SECTION IV

MAINTENANCE

4.1 GENERAL

The VLF receiver is conservatively designed to give trouble-free service. It presents no special maintenance problems, and normally requires no care beyond being kept clean. Should trouble occur, down time will be minimized if the maintenance technician is thoroughly familiar with Section II of this manual in which the circuits are described before beginning the troubleshooting. Field maintenance should be confined to cleaning and the replacement of fuses and plug-in modules. All other maintenance should be carried out in a well-equipped shop and performed only by experienced personnel.

4.2 PLUG-IN MODULE REMOVAL

The plug-in modules can be easily removed by simply pulling them upward from the receptacles into which they are fitted. The numbers on the module pins correspond to the numbers indicated on the schematic diagrams at the points where the connecting leads pass through the lines outlining each module. Modules having completely different functions are keyed to prevent them from being damaged as a result of being placed in the wrong receptacle. All plug-in modules have their type numbers etched on the back of the cards. By referring to the schematic diagrams their reference designation prefixes can be found, and thus their proper location in the unit.

4.3 TROUBLESHOOTING, RECEIVER SECTION

If the frequency display lights and the reading changes as receiver is tuned the counter assembly is probably working properly. Should the display light up and indicate all zeros, but not change with tuning, the counter is still probably functioning, but not receiving the local oscillator input. Initial troubleshooting should be directed toward localizing the trouble to a specific section of the receiver. In the case of the plug-in modules, a quick check can be made by plugging in a spare module known to be good. If these substitutions do not cure the trouble, then the audio and AGC amplifiers, and the +12 and -12 Vdc power supplies can be eliminated from consideration. Note that the +4.5 and -4.5 Vdc and +200 Vdc power supplies are used only by the counter assembly. If the frequency display is indicating properly as the receiver tuning is shifted, then the local oscillator is probably operating properly. This leaves a series chain consisting of subassemblies A1, A2, A3, A5, and A12 as primary suspects. To check out the chain feed a signal within the receiver's tuning range into the antenna input, tune the receiver to the frequency, and trace the signal through the subassemblies using a wideband oscilloscope. Once the malfunctioning stage is known voltage and resistance measurements will usually pin point the defective part. Typical transistor and module pin voltages are given in Table 4-1.

4.4 TROUBLESHOOTING, COUNTER ASSEMBLY

If the maintenance technician understands how the counter assembly functions, troubleshooting the unit will be very simple. Should the cause of trouble not be immediately apparent, first determine if the +4.5 and -4.5 Vdc and +200 Vdc power supplies are functioning properly. If they are, the next step is to localize the trouble to a specific module. The input amplifier and local oscillator counting decades are most easily checked by feeding in a signal of known frequency and tracing it using a wideband oscilloscope. The timing and gating circuits can be quickly checked by tracing the signal from the 1-MHz oscillator through to the amplifier and gate module, A11A2. Both the functional block diagram, Figure 2-2, and the gate generator timing chart, Figure 2-3, will be of assistance in signal tracing. Once the malfunctioning module is located, voltage and resistance measurements will usually pin point the defective component. Note that with no signal input the display should reset to 000.0 kHz, if functioning properly. Placing the MODE switch in a DECIMAL SHIFT position should change the display to 00.00 kHz. If it does not, check for a 10-Hz pulse train output from A11A1, pin 18.

4.5 ALIGNMENT PROCEDURES

4.5.1 General. - The alignment procedures given here are suitable when making periodic performance checks, or when making adjustments after replacing transistors or components. Only those controls specifically referred to within a series of steps given for aligning a particular circuit affect the alignment of that circuit. Those controls not mentioned in any one series of steps may be left in any position. The alignment of this receiver should be

performed only with suitable equipments by technicians thoroughly familiar with the receiver. If the limits and tolerances specified in the following procedures cannot be obtained, then a factory alignment is necessary. Both dust covers and the IF and BFO assembly cover must be removed for alignment.

