

# SPECIFICATION

(Reference sheet)

- Supplier : Samsung electro-mechanics
- Product : Multi-layer Ceramic Capacitor

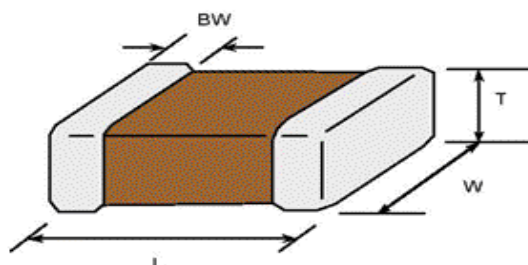
- Samsung P/N : **CL31A226KOCLNNC**
- Description : **CAP, 22uF, 16V, ±10%, X5R, 1206**

## A. Samsung Part Number

**CL** **31** **A** **226** **K** **O** **C** **L** **N** **N** **C**  
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪

① Series	Samsung Multi-layer Ceramic Capacitor									
② Size	1206 (inch code)	L: 3.20 ± 0.20 mm		W: 1.60 ± 0.20 mm						
③ Dielectric	X5R	⑧ Thickness division		Low profile						
④ Capacitance	22 uF	Inner electrode		Ni						
⑤ Capacitance tolerance	±10 %	Termination		Cu						
⑥ Rated Voltage	16 V	⑨ Product		Sn 100% (Pb Free)						
⑦ Thickness	0.85 ± 0.10 mm	⑩ Special		Normal						
		⑪ Packaging		Reserved for future use						
				Cardboard Type, 7" reel						

## B. Structure & Dimension



Samsung P/N	Dimension(mm)			
	L	W	T	BW
CL31A226KOCLNNC	3.20 ± 0.20	1.60 ± 0.20	0.85 ± 0.10	0.50 ± 0.30

### C. Samsung Reliability Test and Judgement Condition

	Judgement	Test condition
Capacitance	Within specified tolerance	120Hz $\pm 20\%$ / $0.5 \pm 0.1V_{rms}$
Tan $\delta$ (DF)	0.1 max.	*A capacitor prior to measuring the capacitance is heat treated at $150^{\circ}C \pm 10^{\circ}C$ for 1hour and maintained in ambient air for $24 \pm 2$ hours.
Insulation Resistance	10,000Mohm or $100Mohm \times \mu F$ Whichever is smaller	Rated Voltage 60~120 sec.
Appearance	No abnormal exterior appearance	Microscope ( $\times 10$ )
Withstanding Voltage	No dielectric breakdown or mechanical breakdown	250% of the rated voltage
Temperature Characteristics	X5R (From $-55^{\circ}C$ to $85^{\circ}C$ , Capacitance change should be within $\pm 15\%$ )	
Adhesive Strength of Termination	No peeling shall be occur on the terminal electrode	500g-f, for $10 \pm 1$ sec.
Bending Strength	Capacitance change : within $\pm 12.5\%$	Bending to the limit (1mm) with 1.0mm/sec.
Solderability	More than 75% of terminal surface is to be soldered newly	SnAg3.0Cu0.5 solder $245 \pm 5^{\circ}C$ , $3 \pm 0.3$ sec. (preheating : $80 \sim 120^{\circ}C$ for 10~30sec.)
Resistance to Soldering Heat	Capacitance change : within $\pm 7.5\%$ Tan $\delta$ , IR : initial spec.	Solder pot : $270 \pm 5^{\circ}C$ , $10 \pm 1$ sec.
Vibration Test	Capacitance change : within $\pm 5\%$ Tan $\delta$ , IR : initial spec.	Amplitude : 1.5mm From 10Hz to 55Hz (return : 1min.) 2hours $\times$ 3 direction (x, y, z)
Moisture Resistance	Capacitance change : within $\pm 12.5\%$ Tan $\delta$ : 0.2 max IR : $500Mohm$ or $12.5Mohm \times \mu F$ Whichever is smaller	With rated voltage $40 \pm 2^{\circ}C$ , 90~95%RH, 500+12/-0hrs
High Temperature Resistance	Capacitance change : within $\pm 12.5\%$ Tan $\delta$ : 0.2 max IR : $1,000Mohm$ or $25Mohm \times \mu F$ Whichever is smaller	With 100% of the rated voltage Max. operating temperature 1,000+48/-0hrs
Temperature Cycling	Capacitance change : within $\pm 7.5\%$ Tan $\delta$ , IR : initial spec.	1 cycle condition Min. operating temperature $\rightarrow 25^{\circ}C$ $\rightarrow$ Max. operating temperature $\rightarrow 25^{\circ}C$  5 cycle test

※ The reliability test condition can be replaced by the corresponding accelerated test condition.

### D. Recommended Soldering method :

Reflow ( Reflow Peak Temperature :  $260 \pm 5^{\circ}C$ , 30sec. )



Product specifications included in the specifications are effective as of March 1, 2013.

Please be advised that they are standard product specifications for reference only.

We may change, modify or discontinue the product specifications without notice at any time.

So, you need to approve the product specifications before placing an order.

Should you have any question regarding the product specifications,

please contact our sales personnel or application engineers.

