

DOCUMENT NO.	MLB-0101-07
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WRITTEN	CHECKED	APPROVED
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QUALITY REPORT

FAILURE RATE AND MTBF DATA

0402 MULTI LAYER CERAMIC CHIP CAPACITOR (NPO, X7R & Y5V)

TESTED PRODUCT: -NPO: C0402C0G500-101JNE
 -X7R: C0402X7R160-103KNE
 -Y5V: C0402Y5V250-104ZNE



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HALT MODEL

MTBF (mean time between failure) after HALT test is transformed to that of rated condition (operating condition) by using the following HALT model, and assurance time in normal condition can be predicted.

$$\begin{aligned}
 A_L &= L_1/L_2 \\
 &= \{V_2/V_1\}^n \cdot \exp\{Ea/k(1/T_1 - 1/T_2)\} \\
 &= A_V \cdot A_T
 \end{aligned}$$

A_L, A_V, A_T : acceleration factor, voltage acceleration factor, temperature acceleration factor

- n: voltage index
- Ea: activation energy (eV)
- V: applied voltage (volt)
- T: absolute temperature (°K)
- k: BOLTZMANN constant (8.625×10^{-5} eV/°K)

	Ea	n	Test Condition		Rated Voltage
			Temperature (°C)	Voltage (V)	
NP0	1.15	2.9	140	Rated voltage*8	V_{dc}
X7R					
Y5V	1.07	2.4			

1. USER'S REQUEST

Failure rates and MTBFs data for 0402 (NP0, X7R, Y5V)

2. TEST DATA (For MLCC only)

HALT model was adopted for the calculation of Failure rates and MTBFs.

For the technical data and procedure, see page 4

Test results are as follows

2.1 Basic Conditions

	Temperature	Voltage	Test Hour
Field condition	25°C	Rated Voltage	96 Hr
Test condition	140°C	Rated Voltage*8	

2.2 Basic Quantities

	Acceleration Factor
NP0	1.47×10^8
X7R	1.47×10^8
Y5V	1.11×10^8

2.3 Test Results (Failure Mode: IR short)

Size	Item	Failure Quantity	Total Test Hour	MTBF (year)	Failure Rate (λ in FIT)
0402	NP0	1/40	3804.12	3804.12	0.0036
	X7R	0/40	3840.00	4173.91	0.0016
	Y5V	29/40	2984.81	102.92	0.0663

