Chapter 6 - Corrective Maintenance

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6.1 Introduction

6.1.1
This Chapter provides alignment and repair procedures to enable maintenance personnel to correct deficiencies found as a result of scheduled maintenance and troubleshooting procedures in Chapter 4 and 5 respectively. Before any alignment is attempted all faulty components should be located and replaced. A definite need for alignment should be established by accomplishing sensitivity and bandwidth tests (paragraphs 4.3.1 and 4.3.2) after eliminating faulty components.

6.1.2
The alignment section describes the recommended method by which the equipment is set up, test equipment is connected and used, and necessary adjustments are made to ensure proper equipment performance.

6.1.3
The repair section outlines the methods necessary for disassembly, cleaning, repairing, and reassembly required to replace a faulty component within the receiver.

6.2 Alignment and Adjustment Procedures

6.2.1 General Alignment Information.

Use a fluted no. 8 Bristol wrench for adjusting the antenna, the RF, and the variable IF cores. Use the same tool for adjusting the tuning shafts during mechanical synchronization. Use a nonmetallic screwdriver for adjusting the various trimmer capacitors. Use a hexagonal, nonmetallic tool for adjusting the cores in T501, T502, T503, and Z503 on the IF sub-chassis. Be sure that this tool is inserted through the top core into the bottom core, and that the bottom core turns without disturbing the setting of the top core. Make this type of adjustment only after the particular coil or transformer has been replaced.

6.2.2 Test Equipment and Special Tools

1. RF Signal Generator AN/URM-25
2. Impedance Adapter MX-1487/U
3. Electronic Multi-meter AN/USM-116
4. Multi-meter AN/PSM-4

6.2.3 Test Conditions

1. Temperature: Normal room or shelter.
2. Humidity: Normal room or shelter.
3. Line Voltage and Frequency: 115 or 230 volts AC ± 1 percent at 60 Hz.
4. Warm-up Period: At least 15 minutes.
5. Standard Modulation: 30 percent AM at 400 Hz.

6.2.4 Preparation for Alignment

Before applying power to the receiver, the following conditions must exist:

1. All the controls must operate freely and the knobs must be securely attached to their shafts.
2. The tubes and tube shields must be securely in place.
3. All connectors must be seated firmly.
4. The KILOCYCLE CHANGE dial overtravel must not be less than 25 kHz at each end.
5. The receiver must be grounded, and ac power must be applied; the front-panel controls must be set according to table 4-2.
6. 5.a With the exception of the ANT TRIM and LOCAL GAIN control which will be adjusted after applying power.[1]
7. 5.b **After applying power** to the receiver, the following conditions must exist: [2]
8. The B+ voltage between chassis ground and the +150V test point E607 (Figure 6-28) should be between +148 volts and +153 volts.
9. All tube filaments must be lit.
10. The antenna relay must be actuated when the FUNCTION switch is placed in the STANDBY and CAL positions.
11. CARR-METER ADJ control R523 (Figure 6-16) on the IF sub-chassis must be adjusted for a CARRIER LEVEL meter indication of 0.

6.2.5 Mechanical and Electrical Synchronization

The receiver tuning elements, which consist of the frequency indicator, KILOCYCLE CHANGE, and MEGACYCLE CHANGE 10-turn stops, the 6-position RF band switch, the second crystal band switch, and the VFO, must be in synchronization with the RF gear train before electrical alignment is attempted. If the receiver is being realigned because of low sensitivity or replacement of parts such as the variable IF, the fixed IF, or the RF transformers, it should not be necessary to check the mechanical and electrical synchronization. Non-synchronization of the tuning shafts and the RF gear train is likely to occur as a result of the removal and replacement of the RF sub-chassis, crystal-oscillator sub-chassis, VFO sub-chassis, or the disassembly of part or all of the RF gear train assembly. Check and adjust the following items as may be necessary.

6.2.5.1

Ten-Turn Stops. Check the 10-turn stops (Figure 6-3) by rotating the MEGACYCLE CHANGE and KILOCYCLE CHANGE shafts fully counterclockwise. The first two digits on the frequency indicator should indicate halfway between 99 and 00 MHz (off the detent position). The next three digits should indicate between -963 and -972 kHz.

⇒Note:	If the cam followers do not function as described below, follow repair procedure in paragraphs 6.3.16 through 6.3.19.

[1,2]Courtesy of Perry Sandeen

6.2.5.2 Slug-Rack Cams and Followers. (See Figure 6-2.)

Check the slug-rack cam followers at the high and low ends of each coil range. Normally, all cam followers should be near (but not at) the peak of the cams at the high end of the coil ranges.

1. All cam followers, except the cams for the 0.5- to 1-MHz range, should not quite reach the peak of the cams at the high end of the range.

2. The cam followers for the 0.5- to 1-MHz range may pass over the peak of the cams for a KILOCYCLE CHANGE control reading of +025 or higher.
3. All cam followers except the 0.5- to 1-MHz cam followers should not quite reach the valley of the cams as the KILOCYCLE CHANGE control is turned to the low end of the coil range.
4. The 0.5- to 1-MHz cam followers may pass through the valley and start up the other side of the cams as the KILOCYCLE CHANGE control is adjusted to a reading of about 475.
5. The cam follower on first variable IF transformer Z213 (17.5 to 25 MHz) is near the valley of the cam when the KILOCYCLE CHANGE control reading is 500, and rises to near the peak at 07 +000.
6. The cam follower on second variable IF transformer Z216 (3 to 2 MHz) is near the valley of the cam when the KILOCYCLE CHANGE control is rotated fully clockwise, and near the peak when the KILOCYCLE CHANGE control is fully counterclockwise.

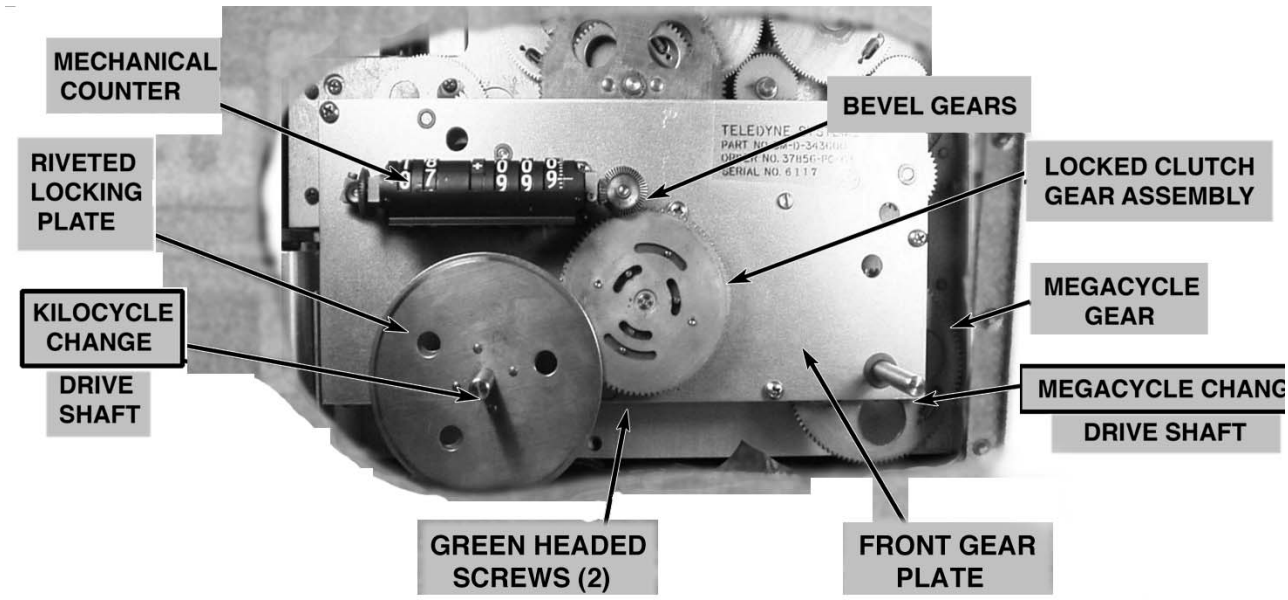


Figure 6-1 RF Gear Train Assembly, Location of Parts-Norris

6.2.5.3 Camshafts. (See Figures 6-2 and 6-3)

⇒**Note:**	If any cams have been synchronized with the RF sub-chassis removed from the main frame, the VFO sub-chassis must be synchronized (par 6.2.5.6) after the RF sub-chassis is replaced.

1. Set the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a frequency-indicator reading of 7+000. The camshafts are synchronized if the cam positioning marks on the pressed cam plates line up with the points of the cams and the intermittent switch drive gears. Figure 6-2 shows the front and Figure 6-13 shows the rear of the cam plate.

2. If all the cams line up at some other frequency indications, perform the following:

   a) Position the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls until the cam points are lined up with the cam positioning marks.
   b) Loosen the two bevel gear clamps on the mechanical counter (Figure 6-1).
   c) Manually adjust the counter dial to 07 +000.
   d) Tighten the gear clamps.

3. If one cam does not line up with the cam position mark, perform the following:

   1. Loosen the clamp on the front end of the individual camshaft.
   2. Line up the cam point with the cam positioning mark.
   3. Tighten the clamp.

⇒**Note:**	To avoid losing the nut, do not loosen the clamp more than necessary. Be careful not to strip the screw thread when tightening.

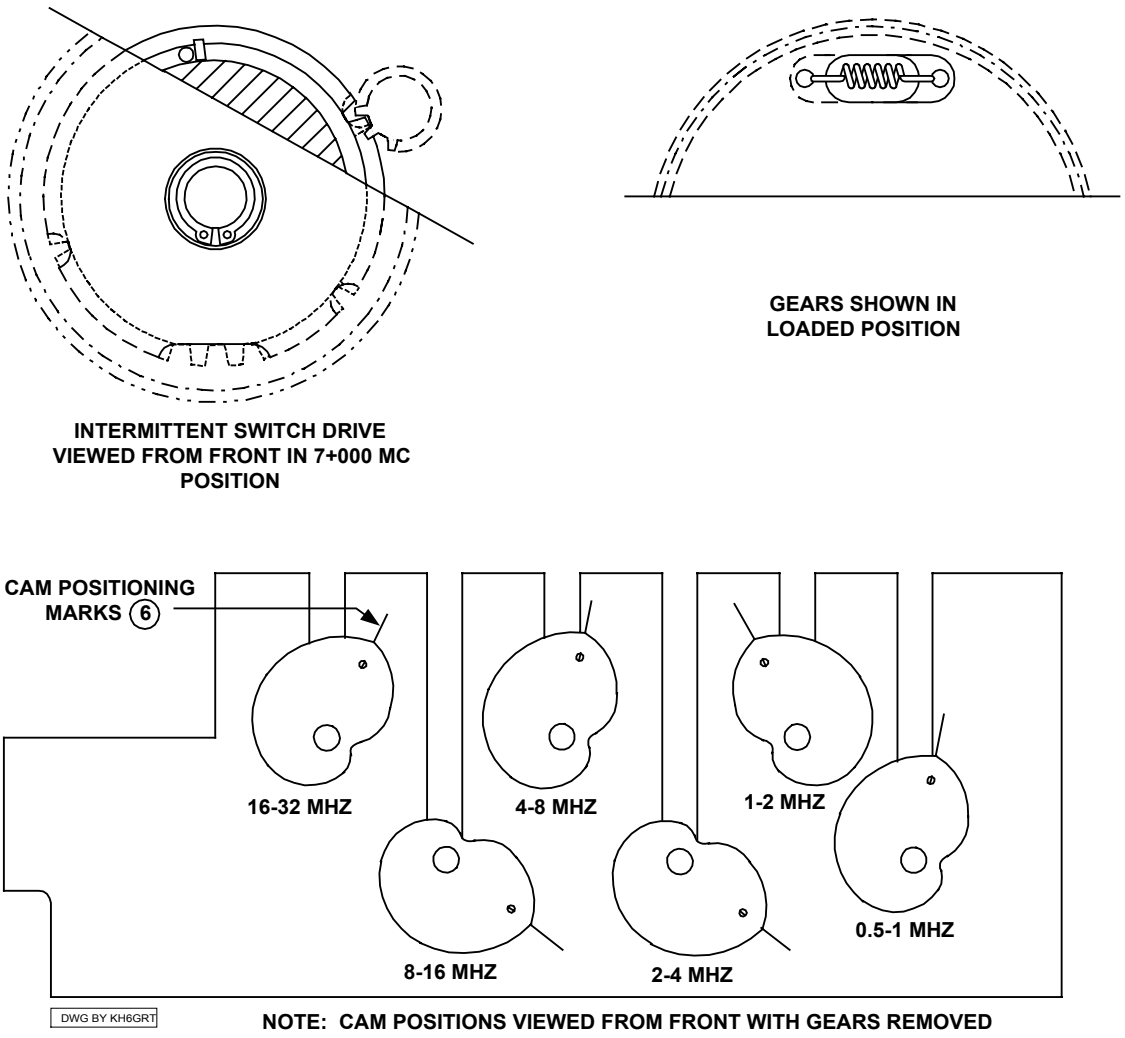


Figure 6-2 Mechanical Alignment Details[1]

6.2.5.4 Six-Position RF Band Switch. (See Figure 6-20.)

1. Position the MEGACYCLE CHANGE and KILOCYCLE CHANGE controls for a frequency-Indicator reading of 07 +000.
2. Remove V207.
3. Disconnect P108 (Figure 6-14) from J208.
4. Connect Multi-meter AN/PSM-4 ( ) between pin 6 of XV207 and pin D of J208. The Indication should be approximately 200k ohms after Field Change 7 has been accomplished.
5. Turn the MEGACYCLE CHANGE control to 08. The AN/PSM-4 ( ) should indicate an infinite reading.
6. If the indications are not as in 4 and 5 above, continue with procedures 7, 8, and 9.
7. Disconnect the PSM-4 ( ) and reinsert V207.

[1]Courtesy of Pete Wokoun, KH6GRT

8. Remove the front panel (paragraph 6.3.2) and the RF sub-chassis (paragraph 6.3.3).

9. Loosen the RF band switch clamp (Figure 6-3). Turn the band switch shaft until the rotors are centered on the contacts, which provide the indications required in procedures 4 and 5 above. Tighten the RF band switch clamp.

6.2.5.5 Crystal-Oscillator Sub-chassis Band Switch.

The crystal-oscillator band switch is synchronized when the indicator-wheel number (Figure 6-14) that appears in the hole on the crystal-oscillator sub-chassis agrees with the first two digits of the frequency indicator.

⇒Note:	Only even numbers appear on the indicator wheel; odd numbers appear as straight lines between numbers; 00 on the frequency indicator appears as 0.

1. If the indication is incorrect set the receiver controls as directed in paragraph 5.5.2 and turn the FUNCTION switch to STANDBY.

1a. Paragraph 5.5.2 is reproduced below for your convenience:[3]

Line Meter	OFF	Ant. Trim	0, or maximum output
Line Gain	0	BFO	Off
AGC	MED	Dial Lock	Unlocked, fully counterclockwise
Line Meter	Off	Zero Adj.	Disengaged, fully counterclockwise
Audio Response	Wide	Local Gain	10, or desired volume
Bandwidth	8	Ovens	Off
BFO Pitch	0	MEGACYCLE CHANGE	01, or as specified
Break In	OFF	Kilocycle Change	510, or as specified
Function	MGC	RF Gain	10

2. Connect Electronic Multi-meter AN/USM-116 ( ) between test point E210 (Figure 6-19) and chassis ground.

3. Loosen the shaft coupler. Insert a long screwdriver through the SYNC XTAL OSC hole in the rear panel of the receiver and turn the crystal-oscillator band switch shaft to the correct number.

4. Tighten the shaft coupler.

5. Turn the MEGACYCLE CHANGE control to each side of the detent point. The AN/USM-116 ( ) indication should be -3.5 to -8 volts at the detent point and should drop to zero each side of the detent point. If not, readjust the crystal-oscillator band switch shaft (4 and 5 above) to meet this condition.

6. Disconnect the AN/USM-116 ( ).

[3]Courtesy of Perry Sandeen

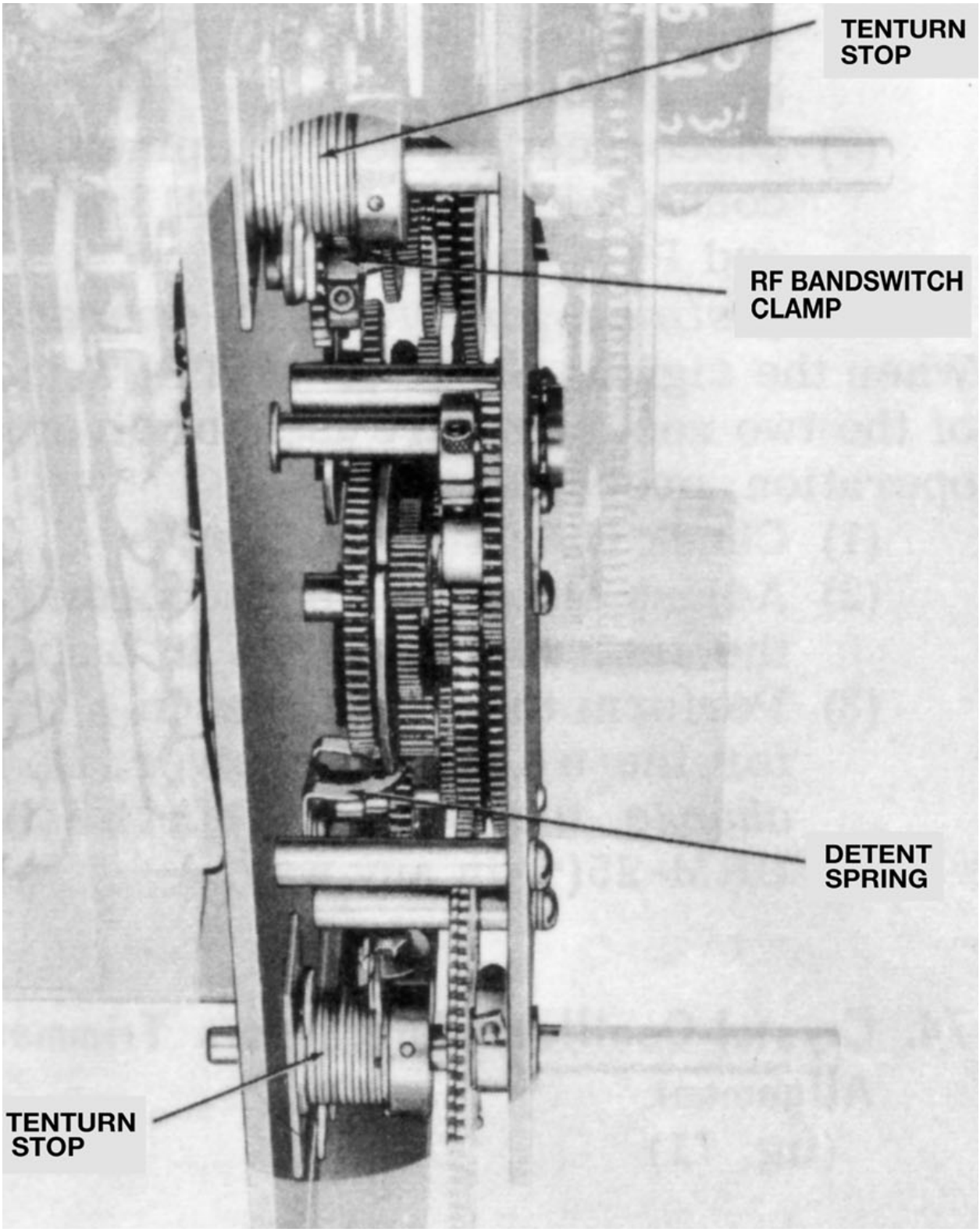


Figure 6-3 Location of RF Band Switch Shaft Clamp, Detent Spring and Ten-Turn Stops

Image courtesy of Tom Norris

6.2.5.6 VFO Tuning Shaft.

1. Preset the receiver (paragraph 5.5.2). Turn the FUNCTION switch to MGC. Allow 15 minutes for warm-up.
2. Tune the receiver to station WWV or a local station of known frequency. Be sure to set the frequency indicator exactly to the station's assigned frequency.
3. Turn the BANDWIDTH switch to 1.
4. Remove the anti-backlash spring on the Oldham coupler (Figure 6-4) and loosen the VFO (Figure 6-15) shaft clamp nearest the front panel.

⇒Caution:	The VFO will be permanently damaged if the shaft is turned too far in either direction. The end of shaft travel can be felt while turning the shaft with the fingers. Do not force the shaft.

5. Holding the VFO shaft steady, turn the shaft until the station is tuned for maximum loudness.
6. Tighten the shaft coupler and replace the anti-backlash spring.
7. With the first two digits of the frequency indicator set at any position except 00, check the receiver calibration at the low, middle, and high frequency end of the band.

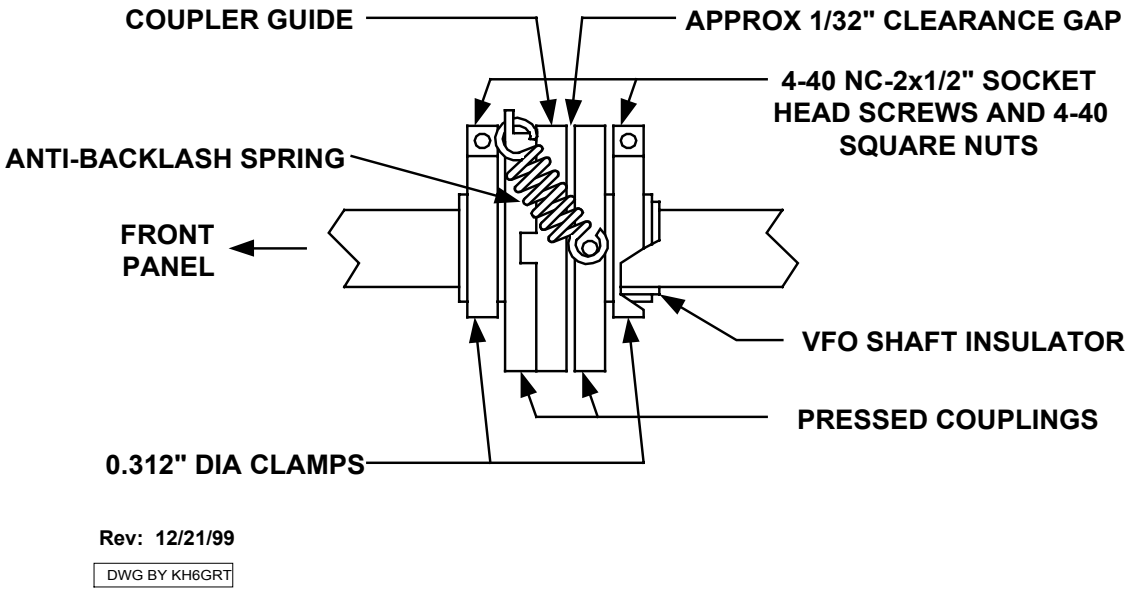


Figure 6-4 Oldham Coupler Details[2]

[2]Courtesy of Pete Wokoun, KH6GRT

6.2.6 Adjusting ZERO ADJ Control

Check the adjustment of the ZERO ADJ control as follows:

1. Turn the ZERO ADJ knob fully counterclockwise. Slowly turn the knob clockwise and observe the free play in the knob. The free play should be approximately 1/8 turn.
2. If there is no free play, or if the free play is excessive, remove the knob.
3. With the thumb and forefinger, adjust the shaft for approximately 1/8-turn free play.
4. Replace the knob so that the stop on the rear of the knob is directly to the right of, and touching the finger on, the ZERO ADJ control locking washer on the front panel. Tighten the knob.
5. Turn the ZERO ADJ control fully clockwise to the stop, and check to see that the locked clutch gear assembly (Figure 6-1) is disengaged. Do this by rocking the KILOCYCLE CHANGE control back and forth and observing the reading of the frequency indicator to see that it does not change.
6. Turn the ZERO ADJ control fully counterclockwise to the stop and recheck for approximately 1/8-turn free play.
7. Repeat the procedures in 2 through 6 above if the free play and clutch disengagement are not as specified.

6.2.7 Alignment of Fixed-Tuned IF Circuits

IF transformers T501, T502, and T503 are stagger-tuned in some models and all are tuned to 455 kHz in other models. IF transformer T208 (Figure 6-19) and tuned circuit Z503 are tuned to 455 kHz on all models. Normally, none of these components require alignment.

However, when T501, T502, or T503 is replaced in any model, all three transformers should be aligned as directed in the procedures given in paragraph 6.2.7.1 below. Transformer T208 can be adjusted from the top of the transformer cover, but T501, T502, T503, and Z503 cannot be adjusted unless their covers are removed and modified covers installed temporarily

6.2.7.1 **Alignment of T501, T502, and T503.** (See Figure 6-16.)

1. Set the controls as indicated in paragraph 5.5.2. Turn the BANDWIDTH switch to 16, and the FUNCTION switch to MGC.

2. Disconnect P114 from J514, P213 from J513, and P218 from J518. Connect P114 to J513.

3. Connect the output of the AN/URM-25 ( ) to the IF OUTPUT jack on the receiver rear panel.

4. Remove the cover from T501, T502, or T503, whichever is to be replaced, by removing the top nuts and lockwashers. Punch or drill a hole in the top of the removed cover. The hole must be large enough to pass the alignment tool and must be centered over the transformer core when installed.

5. Install the replacement transformer T501, T502, or T503 complete with the modified cover.

6. Locate resistor R504 (Figure 6-18). If the resistor has a value of 1,000 ohms, replace it with a 560-ohm resistor of the same wattage.

7. Connect the AN/USM-116 ( ) to the front panel DIODE LOAD jack.

8. Remove the cover from transformer T501 and replace it with the modified cover (4 above). Tune the AN/URM-25 ( ) to 467 kHz and adjust its output for a diode load voltage between -3 and -7 volts.

9. Adjust the secondary (top) slug of T501 for maximum diode load voltage. Reduce the signal generator output, as necessary, to keep the diode load voltage between -3 and -7 volts.

10. Remove the modified cover from T501 and replace it with the permanent cover.

11. Follow the procedures given in 8, 9, and 10 above and adjust the primaries and secondaries of T502 and T503, and the primary of T501, in the order listed in table 6-1

12. When the alignment is complete and the permanent covers are on all three transformers, disconnect the test equipment and reconnect P114 to J514, P113 to J513, and P218 to J518.

