

Constructing the Fort Smith SideKick

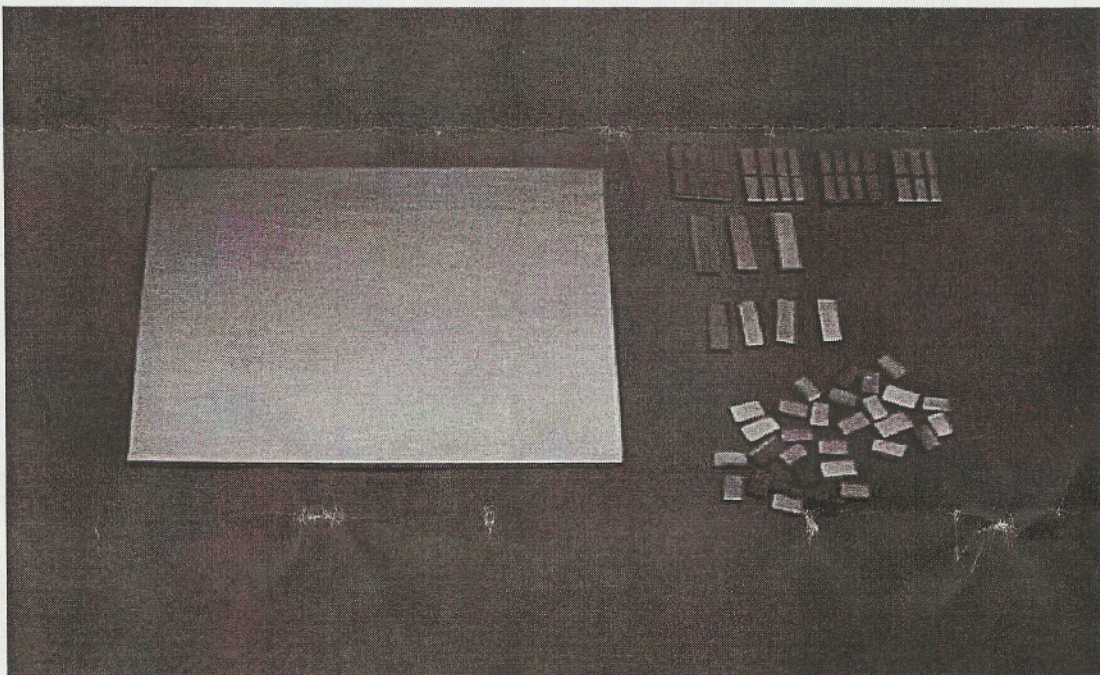
Introduction: Thank you for purchasing the Fort Smith SideKick Receiver kit. We think it is going to be a great addition to QRP as it will be the perfect companion receiver for all of those TunaTin 2 and other crystal controlled transmitter that you have. A very special thanks to Dave Benson, K1SWL, for allowing us to kit this great receiver and to Frank Roberts, VE3FAO, who did the layout Manhattan Style and wrote all of this manual except for the intro. Enjoy. If you need help, please email w5jay@alltel.net.

"Build for Aesthetics – Functionality will Follow"

Step 1: Preparing the Copper Printed Circuit Board and Pads.

Your kit contains a 2 ½ " by 3 " copper printed circuit board, one ½" strip of PC Board material along with several strips 1/8" wide.

- (a) Clean and polish the PC Board and strips
- (b) Cut three ½" x ½" pads for the IC sockets. The surface of these pads are then grooved to form 8 separate isolated sections of equal size in two rows of four to match the pin configuration of the IC sockets.
In a similar manner cut a 3/8" x ½" pad and groove it to form 6 isolated sections of equal size in two rows of three for transformer T1.
- (c) Using side cutters cut the 1/8" strips into the following pads:
 - 3 – 1/2 " long
 - 4 – 3/8 " long
 - 30 – 3/16" long



Step 1: The PC Board & Pads

Step 2: Preparing the PCB for Wiring

- (a) Glue the pads to the PC Board using the layout drawing as a guide

Hint: Use grid lines as a guide for placement. Most pads are aligned either vertically or horizontally with others.

Hint: Keep a piece of fine sand paper handy to remove any copper burrs and square up the corners of the pads. Ensure that the bottom of the pads are perfectly flat and rough to make a good seal when glued.

(b) Drill the following holes in the PCB using the layout drawing as a guide:

4 - 1/8 " mounting holes – one in each corner

10 - 5/64 " power distribution holes

3 for V+

To the right of D13/C112 pad

To the right of D6 pad

To the right of U2/C102 pad

5 for Vr

To the right of D2 pad

Below R15/Q2 pad

Above R15/Q2 pad

To the right of U1 pin 8

To the right of U3 pin 8

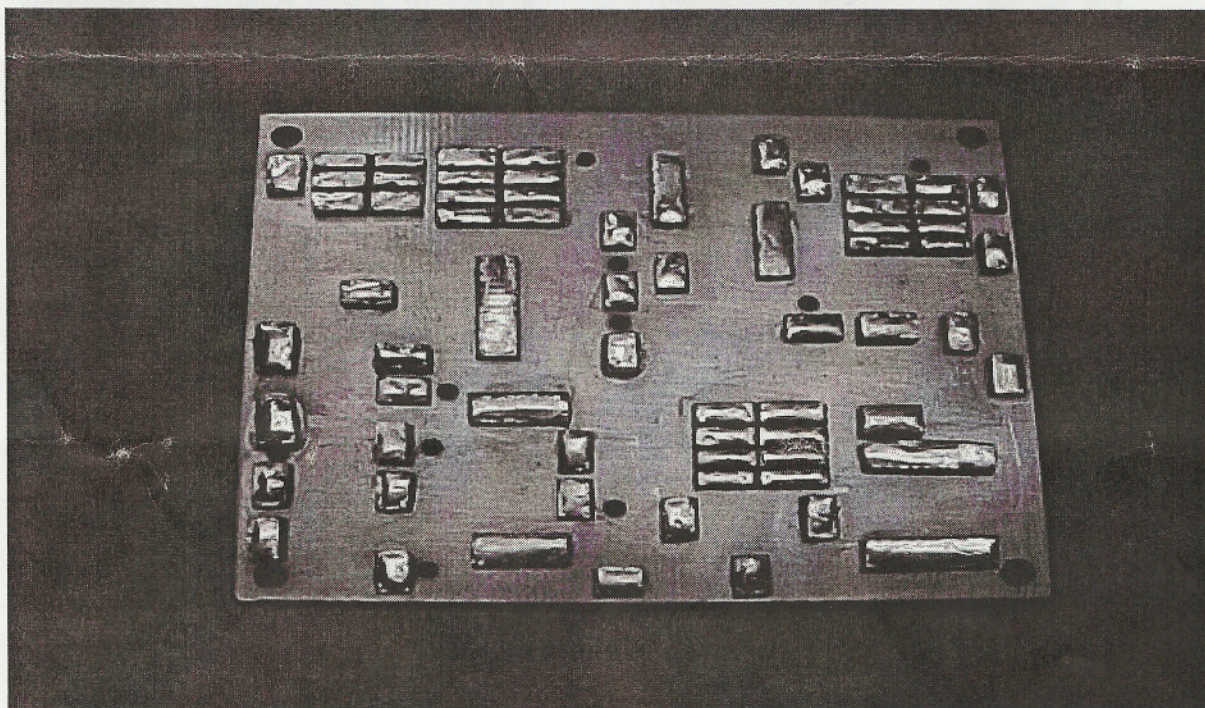
2 for +8V

Below D2/U2/R11 pad

Above R4/R12 pad

(c) Tin all pads.

Hint: After tinning check for shorts between the pads and ground, as well as between adjacent sections of the transformer and IC pads before proceeding.



Step 2

Step 3: Installing the PC Board wiring

(a) Install inter-pad and ground wiring as follows:

Hint: Use solid wire to avoid stray stands from shorting to ground. Cut off component leads make good inter-pad wiring.

T1 upper primary pad to antenna pad
 T1 lower primary pad to ground
 T1 upper secondary pad to U1 pin 1
 T1 center secondary pad to U1 pin 2

U1 pin 3 to ground

U3 pin 2 to R1/C15 pad
 U3 pin 3 to ground
 U3 pin 6 to Y4/C17 pad
 U3 pin 7 to C17/C18 pad

U4 pin 1 to R9/Q1 pad and continue to R7/R8 pad
 U4 pin 2 to R2/R7 pad
 U4 pin 3 to R3/R4/C22 pad
 U4 pin 4 to ground
 U4 pin 7 to C25/C27/R13 pad

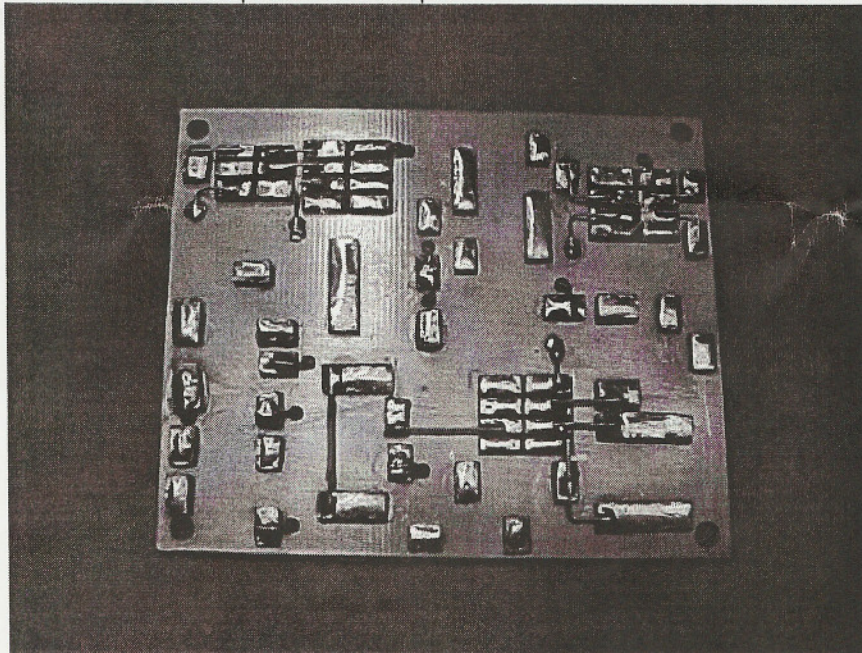
R11/C25/C26 pad to R10 pad (Use insulated wire)

