



SMK-1 Homebrew Enclosure Kit



*Detailed instructions for assembly of an
all-copper clad homebrew enclosure,
custom-designed for the
NorCal SMK-1 Transceiver*

Brought to you by the New Jersey QRP Club
<http://www.njqrp.org>

SMK-1 Enclosure Kit

Assembly Manual

Get ready for an exciting new facet of homebrewing! A number of QRP clubs and manufacturers have been supplying a steady stream of unique and interesting projects lately. Some of these are simple pc-board and parts kits while others also include an enclosure. Well, working in cooperation with NorCal, the NJQRP Club now provides an easy-to-build enclosure as a companion to the SMK-1 transceiver kit. By purchasing the SMK-1 Enclosure Kit you are taking part in the latest approach to homebrewing which combines building the case as well as electronics! This manual will guide you through the process of constructing the enclosure and installing the SMK-1 PC board. A number of drawings and photographs, along with detailed directions, will guide you easily through the process.

BOX DESCRIPTION

Like we said, the SMK-1 case is one that you homebrew. Don't worry though, you won't have to go through the hassles of scribing, bending and cutting metal; we've already done all that work for you!

This do-it-yourself case is a little different than most that you may be familiar with. It is not made of aluminum or steel or even plastic. It's fabricated from copper-clad glass-epoxy printed circuit board material. Being homebrew, it is a fitting companion to the Norcal kit and adds to the enjoyment of your project. All you need to do is carefully follow the directions in this manual and you will find it easy to make a very attractive case. No drilling, sawing or punching is necessary; only a little soldering is needed, and perhaps some touchup with a

file. In fact, once you built it you may even be inspired to make your own pc board case for the next homebrew project you have lined up.

Cases made of pc board stock have lots of advantages over other material. The raw material is relatively common and easy to machine. It is lightweight and, in small cases, quite strong. The copper surface provides a good continuous electrical shield for electronic circuits inside while presenting an outer skin that can be left "natural" or painted in any color you want.

If you want a short treatise on this construction method check out Joe's Quickie No. 34 in the Information Exchange column in the April 2000 issue of the QRP Quarterly.

The SMK-1 Enclosure Kit consists of eight pieces of

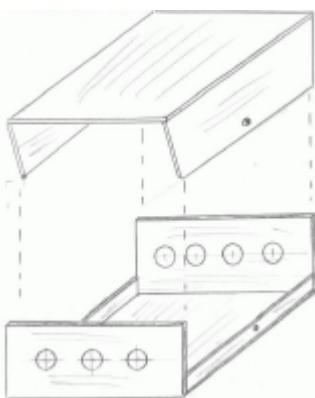


Figure 1: "Interlocking U's"

printed circuit stock which will be soldered into the top and bottom of a cabinet. (Skip ahead to Figure 2 to see a set of diagrams depicting all supplied parts.) The case top is an open "U" which sits over another open "U" formed by the case bottom. The bottom also has internal side rails which lend strength to the front and rear panels, and to which the top is connected via sheet metal screws.

Also provided with the kit are the mounting hardware, knobs and jacks needed for the SMK-1 transceiver. Clear acetate sheet overlays are even supplied to be used as attractive labels for the front and rear panels.

PACKAGE CONTENTS

It's a good idea first off to identify the kit parts and make sure that they are all present. The following list details them and identifies the cabinet parts by letter. Match them to Figure 2 and check them off in the spaces provided in the parts list. If by some misfortune anything is missing, please contact NJQRP for a replacement.

Parts list -- Bag 1

- a Top cover panel
- b, c Two top cover side pieces
- d Bottom plate
- e Front panel
- f Rear panel
- g, h Two side rails
- 1 front panel clear acetate label
- 1 rear panel clear acetate label
- 1 right angle alignment gauge (approx. 1 inch square)

Parts list -- Bag 2

- 2 Nylon standoffs
- 3 knobs
- 1 BNC jack
- 2 1/8" phono jacks
- 1 coaxial DC power jack
- 4 #4 x 1/4" sheet metal screws
- 4 Self-adhesive rubber feet

General Guidelines

Before we start construction, let's start off with a couple of tips in case you are assembling a pc board case for the first time.

