# TECHNICAL MANUAL

## DIRECT SUPPORT AND GENERAL SUPPORT MAINTENANCE MANUAL

# RADIO SET AN/PRC-70

U.S. ARMY ELECTRONICS COMMAND
FORT MONMOUTH N.J.

NOVEMBER 1975

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## WARNING

DO NOT TOUCH the LINE binding posts, while pressing the RINGER button on remote control unit. A shock hazard is present at LINE binding posts during RINGER operation.

The fumes of trichloroethane are toxic. Provide thorough ventilation whenever used. DO NOT USE NEAR AN OPEN FLAME. Trichloroethane is not flammable, but exposure of the fumes to an open flame or hot metal surface forms highly toxic phosgene gas.

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| Technical Manual<br><br>No. 11-5820-553-34 | TM 11-5820-553-34<br><br>HEADQUARTERS,<br>DEPARTMENT OF THE ARMY<br>Washington, D.C., November 1975 |

# DIRECT SUPPORT AND GENERAL SUPPORT

# MAINTENANCE MANUAL

# RADIO SET AN/PRC-70

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# CHAPTER 1

# INTRODUCTION

## Section I. GENERAL

### 1-1. Scope

This manual contains direct support and general support maintenance instructions for Radio Set AN/PRC-70. Topics covered include equipment functioning, corrective maintenance, troubleshooting, testing, inspection, and modification. Maintenance instructions for auxiliary equipment used with the radio set are contained in separate technical manuals. Refer to Appendix A for reference to auxiliary equipment items.

### 1-2. Maintenance Forms and Records

Department of the Army forms and procedures used for equipment maintenance will be those prescribed in TM 38-750.

### 1-3. Destruction of Army Materiel to Prevent Enemy Use

Refer to TM 750-244-2 for destruction of Army materiel to prevent enemy use.

### 1-4. Administrative Storage

Refer to TM 740-90-1 for administrative storage procedures.

## 1-5. Reporting of Errors

Reporting of errors, omissions, and recommendations for improving this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028, Recommended Changes to Publications, and forwarded direct to Commanding General, U. S. Army Electronics Command, ATTN: AMSEL MA-Q, Fort Monmouth, N. J., 07703.

## Section II. DESCRIPTION AND DATA

### 1-7. Description

The description of Radio Set AN/PRC-70 is contained in Chapter 1 Section II paragraph 1-7 of TM 11-5820-553-12.

### 1-8. Tabulated Data

Tabulated data for Radio Set AN/PRC-70 is contained in Chapter 1 Section II paragraphs 1-8 and 1-9 of TM 11-5820-553-12.

# CHAPTER 2

# FUNCTIONING OF EQUIPMENT

## Section I. RECEIVER-TRANSMITTER FUNCTIONAL ANALYSIS

### 2-1. General

This section contains the functioning theory for Receiver-Transmitter RT-1133/PRC-70 (hereafter referred to as the RT unit). Functioning theory for the RT unit subassemblies is given in section II of this chapter. The information in this chapter is provided to aid in troubleshooting the RT unit.

### 2-2. Simplified Block Diagram Analysis (Fig. FO-1)

a. Receive Path. The received RF signal (2 to 76 MHz) enters the RT unit through the WHIP or ANT connector or the WIRE terminal. The signal passes through the antenna matching network and the receive/transmit relays to a 2 to 76 MHz bandpass filter. From the bandpass filter, the signal is applied to a mixer upconverter where it is converted to the first intermediate frequency of 111.455 MHz. The local oscillator required for this conversion (and for subsequent frequency conversion) is provided by a digital synthesizer which is controlled by the front panel frequency selector. All signals developed by the synthesizer are phase-locked to a 4.5 MHz temperature-compensated crystal oscillator (TCXO). A crystal filter and an IF amplifier follow the upconverter to provide gain and selectivity to the first IF signal. The signal is then heterodyned to the second IF of 11.455 MHz in the second mixer. A crystal filter and an IF amplifier also follow this mixer to provide additional gain and selectivity. The signal is then converted to the third IF of 455 kHz in the third mixer. A group of switched filters follows the third mixer. The selectivity provided by these filters depends on the mode selected. Then the 455 kHz signal is routed through an IF amplifier to the demodulator. Besides gain, this IF amplifier also develops the AGC voltage for the preceding IF stages. Audio content of the signal is detected in the demodulator and applied to the audio preamplifier circuits. Bandpass filtering, as well as gain, is provided by the preamplifier. The signal is then amplified in the audio output stage, which provides the audio for the AUDIO, X-MODE, and RXMT connectors of the receiver-transmitter.

b. Transmit Path. Voice, burst CW, burst FSK, or cipher audio signals are input to the receiver-transmitter through the AUDIO, RXMT, and X-MODE connectors. In the standard CW and FSK modes, keying signals are input through the AUDIO connector. The audio signals are initially shaped and bandlimited in the audio preamplifier circuits. From the preamplifier, AM, SSB, FSK, and the CW baseband audio is applied to a SSB modulator where it is used to modulate a 455 kHz signal from the synthesizer. AM is generated by reinsertion of the carrier and FM audio is applied directly to an FM modulator consisting of an 11.455 MHz VCXO (Voltage Controlled Crystal Oscillator). SSB, AM, CW, and FSK signals are converted to 11.455 MHz in the third mixer stage. From this point, the SSB, AM, CW, FSK, and FM signals all follow the same path through a transmit IF amplifier and a crystal filter to the second mixer. In the second mixer, the signal is converted to 111.455 MHz, and then routed through another transmit IF amplifier and crystal filter to the upconverter. The upconverter converts the signal to the operating frequency and outputs it to the transmit broadband amplifier through a 76 MHz bandpass filter. In the broadband amplifier the signal is amplified to a level of 80 milliwatts. This level is maintained by the automatic gain control (AGC) loop. The signal is then amplified in the driver stage to a level of approximately 3.0 watts. This level is applied to a harmonic filter network in the LO PWR and TUNE modes. In the HI PWR mode, the signal is amplified to a level of approximately 40 watts in the final amplifier stage before being applied to the harmonic filters. From the harmonic filters, the signal is routed through a detector stage and the antenna matching network to the antenna.

2-3. Detailed Block Diagram Analysis (Fig. FO-2, sheets 1 and 2)

a. IF Circuits. The same IF frequencies (111.455 MHz, 11.455 MHz, and 455 kHz) are used for both transmit and receive. Also, the same mixers and filters are used in both modes. However, separate IF amplifiers are required for each mode due to the different output levels needed. Figure FO-2 shows the levels involved at various points in the IF circuits. Physically, the IF circuits are contained in eight modules. The following subparagraphs briefly describe the function of these modules:

(1) Bandpass filter module (1A1FL1.) In the receive mode, the bandpass filter attenuates the first IF frequency (111.455 MHz) and the pump VFO frequencies (113.4550 to 187.4549 MHz) to prevent these frequencies from reaching the antenna. Image frequencies are also attenuated. In the transmit mode the filter helps prevent harmonic outputs above 76 MHz and below 2 MHz.

(2) Upconverter module (1A1A13). The upconverter provides mixing to the first IF (111.455 MHz) and provides the gain to raise the first local oscillator frequencies (113.4550 to 187.4549 MHz) to the required pump level.

(3) First IF selectivity module (1A1A14). This module provides both gain and selectivity for the first IF.

(4) First IF AGC and gain module (1A1A15). This module receives the 30 dB tuner AGC in the receive mode and provides gain for the 111.455 MHz IF signal in both receive and transmit modes.

(5) Second mixer (1A1A16). The second mixer module provides mixing to the second IF (11.455 MHz) and the first IF (111.455 MHz) in the receive and transmit modes respectively. The second local oscillator of the radio set is located in this module where it generates the 100 MHz signal.

(6) Second IF (1A1A17). This module provides gain for the 11.455 MHz IF in both receive and transmit. It also contains receive and transmit AGC circuits.

(7) IF selectivity (1A1A19). The IF selectivity module provides SSB and AM selectivity and provides mixing to the third IF (455 kHz).

(8) Receive IF and detection (1A1A22). This module amplifies the 455 kHz IF to provide the major gain for the unit in the receive mode. It also demodulates the signal and develops the AGC control voltage.

b. Audio Circuits. The audio circuits consist of the various modulators, squelch circuits, receive audio circuits, and the audio AGC circuits. These circuits are contained in two modules as described in the following subparagraphs:

(1) Modulator and squelch module (1A1A21). This module contains the FM and AM/DSB modulators. It also contains all of the squelch circuitry. The squelch circuit distinguishes voice characteristics from noise, hence level control is not required.

(2) Audio module (1A1A23). The audio module contains the audio preamplifiers, sidetone circuits, audio output amplifier, and audio AGC circuits. In the receive mode, audio from the demodulator is first amplified in a wideband audio amplifier. For secure FM operation, this wideband audio is output to the voice security equipment. It is also applied to the AGC circuits, which develop the audio AGC, and is routed through a bandpass filter to the narrowband audio

amplifier. From the narrowband amplifier, the audio is routed through the sidetone circuits to the audio output amplifier. The sidetone pad switch logic controls the levels and switching of sidetone audio, depending on the operating mode. The audio output amplifier provides the necessary audio level to the headset, etc. In the transmit mode, microphone or retransmit audio is routed through an isolation transformer and switch and an AGC bridge to the wideband audio amplifier. The audio is then routed through the voice band-pass filter and narrowband amplifier, and is output to the modulator and squelch module.

c. Synthesizer Circuits. The synthesizer circuits generate all required heterodyne frequencies for the receiver-transmitter. These circuits also provide the necessary tones for CW and FSK keying and the 150 Hz squelch tone for the FM mode. A temperature compensated crystal oscillator (TCXO) generates a 4.5 MHz signal which is the frequency reference for all synthesizer circuits. The first heterodyne frequency is developed in two interpolation loops which are phase locked to the 4.5 MHz reference signal. Frequencies 10 kHz and below are interpolated in the lower loop and frequencies above 10 kHz are interpolated in the upper loop. The functions of the various synthesizer modules are described briefly in the following subparagraphs:

(1) Oscillator digital divider module (1A1A11). Contains the TCXO which generates the 4.5 MHz reference signal for the system. A fixed divider converts the 4.5 MHz reference signal to other frequencies required by the system.

(2) Oscillator distributor module (1A1A10). Contains an 11 MHz generator for input to the IF selectivity module and distributes the 455 kHz IF signal, the 150 Hz FM tone, the 2 kHz CW tone, and the 1579 and 2432 Hz FSK tones.

(3) Lower loop module (1A1A9). Contains the variable divider (hybrid), 1 kHz hybrid phase detector, lower loop VFO, and other circuitry associated with the interpolation loop.

(4) Translator module (1A1A6). Provides for the lower loop translation to the upper loop.

(5) Upper loop divider (1A1A7). Contains the variable and fixed dividers that produce the 100 kHz signals for the upper loop phase detector.

(6) Upper loop phase detector (1A1A8). Provides the sample-hold phase detector and loop filter for the upper loop.

(7) Pump VFO (1A1A18). Provides the upper loop VFO frequencies (113.455 to 187.455 MHz).

d. Power Amplifier/Coupler Circuits. The power amplifier and coupler circuits develop the transmitter RF output to the antenna. These circuits are contained in eight modules as described in the following subparagraphs:

(1) Transmit broadband module (1A1A12). Amplifies the upconverter output signal to a level of 80 milliwatts.

(2) Power Amplifier and Driver module (1A1A29). This module has four functions:

(a) Provides the necessary power output for the HI PWR transmit mode.

(b) Provides about 3 watts output to the antenna in the LO PWR mode.

(c) Provides RF power for use during the antenna coupler tune cycle.

(d) Contains the gain control attenuator (photocell/neon bulb assembly).

(3) Filter module (1A1A28). Contains ten low-pass filters which are switched by the band-switch motor to provide harmonic attenuation.

(4) Detector module (1A1A27). Contains sensors for the amplifier ALC loop and sensors for the antenna coupler tuning sequence.

(5) Coupler module (1A1A24). Contains the antenna matching network, the switch control circuits, and pulse amplifiers for the reactors in the matching network. Additionally, it contains the coupler logic control for the coupler tune cycle.

(6) ALC module (1A1A25). Contains the amplifiers for the automatic level control (ALC) and for the final protection circuits.

## Section II. SUBASSEMBLY FUNCTIONAL ANALYSIS

### 2-4. Frequency Selector 1A1A1 (Fig. FO-3)

Frequency selector module 1A1A1 contains the frequency selection controls and the POWER, MODE, and SQUELCH switches. The frequency selection controls consist of six, multi-section rotary switches. These switches generate 27 bits of frequency data which are used to preset variable dividers in lower loop module 1A1A9 and in upper loop divider module 1A1A7. Additionally, 10 bits of band-switch data are generated to tune harmonic filter 1A1A28 and to coarse tune coupler module 1A1A24.

### 2-5. Flyback Regulator 1A1A2 (Fig 2-1)

Module 1A1A2 is part of the receiver-transmitter power supply. This module generates +5V filtered power for power amplifier and driver module 1A1A29. It also develops +38V, -5V, and +5V outputs for other modules in the power supply. A trigger signal from module 1A1A3 (para. 2-6) is applied to an amplifier which, in turn, triggers a series switch transistor. +24V is applied to the series switch from the battery. The resulting interrupted 24V is applied to a transformer where it produces 38V and 5V outputs. These voltages are then rectified to produce DC outputs of -5V, +5V (two outputs), and +38V. One of the +5V outputs is filtered and output to power amplifier and driver module 1A1A29. The remaining outputs (unfiltered) are output to 1A1A3, 1A1A4, and 1A1A5. A +5V and a -5V output are

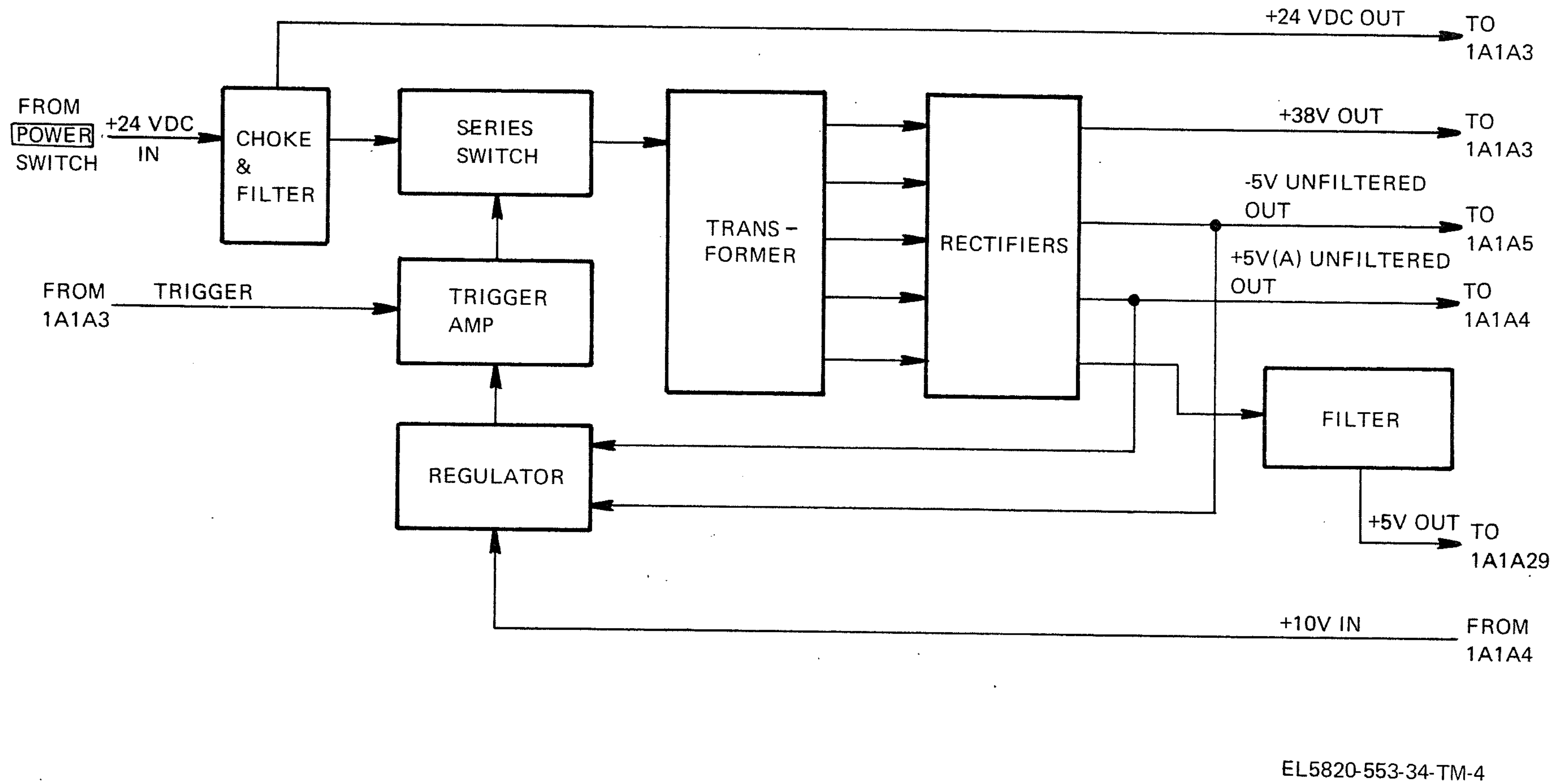



Figure 2-1. Flyback regulator 1A1A2 block diagram

fed back to a regulator circuit along with a +10V input from 1A1A4. The regulator circuit controls the bias to the trigger amplifier thereby regulating the outputs of this module.

2-6. Trigger and 30V Regulator 1A1A3 (Fig. 2-2).

Module 1A1A3 generates the trigger signal for 1A1A2, 1A1A4, and 1A1A5. An oscillator signal is gated and switched to produce the trigger output. The +38V input from 1A1A2 is applied to a voltage regulator and filter circuit to generate the +30V power for 1A1A9 and 1A1A21.

2-7. 10V Regulator 1A1A4 (Fig. 2-3).

Module 1A1A4 generates +10V power for coupler 1A1A24, the transmit/receive relay, and other modules through the POWER switch. This module also provides filtering for the +5V power from 1A1A2. +24V is applied to a series switch transistor from the POWER switch. This voltage is interrupted by the amplified trigger input from 1A1A3. The resulting 10V squarewave is fed to a regulator and then is fed back to control the trigger amplifier. The filters smooth out the ripple in the +10V power, as well as the +5V (A) analog power from 1A1A2. A default output from this module is tied back to the +5V (digital power) output from 1A1A2. This connection is made to load the +5V (A) analog output when no current is being drawn by other circuits.

