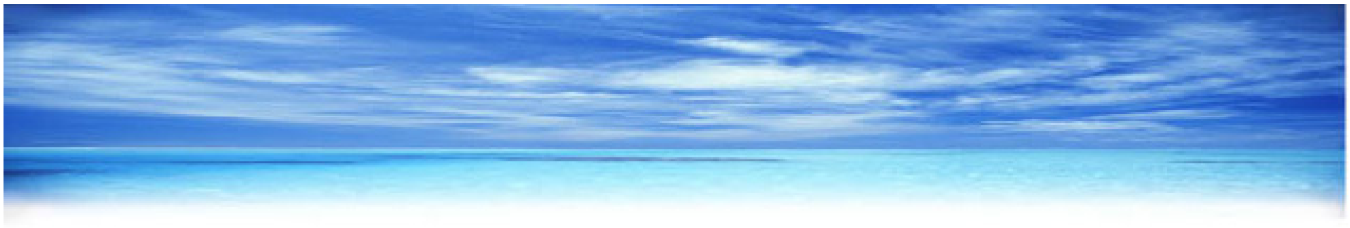

TM5700/TM5900 Manufacturing Guide

February 20, 2004

Crusoe™ Processor Model TM5700/TM5900

TM5700/TM5900 Manufacturing Guide
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Manufacturing Guide

Crusoe TM5700/TM5900 processors are packaged in a 21 mm x 21 mm 399-contact flip-chip organic ball grid array (FC-OBGA) package. This document provides manufacturing guidelines for mounting TM5700/TM5900 processors on printed circuit boards (PCBs). This document includes information on device reflow soldering and assembly rework guidelines.

Note
TM5700/TM5900 processor package ballout, thermal, mechanical, marking specifications, and a mechanical drawing are provided in the *TM5700/TM5900 Data Book*.

The reflow profile guidelines below were developed to optimize FC-OBGA / mixed SMT technology assemblies used for TM5700/TM5900-based system designs. These guidelines can be used to achieve maximum solderability using no-clean (essentially RMA) type chemistries.

1.0 Overview

It is important to note that achieving a ‘picture’ perfect profile is not the objective. The objective is to maximize flux activation, reduce exposure to oxidation, and provide uniform solder paste melting and wetting across the total assembly surface during the reflow phase of the process.

The reflow profile guidelines provided below are intended as a starting point for determining the optimal profile for any given PCB assembly and manufacturing environment. The profile will need slight adjustments when using Palladium components, moving more toward the peak maximum temperature ranges. Final proof of a successful profile resides with the visual appearance of good wetting angles for every component on the assembly and the lack of appearance of grainy or disturbed solder joints.

2.0 Standard Temperature Reflow Profile Guidelines

The table and figure below provide standard temperature reflow profile guidelines for the TM5700/TM5900 FC-OBGA package. Note that the solder reflow process is highly dependent on factors such as oven type, solder paste selection, PCB thickness and density, component distribution on the PCB, etc. A specific thermal profile as provided below cannot suite all designs and manufacturing situations.

2.1 Reflow Profile Recommendations

The reflow profile information provided below is meant to be a guideline and not a firm rule. The ultimate determining factors in whether a specific reflow profile is acceptable should be visually good and mechanically sound solder joints.

Table 1: Standard Temperature Mixed SMT Reflow Recommendations

Zone	Temperature Range	Ramp Rate	Duration
Pre-heating 1	Begin: room temperature	Min: 2.0°C/second	Typical: 90 seconds
	End: 150°C	Max: 2.5°C/second	Max: 120-240 seconds
Soaking 2	Begin: 150°C	Min: 0.2°C/second	Typical: 60-90 seconds
	End: 170-183°C	Max: 0.5°C/second	Max: 120 seconds
Reflow 3	Begin: 170-183°C	Min: 2.0°C/second	Typical: 60 seconds
	Peak: 208-225°C		Max: 45-90 seconds
	End: 170-183°C		
Cool-down	Begin: 170-183°C	Typical: 2-4°C/sec	Typical: 90 seconds
	End: room temperature	Max: 6°C/sec	

1. Pre-heating zone ramp from room temperature to 150°C: The overall objective is to minimize the time the assembly remains in the oven to avoid oxidation. The starting point to determine the correct ramp rate is recommended at 2.0°C/second. Then, increase the ramp rate incrementally to 2.5°C/second. If problems such as solder balls are noted, the ramp should be reduced until the defects are eliminated. PCB characteristics can contribute to solder balls and it is recommended to use a matte finish solder mask. The moisture content can also contribute to solder balls and should be managed appropriately.

