SECTION 4
MAINTENANCE

4.1 DISASSEMBLY

Disassemble only to the extent necessary to accomplish repair and testing. Reverse the procedure to reassemble the unit.

4.1.1 UNIT DUST COVERS

Remove three pan-head Phillips screws from the top and eight flat-head Phillips screws from the sides. Remove the bottom cover first and then the top cover. If the top cover is difficult to remove, loosen the three pan-head Phillips screws at the top of the Rear Panel. After top cover is removed, re-tighten these three screws.

4.1.2 SYNTHESIZER MODULE

Remove four pan-head Phillips screws from Front and Rear Panels. If necessary, pry up module evenly with a flat-blade screwdriver at front and back ends of module bottom. Avoid scratching the card-edge connectors.

4.1.2.1 SYNTHESIZER LOGIC BOARD

Remove seven flat-head Phillips screws from cover on longer side of Synthesizer and remove cover. Remove five hex spacers. Printed circuit assembly is then removable.

4.1.2.2 SYNTHESIZER MODULATOR BOARD

Remove seven flat-head Phillips screws from cover on smaller side of Synthesizer and remove cover. Remove four hex spacers. Printed circuit assembly is then removable.

4.1.2.3 SYNTHESIZER VCO SUBASSEMBLY

Remove Modulator Board as in 4.1.2.2. Remove Logic subassembly cover as in 4.1.2.1. Remove five pan-head Phillips screws from side opposite the VCO.

4.1 DISASSEMBLY (cont.)

4.1.3 R/T MODULE

Remove four pan-head Phillips screws from Front and Rear Panels. Beneath the Chassis, pull the guard RF cable from connector on R/T and remove.

4.1.3.1 R/T SUBASSEMBLY

Remove twelve flat-head Phillips screws from cover and remove. Remove seven 2-56 flat-head Phillips screws holding case bottom to heatsink. Do not remove larger screws. Remove three hex spacers and five pan-head Phillips screws from the printed circuit assembly and lift out.

4.1.4 AUDIO BOARD

The board pulls straight up out of the Chassis. No screws, use holes at top for prying or pulling.

4.1.5 GUARD MODULE

Remove three pan-head Phillips screws, one from Rear Panel, two from under the Chassis. Pull the connector from the Guard RF input jack, then remove the module. Pushing the module with a screwdriver (inserted through the jack clearance hole) will ease module removal. Be careful not to damage the jack.

4.1.5.1 GUARD SUBASSEMBLY

Remove eleven flat-head Phillips screws and remove the lid. Remove four hex spacers and four pan-head Phillips screws and lift out.

4.1.6 GUARD TONE MODULE (If installed)

Remove two pan-head Phillips screws and module can be lifted for inspection and testing. Unsolder five wires to remove the module.

4.1.7 POWER SUPPLY MODULE

Remove three pan-head Phillips screws, one from Front Panel and two from under the Chassis. Remove module.

4.1 DISASSEMBLY (cont.)

4.1.8 REGULATOR ASSEMBLY (15 VDC)

Remove four pan-head Phillips screws from module cover corners and remove assembly from Rear Panel.

4.2 TEST EQUIPMENT

The following test equipment, or equivalent, is required to properly align the RT-138. All test equipment must be properly calibrated before alignment is started.

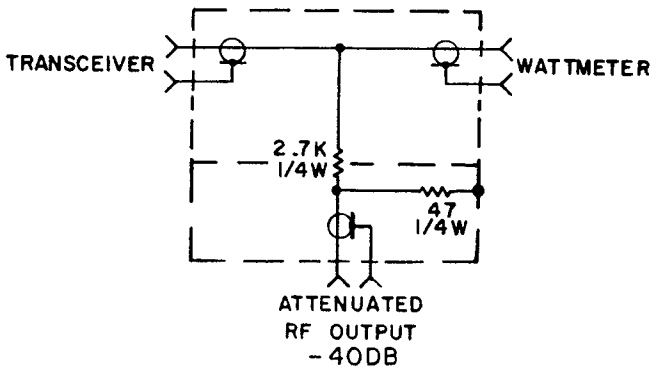
ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
A.	D.C. Voltmeter	-Input Impedance: 2.0 Megohms or greater -Accuracy: 0.1% full scale	Weston Model 4440 Keithley 178
B.	A.C. Voltmeter	-Input Impedance: 2.0 Megohms or greater -Voltage Range: 1 Millivolt to 100 volts	Triplett Model 801, Type 2
C.	RF Signal Generator	-Freq. Range: 1-200 MHz -Freq. Accuracy: 0.0001% -Modulation: FM (0-10 kHz dev) AM (0-50%) -Output Level: 0-1,000 µV Calibrated	Wavetek Model 3000 Wavetek Model 3001 Wavetek Model 3002 Hewlett Packard 8640A IFR Model 1000S Cushman Model CE-50A-1
D.	Deviation Meter	-Freq. Range: 138-174 MHz -Freq. Accuracy: ±0.0001% -Freq. Set: within ± 500 Hz of all 10 kHz channels -FM Detector: ±10% from ± 200 Hz to ±10 kHz dev. -FM Detector Output	Boonton 82AD Marconi TF 2300B IFR Model 1000S Cushman Model CE-50A-1
E.	Audio Signal Generator	-Freq. Range: 300 Hz to 10 kHz -Output Level: 0-2.5 VRMS	Hewlett-Packard Model 651A IFR Model 1000S Cushman Model CE-50A-1

4.2 TEST EQUIPMENT (cont.)

ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
F.	EIA Tone Generator	-Freq. Range: 67.0 (203.5) Hz -Freq. Accuracy: ±0.1 Hz	Automated Industrial Electronics DTG-1 IFR Model 1000S Cushman Model CE-50A-1
G.	RF Power Meter	-Impedance: 50 ohms -Range: 0 to 20 watts	Bird Electronics Corp. Termaline Model 611 Coaxial Dynamics 85
H.	Oscilloscope	-Sensitivity: 5 mVP-P Per div. -Time Base: 0.05 µsec/div. to 5 sec/div. -Dual trace -Horizontal Input	Tektronix, Inc. Type 475 or 465
I.	Audio Distortion Analyzer	-Freq. Range: 300 Hz - 15 kHz -Distortion Levels: 0.1% to 100%	Hewlett-Packard Model 332A Marconi TF 2337A Sinadder No. 3
J.	Frequency Counter	-Freq. Range: 24 to 174 MHz -Sensitivity: 100 mVRMS	Fluke Model 1952A Hewlett-Packard 5382A IFR Model 1000S Cushman Model CE-50A-1
K.	Regulated D.C.	-Volt Range: 0-40 VDC -Volt Regulation: ±0.25VDC from 0.5-10A	Trygon Model HR40-7C
L.	R.F. Isolation Pad	See Figure 4.2-1 for schematic	Wulfsberg Part Number 300-2069-000
M.	FLEXCOMM Test Set or Control Unit		Appropriate WEI Control Unit or PR-200 Test Set
N.	FLEXCOMM Test Harness	See Figure 7.1-2 for the schematic	WEI TSH-200

4.2 TEST EQUIPMENT (cont.)

ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
O.	Multimeter	-Ohmmeter Function	Triplett Model 630
P.	Head Phones	-Impedance: 600 ohms	Telex Communications Model MR-6
Q.	600 Ohm Load	-Value: ±10% 1 watt	
R.	EC-200 Extender Cable	Power Supply/Guard Module Extender	Wulfsberg Part Number 149-0061-000
S.	EC-202 Extender Cable	Audio Board Extender	Wulfsberg Part Number 149-0063-000
T.	EC-203 Extender Cable	Synthesizer Extender	Wulfsberg Part Number 149-0068-000
U.	EC-1 Test Coax, BNC to 2-Pos Socket		Wulfsberg Part Number 149-0069-000
V.	Coaxial Fuse	50 Ohm DC - 480 MHz Insertion loss ≤ 1 dB	Hewlett-Packard Model 11509A (optional)
W.	Spectrum Analyzer	10 - 512 MHz	IFR Model 1000S Cushman Model CE-50A-1



R.F. ISOLATION PAD SCHEMATIC
FIGURE 4.2-1

4.3 RT-138 OVERALL PERFORMANCE TESTS

The following procedures determine the overall performance of the RT-138. Follow the steps in sequence. Should requirements not be met, refer to the alignment procedures. If alignment specifications cannot be met, refer to the troubleshooting section.

4.4 PERFORMANCE TESTS

Remove the dust cover (Section 4.1.1) and connect the RT-138 to its test harness (WEI TSH-200). Apply power and measure the Power Supply voltages. The test pins are found on the underneath side of the Chassis.

Voltage	Should Be	Test Point
Input Bus Voltage	+27.5 ± 2.0 VDC	A1J2 Pin 5
28 Volt Regulator Output	+28 ± 2.5 VDC	A1J2 Pin 9
-28 Volt Regulator Output	-28 ± 2.5 VDC	A1J2 Pin 8
5 Volt Regulator Output	+5 ± 0.5 VDC	A1J2 Pin 2
15 Volt Regulator Outputs	+14.5 ± 1.5 VDC	A1E5, A1E8

NOTE: All voltage measurements should be made with respect to Chassis ground. The pin numbers refer to the Power Supply connector except for the 15V outputs.

