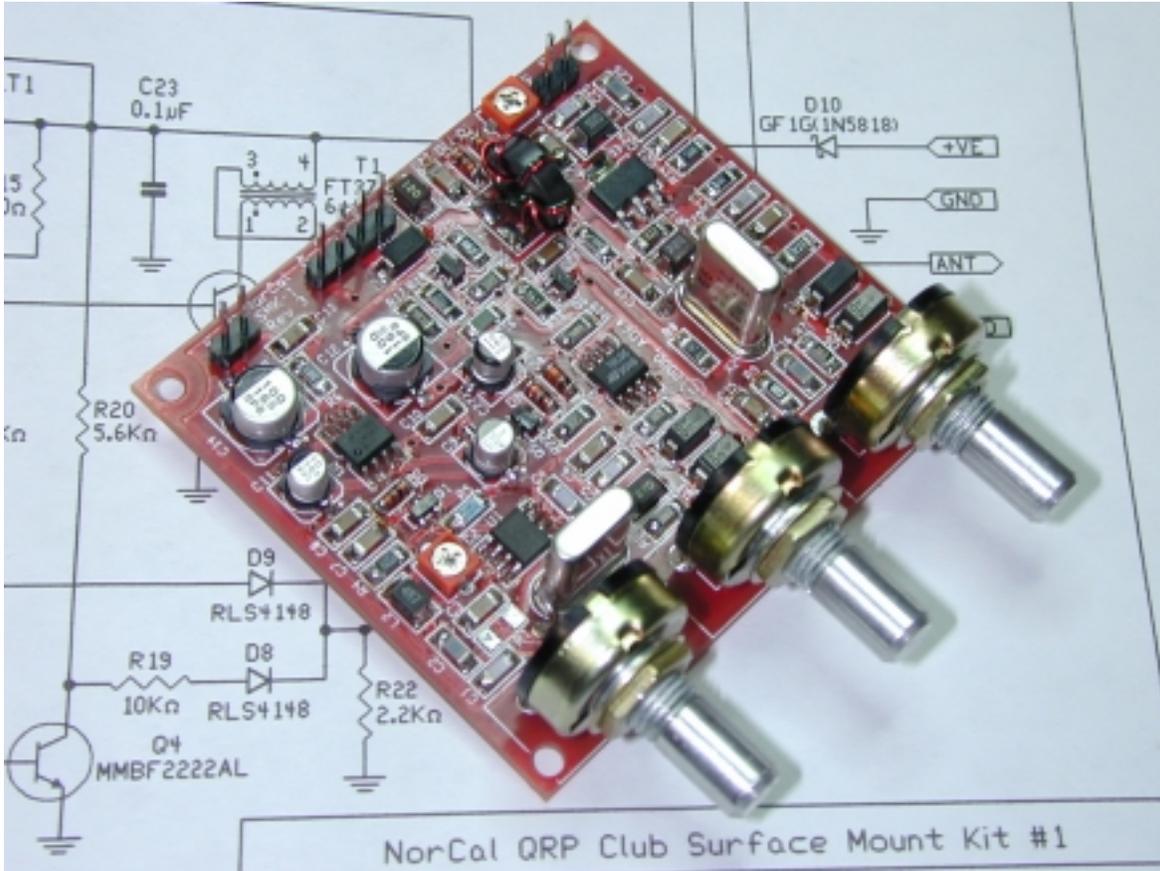


The NorCal QRP Club SMK-1 Construction Manual



A Learning Tool For Surface Mount Construction Kit Building

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Revision 0.1
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WARNING – DO NOT OPEN ANY OF THE PARTS BAGS YET!

The SMK-1 Construction Manual

Introduction

Thank you for buying a NorCal QRP Club SMK-1 kit. We're sure you will enjoy learning/practicing surface mount construction techniques by building the SMK-1. As a bonus, when built, the SMK-1 is a fully working 40m CW transceiver that you will be able to use on the air to make contacts!

The idea to produce the SMK-1 kit came from Doug Hendricks, KI6DS, who thought it would be a good idea to have a cheap learning tool to get hams used to doing surface mount construction, since that's the way virtually the whole electronic industry has gone and will inevitably become the technique of necessity for ham kits in the future.

