REPAIR & RESTORATION OF HALLICRAFTERS SR-2000

UPDATE 2/1/2021

CAUTION: FATAL VOLTAGES ARE OPEN AND EXPOSED ONCE THE COVERS OR CASE IS REMOVED. OBSERVE THE FREE HAND RULE. THAT IS, ANY TIME THE POWER IS APPLIED, IF YOU ARE RIGHT-HANDED YOUR LEFT HAND IS IN YOUR HIP POCKET. IF YOU ARE LEFT-HANDED YOUR RIGHT HAND IS IN YOUR HIP POCKET. YOU PROCEED AT YOUR OWN RISK.

INTRODUCTION

This is not a "restore to museum" quality guide. Cleaning, painting and front panel touchup are not covered. There are reams of documents that cover those actions. There are very few documents that delve into the inner workings of these radios. This document does. This document applies directly to the production run reflected by the 155-000348C schematic. Earlier or later production run units may vary slightly in signal levels and measurements. There have been many post production modifications recommended for the 2000 and they effect the trouble shooting very little.

This document takes a systematic approach to rehab. In all discussions the word ***manual*** refers to:

OPERATING AND
SERVICE INSTRUCTIONS
FOR
COMMUNICATIONS
TRANSCEIVER
MODEL SR-2000

If this procedure is followed, in the order presented, you will minimize the frustration of restarts and backups and chasing red herrings. It ***assumes*** a working knowledge of radio and tube circuit theory. For the most part it will lead you to the stage or stages where faults have occurred. At this point you must have the skills to locate the failed component. Each step of this process assumes all proceeding steps have been successfully completed. If you try to jump into the middle of the process you may end up in confusion.

You have obviously elected to spend time and effort in this restoration. **So, I highly recommend** that you do a dry run with the schematic, manual and this document. As you read this document follow it through the schematic and the manual. A wealth of knowledge will be gained by doing so.

CAUTION: FATAL VOLTAGES ARE OPEN AND EXPOSED ONCE THE COVERS OR CASE IS REMOVED. OBSERVE THE FREE HAND RULE. THAT IS, ANY TIME THE POWER IS APPLIED, IF YOU ARE RIGHT-HANDED YOUR LEFT HAND IS IN YOUR HIP POCKET. IF YOU ARE LEFT-HANDED YOUR RIGHT HAND IS IN YOUR HIP POCKET. YOU PROCEED AT YOUR OWN RISK.

TABLE OF CONTENTS

1. SR-2000 INITIAL INSPECTION AND TESTING.

SO, YOU JUST GOT AN SR-2000 FROM E-BAY OR SOMEONE THAT SAID “IT WORKED FINE THE LAST TIME I TURNED IT ON”. NOW WHERE DO YOU START? THE FOLLOWING PROCESS HAS EVOLVED OVER YEARS OF REFURBISHING THE SR SERIES EQUIPMENT. IT SHOULD BE FOLLOWED IN THE ORDER IT IS WRITTEN. THIS PROCEDURE IS DESIGNED TO PROGRESS IN AN ORDERLY MANNER TO MINIMIZE RUNNING IN CIRCLES. YOU **MUST** HAVE THE MINIMUM OF TEST EQUIPMENT LISTED TO PROPERLY REHAB OR REPAIR THIS EQUIPMENT. BE AWARE THIS IS NOT SOMETHING THAT WILL BE ACCOMPLISHED WITH GREAT SPEED. THE AVERAGE TIME TO COMPLETION IS AROUND 80 HOURS. SOME HAVE TAKEN AS MUCH AS 200 HOURS, SOME AS FEW AS 20 HOURS.

1-1. VISUAL AND MECHANICAL INSPECTION

Complete chassis cleaning and mechanical inspection are always advised. Cleaning of the controls, rotary switches and the relays is of particular importance. Look closely for broken or burned components. Check the rotation of the controls and mechanical stops of the main tuning dial (Section 8-8-A in the manual). Try to eliminate the mechanical problem first. If you are going to upgrade to a higher production run complete those upgrades before you start the electrical tests. If your rig is paired with an HA-20 disconnect it and install a jumper from pin 2 to pin 10 of J2. Test pin 10, it should be grounded.

1-2. RECAPPING;

There are only 2 capacitors that are considered ***must replace*** components. They are C146, 25 uf/25v and C147, 2 X 30 uf/350v. Capacitor C147 carries a heavy current load. Therefore, the ESR rating of its replacement is important. They should have an ESR rating of 1.0 ohm or less. ESR’s less than 0.3 ohm are available. This is not a place to save money. C147 is a dual cap. There are sources for this capacitor, ***but*** be careful. Some manufactures of these parts use inexpensive low-quality parts. Don't buy from suppliers who will not quote or guarantee the ESR rating. Very low ESR individual capacitors are readily available. So, replacing the dual cap with two capacitors under the chassis is sometimes a better solution. Generally speaking, shotgun replacement of the paper caps is not recommended at this stage of refurbishment.

The Het oscillator in early production units had a tendency to drift. To correct for the drift C104 was changed to a 22pF N1500. C105 was changed to 100pF N750. This is considered a <u>mandatory</u> change.

1-3. AFTER MARKET MODIFICATIONS

If you find any modifications, re-wirings or added components evaluate the mods closely. The best on line source for proper modifications is k9axn.com. If the authenticity of the mods cannot be verified remove them and return the rig to the original configuration.

1-4. INITIAL POWER UP

Note: Initial assumption is, the power supply has been fully restored and meets original specifications. See section 6-3 power supply information. The guide to power supply refurbishing is located in section 8-3 of this document.

1-4-1. TEST EQUIPMENT REQUIRED

DVM or VTVM

1-4-2. POWER UP PRE-SET CONDITIONS

First and of critical importance, you **must** have a power supply that has been tested and meets all the original specifications. You will not be transmitting power until late in this process so there is no need to activate the high voltage. The power supply front panel switch should be in the **SSB LOW POWER** position. Do not turn on the High Voltage until you get to the Transmitter PA tests. It is ***not*** necessary to start with a low AC voltage and increase the voltage over time to cook the rig. There are no domino circuits in the SR-2000. If you have a short somewhere, you may cook a resistor and it will smell bad but it will lead you straight to the problem. So, set **all the gain and drive controls** to minimum. **Every** time you turn on your SR-2000 all these controls should be at minimum. The **STANDARD PRE-POWER UP CONFIGURATION** will always be: all gain controls set to minimum, RIT off, RIT CONTROL at mid-range, CAL ADJ at mid-range, CAL OFF, NOISE BLANKER OFF, Preset the PRESELECTOR to the approximate position in the band you will be operating. Set the FUNCTION switch to either USB or LSB depending upon which band you will be testing the default is 80 meters LSB @3.900MHz. Ensure that a jumper plug in installed in J2 on the rear of the radio. The jumper plug should have a jumper between pins 2 and 10.

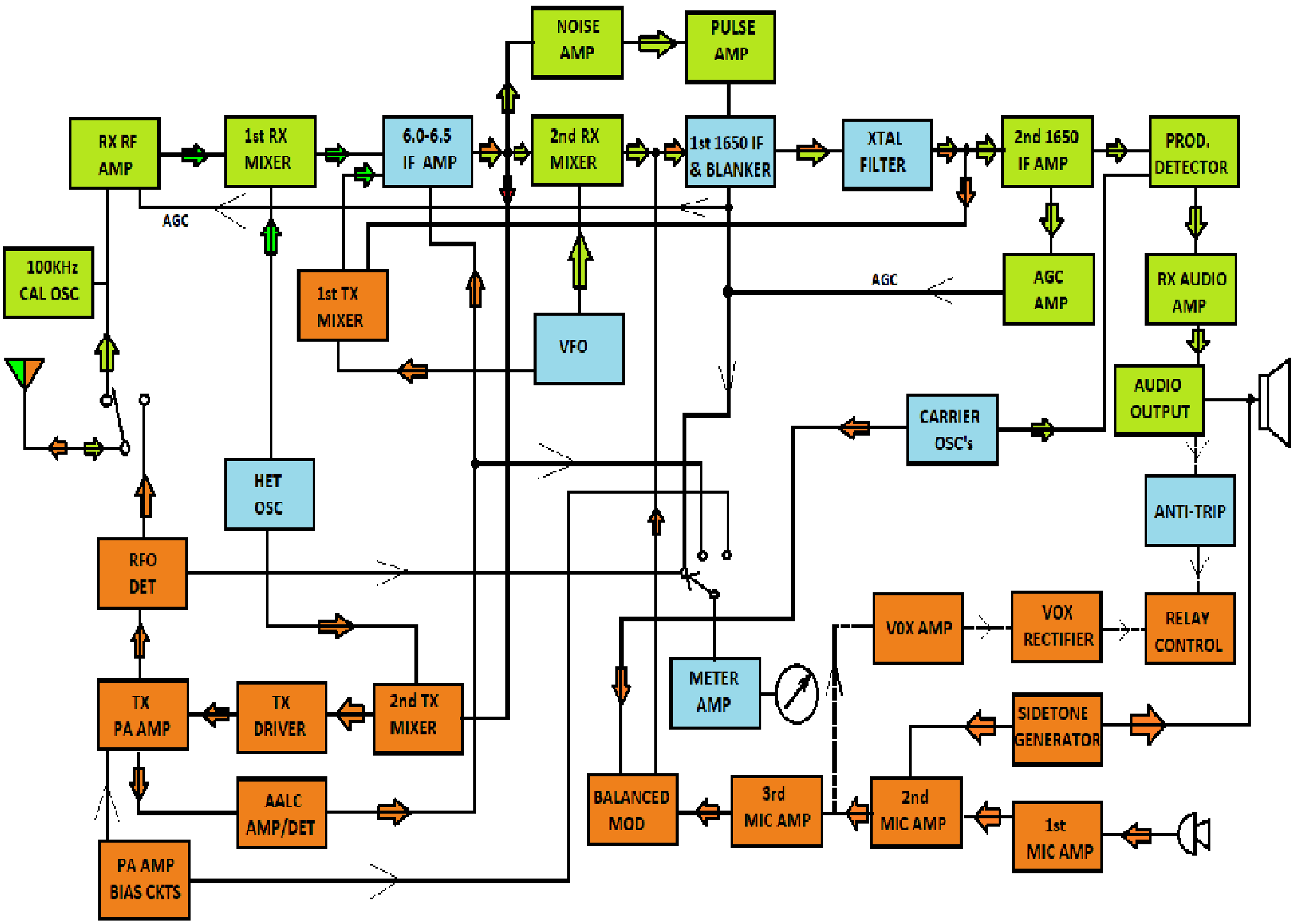
CAUTION: FATAL VOLTAGES ARE OPEN AND EXPOSED ONCE THE COVERS OR CASE IS REMOVED.

1-4-3. INITIAL POWER UP TESTS

Ok it is time apply power. **It is assumed that you have a fully recapped power supply that meets all specifications.** It is also assumed the case has been removed from the SR-2000. Attach the power supply and plug it in. Set the operation switch to REC. Now let it sit there for 10 to 15 minutes. Locate R50, 3300-ohm, 10-watt resistor connected to V10. The voltage at one end should 150vdc and 280vdc at the other. If you do not have the 280vdc assuming your power supply has been proven functional then there is a wiring error between J6 and R50. If you do not have the 150vdc you have a fault in the wiring or the 150v regulator. This fault must be cleared before you proceed. Now the only thing we need to do at this time is rough set the bias voltage.

Measure the voltage on the wiper tab of R114 (BIAS ADJ control). The control should be set for -68 to -70vdc. This is a preliminary setting done in the receive mode, a rough adjustment and will be precisely set later. If you cannot set this voltage then you have a fault in the power supply or the bias divider network, R114, C182 and R113. Ensure that you have -90vdc on pin 4 of J6 and -20vdc on pin 3 of J6. This fault must be cleared before you continue.

2. PRELIMINARY TESTING PROCESS



The repair process will follow the 4 basic steps of transceiver repair; first the oscillators, second the receiver, third the transmitter and finally a complete alignment.

2-1. CHECK AND ADJUSTMENT OF OSCILLATORS:

Before starting any receiver or transmitter troubleshooting or the RF or I.F. alignment it is **imperative** that the xtal oscillators and the VFO are **precisely** on frequency. If you will devote the time to these considerations you will be rewarded with a rig that performs as well as any modern rig. A frequency counter and scope are required. The procedure in the book will work ok, but will compound errors. If you get all the oscillators "on freq" with proper output levels individually, then all else will fall into place. Do not make any adjustments until the rig has been on for at least 30 minutes. Optimize the VFO **last** to insure it is stable. Do not hurry. Take your time, these processes are critical.

2-1-1. TEST EQUIPMENT REQUIRED

Oscilloscope, 100MHz bandwidth with X1 and X10 probes, Frequency counter.

2-1-2. CARRIER OSCILLATOR:

The carrier oscillator is comprised of V14A and its associated circuitry. The carrier oscillator has three modes of operation. They are: LSB, USB and USB/CW off-set. First thing to check is the output of the carrier osc in both USB and LSB modes. After warm up you should have approximately 6 vpp on pin 8 of V9A (test point D). Now adjust T4 for max. The voltage on pin 4 or 3 of T4 should be 8 Vpp. If these voltages are more than 15% low then you most likely have a fault in the oscillator and this fault must be corrected before you proceed. Once you are satisfied with the oscillator output set the function switch to USB. Connect a scope to pin 8 of V9A to monitor the output voltage of the osc. Connect the frequency counter to either pin 4 or 3 of T4.

You will find that if you adjust T4 in one direction from the peak the signal drops off very fast. In the other direction it falls more slowly. T4 should be adjusted about 2% to 5% off peak toward the slow fall off side. The manual states that the signal level should be adjusted off peak to 80% of the max voltage. This will cause a reduction in the max power in CW or TUNE functions. This is a stable circuit and at 2% to 5% of peak to the slow roll-off side functions quite well. Switch back and forth from USB to LSB to insure both oscillators start without any hesitation. In USB mode adjust C139 for exactly 1651.550 KHz. Switch to LSB mode and adjust C136 for exactly 1648.550 KHz. Adjustment of T4 and C136 and C139 can interact. Re-check the output voltage and re-check the frequency back and forth several times to insure everything is stable and there is no hesitation in the oscillator startup.

To check the USB/CW off set, set the function switch to USB and monitor the frequency of the carrier oscillator. Ensure the high voltage is turned off. Then switch the function switch to CW. The frequency should drop at least 50 HZ. If it does not suspect C135 or its control line.

2-1-3. HETERODYNE OSCILLATOR:

The Het Osc is comprised of V12 and its associated circuitry. This oscillator is the most troublesome of the three. There are no adjustments to pull the frequency of each xtal. So, if you do not have a box of spare xtals you are rather limited in what you can do to put it precisely on frequency. First thing, check the oscillator output. Connect the scope to pin 8 of V2. The minimum peak to peak voltages for each band should be: 80 meters 4 Vpp, 40 meters 4 Vpp, 20 meters 2.5 Vpp, 15 meters 2.5 Vpp, 10 meters (all 4 bands) 2 Vpp.
Adjustment of L19 may be required.

The Het oscillator in early production units had a tendency to drift. To correct for the drift C104 was changed to a 22pF N1500. C105 was changed to 100pF N750

2-1-3-1 Adjustment of L19

Remove V4 to remove the VFO injection signal. Ensure the HIGH VOLTAGE is off (both meters on the P2000 indicate ZERO). Connect the scope to test point B (V11 pin 2). Turn the OPERATION control to MOX and the FUNCTION control to TUNE. Adjust L19 to get at least 5.5vpp on 80 and 40 meters and 2.0vpp on 10 meters. If you get 5.5vpp on 80 and 40 meters and 2.0vpp on 10 meters then 20 and 15 meters should be 2.0vpp or better. If the output does not meet these minimums this fault **must** be cleared before proceeding. Once you are satisfied with the oscillator output signal levels, disconnect the scope and connect the frequency counter to pin 8 of V2A and check the frequency on each band. If the xtal frequencies are **all** high or **all** low then swapping out C104 and/or C105 may bring them back in spec. The end unit frequency spec is + or – 3 KHz at any dial point across any band. With the VFO and Carrier oscillators dead on whatever error you have in the heterodyne oscillator is what you will have to live with. The CAL ADJ and the RIT CONTROL will correct for these errors. The use of the CAL ADJ and RIT CONTROL adjustments to compensate for errors will be discussed later in the VFO discussions. Turn the FUNCTION control to USB or LSB and reinstall V4.

2-2-1. VFO:

The VFO is comprised of:

V13 and associated circuitry;
V4B and associated circuitry;
The VFO correction circuitry;
The RIT and CAL circuitry.

From the manual:

Frequency Stability is; Less than 250 cycles drift in the first hour, after a fifteen-minute **warm-up**, and less than 100 cycles per hour thereafter.

Due to the age of the SR-2000 a more reasonable warm up time is 20 to 30 minutes.

2-2-2. VFO RIT/CAL

The RIT/CAL ckts are used to change the bias voltage on a varicap in the VFO. The CAL is used to make minor corrections to the VFO frequency. The RIT when turned on allows for minor corrections in the RECEIVER without changing the transmit frequency. In cw mode with the RIT turned on the RIT CONTROL functions as the BFO.

Set the RIT lever switch to off, adjust the RIT control to the center of its rotation. Set the CAL control to the center of its rotation. This is the setting for these controls throughout all testing unless otherwise noted. Set the main tuning to near 300 on the black scale. Connect the frequency counter to pin 3 of V4A. Fine tune the main tuning for 4550.0 on the counter. Rotate the CAL control to max counter clockwise and note the counter reading. Rotate the CAL max clockwise and note the counter reading. The difference from counter clockwise to cc rotation should be minimum 4 KHz; most rigs will run approximately 6 KHz. Readjust the CAL pot back to 4550 Hz on the counter. Turn the RIT on. Adjust the RIT CONTROL for 4550Hz on the counter. The RIT CONTROL should be at the center of its rotation and not more than 10 to 15^{o} off the center of its rotation. If it is off too far then you have a dirty switch (S7) or a fault in the voltage divider network. Clear this fault before proceeding. When the RIT CONTROL is rotated min to max you should see the same swing in frequency as when you rotated the CAL control earlier.

2-2-2-1 VFO F-M-ing

Some units exhibit VFO f-m-ing. This manifests as garbled audio in the transmitter and receiver. This is the effect of wiring from the CAL and RIT controls to the RIT switch and on to the VOX relay, K2 picking up noise. This has been a historic fault in all the SR series transceivers. The cure is to place bypass capacitors in the circuit. The bypass capacitor has been installed in various places across the SR models and production runs. If it is installed on the VFO side of the VOX relay you get key chirp when using the RIT function. I recommend two 1-2uf/25v capacitors. One on the wiper of R90 the CAL ADJ control, the other on the wiper of R91 the RIT control. These capacitors can be physically mounted on the RIT on/off switch.

