Tool Selection Guide

February 2013

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Basic Tools

To build this board requires a few basic electronic hand tools. The tools listed below are recommended for anyone building these types of DIY boards.

Soldering Iron

The first is a suitable soldering iron. Anything between 25 and 40 watts is useable, with at least a 1/16-inch wide chisel tip. However, tips that are closer to 1/8-inch will provide better heating of the joint being soldered. While a temperature controlled soldering station is very nice, one can get by nicely with a much more modest solder iron setup. The iron shown in figure 1 is an inexpensive, adjustable 25-40 watt unit, and quite suitable for constructing this type of kit.

Figure 1: Soldering Iron

If you have never soldered any electronic parts, a little practice before starting on your kit might be in order. Go to your local Radio Shack, or other parts store, and buy a few small resistors and capacitors. If they have any sort of perforated PC board material available, get some of that too. You can practice putting the parts through the holes, bending the leads slightly, and soldering them in. Do not clip off the leads; the parts can be unsoldered and reused for more practice. If you can't find any perforated PC board material, buy a piece of blank PC board material, and drill several holes in it spaced the lead width of the parts you have available, and use that for practice. Another approach might be to take apart an old wireless telephone and remove the existing parts by heating the PC board with a small torch and rapping it on a solid surface to knock them out. Wear eye protection when using this method for parts removal!

Another alternative is the **Elenco Practical Soldering Project Kit** This kit can be purchased from Amazon for less than 10 dollars and has a well written set of instructions on learning to solder.
Soldering a part requires placing the tip of the soldering iron against the component lead and the PC board surface, heating it for a few seconds, and then adding a little bit of solder. If the joint is hot, the solder will flow quickly. Once the solder has flowed, remove the soldering iron and the solder, and let the joint cool. If the job was done correctly, the solder will have flowed

smoothly, and the joint will look shiny. Later in this article are many examples of correctly soldered joints.

Solder

Solder plays a key role in electronics construction. The right kind will work well, and is easy to use. The wrong kind can be hellish! A suitable solder for electronics work will contain approximately 37% tin, and 63% lead. Anything around those two values, with a rosin flux core is suitable. Do not use "no lead" solders intended for plumbing; they will not work well. Nor will solders with acid flux cores. Also, stay away from solders with water-soluble (organic) fluxes. While they seem to work well while building, failure to remove all of the flux later will lead to corrosion where the flux remains. This is also true of any acid flux core solders.

The best solders also contain about 2% silver. This improves conductivity of the joint, and keeps it bright looking. Figure 2 shows a small roll of solder containing 2% silver, and readily available from Radio Shack. Kester also makes a similar product that is available from Mouser and DigiKey.

Figure 2 - Solder available from Radio Shack

Side Cutters (also called Diagonal cutters or “dikes”)

The other basic tool that one needs, especially when soldering a PC board, is a pair of side cutters. A favorite is shown in figure 3. These are made by Xcelite, and are available from Mouser, DigiKey, and others supply sources. These cutters are used to clip off the excess lead length of parts soldered into the PC board.

Figure 3 - Side cutters are very useful in clipping off excess lead length

Third Hand Apparatus

Another tool that is very handy to have, but not a necessity, is a "third hand" apparatus of some kind. A commercial version is shown in figure 4. One of these will hold the PC board while parts are being soldered, or hold parts while leads are being attached. One could make the equivalent of this unit with a pair of "pincher" clothespins, a small block of wood, and a bit of fabricating.

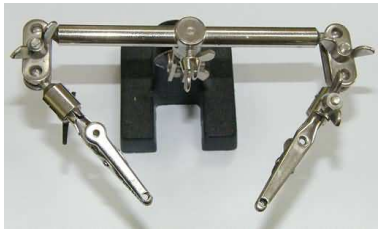


Figure 4: "Third Hand" holds PC board during assembly

Solder Braid

Solder Braid or solder wick is good to have on hand for those occasional mistakes. It is made of a braided copper wire that is impregnated with a rosin flux. If you bridge two solder points when soldering the PCB this can remove the excess solder. This is available Radio Shack, Mouser, DigiKey, and others supply sources

Figure 1 Solder Braid

Needle Nose Pliers

Although though not as vital as the above component, needle nose pliers will be invaluable in forming component leads and in helping straighten bent pins on ICs, This is available Radio Shack, Mouser, DigiKey, and others supply sources.


