VHF/FM COMMUNICATIONS TRANSCEIVER

RT-9600F
VHF HI-BAND
150 - 174 MHZ

INSTALLATION AND MAINTENANCE MANUAL ADDENDUM WITH PARTS LIST

EQUIPMENT
PART NUMBERS: 400-0140-002/052
400-0140-005/055
400-0140-008/058
400-0140-011/061
400-0140-024/074
400-0140-025/075
400-0140-026/076
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SECTION 1

DESCRIPTION AND OPERATION

1.1 INTRODUCTION

This addendum contains information pertaining to the installation and maintenance of the RT-9600F. The RT-9600F includes a new Fastlock Synthesizer and is equipped with the VP Interface capability. This addendum is to be used with the RT-9600 Install and Maintenance Manual and the RT-9600, with VP Interface Install and Maintenance Addendum.

The RT-9600F is compatible with "standard" RT-9600 systems. Module swapping must be judiciously applied since some modular subassemblies will not interchange. The RT-9600F, with VP Interface, must be used in conjunction with a unique control unit, the C-962S, and with the unique wiring interconnect defined in the VP Interface Addendum.

1.2 PURPOSE OF EQUIPMENT

The Global Wulfsberg RT-9600F provides either standard FM or voice secure (VP) two-way voice communications in the frequency range of 150.0000 to 173.9975 MHz when used in conjunction with an external encryption unit. The RT-9600F is compatible with digital Coded Squelch Systems and other accessory equipment requiring non return to zero modulation. Channeling is in 2.5 kHz increments for a total of 9600 channels.

1.3 MODEL VARIATIONS

There are sixteen models of the RT-9600F, eight with VP Interface. These sixteen models are defined in Section 1.5. Individual variations should be considered to insure that the desired model is procured.

1.4 TECHNICAL CHARACTERISTICS OF RT-9600F TRANSCEIVER

1.4.1 GENERAL SPECIFICATIONS

Frequency Range:	FCC Type Accepted 150 to 174 MHz. DOC Type Accepted 150 to 174 MHz.
Channeling:	25 or 30 kHz (standard or split) under FCC parts 74, 83 and 90. 30 kHz under DOC RSS-119. 25 KHz under DOC RSS-182.
Tunability:	Capable of 2.5 kHz increments.
Mode:	Simplex or Semi-duplex, 16F3.

1.4 TECHNICAL CHARACTERISTICS (cont)

1.4.1 GENERAL SPECIFICATIONS

Physical Dimensions:	See Figures 2.4-1 and 2.4-2 of RT-9600 Installation Manual
Weight:	9.3 lbs (4.22 kg).
Mounting:	Hardmount--any position Per ARINC 404 and 404A
Power Requirements:	
Voltage:	13.75VDC ± 20% or 27.5VDC ± 20%
Current:	
Standby:	1.3 Amps maximum
Receive:	1.5 Amps maximum
Transmit:	5.5 Amps maximum
Control:	Remote with C-962(S) Control Unit.
Warm-up Time:	Not required
Temperature:	
Storage:	-55 to +85° C.
Operate:	-40 to +60° C.
Altitude:	51,000 feet MSL.
Certification:	FCC Parts 15, 74, 83, and 90. DOC RSS-119 (501 191 126X) DOC RSS-182 (501 821 271V).
Other:	Meets RTCA DO138 Environmental Catagory AAGAAAEXXXXS (when shock-mounted) and AANAAAEXXXXS (when rigid mounted) to Global Wulfsberg operational standards.

1.4 TECHNICAL CHARACTERISTICS (cont.)

1.4.2 TRANSMITTER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Nominal Output Power:	Operator selectable, 1 or 10 Watts.
Output Power Tracking:	±20%, from nominal over frequency range.
Output Impedance:	50 ohms.
Duty Cycle:	Continuous (EIA).
Frequency Stability:	± 0.0005% over -40 to +60° C temp. range
Audio Input:	0.25 VRMS into 200 ohms input circuit for ±3.0 kHz deviation, adjustable.
Audio Distortion:	5%
Modulation:	±5 kHz deviation, limited.
Modulation Tracking:	±0.9 dB across frequency range.
Modulation Bandwidth	NEAR DC to 3kHz
Sidetone Output:	50 mW into 600 ohms, adjustable.
Microphone Circuit:	Carbon or equivalent.
FM Hum and Noise:	-30 dB.
Harmonics:	-70 dB below carrier level.
Spurious:	-80 dB below carrier level.

1.4.3 MAIN RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Usable Sensitivity:	0.5 µV, 12 dB SINAD (EIA).
Quieting Sensitivity:	1.0 µV, 20 dB quieting (EIA).
Adjacent Channel:	-70 dB (EIA).
Intermodulation:	-70 dB (EIA).

1.4 TECHNICAL CHARACTERISTICS (cont.)

1.4.3 MAIN RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Response:	
Spurious:	-90 dB.
Image:	-90 dB.
Modulation Acceptance:	±7 kHz minimum (EIA)
Squelch:	
Threshold Setting:	4 dB SINAD or less.
Tight Setting:	18 to 20 dB SINAD.
Audio Output:	100 mW into 600 ohms, adjustable
Audio Distortion:	±7% EIA.
Frequency Tolerance:	± 0.001% over -40° to +60° C temp. range
Hum and moise:	
Unsquelched:	-30 dB.
Squelched:	-45 dB.
DF Output:	400 mVRMS open circuit (50% modulation) 500 ohms output impedance.

1.4.4 GUARD RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Channel Frequency:	Customer specified. Any frequency between 150.0000 and 173.9975 MHz allowed. VP systems are restricted to one Guard frequency channel.
Response:	
Image:	-85 dB.
Spurious:	-75 dB.

All other specifications same as the main receiver except the guard receiver has no DF Output and no VP capability.

1.4 TECHNICAL CHARACTERISTICS (cont.)

1.4.5 SUBAUDIBLE TONE SQUELCH OPTION (CTCSS)

Number of Tones:	Eight.
Selection Method:	Selected by coding four wires on the main connector. The wire coding is generated in the control units or by external switching and may be changed between transmit and receive.
Frequency Range:	60 to 250 Hz - Field Adjustable.

1.5 SYSTEM COMPONENTS

The following are the currently defined components of the RT-9600F Transceiver.

MODEL NUMBER	DESCRIPTION	GWS PART NUMBER
RT-9600F-2	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Conn	400-0140-002
RT-9600F-5	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector, with Guard Receiver	400-0140-005
RT-9600F-8	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector with CTCSS Tones	400-0140-008
RT-9600F-11	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector, with Guard Receiver and CTCSS Tones	400-0140-011
RT-9600F-24	9600 Channel VHF HI-Band Transceiver, 14/28VDC, 100 mW Audio, Recessed Conn.	400-0140-024
RT-9600F-25	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver	400-0140-025
RT-9600F-26	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with with CTCSS Tones	400-0140-026

1.5 SYSTEM COMPONENTS (cont.)

MODEL NUMBER	DESCRIPTION	GWS PART NUMBER
RT-9600F-27	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver and CTCSS Tones	400-0140-027
RT-9600F-52	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector and VP Interface	400-0140-052
RT-9600F-55	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector, with Guard Receiver, with VP Interface.	400-0140-055
RT-9600F-58	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector with CTCSS Tones, with VP Interface.	400-0140-058
RT-9600F-61	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector, with Guard Receiver and CTCSS Tones, with VP Interface.	400-0140-061
RT-9600F-74	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with VP Interface.	400-0140-074
RT-9600F-75	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver, with VP Interface.	400-0140-075
RT-9600F-76	9600 Channel VHF HI-Band Transceiver 14/28 VDC, 100 mW Audio, Recessed Connector, with CTCSS Tones, with VP Interface.	400-0140-076
RT-9600F-77	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver and CTCSS Tones, with VP Interface.	400-0140-077

NOTE: Transceiver Part Numbers 400-0140-1XX are reserved for factory re-manufacturing of the 400-0052-00X, and 400-0052-1XX transceivers to the equivalent of 400-0140-0XX transceivers.

SECTION 2

INSTALLATION

2.1 GENERAL

This section contains instructions and considerations for the proper installation of the RT-9600F Transceiver System.

The information presented herein is necessary for the proper operation and satisfactory performance of the equipment.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Physically compare the presence of each item in the shipment with that shown on the packing list. Exercise care when unpacking each unit. Make a visual inspection of each unit for evidence of damage incurred during shipment. If a claim for damage is to be made, save the shipping container to substantiate the claim. When all equipment is unpacked, it is suggested the carton and packing material be saved for possible reshipment.

2.3 INSTALLATION - IN-96A/ IN-97A RIGIDMOUNT

The rigidmount captivates the transceiver and may be mounted in any convenient remote location. Allow sufficient room at the front and rear for cable and connector entry.

Mounting dimensions for the rigidmount are shown in Figure 2.3-2 of the RT-9600 Installation Manual. The mount is secured to the mounting surface with Number 8 machine screws, or equivalent and appropriate lock nuts.

NOTE: The system has been vibration, temperature and altitude tested to assure performance in any aircraft environment; however, controlled environments improve the system reliability. This factor should be considered when selecting a remote site.

The rigidmount connector should be wired using the crimp sockets that accompany the rigidmount installation kit. The sockets should be attached to the aircraft wiring and installed into the connector using the following equipment schedule.

Socket	No.16, GWS P/N 129-1017-000 ITT Cannon P/N 031-9084-001 (Accepts Wire No. 16, 18, 20)	No.20 GWS P/N 129-1019-000 ITT Cannon P/N 031-9134-004 (Accepts Wire No. 20, 22, 24)

2.3 INSTALLATION - IN-96A/ IN-97A RIGIDMOUNT (cont.)

CrimpTool	ITT Cannon P/N M22520/1-01 (with M225/1-02 head) or ITT Cannon P/N MS-3191-1 (with std. locator head) or Daniels P/N M22520/1-01 TH276 or TH25 head)	ITT Cannon P/N M22520/1-01 (with L-3198-20 HD head) or ITT Cannon P/N MS-3191-1 (with P20-2191-20 head) or Daniels P/N M22520/1-01 (with (with TH164 or TH25 head)
Extraction Tool	ITT Cannon P/N CET-16-9	ITT Cannon P/N CET-20HDL or ITT Cannon P/N CET-20-11

Crimp. Insertion and Extraction Tool Manufacturer Names and Addresses

Daniels Manufacturing
2260 Franklin Road
Bloomfield Hills, MI
48013
(313)338-9611

ITT Cannon
10550 Talbert Avenue
Fountain Valley, CA
92708
(714)964-7400

2.4 INSTALLATION - TRANSCEIVERS

To wire an RT-9600F without the VP interface, see the installation instructions and wiring diagram in the RT-9600 Installation Manual, PN 150-0061-000.

To wire an RT-9600F with VP interface, see the installation instructions and wiring diagram in the RT-9600, with VP Interface Installation Addendum. Refer to the wiring consideration notes in Section 2.7.

The MIC and SIDETONE adjustments on the front of the transceiver allow variation of the levels to accommodate differences in installations. They are multiple turn potentiometers.

MIC is factory set so that 0.25 VRMS at 1000 Hz will provide standard deviation. If the microphone to be used with the transceiver does not provide standard output, its output may be compensated by adjusting the MIC setting.

2.4 INSTALLATION - TRANSCEIVERS

Internal to the transceiver are HIGH POWER and LOW POWER transmitter output power adjustments. These are adjusted at the factory for 10 w/1 w respectively. For use under FCC Parts 83 or 90, DOC RSS-119, and RSS-182 no adjustment of these potentiometers should be made. For use under FCC Part 87, it is mandatory that the HIGH POWER setting be adjusted so that the RF power output shall not exceed 5 watts. See the appropriate section in the RT-9600 Maintenance Manual for transmitter power adjustment procedures.

NOTE: Although not specifically type accepted under Part 87, the RT-9600F complies with Part 87 requirements when adjusted as outlined above.

SIDETONE should be adjusted to a level that will give the desired audio output without causing feedback squeal when used with a speaker. The sidetone level will not be changed by the volume control on the control unit.

See the RT-9600 Installation Manual, Figures 2.4-1 and 2.4-2, for transceiver outline drawings.

2.5 INSTALLATION - CONTROL UNITS

All control units are designed to mount on Dzus rails per MS-25213. The IN-722/962 should be used with the C-962S.

See the RT-9600 Installation Manual, Section 2.5 for other installation details.

2.6 INSTALLATION - ANTENNAS

See RT-9600 Installation Manual, Section 2.6.

SECTION 3

THEORY OF OPERATION

3.1 GENERAL

The RT-9600F operation theory is much like the operation theory of the standard RT-9600. This addendum will only describe those functions that are unique to the RT-9600F. The schematics in Section 5 will aid in the theory of operation description.

3.2 OPERATIONAL BLOCK DIAGRAM

The description of the RT-9600F block diagram is the same as the standard RT-9600 with the exception of the Synthesizer Module. See Figure 3.2-1 for RT-9600F Synthesizer Module Block Diagram.

3.3 SYNTHESIZER MODULE CIRCUIT THEORY

The Fastlock Synthesizer Module (A102) consists of the Synthesizer P.C. Board (A109), the TCVCXO Assembly (A103), the VCO Assembly (A110), and the Buffer Assembly (A111). The TCVCXO Assembly is mounted on the Synthesizer P.C. Board and is treated as a component. The VCO Assembly is encapsulated and is non-repairable and for practical purposes is treated as a component.

The Synthesizer Board (A109) contains a microprocessor controller which scans the frequency input lines for channel changes, generates the receiver preselector tuning voltage, and adjusts the modulation amplifiers for constant modulation sensitivity across the RF frequency band. This board also contains the phase locked loop (PLL) Synthesizer I.C. and loop filter, which together with the Voltage Controlled Oscillator (VCO) and the Buffer Amplifier form the frequency determining loop.

3.3.1 CONTROLLER OPERATION

The microprocessor controller (A109 U105) has several functions to perform. The controller must monitor the frequency input and PTT lines for channel changes, as well as OUT OF LOCK line from the PLL I.C. (A109 U121). It must control the receiver preselector tuning voltage generator, control the frequency of the Temperature-Compensated Voltage Controlled Crystal Oscillator (TCVCXO), set the gain of the TCVCXO and VCO modulation amplifiers for constant modulation sensitivity across the frequency band, select either the receive VCO or the transmit VCO, enable or disable the transmitter, and select the proper PLL filter for fast lock operation.

3.3.1.1 FREQUENCY SELECTION

The frequency selection is accomplished by means of sixteen BCD-weighted control lines and the processed PTT line. Grounding of a line at the card edge connector indicates its selection. The μP controller (A109 U105) reads these BCD frequency inputs by means of dual 4-line to 1-line data selectors (A109 U103 and A109 U104). The PTT line, buffered and inverted by A109 U107D, is applied to Pin 39 of A109 U105.

When a change in the frequency control lines or the PTT line occurs, the controller immediately disables the transmitter by raising Pin 24 high. It then calculates and outputs the proper digital word to the receiver preselector tuning voltage generator (A109 U102), the proper gain value to the TCVCXO modulation amplifier (A109 U116A), and the proper gain value to the VCO modulation amplifier (A109 U117A). The controller sets the TCVCXO frequency for either normal (5 kHz) or pulled (2.5 kHz) spacing by means of transistor A109 Q102. The controller then outputs clocked serial data to the PLL I.C. (A109 U121), programming the chip for the proper divide ratios. At completion of this serial data transfer, the controller latches the data into the PLL counter registers by generating a positive pulse on the ENABLE line (A109 U121, Pin 13). It then selects the proper VCO by means of NAND gates A109 U107B and A109 U107C. The controller momentarily selects the wide-bandwidth mode of the loop filter by turning on FET switches A109 Q105, A109 Q106, and A109 Q107 through open-collector inverter A109 U108A. After approximately 3 ms these transistors are turned off, returning the loop filter to its normal operating bandwidth. If the PTT line indicates transmitter operation, the transmitter is enabled approximately 12 ms after this.

An OUT OF LOCK condition is essentially treated the same as a channel change. If an OUT OF LOCK condition occurs, indicated by a low on A109 U105, Pin 6, the controller will immediately disable the transmitter, re-program the counters within the PLL I.C., switch bandwidths for 3 ms and re-enable the transmitter, if required, after 12 ms.

The controller also updates the PLL I.C. counter registers periodically, approximately once every 40 ms. This guards against unforeseen transients causing the PLL I.C. to "forget" its programmed divide ratios.

3.3.2 RECEIVER PRESELECTOR TUNING VOLTAGE GENERATION

Based on the frequency control lines, the synthesizer generates a voltage which is used to tune the receiver preselector. Controller A109 U105 outputs a seven bit binary number which represents this voltage. A digital-to-analog converter composed of operational amplifier A109 U102 and resistors A109 R107 through A109 R118 converts this binary number to a voltage which typically ranges between 5 VDC and 14.8 VDC. A typical preselector tuning curve can be seen in Figure 3.3.2-1. Potentiometer A109 R109 sets the starting point (i.e., voltage at 150 MHz) at nominally 5 VDC. Potentiometer A109 R107 sets the slope of the preselector tuning curve without moving the 5 VDC starting point. These adjustments allow additional freedom in matching the variations to be expected within the receiver preselector. Diode A109 CR101 causes the preselector tuning curve to shift in voltage with temperature variations. This shift matches the requirements of the preselector tuning as its temperature varies.

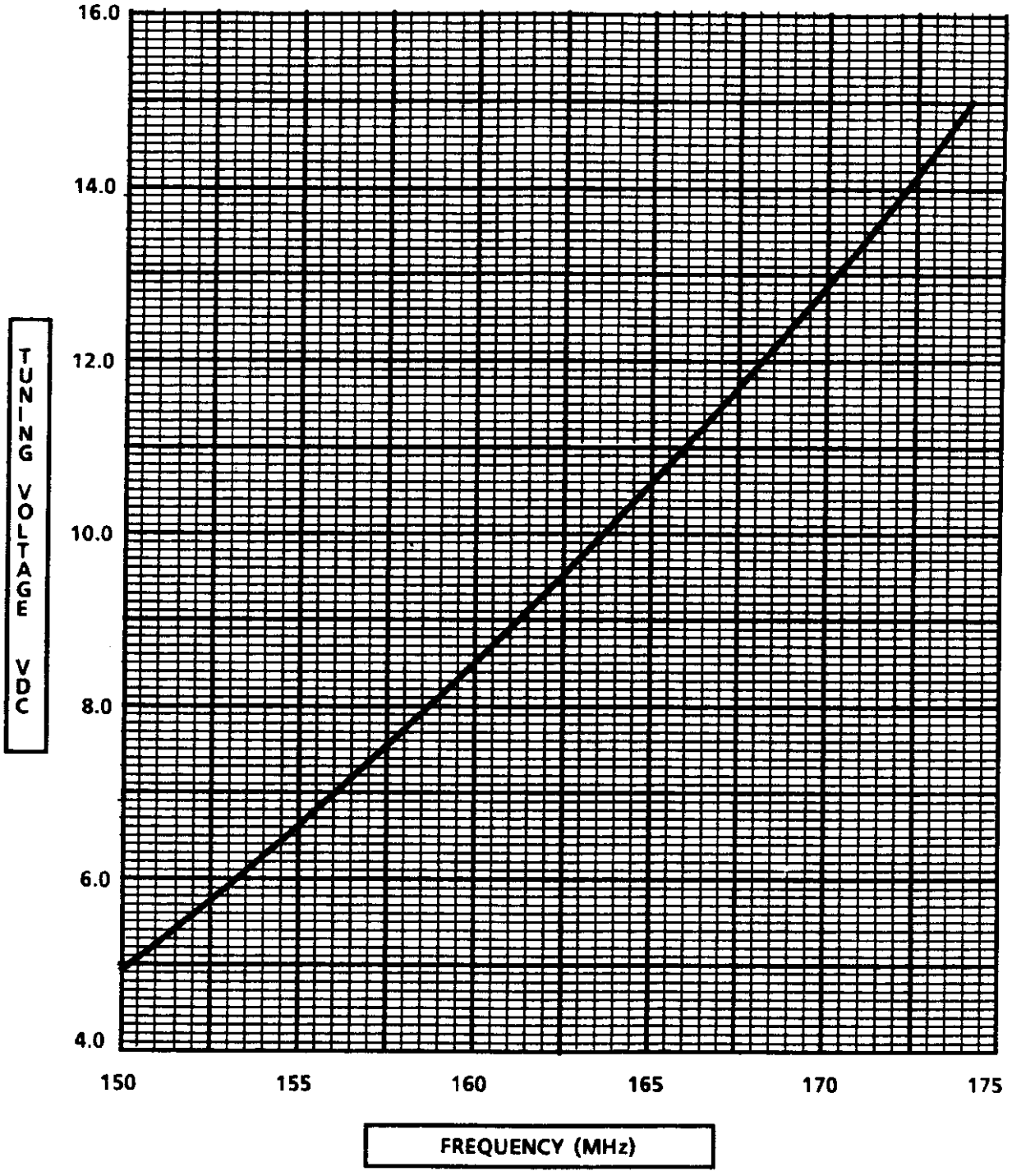
3.3.3 TCVCXO FREQUENCY CONTROL

Although the PLL reference frequency (and thus, the normal channel spacing) remains at 5 kHz, intermediate 2.5 kHz channelling capability is accomplished by "pulling" the tunable reference oscillator (A103) off of its nominal 12.8 MHz frequency. If the frequency input lines require a 2.5 kHz channel spacing, controller A109 U105 outputs a high on Pin 35 which switches on transistor A109 Q102 by means of open collector inverter A109 U108F. This applies a fixed current to the summing input of A109 U116A. The corresponding DC voltage shift at the output of A109 U116A shifts the frequency of the TCVCXO, which in turn produces a shift in the synthesizer output frequency. If the TCVCXO is pulled the correct amount, a 2.5 kHz offset in output frequency is achieved. The required TCVCXO offset varies across the frequency band, therefore, the gain of A109 U116A must be controlled across the band. Figure 3.3.3-1 shows a curve of TCVCXO Modulation Amplifier Gain vs Synthesizer Output Frequencies.

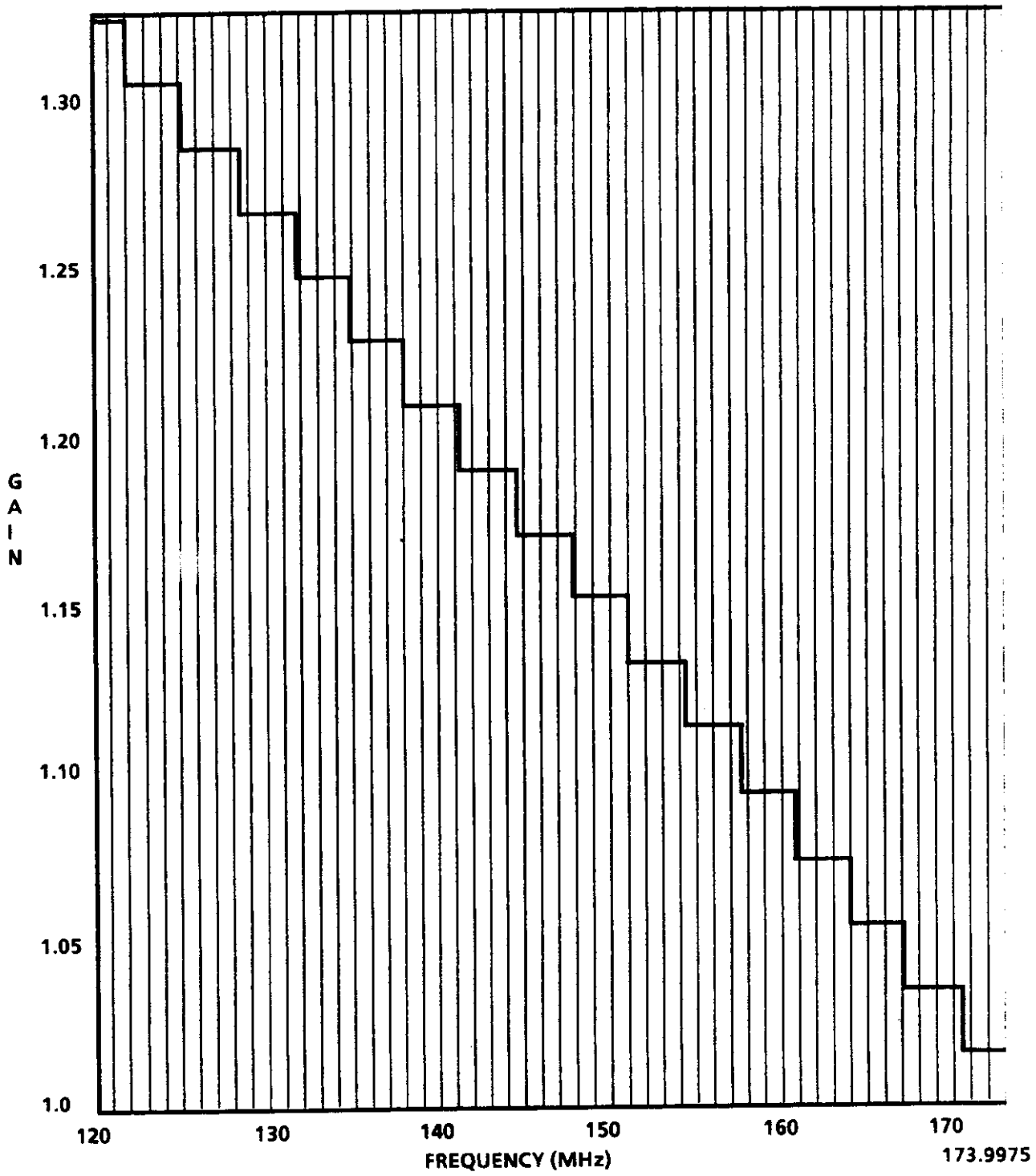
Potentiometer A109 R167 adjusts the overall TCVCXO frequency, while potentiometer A109 R146 adjusts the intermediate 2.5 kHz channel spacing.

3.3.4 TCVCXO/VCO MODULATION AMPLIFIERS

To extend the transmitter modulation frequency response at low audio frequencies, a scheme was adopted whereby modulation audio is applied to both the VCO and the TCVCXO. In this architecture, the VCO is responsible for modulation of the higher audio frequencies, the TCVCXO for the lower audio frequencies, while the two combine at frequencies in the neighborhood of the loop bandwidth.



TUNING VOLTAGE vs FREQUENCY
FIGURE 3.3.2-1



TCVCXO MODULATION AMPLIFIER GAIN
Figure 3.3.3-1

3.3.4 TCVCXO/VCO MODULATION AMPLIFIERS (cont.)

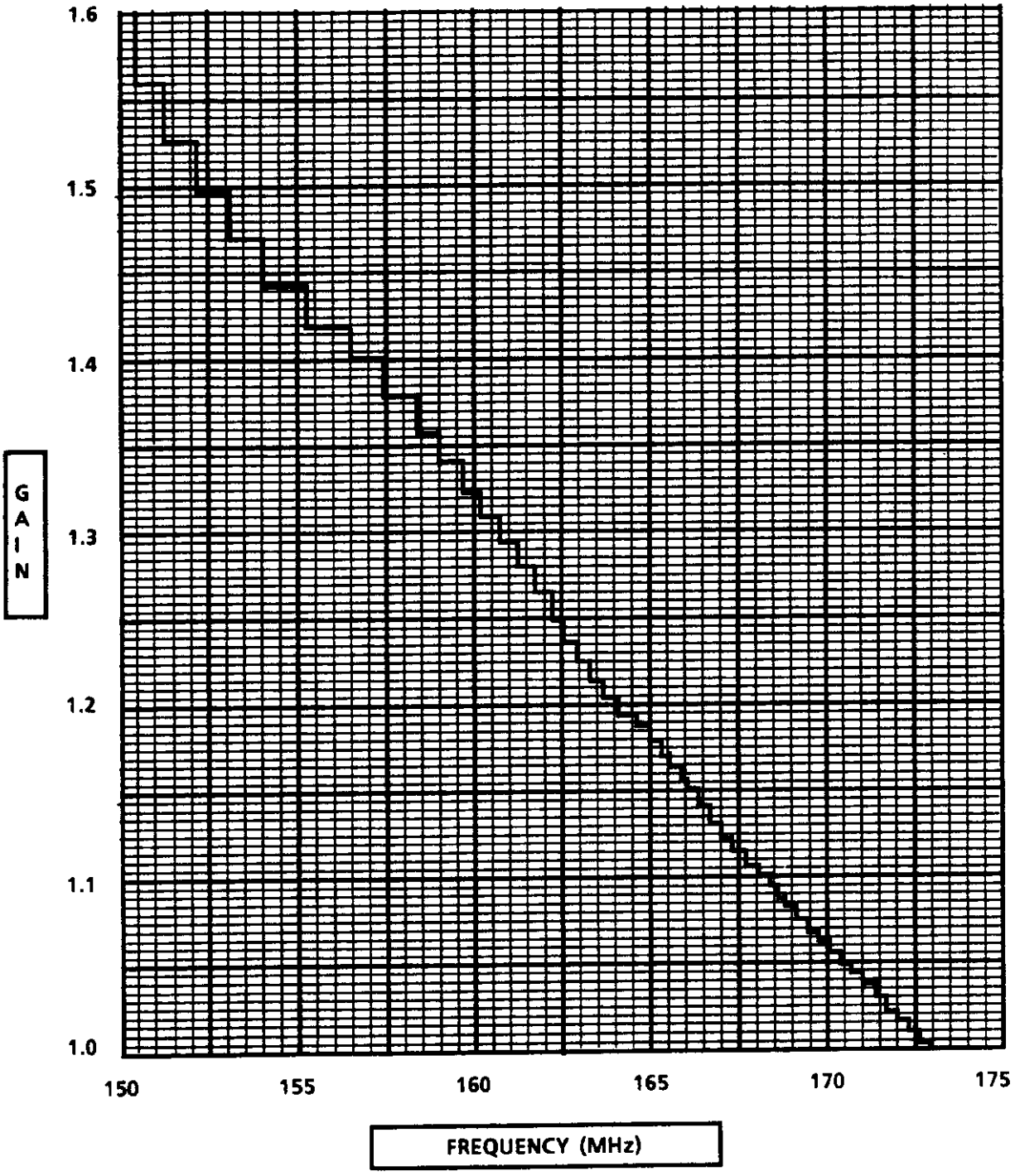
Buffer amplifiers A109 U116B and A109 U117B provide the high input impedence required to AC-couple the low frequency signals to their respective amplifier chains, as well as providing some gain. The following stages in both the VCO and TCVCXO amplifier chains are digitally-controlled variable gain stages (A109 U116A and A109 U117B). The reason for these stages is that ideally, a fixed level input signal to the modulator chain should produce a constant level of deviation regardless of whether the synthesizer is running at 150 MHz or 173.9975 MHz. However, the modulation sensitivity as seen from the TCVCXO input is a function of the synthesizer loop divide ratios (which also changes across the band). To accomplish modulation flatness, then, it is necessary to vary the gain of TCVCXO modulation amplifier A109 U116A and VCO modulation amplifier A109 U117A accordingly.

3.3.4.1 TCVCXO MODULATION

The gain of the TCVCXO modulation is varied by selectively switching resistors A109 R139 through A109 R143 in or out of the feedback network. The gain of A109 U116A is changed from 1.0 at 173.9975 MHz to 1.33 at 130 MHz. Based on the frequency control lines and the PTT line, controller A109 U105 addresses Hex Flip Flop A109 U109 and writes a five bit number to be latched into A109 U109. The outputs of U109 drive open collector inverter A109 U110, which translates the 5 VDC TTL signals to 14 VDC signals and turns on or off the appropriate analog switches of A109 U111 and A109 U114. The TCVCXO modulation audio is summed into Pin 2 of A109 U116A along with the 2.5 kHz offset injection current, if any. See Figure 3.3.3-1 for a graph of TCVCXO Modulation Amplifier Gain vs. Frequency.