The performance tests will be made under the following conditions. Unless otherwise specified, the Signal Generator will be modulated at ±3 kHz deviation, 1000 Hz modulating frequency. The audio output will be terminated with a 600 ohm load and the receiver volume shall be adjusted to produce 4.5 VRMS TYP with normal modulation.

All tests are configured assuming the use of a TSH-200 Wulfsberg Electronics Custom Test Harness and a FLEXCOMM Control Unit for channeling and tone control. The Transceiver antenna port should be connected through a DB-1 coupler (WEI P/N 300-2069-000) to a power dummy load. The -40 dB coupled output may be used to sample the transmitter output with a spectrum analyzer, frequency counter or modulation meter. The receiver tests may be performed by connecting the signal generator to the -40 dB coupled port of the DB-1.

4.4 PERFORMANCE TESTS (cont.)

CAUTION

Signal generators are subject to costly burnout if the transmitter is inadvertently keyed while the signal generator is connected directly to the Transceiver antenna port. Wulfsberg Electronics recommends the use of a WEI DB-1 40 dB coupler for isolation of the generator or use of a Hewlett-Packard 11509A, 50 ohm coaxial fuse between the signal generator and transceiver.

Unless otherwise specified, the transmitter output will be terminated with a 50 ohm load.

4.4.1 RECEIVER SENSITIVITY

The Main Receiver sensitivity should be tested at three frequencies. When a Test Set or Thumbwheel Control Unit is available, the following frequencies should be checked; 138.000, 156.000 and 173.997 MHz. Set the RF signal generator output level to 0.5 µV with standard modulation. The SINAD ratio should be greater than 12 dB at those channels tested. Repeat the procedure at the Guard Receiver frequency.

NOTE: It may be necessary to disable the squelch during the receiver sensitivity tests.

4.4.2 RECEIVER AUDIO OUTPUT

Using a 1000 µV signal with standard modulation, the audio output shall be typically 4.5 VRMS across 600 ohms. The test should be performed at one channel for the Main Receiver and at one channel for the Guard Receiver.

4.4.3 RECEIVER TIGHT SQUELCH

Make this measurement at one Main Receiver frequency and at one Guard Receiver frequency. Slowly increase the RF signal generator output level until the squelch light glows. Measured "SINAD" shall be between 14 and 18 dB.

4.4 PERFORMANCE TESTS (cont.)

4.4.4 RECEIVER CTCSS SQUELCH

Select a tone number on the Test Set or a preset channel with receiver CTCSS tone. Modulate the RF signal generator at the tone frequency with 300 Hz deviation. Apply 1000 µV level and verify that audio is present.

4.4.5 TRANSMITTER POWER OUTPUT

The transmitter shall produce between 8 and 12 watts. This test should be performed at the same frequencies as that for Section 4.4.1.

4.4.6 TRANSMITTER DEVIATION CAPABILITY

With an input of 0.25 VRMS at 1000 Hz, the transmitter shall produce a deviation greater than ± 3.0 kHz. This test should be performed at the same frequencies as that for Section 4.4.1.

4.4.7 TRANSMITTER DEVIATION LIMITER

A 2.5 VRMS audio input shall produce not greater than ± 5 kHz deviation at all modulation frequencies between 300 and 2500 Hz. This test need be performed at one frequency only.

4.4.8 TRANSMITTER CTCSS

Selection of a tone from either a Test Set or a Control Unit shall produce a tone deviation of between ± 550 and ± 950 Hz (± 750 Hz nominal). The frequency shall be within 0.1 Hz of specified. This test need be performed at only one transmit channel.

4.4.9 FINAL RT-138 SETTINGS

When the following adjustments have been made, or verified, the unit should be ready to return to service.

1. Guard Receiver Frequency: The Guard Receiver local oscillator shall be within ± 750 Hz of the desired frequency. See Section 4.6.10 for the test procedure.

2. Sidetone Output: With an input of 0.25 VRMS at 1000 Hz the sidetone shall produce 1.4 VRMS.

3. CTCSS Frequency: Each CTCSS tone shall be within 0.1 Hz of specified tone frequency.

4. Carrier Frequency: Frequency error shall not exceed ± 0.0005% on any channel.

4.5 TROUBLESHOOTING

This section is intended for use in isolating unit malfunctions. The troubleshooting procedure is presented in two sections. The first will discuss the complete unit, the second will discuss each module separately.

4.5.1 COMPLETE RT-138 TROUBLESHOOTING PROCEDURE

The RT-138 is separated into five modules; Power Supply, Synthesizer, Main Receiver/Transmitter, Audio Board, and Guard Receiver. Refer to Figures 3.2-1 and 5.1-1.

1. The Power Supply and Regulator Assembly contain the circuitry to convert the input bus voltage (+27.5 VDC) to the proper operating voltages. The outputs, +28, +15, +5.0 and -28 VDC go to the various modules.

2. The Synthesizer Module contains frequency determining circuitry. The module takes the BCD tuning input code and converts it to the proper receiver/transmitter injection frequencies. The PTT input determines transmit and receive injection frequencies. Since the Synthesizer performs the modulation function, another input is modulation audio. In addition to the RX/TX injection output, the Synthesizer has a Tuning Voltage (TV) to tune the preselectors in the Main Receiver.

3. The R/T Assembly produces the transmitter output power and the Main Receiver audio output. In transmit, the R/T Module amplifies the low level Synthesizer RF output. The amplified RF power is then passed through the T/R Relay to the antenna. In receive, the R/T Module passes this signal to the Main Receiver through the T/R Relay. A power splitter provides an RF output to the Guard Receiver. The Main Receiver uses the RF injection signal supplied by the Synthesizer and the tuning voltage (TV). After IF amplification, the FM output is buffered and filtered. It is necessary for the output to be processed and amplified by the Audio Board.

4. The Audio Board coordinates the various functions of the Transceiver. It not only processes audio signals from both the Main and Guard Receivers, but it also processes the microphone audio. The Audio Board outputs high level audio for both receive audio and sidetone. The Audio Board supplies the 32 EIA tone frequencies for the transmit CTCSS function. The board processes the received EIA tones and detects the proper tone frequency for use in the receiver squelch circuit. The Audio Board has five tone select inputs and a tone enable input.

4.5 TROUBLESHOOTING (cont.)

4.5.1 COMPLETE RT-138 TROUBLESHOOTING PROCEDURE (cont.)

5. The Guard Receiver Module is different than the Main Receiver in that it contains the receiver squelch circuitry.

4.5.2 SYNTHESIZER MODULE TROUBLESHOOTING PROCEDURE

The detailed block diagram of the Synthesizer is shown in Figure 3.3-1. The Synthesizer must have the following seven supporting inputs to operate properly.

Synthesizer Inputs	Source of Inputs
BCD Tuning	Control Unit
PTT Line ($\overline{TX}$)	Audio Board
Modulation	Audio Board
+5V	Power Supply
+27.5V	Filtered Bus Voltage
+28V	Power Supply
+15V	Regulator Assembly

The BCD tuning lines and the PTT must be HI or LO. The input voltage levels are internally converted to levels required by the program and swallow counters.

The modulation signal is an audio frequency signal having a value of approximately 1.3 VRMS to produce $\pm$ 3.0 kHz deviation.

The Synthesizer has the following five outputs which must be present.

Synthesizer Output	Output Termination
$\overline{\text{SYNTH UNLOCK}}$	R/T Module, Audio Board
Tuning Voltage (TV)	R/T Module
118.00 to 173.997 MHz Drive	R/T Module
HI/LO	Unused
RT-138 SELECT	Audio Board

4.5 TROUBLESHOOTING (cont.)

4.5.2 SYNTHESIZER MODULE TROUBLESHOOTING PROCEDURE (cont.)

The transmit disable voltage ($\overline{\text{SYNTH UNLOCK}}$) must be either 0.1 or 8.5 VDC. If the voltage is 0.1 VDC or less, the transmitter will be disabled.

The Tuning Voltage (TV) is a buffered version of the VCO tuning. Depending upon the channel frequency, the TV is 3.75 to 16.5 VDC. Figure 3.3.2-1 shows typical tuning voltage curves. The RF output must have an approximate amplitude of +6 dBm and be the correct frequency.

4.5.3 MAIN RECEIVER/TRANSMITTER MODULE TROUBLESHOOTING PROCEDURE

The R/T Module has two sections, the Receiver and Transmitter. The R/T block diagram is shown in Figure 3.4-1.

The receiver section must have three supporting inputs to operate properly. The supporting inputs are as follows:

Receiver Inputs	Source of Inputs
+15V	Regulator Assembly
TUNING VOLTAGE (TV)	Synthesizer
RX/TX RF Injection	Synthesizer

The Tuning Voltage (TV) must be between 3.75 and 17.35 VDC, the exact value determined by the Synthesizer channel frequency. See Figure 3.3.2-1.

