ARRL Handbook CD

Template File

Title:	NorCal Sierra
Chapter:	15
Topic:	The NorCal Sierra: An 80-15 M CW Transceiver

Template contains:

Note from Wayne Burdick, N6KR.

Sierra drawings.

Band module drawings.

Specifications.

Construction, Alignment and Troubleshooting.

January 16, 1996

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To all who are interested in the Sierra QRP Transceiver:

I designed the Sierra for the Northern California QRP Club (NorCal) back in 1993, and was pleased that the ARRL chose to publish the design in the new *Handbook.* In the intervening years, the Sierra has been field tested by NorCal members, and over 120 of the original Sierras are in use.

The *Handbook* article provides nearly all the information needed to duplicate the NorCal version of the Sierra, but there was no room for the PC board layouts. In this information packet you'll find 1:1 positive masters of the main board and band module. Also included are front- and back-panel layouts and silk screens.

Since the Sierra boards are fairly dense, as well as being double-sided with plated-through holes, not everyone will be able to duplicate them using home PCB etching techniques. In this case, you may actually find it easier to use "ugly" construction (point-to-point wiring using "islands" cut into a copper ground plane). There are also suitable prototyping boards available ("Vector-board" for example). I believe that at least one Sierra has been built in this way.

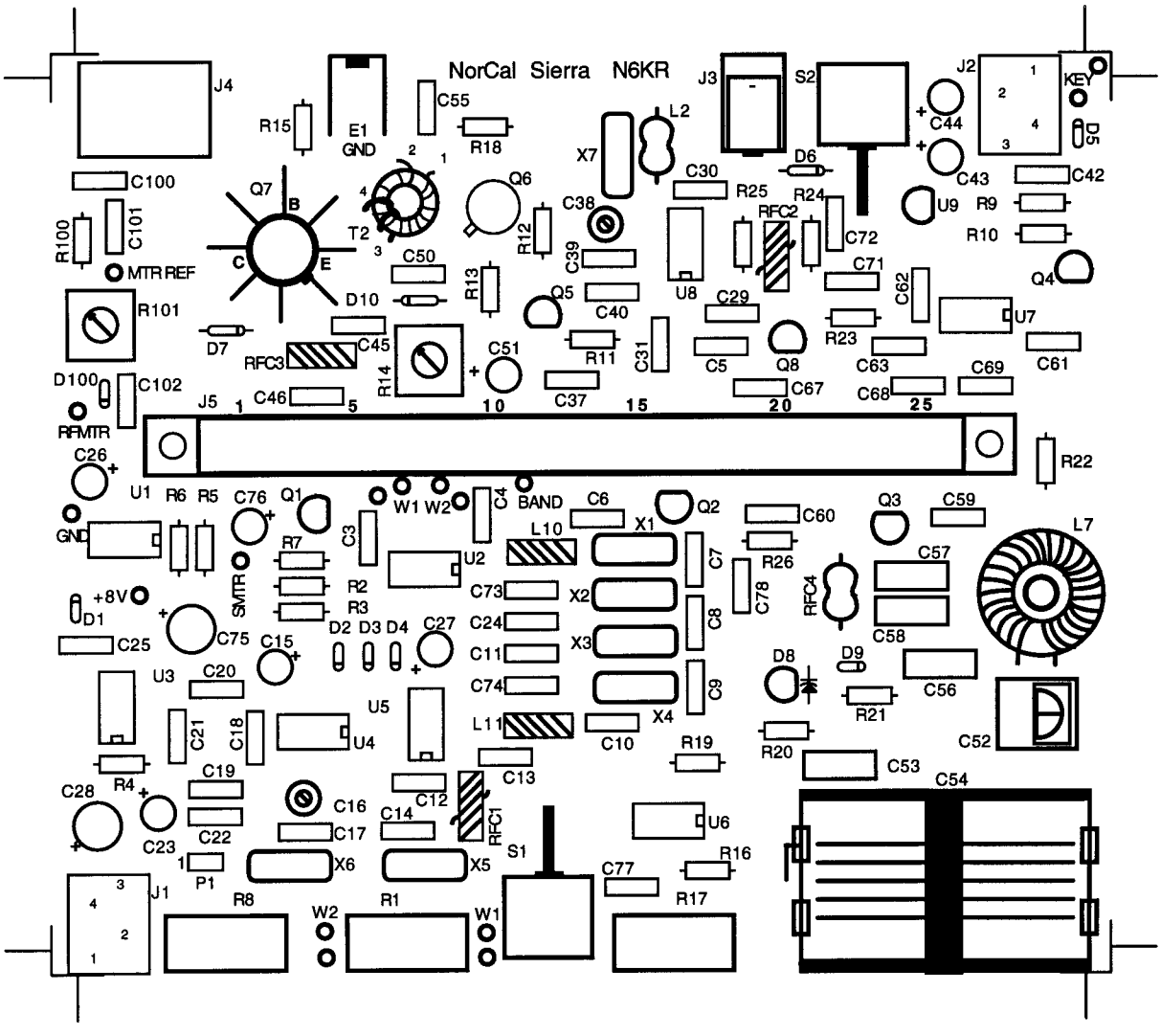
Sierra Commercial Availability

Unfortunately, I cannot offer boards or other components for the original Sierra. However, after the first run of Sierras was completed for NorCal, Bob Dyer, KD6VIO, proposed starting his own kit company to sell the Sierra and my other NorCal designs. I agreed to help him get started, and last year I completely upgraded the Sierra design for his new company, Wilderness Radio. Wilderness now has the new Sierra kit in stock. The upgraded rig has many new features, summarized in the attached sheets.

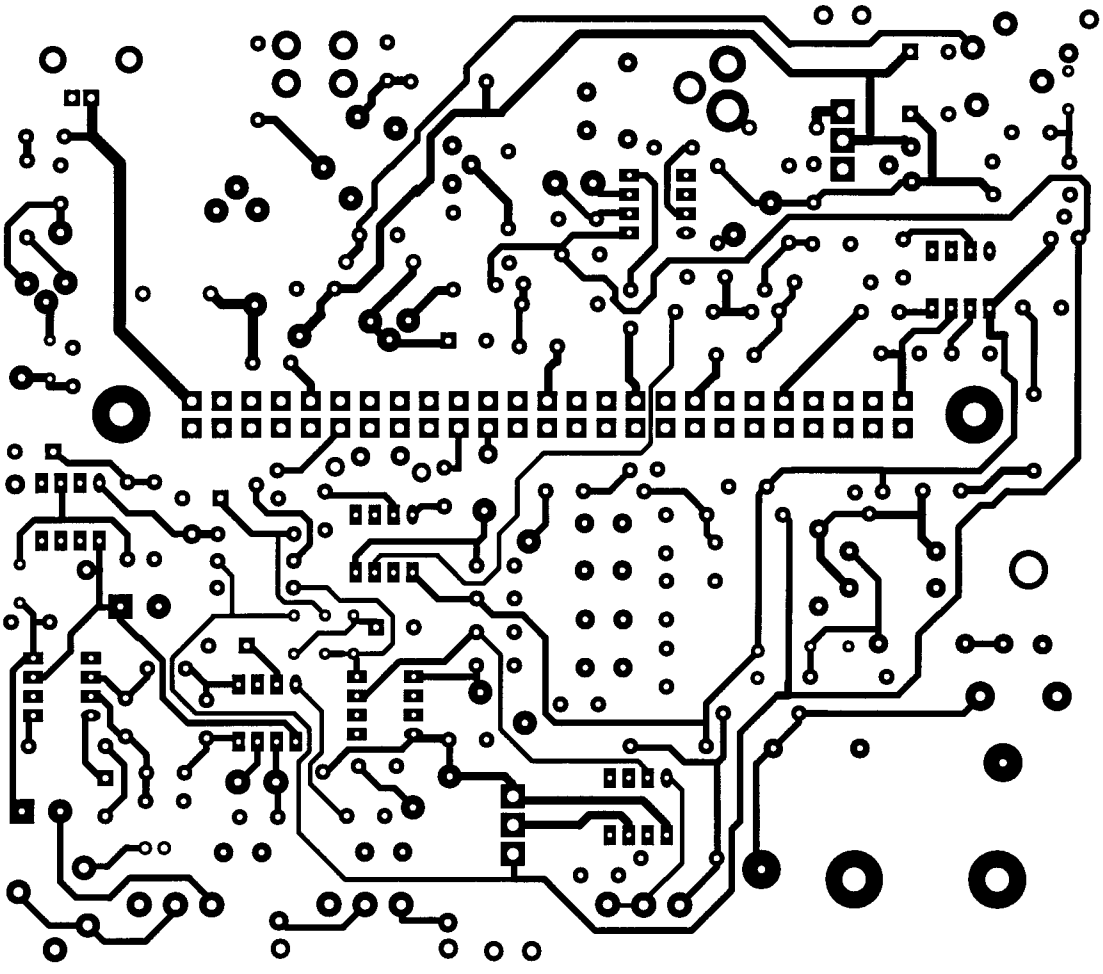
If you have any other questions about either the original or new Sierra transceiver, please write to me at the above address. I can also be reached by phone or e-mail (burdick@interval.com).

