

Solder Reflow Profiles for Standard and Lead-Free SMT Packages

Introduction

Application Note 102 applies to all packaged SMT devices that Custom MMIC delivers. This Application Note documents the common solder attach reflow profile for both standard and lead-free packages. The information provided 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, which can cause permanent 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 following 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 approach should be followed to ensure proper solder reflow and device attach. The profile depicted here is intended as an example only and should be considered as a starting point. Other 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 components on the board. Users are advised to optimize their own profile parameters in order to obtain proper solder reflow and device attach.



Classification Temperatures (T_c)

Package Thickness	Volume MM ³ < 350	Volume MM ³ ≥ 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 MM ³ < 350	Volume MM ³ 350 - 2000	Volume MM ³ >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 maximum peak package body temperature (T_p) can exceed the values specified in Tables 4 or 5. The use of a higher T_p does not change the classification temperature (T_c).

Note 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.

Note 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 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 classification level or a higher peak classification temperature is desired



Profile Feature	SnPb Eutectic Assembly	Pb Free Assembly
Preheat/Soak Temperature Min (T _{min}) Temperature Max (T _{max}) Time (ts) from (T _{min} to T _{max})	100° C 150° C 60 - 120 seconds	150° C 200° C 60 - 120 seconds
Ramp-Up Rate (TL to T _p)	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 (T _p)	For users T _p must not exceed the Classification temperature in Table 4 For suppliers T _p must not exceed the Classification temperature in Table 4	For users T _p must not exceed the Classification temperature in Table 5 For suppliers T _p must not exceed the Classification temperature in Table 5
Time (t _p)* within 5° C of the specified Classification temperature (T _C), see re-flow profile	20* seconds	30* seconds
Ramp-Down Rate (T _p 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 (T _p) is defined as a supplier minimum and a user maximum		

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

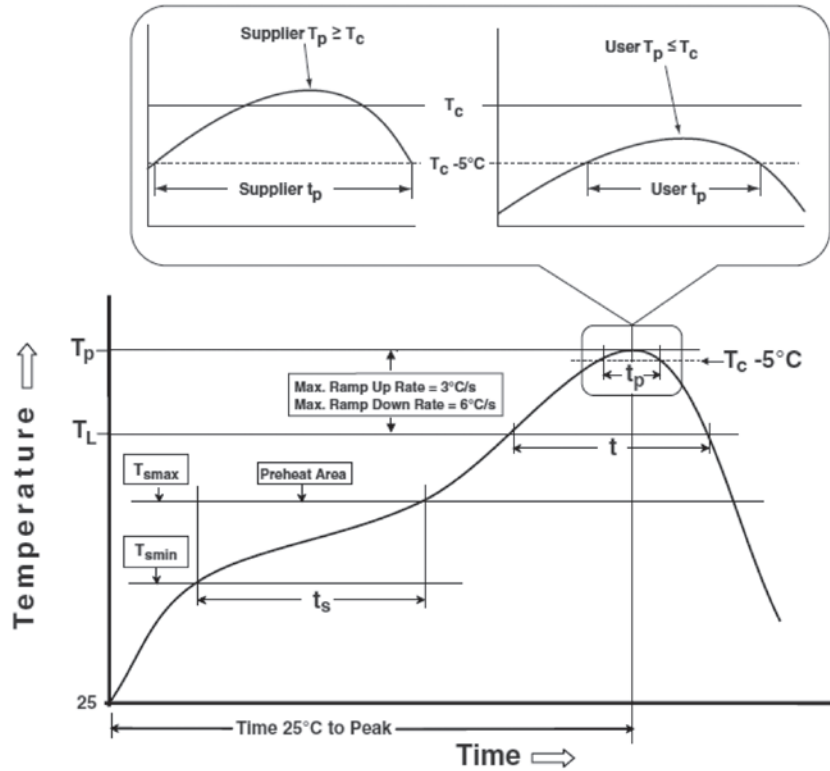
Note 1: All temperatures refer to the center of the package, measured on the package body surface that is facing up during assembly reflow (e.g., live-bug). If parts are reflowed in other than the normal live-bug assembly reflow orientation (i.e., dead-bug), T_p shall be within ± 2° C of the live-bug 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.

Note 2: 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.

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.



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

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