

Comparison Evaluation of MLCC



Revised 2014. 02. 12

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I. Introduction



Introduction

- **Specimen:** Multi-Layer Ceramic Capacitor (1005 size)
- **Test:**
 - Solder wettability test
 - Temperature cycle test
 - Damp heat cycle test
 - 85%/85° C test
- **Test term:** 2013. 12. 31 ~ 2104. 1. 29
- **Test environment:** Refer each test information
- **Test apparatuses:**
 - Solderability tester (6 sigma, Robotic Process System, USA)
 - Temperature and humidity environmental test chamber (Excal 5425H, Climats, France)
 - Temperature and humidity environmental test chamber (TH403A, ETAC, Japan)
- **Etc:** Blind test
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Introduction

- **Test apparatuses:**
 - Solderability tester (6 sigma, Robotic Process System, USA)



Introduction

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 - Temperature and humidity environmental test chamber (Excal 5425H, Climates, France)



Introduction

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 - Temperature and humidity environmental test chamber (TH403A, ETAC, Japan)



Solder wettability test

- **Test standard:** IEC 60068-2-58
 - According to “IEC 60068-2-58”, the solder wettability test was performed using solderability tester.
- **Etc:**
 - Solder composition: Sn-3.0Ag-0.5Cu
 - Solder temperature: $(260 \pm 5)^\circ \text{C}$
 - Dipping time: (3 ± 0.1) sec
 - Number of samples: 10 ea
 - Flux was used
 - Criterion: No pin holes observed from surface of solder.

Information on Solder

Manufacturer: Senju Metal Industry Co.

Name of goods: M705-GRN360-K2-V

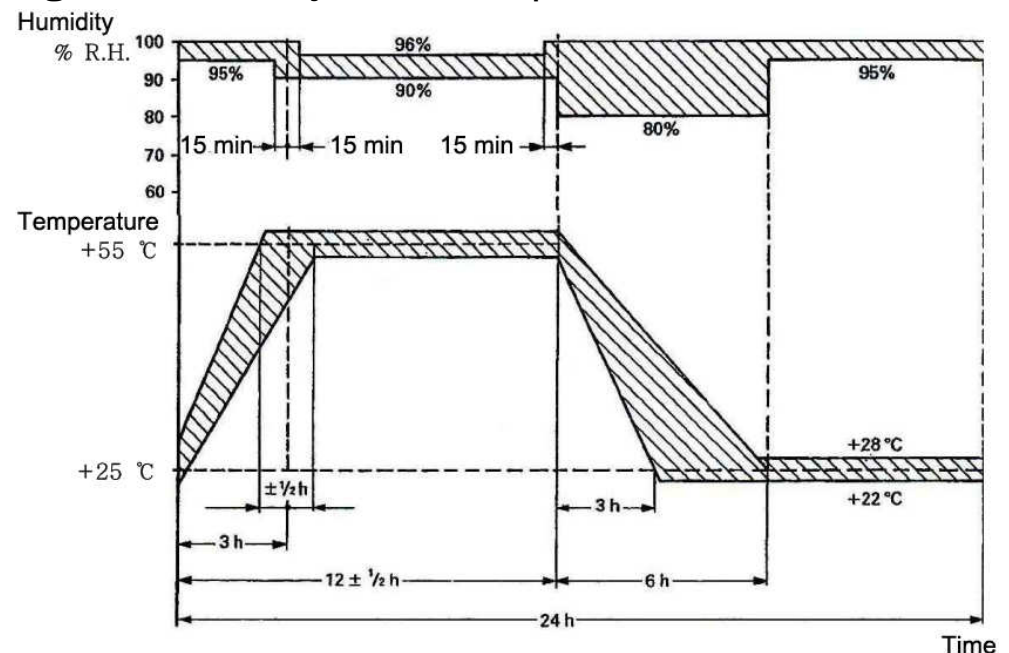
Composition: Sn-3.0Ag-0.5Cu

Temperature cycle test

- **Test standard:** IEC 60384-1
 - According to “IEC 60384-1”, the temperature cycle test was performed using temperature and humidity test chamber (Excal 5425H).
- **Etc:**
 - Test temperature: minimum service temp., maximum service temp.
 - Dwell time: each 30 min
 - Time of temperature change: in 3 min
 - Number of cycles: 5 cycles
 - Number of samples: 10 ea
 - Criterion: Capacitance was not changed drastically after temperature cycle test.

Damp heat cycle test

- **Test standard:** IEC 60384-1
 - According to “IEC 60384-1”, the temperature cycle test was performed using temperature and humidity test chamber (Excal 5425H).
- **Etc:**
 - High temperature: maximum service temperature, 16 hour
 - Humidity: 95%
 - Low temperature: minimum service temperature, 2 hour
 - Humidity: rest of cycles
 - Number of samples: 10 ea
 - Criterion: Capacitance was not changed drastically after temperature cycle test.







(Graph for humidity condition of damp heat cycle test)

85%/85° C test

- **Test standard:** IEC 60384-1
 - According to “IEC 60384-1”, high temperature and high humidity test was performed during 500 hour using temperature and humidity test chamber (ETAC TH403A).
- **Etc:**
 - Temperature: 85 ° C
 - Humidity: 85%
 - Test time: 500 hour
 - Number of samples: 10 ea
 - Criterion: Capacitance was not changed drastically after temperature cycle test.
 - Capacitance was measured at 100, 200, 300, 400, and 500 hour (5 times).