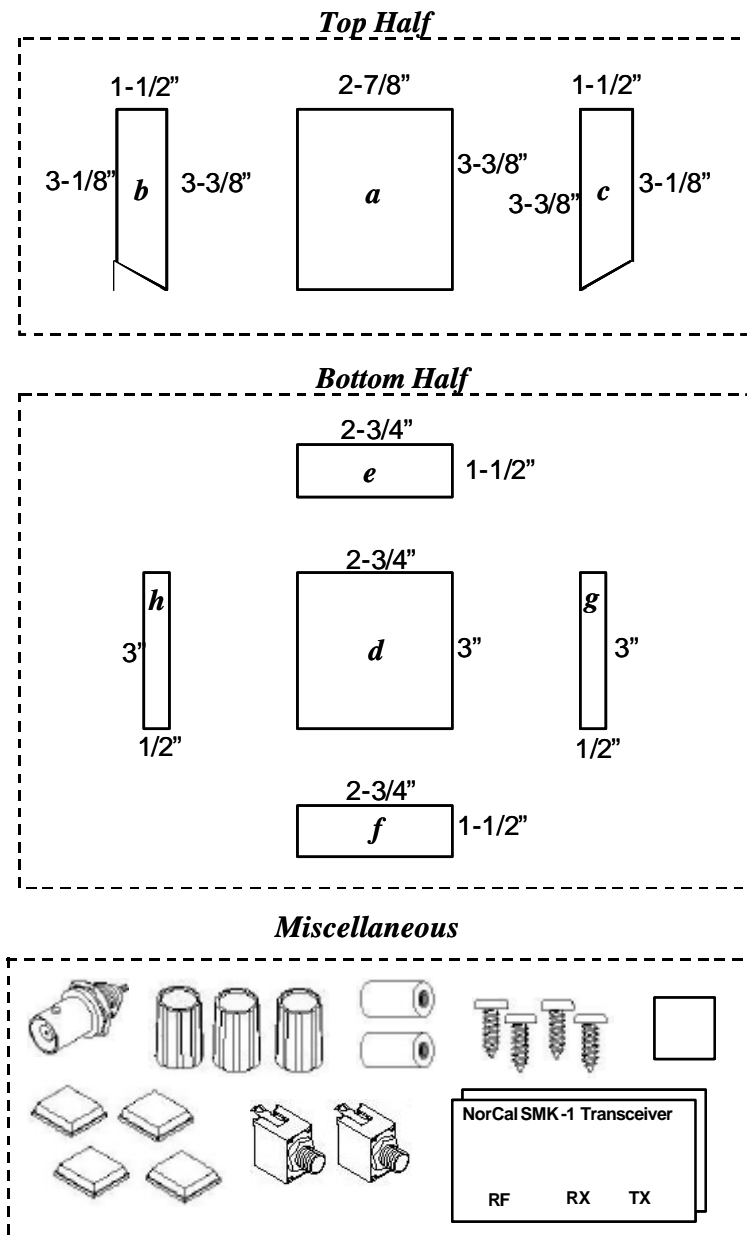
You will need only a couple of hand tools and supplies that are probably already at hand. They will be discussed in the text but here is a sample list:

- Soldering iron
- Non-acid solder
- Scotchbrite or other soap-free non-abrasive pad
- Flat file
- Alcohol or other non-water-based solvent
- Clear adhesive to attach panel labels
- Mechanic's square (optional)
- Rosin core flux (optional)
- Paint (optional but an excellent choice for durability is Rustoleum™)
- Clear spray (optional though Krylon™ clear protects copper from corrosion)

This process has a lot in common with assembly using surface mount components. While ordinarily solder joints should not be relied on for mechanical strength, good joints are the only source of strength for surface mounting and for pc-board cases. So every effort must be made to produce good joints.

High quality solder connections begin with clean surfaces. While the copper-clad board pieces in this kit are shipped in good condition, the copper will form an oxide film over time and normal handling can contaminate the surfaces with finger oils and slight corrosion. A good practice to follow is vigorous scrubbing with a gentle abrasive such as a Scotchbrite pad followed by cleaning with rubbing alcohol or other non-aqueous solvent. Once cleaned this way the copper should stay clean enough for several days so long as you keep it dry and don't handle it any more than necessary during assembly.

Figure 2: KIT CONTENTS



As with any soldering operation, the **proper iron and amount of heat** should be used. Generally any soldering iron suitable for electronics use with a 35 to 50 watt rating is fine. 600-deg to 800-deg F should do the trick if you are using a temperature-controlled solder station. Irons with less wattage will not have enough heat capacity to produce good joints while higher-wattage ones can overheat the adhesive that holds the copper onto the printed board base layer causing delamination. A flat chisel tip is preferred over a cylindrical or conical one so that enough heat can be transferred to the solder as a running seam is made.

