Tutorial for Soldering Electrical Components onto Printed Circuit Boards

EEC134B Spring 2015

Edward Wu

997339473

Team Teabo

Background of Solder

Solder is a low-melting alloy, especially one based on lead and tin or (for higher temperatures) on brass or silver, used for joining less fusible metals. In order to distribute solder onto the board, the solder has to be heated (usually with a soldering iron) until it melts into a fluid form in which it can flow and join the electronic component with the board before it cools down to harden.

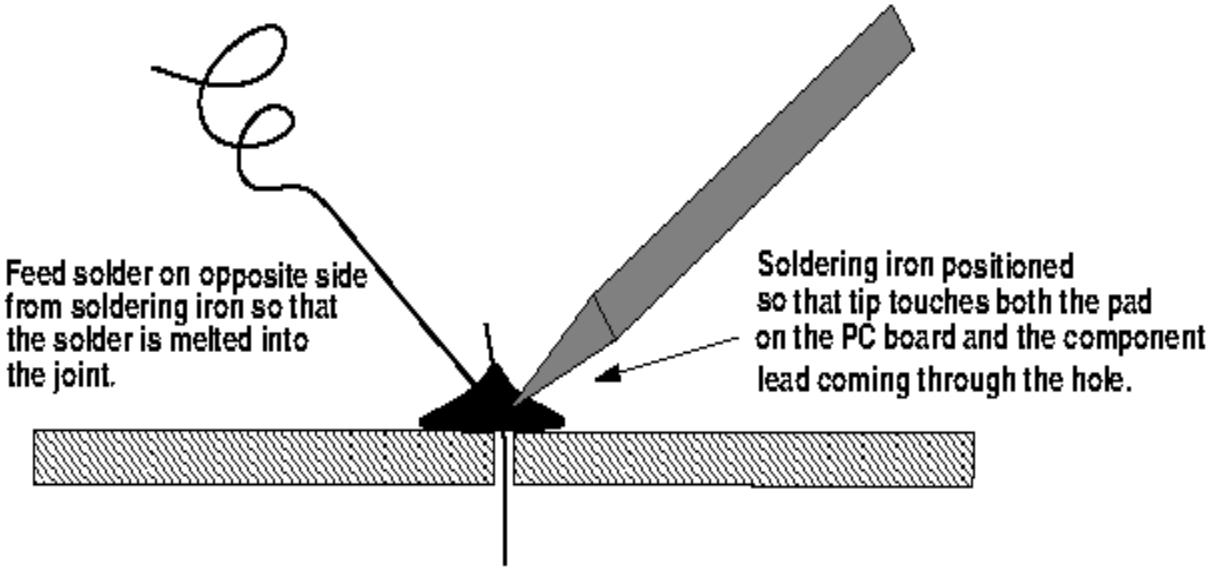
Certain Printed Circuit Boards (PCBs) have a layer of coated soldermask. It is a thin lacque-like layer of polymer that is used for protection against oxidation and prevent solder bridges from forming between closely spaced solder pads. Melted solder will not stick to the mask and will be more likely to stick to metal contacts. In the next section, I will going over the specific types of solder used to aide in the construction of our finalized PCB.

Specific Types of Solder and Introduction of Flux

The two types of the solder utilized are wire solder and solder paste. Wire solder can be applied using a soldering iron on a larger scale because it can be used to make easy connections such as through hole components. The solder paste, on the other hand is used for smaller scale components (surface mount components) and is heated with the use of either a reflow oven or a hot plate. Flux is used as an aide for soldering because it helps with the conductive purposes of the soldering connections.

