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Date: July 2011

Sub: **AEC-Q200** Testing Data

**Automotive Electronics Council**  
Stress Test Qualification For Passive Components

Table 3 - Test Methods Referenced Aluminum Electrolytic Capacitors  
Grade **1**: -40°C to +125°C

Component: ALUMINUM ELECTROLYTIC CAPACITOR

NIC Components PN: NATT471M35V12.5X14KLBYP

DESC: 470uF @ 35VDC, 12.5mm X 14mm Size

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**Aluminum Electrolytic Capacitors**  
For automotive equipment

### Environmental Test Summary

SUPPLIER ; Nippon Industries Co., Ltd.		USER PART NUMBER ;			
NAME OF LABORATORY ; QA & Engineering Lab.		PART NAME / SUPPLIER PART NUMBER ; ALUMINUM ELECTROLYTIC CAPACITOR / NATT471M35V12.5X14KLBIF			
AEC Q200 Test No.	Description	Test Condition	# Lots Tested	Q'ty Tested	Number Failed
3	High Temperature Exposure (Storage)	1000hrs. at 125°C	1	80	0
4	Temperature Cycling	-40°C × 30min ← → +125°C × 30min 1000 cycles	1	80	0
6	Moisture Resistance	MIL-STD-202 Method 202	1	80	0
7	Biased Humidity	1000hrs. at 85°C/85%RH Rated voltage	1	80	0
8	Operational Life	2000hrs. at 125°C Rated voltage	1	80	0
10	Physical Dimension	Per spec.	1	30	0
12	Resistance to Solvents	MIL-STD-202 Method 215	1	5	0
13	Mechanical Shock	MIL-STD-202 Method 213	1	30	0
14	Vibration	5G 20min 12 cycles, 3 directions (X, Y, Z)	1	30	0
15	Resistance to Soldering Heat	MIL-STD-202 Method 210	1	30	0
16	Thermal Shock	-55°C × 15min ← → +125°C × 15min. 300 cycles	1	30	0
17	ESD	AEC-Q200-002	1	15	0
18	Solderability	J-STD-002B	1	15	0
19	Electrical Characterization	Per spec.	3	90	0
20	Flammability	UL-94-V-0	-	-	-
21	Board Flex	AEC-Q200-005	1	30	0
22	Terminal Strength (SMD)	AEC-Q200-006	1	30	0
27	Surge Voltage	AEC-Q200-007	1	30	0

ITEM

High Temperature Exposure (Storage)

P.3

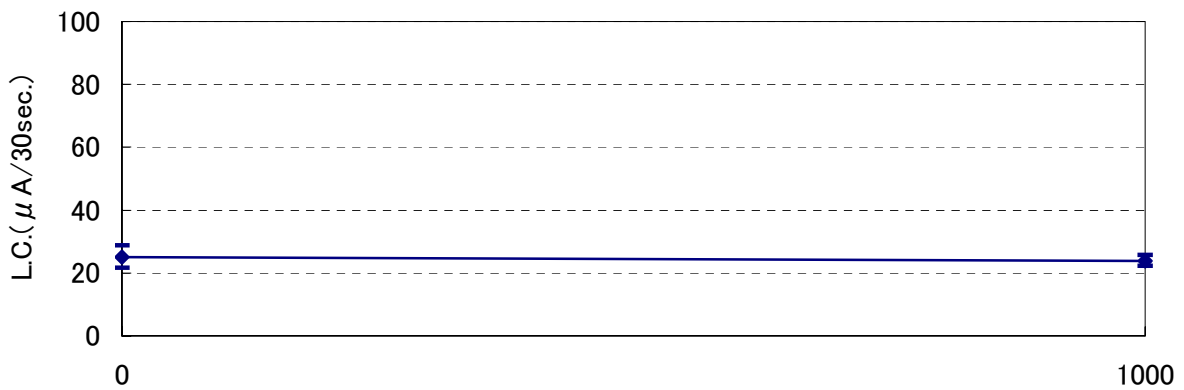
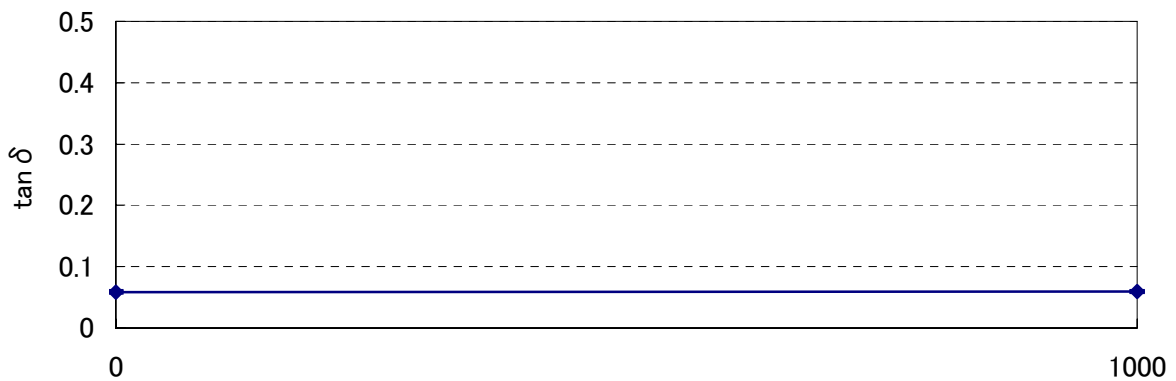
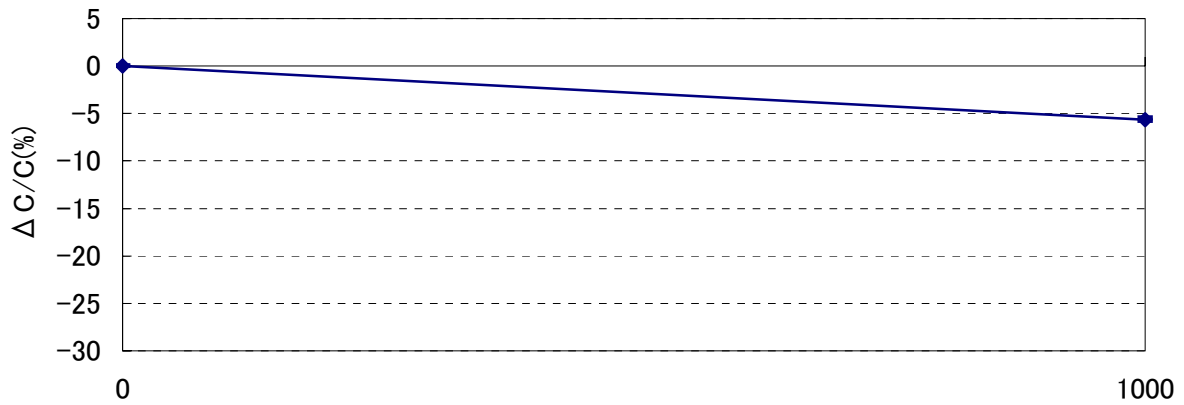
TEST CONDITION

1000 hours at 125°C with no voltage applied.

The rated voltage applied for 1 hour after the test.

MODEL No. : NATT471M35V12.5X14KLBYF

n = 80 pcs.