# 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**  
**① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪**

- |  |                            |
|--|----------------------------|
| ① Samsung Multilayer Ceramic Capacitor   | ⑦ Thickness Option         |
| ② Size(mm)                               | ⑧ Product & Plating Method |
| ③ Capacitance Temperature Characteristic | ⑨ Samsung Control Code     |
| ④ Nominal Capacitance                    | ⑩ Reserved For Future Use  |
| ⑤ Capacitance Tolerance                  | ⑪ Packaging Type           |
| ⑥ Rated Voltage                          |                            |

### ① Samsung Multilayer Ceramic Capacitor

### ② 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

### ③ CAPACITANCE TEMPERATURE CHARACTERISTIC

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

#### ※ Temperature Characteristic

Temperature Characteristics	Below 2.0pF	2.2 ~ 3.9pF	Above 4.0pF	Above 10pF
C△	C0G	C0G	C0G	C0G
P△	-	P2J	P2H	P2H
R△	-	R2J	R2H	R2H
S△	-	S2J	S2H	S2H
T△	-	T2J	T2H	T2H
U△	-	U2J	U2J	U2J

J :  $\pm 120\text{PPM}/^{\circ}\text{C}$ , H :  $\pm 60\text{PPM}/^{\circ}\text{C}$ , G :  $\pm 30\text{PPM}/^{\circ}\text{C}$

### ④ 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, 0.01 $\mu\text{F}$
104	100,000pF, 100nF, 0.1 $\mu\text{F}$

## ⑤ CAPACITANCE TOLERANCE

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

## ⑥ 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		

## 7 THICKNESS OPTION

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

General Capacitors

## 8 PRODUCT & PLATING METHOD

Code	Electrode	Termination	Plating Type
<b>A</b>	Pd	Ag	Sn_100%
<b>N</b>	Ni	Cu	Sn_100%
<b>G</b>	Cu	Cu	Sn_100%

## 9 SAMSUNG CONTROL CODE

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

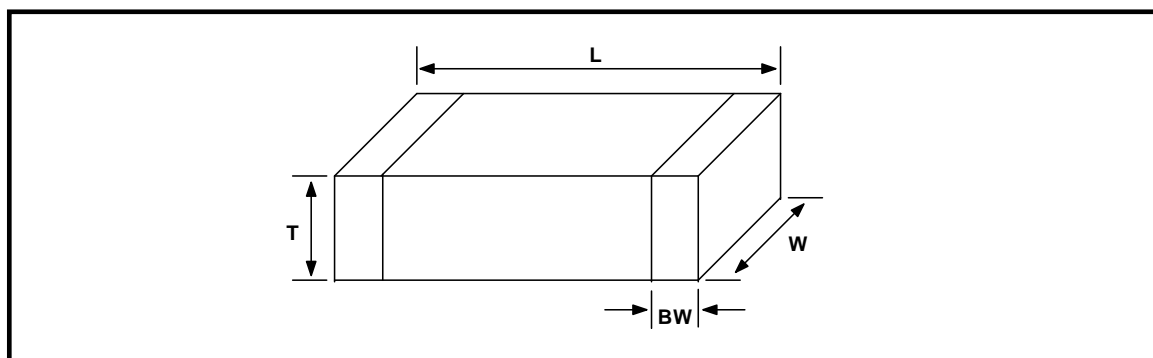
## Ⓜ RESERVED FOR FUTURE USE

Code	Description of the code
N	Reserved for future use

## Ⓜ 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"	O	Paper 10"
D	Paper 13" (10,000EA)	S	Embossing 10"
E	Embossing 7"		

## APPEARANCE AND DIMENSION



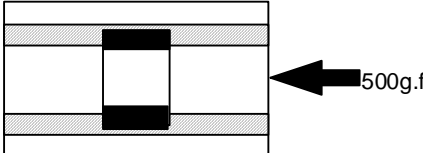
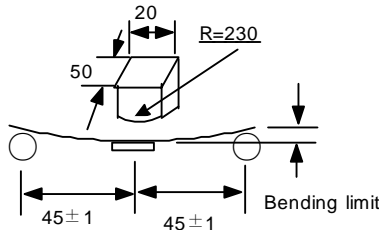
CODE	EIA CODE	DIMENSION ( mm )			
		L	W	T (MAX)	BW
03	0201	0.6 ± 0.03	0.3 ± 0.03	0.33	0.15 ± 0.05
05	0402	1.0 ± 0.05	0.5 ± 0.05	0.55	0.2 +0.15/-0.1
10	0603	1.6 ± 0.1	0.8 ± 0.1	0.9	0.3 ± 0.2
21	0805	2.0 ± 0.1	1.25 ± 0.1	1.35	0.5 +0.2/-0.3
31	1206	3.2 ± 0.15	1.6 ± 0.15	1.40	0.5 +0.2/-0.3
		3.2 ± 0.2	1.6 ± 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

## RELIABILITY TEST CONDITION

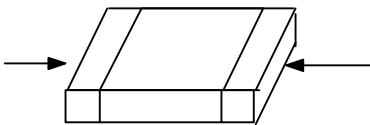
NO	ITEM		PERFORMANCE	TEST CONDITION		
1	Appearance		No Abnormal Exterior Appearance	Through Microscope(×10)		
2	Insulation Resistance		10,000MΩ or 500MΩ·μF whichever is smaller  Rated Voltage is below 16V ; 10,000MΩ or 100MΩ·μF whichever is smaller	Apply the Rated Voltage For 60 ~ 120 Sec.		
3	Withstanding Voltage		No Dielectric Breakdown or Mechanical Breakdown	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 50mA current		
4	Capacitance	ClassⅠ	Within the specified tolerance	Capacitance	Frequency	Voltage
				≤ 1,000 pF	1kHz ±10%	0.5 ~ 5 Vrms
				>1,000 pF	1kHz ±10%	
		ClassⅡ	Within the specified tolerance	Capacitance	Frequency	Voltage
				≤ 10 μF	1kHz ±10%	1.0±0.2Vrms
				>10 μF	120Hz ±20%	0.5±0.1Vrms
5	Q	ClassⅠ	Capacitance ≥ 30pF : Q ≥ 1,000 			



