1. INTRODUCTION

MA Series green type capacitors are manufactured by using green materials without lead and cadmium. These capacitors feature series connection of multi-layer capacitor units in a MLCC to realize high voltage performance. Reliable performances are built-in through exact formulation of dielectric powders, preparation of conductive paste, advanced automatic manufacturing, and strict quality control to assure excellent control in dielectric thickness, electrode integrity, and electrode-to-termination continuity.

2. FEATURES

a. Special interior design offers high voltage rating in a given case size.
b. High reliability and stability.
c. RoHS compliant

3. APPLICATIONS

a. DC to DC converter.
b. High voltage coupling/DC blocking.
c. Back-lighting inverters.
d. LAN/WLAN interface.
e. Modem.
f. Power supplies.

4.HOW TO ORDER

MA	1825	XR	—	104	K	—	102	ER	G
PDC Family	**Size**	**Dielectric**		**Capacitance**	**Tolerance**		**Rated voltage**	**Packaging**	**Control Code**
	Inch (mm) **1206** (3216) **1210** (3225) **1808** (4520) **1812** (4532) **1825** (4563) **2220** (5750) **2225** (5763)	CG: C0G XR: X7R		Two significant digits followed by no. of zeros. And R is in place of decimal point. eg.: R47=0.47pF 0R5=0.5pF 1R0=1.0pF 100=10x10^0 =10pF	**B**=±0.1pF **C**=±0.25pF **D**=±0.5pF **F=**±1% **G**=±2% **J**=±5% **K**=±10% **M**=±20%		Two significant digits followed by no. of zeros. And R is in place of decimal point. **102=** 1000 VDC **202=** 2000 VDC **302=** 3000 VDC	PR: Tpae and Reel, Paper Tape ER: Tape and Reel, Embossed Tape No Code: Bulk	G: RoHS compliant

5. EXTERNAL DIMENSIONS

Size Inch (mm)	L (mm)	W (mm)	T(mm)	M_B min (mm)
1206 (3216)	3.20±0.20	1.60±0.20	1.80 max.	0.30
1210 (3225)	3.20±0.40	2.50±0.30	2.80 max.	0.30
1808 (4520)	4.50±0.40	2.00±0.20	2.20 max.	0.26
1812 (4532)	4.50±0.40	3.20±0.30	2.80 max.	0.26
1825(4563)	4.50±0.40	6.30±0.40	2.80 max.	0.30
2220 (5750)	5.70±0.40	5.00±0.40	2.80 max.	0.30
2225 (5763)	5.70±0.40	6.30±0.40	2.80 max.	0.30

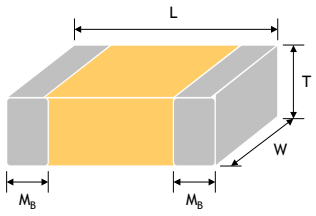


Fig. 1 The outline of MLCC

6.GENERAL ELECTRICAL DATA

Dielectric	NP0		X7R	
Size	1206, 1210, 1808, 1812		1206, 1210, 1812, 1808, 1825, 2220, 2225	
Rated voltage (WVDC)	1KV, 2KV, 3KV		1KV, 2KV, 3KV	
Capacitance range*	1KV	1.5pF ~ 2.2nF	1KV	100pF ~ 100nF
	2KV	1.5pF ~ 1.2nF	2KV	150pF ~ 12nF
	3KV	2.2pF ~ 470pF	3KV	150pF ~ 3.9nF
Capacitance tolerance	Cap≤5pF: B (±0.1pF), C (±0.25pF) 5pF<Cap<10pF: C (±0.25pF), D (±0.5pF) Cap≥10pF: F (±1%), G (±2%), J (±5%),K (±10%)		J (±5%), K (±10%), M (±20%)	
Tan δ*	Cap<30pF: Q≥400+20C Cap≥30pF: Q≥1000		≤2.5%	
Insulation resistance at 500Vdc for 60 seconds	≥100GΩ or R•C≥1000 whichever is smaller		≥10GΩ or R•C≥500Ω-F whichever is smaller	
Operating temperature	-55 to +125℃			
Temperature coefficient	±30ppm / ℃		±15%	
Termination	Ag (or Cu)/Ni/Sn (lead-free termination)			

* Measured at the condition of 30~70% related humidity.

