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Date: October 2009

Sub: **AEC-Q200** Testing Data

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

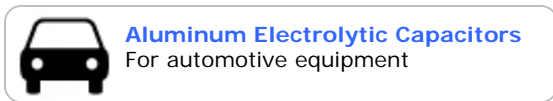
Table 3 - Test Methods Referenced Aluminum Electrolytic Capacitors  
Grade 2: -40°C to +105°C

Component: ALUMINUM ELECTROLYTIC CAPACITOR

NIC Components PN: NACK331M35V10X10.5TR13YF

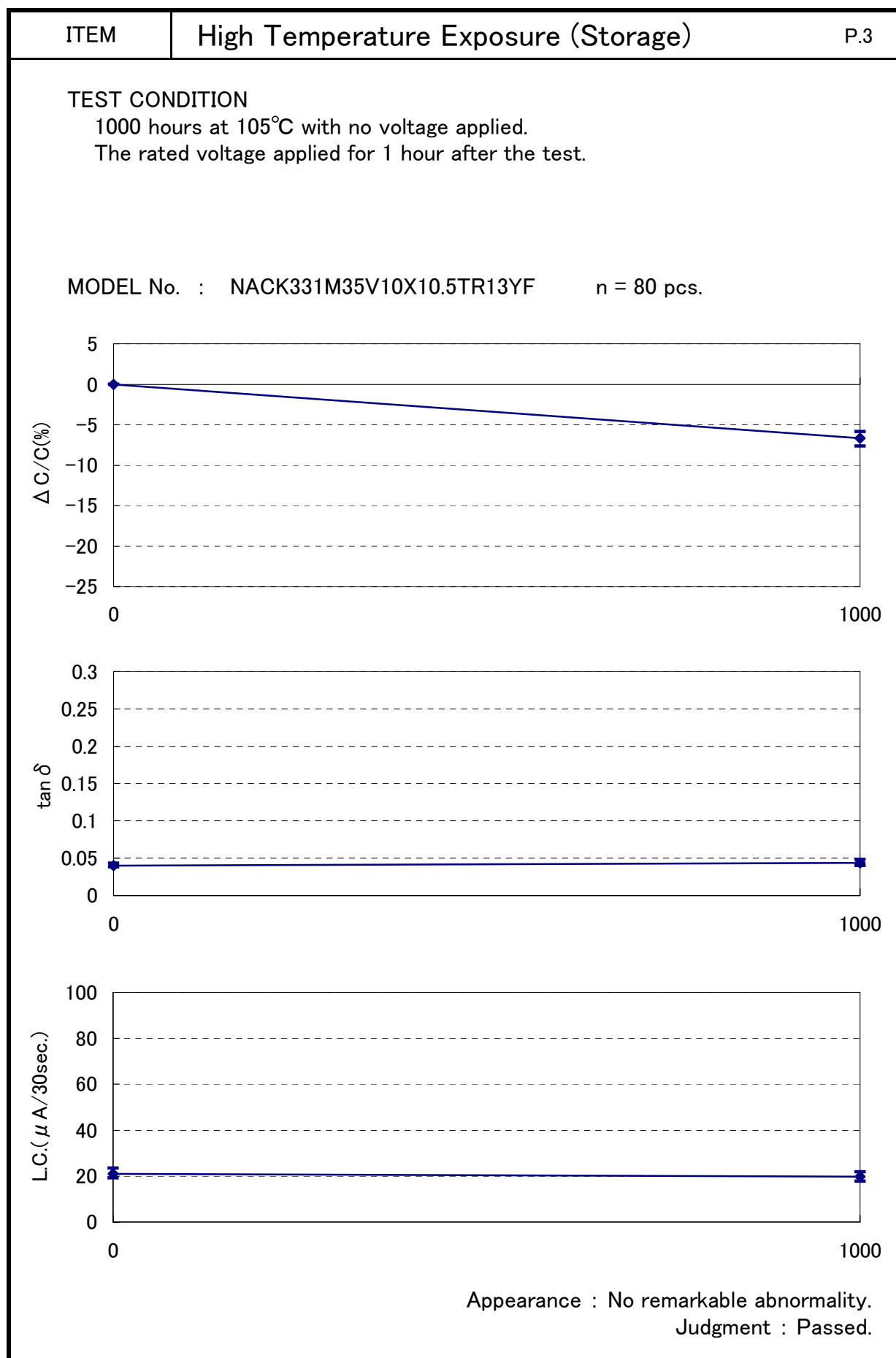
DESC: 330uF @ 35VDC, 10mm X 10.5mm Size

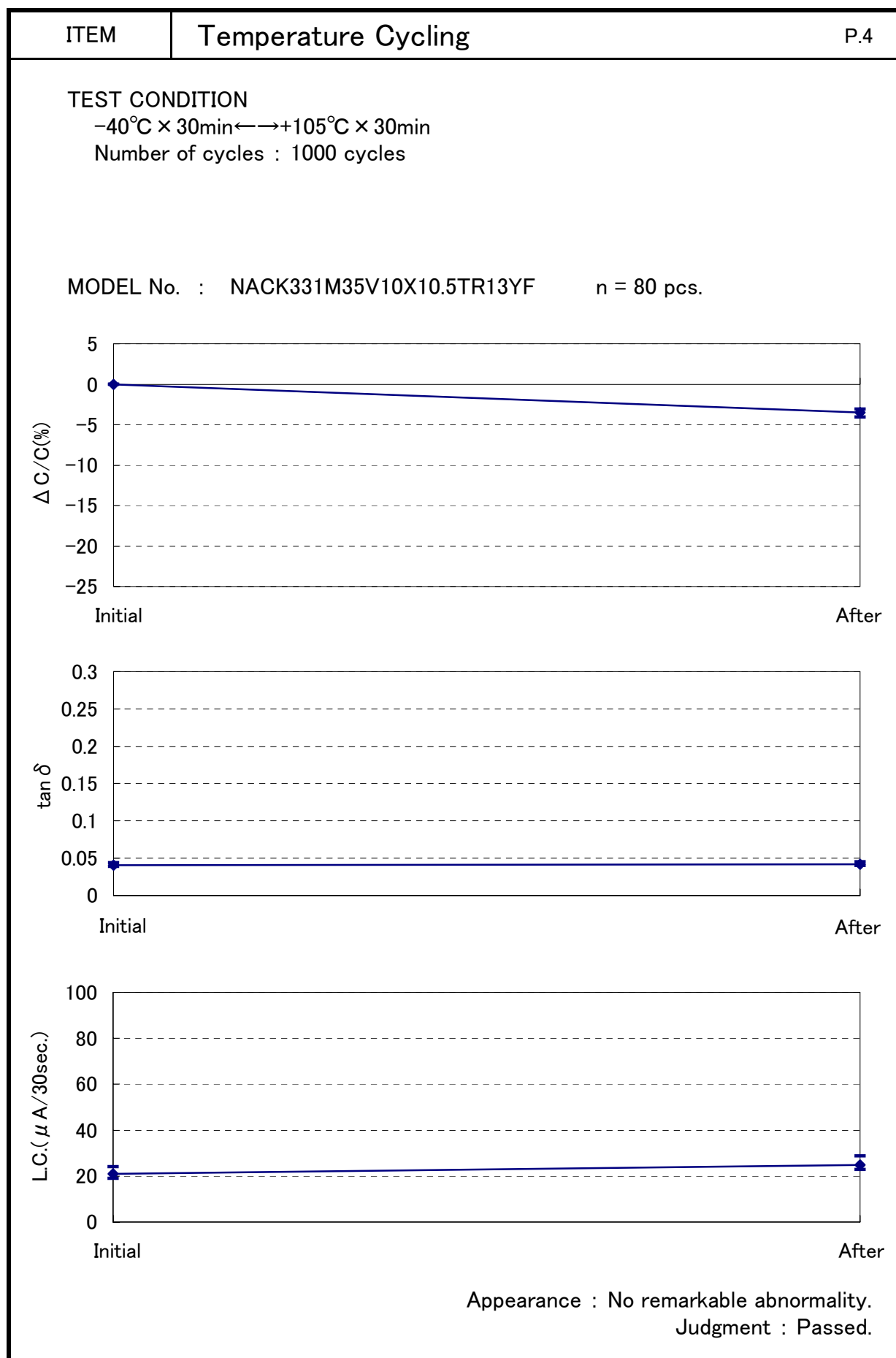
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- Surge Voltage ... Page 20



