App Note:

What You Need To Know About Soldering

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I. Objective

The purpose of this paper is to show the reader how to solder components onto a printed circuit board, also known as PCB. What will be presented are tips and helpful approaches on how to solder. There are two primary methods of how to solder: the use of a hot plate and a soldering iron.

II. Introduction

For the frequency modulated continuous wave (FMCW) radar system, both methods of soldering were implemented. The use of a soldering iron involves soldering components such as ICs. The use of a hot plate involves soldering components that were surface mounts. You can also use a soldering iron to solder surface mount components, but that is strongly not recommended. For our radar system, we planned to have both the RF and baseband combined together on one board. Unfortunately, the components were burnt out on accident and had changed our original plan. We did not want to risk using up our last parts and resorted in making a baseband PCB since we did not have enough time to purchase extra components for our RF part of the PCB. We decided to only have a baseband PCB and kept the rest of the components as SMA.

Figure 1 is our baseband board. The baseboard has no surface mount components soldered on top. On the top half of the baseband board is our transmitting side. The top left is where the Teensey 3.1 will be located, then the Teensey 3.1 is connected to the VCO, attenuator, RF choke, low noise amplifier, and power splitter. On the bottom half of the base band board (below the “The Dream Team” logo) is the receiving side. Located on the receiving side is our LPF, gain stage, mixer, and two power amplifiers.

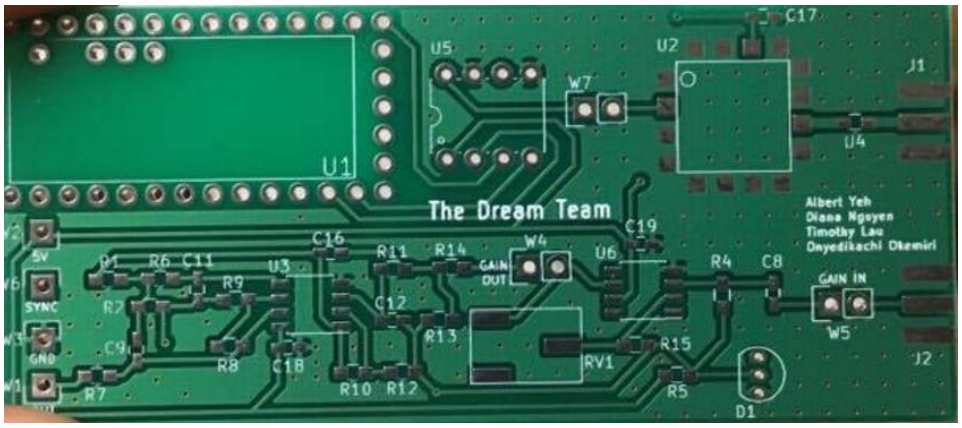

Figure 1: Baseband PCB

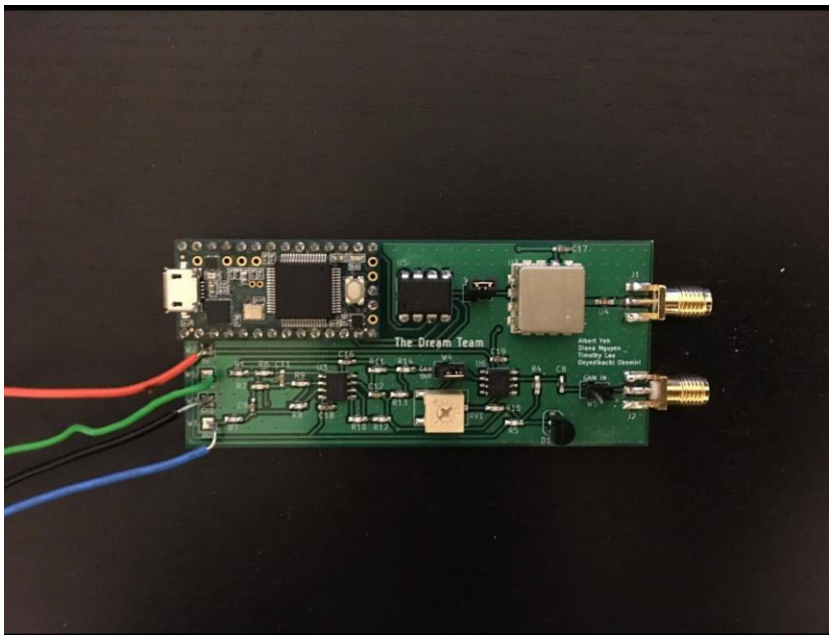

Figure 2: Completed Baseband PCB

Figure 2 is our completed baseband PCB.

III. Methods of Soldering

There are two methods of soldering. These two methods are having to use a soldering iron or a hot plate. To solder the baseband PCB, we primarily used the hot plate using soldering paste to solder our SMD components. Then, we used the soldering iron with a soldering wire to solder the wires on top of our test pins of the baseband board.

IV. Soldering Iron

To use a soldering iron, you would need a soldering wire. We have test pins throughout our PCB to make sure that each stage (the LPF and gain stage) are working properly on its own before combining the entire system and testing the baseband as an overall system. Once we have soldered the test pins, we also had to solder wires connecting to our voltage and ground so that our baseband board can be powered up. It's a tedious process to solder on a PCB due to its small area of space. I find it easier to use a hot plate and soldering paste. If there is flux available, it is best to use it as it helps unclean any mess. We did not use flux as it not was available around us at our convenience. When using flux, add a little amount of flux. Using too much flux can be problematic.

