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Tecate Group Ultracapacitor Soldering and Handling Instructions

Tecate Group carry's a variety of different ultracapacitor cells. Aside from the Tecate's own Powerbust® line, there are offerings from Maxwell Technologies and CAP-XX. Most of these products are designed to be mounted to PC boards by way of soldering. All these offerings have been converted to be compliant with the requirements of the RoHS directive and as such have moved to lead free preparations that require adjustments in the processes which are used to interconnect these compliant products with their substrates. Although all these products are classified as ultracapacitors, based on their construction they each possess a slightly different soldering and handling specification

NOTE: Please note that the process and parameters described in this document were developed on specific equipment. The parameters will apply to that equipment and it is very likely that alternative pieces of equipment will require adjustment and fine tuning of those parameters to achieve an optimized result.

This document is broken into 4 sections, outlining each of the manufacturer's recommended procedure.

1. Tecate TPL/PBL/TPLE/TPLS Series

a. General Notes

- During soldering, electrical characteristics may deteriorate due to excessive heat and there may be a built up of internal pressure.
- Depending on the type and size of the board, overheating of ultracapacitor may cause the safety vent to burst. This will greatly shorten the product life or cause leaking problem.
- Do not dip the entire ultracapacitor body into melted solder.
- Only flux the leads of ultracapacitor.
- Ensure there is no direct contact between the sleeve of the ultracapacitor and the PC board or any other component.
- Excessive heat during soldering may cause sleeve to shrink or crack.
- The lead material is a steel core coated with Copper (30-45um depending upon the lead diameter) plated withTin (~11µm).

b. Hand Soldering

Warning. Do not touch the ultracapacitor external sleeve with the soldering rod which can cause the sleeve to melt or crack.

The recommended temperature of the soldering rod tip is less than or equal to 350°C. The soldering duration should be shorter than 3 seconds. Minimize the time that the soldering iron is in direct contact with the terminals of ultracapacitor as excessive heating of the leads may lead to higher equivalent series resistance (ESR).

Solder Composition and size: Sn96.5Ag3.0Cu0.5 alloy
Recommended solder: Kester SN96227558 – includes flux core, other solders are available on the market which will be equivalent to this type.
Flux: If not using flux core wire, use a halide free, activated rosin based flux. There are many such fluxes available on the market.
Maximum contact time with component leads: 10 seconds

c. Wave Soldering

Recommended Solder Pot Temperature: 248°C / 478°F
Solder Composition: Sn96.86, Ag2.7, Cu0.44 alloy
Recommended Solder: Nihon Genma Mfg. Co., Ltd. NP303-CQS-1
Recommended Preheat: Preheat board from bottom side only, bring top of board to 100°C maximum immediately before soldering, preheat time will depend upon heating efficiency. Use a maximum

preheating time of 60 seconds for PC boards 0.8 mm or thicker. Use the following table for wave soldering on leads only:

Solder Bath Temperature (°C)	Recommended Solder Exposure (seconds)	Maximum Exposure (seconds)
220	7	9
240	7	9
250	5	7
260	3	5

NOTE: Do not exceed 100°C on the top of the board, exceeding this temperature may damage ultracapacitors

d. Reflow Soldering

Reflow soldering should not be used on TPL/PBL/TPLE/TPLS family of ultracapacitors.

2. Tecate PC & Maxwell PC10

a. Hand Soldering PC Products

In order to hand solder PC products good soldering practices must apply. It is assumed in this document that the user has experience with hand soldering of electronic components and that fundamental soldering processes are understood. These cells have a lead free tin on the leads. In addition, there has been a move toward lead free board designs which means that lead free soldering techniques must be employed. The tinning process has applied a thin film of lead free alloy to the leads. The composition of that alloy is:

96.5 Sn ,3.0 Ag ,0.5 Cu
Melting Point: 217°C
Or
99.3 Sn / 0.7 Cu
Melting Point: 227°C

In general, lead free soldering by hand requires higher heat and more active fluxes than solder containing lead as a constituent. Therefore new thermal profiles must be adopted and new cleaning agents should be utilized. The following are the parameters and materials that should be used for lead free hand soldering of PC products:

Recommended Solder tip temperature: 343°C / 650°F
Solder Composition and size: Sn96.5Ag3.0Cu0.5 alloy, .062 dia
Recommended solder: Kester SN96227558 or K100LD – includes flux core, other solders are available on the market which will be equivalent to this type.
Flux: If not using flux core wire, use a halide free, activated rosin based flux. There are many such fluxes available on the market.
Maximum contact time with component leads: 10 seconds

NOTE: Excessive time in contact with the component leads will potentially damage the device. Limit lead contact time to 10 second.

b. Wave Soldering PC Components

In order to wave solder PC components special attention must be paid to the dwell time and total time at temperature since the ultracapacitors are a temperature sensitive component. Below are the recommendations for wave soldering PC components.