3.3.4.2 VCO MODULATION

The gain of VCO modulation amplifier A109 U117A is varied in much the same fashion. Controller A109 U105 writes a six bit number to Hex Flip Flop A109 U112 based on the frequency control lines selected. The outputs of A109 U112 drive open collector inverter A109 U113. Inverter A109 U113 translates the 5 VDC TTL level signals to 14 VDC signals which control analog switches A109 U114 and A109 U115. The gain of A109 U117A is varied from 1.0 at 173.9975 MHz to 1.60 at 150 MHz by selectively switching resistors A109 R152 through A109 R156 in and out of the feedback circuit of A109 U117A. Figure 3.3.4-1 shows a curve of VCO Modulation Amplifier Gain vs. Synthesizer Output Frequency.



VCO MODULATION AMPLIFIER GAIN vs. SYNTHESIZER OUTPUT FREQUENCY
FIGURE 3.3.4-1

3.3.5 PHASE LOCK LOOP

The synthesizer phase lock loop consists of a 12.8 MHz reference TCVCXO (A103), a MC145159 phase lock loop integrated circuit, an MC12016 dual modulus prescaler, transmit and receive VCO's (A110), and loop filter components consisting primarily of resistors A109 R177 through A109 R182 and capacitors A109 C191, A109 C192, and A109 C213. The Buffer Assembly (A111), following the VCO's, boosts the VCO output up to levels suitable for driving the prescaler and the first mixer.

The TCVCXO, as explained previously, is a temperature compensated crystal oscillator with a frequency control input that can be used to pull the nominal 12.8 MHz oscillator a few hundred Hertz for modulation purposes and to accomplish the 2.5 kHz channel spacing.

The MC145159 PLL synthesizer I.C. (A109 U121) contains three counters, a sample-and-hold phase detector, a digital frequency steering circuit, and a lock detector circuit. The divide-by-R counters internally divide the 12.8 MHz reference frequency (input to A109 U121, Pin 2) down to 5 kHz. The divide-by-N counters internally divide the output of the dual modulus prescaler (A109 U122, Pins 2 and 3) down to also provide a 5 kHz signal when in lock. The sample-and-hold phase detector compares the phase/frequency of the reference and variable signals, and outputs a voltage to the loop filter and VCO, available at the ANALOG PHASE DETECTOR output, Pin 17, that is proportional to the phase difference between the two signals. If the phase relationship between the reference and variable signals is constant (i.e., the loop is in lock), there will be no change in the voltage at the APD_{OUT} Pin, and thus no change in the synthesizer output frequency. If the phase relationship between the two signals is varying, the voltage applied to the loop filter and thus to the VCO will move in the correct direction to re-acquire lock.

3.3.5.1 PRESCALER

As the internal divide-by-N counters of A109 U121 are not fast enough to handle an input frequency in the 150 MHz to 174 MHz range, the synthesizer output frequency is prescaled by dual modulus prescaler A109 U122 before being input to A109 U121, Pin 10. This ECL chip divides the synthesizer output frequency by either 40 or 41, depending upon the state of the MODULUS CONTROL line (A109 U121, Pin 8). The divide-by-A counter, internal to the PLL I.C. (A109 U121), determines the number of counts for which the prescaler is instructed to divide, by 40 or 41. This counter, along with the divide-by-N and divide-by-R counters, are programmed by the controller (A109 U105) by means of three lines: DATA, CLOCK, and ENABLE. The serial data stream on the DATA line is comprised of the 14-bit divide-by-R word, followed by

3.3.5.1 PRESCALER (cont.)

the 10-bit divide-by-N word, followed by the 7-bit divide-by-A word, followed by a bit set to "1". After each bit is set up on the DATA line, a pulse on the CLOCK line occurs to shift it into the PLL I.C.. A pulse on the ENABLE line at the completion of the 32 bit stream latches the words into their respective counters.

3.3.5.2 FREQUENCY STEERING OUTPUT

The FREQUENCY STEERING OUTPUT (Pin 6 of U121) is routed directly to the largest capacitor (A109 C192) of the loop filter to aid in pulling the VCO into lock. If the divided down variable frequency on f_{IN} (Pin 10 of A109 U121) is higher than the divided down reference frequency of OSC_{IN} (Pin 2 of U121), the difference in phase between the signals applied to the internal phase detector/comparator will be continually decreasing. Eventually, the phase difference will decrease through 0 degrees to start over at 360 degrees (cycle skipping). At this time, the three-state FREQUENCY STEERING OUTPUT goes low, accelerating the voltage on A109 C192 and thus the VCO output frequency in a downward direction (i.e., towards lock). If the divided down variable frequency is lower than that of the divided down OSC_{IN} reference frequency, cycle skipping occurs as the accumulated phase difference increases through 360 degrees to 0 degrees and this output goes high. The output maintains a high-impedence state when the counted down VCO and OSC_{IN} frequencies are in a one-to-one ratio over a 360 degree window with respect to the divided down OSC_{IN} reference frequency.

3.3.5.3 LOCK DETECT

The LOCK DETECT line (Pin 9 of A109 U121) is high during lock and goes low to indicate an out of lock condition (i.e., cycle skipping). This output is routed to the controller (A109 U105) where it is continuously monitored. Detection of an out of lock condition is treated much like detection of channel change, as explained previously.

The loop filter heavily filters the slight AC component riding on the DC tuning voltage (APD_{OUT} at A109 U121, Pin 17) to reduce the noise sidebands of the VCO output. The normal bandwidth of the loop is about 50 Hz. Because it is so low, the loop will not quickly respond to any step changes in tuning voltage which typically occur when a channel change is made. To speed up the response of the loop, and thus the lock acquisition time, the controller (A109 U105) switches the loop bandwidth to a much higher frequency for a preset length of

time (approximately 3 ms). This is done by shorting around loop resistors A109 R177, A109 R179, A109 R180, and A109 R182 by means of FET switches A109 Q105, A109 Q106, and A109 Q107 and quickly charging loop capacitors A109 C191, A109 C192, and A109 C213 to their new voltages. After 3 ms has elapsed, the loop is assumed to be stabilized and the lower loop bandwidth is restored for normal operation.

3.3.6 VCO ASSEMBLY

The VCO ASSEMBLY (A110) is an encapsulated package that contains two VCO circuits and a buffer stage. One VCO provides RF output to tune the receiver and the other VCO provides RF output to drive the transmiter power amplifier in the R/T Module via the Buffer Assembly. Either active VCO also provides the prescaler inject signal via the Buffer Assembly.

The output of the loop filter is applied to the tuning voltage input of the VCO's. Which VCO is active depends upon the state of the PTT line. The XMT VCO covers the frequency range of 150 MHz to 173.9975 MHz, corresponding to the tuning voltage range of (typically) 3.3 VDC to 7.0 VDC. The RCV VCO covers the frequency range of 130 MHz to 153.9975 MHz, providing 20 MHz low-side injection for the receiver, and corresponds to a tuning voltage range of (typically) 3.3 VDC to 7.0 VDC. In addition to the tuning voltage input, the XMT VCO has a separate VCO MODULATION input line upon which modulation audio is applied to a second varactor (A110 CR103) which is lightly coupled to the main frequency-determining tank. This allows for a much lower modulation sensitivity and better hum and noise performance.

3.3.7 BUFFER ASSEMBLY

The Buffer Assembly (A111) is comprised of two separate amplifier sections with a common input from the VCO assembly. One amplifier section includes A111 Q101, A111 Q102, and A111 Q103. This section output is the prescaler injection signal and provides a stable injection level to the prescaler over all conditions of voltage and temperature. The other amplifier section includes A111 Q104, A111 Q105, and A111 Q106. This section output provides the RX/TX Injection signal. The RX signal is fed to the receiver first mixer when in the RECEIVE MODE and the TX signal drives the Power Amplifier stages when in the TRANSMIT MODE. The RX/TX Injection level available at P101 is typically +15 dBm.

SECTION 4

MAINTENANCE

4.1 DISASSEMBLY

See the RT-9600 Maintenance Manual, Section 4.1, with the following exceptions for new synthesizer module.

4.1.1 SYNTHESIZER MODULE

Divider Assembly PC Board

1. Remove synthesizer cover by removal of eleven flat-head Phillips screws.
2. Unsolder one choke and one resistor between the PC Board and buffer assembly.
3. Unsolder three chokes and two resistors between the PC Board and the VCO.
4. Remove seven hex posts.
5. Lift the divider assembly from module.

TCVCXO

1. First remove divider board.
2. Unsolder four leads.
3. Remove the TCVCXO.

VCO

1. Remove synthesizer cover by removal of eleven flat-head Phillips screws.
2. Unsolder three chokes and two resistors between the PC Board and the VCO.
3. Unsolder buffer assembly (one resistor, one wire).
4. Remove three pan-head Phillips screws from rear side of the synthesizer case.
5. Remove VCO.

4.2 TEST EQUIPMENT

See the RT-9600 Maintenance Manual.

4.3 RT-9600F OVERALL PERFORMANCE TESTS

See the RT-9600 Maintenance Manual.

4.4 PERFORMANCE TESTS

See the RT-9600 Maintenance Manual.

4.5 TROUBLESHOOTING

4.5.1 GENERAL

The RT-9600 Fastlock Synthesizer consists of the following three modules: the Synthesizer P.C. Board (A109), the VCO Assembly (A110), and the Buffer Assembly (A111). These modules combine with a few external components to form the Synthesizer Module (A102). For a description of the function of each module to aid in locating a failure see the Theory of Operation. Reference to the block diagram and the synthesizer schematic may also be helpful.

4.5.2 SYNTHESIZER MODULE INPUTS FOR PROPER OPERATION

The synthesizer module must have six supporting inputs or groups of input lines for proper operation. They are as follows:

Synthesizer Inputs	Source of Input
BCD TUNING (17 lines)	CONTROL HEAD
PTT	CONTROL HEAD
MODULATION	AUDIO MODULE
+5 VDC	POWER SUPPLY
+14 VDC	POWER SUPPLY
+24 VDC	POWER SUPPLY

The BCD TUNING lines are used to select the frequency of operation of the synthesizer. They can be at one of only two voltage levels: a HI voltage level (about 10 VDC) or a LOW voltage level (0-2 VDC). These lines are LOW when selected. The frequency of operation selected can easily be calculated by adding up the BCD-weighted lines selected. As an example, for 156.957 MHz, the lines selected would be:

1 $\overline{100\ \text{MHz}}$ line is assumed selected
5 $\overline{40}$ and $\overline{10\ \text{MHz}}$ lines selected
6 $\overline{4}$ and $\overline{2\ \text{MHz}}$ lines selected

9 $\overline{.8}$ and $\overline{.1\ MHz}$ lines selected
5 $\overline{.04}$ and $\overline{.01\ MHz}$ lines selected
7 $\overline{.005}$ and $\overline{.0025\ MHz}$ lines selected

The input voltage levels are internally converted to levels that can be multiplexed onto the microprocessor controller data bus.

$\overline{PTT}$ is an active low input that, when selected, causes the microprocessor controller to deselect the RCV VCO and select the XMT VCO. It also causes different loop divide ratios to be programmed into the PLL IC (A109 U121), shifting the synthesizer operating frequency from 20 MHz below the selected frequency (for receiver low-side injection) to directly on the selected frequency (for transmitter operation).

Audio at the MODULATION input is level-adjusted and slightly filtered before being sent to both the XMT VCO (A110) and the TCVCXO (A103). Typically, 0.55 VRMS input at P102 Pin M will produce ±5 kHz deviation.

The +5 VDC input supplies power to all of the digital circuitry on the synthesizer board. Is should be 5.0 VDC ±0.5 VDC under all conditions.

The +14 VDC input supplies power to much of the audio circuitry on the board, as well as supplying power to +9 VDC and +6.25 VDC regulators on the synthesizer board. It should be 14 VDC ±0.5 VDC under all conditions.

The +24 VDC input is used primarily by the preselector tuning voltage generator (A109 U102). It should be 24 VDC ±1 VDC under all conditions.

4.5.3 SYNTHESIZER MODULE OUTPUTS FOR PROPER OPERATION

The synthesizer module must have the following three outputs for proper operation:

Synthesizer Output	Output Termination
$\overline{\text{TX DISABLE}}$	R/T MODULE
TUNING VOLTAGE	R/T MODULE
RX/TX INJECTION	R/T MODULE

The $\overline{\text{TX DISABLE}}$ line must be in one of only two states: HI (+8.5 VDC) or LOW (0.1 VDC). If this line is LOW, the transmitter will be disabled. This line is LOW when the transceiver is in the receive mode, or during channel changes in the transmit mode. The transmitter will be enabled only after the synthesizer locks on frequency when the $\overline{\text{PTT}}$ line is actuated. An out of lock condition, due to some malfunction in the synthesizer, will also cause the $\overline{\text{TX DISABLE}}$ line to go LOW.

The TUNING VOLTAGE output is a voltage that is generated to tune the preselector in the receiver. It ranges from 5.0 VDC to 150 MHz to approximately 14.8 VDC at 173.9975 MHz for a typical receiver.

The RX/TX INJECTION output is the RF drive to the first mixer in the receive mode or to the power amplifier chain in the transmit mode. The frequency of this output varies from 130 to 153.9975 MHz in the receive mode, and from 150 to 173.9975 MHz in the transmit mode. The typical power level at this port is +17 dBm.

4.5.4 SYNTHESIZER MODULE TROUBLESHOOTING SEQUENCE

The synthesizer module is potentially difficult to troubleshoot as much of the circuitry is "in the loop"--proper inputs depend upon proper outputs. However, using the following troubleshooting procedure may aid in locating the defective part or parts.

Failure to achieve frequency lock, as indicated by an unstable or incorrect output frequency, may be due to a number of different things. The following levels or waveforms are some key points to check if an out of lock condition persists.

1. Verify the DATA, CLOCK, and ENABLE signals from the microprocessor controller are reaching the PLL IC (A109 U121, Pins 12, 11, and 13 respectively). The sequence of the high and low bits on the DATA line should be a function of the frequency selected. The CLOCK line should show a series of 32 +9 VDC pulses, followed by a single +9 VDC pulse on the ENABLE line. The entire sequence should repeat itself approximately every 40ms, as the controller continually updates the PLL IC.

2. If these signals are not present, either hex invertor A109 U108 or μP controller A109 U105 has failed, or controller A109 U105 is not running. Verify that A109 U105 Pin 4 is high and that a 3.2 MHz clock signal is present at A109 U105 Pins 2 and 3.

3. If the DATA, CLOCK, and ENABLE signals are present. but the loop does not lock up, verify the presence of a 12.8 MHz signal at A109 U121 Pin 2 and the presence of a 3.25 to 4.35 MHz signal at A109 U121 Pin 10. If the latter signal is not present, work backwards through the RF chain (i.e., input to the prescaler and input to the buffer assembly) to discover where the break occurs.

4. If there is no RF signal (130 to 174 MHz) at the output of the VCO, verify that the proper VCO is selected (outputs of A109 U107B and A109 U107C). Also verify the presence of a DC tuning voltage at the input of the VCO. If the tuning voltage signal is not present, A109 U121 may have failed.

5. If the loop achieves lock, but on an incorrect frequency, one or more of the input lines may have failed. Verify that the proper inputs to input multiplexers A109 U103 and A109 U104 are selected according to the frequency selected on the control head.

6. If the synthesizer cannot be channelled to the intermediate 2.5 kHz channels, A109 Q102 may have failed. Also verify the presence of a low signal at A109 U108F Pin 12 whenever a 2.5 kHz increment is selected.

A failure in the modulation amplifier chains (A109 U116, A109 U117, and associated digital switching stages) will generally result in loss of modulation or modulation flatness across the RF and audio frequency bands. If this happens, check the following points:

1. If the synthesizer will modulate at high audio frequencies (>100 Hz) but not at low audio frequencies, the failure is most likely in the TCVCXO amplifier chain (A109 U116). The total audio gain from modulation input (P102 Pin M) to amplifier output (A109 U116A Pin 1) varies across the radio frequency band, controlled by the switching in and out of various resistors in the feedback network of A109 U116A. The total audio gain should vary from 2.66 at 130 MHz to 2.32 at 150 MHz to 2.00 at 173.9975 MHz. Verify the presence of the proper level audio signals throughout this chain.

2. If the synthesizer will modulate at extremely low audio frequencies (<30 Hz) but not at high audio frequencies, the failure is most likely in the VCO amplifier chain (A109 U117). The total audio gain from modulation input (P102 Pin M) to amplifier output (A109 U117 Pin 1) also varies across the radio frequency band. The total amplifier chain gain will depend upon the setting of A109 R193. The gain on non-inverting amplifier A109 U117A, as measured from Pin 3 to Pin 1, should vary between 2.0 at 150 MHz to 1.25 at 173.9975 MHz.

4.6 ALIGNMENT PROCEDURES

4.6.1 GENERAL

The following is a brief alignment procedure to follow in order to completely align the RT-9600F Fastlock Synthesizer Module. It is assumed that the synthesizer module is installed in a known good RT-9600F transceiver. Reference to the synthesizer schematic or the synthesizer assembly component locator may be helpful in locating the various test points or adjustment locations.

4.6.2 POWER SUPPLY VOLTAGES

With a DC voltmeter, measure the power supply voltages at the following test points. All voltage measurements should be made with respect to chassis ground. There are no adjustments to make.

1. Verify +14 VDC ±0.5 VDC at A1J8 Pin N.
2. Verify +24 VDC ±1.0 VDC at A1J8 Pin J.
3. Verify +5 VDC ±0.5 VDC at A1J8 Pin K.

4.6.3 FREQUENCY ALIGNMENT

1. With a DC voltmeter, monitor the voltage at A109TP101. Adjust A109R167 for 5.00 VDC ±0.01 VDC. (This control is extremely touchy--be careful to adjust it properly.)
2. Channel the transceiver to 153.000 MHz, and key the transmitter. Verify the output frequency is equal to the frequency stamped on the case of the TCVCXO (A103) ±100 Hz. If a frequency error exists, remove the screw plug of the TCVCXO and adjust it for the specified frequency. If no frequency is specified on the case of the TCVCXO, adjust it for 153.000000 MHz.
3. Channel the transceiver to 153.002 MHz, and key the transmitter. Adjust A109R146 for an output frequency 2.5 kHz above the frequency specified in Step 2, ±100 Hz. If no frequency is specified on the case of the TCVCXO, adjust A109R146 for an output frequency of 153.002500 MHz.

4.6.4 PRESELECTOR TUNING VOLTAGE ALIGNMENT

1. With a DC voltmeter, monitor the tuning voltage at A1J8 Pin H.
2. Channel the transceiver to 150.000 MHz. Adjust A109R109 for a tuning voltage of 5.00 VDC ±0.01 VDC.
3. Channel the transceiver to 173.997 MHz. Adjust A109R107 for a tuning voltage of 14.8 VDC ±0.05 VDC.
4. Repeat Steps 2 and 3 as there may be a slight interaction between the setting of the potentiometers.

4.6.5 MODULATION BALANCE ADJUST

1. Channel the transceiver to 162.100 MHz, and input a 3 Vpp, 50 Hz square wave to the DVP MOD input line of the transceiver (A1P1, Pin 18).

2. Key the transmitter, feeding a portion of the output signal to the input of the modulation meter. Observe the waveform at the audio output port of the modulation meter.

   NOTE: It is important that the modulation meter used for this test has an audio frequency response extending to 10 Hz or below.

3. The recovered waveform should be a square wave with a visible amount of distortion (i.e., overshoot or undershoot on the edge transitions). Adjust A109R193 for the least distorted (squarest) waveform possible.

4.6.6 LOCK TIME ADJUSTMENT

A109R170 is adjusted in the factory to minimize lock time upon channel changes. This is a factory adjustment and should not be re-aligned in the field.

4.6.7 VCO TUNING VOLTAGE ALIGNMENT

1. With a high impedence DC voltmeter, monitor the tuning voltage at A109U121, Pin 17.

2. Channel the transceiver to 173.997 MHz. Adjust the slug of A110L101 for 7.00 VDC when in receive mode, and the slug of A110L103 for 7.00 VDC when in transmit mode.

3. Channel the transceiver to 150.000 MHz. Verify the tuning voltages are between 3.1 to 3.7 VDC when in receive mode, and between 3.4 to 3.9 VDC when in transmit mode. There are no further adjustments to make.

SECTION 5

SCHEMATIC DIAGRAMS

5.1 ASSEMBLY AND COMPONENT NUMBERS

Schematic components are shown in this section according to assembly for the RT-9600F.

ASSEMBLY NUMBER	COMPONENT
A102	Fastlock Synthesizer Module
A6	Power Supply Module

Parts are numbered according to the assembly within the RT-9600F.

SECTION 6

PARTS LIST

6.1 INTRODUCTION

The purpose of this parts list, prepared by Global Wulfsberg Systems, is for the identification, requisition, and issuance of parts for the RT-9600F. Part numbers listed in this parts list meet critical equipment design specification requirements. Use only the part number specified in the parts list for replacement of parts.

6.2 EXPLANATION OF PARTS LIST

The following vendor codes and addresses are a revision to those listed in the RT-9600 Maintenance Manual.

0CA39	Sprague Electric 1600 Curran Memorial Hwy North Adams, MA 02147
01121	Allen-Bradley Company 500 Elm Grove Rd. Milwaukee, WI 53122
07263	Fairchild Semiconductor Corp. North American Sales Sub of Schlumberger Ltd. 10400 Ridgeview Ct. Cupertino, CA 95014
31433	Kemet Electronics Corp 2835 Kemet Way Simpsonville, SC 29681
71590	Centralab Components Inc. A North American Philips Company HWY 20 West Fort Dodge, IA 50501
GWS	Global Wulfsberg Systems 2144 Michelson Irvine, CA 92715

6.3 PARTS LIST

6.3.1 RT-9600F TRANSCEIVER

CKT SMBL	DESCRIPTION	GWS P N	400-0140-XXX REV. B -002	-005	-008	-011	-024	-025	-026	-027
A1	CHASS, 0.1W, PRO CONN	300-2096-002	01	01	01	01	00	00	00	00
A1	CHASS, 0.1W, REC CONN	300-2096-003	00	00	00	00	01	01	01	01
A1	CHASS, DVP, PRO CONN	300-2096-004	00	00	00	00	00	00	00	00
A1	CHASS, DVP, REC CONN	300-2096-005	00	00	00	00	00	00	00	00
A4	RT-9600 GUARD RCVR	300-2101-001	00	01	00	01	00	01	00	01
A5	AUDIO MODULE 100MW	300-2100-001	01	01	01	01	01	01	01	01
A5	RT-9600 DVP AUDIO MOD	300-2100-003	00	00	00	00	00	00	00	00
A6	POWER SUPPLY	300-2099-000	01	01	01	01	01	01	01	01
A7	RT-9600 TONE MODULE	300-2102-000	00	00	01	01	00	00	01	01
A8	RT-9600 R/T MODULE	300-2097-000	01	01	01	01	01	01	01	01
A8	RT-9600 DVP R/T MOD	300-2097-003	00	00	00	00	00	00	00	00
A102	FAST LOCK SYNTH	300-2326-000	01	01	01	01	01	01	01	01
	RT-9600F TOP CVR	146-0260-001	01	01	01	01	01	01	01	01
	RT-9600F BOTTOM CVR	146-0261-002	01	01	01	01	01	01	01	01
	RT-9600F HAND STRIP	156-012230-01	01	01	01	01	01	01	01	01
	RT-9600F INT FREQ LBL	156-0095-000	01	01	01	01	01	01	01	01
	NAMEPLATE	156-012203-01	01	01	01	01	01	01	01	01
	RT-9600F DOC TP APP LBL	156-012202-01	01	01	01	01	01	01	01	01
	PHASE DELAY TAG	156-0233-000	01	01	01	01	01	01	01	01
	RUBBER BUMPER	179-0025-000	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/8 PHP	188-0200-012	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/16 FHP	188-0201-006	20	21	21	22	20	21	21	22
	SCREW, 4-40 X 1/4 FHP	188-0201-008	02	02	02	02	02	02	02	02
	SCREW, 4-40 X 3/8 FHP	188-0201-012	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/16 SEMS	188-0208-006	13	15	17	19	13	15	17	19
	SCREW, 10-32 X 3/8 FHP	188-0401-012	02	02	02	02	02	02	02	02
	WASHER SPLITLOCK #4	188-4200-000	03	03	03	03	03	03	03	03
	HANDLE 4.37 LONG	189-0013-000	01	01	01	01	01	01	01	01

6.3.1 RT-9600F TRANSCEIVER (cont.)

CKT SMBL	DESCRIPTION	GWS P N	400-0140-XXX REV. B -052	-055	-058	-061	-074	-075	-076	-077
A1	CHASS, 0.1W, PRO CONN	300-2096-002	00	00	00	00	00	00	00	00
A1	CHASS, 0.1W, REC CONN	300-2096-003	00	00	00	00	00	00	00	00
A1	CHASS, DVP, PRO CONN	300-2096-004	01	01	01	01	00	00	00	00
A1	CHASS, DVP, REC CONN	300-2096-005	00	00	00	00	01	01	01	01
A4	RT-9600 GUARD RCVR	300-2101-001	00	01	00	01	00	01	00	01
A5	AUDIO MODULE 100MW	300-2100-001	00	00	00	00	00	00	00	00
A5	RT-9600 DVP AUDIO MOD	300-2100-003	01	01	01	01	01	01	01	01
A6	POWER SUPPLY	300-2099-000	01	01	01	01	01	01	01	01
A7	RT-9600 TONE MODULE	300-2102-000	00	00	01	01	00	00	01	01
A8	RT-9600 R/T MODULE	300-2097-000	00	00	00	00	00	00	00	00
A8	RT-9600 DVP R/T MOD	300-2097-003	01	01	01	01	01	01	01	01
A102	FAST LOCK SYNTH	300-2326-000	01	01	01	01	01	01	01	01
	RT-9600F TOP CVR	146-0260-001	01	01	01	01	01	01	01	01
	RT-9600F BOTTOM CVR	146-0261-002	01	01	01	01	01	01	01	01
	RT-9600F HAND STRIP	156-012230-01	01	01	01	01	01	01	01	01
	RT-9600F INT FREQ LBL	156-0095-000	01	01	01	01	01	01	01	01
	NAMEPLATE	156-012203-01	01	01	01	01	01	01	01	01
	RT-9600F DOC TP APP LBL	156-012202-01	01	01	01	01	01	01	01	01
	PHASE DELAY TAG	156-0233-000	01	01	01	01	01	01	01	01
	RUBBER BUMPER	179-0025-000	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/8 PHP	188-0200-012	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/16 FHP	188-0201-006	20	21	21	22	20	21	21	22
	SCREW, 4-40 X 1/4 FHP	188-0201-008	02	02	02	02	02	02	02	02
	SCREW, 4-40 X 3/8 FHP	188-0201-012	03	03	03	03	03	03	03	03
	SCREW, 4-40 X 3/16 SEMS	188-0208-006	13	15	17	19	13	15	17	19
	SCREW, 10-32 X 3/8 FHP	188-0401-012	02	02	02	02	02	02	02	02
	WASHER SPLITLOCK #4	188-4200-000	03	03	03	03	03	03	03	03
	HANDLE 4.37 LONG	189-0013-000	01	01	01	01	01	01	01	01

6.3.2 RT-9600F FAST-LOCK SYNTHESIZER (A102)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
A102	300-2326-000 REV. C				
A109	RT-9600 FAST-LOCK SYN CARD	300-2327-000	01	GWS	
A110	VHF HI-BAND FAST-LOCK VCO	300-2328-000	01	GWS	
A111	RT-9600 FAST-LOCK BUF ASSY	300-2329-000	01	GWS	
L101 THROUGH L104					
	CHOKE, 1.2 µH	118-1041-000	04	24226	10/121
R101	RESISTOR, 10K OHM 1/4W	230-0105-022	02	01121	RCR07G103KS
R102	RESISTOR, 10K OHM 1/4W	230-0105-022	02	01121	RCR07G103KS
R103	RESISTOR, 100 OHM 1/4W	230-0103-022	01	01121	RCR07G101KS
	RT-9600 SYNTH COVER	146-0272-001	01	GWS	
	SYNTH CASE	146-0273-002	01	GWS	
	RT-9600 FAST LOCK SYN LBL	156-0343-000	01	GWS	
	SCREW, 2-56 X 1/4 PHP	188-0100-008	04	GWS	
	SCREW, 2-56 X 3/16 FHP	188-0101-006	12	GWS	
	SCREW, 2-56 X 3/8 FHP	188-0101-012	04	GWS	
	SCREW, 2-56 X 7/16 FHP	188-0101-014	06	GWS	
	WASHER SPLITLOCK #2	188-4100-000	04	GWS	
	2-56 X 3/16 HEX POST 1/2L	191-0012-016	06	GWS	
	2-56 X 3/16 HEX POST 9/16L	191-0012-018	04	GWS	

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
	RT-9600F FAST-LOCK SYNTH CARD ASSEMBLY, REV. D	300-2327-000			
A103	12.80 MHZ TCVCXO	300-1111-000	01	GWS	
C101	CAP, MONO-CER 150 PF X7R	209-2151-111	01	31433	C320C151K1G5CA
C102	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C103	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C104	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C105	CAP, TANT 1.0µF 35V	195-0107-035	02	31433	T110B105M100AS
C106	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C107	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C108 THROUGH C110					
	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C111	CAP, TANT 4.7µF 50V	195-0477-026	04	31433	T110B475K050AS
C112	CAP, TANT 6.8µF 20V	195-0687-024	01	31433	T110B685K020AS
C113 THROUGH C121					
	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C122 THROUGH C129					
	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C130 THROUGH C135					
	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C136 THROUGH C141					
	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C142	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C143 THROUGH C145					
	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C146	CAP, TANT 39µF 10V	195-0396-032	02	31433	T110B396M010AS
C147 THROUGH C151					
	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C152 THROUGH C155					
	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C156	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C157	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C158	CAP, MONO-CER 0.022µF	209-2223-010	02	31433	C321C223J2R5CA
C159	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C160	NOT USED				
C161	CAP, MONO-CER 47 PF	209-2470-100	04	31433	C320C470J2G5CA
C162	CAP, MONO-CER 47 PF	209-2470-100	04	31433	C320C470J2G5CA
C163	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C164	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C165	CAP, MONO-CER 1000 PF	209-2102-011	01	31433	C312C102K1R5CA
C166 THROUGH C169					
	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C170	CAP, TANT 4.7µF 10V	195-0477-032	04	31433	T110B475K050AS
C171	CAP, TANT 15µF 20V	195-0156-034	02	31433	T110B156M020AS
C172	CAP, TANT 39µF 10V	195-0396-032	02	31433	T110B396M010AS

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
C173	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C174	CAP, MONO-CER 220 PF	209-2221-100	04	31433	C320C221J1G5CA
C175	CAP, MONO-CER 4700PF COG	209-2472-004	01	31433	C320C472G1G5CA
C176	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C177	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C178	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C179	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C180	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C181	CAP, TANT 4.7µF 10V	195-0477-032	04	31433	T110B475K050AS
C182	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C183	CAP, TANT 22µF 35V	195-0226-025	01	31433	T110C226K035AS
C184 THROUGH C186					
	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C187	CAP, MONO-CER 0.022µF	209-2223-010	02	31433	C321C223J2R5CA
C188	CAP, MONO-CER 47 PF	209-2470-100	04	31433	C320C470J2G5CA
C189	CAP, MONO-CER 47 PF	209-2470-100	04	31433	C320C470J2G5CA
C190	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C191	CAP, POLY 0.01µF	198-0028-000	01	OCA39	714P103X9100GG
C192	CAP, POLY 2.0µF	198-0027-000	01	OCA39	730P205X9100
C193	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C194	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C195	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C196	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C197	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C198	CAP, MONO-CER 220 PF	209-2221-100	04	31433	C320C221J1G5CA
C199	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C200	CAP, TANT 15µF 20V	195-0156-034	02	31433	T110B156M020AS
C201	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C202	CAP, TANT 4.7µF 50V	195-0477-026	04	31433	T110B475K050AS
C203	CAP, TANT 3.3µF 15V	195-0337-023	02	31433	T110A335K015AS
C204	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C205	CAP, DISC-CER 220 PF	208-0005-000	01	71590	CE-221
C206	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C207	CAP, MONO-CER 220 PF	209-2221-100	04	31433	C320C221J1G5CA
C208	CAP, MONO-CER 470 PF X7R	209-2471-112	33	31433	C320C471M2R5CA
C209	CAP, MONO-CER 0.1µF X7R	209-6104-011	08	31433	C330C104K1R5CA
C210	CAP, TANT 1.0µF 35V	195-0107-035	02	31433	T110B105M100AS
C211	CAP, MONO-CER 0.01µF X7R	209-1103-011	41	31433	C315C103K5R5CA
C212	CAP, TANT 3.3µF 15V	195-0337-023	02	31433	T110A335K015AS
C213	CAP, POLY 4700 PF	198-0029-000	01	OCA39	714P472X9200FG
C214	CAP, MONO-CER 220 PF	209-2221-100	04	31433	C320C221J1G5CA
C215	CAP, 10 PF DISC-CER	208-0001-000	01	71590	DTZ-10
CR101	1N914	106-5007-000	02	07263	1N914
CR102	NOT USED				
CR103	1N914	106-5007-000	02	07263	1N914

