# Application Notes: Attachment Techniques

## Power, RF & Microwave Capacitors

## 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).

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

NB: the new S termination has been tested according to JEDEC specification J-STD-020C. P and V terminations are still available on request. Please consult us.

## 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.

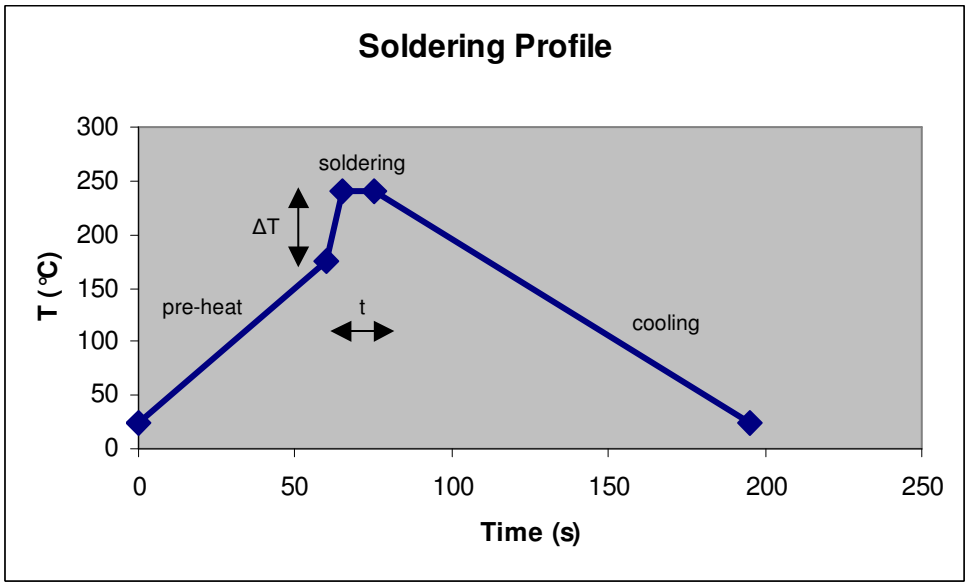
| *Dielectric Type* | *A* | *C* | *S* |
|---|---|---|---|
| CHA / SHA | 5 ±1s ([1]) | | 120 ±5s |
| CHB / SHB | 30 ±2s ([1]) | 30 ±2s | 120 ±5s |
| CPX / CLX / CPE / CLE | 30 ±2s ([1]) | 30 ±2s | 120 ±5s |
| CPF / CLF | 30 ±2s ([1]) | | 120 ±5s |
| SHL | | | 120 ±5s |
| SHS / SHF / SHN / SHT | 5 ±1s ([1]) | | 120 ±5s |
| Lasertrim® | | | 5 ±1s |

([1]): in this case, Sn62/Pb36/Ag2 solder bath is used.

## III. STANDARD SMD REQUIREMENTS

### III.1. Generic Soldering Profile

Below are the recommended soldering processes and temperature time limits as per CECC30000 and IEC68. Pre-heating and cooling phases are run at a maximum rate of 2°C/s.




The maximum recommended soldering temperatures are:

- for reflow soldering, between 220 and 240°C and t < 15s;

- for wave soldering, between 230 and 250°C and t < 5s.

The final pre-heating temperature differs depending on the size:

- for case sizes less than or equal to 1515, ΔT = 100°C;

- for case sizes greater than 1515, ΔT = 65°C;

NB: please contact us for further information regarding vapor phase soldering, infrared soldering and double-wave soldering.

### III.2. Lead-free Soldering Profile

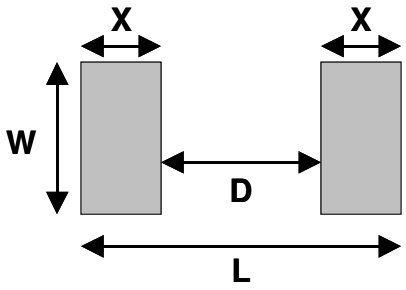
Our lead-free terminations - S type - have been fully tested and are compliant with the soldering recommendations mentioned in specification JEDEC STD 020 rev.C

The non-magnetic terminations - A or C types - are more sensitive to increased soldering temperature and SnAgCu soldering pastes; therefore a particular study must be conducted with our customers to define the optimized soldering process parameters.

The soldering pastes used in lead-free processes, i.e. SnAgCu type, are more active than the standard SnAgPb ones. Therefore, the values given in chapter II are no longer valid in this case and must be defined on a case-by-case basis.

### III.3. 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).

## 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. Non Magnetic Terminations

A-type non-magnetic terminations have a lower wettability than the standard magnetic terminations - V or S types for instance. Actually, this is a typical phenomenon as these non-magnetic terminations do not have a tin layer. 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.

### 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.

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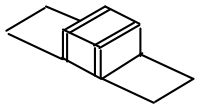
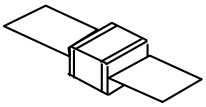
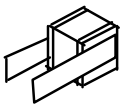
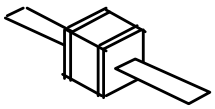
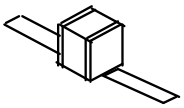
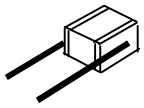
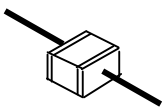
## V. RIBBONS AND WIRES

### V.1. Types

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

NB: for non-magnetic requirements, only the micro-strip ribbon is available using either the code A1 (silver palladium) or the code C1 (copper barrier).

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## Power, RF & Microwave Capacitors

### V.2. Ribbon and Wire Matrix

| Termination Type | Code | SHB / CHB | CLX / CPX | CLE / CPE | CLF / CPF |
|---|---|---|---|---|---|
| Micro-strip Ribbon | 1 | 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 |
| Axial Wire | 7 | AVAILABLE | | AVAILABLE | |

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### V.3. Dimensions Matrix

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

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

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

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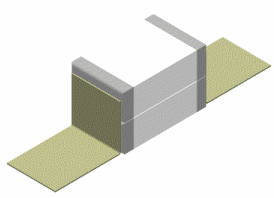
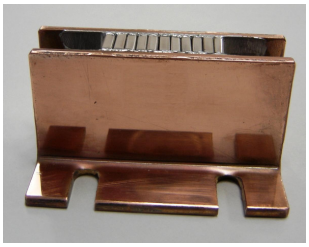
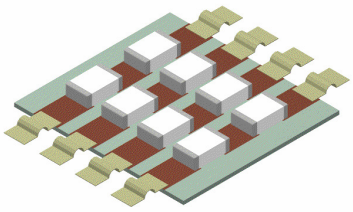
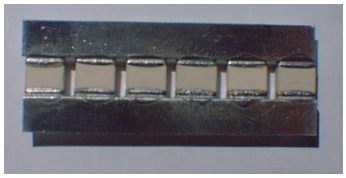
### V.4. Examples of Specific Developments

| *Description* | *Schematic* |
|---|---|
| Capacitors in parallel with ribbons |  |
| Power Capacitor Solutions |  |
| Capacitors in series/parallel configuration on a PCB |  |
| Six capacitors in parallel with a ±1% tolerance |  |
| Extended DC voltage capacitors with black coating |   |