The RX/TX injection is from the Synthesizer. The frequencies are between 118.000 and 173.997 MHz. This level should be approximately +6 dBm.

The Receiver section has the following outputs.

Receiver Outputs	Output Termination
MAIN RX AUDIO	Audio Board
GUARD RF	Guard Receiver

4.5 TROUBLESHOOTING (cont.)

4.5.3 MAIN RECEIVER/TRANSMITTER MODULE TROUBLESHOOTING PROCEDURE (cont.)

The MAIN RX AUDIO is the buffered detected FM output. The output is 0.50 VRMS for a 1000 µV signal modulated ± 3 kHz by a 1 kHz tone.

The GUARD RF output from the R/T Module is one-half of the antenna induced power. It is supplied from Power Splitter A7PS1.

The transmitter section of the R/T Module must have the following inputs.

Transmitter Inputs	Source of Inputs
DC Supply Voltages	15V Regulator Assy, 27.5 Aircraft Power
($\overline{TX}$)	Audio Board
$\overline{\text{SYNTH UNLOCK}}$ (HIGH)	Synthesizer
RX/TX RF Injection	Synthesizer

The ($\overline{TX}$) is a switched ground active only during transmit. It is used to activate the RF driver and the T/R relay.

$\overline{\text{SYNTH UNLOCK}}$ inhibits the transmitter when the Synthesizer is unlocked. This voltage must be in one or two states, approximately 0.1 or 8.5 VDC. The low voltage is the disable condition.

The RX/TX RF Injection supplies on-channel RF at a +6 dBm level for transmit.

The Transmitter section has the following outputs.

Transmitter Outputs	Output Termination
RF OUTPUT (8-12 watts)	Antenna
$\overline{\text{TX PWR LITE}}$	Audio Board

The $\overline{\text{TX PWR LITE}}$ signal inhibits transmitter sidetone audio except when RF power is being generated. It must be in one of two states, approximately 1.5 or 7.6 VDC.

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE

The Audio Board uses many switching and low-level inputs and supplies several switching and audio outputs. Voltage measurements should be considered normal if within ± 20% for DC voltages, ± 10% for AC. The Audio Board block diagram is shown in Figure 3.5-1. The seventeen supporting inputs are as follows.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

Audio Board Input	Source of Input
+15 VDC	Regulator Assembly
MAIN RX AUDIO	R/T Module
$\overline{\text{MAIN SQUELCH DISABLE}}$	Control Unit
$\overline{\text{MAIN AUDIO INHIBIT}}$	External Decoder
$\overline{\text{MAIN RX AUDIO DISABLE}}$	Control Unit
UNSQ GUARD RX AUDIO	Guard Module
$\overline{\text{GUARD SQUELCH DISABLE}}$	Control Unit
$\overline{\text{GUARD AUDIO INHIBIT}}$ (CTCSS)	External Decoder (or Optional Internal Decoder)
$\overline{\text{GUARD RX AUDIO DISABLE}}$	Control Unit
GUARD SQUELCH CONTROL	Guard Module
$\overline{\text{SYNTH UNLOCK}}$	Synthesizer Module
MIC HI AND LO/$\overline{\text{PTT}}$	External Microphone
$\overline{\text{TONES (A,B,C,D,E)}}$	Control Unit
$\overline{\text{TONE ENABLE}}$	Control Unit
$\overline{\text{R/T SELECT}}$	Synthesizer Module
$\overline{\text{TX PWR LITE}}$	R/T Module
EXT ENCODER IN	External Tone Generator

The +15 VDC supplies power to the Audio Board.

MAIN RX AUDIO is a 10 kHz low-pass filtered audio from the R/T Module. It measures 500 mVRMS when the Main Receiver is receiving a 1000 µV signal modulated $\pm$ 3 kHz by a 1 kHz tone.

$\overline{\text{MAIN SQUELCH DISABLE}}$, when pulled low, enables the Main RX Audio channel and lights the MAIN squelch indicator unless the Synthesizer is unlocked, the Transceiver is transmitting, or the main audio is disabled by the Control Unit T/R SELECT switch. Unless it is grounded by the Control Unit SQUELCH TEST switch, it is typically 10V.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

$\overline{\text{MAIN AUDIO INHIBIT}}$, when pulled low, disables the Main Receiver audio unless squelch test is active. This input is intended for external decoder use. When open, it typically measures 9V.

$\overline{\text{MAIN RX AUDIO DISABLE}}$, when pulled low, disables the Main Receiver audio. Sidetone and all squelch indicators are unaffected. Guard audio reduction is disabled, so that the guard audio level is the same as the Main Receiver level. This line is grounded by the Control Unit T/R SELECT switch when in GUARD position. If in MAIN or BOTH positions, it will typically measure 10V.

UNSQ GUARD RX AUDIO is 10 kHz low-pass-filtered audio from the Guard Receiver. After buffering by A3U15A, this audio is gated and level-controlled by A3U16 and summed into the main audio channel. A 1000 µV RF signal to the Guard Receiver, modulated $\pm$ 3 kHz by a 1 kHz tone, produces 1.0 VRMS at this input.

$\overline{\text{GUARD SQUELCH DISABLE}}$, when pulled low, gates the Guard Receiver audio into the main audio channel and lights the GUARD squelch indicator unless transmitting or the guard audio is inhibited by the Control Unit. Otherwise it typically measures 10V.

$\overline{\text{GUARD AUDIO INHIBIT}}$ (CTCSS), when pulled low, disables the Guard Receiver audio unless the squelch test is active. This input is intended for external decoder use. If open, this line will typically measure 9V.

$\overline{\text{GUARD RX AUDIO DISABLE}}$, when pulled low, disables the Guard Receiver audio. This line is grounded by the Control Unit T/R SELECT switch in the MAIN position. If in GUARD or BOTH positions, it typically measures 8V if $\overline{\text{TX}}$ is ungrounded, the GUARD receiver is unsquelched and $\overline{\text{GUARD AUDIO INHIBIT}}$ is high or open. It will typically measure 9V if the SQUELCH TEST switch is actuated.

GUARD SQUELCH CONTROL, when above 10V, enables guard squelch gate A3U16A unless transmitting or disabled by the Control Unit. This signal, from the Guard Receiver, is near ground when the Guard Receiver is squelched. Otherwise it is approximately 13V.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

$\overline{\text{SYNTH UNLOCK}}$, when pulled low, extinguishes the main squelch lite and disables the modulation, sidetone, and main receiver audio squelch gates. This line is grounded by the Synthesizer, otherwise it measures 15V.

MIC HI and MIC LO/$\overline{\text{PTT}}$: MIC HI supplies button current to the microphone and returns audio to microphone transformer A3T2 if $\overline{\text{RT SELECT}}$ is activated. MIC LO/$\overline{\text{PTT}}$, when grounded, completes the microphone audio circuit and generates the $\overline{\text{TX}}$ or $\overline{\text{PTT}}$ signal and the TX switched +15V. TX switched voltage is intended for external accessories. If a microphone is not connected, MIC HI measures 15V and MIC LO/$\overline{\text{PTT}}$ measures 14V.

$\overline{\text{TONE ENABLE}}$, when pulled low, enables CTCSS tone generation and decoding. It typically measures 10V when HI, ground when LO.

$\overline{\text{TONE (A,B,C,D,E)}}$ lines select the CTCSS (Continuous Tone Controlled Squelch System) tone frequency to be transmitted and decoded. See Table 4.5.4-1. These signals come from the Control Unit and typically measure 10V when HI, ground when LO.

$\overline{\text{RT SELECT}}$, when pulled low, connects the MIC HI and AUDIO HI lines to the connector. This signal is generated when a valid frequency is selected by the Control Unit. If more than one FLEXCOMM Transceiver is connected to a single Control Unit and aircraft audio system, this feature connects only the selected Transceiver to the microphone and audio output lines. It measures 15V when HI, ground when LO.

$\overline{\text{TX PWR LITE}}$ is pulled low by the R/T Module when transmitting. This signal enables the transmit modulation and sidetone gates unless the Synthesizer is unlocked. In receive mode, this voltage (8-11 VDC) is affected by the light sensor of the Control Unit.

EXT ENCODER IN provides a modulating input which bypasses the clipper, filter and preemphasis circuits. This input is available for external encoders (60-3000 Hz). A 1.0 VRMS signal will deviate the carrier approximately $\pm$ 3 kHz.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

These lines are used to program a synthesized CTCSS encoder/ decoder in the Transceiver. The lines follow a binary code with E the most significant bit and A the least significant. Logic "0" is a ground line and logic "1" must be greater than 8 volts.