### Environmental Test Summary

AEC Q200 Test No.		Description	Test Condition	# Lots Tested	Q'ty Tested	Number Failed
SUPPLIER ; Nippon Industries Co., Ltd.			USER PART NUMBER ; NACK331M35V10X10.5TR13YF			
			PART NAME / SUPPLIER PART NUMBER ; ALUMINUM ELECTROLYTIC CAPACITOR /			
3	High Temperature Exposure (Storage)	1000hrs. at 105°C	1	80	0	
4	Temperature Cycling	-40°C × 30min ← → +105°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 105°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 ← → +105°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	

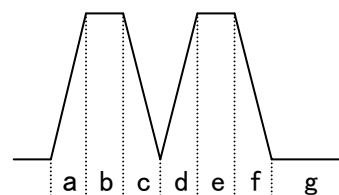




ITEM **Moisture Resistance** P.5

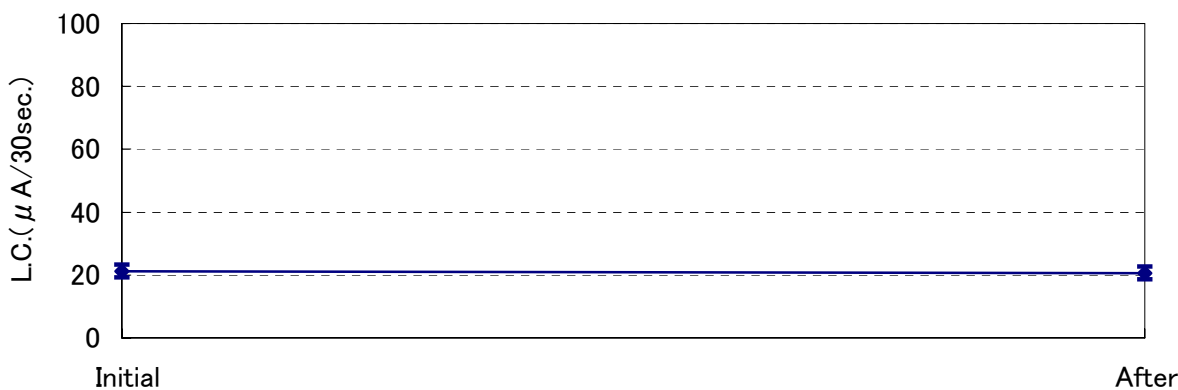
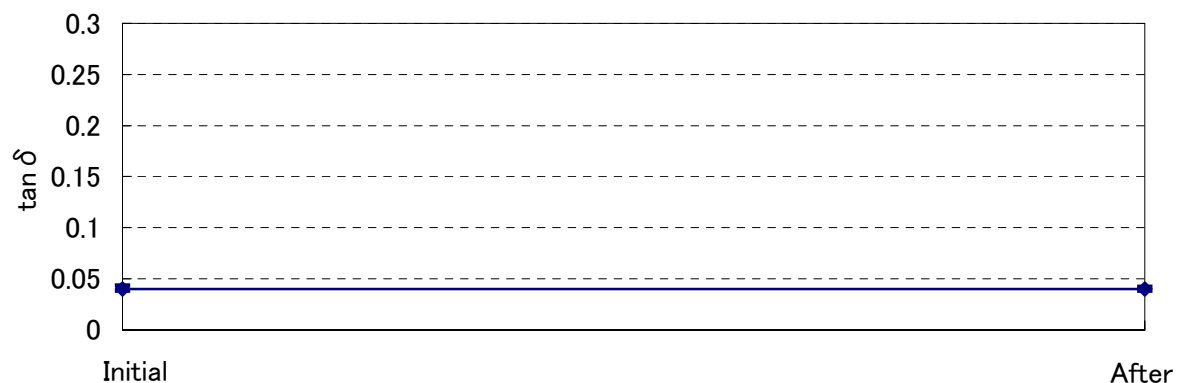
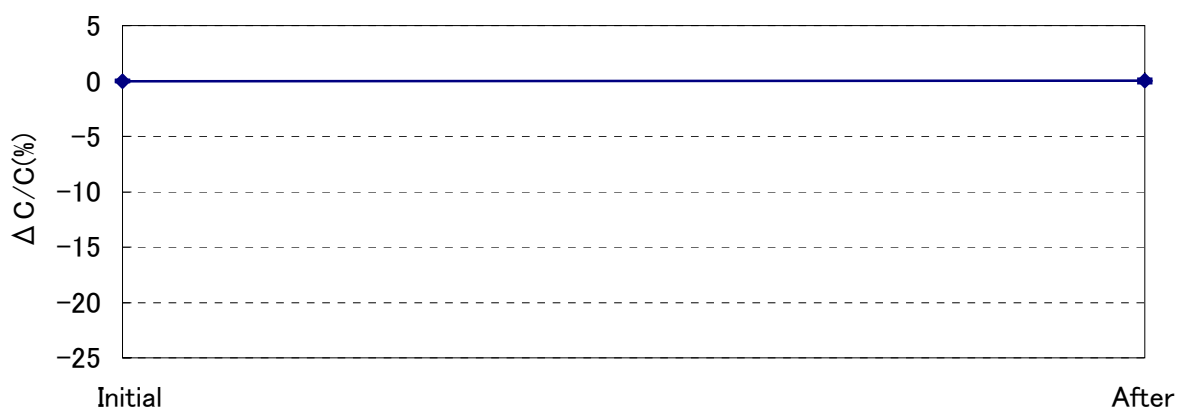
TEST CONDITION

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. : NACK331M35V10X10.5TR13YF n = 80 pcs.



