Working with Surface Mount Components

Surface Mount Technology

- An alternative to the through-hole components we used in the fall is to use components soldered to the surface of the circuit board
  - SMD (Surface Mount Device) – The actual components
  - SMT (Surface Mount Technology) – The overall technology

- Advantages
  - Smaller and lighter components allow circuits to be smaller
  - Easier automated assembly
  - More space available for routing board traces (components only on one side)

- Disadvantages
  - Easier to lose components
  - Cannot be prototyped and tested easily like a breadboard
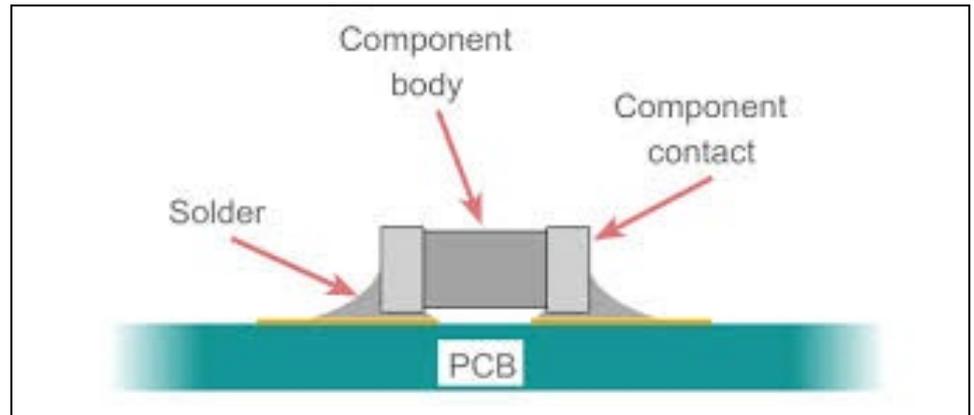 - More challenging to solder by hand

Surface Mount Soldering

- In surface mount soldering, the component sits on top of the PCB

- Solder Pads are exposed sections of copper (or other bare metal

- Solder flows around and below the component onto the pad
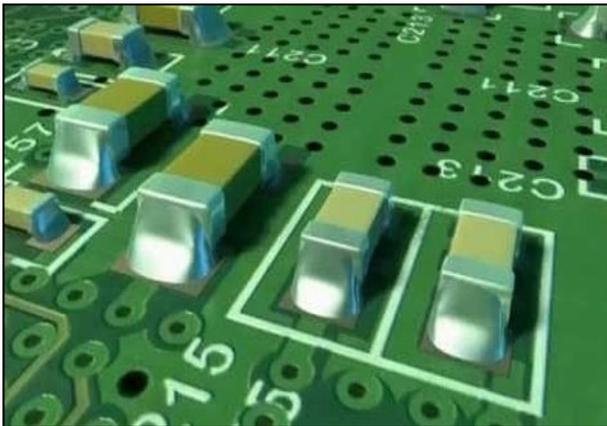
Two-terminal SMD

- Resistors and Capacitors
  - Case Code usually reported in XXYY format, where XX is the length, and YY is the width in mm or thousandths of an inch (MILS)
  - VERY important not to mix up imperial and metric values! Ex. 0603 can be 0.6mm x 0.3 mm OR 0.06 x 0.03 in
  - Both would be called a 0603 package

- Other two-terminal devices, like diodes, may have their own package sizes and dimensions
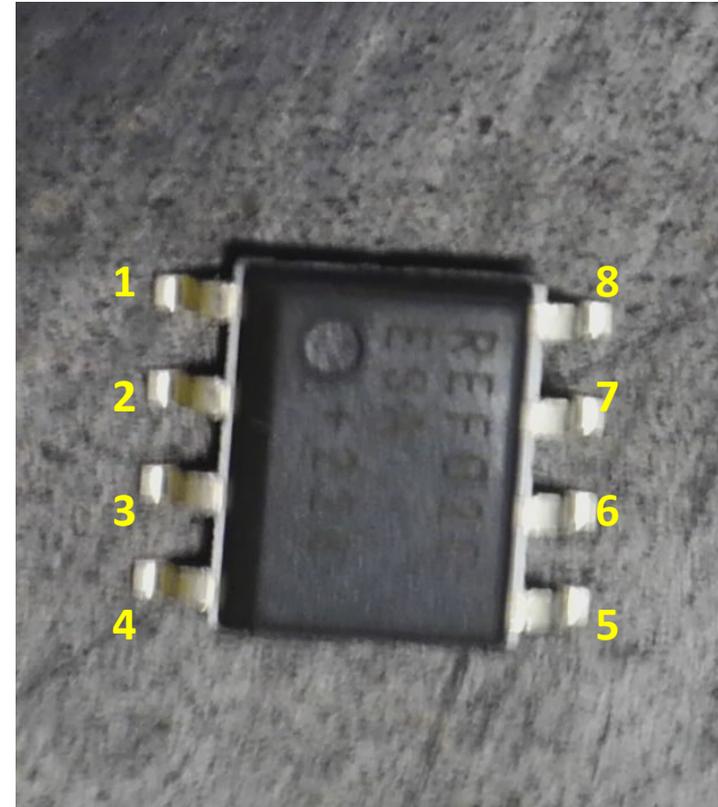
- Since the