4.5.2 Equipments Required. - The following equipments, or their equivalents, are required to perform the complete receiver alignment:

(1) Signal Generator, Hewlett-Packard Type 606A

(2) VTVM, RCA Type WV-98B

(3) AC VTVM, Hewlett-Packard Type 400H

(4) Oscilloscope, Tektronix Type 544

(5) Headphones

(6) Assorted cables, connectors, and alignment tools

4.5.3 Signal IF Alignment. - Proceed as follows:

(1) Set up equipment as shown in Figure 4-1

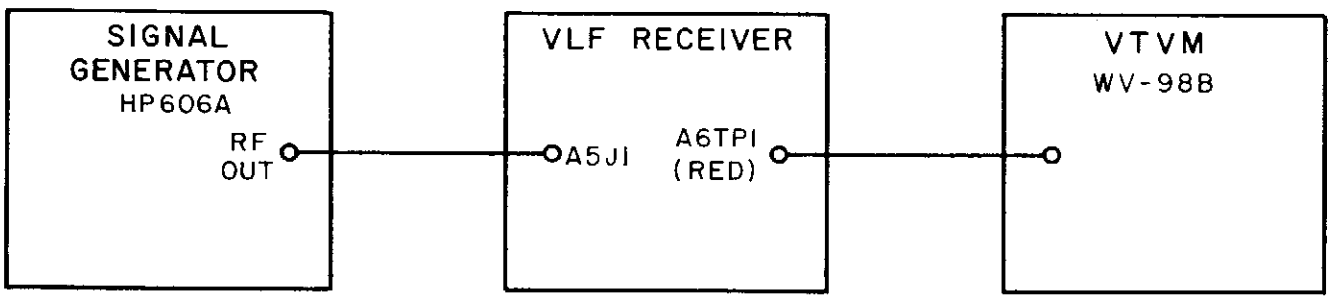

Figure 4-1. Equipment Setup, IF Alignment

(2) Make the following initial control settings:

(a) Receiver: BFO off, IF BANDWIDTH to 6 kHz, IF GAIN set at midrange.

(b) Signal Generator: Using internal crystal calibration, set for 2-MHz output modulated 50% by 400-Hz tone.

(c) VTVM: Set to 1.5-Vdc range.

(3) Adjust signal generator output level for 1-Vdc reading on VTVM.

(4) Adjust in the order given A5A3L4, A5A3L3, A5A3L2, A5A3L1, A5A1L2, and A5A1L1 for maximum reading on VTVM.

NOTE

Reduce signal generator output as necessary to maintain 1-Vdc reading on VTVM.

(5) Reconnect P7 to A5J1.

4.5.4 BFO Alignment. - Proceed as follows:

(1) Set up equipment as shown in Figure 4-2. Use headphones to monitor receiver output.

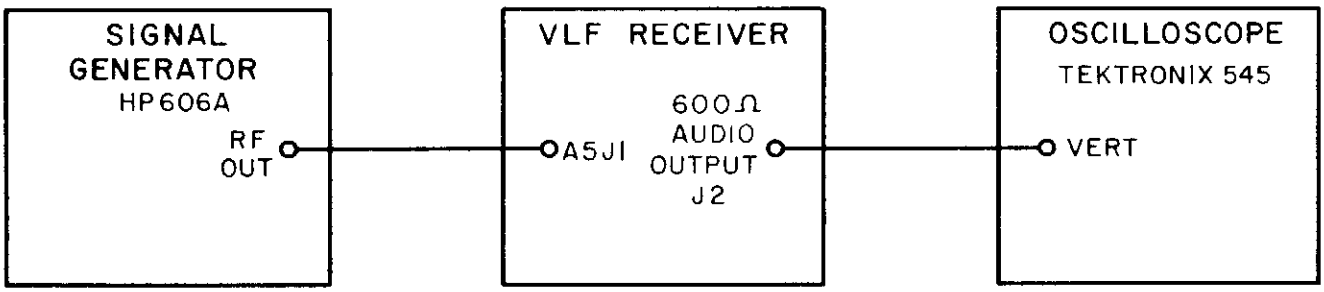

Figure 4-2. Equipment Setup, BFO Alignment

(2) Make the following initial settings:

(a) Receiver: BFO switch to ZERO, IF BANDWIDTH to 6 kHz, IF GAIN to midrange, AUDIO BW to NORMAL.

