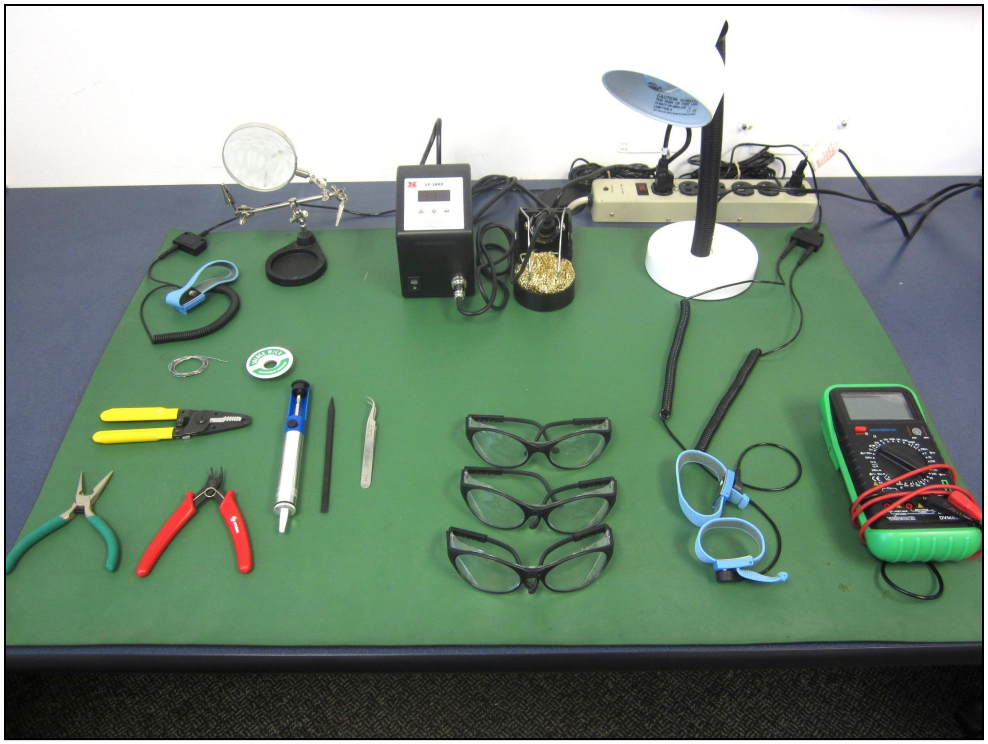
LaACES Student Ballooning Course

Assembly Techniques

Workstation Setup,
Safety,
& Soldering Tutorial

Workstation setup

- Prior to assembly or any work, a clean and organized workstation is vital for safety and proper assembly



Items you need

- Safety Glasses
- Multimeter
- Extra light source if needed
- Soldering iron.
- Needle nose pliers
- Tweezers
- De-solder gun
- Solder
- ESD mat
- Wire cutters

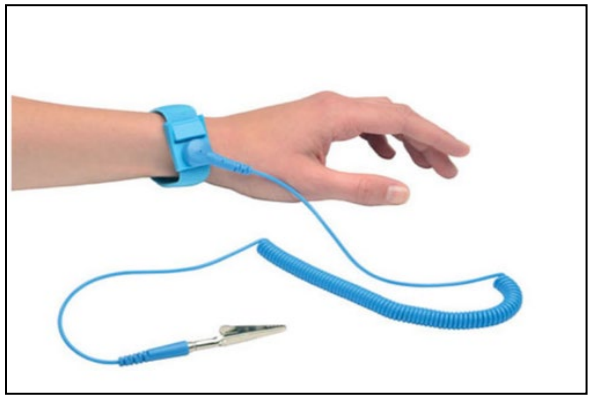
Safety comes first.

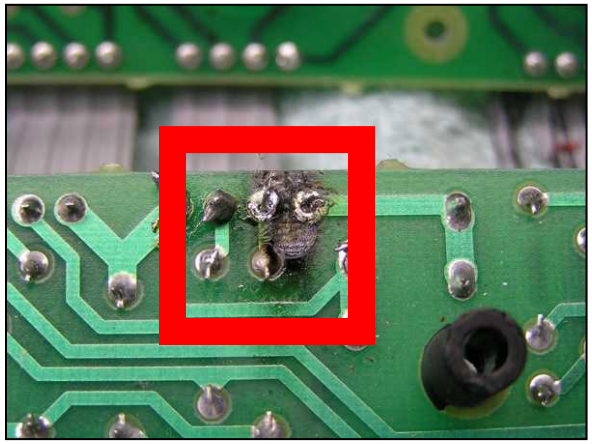
Safety in the lab is like wearing your seatbelt; you regret not wearing it milliseconds after its too late.

- Situational Awareness is key!
  Be mindful of where you are and what hazards are around you.
- Safety Glasses:
  Hindsight is only 20/20 if you have both your eyes. Wear them!
- Soldering irons can get in excess of 650°F
- It takes 1 amp of electricity to cause fatal heart irregularities.

Safety (for the components)

- Electrostatic discharge (ESD) can destroy electrical components.
  - Leave components in static shielding bags until ready for use.
  - ESD strap prevents you from "shocking" the components with static electricity.
- Excessive heat from soldering can harm electrical parts.





Soldering Tutorial

Soldering Safety:

- Again, situational awareness is key!
  - Be mindful of where you are and where hot items are.
  - Hair (get it out of the way)
  - Eye protection
- There is lead in the solder so wash your hands afterwards.

Soldering Tutorial

Soldering – fastening metal objects together using molten metal (solder) as the glue.

Three requirements

- Low melting point metal (wire solder)
- Heat source (soldering iron)
- Flux (to prevent surfaces from oxidizing)

Types of Solder

Tin-Lead solders

60% Tin, 40% Lead - solid at 361° F, liquid at 374° F

63% Tin, 37% Lead - eutectic point is 361° F

no "pasty" range so joint movement less a problem

Silver-bearing Solder

62% Tin, 36% Lead, 2 % Silver - solid at 354 ° F, liquid at 372 F

often used for surface mount components whose contacts contain trace amounts of silver

Soldering Irons

Constant wattage

Iron is continuously “ON” and eventually reaches equilibrium temperature

20 to 25 watt iron sufficient for circuit board assembly

Constant temperature

Tip incorporates a thermostatic element to maintain desired tip temperature

650 – 750 ° F appropriate for circuit board assembly

But wait…..even better…

Weller® 30 watt iron

Soldering Irons

Temperature Controlled Solder Station

Feedback control maintains tip at desired temperature

Adjustable, often with analog or digital temperature display

Many have grounded tip to help prevent ESD damage

Weller® solder station

Types of Flux

- Rosin Flux

  Type R – ordinary rosin – most common

  Leaves a residue that can be removed for cosmetic reasons if desired.