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
L101	CHOKE, 47µH	118-1055-000	02	99800	1025-60
L102	CHOKE, 1.2µH	118-1041-000	03	24226	10/121
L103	CHOKE, 47µH	118-1055-000	02	99800	1025-60
L104	CHOKE, 10µH	118-1145-000	02	91637	IM-4-10
L105	CHOKE, 10µH	118-1145-000	02	91637	IM-4-10
L106	CHOKE, 1.2µH	118-1041-000	03	24226	10/121
L107	CHOKE, 1.2µH	118-1041-000	03	24226	10/121
Q101	2N3904 NPN	106-0041-000	03	04713	2N3904
Q102	MPS3702 PNP	106-0057-000	02	04713	MPS 3702-18
Q103	MPS3702 PNP	106-0057-000	02	04713	MPS 3702-18
Q104	2N3904 NPN	106-0041-000	03	04713	2N3904
Q105	2N7000 POWER MOSFET	106-0073-000	01	04713	2N7000
Q106	3N170 N-CHANNEL	106-0074-000	02	04713	3N170
Q107	3N170 N-CHANNEL	106-0074-000	02	04713	3N170
Q108	2N3904 NPN	106-0041-000	03	04713	2N3904
R101	RESIST, 2.80K OHM 1%	231-2804-021	03	91637	RN55D2801F
R102	RESIST, 2.55K OHM 1%	231-2554-021	03	91637	RN55D2551F
R103	RESIST, 390 OHM 1/2W	230-0393-032	01	01121	RCR07G391KS
R104	RESIST, 1.10K OHM 1%	231-1104-021	01	91637	RN55D1101F
R105	RESIST, 120K OHM 1/4W	230-0126-022	01	01121	RCR07G124KS
R106	RESIST, 2[illegible]K OHM 1/4W	230-0224-022	02	01121	RCR07G222KS
R107	RESIST, ADJ 1K OHM	233-0015-007	03	32997	3329H-1-102
R108	RESIST, 3.57K OHM 1%	231-3574-021	02	91637	RN55D3571F
R109	RESIST, ADJ 1K OHM	233-0015-007	03	32997	3329H-1-102
R110	RESIST, 2.21K OHM 1%	231-2214-021	01	91637	RN55D2211F
R111	RESIST, 12.1K OHM 1%	231-1215-021	03	91637	RN55D1212F
R112	RESIST, 4.02K OHM 1%	231-4024-021	01	91637	RN55D4021F
R113	RESIST, 8.06K OHM 1%	231-8064-021	02	91637	RN55D8061F
R114	RESIST, 16.2K OHM 1%	231-1625-021	04	91637	RN55D1622F
R115	RESIST, 32.4K OHM 1%	231-3245-021	03	91637	RN55D3242F
R116	RESIST, 64.9K OHM 1%	231-6495-021	03	91637	RN55D6492F
R117	RESIST, 127K OHM 1%	231-1276-021	03	91637	RN55D1273F
R118	RESIST, 255K OHM 1%	231-2556-021	03	91637	RN55D2553F
R119	RESIST, PACK 10K OHM	234-0001-000	05	91637	MSP08A01-1C3G
R120	RESIST, PACK 7/10K OHM	234-0010-000	03	91637	MDP1403-103G
R121	RESIST, PACK 6.8K OHM	234-0002-000	03	91637	MSP08A01-682G
R122	RESIST, PACK 10K OHM	234-0001-000	05	91637	MSP08A01-1C3G
R123	RESIST, PACK 7/10K OHM	234-0010-000	03	91637	MDP1403-103G
R124	RESIST, PACK 6.8K OHM	234-0002-000	03	91637	MSP08A01-682G
R125	RESIST, PACK 10K OHM	234-0001-000	05	91637	MSP08A01-1C3G
R126	RESIST, PACK 7/10K OHM	234-0010-000	03	91637	MDP1403-103G
R127	RESIST, PACK 6.8K OHM	234-0002-000	03	91637	MSP08A01-682G
R128	RESIST, 6.8K OHM 1/4W	230-0684-022	03	01121	RCR07G682KS
R129	RESIST, 8.2K OHM 1/4W	230-0824-022	01	01121	RCR07G820KS
R130	RESIST, PACK 10K OHM	234-0001-000	05	91637	MSP08A01-1C3G

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
R131	RESIST, PACK 10K OHM	234-0001-000	05	91637	MSP08A01-1C3G
R132	RESIST, 4.7K OHM 1/4W	230-0474-022	01	01121	RCR07G472KS
R133	RESIST, 100 OHM 1/4W	230-0103-022	05	01121	RCR07G101KS
R134	RESIST, 100 OHM 1/4W	230-0103-022	05	01121	RCR07G101KS
R135	RESIST, 100K OHM 1/4W	230-0106-022	02	01121	RCR07G104KS
R136 THROUGH R138					
	RESIST, 100 OHM 1/4W	230-0103-022	05	01121	RCR07G101KS
R139	RESIST, 16.2K OHM 1%	231-1625-021	04	91637	RN55D1622F
R140	RESIST, 32.4K OHM 1%	231-3245-021	03	91637	RN55D3242F
R141	RESIST, 64.9K OHM 1%	231-6495-021	03	91637	RN55D6492F
R142	RESIST, 255K OHM 1%	231-2556-021	03	91637	RN55D2553F
R143	RESIST, 127K OHM 1%	231-1276-021	03	91637	RN55D1273F
R144	RESIST, 2.80K OHM 1%	231-2804-021	03	91637	RN55D2801F
R145	RESIST, 2.80K OHM 1%	231-2804-021	03	91637	RN55D2801F
R146	RESIST, ADJ 1K OHM	233-0015-007	03	32997	3329H-1-102
R147	RESIST, 200K OHM 1%	231-2006-021	01	91637	RN55D2003F
R148	RESIST, 2.10K OHM 1%	231-2104-021	01	91637	RN55D2101F
R149	RESIST, 2.2K OHM 1/4W	230-0224-022	02	01121	RCR07G222KS
R150	RESIST, 10K OHM 1/4W	230-0105-022	03	01121	RCR07G103KS
R151	RESIST, 12.1K OHM 1%	231-1215-021	03	91637	RN55D1212F
R152	RESIST, 255K OHM 1%	231-2556-021	03	91637	RN55D2553F
R153	RESIST, 127K OHM 1%	231-1276-021	03	91637	RN55D1273F
R154	RESIST, 64.9K OHM 1%	231-6495-021	03	91637	RN55D6492F
R155	RESIST, 32.4K OHM 1%	231-3245-021	03	91637	RN55D3242F
R156	RESIST, 8.06K OHM 1%	231-8064-021	02	91637	RN55D8061F
R157	RESIST, 16.2K OHM 1%	231-1625-021	04	91637	RN55D1622F
R158	RESIST, 12.1K OHM 1%	231-1215-021	03	91637	RN55D1212F
R159	RESIST, 100K OHM 1%	231-1006-021	01	91637	RN55D1003F
R160	RESIST, 113K OHM 1%	231-1136-021	01	91637	RN55D1133F
R161	RESIST, 14.3K OHM 1%	231-1435-021	02	91637	RN55D1432F
R162	RESIST, 3.57K OHM 1%	231-3574-021	02	91637	RN55D3571F
R163	RESIST, 14.3K OHM 1%	231-1435-021	02	91637	RN55D1432F
R164	RESIST, 16.2K OHM 1%	231-1625-021	04	91637	RN55D1622F
R165	RESIST, 73.2K OHM 1%	231-7325-021	02	91637	RN55D7322F
R166	RESIST, 150 OHM 1/4W	230-0153-022	01	01121	RCR07G151KS
R167	RESIST, ADJ 5K OHM	233-0015-009	01	32997	3329H-1-502
R168	RESIST, 10K OHM 1/4W	230-0105-022	03	01121	RCR07G103KS
R169	RESIST, 5.90K OHM 1%	231-5904-021	02	91637	RN55D5901F
R170	RESIST, ADJ 10K OHM	233-0015-010	02	32997	3329H-1-103
R171	RESIST, 3.3 OHM 1/4W	230-0331-022	02	01121	RCR07G329KS
R172	RESIST, 681 OHM 1%	231-6813-021	02	91637	RN55D6810F
R173	RESIST, 3.3 OHM 1/4W	230-0331-022	02	01121	RCR07G329KS
R174	RESIST, 681 OHM 1%	231-6813-021	02	91637	RN55D6810F
R175	RESIST, 5.90K OHM 1%	231-5904-021	02	91637	RN55D5901F
R176	RESIST, 22 OHM 1/4W	230-0222-022	03	01121	RCR07G220KS

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
R177	RESIST, 2.55K OHM 1%	231-2554-021	03	91637	RN55D2551F
R178	RESIST, 3.9K OHM 1/4W	230-0394-022	01	01121	RCR07G392KS
R179	RESIST, 34.0K OHM 1%	231-3405-021	03	91637	RN55D3402F
R180	RESIST, 34.0K OHM 1%	231-3405-021	03	91637	RN55D3402F
R181	RESIST, 10K OHM 1/4W	230-0105-022	03	01121	RCR07G103KS
R182	RESIST, 73.2K OHM 1%	231-7325-021	02	91637	RN55D7322F
R183	RESIST, 22 OHM 1/4W	230-0222-022	03	01121	RCR07G220KS
R184	RESIST, 27K OHM 1/4W	230-0275-022	01	01121	RCR07G273KS
R185	RESIST, 1K OHM 1/4W	230-0104-022	02	01121	RCR07G102KS
R186	RESIST, 2.55K OHM 1%	231-2554-021	03	91637	RN55D2551F
R187	RESIST, 5.62K OHM 1%	231-5624-021	01	91637	RN55D5621F
R188	RESIST, 34.0K OHM 1%	231-3405-021	03	91637	RN55D3402F
R189	RESIST, 6.8K OHM 1/4W	230-0684-022	03	01121	RCR07G682KS
R190	RESIST, 6.8K OHM 1/4W	230-0684-022	03	01121	RCR07G682KS
R191	RESIST, 2.7K OHM 1/4W	230-0274-022	01	01121	RCR07G272KS
R192	RESIST, 100K OHM 1/4W	230-0106-022	02	01121	RCR07G104KS
R194	RESIST, 47K OHM 1/4W	230-0475-022	01	01121	RCR07G473KS
R195	RESIST, 1K OHM 1/4W	230-0104-022	02	01121	RCR07G102KS
R196	RESIST, 22 OHM 1/4W	230-0222-022	03	01121	RCR07G220KS
R197	RESIST, 1.8K OHM 1/4W	230-0184-022	01	01121	RCR07G182KS
R193	RESIST, ADJ 10K OHM	233-0015-010	02	32997	3329H-1-103
TP101	JACK 2 PIN PC MTG	129-2059-002	02	GWS	
TP102	JACK 1 PIN PC MTG	129-2059-001	02	GWS	
U101	555 LIN TIMER	106-7052-000	01	18324	NE555N
U102	358 LIN DUAL OP AMP	106-7044-000	03	27014	LM358
U103	74HC253 DUAL 4T01 MULTP	106-7147-000	02	04713	MC14049UBCP
U104	74HC253 DUAL 4T01 MULTP	106-7147-000	02	04713	MC14049UBCP
U105	8748 MICROPROCESSOR	106-7118-020	01	GWS	
U106	74HC74 DUAL D FLIP-FLOP	106-7144-000	01	04713	MC74HC74
U107	74HC00 QUAD 2 INPT NAND	106-7148-000	01	04713	M674HC00
U108	7406 TTL HEX INV	106-7039-000	03	01295	SN7406N
U109	74LS378HEX D FLIP-FLOP	106-7145-000	02	04713	SN74L5378
U110	7406 TTL HEX INV	106-7039-000	03	01295	SN7406N
U111	4066 CMOS QUAD SW	106-7019-000	03	02735	CD4066BE
U112	74LS378 HEX D FLIP-FLOP	106-7145-000	02	04713	SN74L5378
U113	7406 TTL HEX INV	106-7039-000	03	01295	SN7406N
U114	4066 CMOS QUAD SW	106-7019-000	03	02735	CD4066BE
U115	4066 CMOS QUAD SW	106-7019-000	03	02735	CD4066BE
U116	358 LIN DUAL OP AMP	106-7044-000	03	27014	LM358
U117	1458 LIN DUAL OP AMP	106-7006-000	01	04713	MC1458CPI
U118	MC1404AU6 6.25V REF	106-7150-000	01	04713	MC1404AU6
U119	CA3140 LIN OP AMP	106-7055-000	01	02735	CA3140S
U120	358 LIN DUAL OP AMP	106-7044-000	03	27014	LM358

6.3.3 RT-9600F FAST-LOCK SYNTHESIZER CARD ASSEMBLY (A109) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
U121	MC145159 SYNTH PLL IC	106-7146-000	01	04713	MC145159P1
U122	MC12016 40/41 PRESCALER	106-7138-000	01	04713	MC12016P
U123	78L08 LIN 8V REG	106-7043-000	01	01295	LM78L08ACZ
VR101	1N5228B 3.9V ZENER	106-4021-000	01	04713	1N5228B
	PC RT-9600 FAST LOCK SYN	108-6209-000	01	GWS	
	TRANSISTOR INSULATOR	111-0024-000	02	GWS	
	*I.C. SOCKET LOW PROF	11325-3	01	GWS	

* PN11325-3 REPLACES PN 129-3036-000 (SOCKET 40 PIN DIP) REV. C

6.3.4 RT-9600F FAST-LOCK BUFFER ASSEMBLY (A111)

CKT SYMBOL	DESCRIPTION	GWS PN	ASSY QTY	VENDOR CODE	VENDOR PN
	RT-9600F FAST LOCK BUFF	300-2329-000, REV. B			
C101	CAP, TANT 15µF 20V	195-0156-034	01	31433	T110B156M020AS
C102	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C103	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C104	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C105	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C106	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C107	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C108	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C109	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C110	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C111	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C112	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C113	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C114	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C115	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C116	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C117	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C118	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C119	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C120	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C121	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C122	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C123	CAP, DISC-CER 470 PF	208-0006-000	12	71590	CE-471
C124	CAP, DISC-CER 100 PF	208-0004-000	11	33498	AC1-X5F-101F
C125	CAP, DISC-CER 0.01µF	208-0011-000	02	71590	UK50-103
C126	CAP, DISC-CER 220 PF	208-0005-000	01	71590	CE-221
C127	CAP, DISC-CER 0.01µF	208-0011-000	02	71590	UK50-103
C128	CAP, DIP-MICA 5 PF	199-0501-013	01	14655	CM04CD050D03
C129	CAP, DIP-MICA 10 PF	199-1001-013	01	14655	CM04CD100D03
L101	CHOKE, 0.47µH	118-1002-000	05	24226	10/470
L102	CHOKE, 0.47µH	118-1002-000	05	24226	10/470
L103	CHOKE, 0.15µH	118-1031-000	01		
L104 THROUGH L106					
	CHOKE, 0.47µH	118-1002-000	05	24226	10/470
P101	JACK, SMB, BLKHD MTG	129-0028-000	01	GWS	
Q101	2N5179 NPN RF	106-0005-000	05	04713	2N5179
Q102	2N5179 NPN RF	106-0005-000	05	04713	2N5179
Q103	2N5179 NPN RF	106-0005-000	05	04713	2N5179
Q104	2N5179 NPN RF	106-0005-000	05	04713	2N5179
Q105	2N5179 NPN RF	106-0005-000	05	04713	2N5179
Q106	2N5179 NPN RF	106-0005-000	05	04713	2N5179
R101	RESIST, 220 OHM 1/4W	230-0223-022	04	01121	RCR07G221KS
R102	RESIST, 15 OHM 1/4W	230-0152-022	01	01121	RCR07G150KS
R103	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS

6.3.4 RT-9600F FAST-LOCK BUFFER ASSEMBLY (A111) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
R104	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R105	RESIST, 150 OHM 1/4W	230-0153-022	06	01121	RCR07G151KS
R106	RESIST, 100 OHM 1/4W	230-0103-022	04	01121	RCR07G101KS
R107	RESIST, 220 OHM 1/4W	230-0223-022	04	01121	RCR07G221KS
R108	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R109	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R110	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R111	RESIST, 100 OHM 1/4W	230-0103-022	04	01121	RCR07G101KS
R112	RESIST, 120 OHM 1/4W	230-0123-012	01	01121	RCR07G121KS
R113	RESIST, 1.8K OHM 1/4W	230-0184-022	01	01121	RCR07G182KS
R114	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R115	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R116	RESIST, 1.5K OHM 1/4W	230-0154-022	01	01121	RCR07G152KS
R117	RESIST, 68 OHM 1/4W	230-0682-022	01	01121	RCR07G680KS
R118	RESIST, 47 OHM 1/4W	230-0472-022	01	01121	RCR07G470KS
R119	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R120	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R121	RESIST, 120 OHM 1/4W	230-0123-012	01	01121	RCR07G121KS
R122	RESIST, 100 OHM 1/4W	230-0103-022	04	01121	RCR07G101KS
R123	RESIST, 220 OHM 1/4W	230-0223-022	04	01121	RCR07G221KS
R124	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R125	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R126	RESIST, 120 OHM 1/4W	230-0123-012	01	01121	RCR07G121KS
R127	RESIST, 100 OHM 1/4W	230-0103-022	04	01121	RCR07G101KS
R128	RESIST, 220 OHM 1/4W	230-0223-022	04	01121	RCR07G221KS
R129	RESIST, 10K OHM 1/4W	230-0105-022	05	01121	RCR07G103KS
R130	RESIST, 2.2K OHM 1/4W	230-0224-022	06	01121	RCR07G222KS
R131	RESIST, 120 OHM 1/4W	230-0123-012	01	01121	RCR07G121KS
T101 THROUGH T105					
	5T RF BALUN	118-2002-000	05	GWS	
	#22 GAUGE BUSS WIRE	091-1000-000	01	GWS	
	TEFLON STANDOFF	107-0017-000	46	GWS	
	TEFLON FEEDTHRU	107-0018-000	03	GWS	
	RT-9600F BUFF COMP PLT	146-0277-001	01	GWS	
	RT-9600F BUFF FRAME	146-0278-001	01	GWS	
	TEFLON TUBE #20	190-0006-000	A/R	GWS	

6.3.5 RT-9600F POWER SUPPLY (A6)

CKT SYMBOL	DESCRIPTION	GWS P.N	ASSY QTY	VENDOR CODE	VENDOR PN
	RT-9600F POWER SUPPLY	300-2099-000 REV. C			
C1	CAP, 470µF 40V ALUM	196-0006-000	02	25088	470/40/81006
C2	CAP, 470µF 40V ALUM	196-0006-000	02	25088	470/40/81006
C3	CAP, .1µF 20V DISC-CER	208-0010-000	02	71590	UK20-104
C4	CAP, 39µF 10V TANT	195-0396-032	01	31433	T110B396M010AS
C5 THROUGH C7					
	CAP, .056µF 100V MYLAR	204-0013-000	03	27735	PE21-.056-100-5
C8	CAP, 1.0µF TANT	195-0107-035	02	31433	T110A105M035AS
C9	CAP, 1.0µF TANT	195-0107-035	02	31433	T110A105M035AS
C10	CAP, .1µF 50V GLASS CER	198-0006-000	02	71590	C41C104KNP
C11	CAP, .1µF 50V GLASS CER	198-0006-000	02	71590	C41C104KNP
C12	CAP, 4.7µF 10V TANT	195-0477-032	02	31433	T110A475M010AS
C13	CAP, 100µF TANT	195-0105-032	01	31433	T110C107M010AS
C14	CAP, .1µF 20V DISC-CER	208-0010-000	02	71590	UK20-104
C15	CAP, .05µF 20V DISC-CER	208-0015-000	01	71590	UK20-503
C16	CAP, 220 PF MONO-CER	209-2221-100	01	31433	C320C221J1G5CA
C17	CAP, 4.7µF 10V TANT	195-0477-032	02	31433	T110A475M010AS
CR1	1N4002 SILICON DIODE	106-5009-000	02	04713	1N4002
CR2	1N4002 SILICON DIODE	106-5009-000	02	04713	1N4002
CR3	1N4754A 3.9V ZEN DIO 5%	106-4010-000	01	04713	1N4754A
L1	CHOKE, RT-9600F	118-1054-000	01	GWS	
Q1	TRANS, GES98 NPN	106-0001-000	01	03508	GES-98
Q2	TRANS, 2N3904 NPN	106-0041-000	01	04713	2N3904
Q3	TRANS, 2N5879 PNP	106-0036-000	01	04713	2N5879
R1 THROUGH R3					
	RESIST, 680 OHM 1/4W 10%	230-0683-022	03	01121	RCR07G681KS
R4	RESIST, 1.2K OHM 1/4W 10%	230-0124-022	01	01121	RCR07G122KS
R5	RESIST, 2200 OHM 1/4W 10%	230-0224-022	04	01121	RCR07G222KS
R6	POTENTIOMETER 5K	233-0011-000	01	32997	3006P-1-502
R7	RESIST, 3300 OHM 1/4W 10%	230-0334-022	02	01121	RCR07G332KS
R8	RESIST, 2200 OHM 1/4W 10%	230-0224-022	04	01121	RCR07G222KS
R9	RESIST, 3300 OHM 1/4W 10%	230-0334-022	02	01121	RCR07G332KS
R10	RESIST, 220 OHM 1/4W 10%	230-0223-022	01	01121	RCR07G221KS
R11	RESIST, 2200 OHM 1/4W 10%	230-0224-022	04	01121	RCR07G222KS
R12	RESIST, 100K OHM 1/4W 10%	230-0106-022	01	01121	RCR07G104KS
R13	RESIST, 3.9 OHM 2W 10%	232-0016-000	01	07233	SPH-3.9 10%
R14	RESIST, 1500 OHM 1/4W 10%	230-0154-022	01	01121	RCR07G152KS
R15	RESIST, 2200 OHM 1/4W 10%	230-0224-022	04	01121	RCR07G222KS
T1	AUDIO TRANSFORMER	118-4009-000	01	29032	TR-1306
U1	I.C. MC34072A	106-712744-03	01	04713	MC35072U
U2	I.C. LM380 AUDIO PWR AMP	106-7009-000	01	27014	SL60827
VR1	I.C. UA78L24 24V VOLT REG	106-7035-000	01	04713	MC78L24ACP
VR2	I.C. UA7805 5V VOLT REG	106-7022-000	01	04713	MC7805CK
	TERMINAL, FORKED	16136-1	06	GWS	
	PRINTED CIRCUIT BOARD	108-6045-01	01	GWS	

6.3.5 RT-9600F POWER SUPPLY (A6) (cont.)

CKT SYMBOL	DESCRIPTION	GWS P N	ASSY QTY	VENDOR CODE	VENDOR PN
	HEATSINK	146-0283-002	01	GWS	
	THERMAL INSULATOR	10618-7	02	GWS	
	SCREW, 6-32 X 1/2PHP	188-0300-016	02	GWS	
	NUT, 6-32 X 5/16 KEP	188-2301-000	02	GWS	
	LUG, #6 SOLDER	109-0006-000	01	GWS	
	SCREW, 4-40 X 1/2 PHP	188-0200-016	02	GWS	
	WASHER, #4 FLAT	NAS620-CL4	06	GWS	
	LUG, #4 SOLDER	109-0004-000	01	GWS	
	NUT, 4-40 X 3/16 NYLOCK	188-2203-000	02	GWS	
	WASHER, #4 SPLIT LOCK	188-4200-000	04	GWS	
	SCREW, 4-40 X 7/16 PHP	188-0200-014	04	GWS	
	#4 NYLON SCREW INSUL	190-0017-001	02	GWS	
	WIRE, BUS 22 AWG	16017-22	A/R	GWS	

VHF/FM COMMUNICATIONS TRANSCEIVERS

RT-7200
RT-9600
AN/ARC-513(V)

INSTALLATION/OPERATORS MANUAL

U.S. FCC DATA:
TYPE ACCEPTANCE NUMBERS: RT-7200, RT-9600
TYPE ACCEPTED UNDER PARTS: 74,83,90

CANADIAN DOC DATA:
APPROVAL NUMBERS, RT-7200: RSP-100 (B8560)
RSS-119 (501 192 155I)
RSS-182 (501 821 272VLC)
APPROVAL NUMBERS, RT-9600: RSP-100 (B8559)
RSS-119 (501 191 126X)
RSS-182 (501 821 271V)

EQUIPMENT PART NUMBERS:
RT-7200: 400-0087-000/003
RT-9600: 400-0052-000/027
RT-5065/ARC-513(V): 400-0087-005
RT-5052/ARC-513(V): 400-0052-999

U.S. PATENT NUMBERS: 4,189,689
4,320,357

MANUAL PART NUMBER: 150-0061-000
REVISION E

RT-7200, RT-9600, AN/ARC-513 (V)

LIMITED ONE YEAR WARRANTY

Wulfsberg Electronics, Inc., unit of Sundstrand Corporation (hereinafter called WEI), Overland Park, Kansas has designed, engineered and constructed the equipment with the finest material and components available. This equipment has been thoroughly inspected and tested before leaving the factory.

WEI warrants each item of new equipment manufactured by it to be free from defects in design, workmanship and material under normal use for which intended for one year after date of installation.

WEI will hereunder replace or repair (at WEI's discretion) any WEI part or component, which shall within such warranty period, be returned, transportation charges prepaid, to an authorized warranty service center. Such service centers, if authorized in advance by WEI, may return the part or unit to WEI's factory for compliance with this warranty. This warranty of parts includes bench time required to locate the defect, repair same or replace such part.

This warranty shall not apply to any unit or part thereof, which has not been installed by a WEI approved installation facility in accordance with the installation instructions, or which has been repaired or altered in anyway so as to adversely affect its performance or which has been subjected to misuse, negligence or accident.

This warranty is expressly in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness, and of all other obligations or liabilities on the part of the seller.

WEI reserves the right to make changes in design or additions to or improvements in its equipment without obligation to install such additions or improvements in equipment theretofore manufactured.

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SECTION 1

DESCRIPTION AND OPERATION

1.1 INTRODUCTION

The Commercial RT-7200 and Military RT-5065/ARC-513 (V) Transceiver Systems provide two-way voice communication in the 138.000 to 173.995 MHz band, while the Commercial RT-9600 and Military RT-5052/ARC-513 (V) Transceiver Systems provide two-way voice communications in the 150.0000 to 173.9975 MHz band. Both frequency bands are commonly known as the VHF Hi-Band.

Depending on the control unit used, either 11, 15 or 20 preset channels are provided along with a manually selectable frequency control or CTCSS tone selection. Also, an optional two frequency crystal controlled Guard Receiver allows continuous monitoring of a previously selected frequency.

1.2 PURPOSE OF EQUIPMENT

The Commercial RT-7200 and Military RT-5065/ARC-513 (V) Transceivers are designed to provide two-way voice communications within the frequency range of 138.000 to 173.995 MHz in 5.0 kHz increments, for a total of 7200 channels.

The Commercial RT-9600 and Military RT-5052/ARC-513 (V) Transceivers are designed to provide two-way voice communications within the frequency range of 150.0000 to 173.9975 MHz in 2.5 kHz increments, for a total of 9600 channels.

1.3 MODEL VARIATIONS WITH TRANSCEIVER AND CONTROL UNIT PART NUMBERS

1.3.1 COMMERCIAL PRODUCTS

There are four styles of RT-7200 and eight styles of RT-9600 Commercial Transceivers currently available as defined in Section 1.6.1. See section 1.6.4 for the currently available Commercial Control Units. See Sections 1.6.3 and 1.6.6 for discontinued commercial transceivers and control units.

1.3.2 MILITARY PRODUCTS

Derivatives of the RT-7200 and RT-9600 Transceiver Systems have been supplied for the JETDS Radio Set System AN/ARC-513 (V). These transceivers and control units are described in Sections 1.6.2 and 1.6.5.

1.4 DESIGN FEATURES

Several important features in the design offer maximum reliability, flexibility, ease of installation, operation, and maintenance.

-- Plug-in modular construction with bifurcated gold card-edge connectors.

-- MIL grade epoxy impregnated fiberglass printed circuit boards with MIL spec post coating for humidity and dust protection.

-- All solid state.

-- Burn-out proof transmitter due to open or short-circuited transmission line.

-- RF gated audio sidetone exists when transmitter is producing RF power.

-- Automatic signal-to-noise squelch with manual override.

-- Separate input (without preemphasis) for external CTCSS tones, tone bursts, DTMF encoders, voice scramblers, data, etc.

-- AM detector for use with direction finding equipment.

-- Operates on either 14 or 28V DC power.

-- Low profile 1/2 ATR short package.

-- No band spread limitation.

1.5 TECHNICAL CHARACTERISTICS

1.5.1 RT-7200 AND RT-5065/ARC-513 (V)

GENERAL SPECIFICATIONS

Frequency Range:	FCC Type Accepted 150 to 174 MHz. DOC Type Accepted 138 to 174MHz.
Channelling:	25kHz (standard) or 30 kHz (standard or split) under FCC Parts 83 and 90. 30 kHz under DOC RSS-119. 25 kHz under DOC RSS-182.
Tunability:	Capable of 5 kHz increments.
Mode:	Simplex or semi-duplex 16F3.
Physical Dimensions:	See Figure 2.4-1.
Weight:	9.3 lbs (4.22 kg).
Mounting:	Rigidmount-upright only.
Power Requirements:	
Voltage:	13.75V DC ± 20% or 27.5V DC ± 20%.
Current:	
Standby:	1.3 Amps maximum.
Receive:	1.5 Amps maximum.
Transmit:	5.5 Amps maximum.
Control:	Remote with C-722/C-722A Control Unit.
Warm-up Time:	None Required.
Temperature:	
Storage:	-55 to +85° C.
Operate:	-40 to +60° C.
Altitude:	51,000 feet MSL.
Certification:	FCC Parts 15, 74, 83 and 90. DOC RSS-119 (501 192 1551) DOC RSS-182 (501 272 VLC).

1.5 TECHNICAL CHARACTERISTICS

1.5.1 RT-7200 AND RT-5065/ARC-513 (V) (cont.)

GENERAL SPECIFICATIONS

Other:	Meets RTCA DO-138 Environmental Catagory AAGAAAEXXXXS (when shockmounted) and AANAAAEXXXXS (when rigid mounted) to Wulfsberg defined operational standards.

TRANSMITTER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Nominal Output Power:	Operator selectable, 1 or 10 Watts.
Output Power Tracking:	+ 20%, -40% from nominal over frequency range.
Output Impedance:	50 ohms.
Duty Cycle:	Continuous (EIA)
Frequency Stability:	± 0.0005% over -40 to + 60°C.
Modulation:	± 5 kHz deviation, adjustable.
Audio Input:	0.25 VRMS into 200 ohms input circuit for ± 3.0 kHz deviation, adjustable.
Audio Distortion:	5%
Modulation Tracking:	± 0.9dB across frequency range.
Sidetone Output:	100 mW into 600 ohms, adjustable.
Microphone Circuit:	Carbon or equivalent.
FM Hum and Noise:	-26 dB.
Harmonics:	-70 dB below carrier level.
Spurious:	-80 dB below carrier level.