Specimens

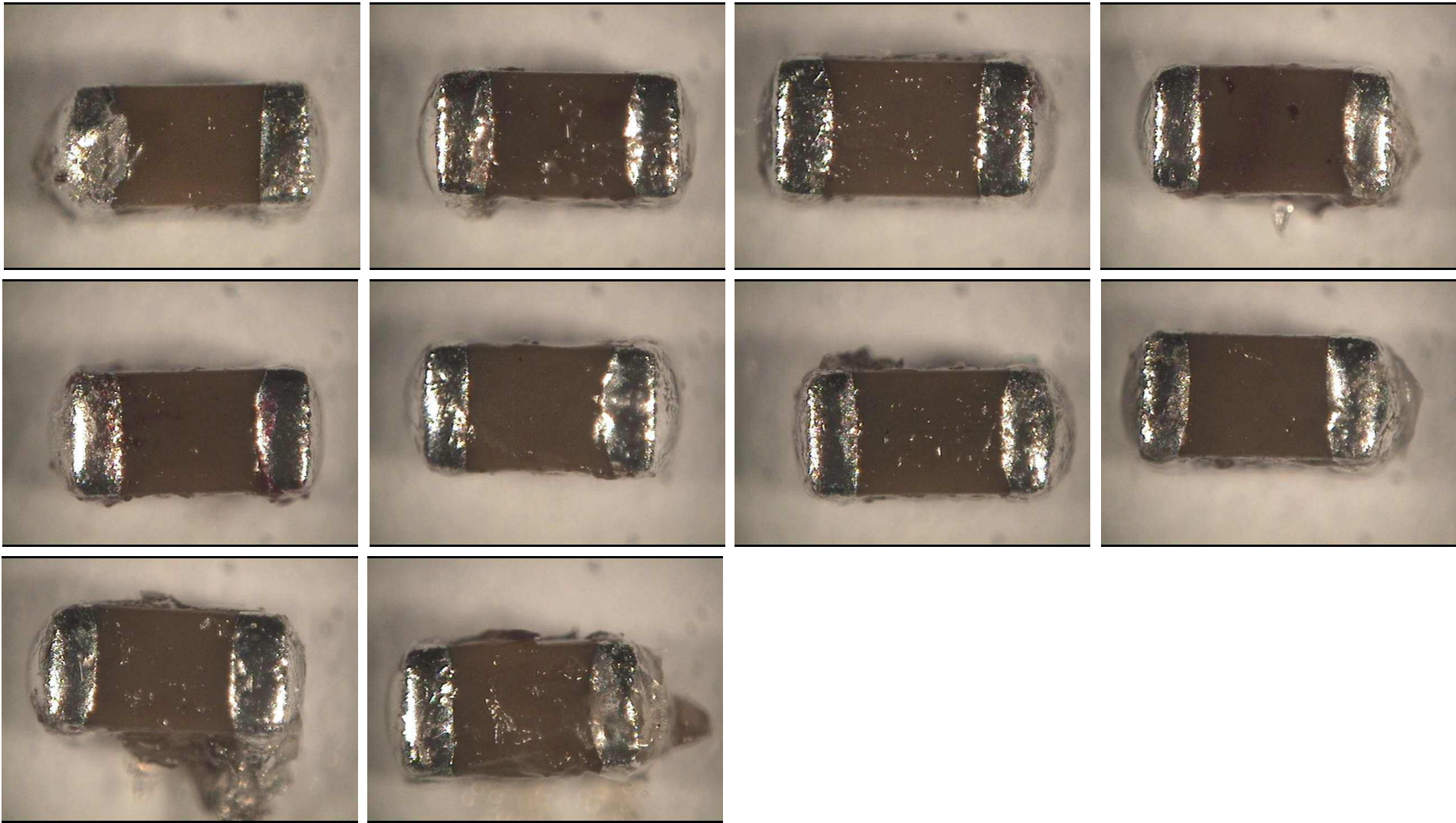
Chip size(mm)	A	B	C	D
1005				

	A	B	C	D
Capacitance	0.1 uF	0.1 uF	0.1 uF	0.1 uF
Tolerance	±10 %	±10 %	±10 %	±10 %
Temp. range	-55 ~ +125 °C	-25 ~ +85 °C	-55 ~ +125 °C	-55 ~ +125 °C
Resistance to soldering heat	260 ± 5 °C 10 ± 1 sec	270 ± 5 °C 10 ± 0.5 sec	260 ± 5 °C 10 ± 0.5 sec	270 ± 5 °C 10 ± 1 sec

