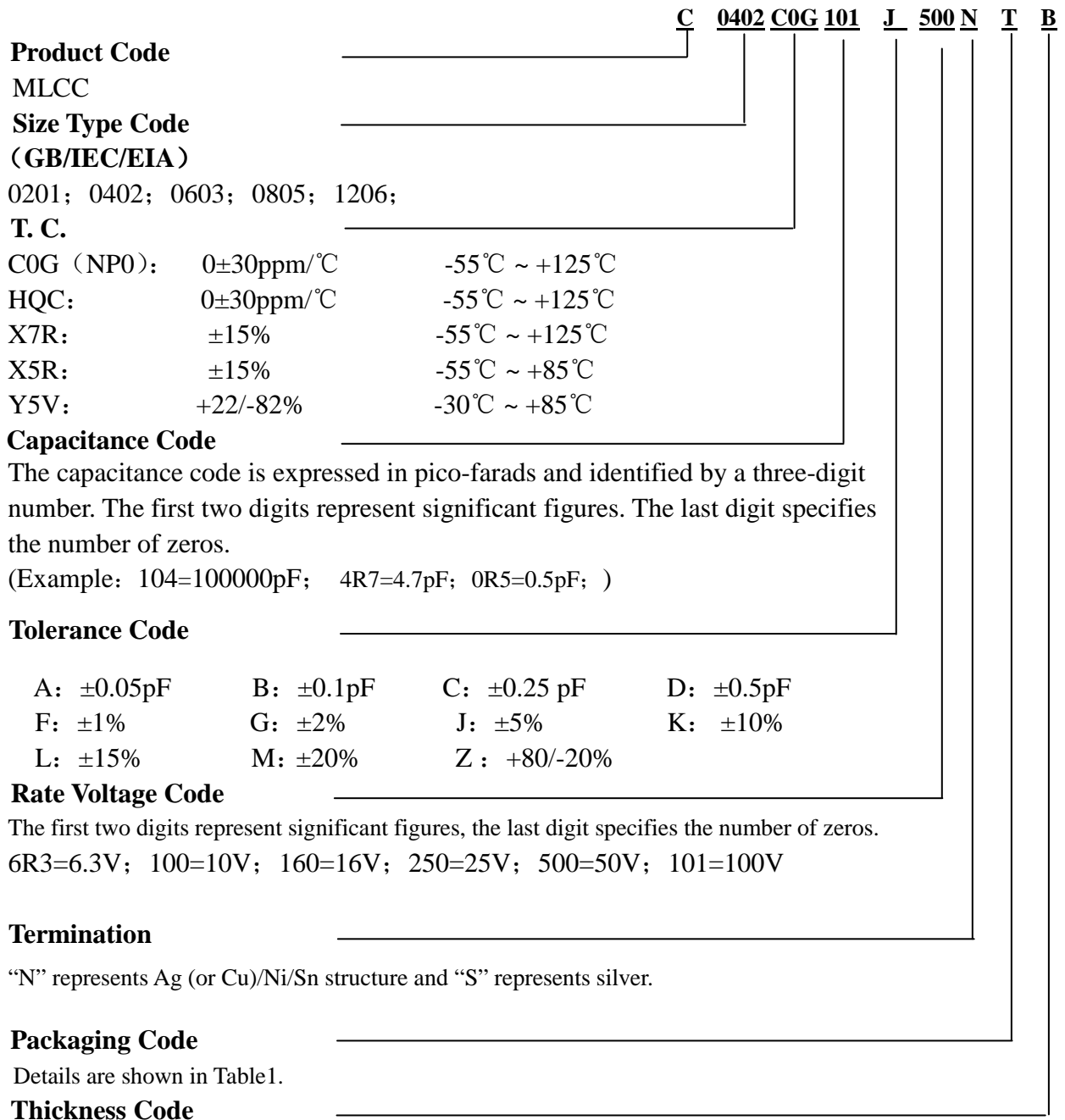


Part Number System



Products should be marked with the Thickness 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, D (0.80±0.10) for 0603, Thickness code “A、B、D” can be ignore, Other products must be added the thickness of the thickness of code.