## RELIABILITY TEST CONDITION

NO	ITEM		PERFORMANCE		TEST CONDITION																												
7	Temperature Characteristics of Capacitance	Class I	<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>		Characteristics	Temp. Coefficient (PPM/℃)	C0G	0 ± 30	PH	-150 ± 60	RH	-220 ± 60	SH	-330 ± 60	TH	-470 ± 60	UL	-750 ± 120	SL	+350 ~ -1000	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>	Step	Temp.(℃)	1	25 ± 2	2	Min. operating temp. ± 2	3	25 ± 2	4	Max. operating temp ± 2	5	25 ± 2
			Characteristics	Temp. Coefficient (PPM/℃)																													
			C0G	0 ± 30																													
			PH	-150 ± 60																													
RH	-220 ± 60																																
SH	-330 ± 60																																
TH	-470 ± 60																																
UL	-750 ± 120																																
SL	+350 ~ -1000																																
Step	Temp.(℃)																																
1	25 ± 2																																
2	Min. operating temp. ± 2																																
3	25 ± 2																																
4	Max. operating temp ± 2																																
5	25 ± 2																																
Class II	<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>		Characteristics	Capacitance Change with No Bias	A(X5R)/B(X7R)	± 15%	X(X6S)	± 22%	F(Y5V)	+22% ~ -82%	(1) Class I Temperature Coefficient shall be calculated from the formula as below. $\text{Temp. Coefficient} = \frac{C2 - C1}{C1 \times \Delta T} \times 10^6 \text{ [ppm/℃]}$ <p>C1; Capacitance at step 3 C2: Capacitance at 85℃ ΔT: 60℃(=85℃-25℃)</p> <p>(2) CLASS II Capacitance Change shall be calculated from the formula as below. <math display="block">\Delta C = \frac{C2 - C1}{C1} \times 100(\%)</math><p>C1; Capacitance at step 3 C2: Capacitance at step 2 or 4</p></p>																						
	Characteristics	Capacitance Change with No Bias																															
	A(X5R)/B(X7R)	± 15%																															
	X(X6S)	± 22%																															
F(Y5V)	+22% ~ -82%																																
8	Adhesive Strength of Termination	No Indication Of Peeling Shall Occur On The Terminal Electrode.		Apply 500g.f * Pressure for 10± 1 sec. * 200g.f for 0201 case size. 																													
		9	Bending Strength	Apperance	No mechanical damage shall occur.	Bending limit ; 1mm Test speed ; 1.0mm/SEC.																											
Capacitance	<table><tr><th>Characteristics</th><th>Capacitance Change</th></tr><tr><td>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>			Characteristics	Capacitance Change	Class I	Within ± 5% or ± 0.5 pF whichever is larger	Class II	A(X5R)/B(X7R)/X(X6S)	Within ± 12.5%	F(Y5V)	Within ± 30%	Keep the test board at the limit point in 5 sec., Then measure capacitance. 																				
	Characteristics			Capacitance Change																													
	Class I			Within ± 5% or ± 0.5 pF whichever is larger																													
Class II	A(X5R)/B(X7R)/X(X6S)	Within ± 12.5%																															
	F(Y5V)	Within ± 30%																															

## RELIABILITY TEST CONDITION

NO	ITEM		PERFORMANCE		TEST CONDITION													
10	Solderability		<div>More Than 75% of the terminal surface is to be soldered newly, So metal part does not come out or dissolve</div> <div></div>		Solder	Sn-3Ag-0.5Cu	63Sn-37Pb											
					Solder Temp.	245±5℃	235±5℃											
					Flux	RMA Type												
					Dip Time	3±0.3 sec.	5±0.5 sec.											
					Pre-heating	at 80~120℃ for 10~30 sec.												
11	Resistance to Soldering heat	Apperance	No mechanical damage shall occur.		Solder Temperature : 270±5℃													
		Capacitance	Characteristics		Capacitance Change		Dip Time : 10±1 sec.											
			Class I		Within ±2.5% or ±0.25 pF whichever is larger		Each termination shall be fully immersed and preheated as below :											
			Class II	A(X5R)/B(X7R)	Within ±7.5%		<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>			STEP	TEMP.(℃)	TIME(SEC.)	1	80~100	60	2	150~180	60
				STEP	TEMP.(℃)	TIME(SEC.)												
				1	80~100	60												
		2	150~180	60														
		X(X6S)	Within ±15%															
		F	Within ±20%															
	Q (Class I)	Capacitance ≥ 30 pF : Q ≥ 1000 																