  Type RMA – mildly activated rosin

  Type RA – activated rosin – use with care

  RMA and RA fluxes leave a slightly corrosive residue that generally should be removed (with a solvent) after soldering

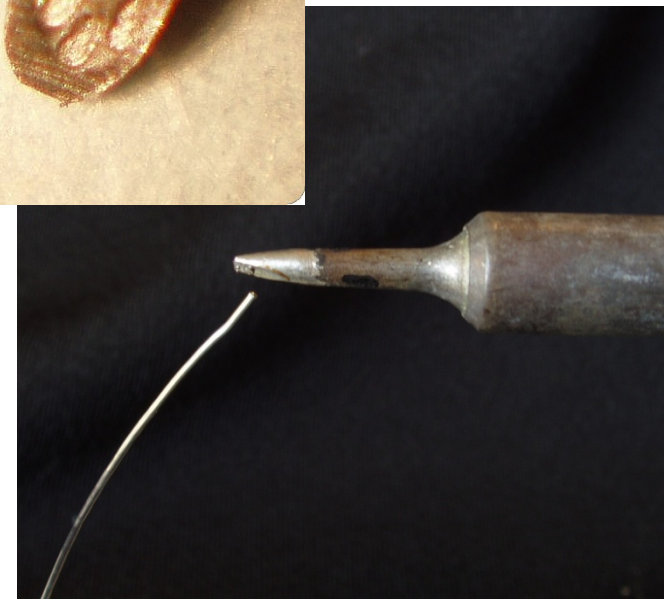
- Acid Flux – **NEVER, EVER** use this for electronics

Flux-core solder

Most solder used for electronics assembly is in wire form, with the flux incorporated inside the solder.

Multi-core solder has several (usually five) separate flux channels within the solder.

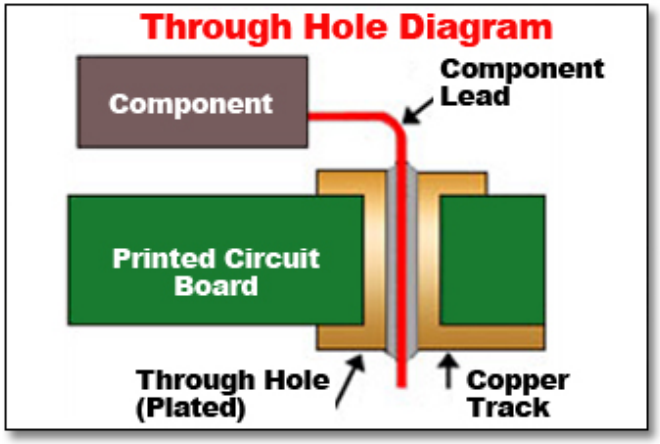
For circuit board assembly use wire solder with a diameter of about 0.025 inch or less

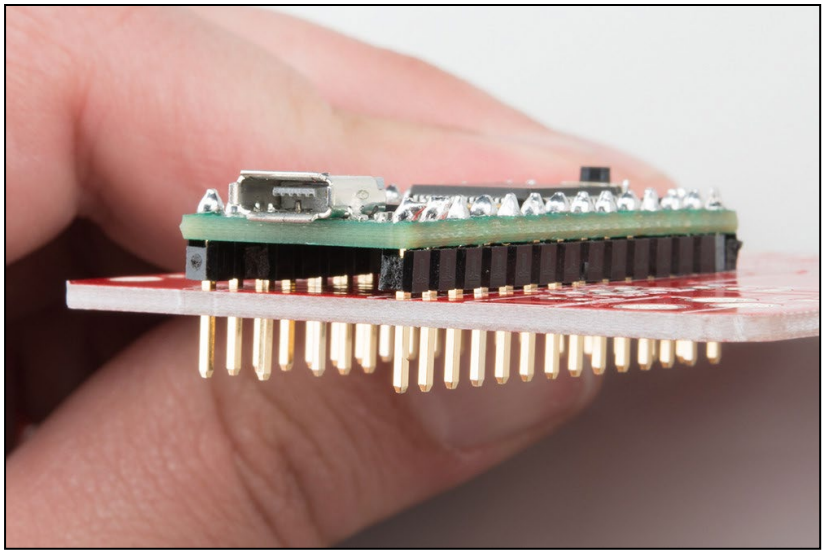


Two Types of Soldering

- 1st type: Through Hole

  Component has metal leads that goes through the board.

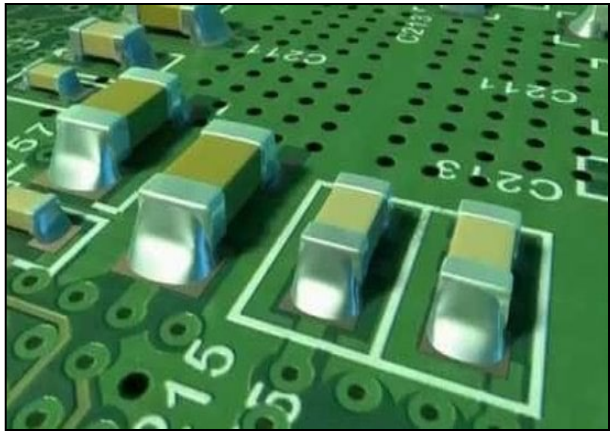


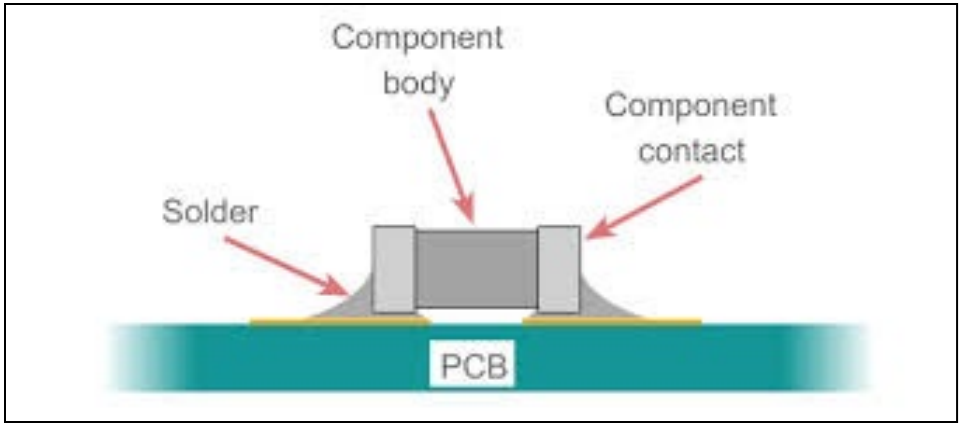


Two Types of Soldering

- 2nd type: Surface Mount.

  Component has metal pads that rest on top of board.





Soldering Tutorial

Component Placement & Inspection

- Inspect all components before and after soldering.
- Components should be as close to the board as possible without stressing the leads.
- Orient components so that their value markings can be easily read after installation. Have resistor color bands all reading in the same direction.
- When IC chips are to be soldered directly on to circuit boards (a socket is not used) their pins are often slightly too far apart and must be gently aligned. Be sure to be grounded when handling ESD sensitive chips.

Soldering Tutorial

Soldering tips:

- Easier to add solder or re-melt it vs. remove it
- Easier to solder using the side of the iron, rather than the just the tip
- Make sure the iron is heating both the pad and the pin
- Good lighting
- Install smaller components first.
- Install integrated circuits (IC's) into sockets, not directly on the board

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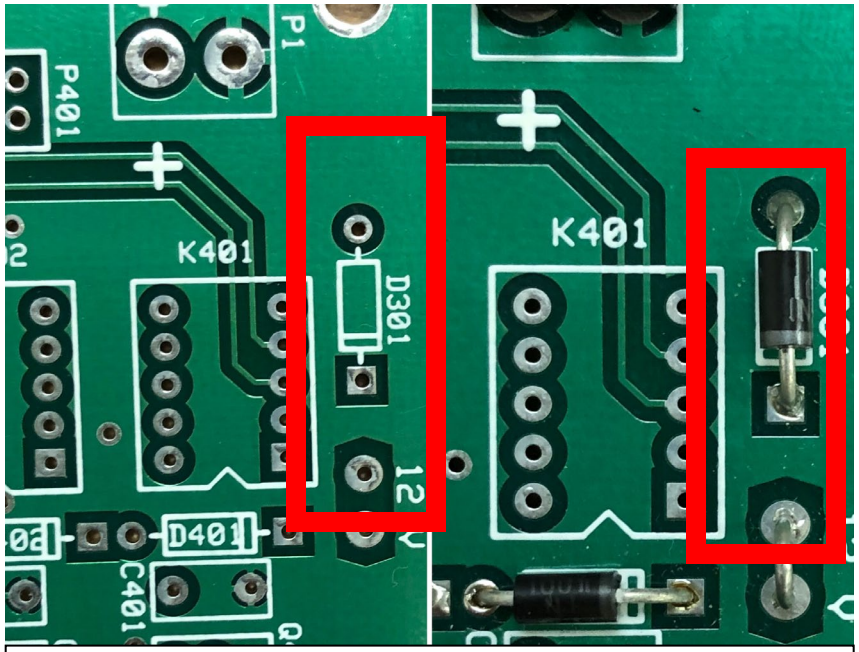
Soldering Tutorial

Through-Hole Component

Some components are "*polarized*", meaning they have a negative and positive lead. Make sure the polarized component is oriented correctly with the board.



