hallicrafters

REPAIR MANUAL

COMMUNICATIONS

HF TRANSCEIVER
MODEL
SR-400 SERIES

WDØGOF Walt Cates V4.0 7/7/24

NOTES

REPAIR & RESTORATION

OF

HALLICRAFTERS SR-400 SERIES CYCLONE TRANSCEIVERS

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 does. This document applies to the Cyclone, Cyclone II and Cyclone III. The data and schematics presented here illustrate mostly the Cyclone II and the Cyclone III but, also apply to the Cyclone. The first generation 400 (Cyclone) had many things not quite correct. Mr. Orwin (Hallicrafters engineer) fixed those when he designed the Cyclone II. The best advice I can offer to owners of the original SR-400 is to upgrade it to the Cyclone II level. A document for upgrading a Cyclone to the Cyclone II is available. It can be downloaded at https://wd0gof.com/hallicrafters-radio/technical-discussions/sr-400/. Just to clear the air I am not a fan of the Cyclone III either. I use my Cyclone II.

This document takes a systematic approach to rehab. It is designed to be used in conjunction with the original equipment manual. In all discussions the word ***manual*** refers to:

OPERATING AND
SERVICE INSTRUCTIONS
FOR
COMMUNICATIONS
TRANSCEIVER
MODEL SR-400(X)

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 on 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.

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1. SR-400 INITIAL INSPECTION AND TESTING.

SO, YOU JUST GOT AN SR-400 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-400. 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 60 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 factory 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.

1-2. RECAPPING;

There are only six capacitors that are considered ***must replace*** components. They are: C70 and C218, 5 uf/25v; C146, 25 uf/25v; C147, 2 X 30 uf/350v; C240, 175 uf/25v and C244, 500 uf/6v. C240 and C244 are found only in the SR-400A. 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.

1-3. AFTER MARKET MODIFICATIONS

If you find any modifications, re-wirings or added components remove them and return the rig to the original configuration. For valid circuit modifications see k9axn in section 5-4.

1-4. INITIAL POWER UP

Note: When bench testing the SR-400 set the antenna switch (S2) to SEPARATE. Connect the load and wattmeter to ANTENNA (J1 or J2). Connect the signal generator to REC ONLY (J3). This will eliminate the possibility of transmitting into the signal generator. It will also speed up the transition from RX to TX while testing.

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 (See https://wd0gof.files.wordpress.com/2018/12/PS500-SPECA.pdf for power supply test specifications).
You will not be transmitting power until late in this process so temporarily replace the 5-amp slo-blow fuse with a 4-amp normal delay fuse. 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-400. 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-400 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, NOTCH pressed in and *fully counterclockwise*. Preset the PRESELECTOR to the approximate position in the band you will be operating, set the LOAD and PLATE tuning to the appropriate settings corresponding to the chart in the original manual (the chart is in section 5). Set the FUNCTION switch to either USB or LSB depending upon which band you will be testing the default is LSB. Ensure that a jumper plug is installed in J4 on the rear of the radio. The jumper plug should have a jumper between pins 2 and 10.

1-4-3. INITIAL POWER UP TESTS

Ok it is time to apply power. **It is assumed that you have a fully recapped power supply that meets all specifications.** Attach the power supply and plug it in. Set the operation switch to REC ONLY. If it blows the fuse, you most likely have a short in the hi-voltage or the B+ locate the fault and repair before continuing. Now let it sit there for 10 to 15 minutes. Locate R50, 2000-ohm, 10-watt resistor connected to V10. The voltage at one end should 150vdc and 250 – 280vdc at the other if not; you have a fault in the wiring or the 150v regulator. This fault must be cleared before you proceed. Otherwise, the only thing we need to do at this time is rough set the bias voltage. Some models of the PS-500 power supplies have a bias control on the rear of the chassis. If yours has the bias control pot, proceed to **A** below. If it does not, go to **B**.

A. On the underside of the Final tubes locate the grid side of R107 (100k). This is where we will measure the bias voltage in the *receive mode*. Set your meter on the 200vdc range. Now adjust the bias adjust control on the power supply for maximum negative voltage. Continue to step **B**.

B. Turn the power off; plug your meter into the red (+) and blue (-) test jacks on the power supply. Set the meter on the 2vdc range. Set the function switch to LSB, connect a mic, and set the RF GAIN and MIC GAIN to **minimum**. Turn the power back on. Let it warm up. Set the OPERATION switch to MOX. Key the mic. Adjust the BIAS ADJ control on the front panel for 0.7 vdc on the test meter. If you cannot adjust it or it is very high then you have a problem in the final PA or bias divider and this must be corrected before you proceed **(GO TO section 3-3-1 for bias checks when fault is corrected return to section 1-5)**. If all is well with the bias you are now ready to proceed to the CHECK AND ADJUSTMENT OF OSCILLATORS section.

1-5. 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.

1-5-1 TEST EQUIPMENT REQUIRED

Oscilloscope, 100MHz bandwidth and two probes, Frequency counter.

1-5-2. CARRIER OSCILLATOR:

The carrier oscillator is comprised of V14A and its associated circuitry. First thing is to check 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. 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. Switch back and forth from USB to LSB to insure both oscillators start without any hesitation. In USB mode adjust C139 for exactly 1652.800 KHz. Switch to LSB mode and adjust C136 for exactly 1650.000 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 ensure that everything is stable and there is no hesitation in the oscillator startup. More information on the carrier oscillator is found in section 6-13.

1-5-3. 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. If the output does not meet these minimums this fault **must** be cleared before proceeding. (SEE 1-5-3-1)

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. With the four 10-meter xtals you are pretty much stuck with where ever they are unless you have a bag of xtals to swap. For the 80, 40, 20- and 15-meter bands, each band has a loading cap (C103, C102, C101 and C100 respectively). These loading caps can be swapped out to pull individual xtals on to frequency. 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 use of the CAL ADJ and RIT CONTROL adjustments will be discussed later to compensate for errors in the het osc. More information on the Het oscillator is found in section 6-14

1-5-3-1. LOW HET OSC OUTPUT ON HIGH BANDS.

While monitoring the voltage on V2 pin 8, select the 40m band and adjust L19 for maximum peak to peak voltage on the scope. If that does not clear the fault, try several 7056 tubes. If that fails to clear the fault you most likely have a capacitor or resistor that has drifted out of tolerance.

1-5-4. VFO:

The VFO is comprised of V13, V4B and associated circuitry, the VFO correction circuitry and the RIT/CAL circuitry. This VFO is an extremely stable design. It does not need to be "redesigned" or modified to maintain stability. If there are stability problems there is a bad part. In the following procedures we will find that bad part.

From the manual:

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

1-5-4-1. RIT/CAL ADJUSTMENT

The RIT/CAL ckts are used to change the bias voltage on a varicap in the VFO. This is used to make minor corrections to the VFO 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 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 ccw and note the counter reading. Rotate the CAL max cw and note the counter reading. The difference from ccw to cc rotation should be minimum 4 KHz; most rigs will run approximately 6 KHz. Readjust the CAL pot for 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.

1-5-4-1-1 RIT/CAL OPERATION

Start with RIT off.
Tune the VFO to the nearest 25KHz to the frequency you intend to operate at.
(For the Cyclone and the Cyclone II tune to the nearest 100KHz point on the dial)
Pull the CAL switch on.
Adjust the CAL ADJ for zero beat.
Switch to RIT.
Adjust RIT CONTROL for zero beat.
Switch the RIT on and off to insure the zero beat notes match.
Return the RIT switch to the ON position and you are ready to operate.
The RIT control will now control only the receiver.
Switch to desired operational mode and communicate with the world.

All of this assumes that your oscillators are on frequency and the station you contact is also dead-on frequency.

1-5-4-2. VFO CORRECTOR

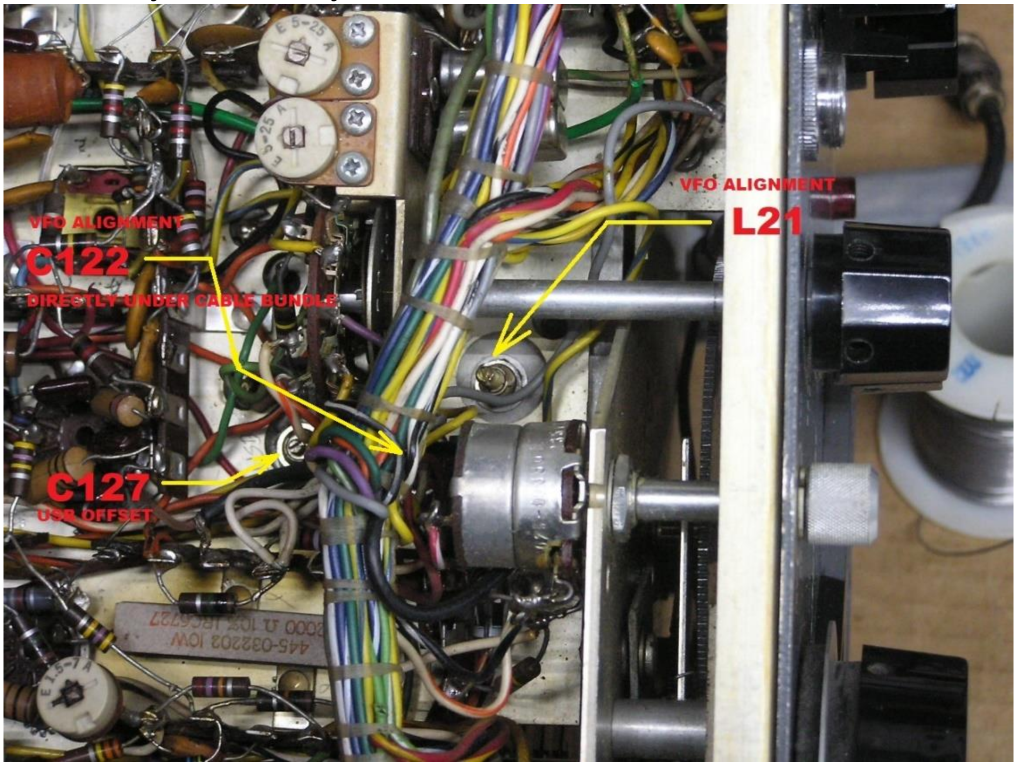
The VFO correction ckt adjusts for the frequency off set between USB and LSB (NOTE: CW operates in the USB MODE). Before the VFO is aligned it must be established that the correction ckts are working properly. Connect the frequency counter to pin 3 of V4A. Set the function switch to LSB, 40-meter band and tune the main tuning until the frequency counter reads 4.5530 MHz. Switch to USB and the frequency should drop 3000 Hz or to 4.5500 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. There are only 5 possibilities for this fault. First check the ***offset switching voltage*** on pin 4 of J4 (the ACCESSORY PLUG). In USB it should be 150 vdc.

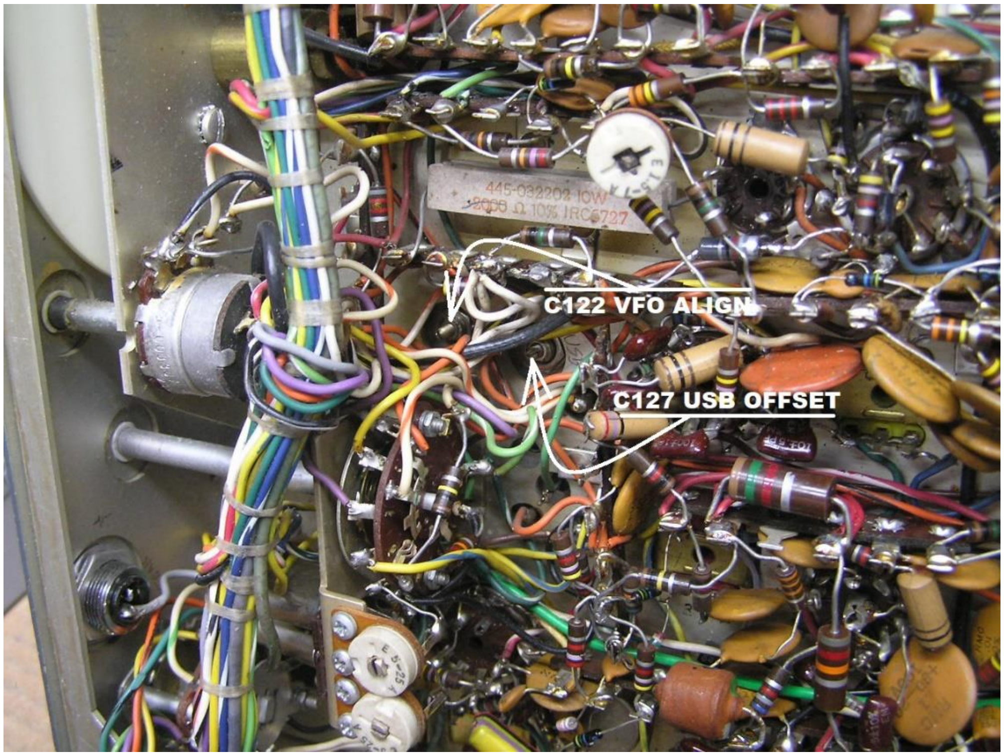
In LSB it should be a negative voltage in the range of -20 to -28 vdc. If the ***offset switching voltage*** is correct and the offset is un-settable then R85 is possible but least likely. CR12, C126 and/or C127 are most likely the cause. If the offset voltage is incorrect the most likely cause is the FUNCTION switch S3A. This fault must be cleared before you proceed.

1-5-4-3. VFO ALIGNMENT

Before starting the VFO alignment perform a VFO stability test in LSB and USB modes. Connect the frequency counter to V4A pin 3. Temporarily move the probe from the counter to the scope you should see 1.6vpp minimum across the band. Return the probe to the counter. After a 20 minute warm up record the VFO frequency every 10 minutes for one hour. In the one-hour test it should meet the requirements of paragraph 1-5-4 above. 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 4. SUBSYSTEM TROUBLESHOOTING AND TESTING for corrective action.

Proceed to section 8-8-A of the original manual and perform the mechanical indexing adjustments before you proceed. When the mechanical indexing adjustments have been completed 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. NOTE: Many of the factory manuals do not have the location of L21 defined.

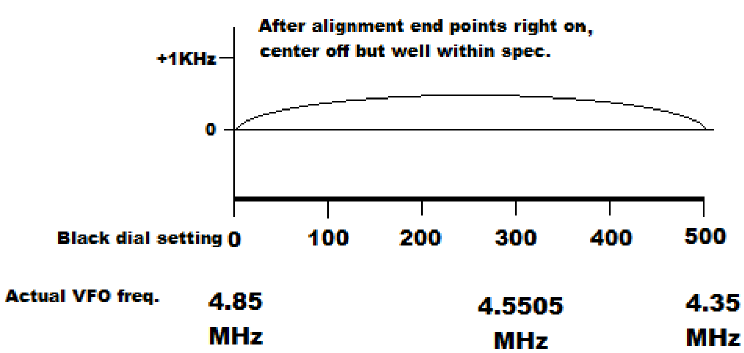


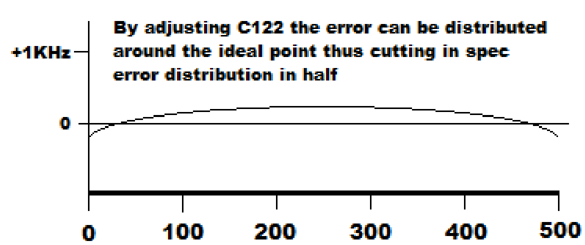


If the actual frequency consistently falls above or below the spec frequency adjustment of trimmer C122 is indicated. Move the dial to the black 500 index mark (be sure you are looking head on at the dial to eliminate parallax error). Adjust C122 for exactly 4.35 MHZ.

Rerun and record the 6 data points again. If at the Ø or the 500 index 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.*** Adjust the tuning dial to the black 500 and adjust L21 for 4.350 MHz. Adjust the dial to the black Ø and adjust C122 for 4.850 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 C32A is indicated (I use 1 KHz for my shop spec). **Knifing should never be attempted on the SR-400 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.





Connect the scope via 10X probe to V4 pin 3. You should see a minimum of 1.6vpp across the band.

More information on the VFO can be found in section 6-12

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.

2. RECEIVER FAULT ISOLATION

YOU MUST HAVE ALL THE OSCILLATORS TESTED AND ALIGNED BEFORE PROCEEDING. SEE SECTION 1-5.

2-1. 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).
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 0.4 millivolts to 30v peak to peak output.

2-2. 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	CW	OFF
NOTCH	CCW	BAND SELECTOR	7.0
PRESELECTOR	40	AF GAIN	MAX
RF GAIN	MAX	NOISE BLANKER	OFF
METER	RFO/S	RF LEVEL	CCW
MIC GAIN	CCW	RIT	OFF
LOAD & PLATE	N/A	RIT CONTROL	MID RANGE

2-3. 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. 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 R42 and R123. 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.

2-4. RECEIVER FAULT ISOLATION CHART

	Injection point	Frequency	Signal injection level	Audio output	If good go to next step. If not check suggestions below.
1	V15 pin 7	1000 Hz	14 vpp 1:1 probe	½ wt.	Problem most likely V15 or associated circuitry. See section 4-2 for details.
2	V9B pin 2	1000 Hz	0.6 vpp 1:1 probe	½ wt.	Problem is most likely V9B or associated circuitry. See section 4-3 for details.
3	V9A Pin 7	1650 KHz	5000 uv	½ wt.	Problem is most likely V9A or associated circuitry. See section 4-4 for details.
4 *	V7A Pin 2	1650 KHz	425 uv	½ wt.	Problem is most likely V7A or associated circuitry. See section 4-5 for details.
5	Tie point C54/C59	1650 KHz	5000 uv 1:1 probe	½ wt.	Problem is most likely xtal filter or notch filter. See section 4-6 for details.
6	V6 pin 1	1650 KHz	35 uv	½ wt.	Problem is most likely V6 or associated circuitry. See section 4-7 for details.
7	V4A Pin 2	6.250 MHz	100 uv	½ wt.	Problem is most likely V4A or associated circuitry. See section 4-8 for details.
8 @	V3A Pin 2	6.250 MHz	15 uv	½ wt.	Problem is most likely V3 A or B or associated circuitry. See section 4-9 for details.
9 #	V2A Pin 9	7.250 MHz	8 uv	½ wt.	Problem is most likely V2A or associated circuitry. See section 4-10 for details.
10 ~	Junction C15&C20	7.250 MHz	6 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 4-11 for details.
12 $	Tie point S1D wiper and 6.25 trap	7.250 MHz	0.5 uv	½ wt.	Problem is most likely S1D, S1C, or associated circuitry.
13 **	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 section 8-12.

2-5 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.

2-5-1. 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 5000 uv. 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.

2-5-2. 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 2-5-1 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. The 1uv set level is my personal preference. Any level between 0.5 and 1.5uv is acceptable.

2-6. 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 zero you most likely have an agc fault in V8A, or associated circuitry.

2-7. CAL OSCILLATOR

2-7-1. CYCLONE I & II TEST

Connect a frequency counter to the junction of CR10 and C88. Pull on the calibrator. Adjust C89 until it reads exactly 100.00000 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.

2-7-2. CYCLONE III TEST

A**.** Connect a frequency counter and the collector of Q1. Pull on the calibrator Adjust C89 until it reads exactly 100.00000 KHz

B**.** Connect the frequency counter to the junction of L29 and C250. The counter should display 25.000 KHz. If test A is not there or you cannot pull it in spec then V11B or associated circuitry is at fault. If test A is good and test B is not then Q1, IC1 or the low voltage rectifier circuit is at fault. This concludes the receiver tests. About 80% of the radio is now proven to be functional.