NP0: Apply 1.0±0.2Vrms, 1.0MHz±10% for Cap≤1000pF and 1.0±0.2Vrms, 1.0kHz±10% for Cap>1000pF, 25℃ at ambient temperature

X7R: Apply 1.0±0.2Vrms, 1.0kHz±10%, at 25℃ ambient temperature.

7.CAPACITANCE RANGE

DIELECTRIC		NP0 (C0G)											
SIZE		1206			1210			1808			1812		
RATED VOLTAGE (VDC)		1000	2000	3000	1000	2000	3000	1000	2000	3000	1000	2000	3000
Capacitance	1.5pF (1R5)												
	1.8pF (1R8)												
	2.2pF (2R2)												
	2.7pF (2R7)												
	3.3pF (3R3)												
	3.9pF (3R9)												
	4.7pF (4R7)												
	5.6pF (5R6)												
	6.8pF (6R8)												
	8.2pF (8R2)												
	10pF (100)												
	12pF (120)												
	15pF (150)												
	18pF (180)												
	22pF (220)												
	27pF (270)												
	33pF (330)												
	39pF (390)												
	47pF (470)												
	56pF (560)												
	68pF (680)												
	82pF (820)												
	100pF (101)												
	120pF (121)												
	150pF (151)												
	180pF (181)												
	220pF (221)												
	270pF (271)												
	330pF (331)												
	390pF (391)												
	470pF (471)												
	560pF (561)												
	680pF (681)												
	820pF (821)												
	1,000pF (102)												
	1,200pF (122)												
	1,500pF (152)												
	1,800pF (182)												
	2,200pF (222)												
	2,700pF (272)												
	3,300pF (332)												
	3,900pF (392)												
	4,700pF (472)												
	5,600pF (562)												
	6,800pF (682)												
	8,200pF (822)												
	0.010μF (103)												

DIELECTRIC		X7R									
SIZE		1206		1210		1808			1812		
RATED VOLTAGE (VDC)		1000	2000	1000	2000	1000	2000	3000	1000	2000	3000
Capacitance	100pF (101)										
	120pF (121)										
	150pF (151)										
	180pF (181)										
	220pF (221)										
	270pF (271)										
	330pF (331)										
	390pF (391)										
	470pF (471)										
	560pF (561)										
	680pF (681)										
	820pF (821)										
	1,000pF (102)										
	1,200pF (122)										
	1,500pF (152)										
	1,800pF (182)										
	2,200pF (222)										
	2,700pF (272)										
	3,300pF (332)										
	3,900pF (392)										
	4,700pF (472)										
	5,600pF (562)										
	6,800pF (682)										
	8,200pF (822)										
	0.010µF (103)										
	0.012µF (123)										
	0.015µF (153)										
	0.018µF (183)										
	0.022µF (223)										
	0.027µF (273)										
	0.033µF (333)										

DIELECTRIC		X7R								
SIZE		1825			2220			2225		
RATED VOLTAGE (VDC)		1000	2000	3000	1000	2000	3000	1000	2000	3000
Capacitance	1,000pF (102)									
	1,200pF (122)									
	1,500pF (152)									
	1,800pF (182)									
	2,200pF (222)									
	2,700pF (272)									
	3,300pF (332)									
	3,900pF (392)									
	4,700pF (472)									
	5,600pF (562)									
	6,800pF (682)									
	8,200pF (822)									
	0.010µF (103)									
	0.012µF (123)									
	0.015µF (153)									
	0.018µF (183)									
	0.022µF (223)									
	0.027µF (273)									
	0.033µF (333)									
	0.039µF (393)									
	0.047µF (473)									
	0.056µF (563)									
	0.068µF (683)									
	0.082µF (823)									
	0.10µF (104)									

