AMP Lab Ruler Converter

Objective: Learn how to completely solder the AMP Lab Ruler board by safely and correctly using the available tools and equipment provided by the AMP Lab.

Estimated Time: 1 - 2 sessions (for 2 hours of instruction per session)

To take with you after certification

Prior to soldering:

- Find an unoccupied workspace.
- Make sure your work space is clean and free of any trash or unnecessary tools.
- Make sure your tools (pick, tweezers, brush, desoldering pump, PCB, alcohol, components, safety goggles, etc.) are available and ready to be used next to your work area.
- Turn on the power strip on your table; this should turn on the HEPA Filter vacuum, overhead magnification/light, and soldering iron.
- Please check the condition of your iron to make sure it is in good working order by first tinning the tip with solder. If there appears to be a problem with any equipment, please contact a soldering instructor from the AMP Lab website.

While soldering:

- **WEAR PROPER EYE PROTECTION AT ALL TIMES!!!**
- Keep the HEPA vacuum on while soldering,
- It is recommended that you use the available magnification lens to check on your work after each time you solder a component.
- Use the available PCB clamps when necessary.
- You can change the soldering iron temperature if you feel the need to.

Recommended Order of Soldering (Right Handed people):

- 104 Capacitor
- 4700 Resistor
- 6191 Resistor
- LT1370 Regulator
- 5362 Resistor
- 107 Capacitor(s)
- MBRD 835
- 6.8uH Inductor
- 10 Resistor
- 102 Capacitor
- 475 Capacitor

- 336 Capacitor
- TPD2E001 Diode
- 104 Capacitor
- Micro-USB Connector

Recommended Order of Soldering (Left Handed people):

- Micro-USB Connector
- TPD2E001 Diode
- 104 Capacitor
- 336 Capacitor
- 6.8uH Inductor
- 475 Capacitor
- 102 Capacitor
- 10 Resistor
- LT1370 Regulator
- MBRD 835
- 5362 Resistor
- 6191 Resistor
- 4700 Resistor
- 104 Capacitor
- 107 Capacitor(s)

Recommended steps for components:

- TPD2E001 Diode and LT1370 Regulator:
    a. Before putting the component down, take your iron and place it on one of the small leg pads to heat it up. Melt a tiny bit of solder in the joint to allow it to melt onto the pad. Take the iron off to let solder solidify. (Figure 3)
    b. Put a bit of flux on the target pad.
    c. Put the component (in the correct orientation!) on the pad, hold it down, and reflow the solder. The component should become flush with the pad and solder should stick to it. (Figure 4)
    d. At this point, one lead of the component should be stuck on and the component should stay secured in place.
    e. Solder the next joint by heating the iron tip along both the pad and the lead and feed solder into the joint. Do not put too much.
    f. Repeat step (e) until the rest of the legs are soldered on. (Figure 5)
    g. The next part to solder is the heat sink. At this point, it may be necessary to turn up the temperature. We recommend turning it up slowly (increase by increments of 25 degrees C). If you are not too sure what temperature to use, try using 800 degrees C. To change the temperature, your station must have a key card. Press and hold the star button until one of the digits on the display begins to blink. Press the up or down button to change that digit and press the star button again to move to another digit.

h. Place the iron down on the pad and heat up both the component and the pad. Place it down such that you get as much surface area contact on the pad. (Figure 6)
i. Slowly feed solder into the iron and allow it to melt. Continue until most of the pad is soldered on. Try to make the connection look as clean as possible.(Figure 7)
j. Remember to turn down the iron temperature when you are done (750 degrees C is fine).