3. TRANSMITTER TESTING

At the start of the receiver testing, you replaced the power supply fuse with a 4-amp normal delay. It is time to re-insert the 5-amp slo-blow fuse. The goal of this section is **not** to get maximum power out of the radio. The goal is simply to prove that the major transmitter sections are functioning. For now, 100 watts or better is good.

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MAJOR KEY POINT, the transmitter testing process **assumes** that the receiver has been tested and is operating to specs. Also, it if impossible to map every possible failure with in the transmitter. This process will take you to the most likely solution of the major faults. On rare occasions the process will get you close and then you will have to rely on your intuitive problem-solving skills.

3-1. TEST EQUIPMENT REQUIRED

500-watt wattmeter & dummy load
100 MHz scope
Frequency counter
Audio oscillator with 600-ohm output
Driver capacitive pickup (home brew item see section 3-5-1)
600-ohm dynamic mic
Multimeter 2 VDC full-scale and 10 VDC full-scale recommended
Optional telegraph key

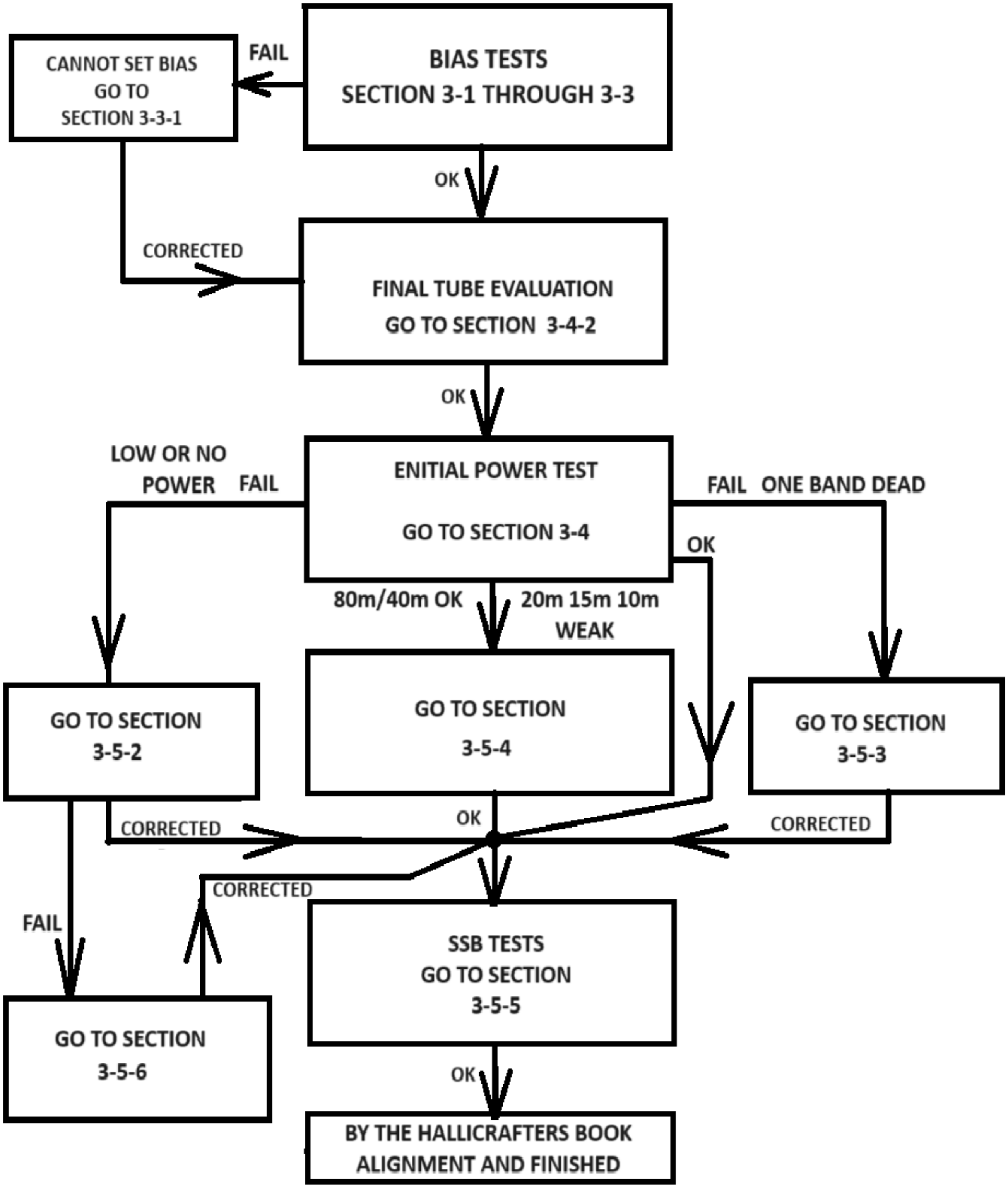
3-2. STANDARD TEST CONDITIONS

You will start with the following control settings

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

WATTMETER AND LOAD CONNECTED J1.

3-2-1 TRANSMITTER FAULT ISOLATION FLOW CHART



3-3. BIAS ADJUST (plate idle current adjustment)

With the power off plug your meter into the test jacks on the power supply chassis + to the red jack – to the blue jack. **CAUTION the meter leads will be attached to the PA high voltage, fatal shock hazard is present.** Ensure the front panel settings are in accordance with paragraph **3-2** then power up. Allow 15 minutes for tubes to get to full operating temperature. Install microphone. Key mic and adjust the BIAS ADJ on the front panel for a reading of 0.7 volts dc on the meter. This equates to an idle current of 70 mills of plate current. **Always** use this method to test and adjust the plate idle current. The front panel plate current readings are not accurate enough to properly set the idle current. The next series of tests will be conducted in the MOX, CW mode. You will need to switch the FUNCTION switch from LSB to CW quite often. You MUST keep the transmit duty cycle short. I find it easier to plug a key into the key jack on the rear of the transceiver. Then you can set the FUNCTION switch to the CW position and leave it there and press the key when you want power. This saves wear and tear on the FUNCTION switch and reduces the chances of leaving the transmitter keyed too long. For the remainder of the tests when you are instructed to "**key the transmitter**" you will either switch the FUNCTION switch from LSB to CW or press the key.

3-3-1 BIAS WILL NOT ADJUST PROPERLY

CAUTION: There are many versions of the P-500 and the PS-500 power supplies, any of which may be connected to your SR-400. You should measure and record the negative bias, B+ and the PA high voltage. If they differ from the standards in the factory manual and schematics you will have to arbitrate the readings in the following tests.

3-3-1-1 BIAS VOLTAGE CHECK.

In the receive mode measure voltage at the high end of the BIAS ADJ potentiometer (R125). It should be -123 to -130vdc. NOTE: The condition of the PA tubes can cause a large variance in the bias voltage seen on the wiper of R115.

Case 1: Some power supplies have a bias adjust pot on the rear of the chassis. If yours has the pot, it should be adjusted for -125 vdc at the top of R115 in the receive mode. If it cannot be adjusted for the proper voltage you have a fault in the power supply or a wiring error in the SR-400.

Case 2: Your power supply does not have a bias control on the rear of the chassis. With the RF and MIC levels turned to minimum key the transmitter with the mic in either SSB mode. You should measure -123v to -130vdc at the top of R115, this is the bias line voltage. Rotate R115 from stop to stop the voltage on the center tap should vary from -50v to the bias line voltage.

If you get improper results in either case test, disconnect the plate caps on both tubes and repeat the tests. If the results are good the tubes are bad. If the results are still incorrect there is most likely a leaky cap or out of tolerance resister in the grid or cathode circuits of the PA tubes.

3-3-2 FINAL TUBE CONDITION INDICATOR

Locate R115, the bias adjust pot. Key the transmitter with no drive/no power out. Double check that the plate current is correctly adjusted, 70ma. Measure the negative voltage on the wiper arm of R115. It should be between -80 and -95vdc when keyed. A reading of less than -80vdc indicates a weak tube. A reading of over -95vdc indicates a gassy tube. This voltage reading is typical for a PA where the B+ =750vdc under load and plate voltage = 260vdc. There are 4 configurations of the PS-500 power supply, and dozens of 'modified' versions. The high voltage varies from 725 to 830vdc and the B+ voltage varies from 240 to 280vdc. So, if your bias voltage for 70ma plate current is outside the -80 to -95v range first check the B+ and high voltage before you order new final tube.

3-4 INITIAL TRANSMITTER TESTS

Reset all controls as stated in section 3-2

3-4-1 TRANSMITTER POWER TEST

The following tests are preliminary test to assess the overall transmitter performance. One hundred watts is sufficient at this point.

Set the meter that is plugged into the power supply to the 10 vdc full scale range. Set the RF LEVEL to 5. In the next series of tests monitor the plate current via the meter plugged into the power supply. One volt equals 100 mills of plate current. **Keep adjusting the RF LEVEL to keep the plate current below 200 mills.** Keep the duty cycle short. Power up and allow 5 minutes warm up. Key the transmitter in the CW mode. Peak the plate current with the PRESELECTOR. Peak the plate current with L10, L33 and LOAD control. Tune the PLATE control for a dip in plate current which should coincide with a peak in power output. If the plate current dip and the power output peak do not coincide it indicates the PA needs neutralization. You will address this later. But for now, remember to **keep the duty cycle very short** until you get it neutralized.

Set the band switch to 3.5, set the tuning to 3.900, key the transmitter and adjust the PRESELECTOR, L11, L34 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out.

Set the band switch to 7, set the tuning to 7.26, key the transmitter and adjust the PRESELECTOR, L10, L33 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out.

Set the band switch to 14, set the tuning to 14.3, key the transmitter and adjust the PRESELECTOR, L9, L32 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out.

Set the band switch to 21, set the tuning to 21.37, key the transmitter and adjust the PRESELECTOR, L8, L31 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out.

Set the band switch to 28.5, set the tuning to 27.75, key the transmitter and adjust the PRESELECTOR, L7, L30 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out.

If you achieved 100 watts on all bands (50 watts on10 meters) proceed to section 5-2 PA NEUTRALIZATION.

When the neutralization is complete it is time to move on to a complete alignment. Some of the alignment has already been completed. You will need to complete the following steps in the original factory manual: 8-5 and 8-9 through 8-12.

If the minimum power is not achieved proceed to section 3-5 the TRANSMITTER FAULT ISOLATION. Once you get the transmitter working then return to the beginning of 3-4-1 and proceed from there.

3-5, TRANSMITTER FAULT ISOLATION

The assumption at this point is that the receiver works. If it does not you need to back up to section 2 and clear the receiver faults. For the TX fault isolation tests preset the equipment as listed in 3-2. STANDARD TEST CONDITIONS.

3-5-1, DRIVER CAPACITIVE PICKUP TOOL

The driver capacitive pickup tool is simply a metal sleeve. It is constructed to be a close fit over the driver tube in place of the normal tube shield and NOT contacting ground. As shown above I took an old tube shield, removed the internal spring, and cut off the base of the shield. I then bent a large loop one end of a piece of buss wire, just a little larger than the inside diameter of the shield. On the other end of the buss wire I formed a small loop. Using the tabs that originally held the spring in place in the shield, I mounted the buss wire assembly in the shield

******The amplitude of the sampling depends upon how you construct your pickup. The length of the tube and the closeness of the fit will affect the coupling. The one pictured above shows 40 vpp for 200 watts output at 3.900 MHz. You will need to test your device on a working system to develop the norms for it.

3-5-2, LOW OR NO POWER ACROSS ALL BANDS

A. Set the band switch to 3.5 and the main tuning to 3.9MHZ. Set the PRESELECTOR near the upper end of the 80-meter band. Power up and warm up. Remove the shield from V18 and install the DRIVER CAPACITIVE PICK-UP tool. Connect the scope to the pick-up tool. Key the transmitter, peek the PRESELECTOR, L11 and L34. If you have **40 vpp on the scope, unkey the transmitter. Move the probe from the scope to the frequency counter, key the transmitter. You should get 3.9MHZ on the counter. Unkey the transmitter. If you have 3.9MHZ at **40 vpp or better and there is no or low power out, your problem is in the PA. Check the PA tubes. If tubes are good go to the voltage charts in section 6-18 for the Cyclone and Cyclone II or 6-19 for the cyclone III. If the fault is cleared go to section 3-5-5, otherwise go to B.

B. Connect the 10:1 scope probe to pin 2 of V18. NOTE: as soon as you connect the probe to the tie-point you will detune the ckt. Some adjustment of L11 may be required to peak the signal. Key the transmitter, advance the RF LEVEL control to 7 and peak L11. A signal level of 5 vpp should produce 200 watts. If you have 5 vpp and still no power out the problem is in the driver or associated circuitry, go to section 3-5-5 when the driver fault is cleared and power is restored. If the signal is not 5vpp or greater, go to step C.

C. connect the probe to pin 7 of V11. Pull V2. Key the transmitter; you should see 4 vpp on the scope. If the signal is good go to step D. If not, the problem is in the Het Osc transmitter switching circuit. NOTE: If you are following the document as it is laid out, you have already proven the HET oscillator is functioning properly. If not go to 1-5-3 and test the HET osc. Reinstall V2 and pull V12 (This will remove the RF from the diode switching circuit.) Check the dc voltage on the tie point of L20 and the cathode of CR11. It should be greater than 12 volts in receive mode and less than 1.6 volts in transmit mode. If this voltage is correct then C106, L20, CR11 or C47 is bad. When the fault is cleared and power output is restored go to section 3-5-5, otherwise go to D.

D. Reinstall V2 Pull V12. Connect the scope to pin 7 of V11. Key the transmitter. You should have 3.5 vpp. If the signal is correct go to step E. If you do not get 3.5vpp or better, the fault is in V2B and its associated circuitry go to section 6-3. When the fault is cleared and you have power output go to section 3-5-5.

E. Reinstall V12 and move the scope to pin 7 of V2 (VFO signal injection). You should have 3.5vpp. If the signal is good go to F. If the signal is not correct and the radio is a Cyclone or Cyclone II check the components in the cathode of V4B. For the cyclone III Check the switching of CR34 and CR30. When the fault is cleared and you have power output go to section 3-5-5

F. Move the scope to V2 pin 2(1650 IF injection point). Key the transmitter. If the signal is 2.1vpp or greater the fault is most likely in V2, or its associated circuitry. **Note:** Here again since you have proven that the receiver is functioning properly you can eliminate T1, T2 and V3 as a cause. If the signal is not good then go to G.

G. Move the probe to V6 pin 1. Key the transmitter. The signal should be 1 vpp. If the signal is good then the fault is most likely the alignment of L15 and L16. If the signal is not good the fault is in the balanced modulator T6 and its associated circuitry go to section 3-5-5-3-1. When the fault is cleared go to 3-5-5.

3-5-3, NO OR LOW POWER ON A SINGLE BAND.

Select the affected band and follow the procedure in **3-5-2.** Eliminate the common components and concentrate only on the switches and switched components. Go back and review the results of tests in **1-5-3** (het osc tests). Once the fault is cleared go to 3-5-5.

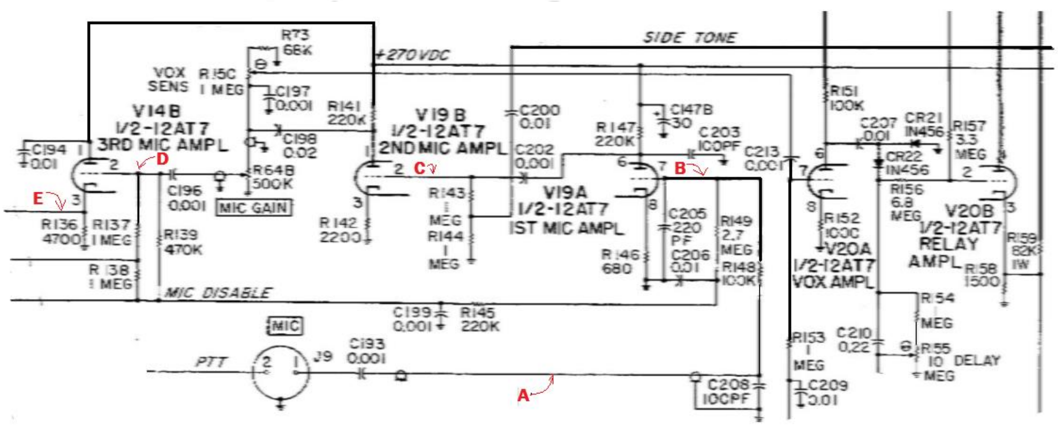
3-5-4, 80/40M OK 20 THROUGH 1OM WEAK OR DEAD.

Pull V4 to kill the VFO. Connect a 10x scope probe to pin 7 of V11. Select the 40m band, Key the transmitter and adjust L19 for maximum peak to peak voltage. Replace V11. Recheck the power output on 20, 15 and 10meter bands. If the transmitter still fails to meet minimum power output: first, you may have to try several V12 tubes in the radio. Second, you may have a bias problem with or a failed CR11. If adjustment of L19 solves the problem go to 3-5-5.

3-5-5 SSB TEST

Tune up the transmitter on 40 meters 7.250MHz. Switch to LSB, set the meter switch to AALC. Set the MIC GAIN to 5. Inject a 1000Hz signal into pin 1 of J9. When you apply a ground to pin 2 of J9 you should have power output. Adjust the MIC GAIN for a reading of S1 on the panel meter. You should have a minimum of 100watts output. If this is achieved you are finished with testing and ready for a full alignment as instructed in the HALLICRAFTERS OPERATING AND SERVICE INSTRUCTION.
If you did not achieve 100watts output go to 3-5-5-1, 3-5-5-2 and 3-5-5-3 clear the fault and rerun the 3-5-5 test.

3-5-5-1 MICROPHONE AMPLIFIER SIGNAL TRACE



The mic amplifier is composed of one half of V14 and V19. V19 is operational at all time in all modes. V14B is biased on only when the transmitter is keyed in one of the SSB modes. For the following test you will need to inject a 1KHz signal from a **600-ohm** source, into pin 1 of the mic jack. To measure the signal at test point E you will need to apply a momentary ground to pin 2 of the mic jack.

3-5-5-2, SSB MIC AMP TEST PROCEDURE

Pull the 2nd TX mixer V11.
Set controls: MIC GAIN max counter-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.
NOTE: V19 and V20 are active in both RX and TX modes therefore tests A B C and D can be performed without keying the transmitter.

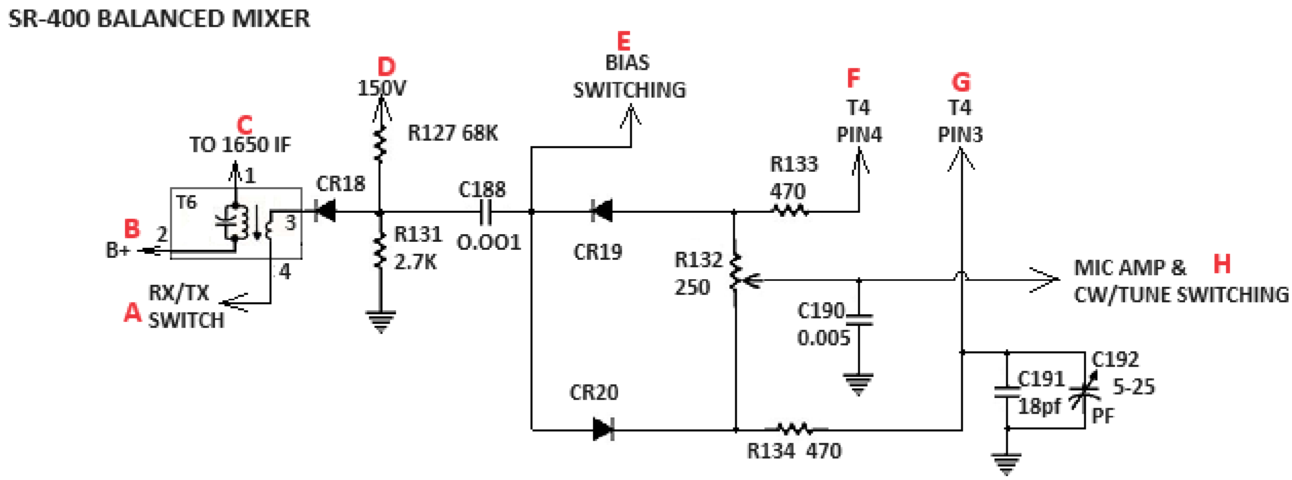
Connect scope to test point A. Inject 1KHz signal into pin 1 of the MIC jack. Adjust the audio signal generator for a 20mvpp signal at test point A.

