Part Number System

C **0402** **C0G** **101** **J** **500** **N** **T** **B**

Product Code

MLCC

Size Type Code

（GB/IEC/EIA）

0201；0402；0603；0805；1206；

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

Termination

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

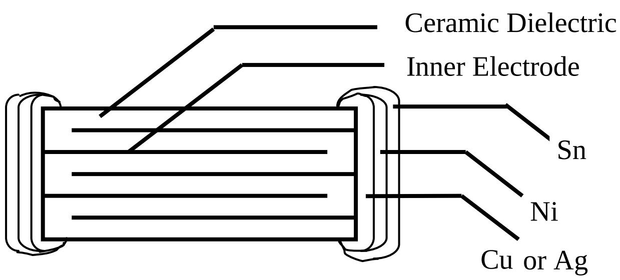
Packaging Code

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



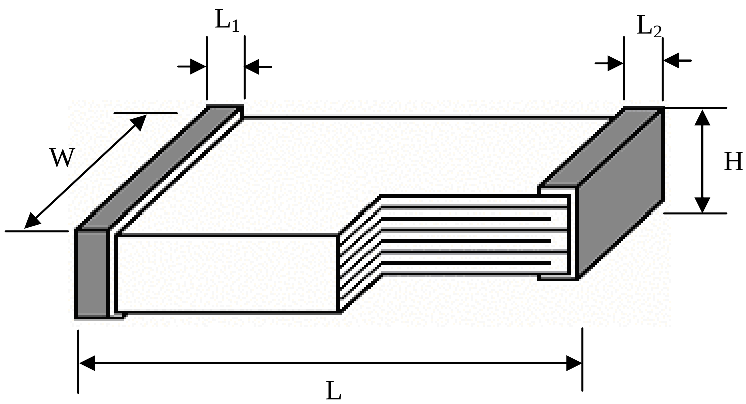
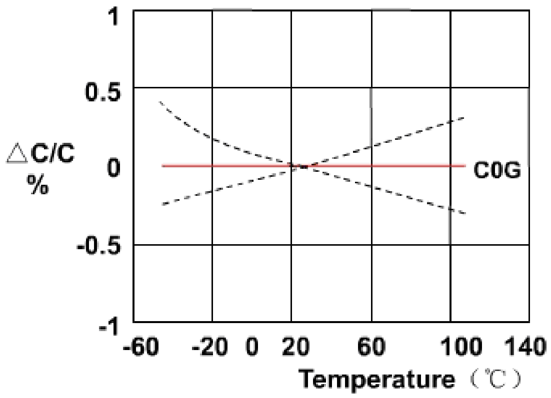


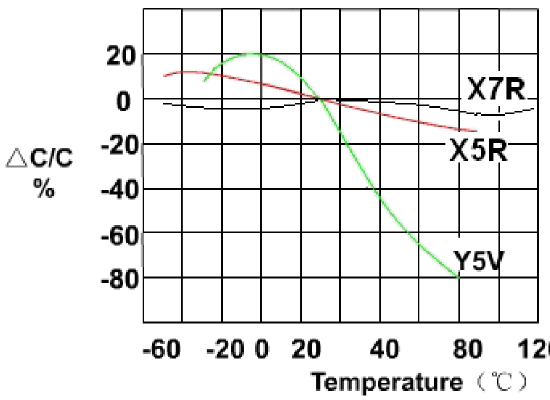
Figure 1   Dimension and Cross-section of MLCC

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±0.20	1.25±0.20	0.50/1.45	0.20/0.75
1206 （3216）	3.2±0.20	1.6±0.20	0.50/1.80	0.25/0.75