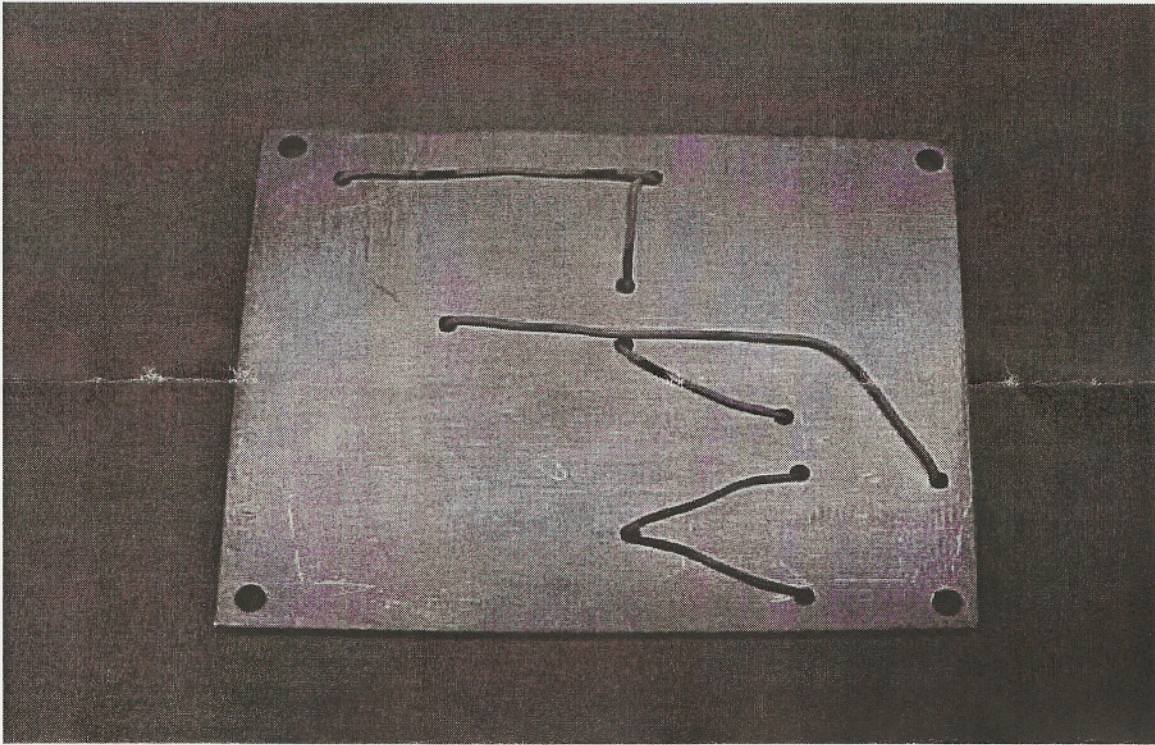
(b) Install insulated power distribution wiring under the Printed Circuit Board

V+ D13/C112 pad to R6 pad
 R6 pad to U2/C102 pad

Vr D2 pad to R15/Q2 pad (lower hole)
 R15/Q2 pad (upper hole) to U1 pin 8
 U1 pin 8 to U3 pin 8

8V D2/U2/R11 pad to R4/R12 pad





Step 3 (bottom of PCB)

Step 4: Installing Resistors and Diodes (except D1)

Hint: Measure and confirm the value of each resistor before installing.

Hint: Install all the resistors in their prone position so the color codes can be read from left to right.

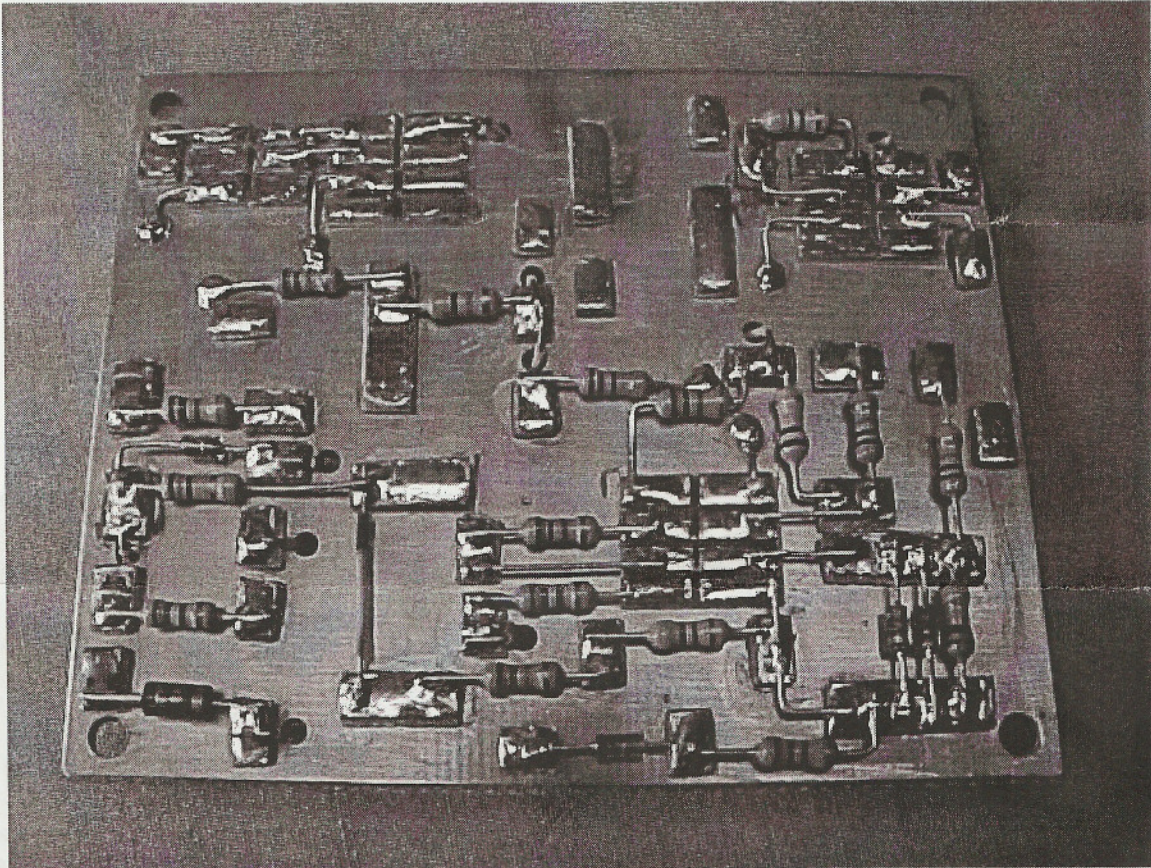
(a) Using the layout drawing as a guide, install resistors as follows:

