RACAL RA6790/GM

ALIGNMENT AND TUNING MANUAL

From

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CHAPTER 3
ASSEMBLED RECEIVER ALIGNMENT AND TEST

3-1. INTRODUCTION.

This chapter provides both alignment procedures and an end-to-end check for an assembled Receiver. The information is presented in two sections with alignment procedures contained in Section I and procedures for an end-to-end check presented in Section II. The alignment procedures are designed to permit alignment of any one or all of the various functions in the Receiver; however, the adjustments in some functions interact with other functions so chat care must be taken when any one function alone is aligned. The end-to-end checks are designed to make sure that a Receiver is operational after assembly of new or repaired circuit cards or modules.

SECTION I. ASSEMBLED RECEIVER ALIGNMENT

3-2. GENERAL.

The circuit card and module assemblies may be aligned and checked after they are installed in a working Receiver. The following paragraphs provide detailed step-by-step instructions for aligning the Receiver assemblies. The alignment procedures require that external power be connected to the Receiver, the Receiver power switch turned on and that the mode, bandwidth, AGC and frequency be set as described in each procedure.

Refer to T.O. 31R2-2URR-251 for location of circuit cards and adjustments.

a. Power Supply Assembly A10.

The power supply used in the Receiver does not contain any adjustments or controls other than the line voltage select card located in A10J1. If all voltages checked correctly as specified in Section XI of Chapter 2, it can be assumed that the power supply is functioning properly. If the power supply has not been tested then the 3-1 voltage levels as spelled out in Chapter 2 should be checked before performing any alignment procedures.

WARNING

The filter capacitors used in the power supply will retain an electrical charge after power is removed.

The capacitors should be discharged slowly by shorting the terminals through a protected resistive device. Disconnect the ac line cord from A10J1. Remove the metal cover from the power supply and then reinsert line cord and turn Receiver power on. Using the digital multimeter, check the voltages appearing on connector

A10A1 (refer to Table 2-28 in Chapter 2). Do not disconnect power output connector J3 during these measurements, as this will unload the power supply and could result in erroneous readings.

b. Low Pass Filter, Assembly Al.

Test equipment required to align the low pass filter Al is the Spectrum Analyzer listed in Table 1-2.

(1) Connect the output of the Tracking Generator to the RF IN connector Jl of the Receiver. Use 50-ohm cable.

(2) Connect the output cable (A1W2) to the input of the Spectrum Analyzer, utilizing a 50-ohm cable.

(3) Set the Tracking Generator as follows:

Mode:	Marker
Function:	Track Analyzer
RF Output Level:	0 dBm
Marker Intensity:	Maximum
Resolution:	1 kHz

(4) Set the Spectrum Analyzer as follows:

Scan Width:	0-100 Mhz
Input Attenuation:	20 dB
Scan Time:	20 Msec/Div.
Log. Ref. Level:	0 dBm, 10 dB Log
Video Filter:	10 kHz
Scan Mode:	Internal
Scan Trigger:	Auto

(5) Set the Marker to a frequency of 30 MHz.

(6) Observe trace and adjust LI for maximum amplitude at the marker frequency.

(7) Note response at 30 MHz and ensure that it is not more than 1.0 dB below LOG REF line (see Figure 3-1).

(8) Set marker to a frequency of 40.455 MHz. Adjust L3 for minimum amplitude at the marker frequency.

(9) Set marker to a frequency of 43.19 MHz. Adjust L2 for minimum amplitude at the marker frequency.

(10) Set marker to a frequency of 52.30 MHz. Adjust L4 for minimum amplitude at the marker frequency.

(11) Compare spectrum analyzer trace with that depicted in Figure 3-1. The shape and minimum trace points should closely approximate this shape. If not, repeat the alignment procedures until the trace most nearly follows that shown in the illustration.

(12) Disconnect the test equipment and reconnect cable A1W2 to J5 on the chassis.

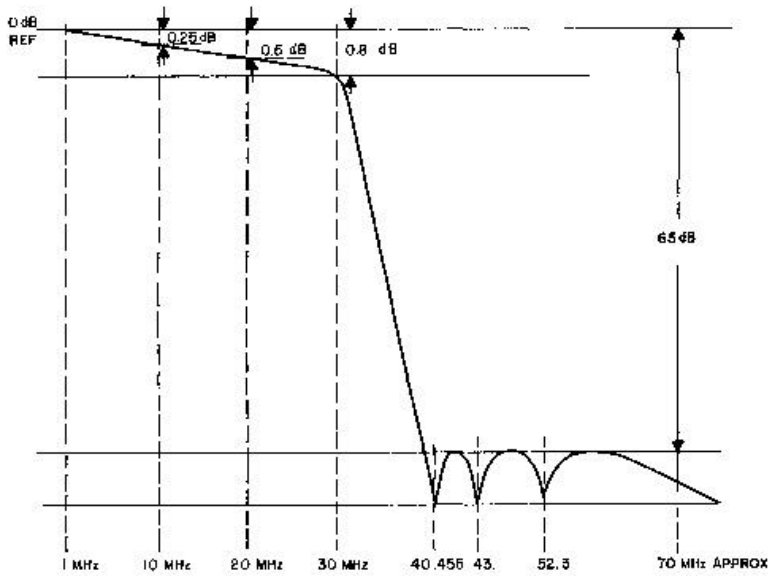
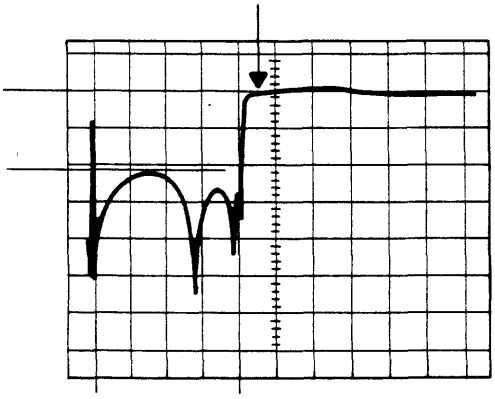


