Capacitor Terminations

and Soldering Recommendations

I. Termination Types

Our capacitors are delivered with one of the following terminations (for technical reasons, only a limited number of termination types are available in certain cases). All our terminations are backward compatible.

Parameter	Value	Comment
Termination Materials	A C S	non-magnetic (silver-palladium) non-magnetic (pure tin over copper barrier) lead-free (pure tin over nickel barrier)

NB:
- terminations type C recommended for non magnetic applications.
- termination type A available for non magnetic applications (for historical reason, we have also another code, the code “P”, for the same type of termination. The parts that were designed-in before 2005 might still have a code “P” instead of “A” in the part numbering. But both codes correspond to the same type of termination).

II. Specifications

Care must be taken when using particular terminations: if the terminations are heated up above a particular temperature and/or for too long a period of time, there is a risk of leaching (dissolution of the termination revealing the inner electrodes). The chart below gives the resistance to soldering heat per termination type, based on a SAC387 solder bath at 260°C.

Dielectric Type	A	C	S
CHA / SHA		10 ±1s ([3])	120 ±5s
CHB / SHB		30 ±2s	120 ±5s
CPX / CLX / CPE / CLE		30 ±2s	120 ±5s
CLF	10 ±2s ([1])	On request	120 ±5s
SHL			120 ±5s
SHS		10 ±1s ([4])	120 ±5s
SHF / SHN / SHT	5 ±1s ([2])		120 ±5s

([1]): results extrapolated from 30±2s data obtained with Sn62/Pb36/Ag2 solder bath.
([2]): data obtained with Sn62/Pb36/Ag2 solder bath.
([3]): termination only available on CHA series.
([4]): preliminary data.

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III. STANDARD SMD REQUIREMENTS

III.1. Soldering Recommendations

Regarding the soldering attachments, three methods are generally used: the vapor phase soldering, the infrared reflow soldering and the wave soldering. Unless particular skill about the use of the wave soldering, this method is not recommended since the melted solder is directly in contact with the ceramic. This can potentially crack the capacitor because the ceramic is sensible to the thermal shocks. Moreover, this method needs to maintain the components with an insulating resin which increases the thermo-mechanical strains between the ceramic and the board both on soldering phase and operating condition. The vapour phase and IR reflow soldering are less aggressive, inducing more restricted thermal shocks. This is the reason why they are preferred to the wave soldering method for reliable applications. In all cases, proper pre-heating is essential.

The circuit should be pre-heated at a typical rate of 1°C/s within 65°C to 100°C of the maximum soldering temperature. While multilayer ceramic capacitors can withstand the peak soldering temperatures for short durations, they should be minimized whenever possible.

Above precaution given for SMD types are applicable for the implementation of large bare chips (1515 and above). But in general, large bare chips above 2225 are not recommended to be mounted on epoxy printed board due to the thermal expansion mismatch between ceramic capacitor body and epoxy. This is the reason why leaded components will be preferred especially for reliable applications.

For information, the typical thermal profiles of these three soldering processes are given hereafter. These typical diagrams are only given as an aid to SMD users in determining specific processes linked to their instrumentations and to their own experience.

NB: reference documents are IEC 61760-1, CECC30000 and IEC68 standards. Please, refer to this standard for more information.

