GENERAL CONSTRUCTION & ASSEMBLY TECHNIQUES FOR OUR KITS

COMMON PRACTICES

There are certain techniques that we suggest to use in construction because they are efficient, reliable, and proven. These instructions come under the general heading of "common practice". They will help you to achieve professionals results of which you will be proud.

A. TOOLS

Certain tools are suggested for constructing our kits, others are highly recommended.

Suggested:

1. Long Nose Pliers (2")

2. Diagonal Sidecutters (Wirecutters)

3. Small Slot Screwdrivers

4. Medium Screwdriver

5. Gas Pliers or Slip joint Pliers

6. Pencil Soldering Iron with 40-50 Watt Tip (60 watt maximum)

7. Wire Stripper

8. Crescent Wrench (1/2" or larger)

9. Hobby Knife (X-Acto knife or sharp penknife)

Highly Recommended:

1. Small Socket Set (1/4" to 1/2") or Spintight Set

2. Automatic Wire Strippers

3. Grounded (3-wire) Pencil Soldering iron (RST-303 stand)

4. Set of Jeweler's Screwdrivers

Remember, the caliber of the work you perform will be in direct proportion to the quality of care used in construction. If you need a certain tool to do a job, beg, borrow, steal or buy it – the reward will be a job well done.

B. HARDWARE

Silicon rubber RTV, hot melt glue, epoxy, paraffin wax, super glue, are available through most hardware stores and are used on many of our kit assemblies.

Wherever machine screws and hex nuts are used, use a lock washer on the NUT side of the chassis. Where a wire is connected to the chassis at this screw, use a locking solder lug.

Some manufactures use Loc-Tite to hold screws in place. We do not feel this is necessary. However, if it makes you feel better, you can use a SMALL drop of Loc-Tite (or even clear fingernail polish) to secure the bolt to the nut.

Self-tapping screws are used where it is impractical or impossible to use a machine screw and nut. Do NOT overtighten a self-tapping screw, or it will strip the material it is being threaded into. Perhaps the best advice is this: tighten the screw until you think it needs just another SMALL amount of tightening and DON'T TAKE IT.

C. SOLDERING

Soldering is an art unto itself. In electronics, a good solder job will have more effect than any other factor in the quality of construction. While a discussion of soldering techniques is beyond the scope of this manual, we will review the basic rules.

1. The joint must be mechanically strong. Solder makes a very poor glue.

2. Greasy tools and solder joints mix like oil and water. Use alcohol to clean suspected oily joints or tools BEFORE soldering.

3. Movement during cooling makes a cold joint. Cold solder will fall off of a soldered joint in chunks under minimal vibration. Good joints are shiny and bright, cold joints usually appear dull and grayish.

4. Avoid using too much solder – solder blobs have a way of shorting out adjacent connections. (The exception to this is some HV points requiring large, smooth blobs of solder to reduce corona discharge and leakage. This is noted where required.)

5. A hot, clean iron solders swiftly and cleanly. Irons too small or filthy cause the joint to get hot too slowly, melting insulation and oxidizing metal. 40 to 50 watt irons and 100 to 150 watt guns are just about right.

6. CAUTION — NEVER BEND A LEAD NEXT TO THE COMPONENT BODY. IT WILL BREAK! THIS IS ESPECIALLY TRUE OF OUR HIGH VOLTAGE DIODES AND THESE COST MONEY. YOU USUALLY ONLY GET ONE BEND BEFORE THE LEAD BREAKS.

D. CABLING

Cabling refers to the bundling together of wires with lacing cord or nylon cable ties. This technique provides great strength and vibration resistance to the wires in a cable, not to mention giving a clean appearance to the finished product. This approach is suggested for our more complicated projects.

E. MODIFICATIONS OF ASSEMBLY may add to repair or trouble shooting costs. Certain situations may require total circuit replacement to get you a functioning kit. This is at the customer cost. The only consolation is you get your original work back for you to possibly savlage from checking against the factory assembled unit.

The information Unlimited troops are ready to help. However, you may wish to help yourself by reading some background material. Our suggestions are:

PRACTICAL ELECTRONICS - "The ARRL Radio Amateur's Handbook" (American Radio Relay League)

THEORETICAL ELECTRONICS - "Integrated Electronics" (Miilman and Halkias)

See the many books offered in our catalog.