NOTE: These wave soldering parameters represent recommended parameters for specific equipment. Other equipment may require adjustment of the parameters.

Equipment used for parameter development: Electrovert Econopack 03

Recommended Solder Pot Temperature: 248°C / 478°F
Solder Composition: Sn96.5Ag3.0Cu0.5 alloy
Recommended Flux: Kester 2331ZX
Recommended Preheat: Preheat board from bottom side only, bring top of board to 100°C maximum immediately before soldering, preheat time will depend upon heating efficiency.
Conveyor speed: 2.8cm / sec
Dwell time: 2.5 seconds

NOTE: Do not exceed 100°C on the top of the board; exceeding this temperature may result in damage to the parts.

3. Maxwell BC Series

BC products covered by this section include the Maxwell BCAP0350, BCAP0310, with radial connection points. All products comprising the BC series product line are RoHS compliant.

a. General Precautions

Excessive heat applied to the ultracapacitor during soldering processes may damage the component causing deterioration in performance and life. The following precautions should be followed when soldering the Maxwell BOOSTCAP® ultracapacitor.

i) The ultracapacitor is polarized. Reference the label for positive and negative potentials.
ii) The ultracapacitor case is at the positive potential. Ensure that the case is adequately insulated from other components

b. Mounting Recommendations

PCB Thickness Compatibility

PCB Thickness*	Compatibility
350F cell	
Below 1.5 mm	Possible, but not recommended. Board may not support the mass.
Between 1.5 to 2.4 mm	Recommended
Between 2.4 to 3.2 mm	Possible, but not recommended
Over 3.2 mm	Not recommended/ not supported
310F cell	
Below 1.5 mm	Possible, but not recommended
Between 1.5 to 2.4 mm	Recommended
Over 2.4 mm	Not recommended/ not supported

*not including trace thickness

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PCB Hole Layout Dimension

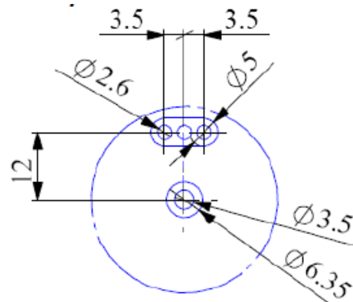

Figure 1. Board drillings for BCAP0310 P270 T10.

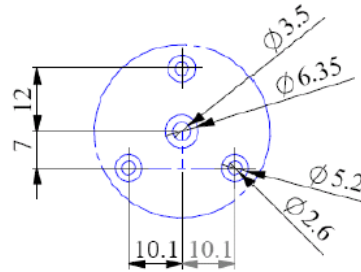

Figure 2. Board drillings for BCAP0350 E270 T11.

c. Solder Tab Composition

The lead tabs are comprised of Aluminum alloy. The tabs are Nickel plated followed by Tin over the Nickel. The Nickel thickness is 1um and the Tin thickness is 2.5um.

d. Hand Soldering Radial D-cell Components

In order to hand solder, good soldering practices must apply. It is assumed in this document that the user has experience with hand soldering of electronic components and that fundamental soldering processes are understood.

In general, lead-free soldering by hand requires higher heat and more active fluxes than solder containing lead as a constituent. The following are the parameters and materials that should be used for lead-free hand soldering:

Recommended Solder tip temperature: 343°C / 650°F
Solder Composition and size: Sn96.5Ag3.0Cu0.5 alloy, .062 dia
Recommended solder – Kester SN96227558 – includes flux core, other solders are available on the market which are equivalent to this type.
Flux – If not using flux core wire, use a halide free, activated rosin based flux. There are many such fluxes available on the market.
Maximum contact time with component leads – 10 seconds

NOTE: Excessive time in contact with the component leads will potentially damage the device. Limit lead contact time to 10 seconds.

e. Wave Soldering Radial D-cell Components

Components are wave solderable. Wave soldering is used in the fabrication of BPAK, BMOD and PBD products based on the Radial D-cell capacitors. The recommended schedule for wave soldering is provided below. These recommendations are based on specific wave soldering equipment. Adjustments may be necessary due to equipment. The equipment used for establishing the following recommendation is Kirsten 5360.