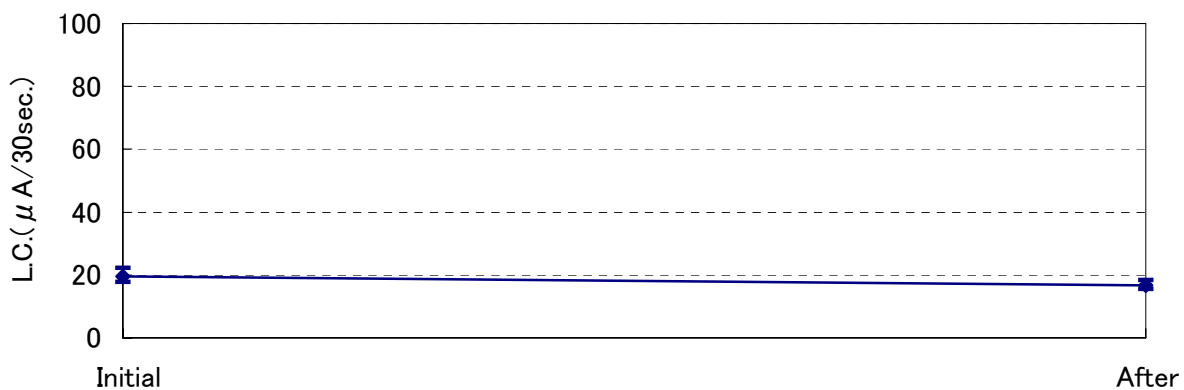
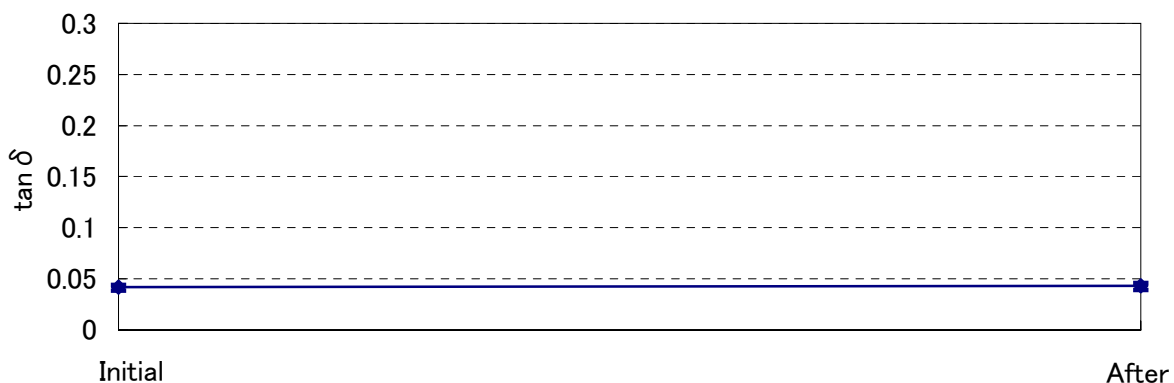
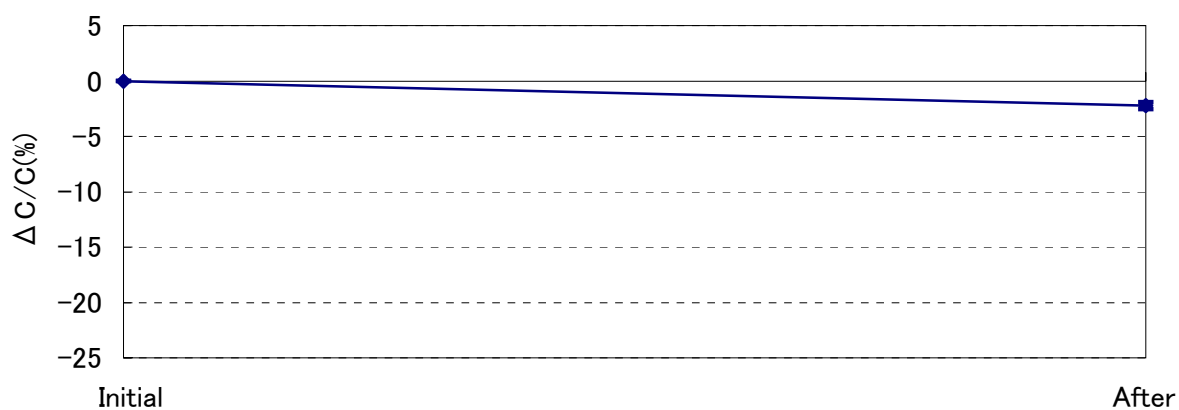
Appearance : No remarkable abnormality.  
Judgment : Passed.

ITEM	Biased Humidity	P.6
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**TEST CONDITION**

1000 hours at 85°C with the rated voltage applied.  
 Humidity ; 85% RH

MODEL No. : NACK331M35V10X10.5TR13YF      n = 80 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

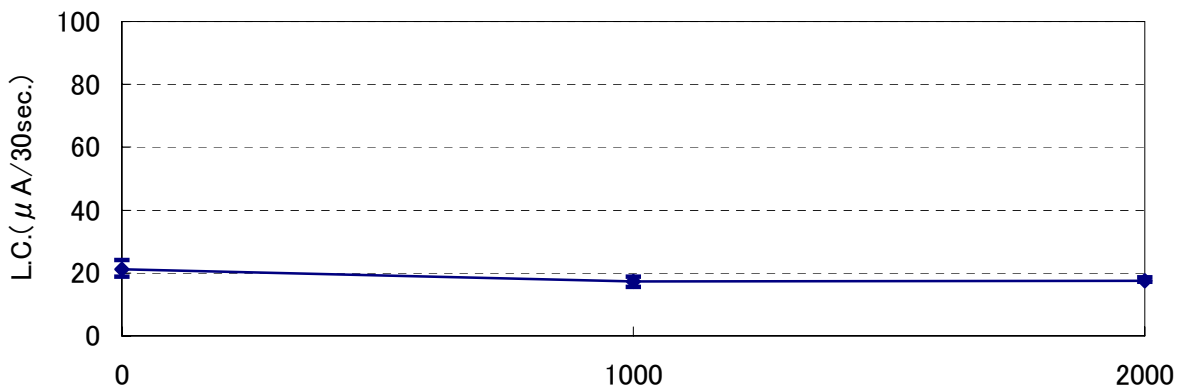
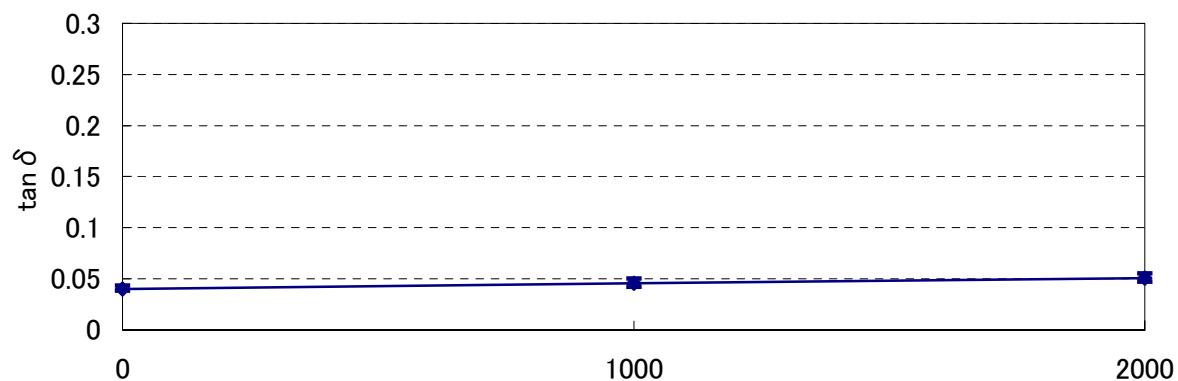
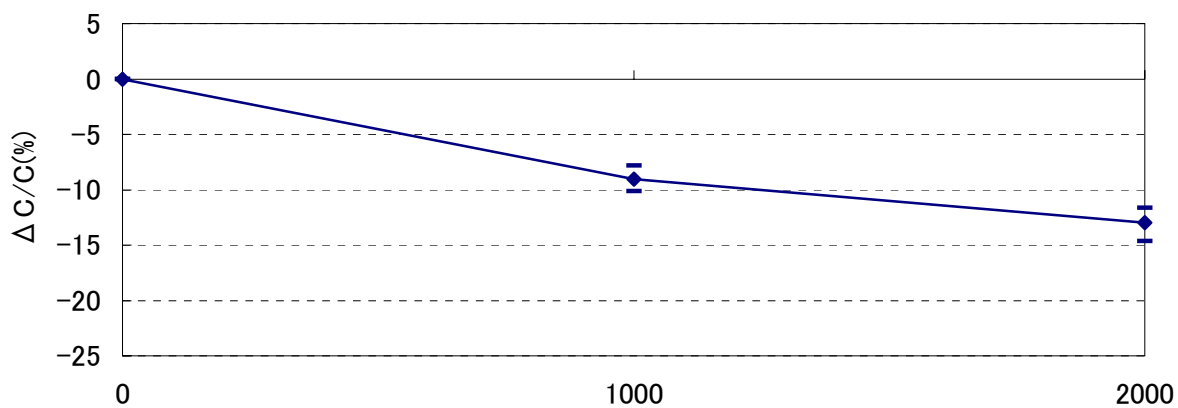
ITEM	Operational Life	P.7
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**TEST CONDITION**

2000 hours at 105°C with the rated voltage applied.