Properly oriented polarized diode, before and after.

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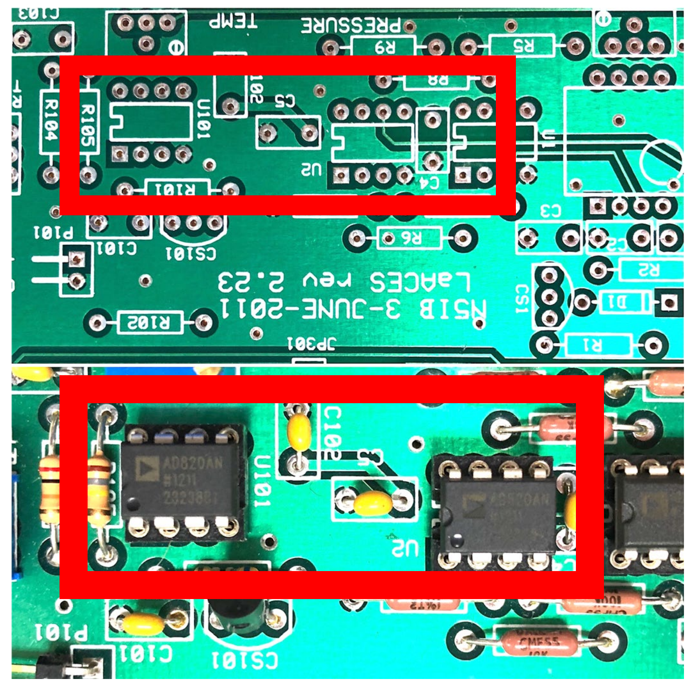
Soldering Tutorial

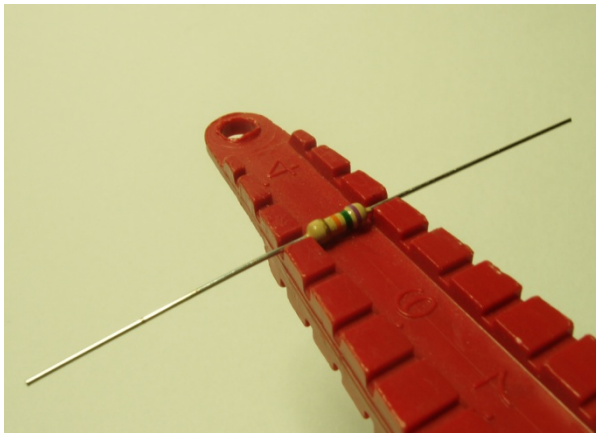
Through-Hole Component

- Some components have designated pin numbers. Make sure you align the correct pin with the correct hole. Pin-1 sometimes is designated with a dot on the component, as is the case of the photo to the right. Refer to datasheets and/or schematics to find pin-1 if need be.

Properly aligned IC's, before and after.

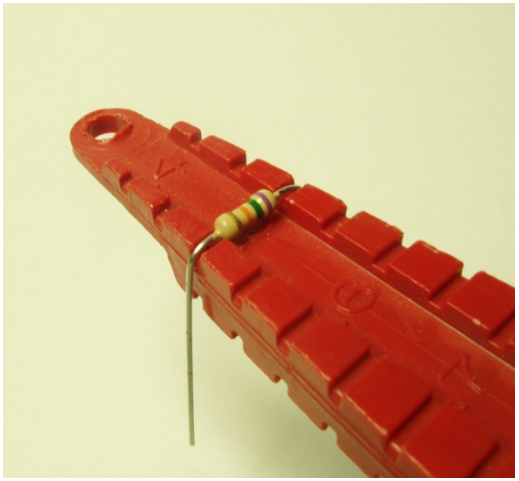


Soldering Tutorial
Through-Hole Component

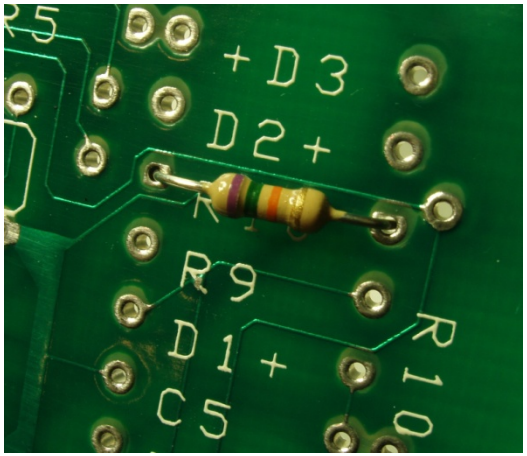


Use a lead bending jig, if available, to form the component leads to the correct spacing

If a bending jig is not on hand, grasp the leads, not the body, of the component with needle-nosed pliers and bend gently.

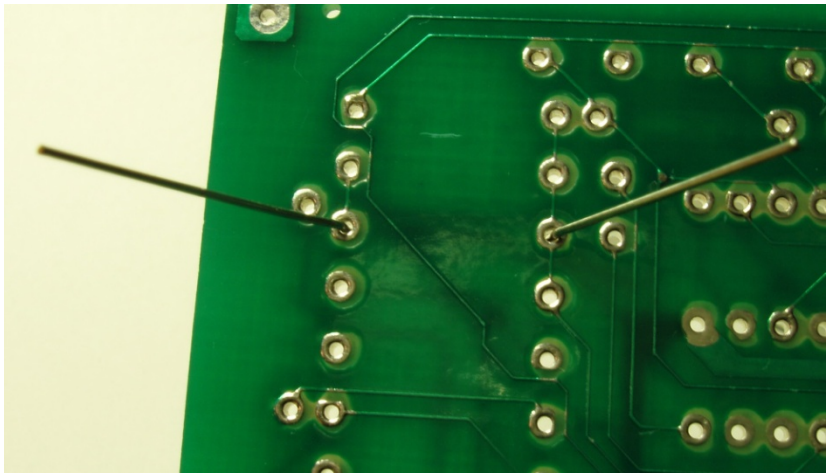


Soldering Tutorial
Through-Hole Component



Insert the component's leads through the holes in the circuit board. The body should lie flat against the board without having to force it down.