A good quality **rosin core solder** is fine though some of the more modern "no-wash" type mixes are good too. Do not use acid core solder as it will destroy your soldering iron tip and eventually lead to severe corrosion of the copper surface of the enclosure you are building.

Since you want the top and bottom of your enclosure to fit snugly without unsightly gaps or seams, **alignment** of the pieces while you are soldering is quite important. Copper clad board boxes have their individual sides joined together at right angles. Accuracy in aligning each piece accurately is what makes the enclosure go together properly and look attractive.

A simple **alignment gauge** is included with the enclosure kit to help you make good right-angle joints. It is accurately cut on at least one corner for perpendicularity (love those big words!). It is a good idea to check all four corners against a machinists or carpenter's square to see which one is best. You may also care to use a file to "knock off" 1/8 or so on the exact corner so that it will fit flush against a corner of your box after soldering to ensure "squareness" in the finished product. This will also let you know at a glance which is the best corner! Using

the gauge will be described in the detailed assembly steps so that the enclosure pieces can easily be aligned the correct way.

Finally, you need a **good clean uncluttered work surface!** That should be obvious, but it is important. When working with the pc board material, a fairly benign surface is necessary to keep the copper on the pc board material clean and scratch-free. A soft cloth or towel laid out on the table surface is best but in a pinch you can use cardboard or newspaper. A side benefit of using an overlay on your work bench is that you will help protect that surface as well as that of the project you are working on. Eliminating clutter helps you keep track of all the parts.

DETAILED DIRECTIONS

Ok, the preliminaries are out of the way so let's get started! Heat up your iron kick the kids and pets out of your workshop and turn on your rig so that you can be soothed by the sound of cw on 7040 as you work.

If you have already inventoried the parts, *great!* If not please go back to the **Package Contents** section on page 3 and do so. Select pieces *a*, *b* and *c* to build the case top first.

Please refer to "Figure 3: Top Half Assembly" drawing on the next page. Note from the end view that the two side pieces *b* and *c* will be assembled to the **inside** of top cover panel *a* rather than alongside it. If the sides are soldered alongside the cover, the cover will not fit on the bottom properly. Also observe that the top cover is longer than it is wide so that the longer side of pieces *b* and *c* will be against the long dimension of *a*. Be aware that the side view is shown upside-down. When the case is finally assembled the "overhang" will be at the top of the enclosure front panel. All right, that's enough visualization.

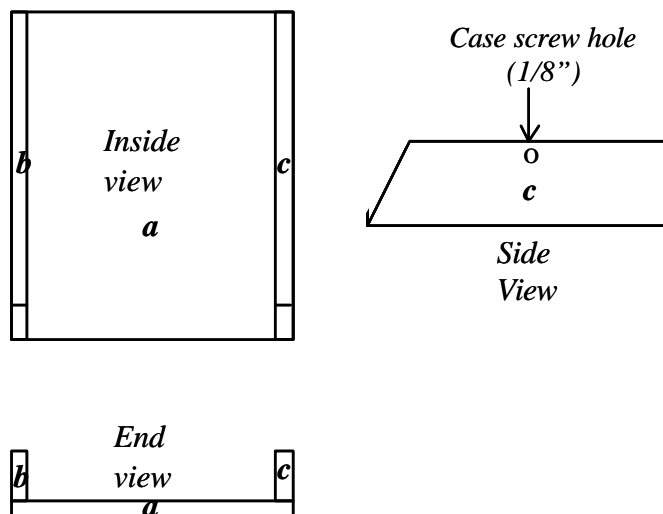


Figure 3: Top Half Assembly

Lay piece *a* on the workbench and set one of the side pieces (either one) on top of it along one side. Line the side piece up flush with the edge of the top cover, using the alignment gauge to ensure that the two pieces are lined up at right angles. The photo in Figure 4 demonstrates how this is done.