Structure & Dimension

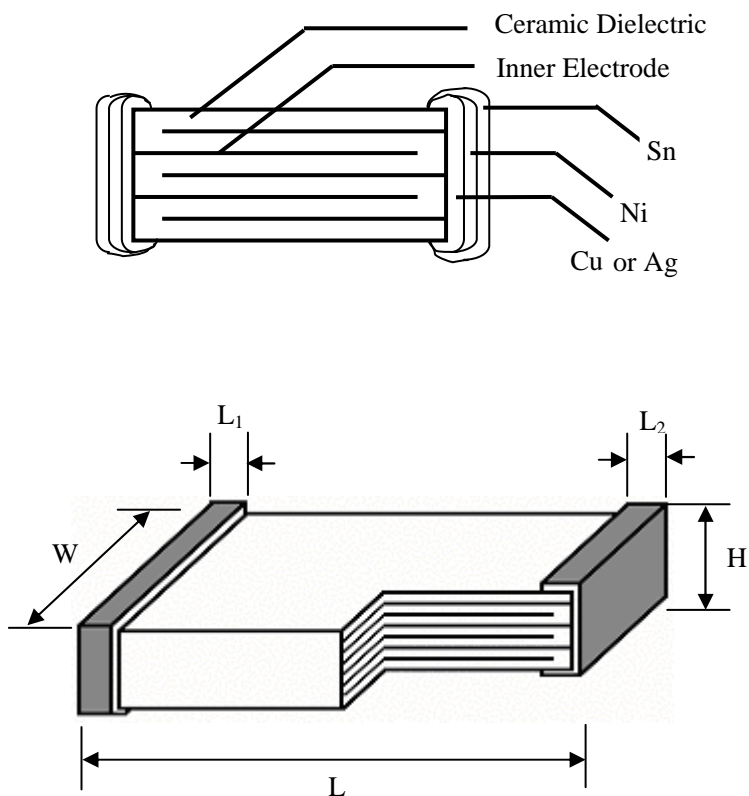
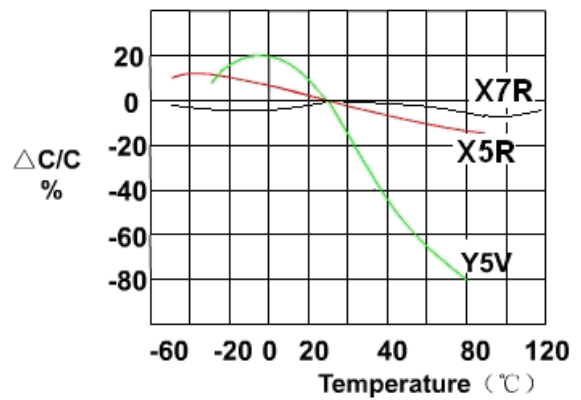
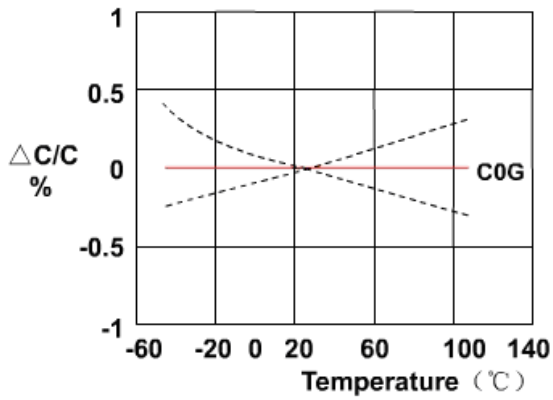


Figure 1 Dimension and Cross-section of MLCC

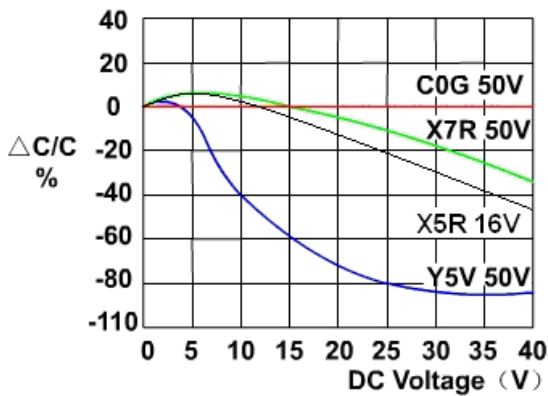
GB/IEC/EIA (JIS/EIAJ)	L/mm	W/mm	H (Min/Max) /mm	L ₁ (Min/Max) /mm
0201 (0603)	0.6±0.03	0.3±0.03	0.27/0.33	0.05/0.20
0402 (1005)	1.0±0.05	0.5±0.05	0.45/0.55	0.10/0.35
0603 (1608)	1.6±0.10	0.8±0.10	0.70/0.90	0.15/0.60
0805 (2012)	2.0±0.20	1.25±0.20	0.50/1.45	0.20/0.75
1206 (3216)	3.2±0.20	1.6±0.20	0.50/1.80	0.25/0.75