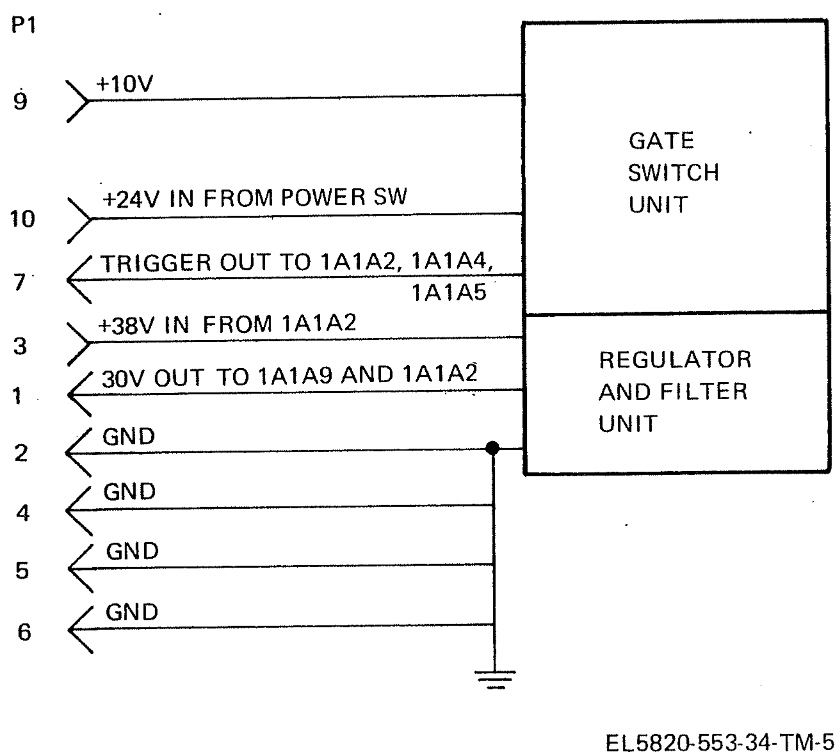



Figure 2-2. Trigger and 30 V regulator 1A1A3 block diagram

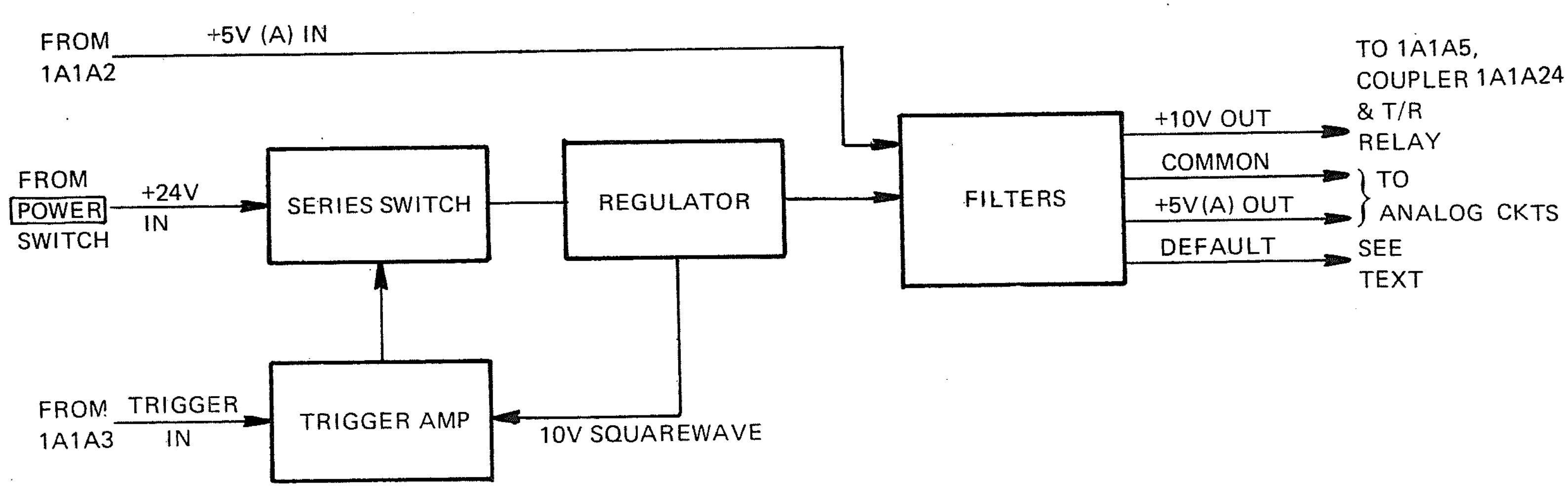



Figure 2-3. 10 V regulator 1A1A4 block diagram

2-8. 5V Regulator 1A1A5 (Fig. 2-4)

Module 1A1A5 generates +5V power for the receiver-transmitter logic circuits, for coupler 1A1A24, and for other modules via front-panel controls. Filtering is also provided on this module for the -5V power from 1A1A2. +24V is applied to a series switch transistor from the POWER switch. This voltage is interrupted by the amplified trigger input from 1A1A3. The resulting 5V squarewave is fed to a regulator and is then fed back to control the trigger amplifier. +10V bias is also applied to the regulator from 1A1A4. The filters smooth out the ripple in the +5V power as well as the -5V power from 1A1A2.

2-9. Translator 1A1A6 (Fig. 2-5)

Module 1A1A6 provides the mixers, buffers, and filters required to translate the synthesizer lower loop interpolations to the upper loop. The lower loop interpolations (10 kHz digits and below) are represented by a variable 4.7550 to 4.8549 MHz input to a balanced mixer. A 100 MHz signal from module 1A1A16 is also applied to the mixer through an amplifier buffer stage. The mixer sum frequency output (104.7550 to 104.8549 MHz) is amplified and filtered and applied to another balanced mixer. The high level input to this mixer is the 113.4550 to 187.4549 MHz output of pump VFO module 1A1A18 (part of the upper interpolation loop). The resulting difference-frequency output (8.7 to 82.6 MHz) is filtered and amplified, and then is fed to upper loop divider 1A1A7.

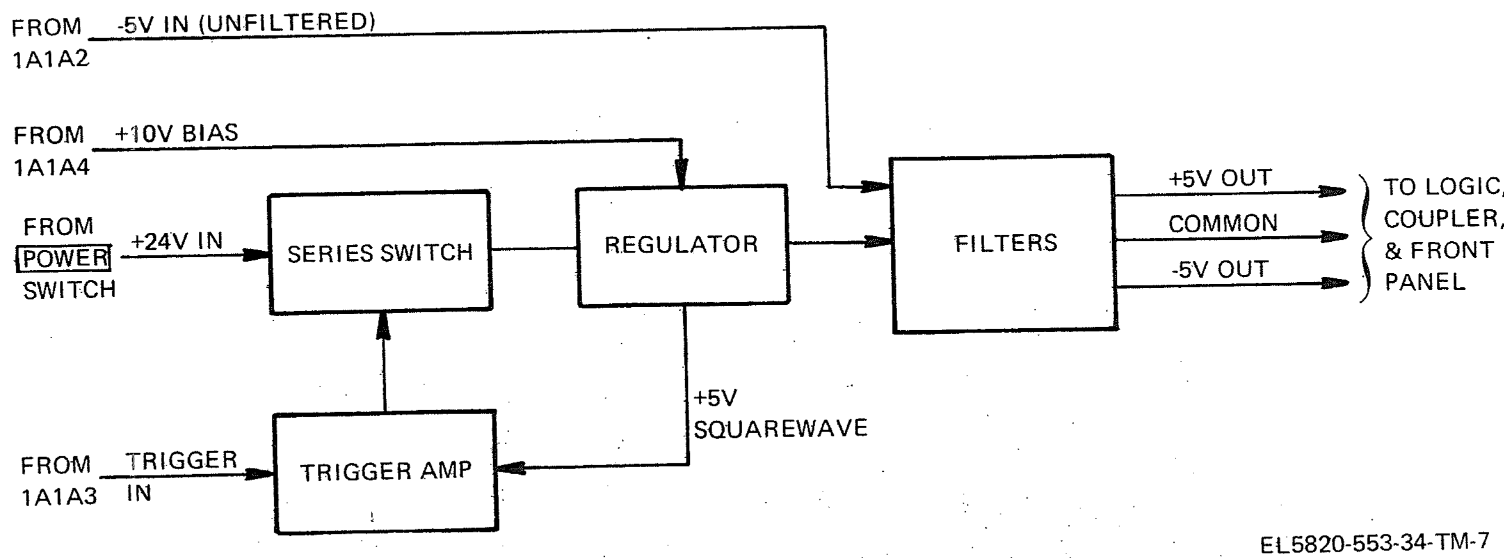



Figure 2-4. 5 V regulator 1A1A5 block diagram

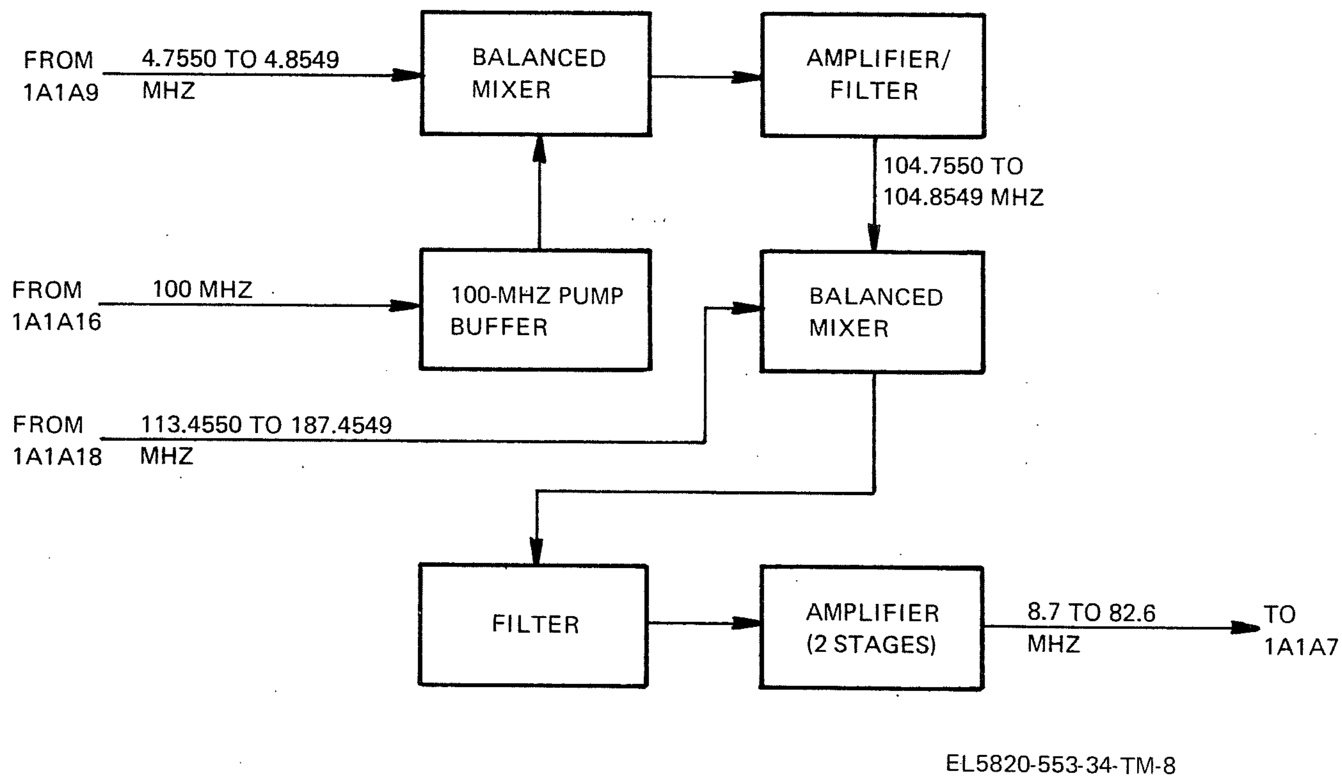



Figure 2-5. Translator 1A1A6 block diagram

2-10. Upper Loop Divider 1A1A7 (Fig. 2-6)

Upper loop divider 1A1A7 is a variable digital divider. Preset data is applied to the module from the frequency controls (1A1A1). This data causes the divider to vary its division ratio between 87 and 826. An 8.7 to 82.6 MHz signal is received from the translator mixer (1A1A6). This signal is converted to 100 kHz by the divider. The 100 kHz output is fed to the upper loop phase detector (1A1A8) used to control the pump VFO. The 500 kHz input from 1A1A11 is fed into a (÷5) divider in 1A1A7. The output (100 kHz) goes to 1A1A8.

2-11. Upper Loop Phase Detector 1A1A8 (Fig. 2-7)

a. Upper loop phase detector 1A1A8 controls the overall operation of the upper interpolation loop of the synthesizer. The 100 kHz signal from the variable divider in module 1A1A7 (para. 2-10) is compared in the phase detector with a 100 kHz reference signal from the ÷5 divider in module 1A1A7 (para. 2-10).

b. If the variable divider output frequency is higher than the reference, one of two digital frequency discriminator outputs goes high. This output is fed to the out-of-lock detector and to the sample-hold phase detector, where it clamps the ramp voltage to zero and causes the pump VFO (1A1A18) to sweep down in frequency. If the frequency of the VFO is sufficiently close, it will slew through the desired frequency in microseconds. This causes the digital frequency discriminator output to go low and that allows the sample-hold phase detector to acquire phase lock before the out-of-lock detector has enabled the

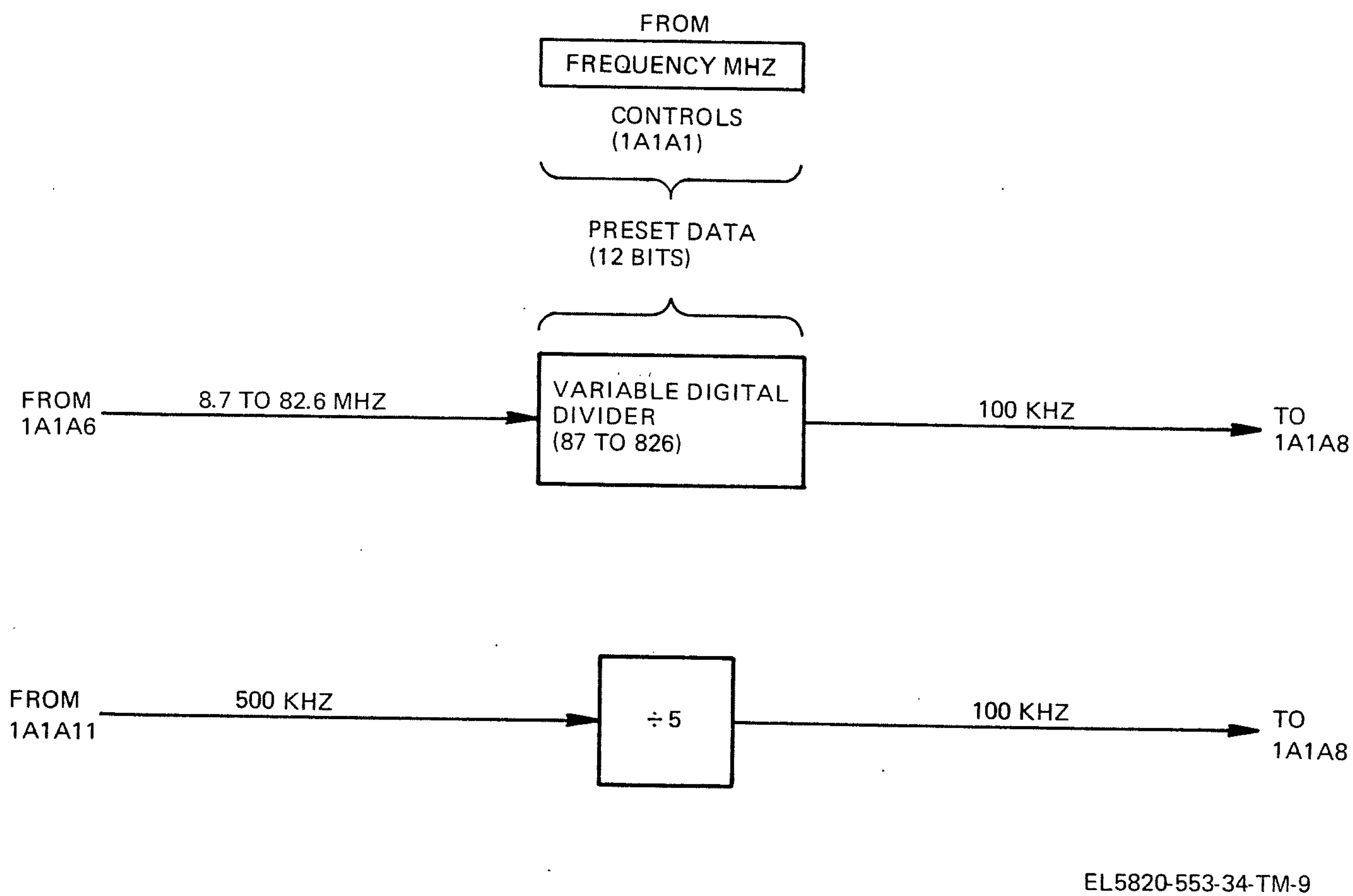



Figure 2-6. Upper loop divider 1A1A7 block diagram

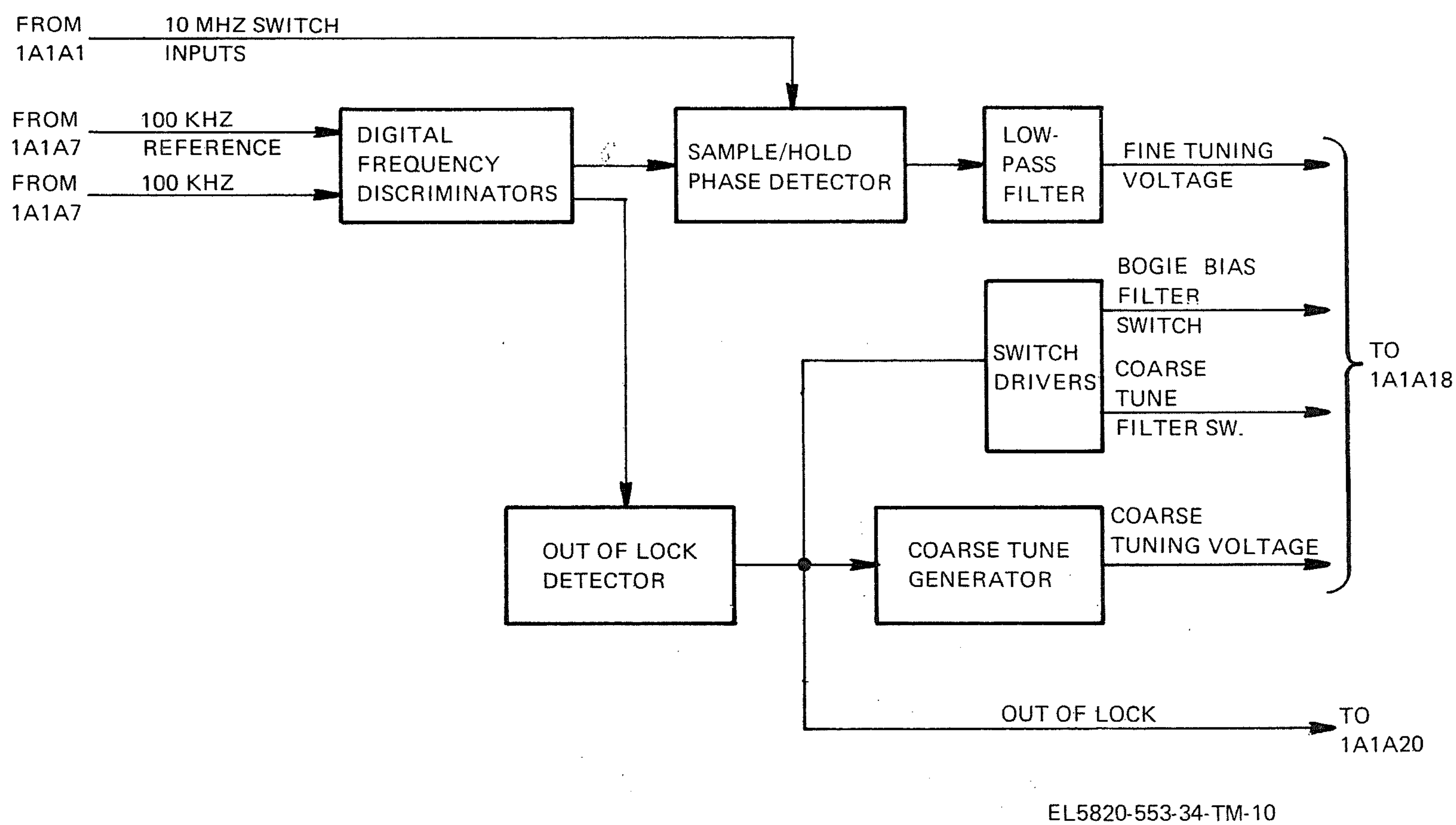



Figure 2-7. Upper loop phase detector 1A1A8 block diagram

coarse tune voltage. Otherwise, the out-of-lock detector enables the coarse tune voltage causing it to slowly drift down. As the VFO frequency slews through the desired frequency, the digital frequency discriminator output goes low, allowing the sample-hold phase detector to acquire lock. After phase lock the digital frequency discriminator output is a squarewave.

