

## 1. Introduction

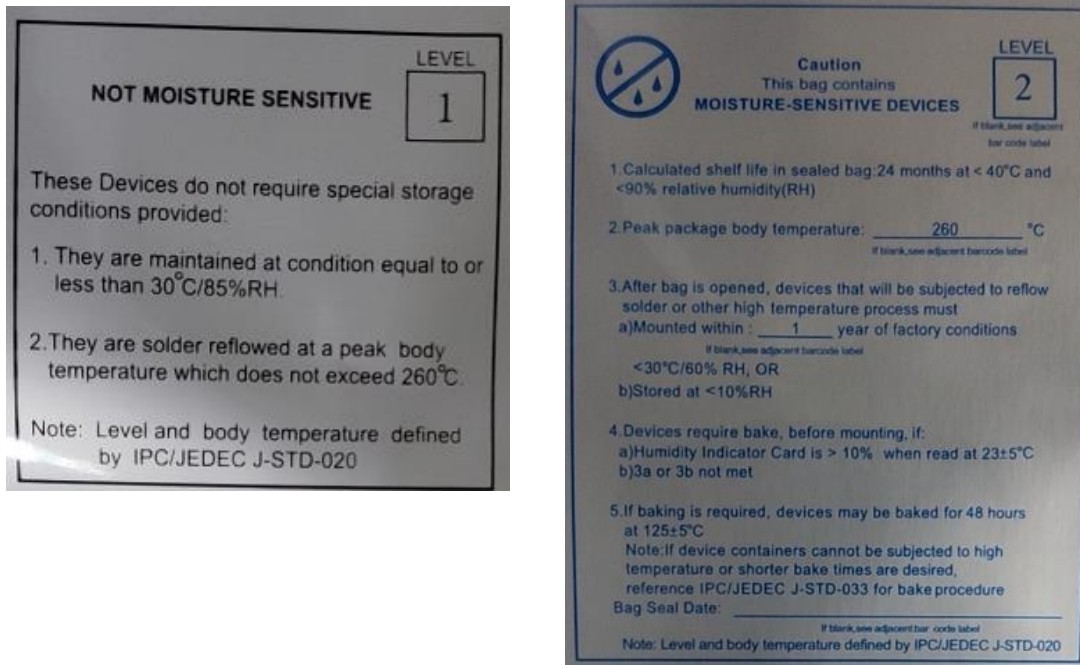
All plastic integrated-circuit packages have a tendency to absorb moisture. During surface-mount assembly, this moisture can vaporize when subjected to the heat associated with solder reflow operations. Vaporization creates internal stresses that can cause the plastic molding compound to crack. This cracking process is commonly referred to as the “popcorn effect.”

Cracks in the plastic molding may cause internal damage or may allow contamination to penetrate to the die, which can reduce the reliability of the semiconductor device.

Since plastic packages absorb moisture, care must be taken to prevent exposure to humid conditions greater than 10% RH for extended periods of time prior to surface mount reflow processing. If exposed to excessive moisture, the devices should be baked to remove moisture prior to solder reflow operations.

All MPS surface mount ICs have a moisture sensitivity level and peak reflow classification. This information is displayed on the reel, MBB and box packing.

The figure below show an example of the labels.



## 2. Definitions

### Dry Pack

Dry pack consists of desiccant material and a humidity indicator card (HIC) sealed with the surface mount device (SMD) packages inside a moisture barrier bag (MBB).



## Moisture Sensitivity Technical Note

### Floor Life

The allowable time period between removals of moisture-sensitive devices from a moisture-barrier bag, dry storage, or dry bake and the soldering (surface mount) process.

### Shelf Life

The minimum time that a dry-packed, moisture-sensitive device can be stored in an unopened moisture barrier bag (MBB) such that a specified interior bag ambient humidity is not exceeded.

### 3. Dry Packing Requirements

- a) Dry-packing requirements for the various moisture sensitivity levels are shown in Table 1 below.