Turn the board over and gently bend the component leads outward to hold the component in place



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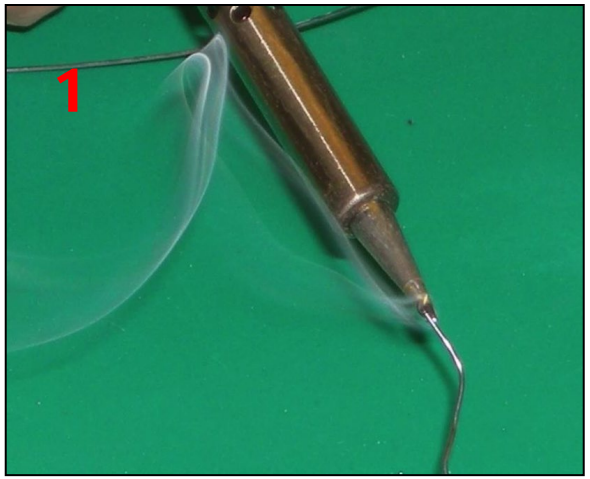
Soldering Tutorial

Through-Hole Component

"Tin your Tip"

1. Once the iron is hot enough, "tin the iron tip" by melting an inch or so of solder on the tip and then cleaning the tip on the sponge.
2. Tip should look look shiny .



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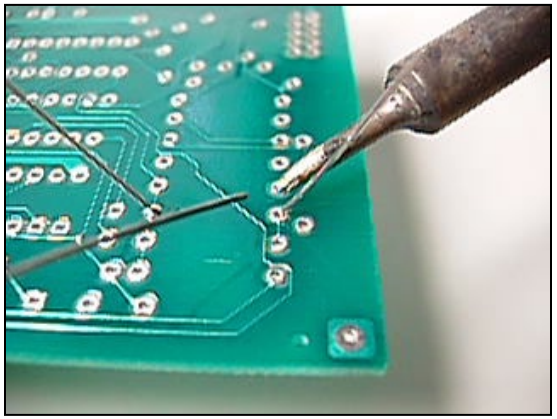
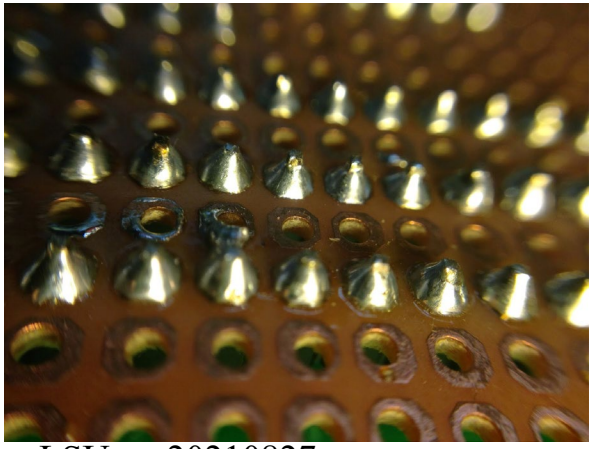
Soldering Tutorial

Through-Hole Component

Apply the iron in contact with both the circuit board pad and the component lead. Apply solder to the joint, not to the iron, and allow the heated joint to melt the solder.



You want a "Hershey kiss" of solder when you are done.



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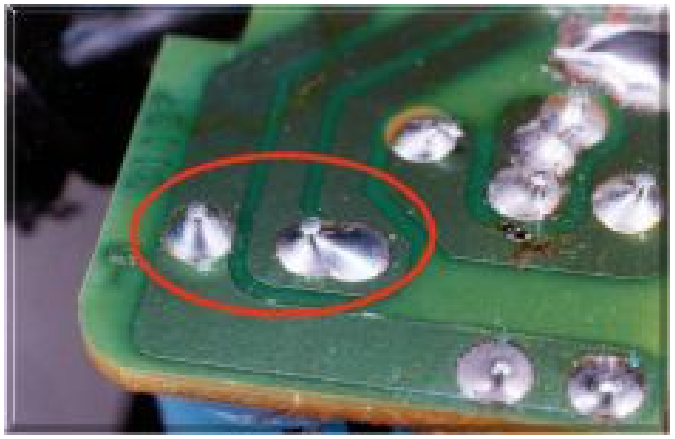
Soldering Tutorial

Good Through-Hole Solder

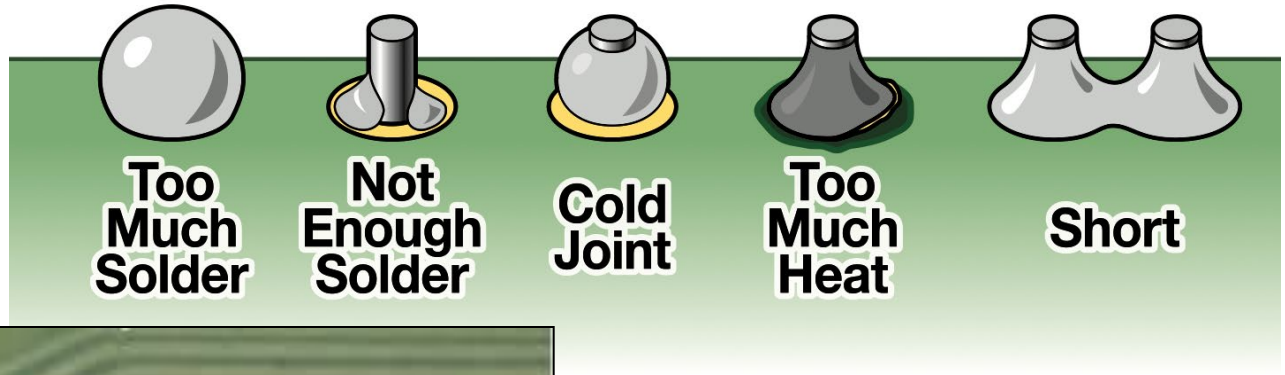
Inspect the soldered. It should be uniform and shiny, with no cracks, gaps, or graininess. The images below are examples of good soldering.

