



# Kit Building And Soldering Guide

Electronics is FUN!



A comprehensive guide for "First Time" kit builders, students, and experimenters. Learn the basics to enter the exciting world of Electronics Kit Building!

New SMT  
SECTION!

## Provides complete information on...

- ✓ **Required Tools**
  - ✓ **How to Solder**
  - ✓ **PC Board Soldering**
  - ✓ **Desoldering**
  - ✓ **Identifying Parts and Components**
  - ✓ **Resistor Color Code**
  - ✓ **Construction Techniques**
- ◆ **Build It!**
  - ◆ **Learn It!**
  - ◆ **Achieve It!**
  - ◆ **Enjoy It!**



## INTRODUCTION

*This guide, normally provided as a stand-alone document, has been included in this catalog as a handy reference to kit building, soldering, de-soldering, and component identification. The guide can also be downloaded at [www.ramseykits.com](http://www.ramseykits.com). The guide was written to help the first-time kit builder understand the in's and out's of kit building. We hope you find the information useful, not only to help you with your Ramsey Kit, but as a general resource for hobby electronics and techniques. (The font is even larger to make it an easy to read reference at your bench while working!)*

## TOOLS USED IN PC-BOARD KIT-BUILDING



You can "get by" in PC-board kit assembly with a soldering iron, solder, and a small pair of diagonal cutters (OR wire nippers), but you'll find yourself wishing for needle-nose pliers with every other move you make! Also important is a sponge, steel wool, or damp rag for keeping the tip of the soldering iron clean and shiny. You may also find a wire nipping tool easier to use for PC work than diagonal cutters.

There are a variety of "convenience tools" for electronic kit building such as soldering aids, "third hands" or mini-vises, tweezers (*for inserting small parts in tight spots*), or magnifiers, and YOU will have to decide from experience which ones are useful to you.

Choosing a soldering iron is like choosing a tennis racquet, fishing rod or other very personal tool. If you are new to soldering try to get some guidance from someone with experience. You want the level of heat and the style of tip that helps you to accomplish the one goal of all soldering, a perfect connection! If you can't get any personal help in choosing a soldering iron, start with our WLC-100 Soldering Station or visit your local Radio Shack. DO NOT try to use a soldering GUN on a PC-board kit project!

Screwdrivers, pliers, nut-drivers, wire-strippers and other common tools become needed only at the stage of working with enclosures or making connections to Mini-Kit PC-boards. If your kit requires adjustment of a coil, a non-metallic "alignment tool" will be needed and is explained in your kit manual.





## KIT PC-BOARD SOLDERING

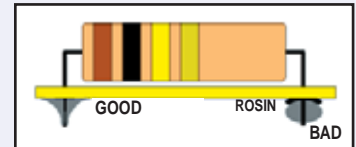


Unprofessional soldering practices are the nightmare of ANY electronics manufacturer or service shop. GOOD soldering is essential to the performance of your project. A "cold" solder connection is caused by too little heat OR by heating only the component wire and not the wire and PC copper foil together. The tell-tale sign of too little heat is a dull, rough-looking connection. If you heat only the wire the solder forms a cute ball around the wire, and rosin may completely insulate your ball from the copper.

### **SOLDER BRIDGES**

You probably know that a solder bridge is a perfect and unintended connection of two PC-board points that should NOT be connected. They happen most easily when soldering IC's and other devices with pins close together. The only technique for avoiding solder bridges is for you to be in complete control of the tip of your soldering pencil. The best single tools for avoiding bridges are a proper point on the soldering iron, bright light, perhaps with some magnification of your work, and thin diameter solder.

Study your connection before you zap it with heat and solder. Choose the best "approach angle" for the iron's tip to heat the connection. Plan ahead to make the solder do what YOU want it to do, and you just won't build any solder bridges!



### **TEN COMMANDMENTS OF GOOD PC-BOARD SOLDERING**

1. *If the soldering iron tip is covered with burned rosin, it cannot properly heat your connection*
2. *If you heat only the wire and not the wire and PC trace together, a cold, bad connection is likely.*
3. *If your soldering tip is big enough to bridge two adjoining connections, it probably will!*
4. *Dirty, grubby solder will contribute to dirty, grubby connections.*
5. *Any use of acid core (plumbers!) solder in electronics work will destroy everything...DON'T USE IT!*
6. *A connection in a large area of PC-board copper requires more heat than one pin of an IC.*
7. *If your connection looks dull or brittle, it's no good.*
8. *If your connection looks like a ball instead of a shiny cone, it's no good.*
9. *Thin fresh shiny rosin core solder is easier to use for PC-board work than thicker "hardware store" solder.*
10. *Pre-tin any stranded hookup wires leading in and out of your PC-board kit project. It will prevent problems later!*

## THE PAINFUL BUT USEFUL ART OF "DE-SOLDERING"

The art of PC-board "de-soldering" is harder than good, basic soldering, but it is a skill necessary for service technicians - or experimenters who like to salvage parts from scrapped PC boards - and for folks who make mistakes in building kits!