BINARY TONE CHART					ENCODE OR DECODE TONE FREQUENCY	E.I.A. TONE CHART
E	D	C	B	A		
1	1	1	1	1	67.0	XZ
1	1	1	1	0	71.9	XA
1	1	1	0	1	74.4	WA
1	1	1	0	0	77.0	XB
1	1	0	1	1	79.7	SP
1	1	0	1	0	82.5	YZ
1	1	0	0	1	85.4	YA
1	1	0	0	0	88.5	YB
1	0	1	1	1	91.5	ZZ
1	0	1	1	0	94.8	ZA
1	0	1	0	1	97.4	ZB
1	0	0	1	1	100.0	1Z
1	0	1	1	1	103.5	1A
1	0	0	1	0	107.2	1B
1	0	0	0	1	110.9	2Z
1	0	0	0	0	114.8	2A
0	1	1	1	1	118.8	2B
0	1	1	1	0	123.0	3Z
0	1	1	0	1	127.3	3A
0	1	1	0	0	131.8	3B
0	1	0	1	1	136.5	4Z
0	1	0	1	0	141.3	4A
0	1	0	0	1	146.2	4B
0	1	0	0	0	151.4	5Z
0	0	1	1	1	156.7	5A
0	0	1	1	0	162.2	5B
0	0	1	0	1	167.9	6Z
0	0	1	0	0	173.8	6A
0	0	0	1	1	179.9	6B
0	0	0	1	0	186.2	7Z
0	0	0	0	1	192.8	7A
0	0	0	0	0	203.5	M1

CTCSS PROGRAMMING
TABLE 4.5.4-1

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

The Audio Board has the following seven outputs:

Audio Board Output	Output Termination
UNSQ MAIN RX AUDIO	External Decoder
AUDIO HI AND LO	Control Unit
$\overline{\text{MAIN SQ LITE}}$	Control Unit
$\overline{\text{GUARD SQ LITE}}$	Control Unit
MODULATION	R/T Module
$\overline{\text{TX}}$	R/T, Synthesizer, Control Unit and Guard Receiver
TX (SWITCHED +15V)	External Accessories

UNSQ MAIN RX AUDIO is the buffered and amplified MAIN RX AUDIO. The output is 1.0 VRMS for a 1000 µV RF signal modulated ± 3 kHz by the 1 kHz tone. This signal can be used for external decoding from 60 to 5000 Hz.

AUDIO HI and AUDIO LO supply up to 100 mW of audio (7.75 VRMS) to a 600 ohm load. A 1 kHz tone input of 0.50 VRMS at the MAIN RX AUDIO input or a 1 kHz tone at 0.25 VRMS at the microphone input will provide 100 mW output. When $\overline{\text{RT SELECT}}$ is not grounded, this output is disabled by A3K1 and internally terminated.

$\overline{\text{MAIN SQ LITE}}$ pulls low when the receiver squelch opens unless transmitting or the Synthesizer is unlocked. It also drives the annunciator on the Control Unit. When the squelch lite is extinguished this voltage (4-11 VDC) will be affected by the light sensor of the Control Unit.

$\overline{\text{GUARD SQ LITE}}$ pulls low when the Guard Receiver squelch opens unless transmitting. It drives the annunciator on the Control Unit.

MODULATION is the preemphasized clipped, and low-pass-filtered microphone audio. This output is enabled when $\overline{\text{TX PWR LITE}}$ is pulled low. For ± 3 kHz deviation of a 1 kHz tone, this line should be 1.3 VRMS with a mic input of 0.25 VRMS.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO BOARD TROUBLESHOOTING PROCEDURE (cont.)

$\overline{TX}$ pulls low when MIC LO/$\overline{PTT}$ is grounded. This signal goes to the R/T, Synthesizer and Guard Modules and the Control Unit. It will be 15V when HI, ground when LO.

TX switched +15V provides 50 mA maximum for controlling external accessories when MIC LO/$\overline{PTT}$ is pulled low.

Typical voltage levels for the Audio Board are included on the schematic diagram, Figure 5.1-7. These signals are RMS values and are typically sine waves, except when the modulation processor is overdriven by 20 dB (2.50 VRMS).

4.5.5 GUARD RECEIVER TROUBLESHOOTING PROCEDURE

The Guard Receiver's block diagram is shown in Figure 3.6-1.

The five supporting inputs to the Guard Receiver are as follows:

Guard Receiver Input	Source of Input
+15 VDC	Regulator Assembly
+5 VDC (Unused)	Power Supply
$\overline{TX}$ (Unused)	Audio Board
$\overline{GUARD\ TONE\ ENABLE}$ (Unused)	Control Unit
GUARD RF	R/T Module

Regulated +15 VDC is used to power the majority of the active circuitry on the Guard Receiver. Part of the squelch circuitry is powered by the 10V internal regulator.

$\overline{TX}$, $\overline{GUARD\ TONE\ ENABLE}$ and +5 VDC are unused.

The GUARD RF input is derived from the R/T Module's Power Splitter. It is possible to check the operation of the Power Splitter by removing the Guard RF connection and injecting an RF signal. There should be approximately 3 dB greater sensitivity when the Guard Receiver is operated in this manner.

4.5 TROUBLESHOOTING (cont.)

4.5.5 GUARD RECEIVER TROUBLESHOOTING PROCEDURE (cont.)

The Guard Receiver has the following three outputs:

Guard Receiver Output	Output Termination
GUARD AUDIO	Audio Board
UNSQUELCHED FLAT GUARD AUDIO	External Decoder
GUARD SQUELCH	Audio Board

The GUARD AUDIO output is buffered (10 kHz low-pass-filtered) receiver audio. The output will be 0.59 VRMS adjusted by the guard volume control. This measurement should be taken with a standard test input signal to the Guard Receiver.

UNSQUELCHED FLAT GUARD AUDIO is the same as Guard Audio, with an added 2.2 kohm series resistor for isolation. External decoders use this output which is reasonably constant from 60 to 5000 Hz.

The Guard Receiver contains the squelch control and the Audio Board contains the guard audio gate. The control signal is developed by squelch comparator A8U5B and is a switched output. The inhibit mode occurs when this output is 2.0 VDC or less, and the active mode occurs when this output is 7.0 VDC or greater.

4.5.6 POWER SUPPLY TROUBLESHOOTING PROCEDURE

Figure 3.7-1 is the block diagram of the Power Supply. The Power Supply has only one input, 27.5V aircraft power.

Aircraft power (27.5 VDC) is filtered by Chassis mounted L-C components before application to the Power Supply input terminals.

The Power Supply has three outputs:

Power Supply Output	Output Termination
+5V	Other Modules
+28V (regulated)	Synthesizer
-28V (regulated)	Synthesizer and Control Unit

4.5 TROUBLESHOOTING (cont.)

4.5.6 POWER SUPPLY TROUBLESHOOTING PROCEDURE (cont.)

The +5V output is generated by a pulse-width modulated inverter and is current limited to 2 amps by A2Q4.

An output winding of A2T1 is bridge rectified providing unregulated 40 volt inputs to the plus and minus 28V regulators, A2U2 and A2U3.

4.6 ALIGNMENT PROCEDURES

The alignment sequence is critical in most cases and should be checked and adjusted in the order given. The module interfaces are all normalized and incorrect adjustment in a module will compromise the remaining alignments. It is important that the Synthesizer reference oscillator and VCO's be properly adjusted prior to the R/T Assembly preselector alignment. It is equally important that the Main R/T and Guard Receiver normalized audio interface levels be proper before setting system audio output levels and squelch settings.

Extender Assemblies are required for some tests and adjustments; or, interfering modules may be removed to gain access to adjustment points.

All tests are configured assuming the use of a TSH-200 Wulfsberg Electronics Custom Test Harness and either a PR-200 Control Programmer for channeling test frequencies or a FLEXCOMM Control Unit programmed with shop test frequencies. The TSH-200 provides for activating/de-activating the transmitter as well as CTCSS tone enable/disable and squelch overrides. All tests on the transmitter and Main Receiver are made with the Control Unit T/R MODE SELECT set to MAIN and the MAIN/GUARD transmit select in the MAIN position. The MAIN TONE should be OFF unless selected for a particular adjustment. The volume pot should be "mid-range" unless otherwise stated. For Guard Receiver alignments the T/R SELECT should be set to the GUARD position.

4.6.1 POWER SUPPLY PRELIMINARY CHECKS

The Power Supply checks monitor voltages found on the bottom of the unit. Make all measurements with respect to the Chassis. See Figure 4.6-1 for the Power Supply adjustment location.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.1 POWER SUPPLY PRELIMINARY CHECKS (cont.)

1. Monitor +15 VDC power at A1E5 and A1E8. Verify 15 ± 1 VDC.

2. Monitor +5 VDC (Pin 15 of A1J2). The voltage should be + 5.0 ± 0.5 VDC. Adjust A2R28 if necessary.

3. Monitor +28 VDC (Pin 10 of A1J2). The voltage should be + 28.0 ± 2.5 VDC. There is no adjustment.

4. Monitor -28 VDC (Pin 8 of A1J2). The voltage should be - 28.0 ± 2.5 VDC. There is no adjustment.

4.6.2 SYNTHESIZER REFERENCE CRYSTAL FREQUENCY ADJUSTMENTS

1. Connect a frequency counter to the RF output through a 40 dB coupler (WEI DB-1). Make sure the transmitter is terminated in a proper dummy load.