Electrical Characteristics

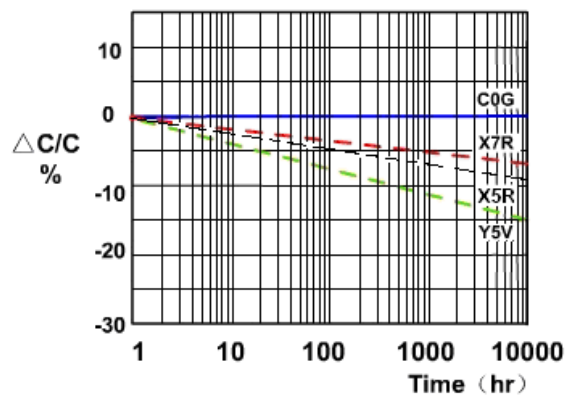
CAPACITANCE-TEMPERATURE CHARACTERISTICS



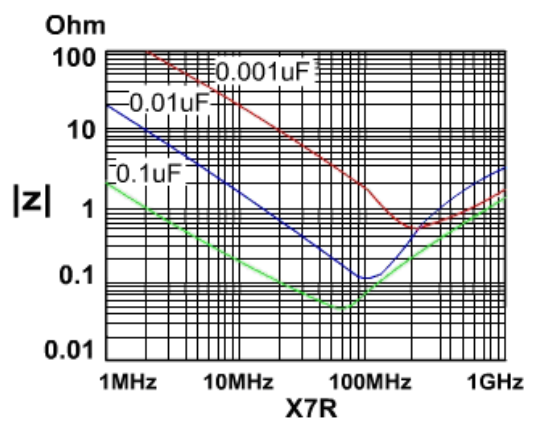
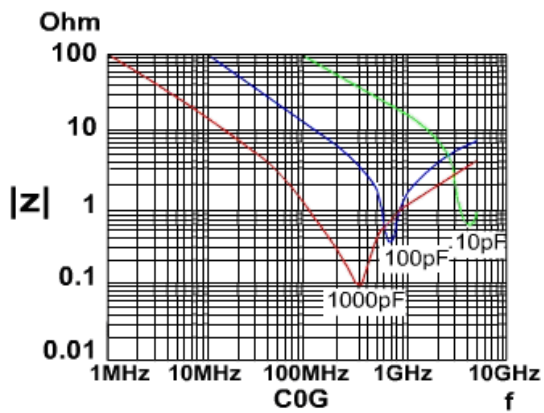
CAPACITANCE-DC VOLTAGE BIAS CHARACTERISTICS



CAPACITANCE CHANGE-AGING



IMPEDANCE-FREQUENCY CHARACTERISTICS



※Please consult us for HF/MW MLCC

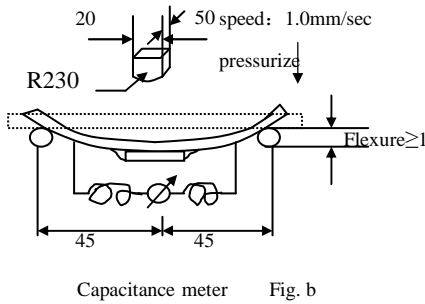
SUPERCAP

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 reference time of 1,000 hours. The selection of this reference time has proven practical, as the actual decline of capacitance after 1,000 hours is very low.

Specifications and Test Methods

No	Item	Specification		Test Method
		Class1	Class2	
1	Category temperature range	C0G: -55°C ~ +125°C	X7R: -55°C ~ +125°C X5R: -55°C ~ +85°C Y5V: -30°C ~ +85°C	
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×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 (R _i)	C0G: C ≤ 10000pF R _i ≥ 10000MΩ; C > 10000pF R _i ×C ≥ 100MΩ·Mf	C ≤ 0.025μF R _i ≥ 4000MΩ; C > 0.025μF R _i ×C ≥ 100MΩ·μF	The insulation resistance shall be measured with DC rated voltage at 15°C~35°C and RH 25% ~ 80% and within 1min ±5s of charging.
7	Capacitance	Within the specified tolerance at 500 hours		
8	Tangent of Loss Angle	C0G: C ≥ 50pF, tgδ ≤ 15×10 ⁻⁴ ; C < 50pF, tgδ ≤ 1.5×(150/C+7)×10 ⁻⁴	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 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 Y5V: U _R ≥ 25V tgδ ≤ 500×10 ⁻⁴ (C < 0.10μF) tgδ ≤ 1000×10 ⁻⁴ (C ≥ 0.10μF) U _R = 16V tgδ ≤ 1250×10 ⁻⁴ U _R ≤ 10V tgδ ≤ 1500×10 ⁻⁴	Test Condition: Temperature: 15°C ~ 35°C; 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±0.2V _{rms}