All you will need to turn the SMK-1 into a fully working rig is a case, some knobs, an antenna jack, a power jack, a key jack and an earphone jack. Fortunately, the New Jersey QRP Club has come to your rescue here! They are supplying a custom designed PCB construction case, knobs and connectors kit for the SMK-1 for only \$10 including shipping to anywhere. You can order one from them by sending a check or money order for \$10 made payable to George Heron to:

George Heron, N2APB
2419 Feather Mae Court
Forest Hill
MD 21050
USA

The SMK-1 contains over 80 components. Most of them are surface mount parts. Some parts, like crystals, trimcaps and pots, are either too expensive or not easily obtained in surface mount packages so through hole parts are used.

The surface mount parts used in the SMK-1 were chosen to be large enough for most hams to be able to handle them with a small pair of tweezers and solder them in place using a fine-tip soldering iron. They are not the smallest surface mount parts by a long way, but they are small. I have personally built several kits now without using a magnifier, but I do recommend you use one if you have one! It will make life a lot easier for you, especially if your eyesight isn't quite what it used to be!

I recommend that you use a 1/16th inch or smaller soldering iron tip, preferably temperature controlled, and use 0.020" silver solder (although just about any solder will do!). You will need a small pair of angled tweezers to

be able to handle the components with dexterity and without damage.

Have fun building your SMK-1 kit – please let us all know your progress and give us your comments/feedback on the QRP-L email reflector.

General Description

The SMK-1 circuit is basically a modified Tuna Tin 2 transmitter integrated with a modified MRX-40 receiver. It is a further modification of the modified TT2/MRX-40 that I built for the indoor foxhunt at Pacificon 1999. All this is fitted onto a small 2.475" x 2.25" PCB.

The transmitter consists basically of the two 2N2222A transistor lineup of the original TT2 but with electronic keying. A key-switched crystal oscillator that has some degree of VXO feeds a medium power packaged version of the 2N2222A as a final in class A mode. After harmonic filtering, the result is about 350mW of fairly clean transmit power on 7.040MHz (+/- a bit).

The RX front end uses the ubiquitous NE602 mixer/oscillator with a crystal VXO. The RX is a direct conversion receiver, so you will hear both sidebands as you tune through a station. The input stage of the NE602 has been biased a bit harder than normal by R1, a 22K resistor (this resistor may need tweaking, if your receiver is overdriven, increase the value of this resistor. Try 27K or 39K). This gives the device more conversion gain.

The audio output of the NE602 direct conversion front end goes through a FET switch that serves to mute the audio to an acceptable sidetone level during TX and then on to a standard LM386 audio power amplifier running as much gain as it can.

The three controls on the front panel of the SMK-1 are (left to right as you look at it) RF attenuation, RX tuning, TX tuning. Operating the SMK-1 requires a little knowledge of where you are receiving and transmitting – there will be more on this in a later section of this manual.

Don't Open The Parts Bags Yet – MUST READ!

The parts bags have been loaded with components in the exact order that you should solder them onto the SMK-1 PCB. Since the components are tiny and many of them have no markings on them at all, you must only open one component compartment at a time! Solder all the parts from that compartment onto the PCB before opening the next compartment. It is imperative that you do it this way, so you only have one value open at a time. If you get the parts mixed up, tough bananas! You have been warned!!

In a few of the kits shipped, one of the small orange trimmer capacitors was put into the wrong compartment – it was placed in with the 4.7uH inductor. If your kit is one of these, when you get to the stage where you fit the 4.7uH inductor, save the orange trimcap on one side until you get to the one at the bottom of the bag and solder them in together then.

The through-hole parts and the transmit output transformer are fitted last. Save the crystals, pots and trimcaps till the end before you solder them in – it will make life much easier.

Missing/Defective Parts

Due to the care and methodology put into the kitting process, it is virtually impossible that any parts will be missing from your SMK-1 Kit. However, due to the nature of the small surface mount components in the kit, it is very easy for you to lose parts and we anticipate that there will be some loss! NorCal will only be able to replace parts for \$2. Send your lost parts requirements with a check or money order for \$2 made payable to Doug Hendricks to:

Doug Hendricks, KI6DS
862 Frank Avenue
Dos Palos
CA 93620
USA

Please include an SASE for the parts.