**Table 1 Dry Packing Requirements**

| MSL Level | Dry Before Bag | MBB With HIC | Desiccant | MSID Label   | Caution Label  |
|-----------|----------------|--------------|-----------|--------------|--|
| 1         | Optional       | Optional     | Optional  | Not Required | Not Required if classified at 220 - 225 °C [428 - 437 °F]<br>Required* if classified at other than 220 - 225 °C [428 - 437 °F] |
| 2         | Optional       | Required     | Required  | Required     | Required   |
| 2a-5a     | Required       | Required     | Required  | Required     | Required   |
| 6         | Optional       | Optional     | Optional  | Required     | Required   |

\*A "Caution" label is not required if level and reflow temperature are given, in human readable form, on the barcode label attached to the lowest level shipping container.

- b) The floor life of SMDs will be modified by environmental conditions other than 30 °C/60% RH. Please refer to below table.

**Table 2 Moisture Classification Level and Floor Life**

| Moisture Sensitivity Level | Floor Life (out of bag) at factory ambient ≤30 °C/60% RH or as stated                                 |
|----------------------------|---|
| 1                          | Unlimited at ≤30 °C/85% RH  |
| 2                          | 1 year  |
| 2a                         | 4 weeks   |
| 3                          | 168 hours   |
| 4                          | 72 hours  |
| 5                          | 48 hours  |
| 5a                         | 24 hours  |
| 6                          | Mandatory bake before use. After bake, must be reflowed within the time limit specified on the label. |



## Moisture Sensitivity Technical Note

### c) Drying of SMD Devices

Drying Requirements - Levels 2 - 5a

SMD devices classified at Levels 2 through 5a that exceed floor life may be adequately dried by baking according to Table 3 (for rebake prior to reflow) or Table 4 (for drying prior to dry packing).

**Table 3 Reference Conditions for Drying Mounted or Unmounted SMD Packages**  
(User Bake: Floor life begins counting at time = 0 after bake)

| Package Body  | Level | Bake @ 125 °C +10/-0 °C       |   | Bake @ 90 °C +8/-0 °C<br>≤5% RH |   | Bake @ 40 °C +5/-0 °C<br>≤5% RH |   |
|---|-------|-------------------------------|---|---------------------------------|---|---------------------------------|---|
|   |       | Exceeding Floor Life by >72 h | Exceeding Floor Life by ≤72 h                     | Exceeding Floor Life by >72 h   | Exceeding Floor Life by ≤72 h                     | Exceeding Floor Life by >72 h   | Exceeding Floor Life by ≤72 h                     |
| Thickness ≤1.4 mm                                     | 2     | 5 hours                       | 3 hours   | 17 hours                        | 11 hours  | 8 days                          | 5 days  |
|   | 2a    | 7 hours                       | 5 hours   | 23 hours                        | 13 hours  | 9 days                          | 7 days  |
|   | 3     | 9 hours                       | 7 hours   | 33 hours                        | 23 hours  | 13 days                         | 9 days  |
|   | 4     | 11 hours                      | 7 hours   | 37 hours                        | 23 hours  | 15 days                         | 9 days  |
|   | 5     | 12 hours                      | 7 hours   | 41 hours                        | 24 hours  | 17 days                         | 10 days   |
|   | 5a    | 16 hours                      | 10 hours  | 54 hours                        | 24 hours  | 22 days                         | 10 days   |
| Thickness >1.4 mm ≤2.0 mm                             | 2     | 18 hours                      | 15 hours  | 63 hours                        | 2 days  | 25days                          | 20 days   |
|   | 2a    | 21 hours                      | 16 hours  | 3 days                          | 2 days  | 29 days                         | 22 days   |
|   | 3     | 27 hours                      | 17 hours  | 4 days                          | 2 days  | 37 days                         | 23 days   |
|   | 4     | 34 hours                      | 20 hours  | 5 days                          | 3 days  | 47 days                         | 28 days   |
|   | 5     | 40 hours                      | 25 hours  | 6 days                          | 4 days  | 57 days                         | 35 days   |
|   | 5a    | 48 hours                      | 40 hours  | 8 days                          | 6 days  | 79 days                         | 56 days   |
| Thickness >2.0 mm ≤4.5 mm                             | 2     | 48 hours                      | 48 hours  | 10 days                         | 7 days  | 79 days                         | 67 days   |
|   | 2a    | 48 hours                      | 48 hours  | 10 days                         | 7 days  | 79 days                         | 67 days   |
|   | 3     | 48 hours                      | 48 hours  | 10 days                         | 8 days  | 79 days                         | 67 days   |
|   | 4     | 48 hours                      | 48 hours  | 10 days                         | 10 days   | 79 days                         | 67 days   |
|   | 5     | 48 hours                      | 48 hours  | 10 days                         | 10 days   | 79 days                         | 67 days   |
|   | 5a    | 48 hours                      | 48 hours  | 10 days                         | 10 days   | 79 days                         | 67 days   |
| BGA package >17 mm x 17 mm or any stacked die package | 2-5a  | 96 hours                      | As above per package thickness and moisture level | Not applicable                  | As above per package thickness and moisture level | Not applicable                  | As above per package thickness and moisture level |
|   |       | (See Note 2)                  |   |                                 |   |                                 |   |