- Through Hole Components (Display, microUSB connector housing)
    a. Before soldering anything, make sure the wire length is sufficient (for the display, we recommend around 30mm). Also, make sure the connections are correct (For the display, connect black to the unmarked hole and red and white to the holes with "+" marks).
    b. Strip the wire to expose the bare copper.
    c. If necessary, make sure the PCB is mounted in vise clamps or a similar device such that the other side of the board is facing you (remember, you'll probably want to solder the through hole part from underneath the board where the wire leads will stick out, as shown in Figure 8.)
    d. Stick the wires through the desired holes from the top of the board.
    e. Touch the joint between the pad and wire with the iron for about 1-2 seconds (Figure 8), then begin feeding the solder into the joint (Figure 9.) Feed solder for about 3 seconds, take it off with the iron still on, and wait for an additional 2-3 seconds for the flux to completely evaporate. The result should look conical and smooth (refer to soldering poster behind soldering station) (Figure 10.)
    f. Cut the extra wire such that it is slightly above the conical shape (i.e. not too short) (Figure 11).
    g. Clean the joint with isopropyl alcohol and brush it thoroughly.
    h. For a component with fixed leads (microUSB connector): place the component leads in the holes first. Touch the iron tip to the lead and pad and wait for 1-2 seconds. Then begin to feed solder in for about 3 seconds. Leave the iron on for about 2-3 seconds, then repeat with the other through hole leads.

- Hard-to-reach SMD leads (microUSB connector):
    a. After the through hole parts have been soldered, make sure that the SMD leads are aligned with the pads.
    b. CAREFULLY touch the iron tip to the pad and lead. This might be difficult, as the leads are pretty small and tucked away. Be patient.
    c. After a couple of seconds, slowly feed the solder into the joint. Be careful that the solder does not bridge and be careful not to solder the connector chassis to the lead (This may possibly lead to a short in the circuit).
    d. Repeat steps b - c until all pads are soldered.

- Two-Leaded SMD Components (1206 resistors, capacitors, Inductor, etc.):

a. First, take your iron and place it on a non-Ground pad to heat the pad up. Melt a tiny bit of solder in the joint to allow it to melt onto the pad. Take the iron off to let solder solidify (Figure 1).
b. Put a bit of flux on the target pad.
c. Put the component (in the correct orientation!) on the pad, hold it down (Figure 2), and reflow the solder. The component should become flush with the surface of the board, and solder should stick to it.
d. At this point, one lead of the 1206 component should be stuck on and the component should stay firmly in place.
e. Solder the next joint by heating the iron tip along both the pad and the lead and feed solder into the joint. Do not put too much.
f. At this point, the component should be soldered onto the board.
g. Check to make sure there are no rhino horns, cold joints, and balls of solder.
h. Check that the solder joints are within acceptable limits according to the soldering chart in the room.

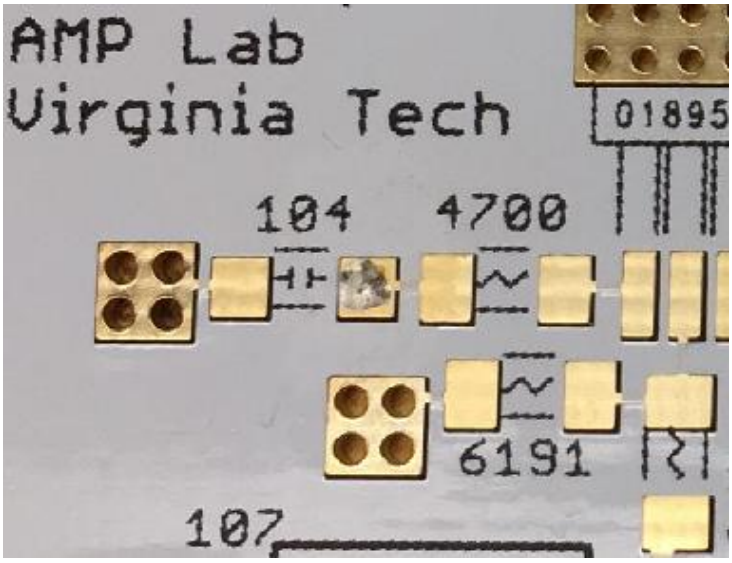

Figure 1.