2-2-3. VFO CORRECTOR

The VFO correction ckt adjusts for the frequency off set between USB and LSB (NOTE: CW operates in the USB MODE). Before the VFO is aligned it must be established that the correction ckts are working properly. **NOTE: RIT OFF, CAL ADJ and RIT CONTROL both in center of rotation.** Connect the frequency counter to pin 3 of V4A. Set the function switch to LSB, any band and tune the main tuning until the frequency counter reads 4.5530 MHz (approximately 300 on the black scale). Switch to USB and the frequency should drop 3000 Hz or to 4.550 MHz. If not adjust C127 for exactly 4.5500. If you cannot then there is a fault in the corrector ckt that must be repaired before you can continue with the VFO alignment. First check the ***offset switching voltage*** on pin 4 of J4 (the ACCESSORY PLUG). In USB it should be 150 vdc. In LSB it should be a negative voltage in the range of -10 to -28 vdc. If the voltage is switching properly yet there is no shift in frequency R85 is possible but least likely. CR12, C125, C126 and/or C127 are most likely the cause. If the offset voltage is not correct then S3A rear, R125, R124 or a wiring problem are the most likely fault.

2-2-4 VFO STABILITY TEST

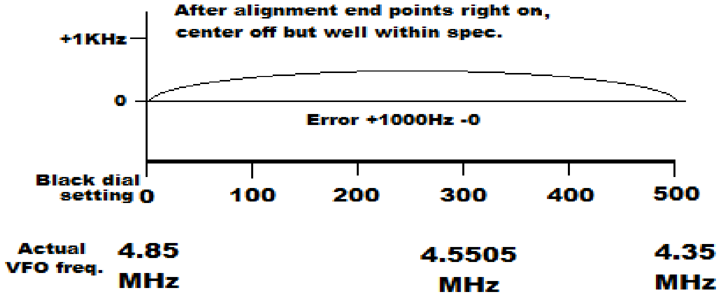
NOTE: RIT OFF, CAL ADJ and RIT CONTROL both in center of rotation.
If you have not already done so proceed to section 8-8-A of the original manual and perform the mechanical indexing adjustments before you proceed.

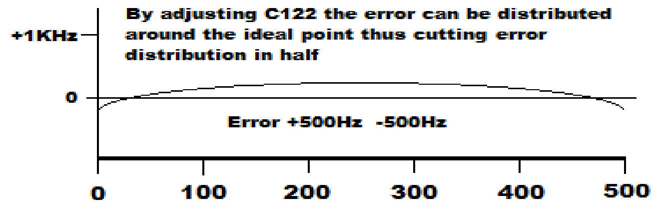
Before starting the VFO alignment perform a VFO stability test. Connect the frequency counter to V4A pin 3. Power up and warm up for 30 minutes. Record the VFO frequency every 10 minutes for one hour. In the one hour test it should meet the requirements of section 2-2-1. After 1 hour perform a short-term drift test by recording the freq every minute for 5 minutes. The short-term drift should not exceed 100 cycles. If either of these tests does not meet specifications go to the VFO DRIFT subsection of section 5. RX SUBSYSTEM TROUBLESHOOTING AND TESTING for corrective action.
NOTE: RIT OFF, CAL ADJ and RIT CONTROL both in center of rotation.
Assuming the that mechanical indexing adjustments have been completed (section 8-8-A of the user manual) connect the frequency counter to V4A pin 3. Record the VFO frequency every 100 KHz from 0 to 500 (black scale). A data sheet is provided in the DATA SHEET section with the data points and the spec frequencies. You may want to make several copies of the data sheet.

If the actual frequency consistently falls above or below the spec frequency adjustment of trimmer C122 is indicated. Move the dial to the black 500 index mark (be sure you are looking head on at the dial to eliminate parallax error). Adjust C122 for exactly 4.351450 MHZ.

Rerun and record the 6 data points again. If at the Ø or the 500 indices mark you are more than 1 KHz off, tracking of C122 and L21 is required. ***The original manual spec at this point is 2 KHZ. But it is normally not difficult to get it less than 500 Hz. So why not try.*** Set the tuning dial to the black 500 and adjust L21 for 4.35145 MHz. Tune the dial to the black Ø and adjust C122 for 4.851450 MHZ. You may have to repeat this several times to get it correct. Under correcting or overcorrecting at one end or the other is sometimes required to get it to fall in.

Rerun and record the data. If any of the mid points fall more than 2 KHz from spec knifing of C120 is indicated (I use 1 KHz for my shop spec). **Knifing should never be attempted on the SR-2000 unless you are very skilled at knifing.** C120 is fragile and can be destroyed very easily. If you have a uniform distribution of the error you can split the difference by adjusting C122. That is move the end points half the max error in the opposite direction of the error. Once again you may have to go back and forth adjusting C122 and L21 to equalize the error at both ends.





This completes the oscillator test and adjustment process. Again, let me stress that diligence in getting the oscillators correct will pay max benefits in the end product.

3. RECEIVER FAULT ISOLATION

3-1. EQUIPMENT REQUIRED.

HF RF signal generator capable of 0.5 microvolts to 300 millivolts and covering 1600 KHZ to 30 MHZ
Audio output meter (similar to General Radio 1840A). [See TECH NOTES 8-2 for substitute]
Scope 100 MHZ or better with 1:1 and 10:1 probes or switchable probe.
Audio oscillator with 600-ohm output Z_0 capable of from 0.7 millivolts to 30v peak to peak output.

3-2. STANDARD TEST CONDITIONS

For the RECEIVER FAULT ISOLATION tests the following preset conditions are required.

OPERATION	REC
FUNCTION	LSB
CAL	OFF
CAL ADJ	MID RANGE
MAIN TUNING	250 (BLACK SCALE)
BAND SELECTOR	7.0
PRESELECTOR	40
AF GAIN	MAX
RF GAIN	MAX
NOISE BLANKER	OFF
METER	RFO/S
RF LEVEL	COUNTER CLOCKWISE
MIC GAIN	COUNTER CLOCKWISE
RIT	OFF
RIT CONTROL	MID RANGE
LOAD & PLATE	N/A

3-3. PROCEDURE OVERVIEW & PRESET CONDITIONS

This test is a standard progression from output to input of a receiver. It assumes the probability of multiple faults. At any point in the procedure if a fault is detected it must be cleared before you can go the next step. The signal levels were derived from years of testing. The levels are not absolute in that an individual receiver may vary as much as 10%. Any deviation of more than that should be considered a fault. In the case where post production modifications have been installed as much as 25% differences may occur.

AGC problems can be difficult to localize particularly if there are other faults in the system. So, for the 13 step FAULT ISOLATION procedure that follows we will disable the agc. Locate the junction of R32 (2.2meg) and R33 (1 Meg). Place a clip lead from that junction to ground. Once the fault isolation is complete and the receiver is working properly tests of the agc circuit will be performed. **A 10:1 scope probe will be used to inject signals. Some measurements will require a 1:1 scope probe and these measurements will be noted**. The signal levels on the chart are injected signal levels therefore, **when using the 10:1 probe the source will be set for 10 times** the level stated in the chart. The first two audio signals are measured peak to peak using a tee connector on the audio oscillator. One side of the tee connects directly to the scope the other to the 1:1 injection probe. The remaining signals are RMS values as set on the RF signal generator output meter. **NOTE:** Section 4 contains individual ckt and sub-ckt fault isolation tests.

3-4. RECEIVER FAULT ISOLATION CHART

	INJECTION POINT	FREQUENCY	SIGNAL INJECTION LEVEL	AUDIO OUTPUT	IF GOOD GO TO NEXT TEST. IF NOT CHECK SUGGESTIONS BELOW.
1	V15 pin 7	1000 Hz	16 vpp 1:1 probe	½ wt	Problem most likely V15 or associated circuitry. See section 5-2 for details.
2	V9B pin 2	1000 Hz	0.4 vpp 1:1 probe	½ wt	Problem is most likely V9B or associated circuitry. See section 5-3 for details.
3	V9A Pin 7	1650 KHz	5000 uv	½ wt	Problem is most likely V9A, audio gain pot or associated circuitry. See section 5-4 for details.
4 *	V7A Pin 2	1650 KHz	800 uv	½ wt	Problem is most likely V7A or associated circuitry. See section 5-5 for details.
5	Tie point C59/C60	1650 KHz	650 uv 1:1 probe	½ wt	Problem is most likely xtal filter.
6	V6 pin 1	1650 KHz	35 uv	½ wt	Problem is most likely V6 or associated circuitry. See section 5-7 for details.
7	V4A Pin 2	6.250 MHz	40 uv	½ wt	Problem is most likely V4A or associated circuitry. See section 5-8 for details.
8 @	V3A Pin 2	6.250 MHz	20 uv	½ wt	Problem is most likely V3 A or B or associated circuitry. See section 5-9 for details.
9 #	V2A Pin 9	7.250 MHz	40 uv	½ wt	Problem is most likely V2A or associated circuitry. See section 5-10 for details.
10 ~	Junction C15&C20	7.250 MHz	25 uv	½ wt	Problem is most likely 6.5 MHz traps, S1F, V18 grid or associated circuitry.
11 $	V1 pin 1	7.250 MHz	0.5 uv	½ wt	Problem is most likely V1 or associated circuitry. See section 5-11 for details.
12 **	J1 direct from sig. generator	7.250 MHz	0.5 uv	½ wt	Problem is most likely K1, 6.25 MHz trap, L17 or associated circuitry. **Upon successful completion to this point leave all equipment set as they are for AGC test in next section.**

* May require peaking of T3
@ May require peaking of T2
# may require peaking of T1
~ May require peaking of L10 and PRESELECTOR
$ May require peaking of L3 and PRESELECTOR
** If the RX is working at this point perform the 6meg

trap alignment. See manual section 8-12-L&M.

3-5 AGC TEST

The following agc test results are dependent upon overall gain and sensitivity of the receiver. This assumes a fully functional receiver and proper alignment. If you are in the process of restoring to operation you may not get the agc figure of merit in spec. When you have removed all the receiver and transmitter faults and have done a complete alignment you will re-run these two tests for compliance to spec.

3-5-1. AGC FIGURE OF MERIT

With the ground jumper still connected to the agc line, tune the receiver to 7.250 MHz. Set the input at the antenna jack to 5.0 uv. Adjust the AF gain control for 1-watt audio output.
Test 1: Remove the clip lead from the agc line. The audio output should drop about 1 db. You are now through with the clip lead.
Test 2: Re-adjust the AF gain for 1-watt audio output with 5 uv RF input. Increase the signal from 5 uv to 5000uv. There should be a change of less than 10 db in the audio output.
If either of these tests fails you have a problem in the agc circuit or the AGC threshold is improperly adjusted.

3-5-2. AGC THRESHOLD ADJUSTMENT

Tune up the receiver to 7.250 MHz with a 1uv signal in. Turn the AGC threshold pot fully clockwise. Set the scope input to DC, 1v per division. Connect the scope, in DC mode, using a 1:1 probe to the junction of R2 and C12 (in the grid ckt of V1). Slowly turn the AGC THRESHOLD pot counter-clockwise until the trace on the scope just starts to move in the negative direction. If the adjustment is successful re-run the tests in 3-5-1 if it fails either test there is a fault in the agc amp. **NOTE:** The procedure in the manual, 8-4-D should not be used. The manual procedure sets the AGC threshold at the level of ambient noise which is always changing. By setting the threshold at 1 uv you accomplish two tasks. First, you provide wide open gain for weak signals. Second, you set the agc linearity start point at a measurable level insuring an accurate AGC figure of merit measurement.

3-6. S-METER ZERO

Turn the RF GAIN and the AF GAIN controls fully counter-clockwise. Set the meter switch to RFO S. Locate CR17. Place a clip lead from ground to the anode of CR17. Power up and warm up at least 15 minutes. Adjust METER ZERO (R120) for a meter reading of exactly zero. If it will not zero you have a fault in the meter circuit V8B. Remove the clip lead, if the meter moves off of zero you most likely have an agc fault in V8A, or associated circuitry.

3-7. CAL OSCILLATOR

Connect a frequency counter to the junction of CR10 and C88. Pull on the calibrator. Adjust C89 until it reads exactly 100.000 KHz. Move the probe from the counter to the scope and you should have 25vpp or better. If it will not adjust or does not oscillate the fault is in V11B or associated circuitry.

**THIS COMPLETES THE RECEIVER FAULT ISOLATION PROCESS.
YOU ARE READY TO PROCEED TO TRANSMITTER FAULT ISOLATION
OR FULL ALIGNMENT**

4. TRANSMITTER PRETESTING

The goal of this section is **not** to get maximum power out of the radio. The goal is simply to prove that the major subsystems are functioning.

CAUTION: FATAL VOLTAGES ARE OPEN AND EXPOSED ONCE THE COVERS OR CASE IS REMOVED. OBSERVE THE FREE HAND RULE. THAT IS, ANY TIME THE POWER IS APPLIED, IF YOU ARE RIGHT-HANDED YOUR LEFT HAND IS IN YOUR HIP POCKET. IF YOU ARE LEFT-HANDED YOUR RIGHT HAND IS IN YOUR HIP POCKET

MAJOR KEY POINT, the transmitter testing process **assumes** that the receiver has been tested and is operating to specs. ***It is of the utmost importance that the receiver is operating to specifications.*** ALL of the transmitter testing to follow is based on this assumption.

4-1. TEST EQUIPMENT REQUIRED

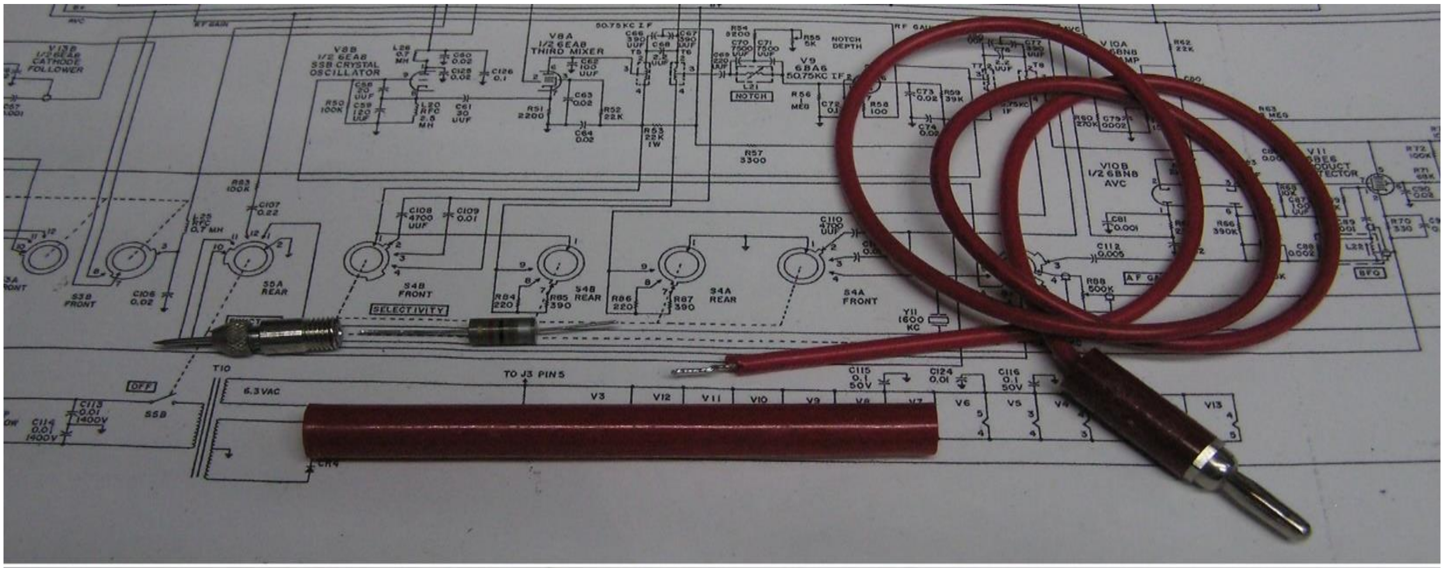
1500-watt wattmeter & dummy load
100 MHz scope
Frequency counter
Audio oscillator with **600-ohm** output
600-ohm dynamic mic
Multimeter or DVM
Optional telegraph key
Modified driver tube shield signal pick-up.
RF blocking DC meter probe.

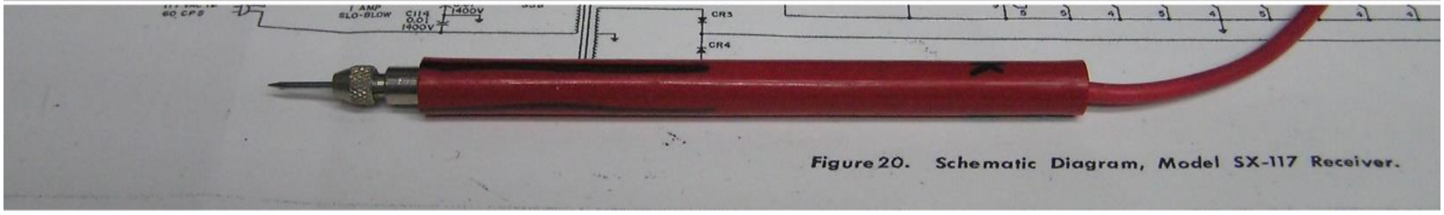
4-1-1. DRIVER TUBE PICK UP

For the drive tests you will need to construct a capacitive pick-up collar. This collar is nothing more than a snuggly fitting metal tube placed over the driver tube in place of the tube shield. This collar will get hot enough to melt your scope probe. That is why the long buss wire was used. I constructed one from an old snug fitting tube shield. I cut off the bottom so the shield would not contact ground. I then bent a buss wire into a loop with a pigtail. I used the tabs that formally held the spring in place to anchor the buss wire in place. The signal levels in this document were determined with the pick-up probe I constructed. The levels are dependent on the size and fit of the pick-up. Some difference can be expected to occur with different construction methods. Norms for your pick-up will need to be determined on a working system.

4-1-2. RF BLOCKING PROBE

Most DVM and analog meters work fine unless you are trying to measure a dc voltage with RF present, like the plate, grid or cathode of an oscillator or mixer. It is simple to make an RF blocking probe for the meter. Install a 270uh – 1mh chock in the barrel of the red dc probe. It will work with oscillators and low power mixers. Don't go messing about in the PA of a transmitter with one. Mark this probe and set it aside for ***special*** use only.





`

4-2. STANDARD TEST CONDITIONS

You will start with the following control settings

OPERATION	OFF
FUNCTION	LSB
CAL	OFF
CAL ADJ	MID RANGE
MAIN TUNING	7.3MHZ
BAND SELECTOR	7.0
PRESELECTOR	40
AF GAIN	MIN
RF GAIN	MIN
NOISE BLANKER	OFF
METER	RFO/S
RF LEVEL	COUNTER CLOCKWISE
MIC GAIN	COUNTER CLOCKWISE
RIT	OFF
RIT CONTROL	MID RANGE
LOAD & PLATE	PRESET TO VALUES ON CHART ON PAGE 20 OR 21 OF MANUAL

Wattmeter and load connected to J1.