Move the scope probe to test point B. You should have 20mvpp. If not, check C193, C203, C205 and R149.
Move the scope probe to test point C. You should have 500mvpp. If not, the fault lies in the V19A amp.
Move the scope probe to test point D. You should have 1.5vpp. If not, the fault lies in the V19B amp.
Move the scope probe to test point E. Apply a ground to pin 2 of the MIC jack. You should have >.75vpp. If not the fault lies in the V14 cathode follower or the PPT circuits or the MIC DISABLE circuits.
Power down and reinsert V11. When normal operation is achieved You are ready for a full alignment. Go to section V111 in the HALLICRAFTERS, OPERATING AND SERVICE INSTRUCTIONS manual.

3-5-5-3 TUNE/CW/SSB BALANCED MIXER STATIC TEST

In the CW and TUNE functions the USB carrier signal is fed straight through the balanced mixer. The function switch via S3A front, pin 8 applies a ground to the wiper of the carrier bal. potentiometer R132. This causes CR19 to be cut off and CR20 to be saturated resulting in feeding the USB carrier signal through T6 directly to the first 1650 IF amp.

3-5-5-3-1, SR-400 CW/TUNE/SSB BALANCED MIXER DATA



Test conditions: MOX, any band, MIC & RF LEVEL minimum. For cw/tune and ssb keep the tx time short.

TEST POINT	A	B	C	D	E	F	G	H
RX	14.6vdc	274vdc	0.0	150vdc	13.5vdc	10.5vpp	10.5vpp	13.7vdc
TUNE	1.6vdc	273vdc	2.1vpp 1650khz	-------	3.5vdc	-------	-------	0.0
LSB KEYED	---------	--------	0.0	--------	11.4vdc	--------	--------	11.4vdc

3-6, PRESELECTOR TRACKING

Grab your schematic and figure 15 (SR-2000) or figure 16 (SR400) in the factory manual and follow along.

The preselector control (C7A, C7B and C7C) tunes three sets of band coils. First (C7A) is the RX RF amp grid. The second (C7B) set of band coils tunes the RX RF amp plate and the 2nd TX mixer and Driver grid. The third (C7C) set of coils tunes the driver plate.

First problem, there are an infinite possibility of positions of the preselector and the coils to reach resonance on each band. The factory alignment procedure does not address this characteristic.

Over time and repeated tune and align operations the peak for the preselector drifts. A common error when aligning is to peak the preselector and then adjust the coils. Over time the peak will drift the preselector off its mechanical design point. This can cause the mixer/driver to oscillate or inability to get max power out of the PA across the bands.

To correct for this condition, we set the preselector to it intended mechanical position and then adjust the coils. Sometimes the preselector is so far off you must creep it back. That is, move the preselector a small amount in the direction of its intended position, peak the coils and do it again until you walk the preselector and the coils back to their correct position. The photo below shows the proper position for the pointer for each band center.

Second problem, L7 – L11 tune both the receiver and the transmitter. This one is easy. Align the transmitter coils first (L7 to L11 and L30 to L34). Once the transmitter coils are aligned, tune the receiver coils L1 – L5. Do not readjust L7 – L11 for the receiver.

4. SUBSYSTEM TROUBLESHOOTING AND TESTING

4-1 VFO DRIFT

You have performed all the tests in section 1-5-4 and determined that you have a drift problem.
If the drift is present in LSB and USB then the prime suspects are C121, C123 and C124. Do not be concerned about which is bad replace all three. Note the N and NPO designations of these capacitors. If you have the drift problem in USB but not LSB the most likely cause is C126 or C127. C127 has a very low failure rate so replace C126 then test for drift. A bad ground on C127 could also be a source of trouble. Grounding particularly on C120 and C122 could also be the source. AGAIN, let me stress there is no need to modify or redesign this VFO. If all the parts are "true" it is a **ROCK**.

4-2. V15 RX FAULT ISOLATION

Turn the power off. 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 it failed step 1 in the RECEIVER FAULT ISOLATION CHART then V15 or its associated circuitry is at fault. Check J6. See section 6-11.

4-3. V9B RX FAULT ISOLATION

This circuit is straight forward. Check the voltages in section 6-10. If they are correct then the options are few. C78, C77 or R48 are the most likely cause of the fault.

4-4. V9A RX FAULT ISOLATION

Power up and set the standard test conditions. In LSB mode you should have a 6 vpp signal on pin 8 of V9A. Move the probe from the scope to the frequency counter. You should see 1650 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. If the BFO/CARRIER signal is good then V9A is at fault. Go to section 6-10.

4-5. V7A RX FAULT ISOLATION

Perform the voltage measurements per the chart in section 6-8. If the voltages are good then the likely causes of the fault are V7A or T3. If the voltages are not correct check V7A, C60, C71, or C72.

4-6. XTAL RX FILTER/NOTCH FAULT ISOLATION

Lift the lead of C61 that connects to Y12. Into the lifted lead of C61 inject 1500 uv of 1650 KHz you should get ½ watt of audio out. If you get ½ watt of audio then the fault is in the Y12/CR23 bias or switching networks. Reconnect C61. If you do not get the ½ watt audio move the injection probe to the output side of the filter. Reduce the level of injection to 500 uv. If you get ½ watt audio output then the filter is bad. If you do not get proper audio out then L16, R169, C228 or Y13 and its associated bias and switching network are at fault.

4-7. V6 RX FAULT ISOLATION

See section 6-7

4-8. V4A RX FAULT ISOLATION

NOTE: In the following steps you will inject a signal into the plate circuit with the tube removed. Be sure your injection probe will handle the B+ voltage.Assumption: You have injected 35uv @ 6 – 6.5 MHz 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: CYCLONE II suspect C53. CYCLONE III suspect CR30, R176 or C223. See section 6-5.

4-9. V3 RX FAULT ISOLATION

See note in 4-8. 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 the manual to isolate the fault. See section 6-4.

4-10 V2 RX MIXER FAULT ISOLATION

See note in 4-8. 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, C30 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 the manual 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. see section 6-3.

4-11 V1 RX FAULT ISOLATION

See note in 4-8. 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 V2 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 audio output then C15 is open. If there is audio output but you cannot get ½ watt ground the tie point of R3, R5 and R7. If the audio increases more than 2db then the RF GAIN pot is at fault. Check the voltages and resistances per the charts in the manual. See section 6-2.

5. TECH NOTES

5-1. BASIC TUNE UP

The RF power out and PLATE current monitoring leaves a little to be desired in the SR-150 through the SR-500. This short fall was corrected in the SR-2000 with the addition of a dedicated plate current meter in the power supply.

5-1-1. THE PROBLEM:

During PA tune up the RF power out peak and the plate current dip (**true resonance** point) do not always coincide. Proper tuning should always be to the plate current dip. To accomplish this the way the equipment is designed requires constantly switching the meter switch on the 400 from RFO to PLATE MA. Proper neutralization of the PA finals will minimize this effect. Regardless of how well the equipment is neutralized, differences in the power peak and the plate current dip will occur across the bands.

5-1-2. WHY IS THIS IMPORTANT?

At **true resonance** the PA tubes are operating at their most efficient point, and this adds to the life of the tubes.
At **true resonance** spurs and harmonics are at minimum.
At **true resonance** components in the plate circuit are under minimum stress (very important in the SR-150).
At **true resonance** your rig just sounds better.

5-1-3. A SIMPLE SOLUTION.

Plug an external meter into the test jacks in the power supply and leave it there as a permanent monitor. Commonly one of the jacks is red the other is blue. CAUTION the meter leads will always have the plate voltage present. The meter should be set to the 10vdc full scale range, red lead to the red jack and black lead to the blue jack. Then you can leave the meter switch in the RFO S position during tune up and operation. The only time you will need to change the meter switch is when checking AALC.

5-1-4. SUMMATION:

This simple meter addition not only simplifies tune up but adds a constant critical monitor to your system. Any problem in the PA, transmission lines or the antenna are immediately reflected in the plate current.

5-2 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-400. Before starting the process, you need to tune the TX as best as you can at 21.3 MHZ.
***NOTE* KEEP THE DRIVE LOW AND THE POWER OUT BELOW 100 WATTS INTO A DUMMY LOAD.**
After tuning up be careful not to move the PRESELECTOR, load, or plate controls throughout the rest of this process. Power down and remove the top and bottom covers and the P.A. cover.

1, Disconnect the plate voltage at the bottom of L26 be sure the lead is out of harm's way.

2, A. Cyclone and Cyclone II--Disconnect the screen voltage at the bottom of R104.
Be sure the lead is out of harm's way.

2, B. For the 400A—Disconnect either end of R301 and put the lead out of harm's way.

3, Replace the bottom cover and the P.A. cover. Turn the RF LEVEL fully counter clockwise.

4, 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.

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

6, In the tune position, key the TX.

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

8, With a nonmetallic tuning wand adjust C171 (cyclone and cyclone II) or C117 (400A) for a minimum signal on the scope or meter. Adjust the scope sensitivity and RF LEVEL controls to maintain a good presentation of the minimum point.

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.

5-3. OPTIONAL 6 MEG IF ALIGNMENT

The goal in this operation is to produce flat response through the 6 Meg I.F. Some roll of at the ends is expected but from 3.550 through 3.950 the response should be flat. We will accomplish this task in the transmit mode using the signals generated within the radio. The expected output level of the 6meg I.F. is 1vpp.

It is important that the bias has been set up to spec (70mills with no drive to the finals).

1, Remove v12 the heterodyne oscillator tube.
2, Set band switch to 80 meters
3. Connect X10 scope probe to V11A pin 7
4. PRESET the following controls:
    RF GAIN MINIMUM
    AF GAIN MINIMUM
    MIC GAIN MINIMUM
    RF LEVEL MINIMUM
    RIT switch OFF
    RIT control center of its rotation.
    CAL center of its rotation
    FUNCTION to USB
5. Turn the OPERATION switch to MOX and allow 20 minutes for warm up.
6. Tune the freq dial to 3.550.
7. Switch the function switch to the TUNE position.
8 Adjust the top and bottom slug of T1 for peak. Then adjust the bottom slug DOWN for a reduction in signal of about 5%. Then adjust the top slug UP for an equal reduction of signal.
9. Adjust the top and bottom slug of T2 in the same manner as you did T1.
10 Tune the freq dial to 3.950
11. Adjust both slugs in T1 and T2 for peak signal. Record or make note of the peak voltage.
12. Tune the freq dial slowly back to 3.550 while observing the signal on V11A pin 7. If the signal does not dip or peak more than 0.1v then all is well and you are done. You may have to repeat the steps 6 through 12 several times to get it to balance at both ends.

5-4. 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.

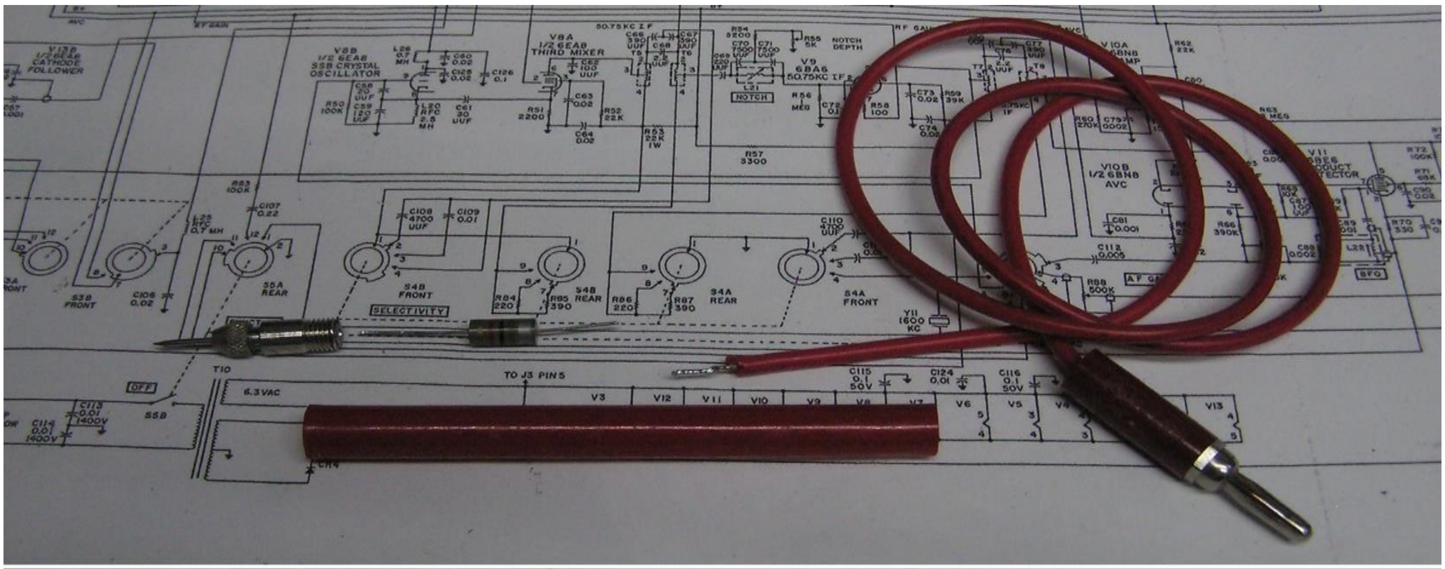
https://groups.io/g/HallicraftersRadios: This is a member only site. It is free to join and I strongly recommend joining if you are a Hallicrafters fan. In the files section of this site is the largest collection of Hallicrafters technical information I have found anywhere. With over 1000 members, any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

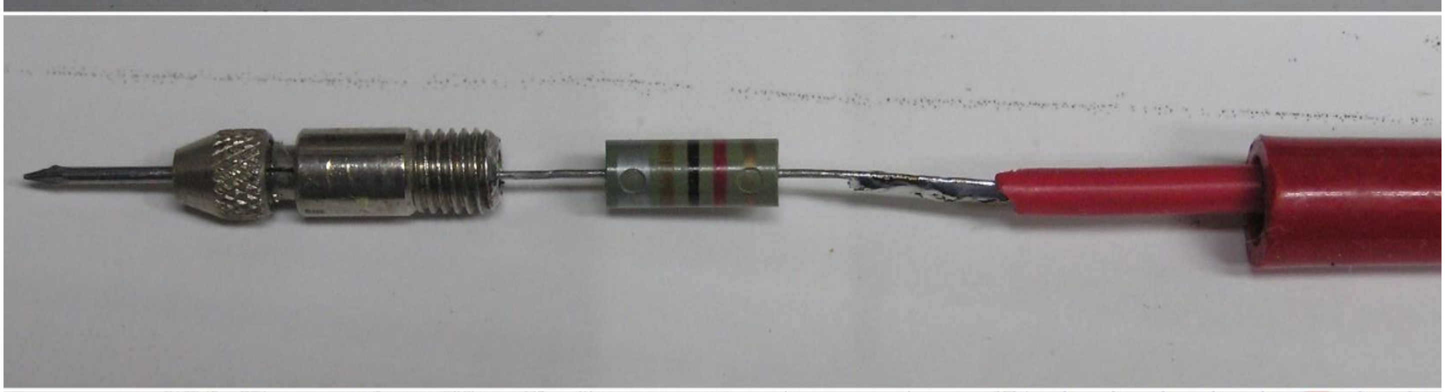
6. SUBSYSTEM SCHEMATICS & CHARTS

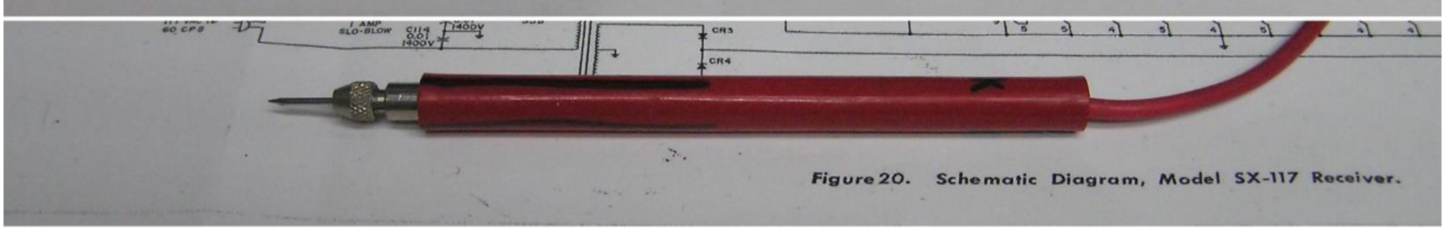
This section contains uncluttered subsystem schematics and static condition voltage charts. Static condition voltages, generally, are measurements taken in no signal conditions to reflect static bias conditions of subsystems. With some systems signal levels, peak to peak, are important to static operation and those values are include.

6-1 TEST EQUIPMENT REQUIRED

In addition to test equipment preciously mentioned in this document you will need a RF BLOCKING DC 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. Do not go messing about in the PA of a transmitter with one. Mark this probe and set it aside for ***special*** use only.

