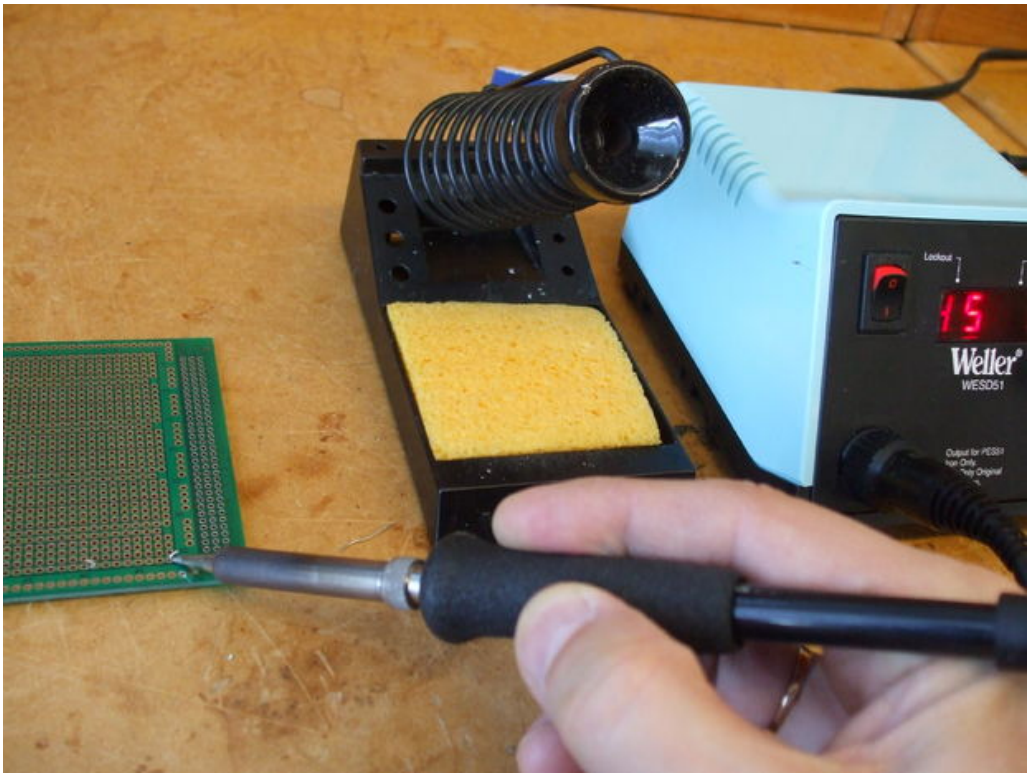
How to Solder - Basic Soldering Guide



Soldering is process of joining two metals together with soldering iron by the use of a solder to form a dependable electrical joint.

This is a basic soldering guide for beginners about hand soldering with a soldering iron. I hope that it will be good help for most of your DIY projects from electronics. If you are experienced in soldering, your comments are welcome in "comments" area.
In this instructable I will cover the following topics:

- safety precautions before we start soldering operation

- choosing appropriate soldering iron and solder

- preparing for soldering

- soldering

- inspection of solder joints

Step 1:

Most of solder wires or solder paste contain lead (solder alloy is mixture of tin and lead). During soldering operation lead may produce fumes that are dangerous for your health. In addition, soldering wire usually has a flux in the middle of wire. There are different types of cored solder with different solder to flux rate. Flux containing rosin (colophony) produces solder fumes that, if inhaled, can be hazardous.

• Soldering should be performed only in a well-ventilated area.
• Use smoke absorber
• Soldering iron is very HOT (for most of soldering operation temperature of iron is 350 -400 degrees Celsius). Never touch tip of the soldering iron with your hand.
• Never leave your hot iron down on anything other than an iron stand.
• Keep flammable liquids and materials (such as alcohol, solvent etc.) away from the work area.
• Wear eye protection.
• Do not cut off a grounding prong on an iron plug to make it fit an ungrounded receptacle.
• Hold wires to be heated with tweezers, pliers or clamps to avoid receiving burns on your fingers from objects that are heated.
• Wear ESD (Electro-Static Discharge) protection if you are going to solder electro-static sensitive components such as CMOS components. For most of DIY projects it will be good enough to wear ESD wrist straps (shown on the picture below).
• Wash your hands with soap and water after soldering.