Figure 6 Needle Nose Pliers

Solder Iron Tip Cleaner

A clean solder iron tip is essential to good solder joints. The tip must be kept clean to ensure the best heat transfer between the iron the part and the solder. The dirt build up on a soldering iron is mostly due to rosin residue. The traditional method of cleaning the tip is with a damp sponge. This will clean off burnt rosin residue on the tip of the iron but will eventually lead to the tip corroding. The item pictured below is a much better method of cleaning the iron and doesn't require any water. Just plunge the tip into the metal mesh and withdraw it and the tip will be clean. This particular cleaner is available from Amazon for about 10 dollars and is well worth the investment.

Figure 7 Hakko Tip Cleaner

Digital Volt Meter (DVM)

This device is used as a diagnostic tool and can be used to troubleshoot as well as test for proper operation. You will need this item when powering the board up for the first time. There will be further instructions later in this manual.

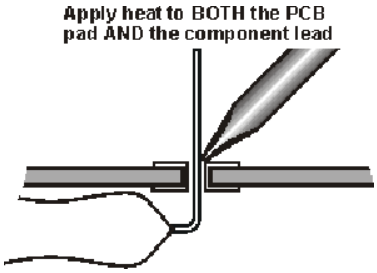
Digital Volt Meter (DVM)

PIC Programmer

The PIC chip on the PCB is used to control all the functions to create blinky flashy. When you order the part from the supplier (Typically Mouser) it will come in un-programmed. You will need a PIC programmer and the software for the board. There are several manufactures out there supplying PIC programmers. The one shown below is made by the original designer of the PIC chip, Microchip. The programming instructions are included later in this manual.

Soldering

Proper positioning of the soldering iron tip and solder are essential in obtaining a well-made soldered joint. The tip must be in contact with both the lead to be soldered and the PC board pad.



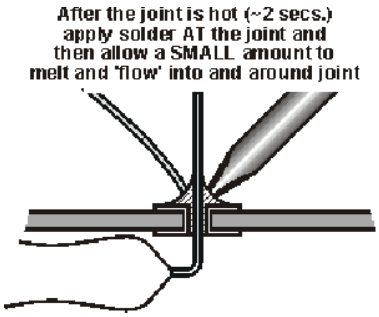
Important!

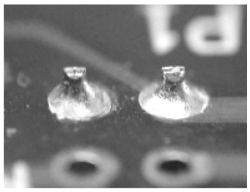
A clean soldering iron tip is essential to heat transfer.

Be aware that it is possible to damage the board and the component if they are heated for too long.

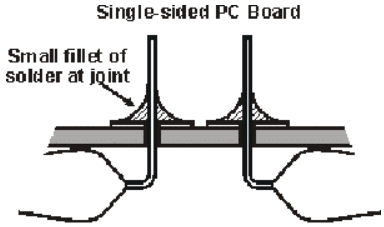
Once the tip has heated the pad and lead apply solder to the **OPPOSITE** side of the joint. The solder should flow evenly around the pad and the lead. Remove the solder iron and give the joint a minute to cool.

DO NOT blow on the joint or move the component as this can cause a poor solder joint (called a cold solder joint). A cold solder joint will not conduct electricity properly and will cause problems during operation.

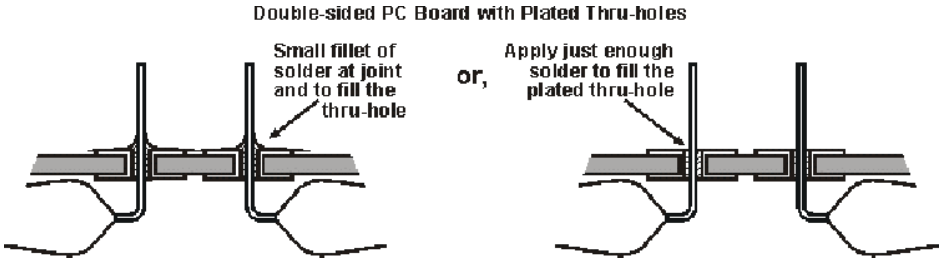




This shows a well-made connection to a single-sided PC board. A small amount of solder has been melted by the heat from the component lead and the PC board pad. A small additional amount of solder has been added to the joint to form a small rising *fillet* around the lead



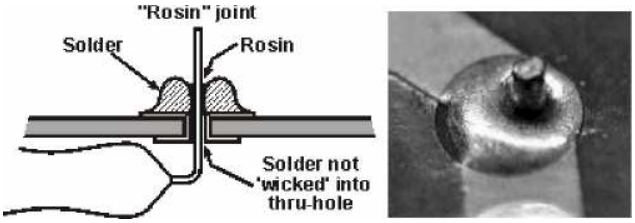
If the PC board was of the plated-thru hole type, capillary action of the lead in the *plated-through hole* has drawn the solder down into the hole. (**left**)



Note that some soldering requirements may dictate that *no fillet* be created when soldering to plated-thru holes. (**right**) In this instance, apply only enough solder to *fill* the plated thru hole. Use of .020" diameter solder greatly enhances your ability to perform this operation. Use of .03" or larger diameter solders will generally cause more solder than required to be applied the instant the solder is applied to the joint.