8.PACKAGE DIMENSION AND QUANTITY

Size	Thickness (mm)	Paper tape		Plastic tape	
		7" reel	13" reel	7" reel	13" reel
1206 (3216)	0.80±0.10	4k	15k	-	-
	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
1210 (3225)	0.95±0.10	-	-	3k	10k
	1.25±0.10	-	-	3k	10k
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	1k	-
1808 (4520)	1.25±0.10	-	-	2k	-
	1.40±0.15	-	-	2k	-
	1.60±0.20	-	-	2k	-
	2.00±0.20	-	-	1k	-
1812 (4532)	1.25±0.10	-	-	1k	-
	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	3k
1825 (4563)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2220 (5750)	1.60±0.20	-	-	1k	-
	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-
2225 (5763)	2.00±0.20	-	-	1k	-
	2.50±0.30	-	-	0.5k	-

Unit: pieces

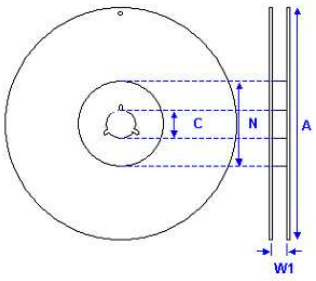


Fig. 4 The dimension of reel

Size	1206, 1210, 1812			1808, 1812, 1825, 2220, 2225
Reel size	7"	10"	13"	7"
C	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2	13.0+0.5/-0.2
W_1	8.4+1.5/-0	8.4+1.5/-0	8.4+1.5/-0	12.4+2.0/-0
A	178.0±0.10	250.0±1.0	330.0±1.0	178.0±0.10
N	60.5±1.0	100.0±1.0	100±1.0	60.5±1.0

8-1. CARDBOARD TAPE DIMESIONS

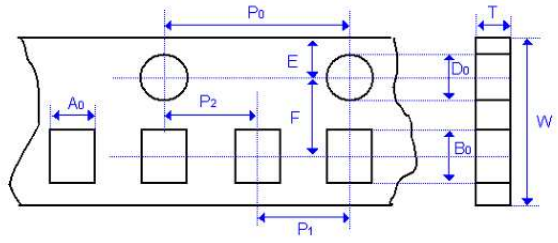


Fig. 2 The dimension of paper tape

8-2. EMBOSSED TAPE DIMENSIONS

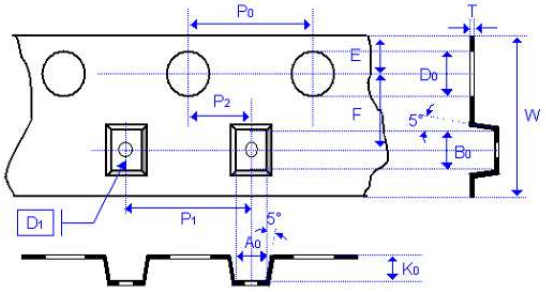


Fig. 3 The dimension of plastic tape

Size	1206			1210		1808	
Chip Thickness	0.80±0.10	0.95±0.10 1.25±0.10	1.60±0.20 1.60+0.3/-0.1	0.95±0.10 1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	1.25±0.10 1.40±0.15 1.60±0.20	2.00±0.20
A_0	2.00±0.10	<2.00	<2.00	<3.05	<3.10	<2.50	<2.50
B_0	3.50±0.10	<3.60	<3.70	<3.80	<4.00	<5.30	<5.30
T	0.95±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.23±0.05	0.25±0.05	0.25±0.05
K_0	-	<2.50	<2.50	<2.50	<3.50	<2.50	<2.50
W	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	12.0±0.20	12.0±0.20
P_0	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.100	4.00±0.10	4.00±0.10	4.00±0.10
$10xP_0$	40.0±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.20	40.0±0.20	40.0±0.20
P_1	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
P_2	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D_0	1.50±0.05	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50±0.10/-0	1.50+0.10/-0
D_1	-	1.00±0.10	1.00±0.10	1.00±0.10	1.00±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10	1.75±0.10
F	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	3.50±0.05	5.50±0.05	5.50±0.05