Solder is efficient and stubborn, especially once it has adhered correctly to a PC-board connection. Those days of clipping away an old part from big solder lugs, and easily soldering the new part are gone except for keeping vintage equipment in good repair.

"Desoldering" is the skilled and swift removal of all solder from a PC connection. You re-melt the solder and "suck" it away as cleanly as possible. Most beginners will have reasonable success with any spring-powered vacuum device available from Ramsey or an electronics store. Remember...

- Follow kit-building instructions very carefully so that you will not need to do needless "desoldering" to get it working!
- If possible, ask an expert to SHOW you how to "de-solder".
- Use a bright light and magnifier to SEE what you are doing.
- Your goal is to get the connections clean enough so that you can easily re-solder the new part.





## **SORTING PARTS AND GETTING READY!**

Prepare a clear, uncluttered workspace. In addition to room needed for tools and handling the circuit board, allow space for some kind of "parts organizer" that will not be bumped or dropped. This organizer can be a small tray or box. (A cardboard egg crate works great; styrofoam can give you static problems so we don't recommend it!) Refer to the Parts List published in the kit manual. Organize the kit parts according to basic types. Check carefully to make sure a small part did not slip away when opening the kit's packaging.

Please make sure that you have sufficient lighting for clear parts identification and accurate circuit soldering. This might seem like gratuitous advice but experience has shown that brown, orange, red and silver resistor colors and tiny numbers on capacitors and transistors all start to look the same in dim light after a hard day's work! Some PC-boards are very tiny with tight parts layouts.

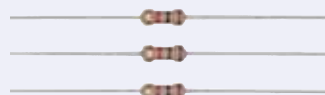
Take a little time to read through the instruction manual for your kit before you start assembly.

## **IDENTIFYING KIT PARTS**

### **RESISTORS**

The universal color coding of resistors does not change, fortunately, but resistor body colors and the style of wire leads can vary. Also, resistors may be packed loose or supplied on tape strips. Install any resistor as shown on the PC board parts layout diagram. Keep all leads as short as possible.

**SEE THE RESISTOR COLOR CODE TABLE ON THE FOLLOWING PAGES!**



### **CERAMIC DISC CAPACITORS**

It is helpful practice to become as familiar as possible with the various marking codes for ceramic capacitors. The first fact to keep in mind is that there are several accepted methods for marking the value of these capacitors! While resistor color codes have withstood change over many decades, the protocols for marking increasingly tiny capacitors have many variations! While capacitors also can be color-coded, Ramsey Kits use disc capacitors marked by a number-letter code. The first two digits establish the first two numbers of the value. The third digit is the multiplier. The letter designates the manufacturing "tolerance" or accuracy for the value printed.



Values under 100 picofarads, used widely in our FM and VHF kits, are printed clearly with no need to interpret them further. Small capacitors stamped 4.7, 10, 15, 33, 68 and so forth are 4.7, 10, 15, 33, 68 picofarads respectively! A 100 picofarad capacitor, also commonly used in our kits, can be marked either 100 or 101! If it's marked 100, believe it. If it is marked 101, the value is 10 (first 2 digits) X 10 (3rd digit multiplier) = 100 picofarads! If it is marked 101J, we know that it is made to 5% accuracy, while H signifies 3% and K is 10%.

Rule of thumb: If the 3rd digit is a 0, you may assume the value is in picofarads, and you can take the three numbers together as the picofarad value for that capacitor. So, just as in the above example, both "470" and "471" are 470 pf. There is a growing trend to mark capacitors very clearly in nanofarads. Be sure not to confuse 10nf or 100nf with 10 or 100 picofarads!