c. If the variable divider output frequency is initially lower than the reference, the phase detector operates as above except the ramp of the sample-hold phase detector is clamped high and the coarse tune voltage drifts up causing the VFO frequency to slew up through the desired frequency.

d. The out-of-lock detector not only controls the coarse tune voltage ramp, but also controls two switch driver circuits. These switch drivers provide DC control voltages to two FET switches located in pump VFO module 1A1A18 (para. 2-20).

2-12. Lower Loop 1A1A9 (Fig. 2-8)

The lower loop module (1A1A9 interpolates and phase-locks the HF-VFO for control panel frequency settings below 10 kHz. The HF-VFO operates between 2.550 and 3.549 MHz with one output being supplied to a fixed divide-by-10 circuit and another output to a variable divider (2550 to 3549) circuit. The variable divider is preset by the 100 Hz, 1 kHz and 10 kHz frequency selector switches on the control panel. The output of the variable divider is supplied as one input to the 1 kHz phase detector, and a 1 kHz reference frequency from the oscillator-

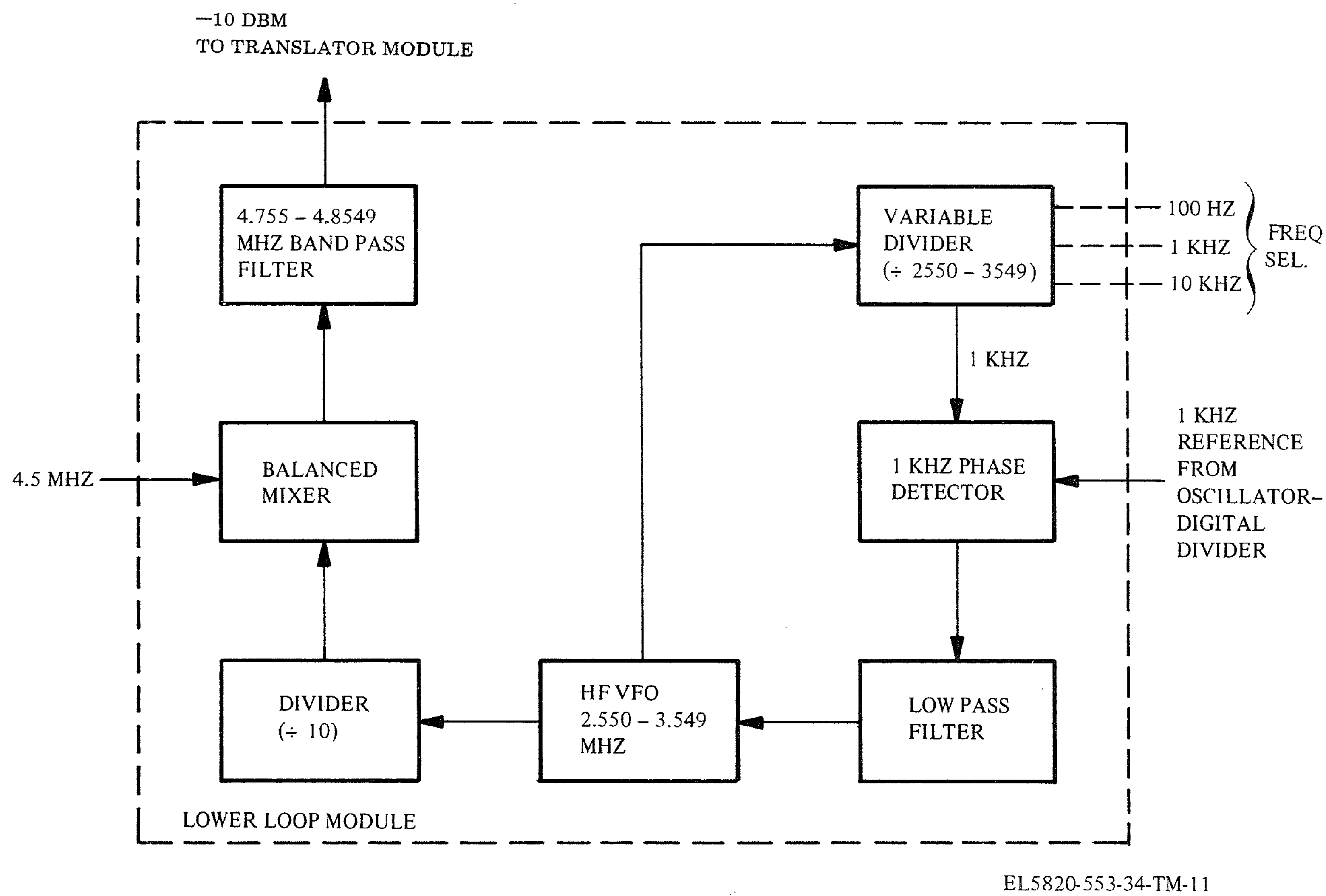



Figure 2-8. Lower loop 1A1A9 block diagram

digital divider (1A1A11) is supplied as the other input. These two inputs to the phase detector are compared and a dc output is applied through a low pass filter to the HF-VFO which retunes the VFO until the inputs of the 1 kHz phase detector are balanced. The HF-VFO output to the divide-by-10 circuit is supplied to the balanced mixer at a frequency of 255 kHz to 354.9 kHz. A fixed 4.5 MHz signal from the oscillator digital divider (1A1A11) is supplied to the balanced mixer and is added to provide a 4.755 to 4.8549 MHz output through a filter network to the translator module (1A1A6).

2-13. Oscillator Distributor 1A1A10 and Oscillator Digital Divider 1A1A11 (Fig. 2-9)

Modules 1A1A10 and 1A1A11 operate together to generate most of the reference signals, heterodyne signals, and the CW, FSK, and FM tone signals. A temperature compensated crystal oscillator (TCXO) in 1A1A11 generates the master reference signal (4.5 MHz) for the receiver-transmitter. All of the signals mentioned above, as well as those generated by theVFO circuits of 1A1A9 and 1A1A18, are phase locked to, or derived from, the 4.5 MHz reference. A digital divider on 1A1A11 divides the 4.5 MHz reference to produce outputs of 455 kHz, 500 kHz, 150 Hz, 1 kHz, and the 2000 Hz, 1579 Hz, and 2432 Hz CW and FSK tones. Control signals are applied to the divider from the MODE switch of the frequency selector module and from modules 1A1A20, 1A1A21, and 1A1A24A. The 455 kHz output of the divider is initially passed through a shaper and a filter on 1A1A11

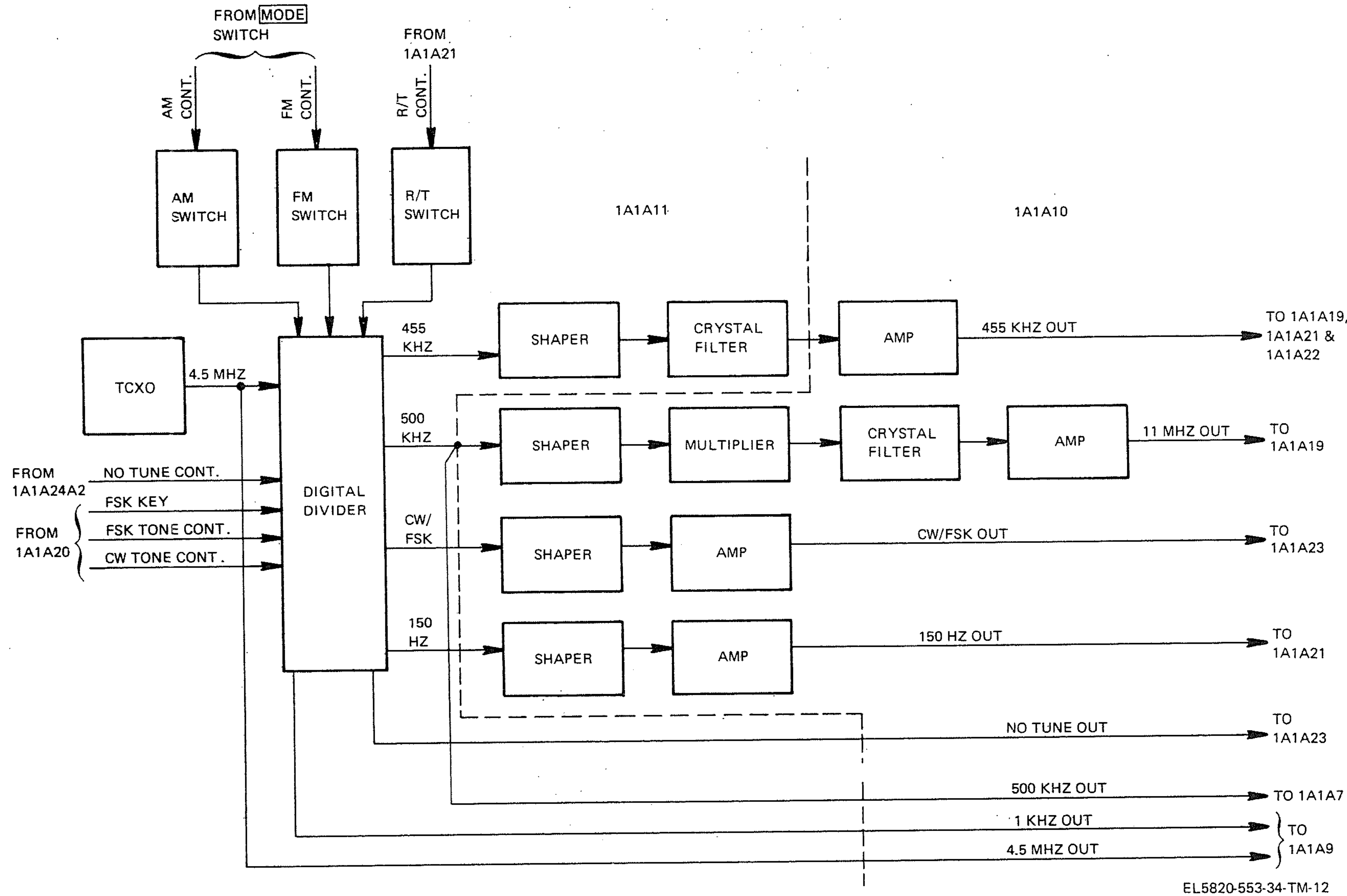



Figure 2-9. Oscillator distributor 1A1A10 and oscillator digital divider 1A1A11 block diagram

to produce a sinusoidal waveform. This signal is then amplified on 1A1A10 before being fed to 1A1A19, 1A1A21, and 1A1A22. The 500 kHz divider signal is routed through a shaper, a multiplier, a filter, and an amplifier on 1A1A10 to produce the 11 MHz heterodyne signal for 1A1A19. The CW/FSK tones and the 150 Hz tone are routed through shapers and amplifiers on 1A1A10.

2-14. Transmit Broadband 1A1A12 (Fig. 2-10).

Module 1A1A12 develops the 80 milliwatt RF signal for driver/power amplifier 1A1A29. The AGC voltage for the second IF (1A1A17) is also developed in this module. A -13 dBm RF signal is fed to a preamplifier from 1A1FL1, by the R/T relay, in the transmit mode. The preamplifier output is applied to a broadband amplifier (2 to 76 MHz) where the level is raised to +19 ± 1.25 dBm (approximately 80 milliwatts). A sample of the output RF is rectified and fed back to a level detector. The level detector output is amplified to produce the 1.1 to 1.5 Vdc AGC voltage for second IF module 1A1A17.

2-15. Upconverter 1A1A13 (Fig. 2-11)

Upconverter 1A1A13 provides different functions in the receive and transmit modes. In the receive mode, the received signal is applied to the upconverter mixed through bandpass filter 1A1FL1. A pump signal (113.4550 to 187.4549 MHz from 1A1A18) is also applied to the mixer through a pump buffer. The resulting 111.455 MHz mixer output is routed through a low pass filter and out to the first IF selectivity module (1A1A14). In the transmit mode, a 111.455 MHz

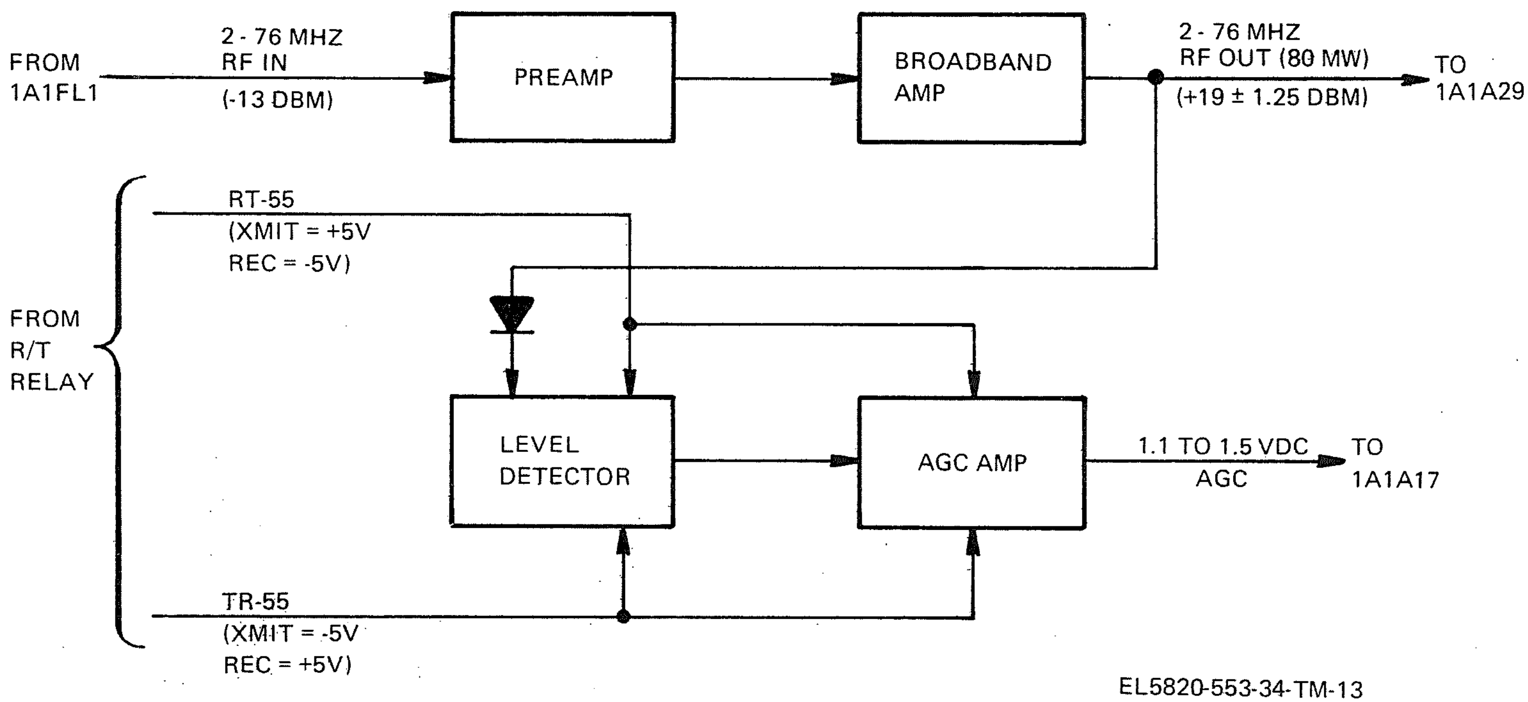



Figure 2-10. Transmit broadband 1A1A12 block diagram

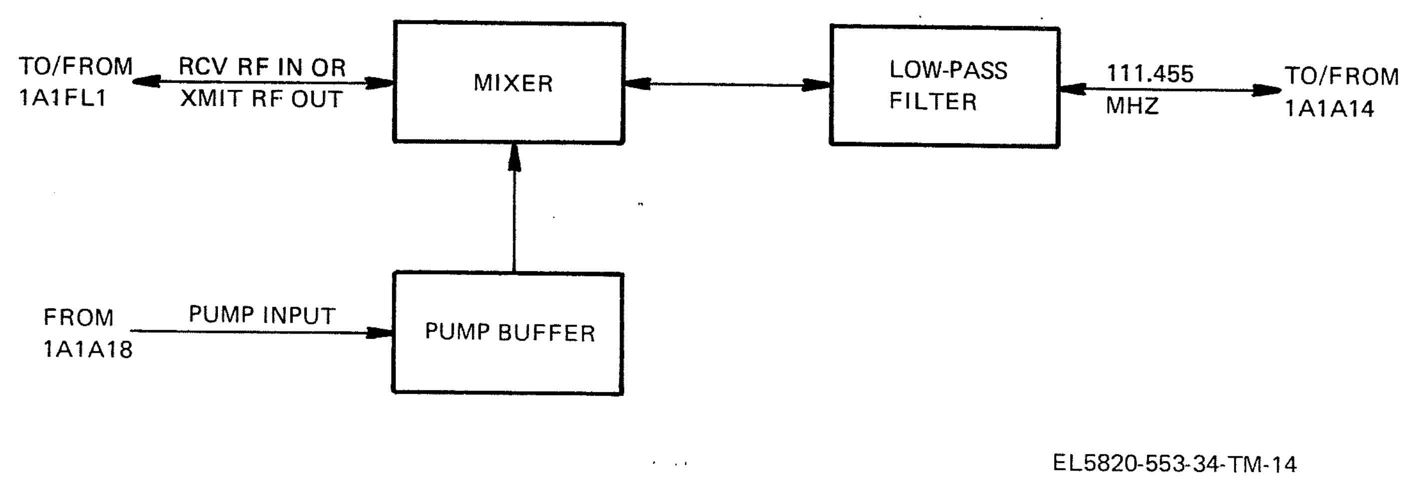



Figure 2-11. Upconverter 1A1A13 block diagram

signal is received from 1A1A14. This signal is mixed with the proper pump frequency to produce a RF signal in the operating frequency. The output is routed through bandpass filter 1A1FL1 to 1A1A12 (para. 2-14). The input/output levels of the upconverter are as follows:

| MODE | INPUT | OUTPUT |
|---|---|---|
| Receive | -117 to +4.5 dBm | -124 to -1.5 dBm |
| Transmit | -6 dBm ± 3.5 dBm | -12.5 dBm ± 3 dB |

2-16. First IF Selectivity 1A1A14 (Fig. 2-12).

