TECHtips

Electronics Manufacturing Insights from ACI Technologies, Inc.

BGA Placement on Rework Station

The success of ball grid array (BGA) placement on electronic assemblies is as much a matter of proper preparation and planning, as it is technique. In some designs, it is more appropriate to apply BGAs using a rework station that isolates the placement of the device, without subjecting the entire assembly to thermal reflow. This is especially beneficial in board constructions where the number of BGAs is limited, and the application of the solder paste is difficult, due to small pitch features that stretch the limitation of the stencil construction. Another application for rework stations, involves very large and thermally conductive BGAs, which will not uniformly reflow with other components on the assembly, and may require special process parameters for their proper placement. The most common use of BGA rework stations are for assemblies requiring BGA removal and replacements due to failures in the initial assembly stage.

There are several types of rework stations with different means of applying thermal energy to the BGA. Some systems use top convection heaters for nozzles that are applied directly over the part while bottom infrared (IR) systems heat the entire assembly. There are also rework stations that apply a direct IR laser onto the part to minimize the heat gradient across adjacent devices. Whichever system is utilized, there are fundamental guidelines that should be applied to achieve maximum results.

Thermal Profiling

In a manner similar to any surface-mount technology (SMT) reflow process, the use of thermocouples, advantageously placed on locations surrounding the BGA, is a preliminary necessity for setting proper reflow conditions. Unlike standard thermal reflow ovens, where indiscriminate reflow occurs across all devices, care must be taken to develop a profile that will not adversely affect adjacent components, including ones directly beneath the BGA. Most systems have the capacity to accommodate at least four thermocouples. The purpose of the profile is to observe the thermal gradient around the surrounding area, where temperature, soak, and ramp time adjustments can be made to optimize the reflow conditions, if necessary. Typical locations for the thermocouples are to place one at a corner of the BGA, one at the opposite corner, one near the adjacent components, and one on the underside of the BGA. Some application-specific integrated circuit (ASIC) devices and printed circuit boards (PCB) are expensive and cannot be sacrificed for profile reasons. In these situations, profile as many adjacent areas as necessary to develop a reliable reflow model. Figure 1 is a typical reflow profile.

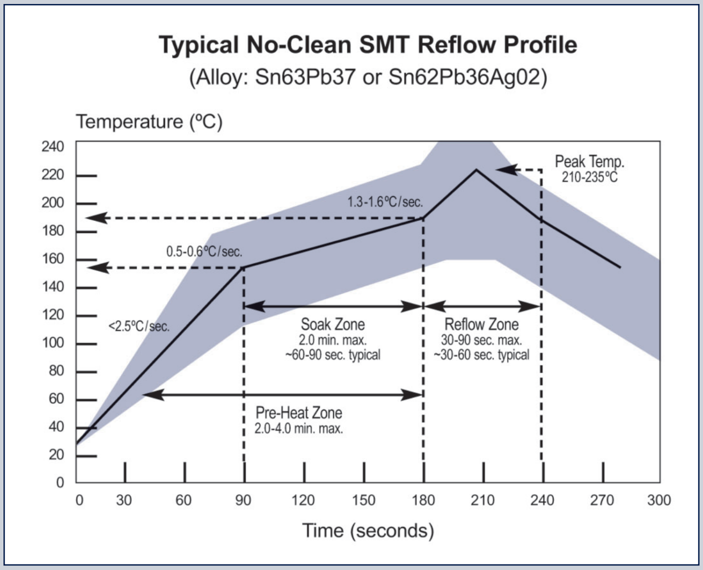

Figure 1: Typical No-Clean SMT Reflow Profile

Cleaning

In applications for rework, removal of the old BGA will leave excessive solder in the pad areas of the substrate. Removal of the old solder is obviously important; however, care must be taken to remove the solder all the way through to the pad's metallurgical surface. This may require a copper braid to extract residual solder, so that the pads are as uniform as possible to avoid planarity issues upon re-attachment of the BGA (Figure 2). A subsequent cleaning process to remove

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excessive flux and other residues will be necessary to prepare the pad surface. Be aware that in many cases, the original surface finish has been consumed, and that additional flux will be needed to reactivate the pad surface.