## Moisture Sensitivity Technical Note

**Table 4 Default Baking Times Used Prior to Dry-Pack that were Exposed to Conditions  $\leq 60\%$  RH (MET = 24 h)**

| Package Body Thickness      | Level | Bake @ 125 °C +10/-0 °C | Bake @ 150 °C +10/-0 °C |
|-----------------------------|-------|-------------------------|-------------------------|
| $\leq 1.4$ mm               | 2     | 7 hours                 | 3 hours                 |
|                             | 2a    | 8 hours                 | 4 hours                 |
|                             | 3     | 16 hours                | 8 hours                 |
|                             | 4     | 21 hours                | 10 hours                |
|                             | 5     | 24 hours                | 12 hours                |
|                             | 5a    | 28 hours                | 14 hours                |
| $> 1.4$ mm<br>$\leq 2.0$ mm | 2     | 18 hours                | 9 hours                 |
|                             | 2a    | 23 hours                | 11 hours                |
|                             | 3     | 43 hours                | 21 hours                |
|                             | 4     | 48 hours                | 24 hours                |
|                             | 5     | 48 hours                | 24 hours                |
|                             | 5a    | 48 hours                | 24 hours                |
| $> 2.0$ mm<br>$\leq 4.5$ mm | 2     | 48 hours                | 24 hours                |
|                             | 2a    | 48 hours                | 24 hours                |
|                             | 3     | 48 hours                | 24 hours                |
|                             | 4     | 48 hours                | 24 hours                |
|                             | 5     | 48 hours                | 24 hours                |
|                             | 5a    | 48 hours                | 24 hours                |

Note 1: If baking of packages  $> 4.5$  mm thick is required, see appendix B in IPC/JEDEC J-SDT-033.

#### 4. Shelf life

MPS warrants the shelf life of its analog IC devices for two (2) years based on production date code, assuming the integrity of the seal has not been compromised during that time period and consider to store in environment of  $< 40$  °C/90% RH.

Please see MPS International Ltd. Standard Terms and Conditions for other warranties applied to its products.

