Part Number System

Scope

This specification is applies to Multilayer Ceramic Chip Capacitor (MLCC) for use in electric equipment for the voltage is ranging from 6.3V to 2000V.

The MLCC support for Lead-Free wave and reflow soldering, and electrical characteristic and reliability are same as before. **(This product compliant with the RoHS.)**

C 1206 X7R 102 K 202 N T B

Product Code

MLCC

Size Type Code

（GB/IEC/EIA）

0201；0402；0603；0805；1206；1210；1808；1812；2220；2225

T. C.

C0G（NP0）:	0±30ppm/℃	-55℃ ~ +125℃
HQC:	0±30ppm/℃	-55℃ ~ +125℃
X7R:	±15%	-55℃ ~ +125℃
X5R:	±15%	-55℃ ~ +85℃
Y5V:	+22/-82%	-30℃ ~ +85℃

Capacitance Code

The capacitance code is expressed in pico-farads and identified by a three-digit number. The first two digits represent significant figures. The last digit specifies the number of zeros.

(Example：104=100000pF； 4R7=4.7pF；0R5=0.5pF；)

Tolerance Code

A：±0.05pF	B：±0.1pF	C：±0.25 pF	D：±0.5pF
F：±1%	G：±2%	J：±5%	K：±10%
L：±15%	M：±20%	Z：+80/-20%	

Rate Voltage Code

The first two digits represent significant figures, the last digit specifies the number of zeros.

6R3=6.3V；100=10V；160=16V；250=25V；500=50V；101=100V

251=250V；501=500V; 631=630V; 102=1KV; 202=2KV

Termination

"N" represents Ag (or Cu)/Ni/Sn structure and "S" represents silver.

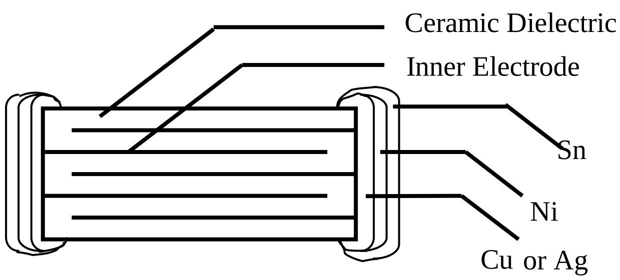
Packaging Code

Details are shown in Table1.

Thickness Code

Products should be marked with the Thinkness code (Named T in the below),except when describing the following: A（0.30±0.03） for 0201,B（0.50±0.05） for 0402 T, D （0.80±0.10 ） for 0603 T, Thickness code "A、B、D" can be ignore，Other products must be added the thickness of the thickness of code.

Structure & Dimension



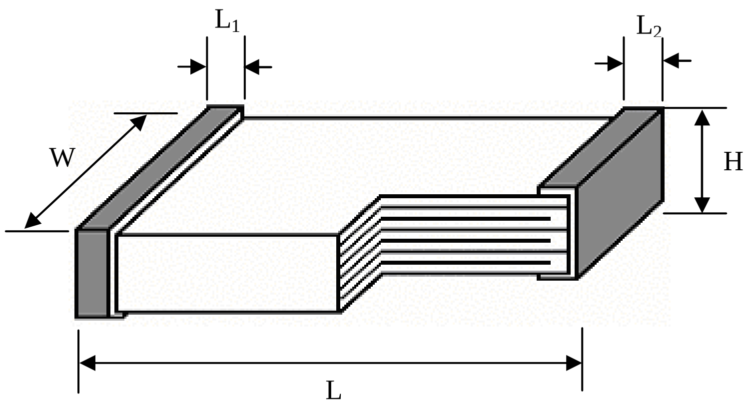
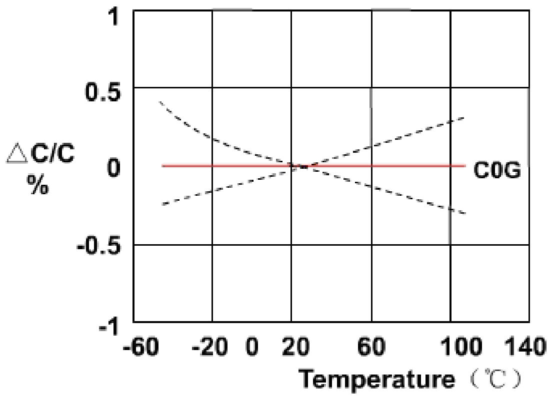


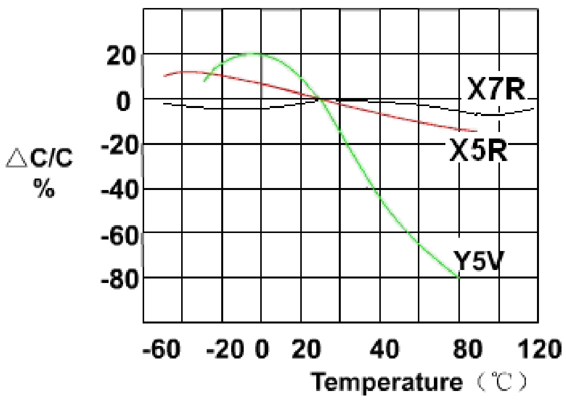
Figure 1 Dimension and Cross-section of MLCC