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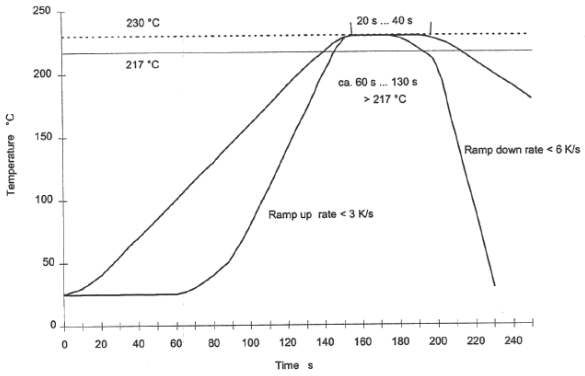
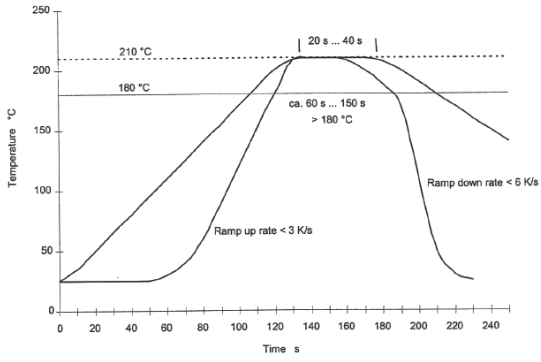
III.1.1. Vapour Phase Soldering



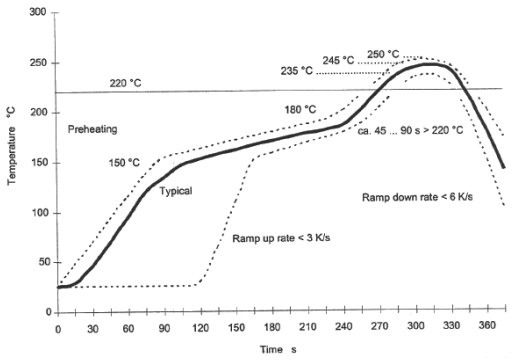
Lead free SnAgCu solders - Vapour Phase



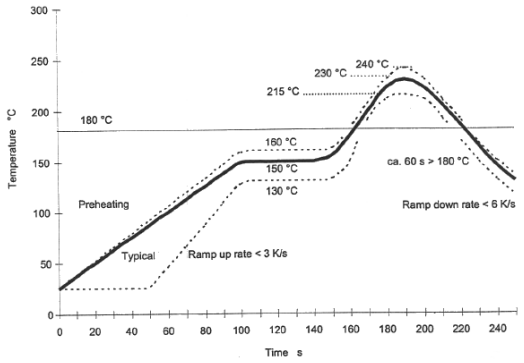
SnPb solders - Vapour Phase

NB: the lines indicate the upper and lower limits of typical process (terminal temperature).

III.1.2. Infrared Soldering



Lead free SnAgCu solders – Infrared Soldering



SnPb solders – Infrared Soldering

NB:
- these profiles are given for mid size components.
- continuous lines: typical process (terminal temperature).
- dotted lines: process limits, bottom process limit (terminal temperature), upper process limit (top surface temperature).

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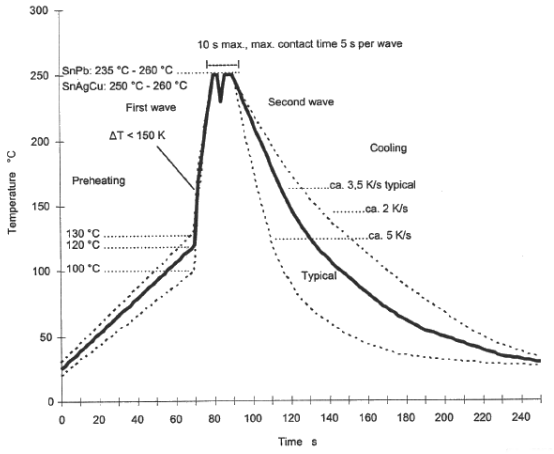
III.1.3. Wave Soldering



SnAgCu and SnPb solders - Double Wave Soldering

NB:
- continuous lines: typical process.
- dotted lines: process limits.

III.2. Moisture Sensitivity Classification

Our standard lead-free terminations - S and C types - have been fully tested and are compliant with the requirements mentioned in specification JEDEC STD 020 (level 1: not moisture sensitive).

III.3. Whiskers Classification

Our standard lead-free terminations - S and C types - have been fully tested and are compliant with the requirements mentioned in specification JEDEC STD 201. Our terminations exhibit a matte finish and receive a special heat treatment to relieve stress inside the tin.

