PLUSIVO

Mastering the Art of Soldering

User Guide for the Plusivo Soldering Kit

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1. Introduction

In this book you will learn to master the art of soldering electronic parts, including how to avoid common pitfalls of soldering, how to choose the appropriate tools and how to accomplish the best result possible with the least amount of effort. Included also are safety tips that one must consider in order to avoid untoward accident when doing the soldering job.

By reading this book, in just one hour, you will learn what most professional engineers and technicians know about soldering.

2. Safety Precautions

Protecting oneself at all times is always utmost priority and electronics is no fun anymore if there will be untoward accident when doing the soldering job. With soldering, the main safety hazard is related to the high temperature of the soldering iron tip. Other safety precautions that you should take into consideration are related to the fumes generated that are harmful to your eyes and lungs, the hot solder splashes that might cause injury to yourself as well as to other people around you and the toxic soldering materials being handled that you might ingest if not careful.

The product we sell is safe when used properly but you as the end-user has also a big part and responsibility to ensure that no harm or damage (both ways) will result in using the product. Make sure you follow these rules when using the soldering iron and during the soldering process.

1. Always protect yourself at all times by wearing safety eyeglasses.
2. Always solder in a well ventilated area or work with a fume extractor so that you do not inhale the fumes released during the soldering process.
3. Never leave the soldering iron un-attended while it is powered on
4. Unplug the soldering iron when you're not going to use it for the next 10 minutes or so.
5. Use the holder as stand for your soldering iron and do not place it elsewhere, it might cause accidental fire.
6. Do not solder live circuits.
7. Do not touch flammable items (e.g. alcohol, solvents, paper, wood, etc) with the hot soldering iron tip and keep them away from your work space
8. Make sure that the hot soldering iron tip does not touch the power supply cord.
9. Keep your fingers and skin away from the hot soldering iron tip
10. Do not touch the parts immediately after soldering, they might still be hot
11. Do not eat while soldering nor lick your fingers or put any soldering materials or tools in the mouth.
12. Always wash your hands after soldering
13. If something unusual happens or if you suspect that something is wrong or has malfunctioned, do not do anything with the product and immediately contact the seller for assistance.

2.1 Safety Summary

Wear protective eyeglasses 	**Hot: Do not leave unattended** 
No food and drink 	**Use in a well ventilated area** 

Do not work near flammable items 	**Place the iron in holder when not in use** 
Keep your fingers away from the metal part 	**Wash your hands after soldering** 

3. Tools for Soldering and Desoldering

3.1. Introduction

In this chapter we are going to cover the safety precautions first, followed with the usage of each tool. We will explain how to choose the best tool for the job, how to use the tools safely and how to obtain the best results in practice.

Adjustable Temperature Soldering Iron

Soldering Iron Stand

Desoldering Pump

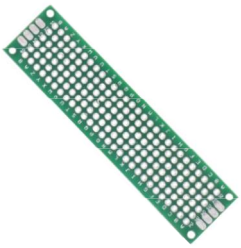
Solder Tube

Solder Wick

Anti ESD Tweezers

Soldering Iron Tip Set

Mini Wire Stripper Tool



Printed Circuit Board

3.2. The Soldering Iron

There are a number of soldering irons that you can use and choosing appropriate iron depends primarily on the way that you'll utilize it and the kind of activities or projects you plan to do. When selecting iron to use, the three most essential considerations are temperature, wattage, and the soldering iron tip.

For best results we recommend that you use an adjustable temperature soldering iron which has many advantages. Using a fixed temperature soldering iron might leave you with a

temperature that is either too high for lead solder or too low for lead free solder. Whereas, with the adjustable soldering iron, you can always set the optimal temperature based on the solder alloy composition that you use.

Moreover, having an adjustable temperature soldering iron comes in handy when desoldering because you usually need a higher temperature to be able to remove the parts easily from the board.

Adjustable Temperature Soldering Iron

It is also important that you select the right soldering iron tip for the job. Use a fine and sharp tip for surface mount devices and a wide tip for desoldering.

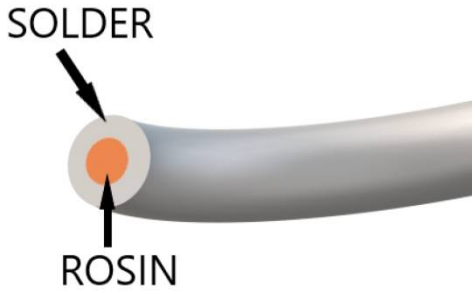
If you want your soldering iron tips to last for a long time, you need to take care of them. After you finish using the soldering iron, you should add some solder to the soldering iron tip so that it remains covered in solder when not in use. This will protect the soldering iron tip and will prevent it from oxidizing, so it will be working properly every time you want to use it.

While working with the soldering iron, you should always take the necessary safety precautions presented in the former chapter.

3.3. The Solder

The solder wire is the metal alloy that is used for soldering the parts and wires together. It is usually made from a material that has a low melting point and flows nicely on other metals. The solder that comes with this kit is without the toxic lead for distribution in EU while those sold in US is the tin wire solder tube with lead. EU commercially requires that on hand electronics use lead-free solder (RoHS) due to the health risks involved. It is extra popular these days for environmental and health reasons. The solder may come in a spool or sometimes enclosed in a tube, called solder wire tube.

Most of the times, the solder wire also has a rosin core. The rosin core's role is to help eliminate oxides and dirt and to make the solder flow nicely on the component's terminals and pads.



Rosin Core Solder

There are four common types of rosin cores:

- R - Rosin: pure rosin with no activators, mildest
- RMA - Rosin Mildly Activated: contains mild activators
- RA - Rosin Activated: rosin with strong activators
- AC - Non Rosin Activated

The molted rosin is acidic and it is able to dissolve thin layers of oxides even without other additives. We suggest that you usually use RMA, as it features a good balance of cost, availability and cleaning performance.

There are two main types of soldering wires: tin-lead based soldering wire (SnPb) and lead-free soldering wire. From a technical point of view, the lead-based soldering wire is the best in terms of performance, as it has a low melting point and it flows nicely on other metals. However, the lead-free soldering wires have gained traction mostly due to environmental concerns, since they are environmentally clean. The lead based solders usually melt at about 183 °C (361 °F). The lead free alloys have a higher melting point.

As a reminder, you should always take the necessary safety precautions presented in the beginning!

3.4. The Desoldering Pump

As its name indicates, the desoldering pump is used for sucking the solder so that you can desolder the electronic parts easier. The tip is usually made from a thermoresistant material.

In order to use the desoldering pump, press the piston, then place the desoldering pump tip near the soldering joint and push the trigger button in order to suck the solder.

3.5. The Soldering Wick

Soldering Wick

The soldering wick is usually made from braided copper wire and it absorbs the solder. It is mainly used for wicking the solder from the circuit board. It is useful when too much solder has been applied or when you want to desolder.

A less known use of the soldering wick is for soldering the surface mounted parts. This soldering technique consists of applying a generous amount of solder over the surface mounted chip's pins and then soldering them, irrespective of the possible formation of solder bridges. Then, the soldering wick is used to absorb the extra solder, leaving the surface mounted chip's pins cleanly soldered to the pads.

3.6. The Soldering Iron Stand

The soldering iron stand is where you put your soldering iron when not in use. It helps in preventing burns. The wet sponge is for cleaning the soldering iron tip and is used to eliminate excess solder.

Insert the spring holder into the base and screw it in

Soak the sponge in water before use

Use the wet sponge for cleaning the soldering iron tip

When the soldering iron is not in use, you can put it at rest on the soldering iron stand

3.7. Tweezers

Tweezers are usually made from high quality stainless steel with anti static plating and have fine tips. They are usually straight or curved tweezers. They are especially designed for electronic projects that require high precision, such as holding small items and small parts. You can use it and ideal for grabbing little screws and wicking coils.

Straight Tweezers

Curved Tweezers

3.8. Soldering Iron Tip Set

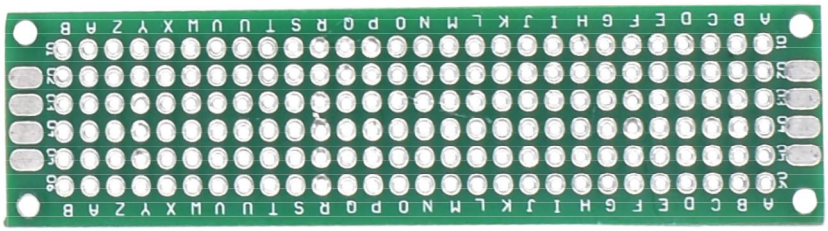
The soldering iron is not complete without the soldering tip. It is the part that is found at the end of soldering iron and usually made of copper plated iron and have an angle ranging from 22° to 90°. It is the part that heats up causing the solder to flow around the two components being joined. It is a replaceable part and comes in various tips that differ in size and shape depending on the soldering work you would do. When using a soldering tip, it's important to ensure it appropriate for the soldering iron.

3.9. Mini Wire Stripper Tool

The mini wire stripper tool is safe and easy to use during soldering process. It has several settings for stripping wires and also cables of differing width. The grip is made of plastic and the knife is made of metal. It is a necessary accessory when you're doing soldering especially when you need to punch down excess wires/leads.

3.10. Printed Circuit Board (PCB)

A PCB is basically a board that connects electronic components. This is where you will do soldering of electronic components.



3.11. Digital Multimeter

The compact digital multimeter can be used to measure DC voltage and AC voltage, DC current, resistance, diodes, continuity test and other parameters. This multimeter is the ideal tool for laboratories, factories, enthusiasts and families.

Please take the time and read these operating instructions before use and retain them for future reference. Failure to follow these instructions may lead to serious injury and damage to property.

Safety notes

1. When measuring, do not enter a limit that exceeds the range.
2. Measure a safe value, 36V DC or 25V AC, to check whether the connections are correct, whether the insulation is good to avoid the shock.
3. When changing the function and range, the test leads should leave the test point.
4. In the resistance mode, please do not add voltage to the input.

General characteristics

- Maximum display value: 1999 (31/2) bit, automatic polarity display
- Sampling rate: about 3 times per second
- Over range indication: the highest bit is "1"
- Low voltage display: "  " symbol appears
- Working environment: (0~40) °C, relative humidity < 80%
- Power: 3V battery
- Accuracy: ± (reading % + the least significant digits)
- Ambient temperature: (23±5) °C, relative humidity < 75%, calibration guarantee period for one year from the day of production.