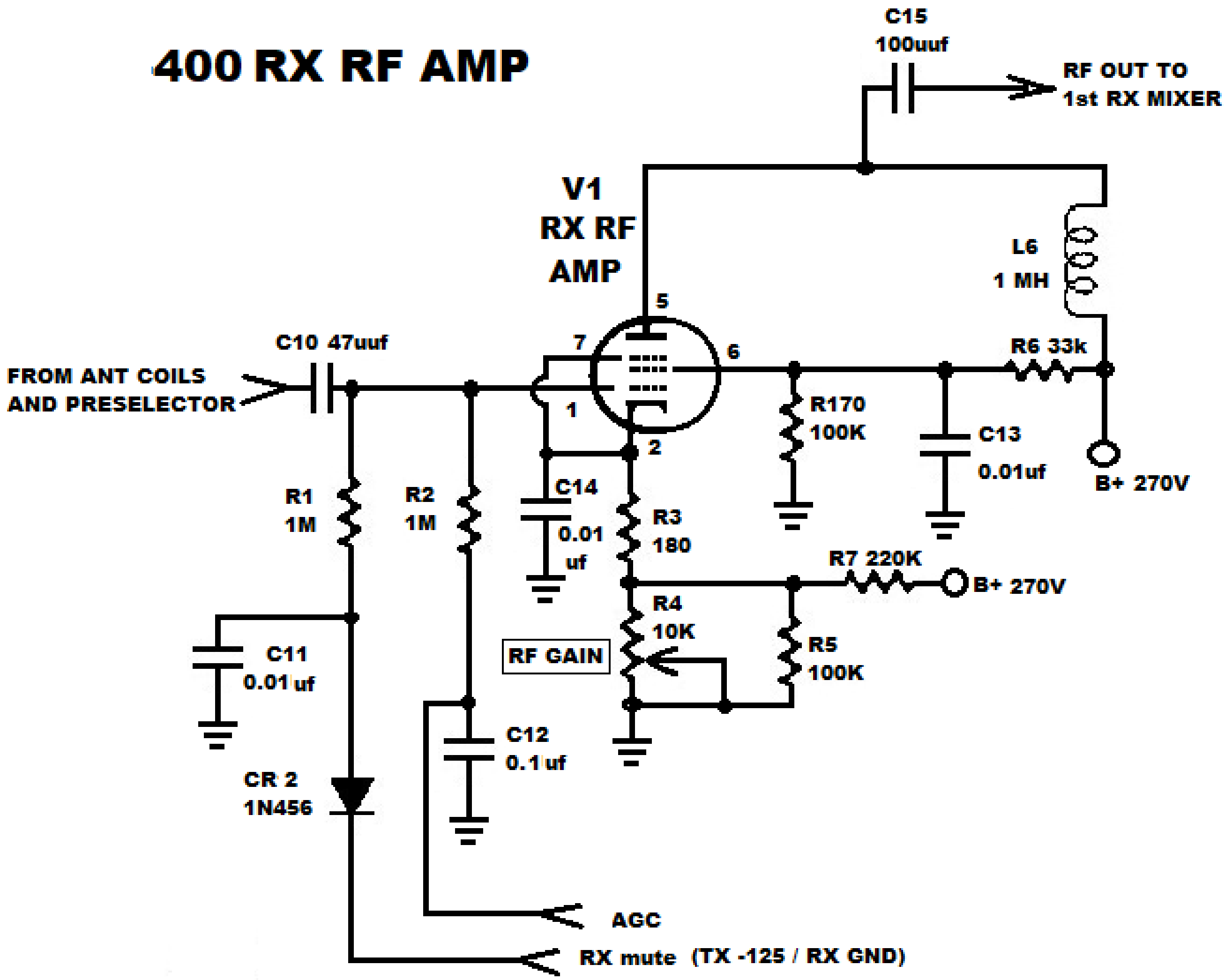






`

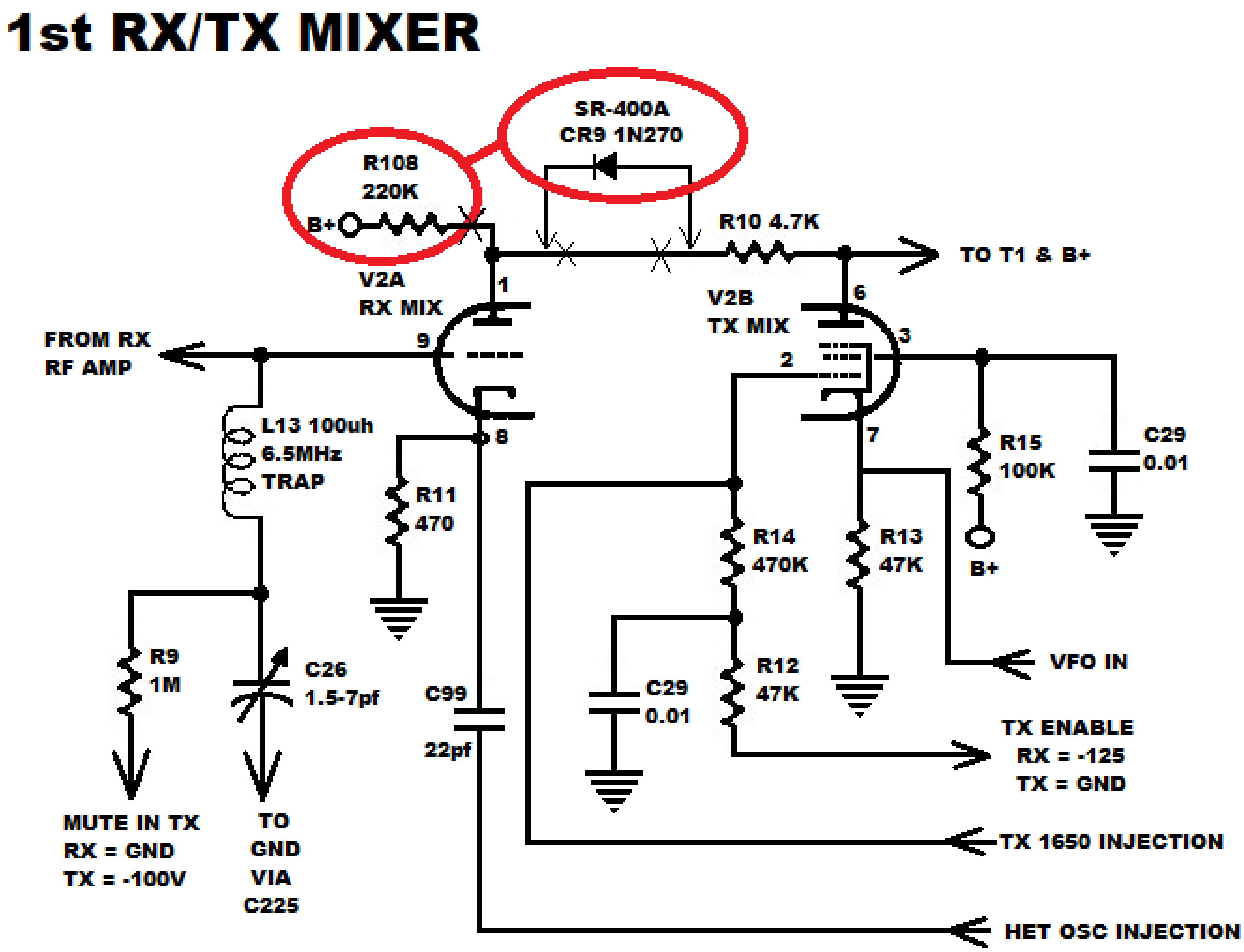
6-2. RX RF AMP



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+ = 281vdc.

PIN #	1	2	5	6
GAIN @ MIN	-0.05	17.22	281	191
GAIN @ MAX	-0.05	1.53	281	152

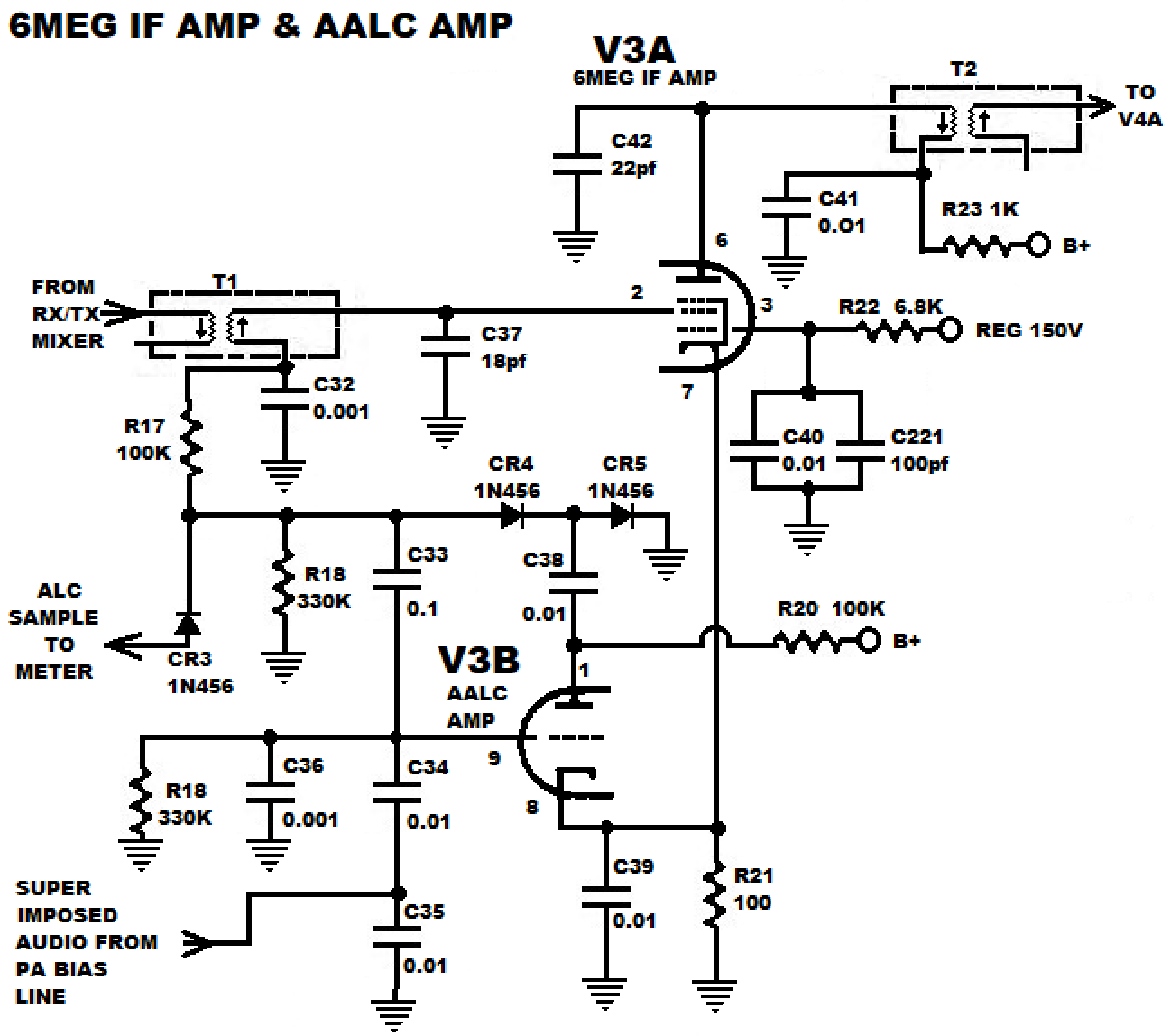
6-3. RX TX 1st MIXER



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.

PIN #	1	9	8	2	3	6	7
RX MODE	211	0	4.3	-82	249	281	0
TX MODE	281	-50	-0.02	0	185	281	7.0

6-4. 6MEG IF AMP & AALC AMP



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.

V3A 6MEG IF AMP

PIN #	2	3	6	7
DC VOLTAGE	0	140	271	2.92

V3B AALC AMP

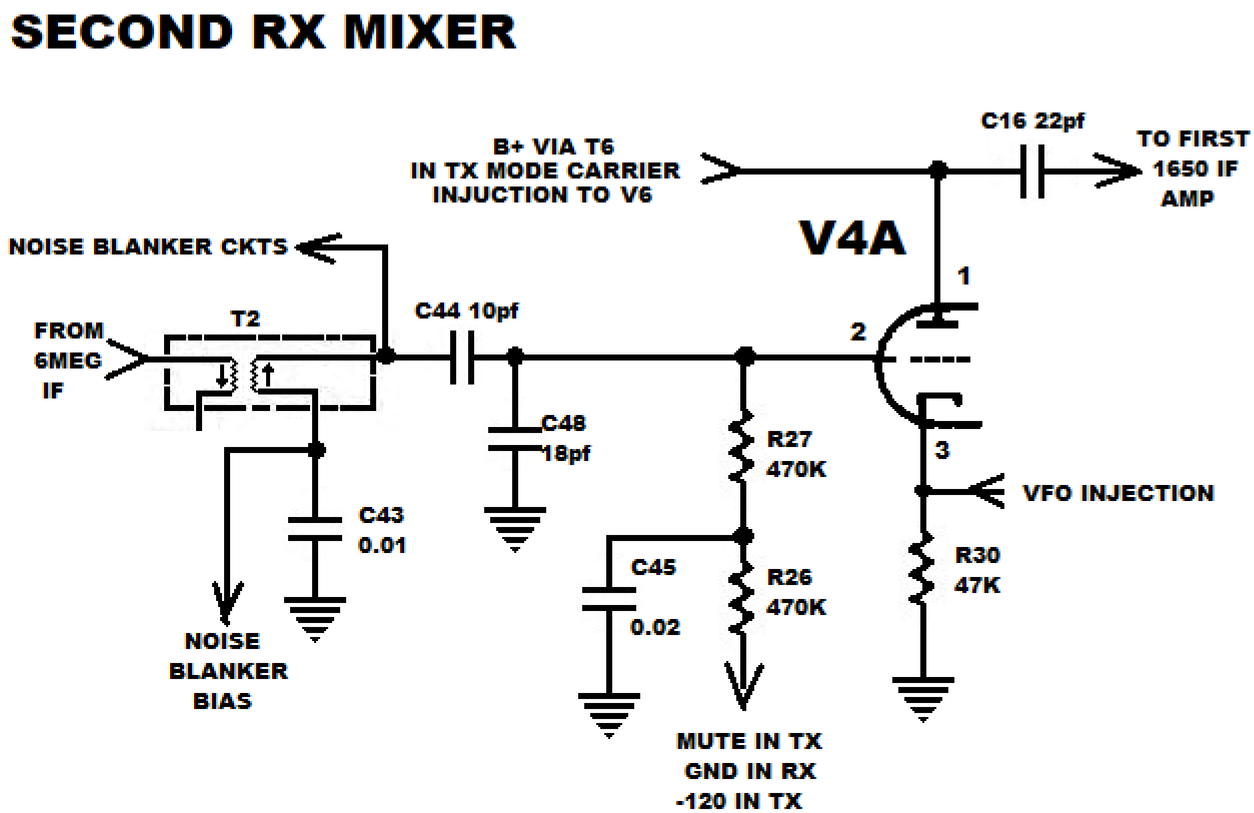
PIN #	1	8	9
DC VOLTAGE	254	13.5	0

6-4-1. AALC

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 adjustment 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 AALC voltage acts like a transmitter AGC on the if amp in the transmit mode to reduce the distortion and spurs that accompany flat-topping.

6-5. 2nd RX MIXER



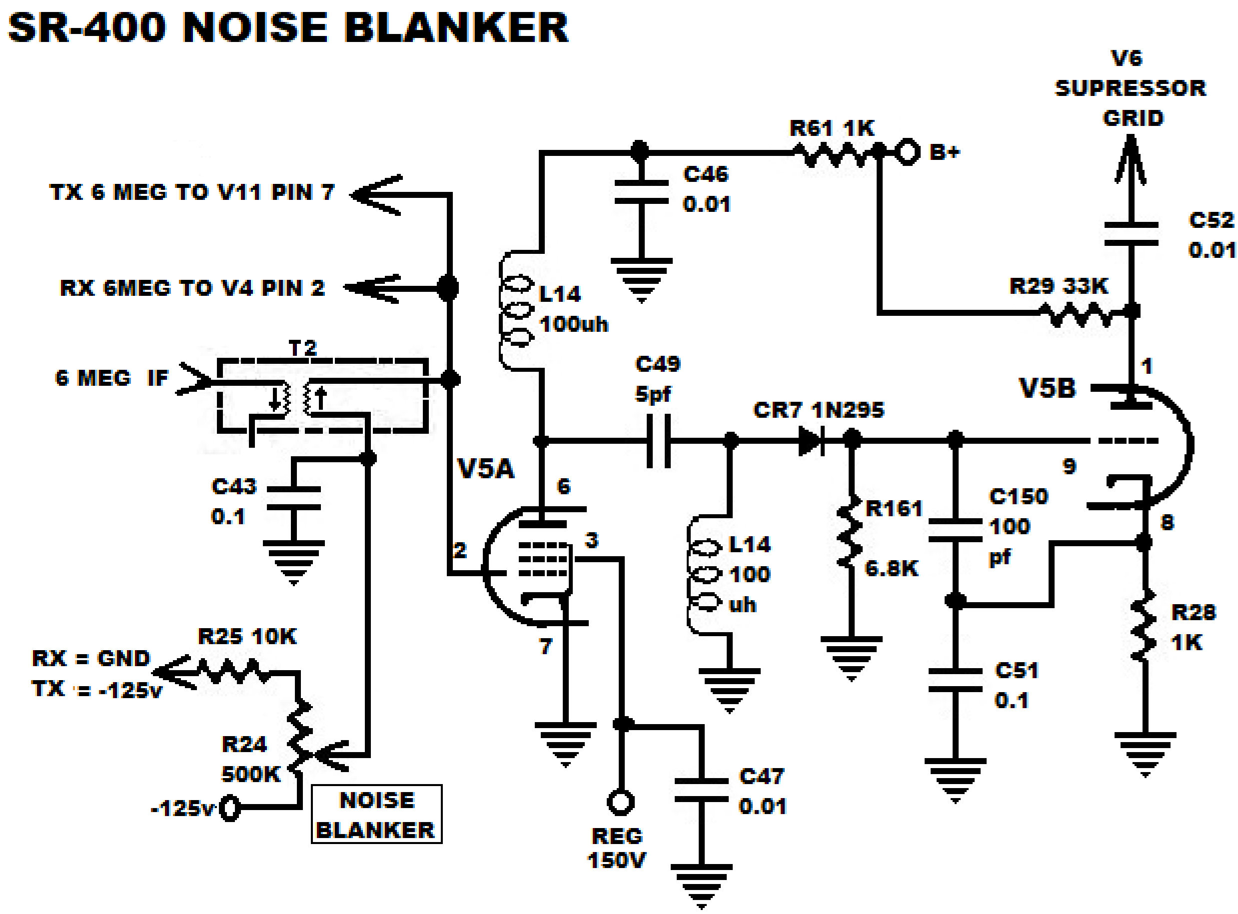
These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.

PIN #	1	2	3
RX MODE	281	0	5.8
TX MODE	279	-61.5	0.3

PIN #	3
VFO INJECTION	1.6vpp

NOTE: In transmit mode V4A is biased off. Carrier signal from T6 is passed to V6 via C16. In CW mode the signal is amplified and passes through FL1 and on to V2B the 1st TX mixer. In SSB mode the balanced mixer, suppress carrier signal is amplified by V2B and presented to FL1 where the unwanted sideband is stripped off. The remaining sideband signal is then presented to the 1st TX mixer.

6-6. NOISE BLANKER

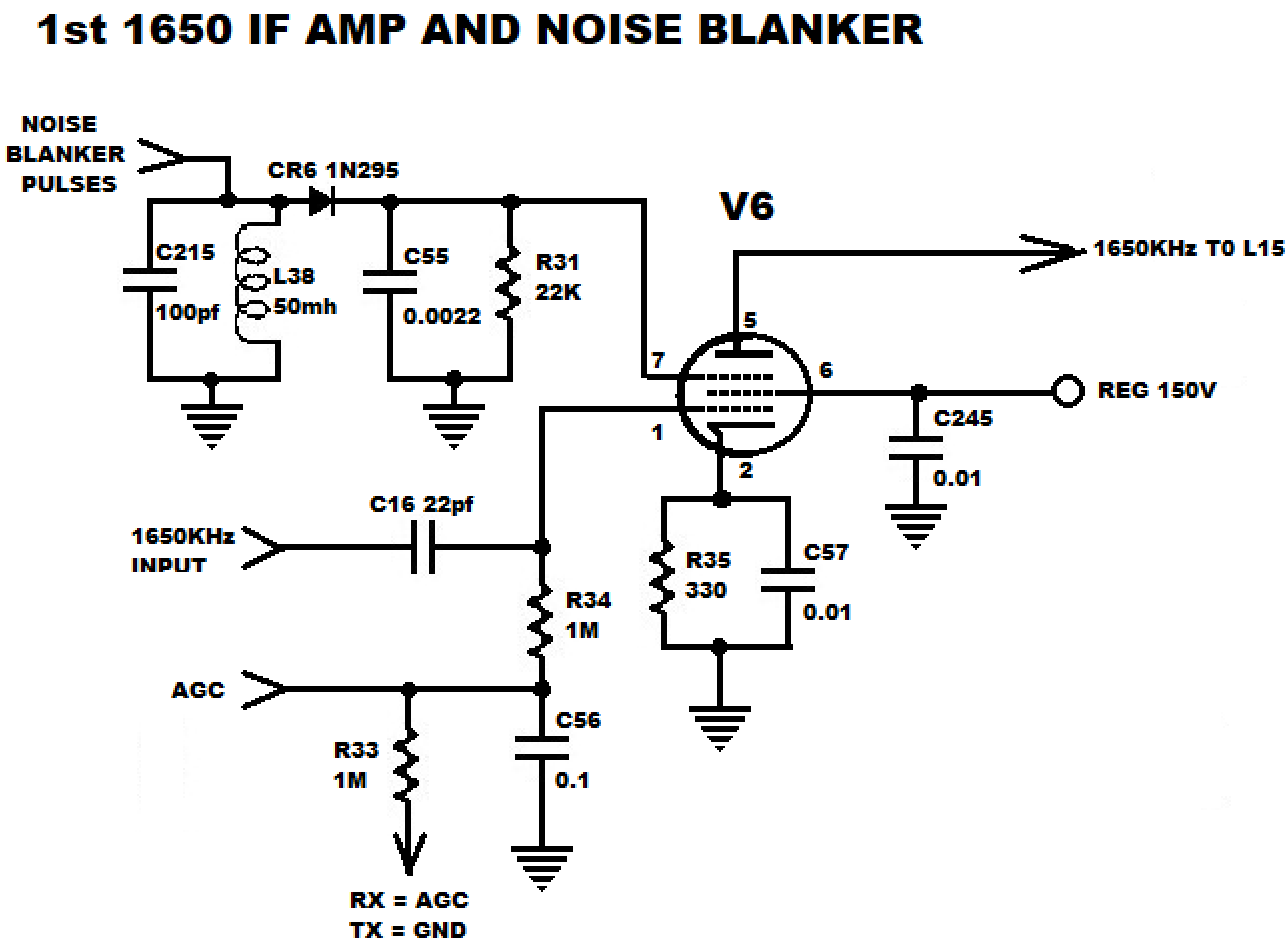


These tests are done with all gain and drive controls set to minimum, in RX mode. Test unit B+ = 281.

