Tips in Soldering

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INTRODUCTION

Basic soldering skills is a trait that every electronic/electrical engineer should know. Regarding basic soldering skills, it is important to be familiar with the tools and materials needed to solder. In addition, it is good to know how to solder different components, whether that be a component that goes through a circuit board or gets mounted on the top side of the circuit board. Also, in case you make a mistake, it is good to know how to rework/remove components that have already been soldered on. Finally, the utmost important thing is safety, getting burned from a hot solder iron is painful, so one must exercise extreme caution when handling a hot solder iron. Having basic soldering skills allows for putting the circuit board together and functioning properly for the purposes of the RF System Senior Design course.

SOLDERING TOOLS & MATERIALS

Some of the common soldering tools and materials used for the course are listed below. **Figure 1** contains some of the tools provided in this section.

- Soldering Iron
- Iron tips of different sizes
- Solder Tip Cleaning Wire
- Sponge
- Solder Flux
- Rosin Lead-Free Solder
- Solder Paste
- Steel brush
- Solder Sucker
- Solder Wick
- Hot Plate
- Safety glasses
- Air ventilation - Solder Fume Extractor
- Tweezers
- Magnifying Lens
- Circuit Card Holder
- Wire cutters/strippers
- IR Thermometer Gun with Laser Targeting
- Isopropyl Alcohol (IPA)

Figure 1. Typical Soldering Tools

SAFETY CONSIDERATIONS

First of all, it is important to always wear eye protection when performing any soldering. You wouldn't want to burn your eye out with a hot solder iron. Realistically though, there have been instances where solder will "spit" and people who weren't wearing eye protection get hot solder lodged in their eye. This is due to the rosin that's typically used in solder. Therefore, always wear eye protection.

Lead that is sometimes contained in solder can give rise to serious chronic health effects. Serious chronic health effects are associated with extended exposure to lead. Exposure will primarily be through accidental ingestion from your skin. Therefore, always wash your hands after performing any soldering tasks.

Use proper ventilation (i.e. benchtop solder fume extractor) when using solder that contains rosin. Soldering generates rosin fumes, this can cause eye, throat and lung irritation, nose bleeds and headaches. Repeated exposure can even cause respiratory and skin sensitisation, causing and aggravating asthma. Rosin is known to be a serious health hazard. Therefore use proper ventilation when soldering.

SOLDERING THROUGH-HOLE COMPONENTS

Typical through-hole components are resistors and capacitors. Also, common through-hole components are connectors and sockets. A keynote when soldering through-hole components onto a circuit board; instead of soldering ICs directly onto the circuit board use a socket instead. This will ensure that if your IC doesn't work correctly after soldering it directly onto the circuit board, using a socket instead you can simply remove it from the socket and replace it with a new one. This saves the painstaking task of rework.

When soldering through-hole components, it is a good idea to use a circuit card holder. **Figure 2** shows a typical circuit card holder when soldering through hole components.

Figure 2. Circuit Board Holder for Soldering

When using a circuit board holder, it's good to mount the components on first before placing the circuit board on the holder. Typically, running the resistor and capacitor leads through the hole and bending them off to the side allows the component to sit in place closests to the board. After the components have been set on the circuit board, then mount the circuit board upside down on the holder. This makes it much easier to solder by keeping the circuit board steady and in place, unlike the board moving all over the place if it were set on a bench top and the components create an uneven surface. After the leads have been soldered onto the board, remove the excess leads with a wire cutter.

As for IC sockets or connectors, they don't have long leads which makes it difficult to keep them in place once the circuit board has been set upside down in the holder. You may either need a second set of hands to hold the socket/connector in place while you apply the solder. You can also use an elevated object that'll hold the socket/connector in place in case you don't have someone else there to help you. **Figure 3** shows soldering of an IC socket onto the circuit board. In addition, it is wise to use a thin tipped solder point to make applying solder much easier on smaller leads.