There's more! Some manufacturers don't care about codes and print the value and tolerance VERY plainly. E.g., "820+20%" means 820 pf. at 20% tolerance. Yet another style of capacitor for values such as .1 uf is manufactured as a neat, rectangular block, with the value and other identifying data stamped on the top. For example, the information of interest to you in the marking ".1J63" on such a capacitor is the ".1" for .1 uf. **SEE THE CAPACITOR TABLES ON THE FOLLOWING PAGES!**

### **ELECTROLYTIC CAPACITORS**

Virtually every kit uses one or more electrolytic capacitors. These are polarized capacitors, which means that they have positive (+) and negative (-) leads and MUST be installed correctly on the PC board. Your kit instruction manual is very clear about correct polarity of these capacitors, and the positive (+) side is generally etched on the PC-board itself. Ordinarily, only the negative side is marked on the capacitor by a stripe or band usually containing zeros or minus signs. And unless they have been trimmed, electrolytic caps have a long and a short lead. The longer lead is generally the positive. Another important thing to note about electrolytic capacitors is that they can actually explode if installed backwards so when we mention being careful about polarity, we're quite serious about it!



### **INDUCTORS**

Coils or inductors supplied with Ramsey kits can come to you in ANY of these styles:

- unshielded, slug-tuned
- shielded, slug-tuned
- enameled wire and easy do-it-yourself winding directions
- Color-coded coil similar in appearance to a resistor



Your kit manual provides clear information for correctly identifying any coils used.

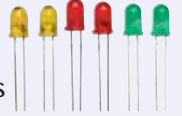


### DIODES

If a kit uses one diode or a number of the same kind of diode you are in luck. Just be sure to understand the difference between the cathode (banded) end and the anode before installing. If the kit uses several different diodes it is necessary to identify each of them correctly. Believe it or not, there ARE printed markings on even tiny diodes. You'll need a magnifying glass even if you claim perfect 20-20 vision! If you are unsure about correct diode identification, please ask for help.



An LED (light-emitting diode) is indeed a diode, not a lamp. If your kit uses LEDs the instruction manual shows you clearly how to install them correctly. A numeric display such as used in frequency counters or tone decoders is a series of LED's.



### TRANSISTORS

The most common single transistor for most Ramsey kits is the versatile NPN 2N3904. We use a variety of other types as well. Please pay close attention to how the "flat" side or other special characteristic of any transistor is oriented on your kit manual's PC-board drawing.



### INTEGRATED CIRCUITS ("IC's")

Many Ramsey kits employ at least one IC. And, for most kits, we encourage careful, direct soldering of the IC to the PC board. Our years of factory service experience have shown us that IC sockets can cause needless problems. If you prefer to use sockets, buy them and do so. Be careful when setting IC's into sockets. It is VERY important to orient the end with the notch, dot, or band in the direction shown on the PC-board drawing!



### NON-CRITICAL PART VALUES

The majority of components in our circuits have a specific value for a specific purpose. For example, a certain resistor is needed to provide correct bias to a transistor. And, of course, the frequency of tuned circuits is directly determined by the capacitor and inductor. However, some parts values are not critical at all, and your kit manual may specify, for example, that an electrolytic capacitor may be in a range of 2 to 5 uf or 4.7 to 10 uf. Or we can state a range of values for resistors or potentiometers or that "any" NPN transistor will work in a given circuit position.

### COMPONENTS ON SOLDER-SIDE OF PC BOARD

99.99% of all parts in all kits are mounted on the component side (top side) of the drilled PC board. Occasionally the assembly will call for a small capacitor or resistor to be soldered across two points on the bottom side of the board. When this is required, be sure to cut away excess wire to avoid shorting other PC-board connections.

## THE WORLD OF SURFACE MOUNT (SMT) COMPONENTS

Welcome to the latest innovation in electronics: (S)urface (M)ount (T)echnology, or SMT. Just as the transistor revolutionized the amount of space required to construct electronic circuits, the advent of surface mount components has further "shrunk" the dimensions of the space needed for modern day circuits. These "chip" components are commonly used in everything from camcorders to high speed computers. While the components may look strange at first (where are the leads??!!) rest assured that they are not too difficult to install. You'll want to have some special equipment to solder these parts, nothing fancy or expensive, just things you'll want to have handy before beginning.



A small pair of tweezers and good eye to hand coordination are necessary for proper SMT assembly. A magnifying lens is recommended to check solder connections. And of course, a soldering iron. A friendly warning for you: don't pull out your trusty soldering gun for surface mount projects as the gun generates too much heat for the tiny solder "tabs" on the component ends. A standard pencil type iron will work just fine.

Let's take each type of component on its own so that you can become more familiar with them and feel more comfortable working with Surface Mount parts. They're also identified differently than standard components so you'll want to familiarize yourself with what's what and who's who in the world of these tiny components. And while you may not be interested in working with them you might be forced to at some point since so many manufacturers are making parts only in SMT packages.

