SMT plastic device treatment

APPLICATION NOTE

This document provides instructions of storage, handling, reconditioning and soldering for plastic SMT devices, according to IPC/JEDEC® J-STD-020.

Optoi guarantee does not cover damage, which may occur during processing, especially soldering process.

Introduction

Optoi surface-mounted (SMT) devices are moisture-sensitive (MSD), which means that they are sensitive to temperature shocks and reflow soldering. Moisture from atmospheric humidity will enter permeable packaging materials by diffusion and preferentially collect at different material interfaces. During solder reflow, the combination of rapid moisture expansion and materials mismatch can result in package cracking and/or delamination of critical interfaces within the package (popcorn effect). All SMT package shapes and sizes are sensitive to this effect and the sensitivity increases with the thermal stress from respective process.

Drypack

Devices are packed in moisture barrier bags to prevent them from moisture absorption during storage. Each bag contains a dessicant and a humidity indicator card, and exhibits a label (example in Figure 1), providing information about Moisture Sensitivity Level (MSL) and Peak package body temperature (TP). Devices in dry packs can be stored for at least 12 months from their sealing date. If the humidity indicator card inside the dry pack exceeds 10%RH, the devices should be baked before soldering (see section 4. Drying).

Floor life

Time between soldering and removing from dry bags (floor life) must be compliant with IPC/JEDEC® J-STD-020 (Table 1). The Moisture Sensitivity Level (MSL) depends on package volume and defines the floor life of the component, together with its storage conditions, and handling precautions after dry pack opening. MSL level and floor life are specified on each product label. If the humidity indicator card shows >10% (at 23°C ±5°C), devices should be baked before mounting (see section 4. Drying).

Drying

In case of moisture absorption, devices should be baked before soldering, according to IPC/JEDEC® J-STD-020 and MSL level.
Recommended conditions are: 30 h at 100 °C.

SMD reels and tubes can not be baked at such temperature. Alternative high-temperature resistant containers must be used, or lower-temperature and longer-time bake should be set by the user. Alternative high-temperature resistant containers must be used, or lower-temperature and longer-time bake should be set by the user.

Soldering recommendation

A standard surface-mount reflow soldering profile can be used, according to IPC/JEDEC® J-STD-020 (Figure 2). Tolerance for peak profile temperature (TP) is defined as a supplier minimum and a user maximum. Recommended TP value is indicated for each Optoi device in the Moisture Sensitive Caution Label on dry pack. An example of recommended reflow soldering profile is reported in Figure 3.