1.5 TECHNICAL CHARACTERISTICS

1.5.1 RT-7200 AND RT-5065/ARC-513 (V) (cont.)

MAIN RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Usable Sensitivity:	0.5 uV, 12 dB SINAD (EIA).
Quieting Sensitivity:	1.0 uV, 20 dB quieting (EIA).
Adjacent Channel:	-68 dB (EIA).
Intermodulation:	-60 dB (EIA).
Response:	
Spurious:	-85 dB.
Image:	-80 dB.
Modulation Acceptance:	7 kHz minimum (EIA).
Squelch:	
Threshold Setting:	4 dB SINAD or less.
Tight Setting:	18 to 20 dB SINAD.
Audio Output:	100mW into 600 ohms.
Audio Distortion:	7% (EIA).
Frequency Tolerance:	0.001% over temperature range.
Hum and Noise:	
Unsquelched:	-26 dB.
Squelched:	-45 dB.
DF Output:	400 mVRMS open circuit (50% modulation), 500 ohms output impedance.

1.5 TECHNICAL CHARACTERISTICS

1.5.1 RT-7200 AND RT-5065/ARC-513 (V) (cont.)

GUARD RECEIVER OPTION SPECIFICATIONS (STANDARD TEST CONDITIONS)

Channel 1 Frequency:	Customer specified. Any frequency between 138.000 and 173.995 MHz allowed. 156.800 MHz (RT-5065/ARC-513 Version)
Channel 2 Frequency:	Customer specified. Any frequency between 138.000 and 173.995 MHz allowed. 156.300 MHz (RT-5065/ARC-513 Version)
Response:	
Image:	-85 dB.
Spurious:	-75 dB.

All other specifications same as the main receiver except the guard receiver has no DF Output.

SUBAUDIBLE TONE SQUELCH OPTION (CTCSS) SPECIFICATIONS

Number of Tones:	Eight.
Selection Method:	Selected by coding four wires on the main connector. The wire coding is generated in the control units or by external switching and may be changed between transmit and receive.
Frequency Range:	60 to 250 Hz - field adjustable.

1.5.2 RT-9600 AND RT-5052/ARC-513 (V)

GENERAL SPECIFICATIONS

Frequency Range:	FCC Type Accepted 150 to 174 MHz. DOC Type Accepted 150 to 174 MHz.
Channelling:	25 or 30 kHz (standard or split) under FCC parts 74, 83 and 90. 30 kHz under DOC RSS-119. 25 KHz under DOC RSS-182.
Tunability:	Capable of 2.5 kHz increments.

1.5 TECHNICAL CHARACTERISTICS

1.5.2 RT-9600 AND RT-5052/ARC-513 (V) (cont.)

GENERAL SPECIFICATIONS

Mode:	Simplex or Semi-duplex, 16F3.
Physical Dimensions:	See Figures 2.4-1 and 2.4-2.
Weight:	9.3 lbs (4.22 kg).
Mounting:	Rigidmount-upright only.
Power Requirements:	
Voltage:	13.75V DC ± 20% or 27.5V DC ± 20%.
Current:	
Standby:	1.3 Amps maximum
Receive:	1.5 Amps maximum
Transmit:	5.5 Amps maximum
Control:	Remote with C-962/C-962A Control Unit.
Warm-up Time:	None required, 3 Minutes (early production units)
Temperature:	
Storage:	-55 to +85° C.
Operate:	-40 to +60° C.
Altitude:	51,000 feet MSL.
Certification:	FCC Parts 15, 74, 83, and 90. DOC RSS-119 (501 191 126X) DOC RSS-182 (501 821 271V).
Other:	Meets RTCA DO-138 Environmental Catagory AAGAAAEXXXXS (when shock mounted) and AANAAAEXXXXS (when rigid mounted) to Wulfsberg operational standards.

1.5 TECHNICAL CHARACTERISTICS

1.5.2 RT-9600 AND RT-5052/ARC-513 (V) (cont.)

TRANSMITTER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Nominal Output Power:	Operator selectable, 1 or 10 Watts.
Output Power Tracking:	± 20% from nominal over frequency range.
Output Impedance:	50 ohms.
Duty Cycle:	Continuous (EIA).
Frequency Stability:	± 0.0005% over -30° to + 60° C.
Modulation:	± 5 kHz deviation, limited.
Audio Input:	0.25 VRMS into 200 ohms input circuit for ± 3.0 kHz deviation, adjustable.
Audio Distortion:	5%.
Modulation Tracking:	± 0.9 dB across frequency range.
Sidetone Output:	100 mW into 600 ohms, adjustable.
Microphone Circuit:	Carbon or equivalent.
FM Hum and Noise:	-30 dB.
Harmonics:	-70 dB below carrier level.
Spurious:	-80 dB below carrier level.

MAIN RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Usable Sensitivity:	0.5 uV, 12 dB SINAD (EIA).
Quieting Sensitivity:	1.0 uV, 20 dB quieting (EIA).
Adjacent Channel:	-70 dB (EIA).
Intermodulation:	-70 dB (EIA).

1.5 TECHNICAL CHARACTERISTICS

1.5.2 RT-9600 AND RT-5052/ARC-513 (V) (cont.)

MAIN RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS) (cont.)

Response:	
Spurious:	-90 dB.
Image:	-90 dB.
Modulation Acceptance:	7 kHz minimum (EIA).
Squelch:	
Threshold Setting:	4 dB SINAD or less.
Tight Setting:	18 to 20 dB SINAD.
Audio Output:	100 mW into 600 ohms. 10 Watts into 4 ohms (RT-5052/ARC-513 Version)
Audio Distortion:	7% EIA.
Frequency Tolerance:	± 0.001% over temperature range.
Hum and Noise:	
Unsquelched:	-30 dB.
Squelched:	-45 dB.
DF Output:	400 mVRMS open circuit (50% modulation) 500 ohms output impedance.

GUARD RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS)

Channel 1 Frequency:	Customer specified. Any frequency between 150.0000 and 173.9975 MHz allowed. 156.8000 MHz (RT-5052/ARC-513 Version)
Channel 2 Frequency:	Customer specified. Any frequency between 150.0000 and 173.9975 MHz allowed. 156.3000 MHz (RT-5052/ARC-513 Version)

1.5 TECHNICAL CHARACTERISTICS

1.5.2 RT-9600 AND RT-5052/ARC-513 (V) (cont.)

GUARD RECEIVER SPECIFICATIONS (STANDARD TEST CONDITIONS) (cont.)

Response:

Image:	-85 dB.
Spurious:	-75 dB.

All other specifications same as the main receiver except the guard receiver has no DF Output.

SUBAUDIBLE TONE SQUELCH OPTION (CTCSS)

Number of Tones:	Eight.
Selection Method:	Selected by coding four wires on the main connector. The wire coding is generated in the control units or by external switching and may be changed between transmit and receive.
Frequency Range:	60 to 250 Hz - Field Adjustable.

1.5.3 CONTROL UNITS **

Physical Dimensions:

C-960, C-5333/ARC-513(V), C-5368/ARC-513(v), and C-5413/ARC-513(v).	See Figure 2.5-1
C-961	See Figure 2.5-2
C-920	See Figure 2.5-3
C-722, C-962, C-5421/ARC-513 (V), and C-5422/ARC-513(V)	See Figure 2.5-4
C-722A, C-962A	See Figure 2.5-5
C-963	See Figure 2.5-6
HA-4	See Figure 2.5-7
HS-4	See Figure 2.5-8

1.5 TECHNICAL CHARACTERISTICS (cont.)

1.5.3 CONTROL UNITS ** (cont.)

Weight:	lbs	kg
C-960, C-5333/ARC-513 (V), C-5368/ARC-513 (V), and C-5413/ARC-513 (V)	2.0	0.91
C-961	1.8	0.83
C-920	2.3	1.04
C-722, C-962, and C-5421/ARC-513 (V)	2.5	1.13
C-722A, C-962A	2.5	1.13
C-963	0.8	0.36

** FOR DETAILED CONTROL UNIT INFORMATION SEE THE APPROPRIATE CONTROL UNIT MAINTENANCE MANUAL AVAILABLE FROM WULFSBERG ELECTRONICS, INC.

1.5.4 ANTENNAS

Physical Dimensions:	
AT-31	See Figure 2.6-1
AT-690	See Figure 2.6-2
AT-695	See Figure 2.6-3
AT-960, AS-5013/ARC-513 (V)	See Figure 2.6-4

Weight:	lbs	kg
AT-31	2.5	1.13
AT-690	0.6	0.27
AT-695	0.5	0.23
AT-960, AS-5103/ARC-513 (V)	2.8	1.27

1.5 TECHNICAL CHARACTERISTICS (cont.)

1.5.5 TRANSCEIVER MOUNT

Physical Dimensions and Weight:

1N96/1N97/MT-5178/ ARC-513 (V)	See Figure 2.3-1
IN-96A/IN-97A	See Figure 2.3-2

1.6 SYSTEM COMPONENTS

The following are the currently defined components of the RT-7200, RT9600, AN/ARC-513 (V) Transceiver Systems.

1.6.1 COMMERCIAL TRANSCEIVERS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
RT-7200-0	7200 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Recessed Connector.	400-0087-000
RT-7200-1	7200 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Recessed Connector, with Guard Receiver.	400-0087-001
RT-7200-2	7200 Channel VHF HI-Band Transceiver, 14/28 VDC,100 mW Audio, Recessed Connector, with CTCSS Tones.	400-0087-002
RT-7200-3	7200 Channel VHF HI-Band Transceiver, 14/28VDC, 100mW Audio, Recessed Connector, with Guard Receiver and CTCSS Tones.	400-0087-003
RT-9600-2	9600 Channel VHF HI-Band Transceiver, 14/28VDC, 100mW Audio, Protruding Connector.	400-0052-002
RT-9600-5	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Protruding Connector, with Guard Receiver.	400-0052-005

1.6 SYSTEM COMPONENTS (cont.)

1.6.1 COMMERCIAL TRANSCEIVERS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
RT-9600-8	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Protruding Connector with CTCSS Tones.	400-0052-008
RT-9600-11	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, protruding Connector, with Guard Receiver and CTCSS Tones.	400-0052-011
RT-9600-24	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Recessed Connector.	400-0052-024
RT9600-25	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver.	400-0052-025
RT-9600-26	9600 Channel VHF HI-Band Transceiver 14/28 VDC, 100 mW Audio, Recessed Connector, with CTCSS Tones.	400-0052-026
RT-9600-27	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100 mW Audio, Recessed Connector, with Guard Receiver and CTCSS Tones.	400-0052-027

1.6.2 MILITARY TRANSCEIVERS

JETDS NUMBER	DESCRIPTION	WEI PART NUMBER
RT-5052/ ARC-513 (V)	Similar to the discontinued RT-9600-12 and having defined GD 1 and GD 2 frequencies installed.	400-0052-999
RT-5065/ ARC-513 (V)	Similar to RT-7200-1 and having defined GD 1 and GD 2 frequencies installed.	400-0087-005

1.6 SYSTEM COMPONENTS (cont.)

1.6.3 DISCONTINUED COMMERCIAL TRANSCEIVERS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
RT-9600-0	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio, Recessed Connector.	400-0052-000
RT-9600-1	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio, Protruding Connector.	400-0052-001
RT-9600-3	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio Recessed Connector, with Guard Receiver.	400-0052-003
RT-9600-4	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio Protruding Connector, with Guard Receiver	400-0052-004
RT-9600-6	9600 Channel VHF Hi-Band Transceiver, 14/28VDC, 10W Audio, Recessed Connector, with CTCSS Tones.	400-0052-006
RT-9600-7	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio, Protruding Connector, with CTCSS Tones.	400-0052-007
RT-9600-9	9600 Channel VHF Hi-Band Transceiver, 14/28VDC, 10W Audio, Recessed Connector, with Guard Receiver and CTCSS Tones.	400-0052-009
RT-9600-10	9600 Channel VHF Hi-Band Transceiver, 14/28 VDC, 10W Audio Protruding Connector, with Guard Receiver and CTCSS Tones.	400-0052-010

1.6 SYSTEM COMPONENTS (cont.)

1.6.3 DISCONTINUED COMMERCIAL TRANSCEIVERS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
	*NOTE: These Transceivers (RT-9600-12 through RT-9600-23) contain a special IF Bandwidth R/T module that gave the main receiver a Modulation Acceptance BW specification of ± 9.0 kHz minimum. It was designed to allow improved ADF compatibility. The degree of improvement, however, is not sufficient to warrant consideration of this model variation for future applications.	
*RT-9600-12	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Recessed Connector	400-0052-012
*RT-9600-13	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Protruding Connector.	400-0052-013
*RT-9600-14	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Protruding Connector.	400-0052-014
*RT-9600-15	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Recessed Connector, with Guard Receiver.	400-0052-015
*RT-9600-16	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Protruding Connector, with Guard Receiver.	400-0052-016
*RT-9600-17	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Protruding Connector, with Guard Receiver.	400-0052-017
*RT-9600-18	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Recessed Connector, with CTCSS Tones.	400-0052-018
*RT-9600-19	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Protruding Connector, with CTCSS Tones.	400-0052-019

1.6 SYSTEM COMPONENTS (cont.)

1.6.3 DISCONTINUED COMMERCIAL TRANSCEIVERS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
*RT-9600-20	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Protruding Connector, with CTCSS Tones.	400-0052-020
*RT-9600-21	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 10W Audio, Recessed Connector, with Guard Receiver and CTCSS Tones.	400-0052-021
*RT-9600-22	9600 Channel VHF HI-Band Transceiver, 14/28 VDC 10W Audio, Protruding Connector, with Guard Receiver and CTCSS Tones.	400-0052-022
*RT-9600-23	9600 Channel VHF HI-Band Transceiver, 14/28 VDC, 100mW Audio, Protruding Connector, with Guard Receiver and CTCSS Tones.	400-0052-023

1.6.4 COMMERCIAL CONTROL UNITS

C-722A-10	RT-7200 Control Unit, 138-174 MHz, 7200 Channel, 28V Integral Lights.	400-0084-010
C-722A-20	RT-7200 Control Unit, 138-174 MHz, 7200 Channel, 5V Integral Lights.	400-0084-020
C-722A-30	RT-7200 Control Unit, 138-174 MHz, 7200 Channel, 14V Integral Lights.	400-0084-030
C-962A-10	RT-9600 Control Unit, 150-174 MHz, 9600 Channel, 28V Integral Lights.	400-0073-010

1.6 SYSTEM COMPONENTS (cont.)

1.6.4 COMMERCIAL CONTROL UNITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
C-962A-20	RT-9600 Control Unit, 150-174 MHz, 9600 Channel, 5V Integral Lights.	400-0073-020
C-962A-30	RT-9600 Control Unit, 150-174 MHz, 9600 Channel, 14V Integral Lights.	400-0073-030
C-963	Tone Burst Encoder, 5 Tones, Lighted, 1 1/8 Inch High, Dzus Rail Mount.	400-0068-000
HA-4-110	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Coil Cord, Light Ash	400-0101-110
HA-4-111	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Coil Cord, Beige	400-0101-111
HA-4-112	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Coil Cord, White	400-0101-112
HA-4-113	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Coil Cord, Black	400-0101-113
HA-4-114	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Coil Cord, Ivory	400-0101-114

1.6 SYSTEM COMPONENTS (cont.)

1.6.4 COMMERCIAL CONTROL UNITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
HA-4-210	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Clear Fire Retardant Cord, Light Ash	400-0101-210
HA-4-211	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Clear Fire Retardant Cord, Beige	400-0101-211
HA-4-212	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Clear Fire Retardant Cord, White	400-0101-212
HA-4-213	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Clear Fire Retardant Cord, Black	400-0101-213
HA-4-214	Handset Assembly, Modular, Push-To-Talk for FM, with Handset, Hanger and Clear Fire Retardant Cord, Ivory	400-0101-214

1.6.5 MILITARY CONTROL UNITS

JETDS NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
C-5333/ARC-513 (V)	Same as Discontinued C-960-0	400-0053-000
C-5368/ARC-513 (V)	Same as Discontinued C-964-1	400-0064-001
C-5413/ARC-513 (V)	Similar to Discontinued C-960-3 and having pre-programmed Diode Cards	400-0053-999

1.6 SYSTEM COMPONENTS (cont.)

1.6.5 MILITARY CONTROL UNITS (cont.)

JETDS NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
C-5421/ARC-513 (V)	Similar to the Discontinued C-962	400-0073-001
C-5422/ARC-513 (V)	Similar to the Discontinued C-722	400-0084-001

1.6.6 DISCONTINUED COMMERCIAL CONTROL UNITS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
C-722	RT-7200 Control Unit, 138-174 MHz, 7200 Channel	400-0084-000
C-920	RT-9600 Control Unit, 9600 Channel, up to 20 Simplex or Semi-Duplex Channels RT-9600 Control Unit, 9600 Channel, 11 diode-wired Preset Channels.	400-0057-000
C-960-0	With 28V DC Red Lights	400-0053-000
C-960-1	With 28V DC White Lights	400-0053-001
C-960-2	With 5V DC Red Lights	400-0053-002
C-960-3	With 5V DC White Lights	400-0053-003
C-961	Control Unit, 9600 Channel, 11 Preset Channel Rotary Switch, 14 or 28V DC lights, 3 inch Dzus	400-0060-000
C-962	Control Unit, 9600 Channel, 15 Operator Settable Preset Channel Rotary Switch Control, LED Frequency Readout	400-0073-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.6 DISCONTINUED COMMERCIAL CONTROL UNITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
	Brown color RT-9600 Control Unit, 9600 Channels, 11 diode-wired Preset Channels, "DF" Position on Function Switch.	
C-964-0	With 28V DC White Lights	400-0064-000
C-964-1	With 5V DC White Lights	400-0064-001

1.6.7 INSTALLATION KITS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN-96	RT-7200/RT-9600-24 Installation Kit with Shockmount, Crimp type Connector and Crimp Sockets.	149-0029-000
	Included in the IN-96:	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (61 ea)	129-1019-000
	Shockmount Assembly	300-2122-000
IN-96A	RT-7200/RT9600-24 Installation Kit with Rigidmount, crimp type Connector and Crimp Sockets	149-0029-001
	Included in the IN-96A	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (61 ea)	129-1019-000
	Spacer, 0.75 O.D. X 0.25 I.D. X 0.316L (08 ea)	129-0021-010
	Rigidmount Assembly	300-2122-002
IN-97	RT-9600-2 Installation Kit with Shockmount, Crimp type Connector, and Crimp Sockets.	149-0033-000
	Included in the IN-97:	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (61 ea)	129-1019-000
	Shockmount Assembly	300-2122-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.7 INSTALLATION KITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN-97A	RT-9600-2 Installation Kit with Rigidmount, Crimp Type Connector and Crimp Sockets.	149-0033-001
	Included in the IN-97A:	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (61 ea)	129-1019-000
	Spacer, 0.76 O.D. x 0.25 I.D. x 0.3161 (08 ea)	191-0021-010
	Rigidmount Assembly	300-2122-003
IN-722/962	Installation Kit, C-722A/C-962A Control with Solder Type Connectors.	149-0034-000
	Included in the IN-722/962:	
	Large End Disc Latch with Screws and Nuts (02 ea)	129-1012-000
	Small End Disc Latch with Screws and Nuts (02 ea)	129-1013-000
	Large Junction Shell	129-1020-000
	Small Junction Shell	129-1021-000
	Plug, 50S, Rectangular, Solder	129-2033-000
	Plug, 25S, Rectangular, Solder	129-2034-000
	Rubber Cable, Boot, 0.312 I.D.	129-0004-000
	Rubber Cable Boot, 0.437 I.D.	179-0006-000
IN-722/962-1	Installation Kit, C-722A/C962A Control with Crimp Type Connector and Crimp Sockets.	149-0034-001
	Included in the IN-722/962-1:	
	Large End Disc Latch with screws and nuts (02 ea)	129-1012-000
	Small End Disc Latch with screws and nuts (02 ea)	129-1013-000
	Large Junction Shell	129-1020-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.7 INSTALLATION KITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN-722/962-1 (cont.)	Small Junction Shell	129-1021-000
	Crimp Socket, No.20, D Style (75 ea)	129-1046-000
	Plug, 50S D Submin, Crimp less contacts	129-2139-000
	Plug, 25S, D Submin, Crimp less contacts	129-2140-000
	Cable Boot, 0.312 I.D.	179-0004-000
	Cable Boot, 0.437 I.D.	179-0006-000

1.6.8 INSTALLATION CONNECTOR KITS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN-96A-2	Plug, 67S, DPXB, Crimp Type with sockets for Recessed Transceiver connector.	149-0029-002
	Included in the IN-96A-2:	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (64 ea)	129-1019-000
	Plug 67S, Arinc, Crimp less sockets	129-2040-000
IN-97A-2	Plug, 67S, DPXB, Crimp Type with sockets for Protruding Transceiver Connector.	149-0033-002
	Included in the IN-97A-2:	
	Size 16 Socket (03 ea)	129-1017-000
	Size 20 Socket (64 ea)	129-1019-000
	Jack, 67S, Arinc, crimp less sockets	129-2045-000
IN-960	Plug, 22-55S, Round Cable Mounting, solder with cable boot	149-0030-000
	Included in the IN-960:	
	Plug, 22-55S, Cable Mtg, Solder	129-2042-000
	Rubber Cable Boot, 0.437 I.D.	179-0006-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.8 INSTALLATION CONNECTOR KITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN722/962-2	Plug 25S, D, Solder Type with latches and cable boot.	149-0034-002
	Included in the IN-722/962-2:	
	Small End Disc Latch with screws and nuts (02 ea)	129-1020-000
	Small Junction Shell	129-1021-000
	Plug, 25S, D, Submin, Solder	129-2034-000
	Cable Boot, 0.312 I.D.	179-0004-000
IN-722/ 962-3	Plug, 50S, D, Solder Type with latches and cable boot.	149-0034-003
	Included in the IN722/962-3:	
	Large End Disc Latch with screws and nuts (02 ea)	129-1013-000
	Large Junction Shell	129-1020-000
	Plug, 50S, D, Submin, Solder	129-2033-000
	Rubber Cable Boot, 0.437 I.D.	179-0006-000
IN-722/ 962-4	Plug, 25S, D, Crimp type with Sockets, latches and cable boot.	149-0034-004
	Included in the IN-722/962-4:	
	Small End Disc Latch with screws and nuts (02 ea)	129-1013-000
	Small junction shell with screws and nuts (02 ea)	129-1021-000
	Crimp Sockets, No.20, D style (25 ea)	129-1046-000
	Plug, 25S, D, Submin, crimp less sockets	129-2140-000
	Rubber Cable Boot, 0.312 I.D.	179-0004-000
IN-722/ 962-5	Plug, 50S, D, Crimp type with sockets, latches and cable boot	149-0034-005
	Included in the IN-722/962-5:	
	Large End Disc Latch with screws and nuts	129-1012-000
	Large Junction Shell	129-1020-000
	Crimp Sockets, No.20, D style (50 ea)	129-1046-000
	Plug, 50S, D, Submin, crimp less sockets	129-2139-000
	Rubber Cable Boot, 0.437 I.D.	179-0006-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.8 INSTALLATION CONNECTOR KITS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
IN-963	Plug, 9S, Rectangular, with hood, lever locks, and Cable Boot.	149-0041-000
	Included in the IN-963:	
	Plug, 9S, Rectangular with hood and lever locks	129-2018-000
	Rubber Cable Boot, 0.220 I.D.	179-0005-000
IN-200-0	Plug, 22-55S, Round Cable Mounting, Crimp Type with Sockets and Cable Boot	149-0058-000
	Included in the IN-200-0:	
	Crimp Sockets, No. 20 (55 ea)	129-1041-000
	Plug, 22-55S, cable mount, crimp less sockets	129-2109-000
	Rubber cable boot, 0.437 I.D.	179-0006-000

1.6.9 ANTENNAS, MICROPHONE AND ACCESSORY

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
AT-31	Antenna, D and M, 30-50 118-152, 138-174 MHz Broadband Blade	121-0016-000
AT-690	Antenna, High-Band VHF, 17 Inch Fiberglass Whip	121-0004-000
AT-695	Antenna, High-Band VHF, Whip, 4-Hole Mtg	121-0019-000
AT-960	Antenna, High-Band VHF Jet Blade	121-0010-000
M-66T	Microphone, Telex 66T Aircraft, Noice Canceling	137-0022-000
TC-1	Transportable Case, Samsonite, for RT-7200/RT-9600 Systems	400-0104-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.10 MODULES AND CRYSTALS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
XTL-MC96EU	RT-7200/RT-9600 Guard Receiver Module crystal ground for specified frequency per each, installed by user	139-0046-000
MC-72A-0	R/T Module, RT-7200	300-2165-000
MC-72B-0	Synthesizer Module, RT-7200	300-2166-000
MC-72E-0	Two Channel Guard Receiver Module, RT-7200	300-2169-000
MC-96A	R/T Module, RT-9600	300-2097-000
MC-96B	Synthesizer Module, RT-9600	300-2098-000
MC-96C	Power Supply Module, RT-7200 and RT-9600	300-2099-000
MC-96D-1	Audio Module, 100 mWatt, RT-7200 and RT-9600-2/27	300-2100-001
MC-96E-1	Two Channel Guard Receiver Module, RT-9600	300-2101-001
MC-96F-0	Tone Squelch Module, eight subaudible CTCSS Tones, RT-7200 and RT-9600	300-2102-000
HC-4-000	HA-4/WH-5 Handset Coil Cord, Modular Plugs, Light Ash	123-1025-000
HC-4-001	HA-4/WH-5 Handset Coil Cord, Modular Plugs, Beige	123-1025-001
HC-4-002	HA-4/WH-5 Handset Coil Cord, Modular Plugs, White	123-1025-002
HC-4-003	HA-4/WH-5 Handset Coil Cord, Modular Plugs, Black	123-1025-003

1.6 SYSTEM COMPONENTS (cont.)

1.6.10 MODULES AND CRYSTALS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
HC-4-004	HA-4/WH-5 Handset Coil Cord, Modular Plugs, Ivory	123-1025-004
HC-4F-0	HA-4/WH-5 Clear Fire Retardant Handset Coil Cord, Modular Plugs	123-1026-000
HC-4R-0	HA-4/WH-5 Retractable Cord Unit, Black Case, Modular Plug, Grey Cord	300-2265-000
HH-4-010	HA-4 Handset Hanger, for use with Semi-Duplex Flitecomm FM, Light Ash	400-0101-010
HH-4-011	HA-4 Handset Hanger, for use with Semi-Duplex Flitecomm FM. Beige	400-0101-011
HH-4-012	HA-4 Handset Hanger, for use with Semi-Duplex Flitecomm FM, White	400-0101-012
HH-4-013	HA-4 Handset Hanger, for use with Semi-Duplex Flitecomm FM, Black	400-0101-013
HH-4-014	HA-4 Handset Hanger, for use with Semi-Duplex Flitecomm FM, Ivory	400-0101-014
HS-4-020	HA-4 PTT Handset, for use with Flitecomm and Flexcomm FM, Light Ash	300-2174-020
HS-4-021	HA-4 PTT Handset, for use with Flitecomm and Flexcomm FM, Beige	300-2174-021

1.6 SYSTEM COMPONENTS (cont.)

1.6.10 MODULES AND CRYSTALS (cont.)

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
HS-4-022	HA-4 PTT Handset, for use with Flitecomm and Flexcomm FM, White	300-2174-022
HS-4-023	HA-4 PTT Handset, for use with Flitecomm and Flexcomm FM, Black	300-2174-023
HS-4-024	HA-4 PTT Handset, for use with Flitecomm and Flexcomm FM, Ivory	300-2174-024

1.6.11 MAINTENANCE MANUALS

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
SM-9600	Maintenance Manual - RT-9600	150-0058-000
SM-7200	Maintenance Manual - RT-7200	150-0082-000
SM-722/722A/ 962/962A	Maintenance Manual, C-722/ C-722A/C-962/C-962A Control Units	150-0073-000
SM-963	Maintenance Manual, C-963 Control Unit	150-0068-000
SM-TC1	Maintenance Manual, TC-1 Transportable Case	150-0103-000

1.6 SYSTEM COMPONENTS (cont.)

1.6.12 TEST EQUIPMENT

MODEL NUMBER	DESCRIPTION	WULFSBERG PART NUMBER
EC-41	Module Extender Card, RT-9600	300-2084-000
EC-962	Logic Board Extender Cable C-722A/C-962A	149-0051-000
TS-961	VHF FM High-Band Synthesized Control Unit to Test RT-7200/ RT-9600 Transceivers	400-0089-000
TSH-96	Bench Test Harness Kit, RT-7200/RT-9600	149-0050-000

1.6.13 MILITARY ACCESSORIES

JETDS NUMBER	DESCRIPTION	WEI PART NUMBER
MT-5178/ ARC-513(V)	Transceiver Shockmount, same as IN-96	149-0029-000
AS-5103/ ARC-513(V)	Antenna, same as the AT-960	121-0010-000
TS-5125/ ARC-513(V)	Test Set, 138 to 174 MHz, for testing the RT-5052/ ARC-513(V) and RT-5065/ ARC-513(V) Transceivers	400-0091-000
TS-5141/ ARC-513(V)	Test Set, 138 to 174MHz, for testing the C-5333, C5368, C-5413, C-5421, and C-5422 Control Units	400-0067-001

1.7 CONTROL FUNCTION

The function of each control on the C-960 and C-961 (identical in features and functions to that of the C-960) are shown in Figure 1.7-1. The C-961 has an additional feature from that of the C-960. Above the thumbwheels there is an additional space for a stick-on label (WEI P/N 156-0096-000) to indicate the preset frequencies installed. The functions and controls of the C-722/C-962 are shown in Figure 1.7-2, those of the C-722A/C-962A in Figure 1.7-3 and those of the C-920 in Figure 1.7-4.

NOTE

The C-722/C-722A and C-962/C-962A Control Units have an internally accessible THUMBWHEEL ENABLE switch (A4S1C). When this switch is in the OFF position (leverarm away from PC board toward bottom of unit), the manual (M) channel selector position becomes inoperative.