Size	1812		1825		2220		2225	
Chip Thickness	1.25±0.10 1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30	1.40±0.15 1.60±0.20 2.00±0.20	2.50±0.30	2.00±0.20	2.50±0.30
A_0	<3.90	<3.90	<6.80	<6.80	<5.80	<5.80	<6.80	<6.80
B_0	<5.30	<5.30	<5.30	<5.30	<6.50	<6.50	<6.50	<6.50
T	0.25±0.05	0.25±0.05	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10	0.30±0.10
K_0	<2.50	<3.0	<2.50	<3.10	<2.50	<3.10	<2.50	<3.10
W	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20	12.0±0.20
P_0	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10	4.00±0.10
$10xP_0$	40.0±0.20	40.00±0.20	40.00±0.20	40.00±0.20	40.0±0.20	40.0±0.20	40.0±0.20	40.0±0.20
P_1	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10	8.00±0.10
P_2	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05	2.00±0.05
D_0	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0.00	1.50+0.10/-0	1.50+0.10/-0
D_1	1.50±0.10	1.50+/-0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10	1.50±0.10
E	1.75±0.10	1.75+/-0.1	1.75±0.1	1.75±0.10	1.75±0.1	1.75±0.10	1.75±0.10	1.75±0.10
F	5.50±0.05	5.50+/-0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05	5.50±0.05

9.APPLICATION NOTES

STORAGE

To prevent the damage of solderability of terminations, the following storage conditions are recommended:

Indoors under 5 ~ 40℃ and 20% ~ 70% RH.

No harmful gases containing sulfuric acid, ammonia, hydrogen sulfide or chlorine.

Packaging should not be opened until the capacitors are required for use. If opened, the pack should be re-sealed as soon as is practicable. Taped product should be stored out of direct sunlight, which might promote deterioration in tape or adhesion performance. The capacitors should be used within 6 months and checked the solderability before use.

HANDLING

Chip capacitors are dense, hard, brittle, and abrasive materials. They are liable to suffer mechanical damage, in the form of cracks or chips. Chip Capacitors should be handled with care to avoid contamination or damage. To use vacuum or plastic tweezers to pick up or plastic tweezers is recommended for manual placement. Tape and reeled packages are suitable for automatic pick and placement machine.

PREHEAT

In order to minimize the risk of thermal shock during soldering, a carefully controlled preheat is required. The rate of preheat should not exceed 4℃ per second and the final preheat temperature should be within 100℃ of the soldering temperature for small chips such as 1206, within 50℃ of the soldering temperature for bigger chips such as 1210, 1808, 1812, 1825, 2220 and 2225, etc.

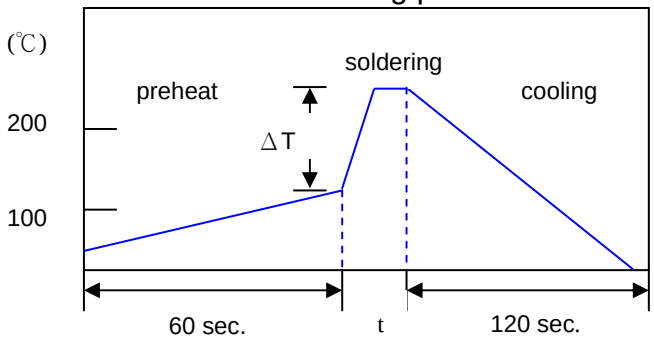
SOLDERING

Use middy activated rosin RA and RMA fluxes do not use activated flux. The amount of solder in each solder joint should be controlled to prevent the damage of chip capacitors caused by the stress between solder, chips, and substrate.

Hand soldering with temperature-controlled iron not exceeding 30 watts and diameter of tip less than 1.2 mm is recommended, tip of iron should not contact the ceramic body directly, and the temperature of iron should be set to not more than 260℃.