Good luck with all of your projects!

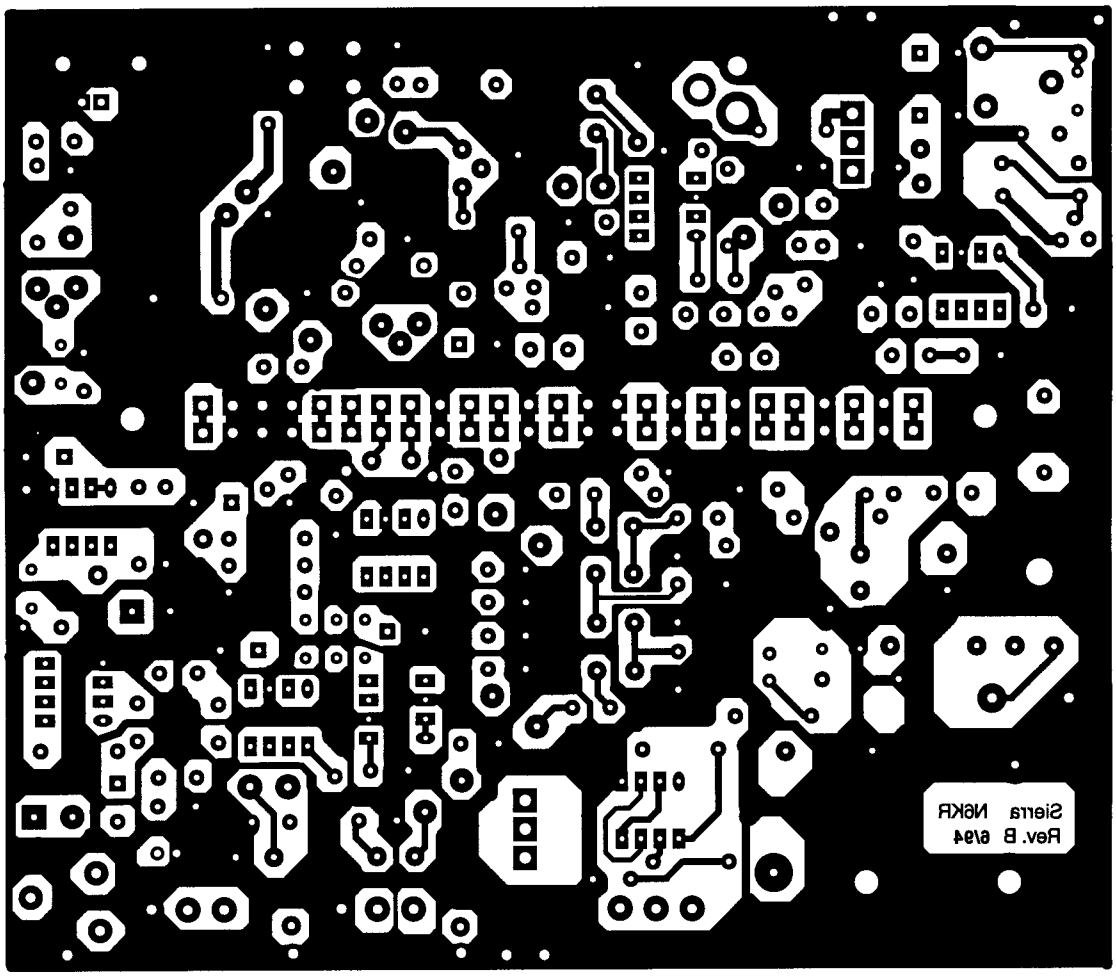
73,
Wayne A. Burdick
N6KR



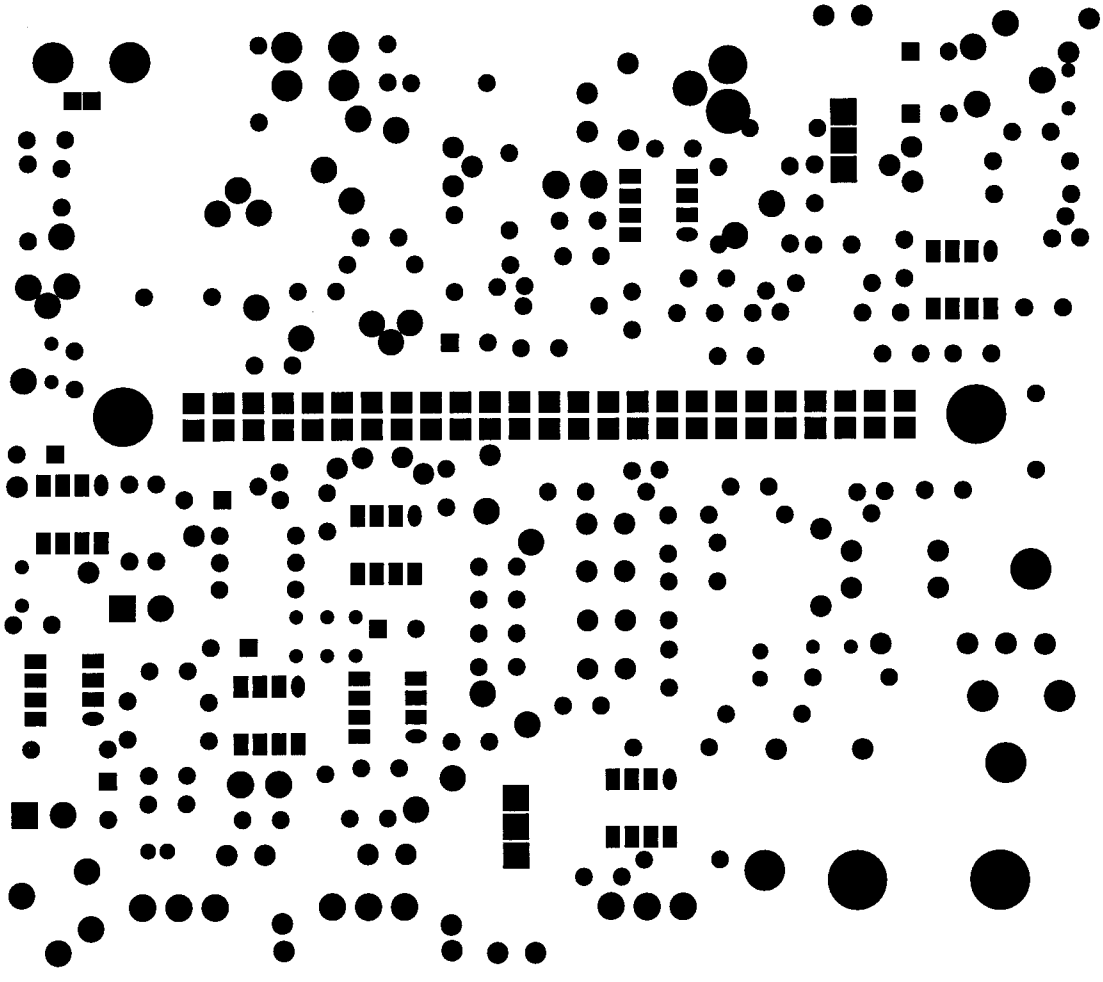
Sierra silkscreen



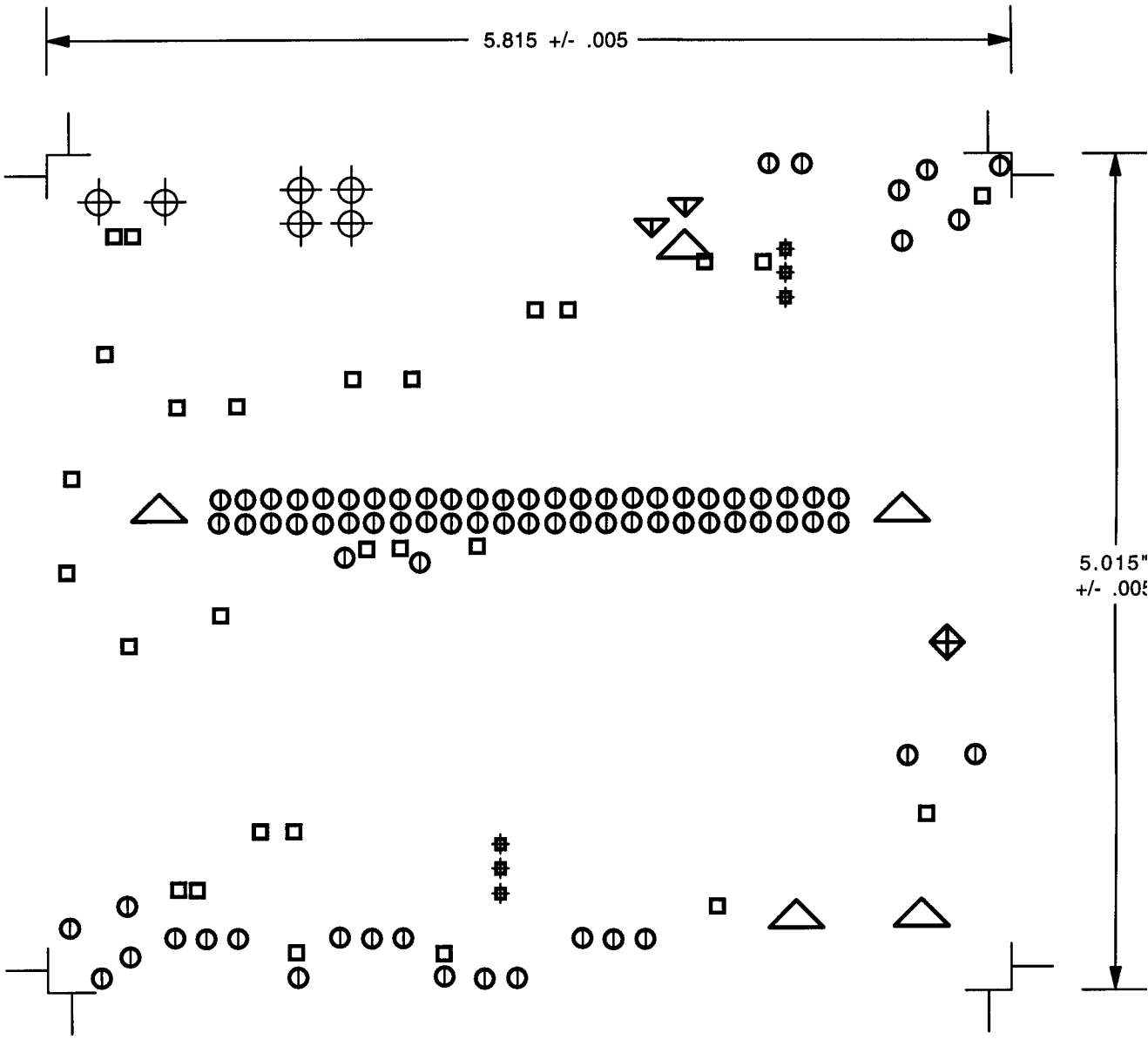
Sierra, component side



Sierra , solder side



Sierra, solder mask (both sides)



Finished Hole Sizes +/- .002"

.140"

.125"

.106"

.082"

.063"

.052"

.042"

ALL OTHERS .031"

All holes are plated through

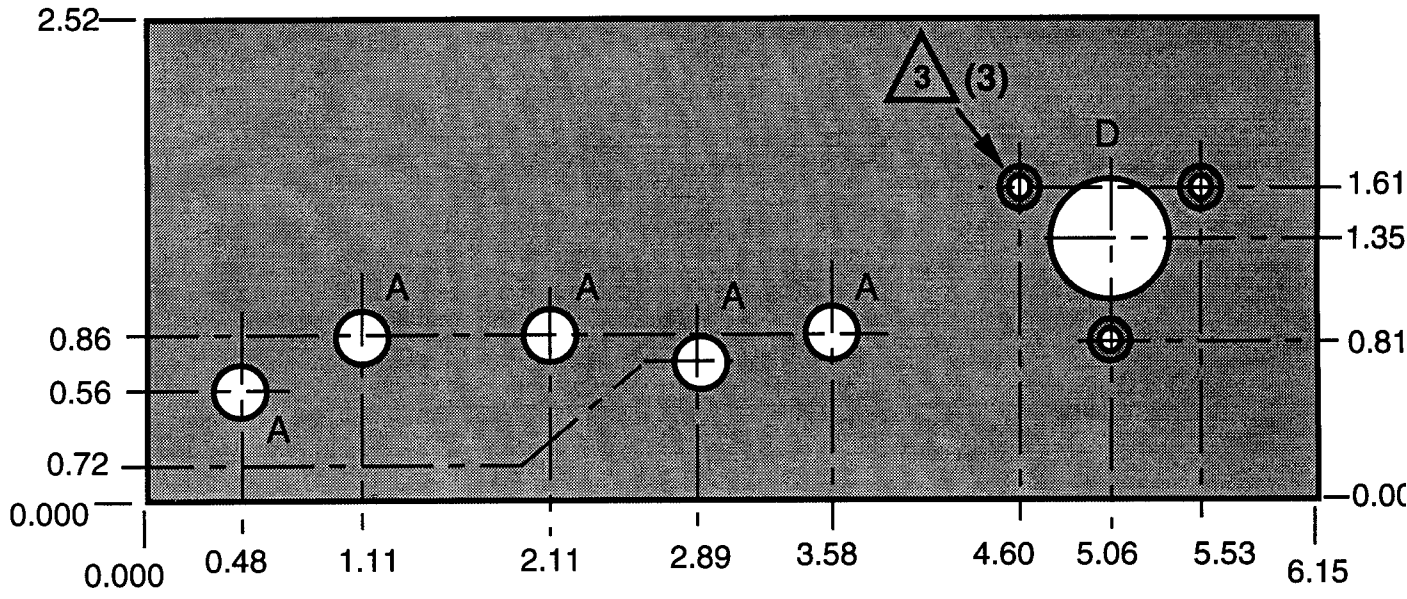
Solder mask: CLEAR

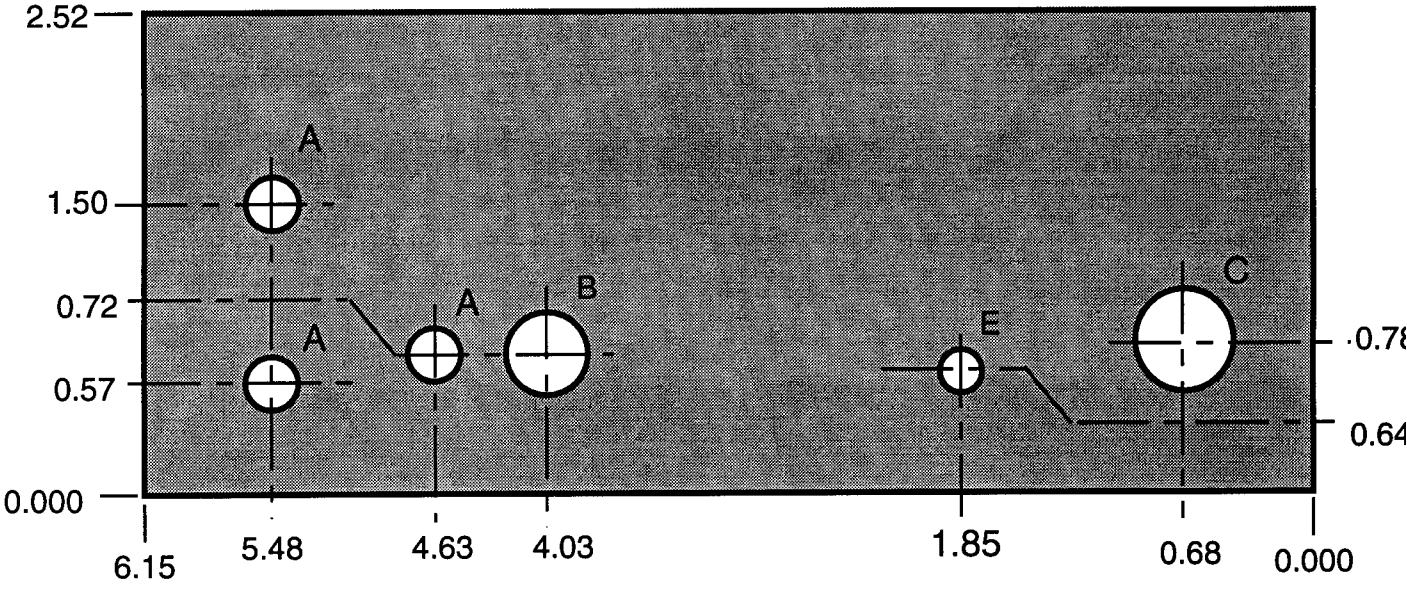
Sierra QRP Transceiver

Wayne Burdick 415-354-0928

Rev. B. 7-16-94

Front





Back

Identifier	Hole Dia.
A	0.270
B	0.430
C	0.510
D	0.625
E	0.220

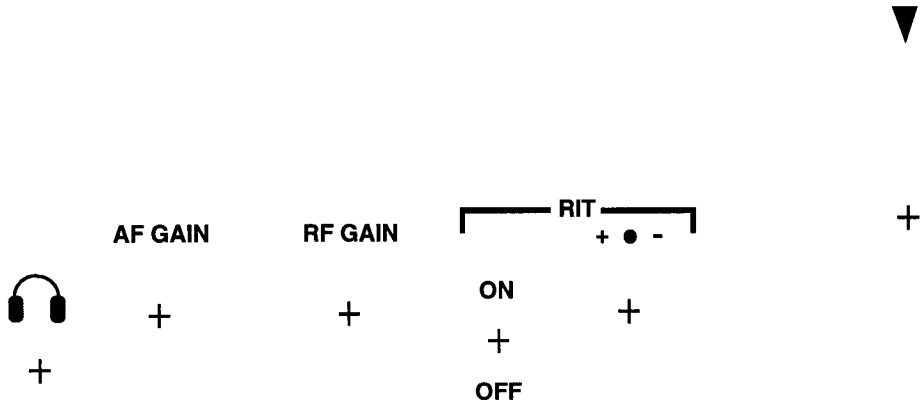
Notes: Unless otherwise specified

1. 1 front and 1 back required per unit
2. Mat'l: .060 aluminum; sanded finish
3. Drill and countersink for #4 F.H.M.S.

TITLE			
Sierra Front and Back Panels			
BY	Wayne Burdick		DATE 10-3-94
REV C		TOL. .005"	SHEET 1 OF 1

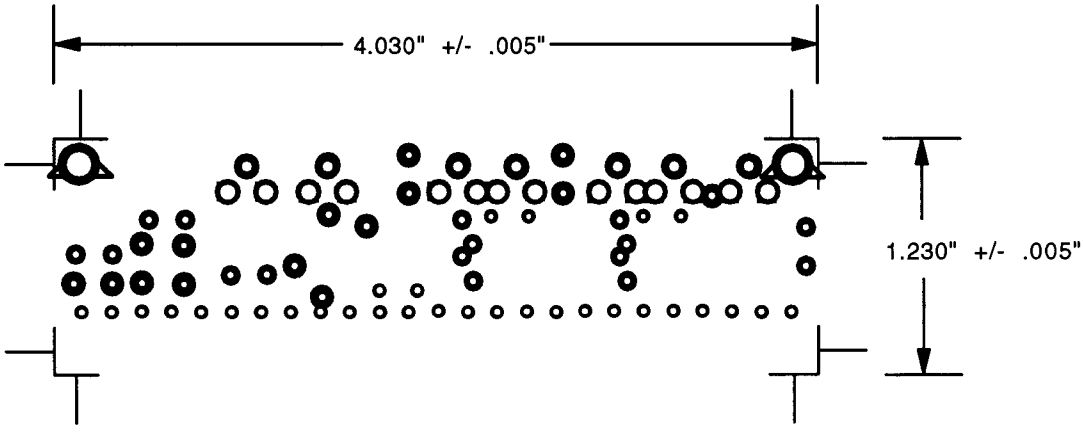