2. Channel the unit to 173.0000 MHz.

3. Activate the transmitter PTT on the TSH-200.

4. Adjust A10C14 for a frequency of 173.000 MHz ± 100 Hz.

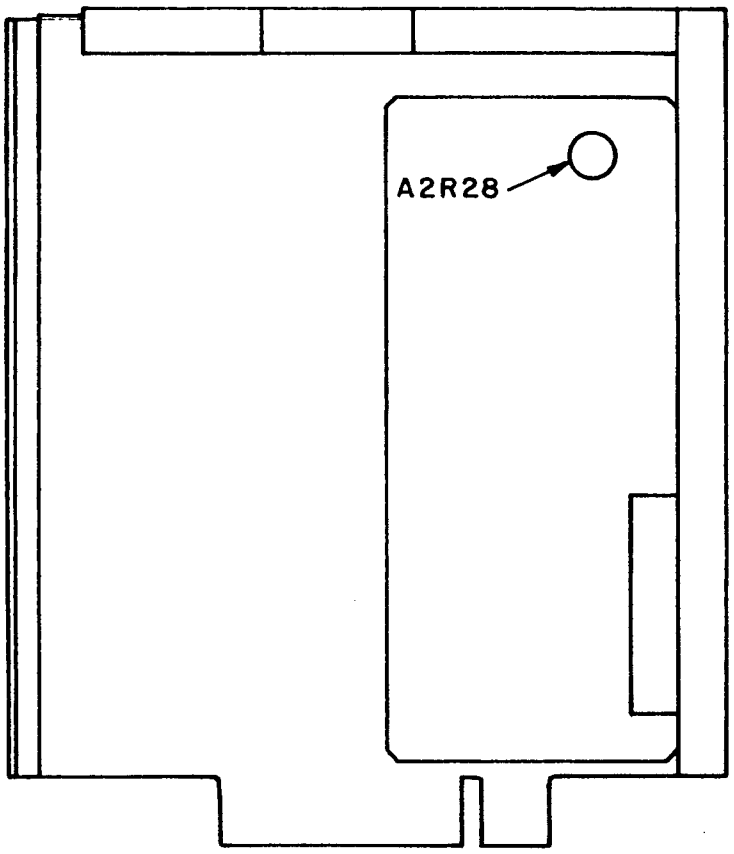
   If a part has been changed, A10C14 may have insufficient range and A10R26 might need a slight adjustment. Required varactor bias, measured at the A10R26-A10R27 junction, is 4.3-5.2 VDC. If A10R26 is adjusted, repeat the capacitor alignment.

5. Select 145.0025 MHz and adjust A10R29 for 145.0025 MHz ± 30 Hz.

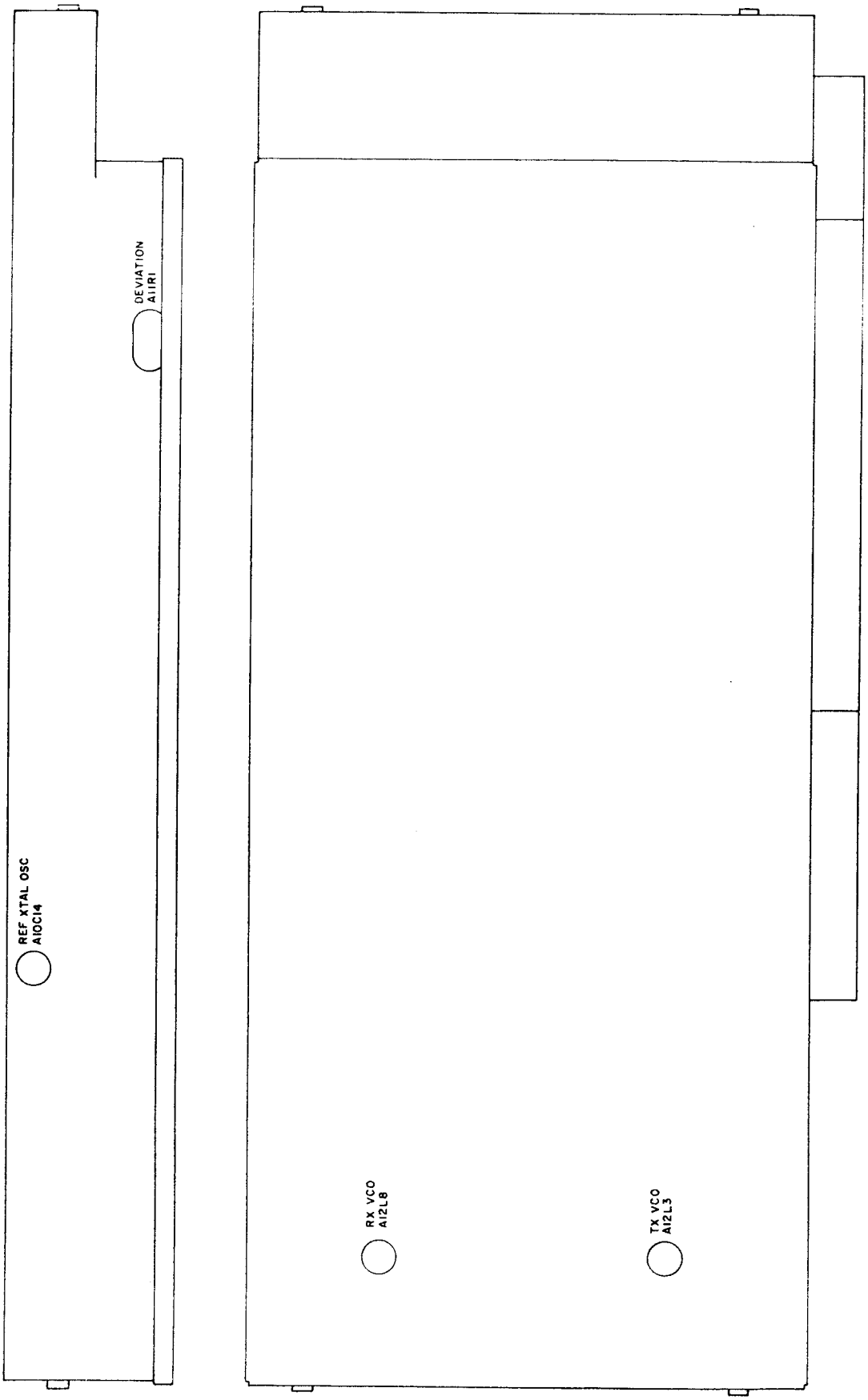
6. De-activate PTT.

4.6.3 SYNTHESIZER VCO TUNING VOLTAGE ADJUSTMENT

Place the Synthesizer Module on an extender (WEI EC-203) to gain access to the VCO adjustments. Tuning voltage can be monitored at A1J6 pin 11. See Figure 4.6-2 for adjustment locations.



FLEXCOMM POWER SUPPLY ADJUSTMENT LOCATION
FIGURE 4.6-1



RT-138 SYNTHESIZER ADJUSTMENT LOCATIONS
FIGURE 4.6-2

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.3 SYNTHESIZER VCO TUNING VOLTAGE ADJUSTMENT (cont.)

Align the Receive VCO as follows:

1. Channel the unit to 138.000 MHz (Receive).
2. Adjust A12L8 slug for a tuning voltage of 3.75 ± 0.02 VDC.
3. Channel the unit to 173.997 MHz and verify a tuning voltage of 16.00 to 17.50 VDC.

