General Multilayer Ceramic Capacitors

MLCC is an electronic part that temporarily stores an electrical charge and the most prevalent type of capacitor today. New technologies have enabled the MLCC manufacturers to follow the trend dictated by smaller and smaller electronic devices such as Cellular telephones, Computers, DSC, DVC

General Features

- Miniature Size
- Wide Capacitance and Voltage Range
- Tape & Reel for Surface Mount Assembly
- Low ESR

Applications

- General Electronic Circuit

Part Numbering

CL	10	B	104	K	B	8	N	N	N	C
❶	❷	❸	❹	❺	❻	❼	❽	❾	❿	⓫

❶ Samsung Multilayer Ceramic Capacitor
❷ Size(mm)
❸ Capacitance Temperature Characteristic
❹ Nominal Capacitance
❺ Capacitance Tolerance
❻ Rated Voltage
❼ Thickness Option
❽ Product & Plating Method
❾ Samsung Control Code
❿ Reserved For Future Use
⓫ Packaging Type

❶ Samsung Multilayer Ceramic Capacitor

❷ SIZE(mm)

Code	EIA CODE	Size(mm)
03	0201	0.6 × 0.3
05	0402	1.0 × 0.5
10	0603	1.6 × 0.8
21	0805	2.0 × 1.25
31	1206	3.2 × 1.6
32	1210	3.2 × 2.5
43	1812	4.5 × 3.2
55	2220	5.7 × 5.0

❸ CAPACITANCE TEMPERATURE CHARACTERISTIC

Code	Temperature Characteristics				Temperature Range
C	Class Ⅰ	COG	C△	0±30(ppm/℃)	-55 ~ +125℃
P		P2H	P△	-150±60	
R		R2H	R△	-220±60	
S		S2H	S△	-330±60	
T		T2H	T△	-470±60	
U		U2J	U△	-750±60	
L		S2L	S△	+350 ~ -1000	
A	Class Ⅱ	X5R	X5R	±15%	-55 ~ +85℃
B		X7R	X7R	±15%	-55 ~ +125℃
X		X6S	X6S	±22%	-55 ~ +105℃
F		Y5V	Y5V	+22 ~ -82%	-30 ~ +85℃

※ **Temperature Characteristic**

Temperature Characteristics	Below 2.0pF	2.2 ~ 3.9pF	Above 4.0pF	Above 10pF
CΔ	C0G	C0G	C0G	C0G
PΔ	-	P2J	P2H	P2H
RΔ	-	R2J	R2H	R2H
SΔ	-	S2J	S2H	S2H
TΔ	-	T2J	T2H	T2H
UΔ	-	U2J	U2J	U2J

J : ±120PPM/℃, H : ±60PPM/℃, G : ±30PPM/℃

❹ NOMINAL CAPACITANCE

Nominal capacitance is identified by 3 digits.
The first and second digits identify the first and second significant figures of the capacitance.
The third digit identifies the multiplier. 'R' identifies a decimal point.

● Example

Code	Nominal Capacitance
1R5	1.5pF
103	10,000pF, 10nF, 0.01μF
104	100,000pF, 100nF, 0.1μF

❺ CAPACITANCE TOLERANCE

Code	Tolerance	Nominal Capacitance
A	±0.05pF	Less than 10pF (Including 10pF)
B	±0.1pF	
C	±0.25pF	
D	±0.5pF	
F	±1pF	
F	±1%	More than 10pF
G	±2%	
J	±5%	
K	±10%	
M	±20%	
Z	+80, -20%	

❻ RATED VOLTAGE

Code	Rated Voltage	Code	Rated Voltage
R	4.0V	D	200V
Q	6.3V	E	250V
P	10V	G	500V
O	16V	H	630V
A	25V	I	1,000V
L	35V	J	2,000V
B	50V	K	3,000V
C	100V		

❼ THICKNESS OPTION

Size	Code	Thickness(T)	Size	Code	Thickness(T)
0201(0603)	**3**	0.30±0.03	1812(4532)	**F**	1.25±0.20
0402(1005)	**5**	0.50±0.05		**H**	1.6±0.20
0603(1608)	**8**	0.80±0.10		**I**	2.0±0.20
0805(2012)	**A**	0.65±0.10		**J**	2.5±0.20
	C	0.85±0.10		**L**	3.2±0.30
	F	1.25±0.10	2220(5750)	**F**	1.25±0.20
	Q	1.25±0.15		**H**	1.6±0.20
	Y	1.25±0.20		**I**	2.0±0.20
1206(3216)	**C**	0.85±0.15		**J**	2.5±0.20
	F	1.25±0.15		**L**	3.2±0.30
	H	1.6±0.20			
1210(3225)	**F**	1.25±0.20			
	H	1.6±0.20			
	I	2.0±0.20			
	J	2.5±0.20			
	V	2.5±0.30			

❽ PRODUCT & PLATING METHOD

Code	Electrode	Termination	Plating Type
A	Pd	Ag	Sn_100%
N	Ni	Cu	Sn_100%
G	Cu	Cu	Sn_100%

❾ SAMSUNG CONTROL CODE

Code	Description of the code	Code	Description of the code
A	Array (2-element)	**N**	Normal
B	Array (4-element)	**P**	Automotive
C	High - Q	**L**	LICC

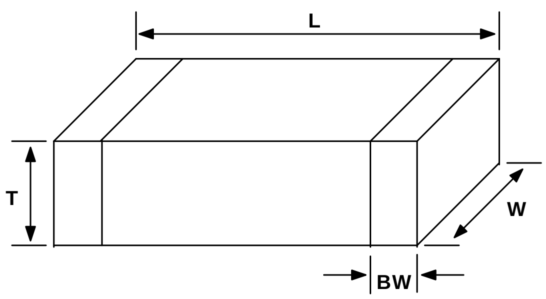
⑩ RESERVED FOR FUTURE USE

Code	Description of the code
N	Reserved for future use

⑪ PACKAGING TYPE

Code	Packaging Type	Code	Packaging Type
B	Bulk	F	Embossing 13" (10,000EA)
P	Bulk Case	L	Paper 13" (15,000EA)
C	Paper 7"	0	Paper 10"
D	Paper 13" (10,000EA)	S	Embossing 10"
E	Embossing 7"		

APPEARANCE AND DIMENSION



CODE	EIA CODE	DIMENSION (mm)			
		L	W	T (MAX)	BW
03	0201	0.6 ± 0.03	0.3 ± 0.03	0.33	0.15 ± 0.05
05	0402	1.0 ± 0.05	0.5 ± 0.05	0.55	0.2 +0.15/-0.1
10	0603	1.6 ± 0.1	0.8 ± 0.1	0.9	0.3 ± 0.2
21	0805	2.0 ± 0.1	1.25 ± 0.1	1.35	0.5 +0.2/-0.3
31	1206	3.2 ± 0.15	1.6 ± 0.15	1.40	0.5 +0.2/-0.3
		3.2 ± 0.2	1.6 ± 0.2	1.8	0.5 +0.3/-0.3
32	1210	3.2 ± 0.3	2.5 ± 0.2	2.7	0.6 ± 0.3
		3.2 ± 0.4	2.5 ± 0.3	2.8	
43	1812	4.5 ± 0.4	3.2 ± 0.3	3.5	0.8 ± 0.3
55	2220	5.7 ± 0.4	5.0 ± 0.4	3.5	1.0 ± 0.3

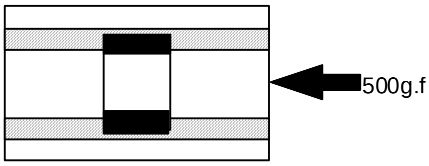
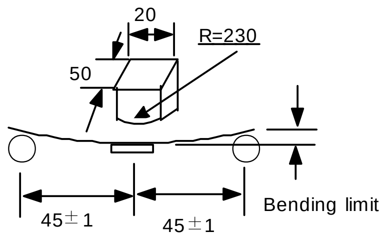
RELIABILTY TEST CONDITION