Back Panel

Front Panel



NorCal Sierra CW Transceiver

Sierra Front/BackPanel Artwork Rev. B 10-3-94 Wayne Burdick, N6KR



Finished Hole Sizes +/- .002"

△ .125"

□ .072"

⊕ .052"

ALL OTHERS .031"

All holes are plated through

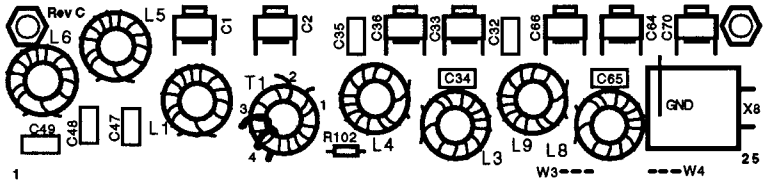
Solder mask: CLEAR

Sierra Band Module

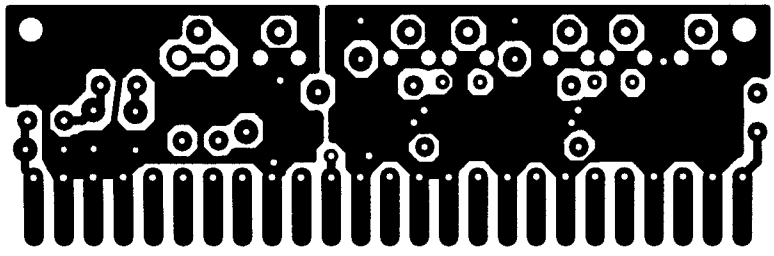
Wayne Burdick 415-354-0928

Rev. B. 7-16-94

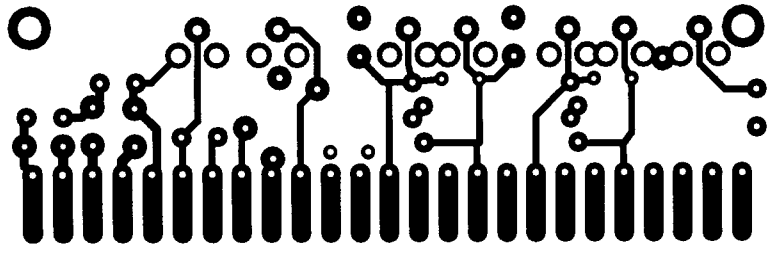
BAND MODULE DIMENSIONS & DRILL GUIDE



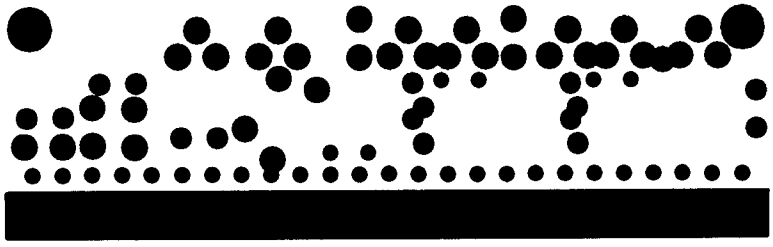
BAND MODULE SILK



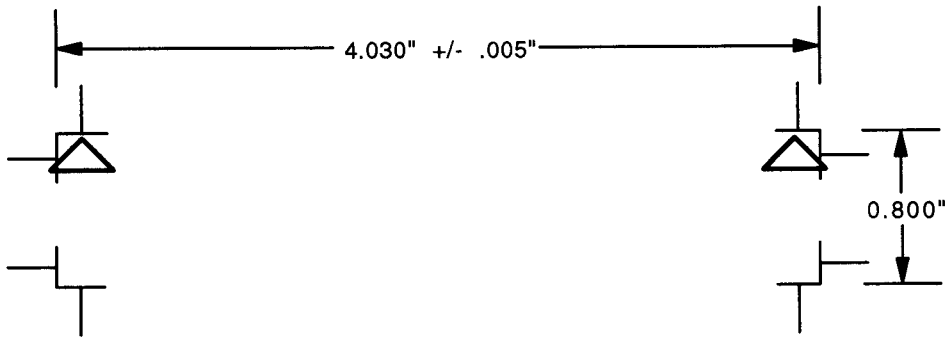
BAND MODULE TOP COPPER
(GOLD PLATED FINGERS)



