1 In designing device circuits

(1) Confirming the installation and operating environment of capacitors,use them within the rated performance limits prescribed in their catalog or product specifications. Otherwise, excessive use conditions cause the capacitors to have catastrophic failure such as short circuit, open circuit or firing.
(2) Do not apply a DC voltage which exceeds the full rated voltage. The peak voltage of a superimposed AC voltage (ripple voltage) on the DC voltage must not exceed the full rated voltage.
(3) By considering the temperature characteristic and the DC bias characteristic of the ceramic capacitors, please determine the right capacitance. The capacitance of the capacitors changes in low and high temperature ambiences and depends on the applied bias voltages. The capacitance change (i.e. reduction) may affect the performance of the circuit which is containing the capacitors. Therefore, please examine the capacitors in the actual operational conditions to verify that they are right ones.
(4) The common failure mode of multilayer ceramic capacitors is contingent insulation breakdown or short circuit. When the capacitors are used in a high-power circuit, they may damage the surroundings of the capacitors when failed. Therefore, the high-power circuit should have protective device/protective devices to shut down the circuit from the capacitor/capacitors. The reliability of the capacitors improves when the ambient temperatures are in the normal temperature range and the applied voltages are low.
(5) When large high frequency ripple current acrosses multilayer ceramic capacitor , the capacitor can vibrate. The phenomenon occurs as the capacitor, has natural vibration frequency due to the mechanical dimensions, resonates to the large high frequency ripple current.
To prevent the resonance, please select the capacitor or change the ripple current frequency.
For your information, we indicate the following resonance frequency to each chip size.

Size Code NTS, NTF, NTJ, NTD	Chip Size	(kHz)
31	3.2× 1.6	650, 1200, 1600
32	3.2× 2.5	650, 850, 1200
43	4.5× 3.2	450, 650, 1200
55	5.7× 5.0	350, 450, 850

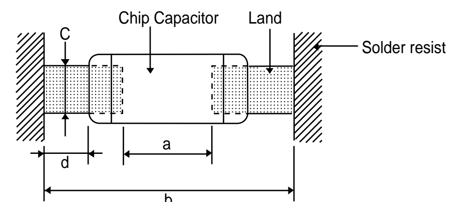
Size Code		Chip Size	(kHz)
THC,THP	THD		
21		2.0× 1.25	900, 1500, 1800
31		3.2× 1.6	600, 1200, 1600
32	32	3.2× 2.5	600, 750, 1200
43	43	4.5× 3.2	400, 600, 1000
55	55	5.7× 5.0	300, 400, 900
76	76	7.5× 6.3	250, 350, 750
	80	10.0× 9.0	160, 200, 600
	90	20.0×12.7	90, 160, 500
	99	25.0×12.7	75, 160, 300

(6) The capacitance of the capacitors depends on the ambient temperatures and bias voltages. Therefore, please examine the capacitors when they are to be used in a time-constant circuit before the use.
(7) Consult us for devices that requires high reliability. For components which are used to the devices whose failure affects human life or causes social loss by serious damage, higher reliable designs than general purpose components are required.

2 In designing PC boards

(1) Put the proper volume of solder (the size of fillet) on PC boards for installing surface mount capacitors, because it directly affects the installed capacitors. The design of copper pad patterns and dimensions should be set so that the proper volume of solder can be provided. The standard land dimensions are shown below.

(2) Land width of PC boards shall not exceed the width of chip capacitors.



●Chip type (mm)

Code \ Size Code	21	31	32	43	55	76
a	1.2 to 1.4	2.2 to 2.5	2.2 to 2.5	3.5 to 3.7	4.5 to 4.7	5.0 to 5.2
b	3.0 to 4.6	4.2 to 5.8	4.2 to 5.8	5.5 to 6.1	6.7 to 8.3	8.8 to 10.8
c	0.9 to 1.2	1.2 to 1.6	1.8 to 2.5	2.3 to 3.2	3.5 to 5.0	4.7 to 6.3
d	0.3 to 0.6	0.4 to 0.8	0.5 to 1.0	0.6 to 1.1	0.7 to 1.2	0.8 to 1.3

●Metal Cap type (mm)

Code \ Size Code	43	55	76
a	2.5 to 3.5	3.5 to 4.5	5.5 to 6.5
b	5.5 to 6.1	6.5 to 7.5	8.8 to 9.8
c	2.3 to 3.2	4.0 to 5.0	5.5 to 6.5
d	0.6 to 1.1	0.5 to 1.5	0.8 to 1.8

(3) When the multilayer ceramic capacitors are mounted on a substrate, the chips may crack when mechanical stress is put. Also, when the substrate is bent, they may also crack. Therefore, please make sure that the material and size of the substrate and the capacitor positions are right.