Multi-terminal SMD

- Used for Integrated Circuits

- Standard SMD footprints (large to small)
  - Small outline integrated circuit (SOIC)
  - Small outline transistors (SOT)
  - Dual Flat No-Lead (DFN)
  - Ball Grid Array (BGA)

- SOIC (Package we will use) has the same basic layout and pin numbering as the DIP (Through-hole) Package
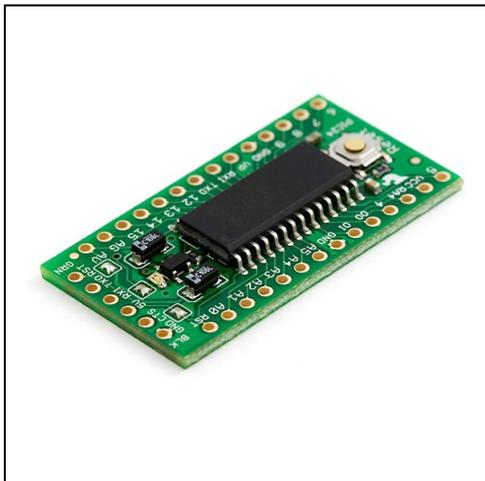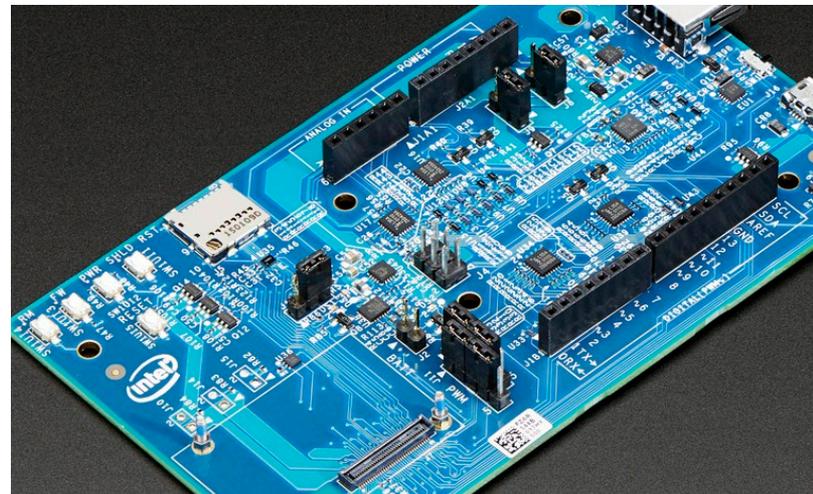
Prototyping with Surface Mounted Device (SMD) components

- Difficult to prototype SMD components without a PCB board

- Can solder wires directly to the leads
  - Requires very fine wire and tricky soldering

- Instead, you usually buy a pre-soldered board with a connector or through-hole pins (Called a breakout board)