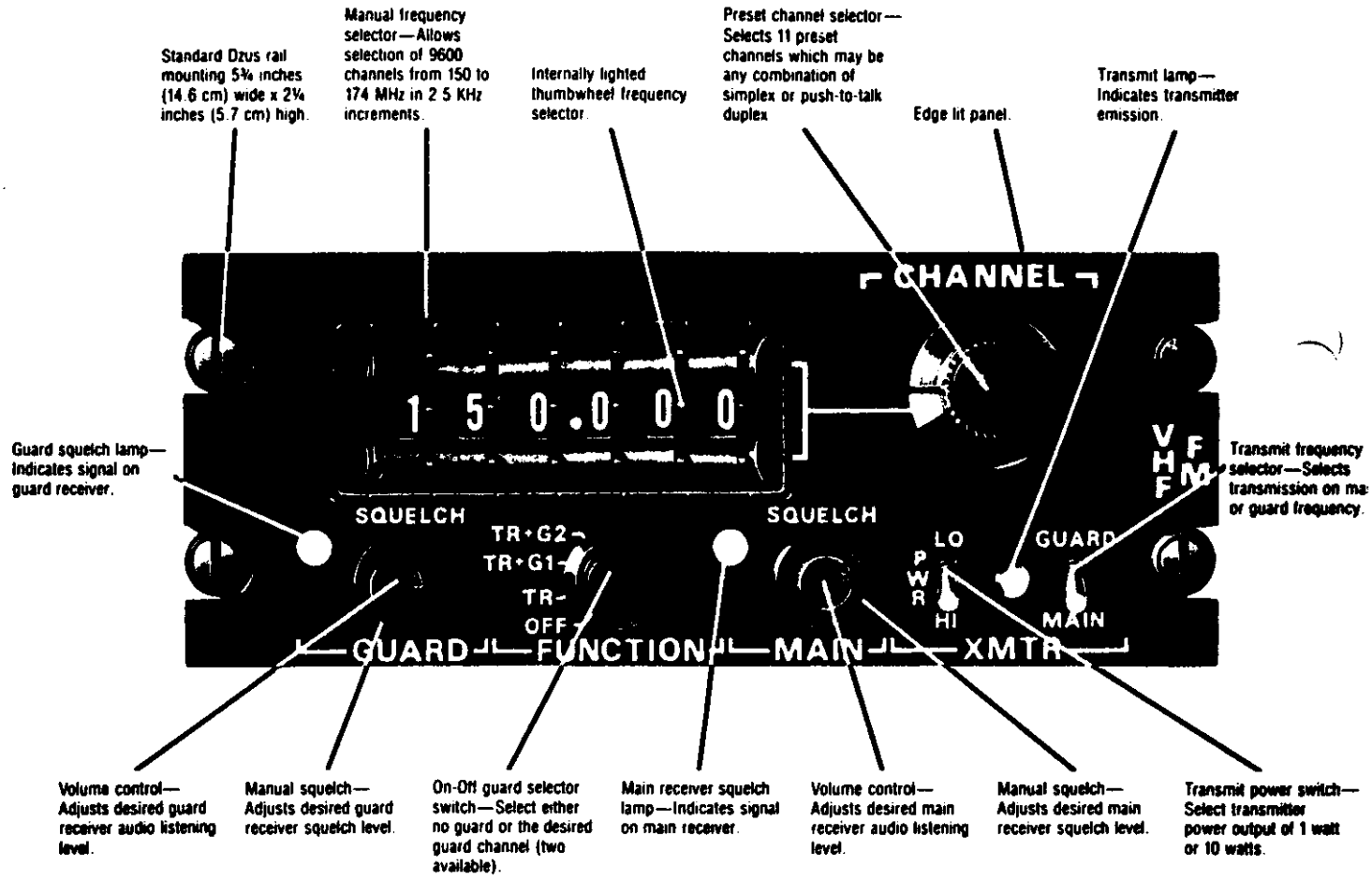
When the THUMBWHEEL ENABLE switch (A4S1C) is in the ON position, any operator of the system must be responsible for assuring proper operation as required by FCC Rules and Regulations, paragraph 90.433.

1.8 PRESET CHANNELS

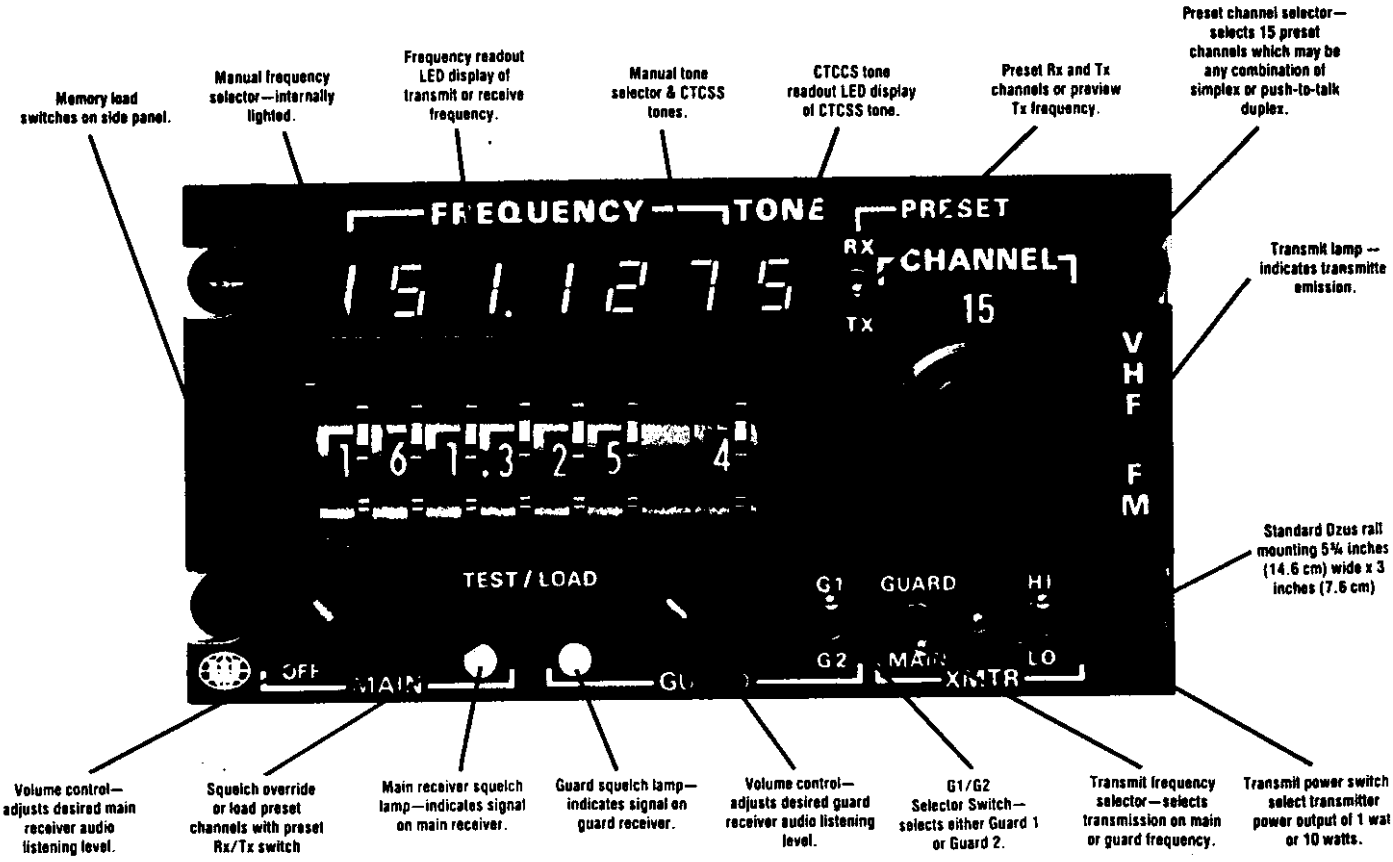
Each of the control units feature the capability to preset the transmit and receive frequencies as well as the tone squelch frequencies. By inserting diodes in the channel cards as outlined in Section 1.10, it is possible to program the control unit to cause the transceiver to transmit on a different frequency than it receives and to use a different tone squelch, or none at all, on transmit than receive. Using the preset feature, there are no restrictions on transmit to receive frequency spacing or combinations of tone squelch functions. The C-722/C-722A/C-962/C-962A Control Units do not use diode channel cards, instead their channels are front panel programmable.

1.9 TONE SQUELCH (CTCSS)

This is an option in the RT-7200/RT-9600 that will allow the receiver audio to be heard only when the transmitter being received is modulated with a continuous tone in the frequency range of 50 to 250 Hz. The exact frequency necessary to open the tone squelch is determined by the coding of the TONE SELECT lines in the transceiver See the RT-7200 or RT-9600 Maintenance Manual for adjustment details.

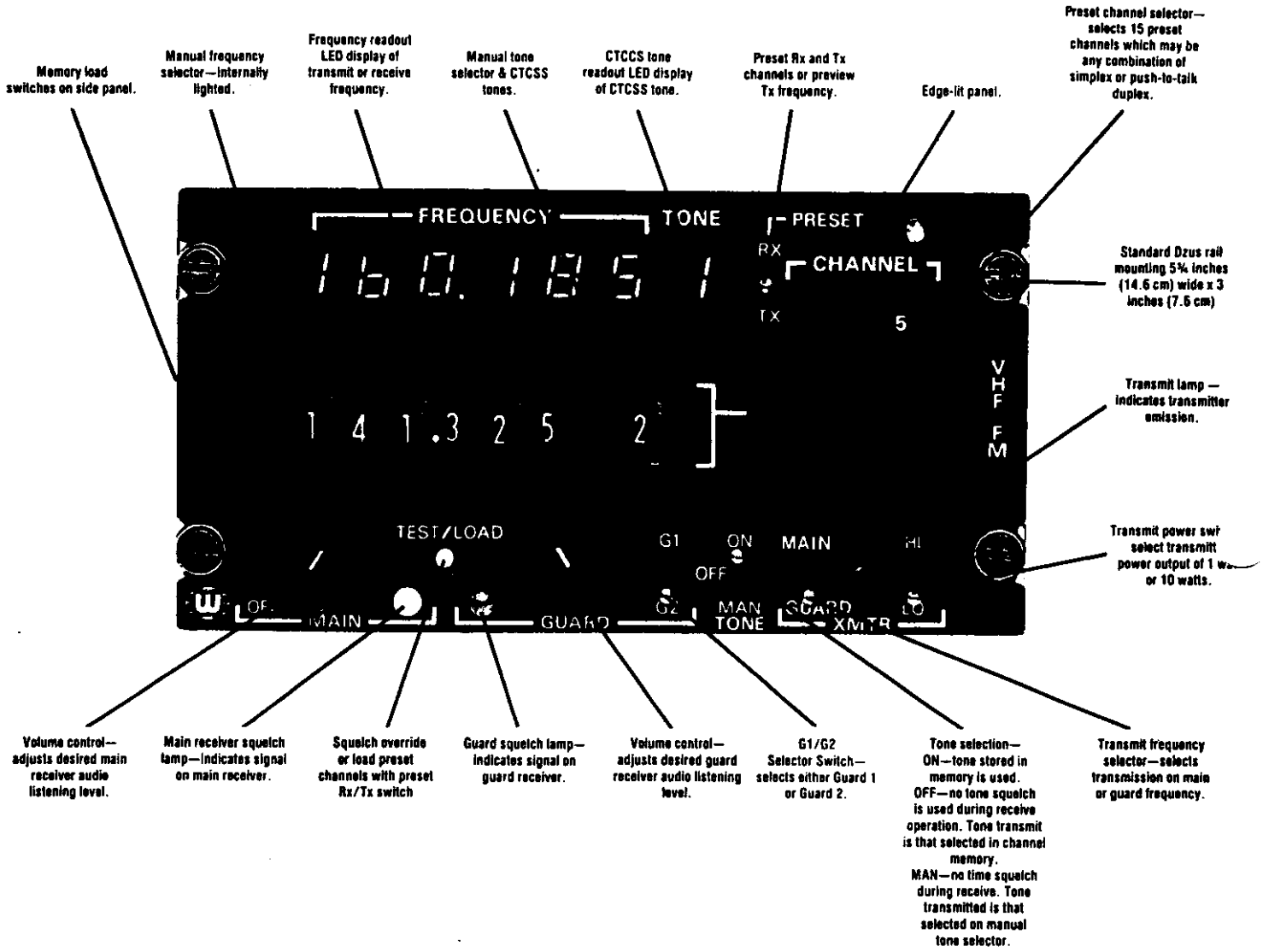


CONTROLS AND FUNCTIONS OF THE
C-960 AND ARC-513 (V): C-5333, C-5368, C-5413
FIGURE 1.7-1



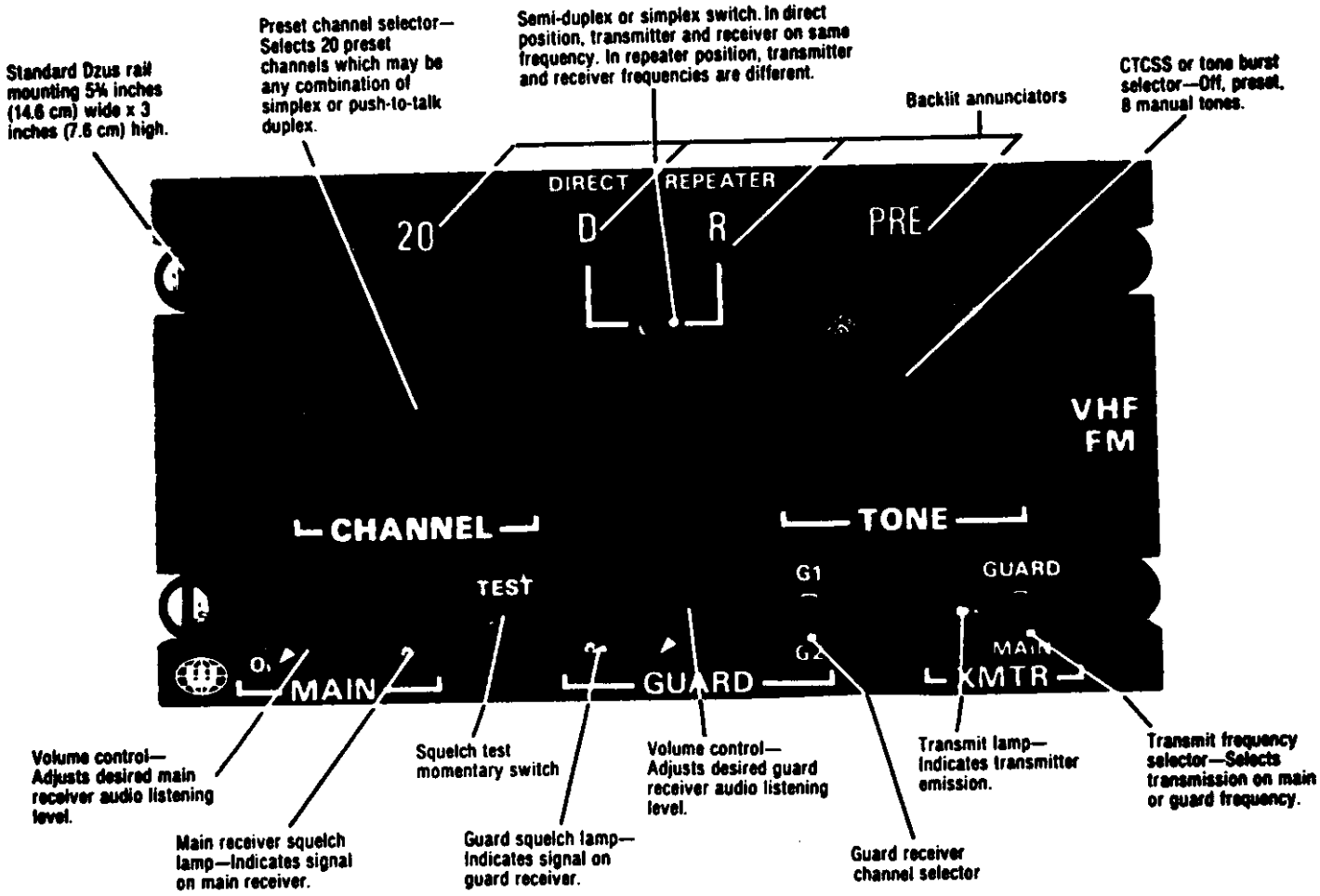
NOTE: All C-722 and recent C-962 Control Units have an internally accessible THUMBWHEEL ENABLE switch (A4S1C). When this switch is placed in the OFF (leverarm away from PC Board towards bottom of unit) position, the manual M channel selector position becomes inoperative.

CONTROLS AND FUNCTIONS OF THE
C-722/C-962 AND ARC-513 (V): C-5421, C-5422
FIGURE 1.7-2



NOTE: All C-722A and recent C-962A Control Units have an internally accessible THUMBWHEEL ENABLE switch (A4S1C). When this switch is placed in the OFF (leverarm away from PC Board towards bottom of unit) position, the manual M channel selector position becomes inoperative.

CONTROLS AND FUNCTIONS OF THE C-722A/C-962A
FIGURE 1.7-3



CONTROLS AND FUNCTIONS OF THE C-920
FIGURE 1.7-4

1.9 TONE SQUELCH (CTCSS) (cont.)

When used on transmit, the tone squelch signal will modulate the transceiver at a typical deviation of 700 Hz and will open the squelch on another receiver equipped to recognize the tone frequency being transmitted. The tone frequency transmitted is selected by the TONE SELECT lines in the same manner as the receive tone.

Tone squelch is not programmed on the MANUAL channel of the C-960 or C-961, but may be selected on any preset channel in the C-960, C-961 or C-920. To allow a squelch test to be heard on the C-960 or C-961, it is necessary to select a preset channel not having tone squelch programmed or to switch to the MANUAL channel.

For the C-722/C-722A/C-962/C-962A, the CTCSS tone squelch may be preset to one of eight possible tone frequencies, on each of the 15 programmable channels. The transmit and receive tones may be different. With the channel selector in the MANUAL position, the tone selection is directly controlled by the TONE THUMBWHEEL switch. Transmit and receive tones are the same for this condition.

1.10 PRESET CHANNEL PROGRAMMING INSTRUCTIONS FOR THE C-920, C-960 AND C-961

Four things (Receive Frequency, Transmit Frequency, Receive Tone Number, and Transmit Tone Number) must be known before a channel is programmed.

This information is then changed to Binary Coded Decimals by converting every number in each piece of data. Each tone number requires consideration of just one number (0 through 7) and each frequency requires conversion of seven numbers. For example, 173.9675 MHz has 7 numbers while tone 4 has one.

First, convert each number to 8-4-2-1 BCD with the following routine. Thinking of 1,2,4, and 8 select the appropriate combination that will add together to equal the number under consideration. For instance, 4 plus 2 equals six.

1.10 PRESET CHANNEL PROGRAMMING INSTRUCTIONS FOR THE C-920, C-960 AND C-961 (cont.)

Second, install diodes in the card locations corresponding to the combination of 1, 2, 4, and 8 selected. Since a 2 and a 4 are required to make the 6 needed in the example, place a diode in the 0.02 and the 0.04 position on the preset card to program the second digit to the right of the decimal point (the 6 in the example). To program the first digit to the right of the decimal use the 0.1, 0.2, 0.4, and 0.8 positions. For other positions use the locations labeled accordingly. The 100 and 40 locations are internally wired and consequently no diode positions will be found.

The right two numbers in the frequency are programmed slightly differently. To program them, simply disregard the rightmost number (5 in the example) and select the appropriate combination of 2 and 5 that adds to equal the next to rightmost number (7 in the example) and place diodes in those locations.

The Tone Number is programmed exactly like the frequency except on the Diode Card; A is used in place of 1, B in place of 2, C in place of 4, and D in place of 8 in programming tones. Always place a diode in the D location to enable the tone function even though it is not required to add up to the tone number desired. **LEAVE ALL TONE LOCATIONS (A, B, C, AND D) EMPTY IF NO TONE OPERATION IS DESIRED.**

Place all diodes on the side of the card with pin M and connect the cathodes to pin M for receive programming and to pin 11 for transmit programming.

The guard transmit frequencies are coded in the same way as the main frequencies with Guard 1 transmit diodes connected to pin M and Guard 2 transmit diodes connected to pin 11.

When the card is programmed, label it at the top with the frequencies programmed. Label the receive frequency on the side with pin M and the transmit frequency on the side with pin 11, and place it in the proper channel connector in the control unit. (See Figures 1.10-1 and 1.10-2).

Stick-on labels are provided for recording how a control unit is preset and should be affixed to the cover of the control unit. Replacement labels may be obtained from Wulfsberg by ordering part number 156-0094-000 for the C-960 and C-961 and 156-0106-000 for the C-920.

1.10 PRESET CHANNEL PROGRAMMING INSTRUCTIONS FOR THE C-920, C-960, AND C-961 (cont.)

The following are examples of where diodes would be placed to program various frequencies and tones.

156.690 Tone 2 Transmit

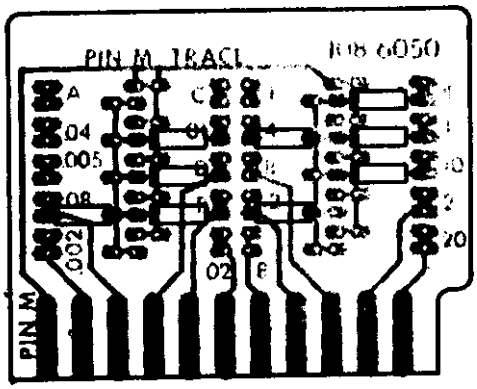
Diodes in lines labeled 10, 1, 4, 0.2, 0.4, 0.01, 0.08, B, D, with cathodes on trace to pin 11.

168.807 Tone 5 Receive

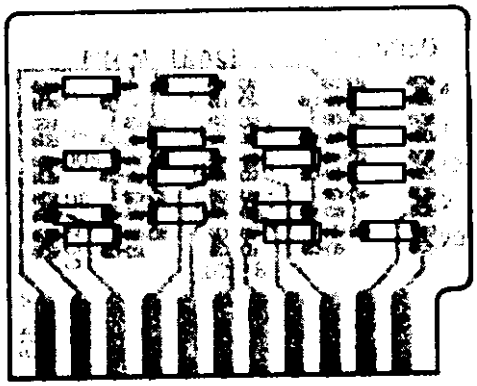
Diodes in lines labeled 20, 8, 0.8, 0.002, 0.005, A, C, D with cathodes on trace to pin M.

172.565 No Tone Guard 1 Transmit

Diodes in lines labeled 10, 20, 2, 0.1, 0.4, 0.02, 1.04, 0.005 with cathodes on trace to pin M.

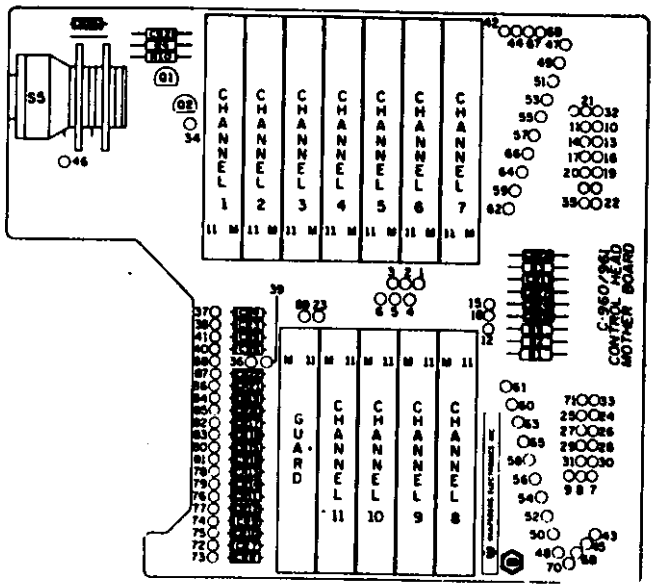


DIODES IN PLACE FOR
155.690 TONE 2 TRANSMIT



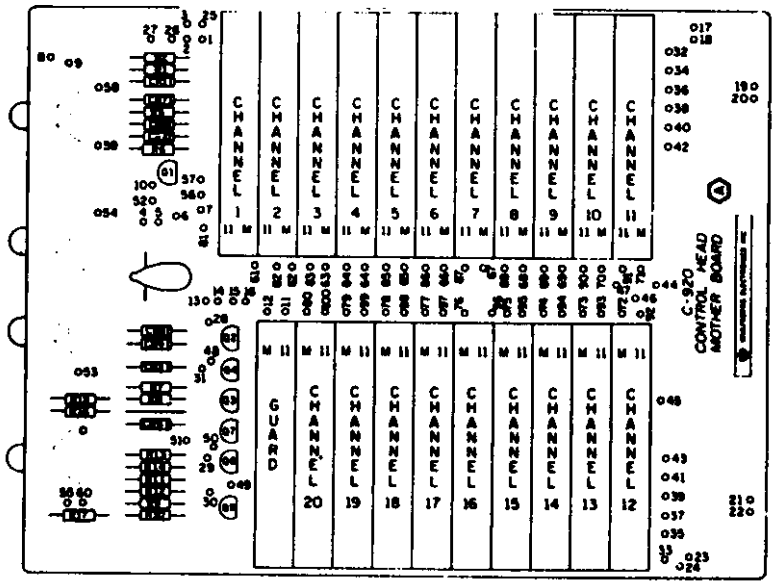
155.690 TONE 2 TRANSMIT
PLUS 168.8075 TONE 2 RECEIVE

FRONT
OF
CONTROL



C-960/C-961 PRESET CHANNEL CARD LOCATIONS
FIGURE 1.10-1

FRONT
OF
CONTROL



C-920 PRESET CHANNEL CARD LOCATIONS
FIGURE 1.10-2

1.11 PRESET CHANNEL PROGRAMMING INSTRUCTIONS FOR THE C-722/C-722A/ C-962/C-962A

NOTE

The C-722/C-722A and C-962/C-962A Control Units have an internally accessible THUMBWHEEL ENABLE switch (A4S1C). When this switch is in the OFF position (leverarm away from PC Board toward bottom of unit), the manual (M) channel selector position becomes inoperative.

When the THUMBWHEEL ENABLE switch (A4S1C) is in the ON position, any operator of the system must be responsible for assuring proper operation as required by FCC Rules and Regulations, paragraph 90.433.

1.11.1 THUMBWHEEL ENABLE FUNCTION

The THUMBWHEEL ENABLE FUNCTION is provided to prevent control unit programming by individuals not responsible for assuring proper operation per FCC Rules and Regulations, paragraph 90.433.

In order to program the preset channels on a C-722/C-722A or a C-962/C-962A (one having a Mod 1, or above, Logic Board) proceed as follows:

1. Set switch A4S1C to the ON (leverarm up) position. See Figure 1.11-1 for location and operation of switch.
2. Program the Main TX/RX and Guard TX (if desired) frequencies as described in Sections 1.11.2 and 1.11.3.
3. Set switch A4S1C to the OFF (leverarm down) position.

1.11.2 MAIN TX/RX FREQUENCY

1. Set switch A4S1 on Logic Board labled MEMORY LOAD to the ON position. Set A4S1C to the MAIN LOAD position. See Figures 1.7-2 and 1.7-3 for switch locations.
2. Select the desired channel to be programmed on the CHANNEL SELECTOR knob.
3. Set up TX frequency and CTCSS tone on the thumbwheels. (If no tone is desired, set the CTCSS selector to the OFF position.)

1.11 PRESET CHANNEL PROGRAMMING INSTRUCTIONS FOR THE C-722/C-722A/C-962/C-962A (cont.)

1.11.2 MAIN TX/RX FREQUENCY (cont.)

4. Set TX selector to MAIN.

5. Operate LOAD SELECT switch to TX LOAD position.

6. Push and release TEST/LOAD button. The TX frequency is now loaded for the selected channel.

7. Set up RX frequency and CTCSS tone on the thumbwheel.

8. Operate LOAD SELECT switch to RX LOAD position.

9. Push and release TEST/LOAD button. The RX frequency is now loaded for the selected channel.

10. Changes in stored channel information may be inhibited by operating MEMORY LOAD switch A4S1B to the OFF position.

CAUTION

All unallocated channel locations must be programmed to 1000.000 MHz TX and RX.

1.11.3 GUARD TX FREQUENCY

1. Set internal switch A4S1B on Logic Board labeled MEMORY LOAD to the ON position. Set internal switch A4S1A to the GUARD LOAD position.

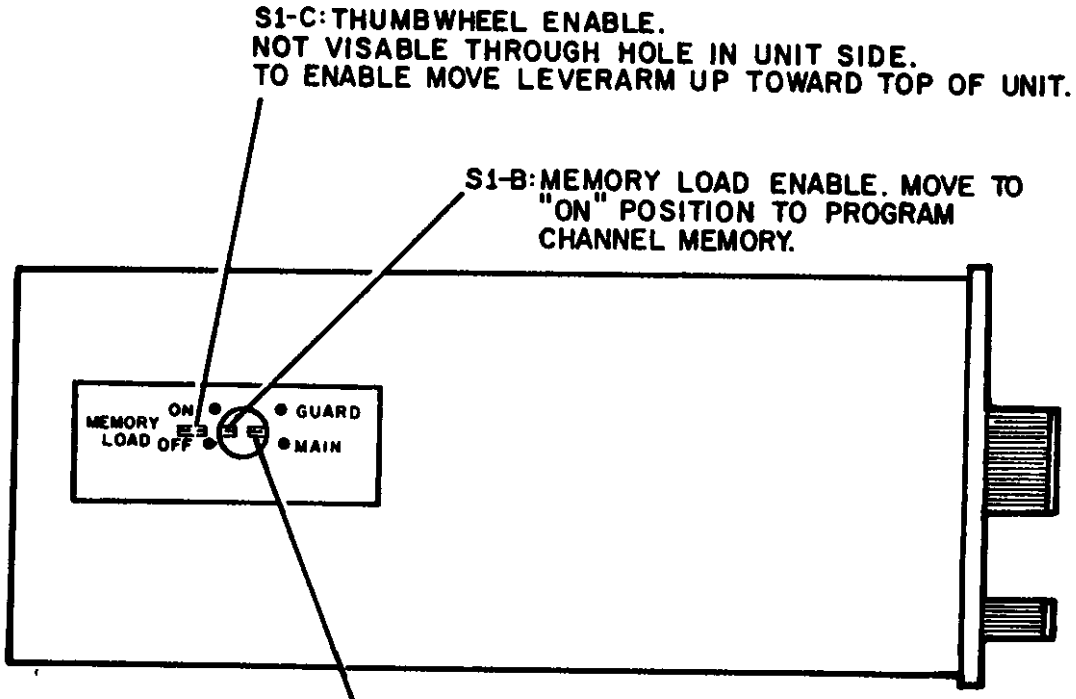
2. Any channel other than manual may be selected for the guard frequency programming operation.

3. Set GUARD TX SELECTOR switch to the particular Guard channel to be programmed (G1 or G2).

4. Set up TX frequency and CTCSS tone on the thumbwheels. (If no tone is required, set the TONE SELECTOR thumbwheel in the OFF position.)

5. Set TX-GUARD/MAIN selector to GUARD position.

6. Operate LOAD SELECT switch to TX LOAD position.



C-722A/C-962A OPERATIONAL MODE SWITCHES
FIGURE 1.11-1

1.11 PRESET CHANNEL PROGRAMMING INSTRUCTION FOR THE C-722/C-722A/C-962/C-962A (cont.)

1.11.3 GUARD TX FREQUENCY (cont.)

7. Push and release TEST/LOAD button. The Guard TX frequency is now loaded.

8. To load the other TX Guard frequencies, repeat steps 3 through 7.

9. Changes to guard frequencies may be inhibited by operating the internal MEMORY LOAD switch to the OFF position or by returning the GUARD/MAIN LOAD switch to the MAIN position.

NOTE

For proper control operation, the GUARD/MAIN switch MUST be returned to MAIN position.

CAUTION

Any unallocated Guard TX channel location(s) must be programmed to 100.0000 MHz.

1.12 FREQUENCY/TONE REVIEW (C-722/C-722A/C-962/C-962A)

NOTE: Do not operate the TEST/LOAD button during this procedure.

1.12.1 UNKEYED TRANSMITTER (C-722/C-962)

The frequency display will show the receive frequency and tone associated with the particular channel selected on the CHANNEL SELECTOR switch.

1.12.2 UNKEYED TRANSMITTER (C-722A/C-962A)

If the seven segment frequency display has been enabled by grounding rear connector P2, pin 23, the display will show the receive frequency and tone being used. To review channel memory of both frequency and tone information, make certain that the TONE switch is in the ON position, otherwise the tone stored in memory will not be displayed. If P2, pin 23 has not been grounded, the received frequency/tone information can still be reviewed by placing the PRESET switch into the RX position.

1.12 FREQUENCY/TONE REVIEW (C-722/C-722A/C-962/C-962A) (cont.)

1.12.3 KEYED TRANSMITTER (C-722/C-962)

The frequency display will immediately show the transmit frequency and tone. It may be different than the receive frequency, on any selected channel other than manual.

1.12.4 KEYED TRANSMITTER (C-722A/C-962A)

If the seven segment frequency/tone display has been enabled, then the display will show the transmitter frequency and tone being used as determined by the G1/G2, XMTR MAIN/GUARD, and TONE switches.

If it is desired to review the transmit channel memory of both frequency and tone without actually transmitting, make certain that the TONE switch is in either the ON or the OFF position. Then place the PRESET switch into the TX position. This will display the transmit channel memory as determined by the G1/G2 and XMTR MAIN/GUARD switches.

1.13 MANUAL OPERATION (C-722/C-722A/C-962/C-962A)

1. Rotate the CHANNEL SELECTOR switch to the manual channel.

2. Set the thumbwheels to the frequency and tone desired. The selected frequency and tone is common to both transmit and receive operations (Simplex channel).

