Advanced Assembly
SMT Assembly for Engineers

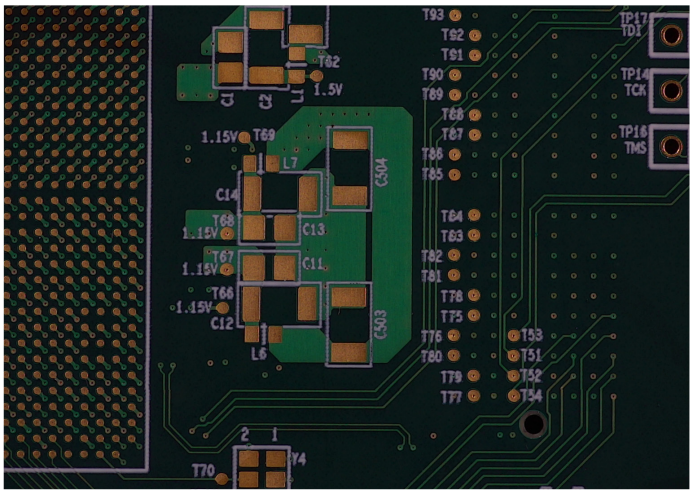
ASSEMBLING HIGH CURRENT HEAVY COPPER PCBS

Assembling high current heavy copper Printed Circuit Boards (PCBs) can be difficult, as the heavy copper functions like a double-edged sword. While heavy copper serves to remove heat efficiently from the components when the board is operating, it does the same while soldering components to the board, which is detrimental to proper soldering. This necessitates supplying extra heat to the junction to facilitate soldering, which may be harmful to the component being soldered.

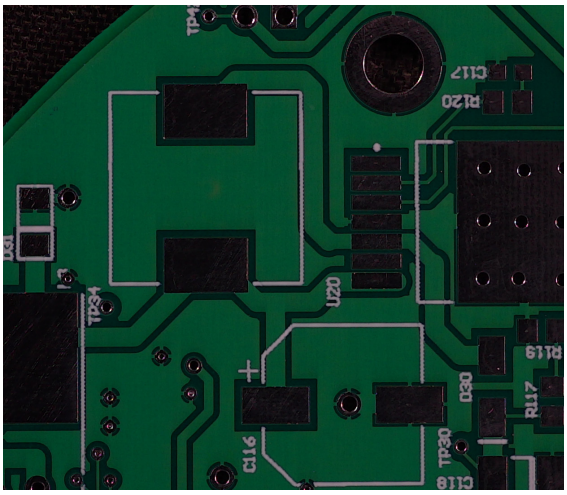
NEED TO SUPPLY EXTRA HEAT

Extra heat may also be necessary when reflow soldering or wave soldering a heavy copper PCB. Usually the preheating zones in the oven supply this, while slowing down the conveyor speed also allows the board to soak up the extra heat. However, the metal in the board can retain the heat for a long time, leading to a failure in the bond between the copper and the substrate, causing the copper trace to lift off the board.

Of course, the above is highly dependent on the thickness and area of the heavy copper on the PCB, and the assembler may have to make several trial operations to reflow a board satisfactorily with medium amounts of heavy copper on it. They need to establish a suitable thermal profile for a specific board assembly for a proper reflow sequence. Large heavy copper board assemblies may also need gradual cooling time to prevent delamination.



HAND SOLDERING

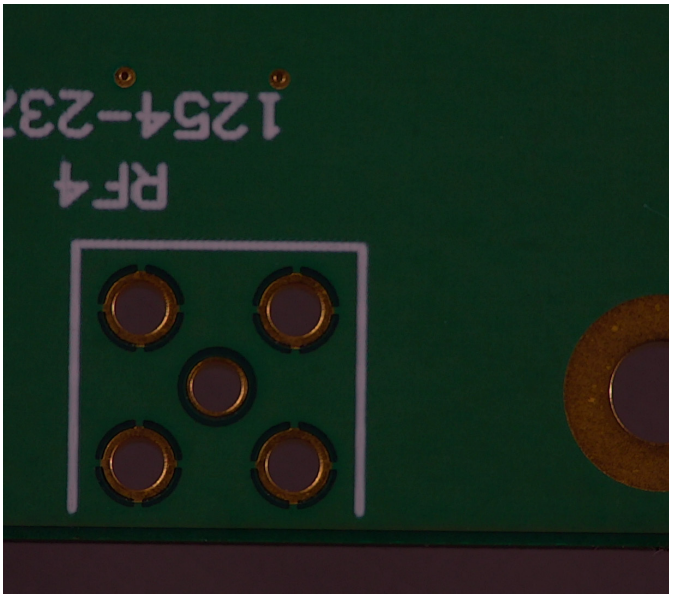


For boards with extra heavy copper, hand soldering may be the only option for assembling components on them. Such boards may need preheating on a hot plate before the assembler can use a soldering iron. Heavy copper PCBs also tend to have thick copper in the vias, and it is a problem to heat the vias sufficiently to allow proper solder flow without the via pads detaching themselves from the substrate. Usually, fabricators use laminates rated for withstanding high-temperature lead-free operations, which prevents pads from detaching even when retaining high amounts of heat.