For our radar system, we did not need to use the soldering iron as often as compared to the hot plate. We mainly soldered test pins and wires on ground holes of the PCB. You can refer to Figure 2 above to see the placement of the wires and test pins.

V. Hot Plate

In order to use a hot plate, you would need soldering paste. Soldering paste cannot be left outside for too long as it needs to be refrigerated. Soldering paste is inside a syringe. Don't worry, the needle is not pointy and will not stab you to the point you will bleed (unless you apply a great amount of pressure). You should also try your best to not have soldering paste touching your skin. If it ends up touching your skin, I would suggest for you to wash that area of skin when you are done with soldering. Try not to have the paste be touching any bodily fluids (i.e. your mouth or eyes) as it can be problematic and dangerous.

I find that having to use a hot plate to solder is much easier than using a soldering iron. Well, why is that? You can dab a little amount of soldering paste on top of the pad. If you have added too much, you can always clean it up using a tissue; whereas if you had made a mistake using a soldering iron, you would need a solder sucker to fix your mistake.

When using the hot plate, you would need a few handy tools that will make soldering a lot easier. The tools you would need is a toothpick, tweezers, and a tissue. Instead of using the

syringe of the solder paste to dab onto the pad, squirt an enough amount of solder paste onto a tissue and dab the paste using the toothpick. Then you can use the toothpick to lightly dab on top of the pad. This helps adding solder paste onto the pad a lot easier and less messy. If you made a mess, just wipe the entire paste off with a tissue and start over again. Once you have added the right amount of solder paste on top of the pad, use the tweezers to pick up the surface mount components and gently add it on top of the pad that is filled with solder paste. To hot plate, we set the temperature at medium, which was the recommended temperature by the teaching assistants. Gently place the PCB board on top of the hot plate. To prevent being at risk of burning yourself, use two tweezers and lift the PCB on both ends to gently lay the PCB on top of the hot plate. Make sure that the PCB is laid on top of the hot plate evenly. If one end of the PCB is tilted and is touching the hot plate, the PCB may burn. This issue happened to our group when we were trying to hot plate our surface mount components. Looking away for one second may lead your PCB to burn on accident. You will know when the PCB is ready to be taken off the hot plate when you can see the solder looking very shiny. Once the solder looks shiny, gently lift the PCB board off the hot plate. Be very cautious when carrying the PCB board as it is very hot. Let the PCB sit for about one to two minutes or until the PCB has completely cooled down. You can use a magnifying glass to see if all the surface mount components are properly aligned on top of their pads.

When we were soldering surface mount components onto our radar system PCBs, we added all the surface mounts on top of the pads covered with solder paste first before hot plating. This was our preference as it saved a lot of time. It is possible to add the surface mount component on the pad and hot plate each component one-by-one, but this would take a lot of time; although, having to hot plate each surface mount component one-by-one may help with debugging and double-checking to see if all of the components are on the board correctly. It is possible to use a soldering iron to solder surface mount components on the PCB board. My friend has done it before when he interned in Taiwan. When my group and I got our first PCB design for our radar, we thought we had to use a soldering iron to solder surface mount components. Thankfully, a teacher assistant stopped us and told us to come in during off-hours to use the hot plates in their lab. You can refer to Figure 2 above to see how our surface mount components looked like when they are soldered on top of pads. In my opinion, it looks a lot cleaner when using a hot plate to solder instead of using a soldering iron.

VI. Tips

Each soldering iron has its own individual tip. Each tip has a different size and can fit any iron. When working in the lab, some soldering irons have their own set tip without you having the option to adjust the tip when needed. The sizing of the tips do matter. When putting together the PCB for our radar system, the size of the surface mount components are 1.66mm by 8mm for 0603; which is small. If you can find a soldering iron that has a fine tip, use that. The wider tip is still capable of getting the job done but you should be extra careful to prevent causing any shorts.

Another tip is to communicate with whoever is designing the PCB. The sizing of the through-holes or pads should match the product you plan to solder with. If the sizing is different, you may end up wasting more time and money purchasing another component to fit the size on the pads or through-holes of the PCB. Communication is important within group.

VII. Testing

Now that you have an understanding of how to solder, which method works with what type of soldering method, and understanding the basic tips, you are now ready to learn how to test for connections. Just because a component looks like it's soldering on top of the pad does not mean the component would always work. You never know if you must have accidentally burnt out a component by applying too much heat on it or having the solder spill onto other pad. If any solder spilled onto the next pad, you may have caused a short. You may also make the mistake of having the solder not covering enough of the pad area or the through-hole. Remember, do not power your board yet. Our group have made the mistake of soldering on the wrong pins of our power amplifier. We have our PCB designer and our soldering person to work together on placing the components. Due to miscommunication and confusion, we've accidentally soldered the wrong pins of our power amplifier and powered our PCB. This resulted in causing the power amplifiers to be fried. The best way to test for connections is having to test each component one at a time. You should not power your board until you have tested that each of the component is soldered on correctly. Also, it may be best to have test pins created onto your PCB. Having test pins helps de-bug where the problem may be. Our group had a difficulty figuring out what was wrong with our PCB when the power amplifiers burnt out. We tested both the LPF and gain

stage separately. Both seemed to be working, but when we tested the system as an overall, there was nothing being amplified.