PIN #	1	2	3	6	8	9
R24 @ MIN	130	-134	152	278	3.17	0
R24 @ MAX	128	-3	152	267	3.21	0.16

The 6meg IF signal plus the noise is presented to V5A and amplified. C49 and L14 strip off the 6meg IF signal and present the remaining noise signal to CR7. The noise is shaped by CR7, R161 and C150 into a positive signal proportional to the noise pulses. These pulses are amplified and fed to the suppressor grid of V6 reducing gain for the duration of the noise pulse.

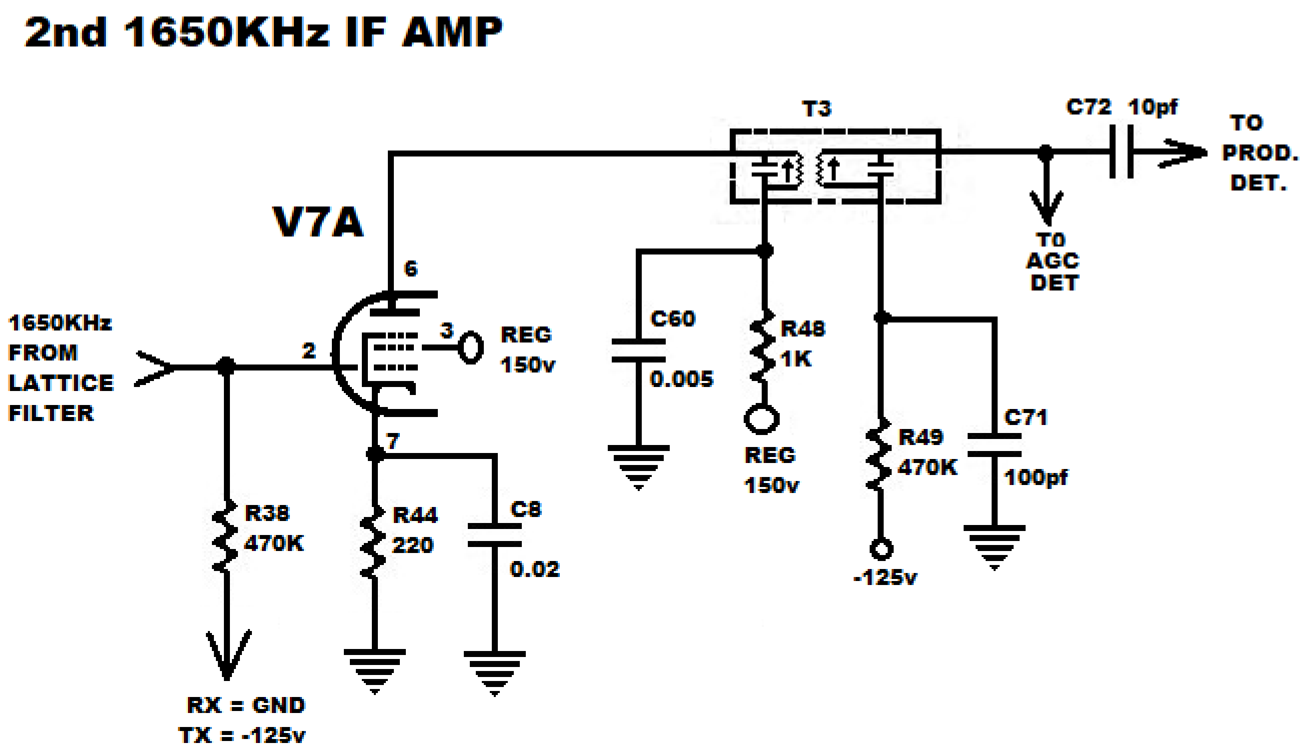
6-7. 1st 1650 IF & NOISE BLANKER



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+ = 281vdc.

PIN #	1	2	5	6	7
RX MODE	-0.8	11	281	152	-0.03
TX MODE	-0.3	12	281	152	0

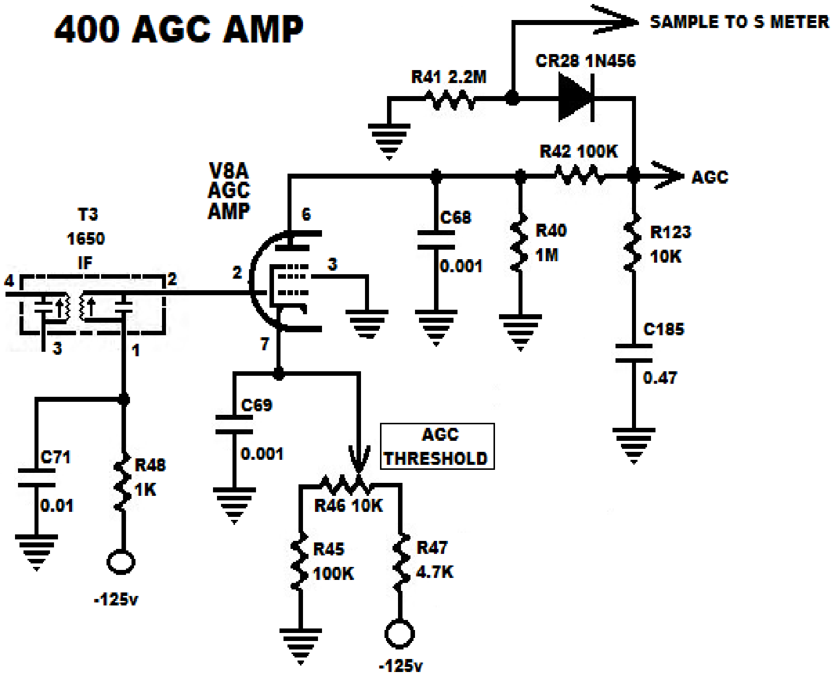
6-8. 2nd 1650 IF AMP



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281

PIN #	2	3	6	7
RX MODE	0	152	271	2.57
TX MODE	-96	152	281	0

6-9. AGC AMP

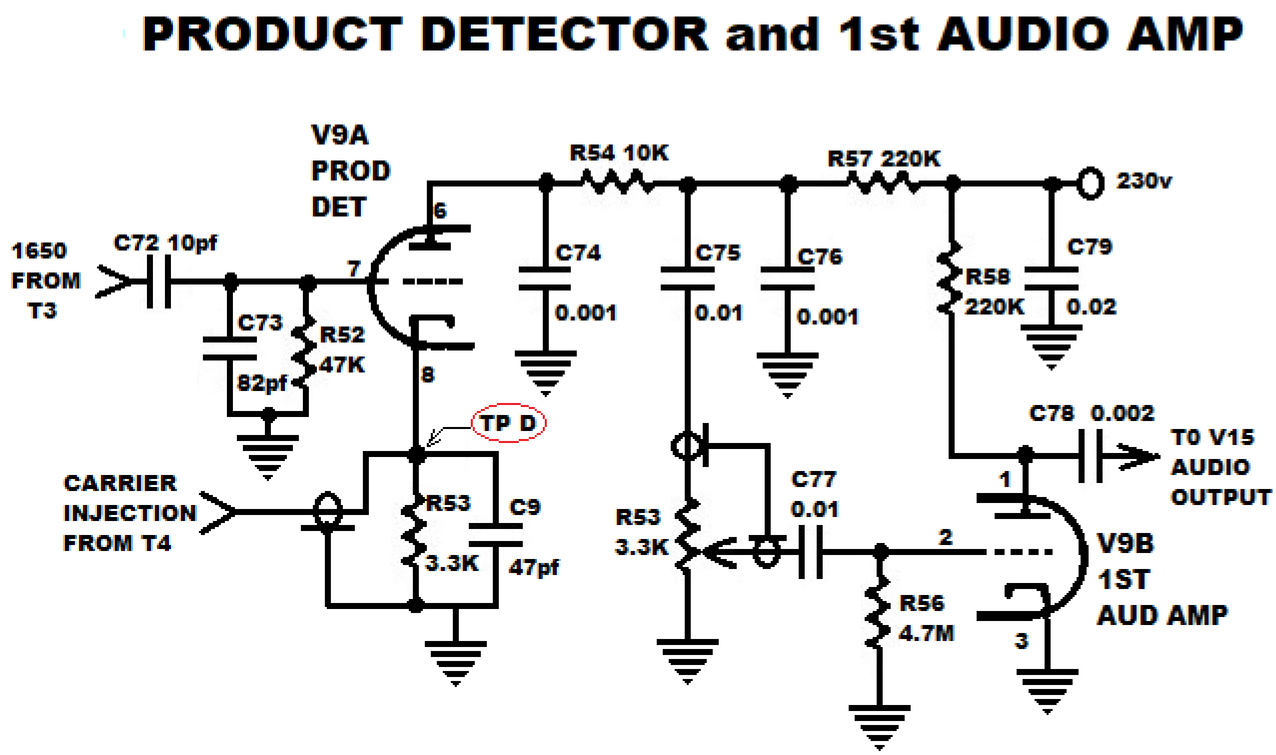


These tests are done with all gain and drive controls set to minimum. Measurements will be taken with AGC THRESHOLD set at min and max. Test unit B+ = 281

Pin #	2	6	7
R46 @ MIN	-76	-40	-129
R45 @ MAX	-86	0	-118

The adjustment of R46 is covered in section 8-4-D of the factory manual. That procedure is arbitrary at best. The threshold is the point where you want to start limiting the gain of the receiver. Any signal below that threshold will have maximum amplification. My personal choice for the threshold level is 1uv. You may select whatever level you prefer. See section 2-5-2 for alternate adjustment instructions.

6-10. PRODUCT DETECTOR & 1ST AUDIO AMP

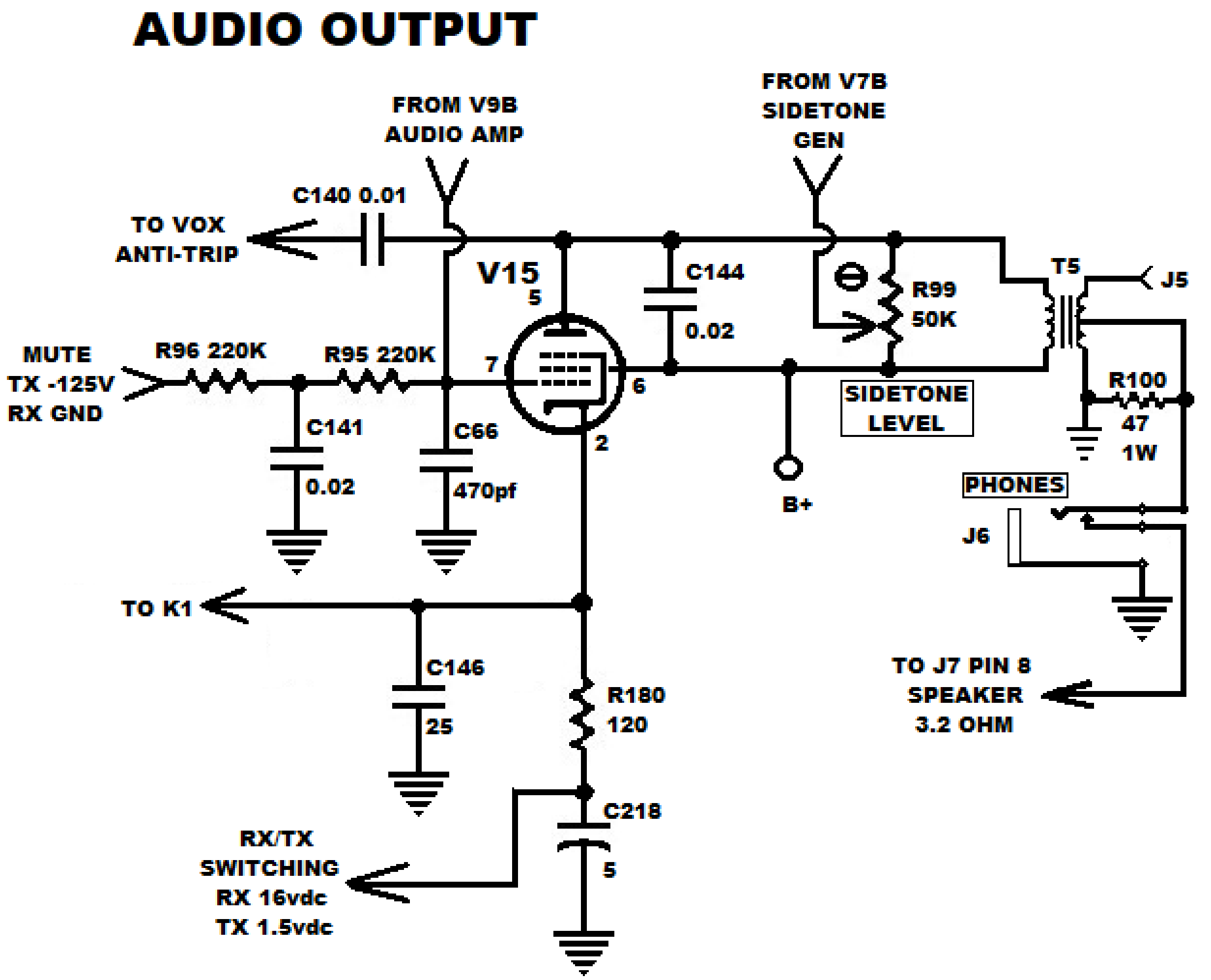


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc

CARRIER INJECTION	TP D
PEAK TO PEAK VOLTAGE	5.7vpp

PIN #	1	2	6	7	8
VOLTAGE	40.3	-0.60	61	-0.03	2.48

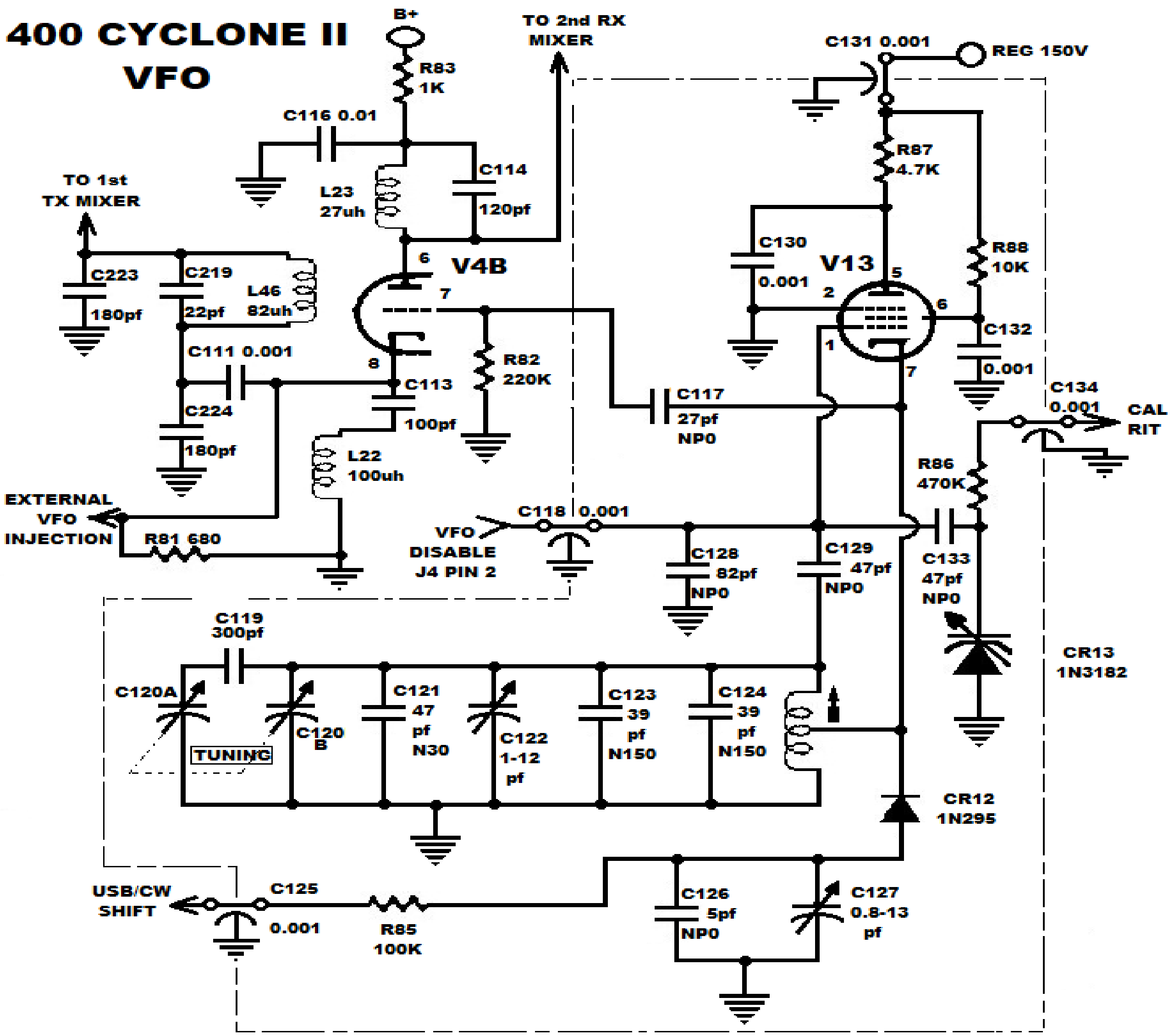
6-11. AUDIO OUTPUT



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.