9	Capacitance Temperature Coefficient or Temperature Characteristics	C0G: : $\Delta C/C \leq 0 \pm 30 \text{ppm}/^\circ\text{C}$	X7R, X5R: $\Delta C/C \leq \pm 15\%$ Y5V: $-82\% \leq \Delta C/C \leq +22\%$	Preliminary Drying 16~24hrs (C0G). The temperature coefficient is calculated by the capacitance value which is measured at 25°C and -55°C and 125°C. Special preconditioning 1hr at 150°C followed by 24hrs (X7R, X5R, Y5V). The ranges of capacitance change compared with the temperature ranges (θ_1 , 25°C, θ_2) shall be within the specified ranges. X7R: $\theta_1 = -55^\circ\text{C}$, $\theta_2 = 125^\circ\text{C}$; X5R: $\theta_1 = -55^\circ\text{C}$, $\theta_2 = 85^\circ\text{C}$; Y5V: $\theta_1 = -30^\circ\text{C}$, $\theta_2 = 85^\circ\text{C}$,	
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: $\Delta C/C \leq \pm 5\%$ or $\pm 0.5 \text{pF}$, whichever is larger; X7R, X5R: $\Delta C/C \leq \pm 12.5\%$; Y5V: $\Delta C/C \leq \pm 30\%$.			
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°C for 2 to 3 minutes and immerse it into molten solder of $235 \pm 5^\circ\text{C}$ (or $245 \pm 5^\circ\text{C}$) for $2 \pm 0.5 \text{s}$.	
12	Resistance to Soldering Heat	Visual	No visible damage		Special preconditioning 1hr at 150°C followed by 24hrs (X7R, X5R, Y5V). Preheat the capacitor at 150°C for 1 minute. Immerse the capacitor in an eutectic solder solution at $260 \pm 5^\circ\text{C}$ for $10 \pm 1 \text{seconds}$. Recovery it, let sit at room temperature for 6~24hrs (C0G), or $24 \pm 2 \text{hrs}$ (X7R, X5R, Y5V)
		Cap. Change	C0G: $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25 \text{Pf}$, which is larger	X7R, X5R: $-10\% \leq \Delta C/C \leq +20\%$ Y5V: $\Delta C/C \leq \pm 20\%$	
13	Rapid change of	Visual	No visible damage		Special preconditioning 1hr at 150°C followed by 24hrs (X7R,

SUPERCAP

	temperature	Cap. Change	C0G: $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25\text{pF}$, which is larger	X7R, X5R: $\Delta C/C \leq \pm 15\%$ Y5V: $\Delta C/C \leq \pm 20\%$	X5R, Y5V). Fix the capacitor to supporting jig. According to sub-clause 4.11 of IEC60384-21/22. C0G, X7R: $\theta_1 = -55^\circ\text{C}$, $\theta_2 = 125^\circ\text{C}$; X5R: $\theta_1 = -55^\circ\text{C}$, $\theta_2 = 85^\circ\text{C}$; Y5V: $\theta_1 = -30^\circ\text{C}$, $\theta_2 = 85^\circ\text{C}$ $t_1 = 30\text{min}$, 5 cycles, recovery $24 \pm 2\text{hrs}$.
14	Adhesion	Visual	No visible damage		According to sub-clause 4.7 of IEC60384-21/22 $F = 5\text{N}$, $t = 10 \pm 1\text{s}$
15	Climatic Sequence	Visual	No visible damage		Special preconditioning 1hr at 150°C followed by 24hrs (X7R, X5R, Y5V). According to sub-clause 4.12 of IEC60384-21/22. Dry Heat: $T = 125^\circ\text{C}$ (C0G, X7R) or 85°C (X5R, Y5V), $t = 16\text{hrs}$ Damp Heat, Cycle: First Cycle, One cycle = 24hrs. Cold: $T = -55^\circ\text{C}$ (C0G, X7R, X5R) or -30°C (Y5V), $t = 2\text{hrs}$ Damp Heat Cycle: Remaining 9 Cycles One cycle = 24hrs.
		Cap. Change	C0G: $\Delta C/C \leq \pm 5\%$ or $\pm 0.5\text{pF}$, which is larger	X7R, X5R: $\Delta C/C \leq \pm 15\%$ Y5V: $\Delta C/C \leq \pm 30\%$	
		Tangent of loss angle	C0G: $\text{tg}\delta \leq 30 \times 10^{-4}$ ($C \geq 50\text{pF}$) or $3 \times (150/C + 7) \times 10^{-4}$ ($C < 50\text{pF}$)	X7R: $\text{tg}\delta \leq 700 \times 10^{-4}$ X5R: $\text{tg}\delta \leq 1250 \times 10^{-4}$ Y5V: $U_R \geq 25\text{V}$ $\text{tg}\delta \leq 750 \times 10^{-4}$ $c < 0.1 \mu\text{F}$ $\text{tg}\delta \leq 1250 \times 10^{-4}$ $c \geq 0.1 \mu\text{F}$ $U_R = 16\text{V}$ $\text{tg}\delta \leq 1500 \times 10^{-4}$ $U_R = 10\text{V}$ $\text{tg}\delta \leq 2000 \times 10^{-4}$	
Insulation Resistances	C0G: $R_i \geq 2500\text{M}\Omega$ or $R_i \times C \geq 25\text{M}\Omega \cdot \mu\text{F}$ which is smaller	X7R, X5R, Y5V: $R_i \geq 1000\text{M}\Omega$ or $R_i \times C \geq 5 \text{M}\Omega \cdot \mu\text{F}$ which is smaller			
16	Damp Heat, Steady State	Visual	No visible damage		Special preconditioning 1hr at 150°C followed by 24hrs (X7R, X5R, Y5V). According to sub-clause 4.13 of IEC60384-21/22. Test Temperature: $60^\circ\text{C} \pm 2^\circ\text{C}$ RH 90~95% Duration: 21d, recovery $24 \pm 2\text{hrs}$.
		Cap. Change	C0G: $\Delta C/C \leq \pm 5\%$ or $\pm 0.5\text{pF}$, which is larger	X7R, X5R: $\Delta C/C \leq \pm 15\%$ Y5V: $\Delta C/C \leq \pm 30\%$	
		Tangent of loss angle	C0G: $\text{tg}\delta \leq 30 \times 10^{-4}$ ($C \geq 50\text{pF}$) or $3 \times (150/C + 7) \times 10^{-4}$ ($C < 50\text{pF}$)	X7R: $\text{tg}\delta \leq 700 \times 10^{-4}$ X5R: $\text{tg}\delta \leq 1250 \times 10^{-4}$ Y5V: $U_R \geq 25\text{V}$ $\text{tg}\delta \leq 750 \times 10^{-4}$ $c < 0.1 \mu\text{F}$ $\text{tg}\delta \leq 1250 \times 10^{-4}$ $c \geq 0.1 \mu\text{F}$ $U_R = 16\text{V}$ $\text{tg}\delta \leq 1500 \times 10^{-4}$ $U_R = 10\text{V}$ $\text{tg}\delta \leq 2000 \times 10^{-4}$	
Insulation Resistances	C0G: $R_i \geq 2500\text{M}\Omega$ or $R_i \times C \geq 25 \text{M}\Omega \cdot \mu\text{F}$ which is smaller	X7R, X5R, Y5V: $R_i \geq 1000\text{M}\Omega$ or $R_i \times C \geq 5 \text{M}\Omega \cdot \mu\text{F}$ which is smaller			
17	Vibration	No visible damage. Cap. Change: C0G: $\Delta C/C \leq \pm 2.5\%$ or $\pm 0.25\text{pF}$, which is larger X7R, X5R: $\Delta C/C \leq \pm 15\%$ Y5V: $\Delta C/C \leq \pm 20\%$ $\text{tg}\delta$: 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.		