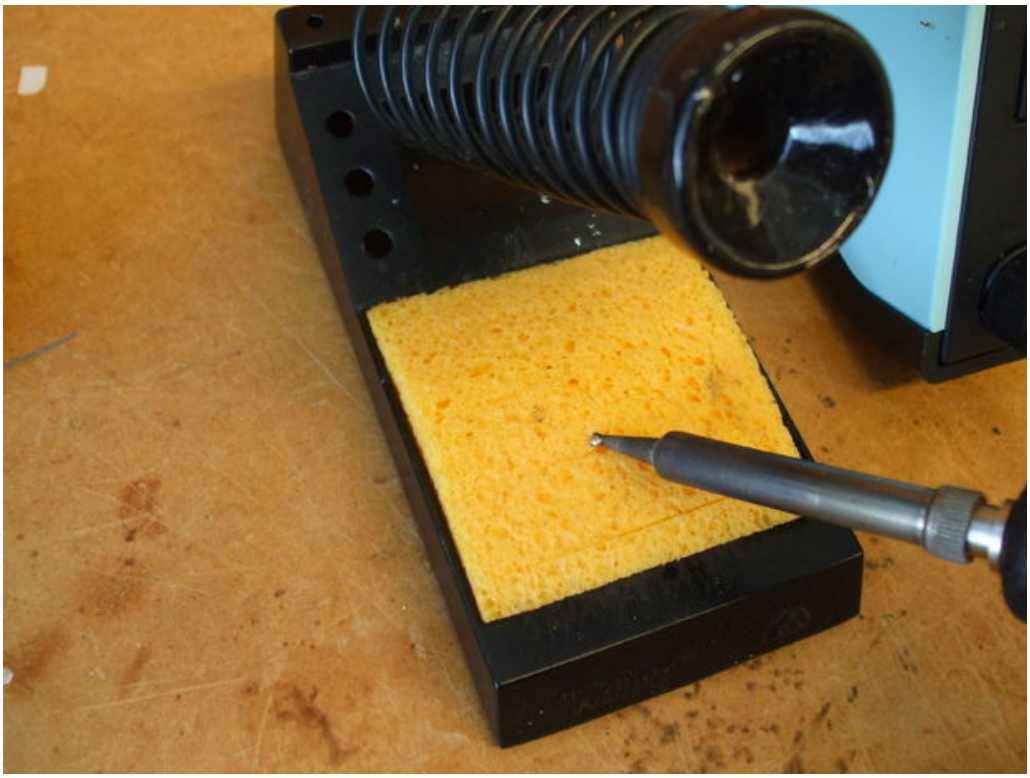
Step 2:

Main requirement in the process of soldering is heat. Soldering iron is tool that generates heat. There are wide selection of soldering stations, soldering irons and soldering guns. They come in a wide variety of shapes, sizes and wattages. Which soldering iron is the best soldering iron for you depends on the types of soldering projects that you plan to do.

For every soldering project you need enough heat to quickly melt the solder and apply it to solder joint, but at the same time you do not want too much heat that can burn or melt delicate electronic components on circuit boards. If you do not pay attention on temperature of iron you can accidentally ruin your soldering project by applying too much heat. Too much heat from soldering iron can damage or even lift and break copper conductors and pads on circuit board as well. Electronic temperature control means that you will always know if the tip of the soldering iron is hot enough for the material you are soldering. It makes your soldering process a whole lot easier. Temperature of iron can be adjusted with the front panel temperature control knob - you can precisely control the temperature of soldering iron within 9 degrees Fahrenheit. This means that you can rest assured that your soldering iron is hot enough and ready for soldering, and at same time you know that it is not too hot to burn components on circuit board. This is main reason why I always recommend a temperature controlled soldering iron. In this instructable I am using 50 Watts Weller WESD51 temperature controlled soldering iron.

For soldering operation we also need a solder. One of the most commonly used solder alloys is solder that is 60% tin (Sn) and 40% lead (Pb). Another commonly used solder alloy is solder that is 63% tin (Sn) and 37% lead (Pb) – this works especially well on small electronic parts. Recently, there is big increase in use of lead-free solder since lead fumes can be dangerous for health. Solder is usually in form of solder wire (with flux in the middle of wire). Solder wire is available in different sizes but in soldering of electronic circuits we usually use solder wire which thickness is 010” 020" and 030”. In this project I am using a solder wire 030” which is 60% tin (Sn) and 40% lead (Pb).