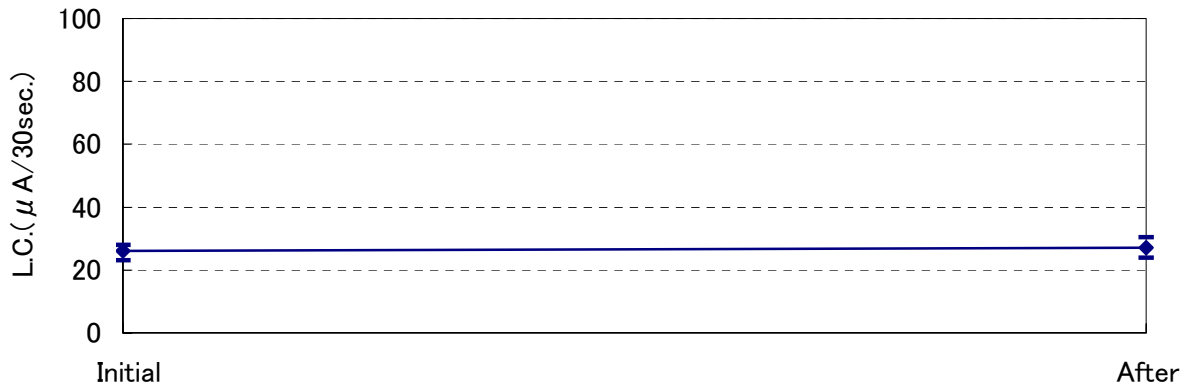
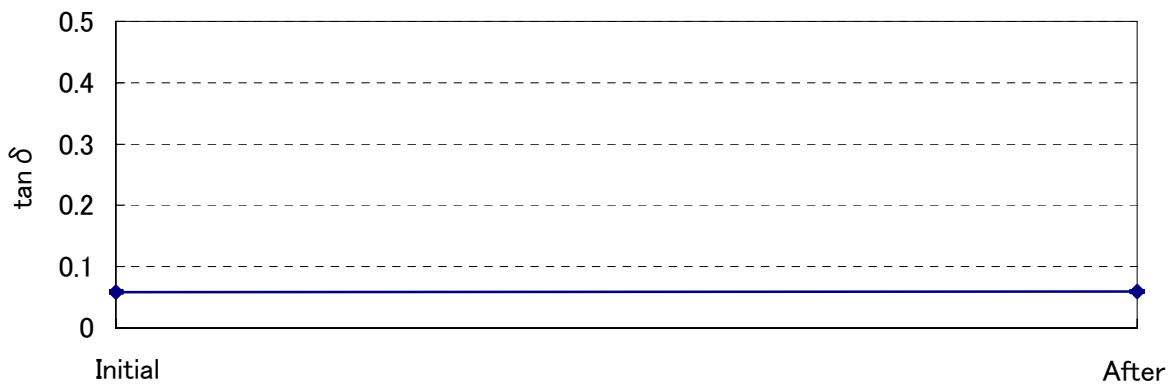
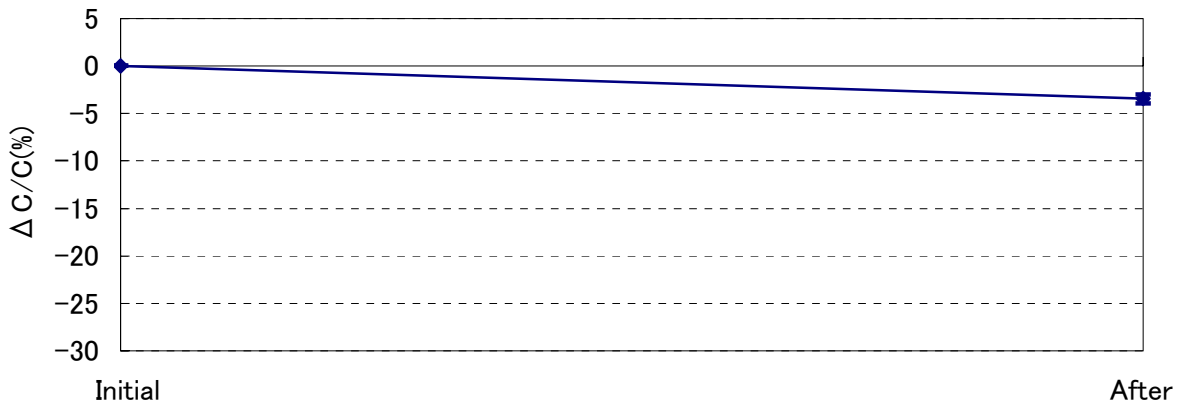
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Temperature Cycling	P.4
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**TEST CONDITION**

-40°C × 30min ← → +125°C × 30min  
Number of cycles : 1000 cycles

MODEL No. : NATT471M35V12.5X14KLBYF      n = 80 pcs.



Appearance : No remarkable abnormality.  
Judgment : Passed.

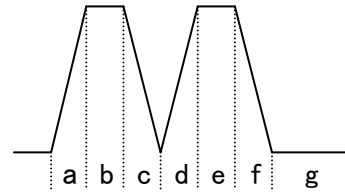
ITEM

Moisture Resistance

P.5

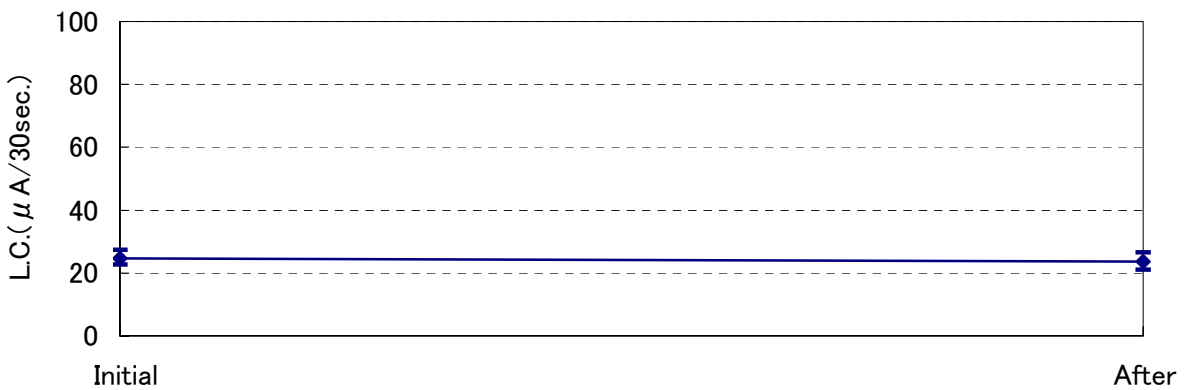
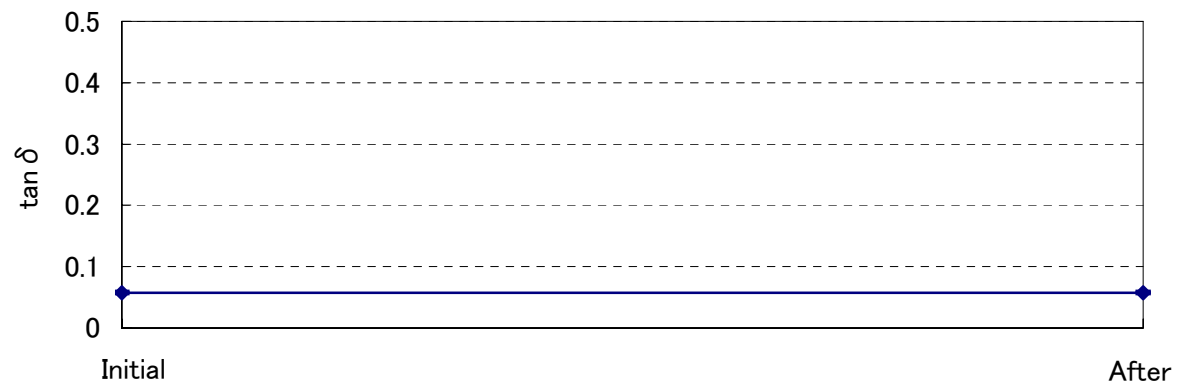
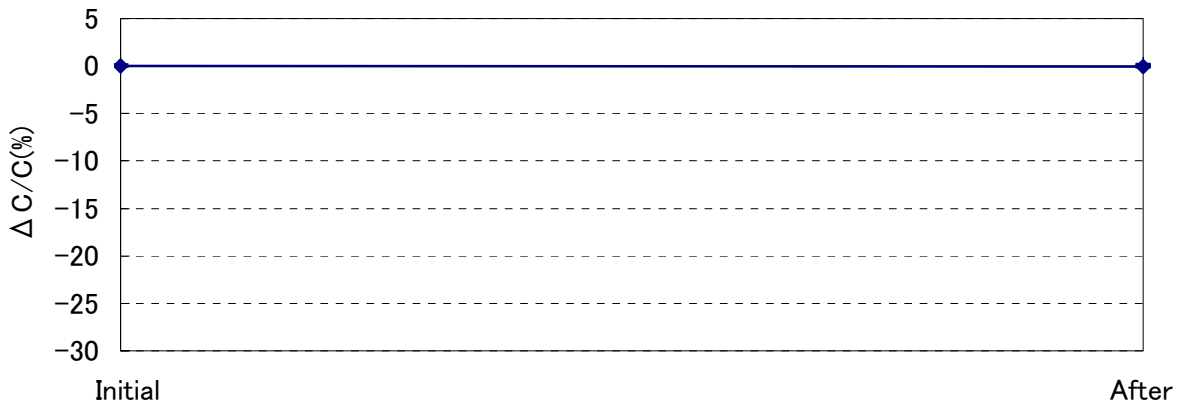
TEST CONDITION

Step	Temp.(°C)	Humidity (%)	Time (hrs)
a, d	25 → 65	95	2.5
b, e	65	95	3
c, f	65 → 25	95	2.5
g	25	95	8



Number of cycles : 10 cycles

MODEL No. : NATT471M35V12.5X14KLBYF n = 80 pcs.



Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM

Biased Humidity

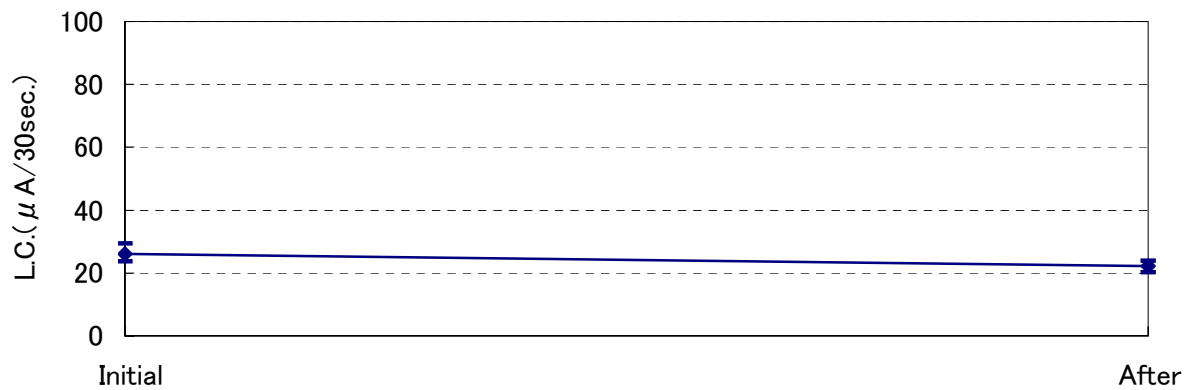
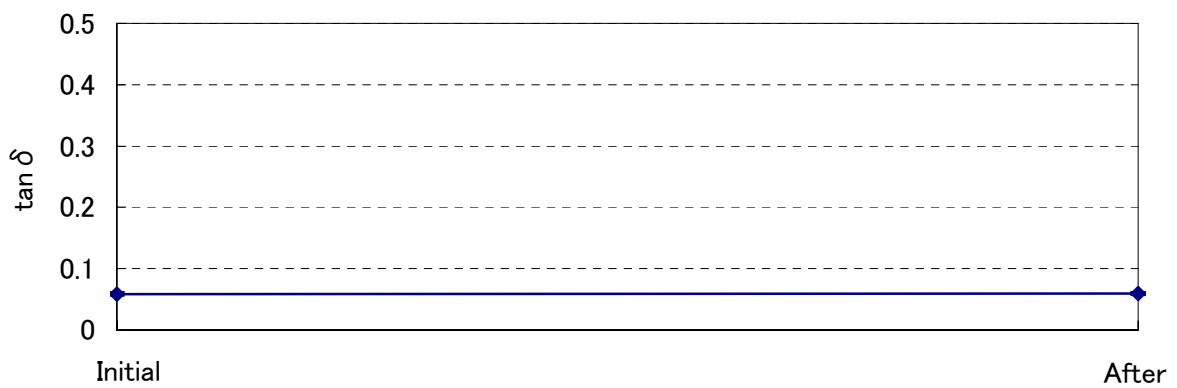
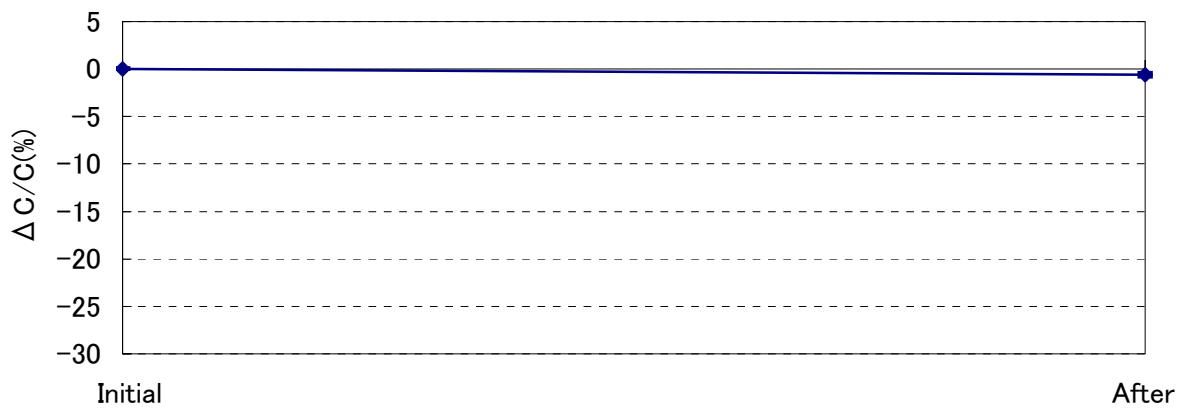
P.6

TEST CONDITION

1000 hours at 85°C with the rated voltage applied.

Humidity ; 85% RH

MODEL No. : NATT471M35V12.5X14KLBYF      n = 80 pcs.



Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM

Operational Life

P.7

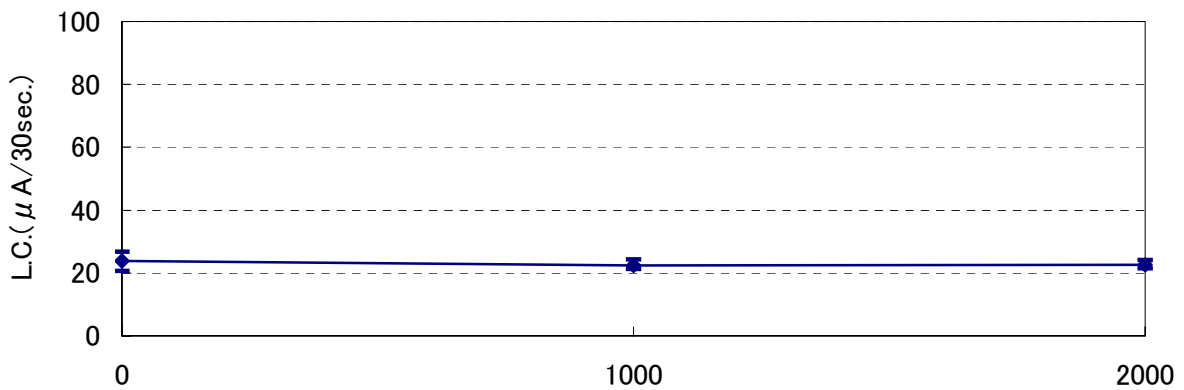
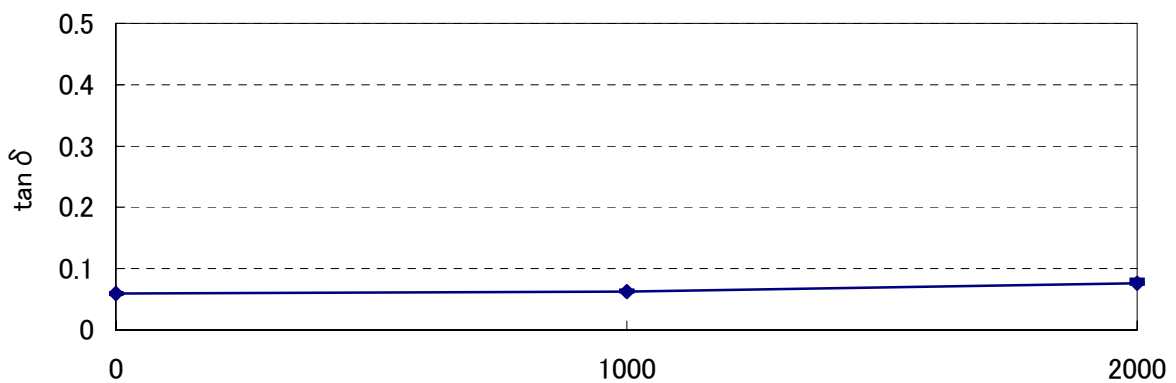
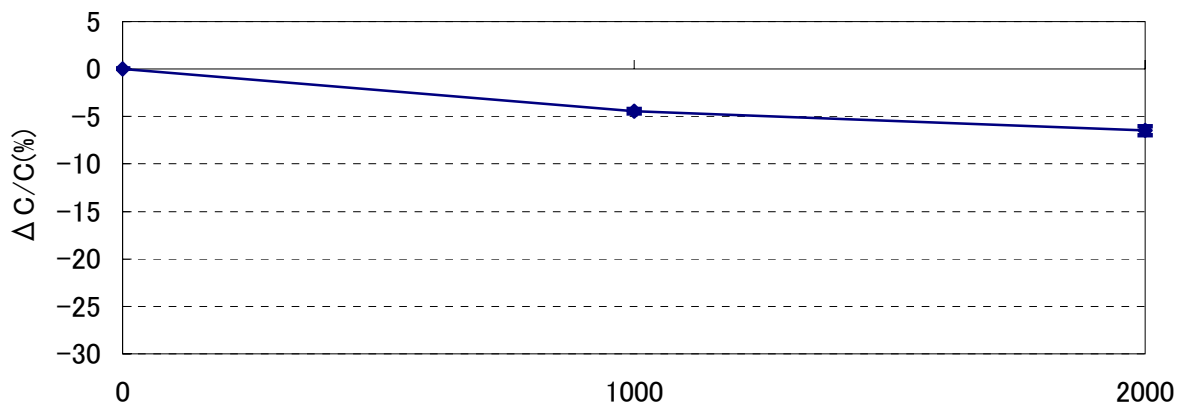
TEST CONDITION

2000 hours at 125°C with the rated voltage applied.