18	Endurance	Visual	No visible damage		<p>Special preconditioning 1hr at 150°C followed by 24hrs (X7R, X5R, Y5V).</p> <p>According to sub-clause 4.14 of IEC60384-21/22.</p> <p>Test Temperature: 125°C (C0G, X7R) or 85°C (X5R, Y5V)</p> <p>Duration: 1000hrs Voltage: $1.5 \times U_R$ *.</p> <p>under the room temperature, recover 6~24hr (C0G) or 24±2hr (X7R, X5R, Y5V) before checking the visual and testing the electric characteristics.</p> <p>For Y5V≥1.0μF, do special preconditioning 1hr at 150°C after taking out from the test box, recover 24±2 hours, and then test the electric characteristics.</p> <p>* Some high-Capacity products using $1.0 \times U_R$, detailed specifications, please to our sales representatives or engineers consulting</p>
		Cap. Change	C0G: $\Delta C/C \leq \pm 3\%$ or $\pm 0.5\text{pF}$, which is larger	X7R, X5R: $\Delta C/C \leq \pm 20\%$ Y5V: $\Delta C/C \leq \pm 30\%$	
		Tangent of loss angle	C0G: $\text{tg}\delta \leq 30 \times 10^{-4}$ ($C \geq 50\text{pF}$) or $3 \times (150/C + 7) \times 10^{-4}$ ($C < 50\text{pF}$)	X7R: $\text{tg}\delta \leq 800 \times 10^{-4}$ X5R: $\text{tg}\delta \leq 1250 \times 10^{-4}$ Y5V: $U_R \geq 25\text{V}$ $\text{tg}\delta \leq 750 \times 10^{-4}$ $c < 0.1 \mu\text{F}$ $\text{tg}\delta \leq 1250 \times 10^{-4}$ $c \geq 0.1 \mu\text{F}$ $U_R = 16\text{V}$ $\text{tg}\delta \leq 1500 \times 10^{-4}$ $U_R = 10\text{V}$ $\text{tg}\delta \leq 2000 \times 10^{-4}$	
Insulation Resistances	C0G: $R_i \geq 4000\text{M}\Omega$ or $R_i \times C \geq 25 \text{M}\Omega \cdot \mu\text{F}$ which is smaller	X7R, X5R, Y5V: $R_i \geq 2000\text{M}\Omega$ or $R_i \times C \geq 5 \text{M}\Omega \cdot \mu\text{F}$ which is smaller			
19	Load humidity	Visual	No visible damage		<p>According to sub-clause 9.9 of JIS-C-5102 9.9:</p> <p>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.</p> <p>Test temperature: 60±2°C RH 90~95%</p> <p>Test voltage: U_R Duration: 500hr</p> <p>under the room temperature, recover 6~24hr (C0G) or 24±2hr (X7R, X5R, Y5V) before checking the visual and testing the electric characteristics.</p>
		Cap. Change	C0G: $\Delta C/C \leq \pm 7.5\%$ or $\pm 0.75\text{pF}$, which is smaller	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 °C after taking out from the test box, followed by 48±4 hours, and then test the electric characteristics.)	
		Tangent of loss angle	C0G: $\text{tg}\delta \leq 30 \times 10^{-4}$ ($C \geq 50\text{pF}$) or $3 \times (150/C + 7) \times 10^{-4}$ ($C < 50\text{pF}$)	X7R: $\text{tg}\delta \leq 700 \times 10^{-4}$ X5R: $\text{tg}\delta \leq 1250 \times 10^{-4}$ Y5V: $U_R \geq 25\text{V}$ $\text{tg}\delta \leq 750 \times 10^{-4}$ $c < 0.1 \mu\text{F}$ $\text{tg}\delta \leq 1250 \times 10^{-4}$ $c \geq 0.1 \mu\text{F}$ $U_R = 16\text{V}$ $\text{tg}\delta \leq 1500 \times 10^{-4}$ $U_R = 10\text{V}$ $\text{tg}\delta \leq 2000 \times 10^{-4}$	
Insulation Resistances	C0G: $R_i \geq 2500\text{M}\Omega$ or $R_i \times C \geq 50\text{M}\Omega \cdot \mu\text{F}$ Which is smaller	X7R, X5R, Y5V: $R_i \geq 500\text{M}\Omega$ or $R_i \times C \geq 25\text{M}\Omega \cdot \mu\text{F}$ 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