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th>PERFORMANCE</th><th colspan="3">TEST CONDITION</th></tr>
<tr><td>1</td><td colspan="2">Appearance</td><td>No Abnormal Exterior Appearance</td><td colspan="3">Through Microscope(×10)</td></tr>
<tr><td>2</td><td colspan="2">Insulation Resistance</td><td>10,000㏁ or 500㏁·㎌ whichever is smaller

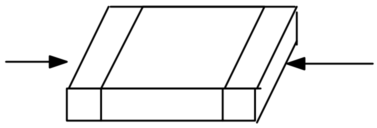
Rated Voltage is below 16V ;
10,000㏁ or 100㏁·㎌ whichever is smaller</td><td colspan="3">Apply the Rated Voltage For 60 ~ 120 Sec.</td></tr>
<tr><td>3</td><td colspan="2">Withstanding Voltage</td><td>No Dielectric Breakdown or
Mechanical Breakdown</td><td colspan="3">ClassⅠ: 300% of the Rated Voltage for 1~5 sec.
ClassⅡ:250% of the Rated Voltage for 1~5 sec. is applied with less than 50㎃ current</td></tr>
<tr><td rowspan="6">4</td><td rowspan="6">Capacitance</td><td rowspan="3">Class Ⅰ</td><td rowspan="3">Within the specified tolerance</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤ 1,000㎊</td><td>1㎒±10%</td><td rowspan="2">0.5 ~ 5 Vrms</td></tr>
<tr><td>>1,000㎊</td><td>1㎑±10%</td></tr>
<tr><td rowspan="3">Class Ⅱ</td><td rowspan="3">Within the specified tolerance</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤ 10㎌</td><td>1㎑±10%</td><td>1.0±0.2Vrms</td></tr>
<tr><td>>10㎌</td><td>120㎐±20%</td><td>0.5±0.1Vrms</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Q</td><td rowspan="3">Class Ⅰ</td><td rowspan="3">Capacitance ≥ 30㎊ : Q ≥ 1,000
< 30㎊ : Q ≥ 400 +20C
(C : Capacitance)</td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤ 1,000㎊</td><td>1㎒±10%</td><td rowspan="2">0.5 ~ 5 Vrms</td></tr>
<tr><td>>1,000㎊</td><td>1㎑±10%</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Tan δ</td><td rowspan="4">Class Ⅱ</td><td rowspan="4">1. Characteristic : A(X5R), B(X7R), X(X6S)
<table>
<tr><th>Rated Voltage</th><th>Spec</th></tr>
<tr><td>≥25V</td><td>0.025 max</td></tr>
<tr><td>16V</td><td>0.035 max</td></tr>
<tr><td>10V</td><td>0.05 max</td></tr>
<tr><td>6.3V</td><td>0.05 max/ 0.10max*1</td></tr>
</table>
2. Characteristic : F(Y5V)
<table>
<tr><th>Rated Voltage</th><th>Spec</th></tr>
<tr><td>50V</td><td>0.05 max, 0.07max*2</td></tr>
<tr><td>35V</td><td>0.07 max</td></tr>
<tr><td>25V</td><td>0.05 max/
0.07 max*3/ 0.09max*4</td></tr>
<tr><td>16V</td><td>0.09 max/ 0.125max*5</td></tr>
<tr><td>10V</td><td>0.125 max/ 0.16max*6</td></tr>
<tr><td>6.3V</td><td>0.16max</td></tr>
</table></td><td>Capacitance</td><td>Frequency</td><td>Voltage</td></tr>
<tr><td>≤ 10㎌</td><td>1㎑±10%</td><td>1.0±0.2Vrms</td></tr>
<tr><td>>10㎌</td><td>120㎐±20%</td><td>0.5±0.1Vrms</td></tr>
<tr><td colspan="3">*1. 0201 C≥0.022uF, 0402 C≥0.22uF, 0603 C≥2.2uF,
0805 C≥4.7uF, 1206 C≥10uF, 1210 C≥22uF,
1812 C≥47uF, 2220 C≥100uF,
All Low Profile Capacitors (P.16).
*2.. 0603 C≥0.47uF, 0805 C≥1uF
*3. 0402 C≥0.033uF, 0603 C>0.1uF
All 0805, 1206 size, 1210 C≤ 6.8uF
*4.. 1210 C>6.8uF
*5.. 0402 C≥0.22uF
*6.. All 1812 size</td></tr>
</table>

RELIABILTY TEST CONDITION

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th colspan="3">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Temperature Characteristics of Capacitance</td><td>Class Ⅰ</td><td colspan="3">
<table>
<tr><th>Characteristics</th><th>Temp. Coefficient (PPM/℃)</th></tr>
<tr><td>C0G</td><td>0 ± 30</td></tr>
<tr><td>PH</td><td>-150 ± 60</td></tr>
<tr><td>RH</td><td>-220 ± 60</td></tr>
<tr><td>SH</td><td>-330 ± 60</td></tr>
<tr><td>TH</td><td>-470 ± 60</td></tr>
<tr><td>UL</td><td>-750 ± 120</td></tr>
<tr><td>SL</td><td>+350 ~ -1000</td></tr>
</table>
</td><td rowspan="2">Capacitance shall be measured by the steps shown in the following table.
<table>
<tr><th>Step</th><th>Temp.(℃)</th></tr>
<tr><td>1</td><td>25 ± 2</td></tr>
<tr><td>2</td><td>Min. operating temp. ± 2</td></tr>
<tr><td>3</td><td>25 ± 2</td></tr>
<tr><td>4</td><td>Max. operating temp ± 2</td></tr>
<tr><td>5</td><td>25 ± 2</td></tr>
</table>
(1) Class Ⅰ
Temperature Coefficient shall be calculated from the formula as below.
$\text{Temp, Coefficient} = \frac{C2 - C1}{C1 \times \triangle T} \times 10^{6}$ [ppm/℃]
C1; Capacitance at step 3
C2: Capacitance at 85℃
△T: 60℃(=85℃-25℃)

(2) CLASS Ⅱ
Capacitance Change shall be calculated from the formula as below.
$\triangle C = \frac{C2 - C1}{C1} \times 100(\%)$
C1; Capacitance at step 3
C2: Capacitance at step 2 or 4</td></tr>
<tr><td>Class Ⅱ</td><td colspan="3">
<table>
<tr><th>Characteristics</th><th>Capacitance Change with No Bias</th></tr>
<tr><td>A(X5R)/ B(X7R)</td><td>±15%</td></tr>
<tr><td>X(X6S)</td><td>±22%</td></tr>
<tr><td>F(Y5V)</td><td>+22% ~ -82%</td></tr>
</table>
</td></tr>
<tr><td>8</td><td colspan="2">Adhesive Strength of Termination</td><td colspan="3">No Indication Of Peeling Shall Occur On The Terminal Electrode.</td><td>Apply 500g.f * Pressure for 10±1 sec.
* 200g.f for 0201 case size.

</td></tr>
<tr><td rowspan="5">9</td><td rowspan="5">Bending Strength</td><td>Apperance</td><td colspan="3">No mechanical damage shall occur.</td><td rowspan="5">Bending limit ; 1mm
Test speed ; 1.0mm/SEC.
Keep the test board at the limit point in 5 sec., Then measure capacitance.