Ripple current : 850mA/100kHz

MODEL No. : NACK331M35V10X10.5TR13YF      n = 80 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	Physical Dimension							P.8
MODEL No. : NACK331M35V10X10.5TR13YF								
unit : mm								
	$\phi D$	L	W	H	C	R	P	
1	10.00	10.42	10.31	10.31	10.92	1.16	4.67	
2	10.00	10.41	10.32	10.31	10.94	1.16	4.66	
3	10.01	10.41	10.30	10.31	10.94	1.17	4.66	
4	10.00	10.40	10.31	10.30	10.92	1.16	4.66	
5	10.00	10.42	10.32	10.31	10.93	1.17	4.65	
6	10.01	10.41	10.30	10.31	10.94	1.17	4.67	
7	10.00	10.42	10.31	10.30	10.92	1.17	4.67	
8	10.00	10.41	10.32	10.31	10.94	1.16	4.66	
9	10.01	10.41	10.31	10.32	10.95	1.17	4.65	
10	10.01	10.41	10.32	10.31	10.94	1.17	4.66	
11	10.01	10.42	10.31	10.32	10.92	1.16	4.66	
12	10.00	10.42	10.30	10.31	10.95	1.18	4.67	
13	10.00	10.40	10.31	10.32	10.93	1.17	4.66	
14	10.00	10.40	10.31	10.32	10.95	1.16	4.66	
15	10.01	10.41	10.32	10.31	10.93	1.18	4.65	
16	10.00	10.40	10.31	10.30	10.95	1.17	4.65	
17	10.01	10.40	10.31	10.30	10.94	1.18	4.65	
18	10.00	10.42	10.32	10.31	10.93	1.17	4.67	
19	10.00	10.42	10.31	10.32	10.95	1.17	4.66	
20	10.01	10.41	10.31	10.30	10.94	1.16	4.66	
21	10.00	10.42	10.31	10.31	10.93	1.16	4.66	
22	10.00	10.41	10.32	10.31	10.94	1.16	4.65	
23	10.01	10.40	10.31	10.32	10.93	1.16	4.66	
24	10.00	10.42	10.31	10.31	10.95	1.18	4.65	
25	10.00	10.41	10.30	10.31	10.93	1.17	4.66	
26	10.00	10.41	10.31	10.31	10.92	1.17	4.65	
27	10.01	10.41	10.30	10.31	10.92	1.16	4.66	
28	10.00	10.40	10.32	10.31	10.93	1.17	4.66	
29	10.00	10.40	10.31	10.32	10.93	1.16	4.67	
30	10.00	10.42	10.31	10.30	10.94	1.17	4.66	
$\bar{X}$	10.00	10.41	10.31	10.31	10.94	1.17	4.66	

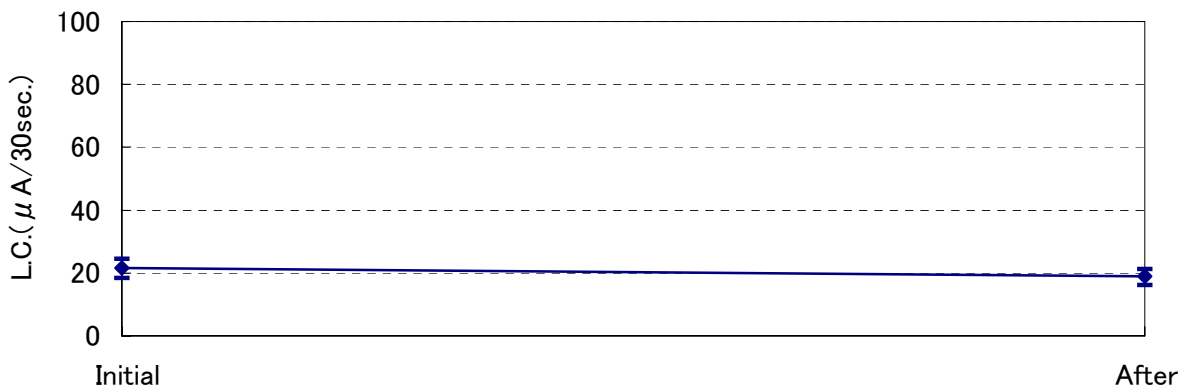
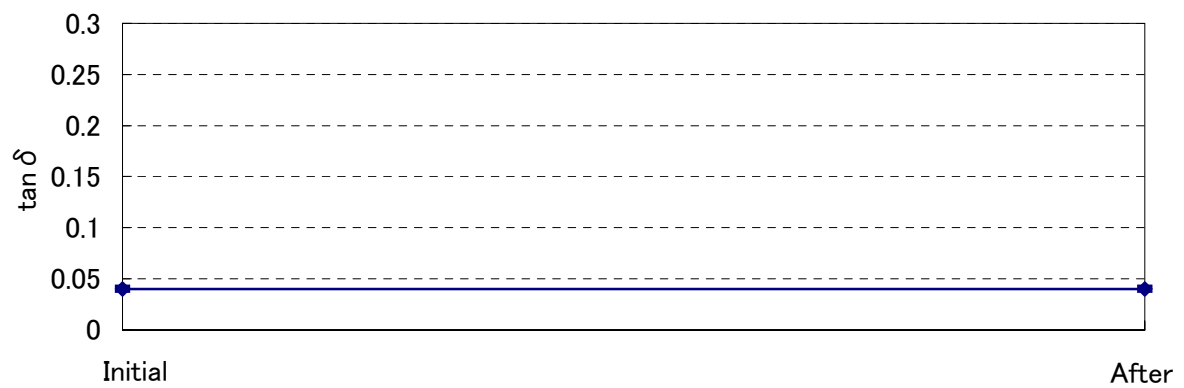
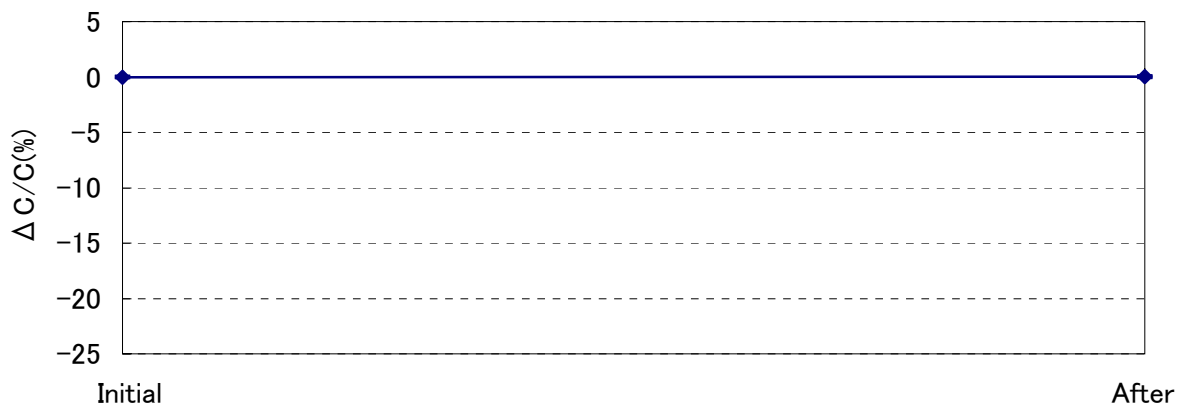
ITEM	Resistance to Solvents	P.9
<p data-bbox="268 293 539 324"><b>TEST CONDITION :</b></p> <p data-bbox="304 331 790 362">Dipped in the solvent at 20 to 25°C.</p> <p data-bbox="304 369 683 400">Solvent ; Isopropyl alcohol</p> <p data-bbox="304 407 600 439">Dipping time ; 3 min.</p> <p data-bbox="268 551 472 582"><b>APPERANCE :</b></p> <p data-bbox="304 589 1066 620">No significant change observed. The marking was legible.</p> <p data-bbox="268 732 480 763"><b>TEST MODEL :</b></p> <p data-bbox="304 770 933 801">NACK331M35V10X10.5TR13YF      n = 5pcs.</p> <p data-bbox="268 913 416 945"><b>RESULT :</b></p> <p data-bbox="304 952 834 983">All samples met the specified standard.</p>		

