SILICON MICROSTRUCTURES INCORPORATED

RoHS Directive and SMI's Plan towards compliance

The RoHS Directive aim is simple – to restrict the use of **six substances** (See Figure 1 Below) within electrical and electronic equipment (EEE), thereby contributing to the protection of human health and the environment. While this is often called a Lead-Free Initiative, the other compounds listed below may also be present in electronic assemblies.

Figure 1 – Restricted Materials under RoHS Directive

Substance	Maximum Concentration
Lead – Pb	0.1 %
Mercury - Hg	0.1 %
Cadmium - Cd	0.01%
Hexavalent Chromium Cr (VI)	0.1 %
Polybrominated biphenyls – PBB	0.1 %
Polybrominated diphenyl ethers - PBDE	0.1 %

Article 1 of Commision decision 2005/618/EC states: ***'For the purposes of Article 5(1)(a), a maximum concentration value of 0.1% by weight in homogeneous materials for lead, mercury, hexavalent chromium, polybrominated biphenals (PBB) and polybrominated diphenyl ethers (PBDE) and 0.01% by weight in homogeneous materials for cadmium shall be tolerated'***

Although RoHS is a European Union (EU) Directive, manufacturers of EEE outside Europe must also abide by this legislation if the equipment they produce is ultimately imported into a EU member state.

The biggest impact for most assemblers of electronic product is that lead (Pb) is no longer an acceptable component in solder. The solution has been to use a solder without lead, but this alternate solder melts at a higher temperature. This requires a higher temperature reflow during soldering. While conventional tin-lead can be reflowed at 230 to 235 C, the reflow temperature for lead-free components needs to be in the 260 C range (depending on package size and thickness). The agreed upon temperature ramp for soldering is found in **IPC/JEDEC J-STD-020C - *Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices*.**

For some SMI Pressure Sensing products, this higher temperature has required a change in some housing plastics to withstand the higher reflow conditions.

SMI's Roadmap on Compliance

SMI has been working with its suppliers over the last year to create RoHS compliant versions of all SMI products

1. Die and wafer products -- As a starting point, all SMI die and wafer products were found to be compliant to the RoHS Directive.

2. Packaged parts -- The table below is specific to the SMI packaged products.

All **SOIC Packages** were found to be RoHS compliant.

The other **ceramic-based parts** required modifications to the substrates and are now available in compliant versions. Two changes were required. First some of the substrate materials were modified to meet compliance. Second, some of the housings and caps were modified from using **Ultem 2200** to a higher temperature plastic **Vectra E130i** in order to meet the higher temperature reflows required with the compliant solder during surface mounting.

While SMI has verified the packages on a profile conforming to the JEDEC standard, it is recommended that the solder process be verified by the user before high-volume production. SMI did specifically look at cap and port deformation on these products and found no dimensional changes after reflow at the Jedec Lead-free profile.

Marking: SOIC packages are all compliant and are not marked. Compliant Ceramic Packages are marked with an "R" in a conductor layer on the ceramic.

Transition: During a transition period, customers may specify RoHS compliant parts. If compliance is not specified, SMI may ship non-compliant parts from stock if they are available, otherwise compliant parts will be built to fulfill the order.

Compliance Table for SMI Packaged Products

Product	Package Style	Non-compliant Version	Compliant Package or Cap Material	Compliant Version
SM5310	SMT Ceramic	**Y**	**Vectra E130i**	**S**
SM5350	Pinned SMT Ceramic	**Y**	**Vectra E130i**	**S**
SM5410	Pinned Thru-hole Ceramic	**Y**	**Vectra E130i**	**S**
SM5420	SOIC-8 SMT		**Epoxy Resin**	**R**
SM5430	SOIC-16 SMT		**Vectra E130i Epoxy Resin**	**R**
SM5450	Pinned Thru-hole Ceramic	**Y**	**Vectra E130i**	**S**
SM5470	SOIC-16 SMT		**Vectra E130i Epoxy Resin**	**R**
SM55XX	SIP pinned Ceramic	**Y**	**Ultem**	**S**
SM56XX	DIP pinned Ceramic	**Y**	**Ceramic**	**S**
SM5812	DIP pinned Ceramic	**Y**	**Ceramic**	**S**
SM5822	SOIC-16 SMT		**Vectra E130i Epoxy Resin**	**R**
SM5852	DIP pinned Ceramic	**Y**	**Ceramic**	**S**
SM5872	SOIC-16 SMT		**Vectra E130i Epoxy Resin**	**R**

Y = Non-compliant may be in stock and shipped unless RoHS specified; **S** = RoHS must be specified in order – may have 6 week lead-time; **R** = Always Compliant
Consult Sales for ordering information

APPENDIX 1 –
Temperature Profile Requirements for Solder Re-flow for Sn-Pb and Pb-Free Packages

Refer to the JEDEC J-STD-020C for complete details. Tables 4-2, 4-3, and 5-2 are reproduced here. Figure 5-1 describes the various zones of heating.

IPC/JEDEC J-STD-020C *- Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices* http://www.jedec.org/download/search/jstd020c.pdf

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.

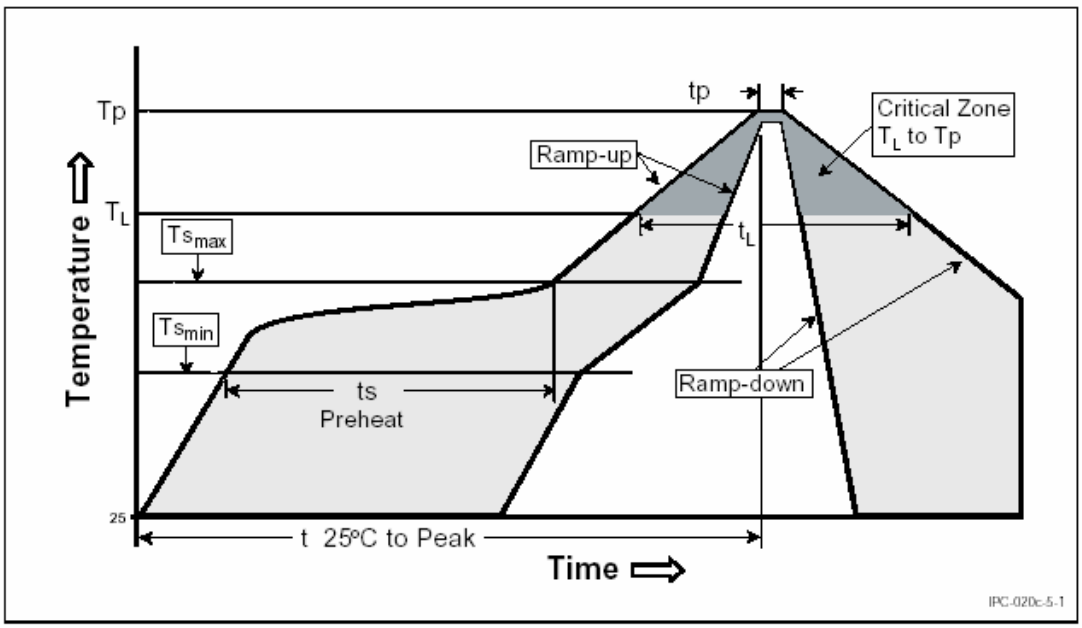

Figure 5-1 Classification Reflow Profile

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.