BREAKING DOWN REWORK

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It is said that rework is more of an art than a science. An operator cannot be given a recipe or list of steps to follow that will insure proper rework. Instead, the operator must use the rework equipment like an artist uses a brush and paint. Just like the artist cannot paint a masterpiece without the proper supplies, the rework operator cannot perform rework properly without the proper equipment. In choosing different rework systems, it is possible to break the various systems down to three basic fundamentals: vision, placement and heating.

While vision, placement and heating are the fundamental aspects of a rework system, we must also consider the component that is being reworked. For example, what vision is needed for a QFP vs. BGA as well as BGA vs. µBGA. As we are all aware, the use of BGAs and its sibling, the µBGA (CSP) is increasing and will by all indications continue to increase. This means there will be an increased need for rework of these types of components. Additionally, QFP use will continue with the lead spacing getting smaller and smaller. Remember when a 0.25" component was considered a small pitch for a fine pitch component? In most cases, each of these components must be reworked differently.

Vision

As the lead pitches have gotten smaller, the need for vision has increased. Pitches on both BGAs and QFPs continue to get smaller. Rework systems are available without vision, with overhead viewing, with angular viewing and with more sophisticated split beam vision.

For obvious reasons, systems without vision depend on the skill and eyesight of the operator. As the pitch size gets smaller, the need for vision increases. Some systems use a microscope or magnifying glass as a method of adding vision to an otherwise "visionless" system. Systems without vision are popular for PLCC and other larger pitched devices. Alignment of µBGAs is extremely difficult if not impossible without vision.

Overhead or "bird's eye" vision is advantageous when working with quad flat packs. Overhead viewing looks straight down on the component and can be done via microscope or video camera. Many times this type of viewing also utilizes a split imager. This allows the opposite corners of the component to always be in the field of view, regardless of component size. BGAs can be aligned using a template system on overhead viewing systems, but takes longer than with a split beam system.

Angular viewing systems use a single camera that typically rotates around all sides of the component. Again, this type of vision is advantageous for QFPs and PLCCs but not for

array components where the leads and pads are not visible when looking at the top of the component. Some systems use a combination of the overhead and angular vision.

When working with BGAs and particularly µBGAs, the preferred vision system is the split beam system. This vision system allows the operator to look at superimposed images of the bottom side of the component and the pads on the board. Split beam systems allow for the alignment of the widest range of components. Of course as the vision gets more sophisticated, the price of the system increases.

A split imager is incorporated into many of these vision systems. The use of a split imager allows the operator to look at opposite corners of the component at high magnification. Thus, the operator can see a large component like a QFP-208 and a small component like a µBGA at the same magnification. Most systems have an adjustable magnification as well as a split imager. This allows the operator to adjust the magnification to see the entire component at a low magnification or "zoom in" for a highly magnified view. Magnification range is typically 6X to 80X.

Placement

After the component is aligned, the next step is placing the component on to the pads. There again exists a difference between the BGA, µBGA and QFP components as well as between rework systems.

Rework systems fall into two categories, placement and reflow in one location and placement and reflow done separately. Typically, systems that place and reflow in separate locations have a board holder that slides between the alignment area and the heating area. These systems are usually less expensive than the systems that place and reflow in one location. By placing in one location and having to slide the board to another location for reflow, there is a chance of accidental misalignment due to board transportation or nozzle misalignment.

In placing the component onto the board, the systems that place and reflow in one location have another benefit. As stated several times, different components may require different methods. Systems with co-located reflow and placement can hold the component in place during reflow, most with a specific pressure. This is important for a QFP because the leads act as a springs. Many rework systems have adjustable pressure control. By holding a QFP with pressure, all the component leads will be touching the pads on the board. On the other hand, for a BGA, the pressure control would collapse the solder balls during reflow. Most rework manufacturers recommend releasing a BGA after placing the component to the board. This also allows the surface tension between the pads on the board and component to self-center the component. Micro BGAs and CSPs as mentioned before are much lighter and smaller than BGAs. Therefore it is advantageous to hold the component in place, but with no pressure! Systems with precise Z stops are available that allow the component to be held in place at a specific height so as to eliminate the pressure.

Heating and Reflow

BGAs have significantly changed not only the vision needed for alignment, but also the heating that is required for rework. As components and boards themselves have become

more advanced, the need for a bottomside preheater has become more important. Applying topside heat in most cases is sufficient (though maybe not preferred) for QFPs and other perimeter leaded components. For QFPs, most rework manufacturers direct the heat directly to the leads thus protecting the body of the component. The preheater still brings the board up to a temperature so as to prevent warping and thermal stress to the board.

When working with BGAs, the preheater is much more important. Not only does it prevent warping and thermal stress to the board, but also brings the board up to a temperature that makes reflow easier for the top heater. This also benefits in reduced reflow time. That is not to say that the preheater will help the solder to flow, because the preheater should not bring the board temperature to reflow temperature. The underside preheater should bring the board temperature to 140 to 160 ° C.

Regarding the top or reflow heater, it must be understood that heat will be transferred through the BGA component. Precise temperature control, meaning minimal temperature variation is a must. This ensures the component will not be subjected to temperatures above its specifications. The controller should precisely follow the profile parameters as programmed by the process engineers.

There are other factors that will also affect the reflow process. They include the use of nitrogen, the air / gas flow rate and the nozzle. The benefits of nitrogen have been well documented. It should be restated that the use of nitrogen does have a significant positive affect on solder joint integrity. The air / gas flow rate will typically depend on the type of component being reworked. Usually, the smaller the component, the lower the air / gas flow rate. High flow rates may "blow" small components out of alignment.

Choosing the correct sized nozzle will affect the heat distribution around the component. The nozzle will serve to create a small reflow area (inside the nozzle) and protect the adjacent components from overheating. It is important for reflow as well as protection of adjacent components to have a nozzle that fits the package size as per the manufacturer's specifications.

Conclusion

Want a rework system that incorporates the 3 key aspects of rework. The best is to have placement and reflow at one site. Again rework is an art not a science.

As with everything else in life, the bottom line is cost vs. throughput. The best rework systems incorporate the top features from the 3 key aspects of rework: precise computer controlled heating, bottom of component and top of board split beam vision as well as placement and reflow in a single location.

Johnson, Ron. *Breaking Down Rework* Canadian Electronics. Vol.17 No.3, May 2002, Pg.8