(b) Signal Generator: Using internal calibration, set for 2-MHz CW output.

(3) Adjust A5A4T1 for maximum amplitude as indicated on oscilloscope.

(4) Modulate signal generator output 50% with 1-kHz tone.

(5) Adjust A5A4R26 for minimum 1-kHz audio output in headphones.

(6) Turn signal generator modulation off.

(7) Set BFO switch to VAR, BFO FREQ control to midrange.

(8) Adjust A5A4L1 for zero-beat indication on oscilloscope.

(9) Reconnect P7 to A5J1.

4.5.5 Noise IF Alignment. - Proceed as follows:

(1) Set up equipment as shown in Figure 4-1 except that signal generator output connects to A12J1.

(2) Make the following initial control settings:

(a) Receiver: BFO off, IF BANDWIDTH to 6 kHz, IF GAIN set at midrange, NOISE CANCELLER THRESHOLD to OFF.

(b) Signal Generator: Using internal crystal calibration, set for 2-MHz output modulated 50% by 400-Hz tone.

(c) VTVM: Set to 1.5-Vdc range.

(3) Adjust signal generator output level for 1-Vdc reading on VTVM.

(4) Adjust A12A2L1, A12A2L2, and A12A2T2 for maximum reading on VTVM. The signal generator output level should be decreased as required to maintain 1-Vdc reading on VTVM.

(5) Connect VTVM to feedthru capacitor A12C6; set to 15-Vdc scale.

(6) Set NOISE CANCELLER THRESHOLD control to maximum ccw position without turning to OFF.

(7) Using internal crystal calibration, set signal generator for 2-MHz CW output; adjust output level for a reading of 7 Vdc on the VTVM.

(8) Adjust A12A1L1, A12A1L2, A12A1L3, and A12A1L4 for a minimum reading on the VTVM. Reduce the signal generator output as required to maintain a reference level of approximately 7 volts on the VTVM.

4.5.6 Local Oscillator Alignment. - Proceed as follows:

(1) Turn MAIN TUNING control to low-frequency limit; FINE TUNING control maximum counterclockwise; set MODE switch to NORMAL DISPLAY TUNE.

(2) Adjust A4L1 for reading on frequency display of 000.7 to 000.9.

(3) Turn MAIN TUNING control to high-frequency limit, FUNE TUNING control maximum clockwise.

(4) Frequency display should read in 600 kHz to 610 kHz range. If not, adjust A4C4 until a reading in this range is obtained.

(5) Repeat steps (1) through (4) until no further adjustment is necessary.

CAUTION

Do not adjust A4C6. This is a factory adjustment.

4.5.7 Balanced Mixer Adjustment. - Proceed as follows:

(1) Connect VTVM set to 1.5-Vdc range to A6J1 (the red test point).

(2) Make the following receiver control settings: IF BANDWIDTH to 1 kHz, IF GAIN control to midrange, BFO off, tune receiver to 3 kHz.

(3) Set A3A1C8, A3A1C15, A3A1R27, and A3A1R30 to midrange.

(4) Adjust A3A1C8, A3A1C15, A3A1R19, and A3A1R27 for minimum reading on VTVM. The adjustment of A3A1C8 and A3A1C15 is quite critical. If no indication is obtained on VTVM, increase receiver gain slightly or tune to lower frequency and continue adjustment of A3A1C8, A3A1C15, A3A1R19, and A3A1R27 until no further decrease is noted on the VTVM.