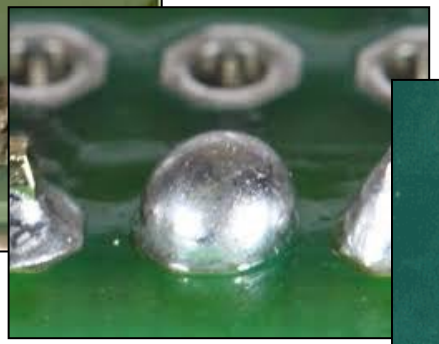


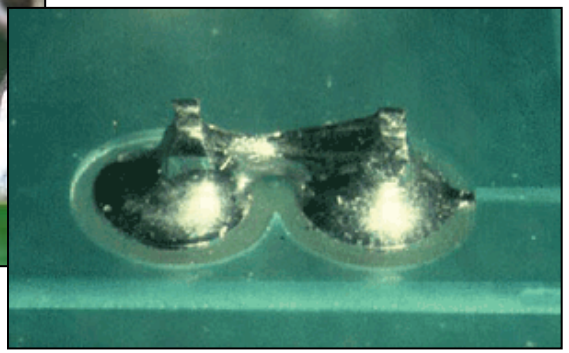
Soldering Tutorial

Bad soldering

90 % of all failures are related to soldering problems

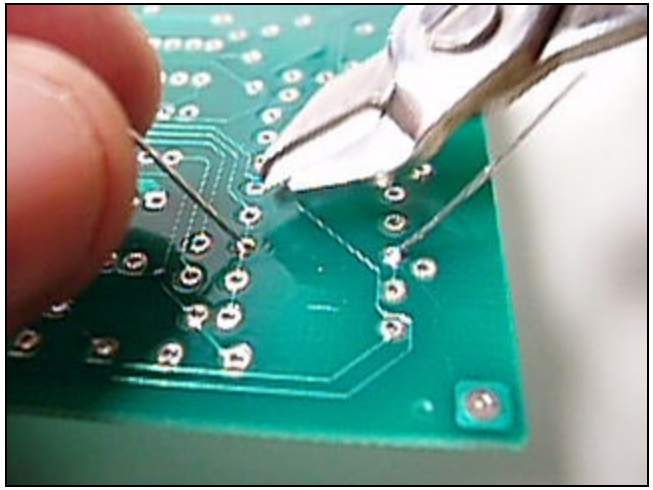


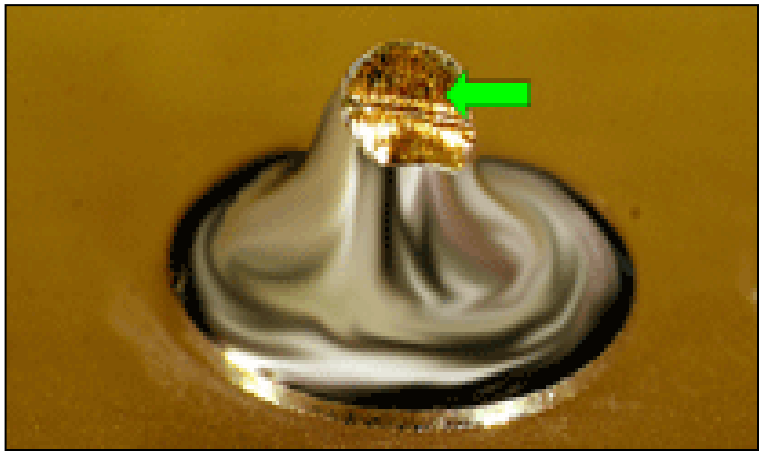




Soldering Tutorial
Through-Hole Component

- After inspection, if solder is good use a pair of wire cutters to cut off the excess lead length as close to the board as possible. Hold the lead so will not fly away when cut, a possible occasion for eye injury.
  - **!! WEAR SAFETY GLASSES !!**

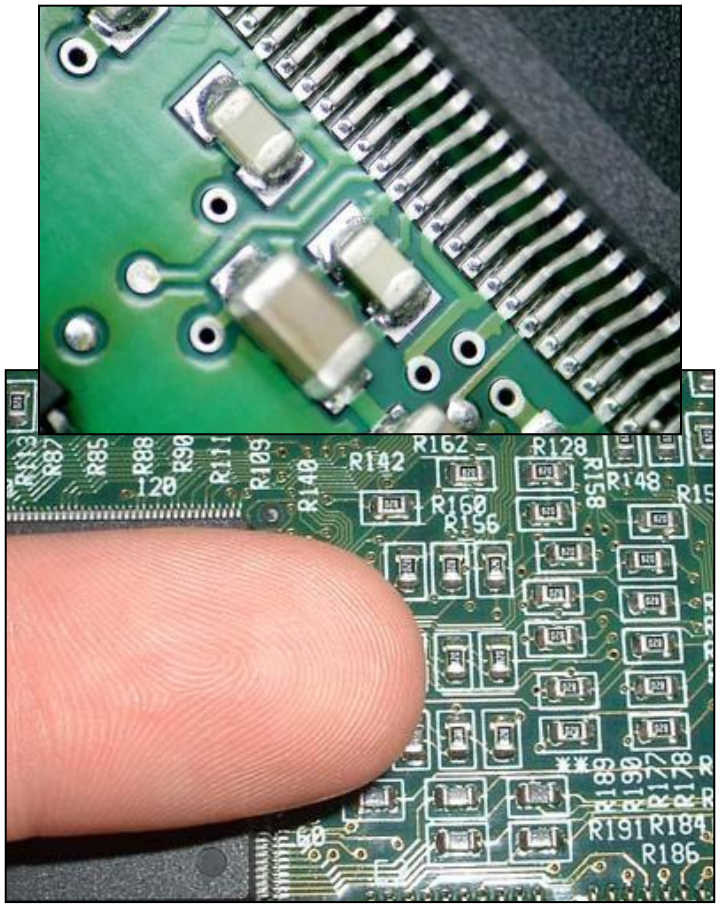




Soldering Tutorial

Surface Mount Soldering

- Surface mount devices (SMD) are notoriously tiny.
- Most people prefer this method of soldering once they get the hang of it.
- There are two main types of SMD, two-terminal and multiple-terminal. We will cover two-terminal first.



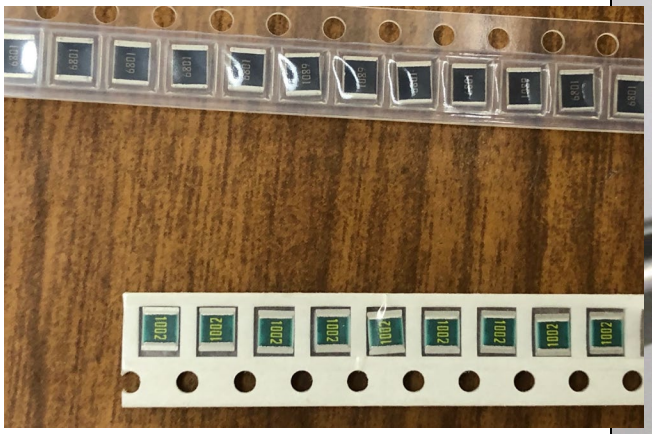
Soldering Tutorial
Surface Mount Soldering

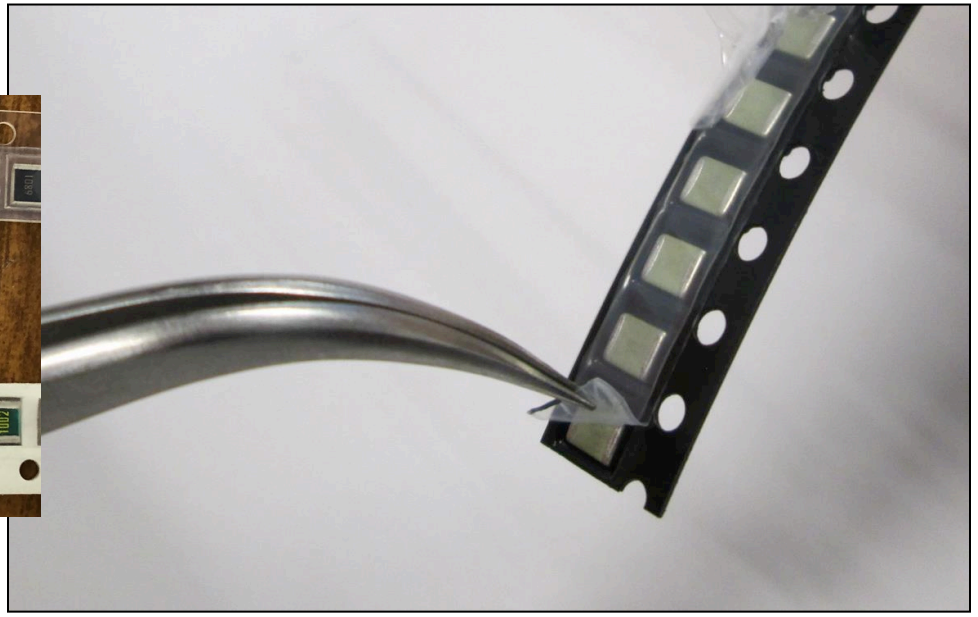
- SMD soldering tips:
  - Work on a clean, well lit, and light colored surface to prevent you from losing small SMD's.
  - Tweezers are your best friend.
  - Less solder is more
  - Coat the pad with a tiny bit of flux before soldering.

Soldering Tutorial

Surface Mount Soldering

Many SMD's are stored in strips, see photos below.
Use a pair of tweezers to peel back the plastic to free one SMD at a time as you need them.