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Recommended wave soldering profile for printed circuit assembly using leaded eutectic alloy

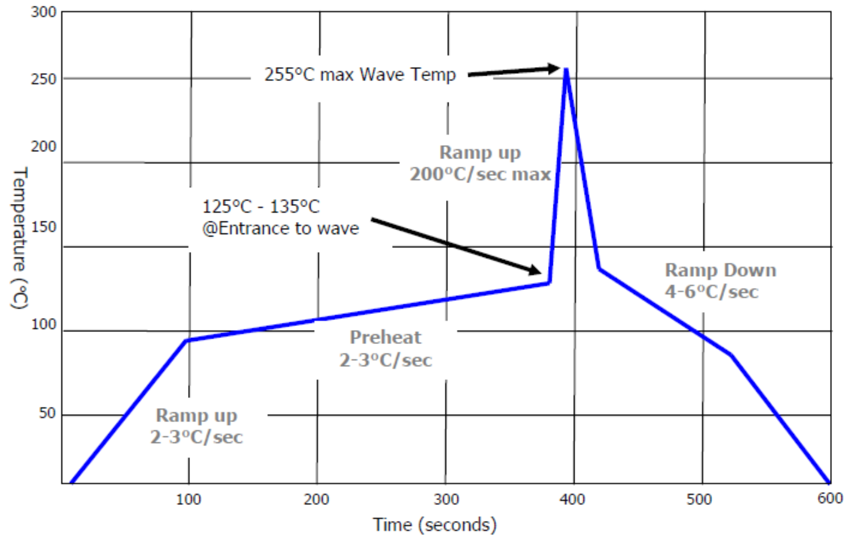

Figure 3. Recommended wave solder profile for Eutectic solder.

Total soldering process time from room temperature to peak temperature 255°C and cool down is 10 minutes Max. The time to reach the required temperatures depends on the design of the application and on the power of pre-heating section of the soldering machine. All temperatures are measured on the leads of the component on top of the PCB.

Solder: Eutectic Solder (Sn63/Pb37) 183°C
Recommended Flux: Kester 2331ZX
Ramp Up Rate: 1°-3° C/sec. Max
Preheat: 140° to 170°C for 150 sec. Max
Temperature Entrance into Wave ~170°C
Ramp to Peak Temp: 200°C/sec.
Peak Temp: 240°C for 1.5 to 5 sec. Max
Cool Down Rate: 6°C /sec. Max

Recommended wave soldering profile for printed circuit assembly using lead-free alloy

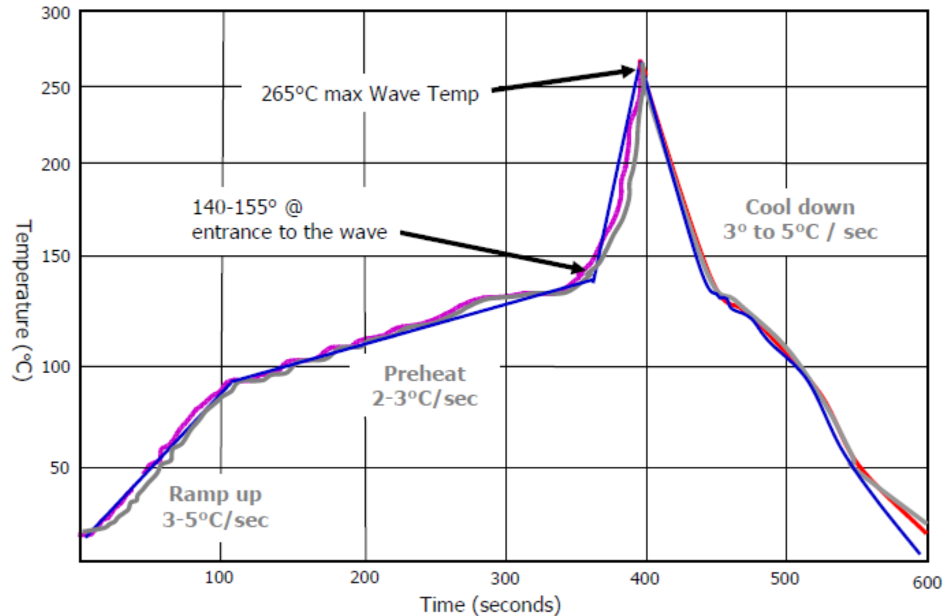

Figure 4. Recommended wave solder profile for "lead-free" process.

Total soldering process time from room temperature to peak temperature 265°C and cool down is 10 minutes Max. The time to reach the required temperatures depends on the design of the application and on the power of pre-heating section of the soldering machine. All temperatures are measured on the leads of the component on top of the PCB.