Fig. 3_1: Low Pass Filter Spectrum Display

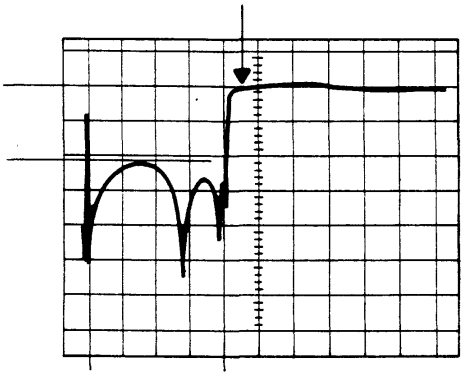
45 MHz RELATIVE LEVEL>20dB



0.5MHz 40.453MHz <^ EACH GRATICULE = 10 MHz

Figure 3-2. Alignment Waveforms

45 MHz RELATIVE LEVEL>20dB
EACH GRATICULE lOdB



<^ EACH GRATICULE = 10 MHz

Figure 3-2. Alignment Waveforms

c. First Mixer, Circuit Card Assembly A2.

The first mixer assembly A2 is located in the bottom portion of the Receiver. The spectrum analyzer, RF signal generator, RF millivoltmeter and digital multimeter, listed in Table 1-2, are required to align the first mixer assembly A2.

(1) Utilizing cable W2, connect the output of the tracking generator to Jl on A2 board.

(2) Connect the spectrum analyzer via the high impedance probe to TP2 of A2 and set the spectrum analyzer as follows:

Center Frequency:	28.24 MHz
Output Level:	+10 dBm
Input Attenuator:	20 dB
Log Reference Level:	+10 dBm, 10 dB Log
Bandwidth	300 kHz
Scanwidth:	1 MHz/Div
Scan Time:	20 Msec/Div
Video Filter:	10 kHz

(3) Set Receiver mode to AM, 3.2 kHz Bandwidth, AGC to Manual and IF GAIN control to maximum clockwise position.

(4) Adjust LI for a notch (minimum amplitude) at 28.24 MHz.

(5) Set analyzer center frequency to 38.23 MHz. Adjust L4 for notch.

(6) Set analyzer center frequency to 40.38 MHz. Adjust L2 for notch.

(7) Set analyzer center frequency to 40.455 MHz. Adjust L3 for notch.

(8) Check filter passband level from 45 to 70 MHz. Ensure that this level is greater than +9 dBm.

(9) Check relative level at 41 MHz compared to level at 45 MHz. If relative level is greater than 10 dB below 45 MHz level, adjust L3 slightly (one-quarter turn or less) until 41 MHz level is only 10 dB below 45 MHz level.

(10) Set spectrum analyzer for 0-100 MHz scan-width. Check relative level from 0.5 to 40.455 MHz compared to level at 45 MHz. Ensure this level is at least 20 dB lower (see Figure 3-2A).

(11) Disconnect tracking generator then connect the digital multimeter between the collectors of Q3 or Q4 and ground. Set the digital multimeter to the 200-uVolt dc scale.

(12) Adjust R9 for 0 Volt reading. Disconnect digital multimeter from Q3-Q4 and ground. Reconnect P2 of cable W2 to J4 on circuit card A7.

(13) Disconnect PI of cable W2 from Jl on A2 circuit card and PI of cable A2W1 from J5 on chassis then connect the tracking generator to PI (RF input to A2).

(14) Connect the spectrum analyzer, using the high impedance probe, to the links between E3 and E5. Set the spectrum analyzer controls as follows:

Output Level;	0 dBm
Bandwidth:	100 kHz
Scanwidth:	2 MHz/Div
Input Attenuation:	10 dB
Scan Time:	^0 as

Log Ref. Level: -10 dBa
Log/Lin. Switch: -0 dB Log

(15) Adjust the tracking generator for 30 MHz and adjust coils Lll and L12 for-peak response.
(16) Set tracking generator to sweep between 0 and 100 MHz. Check that all frequencies above 56 MHz are at least 20 dB down from a reference level at 30 MHz.
(17) Disconnect the tracking generator from Pi and the spectrum analyzer from E3-E5. Reconnect PI of cable W2 to Jl on A2.
(18) Connect the RF signal generator to PI of A2 and adjust for 2.0000 MHz at -20 dBm. Adjust the Receiver frequency to 2.00000 MHz. AGC to MAN and IF GAIN to maximum.
(19) Connect the spectrum analyzer, using the high impedance probe, to El on A3 (First IF output of A2). Set analyzer to display 40.455 MHz.
(20) Adjust transformer T3 for maximum output. Ensure that the output level is not less than -17 dBm.
(21) Set the RF signal generator frequency to 10.000 MHz and adjust the Receiver frequency to 10.00000 MHz.
(22) Ensure that the output level is not less than -17 dBm.
(23) Set the RF signal generator frequency to 29.999 MHz and adjust the Receiver frequency to 29.99900 MHz.
(24) Ensure that the output level is not less than -17 dBm.
(25) Turn the Receiver off. Disconnect all test equipment and reconnect PI of cable A2W1 to J5.

d. <u>Second Mixer, Circuit Card Assembly A3.</u>

The second mixer assembly A3 is located in the bottom portion of the Receiver. The RF signal generator and RF millivoltmeter, listed in Table 1-2, are required to align this assembly.