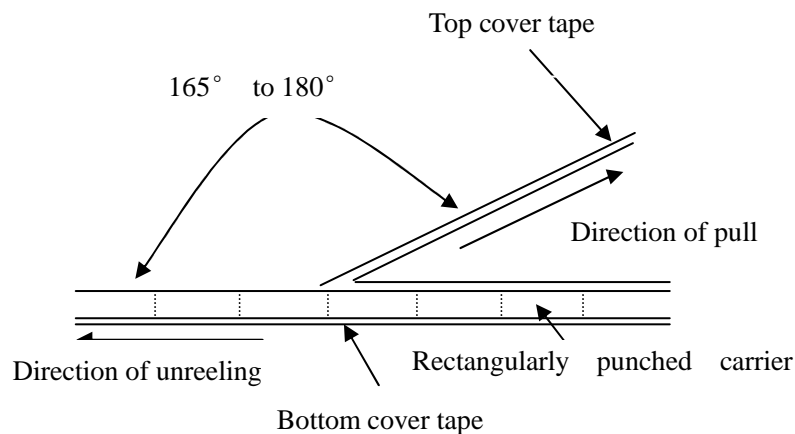
When a tensile force 1.02kgf is applied in the direction of unreeling the tape, the tape shall withstand this force.

- 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

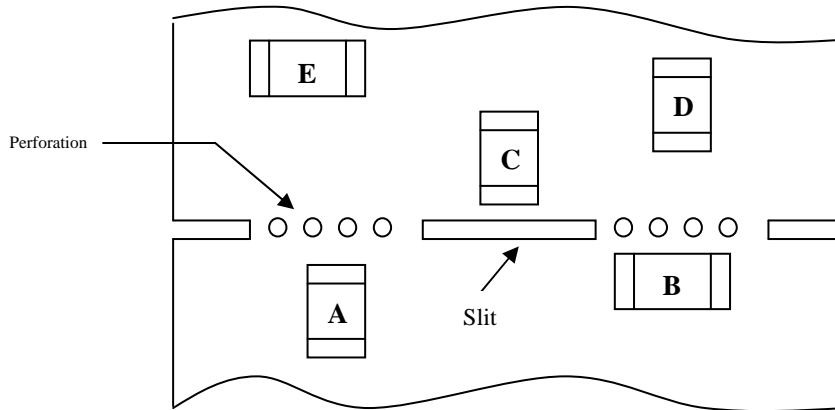
Unless otherwise specified, the peel force of top cover tape shall be 10 to 60 gf when the top cover tape is pulled at a speed of 300mm/min with the angle between the taped during peel and the direction of unreeling maintained at 165 to 180° as illustrated in Fig.