H. ASSEMBLY TECHNIQUES

P.C. Boards. By far the greatest difficulty in assembling a kit correctly is using the proper technique when assembling printed circuit boards. An analysis of poor or improper operation on units returned for repair reveal the following faults to be most common.

1. Component lead is not soldered to foil. Assembler missed applying solder or heat to an individual lead. This error may be eliminated by either soldering each part as it is put in or installing a number of parts, soldering all the leads, then checking when clipping off the excess wire to be sure each lead has been soldered.

2. Solder bridge left between PC Board traces. Usually happens late at night when sleepy and also when using large iron or soldering gun for assembly of densely packaged boards. Solution: Drink lots of coffee and use a 40 watt pencil iron with a conical or chisel tip.

3. Intermittent or spurious oscillations caused by leaving air space between component and board in high-gain or RF circuitry. Sometimes caused by "improving" circuit design by adding sockets to high gain IC's. Solution: Before soldering parts to foil, press part as far down as it will go onto board without forcing — usually a 1/16" to 1 /32" lead is advisable. Use sockets if you must at your own risk.

4. We also have a technician who swears at:

Assemblers who bend component leads at right angles to the foil before soldering, thus insuring that the component and PC foil come off in one piece.

Assemblers who refuse to cable-tie wire bundles as per instructions and get maximum use of our high-gain amplifiers by turning them into uncontrolled feedback oscillators.

Assemblers who substitute their only slightly different "MIL-SPEC" parts to "improve" our circuit performance and wind up with unforeseen problems.

For the most part, however, he gets to smile a lot at the well constructed kits returned to us for minor repairs.

5. Every now and again we get a board back with a part in upside down or backwards. The following parts have a polarity or a special way they MUST be installed: integrated circuits (notch on one end of IC must correspond with notch on instructions or as noted on board); Transistors (have either a "flat" side if plastic or a keyway "notch" if metal); Diodes (banded end is cathode), most tapped coils (color dot is "hot" or RF side). Parts which mechanically can only be installed one way.

Resistors, most capacitors other than electrolytics, crystals, incandescent bulbs, ferrite chokes and beads are all non-polar and can be installed in either direction. However, it these non—polar parts are all installed with the values reading in one direction, not only does it add a touch of class to the assembly, but also makes servicing and trouble-shooting much easier.

6. Perhaps the most difficult trouble to find is the wire that is soldered to a terminal, but through carelessness a long wire whisker is allowed to remain untrimmed. Murphy's Law demands that this whisker touch another circuit which will cause maximum damage. Solution: strip a minimum amount of insulation from wires, then twist the strands together before soldering.

COMPONENT IDENTIFICATION

You have been supplied with a sheet of instructions on the coding of the most common components. It is true that the great majority of the components supplied, to you with this kit will fall neatly into one of the categories on this sheet. However, every now and again you will come across a component that is either marked with a special code or with numbers that don't fit the general description on the sheet of coding instructions. This section will help you determine the values of these strangely coded parts.

CAPACITORS

Capacitors have the highest chance of being misread. When you remember that the range of capacitance of common capacitors goes from 1 picofarad (1 X 10 -12" farad) to 10,000 microfarads (1 x 10 -2" farad), you realize the ratio of large to small, is ten billion to 1 (10 10":1), and the coding for this wide range is rather diverse.

1. Disc ceramic capacitors are, for the most part, marked with their value as shown on the coding sheet, in either picofarads (pF) or microfarads (uF). 1000 pF is the common dividing line between pF and uF, so if the value stamped on the disk is less than 1000, the value is in picofarads, and if less than 1, the value is in microfarads. Since the dividing line is at 1000 pF, some manufacturers call a 1000 pF capacitor "1000" and others call it a ".001". Please note that these capacitors are identical (1000 pF = .001 uF).

Every now and again a manufacturer will use the European/metric marking on the disk. While this is not the most common system, it is not at all unusual, and you should be alert for it's use. Basically, the marking is a 3-digit number, most commonly followed by an alphabetic letter. The three digit number is read just like a resistor (first number, second number, number of zeros to add), and the alpha letter is the tolerance. Thus, a capacitor marked "124K" is a 120000 pF (120,000 pF) 10% tolerance capacitor. Note that 120,000 pF = .12 uF, and this capacitor would have been called out as a .12 uF in the instructions. It might be helpful for you to prove to yourself that **102 " = 1000 pF = .001 uF, that "103" = .01 uF, and that "104" = .1 uF, and so on.

2. It is also true that "plastic" capacitors (i.e. those that use nylon, polypropylene, polycarbonate, etc., as a dielectric) also more often than not use the metric identifier. However,

most plastic capacitors use a marking like 2A103JT (for example), and it is up to you to pick the 103J out of this part number and correctly identify the .01 uF 5% value. (OK, OK, for you over achievers the 2A refers to the dielectric material and method of construction and the T refers to the package style).

Some plastic capacitors, notably polystyrene, come marked not only in picofarads and microfarads, but also in nanofarads (as if we didn't have enough trouble). One nanofarad equals 1000 picofarads (which, you might remember, equals .001 microfarads). Thus, a capacitor marked 3.3N H would be called out as a 3300 pF 2% capacitor (or a .0033 uF 2% capacitor).

E. SEMICONDUCTORS

Transistors, diodes, integrated circuits, all the various forms of semiconductor have a fairly easy (if you are "in the know") part numbering system.

1. Transistors are by far the easiest components to identify. Most transistors conform to the industry standard "2N" numbering system — the only problem being that there are over 8000 different devices registered with 2N designation. It is also true that several 2N numbers will do similar tasks in the circuit (in fact, for Information Unlimited part number PN2222, there are well over 2000 separate 2N numbers that will perform adequately in many of our circuits!).

2. Diodes, due to their small size, are the most difficult components in the kit to identify. There is one inviolate rule regarding diodes and that is there will always be a black band at one end, the CATHODE end, of the diode. Also, most diodes are registered as "1N" devices; once again, there are several thousand such registered diodes.

Some glass diodes come with several colored bands, just like resistors. Holding the black cathode band to the left, the colors are read from left to right and are the diode 1N numbers. Thus, a diode marked black-orange-yellow would be read as (black-cathode stripe) 1N34.

Very small glass diodes generally have the 1N designation broken up into two or three lines, plus the manufacturer's logo. The diodes are small enough that: (a) You need a magnifying glass to read the letters and (b) The diode, being cylindrical, makes it hard to know where to start reading the numbers.

As if that wasn't bad enough, some diodes have an "A" or "B" suffix, notably zener diodes. Now, given that it is late in the evening, you are using a cracked magnifying glass, the printing on the glass (while no great shakes to begin with) has blurred ever so slightly in transit, you are excused for misreading 1N4007 into 1N4001. But beware as the high number will work for the low number but vice versa will go poof!

3. Integrated circuits are by far the hardest semiconductor to properly identify; there is no industry standard "1 N, 2N, 3N" designation, but (it seems) "every manufacturer for himself'. For example, by far and away the most popular IC is the old reliable 741, the first mass produced, cheap, easy-to-use op-amp. 741, right? Not to Fairchild. To them, it is a U5B7741312-7225F, and their part is so marked.

We have been fairly careful to use manufacturers who have easy-to-read numbers, but you should be aware of some of the above variances.

TESTING/CALIBRATION

A. Use type of batteries as required. Nicads produce 1.2 volts per cell while Alkaline and others are 1.5. Nicads will deliver large amounts of current and maintain a relatively constant voltage. Improper use of batteries can destroy laser tubes, transformers and other expensive components. This will void all component warranties.

B. A cheap multimeter is strongly suggested for testing and troubleshooting. These are available from $15.00 to $25.00.

C. A scope is an excellent supplement to any hobbyist lab. It allows viewing wave shape levels and is often required in some of our more complex projects. Scopes can range in price from several hundred to several thousand dollars. Check surplus houses as they are often available at a good price.

D. Safety goes without saying — No one should attempt any of our kits that are labelled dangerous without a full understanding of electricity and associated safety procedures. This is compounded by lasers, since now an optical hazard also exists.

COLOR CODE FOR ¼, ½, 1 & 2 WATT CARBON FILM RESISTORS

COLOR	1st, 2nd sign. figs.	Decimal mult.	Tolerance
BLACK	0	x1	- - - -
BROWN	1	x10	1%
RED	2	x100	2%
ORANGE	3	x1000	- - - -
YELLOW	4	x10,000	- - - -
GREEN	5	x100,000	- - - -
BLUE	6	x1,000,000	- - - -
PURPLE	7	x10,000,000	- - - -
GREY	8	-	- - - -
WHITE	9	-	- - - -
GOLD	-	0.1	5%
SILVER	-	0.01	10%
NO COLOR	-	-	20%

1000 ohm = 1 K ohm
1,000,000 ohm = 1,000 K ohm = 1 meg. ohm