GB/IEC/EIA （JIS/EIAJ）	L/mm	W/mm	H（Min/Max）/mm	L_1（Min/Max）/mm
0201 （0603）	0.6±0.03	0.3±0.03	0.27/0.33	0.05/0.20
0402 （1005）	1.0±0.05	0.5±0.05	0.45/0.55	0.10/0.35
0603 （1608）	1.6±0.10	0.8±0.10	0.70/0.90	0.15/0.60
0805 （2012）	2.0±0.10	1.25±0.10	0.50/1.45	0.20/0.75
1206 （3216）	3.2±0.10	1.6±0.10	0.50/1.80	0.25/0.80
1210 （3225）	3.2±0.30	2.5±0.20	0.90/2.80	0.30/0.80
1808 （4520）	4.5±0.30	2.0±0.20	1.40/2.80	0.30/1.50
1812 （4532）	4.5±0.30	3.2±0.30	1.05/2.80	0.30/1.50
2220 （5750）	5.7±0.40	5.0±0.40	1.80/3.00	0.30/1.10
2225 （5763）	5.7±0.40	6.4±0.40	1.80/3.00	0.30/1.10

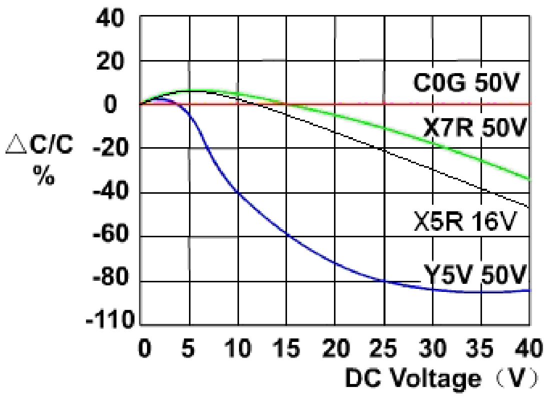
Electrical Characteristics

CAPACITANCE-TEMPERATURE CHARACTERISTICS

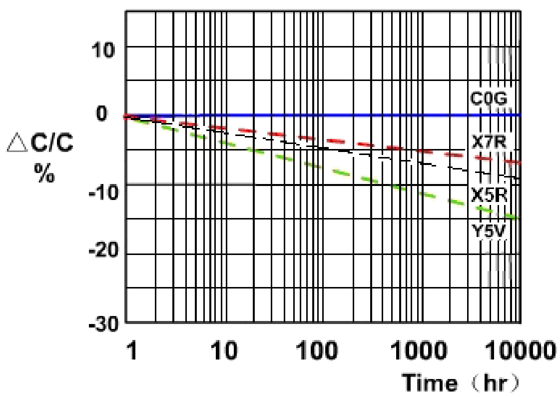




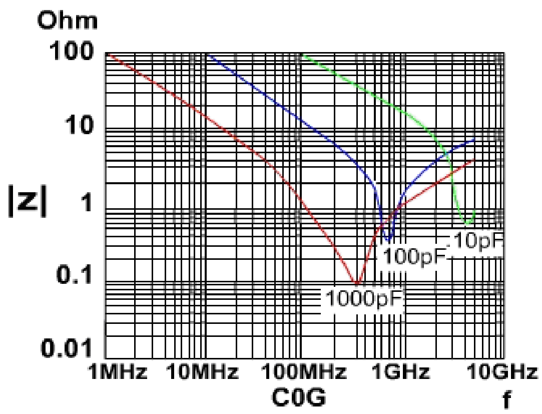
CAPACITANCE-DC VOLTAGE BIAS CHARACTERISTICS



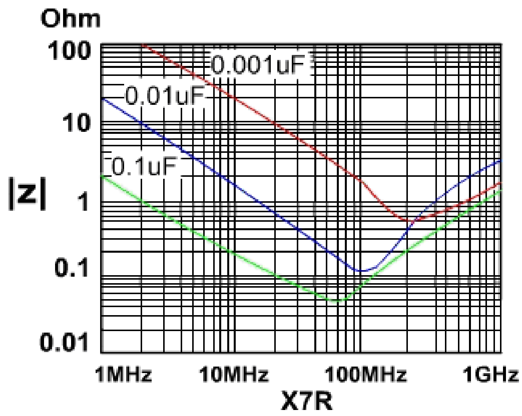
CAPACITANCE CHANGE-AGING



IMPEDANCE-FREQUENCY CHARACTERISTICS



※Please consult us for HF/MW MLCC



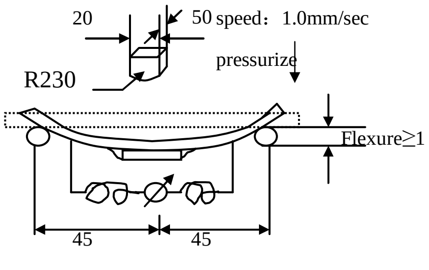
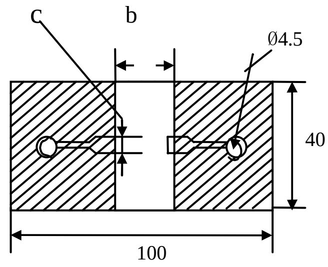
The capacitance of Class 2 dielectric changes with time. The change with time is known as "aging". It is caused by gradual realignment of the crystalline structure of the ceramic dielectric material as it is cooled below its Curie temperature, which produces a loss of capacitance with time. The aging process is predictable and follows a logarithmic decay. The aging process is reversible. If the capacitor is heated to a temperature above its Curie point for some period of time, de-aging will occur and the capacitor will regain the capacitance lost during the aging process.

