

Precautions on the use of High Reliability Application Multilayer Ceramic Capacitors

PRECAUTIONS

1. Circuit Design

- Precautions**
- ◆ Verification of operating environment, electrical rating and performance
 1. A malfunction in medical equipment, spacecraft, nuclear reactors, etc. may cause serious harm to human life or have severe social ramifications.
As such, any capacitors to be used in such equipment may require higher safety and/or reliability considerations and should be clearly differentiated from components used in general purpose applications.
 - ◆ Operating Voltage (Verification of Rated voltage)
 1. The operating voltage for capacitors must always be lower than their rated values.
If an AC voltage is loaded on a DC voltage, the sum of the two peak voltages should be lower than the rated value of the capacitor chosen. For a circuit where both an AC and a pulse voltage may be present, the sum of their peak voltages should also be lower than the capacitor's rated voltage.
 2. Even if the applied voltage is lower than the rated value, the reliability of capacitors might be reduced if either a high frequency AC voltage or a pulse voltage having rapid rise time is present in the circuit.

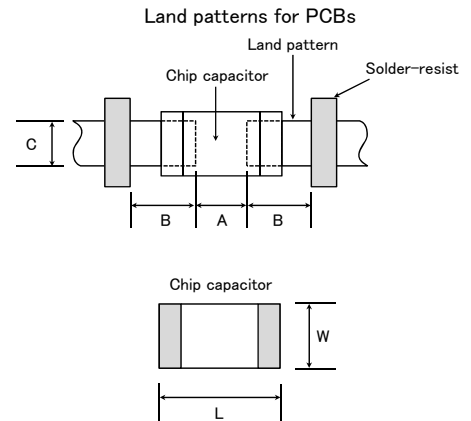
2. PCB Design

- Precautions**
- ◆ Pattern configurations (Design of Land-patterns)
 1. When capacitors are mounted on a PCB, the amount of solder used (size of fillet) can directly affect capacitor performance. Therefore, the following items must be carefully considered in the design of solder land patterns:
 - (1) The amount of solder applied can affect the ability of chips to withstand mechanical stresses which may lead to breaking or cracking. Therefore, when designing land-patterns it is necessary to consider the appropriate size and configuration of the solder pads which in turn determines the amount of solder necessary to form the fillets.
 - (2) When more than one part is jointly soldered onto the same land or pad, the pad must be designed so that each component's soldering point is separated by solder-resist.
 - ◆ Pattern configurations (Capacitor layout on panelized [breakaway] PC boards)
 1. After capacitors have been mounted on the boards, chips can be subjected to mechanical stresses in subsequent manufacturing processes (PCB cutting, board inspection, mounting of additional parts, assembly into the chassis, wave soldering the reflow soldered boards etc.) For this reason, planning pattern configurations and the position of SMD capacitors should be carefully performed to minimize stress.

- Technical considerations**
- ◆ Pattern configurations (Design of Land-patterns)
 1. The following diagrams and tables show some examples of recommended patterns to prevent excessive solder amounts. (larger fillets which extend above the component end terminations) Examples of improper pattern designs are also shown.

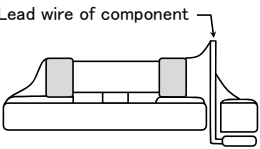
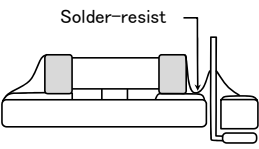
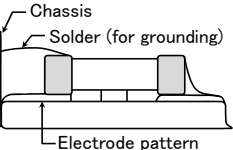
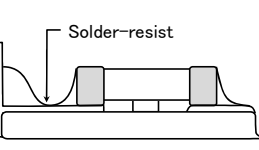
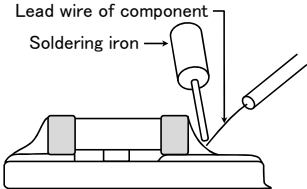
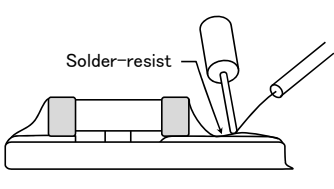
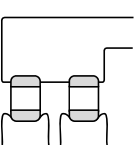
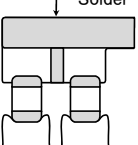
(1) Recommended land dimensions for a typical chip capacitor land patterns for PCBs
Recommended land dimensions for reflow-soldering (unit: mm)

Type		107	212	316	325
Size	L	1.6	2.0	3.2	3.2
	W	0.8	1.25	1.6	2.5
A		0.8~1.0	0.8~1.2	1.8~2.5	1.8~2.5
B		0.6~0.8	0.8~1.2	1.0~1.5	1.0~1.5
C		0.6~0.8	0.9~1.6	1.2~2.0	1.8~3.2



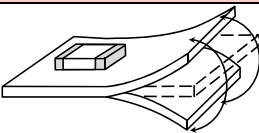
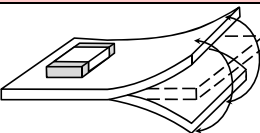
Excess solder can affect the ability of chips to withstand mechanical stresses. Therefore, please take proper precautions when designing land-patterns.