## RELIABILITY TEST CONDITION

NO	ITEM	PERFORMANCE		TEST CONDITION
13	Humidity (Steady State)	Appearance	No mechanical damage shall occur.	
		Capacitance	Characteristics	Capacitance Change
			Class I	Within $\pm 5.0\%$ or $\pm 0.5\mu\text{F}$ whichever is larger
			Class II	Within $\pm 12.5\%$
				Within $\pm 30\%$
		Q CLASS I	Capacitance $\geq 30\mu\text{F}$ : $Q \geq 350$ $10 \leq \text{Capacitance} < 30\mu\text{F}$ : $Q \geq 275 + 2.5 \times C$ Capacitance $< 10\mu\text{F}$ : $Q \geq 200 + 10 \times C$ (C: Capacitance)	
		Tan $\delta$ 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, $C < 1.0\mu\text{F}$ ) 0.125max(16V, $C \geq 1.0\mu\text{F}$ ) 0.15max (10V) 0.195max (6.3V)
		Insulation Resistance	1,000 $\text{M}\Omega$ or $50\text{M}\Omega \cdot \mu\text{F}$ whichever is smaller.	
14	Moisture Resistance	Appearance	No mechanical damage shall occur.	
		Capacitance	Characteristics	Capacitance Change
			Class I	Within $\pm 5.0\%$ or $\pm 0.5\mu\text{F}$ whichever is larger
			Class II	Within $\pm 12.5\%$
				Within $\pm 30\%$
			F(Y5V)	Within $\pm 30\%$
				Within $\pm 30\%$
		Q (Class I)	Capacitance $\geq 30\mu\text{F}$ : $Q \geq 200$ Capacitance $< 30\mu\text{F}$ : $Q \geq 100 + 10/3 \times C$ (C: Capacitance)	
		Tan $\delta$ (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, $C < 1.0\mu\text{F}$ ) 0.125max(16V, $C \geq 1.0\mu\text{F}$ ) 0.15max (10V) 0.195max (6.3V)
		X(X6S) 0.11max (6.3V and below)		
		Insulation Resistance	500 $\text{M}\Omega$ or $25\text{M}\Omega \cdot \mu\text{F}$ whichever is smaller.	

Temperature :  $40 \pm 2^\circ\text{C}$   
 Relative humidity : 90~95 %RH  
 Duration time : 500 +12/-0 hr.  
 Leave the capacitor in ambient condition for specified time\* before measurement.  
 CLASS I : 24 $\pm$ 2 Hr.  
 CLASS II : 24 $\pm$ 2 Hr.

Applied Voltage : rated voltage  
 Temperature :  $40 \pm 2^\circ\text{C}$   
 Humidity : 90~95%RH  
 Duration Time : 500 +12/-0 Hr.  
 Charge/Discharge Current : 50mA max.  
 Perform the initial measurement according to Note1.  
 Perform the final measurement according to Note2.

## RELIABILITY TEST CONDITION

NO	ITEM		PERFORMANCE		TEST CONDITION														
15	High Temperature Resistance	Appearance	No mechanical damage shall occur.		Applied Voltage : 200%* of the rated voltage Temperature : max. operating temperature Duration Time : 1000 +48/-0 Hr. Charge/Discharge Current : 50mA 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.														
		Capacitance	Characteristics		Capacitance Change														
			Class I		Within ±3% or ±0.3pF, Whichever is larger														
			Class II	A(X5R)/ B(X7R)	Within ±12.5%														
				X(X6S)	Within ±25%														
				F(Y5V)	Within ±30%														
					Within ±30%														
		Q (Class I)	Capacitance ≥30pF : Q ≥ 350 10≤ Capacitance <30 pF : 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<1.0μF) 0.125max(16V, C≥ 1.0μF) 0.15max (10V) 0.195max (6.3V)															
			X(X6S) 0.11max (6.3V and below)																
Insulation Resistance	1,000 MΩ or 50MΩ·μF whichever is smaller.																		
16	Temperature Cycle	Appearance	No mechanical damage shall occur.		Capacitor shall be subjected to 5 cycles. Condition for 1 cycle :														
		Capacitance	Characteristics		Capacitance Change														
			Class I		Within ±2.5% or ±0.25pF Whichever is larger														
			Class II	A(X5R)/ B(X7R)/	Within ±7.5%														
				X(X6S)	Within ±15%														
				F(Y5V)	Within ±20%														
				Q (Class I)	Within the specified initial value														
		Tan δ (Class II)	Within the specified initial value																
		Insulation Resistance	Within the specified initial value																
				<table><tr><td>Step</td><td>Temp.(℃)</td><td>Time(min.)</td></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>			Step	Temp.(℃)	Time(min.)	1	Min. operating temp.+0/-3	30	2	25	2~3	3	Max. operating temp.+3/-0	30	4
Step	Temp.(℃)	Time(min.)																	
1	Min. operating temp.+0/-3	30																	
2	25	2~3																	
3	Max. operating temp.+3/-0	30																	
4	25	2~3																	
		Leave the capacitor in ambient condition for specified time* before measurement * 24 ± 2 hours (Class I) 24 ± 2 hours (Class II)																	

## RELIABILITY TEST CONDITION

Recommended Soldering Method						
18	Recommended Soldering Method By Size & Capacitance	Size inch (mm)	Temperature Characteristic	Capacitance	Condition	
					Flow	Reflow
		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  $150^{\circ}\text{C} \pm 0/-10^{\circ}\text{C}$  for 1 hour. Then Leave the capacitor in ambient condition for  $48 \pm 4$  hours before measurement. Then perform the measurement.