Surface Mount Soldering

- Because of the small size of the components, preparation is key

- SMD soldering tips:
  - Work on a clean and well-lit surface to prevent you from losing components
  - Use Tweezers or forceps to handle components
  - Secure the board while working
  - Clean and prepare the PCB before soldering
  - Add solder slowly and sparingly
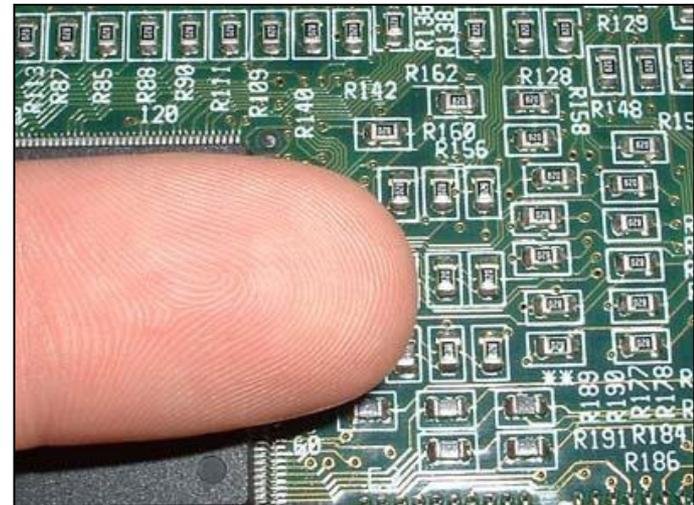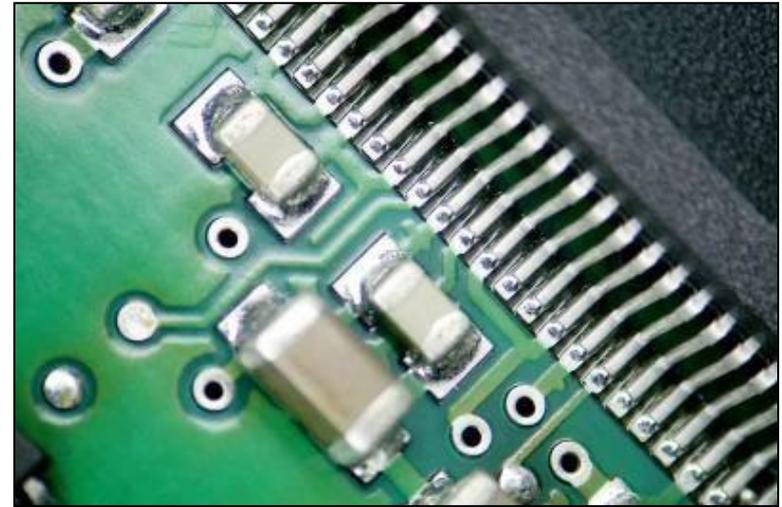
Use Magnification and Lighting

- Work somewhere with adequate overhead lighting or use a benchtop light source

- Have a hands-free magnifier or camera/microscope
  - Headband-mounted magnifiers are great

- Document-style webcams with a good zoom work well with a laptop or moniror

Prepare the PCB surface for work

- Make sure the board is clean and free of foreign matter

- May need to clean the surface of the board using a brush and isopropyl alcohol
  - 70% ok, but 90%+ is better

- If your solder does not have flux core, be sure to add flux
  - Additional flux can sometimes help, (even with rosin core flux solder)
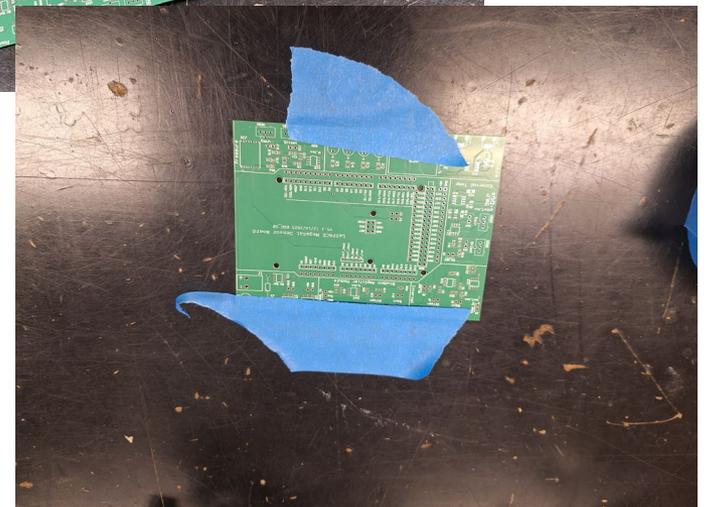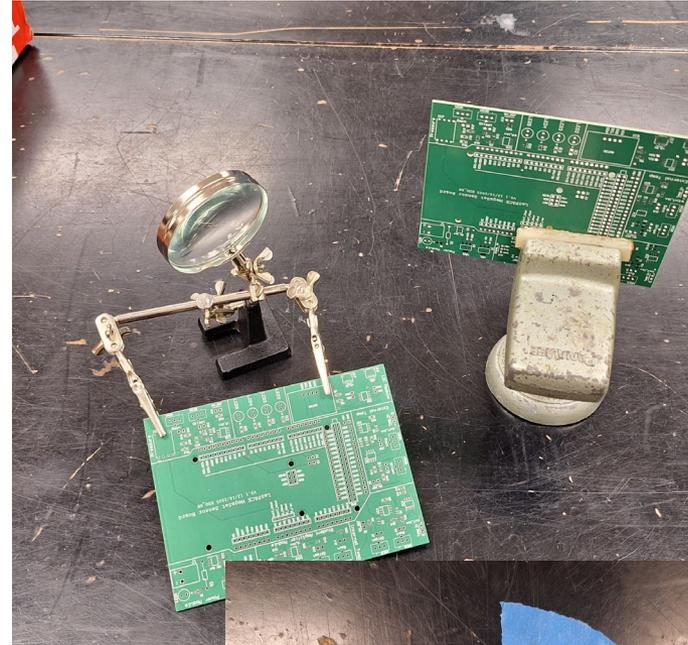
Secure your work