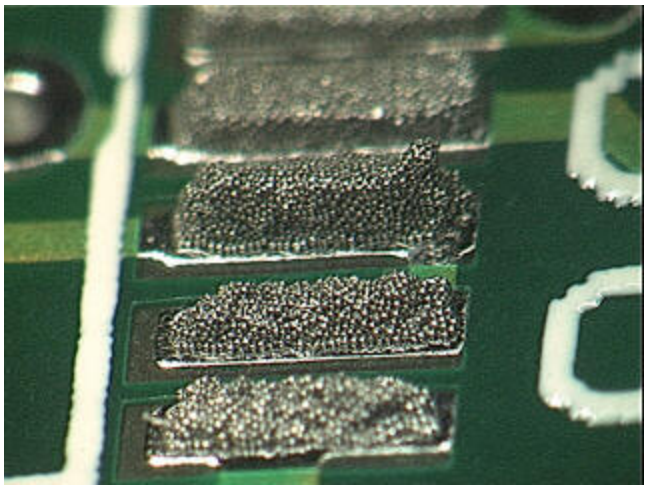
1) Wire Solder

Wire solder is the most generic kind of solder and is relatively simple to apply. As mentioned before, it is utilized mainly for larger scale components such as through hole components. The advantages to having wire solder is that it is quite easy to put on in an efficient manner as shown below.



Certain disadvantages of using regular wire solder is that small scale components that needs to soldered on can't be connected efficiently. The amount of solder applied using wire paste may overflow and may immerse the entire component which can damage most surface mount components. The soldering iron isn't a very precise tool to guide where the solder will be positioned.

2) Solder Paste

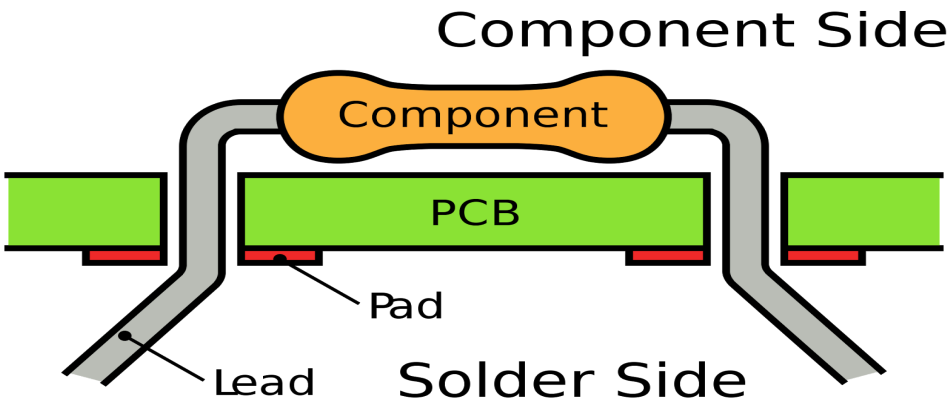


Solder paste contains tiny amounts of solid solder particles mixed together with flux. The advantages of using solder paste can be used to connect smaller scale electrical parts such as surface mount components. Some disadvantages can be that it takes a long time to apply onto the PCB if doing so by hand. If you aren't careful you can misplace the paste and have to reapply after removing the excess amount.

3) Flux

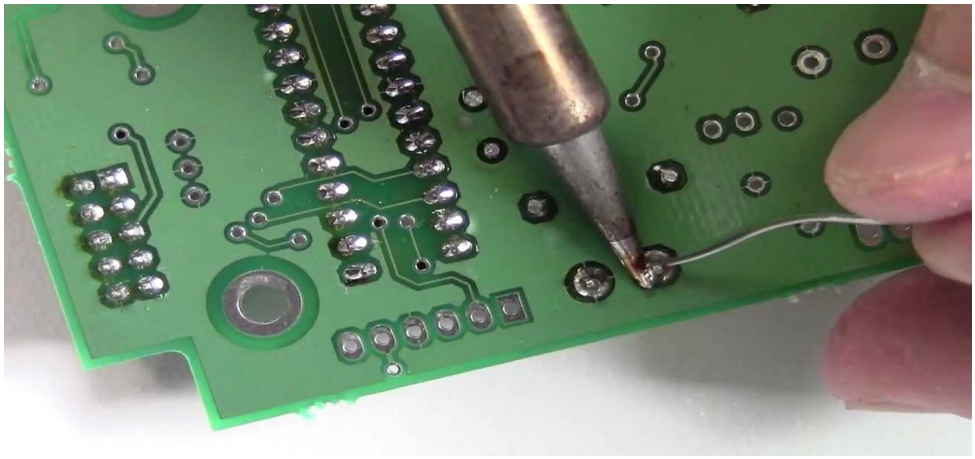
Flux is used as a chemical flowing agent. It reduces the oxides from when the melted solder come in contact with air. The melted solder flows more fluidly when combined with flux. Flux is usually helpful for helping conductivity after applying wire solder. In the case of solder paste, you can apply flux with the solder paste via syringe on the metal contact before you apply the paste.