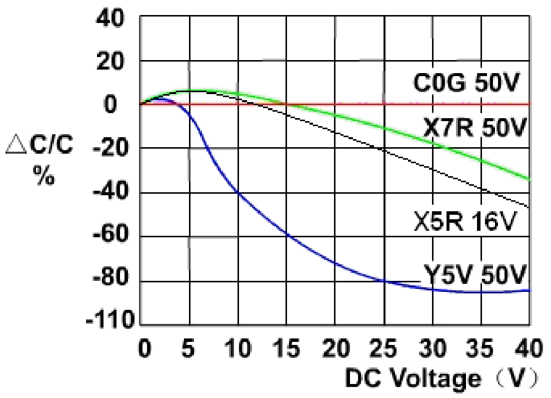
Electrical Characteristics

CAPACITANCE-TEMPERATURE CHARACTERISTICS

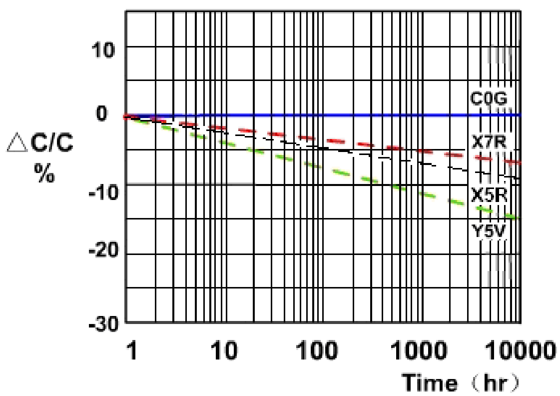




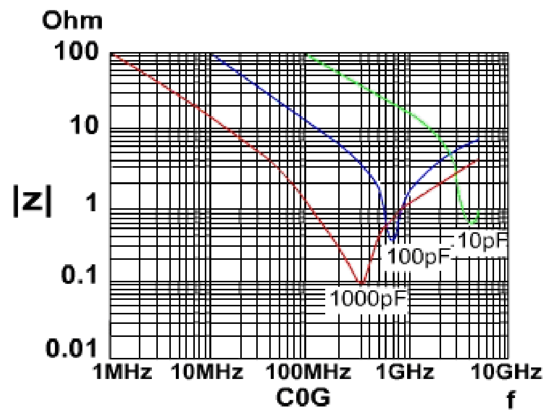
CAPACITANCE-DC VOLTAGE BIAS CHARACTERISTICS



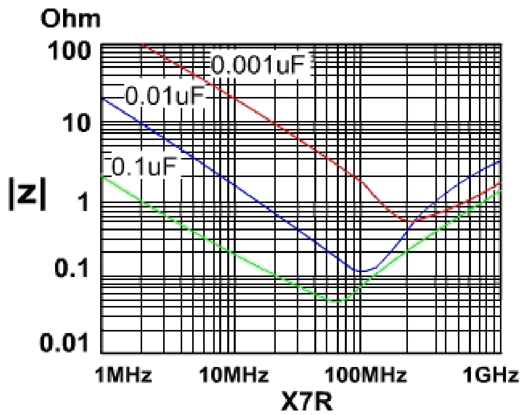
CAPACITANCE CHANGE-AGING



IMPEDANCE-FREQUENCY CHARACTERISTICS



※Please consult us for HF/MW MLCC



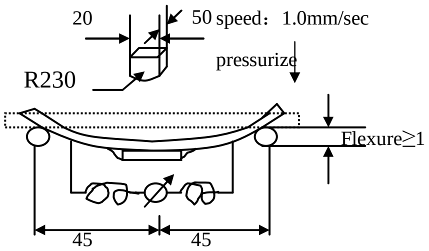
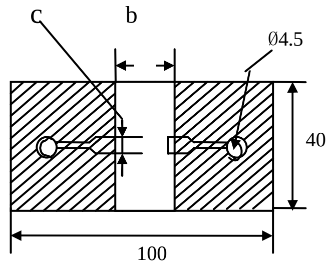
The capacitance of Class 2 dielectric changes with time. The change with time is known as "aging". It is caused by gradual realignment of the crystalline structure of the ceramic dielectric material as it is cooled below its Curie temperature, which produces a loss of capacitance with time. The aging 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.