- Have something to securely hold the board while working on it

- But be able to reposition the work as needed

- Clip style holders

- Masking tape works for a board like the MegaSAT where most components are only on one side

Solder Tips and Solder Size

- Solder tips and solder come in a variety of sizes
- In most cases, you will want the smallest tip and thinnest solder available in your lab
- **Don't forget to check the tip before switching on the iron**
- You may wat to switch to larger tips for larger connectors (large power pins)
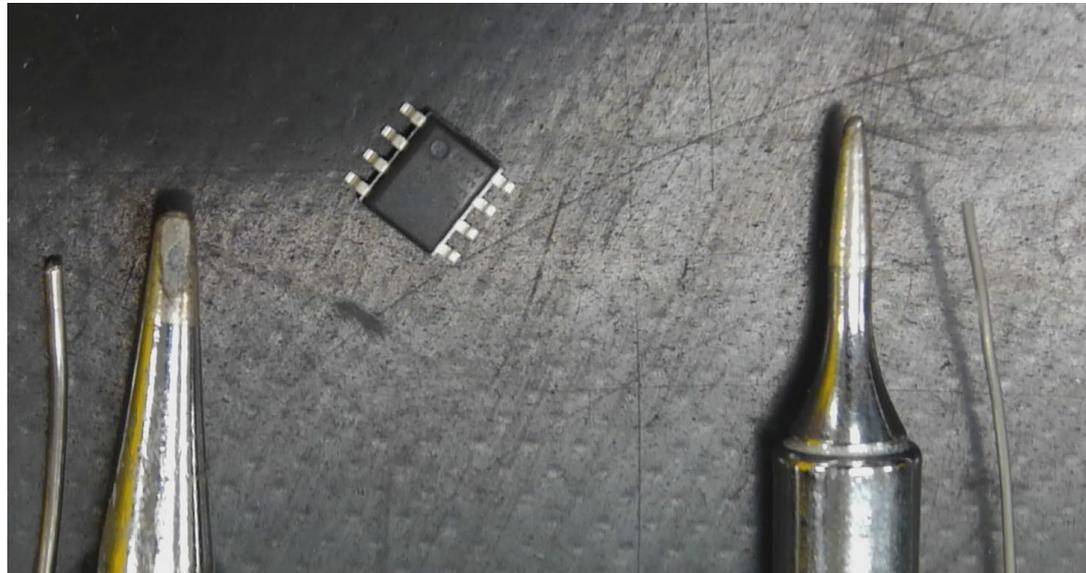
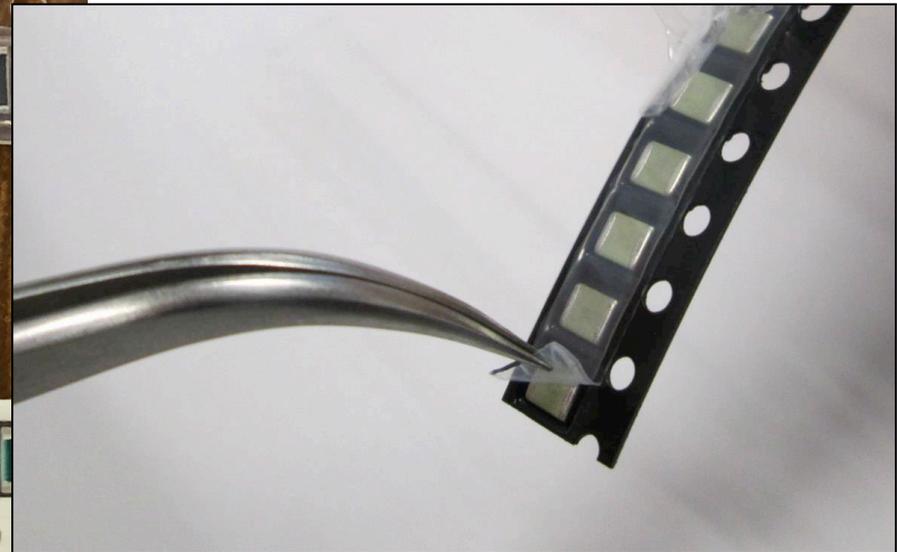The left solder and tip are larger than the pins of the SOIC chip

