SURFACE MOUNT TECHNOLOGY

Why is it useful to know about this?

Early electrical circuits were often made by joining components together with cotton/rubber covered wire and binding posts on a wooden plinth, as seen in historic photographs.

With the widespread introduction of thermionic valves and consumer electronics, metal chassis (steel or aluminium) were used along with valve bases and tag strips for attaching and connecting components. These were soldered together using quite large soldering irons. Later printed wiring boards with valve bases attached were used.

The introduction of semiconductor circuits allowed further miniaturisation. Much of this construction was still labour intensive and required extensive drilling of PCBs.

As component size decreased and large scale integration became commonplace we started to see components stuck to the surface of circuit boards as PCB technology improved. Circuits then became totally (or almost) machine soldered.

Repairing circuits with leaded components is something most of us have attempted or even succeeded at. Many of our amateur radio products are now largely composed of surface mount boards and servicing requires different techniques. Professional repair rates are not cheap, so if possible DIY is well worth considering.

How to Start

Practice removing components from an old PC board. Lots around! An alternative is to purchase one of the increasing number of surface mount construction kits available.

Tools Needed

- Fairly good eyesight and a steady hand
- Magnification aids unless extremely myopic
- Bright lighting
- Flush cutters
- Stainless or ceramic tweezers – dental tools
- Cotton Buds and Sausage Sticks
- IPA
- Temp controlled soldering iron – tip(s) of choice
- Solder tip cleaning method
- 'REAL' solder – 60/40 or 63/37 flux cored, small diameter
- Liquid or gel flux – non corrosive
- Solder wick
- BluTack
- Masking tape – low tack
- Helping hands or PCB holder
- Antistatic mat and wrist strap

Advanced Tools

- Chipquick – low melting point solder 138C (281F)
- Hot air rework station
- Vacuum desoldering tool
- Reflow oven
- Vacuum pick-up and placement tool
- Solder paste dispenser

SM Removal Procedure

The first problem encountered when working on an old board will be that it has almost certainly been manufactured using lead free solder. Two problems: it has a dull surface so it is difficult to tell when it has melted; the melting point is higher.

Best way to overcome this is to apply some liquid flux to the solder joints and reflow with a soldering iron adding more 'real' solder. Subsequent removal with a soldering iron or hot air is much easier – also less likely to damage the PCB which is the most valuable part of the system.

Alternatively reflow across all pins using the same technique but with Chipquick - MP 138C.
Sn-Ag-Cu solder melting point ca. 217C
60/40 Pb/Sn melting point 188C
63/37 eutectic - melting point 183C (no pasty stage)

Remove chip, desolder braid or desolder sucker, IPA clean, re-tin with real solder, remove excess solder and replace component.

Caveat which bears repeating – do not damage the PCB by overheating. Modern PCBs are much tougher than units from 30 years ago! Lifted or damaged tracks can be repaired but it is a fiddle.

SM Installation

To replace a 2 pin component, apply flux to pads and chip, hold chip in place to stop surface tension moving it and tack one end with a small blob of solder. Then solder the other end followed by reflowing the tacked end. Finally check the joints under good magnification.

3 or more pinned components are attached in a similar fashion, but need to be checked for alignment before soldering the remaining pins. Clean new Blutack can be used to hold SOIC or larger chips in place whilst soldering, if needed.

Some components have invisible or inaccessible solder pads. Solder paste and a hot air station will then be needed, using a suitably sized nozzle to avoid loosening other components nearby.

Finally, small PCBs can be populated by hand using solder paste from a small dispensing machine, a small hand vacuum pickup tool (if needed) or tweezers and then using a small reflow oven. These ovens can be constructed from a small toaster oven of the type using ceramic heating elements.

Conclusions

Surface mount repair and construction is possible with the larger components if the right aids are used together with reasonable quality equipment, some of which can be home built. Practice on old boards or surface mount kits is recommended before tackling your pride and joy!

73 de Ted G7BQM

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