Table 6-1- IF Alignment Chart

Step	Modified Cover On	AN/URM-25 ( ) Frequency	Adjust
1	T501 and T502	467	T501 secondary (top slug) T502 primary (bottom slug)
2	T501 and T502	443	T501 primary (bottom slug) T502 secondary (top slug)
3	T503	455	T503 primary (bottom slug) T503 secondary (top slug)

6.2.7.2 Alignment of Z503.

1. Perform the procedures given in 1 through 3 above.

2. Turn the FUNCTION switch to AGC.

3. Replace Z503 if it is defective. Remove the cover from the old Z503, and punch or drill a hole in the top of it. Replace the cover on the new coil.

4. Connect the AN/USM-116 ( ) to AGC terminal 4 and chassis ground on the rear panel of the receiver.

5. Tune the AN/URM-25 ( ) to 455 kHz, and adjust the attenuator on the AN/URM-25 ( ) for an AGC voltage indication of -1 to -2 volts on the AN/USM-116 ( ).

6. Adjust the single core in Z503 for maximum AGC voltage; then remove the cover (3 above) and replace it with the new cover.

6.2.7.3 Alignment of T208.

1. Set the receiver controls as instructed in paragraph 6.2.7.1, step 1. Turn the BANDWIDTH switch to 2.
2. Connect the output of the AN/URM-25 ( ) to test point E211 (Figure 6-19). Connect the AN/USM-116 to the front panel DIODE LOAD jack.
3. Tune the AN/URM-25 ( ) to 455 kHz and adjust the AN/URM-25 ( ) attenuator to a AN/USM-116 reading of between -3 and -7 volts.
4. Adjust T208 for maximum indication on the AN/USM-116 ( ). The adjustment of T208 will be broad.
5. Disconnect the test equipment

6.2.8 Adjustment of GAIN ADJ Potentiometer R519 (See Figure 6-16.)

6.2.8.1 General.

The correct adjustment of this control is very important. If it is set too low, the receiver sensitivity will be below that required; if it is set too high, the receiver noise will be excessive. This adjustment should be checked monthly and whenever any tubes are replaced in the RF or IF sub-chassis. When two receivers are operated in diversity operation, the IF outputs should be balanced with GAIN ADJ R519. This is done by setting the gain of one receiver, and then matching the gain of the other receiver to it.

6.2.8.2 Procedure for Adjustment.

1. Disconnect P114 from J514, P213 from J513, and P218 from J518. Connect P114 to J513.
2. Connect the AN/URM-25 ( ) through Adapter, Test MX-1487/URM-25D or Impedance Matching Network CU-206/URM-25F to the IF OUTPUT jack on the rear panel of the receiver.
3. Tune the AN/URM-25 ( ) to 455 kHz and adjust the AN/URM-25 ( ) attenuator for an output level of 150 micro-volts. Be sure that the modulation is turned off.
4. Connect the AN/USM-116 ( )to the front panel DIODE LOAD jack.
5. Set the receiver controls as instructed in paragraph 5.5.2. Turn the FUNCTION switch to MGC.
6. Loosen the hexagonal nut on the GAIN ADJ control and adjust the control for a diode load voltage reading of -7 volts ±1 VDC. Tighten the hexagonal nut.
7. Disconnect the test equipment. Reconnect P213 to J513, P218 to J518, and P114 to J514.

6.2.8.3 Adjustment for Diversity Operation.

When the signals at the IF OUTPUT jacks of the two receivers are used for diversity operation, proceed as follows:

1. Check forward and reverse resistance of CR101. The ratio must be at least 50 to 1.
2. Adjust one receiver according to the instructions given in paragraph 6.2.8.2 above.
3. Perform the procedures in paragraph 6.2.8.2 above for the second receiver. Do not change the settings of the AN/URM-25 ( ) in any way.

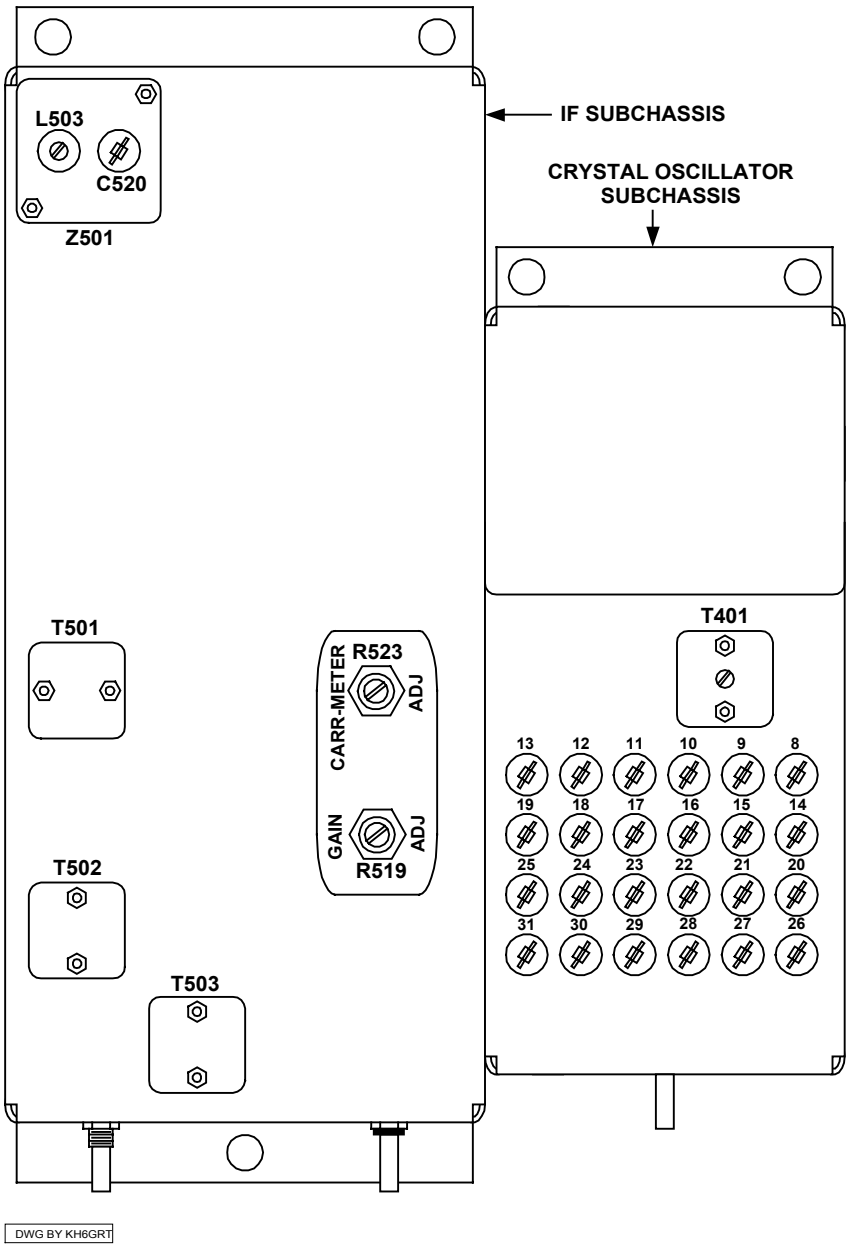


Figure 6-5 Crystal-Oscillator and IF Sub-chassis Alignment Points[3]

[3]Courtesy of Pete Wokoun, KH6GRT

6.2.9 Crystal-Oscillator Sub-Chassis Trimmer Adjustment (See Figure 6-5.)

1. Check the synchronization of the crystal-oscillator sub-chassis band switch (paragraph 6.2.5.5).
2. Preset the receiver controls (paragraph 5.5.2). Turn the FUNCTION switch to CAL.
3. Turn the MEGACYCLE CHANGE control to 08 and adjust the corresponding trimmer for a maximum CARRIER LEVEL meter indication.
4. Turn the MEGACYCLE CHANGE control to each band from 08 through 31 and adjust the corresponding trimmer for a maximum CARRIER LEVEL meter indication.

⇒Note:	Trimmers no. 8 and 9 correspond to frequency-indicators no. 08 and 09. There are no adjustments for bands 00 through 07. Check only for output on these bands.

6.2.10 Second Variable IF Alignment

6.2.10.1 Preparation.

1. Preset the receiver controls (paragraph 5.5.2). Turn the frequency indicator to 01 900.
2. Calibrate the receiver (paragraph 2.3.2.1).
3. Turn the FUNCTION switch to MGC.
4. Connect the AN/USM-116 ( ) to the DIODE LOAD jack on the front panel and connect the AN/URM-25 to test point E210 using Test Lead CX-1363/U (part of AN/URM-25 ()).

6.2.10.2 Alignment. (See Figure 6-6.)

⇒Note:	In steps 2 and 5 below, set the AN/URM-25 ( ) to the specified frequency. Check the accuracy of the setting by means of Frequency Counter AN/USM-207 ( ). During alignment readjust the AN/URM-25 ( ) output level as necessary to keep the AN/USM-116 ( ) indication between -3 and -5 volts.

1. Set the receiver frequency-indicator at 01 900.
2. Tune the AN/URM-25 ( ) to 2.1 MHz.
3. Adjust the slugs in Z216-1, Z216-2, and Z216-3, (L233-1 through L233-3) for a maximum AN/USM-116 ( ) indication.
4. Set the receiver frequency-indicator at 01 100.
5. Tune the AN/URM-25 ( ) to 2.9 MHz.
6. Adjust the trimmer capacitors in Z216-1, Z216-2, and Z216-3 (C291-1 through C291-3) for a maximum AN/USM-116 ( ) indication.
7. Repeat the procedures given in 1 through 6 above until no further increase in AN/USM-116 indication is obtainable.

6.2.11 First Variable IF Alignment

6.2.11.1 Preparation.

1. Preset the receiver controls (paragraph 5.5.2).
2. Set the frequency indicator at 01 200.
3. Calibrate the receiver (paragraph 2.3.2.1).
4. Turn the FUNCTION switch to MGC.
5. Connect the AN/USM-116 ( ) to the DIODE LOAD jack on the front panel. Connect the AN/URM-25 to test point E209 using Test Lead CX- 1363/U (part of AN/URM-25 ( )).

6.2.11.2 Alignment. (See Figure 6-6.)

⇒Note:	In steps 2 and 7 below, set the AN/URM-25 ( ) to the specified frequency. Check the accuracy of the setting by means of Frequency Counter AN/USM- 207. During alignment readjust the AN/URM-25( ) output level as necessary to keep the AN/USM116 ( ) indication between -3 and -5 volts.

1. Set the receiver frequency indicator to 01 250.
2. Tune the AN/URM-25 ( ) to 18.25 MHz.
3. Adjust the slugs in Z213-1, Z213-2, and Z213-3 (L232-1 through L232-3) for a maximum AN/USM-116 ( ) indication.
4. Set the receiver frequency indicator to 07 200.
5. Recalibrate the receiver.
6. Set the receiver frequency indicator to 07 250
7. Tune the AN/URM-25 ( ) to 24.25 MHz.
8. Adjust the trimmer capacitors in Z213-1, Z213-2, and Z213-3 (C283-1 through C283-3) for a maximum AN/USM-116 ( ) indication.
9. Repeat the procedures given in 1 through 8 above until no further increase in AN/USM-116 indication is obtainable.

6.2.12 RF Coil Alignment

6.2.12.1 Preparation.

1. Preset the receiver controls (paragraph 5.5.2).
2. Turn the ANT TRIM control to 0 and the FUNCTION switch to MGC.
3. Connect the AN/USM-116 ( ) to the DIODE LOAD test jack on the front panel. Using Impedance Adapter MX-1487/U, connect the RF OUTPUT of AN/URM-25 () to ANTENNA UNBALANCED jack J103 on back of receiver.

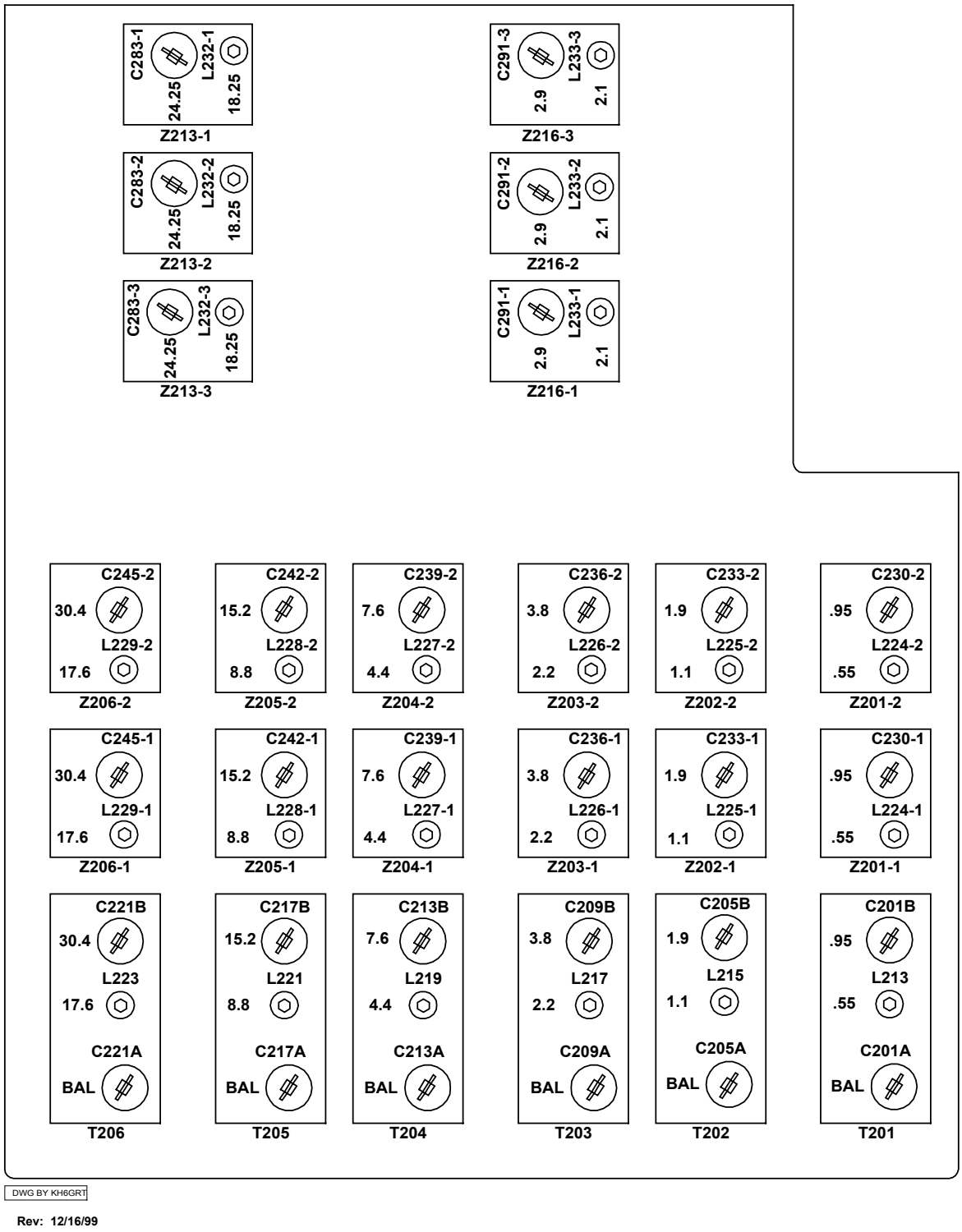


Figure 6-6 RF and Variable IF Alignment Points[4]

[4]Courtesy of Pete Wokoun, KH6GRT

6.2.12.2 Procedure. (See Figure 6-6.) Perform each step in the RF alignment chart (table 6-2) by repeating the two steps given below.

1. Set the receiver and the AN/URM-25 ( ) to the frequency listed. Check the accuracy of the signal generator setting by means of Frequency Counter AN/USM-207.

2. Adjust the slugs or trimmer capacitors for maximum AN/URM-116 ( ) indication.

⇒**Note:**	Adjust the AN/URM-25 ( ) RF output level, as necessary, to keep the AN/URM-116 ( ) indication between -3 and -7 volts.

6.2.13 Beat-Frequency Oscillator Neutralization

1. Preset the receiver controls (paragraph 5.5.2). Set the BANDWIDTH switch to 1 and the FUNCTION switch to CAL.
2. Tune the receiver for a maximum CARRIER LEVEL meter indication at any 100-kHz calibration point.
3. Turn the BFO switch to ON and turn the BFO PITCH control to 1.
4. Set the FUNCTION switch to AGC and the BANDWIDTH switch to 2.
5. Connect RF Voltmeter ME-30B/U to IF OUTPUT jack J116 on the receiver rear panel.
6. Disconnect P213 (Figure 6-14) from J513, and short J513 to chassis ground.
7. Insert an insulated screwdriver through the receiver left end plate access hole and adjust BFO neutralization capacitor C525 (Figure 6-17) for a minimum ME-30B/U indication.

6.2.14 Calibration Oscillator Adjustment C310.

This adjustment requires the use of an extremely accurate frequency standard for determining the reference frequency. Harmonics of the 5 Megahertz output from either the AN/URQ-9 or AN/URQ-10 (frequency standard) are to be used in making this adjustment.

1. Tune the receiver to 25 MHz (5th harmonic of the frequency standard's 5 MHz output).

2. Turn the BANDWIDTH switch to .1.

3. Tune the receiver to the exact resonance by adjusting the KILOCYCLE CHANGE and ANT TRIM controls for a maximum CARRIER LEVEL meter indication.

4. Turn the LINE GAIN control to approximately 5, turn the LINE METER switch to -10 and adjust the LINE GAIN control for a half-scale LINE LEVEL meter indication.

5. Turn the BFO switch to ON and adjust the BFO PITCH control to the exact zero beat with the signal from the frequency standard. This will be when the LINE LEVEL meter indication drops to zero and fluctuates at a rate slow enough to be counted.

6. Turn the FUNCTION switch to CAL.

7. Use a screwdriver to adjust the CAL ADJ capacitor C310 (Figure 6-21) through the rear-panel access hole for exact zero beat (a minimum LINE LEVEL meter indication).

8. Turn the FUNCTION switch to AGC, and tune to other harmonics of the 5 MHz frequency (5, 10, 15 and 20 MHz) to check the accuracy of the calibration oscillator adjustment.

Table 6-2 - RF Alignment Chart

Receiver MHz	Receiver kHz	AN/URM-25 ( ) Freq kHz	Adjust Slugs For Peak	Adjust Trimmer Capacitors For Peak
00	550	550	L213 L224-1 L224-2	
00	950	950		C201-B C230-1 C230-2
01	100	1,100	L215 L225-1 L225-2	
01	900	1,900		C205-B C233-1 C233-2
02	200	2,200	L217 L226-1 L226-2	
03	800	3,800		C209-B C236-1 C236-2
04	400	4,400	L219 L227-1 L227-2	
07	600	7,600		C213-B C239-1 C239-2
08	800	8,800	L221 L228-1 L228-2	
15	200	15,200		C217-B C242-1 C242-2
17	600	17,600	L223 L229-1 L229-2	
30	400	30,400		C221-B C245-1 C245-2

6.2.15 CARR-METER ADJ Potentiometer R-523 Adjustment. (See Figure 6-16.) (Pg.6-40)

1. Set the FUNCTION switch to AGC and turn the RF GAIN control fully counterclockwise.

2. Adjust the CARR-METER ADJ potentiometer on the IF sub-chassis for a zero reading of the CARRIER LEVEL meter on the receiver front panel.

6.2.16 Variable-Frequency Oscillator End-Point Adjustment. (See Figure 6-7.)

After the receiver has been in service for about a year, a frequency check of the variable-frequency oscillator may reveal that its range may not be exactly 3.455 to 2.455 MHz. In most cases, this condition is caused by aging of the frequency-determining components in the sealed VFO sub-chassis, and can be compensated for by the adjustment of end-point adjustment L701. Access to this adjustment is made by the removal of the screw on the front of the sealed VFO unit.

⇒**Note:**	Make this adjustment if the inaccuracy of the VFO exceeds 500 Hz when checked from 000 to +000 on the last three digits of the frequency indicator. Make the end-point adjustment as follows:

1. Remove the VFO sub-chassis (paragraph 6.3.11.1).
2. Remove the end-point-adjustment cover nut.
3. Replace the VFO sub-chassis (paragraph 6.3.11.2).
4. Preset the receiver controls (paragraph 5.5.2) and allow the receiver to warm up for at least 1 hour.

⇒**Note:**	**Note:** Set the OVENS switch on the receiver rear panel to the ON position.

5. Calibrate the receiver (paragraph 2.3.2.1) at exactly 07 +000.

6. Remove the front panel (paragraph 6.3.2.1).

7. Turn the riveted locking plate (Figure 6-1) by hand for a frequency-indicator setting of 07000 low end of band. Note: no "+" sign in frequency indicator setting.

8. Use a screwdriver (1/8-inch wide blade) through the VFO end-point-adjustment access hole (Figure 6-7) to adjust L701 for zero beat.

9. Turn the riveted locking plate by hand for a setting of exactly 07 +000.

10. Turn the shaft of the BFO PITCH control for zero beat.

11. Repeat the procedures given in 7 through 10 above until no further improvement can be made.

12. When the job has been completed, remove the VFO, replace the end-point-adjustment nut, replace the VFO, replace the front panel (paragraph 6.3.2.2).

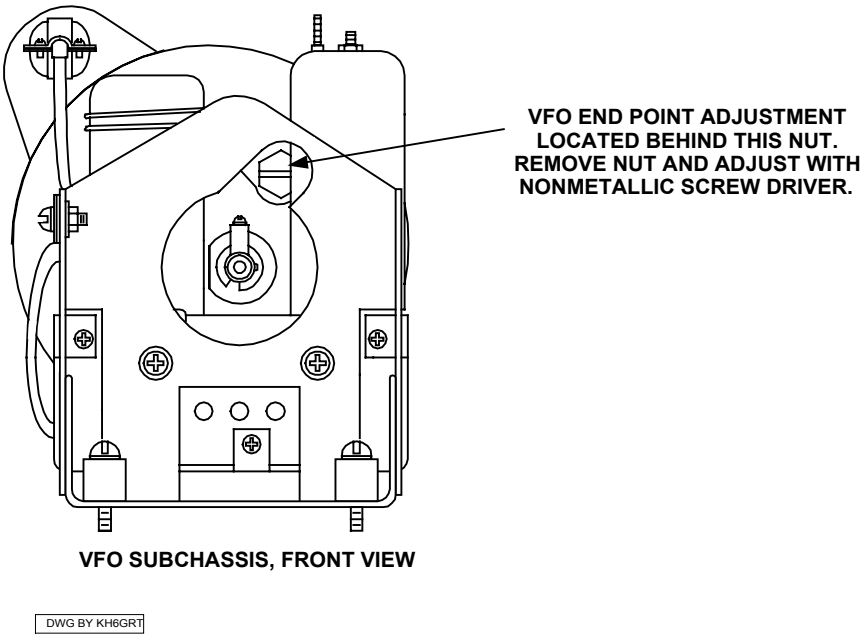


Figure 6-7 Variable Frequency Oscillator End-Point Adjustment[5]

[5]Courtesy of Pete Wokoun, KH6GRT

6.2.17 Crystal Filter Neutralizing.

(See Figure 6-5.) Capacitor C520 in tuned circuit Z501 usually needs adjustment only when part or all of Z501 is replaced or when C520 is turned accidentally.

Proceed as follows:

1. Preset the receiver controls (paragraph 5.5.2). Set the BANDWIDTH switch to .1 and the FUNCTION switch to MGC.
2. Connect the AN/USM-116 ( ) to the DIODE LOAD test jack on the front panel. Connect the AN/URM-25 ( ) to test point E211 (Figure 6-19) using Test Lead CX-1363/U (part of AN/URM-25 ( )).
3. Tune the AN/URM-25 ( ) to 455 kHz and adjust its RF output level for a AN/USM-116 ( ) indication of -5 volts.
4. Rock the AN/URM-25 ( ) tuning dial for a maximum AN/USM-116 ( ) indication: then readjust the RF output level for a -7 volt AN/USM-116 ( ) indication.
5. Record the AN/URM-25 ( ) RF output level, and then increase it by 60 dB.
6. Increase the AN/URM-25 ( ) frequency until the AN/USM-116 ( ) again indicates -7 volts.
7. Adjust C520 for a dip in the AN/USM-116 ( ) indication, and mark the C520 setting on the Z501 shield can.
8. Decrease the AN/URM-25 ( ) frequency below 455 kHz until the AN/USM-116 ( ) indication is again -7 volts.

9. Readjust C520 for a dip in the AN/USM-116 ( ) indication and mark this second C520 setting on the Z501 shield can.
10. Set C520 halfway between the marks made in procedures 7 and 9 above.
11. Retune the AN/URM-25 ( ) for a maximum AN/USM-116 ( ) indication at 455 kHz, then readjust the RF output level for a -7-volt AN/USM-116 ( ) indication. Record the AN/URM-25 ( ) frequency setting.
12. Turn the BANDWIDTH switch to 1.
13. Retune the AN/URM-25 ( ) for a maximum AN/USM-116 ( ) indication. Compare the peak frequency with the one recorded in procedure 11 above.
14. If the peak frequency is different, adjust L503 in Z501 until the peak frequency is the same for both the .1 and 1-kHz positions of the BANDWIDTH switch.

⇒**Note:**	This may require several readjustments of L503.

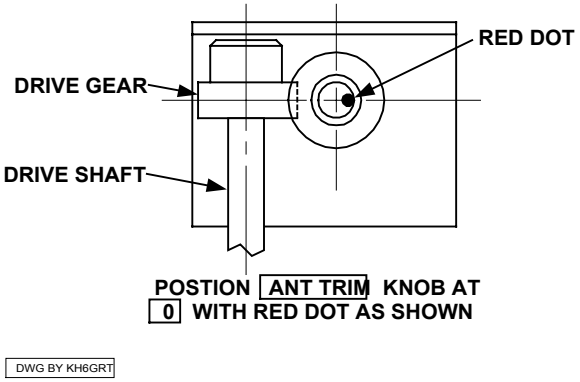


Figure 6-8 ANT TRIM Control Adjustment[6]

6.2.18 Antenna Trimmer Control Adjustment.

6.2.18.1 The ANT TRIM control is properly adjusted if the gear with the red dot is positioned as shown in Figure 6-8 when the ANT TRIM control is set at 0.

6.2.18.2 If adjustment is necessary, proceed as follows:

1. Loosen the drive gear set screws.
2. Turn the gear with the red dot to the position shown in Figure 6-8.
3. Turn the ANT TRIM knob to 0 while holding the drive gear to prevent the gear with the red dot from turning.
4. Tighten the drive gear set screws.

