

Flip Chip Rework

Flip chip components have been gaining popularity in the electronics industry since their introduction in the 1960s. Advances in attach methods and adhesives, as well as the drive for smaller and faster electronic devices made the technology take off. The basic premise of the flip chip is that the chip (semiconductor device) is mounted flipped from the traditional position. The traditional method of mounting a die is to mount it on a lead frame with the circuit and bond pads face up. The bond pads then receive a bond wire which then connects to the proper lead on the lead frame. Flip chips are mounted face down onto a substrate using small bumps on the bond pads to make direct electrical connection to their respective pads on the substrate. Stay tuned for more information on attachment techniques next month. This article will focus on how to rework flip chips.

All types of underfill and adhesives have varying setting temperatures and rework temperatures. The techniques described below are applicable for the generic types of flip chip bonds. Follow your specific manufacturer instructions for optimizing rework results.

Reflow Solder Flip Chip Removal

The simplest flip chips to rework are those that have been attached using solder bumps. These chips are installed in a similar fashion to standard surface mount technology (SMT) components. If testing proves that a flip chip needs to be reworked prior to underfill, the removal process is the same as that of an SMT component. Simply apply flux and heated gas to both the chip and substrate to bring the assembly to 10-20 degrees C above the melting point of the solder and remove the flip chip with a vacuum removal tool. Once the flip chip has been removed, carefully remove all excess solder from the mounting pads. Clean the area thoroughly and inspect the substrate to ensure that it has not been damaged. Reattach a new flip chip.

If the chip already has been underfilled, rework is dependent on the type of underfill. The bond of most epoxy underfills can be broken utilizing heat. Some epoxies have solvents that reduce the heat needed to break the adhesion, but the tradeoff is the time that it takes for the solvent to break down the epoxy. Heat the area with hot gas according to the manufacturer's rework profile and remove the chip



Figure 1: Examples of flip chip rework stations. Features for flip chip rework include placement accuracy of better than 10 microns and precision thermal management.

with a sliding motion. Remove any epoxy residue with the appropriate solvent, clean the substrate and attach a new chip. Some examples of flip chip rework stations are shown in Figure 1.

Adhesive Flip Chip Removal

Another method of flip chip attach uses adhesives, anisotropic conductive film (ACF), isotropic conductive adhesive (ICA), or non conductive adhesive (NCA). Many of these adhesives can be softened by heating. The manufacturer's data sheet will typically show a "tacking condition" where the adhesive begins to get tacky and a "bonding condition", which shows the temperature, pressure, and time needed for the adhesive to actually form a reliable bond. Some adhesives can be reworked at the tacking condition temperature, while others need to be heated to the bonding condition temperature. Again, consult the manufacturer's data sheet for rework activation temperatures and recommended solvents for cleaning the bond area prior to setting a new flip chip.

If the assembly cannot withstand the heat prescribed in the manufacturer's specifications for rework, a solvent may be used to break down the adhesive at a lower temperature. Before using a solvent the engineer must verify that all components can withstand exposure to the solvent without any degradation. This solvent may be either applied to the general area of the flip chip or the entire substrate may be submerged in a solvent bath. As with reflow underfill, the

tradeoff for lowering the temperature of rework is the time that the solvent will take to dissolve the adhesive bond. This time is typically 8-24 hours.

Thermosonic and Thermocompression Flip Chip Removal

Both of these methods of flip chip attach create extremely strong inter-metallic bonds at the chip to substrate interface. There are no rework processes that can be recommended that will not damage the substrate pad when attempting to remove a flip chip that has been attached with either thermosonic or thermocompression assembly techniques.

In summary, most of the more common production methods of attaching flip chips can be reworked. The keys to successful removal are to know which method of attaching the chip and substrate has been used, know which adhesives or epoxies were used, and follow the manufacturer's instructions for removal. In the process of flip chip rework, a little research can go a long way.

For further information regarding flip chip rework, please contact ACI Technologies at 610.362.1320 or via email to helpline@aciusa.org.

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