DC Voltages (DC Volts)

Range	Accuracy	Resolution Ration
200 mV	±(0.5% + 4)	100 µV
2 V		1 mV
20 V		10 mV
200 V		100 mV
500 V	±(1.0% + 5)	1 V

Input impedance: 1 MΩ

AC Voltages (AC Volts)

Range	Accuracy	Resolution Ration
200 mV	±(1.2% + 10)	100 mV
500 mV		1 V

Input impedance: 1 MΩ
Frequency response: (40~200) Hz

DC Current

Range	Accuracy	Resolution Ration

20 µA	±(1.5% + 3)	0.01 µA
200 µA		0.1 µA
2 mA		1 µA
20 mA		10 µA
200 mA		100 µA
10 A	±(2.0% + 5)	10 mA

Maximum input current: 10 A (not more than 10 seconds)
Overload protection: 0.2 A / 250 V fuse (10A range is without insurance)

Resistance

Range	Accuracy	Resolution Ration
200 Ω	±(1.0% + 5)	0.1 Ω
2 kΩ	±(0.8% + 3)	1 Ω
20 kΩ		10 Ω
200 kΩ		100 Ω
2 MΩ	±(1.0% + 15)	1 kΩ

Overload protection: 250 V DC and AC peak

Diode and ON/OFF Test

Range	Display	Test Conditions
	The diode forward voltage	DC current is about 1 mA Reverse voltage: 3 V
	Buzzer sound Test Resistance smaller than (70 ±20) Ω	Circuit starting voltage: about 3V

Overload Protection: 250 V DC or AC peak

DC voltage measurement

1. Insert the black wire to "COM" and the red wire to the "V/Ω" port;
2. Put the range switch to the corresponding DCV range and then put the test probes to the source to be measured. The polarity will be shown on the display.

Note:
1. If the range of the voltage to be measured is unknown, put the range switch to the highest rank, then according to the value displayed, turn to the corresponding range;
2. If on the display is shown "1", this means that the range is exceeded and the range switch must be set to a higher gear;
3. Do not measure a voltage over 500 V, because there is a risk to damage the instrument circuit;
4. When measuring a high voltage circuit, pay attention not to touch any high voltage part of the circuit.

AC voltage measurement
1. Insert the black probe to "COM" and the red probe to "V/Ω";
2. Put the range switch to the corresponding ACV range and then put the test probes to the source to be measured.

Note:
1. If the range of the voltage to be measured is unknown, put the range switch to the highest rank, then according to the value displayed, turn to the corresponding range;
2. If on the display is shown "1", this means that the range is exceeded and the range switch must be set to a higher gear;
3. Do not measure a voltage over 500 Vrms, because there is a risk to damage the instrument circuit;
4. When measuring a high voltage circuit, pay attention not to touch any high voltage part of the circuit.

DC current measurement
1. Insert the black probe to "COM". The red probe can be inserted to "V/Ω" for measuring up to 200 mA, or insert the red probe to "10 A" for a maximum 10 A measurement;
2. Put the range switch to the corresponding DCA range and then put the multimeter (the 2 probes) in series with the part of the circuit that you want to measure how much current it draws. The polarity will be shown on the display.

Note:
1. If the range of the current to be measured is unknown, put the range switch to the highest rank, then according to the value displayed, turn to the corresponding range;
2. If on the display is shown "1", this means that the range is exceeded and the range switch must be set to a higher gear;
3. The maximum input current is 200 mA or 10 A (depending on the port that the red probe was inserted). If you try to measure a current higher than the maximum input specifications, the fuse will blow. Check the fuse if you have no reading on the display.

Resistance measurement
1. Insert the black wire to "COM" and the red wire to the "V/Ω" port;
2. Put the range switch to the corresponding resistor range and connect the two test probes to the element you want to measure.

Note:
1. If the resistance value exceeds the selected range value, on the display will be shown "1" and the range switch should be changed to a higher gear. When the measured resistance

value is more than 1 MΩ, the reading takes a few seconds to stabilize, which in high resistance mode is normal.
2. When the input is open, the overload condition is displayed.
3. When measuring the on-line resistance, make sure that all the power of the circuit under test are turned off and all the capacitors are fully discharged.
4. Do not input voltage in the resistance range.

Diode test
1. Insert the black probe to "COM" and the red probe to "V/Ω" (note that the polarity of the red probe is "+");
2. Put the range switch to " ". Connect the black probe to the cathode and the red probe to the anode. On the display will be shown the approximative forward voltage drop.

Non-contact voltage detection (with NCV instruments)
1. Set the function range switch to the NCV range position.
2. Close the instrument to > 100 VAC
3. When the instrument distance < 30 mm, the instrument within the non-contact voltage detection alarm will start to beep.

Data retention function
Press the (right) key, then the measurement data will be locked, and will be easy to read and record. Then press the right button to reset the instrument to restore the measurement.

Back-light display
Press the "left" button and the back-light will be turned on for about 10 seconds.

Instrument maintenance
This instrument is a precision instrument, the user should not arbitrarily change the circuit.

Note:
1. Do not connect voltages above 500 VDC or 500 Vrms;
2. Do not measure the voltage value when the range switch is in resistance mode "Ω";
3. Do not use the multimeter for testing when the battery is not installed or the back cover is not installed;
4. Before replacing the battery of fuse, remove the test leads from the test point and turn off the power switch.

Fuse replacement
When replacing the fuse, use the same fuse as the model type.

This manual is subject to change without notice.
The contents of this manual is considered correct, it the user found omission, please contact the manufacturer. The Company does not assume any accidents and hazards caused by incorrect operation of the user.
The functions described in this manual do not serve as a reason for the use of the product for special purposes.

4. Creating Awesome Soldering Joints

4.1. General Guidelines for Soldering

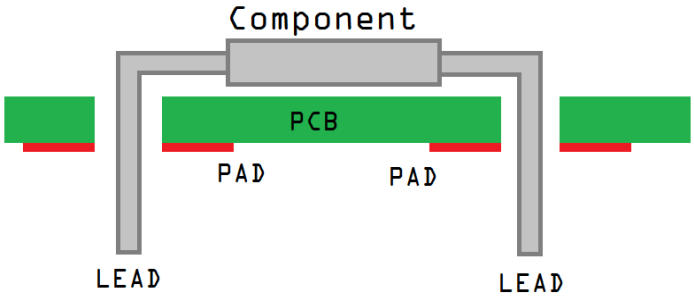
While soldering, there should be at least 20 cm distance between the eyes and the board and the soldering iron movement should be easy. An incorrect position can lead to fume inhalation and back pain.

4.2. Soldering Through-Hole Technology (THT) Components

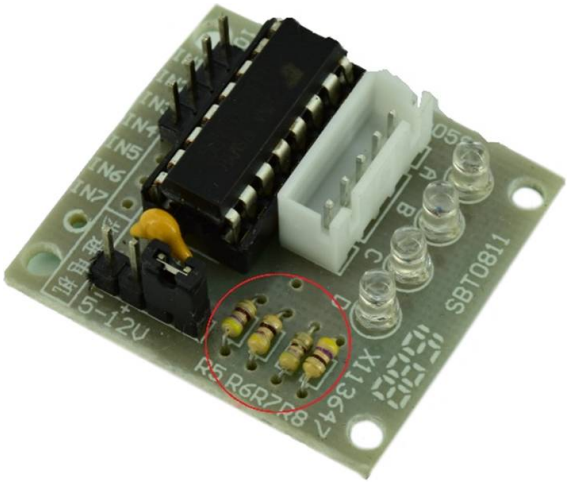
After introducing precautions and tools that are used with soldering process, we now proceed to learning how to solder THT parts/components or through-hole-technology soldering using a point to point soldering method. Let us begin with some definition of terms and some terminologies.

4.2.1. Through-hole Technology or THT

Through-hole technology or through-hole soldering as the name implies (through-hole or thru-hole) is the method when you build your electronic circuits by mounting or inserting electronic component leads into holes drilled in printed circuit boards or PCB. The leads are then manually or automatically soldered or affixed to pads on the opposite side of the board. The electronic components used in this process are called THT components.



Through-Hole Technology Diagram

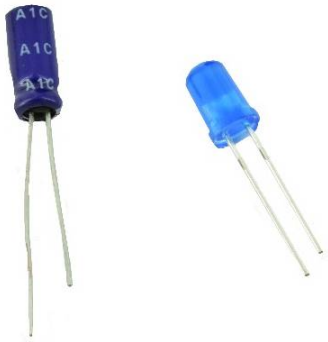


Components mounted on PCB

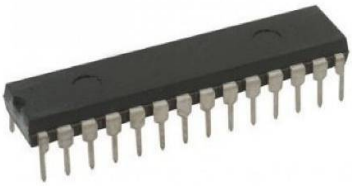
4.2.2 Types of Leads of THT Components?

THT components' leads come in the following types: axial, radial and multiple leads. These types depend on the position of the leads in the electronic component. **Axial leads** are positioned at each end of the cylindrical body or along the axis of symmetry of the component and soldered horizontally on a PCB. Examples of components having axial leads are the following:

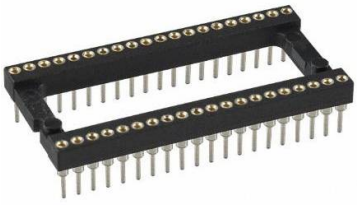
Radial leads are positioned in parallel from the same surface of a component and mounted vertically or perpendicular to the PCB as seen from the following examples.



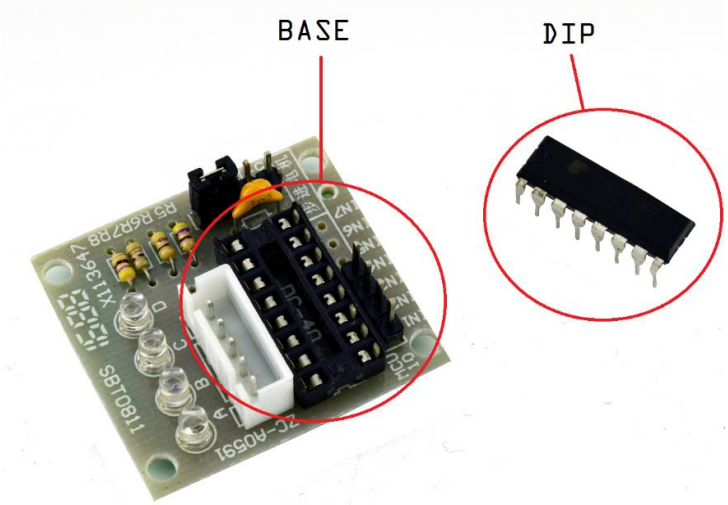
Electronic components with **multiple leads** are those with more than two leads and uses single or dual in-line (DIP) packages to be mounted either directly onto the PCB or via a socket or base. DIP is described as an electronic segment package with a rectangular housing and two parallel lines of electrical pins. It is the most widely used package because it can easily be mounted and is also available with 8, 12, 14, 16, and 20 pins.



DIP



Base



DIP mounted on PCB

4.3 Preparations before Soldering

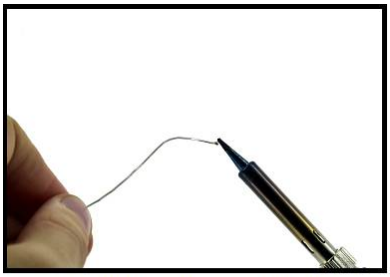
Before soldering, prepare your soldering iron, PCB and the components to be soldered and follow the following steps:

1. Check if the tip is screwed tightly in place in the soldering iron then turn on the soldering iron and let it heat up at desired temperature (with adjustable temperature, set it at 325-375 degrees C).