(1) Disconnect PI of cable A3W2 from J6, located on the Receiver chassis, and connect PI to the RF mi Hi voltmeter with high impedance probe.
(2) Connect the RF signal generator to Jl-RF IN on Receiver rear panel.
(3) Turn the Receiver on and set the MODE to AM, any bandwidth, AGC to manual and IF GAIN to the maximum clockwise position and Receiver frequency to 1.5 MHz.
(4) Adjust the RF signal generator frequency to 1.5 MHz and the output level for a RF millivoltmeter indication of -10 dBm.
(5) Adjust coils L8, L7, L6, L5 and Tl, in the order given, for peak output indication on the RF millivoltmeter. Readjust the RF signal generator level as required to maintain the -10 dBm output reference.
(6) After all coils have been adjusted for peak output, check the output level of the RF signal generator. RF signal generator output level should not be greater than -53 dBm. If gain is not correct adjust R26 (maintain -10 dBm reference) and RF signal generator until gain is as specified. If R26 adjusts to maximum and specified gain cannot be obtained, then slightly adjust C3 for peak output. Readjust R26 for specified gain.
(7) Turn the Receiver off and disconnect all test equipment. Reconnect PI of

cable A3W2 to J6.

e. Main IF/AF, Circuit Card Assembly A4.

This assembly is located in the top portion of the Receiver. The test equipment required to align the assembly includes the spectrum analyzer, AM/FM signal generator, digital multimeter, RF millivoltmeter, junction box, distortion analyzer, and the 50-ohm adapter, listed in Table 1-2.

(1) Remove the cover from the filter assembly. Verify that a 4 kHz (or less) symmetrical filter is installed in the Receiver. Turn the Receiver ON and initialize the Receiver (if necessary) by running the automatic BITE sequence. Set the Receiver frequency to 1.500000 MHz, select the 4 kHz (or less) filter, the AGC SHORT mode, and the AM operating mode.

(2) Locate the coaxial cable connecting the A3 board output to the A4 input (cable will be labeled W1P1J6 at the A3 end). Connect the output of the tracking generator to the miniature cable connector W1P1. This connection will inject the signal into A4J1. Connect the input of the spectrum analyzer to J2, IF OUT, located on the rear of the receiver. Set the tracking generator/spectrum analyzer controls as follows:

Output Level:	-50 dBm
Center Frequency:	455 kHz
Input Attenuation:	10 dB
Scan Width/Div.:	20 kHz
Scan Time:	0.1 Second
Log Ref.:	0 dB, 10 dB/Log
Video Filter:	100 Hz

(3) Remove a filter and connect a link between the filter input and output sockets. Select this filter position, set AGC to MAN and the IF GAIN control to the maximum clockwise position.

(4) While observing the analyzer trace adjust LI and L2 to obtain the bandpass waveform as shown in Figure 3-2B. Adjust the IF Gain control to maintain a peak indication of -4 to -6 dB on the spectrum analyzer display. If a double peak is obtained the trough must be no greater than 0.5 dB below the peaks.

(5) Connect AM/FM signal generator with 50-ohm cable to Receiver antenna input (J1-RF IN). Set AM/FM signal generator to 0.5 mv (-113 dBm). Connect RF millivoltmeter to J2-IF OUT.

(6) Set R39 and R1L9 to mid-range. Set R47 fully CCW. Set R105 fully CW. Connect digital multimeter to TP9.

(7) Set AM/FM signal generator and Receiver to 1.55 MHz. Select manual gain. Set IF Gain to maximum. Adjust R39 for -10 dBm on RF millivoltmeter.

(8) Select AGC SHORT. Set AM/FM signal generator to -80 dBm (22.5 mv). Adjust R47 for 8.5 +.05 VDC on digital multimeter.

(9) Select manual GAIN. Adjust IF GAIN control for 8.5+0.05 VDC on digital multimeter. Adjust R105 for an increase of 1 dB on RF millivoltmeter.

(10) Select AGC SHORT. Remove RF signal. Set R119 for 10 j^.Ol VDC on digital multimeter.

(11) Connect AM/FM signal generator to J1-RF IN. Set output of AM/FM signal

generator to .5 uV. Note reading of RF millivoltmeter. Increase output of AM/FM signal generator +120 dB in 10 dB steps and assure
that reading on RF millivoltmeter remains within 3 dB of that obtained at the .5 uV RF input level.

(12) Remove the link between the filter input and output sockets and reinstalls the filter previously removed. Determine the bandpass filters installed in the Receiver.