Remove components from packaging
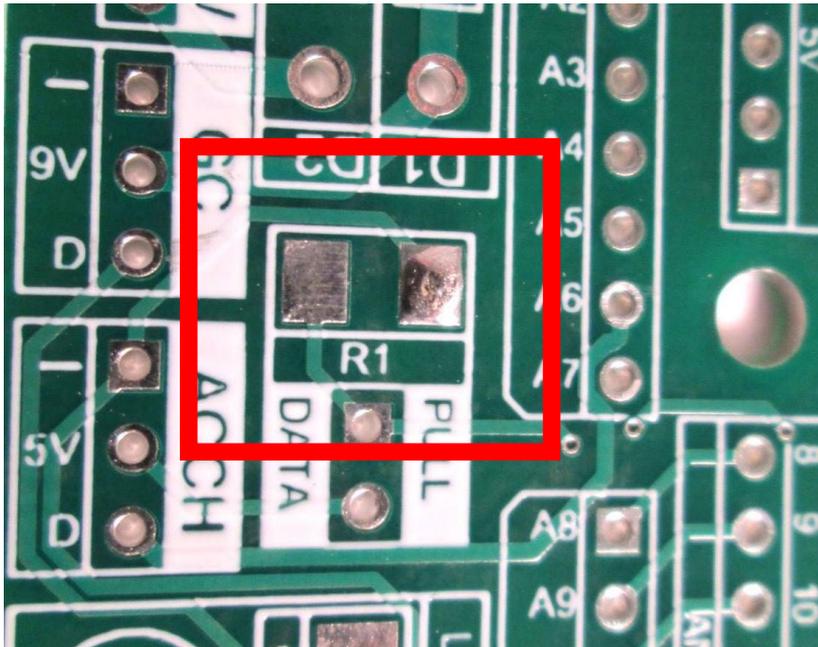
Most SMD's are packaged in strips.

Use a pair of tweezers to peel back the plastic to <u>free one SMD at a time</u> as you need them.

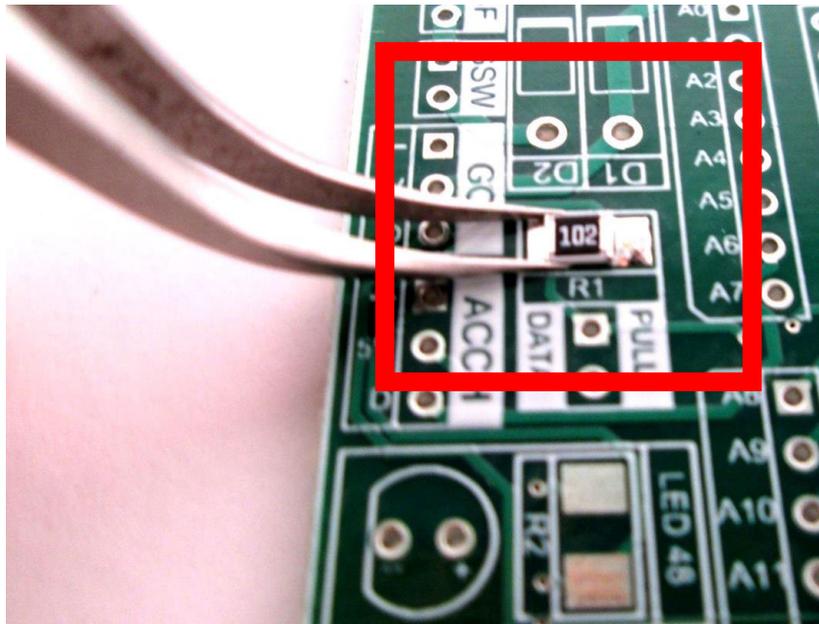A small, shallow tray or lid can be used to hold components while working.