Ripple current : 550mA/100kHz

MODEL No. : NATT471M35V12.5X14KLBYF

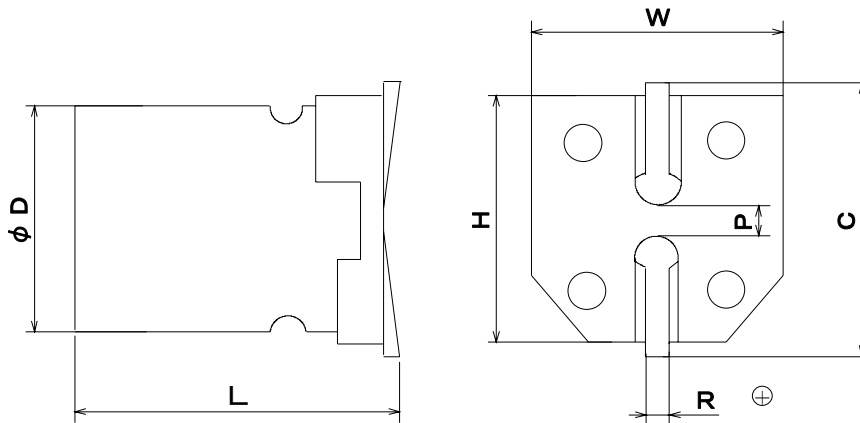
n = 80 pcs.



Appearance : No remarkable abnormality.

Judgment : Passed.

ITEM	Physical Dimension	P.8
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MODEL No. : NATT471M35V12.5X14KLBYF

unit : mm

	$\phi D$	L	W	H	C	R	P
1	12.47	13.45	12.81	12.82	13.51	1.22	4.70
2	12.46	13.45	12.82	12.82	13.51	1.22	4.70
3	12.46	13.47	12.80	12.81	13.53	1.22	4.70
4	12.47	13.47	12.81	12.82	13.53	1.23	4.72
5	12.45	13.46	12.82	12.81	13.53	1.22	4.70
6	12.46	13.46	12.82	12.81	13.52	1.22	4.72
7	12.46	13.47	12.80	12.81	13.52	1.23	4.71
8	12.45	13.46	12.82	12.81	13.53	1.22	4.71
9	12.47	13.46	12.81	12.81	13.52	1.23	4.72
10	12.46	13.46	12.81	12.82	13.51	1.21	4.71
11	12.47	13.46	12.82	12.82	13.51	1.21	4.71
12	12.47	13.46	12.81	12.81	13.51	1.22	4.71
13	12.45	13.47	12.81	12.81	13.51	1.22	4.70
14	12.45	13.46	12.82	12.81	13.52	1.22	4.72
15	12.46	13.45	12.82	12.82	13.53	1.22	4.70
16	12.47	13.46	12.81	12.80	13.52	1.21	4.70
17	12.46	13.46	12.81	12.82	13.53	1.22	4.71
18	12.46	13.46	12.81	12.82	13.52	1.22	4.70
19	12.46	13.46	12.81	12.81	13.51	1.23	4.72
20	12.47	13.46	12.81	12.81	13.52	1.22	4.70
21	12.46	13.47	12.80	12.81	13.53	1.22	4.70
22	12.45	13.46	12.81	12.81	13.51	1.21	4.71
23	12.46	13.46	12.81	12.80	13.53	1.21	4.71
24	12.46	13.46	12.81	12.82	13.53	1.23	4.70
25	12.46	13.46	12.81	12.82	13.52	1.21	4.70
26	12.46	13.45	12.82	12.82	13.51	1.23	4.70
27	12.46	13.45	12.81	12.81	13.52	1.22	4.71
28	12.46	13.46	12.81	12.81	13.51	1.21	4.70
29	12.46	13.45	12.80	12.81	13.51	1.22	4.72
30	12.45	13.45	12.81	12.81	13.51	1.21	4.72
$\bar{X}$	12.46	13.46	12.81	12.81	13.52	1.22	4.71

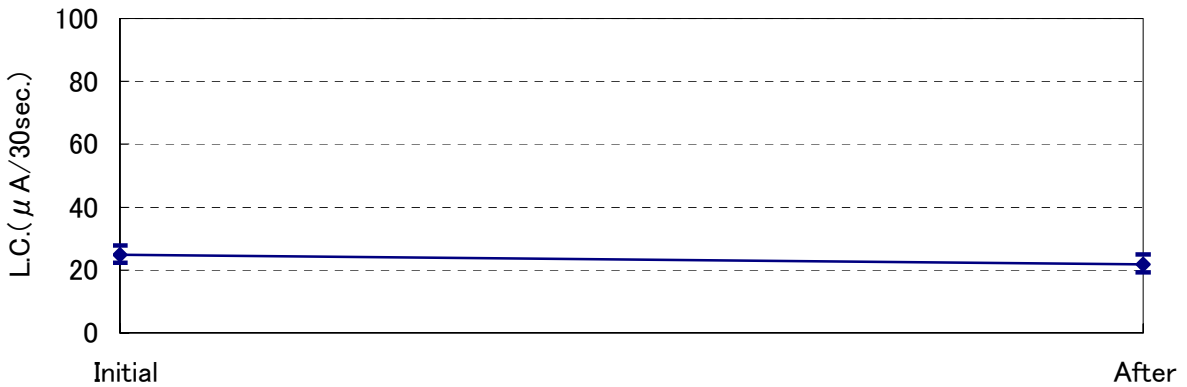
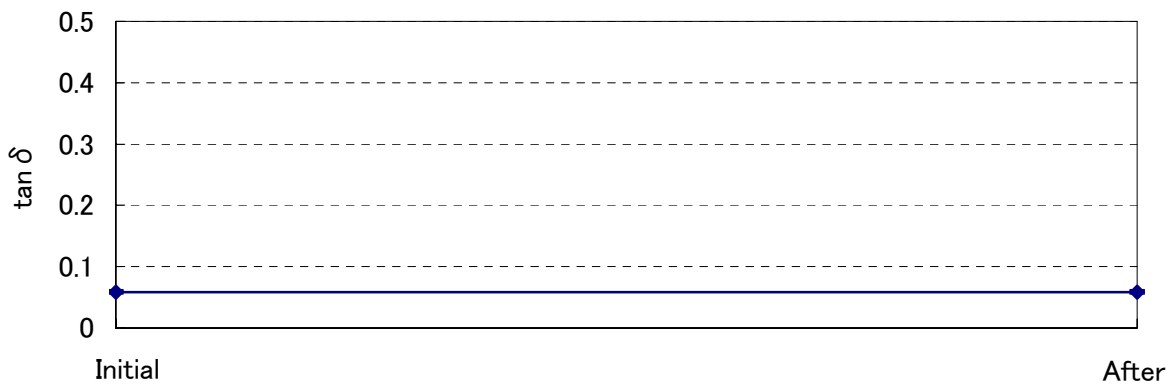
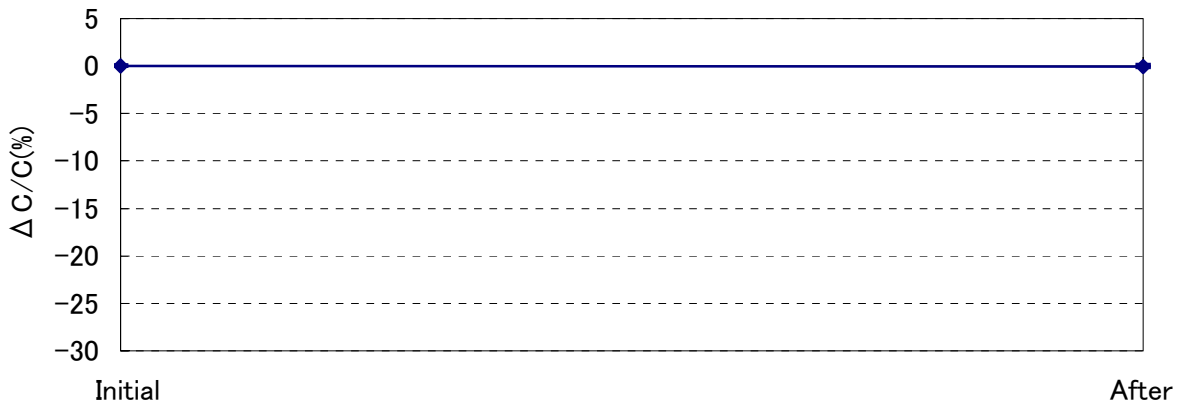
ITEM	Resistance to Solvents	P.9
<p>TEST CONDITION :</p> <p>Dipped in the solvent at 20 to 25°C. Solvent ; Isopropyl alcohol Dipping time ; 3 min.</p> <p>APPERANCE :</p> <p>No significant change observed. The marking was legible.</p> <p>TEST MODEL :</p> <p>NATT471M35V12.5X14KLBYF      n = 5pcs.</p> <p>RESULT :</p> <p>All samples met the specified standard.</p>		

ITEM	Mechanical Shock	P.10
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**TEST CONDITION**