(4) For a leaded capacitor, design the PC boards with the correct terminal hole space equal to the lead space of the capacitor.

3 Installation

(1) When installing leaded capacitors in the PC boards by means of an automatic insertion machine, minimize the mechanical shock applied to the capacitors by the lead clinch unit of the machine.
(2) When the capacitors are to be mounted on a substrate, please minimize the shock and weight to the capacitor bodies. The nozzle pressure during the mounting process should be adjusted to 1N～3N maximum in static load.
(3) Periodically maintain and inspect installation machines.
(4) Where an adhesive is used to pre-anchor capacitors on PC boards, use appropriate copper pad dimensions,type of adhesive, coating volume, curing temperature and time, etc. to prevent the capacitors from deteriorating.

4 Soldering

(1) Use flux with a halogen content of less than 0.1 wt. %. Do not use strong acid flux.
(2) Minimize a volume of flux to coat the PC boards with.
(3) Follow the soldering conditions prescribed in the catalog or product specifications. Excessive thermal stress affects the performance of the capacitors.
(4) Note that surface mount capacitors with the size 3.2×1.6 or smaller tend to stand up during vapor phase reflow soldering.
(5) For reflow soldering, place surface mount capacitors on the PC boards as soon as possible after solder paste was coated.
(6) Please be aware that thermal deformation of substrates during mounting process cause stress to the substrates. Especially, substrates which are mounting chip capacitors are to be flow soldered to solder leaded parts or solder other parts onto the substrates, please make sure that the deformation during the soldering causes no harm. In fact, the deformation may cause stress to the substrates which leads to the capacitor element cracks/insulation-layer break down/insulation resistance degradation.The effect of the stress due to the deformation depends on the material of the substrates. Therefore, please be aware of the following information.

a) Ceramic substrates
The stress due to the deformation of ceramic substrates is thought be the minimum. Heat contract difference during solder hardening can be the effect to ceramic capacitors mounted on the substrates. So, please avoid forced cooling during the hardening.

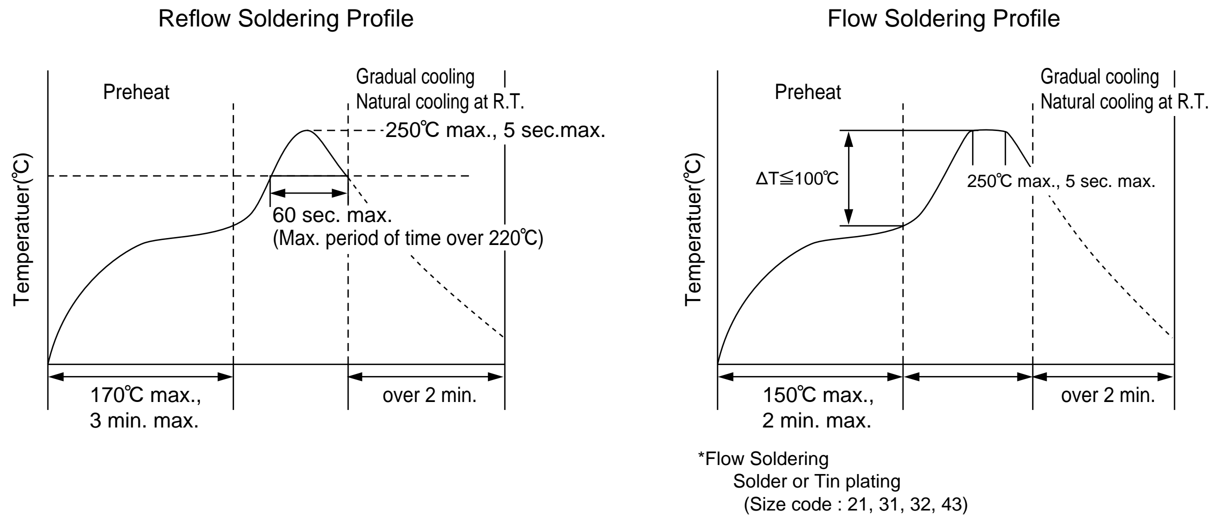
b) Glass epoxy substrates
The stress due to the deformation and warp of glass epoxy substrates affects ceramic capacitors mounted. The stress depends on the size and material of the substrates, pattern positions and thermal gradient during soldering. Temperature difference between the both sides of the substrates may also cause the stress. When the material of the substrates, which are mounting ceramic capacitors, is FR-4 or the equivalent and other parts are to be flow soldered, the surface of the side with the capacitors shall be sufficiently preheated to 150℃ or over before the flow soldering. During the soldering, the temperature difference between the side with the capacitors and the other side of the substrate should be 100℃ maximum.

c) Metal substrates
The deformation and warp of metal substrates considerably affect ceramic capacitors mounted. Therefore, please use metal caps which can moderate the stress of the substrates.