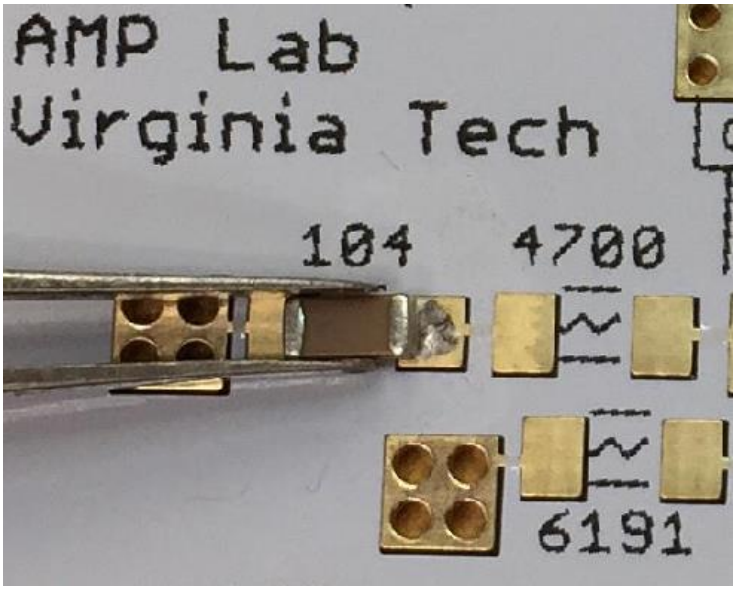

Figure 2.

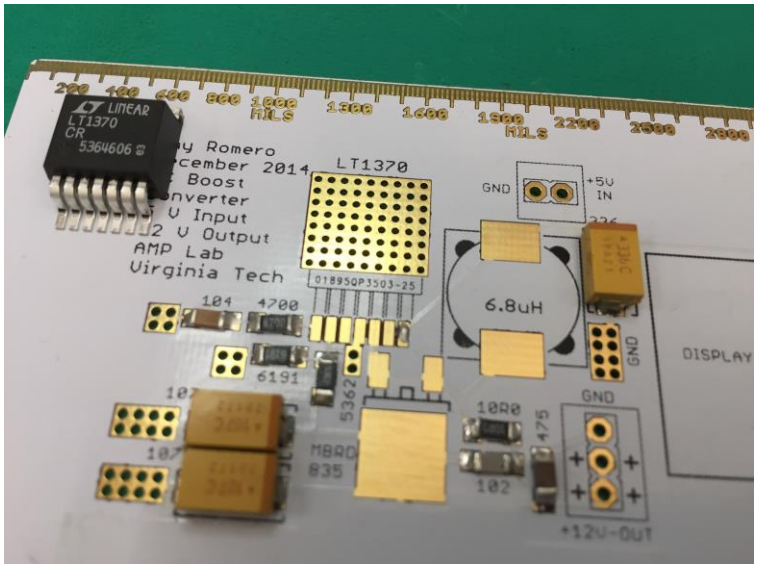

Figure 3.

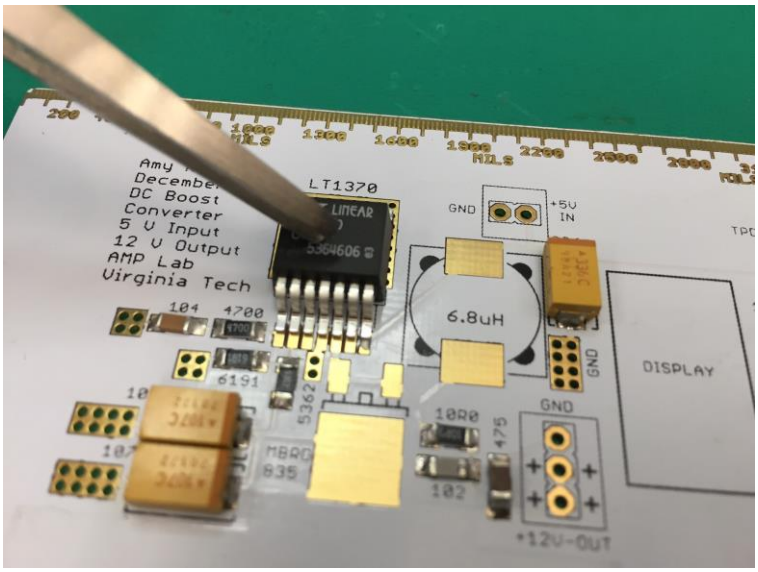

Figure 4.