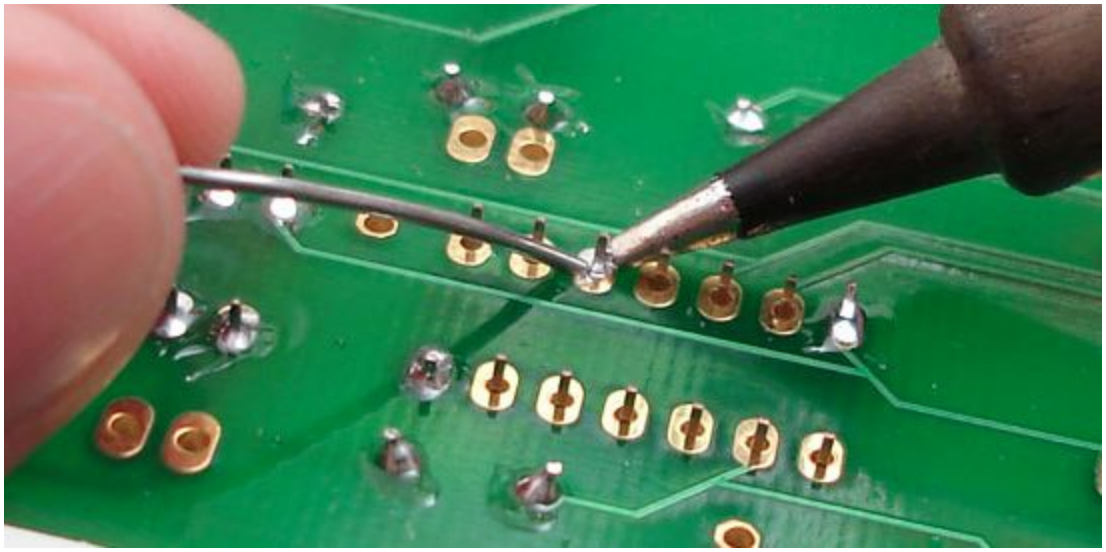

Figure 3. Soldiering IC Socket Leads

SOLDERING SURFACE MOUNT COMPONENTS

To solder surface mount components you'll need a hot plate, tweezers, a magnifying glass, and solder paste. Ensure the hot plate has not been previously used where it is still hot; use a thermometer (see **Figure 4**) to verify the hot plate surface is at room temperature.

Figure 4. Hot Plate (top left), Thermometer Gun (top right), and Solder Paste (bottom)

Passive surface mount components primarily used were 603 capacitors and resistors. They're very tiny and don't require that much solder paste to be put on the pad. The RF components used for the RF printed circuit board (PCB) were surface mount components as well. **Figure 5** provided shows the RF PCB before any surface mount components had been soldered on and **Figure 6** shows the same RF PCB with surface mount components after solder.

