

Preconditioning of SMT Packages

Introduction

National Semiconductor, as an integrated circuit manufacturer, is compelled to provide high quality, reliable surface mount components to many industries such as automotive, telecommunications, avionics, and computing. The integrated circuit components are subjected to one common process of surface mounting. Surface mounting entails placing components on a printed circuit board (PCB) with flux, and then passing these boards through a furnace to a temperature great enough to melt the solder on the leads. Upon cooling the solder solidifies, attaching the components to the PCB.

The surface mount process may seem simple, but many problems can arise. For instance, moisture absorbed by the plastic packages can induce cracking. Such cracking is caused by extreme internal pressure created by moisture vaporizing under the hot temperature of solder reflow conditions. Once cracked, the surface mount package reliability is compromised, leading to potential corrosion of the device by moisture and ionic contaminants.

Preconditioning and Reliability

Preconditioning is a simulation of the surface mount process that is typically done at the PCB assembly houses. At National Semiconductor preconditioning is done prior to the following reliability tests: temperature-humidity bias, autoclave, and temperature cycle. The preconditioning flow that is used is given in *Figure 1*.

The moisture soak conditions for preconditioning are dependant on the moisture sensitivity level (MSL), as defined by the JEDEC/IPC joint industry standard, J-STD-020A. These soak conditions are given in *Table 1*.

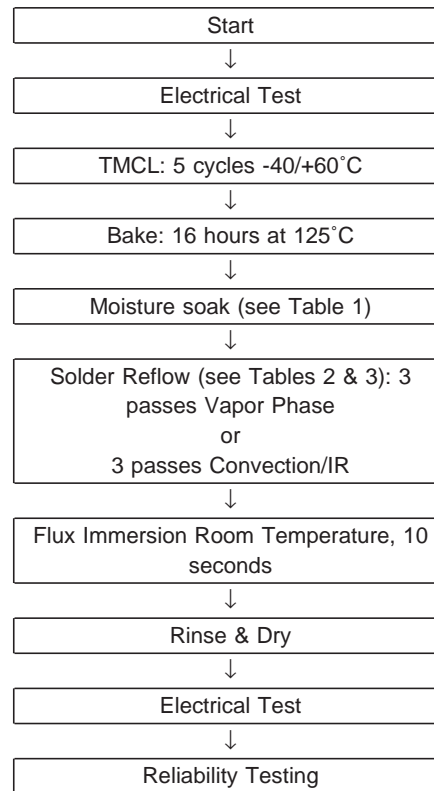


FIGURE 1. Preconditioning Flow for Surface Mount Packages

TABLE 1. Preconditioning Soak Requirements

Moisture Sensitivity Level (MSL)	Standard Soak Conditions	Accelerated Soak Conditions	Customer Floor Life
1	85°C/85% RH, 168 hr	Same as standard	Unlimited
2	85°C/60% RH, 168 hr	Same as standard	1 year
2a	30°C/60% RH, 840 hr (Note 1)	60°C/60% RH, 150 hr (Note 1)	4 weeks
3	30°C/60% RH, 336 hr (Note 1)	60°C/60% RH, 70 hr (Note 1)	168 hours
4	30°C/60% RH, 96 hr (Note 2)	60°C/60% RH, 20 hr (Note 2)	72 hours

Note 1: A Manufacturer's Exposure Time (MET) of 7 days is assumed for Levels 2a and 3. Note that this differs from the default value of 24 hours given in J-STD-020A.

Note 2: An MET of 24 hours is assumed for Level 4.

For a given reflow profile, the small packages on the PCB will reach a higher peak temperature than the large packages on the same PCB. This difference in peak temperature

is due to the fact that the large packages have greater thermal mass (heat capacity) than the small packages; thus their temperature rise is more limited. For preconditioning, the

large packages are reflowed at a peak body temperature of 220°C (or 215-219°C if vapor phase reflow is used), whereas the small packages are reflowed at a peak temperature of 235°C. *Table 2* defines the peak temperature used for the

various packages at National Semiconductor. *Table 3* defines the details of the reflow profiles for each of the two possible peak reflow temperatures and for each of the two reflow methods.

TABLE 2. Peak Reflow Temperatures

Peak Reflow Temperature	Package Types
220°C (+5/-0°C) - Conv./IR or 215 - 219°C - VPR	PQFP/TQFP ≥ 2mm thick OR ≥ 20x20mm body size, PLCC, SO /= 300 mil wide, SOJ ≥ 20 leads, PBGA, Multi-chip Packages
235°C (+5/-0°C) - Conv./IR	PQFP/TQFP < 2mm thick AND < 20x20mm body size, SO < 300 mil width, SO-EIAJ, TSOP, TSSOP, SSOP, TO-263, SOT, MSOP, SC-70, CSP

Note 3: Conv./IR refers to convection/infrared reflow; VPR refers to Vapor Phase Reflow

TABLE 3. Reflow Profiles

	Convection or IR/Convection	VPR (Note 4)
Average ramp-up rate (183°C to Peak)	3°C/second max	10°C/second max
Preheat temperature 125(±25)°C	120 seconds max	
Temperature maintained above 183°C	60-150 seconds	
Time within 5°C of actual peak temperature	10-20 seconds	60 seconds
Peak temperature range	220 +5/-0°C or 235 +5/-0°C	215 - 219°C
Ramp-down rate	6°C /second max	10°C/second max
Time 25°C to peak temperature	6 minutes max	

Note 4: At National Semiconductor Vapor Phase Reflow (VPR) is only used for packages requiring the lower peak reflow temperature (see Table 3).

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