4-2-1. STANDARD TEST PROCEDURES

The majority of the following test procedures do not require the presence of HIGH VOLTAGE or SCREEN VOLTAGE on the PA tubes. Do NOT turn on the high voltage unless you are instructed to do so. At times you will be instructed to switch the FUNCTION switch to the TUNE position to make a measurement or observation. You can plug a key into the key jack and set the FUNCTION switch to CW. Then when you need to make a measurement or observation simply press the key. This will save wear and tear on the function switch and reduce the possibility of leaving the rig keyed too long

4-3, DRIVER OUTPUT TEST

The High Voltage will remain off for the following tests.
Set all controls to the standard setup condition. Power up, warm up 10 minutes. Remove the tube shield from V18 and install the capacitive pickup and connect the scope. You will be testing all bands. Adjustment of the PRESELECTOR and the driver grid and plate coils will be required for each band. The process will be:

<Select band.
<Preset PRESELECTOR to proper band segment.
<Preset main tuning.
<KEY transmitter.
<Peak PRESELECTOR.
<Peak driver grid and plate coils as indicated in chart below.
<Record peak to peak voltage reading on scope.

BAND	MAIN TUNING	GRID COIL	PLATE COIL	VOLTAGE PEAK TO PEAK
80,	3.900	L11	L34	20 vpp
40,	7.23	L10	L33	28 vpp
20,	14.28	L9	L32	26 vpp
15,	21.36	L8	L31	25 vpp
10,	28.75	L7	L30	20 vpp

If any or all bands do not produce the peak-to-peak voltage noted go to section 6 and perform tests 6-1 and 6-13.

NOTE: 18vpp on any band will drive Blue Burle tubes to saturation and the Green Burle tubes will require 21vpp to fully saturate. The Black Burle tubes cannot be used in the SR-2000. For in-depth discussions on the bias conditions and matching of the 8122 tubes go to **k9amx.com** .

4-4, PA FINAL PRETEST:

When all faults have been cleared and the driver output is correct on all bands power down. Go get a cup of coffee, pick up the Hallicrafters owner's manual, and go to Section V of the manual and read the TUNING PROCEDURE and the instructions in section VIII paragraphs 8-3 and 8-4. If necessary, review the FUNCTIONS OF OPERATING CONTROLS in section IV. Be very sure you understand all the processes in the TUNING PROCEDURE. Any misstep from this point on could cost you a set of $1600 final tubes. If you are unable to get normal power out you have a fault in the PA sub-circuits. **VOLTAGES IN THE PA SUB-CIRCUITS ARE LETHAL. IF YOU ARE NOT EXPERIENCED IN HIGH VOLTAGE RF TROUBLESHOOTING IT IS TIME TO FIND A MENTOR.** Go to section 6-14 for PA fault isolation if the system fails to tune up.

Now that you are rested and familiar with the process; complete the processes in section VIII paragraphs **8-3** and **8-4**, then proceed to section V of the owner's manual and tune up. If all goes well, you are done, get on the air and communicate with the world. If **not** go to section **6**.

5. RX SUBSYSTEM TROUBLESHOOTING AND TESTING

5-1 VFO DRIFT

You have performed all the tests in section 2-2-4 and determined that you have a drift problem. Perform the drift test in receive, LSB mode. Then perform the same test in receive, USB mode. If you have the drift problem in USB but not LSB the most likely cause is CR12, C126 or C127. A bad ground on C127 could also be a source of trouble. If you determine the drift is the same in LSB and USB just about any of the N or NPO capacitors inside the VFO enclosure could be suspect. The most common caps at fault are C121, C123 and C124. Grounding particularly on C120 and C122 could also be the source. You can either shotgun the VFO and replace all the caps or replace them one at a time until you find the bad one. In many cases more than one is contributing to the failure.

5-2. V15 RX FAULT ISOLATION

Turn the power 0ff. Disconnect the power supply. Pull V15. Inject 1000 Hz at 20 vpp into pin 5 of the V15 socket. Connect J5 (AUDIO 500-ohm phono jack on rear of chassis) to the scope. If you get 15 vpp at J5 the output transformer and associated circuitry are good. If this test is good and yet it failed step 1 in the RECEIVER FAULT ISOLATION CHART then V15 or its associated circuitry is at fault.

5-3. V9B RX FAULT ISOLATION

This circuit is pretty straight forward. Check the voltages and resistances against the charts in section 7-9. If they are correct then the options are few; V9, C78, C77 or R48 are the most likely cause of the fault.

5-4. V9A RX FAULT ISOLATION

Power up and set the standard test conditions. In LSB mode you should have a 6 vpp signal (injection from the carrier oscillator) on pin 8 of V9A. Move the probe from the scope to the frequency counter. You should see 1648.55 KHz on the counter. If you do not get the proper level of signal on frequency then the fault is likely in the BFO/Carrier oscillator or C138 otherwise V9A is at fault. Ref section 7-9.

5-5. V7A RX PLATE FAULT ISOLATION

NOTE: In this next step you will be injecting signal into the plate pin of the tube socket. You will need an injection probe rated for 300 vdc or higher. Pull V7. Using the high voltage blocking probe inject 1000uv of 1650 KHz into pin 6 of the socket for V7. You may have to peak T3 for peak audio out. You should get a minimum of ½ watt audio output. If not suspect T3 or C72. If you get at least ½ watt audio then V7 or its associated CKT's are at fault.

5-6. V7A RX CKT FAULT

If you got at least ½ watt audio out in step 5-5 reinstall V7 and perform the voltage and resistance test per the charts in the manual for V7. If the voltages and resistances are good then the likely cause of the fault is;V7 C62, FL1. Disconnect C62 from FL1. Inject 1650 KHz into the loose lead of C62, tune for peak audio out. No audio C62 or V7 bad. Good audio FL1 bad.

5-7. V6 RX FAULT ISOLATION

NOTE: In this next step you will be injecting signal into the plate pin of the tube socket. You will need an injection probe rated for 300 vdc or higher. Pull V6, power up and inject 3000 uv at 1650 KHz into pin 5 of the V6 socket. If you do not get at least ½ watt audio out then L15, C59, C60 or FL1 at fault. If you get ½ watt then V6 or associated circuitry are at fault. If the tube is known to be good then refer to the voltage and resistance charts in the manual. If the voltages and resistances are correct then suspect C55, C56, C57 or C245. If all this checks ok then pull V5 and repeat step 6 in the RX FAULT ISOLATION chart in section **3-4**. If you get ½ watt audio out then V5 or its associated circuitry are at fault.

SUBSYSTEM TROUBLESHOOTING AND TESTING

5-8. V4A RX FAULT ISOLATION

Assumption: You have injected 35uv @ 1650 KHz into pin 1 of V6 and there was ½ watt audio output. And, when you inject 100uv into pin 2 of V4 you do not get ½ watt output. Check for 260 Vdc pin 1 of V4. If there is no 260 Vdc check pin 1 and 2 of T6. The B+ is supplied to V4 through R126 and T6. Pin 2 of V4A should be zero volts dc in receive mode. If it is a high negative voltage, clean the contacts (pins 9, 1 and 5) of relay K2. Pin 3 of V4 should have 1.5 vpp RF injection from the VFO and the DC bias should be approximately 11vdc. If the DC bias is incorrect then either R30 or the tube is bad. If there is no injection RF on pin 3 suspect C53. See chart in section 7-5

5-9. V3 RX FAULT ISOLATION

Pull V3 and check the voltage on the socket pin 6, it should be 260 vdc. If there is no 260 vdc then suspect T2, C42 or R23. With V3 pulled inject 6.25 MHz at 150uv into V3 socket pin 6. Tune the main tuning to approximately 250 on the black scale, and peek the audio output. If you do not get ½ watt audio out then suspect C42, C44 or T2. If the proceeding checks are good there is a bias problem or V3 is bad. If V3 is known to be good refer to the voltage and resistance charts in section 7-3 to isolate the fault.

5-10. V2 RX MIXER FAULT ISOLATION

Pull V2 and check the voltage on the socket pin 6, it should be 260 vdc. If there is no 260 vdc then suspect T1, or R16. With V2 pulled inject 6.25 MHz at 25uv into V2 socket pin 6. Tune the main tuning to approximately 250 on the black scale, and peek the audio output. If you do not get ½ watt audio out then suspect C30, C31 or T1. If the proceeding checks are good there is a bias problem, injection problem or V2 is bad. If V2 is known to be good refer to the voltage and resistance charts in section 7-2 to isolate the fault. If the tube voltages and resistances are good check the mixer injection voltage. Pin 7 of V2 should have 1.5 vpp at approximately 4.600 MHz.

5-11. V1 RX FAULT ISOLATION

Pull V1 and check the voltage on the socket pin 5, it should be 260 vdc. If there is no 260 vdc then suspect L6. With V1 pulled inject 7.25 MHz at 45uv into V1 socket pin 5. Tune the main tuning to approximately 250 on the black scale, and peek the audio output. If there is no or weak audio output then the fault most likely lies in the band coils and trap from C10 to C25. If there is audio reinstall V1 inject 0.5uv @ 7.250 MHz into pin 1. CASE 1, you get week audio suspect R3 R7 R5 R4A dirty contact on K2 contacts 3, 7, and 11. See chart in section 7-1

6. TX SUBSYSTEM TROUBLESHOOTING AND TESTING

For proofing the transmitter section, we will start at the second mixer stage. All trouble shooting required for the driver and circuits feeding the driver can be done without turning on the HIGH VOLTAGE. This will save wear and tear on the final tubes. If we find a fault, we will work back through the transmitter circuits until we isolate the fault.

ADDITIONAL subsystem schematics and voltage charts are provided in SECTION 7. These schematics and voltage charts will provide additional information for fault isolation once you determine a subsystem fault.

6-1, TX second mixer output test

You have arrived at this point because one or more of the bands failed the tests in **4-3**. If all bands were dead conduct the test on 80 meters. Otherwise go the band that failed in **4-3**.
Connect the scope to pin 2 of V18. Key the TX, you should have 6 vpp on pin 2 of V18. Some adjustment of the coils L7 through L11 may be required due to scope probe loading. Disconnect the scope and connect the frequency counter to pin 2 of V18. Key the TX and the counter should display the TX frequency determined by the band selection and the main tuning dial. If it is not there or the wrong frequency you may have a fault in the 2nd TX mixer or its associated circuitry. Go to **6-2 TX second mixer input test**. If you get a proper signal return to **4-3** and rerun tests.

Quick review: We got to this point because the initial driver output test failed. Once you establish proper signal from the 2nd TX Mixer rerun the test in **4-3**. If you still do not have proper output power there is a fault in the driver V18 or its associated circuitry or the PA. Go to section 6-13 DRIVER FAULTS and clear the fault before proceeding.

6-2, TX second mixer input test

The inputs to the second TX mixer are the Het osc and the 6.5 MHz I.F. They are measured at the grid of V11 the 2nd XMTR MIXER.

6-3, TRANSMITTER Het oscillator signal levels

To measure the Het osc disable the 6.5 MHz I.F. by pulling V4. Connect the scope to pin 2 of V11. Key the transmitter. Note and compare voltage present to the chart below.

BAND	PEAK TO PEAK READING
80,	6.0 vpp
40,	5.8 vpp
20,	3.8 vpp (Will be 3.8vpp if R160 [pin 4 S1B REAR] is 15 ohms.)
15,	4.0 vpp
10,	3.8 vpp

If the het osc signals do not meet or exceed the levels above go to section **6-10 Het osc low or no signal.** This fault must be cleared before proceeding to the next section. Reinstall V4 when fault is cleared. If all is well with the het osc injection levels go to **6-4**.

6-4, TRANSMITTER 6.5 MHz I.F. INJECTION

With V4 reinstalled pull V12. Set the VFO to 250 on the black dial scale any band. With the scope connected to pin 2 of V11 key the transmitter. You should have 3.0vpp (Will vary depending on the accuracy of the 6.5Mc alignment). For future reference run the VFO to 0 on the dial key up and note the signal level. Now run the VFO to 500 on the dial, key up and note the signal level. If either or both ends drop below 2.2 vpp then alignment of the 6.5 MHz I.F. is indicated and will be dealt with later. If the signal is not there or the level is below 2.8 vpp go back to section **6-3 TX 6.5 MHz low injection**.

When the signal levels from the het osc and the 6.5 MHz I.F. are verified as good return to **4-3** and continue testing.

6-5 BALANCED MOD TEST

The balanced modulator has two functions. In either SSB mode the balanced modulator presents a double sideband signal with reduced carrier to the 1650 IF and lattice filter F1, where the undesired sideband is eliminated. In the CW mode the circuit is biased to an unbalanced condition where the carrier signal is passed through to the IF and lattice filter.

The prerequisites for the balanced mod test are; 1, the receiver is working, 2, the 1650 IF is in alignment, 3, the carrier oscillator is functioning properly.

With a 20mvpp 1000Hz signal applied to the mic input and the mic gain at max, when you key the mic you should measure 1.9vpp of audio at the wiper of R132 in the balanced modulator. You should measure also 4.5vpp of the 1650 IF signal at the junction of C62 and C63 (output of FL1).

If the 1.9vpp audio is not present go to section 6-15-1 and run the mic amp tests.

If the 1650 IF signal is not present the balanced modulator is at fault.

6-5-1. SSB TEST

Inject a 20 mvpp signal into pin 1 of J8 and gnd pin two of J8 for tests in SSB modes. For CW tests either select TUNE or select CW and press the key to make measurements or observations.

6-6 SSB TEST

This test is dependent upon all the functions of the receiver and the oscillators have been tested and meet specs. The SSB tests will be performed only on 80meters, LSB. If there is a receiver fault in the 1650 IF you will not be able to perform these tests. Verify test in 3-4 step 6.

1, Start with the controls to the standard test conditions. Set the band switch to 80-meters, function to LSB, operation to MOX, mic audio to max. Connect a scope to pin 3 of V14B. Inject 1000Hz into pin 1 of J8. Temporarily ground pin 2 of J8 and adjust the output of the audio oscillator for 1vpp on the scope.

2, Move the scope to the input of FL1. Temporarily ground pin 2 if J8, you should see 1vpp on the scope. You may have to adjust T6 for max signal. Remove the signal from pin 1 of J8. Temporarily ground pin 2 of J8. Adjust CARRIER BAL, R132 and C192 for minimum signal on the scope.

There are no active components in the balanced modulator. If there is a fault in SSB modes check the diodes, switches and resistors.

6-7 CW/TUNE TEST

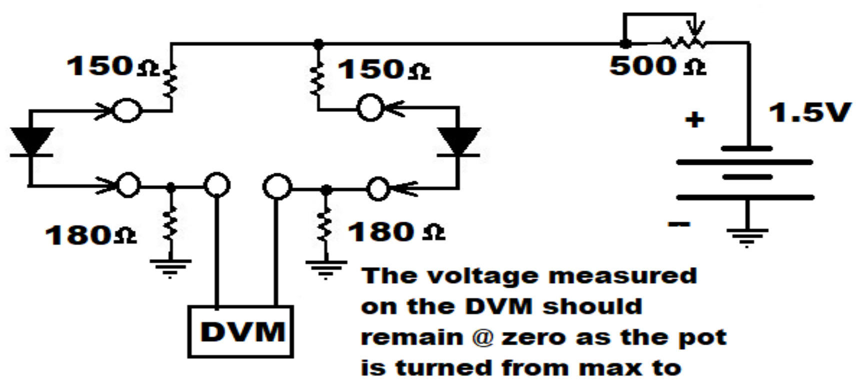
In CW and TUNE modes, the function switch S3A-front applies a ground to R123 and R122. This drops the voltage on the balanced mixer, diode/resistor network, from approx. 144vdc to approx. 38vdc. This in-turn reverse biases CR20 and forward biases CR19. With no audio coming from the mic amp ckt the carrier signal is passed directly to T6 and on to the 1650 IF and filter.

1, Connect the scope to the input of FL1, 80meters, MOX, LSB and mic gain at zero.

2, Move the function switch to TUNE. You should see 1vpp on the scope.

6-8. CARRIER BALANCE

The BALANCED MODULATOR is a very simple ckt but it is also very difficult ckt to pinpoint faults. Fortunately, there are very few components to “guess at”. The variable cap C192 is the highest failure rate component in the ckt. Second is the diodes CR19 and CR20. These two diodes “should be a matched pair” of germanium diodes. These diodes MUST have a V_F of 0.25vdc or less. Great quantities of these diodes are still available and can be found for around $0.50 ea. Matched pairs go for around $30.00 a set. I purchase 10 to 15 at a time and match them myself. If you do not have a curve tracer a simple matching circuit can be made.



6-9. CW CARRIER INJECTION

In CW mode S3A FRONT pin 10 supplies a gnd via two 10K resisters to the tie-point of CR19 and CR20. This unbalances the mixer. This gnd cuts off CR20 and biases CR19 full on, feeding the carrier osc signal directly to V6 in CW and TUNE modes. A problem on this line could cause normal CW or TUNE modes but out of spec carrier rejection in SSB modes. With the radio turned off measure the resistance to gnd from C20 anode. It should be 20k in CW or TUNE modes and greater that 150K in LSB and USB modes.

6-10. HET OSC LOW OR NO SIGNAL IN TX MODE

Re-run the tests in section 2-1-3. If the results of the test rerun are incorrect then there is a fault in V12 or its associated circuitry. If the rerun tests are good then pull V4 and check the following:

CR11 is the switch that routes the het signal to the 2nd TX mixer V11A in transmit mode. For the following tests turn the RF and MIC gain controls fully counter clockwise and the band switch on the 80-meter band. There is RF present in the switching circuits so you will have to **pull V12** to get accurate dc measurements. In receive mode the anode of CR11should be 5.9 vdc and the cathode should be between 14.8 and 16.5 vdc. If there is no or erratic voltage on the cathode of CR11 then L20 is most likely open.

When you key the transmitter (**with V12 still pulled**) the cathode should drop to less than 2 vdc. The anode should be about 0.3 vdc higher than the cathode. If these voltages measurements are correct then the diode and the switching are good.
1, If when in the transmit mode the drop across CR11 is more than 0.4 vdc the diode is bad.
2, If the cathode voltage in the receive mode is not above 14.8 vdc then replace V15.
3, If in transmit mode the voltage on the cathode of CR11 does not drop below 2 vdc then there is a problem in the grid bias RX/TX switching of V15.
Reinstall V12 and connect the scope to the junction of L20 and CR11, key the transmitter. You should see a signal of 4 vpp or more.
1, If not then C107 or L20 is bad (this is predicated on the fact that all signals in the tests in section 1-5-3 were good).
2, Check the signal voltage across C106 in the transmit mode. There should be little or no loss across the capacitor. If there is replace C106.

That completes the testing of the het osc TX switching circuits. Go to section **4-3** in this document and run the driver tests

6-12 TX 6.5 MHz LOW INJECTION TO 2ND MIXER

Once again, the prerequisite is that the receiver has been debugged and is working at or near spec. If the receiver is working properly and the 6.5 IF injection is low then C97 or the wire to C97 is the most likely cause.

6-13 TX DRIVER FAULT

Verify on all bands, that the proper drive signal is present in section **6-1**. Rerun the tests in section 4-3.
If the 6-1 test is good and 4-3 is bad then V18 or its associated circuitry is at fault.

- Replace the tube.
- Check the voltages on pins 1, 2, 7 and 8.
- Check the resistance to gnd on pins 1, 2, 7 and 8.
- Clean the S1G and S1H.

Once the fault is cleared return to **4-3** verify the driver is functioning properly.