(13) In order to examine the bandpass characteristics of the filters, the tracking generator and spectrum analyzer must be used in the same manner as in Step 4 above. Set the tracking generator/spectrum analyzer as follows:

Frequency: 455 kHz
TG Level: 40 dBm
Input Attenuation: 30
Log. Ref. Level: 0, 10 dB/Log.
Linear Sensitivity: Adjusted to set trace at 0 Log marker on display.
Scan Time: .5 Seconds
Scan Width/Div. See Chart Below
Bandwidth: See Chart Below
Video Filter: 10 Hz

(14) Ensure that the Receiver is in manual gain and that the IF Gain control is at maximum CW rotation. Select each filter position via the MODE panel. Observe the trace on the spectrum analyzer for each filter selected. It may be necessary to adjust the IF gain control to avoid distortion of the IF passband. Table 3-1 provides the passband maximum and minimum values for the 3 dB and 60 dB points. Note that the Scan width and Bandwidth will have to be adjusted to each filter as follows:

Filter B/W	Scan Width/Div.	Bandwidth
400 Hz	0.5 kHz	0.3 kHz
1000 Hz	0.5 kHz	0.3 kHz
1200 Hz	0.5 kHz	0.3 kHz
2.0 kHz	1.0 kHz	1.0 kHz
3.0 kHz	1.0 kHz	1.0 kHz
3.2 kHz	1.0 kHz	1.0 kHz
6.8 kHz	2.0 kHz	1.0 kHz
16 kHz	5.0 kHz	3.0 kHz
USB/LSB	1.0 kHz	1.0 kHz

(15) If the A5 ISB option is installed, the LSB filter must be checked by using the HI-Z probe on TP7 of the A5 board. Ensure that the Receiver is in the LSB mode.

(16) Disconnect all test equipment. Restore cable W1P1J6 to coaxial fitting J6 on the chassis.

(17) Connect AM/FM signal generator to the Receiver RF input jack Jl. Attach the junction box to connector J3, AF OUT, on the rear of the Receiver. Connect the input of the distortion analyzer to the BNC connector labeled "MONITOR" on the junction box. Set the distortion analyzer Function Switch to Voltmeter

and the Meter Range to +10 dB (1 mW).

(18) Select the FM mode, adjust the AM/FM signal generator frequency for 1.5 MHz with an output of -40 dBm and modulate the signal at 1 kHz with a peak deviation of +4 kHz. Check the audio output indication on the distortion analyzer meter. Adjust coil L3 for peak audio output.

(19) Turn Receiver off. Disconnect all test equipment and replace filter assembly cover.

f. ISB IF/AF, Circuit Card Assembly A5.

This circuit card is an optional assembly and may not be present in all Receivers. If it is used, the A5 assembly is installed in the top portion of the Receiver, towards the rear. The test equipment required to align the A5 module includes the spectrum analyzer, AM/FM signal generator, digital multimeter, and RF Millivoltmeter, shown in Table 1-2.

NOTE

The LK 1 link on the A4 circuit card must be installed for ISB operation and the alignment procedures for A4 must be performed prior to any adjustment on the A5 circuit card.

(1) Connect the AM/FM signal generator to Jl-RF IN on the rear panel. Turn the Receiver on and adjust frequency to 1.5000 MHz, AGC to MAN, IF gain to maximum and mode to LSB.

(2) Connect the high impedance test probe of the RF millivolt-meter to TP7 on circuit card A5. Set the AM/FM signal generator to 1.4982 MHz at an output level of 30 uVolts (-73 dBm).

TABLE 3-1. BANDPASS FILTER CHARACTERISTICS

Bandpass Filter	Passband *3 dB Maximum	- Hz Attenuation	Stopband 60 dB Minimum	- Hz Attenuation
	From	To	Below	Above
400 Hz	-200	+200	-1240	+1240
1.2 kHz	-600	+600	-3600	+3600
6.8 kHz	-3400	+3400	-1120	+12000
LSB	+350	+3050	-300	+4000
USB	-350	-3050	-4000	+300
400 Hz	-200	+200	-500	+500
(Defined delay) 1.2 kHz	-600	+600	-1500	+1500
(Defined delay) 1.2 kHz	-600	+600	-1500	+1500
(Defined delay) 3.24 kHz	-1620	+1620	-2150	+2150
(Defined delay) 6.8 kHz	-3400	+3400	-6800	+6800
(Defined delay) 16.0 kHz	-8000*	+8000*	-16000	+16000
(Defined delay) 500 kHz	-250	+250	-1500	+1500
(Linear phase) 1.0 kHz	-500	+500	-3000	+3000
(Linear phase) 2.0 kHz	-1000	+1000	-6000	+6000
(Linear phase) 3.0 kHz	-1500	+1500	-9000	+9000
(Linear phase) 6.0 kHz	-3000	+3000	-18000	+18000

NOTES:

*16.0 kHz (defined delay) filter shall be 2 dB maximum attenuation. LSB filter should be monitored at TP7 on A5 board if this board is installed.

(3) Adjust R19 and R23 to the full clockwise positions. Cancel MAN AGC and note the indication of the RF millivoltmeter. RF millivoltmeter should read 70 +10 millivolts.

(4) Reduce the AM/FM signal generator output to -113 dBm (0.5 uVolts). Select MAN AGC, cancel SHORT AGC, adjust R19 for 64 +10 millivolts indication on RF millivoltmeter.

(5) Connect the digital multimeter to TP9 on A5. Cancel MAN AGC, select SHORT AGC. Increase AM/FM signal generator output to -78 dBm (30 uVolts). Set R23 for an indication of 8.5 +0.05 Volts dc on the digital multimeter.

(6) Disconnect the AM/FM signal generator from Jl-RF IN, the digital multimeter from TP9 and the RF millivoltmeter from TP7.