## 5. MPS Recommended IR Reflow Temperature Profile

The profile meets IPC/JEDEC J-STD-020 spec

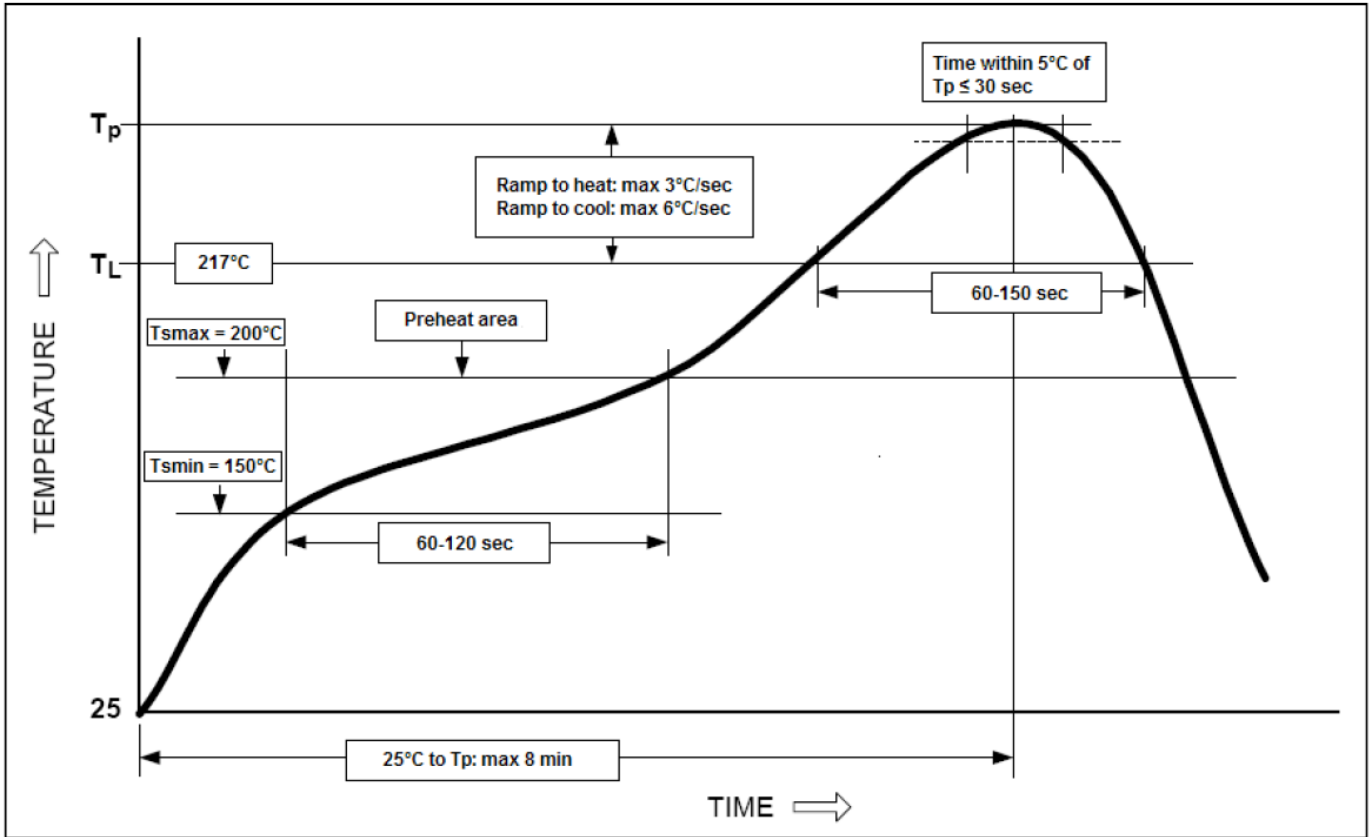


Table:  $T_p$  for Pb-Free Process

| Package Thickness | Volume $\text{mm}^3$ <350 | Volume $\text{mm}^3$ 350 - 2000 | Volume $\text{mm}^3$ >2000 |
|-------------------|---------------------------|---------------------------------|----------------------------|
| <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                    |

## 6. Reference Docs

**IPC/JEDEC J-STD-033** Handling, Packing, Shipping and Use of Moisture/Reflow Sensitive Surface Mount Devices

**IPC/JEDEC J-STD-020E** Moisture/Reflow Sensitivity Classification for Nonhermetic Surface Mount Devices