</td></tr>
<tr><td rowspan="4">Capacitance</td><td colspan="2">Characteristics</td><td>Capacitance Change</td></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±5% or ±0.5 pF whichever is larger</td></tr>
<tr><td rowspan="2">Class Ⅱ</td><td>A(X5R)/ B(X7R)/ X(X6S)</td><td>Within ±12.5%</td></tr>
<tr><td>F(Y5V)</td><td>Within ±30%</td></tr>
</table>

RELIABILTY TEST CONDITION

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th>PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td>10</td><td colspan="2">Solderability</td><td>More Than 75% of the terminal surface is to be soldered newly, So metal part does not come out or dissolve
</td><td><table>
<tr><td>Solder</td><td>Sn-3Ag-0.5Cu</td><td>63Sn-37Pb</td></tr>
<tr><td>Solder Temp.</td><td>245±5℃</td><td>235±5℃</td></tr>
<tr><td>Flux</td><td colspan="2">RMA Type</td></tr>
<tr><td>Dip Time</td><td>3±0.3 sec.</td><td>5±0.5 sec.</td></tr>
<tr><td>Pre-heating</td><td colspan="2">at 80~120℃ for 10~30 sec.</td></tr>
</table></td></tr>
<tr><td rowspan="6">11</td><td rowspan="6">Resistance to Soldering heat</td><td>Apperance</td><td>No mechanical damage shall occur.</td><td rowspan="6">Solder Temperature : 270±5℃
Dip Time : 10±1 sec.
Each termination shall be fully immersed and preheated as below :
<table>
<tr><th>STEP</th><th>TEMP.(℃)</th><th>TIME(SEC.)</th></tr>
<tr><td>1</td><td>80~100</td><td>60</td></tr>
<tr><td>2</td><td>150~180</td><td>60</td></tr>
</table>Leave the capacitor in ambient condition for specified time* before measurement
* 24 ± 2 hours (Class Ⅰ)
24 ± 2 hours (Class Ⅱ)</td></tr>
<tr><td>Capacitance</td><td><table>
<tr><th colspan="2">Characteristics</th><th>Capacitance Change</th></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±2.5% or ±0.25㎊ whichever is larger</td></tr>
<tr><td rowspan="3">Class Ⅱ</td><td>A(X5R)/ B(X7R)</td><td>Within ±7.5%</td></tr>
<tr><td>X(X6S)</td><td>Within ±15%</td></tr>
<tr><td>F</td><td>Within ±20%</td></tr>
</table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Capacitance ≥30㎊ : Q≥ 1000
<30㎊ : Q≥ 400+20×C
(C: Capacitance)</td></tr>
<tr><td>Tan δ (Class Ⅱ)</td><td>Within the specified initial value</td></tr>
<tr><td>Insulation Resistance</td><td>Within the specified initial value</td></tr>
<tr><td>Withstanding Voltage</td><td>Within the specified initial value</td></tr>
<tr><td rowspan="5">12</td><td rowspan="5">Vibration Test</td><td>Appearance</td><td>No mechanical damage shall occur.</td><td rowspan="5">The capacitor shall be subjected to a Harmonic Motion having a total amplitude of 1.5mm changing frequency from 10Hz to 55Hz and back to 10Hz In 1 min.

Repeat this for 2hours each in 3 mutually perpendicular directions</td></tr>
<tr><td>Capacitance</td><td><table>
<tr><th colspan="2">Characteristics</th><th>Capacitance Change</th></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±2.5% or ±0.25㎊ whichever is larger</td></tr>
<tr><td rowspan="3">Class Ⅱ</td><td>A(X5R)/ B(X7R)</td><td>Within ±5%</td></tr>
<tr><td>X(X6S)</td><td>Within ±10%</td></tr>
<tr><td>F(Y5V)</td><td>Within ±20%</td></tr>
</table></td></tr>
<tr><td>Q (Class Ⅰ)</td><td>Within the specified initial value</td></tr>
<tr><td>Tan δ (Class Ⅱ)</td><td>Within the specified initial value</td></tr>
<tr><td>Insulation Resistance</td><td>Within the specified initial value</td></tr>
</table>

General Capacitors

RELIABILTY TEST CONDITION

NO	ITEM		PERFORMANCE			TEST CONDITION
13	Humidity (Steady State)	Appearance	No mechanical damage shall occur.			Temperature : 40±2 ℃ Relative humidity : 90~95 %RH Duration time : 500 +12/-0 hr. Leave the capacitor in ambient condition for specified time* before measurement. CLASSⅠ : 24±2 Hr. CLASSⅡ : 24±2 Hr.
		Capacitance	Characteristics		Capacitance Change	
			Class Ⅰ		Within ±5.0% or ±0.5㎊ whichever is larger	
			Class Ⅱ	A(X5R)/ B(X7R)/ X(X6S)	Within ±12.5%	
				F(Y5V)	Within ±30%	
		Q CLASSⅠ	Capacitance ≥ 30㎊ : Q≥ 350 10≤ Capacitance <30㎊ : Q≥ 275 + 2.5×C Capacitance < 10pF : Q≥ 200 + 10×C (C: Capacitance)			
		Tan δ CLASS Ⅱ	1. Characteristic : A(X5R), B(X7R) 0.05max (16V and over) 0.075max (10V) 0.075max (6.3V except Table 1) 0.125max* (refer to Table 1)		2. Characteristic : F(Y5V) 0.075max (25V and over) 0.1max (16V, C<1.0㎌) 0.125max(16V, C≥1.0㎌) 0.15max (10V) 0.195max (6.3V)	
		Insulation Resistance	1,000 ㏁ or 50㏁·㎌ whichever is smaller.			
14	Moisture Resistance	Appearance	No mechanical damage shall occur.			Applied Voltage : rated voltage Temperature : 40±2 ℃ Humidity : :90~95%RH Duration Time : 500 +12/-0 Hr. Charge/Discharge Current : 50㎃ max. Perform the initial measurement according to Note1. Perform the final measurement according to Note2.
		Capacitance	Characteristics		Capacitance Change	
			Class Ⅰ		Within ±5.0% or ±0.5㎊ whichever is larger	
			Class Ⅱ	A(X5R)/ B(X7R)/ X(X6S)	Within ±12.5% Within ±12.5% Within ±30%	
				F(Y5V)	Within ±30%	
					Within ±30%	
		Q (Class Ⅰ)	Capacitance ≥30㎊ : Q≥ 200 Capacitance <30㎊ : Q≥ 100 + 10/3×C (C: Capacitance)			
		Tan δ (Class Ⅱ)	1. Characteristic : A(X5R), B(X7R) 0.05max (16V and over) 0.075max (10V) 0.075max (6.3V except Table 1) 0.125max* (refer to Table 1)		2. Characteristic : F(Y5V) 0.075max (25V and over) 0.1max (16V, C<1.0㎌) 0.125max(16V, C≥1.0㎌) 0.15max (10V) 0.195max (6.3V)	
			X(X6S) 0.11max (6.3V and below)			
		Insulation Resistance	500 ㏁ or 25㏁·㎌ whichever is smaller.			

RELIABILTY TEST CONDITION

<table>
<tr><th>NO</th><th colspan="2">ITEM</th><th colspan="3">PERFORMANCE</th><th>TEST CONDITION</th></tr>
<tr><td rowspan="11">15</td><td rowspan="11">High Temperature Resistance</td><td>Appearance</td><td colspan="3">No mechanical damage shall occur.</td><td rowspan="11">Applied Voltage : 200%* of the rated voltage
Temperature : max. operating temperature
Duration Time : 1000 +48/-0 Hr.
Charge/Discharge Current : 50㎃ max.