R1	470 ohm	yellow-violet-brown-gold
R2	10 K	brown-black-orange-gold
R3	10 K	brown-black-orange-gold
R4	510 K	green-brown-yellow-gold
R6	10 ohm	brown-black-black-gold
R7	510 K	green-brown-yellow-gold
R8	1 Meg	brown-black-green-gold
R9	4.7 Meg	yellow-violet-green-gold
R10	22 K	red-red-orange-gold
R11	510 K	green-brown-yellow-gold
R12	1 Meg	brown-black-green-gold
R13	1 Meg	brown-black-green-gold
R14	10 ohm	brown-black-black-gold
R15	47 K	yellow-violet-orange-gold
R16	22 K	red-red-orange-gold
R17	2.2 K	red-red-red-gold
R18	1 Meg	brown-black-green-gold

(b) Using the layout drawing as a guide, install the diodes as follows:

D2	1N4148 Cathode to Vr pad
D3	1N4148 Cathode to R7/R8 pad
D4	1N4148 Cathode to R2/R2 pad
D5	1N4148 Cathode to "Mute Switch Input" pad
D13	1N4001 Cathode to C112/V+ pad

Note: D1 will be installed with the transistors



Step 4

Step 5: Installing the Capacitors (except the electrolytic capacitors)

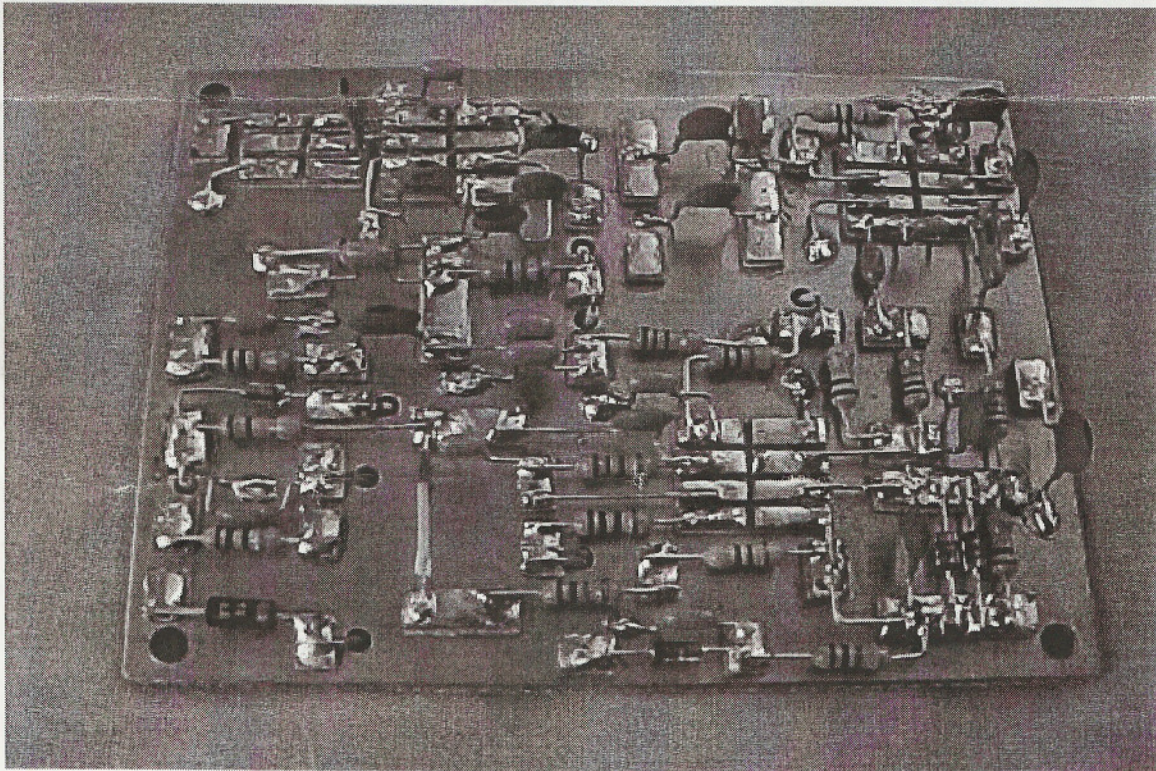
Hint: Install all capacitors so the printed value faces the outside of the PCB or away from other components. This will assist in reading their values during troubleshooting.

(a) Using the layout drawing as a guide, install the capacitors except C7 as follows:

C1	47 pf	NPO ceramic disk	47J
C2	47 pf	NPO ceramic disk	47
C3	10 pf	NPO ceramic disk	10
C4	2700 pf	monolithic	272
C5	2700 pf	monolithic	272
C6	3300 pf	monolithic	332
C7	value to be selected during alignment		
C8	82 pf	NPO ceramic disk	82J

C11	47 pf	NPO ceramic disk	47
C12	150 pf	ceramic disk	151
C13	150 pf	ceramic disk	151
C14	150 pf	ceramic disk	151
C15	150 pf	ceramic disk	151
C16	68 pf	NPO ceramic disk	68J
C17	47 pf	NPO ceramic disk	47
C18	47 pf	NPO ceramic disk	47
C19	.033 uF	monolithic	333
C20	.1 uF	monolithic	104
C21	.01 uF	monolithic	103
C22	150 pf	ceramic disk	151
C23	150 pf	ceramic disk	151
C24	.1 uF	monolithic	104
C25	820 pf	monolithic	821
C26	.0022 uF	ceramic disk	222
C101	.1uF	monolithic	104
C102	.01uF	monolithic	103
C103	.01uF	monolithic	103
C104	.01uF	monolithic	103
C105	.01uF	monolithic	103

Hint: The 7 small capacitors left over will be used during the alignment.