BAND MODULE BOTTOM COPPER
(GOLD PLATED FINGERS)



BAND MODULE SOLDER MASK



Finished hole sizes, +/- .002

△ .125"

Sierra Band Module Cover

Wayne Burdick 415-354-0928

Rev. B. 7-16-94

No copper required on this board
Silkscreen and (2) holes only

Solder mask: CLEAR,
covering entire board

COVER DIMENSIONS

COVER MOUNTING HOLES

RX TX Pre-mix XTAL

[redacted] MHz

Sierra Band Module Rev. C 9-20-94

COVER SILK

Wilderness Sierra QRP Transceiver Specifications

Physical:

Cabinet: 2.6" (H) x 6.3" (W) x 5.3" (D) , painted and silkscreened
Main PCB: 5.8" (W) x 5" (D)
Band Module: 1.25" (H) x 4.0" (W) x 0.5" (D)
Weight: Approx. 2lb.
All parts including controls and connectors mount directly to PC board--no chassis wiring
Band modules include 4 double-tuned circuits and 1 crystal each
Quick-release latches on either side of the cabinet for changing band modules
Plenty of room inside the box for band module stowage, keyer, batteries, antenna tuner, etc.
Plenty of unused panel space to add a meter, accessory controls, etc.

DC Power Requirements:

10 to 16VDC; reverse-polarity protection
Receive: 30mA typical with headphones, 30 to 70mA when using speaker (varies with volume)
Transmit: 200-450mA (varies with band and power output setting)

Frequency Coverage:

3.500-3.650MHz, 7.000-7.150MHz, 10.000-10.150MHz,
14000-14.150MHz, 18.000-18.150MHz, 21.000-21.150MHz
(Note: Manual includes information on building 160, 12, and 10 meter band modules)

Transmitter:

Power Output: 1.5 to 3.5 watts, depending on band and supply voltage
Spurious products: -40dB or better (typical)
Final Amp efficiency: 60-75% (typical)
Load Tolerance: 1.5:1 or better SWR recommended; will survive brief operation into high SWR
Adjustable sidetone volume level
Transmit-receive delay: 0.2 seconds nominal; can be changed

Receiver:

Sensitivity: Better than 0.5uV for 10dB S+N/N
Selectivity: Bandwidth is continuously adjustable from approx. 150Hz to 1600Hz wide @ -6dB;
With ABX control at 50%: approx. 400Hz @ -6dB
AGC range: 60 to 80 dB (est.)
I.F.: 4.915MHz; 4-pole Cohn crystal filter plus single-crystal filter following I.F. amp
R.I.T. Range: +/- 2KHz; can be increased (see text)
Audio output: 0.25 watts max into 8 ohm load

VFO:

VFO operating range: 2.935 to 3.085 MHz (150Khz); 8:1 vernier drive built-in
Calibration: 5KHz increments; typical accuracy, +/- 2KHz
Drift: less than 100 Hz in first 30 minutes from cold start
(RIT off, 25 degrees C, top cover installed)

Wilderness Radio

P.O. Box 734, Los Altos, CA 94023-0734 (415) 494-3806

Sierra Construction, Alignment, and Troubleshooting

Wayne Burdick, N6KR
January 30, 1996

Main PCB Assembly

Resistors, Diodes, Miniature RF Chokes

[ ] Install all of the resistors, double-checking the color code to make sure you're installing the proper value. The resistors should all be oriented in one direction for ease of reading the color codes later--i.e., first band to the left or top, last band to the right or bottom.

[ ] Diodes must be installed with the cathode end--the end with the widest band--oriented in the same direction as the banded end on the PC board outlines. The exception is D8, which has a flat-sided package like a transistor. Install this part as shown on its PC board outline.

[ ] Install the miniature RF chokes (RFC4 and L2) and solder. Note that these chokes look a lot like resistors, only larger.

Capacitors

[ ] Install all of the fixed capacitors except the electrolytics; this includes the disc, mica, polystyrene, ceramic, and film types. (Refer to the parts identification drawings.)

[ ] Next, install the electrolytic capacitors. These are polarized; be sure that the (+) lead is installed in the (+) hole in the board. The (+) lead is usually longer than the (-) lead. The (-) lead is usually marked on the body of the capacitor with a black band.

[ ] Next, install all of the variable capacitors *except* C54 (the VFO main tuning capacitor). This includes C16, C38, and C52. (Install C52 backwards from the silkscreen to insure that the rotor is grounded.)

ICs and Transistors

[ ] Install all of the transistors except Q7, the final amplifier transistor. Align the tab or flat side of each transistor with its PC board outline.

[ ] Q7 uses a heat sink, which should be pressed carefully onto Q7 before installing it on the board. If you've never used a press-on heat sink before, be forewarned that it's tricky. Don't bend the leads as you're doing it--they may break. Place the heat sink on a hard surface, then press the case of Q7 into the heatsink. It may be helpful to hold the case of Q7 with long-nose pliers until you get it into the heatsink, pressing the bottom of the case with a small screwdriver or awl.

[ ] Install Q7 with its body about 1/16" above the PC board so it doesn't short to its own copper pads. You can optionally use a thin transistor mounting spacer.

[ ] Install all of the ICs. All ICs except U9 are 8-pin DIPs (dual-inline packages). The notched or dimpled end of each IC must be aligned with the notched end of its PC board outline. Also note that the pad for pin 1 of each IC is round, while the other pads are square. U9 is a flat-sided unit like a plastic transistor; install it as indicated on its PC board outline.

Toroids

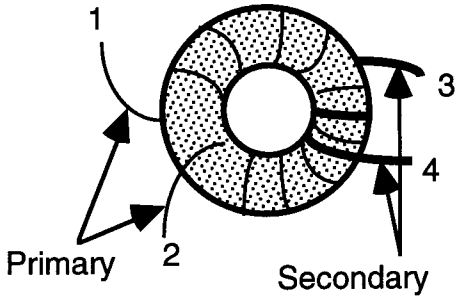
[ ] First, wind the simplest toroids (L10, L11, and RFC1, 2 and 3) as shown in the drawings below, using the cores and number of turns specified in the parts list.

Note: The FT-37-43 cores and FT-37-61 cores are both black. These cores have completely different characteristics--guaranteed headaches if you get them mixed up!

[ ] Cut the toroid leads to about 1/2 inch long, then use medium-grit sandpaper to remove the insulation to within about 1/8" of the toroid body. Don't nick the wire or sand it down too thin. The sanding job can be made easier by using a cigarette lighter or wooden match for 5 seconds or so on each lead to burn off most of the insulation.

[ ] Install these toroids (L10, L11, RFC1, 2, and 3) as indicated by the PC board outlines. (All of these toroids mount vertically.)

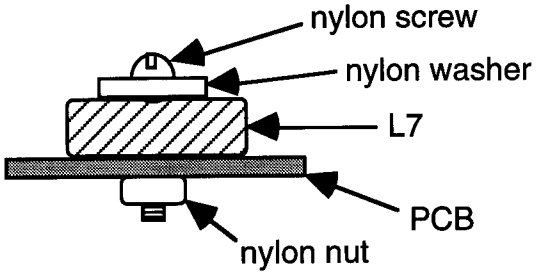
[ ] Next, wind transformer T2. The secondary winding (the one with fewer turns) should be wound on top of the primary winding, resulting in something like the drawing below.



