EMULATION TECHNOLOGY, INC.
World Leader in Adapters, Clips, and Test Accessories

Socket Mounting Recommendations and Reflow Profile

Purpose

This document is meant to serve as a guide for mounting Emulation Technology, Inc. surface mount device (SMD) sockets to the printed circuit board (PCB). The recommendations described here are guidelines only, and modifications may be needed for your particular socket, PCB, and process.

Application

The sockets this document applies to are as follows: Clam Shell, Knob Lock, Screw Lock, Twist Lock, Quick Lock and Lever Lock in SMD style. These sockets utilize a patented spring-pin technology. This technology allows the pins to be soldered to the PCB while still providing compliance to the device under test (DUT) via springs located at the other end of the pin. The pins themselves do not have solder pre-forms as a BGA would with its solder balls. However, the sockets are designed to mount to the same PCB footprint and pads as required by the BGA, or any other IC package the socket was designed for (except if locating pegs are used; see ‘Locating Pegs’ section of this document). When compared to mounting a BGA, an extra volume of solder paste is required to mount the sockets to the PCB. To effect this, a properly dimensioned stencil is required. Once the paste has been applied, a standard reflow process is then used to solder the socket to the PCB. After the socket is verified to have proper electrical connection to the PCB, the system is then ready to be used.

Locating Pegs

Although designed to mount to the same footprint as the IC, with just a small amount of additional keep-out area, ET’s sockets are shipped with removable locating pegs. The sockets are typically shipped with two locating pegs, which require two thru-holes drilled into the PCB. These pegs help to align the socket on the PCB, and hence align the socket’s pins to the PCB’s pads, during the soldering process. Furthermore, plating the thru-holes allows the locating pegs to be soldered to the PCB for better mechanical stability during everyday use and handling of the socket. In the case that provisions for thru-holes cannot be provided, the user can simply remove the locating pegs from the socket by using a fine-diameter tool inserted into the peg holes at the top of the socket body to tap the pegs out the bottom of the socket body. In the case of socket designs which use the locating pegs also as lid alignment pegs, use a blunt tool to push the pegs up from the bottom of the socket body so that the pegs end flush with the bottom of the socket body, or replace the pegs with short pegs that do not protrude out the bottom of the socket body. In any case, the proper volume of solder paste is required to ensure mechanical and electrical integrity. Recommended stencil dimensions are given in the next section of this document.

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Stencil

Table 1 shows recommended stencil dimensions. A LASER-cut, electro-polished and Ni-plated stainless steel stencil is recommended to give the most consistent paste release. The apertures can be made round except for the smaller pitches, where square apertures are recommended. Remember to keep the stencil small enough to fit within the keep-out area of the socket, but yet have provisions to remove it from the PCB once the paste has been applied.

Table 1: Recommended stencil dimensions.

Device Pitch (mm)	PCB Pad Diameter (mm / in)	Stencil Thickness (mm/in)	Stencil Aperture (mm/in)
1.27	Min. 0.60 / 0.023	0.15 / 0.006	0.66 / 0.026
1.00	Min. 0.50 / 0.019	0.15 / 0.006	0.55 / 0.022
0.80	Min. 0.40 / 0.016	0.13 / 0.005	0.44 / 0.017
0.75	Min. 0.35 / 0.014	0.13 / 0.005	square 0.39 / 0.015
0.65	Min. 0.35 / 0.014	0.13 / 0.005	square 0.39 / 0.015
0.50	Min. 0.30 / 0.012	0.13 / 0.005	square 0.33 / 0.013

Solder Paste

Emulation Technology, Inc. recommends using solder paste without (<0.5%) silver (Ag) to reduce the solder's wetting ability and prevent the paste from running up the pins, thus maximizing the solder volume on the joints. Brands such as Qualitek or Alpha Metals produce such solder paste.

Reflow Profile

Both standard Sn-Pb eutectic and Pb-free reflow profiles are shown below.