Important Note: The power plug in this manual may differ from actual product. It will depend on the country where the kit is being distributed.

2. When the tip is hot enough, clean it by wiping on the damp sponge

3. Proceed with “tinning the tip” by covering or coating the tip with the solder. Let the solder flow evenly around the tip. This will improve heat conductivity and will help protect the soldering iron tip and make it last for a long time.

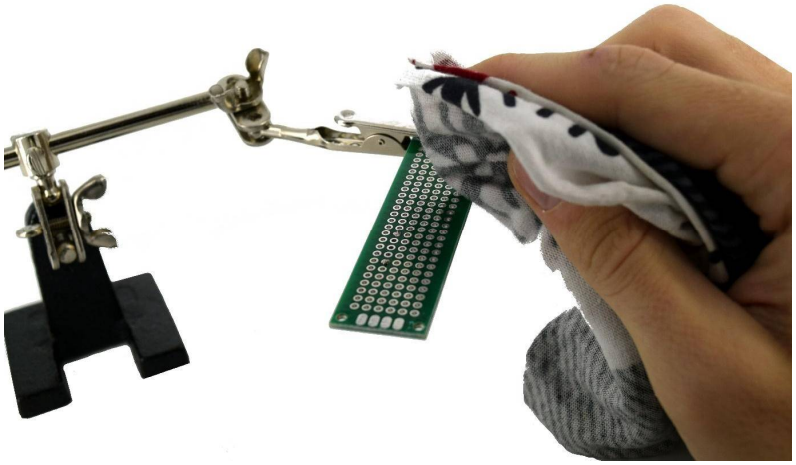


1. APPLY SOLDER TO THE TIP

2. ROLL THE TIP ON A SPONGE

3. PROPERLY TINNED SOLDERING IRON TIP

4. Clean and prepare the PCB and electronic components to be used. Make sure that they are free from contaminations such as grease and dirt by gently wiping them with isopropyl alcohol. You can place the PCB in a vise to prevent it from moving.



5. It is very important for the PCB not to move during the soldering process. PCB can be gripped by a vise to prevent it from moving as seen below.

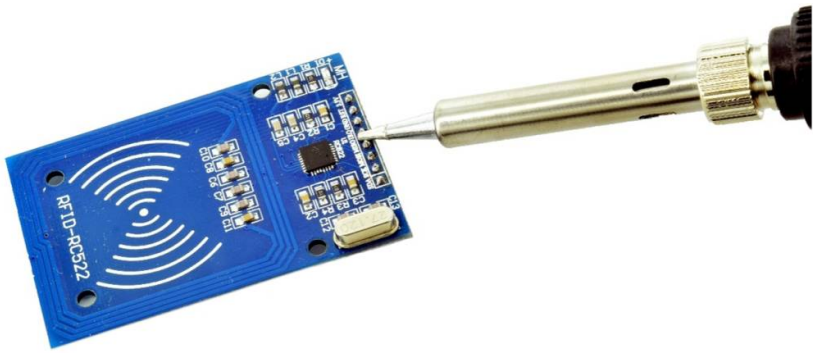
4.4 What To Do and Not To Do When Soldering

Soldering may seem to be a complicated task and may appear difficult to do but with a little practice using this guide, it can be quite simple afterwards. Before we proceed to the step-by-step instructions on how to solder a component, there are dos and don'ts that you need to know about soldering. The **X** mark will indicate things that you should avoid.

1. Do not apply excessive pressure

X: Try not to apply too much pressure with the soldering iron on the PCB or the parts being soldered. It won't help in soldering the joints more rapidly, but will only just harm the plating and can even destroy the best tips.

✓**:** Just apply enough pressure on the PCB so as not to destroy the board or the components being soldered.



2. Select the Correct Soldering Tip

✓: It is recommended to pick the largest tip workable for each solder joint. Select the tip that has the biggest contact area.

3. Return the Soldering Iron to the Soldering Iron Stand

X: Try not to leave the soldering iron unattended when it is ON because it will get damaged and may cause unwanted accidents.

✓: Always put the tool to the stand when not in use.

4. Changing the Cartridges

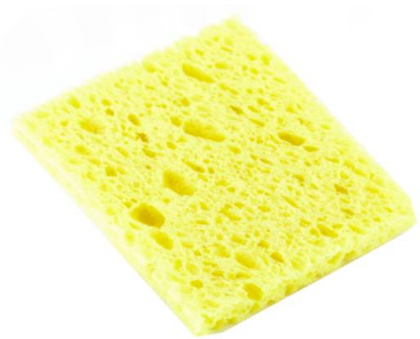
X: Try not to use pliers or any other tool to remove and replace the cartridges because it will cause irreversible damage to the tips.

5. Keep the tips' surface clean: Always make sure that tips' surfaces are clean. Having dirty rusty surface is one of the reasons why the heat is not transferred properly

X: Avoid using sandpaper or files for cleaning the tip.

✓**:** Keep the tips clean and re-tin them before placing the soldering iron in its stand. You can use moist sponge (moistened with deionized water, try not to use tap water) to remove stains on the tip (moist sponge cools the iron too fast). You can also use non-abrasive brass wire.

Brass wire (not included in the kit)

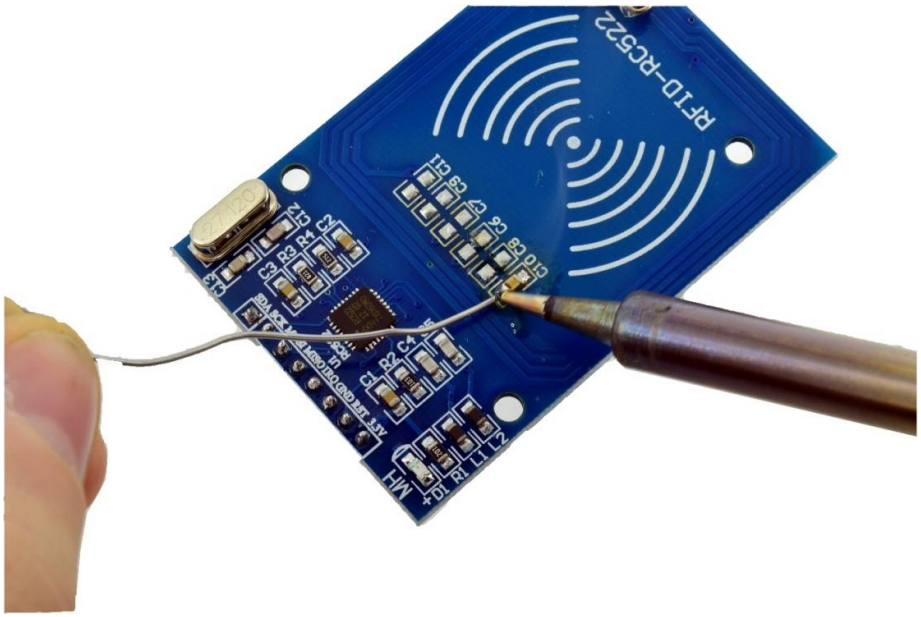


Sponge

6. Applying Solder

X: Try not to melt solder directly onto the tip unless required.

✓: The solder wire should be applied to the surfaces being soldered. The diameter of the wire used must match the solder joint you are doing.



7. Possible to work on the lowest temperature: The higher the temperature, the bigger the danger of oxidation is.

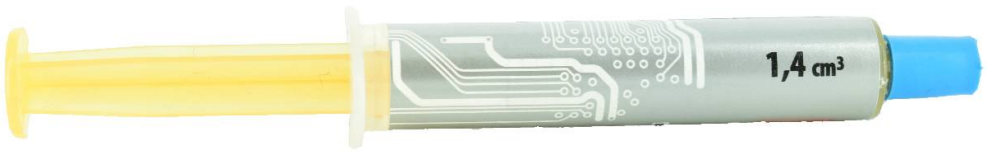
X: Try not to work on a high temperature because it can harm the PCB and shorten the life of the tips.

✓: It is recommended to preheat if the solder needs temperatures above 380°C.

8. Avoid rust

X: Avoid using too much flux because it can create rust on the tip.

✓: The internal flux from small solder rolls is not sufficient. You can add external flux as necessary.



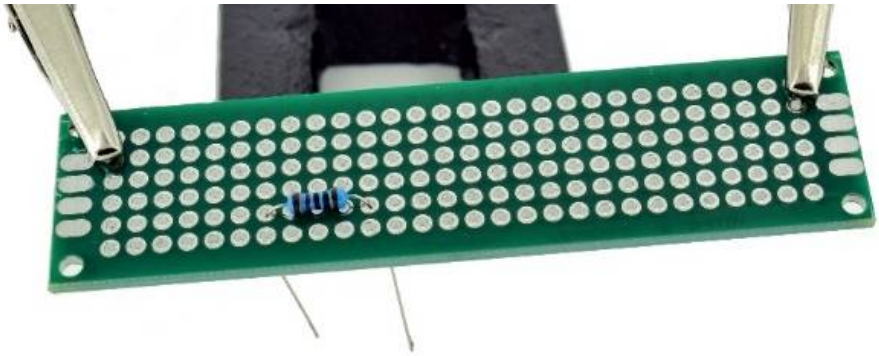
Solder flux (not included in the kit)

4.5 How to Solder THT components

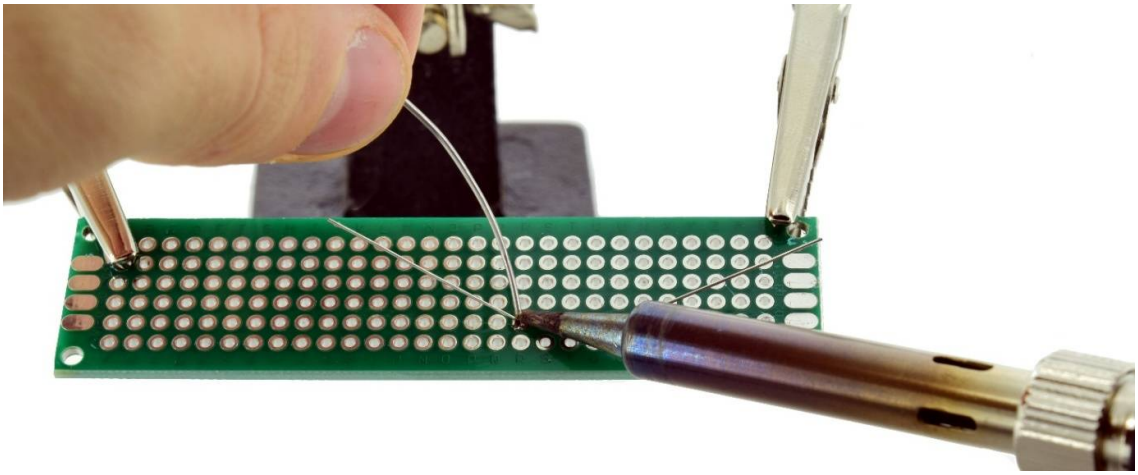
Before we begin, always keep in mind that safety is of utmost priority and remember all the necessary precautions mentioned from previous section.