Add solder to a single pad of the component

- Put a small amount of solder on the pad
- Like through-hole, preheat the pad slightly with the iron first, then add the solder
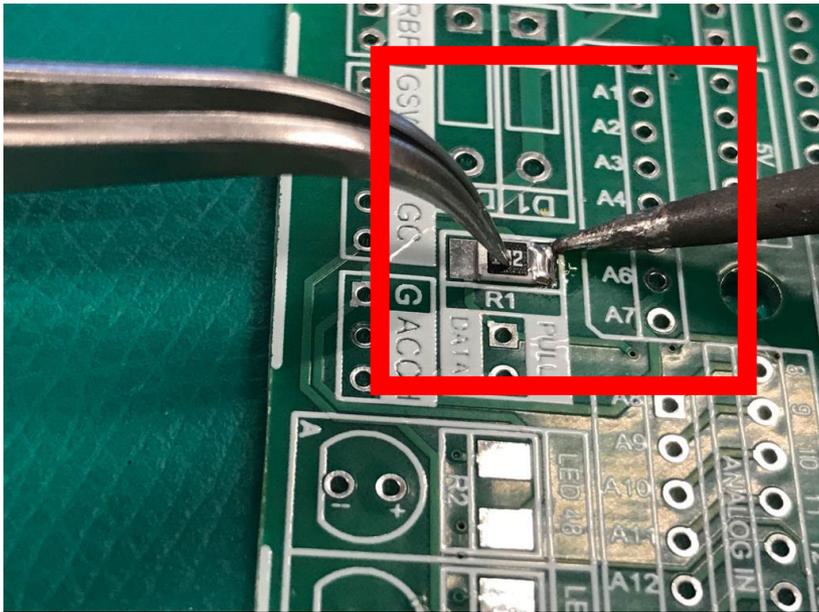- This pad will be used to hold the component in place

Placing the Component

- Use tweezers to hold the SMD on the pad

- We are going to remelt the solder to fix the component in place

Remelting the solder

Hold the part in place even after you remove the iron while the solder cools.

- While holding the component down with tweezers, heat the pad to remelt the solder
- Take care not to press down too hard and send the component flying
- This will allow you to push the part flush to the board
- Remove the iron while continuing to hold the component in place
- The solder will cool, harden, and should hold the part in place
- Make sure the part is straight on the pad before moving on. If it is not straight, reheat the solder and adjust the position
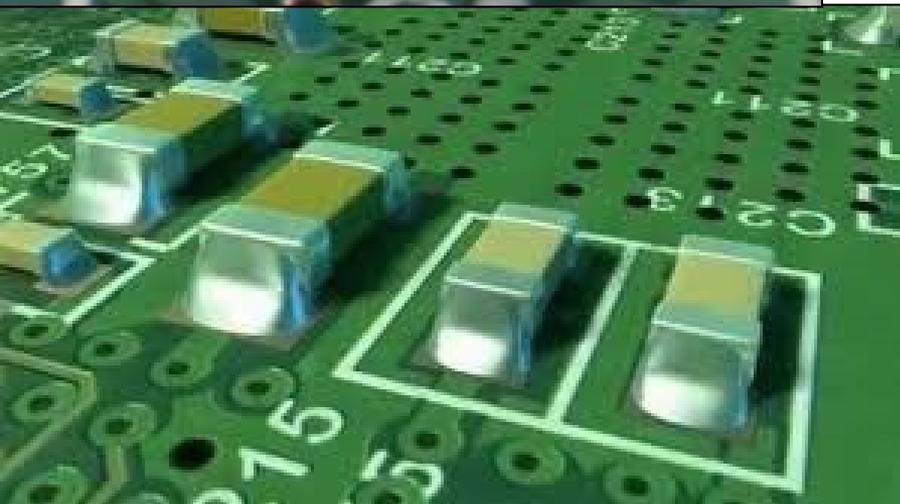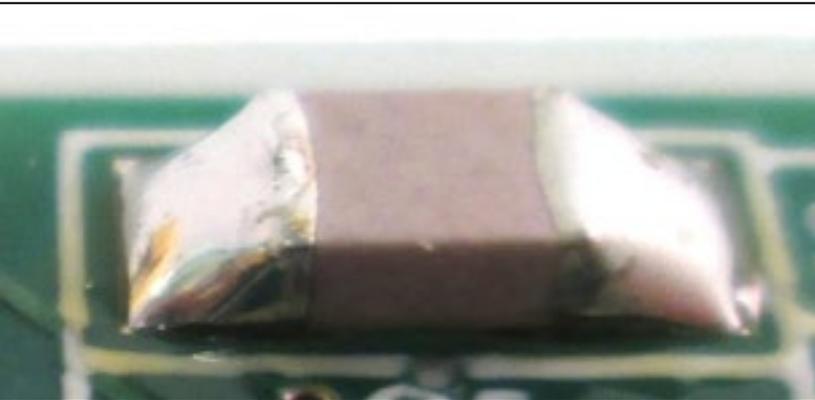
Soldering the second pad
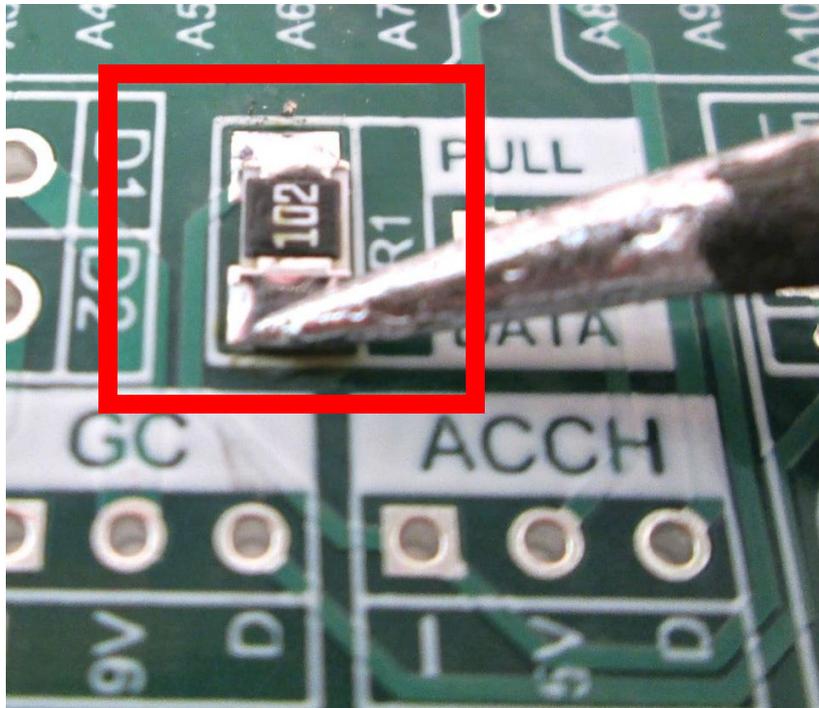
- Heat the other pad slightly and apply solder on the other pad