### RESISTORS

Resistors typically come in a rectangular package stamped with a number. The number indicates the value of the resistor but it's a little different from the color bands you're used to. Typically a resistor will be imprinted with three numbers; the first two indicate the value and the third is the number of zeros to add. Therefore "470" = 47 Ohms (4, 7, and no zeros) and "471" = 470 ohms (4, 7, and one zero equals 470). A 1k resistor will read "102" for 1, 0, and then two more zeros (1, 0, 00 = 1000 ohms or 1k).





## CAPACITORS

SMT capacitors could use one of three different identification systems. One is the same system used on the thru-hole parts mentioned earlier. The second is a two character alphanumeric code where the letter represents the most two significant digits and the number is the multiplier. The last really isn't an identification system at all because no information is printed on the part. Keep these parts in the bags we provide that have the value attached.



## ELECTROLYTIC CAPACITORS

Electrolytic capacitors have a polarity and must be installed in the correct orientation to work properly. Sometimes they're in a rectangular package similar to the ceramic caps described previously but the package will always have a band or a line denoting either the positive or the negative end. Some larger value electrolytics are packaged in a cylindrical metal can and typically the negative lead is marked by a black semi-circle on the side closest to the negative pad. The PC board silkscreen will show the placement of the positive lead. Always be careful when soldering electrolytics because, like their big brothers, when they're installed backwards the surface mount parts can explode too!



## INDUCTORS

Coils or inductors supplied with Ramsey kits can come to you in many different styles. Some have a 3 number code on them similar to the resistors and caps mentioned previously and the number shows the value in microhenries. Your kit manual provides clear information for correctly identifying any coils used.



## DIODES

Most SMT diodes have three leads to make them easier to orient than their larger counterparts. A diode with three leads will have two on one side and one on the other and you simply have to line it up on the pads and solder.



An LED (light-emitting diode) is a diode, not a lamp. If your kit uses LEDs they may come in a few different packages and the instruction manual shows you clearly how to install them correctly.

## INTEGRATED CIRCUITS ("IC's")

Surface mount integrated circuits present some interesting challenges when soldering them in, since the leads are so tiny and typically very close together. The part will have a dot or notch on it to denote pin one and must be oriented as shown on the PC board in order to work. When soldering them in we'll normally tack down the two leads on opposite corners to be sure that the IC will connect to all the pads without overlapping and to make sure it's placed exactly where we want it before soldering all the other leads. Some surface mount ICs will have the part number printed on the top of the package and others use a code to designate which IC you're installing. We'll always let you know which identification method you're dealing with when installing ICs.



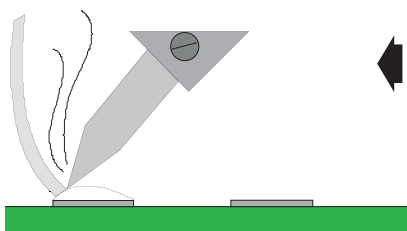
## TRANSISTORS

We use a variety of different transistors but they're all easy to orient and install. Most will have a cryptic number stamped on them and not the actual part number. Of course, your manual will tell you which is which without you having to go to the internet and find a lookup table, but they do exist if you ever feel the need to figure out what a part is on your own.



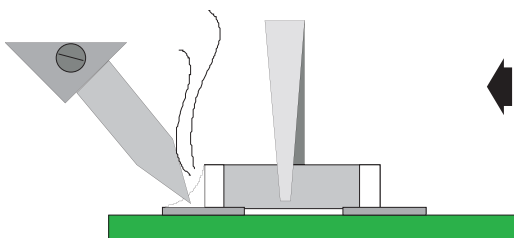
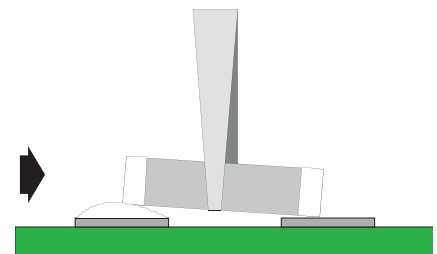
## SURFACE MOUNT SOLDERING TECHNIQUES

The following pictures should help you learn the proper way to solder those tiny surface mount components. Don't be intimidated by their size; by following a few simple procedures you can become an SMT pro in no time!



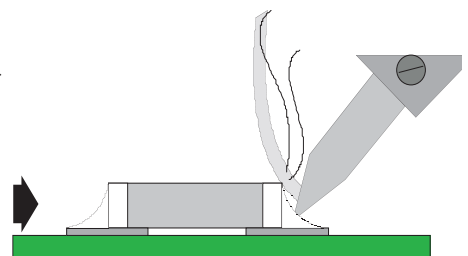
Patience is the key when installing surface mount components. Typically, the first step (after identifying the component) is to "tin" one of the PC traces that will connect to the part. This is by far the easiest method for surface mount soldering.