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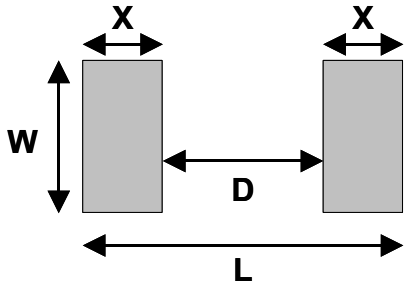
III.4. Pad Dimensions

The metallized pads on the end user's substrate must be properly designed. Improper spacing or dimensioning of the pads may result in poor solder joints or a tombstone effect. Pad designs are given below for the most common sizes of multilayer ceramic capacitors for both wave and reflow soldering.



Case Size	W	X	D	L
SHL (0402)	0.70mm	0.90mm	0.40mm	2.20mm
CHA / SHA (0505)	1.80mm	1.00mm	0.80mm	2.80mm
SHS (0603)	1.00mm	1.10mm	0.60mm	2.80mm
SHF (0805)	1.50mm	1.30mm	0.60mm	3.20mm
CHB / SHB (1111)	3.00mm	1.00mm	1.90mm	3.90mm
CPX / CLX (2225)	6.90mm	1.00mm	5.00mm	7.00mm
CPE / CLE (4040)	10.20mm	1.00mm	8.30mm	10.30mm

NB: these dimensions are suggested for a reflow soldering process. If a wave soldering process is used, the X dimension has to be increased by 0.50mm (0.40mm for L and A case sizes), thus leading to an increase of 1.00mm to the L dimension (0.80mm for L and A case sizes).

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IV. Specific Requirements

IV.1. Large Sizes

Capacitors with dimensions greater than or equal to 1515 size code (i.e. greater than or equal to 3.81mm x 3.81mm) are not usually handled by pick and place equipments. Therefore, manual soldering has to be used and the capacitors undergo a pre-heating sequence prior to the soldering operation. The steps are required to avoid damage which may affect the reliability of the capacitors :

- three heating plates must be used as follows :

  → heating plate at 120°C for 5 to 10 minutes;

  → heating plate at 170°C for 5 to 10 minutes;

  → heating plate at 240°C for 5 to 10 minutes.

When using chips with ribbons, the capacitor and its ribbon must be pre-heated on a heating plate prior to any soldering operation. Do not heat the ribbons above 280°C for more than 10s.

Mounting chips larger than 2225 size directly onto epoxy printed boards is not recommended due to the thermal expansion coefficient mismatch between the ceramic capacitor body and the epoxy. In such cases, chips equipped with wires and ribbons are preferable.

IV.2. Silver-Palladium Terminations

The silver-palladium non-magnetic termination – A type - has a lower wettability than the standard terminations - S or C types. Actually, this is a typical phenomenon as these non-magnetic terminations do not have a tin layer. These kind of terminations are not compatible with SAC soldering. To improve the wettability of such terminations, we recommend the following:

- use a more activated flux;

- increase the quantity of soldering paste;

- use an nitrogen controlled atmosphere if appropriate.

If the customer's production process cannot be modified as suggested above, the use of a C-type termination (copper barrier with tin layer) will solve the problem.

Capacitor Terminations and Soldering Recommendations

IV.3. Hand Soldering

The most important aspect of hand soldering is operator skill. Care should be taken to avoid touching the capacitor with bare hands and to prevent the tip of the soldering iron coming into contact with the ceramic component. If hand soldering is the choosen technique, the following rules must be observed:

- pre-heat the circuit to 150°C;
- do not put the ceramic and/or termination in contact with the iron tip;
- maximum tip temperature of 315°C;
- maximum tip diameter of 3mm;
- soldering time must be very quick (a couple of seconds).

NB: multilayer ceramic capacitor attachments with a soldering iron are discouraged due to the process control limitations.

IV.4. Flux

Flux applied to surfaces that are to be joined by soldering. The flux cleans the surfaces, prevents oxidation during soldering and results in a better bond. The flux must be compatible with the soldering temperature and soldering times given in this document.