The amount of de-aging depends on both the elevated temperature and the length of time at that temperature. Exposure to 150° C for one-half hour is sufficient to return the capacitor to its initial value.Because the capacitance changes rapidly immediately after de-aging。capacitance measurements are indexed to a referee time of 1,000 hours. The selection of this referree time has proven practical, as the actual decline of capacitance after 1,000 hours is very low.

Specifications and Test Methods

No	Item	Specification: Class1	Specification: Class2	Test Method
1	Category temperature range	C0G: -55℃ ~ +125℃	X7R: -55℃ ~ +125℃ X5R: -55℃ ~ +85℃ Y5V: -30℃ ~ +85℃	
2	Rated Voltage (U_R)	See the previous		The rated voltage is defined as the maximum voltage which may be applied continuously to the capacitor at the rated temperature. (The sum of the DC voltage and the AC voltage applied to the capacitor should not exceed the rated voltage. The peak of the AC voltage should not exceed the value defined as the reactive power.
3	Visual Examination	No defects or abnormalities		Visual Inspection
4	Dimensions	Within the specified dimension.		Using calipers
5	Voltage Proof	$2.5\times U_R$, 1min, No breakdown or flashover		No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 minute
6	Insulation Resistances (Ri)	C0G： C ≤ 10000pF Ri ≥ 10000MΩ； C > 10000pF Ri×C ≥ 100MΩ·Mf	C ≤ 0.025μF Ri ≥ 4000MΩ； C > 0.025μF Ri×C ≥ 100MΩ·μF	The insulation resistance shall be measured with DC rated voltage at 15℃~35℃and RH 25％~ 80％ and within 1min ±5sof charging.
7	Capacitance	Within the specified tolerance at 500 hours		Test Condition: Temperature:15℃~35℃; RH:25% ~ 80％ Frequency: C0G: C≤1000pF, f=1MHz； C>1000pF, f=1KHz X7R, X5R, Y5V： C≤100pF, f=1MHz； C>100pF, f=1KHz； C≥10μF，f=120Hz or 1KHz。 Voltage: 1.0±0.2Vrms
8	Tangent of Loss Angle	C0G: C≥50pF, $tg\delta\leq15\times10^{-4}$; C<50pF, $tg\delta\leq1.5\times(150/C+7)\times10^{-4}$	X7R: $U_R\geq50V$ $tg\delta\leq350\times10^{-4}$ $U_R=25V$ $tg\delta\leq350\times10^{-4}$ $U_R=16V$ $tg\delta\leq500\times10^{-4}$ $U_R\leq10V$ $tg\delta\leq700\times10^{-4}$ X5R： $U_R\geq25V$ $tg\delta\leq750\times10^{-4}$ $U_R=16V$ $tg\delta\leq800\times10^{-4}$ $U_R=10V$ $tg\delta\leq900\times10^{-4}$ $U_R=6.3V$ $tg\delta\leq1000\times10^{-4}$ Y5V: $U_R\geq25V$ $tg\delta\leq500\times10^{-4}$(C<0.10μF) $tg\delta\leq1000\times10^{-4}$(C≥0.10μF) $U_R=16$ $tg\delta\leq1250\times10^{-4}$ $U_R\leq10V$ $tg\delta\leq1500\times10^{-4}$	

SUPERCAP

9	Capacitance Temperature Coefficient or Temperature Characteristics		C0G：: △C/C≤0±30ppm/℃	X7R, X5R: △C/C≤ ±15% Y5V: -82%≤△C/C≤+22%	Preliminary Drying 16~24hrs (C0G). The temperature coefficient is calculated by the capacitance value which is measured at 25℃ and -55℃ and 125℃. Special preconditioning 1hr at 150℃ followed by 24hrs (X7R, X5R ,Y5V). The ranges of capacitance change compared with the temperature ranges (θ_1, 25℃, θ_2) shall be within the specified ranges. X7R：θ_1=-55℃，θ_2=125℃； X5R：θ_1=-55℃，θ_2=85℃； Y5V：θ_1=-30℃，θ_2=85℃，
10	Bond strength of the termination		No visible damage C0G: ΔC/C ≤ ±5% or± 0.5pF, whichever is larger; **X7R, X5R:** ΔC/C ≤ ±12.5%; **Y5V:** ΔC/C ≤ ±30%.  Capacitance meter Fig. b		Solder the capacitor to the test jig(glass epoxy boards)shown in Fig.a using a eutectic solder. Then apply a force in the direction shown in Fig.b. The soldering shall be done with the reflow method and shall be conducted with care so that the soldering is uniform and free of defects such as heat shock.  t：0.8mm Fig: a
11	Solderability		90% of the terminations is to be soldered evenly and continuously.		Immerse the test capacitor into a methanol solution containing rosin for 3 to 5 seconds, preheat it 150 to 180℃ for 2 to 3 minutes and immerse it into molten solder of 235±5℃ (or 245±5℃) for 2 ±0.5s.
12	Resistance to Soldering Heat	Visual	No visible damage		Special preconditioning 1hr at 150℃ followed by 24hrs (X7R, X5R , Y5V). Preheat the capacitor at 150℃for 1 minute. Immerse the capacitor in an eutectic solder solution at 260±5℃ for 10±1seconds. Recovery it, let sit at room temperature for 6~24hrs (C0G) , or 24±2hrs(X7R, X5R, Y5V)
		Cap. Change	C0G: ΔC/C ≤ ±2.5% or ±0.25Pf，which is larger	X7R,X5R: -10% ≤ΔC/C ≤ +20% Y5V: ΔC/C ≤±20%	
13	Rapid change of	Visual	No visible damage		Special preconditioning 1hr at 150℃ followed by 24hrs (X7R,