MLCC HALT

SPL QTY: 40 PCS

REQUEST NO: MLB-0101-07					REQUEST NO: MLB-0101-07					REQUEST NO: MLB-0101-07				
TEST DATE: 01-02-2007					TEST DATE: 01-02-2007					TEST DATE: 01-02-2007				
TEST CONDITION: 140, Vr ^{x8} , 96Hr					TEST CONDITION: 140, Vr ^{x8} , 96Hr					TEST CONDITION: 140, Vr ^{x8} , 96Hr				
PART NO: C0402C0G500-101JNE					PART NO: C0402X7R160-103KNE					PART NO: C0402Y5V250-104ZNE				
			INITIAL	AFTER				INITIAL	AFTER				INITIAL	AFTER
			IR()	IR()				IR()	IR()				IR()	IR()
		Hr	MIN	MIN			Hr	MIN	MIN			Hr	MIN	MIN
1			1.3E+06	8.5E+05	1			2.5E+04	2.3E+04	1		67.86	6.9E+04	OVLD
2			2.2E+06	3.1E+05	2			4.0E+04	3.8E+04	2		58.00	5.2E+04	OVLD
3			6.6E+05	7.9E+05	3			2.8E+04	4.1E+04	3		55.48	6.3E+04	OVLD
4			1.3E+06	7.8E+05	4			6.0E+04	3.0E+04	4		64.52	5.5E+04	1.4E+00
5			1.7E+06	8.9E+05	5			7.0E+04	2.7E+04	5			6.6E+04	2.2E+02
6			1.5E+06	7.2E+05	6			3.9E+04	4.8E+04	6		76.28	3.2E+04	OVLD
7			2.6E+06	1.1E+04	7			3.5E+04	3.5E+04	7		57.65	3.1E+04	OVLD
8			1.5E+06	6.0E+05	8			7.3E+04	6.1E+04	8		63.76	7.4E+04	OVLD
9			2.3E+06	6.2E+05	9			2.6E+04	1.7E+04	9		70.13	5.4E+04	OVLD
10			1.1E+06	6.9E+05	10			3.4E+04	4.8E+04	10		72.00	6.6E+04	OVLD
11			3.8E+06	8.9E+05	11			8.7E+04	5.6E+04	11		69.17	2.8E+04	OVLD
12			1.0E+06	7.5E+05	12			2.5E+04	3.9E+04	12			4.0E+04	2.5E+02
13			3.1E+06	8.9E+05	13			4.9E+04	4.2E+04	13		54.53	1.0E+05	1.9E+00
14			1.3E+06	7.5E+05	14			7.8E+04	7.3E+04	14		59.30	4.1E+04	OVLD
15			2.4E+05	7.2E+05	15			3.4E+04	4.9E+04	15		77.94	5.7E+04	OVLD
16			1.1E+06	7.4E+05	16			4.1E+04	5.2E+04	16		67.45	4.5E+04	OVLD
17			8.1E+05	7.2E+05	17			5.9E+04	3.2E+04	17			4.8E+04	3.3E+02
18			9.9E+05	8.6E+05	18			3.1E+04	2.3E+04	18		65.88	7.4E+04	OVLD
19			1.6E+06	8.6E+05	19			6.2E+04	3.7E+04	19		61.06	3.9E+04	OVLD
20			9.5E+05	7.6E+05	20			3.5E+03	1.2E+04	20		63.33	2.8E+04	OVLD
21			6.8E+05	8.4E+04	21			6.3E+04	2.1E+04	21		71.78	2.1E+04	OVLD
22			7.0E+05	8.9E+05	22			6.4E+04	3.0E+04	22		66.52	3.6E+04	OVLD
23		60.12	4.8E+05	OVLD	23			5.1E+04	4.8E+04	23			3.9E+04	3.5E+02
24			5.1E+05	8.9E+05	24			5.4E+04	5.6E+04	24			6.1E+04	1.6E+03
25			9.7E+05	6.6E+05	25			3.1E+04	2.5E+04	25		62.09	8.1E+04	OVLD
26			7.2E+05	8.3E+04	26			4.3E+04	2.3E+04	26		75.06	2.4E+04	1.7E+00
27			8.8E+05	2.7E+05	27			7.9E+04	1.5E+04	27			2.2E+04	7.2E+03
28			2.9E+06	2.4E+05	28			6.8E+04	1.3E+04	28		68.07	4.7E+04	OVLD
29			8.5E+05	1.3E+05	29			8.0E+04	7.2E+04	29		70.72	2.6E+04	OVLD
30			4.0E+05	4.5E+05	30			3.1E+04	1.2E+04	30			4.9E+04	2.6E+02
31			2.7E+05	2.6E+05	31			5.4E+04	3.9E+04	31		78.37	3.4E+04	1.4E+00
32			3.1E+05	1.3E+05	32			8.1E+04	3.6E+04	32			4.0E+04	3.4E+02
33			2.5E+05	8.9E+05	33			6.1E+04	3.4E+04	33			2.6E+04	4.6E+03
34			7.7E+05	3.9E+05	34			9.3E+04	1.4E+04	34		68.90	5.2E+04	OVLD
35			6.3E+05	1.1E+04	35			1.6E+05	2.9E+04	35			3.5E+03	3.5E+02
36			6.9E+05	2.3E+05	36			1.0E+05	4.6E+04	36		72.54	2.8E+04	OVLD
37			3.7E+05	1.2E+05	37			8.7E+04	3.9E+04	37		67.00	7.2E+04	OVLD
38			5.6E+05	4.8E+04	38			1.5E+05	1.9E+04	38			1.6E+04	8.8E+02
39			6.0E+05	4.9E+04	39			9.4E+04	1.7E+04	39		54.33	3.1E+04	OVLD
40			3.1E+05	3.1E+04	40			6.4E+04	4.3E+04	40		69.09	2.3E+04	OVLD
TEST HOUR	96	MAX	3.8E+06	8.9+05	TEST HOUR	96	MAX	1.6E+05	7.3E+04	TEST HOUR	96	MAX	1.0E+05	7.2E+03
FAILURE HOUR	60.12	MIN	2.4E+05	1.1E+04	FAILURE HOUR	0.00	MIN	3.5E+03	1.2E+04	FAILURE HOUR	1928.81	MIN	3.5E+03	1.4E+00
FAILURE QUANTITY	1	AVG	1.1E+06	5.1E+05	FAILURE QUANTITY	0	AVG	6.0E+04	3.5E+04	FAILURE QUANTITY	29	AVG	4.5E+04	1.1E+03
GOOD QUANTITY	39				GOOD QUANTITY	40	DATE			GOOD QUANTITY	11	DATE		
TOTAL TEST HOUR	3804.12				TOTAL TEST HOUR	3840.00				TOTAL TEST HOUR	2984.81			
Fit	0.0036				Fit	0.0016				Fit	0.0663			