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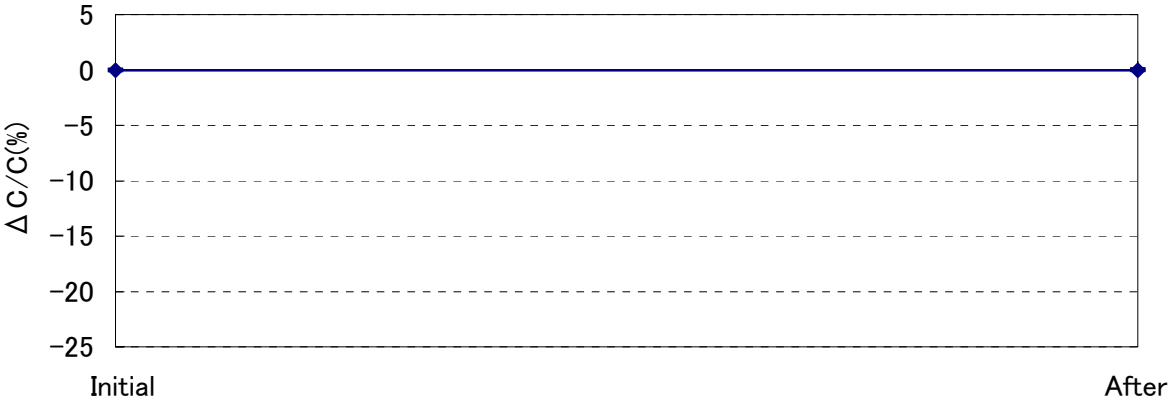
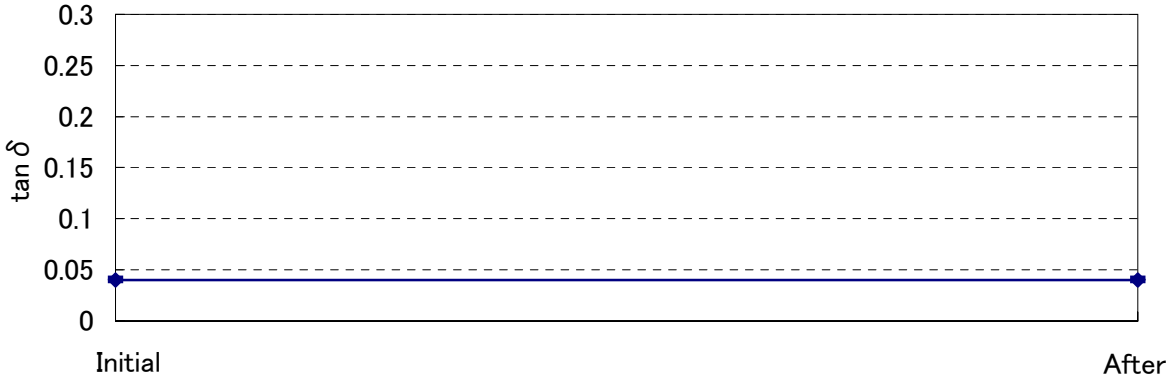
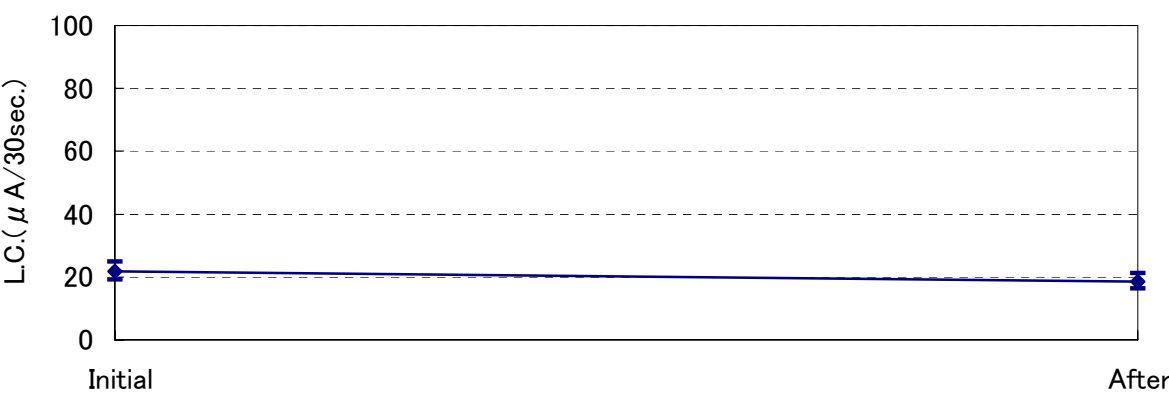
**TEST CONDITION**

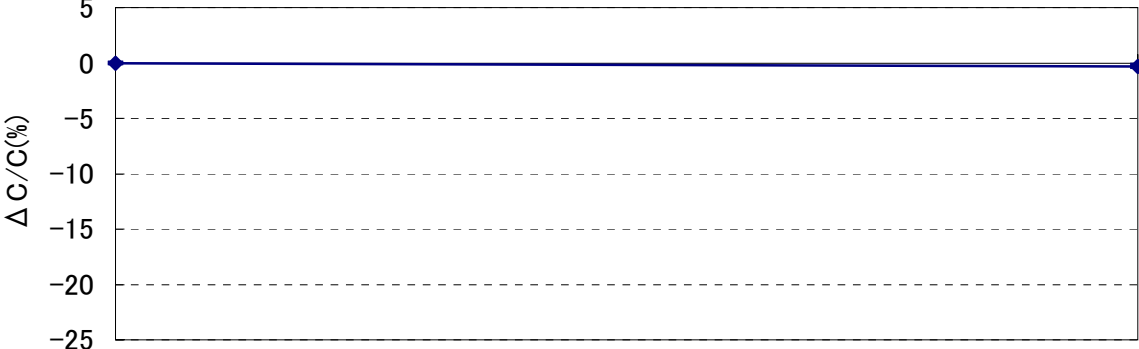
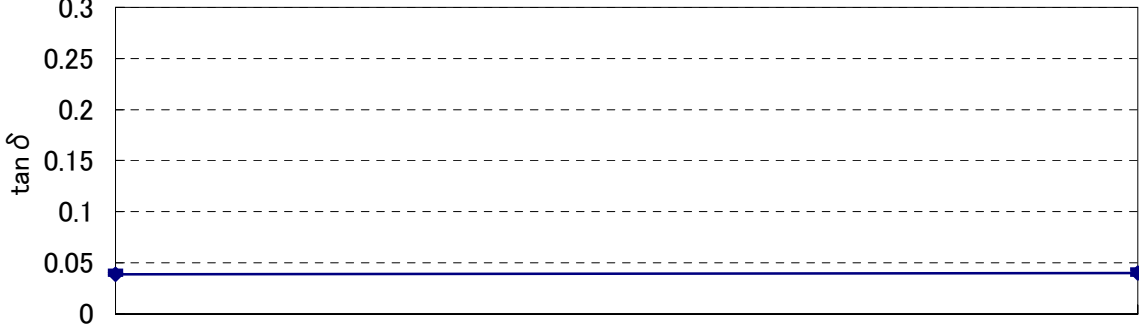
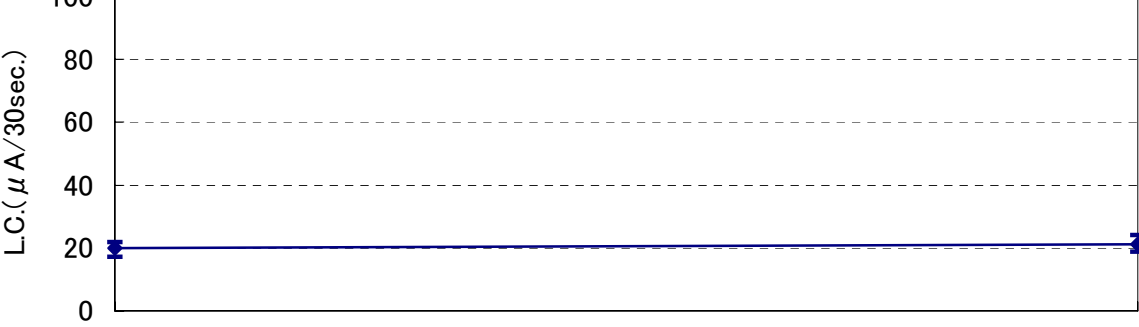
Peak acceleration ; 1000 m/s<sup>2</sup> (100G)  
 Duration of a pulse ; 6 ms  
 Pulse shape ; half-sine  
 Number of shocks ; X-X', Y-Y', Z-Z' 6 directions × 3 times  
 → Total 18 times