Peak acceleration : 1000 m/s<sup>2</sup> (100G)  
 Duration of a pulse ; 6 ms  
 Pulse shape ; half-sine  
 Number of shocks ; X-X', Y-Y', Z-Z' 6 directions × 3 times  
 → Total 18 times

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	Vibration	P.11
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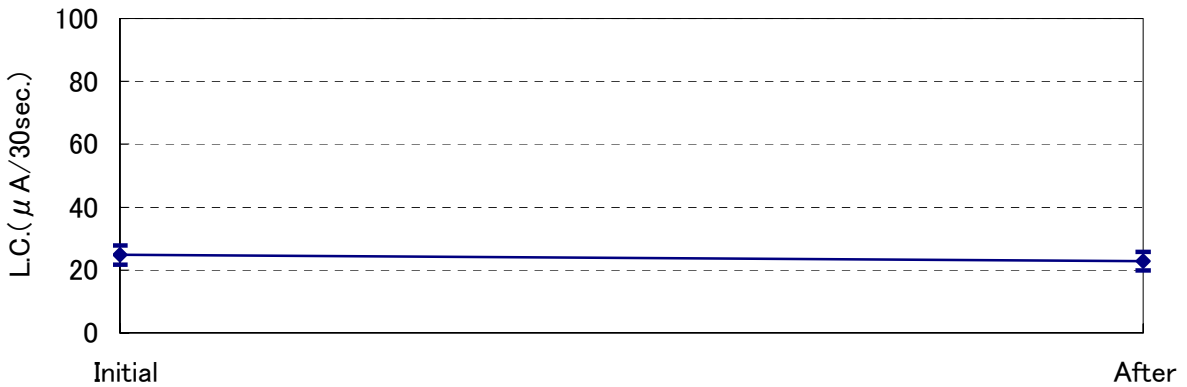
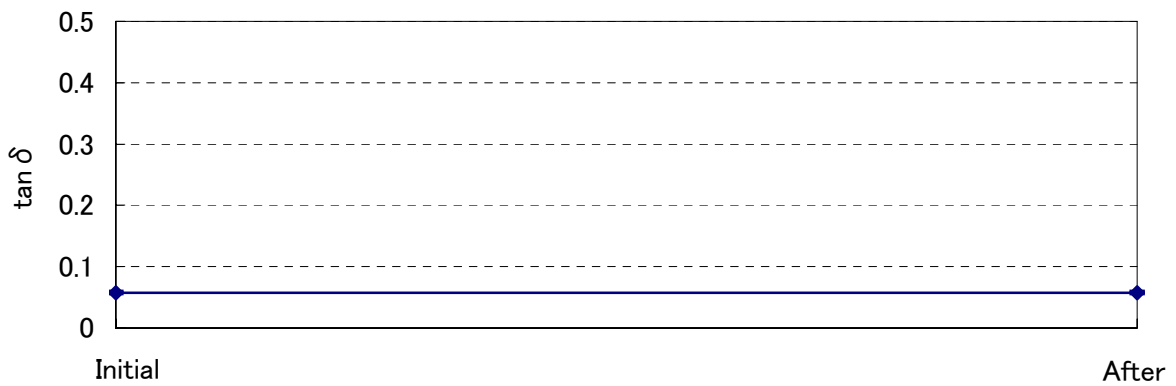
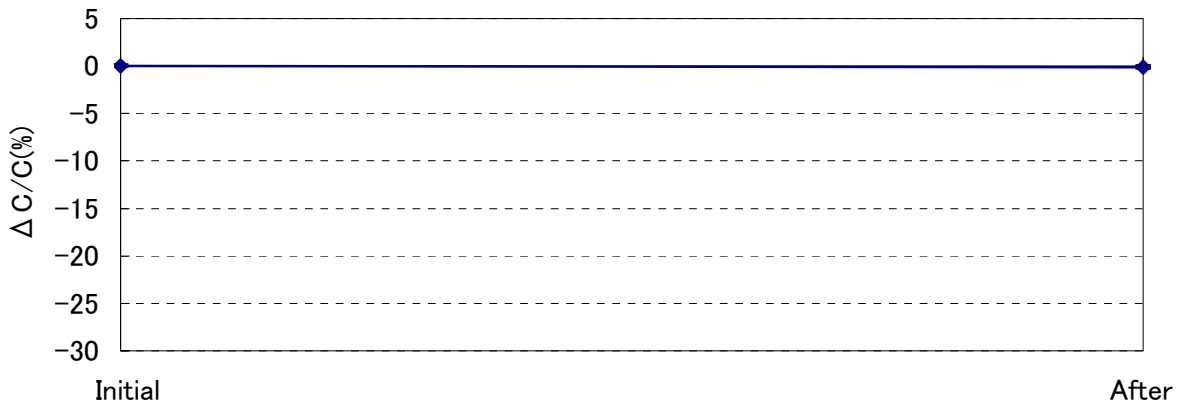
**TEST CONDITION**

Direction and duration of vibration ; 3 orthogonal directions mutually each for 4h. Total 12h.

Frequency ; 10 to 2000 Hz

Acceleration ; 5G

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



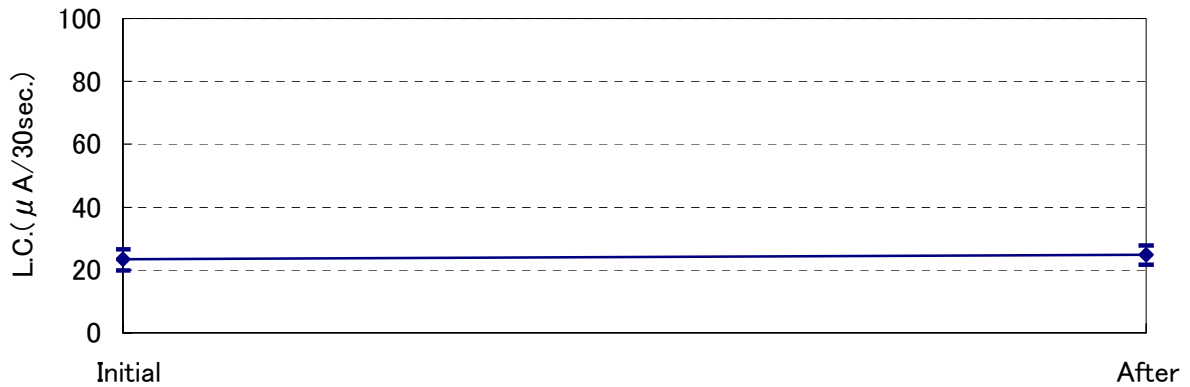
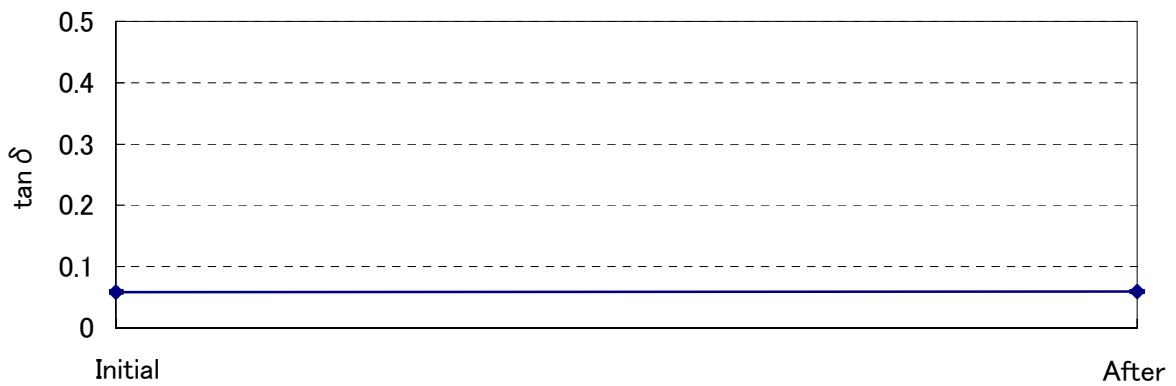
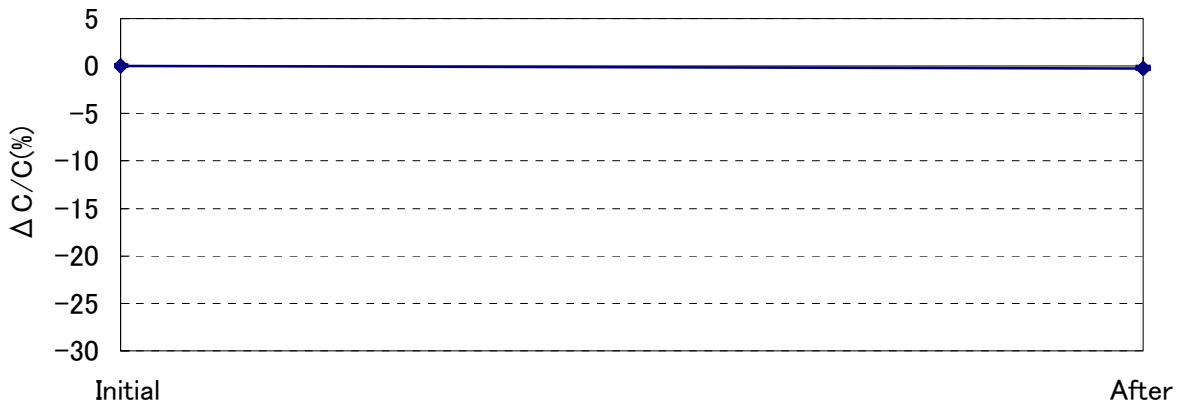
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Resistance to Soldering Heat	P.12
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TEST CONDITION