(7) Disconnect PI of cable Wll from J3 and A4. Connect the tracking generator to Jl and connect the spectrum analyzer to TP7 on A5, using the high Z probe. Adjust the spectrum analyzer as follows:

Output Level:	-54 dBm (tracking generator)
Center Frequency:	455 kHz
Input Attenuation:	10 dB
Sweep Width:	20 kHz/div.
Bandwidth:	3 kHz/div.
Log Ref. Level:	0 dBm
Log/Lin Switch:	10 dB Log

(8) Set AGC to MAN and the IF GAIN control for approximately -6 dBm on the spectrum analyzer. While observing the spectrum analyzer trace, adjust LI and L2 to obtain the bandpass waveform shown for Step 12 of the L4 adjustment procedures in Paragraph e. If a double peak is obtained the trough should be no greater than 0.5 dB below the peaks.

(9) Disconnect the tracking generator from Jl and reconnect P2 of cable Wll to J3 on A4. Disconnect PI of cable Wl from J7 on chassis (output of A3) and connect the tracking generator to PI.

(10) With the tracking generator/spectrum analyzer controls adjusted as described in Step 7 and the LSB mode selected on the Receiver, adjust the IF GAIN control for approximately -6 dBm. Refer to Table 3-1 for the LSB filter passband and stopband characteristics and ensure that the spectrum analyzer trace display meets those characteristics.

(11) Turn the Receiver off. Disconnect the tracking generator from PI and reconnect PI of cable Wl to J7 on chassis. Disconnect the spectrum analyzer from TP7.

g. Remote Interface and Microprocessor, Circuit Card Assemblies A6A1 and A6A2.

The remote interface card (A6A1) is an optional assembly and may or may not be installed in the Receiver. When it is used, both the A6A1 and A6A2 cards are mounted on the right hand side of the top portion of the Receiver. These two circuit cards do not contain any variable components and therefore do not require any alignment or adjustment.

h. First LO Synthesizer, Circuit Card Assembly A7.

This circuit card assembly is located in the bottom portion of the Receiver. The test equipment required to align the assembly includes the spectrum analyzer, digital multimeter, digital frequency counter and 50-ohm adapter, listed in Table 1-2.

(1) Connect the digital multimeter between TP5 and ground on the A7 circuit card assembly. Set R16 for a digital multimeter indication of 5.2 +0.01 Volts dc.

(2) Disconnect PI of cable W2 from Jl on A2. Connect the spectrum analyzer to PI (1st LO output) using 50-ohm adapter.

(3) Set receiver frequency to 1.046 MHz and adjust the spectrum analyzer to observe 1 kHz sidebands on the 41.501 MHz output at a nominal +9 dBm level.

(4) Adjust R5 for the best rejection of "the 1 kHz sidebands. A sideband rejection of 55 dB or more is acceptable.

(5) Disconnect the spectrum analyzer from Fl and connect the digital frequency counter to this point. Tune the Receiver over its entire range (0.5 to 30 MHz) and note that the digital frequency counter tracks 40.455000 MHz abve the Receiver freqency + instrument error.

(6) Turn the Receiver off. Disconnect the digital frequency counter from J4 and reconnect PI of cable W2 to Jl on A2. Disconnect the digital multimeter from TP5.

i. Second LO/BFO Synthesizer, Circuit Card Assembly A8.

This circuit card assembly is located in the bottom portion of the Receiver. The test equipment required to align this assembly includes the 50-ohm adapter, digital multimeter, RF millivoltmeter and the digital frequency counter, listed in Table 1-2.

(1) Check the links LK1 and LK2 on circuit card A8 and verify that they are connected as required for the reference frequency IN/OUT mode of operation. The links should be made as follows:
1 MHz - Links LK1 and LK2 linked.
5 MHz - Link LK1 open, LK2 linked.
10 MHz - Link LK1 linked, LK2 open.

(2) Make sure the REF-INT/EXT switch S2, on the rear panel, is set to the INT position.

(3) Disconnect PI of cable W4 from J2 on A3. Connect the digital frequency counter to Pi (2nd LO output). Connect the digital multimeter between TP5 and ground. Set the digital multimeter to the 10 Volt dc range.

(4) Turn the Receiver on. Digital multimeter should read between 3 to 8 volts dc (not adjustable). Digital frequency counter should read 40 MHz +20 Hz.

(5) Disconnect the digital frequency counter from PI and connect the RF millivoltmeter with the 50-ohm adapter to PI. RF millivoltmeter should read 0 dBm +2 dB. If reading is not within the limits adjust L9 and L10 for maximum output. Recheck RF millivoltmeter for correct indication.

(6) Disconnect the RF millivoltmeter from PI and reconnect PI of cable W4 to J2 on A3. Disconnect the digital multimeter from TP5.

(7) Set the Receiver MODE to CW and the BFO to center.

(8) Disconnect P2 of cable W6 from J5 on A4 and connect the digital frequency

counter to P2 (BFO output). Connect the digital multimeter between TP8, and ground and set on the 10 Volt dc range.

NOTE

With the probe of the digital multimeter on TP8 a FAULT may be indicated on the front panel. This is normal and alignment procedures should be continued with the FAULT indicator on. FAULT indication should extinguish when the digital multimeter probe is removed.

(9) The digital frequency counter should indicate 455,000 +1 Hz. Digital multimeter should indicate between 4.5 and 7 Volts dc. If correct digital multimeter reading is not obtained, adjust coil L4 for correct indication on digital frequency counter.

(10) Select BFO variable on the Receiver and tune the BFO over its entire range (-8 to +8 kHz) while observing the Receiver front panel BFO and digital frequency counter indications. Digital frequency counter should track 455,000 Hz above the Receiver BFO indicated frequency. Also observe

the digital multimeter indication while tuning the BFO. Digital multimeter should not deviate more than +1.5 Volts from reading obtained in Step 9 at BFO center.