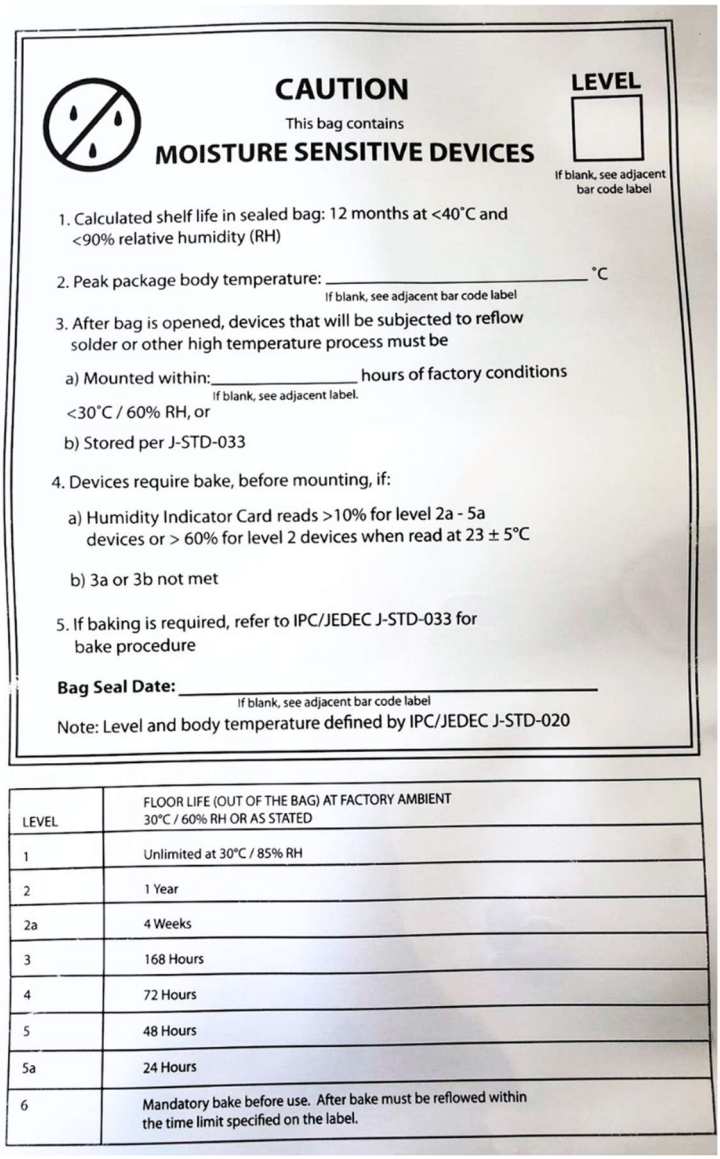

Figure 1: Example of Moisture Sensitive Caution Label on dry pack.

LEVEL	FLOOR LIFE	
	Time	Conditions
1	Unlimited	≤ 30°C/85%RH
2	1 year	≤ 30°C/60%RH
2a	4 weeks	≤ 30°C/60%RH
3	168 hours	≤ 30°C/60%RH
4	72 hours	≤ 30°C/60%RH
5	48 hours	≤ 30°C/60%RH
5a	24 hours	≤ 30°C/60%RH
6	Time on Label (TOL)	≤ 30°C/60%RH

Table 1: MSL classification according to IPC/JEDEC® J-STD-020

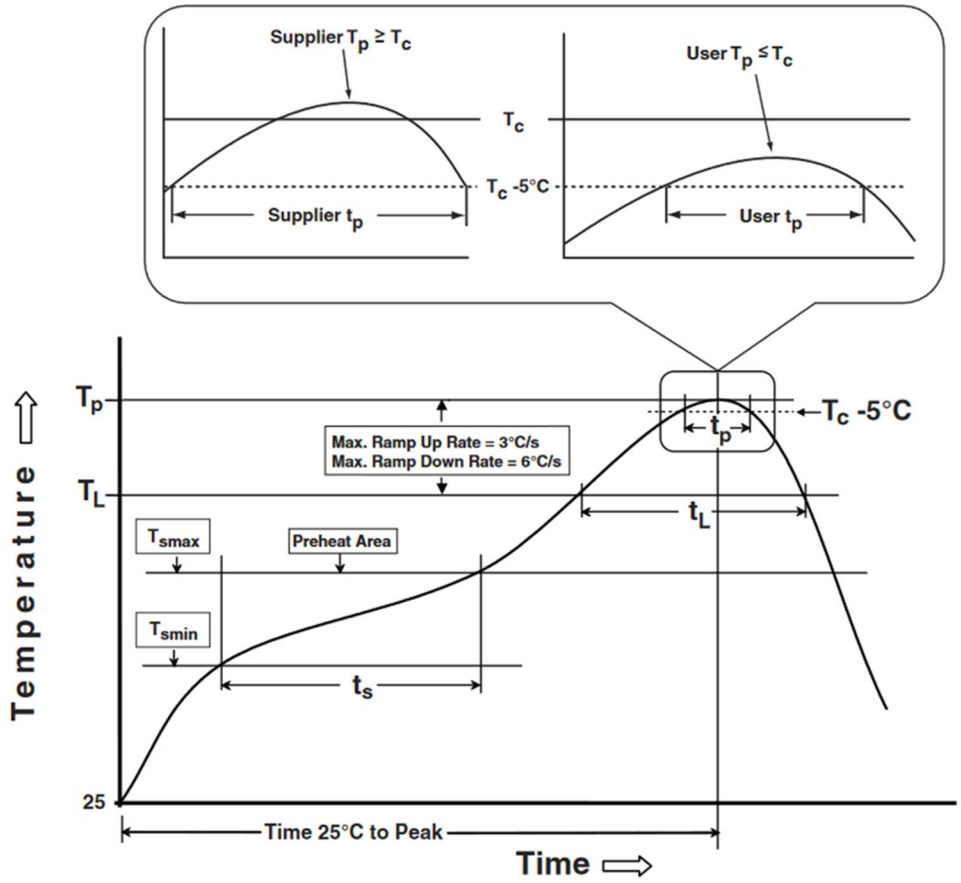

Figure 2: Reflow soldering profile according to IPC/JEDEC® J-STD-020.

