

Methods for Surface Mount Soldering for Novices

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Introduction

Soldering circuit board components is a skill that can be applied not only in an educational setting, but in future occupational uses for students. The goal of this project is to teach beginning students the most effective ways to solder in preparation for a potential instructional course. The procedure followed was based off of the DStat potentiostat schematics.

Materials and Methods

- Quik Chip Solder Paste
- Dstat circuit boards
- Maxwell 8858-I Heat Gun
- DStat components

To start, the solder was applied all at once to the board by the Chip Quik applicator. The chips, components, and resistors were all added at once then placed on a hot plate to melt the solder into place.

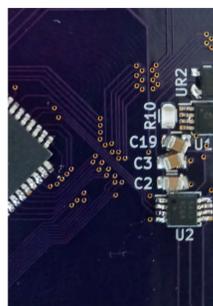


Figure 1: Looking at C19 and C3, the components shifted and were soldered together.

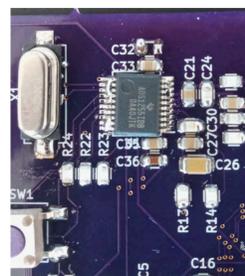


Figure 2: Looking at U2 the feet have shifted off of the plates along with bridging due to excess solder paste and displacement by the heat gun. C32 has also flipped up on one side.

Problems

- Components shifting and locking together
- Bridging along the chip feet
- Shifting feet of the chips in response to too much solder paste
- Magnetic Stir bar in heat plate displaced Components.
- Unequal and uncontrolled heating of the board via hot plate
- Heat gun was used instead of the hot plate, but the heat gun was too large

Experimental Applications



Figure 3: One attempt to help resolve the issues with the paste was utilizing a soda can to make a stencil. After three days of being unrolled and placed under three full bottles of wine, the can would still roll back up to its original shape. The can was cut into individual pieces that could be smoothed out before attempting to cut the tiny component pieces out.



Figure 4: The can was much too thick to accurately cut the precise pieces with only a craft tool or boxcutter. Aluminum foil (top sheet) was then attempted to be cut out but was much too flimsy to withstand the multiple cuts and pressure without tearing.

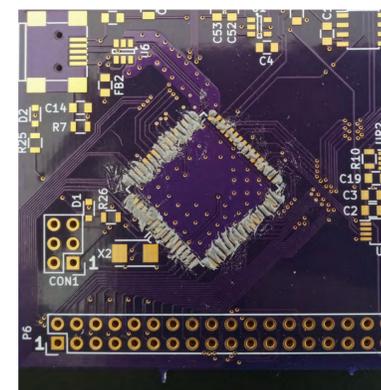


Figure 5: These four sides are comparing various methods on applying the solder paste. **Top left:** Used paint brush to apply solder and cleaned up with a toothpick. **Top Right:** Toothpick only. **Bottom left:** Syringe dots with toothpick cleaning. **Bottom right:** Syringe and cleaning with scoopula.

Summary of Success

The best method found in this procedure to apply solder paste can be summarized in less solder paste and lots of patience. After downsizing to a much smaller heat gun with a nozzle to condense the air even further, the components were soldered on one at a time. This was done to help minimize the parts coming together. In heating the parts individually, the board as a whole was heated as well. This made the solder application much easier because it softened the paste from the applicator for a much easier transfer. The solder paste also spread much like it does before it hardens so it was clear how much to use to prevent flooding the area with too much paste.



Figure 6: Finished board

Final Method:

- Heat board slightly
- Apply solder paste
- Place component
- Heat with hot gun

Final Board:

With the new method, none of the components fused together. There were still small issues with one sided flipping, but because all the focus was on one part instead of heating the whole board at once, it was easily corrected. It was also determined to leave the chips to be attached by the instructor.

Future Goals

This soldering procedure allows a simple and accurate application of soldering paste for novices. After completing this specific board, it can be programmed and locked into the 3D printed holding box pictured below. Once the DStat is finished, it will be tested against officially made potentiostats.



Figure 7: 3D Printed box for DStat potentiostat

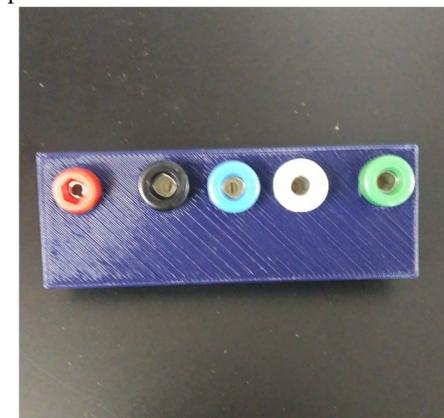


Figure 8: Banana jacks for front cover DStat potentiostat

References

1. Dryden MDM, Wheeler AR (2015) DStat: A Versatile, Open-Source Potentiostat for Electroanalysis and Integration. PLoS ONE 10(10)
2. Baddeley, Bob (March 10, 2016) Tools of the Trade – Solder Paste Dispensing. Hackaday

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