Soldering Profile for RoHS Compliant Power Supplies

What is RoHS?

The member states of the European Union have issued a law, referred to as **R**estriction of **H**azardous **S**ubstances (**RoHS**) Directive 2002/95/EU, restricting the use of certain hazardous substances in electrical and electronic equipment manufactured and/or sold within the EU. This Directive requires that all **E**lectrical and **E**lectronic **E**quipment (**EEE**) sold within the EU be free of lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls (PBB) and polybrominated diphenly ethers (PBDE), .

Of the six (6) substances included in RoHS Directive, lead is the one of primary concern for internal components and soldering of electrical converters.

In the electronics circuit assemblies there are three sources of lead:

1. Solderable traces on the circuit board;
2. Solderable finish on the components themselves;
3. Solder used to connect the two in all variations: alloy, solder paste for reflow and liquid solder for wave.

Lead-free solder alternatives:

Conventional Sn60/Pb40 eutectic tin lead solder (liquid temperature: 183°C) can be successfully soldered at temperature of 220°C. By comparison, most (not all) lead-free solder alloys have a higher liquid temperature and require soldering profiles with peak temperature in range of 240-260 °C.

Lead-free component manufacturers' alternatives:

1. To select the lead-free termination finish that is compatible to the lead free and the current tin lead solders.
2. To modify the board so it can tolerate higher reflow or wave flow temperature associated with the higher melting points of most of the lead-free solder pastes.

   Most lead-free solder systems will require a peak reflow or reflow temperature from 240°C to 260°C.

Lead-free technology mounting process:

There are two important issues to take into consideration when using lead-free solder:

1. Wettability - how well the solder flows around the components. The conventional Sn/Pb eutectic solder is flows better than the lead-free solders.

   This problem can be resolved with improvement of flux composition based on nitrogen atmosphere to minimize the solder oxidation.

2. The melting point for lead-free solder is higher than Sn/Pb eutectic solder. In the mounting process the peak temperature is set above the actual melting point of the solder to provide a safety margin. For the lead-free solder this temperature peak is so high that it can pose a threat to the heat resistance of the components themselves. Heat resistance varies according to the specific component, but for the components designed for Sn/Pb eutectic solder, the maximum heat resistance is 240°C.

   Achieving lead-free circuit boards will require lowering the peak temperature in the bonding process to a level that matches the heat resistance of the electronic components and minimizes the heating time.

Soldering Profile for RoHS Compliant Converters

Lead-free technology mounting process (con't):

Soldering methodology: Components can be mounted onto circuit boards manually with soldering iron or by the flow soldering method with liquid solder wave.

the most common methods of soldering are reflow and wave flow, where solder paste is printed onto the paths on the circuit board, the components are set into the place and then the board passes through a furnace. There the solder paste is heated and melting to bond the component on the board. All leads on the board are heated uniformly. The concern for lead-free soldering is when the temperature reaches the point of solder melting for some leads; it may have exceeded the heat threshold for other electronic components on the same board.

New method: The optimal conditions of surface or through-hole mounting are to ensure temperature uniformity on the board and lowering the peak temperature. To achieve these conditions, a furnace with seven to nine heating/cooling zones is required and the temperature profile must be carefully set. The temperature can be precisely controlled. Component placement is uniform with minimum temperature differences on the board.

Conventional method: Three heating zones. Heat rises more slowly where components are tightly packed, creating temperature differences on the board.

Illustrations for Wave Flow Soldering: