

**REPAIR & RESTORATION
OF
HALLICRAFTERS
SR-400 CYCLONE II
SR-400A CYCLONE III**

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.

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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 only to the Cyclone II and Cyclone III. The first question you might ask is “why did I not include the SR-400 Cyclone”? The first generation 400 had too 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. Contact me and I will send you the document. Just to clear the air I am not a fan of the Cyclone III either. I use my Cyclone II. I turn on my Cyclone III once a month for 2 or 3 hours just to keep it dry.

This document takes a systematic approach to rehab. Unless otherwise noted all discussions apply to either the Cyclone II or III. 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
TRANSCIVER
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 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.

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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 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; C46, 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 5-3.

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. You will not be transmitting power until late in this process so temporarily replace the 5 amp slow 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 located in section 5). Set the FUNCTION switch to either USB or LSB depending upon which band you will be testing the default is LSB. Insure that a jumper plug is installed in J4 on the rear of the radio. The jumper plug should have a jumper between pins 4 and 10.

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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.** 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 doesn't, 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. 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.

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. 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.

1-5-4. VFO:

The VFO is comprised of V13, V4B and associated circuitry, the VFO correction circuitry and the RIT/CAL circuitry.

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.

Due to the age of the SR-400 a more reasonable warm up time is 30 to 40 minutes.

1-5-4-1. RIT/CAL

The RIT/CAL cks 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° 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.

1-5-4-2. 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 cks 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.

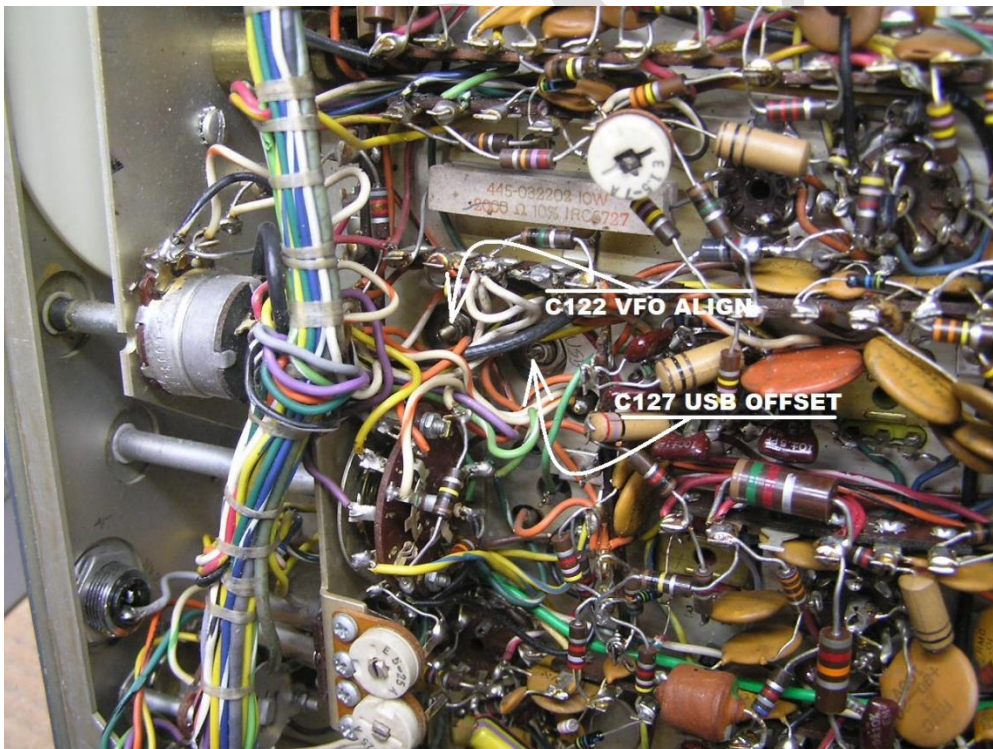
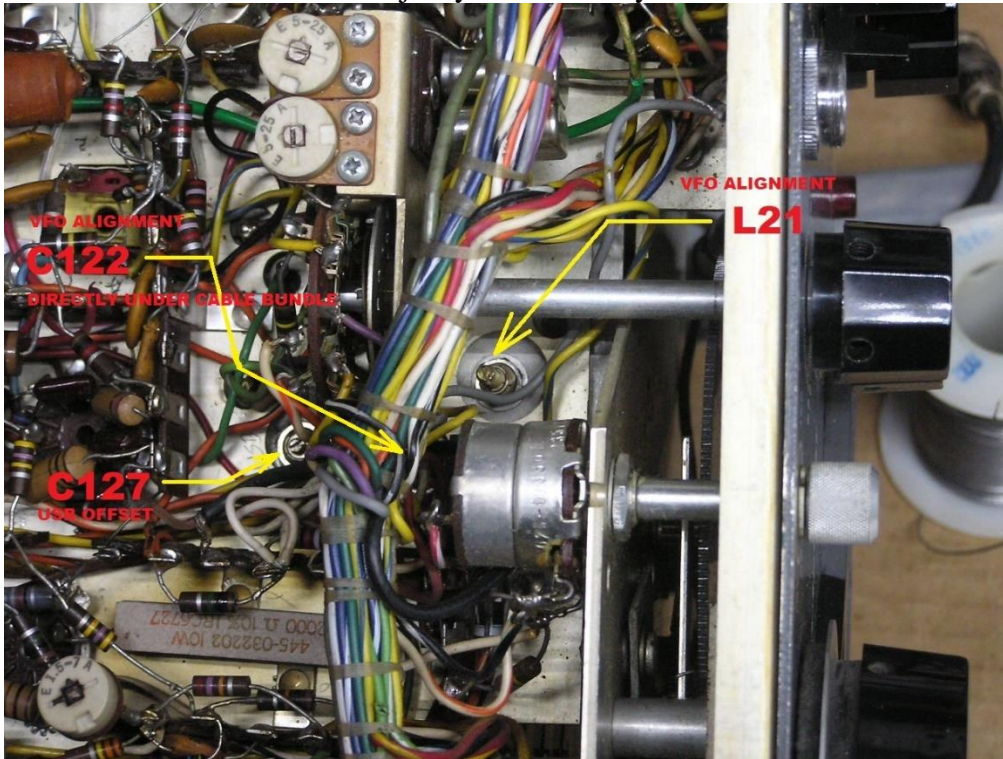
1-5-4-3. VFO ALIGNMENT

Before starting the VFO alignment perform a VFO stability test. 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 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.

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VFO ALIGNMENT CONTINUED:

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: A majority of the factory manuals do not have the location of L21 defined.

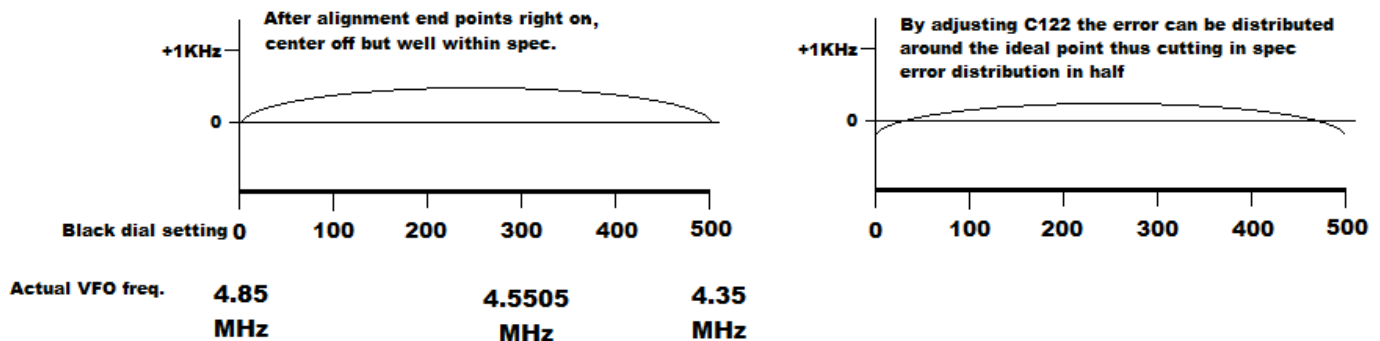


REPAIR AND RESTORATION OF THE SR-400

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 \emptyset 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 \emptyset 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.



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 (BLACK SCALE)
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
RIT CONTROL	MID RANGE
LOAD & PLATE	N/A

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 T1

\$ May require peaking of L3 and PRESELECTOR

** If the RX is working at this point perform the 6meg trap alignment. See section 8-12.

@ May require peaking of T2

~ May require peaking of L10 and PRESELECTOR

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 completer 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. 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.

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 of zero you most likely have an agc fault in V8A, or associated circuitry.

2-7. CAL OSCILLATOR

2-7-1. CYCLONE 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.

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.

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 figure section)
 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 to J1.

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.** Insure 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 to 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 final tube condition indicator.

Once you have set the idle current there is a quick test to indicate the condition of your final tubes.

Locate R115, the bias adjust pot. Key the transmitter with **no drive/no power out**. Double check that the idle 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 tuber. This voltage reading is typical for a PA where the B+ =750vdc under load and screen voltage = 260vdc. There are 4 configurations of the PS-500 power supply, and dozens of ‘modified’ versions. The B+ varies from 725 to 830vdc and the screen 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 Screen 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. Tune the PLATE 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, 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 14, 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.

REPAIR AND RESTORATION OF THE SR-400

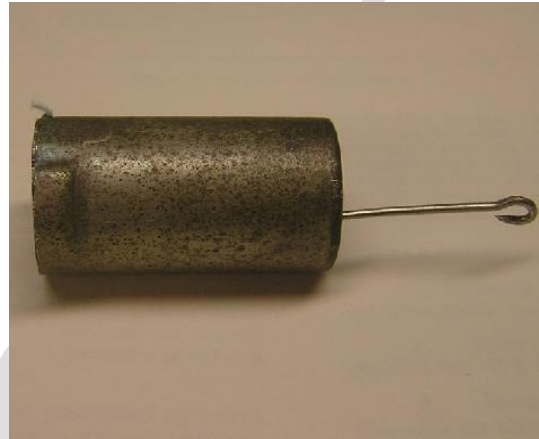
Set the band switch to 21, key the transmitter and adjust the PRESELECTOR, L8, L31 and LOAD for max plate current, and dip the PLATE. Temporarily advance the RF LEVEL and record the max power out. Set the band switch to 28.5, key the transmitter and adjust the PRESELECTOR, L7, L30 and LOAD for max plate 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 on 10 meters) proceed to section 4-2 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 making contact with 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. If not go to step 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. If the signal is incorrect go to step C.

C. If the signal is not correct 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 correct go to step D. If it is not, and since the receiver is working properly, the problem is in the Het Osc transmitter switching circuit. Check the dc voltage on the tie point of L20 and the cathode of CR11. It should be greater than 14 volts in receive mode and less than 1.9 volts in transmit mode. If this voltage is correct then either CR11 or C47 is bad. The voltage on the cathode of CR11 is developed by the cathode current of V15 (the audio output tube). If the voltage on the cathode of CR11 does not drop in transmit mode check the grid of V15. The grid should go to gnd in transmit mode, if it does not check relay K2. If the voltage is not correct in receive mode measure the voltage on the opposite end of L20. If the voltage is good then L20 is bad.

D. Reinstall V2 and remove V12. Connect the scope to pin 7 of V11. Key the transmitter. You should have 3.5 vpp. If the signal is correct, and the test B above was good, then the fault is in V11 and its associated circuitry.

E. If the signal is not good, reinstall V12 and move the scope to pin 7 of V2 (VFO signal injection). Key the transmitter and you should have 3.5vpp. If the signal is not correct the fault is most likely CR34 or V2.

F. If the signal is good move the scope to V2 pin 2(carrier/balanced mod injection signal). Key the transmitter. If the signal is 0.6 vpp 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.

G. If the signal is not good 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.

This completes the transmitter fault isolation process. You should have found the fault at this point. If not then verify that the receiver is functioning properly. Then restart section 3 test procedures. There are many circuits that are used in both RX and TX, by verifying the RX functions you are also proofing all the common ckts.

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).

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. 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. 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.

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.

4-3. V9B RX FAULT ISOLATION

This circuit is pretty straight forward. Check the voltages and resistances against the charts in the manual. 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.

4-5. V7A RX FAULT ISOLATION

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; V7A, C8, C60, C71, C72 or T3.

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

NOTE: In this next step you will be injecting signal into the plate pin of the tube socket. If your probe is NOT D.C. blocking and not rated for 300 vdc or higher you WILL DESTROY the attenuator in your signal generator. You will need to acquire or construct an injection probe that will handle that voltage.

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 L5, C54, C59 or C182 is 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 (Paragraph 2-4). If you get ½ watt audio out then V5 or its associated circuitry are at fault.

SUBSYSTEM TROUBLESHOOTING AND TESTING

4-8. V4A RX FAULT ISOLATION

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.

4-9. V3 RX FAULT ISOLATION

WARNING DAMAGE TO TEST EQUIPMENT POSSIBLE. See note in 4-7. 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.

4-10 V2 RX MIXER FAULT ISOLATION

WARNING DAMAGE TO TEST EQUIPMENT POSSIBLE. See note in 4-7. 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.

4-11 V1 RX FAULT ISOLATION

WARNING DAMAGE TO TEST EQUIPMENT POSSIBLE. See note in 4-7. 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.

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 have the plate voltage present at all times. 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.

5-1-5. MANUAL SECTION 5-4 MARK UP:

The following, **in italics**, is a markup of **part** of *section 5-4* from the original manual. You must first read and understand all of section 5 in the original manual before implementing the following suggestions.

The “**red letters**” are suggested deviations and cautions from original manual section 5-4.

FROM THE FACTORY MANUAL

5-4 BASIC TRANSMITTER TUNE-UP

The Model SR-400 Transceiver can be tuned up on several frequency segments that are outside the amateur bands. Care must be exercised not to transmit on these frequencies. The receiver group of controls, not specifically mentioned below, has no direct bearing on the transmitter tune-up procedure and may be disregarded for the moment.

A. Pre-set the panel controls for transmitter tune-up as follows:

- OPERATION.....REC
- FUNCTION.....TUNE
- BAND SELECTOR.....Desired band
- PRESELECTOR.....Set at band segment in use
- Tuning dial.....Set to desired frequency
- METER.....PLATE MA

The meter circuit commonly has an accuracy of + or - 20%. It is highly recommended that the initial bias adjustment be done with an external meter connected to the plate current jacks, TP201 and TP202 on the PS-500. For operational tune-up procedures the meter ckt inaccuracy is not an issue. It is of great benefit if the plate current and the power out are monitored simultaneously. If you normally operate your station with an inline wattmeter, set the meter switch to PLATE-MA. If an inline wattmeter is not used, do the following. Attach a meter to TP201 and TP202 on the power supply chassis to monitor the plate current. Set the meter switch to RFO/S to monitor the power out.

- RF LEVEL.....At zero (Full CCW)
- MIC. GAIN..... At zero (Full CCW)

At initial turn on and at shutdown always set these two controls to zero or full CCW. This will lessen the possibility of inadvertent emissions that could damage the transceiver and shorten the life of the PA tubes.

- *PLATE (Final tune capacitor).....Use chart settings
- *LOAD (Final loading capacitor).....Use chart settings

Always dip the PLATE current first. Then peak the power with the LOAD.