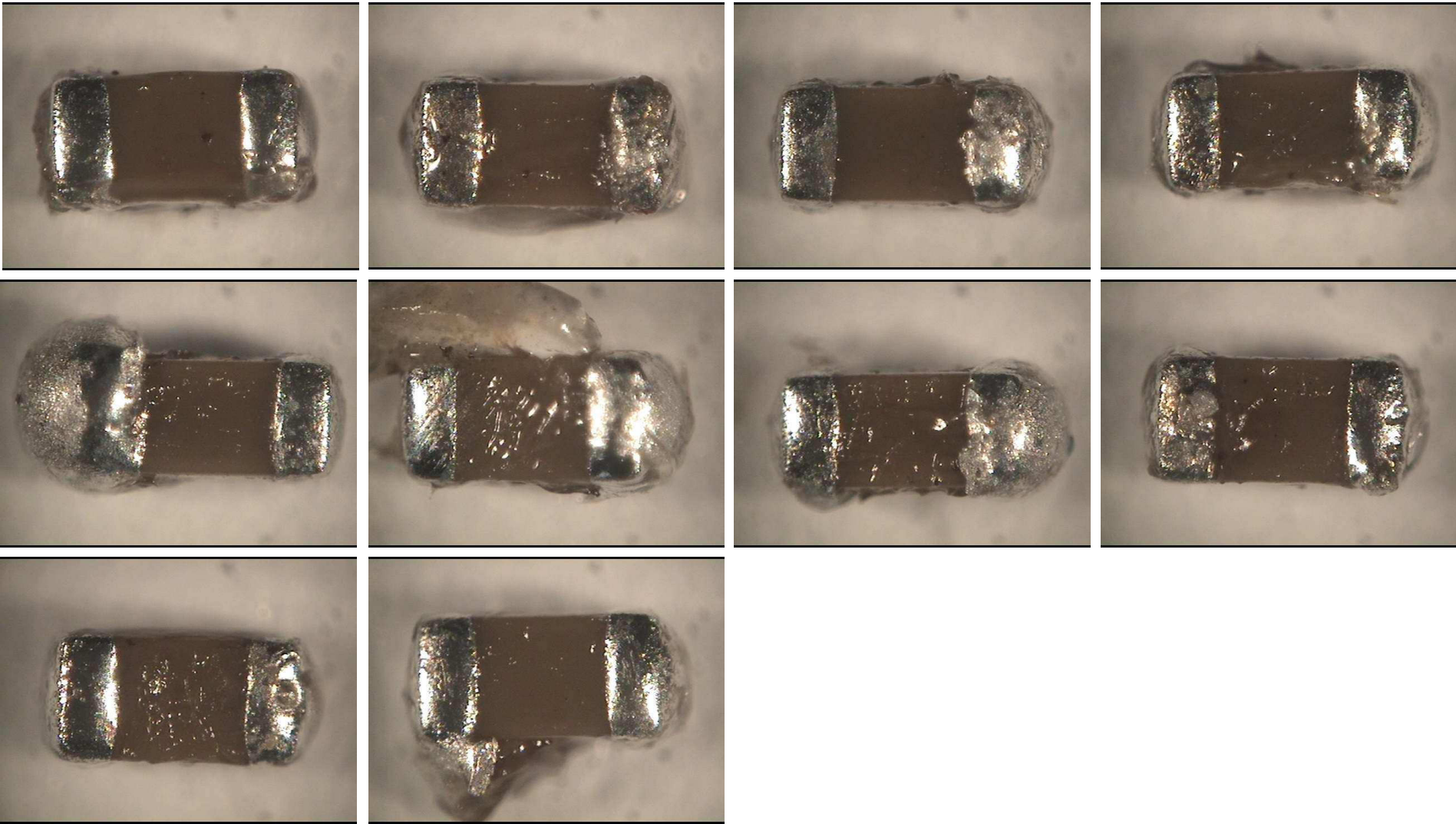
II. Solder wettability test



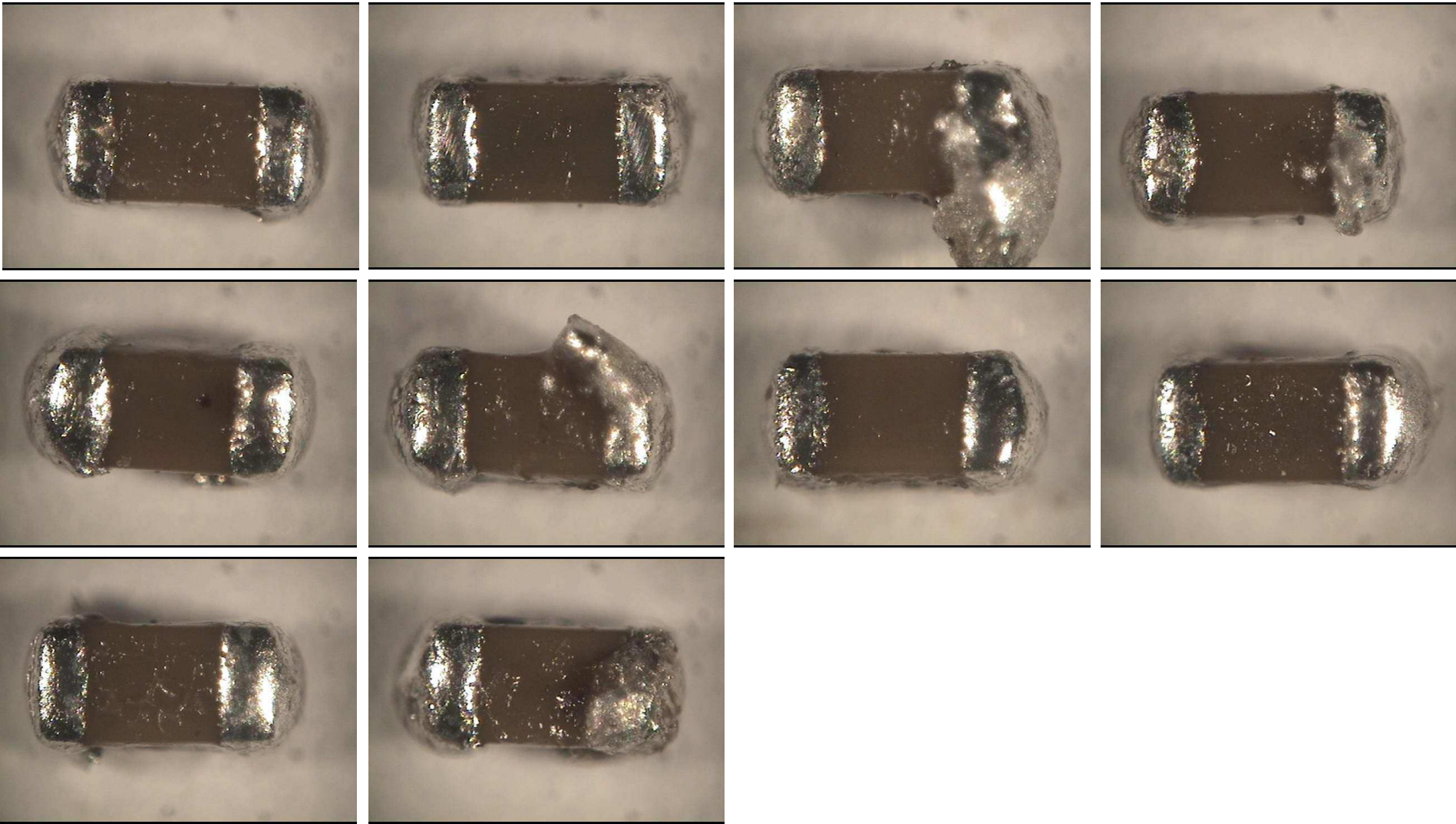
A社 1005



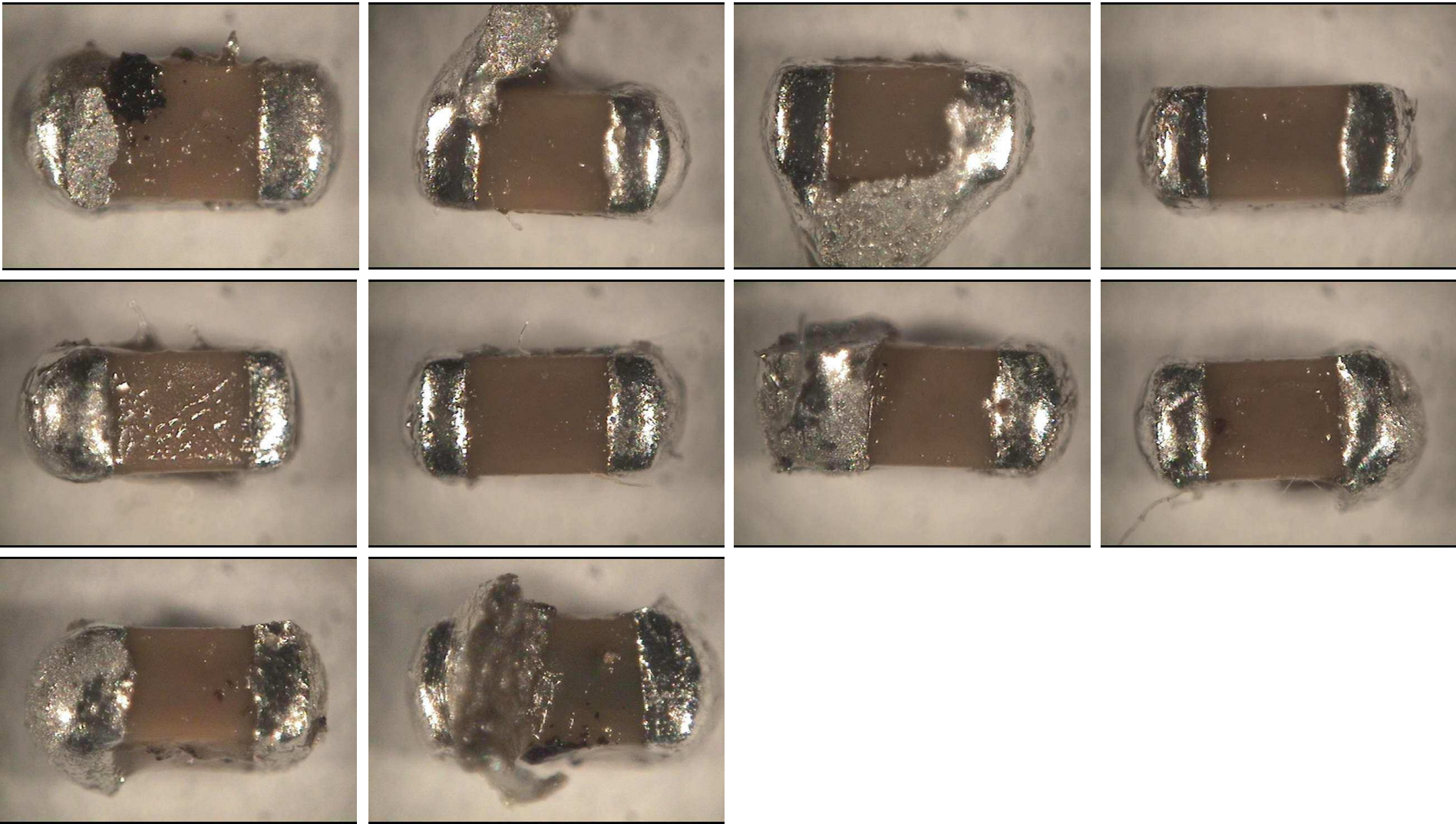
B社 1005



C社 1005



D社 1005



III. Temperature cycle test



A社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company A 1005 (@ 1 Vrms)	No.1	95.99	102.49	6.77	84.85	90.24	6.36
	No.2	93.84	100.31	6.89	82.61	88.48	7.10
	No.3	97.75	104.89	7.30	86.29	92.27	6.93
	No.4	95.89	102.80	7.21	84.41	90.14	6.79
	No.5	101.28	108.09	6.72	89.78	95.40	6.26
	No.6	98.14	104.87	6.86	86.89	92.44	6.38
	No.7	98.89	105.35	6.53	87.68	92.98	6.04
	No.8	101.24	108.24	6.91	89.24	95.26	6.75
	No.9	98.87	105.61	6.82	87.67	93.30	6.42
	No.10	98.11	104.68	6.70	86.94	92.44	6.32
Avg. rate of change (%)=			6.87	6.54			

<Judgement>

The test results is satisfied with regulation.

However, No.2 &No.3 & No.4 result is close to a limit value($\pm 10\%$).

B社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company B 1005 (@ 1 Vrms)	No.1	101.07	101.68	0.60	90.37	90.67	0.33
	No.2	98.47	99.31	0.85	88.23	88.74	0.58
	No.3	99.25	99.98	0.74	88.73	89.19	0.52
	No.4	96.20	97.06	0.89	85.81	86.40	0.69
	No.5	100.53	101.37	0.84	89.95	90.36	0.46
	No.6	99.78	100.63	0.85	89.57	90.15	0.64
	No.7	96.81	97.40	0.61	87.03	87.31	0.32
	No.8	96.44	97.19	0.78	86.60	86.91	0.36
	No.9	96.58	97.34	0.79	86.41	86.85	0.51
	No.10	98.70	99.56	0.87	88.36	88.79	0.49
Avg. rate of change (%)=				0.78			0.49

<Judgement>

The test results is satisfied with regulation.

C社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company C 1005 (@ 1 Vrms)	No.1	104.06	109.24	4.98	89.07	93.08	4.50
	No.2	100.89	107.61	6.66	86.84	92.25	6.23