6-14 FINAL PA FAULT

VOLTAGES IN THE PA SUB-CIRCUITS ARE LETHAL. IF YOU ARE NOT EXPERIENCED IN HIGH VOLTAGE RF TROUBLESHOOTING AND HAVE THE PROPER TEST EQUIPMENT IT IS TIME TO FIND A MENTOR.

6-14-1 UNABLE TO SET PA BIAS.

6-14-1-1 PRELIMINARY RESISTANCE CHECKS

Making the following resistance checks will eliminate the need to make high voltage measurements. This will reduce the chances of harm to machine or person. With the power supply completely disconnected. With the high voltage connector and the low voltage connector disconnected remove the bottom PA cover and measure the resistance from Pin 13 of J5 to the plate of either 8122 final. It should be approx. 18 ohms. Measure the resistance from Pin 14 of J5 to pin 2, 7, or 10 of both 8122's. You should measure 320 ohms on each, the readings should match. Measure the resistance from C169 (on the outside of the PA enclosure) to pin 3 or 11 of each 8122. You should measure 10K. Measure the resistance of R106 and R108, they should be 2.7 ohms. Replace the PA bottom cover.

6-14-1-2 BIAS SWITCHING TEST

We are now going to reconnect the power supply and check the bias switching. You will not need to turn on the high voltage for this test.

Set up the standard conditions as per paragraph **3-2** of this document. Connect a dummy load to the antenna connection of the radio.

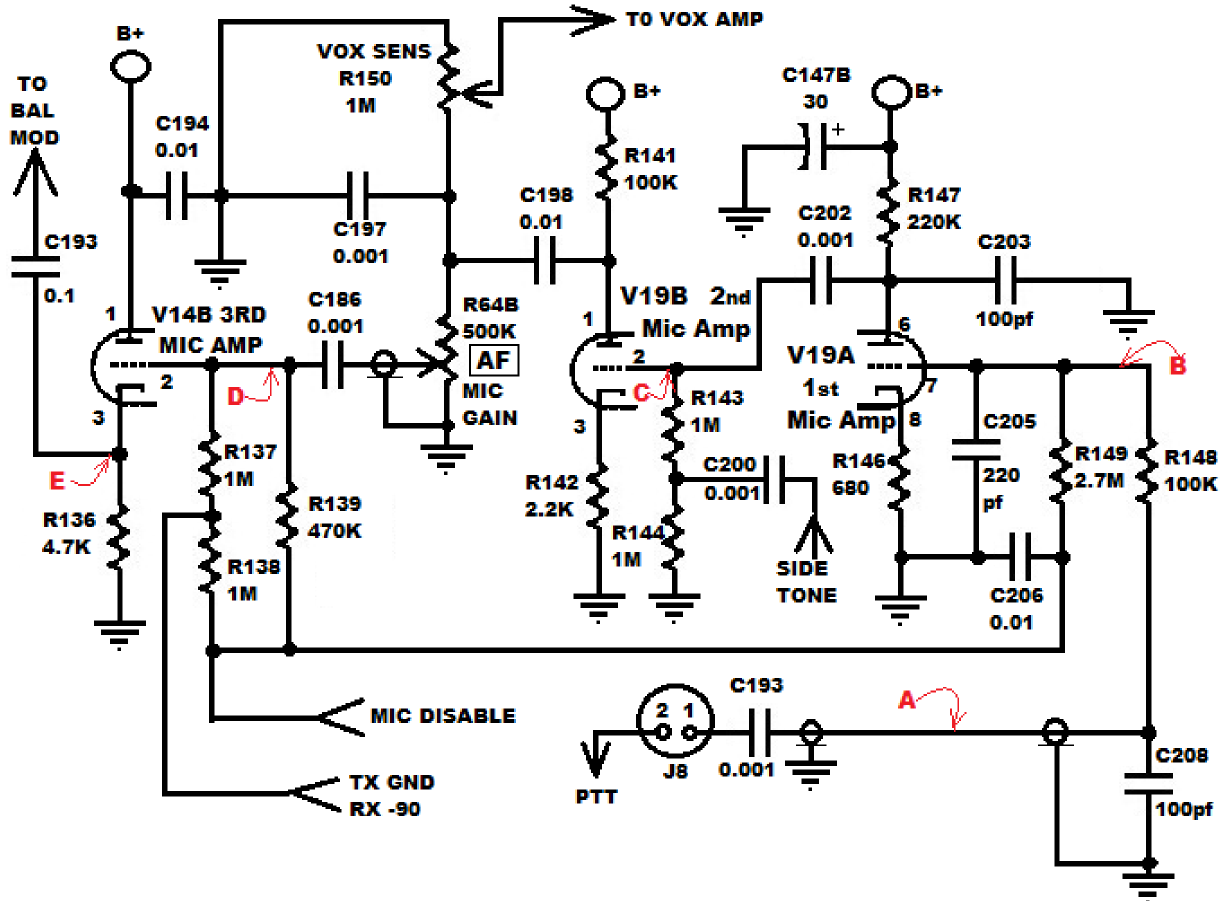
In the following test you may see a slight difference in the voltages you measure. The BIAS (-90v) and the FINAL BIAS (-20v) will vary slightly from one power supply to another. The actual value of the -20vdc depends upon the setting of the BIAS ADJ pot R114.
Locate C169. Connect a mic to the mic jack. Ensure that the mic AF gain and tx RF controls are both at minimum. Turn the OPERATION switch to MOX. Measure the voltage on C169 it should be -70vdc in receive mode. While observing the voltage key the mic. It should drop to -20vdc.
>If the -70v does not drop to -20v when mic is keyed. Check C157, L25, L17 and clean contacts of K1.
>The voltage at the top of L25 should be grounded via K1 and L17 when K1 is energized.
>All other bias faults most probably will be caused by R113, C182, R114, R115 or R116.

6-14-1-3 BIAS TEST WITH HIGH VOLTAGE.

In sections 5-5-1-1 and 5-5-1-2 we proved the voltage continuity and the bias switching functions. Perform the procedures as described in section 8-3 (page 33) of the factory manual. REMEMBER while testing keep the tx duty cycle very short. If you still cannot properly adjust the bias, replace the 8122's.

6-15 TUNE/CW WORKS SSB NO POWER

6-15-1 MICROPHONE AMPLIFIER SIGNAL TRACE



The mic amplifier is composed of one half of V14 and V19. V19B is operational at all time in all modes. V14B is biased on only when the transmitter is keyed in one of the SSB modes. V19A is active any time the function switch is in either USB or LSB. For the following test you will need to inject a 1KHz signal from a **600-ohm** source, into pin 1 of the mic jack.

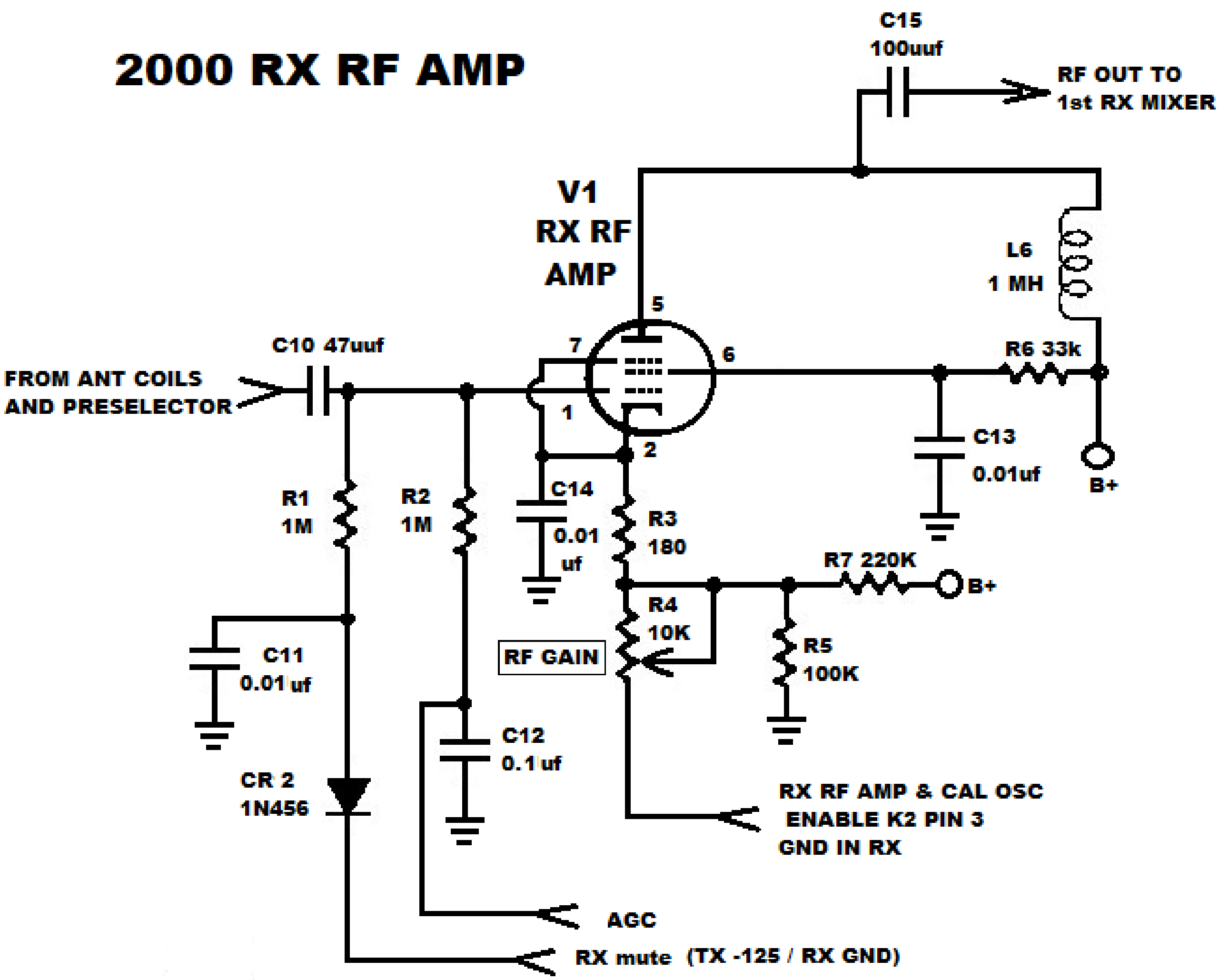
TEST PROCEEDURE
Remove top and bottom covers.
Set controls: MIC GAIN max clockwise; BAND SELECTOR to 3.5; FUNCTION to LSB;
Connect power supply cable and turn the operation switch to the MOX position and allow rig to warm up.
DO NOT turn on the high voltage.

Connect a 1x scope probe to test point A. Inject 1KHz signal into pin 1 of the MIC jack. Adjust the audio signal generator for a 20mvpp signal at test point A.
Move the scope probe to test point B. You should have 20mvpp.
Move the scope probe to test point C. You should have 500mvpp.
Move the scope probe to test point D. You should have 5vpp.
Move the scope probe to test point E. Apply a ground to pin 2 of the MIC jack. You should have >4.8vpp.

7. SUBSYSTEM SCHEMATICS AND VOLTAGE CHARTS

The following subsystem schematics and voltage charts are provided as starting point troubleshooting aids. The schematics have been broken out of the overall system schematic for better understanding of circuit function. For the most part the voltages in the charts represent static circuit condition. By "static" it is meant to imply a no signal in / no drive condition. Some voltages represent special condition measurements. These conditions will be explained in the discussion accompanying the charts.

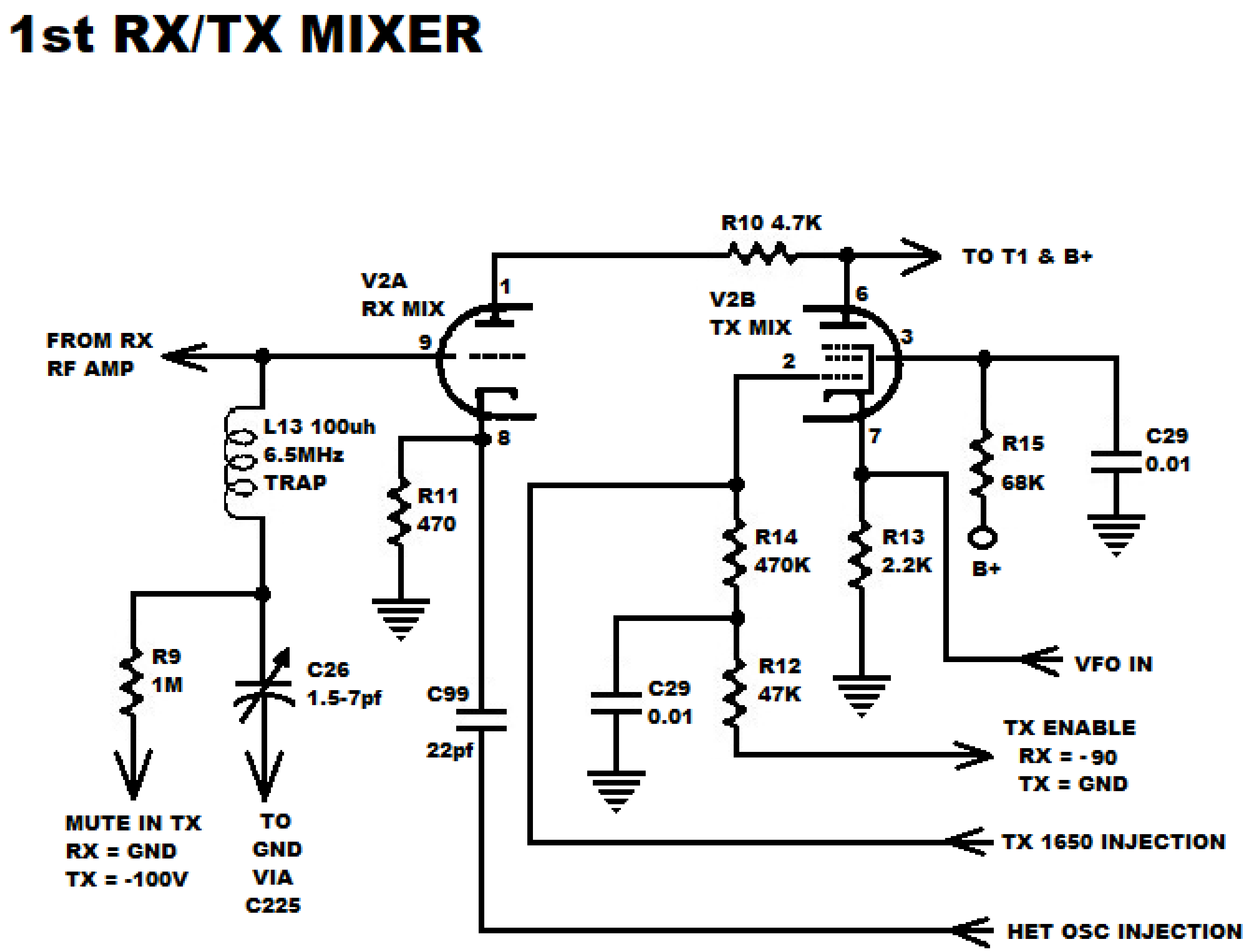
7-1 RX RF AMP



For this test terminate the antenna jack J1 with 50ohm load. Measurements will be taken with RF GAIN at minimum and at maximum.
Test unit B+ = 306.