* refer to table(3) : 150%/100% of the rated voltage

Perform the initial measurement according to Note1 for Class Ⅱ

Perform the final measurement according to Note2.</td></tr>
<tr><td rowspan="6">Capacitance</td><td colspan="2">Characteristics</td><td>Capacitance Change</td></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±3% or ±0.3㎊,
Whichever is larger</td></tr>
<tr><td rowspan="4">Class Ⅱ</td><td>A(X5R)/
B(X7R)</td><td>Within ±12.5%</td></tr>
<tr><td>X(X6S)</td><td>Within ±25%</td></tr>
<tr><td rowspan="2">F(Y5V)</td><td>Within ±30%</td></tr>
<tr><td>Within ±30%</td></tr>
<tr><td>Q
(Class Ⅰ)</td><td colspan="3">Capacitance ≥30㎊ : Q ≥ 350
10≤ Capacitance <30 ㎊ : Q ≥ 275 + 2.5×C
Capacitance < 10㎊ :Q ≥200 +10×C (C: Capacitance)</td></tr>
<tr><td rowspan="2">Tan δ
(Class Ⅱ)</td><td colspan="2">1. Characteristic : A(X5R), B(X7R)
0.05max
(16V and over)
0.075max (10V)
0.075max
(6.3V except Table 1)
0.125max*
(refer to Table 1)</td><td>2. Characteristic : F(Y5V)
0.075max
(25V and over)
0.1max(16V, C<1.0㎌)
0.125max(16V, C≥1.0㎌)
0.15max (10V)
0.195max (6.3V)</td></tr>
<tr><td colspan="3">X(X6S) 0.11max (6.3V and below)</td></tr>
<tr><td>Insulation Resistance</td><td colspan="3">1,000 ㏁ or 50㏁·㎌ whichever is smaller.</td></tr>
<tr><td rowspan="9">16</td><td rowspan="9">Temperature Cycle</td><td>Appearance</td><td colspan="3">No mechanical damage shall occur.</td><td rowspan="9">Capacitor shall be subjected to 5 cycles.
Condition for 1 cycle :
<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</td></tr><tr><td>2</td><td>25</td><td>2~3</td></tr><tr><td>3</td><td>Max. operating temp.+3/-0</td><td>30</td></tr><tr><td>4</td><td>25</td><td>2~3</td></tr></table>Leave the capacitor in ambient condition for specified time* before measurement
* 24 ± 2 hours (Class Ⅰ)
24 ± 2 hours (Class Ⅱ)</td></tr>
<tr><td rowspan="5">Capacitance</td><td colspan="2">Characteristics</td><td>Capacitance Change</td></tr>
<tr><td colspan="2">Class Ⅰ</td><td>Within ±2.5% or ±0.25㎊
Whichever is larger</td></tr>
<tr><td rowspan="3">Class Ⅱ</td><td>A(X5R)/
B(X7R)/</td><td>Within ±7.5%</td></tr>
<tr><td>X(X6S)</td><td>Within ±15%</td></tr>
<tr><td>F(Y5V)</td><td>Within ±20%</td></tr>
<tr><td>Q
(Class Ⅰ)</td><td colspan="3">Within the specified initial value</td></tr>
<tr><td>Tan δ
(Class Ⅱ)</td><td colspan="3">Within the specified initial value</td></tr>
<tr><td>Insulation Resistance</td><td colspan="3">Within the specified initial value</td></tr>
</table>

General Capacitors

RELIABILTY TEST CONDITION

No	Recommended Soldering Method					
		Size inch (mm)	Temperature Characteristic	Capacitance	Condition: Flow	Condition: Reflow
18	Recommended Soldering Method By Size & Capacitance	0201 (0603)	-	-	-	○
		0402 (1005)				
		0603 (1608)	Class I	-	○	○
			Class II	C < 1μF	○	○
				C ≥ 1μF	-	○
		0805 (2012)	Class I	-	○	○
			Class II	C < 4.7μF	○	○
				C ≥ 4.7μF	-	○
			Array	-	-	○
		1206 (3216)	Class I	-	○	○
			Class II	C < 10μF	○	○
				C ≥ 10μF	-	○
			Array	-	-	○
		1210 (3225)	-	-	-	○
		1808 (4520)				○
		1812 (4532)				○
		2220 (5750)				○

Note1. Initial Measurement For Class Ⅱ

Perform the heat treatment at 150℃+0/-10℃ for 1 hour. Then Leave the capacitor in ambient condition for 48±4 hours before measurement. Then perform the measurement.

Note2. Latter Measurement

1. CLASS Ⅰ

Leave the capacitor in ambient condition for 24±2 hours before measurement
Then perform the measurement.

2. Class Ⅱ

Perform the heat treatment at 150℃+0/-10℃ for 1 hour. Then Leave the capacitor in ambient condition for 48±4 hours before measurement. Then perform the measurement.

*Table1.

Tan δ	0.125max*
Class Ⅱ A(X5R), B(X7R)	0201 C ≥ 0.022μF 0402 C ≥ 0.22μF 0603 C ≥ 2.2μF 0805 C ≥ 4.7μF 1206 C ≥ 10.0μF 1210 C ≥ 22.0μF 1812 C ≥ 47.0μF 2220 C ≥ 100.0μF All Low Profile Capacitors (P.16).

*Table2.

High Temperature Resistance test	
⊿C (Y5V)	± 30%
Class Ⅱ F(Y5V)	0402 C ≥ 0.47μF 0603 C ≥ 2.2μF 0805 C ≥ 4.7μF 1206 C ≥ 10.0μF 1210 C ≥ 22.0μF 1812 C ≥ 47.0μF 2220 C ≥ 100.0μF

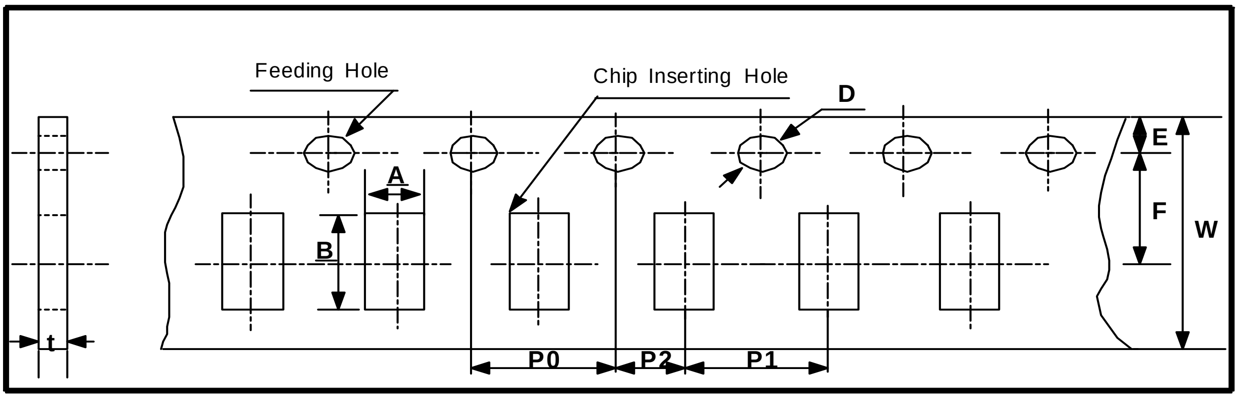
*Table3.

High Temperature Resistance test		
Applied Voltage	100% of the rated voltage	150% of the rated voltage
Class Ⅱ A(X5R), B(X7R), X(X6S), F(Y5V)	0201 C ≥ 0.1μF 0402 C ≥ 1.0μF 0603 C ≥ 4.7μF 0805 C ≥ 22.0μF 1206 C ≥ 47.0μF 1210 C ≥ 100.0μF All Low Profile Capacitors (P.16).	0201 C ≥ 0.022μF 0402 C ≥ 0.47μF 0603 C ≥ 2.2μF 0805 C ≥ 4.7μF 1206 C ≥ 10.0μF 1210 C ≥ 22.0μF 1812 C ≥ 47.0μF 2220 C ≥ 100.0μF

Note3. All Size In Reliability Test Condition Section is "inch"