MODEL No. : NACK331M35V10X10.5TR13YF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	Vibration	P.11						
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. : NACK331M35V10X10.5TR13YF      n = 30 pcs.								
 <p>ΔC/C(%)</p> <table border="1"> <thead> <tr> <th>Condition</th> <th>ΔC/C(%)</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0</td> </tr> <tr> <td>After</td> <td>0</td> </tr> </tbody> </table>			Condition	ΔC/C(%)	Initial	0	After	0
Condition	ΔC/C(%)							
Initial	0							
After	0							
 <p>tan δ</p> <table border="1"> <thead> <tr> <th>Condition</th> <th>tan δ</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0.05</td> </tr> <tr> <td>After</td> <td>0.05</td> </tr> </tbody> </table>			Condition	tan δ	Initial	0.05	After	0.05
Condition	tan δ							
Initial	0.05							
After	0.05							
 <p>L.C.(μA/30sec.)</p> <table border="1"> <thead> <tr> <th>Condition</th> <th>L.C.(μA/30sec.)</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>20</td> </tr> <tr> <td>After</td> <td>20</td> </tr> </tbody> </table>			Condition	L.C.(μA/30sec.)	Initial	20	After	20
Condition	L.C.(μA/30sec.)							
Initial	20							
After	20							
<p>Appearance : No remarkable abnormality. Judgment : Passed.</p>								

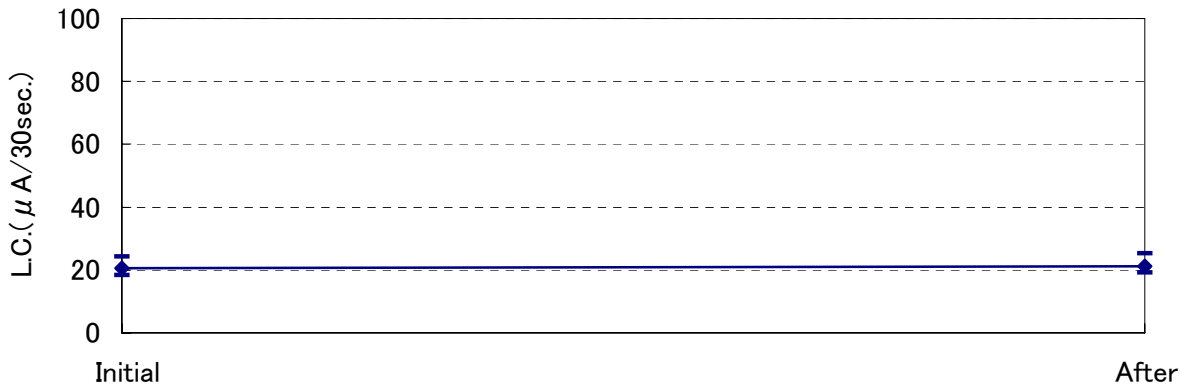
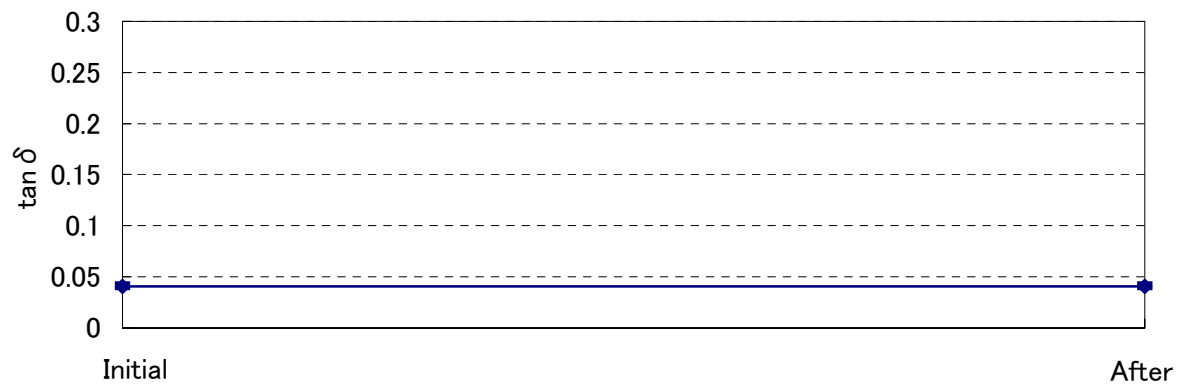
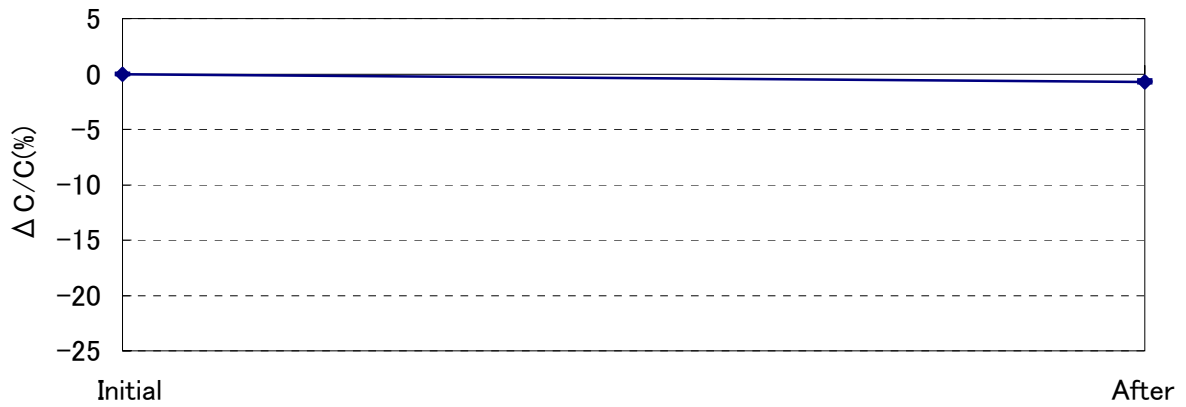
ITEM	Resistance to Soldering Heat	P.12						
<p>TEST CONDITION</p>								
<p>Vapor phase reflow ; <math>215 \pm 5 \text{ }^\circ\text{C} \times 60 \pm 5 \text{ sec.}</math></p>								
<p>MODEL No. : NACK331M35V10X10.5TR13YF      n = 30 pcs.</p>								
 <p><math>\Delta C/C(\%)</math></p> <table border="1"> <thead> <tr> <th>Time</th> <th><math>\Delta C/C(\%)</math></th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0</td> </tr> <tr> <td>After</td> <td>0</td> </tr> </tbody> </table>			Time	$\Delta C/C(\%)$	Initial	0	After	0
Time	$\Delta C/C(\%)$							
Initial	0							
After	0							
 <p><math>\tan \delta</math></p> <table border="1"> <thead> <tr> <th>Time</th> <th><math>\tan \delta</math></th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0.04</td> </tr> <tr> <td>After</td> <td>0.04</td> </tr> </tbody> </table>			Time	$\tan \delta$	Initial	0.04	After	0.04
Time	$\tan \delta$							
Initial	0.04							
After	0.04							
 <p>L.C.(<math>\mu\text{A}/30\text{sec.}</math>)</p> <table border="1"> <thead> <tr> <th>Time</th> <th>L.C.(<math>\mu\text{A}/30\text{sec.}</math>)</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>20</td> </tr> <tr> <td>After</td> <td>20</td> </tr> </tbody> </table>			Time	L.C.( $\mu\text{A}/30\text{sec.}$ )	Initial	20	After	20
Time	L.C.( $\mu\text{A}/30\text{sec.}$ )							
Initial	20							
After	20							
<p>Appearance : No remarkable abnormality. Judgment : Passed.</p>								