Module 1A1A14 operates in both the transmit and receive modes to provide selectivity for the 111.455 MHz IF. However, the module functions differently in the transmit mode than it does in receive mode. In the transmit mode, the 111.455 MHz transmit IF is received from module 1A1A15. This signal is routed through a 111.455 MHz crystal filter and an enabled diode switching circuit, and is then output to 1A1A13. The remaining circuitry of the module is disabled by the TR-55 signal (-5V in the transmit mode). In the receive mode, the diode switching circuit is disabled and a two-stage IF amplifier is enabled by the TR-55 signal (+5V in the receive mode). The 111.455 MHz signal from up-converter 1A1A13 is routed through the amplifier and the crystal filter, and then is output to 1A1A15. The input/output levels of module 1A1A14 are as follows:

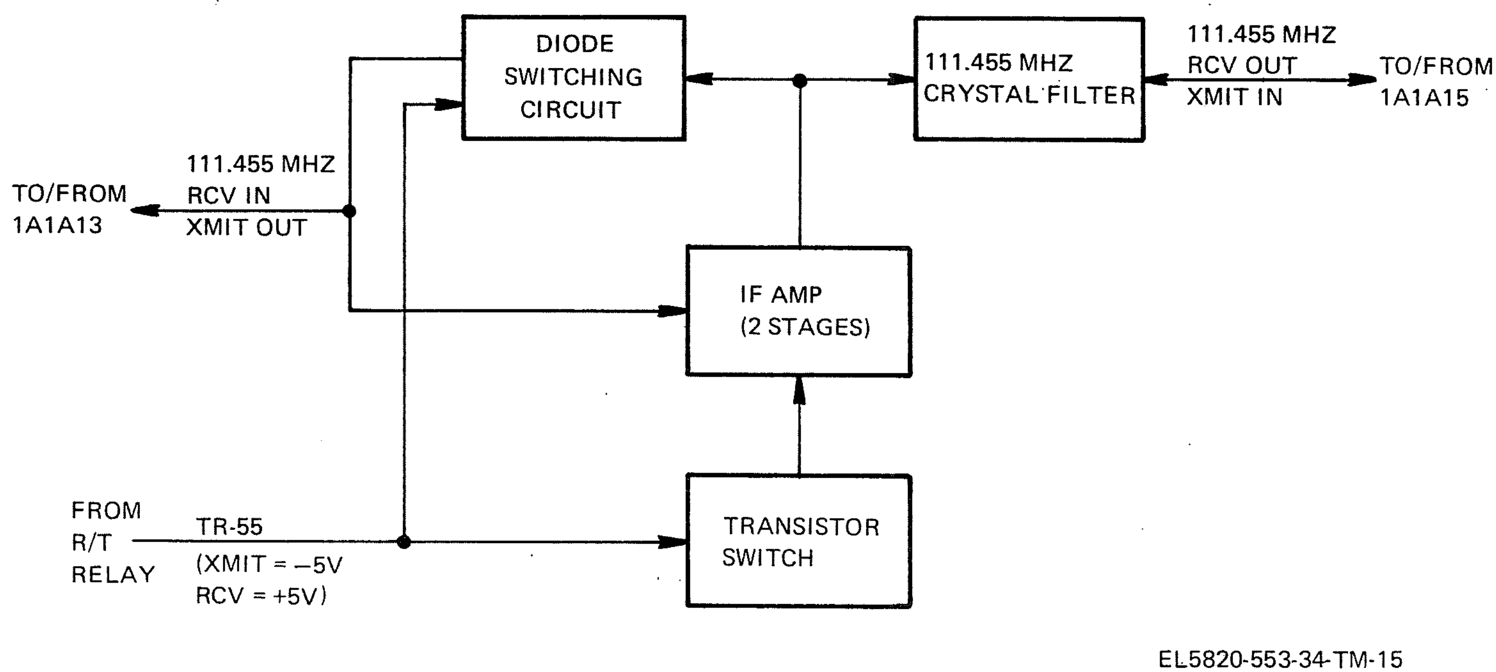



Figure 2-12. First IF selectivity 1A1A14 block diagram

| MODE | INPUT | OUTPUT |
|---|---|---|
| Receive | -124 to -1.5 dBm | -116 to +9.5 dBm |
| Transmit | 0 dBm ± 4 dB | -6 ± 3.5 dBm |

2-17. First IF AGC and Gain 1A1A15 (Fig. 2-13).

a. General. Module 1A1A15 provides signal gain for the 111.455 MHz IF in both the receive and transmit modes. Also, AGC is provided for the receive IF in this module.

b. Receive Mode. In the receive mode, the 111.455 MHz signal from 1A1A14 (-116 to +9.5 dBm) is applied to the receive IF amplifier via a diode switching circuit. This input diode switching circuit and a similar circuit at the output of the receive IF amplifier are enabled by the TR-55 signal (+5V in the receive mode). The three-stage receive IF amplifier boosts the 111.455 MHz signal to a level of -103 to -1.5 dBm. Receive AGC from 1A1A22 is applied to the receive IF amplifier through an AGC amplifier. This maintains the IF output levels within the specified limits. A transistor switch enables the AGC amplifier only in the receive mode.

c. Transmit Mode. In the transmit mode, the 111.455 MHz signal from 1A1A16 (-18.5 dBm ± 5 dB) is applied to the transmit IF amplifier through a diode switching circuit. The TR-55 signal (-5V in the transmit mode) enables this diode switch, as well as a transistor switch circuit which controls the transmit IF amplifier. The two-stage transmit IF amplifier boosts the signal to a level of 0 ± 4 dBm for an output to 1A1A14.

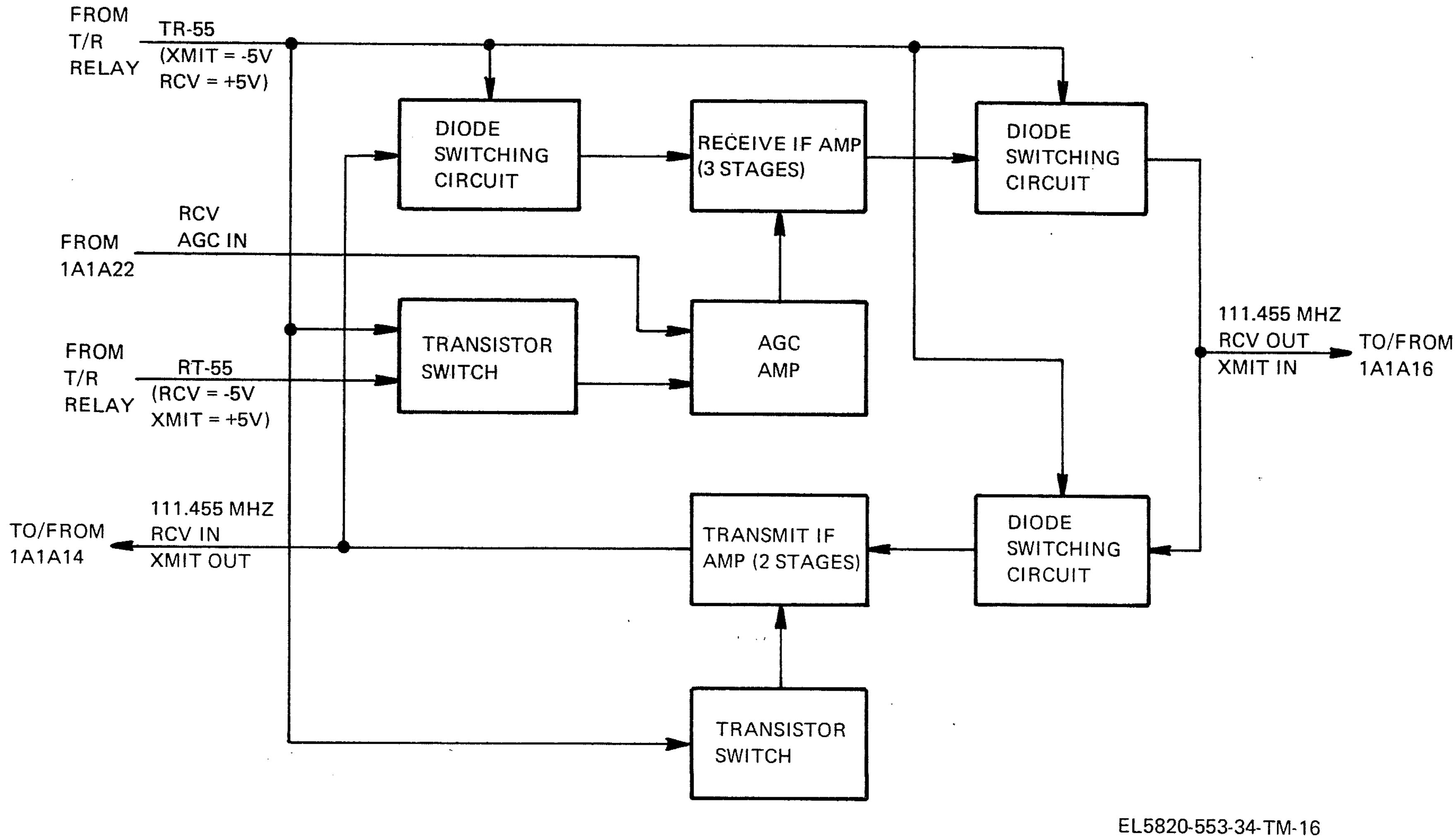



Figure 2-13. First IF AGC and gain 1A1A15 block diagram

2-18. Second Mixer 1A1A16 (Fig. 2-14)

Module 1A1A16 generates outputs of 100 MHz and either 11.455 or 111.455 MHz, depending on the mode in use. A crystal oscillator in this module generates a 100 MHz signal which is buffered and applied to a balanced mixer. The 100 MHz signal is also output to translator module 1A1A6 (para. 2-9). In the receive mode, the balanced mixer receives a 111.455 MHz input from 1A1A15. The resulting 11.455 MHz difference frequency is passed through a crystal filter and output to second IF module 1A1A17. In the transmit mode, an 11.455 MHz signal is received from 1A1A17 and is routed through the crystal filter to the balanced mixer. The 111.455 MHz sum frequency from the mixer is then output to 1A1A15. The input/output levels of module 1A1A16 are as follows:

| MODE | INPUT | OUTPUT |
|---|---|---|
| Receive | -103 to -1.5 dBm | -113 to -9.5 dBm |
| Transmit | -4.5 dBm ± 6 dB | -18.5 dBm ± 5 dB |

2-19. Second IF 1A1A17 (Fig. 2-15).

a. General. Module 1A1A17 provides signal gain and AGC control for the 11.455 MHz IF in both the receive and transmit modes. Keying is also applied to this module in the CW transmit mode.

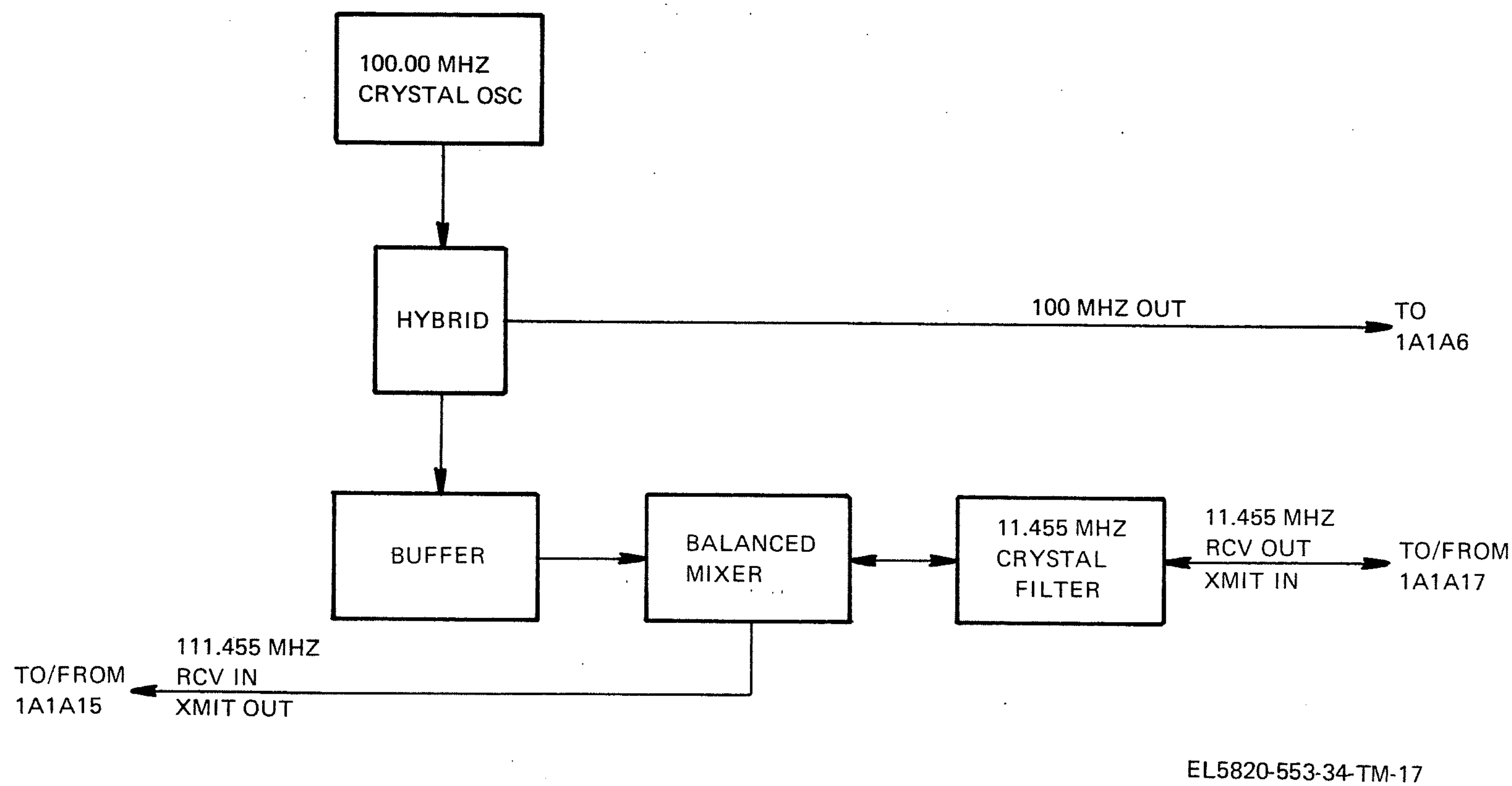



Figure 2-14. Second mixer 1A1A16 block diagram

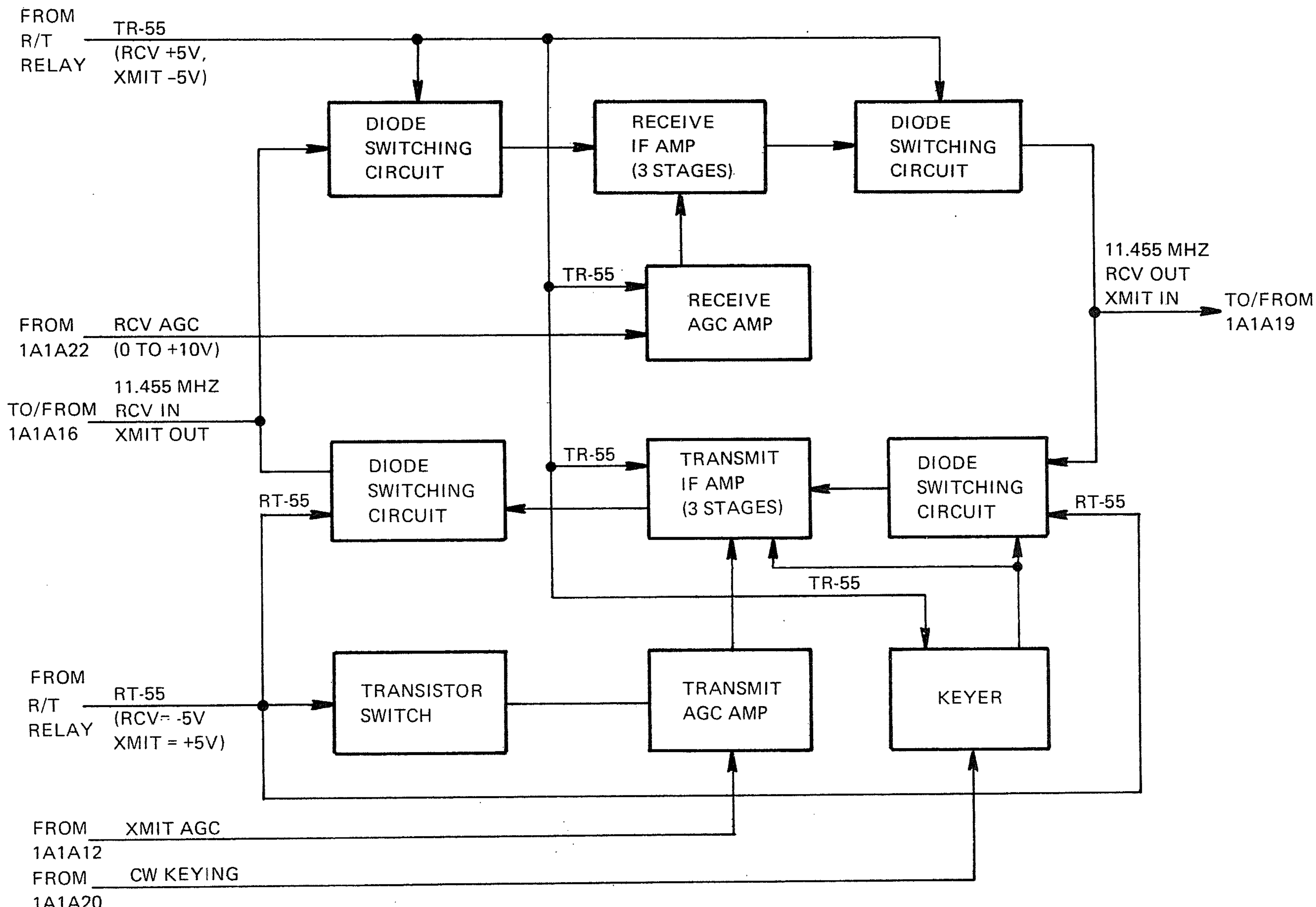



Figure 2-15. Second IF 1A1A17 block diagram

b. Receive Mode. In the receive mode, the 11.455 MHz signal from 1A1A16 (-113 to -9.5 dBm) is applied to the receive IF amplifier via a diode switching circuit. This diode switching circuit and another at the amplifier output are enabled by the TR-55 signal (+5V in the receive mode). The three-stage receive IF amplifier boosts the 11.455 MHz signal to a level of -87 to +2.5 dBm. Receive AGC from 1A1A22 is applied to the receive IF amplifier through an AGC amplifier. The TR-55 signal enables the receive AGC amplifier only during the receive mode.

c. Transmit Mode. In the transmit mode, the 11.455 MHz signal from 1A1A19 (-22 dBm ±3.5 dB) is applied to the transmit IF via a diode switching circuit. The RT-55 signal (+5V in the transmit mode) enables the input and output diode switching circuits and a transistor switch for the transmit AGC amplifier. The three-stage transmit IF amplifier boosts the 11.455 MHz signal to a level of -4.5 dBm ± 6 dB. Transmit AGC from 1A1A12 is applied to the transmit IF amplifier through an AGC amplifier. A transistor switch enables the transmit AGC amplifier only in the transmit mode. CW keying signals from 1A1A20 are applied to a keyer circuit in the CW transmit mode. The keyer controls the dc ground return for all transmit circuitry.