The following are the basic steps in basic soldering or to make a very good solder connection:

1. Insert the leads of the components or the parts that you will need to solder through the holes of the PCB; you can use a pair of tweezers in this step to secure the components in place.



2. Heat the solder joint evenly by touching the tip (use the side of the tip) of the soldering iron to the copper pad and the component lead or the part you want to solder. Do this for a few seconds. Then apply enough solder to joint by touching the solder in between the lead and the soldering iron. It is important to note that you need to apply the solder to joint, not to the tip of the soldering iron



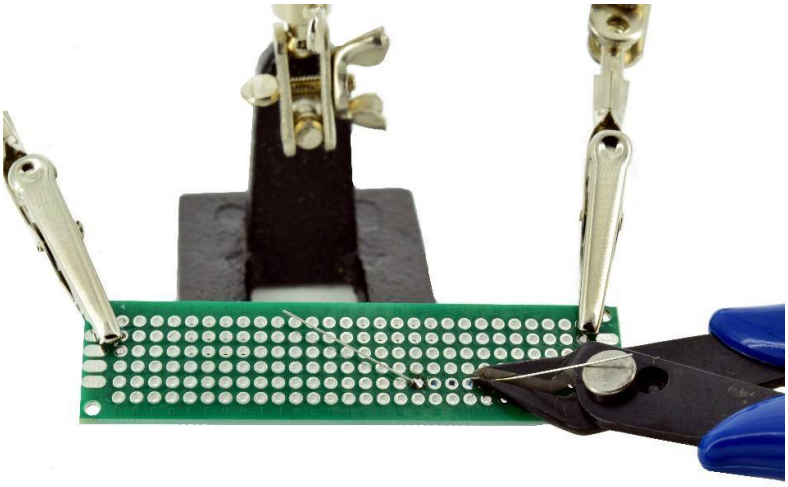
In this step, the solder will melt and flow. If the solder does not flow, just heat again the joint and try again. Since both the lead and the pad are hot, the solder will flow smoothly in place. Let the solder flow into the joint, fill the hole and form a volcano-shaped joint.

Note: Avoid applying too much solder as it might spill to nearby joint or can cause bridging. Whereas, applying little solder can cause weak solder joints.

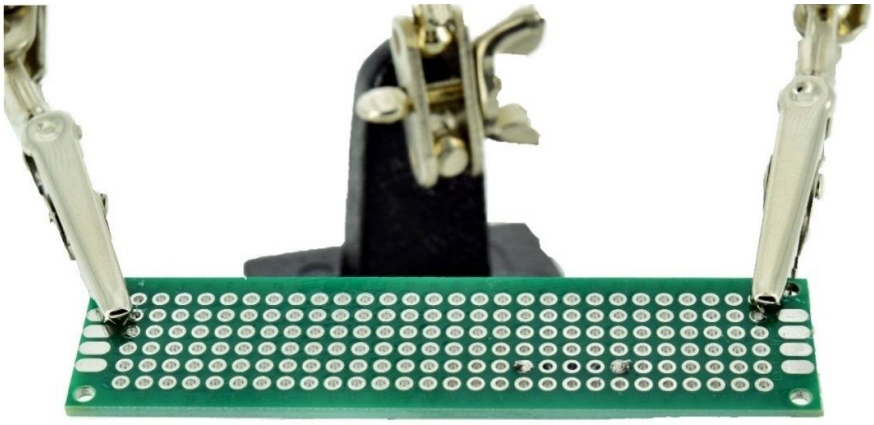
3. Do not move PCB and let the joint cool down naturally and let the solder to solidify. Check if you were able to create a good solder joint.

   NOTE: A good solder joint is smooth and shiny and has cone-shape, not a ball or a clump

4. After creating a good solder, remove the soldering iron and snip the extra wire from the leads/terminals.

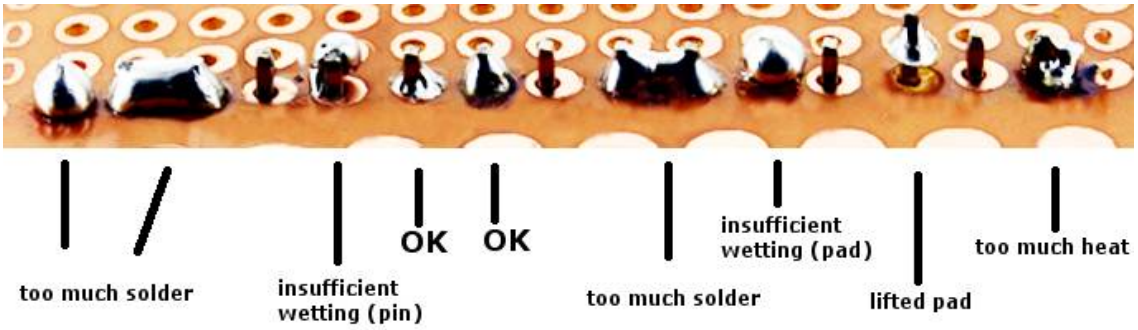


5. Now you're done.



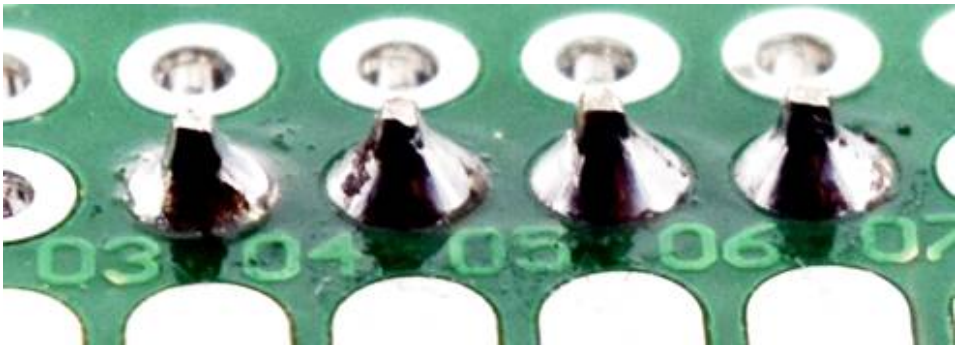
4.6 Common Solder Joint Issues

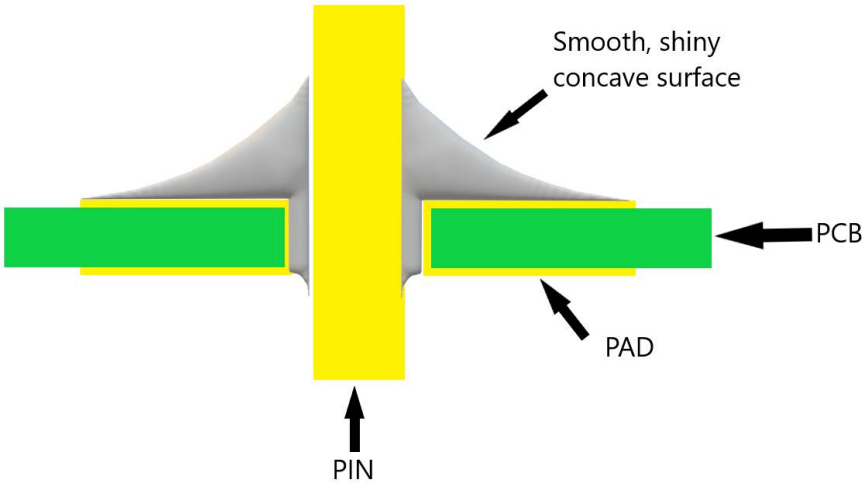
You can see from the image below some common solder joints that you can make whether you are expert or a beginner in soldering. Let us discuss some common soldering issues and see how we can avoid and fix them.



4.6.1 The Ideal Solder Joint

A good solder joint is smooth and shiny and has cone-shape, not a ball or a clump as shown from the following image and the diagram. The concave surface's wetting point should be between the range 40-70 degrees which means that the solder has not been hot and exhausted the flux and the leg is in the center of the joint.





THT Ideal Solder Joint Diagram

4.6.2 Repairing and Preventing Common Soldering Issues

1. Disturbed Joint

When a joint is accidentally moved as the solder hardens, you end up with a disturbed solder joint which looks rough or frosted.

How to Repair: Reheat the solder and make sure that there is no movement as it cools

How to Avoid: Stabilize the PCB with a third hand device

Soldering Vise (not included in the kit)

2. Cold Joint

When the solder doesn't melt completely, the result will be a cold joint. Cold solder joints are weak and usually develop cracks over time and thus unreliable.

How to Repair: Reheat the joint and until the solder flows

How to Avoid: Preheat the soldering iron with adequate power

3. Overheated Joint

An overheated joint results from the solder not flowing well. Usually it has residue of burnt flux that makes it difficult to repair.

How to Repair: Carefully remove the burnt flux using the tip of a knife or very little alcohol & a toothbrush

How to Avoid: Clean the joint to avoid overheating and keeping the soldering iron clean and hot

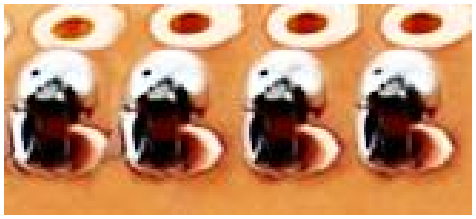
4. Insufficient Wetting (Pad)

Insufficient wetting of the pad results when the solder after wetting the leads does not form good bond with the pad. These are usually caused by a dirty circuit board or when the pad and the pin are not heated properly.

How to Repair: Heat the solder joint evenly by touching the of the soldering iron to the base of the joint until solder flows to cover the pad

How to Avoid: Carefully clean the board and heat the pad and pin properly

5. Insufficient Wetting (Pin)

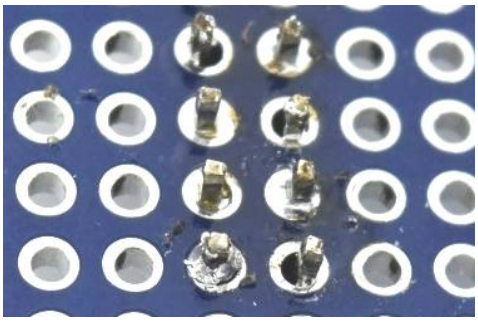


From the image, you can see that the solder has not wetted the pin at all. There was not enough heat applied on the pin and not enough solder has flowed nicely to cover the pin.

How to Repair: Reheat and apply enough solder and make sure that the tip of the iron is touching both the pin and pad

How to Avoid: Heat the pad and pin evenly

6. Solder Starved



When a joint does not have sufficient solder, it is called a starved solder. This case may still have good connection but since it is not a strong joint, it will usually develop cracks over time.