[Note: The one photo we have of using the alignment gauge technique actually shows its use in soldering the side rails to the base (described in the next pages); but the technique is the same as used in soldering the top half

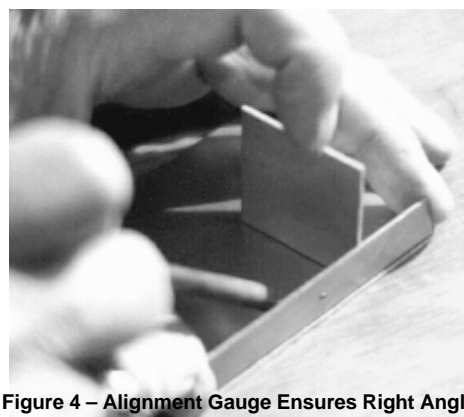


Figure 4 – Alignment Gauge Ensures Right Angle Positioning

sides.] It may seem awkward at first since you have only two hands but you have to do it with only one hand since you will need the other for soldering!

Carefully load some solder on your soldering iron top and place a solder “tack” in the middle of the seam between the side and top pieces to hold it in place. Now add a couple more tack joints about ½ inch or so from the front and back edges while holding the pieces together with the alignment gauge.

When complete, the side and top covers should be accurately at right angles. Check along the seam from front-to-back and carefully redo the tack joints as needed to get the proper alignment.

Once you are sure of correct alignment you can **complete the solder seam**. You have two choices here. If you are cautious and don’t want extra bother, don’t run the seam all the way out to the front and rear edges of the cover. That is, keep them back about 5/16 inch from the front face of the side pieces and about 1/8 inch from the rear face. If you are adventurous, run the seam all the way out. This will require a little filing on the bottom cover later, but will give you a somewhat stronger box. To make the continuous seam, start at the back end of the seam and slowly add solder to the joint as you move the soldering iron along the seam. Take care not to disturb the right-angle that the cover and side piece make with each other.

Now that you are an accomplished expert, repeat the above process with the other side piece. You now have a completed top cover! It should look like the photo below in Figure 5.

Bottom Half Assembly

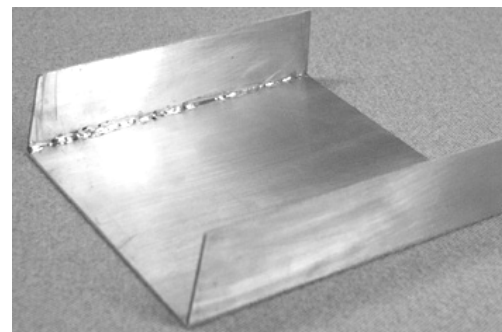


FIG 5: Completed Top Half

Next you will assemble the bottom cover. Begin by identifying bottom cover *d* front panel *f* and rear panel *e*. You can tell the front and rear covers apart by noting that the front panel has three holes while there are four on the rear.

Examine Figure 5, the Bottom Half Assembly drawing, as illustrated on the next page. It shows that the front and rear panels mount on the outside edges of the bottom cover and the side rails go between the end panels inside the whole shebang.

We’ll first solder both side rails (*parts g and h*) to the base plate (*part d*). By placing the smaller, less-critical side rails in place first, the later step of soldering the front and rear panels in place will be made much easier.

Using the alignment gauge exactly as shown previously in figure 4, solder one side rail in place using the *tack-first, seam-solder second* technique already described. The side rails are identical and can be used interchangeably. Make sure the edges of the side rail are even with the front and rear edges of the base plate, as this flush right angle edge will be the mounting datum for the front and rear panels. Don’t worry if the side rail is not exactly even with the base plate, as you’ll have a chance to “square things up” with the flat file before putting the front/rear panels in place.

Next, solder the second side rail in place in the same manner as you did for the first one. Now is the time to file the edges to ensure flush perpendicularity. The completed base-and-rail assembly is shown on the next page in Figure 6.

