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High Temperature Soldering Recommendations

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1. Capacitor Size

Size selection is based primarily on capacitance value and voltage rating. Because mass affects the thermal shock behavior of chips, size selection must consider the soldering method used to attach the chip to the board. Sizes 1812 and smaller can be wave, vapor phase or reflow soldered. Larger units require reflow soldering.

2. Terminal Material

Nickel barrier termination, with exceptional solder leach resistance is recommended for all applications up to 160°C involving solder. Novacap offers four versions of the nickel barrier termination. The "N" termination is a nickel barrier with 100% matte tin for a lead free capacitor. The "Y" termination is a nickel barrier with 90/10 tin/lead for military applications. The “C” termination is a polymer base nickel barrier with 100% matte tin and a “D” termination with a polymer base nickel barrier with 90/10 tin/lead. Silver palladium termination is required for applications above 160°C.

3. Soldering

Soldering methods commonly used in the industry and recommended are Reflow Soldering, Wave Soldering, and to a lesser extent, Vapor Phase Soldering. All these methods involve thermal cycling of the components and therefore the rate of heating and cooling must be controlled to preclude thermal shocking of the devices. In general, rates which do not exceed 120°C per minute and a ΔT spike of 100°C maximum for any soldering process on sizes 1812 and smaller is advisable. Other precautions include post-soldering handling, primarily avoidance of rapid cooling with contact with heat sinks, such as conveyors or cleaning solutions. Large chips are more prone to thermal shock as their greater bulk will result in sharper thermal gradients within the device during thermal cycling. Units larger than 1812 experience excessive stress if processed through the fast cycles typical of solder wave or vapor phase operations. Solder reflow is most applicable to the larger chips as the rates of heating and cooling can be slowed within safe limits. In general, rates that do not exceed 60°C per minute and a ΔT spike of 50°C maximum for any soldering process on sizes larger than 1812 is advisable. Attachment using a soldering iron requires extra care, particularly with large components, as thermal gradients are not easily controlled and may cause cracking of the chip. Precautions include preheating of the assembly to within 100°C of the solder flow temperature, the use of a fine tip iron that does not exceed 30 watts, and limitation of contact of the iron to the circuit pad areas only.

4. Cleaning

Chip capacitors can withstand common agents such as water, alcohol and degreaser solvents used for cleaning boards. Ascertain that no flux residues are left on the chip surfaces as these diminish electrical performance.

5. Board Design Considerations

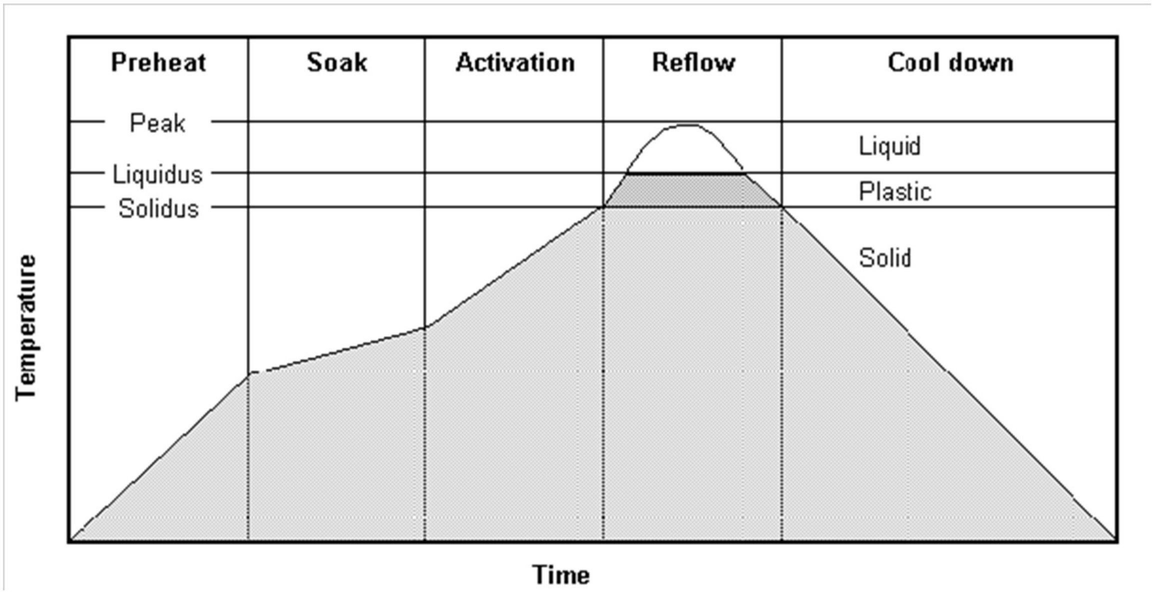
NOVACAP has adopted the IPC-SM-782 methodology for solder reflow land patterns. The NOVACAP recommended solder pads brochure is available for reference on the NOVACAP Website.

6. Solders

A wide variety of solders are available in the industry. All four nickel barrier terminations (N, Y, C, and D) have exceptional solderability, leach resistance, and are compatible with all leaded and lead free solders. Care should be taken with the palladium silver (P) termination. The palladium silver termination can leach which is the dissolution of the termination into the solder. The result is exposure of the underlying ceramic surface that would cause poor solder fillets or no solder fillets at all. Reduced capacitance or open circuit conditions could happen with excessive leaching. Tin is the predominant leaching component in solder. The solder selection should have silver as part of the composition.

7. **Reflow Process**

The soldering process involves four separate inputs (two surfaces, solder paste, and heat source); therefore, no single temperature profile is ideal for all products and heating methods. A good profile will meet or exceed the minimum times at the coolest spot on the product while not exceeding the maximum times at the hottest point on the product. Because of the variability of soldered devices and reflow equipment, it may be necessary to deviate from the suggestions given here.



Preheat: Duration: 45 to 90 seconds. During preheat, low boiling point solvents and moisture are evaporated slowly to prevent spattering. Temperature ramps up from ambient (around 23°C) to 110°C at between ½° and 2°C per second.

Soak: Duration: 20 to 90 seconds. The soak stage is used to stabilize temperature across the entire product and continue evaporation of low boiling point materials. Small and thermally uniform parts do not need much soak, while boards with large components may require over a minute. Temperature ramps up from 110°C to 140°C at between ½° and 2°C per second.

Activation: Duration: 10 to 90 seconds for alloys with solidus under 250°C but may take up to 120 seconds for alloys with a higher solidus on thermally challenging products. The flux transitions from a gel state to a fluid state, then cleans the surfaces to be soldered. Excessive time in the activation range will use up available flux activity and may result in non-wetting, de-wetting, and related solder defects. Temperature ramps up from 140°C to the alloy solidus at between ½° and 2°C per second.

Reflow: Duration: 25 to 90 seconds for most alloys. Soldering begins upon reaching the solidus temperature of the alloy being used. For maximum joint strength, a peak temperature of 20° to 40°C above the liquidus must be reached. Rapid cooling can cause stress-related damage. Temperature ramps up from solidus to a peak at 20° to 40°C above liquidus and back down to solidus at between 1° and 3°C per second. The duration for palladium silver terminations should be kept to the minimum time possible.

Cool down: Product is cooled down to safe temperatures prior to handling. Total Time: 100 to 360 seconds for most products and alloys, averaging 230 seconds.