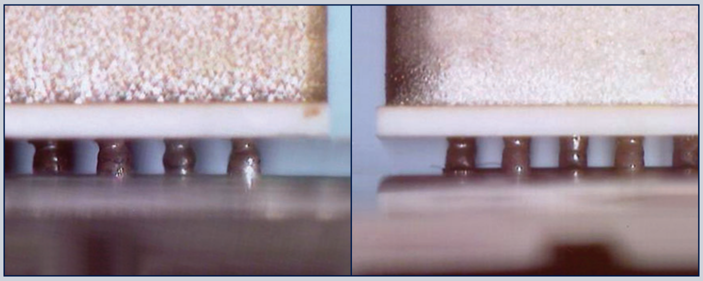

Figure 2: Coplanarity – High melt joints with .014 inch/inch board warp.

Note: Care must be taken to not overheat the pad during the removal of the solder. This can cause pad lifting, which will require extensive and timely repair.

Solder Volume

Whether a new or re-balled device is being placed, it is always advisable to consider any constraints that would impede the application of additional solder paste for the reflowing process. In some cases, the addition of solder paste is not required for applying a BGA. The application of a gel flux to the bottom of the BGA is sufficient to activate the pad surface and allow proper wetting of the BGA solder balls during reflow. A critical assessment should be made on the effect of the lower solder volume on reliability. Some design criteria will require a minimum solder volume to mitigate any potential strain applied during the lifetime of the assembly. Many of the higher level applications require a more rigorous environmental stress screening, and therefore the additional solder reinforcement on the BGAs will be a requirement.

The application of solder paste will require special stencils that allow sufficient clearance for adjacent components while allowing maneuverability for the specialized squeegees to apply a uniform coating of paste. The stencils are robust enough to not bend while pressure is being applied during the screening process (Figure 3). It is also critical to maintain a flush contact against the substrate to alleviate bleeding of the paste. Solder paste can also be applied with the use of dispensing systems that release a predetermined volume of solder in each of the pad areas. These systems can be either manually controlled or automated to allow the dispenser to move to the programmed pad locations and apply the paste.

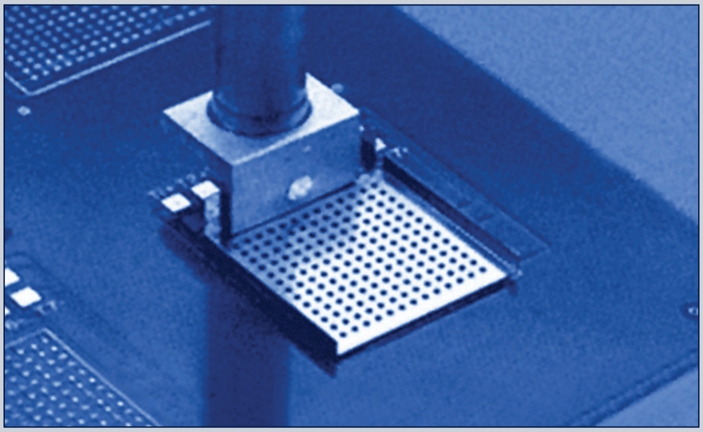

Figure 3: Ball Grid Array Stencil

The addition of the solder paste to the BGA will change the reflow characteristics which makes it more critical to develop a proper reflow profile. Avoid excessive ramp up times which will volatilize the remaining flux prior to the liquidus stage, and cause potential "head in pillow" effects. Some large ASICs can be difficult to collapse without adverse effects to adjacent devices, or in some cases, the substrate. Therefore, applying a higher temperature to avoid longer ramp times may not be the solution. The primary solution is to increase the preheat time, while setting the preheat temperatures below the flux activation point. A faster ramp during the soak stage will allow the flexibility to increase the liquidus temperature slightly to ensure uniform collapse across the BGA. Some applications may require the addition of flux if the preheat cycles are inadvertently long. Avoid excessive application of flux which may increase the incidence of voiding.

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