PIN #	2	5	6	7
RX MODE	14.9	273	281	0
TX MODE	1.9	281	281	-83

6-12. VFO

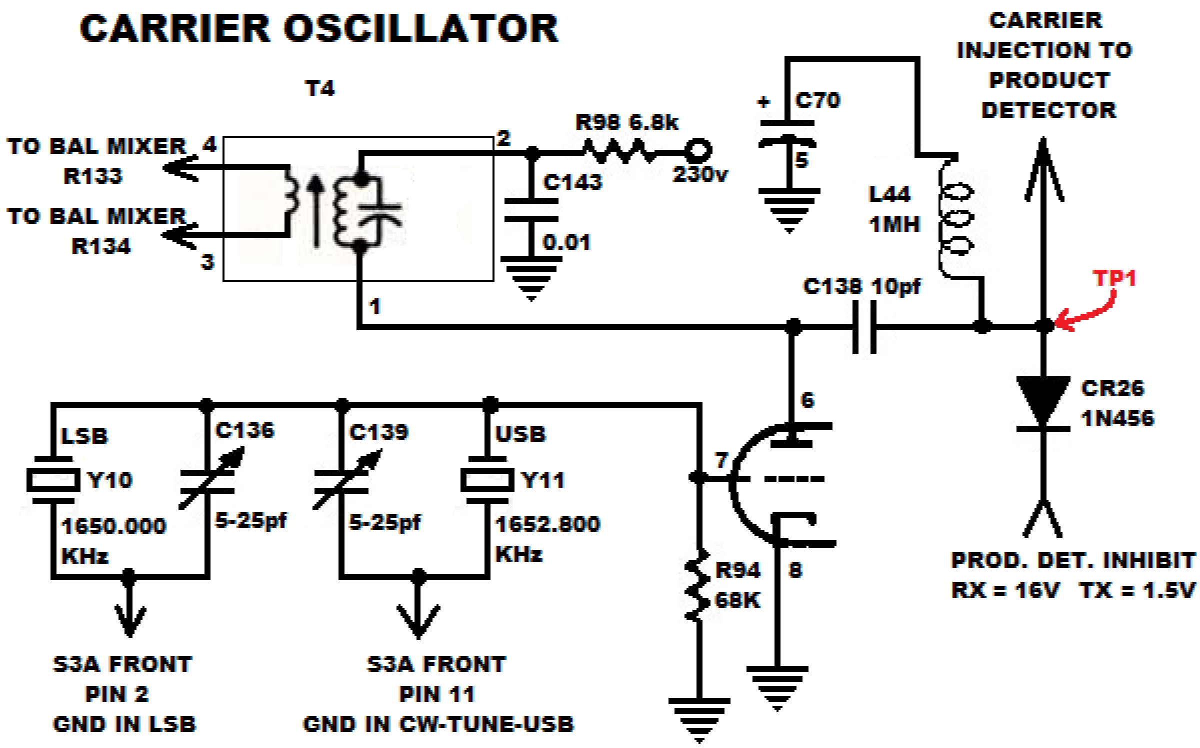


These tests are done with all gain and drive controls set to minimum, in RX mode.
Use the RF BLOCKING dc probe for these measurements.
Test unit B+ = 281.

V4B	6	7	8
VOLTAGE	186	-11	0

V13	1	5	6	7
VOLTAGE	-2.98	97	109	0

6-13 CARRIER OSCILLATOR



These tests are done with all gain and drive controls set to minimum, MOX, LSB.
Test unit B+ = 281.

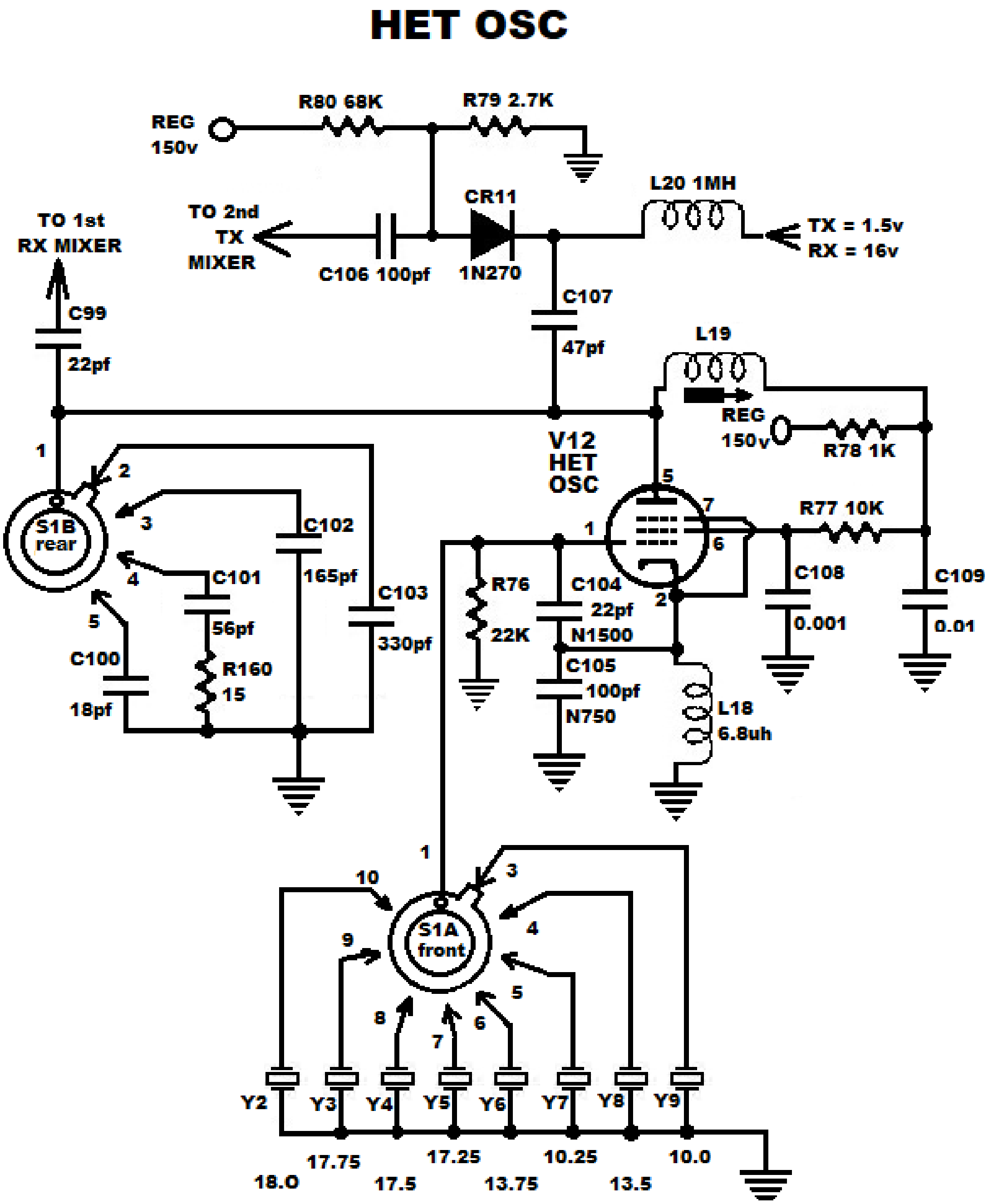
PIN #	6	7
VOLTAGE	263	-6

NOTE: Use an RF blocking probe for these measurements.

RF peak to peak measurements made with an oscilloscope.

TEST POINT	T4 PIN3	T4 PIN4	TP1
CYCLONE II & III	8vpp	8vpp	6vpp
CYCLONE	4.5vpp	4.5vpp	3.4vpp

6-14. HET OSCILLATOR

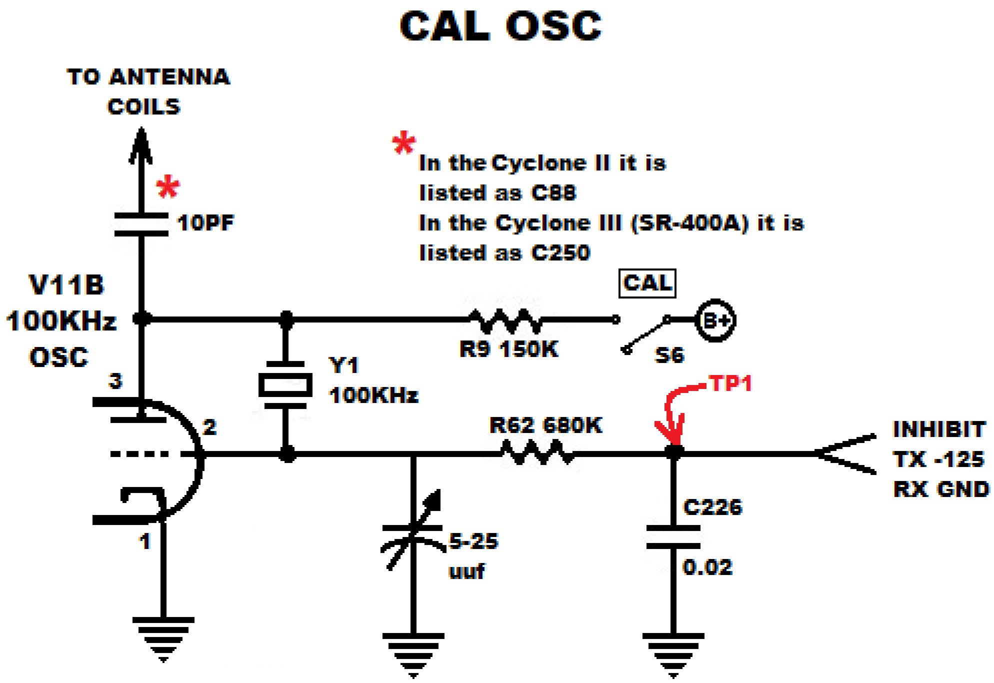


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.

PIN #	1	2	5	6
VOLTAGE	-6.2	0	146	83

NOTE: Use RF blocking probe to take measurements.

6-15. CAL OSC



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc.
NOTE: Use RF blocking probe to take measurements.

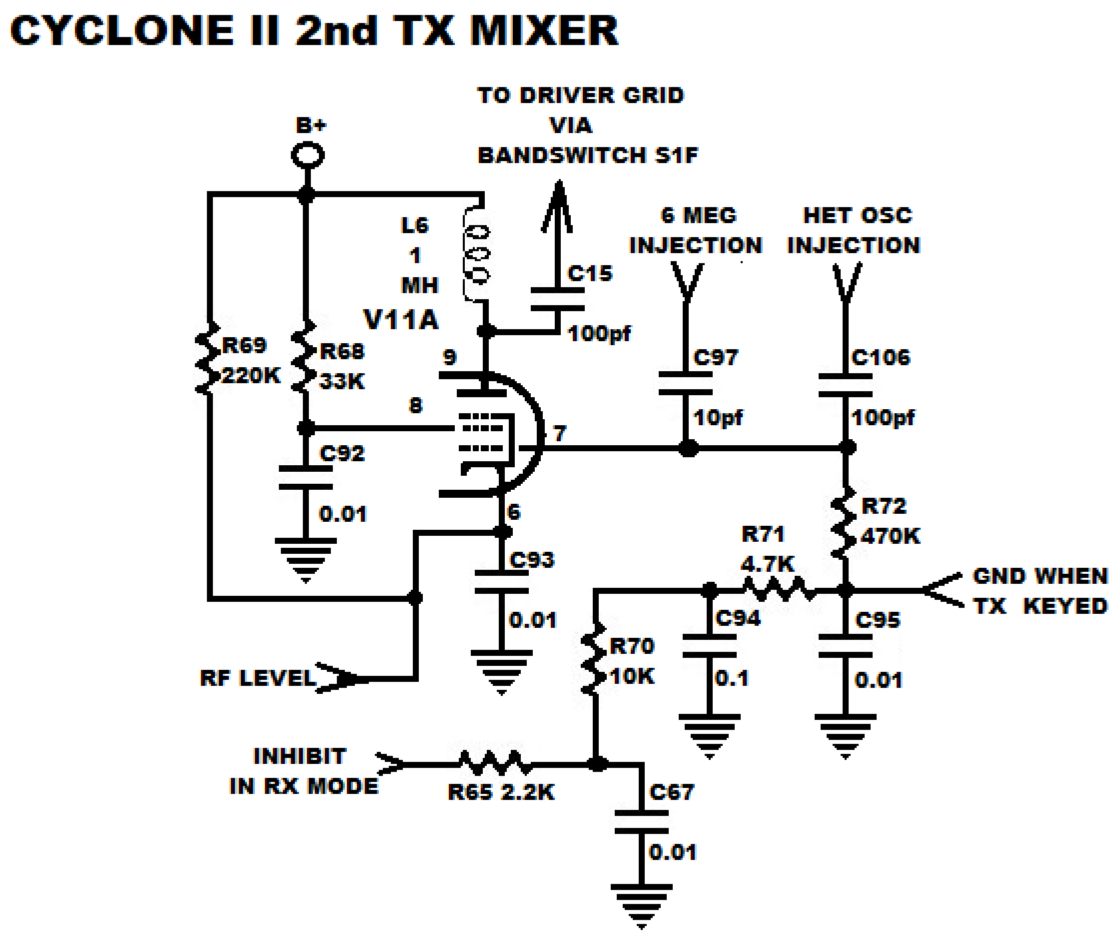
Pull the CAL control to the on position.

PIN #	2	3
VOLTAGE	-60	98

Push the CAL control to the off position
Turn all the gain and drive controls to minimum. Test point 1 will be measured in the receive mode and the transmit mode

TP1	RX MODE	TX MODE
VOLTAGE	0	-125

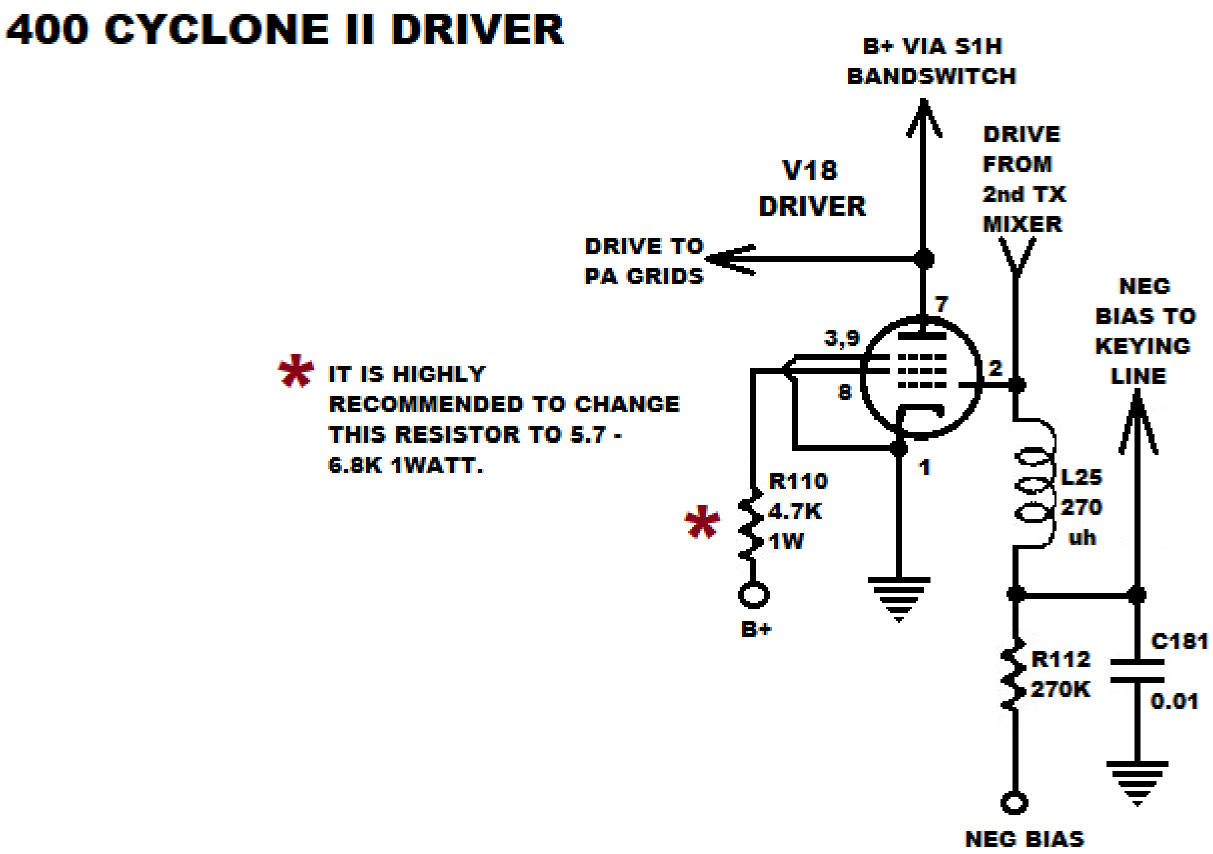
6-16. 2ND TX MIXER



These tests are done with all gain and drive controls set to minimum. Set the preselector to fully clockwise position. Measurements will be taken in RX mode, and in TX mode with the RF LEVEL at minimum and maximum.
Test unit B+ = 281vdc.

