

## **BGA Rework**

### Introduction

Unlike surface mount components with leads around the perimeter (i.e. QFP), Ball Grid Array (BGA) packages contain a matrix of solder spheres on the bottom side. From a design standpoint, one of the benefits that a BGA offers versus a QFP is having greater number of I/O connections over the same amount of real estate. The disadvantage however, is that those I/O connections are now hidden making rework a more complicated process requiring specialized equipment. This article details the steps of reworking a BGA device on a motherboard using an [AT-GDP Rework Station](#). A Lead Free profile has been applied during removal and installation processes.

### Components

BGA measures 31mm x 31mm (1.22" x 1.22") and contains 421 spheres (Figure 1). Solder spheres measure 0.6mm in diameter with a pitch of 1.0mm. Motherboard measures 229mm x 305mm x 1.52mm thick (9" x 12" x 0.060").



Figure 1: BGA on a motherboard

## Removal

After securing the motherboard by the board holder's clamps, an operator installs a vacuum pick up tip and nozzle suitable for the BGA device. Implementing machine's optics, the nozzle is aligned over the component. A pre-established profile is selected from the software' library and Start icon is selected. At this point the process is hands-off. Rework station automatically drives the nozzle down to a board and covers the BGA. Machine then activates vacuum pick up tip so as to remove the component once reflow is achieved and the heating cycle is initiated. Figure 2 shows a nozzle covering the device during reflow.

Heating is precisely controlled by the software (Figure 3). It mimics an original profile with heat applied from both top and bottom sides of a board. Source of bottom heating is Quartz IR while the top side is forced air or nitrogen convection. As is shown in the [video of removal](#), upon completion of reflow, the machine lifts a BGA off a board and moves nozzle up along Z axis to its starting point.

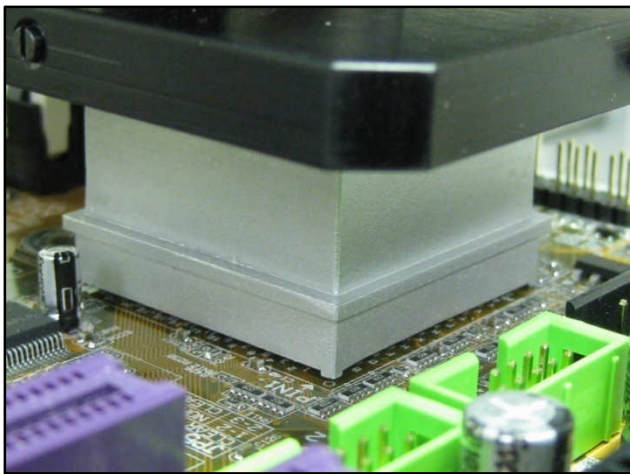


Figure 2: Nozzle covering BGA during reflow

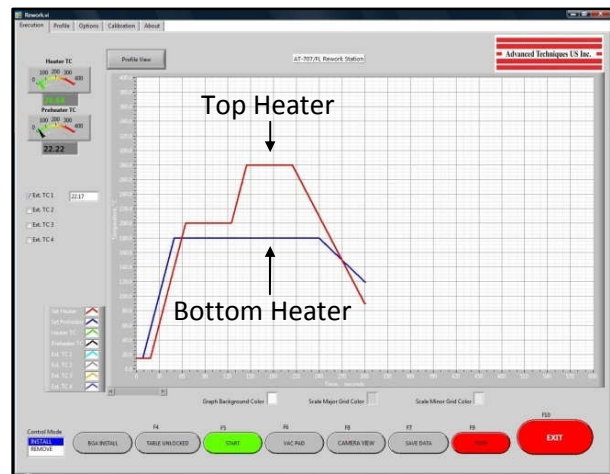


Figure 3: Screenshot of a profile

Residual solder remains on the board after removing a component. It takes the shape of Hershey's kisses candy due to surface tension of molten solder. As a result of its uneven shape and volume, solder must be removed prior to installing a new component (Figure 4). This may be accomplished by using a vacuum de-soldering tool or more commonly by wicking solder with a copper braid and soldering iron.