Technical Support

For simple questions please use email to obtain technical support from your fellow QRP'ers on the QRP-L email reflector. To subscribe, send an email to listserv@lehigh.edu with the words "subscribe qrp-l <your

name> <your callsign>" on the first line of the email body.

For more complex problems or issues or if you don't obtain satisfaction from the QRP-L email list, please email me at ad6a@arrl.net

Surface Mount Soldering Technique

Use a fine soldering iron tip (1/16th inch or less) at about 700°F if possible. Use fine solder (0.020"), silver solder if you can get it.

First, tin one PCB pad of the component you are going to solder down. Don't overdo the amount of solder – just a slight bump of solder is enough – maybe a ¼" of solder from your reel.

Next, pick up the component you are going to solder down using your tweezers – carefully, lengthwise – make sure you have it firmly, but not so firmly that it goes "ping" and flies across the room! With your soldering iron in one hand and the tweezers with the part in the other, carefully place the part down onto the pads in position – take care to line it up straight. Quickly dab the wetted soldering iron onto the lead/pad that you tinned previously to get it to stick nicely and sit flat.

Re-run the solder on this pad if you need to adjust the position of the component. You must get it straight and/or symmetrical across the pads at this time – once you solder another pin, you will have no chance to re-position it at all.

Once you are happy with its alignment on the pads (try to get it right first time to minimize the possible heat damage to the component), solder the other lead/s down carefully. Go back and touch up the first lead if necessary. That's it – simple!

If you need to remove a part for any reason, the best method is to use two soldering irons at once, one on each end. If you only have one iron, add solder to both sides of the part and heat them alternately until the part comes away on the tip of the soldering iron. You will need to use some solder wick to clean the PCB pads before soldering down a new component. Surface mount components that have been removed by this method are usually good candidates for the trash can – try not to reuse them unless you really have to.

Getting Started With Bag #1

Turn Bag #1 around so that you are looking at it like this with the “This Side Up” label in the bottom left hand corner:

| | | |
|------------------------|------------------------|------------------------|
| Item 6 13 x 0.1uF | Item 1 3 x 82pF | Item 2 1 x 100pF |
| Item 3 2 x 270pF | Item 4 1 x 390pF | Item 5 3 x 470pF |
| Item 22 1 x 10 Ohm | Item 23 1 x 56 Ohm | Item 24 1 x 100 Ohm |
| Item 25 1 x 220 Ohm | Item 26 1 x 560 Ohm | Item 27 2 x 1K |
| Item 28 2 x 2.2K | Item 29 1 x 3.3K | Item 30 1 x 4.7K |
| Item 31 1 x 5.6K | Item 32 1 x 8.2K | Item 33 5 x 10K |
| Bag #1 This Side Up | Item 34 1 x 22K | Item 335 1 x 47K |

Using a sharp knife, cut open just the top left hand compartment that contains Item #6, the thirteen 0.1uF capacitors. Remove the capacitors from their containers carefully, making sure that they do not fly off and get lost!

Using the PCB legend on the board together with the parts list and schematic, locate the 13 circuit references for this component type and, one at a time, solder them to the PCB.

When you have all 13 parts soldered down, move onto the next compartment on the right that contains Item #1, the three 82pF capacitors. Solder these parts to the PCB.

Next do Item 2, Item 3, Item 4 ...and so on down the bag until you have fitted all the parts from Bag #1.

Continuing With Bag #2

Likewise, turn Bag #2 around so that you are looking at it like this with the “This Side Up” label in the bottom left hand corner:

| | | |
|---------------------------|----------------------------|----------------------------|
| Item 21 1 x PZT2222A | Item 36 1 x 1M | Item 37 1 x 2M |
| Item 18 2 x MMBF2222AL | Item 19 1 x MMBF3906LT1 | Item 20 1 x MMBFJ309LT1 |
| Item 42 1 x SA602AD | Item 43 1 x LM386 | Item 12 5 x RLS4148 |
| Item 44 1 x L78L06 | Item 10 4 x SS16 | Item 11 1 x GF1G |
| Item 13 1 x 1uH | Item 14 1 x 4.7uH | Item 15 1 x 12uH |
| Item 16 1 x 22uH | Item 17 1 x 27uH | Item 7 1 x 1uF |
| Bag #2 This Side Up | Item 38 2 x 15-50pF | Item 39 1 x FT37-43 |

Using the same technique as for Bag #1, solder the parts to the PCB one compartment at a time. Some of the parts in Bag #2 are polarized. Make sure you align the bar ends of the diodes (items 12, 10 and 11) with the bar marked on the PCB legend before soldering them down. Item #7, the 1uF capacitor, has one side painted black. This is the negative end and should be at the opposite end from the + symbol that's marked on the PCB legend. Pay careful attention to the alignment of all the polarized components or your kit will not work!