Soldering Technique for Through Hole Components



The PCB pads have several holes that the leads of the electrical component can go through. The solder will hold the component onto the board by being applied on the other side where the leads go through the hole. The instrument to apply the solder would be the soldering iron.

A soldering iron's temperature can be adjusted to allow for different melting points and also to cater towards a devices temperature range in order to avoid damage to the electrical device. In the case of my PCB I adjusted the temperature to around 300 C. The melting point the alloy tin/lead solder is about 183-188 degrees Celsius.



First, you put the leads through the hole. The component needs to held in place in order for the solder to applied. You can use clamping devices to hold your PCB down and keep the component from moving.

Next, you will have one the soldering iron in one hand and the wire solder in the other. Place the tip of the soldering iron onto the pad where you want to apply solder to. When the pad is heated, you can feed the solder wire to the place where you want the lead to connect to the hole (as scene in the image above). As soon as the solder touches the heated iron, it will melt and begin to fuse the lead into the hole.

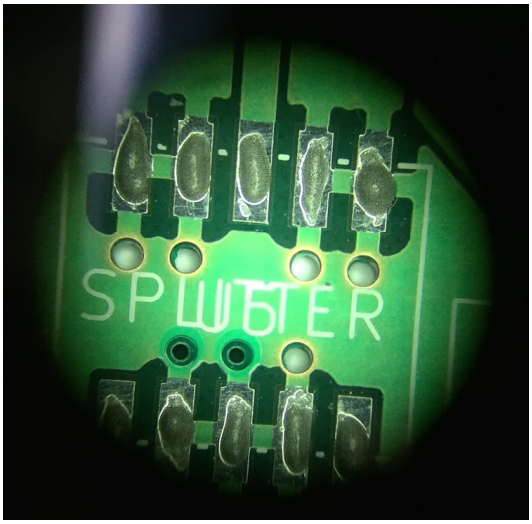
Soldering Technique for Surface Mount Components

Surface mount components are positioned right on top of the metal pads. The component and the pad are joined with the help of solder paste. The method I used to put solder paste on my PCB is with the use of the foot pump (shown below).

The method of administering solder paste onto the PCB is by applying it with a syringe and air pump. The syringe is prefilled with solder paste and can either push out the solder with a plunger or with air pressure activated through a foot pump.

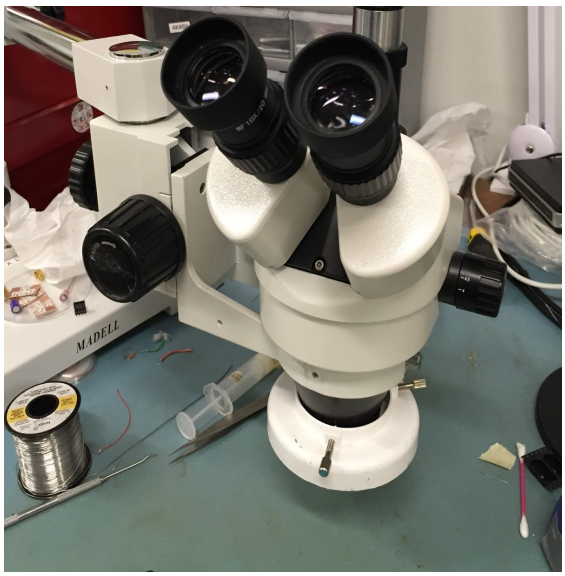
The solder released from the pump is controlled by a foot pedal. The syringe attached to an air pressure line.The foot pedal controls the flow of the solder. Simply press the pedal and this makes the solder paste come out of the syringe at a controlled and steady rate.