NOTE

The C-722/C-722A and C-962/C-962A Control Units have an internally accessible THUMBWHEEL ENABLE switch (A4S1C). When this switch is in the OFF position (leverarm away from PC Board towards bottom of unit), the manual (M) channel selector position becomes inoperative.

When the THUMBWHEEL ENABLE switch (A4S1C) is in the ON position, any operator of the system must be responsible for assuring proper operation as required by FCC Rules and Regulations, paragraph 90.733.

1.14 SPECIAL OPERATIONAL CONSIDERATIONS FOR DIRECTION FINDING APPLICATIONS

The RT-7200 and RT-9600 are designed to interface with available DF and ADF equipment that use the commutated antenna technique for generating an amplitude modulated RF envelope, the phase of which contains relative bearing information.

Systems that use high commutation rates (above several kHz), such as the Collins DF301E, require that certain FM communication compromises be made. As the signal is being monitored (while in the DF mode), its modulation can become distorted and noisy, sometimes to the point of being unintelligible, and the squelch performance can become erratic to the point of full squelch blocking. These factors do not compromise the full and accurate performance of the direction finder. It works as well as it is designed to work with any AM transceiver. The compromise is limited to the occasional inability to intelligibly communicate with the homing signal.

A further caution to consider is that inherent to its design, the Collins DF301E produces sidelobes of receiver responses which theoretically make possible false pointing on strong, nearby off-frequency signals. (This consideration is not limited to interfaces with the RT-7200 or RT-9600 only.) Depending on the frequency difference to the off-frequency interfering signal the distance relationship from the aircraft to the homing signal and from the aircraft to the off-frequency interfering signal needs to be kept less than 50 to 1, typically, to eliminate this potential. (This caution typically does not apply to systems using subaudible commutation rates.)

SECTION 2

INSTALLATION

2.1 GENERAL

This section contains instructions and considerations for the proper installation of the RT-7200 and RT-9600 Transceiver Systems.

The information presented herein is necessary for the proper operation and satisfactory performance of the equipment.

2.2 UNPACKING AND INSPECTING EQUIPMENT

Physically compare the presence of each item in the shipment with that shown on the packing list. Exercise care when unpacking each unit. Make a visual inspection of each unit for evidence of damage incurred during shipment. If a claim for damage is to be made, save the shipping container to substantiate the claim. When all equipment is unpacked, it is suggested the carton and packing material be saved for possible reshipment.

2.3 INSTALLATION - IN-96A/IN-97A RIGIDMOUNT AND MT-5178/ARC-513 (V) SHOCKMOUNT

The rigidmount captivates the transceiver and may be mounted in any convenient remote location. Allow sufficient room at the front for cable and connector entry.

Mounting dimensions for the rigidmount are shown in Figure 2.3-2 and for the Military Shockmount in Figure 2.3-1. The mount is secured to the mounting surface with Number 8 machine screws, or equivalant and appropriate lock nuts.

NOTE

The system has been vibration, temperature and altitude tested to assure performance in any aircraft environment; however, controlled environments improve the system reliability. This factor should be considered when selecting a remote site.

2.3 INSTALLATION - IN-96A/IN-97A RIGIDMOUNT AND MT-5178/ARC-513 (V) SHOCKMOUNT (cont.)

The rigidmount connector should be wired using the crimp sockets that accompany the rigidmount installation kit. The sockets should be attached to the aircraft wiring and installed into the connector using the following equipment schedule.

SOCKET	No. 16, WEI P/N 129-1017-000 ITT Cannon P/N 031-9084-001 (Accepts Wire No. 16, 18, 20)	No. 20 WEI P/N 129-1019-000 ITT Cannon P/N 031-9134-004 (Accepts Wire No. 20, 22, 24)
CRIMP TOOL	ITT Cannon P/N M22520/1-01 (with M225/1-02 head) or ITT Cannon P/N MS-3191-1 (with std. locator head) or Daniels P/N M22520/1-01 (with TH276 or TH25 head)	ITT Cannon P/N M22520/1-01 (with L-3198-20 HD head) or ITT Cannon P/N MS-3191-1 (with P20-2191-20 head) or Daniels P/N M22520/1-01 (with TH164 or TH25 head)
EXTRACTION TOOL	ITT Cannon P/N CET-16-9	ITT Cannon P/N CIET-20HDL or ITT Cannon P/N CET-20-11

Crimp, Insertion and Extraction Tool Manufacturer Names and Addresses

Daniels Manufacturing
2260 Franklin Road
Bloomfield Hills, MI
48013
(313)338-9611

ITT Cannon
10550 Talbert Avenue
Fountain Valley, CA
92708
(714)964-7400

2.4 INSTALLATION - TRANSCEIVERS (See Figures 2.4-1 and 2.4-2)

Use the installation wiring diagram appropriate to the control unit to be used and refer to the wiring consideration notes in Section 2.7.

The MIC and SIDETONE adjustments on the front of the transceiver allow variation of the levels to accommodate differences in installations. They are multiple turn potentiometers.

MIC is factory set so that 0.25 VRMS at 1000 Hz will provide standard deviation. If the microphone to be used with the transceiver does not provide standard output, its output may be compensated for by adjustment of the MIC setting.

Internal to the transceiver are HIGH POWER and LOW POWER transmitter output power adjustments. These are adjusted at the factory for 10 watt/1 watt respectively. For use under FCC Parts 83 or 90, and DOC RSS-119 and RSS-182 no adjustment of these potentiometers should be made. For use under FCC Part 87, it is mandatory that the HIGH POWER setting be adjusted so that the RF power output shall not exceed 5 watts. See the appropriate section in the RT-7200 or RT-9600 Maintenance Manual for transmitter power adjustment procedures. (NOTE: Although not specifically type accepted under Part 87, the RT-7200 and RT-9600 comply with Part 87 requirements when adjusted as outlined above.)

SIDETONE should be adjusted to a level that will give the desired audio output without causing feedback squeal when used with a speaker. The sidetone level will not be changed by the volume control on the control unit.

2.5 INSTALLATION - CONTROL UNITS

All control units are designed to mount on Dzus rails per MS-25213. The C-961 and C-920 are directly interchangeable except for depth. The following installation kits should be used with the indicated controls: C-960 with IN-960; C961 with IN-722/962; C-920 with IN-920; C-962/C-962A with IN-722/962; C-722/C-722A with IN-722/962 (See Section 1.6.7 and 1.6.8 for complete installation kit contents). Outline dimensions may be found in Figures 2.5-1 through 2.5-5. The C-722/C-722A Control Units must be used with the RT-7200.

2.6 INSTALLATION - ANTENNAS

The antennas should be mounted on the bottom of the aircraft if possible; however, top mounting is acceptable if the location is selected with consideration given to possible shadowing of the signal by aircraft structures.

Should pressure or moisture seal be required, a bead of sealant such as Dow Corning RTV-738 should be applied to the outside perimeter of the mounting surface. Mounting dimensions may be found in Figures 2.6-1, 2.6-2, 2.6-3 and 2.6-4.

VHF/FM COMMUNICATIONS TRANSCEIVER

RT-9600
AN/ARC-513(V)

MAINTENANCE MANUAL WITH PARTS LIST

U.S. FCC DATA:
TYPE ACCEPTANCE NUMBER: RT-9600
TYPE ACCEPTED UNDER PARTS: 74,83,90

CANADIAN DOC DATA:
APPROVAL NUMBERS: RSP-100 (B8559)
RSS-119 (501 191 126X)
RSS-182 (501 821 271V)

U.S. PATENT NUMBER: 4,189,689

EQUIPMENT PART NUMBERS:
RT-9600: 400-0052-000 THROUGH 400-0052-027
RT-5052A/ARC-513(V): 400-0052-998
RT-5052/ARC-513(V): 400-0052-999

MANUAL PART NUMBER: 150-0058-000
MANUAL TEXT PART NUMBER 150-0058-001
REVISION D

LIMITED ONE YEAR WARRANTY

Wulfsberg Electronics, Inc., unit of Sundstrand Corporation (hereinafter called WEI), Overland Park, Kansas has designed, engineered and constructed the equipment with the finest material and components available. This equipment has been thoroughly inspected and tested before leaving the factory.

WEI warrants each item of new equipment manufactured by it to be free from defects in design, workmanship and material under normal use for which intended for one year after date of installation.

WEI shall hereunder replace or repair (at WEI's discretion) any WEI part or component, which shall within such warranty period, be returned, transportation charges prepaid, to an authorized warranty service center. Such service centers, if authorized in advance by WEI, may return the part or unit to WEI's factory for compliance with this warranty. This warranty of parts includes bench time required to locate the defect, repair same or replace such part.

This warranty shall not apply to any unit or part thereof, which has not been installed by a WEI approved installation facility in accordance with the installation instructions, or which has been repaired or altered in anyway so to adversely affect its performance or which has been subjected to misuse, negligence or accident.

This warranty is expressly in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness, and of all other obligations or liabilities on the part of the seller.

WEI reserves the right to make changes in design or additions to or improvements in its equipment without obligation to install such additions or improvements in equipment theretofore manufactured.

RECORD OF REVISIONS

Page Number	Revision Level	Revision Date	Insertion Date	Page Number	Revision Level	Revision Date	Insertion Date
--	A	8/78					
--	B	1/80					
--	C	6/84					
ALL	D	4/86					

SERVICE INFORMATION RECORD

SEE SERVICE BULLETIN/PRODUCT INFORMATION LETTER RECORD IN SECTION 7 OF THIS MANUAL.

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(continued)

SECTION 3

THEORY OF OPERATION

3.1 GENERAL

The RT-9600 operational theory is presented in two sections. The first section is a basic presentation of module functions while the second section is a more detailed description of operation of each module. Figure 3.2-1, the RT-9600 Block Diagram, and the schematics in Section 5 will aid in the theory of operation description.

The RT-9600 is a VHF-FM Transceiver designed for airborne applications in the 150.0000 to 173.9975 MHz band. The transceiver operates simplex or semiduplex on channels spaced every 2.5 kHz in the VHF Hi-Band frequency range, for a total of 9600 available channels.

3.2 COMPLETE OPERATIONAL BLOCK DIAGRAM

The RT-9600 consists of six modules: Synthesizer, Guard Receiver, Audio, Power Supply, Tone and R/T. These modules plug into the Chassis Assembly which provides the mechanical support, electrical interconnection, and DC power conditioning for the transceiver.

The Synthesizer Module provides the low level drive for the transmitter and local oscillator injection for the main receiver. A novel patented circuit is used to greatly simplify the synthesizer design. As shown on the block diagram, the reference oscillator frequency is pulled slightly by an input logic-generated pulling voltage. Another feature of the synthesizer is a unique patented circuit that automatically tailors the modulation signal. The synthesizer contains the modulation circuitry for use in the transmit mode. A temperature controlled oven contains the stabilized Reference Oscillator Sub-Module (A3) which holds excellent frequency stability at all 9600 channels, both receive and transmit. Recent production units have the oven and reference oscillator replaced with a TCXO (see Section 3.3.1). Out-of-lock and out-of-band detectors are also a part of the synthesizer which inhibit transmitter output power whenever either condition might occur. The synthesizer is channelled from BCD complement codes ("one" equals ground, "zero" equals open circuit) applied to the tuning input lines. The synthesizer must also sense the PTT line (active ground) and provide a 20 MHz low-side shift in output frequency when in the receive mode.

3.2 COMPLETE OPERATIONAL BLOCK DIAGRAM (cont.)

The R/T Module contains the 9600 channel receiver and transmitter. It must work in conjunction with the synthesizer, and in so doing, is capable of VHF-FM and VHF-AM detection as well as 10 or 1 watt VHF-FM transmission. The R/T Module does not contain all the switching and interface circuitry required to select between transmit and receive or to squelch the receiver in the absence of a usable signal. It does contain all of the RF, IF, detector and RF power circuitry. A tuning voltage amplifier interfaces the synthesizer-generated tuning voltage with the receiver preselector. The R/T Module also contains the antenna relay and the receiver power splitter which divides the receive RF energy equally between the main and guard receivers.

The Audio Module contains all of the interfacing circuitry required to make the R/T and Synthesizer Modules perform as a complete 9600 channel transceiver. The PTT control of the antenna relay, sidetone audio, modulation signal, and the complete MIC audio processing are provided by the Audio Module. The audio power amplifier, volume control, and squelch circuitry for the main receiver are also located on the Audio Module. The volume and squelch controls are designed such that the external control signals are DC voltages only. No low level audio or video is needed at the control unit thus making the entire system immune to aircraft wiring interferences.

The Tone Module contains the tone generator which provides eight selectable subaudible tone frequencies for transmitter modulation when system compatibility with CTCSS environments is desired. The module also contains the eight tone selective filters and detectors useful in the receive side of the CTCSS system. The Tone Module provides a receiver mute signal to the Audio Module whenever the correct CTCSS tone is absent.

The Guard Receiver Module is a complete two channel receiver, lacking only an audio power amplifier. The channels are crystal controlled and the local oscillator injection is determined by two varactor tuned multiplier stages. The preselector is also varactor tuned. The tuning voltage for the multiplier and preselector is set by an independent potentiometer for each channel. Through the use of varactor tuning complete bandspreading is possible between the two channels. The guard receiver uses squelch and volume control circuitry identical to that in the Audio Module. Low level guard audio is fed to the Audio Module for amplification by the audio power amplifier.

3.2 COMPLETE OPERATIONAL BLOCK DIAGRAM (cont.)

NOTE

Two Guard Receiver Module styles are in existence. Early serial number units have a 21.4 MHz first IF frequency; the later units use a 16.9 MHz IF. See Parts Listing Sections 6.3.5 and 6.3.6 for differences.

The Power Supply Module section delivers the regulated voltages to the various modules. In addition to the unregulated 14 VDC power, the various sections of the transceiver receive regulated 5, 8.5 and 24 VDC from the power supply.

The chassis contains the module connections and intermodular wiring. In addition, the chassis also contains a 28 to 14 VDC regulator and an ON/OFF relay.

3.3 SYNTHESIZER BLOCK DIAGRAM AND CIRCUIT THEORY

The Synthesizer Module block diagram is shown in Figure 3.3-1. The VCO is an encapsulated module and for all practical purposes is considered a black box. The buffer sub-module is built in an RF shielded compartment. The TCXO or Reference Oscillator/Oven (in early production units) is a sub-module which attaches to the back side of the synthesizer printed circuit board. The remainder of the circuitry shown is located on the printed circuit board. The detailed circuit theory discussion will be aided by reference to the Synthesizer Module schematic diagram in Section 5.

3.3.1 REFERENCE FREQUENCY GENERATOR

3.3.1.1 TCXO CIRCUIT THEORY

A Temperature Compensated Crystal Oscillator (TCXO) is used to generate the 10.24 MHz signal required by the reference divider. The TCXO is a purchased subassembly with an RF output at approximately 10.24 MHz, four DC voltage outputs referred to as pulling voltages, and two DC voltage inputs for frequency control. The functions of these inputs and outputs are identical to those described in Section 3.3.1.2 for the Reference Oscillator Assembly.

3.3 SYNTHESIZER BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.3.1 REFERENCE FREQUENCY GENERATOR (cont.)

3.3.1.2 REFERENCE OSCILLATOR/OVEN CIRCUIT THEORY (EARLY PRODUCTION UNITS ONLY)

The Reference Oscillator/Oven is a self-contained frequency standard of 10.24 MHz. Refer to the synthesizer schematic, reference oscillator assembly in Section 5. The frequency determining element is high quality crystal A3Y1. It forms the resonant reactance for the stabilized Colpitts oscillator using A2Q1 and A3Q2. Components A3L2 and A3CR1 form the remaining tuned circuit reactances for the frequency standard. Inductor A3L1 and resistor A3R17 provide a high reactance DC return for A3CR1; A3C10 accommodates variations in A3CR1. DC blocking is provided by A3C1; A3C2 and A3C3 form the oscillator feedback. A highly stable DC bias is maintained on oscillator A3Q1 by use of negative DC feedback derived from the amplitude of buffer A3Q2, level shifted by A3CR2 and A3CR3, and filtered by A3L3. Resistor A3R1 is a high impedance pulling voltage feed to A3CR1. High frequency bypass is provided by A3C4, A3C5 and A3C6. Capacitor A3C7 is the output coupling capacitor. Resistors A3R2 through A2R6 provide bias.

Transistor A3Q3 in conjunction with frequency setting potentiometers A3R8 through A3R11 and A3R13, generate the four pulling voltages required for the 0.0, 2.5, 5.0, and 7.5 kHz frequency increments. Resistors A3R12 and A3R14 provide bias.

The entire reference oscillator circuitry is powered by a self-contained regulator consisting of A3U1 and A3C8.

Resistor A3R7 is the resistance wire which heats the reference oscillator to 70°C. The current control for A3R7 is derived from the oven controller consisting of A2U8 and A2Q2. A resistance bridge formed with thermistor A3R15 and resistors A3R16, A2R2, A2R3, and A2R4 force the oven temperature to be held at approximately +70°C. Capacitors A3C9 and A2C7 provide low frequency compensation for the temperature controller. Resistors A2R5 and A2R6 provide bias. Thermal fuse A3TF1 protects against oven burn-up at extremely high temperatures by cutting off heater and oscillator power.

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.1 PRESELECTOR AND TUNING VOLTAGE GENERATOR (cont.)

with RF decoupling provided by A4L28, A4C99 and A4C100. The bias for A4Q12 is supplied through A4R89 with A4R93 providing base pull-down when the GUARD CHANNEL SELECT line is activated. Collector pull-up resistors for A4Q12 and A4Q14 are A4R90 and A4R91. Drive current for A4Q14 is supplied by A4R94.

3.7.2 FIRST MIXER/IF AMPLIFIER

After passing through the preselector, the VHF signal enters diode ring broadband passive mixer A4MX1. At that point the signal is mixed with the L.O. (local oscillator) injection which is developed from the crystal oscillator and multiplier (to be described in detail in Section 3.7.6). The L.O. frequency is 21.4 or 16.9 MHz, depending on the guard receiver style, below the channel frequency. Before the L.O. injection reaches the balanced mixer, it passes through an impedance stabilizing pad network consisting of A4R7, A4R8, and A4R9.

The IF signal passes through monolithic crystal filter A4FL1. It is coupled into and out of the filter with the impedance matching networks consisting of A4L7, A4L8, A4C16 through A4C19, and A4C105.

The first IF signal is then amplified by the two stage amplifier consisting of dual-gate MOSFETs A4Q2, A4Q3 and associated circuitry. The functions of the associated components parallel closely the function of the equivalent parts in the RF amplifier. Gate number 1 bias voltages are generated through A4R12 and A4R13 for A4Q2 and A4R17 and A4R18 for A4Q3. Decoupling capacitors A4C22, A4C23, A4C26, and A4C27 are provided on gate number 1 bias. Gate number 2 bias is supplied to the IF amplifiers through A4R10, A4R11, A4R16, and A4R19 with AC bypass provided by A4C20, A4C21, A4C29, and A4C30. The operating currents of the amplifiers are set with source resistors A4R14 and A4R20, with AC source bypass capacitors A4C24, A4C25, A4C31, and A4C32. The drain's 8.5 VDC supply is fed through the decoupling networks consisting of A4R15, A4R24, A4C26, A4C27, A4C33, A4C34, A4L11, and A4L12.

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.2 FIRST MIXER/IF AMPLIFIER (cont.)

The drains are tuned to approximately the IF frequency with A4L10 and A4L13 which resonate with the output capacitance of the respective stage and the input capacitance of the following stage. A "Q" lowering resistor (A4R23) is provided in the drain circuit of A4Q3. Capacitor A4C28 couples between the first and second stage. The 6.2 VDC gate number 2 bias is generated by the voltage divider consisting of A4R21 and A4R22 and decoupled through A4L9.

3.7.3 SECOND MIXER/IF AMPLIFIER

The first IF amplifier output signal is coupled into the second mixer through A4C35. The second mixer is a class B amplifier consisting of A4Q4 and associated circuitry. A very light base bias is provided to the grounded emitter circuit through A4R25. A resonant circuit consisting of A4L14 and A4C37 tunes the collector at 455 kHz and supplies DC feed. Resistor A4R26 is necessary to limit the tuned circuit "Q".

The second L.O. injection is coupled into the mixer through coupling capacitor A4C36. The second L.O. signal is generated by JFET oscillator A4Q6 and associated circuitry. The N-channel device has the DC gate return to ground provided by A4R45. The drain current is set by A4R43 and the DC power feed is through A4R42, A4C60 and A4L25. The oscillator is a Pierce design in which A4Y1 resonates with A4C61 and A4C63 at 21.855 or 17.355 MHz, depending on the guard receiver style. The injection drive to A4Q4 is limited by A4R44 and source bypass is accomplished with A4C62.

The output of the second mixer, which is the 455 kHz second IF frequency, is coupled to the second IF amplifier through A4C38. The amplifier is a collector feedback design using A4Q5 as the active device. A stabilized bias is provided by A4R28 and A4R29 which supply base bias from the collector voltage. The collector load is A4R27 and is supplied with DC power through DC coupling inductor A4L15 and bypass capacitor A4C39. A parallel resonant circuit, which is coupled to the collector through A4C116, is formed by A4L36 and A4C115.

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.3 SECOND MIXER/IF AMPLIFIER (cont.)

The output of the second IF amplifier is applied to 6-pole ceramic filter A4FL2. The filter has a bandwidth of ± 13 kHz and is used to improve the adjacent channel rejection properties of the transceiver since the primary selectivity is set by first IF filter A4FL1.

3.7.4 DETECTOR AND VOLUME CONTROL

The filtered 455 kHz is passed to the FM detector consisting of A4U1 and associated circuitry. The signal is passed to A4U1 through impedance matching resistor A4R123. An output tuned circuit (tuned to 455 kHz) is provided by A4L26 and A4C103. The quadrature resonant network consists of A4L27, A4C117, A4C79, and A4C80. The "Q" of the network is set by A4R129. The 8.5 VDC power is fed to A4U1 through decoupling resistor A4R54 and bypass capacitors A4C75 and A4C76. Components A4R124, A4C77, A4C78, A4C81, and A4C82 are parts required by the IC manufacturer for normal performance. Capacitor A4C101 provides AC bypass for the 8.5 VDC line.

The detected audio is passed to buffer amplifier A4U2A through coupling capacitor A4C83. The amplifier gain is set by A4R55 and A4R56 and biased through voltage divider resistors A4R57 and A4R58 with AC bypass provided by A4C84.

The volume control circuitry is identical to the main receiver volume control and the discussion of the detailed circuit theory will be aided by reference to Section 3.5.3 and Figure 3.5.3-1. The circuit is a four resistance Wheatstone bridge with feedback control. One leg of the bridge is the volume control potentiometer and the opposing leg of the bridge is paralleled pair of optoisolators A4R81 and A4R80 with coupling resistor A4R79. The other two bridge resistors are A4R78 and A4R85. The bridge is kept in perfect balance by high gain amplifier control A4U4A. The amplifier drives the optoisolator pair to produce the proper resistance through decoupling resistor A4R83 and capacitor A4C95. Diode A4CR16 keeps the amplifier from saturating at very low volume levels. Resistors A4R82 and A4R84 work in conjunction with A4C102 and A4C96 to kill all audio frequency gain in the control amplifier. The optoisolators are biased to 5 VDC through decoupling resistor A4R128 and capacitor A4C90; A4C97 provides AC noise immunity for the volume control line. The optoisolators act to voltage divide the audio entering through A4R77. DC blocking is

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.4 DETECTOR AND VOLUME CONTROL (cont.)

provided by A4C94. The attenuated audio is amplified by buffer amplifier A4U4B. The gain is set by A4R86 and A4R87. Capacitor A4C98 eliminates all DC gain. The DC quiescent operating current in A4U4B is set by A4R88.

The UNSQUELCHED GUARD AUDIO is fed out of the guard receiver from unity gain buffer amplifier A4U2B. The DC is blocked by A4C93 and the output impedance is set by A4R76.

3.7.5 SQUELCH DETECTOR

The guard receiver squelch detector is formed by A4U3A and A4U3B. Integrated circuit A4U3A and associated circuitry is the 8 kHz high-pass filter which causes the squelch detector to operate on the high frequency signal components only, thereby eliminating any squelch interaction with the modulation frequencies. The frequency selective components of the filter are A4R60, A4R61, A4R62, and A4C85 through A4C88; A4R59 is an impedance matching component. Components A4CR14, A4CR15, A4C89, and A4C91 form a peak-to-peak detector with time constants which are set by A4R63 and A4R65. The peak-to-peak detector is referenced to 3.3 VDC, which is produced from 5 VDC, by A4R121 and A4R127. DC compensation for A4U3A is provided by A4R64.

Comparator A4U3B and associated circuitry is used to sense the squelch break point. Resistors A4R67, A4R70 and A4R71 set the reference voltage and hysteresis on the comparator using the external squelch control as a variable 50 K potentiometer to ground. AC bypass is provided by A4C92. Isolation for the externally controlled SQUELCH DISABLE function is provided by A4R66, A4R72 and A4CR13.

The GUARD AUDIO INHIBIT output from the guard receiver is driven through isolation resistor A4R73. The guard squelch switch, located on the Audio Module, is driven by this signal.

The GUARD SQUELCH ANNUNCIATE signal is driven from switch transistor A4Q11. The transistor is driven from A4U3B through A4R73 and A4R74. Base pull-down current, when the squelch is not active, is provided by A4R75.

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.6 FIRST LOCAL OSCILLATOR AND MULTIPLIER

The first local oscillator is A4Q10 and associated circuitry. Since the oscillator is followed by two multiplier stages, the oscillator operating frequency is one-ninth or one-sixth (depending upon the guard receiver style) of the first L.O. injection frequency. The two guard channels are determined by two fundamental cut crystals, A4Y2 and A4Y3. The selection between guard channel number 1 and channel number 2 is made with pin diodes A4CR11 and A4CR12 respectively. The diodes are driven from crystal select switch transistors A4Q13 and A4Q17 through A4R47, A4R46, A4L31, and A4L32. Capacitors A4C67 and A4C64 are for AC bypass. The crystals are in a Colpitts style oscillator configuration resonating with feedback capacitors A4C72 and A4C73 and their respective coupling capacitors A4C68 and A4C66 and with trimmer adjustment capacitors A4C69 and A4C65. The operation frequency, and hence the crystal cut frequency, ranges from 14.2890 to 16.9550 MHz, or 22.1833 to 26.1829 MHz (depending on the guard receiver style). (See Section 4.6.14 for the crystal calculation formula.) The oscillator base bias is set by A4R49 in conjunction with diode drive resistors A4R47 and A4R46 through AC isolation inductor A4L30; the DC operating current is set by emitter resistor A4R51. The 8.5 VDC power is fed to the transistor through AC blocking inductor A4L29 which has A4R50 in parallel to swamp out any resonances. The power feed decoupling is handled by A4L33, A4C70 and A4C71. The oscillator output is coupled to the first multiplier by A4C74.

Two multipliers, A4Q7, A4Q8 and associated circuitry, follow the oscillator. Each multiplier is followed by a two-pole bandpass filter. The bandpass filter between A4Q7 and A4Q8 tunes between 42.8670 and 50.8650 MHz or 44.3670 to 52.3658 MHz (depending on the guard receiver style). Transistor A4Q7 is coupled to this filter by A4C41. The filter is tuned with varactors A4CR5 and A4CR6 which resonate with A4L17 and A4L19 respectively. An additional resonating fixed capacitor (A4C43) is required across A4L17. Filter coupling is provided by A4L18. The varactor tuning voltage is supplied through decoupling components A4R52, A4R53, A4R113, A4R114, and A4C44 through A4C47. Second multiplier A4Q8 is coupled at the input by A4C48 and at the output by A4C50. The bandpass filter on the output of second multiplier A4Q8 tunes frequencies from 128.6000 to 152.5975 MHz, or 133.10000 to 157.0975 MHz (depending upon the guard receiver style). It is tuned with

3.7 GUARD RECEIVER MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.7.6 FIRST LOCAL OSCILLATOR AND MULTIPLIER (cont.)

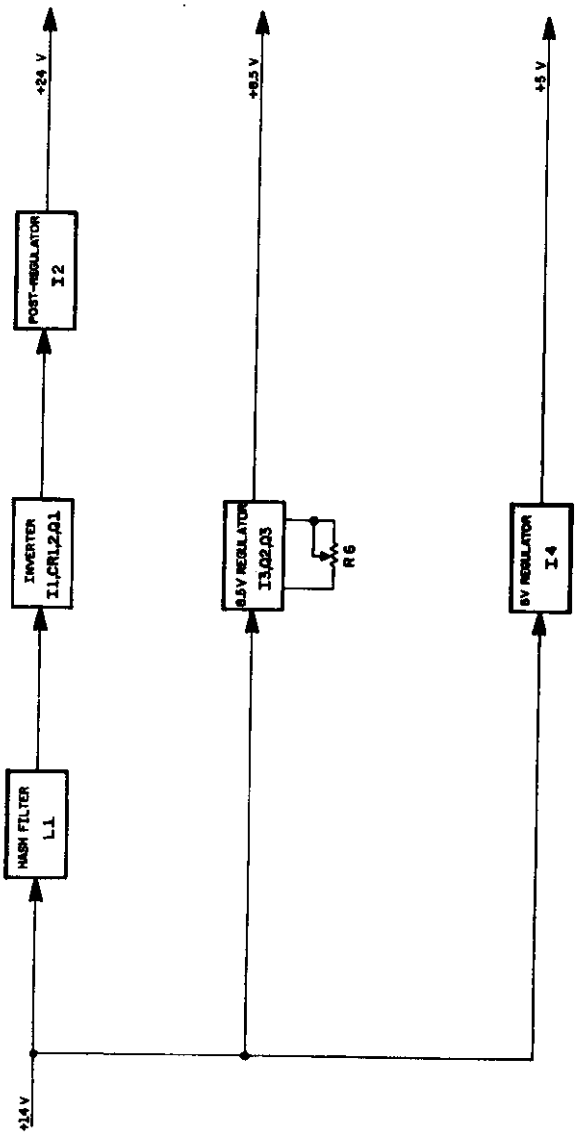
varactors A4CR7 and A4CR8 which resonate with A4L21 and A4L23. Filter coupling is provided by A4L22. The varactor tuning voltage is supplied through decoupling components A4R36, A4R37, A4R115, A4R116, A4C52, A4C53, and A4C54. The multiplier stages are biased into class AB service by A4R30, A4R31, A4R33, and A4R34 and temperature compensation diodes A4CR9 and A4CR10. The transistor operating currents are set by emitter resistors A4R32 and A4R35 which are AC bypassed by A4C42 and A4C51. The DC power is fed to the multiplier transistors through AC blocking inductors A4L16 and A4L20 which have DC power line bypassing provided by A4C40 and A4C49. Further filtering is provided by the decoupling network consisting of A4L34, A4L35, A4C113, and A4C114.

The multiplier stages are followed by a broadband class AB amplifier consisting of A4Q9 and associated circuitry. The base bias is provided by A4R38 and A4R39. The operating current is set by emitter resistor A4R41 which is AC bypassed by A4C59. The collector of A4Q9 is impedance matched through 4:1 impedance transforming balun A4L24. The buffer input is coupled through A4C55, and the output is DC blocked through A4C58. Filter A4FL3 removes unwanted signals from the output of A4Q9. The DC power is fed to the buffer amplifier through the decoupling network consisting of A4R40, A4C56 and A4C57.

3.8 POWER SUPPLY MODULE BLOCK DIAGRAM AND CIRCUIT THEORY

The Power Supply Module block diagram is shown in Figure 3.8-1. There are three regulated voltages generated by the power supply, two of them (8.5 and 5 VDC) are developed by series pass type regulators operating from the unregulated 14 VDC input. The 24 VDC is generated by an inverter with post regulation.

The detailed circuit theory understanding will be aided by reference to the Power Supply Module Schematic in Section 5.