[6]Courtesy of Pete Wokoun, KH6GRT

6.3 REPAIR

6.3.1 Notes on Removals and Replacements.

This section contains instructions for the removal and replacement of the sub-chassis, the subassemblies, and certain parts in Radio Receiver R-390A/URR. All the sub-chassis, except the RF sub-chassis, can be removed from the main frame of the receiver without removal of the front panel or other subassemblies in the receiver. Avoid changing the setting of the KILOCYCLE CHANGE control or any of the switches or shafts operated by the MEGACYCLE CHANGE control when the RF, the Crystal Oscillator, or the VFO sub-chassis are operated out of the receiver main frame. If these controls must be operated, reset them to their previous settings.

6.3.1.1
All the threaded fasteners that secure the subassemblies to the main frame of the receiver are color coded with green screw heads. Loosen and remove only these screws unless otherwise instructed. The only exceptions to the use of the green-headed screws are the front-panel screws that secure the front panel of the receiver (Figure 6-9). Some of the securing screws are the conventional threaded type, and the remainder are captive screws. Captive screws remain attached to the sub-assembly that they secure when the sub-assembly is removed from the main frame. All captive and mounting screws are loosened and removed with the Phillips screwdriver supplied with the receiver. All knobs, shaft couplers, gears, and cams are loosened and removed with a No. 8 Bristol (fluted) wrench.

6.3.1.2
All RF and power connectors used in the receiver are readily removed by hand. The rectangular power connectors are removed by being pulled outward with a slight rocking motion. The polygon-shaped power connectors have locking shells that must be rotated counterclockwise before being removed from their mating connectors. The coaxial RF connectors also must be rotated counterclockwise before being removed from their mating connectors.

6.3.1.3
The use of two wooden blocks, about 2 inches thick and 12 inches long, is necessary for supporting the main frame of the receiver when it is placed on a bench or table. Place the wooden blocks under the bottom side edges of the receiver. This allows the front panel to be removed and rested on its handles.

6.3.2 Removal and Replacement of Front Panel.

(See Figure 6-9, next page) The front panel must be removed whenever the removal of the RF sub-chassis and its RF gear train assembly is required. Follow the procedures in the order listed in paragraph 6.3.2.1 to prevent damage or mechanical misalignment of the tuning system.

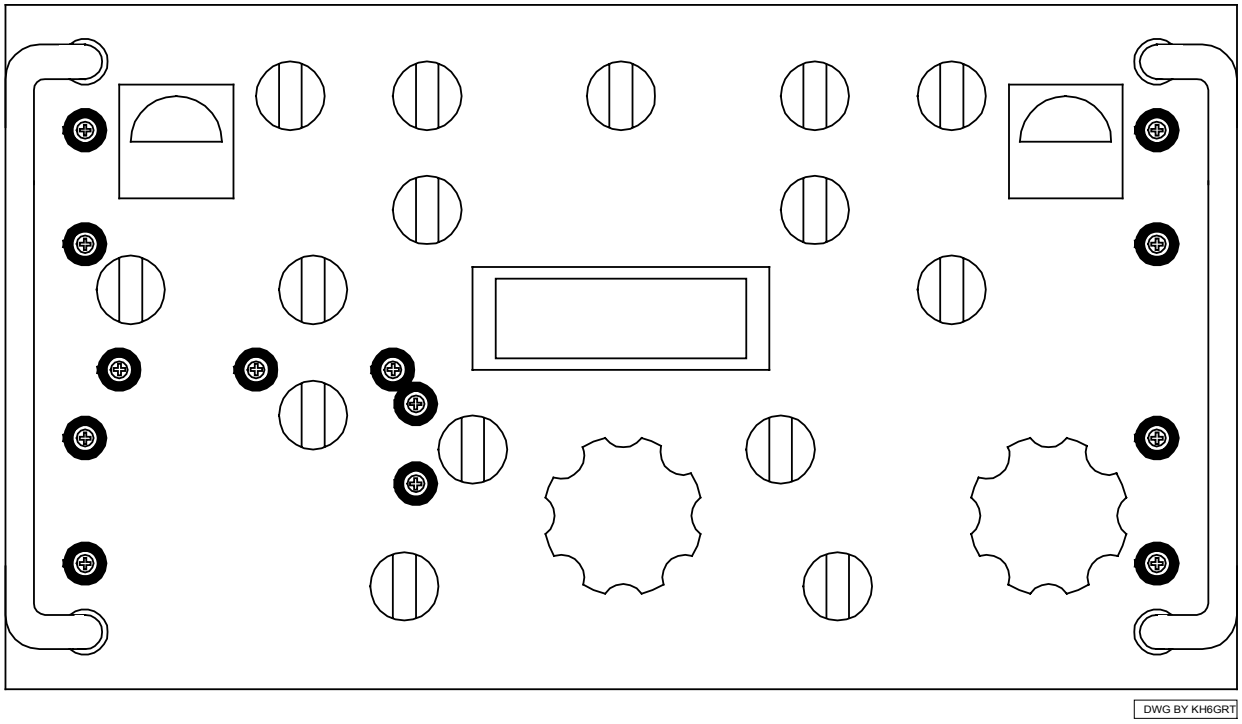


Figure 6-9 Location of Front Panel Mounting Screws[7]

6.3.2.1 Removal

1. Remove the top and bottom dust covers if they were not removed during installation.
2. Turn the DIAL LOCK fully counterclockwise.
3. Turn the KILOCYCLE CHANGE control knob fully counterclockwise (approximately -963 on the kilocycle counter).
4. Turn the MEGACYCLE CHANGE control knob fully counterclockwise (approximately 00 on the megacycle counter).
5. Set the BFO PITCH and the ANT TRIM knobs to 0, and the BANDWIDTH switch to 16.
6. Use a no. 8 Bristol wrench to remove the MEGACYCLE CHANGE, KILOCYCLE CHANGE, ANT TRIM, and DIAL LOCK control knobs.
7. Use a 1/2-inch socket wrench to loosen the hexagonal nut on the DIAL LOCK shaft, turn the DIAL LOCK mechanism (Figure 6-32) behind the front panel (to disengage it) so that it is in a vertical position, and hand tighten the hexagonal nut.
8. Use the no. 8 Bristol wrench to loosen, but do not remove the BFO PITCH shaft coupler. Grasp the BFO PITCH control knob and pull it outward from the front panel to separate the knob shaft and coupler from the BFO PITCH shaft.
9. Use the no. 8 Bristol wrench to loosen the BANDWIDTH shaft coupler, and pull the knob and shaft outward.

[7]Courtesy of Pete Wokoun, KH6GRT

10. Remove the four 5/8-inch by 8-32 flat Phillips-head screws on the left side of the front panel. These screws are vertical and in line with the left front-panel handle. Remove the four similar screws on the right side of the front panel. Remove the five 7/16-inch by 6-32 flat Phillips screws and the external tooth lock washers on the front panel.

11. Grasp the front-panel handles and pull forward with a slight vertical rocking motion. The front panel will separate from the main frame, while riding on the shafts of the KILOCYCLE CHANGE, the MEGACYCLE CHANGE, and the ANT TRIM controls.

12. Carefully lower the front panel to the bench top; rest it on its handles.

⇒Caution:	Be sure that the DIAL LOCK mechanism does not bind on the riveted locking plate mounted on the KILOCYCLE CHANGE shaft while attempting to remove front panel.

6.3.2.2 Replacement

1. Check to see that the DIAL LOCK mechanism is in a vertical position and that the ZERO ADJ knob is fully counterclockwise.

2. Grasp the front panel by the two handles and slide it forward on the KILOCYCLE CHANGE, the MEGACYCLE CHANGE, and the ANT TRIM shafts with a slight vertical rocking motion, while pushing forward.

3. Grasp the DIAL LOCK shaft and rotate the mechanism so that its jaws loosely clutch the riveted locking plate on the KILOCYCLE CHANGE shaft. Set the mechanism in the position that allows the raised surface on the mechanism to fall into the aligning dimple on the rear side of the front panel.

4. Replace and secure the front panel with the eight 5/8-inch by 8-32 screws and the five 7/16-inch by 6-32 screws and the five lock washers.

5. Tighten the DIAL LOCK hexagonal nut with a 1/2-inch socket wrench. Replace the knob, allowing a 1/8-inch clearance between the knob and the front panel.

6. Replace the remaining knobs on their respective shafts. Allow a 1/8-inch clearance between the front panel and the MEGACYCLE CHANGE and the KILOCYCLE CHANGE control knobs.

7. Engage and tighten the shaft couplings on the BANDWIDTH and BFO PITCH controls. Be sure that the BANDWIDTH control knob is tightened on the 16 position and that the BFO PITCH control and the ANT TRIM knobs are tightened to 0.

8. Turn all the knobs previously removed through their entire range, checking for smoothness of operation and freedom from binding.

6.3.3 Removal and Replacement of RF Sub-chassis.

(See Figure 6-10) Remove the RF sub-chassis and the crystal-oscillator sub-chassis as one unit.

6.3.3.1 Removal

To remove the RF and crystal-oscillator sub-chassis, proceed as follows:

1. Place the receiver on its left side and remove the anti-backlash spring from the Oldham coupler (Figures 6-4 and 6-25) on the VFO assembly.
2. Remove the front panel (paragraph 6.3.2.11).
3. Remove the RF sub-chassis cover plate.
4. Disconnect plugs P110, P205, P206, P207, P717, P213, P218, and P108 (Figure 6-14).
5. Remove the two 5/16-inch by 6-32 green-headed Phillips screws and lock washers (Figure 6-1). One of the screws is removable through an access hole in the front gear plate.
6. Remove the two 1/2-inch by 6-32 green-headed Phillips screws and lock washers (1, Figure 6-10) through the access hole provided in the left side of the main frame. These two screws are in a vertical row.
7. Remove the three 1/2-inch by 6-32 green-headed Phillips screws and lock washers (2) that are located at the right side of the main frame. These three screws are in a vertical row.
8. Loosen the two green-headed captive screws (3) and the two green headed captive screws (4).
9. Grasp the RF sub-assembly by the two 5-5/8-inch spacers and lift it carefully upward out of the main frame. Place the RF sub-chassis on the bench. Remove the crystal-oscillator sub-assembly only when necessary (paragraph 6.3.7.1).

6.3.3.2 Replacement

These instructions are for replacement of the RF sub-chassis with the crystal-oscillator sub-chassis attached, if the crystal-oscillator sub-chassis has been removed from the RF sub-chassis, secure it to the RF sub-chassis (paragraph 6.3.7.2).

⇒Caution:	Before reinstalling the sub-chassis, be sure that the KILOCYCLE CHANGE shaft is fully counterclockwise.

1. If the center disk of the Oldham coupler has been removed, apply a little grease on it and place it on the end disk attached to the VFO sub-chassis shaft.
2. Grasp the RF sub-chassis by the two 5-5/8-inch spacers and place it into the main frame. Secure the RF sub-chassis in place by replacing, but not tightening, one or two of the green-headed Phillips machine screws and their lock washers. Leaving these screws loose allows shifting of the sub-chassis when replacing the other screws.

3. Set the receiver on its left side with two wooden blocks under it and check the fitting of the Oldham coupler on the VFO sub-chassis. The center disk of the Oldham coupler should join the two end disks with about 1/32-inch play in the coupler.
4. Engage the two green-headed captive screws (3) at the rear of the crystal-oscillator sub-assembly; do not lock them. Engage, but do not lock, the two green-headed captive screws (4) at the rear of the RF sub-assembly.
5. Engage the three green-headed Phillips screws and lock washers (2) and the two green-headed Phillips screws (1). Engage the two green-headed Phillips screws and lockwashers at the front under the clutch gear and tuning mechanism.
6. Tighten all the green-headed screws (Figure 6-10) in the following order:
7. Three marked (2).
8. Four captive screws marked (3) and (4).
9. Two marked (1).
10. Two below the clutch gear (Figure 6-1).
11. Reconnect plugs P110, P717, P205, P206, P207, P213, P218, and P108.
12. Replace the front panel (paragraph 6.3.2.2).

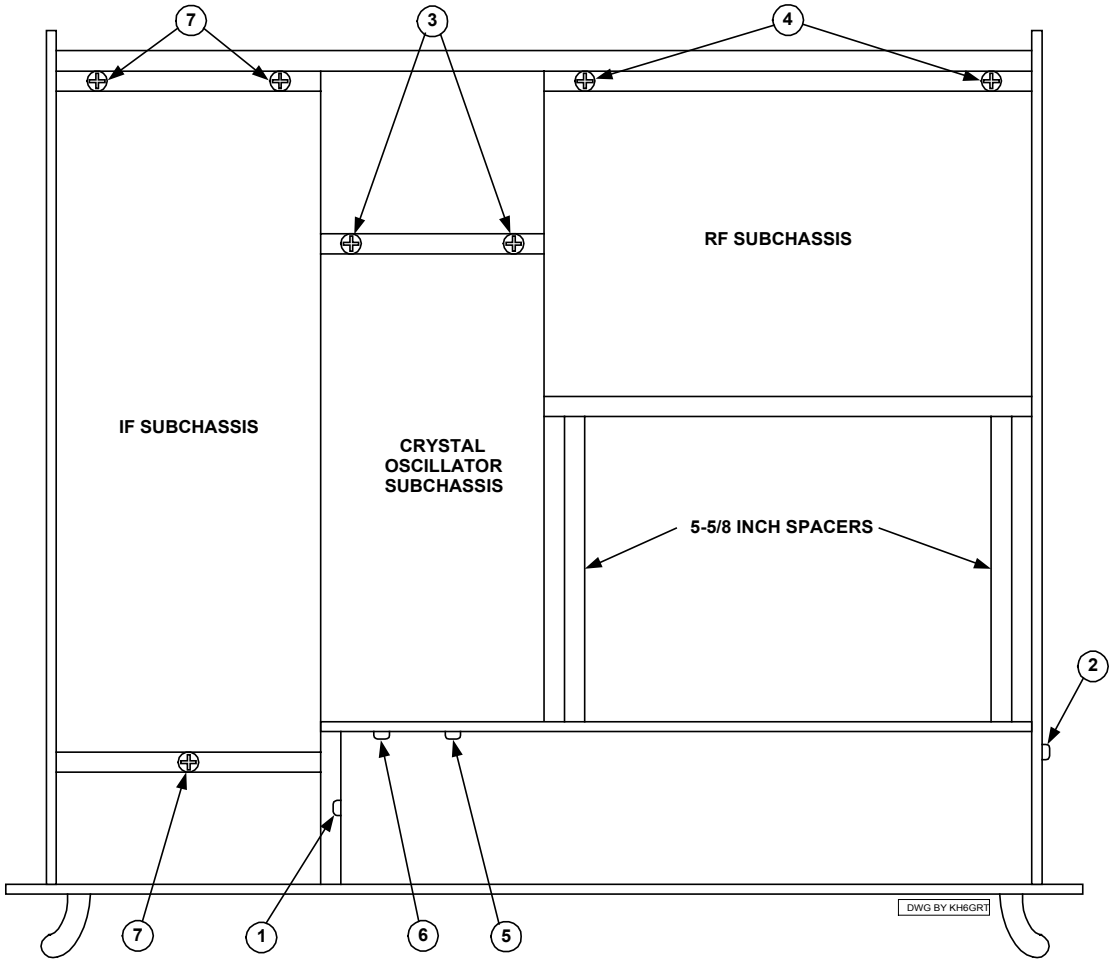


Figure 6-10 RF, IF and Crystal Calibrator Sub-chassis - Removal and Replacement, Location of Screws[8]

[8]Courtesy of Pete Wokoun, KH6GRT

6.3.4 Removal and Replacement of RF Sub-chassis Parts.

6.3.4.1 Slug Racks and Tension Springs.

1. Removal

a. Use a spring puller to disengage the tension springs (Figure 6-14). Temporarily secure the tension springs to the gear and cam plates.

b. Lift each slug rack straight up out of the coils and tag it for identification.

⇒Caution:	Handle the slug racks carefully to prevent damage to the iron cores.

2. Replacement

a. Reinsert each slug into the same coils from which it was removed to prevent severe misalignment of the receiver.

b. Reengage the tension springs to the holes at the ends of each slug rack.

c. Remove the identification tags. 6.3.4.2 Band Switch Shaft

6.3.4.2 Band Switch Shaft.

1. Removal

a. Loosen but do not remove the RF band switch shaft coupler (Figure 6-32) at the front end of the band switch shaft (Figure 6-20).

b. Slide the band switch shaft straight back through the hole in the rear of the RF sub-chassis. Be careful not to disturb the rotor settings of switch wafers S201 through S208 (Figures 6-20 and 6-21).

⇒Caution:	Be careful not to damage the switch wafer rotors or disturb their settings.

2. Replacement.

a. Slide the band switch shaft into the band switch as far as it will go.

b. Tighten the band switch shaft coupler clamp.

6.3.4.3
Removal and Replacement of Mechanically Tuned Coils and Transformers. (See Figure 6-19.)

1. Removal

a. Remove the slug rack and the tension springs (paragraph 6.3.4.1).

b. Remove the Phillips-head screw in the bottom of the slug hole.

c. Pull the coil or transformer straight up from the RF sub-chassis.

d. Remove the coil or transformer cover (if necessary) by pressing inward on the tabs on the sides of the cover and lifting the cover off.

2. Replacement

a. Slide the cover down over the coil or transformer until the tabs snap into place.

b. Plug the coil or transformer into the jacks on the RF sub-chassis.

c. Replace the screw in the bottom of the slug hole.

d. Replace the slug rack and the tension springs (paragraph 6.3.4.2).

6.3.5 Removal and Replacement of Crystal Oven HR202. (See Figure 6-11.)

Replacement of crystal oven HR202 does not require removal of the RF sub-chassis from the main frame.

6.3.5.1 Removal

1. Remove the retaining springs and the clamp that hold the oven in its octal socket.

2. Pull the oven straight up out of its socket.

6.3.5.2 Replacement

1. Insert the oven in its socket. Make sure that the key on its base lines up with the key-way in the octal socket.

2. Replace the retaining springs and the clamp.

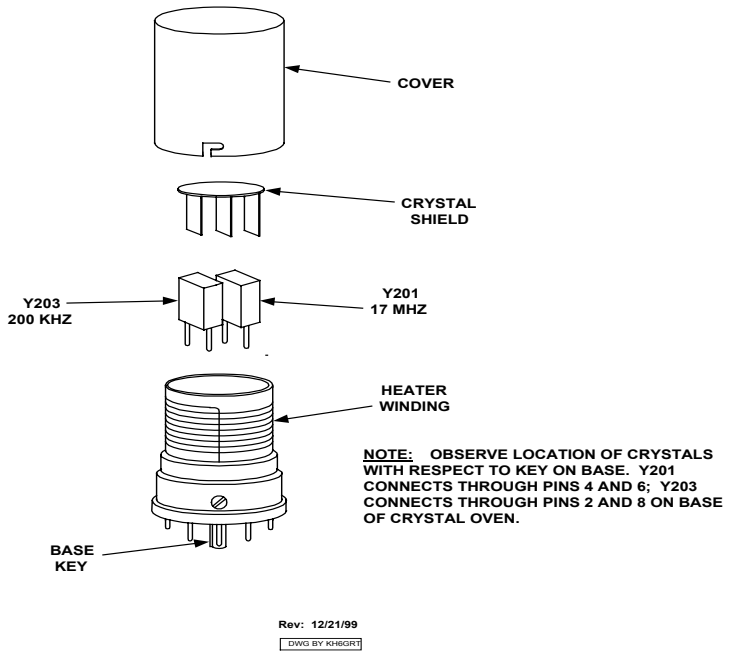
6.3.6 Disassembly and Assembly of Crystal Oven HR202 to Replace Crystals.
(See Figure 6-11.)

6.3.6.1 Disassembly

1. Loosen but do not remove the screws that secure the oven cover to the oven.
2. Turn the cover to the left (counterclockwise) until it stops, and lift the cover straight up from the body of the oven.
3. Lift the crystal shield out of the oven body.
4. Unplug crystals Y201 and Y203 and remove them.

6.3.6.2 Re-assembly

1. When inserting crystals Y201 and Y203, be sure to plug them in at the proper locations with respect to the key on the base (Figure 6-11).
2. Gently push the crystal shield back into place.
3. Line up the slots at the base of the cover with the screws on the base of the crystal oven.
4. Push the cover down and turn it to the right (clockwise) until it stops.
5. Tighten the securing screws on the base.



REPLACE Figure 6-11 Location of Crystals Y201 and Y202[9]

[9]Courtesy of Pete Wokoun, KH6GRT

6.3.7 Removal and Replacement of Crystal-Oscillator Sub-chassis. (See Figure 6-10.)

Two methods can be used for the removal of the crystal-oscillator sub-chassis. This procedure, however, is for the removal of the crystal-oscillator sub-chassis when the RF sub-chassis is to be retained in the main frame of the receiver. When the RF and crystal-oscillator sub-chassis have been previously removed from the main frame, omit the procedures given in 1, 7, and 9 below.

6.3.7.1 Removal

1. Remove the front panel (paragraph 6.3.2.1).
2. Disconnect plugs P110 and P215 (Figure 6-14).
3. Temporarily replace the MEGACYCLE CHANGE knob and turn It until the gears are positioned with their holes lined up with the access hole in the front plate. This makes the 5/16-inch by 6/32 green-headed Phillips screw (5, Figure 6-10) accessible.
4. Remove the screw (5) and its lock washer and the two green-headed screws and their lock washers (6). The latter two screws are in a vertical row.
5. Loosen, but do not remove, the shaft coupler set screw on the crystal-oscillator drive shaft (Figure 6-14).
6. Loosen the two green-headed captive screws (3, Figure 6-10) at the rear of the crystal-oscillator sub-chassis.
7. Temporarily disconnect plugs P205, P206, and P207 (Figure 6-14) to provide enough clearance for sub-chassis removal.
8. Raise the rear end of the sub-chassis approximately one-fourth inch, slide the sub-chassis backward, and lift it out of the main frame.
9. Reconnect plugs P205, P206, and P207.

⇒Caution:	Be careful not to damage the metal grounding strip that contacts the bottom edges of the RF and the crystal-oscillator sub-chassis.

6.3.7.2 Replacement

⇒Note:	**Note:** Only even numbers appear on the indicator wheel; odd numbers appear as straight lines; 00 on the frequency indicator appears as 0.

1. Set the crystal-oscillator sub-chassis dial indicator to 0 and the first two digits of the frequency indicator to 00. Turn the sub-chassis over and adjust (if necessary) for proper mating of the rotor and the fixed contacts of S401 and S402 (Figure 6-23).

⇒Note:	Adjust the crystal-oscillator shaft at the rear of the crystal-oscillator sub-chassis when the sub-chassis is mounted in the main frame. This is done with a long-shafted screwdriver through the SYNC XTAL OSC hole at the rear of the receiver main frame.

2. Temporarily disconnect plugs P205, P206, and P207 (Figure 6-14).

⇒Caution:	Be careful not to damage the metal grounding strip that contacts the bottom edges of the RF and the crystal-oscillator sub-chassis.

3. Place the sub-chassis in position on the deck of the main frame, and carefully slide it forward and engage the drive shaft.

4. Engage, but do not lock, the two green-headed captive screws at the rear of the sub-chassis.

5. Tighten the sets-crew in the shaft coupler on the crystal-oscillator drive shaft, and be sure that the coupler and gear are pushed against the Oilite® bearing on the sub-chassis.

6. Replace the three green-headed Phillips screws and their lockwashers (5 and 6, Figure 6-10) at the front of the crystal-oscillator sub-chassis. Long-nosed pliers may be used to hold the screws while starting them.

7. Lock the two green-headed captive screws at the rear of the sub-chassis.

8. Reconnect plugs P205, P206, P207, P110, and P215.

9. Replace the front panel (paragraph 6.3.2.2).

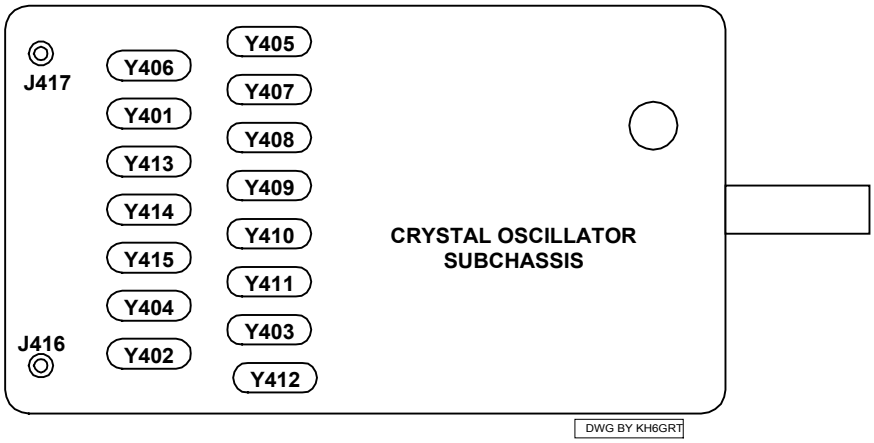


Figure 6-12 Location of Crystals Y401 through Y415[10]

[10]Courtesy of Pete Wokoun, KH6GRT

6.3.8 Removal and Replacement Crystals Under HR401 Crystal Oven Cover.
(See Figure 6-12.)

6.3.8.1 Removal

9. Remove the Phillips screw and the lock washer from the top of the sub-chassis and the two similar screws and lock washers at the rear end of the sub-chassis.

⇒**Note:**	Do not loosen the four Phillips screws on top of the oven cover.

2. Lift the cover straight up from the oven.

3. The 15 plug-in crystals, Y401 through Y415, are now accessible for replacement.

4. Pull the defective crystal straight up out of the crystal socket.

6.3.8.2 Replacement

1. Replace the defective crystal.

2. Replace the oven cover. Be sure that the two plugs at the bottom rear of the oven cover line up with their jacks on the sub-chassis.

3. Replace the three Phillips screws and the lockwashers.

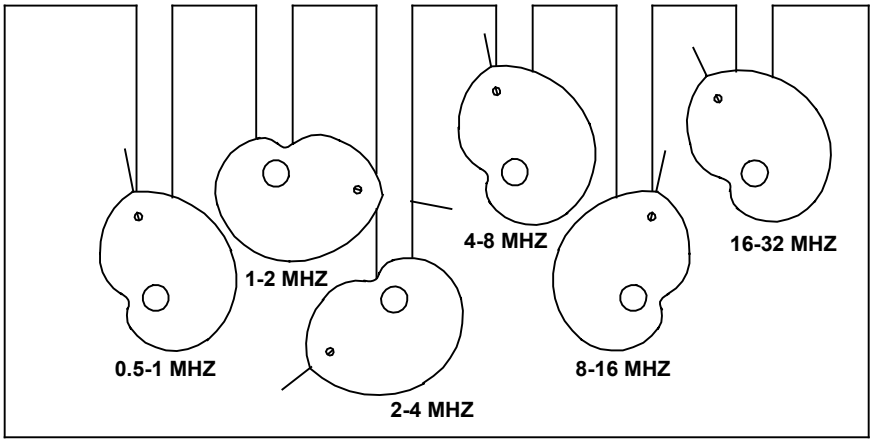


Figure 6-13 RF Gear Train Assembly Cam Positions. Viewed From rear, Simplified Mechanical Diagram[11]

[11]Courtesy of Pete Wokoun, KH6GRT

6.3.9 Removal and Replacement of IF Sub-chassis.

Removal of this sub-chassis does not require the removal of other sub-chassis or parts except for those connectors that connect to the sub-chassis.