PIN #	1	2	5	6
GAIN @ MIN	0	17.4	306	221
GAIN @ MAX	0	2.7	303	221

7-2 RX/TX FIRST MIXER

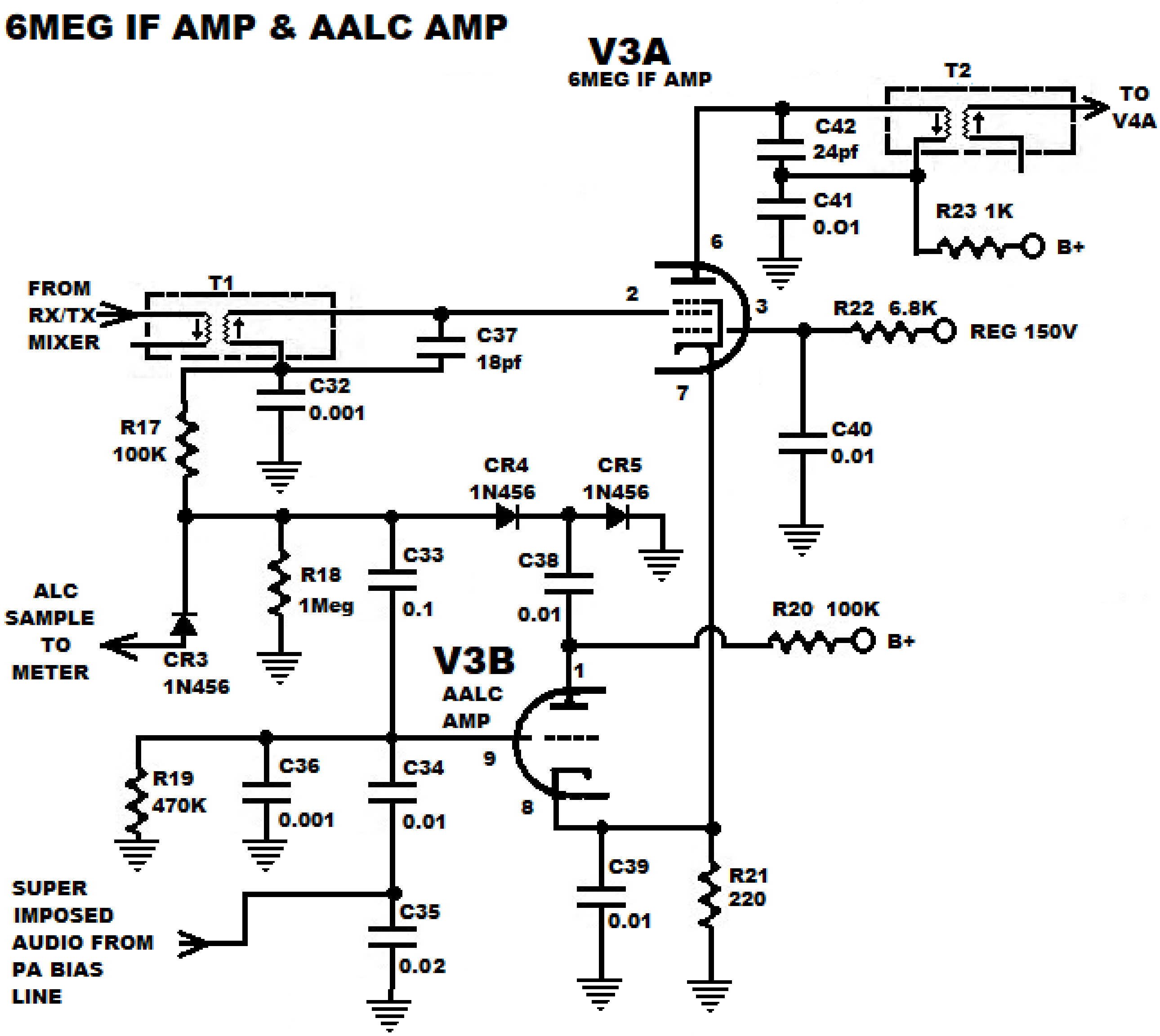


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306. TX MODE = TUNE

PIN #	1	9	8	2	3	6	7
RX MODE	236	0	4.7	-45	286	295	0
TX MODE	298	-33	-0.03	0	225	297	7.4

7-3, 6MEG IF AMP & AALC AMP

6MEG IF AMP & AALC AMP



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.
V3A 6Meg IF amp

PIN #	2	3	6	7
DC VOLTAGE	-0.1	141	298	2.3

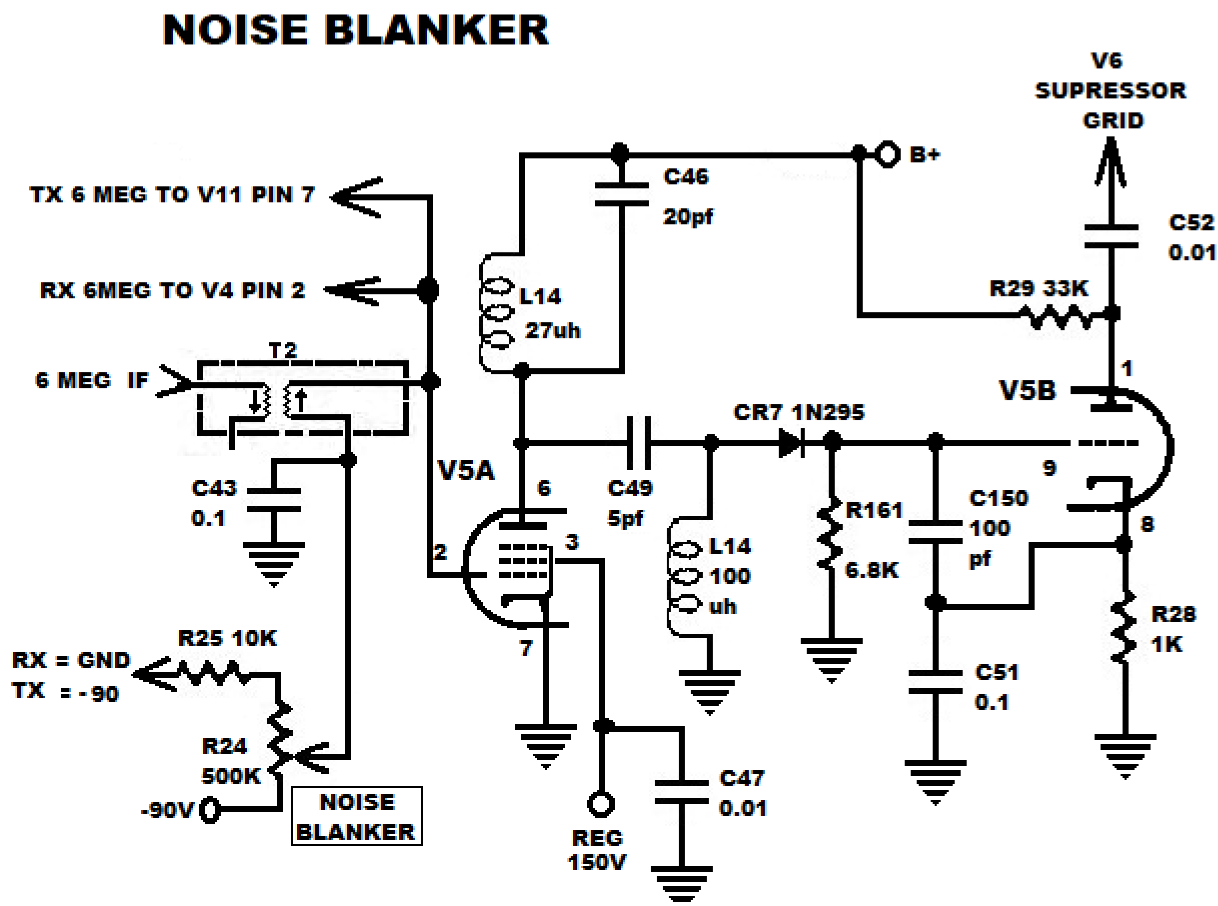
7-3-1, V3B AALC AMP DISCUSSION

PIN #	1	8	9
DC VOLTAGE	107	2.3	0

V3B AALC FUNCTIONS
The Amplified Automatic Level Control circuits are a transmitter function. When transmitting an SSB signal, if the linear PA is overdriven flat-topping occurs. When flat-toping occurs, an audio signal is superimposed on the grid bias line. This is an effect of the grids starting to draw current. The goal is to drive the linear amp right to and slightly beyond the point of drawing grid current. See section 5-6-D in the factory manual for proper setting of AALC operation. The AALC function has a limited range of operation so, one should monitor the AALC function via the front panel meter until a feel for proper has been achieved.

AALC action is a single sideband function. When driven to peak levels, control grid current begins to flow in the final amp tubes. The grid current pulses generate a small audio signal which is sampled and directed to the AALC circuits. The signal voltage is amplified to useable levels by the AALC amp V3B and then rectified by diodesCR4 and CR5 to become a varying dc bias voltage that is proportional to the level of the overdrive condition. This bias voltage is then fed to the 6meg IF amp V3A grid to reduce the stage gain as the AALC bias voltage increase. A sample of the control voltage is passed to the meter amp V8B grid to actuate the meter as an indication of the level of AALC action, when the meter switch is set to the AALC position. When the mic gain is properly adjusted the AALV voltage acts like a transmitter AGC on the if amp in the transmit mode to reduce the distortion and spurs that accompany flat-topping.

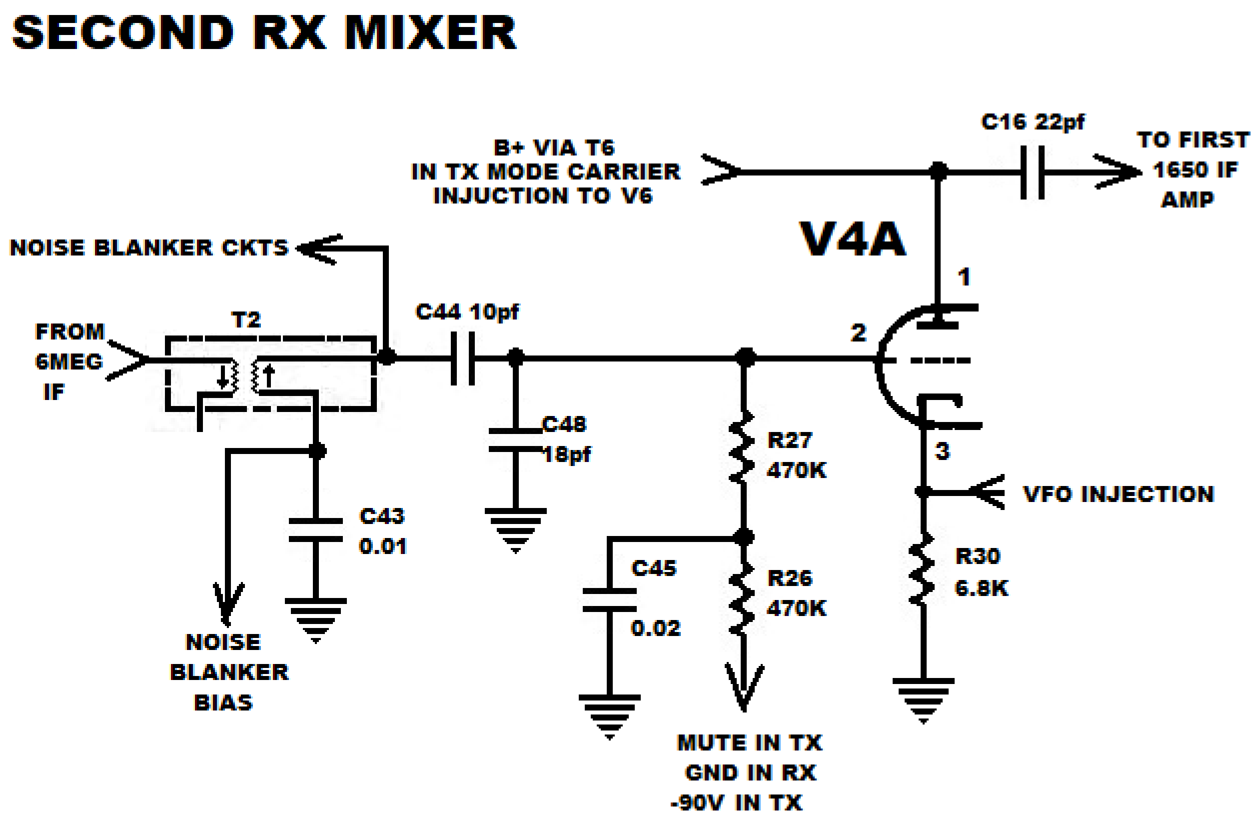
7-4 NOISE BLANKER



These tests are done with all gain and drive controls set to minimum, in RX mode.
Test unit B+ = 306.

PIN #	1	2	3	6	8	9
R24 @ MIN	175	-90	150	306	4.1	0
R24 @ MAX	172	-2.0	150	306	4.1	0.6

7-5 SECOND RX MIXER



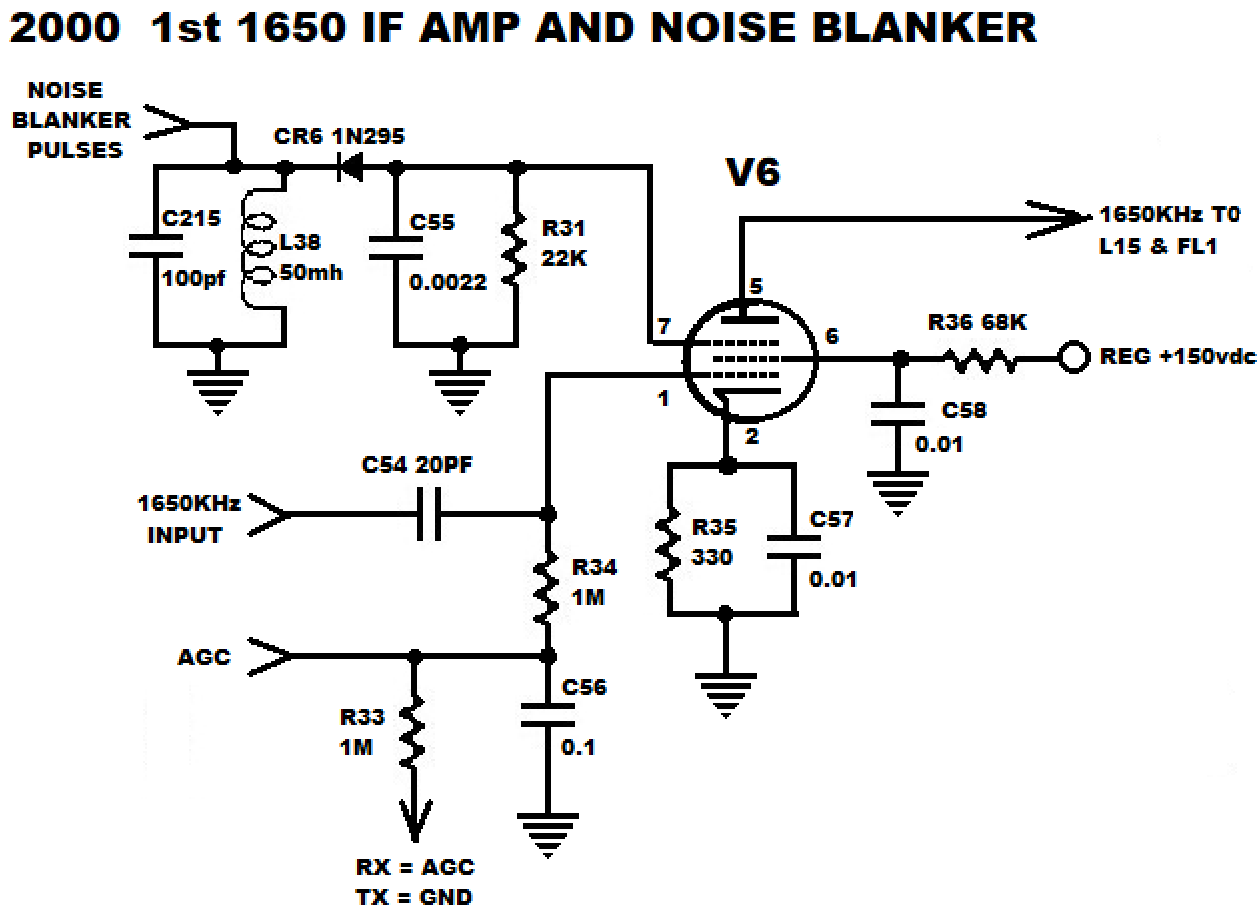
These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.

PIN #	1	2	3
RX MODE	306	0	5.9
TX MODE	304	-43.9	0

PIN #	3
VFO INJECTION	1.2vpp

NOTE: In transmit mode C16 passes carrier signal to V6.

7-6, FIRST 1650 IF AMP & BLANKER

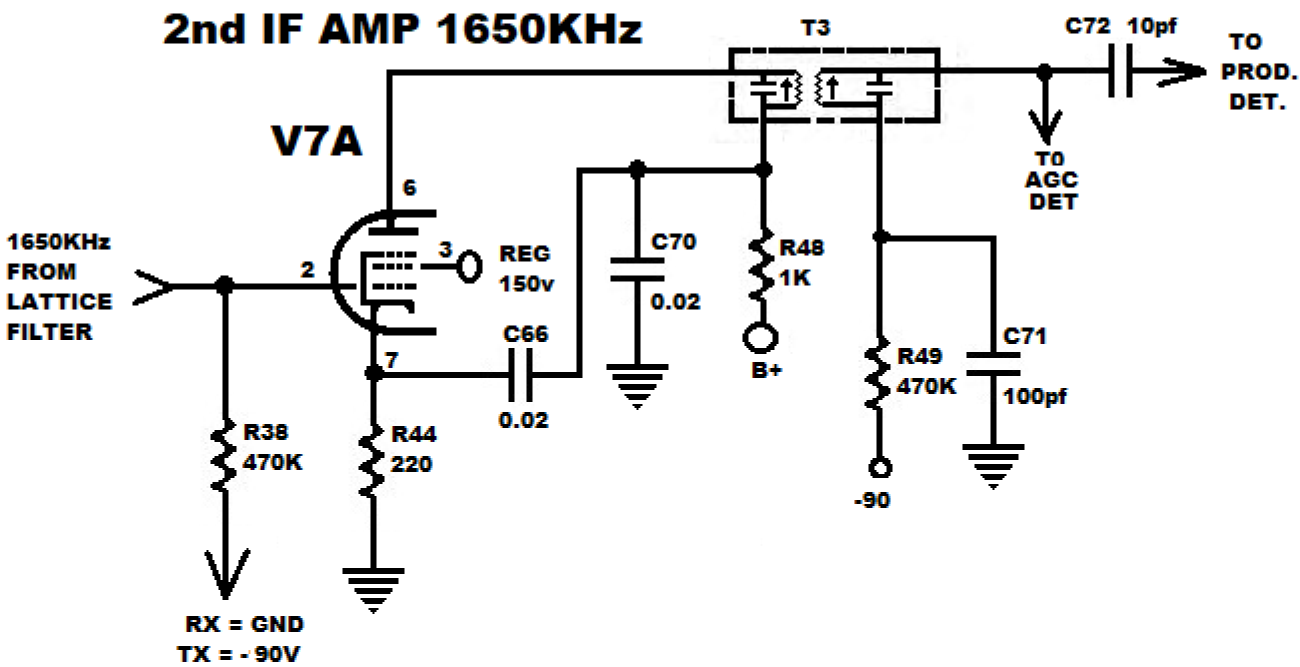


***Early production runs, pin 6 of V6 is connected directly to B+. If R36 is missing it is highly recommended to install it and connect it to the regulated 150v line.**

This test is conducted with no signal in and the gain controls set to minimum. Voltages will be measured in RX mode and TX TUNE mode. Ensure the drive to the transmitter is set to minimum.
Test unit B+ = 306.

PIN #	1	2	5	6	7
VOLTAGE	0.2	1.2	302	*52	-0.003

7-7, SECOND 1650 IF AMP

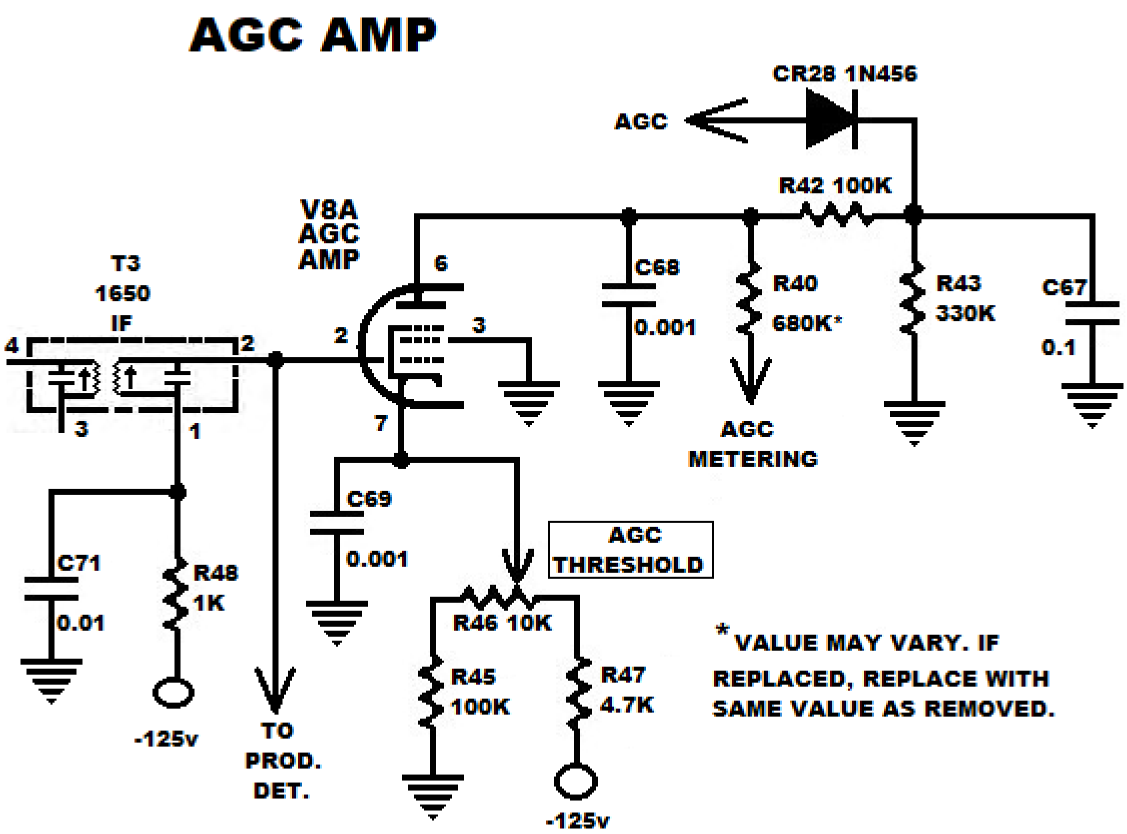


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.