For bigger chips such as 1210, 1808, 1812, 2220 and 2225, etc. wave soldering and hand soldering are no recommended.

Recommended soldering profiles as following:



Soldering	Solder Temp.(T)	Soldering Time (t)
Reflow	235 – 260 ℃	< 15 sec.
Wave	230 – 260 ℃	< 5 sec.

Chip Size	ΔT
1206	100 ℃
1210, 1808, 1812, 1825, 2220, 2225	50 ℃

COOLING

After soldering, cool the chips and the substrate gradually to room temperature. Natural cooling in air is recommended to minimize stress in the solder joint. A cooling rate not exceeding 4℃ per second should be used when forced cooling is necessary.

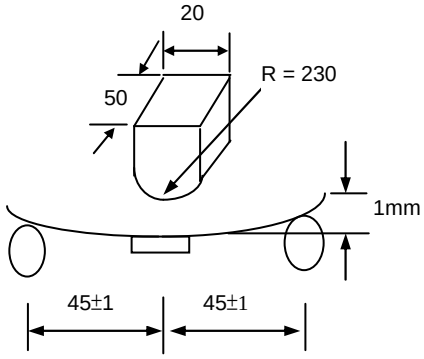
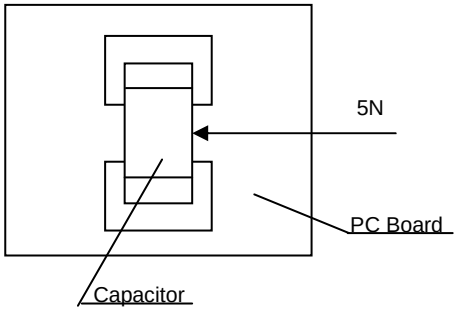
CLEANING

All flux residues must be removed by using suitable electronic-grade vapor-cleaning solvents to eliminate contamination that could cause electrolytic surface corrosion. Good results can be obtained by using ultrasonic cleaning of the solvent. The choice of the proper system is depends upon many factors such as component mix, flux, and solder paste and assembly method. The ability of the cleaning system to remove flux residues and contamination from under the chips is very important.