6.3.9.1 Removal

1. Set the BANDWIDTH switch to 16 and the BFO PITCH control to 0.
2. Disconnect plugs P112, P116, P213, and P218 (Figure 6-14).
3. Loosen the shaft couplers on the BANDWIDTH and BFO PITCH controls (Figure 6-32). Slide the knobs and shafts outward.
4. Loosen the three green-headed captive screws (7, Figure 6-10) that secure the IF sub-chassis to the main frame.
5. Lift the IF sub-chassis out of the main frame.

⇒Caution:	Do not change the settings on the BANDWIDTH and BFO PITCH shafts unless absolutely necessary. If they are moved, reset them when replacing the IF sub-chassis in the main frame.

6.3.9.2 Replacement

Replace the IF sub-chassis into the main frame of the receiver as follows:

1. Set the IF sub-chassis into the main frame of the receiver.
2. Engage, but do not lock, the three green-headed captive screws.
3. Slide the shafts and couplers of the BANDWIDTH and BFO PITCH controls forward so that they engage the shafts on the IF sub-chassis.
4. Before tightening the couplers, set the BANDWIDTH control knob to 16 and the BFO PITCH control knob to 0, and then tighten the couplers.
5. Reconnect plugs P112, P116, P213, and P218.
6. Tighten the three green-headed captive screws.

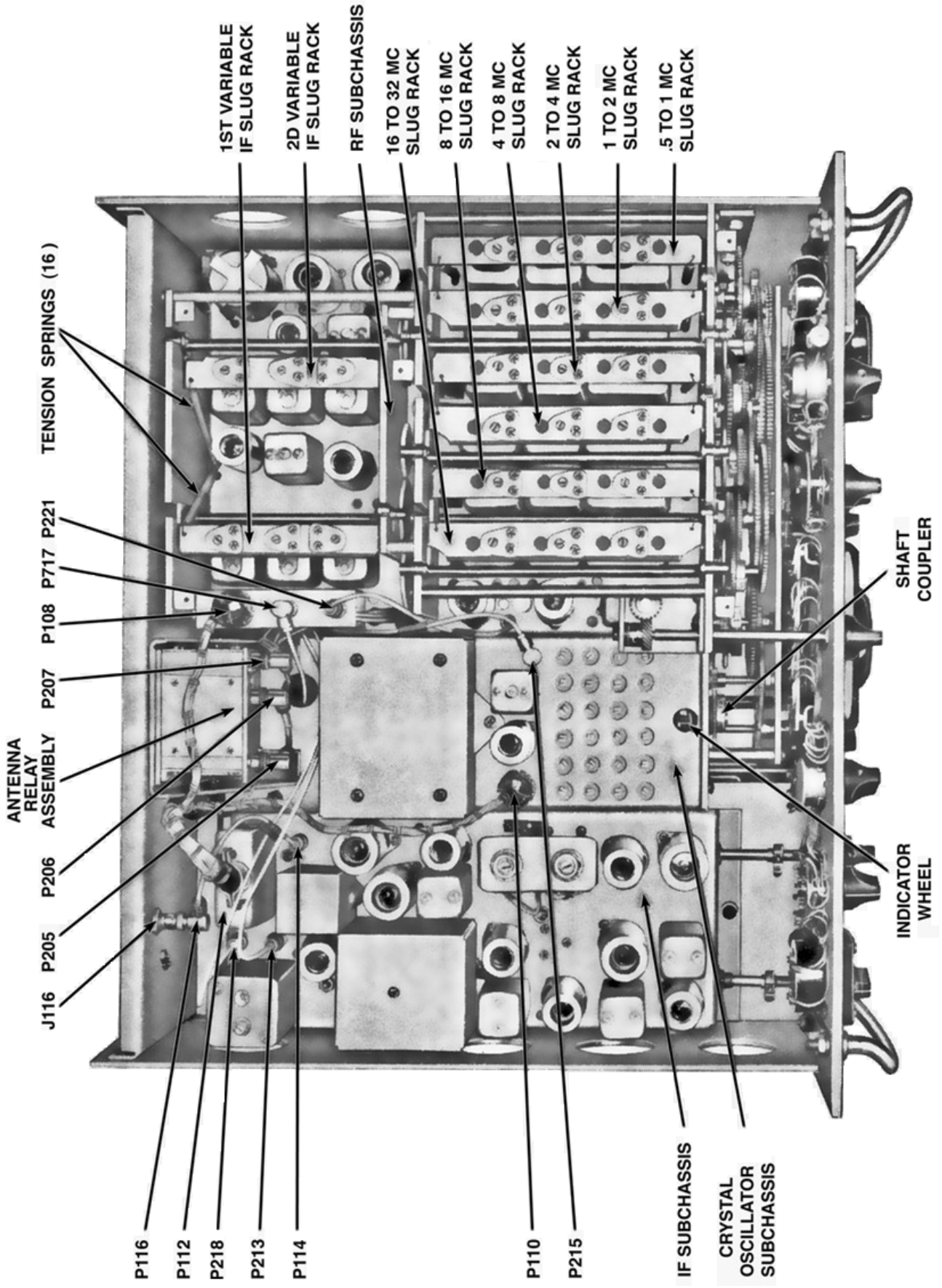


Figure 6-14 Radio Receiver R-390A/URR. Top View-Norris

6.3.10 Removal and Replacement of IF Sub-chassis Parts.

6.3.10.1 IF Transformers (See Figure 6-16.)

IF transformers T501, T502, and T503 are stagger tuned in some models. In other models, T501, T502, and T503 are tuned to 455 kHz. Whenever any one of these transformers is replaced, perform the alignment procedures described in paragraph 6.2.7.

6.3.10.2 Crystal Filters

Serial no. 1 through 413 receivers manufactured by the Electronics Assistance Corp. under contract No. 22137-PC-60 used crystal (ceramic) filters in lieu of mechanical filters. Faulty ceramic filters should be replaced with mechanical types.

6.3.10.3 Mechanical Filters

To install a new mechanical filter, follow the procedures given in steps 1 through 10 below.

⇒Note:	When replacing mechanical filters in the IF sub-chassis with MOD numbers 1 and above on Order No. 363-Phila-54 and in all receivers on Order No. 14-Phila-56, refer to the procedure in step 10 below. Some receivers bearing Order No. 14-Phila-56 have alternate type filters (paragraph l.5.2b).

1. After removing the defective filter, remove the small mica capacitors from the filter connection wires. One of these capacitors (C507, C508, C509, or C510) is located beneath the chassis (Figure 6-18), the other (C513, C514, C515, or C516) above the chassis (Figure 6-16).

2. Install the new filter and re-solder the connecting wires to the proper terminals. Do not reinstall the original mica capacitors across the filter terminals.

3. Connect Electronic Multi-meter AN/USM-116 ( ) to the DIODE LOAD jack on the front panel and Signal General AN/URM-25 ( ) to ANTENNA UNBALANCED jack J103 on the rear of the receiver.

4. Turn the BANDWIDTH control on the front panel to the position corresponding to the filter being replaced.

5. Tune the AN/URM-25 ( ) and the receiver to the same frequency.

6. The proper replacement value for C507, C508, C509, or C510, and C513, C514, C515, or C516, will be between 56 pF and 130 pF. Lightly solder a random value capacitor within this range across the filter input terminals and another across the output terminals. Do not make a permanent connection.

7. Apply power to the receiver and adjust the AN/URM-25 ( ) output level to produce 5 volts on the AN/USM-116 ( ). Record the AN/URM-25 ( ) RF output level (micro-volts).

8. Try various capacitor values across the input and output terminals. Select the trial values (in pF) from the following list: 56, 62, 75, 82, 91, 100, 110, 120, and 130. Adjust and record the AN/URM-25( ) output level for each trial value.

9. The capacitor values that require the lowest AN/URM-25 ( ) output level (highest gain) for a 5-volt reading of the AN/USM-116 ( ) are the proper values for the replacement filter. Determine these values and solder the capacitors permanently in place. The proper value for the input capacitor is not necessarily identical with the value for the output capacitor. Both values must be determined independently. Replacement capacitors must be the silvered mica type.

10. In IF sub-chassis with MOD numbers 1 and above on Order No. 363-Phila-54 and in all receivers on Order No. 14-Phila-56, variable trimmer capacitors are provided for tuning the mechanical filters FL502 through FL505. Do not disconnect these capacitors. Connect the AN/URM-25 ( ) and the AN/USM-116 ( ) as in step 3 and adjust the trimmers for maximum gain. The trimmer associated with each filter is listed below in table 6-3.

Table 6-3 - Mechanical Filters and Associated Trimmers

Bandwidth (kHz)	Mechanical Filter	Input Trimmer	Output Trimmer
2	FL502	C567	C568
4	FL503	C566	C569
8	FL504	C565	C570
16	FL505	C564	C571

6.3.11 Removal and Replacement of VFO Sub-chassis. (See Figure 6-15.)

Removal of this sub-chassis does not require the previous removal of any other sub-chassis. Handle this sub-chassis carefully to prevent damage or misalignment.

⇒Note:	To prevent mis-aligning the VFO, avoid turning the VFO sub-chassis shaft or the KILOCYCLE CHANGE shaft on the RF gear train assembly. If the KILOCYCLE CHANGE shaft must be turned, record the setting and be sure to return it to the same setting before replacing the VFO. Do not disturb the Oldham coupler shaft clamps.

6.3.11.1 Removal

1. Remove the Oldham coupler anti-backlash spring on the VFO sub-chassis drive shaft and place it in a tray for safekeeping.

2. Turn the KILOCYCLE CHANGE control so that one slot in the Oldham coupler is vertical and the other is horizontal.

3. Loosen the three green-headed captive screws (Figure 6-15) that secure the sub-chassis.

4. Loosen, but do not remove, the two Phillips screws that secure the triangular bracket at the rear of the VFO sub-chassis. This is done to provide extra clearance for the removal of the sub-chassis.

5. Disconnect plugs P109 (Figure 6-15) and P717 (Figure 6-14).

6. Carefully remove the VFO sub-chassis from the main frame. The coupler guide of the Oldham coupler (Figure 6-4) will fall free. Place it in a tray with the anti-backlash spring for safekeeping until the VFO sub-chassis is to be replaced.

6.3.11.2 Replacement Replace the VFO sub-chassis as follows:

1. Smear a little grease on the coupler guide of the Oldham coupler and press it in place against the first coupling of the VFO drive shaft of the RF gear train tuning assembly.

2. Lower the VFO sub-chassis into position in the main frame and engage the Oldham coupler; at the same time, engage, but do not lock, the three green-headed captive screws. Replace the Oldham coupler anti-backlash spring.

3. Tighten the two Phillips-head screws that secure the triangular-shaped bracket at the rear of the VFO sub-chassis.

4. Tighten the three green-headed captive screws.

5. Reconnect plugs P109 and P717.

6. Check the frequency of the VFO (paragraph 6.2.5.6) if the shaft on the VFO has been turned from its original settings.

⇒**Note:**	Re-mating the Oldham coupler will accurately reposition the VFO shaft.

6.3.12 Removal and Replacement of VFO Sub-chassis Parts. (See Figure 6-25.)

6.3.12.1 External Cover.

1. Removal

a. Remove the VFO sub-chassis (paragraph 6.3.11.1).

b. Remove the two Phillips-head screws that secure the J709 mounting bracket.

c. Remove the three Phillips-head screws and lockwashers spaced 120 degrees around the front edge of the external cover.

d. Remove the J709 cable clamp.

e. Slide the external cover back slowly until it is disengaged from the heater winding cover.

2. Replacement

a. Slide the external cover into place, and line up the three holes spaced at 120 degrees. Be sure that the two J709 mounting bracket holes are in a horizontal plane.

b. Replace and secure the three Phillips-head screws and lockwashers.

c. Replace and secure the J709 mounting bracket.

d. Replace and secure the J709 cable clamp.

e. Replace the VFO sub-chassis (paragraph 6.3.11.2).

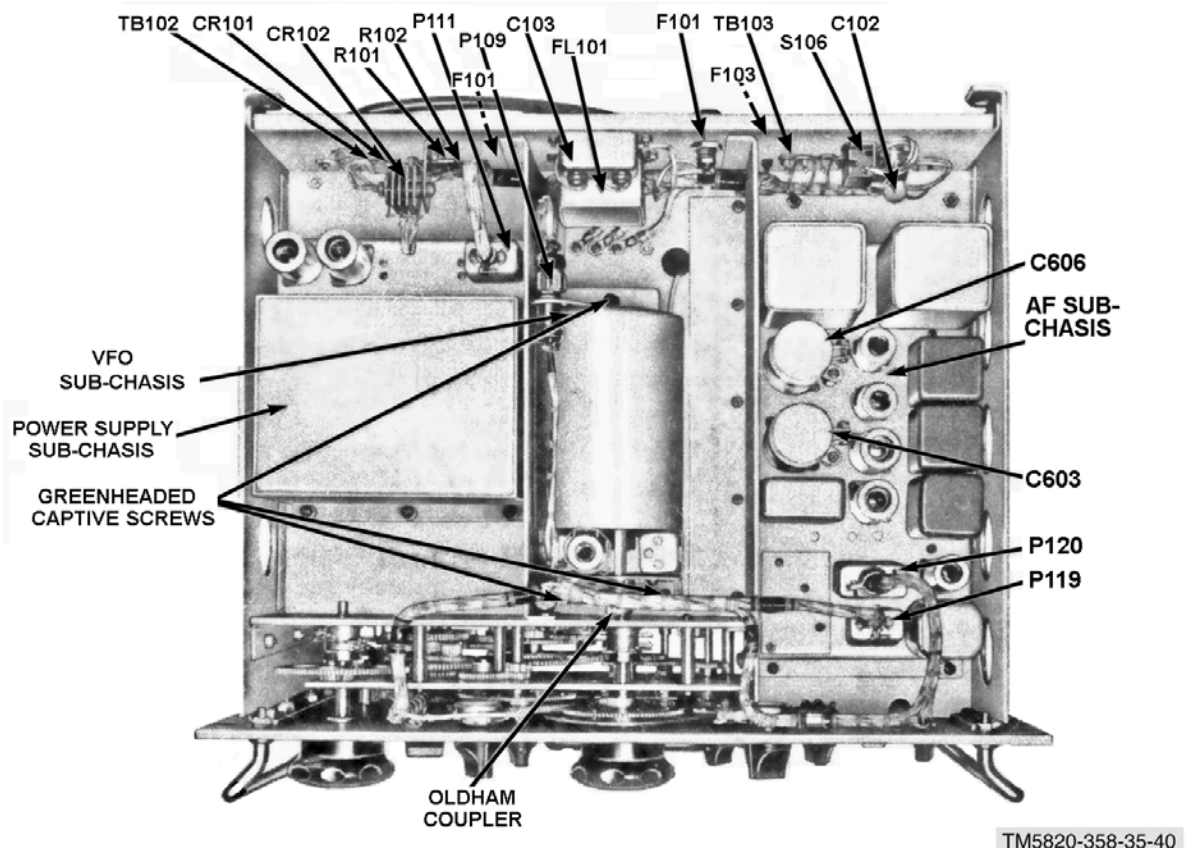


Figure 6-15 Radio Receiver R-390A/URR, Bottom View -Norris

6.3.12.2 Heater Winding Cover.

1. Removal

a. Remove the external cover (paragraph 6.3.12.1(1)) above.

b. Carefully remove the insulating sleeve from the heater winding cover.

c. Remove the three Phillips-head screws spaced 120 degrees around the front edge of the heater winding cover.

d. Unsolder the two heater winding leads from the VFO sub-chassis terminals. Tag them for identification.

e. Slide the heater winding cover back slowly until it is disengaged from the sealed inner cover. Do not remove the sealed inner cover.

f. Note the position of the compartment slot and the thermostat alignment pin before sliding the thermostat out of the heater winding cover.

2. Replacement

a. Slide the thermostat into the new winding cover. Position the thermostat as in 1.f. above.

b. Slide the heater winding cover into place; line up the three holes spaced at 120 degrees spacing; replace the three Phillips-head screws.

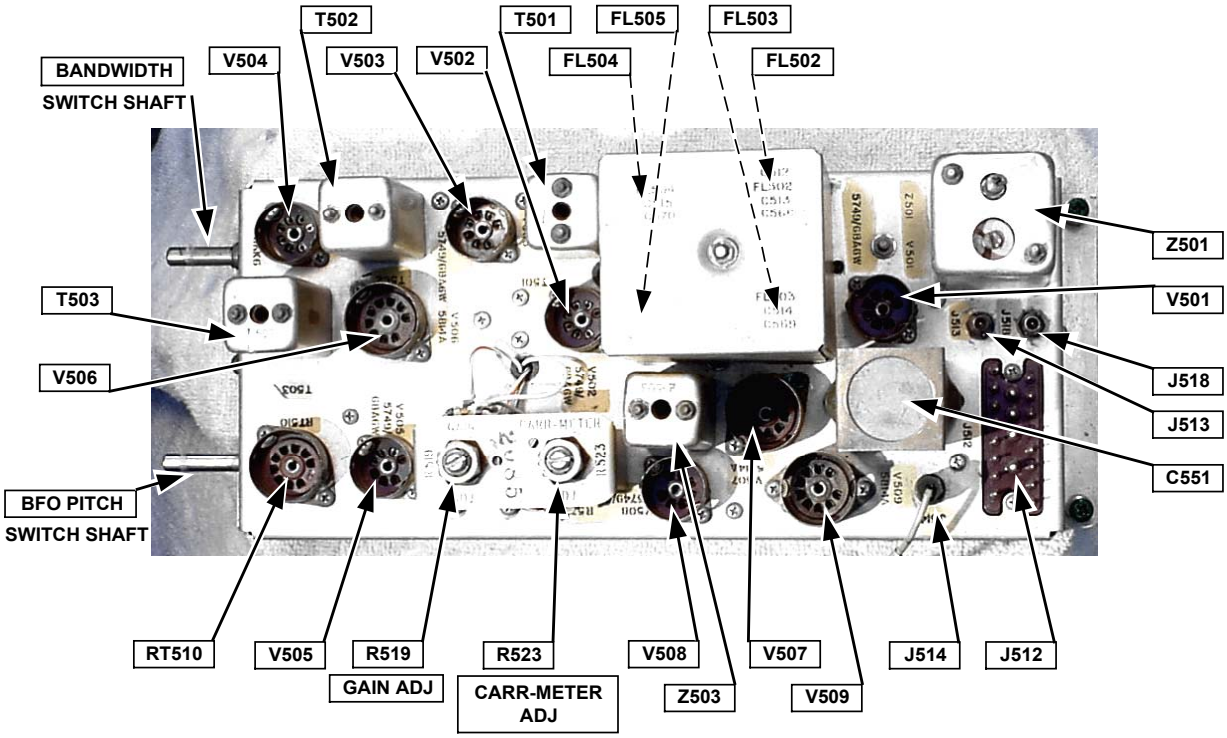


Figure 6-16 IF Sub-chassis, Top View[12]

[12]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

6.3.13 Power-Supply Sub-chassis Removal and Replacement.

Removal and replacement of the power-supply sub-chassis does not require the removal or replacement of other sub-chassis or parts in the receiver, except for plug P111.

6.3.13.1 Removal

1. Disconnect plug P111.

2. Loosen the six green-headed captive screws that fasten the sub-chassis to the main frame of the receiver.

3. Withdraw the sub-chassis from the receiver.

6.3.13.2 Replacement

1. Carefully lower the power-supply sub-chassis into the receiver.

2. Engage the six green-headed screws that fasten the sub-chassis to the main frame of the receiver. Tighten each of the screws.

3. Reconnect plug P111.

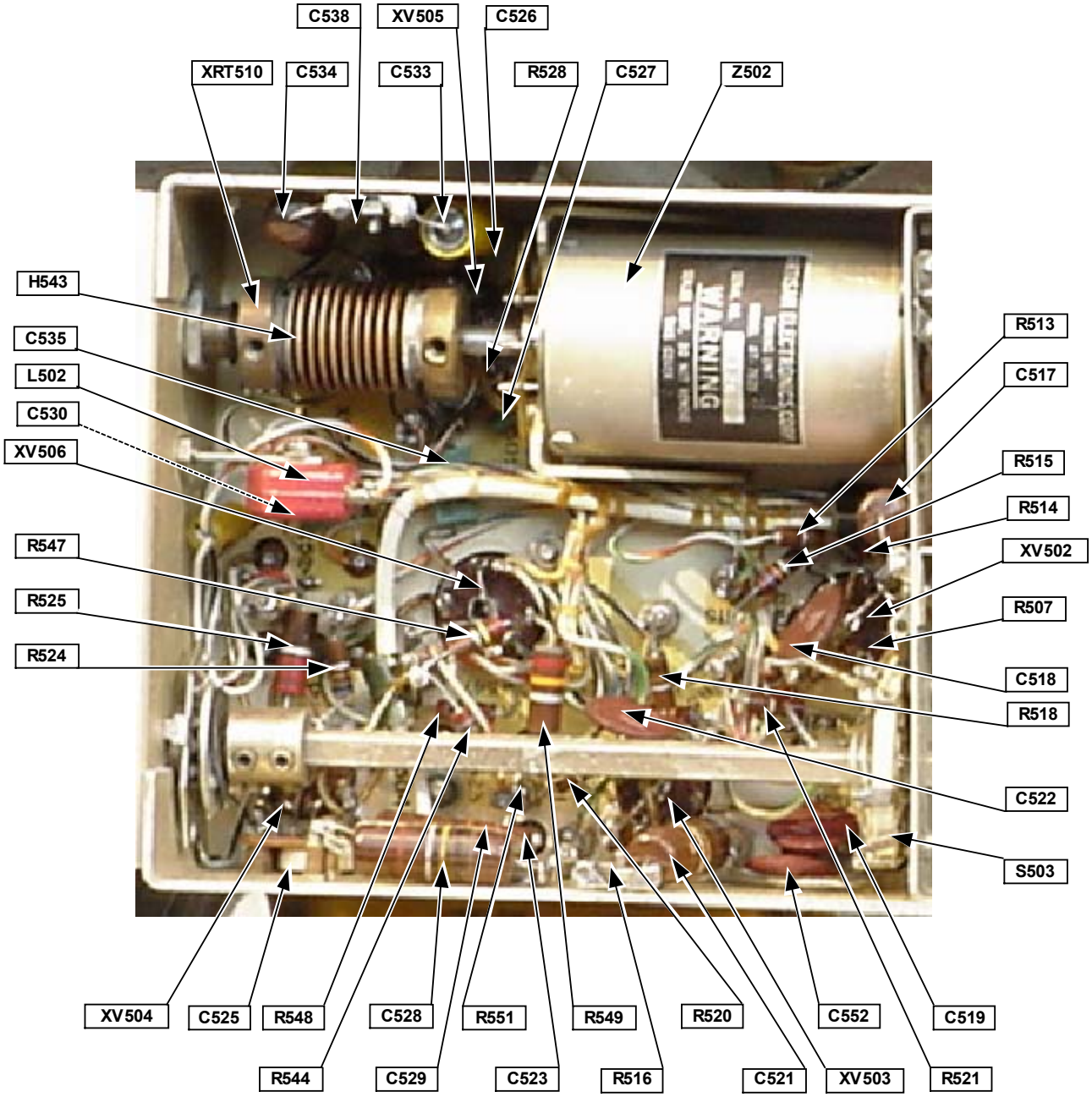


Figure 6-17 IF Sub-chassis, Front Section[13]

[13]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

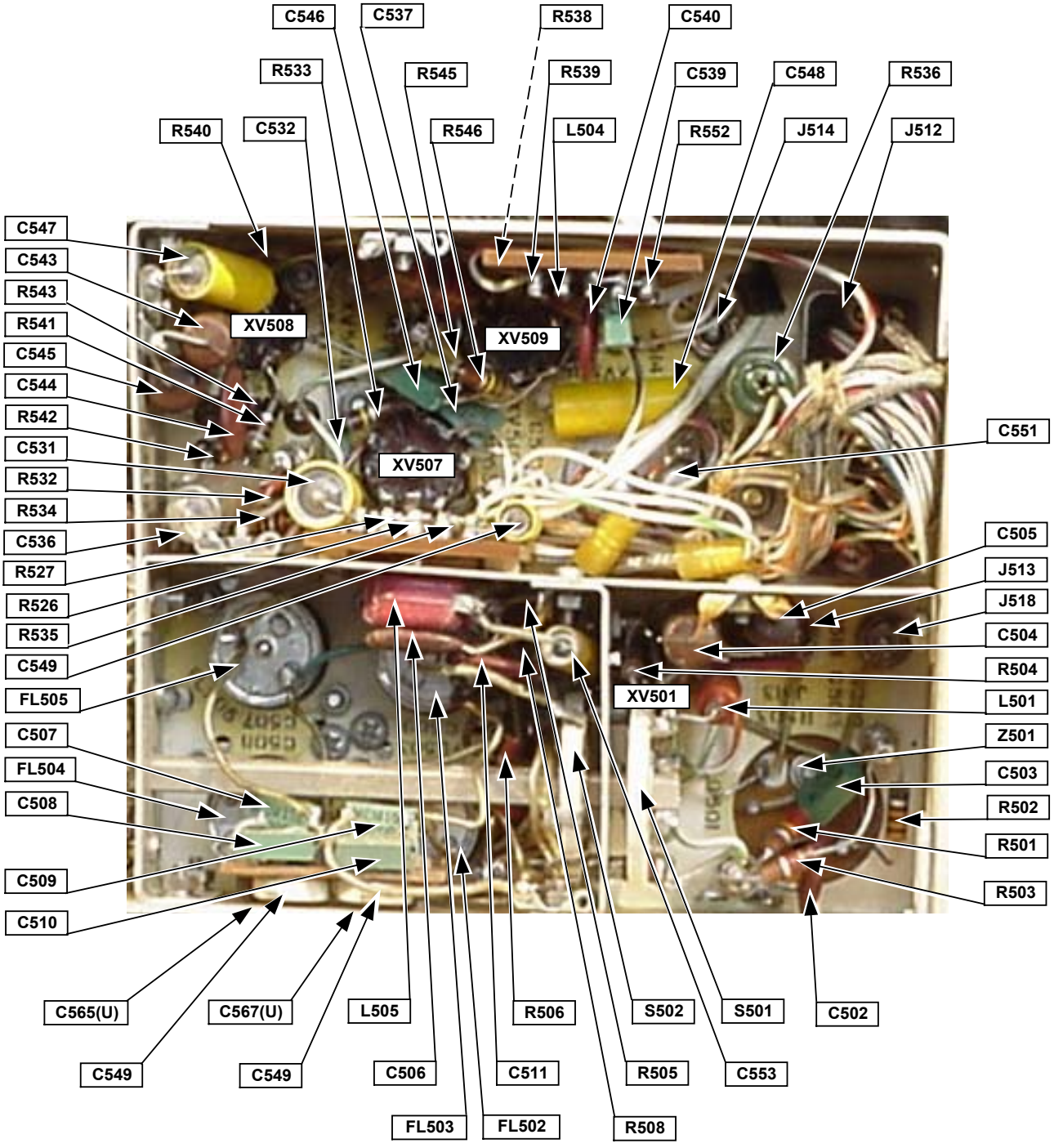


Figure 6-18 IF Sub-chassis, Rear Section[14]

[14]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

6.3.14 AF Sub-chassis

Removal and Replacement.

The AF sub-chassis can be removed from the main frame without the removal of other sub-chassis or parts, with the exception of the cable connectors that connect directly to the AF sub-chassis.

6.3.14.1 Removal

1. Disconnect plugs P119 and P120.

2. Loosen the four green-headed captive screws that fasten the AF sub-chassis to the main frame.

3. Lift the AF sub-chassis from the main frame.

6.3.14.2 Replacement

1. Place the AF sub-chassis on the main frame.

2. Engage and tighten the four green-headed captive screws.

3. Reconnect plugs P119 and P120.

6.3.15 Removal and Replacement of Incandescent Lamps.

6.3.15.1 Removal

1. Remove the four Phillips screws from the corners of the frequency-indicator window.

2. Move the frequency-indicator window a few inches away from the front panel. Its connecting wires will hold it in position.

3. Remove the defective incandescent lamps.

6.3.15.2 Replacement

1. Insert the new incandescent lamps.

2. Place the frequency-indicator window in position; line up the four screw holes.

3. Replace and tighten the four Phillips screws.

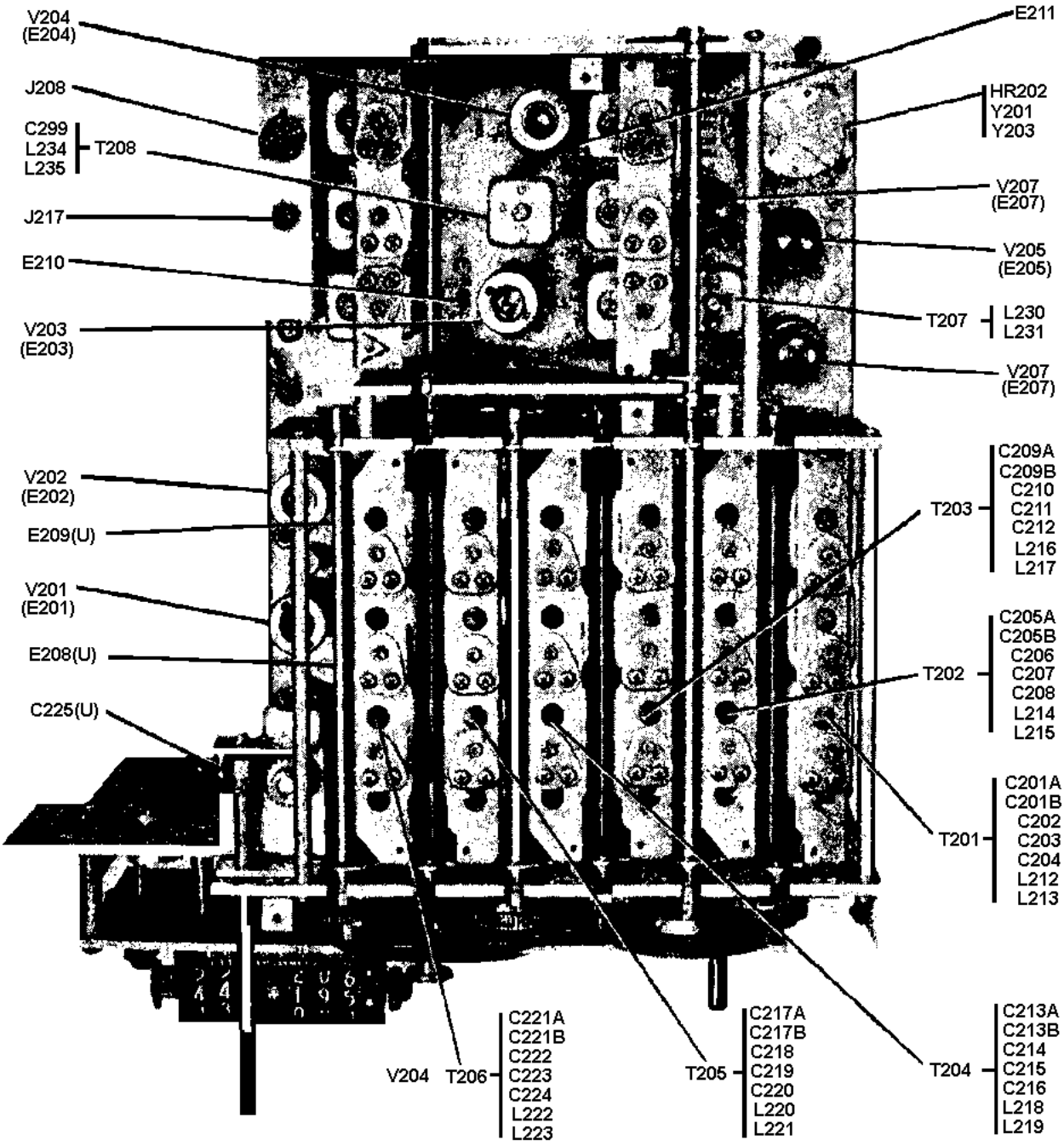


Figure 6-19 RF Sub-chassis, Top View (Sheet 1 of 2)

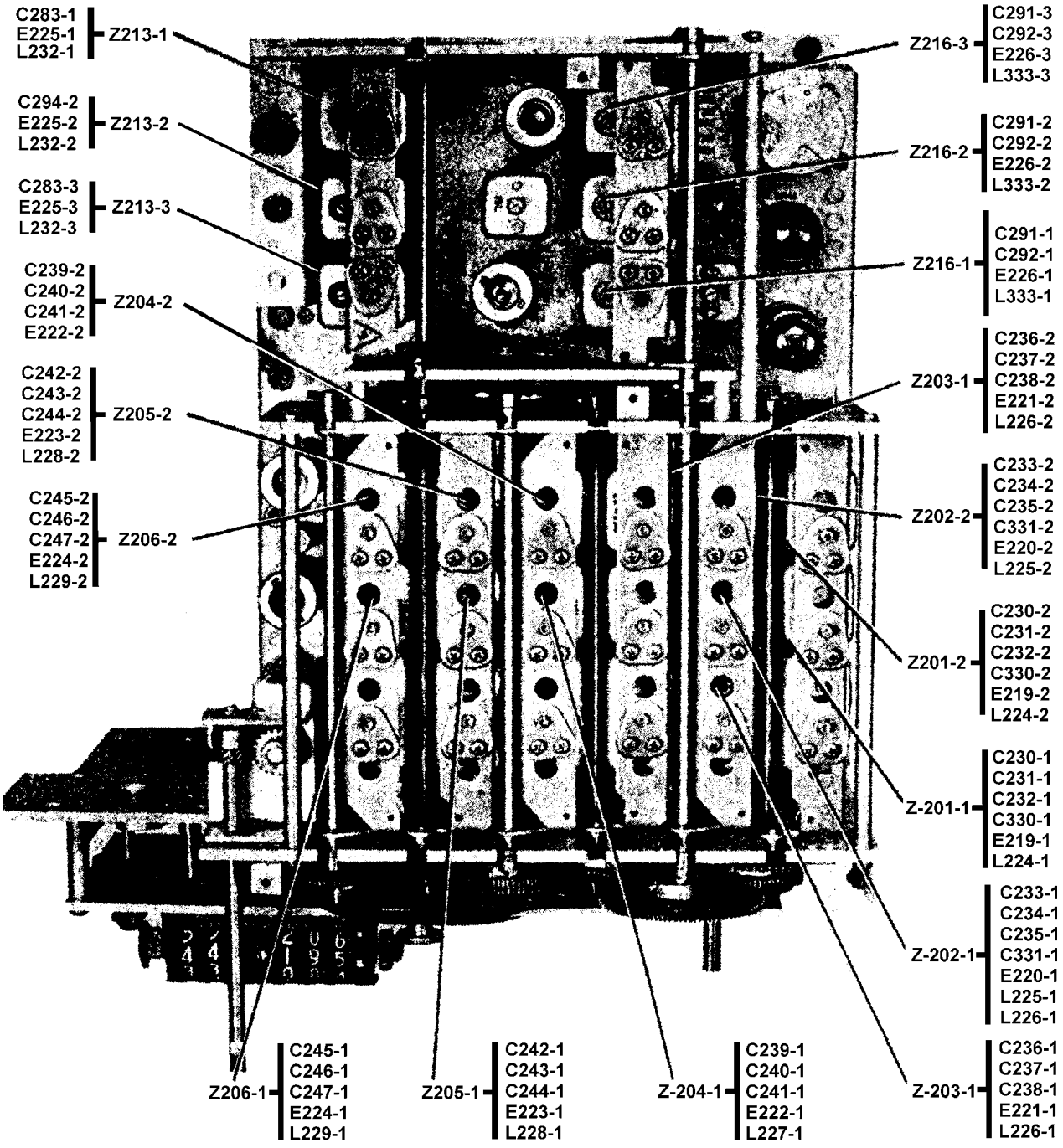


Figure 6-19 RF Sub-chassis, Top View (Sheet 2 of 2)

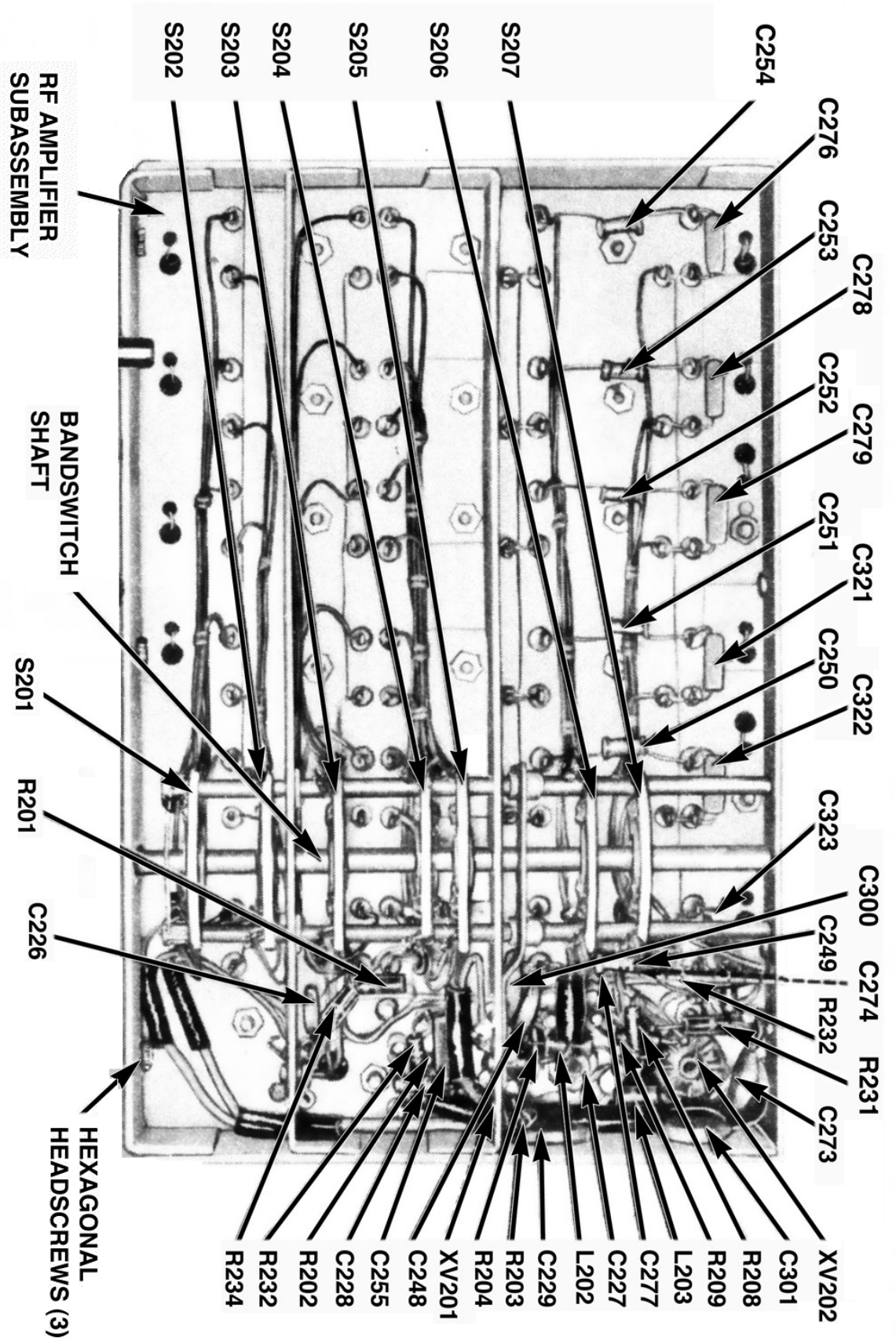


Figure 6-20 RF Sub-chassis, Front Section-Norris

Image courtesy of Tom Norris. Digital editing courtesy of Perry Sandeen

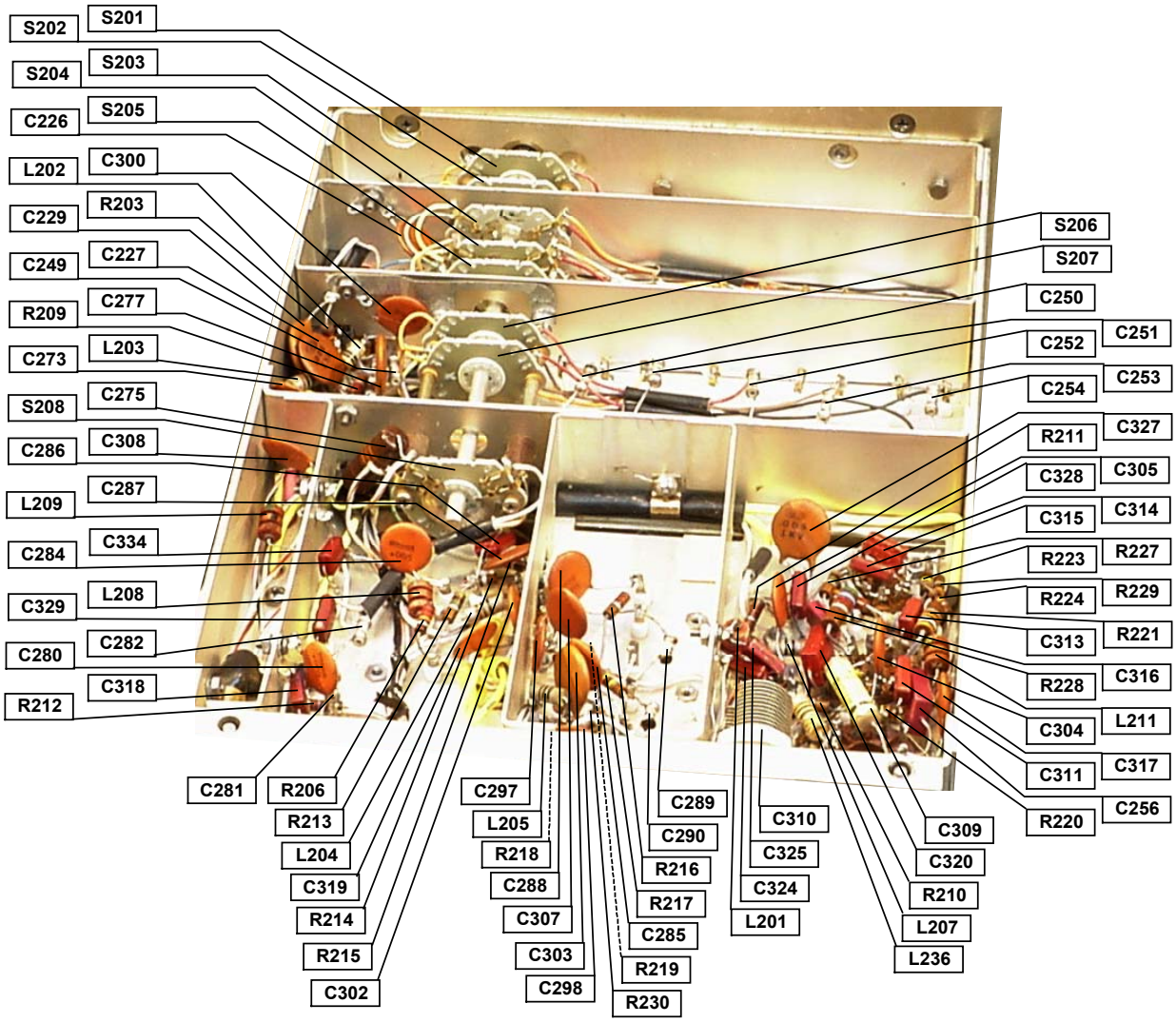


Figure 6-21 RF Sub-chassis, Bottom View, Rear Section[14]

[14]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

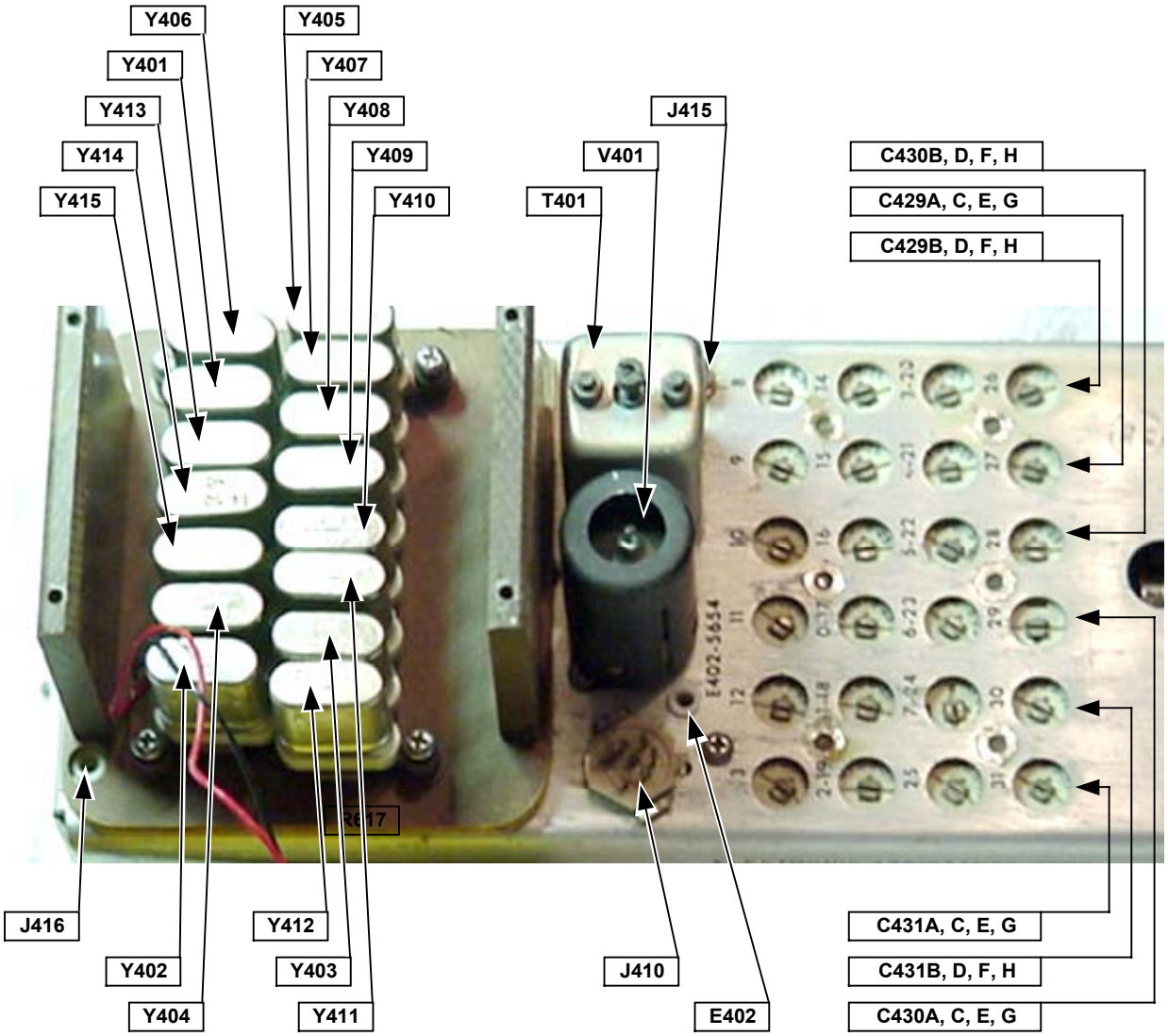
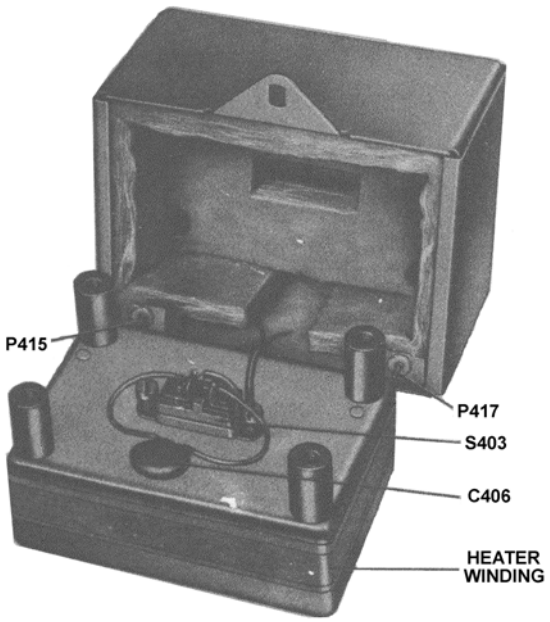


Figure 6-22 Crystal Oscillator Sub-chassis - Top View[15]

[15]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT



Right-Figure 6-24 Crystal Oscillator Sub-chassis, Internal View of Crystals. This was placed here out of sequence to save space

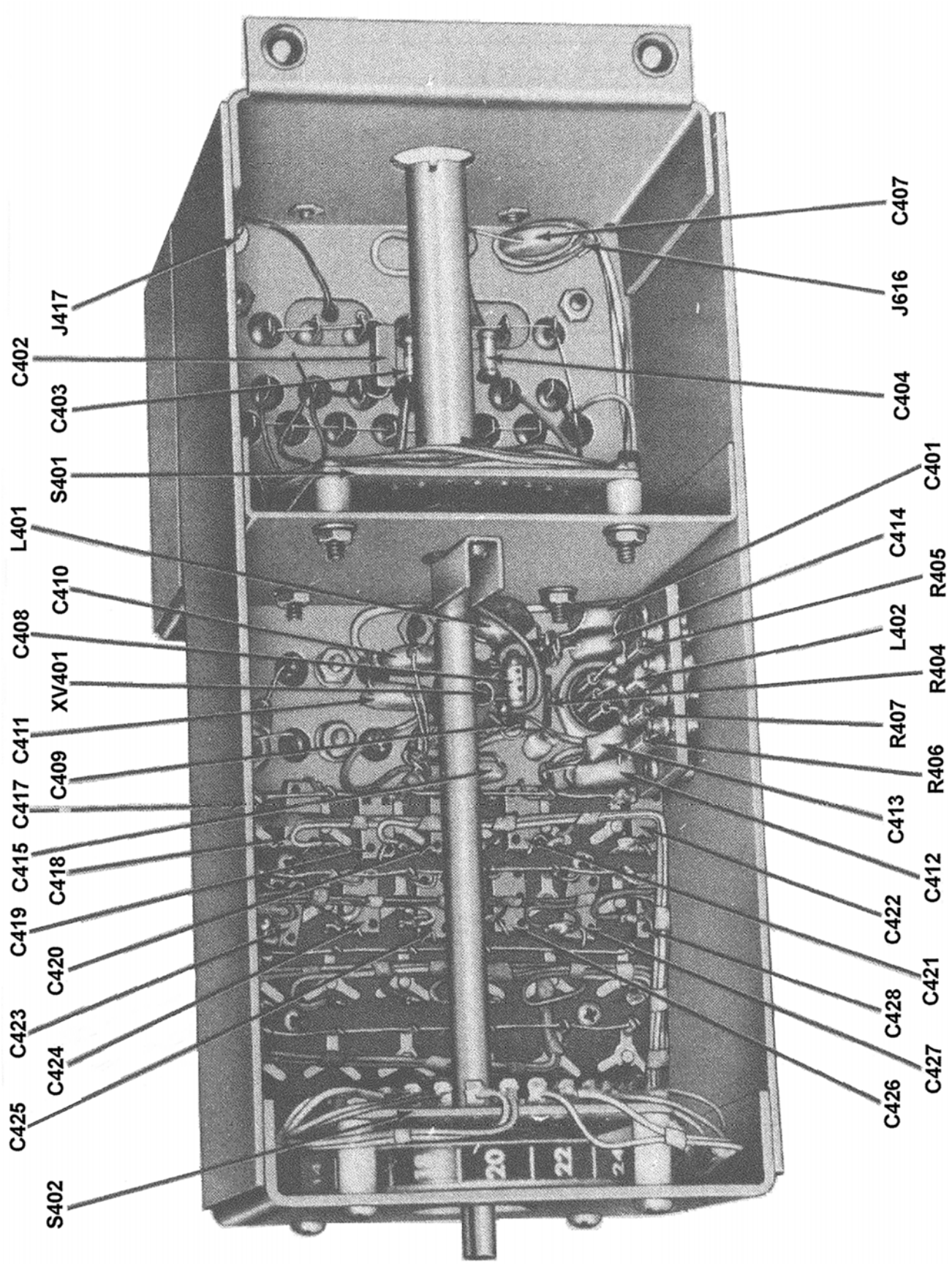


Figure 6-23 Crystal Oscillator Sub-chassis, Bottom View

6.3.16 Disassembly of RF Gear Train Assembly (See Figure 6-36.)

Under certain circumstances, such as gear damage, it may be necessary to disassemble and reassemble all or part of the gear train assembly. Do not disassemble parts that can be removed as an assembly unless the defect is in one of the assembly parts. For example, parts no. 1 through 6 of the riveted locking plate assembly need not be disassembled if the defect is in some other portion of the RF gear train assembly. The instructions given should be used as a guide when the method of removal and replacement of parts is not obvious. The numbers used in the instructions refer to those that identify the parts in Figure 6-36.

When disassembling the RF gear train assembly, lay out the parts in the order of disassembly. This will simplify reassembly. Proceed as follows:

1. Remove the front panel (paragraph 6.3.2.1).

2. Remove the eight slug racks and sixteen tension springs (paragraph 6.3.4.1).

3. Remove the RF sub-chassis (paragraph 6.3.3.1) and the crystal-oscillator sub-chassis (paragraph 6.3.7.1).

4. Set the frequency indicator to 07 +000.

5. Loosen the socket-head screw (20) and square nut (5) on the gear clamp (6).

6. Remove the riveted locking plate (1) and spur gear (2). If necessary, separate the riveted locking plate (1) and the spur gear (2) and remove the two rack gear springs (3) (only one shown) and the retaining ring (4).

⇒Note:	When a specific item is to be replaced, follow the disassembly procedures only to the step that results in removal of the item to be replaced. For replacement, start with the step that results in replacement of the item.

7. Remove the four machine screws (19) (only one shown) to remove the mechanical counter.

⇒Note:	It is not necessary to perform procedures 8 and 9 below unless bevel gears (9) and (24) require replacement.

8. Loosen the socket-head screw (7) in the gear clamp (8) to remove the bevel gear (9).

9. If necessary, loosen the socket-head screw (22) in the gear clamp (23) to remove the bevel gear (24).

10. Loosen the socket-head screw (100) and square nut (98) of the gear clamp (99) to release the spur gear (93) and washer (92). Pull out the locked clutch gear assembly (21), washer (16), and pressed bevel gear (25).

11. Loosen the socket-head screw (11) to remove the bevel gear (10), gear clamp (15), and gear bushing (14).

12. If necessary, remove the front pressed coupling of the Oldham coupler (Figure 6-4).

12a. Drive taper pin out of KC shaft if necessary[16]

13. Loosen the six binder-head screws (13) and (30) (only two shown), six split lockwashers (12) and (31) (only two shown), one special screw (28), and split lockwasher (29). Pull the front gear plate (32) forward to remove it.

14. If necessary, remove the retaining ring (121) and shim washers (122) and (123). Pull out the pinned stop assembly (94).

15. If necessary, remove the E-type retaining ring (85) and the pressed gear (86).

16. If necessary, remove the two machine screws (26) (only one shown) and the staked gear post (27).

17. Remove the pinned gear assembly (74), gear bushing (77), and shim washers (76) from the riveted front gear plate (109).

18. Remove the pinned gear assembly (95) and washers (96).

19. Remove the two binder-head screws (67), split lockwashers (68), and flat washers (69)(only one each shown), to remove the detent spring (70).

20. Lift off the final differential gear assembly (39) from the differential shaft (73).

21. Pull out the pinned gear (110).

22. Remove the retaining ring (41) and the riveted gear (42).

23. Pull out the pinned spur gear (66) with the spur gear (79), gear clamp (77), socket-head screw (27), square nut (80), and gear bushing (78).

24. Loosen the socket-head screw (133) and square nut (131) of the gear clamp (132). Remove the loaded rack gear assembly (129).

25. Loosen the socket-head screw (137) and square nut (135) of the gear clamp (136). Pull out the gear assembly (134).

26. Loosen the socket-head screw (45) and square nut (43) of gear clamp (46). Pull out the soldered rack gear (44). Remove the retaining ring (47). Pull out the gear assembly, which consists of the soldered gear (48), spur gear (49), and two gear rack springs (50).

27. Loosen the socket-head screw (51) and square nut (54) of gear clamp (52). Remove the soldered rack gear (53). Remove the retaining ring (58) and pull out the gear assembly (59).

28. Remove the three machine screws (55)(only one shown). Lift off the 8- to 15-MHz gear (63) with its leading gear (64) and two gear rack springs (65).

[16] Courtesy of David Wise.

29. Loosen the socket-head screw (140) and square nut (138) of gear clamp (139). Pull out the loaded rack gear assembly (141)

30. Loosen the socket-head screw (116) and square nut (114) of gear clamp (115). If necessary, pull out the oscillator spur gear (117), flat washer (113), and oscillator dial hub (124).

⇒Caution:	Observe the positioning of the parts (Figure 6-2) of the switch gear assembly (87) before attempting to remove it. Be careful not to lose the ball bearing's ball.

31. If necessary, remove the retaining ring (88). Lift off the switch gear assembly (87) as one unit.

32. If necessary, remove the E-type retaining ring (102) and the locking gear (103).

33. Loosen the two set-screws (177) and (178) and remove the retaining ring (176). Slide the antenna trimmer shaft (170) forward to remove the special washer (175), helical gear bushing (174), helical gear clamp (173), helical-driven gear (172), and shaft insulator (171).

34. Loosen the socket-head screw (35) and the square nut (33) of the gear clamp (34). Pull out the idler gear (36) and gear bushing (37). Remove the retaining ring (125) and shaft sleeve (38) if necessary.

35. Loosen the socket-head screw (82) and the square nut (84) of the gear clamp (83). Slide the megacycle gear (90) and the soldered megacycle gear (91) off the RF stop assembly (101). To separate items (90) and (91), remove the retaining ring (81) and the multi-turn gear springs (89).

36. Remove the retaining ring (106) and washers (105 and 104). Pull out the RF stop assembly (101).

6.3.17 Disassembly of Camshaft Assemblies. (See Figure 6-36.)

⇒Caution:	Mark each cam and camshaft for identification before removing it. If it is necessary to disassemble the camshaft assemblies, perform the procedures given in paragraph 6.3.16 and proceed as follows:

1. Slide the band switch shaft (Figure 6-20) to the rear to clear the riveted front gear plate (109).

2. Mark the pressed rear plate (180) at the points of the two soldered RF cams (185) and (187).

3. Remove the two taper pins (186) and (188) and pull the soldered RF cams (187) and (185) off the camshafts (184) and (183).

4. Remove the three hexagonal-head screws (Figure 6-20).

5. Remove the three Phillips-head screws (not shown) that secure the pressed rear plate (180) to the RF amplifier sub-assembly.

6. Remove the flathead machine screw (127) and the machine screw (182) and split lockwasher (181) that secure the long post (156).

7. Slide the pressed rear plate (180) to the rear to remove it.

8. Remove the two Phillips-head screws, two lockwashers, and two nuts (not shown) from the two cam plate brackets (118) (only one shown). The Phillips-head screws secure the RF gear grain assembly to the RF amplifier sub-assembly.

9. Separate the RF amplifier sub-assembly from the RF gear train assembly.

10. Remove the six flathead machine screws (126) (only one shown) from the three short posts (152) (only one shown). Remove the pressed auxiliary cam plate (179).

⇒Note:	The camshafts can now be removed in any order. Go directly to the step that results in the removal of the camshaft or the cams to be replaced. Mark the pressed cam plate (149) at the points of the cams before removal.

11. Remove the taper pin (158) from the soldered RF cam (157). Slide the 0.5- to 1-MHz camshaft (164) straight forward to remove it. Remove taper pin (57) to release soldered RF cam (56).

12. Remove taper pin (154) from the soldered RF cam (153). Slide the 1- to 2-MHz camshaft (184) straight forward to remove it. Remove taper pin (147) to release soldered RF cam (146).

13. Remove taper pin (159) from soldered RF cam (162). Slide the 2- to 4-MHz camshaft (163) straight forward to remove it. Remove taper pin (61) to release soldered RF cam (60).

14. The 4- to 8-MHz camshaft assembly and the 16- to 32-MHz camshaft assembly are Identical; each consists of camshafts (168) and (169), soldered RF cams (142) and (144) secured by taper pins (143) and (145), and soldered RF cams (155) and (165) secured by taper pins (166) and (167). Disassemble by removing the taper pin from each cam.

15. Remove the taper pin (161) from the soldered RF cam (160). Slide the 8- to 16-MHz camshaft (183) straight forward to remove it. Remove taper pin (75) to release the pressed gear assembly (62).

16. To remove the four long posts (148), remove the four Phillips-head screws (151) and four lockwashers (150), four Phillips-head screws (130) and four lockwashers (128). (Only one of each of the numbered items above is shown).

⇒Note:	The four long posts (148) fasten the pressed cam plate (149) to the riveted front gear plate (109).

6.3.18 Re-assembly of Camshaft Assemblies. (See Figures 6-2 and 6-36.)

When a specific item is to be replaced, go directly to the procedure that results in replacement of the item and follow the re-assembly procedures from that step onward.

1. To fasten the pressed cam plate (149) to the riveted front gear plate (109), replace the four long posts (148), four machine screws (151), four lockwashers (150), four Phillips-head screws (130), and four lockwashers (128). (Only one of each of the numbered Items above Is shown.)

⇒Note:	Figure 6-13 shows the normal positions of the cams viewed from the rear, with the two rear plates removed and the frequency indicator set at 07 + 000.

2. Slide the 8- to 16-MHz camshaft (183) through the holes marked A. Replace the pressed gear assembly (62) and the taper pin (75). Set the point of the cam to the cam positioning mark on the riveted front gear plate. Set the point of the soldered RF cam (160) to the mark previously made on the pressed cam plate (149) and replace the taper pin (161).

3. Slide the 4- to 8-MHz and the 8- to 16-MHz camshafts (168) and (169) through the holes marked B and C. Replace the soldered RF cams (142) and (144) and secure them with the taper pins (143) and (145). Set the points of the cams to the cam positioning marks on the riveted front gear plate. Replace the soldered RF cams (155) and (165). Set the points of the cams to the marks previously made on the pressed cam plate (149). Replace the taper pins (166) and (167).

4. Slide the 2- to 4-MHz camshaft (163) through the holes marked D. Replace the soldered RF cam (60) and taper pin (61). Set the point of the cam to the cam positioning mark. Replace the soldered RF cam (162) and taper pin (159) with the point of the cam set at the mark previously made on the pressed cam plate (149).

5. Slide the 1- to 2-MHz camshaft (184) through the holes marked E. Replace the soldered RF cam (146) and taper pin (147). Set the point of the cam to the cam positioning mark. Replace the soldered RF cam (153) and taper pin (154) with the point of the cam set at the mark previously made on the pressed cam plate (149).

6. Slide the 0.5- to 1-MHz camshaft (164) through the holes marked F. Replace the soldered RF cam (56) and taper pin (57). Set the point of the cam to the cam positioning mark. Replace the soldered RF cam (157) and taper pin (158) with the point of the cam set at the mark previously made on the pressed cam plate (149).

7. Secure the pressed auxiliary cam plate (179) with the three short posts(152) and six flathead machine screws (126) (only one of each shown).

8. Place the RF amplifier sub-assembly (Figure 6-20) in position to fasten it to the RF gear train assembly. Engage, but do not tighten the two Phillips-head screws (not shown), two lockwashers (not shown), and two nuts (not shown) that fasten the two cam plate brackets (188) to the RF amplifier sub-assembly.

9. Slide the pressed rear plate (180) forward on the two camshafts (183) and (184) until it is against the rear of the RF amplifier sub-assembly. Engage but do not tighten the three Phillips-head screws (not shown) that fasten the pressed rear plate (180) to the RF amplifier sub-assembly.

10. Replace the long post (156) but do not tighten the flathead machine screw (127) and the Phillips-head screw (182) and split lockwasher (181).

11. Replace the three hexagonal-head screws (Figure 6-20).

12. Slide the band switch shaft (Figure 6-20) forward until its retaining rings rest against the riveted front gear plate (109).

13. Tighten all the screws in the procedures given in 8, 9, 10, and 11 above.

14. Replace the two soldered RF cams (187) and (185) on the two camshafts (184) and (183). Set the points of the cams at the marks previously made on the pressed rear plate (180). Replace the two taper pins (186) and (188).

6.3.19 Re-assembly of RF Gear Train Assembly. (See Figure 6-36.)

1. Slide the RF stop assembly (101) into the hole marked G. Replace the two washers (104) and (105) and rotating ring (106). Slide the combination of the soldered megahertz gear (91), megahertz gear (90), two multi-turn gear springs (89), gear clamp (83), socket-head screw (82), and square nut (84) on the RF stop assembly. Do not tighten the socket-head screw (82).

2. Push the shaft sleeve (38) into the hole marked H and replace the retaining ring (125), if both have been removed. Slide the gear bushing (37), idler gear (36), and gear clamp (34) on the shaft sleeve (38). Tighten the socket-head screw (35) and square nut (33).

3. Slide the antenna trimmer shaft (170) into the hole marked I. Replace the shaft insulator (171), helical- driven gear (172), helical gear clamp (173), and helical gear bushing (174). Push the antenna trimmer shaft (170) as far as it will go toward the rear. Replace the special washer (175) and retaining ring (176). Mesh the helical-driven gear (172) and its mating gear. Tighten the two set-screws (177) and (178).

4. If necessary replace the locking gear (103) and E-type retaining ring (102) on the shaft marked K.

5. If necessary, slide the switch gear assembly (87) on the shaft marked J and replace the retaining ring (88). Position the assembly (Figure 6-2).

6. If necessary, slide the oscillator dial hub (124) into the hole marked L; then slide the oscillator spur gear (117), flat washer (113), and gear clamp (115) on the hub (124). Replace but do not tighten the socket-head screw (116) and square nut (114).

7. Slide the loaded rack gear assembly (141) on the 16- to 32-MHz shaft (168). Load the assembly (141) two teeth before meshing it with the pressed gear assembly (62). Tighten the socket-head screw (14) and square nut (138) of the gear clamp (139).

8. Place the 8- to 16-MHz gear (63) with its loading gear (64) on the pressed gear assembly (62). Replace the two gear rack springs (65) and the three machine screws (55) (only one shown).

9. Slide the gear assembly (59) on the 2- to 4-MHz camshaft (163) and replace the retaining ring (58). Replace the gear clamp (52), socket-head screw (51), square nut (54), and soldered rack gear (53). Tighten the socket-head screw (51).

10. Slide the gear assembly consisting of soldered gear (48), spur gear (49), and two gear rack springs (50) on the 0.5- to 1-MHz camshaft (164). Replace the retaining ring (47), gear clamp (46), socket- head screw (45), square nut (43), and soldered rack gear (44). Tighten the socket-head screw (45).

11. Slide the gear assembly (134) with gear clamp (136), socket-head screw (137), and square nut (135) on the 4- to 8-MHz camshaft (one of two) (167). Load the gear assembly (134) two teeth before meshing it with the soldered rack gear (53).

12. Slide the loaded rack gear assembly (129) on the 1- to 2-MHz camshaft (184). Load the loaded rack gear (129) two teeth before meshing it with the soldered rack gear (44). Tighten the socket-head screw (133) and square nut (131) of the gear clamp (132).

13. Slide the shaft of the assembly consisting of the pinned spur gear (66), gear clamp (71), socket-head screw (72), square nut (80), spur gear (79), and gear bushing (78) into the hole marked M.

14. Replace the riveted gear (42) and retaining ring (41) on the 8- to 16-MHz camshaft (183).

15. Slide the shaft of the pinned gear (110) into the hole marked N.

16. Slide the differential gear assembly (39) on the differential shaft (73), Load the loaded rack gear assembly (59) two teeth before meshing the final differential gear assembly (39) with it. Load the combination of the megahertz gear (90) and soldered megahertz gear (91), which was assembled in paragraph 6.3.19 step 1. Slide the assembly forward to mesh it with the final differential gear assembly (39). Tighten the socket-head screw (82).

17. Secure the detent spring (70) with the two binder-head screws (67), two flat washers (69), and two split lockwashers (68) (only one of each shown).

18. Slide the shaft of the pinned gear assembly (95) with two washers (96) into the hole marked O.

19. Slide the shaft of the pinned gear assembly (74) with gear bushing (77) and shim washers (76) into the hole marked P.

20. If necessary, slide the staked gear post (27) into the hole marked U, and replace the two machine screws (26) (only one shown).

21. If necessary, replace the pressed gear (86) and E-type retaining ring (85).

22. Slide (if necessary) the shaft of the pinned stop assembly (94) into the hole marked Q. Replace the shim washers (123) and (122) and retaining ring (121).

23. Slide the front gear plate (32) into place. Replace the six binder-head screws (13) and (30) (only two shown) and six split lockwashers (12) and (31) (only two shown). Secure the special screw (28) and split lockwasher (29) in the hole marked V.

24. Replace the front pressed coupling of the Oldham coupler (Figure 6-4).

25. Slide the gear bushing (14), gear clamp (15), and bevel gear (10) onto the shaft of the pinned gear (110). Tighten the socket-head screw (11).

26. Slide the shaft of the locked clutch gear assembly (21), with the washer (16) in place, through the hole marked R. Replace the washer (92), spur gear (93), and gear clamp (99) with socket-head screw (100) and square nut (98). Load the loaded rack gear (part of (21)) two teeth, mesh it with the pressed bevel gear (25), and slide the combination into place. Slide the pressed gear assembly consisting of (92), (93), (99), (98), and (100) forward on the shaft of the locked clutch gear assembly (21) until the spur gear (93) is against the front gear plate (32) and is meshed with the pressed gear (86).

26a. Adjust (27)'s position slightly to mesh (86) as closely as possible without binding, to (39) and (93). This is most easily done with a right-angle Phillips screwdriver: loosen (100) and pull (21) part way forward to expose (26).[17]

27. If necessary, replace the gear clamp (23) with socket-head screw (22) and bevel gear (24) on the mechanical counter (17) shaft marked T. Tighten the socket-head screw (22).

28. Replace (if necessary) the gear clamp (8) with socket-head screw (7) and bevel gear (9) on the remaining mechanical counter (17) shaft.

29. Set the mechanical counter (17) to 07 + 000. Place the mechanical counter (17) in position and secure the four machine screws (19) (only one shown).

30. Replace (if necessary) the two rack gear springs (3) (only one shown) and retaining ring (4). Slide the gear clamp (6) with socket-head screw (20) and square nut (5) on the hub of the spur gear (2). Load the spur gear (2) two teeth and slide it on the pinned stop assembly (94) until the spur gear (2) meshes with the front gear of the locked clutch gear assembly (21).

31. Replace the crystal-oscillator sub-chassis (paragraph 6.3.7 2) and the RF sub-chassis (paragraph 6.3.3.2).

32. Check the mechanical and electrical synchronization (paragraph 6.2.5).

33. Replace the eight slug racks and sixteen tension springs (paragraph 6.3.4.1).

34. Replace the front panel (paragraph 6.3.2.2).

[17]Courtesy of David Wise

6.4 Parts Location.

The physical location of major components and detail parts is illustrated in Figures 6-14 through 6-33. In addition, zoning indexes are provided with each sheet of the schematic diagram as an aid in locating detail parts. The zoning index precedes the applicable Figure. Zoning Indexes are also provided for the power distribution diagram, Figure 5-11, the signal flow diagram, Figure 5-12, and the RF gear train diagram, Figure 6-36.

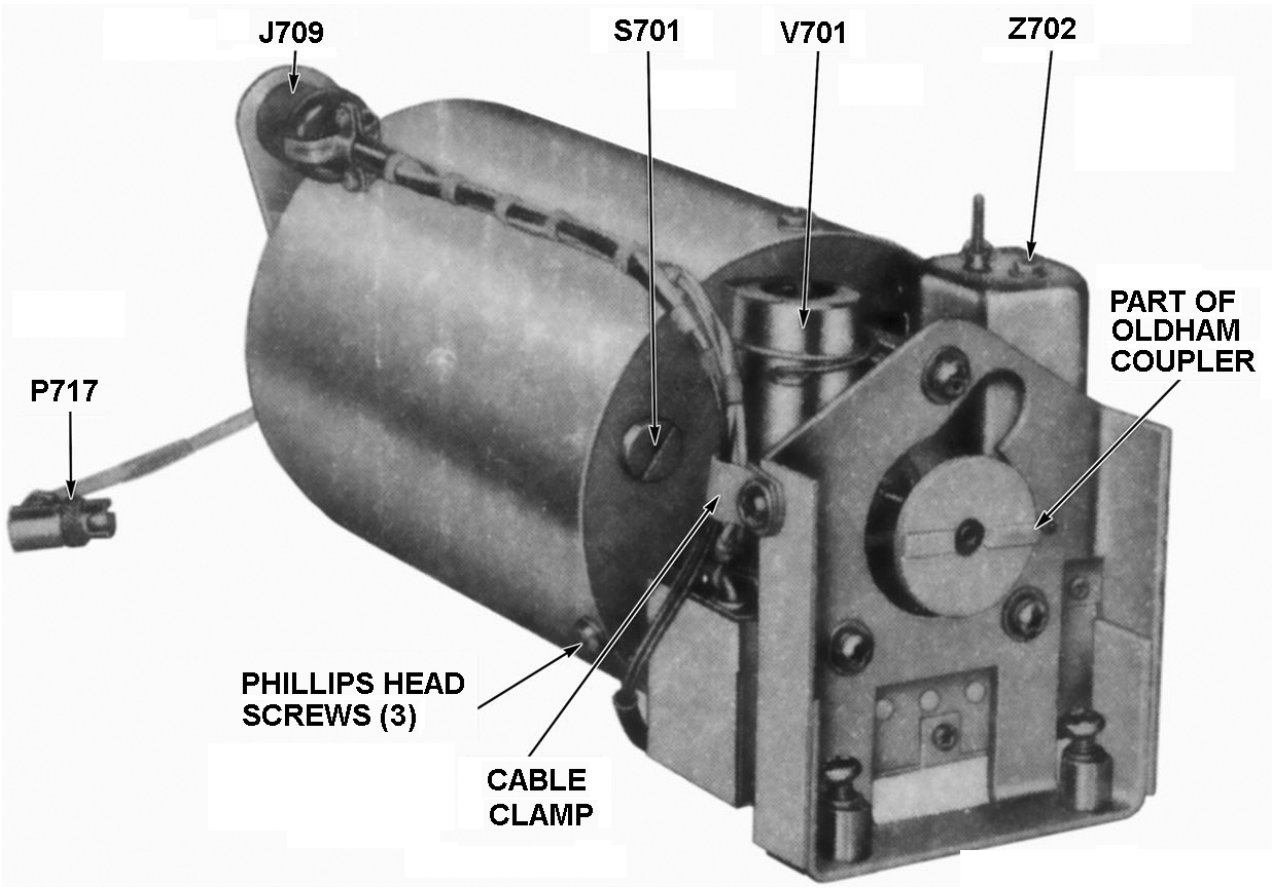


Figure 6-25 VFO Sub-chassis, Top View

Photo and annotation courtesy of Tom Norris, digital editing courtesy of Perry Sandeen

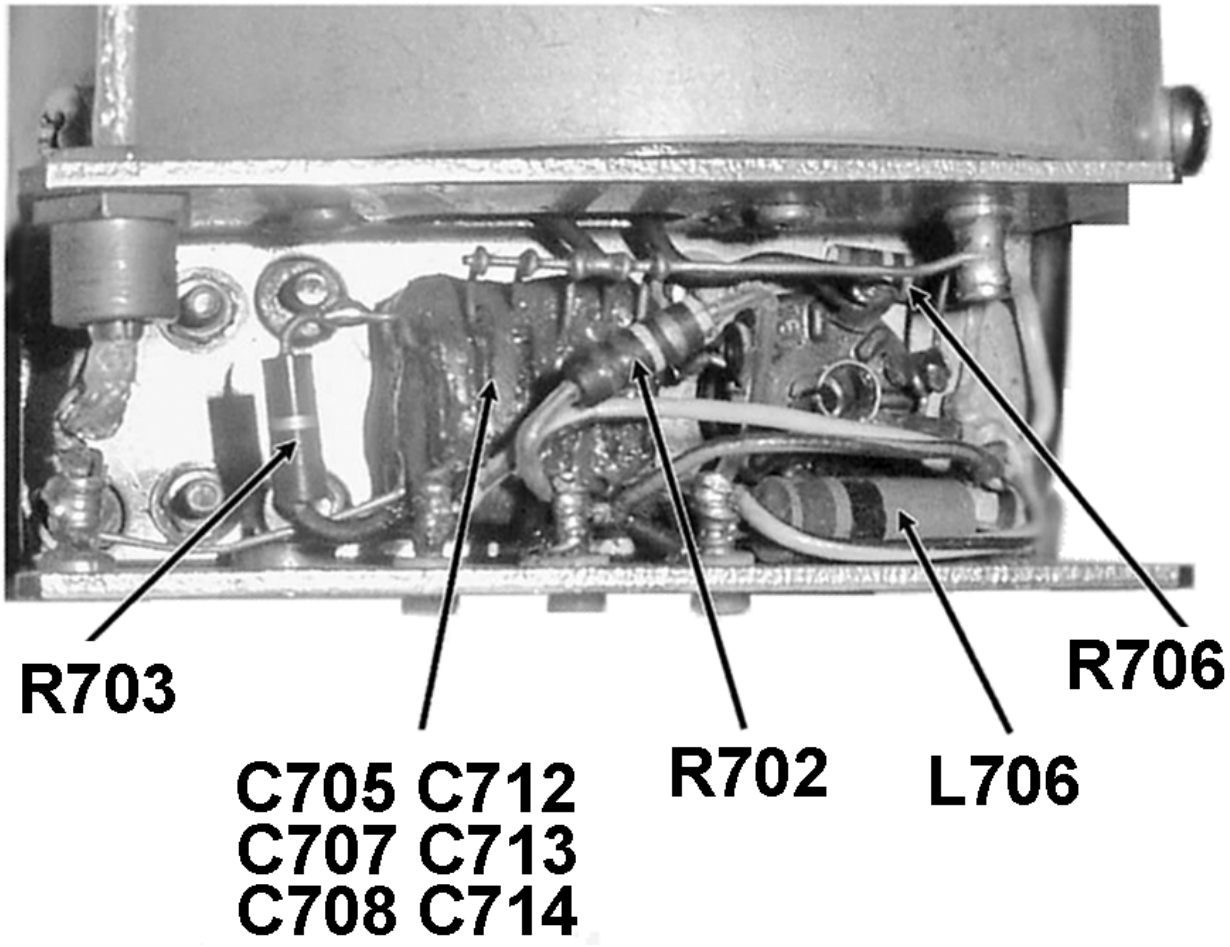


Figure 6-26 VFO Sub-chassis, Bottom View, Typical (Cosmos)
(there will be slight differences depending on which manufacture supplied the PTO)