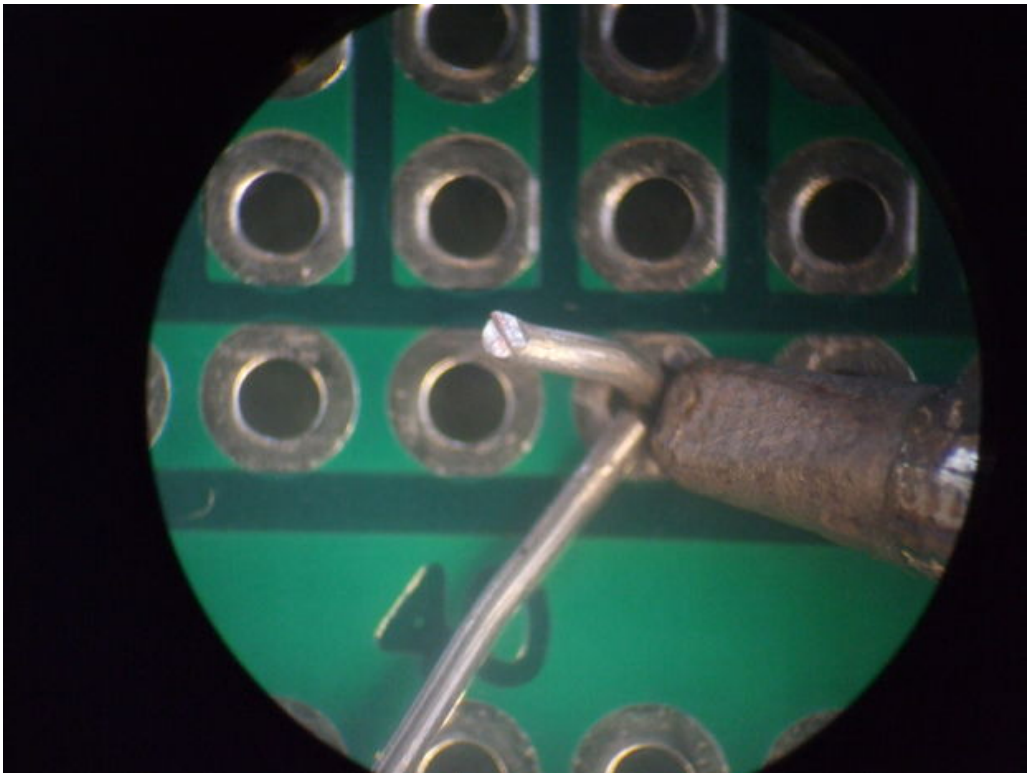
Step 3:



Turn on power switch on soldering station. Set desired temperature of soldering station by turning knob on front panel. Most of good soldering stations take 1-2 minutes to reach to desired temperature. Use distilled water to dampen the sponge in the stand (sponge should be damp, not soaking wet). The iron tip should be cleaned before every use by wiping it on wet sponge (when tip is hot enough). A brand new tip needs to be coated, heated, and then covered with solder before its first use (this technique is called “tinning“of the tip). The purpose of tinning is to form a thin layer around the tip which provides the better transfer of heat from the tip to the solder joint. Only clean iron tip transfers heat well.

Clean properly the soldering area and all components as well. All components must be clean and free from oxidation or any other contamination. You cannot make a good solder joint on a dirty soldering surface – solder simply will not stick to dirty component or dirty pads on printed circuit board. The copper pads on circuit board should be wiped with a solvent such as isopropyl alcohol to remove any grease and if needed with abrasive stick. Then, some flux should be applied. Flux is mixture of natural and synthetic rosins. Flux removes oxide film and keeps removing it during soldering process. This oxide film forms very quickly on the surface of heated metal.

Step 4:



Insert component in circuit board by using a pair of tweezers. If soldering iron is hot enough, take it from stand and hold it as a pen.