PACKAGING

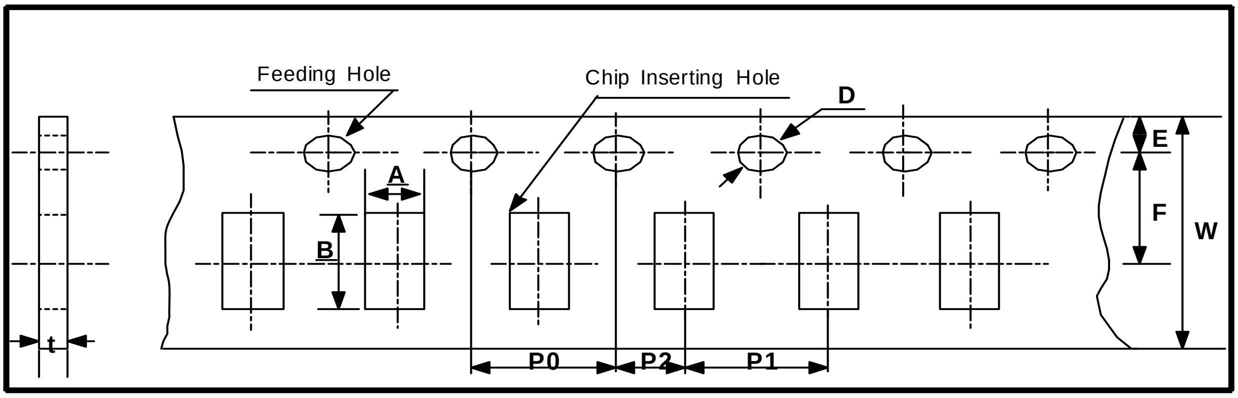
● CARDBOARD PAPER TAPE (4mm)



unit : mm

<table>
<tr><th colspan="2">Symbol
Type</th><th>A</th><th>B</th><th>W</th><th>F</th><th>E</th><th>P1</th><th>P2</th><th>P0</th><th>D</th><th>t</th></tr>
<tr><td rowspan="3">Dimension</td><td>0603
(1608)</td><td>1.1
±0.2</td><td>1.9
±0.2</td><td rowspan="3">8.0
±0.3</td><td rowspan="3">3.5
±0.05</td><td rowspan="3">1.75
±0.1</td><td rowspan="3">4.0
±0.1</td><td rowspan="3">2.0
±0.05</td><td rowspan="3">4.0
±0.1</td><td rowspan="3">Φ1.5
+0.1/-0</td><td rowspan="3">1.1
Below</td></tr>
<tr><td>0805
(2012)</td><td>1.6
±0.2</td><td>2.4
±0.2</td></tr>
<tr><td>1206
(3216)</td><td>2.0
±0.2</td><td>3.6
±0.2</td></tr>
</table>

● CARDBOARD PAPER TAPE (2mm)



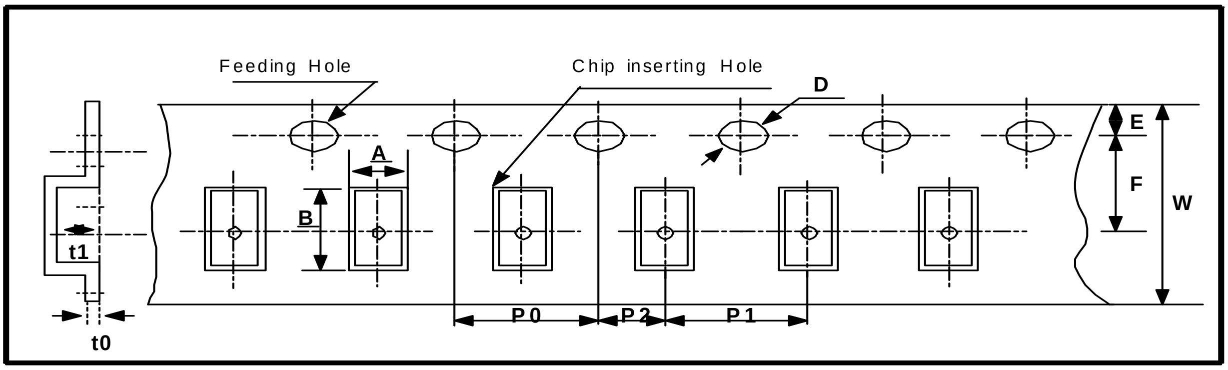
unit : mm

<table>
<tr><th colspan="2">Symbol
Type</th><th>A</th><th>B</th><th>W</th><th>F</th><th>E</th><th>P1</th><th>P2</th><th>P0</th><th>D</th><th>t</th></tr>
<tr><td rowspan="2">Dimension</td><td>0201
(0603)</td><td>0.38
±0.03</td><td>0.68
±0.03</td><td rowspan="2">8.0
±0.3</td><td rowspan="2">3.5
±0.05</td><td rowspan="2">1.75
±0.1</td><td rowspan="2">2.0
±0.05</td><td rowspan="2">2.0
±0.05</td><td rowspan="2">4.0
±0.1</td><td rowspan="2">Φ1.5
+0.1/-0.03</td><td>0.37
±0.03</td></tr>
<tr><td>0402
(1005)</td><td>0.62
±0.04</td><td>1.12
±0.04</td><td>0.6
±0.05</td></tr>
</table>

General Capacitors

PACKAGING

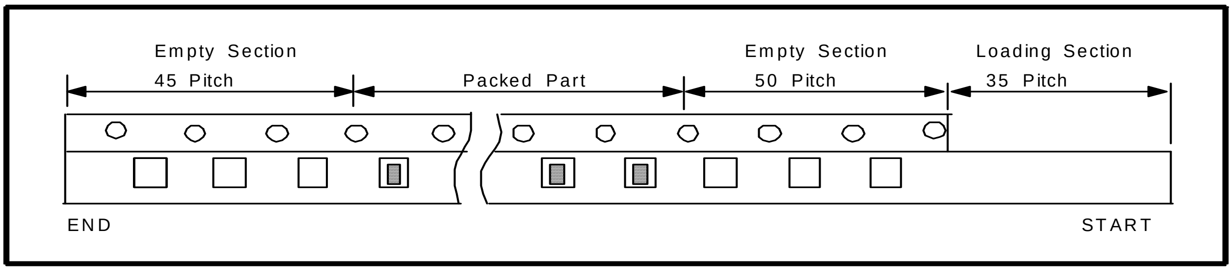
● EMBOSSED PLASTIC TAPE



unit : mm

Symbol / Type		A	B	W	F	E	P1	P2	P0	D	t1	t0
Dimension	0805 (2012)	1.45 ±0.2	2.3 ±0.2	8.0 ±0.3	3.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Φ1.5 +0.1/-0	2.5 max	0.6 Below
	1206 (3216)	1.9 ±0.2	3.5 ±0.2									
	1210 (3225)	2.9 ±0.2	3.7 ±0.2									
	1808 (4520)	2.3 ±0.2	4.9 ±0.2	12.0 ±0.3	5.60 ±0.05		8.0 ±0.1				3.8 max	
	1812 (4532)	3.6 ±0.2	4.9 ±0.2									
	2220 (5750)	5.5 ±0.2	6.2 ±0.2									

