DOCUMENT NO.	MLB-AK-K77
DATE	02.02.2007

WRITTEN	CHECKED	APPROVED
/	/	/

QUALITY REPORT

FAILURE RATE AND MTBF DATA

0603 AND 0805 MULTI LAYER CERAMIC CHIP CAPACITOR

(NP0, X7R & Y5V)

TESTED PRODUCT:	**–NP0:**	**C0603C0G500-100JNE**	**C0805C0G500-100JNE**
	–X7R:	**C0603X7R500-102KNE**	**C0805X7R500-102KNE**
	–Y5V:	**C0603Y5V250-104ZNE**	**C0805Y5V500-104ZNE**

VENKEL LTD.

5900 SHEPHERD MOUNTAIN COVE
AUSTIN, TEXAS 78730

Phone: 512 / 794-0081
Fax: 512 / 794-0087
Toll Free: 800 / 950-8365
email: sales@venkel.com
www.venkel.com

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.

$$A_L = L_1/L_2$$

$$= \{V_2/V_1\}^n.\exp\{Ea/k(1/T_1 - 1/T_2)\}$$

$$= A_V \cdot A_T$$

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	400	V_{dc}
X7R				Rated voltage*8	
Y5V	1.07	2.4			

5900 Shepherd Mountain Cove • Austin, TX 78730
Phone: 512 / 794-0081 • Fax: 512 / 794-0087 • Toll Free: 800 / 950-8365
e-mail: sales@venkel.com • www.venkel.com

VENKEL LTD.

1. USER'S REQUEST

Failure rates and MTBFs data for 0603, 0805 (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 pages 4 and 5

Test results are as follows

2.1 Basic Conditions

	Temperature	Voltage	Test Hour
Field condition	50°C	Rated Voltage	500 Hr
Test condition	140°C	Rated Voltage*8	

2.2 Basic Quantities

	Acceleration Factor
NP0, X7R	3.35 E6
Y5V	6.33 E5

2.3 Test Results (Failure Mode: IR short)

Size	Item	Failure Quantity	Total Test Hour	MTBF (year)	Failure Rate (λ in FIT)
0603	NP0	9/40	17,830	767,616	0.15
	X7R	14/40	16,629	454,233	0.25
	Y5V	15/40	17,156	82,646	1.38
0805	NP0	6/40	18,238	1,162,429	0.10
	X7R	11/40	17,400	604,919	0.19
	Y5V	11/40	17,492	114,906	0.99

MLCC HALT

MLCC HALT DATA (Test Condition: 140°C Rated Voltage x 8)

PART NO: C0603C0G500-100JNE					
LOT NO: AHA0236					
				INITIAL	AFTER
				IR(MΩ)	IR(MΩ)
SPEC				MIN	MIN
NO.		Hr		1.0E+04	
1				3.5E+07	1.2E+07
2		194		7.4E+06	OVLD
3				9.5E+06	2.4E+06
4				5.2E+06	4.0E+06
5		246		8.5E+06	OVLD
6				1.3E+07	9.6E+06
7				4.4E+06	7.1E+06
8				4.9E+06	6.4E+06
9				1.7E+07	1.4E+07
10				8.5E+06	4.4E+06
11				9.3E+06	5.4E+06
12		425		6.7E+06	OVLD
13				5.5E+06	7.3E+06
14				8.8E+06	4.2E+06
15		298		6.5E+06	OVLD
16				6.7E+06	1.5E+06
17				5.4E+06	1.2E+06
18				1.0E+07	1.5E+06
19				6.2E+06	3.6E+06
20				7.5E+06	4.5E+06
21				7.2E+06	2.4E+06
22				8.4E+06	2.1E+06
23				3.5E+07	8.9E+06
24				5.2E+06	2.1E+06
25		54		9.4E+06	OVLD
26				6.8E+06	2.3E+06
27		359		8.9E+06	OVLD
28				3.5E+06	6.3E+05
29				3.2E+06	8.7E+05
30				2.0E+06	1.1E+06
31		150		6.3E+06	OVLD
32				5.8E+06	4.1E+06
33				7.2E+06	5.8E+06
34				6.1E+06	4.0E+06
35		499		6.7E+06	OVLD
36				3.0E+06	3.6E+06
37				4.7E+06	4.1E+06
38				5.5E+06	2.1E+06
39		105		4.4E+06	OVLD
40				7.1E+06	1.3E+06
TEST HOUR		500			
FAILURE HOUR		2330			
FAILURE QUANTITY		9			
GOOD QUANTITY		31			
TOTAL TEST HOUR		17830			
Fit		0.15			