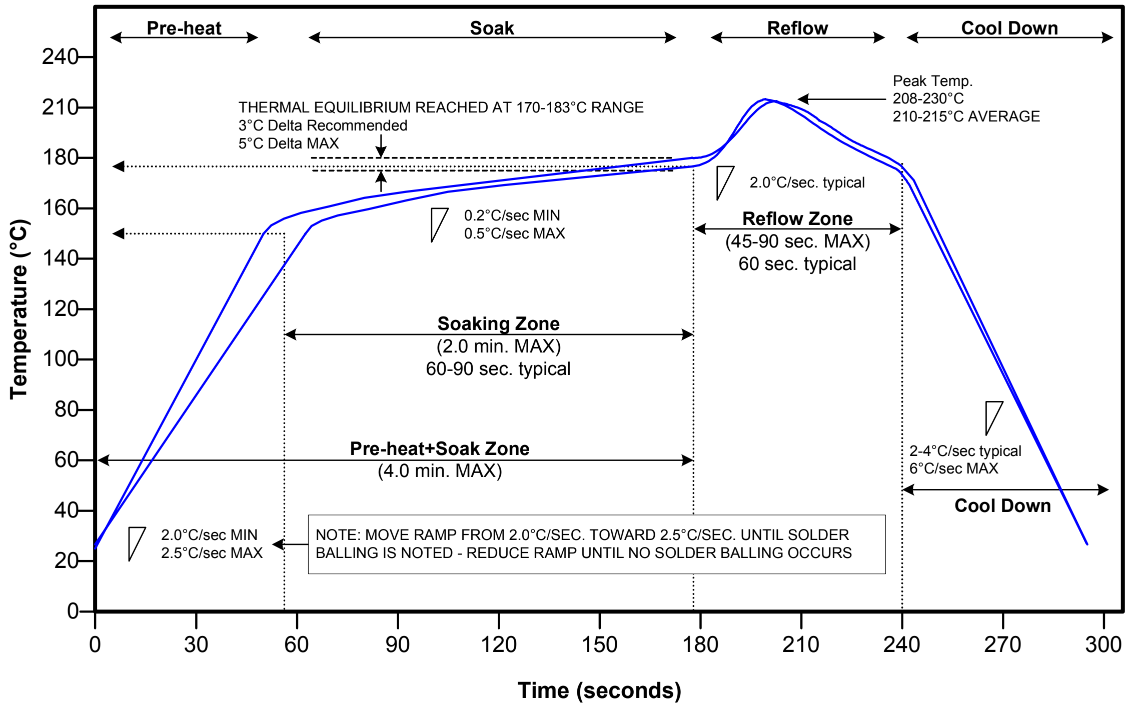
2. Soaking zone ramp and thermal equilibrium: After reaching 150°C, slow the ramp rate to 0.2-0.5°C/second. The objective is to achieve thermal equilibrium across the assembly. The hottest and coldest measurements should not exceed 3°C (ΔT), minimum-to-maximum. The recommendation is to achieve the ΔT of 3°C in the range of a 170-183°C window. To minimize oxide build up, move out of the soaking zone into reflow immediately upon reaching equilibrium.

3. Reflow zone ramp: After reaching thermal equilibrium in the soaking zone, move the ramp from 0.5°C/second to a minimum of 2.0°C/second. Slow heating in the reflow area can result in tombstoning and/or grainy and uneven wetting visual characteristics. If the heating rate is too fast in the reflow area, solder balls (splatter) can develop. Transmeta FC-OBGA packages are qualified to JEDEC Level 3 moisture sensitivity level. Therefore, the maximum temperature to which the components can be exposed during reflow or rework is 225°C.

2.2 Reflow Profile Diagram

A reflow profile diagram for the standard temperature reflow process is provided in the figure below. This figure should be used in conjunction with the table above for developing optimal reflow processes for PCB assemblies containing TM5700/TM5900 FC-OBGA devices. Specific details of the profile will depend on the board design, furnace, and solder paste properties. Solder paste vendors are typically an excellent resource for determining the proper solder paste to use, and for helping to achieve an optimal reflow profile.

Figure 1: Standard Temperature Reflow Profile Diagram



3.0 Other Assembly Issues

Pad Design and Solder Paste Volume

The FC-OBGA solder wetting appearance, and subsequent second-level reliability, is subject to the solder pad design and the amount of solder paste used to mount the component. Transmeta board level reliability data was collected utilizing FR-4 boards, and non-solder mask defined pads (NSMD) with a HASL finish. The metal pad size was 0.55 mm diameter, with a solder mask opening of 0.65 mm diameter. Transmeta has also successfully manufactured boards using solder mask defined pads (SMD), with 0.75 mm diameter metal pads and 0.60 mm diameter solder mask opening. While these specific pad dimensions are not an absolute requirement in order to achieve acceptable solder joint reliability, it is important to understand the impact of pad design on overall yields, quality, reliability, and board manufacturability. Several publications are available which discuss the advantages and disadvantages of various pad designs in detail. Such details are beyond the scope of this document.

Solder paste volume should also be optimized based on pad design and production process parameters. Every effort should be made to use the maximum volume of solder paste without causing slumping of the printed paste or shorting during reflow. Exact solder paste volumes will depend on various process parameters, including stencil thickness, stencil opening design, squeegee material, and printing speed. It is desirable to maximize the solder paste volume for the FC-OBGA to compensate for board warp and coplanarity changes from component-to-component and board-to-board.

Component Placement in Paste

OBGA ball deposition into the solder paste is a critical parameter for wetting. It is speculated that the surface area of the ball actually making contact with the paste provides the only active area available for oxide cleaning. For this reason, it is important that all component solder balls make contact with the solder paste which has been printed on the PCB.

4.0 ESD

Although TM5700/TM5900 processors contain protective circuitry to resist damage from electrostatic discharge (ESD), the devices should only be used or handled at a static safeguarded work area. Do not ship or store the devices near strong electrostatic, electromagnetic, magnetic or radioactive fields.