Identification of pin one for the 8 pin SOIC chips. Locate the LM386 chip. You will note a small indentation or dot in one corner. That is pin one. Also, note that the edge of the IC is beveled on that side. That indicates the side with pin 1. Use this information to find pin 1 on the SA602 and the L78L06 chips. Be careful to place them correctly.

10uF & 100uF Capacitors

Next, locate the 10uF and 100uF capacitors, items 8 & 9. Solder them in place on the PCB paying careful attention to the polarization. The black end of the capacitor is negative (-) and should be at the opposite end from the + symbol on the PCB legend.

TX Output Transformer (T1)

The output transformer is bifilar wound on the toroid. It is quite easily done. Take the toroid and the two pieces of red and green wire. Hold the two pieces of wire parallel and wind 6 turns on the toroid, counting one turn each time you go through the toroid. When you finish, prepare the ends of the wire by trimming them about 1 inch long at first. Then burn the insulation off to the edge of the core, use a piece of sandpaper to get all of the insulation off and make sure that you have bright copper wire showing. Tin each of the four leads. Now, trim each of the leads so that they are ¼" long. Solder the toroid on the pads, making sure that you solder the red leads to pads 1 & 2 and the green leads to pads 3 & 4. You must do this correctly.

Crystals

The crystals are through hole parts. Place them in the position indicated and solder them in. The cases must be grounded and we have provided a place to do this. Find a cutoff resistor lead (sorry, but there are no leaded resistors here, but you should have one around). Solder it in the hole next to the crystal. Bend the lead over the crystal and solder it to the case of the crystal. Do this quickly so as to not kill the crystal!!

Pots

Next, solder in the pots. Make sure that they are fully seated to the board. This is important when you mount your SMK-1 in its case (You did order the case and connectors from the NJ QRP Club didn't you??).

Finally, solder in the two trim caps. They are the little square orange devices from Bag #2. When you solder them in, make sure that you orient them exactly as shown on the silkscreen of the board.

Wiring Up

Wiring the connectors is simple. Use small gauge stranded hookup wire and connect the speaker jack, key jack, power jack and antenna jack of your choice to the back of the board.

Testing

Now it is time to test your efforts. Attach a dummy load. Then apply 12 volts. Check for smoke, and hopefully there won't be any!! Replace the dummy load with an antenna. We will start with the receiver section. Plug in a set of headphones. Peak TC1 first to make sure that you have 2 peaks. Go for highest noise level or signal. Next peak TC2 for loudest signal. Next do the transmitter, and that is the easy part. Plug in a key, and transmit. Monitor on another receiver to make sure that you are putting out power.

If you have problems, go to qrp-l, and post your problem. There are literally thousands of fellow qrpers there who will be more than happy to help with your problem.

Operation

Test units of the SMK-1 have tuned from about 7.035 to 7.039.7 on the receiver, and 7.0375 to 7.039 on the transmitter. Thus the transmitter is the limiting factor on making contacts. Use a transceiver to verify which side of your signal that you want to tune the receiver to. You will soon learn that a dc receiver has two sidebands, and that you want to be on the correct one to make contacts. Verify the correct sideband on a transceiver, and then note which way that you tune the receiver in relation to the tone, (whether it goes up or down in pitch as you tune). Don't worry, you will soon get the hang of it. If you have questions, again, get on qrp-l, someone will be there to assist you.

Again, the purpose of this kit was to assist you in learning how to work with surface mount parts. We believe that it succeeds, and for a very modest cost. The transceiver does work, and it is capable of making contacts. It is not an ICOM 706 by any means though. We will be coming out with a full featured single band surface mount kit later, this kit is just for training and we hope that you have enjoyed it.

Parts Placement