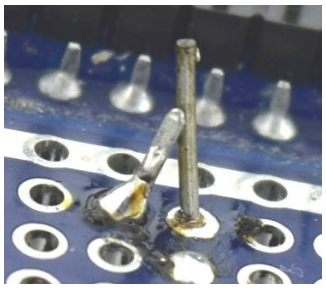
How to Repair: Reheat the joint and add enough solder to make the joint stronger

7. Too Much Solder

Joint with too much solder can still be considered fine, but we never can tell if the electrical connection is reliable or not. As mentioned above, a good joint is the one with cone shape or with a concave surface.

How to Repair: Remove excess solder using tip of the soldering iron or use solder-sucker or solder wick.

8. Untrimmed Leads



The excessively long leads portrayed in the photo above are obviously dangerous, as they can cause potential short circuits.

How to Repair: Trim all the leads to the top of the solder joint

9. Solder Bridge

A solder bridge forms when you use too much solder joining the tip of the two pins or pads.

How to Repair: Remove excess solder using tip of the soldering iron or use solder-sucker/desoldering pump or solder wick

How to Avoid: Use just enough solder to make a good joint

10. Lifted Pad

This frequently happens when attempting to desolder the components from the circuit board. Oftentimes, it can be caused by overworking the joint causing the adhesive bond on the board is ruined.

How to Repair: For the example above, you can solder the lifted pad to the leg of the nearest component. For other cases, fold the lead over towards a copper trace and solder. If the board has a solder-mask, carefully scrape off enough to expose the bare copper.

11. Stray Solder Spatters

Bits of solder can often cause a short circuit on the board. They are there because of the sticky flux used.

How to Repair: Remove the bits of solder using the tip of the knife or tweezers

Problems encountered when soldering can be repaired with patience, here are the tips that you will bear in mind if soldering goes wrong:

1. Do not panic, relax and take as much time as necessary.
2. Stop what you are doing and let the joint cool.
3. Clean the soldering iron and its tip with the appropriate cleaning materials (brass wire, sponge)
4. Get rid of any burn flux from the joint.
5. Prepare the soldering iron by letting it heat up to desired temperature.
6. Reheat the joint and try again

4.7. Soldering Surface Mount Technology (SMT) Components

From the previous topic, we've introduced to you soldering through-hole components. We've shown you guides on how to solder through-hole components including what to prepare before the process and what the finish product would look like. In this chapter, we'll discuss what surface mount technology is and how to solder surface mount parts onto the surface of PCB.

4.7.1 Surface-Mount Technology

Surface-mount technology is the process when you build your electronic circuits by mounting electronic components directly onto the surface of printed circuit boards or PCB. This is different from the previous method discussed wherein components are mounted onto the holes of the circuit board.

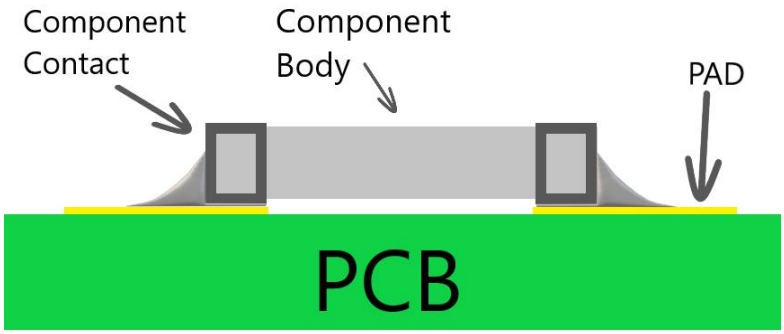


Diagram of Surface Mount Component

4.7.2 What are Surface Mount Devices?

SMD or surface mount devices are those with components that are soldered onto the surface of a PCB in surface-mount technique. The electronic components are usually small in size as compared with their through-hole technology counterpart and are often square, rectangular or oval in shape, and with very small footprints.

In contrast with those used in THT, SMD components do not have wire leads or terminals that is inserted through a PCB. Instead, SMDs components have smaller leads or pins or sometimes no leads at all and are mounted or soldered onto the surface of the circuit board. Due to smaller sizes of SMD, soldering and desoldering of these components require high level of soldering precision.

PCB with surface-mount components

4.7.3 How to Solder SMT Components: Preparations and Steps

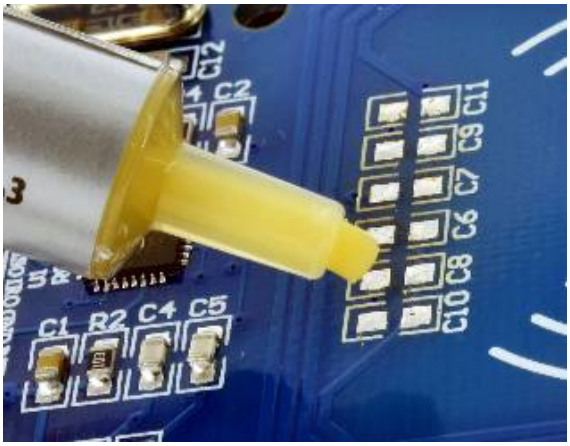
In soldering SMT components, same preparations just like what is discussed in THT soldering will be done (preparing soldering kit, PCB and SMT components). But this time, maybe you will need to use **tweezers** often to hold the smaller SMT components. You may need to use additional tools like the **magnifiers** and light (not included in the kit) to magnify and see clearly the parts you are working on since the components are very small. You may also need to use **flux** (not included in the kit) to clean the pad so that solder will stick properly.

In soldering surface-mount (SM) components, the general steps are the following:

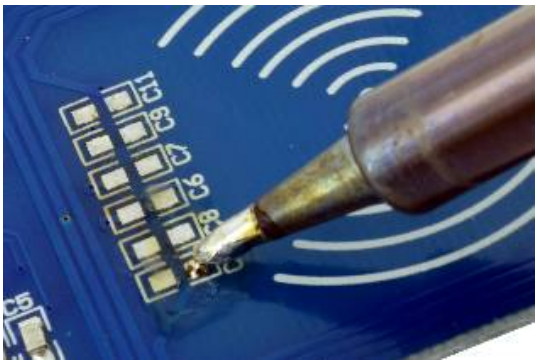
1. Add flux to the PCB
2. Solder the SM component on one side
3. Solder the other side of the SM component

The following is a detailed step-by-step guide in soldering SM components. The contact point of this component is usually located at the two ends of the component; the two ends are the points that are needed to be soldered onto the surface of the PCB. To solder, use the following steps:

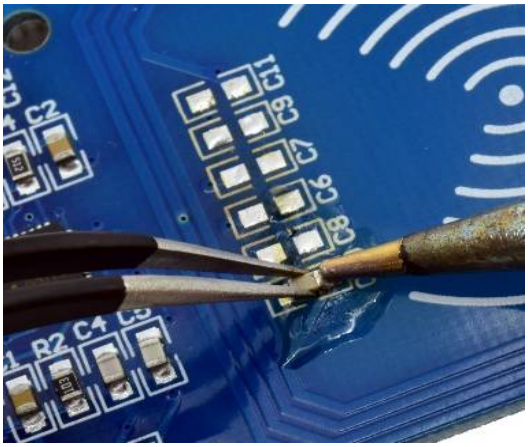
1. Apply a small amount of flux to one pad (the pad is where the contact point of the component will be placed). The purpose of the flux is to clean the area so that the solder will stick properly.



2. Add a little amount of solder to the pad

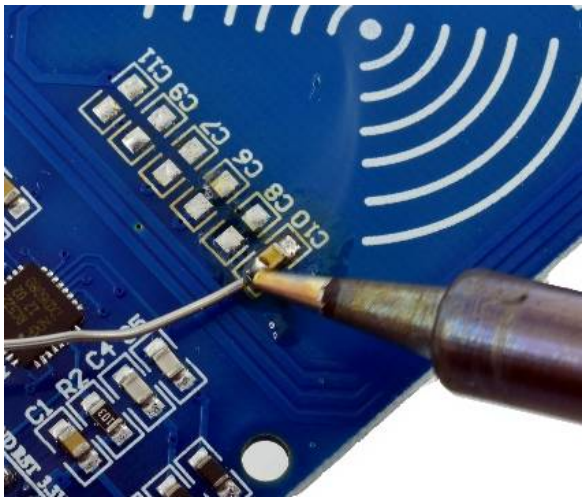


3. While warming the solder on the pad, use tweezers to carefully place the component in position. Hold it steady in place. Tack one side of the component on one pad by placing the tip of the soldering iron in between the pad (with little solder) and the component end and letting the solder flow. Add additional solder as needed.



4. Remove soldering iron and keep the component in place using tweezers until the solder solidifies. Inspect the component if it is properly sitting flat onto the pad on the surface of the PCB. If you need to reposition the component, re-melt solder and carefully push the component using tweezers in place until the solder solidifies.

5. Now work on soldering the other side of the pad. Place the soldering iron tip between the component and the pad and melt little solder in between the pad and the component. You will create a smooth “fillet” or ramp between the pad and the component.



6. Remove soldering iron and let the solder cool. Clean the area and inspect the solder joints (both ends) using magnifiers or loupe to make sure that the component is in place and check if you made a good connection. Add more solder if necessary. A good solder joint should look like the solder adhered or clung to the metal.

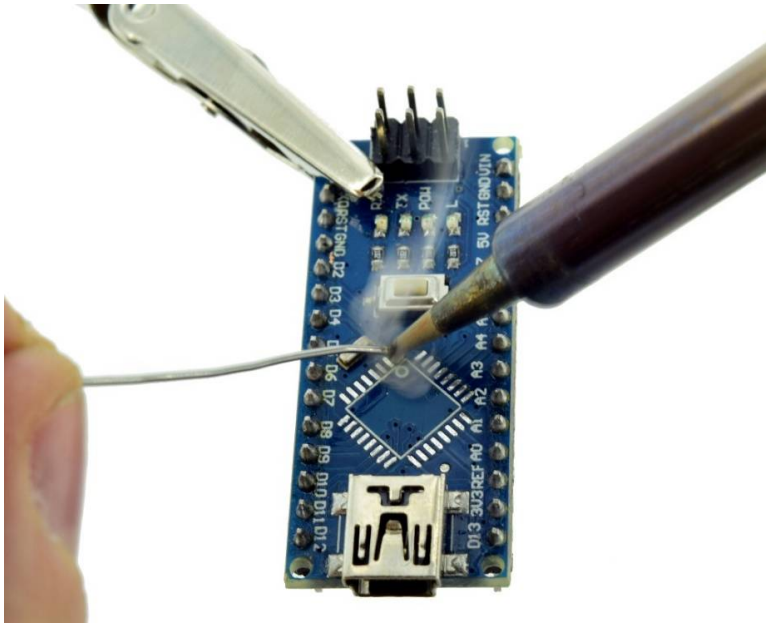
4.8. Advanced Tricks for Soldering Surface Mount Devices

In soldering surface mount components, alignment is very important. Small components like capacitors and resistors are forgiving and adequate to start off with. Others, like SM chips, heavily depend on their placement to function properly.