- No tweezers should be needed as the solder should hold it in place

- At this point check if the first pad needs additional solder, add if necessary
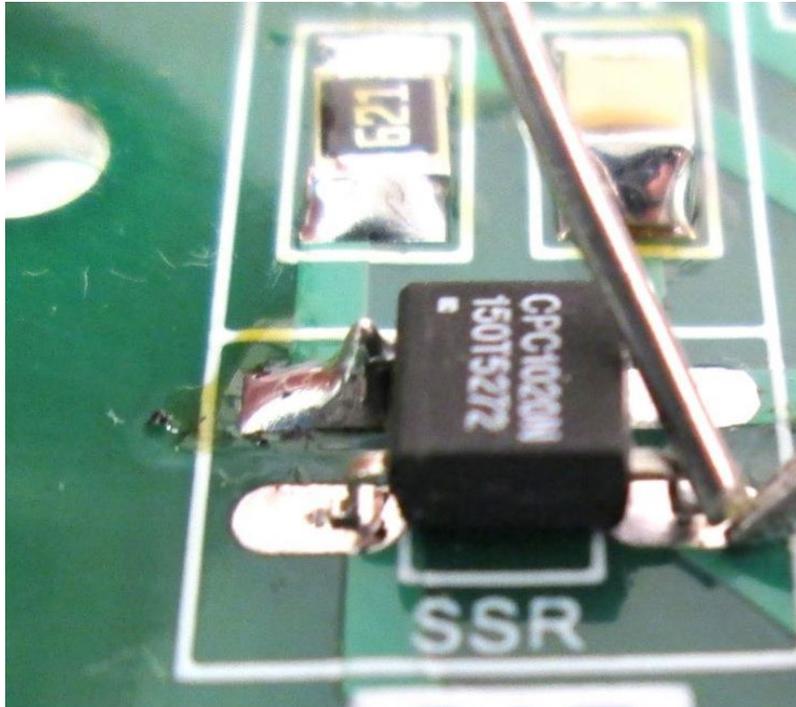
Good SMT Joints

- Good surface mount solders have:
  - No cracks, gaps, or graininess, and should be shiny
  - Just enough solder to make the connection
  - Component should relatively flush with the board
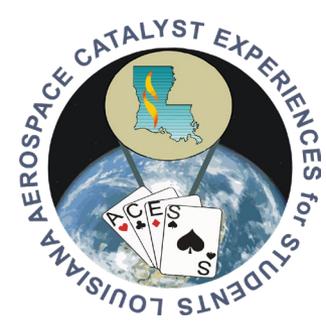
Multi-terminal or Multi-Pin components

- Multiple-terminal SMD follows the same basic procedure as two-terminal SMD.