The most common problems assemblers encounter when assembling heavy copper PCBs are cold solder joints, as inadequate heat prevents flow of solder from one side of the board to the other.

DESIGN IS IMPORTANT

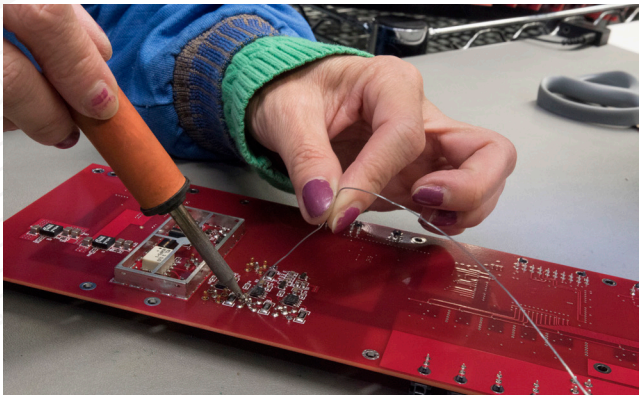
Designers of heavy copper boards must take care to provide thermal relief to solder pads connected to planes of heavy copper. They need to provide neck downs to pads connected to thick copper traces. Both the above allow adequate thermal transfer of heat from the soldering iron to the pads, without the heat being removed too quickly by the thick copper. Buried thick copper is another manufacturing method that does not need extra heat as thinner pads connected to the thick copper can be soldered with nominal amounts of heat.



Apart from adequate thermal relief to solder pads and vias where they interconnect with thick copper layers, assemblers of heavy copper boards may need to make certain they cover the soldering area with the proper flux—it should be easy to apply and the flux must not evaporate too quickly.

RAISING THE TEMPERTAURE OF THE BOARD

Assemblers must also make certain they apply adequate heat to raise the temperature of the pad or via to above the melting point of solder they are using. For this, it is necessary to ensure the soldering tool or iron is of adequate wattage to supply consistent heat over the time necessary to allow the solder to melt and flow—inadequate heat supply will certainly cause dry solder joints.



There are several methods available to assemblers for heating a heavy copper board to enable soldering. They may place the board on a hot plate or a preheating device before soldering, to bring the board up to the temperature suitable for melting solder. They may also apply two soldering irons to both sides of the board, to make it attain the required temperature.

The assemblers may also use IR reflow ovens or wave solder systems, provided the board can withstand the preheating temperatures without delamination. They may need to adjust the speed of the conveyor to allow the board to heat up adequately. It may be necessary to ascertain the SMD components will be able to survive the temperature excursion without damage.

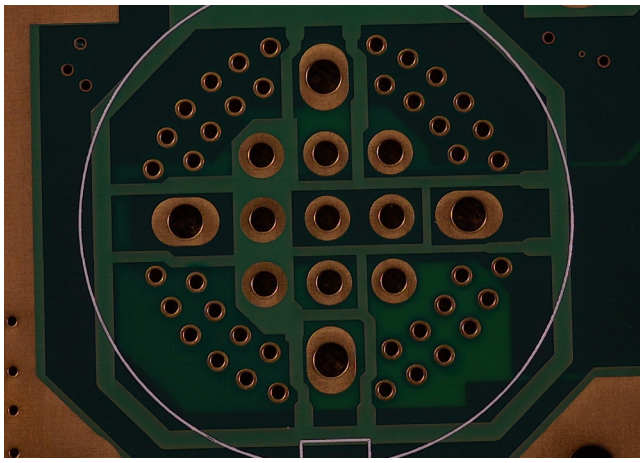
OPTIMIZING REFLOW OR WAVE SOLDERING

It may be necessary to optimize the reflow profile for a satisfactory outcome, as wrong selection of parameters and attitudes may cause substantial damage to the components being soldered. For assembling high current heavy copper PCBs to realize a proper soldering process in a reflow or wave soldering machine, the assembler may have to consider:

- Limiting the peak temperature to about 240C
- Providing linear heating
- Avoiding jumps in the gradient, especially during the transition from soak to reflow
- Maintaining a uniform curve of progression around the peak temperature during the time interval when the temperature is liquidus
- Using the end heating zone to achieve gentle cooling
- For active cooling zones, it may be necessary to increase the operating point of the chiller
- For non-active cooling zones, reducing the fan speed to the minimal value may help achieve gentle cooling
- Reducing the conveyor speed—this may require simultaneous temperature adjustments in all the heating zones

CONCLUSION

Assembling high current heavy copper PCBs is possible but replete with difficulties and fabricators are trying out newer methods to overcome them. One of the requirements for using heavy copper is improving the heat conduction. Fabricators are trying out new types of dielectrics that offer high heat conductivity with high electric insulation. Such thermal clads allow attaching the heavy copper to the PCB after assembly, thereby saving a lot of unnecessary effort, expense, and time.



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