4.8.1 Steps in Soldering Surface Mount Chip

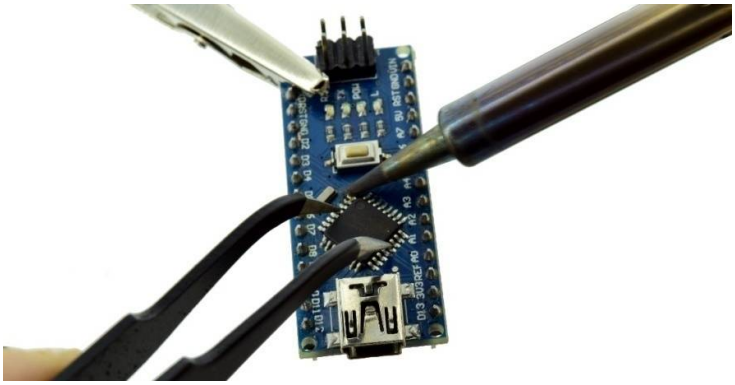
1. First, you have to apply the flux to the pad or the contact point where it will be placed. Using tweezers, place and align the chip. **Do not put the chip yet.** You may use loupe to ensure that the pins are properly positioned on their pads. Be careful not to bend the pins.

2. Before placing the component onto the surface, add a small amount of solder to the pad where the component is going to be installed.



Application of solder to one pad

3. While warming the solder on that pad, use the tweezers to put the component in place. If it is not aligned properly, you can make adjustments while the solder is still melting, or just reheat the pad, re-align, hold still, and remove the soldering iron.



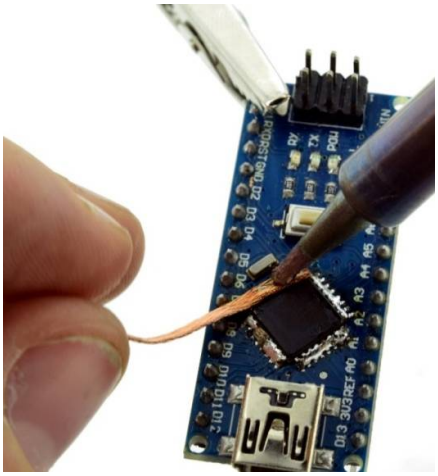
Installation of SM Chip onto the Surface

4. Before proceeding to soldering all the other pins, use a loupe to make sure the alignment is good. Then solder all the remaining pins while continuing to check the placement of the component.

5. Make sure that there are no solder bridges that could be causing short circuits, unless you are working with fine pitch component. The pitch is so close on these pins, so just solder each side and let it cool before proceeding on the next side. When they are all done, let the whole component cool and use the solder wick to remove the excess solder on each side, but leave enough solder to make a proper connection. Repeat the process if there are still solder bridges.

If you remove too much of the solder, you may add more and may repeat the process. Make sure to let the component cool on each side so it will not be damaged by the excessive heat. Take as much as time with this process.

If the solder wick is stuck on the board, **don't pull it with your finger**, just apply a little bit of solder on it and when you see smoke, you can pull it out.



Removal of excess solder using a Solder Wick

6. Do a quick inspection using your loupe to see if there are any bridges left and check that there is a good connection between the pins and the pad.

7. After a close inspection, clean the component using cotton buds dipped in isopropyl alcohol.

The technique is called **Flow and Wick** where solder is allowed to flow across the pads and the wick is used to clear off all the solder bridges. Because surface tension holds some of

the solder under the pin no matter how long the wick is applied, this technique usually works. For this technique, just be gentle and try to limit how long you apply heat to the component and the PCB.

5. Mistake? Just desolder it!

5.1 Introduction

The previous chapters discussed what you need to know about soldering: the materials that you will need, safety precautions, soldering THT and SMT components as well as some common soldering issues. But have you ever wondered what to do if you want to remove those components that you soldered?

Desoldering and replacing component/components is not as easy as soldering them. In fact, one of the frustrations one experience is when you mounted a wrong component on PCB and then you need to remove and fix it. In this case, you need to know how to desolder.

When desoldering, you will need to use a **desoldering pump**, **solder wick** (not included in the kit), **isopropyl alcohol** (not included in the kit), **soft toothbrush** (not included in the kit), **cleaning sponge** (not included in the kit), **flat-tip screwdriver**

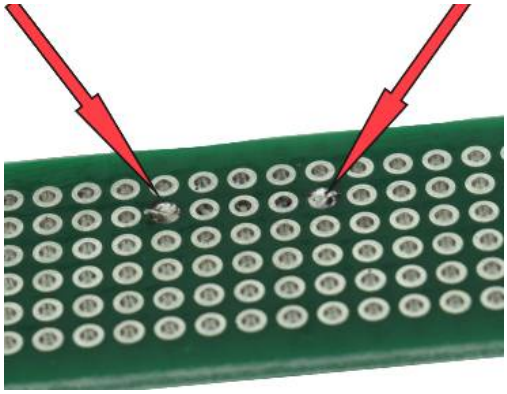
The desoldering pump and the solder wick are both introduced at the beginning of this manual. Other materials are simple materials that can found at home.

5.2 Preparations before Desoldering

Before desoldering, prepare your soldering iron, and the materials mentioned above and do the following steps:'

1. Turn ON the soldering iron. Wait for the iron to get hot and clean the soldering iron tip using wet sponge. Every time you notice black parts on the soldering iron tip, clean it again.

2. Locate the component's terminals. Find the component that you want to remove and locate its terminals. It is on one side of the PCB, the solder side. The other side is the component side where you can find the component.

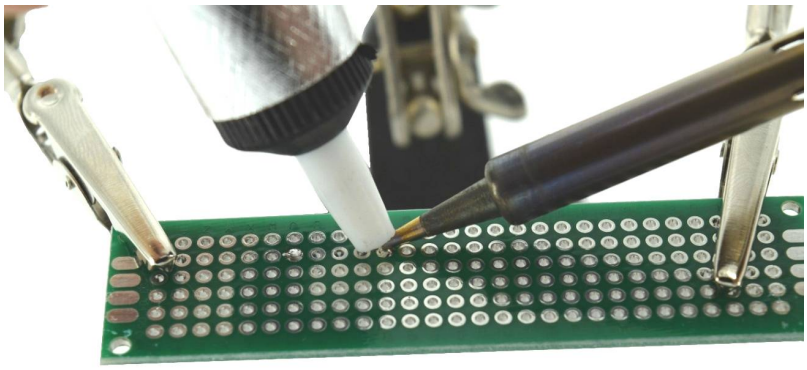


3. Cleaning the terminals. After you locate the component's terminals, wet a toothbrush with isopropyl alcohol and brush the terminals.

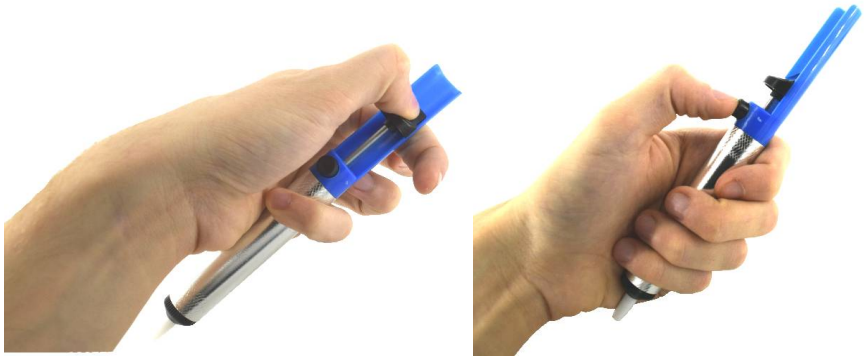
5.3 How To Desolder

Now we are going to show you few different methods on how to desolder components attached to a PCB. These include using a solder sucker, a solder wick or a flathead screwdriver.

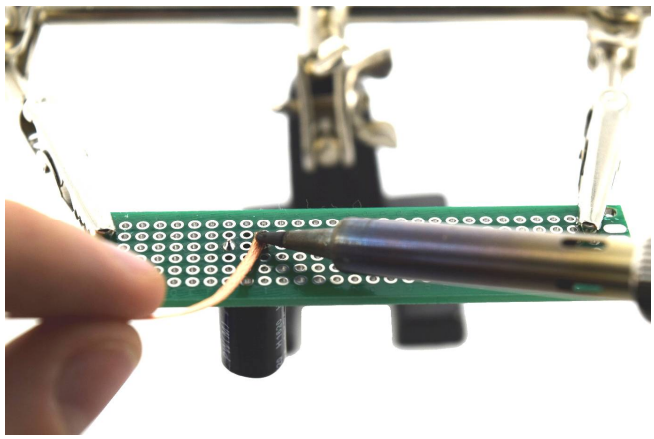
5.3.1a. Desoldering with a Solder Sucker



First press down on the spring plunger, align the nozzle over the joint you want to desolder and heat up the joint with an iron. When it melts, pull the iron tip out, place the hole of the nozzle and press the release button to activate the vacuum.



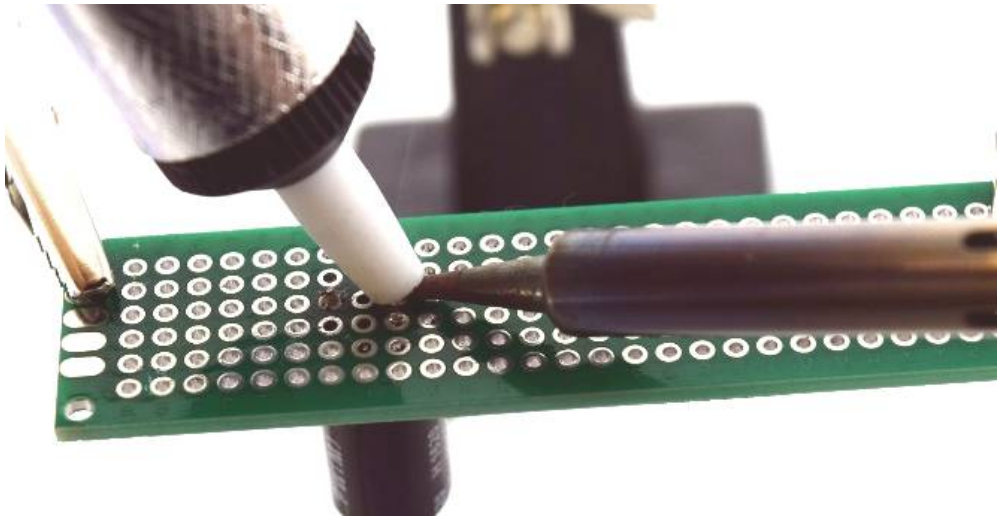
5.3.1b. Desoldering with a Solder Wick



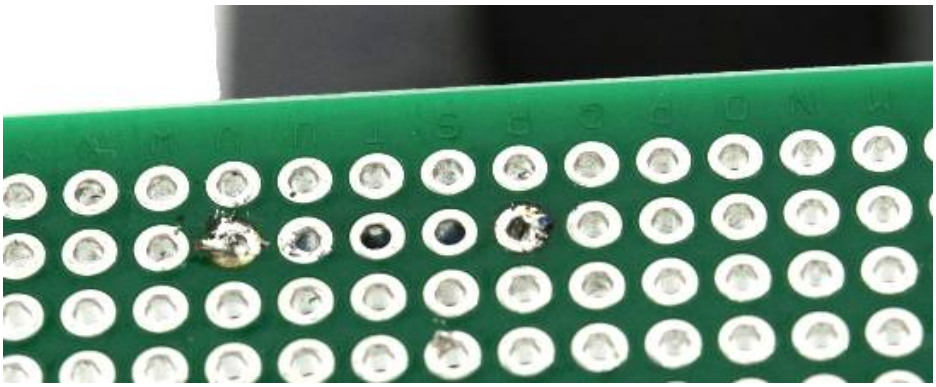
First you have to cut any used portion of the wick. When using it, make sure to hold it at the bottom because heat transfers quickly through the copper. Add a bit of solder to your iron tip because it helps transfer heat from the iron to the wick. Hold the wick over the joint, gently press the iron on top of it, and then keep holding the wick on the joint for several seconds to make sure all the solder is removed.