	No.3	97.22	102.13	5.05	84.58	88.37	4.48
	No.4	97.83	102.44	4.71	84.95	88.48	4.16
	No.5	99.06	103.56	4.54	85.92	89.40	4.05
	No.6	105.16	110.29	4.88	90.08	94.02	4.37
	No.7	102.77	107.69	4.79	88.67	92.56	4.39
	No.8	98.79	103.82	5.09	85.74	89.74	4.67
	No.9	98.43	103.05	4.69	85.78	89.22	4.01
	No.10	97.57	102.07	4.61	84.83	88.04	3.78
Avg. rate of change (%)=				5.00			4.46

<Judgement>

The test results is satisfied with regulation.

D社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company D 1005 (@ 1 Vrms)	No.1	109.58	115.27	5.19	91.25	95.32	4.46
	No.2	112.24	118.22	5.33	93.23	97.69	4.78
	No.3	111.08	116.85	5.19	92.31	96.26	4.28
	No.4	105.52	110.91	5.11	88.35	92.00	4.13
	No.5	109.55	115.42	5.36	91.14	95.74	5.05
	No.6	110.28	115.99	5.18	91.49	95.52	4.40
	No.7	110.24	115.54	4.81	92.36	95.78	3.70
	No.8	104.46	109.30	4.63	87.21	90.58	3.86
	No.9	108.12	112.90	4.42	91.16	94.38	3.53
	No.10	106.09	111.21	4.82	88.79	92.21	3.85
Avg. rate of change (%)=				5.00			4.21

<Judgement>

The test results is satisfied with regulation.

Summary

Temperature cycle test

Sample (1005)	Test result:1KHz			Test result:1MHz		
	Min. value	Max. Value	Avg.value	Min. value	Max. Value	Avg.value
A	6.53%	7.30%	6.87%	6.04%	7.10%	6.54%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
B	0.60%	0.89%	0.78%	0.32%	0.69%	0.49%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
C	4.61 %	6.66%	5%	3.38%	6.23%	4.46%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
D	4.42%	5.36%	5%	3.55%	5.05%	4.21 %
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○

<Total Judgement>

All of test samples are satisfied with regulation.