IV.5. Storage Conditions

It is recommended to store the capacitors at ambient temperature of 5 to 40°C and 20 to 70%RH humidity. The parts should be used within 6 months from the time of delivery. If the parts are stored over six months, a solderability test has to be performed prior use in production.

When the chip monolithic ceramic capacitors are stored in high temperature and humidity conditions or corrosive environments - such as with sulfide or chloride gas, acid, alkali or salt - the surface of terminations (external electrode) deteriorates causing solderability to degrade. Such a solderability degradation could also occur if the parts are stored out of their packaging (reel or plastic bag) for a long period of time. In this case, the terminations must be checked (to avoid oxidation for instance) and a solderability test must be performed.

Generally speaking, no surface preparation is required. However, it may be advantageous to clean the HiQ capacitors with any standard microelectronic cleaning solvent to remove dust and other agents.

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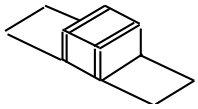
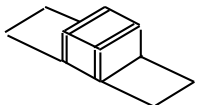
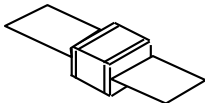
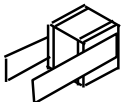
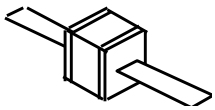
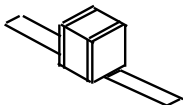
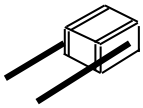
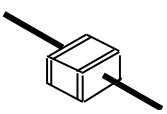
V. Leads and Wires

V.1. Leads and Wires Types

Termination Type	Code	Description
	1	Micro-strip Ribbon
	1S	Short Micro-strip Ribbon
	2	Axial Ribbon
	3	Radial Ribbon
	4	Narrow Axial Ribbon
	5	Narrow Micro-strip Ribbon
	6	Radial Wire
	7	Axial Wire

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V.2. Leads and Wires Matrix

Termination Type	Code	CHB	SHB	CLX / CPX	CLE / CPE	CLF
Micro-strip Ribbon	1	AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE
Short Micro-strip Ribbon	1S				AVAILABLE	
Axial Ribbon	2	AVAILABLE			AVAILABLE	
Radial Ribbon	3	AVAILABLE				
Narrow Axial Ribbon	4					
Narrow Micro-strip Ribbon	5	AVAILABLE				
Radial Wire	6	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE
Axial Wire	7	AVAILABLE		AVAILABLE	AVAILABLE	

V.3. Leads and Wires Soldering Conditions

Leads and wires are soldered to the chip capacitor using HMP soldering paste at 300°C. Therefore, these assemblies are suitable for a generic SMD soldering profile – with lead or lead-free soldering paste – or hand soldering as long as operating conditions and recommendations described in this document are fulfilled.

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V.4. Leads and Wires Dimensions

Within each cell, the length is given first, then the width/diameter of any single ribbon or wire.

Termination Type	Code	CHB	SHB	CLX / CPX	CLE / CPE	CLF
Micro-strip Ribbon	1	8.00 2.40	8.00 2.40	8.00 5.40	16.00 8.90	6.10 15.00
Short Micro-strip Ribbon	1S				8.50 8.90	
Axial Ribbon	2	8.00 2.40			16.00 8.90	
Radial Ribbon	3	8.00 2.40				
Narrow Axial Ribbon	4					
Narrow Micro-strip Ribbon	5	8.00 1.27				
Radial Wire	6	20.00 0.60		30.00 0.60	30.00 0.90	30.00 0.90
Axial Wire	7	20.00 0.60		30.00 0.60	30.00 0.90	

NB: dimensions are in mm, length is the minimum value.

V.5. Interaxial Dimensions

Termination Type	Code	CHB	CLX / CPX	CLE / CPE	CLF
Radial Wire	6		7.62±0.80	12.70±0.80	15.24±0.80

NB: dimensions are in mm.

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