Step 5

Step 6: Installing the Remaining Components:

(a) Install the crystals:

Y1, Y2 and Y3	Filter	4.00 MHz	S40ECSD
Y4	BFO	4.00 MHz	S40ECSD

Hint: Grounding for crystals Y1 – Y3 cases can be a single jumper wire across all three crystals soldered to one location adjacent to Y1

(b) Install semiconductors and tuning diode:

Note: Use the layout drawing to determine the orientation of these components

U2	Voltage Regulator	78L08
Q1	Mute Switch	MPF 102
Q2	Oscillator	2N4401
D1	Tuning Diode	V149

(c) Install RFC 1

RFC 1	22 uH	red-red-black-gold
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(d) Install Electrolytic Capacitors

Note: Observe the correct polarity

C 27	47 uF 25v	+ to C25/R13 pad
C106	47 uF 25v	+ to U4 pin 7
C 112	220uF 25v	+ to D13/V+ pad

(e) Install IC sockets

Note: Align the notch on each socket as shown in the layout drawing. The notches on U1 and U3 face the top of the PCB. The notch on U4 faces the bottom of the PCB.

Hint: Carefully bend the lower half of each pin out to either side of the socket. This will help in soldering the pins and give a lower profile to the socket.

Hint: Solder the two opposite corner pins first, then check the alignment of the socket on the pad before soldering the remaining pins.

(f) Install T1

Orient the transformer so that the side with three pins faces U1 IC socket.

Hint: If you carefully bend the lower half of the leads outward they will be easier to solder onto the pad. This will also allow the tabs on the transformer case to reach the PCB. Bend 1/16 " of each tab at right angles to touch the case for soldering.

Step 7: Winding and Installing Toroid L1

(a) Prepare L1

L1 T50-6 1/2" diameter Yellow Toroid Core

L1 is wound as follows:

25 turns for 7 – 7.05 MHz segment of the 40 Meter band

24 turns for 7.1 – 7.15 MHz (Novice) segment of the 40 M band

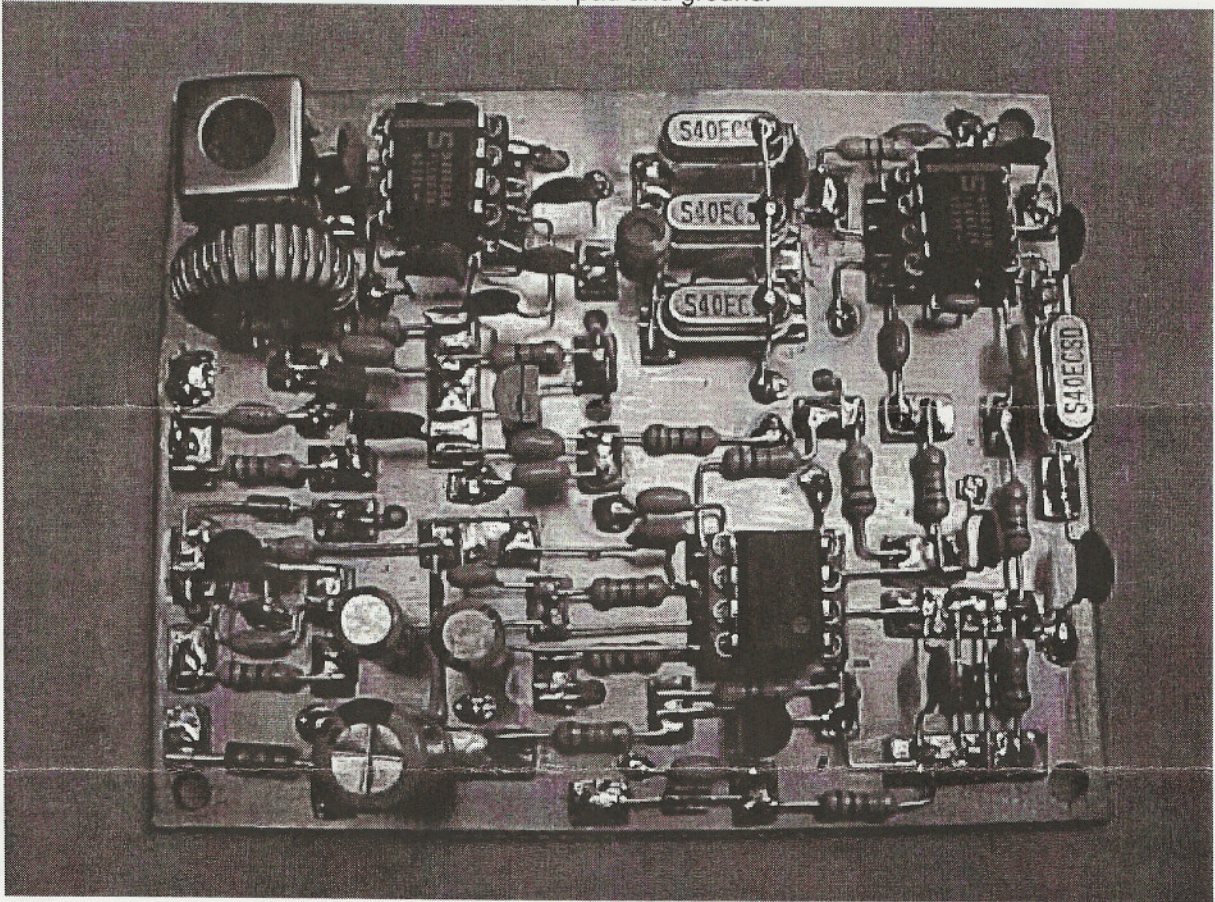
Hint: Each time the wire passes through the core it counts as a turn.

Pull each winding tightly. Spread the windings evenly around the core.

(b) Install L1

Cut the excess wire off to about ¼", scrape off the insulation from the ends and tin.

Install L1 between C6/C7 pad and ground.



Completed Printed Circuit Board

Step 8: Testing and Aligning the Fort Smith SideKick

Note: Do not install the IC's yet.