● TAPING SIZE

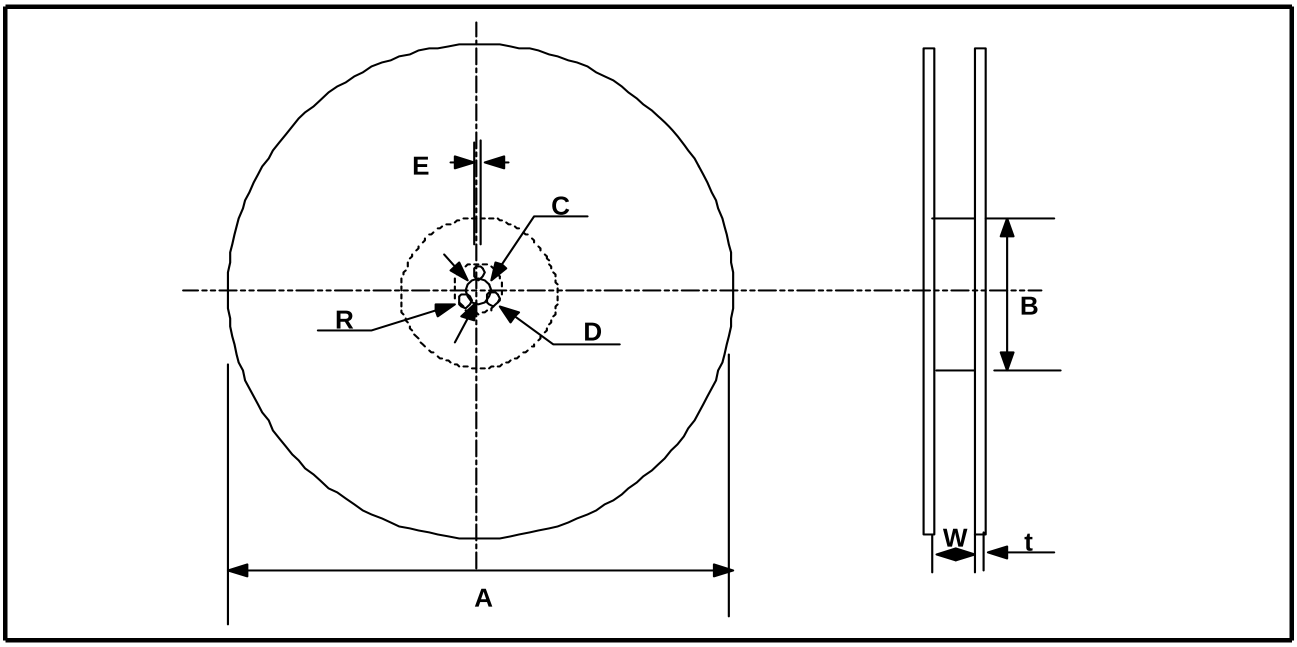


Type	Symbol	Size	Cardboard Paper Tape	Symbol	Size	Embossed Plastic Tape
7" Reel	C	0201(0603)	10,000	E	All Size ≤3216 1210(3225),1808(4520) (t≤1.6mm)	2,000
		0402(1005)	10,000		1210(3225)(t≥2.0mm)	1,000
		OTHERS	4,000		1808(4520)(t≥2.0mm)	1,000
10" Reel	O	-	10,000	-	-	-
13" Reel	D	0402(1005)	50,000	F	All Size ≤3216 1210(3225),1808(4520) (t<1.6mm)	10,000
		OTHERS	10,000		1210(3225)(1.6≤t<2.0mm) 1206(3216)(1.6≤t)	8,000
	L	0603(1608)	10,000 or 15,000		1210(3225),1808(4520) (t≥2.0mm)	4,000
		0805(2012) (t≤0.85mm)	15,000 or 10,000(Option)		1812(4532)(t≤2.0mm)	4,000
		1206(3216) (t≤0.85mm)	10,000		1812(4532)(t>2.0mm) 5750(2220)	2,000

General Capacitors

PACKAGING

● REEL DIMENSION

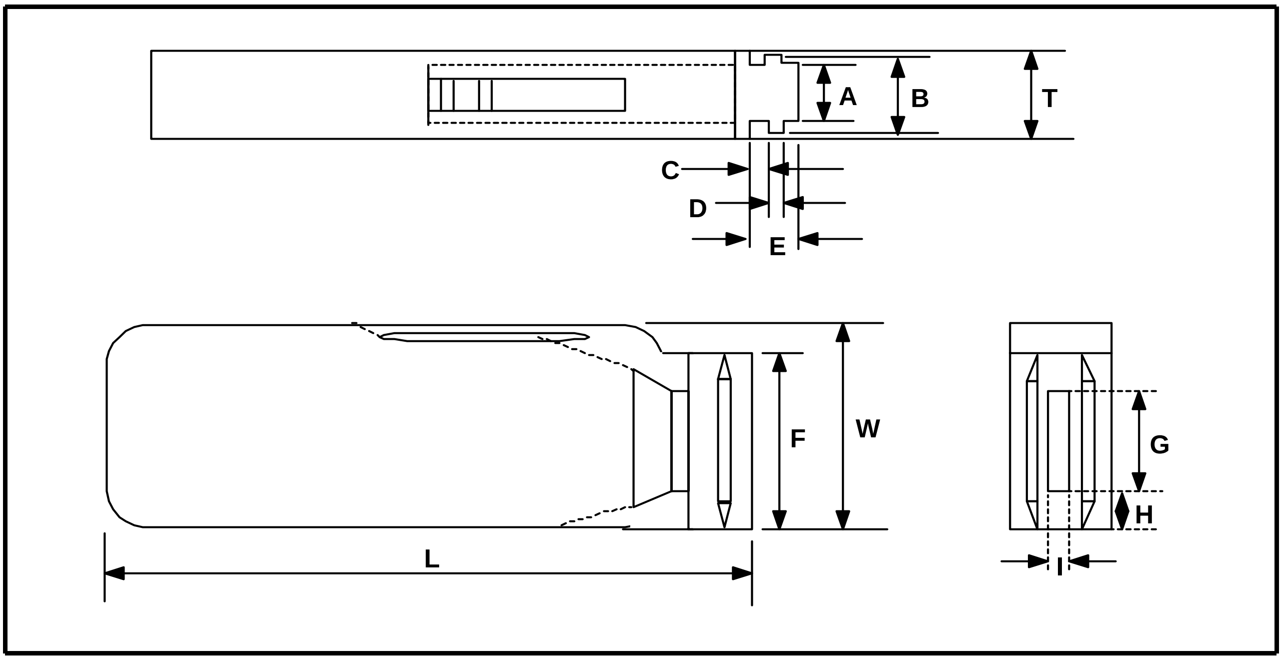


unit : mm

Symbol	A	B	C	D	E	W	t	R
7" Reel	ϕ180+0/ -3	ϕ60+1/ -3	ϕ13±0.3	25±0.5	2.0±0.5	9±1.5	1.2±0.2	1.0
13" Reel	ϕ330±2.0	ϕ80+1/ -3					2.2±0.2	

● BULK CASE PACKAGING

- Bulk case packaging can reduce the stock space and transportation costs.
- The bulk feeding system can increase the productivity.
- It can eliminate the components loss.



unit : mm

Symbol	A	B	T	C	D	E
Dimension	6.8±0.1	8.8±0.1	12±0.1	1.5+0.1/-0	2+0/-0.1	3.0+0.2/-0

Symbol	F	W	G	H	L	I
Dimension	31.5+0.2/-0	36+0/-0.2	19±0.35	7±0.35	110±0.7	5±0.35

● QUANTITY OF BULK CASE PACKAGING

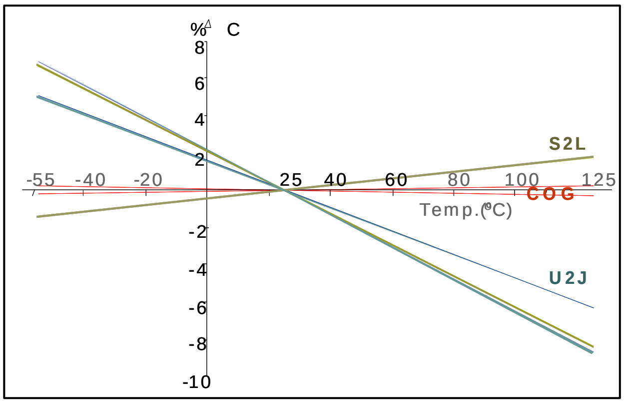
unit : pcs

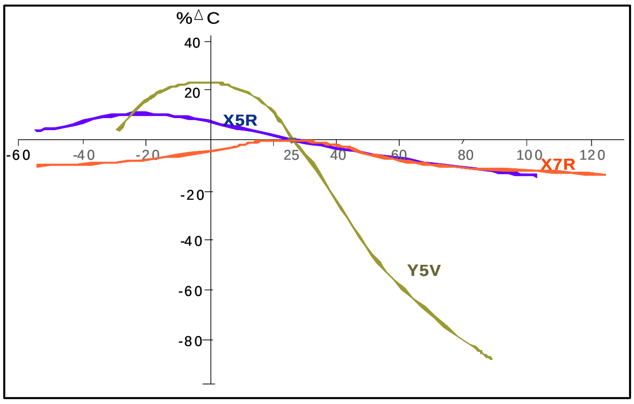
Size	0402(1005)	0603(1608)	0805(2012)	
			T=0.65mm	T=0.85mm
Quantity	50,000	10,000 or 15,000	10,000	5,000 or 10,000