SUPERCAP

Specifications and Test Methods

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Item</th><th colspan="2">Specification</th><th rowspan="2">Test Method</th></tr>
<tr><th>Class1</th><th>Class2</th></tr>
<tr><td>1</td><td>Category temperature range</td><td>C0G:
-55℃ ~ +125℃</td><td>X7R: -55℃ ~ +125℃
X5R: -55℃ ~ +85℃
Y5V: -30℃ ~ +85℃</td><td></td></tr>
<tr><td>2</td><td>Rated Voltage
(U_R)</td><td colspan="2">See the previous</td><td>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.</td></tr>
<tr><td>3</td><td>Visual Examination</td><td colspan="2">No defects or abnormalities</td><td>Visual Inspection</td></tr>
<tr><td>4</td><td>Dimensions</td><td colspan="2">Within the specified dimension.</td><td>Using calipers</td></tr>
<tr><td>5</td><td>Voltage Proof</td><td colspan="2">2.5×U_R, 1min, No breakdown or flashover</td><td>No failure shall be observed when 250% of the rated voltage is applied between the terminations for 1 minute</td></tr>
<tr><td>6</td><td>Insulation Resistances
(Ri)</td><td>C0G：
C ≤ 10000pF
Ri ≥ 10000MΩ；
C > 10000pF
Ri×C ≥ 100MΩ·Mf</td><td>C ≤ 0.025μF
Ri ≥ 4000MΩ；
C > 0.025μF
Ri×C ≥ 100MΩ·μF</td><td>The insulation resistance shall be measured with DC rated voltage at 15℃~35℃and RH 25％~ 80％ and within 1min ±5sof charging.</td></tr>
<tr><td>7</td><td>Capacitance</td><td colspan="2">Within the specified tolerance at 500 hours</td><td rowspan="4">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</td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Tangent of Loss Angle</td><td rowspan="3">C0G:
C≥50pF,
tgδ≤15×10^{-4};
C<50pF,
tgδ≤1.5×(150/C+7)×10^{-4}</td><td>X7R:
U_R≥50V tgδ≤350×10^{-4}
U_R =25V tgδ≤350×10^{-4}
U_R=16V tgδ≤500×10^{-4}
U_R≤10V tgδ≤700×10^{-4}</td></tr>
<tr><td>X5R：
U_R ≥25V tgδ≤750×10^{-4}
U_R =16V tgδ≤800×10^{-4}
U_R =10V tgδ≤900×10^{-4}
U_R =6.3V tgδ≤1000×10^{-4}</td></tr>
<tr><td>Y5V:
U_R≥25V
tgδ≤500×10^{-4}(C<0.10μF)
tgδ≤1000×10^{-4}(C≥0.10μF)
U_R =16 tgδ≤1250×10^{-4}
U_R≤10V tgδ≤1500×10^{-4}</td></tr>
</table>

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		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.
			C0G**:** ΔC/C ≤ ±5% or ± 0.5pF, whichever is larger; **X7R, X5R:** ΔC/C ≤ ±12.5%; **Y5V:** ΔC/C ≤ ±30%.  Capacitance meter Fig. b		 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,

<table>
<tr><td></td><td>temperature</td><td>Cap. Change</td><td>C0G: ΔC/C ≤±2.5% or ±0.25pF，which is larger</td><td>X7R, X5R: ΔC/C ≤ ±15%
Y5V: ΔC/C ≤±20%</td><td>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.</td></tr>
<tr><td>14</td><td>Adhesion</td><td>Visual</td><td colspan="2">No visible damage</td><td>According to sub-clause 4.7 of IEC60384-21/22
F=5N, t=10±1s</td></tr>
<tr><td rowspan="4">15</td><td rowspan="4">Climatic Sequence</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 4.12 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.</td></tr>
<tr><td>Cap. Change</td><td>C0G: ΔC/C ≤±5% or ±0.5pF，which is larger</td><td>X7R, X5R: ΔC/C ≤±15%
Y5V: ΔC/C ≤ ±30%</td></tr>
<tr><td>Tangent of loss angle</td><td>C0G:
tgδ≤30×10^{-4}
(C≥50pF)
or $3\times(150/C+7)\times10^{-4}$
(C<50pF)</td><td>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}</td></tr>
<tr><td>Insulation Resistances</td><td>C0G:
Ri≥2500MΩ or
Ri×C≥25MΩ·μF
which is smaller</td><td>X7R, X5R ,Y5V：
Ri≥1000MΩ or
Ri×C≥5 MΩ·μF
which is smaller</td></tr>
<tr><td rowspan="4">16</td><td rowspan="4">Damp Heat, Steady State</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 4.13 of IEC60384-21/22.
Test Temperature:
60℃±2℃
RH 90~95%
Duration:21d, recovery 24±2hrs.</td></tr>
<tr><td>Cap. Change</td><td>C0G: ΔC/C ≤ ±5% or ±0.5pF，which is larger</td><td>X7R , X5R: ΔC/C ≤±15%
Y5V: ΔC/C ≤±30%</td></tr>
<tr><td>Tangent of loss angle</td><td>C0G:
tgδ≤30×10^{-4}
（C≥50pF）
or $3\times(150/C+7)\times10^{-4}$
（C<50pF）</td><td>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}</td></tr>
<tr><td>Insulation Resistances</td><td>C0G:
Ri≥2500MΩ or
Ri×C≥25 MΩ·μF
which is smaller</td><td>X7R, X5R , Y5V:
Ri≥1000MΩ or
Ri×C≥5 MΩ·μF
which is smaller</td></tr>
<tr><td>17</td><td>Vibration</td><td colspan="3">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</td><td>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.</td></tr>
</table>