Application of technical requirements

Capacitor Layout on PCB:

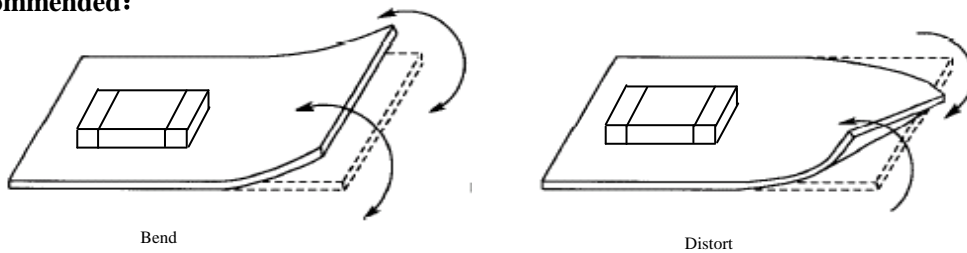
Mechanical stress varies according to the location of chip capacitors on PCB. The recommendation for better design is as Fig.



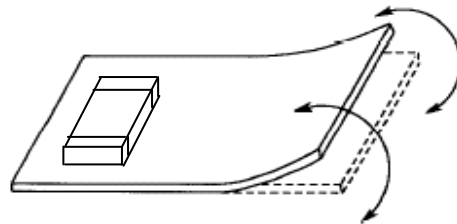
The stress in capacitors is in the following order: $A > B = C > D > E$

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

a. Not recommended:

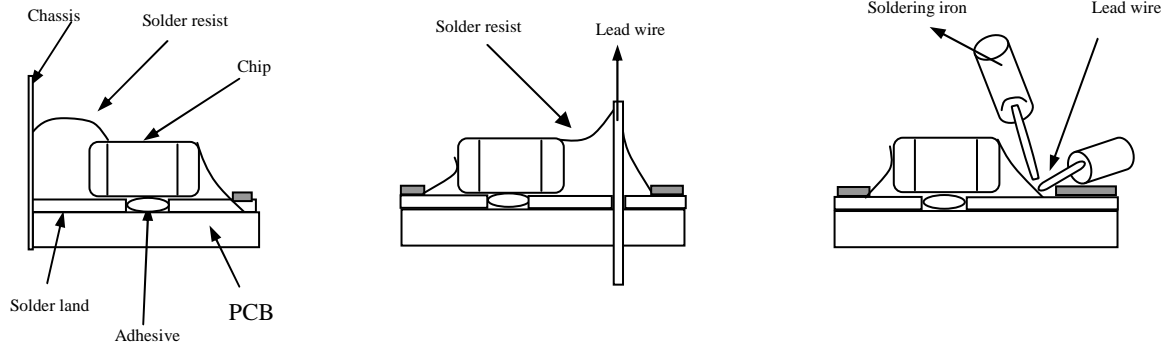


b. Recommended:

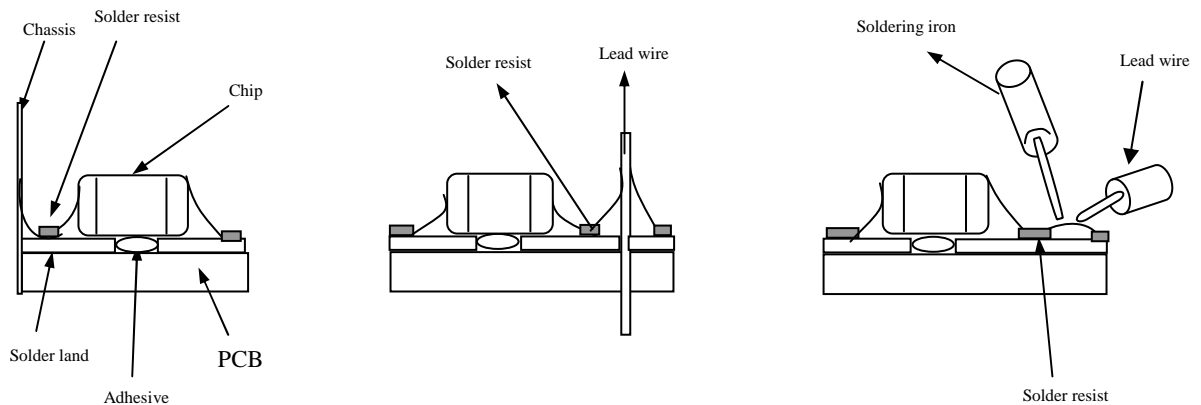


■ Solder Buildup and Soldering Methods:

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		
Double-sided Mounting		

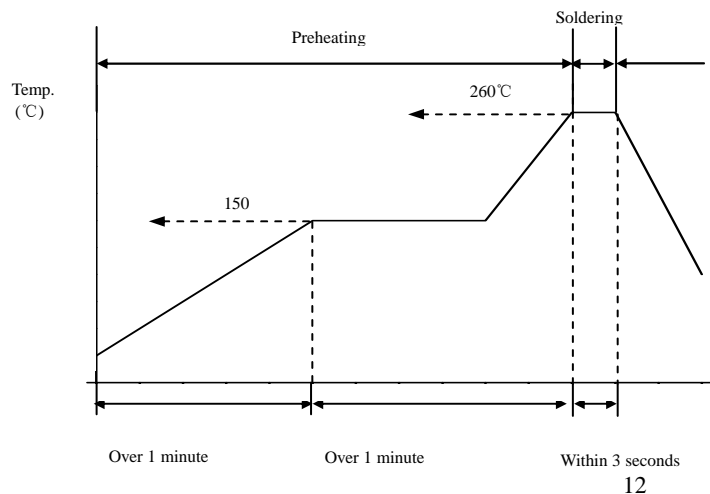
■ Soldering

● Flux Selection :