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

-55°C × 15min ← → +105°C × 15min.  
 Maximum transfer time : 20 seconds  
 Number of cycles : 300 cycles

MODEL No. : NACK331M35V10X10.5TR13YF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.

ITEM	ESD	P.14						
<p>TEST CONDITION : As specified in AEC-Q200 REV C</p>								
<p>TEST MODEL : NACK331M35V10X10.5TR13YF      n = 15pcs.</p>								
<p>RESULT :</p>								
±500V	±1kV	±2kV	±4kV	±6kV	±8kV	±12kV	±16kV	±25kV
OK	OK	OK	OK	OK	OK	OK	OK	OK
<p>Appearance : No remarkable abnormality. Judgment : Passed.</p>								

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>NACK331M35V10X10.5TR13YF      n = 15pcs.</p> <p>RESULT :</p> <p>All samples met the specified standards.</p>		

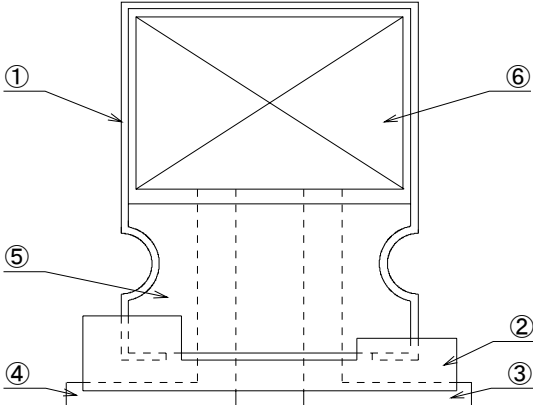
ITEM

## Electrical Characterization

P.16

MODEL No. NACK331M35V10X10.5TR13YF

No.	Lot.No.(81179U4)			Lot.No.(83289U5)			Lot.No.(84179U5)		
	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	317.7	0.042	18.32	314.8	0.042	19.22	320.0	0.039	16.06
2	315.6	0.044	18.22	314.3	0.044	15.95	323.9	0.040	16.14
3	317.2	0.041	20.89	320.3	0.037	15.85	318.1	0.038	16.15
4	316.6	0.044	19.68	313.0	0.044	16.44	323.6	0.040	17.25
5	319.5	0.040	18.51	318.1	0.042	17.81	324.4	0.039	17.93
6	318.3	0.042	18.95	315.7	0.043	16.43	323.3	0.040	17.28
7	318.0	0.044	18.15	312.4	0.045	16.34	324.7	0.039	16.91
8	319.4	0.040	19.36	315.6	0.039	15.76	325.8	0.040	18.54
9	319.9	0.040	19.31	318.0	0.041	17.52	323.2	0.039	17.48
10	316.5	0.044	19.20	315.6	0.042	18.22	322.9	0.040	16.92
11	318.3	0.042	18.43	316.6	0.042	15.69	324.7	0.039	18.23
12	316.9	0.042	20.40	317.7	0.039	15.85	324.6	0.040	17.14
13	319.1	0.043	18.64	315.6	0.044	17.11	324.0	0.040	16.93
14	315.4	0.043	18.24	318.5	0.038	16.27	323.7	0.039	16.60
15	317.4	0.042	18.90	317.8	0.037	16.24	325.0	0.039	17.25
16	316.7	0.042	21.46	318.7	0.038	15.20	321.9	0.039	17.94
17	319.9	0.042	20.29	318.7	0.040	15.90	322.6	0.039	17.19
18	320.4	0.039	20.54	320.3	0.038	15.81	318.4	0.040	15.97
19	320.0	0.040	20.61	317.0	0.039	15.51	318.5	0.039	18.43
20	320.3	0.040	20.62	317.5	0.040	15.59	326.8	0.040	18.41
21	319.1	0.040	20.91	317.7	0.039	17.38	323.7	0.039	17.29
22	318.8	0.043	21.85	318.8	0.039	16.69	319.7	0.039	17.00
23	319.9	0.043	20.47	319.7	0.038	16.10	324.6	0.040	18.02
24	322.4	0.038	20.13	319.6	0.040	16.20	326.1	0.040	17.95
25	317.6	0.040	20.67	321.0	0.039	15.92	324.9	0.040	17.97
26	320.0	0.040	19.46	317.5	0.040	15.34	325.1	0.040	17.30
27	318.4	0.044	20.65	318.7	0.038	15.63	325.8	0.039	18.10
28	320.6	0.040	20.61	317.2	0.039	17.31	324.0	0.040	20.30
29	316.2	0.043	21.42	319.2	0.039	17.46	326.4	0.039	18.03
30	319.0	0.040	21.15	320.2	0.037	15.72	322.6	0.040	17.68
$\bar{X}$	318.5	0.042	19.87	317.5	0.040	16.42	323.4	0.039	17.48
Max	322.4	0.044	21.85	321.0	0.045	19.22	326.8	0.040	20.30
Min	315.4	0.038	18.15	312.4	0.037	15.20	318.1	0.038	15.97
$3\sigma$	4.9	0.005	3.29	6.3	0.007	2.78	7.0	0.002	2.66

ITEM	Flammability		P.17	
				
MODEL No. NACK331M35V10X10.5TR13YF				
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	-	-