18	Endurance	Visual	No visible damage		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×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 × U_R, detailed specifications, please to our sales representatives or engineers consulting
		Cap. Change	C0G: ΔC/C ≤±3% or ±0.5pF，which is larger	X7R , X5R: ΔC/C ≤±20% Y5V: ΔC/C ≤ ±30%	
		Tangent of loss angle	C0G: $tg\delta \le 30\times10^{-4}$ （C≥50pF） or $3\times(150/C+7)\times10^{-4}$ （C<50pF）	X7R: $tg\delta \le 800\times10^{-4}$ X5R: $tg\delta \le 1250\times10^{-4}$ Y5V： $U_R \ge 25V$ $tg\delta \le 750\times10^{-4}$ c<0.1μF $tg\delta \le 1250\times10^{-4}$ c ≥0.1μF U_R=16V $tg\delta \le 1500\times10^{-4}$ U_R =10V $tg\delta \le 2000\times10^{-4}$	
		Insulation Resistances	C0G: Ri≥4000MΩ or Ri×C≥25 MΩ·μF which is smaller	X7R ,X5R ,Y5V： Ri≥2000MΩ or Ri×C≥5 MΩ·μF which is smaller	
19	Load humidity	Visual	No visible damage		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.
		Cap. Change	C0G: ΔC/C ≤±7.5% or ±0.75pF ，which is smaller	X7R: ΔC/C ≤±12.5% X5R: ΔC/C ≤±15% Y5V:ΔC/C≤±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.)	
		Tangent of loss angle	C0G: $tg\delta \le 30\times10^{-4}$ （C≥50pF） or $3\times(150/C+7)\times10^{-4}$ （C<50pF）	X7R: $tg\delta \le 700\times10^{-4}$ X5R: $tg\delta \le 1250\times10^{-4}$ Y5V： $U_R \ge 25V$ $tg\delta \le 750\times10^{-4}$ c<0.1μF $tg\delta \le 1250\times10^{-4}$ c ≥0.1μF U_R=16V $tg\delta \le 1500\times10^{-4}$ U_R =10V $tg\delta \le 2000\times10^{-4}$	
		Insulation Resistances	C0G: Ri≥2500MΩ or Ri×C≥50MΩ·μF Which is smaller	X7R、X5R、Y5V: Ri≥500MΩ or Ri×C≥25MΩ·μF Which is smaller	

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

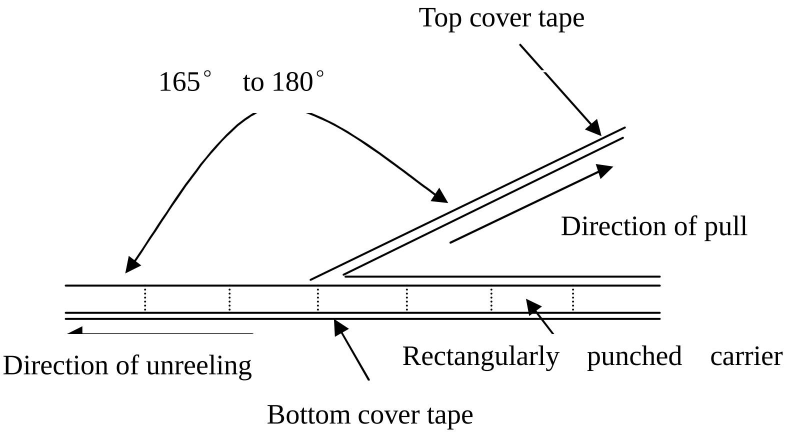
When a tensile force 1.02kgf is applied in the direction of unreeling the tape, the tape shall withstand this force.