2-20. Pump VFO 1A1A18 (Fig. 2-16).

Pump VFO 1A1A18 generates the pump frequencies (113.4440 to 187.4549 MHz) for upconverter 1A1A13, and for the upper loop (translator 1A1A6). The module actually contains two separate VFO circuits, one for low-band frequencies (113.4550 to 146.4549 MHz) and another for high-band frequencies (146.4550 to 187.4549 MHz). High or low-band enable signals are received from the frequency control module (1A1A1) and applied to diode switching circuits at the output of each VFO to enable the proper VFO coarse tuning and fine tuning control. Coarse and fine tuning control voltages are received from 1A1A8, filtered, and applied to the varactors in the two VFO's. The filtered coarse tuning voltage is also applied to a bogie bias circuit. The bogie bias voltage is filtered and applied to the two VFO's. This voltage keeps the fine-tune sensitivity relatively constant across the entire frequency range of the VFO. The filters for the coarse tuning and the bogie bias signals are switched out of the circuit during frequency lock-up by control signals from 1A1A8. This is necessary because the tuning varactor diodes in the VFO's must follow the coarse tune and fine tune ramp voltages without significant delay during lock-up. The VFO output for the upconverter 1A1A13 is output directly from a hybrid transformer. The VFO output for the translator 1A1A6 is output through a buffer and a low-pass filter.

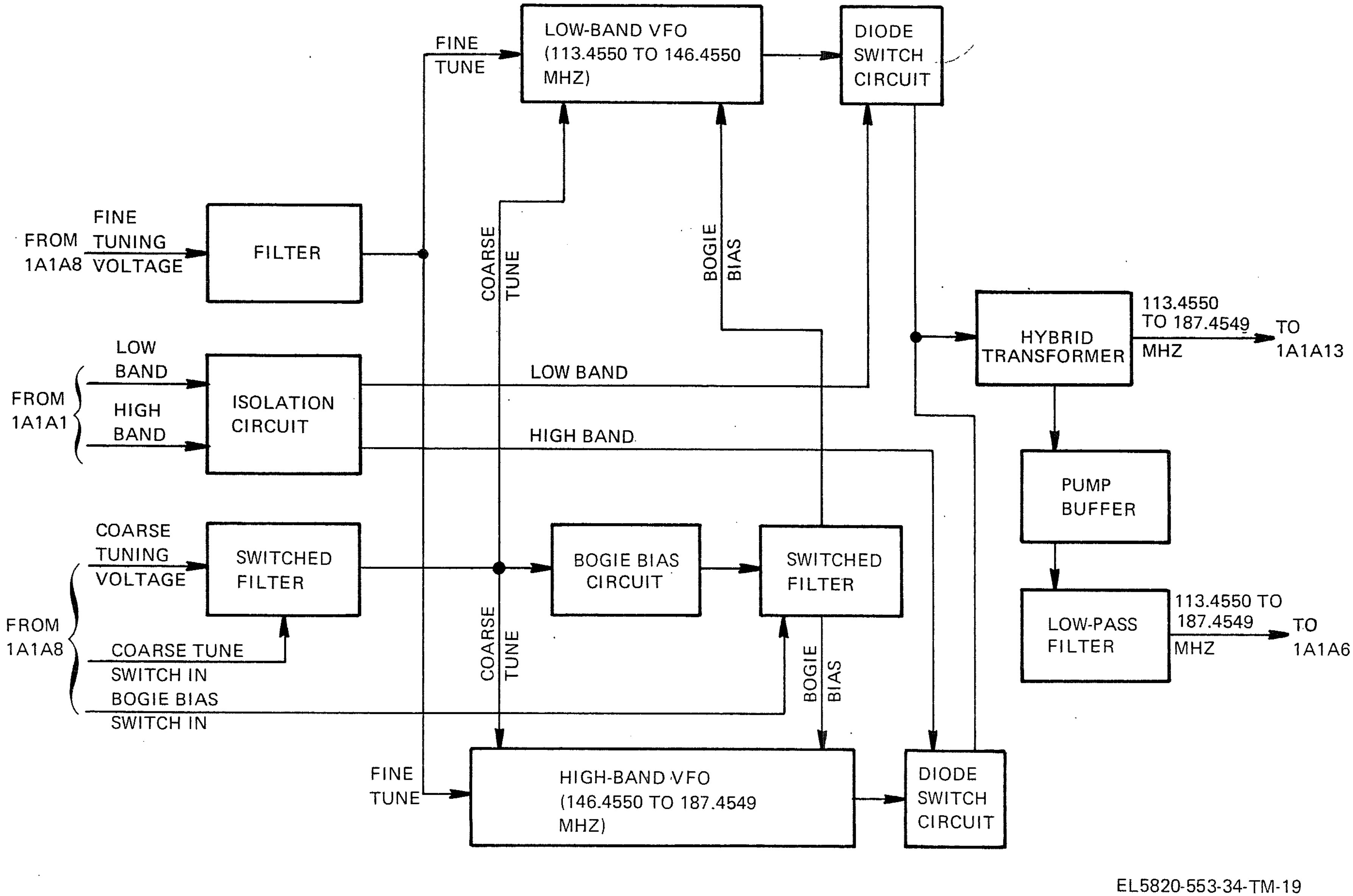



Figure 2-16. Pump VFO 1A1A18 block diagram

2-21. IF Selectivity 1A1A19 (Fig. 2-17).

a. General. Module 1A1A19 develops the 455 kHz receive IF and the 11.455 MHz transmit IF. This module also provides selectivity for the 455 kHz IF by the use of switched filters or an FM pad. As shown in figure 2-17, numerous FET switches are used to accomplish the required signal routing on the module, depending on the mode involved. The Boolean expression shown in each switch block is the combination of signal conditions or modes that is required to enable that particular FET switch.

b. Mixer Operation. The balanced mixer and buffer circuits operate in all modes except FM transmit. An 11 MHz input (-2 dBm) from 1A1A10 is applied to the balanced mixer through a buffer stage. In the receive mode, the mixer receives an 11.455 MHz (-87 to +2.5 dBm) input from 1A1A17 and produces a difference-frequency output of 455 kHz. In the transmit mode (except FM), a 455 kHz signal is applied to the mixer to generate the sum-frequency 11.455 (-22 dBm ± 3.5 dB) output to 1A1A17. In the FM transmit mode, a FET switch disables the buffer stage and routes the 11.455 MHz FM signal directly to 1A1A17 via a diode switch.

c. Receive Mode Operation. Operation of the module in all of the receive modes is essentially the same. The 455 kHz IF signal from the balanced mixer (b. above) is routed through an enabled FET switch ($\overline{AM}$ + R + TUNE) and applied to three filter input FET switches. One of these input switches will be enabled,

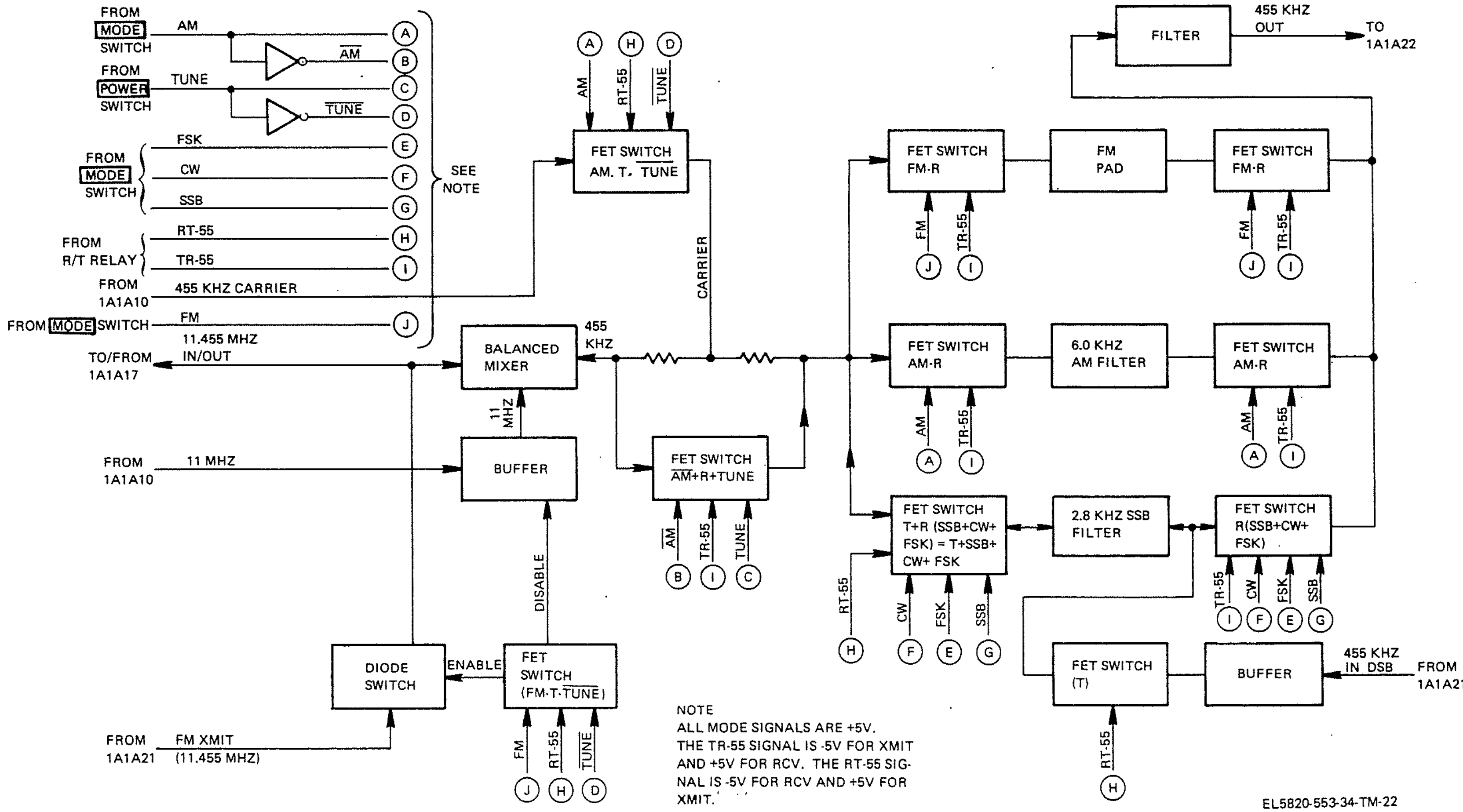



Figure 2-17. IF selectivity 1A1A19 block diagram

depending on the operating mode involved. The 455 kHz signal is then routed through a 2.8 kHz SSB filter, a 6.0 kHz AM filter, or an FM pad, as appropriate. FET switches are also provided at the filter outputs. The 455 kHz signal is routed through an additional spike filter before being output to 1A1A22. The output level is -106 to -12.5 dBm.

d. SSB, CW, and FSK Transmit Modes. In the SSB, CW, and FSK transmit modes, a 455 kHz signal from 1A1A21 is routed through a buffer and a FET switch (T) to the SSB filter. The filter removes the lower sideband, producing an SSB output. From the filter, the signal is routed through another FET switch (T + SSB + CW + FSK) and a resistor network to the balanced mixer. The mixer generates the 11.455 MHz output to 1A1A17 as described in b. above.

e. AM Transmit Mode. In the AM transmit mode, the 455 kHz, SSB signal is developed in the same manner as described in d. above. However, the signal is mixed with a 455 kHz carrier signal in the resistor network preceding the balanced mixer. The 455 kHz carrier is received from 1A1A10 and is routed through a FET switch (AM-T-$\overline{\text{TUNE}}$) to the resistor network. The resulting AM signal actually consists of a carrier and one sideband (upper sideband only). This signal is applied to the mixer to generate the 11.455 MHz output to 1A1A17.

## 2-22. DC Control 1A1A20 (Fig. 2-18)

DC control module 1A1A20 provides transmitter keying and control signals in the CW, FSK and retransmit modes. These keying and control signals are used to control the R/T relay, module 1A1A11, and external equipment (in the retransmit mode). A PTT (push-to-talk) input from the AUDIO connector is applied to this module and is combined with the mode control signals from the MODE switch to generate the proper keying and control signals from each mode. The gating required to generate these outputs can best be understood by referring to figure 2-21. The retransmit mode signal from the SQUELCH switch is combined with a squelch control signal from 1A1A21 to generate the retransmit key output. This signal ground is routed through another set of SQUELCH switch contacts when the switch is set to RXMT, and is output to the RXMT, AUDIO, and X-MODE connectors. A 24 to 12 volt converter is also contained on this module. A 24V input is applied to this circuit only when the MODE switch is set to CW or FSK. The resulting 12V output is applied to a set of SQUELCH switch contacts. Then, when the SQUELCH switch is set to any position except RXMT, the 12V signal is output to the RXMT, AUDIO, and X-MODE connectors on the retransmit key line for use by external equipment.

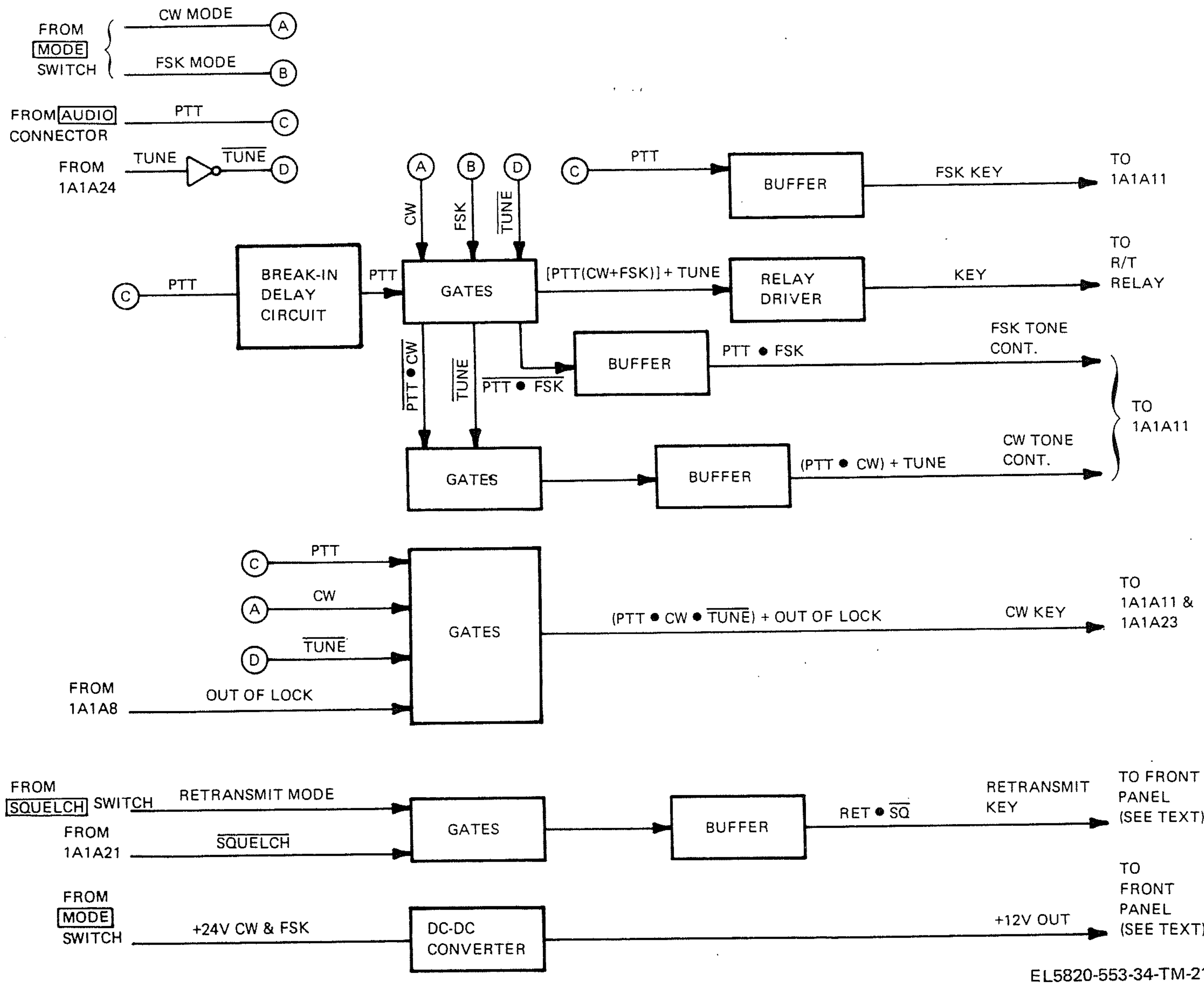



Figure 2-18. DC control 1A1A20 block diagram

2-23. Modulator/Squelch 1A1A21 (Fig. 2-19).

a. General. Module 1A1A21 contains the 11.455 MHz FM modulator, the 455 kHz DSB modulator (for CW, AM, SSB, and FSK modes), and the receiver squelch. Each of these circuits is described in the following subparagraphs.

b. FM Modulator. The FM modulator is a solid state device which generates an 11.455 MHz FM signal with a deviation level of ± 8 to ± 10 kHz. The modulator is enabled in the FM mode through a gating circuit and a transistor switch. +10V operating power is supplied to the modulator through the enabled transistor switch. Audio (wideband and narrowband) is applied to the modulator from 1A1A23 through a preamplifier. A 150 Hz tone from 1A1A10 is also applied to the modulator through the preamplifier. This signal is set to drive the modulator at a low deviation level (3.0 ± 0.5 kHz). This is sufficient, during periods when no voice modulation is being supplied, to keep the distant station's receiver unsquelched during pauses in the transmitting operator's speech.

c. DSB Modulator. The double sideband (DSB) modulator develops a 455 kHz suppressed carrier double sideband signal in the CW, FSK, SSB, and AM modes. Audio from 1A1A23 is applied to the modulator through a FET switch. This switch is enabled in all transmit modes except FM and is also enabled in all modes during the tune cycle. The 455 kHz carrier signal from 1A1A10 is applied to the balance through a transistor switch in all transmit modes. A peak/RMS limiter circuit at the modulator output controls the output level at -5 dBm ± 1.5 dB PEP.