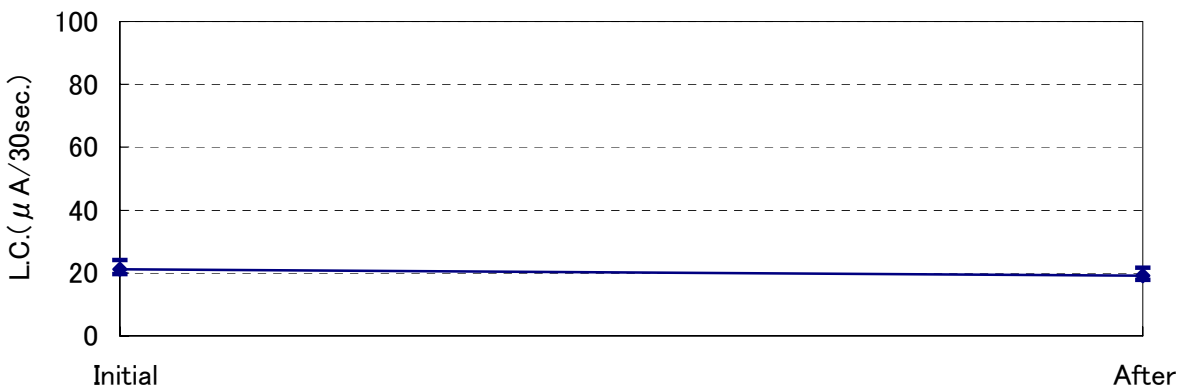
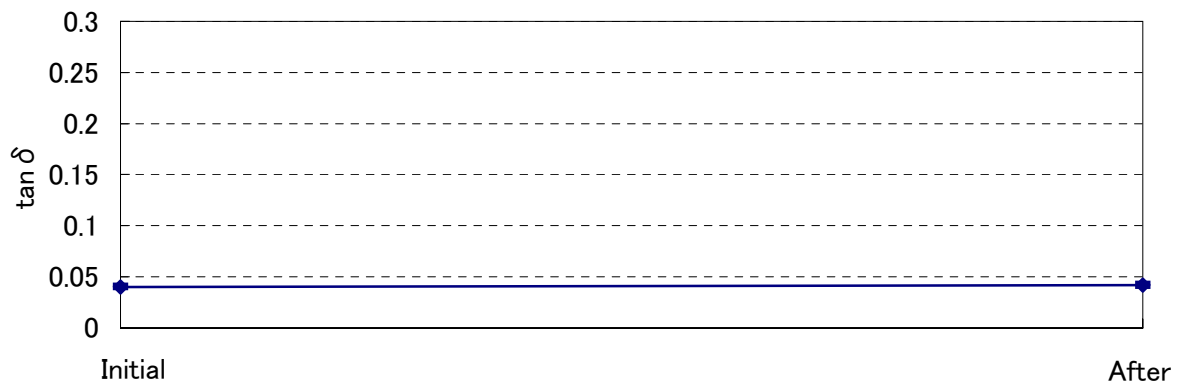
ITEM	Board Flex	P.18						
<p><b>TEST CONDITION</b></p>								
<p>The capacitor mounted on the under side of a circuit board with bending fixture. The capacitor must maintain for 60 seconds after the circuit board is bent by 2mm at 1mm/s.</p>								
<p>MODEL No. : NACK331M35V10X10.5TR13YF      n = 30 pcs.</p>								
<table border="1"> <caption>ΔC/C(%) Data</caption> <thead> <tr> <th>Condition</th> <th>Value (%)</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0</td> </tr> <tr> <td>After</td> <td>0</td> </tr> </tbody> </table>			Condition	Value (%)	Initial	0	After	0
Condition	Value (%)							
Initial	0							
After	0							
<table border="1"> <caption>tan δ Data</caption> <thead> <tr> <th>Condition</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>0.04</td> </tr> <tr> <td>After</td> <td>0.04</td> </tr> </tbody> </table>			Condition	Value	Initial	0.04	After	0.04
Condition	Value							
Initial	0.04							
After	0.04							
<table border="1"> <caption>L.C.(μA/30sec.) Data</caption> <thead> <tr> <th>Condition</th> <th>Value (μA/30sec.)</th> </tr> </thead> <tbody> <tr> <td>Initial</td> <td>20</td> </tr> <tr> <td>After</td> <td>20</td> </tr> </tbody> </table>			Condition	Value (μA/30sec.)	Initial	20	After	20
Condition	Value (μA/30sec.)							
Initial	20							
After	20							
<p>Appearance : No remarkable abnormality. Judgment : Passed.</p>								

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. : NACK331M35V10X10.5TR13YF      n = 30 pcs.



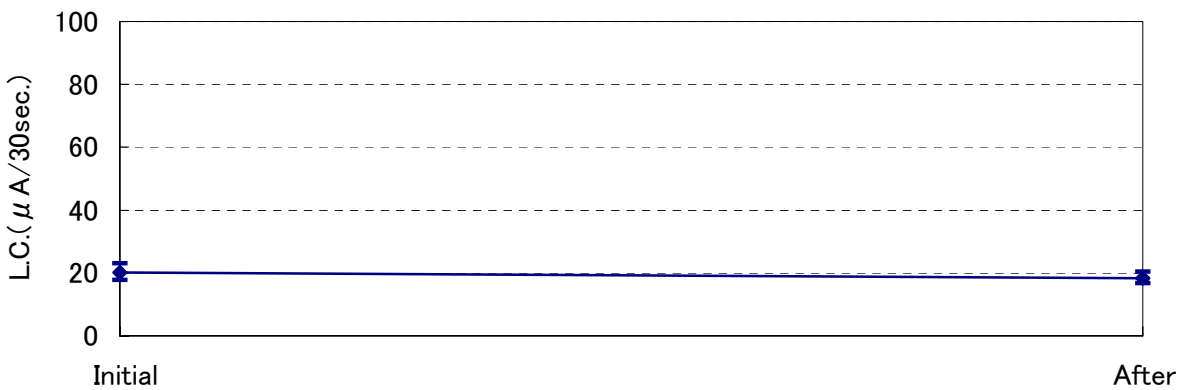
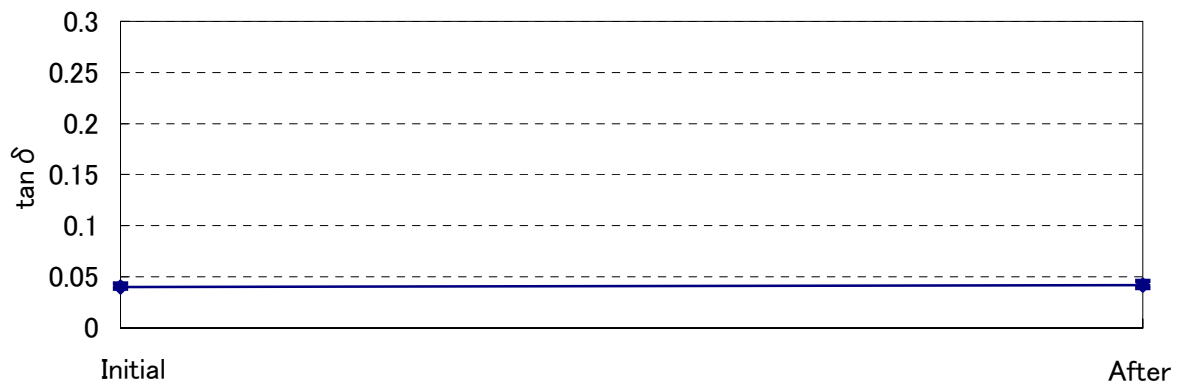
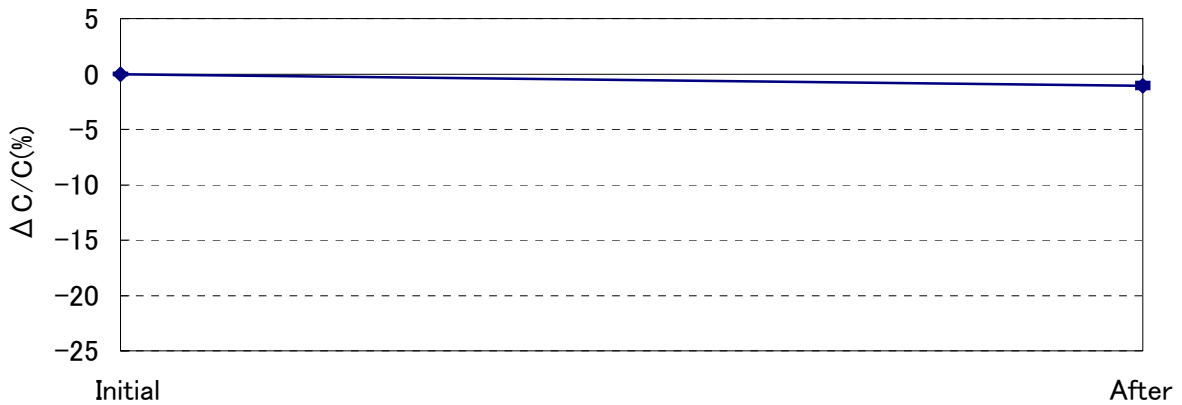
Appearance : No remarkable abnormality.  
 Judgment : Passed.

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. : NACK331M35V10X10.5TR13YF      n = 30 pcs.



Appearance : No remarkable abnormality.  
 Judgment : Passed.