APPLICATION MANUAL

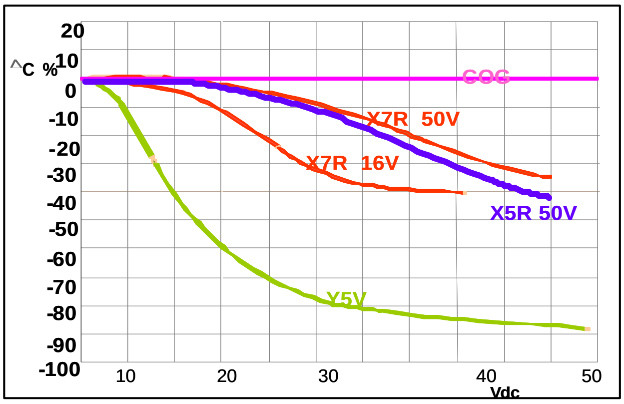
● ELECTRICAL CHARACTERISTICS

▶ CAPACITANCE - TEMPERATURE CHARACTERISTICS

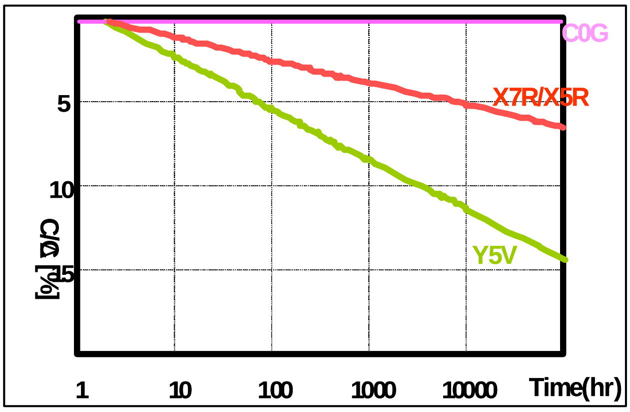




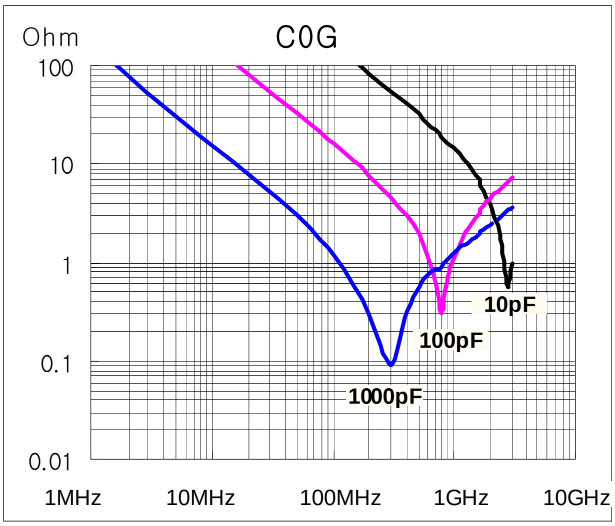
▶ CAPACITANCE - DC VOLTAGE CHARACTERISTICS

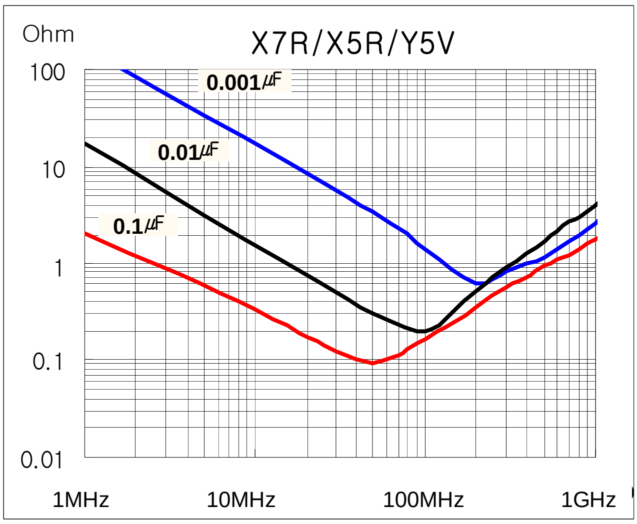


▶ CAPACITANCE CHANGE - AGING



▶ IMPEDANCE - FREQUENCY CHARACTERISTICS





General Capacitors

● STORAGE CONDITION

▶ Storage Environment

The electrical characteristics of MLCCs were degraded by the environment of high temperature or humidity. Therefore, the MLCCs shall be stored in the ambient temperature and the relative humidity of less than 40℃ and 70%, respectively.

Guaranteed storage period is within 6 months from the outgoing date of delivery.

▶ Corrosive Gases

Since the solderability of the end termination in MLCC was degraded by a chemical atmosphere such as chlorine, acid or sulfide gases, MLCCs must be avoid from these gases.

▶ Temperature Fluctuations

Since dew condensation may occur by the differences in temperature when the MLCCs are taken out of storage, it is important to maintain the temperature-controlled environment.

● DESIGN OF LAND PATTERN

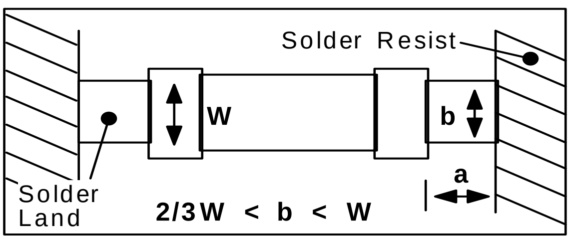
When designing printed circuit boards, the shape and size of the lands must allow for the proper amount of solder on the capacitor.

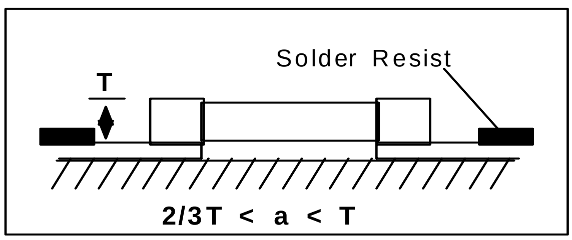
The amount of solder at the end terminations has a direct effect on the crack.

The crack in MLCC will be easily occurred by the tensile stress which was due to too much amount of solder. In contrast, if too little solder is applied, the termination strength will be insufficiently.

Use the following illustrations as guidelines for proper land design.

Recommendation of Land Shape and Size.





● ADHESIVES

When flow soldering the MLCCs, apply the adhesive in accordance with the following conditions.

▶ Requirements for Adhesives

They must have enough adhesion, so that, the chips will not fall off or move during the handling of the circuit board.

They must maintain their adhesive strength when exposed to soldering temperature.

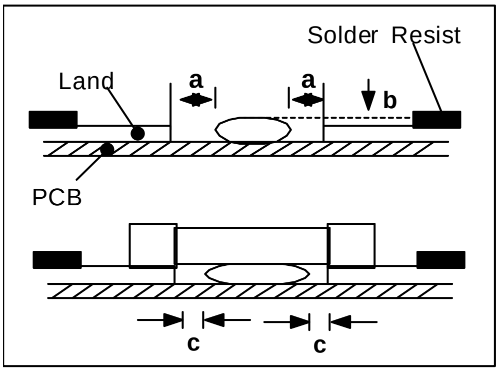
They should not spread or run when applied to the circuit board.