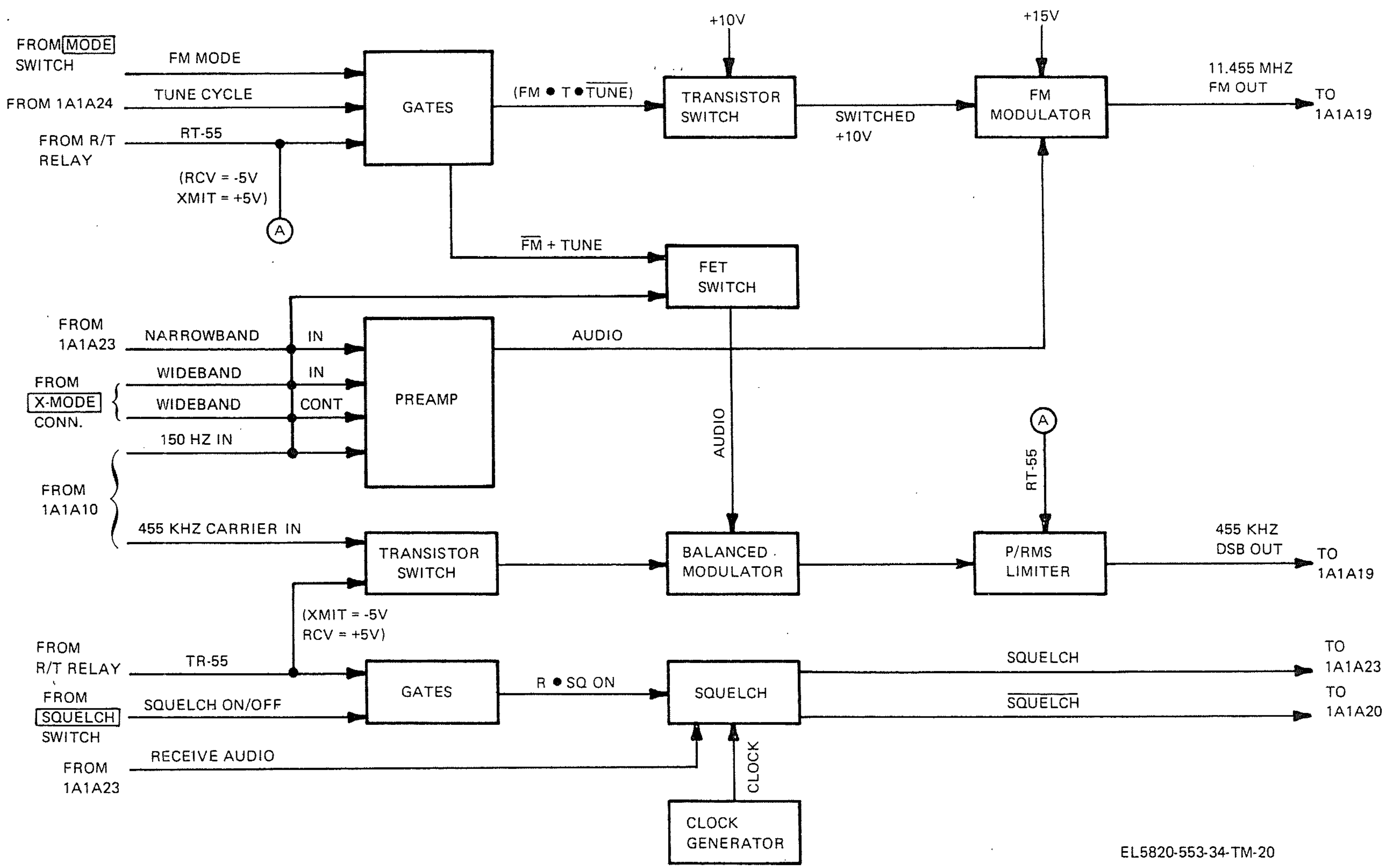



Figure 2-19. Modulator squelch 1A1A21 block diagram

d. Squelch. The squelch circuit is a solid state device which squelches the receiver audio when no signals are being received. Power is applied to the device through a gating circuit. These gates are enabled in all receive modes whenever the SQUELCH switch is in ON or RXMT position. Receive audio is applied to the squelch from 1A1A23. A separate clock generator develops the 75 Hz clock required by the squelch. The squelch is essentially a digital counter. Noise signals coming into the squelch will contain a known number of pulses or "zero crossings". These crossings are counted by the squelch and, if a sufficient number are present, the squelch output signal will be generated. When a signal is received from a distant station, the signal applied to the squelch will contain fewer zero crossings and the receiver will be unsquelched.

2-24. Receive IF and Detection 1A1A22 (Fig. 2-20).

The receive IF and detection module (1A1A22) performs the IF amplification and audio detection functions of the receiver. The AGC voltage is also produced in this module. The -106 to -12.5 dBm 455 kHz IF signal from the selected IF bandpass filter is applied to this module where it is amplified and detected to its audio component. The AGC function for the receiver is provided by the AGC portion of this module. The 455 kHz IF signal from the IF amplifier is sampled, detected and a dc level proportional to the signal strength is developed. This AGC level is provided to the tuner for receiver gain control and also to the IF amplifier within this module to control the IF gain. The detection portion of this module

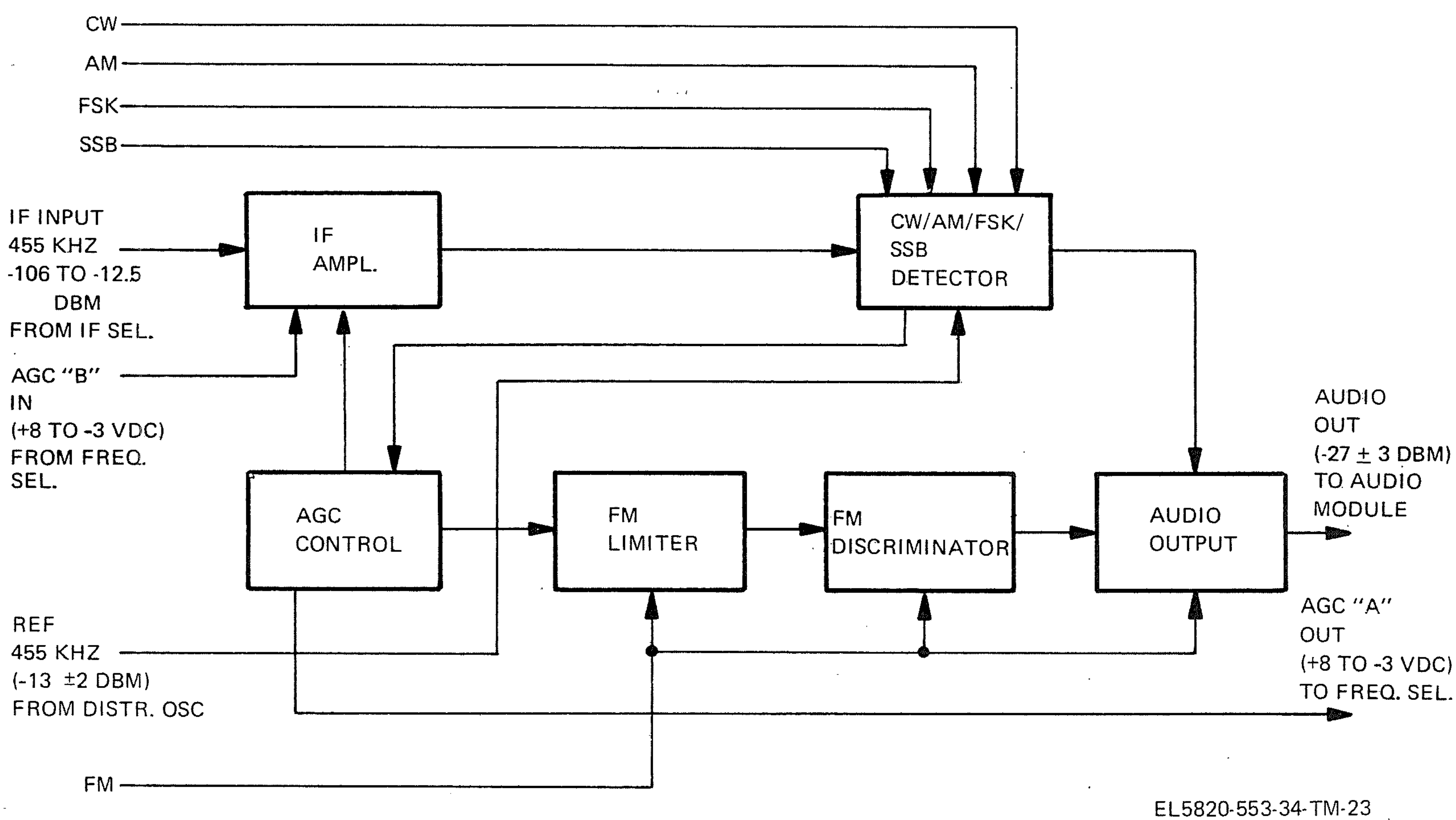



Figure 2-20. Receive IF and detection 1A1A22 block diagram

provides the proper type of detection as required by the setting of the front panel MODE switch. In the FM mode of operation an FM discriminator is used, and in any other mode an SSB/AM detector is used. A $-13 \pm 2$ dBm 455 kHz signal is provided as an input to the detection section for the purpose of carrier insertion or as a beat frequency to generate an audio difference. Mode select voltages are supplied to the receive IF and detection module through the front panel MODE switch. The $-27 \pm 3$ dBm audio is supplied to the audio module (1A1A23).

2-25. Audio Module 1A1A23 (Fig. 2-21).

a. General. Module 1A1A23 contains the receive audio amplifiers, filters, and audio AGC circuits. The transmit microphone preamplifier, retransmit pad, and sidetone audio circuits are also contained on 1A1A23. Operation of the module in the various modes is described in the following subparagraphs.

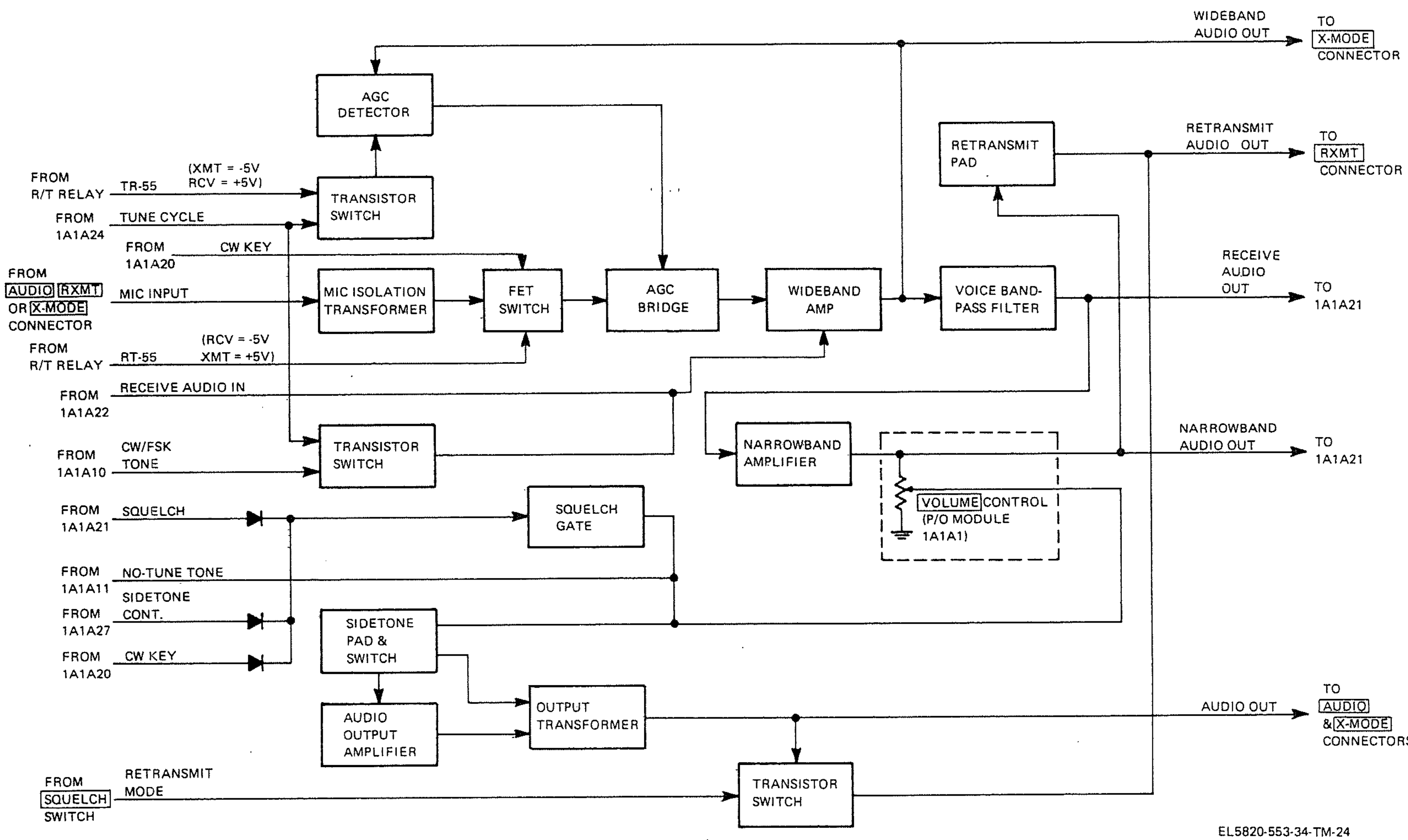



Figure 2-21. Audio 1A1A23 block diagram

b. Normal Receive Mode. Receive audio from module 1A1A22 (30 mV/ 6 kilohms) is applied directly to the wideband audio amplifier on 1A1A23. The wideband amplifier output (0.5 VRMS/10 Hz to 13 kHz) is routed to the X-MODE connector and to the input of a voice bandpass filter. A sample of the wideband audio is also fed back to an AGC detector. The AGC detector is enabled only in the receive mode or during a transmitter tune cycle. An AGC bridge circuit feeds the AGC control voltage from the detector to the wideband amplifier input to control the input level. Audio from the voice bandpass filter is output to the squelch circuits on 1A1A21 and to a narrowband audio amplifier in this module. The narrowband audio (1.0 VRMS/10 kilohms) branches out to module 1A1A21, to the VOLUME control (module 1A1A1), and to a retransmit pad. The retransmit pad is disabled during the normal receive mode. From the VOLUME control, the audio is combined with a squelch gate output and a no-tune tone signal. In the receive mode, the squelch gate is disabled (receiver unsquelched) whenever the squelch signal from 1A1A21 goes low. The no-tune tone is present only during the tune cycle and not during normal reception. The combined squelch gate output and narrowband audio is routed through a sidetone pad and switch circuit to the audio output amplifier. In the receive mode, the sidetone pad is disabled and the amplifier output is routed through an output transformer and out to the AUDIO and X-MODE connectors. The power level at this point is 10 milliwatts (minimum) at 500 ohms.

c. Retransmit Receive Mode. Operation of the module in the retransmit receive mode is slightly different from the normal receive mode (b. above). In this mode, audio from the narrowband amplifier is routed through the retransmit pad and out to the RXMT connector. A transistor switch receives the retransmit mode signal from the SQUELCH switch and selects this output. The retransmit audio output level is either 5.6 mV/150 ohms or 2.45 V/500 ohms.

d. Voice Transmit Mode. Module 1A1A23 operates in the same manner in all voice transmit modes, including the retransmit mode. Microphone audio from the AUDIO, RXMT, or X-MODE connector (0.3 to 10 mV/150 ohms) is routed through an isolation transformer and a FET switch to the wideband amplifier. The FET switch is enabled only in the transmit mode. The AGC detector and bridge circuits are disabled in the transmit mode. From the wideband amplifier the audio is routed through the voice bandpass filter and the narrowband amplifier and is output to the modulator circuits on 1A1A21. A sidetone control signal from 1A1A27 will disable the squelch gate, allowing the narrowband audio from the VOLUME control to be applied to the sidetone pad. Audio from the sidetone pad is routed through the output transformer and out to the AUDIO and X-MODE connectors.

e. CW or FSK Transmit Mode. In the CW or FSK mode, keyed tone signals (30 mV/1 kilohm) are received from 1A1A10 and routed through an enabled transistor switch to the wideband amplifier. The AGC detector and bridge is disabled in this mode. From the wideband amplifier, the audio is routed through the voice bandpass filter and the narrowband amplifier, and is output to the modulator circuits on 1A1A21. A CW key signal from 1A1A20 disables the squelch gate in this mode, allowing the narrowband audio from the VOLUME control to be applied to the sidetone pad. Audio from the sidetone pad is then routed through the output transformer and out to the AUDIO and X-MODE connectors.

f. Tune Cycle Mode. In the tune cycle, the microphone input to 1A1A23 is disabled by a signal from 1A1A24, through the AGC detector and bridge. The tune cycle signal simultaneously enables a transistor switch, allowing the CW tone from 1A1A11 to be routed through the wideband amplifier, voice bandpass filter and narrowband amplifier circuits in the same manner as described in e. above. In this mode, the squelch gate is enabled which inhibits the narrowband audio from being routed through the sidetone pad. Instead, a no-tune tone is received from 1A1A11 while the tuning is in progress. This tone is routed through the sidetone pad and the output transformer, then out to the AUDIO and X-MODE connectors.