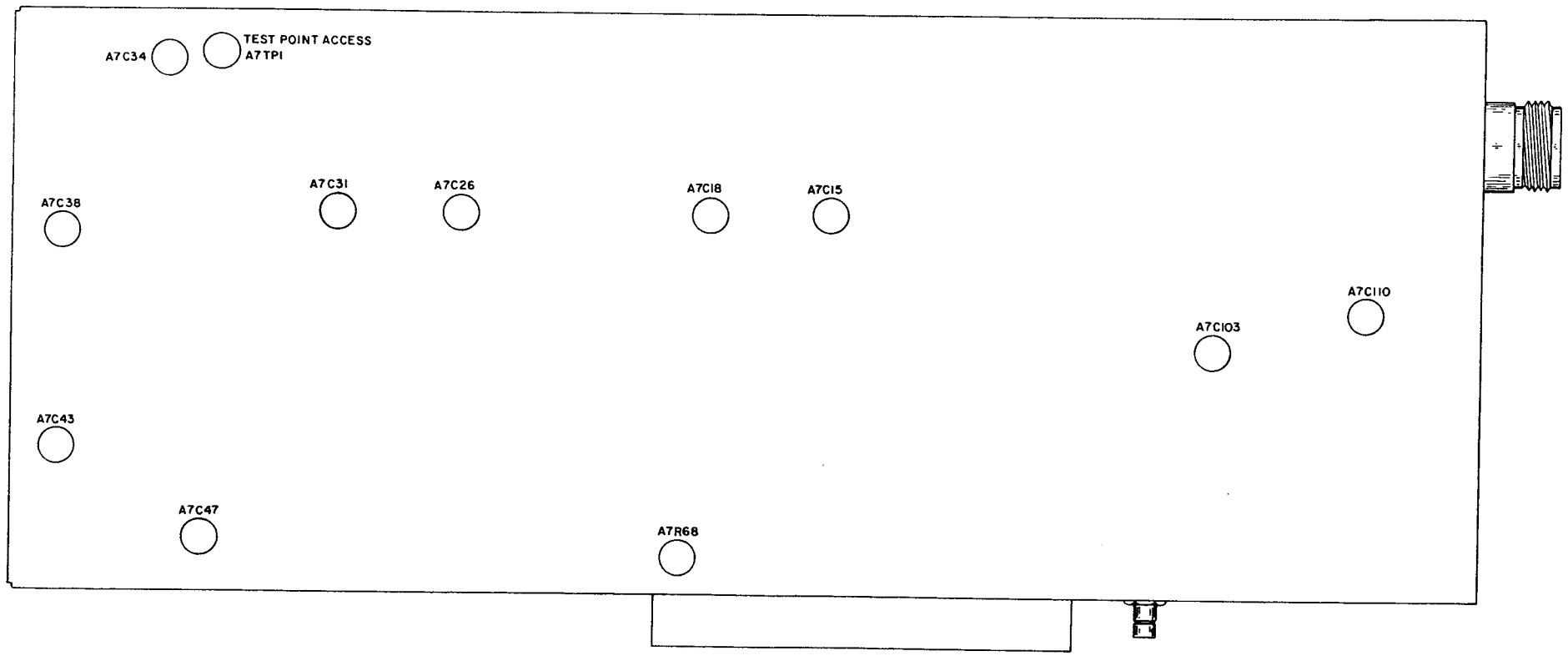
Align the Transmit VCO as follows:

1. Terminate the Transceiver with a wattmeter or dummy load.
2. Channel the unit to 138.000 MHz.
3. Activate the transmitter PTT.
4. Adjust A12L3 for a tuning voltage of 3.75 ± 0.02 VDC.
5. Channel the unit to 173.997 MHz and verify a tuning voltage of 16.00 to 18.00 VDC.
6. De-activate PTT.
7. Remove the extender and return the Synthesizer to its Chassis location.

4.6.4 R/T MODULE TRANSMITTER ALIGNMENT

The RT-138 transmitter power flatness is determined primarily by fixed components. Only two adjustments are available for field alignment. See Figure 4.6-3 for R/T Module adjustment location.

1. Terminate the Transceiver antenna port with a wattmeter.
2. Channel the unit to 156.000 MHz and key the transmitter.
3. Initially adjust A7C103 and A7C110 for maximum RF power.
4. Optimize A7C103 and A7C110 to obtain the best possible power flatness at 138.000, 156.000 and 173.000 MHz. Power should be 8 to 12 watts on all channels.
5. De-activate PTT.



PART NUMBER	DESCRIPTION				ITEM
DASH NO	PART NUMBER SCHEDULE				
WULFSBERG ELECTRONICS, INC.					
SCALE 2:1	Tolerance Unless Noted: .XX ±.01 Fractions ±1/64 .XXX ± .005 Angles ± 1/2°				
DRAWN BY JF 1-20-83	TITLE RT-138 R/T ASSY. TUNING HOLE LOCATIONS				
MECH ENGR APPROVAL					
ELECT ENGR APPROVAL WBS 2-2-83	SHEET 1 OF 1	SIZE D	NUMBER 148-0372-000		
PROJ ENGR APPROVAL					
REV A	ORIGINAL RELEASE	CO Number	DATE		

151-0016 REV C

RT-138 R/T MODULE ADJUSTMENT LOCATIONS
FIGURE 4.6-3

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.4 R/T MODULE TRANSMITTER ALIGNMENT (cont.)

NOTE: After alignment, harmonic and spurious should be checked with a spectrum analyzer coupled with a 40 dB coupler (WEI DB-1).

4.6.5 R/T MODULE PRESELECTOR ALIGNMENT

This alignment matches the tuning characteristics of over-coupled varactor tuned filter pole pairs to a normalized tuning voltage.

The tuning voltages generated by the Synthesizer should be monitored while aligning the preselector to insure the alignment is not performed with erroneous inputs. The voltage may be measured at Pin 11 of the Synthesizer Modulator Board (Chassis connector A1J6).

RECEIVE FREQ.	REQUIRED TUNING VOLTAGES
138.0000	~~3.72 - 3.78~~ 4.5 VDC
173.9975	16.00 - 17.25 VDC

The Synthesizer must be aligned properly prior to this test. If the tuning voltages are not correct, refer to the Synthesizer alignment and/or troubleshooting section.

To minimize tuning interaction, a swamp and tune technique is utilized. A 220 ohm resistor is used to swamp the tuned circuit. One lead of the resistor should be short. By touching one resistor lead to the screw head on the trimmer capacitor and grounding the other lead to the lid surface, the circuit may be effectively swamped while adjustments are made to the other trimmer capacitor of the pole pair. It is not necessary to remove the R/T covers to align the trimmer capacitors.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator (-40 dBm) to the Transceiver RF connector.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.5 R/T MODULE PRESELECTOR ALIGNMENT (cont.)

2. Connect a micro-wattmeter or spectrum analyzer to test point A7TP1 utilizing WEI fabricated EC-1 or a customer fabricated assembly.

3. Channel the unit to 173.997 MHz. Capacitor adjustments are performed at the high-frequency end.

4. Connect the swamping resistor between A7C18 screw head and the lid (ground). Adjust A7C15 for a signal maximum or peak.

5. Move the swamping resistor to A7C31. Adjust A7C26 for a peak indication.

6. Move the swamping resistor to A7C15 and adjust A7C18 for a peak.

7. Move the swamping resistor to A7C26 and adjust A7C31 for a peak.

8. Repeat steps 4 through 7.

The preselector coils are factory aligned and normally will not require adjustment. If sensitivity proves to be inadequate at 138 MHz, the coils are aligned as follows.

1. Remove the cover from the R/T Assembly.

2. Channel the unit to 138.000 MHz.

3. Swamp A7C18 and peak A7L8 by compressing or spreading the coil turns.

4. Swamp A7C31 and adjust (compress or spread) A7L12 turns for a peak.

5. Swamp A7C15 and adjust A7L10.

6. Swamp A7C26 and adjust A7L14.

7. Repeat high and low frequency steps until no further adjustments are necessary.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.6 R/T MODULE IF BAND PASS FILTER ALIGNMENT

This section aligns the IF filters for minimum audio distortion of an FM signal.

The R/T Module low pass filter and preselector, along with the Synthesizer adjustments, must be properly aligned prior to this test.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator to the RF output of the Transceiver.
2. Connect a distortion analyzer to the audio output of the test harness (WEI TSH-200).
3. Channel the Transceiver and adjust the signal generator to a convenient channel frequency.
4. Adjust the signal generator for 1000 μV, 1 kHz tone and 5 kHz deviation.
5. Set the Control Unit volume pot to mid-range.
6. Check that the audio output from the R/T Assembly (pin 17 of the R/T Module Chassis connector A1J7) does not exceed 0.9 VRMS. Adjust A7R68 on the R/T Module if necessary.
7. Sequentially adjust the four trimmer caps, A7C34, A7C38, A7C43, and A7C47 in the IF matching network for least distortion. Repeat the sequential alignment until no further improvement in distortion can be obtained. This alignment is critical to the adjacent channel and squelch blocking performance of the Transceiver and should be optimized.

4.6.7 R/T MODULE NORMALIZED AUDIO INTERFACE LEVEL ADJUSTMENT

This adjustment sets the audio interface level to a normalized level for a signal input with standard modulation.

The Synthesizer and R/T Modules must be properly aligned prior to this adjustment.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.7 R/T MODULE NORMALIZED AUDIO INTERFACE LEVEL ADJUSTMENT (cont.)

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator to the RF connector of the Transceiver.
2. Connect an RMS voltmeter to the R/T Module Chassis connector pin 17 of A1J7.
3. Channel the Transceiver and signal generator to a convenient channel frequency.
4. Set the signal generator for 1000 μV and a 1 kHz tone deviated ± 3 kHz.
5. Adjust A7R68 on the R/T Module for 0.50 VRMS.