Solder: Lead-free (Sn96.5/Ag 3.0/Cu0.5) liquidus point 217°C
Recommended Flux: Kester 979T
Ramp Up Rate: 3°-5° C/sec. Max
Preheat: 140° to 155° C 2°-3° C/sec on top of board
Temperature entrance into wave: 140° to 155° C on top of board
Ramp to peak temp: 200°C/sec
Peak Temp: 265°C for 1.5 to 5 sec. Max
Cool Down Rate: 3°C-5°C /sec. Max
Conveyor Speed: 40-50 cm/min

Note : Due to the relatively high thermal mass of the component and especially if the total number or the density of components on the PCB is high, the use of a standard thermo-profiling device is strongly recommended to achieve good soldering results and to avoid excessive temperature in the capacitor.

4. CAP-XX

CAP-XX ultracapacitors are heat sensitive. Overheating of the ultracapacitor cells may result in degradation of performance and useful life.

a. Handling Precautions

CAP-XX cells are recommended to be stored in a controlled environment, at a temperature of 18°C - 28°C, and relative humidity of 40% - 60%.

Device storage and handling conditions should not exceed the following limits:

G Series (General Purpose range): -40°C to 70°C
H Series (High Temperature range): -40°C to 80°C

CAP-XX ultracapacitors are shipped in stackable polymeric trays, each tray holding 20 to 50 devices, nested within cavities molded in the tray. These trays are designed to protect the devices during transportation and facilitate their removal by hand or vacuum pens.

The ultracapacitor device is hermetically sealed and bending or applying too much pressure on the device may damage the seals leading to device failure. CAP-XX ultracapacitors should not be exposed to more than 400kPa pressure across flat surface of device (10 kg or 22 lb max).

CAP-XX ultracapacitors are fully discharged when shipped. Devices should be handled and soldered in a discharged state.

b. Assembly Preparation

CAP-XX ultracapacitors are offered with the option of an adhesive layer on the bottom of the device to assist in mounting on the PCB. The adhesive release tape must be removed from the adhesive prior to positioning on the PCB. The PCB surface must be clean and free from oil, grease or flux residue.

With the adhesive exposed the device should be positioned and pressed firmly into place. An extended hold time is not required.

Standard CAP-XX ultracapacitors are offered without the adhesive layer at bottom. To assemble onto PCB, remove the device from the tray by hand, with a vacuum pen, or by an automated pick and place robotic arm with vacuum pen, locate onto PCB and solder terminals to PCB as described below.

c. Soldering Recommendation

Note: CAP-XX ultracapacitors cannot be reflow soldered not wave soldered.

CAP-XX ultracapacitor terminals are manufactured from tinned (pure bright tin), annealed (low temper) copper that is pliable. Care should be taken to avoid bending the terminals.

The cells are designed for direct soldering onto printed circuit board. Soldering the terminals to the PCB will ensure the highest contact reliability and lowest contact resistance.

The use of water-soluble flux is recommended as solvent based washing is not acceptable. It is recommended that the assembly be washed after soldering with water-soluble flux to remove any highly flux residue (See Section on Washing below). Alternatively, a no-clean (low residue) flus can be used, with no washing required.

d. Hand Soldering

CAP-XX recommends the use of low temperature solder compounds. Soldering should be accomplished with a low wattage soldering iron, by applying heat just long enough to achieve a good connection.

The cell terminal temperature (measured at the base of the terminal) should not exceed the following:

Soldering Temperature: Do not exceed 400°C

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Solder time: Do not exceed 5 seconds

Never attempt to solder directly to the device casing. The resultant heat will cause permanent internal damage to the capacitor.

If a hot-air-flow iron is used to reflow the solder during re-mount or de-mount, care must be taken to prevent excessive heating of the package adjacent to the solder terminals.

e. Automated Soldering

Soldering may be automated with a hot bar soldering jig, with soldering irons mounted on an automated raise-lower device with time and pressure controls. It is also possible to mount cells using conductive adhesive, ultrasonic welding or laser welding.

Infrared Reflow Soldering
CAP-XX cells are **NOT SUITABLE** for infrared reflow soldering.

Hot-Air Reflow Soldering
CAP-XX cells are **NOT SUITABLE** for hot-air reflow soldering.

Wave Soldering
CAP-XX cells are **NOT SUITABLE** for wave soldering.

f. **Washing**

Do not use solvent cleaners as these may damage the device packaging. Unacceptable solvents include acetone, benzene, isopropyl alcohol and halogenated solvents.

Use only aqueous cleaning solutions based on deionized water. For details of specific detergent compatibility please contact Tecate Group.

Washing may take place at elevated temperature not exceeding 70°C. Spray pressure should not exceed 50 psi. The device may be fully submerged during the washing process.

g. Drying

Post-wash drying should be kept to the minimum necessary duration, at temperatures not exceeding 70°C (G series) or 80°C (H series). Rapid airflow around the device during drying will assist in the removal of moisture trapped in the package.