

Introduction

The most commonly used techniques for mounting SMDs (Surface Mounted Devices) to PC boards are Infrared (IR) and Vapor Phase (VP) reflow. IR and VP reflow are preferred over wave soldering. Wave soldering typically involves increased heating rate, higher temperatures and increased flux exposure. **If wave soldering is to be used as a reflow method, Intersil must be contacted prior to use.** (See Technical Brief TB363, "Guidelines for Handling and Processing Moisture Sensitive Surface Mount Devices (SMDs)).

The dynamics of the reflow process are influenced by the type of equipment used. The variables involved must be understood to properly control the board level interconnection of SMDs.

The primary phases of the reflow process are: flux activation, melting the solder particles in the solder paste, wetting the surfaces to be joined, and solidifying the solder into a strong metallurgical bond.

Optimum fusing of the component leads with the solder paste on the board is achieved when the leads attain the melting temperature of the plated solder alloy. To avoid thermal shock of the SMDs the maximum heating and cooling rates (i.e., ramp rate) should be controlled.

IR Reflow

The IR reflow technique involves thermal energy supplied via lamps radiating at a given range of wavelength. This heating approach in its basic form is essentially a line-of-sight surface-heating technique. Therefore, the amount of thermal energy absorbed varies with board size, component size, component orientation, and materials used. The surface temperature of the board is not uniform throughout and board edges tend to run 10°C to 20°C higher than the center. If not properly planned, component overheating is possible.

Vapor Phase Reflow

The vapor phase reflow technique uses vapor from a boiling inert fluorocarbon liquid. The heat of condensation provides a thermal constraint dependent on the liquid selected. A typical material in the industry has a boiling point of 215°C. PC board temperature exposure should be very uniform. With essentially no temperature gradient across the surface of the board, component location design rules for even heating is not significant compared to IR reflow.

Solder Profile Development

Heating Rate - To avoid thermal shock to sensitive components the maximum heating rate should be controlled. It is desirable to hold the heating rate to less than 5°C/s.

Preheat Zone - Boards should be preheated prior to the reflow step. Over-baking the solder paste and exceeding the

glass transition temperature of the epoxy in FR-4 boards should be avoided. Depending on the type of IR or VP equipment, the temperature of the component and the PC board should be within the range from 105°C to 145°C.

Time above Solder Melting Point - It is recommended that the solder at the joint be kept above its melting point for sufficient time to flow and wet the lands and the leads. Depending on type of equipment and component size; time above 180°C could range from 10s to 150s. Extended duration above the solder melting point may damage the board and sensitive components. This value should be minimized but sufficient to allow for good solder joint formation.

Peak Reflow Temperature - The peak temperature of the solder joint during reflow should be high enough for adequate flux action and solder flow to obtain good wetting. The maximum peak temperatures for IR and VP reflow are 219°C/225°C or 235°C/240°C, depending on package dimensions (Refer to J-STD-020A). Residence time at peak temperatures should be minimized.

Cooling Rate - The cooling rate of the solder joint after reflow is important because the faster the cooling rate, the smaller the grain size of the solder, and the higher the fatigue resistance. However, care should be taken to avoid an excessive temperature gradient resulting in potential damage due to mechanical stress.

Summary of Soldering Precautions

The soldering process can create a thermal stress on any semiconductor component. The melting temperature of solder is higher than the maximum rated temperature of the device. The amount of time the device is heated to a high temperature should be minimized to assure device reliability. Therefore, the following precautions should always be observed in order to minimize the thermal stress to which the devices are subjected.

1. Always preheat the device.
2. The delta temperature between the preheat and soldering should always be less than 100°C. Failure to preheat the device can result in excessive thermal stress which can damage the device.
3. The maximum temperature gradient should be less than 5°C per second when changing from preheating to soldering.
4. The peak temperature in the soldering process should be at least 30°C higher than the melting point of the solder chosen.
5. After soldering is complete, forced cooling will increase the temperature gradient and may result in latent failure due to mechanical stress.
6. During cooling, mechanical stress or shock should be avoided.

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