(11) Disconnect the digital frequency counter from P2 and reconnect P2 of cable W6 to J5 on A4. Disconnect the digital multimeter from TP8.

(12) Disconnect PI of cable W3 from J2 on A7. Connect the digital frequency counter and oscilloscope to PI. Ensure that the frequency is 1 MHz +0.5 Hz, and the output level is switching between approximately 0 and +5 Volts (TTL).

(13) Turn the Receiver off. Disconnect digital frequency counter and oscilloscope from PI and reconnect PI of cable W3 to J2 on A7.

j. Front Panel Interface, Circuit Card Assembly A9.

This circuit card does not contain any variable components, and therefore does not require any alignment or adjustment procedures.

SECTION II. ASSEMBLED RECEIVER TEST

3-3. GENERAL.

This section provides procedures to check the Receiver's operation after repairs and/or alignment have been made. The test procedures are designed to provide an overall operational check of the Receiver and to ascertain that its functional capabilities have not been impaired.

These tests determine power supply operation, synthesizer performance, reference frequency accuracy, audio power and distortion, gain modes and final IF frequency. Before the tests are conducted all repairs and reassembly should be inspected for quality workmanship and completeness. All shields and covers should be in place and the Receiver allowed to warm up for at least 30 minutes.

a. Power Check.

(1) Make sure that circuit card switch is installed correctly and proper fuse is installed for the line voltage to be used.
(2) Connect the power cord to the Receiver then to the power source. Set REF IN/OUT switch on rear panel to INT.
(3) Turn Receiver POWER switch to on and note that there is a random display of information on the two front panel LCD's.
(4) Make sure that all LCD back lighting lamps are on.
(5) Make sure that the FAULT indicator is off. If this indicator is on refer to Receiver manual 31R2-2URR-251 for information on clearing the fault.
(6) Perform BITE check as outlined in Receiver manual 31R2-2URR-251,

b. Frequency Tuning and Display.

(1) Press ENTER then press numeral keys 0, 0, 5. 0, 0, 0, O and O and note that 0.500000 MHz is displayed.
(2) Press ENTER then press numeral keys 1, 5, 0, 0, 0, 0, 0 and 0 and note that 15.000000 MHz is displayed.
(3) Press TUNE RATE pushbutton until there is no indication under tuning.
(4) Rotate tuning knob both clockwise and counterclockwise and note frequency displayed slowly increases with clockwise rotation and decreases with counterclockwise rotation at a 1 Hz per step rate.
(5) Select both SLOW and FAST tuning rates repeating step (4) for each tuning rate; SLOW changed at a 30 Hz rate, FAST at a 1 kHz rate.
(6) Press the LOCK pushbutton then rotate the tuning knob and note that there is no frequency change.
(7) Press ENTER then press numeral keys 2 and 9 and note that frequency displayed is 29.000000 MHz.

c. Frequency Calibration Resolution.

This test requires the digital frequency counter listed in Table 1-2.

(1) Disconnect PI of cable W4 from J2 and A3 and using the cable coupler connect the digital frequency counter to PI on cable W4.
(2) Ensure that the frequency is 40 MHz j^8 Hz. This ensures that the internal

standard is 5 MHz +1 Hz.

(3) Disconnect digital frequency counter and reconnect PI of cable W4 to J2 and A3.

d. RF Gain Control.

This test requires the distortion analyzer and RF signal generator listed in Table 1-2.

(1) Using a 600 ohm termination connect distortion analyzer to AF LINE output.

(2) Set the Receiver controls as follows:

Power	ON
Gain Mode	Manual
Detection Mode	CW
BW	3.24 kHz (or closest bandwidth available)

(3) Set the RF signal generator for an output of 1.5 MHz at –110 dBm (1.0 uVolts), CW. Connect RF signal generator to RF IN connector Jl on rear panel.

(4) Adjust the manual IF GAIN control on the Receiver front panel fully clockwise (maximum gain) and adjust the line level control for 1 mW output on distortion analyzer with analyzer in voltmeter mode.

(5) Adjust the IF GAIN control counterclockwise from maximum and ensure level changes indicated on the distortion analyzer are continuous.

(6) Increase RF signal generator level to -10 dBm (70 millivolts) and set IF GAIN control to maximum.

(7) Decrease the RF signal generator output to restore the 1 mW reference and note the RF signal generator level. This should be less than -100 dBm.

e. Final IF Frequency.

This test requires the RF signal generator, 50 ohm adapter, digital frequency counter, and RF millivoltmeter listed in Table 1-2.

(1) Set up the equipment as follows:

(2) Set the Receiver controls as follows;

Power	ON
Gain Mode	AGC-SHORT
BW	3.0 kHz (or closest bandwidth available)
Receiver Tuned Frequency	1.5 MHz
Detection Mode	CW

(3) Set the RF signal generator for an output of 1.5 MHz, CW at a level of -10 dBm. Connect the 50 ohm adapter (load) with the RF millivoltmeter to IF OUTPUT connector J2.

(4) Note the IF output level indicated on the RF mi Hi voltmeter.

(5) Remove the 50 ohm adapter (load) from the IF output and observe that the indicated output voltage increases by 6 dB ^1 dB.

(6) (Connect the digital frequency counter to IF output jack J2 and measure the lF frequency. This should be 455.000 kHz.

f. Fixed and Variable BFO Operation.

This test requires the 50 ohm adapter and digital frequency counter listed in Table 1-2.