- (a) Check power distribution.
Connect a +12 to +15 V DC power source to the SideKick
+ to D13 pad
- to ground

Measure the voltages at the following test points:

D13/C112 pad +12 to +15 V

U2/R11/D2 pad +8 V

D2/Vr pad + 7.3 V

- (b) Disconnect power and Install the IC's observing their correct orientation
- | | | |
|----|---------|------------------------------------|
| U1 | NE 602 | Pin 1 facing the top of the PCB |
| U3 | NE 602 | Pin 1 facing the top of the PCB |
| U4 | NE 5532 | Pin 1 facing the bottom of the PCB |

- (c): Complete the External Connections

Using the layout drawing and schematic as a guide connect the following:

100 K Tuning Control
 Pin 1 to +8 V pad
 Pin 2 to C103/R18 pad
 Pin 3 to ground

5 K Gain Control
 Pin 1 to ground
 Pin 2 to Antenna
 Pin 3 to T1 Primary pad

Headphone Jack
 Center pin to R14 pad
 Shield to ground

(d): Adjust the Operating Frequency
 Set the tuning pot fully counter clockwise. Apply power to the receiver and check pad R18/C103 for 0 V. If you find +8 V on the pad reverse the outside leads (pins 1 and 3) of the 100 K pot.

Using a signal generator or calibrated transmitter connected to a dummy load, locate the frequency that the SideKick is receiving by moving the generated signal around the low end of the 40 Meter band until a loud signal is heard on the receiver. Note the frequency being generated.

Remove power and install C7 between L1/C6 pad and ground. Select the value of C7 according to the tables below. Slight changes can be made to the frequency settings after installing C7 by compressing (to decrease) or expanding (to increase) the windings of L1

When completed the Fort Smith SideKick should receive about a 40 KHz segment of the 40 Meter band.

For 7 – 7.05 MHz Operation:

If Frequency was between:	Install the following value for C7
7000 - 7030	(none)
7030 - 7060	22 pf
7060 - 7090	47 pf
7090 - 7120	68 pf
7120 - 7140	82 pf
7140 - 7160	100 pf
7160 - 7180	120 pf
7180 - 7210	150 pf

For 7.1 – 7.15 MHz (Novice) Operation:

If Frequency was between:	Install the following value for C7
7100 - 7130	(none)
7130 - 7160	22 pf
7160 - 7190	47 pf
7190 - 7220	68 pf
7220 - 7240	82 pf
7240 - 7260	100 pf
7260 - 7280	120 pf
7280 - 7310	150 pf

(e): Adjusting T1

Tune in a station (or just background noise) near the middle of the range you have selected (100 K Tuning pot set in the center) and peak T1 with a small slot screwdriver for the loudest signal.

(f): Testing the Mute Circuit

While receiving a loud signal, short the "Mute Switch Input" pad to ground. The signal should drop in volume and be barely readable. Lift the ground and the signal will return to its original volume.

This completes the construction of the Fort Smith SideKick. I am sure it will provide many hours of enjoyable operation. The selection and assembly of the case is left to the imagination of the builder.

Troubleshooting the Fort Smith SideKick

Note: Before starting to troubleshoot the receiver check that the IC's, transistors and diodes are installed correctly. Inspect your work for solder bridges (particularly on the IC pads), missing solder joints or copper burrs shorting out pads to ground.

- (a) Apply power and listen for a faint rushing sound in the earphones. Then touch U4 pin 6 with a metal probe. You should hear a distinct buzz. The buzz is a lot louder if you touch the probe with your finger while it is on U4 pin 6.
If nothing is heard, make sure the headphone jack is wired properly. Check for +8V on pin 7 of U4 along with V+ (12 – 15V) on pin 8.
- (b) Once the buzz is heard in your earphones, move the probe to U4 pin 2. The buzz should be even louder.
If nothing is heard this time, the problem is likely in the circuitry between U4 pin 2 and U4 pin 6. Check the mute switch JFET for proper orientation and installation.
- (c) If the results of the previous steps were as expected, touch an antenna wire to U3 pin 2. You should hear multiple stations all at once.
If nothing is heard, the problem is likely in the circuitry associated with U3. Ensure the BFO oscillator is running. You can check this by using an oscilloscope and measuring a 1 to 1.5 V pk-pk sine wave at U3 pin 7. If you do not have a scope, tune another receiver to 4000 KHz and listen for a signal from the BFO oscillator. If the BFO is faulty, check Y4, C16, C17 and C18 for correct values and installation.
- (d) Once multiple stations are heard with the antenna on U3 pin 2, move the antenna to T1 input. Set up a signal generator or transmitter operating into a dummy load and vary the output frequency around the low end of the 40 meter band. You should hear the generated signal as you sweep by the frequency being received by the SideKick.
If you can't hear the generated signal use an oscilloscope to verify that the VFO is working. A solid sine wave of approximately 1 V pk-pk should be measured at U1 pin 6. If you don't have a scope, you might try listening for the VFO signal on another receiver at about 3000 KHz. No signal indicates a problem in the VFO circuit Q2, D1, L1 and associated components. Check for correct component values and installation of these parts.
- (e) If the VFO is working this will limit the problem area to T1, U1 and the crystal filter. Once again check for correct component values missed solder joints, solder bridges and copper burrs.
At this point it would be a good idea to have someone else check your work for anything you have overlooked.