IV. Damp heat cycle test



A社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company A 1005 (@ 1 Vrms)	No.1	97.421	99.114	1.74	85.794	87.732	2.26
	No.2	95.773	97.497	1.80	84.211	86.333	2.52
	No.3	97.892	99.858	2.01	85.897	88.253	2.74
	No.4	94.201	96.232	2.16	83.021	95.219	14.69
	No.5	99.797	101.692	1.90	87.833	90.105	2.59
	No.6	96.334	98.273	2.01	84.887	87.142	2.66
	No.7	94.416	96.373	2.07	84.041	85.236	1.42
	No.8	95.774	97.665	1.97	84.754	86.991	2.64
	No.9	95.271	97.408	2.24	83.923	86.068	2.56
	No.10	99.033	100.815	1.80	87.048	89.205	2.48
Avg. rate of change (%)=				1.97			3.66

<Judgement>

The test results is not satisfied with regulation. : NG
No.4 result is over the limit value($\pm 10\%$).

B社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company B 1005 (@ 1 Vrms)	No.1	98.667	98.939	0.28	87.734	88.416	0.78
	No.2	99.232	98.418	-0.82	88.128	88.777	0.74
	No.3	98.047	98.226	0.18	87.164	87.778	0.70
	No.4	94.993	96.921	2.03	84.465	86.882	2.86
	No.5	100.181	100.217	0.04	88.826	89.557	0.82
	No.6	96.729	96.866	0.14	86.211	86.799	0.68
	No.7	98.762	98.907	0.15	87.667	88.316	0.74
	No.8	98.832	98.946	0.12	87.653	88.354	0.80
	No.9	101.244	101.373	0.13	89.791	90.544	0.84
	No.10	96.004	95.204	-0.83	85.446	85.203	-0.28
Avg. rate of change (%)=				0.14	0.87		

<Judgement>

The test results is satisfied with regulation.

C社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company C 1005 (@ 1 Vrms)	No.1	94.725	95.179	0.48	82.122	82.866	0.91
	No.2	102.558	103.096	0.52	88.563	89.392	0.94
	No.3	95.211	95.654	0.47	82.171	83.054	1.07
	No.4	100.319	101.131	0.81	86.001	86.938	1.09
	No.5	95.298	95.813	0.54	82.453	83.283	1.01
	No.6	97.063	97.678	0.63	83.731	84.573	1.01
	No.7	96.462	96.989	0.55	83.68	84.547	1.04
	No.8	99.349	101.649	2.32	85.296	87.874	3.02
	No.9	98.591	99.218	0.64	85.012	85.946	1.10
	No.10	100.144	100.723	0.58	86.364	87.392	1.19
Avg. rate of change (%)=				0.75			1.24

<Judgement>

The test results is satisfied with regulation.

D社 1005

<Test result>

Sample		1 KHz			1 MHz		
		Before (nF)	After (nF)	Rate of change (%)	Before (nF)	After (nF)	Rate of change (%)
Company D 1005 (@ 1 Vrms)	No.1	108.799	112.341	3.26	91.263	93.928	2.92
	No.2	108.305	109.627	1.22	90.792	91.959	1.29
	No.3	110.593	111.985	1.26	92.608	93.539	1.01
	No.4	107.381	108.641	1.17	89.541	90.566	1.14
	No.5	110.076	112.332	2.05	91.939	92.973	1.12
	No.6	100.616	102.142	1.52	84.235	85.137	1.07
	No.7	113.411	114.889	1.30	94.837	95.736	0.95
	No.8	108.573	110.023	1.34	91.042	91.865	0.90
	No.9	112.332	114.091	1.57	93.471	94.632	1.24
	No.10	107.439	108.538	1.02	89.948	90.799	0.95
Avg. rate of change (%)=				1.57			1.26

<Judgement>

The test results is satisfied with regulation.

Summary

Damp heat cycle test

Sample (1005)	Test result:1KHz			Test result:1MHz		
	Min. value	Max. Value	Avg.value	Min. value	Max. Value	Avg.value
A	1.74%	2.24%	1.97%	1.42%	14.62%	3.66%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:×	Judg:○
B	0.04%	2.03%	0.14%	-0.28%	2.86%	0.87%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
C	0.48%	2.32%	0.75%	0.91%	3.02%	1.24%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
D	1.02%	3.26%	1.57%	0.90%	2.92%	1.26%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○

<Total Judgement>

The company A sample result is not satisfied with regulation.

On the others, company **B/C/D** results are satisfied with regulation.

V. 85%/85° C test



A社 1005

<Test result>

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of change (%, 0 to 500 hr)
Company A 1005 (1 Vrms, 1 kHz)	No.1	96.84	101.79	101.03	100.45	100.24	103.82	7.21
	No.2	96.67	101.32	100.54	100.04	100.01	103.41	6.97
	No.3	99.91	99.61	98.32	98.44	98.18	101.66	1.75
	No.4	98.82	105.08	103.88	103.74	103.65	107.49	8.77
	No.5	95.80	100.71	100.78	99.50	99.38	102.97	7.48
	No.6	98.74	103.74	103.51	102.47	102.33	106.24	7.60
	No.7	96.11	100.73	99.44	99.60	99.41	102.81	6.97
	No.8	96.62	101.66	100.76	100.54	100.20	104.15	7.79
	No.9	96.47	101.35	101.23	100.13	99.93	103.29	7.07
	No.10	100.72	105.74	104.38	104.40	104.25	108.12	7.35
Avg. rate of change (%)=								6.90

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of Change (%, 0 to 500 hr)
Company A 1005 (1 Vrms, 1 MHz)	No.1	86.15	89.89	89.92	88.85	88.87	91.25	5.92
	No.2	85.77	89.32	88.21	88.47	88.42	90.86	5.94
	No.3	88.58	87.58	87.33	86.90	86.52	89.01	0.49
	No.4	87.33	92.57	92.09	91.67	91.45	94.07	7.72
	No.5	84.94	88.58	87.11	87.80	87.70	90.16	6.14
	No.6	87.41	91.05	91.53	90.06	90.01	92.72	6.07
	No.7	85.73	89.17	89.87	88.31	88.18	90.50	5.56
	No.8	85.24	89.02	88.18	88.23	88.03	90.63	6.33
	No.9	85.67	89.37	90.58	88.44	88.11	90.53	5.67
	No.10	89.13	92.91	92.93	91.93	91.75	94.51	6.03
Avg. rate of change (%)=								5.59

<Judgement>

The test results is satisfied with regulation.