PIN #	6	7	8	9
RX MODE	5.4	-87.7	278	270
TX MODE	10.8	0	259	260

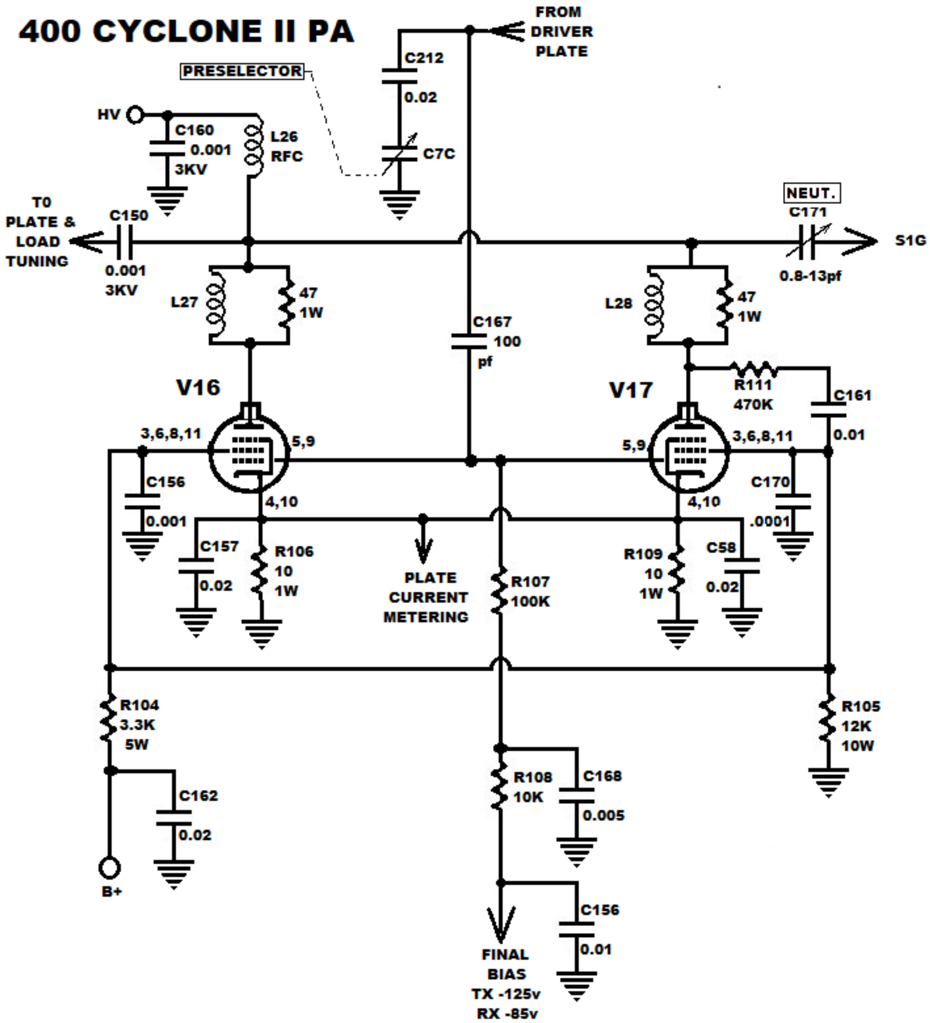
6-17. CYCLONE II DRIVER



These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281vdc

PIN#	2	7	8
RX MODE	-111	281	281
TX MODE	-3	265	250

6-18. CYCLONE II PA

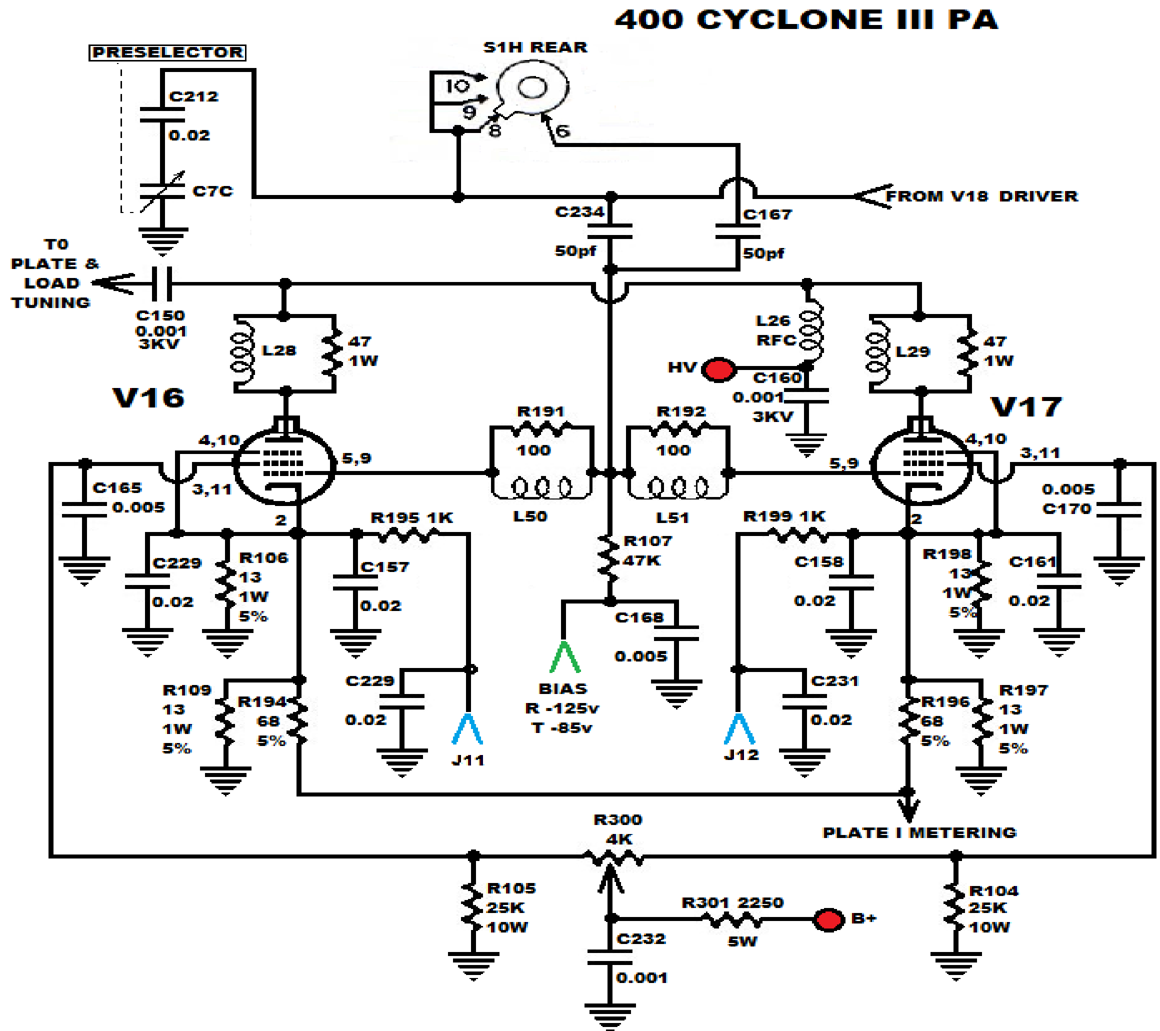


These tests are done with all gain and drive controls set to minimum.
Test unit B+ = 281. Idle current set to70ma.

V16	3	4	5	PLATE CAP
RX MODE	219	0	113	885
TX MODE	204	0.2	74	862

V17	3	4	5
RX MODE	219	0	113
TX MODE	204	0.2	74

6-19. CYCLONE III PA

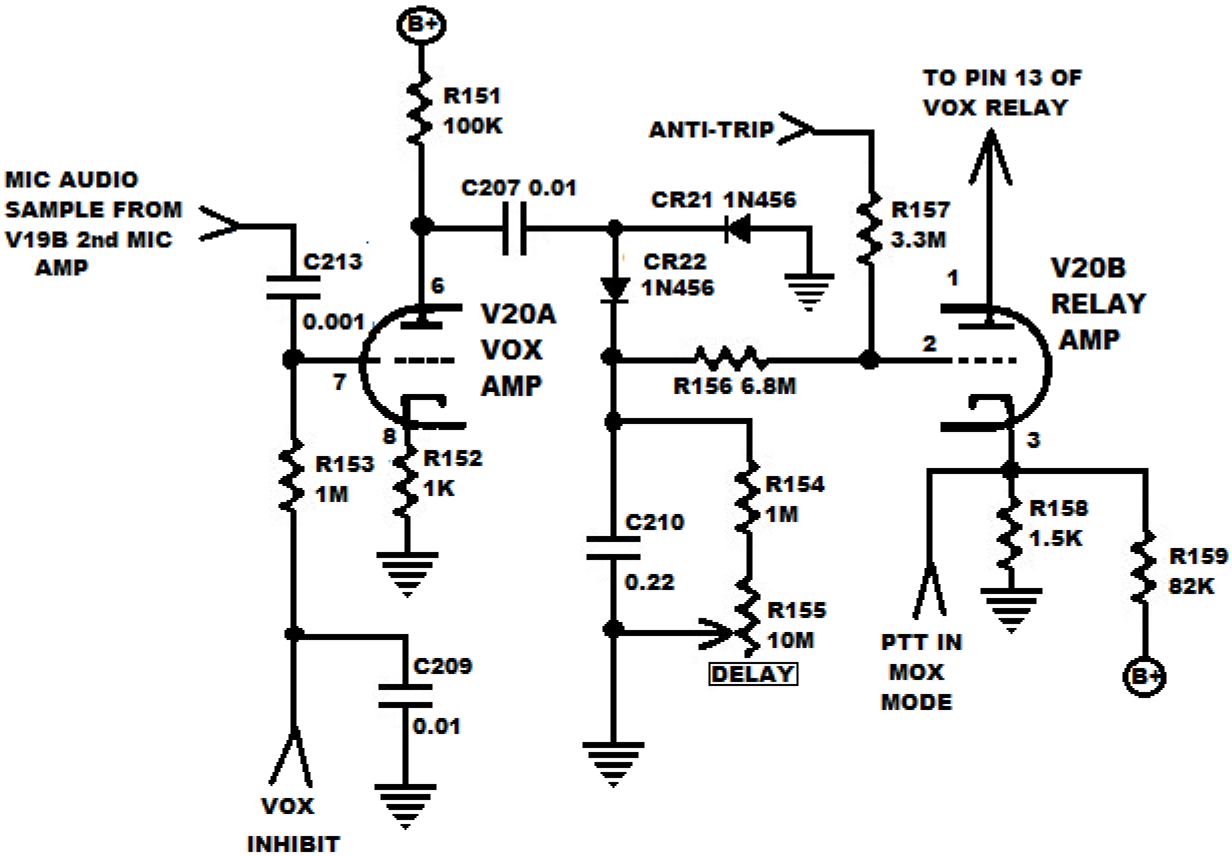


These tests are done with all gain and drive controls set to minimum. Idle current set to70ma. R400 balance pot set for balance at J11 and J12. Test unit B+ = 276, HI voltage in RX mode 890, House voltage = 125vac.

V16 PINS	3,11	2,4,10	5,9	PLATE CAP
RX MODE	218	0.0	-128	890
TX MODE	203	.26	-60	860
//////////////////////////	//////////////////////////	//////////////////////////	//////////////////////////	//////////////////////////
V17 PINS	3,11	2,4,10	5,9	
RX MODE	215	0.0	-128	
TX MODE	200	.25	-60	

6-20. VOX AND RELAY AMPS

400 VOX AMP & RELAY AMP

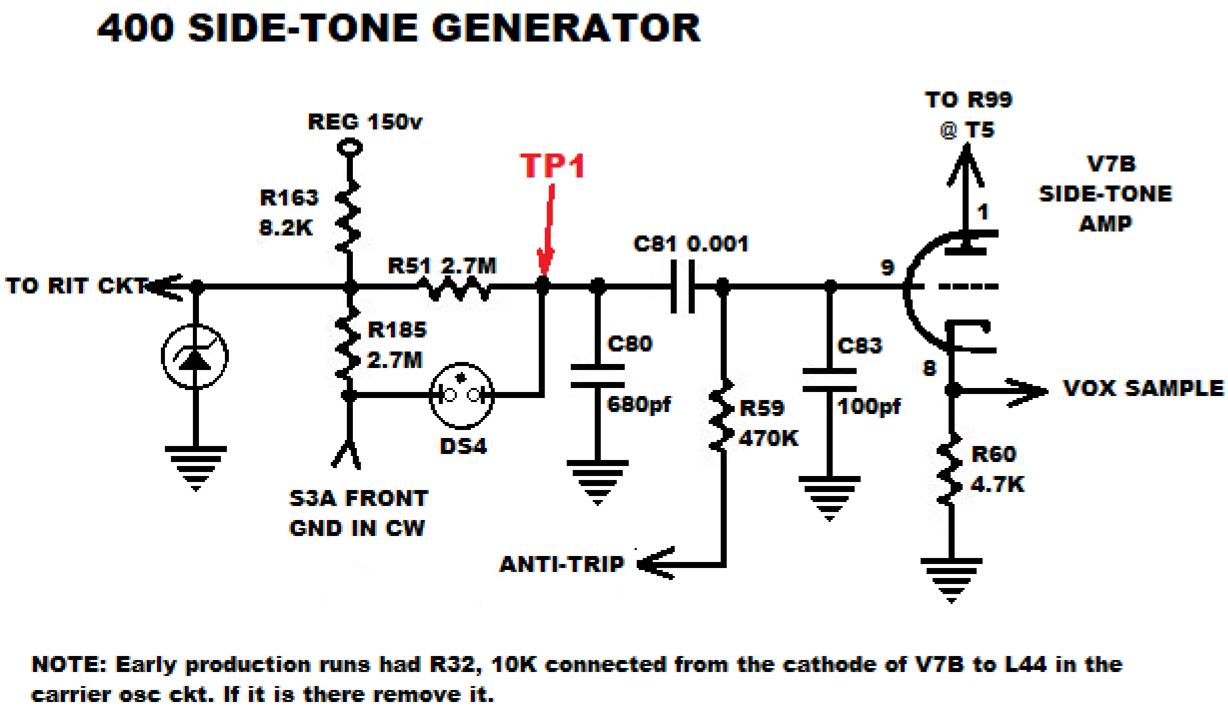


These tests are done with all gain and drive controls set to minimum, in RX mode.
Test unit B+ = 281vdc.

V20A	6	7	8
MOX	248	-42	0
VOX	119	0	1.6

V20B	1	2	3
DELAY MAX	268	0	6
DELAY MIX	168	0.5	0

6-21. SIDE TONE GENERATOR



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+ = 281.

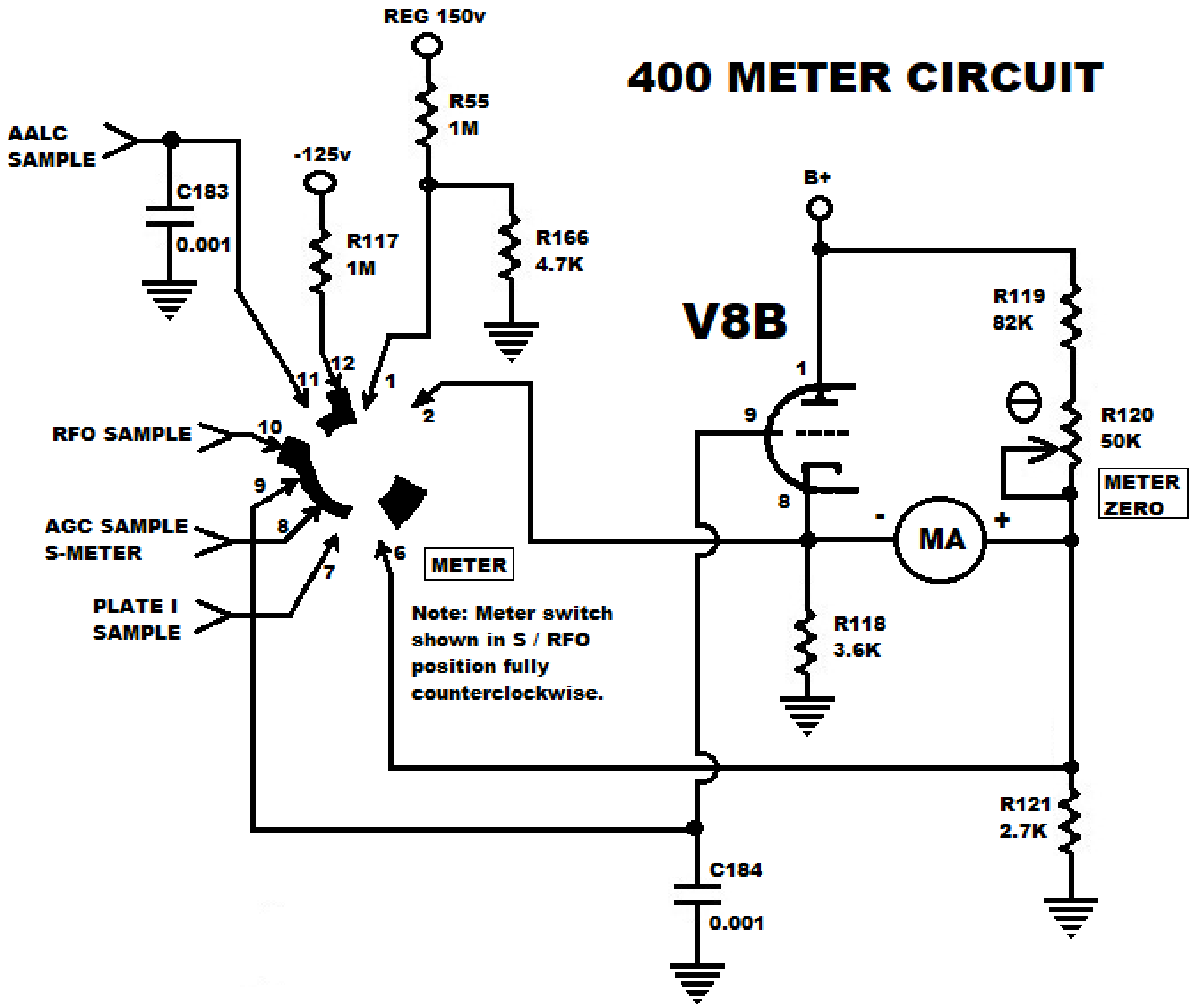
PIN #	1	8	9
UN-KEYED	265	0	-38
KEYED	263	11	0

Test point 1 will be a sawtooth signal.

PEAK TO PEAK	28vpp

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

6-22. METER CIRCUIT



These tests are done with all gain and drive controls set to minimum. Meter switch in the S/RFO position. Test unit B+ = 281vdc.

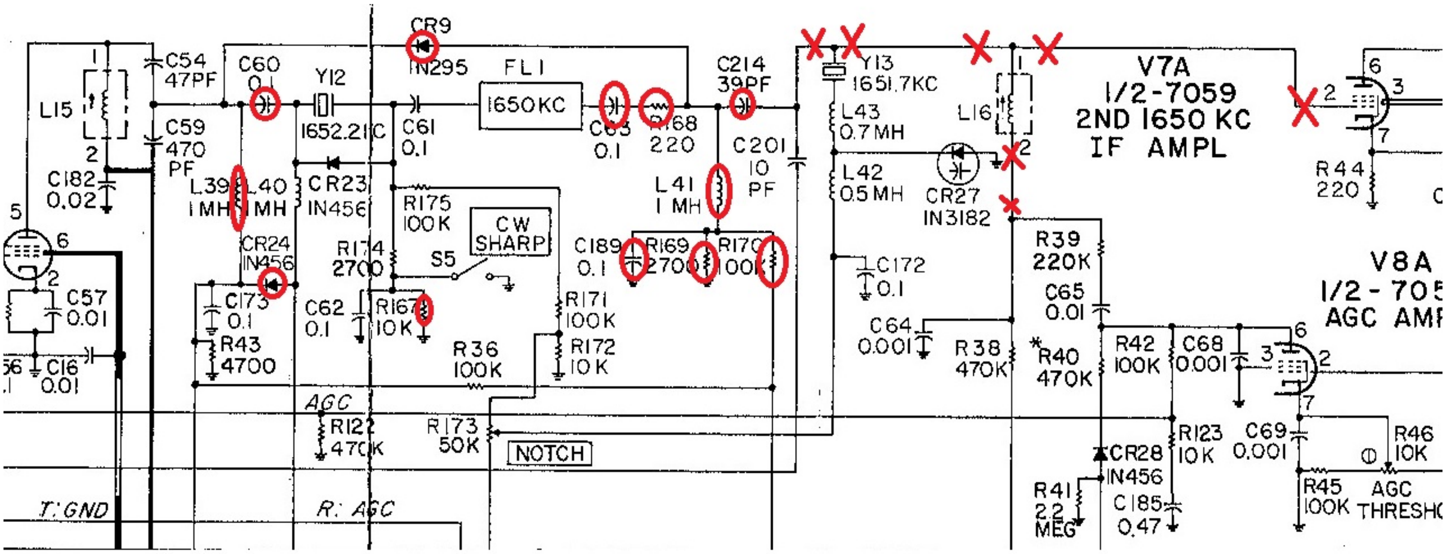
PIN #	1	8	9
METER ZERO AT MIN	277	9.32	-0.09
METER ZERO AT MAX	-------------	10.42	-0.09

7. TECHNICAL DISCUSSIONS

7.1. CYCLONE FL1 & NOTCH FILTER MODIFICATION

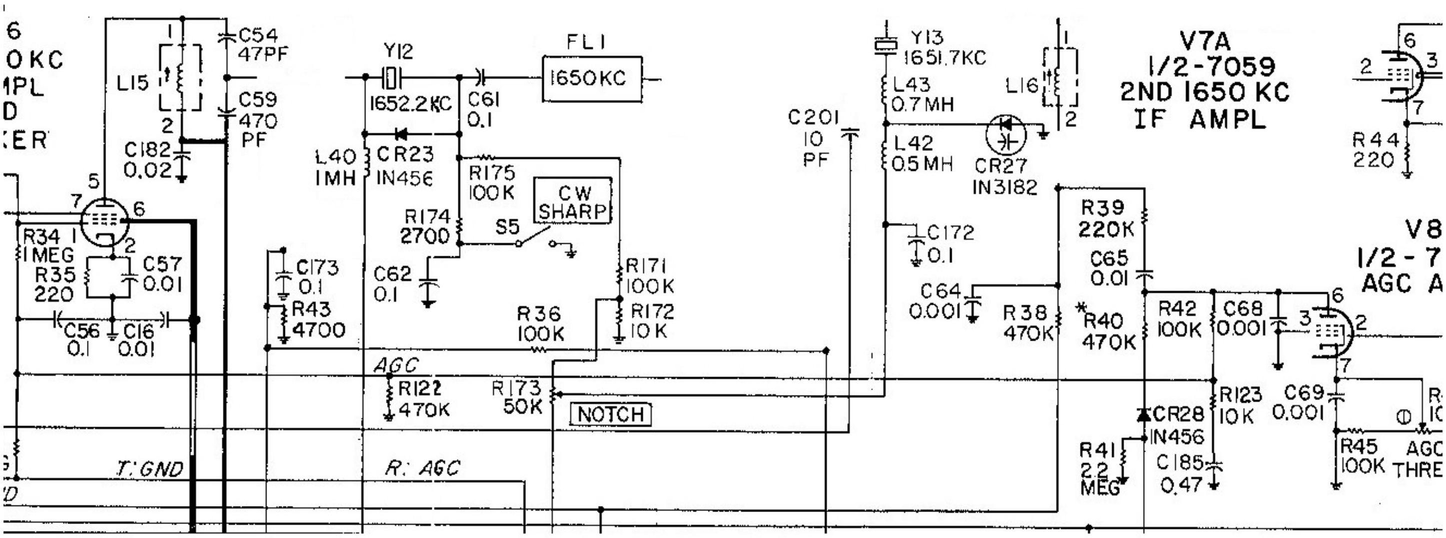
This is the most complicated part of the upgrade. Take time to trace the ckt on the schematics and in the chassis.

