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## Printed Circuit Board Manufacturing Processes

The first step in the PCBA manufacturing process is to manufacture the printed circuit board. From bare copper clad PCB boards, the pattern of traces is created using a photo-mask and a thin layer of photo-resist material to cover the boards. Etching machines are then used to remove the copper from the areas of the board where it is not needed. Although the same processes are used to manufacture multi-layer boards, a greater degree of accuracy and manufacturing process control is required. These boards are made using much thinner individual boards for each layer which are then bonded together. Holes and vias are then created with a plating process and then drilled using automated drilling machines. To enable easy soldering of components, the exposed copper areas of the board are coated with solder plating or gold plating. The board is completed by covering the areas of the board not to be soldered with a solder resist polymer coating. Finally, silk screen printing machines are used to print text onto the boards to indicate board type, component designators, switch setting requirements, test points, and other features that may be helpful.

Once the printed circuit boards are complete, the PCB assembly process begins. The key components of the PCB assembly process include adding solder paste to the board, pick and place of the components, and soldering. The assembly process begins with the solder paste printing machines which place solder paste, a paste of small grains of solder mixed with flux, on the solder pads. This is achieved using a solder screen. Next, the SMT pick and place machines, which are loaded with reels, tubes or trays of components, pick the proper components and place them into the correct position on the board. Soldering is typically achieved using reflow ovens. For through-hole PCBs, however, auto glue dispensing equipment and wave soldering equipment is available. Ultrasonic cleaners are used after reflow to remove remaining flux from the board.

An essential element of the PCB manufacturing process is inspection and test. Automated test equipment is used to guarantee low cost, high quality products. The automated test equipment includes automated optical inspection (AOI) equipment for fast and accurate visual inspection of the electronic assemblies to ensure the quality is high and they are free of manufacturing defects. Automatic X-Ray Inspection (AXI) equipment is also used for boards using BGA or other chip-scale packaged devices. Bed-of-nails testers are used to verify connectivity and to check for opens and shorts of PCBs and PCBAs. In-Circuit Test (ICT) is completed to verify components are in place and of the correct value. Functional testers are also available for customers whose test strategy includes functional testing. Our printed boards and assembled PCBs are manufactured in compliance with IPC-A-600 and IPC-A-610 acceptance criteria.

Other production manufacturing equipment includes hot air reflow machines, BGA rework stations, manual insertion machines, open-short circuit testers, and many types of auto bonding machines.