### Note2. Latter Measurement

#### 1. CLASS I

Leave the capacitor in ambient condition for  $24 \pm 2$  hours before measurement

Then perform the measurement.

#### 2. Class II

Perform the heat treatment at  $150^{\circ}\text{C} \pm 0/-10^{\circ}\text{C}$  for 1 hour. Then Leave the capacitor in ambient condition for  $48 \pm 4$  hours before measurement.

Then perform the measurement.

\*Table1.

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

\*Table2.

High Temperature Resistance test	
$\Delta C$ (Y5V)	$\pm 30\%$
Class II F(Y5V)	0402 $C \geq 0.47\mu F$
	0603 $C \geq 2.2\mu F$
	0805 $C \geq 4.7\mu F$
	1206 $C \geq 10.0\mu F$
	1210 $C \geq 22.0\mu F$
	1812 $C \geq 47.0\mu F$
	2220 $C \geq 100.0\mu F$

\*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 $C \geq 0.1\mu F$	0201 $C \geq 0.022\mu F$
	0402 $C \geq 1.0\mu F$	0402 $C \geq 0.47\mu F$
	0603 $C \geq 4.7\mu F$	0603 $C \geq 2.2\mu F$
	0805 $C \geq 22.0\mu F$	0805 $C \geq 4.7\mu F$
	1206 $C \geq 47.0\mu F$	1206 $C \geq 10.0\mu F$
	1210 $C \geq 100.0\mu F$	1210 $C \geq 22.0\mu F$
	All Low Profile Capacitors (P.16).	1812 $C \geq 47.0\mu F$
		2220 $C \geq 100.0\mu F$

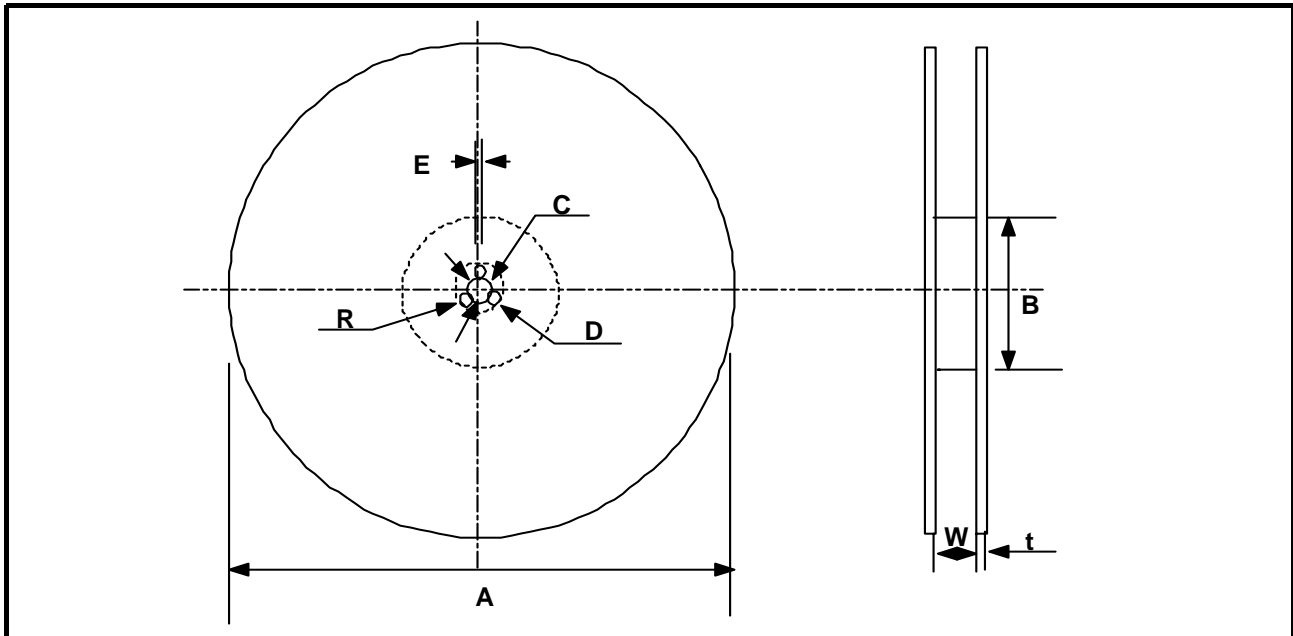
Note3. All Size In Reliability Test Condition Section is "inch"





