/98	8J	72	0	144,000	1	144,000	
1/99 – 3/99	8M	72	0	144,000	1	144,000	
Cumulative Total		3,312	0	6,624,000	1	6,624,000	0.0151%/ 1000 hrs.*

* This estimated failure rate reflects acceleration factor used.