However, No.4 result is close to a limit value($\pm 10\%$).

B社 1005

<Test result>

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of change (%, 0 to 500 hr)
Company B 1005 (1 Vrms, 1 kHz)	No.1	97.30	99.83	99.78	99.20	99.15	100.82	3.61
	No.2	97.70	100.00	100.20	99.39	99.37	100.95	3.33
	No.3	96.61	98.99	99.15	99.43	98.46	100.01	3.52
	No.4	95.17	97.64	97.36	97.07	97.06	102.97	8.20
	No.5	98.73	101.40	100.87	100.65	100.77	102.44	3.76
	No.6	96.12	98.45	98.71	97.80	97.75	99.35	3.36
	No.7	97.79	100.28	99.38	99.58	99.66	101.17	3.46
	No.8	98.47	101.20	101.56	100.41	100.50	102.08	3.67
	No.9	98.43	101.03	100.21	100.22	100.37	101.93	3.55
	No.10	99.17	101.91	101.38	101.25	101.22	102.75	3.61
Avg. rate of change (%)=								4.01

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of Change (%, 0 to 500 hr)
Company B 1005 (1 Vrms, 1 MHz)	No.1	87.06	88.94	88.40	88.43	88.48	89.37	2.66
	No.2	88.01	89.78	89.12	89.24	89.13	90.16	2.45
	No.3	86.52	88.45	87.38	87.83	87.77	88.77	2.60
	No.4	85.30	87.20	87.56	86.60	86.55	91.19	6.90
	No.5	88.23	90.25	90.45	89.64	89.55	90.62	2.71
	No.6	86.42	88.20	87.80	87.66	87.49	88.54	2.45
	No.7	87.82	89.74	89.18	89.05	89.06	90.04	2.53
	No.8	87.98	90.07	90.48	89.35	89.34	90.26	2.59
	No.9	88.22	90.20	89.17	89.56	89.55	90.61	2.70
	No.10	88.65	90.74	90.53	90.17	90.12	91.04	2.70
Avg. rate of change (%)=								3.03

<Judgement>

The test results is satisfied with regulation.

However, No.4 result is close to a limit value($\pm 10\%$).

C社 1005

<Test result>

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of change (%, 0 to 500 hr)
Company C 1005 (1 Vrms, 1 kHz)	No.1	100.09	104.02	105.02	102.79	102.89	105.57	5.47
	No.2	100.63	104.83	105.96	103.54	103.61	106.46	5.79
	No.3	98.44	102.21	103.23	101.09	101.13	103.80	5.44
	No.4	93.46	96.85	97.85	95.97	95.98	98.35	5.23
	No.5	94.85	98.16	99.05	97.21	97.15	99.70	5.11
	No.6	97.13	100.71	101.46	99.66	99.77	102.16	5.18
	No.7	96.97	100.59	101.53	99.56	99.58	102.13	5.32
	No.8	96.60	100.08	101.02	99.04	99.07	101.54	5.11
	No.9	100.98	104.89	106.10	103.86	103.89	106.74	5.71
	No.10	97.18	100.86	101.85	99.73	99.82	102.39	5.36
Avg. rate of change (%)=								5.37

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of Change (%, 0 to 500 hr)
Company C 1005 (1 Vrms, 1 MHz)	No.1	86.97	89.74	90.25	88.86	88.73	90.41	3.96
	No.2	87.08	89.94	90.58	89.17	89.06	90.64	4.09
	No.3	85.95	88.49	89.24	87.80	87.72	89.31	3.91
	No.4	81.59	83.98	84.56	83.31	83.18	84.53	3.60
	No.5	83.03	85.31	85.85	84.67	84.61	86.05	3.63
	No.6	84.53	86.92	87.38	86.26	86.26	87.71	3.77
	No.7	84.34	86.85	87.42	86.08	86.02	87.53	3.78
	No.8	84.27	86.72	87.22	85.87	85.96	87.48	3.80
	No.9	87.38	90.03	90.72	89.35	89.38	90.96	4.10
	No.10	84.72	87.39	87.84	86.62	86.50	87.84	3.68
Avg. rate of change (%)=								3.83

<Judgement>

The test results is satisfied with regulation.

D社 1005

<Test result>

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of change (%, 0 to 500 hr)
Company D 1005 (1 Vrms, 1 kHz)	No.1	108.63	112.54	113.01	111.89	111.36	110.49	1.71
	No.2	108.33	112.33	112.99	111.66	111.36	112.90	4.21
	No.3	99.02	102.51	103.07	101.93	101.70	103.05	4.07
	No.4	103.47	107.08	107.46	106.46	106.15	107.45	3.84
	No.5	110.36	114.03	114.48	113.50	113.12	114.49	3.74
	No.6	107.91	111.62	112.14	111.00	110.73	112.11	3.89
	No.7	107.24	111.13	111.46	110.46	110.14	111.67	4.13
	No.8	105.65	109.06	109.82	108.58	108.42	109.71	3.84
	No.9	106.63	110.26	110.85	109.78	109.39	110.85	3.95
	No.10	106.26	109.80	110.16	109.32	108.97	109.62	3.16
Avg. rate of change (%)=								3.66

Sample		0 hr	100 hr	200 hr	300 hr	400 hr	500 hr	Rate of Change (%, 0 to 500 hr)
Company D 1005 (1 Vrms, 1 MHz)	No.1	90.91	93.35	93.64	92.69	92.45	91.00	0.10
	No.2	91.02	93.44	93.72	92.73	92.57	93.25	2.45
	No.3	83.52	85.57	85.95	84.95	84.88	85.59	2.48
	No.4	87.54	89.81	90.07	89.27	88.98	89.66	2.42
	No.5	92.58	94.91	94.92	94.21	94.07	94.80	2.40
	No.6	90.74	93.04	93.53	92.46	92.27	92.83	2.30
	No.7	89.92	92.14	92.62	91.76	91.54	92.22	2.56
	No.8	88.58	90.62	91.17	90.26	90.10	90.78	2.48
	No.9	89.42	91.66	91.96	91.09	90.86	91.50	2.33
	No.10	89.20	91.38	91.46	90.90	90.63	90.84	1.84
Avg. rate of change (%)=								2.14

<Judgement>

The test results is satisfied with regulation.