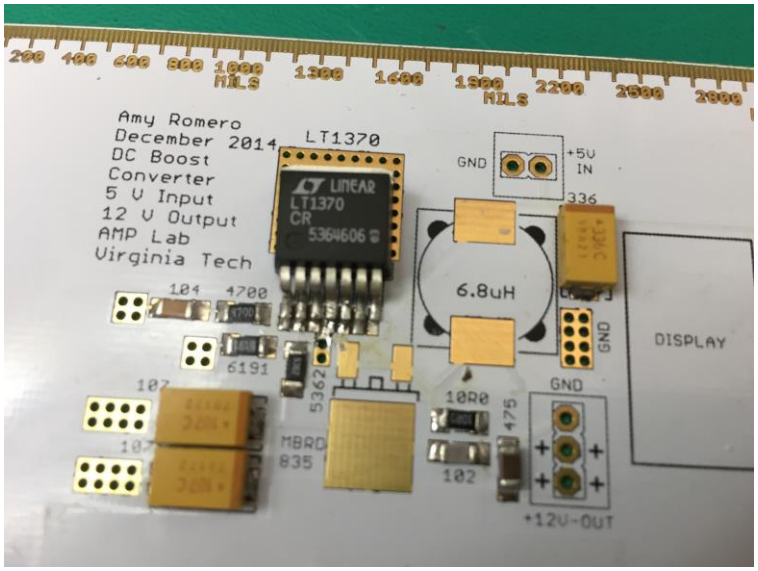

Figure 5.

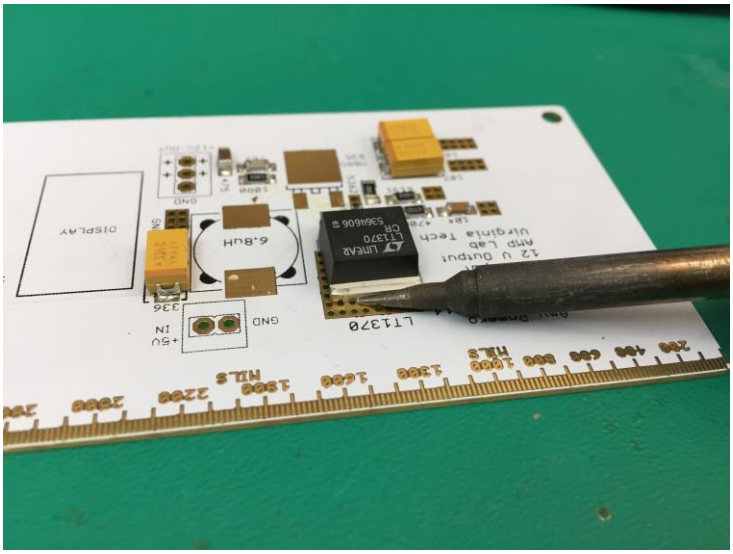

Figure 6.

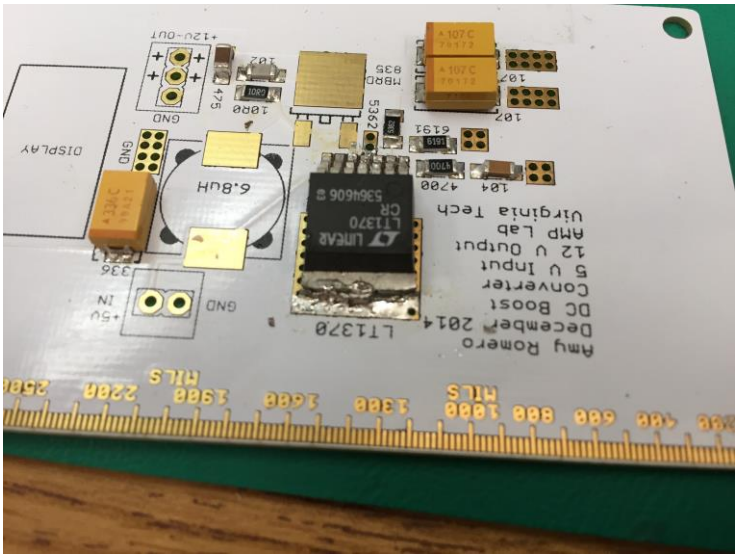

Figure 7.