2-26. Coupler Network 1A1A24 (Fig. 2-22).

The antenna coupler 1A1A24 maximizes the transfer of power between the transmitter and the antenna. The antenna coupler also maximizes the received signal applied from the antenna to the receiver. The matching network is a "T" with inductive arms and shunt capacitor. The inductances are switched out by vacuum relays shorting across them. Two of the output (Resistance arm) inductances and three of the input (Phase arm) inductances are saturable reactors with permanent magnets for memory, so that once set, the inductance can be maintained without power. The shunt capacitance is bandswitched in 10 bands by means of the bandswitch motor. There are two positions of the function switch that activate the coupler. RECEIVE ONLY causes the coupler to home. That is, the coupler is activated long enough to minimize the inductances in the R arm and the Phase arm. It does this by shorting all the coils (except the minimums in each arm) with the relays and pulsing the permanent magnets to maximum magnetism. The coupler then turns off and ceases to draw current. The spring-loaded TUNE position causes the coupler to initiate a full tune procedure, if the coupler has previously been homed. If the coupler has previously been tuned, the TUNE command causes it to fine-tune the elements, if the VSWR has exceeded the tolerance band. If not, the coupler shuts off and does nothing. The full TUNE cycle consists of four steps, as follows:

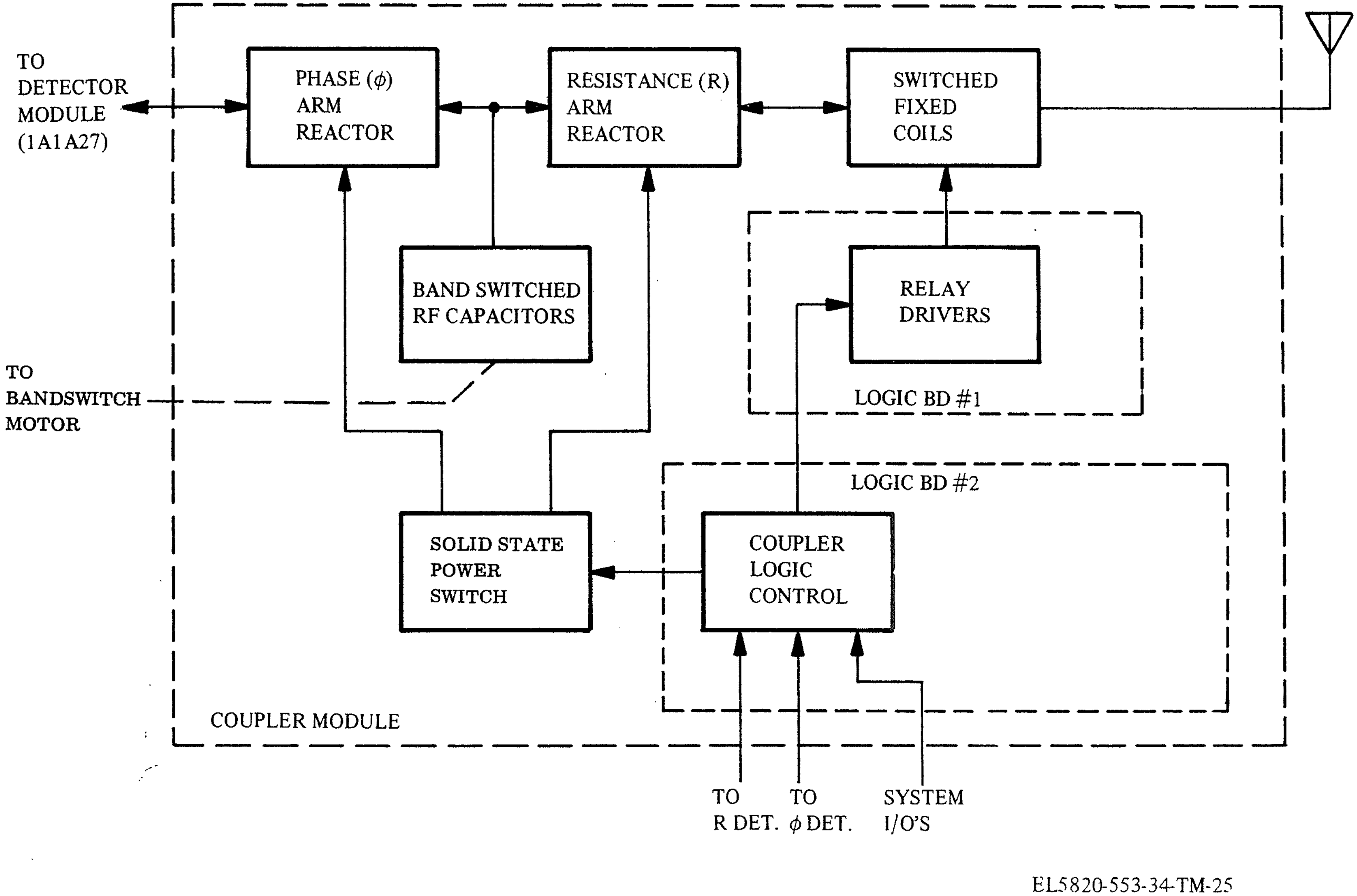



Figure 2-22. Coupler network 1A1A24 block diagram

a. Coarse. This step involves the procedure for rapidly switching in enough inductance in the R arm to permit tuning. Due to the large inductance range required, there are eight binary elements in the R arm. Seven of these are initially switched out. The permanent least significant bit and the next to the least significant bit are saturable reactor variable elements. The coarse steps consist of:

(1) Scanning the variable from minimum inductance to maximum inductance with one pulse. If a sufficient inductance condition is achieved, the variable is reset to minimum, and the logic proceeds on to the next step.

(2) If the inductance, after the scan pulse, is not sufficient the variable is reset to minimum and one binary bit of inductance is switched in.

(3) Another scan pulse is applied to the variable. If sufficient inductance is achieved, the variable is reset and the logic proceeds to the next step. If not, (1) and (2) are repeated until enough inductance has been switched in. The criteria for determining that there is sufficient inductance, is that the input impedance of the coupler passes through 50 ohms-jx during the scan pulse.

b. Normal. Normal is the process of more accurately setting the R arm variable. Upon leaving coarse, the variable has been set to minimum inductance. In normal, it is pulsed in small steps to higher inductance, until the input impedance of the coupler, as seen by the detectors, is 50 ohms-jx. At this time, the next step is begins.

c. Tune. Tune is the process of increasing the Phase arm inductance until the coupler input impedance acquires a positive phase angle. As soon as the phase angle becomes positive, the tune step is complete.

d. Fine. Fine tuning is the process of alternately adjusting the R and Phase arms to more nearly set the input impedance of the coupler to 50 ohms-jo. When this impedance falls within the window of 50 ohms ± 10 and 0° ± 10°, the tuning procedure is complete and the coupler turns off. If the coupler has previously been tuned before initiation of the tune command, the logic starts the fine tune procedure.

e. Coupler Inputs:

(1) Receive Only - High in receive only. Low in all other positions. Causes coupler to home.

(2) Tune Initiate - High in tune. Low in all other positions. High causes the coupler to initiate the tuning procedure.

(3) Band change sense - Open when bandswitch motor is running. Ground at all other times. Open causes the coupler to home when changing bands.

(4) Power mode switch - High in high power. Open in all other positions of the mode switch. High energizes the high power relays when the coupler is not tuning.

(5) Forward power indicator - High when there is RF power from transmitter. Inhibits tune procedure until RF power is present.

(6) Power relay sense - High in high power. Inhibits tuning when transmitter is in high power.

(7) VSWR - High when VSWR is greater than 2.5/1. Inhibits tuning when VSWR is within tolerance limits.

(8) $\overline{\text{VHF-HI}}$ - Ground above 40 MHz and causes coupler bypass relays to switch out lower frequency elements to reduce strays. Also used as band information for coupler logic.

(9) $\overline{\text{VHF-LO}}$ - Ground between 20 MHz and 40 MHz. Used as band information for coupler logic.

(10) $\overline{\text{HF-HI}}$ - Ground between 14 MHz and 20 MHz. Used as band information for coupler logic.

(11) R+ - High when resistive component of network input is greater than 60 ohms. Used as tuning information for coupler logic.

(12) R- High when resistive component of network is below 40 ohms. Used as tuning information for coupler logic.

(13) $\phi$+ - High when phase component of network input is inductive. Used as tuning information for coupler logic.

(14) $\phi$- - High when phase component of network input is capacitive. Used as tuning information for coupler logic.

(15) Tune relay sw - Low when tuning. Plus 24V all other times. Applies power to the reactor drive circuits.

f. Coupler Outputs:

(1) Tune cycle - Causes transmitter power supplies to be switched on during home or tune.

(2) No tune - High when coupler does not tune, or when VSWR exceeds desirable limit. This causes the no-tune alarm to be heard in side tone.

(3) Power relay drive - Low in high power after coupler has completed tuning. This causes the high power relays to energize.

(4) Blank - High when in Receive Only or when bandswitch motor is running, and blanks the transmitter RF signal.

2-27. ALC Module 1A1A25 (Fig. 2-23).

Module 1A1A25 generates the attenuator control signal for the driver and power amplifier 1A1A29. This signal turns off or limits the output of 1A1A29 when abnormal conditions exist on the amplifier output (defective antenna or large coupler mismatch). A reflected power indication control signal from 1A1A27 is applied to the attenuator threshold circuit. A forward power indication control signal from 1A1A27 is also applied to this circuit. The attenuator control signal is output to 1A1A29 to control a PIN diode attenuator circuit in the driver (para. 2-31).

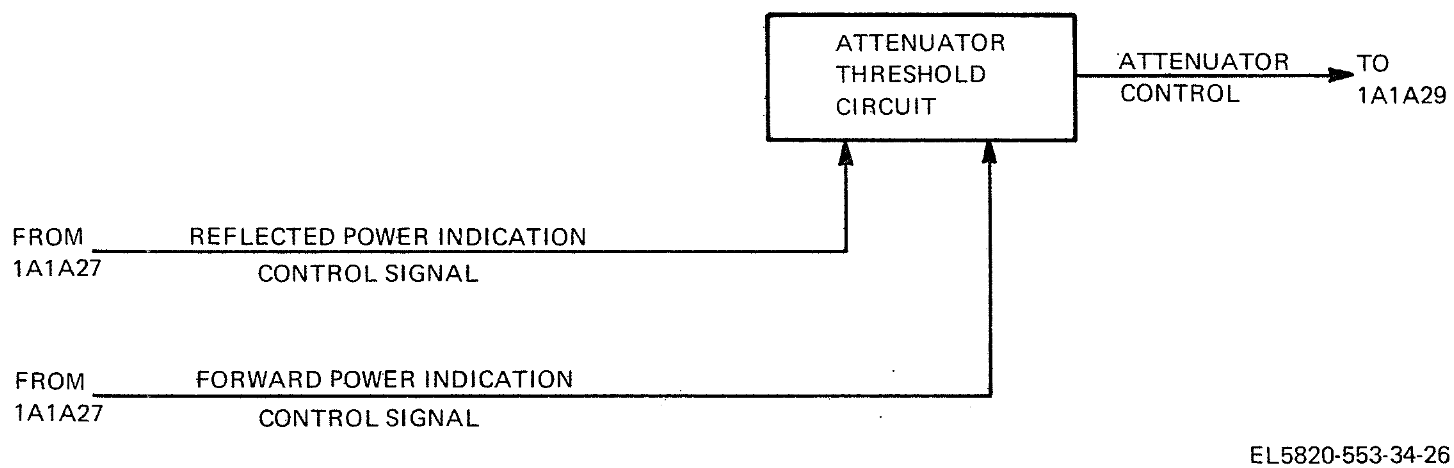
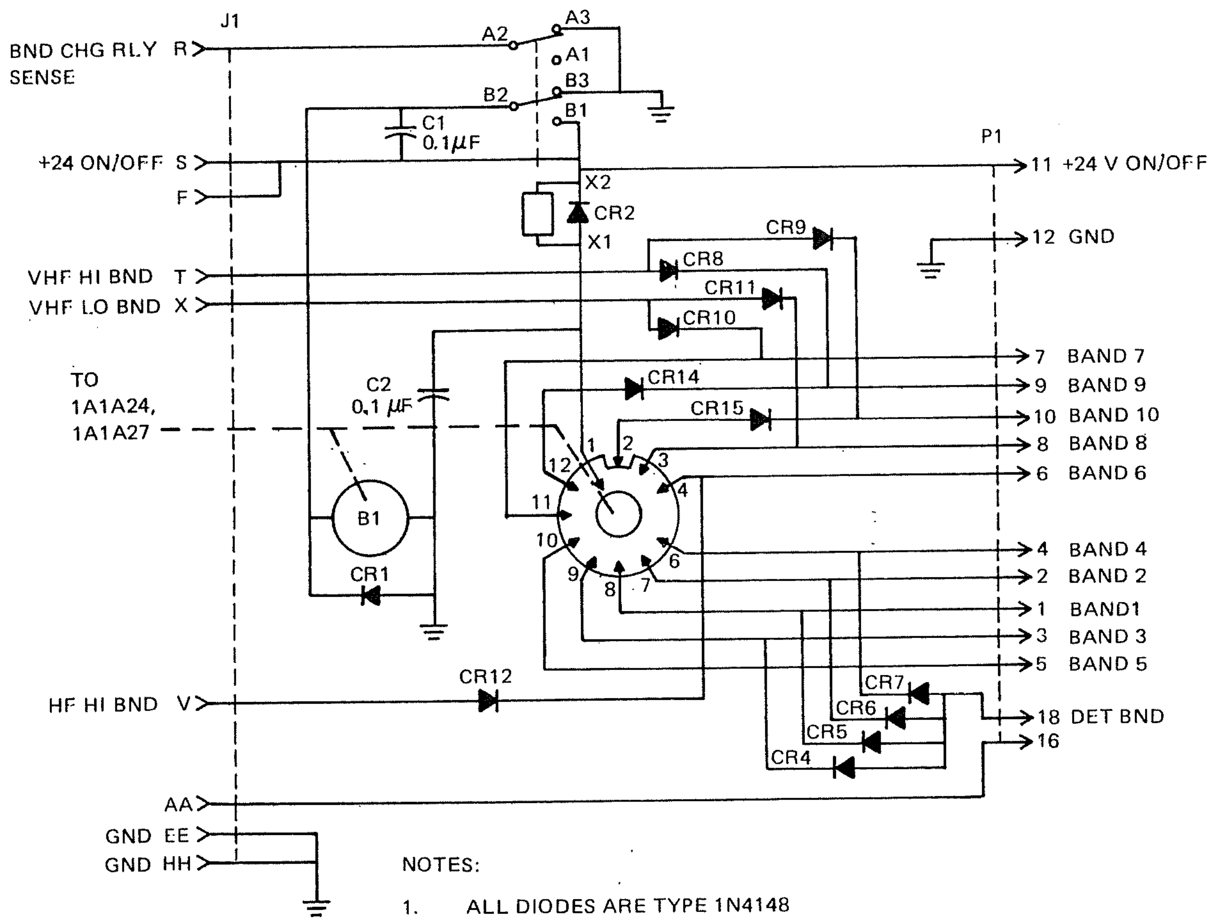



Figure 2-23. ALC 1A1A25 block diagram

The blanking amplifier on this module is used to enable the attenuator control signal (turning off the power amplifier) when coupler relays are being switched during the tune cycle. This prevents the relays from being switched while under RF power.

2-28. Bandswitch Assembly 1A1A26 (Fig. 2-24).

Bandswitch assembly 1A1A26 is a motor-driven 10-position rotary switch. This assembly receives frequency band data (a ground input for the selected band) from the front panel frequency control (module 1A1A1). The ground signal completes the circuit for the coil of relay K1 through the common of the switch. When K1 is actuated, +24V power is applied to the motor. The motor then drives the rotary switch until the switch position corresponding to the selected band is reached. At this point, the ground input is opened through the switch contacts and the motor stops. The motor shaft is also mechanically linked to harmonic filter module 1A1A28 to select the proper filter network in that module (para. 2-30). Additionally, frequency band data is provided by 1A1A26 for detector 1A1A27 and coupler logic 1A1A24A2. Diodes are used to provide the required logic OR functions and circuit isolation.




NOTES:

1. ALL DIODES ARE TYPE 1N4148
2. PREFIX REF DESIGNATION OF PART WITH UNIT NO. TO COMPLETE LOCATIONAL REF DESIGNATION.

EL5820-553-34-TM-27

Figure 2-24. Bandswitch 1A1A26 schematic diagram

2-29. Detector 1A1A27 (Fig. 2-25).

Module 1A1A27 develops the primary control signal for coupler module 1A1A24. RF power from harmonic filter 1A1A28 is routed through four detectors on this module (reflected power, forward power, phase, and resistance). The outputs of the reflected power and forward power detectors are routed through high/low power controlled amplifiers to the ALC module 1A1A25. These amplifiers are switched to the proper output levels for the mode being used. The resulting forward and reflected power indication levels are applied to a ratio amplifier. The ratio amplifier compares the two signals and develops the VSWR indication signal for 1A1A24A2. The forward power indication level is also output to the coupler logic (1A1A24A2). The phase and resistance detectors are switched into the circuit by a relay only during the tune cycle. The outputs of these detectors are routed through gate circuits and output to 1A1A24A2. These signals (+R, -R, +$\phi$, and -$\phi$) control the coupler's pulsed reactors during the tune cycle. A sidetone control amplifier is also contained in this module. This circuit is coupled to the forward power detector and generates a sidetone control (enable) signal to audio module 1A1A23 when forward RF power is detected.