## PACKAGING

### ● REEL DIMENSION



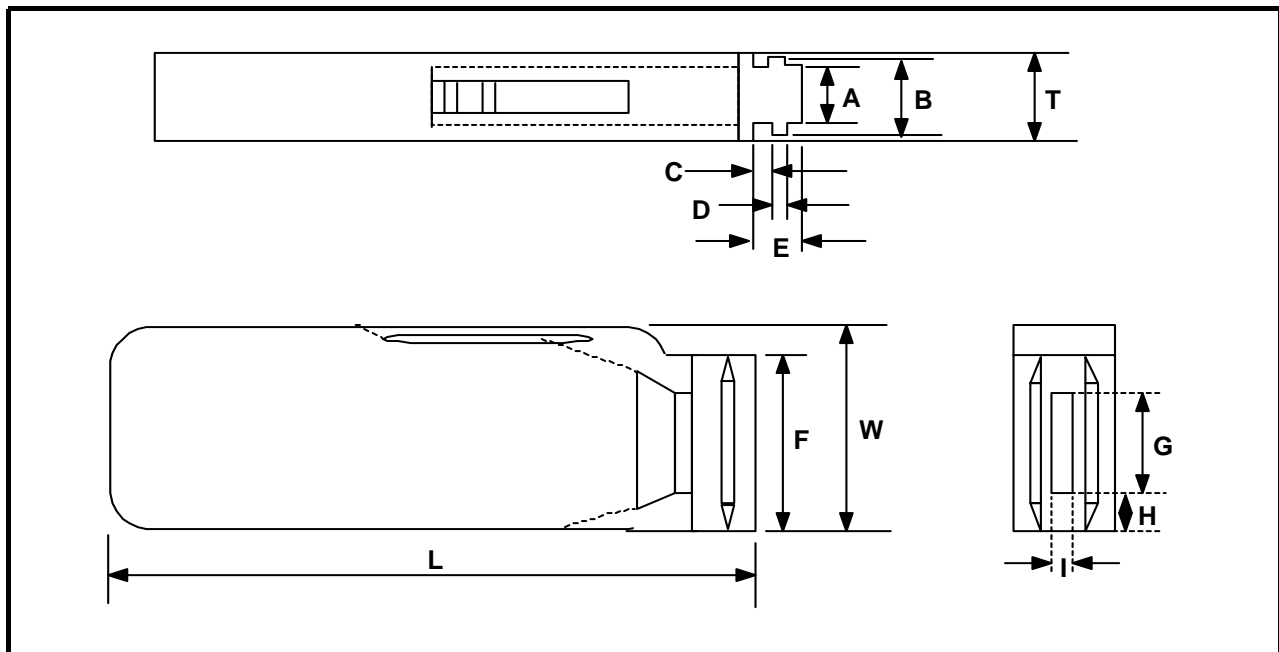
unit : mm

Symbol	A	B	C	D	E	W	t	R
7" Reel	$\phi 180+0/-3$	$\phi 60+1/-3$	$\phi 13\pm 0.3$	$25\pm 0.5$	$2.0\pm 0.5$	$9\pm 1.5$	$1.2\pm 0.2$	1.0
13" Reel	$\phi 330\pm 2.0$	$\phi 80+1/-3$					$2.2\pm 0.2$	



## ● 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	$6.8 \pm 0.1$	$8.8 \pm 0.1$	$12 \pm 0.1$	$1.5 + 0.1/-0$	$2 + 0/-0.1$	$3.0 + 0.2/-0$

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

## ● QUANTITY OF BULK CASE PACKAGING

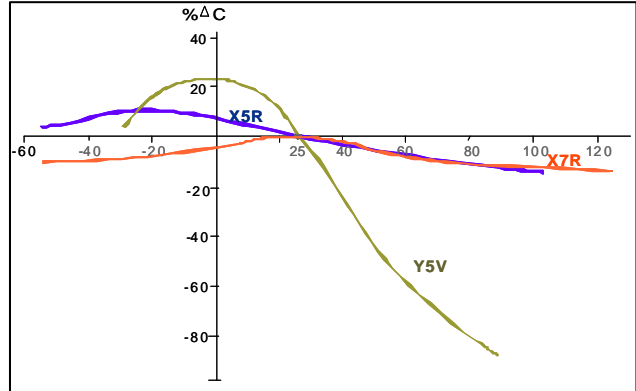
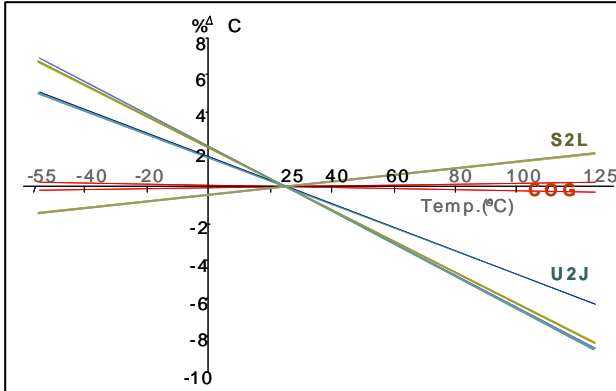
unit : pcs

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

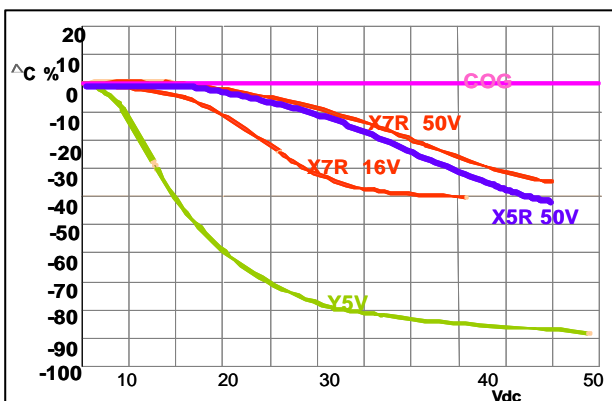
## APPLICATION MANUAL

### ● ELECTRICAL CHARACTERISTICS

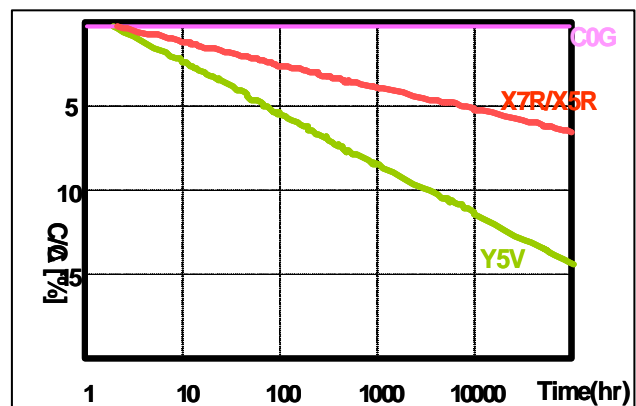
#### ► CAPACITANCE - TEMPERATURE CHARACTERISTICS