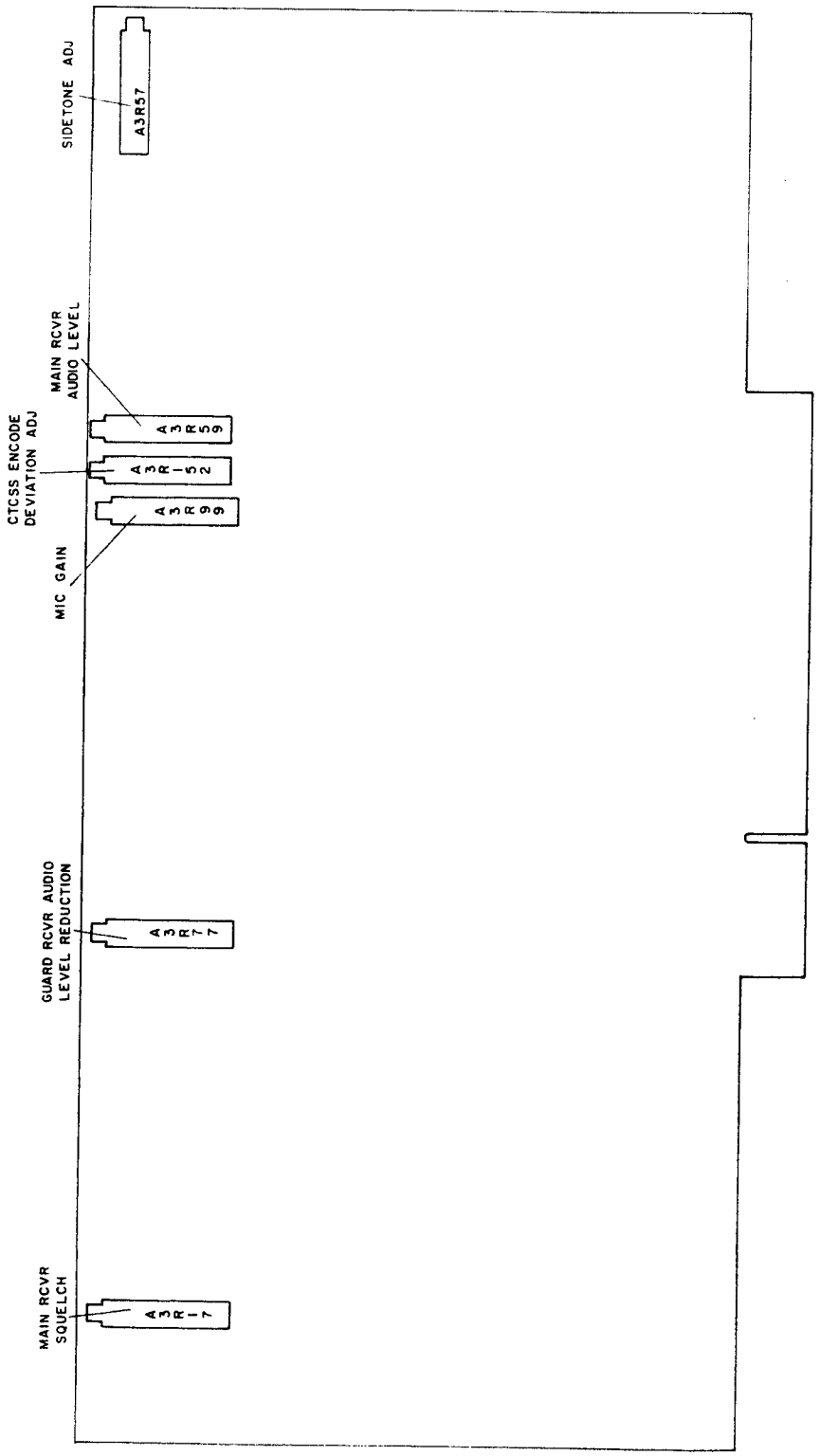
4.6.8 MAIN RECEIVER SQUELCH OPENING ADJUSTMENT

This alignment involves setting the squelch opening signal level by monitoring the output audio SINAD and adjusting A3R17 on the Audio Board. See Figure 4.6-4 for adjustment locations.

The normalized Audio Interface Level out of the R/T Assembly as well as receiver alignment must be made prior to squelch adjustments.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator to the RF output of the Transceiver.
2. Connect a distortion analyzer to the audio output of the test harness.
3. Channel the Transceiver and adjust the signal generator to a convenient channel frequency.
4. Adjust the signal generator for a 1 kHz tone and ± 3 kHz deviation.
5. Set the Control Unit volume pot to mid range.



FLEXCOMM AUDIO BOARD ADJUSTMENT LOCATIONS
FIGURE 4.6-4

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.8 MAIN RECEIVER SQUELCH OPENING ADJUSTMENT (cont.)

6. Increase the signal generator level from zero until the squelch opens. Verify the receiver squelch opening SINAD is set to the desired SINAD ratio (typically 14 to 18 dB).

7. If adjustment is necessary, adjust A3R17 on the Audio Board until the squelch opens reliably at the desired squelch opening SINAD ratio (6 to 21 dB limit, 14 to 18 dB typical).

4.6.9 MAIN RECEIVER SYSTEM AUDIO LEVEL ADJUSTMENT

The normalized R/T Module audio interface level as well as normal receiver alignments must be properly adjusted prior to this test.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator to the RF output of the Transceiver.

2. Connect an audio RMS Voltmeter and desired audio termination (600 ohms) to the system audio output.

3. Channel the Transceiver and adjust the signal generator to a convenient channel frequency.

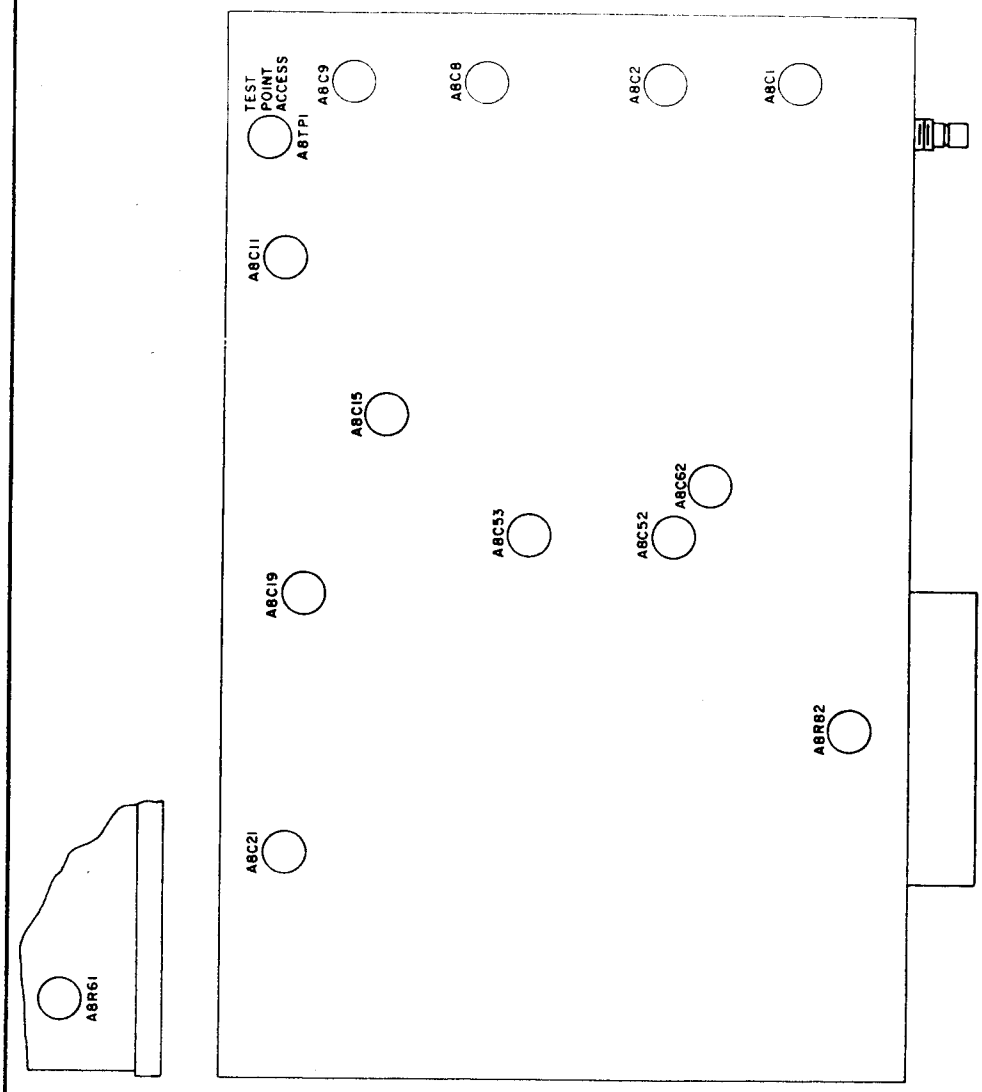
4. Adjust the signal generator for 1000 µV and a 1 kHz tone, ± 3 kHz deviation.

5. Set the Control Unit volume pot to maximum and adjust A3R59 on the Audio Board for the desired system audio level, typically 33 mW into 600 ohms (4.5 VRMS). The adjustment range is 0.01 to 100 mW into 600 ohms (0.0775 to 7.75 VRMS).

4.6.10 GUARD RECEIVER CRYSTAL FREQUENCY AND L.O. TRIPLER

This procedure adjusts the local oscillator on frequency and peaks the tripler circuit. See Figure 4.6-5 for Guard Receiver tuning locations.