Photo and annotation courtesy of Tom Norris, digital editing courtesy of Perry Sandeen

Figure 6-27 AF Sub-chassis, Top View[18]

[18]Photo courtesy of Dan Arney, annotation courtesy of Perry Sandeen

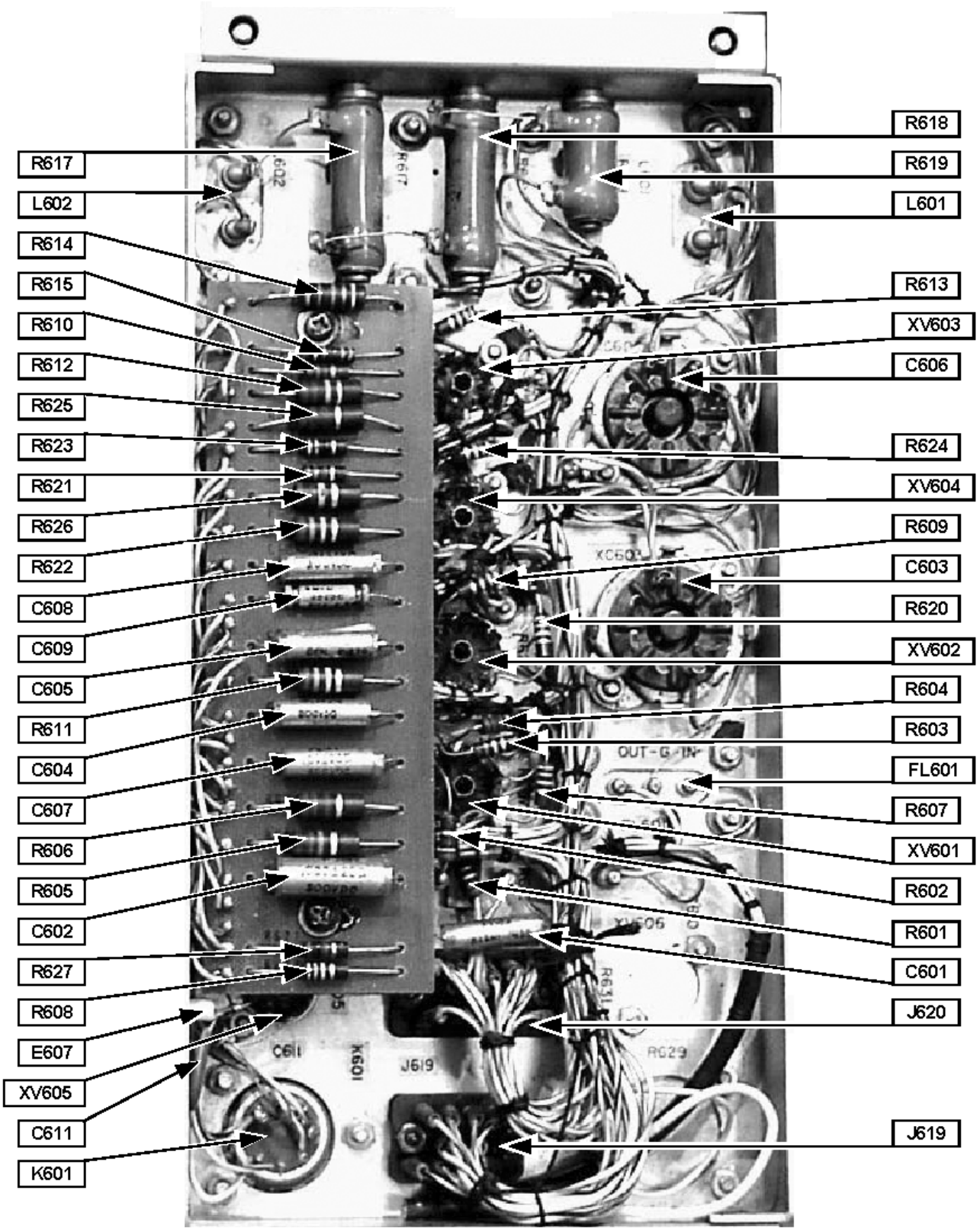


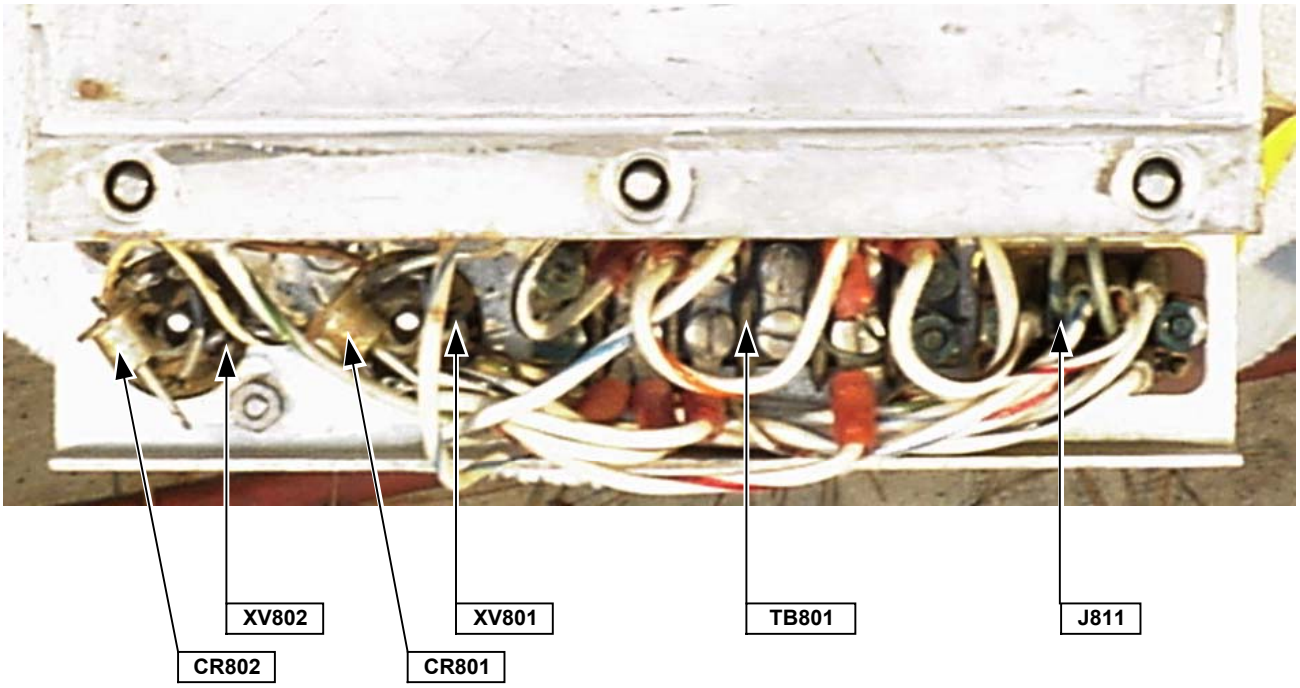
Figure 6-28 AF Sub-chassis, Bottom View[19]

[19]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

Shown with V801 and V802 replaced with CR801 and CR802 (under sockets) by Field Change 6.

Figure 6-29 Power-Supply Sub-chassis, Top View[20]

[20]Photos courtesy of Dan Arney, Annotations courtesy of Pete Wokoun, KH6GRT



Shown with V801 and V802 replaced with CR801 and CR802 (under sockets) by Field Change 6.

Figure 6-30 Power-Supply Sub-chassis, Bottom View[21]

[21]Photo courtesy of Dan Arney, Annotation courtesy of Pete Wokoun, KH6GRT

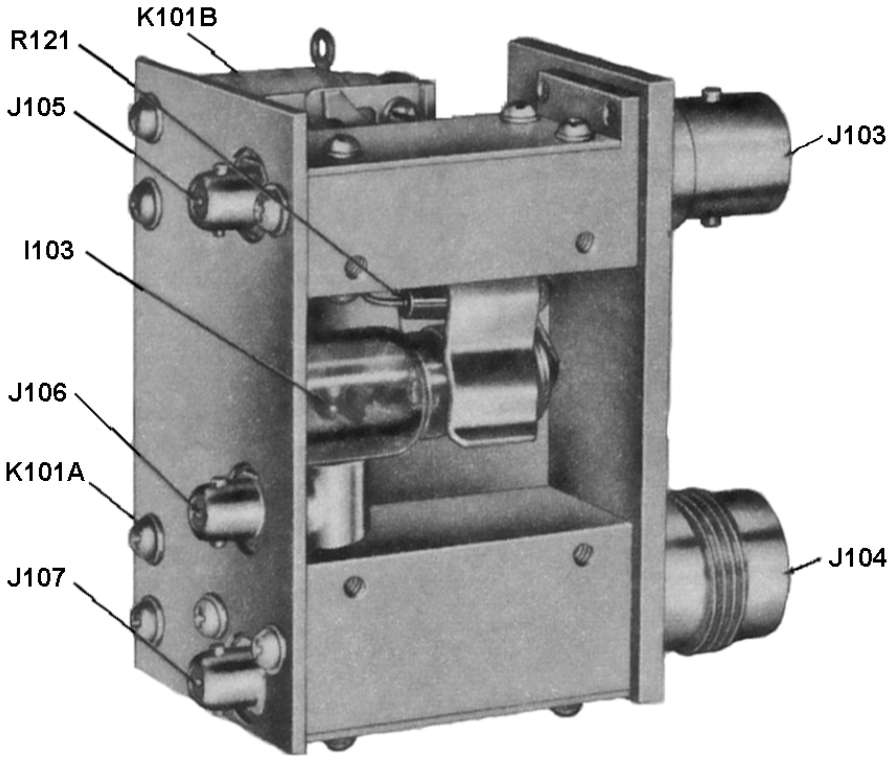


Figure 6-31 Antenna Relay Assembly, Internal View[22]

[22]Photo courtesy of Tom Norris, Digital editing courtesy of Perry Sandeen

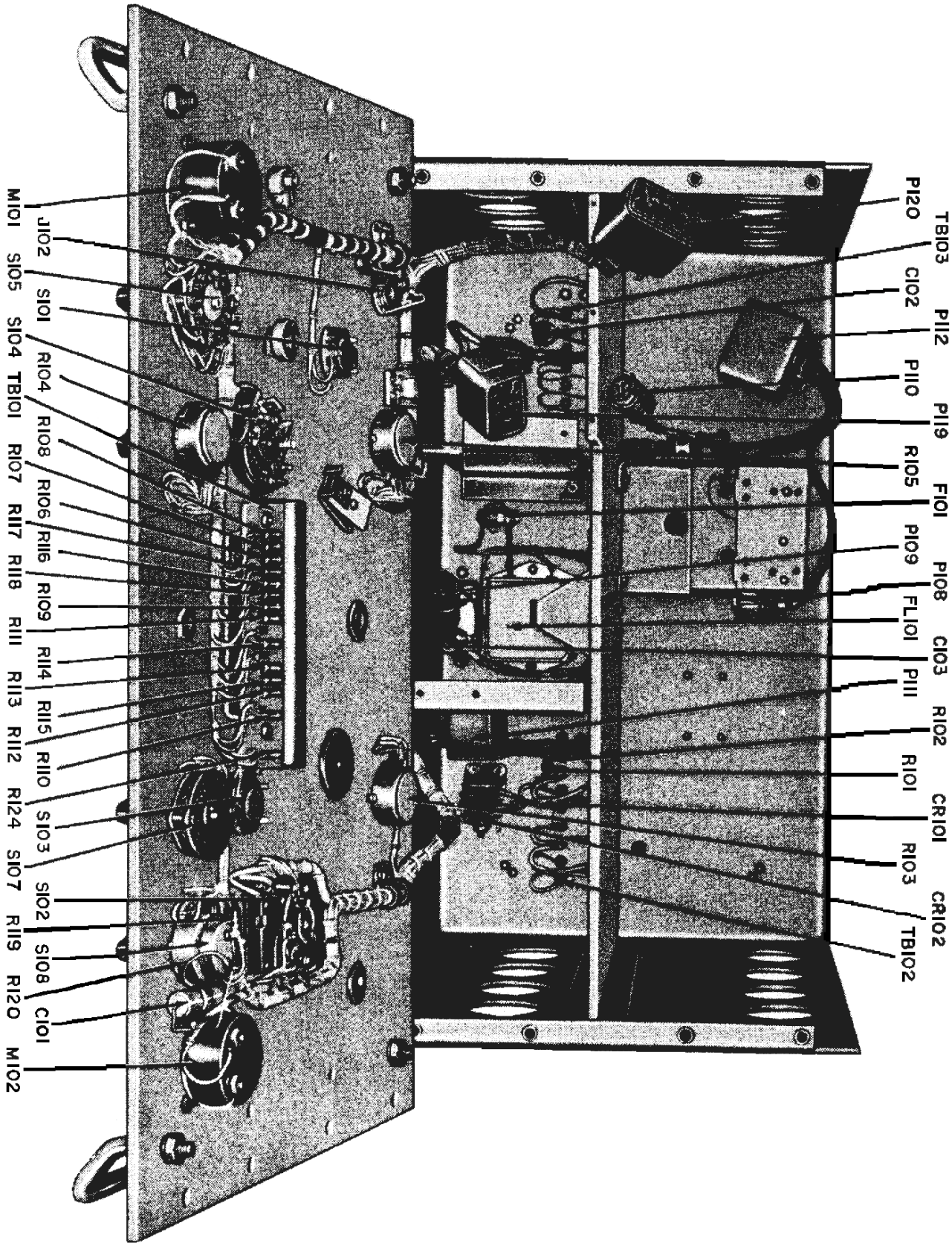


Figure 6-32 Radio Receiver R-390A/URR, Front Panel and Interior of Main Frame[23]

[23]Photo courtesy of Tom Norris, digital editing courtesy Perry Sandeen

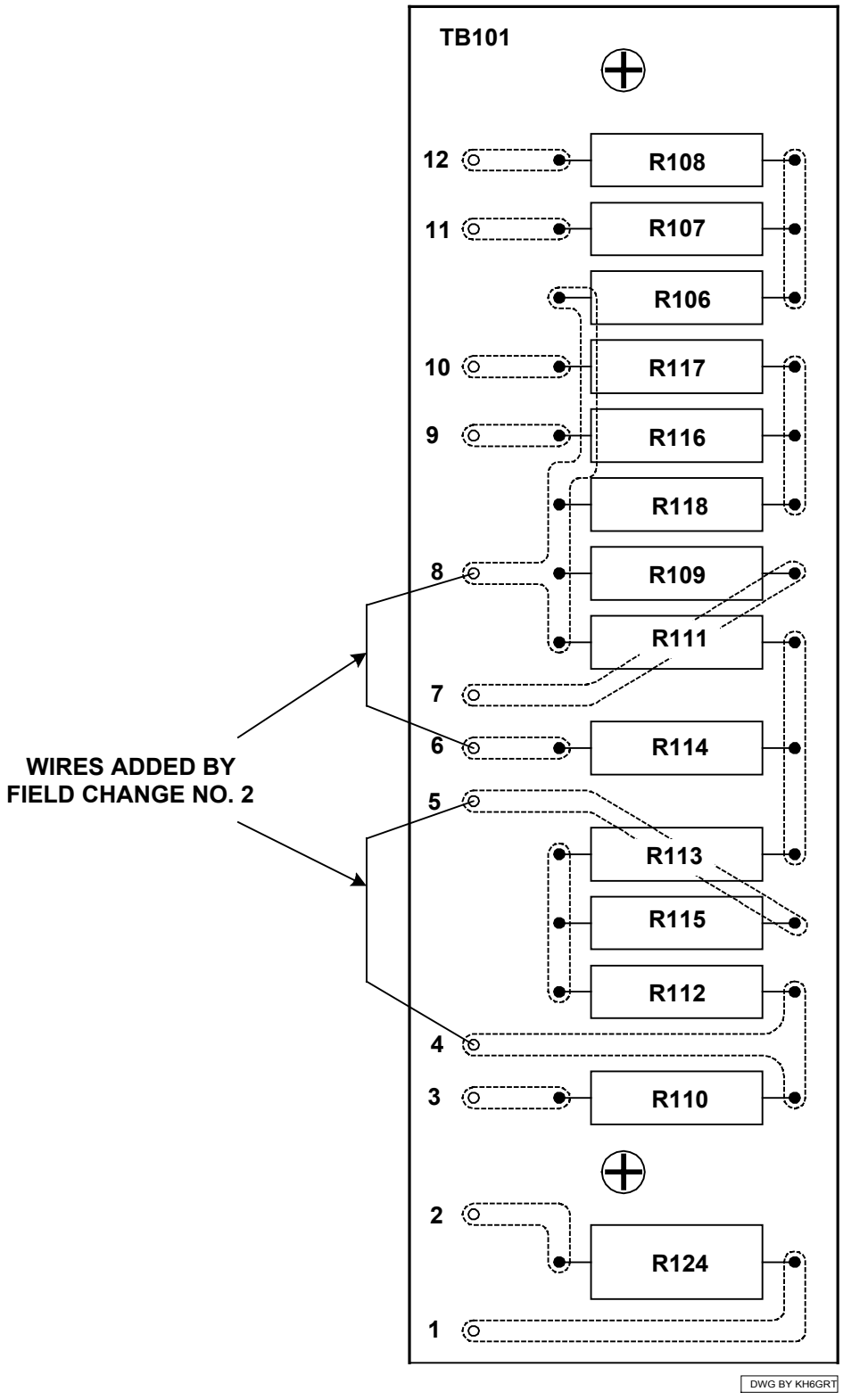


Figure 6-33 R390A TB101 with Field Change[22]

[22]Courtesy of Pete Wokoun, KH6GRT

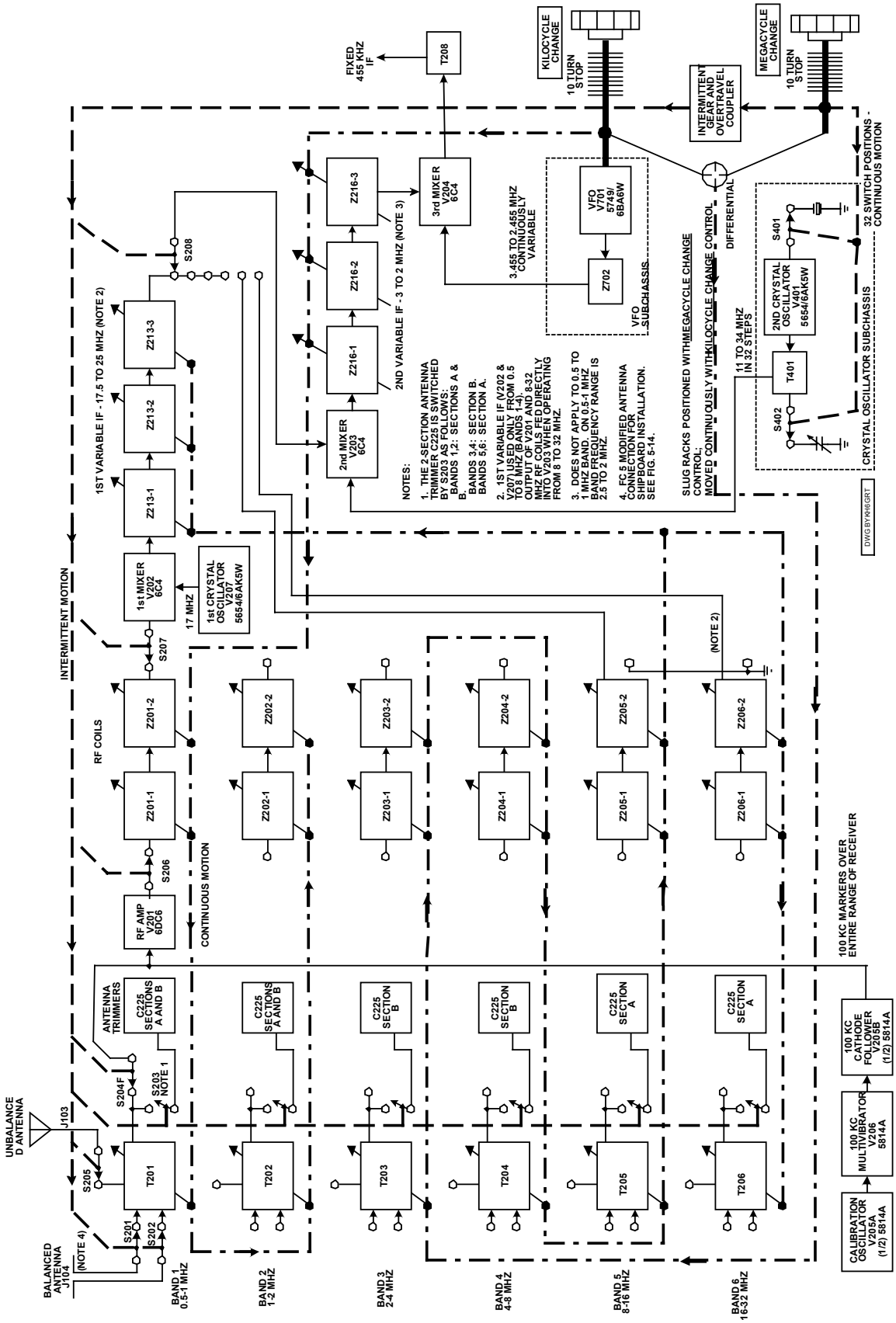


Figure 6-34 Tuning System Showing Relationship of Stages, Block Diagram[23]

[23]Courtesy of Pete Wokoun, KH6GRT

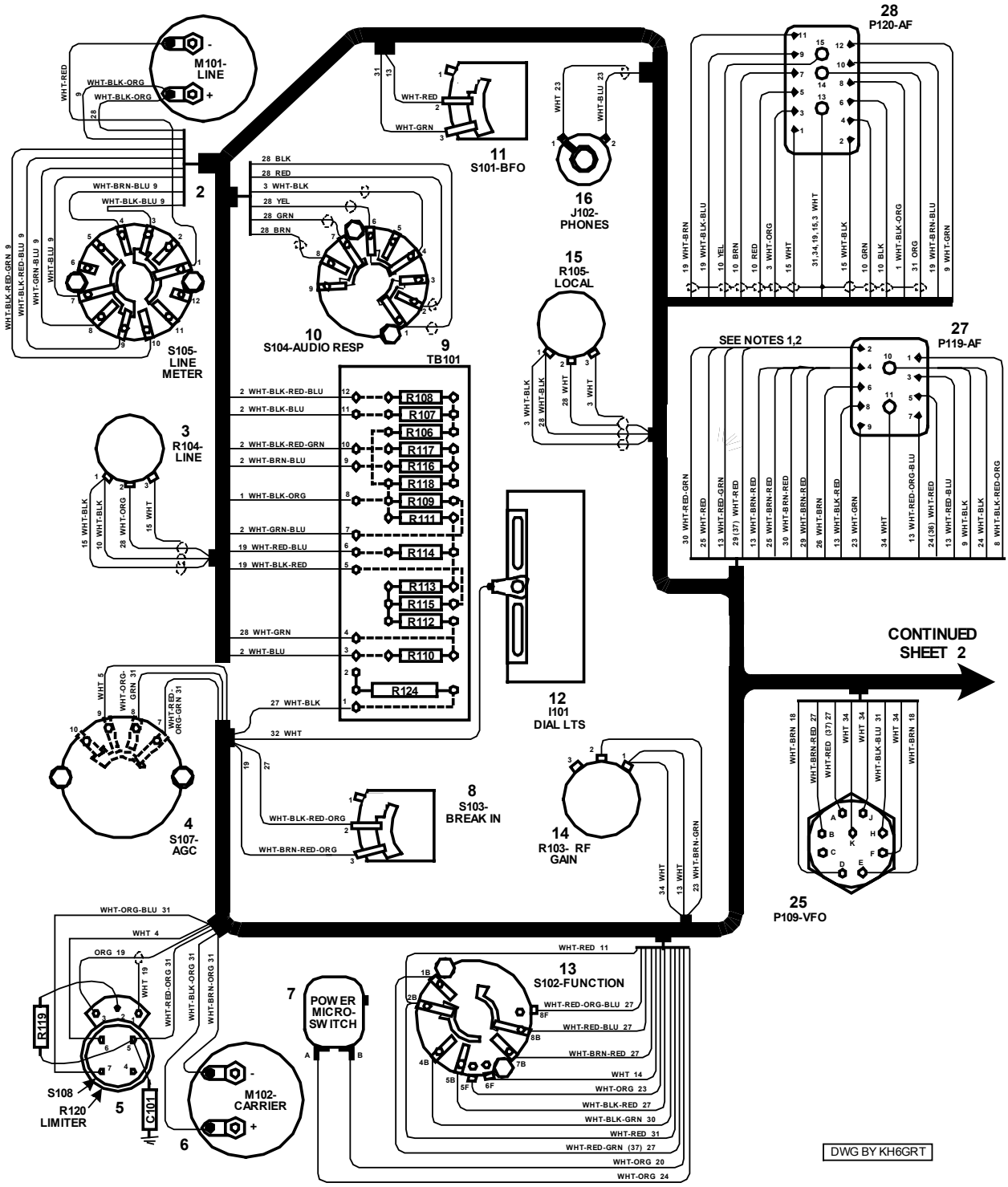


Figure 6-35 Radio Receiver R-390A/URR, Main Frame Wiring Diagram (Sheet 1 of 2)[24]