Summary

85%/85° C test

Sample (1005)	Test result:1KHz			Test result:1MHz		
	Min. value	Max. Value	Avg.value	Min. value	Max. Value	Avg.value
A	1.75%	8.77%	6.90%	0.49%	7.72%	5.59%
	Judg:○	Judg:△	Judg:○	Judg:○	Judg:△	Judg:○
E	3.33%	8.20%	4.01%	2.45%	6.90%	3.06%
	Judg:○	Judg:△	Judg:○	Judg:○	Judg:○	Judg:○
C	5.11%	5.79%	5.37%	3.60%	4.10%	3.83%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○
D	1.71%	4.21%	3.66%	0.10%	2.56%	2.14%
	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○	Judg:○

<Total Judgement>

All of samples results are satisfied with regulation. However, company **A/B** results is close to a limit value($\pm 10\%$).

KETI試験結果の考察

■試験サンプル詳細

Walsin 村田 Yageo Samsung

Chip size(mm)	A	B	C	D
1005				
1608-1				
1608-2				

Spec.	A: Walsin	B: Murata	C: Yageo	D: Samsung
1005	Parts number	0402B104K100C	GRM155B11A104KA01C	CC0402KCX7R6BB104
	SIZE(mm)	1.0X0.5X0.5	1.0X0.5X0.5	1.0X0.5X0.5
	Capacitance	0.1uF±10%	0.1uF±10%	0.1uF±10%
	Voltage	10VDC	10VDC	10VDC
	Temp. chara	X7R	B	X7R
	Top.range	-55~125°C	-25~85°C	-55~125°C
	Soldering tem.	260±5°C/10sec	270±5°C/10sec	260±5°C/10sec
1608-1	Parts number	0603N101J500L	GRM1882C1H101JA01C	CC0603JONPO9BN101
	SIZE(mm)	1.6X0.8X0.8	1.6X0.8X0.8	1.6X0.8X0.8
	Capacitance	100pF±5%	100pF±5%	100pF±5%
	Voltage	50VDC	50VDC	50VDC
	Temp. chara	NPO	CH	NPO
	Top.range	-55~125°C	-20~125°C	-55~125°C
	Soldering tem.	260±5°C/10sec	270±5°C/10sec	260±5°C/10sec
1608-2	Parts number	0603F104Z250C	GRM188F11E104ZA01C	CC0603ZCY5V8BB104
	SIZE(mm)	1.6X0.8X0.4	1.6X0.8X0.4	1.6X0.8X0.5
	Capacitance	0.1uF+80%/-20%	0.1uF+80%/-20%	0.1uF+80%/-20%
	Voltage	25VDC	25VDC	25VDC
	Temp. chara	Y5V	F	Y5V
	Top.range	-25~85°C	-25~85°C	-30~85°C
	Soldering tem.	260±5°C/10sec	270±5°C/10sec	260±5°C/10sec

KETI試験結果の考察

■MLCC部品発掘状況:部品評価結果まとめ

メーカー	A: Walsin			B: 村田製作所			C: YAGEO			D: SAMSUNG		
	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V
素子強度	◎ 合格	◎ 合格	◎ 合格	◎ 合格	○ 準合格	◎ 合格	○ 準合格	○ 準合格	○ 準合格	× 不合格	○ 準合格	◎ 合格
基板曲げ (試料:10個)	2個○	9個○	5個○	0個○	9個○	3個○	4個○	8個○	7個○	0個○	9個○	0個○
	6個×	0個×	0個×	5個×	0個×	1個×	2個×	0個×	0個×	7個×	0個×	3個×
ハンダ濡性	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格	◎ 合格
温度サイクル	○ 準合格			◎ 合格			◎ 合格			◎ 合格		
ダンプヒート	× 不合格			◎ 合格			◎ 合格			◎ 合格		
高温高湿	○ 準合格			○ 準合格			◎ 合格			◎ 合格		

(※ 準合格: 規格値に対して余裕がない結果)

<SUMMARY>

- ①素子強度: D社 (Samsung) 1005製品 (0.1uF/10V) には問題があると言える
- ②温度試験関連: A社 (Walsin) 製品は、全ての試験で見られる (構造的に高温耐久性乏しい)
- ③基板曲げ試験: 全てのアイテムで問題あり⇒試験方法に問題がある可能性あり

KETI試験結果の考察

■MLCC部品発掘状況:KETI試験結果の考察

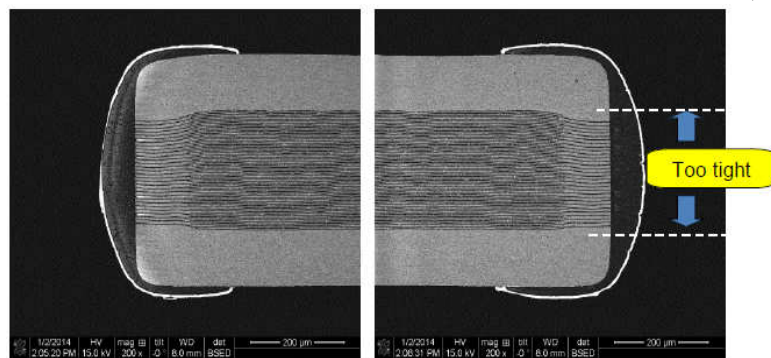
今回のKETIによる試験結果を弊社の視点で考察致しました。ご参考として頂ければと思います。

①素子強度試験

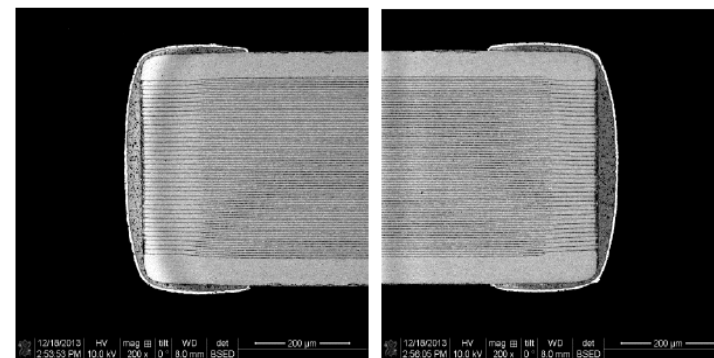
メーカー	A: Walsin			B: 村田製作所			C: YAGEO			D: SAMSUNG		
	1005	1608-1	1608-2	1005	1608-1	1608-2	1005	1608-1	1608-2	1005	1608-1	1608-2
試験項目	0.1uF/10V	100pF/50V	0.1uF/50V	0.1uF/10V	100pF/50V	0.1uF/50V	0.1uF/10V	100pF/50V	0.1uF/50V	0.1uF/10V	100pF/50V	0.1uF/50V
素子強度	◎合格	◎合格	◎合格	◎合格	○準合格	◎合格	○準合格	○準合格	○準合格	×不合格	○準合格	◎合格