They should harden quickly. They should not corrode the circuit board or chip material.

They should be a good insulator. They should be non-toxic, and not produce harmful gases, nor be harmful when touched.

▶ Application Method

It is important to use the proper amount of adhesive. Too little and much adhesive will cause poor adhesion and overflow into the land, respectively.



unit : mm

Type	21	31
a	0.2 min	0.2 min
b	70~100㎛	70~100㎛
c	> 0	> 0

▶ Adhesive hardening Characteristics

To prevent oxidation of the terminations, the adhesive must harden at 160℃ or less, within 2 minutes or less.

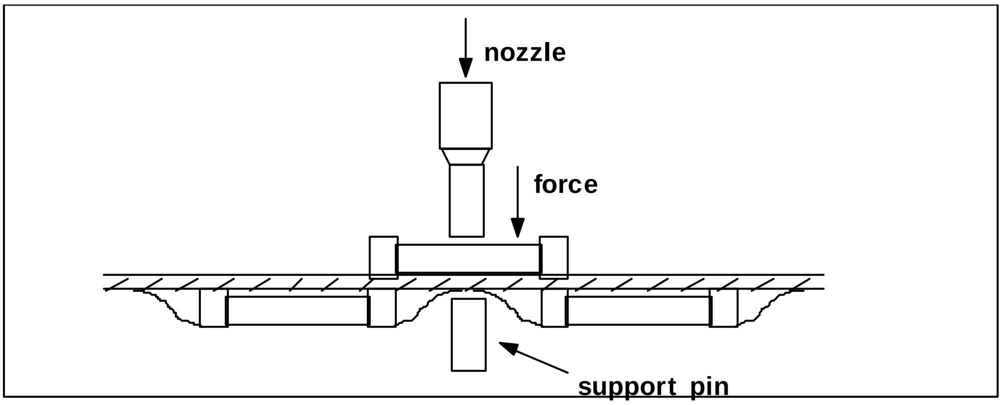
● MOUNTING

▶ Mounting Head Pressure

Excessive pressure will cause crack to MLCCs. The pressure of nozzle will be 300g maximum during mounting.

▶ Bending Stress

When double-sided circuit boards are used, MLCCs first are mounted and soldered onto one side of the board. When the MLCCs are mounted onto the other side, it is important to support the board as shown in the illustration. If the circuit board is not supported, the crack occur to the ready-installed MLCCs by the bending stress.



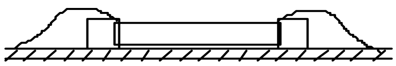
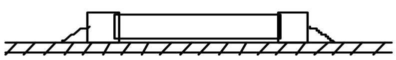
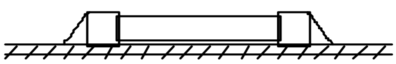
▶ Manual Soldering

Manual soldering can pose a great risk of creating thermal cracks in chip capacitors.

The hot soldering iron tip comes into direct contact with the end terminations, and operator's carelessness may cause the tip of the soldering iron to come into direct contact with the ceramic body of the capacitor.

Therefore the soldering iron must be handled carefully, and close attention must be paid to the selection of the soldering iron tip and to temperature control of the tip.

▶ Amount of Solder

Too much Solder		Cracks tend to occur due to large stress
Not enough Solder		Weak holding force may cause bad connections or detaching of the capacitor
Good		

▶ Cooling

Natural cooling using air is recommended. If the chips are dipped into solvent for cleaning, the temperature difference(△T) must be less than 100℃

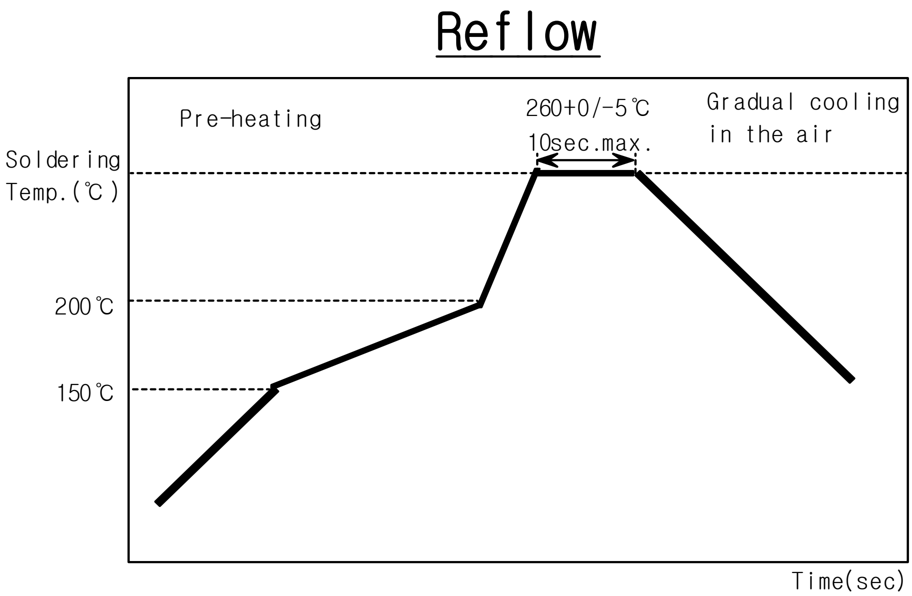
▶ Cleaning

If rosin flux is used, cleaning usually is unnecessary. When strongly activated flux is used, chlorine in the flux may dissolve into some types of cleaning fluids, thereby affecting the chip capacitors. This means that the cleaning fluid must be carefully selected, and should always be new.

▶ Notes for Separating Multiple, Shared PC Boards.

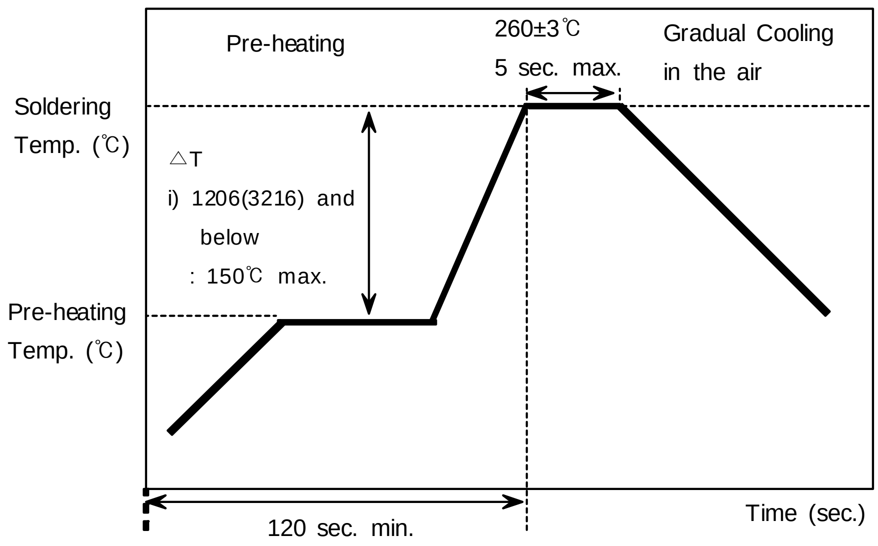
A multi-PC board is separated into many individual circuit boards after soldering has been completed. If the board is bent or distorted at the time of separation, cracks may occur in the chip capacitors. Carefully choose a separation method that minimizes the bending often circuit board.

▶ Recommended Soldering Profile



General Capacitors

Flow



Soldering Iron

Variation of Temp.	Soldering Temp (℃)	Pre-heating Time (Sec)	Soldering Time(Sec)	Cooling Time(Sec)
△T≤130	300±10℃max	≥ 60	≤ 4	-

Condition of Iron facilities		
Wattage	Tip Diameter	Soldering Time
20W Max	3㎜ Max	4 Sec Max

*** Caution - Iron Tip Should Not Contact With Ceramic Body Directly.**

General Capacitors