PIN #	2	3	6	7
RX MODE	0	150	293	2.47
TX MODE	-57	150	297	0

7-8, AGC AMP AND DETECTOR

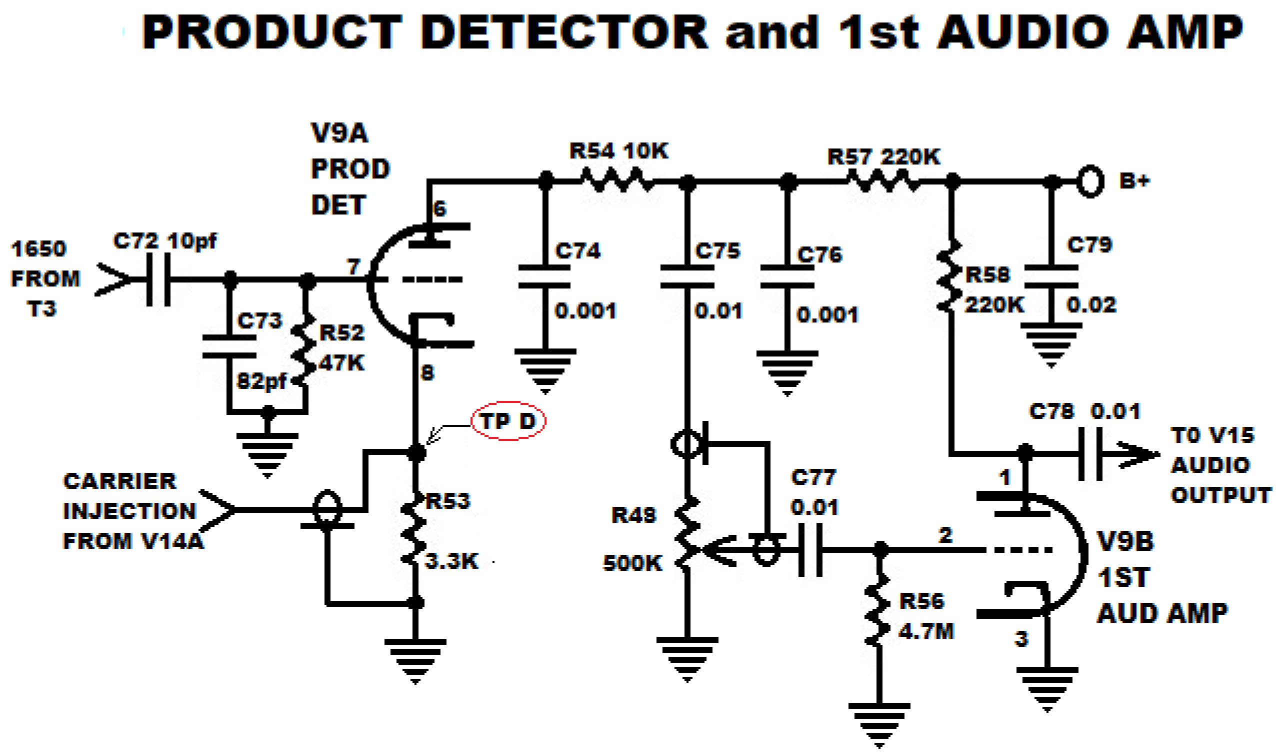
AGC AMP



These tests are done with all gain and drive controls set to minimum. Measurements will be taken with AGC THRESHOLD set at min and max. No signal in , set AGC THRESHOLD for Ø s-units.
Test unit B+ = 306.

Pin #	2	6	7
MEASUREMENT	-53	0	-88

7-9, PRODUCT DETECTOR & FIRST AUDIO AMP



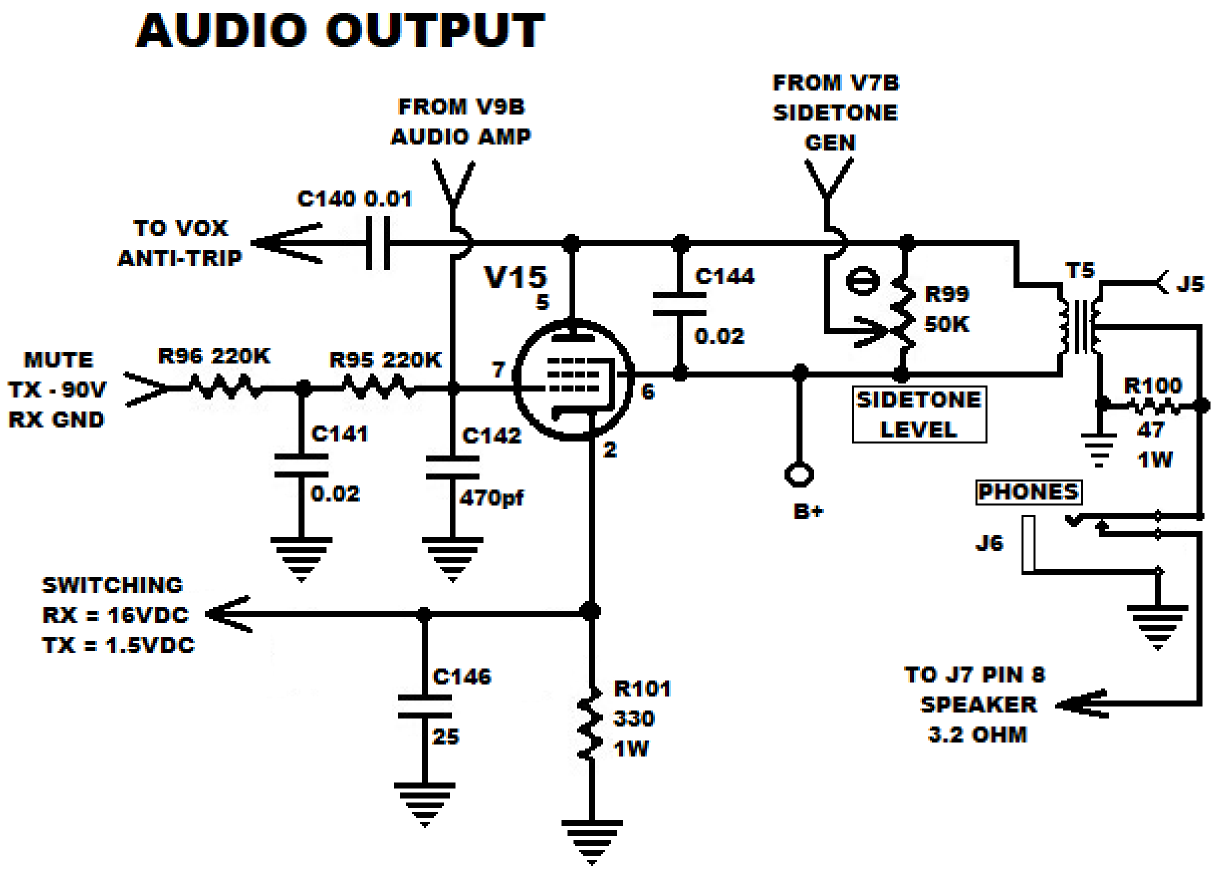
These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.

CARRIER INJECTION	TP D
PEAK TO PEAK VOLTAGE	8.2

PIN #	1	2	6	7	8
VOLTAGE	57	-0.45	88	-0.06	*4.0

- Use RF blocking probe

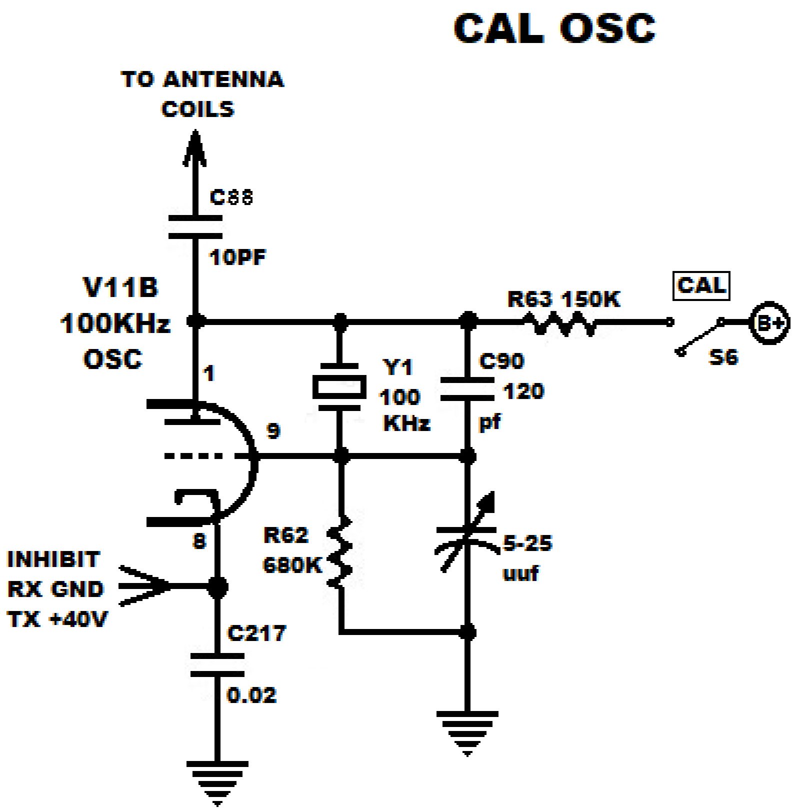
7-10, AUDIO OUTPUT



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.

PIN #	2	5	6	7
RX MODE	16.8	296	306	0
TX MODE	1.28	306	304	-57

7-11, CAL OSC



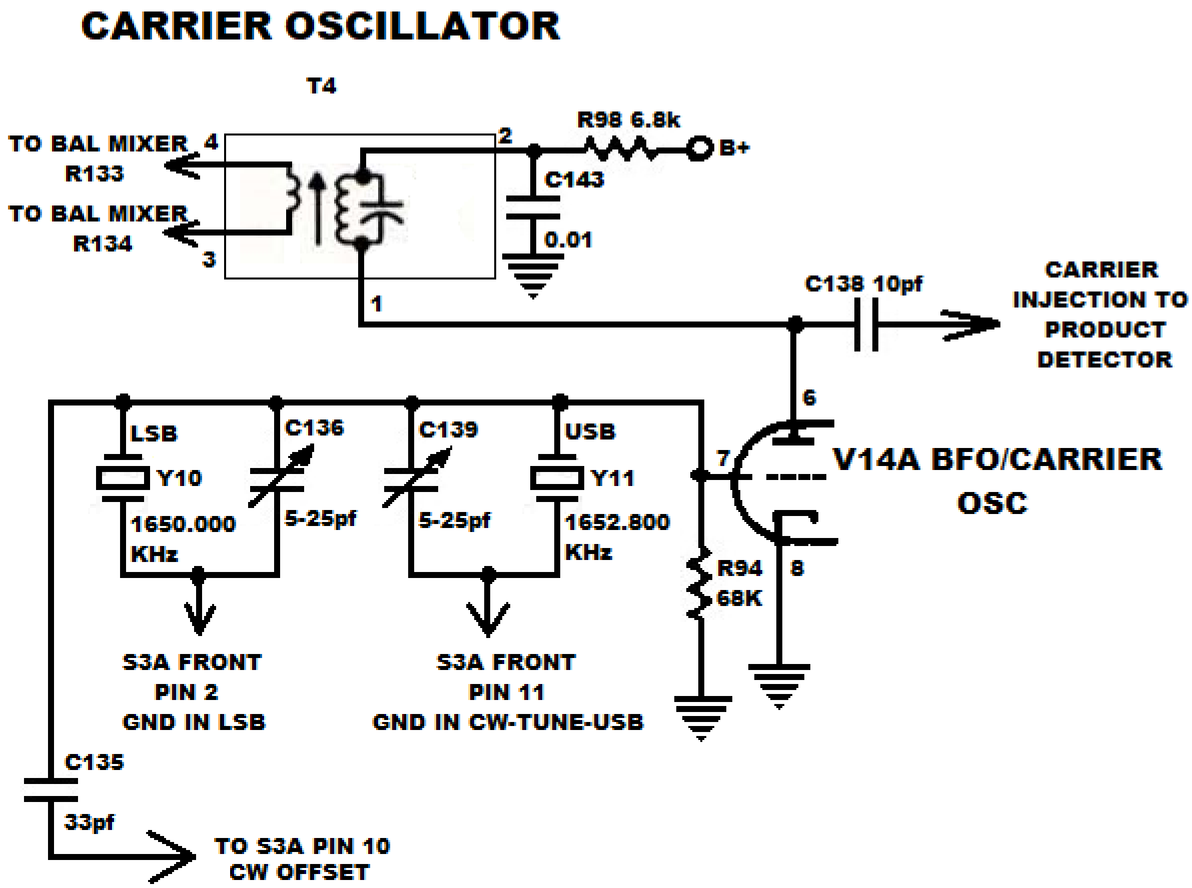
NOTE: This schematic represents production run-3 and higher units. See schematic# 155-00348C. These changes; 1, make the oscillator more stable. 2, If the cal osc is mistakenly left on during transmit mode serious spurs are generated. An inhibit signal is introduced to pin 8 during tx mode.

These tests are done with all gain and drive controls set to minimum. Use RF blocking probe.
Test unit B+ = 306.

Pull the CAL control to the on position.

PIN #	1	2	3
VOLTAGE	70	-47	0

7-12, CARRIER OSCILLATOR

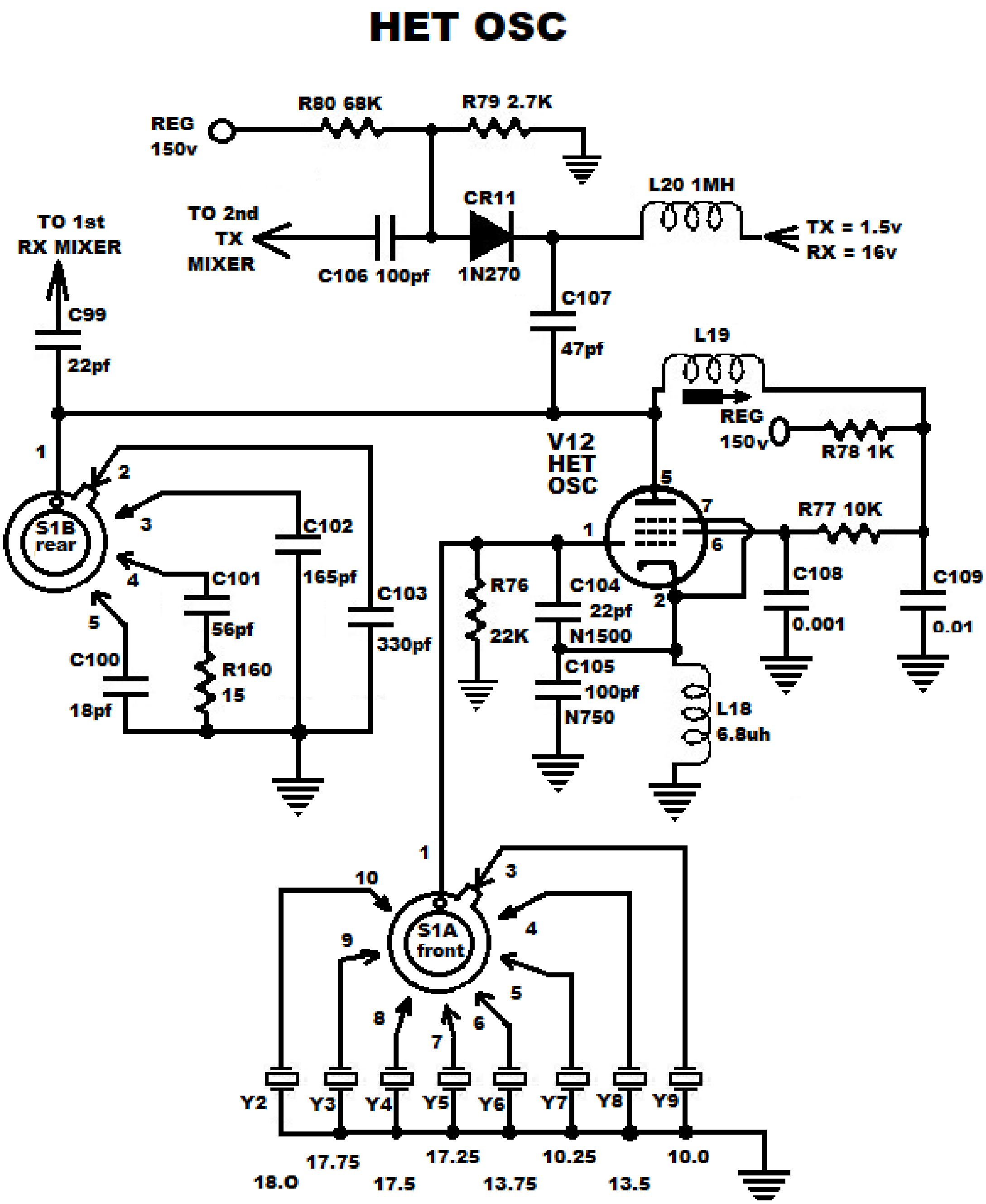


These tests are done with all gain and drive controls set to minimum, MOX, LSB.
Test unit B+ = 306.

PIN #	6	7
VOLTAGE	230	-4.8

NOTE: Use an RF blocking probe for these measurements. Voltage on pin 7 will vary due to the activity of the xtals.