5.3.1c. Desoldering with a Mini Flathead Screwdriver

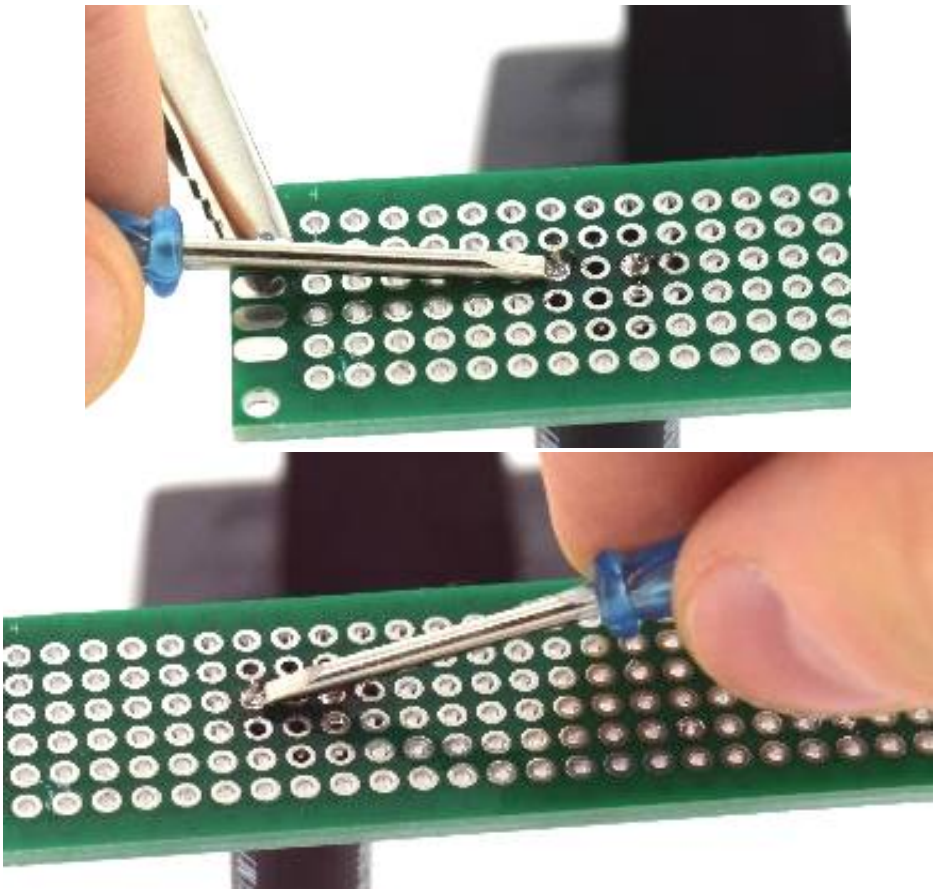
You can also use a mini flathead screwdriver which can move the terminal back and forth so that the terminal will be loose from the hole.



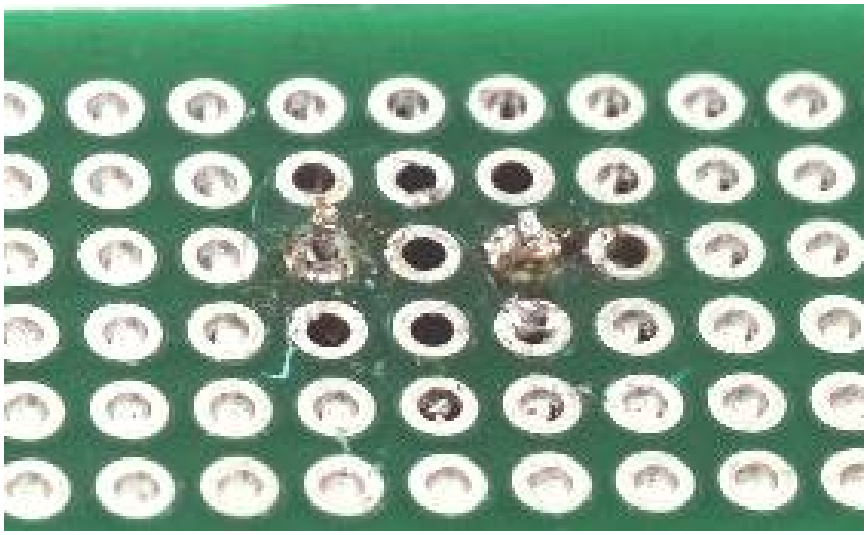
First, you have to solder the two terminals with iron and solder..



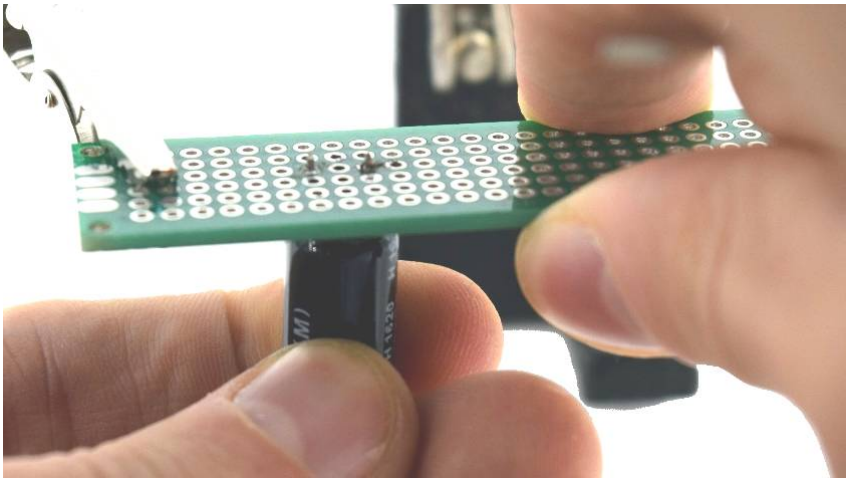
Initially, push the terminal back and forth using the soldering iron. Use the solder sucker to suck the molten solder. Afterwards, use mini flathead screwdriver to push the terminal back and forth



Repeat the process until the terminals are loosened. Make sure that the terminals are at the center and there is no remaining solder attaching the terminals to the holes.



Remove the component very carefully by pulling it with your fingers.



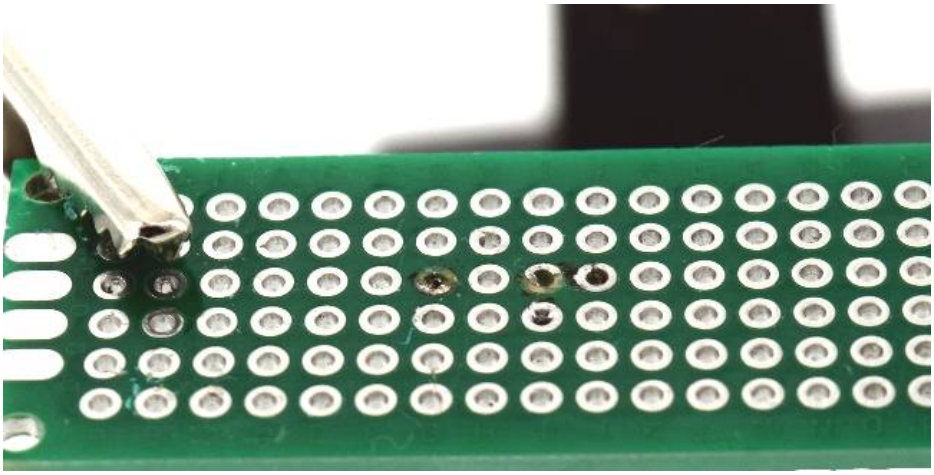
5.3.2. Cleaning the Board

After the component is finally removed from the PCB, remove the brown resin found around the holes using the flathead screwdriver and a soft toothbrush.

Note: Don't use too much pressure on the flathead screwdriver as it may damage the board.

5.3.3. Desoldering Successful

The board is clean and ready for a new component to be mounted in place of the removed piece.



6. How to Solder Wires Together

6.1 Introduction

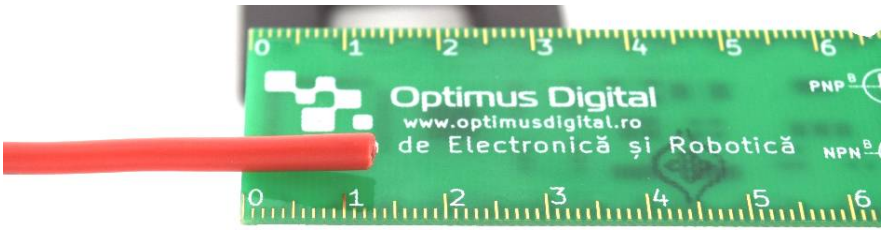
In this chapter, we'll guide on how to connect two wires together using melted solder/ soldering technique. Aside from the common tools and materials used for soldering, you will need some wires to be soldered. You will make use of the mini wire stripper tool with stainless steel blade to punch down wires or for wire insulation stripping on particular connectors.

This chapter will also make use of a heat shrink tube. A heat shrink tube is a tube that is in a form of plastic tubing that shrinks when heat is applied. It is used to protect exposed wires, to guarantee environmental safety and to make waterproof connections. It comes in different colors, flexibility or temperature sensitivity. It is manufactured to a certain diameter like 2:1, 4:1, 5:1 and 6:1. The diameter means stretched size:shrinking size which means that 2:1 size will shrink to half upon application of heat.

A heat gun may also be needed to produce a stream of hot air during soldering method.

6.2 Preparing the Wires to be Soldered

1. Use the mini wire stripper to strip half inch of insulation at the end of each wire. Just be careful not to cut the actual copper wire because it will lessen the conducting strength.