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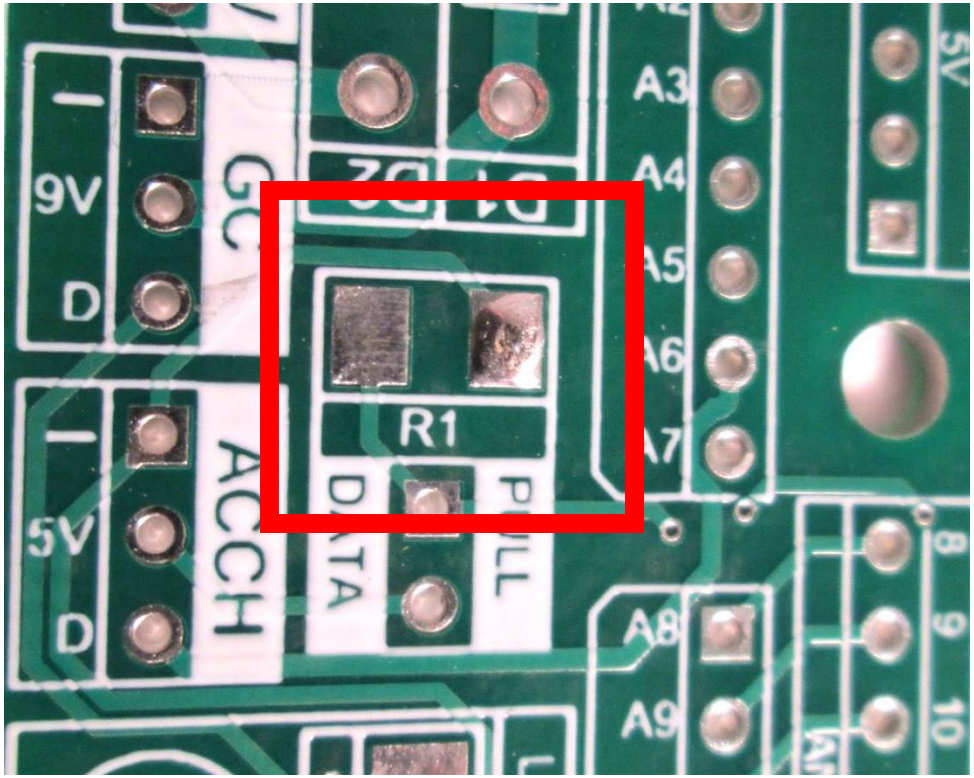
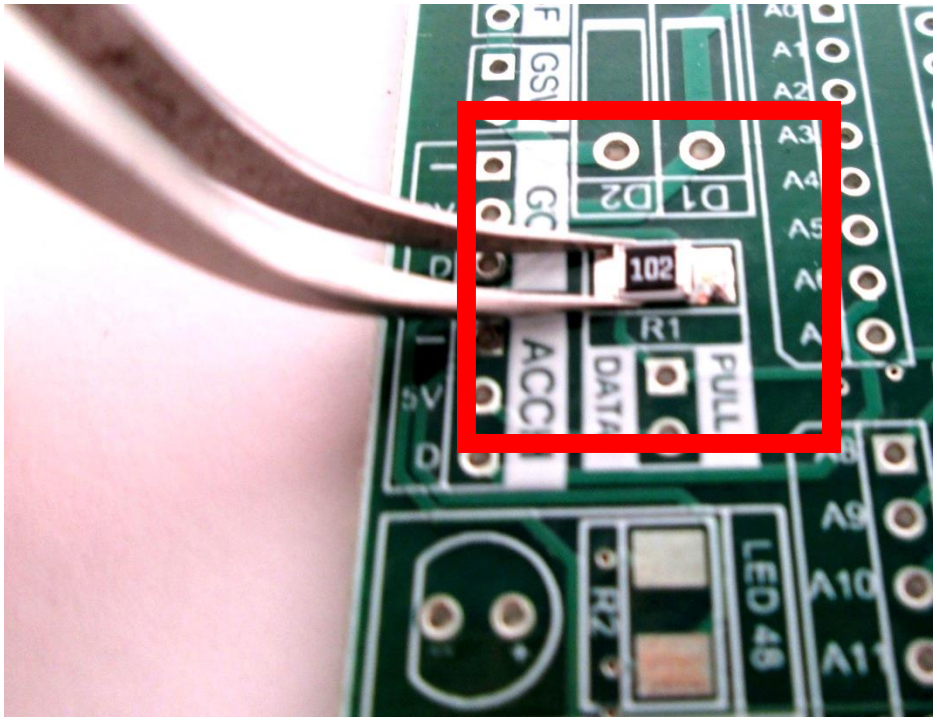
Soldering Tutorial

Surface Mount Soldering



- Put a small amount of solder on the pad. Like through-hole, this is easier if you heat the pad slightly with the iron first.
- The solder will cool before you place the SMD on and that's ok

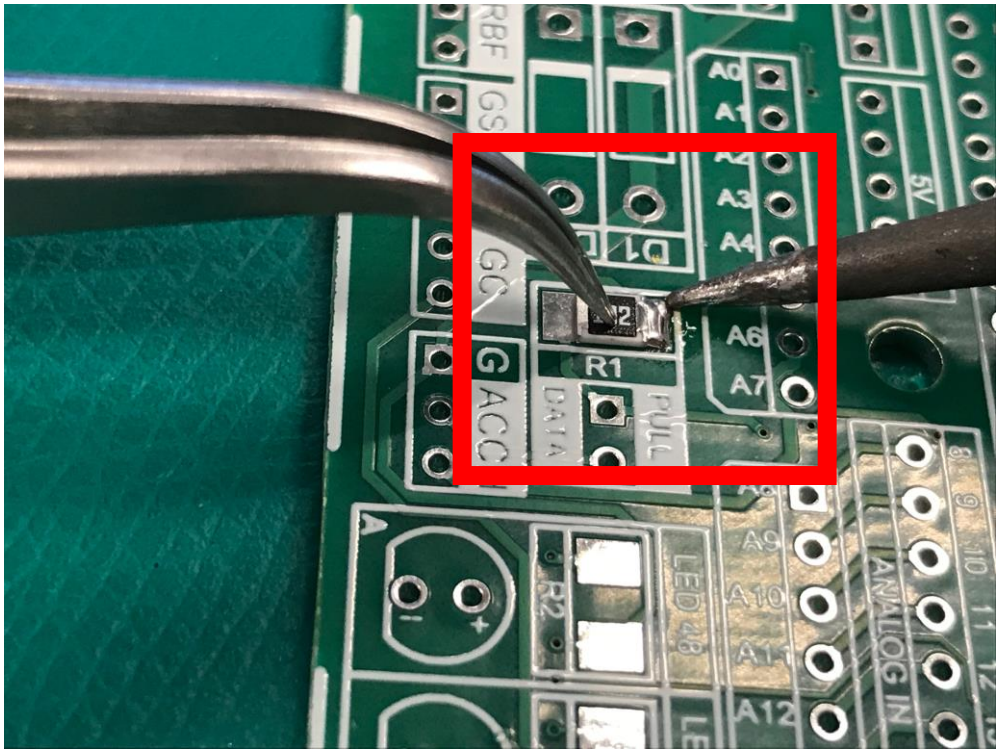
Soldering Tutorial
Surface Mount Soldering