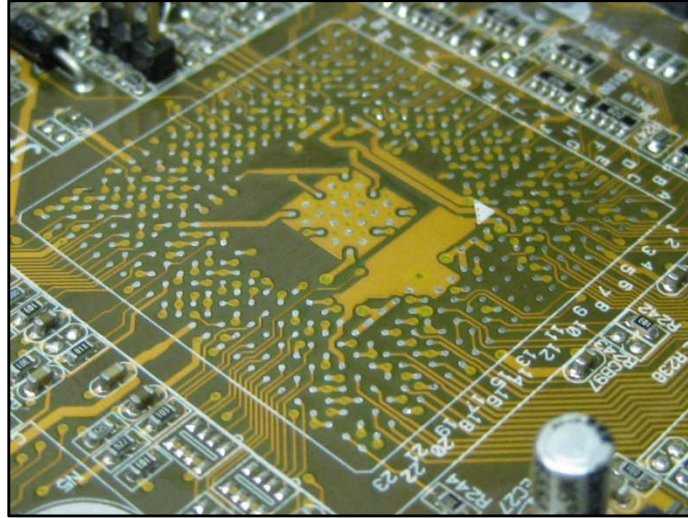


Figure 4: Pads after cleaning off excess solder

### Installation

Once pads on a board have been cleaned to remove residual solder, the component may be installed. After the BGA has been picked up by the rework station, the next step involves transferring flux or solder paste to spheres of a device. Both may be applied by dipping the component in a universal plate. Implementing tacky rework flux however, is more common. As displayed in Figure 5, the BGA is dipped into a Flux Transfer Plate (Part: FTP-ATGDP) that contains a pool of tacky flux 300 $\mu$ m deep. Now the tip of each of the 421 solder spheres contains a small amount of flux that is necessary for proper reflow and joint formation.

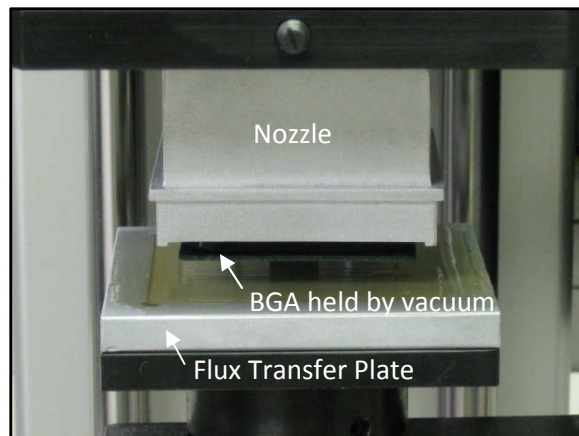


Figure 5: BGA dipped in flux



Component is now ready to be optically aligned over the matching pads on a motherboard. As the Split Vision Optics arm is moved into position (Figure 8). It enables viewing solder spheres of a BGA and pads of a board simultaneously on the same screen. Magnification and LED lighting intensity may be adjusted to create optimum solder sphere size and contrast between the two images. Figure 6 shows a camera view screenshot where solder spheres and pads are misaligned. By adjusting the X-Y micrometers of a vacuum lockable board holder and theta rotation adjustment, BGA's spheres were aligned over board's pads (Figure 7). Component is now ready to be placed and soldered.