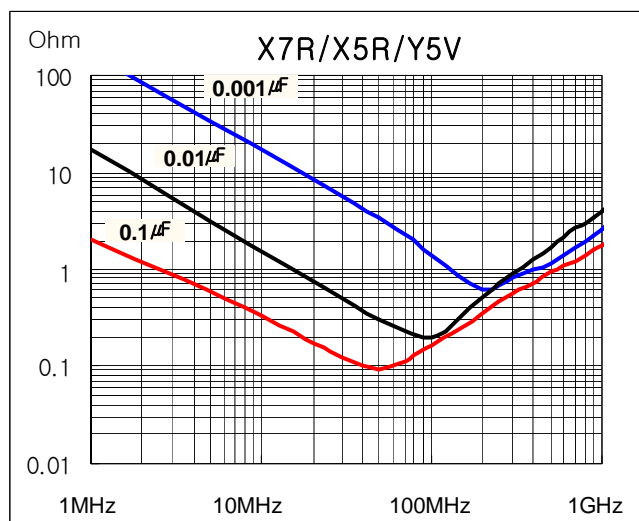
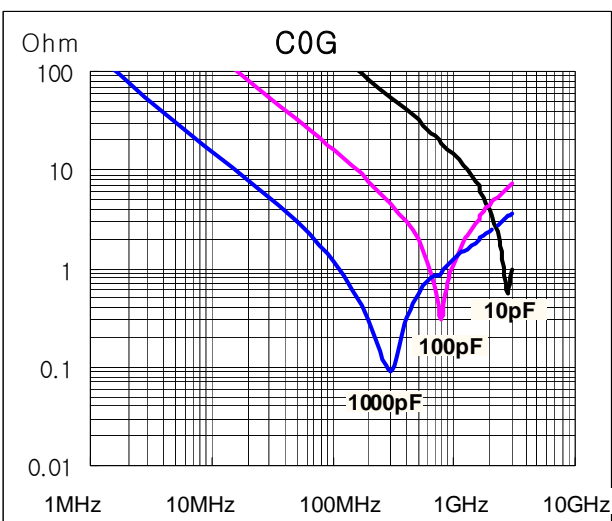
#### ► CAPACITANCE - DC VOLTAGE CHARACTERISTICS



#### ► CAPACITANCE CHANGE - AGING



#### ► IMPEDANCE - FREQUENCY CHARACTERISTICS



## ● 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°C 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

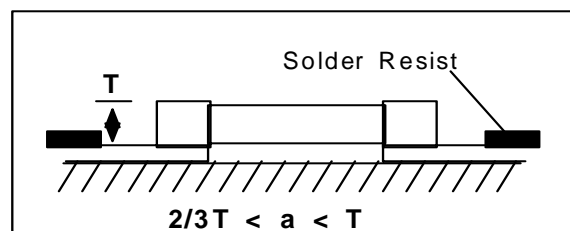
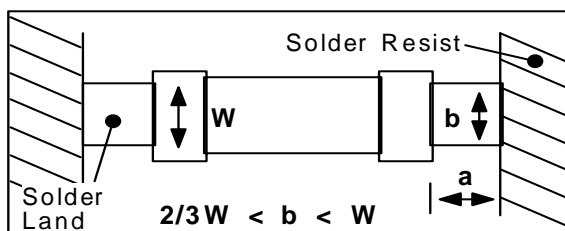
When designing printed circuit boards, the shape and size of the lands must allow for the proper amount of solder on the capacitor.

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.

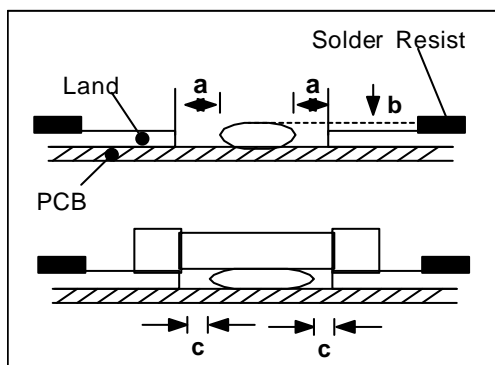
They should not spread or run when applied to the circuit board.