この4社製品の試験結果を比較すると、Samsung社製品1005サイズのみで不合格が見られます。これより同社の1005製品は強度面で問題があると判断できます。素子強度試験方法 (EIAJ ET-7403) は試料に**10N**を加えるものです。実際の基板製造工程では、ドライバー接触/輸送中のストレス印加等で発生しえる数値です。よってこの数値に耐えられない部品については問題があると判断できます。

そこで、Samsung社1005製品で、なぜ素子強度が不足しているのかを考察してみました。下図左 (Samsung社1005製品) と右図 (村田社1005製品) の構造を比較すると、Samsung社製品のMLC層全体の幅が狭い事が解ります。つまり、層幅/層間隔が狭い事が1つの原因であると推測できます。



Samsung社1005製品断面図



村田社1005製品断面図

KETI試験結果の考察



②基板折り曲げ試験

メーカー 試験項目	A: Walsin			B: 村田製作所			C: YAGEO			D: SAMSUNG		
	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V	1005 0.1uF/10V	1608-1 100pF/50V	1608-2 0.1uF/50V
基板曲げ (試料:10個)	2個:○	9個:○	5個:○	0個:○	9個:○	3個:○	4個:○	8個:○	7個:○	0個:○	9個:○	0個:○
	6個:×	0個:×	0個:×	5個:×	0個:×	1個:×	2個:×	0個:×	0個:×	7個:×	0個:×	3個:×

Sample (1005)	OK (20mm bend)	NG (Over limit)	N/A (Damaged)	No result (Stop test)
A(Walsin)	2pcs	6pcs	2pcs	
B(村田)		5pcs	1pc	4pcs
C(Yageo)	4pcs	2pcs		4pcs
D(Samsung)		7pcs		3pcs

Sample (1608-1)	OK (20mm bend)	NG (Over limit)	N/A (Damaged)	No result (Stop test)
A(Walsin)	9pcs			1pc
B(村田)	9pcs			1pc
C(Yageo)	8pcs			2pcs
D(Samsung)	9pcs		1pc	

Sample (1608-2)	OK (20mm bend)	NG (Over limit)	N/A (Damaged)	No result (Stop test)
A(Walsin)	5pcs			5pcs
B(村田)	3pcs	1pc		6pcs
C(Yageo)	7pcs			3pcs
D(Samsung)		3pcs	2pcs	5pcs

[全てのメーカー製品で不合格が発生]

[全てのメーカー製品で試験停止等が発生]

[全てのメーカー製品で試験停止が発生]

この試験では全てのメーカー製品で問題がある事が解ります。KETIの試験のやり方に問題があったとも推測できます。通常、試験停止/試料ダメージは頻繁には発生しない事より試験方法の不備が考えられます。

一方、今回の試験方法 (JEITA ET-7409) は基板に圧力を掛けて20mm折り曲げるという厳しいものです。基板材質はFR4等のガラス系製品が主流となっている今日に於いては、規格の見直しが必要です。よって、セットメーカーの多くでは”基板曲げを段階的に行い”どこまで耐えられるか実力試験を行っています (次ページ参照)。

KETI試験結果の考察

試験方法:

JEITA ET-7409/104 に準じて実施する。JEITA ET-7409/104 に準拠する試験機器を用いて基板を折り曲げるように加重を加える。この時、静電容量を2秒毎に測定し、静電容量が±10%以上に変化した加重を調べる。加重を加える速度は10mm/minとし、曲げ量が最大で20mm 達するまで加重を加えることとする。

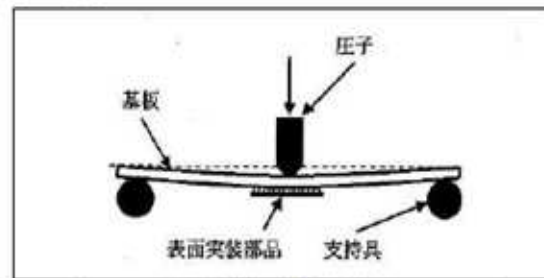
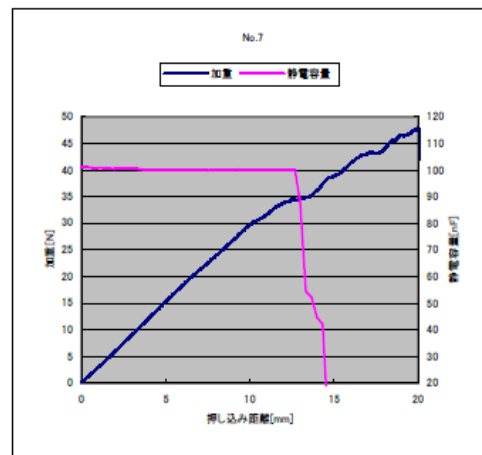
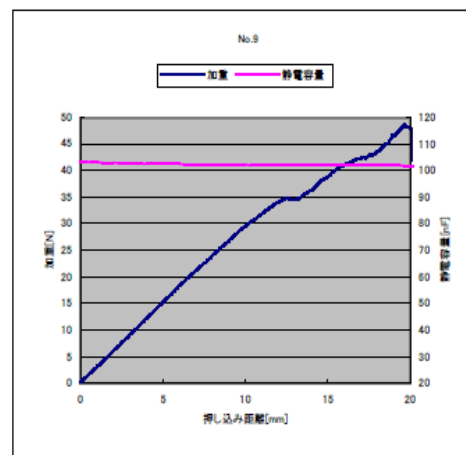


図2 限界曲げ試験イメージ



〔14mm曲げて断線〕



〔20mmまで問題なし〕

〈現在の一般的試験方法〉

- 2mmステップ程度で段階的に加圧していき容量値の変化を測定する
- 断線又は容量値が規格オーバーした段階の基板曲げ距離を測定する
- その結果より、試料の実力値を判定する