PART NO: C0603X7R500-102KNE					
LOT NO: AIA12AM					
				INITIAL	AFTER
				IR(MΩ)	IR(MΩ)
SPEC				MIN	MIN
NO.		Hr		1.0E+04	
1				1.7E+05	7.6E+04
2		336		8.4E+04	OVLD
3				2.2E+05	8.4E+04
4		396		7.1E+04	OVLD
5				4.3E+05	2.0E+05
6				1.1E+05	4.7E+04
7				9.1E+04	6.2E+04
8				5.9E+04	4.3E+04
9		62		3.8E+04	OVLD
10				4.8E+04	3.0E+04
11				1.3E+05	1.5E+04
12		489		6.6E+04	OVLD
13				1.4E+05	7.1E+04
14		296		4.2E+04	OVLD
15				1.7E+05	5.5E+04
16				4.3E+04	1.2E+04
17		193		9.3E+04	OVLD
18				1.1E+05	8.6E+04
19		246		1.7E+05	OVLD
20				3.4E+04	1.7E+04
21				5.6E+04	2.8E+04
22		89		3.6E+04	OVLD
23				5.6E+04	3.0E+04
24				4.2E+04	1.2E+04
25		148		5.1E+04	OVLD
26				8.6E+04	1.6E+04
27		359		5.6E+04	OVLD
28				4.6E+04	2.4E+04
29				8.2E+04	8.0E+04
30		25		9.1E+04	OVLD
31				4.6E+04	1.2E+04
32		439		4.7E+04	OVLD
33				6.2E+04	1.1E+04
34				5.4E+04	9.6E+03
35		125		6.3E+04	OVLD
36				9.6E+04	4.2E+04
37				4.5E+04	7.7E+03
38		426		1.0E+05	OVLD
39				9.6E+04	5.2E+04
40				7.9E+04	5.1E+04
TEST HOUR		500			
FAILURE HOUR		3629			
FAILURE QUANTITY		14			
GOOD QUANTITY		26			
TOTAL TEST HOUR		16629			
Fit		0.25			

PART NO: C0603Y5V250-104ZNE					
LOT NO: BI503DK					
				INITIAL	AFTER
				IR(MΩ)	IR(MΩ)
SPEC				MIN	MIN
NO.		Hr		5.3E+03	
1		86		4.0E+04	OVLD
2				7.7E+04	7.7E+04
3				1.4E+05	2.0E+04
4				3.6E+04	2.5E+04
5				3.7E+05	4.6E+05
6		359		2.1E+05	OVLD
7				1.7E+05	6.8E+04
8				5.3E+04	3.0E+04
9				4.0E+04	4.9E+04
10		459		6.3E+04	OVLD
11				1.3E+05	1.7E+04
12		149		6.4E+04	OVLD
13				8.8E+04	1.6E+05
14				2.1E+05	2.0E+04
15				2.3E+04	5.3E+04
16		439		6.8E+04	OVLD
17				6.9E+04	1.5E+04
18				5.9E+04	9.4E+03
19		258		1.5E+04	OVLD
20				1.4E+04	7.2E+04
21				2.4E+04	9.6E+03
22		128		2.6E+04	OVLD
23				3.5E+04	3.2E+04
24		489		5.6E+04	OVLD
25				1.5E+06	1.5E+04
26		264		1.4E+04	OVLD
27				2.4E+04	2.6E+04
28				2.9E+04	2.1E+04
29		392		4.2E+04	OVLD
30				6.5E+04	4.6E+04
31		47		3.6E+04	OVLD
32				4.5E+05	4.1E+04
33		426		4.5E+04	OVLD
34				5.6E+04	2.5E+04
35		499		8.5E+04	OVLD
36				1.6E+05	1.4E+05
37		189		2.6E+04	OVLD
38				5.6E+04	6.3E+03
39		472		8.7E+04	OVLD
40				4.6E+04	1.4E+04
TEST HOUR		500			
FAILURE HOUR		4656			
FAILURE QUANTITY		15			
GOOD QUANTITY		25			
TOTAL TEST HOUR		17156			
Fit		1.38			

5900 Shepherd Mountain Cove • Austin, TX 78730
Phone: 512 / 794-0081 • Fax: 512 / 794-0087 • Toll Free: 800 / 950-8365
e-mail: sales@venkel.com • www.venkel.com

VENKEL LTD.

MLCC HALT DATA (Test Condition: 140°C Rated Voltage x 8)