The parts circled in red will be removed and discarded. Wires marked with red X will be removed.

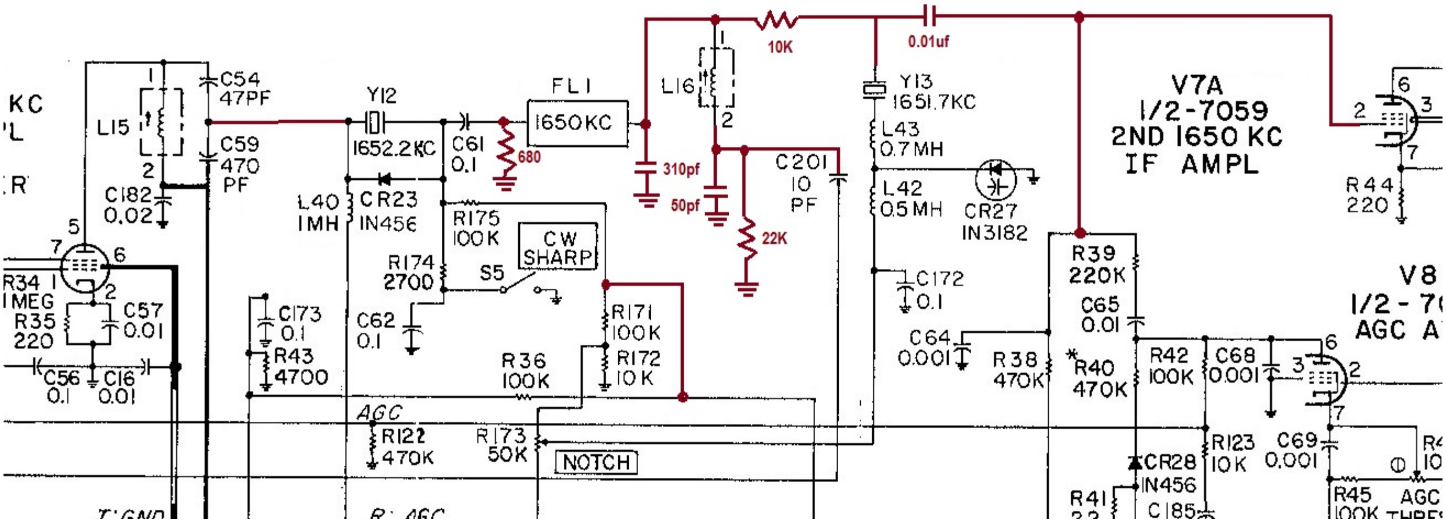


When disconnect wires and components from L16 note which pins are 1 and 2. The other pins (3 & 4) of L16 are not internally connected and can be used as tie points for adding components.

Your chassis should now look like this.



Add and connect components as marked in RED.



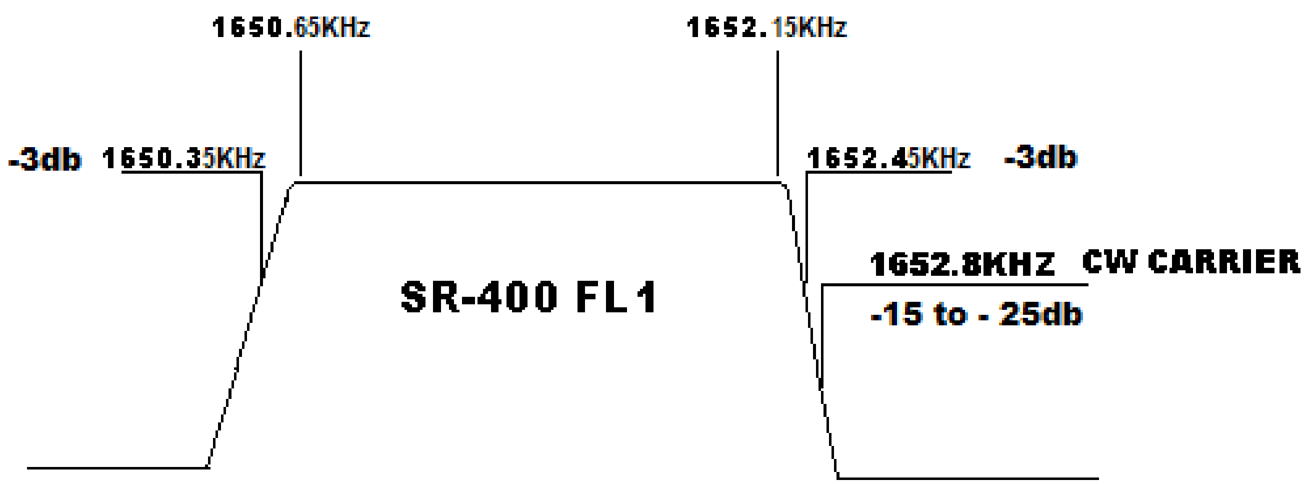
7-2. SR400 LOW POWER IN CW AND TUNE

Tune the rig up on 3.90MHz, LSB mode, MOX, key the mic and slowly repeat the words "three four three four three four". If the power out is substantially higher than it was in the tune function a fault most likely lies somewhere in the 1650 IF system, could be alignment or component drift.

BACKGROUND:
The rig was designed as an SSB rig primarily. CW stretches the limits of the 1650 KHz filter. The CW and TUNE functions use the USB carrier xtal regardless of what band you are on. The passband of FL1 is from 1650.35KHz to 1652.45KHz. In TUNE mode the balanced modulator CR19 & CR20 is biased to a full off-balance mode letting the 1652.8 KHz from the USB carrier osc pass through. This 1652.8 KHz is ideally 12 to 15dB down the skirt of the filter passband. However, this unbalanced pass signal is 5 to 8db stronger than the normal balanced mixer signal and this normally is enough to saturate the TX mixer. With ageing of the filter and associated circuitry it sometimes drops to 18 to 25 dB down and the tune and cw functions suffer power loss.

Before any corrective action is taken, one important test needs to be completed. Complete the adjustment of the VFO off-set. See paragraph 8-14 VFO CORRECTOR, in the factory INSTALLATION AND OPERATING INSTRUCTIONS manual. Then recheck the power in LSB and TUNE.

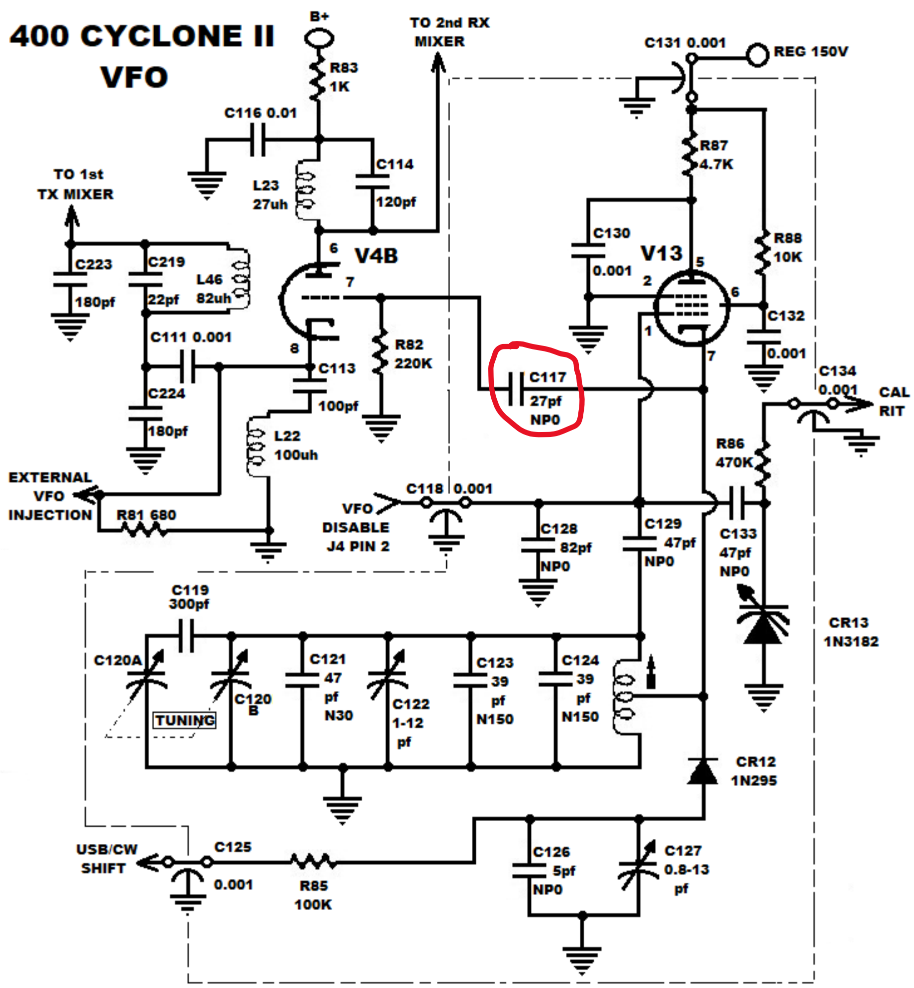
QUICK FIX: Adjust the USB Xtal (trimmer C139) to get 1652.600KHz instead of 1652.8kHz. That will move the carrier back up into the bandpass of the filter. LSB voice will not be affected. CW and USB voice will be shifted 200 HZ which can be easily off set with the cal function. I have offset the USB osc as much as 500Hz and still gotten in-spec performance. Recheck the power out in the Tune function. You can continue to operate in this condition. However, caution this is a cover-up. There is a fault and it will most likely continue to degrade.



7-3. SR-400 WEAK RX/TX

If you have a unit that the transmitter power and the receiver sensitivity both hover at or just below speck you may have a problem with the VFO output. Ideally the peak-to-peak voltage at pin 8 of V4B should be 3.6vpp at the very minimum you should have 3.2vpp. Once you eliminate the tube and the resistors, C117 may be your only option. Increase the value of C117 in increments of 10pf at a time until you attain 3.2vpp on pin 8 of V4B. If you push it to more than 3.7vpp you will most likely end up with transmitter spurs and receiver birdies. Once you get the drive level up and the receiver and transmitter are working properly, you need to check for receiver birdies and inspect the transmitter spectrum.

This same fault can be present in the SR-150 and the SR-2000.

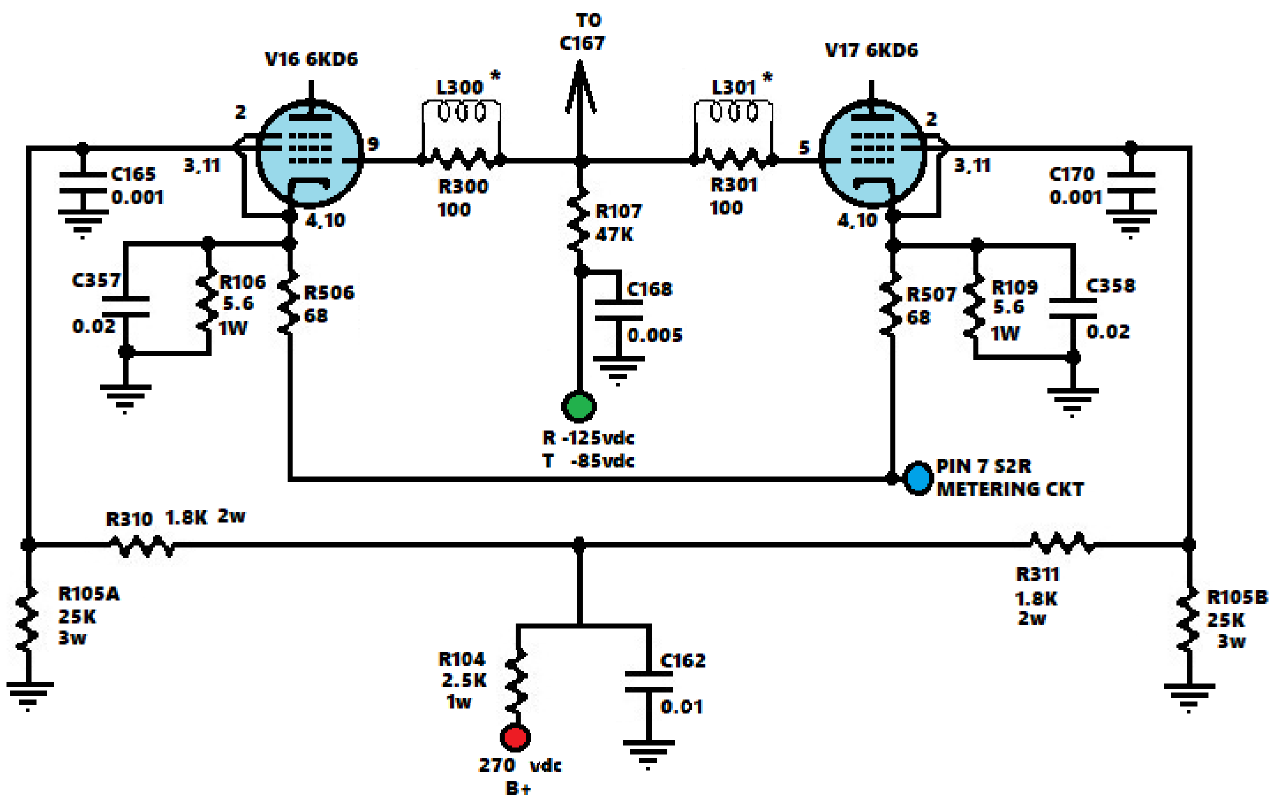


These test measurements are made with all gain and drive controls set to minimum, in RX mode. Use the RF BLOCKING dc probe for these measurements. Test unit B+ = 286vdc.

4B	**6**	**7**	**8**	
VOLTAGE	**186**	**-11**	**0**	
V13	**1**	**5**	**6**	**7**
VOLTAGE	**2.98**	**97**	**109**	**0**

7-4. SR-400 CYCLONE AND CYCLONE II PA UPGRADE TO 6KD6

Changing the PA finals of the Cyclone and the Cyclone II will give an average increase of 25 watts on 80meters and 60 to 75 watts on 15 and 10meters. The 400A uses the 6KD6 with a screen balance network that did not prove to be very beneficial. True you could adjust for a perfect balance at a particular frequency at one drive level. As soon as you change frequency or drive level the balance became skewed. It did not eliminate the need to use matched pairs as so many people thought. Some adjustment of R506 and R507 may be required if you rely on the panel meter for setting PA plate idle current. I do not. The panel meters in all the SR series transceivers are subject to wide errors. I recommend using the test jacks in the power supply to monitor and adjust plate current. The only exception is the SR-2000.



This schematic reflects the changes on the socket side of the PA enclosure. The tube side of the enclosure has no changes.

*** Five turns of #24 wire around the 100 ohm resistors.**

7-5. SR-400 AGC DISCUSSIONS

QUESTION. --->

Thanks again Walt.

This radio is getting to be very nice thanks to you.

A small problem still exists... the S meter is very generous; most strong signals are full scale and weaker ones are S7 to S9. This is after a one hour warm up with the meter zero and AGC set per the manual.

Could you point me in the right direction?

REPLY.

The agc circuit is a closed loop circuit and fault isolation can be a challenge.

The S-Meter is true only when the receiver RF GAIN control is at max. So, let us start there. With power on and no signal input (terminate the antenna in 50 ohms, dummy load works fine). Ground the tie-point of R2 and C12 (grid of V1 this blocks the AGC action). Measure the voltage at the junction of R3, 4A, R5 and R7 (cathode of V1). It should be between +0.1 and -0.1 volts dc. If it is not then R4A is probably at fault or there is a wiring error. That point needs to be as close to ground as possible with the pot at max gain.

The S-meter linearity depends on the receiver train gain, proper alignment and the linearity of V8A & B. Use the fault isolation chart section 2-4 of the repair and restoration document to determine if the receiver train gain is good. In all the steps in the chart the tie-point of R2 and C12 is grounded disabling the AGC.

Next is V8 the AGC/S-meter amp. This tube needs to be hand selected for the best balance of agc and s-meter operation. This is a tedious process every time you swap out V8 you must reset the agc threshold and the meter zero.

Finally, the S-meter was never intended to be precision instrumentation. This is testified to by the considerable wide spec. "25uv to 100uv at the antenna shall produce a reading of S9". I can usually get most radios very close to actual scale. Some not so close. However, all radios will meet the 25-100uv spec with time and diligence. The actual scale is as follows:

0.8uv = S3

3.2uv = S5

50uv = S9

7-6. 12BY7A DRIVER TUBE

In today’s world the 12BY7A used as drivers in amateur radio transmitters is suffering a very short life span. The screen current is the main contributor to these failures. After a few months in service the drive starts to soften resulting in reduced power out. If the screen current in the 12BY7A exceeds 6ma it will suffer a shortened life.

Hallicrafters and other radio manufacturers bought the tubes in bulk to very tight specifications. Today we do not have that option. This condition is exasperated by the higher voltages delivered by power supplies driven by higher primary AC line voltages.

The cure for this problem in the SR series is simple.

For the SR 150 measure the voltage drop across R108 and calculate the current flowing through it. Measure the voltage across R109 and calculate the current flowing through it. If you subtract the R109 current from the R108 current you are left with the screen current.

For the SR 160/500 measure the voltage drop across R93and calculate the current flowing through it. Measure the voltage across R91 and calculate the current flowing through it. If you subtract the R91 current from the R93 current you are left with the screen current.

For the SR-400 and SR-2000 measure the voltage drop across the screen resistor and calculate the screen current. NOW. If the screen current is less than 6 milliamps then you are good.

In most cases the screen resistors need to be increased to 6.2K. With the screen resistor (R93, R108, or R110) at 6.2k a majority of old used and NOS 12BY7A will function properly in the radio.

It is **IMPORTANT** to check the screen current any time the 12BY7A is replaced.

8. DATA SHEETS

8-1. VFO FREQUENCY CORRECTION

BLACK DIAL	SPEC MHz	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5	TEST 6
0	4.850						
100	4.750						
200	4.650						
300	4.550						
400	4.450						
500	4.350						

8.2 PERFORMANCE DATA

8-2-1. RECEIVER PERFORMANCE DATA

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 5uv to 5000uv, no more than a 10 db variation in audio output 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	

8-2-2. TRANSMITTER PERFORMANCE

Tests performed with 50ohm resistive load. Measurements made with BIRD avg power and PEP power meter.
Hi voltage _________vdc B+ _________vdc Bias -_________vdc

Final amplifier bias set to 70 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. Set mic gain to max. A signal level not more than 5mv rms shall produce the minimum specified SSB output power on any band. ________.

SSB Power output: Set mic gain set to 8. Inject a standard 2 tone signal into the mic jack.

FREQ	MIN SPEC	w/std 2 tone
3.8mhz	175 W min	
7.3mhz	175 W min	
14.3mhz	170 W min	
21.3mhz	160 W min	
28.8mhz	150 W min	

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

FREQ	MIN SPEC	AVG POWER
3.8mhz	175 W min	
7.3mhz	170 W min	
14.3mhz	170 W min	
21.3mhz	160 W min	
28.8mhz	150 W min	

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 between. ________