When soldering plated-thru holed which are to only be filled, apply a small amount of solder and allow your iron to remain a short while longer. This will ensure that the solder is 'wicked' down into the hole. You will be able to *see* the solder as it flows into the hole.

These figures show what can happen if the component lead is not heated along with the PC board pad. A rosin joint will result. The solder flows onto the PC board pad, but since the component lead is not hot enough to melt solder, rosin accumulates around the wire. The solder then forms around the rosin coating on the component lead, and there is no connection. Generally, joints of this type can be corrected by reheating the joint.



Similarly, a poor joint will result if you do not properly strip and tin the enameled wire leads of inductors *before* the lead is inserted into the PC board for soldering. Enamel coating allowed to remain on the inductor lead can create a joint similar to the rosin joint, preventing the lead from being adequately heated by the soldering iron. Such a joint *cannot* normally be restored by reheating. Remove the lead from the PC board, strip it of all enamel and tin it. Then resolder the joint.

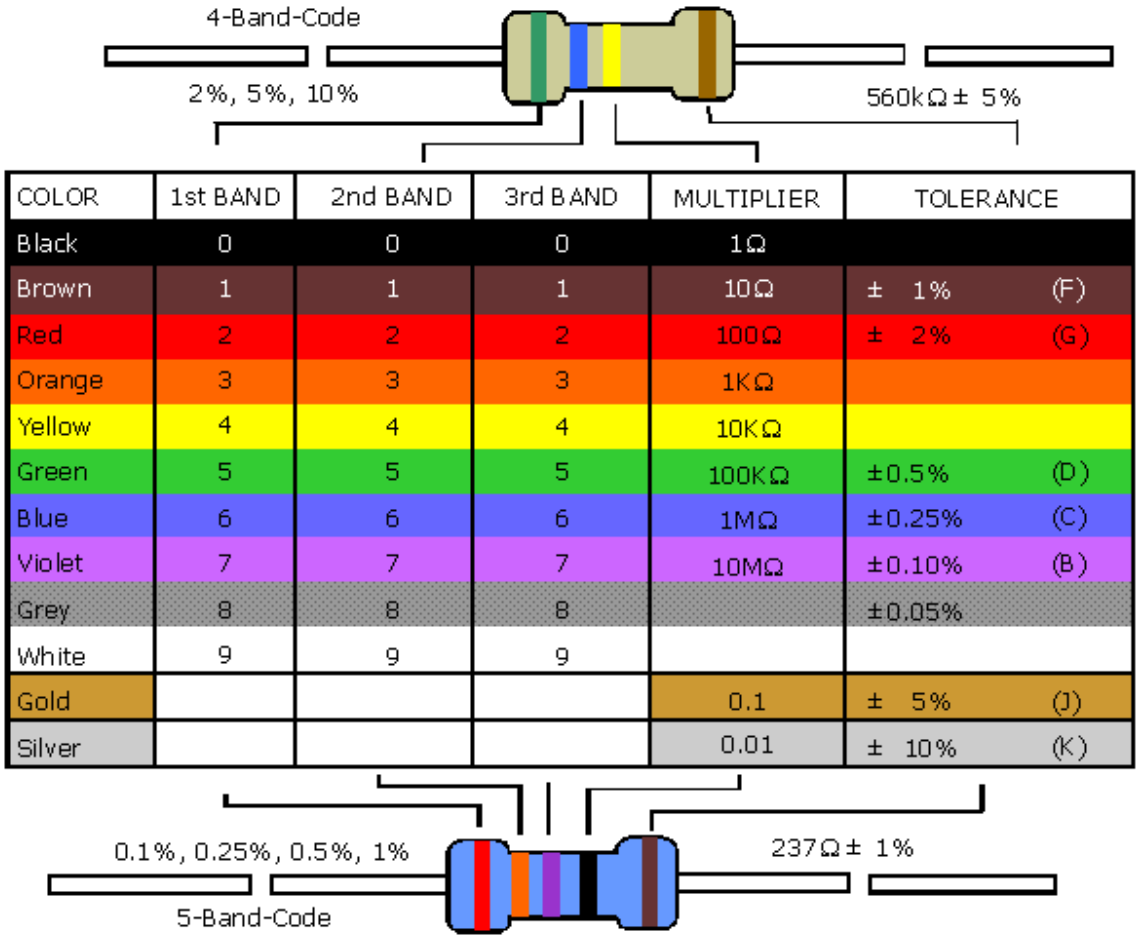
Identifying Components Used in Construction