IN FROM 5K
GAIN POT

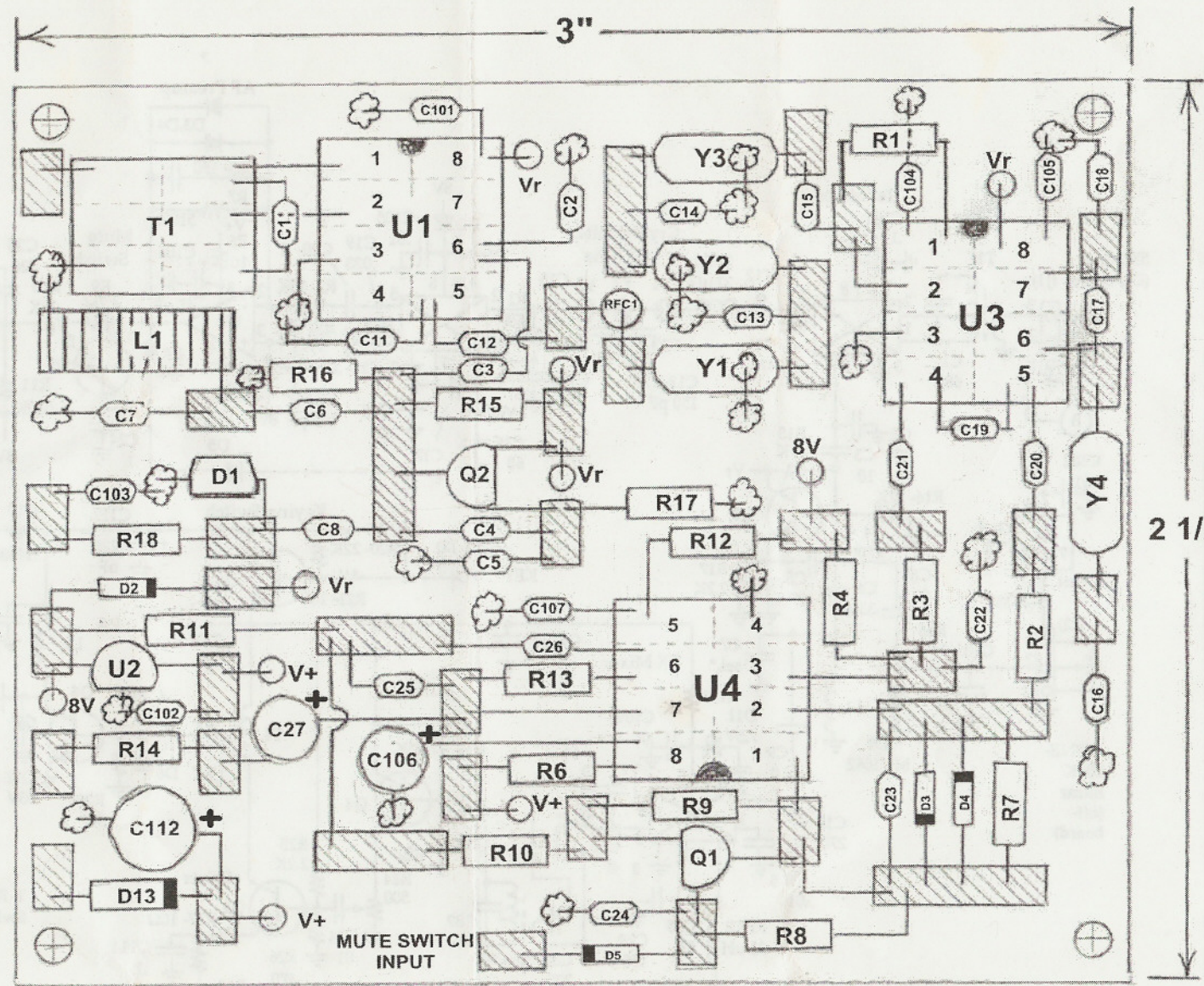
IN FROM 100K
TUNING POT

OUT TO 100K
TUNING POT

AUDIO
OUTPUT

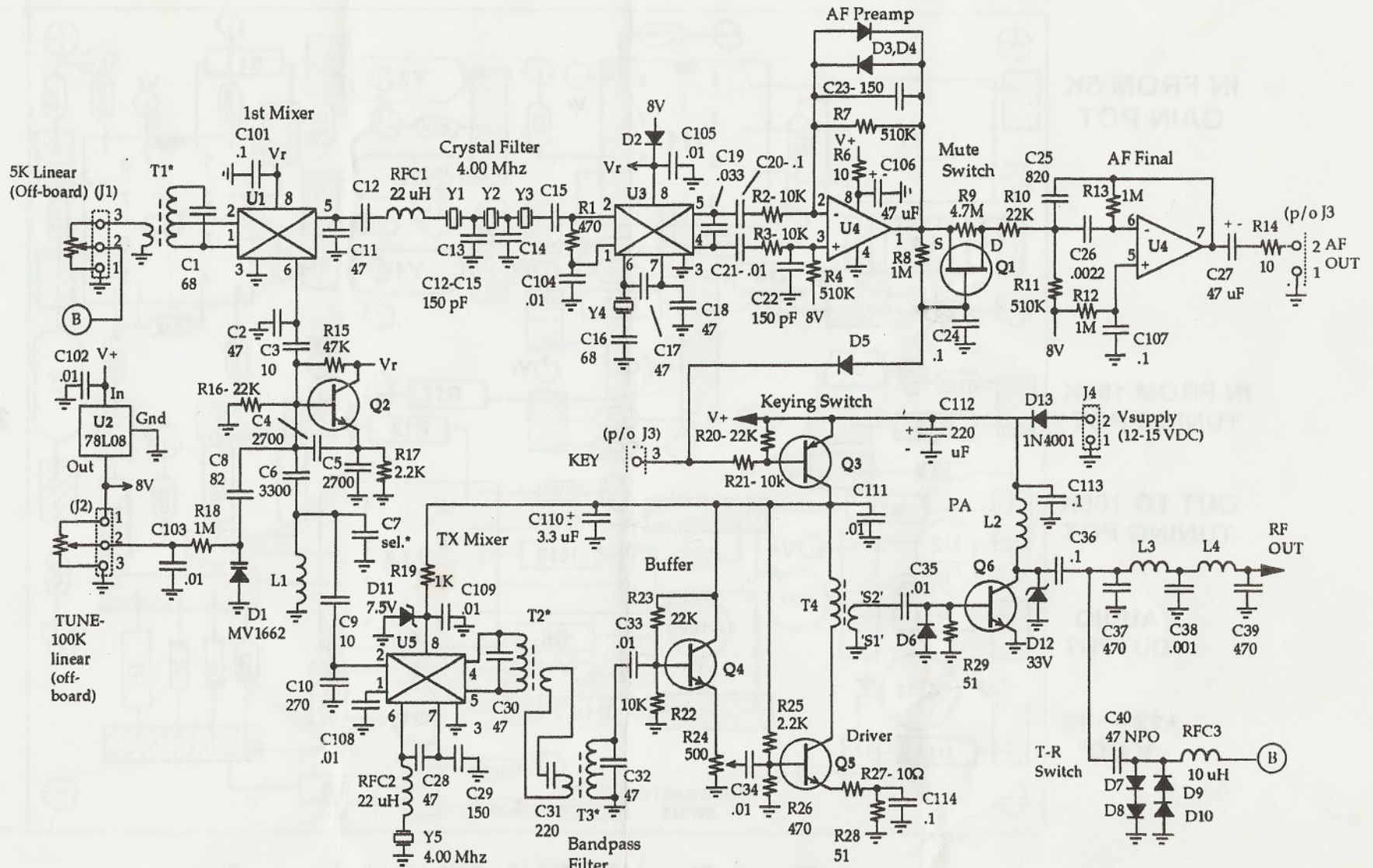
+12 - +15
V DC

MUTE SWITCH
INPUT



Fort Smith SideKick Layout

F.ROBERTS VE3FAO



* T1-T3
C-internal not shown,