7-13, HET OSCILLATOR

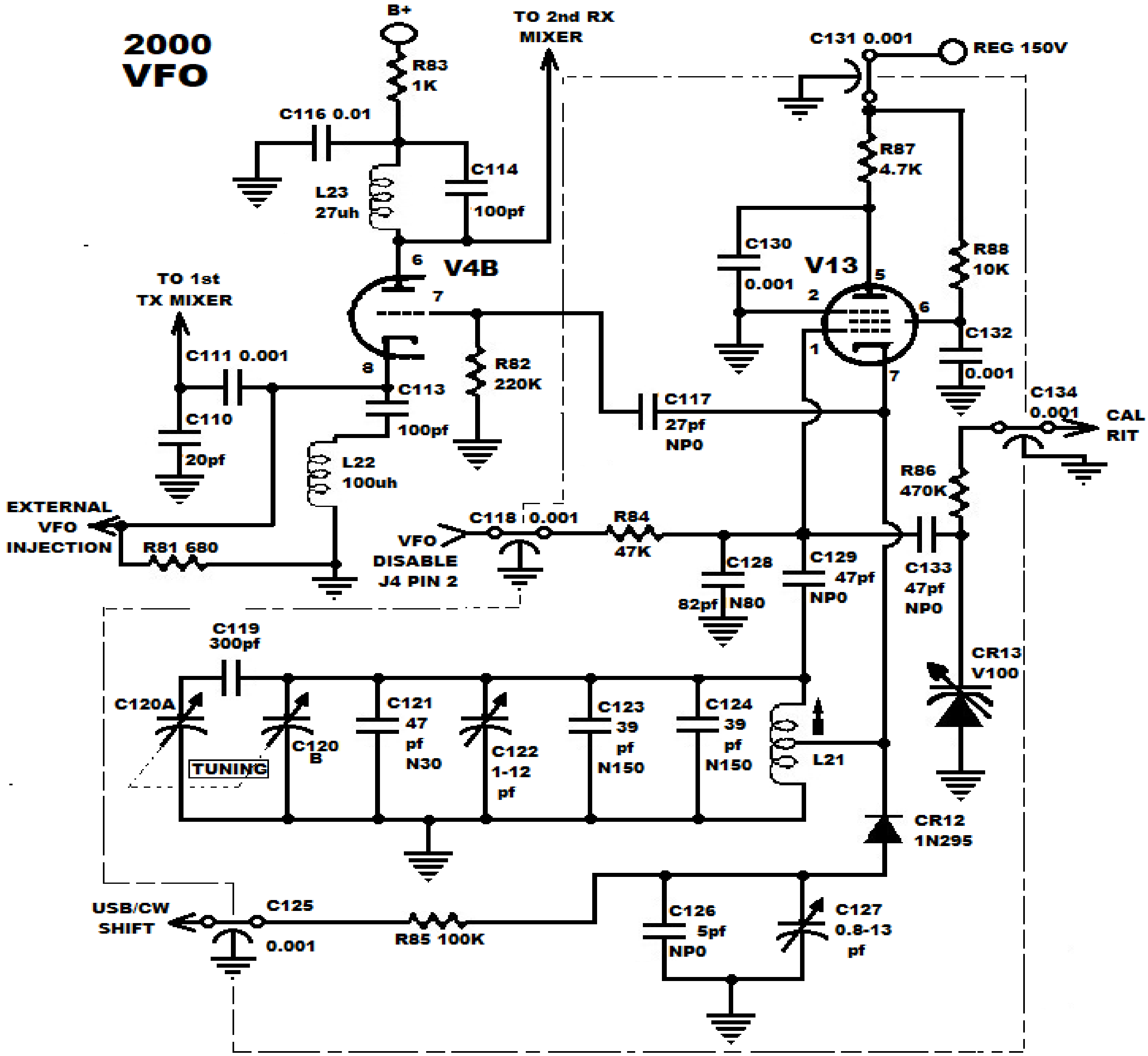


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = _______.

PIN #	1	2	5	6
VOLTAGE	-7.11	0	149	110

NOTE: Use RF blocking probe to take measurements.

7-14, VFO

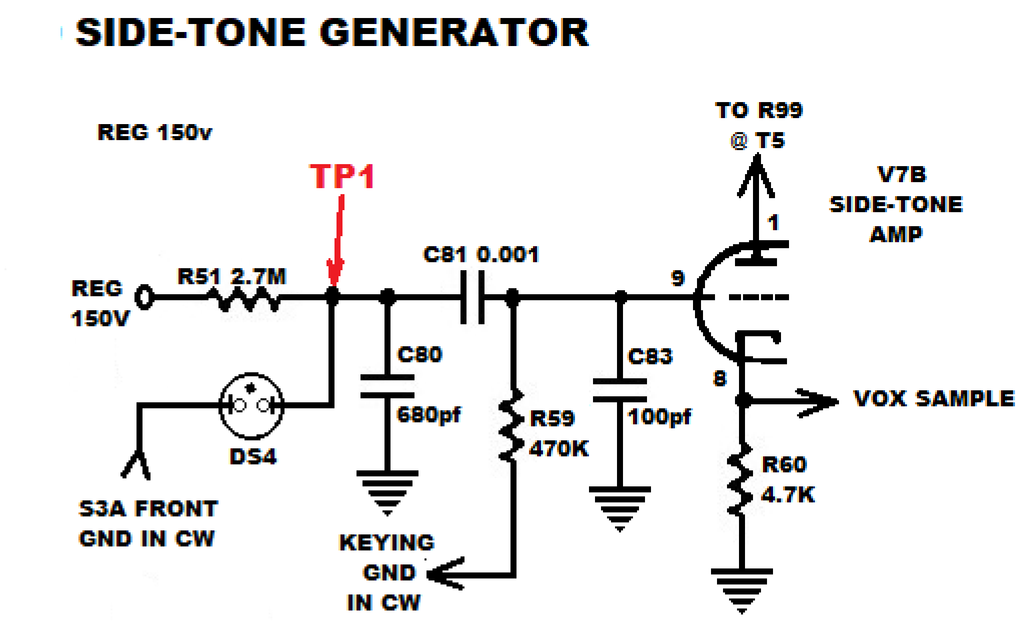


These tests are done with all gain and drive controls set to minimum, in RX mode. Use the RF blocking probe. Test unit B+ = 306.

V4B	6	7	8
VOLTAGE	299	0	0

V13	1	5	6	7
VOLTAGE	-3	105	113	0

7-15, SIDE TONE GENERATOR



In cw mode, R51, ds4 and C80 form saw-tooth generator. When keyed V7A is turned on and the saw-tooth signal is amplified and passed to the audio output transformer T5 via R99. A sample of the sidetone signal is fed to the mic audio/vox circuitry to enable the CW/VOX mode.

These tests are done with all gain and drive controls set to minimum, function CW, operation MOX with a key plugged into KEY jack in the rear.
Test unit B+ = 306

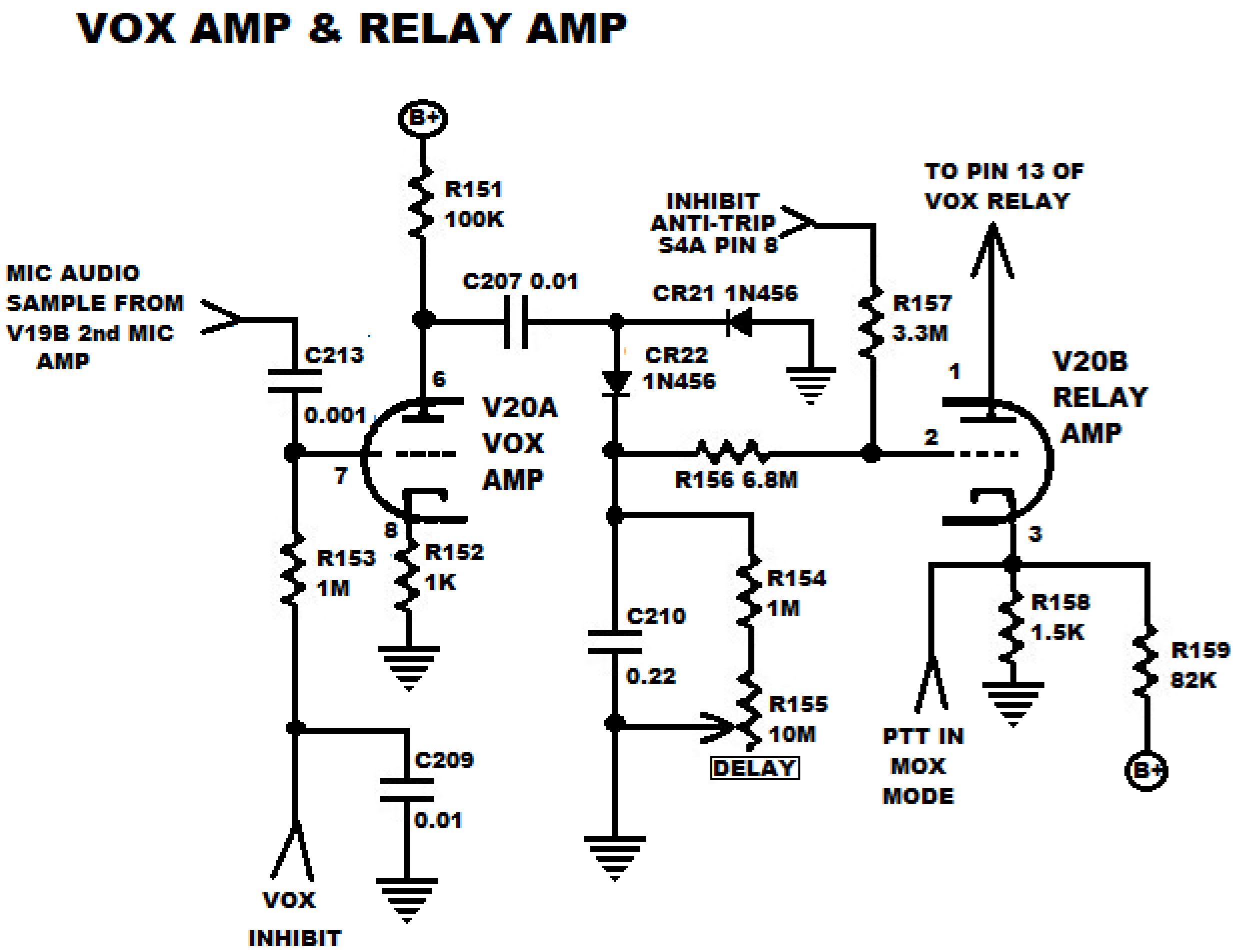
PIN #	1	8	9
KEY UP	291	0	-43
KEY DOWN	300	17	O

Test point 1 will be a sawtooth signal.

PEAK TO PEAK	25vpp

When the function is switched to USB or LSB the signal will flat-line.

7-16, VOX AND RELAY AMPS



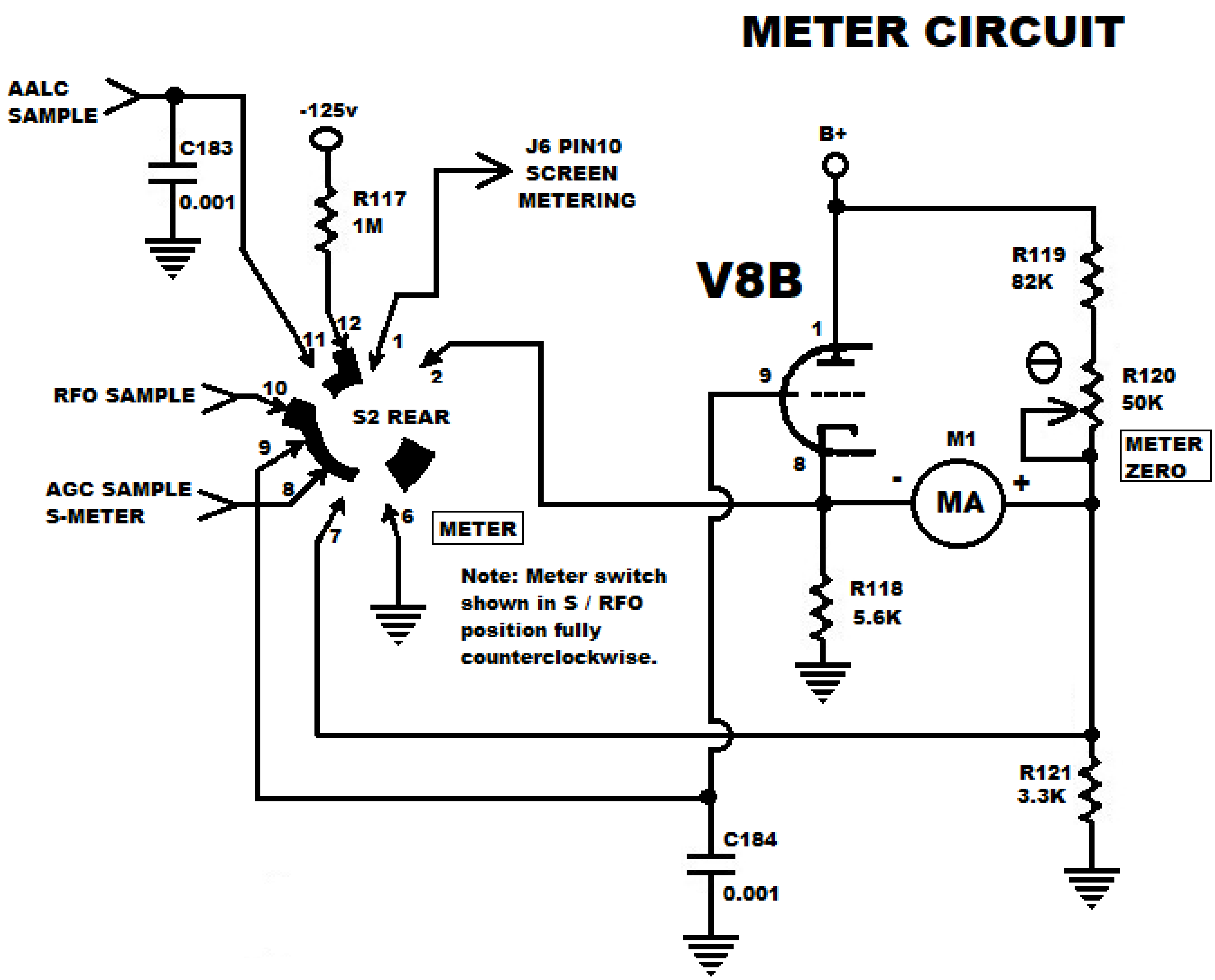
This test is done with all gain and drive controls set to minimum, in RX mode.
Test unit B+ = 306.

V20A	6	7	8
MOX	274	-28	0
VOX	110	0	2.0

This test is done in MOX

V20B	1	2	3
RX USB	292	0	6.2
TUNE MODE	176	-0.1	0

7-17, METER CIRCUIT

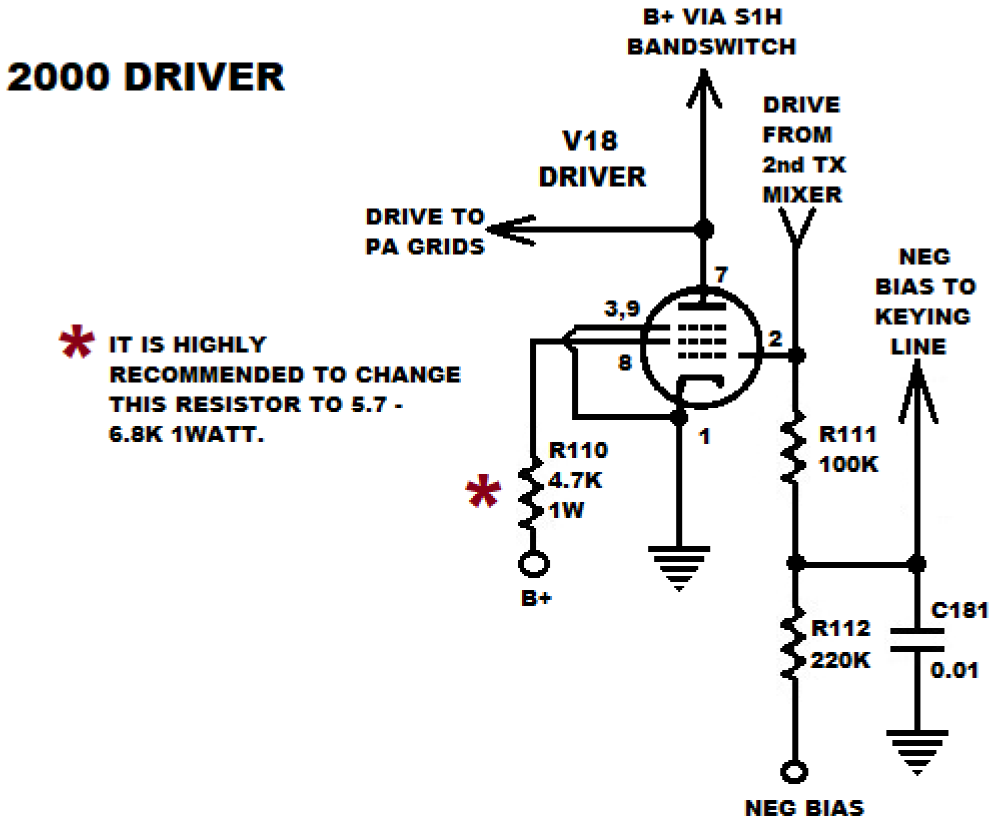


These tests are done with all gain and drive controls set to minimum. Set the meter switch to the S/RFO position.

Test unit B+ = 306.

PIN #	1	8	9
METER ZERO AT MIN	306	10.12	-0.01

7-18, DRIVER

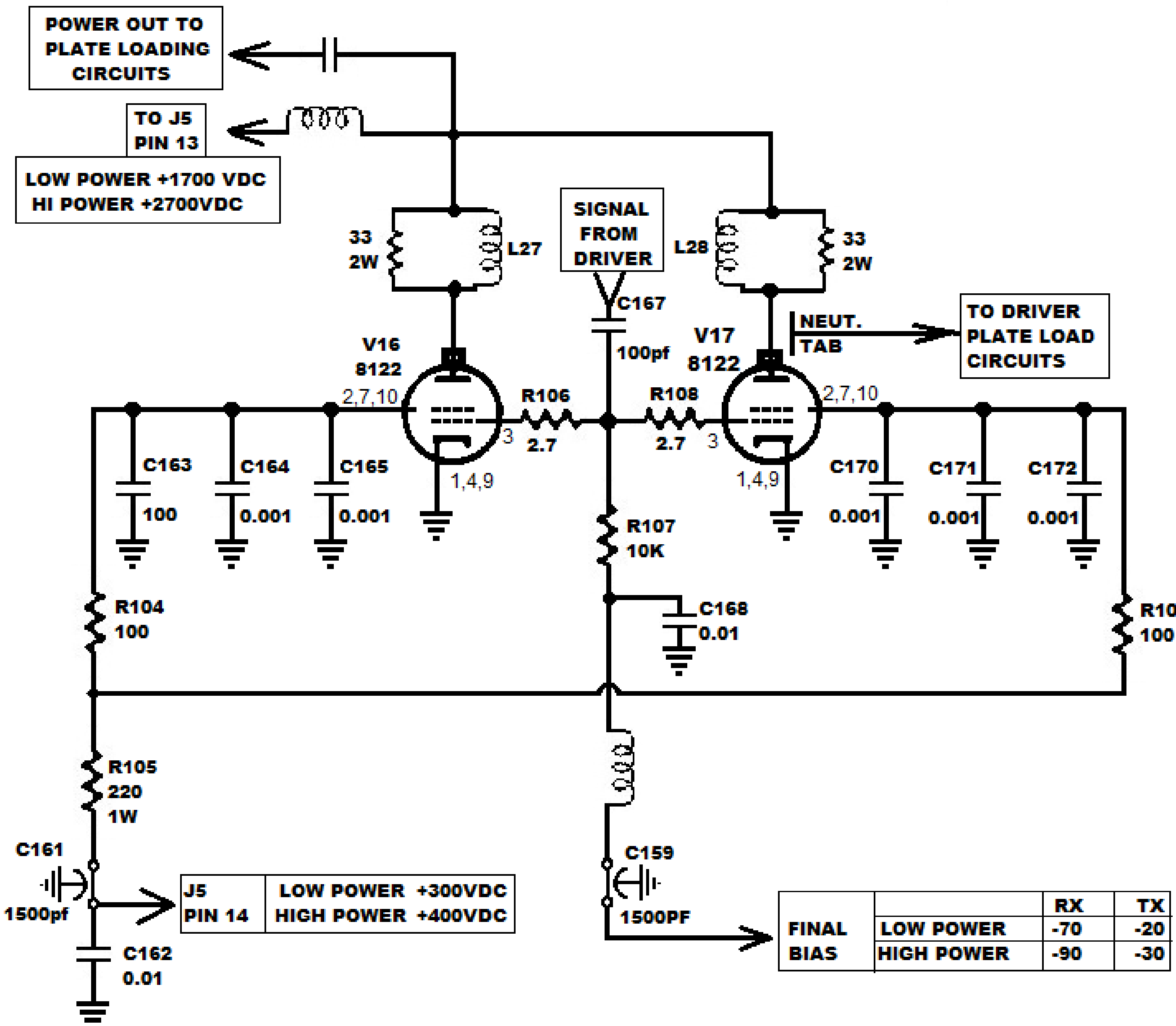


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 306.