You next **solder the front panel** (*part f*) onto

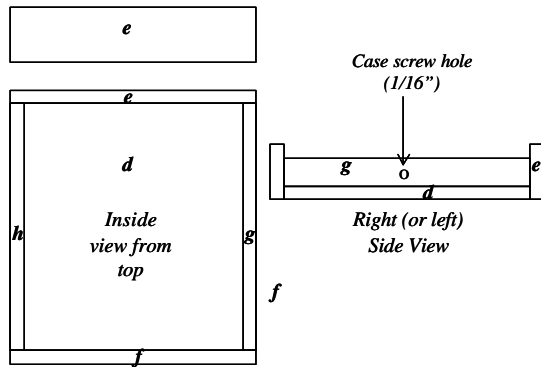


Figure 5: Bottom Half Assembly

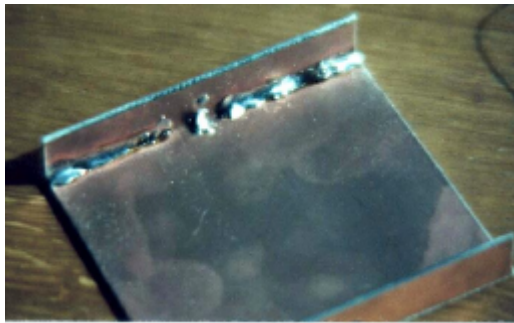


Figure 6: Side Rail on Base Plate

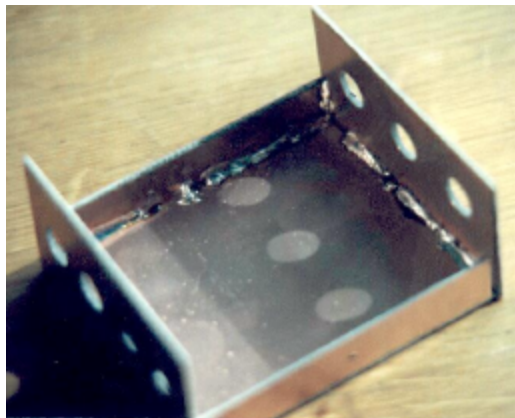


Figure 7: Bottom half assembly complete

the bottom plate (*part d*). Ensure that the front panel is aligned square and flush with the base/rail assembly. Hold it in place with the claw grasp of one hand as you tack solder several points along the joint. Use the same solder-tack technique as you did for the top cover then run a continuous joint in the seam after ensuring proper alignment.

Repeat the same process to **solder the rear panel *e*** to the bottom plate *d*.

You're coming along nicely now! Your completed bottom assembly should look something like that shown in Figure 7.

It's a good idea at this point to **fit the top cover over the bottom** to be sure that everything fits. It should be a snug fit but not so tight that you will stress the top cover when it is installed. If you ran the solder bead all the way out on the top cover you will find that it interferes with the edges of the front and rear panels. Never fear – we'll take care of that next.

If you have continuous solder beads out to the front and rear panels on your top cover it is now necessary to perform a small amount of cosmetic surgery. File off the sharp corners on the front and rear panels so to clear the top-cover bead. See

Figure 8. You only have to "knock off" about 1/16 inch so don't get carried away!

When you are sure that the covers nest together properly, put in the two sheet metal screws that hold the top and bottom halves together. The first time that you screw one of the screws into place, it will be a hard turn on the screwdriver. This is because you are cutting threads into the pcb material on the side rails. But once you have these threads in place, insertion and removal of the screws should be much easier to do.

Do not overtighten these screws! If you are careful in tightening they will last for many on and off cycles. If you inadvertently strip one out by over-tightening, drill out the top cover screw holes and go to the next larger size sheet metal screw!

The pc board edges and corners of the assembled enclosure are sharp and rather abrasive. You may care to bevel them to protect your fingers and keep the box from damaging tabletops and anything else it comes in contact with. A couple of swipes with a flat file will do the trick. Early samples of case like this had a nasty tendency to poke holes in bags and knapsacks before being refined this way!

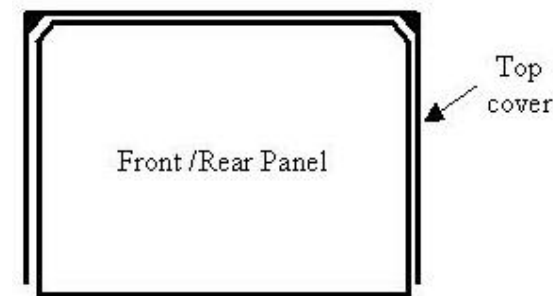


Figure 8: – Bevelled Front And Rear Panel Corners Provide Clearance For Top Cover Solder Beads

Figure 9 on the next page is a photo of the bottom of a complete enclosure with the side screw in place. Note the flush and even nature of all pc board edges.

FINISHING

At this point you



Figure 9: – Bottom/side view of completed enclosure showing flush & straight edges and screw in place.

have a completed enclosure! All that remains is to do some final finishing as you see fit and to install the SMK-1 board and associated hardware.

Painting is a personal thing. While some care to leave a “natural” copper finish, others want to personalize their projects by painting them outrageous colors or match them to other equipment they may have. The whole process is beyond the scope of this manual but here are a couple of tips.