[24]Courtesy of Pete Wokoun, KH6GRT

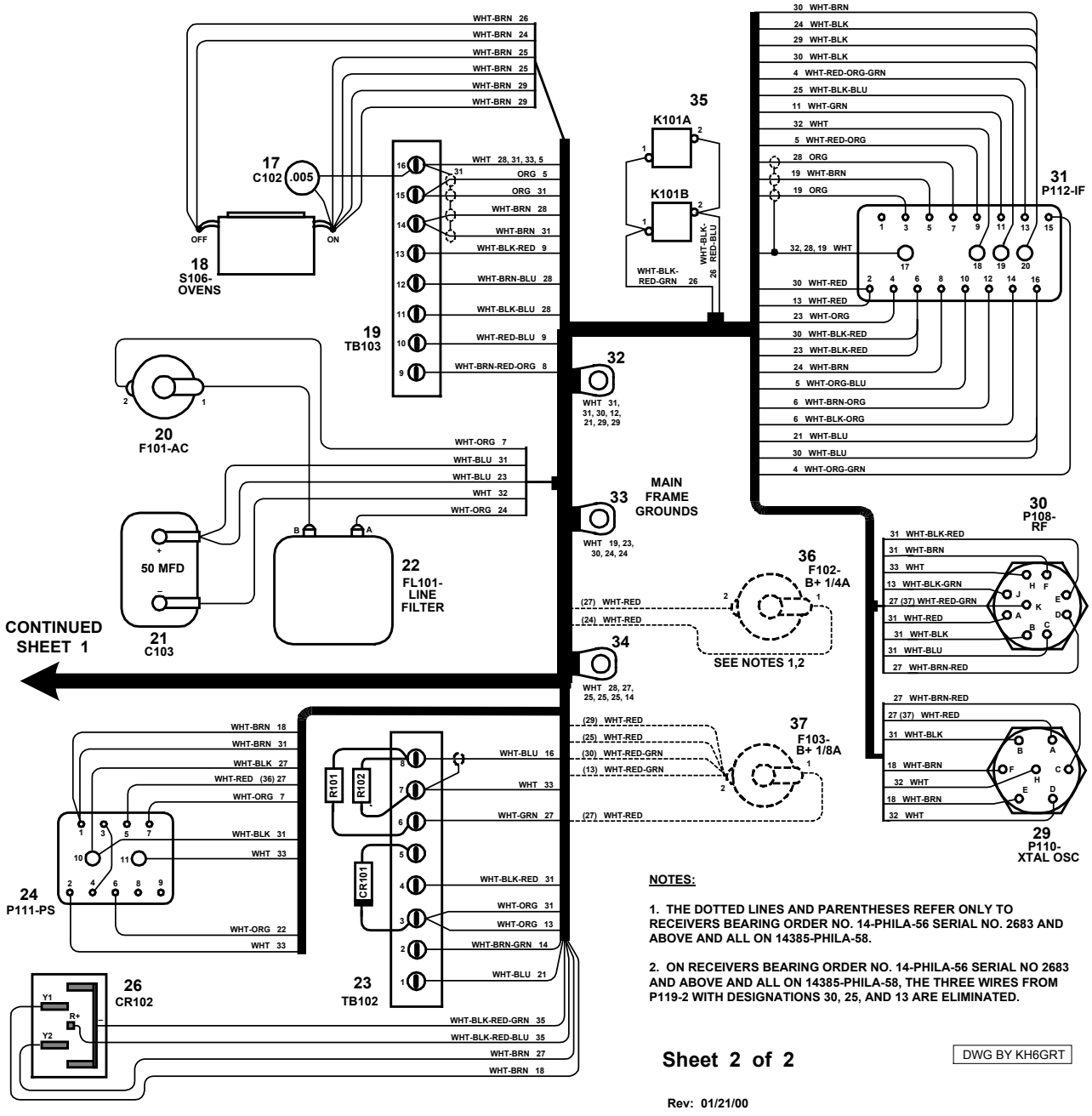


Figure 6-35 Radio Receiver R-390A/URR, Main Frame Wiring Diagram (Sheet 2 of 2)[25]

[25]Courtesy of Pete Wokoun, KH6GRT

Zoning for RF Gear Train Assembly, Exploded View Figure 6-36			
Index No.	**Location**	**Part Name**	**Reference Symbol**
1	1A,1B	Riveted locking plate	A216
2	1A,1B	Spur gear	0323
3	1B	Rack gear springs (2 used)	0322
4	1B	7/16-inch retaining ring	H213
5	2B	4-40 square nut	H219
6	1B,2B	Gear clamp	0207
7	2B	3-56 by 1/4-inch socket head screw	H217
8	2B	Gear clamp	H231
9	2B	Bevel gear	0202
10	2B	Bevel gear	0213
11	2B	4-40 by 9/16-inch socket head screw	H218
12	2A	No. 8 split lockwashers (6 used)	H201
13	2A	8-32 by 3/8-inch binder head screws (6 used)	H230
14	2B	Gear bushing	0221
15	2B	Gear clamp	H231
16	2B	Washers	H251
17	2B	Mechanical counter	M201
18	1B,2B	No. 4 split lockwashers (4 used)	H202
19	1B,2B	4-40 by 5/16-inch machine screws (4 used)	H227
20	2B	4-40 by 9/16-inch socket head screw	H218
21	1B	Locked clutch gear assembly	0295
22	1B	3/56 by 1/4-inch socket head screw	H217
23	1B	Gear clamp	H231
24	1C	Bevel gear	0212
25	2C	Pressed bevel gear	0296
26	2B	6-32 by 3/16-inch machine screws (2 used)	H228
27	2B	Staked gear post	0252
28	2C	Special screw	H240
29	2C	No.5 split lockwasher	H212
30	2C	8-32 by 3/8-inch binder head screws (6 used)	H230
31	2C	No. 8 split lockwashers (6 used)	H201
32	2B,2C	Front gear plate	A201
33	2C	4-40 square nut	H219
34	2C	0.312-inch hole gear clamp	H233
35	2C	4-40 by 1/2-inch socket head screw	H215
36	2C,3C	Idler gear	0204
37	3C	Gear bushing	0242
38	3C	Shaft sleeve	0215
39	3C,3D	Final differential gear assembly	0219
40	2C	Gear panel spacing posts (3 used)	H236
41	2D	1/4-inch retaining ring	H224

Zoning for RF Gear Train Assembly, Exploded View Figure 6-36			
Index No.	**Location**	**Part Name**	**Reference Symbol**
42	2C,2D 3C,3D	No. 8 riveted gear	0205
43	2D	4-40 square nut	H219
44	2D	Soldered rack gear	0201
45	2D	4-40 by 9/16-inch socket head screw	H218
46	2D	Gear clamp	0208
47	2D	Retaining ring	H234
48	2D,3D	Soldered gear	0392
49	2D,3D	Spur gear	0254
50	2D,3D	Gear rack springs (2 used)	0325
51	3D	4-40 by 9/16-inch socket head screw	H218
52	3D	Gear clamp 0209 53 3D Soldered rack gear	0363
54	3D	4-40 square nut	H219
55	3D	4-40 by 1/4-inch machine screws (3 used)	H241
56	3D	0.5 to 1.0 MHz RF cam, front	0311-1
57	3D	No. 6/0 taper pin	0311-2
58	3D	Retaining ring	H234
59	3D	No. 2 gear assembly consisting of: Retaining ring Spur gear Springs (2 used) Soldered gear	H234 0259 0270 0271
60	3D	2.0 to 4.0 MHz RF cam, front	0313-1
61	3D	No. 6/0 taper pin	0313-2
62	4D	8.0 to 16.0 MHz RF cam and gear, front	0315-1
63	3D	8.0 to 16.0 MHz spur gear	0328
64	3D	8.0 to 16.0 MHz loading gear	0324
CS?????	3D	8.0 to 16.0 MHz gear rack springs (2 used)	0273
66	3C	Pinned spur gear	0390
67	3C	6-32 by 1/4-inch binder head screws (2 used)	H216
68	3C	No. 6 split lockwashers (2 used)	H203
69	3C	No. 6 flat washers (2 used)	H291
70	3C	Detent spring	0244
71	4C	0.312-inch hole gear clamp	H233
72	4C	4-40 by 1/2-inch socket head screw	H215
73	3C,3D	Differential shaft	0206
74	4D	Pinned gear assembly	0261
75	4D	No. 6/0 taper pin	0315-2
76	4D	Washers (2 used)	H254
77	4D	Gear bushing	0222
78	4C	Gear bushing	0223
79	4C	Spur gear	0243

Zoning for RF Gear Train Assembly, Exploded View Figure 6-36			
Index No.	**Location**	**Part Name**	**Reference Symbol**
80	4C	4-40 square nut	H219
81	3C	7/16-inch retaining ring	H213
82	3C	4-40 by 9/16-inch socket head screw	H218
83	3C	Gear clamp	0211
84	3B	4-40 square nut	H219
85	3C	1/4-inch E-type retaining ring	H222
86	3B,3C	Pressed gear	0253
87	3B	Switch gear assembly	0307
88	3B	Retaining ring	H237
89	3B,3C	Multi-turn gear springs (2 used)	0319
90	3B,3C	Megahertz gear	0218
91	3B,3C	Soldered megahertz gear	0321
92	4C	Wash	H251
93	4C	Spur gear	0245
94	4B	Pinned stop assembly	0316
95	4B	Pinned gear assembly	0246
96	4B,5B	Washers (2 used)	H254
97	4B	Panel spacing posts (3 used)	H235
98	4C	4-40 square nut	H219
99	4C	0.312-inch hole gear clamp	H233
100	4C	4-40 by 1/2-inch socket head screw	H215
101	4C	RF stop assembly	0317
102	4C	1/8-inch E-type retaining ring	H221
103	4C	Locking gear	0203
104	4C,4D	Washer	H251
105	4C,4D	Washer	H253
106	4C,4D	Retaining ring	H234
107	4D	8-32 by 5/16-inch flathead machine screw	H226
108	4D	8-32 by 5/16-inch flathead machine screws (3 used)	H226
109	5C	Riveted front gear plate	A202
110	SC	Pinned gear	0283
111	5C	No. 8 split lockwashers (3 used)	H201
112	5C	8-32 by 3/8-inch machine screws (3 used)	H230
113	5C	5/16-inch flat washer	H214
114	SB	4-40 square nut	H219
115	5B,5C	Gear clamp	0210
116	5C	4-40 by 9/16-inch socket head screw	H218
117	5C,6C	Oscillator spur gear	0241
118	6D	Cam plate brackets (2 used)	A206
119	6D	6-32 by 7/16-inch machine screws (2 used)	H255

Zoning for RF Gear Train Assembly, Exploded View Figure 6-36			
Index No.	**Location**	**Part Name**	**Reference Symbol**
120		5X,6D No. 6 split lockwashers (2 used)	H203
121	5D	1/4-inch retaining ring	H224
122	5C,5D	Shim washer	H251
123	5C,5D	Shim washer	H253
124	5D	Oscillator dial hub	0240
125	5D	1/4-inch retaining ring	H224
126	5D	6-32 by 3/8-inch flathead machine screws (6 used)	H225
127	SD	6-32 by 3/8-inch flathead machine screw	H225
128	4D	No. 6 split lockwashers (4 used)	H203
129	3D,3E 4D,4E	Loaded rack gear assembly consisting of: Retaining ring Springs (2 used) Spur gear Soldered gear	 H234 0247 0254 0262
130	4D	6-32 by 3/8-inch Phillips-head screws (4 used)	H229
131	4E	4-40 square nut	H219
132	4E	0.312-inch hole gear clamp	H233
133	4E	4-40 by 1/2-inch socket head screw	H215
134	4E	No. 4 gear assembly consisting of: Spur gear Springs (2 used) Spur gear Soldered gear	 0253 0273 0274 0324
135	4E	4-40 square nut	H219
136	4E	0.312-inch hole gear clamp	H233
137	4E	4-40 by 1/2-inch socket head screw	H215
138	4F	4-40 square nut	H219
139	4F	0.312-inch hole gear clamp	H233
140	4F	4-40 by 1/2-inch socket head screw	H215
141	4E,4F	Loaded rack gear assembly consisting of: Retaining ring Springs (2 used) Spur gear Soldered gear	 H234 0247 0254 0262
142	4F	16.0 to 32.0 MHz RF cam, front	0310-1
143	4F	No. 6/0 taper pin	0310-2
144	4E	4.0 to 8.0 MHz RF cam, front	0314-1
145	4E	No. 6/0 taper pin	0314-2
146	4E	1.0 to 2.0 MHz RF cam, front	0312-1
147	4E	No. 6/0 taper pin	0312-2
148	4D,5D	Rack panel spacing posts (4 used)	11244
149	5D	Pressed cam plate	A209

Zoning for RF Gear Train Assembly, Exploded View Figure 6-36			
Index No.	**Location**	**Part Name**	**Reference Symbol**
150	5E	No. 6 split lockwashers (4 used)	H203
151	5E	6-32 by 3/8-inch machine screws (4 used)	H229
152	5E	Rack panel short posts (3 used)	H242
153	6D,6E	1.0 to 2.0 MHz RF cam, inner	0312-3
154	6D,6E	No. 6/0 taper pin	0312-4
155	6D	4.0 to 8.0 MHz RF cam, rear	0314-3
156	5E,6E	Rack panel long post	H243
157	6E	0.5 to 1.0 MHz RF cam, rear	0311-3
158	6E	No. 6/0 taper pin	0311-4
159	6E	No. 6/0 taper pin	0313-3
160	6E	8.0 to 16.0 MHz RF cam, inner	0315-3
161	6D	No. 6/0 taper pin	0315-4
162	6E	2.0 to 4. 0 MHz RF cam, rear	0313-4
163	6D,6E	2.0 to 4.0 MHz RF camshaft	0313-5
164	6D,6E	0.5 to 1.0 MHz RF camshaft	0311-5
165	6D	16.0 to 32.0 MHz RF cam, rear	0310-3
166	6D	No. 6/0 taper pin	0310-4
167	6D	No. 6/0 taper pin	0314-4
168	6D	16.0 to 32.0 MHz RF camshaft	0310-5
169	5D,6D	4.0 to 8.0 MHz RF camshaft	0314-5
170	6D	Trimmer shaft	0236
171	7D	VFO shaft insulator	E227
172	7D	Helical driven gear	0318
173	7D	Helical gear clamp	H245
174	7D	Helical gear bushing	0256
175	7D	Special washer	H232
176	7D	3/16-inch retaining ring	H223
177	7D	8-32 by 1/8-inch setscrew	H220
178	7D	8-32 by 1/8-inch setscrew	H220
179	6E,7E	Pressed auxiliary cam plate	0306

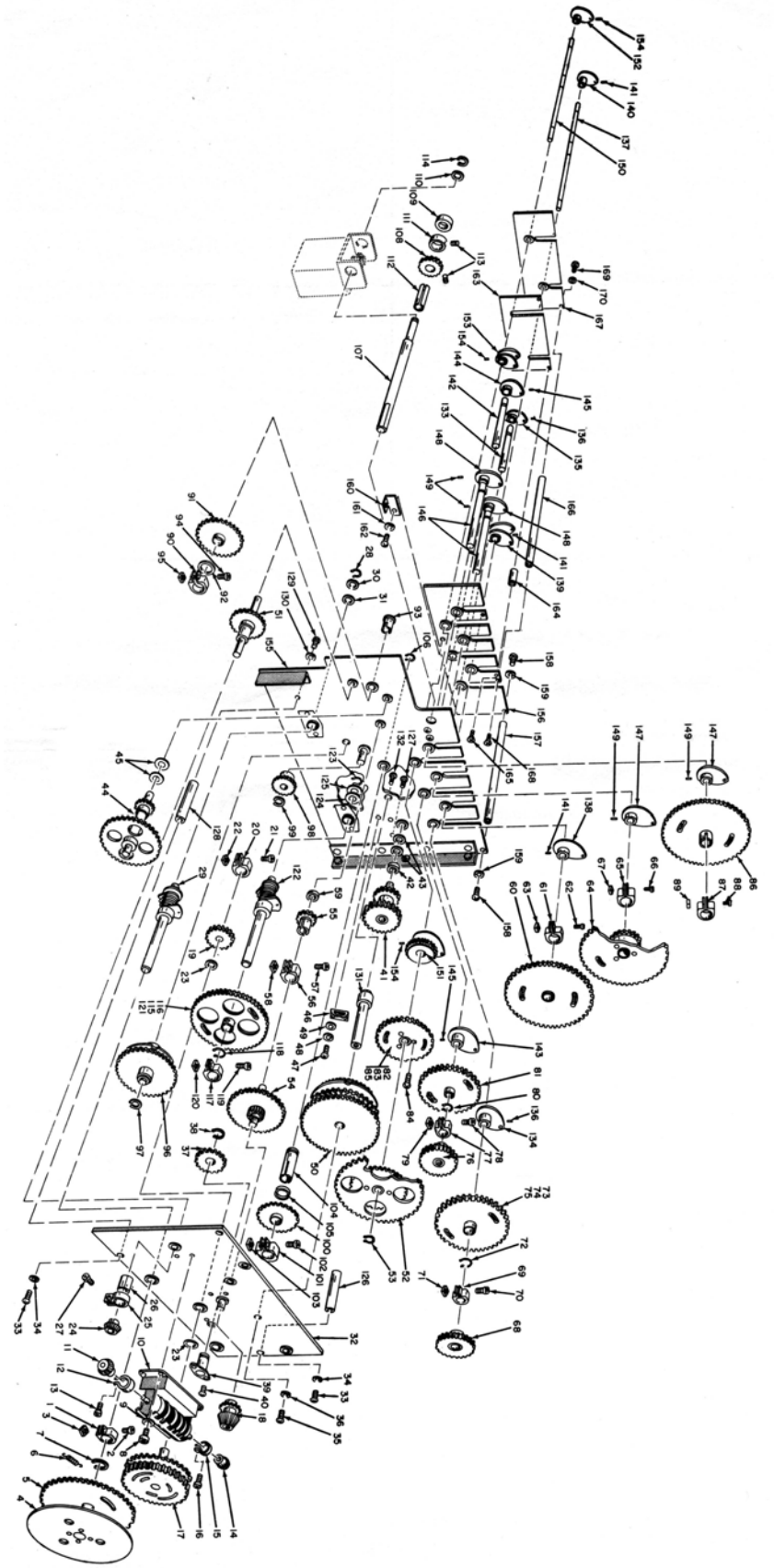


Figure 36 RF Gear Train Assembly, Exploded View

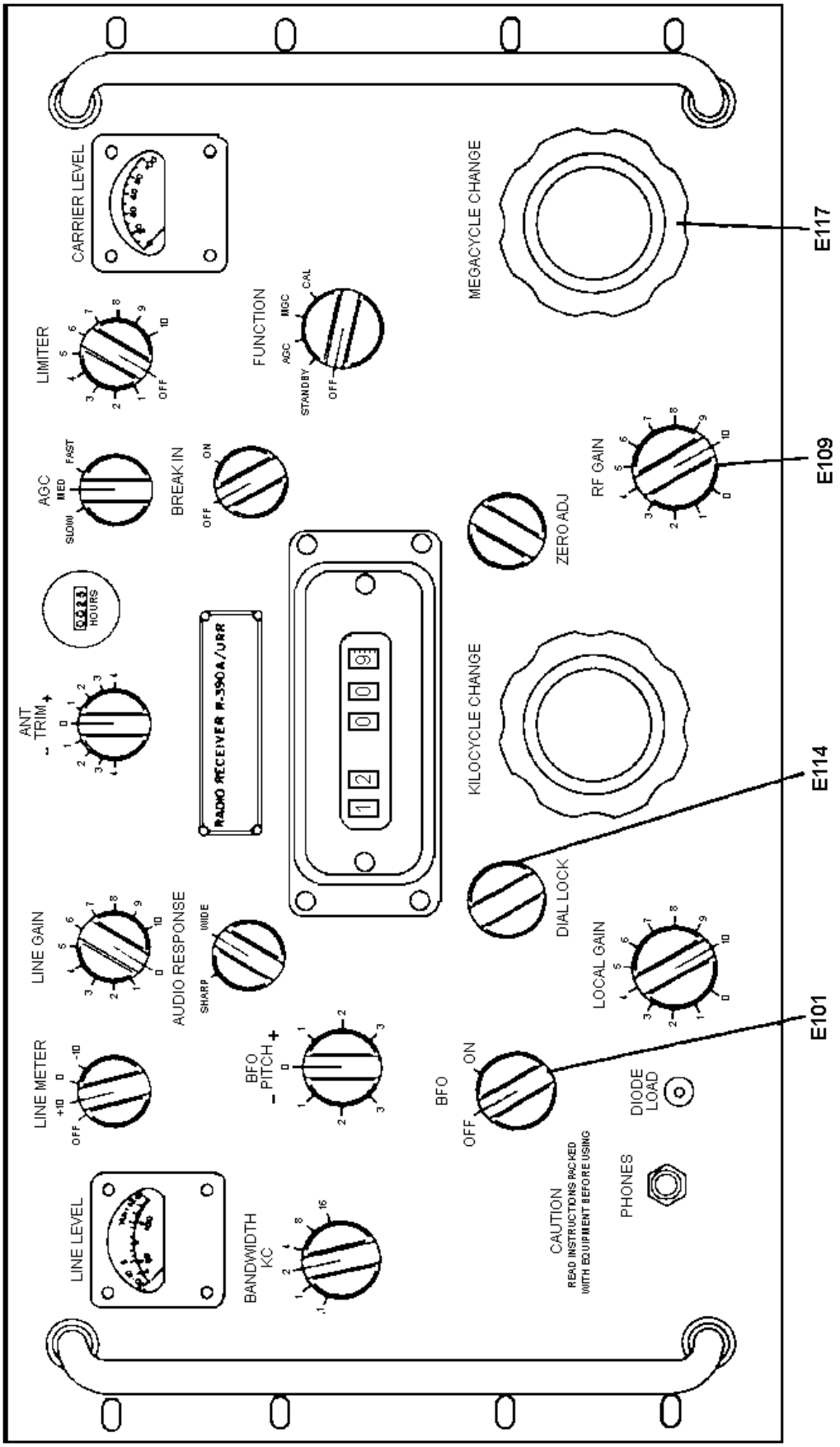


Figure 6-37 Front Panel

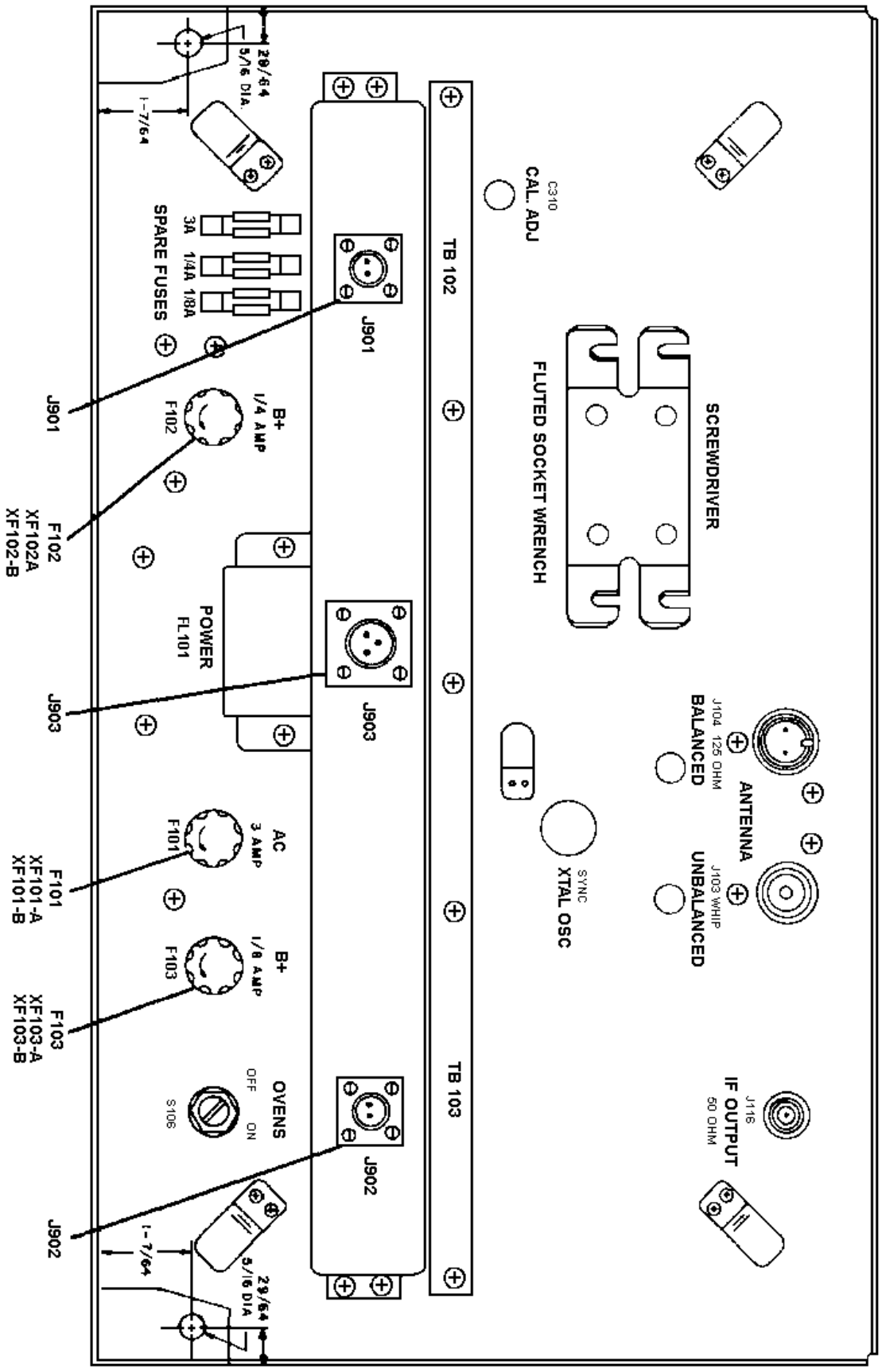


Figure 6-38 - Rear Panel-Shipboard W/ 3 Fuses

Table 6-4 R390A/URR Consolidated List of Crystal Information

BAND MC	XTAL	XTAL FREQ	OSC OUT	NOTES
0.5	Y401	10.0	20.0	
1	Y402	10.5	21.0	First oscillator crystal
2	Y403	11.0	22.0	Y201 – 17 MHz is
3	Y404	11.5	23.0	Only active on
4	Y405	12.0	24.0	Bands below 8MHz
5	Y406	12.5	25.0	
6	Y407	13.0	26.0	
7	Y408	9.0	27.0	
8	Y403	11.0	11.0	
9	Y405	12.0	12.0	All crystals in second
10	Y407	13.0	13.0	oscillator are type CR-
11	Y409	14.0	14.0	36/U
12	Y410	15.0	15.0	
13	Y411	16.0	16.0	First oscillator 17.0 MHz
14	Y412	17.0	17.0	crystal is type CR27A/U
15	Y408	9.0	18.0	
16	Y413	9.5	19.0	200.00 KHz crystal
17	Y401	10.0	20.0	Y202 is a type CR-47/U
18	Y402	10.5	21.0	
19	Y403	11.0	22.0	455.0 Crystal in Z501 IF
20	Y404	11.5	23.0	can is type CR-45/U
21	Y405	12.0	24.0	
22	Y406	12.5	25.0	
23	Y407	13.0	26.0	
24	Y408	9.0	27.0	
25	Y409	14.0	28.0	
26	Y414	14.5	29.0	
27	Y410	15.0	30.0	
28	Y415	15.5	31.0	
29	Y411	16.0	32.0	
30	Y403	11.0	33.0	
31	Y412	17.0	34.0	

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