**NXP Semiconductors**
Application Note

Document Number: AN3300
Rev. 1, 08/2017

# General Soldering Temperature Process Guidelines

## Solder Joint and Package Temperature for Pb-free BGA in SnPB and Pb-free Solders in IR or Convection Reflow Ovens

## 1. Introduction

NXP Semiconductors' commitment to quality, continuous improvement, and global leadership in developing electronics products also extends to protecting and promoting environmental, health, and safety values. NXP continues to develop semiconductor product technology that meets these needs.

Because of legislation in Europe and Japan that bans Pb and other materials, the ball grid array (BGA) from NXP may be provided in a Pb-free version. The Pb-free solder sphere consists of an SnAgCu&SnAg alloy. SnAgCu has a melting temperature of 222 °C, compared to the regular SnPb sphere of 183°C. To achieve good solder joining yields, the solder profile needs to be examined.

A key factor in board assembly is to provide a temperature profile to match the solder paste flux requirement. Some flux needs a long dwell time below the temperature of 180 °C, but others will burn up in a long dwell. Temperatures out of the solder paste flux recommendations could result in poor solderability of all components on the board. The solder paste vendor can provide an ideal reflow profile, which gives the best solderability.

### Contents

Another factor to be taken care of during soldering is the components' processability. This is expressed by the moisture sensitivity level (MSL) and package peak temperature (PPT) as given in J-STD-020C.

# 2. Soldering using SnPb solder

1. Preheat — Raise temperature of leads/spheres to 100 °C over a period of no less than 50 seconds.
2. Infrared or convection reflow.

   Reach a minimum solder joint temperature (SJT) of 225–235 °C so the solder volume of paste and ball melt, but do not exceed any components' specified PPT. SJT dwell time is less than three minutes above the eutectic tin/lead solder melting point of 183 °C. Desirable dwell time above 183 °C is greater than 50 seconds and less than 80 seconds.

   If assembly is expected to use temperatures above 225 °C verify before assembly that all components can withstand PPT greater than 225 °C.

   Profiling the PPT of components on the board is also recommended.

   Packages that were qualified prior to the release of J-STD-020B in August 2002 may have only been qualified for a maximum PPT of 225 °C.

   If semiconductor packages are subjected to process temperatures higher than those used for qualification, reliability issues can occur.

# 3. Soldering using Pb-free solder, Nemi SnAgCu&SnAg Pb-free Solder

1. Preheat - Raise temperature of leads/spheres to 100 °C, over a period of no less than 50 seconds.
2. Infrared or convection reflow.

   Achieve a minimum SJT of 235 °C – 245 °C, but do not exceed the specified PPT. SJT dwell time is less than three minutes above the solder melt temperature of 217 °C. Desirable dwell time above 217 °C is greater than 50 seconds and less than 80 seconds.

In infrared or convection processes the temperature can vary greatly across the PC board, depending on the furnace type, on the size and mass of components, and on components' location on the board. Profiles must be carefully tested to determine the coolest solder joint and the hottest package on the board. Oven settings must ensure the minimum solder joint temperature is reached long enough for good solder joint formation including self-registration of the component in the solder bed. At the same time, the specified PPT of any component on the board must not be exceeded. Thermocouples must be carefully attached with very small amounts of thermally conductive grease or epoxy to the package top for PPT, directly to the solder joint interface between the package leads and board for the SJT measurement.

These guidelines do not necessarily indicate the extremes that can safely be applied to listed surface mount packages. In most cases, the package can withstand higher temperatures than the standard PC board. These guidelines are meant to represent good soldering practices that will yield high quality assemblies with minimum rework.

Solder flux technologies have improved dramatically in recent years, to the point that most of the industry is using “no clean” fluxes. Some of these fluxes require specific reflow profiles. These recommendations should always be obeyed precisely, together with the solder joint and package temperature guidelines above.

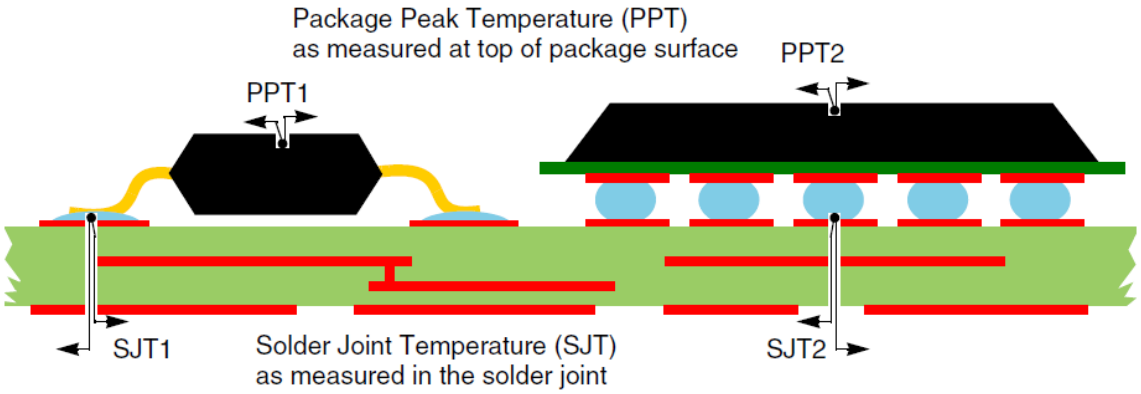


**Figure 1. SJT and PPT must be determined for critical components on the boards**

SJT and PPT must be determined for critical components on the boards. In production, the minimum SJT must be reached and the maximum PPT must not be exceeded for any component on the printed circuit board during any soldering step.

# 4. Revision history

**Table 1. Revision history**

| Revision number | Date | Substantive changes |
|---|---|---|
| 0 | 07/2006 | Initial release |
| 1 | 08/2017 | Section 3 title updated, as SnAg is included for Pb-free solder |

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