	temperature	Cap. Change	C0G: ΔC/C ≤±2.5% or ±0.25pF，which is larger	X7R, X5R: ΔC/C ≤ ±15% Y5V: ΔC/C ≤±20%	X5R , Y5V). Fix the capacitor to supporting jig. According to sub-clause 4.11 of IEC60384-21/22. C0G, X7R: θ_1=-55℃, θ_2=125℃； X5R: θ_1=-55℃, θ_2=85℃； Y5V: θ_1=-30℃, θ_2=85℃ t_1=30min, 5 cycles, recovery 24±2hrs.
14	Adhesion	Visual	No visible damage		According to sub-clause 4.7 of IEC60384-21/22 F=5N, t=10±1s
15	Climatic Sequence	Visual	No visible damage		Special preconditioning 1hr at 150℃ followed by 24hrs (X7R, X5R ,Y5V). According to sub-clause 4.12 of IEC60384-21/22. Dry Heat: T=125℃ (C0G, X7R) or 85℃ (X5R , Y5V), t=16hrs Damp Heat, Cycle: First Cycle, One cycle=24hrs. Cold: T=-55℃ (C0G, X7R, X5R) or -30℃ (Y5V), t=2hrs Damp Heat Cycle: Remaining 9 Cycles One cycle=24hrs.
		Cap. Change	C0G: ΔC/C ≤±5% or ±0.5pF，which is larger	X7R, X5R: ΔC/C ≤±15% Y5V: ΔC/C ≤ ±30%	
		Tangent of loss angle	C0G: tgδ≤30×10^{-4} (C≥50pF) or $3\times(150/C+7)\times10^{-4}$ (C<50pF)	X7R: tgδ≤700×10^{-4} X5R: tgδ≤1250×10^{-4} Y5V： U_R≥25V tgδ≤750×10^{-4} c<0.1μF tgδ≤1250×10^{-4} c ≥0.1μF U_R=16V tgδ≤1500×10^{-4} U_R =10V tgδ≤2000×10^{-4}	
		Insulation Resistances	C0G: Ri≥2500MΩ or Ri×C≥25MΩ·μF which is smaller	X7R, X5R ,Y5V： Ri≥1000MΩ or Ri×C≥5 MΩ·μF which is smaller	
16	Damp Heat, Steady State	Visual	No visible damage		Special preconditioning 1hr at 150℃ followed by 24hrs (X7R, X5R , Y5V). According to sub-clause 4.13 of IEC60384-21/22. Test Temperature: 60℃±2℃ RH 90~95% Duration:21d, recovery 24±2hrs.
		Cap. Change	C0G: ΔC/C ≤ ±5% or ±0.5pF，which is larger	X7R , X5R: ΔC/C ≤±15% Y5V: ΔC/C ≤±30%	
		Tangent of loss angle	C0G: tgδ≤30×10^{-4} （C≥50pF） or $3\times(150/C+7)\times10^{-4}$ （C<50pF）	X7R: tgδ≤700×10^{-4} X5R: tgδ≤1250×10^{-4} Y5V： U_R≥25V tgδ≤750×10^{-4} c<0.1μF tgδ≤1250×10^{-4} c ≥0.1μF U_R=16V tgδ≤1500×10^{-4} U_R =10V tgδ≤2000×10^{-4}	
		Insulation Resistances	C0G: Ri≥2500MΩ or Ri×C≥25 MΩ·μF which is smaller	X7R, X5R , Y5V: Ri≥1000MΩ or Ri×C≥5 MΩ·μF which is smaller	
17	Vibration	No visible damage. Cap. Change: C0G: ΔC/C ≤±2.5% or ±0.25pF， which is larger X7R, X5R: ΔC/C ≤±15％ Y5V: ΔC/C ≤ ±20％ tgδ: as in No.8			According to Test Fc of IEC60068-2-6. Sample shall be mounted on a suitable substrate, the amplitude of 1.5mm, the frequencies from 10 to 55Hz, and back to 10 Hz in about 1 min,. Repeat this for 2hrs each in 3 perpendicular direction, total 6hrs.