10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS

<table>
<tr><th>No.</th><th>Item</th><th>Test Condition</th><th>Requirements</th></tr>
<tr><td>1.</td><td>Visual and Mechanical</td><td>---</td><td>* No remarkable defect.
* Dimensions to conform to individual specification sheet.</td></tr>
<tr><td>2.</td><td>Capacitance</td><td>Class I: (NP0)</td><td>* Shall not exceed the limits given in the detailed spec.</td></tr>
<tr><td>3.</td><td>Q/ D.F. (Dissipation Factor)</td><td>Cap≤1000pF, 1.0±0.2Vrms, 1MHz±10%
Cap>1000pF, 1.0±0.2Vrms, 1KHz±10%
Class II: (X7R)
1.0±0.2Vrms, 1kHz±10%</td><td>NP0: Cap≥30pF, Q≥1000; Cap<30pF, Q≥400+20C
X7R: ≤2.5%</td></tr>
<tr><td>4.</td><td>Temperature Coefficient</td><td>With no electrical load.<table><tr><th>T.C.</th><th>Operating Temp</th></tr><tr><td>NP0</td><td>-55~125℃ at 25℃</td></tr><tr><td>X7R</td><td>-55~125℃ at 25℃</td></tr></table></td><td><table><tr><th>T.C.</th><th>Capacitance Change</th></tr><tr><td>NP0</td><td>Within ±30ppm/℃</td></tr><tr><td>X7R</td><td>Within ±15%</td></tr></table></td></tr>
<tr><td>5.</td><td>Insulation Resistance</td><td>* To apply voltage at 500VDC for 60 sec.</td><td>Class I (NP0) : ≥100GΩ or RxC≥1000Ω-F whichever is smaller.
Class II (X7R) : ≥10GΩ or RxC≥500Ω-F whichever is smaller.</td></tr>
<tr><td>6.</td><td>Dielectric Strength</td><td>* To apply voltage:
1.2 times of U_R
* Duration: 1 to 5 sec.</td><td>* No evidence of damage or flashover during test.</td></tr>
<tr><td>7.</td><td>Solderability</td><td>* Solder temperature: 235±5℃
* Dipping time: 5±0.5 sec.</td><td>75% min. coverage of all metalized area.</td></tr>
<tr><td>8.</td><td>Resistance to Soldering Heat</td><td>* Solder temperature: 260±5℃
* Dipping time: 10±1 sec
* Preheating: 120 to 150℃ for 1 minute before immerse the capacitor in a eutectic solder.
* Before initial measurement (Class II only): Perform 150+0/-10℃ for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap change:
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R: within ±7.5%
* 25% max. leaching on each edge.</td></tr>
<tr><td>9.</td><td>Temperature Cycle</td><td>* Conduct the five cycles according to the temperatures and time.<table><tr><th>Step</th><th>Temp. (℃)</th><th>Time (min.)</th></tr><tr><td>1</td><td>Min. operating temp. +0/-3</td><td>30±3</td></tr><tr><td>2</td><td>Room temp.</td><td>2~3</td></tr><tr><td>3</td><td>Max. operating temp. +3/-0</td><td>30±3</td></tr><tr><td>4</td><td>Room temp.</td><td>2~3</td></tr></table>* Before initial measurement (Class II only): Perform 150+0/-10℃ for 1 hr and then set for 48±4 hrs at room temp.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap change：
NP0: within ±2.5% or ±0.25pF whichever is larger.
X7R: within ±15%
* Q/D.F.:
NP0: ≤2.0 × Initial requirement
X7R: ≤1.5 × Initial requirement
* I.R.≥ 0.25 × initial requirement</td></tr>
<tr><td>10.</td><td>Humidity (Damp Heat) Steady State</td><td>* Test temp.: 40±2℃
* Humidity: 90~95% RH
* Test time: 500+24/-0hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap change:
NP0 within ±5% or ±2pF whichever is larger
X7R within ±15%
* Q/D.F Value:
NP0: Cap≥30pF :Q≥350
10pF≤Cap<30pF :Q≥275+2.5C
Cap<10pF :Q≥200+10C
X7R: ≤7.0%
* I.R.: ≥1GΩ or RxC≥50Ω-F whichever is smaller.</td></tr>
<tr><td>11.</td><td>High Temperature Load (Endurance)</td><td>* Test temp.:
NP0, X7R: 125±3℃
* To apply voltage:
120% of rated voltage.
* Test time: 1000+24/-0 hrs.
* Measurement to be made after keeping at room temp. for 24±2 hrs (Class I) or 48±4 hrs (Class II).</td><td>* No remarkable damage.
* Cap change:
NP0: within ±3% or ±3pF whichever is larger.
X7R: within ±20%
* Q/D.F value:
NP0: Cap≥30pF :Q≥350
10pF≤Cap<30pF :Q≥275+2.5C
Cap<10pF :Q≥200+10C
X7R: ≤7.0%
* I.R.: ≥10V, ≥1GΩ or RxC≥50Ω-F whichever is smaller.</td></tr>
</table>

10.RELIABILITY TEST CONDITIONS AND REQUIREMENTS (Cont.)

No.	Item	Test Condition	Requirements
12.	**Resistance to Flexure of Substrate**	* The middle part of substrate shall be pressurized by means of the pressurizing rod at a rate of about 1 mm per second until the deflection becomes 1 mm.  	* No remarkable damage. * Cap change： NP0 ：within ±10% X7R ：within ±12.5% (This capacitance change means the change of capacitance under specified flexure of substrate from the capacitance measured before the test.)
13.	**Adhesive Strength of Termination**	* Capacitors mounted on a substrate. A force of 5N applied perpendicular to the place of substrate and parallel the line joining the center of terminations for 10±1 sec.  	* No remarkable damage or removal of the terminations.