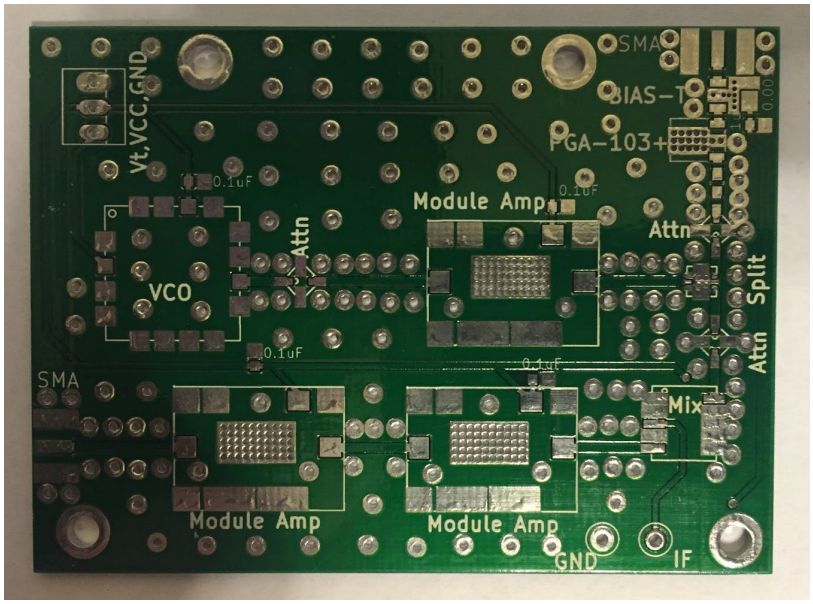

Figure 5. RF PCB Before Without Surface Mount Components

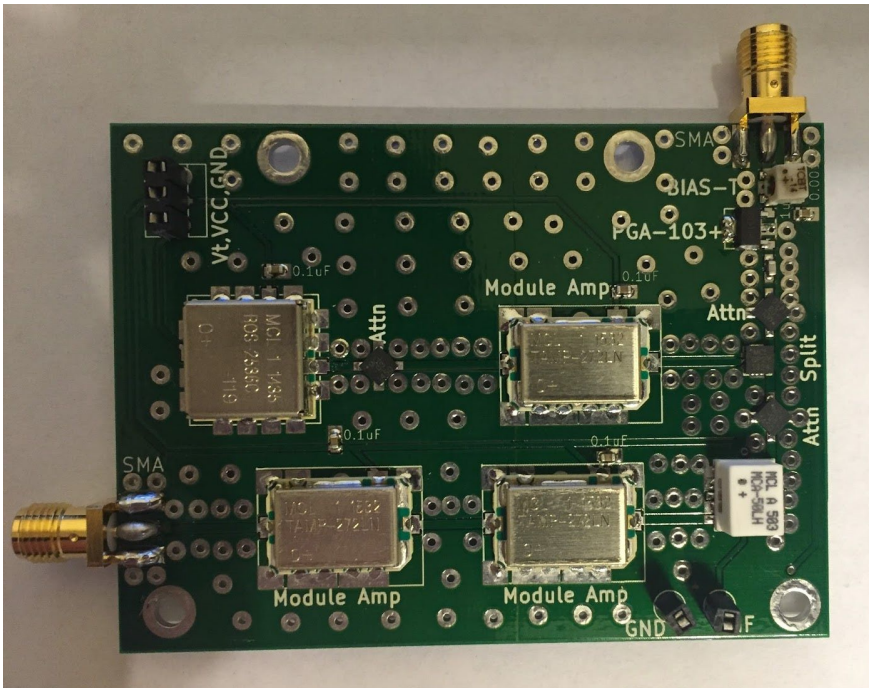

Figure 6. RF PCB with Soldered On Components

To start, place the circuit board atop the hot plate with the hot plate off and at room temperature. To apply solder paste onto the component pads, it is best to use a magnifying glass get a better view and so that you don't accidentally apply too much solder paste or add solder paste where you don't want. Use a toothpick or a scriber to apply a small dab of solder paste at each component pad. For the 603 components, it was best to apply the solder paste first and then set the component over the pads. Use a set of tweezers and a magnifying glass to set the 603 components.

As for the RF components such as the voltage controlled oscillator (VCO) or amplifiers (Amps), the foot layout appears larger than the size of the component, this is ok. The RF components were set in their designated locations prior to applying any solder on their respective pads. Also, keep in mind that the RF components are in the proper orientation, that is, the correct pin for the correct pad (i.e. Vcc to Vcc). After all the RF components are in place, a dab of solder paste was placed at each pin indentation in contact with the pin pad. It may be necessary to apply more solder paste relative to the amount used for each pin pad of a 603 component.

Now, some RF components didn't have similar layout as the VCO or Amps, these were the attenuators, splitter, and mixer. These devices had small pin layouts, so it was necessary to use the magnifying glass and very small amounts of solder paste on each pin. It was difficult because some pins were closely placed together that you don't want to put too much paste and cause a short where you didn't want. Similar to the 603 components, the solder paste was set first and then the RF component was set in place using tweezers and a magnifying glass. Again, keep in mind how the device needs to go onto the layout, you don't want to have Vcc pin to ground when really it needs to be at Vcc.