<table>
<tr><td rowspan="4">18</td><td rowspan="4">Endurance</td><td>Visual</td><td colspan="2">No visible damage</td><td rowspan="4">Special preconditioning 1hr at 150℃ followed by 24hrs (X7R, X5R , Y5V).
According to sub-clause 4.14 of IEC60384-21/22.
Test Temperature:
125℃（C0G, X7R）
or 85℃（X5R, Y5V）
Duration: 1000hrs
Voltage: $1.5\times U_R$ *.
under the room temperature, recover 6~24hr (C0G) or 24±2hr (X7R,X5R,Y5V) before checking the visual and testing the electric characteristics.
For Y5V≥1.0μF, do special preconditioning 1hr at 150℃ after taking out from the test box, recover 24±2 hours, and then test the electric characteristics.
* Some high-Capacity products using $1.0\times U_R$, detailed specifications, please to our sales representatives or engineers consulting</td></tr>
<tr><td>Cap. Change</td><td>C0G: $\Delta C/C \leq \pm 3\%$ or ±0.5pF，which is larger</td><td>X7R , X5R: $\Delta C/C \leq \pm 20\%$
Y5V: $\Delta C/C \leq \pm 30\%$</td></tr>
<tr><td>Tangent of loss angle</td><td>C0G:
$tg\delta \leq 30\times10^{-4}$
（C≥50pF）
or
$3\times(150/C+7)\times10^{-4}$
（$C\lt 50pF$）</td><td>X7R:
$tg\delta \leq 800\times10^{-4}$
X5R:
$tg\delta \leq 1250\times10^{-4}$
Y5V：
$U_R \geq 25V$ $tg\delta \leq 750\times10^{-4}$ $c\lt 0.1\mu F$
$tg\delta \leq 1250\times10^{-4}$ $c \geq 0.1\mu F$
$U_R=16V$ $tg\delta \leq 1500\times10^{-4}$
$U_R=10V$ $tg\delta \leq 2000\times10^{-4}$</td></tr>
<tr><td>Insulation Resistances</td><td>C0G:
Ri≥4000MΩ or
Ri×C≥25 MΩ·μF
which is smaller</td><td>X7R ,X5R ,Y5V：
Ri≥2000MΩ or
Ri×C≥5 MΩ·μF
which is smaller</td></tr>
<tr><td rowspan="4">19</td><td rowspan="4">Load humidity</td><td>Visual</td><td colspan="2">No visible damage</td><td rowspan="4">According to sub-clause 9.9 of JIS-C-5102 9.9:
measurement for high dielectric constant type（X7R、X5R、Y5V）.
Apply 100% of the rated DC voltage at the maximum operating temperature for 1hr. Remove and set for 48 hours at room temperature.Perform initial measurement.

Test temperature:
60±2℃
RH 90~95%
Test voltage: U_R
Duration: 500hr

under the room temperature, recover 6~24hr (C0G) or 24±2hr (X7R,X5R,Y5V) before checking the visual and testing the electric characteristics.</td></tr>
<tr><td>Cap. Change</td><td>C0G: $\Delta C/C \leq \pm 7.5\%$ or ±0.75pF ， which is smaller</td><td>X7R: $\Delta C/C \leq \pm 12.5\%$
X5R: $\Delta C/C \leq \pm 15\%$
Y5V:$\Delta C/C \leq \pm 30\%$(Y5V≥1.0μF do special preconditioning 1hr at 150℃ after taking out from the test box, followed by 48±4 hours, and then test the electric characteristics.)</td></tr>
<tr><td>Tangent of loss angle</td><td>C0G:
$tg\delta \leq 30\times10^{-4}$
（C≥50pF）
or $3\times(150/C+7)\times10^{-4}$
（$C\lt 50pF$）</td><td>X7R:
$tg\delta \leq 700\times10^{-4}$
X5R:
$tg\delta \leq 1250\times10^{-4}$
Y5V：
$U_R \geq 25V$ $tg\delta \leq 750\times10^{-4}$ $c\lt 0.1\mu F$
$tg\delta \leq 1250\times10^{-4}$ $c \geq 0.1\mu F$
$U_R=16V$ $tg\delta \leq 1500\times10^{-4}$
$U_R=10V$ $tg\delta \leq 2000\times10^{-4}$</td></tr>
<tr><td>Insulation Resistances</td><td>C0G:
Ri≥2500MΩ or
Ri×C≥50MΩ·μF
Which is smaller</td><td>X7R、X5R、Y5V:
Ri≥500MΩ or Ri×C≥25MΩ·μF
Which is smaller</td></tr>
</table>

Packing	Chip quantity		Minimum length of Empty compartments		
Tape	Worker (pcs)		Trailer	Unseal	Leader
Paper	A	1500	60 mm	200mm	160 mm
	B	2000			
	C	3000			
	D	4000			
	E	15000			
	I	10000			

Performance of Taping

- Strength of Carrier Tape and Top Cover Tape

- Carrier Tape

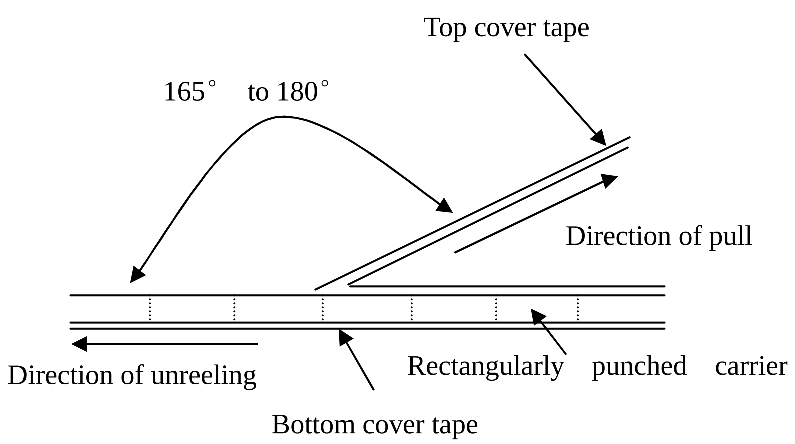
When a tensile force 1.02kgf is applied in the direction of unreeling the tape, the tape shall withstand this force.