1. If you are going to paint your enclosure be sure that all soldering is finished. The heat from soldering inside the case will conduct through the wall and damage your nicely painted surface.
2. Surface preparation is very important to ensure that the paint adheres properly. Use a Scotchbrite™ pad to remove surface roughness and clean the metal immediately prior to painting with acetone, working in a well-ventilated area so that you don't suffer respiratory distress.
3. For a well-preserved “natural” copper finish that will not tarnish use a clear

acrylic spray such as Krylon™ clear spray.

4. Other spray-on acrylic colors will work okay for the short-term but may have a tendency to chip or get scratched in time. An oil-based paint like Rustoleum™ adheres well and gives a tough finish.

5. Chose a light color if you are going to use the acetate overlays provided with the kit. The lettering on them is black, but may not have much contrast against a dark surface.

FRONT & REAR PANEL LABELS

Acetate labels are provided in your Enclosure Kit to help you create a neat and professional-looking project case. These clear overlays are pre-printed but do not have holes cut in them for panel-mounted controls and connectors. Once in place on the panels, a sharp hobby knife such as an Xacto™ knife will cut holes in the appropriate control/jack locations quite nicely. A good treatise on labels is “Homebrew Chassis and Panel Labels” by Ed Roswell, K2MGM. It appeared in the Winter 2000 issue of the QRP Homebrewer.

If you choose to use the acetate labels provided in this kit, merely cut each one out carefully along the outside of the rectangle defining the panel perimeter. This will allow the rectangle to be present on the panel when complete.

Next, spray adhesive or apply a light coating of rubber cement on the panel and carefully position the acetate label sheet over the panel and press into place. in a few minutes, the adhesive will be dry and you can delicately cut out the holes in the acetate over the control/jack holes of the

panel.

It's a good practice to lightly spray the front of the acetate label with clear acrylic like Krylon. This will protect the black toner comprising the actual labels.

See the photo below showing the rear panel with labels applied. The front panel labels are shown in the photo on the cover of this manual.



Figure 10: – Completed rear panel showing acetate labels applied.

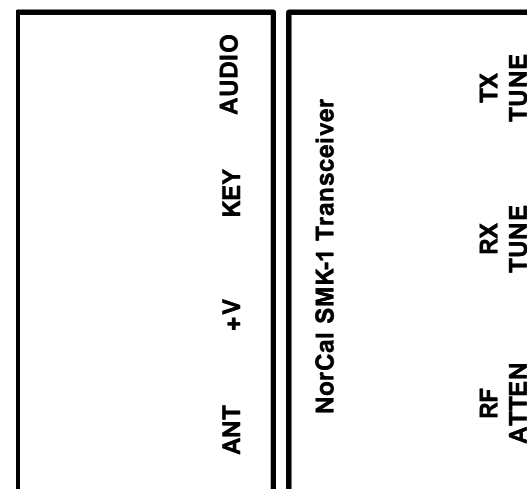


Figure 11: Templates for panel labels

INSTALLING THE SMK-1 BOARD

Now that your enclosure is all assembled, painted and labeled, all that needs to be done is to install actual transceiver circuit board and control hardware.

The SMK-1 board will be supported in the front by the three potentiometers mounted on the edge of the board. These pots will protrude through the corresponding holes in the front panel of the enclosure and we'll use the pot nuts to hold it securely to the front panel.

1) Prepare the pots by removing the nut and washer from each.

2) Using needle nose pliers carefully bend and break off the little alignment tab on the front part of the pot body. This will allow the pots to sit flush against the inside of the front panel.

3) Using small sheet metal screw (supplied), attach a nylon spacer to the bottom side of the board at each of the two rear holes on the SMK-1 board. The screw will be inserted from the top side and protrude down and into the nylon spacer on the bottom of the board. You'll be cutting threads into the spacer, and it will be a tight turn of the screwdriver. Hold the spacer tightly with your pliers and turn the each screw down into its respective spacer until the board is tightly contained between the screw and spacer on each end of the board's rear edge. These two spacers will be the "free-floating" stand-offs for the board, ensuring that the board doesn't flop around or short out inside the enclosure. See figure 12 below showing the nylon spacers/standoffs in place.

