

Introduction

This application note provides guidelines for Diodes® semiconductor packages relating to:

- the board mounting
- recommended reflow solder profiles

This guideline based on IPC/JEDEC J-STD-020D.1 March 2008.

Diodes® semiconductor devices are plated with matte Tin (Pure Sn). They can be used in standard lead-free Tin-Silver-Copper (Sn-Ag-Cu) and also in Tin-Lead (SnPb) applications. From environmental point of view Diodes recommend to use standard lead-free Tin-Silver-Copper (Sn-Ag-Cu).

Reflow Profile Recommendations for Tin Lead and Lead-Free Soldering

Herein after listed information are recommendations and for reference only. Users are advised to optimize their own board level materials, parameters and equipment to get proper reflow outcome.

The maximum number of reflow cycles, which can be done on Diodes® products is limited by 3.

Table 1: SnPb Eutectic Process – Classification Temperature (TC)

Package Thickness	Volume mm ³ < 350	Volume mm ³ ≥ 350
< 2.5mm	235 +0/-5°C	225 +0/-5°C
≥ 2.5mm	225 +0/-5°C	225 +0/-5°C

Table 2: Pb-Free Process – Classification Temperature (TC)

Package Thickness	Volume mm ³ < 350	Volume mm ³ 350-2000	Volume mm ³ ≥ 350
< 1.6mm	260 + 0°C	260 + 0°C	260 + 0°C
1.6mm – 2.5mm	260 + 0°C	250 + 0°C	245 + 0°C
≥ 2.5mm	260 + 0°C	245 + 0°C	245 + 0°C

- Notes:
1. At the discretion of the device manufacturer, but not the board assembler/user, the maximum peak package body temperature (Tp) can exceed the values specified in Table 1 or Table 2. The use of a higher Tp does not change the classification temperature (Tc).
 2. Package volume excludes external terminals (e.g., balls, bumps, lands, leads) and/or non-integral heat sinks.
 3. The maximum component temperature reached during reflow depends on package thickness and volume. The use of convection reflow processes reduces the thermal gradients between packages. However, thermal gradients due to differences in thermal mass of SMD packages may still exist.
 4. Moisture sensitivity levels of components intended for use in a Pb-free assembly process shall be evaluated using the Pb-free classification temperatures and profiles defined in Table 2 and Table 3, whether or not Pb-free.
 5. SMD packages classified to a given moisture sensitivity level by using Procedures or Criteria defined within any previous version of J-STD-020, JESD22-A112 (rescinded), IPC-SM-786 (rescinded) do not need to be reclassified to the current revision unless a change in classification level or a higher peak classification temperature is desired.
 6. Temperature tolerances: The device manufacturer/supplier shall assure process compatibility up to and including the stated classification temperature at the rated MSL level (this means peak reflow temperature +0°C).

Reflow Profile Recommendations for Tin Lead and Lead-Free Soldering (cont.)

Table 3: Classification Reflow Profile

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Temperature Min (T_{SMIN})	100°C	150°C
Temperature Max (T_{SMAX})	150°C	200°C
Time (ts) from (T_{SMIN} to T_{SMAX})	60-120 seconds	60-120 seconds
Average ramp-up rate (T_{SMAX} to T_P)	3 °C/second max.	3 °C/second max.
Liquidus temperature (T_L)	183°C	217°C
Time (t_L) maintained above T_L	60-150 seconds	60-150 seconds
Peak package body temperature (T_P)	T_P must not exceed the Classification Temp in Table 1	T_P must not exceed the Classification Temp in Table 2
Time (t_p)* within 5 °C of the specified classification temperature (T_C), see Figure 1.	20* seconds	30* seconds
Average ramp-down rate (T_P to T_{SMAX})	6°C/second max.	6°C/second max.
Time 25°C to peak temperature T_P	6 minutes max.	8 minutes max.

* Tolerance for peak profile temperature (T_P) is defined as a supplier minimum and a user maximum.

Notes: 7. Tolerance for peak profile temperature (T_p) is defined as a supplier minimum and a user maximum.

8. Tolerance for time at peak profile temperature (T_p) is defined as a supplier minimum and a user maximum.

9. All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow (e.g., live-bug). If parts are reflowed in other than the normal live-bug assembly reflow orientation (i.e. dead-bug), T_p shall be within $\pm 2^\circ\text{C}$ of the live-bug T_p and still meet the T_c requirements. Otherwise, the profile shall be adjusted to achieve the latter. To accurately measure actual peak package body temperatures, refer to JEP140 for recommended thermocouple use.

10. Reflow profiles in this document are for classification/preconditioning and are not meant to specify board assembly profiles. Actual board assembly profiles should be developed based on specific process needs and board designs and should not exceed the parameters in Table 3. For example, if T_c is 260°C and time t_p is 30 seconds, this means the following for the supplier and the user.