[ ] Remove the insulation from T2's leads as described above, install it on the circuit board, and solder. Make sure that the primary and secondary leads line up with the numbers on the PCB outline.

[ ] Wind L7, the VFO toroid. This toroid has a lot of turns, so be sure to wind the turns as close together as possible without overlapping. Prepare the leads as described previously.

[ ] Insert L7's leads into their correct locations on the board, and secure the toroid to the PC board as shown below using nylon hardware. Do not over tighten--the stress can cause VFO instability. Solder L7.

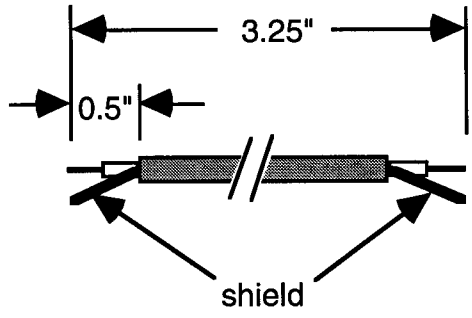


Miscellaneous Components

[ ] Install trimmer potentiometer R14 and solder.

[ ] Install all of the 4.915MHz crystals. The crystals are pre-matched, so any four can be used for the crystal filter (X1-X4).

[ ] Prepare two lengths of RG-174 coax for jumpers W1 and W2 as shown below. Use an Exacto knife to remove the outer jacket from each end. De-braid the shield, then twist about 1/3 of the wires back into a bundle to form a stranded wire. Strip about 1/4" of insulation from the center conductor.



[ ] Install W1 and W2. The center conductor at each end of W1 goes to a point labeled "W1," while the shield at each end of W1 goes to the nearest ground point. (Every point intended for a jumper has a white "donut" symbol on the silkscreen.) W2 is installed in a similar fashion. You can install the coax jumpers on either the top or bottom of the board. If you install the jumpers on the bottom of the board, be careful not to let the shield leads short to any other traces.

As a double-check, note that the two coax cables will end up crossed. Be careful not to overheat the center conductor when soldering the braid.

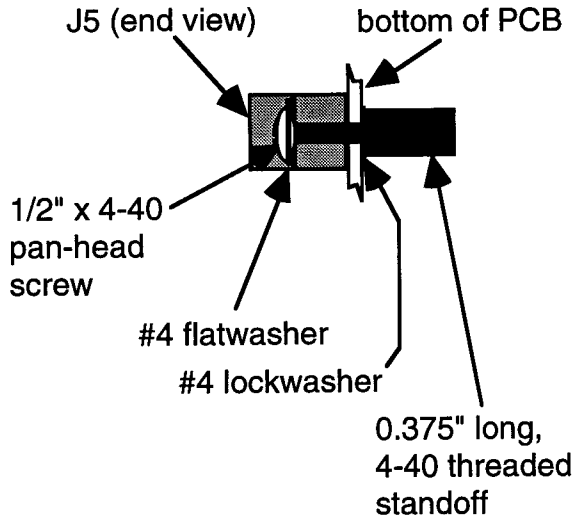
Install the VFO tuning capacitor, C54, as follows:

[ ] Cut a 1" length of solid copper hookup wire, preferably #22 or #24, and solder one end of it to the back-left solder terminal of the capacitor (as viewed from the front).

[ ] The component outline for C54 has a thin white line at the left center showing which hole the 1" wire is inserted into. Insert the wire and place C54 in its proper position on the board.

[ ] On the bottom side of the PC board, use two 4-40 x 1/4" pan head screws and two #4 lock washers to hold C54 in place.
Do not over-tighten these screws, or you'll put stress on the PCB that may cause VFO instability. If the bottom of C54 is warped, be especially careful not to warp the PC board; tighten only one screw if necessary.

[ ] Install the edge connector, J5, using the hardware shown below to hold it firmly against the PC board.



Controls and Connectors

Next, you'll install the front and rear panel controls and connectors onto the board. Keep them flush with the PC board, or as close as their leads will allow them to go, to insure good alignment with the panels. (Poor alignment here might cause eventual warping of the PC board.) Leave the finishing nuts and washers on the shafts for now. These will be used later to secure them to the front and rear panels.

[ ] Install J1, J2, J3, and J4. Bend the leads of J1 and J2 slightly to hold them flush against the PC board as you solder.

[ ] Remove the small metal tabs (near the shafts) of potentiometers R1, R8, and R17. Install the pots flush on the PC board. When seated correctly, each pot will sit a bit above the PC board due to the shoulders on the pins. **Double-check the values (stamped on the body of the pot near the threaded part of the shaft),** then solder. Make sure the pots stay flush as you solder.

[ ] Install S1 and S2. Again, it is important to keep the switches flush with the PC board.

Band Module Assembly

Before you can align and test the Sierra, you'll need to build at least one band module.

Everything but the toroids first...

[ ] Install all of the fixed (disc) capacitors (noting the **special cases** below) and solder.

Special cases:

(1) Most band modules do not use C35 and C32.

(2) The 160-meter band module requires two capacitors that are not on the band module layout, C79 and C80. You'll have to mount these near (and electrically parallel with) C1 and C2, respectively, keeping the leads as short as possible.

[ ] Install the seven vertical-mount trimmer capacitors (C1, C2, C36, C33, C66, C64, and C70). All band modules use the same kind of trimmer (9-50pF) **except** 10 meters (5-30pF).

[ ] As you solder the trimmer capacitors, be sure to keep them flush with the PC board.

[ ] Hold the crystal so that you can read the frequency (stamped into the case), then bend the leads on the crystal down at a 90 degree angle, about 1/16" from the body of the crystal.

[ ] Prepare a short (1") piece of bare #24 or #22 solid wire. Insert one end of the wire into the hole just above the crystal and solder it on the bottom of the board. Next, cut the wire off to about 1/2" long on the top of the board, fold it over the crystal, and solder it to the crystal's case, without obscuring the frequency label (this may require that the wire be angled away from the label).

[ ] **Do not install Jumpers W3 and W4.** These are reserved for use with the KC1 keyer/counter to identify which band edge to report (000, 500, etc.). Refer to the KC1 manual for more details.

...and now, the toroids

[ ] Wind toroids L5 and L6, making sure that the turns are spaced evenly as described earlier in the manual.

[ ] Prepare the leads as described earlier, and solder L5 and L6 into place.

Note that the toroids on the band module are very close together due to space constraints. Keep a small space (1/16"-1/8") between adjacent toroids.

[ ] Wind and install the remaining toroids, except T1.

[ ] Wind T1 in the same manner as described for T2 on the main PC board assembly. The only difference is that pins 3 and 4 are reversed. Orient T1 as shown on the band module silkscreen, then solder.

Alignment and Test

Rather than require a specific set of test equipment, the Sierra alignment and test procedure given below gives you three alternatives. You can use: (1) standard lab test equipment (oscilloscope, frequency counter, signal generator, multimeter, etc., all with high impedance probes); (2) a general-coverage ham transceiver; or (3) nothing but a DMM (digital multimeter) and a home-made RF probe.

Using real lab test equipment is more precise, and helps a great deal if you need to do some troubleshooting. However, you should be able to align the Sierra using methods 2 or 3. These more primitive techniques will also prove useful in the field, where you seldom have access to good test equipment.

Smoke Test

Before turning on power, follow these steps:

[ ] Set both S1 (power) and S2 (RIT) in the OFF position.

[ ] Insert a band module, preferably 40, 30, or 20 meters.

[ ] Connect a 50-ohm, 2-watt (minimum) dummy load to the antenna jack.

[ ] Using a small (1/8") flat-blade screwdriver, turn R14 (drive control) fully counter-clockwise.

[ ] Connect a well-regulated and filtered 11 to 15V DC power supply (or battery) capable of supplying 500mA to J3. The preferred voltage is 13.0 volts.

[ ] Turn on the power supply and S1. If any component is hot to the touch or you see or smell smoke, chances are you have a short or open or bad component--kill the power immediately!