Once this is accomplished, the part can be installed by holding it with tweezers in contact with the "tinned" trace and re-heating the solder.



Be careful that the iron tip does not come in contact with the "tab" on the body of the chip component when reheating the solder. Overheating of this solder tab can cause a fracture of the bond to the component, causing an intermittent connection.

Once you have the part in place, solder the other side, or in the case of a part with more than two leads, solder the rest of the leads or pins.





### SOLDERING SURFACE MOUNT ICs

Look for pin one, marked with a dot or notch, and orient it in the same direction as shown in the Parts Layout Diagram and PC board silkscreen. Place it on the board with tweezers so that the pads line up with the pins and use the finest tip that you own on your soldering iron.

Solder only pin one for now. It may help to hold the IC down with a finger or the tweezers while you solder. Once pin one is soldered, check the orientation to make sure that all the pads still line up. If not, re-heat pin one and gently move the part with the tweezers until it is in position.

When finished, solder the pin in the opposite corner of the IC. This prevents accidentally reheating pin one and moving the part. Now that you have two pins soldered, solder all the rest of them while being careful not to short any pins together. Should that happen it is useful to have some solder wick available to "mop" up any extra.

### STANDARD CAPACITOR & RESISTOR TABLES

CAPACITORS		RESISTORS	
101 = 100 pF	102 = .001 uF = 1 nF	0-Black	6-Blue
103 = .01 uF = 10 nF	104 = .1 uF = 100nF	1-Brown	7-Violet
221 = 220 pF	331 = 330 pF	2-Red	8-Gray
471 = 470 pF		3-Orange	9-White
		4-Yellow	Silver=10% Tolerance
		5-Green	Gold=5% Tolerance

**Thru Hole and SMT Ceramic Capacitor Three Digit Code**  
 1st digit = Most Significant Digit  
 2nd digit = 2nd Most Significant Digit  
 3rd digit = Multiplier or number of zeros to add (Pico Farads)

**RESISTORS**  
 1st Band=Value Number  
 2nd Band=Value Number  
 3rd Band=Number of Zeros  
 4th Band=Tolerance

### DC OPERATING VOLTAGES, ON-OFF SWITCHES, ETC.

Most Ramsey Kits are designed to be battery-powered, and most major kits designed for our standard case and knob sets have internal 9-volt batteries and on-off switches. The Mini-Kits generally operate over a wide range of voltages, from 3 to 18 volts, with 6, 9, or 12 volts being standard. Your kit manual specifies the ideal operating voltage for that kit. It is up to you to supply a switch, wires, battery holders, etc., for the small kits. Hint: it's good practice to use red hookup wire for the DC positive (+) and black for the negative (-).

### THE FINISHING TOUCHES!

Although you will be anxious to "turn on" your project, take one last look at the wiring and soldering connections. A few minutes spent now can save you hours of troubleshooting time later! Look for solder bridges, cold solder joints, missed connections, reversed polarity on components, and stranded wire shorts. Touch up ANY solder connections that seem less than perfect. **ONCE YOU APPLY POWER...IT MAY BE TOO LATE!**

### ABOUT RAMSEY ELECTRONICS® ...

Ramsey Electronics® was started in the early 70's as a hobby kit business. It is the core value of the company from that day going forward to provide the electronic hobbyist, young or old, an experience of achievement, by not only building a neat electronic product, but understanding the theory behind it, including the how's and why's of the entire circuit. Our mission from those early days in the 70's was simple: **Build It, Learn It, Achieve It, Enjoy It!** We must be doing it right, because we are nearing our 4th decade of providing some of the greatest hobbyist experiences to our customers.

In the 1980's Ramsey Electronics® expanded and became one of the largest manufacturers of pager and communications test equipment in the US. At the same time, we developed and received a patent on the first shielded test enclosures that provided hands-on and visual access to the device under test while maintaining RF isolation, and today we are the leading manufacturer in desktop RF isolation chambers for commercial, military, agency, and forensics applications. In the late 90's we designed the first PX series FM stereo broadcast transmitter. While LPFM transmitters were in their infancy, we were one of the first to offer an FCC Certified transmitter to meet the needs of the LPFM market. Our FM broadcast group has rapidly developed and includes a dedicated Military and Government division that provides specialized RIAB and other products exclusively to Military and Government entities throughout the world.