(1) Set the Receiver controls as follows:

Power	ON
Gain Mode	AGC-SHORT
Detection Mode	CW
BW	3 kHz (or closest bandwidth available)
BFO	ON (word BFO displayed in Mode LCD)

(2) Disconnect W6P2 from J5 on the A4 module.

(3) Using the 50 ohm adapter, connect the digital frequency counter to W6P2 to monitor the BFO frequency.

(4) Using the Receiver front panel controls, select each BFO indication listed in BFO indicator column of Table 3-2 and verify the frequencies listed in BFO frequency column are obtained.

(5) Select USB and LSB modes and observe the BFO frequency is 455.000 kHz. (SSB/ISB Receivers fitted with 08409 and 08410 option filters only.)

(6) Disconnect digital frequency counter and reconnect W6P2 to J5 on the A4 module.

TABLE 3-2. BFO TEST RESULTS

BFO INDICATOR	BFO FREQUENCY
0.00 kHz	
+1.11	-1.11
2.22	-2.22
3.33	-3.33
4.44	-4.44
5.55	-5.55
6.66	-6.66
7.77	-7.77
7.88	-7.88
7.99	-7.99

455.000 kHz		456.110	
453.890		457.220	
452.780		458.330	
451.670		459.440	
450.560		460.550	
449.450		461.660	
448.340		462.770	
447.120		462.880	
447.010		462.990	

g. Audio Output Power.

This test requires the digital frequency counter and the RF signal generator listed in Table 1-2.

(1) Disconnect distortion analyzer and connect digital frequency counter to AF LINE output.

(2) Set Receiver controls as follows:

Power	ON
Gain Mode	AGC-SHORT
BW	3 kHz (or closest BW available)
Detection Mode	CW
Receiver Tuned Frequency	1.5 MHz
BFO	+1.00 kHz

(3) Set the RF signal generator for an output of 1.5 MHz at –97 dBm, CW.

(4) Tune the RF signal generator (or Receiver) to produce an AF output of 1.0

kHz +50 Hz as indicated on the digital frequency counter.

(5) Set the AF output level to 1 milliwatt using the LINE LEVEL control on the Receiver front panel and phone output.

(6) Select Receiver bandwidth of 6.0 kHz (or closest bandwidth available) and AM detector mode. Amplitude modulate the input signal 30% at 1 kHz.

(7) Observe that the AF output level is within 5 dB of the reference set in step 5 for both line output and phone output.

(8) Slowly rotate the AF gain control through the control range. Observe that the phone output level varies smoothly over the full control range.

h. Audio Distortion.

This test requires the distortion analyzer and RF signal generator listed in Table 1-2.

(1) Disconnect digital frequency counter and connect distortion analyzer with 600 ohm load to AF LINE output.

(2) Set Receiver control as follows:

Power	ON
Gain Mode	Manual Gain
Detection Mode	CW
BW	3 kHz (or closest bandwidth available)
BFO	-1.00 kHz
Receiver Tuner Frequency	1.5 MHz

(3) Set the RF signal generator for an output of 1.5 MHz at -47 dBm, CW.

(4) Adjust manual gain control for 1 mW output into 600 ohms. Measure distortion. Distortion should be less than 2%.

(5) Connect phone output from Receiver front panel to distortion analyzer and adjust phone output for 10 mW into 600 ohms. Measure distortion. Distortion should be less than 3%.

i. Operation After Restoration of Power.

(1) Carefully note the Receiver tuned frequency, BW and other displayed functions on Receiver front panel and de-energize the Receiver.

(2) After 1/2 hour, energize the Receiver and ensure that the Receiver returns to the display noted in step (1).

j. Out of Band Intermodulation Distortion.

This test requires the RF signal generator, AM/FM signal generator, step attenuator, signal combiner and RF millivoltmeter listed in Table 1-2.

(1) Connect the RF signal generator and AM/FM signal generator to the two inputs of the signal combiner. Connect the output of the signal combiner to the input of the step attenuator and its output to the RF millivoltmeter through its RF probe.

(2) Set the step attenuator to 5 dB then set the RF signal generator to 12.55 MHz, at a level of -10 dBm, CW. Set the AM/FM signal generator to 13.05 MHz at a level of -10 dBm, CW.

(3) Increase the step attenuator to 70 dB. Disconnect the RF millivoltmeter from the step attenuator and connect the RF millivoltmeter to J2 on the Receiver.

(4) Connect the output of the step attenuator to Jl on the Receiver and tune the

Receiver to 12.55 MHz.

(5) Adjust the manual IF gain control on the Receiver for a -10 dBm reading on the RF millivoltmeter.

(6) Tune the Receiver to 12.05 MHz and set step attenuator to 5 dB. Note that the RF millivoltmeter reads 65 dB below reading in step 5.

(7) Tune the Receiver to 13.05 MHz and note that RF millivoltmeter reads 65 dB below reading in step 5.

k. Audio Output Power.

This test requires the AM/FM signal generator, the junction box and the power meter listed in Table 1-2.

(1) Connect the AM/FM signal generator to Jl on the rear panel and set to 29.550 MHz at -97 dBm level and AM modulated at 30%.

(2) Turn Receiver on and tune to 29.550 MHz. Set AGC to medium and select 6.8 kHz bandwidth. Rotate AF control on front panel to maximum clockwise position.

(3) Connect the junction box to connector J3 on the Receiver rear panel and connect the power meter to MONITOR connector on the junction box.

(4) Note that power meter reads at least 1 milliwatt.

(5) Disconnect power meter from MONITOR connector and connect it to L/S OUT (loudspeaker).

(6) Note that power meter reads at least 1 watt.