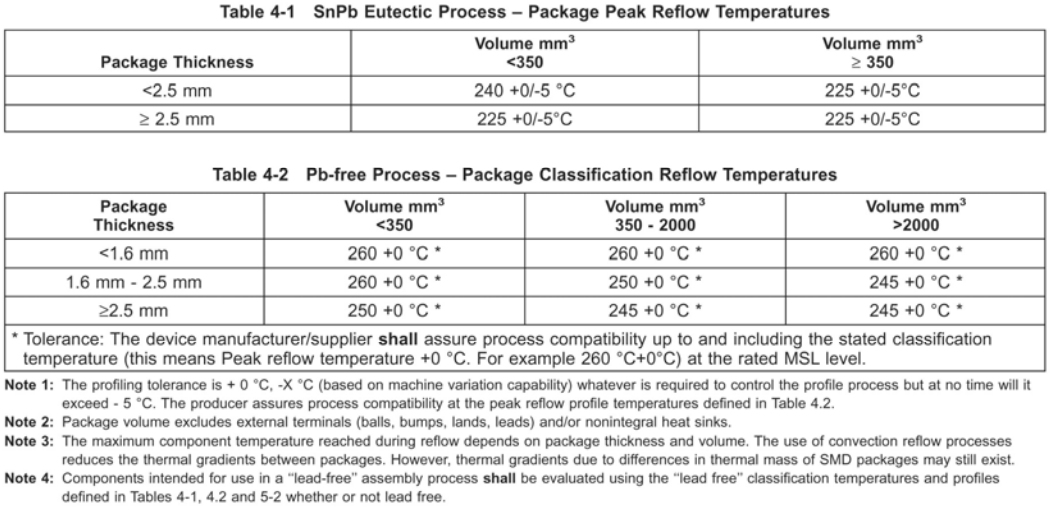

Table 4-1 SnPb Eutectic Process – Package Peak Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 ≥ 350
<2.5 mm	240 +0/-5 °C	225 +0/-5°C
≥ 2.5 mm	225 +0/-5°C	225 +0/-5°C

Table 4-2 Pb-free Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm^3 <350	Volume mm^3 350 - 2000	Volume mm^3 >2000
<1.6 mm	260 +0 °C *	260 +0 °C *	260 +0 °C *
1.6 mm - 2.5 mm	260 +0 °C *	250 +0 °C *	245 +0 °C *
≥2.5 mm	250 +0 °C *	245 +0 °C *	245 +0 °C *

* Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0 °C. For example 260 °C+0°C) at the rated MSL level.

Note 1: The profiling tolerance is + 0 °C, -X °C (based on machine variation capability) whatever is required to control the profile process but at no time will it exceed - 5 °C. The producer assures process compatibility at the peak reflow profile temperatures defined in Table 4.2.

Note 2: Package volume excludes external terminals (balls, bumps, lands, leads) and/or nonintegral heat sinks.

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: Components intended for use in a "lead-free" assembly process **shall** be evaluated using the "lead free" classification temperatures and profiles defined in Tables 4-1, 4.2 and 5-2 whether or not lead free.

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Table 5-2 Classification Reflow Profiles

Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate (Ts_{max} to Tp)	3 °C/second max.	3° C/second max.
Preheat – Temperature Min (Ts_{min}) – Temperature Max (Ts_{max}) – Time (ts_{min} to ts_{max})	 100 °C 150 °C 60-120 seconds	 150 °C 200 °C 60-180 seconds
Time maintained above: – Temperature (T_L) – Time (t_L)	 183 °C 60-150 seconds	 217 °C 60-150 seconds
Peak/Classification Temperature (Tp)	See Table 4.1	See Table 4.2
Time within 5 °C of actual Peak Temperature (tp)	10-30 seconds	20-40 seconds
Ramp-Down Rate	6 °C/second max.	6 °C/second max.
Time 25 °C to Peak Temperature	6 minutes max.	8 minutes max.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.