- It is recommended to use a mildly activated rosin flux (less than 0.1wt% chlorine) . Strong flux is not recommended.
- Please provide proper amount of flux. Excessive flux must be avoided.
- When water-soluble flux is used, enough washing is necessary.

■ Recommended Soldering Profile:

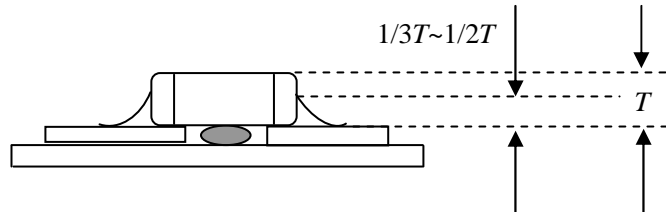
● Reflow Soldering Condition



Cautions:

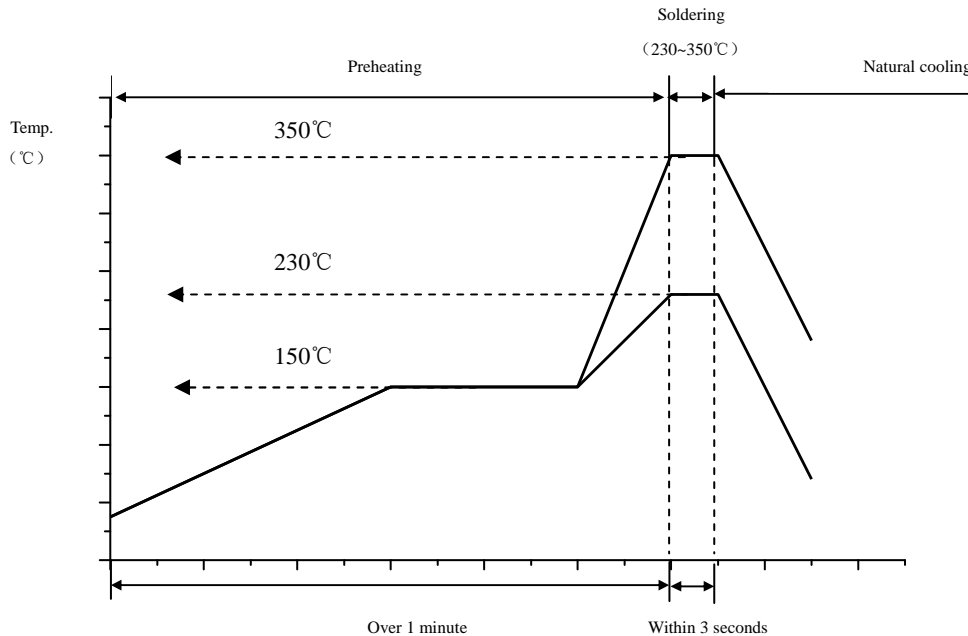
a. Excessive solder will induce higher tensile force in chip capacitor when temperature changes and result in cracking. Insufficient solder may detach the capacitors from the PC board.

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:

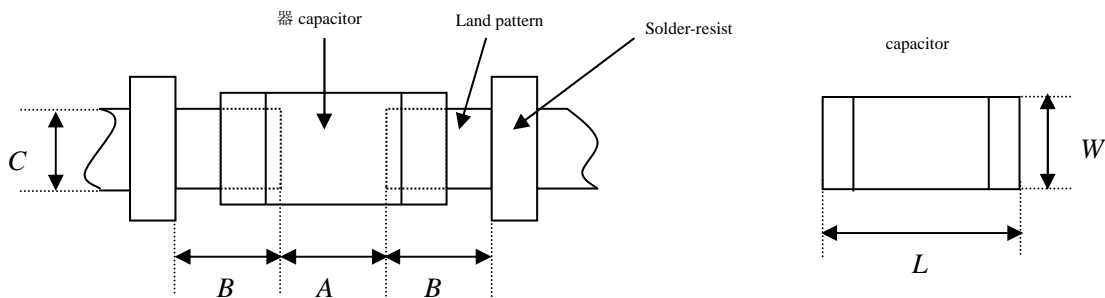
- a. Do not use capacitor above the maximum allowable operating temperature.
- b. Surface temperature including self heating should be below maximum operating temperature.

■ 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