Vapor phase reflow ;  $215 \pm 5 \text{ } ^\circ\text{C} \times 60 \pm 5 \text{ sec.}$

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



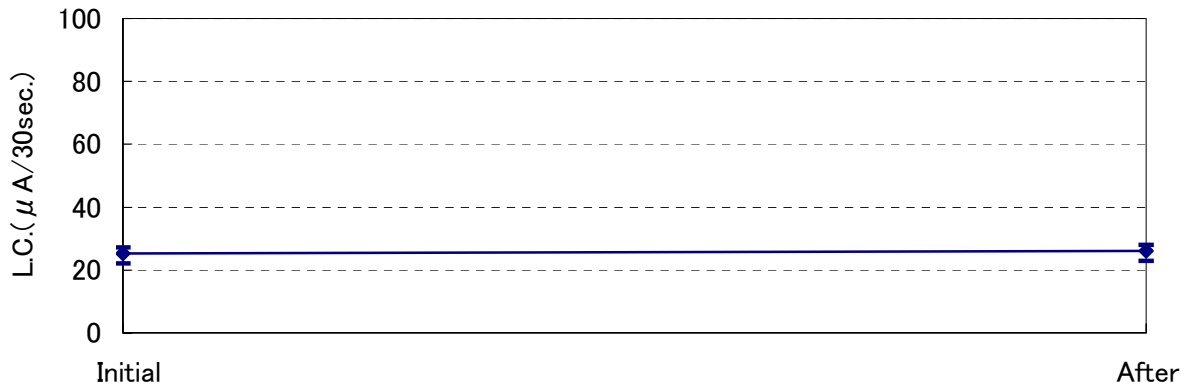
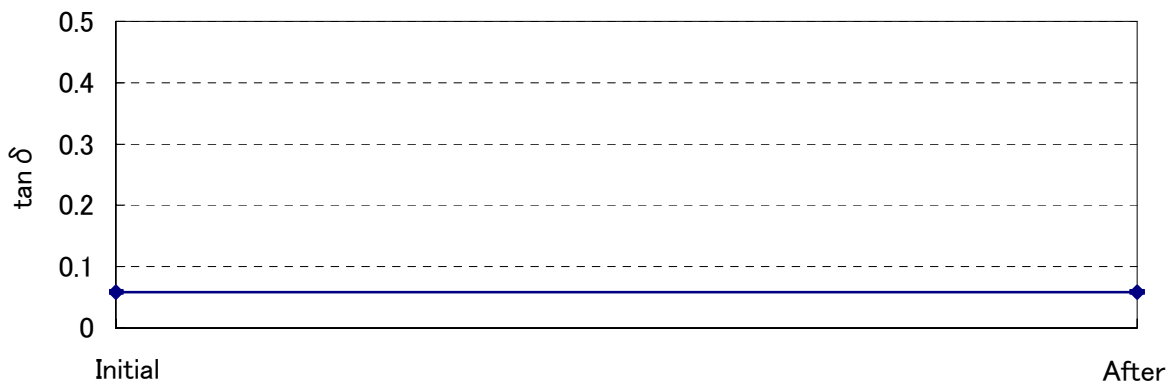
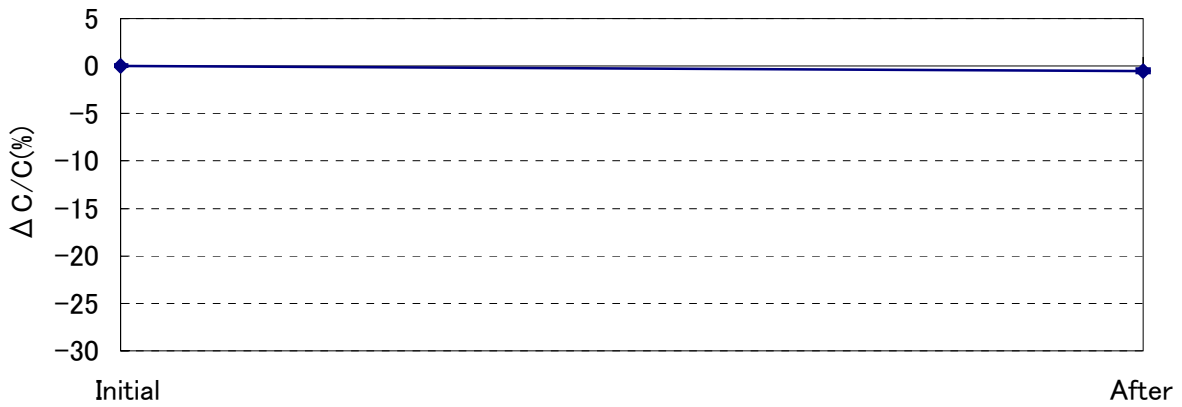
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Thermal Shock	P.13
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**TEST CONDITION**

-55°C × 15min ← → +125°C × 15min.  
 Maximum transfer time : 20 seconds  
 Number of cycles : 300 cycles

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	ESD	P.14
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TEST CONDITION :  
As specified in AEC-Q200 REV C

TEST MODEL :  
NATT471M35V12.5X14KLBYF      n = 15pcs.

RESULT :

±500V	±1kV	±2kV	±4kV	±6kV	±8kV	±12kV	±16kV	±25kV
OK	OK	OK	OK	OK	OK	OK	OK	OK

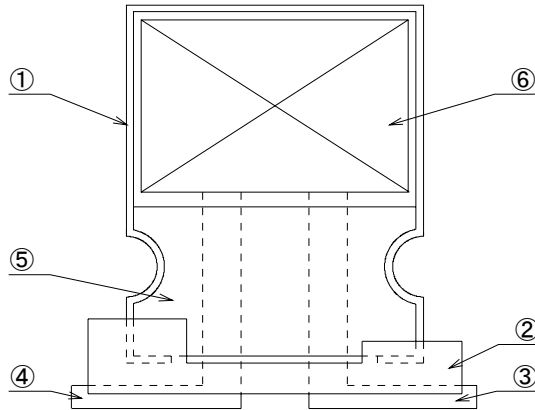
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Solderability	P.15
<p>TEST CONDITION :</p> <ol style="list-style-type: none"><li>1) Solder : Sn-37Pb</li><li>2) Flux : Ethanol solution of rosin (Rosin weight ratio : 25%)</li><li>3) Pretreatment : Pressure Cooker Test 105°C 100% <math>1.22 \times 10^5</math>Pa 4hour</li><li>4) Condition of solder dip The terminals of capacitor are dipped in flux for 5 to 10 seconds after treatment. Afterwards, the capacitor is dipped in a solder bath.<ul style="list-style-type: none"><li>▪ Temperature of solder : <math>235 \pm 2^\circ\text{C}</math></li><li>▪ Dipping depth : 0.20 ~ 0.25 mm</li><li>▪ Dipping time : <math>2 \pm 0.5</math> sec</li><li>▪ Dipping speed and pulling up speed : 25mm/sec.</li></ul></li></ol> <p>EVALUATION CRITERIA :</p> <p>95% of the surface of lead wire must be covered with the dipped solder.</p> <p>TEST MODEL :</p> <p>NATT471M35V12.5X14KLBYF      n = 15pcs.</p> <p>RESULT :</p> <p>All samples met the specified standards.</p>		