- 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

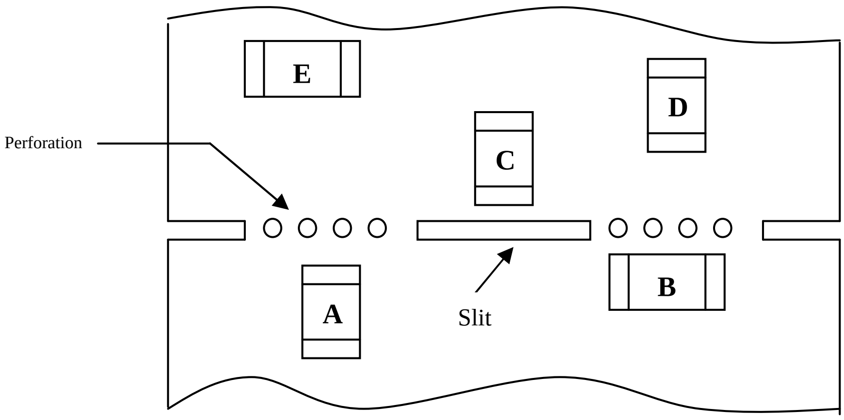
Unless otherwise specified, the peel force of top cover tape shall be 10 to 60 gf when the top cover tape is pulled at a speed of 300mm/min with the angle between the taped during peel and the direction of unreeling maintained at 165 to 180°as illustrated in Fig.



Application of technical requirements

Capacitor Layout on PCB:

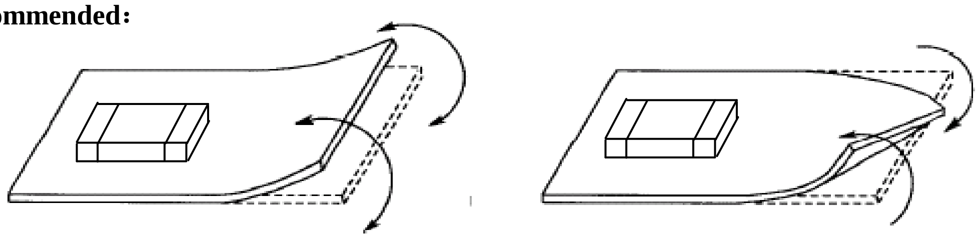
Mechanical stress varies according to the location of chip capacitors on PCB. The recommendation for better design is as Fig.



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

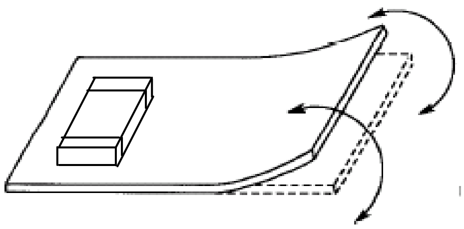
Pay attention not to bend or distort the PCB otherwise the chip capacitor may crack. Please refer to the following examples.

a. Not recommended:



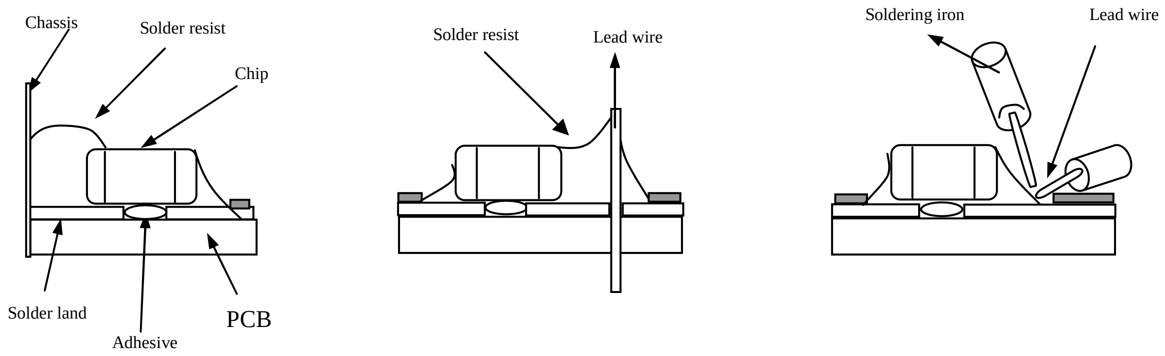
Bend Distort

b. Recommended:

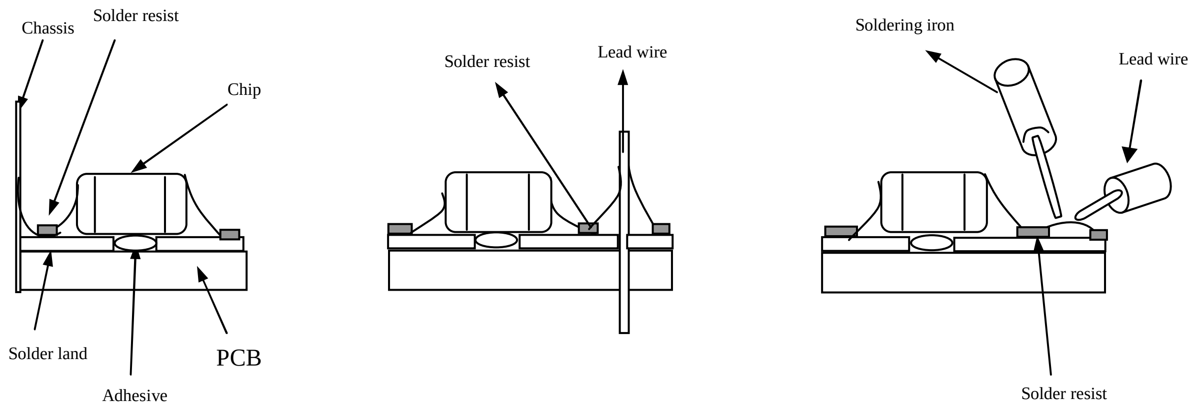


Solder Buildup and Soldering Methods:

a. Examples of soldering method not recommended:



b. Examples of soldering method recommended:



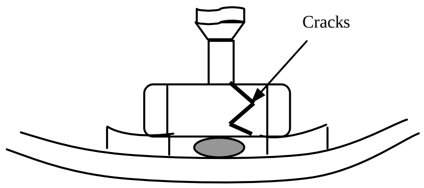
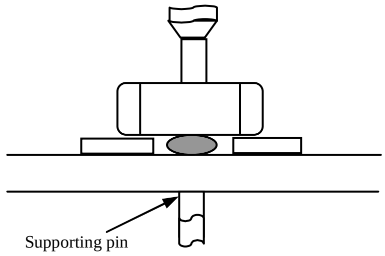
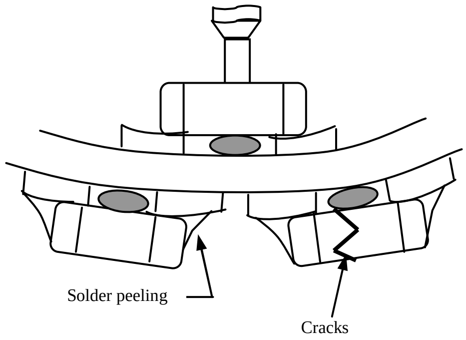
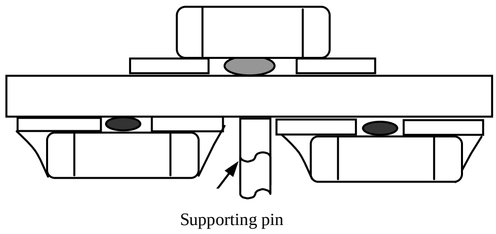
Consideration for Automatic Placement

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：

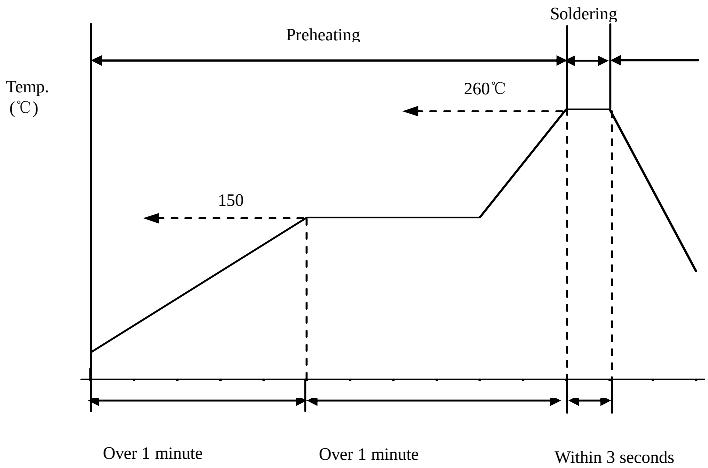
a. It is recommended to use a mildly activated rosin flux （less than 0.1wt% chlorine）. Strong flux is not recommended.