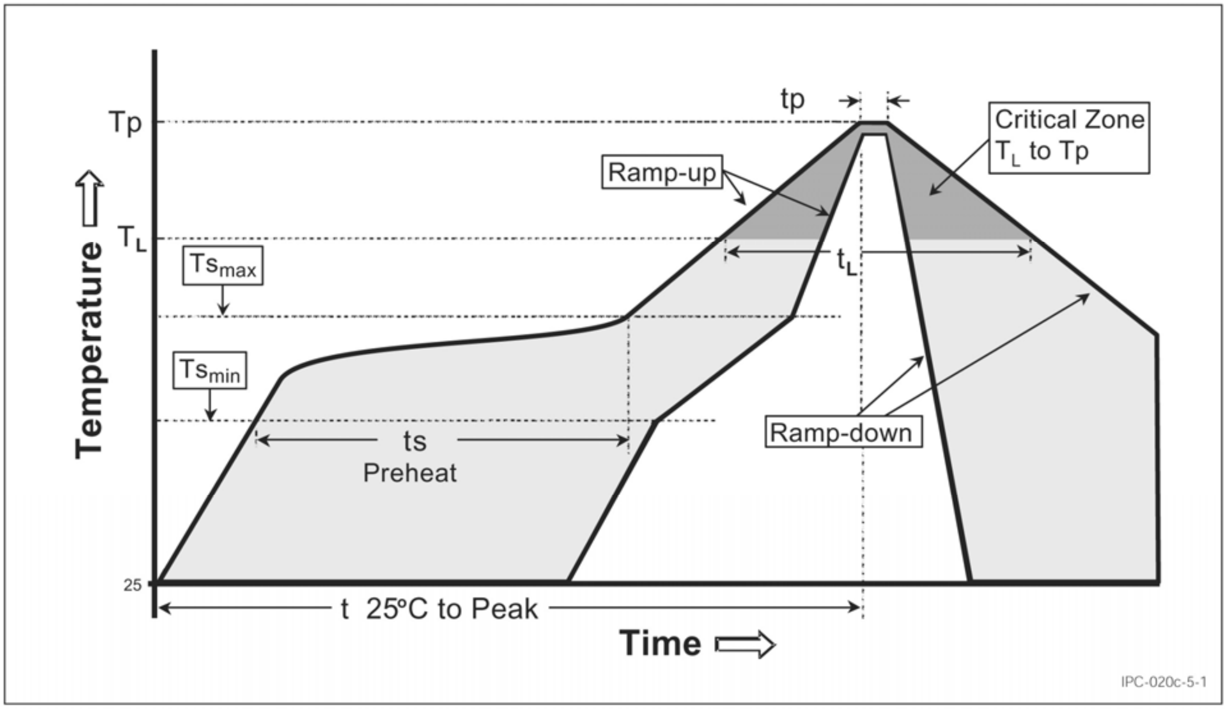

Figure 5-1 Classification Reflow Profile

Verifying the Assembly

After the socket has been reflowed to the PCB, open and short testing should be partaken to ensure proper assembly. The assembly house typically performs x-ray inspection to verify non-shorting of pins. However, as this is only a visual inspection, we recommend using a continuity tester or ohmmeter and simply sweeping random rows and columns of pins to ensure no shorting of pins. No damage to the springs will occur if very slight pressure from the meter’s tips is applied (just touch the probes to the springs). For fine pitch sockets, a microscope would be helpful in placing the meter’s tips appropriately.

After verifying the absence of shorts, open testing should be performed. The most direct, yet tedious, method is to use the continuity tester to directly probe each pin to a breakout or test point on the board. Again no damage will occur if the probes are touched to the springs. If heavy pressure is required to push the socket body towards the PCB to achieve continuity, this means a poor solder joint. If no such test points exist, then the BGA’s via field on the backside of the PCB should be kept solder-mask free to allow for such probing. If the via field is kept open, a simpler open testing method can be performed. Simply use a wet sponge (or some other conductive material) and hold it onto the via field. This shorts all the pins together on the PCB. Insert one probe of the continuity tester into the sponge. Now sweep the pins of the socket with the other probe and check for continuity.

If the above procedures show any shorts or opens, then it is advisable to have the assembly house re-evaluate the assembly method used. An incorrect stencil can lead to too much or too little solder paste, easily leading short or open conditions. This is the primary reason for socket mounting failures.

Important Screw/Twist Lock Socket Note

When tightening the lid of a Screw or Twist Lock socket, it is imperative to not over-tighten the retention screws, otherwise irreparable damage will occur. Such damage is not covered by warranty and will be solely the end user’s responsibility. The maximum allowed torque on these retention screws is 7cN-m (10oz-in). Emulation Technology, Inc. sells the torque screwdriver ET-TORQ-7CN which is preset to 7cN-m.