PIN#	2	7	8
RX MODE	-69	306	306
TX MODE	-4.0	301	251

7-19 P.A.

2000 PA



8. TECH NOTES

8-1 PA NEUTRALIZATION

Proper neutralization will enhance the proper operation, efficiency and life of your final tubes. Theory and opinions on the effects of interelectrode capacitance are as numerous as the writers of such articles. So, to be very basic, we are attempting to neutralize the effects of the interelectrode capacitance of the PA final tubes.

HERE ARE A FEW SITES THAT HAVE DISCUSSIONS ON NEUTRALIZATION.
http://www.somis.org/
http://www.vias.org/basicradio/basic_radio_28_04.html
http://www.w8ji.com/neutralizing__amplifier.htm
http://www.kk5dr.com/Tuneup.htm

The neutralization process in the book is ok, but not very precise. It will work, but I prefer a more precise process. There is nothing new or revolutionary about this process. It is a proven process that has be in use for over 60 years. All I have done is specifically adapt it to the SR-2000. Before starting the process, you need to tune the TX as best as you can at 21.3 MHZ.
***NOTE* KEEP THE DRIVE LOW.**
After tuning up be careful not to move the preselector, load or plate controls throughout the rest of this process. Power down.

1, Disconnect the plate and screen voltage by disconnecting J5.

2, Connect the transmitter output to the scope or RF voltmeter. An RF sampling 'T' should be used between the TX output and dummy load to maintain a 50-ohm load on the TX output.

3, Turn on the rig and let it heat up for at least 20 minutes.

4, In the CW position key the TX.

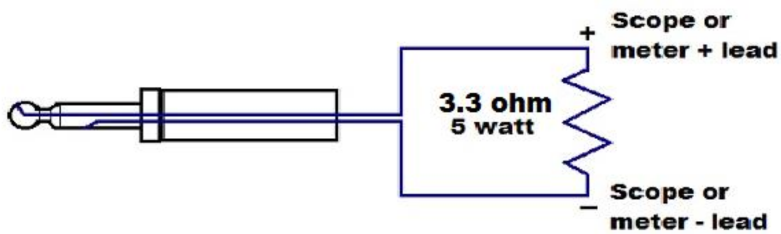
5, Advance the RF LEVEL control until you get about 1 vpp on the scope or meter.

6, With a nonmetallic tuning wand inserted through a hole in the PA cover adjust the spacing of the neutralizing tab located adjacent to V16 for a minimum signal on the scope or meter. A bamboo kabob skewer works well for me. Adjust the scope sensitivity and RF LEVEL controls to maintain a good presentation of the minimum point. Power down and let the rig cool down for an hour then power back up. After a 30-minute warmup recheck the plate current dip and the power peak again.

THIS PROCESS OF NEUTRALIZATION HAS SERVED ME WELL. THIS PROCESS CAN BE ADAPTED TO MOST ANY TRANSMITTER. THIS IS THE MOST PRECISE METHOD OF NEUTRALIZATION I HAVE FOUND. IF IT DOESN'T WORK THEN YOU HAVE SOMETHING WRONG WITHIN THE P.A.

8-2. AUDIO POWER METER SUBSTITUTE

With a phone plug and a 3.3-ohm 5-watt resistor and a scope or ac voltmeter you can substitute for the audio output meter. Or you can measure the voltage across the speaker. If you use the audio power meter or the substitute in the figure below you do not have to listen to the constant tone while testing the rig. My repair bench has a plug wired to a switch so I can select a speaker or the audio power meter. This speeds up tuning and measurement considerably.



Power = [Voltage (rms)]^2 ÷ Resistance

[Peak to Peak voltage] X [0.3535] = rms

½ watt across 3.3 ohms = 1.2845 v rms or 3.192 vpp
1 watt across 3.3 ohms = 1.8165 v rms or 5.138 vpp

8-3. P-2000 RESTORE

The P-2000 power supply for the SR-2000 transceiver is a straight forward design with no special or unusual circuits. As with all vintage power supplies for tube-based rigs all electrolytics should be replaced with modern capacitors. (Marked with a # symbol on schematic below) DO NOT USE NOS OR NIB COMPONENTS. You should search for very low ESR capacitors. By low ESR I mean 100 milliohm or less. Capacitors of 0.05 ohms or less are available and are most desirable. As a general rule I replace all the High Voltage leads internal to the power supply and rewire the high voltage pigtail from the power supply to the rig.

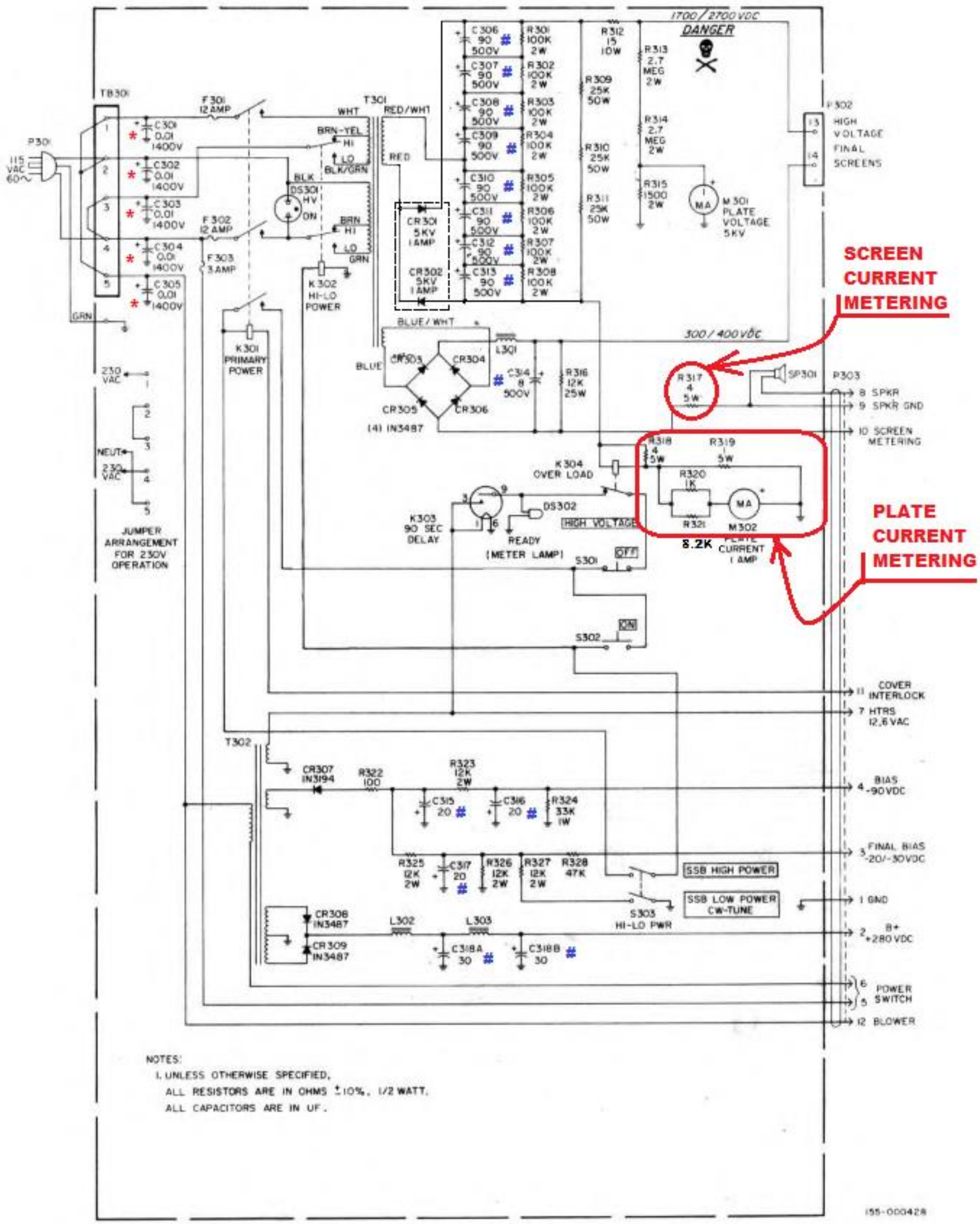
The capacitors C301 through C305 are safety capacitors. If they are replaced use X1/Y2 caps only.
(Marked with ***** on schematic.)

The high voltage plug (P302 on the high voltage pigtail) and J5 on the rear of the SR-2000 are held together by a metal screw. Both screws should be replaced with nylon screws. It is common for arc over to occur because of metal screw.

Proper tuning and operation of the SR-2000 is dependent upon accurate indications of the plate current meter. Due to the age of the rigs, errors of 50 to 150% in the meter circuits are common. It is critical that plate current metering resistors; R318, 4-ohm, 5 w; R320, 1k, 1/2w; R321, 8.2k, 1/2w and R319, 1-ohm, 5w should all be replaced with modern 2% film resistors. There is a simple test for the plate current meter circuit. With the power supply turned off and disconnected from the SR-2000 apply negative 1.5 vdc to the junction of R319, 320 and 321. The meter should read 1 amp, that is full scale. The load on the test voltage source will be 1 amp so a B cell or smaller battery will not work. A D cell battery will work for a short time. R317 the screen current metering resistor should also be checked also. The resistance from pin 9 to pin 10 of P303 should be 4.0 ohms.

K303 is a 90 second thermal delay contactor. It should be replaced with a 120 second delay (see k9axn.com for replacement part). This will save the life of the final tubes.

I made pc boards to replace capacitor mounting boards. Worked quite well and look good also.


SCREEN
CURRENT
METERING
PLATE
CURRENT
METERING
DANGER
1700/2700 VDC
300/400 VDC
HIGH VOLTAGE FINAL SCREENS
M301 PLATE VOLTAGE 5KV
8 SPKR
9 SPKR GND
10 SCREEN METERING
K304 OVER LOAD
K303 90 SEC DELAY
READY (METER LAMP)
8.2K
M302 PLATE CURRENT 1 AMP
11 COVER INTERLOCK
7 HTRS 12.6 VAC
4 BIAS -90VDC
3 FINAL BIAS -20/-30VDC
SSB HIGH POWER
SSB LOW POWER CW-TUNE
1 GND
2 B+ +280 VDC
S303 HI-LO PWR
6 POWER
5 SWITCH
12 BLOWER
JUMPER ARRANGEMENT FOR 230V OPERATION
K301 PRIMARY POWER
K302 HI-LO POWER
NOTES:
1. UNLESS OTHERWISE SPECIFIED,
ALL RESISTORS ARE IN OHMS ±10%, 1/2 WATT.
ALL CAPACITORS ARE IN UF.
155-000428

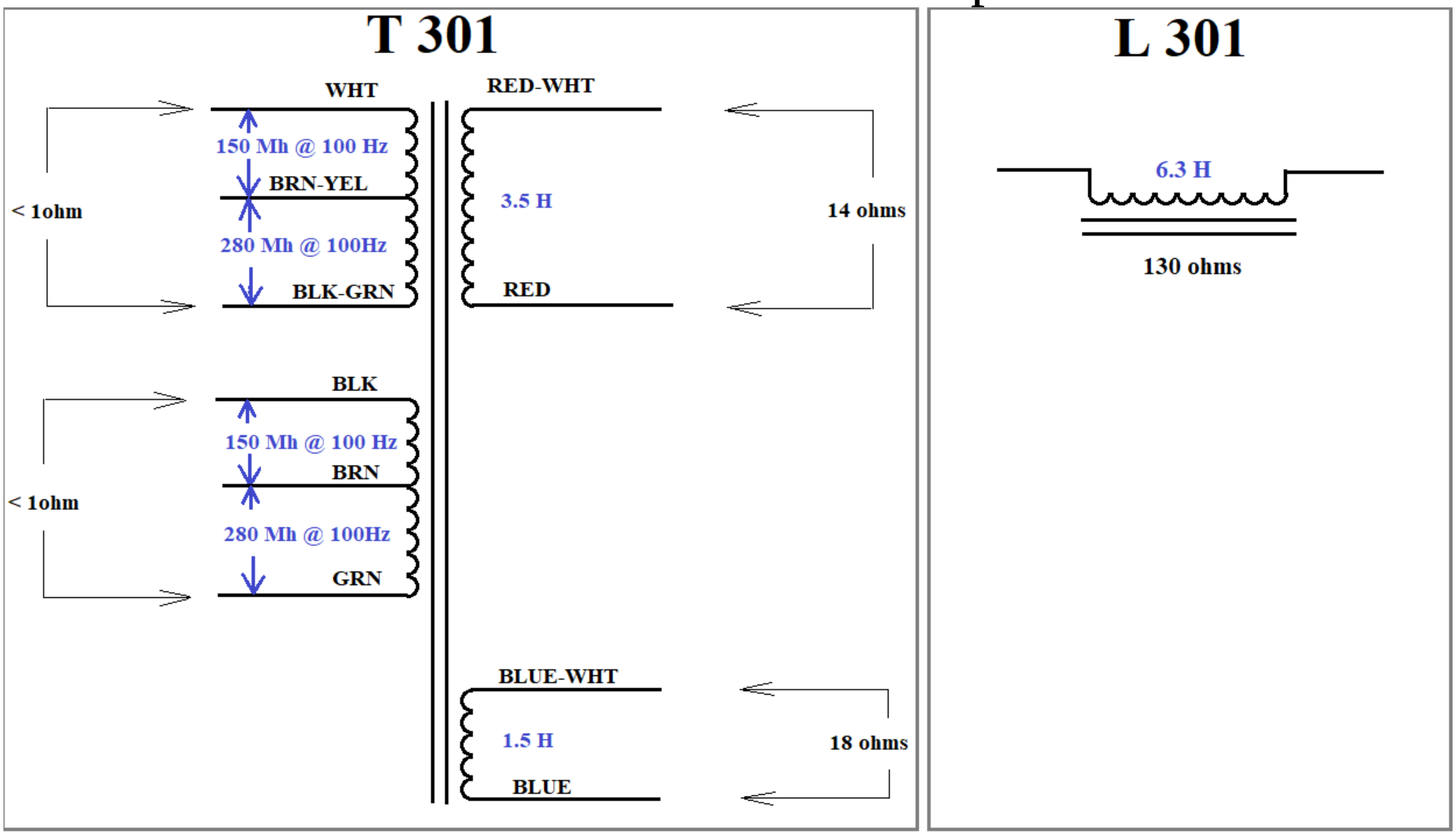
The nylon standoffs came from ACE hardware.

I had some 30/30uf @ 500vdc on hand, but they can be purchased from http://www.leedselect.com/parts-capacitors.html#electrolytic. Minor chasses mod is required.

From http://www.tubesandmore.com/
C-EC50-50-500CE CAPACITOR, ELECTROLYTIC, 50/50 µF @ 500 VDC,

From Newark Electronics, http://www.newark.com/jsp/home/homepage.jsp.
90F1427 Manufacturer Part Number : TVA1508
Description: Aluminum Electrolytic Capacitor; Capacitor Type: General Purpose; Voltage Rating:250VDC; Capacitance:20uF; Capacitor Terminals: Axial Leaded;

HV xfmr and filter choke specs



8-99. ADDITIONAL TECHNICAL INFORMATION SOURCES:

There is a wealth of technical information on the entire Hallicrafters SR series transceivers available on the WWW. Here are three of the best.

https://wd0gof.com/ This is my site.

http://k9axn.com/ : This site belongs to Jim Liles. Jim is the most knowledgeable person I know on the SR-400 and the SR-2000. If you want to make your 400 a super 400 visit Jim's site.

http://www.w9wze.net/ : This site, known as the HHI site is an open to all site. When you get to the site scroll down the left side to **Technical Info** and pick a category. I do not know what the total membership to the "reflector" is but any post to hallicrafters@mailman.qth.net will get almost immediate results.

https://groups.io/g/HallicraftersRadios : This is a member only site. It is free to join and I strongly recommend joining if you are a Hallicrafters fan. In the files section of this site is the largest collection of Hallicrafters technical information I have found anywhere. With over 1000 members any post to the group will result in expert answers to any questions but you will have to be a member to post.

9. DATA SHEETS

9-1. VFO FREQUENCY CORRECTION

BLACK DIAL	SPEC MHz	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6
0	4.851450						
100	4.751450						
200	4.651450						
300	4.551450						
400	4.451450						
500	4.351450						

9.2 PERFORMANCE DATA

9-2-1. RECEIVER PERFORMANCE DATA

OWNER

SERIAL #

DATE

Overall Sensitivity (gain)
The receiver will produce a minimum of 500 mw audio out with 1 uv RF signal at the antenna terminal. Tests performed at center of General Class bands

BAND	TEST FREQ	SIG REQ FOR 500mw
80		
40		
20		
15		
*10 opt 1		
10 std		
*10 opt 2		
*10 opt 3		

* Tests performed only if options are installed.

Overall Sensitivity (S+N:N)
A 1.0uv signal at the antenna terminal will produce a minimum 20db s+n:n.

BAND	TEST FREQ	SIGNAL LEVEL	S+N:N MEASURED
80			
40			
20			
15			
*10 opt 1			
10 std			
*10 opt 2			
*10 opt 3			

* Tests performed only if options are installed.

AGC Figure of merit
With a signal at the antenna terminal from 1uv to +60db no more than a 10 db variation shall occur.

MEASURED CHANGE	

“S” METER CAL
The S meter will read S-9 when between 25 and 100uv are injected at the antenna terminal.

LEVEL FOR S-9	

9-2-2. TRANSMITTER PERFORMANCE

Tests performed with 50ohm resistive load. Measurements made with BIRD avg power and PEP power meter.

Final amplifier bias set to 200 ma SSB mode zero drive. __________

Neutralization performed @ 21.3 MHZ. ________

Carrier balance null _____ db below full power output level (60 db or more).

Microphone input sensitivity at 1000HZ. A signal level not more than 5mv rms shall produce the minimum specified SSB output at specified freq. Mic gain set at max clockwise

FREQ	MIN SPEC low power	PEP LOW	MIN SPEC High power	PEP HIGH	Mic input level 5mv max
3.8mhz	500 watts		950 watts		
7.3mhz	450 watts		850 watts		
14.3mhz	450 watts		850 watts		
21.3mhz	450 watts		850 watts		
28.8mhz	400 watts		750 watts		

*Avg RF power output with 1KHZ @ 5mv at mic input jack measured with Bird or equivalent

CW power output with RF level set just to saturation level.

FREQ	MIN SPEC	AVG POWER
3.8mhz	400 watts	
7.3mhz	400 watts	
14.3mhz	400 watts	
21.3mhz	400 watts	
28.8mhz	400 watts	

SSB TX AUDIO RESPONSE.
From 500 Hz thru 2400 Hz no more than 6 db change in output power. _______
If multiple peaks occur within the pass band there will be no more than 2db from the peak to valley. ________