MODEL No. NATT471M35V12.5X14KLBIF

No.	Lot.No.(08189W8)			Lot.No.(0D229W8)			Lot.No.(11239W8)		
	Cap. ( $\mu$ F)	tan $\delta$	L.C. ( $\mu$ A/30s)	Cap. ( $\mu$ F)	tan $\delta$	L.C. ( $\mu$ A/30s)	Cap. ( $\mu$ F)	tan $\delta$	L.C. ( $\mu$ A/30s)
1	459.7	0.059	23.51	468.4	0.057	25.51	469.0	0.056	23.33
2	461.2	0.059	24.82	470.0	0.056	24.55	468.5	0.057	24.64
3	456.7	0.057	24.60	469.4	0.058	25.23	471.3	0.057	24.61
4	458.3	0.058	23.51	467.1	0.056	26.40	470.0	0.058	24.93
5	458.3	0.058	26.71	465.5	0.058	25.17	471.9	0.057	25.08
6	457.1	0.058	25.40	466.0	0.060	26.80	468.1	0.057	24.95
7	460.8	0.059	25.40	468.5	0.057	25.99	469.0	0.056	24.94
8	456.4	0.058	23.12	469.9	0.057	26.10	468.3	0.057	24.83
9	457.5	0.057	25.58	467.1	0.058	24.98	468.8	0.057	22.70
10	461.2	0.059	23.46	469.8	0.056	26.20	467.1	0.057	23.79
11	457.2	0.057	21.65	468.0	0.059	25.30	468.2	0.056	25.51
12	461.7	0.058	23.15	471.6	0.055	25.32	469.5	0.056	27.23
13	458.2	0.059	24.96	468.4	0.058	27.00	471.8	0.057	23.40
14	455.8	0.057	25.84	469.3	0.058	26.59	468.6	0.057	26.99
15	461.0	0.059	24.50	469.8	0.057	25.99	471.7	0.057	26.79
16	459.3	0.059	22.90	468.6	0.058	26.40	467.8	0.057	25.11
17	460.3	0.059	23.55	469.4	0.058	26.42	468.7	0.057	26.72
18	459.2	0.058	23.27	471.0	0.055	25.13	469.8	0.056	24.10
19	461.0	0.059	23.16	468.2	0.059	26.97	468.0	0.056	24.12
20	460.4	0.058	25.42	468.8	0.058	25.92	471.8	0.056	23.10
21	462.0	0.059	24.32	469.5	0.056	24.17	467.3	0.056	24.22
22	459.7	0.059	23.56	470.8	0.054	23.82	468.4	0.057	24.16
23	458.7	0.058	25.75	470.5	0.056	23.54	469.6	0.057	23.43
24	458.9	0.058	21.00	470.1	0.055	23.70	469.5	0.058	24.68
25	460.3	0.059	26.10	468.8	0.055	24.29	468.7	0.058	24.66
26	457.6	0.057	23.78	468.5	0.055	23.42	469.1	0.058	25.24
27	456.5	0.058	20.55	472.2	0.056	24.14	468.5	0.057	24.25
28	460.2	0.059	28.64	470.8	0.056	24.64	467.4	0.058	25.04
29	461.6	0.059	25.89	472.4	0.056	24.59	471.0	0.058	24.10
30	456.3	0.059	23.89	468.7	0.056	23.14	473.4	0.057	24.32
$\bar{X}$	459.1	0.058	24.27	469.2	0.057	25.25	469.4	0.057	24.70
Max	462.0	0.059	28.64	472.4	0.060	27.00	473.4	0.058	27.23
Min	455.8	0.057	20.55	465.5	0.054	23.14	467.1	0.056	22.70
$3\sigma$	5.5	0.002	5.01	4.8	0.004	3.35	4.7	0.002	3.29

ITEM	Flammability	P.17
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MODEL No. NATT471M35V12.5X14KLBYF

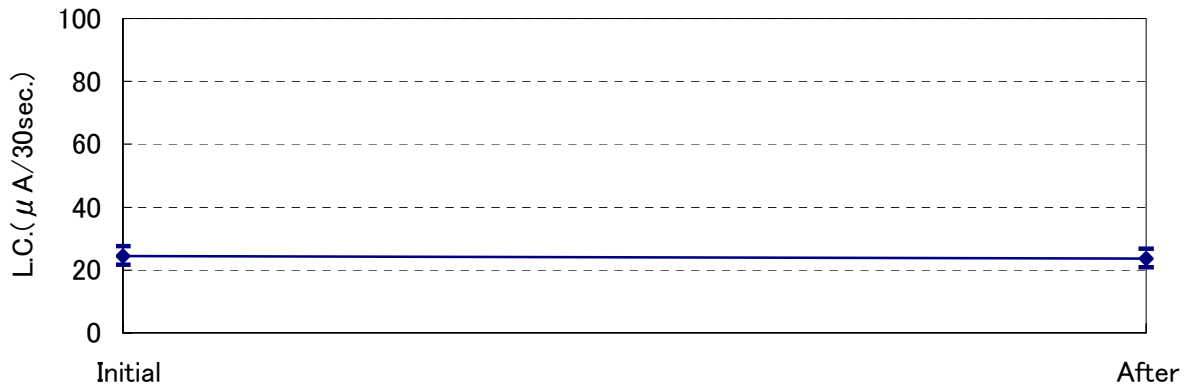
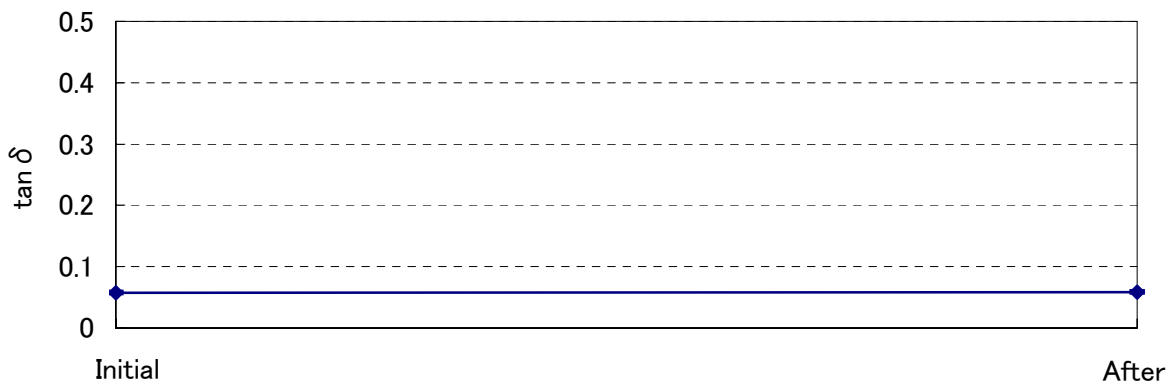
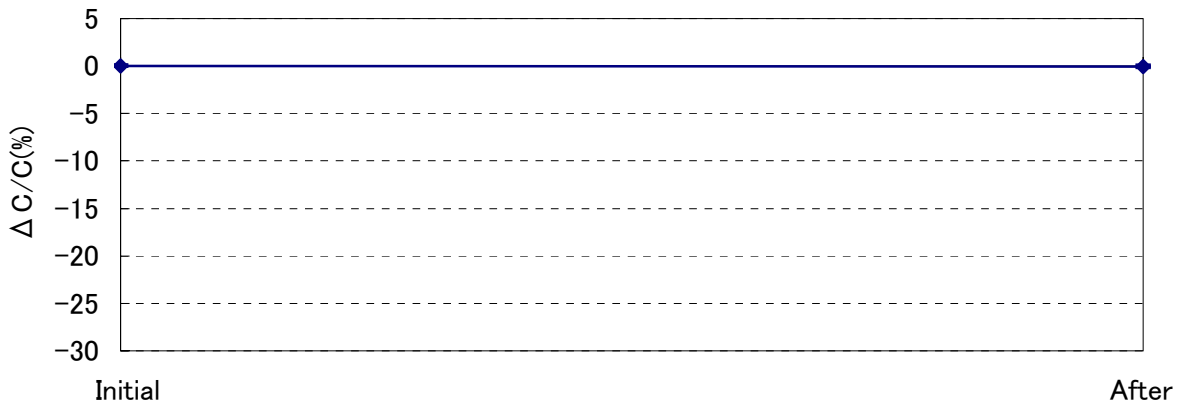
No.	Components	Materials / Treatment	UL Flame Class	UL File No.
1	Case	Aluminum (Plastic coating ; nylon)	-	-
2	Spacer	Thermoplastic resin (PPS)	UL-94-V-0	E53829
3	Terminal (+)	Copper clad steel wire ( Coated with Tin and Bismuth (1%) )	-	-
4	Terminal (-)	Copper clad steel wire ( Coated with Tin and Bismuth (1%) )	-	-
5	Packing	Synthetic rubber	-	-
6	Element	Anode ; Aluminnum foil  Cathode ; Aluminnum foil  Capacitor paper  Electrolyte	-	-

ITEM	Board Flex	P.18
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**TEST CONDITION**

The capacitor mounted on the under side of a circuit board with bending fixture.  
 The capacitor must maintain for 60 seconds after the circuit board is bent  
 by 2mm at 1mm/s.