Below is an image of the correct amount of solder that should be placed on the metal pads.

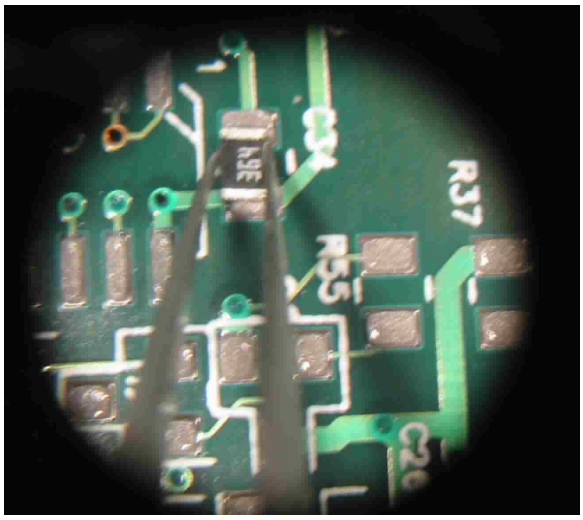


As you can see from the image, there isn't a huge amount of solder paste to saturate the entire pad but there is a healthy amount of solder that when melted will connect the component to the pad.

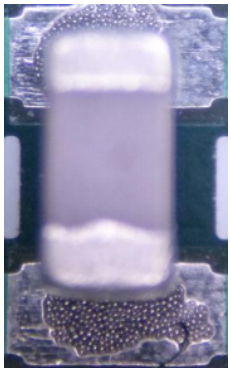
In order to aide with applying a precise amount of solder, I used a microscope to help view the smaller scale metal pads that are too small to see with the naked eye.



Setting your components on the PCB is a process which involves careful placement of the components onto the pads with solder paste on them. The use of tweezers and a microscope help with the exact placement of your components as shown below.



An example of the correct placement of the surface mount component can be seen below when the solder paste is not yet melted.



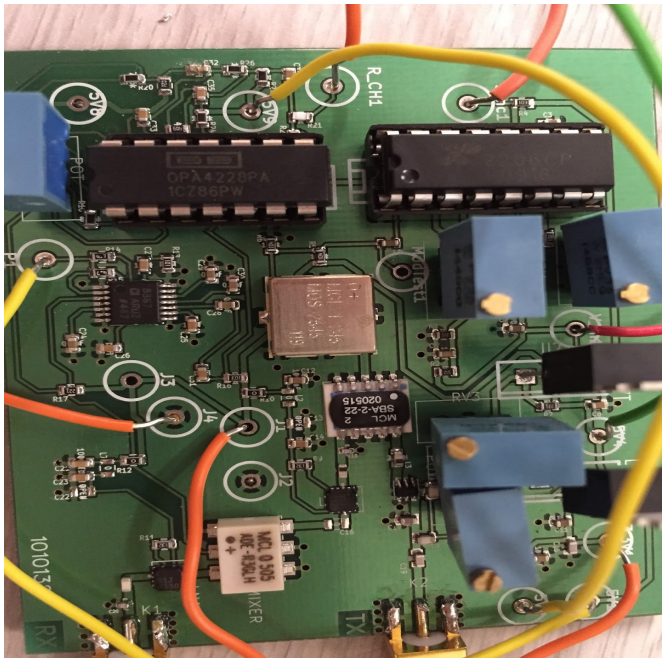
Because each component will be placed one by one with tweezers and the aide of the microscope, you can see how this entire process of soldering surface mounts is extremely time consuming.