(5) Adjust A3A1R30 to see if the null reading on VTVM can be improved. This adjustment is quite critical. Leave control at point which gives minimum reading on VTVM.

(6) Retouch A3A1C8, A3A1C15, A3A1R19, A3A1R27, and A3A1R30 until reading on VTVM does not decrease further.

4.5.8 600-ohm Audio Output Adjustment. - Proceed as follows:

(1) Set up equipment as shown in Figure 4-3.

(2) Make the following initial settings:

(a) Receiver: INPUT ATTENUATOR to 0 dB, IF GAIN control to AGC position, IF BANDWIDTH to 3 kHz, BFO off, AUDIO BW in NORMAL position, tune to 100 kHz.

(b) Signal Generator: Set for 100-kHz signal modulated 50% by 1000-Hz tone. Output level of 300 μV.

(3) Adjust A7 R4 for 1.92 volt rms reading (6 mW into 600Ω load) on AC VTVM.

4.5.9 Audio Filter Adjustment. - Proceed as follows:

(1) Set up equipment as shown in Figure 4-3.

(2) Make initial receiver and signal generator settings as given in paragraph 4.5.8 (2) except AUDIO BW switch is placed in the NARROW position.

(3) Adjust L1 on main chassis for maximum output as indicated on AC VTVM, then back off adjustment by 10% in the opposite direction. Peak output reading should remain the same.

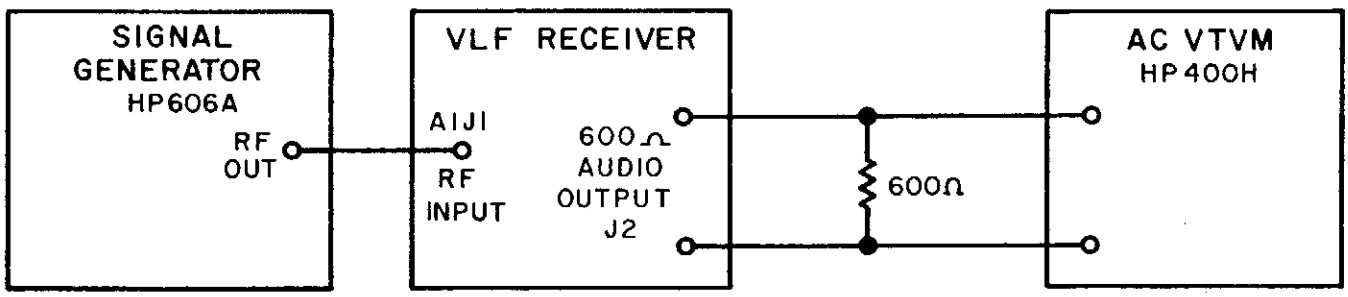

Figure 4-3. Equipment Setup, Audio Output Adjustment

Table 4-1. Typical Transistor Element Voltages

Ref. Desig.	Type	Emitter	Base	Collector
Q1	2N3055	6.2	7.0	10.0
A3A1Q1	2N930	2.9	3.5	9.1
A3A1Q2	2N3251	9.8	9.1	4.9
A3A1Q3	2N2270	4.3	4.9	11.1
A3A1Q4	2N706	6.0	5.8	11.9
A3A1Q5	2N706	5.8	5.6	11.9
A4A1Q1	2N3478	1.8	2.6	12.0
A4A1Q2	2N706	2.7	3.3	12.0
A4A1Q3	2N3478	2.6	3.3	6.0
A4A1Q4	2N706	7.0	7.4	12.0
A4A1Q5	2N3251	6.5	6.0	0.0
A4A1Q6	2N706	2.7	3.3	12.0
A4A1Q7	2N3478	2.8	3.5	7.4
A4A1Q8	2N706	8.2	8.8	12.0
A4A1Q9	2N3251	8.0	7.4	0.0
A5A1Q1	2N3478	1.8	2.5	10.1
A5A1Q2	2N3478	1.8	2.5	10.1
A5A1Q3*	2N706	1.1	1.7	10.9
A5A1Q4*	2N706	1.1	1.7	10.9
A5A1Q5*	2N706	1.1	1.7	10.9
A5A1Q6*	2N706	1.1	1.7	10.9
A5A2Q1*	2N3478	0.9	1.6	11.0
A5A2Q2*	2N3478	0.9	1.6	11.0
A5A2Q3*	2N3478	0.9	1.6	11.0
A5A2Q4*	2N3478	0.9	1.6	11.0
A5A3Q1	2N3478	1.9	2.6	10.2
A5A3Q2	2N3478	0.8	1.5	10.2
A5A3Q3	2N3478	0.8	1.5	10.2
A5A3Q4	2N3251	11.0	10.4	1.5
A5A4Q1#	2N3478	5.2	5.9	9.6
A5A4Q2#	2N3478	2.8	1.7	9.8
A5A4Q3#	2N3478	2.8	1.7	9.8
A5A4Q4#	2N3478	1.8	2.2	9.8
A5A4Q5#	2N3478	2.2	2.9	10.7
A5A4Q6#	2N3478	2.8	1.7	9.8
A5A4Q7#	2N3478	2.8	1.7	9.8
A6Q1	2N706	0.5	1.1	12.0
A6Q2	2N709	11.7	12.0	12.0
A6Q3	2N929	0.0	0.5	12.0
A6Q4	2N929	0.0	0.4	12.0
A6Q5	2N697	10.4	11.0	12.0
A6Q6	2N697	0.0	0.0	11.0
A7Q1	2N2270	0.5	1.1	10.9
A7Q2	2N2270	0.7	1.3	6.4
A7Q3	2N2270	3.6	4.1	11.9
A7Q4	2N2270	5.8	6.4	12.0
A7Q5	2N1305	12.0	11.8	6.6
A7Q6	2N2270	1.9	2.5	10.9

Table 4-1. Typical Transistor Element Voltages - (Cont'd)

Ref. Desig.	Type	Emitter	Base	Collector
A8Q1	2N3055	12.0	12.6	20.5
A8Q2	2N4074	12.6	13.3	20.5
A8Q3	2N4074	6.9	7.4	13.3
A8Q4	2N4074	6.8	7.4	11.5
A9Q1	2N2869	-12.2	-12.4	-23.5
A9Q2	2N526	-6.3	-6.5	-12.4
A12A1Q1	2N2708	1.6	2.3	10.4
A12A1Q2	2N2708	1.6	2.3	10.4
A12A1Q3	2N2708	1.6	2.3	10.4
A12A1Q4	2N3251	8.0	7.3	0.0
A12A1Q5	2N404	0.0	1.8	-12.0
A12A2Q1	2N2708	0.7	1.4	10.0
A12A2Q2	2N404	0.0	0.0	-6.4
A13Q1	2N2270	-12.0	-11.3	-5.5
A13Q2	2N2270	-11.3	-10.6	-5.0
A13Q3	2N1305	-4.9	-5.1	-11.8
A13Q4	2N3251	10.4	9.7	5.5
A13Q5	2N929	-0.5	0.0	9.7
A13Q6	2N929	-0.5	0.0	10.4
A13Q7	2N2270	4.8	5.5	10.4

Test Conditions:

1. All voltages dc referenced to ground.
2. Readings taken with RCA WV-98B VTVM with 115 Vac power input to receiver. No signal input.
3. AUDIO GAIN and MAN IF GAIN controls in max cw positions.
4. FUNCTION switch in MAN position except when taking readings in AGC module A6. Switch then placed in AGC position.
5. NOISE CANCELLER THRESHOLD control in max cw position.

Notes:

* IF BANDWIDTH switch placed in position to energize appropriate transistor.

\# BFO switch placed in position to energize appropriate transistor.