(7) After reflow/flow soldering, please cool the PC boards which mounted capacitors naturally in the air.
(8) Ceramic chip capacitors are solderable by twice maximum in reflow or flow soldering. When the capacitors are to be reflow soldered and then flow soldered, there shall be no additional soldering to the capacitors. However, the capacitors having a size of 5.7×5.0 or larger should be soldered by one time only.
(9) Due to the nature of ceramic, radical heating or cooling and partial heating may crack the ceramic capacitor element. Please have enough pre-heating process before soldering.
(10)Ultrasonic cleaning time shall be ten minutes maximum.
When the power of ultrasonic cleaner is too high, the strength of terminations may drop.
Therefore, carefully examine the cleaning conditions before use.
(11)Adjust the amount of solder cream in order that solder fillet shall be 1/2 to 2/3 height of chips. If fillet can confirm, size of 4.5×3.2 or larger is not this limit.
(12)When more than two chips are mounted on a common land, please separate the chips by the solder resist.
(13)In hand soldering, please take into consideration the following items.

1. Fully pre-heat on a heating plate whose surface temperature is 100℃ to 150℃ .
2. Soldering iron power shall not exceed 30W.
3. Soldering iron tip diameter shall not exceed 3mm.
4. Temperature of iron tip shall be adjusted to not exceed 300℃.
5. The soldering iron tip shall not touch ceramic body directly.
6. After soldering, let the products to be room temperature to cool gradually.

5 Soldering profile



*Flow Soldering
Solder or Tin plating
(Size code : 21, 31, 32, 43)

6 Cleaning

(1) In the case that the assembly boards are washed, choose the appropriate cleaning agent for the washing purpose.
(2) To determine the cleaning conditions, make sure by means of the actual washing equipment that the performance of the capacitors is not affected.
(3) In the case that water-soluble flux was used,sufficiently wash the assembly boards.

7 Coating materials

(1) When ceramic capacitors are to be resin coated or molded, please pay enough attention. Ceramic capacitors molded in resin, and please do not use it. There is fear to destroy a capacitor by stress to occur by the expansion / the shrinkage when resin stiffens. When a thermal expansion shrinkage coefficient in hardening uses big resin, coating in the resin which is soft with capacitors, please make that stress is added to capacitors small as much as possible.
(2) Confirm that harmful resolution or formation gasses are not generated from the coating materials during the curing process or by spontaneously leaving the coated assembly boards.
(3) If a coating material is cured at higher temperatures than the Category temperature of the capacitor, the exterior resin will deteriorate resulting in the capacitor damage.

8 Handling

(1) When cutting off a multi-board to make individual units, curving or twisting the board may crack the capacitors. Appropriate tools should be used to cut it off.
(2) Excessive mechanical shock to capacitors or their assembly boards may make the capacitors crack.
(3) Use leaded capacitors without bending their lead wires as much as possible.
(4) When ceramic capacitors are stored with no load, the capacitance reduces during the storage (named "aging characteristic"). As for the product that capacitance decreased, capacity recovers in an initial value by heat-treating it.
(5) When the electrodes of the ceramic capacitors are made of silver, needle crystals may form on the electrodes in an ambience containing sulfur compounds.

9 Storage

(1) Do not store and use capacitors in the following environment. Water or salt water splashes, dew wets or toxic gasses (hydrogen sulfide, sulfurous acid,chlorine, ammonium) fills, Vibration or mechanical shock exceeding the limits prescribed in the catalog or product specifications.
(2) Do not store capacitors in places that direct sunlight pours down or dewy places.
(3) Avoid high temperature and humidity.
The storage conditions should be : Temperature=Lower than 40℃
Humidity=Lower than 70% RH

10 Catalogs

Specification in catalogs may be subject to change without notice. Performance test data in the catalogs show typical values, which are not assured in the catalogs.

11 Regarding compliance for EU REACH Regulation

According to the content of REACH handbook (Guidance on requirements for substances in articles which is published on May 2008), our electronic components are "articles without any intended release". Therefore they are not applicable for "Registration" for EU REACH Regulation Article 7 (1).

Reference: Electrolytic Condenser Investigation Society
"Study of REACH Regulation in EU about Electrolytic Capacitor" (publicized on 13 March 2008)

For the details, refer to Guideline of notabilia for fixed multilayer ceramic capacitors for use in electronic equipment, EIAJ RCR-2335 issued by Electronic Industries Association of Japan.