PART NO: C0805C0G500-100JNE						PART NO: C0805X7R500-102KNE						PART NO: C0805Y5V500-104ZNE					
LOT NO: AJB14DE						LOT NO: AJA16CC						LOT NO: AJA05BN					
				INITIAL	AFTER					INITIAL	AFTER					INITIAL	AFTER
				IR(MΩ)	IR(MΩ)					IR(MΩ)	IR(MΩ)					IR(MΩ)	IR(MΩ)
SPEC				MIN	MIN	SPEC				MIN	MIN	SPEC				MIN	MIN
NO.		Hr		1.0E+04		NO.		Hr		1.0E+04		NO.		Hr		5.3E+03	
1				1.4E+07	1.1E+07	1		362		5.7E+04	OVLD	1				2.5E+04	3.7E+04
2				1.2E+07	5.6E+06	2				1.1E+05	5.4E+04	2				4.4E+04	2.7E+04
3				1.3E+07	4.4E+06	3				8.2E+04	4.3E+04	3		266		5.4E+04	OVLD
4				4.5E+06	1.2E+06	4		396		4.1E+04	OVLD	4		298		3.7E+04	OVLD
5				8.1E+06	2.3E+06	5				3.3E+04	1.9E+04	5				1.7E+05	3.4E+04
6				7.7E+06	5.6E+06	6				1.1E+05	6.5E+04	6				2.1E+05	4.6E+04
7				1.4E+07	7.0E+06	7		41		1.3E+05	OVLD	7				1.7E+05	3.6E+04
8				6.4E+06	2.6E+06	8				5.5E+04	3.3E+04	8		169		5.3E+04	OVLD
9		131		1.1E+07	OVLD	9				1.8E+05	5.0E+04	9				4.0E+04	2.9E+04
10				4.8E+06	2.3E+06	10				3.8E+04	1.3E+04	10				6.3E+04	1.9E+04
11				5.3E+06	2.4E+06	11		299		9.3E+04	OVLD	11				1.3E+05	4.7E+04
12				1.1E+07	5.4E+06	12				6.1E+04	2.1E+04	12				6.4E+04	3.3E+04
13				1.1E+07	6.7E+06	13				1.1E+05	8.8E+04	13				8.8E+04	1.6E+04
14				5.5E+06	2.3E+06	14				6.2E+04	1.2E+04	14		377		2.1E+05	OVLD
15		169		1.0E+07	OVLD	15				5.5E+04	1.0E+04	15				6.3E+04	4.3E+04
16				6.7E+06	1.5E+06	16		444		6.0E+04	OVLD	16				6.8E+04	3.3E+04
17				6.6E+06	8.9E+05	17				5.5E+04	1.2E+04	17				6.9E+04	2.5E+04
18				1.6E+07	4.5E+06	18				1.7E+05	4.6E+04	18		266		5.9E+04	OVLD
19				1.1E+07	4.6E+06	19		156		6.4E+04	OVLD	19				1.5E+05	6.2E+04
20		233		4.3E+06	OVLD	20				6.4E+04	2.4E+04	20				1.4E+05	5.2E+04
21				8.7E+06	5.4E+06	21				5.0E+04	1.2E+04	21				4.4E+04	1.9E+04
22				3.5E+06	7.8E+05	22		121		4.4E+04	OVLD	22				3.6E+04	1.6E+04
23				6.8E+06	4.4E+06	23				5.1E+04	1.4E+04	23		332		3.5E+04	OVLD
24				1.1E+07	5.5E+06	24				4.4E+04	1.2E+04	24				5.6E+04	2.5E+04
25				5.4E+06	2.0E+06	25				2.1E+05	5.2E+04	25				1.5E+05	1.2E+04
26		69		1.1E+07	OVLD	26				8.6E+04	2.7E+04	26				4.4E+04	1.6E+04
27				5.9E+06	2.2E+06	27		239		5.1E+04	OVLD	27		366		3.4E+04	OVLD
28				1.3E+07	3.5E+05	28		446		4.4E+04	OVLD	28				4.9E+04	1.0E+04
29				4.8E+06	1.0E+06	29				8.7E+04	9.8E+03	29				4.2E+04	1.2E+04
30				1.2E+07	4.1E+06	30				5.5E+04	2.0E+04	30		165		6.5E+04	OVLD
31				6.1E+06	4.1E+06	31				3.9E+04	1.2E+04	31				3.6E+04	6.4E+03
32				1.5E+07	1.1E+06	32				1.1E+05	2.7E+04	32				1.5E+05	4.1E+04
33		225		7.1E+06	OVLD	33		165		7.5E+04	OVLD	33				4.5E+04	2.1E+04
34				1.0E+07	7.7E+06	34				8.9E+04	2.4E+04	34		208		5.6E+04	OVLD
35				4.6E+06	2.2E+06	35				6.3E+04	3.2E+04	35				8.5E+04	3.1E+05
36				6.3E+06	3.1E+06	36				5.6E+04	2.5E+04	36				1.6E+05	2.4E+05
37		411		5.5E+06	OVLD	37				7.7E+04	2.3E+04	37				2.6E+04	1.4E+04
38				5.5E+06	2.5E+06	38		231		6.2E+04	OVLD	38		312		5.6E+04	OVLD
39				1.1E+07	4.4E+06	39				1.0E+05	3.3E+04	39		233		8.7E+04	OVLD
40				6.1E+06	1.1E+06	40				6.6E+04	2.2E+04	40				4.6E+04	7.7E+03
TEST HOUR		500				TEST HOUR		500				TEST HOUR		500			
FAILURE HOUR		1238				FAILURE HOUR		2900				FAILURE HOUR		2992			
FAILURE QUANTITY		6				FAILURE QUANTITY		11				FAILURE QUANTITY		11			
GOOD QUANTITY		34				GOOD QUANTITY		29				GOOD QUANTITY		29			
TOTAL TEST HOUR		18238				TOTAL TEST HOUR		17400				TOTAL TEST HOUR		17492			
Fit		0.10				Fit		0.19				Fit		0.99			

5900 Shepherd Mountain Cove • Austin, TX 78730
Phone: 512 / 794-0081 • Fax: 512 / 794-0087 • Toll Free: 800 / 950-8365
e-mail: sales@venkel.com • www.venkel.com