Heating the PCB with a Hot Plate

The hot plate is one of the method that can be used to melt the solder paste on PCBs. Advantages to using a hot plate are that it is quick and efficient. You can also easily observe the board as the paste melts joining the surface mount components.

First preheat the hot plate. The process works by having the hot plate heating up the entire PCB from the bottom up.When the plate is heated up, you place the PCB onto the plate with the bottom facing the hot surface. The temperature for this hot plate was set in the range of 200 to 215 degrees Celsius. After waiting roughly 30 seconds the solder paste will melt into place. You then remove the PCB from the hot plate and let it cool for about a minute. Inspect the components to see that they have not moved from the original position in which you placed it.

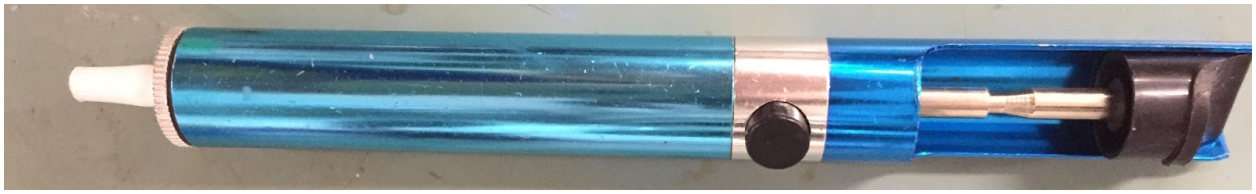
End Result:



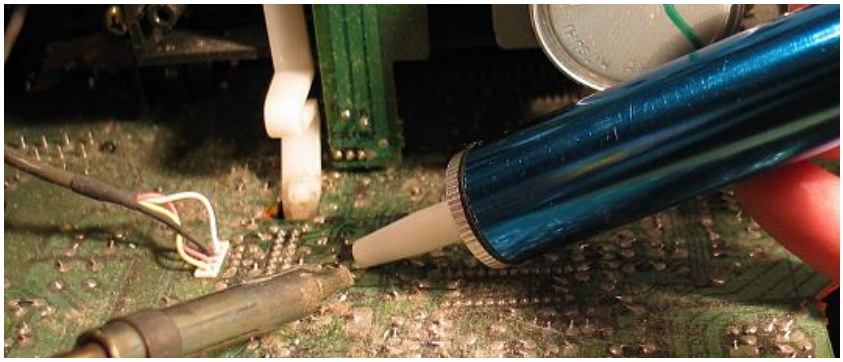
Removing Unwanted Solder

In case you make mistakes in your soldering efforts, there are two ways to efficiently remove solder. You can utilize a desoldering pump or use a solder wick.

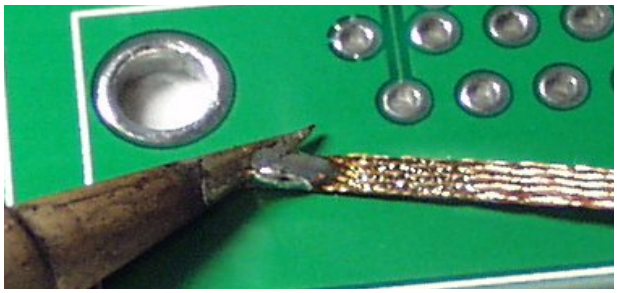
1) Desoldering Pump



The pump contains a spring-loaded piston which is pushed down and locks into place. When triggered by pressing a button, the piston springs up, creating suction that sucks off the soldered connection. The pump is applied to a heated solder connection, then operated to suck the solder away.



2) Solder Wick



The process of solder wicking is basically defined as solder climbing up on a lead (component, connector, external wire). Wicking is a redistribution of solder away from the intended joint. This is done by placing the wick on the solder which you want to remove. You then place the soldering iron on top of the wick to heat the solder which will be redistributed onto the wick as seen above.