leave intact.

The "SW-40+" Transceiver

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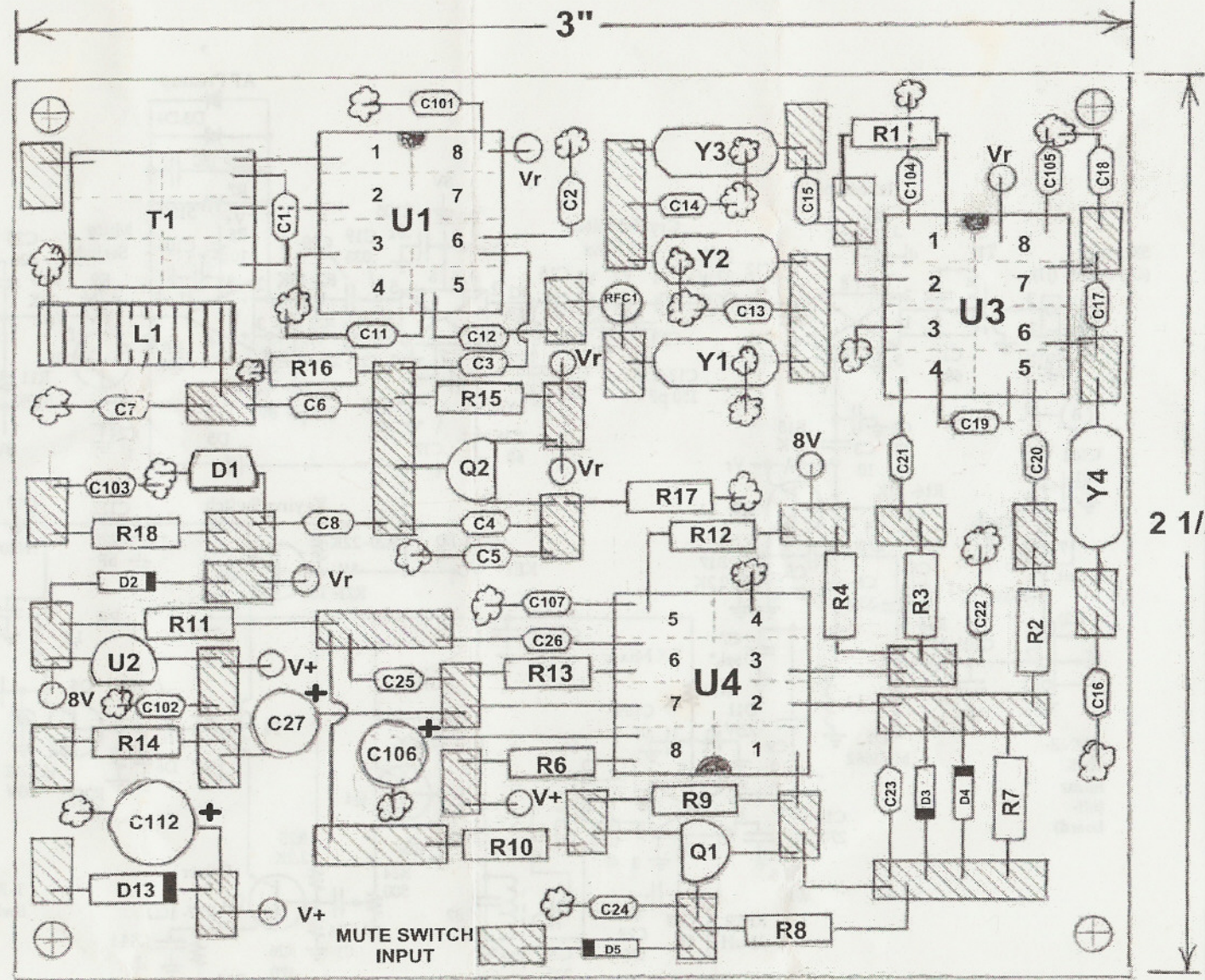
IN FROM 5K
GAIN POT

IN FROM 100K
TUNING POT

OUT TO 100K
TUNING POT

AUDIO
OUTPUT

+12 - +15
V DC



Fort Smith SideKick Layout

F.ROBERTS VE3FAO