For a supplier:

The peak temperature must be at least 260°C. The time above 255°C must be at least 30 seconds.

For a user:

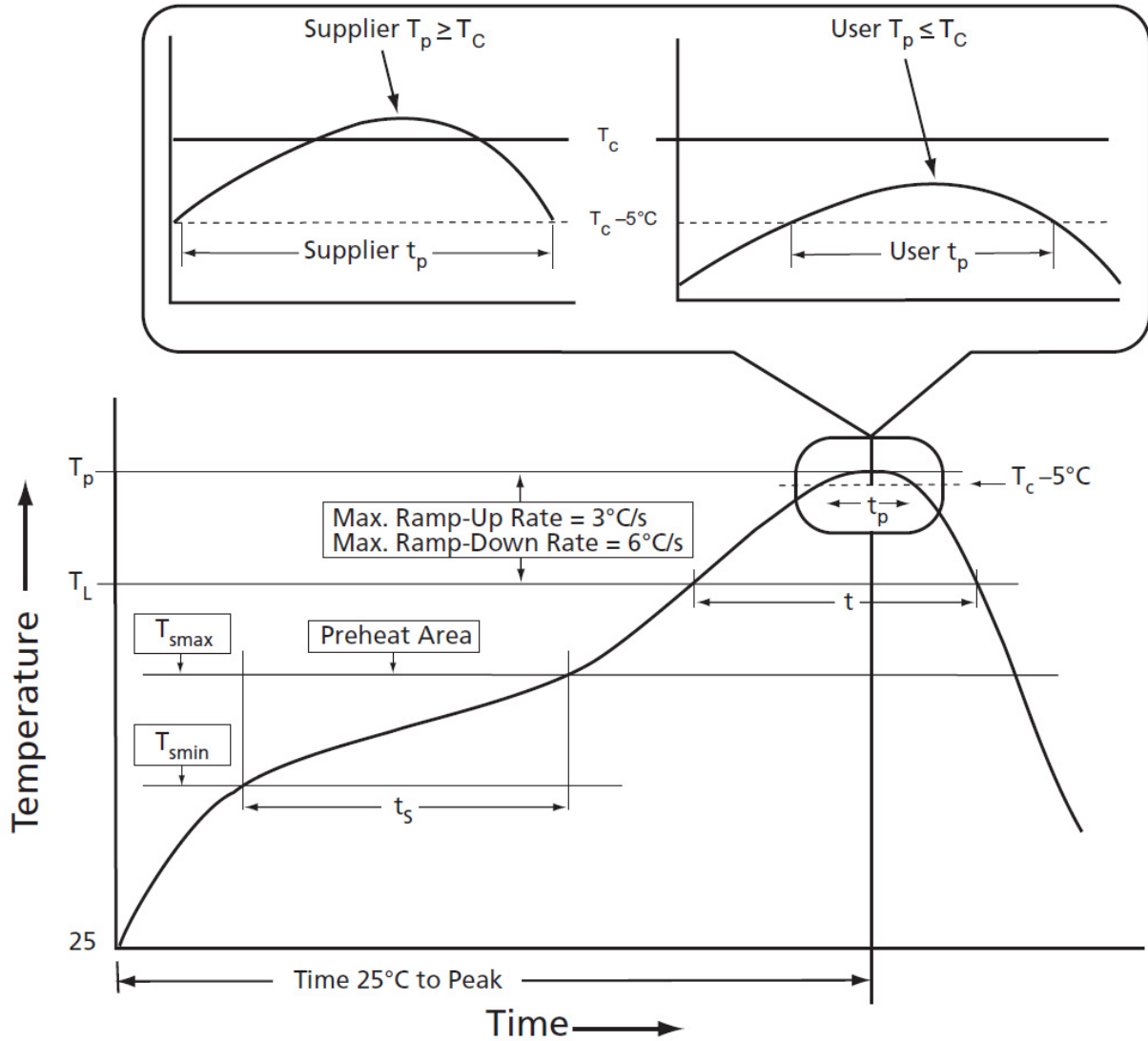
The peak temperature must not exceed 260°C. The time above 255°C must not exceed 30 seconds.

11. All components in the test load shall meet the classification profile requirements.

12. SMD packages classified to a given moisture sensitivity level by using Procedures or Criteria defined within any previous version of J-STD-020, JESD22-A112 (rescinded), IPC-SM-786 (rescinded) do not need to be reclassified to the current revision unless a change in classification level or a higher peak classification temperature is desired.

Reflow Profile Recommendations for Tin Lead and Lead-Free Soldering (cont.)

Figure 1: Reflow Profile Recommendation



Revision History

Revision No	Date	Description
Rev. 1	February 17 th , 2014	Initial Reflow Solder Profile Recommendation

Contact Information

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