(2) Examples of good and bad solder application

Items	Not recommended	Recommended
Mixed mounting of SMD and leaded components		
Component placement close to the chassis		
Hand-soldering of leaded components near mounted components		
Horizontal component placement		

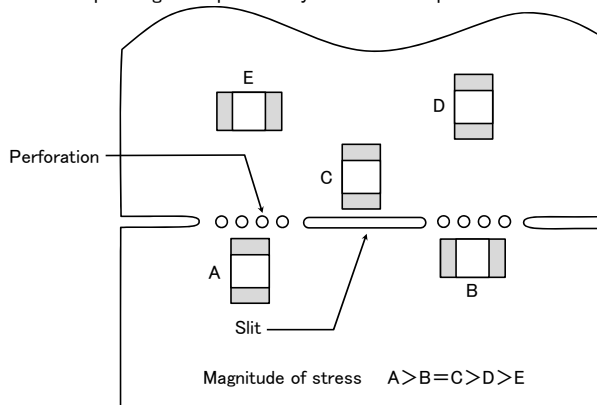
◆ Pattern configurations (Capacitor layout on panelized [breakaway] PC boards)

1-1. The following is examples of good and bad capacitor layout; SMD capacitors should be located to minimize any possible mechanical stresses from board warp or deflection.

Items	Not recommended	Recommended
Deflection of board		

Place the product at a right angle to the direction of the anticipated mechanical stress.

1-2. To layout the capacitors for the breakaway PC board, it should be noted that the amount of mechanical stresses given will vary depending on capacitor layout. The example below shows recommendations for better design.



1-3. When breaking PC boards along their perforations, the amount of mechanical stress on the capacitors can vary according to the method used. The following methods are listed in order from least stressful to most stressful: push-back, slit, V-grooving, and perforation. Thus, any ideal SMD capacitor layout must also consider the PCB splitting procedure.

Precautions

◆ Selection of Flux

1. Since flux may have a significant effect on the performance of capacitors, it is necessary to verify the following conditions prior to use;
 - (1) Flux used should be with less than or equal to 0.1 wt% (equivalent to chlorine) of halogenated content. Flux having strong acidity content should not be applied.
 - (2) When soldering capacitors on the board, the amount of flux applied should be controlled at the optimum level.
 - (3) When using water-soluble flux, special care should be taken to properly clean the boards.

◆ Soldering

1. Temperature, time, amount of solder, etc. are specified in accordance with the following recommended conditions.
Sn-Zn solder paste can affect MLCC reliability performance.
Please contact us prior to usage.

Technical considerations

◆ Selection of Flux

- 1-1. When too much halogenated substance (Chlorine, etc.) content is used to activate the flux, or highly acidic flux is used, an excessive amount of residue after soldering may lead to corrosion of the terminal electrodes or degradation of insulation resistance on the surface of the capacitors.
- 1-2. Flux is used to increase solderability in flow soldering, but if too much is applied, a large amount of flux gas may be emitted and may detrimentally affect solderability. To minimize the amount of flux applied, it is recommended to use a flux-bubbling system.
- 1-3. Since the residue of water-soluble flux is easily dissolved by water content in the air, the residue on the surface of capacitors in high humidity conditions may cause a degradation of insulation resistance and therefore affect the reliability of the components. The cleaning methods and the capability of the machines used should also be considered carefully when selecting water-soluble flux.

◆ Soldering

1-1. Preheating when soldering

Heating: Ceramic chip components should be preheated to within 100 to 130°C of the soldering.

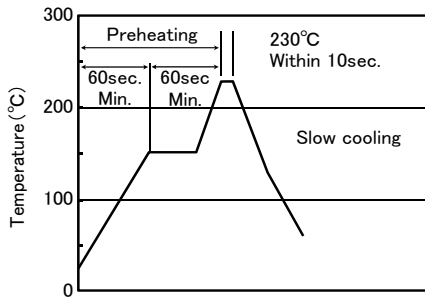
Cooling: The temperature difference between the components and cleaning process should not be greater than 100°C.

Ceramic chip capacitors are susceptible to thermal shock when exposed to rapid or concentrated heating or rapid cooling. Therefore, the soldering process must be conducted with great care so as to prevent malfunction of the components due to excessive thermal shock.

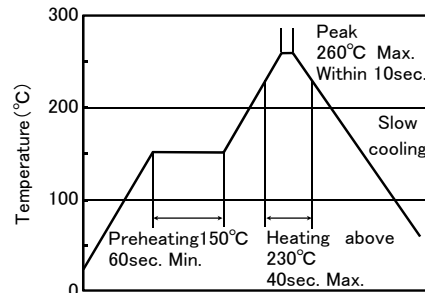
【Recommended conditions for soldering】

[Reflow soldering]

Temperature profile



【Recommended conditions for Pd Free soldering】

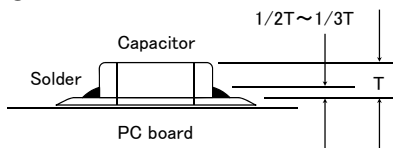


※Ceramic chip components should be preheated to within 100 to 130°C of the soldering.

※Assured to be reflow soldering for 2 times.

Caution

- ①The ideal condition is to have solder mass (fillet) controlled to 1/2 to 1/3 of the thickness of the capacitor, as shown below:



- ②Because excessive dwell times can detrimentally affect solderability, soldering duration should be kept as close to recommended times as possible.