There are many different types of components used in construction of this board. Below is a list of the types of components and how to identify them.

Resistors

Resistors are small tubular shaped components with wire leads coming out each end. Resistors will have different values depending on where they are used in the circuit. The values are defined by a color code marked on the resistors. The table below can be used as a reference to determine the resistor value.

Resistor Color Code



COLOR	1st BAND	2nd BAND	3rd BAND	MULTIPLIER	TOLERANCE	
Black	0	0	0	1Ω		
Brown	1	1	1	10Ω	± 1%	(F)
Red	2	2	2	100Ω	± 2%	(G)
Orange	3	3	3	1KΩ		
Yellow	4	4	4	10KΩ		
Green	5	5	5	100KΩ	±0.5%	(D)
Blue	6	6	6	1MΩ	±0.25%	(C)
Violet	7	7	7	10MΩ	±0.10%	(B)
Grey	8	8	8		±0.05%	
White	9	9	9			
Gold				0.1	± 5%	(J)
Silver				0.01	± 10%	(K)

Capacitors

Capacitors come in various forms and makes. The ones in this kit include electrolytic and MLCC (multilayer ceramic capacitor. These are radial style which means both leads come out the same end of the component.

The electrolytic caps are polarized, which means that have to be installed in the correct orientation. The side of the cap will have a minus sign and must be installed in the board with the unmarked side in the hole with the plus indication on the board. The cap will be labeled with the value and voltage rating.

Electrolytic Capacitor

The MLCC caps will simply have a number on it. For example 102 this stands for a 1000pf capacitor. The 10 is the first 2 numbers of the value and the 2 represents the number of following zeros. Thus 10 with 2 zeros equals 1000.

Radial MLCC Capacitor (value 47000pf)

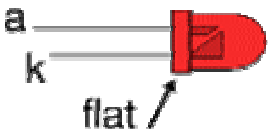
Diodes

Both conventional diodes and light emitting diodes are used in this project.

Conventional diodes are similar in shape to resistors small tubular shaped components with wire leads coming out each end. Diodes are polarized and must be installed in the correct direction. The diode will have a stripe on one end and this must be oriented to the stripe on the printed circuit board. Failure to do so will damage the diode and possibly other components when power is applied.

Conventional Diode

Light Emitting Diodes or LEDs are diodes that emit light. These diodes are typically radial in design and look like small light bulbs. As with all diodes LEDs must be oriented properly. Typically the diode will have a flat side cut into the plastic bulb indicating its polarity. This flat will be indicated on the PCB.

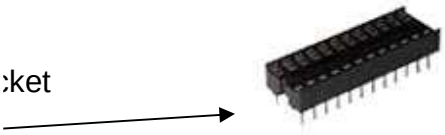


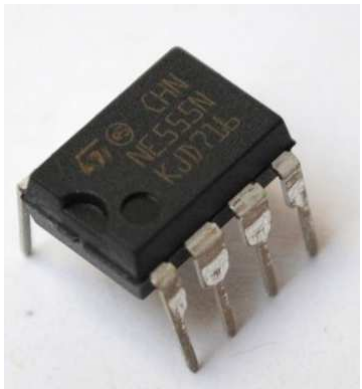
Light Emitting Diode

Integrated Circuits

There are several different types of ICs used in this project. ICs also require proper orientation when installing them on the PCB. They are usually marked with either a notch or a dot at the end nearest pin one. In addition to orientation it is important to remember that ICs are sensitive to heat and are easily damaged. Limiting the time your soldering iron is used to solder the connections reduces the likelihood that the part will be damaged. In this kit it is recommended that sockets be used for the ICs so they can be easily replaced in the event of a failure.

Pin 1 of the IC socket is on the end, closest to the notch.





8 Pin IC (Note notch on left side of chip indicating the end with pin one.)