Use tweezers to hold the SMD centered on the pad

Soldering Tutorial

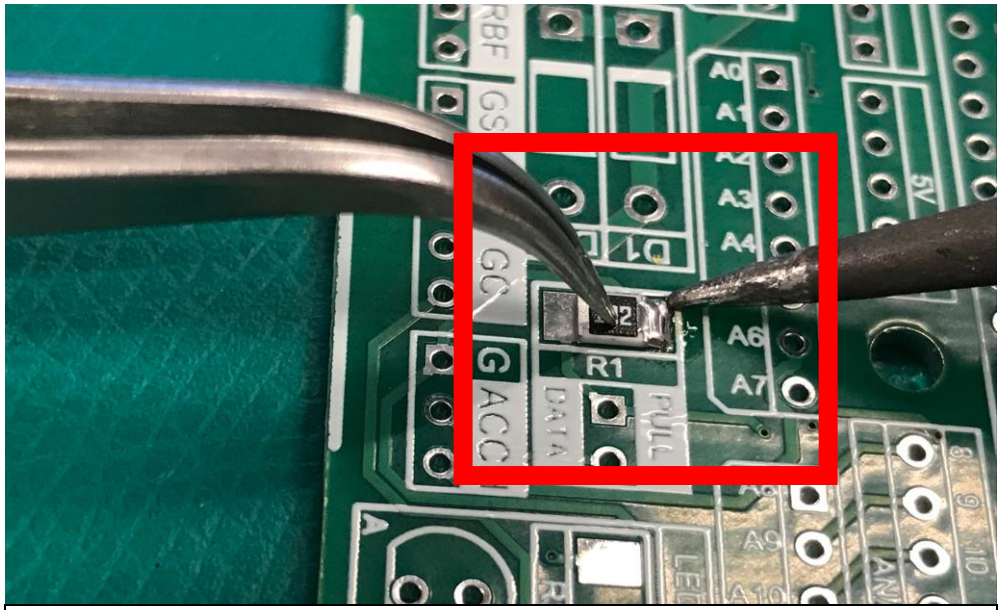
Surface Mount Soldering



Press down firmly on the top of the part with the tweezers and reheat the solder. This will allow you to push the part flush to the board.

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

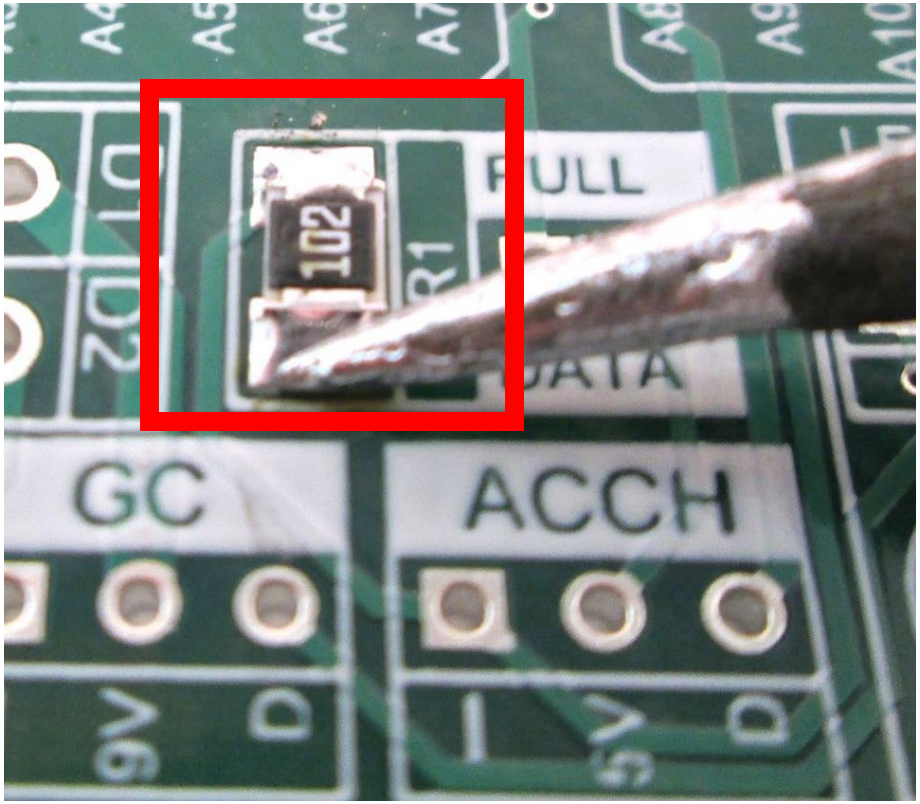
Soldering Tutorial
Surface Mount Soldering



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

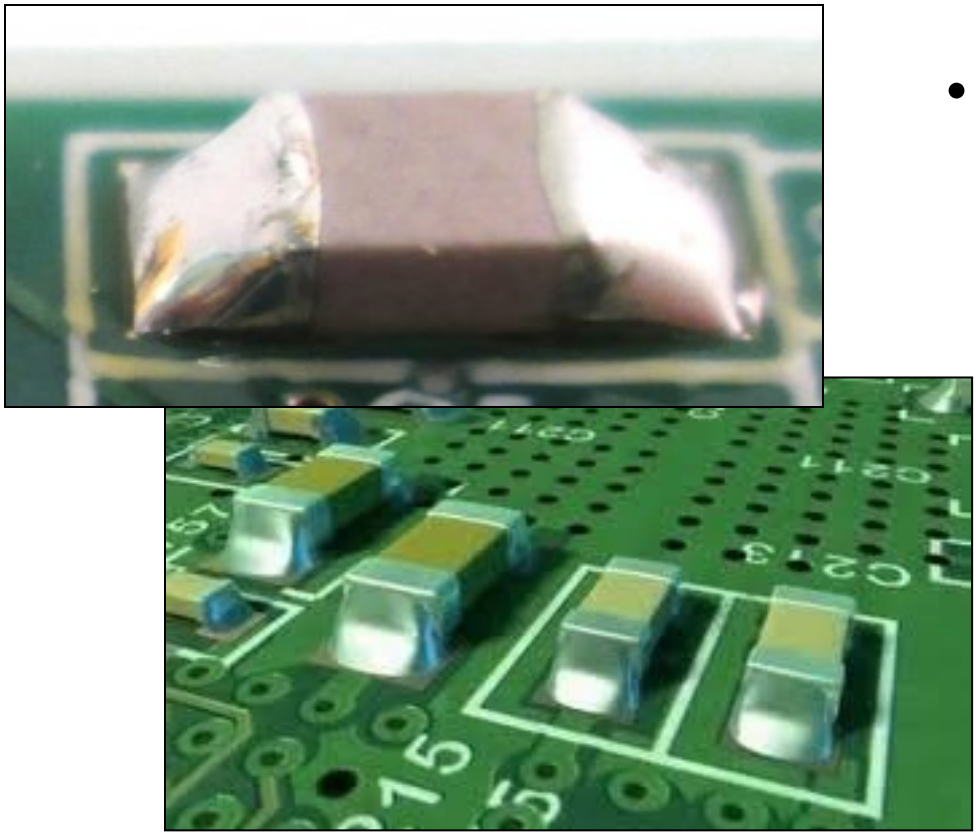
- Press down firmly on the top of the part with the tweezers and reheat the solder. This will allow you to push the part flush to the board.
- Make sure the part is straight on the pad before moving on. If it is not straight, reheat solder and try again