2. Pull the unnecessary jacket of the wire.

If you see a slight cut in the jacket, bend the jacket back and forth until it comes loose. If unsuccessful, try to make a deeper cut on the jacket using stripper. With this procedure, we can get the jacket off without scarifying any copper threads.

3. Use the heat shrink tubing to cover your connections.

Before connecting the wires, cut a piece of heat shrink tube and slide it onto the wire. Heat shrink tube should be longer than the area that is being soldered. It should cover some of the jacket on each end and the half inch connection of the strip wire.

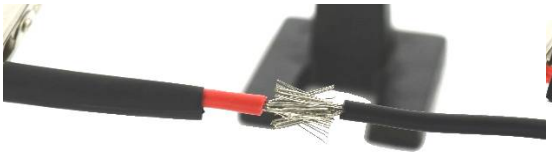
Note: Most heat shrink tube will reduce in size or shrink after being heated so you have to test it first before getting started to make sure the heat shrink tube will shrink down to the size

4. Whip both half inch pieces of copper wire.

Whip each end of the wire out by rubbing the wires between your fingers. It will make a good connection between the copper wires because they touching each other. The wires should look like this:

5. Push the whipped ends into each other.

Join the strands of the separate wires so that it will look like one. Also ensure that the area is smooth because this is the area that you will be soldering. Do this by twisting the strands into each other so they grip together as seen on the following image.



6.3 Soldering the Wires Together

1. Applying the solder flux to the connection.

Apply a little glob of solder flux using your finger or tools and apply it onto the wires.

2. Melt the flux into the wires.

Use a heat gun to melt the flux into the wires by waving the heat gun back and forth, to avoid direct heat on the wires and avoid overheating the jacket.

Note: DO NOT include the heat shrink while heating the flux. Place it far from the area you are applying the heat.

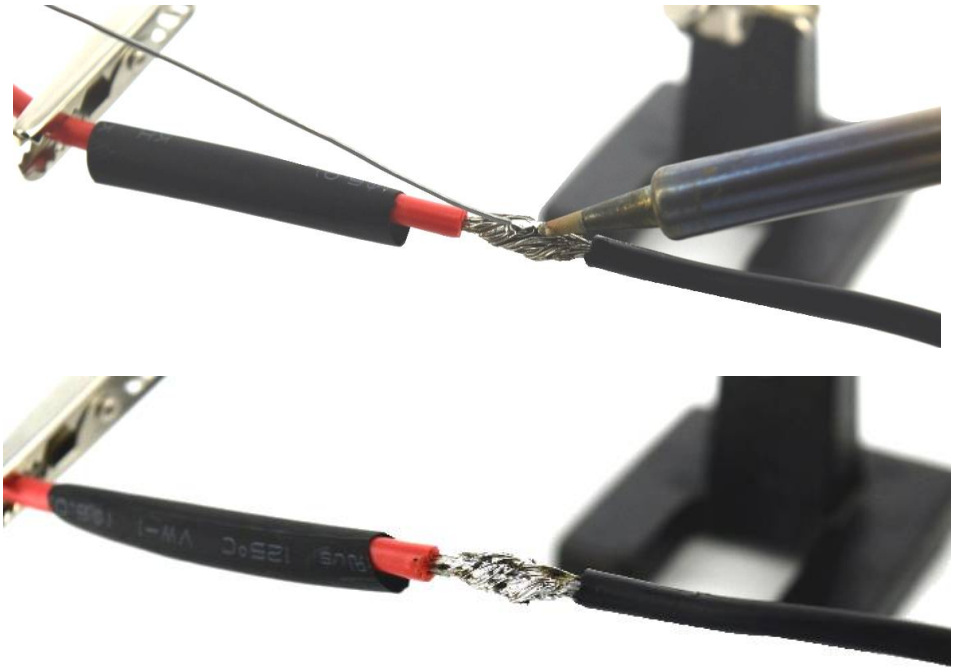
3. Prepare the soldering iron.

Plug in and turn ON the soldering iron, wait for more or less 3 minutes until it heats and set the temperature. Add water to the sponge to clean the tip of the soldering iron.

4. Soldering the wires.

Use the tip of the iron to touch about an inch off the end of the string solder. The iron should spontaneously penetrate the solder right onto the tip of your iron. When the solder is already on the tip of the iron, put it to the copper wires. Add more flux if needed if the solder doesn't flow easily right into the connection. Continue picking up more solders with the iron and add it to the joint until the wires are filled. Make sure to solder the connection equally and completely.

Note: AVOID putting too much solder on the connection as it will add more resistance.

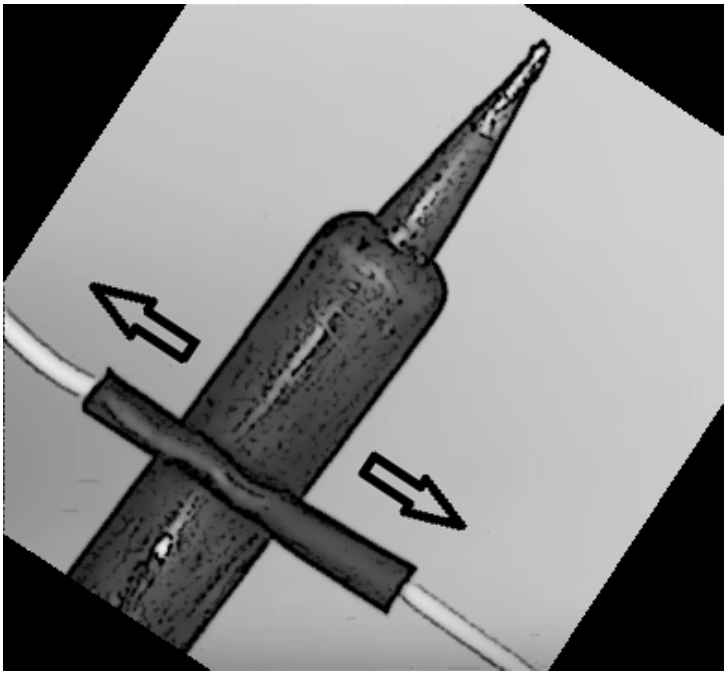


Carefully check the wires if they are fully joined. Also check the joints and all sides of the connection. Pull on the two wires to test if you have formed a stable/good bond.

5. Protect the joint.

Use the heat shrink tube to cover the joint. Slide it over the joint. With the use of a heat gun, heat it back and forth so that there will be less direct heat on the jacket.

Sometimes, you have to make use of what is available to shrink the heat shrink tube. In cases where you do not have the soldering gun, torch or lighter and you only have your soldering iron, you can also shrink the tube by touching the heat shrink tube with the soldering iron and sliding it back and forth until the tube shrink.



7. Soldering Tip Cleaning and Maintenance

Your soldering iron needs to be frequently cleaned in order to keep it in good condition. They are exposed to rusts because they usually come into contact with hot metals. The following are some tips on how to prevent metallic build-up and tip damage throughout the years.

7.1 Soldering Tip Cleaning

Tips usually turn black after using it, this means that the tip has undergone oxidation and has oxides deposit on its surface. Cleaning the tips frequently by removing any dirt or dust can guarantee your tips are free of any oxides. Just make sure to clean it right away to prevent corrosion or rusting. Then always re-tin your tip directly after cleaning it to help prevent oxidation.

Here are different ways to clean the soldering iron tip:

1. First to remember before cleaning the soldering iron tip is to TURN OFF your soldering iron and let it cool down for about 15-20 minutes. After that you can start cleaning the soldering iron as well as the tip without risking burning your skin.

2. One of the most common cleaning methods is a tip cleaning using a **sponge**. Use a sulfur-free sponge that is made precisely for soldering. Make sure that the sponge is clean from dust and contaminants to avoid damage to the tip. Wet the sponge and carefully wipe the tip to remove excess solder, dirt or oxides.

3. Because wet sponge is much cooler than the tip, your tip may experience shock when you clean it with a sponge. It could be the reason why the temperature of the tip changes quickly once they touch. You can try to use **brass wire** to help to minimize the shock. This is durable and can remove the contaminants and soft enough so that they will not scratch the surface of the tip. The brass wire was mentioned in the chapter about do's and dont's in soldering.

4. A **tip cleaner or tinner** can also be used to clean your soldering tip. This is a chemical paste that usually comes in metal tins. It helps remove oxides from the tip which normal cleaning can't remove. Just heat up your soldering iron and then wipe the tip in the paste.

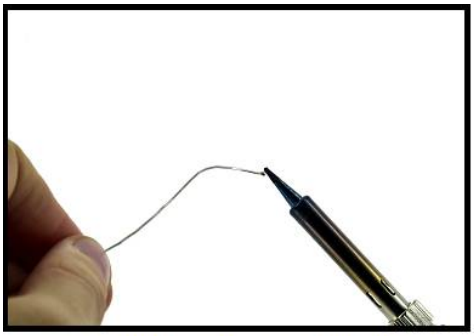
5. A **tip polisher** can be used to maximize the cleaning of tip cleaners and tinners.

6. To clean the tip, a **polishing bar** for soldering tips can also be used. It is also used to remove oxidation and surface contamination from tips. It is important that the tip is retinned instantly after use to prevent oxidation. When using this bar, make sure the soldering tip is cool and carefully scrape the dark-colored oxidation off and you will see the shiny iron plating.

7.2 Soldering Tip Maintenance

All people who are probably new to soldering irons and soldering procedure in overall may not fully understand some of the basic soldering iron tip maintenance that ought to be applied. The most common problems that come with soldering iron tips are rust and corrosion. This eBook will guide you for a few simple soldering iron tip maintenance to make your soldering experience enjoyable and prevent you from replacing your tips immediately.

1. Tin your iron tip before and after you use it. A good thing for tinning is that the tip recovers conductivity and makes soldering a lot easier.



1. APPLY SOLDER TO THE TIP

2. ROLL THE TIP ON A SPONGE

3. PROPERLY TINNED SOLDERING IRON TIP

2. Using highly activated rosin fluxes or acid type fluxes significantly reduce a tip's lifespan. Using iron plated tips will increase service life.

3. The tip has a wettable area, the working area and the one responsible for the heat transfer. If the tip becomes unwettable, you have to apply flux and wipe clean the iron tip.

4. Make use of a polishing bar if you need to file the tip or you want to do heavy cleaning of the tip. This is advisable to use because too much filing the tip or using other products will remove the protective plating and shortens its lifespan

5. Before turning off the iron, do not remove the excess solder from the heated tip because this excess solder will prevent oxidation of the wettable surface if your iron tip.

6. Make use of distilled water in wetting the sponge because tap water may contaminate your soldering tip.

7. After you used the soldering iron, do the following:

- Turn off the soldering iron and let the tip cool.
- Carefully clean the hot tip with a clean wet sponge.
- Apply a coating of solder to the tip.
- Keep the tip in proper storage or in an iron holder.