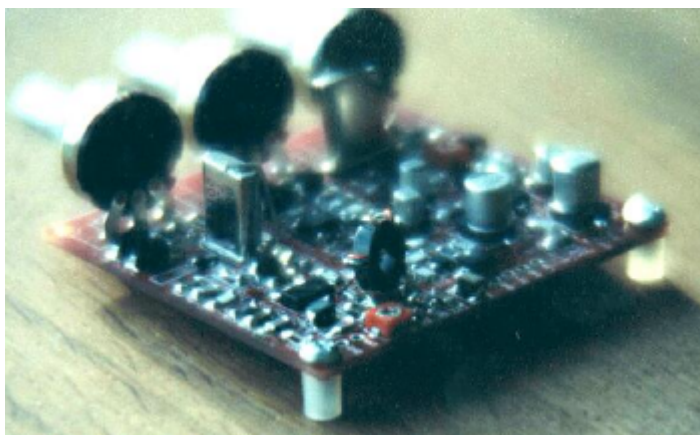


Figure 12: Nylon standoffs in place on rear edge of SMK-1 Transceiver board

4) Carefully insert the board assembly into the enclosure, making sure to align the three potentiometers into the respective holes of the front panel. Place the washers back on the shafts of the pots, and then screw the nuts on each pot shaft. These holes in the front panel may be slightly larger than required, but this was done to account for dimensional tolerance and builder variability. The washers should nicely cover up any over-sized hole, and when the nuts are tightened down on the pot shafts, the board will be held neatly in place. The rear of the board will be supported by the standoffs, which do not need to be fastened down to the bottom plate. They adequately ensure that the board remains parallel to, and isolated from the bottom plate.

ADDING THE REAR PANEL H/W

You will next add the supplied hardware to the rear panel and wire them to the correct pads on the circuit board.

Carefully remove the nuts and washers from the two 1/8" jacks, the coaxial DC power jack, and from the BNC antenna jack. Insert each into its respective location, as shown in the rear panel template on figure 11. As viewed from the rear of

the enclosure, left-to-right, the jacks are:

ANT	PWR	KEY	AUDIO
(BNC)	(COAX)	(1/8")	(1/8")

Insert the jacks into the proper holes of the rear panel. Secure them in place with their respective washers and nuts.

Using short insulated hookup wire, connect the ground and signal/power wires to each of the jacks from the respective pads at the rear edge of the circuit board.

The ground terminal on the 1/8" jacks is the little one on the side, and the signal terminal is the larger one on the opposite side.

The ground terminal of the coaxial DC power jack is middle one, and the +V terminal is the one on the left. (The right terminal is unused.)

The ground terminal of the BNC jack is the ground lug (bend it slightly up and away from the case in order to solder the ground wire to it.) The signal wire should

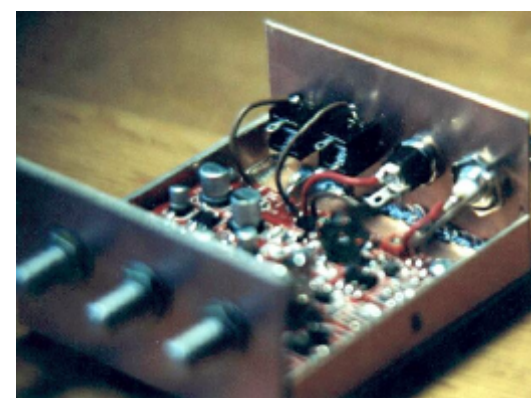


Figure 13: Rear panel hardware installed and wired

be attached to the center terminal of the BNC jack.

Use the photo below in figure 13 as a guide for your wiring.

FINAL STEPS

All that needs to be done now is the finishing touches.

1) Rubber Feet - Carefully peel off the black rubber feet supplied in the strip and apply one each to the bottom side of the enclosure. Make sure they are aligned orthogonal and uniformly for maximum esthetics. (That is, put them neatly in place!) If the surface of the pc board material is clean, the rubber feet should stay in place for a long while.

2) Front Panel Knobs - Using a small flat blade screw driver, partially unscrew the set screw from each knob until they are able to be slipped onto the pot shafts protruding from the front panel. With each pot shaft turned completely counter-clockwise, rotate the knob (which is still loose on the shaft) such that its indicator is pointing to the seven o'clock position and tighten the set screw. This will give the pot and knob normal relative indications during operation.

3) Put the top half of the enclosure on the bottom half and secure it using the two previously-used screws.

THAT'S ALL FOLKS!

Well, there's not much more to do other than create the corresponding cables for your transceiver (DC power, antenna, and key line) and start using it!