Soldering Tutorial
Surface Mount Soldering



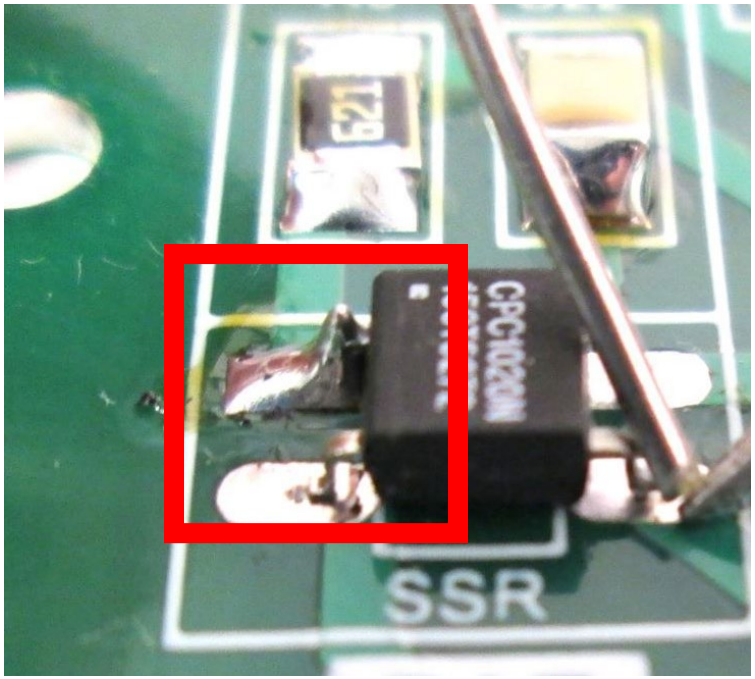
Heat the other pad slightly and put solder on the other end. No tweezers should be needed.

Soldering Tutorial
Surface Mount Soldering



- Good surface mount solders have:
  - No cracks, gaps, graininess, and should be shiny.
  - Just enough solder to make the connection
  - Component is flush with the board.

Soldering Tutorial
Surface Mount Soldering

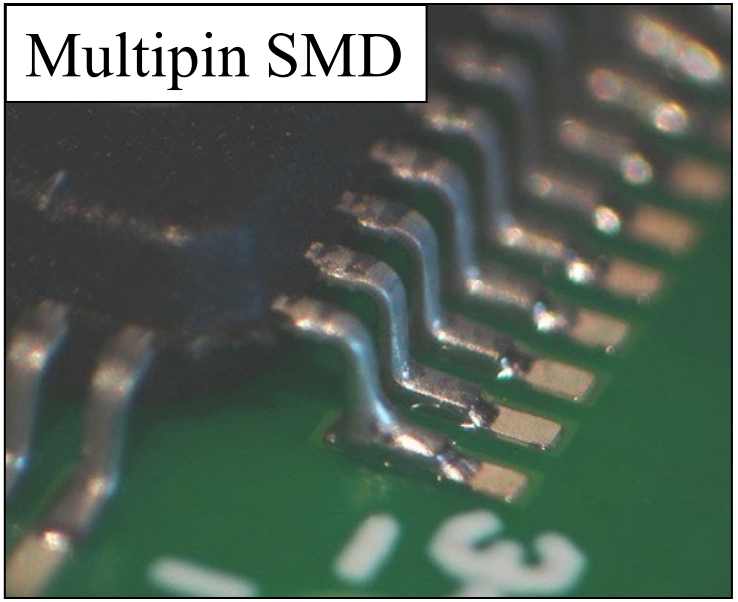


Multiple-terminal SMD fallow the same basic procedure as two-terminal SMD.

- First, tack down one corner with solder. Then check to see all the pins are aligned with the pads before continuing.

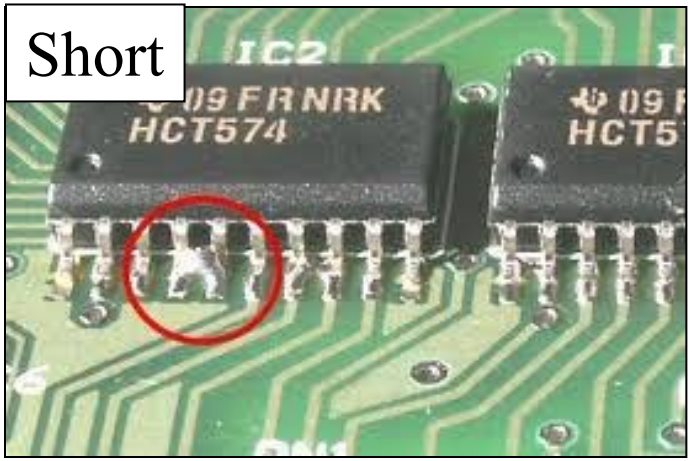
Soldering Tutorial
Surface Mount Soldering

Multipin SMD



- Continue to solder the remaining pins.
  - You will be surprised how little solder you need to make good connection.
  - *If there are a fair amount of pins, feel free to give the component a break from the heat of the soldering iron.*

Soldering Tutorial
Surface Mount Soldering



With surface mount soldering, the two most common issues are shorts and the component not being flush with the board.

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Soldering Tutorial

Fixing Soldering Errors

So, after all your best efforts and careful inspection, you made a mistake…..

Don't Panic… Remain Calm…

- Components **can** be removed from a circuit board.
- Rule of thumb: Components and solder are easier to fix/replace than the circuit board.

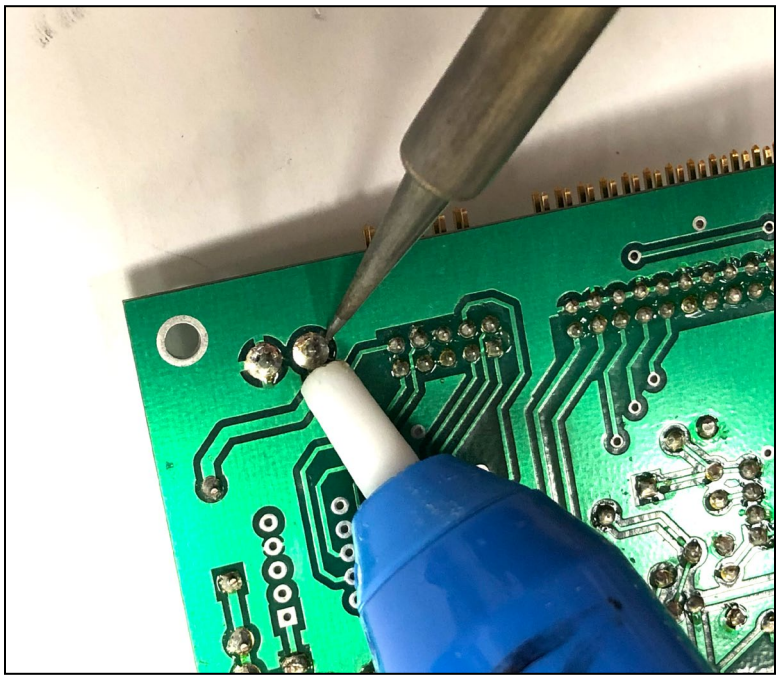
Soldering Tutorial

Fixing Soldering Errors

A "solder sucker" removes *liquid* solder from the board with air pressure.

Soldering Tutorial

Fixing Soldering Errors



Prime the solder sucker with a pump, and place the soldering iron on the solder that you wish to be removed. Once the solder is liquid, press the release button on the solder sucker and it will remove the solder.

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Soldering Tutorial

Fixing Soldering Errors

Think of "solder wik" as a q-tip that can clean up any unwanted solder.

Just like the solder sucker, use the iron to melt the unwanted solder. Than use the solder wik to remove the unwanted solder.

Wik

Soldering Tutorial

Fixing Soldering Errors

If in doubt, it's usually wiser to sacrifice the component by cutting it's leads off, then removing the leads one at a time. This will avoid damaging the traces on the circuit board, which are very difficult to repair.