Finally, once all the components have been set in place, turn on the solder plate. The hot plate does not need to be set to high, you don't want to burn your PCB nor do you want to cause damage to the devices. The devices are sensitive to temperature, so getting them too hot may break them and you won't easily notice if your device still works or not. This can lead to extensive troubleshooting and headaches. Anyways, use the thermometer gun to observe the temperature. A keynote is that solder paste does not require as high temperature as solder in order to melt. Solder paste is comprised of solder flux and very fine filaments of solder mixed together. The appearance of solder paste is gray and dull in color, however, once it melts it looks silver and shiny.

Once you observe the solder paste change from gray and dull to silver and shiny for every device, turn off the hot plate and use a set of tweezers to gently remove the PCB. Ensure to keep the PCB parallel to the ground as you transfer the PCB, otherwise if you turn the PCB upside down the solder may not have solidified and the components will fall off. Set the hot PCB onto a cool surface or another hot plate that hasn't been used that has a surface at room temperature. Give the PCB several minutes to cool down.

Once the PCB has cooled down, use a magnifying glass to inspect your work. Depending on how you did, you may either need to add more solder or remove excess solder, in other words you have to do some rework. If everything checks out good however, ensure to test the PCB for functionality.

SOLDER REWORK/REMOVAL

Sometimes you may have to do some rework, which may require removing a through-hole or surface mount component. It is much easier to remove a surface mount component over a through-hole component. However, if the PCB that requires some rework contains both surface mount and through-hole components, you may need to remove the through-hole components first before removing any surface mount components. The reason for this is that simply placing the PCB on a hot plate and reheating the PCB will melt the solder paste and you can simply use tweezers to remove the component. After that, any excess solder on the pin pads where the device once was can be removed using a solder sucker or sold wick. **Figure 7** shows some solder wick being used to remove excess solder.

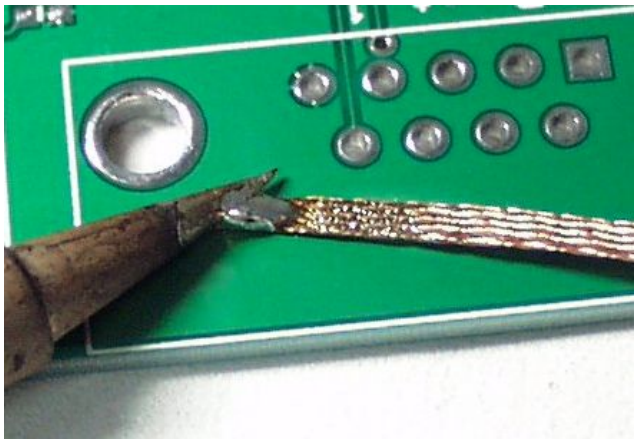

Figure 7. Solder Iron and Solder Wick Used to Remove Solder

Solder wick is basically desoldering braid, it is made from copper due to its good heat conductivity. There are different "gauge" size of solder wick, thicker solder wick is prefered due to easily removing solder. Typically, the site that requires solder to be removed is first cleaned using isopropyl alcohol. Then, the solder wick is placed over the sight that requires solder to be removed. Using a hot solder iron atop the solder wick allows the heat to transfer from the solder wick to the solder. The solder melts and the solder wick acts like a sponge and absorbs the melted solder. You may have to use a good length of solder wick to remove solder at times. To remove through-hole components, the same method described above is simply done.

Keynote is that performing resolder work too many times eventually degrades the PCB and the surface mount and through-hole site contacts. Reheating a site contact too many times

can cause it to “break” off. For example, if the site is a connection to ground, resoldering a contact pin over and over can cause the contact site to melt/break causing an open in the circuit, that is it no longer makes contact to ground. It is good to obtain more than one PCB prints as well as back-up components, especially RF components and SMA connectors.