As long as you had your SMK-1 Transceiver operating before installing it in your new enclosure, it should work just fine right away.

If you do have problems, check for proper signal and ground wiring between the rear

panel jacks and the pc board. Check for +V making it to the board and for proper key closures making it from your external hand key, through the KEY jack and into the board.

If all systems are "go", you'll be transmitting and receiving on the QRP frequencies of 40m!

QUESTIONS

This method of homebrewing project enclosures is bound to be growing in the future. Opportunities for modifications and personal customizations are limited only by your imagination. One of our members of the NJQRP Club has a project in progress wherein he is making the enclosure for his 2N2/40 Transceiver completely out of pc board material, just like with this basic SMK-1 design. In addition, he's also fabricating an entire, modular, multi-board inner structure out of the copper clad boards. Homebrewing boundaries have officially been extended to the horizon!

If you have any questions or problems with the enclosure aspects of this project, please feel free to contact us by email or by US ground mail. We'll do our best to help you fully enjoy all aspects of your homebrew enclosure.

73,

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Additional Assembly Photos

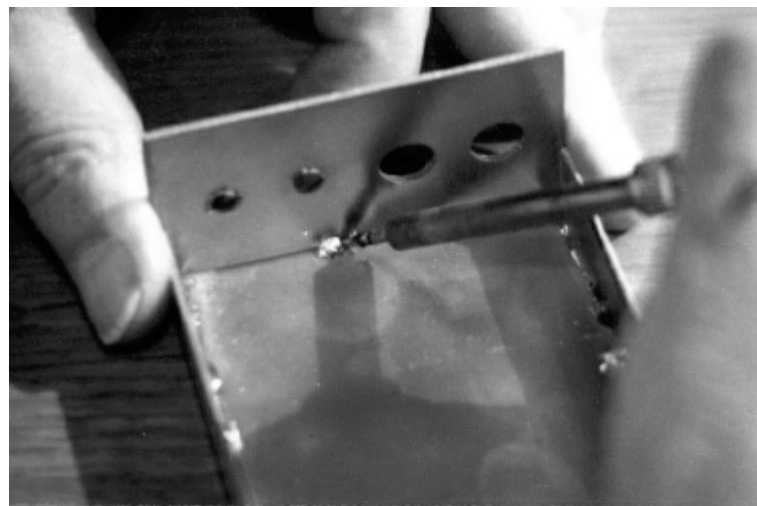


Figure 14: Tack soldering the rear panel into place

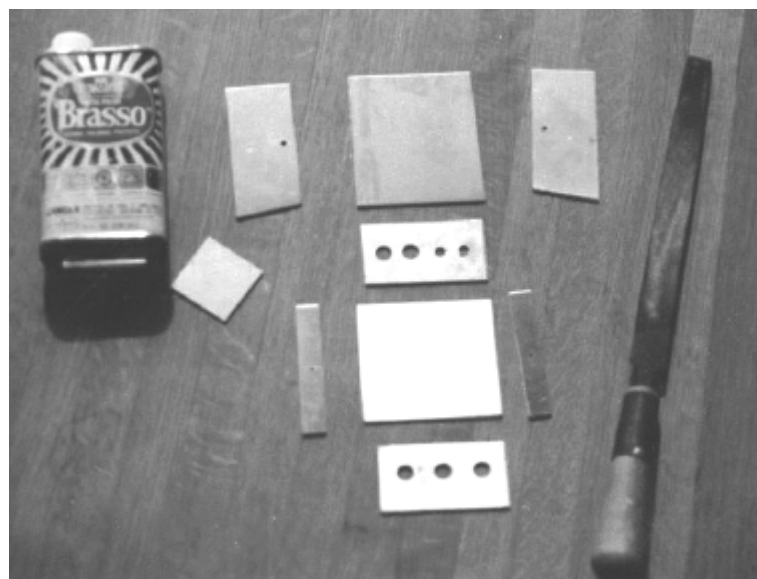


Figure 15: Boards comprising the kit.
(Small alignment gauge shown next to Brasso can.)

Many thanks go out to Doug Hendricks, KI6DS, Dave Fifield, AD6A and the NorCal QRP Club for the design of such an innovative and progressive project as the SMK-1 Transceiver. The continued combining and leveraging of NorCal and NJQRP clubs (and other local clubs) on such projects benefits the entire QRP community and makes projects like the “homebrew enclosure” possible. Thanks guys!

-- n2apb