- Top cover Tape

When a tensile force 1.02kgf is applied to the tape, the tape shall withstand this force.

- Peel Force of Top Cover Tape

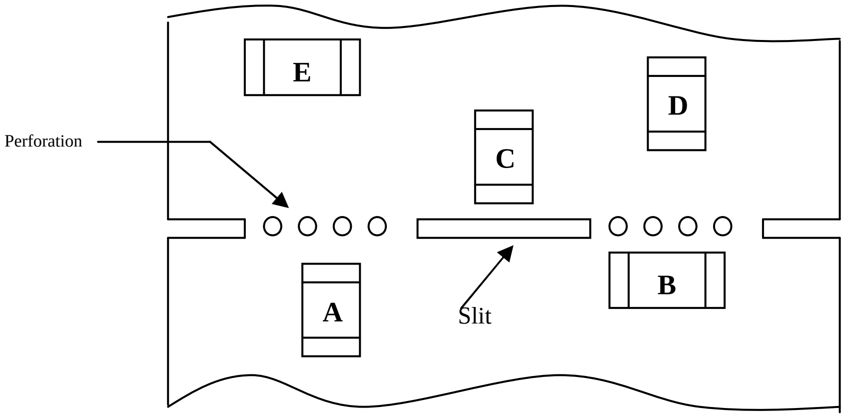
Unless otherwise specified, the peel force of top cover tape shall be 10 to 60 gf when the top cover tape is pulled at a speed of 300mm/min with the angle between the taped during peel and the direction of unreeling maintained at 165 to 180°as illustrated in Fig.



Application of technical requirements

Capacitor Layout on PCB:

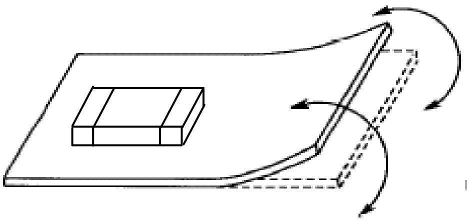
Mechanical stress varies according to the location of chip capacitors on PCB. The recommendation for better design is as Fig.



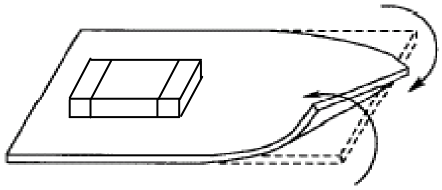
The stress in capacitors is in the following order: A>B=C>D>E

Pay attention not to bend or distort the PCB otherwise the chip capacitor may crack. Please refer to the following examples.

a. Not recommended:

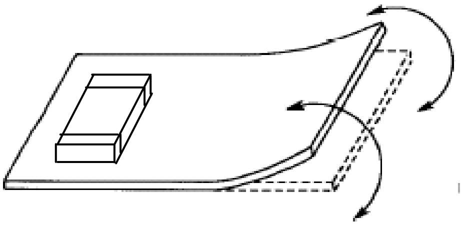


Bend



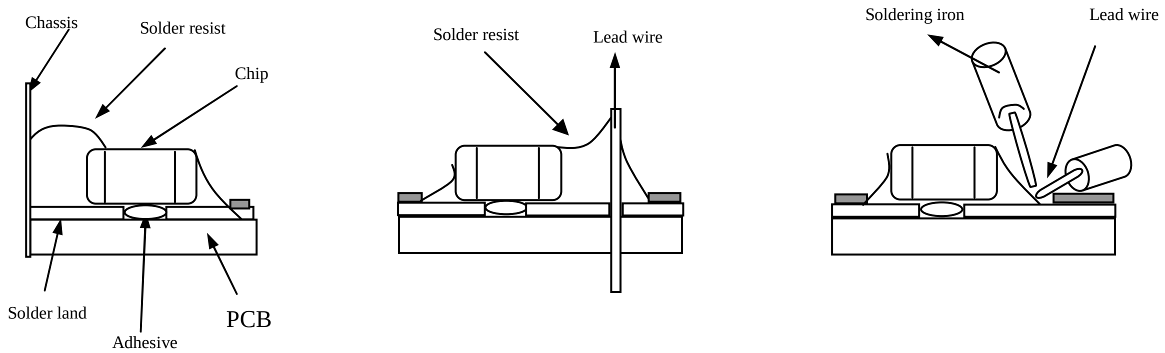
Distort

b. Recommended:

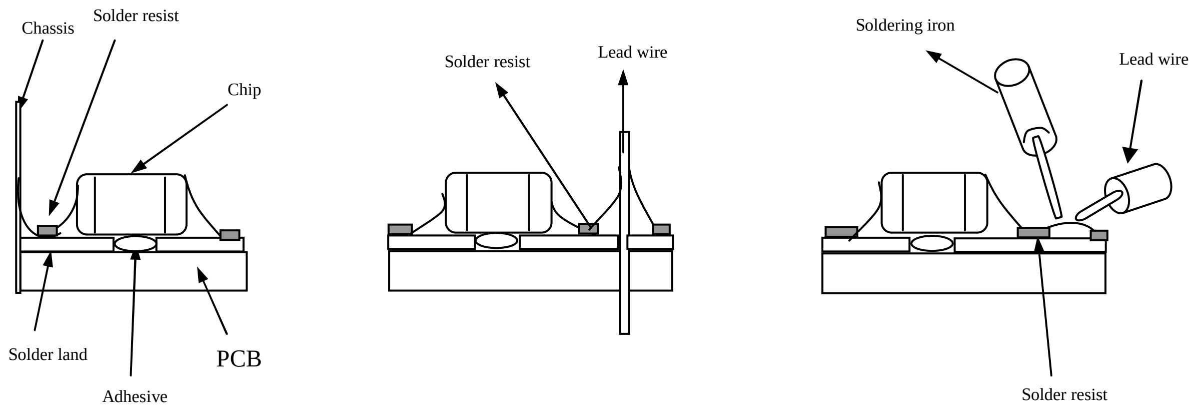


Solder Buildup and Soldering Methods:

a. Examples of soldering method not recommended:



b. Examples of soldering method recommended:



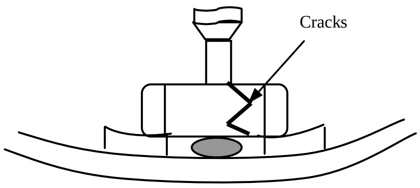
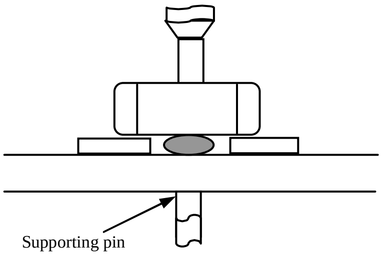
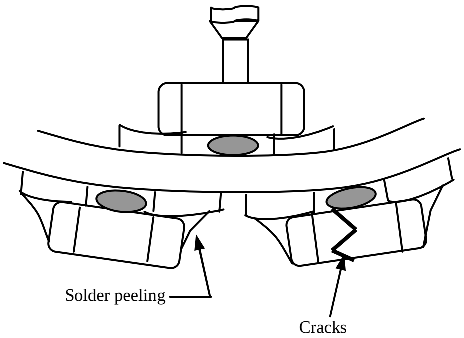
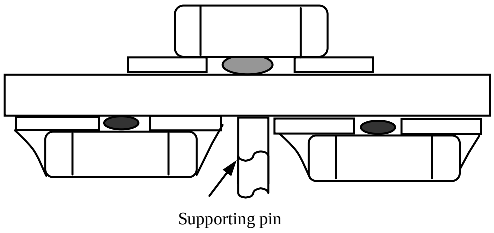
Consideration for Automatic Placement

If the mounting head is adjusted too low, it may induce excessive stress in the chip capacitor to result in cracking. Please take following precautions:

a. Adjust the bottom dead center of the mounting head to reach on the PCB surface and not press it;

b. Adjust the mounting head pressure to be 1 to 3N of static weight;

c. To minimize the impact energy from mounting head, it is important to provide support from the bottom side of the PCB.

	Not recommended	Recommended
Single-sided Mounting		
	Not recommended	Recommended
Double-sided Mounting		

Soldering

● Flux Selection :

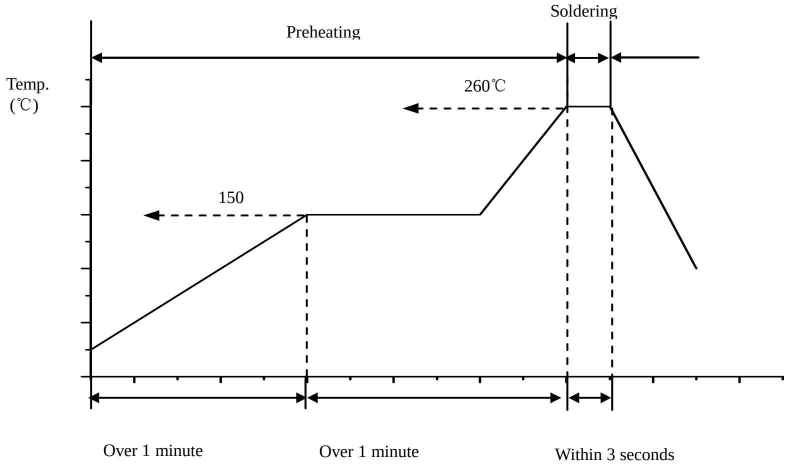
a. It is recommended to use a mildly activated rosin flux （less than 0.1wt% chlorine）. Strong flux is not recommended.

b. Please provide proper amount of flux. Excessive flux must be avoided.

c. When water-soluble flux is used, enough washing is necessary.