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:

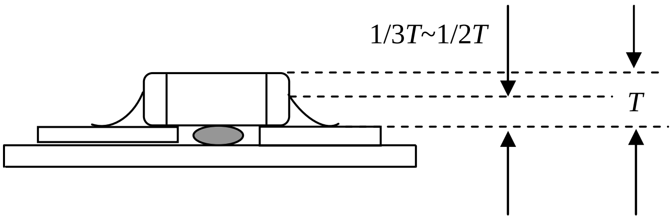
● Reflow Soldering Condition



Cautions:

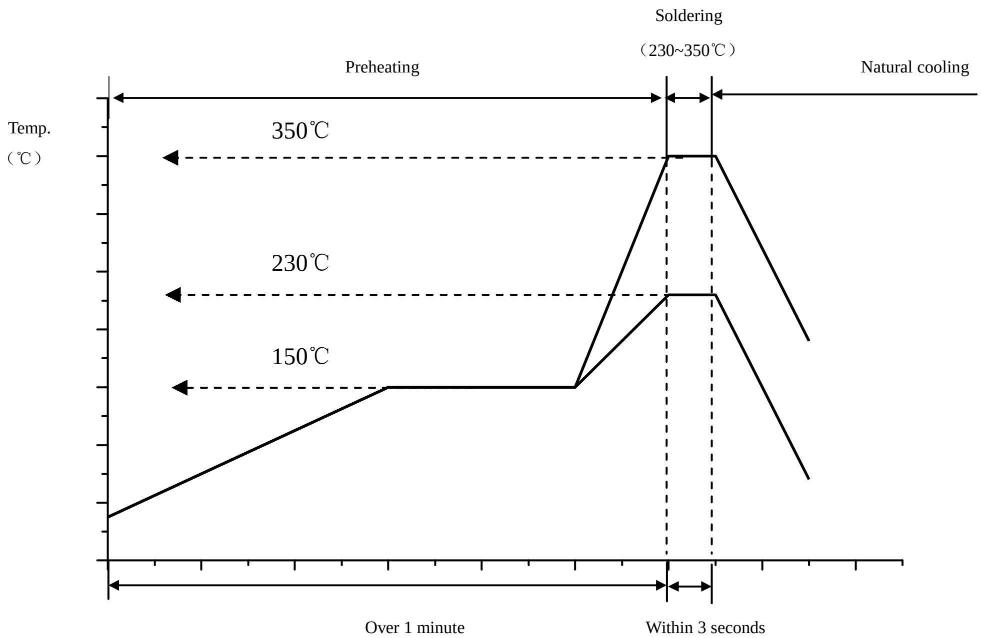
a. Excessive solder will induce higher tensile force in chip capacitor when temperature changes and result in cracking. Insufficient solder may detach the capacitors from the PC board.

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.

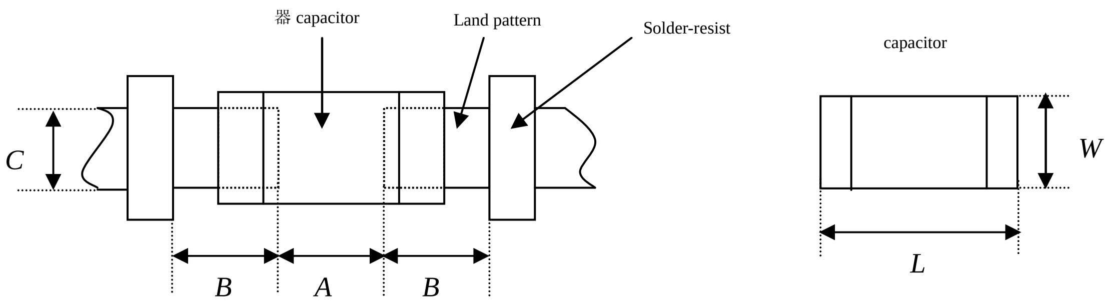
b. Surface temperature including self heating should be below maximum operating temperature.

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
Size	*L*	0.6	1.0	1.6	2.0	3.2
	W	0.3	0.5	0.8	1.25	1.6
A		0.2~0.3	0.45~0.55	0.6~0.8	1.0~1.2	2.2~2.4
B		0.2~0.35	0.40~0.50	0.6~0.7	0.8~0.7	0.8~0.9
C		0.2~0.3	0.45~0.55	0.6~0.8	0.8~1.1	1.0~1.4