APPLICATION NOTE 102

Custom MMIC

Solder Reflow for Standard and Lead Free Packages

Introduction

Application Note 102 applies to all packaged SMT devices that Custom MMIC Design Ser-vices deliver. This Application Note documents the common solder attach reflow profile for both standard and lead free packages. The information provided in this application note is for reference only. Users are advised to optimize their own PCB level design in order to obtain proper solder reflow and device attach. Custom MMIC recommends screen printing with belt furnace reflow to ensure proper device attach. Manual solder reflow should not be used due to the varying temperature extremes that are inherent in manual soldering, can cause perma-nent damage to the product.

General Soldering Guidelines

The melting temperature of solder generally exceeds the maximum operating temperature of the device. In order to avoid potential damage to the product, it is recommended that the solder attach be completed in a timely manner, and the duration the device is subjected to the reflow temperature is kept to a minimum. The following general guidelines should be followed at all times.

1. Always preheat the device before subjecting it to maximum reflow temperature. Failure to do so could induce thermal shock and the stress could result in product damage.

2. Limit the maximum temperature to those specified in the below tables.

3. After completing the soldering process allow the device to cool gradually. Subjecting the device to forced cooling may induce mechanical stresses resulting in damage to the device.

4. Avoid mechanical stresses on the device during the soldering process. The device should be allowed to "self-center" itself during the reflow profile.

Reflow Soldering Profile

The most common SMT reflow method, and the method recommended by Custom MMIC, is with a belt furnace. The below tables show typical reflow profile properties. The profile depicts the typical 3 zone profile design of Preheat, Reflow, and Cooling. This profile ap-proach should be followed to ensure proper solder reflow and device attach. The profile de-picted here is intended as an example only and should be considered as a starting point. Oth-er individual factors will affect solder reflow and SMT attach including type of board or substrate material being used, type of solder being used, and quantity and type of compo-nents on the board. Users are advised to optimize their own profile parameters in order to obtain proper solder reflow and device attach.

Classification Temperatures (Tc)

Package Thickness	Volume MM³ < 350	Volume MM³ ≥ 350
< 2.5 mm	235 °C	220 °C
≥ 2.5 mm	220 °C	220 °C

TABLE 1: *SnPb Eutectic Process—Classification Temperatures per IPC/JEDEC J-STD-020E*

Package Thickness	Volume MM³ < 350	Volume MM³ 350 - 2000	Volume MM³ >350
< 1.6 mm	260 °C	260 °C	260 °C
1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
> 2.5 mm	250 °C	245 °C	245 °C

TABLE 2: *Pb Free Eutectic Process—Classification Temperatures per IPC/JEDEC J-STD-020E*

Note 1: Package volume excludes external terminals (e.g., balls, bumps, lands, leads) and/or nonintegral heat sinks.

Note 2: At the discretion of the device manufacturer, but not the board assembler/user, the maxi-mum peak package body temperature (Tp) can exceed the values specified in Tables 4 or 5. The use of a higher Tp does not change the classification temperature (Tc).

Note 3: The maximum component temperature reached during reflow depends on package thick-ness 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.

Note 4: Moisture sensitivity levels of components intended for use in a Pb-free assembly process shall be evaluated using the Pb-free classification tempera-tures and profiles defined in Tables 3 and 5, whether or not Pb-free.

Note 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 classifi-cation level or a higher peak classification temperature is desired.

Profile Feature	SnPb Eutectic Assembly	Pb Free Assembly
Preheat/Soak Temperature Min (Tsmin) Temperature Max (Tsmax) Time (ts) from (Tsmin to Tsmax)	100° C 150° C 60 - 120 seconds	150° C 200° C 60 - 120 seconds
Ramp-Up Rate (TL to Tp)	3° C/second max.	3° C/second max.
Liquidous temperature (TL) Time (tL) maintained above TL	183° C 60 - 150 seconds	217° C 60 - 150 seconds
Peak package body temperature (Tp)	For users Tp must not exceed the Classification temperature in Table 4 For suppliers Tp must not exceed the Classification temperature in Table 4	For users Tp must not exceed the Classification temperature in Table 5 For suppliers Tp must not exceed the Classification temperature in Table 5
Time (tp)* within 5 °C of the specified Classification temperature (TC), see re-flow profile	20* seconds	30* seconds
Ramp-Down Rate (Tp to TL)	6° C/second max.	6° C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.
** Tolerance for peak profile temperature (Tp) is defined as a supplier minimum and a user maximum*		

TABLE 3: *Class Profiles per IPC/JEDEC J-STD-020E*

Note 1: 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), Tp shall be within ± 2 °C of the live-bug Tp and still meet the Tc requirements, otherwise, the profile shall be adjusted to achieve the latter. To accurately measure actual peak package body temperatures refer to JEP140 for recom-mended thermocouple use.

Note 2: Reflow profiles in this document are for classification/preconditioning and are not meant to specify board assembly profiles. Actual board assem-bly profiles should be developed based on specific process needs and board designs and should not exceed the parameters in Table 3 For example, if Tc is 260 °C and time tp 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.

Note 3: All components in the test load shall meet the classification profile requirements.

Note 4: 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.

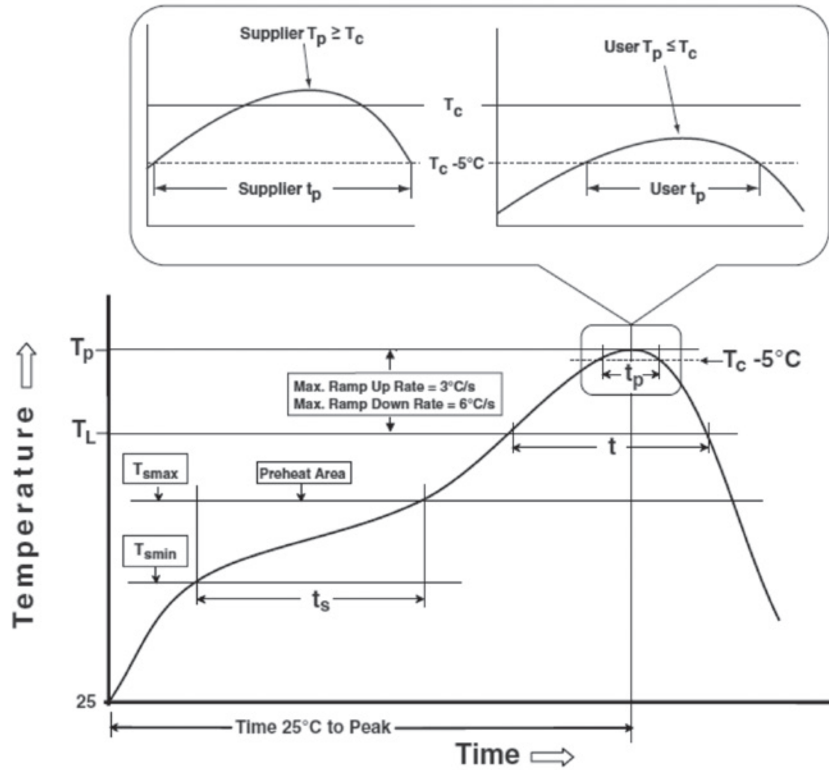

FIGURE 1: *Classification Profile (Not to Scale) per IPC/JEDEC J-STD-020E,*

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