(7) Disconnect power meter from L/S OUT and connect it to the PHONES jack on the front panel.

(8) Note that power meter indicates at least 10 milliwatts.

(9) Rotate AF control through its complete range and note that phone output level varies smoothly.

l. Noise Figure.

This test requires the noise generator, 50 ohm adapter and RF millivoltmeter listed in Table 1-2.

(1) Connect the RF millivoltmeter with the 50 ohm adapter to connector J2 on Receiver rear panel.

(2) Connect the noise generator to connector Jl on the Receiver rear panel. Turn the noise generator on and adjust for 15.5 MHz at a low level•

(3) Turn Receiver on, tune to 15.5 MHz, select 6.8 kHz bandwidth, CW, BFO +1 kHz and maximum IF gain.

(4) Note reading on RF millivoltmeter, then increase noise generator output level until RF millivoltmeter reading increases by 3 dB.

(5) Noise figure shall be no greater than 12 dB.

m. RF Input Impedance.

This test requires the RF signal generator and vector impedance meter listed in Table 1-2.

(1) Connect the RF signal generator output to the RF input of the vector impedance meter.

(2) Connect the vector impedance meter probe to Jl connector on Receiver rear

panel.

(3) Tune the Receiver to 5.0 MHz. Adjust RF signal generator to 5.0 MHz with a +3 dBm output level.

(4) Set vector impedance meter frequency range to 4.5-14 MHz and magnitude range to 100.

(5) Note reading on vector impedance meter. Reading shall be between 45 and 55 ohms and in phase (0 degrees).

(6) Repeat steps 3, 4 and 5 for both 15 and 25 MHz.

(7) Vector impedance meter shall be between 45 and 55 ohms and in phase at both 15 and 25 MHz.

n. Phase Jitter.

This test requires the RF signal generator, signal filter assembly and spectrum analyzer listed in Table 1-2.

(1) Connect the RF signal generator output to the input of the signal filter assembly. Connect the output of the signal filter assembly to Jl on Receiver rear panel.

(2) Connect spectrum analyzer with 600 ohm load to J2 on Receiver rear panel.

(3) Tune the Receiver to 1.400000 MHz, select 6.8 kHz bandwidth, manual AGC, CW mode and tune BFO to +8.00 kHz.

(4) Adjust the RF signal generator for 1.400000 MHz at -40 dBm output level. All modulation off.

(5) Set the spectrum analyzer as follows:

Frequency	8 kHz
Bandwidth	10 Hz
Sweepwidth	100 Hz/div
Scan Time	2 secs/div
Input Attenuator	-10 dBm
IF Attenuator	+20 dB

(6) Adjust the spectrum analyzer for a symmetrical response about the center frequency and adjust the Receiver IF gain control for peak response at 0 dB.

(7) Observe trace and note noise levels are down at least 21 dB at +100 Hz and at least 27 dB down at +200 Hz.

(8) Set the spectrum analyzer sweepwidth to 1 kHz/div and bandwidth to 30 Hz.

(9) Adjust the spectrum analyzer for a symmetrical response about the center frequency and adjust the Receiver IF gain control for peak response at 0 dB.

(10) Observe trace and note noise levels are down at least 42 dB at j^l kHz and 51 dB down at ^2 kHz.

o. Filter Delay Characteristics.

This test requires the 50 ohm adapter and network analyzer listed in Table 1-2.

(1) Connect the network analyzer channel B output to connector A4J1 on circuit card A4 with the cable to circuit card A3 disconnected.

(2) Connect the input of Channel B of the network analyzer to J2 on Receiver rear panel through the 50 ohm adapter.

(3) Be sure filters are installed in the filter slot as shown in Table 3-3.

(4) On the Receiver select LSB and manual AGC.

TABLE 3-3. SPECIAL FILTERS DELAY TEST PARAMETERS

FILTER NUMBER	FILTER SLOT	REFERENCE FREQUENCY	START FREQUENCY	STOP FREQUENCY	DELAY MICROSECONDS
4	FL1	455825	455600	457850	1000
5	FL2	454175	454400	452150	1000
6	FL3	455000	454800	455200	2000
7	FL4	455000	454400	455600	900
8	FL5	455000	453450	456550	1250
9	FL6	455000	451600	458400	1000
10	FL7	455000	447000	463000	1000

(5) Set the automatic synthesizer (part of network analyzer) as follows:

Frequency	455825 Hz
Frequency Step	5 Hz
Steps	10
Time/Step	100 millisecs
Amplitude	-10 dBm

(6) Set the network analyzer controls as follows:

Amplitude Function	B-A
Max Reference Voltage	0 dB
Bandwidth	100 Hz
Phase Reference	A
Delay Mode	CW
Frequency Step	50 Hz
Delay Function	Absolute

(7) Adjust the Receiver manual IF gain control for a 0 dB reading on the network analyzer.

(8) Measure delay at 455825 Hz by pressing START CONT pushbutton on the automatic synthesizer.

(9) On the automatic synthesizer, switch delay function to relative and enter the OFFSET by pressing the appropriate pushbutton. Stop the sweep. The required reference has now been established at +825 Hz.

(10) Set the network analyzer and automatic synthesizer controls to measure the differential delay over the frequency range of 455600 to 457850 Hz in the CW or sweep mode as convenient. Compare the delay reading with the requirement set forth in Table 3-3.

(11) Repeat steps 4 through 10 for filter numbers 4 through 10. Always select the filter to be tested and use the start and stop frequency shown in Table 3-3.