Do not take the recommendation below lightly. There are an infinite combination of settings of the LOAD and PLATE controls that will provide resonance and a plate current dip. The settings suggested in the chart are the design center starting points and should be strictly adhered to. The chart is found on page 20 of the original CYCLONE and CYCLONE II manuals and page 21 for the CYCLONE III.

***IMPORTANT**

Presetting the PLATE and LOAD controls per the chart will avoid incorrect control settings and minimize plate dissipation in the final amplifier tubes during the turn-up procedure.

B. If the transceiver has just been turned on allow a few minutes for the equipment to reach operating temperature before proceeding with the transmitter tune-up.

With the METER selector switch set at PLATE MA the meter pointer will normally rest to the left of the meter scale zero when the transceiver is in the receive mode. This is normal for the meter circuit used in the transceiver.

Caution: From this point on any time you switch from REC to MOX you will be in TX mode if you have properly set the preconditions listed in paragraph A. Be aware of the plate current and power out at all times. Keep the duty cycle low, 5 seconds TX with min 10 seconds rest in RX. Read all of paragraph C before you start. Each of the following paragraphs should be read and understood before any adjustments are made.

TECH NOTES CONTINUED

BASIC TUNE UP CONTINUED

C. Set the OPERATION control to MOX. The idle plate current of the final amplifier stage should indicate less than 100 milliamperes. If 100 ma is exceeded immediately return to REC mode. Check to see that the RF LEVEL control is set to zero and the BIAS ADJ control on the power supply is set at its full clockwise position for maximum bias voltage

There are two versions of the PS-500 power supplies. The early version was produced to work with the SR-500 and the SR-400 Cyclone. This power supply has a potentiometer on the rear of its chassis used to set the BIAS for the SR-500. Many of these power supplies have been reworked and may have the BIAS pot wired in reverse. To be sure of the setting of this pot unplug the power supply from the power source and the R/T unit. Connect an ohmmeter from pin 4 to pin 3 of J201. Set the pot for maximum resistance. With the meter positive lead on pin 3 and the negative lead on pin 4 it should read greater than 30k ohms.

The later version of the PS-500 did not have the pot for BIAS ADJ but, has an AC receptacle to provide power to a cooling fan.

After making the no power checks and adjustments proceed to section 8-3, in the factory manual, and insure that proper idle current can be achieved. If normal function cannot be achieved, this fault must be cleared before proceeding.

D. Set the METER selector at RFO/S and check to see that the PLATE and LOAD controls are preset per the tuning chart. **NOTE: The METER selector setting will vary depending upon how you approach monitoring in paragraph B.** While

monitoring the plate current move the OPERATION control from REC to MOX. Slowly increase the RF LEVEL until you see a slight increase in plate current. Now adjust the PRESELECTOR for max plate current. **Caution:** Monitor the plate current and if it exceeds 300 mills back off on the RF LEVEL to keep it below 300 mills. Adjust the PLATE CONTROL for a dip in plate current. **REMEMBER TO KEEP THE TX DUTY CYCLE SHORT.** At this point you have reached resonance however, the final amplifier stage still requires a loading check and possible adjustment.

NOTE

During the next step of the transmitter tuning procedure the final amplifier tubes will operate at their highest plate dissipation. The plate dissipation at this time will be higher than for continuous operation on either SSB or CW at full power output. For this reason it is recommended that full carrier power be applied only for the length of time needed to evaluate the loading adjustment required.

This is the end of this marked up guide. BUT, this is not the end of the tune-up procedure. It is IMPERATIVE that you continue with paragraph E, of the manual to complete the LOAD tuning procedure. Return to the original manual.

TECH NOTES CONTINUED

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 been 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 30 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 117 (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 off 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). If you are concerned about the final tubes adjust the bias for an idle current of 30 or 40mills.

- 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-x. 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.

<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 close to 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. DATA SHEETS**6-1. 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						

6.2 PERFORMANCE DATA

6-2-1. 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 5uv to 5000uv, no more than a 10 db variation in audio output shall occur.

MEASURED CHANGE	
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“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	
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6-2-2. 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. _____