PROFILE FEATURE	LEAD (Pb)-FREE ASSEMBLY
PreHeat Soak Temperature min (T_{Smin}) Temperature max (T_{Smax}) Time (t_S) from (T_{smin} to T_{Smax})	 150 °C 200 °C 60 s to 120 s
Ramp-up rate (T_L to T_P)	3 °C/s max.
Time 25°C to peak temperature	8 min max.
Liquidus temperature (T_L) Time (t_L) maintained above T_L	217 °C 60 s to 150 s
Peak package body temperature (T_P)	• For **users**: T_P must not exceed the classification temperature in Table 3. • For **suppliers**: T_P must equal of excced the classification temperature in Table 3.
Time (t_P) within 5°C of the specified T_P	30 s
Ramp-down rate (T_P to T_L)	6 °C/s

Table 2: Classification profiles.

Notes

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 orientation). If devices 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.

2. The oven should be loaded with the same configuration or verified equivalent thermal load when running devices or being profiled. All devices in the test load shall meet the classification profile requirements.
3. 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 2. For example, if T_C is 260 °C and time t_P is 30 seconds, this means the following for the device supplier and the user:
   - For a device 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.
4. All ramp rates (up or down) shall be calculated as an average rate over a 5 second period, shall not be an instantaneous value, nor an overall average. The ramp up and down rates between T_P to T_L are the critical zones for the controlled heating and cooling rates. If the ramp rate needs to be controlled below T_L, the device supplier shall convey this limitation to the user per the requirements of J-STD-075.

PACKAGE THICKNESS	VOLUME mm³ < 350	VOLUME mm³ 350 to 2000	VOLUME mm³ ≥ 2000
< 1.6 mm	260 °C	260 °C	260 °C
1.6 mm to 2.5 mm	260 °C	250 °C	245 °C
> 2.5 mm	250 °C	245 °C	245 °C

Table 3: Lead (Pb)-free process – classification temperature (TC).

Notes

1. Package "volume" excludes external terminals (e.g., balls, bumps, lands, leads) and/or non-integral heat sinks. Package volume includes the external dimensions of the package body, regardless if it has a cavity or is a passive package style.
2. At the discretion of the device supplier, but not the board assembler/user, the maximum peak package body temperature (Tp) can exceed the values specified in Table 2. The use of a higher Tp does not change the classification temperature (Tc).
3. The maximum peak package body 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 SMDs may still exist.
4. Moisture Sensitivity Levels (MSLs) of devices intended for use in a Pb-free assembly process shall be evaluated using the Pb-free classification temperatures and profiles defined in Table 2.
5. SMDs 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.

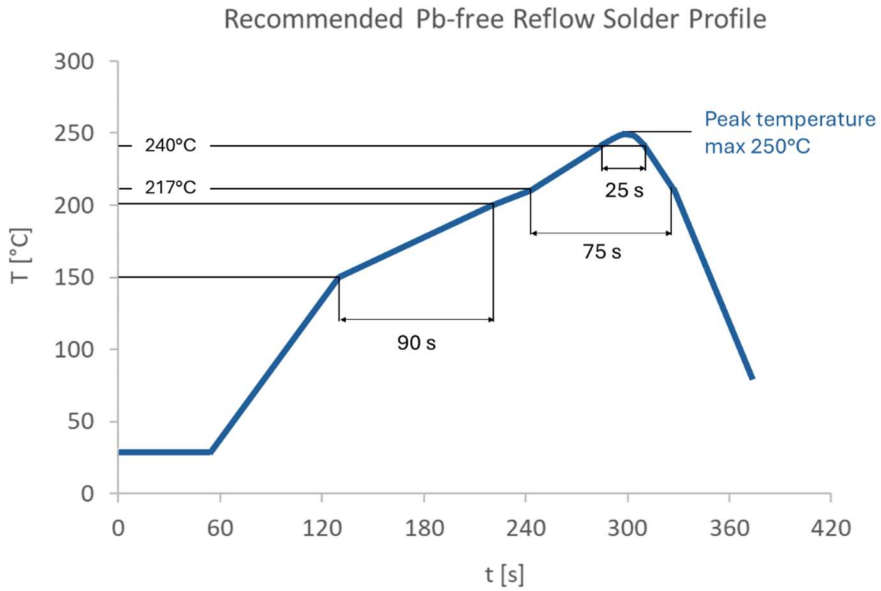

Figure 3: Recommended reflow soldering profile for Optoi devices.