POWER SUPPLY MODULE BLOCK DIAGRAM
FIGURE 3.8-1

3.8 POWER SUPPLY MODULE BLOCK DIAGRAM AND CIRCUIT THEORY (cont.)

3.8.1 5 VDC REGULATOR

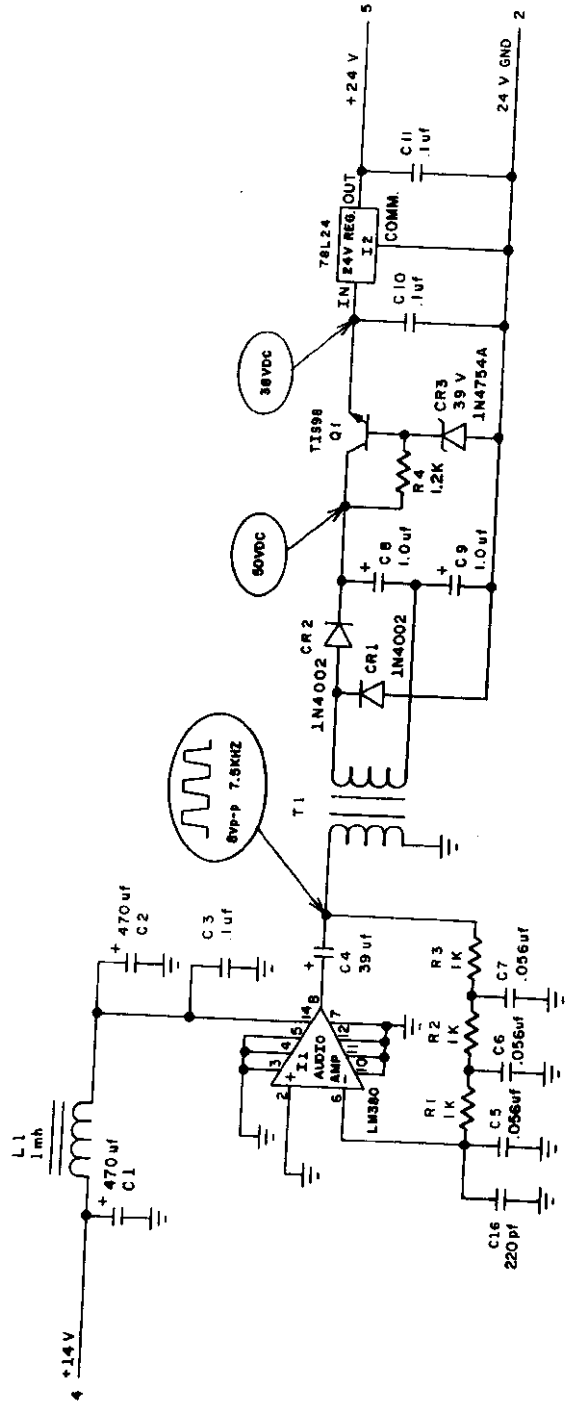
The heart of the 5V regulator is three-terminal regulator A6U4. Input and output bypass capacitors A6C14 and A6C15 are of the values recommended by the integrated circuit manufacturer to maintain stability.

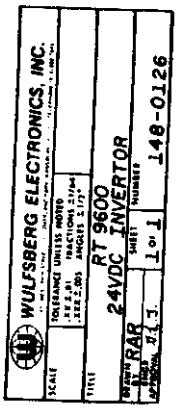
3.8.2 8.5 VDC REGULATOR

The 8.5 VDC regulator is a design using opamp A6U3 and PNP series pass transistor A6Q3 to achieve output regulation at input voltages approaching 8.5 volts. A stable reference voltage is supplied by the 5 VDC line through the decoupling network consisting of A6R5 and A6C12. The 8.5 VDC is set by potentiometer A6R6 which is the adjustable portion of the voltage divider made up of A6R7, A6R6, and A6R8. Gain limit for the opamp is provided by A6R12. Current amplifier A6Q2 is driven from A6U3 through current limit resistor A6R9. The current amplifier in turn drives the series pass transistor through current limit resistor A6R10. Resistor A6R11 provides leakage current protection for series pass transistor A6Q3. The high-frequency stability of the regulator is provided by A6C13.

3.8.3 24 VDC REGULATOR

The detailed circuit theory for this section is aided by Figure 3.8.3-1. The 24 VDC regulator consists of a phase-shift oscillator using audio power amplifier A6U1, a voltage doubler rectifier using A6CR1 and A6CR2, and a post regulator using A6U2. The phase-shift oscillator receives its power from a filtered 14 VDC input. The 14 VDC line is filtered for reduction of both audio frequency ripple as well as power transients by A6C1, A6C2, A6C3, and A6L1. A 7.5 kHz oscillation is established in A6U1 by the phase-shift network consisting of A6R1, A6R2, A6R3, A6C5, A6C6, A6C7, and A6C16. Coupling capacitor A6C4 provides DC blocking between the oscillator and step-up transformer A6T1. The voltage doubling capacitors, in the voltage doubler rectifier, are A6C8 and A6C9. The input voltage to the post regulator is limited to less than 39 volts by the emitter follower stage consisting of A6Q1 with the bias supplied by Zener diode A6CR3 with Zener diode current provided by A6R4. Post regulator A6U2 has input and output bypass capacitors A6C10 and A6C11 as recommended by the integrated circuit manufacturer to maintain stability.





24 VDC REGULATOR SCHEMATIC
FIGURE 3.8.3-1

3.9 CHASSIS CIRCUIT THEORY

A block diagram of the chassis is not provided. Refer to the chassis schematic and the transceiver mount assembly in Section 5 as an aid in the following theory.

3.9.1 ON/OFF RELAY CIRCUIT

The ON/OFF circuit consists of 14V relay A1RY1. If 14V power is used, it is applied through isolation diode A1CR1 to A1RY1, likewise if 28V power is used it is applied through voltage dropping resistor A1R1 and isolation diode A1CR2 to A1RY1. Relay A1RY1 is activated by pulling the ON/OFF line (A1P1, pin 1) to ground (this function is provided by the control unit). When voltage is removed from the coil of A1RY1, A1CR4 shunts the transient voltage spike that would otherwise occur.

When 14V power is used, A1RY1 switches 14V power directly to the RT-9600 modules through a filter consisting of A1L1 and A1C2.

3.9.2 14V DC REGULATOR

When 28VDC power is used it is first passed through voltage dropping resistors R1 and R2 (located on the transceiver mount) and then applied to A1RY1. When A1RY1 is activated, 28V DC is applied to the 14V regulator located on the rear heat sink. The 14V regulator consists of four-terminal regulator A1U1 and NPN series pass transistor A1Q1. The voltage at the emitter of A1Q1 is passed through the voltage divider consisting of A1R4 and A1R2, the voltage developed by A1R4 and A1R2 is applied back to A1U1, pin 4, and compared to an internal reference voltage inside A1U1. Pin 3 of A1U1 provides the necessary voltage to the base of A1Q1 to keep the voltage at the emitter constant, providing the 14V DC power required by the RT-9600 modules. The high frequency stability of the regulator is provided for by bypass capacitors A1C1 and A1C5. The regulated 15V DC power is then supplied to the transceiver through the filter consisting of A1C2 and A1L1.

3.9.3 MODULE CONNECTOR CIRCUITS

High-frequency bypassing is provided by A1C3 and A1C4; A1CR5 protects against negative voltage transients on the PTT line. VHF and UHF filtering is provided by A1L2, A1C6, A1C7, A1C8, A1C9, A1C10, A1C11, and A1C12 to keep all main receiver local oscillator harmonics from causing guard receiver interference. Resistor A1R3 provides a minimum audio level limit for guard receiver audio while A1R5 provides a minimum load impedance on the DF AUDIO output line. Transformer A1T1 provides the impedance matching and signal balancing for all of the 10 watt audio series transceivers. This transformer interfaces with the Audio Module.

SECTION 4

MAINTENANCE

4.1 DISASSEMBLY

Disassemble only to the extent necessary to accomplish repair and testing. Reverse the procedure to assemble the transceiver.

4.1.1 DUST COVERS

Top Dust Cover

(1) Remove ten pan-head Phillips screws from top.

(2) Remove four flat-head Phillips screws from left side.

(3) Remove four flat-head Phillips screws from right side.

(4) Remove top dust cover.

Bottom Dust Cover

(1) Remove two flat-head Phillips screws from front panel.

(2) Remove two flat-head Phillips screws from rear panel.

(3) Remove three flat-head Phillips screws from left side.

(4) Remove three flat-head Phillips screws from right side.

(5) Remove bottom dust cover.

4.1.2 SYNTHESIZER MODULE

(1) Remove one flat-head Phillips screw from front panel.

(2) Remove one flat-head Phillips screw from rear panel.

4.1 DISASSEMBLY (cont.)

4.1.2 SYNTHESIZER MODULE (cont.)

(3) Remove two pan-head Phillips screws from underneath side of the chassis.

(4) Snap off coax connector A1J12 from its mate, A2P1.

Divider Assembly PC Board

(1) Remove synthesizer cover by removal of eleven flat-head Phillips screws.

(2) Unsolder two chokes and one capacitor between the PC Board and buffer subassembly.

(3) Unsolder two chokes and two resistors between the PC board and the VCO.

(4) Remove six hex posts.

(5) Lift the divider assembly from module.

Reference Oscillator Module

(1) Remove four flat-head Phillips screws from oven cover.

(2) Remove oven cover.

(3) Remove reference oscillator cover.

(4) Remove three pan-head Phillips screws from reference oscillator component plate.

(5) Remove the reference oscillator.

VCO

(1) Remove synthesizer cover by removal of eleven flat-head Phillips screws.

(2) Unsolder two chokes and two resistors between the PC board and the VCO.

4.1 DISASSEMBLY (cont.)

4.1.2 SYNTHESIZER MODULE (cont.)

VCO (cont.)

(3) Remove three pan-head Phillips screws from rear side of the synthesizer case.

(4) Remove VCO.

Buffer Subassembly

(1) Remove VCO.

(2) Unsolder two chokes and one capacitor between the PC board and the buffer subassembly.

(3) Remove four hex posts.

(4) Remove the buffer subassembly.

4.1.3 R/T MODULE

(1) Remove two flat-head Phillips screws from front panel.

(2) Remove one flat-head Phillips screw from rear panel.

(3) Remove two pan-head Phillips screws from the underneath side of the chassis.

(4) Snap off coaxial connectors A1J9 and A1J10 from their respective mates, A8P1 and A8P2.

(5) Remove the R/T Module.

Power Amplifier

(1) Remove R/T Module cover by removal of twelve flat-head Phillips screws.

(2) Unsolder five connections between the power amplifier and R/T Module.

(3) Remove two pan-head Phillips screws.

(4) Remove the power amplifier.

4.1 DISASSEMBLY (cont.)

4.1.3 R/T MODULE (cont.)

Receiver PC Board

(1) Remove R/T Module cover by removal of twelve flat-head Phillips screws.

(2) Unsolder four insulated wires.

(3) Unsolder three bare wires.

(4) Remove three pan-head Phillips screws.

(5) Remove one hex post.

(6) Remove the receiver PC board.

Transmitter PC Board

(1) Remove R/T Module cover by removal of twelve flat-head Phillips screws.

(2) Unsolder eight bare wires.

(3) Remove one pan-head Phillips screw from power transistor.

(4) Remove three pan-head Phillips screws.

(5) Remove one hex post.

(6) Remove the transmitter PC board.

4.1.4 AUDIO MODULE

Complete Audio Module

(1) Remove one flat-head Phillips screw from front panel.

(2) Remove two pan-head Phillips screws from underneath side of chassis.

(3) Remove the Audio Module.

4.1 DISASSEMBLY (cont.)

4.1.4 AUDIO MODULE (cont.)

(4) Remove two pan-head Phillips screws from rear of Audio Module.

(5) Remove six pan-head Phillips screws from PC board.

(6) Remove the Audio Module PC board.

4.1.5 TONE MODULE

Complete Tone Module

(1) Remove one flat-head Phillips screw from front panel.

(2) Remove two pan-head Phillips screws from underneath side of Chassis.

(3) Remove Tone Module.

(4) Remove six pan-head Phillips screws from PC board.

(5) Remove the Tone Module PC board.

4.1.6 GUARD RECEIVER MODULE

Complete Guard Receiver Module

(1) Remove one flat-head Phillips screw from rear panel.

(2) Remove two pan-head Phillips screws from underneath side of chassis.

(3) Snap off coaxial connector A1J11 from its mate, A4P1.

(4) Remove the Guard Receiver Module.

4.1 DISASSEMBLY (cont.)

4.1.6 GUARD RECEIVER MODULE (cont.)

Guard PC Board

(1) Unsolder four insulated wires.

(2) Unsolder eight bare wires.

(3) Remove three pan-head Phillips screws from PC board.

(4) Remove one hex post.

(5) Remove the PC board.

4.1.7 POWER SUPPLY MODULE

Complete Power Supply Module

(1) Remove one flat-head Phillips screw from rear panel.

(2) Remove two pan-head Phillips screws from the underneath side of Chassis.

(3) Remove the Power Supply Module.

(4) Unsolder five bare wires.

(5) Remove four pan-head Phillips screws from the PC board.

(6) Remove the Power Supply PC board.

4.1.8 CHASSIS AND HEATSINK ASSEMBLY

Heatsink Subassembly

(1) Remove four flat-head Phillips screws and four locking nuts from rear panel.

(2) Remove four pan-head Phillips screws from transistor covers.

(3) Remove transistor covers.

4.1 DISASSEMBLY (cont.)

4.1.8 CHASSIS AND HEATSINK ASSEMBLY (cont.)

(4) Unsolder three wires.

(5) Remove the heatsink subassembly.

4.2 TEST EQUIPMENT

The following test equipment, or equivalent, is required to properly align the RT-9600. **All test equipment must be properly calibrated before alignment is started.**

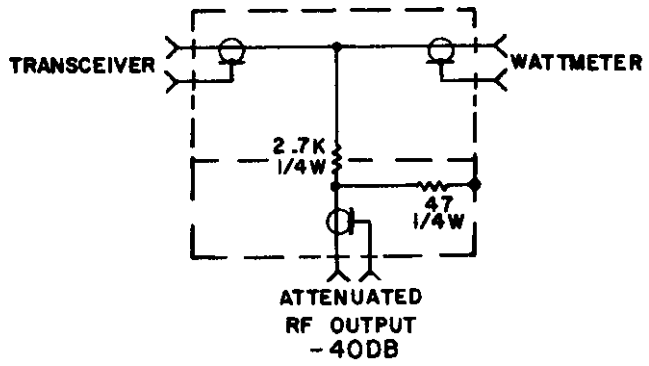
ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
A.	DC Voltmeter	-Input Impedance: 2.0 Megohms or greater -Accuracy: 0.1% full scale	Weston Model 4440
B.	AC Voltmeter	-Input Impedance: 2.0 Megohms or greater -Voltage Range: 1 Millivolt to 100 volts	Triplett Model 801, Type 2 Model 64
C.	RF Signal Generator	-Frequency Range: 150-174 MHz -Frequency Accuracy: ± 0.0002% -Modulation: FM (0-10 kHZ dev) AM (0-50%) External Input -Output Level: 0-1,000 uV Calibrated	Wavetek Model 3000,3001,3002
D.	Modulation Meter	-Frequency Range: 150-174 MHz -Frequency Set: to within 500 Hz of all 2.5 kHz channels -FM Detector: ± 10% from + 200 Hz to ± kHz deviation -FM Detector Output	IFR Model FM/AM 1000A Boonton 82 AD Marconi TF2300B

4.2 TEST EQUIPMENT (cont.)

ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
E.	Audio Signal Generator	-Frequency Range: 300 Hz to 15 kHz -Output Level: 0-2.5 VRMS into 75 ohms	Hewlett-Packard Model 651A, 339A
F.	EIA Tone Generator	-Frequency Range: 67.0-250.3 Hz -Frequency Accuracy: ±0.1 Hz	Automated Industrial Electronics DTG-1
G.	RF Power Meter	-Input Impedance: 50 ohms nominal -Range: 0 to 20 watts	Bird Electronics Corp. Termaline Model 611
H.	Oscilloscope	-Sensitivity: 5mV P-P Per Division -Time Base: 0.05 usec/division to 5 sec/division -Dual Trace -Horizontal Input	Tektronix, Inc. Type 475
I.	Audio Distortion Analyzer	-Frequency Range:300 Hz-15 kHz -Distortion Levels: 0.1 to 100%.	Hewlett-Packard Model 332A, 339A
J	Frequency Counter	-Frequency Range: 24 Hz to 174 MHz -Sensitivity: 100 mVRMS	Fluke Model 1952A Hewlett-Packard 5383A
K.	Regulated DC Power Supply	-Voltage Range: 0-40 VDC -Voltage Regulation: ± 0.25 VDC from 0.5 to 10 amps	Trygon Model HR 40-7C
L.	RF Isolation Pad	See Figure 4.2-1 for suggested schematic	WEI DB1 300-2069-000

4.2 TEST EQUIPMENT (cont.)

ITEM	DESCRIPTION	CHARACTERISTICS REQUIRED	REPRESENTATIVE TYPE
M.	RT-9600 Test Set or Control Unit		Appropriate WEI Control Unit (used in conjunction with TSH-96 Test Harness) or TS-28/TS-28A Test Set
N.	Multimeter	-Ohmmeter Function	Triplett Model 630
O.	Head Phones	-Impedance: 600 ohms	Telex Communications Model MR-6
P.	4 ohm Load	-Value ± 10%, 20 watt	
Q.	600 ohm Load	-Value ± 10%, 1 watt	



RF ISOLATION PAD SCHEMATIC
FIGURE 4.2-1

4.3 RT-9600 OVERALL PERFORMANCE TESTS

The following procedures give the steps necessary to determine the overall performance of the RT-9600. Follow the steps in sequence, and should any requirement not be met, refer to the initial alignment procedure section in order to realign the RT-9600 to meet the specification. If after alignment specification cannot be met refer to the troubleshooting section for assistance in locating the defective part or parts.

4.4 PERFORMANCE TESTS

Before commencing with the performance test remove the dust covers and connect the RT-9600 to its test harness. Next apply power to the unit and measure the power supply voltages at the point indicated in the table below. The test pins are found on the underneath side of the chassis.

NOTE: All voltage measurements should be made with the voltmeter ground connection connected to the RT-9600 chassis. The pin numbers indicated refer to the Power Supply Module 10 pin card-edge connector.

Voltage	Should Be	Test Point
Input Bus Voltage	+13.75 ± 2.0 VDC	J4 pin 4
24V DC regulator output	+24 ± 2.5 VDC	J4 pin 5
8.5V DC regulator output	+8.5 ± 0.2 VDC	J4 pin 6
5V DC regulator output	+5 ± 0.5 VDC	J4 pin 7

The performance test will be made under the following conditions. Unless otherwise specified, the receiver input will be modulated at 3 kHz deviation, 1000 Hz modulating frequency. The audio output will be terminated with a 4 ohm load for the RT-9600-0, -1, -3, -4, -6, -7, -9, -10, and -999; or with a 600 ohm load for the RT-9600-2, -5, -8, -11, -24, -25, -26, -27, and -998. For all receiver tests, except where noted, the receiver volume shall be adjusted to produce 4.4 VRMS with normal modulation signal.

NOTE: Signal generators are subjected to costly burnout if the transmitter is inadvertently keyed during receiver test. Wulfsberg Electronics recommends the use of Hewlett-Packard 11509 A, 50 ohm coaxial fuse between the signal generator and the transceiver.

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

4.4 PERFORMANCE TEST (cont.)

4.4.1 RECEIVER SENSITIVITY

The main receiver sensitivity should be tested at three frequencies within the VHF band. When a test set or thumbwheel style control unit is available, the following frequencies should be checked: 150.0000, 164.6650 and 173.9975 MHz. Otherwise, selection of two preset frequencies with maximum frequency separation shall be chosen. Set the RF signal generator output level to 0.5 uV. The SINAD ratio should be greater than 12 dB at those channels which are tested. Repeat the above procedure at two guard receiver frequencies for determining guard receiver sensitivity performance.

NOTE: It may be necessary to disable the squelch during the receiver sensitivity test. The RT-9600-12 through -23, (which are now obsolete) require slightly higher signal generator output to obtain 12 dB SINAD because of their wider crystal filter.

4.4.2 RECEIVER AUDIO OUTPUT

Using a 1000 uV signal with standard modulation, the audio output shall be capable of not less than 6.3 VRMS across 4 ohms for the RT-9600-0, -1, -3, -4, -6, -7, -9, -10, and -999 and 7.8 VRMS across 600 ohms for the RT-9600-2, -5, -8, -11, -24, -25, -26, -27, and -998. The test should be performed at one channel frequency for both the main and guard receivers.

4.4.3 RECEIVER TIGHT SQUELCH

Make this measurement at one frequency for both the main and guard receivers.

Rotate the control unit or test set manual squelch knobs, where available, for both the main and guard receivers to the maximum clockwise position. Slowly increase the RF Signal Generator output level until the squelch light glows and measure the SINAD ratio. The SINAD ratio shall be between 14 and 18 dB for Audio Modules of mod status 2 and below and for Guard Receiver Modules of mod status 4 and below. The SINAD ratio shall be between 18 and 20 dB for Audio Modules of mod status 3 and above and for Guard Receiver Modules of mod status 5 and above.

4.4 PERFORMANCE TEST (cont.)

4.4.4 RECEIVER CTCSS SQUELCH

Select a tone number on the test set or select a preset channel on the control unit which utilizes a receiver CTCSS tone. Modulate the RF signal generator at the tone frequency with 500 Hz deviation. Apply 1000 uV RF level and verify that audio output is present. Remove the signal generator modulation and verify that audio output is eliminated. This test need be performed at one frequency of the main receiver only.

4.4.5 MAIN RECEIVER DF OUTPUT

Set the RF signal generator modulation to 30% AM at 1000 Hz. The DF audio should be between 0.14 and 1.0 VRMS. The test need be performed at one frequency of the main receiver only.

4.4.6 TRANSMITTER POWER OUTPUT

The transmitter shall produce between 8 and 12 watts when operated in the HI power mode (see exception to this power level in Section 4.6.9) and between 0.8 and 1.2 watts in the LO power mode. The test should be performed at three frequencies, one of which is at the low frequency portion, another at the high frequency portion, and the third near the center frequency portion of the VHF band.

4.4.7 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 three frequencies as that for Section 4.4.6.

4.4.8 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. The test need be performed at one channel only.

4.4 PERFORMANCE TEST (cont.)

4.4.9 TRANSMITTER CTCSS

Selection of a tone channel from the test set or a preset channel on the control unit containing a tone preset shall produce a tone deviation of between 450 and 550 Hz, and at a frequency within 1.0 Hz of specified. This test need be performed at one channel of the transmitter only.

4.4.10 FINAL RT-9600 SETTINGS

The RT-9600 should be considered ready for service when the above tests are passed and the following adjustments have been made and verified.

(1)	Guard Receiver Frequency:	The guard receiver local oscillator shall be within +500 to -2000 Hz of the channel frequency less the IF frequency for the 21.4 MHz style guard receiver and within ±1000 Hz of the channel frequency less the IF frequency for the 16.9 MHz style guard receiver. This frequency should be checked at both guard channels. See Section 4.6.14 for the alignment procedure.
(2)	Sidetone Output:	With an input of 0.25 VRMS at 1000 Hz the sidetone shall be set to produce 1.0 VRMS.
(3)	CTCSS Frequency:	Each CTCSS tone shall be within 0.5 Hz of specified tone frequency.
(4)	Carrier Frequency:	Frequency error shall not be more than 750 Hz 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 TROUBLESHOOTING PROCEDURE

The RT-9600 is separated into its six module parts: Power Supply, Synthesizer, R/T, Audio, Tone, and Guard Receiver. Refer to the overall block diagram, Figure 3.2-1. Also refer to Figure 5.1-1, the RT-9600 Module Locator.

(1) The Power Supply Module contains the circuitry necessary to convert the input bus voltage to the proper transceiver operating voltages. Therefore, the power supply is driven by the +14 VDC bus voltage. It outputs +5.0, +8.5, and +24 VDC 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 synthesizer also takes the PTT input and logically converts between transmit and receive injections depending upon the state of the PTT input. Since the synthesizer performs the modulation function, another input to it is the modulation audio. In addition to the VHF RX/TX INJECTION signal, the synthesizer outputs a DC voltage referred to as the TUNING VOLTAGE (TV). The TV is used to tune the preselector of the main receiver.

(3) The R/T Module produces the transmitter output power and the receiver audio output. In transmitter operation, the R/T Module amplifies the low level synthesizer RF output. The amplified RF power is then passed through the T/R relay (located on the R/T Module) to the antenna. A power level select input to the R/T Module permits selection of the 10 or 1 watt output power levels. In the receive mode, the R/T Module accepts the antenna input and passes it to the main receiver through the T/R relay. A power splitter, also located on the R/T Module, provides an RF output to the Guard Receiver Module. The main receiver uses the RX/TX INJECTION signal supplied by the synthesizer and the TUNING VOLTAGE (TV) to produce AM and FM detected outputs.

4.5 TROUBLESHOOTING (cont.)

4.5.1 COMPLETE TROUBLESHOOTING PROCEDURE (cont.)

The AM detected output is DF AUDIO and FM output is low level unfiltered receiver audio. It is necessary for the low level FM output to be processed and amplified by the Audio Module before it can be used as receive audio.

(4) The Audio Module coordinates all of the various functions of the transceiver. It not only processes low level audio signals from both the main and guard receivers, but it also processes the microphone audio to the synthesizer as a modulation input. Additionally, the Audio Module outputs high level audio for both receive audio and sidetone. The transmit receive switching voltage referred to as +14 V TRANSMIT is also generated by the Audio Module.

(5) The Tone Module supplies the EIA standard tone frequencies, eight of which are selectable, to the transmitter for the transmit CTCSS function. The module also accepts the EIA tones from the receiver. It processes the tones and detects the proper tone frequency for use in the CTCSS receiver squelch function. The Tone Module has five inputs, four of which activate the eight tone frequency selection and the fifth is the receiver audio tone. The Tone Module outputs a transmit tone signal and audio inhibit function for the receiver audio.

(6) The Guard Receiver Module is virtually a self-contained receiver. It uses the antenna induced RF signal supplied to it from the R/T Module and produces a low level detected audio output. The module is different than the main receiver in that it contains the receiver squelch circuitry. Consequently, it also has a squelch gate output.

The above information is intended only for the purpose of showing the general signal flow paths to aid in isolation off any problem to the module level. The following information will specifically address the individual modules and their signal flows and voltage levels.

4.5 TROUBLESHOOTING (cont.)

4.5.2 SYNTHESIZER MODULE TROUBLESHOOTING PROCEDURE

The detailed block diagram of the synthesizer is shown in Figure 3.3-1. In order to operate properly, the synthesizer must have the following seven inputs:

Synthesizer Inputs	Source of Inputs
BCD TUNING	Control Unit
PTT	External Mic
MODULATION	Audio Module
+5 V	Power Supply Module
+8.5 V	Power Supply Module
+14 V	Filtered Bus Voltage
+24 V	Power Supply Module

The BCD TUNING and PTT lines must have only one of two DC voltage levels, HI or LO. Figures 4.3.2-1 through 4.3.2-5 indicate the levels and voltages on the synthesizer inputs for various frequency channels. The input voltage levels are internally converted to levels useful on the program and swallow counters. The levels presented to the counters are also shown in these figures.

The MODULATION signal is an audio frequency signal having a value of approximately 1.1 V P-P to produce $\pm$ 3.5 kHz deviation.

4.5 TROUBLESHOOTING (cont.)

4.5.2 SYNTHESIZER MODULE TROUBLESHOOTING PROCEDURE (cont.)

The synthesizer has the following three outputs, all of which must be present for proper operation:

Synthesizer Output	Output Termination
TX DISABLE	R/T Module
TUNING VOLTAGE (TV)	R/T Module
130.0000 TO 173.9975 MHZ DRIVE	R/T Module

The TX DISABLE voltage must be in one of two states, 0.1 or 8.5 VDC. If the voltage is 0.1 VDC, or less, the transmitter will be disabled due to a synthesizer malfunction. The malfunction may either be due to an illegal channel code to the synthesizer counter, or a loop malfunction causing the synthesizer to lose lock.

The TUNING VOLTAGE (TV) is a buffered version of the voltage which is forced onto the input of the VCO by the loop circuitry. It ranges from 5.0 to approximately 15.0 VDC depending on the channel frequency. Figures 3.3.4-1 and 3.3.4-2 show typical Tuning Voltage Versus Synthesizer Output Frequency curves. The 130.0000 to 173.9975 MHz drive must have an amplitude of +12 dBm minimum (+15 to +17 dBm typical).

INPUT PINS / FREQUENCY	SYNTHESIZER MODULE INPUTS		
	10 MHz	20 MHz	40 MHz
15X.XXX MHz	0-2 VDC	HI	0-2 VDC
16X.XXX MHz	HI	0-2 VDC	0-2 VDC
17X.XXX MHz	0-2 VDC	0-2 VDC	0-2 VDC

INPUT PINS / FREQUENCY	TRANSMIT U23 COUNTER INPUTS		
	10'	20'	40'
15X.XXX MHz	4-5 VDC	LO	4-5 VDC
16X.XXX MHz	LO	4-5 VDC	4-5 VDC
17X.XXX MHz	4-5 VDC	4-5 VDC	4-5 VDC

INPUT PINS / FREQUENCY	RECEIVE U23 COUNTER INPUTS		
	10'	20'	40'
15X.XXX MHz	4-5 VDC	4-5 VDC	LO
16X.XXX MHz	LO	LO	4-5 VDC
17X.XXX MHz	4-5 VDC	LO	4-5 VDC

NOTE: HI refers to voltage 10.0 VDC or greater.
LO refers to voltage 0.5 VDC or less.

RT-9600 CODING - 10 MHz INCREMENTS
FIGURE 4.5.2-1

INPUT PINS / FREQUENCY	SYNTHESIZER MODULE INPUTS			
	1 MHz	2 MHz	4 MHz	8 MHz
1 X 0.XXX MHz	HI	HI	HI	HI
1 X 1.XXX MHz	0-2 VDC	HI	HI	HI
1 X 2.XXX MHz	HI	0-2 VDC	HI	HI
1 X 3.XXX MHz	0-2 VDC	0-2 VDC	HI	HI
1 X 4.XXX MHz	HI	HI	0-2 VDC	HI
1 X 5.XXX MHz	0-2 VDC	HI	0-2 VDC	HI
1 X 6.XXX MHz	HI	0-2 VDC	0-2 VDC	HI
1 X 7.XXX MHz	0-2 VDC	0-2 VDC	0-2 VDC	HI
1 X 8.XXX MHz	HI	HI	HI	0-2 VDC
1 X 9.XXX MHz	0-2 VDC	HI	HI	0-2 VDC

INPUT PINS / FREQUENCY	U22 COUNTER INPUTS			
	1	2	4	8
1 X 0.XXX MHz	LO	LO	LO	LO
1 X 1.XXX MHz	4-5 VDC	LO	LO	LO
1 X 2.XXX MHz	LO	4-5 VDC	LO	LO
1 X 3.XXX MHz	4-5 VDC	4-5 VDC	LO	LO
1 X 4.XXX MHz	LO	LO	4-5 VDC	LO
1 X 5.XXX MHz	4-5 VDC	LO	4-5 VDC	LO
1 X 6.XXX MHz	LO	4-5 VDC	4-5 VDC	LO
1 X 7.XXX MHz	4-5 VDC	4-5 VDC	4-5 VDC	LO
1 X 8.XXX MHz	LO	LO	LO	4-5 VDC
1 X 9.XXX MHz	4-5 VDC	LO	LO	4-5 VDC

NOTE: HI refers to voltage 10.0 VDC or greater.
LO refers to voltage 0.5 VDC or less.