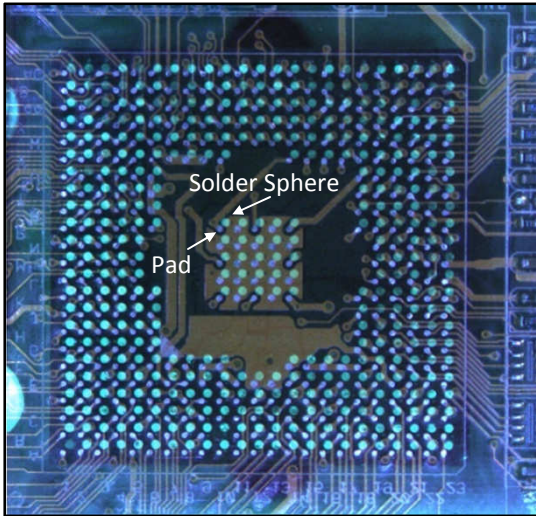


Figure 6: Solder spheres and pads misaligned

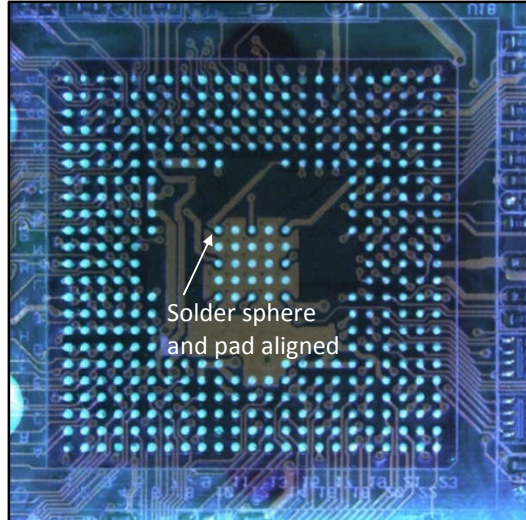


Figure 7: Solder spheres and pads aligned

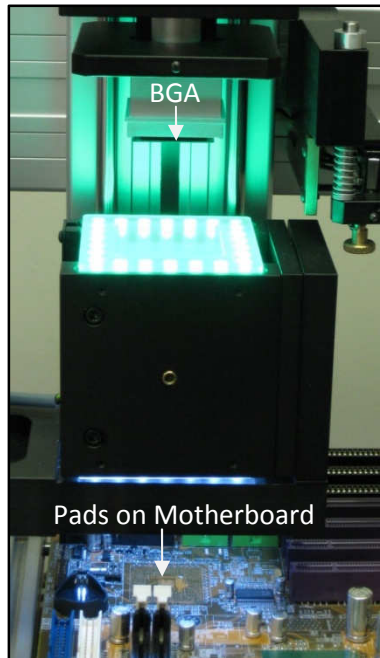


Figure 8: Split Vision Optics arm in position

Upon moving the optics arm to its original position, the device may now be placed on a board and reflowed. As in the removal process, the same pre-established profile is selected from the software's library and a Start icon is selected. Sequence in an Install mode instructs the rework station to automatically places the BGA on a board, lifts up the vacuum tip away from component's surface, and begin heating. Figure 9 shows a nozzle covering the BGA during reflow. Heating is precisely controlled by the software (Figure 3). It mimics an original profile with heat applied from both top and bottom sides of a board. Uniform stream of cool air or nitrogen is directed through the nozzle to form strong, high quality joints. As is shown in the [video of installation](#), upon completion of a cooling stage, machine moves the nozzle up along Z axis to its starting point. Installation process is now completed (Figure 10).

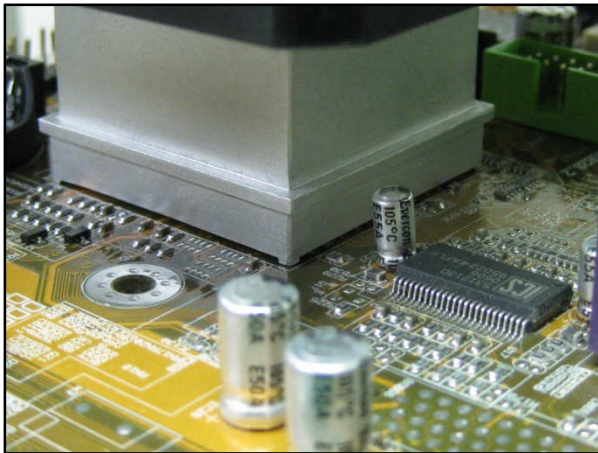


Figure 9: BGA being soldered



Figure 10: BGA installed on a motherboard

## Conclusion

In order to properly rework a BGA component, the rework station must contain features like split vision optics, software controlled sequencing and thermal management, and automation. These features not only simplify the process but also enable achieving high quality results on a consistent basis.

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## Related Links:

[Video of BGA Removal](#)  
[Video of BGA Installation](#)