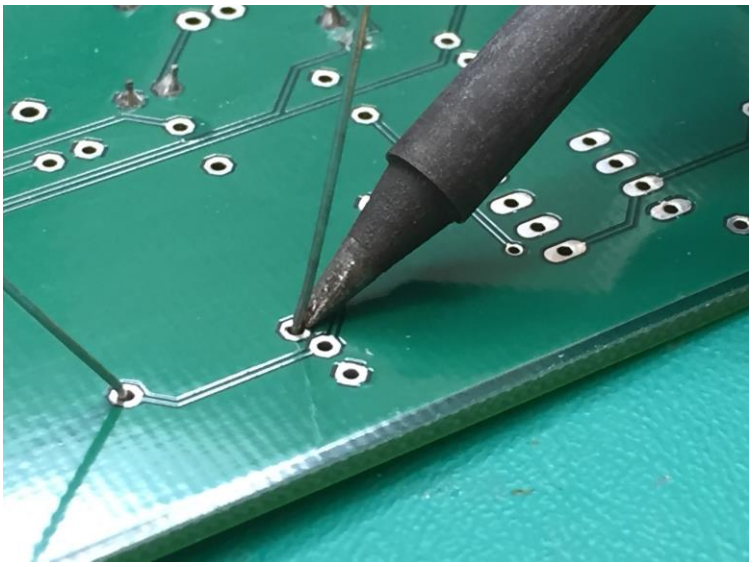

Figure 8.

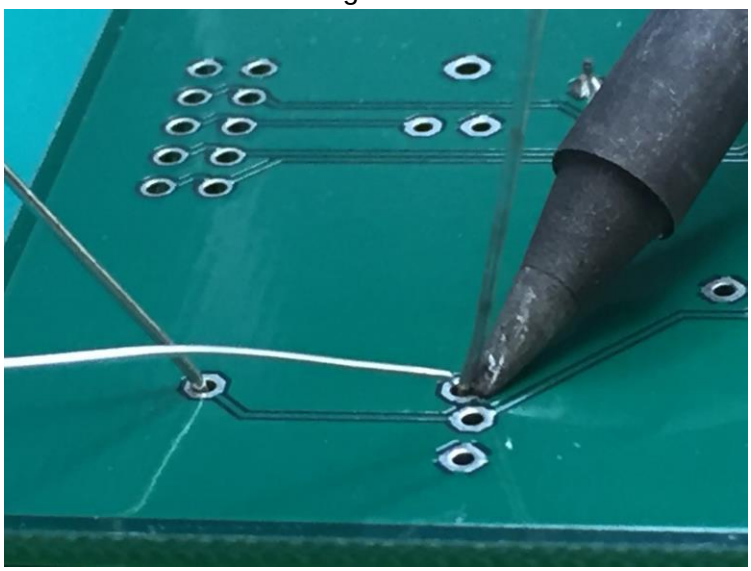

Figure 9.

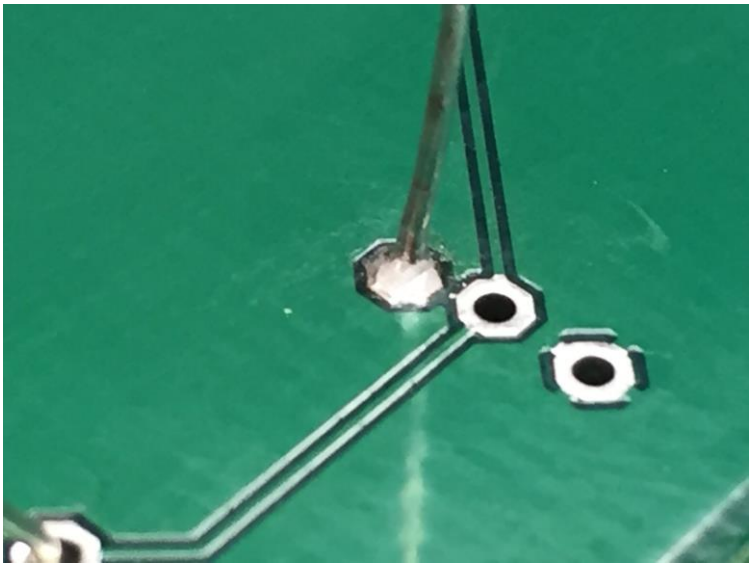

Figure 10.