RT-9600 CODING - 1 MHz INCREMENTS
FIGURE 4.5.2-2

INPUT PINS / FREQUENCY	SYNTHESIZER MODULE INPUTS			
	0.1 MHz	0.2 MHz	0.4 MHz	0.8 MHz
1XX.0XX MHz	HI	HI	HI	HI
1XX.1XX MHz	0-2 VDC	HI	HI	HI
1XX.2XX MHz	HI	0-2 VDC	HI	HI
1XX.3XX MHz	0-2 VDC	0-2 VDC	HI	HI
1XX.4XX MHz	HI	HI	0-2 VDC	HI
1XX.5XX MHz	0-2 VDC	HI	0-2 VDC	HI
1XX.6XX MHz	HI	0-2 VDC	0-2 VDC	HI
1XX.7XX MHz	0-2 VDC	0-2 VDC	0-2 VDC	HI
1XX.8XX MHz	HI	HI	HI	0-2 VDC
1XX.9XX MHz	0-2 VDC	HI	HI	0-2 VDC

INPUT PINS / FREQUENCY	U21 COUNTER INPUTS			
	0.1	0.2	0.4	0.8
1XX.0XX MHz	LO	LO	LO	LO
1XX.1XX MHz	4-5 VDC	LO	LO	LO
1XX.2XX MHz	LO	4-5 VDC	LO	LO
1XX.3XX MHz	4-5 VDC	4-5 VDC	LO	LO
1XX.4XX MHz	LO	LO	4-5 VDC	LO
1XX.5XX MHz	4-5 VDC	LO	4-5 VDC	LO
1XX.6XX MHz	LO	4-5 VDC	4-5 VDC	LO
1XX.7XX MHz	4-5 VDC	4-5 VDC	4-5 VDC	LO
1XX.8XX MHz	LO	LO	LO	4-5 VDC
1XX.9XX MHz	4-5 VDC	LO	LO	4-5 VDC

NOTE: HI refers to voltage 10.0 VDC or greater.
LO refers to voltage 0.5 VDC or less.

RT-9600 CODING - 0.1 MHz INCREMENTS
FIGURE 4.5.2-3

INPUT PINS / FREQUENCY	SYNTHESIZER MODULE INPUTS			
	0.01 MHz	0.02 MHz	0.04 MHz	0.08 MHz
1XX.X0X MHz	HI	HI	HI	HI
1XX.X1X MHz	0-2 VDC	HI	HI	HI
1XX.X2X MHz	HI	0-2 VDC	HI	HI
1XX.X3X MHz	0-2 VDC	0-2 VDC	HI	HI
1XX.X4X MHz	HI	HI	0-2 VDC	HI
1XX.X5X MHz	0-2 VDC	HI	0-2 VDC	HI
1XX.X6X MHz	HI	0-2 VDC	0-2 VDC	HI
1XX.X7X MHz	0-2 VDC	0-2 VDC	0-2 VDC	HI
1XX.X8X MHz	HI	HI	HI	0-2 VDC
1XX.X9X MHz	0-2 VDC	HI	HI	0-2 VDC

INPUT PINS / FREQUENCY	U20 COUNTER INPUTS			
	0.01	0.02	0.04	0.08
1XX.X0X MHz	LO	LO	LO	LO
1XX.X1X MHz	4-5 VDC	LO	LO	LO
1XX.X2X MHz	LO	4-5 VDC	LO	LO
1XX.X3X MHz	4-5 VDC	4-5 VDC	LO	LO
1XX.X4X MHz	LO	LO	4-5 VDC	LO
1XX.X5X MHz	4-5 VDC	LO	4-5 VDC	LO
1XX.X6X MHz	LO	4-5 VDC	4-5 VDC	LO
1XX.X7X MHz	4-5 VDC	4-5 VDC	4-5 VDC	LO
1XX.X8X MHz	LO	LO	LO	4-5 VDC
1XX.X9X MHz	4-5 VDC	LO	LO	4-5 VDC

NOTE: HI refers to voltage 10.0 VDC or greater.
LO refers to voltage 0.5 VDC or less.

RT-9600 CODING - 0.01 MHz INCREMENTS
FIGURE 4.5.2-4

INPUT PINS / FREQUENCY	SYNTHESIZER MODULE INPUTS	
	0.002 MHz	0.005 MHz
1XX.XX00 MHz	HI	HI
1XX.XX25 MHz	0-2 VDC	HI
1XX.XX50 MHz	HI	0-2 VDC
1XX.XX75 MHz	0-2 VDC	0-2 VDC

INPUT PINS / FREQUENCY	U7 SWITCH INPUTS			
	0.0 kHz	2.5 kHz	5.0 kHz	7.5 kHz
1XX.XX00 MHz	8.5 VDC	LO	LO	LO
1XX.XX25 MHz	LO	8.5 VDC	LO	LO
1XX.XX50 MHz	LO	LO	8.5 VDC	LO
1XX.XX75 MHz	LO	LO	LO	8.5 VDC

NOTE: **HI refers to voltage 10.0 VDC or greater.**
LO refers to voltage 0.5 VDC or less.

RT-9600 CODING - 0.0025 MHz INCREMENTS
FIGURE 4.5.2-5

4.5 TROUBLESHOOTING (cont.)

4.5.3 R/T MODULE TROUBLESHOOTING PROCEDURE

The R/T Module consists of two sections, receiver and transmitter. The R/T Module block diagram is shown in figure 3.4-1. Each section will be discussed separately in terms of input and output relationships. The receiver section must have the following four supporting inputs to operate properly:

Receiver Inputs	Source of Inputs
+8.5 V	Power Supply Module
DF DISABLE	Control Unit
TUNING VOLTAGE (TV)	Synthesizer Module
RX/TX INJECTION	Synthesizer Module

The DC voltage to the receiver must be 8.5 $\pm$ 0.2 volts.

The DF DISABLE must be a low impedance to ground, resulting in a DC voltage of 1.0 VDC or less, in order to disable the DF (Direction Finding) output. Normal operation of the AM receiver portion occurs when the DF DISABLE is a high impedance, resulting in an approximate voltage of +8 VDC.

The TUNING VOLTAGE (TV) must be between 5.0 and approximately 15.0 VDC, the exact value determined by the synthesizer channel frequency as described in the synthesizer troubleshooting section.

The RX/TX INJECTION is the VHF signal from the synthesizer which is at frequencies between 130.0000 and 153.9975 MHz. The level should be +12 dBm minimum (+15 to +17 dBm typical).

The receiver section has the following three outputs:

Receiver Outputs	Output Termination
MAIN RX AUDIO	Audio Module
DF AUDIO	External
GUARD RF	Guard Receiver Module

4.5 TROUBLESHOOTING (cont.)

4.5.3 R/T MODULE TROUBLESHOOTING PROCEDURE (cont.)

The MAIN RX AUDIO is the low-level detected FM output. The signal is developed by detector A8U2 and has a level of typically 53 mVRMS when the incoming RF is modulated at ± 3.0 kHz deviation with 1 kHz tone on Mod 0 and Mod 1 modules. The signal is current (as opposed to voltage) on Mod 2 and above modules and cannot be measured with a voltmeter.

The DF (Direction Finding) AUDIO is the detected AM output of the receiver. It is developed in AM detector A8U3 and is only available as an output when the RF DISABLE input is not active. An RF input modulated at 30% produces between 0.14 and 1.0 VRMS of DF AUDIO.

The GUARD RF is an output which is half of the antenna induced power. It is supplied from power splitter A8PS1 which provides an equal split of RF power between the main and guard receivers.

The transmitter section must have the following seven inputs:

Transmitter Inputs	Source of Inputs
+8.5 V	Power Supply Module
+24 V	Power Supply Module
+14 V	Filtered Bus Voltage
+14 V TRANSMIT	Audio Module
TX POWER SELECT	Control Unit
TX DISABLE	Synthesizer Module
RX/TX INJECTION	Synthesizer Module

The regulated +8.5V is used by the transmitter section only as transmitter power detector bias.

The regulated +24V is used to supply operating power to RF level circuit A8U5.

4.5 TROUBLESHOOTING (cont.)

4.5.3 R/T MODULE TROUBLESHOOTING PROCEDURE (cont.)

The filtered +14V is the source of DC power to buffer A8Q7, driver A8Q8, and final amplifier A8U4. It must be capable of delivering at least 5 amps to the transmitter section.

The +14 V TRANSMIT is a switched voltage only active during transmit. It is used to activate the T/R switch and the T/R relay.

The TX POWER SELECT input is a DC voltage. When below 0.5 VDC, transmit power switch A8Q12 causes 10 watts of RF output to be generated. In normal operation (1 watt) the voltage is approximately 8.5 VDC.

The TX DISABLE drives the T/R switch to inhibit the transmitter when the synthesizer is malfunctioning or improperly coded. The TX DISABLE voltage must be in one of two states, 0.1 or approximately 8.5 VDC. The low level is the disable condition.

The RX/TX INJECTION should be between 150.0000 and 173.9975 MHz, depending upon the operating channel. The level should be approximately +12 dBm minimum (+15 to +17 dBm typical).

The transmitter section has the following two outputs:

Transmitter Outputs	Output Termination
RF OUTPUT	Antenna
SIDETONE GATE	Audio Module

The RF OUTPUT is the high level (1 or 10 watts) RF.

The SIDETONE GATE signal is a DC voltage which inhibits transmitter sidetone audio except when RF power is being generated. It must be either 1.5 or approximately 7.6 VDC.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO MODULE TROUBLESHOOTING PROCEDURE

The Audio Module is the interface heart of the transceiver. It uses many switching and low-level inputs and supplies several switching and high-level outputs. The Audio Module block diagram is shown in Figure 3.5-1. The sixteen supporting inputs are as follows:

Audio Module Inputs	Source of Inputs
+5 V	Power Supply Module
+8.5 V	Power Supply Module
+14 V	Filtered Bus Voltage
GUARD RX AUDIO	Guard Receiver Module
EXT GUARD AUDIO INHIBIT	Control Unit
GUARD AUDIO INHIBIT	Guard Receiver Module
MAIN AUDIO INHIBIT	Tone Module
MAIN VOL	Control Unit
SQUELCH DISABLE	Control Unit
MAIN SQL	Control Unit
MAIN RX AUDIO	R/T Module
XMTR SIDETONE GATE	R/T Module
PTT	External Microphone
TRANSMIT TONE	Tone Module
EXT CTCSS TONE IN	External Tone Generator
MIC HI	External Microphone

The +5V supplies bias to most of the opamp circuitry.

The 8.5V supplies operating power to opamp switch A5U6.

The filtered +14V supplies power to the audio preamplifier and audio power amplifier. It is also used as the input to the +14 V TRANSMIT relay.

The GUARD RX AUDIO is the low-level processed audio generated by the guard receiver. It has an adjustable level up to 0.40 VRMS, depending upon the setting of the guard volume control. The signal is applied to guard mute switch A5U6.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO MODULE TROUBLESHOOTING PROCEDURE (cont.)

The EXT GUARD AUDIO INHIBIT is a low impedance to ground for the inhibit mode. The voltage should be less than 2 VDC to provide an inhibit. Otherwise the voltage should be 6 VDC or greater.

The GUARD AUDIO INHIBIT is a signal generated by the guard receiver and is similar to the EXT GUARD AUDIO INHIBIT level.

The MAIN AUDIO INHIBIT signal is generated by the Tone Module. It is one of two levels; the inhibit mode is 0.1 VDC or less, the normal mode is approximately 5.5 VDC.

The MAIN VOL input is a continuously variable DC voltage ranging from 5.0 to 6.3 VDC depending upon the setting of the volume control. High volume corresponds to 6.3 VDC.

The SQUELCH DISABLE signal is one of two states. For normal receiver operation it is 8.5 VDC. An override of the main squelch is produced by 3.0 VDC or less.

The MAIN SQL signal is a continuously variable DC voltage of 0.0 to 6.2 VDC; the low voltage is the maximum tight squelch condition.

The MAIN RX AUDIO is the unprocessed low-level audio from the R/T Module. It is approximately 53 mVRMS under normal modulation for Mod 0 and Mod 1 modules. It is not possible to measure this signal on Mod 2 and above modules (see Section 4.5.3). It is applied to A5U5B for processing.

The XMTR SIDETONE GATE signal is in one of two states. High voltage (7.6 VDC) occurs during the transmit mode and low voltage (1.4 VDC) is present during the receive mode.

The PTT signal is a low impedance to ground for the transmit mode. It is necessary for the voltage to be 2 VDC or less for transmit. The receive mode is caused by a floating input of approximately 10.6 VDC.

The TRANSMIT TONE signal is one of the eight selected EIA subaudible tone frequencies on the Tone Module. It is approximately 63 mVRMS.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO MODULE TROUBLESHOOTING PROCEDURE (cont.)

The EXT CTCSS TONE IN signal is normally not present. When present, it will be approximately 35 mVRMS.

The MIC HI is the speech audio input. The MIC HI will have approximately 8.0 VDC present when a dynamic microphone is used and approximately 4.5 VDC present when a carbon microphone is used. In a test condition, the 0.25 VRMS audio test input should also be found on the MIC HI input.

The Audio Module has the following eight outputs:

Audio Module Output	Output Termination
MAIN SQL ANNUN	Control Unit
UNSQ MAIN AUDIO	Tone Module
MODULATION	Synthesizer Module
TX PWR ANNUN	Control Unit
AUDIO HI	External Speaker or Test Set
SIDETONE HI	External Speaker or Test Set
AUDIO AND SIDETONE HI	External Speaker or Test Set
14 V TRANSMIT	R/T Module

The MAIN SQL ANNUN is an output of 0.2 VDC or less when the main squelch is active. When the transceiver is squelched, the signal is a high impedance and with most control unit or test set terminations, it will be 5 VDC.

The UNSQ MAIN AUDIO is a low-level buffered audio from the Audio Module to the Tone Module for CTCSS squelch detection. It is approximately 0.6 VRMS under standard test modulation conditions.

The MODULATION output consists of the processed microphone audio. It is approximately 0.47 VRMS when standard test audio input is used. The modulation output is present only during transmit conditions and is derived from modulation inhibit switch A5U6C.

4.5 TROUBLESHOOTING (cont.)

4.5.4 AUDIO MODULE TROUBLESHOOTING PROCEDURE (cont.)

The TX PWR ANNUN output is 0.2 VDC or less when transmitter output power is present. When no RF power is present, or during the receive mode, the signal is a high impedance and will be 5 VDC when the RT-9600 is terminated into most control units or the test set.

The AUDIO HI output is the high level receiver audio. It is adjustable from 0 to rated output when the receiver is operating under standard test conditions. The adjustment is controlled by the volume control on the test set or the control unit.

The SIDETONE HI output is the high level audio when the transmitter is active and being modulated. It is adjustable from 0 to rated output by the front panel sidetone adjustment control.

The AUDIO AND SIDETONE LO is the common signal return for the AUDIO HI and SIDETONE HI signals.

The 14V TRANSMIT output is at one of two states. In the receive mode it is 0 VDC and in the transmit mode it is approximately 14 VDC. The output controls the transmit to receive changeover on the R/T Module.

4.5.5 TONE MODULE TROUBLESHOOTING PROCEDURE

The Tone Module block diagram is shown in Figure 3.6-1 and has the following six inputs:

Tone Module Input	Source of Input
+5 V	Power Supply Module
+8.5 V	Power Supply Module
SQUELCH DISABLE	Control Unit
TONE SEL (A, B, C, D)	Control Unit
+14 V TRANSMIT	Audio Module
UNSQ MAIN AUDIO	Audio Module

The +5V input supplies bias voltage for all of the active components.

4.5 TROUBLESHOOTING (cont.)

4.5.5 TONE MODULE TROUBLESHOOTING PROCEDURE (cont.)

The +8.5V regulated input supplies DC operating power to all opamps and integrated circuit switches.

The SQUELCH DISABLE input is an external signal input to the Tone Module and the transceiver. The input is normally floating which means that 5 VDC or greater will appear on that input. During squelch disable operation, however, the SQUELCH DISABLE input becomes a low impedance to ground of 1 VDC or less. The SQUELCH DISABLE input terminates at A7Q4 to override the normal function of the tone detector portion.

The TONE SEL (A, B, C, D) inputs provide for the selection of the eight preset tone frequencies. Tone select lines A, B, and C provide binary coded information for the eight tone channel selection, tone select line D provides for activation of the entire Tone Module upon command. When tone operation is desired, tone select line D (also called CTCSS ENABLE) is a low input level of 1 VDC or less. The Tone Module is deactivated by allowing tone select D input to float and thus produce a level of 8.5 VDC. The eight channel binary code inputs, tone select A, B and C, are coded into eight combinations of high and low levels depending upon the selected tone frequencies. A high level is defined as a floating input of 8.5 VDC, a low level is 1 VDC or less. The binary code is set in such a way that selection of tone frequency number 1 (known as number 0 on early units) is selected when tone select lines A, B and C are all high levels. Similarly, tone frequency number 8 (known as number 7 on early units) is selected when tone select lines A, B and C are low levels.

The +14 V TRANSMIT input is the transmit activation input, the purpose is to convert the CTCSS filter into the CTCSS generator during transmit mode.

The UNSQ MAIN AUDIO input is approximately 0.6 VRMS when the transceiver is operating under standard receiver test conditions. This input is the source of subaudible tone frequencies which are processed by the Tone Module during the receive mode.

4.5 TROUBLESHOOTING (cont.)

4.5.5 TONE MODULE TROUBLESHOOTING PROCEDURE (cont.)

The Tone Module has the following two outputs:

Tone Module Output	Output Termination
MAIN AUDIO INHIBIT	Audio Module
TRANSMIT TONE	Audio Module

The MAIN AUDIO INHIBIT output is a signal which mutes the MAIN RX AUDIO during times of inactive, or incorrect, CTCSS tone modulation. The signal is less than 0.2 VDC during the mute mode of operation and 5.5 VDC or greater during the operate mode. This output is generated by tone detector switch A7Q2.

The TRANSMIT TONE output is a signal at one of the selected EIA subaudible tone frequencies. THe level of the TRANSMIT TONE output is approximately 63 mVRMS for normal operation. The signal is developed and adjusted by potentiometer A7R62.

4.5.6 GUARD RECEIVER MODULE TROUBLESHOOTING PROCEDURE

The Guard Receiver Module is a self-contained receiver and has inputs and outputs as such. The Guard Receiver Module block diagram is shown in Figure 3.7-1. There are the following eight supporting inputs to the Guard Receiver Module:

Guard Receiver Input	Source of Input
+5V	Power Supply Module
+8.5V	Power Supply Module
+24V	Power Supply Module
GUARD VOL	Control Unit
GUARD SQL	Control Unit
SQUELCH DISABLE	Control Unit
GUARD SEL	Control Unit
GUARD RF	R/T Module

4.5 TROUBLESHOOTING (cont.)

4.5.6 GUARD RECEIVER MODULE TROUBLESHOOTING PROCEDURE (cont.)

The +5V input supplies regulated 5 VDC to the guard receiver and is used as bias voltage for several points within the audio circuitry.

The +8.5V is used to power the majority of the active circuitry on the guard receiver.

The +24V input powers the tuning voltage generator. This voltage is necessary due to the high voltages; i.e. 17.5 VDC typical, that are required by the tuning varactor diodes.

The GUARD VOL input is a DC voltage, adjustable from 5.0 to 6.3 VDC depending on the setting of the guard volume control. The signal is applied to the resistance bridge feedback loop at the input to A4U4A.

The GUARD SQL input is also a DC voltage of 0.0 to 6.2 VDC. The signal sets the threshold point of squelch comparator A4U3B.

The SQUELCH DISABLE signal is a DC voltage of 2 VDC or less in the disable mode. In normal operation it is 8.5 VDC.

The GUARD SEL is a DC voltage which has two states. Channel number 1 state occurs when the GUARD SEL is 5.0 VDC or greater; channel number 2 select occurs when this input is 0.2 VDC or less. The signal is applied to the input of channel select switch A4Q12.

The GUARD RF input consists of the RF signal which is derived from the power splitter on the R/T Module. The power splitter supplies an equal amount of antenna signal to the guard and the main receivers. It is possible to check the operation of the power splitter by removing the GUARD RF connection and replacing it with the RF signal from a signal generator. There should be approximately 3.5 dB better sensitivity when the guard receiver is operated this way.

4.5 TROUBLESHOOTING (cont.)

4.5.6 GUARD RECEIVER TROUBLESHOOTING PROCEDURE (cont.)

The Guard Receiver Module has the following four outputs:

Guard Receiver Output	Output Termination
GUARD RECEIVER AUDIO	Audio Module
GUARD AUDIO INHIBIT	Audio Module
GUARD SQL ANNUN	Control Unit
UNSQ GUARD AUDIO	Tone Module

The GUARD RECEIVER AUDIO output is the processed receiver audio from the guard receiver. In this respect the guard receiver differs from the main receiver because the main receiver does not have the audio processing. The output is 0.0 to 0.40 VRMS depending upon the setting of the guard volume control. This measurement is taken with a standard test input signal to the guard receiver. This low level output goes to the Audio Module for amplification of the high level receive audio. The output is developed by buffer amplifier A4U4B.

Since the guard receiver contains the guard squelch circuitry and the Audio Module contains the guard audio mute circuitry, it is necessary for the mute signal (GUARD AUDIO INHIBIT) to be generated by the guard receiver. This signal is developed by squelch comparator A5U3B and is a DC level of one of two states. The inhibit mode occurs when this output is 2 VDC or less and the active mode occurs when this output is 7 VDC or greater.

The GUARD SQL ANNUN output is similar in function to the MAIN SQL ANNUN output generated by the Audio Module. The signal is generated by switch A4Q11 and is 0.2 VDC or less during active squelch condition. When the transceiver is in the blocked condition, the GUARD SQL ANNUN signal is typically 5 VDC depending upon which control unit or test set is used.

4.5 TROUBLESHOOTING (cont.)

4.5.6 GUARD RECEIVER TROUBLESHOOTING PROCEDURE (cont.)

In rare cases the guard receiver is used in a CTCSS tone mode of operation. It is therefore important that the UNSQ GUARD AUDIO output be made available from the guard receiver to the Tone Module for the purpose of CTCSS tone detection. The UNSQ GUARD AUDIO output produces between 0.54 and 0.62 VRMS when the guard receiver is operated from a standard test input signal. Buffer amplifier A4U28 generates this signal.

4.5.7 POWER SUPPLY MODULE TROUBLESHOOTING PROCEDURE

Figure 3.8-1 is the block diagram of the Power Supply Module. The power supply has only one supporting input as follows:

Power Supply Input	Source of Input
+14 V	Filtered Bus Voltage

The +14V input to the power supply is developed from the choke and capacitor filter in series with the incoming power to the transceiver. When the transceiver is being operated from +28 VDC, a voltage regulator located on the rear heatsink of the transceiver converts the input voltage to the +14V required by the power supply and other modules in the transceiver.

The power supply has the following three outputs:

Power Supply Output	Output Termination
+15 V	Other Modules
+8.5 V	Other Modules
+24 V	Other Modules

The +5V output is supplied by 3-terminal regulator A6U4.

The +8.5V is supplied by discrete regulator A6Q3 and associated circuitry.

The +24V output is generated by an inverter circuit and is presented at the output of 3-terminal regulator A6U2.

4.6 ALIGNMENT PROCEDURES

The Alignment Procedures are written for a transceiver which has been completely overhauled. Refer to the appropriate alignment procedure section for the particular area worked on.

4.6.1 POWER SUPPLY ADJUSTMENT

The power supply adjustments involve monitoring power supply voltages which are found on the chassis side of the power supply card-edge connector. **Make all measurements with the voltmeter grounded to the transceiver chassis.**

(1) Monitor pin 4 and verify +14 ± 2 volts. There is no 14VDC adjustment.

(2) Monitor pin 5 and verify +24 ±2.5 VDC. There is no 24 VDC adjustment.

(3) Monitor pin 6. Adjust A6R6 to produce +8.5 ±0.2 VDC.

(4) Monitor pin 7 and verify +5 ±0.5 VDC. There is no 5 VDC adjustment.

4.6.2 FREQUENCY ADJUSTMENT

4.6.2.1 TRANSCEIVERS UTILIZING A REFERENCE OSCILLATOR

The frequency adjustment requires the removal of all modules except for the synthesizer and the power supply. See Figure 4.6-2 for tuning hole locations.

(1) Remove the oven cover.

(2) Disconnect the RX/TX injection coax line from, and connect a frequency counter to, A2P1.

(3) Activate the PTT line.

(4) Channel to 162.5000 MHz and adjust A3R13 to produce 4.7 to 4.9 VDC at the junction of A3R1 and A3C4. Do not disturb the setting of A3R11 at this time.

(5) Channel the transceiver to 162.5000 MHz and adjust A3C10 to produce 162.5000 MHz ±50Hz.

4.6 ALIGNMENT PROCEDURE (cont.)

4.6.2 FREQUENCY ADJUSTMENT (cont.)

4.6.2.1 TRANSCEIVERS UTILIZING A REFERENCE OSCILLATOR (cont.)

(6) Channel the transceiver to 162.5025 MHz and adjust A3R10 to produce 162.5025 MHz ± 50 Hz.

(7) Channel the transceiver to 162.5050 MHz and adjust A3R9 to produce 162.5050 MHz ± 50 Hz.

(8) Channel the transceiver to 162.5075 MHz and adjust A3R8 to produce 162.5075 MHz ± 50 Hz.

(9) If any one of the above frequencies cannot be set due to lack of adjustment range, make an adjustment of A3R11 (in the desired direction) and repeat steps 5, 6, 7, and 8.

(10) Channel the transceiver to the following frequencies and check for output frequency within ± 750 Hz of the channel.

150.0000 MHz	160.0075 MHz
150.0025 MHz	169.9975 MHz
150.0050 MHz	173.9900 MHz
150.0075 MHz	173.9925 MHz
150.9975 MHz	173.9950 MHz
	173.9975 MHz

4.6.2.2 TRANSCEIVERS UTILIZING A TCXO

The frequency adjustment requires the removal of all modules from the transceiver except the synthesizer and power supply.

(1) Find the adjustment hole which is located next to the frequency adjustment decal on the face of the TCXO. See Figure 4.6-2.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.2.2 TRANSCEIVERS UTILIZING A TCXO (cont.)

(2) Channel the transceiver to 163.8400 MHz.

(3) Operate the transceiver in the transmit mode and adjust the TCXO to produce a transmit frequency, as shown on the frequency adjust label, ± 10 Hz. If no frequency is shown, adjust the TCXO to produce 163.8400 MHz ± 10 Hz.

4.6.3 TUNING VOLTAGE ADJUSTMENT (Synthesizer)

The TUNING VOLTAGE adjustments involve monitoring the tuning voltage which is found on the chassis side of the synthesizer card-edge connector pin 7 of P2 on early production units and pin H of P2 on all others. **Make all measurements with the voltmeter grounded to the transceiver chassis.** See Figure 4.6-1 for tuning hole locations.

(1) Remove the Synthesizer Module cover.

(2) Connect a dummy load to the transceiver antenna connector.

(3) Channel the transceiver to 150.0000 MHz and activate the PTT line.

(4) Adjust VCO slug A2L4 to produce 5.0 ± 0.05 VDC.

(5) Deactivate the PTT line and adjust VCO slug A2L1 to produce 5.0 ± 0.05 VDC.

(6) Channel the transceiver to 173.9975 MHz and check for a tuning voltage of between 14.3 and 15.3 VDC.

(7) Activate the PTT line and check for a tuning voltage of between 13.0 and 16.0 VDC.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.4 PHASE DETECTOR ADJUSTMENT (Synthesizer)

It is important that the phase detector be readjusted if any work is done to the synthesizer components which are schematically between (and including) A2U19 and A2U27A.

(1) Remove the Synthesizer Module cover

(2) Channel the transceiver to 162.5000 MHz.

(3) Place an oscilloscope probe on pin 5 of A2U19.

(4) Adjust potentiometer A2R50 until all pulses disappear from the oscilloscope display. The oscilloscope sensitivity should be 0.5 to 1.0V per division. The correct display is a 1.5 VDC line.

4.6.5 MAIN RX PRESELECTOR ALIGNMENT (R/T MODULE)

The preselector alignment requires that the main receiver SINAD ratio be monitored. See Figure 4.6-2 for the tuning hole locations.

(1) Channel the transceiver to 150.0000 MHz.

(2) Connect a signal generator to the antenna input. Adjust the generator to produce standard modulation and channel to the same frequency as the transceiver. Adjust the main receiver volume control, located on the test set or control unit, to produce 5 VRMS receiver output. Adjust the RF level to produce 12 dB SINAD ratio.

(3) Tune potentiometers A8R39 through A8R42 to produce the greatest SINAD ratio.

(4) Readjust the signal generator RF level to produce 12 dB SINAD ratio. Check that the RF level is less than 0.5 uV.

(5) Tune the signal generator and transceiver to 173.9975 MHz. Check that the RF level necessary to produce 12 dB SINAD ratio is less than 0.5 uV, and if so, the alignment procedure is completed. If not, proceed to the following steps.

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.5 MAIN RX PRESELECTOR ALIGNMENT (R/T MODULE) (cont.)

(6) Remove the R/T Module cover. Remove the small silver plated shield cover from the tuning hole.

(7) Using a brass-iron core tuning wand, tune A8L1 through A8L4 for the greatest SINAD ratio. It will be necessary to spread or compress the coils as indicated by the tuning wand. Check that the RF level necessary to produce 12 dB SINAD is less than 0.5 uV.

(8) Tune the signal generator and receiver to 150.0000 MHz. Check that the RF level necessary to produce 12 dB SINAD is less than 0.5 uV, and if so, the alignment procedure is completed. If not, proceed to the following steps.

(9) Tune the signal generator and transceiver to 173.9975 MHz. Using the tuning wand technique, adjust A8L1 through A8L4 for the greatest SINAD ratio. Check that the RF level necessary to produce 12 dB SINAD is less than 0.5 uV.

(10) Tune the signal generator and transceiver to 150.0000 MHz. Tune potentiometers A8R39 through A8R42 to produce the greatest SINAD ratio. It is important to hold the R/T Module cover firmly against the top of the four coil compartments while making this adjustment. Check that the RF level to produce 12 dB SINAD is less than 0.5 uV. Repeat steps 9 and 10 until the sensitivity of 0.5 uV, or better, can be obtained at both frequencies.

4.6.6 MAIN RX DETECTOR ALIGNMENT (R/T MODULE)

The receiver detector alignment consists of the crystal filter alignment and the FM detector alignment procedures. This procedure should be followed if any work has been done in the area of crystal filter A8FL1 or detector A8U2. To perform this alignment it is necessary that the receiver distortion be monitored using a distortion analyzer. See Figure 4.6-2 for the tuning hole locations.

(1) Channel the transceiver to 162.5000 MHz.

***NOTE: Standard modulation for receiver tests is defined as ± 3 kHz deviation at 1 kHz tone.**

4.6 ALIGNMENT PROCEDURES (cont.)

4.6.6 MAIN RX DETECTOR ALIGNMENT (R/T MODULE) (cont.)

(2) Connect a signal generator to the antenna input. Adjust the generator to produce standard modulation * with 1000 uV RF level and tune to the same frequency as the transceiver.

(3) Adjust the main volume control on either the test set or control unit to produce 5 VRMS of receiver output. Measure the receiver distortion, using a distortion analyzer, on the receiver output.

(4) Adjust crystal filter tuning capacitor A8C15 to produce minimum distortion. On Mod 1 and above modules, it is also necessary to adjust A8C107. Check that the distortion is below 7%.

(5) Monitor the audio output level and adjust A8C49 for maximum output level.

(6) For Mod 2 and above modules, monitor the unsquelched main audio on pin 6 of J5 and adjust potentiometer A8R95 to produce between 0.54 and 0.62 VRMS.

4.6.7 MAIN RX S/N SQUELCH ADJUSTMENT (AUDIO MODULE)

The squelch adjustment need only be done if work has been done to receiver detector A8U2 or in the squelch circuitry for the main receiver consisting of A5U3 on the Audio Module.

(1) Channel the transceiver to 162.5000 MHz.

(2) Connect a signal generator to the antenna input. Adjust the generator to produce standard modulation* and tune to the same frequency as the transceiver.

(3) Adjust the squelch control, located on either the control unit or test set, to maximum CW position.

*** NOTE: Standard modulation for receiver tests is defined as ± 3 kHz deviation at 1 kHz tone.**