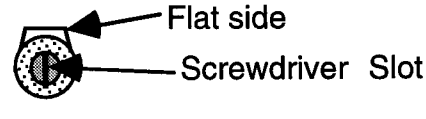
[ ] Connect a milliameter in series with the DC supply and note the current reading, which should be approximately 35mA. If the reading differs by more than about +/- 8 mA from this value, chances are you have a short or open or bad component.

[ ] Using a DMM, verify that the voltage at U1, pin 1, is between 3.5 and 4.0 volts. (This is the no-signal AGC voltage; see **Circuit Details.**) If this voltage is incorrect, refer to **Troubleshooting.**

Receiver Alignment

Follow the steps in Table 1 to align the receiver and all signal sources. You'll need to repeat this procedure for each band module (except for the VFO alignment, which is done once). Use a non-metallic or insulated tuning tool for adjusting trimmer capacitors.

Table 1. VFO, PMO, and Receiver Alignment.

Alignment Step	Using Lab Test Equipment	Using a Test Receiver and Transmitter	Using a DMM and RF Probe
[ ] Set VFO tuning cap (C54) to its **fully-meshed** position, then remove the VFO knob. [ ] Loosen the set screw on the VFO dial and rotate it until the "150" tic mark is exactly straight up (make a temporary pointer mark on the front panel, if necessary, using a thin slice of electrical tape). Then tighten the set screw and replace the VFO knob.			
[ ] With the VFO dial at "150," adjust C52 for a VFO frequency of 2.935 MHz (+/- 1 KHz).	Connect a hi-Z counter probe to the R22/C59 junction (or, for less loading, R22/C61).	Connect a 3' long wire antenna to the test receiver. Tune the receiver to 2.935MHz.	For now, just leave C52 at its midpoint. You can align C54 later using a known on-air signal.
[ ] If the VFO can't reach 2.935MHz, remove the nylon screw from L7 and spread out the turns (to go higher) or compress the turns (to go lower). Then repeat the previous step.			
[ ] Tune the VFO to the "0" mark on the dial *(this is **not** the end of the VFO's rotation).*	Note the new counter reading.	Tune the test receiver until you find the Sierra's VFO signal.	n/a
[ ] If the VFO reads *above* 3.085 MHz, decrease the VFO tuning range by spreading the turns of L7 a bit; if it reads *below* 3.085 MHz, increase the range by slightly compressing the turns of L7. After adjusting the turns, set the dial to "150" and repeat all VFO alignment steps. Note: The worst-case scenario (hopefully rare!) is that, after adjusting the turns of L7, you can't set the VFO's "150" frequency to 2.935 MHz. In this case, you may need to increase or decrease the value of C53. Use only NPO disc, polystyrene, or other stable capacitor types.			
[ ] Set all trimmer capacitors on both the main board (C16, C38) and the band modules (C1, C2, C36, C33, C66, C64, and C70) to their mid-points as shown: 			
[ ] Align the crystal oscillator using C70 on the band module (labeled "XTAL"). See Table 2 for oscillator freq.	Connect the counter to pin 6 of U7 (or for less loading, use pin 7).	Tune the test receiver to the frequency shown in Table 2. Adjust C70 until you hear the oscillator.	Leave C70 at its midpoint. You'll usually be within about 2 or 3 KHz.

[ ] Set the VFO dial to the "0" mark.	Connect a scope to the junction of R25 and Q8-drain.	Tune the test receiver to the low end of the PMO range (Table 2), and find the Sierra's PMO signal.	Connect the RF probe to the junction of R25 and Q8-drain and use E1 for GND.
[ ] Peak the pre-mix band-pass filter with C64 and C66 on the band module (labeled "Pre-mix").	Adjust C64 and C66 for max signal. Use a counter to verify operation at the right frequency.	Adjust C64 and C66 for max signal strength by ear, or as indicated on the test receiver's S-meter.	Adjust C64 and C66 for maximum signal as indicated on the DMM (DC volts scale).
NOTE: If you end up with these two capacitors somewhere in mid-range, chances are you've got the PMO filter aligned at the proper frequency. It may be possible to tune to a higher (wrong) output frequency.			
[ ] Set the RF gain control to its fully clockwise position (max gain). [ ] Set the AF gain to about 12 o'clock, and plug in a pair of 8- to 32-ohm stereo headphones. [ ] Set the VFO for a dial reading of "50." (This corresponds to 7.050MHz on 40 meters.)			
[ ] Set up a signal source at 7.050 MHz (or the corresponding frequency for the band module in use).	Set a signal generator for 10mV rms output at the desired frequency. Connect it to the Sierra's antenna jack.	Setup the test transmitter to output a CW signal into a dummy load. Use a 3' wire at the Sierra's antenna input (J4).	If you don't have any kind of signal source, just connect the *best possible antenna* to the Sierra (or 33' of wire).
[ ] With the headphones on, vary the frequency of the signal source to find the signal.	Once you find the signal, reduce the generator output to the point where the signal is quite weak.	Key the test transmitter, and tune its VFO until you hear the signal in the Sierra's headphones.	You may hear some background noise; if not, try to locate a signal using the VFO knob.
[ ] Peak the receiver front-end filter using C1 and C2 on the band module (labeled "RX").	Adjust C1 and C2 for maximum signal strength by ear, or with a scope at U3-5.	Adjust C1 and C2 for maximum signal strength.	Tune C1 and C2 for max increase in noise or for loudest signal.
[ ] Set the BFO trimmer, C16, for the desired audio pitch. This moves the BFO in relation to the center frequency of the crystal filter, sortof like "IF Shift" on a commercial rig.			

Crystal Oscillator and PMO Frequency Chart

Table 2 lists the crystal oscillator and PMO frequencies used on each band. If you're using a frequency counter or general-coverage receiver during alignment, you can use this table to determine what frequencies to look for.

Note that the crystal oscillator and PMO frequencies are *above* the RF range on all bands except 10 and 12 meters (shown in bold). We use frequencies *below* the RF range on 10 and 12 meters because it is nearly impossible to buy a fundamental-mode crystal above 30 MHz, and not a good idea even if you could. Table 2 also shows how the IF (intermediate frequency) of 4.915 MHz is obtained by the receive mixer on each band. Since the sign of the subtraction is reversed on 10 and 12 meters, the signal you listen to is on the other side of zero beat on the VFO dial. However, the same dial calibration still applies; only the sideband gets inverted.

Table 2. Crystal Oscillator and PMO frequencies.

RF Range	Crystal Oscillator	PMO Range	RX Mixer Formula (see text)
1.800-1.950	9.800	6.715-6.865	IF = PMO - RF (USB)
3.500-3.650	11.500	8.415-8.565	IF = PMO - RF (USB)
7.000-7.150	15.000	11.915-12.065	IF = PMO - RF (USB)
10.000-10.150	18.000	14.915-15.065	IF = PMO - RF (USB)
14.000-14.150	22.000	18.915-19.065	IF = PMO - RF (USB)
18.000-18.150	26.000	22.915-23.065	IF = PMO - RF (USB)
21.000-21.150	29.000	25.915-26.065	IF = PMO - RF (USB)
24.800-24.950	**22.970**	**19.885-20.035**	**IF = RF - PMO (LSB)**
28.000-28.150	**26.170**	**23.085-23.235**	**IF = RF - PMO (LSB)**

Transmitter Alignment

Table 3 lists the steps required to align the transmitter. The receiver alignment must be completed first to insure that the VFO and PMO are operating properly.

Table 3. Transmitter Alignment.