To gain access to the Guard Receiver alignment points, the Guard Receiver should be placed on an extender card. Use the EC-200 Power Supply extender for this purpose.



WULFSBERG ELECTRONICS, INC.
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SIZE C
NUMBER 148-0374-000
SHEET 1 of 1
REV C

RT-138 GUARD RECEIVER ADJUSTMENT LOCATIONS
FIGURE 4.6-5

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.10 GUARD RECEIVER CRYSTAL FREQUENCY AND L.O. TRIPLER (cont.)

1. Monitor A8TP2 using the spectrum analyzer.
2. Preset A8C52 and A8C53 for mechanical midrange.
3. Peak A8L16 and A8L18 for the highest signal level at the local oscillator frequency. (Triple the crystal oscillator frequency.)
4. Peak A8C52 and A8C53 as a final adjustment.
5. Connect a counter to A8TP2 and adjust A8C62 for the required injection frequency. (Crystal oscillator X3 RX frequency -16.90 MHz).

4.6.11 GUARD RECEIVER PRESELECTOR ALIGNMENT

1. Connect the signal generator to the RF input jack and monitor A8TP1 with an analyzer or suitable measuring device.
2. Channel an unmodulated signal generator to the receiver frequency at a level of -40 dBm.
3. Swamp A8L3 with a 220 ohm resistor and peak A8C1.
4. Move swamping resistor to A8L1; peak A8C2.
5. Move swamping resistor to A8L7: peak A8C8.
6. Move swamping resistor to A8L5; peak A8C9.
7. Repeat steps 3 through 6.

4.6.12 GUARD RECEIVER IF BAND PASS FILTER ALIGNMENT

This section aligns the IF filters for minimum audio distortion of a received FM signal.

The preselector and local oscillator multiplier must be properly aligned prior to this test.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.12 GUARD RECEIVER IF BAND PASS FILTER ALIGNMENT (cont.)

1. Connect a signal generator to the Guard RF connector.
2. Connect a distortion analyzer to the audio output of the test harness.
3. Select the GUARD position of the Control Unit T/R SELECT switch.
4. Adjust the signal generator for 1000 μV, 1 kHz tone and 5 kHz deviation on the desired channel frequency.
5. Set the Control Unit VOLUME to mid-range.
6. Check that the audio output from the Guard Receiver (pin 8 of connector A1J8) does not exceed 1.8 VRMS. Adjust A8R82 on the Guard Receiver if necessary.
7. Check that the system audio output is sufficient for the distortion analyzer. Adjust A3R77 (Guard Receiver audio level reduction adjustment) if necessary.
8. Sequentially adjust the four trimmer caps (A8C11, A8C15, A8C19 and A8C21) in the IF matching network for least possible distortion. Repeat the sequential alignment of each trimmer until no further improvement in distortion may be obtained. This alignment is critical to the adjacent channel and squelch blocking performance of the receiver and should be optimized.

4.6.13 GUARD RECEIVER NORMALIZED AUDIO INTERFACE LEVEL ADJUSTMENT

This adjustment sets the audio interface level to a normalized level.

1. Connect a signal generator to the Guard RF input.
2. Connect an RMS voltmeter to pin 8 of A1J8.
3. Set the signal generator to 1000 μV and a 1 kHz tone deviated ± 3 kHz on the desired channel frequency.
4. Adjust A8R45 of the Guard Receiver for a normalized voltage of 0.60 VRMS.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.14 GUARD RECEIVER SQUELCH OPENING ADJUSTMENT

This procedure sets the squelch opening signal level to a specified SINAD.

The normalized Audio Interface Level out of the Guard Receiver, as well as normal receiver alignments must be properly aligned prior to squelch adjustments.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. The Guard Receiver and R/T should be replaced in the Chassis for squelch setting adjustments.
2. Connect a signal generator to the antenna connector.
3. Connect a distortion analyzer to the audio output of the test harness.
4. Select the GUARD mode on the Control Unit T/R SELECTOR.
5. Adjust the signal generator for a 1 kHz tone and $\pm$ 3 kHz deviation on the desired channel frequency.
6. Set the Control Unit volume pot to mid-range.
7. Increase the signal generator level from zero until the squelch opens. Verify the receiver squelch opening SINAD is set to the desired SINAD ratio (typically 14 to 18 dB).
8. If necessary, adjust A8R57 in the Guard Receiver until the squelch opens reliably at the desired squelch opening SINAD ratio (6 to 21 dB limit, 14 to 18 dB typical).

4.6.15 GUARD RECEIVER SYSTEM AUDIO LEVEL ADJUSTMENT

This adjustment involves monitoring the system audio output and adjusting A8R77 on the Audio Board for the desired system guard audio output level while BOTH is selected by the Control Unit T/R SELECTOR.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.15 GUARD RECEIVER SYSTEM AUDIO LEVEL ADJUSTMENT (cont.)

This adjustment is only a reduction of Guard Receiver audio level relative to the Main Receiver audio when both receivers are simultaneously selected.

When only the Guard Receiver is selected by the Control Unit T/R SELECTOR, the Guard Receiver audio level is equivalent to the Main Receiver audio level and is not affected by this relative adjustment.

The Main Receiver system audio level and the Guard Receiver normalized audio interface level must be properly adjusted prior to this test.

CAUTION: DO NOT TRANSMIT INTO THE SIGNAL GENERATOR. DE-ACTIVATE THE TRANSMITTER.

1. Connect a signal generator to the RF output of the Transceiver.
2. Connect an RMS Voltmeter and desired audio termination (600 ohms) to the system audio output.
3. Set the Control Unit T/R SELECTOR to BOTH.
4. Adjust the signal generator for 1000 µV and a 1 kHz tone, ± 3 kHz deviation on the desired Guard channel frequency.
5. Set the Control Unit volume to maximum and adjust A8R77 on the Audio Board for the desired Guard audio level. This adjustment can yield levels equal to, or 40 dB less than the Main Receiver system audio level.

4.6.16 TRANSMITTER MODULATION DEVIATION ADJUSTMENT

This adjustment involves monitoring the recovered audio from the transmitter and adjusting the modulation sensitivity so as not to exceed ± 5 kHz deviation.

1. Connect a modulation meter to the RF output of the Transceiver through an isolation pad (40 dB Coupler WEI DB-1). Make sure the transmitter is terminated in a proper Dummy Load.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.16 TRANSMITTER MODULATION DEVIATION ADJUSTMENT (cont.)

2. Connect a 1000 Hz audio oscillator to the Mic input.

3. Disable the CTCSS tones with the test harness control switch.

4. Adjust the oscillator amplitude to the desired Mic level for standard deviation, typically 0.25 VRMS.

5. Channel the Transceiver to 138.000 MHz.

6. Activate the transmitter.

7. Verify approximately 1.3 VRMS at the modulation output from the Audio Board at Pin 8 of A1J3. Adjust Mic Gain (A3R99) on the Audio Board if necessary.

8. Increase the oscillator amplitude 20 dB to 2.5 VRMS.

9. Observe transmitter deviation at the following or similar frequencies across the band.

   138.000 MHz
   146.000 MHz
   156.000 MHz
   166.000 MHz
   173.900 MHz

10. Select the frequency displaying the largest deviation.

11. Adjust A11R11 (Synthesizer Modulator Board) for ± 5.0 kHz deviation (maximum).

12. Check above channels and any others of interest. The deviation should not exceed ± 5.0 kHz. Typically it will be ± 4.2 to ± 5.0 kHz.

13. De-activate the transmitter.

4.6.17 MIC GAIN AND SIDETONE ADJUSTMENT

This section adjusts the Mic Gain and sets the desired sidetone audio level.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.17 MIC GAIN AND SIDETONE ADJUSTMENT (cont.)

1. Connect a modulation meter to the RF output of the Transceiver through an isolation pad (40 dB Coupler WEI DB-1). Make sure the transmitter is terminated in a proper dummy load.

2. Connect an audio RMS Voltmeter and audio termination (600 ohms) to the system audio output.

3. Connect a 1000 Hz audio oscillator to the Mic input.

4. Disable the CTCSS tones at the test harness control.

5. Adjust the oscillator amplitude to the desired Mic level for standard deviation, typically 0.25 VRMS. Adjustment limits are 0.030 to 0.60 VRMS.

6. Channel the Transceiver to the frequency with the least deviation (as determined in the previous section).

7. Activate the transmitter.

8. Adjust the Mic Gain pot (A3R99) on the Audio Board for $\pm$ 3 kHz.

9. Check other channels of interest. The deviation should be between $\pm$ 3.0 and $\pm$ 3.6 kHz.

10. Set the Control Unit volume pot for maximum audio.

11. Adjust the sidetone pot (A3R57) on the Audio Board for the desired sidetone level at the system audio output, normally 10 dB less than the Main Receiver system audio level. Typically the Main Receiver system audio level is set to 33 mW into 600 ohms. Sidetone should be 3.3 mW or 1.4 VRMS. The adjustment range however, is 0.01 to 100 mW into 600 ohms (0.0775 to 7.75 VRMS).

12. De-activate the transmitter.