- Apply solder, using one pin to hold the component in place

- **Then check to see that all the pins are aligned with the pads before continuing.**

  - Once multiple pins are soldered, the component will be very difficult to move

# Completing soldering the remaining the pins

Multipin SMD
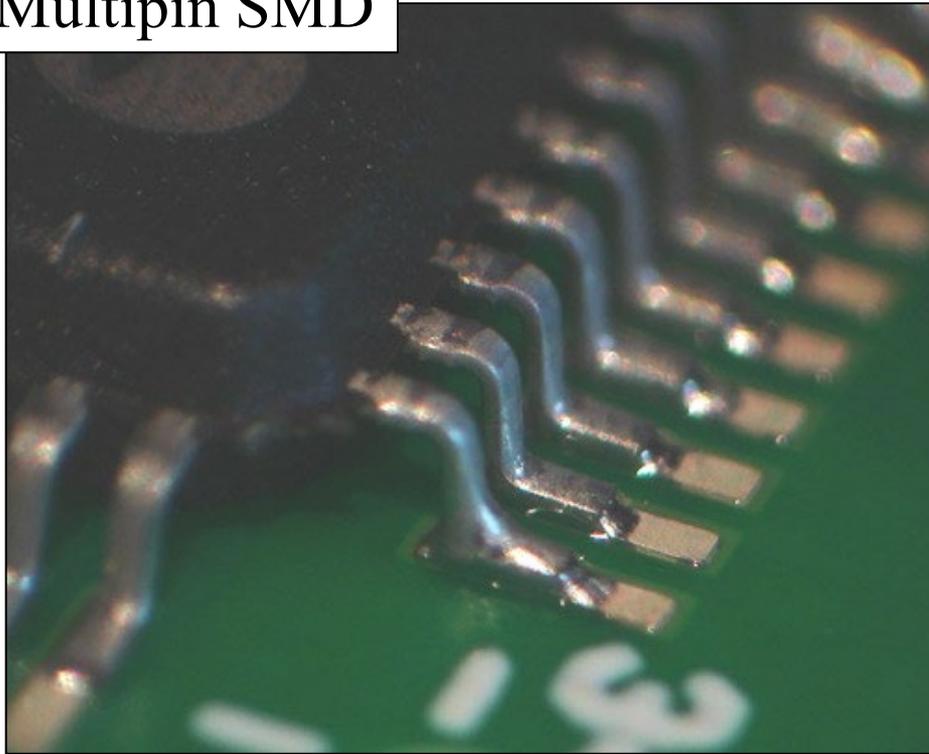
- Apply solder to the remaining pins
- Use solder sparingly
  - It is easier to add solder and remove it
  - The pin and pad do not need to be fully covered
- To prevent heat-damaging components or the PCB you can alternate sides or give the component a short time to cool off
- Make sure you reposition your hands or the board as you work
  - There is no reason to awkwardly reach over the chip when you can simply rotate the board

Correcting Bridged Pins

Short
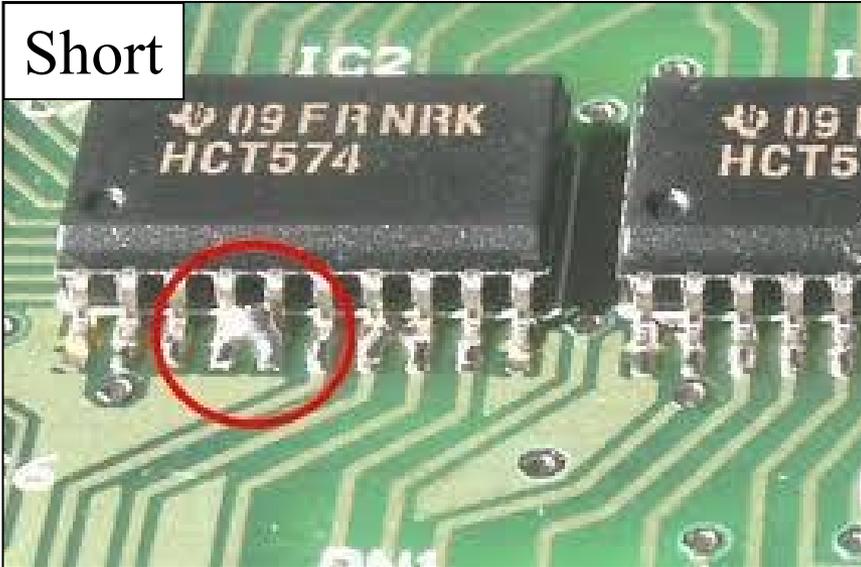
- With surface mount soldering, the two most common issues are shorts between adjacent pins

- The excess solder can often be removed by repeated remelting and cleaning your solder tip
  - A small amount of solder will wick onto the tip
  - If there is a large amount of solder braid or solder pump can be used – carefully

- Also be sure to watch for pins or terminals floating above the board, not connected