Alignment Step	**Using Lab Test Equipment**	**Using a Test Receiver**	**Using a DMM and RF Probe**
[ ] Connect a 50-ohm dummy load to the Sierra's antenna jack. [ ] Plug in a hand key at J2. Avoid using a keyer in "tune" mode. [ ] Plug in a band module; start with 40, 30, or 20 meters if possible. Set the Sierra VFO for a dial reading of "050" (i.e., 7.050 MHz if you're using the 40-meter band module).			
[ ] Prepare to monitor the Sierra's RF output.	Connect a scope to the antenna jack, J4. Also connect a counter --**if it can handle 40V p-p or more.** Use high impedance probes.	Connect a 3' wire antenna to the test receiver's antenna input. Tune the test receiver to 7.050 (or the equivalent for the band in use).	Connect the RF probe to the antenna jack. Set the DMM to its 30V range. You can also use an SWR bridge or wattmeter.
[ ] Set the drive control for maximum (fully clockwise), then **back it down by about 1/8 turn.**			
[ ] Key the Sierra and peak the transmit band-pass filter using C33 and C36 on the band module (labeled "TX"). **Do not key the transmitter for over 3 seconds at a time; allow plenty of cool-down time.**	Start with the scope at 1 volt/division and work up to 5 volt/division as you peak the filter.	Find the Sierra's output signal on the test receiver. As you peak the filter, try to keep the signal around S6 to S9 on the test receiver's S-meter using its RF attenuators and/or gain control.	Peak the filter trimmers carefully and watch for an increase in the DMM reading. Eventually you should hit somewhere in the 5 to 10 volt range.

[ ] Set the power output to the desired level using R14. (See **Operation.**)	Power = $(Vp\text{-}p/2.8)^2$ / 50Ω)	Using a DMM and RF probe: Power = $Vrms^2$/ 50Ω
[ ] Listening in the Sierra's headphones, set the TX offset adjustment, C38, for the desired TX monitor pitch. If the TX monitor tone seems weak, you may have set C38 near its minimum, which would put the TX offset on the wrong side of zero beat.		

Troubleshooting

1. If you have a problem that you can *see* or *smell*, turn off power immediately.

2. Inspect the PC board for solder bridges, cold or non-existent solder joints, incorrectly-installed parts (backwards or wrong part), broken parts, and open circuit traces.

3. Double-check your setup. Often you can trace a problem to a bad scope probe, intermittent clip lead, incorrect power supply voltage, idle chit-chat from passers-by, weak coffee, etc. Try the alignment procedure again if it seems safe to do so.

4. Try signal tracing to locate where the signal is getting lost. A general signal tracing procedure is given below. Unless otherwise noted, measurements were taken with a high-impedance DMM set to DC V and an RF probe.

Low-level Signal Sources:

a. VFO output at the junction of R22 and C59: 640mV rms
b. BFO at U4, pin 6: 230mV rms
c. Crystal oscillator output at U7, pin 6: 250mV rms
d. PMO buffer output at the drain of Q8: 270mV rms

Receiver (with a 10 mV rms signal at J4):

a. RX Mixer output, U2, pin 5: 200mV rms
b. IF amp input, U5, pin 4: 200mV rms
c. Product detector output, U4, pin 5: 12 mVrms (DMM only; AC V)
d. AF amp out, U3, pin 5: 1.47Vrms (DMM only; AC V)
e. AGC voltage, U1, pin 1: 5.6 VDC (DMM only; DC V)

Transmitter (measured on keydown with drive set to minimum):

a. TX mixer oscillator at U8, pin 6: 140mV rms
b. TX mixer PMO injection at U8, pin 1: 89mV rms
c. Buffer output at Q5 source: 400mV rms
d. Driver output at Q6 collector (case): 400mV rms

Transmitter (keydown with drive set to 90% of maximum):

a. Driver output at Q7 base: 1.2Vrms
b. Power Amp output at Q7 collector: 13.9Vrms
c. Output at antenna jack: 9.5V rms.
(Low efficiency? Try reversing T2's secondary leads.)

5. Check all DC voltages using Table 3 (next page). Also, be suspicious of electrolytic caps: if they have high leakage, they can act like they're in parallel with a resistor. This is especially true of C26. If you see a different voltage at C26(+) than you do at pin 3 of U1 with the RF gain control at minimum, toss C26 in the round file.

6. If you still have difficulties, seek help from another NorCal member nearby. Jim, Doug, or Wayne may be able to point you in the right direction.

DC Voltage Chart

These readings were taken with a DMM (30V scale), under the following conditions: power supply = 12.96 (rcv), 12.83 (xmit); regulated supply (output of U9) @ 7.93 volts; dummy load at J4; transmit output 2 watts ("Xmit" readings); headphones plugged in and AF gain at 2 o'clock; RF gain: max; RIT: OFF.

In general, you should expect your readings to be within about 5 to 10% of these. Voltages in **bold** are unstable due to the effect of the DMM probe; use an oscilloscope if possible at these points. Voltages listed as "n/a" either can't be measured or are irrelevant.

Table 3. Sierra DC Voltages, All Active Devices

Device/Pin#	Rcv	Xmit	Device/Pin#	Rcv	Xmit	Device/Pin#	Rcv	Xmit
U1, pin 1	3.69	4.40	U5, pin 1	7.94	7.93	U9, IN	12.68	12.49
U1, pin 2	3.69	4.40	U5, pin 2	7.94	7.93	U9, OUT	7.94	7.93
U1, pin 3	3.69	4.42	U5, pin 3	0.00	0.00	U9, GND	0.00	0.00
U1, pin 4	0.00	0.00	U5, pin 4	2.54	2.55	Q1, emitter	0.00	0.00
U1, pin 5	n/a	n/a	U5, pin 5	3.80	6.69	Q1, base	0.00	0.71
U1, pin 6	n/a	n/a	U5, pin 6	2.54	2.55	Q1, coll.	0.00	0.00
U1, pin 7	n/a	n/a	U5, pin 7	0.00	0.00	Q2, emitter	0.00	0.00
U1, pin 8	7.94	7.93	U5, pin 8	7.94	7.93	Q2, base	0.00	0.69
U2, pin 1	1.44	1.44	U6, pin 1	0.78	0.78	Q2, coll.	0.00	0.00
U2, pin 2	1.44	1.44	U6, pin 2	2.54	2.55	Q3, gate	0.03	0.03
U2, pin 3	0.00	0.00	U6, pin 3	7.94	7.93	Q3, source	0.03	0.03
U2, pin 4	6.68	6.59	U6, pin 4	0.00	0.00	Q3, drain	7.94	7.93
U2, pin 5	6.75	6.63	U6, pin 5	2.54	2.55	Q4, emitter	7.94	7.93
U2, pin 6	7.88	7.88	U6, pin 6	7.94	7.93	Q4, base	7.83	7.19
U2, pin 7	7.41	7.41	U6, pin 7	0.01	0.01	Q4, coll.	0.00	7.74
U2, pin 8	7.94	7.93	U6, pin 8	7.94	7.93	Q5, gate	0.00	0.00
U3, pin 1	1.30	1.30	U7, pin 1	1.42	1.42	Q5, source	0.00	2.00
U3, pin 2	0.01	0.01	U7, pin 2	1.42	1.42	Q5, drain	0.00	7.74
U3, pin 3	0.01	0.01	U7, pin 3	0.00	0.00	Q6, emitter	**n/a**	1.31
U3, pin 4	0.00	0.00	U7, pin 4	6.72	6.72	Q6, base	0.00	2.01
U3, pin 5	3.92	3.92	U7, pin 5	6.73	6.73	Q6, coll.	12.68	9.54
U3, pin 6	7.94	7.93	U7, pin 6	7.86	7.86	Q7, emitter	0.00	0.00
U3, pin 7	3.96	3.96	U7, pin 7	7.14	7.14	Q7, base	0.00	**0.00**
U3, pin 8	1.31	1.30	U7, pin 8	7.94	7.93	Q7, coll.	12.68	**12.89**
U4, pin 1	1.42	1.42	U8, pin 1	0.00	1.42	Q8, gate	0.00	0.00
U4, pin 2	1.42	1.42	U8, pin 2	0.00	1.42	Q8, source	0.68	0.68
U4, pin 3	0.00	0.00	U8, pin 3	0.00	0.00	Q8, drain	7.94	7.93
U4, pin 4	6.74	6.74	U8, pin 4	0.00	6.43			
U4, pin 5	6.76	6.76	U8, pin 5	0.00	6.44			
U4, pin 6	7.85	7.85	U8, pin 6	0.00	7.66			
U4, pin 7	7.60	7.60	U8, pin 7	0.00	7.39			
U4, pin 8	7.94	7.93	U8, pin 8	0.00	7.74			