Recommended Soldering Profile:

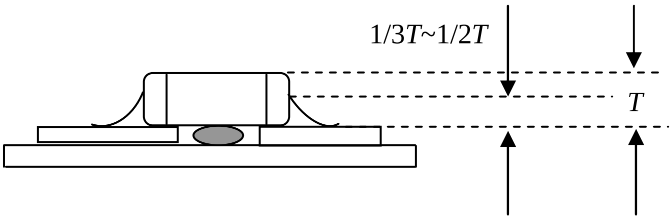
● Reflow Soldering Condition



Cautions:

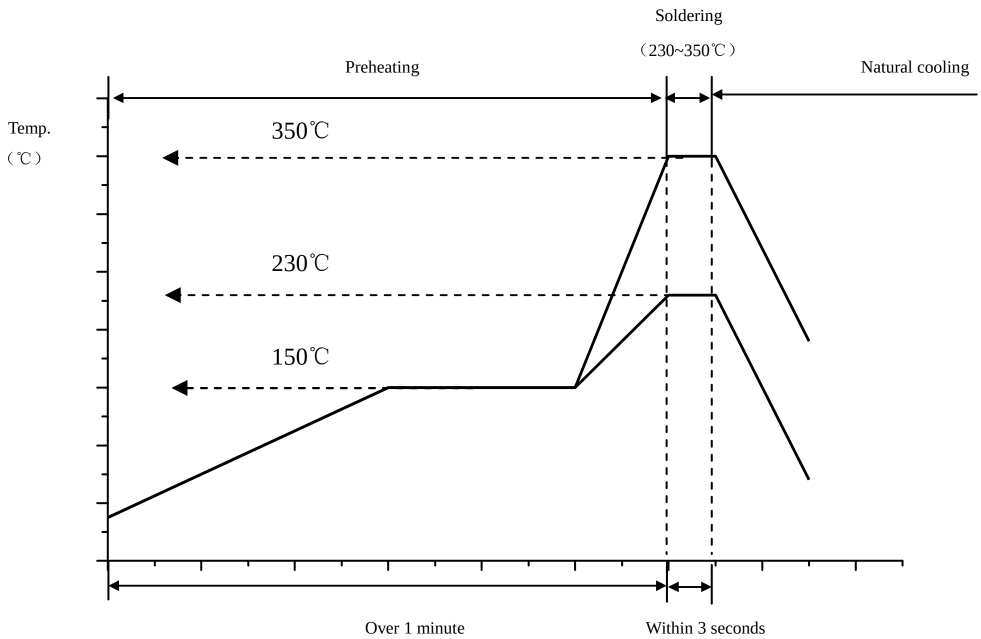
a. Excessive solder will induce higher tensile force in chip capacitor when temperature changes and result in cracking. Insufficient solder may detach the capacitors from the PC board.

The ideal condition is to have solder mass controlled to 1/3 to 1/2 of the thickness of the capacitor



b. Soldering duration should be kept as close to recommended times as possible, because excessive duration can detrimentally affect solderability.

●Hand Soldering Condition:



Cautions:

a. Use a 20W soldering iron with a maximum tip diameter of 1.0mm

b. The soldering iron should not directly touch the capacitor.

Notes

Operating Temperature:

a. Do not use capacitor above the maximum allowable operating temperature.

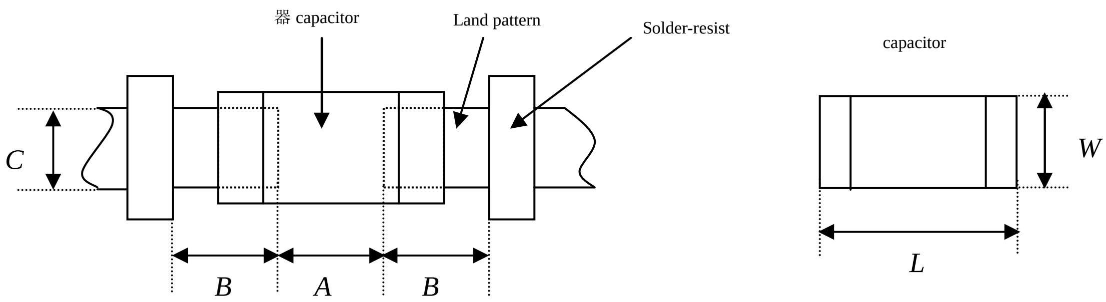
b. Surface temperature including self heating should be below maximum operating temperature.

Operating Voltage:

The operating voltage for capacitors must always be lower than their rated voltage.

Design of Land-patterns:

When the capacitors are mounted on a PCB, the amount of solder at the terminations has a direct effect on the performance of the capacitors. The greater the amount of solder, the higher the stress on the chip capacitor. Therefore, when designing land-patterns, it is necessary to consider the appropriate size and configuration of the solder pads.



Recommend land dimensions for reflow-soldering （unit: mm）

Type		0201	0402	0603	0805	1206	1210	1808	1812	2220	2225
Size	*L*	0.6	1.0	1.6	2.0	3.2	3.2	4.5	4.5	5.7	5.7
	W	0.3	0.5	0.8	1.25	1.6	2.5	2.0	3.2	5.0	6.4
A		0.2~0.3	0.45~0.55	0.6~0.8	1.0~1.2	2.2~2.4	1.8~2.5	2.5~3.4	2.5~3.4	4.0~4.6	4.0~4.6
B		0.2~0.35	0.40~0.50	0.6~0.7	0.8~0.7	0.8~0.9	1.0~1.5	1.8~2.0	1.8~2.0	2.0~2.2	2.0~2.2
C		0.2~0.3	0.45~0.55	0.6~0.8	0.8~1.1	1.0~1.4	1.6~3.2	1.5~1.8	2.3~3.5	3.5~4.8	5.0~6.2