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



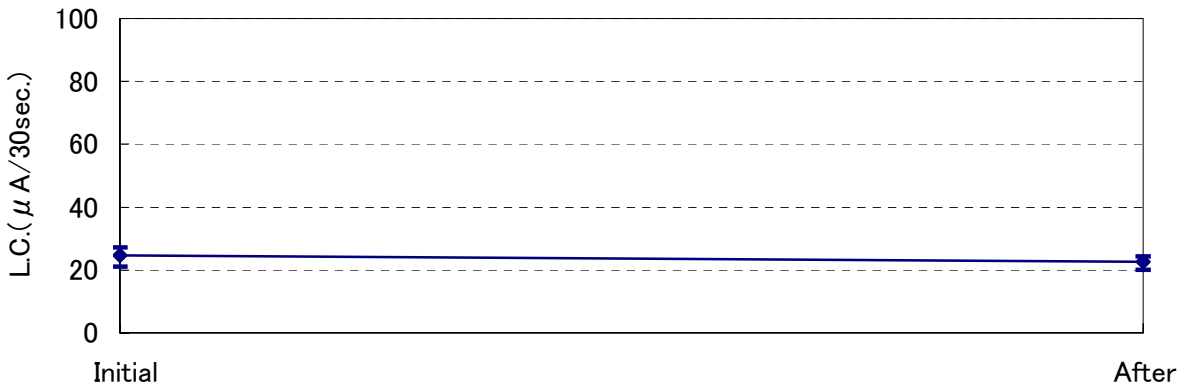
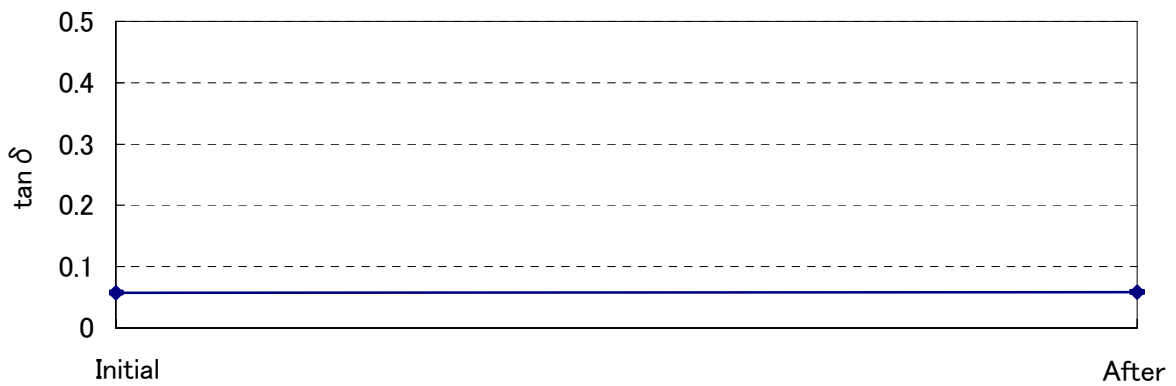
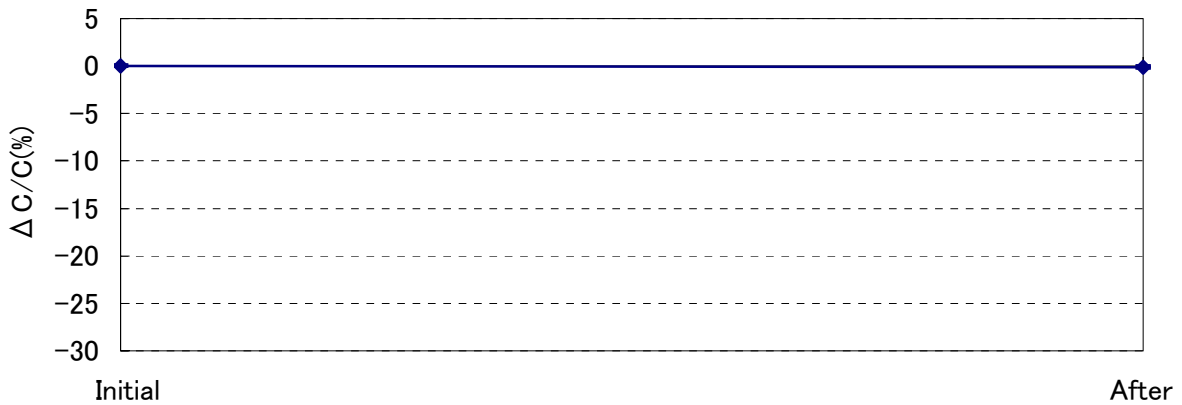
Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	Terminal Strength (SMD)	P.19
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**TEST CONDITION**

The 18N (1.8kg) of horizontal pressure was applied for  $60 \pm 1$  seconds with a press tool.

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



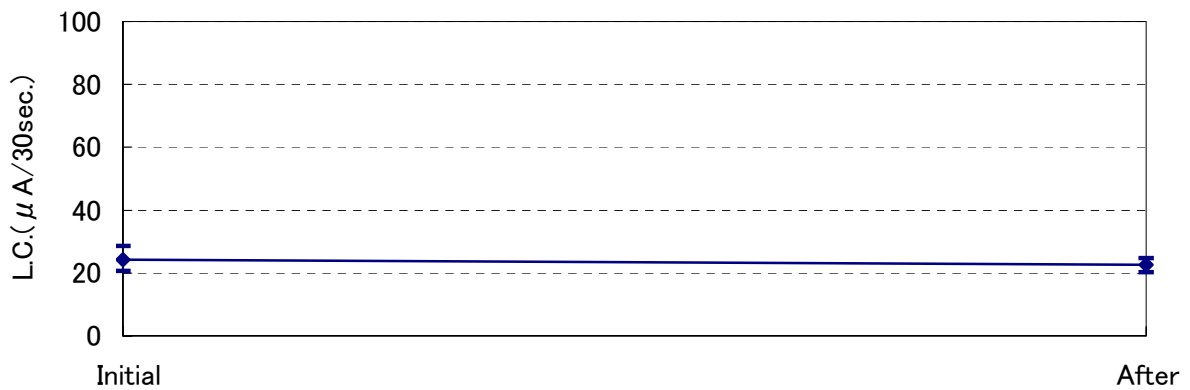
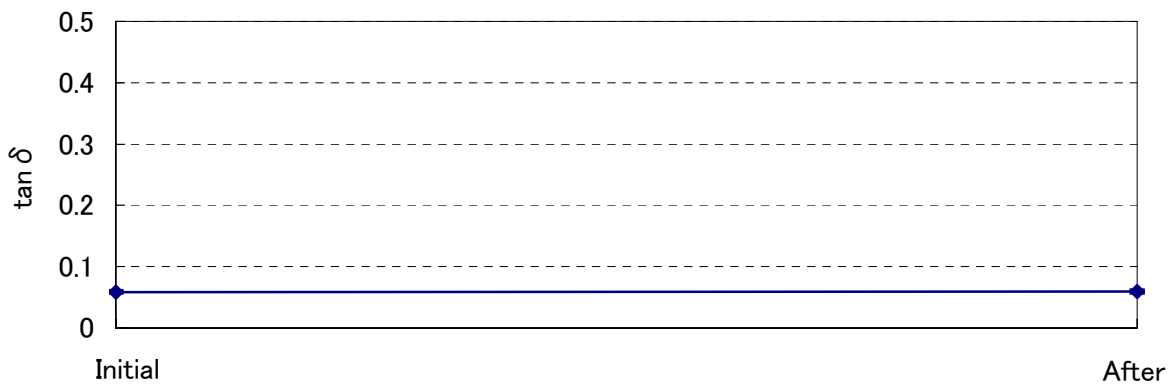
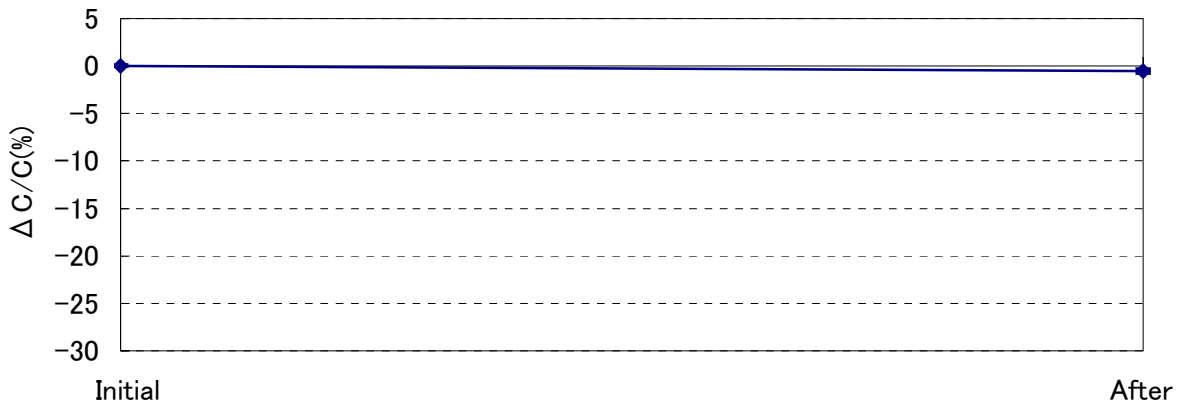
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Surge Voltage	P.20
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**TEST CONDITION**

Surge voltage : 44V  
 Duration: Time on  $30 \pm 5$  seconds / Time off  $6 \pm 0.5$  minutes  
 Number of Cycle : 1000 cycles  
 Test temperature : Room temperature  
 The discharge of surge voltage is made without any designed load.

MODEL No. : NATT471M35V12.5X14KLBYF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.