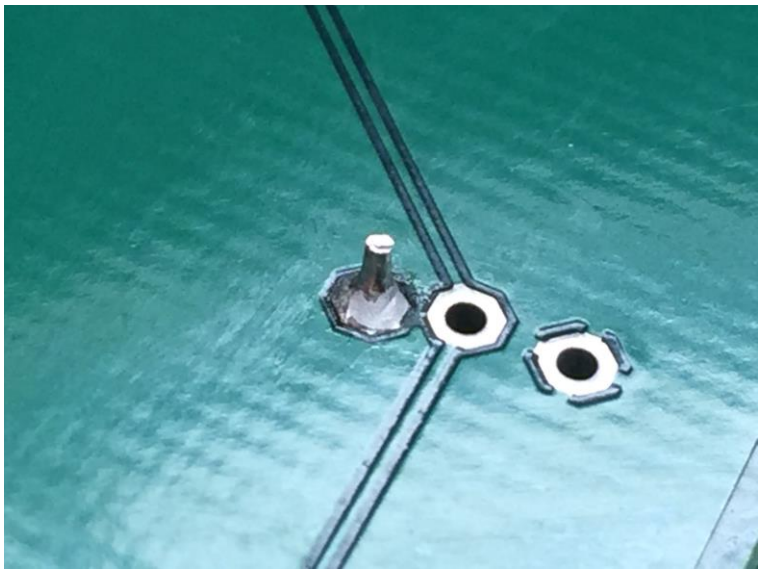

Figure 11.

Questions to consider while soldering:

- Before starting, in what order should I solder these components and how can I populate this PCB such that it will be relatively easy to access most components?
- Is my soldering iron properly tinned? Is solder sticking to the tip easily?
- Am I applying enough heat to this joint?
- Are there any bridges/connections that shouldn't be there?
- Does the joint look acceptable according to AMP Lab standards (poster behind soldering station)?
- Are there any joints that need to be reflowed?

- What methods are available to me if I need to desolder something? What is the most method?
- If I presented this finished product to a professional, what would he/she think? Am I content with this final product?
- Why isn't the solder sticking to my tip? Does my joint need more flux? Do I need to re-tin the tip?

After Soldering:

- Look at PCB under magnification; check for bridged connections along with any residue such as solder balls, flux, hair, etc.
- Put a few drops of alcohol on the target areas and brush thoroughly. This will do a good job of cleaning the board if done correctly.
- Allow the alcohol to evaporate (this can be exacerbated by placing the board at the intake of a vacuum).
- Check the PCB under magnification once more to make sure that no residue remains.

Before exiting the room:

- After you finish soldering, please return the iron temperature to around 750 degrees.
- Please make sure all tools and parts are placed back in their respective areas. If you brought your own parts, please make sure you bring them with you or store them in your project box.
- Please throw away any trash (napkins, Q-Tips, broken components, etc.) and clean up your area such that the next person won't have to clean up after you.
- Turn off all desk lights, vacuums, and soldering equipment.
- Make sure you don't leave any personal belongings in the room (Hokie Passport, bags, keys, phone, PCB, etc.)

Good to know:

- If you plan on soldering, it is recommended that you bring your own tools! You are not guaranteed to find the necessary tools at the AMP Lab.
- The soldering irons are usually at ~700 - 750 degrees C. If you need to change the temperature, then feel free to do so.
- Before soldering, you should check to make sure the temperature is around 700 - 750 degrees Celsius.
- After you finish soldering, please return the iron temperature to around 750 degrees.
- Whenever you reflow something, be careful of using up all of the flux. Replenish the flux if necessary, otherwise you may create a cold joint.