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 $\mu\text{m}$	70~100 $\mu\text{m}$
c	> 0	> 0

### ► Adhesive hardening Characteristics

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

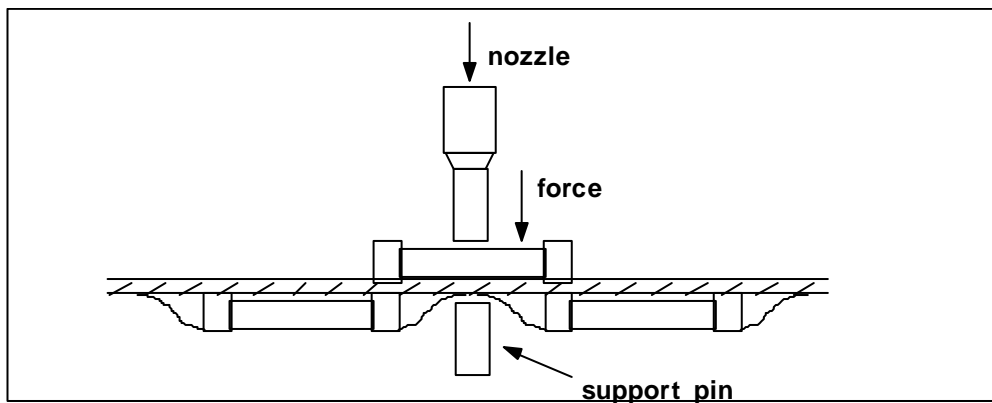
## ● MOUNTING

### ► 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.



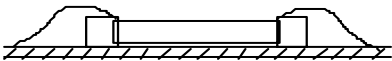
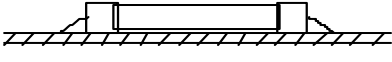
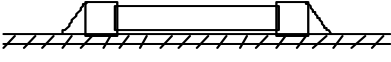
## ► Manual Soldering

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( $\Delta T$ ) must be less than 100°C

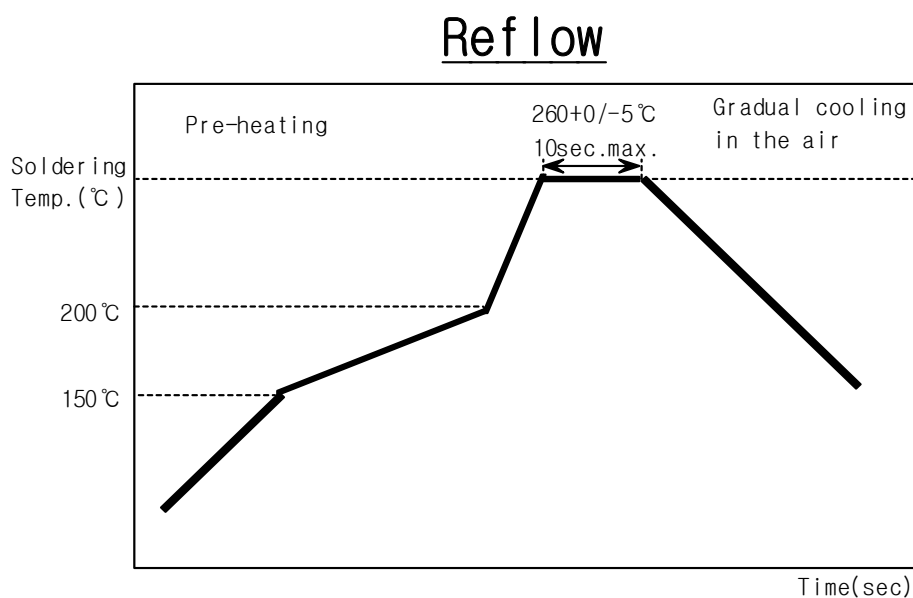
## ► Cleaning

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.

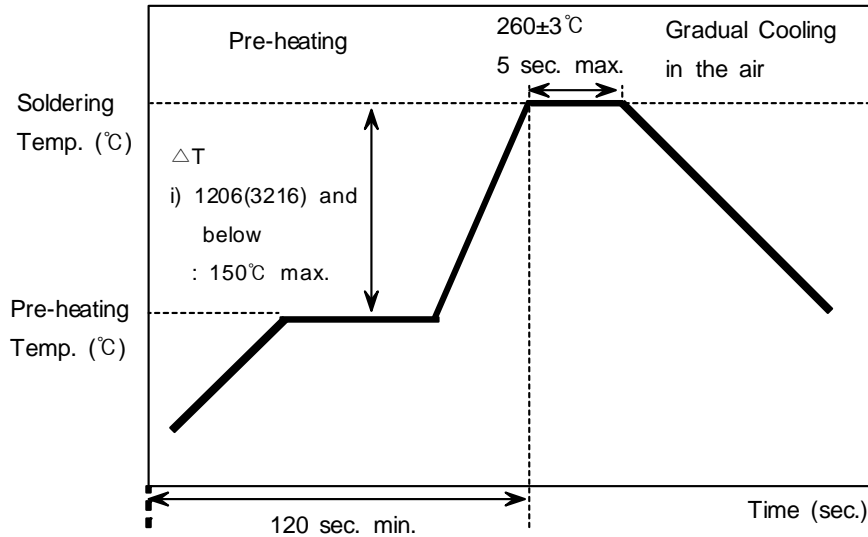
## ► Notes for Separating Multiple, Shared PC Boards.

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 of circuit board.

## ► Recommended Soldering Profile



## Flow



## Soldering Iron

Variation of Temp.	Soldering Temp (°C)	Pre-heating Time (Sec)	Soldering Time(Sec)	Cooling Time(Sec)
$\Delta T \leq 130$	300±10°C max	≥ 60	≤ 4	-

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

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