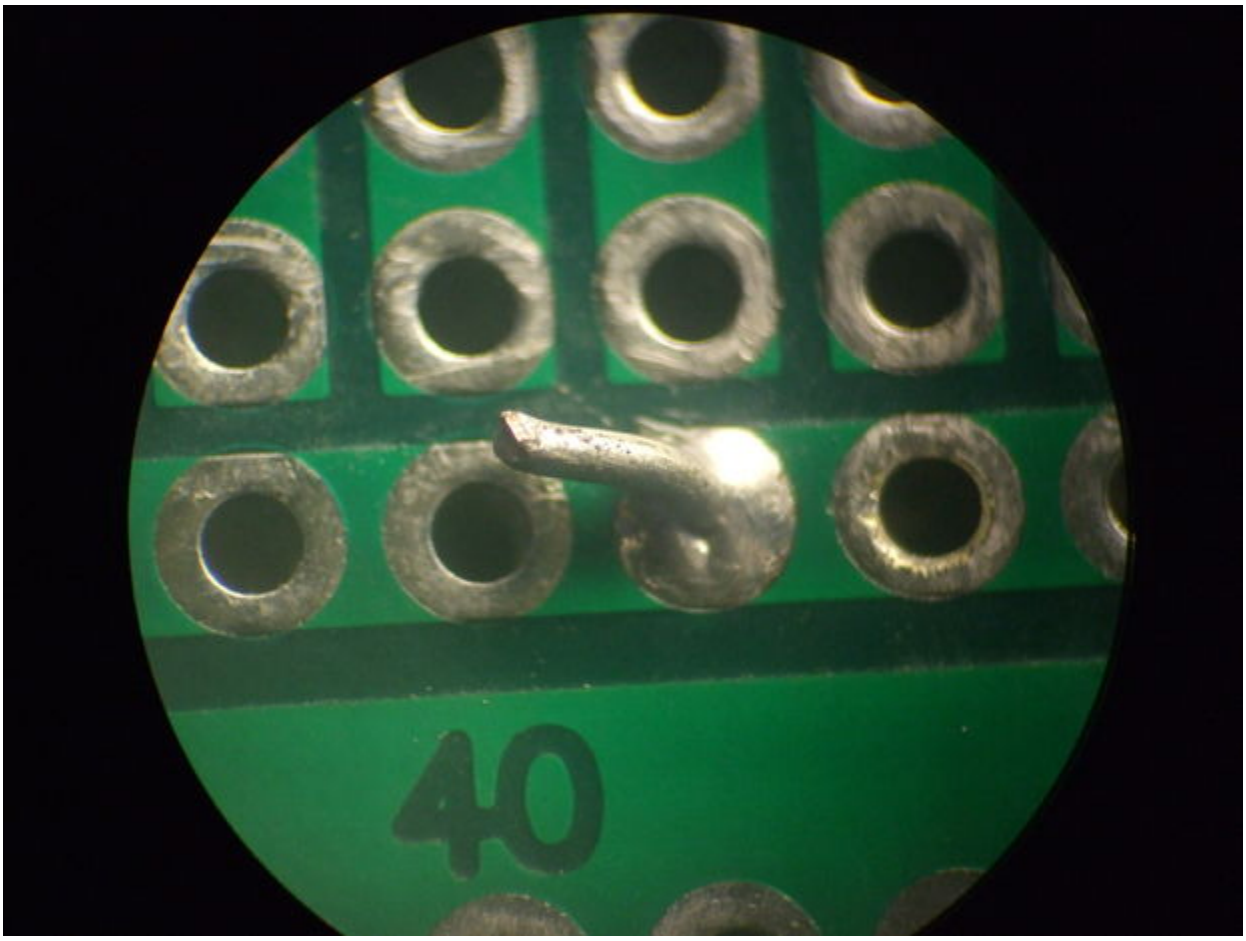
Place a tip of soldering iron to the solder joint and hold for a couple of seconds. Make sure that iron tip touches at the same time both the copper pad on circuit board and the component lead. Heating the only one part but not the other will result in poorly created joints. Thermal linkage is the area of contact between the iron tip and surface of solder joint. The contact between the iron tip and surface is usually very small straight line along iron tip. Thermal linkage can be significantly increased by adding a small amount of solder to the line of contact between iron tip and surface. Molten solder forms a heat bridge between the tip and the solder joint. This solder bridge provides the better and quicker transfer of heat into the solder joint.

Continue heating and then apply some solder to the solder joint, not to the tip of soldering iron. Solder should melt and flow smoothly onto the copper surface of pad filling a gap between component lead and copper pad. Two most common problems with soldering are adding too much or not enough solder.

All soldering operation should be completed in less than 2 seconds. The time of soldering operation depends on the temperature of your iron and size of the joint. If we keep applying heat longer than 2 seconds, this can break the pads or conductors on circuit board or damage temperature-sensitive components.

Remove the soldering iron while keeping the joint sill - do not move circuit board for a few seconds to allow the joint to cool down and solder to solidify.
Clean flux residues with ethanol alcohol or some other solvent.

Step 5:



Immediately after soldering, start visual inspection of solder joint. Good magnifying lamp (or a microscope) is required for proper and thorough inspection. Use an ohm-meter to test a solder joint for continuity.

Adjacent components may be bridged together or the joint may need additional solder for good electrical continuity - too much solder will cause bridging and too little solder can cause weak solder joints.

Good solder joint should be smooth, volcano-shaped, shiny and bright.

Bad solder joints are cold solder joints, solder bridges, solder balls.