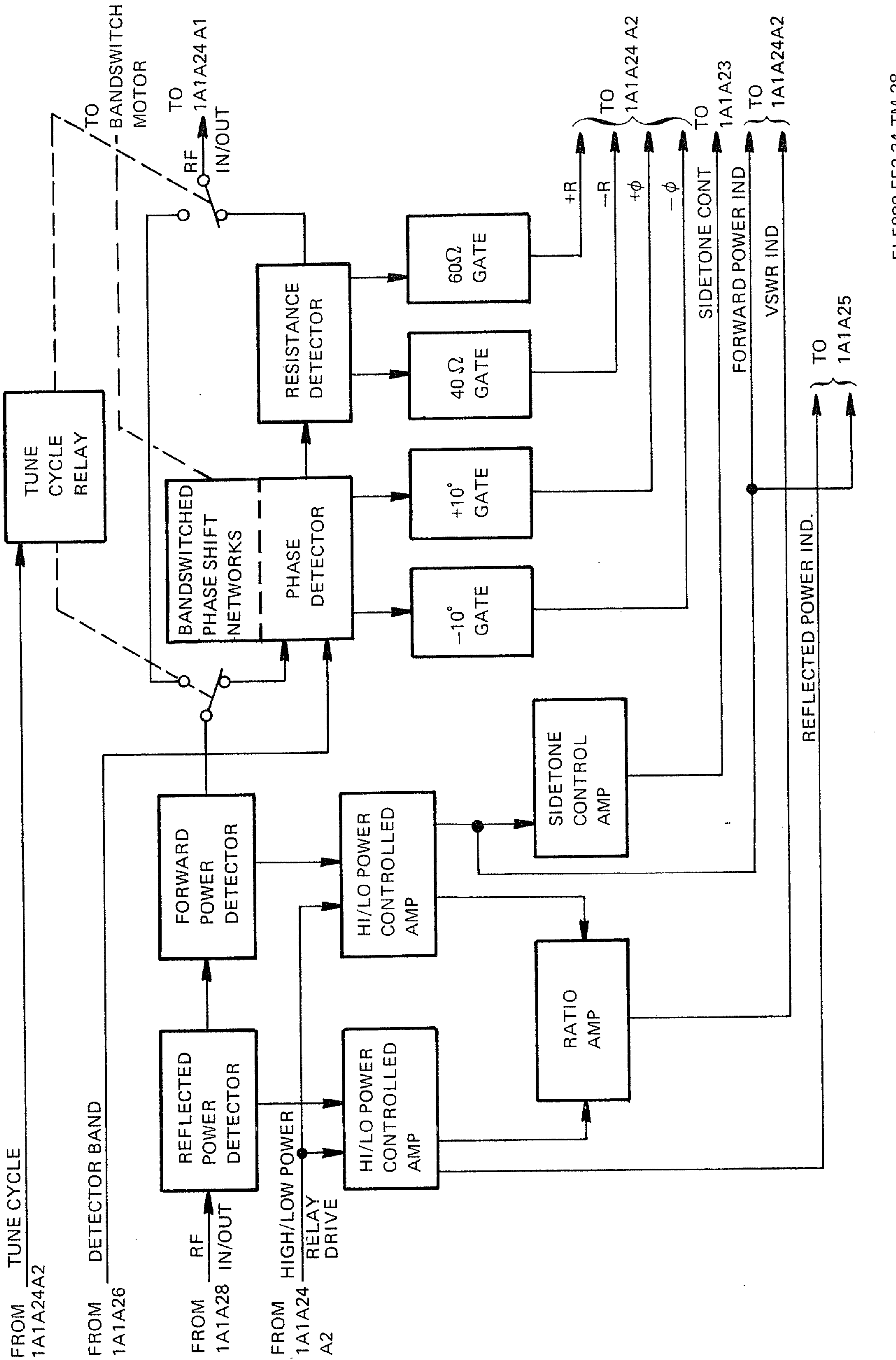



Figure 2-25. Detector 1A1A27 block diagram

2-30. Harmonic Filter 1A1A28 (Fig. 2-26).

Module 1A1A28 provides low pass filtering for the RF output of driver and power amplifier 1A1A29. This module contains 10 low pass filter networks and two 10-position rotary switches (one for input switching and one for output switching). The rotary switches are mechanically linked to the motor in bandswitch assembly 1A1A26 (para. 2-28). Figure 2-29 is the harmonic filter block diagram.

2-31. Power Amplifier and Driver 1A1A29 (Fig. 2-27).

a. General. Module 1A1A29 provides the transmit RF power output. An of approximately 3 watts is developed in the low-power mode. In the high-power mode, the module generates approximately 40 watts of RF.

b. Driver Circuits. RF input power of approximately 80 milliwatts is received from transmit broadband module 1A1A12. Initially this power is applied to an impedance roll-off network which provides a constant impedance of 50 ohms across the 2 to 76 MHz frequency band. The output of this network is applied to a class A (voltage) amplifier. This stage receives attenuation control from a gain control attenuator circuit. The gain control attenuator is a PIN diode circuit which is controlled by an attenuator control signal from ALC module 1A1A25. This circuit disables the driver when abnormal conditions (shorted antenna, etc.) are detected on the transmitter output. The output of

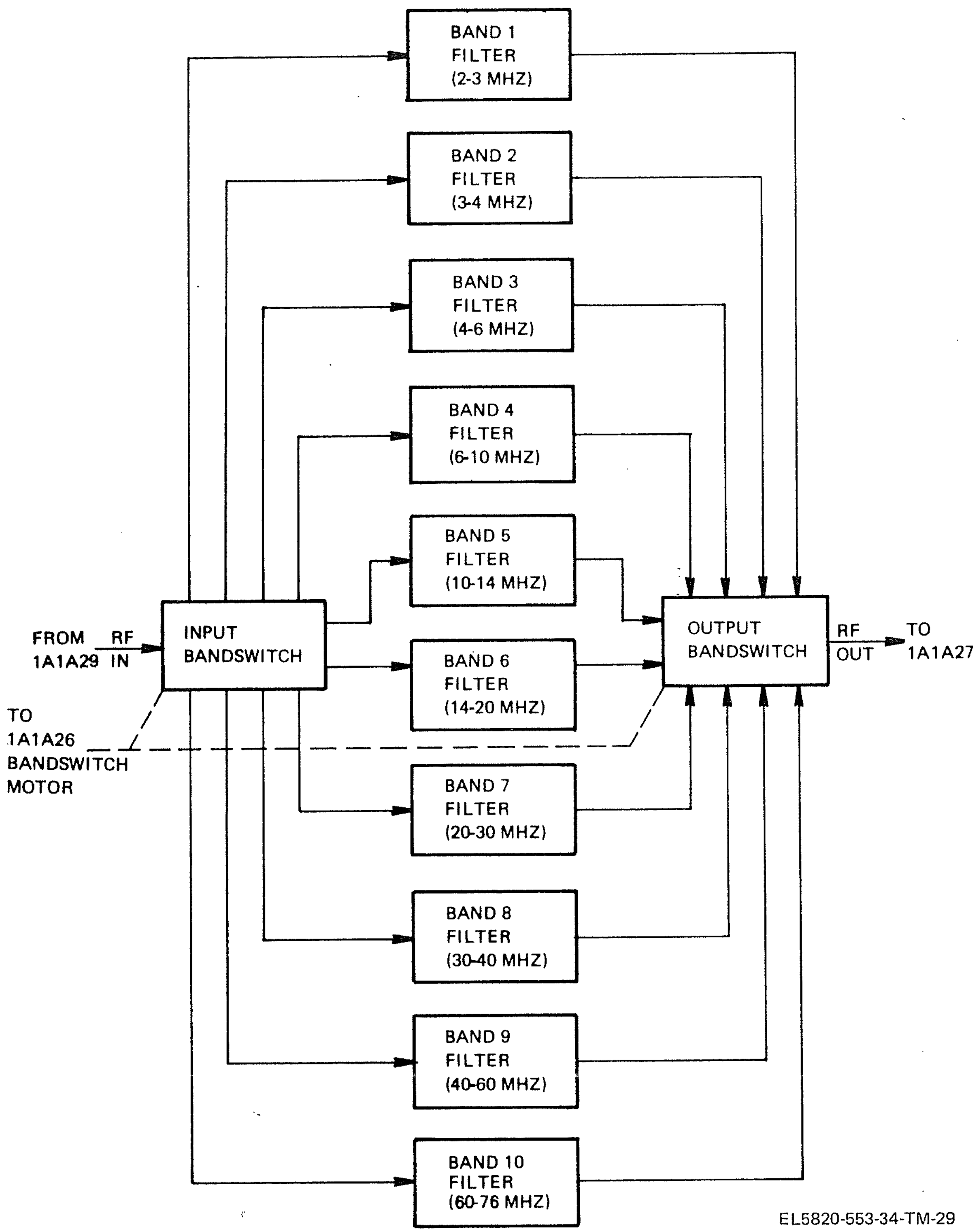



Figure 2-26. Harmonic filter 1A1A28 block diagram

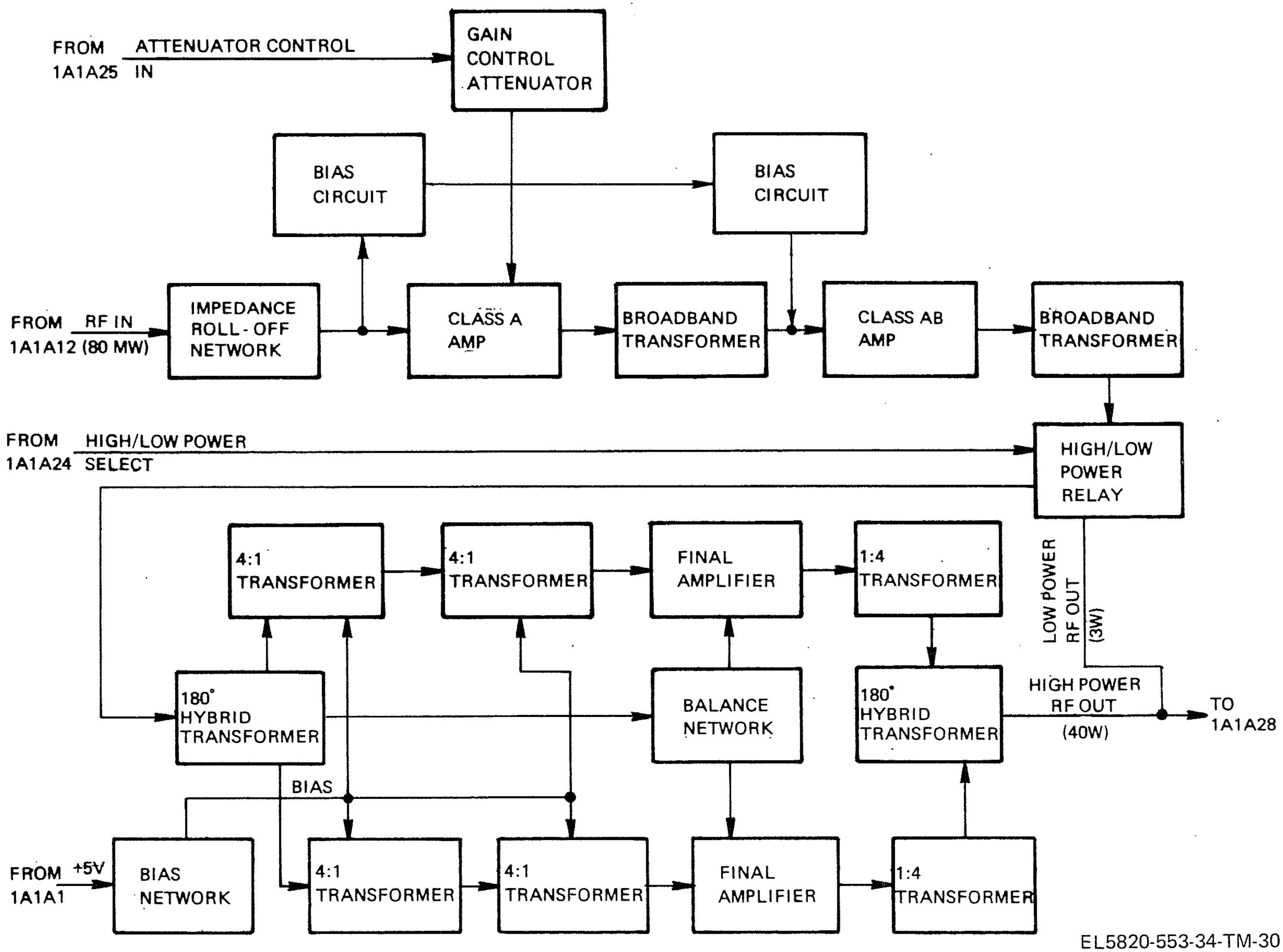



Figure 2-27. Power amplifier and driver 1A1A29 block diagram

the class A stage is coupled through a broadband transformer to a class AB amplifier. Two bias circuits are bridged from the input of the class A stage to the input of the class AB stage to provide self biasing. The class AB stage provides linear operation and develops 3 watts of RF output through a broadband transformer. In the low-power mode, this power is output directly through the high/low power relay to filter module 1A1A28. In the high-power mode, the 3-watt signal is coupled to the input of the power amplifier.

c. Power Amplifier Circuits. The power amplifier consists of two separate amplifiers connected in a power adding arrangement. Power from the driver is initially split into two outputs by a 180 degree hybrid transformer. Each of these outputs is routed through two 4-to-1 step-down transformers in order to match the low-impedance of the amplifier input. A balance (resistor) network is connected between the two amplifiers to equalize their gain. The amplifiers receive bias voltage through a bias network. The bias level is set for linear operation in all modes. RF output from each amplifier is coupled through a 1-to-4 step-up transformer to an output 180-degree hybrid. This hybrid combines the two outputs to provide a total output of approximately 40 watts to 1A1A28.

2-32. Case Assembly 1A1A30 (Fig. FO-6, sheets 1 to 3).

Module 1A1A30 includes the radio set chassis, control panel connectors and controls and their connections with the various relays, the battery, and the two parent boards.

2-33. Receiver/Exciter Parent Board 1A1A31 (Fig. FO-4 and Fig. FO-6, sheet 1).

Module 1A1A31 comprises the interconnections between the various modules and the case assembly (1A1A30).

2-34. P.A./Coupler Parent Board 1A1A32 (Fig. FO-5 and Fig. FO-6, sheets 1 and 2).

Module 1A1A32 comprises the interconnections between such modules as 1A1A29, 1A1A25, 1A1A27, 1A1A28, 1A1A26, 1A1A24, 1A1A1, 1A1A30, and 1A1A31.

2-35. Bandpass Filter 1A1FL1 (Fig. FO-2, sheet 1).

The bandpass filter attenuates frequencies above the range of 2 - 76 MHz. In the receive mode, the filter attenuates the first IF frequency (111.455 MHz) to prevent this frequency from reaching the antenna. It also attenuates the pump VFO frequencies (113.4550 to 187.4549 MHz) to prevent these frequencies from reaching the antenna. In the transmit mode the filter attenuates harmonic outputs above 76 MHz.

# CHAPTER 3

# DIRECT SUPPORT MAINTENANCE INSTRUCTIONS

## Section I. GENERAL

### 3-1. Scope.

This chapter provides instructions for the direct support level of maintenance for Radio Set AN/PRC-70. Direct support maintenance instructions are provided for isolating RT unit malfunctions to the module level. Defective modules and hardware shall be removed and replaced with a like serviceable item. System test procedures are provided to determine the serviceability of the RT unit. Refer to TM 11-5820-553-12 Operator and Organizational Maintenance Manual for Radio Set AN/PRC-70 for operating instructions as well as operator and organizational maintenance procedures. The user of this manual is advised to perform the System tests provided in Section V as a first step in restoring a defective radio set to serviceable condition. These tests will establish the existence of one or more failure symptoms which can be found listed in table 3-1 (Missing Function Table) in Section III. This table will in turn refer to one of the Fault Isolation tables in Section III. These tables contain the troubleshooting steps which will lead to the isolation of a probably faulty module. The Module tests of Section V will prove whether or not a suspected module does indeed have a defect. Section IV provides instructions for radio set assembly and disassembly as well as module removal and replacement. Section II contains a functional listing of direct support maintenance tools and test equipment. The final step in direct support maintenance should be to repeat the System tests of Section V to confirm that the radio set has been restored to serviceable condition.

## Section II. TOOLS AND TEST EQUIPMENT

3-2. Tools and Test Equipment

Tools and test equipment required for direct support maintenance are listed below.

| Item | Purpose | Applicable publication |
|---|---|---|
| Voltmeter, Electronic AN/URM-145. | To measure voltage level of the RF outputs of individual modules in the AN/PRC-70. | TM 11-6625-524-15-1 |
| Voltmeter, Electronic AN/USM-98. | To measure DC voltage levels such as the AGC voltages and the power supplies. | TM 11-6625-438-15 |
| Generator, Signal AN/GRM-50. | To provide AM signals in the 50 kHz to 65 MHz range for signal injection to test operation of the receiver of the AN/PRC-70. | TM 11-6625-573-15 |
| Multimeter TS-352B/U. | To measure voltage and resistance and to make continuity tests. | TM 11-6625-366-15 |

| Item | Purpose | Applicable publication |
|---|---|---|
| Oscilloscope AN/USM-281A. | To make available for observation the waveforms in the AN/PRC-70 to determine duration and voltage level of the signal under test. | TM 11-6625-1703-15 |
| Counter, Electronic AN/USM-207. | To test the output frequencies developed in the AN/PRC-70. | TM 11-6625-700-25 |
| Wattmeter, AN/URM-120. | To measure the output power level of the AN/PRC-70. | TM 11-6625-446-15 |
| Tool Kit, Electronic Equipment TK-105/G. | To supply tools for maintenance and repair of AN/PRC-70. | SB 11-604 |
| Oscillator, Audio TS-421/U. | To provide audio signals in the 20 Hz to 20 kHz range for testing the AN/PRC-70 radio set. | TM 11-6625-355-45 |

| Item | Purpose | Applicable publication |
|---|---|---|
| Generator, Signal AN/USM-44A. | To provide AM signals in the 10 MHz to 420 MHz range for signal injection to test operation of the AN/PRC-70 receiver. | TM 11-6625-508-25 |
| Generator, Signal AN/URM-103. | To provide FM signals in the 18 MHz to 80 MHz range for testing the AN/PRC-70 receiver. | TM 11-6625-586-45 |
| Analyzer, Distortion AN/URM-180. | To measure distortion of received signals in the AN/PRC-70. | TM 11-6625-1576-15 |
| Power Supply, DC, HR 40-7.5B, PP 4838/U. | To provide power for the AN/PRC-70 while under test. | TM 11-6130-268-15 |
| Attenuator, Variable, 50 ohm CN 796/U. | To provide attenuation of output level so that proper level will be seen at input of the test equipment. | TM 11-5985-237-14P |

## Section III. TROUBLESHOOTING

### 3-3. General.

This section contains the procedures for isolating faulty modules in the RT unit. A missing function table provides description of failure symptoms that may occur during system testing (refer to Section V) and references the applicable fault isolation table. The fault isolation tables provide recommended procedural steps and tests required to isolate the malfunction to a replaceable module. The module tests (refer to Section V) will confirm that a suspected module is, in fact, defective. The receiver-transmitter block diagram, figure FO-2, may be helpful at times. Module locations are shown in figure 3-1. Front panel controls are shown in figure 3-2.

### 3-4. Tests and Procedures.

The system test procedures, missing function table, and fault isolation tables are used to isolate a malfunction to a replaceable module. Obvious accessible faulty wiring and connections may be repaired at the direct support maintenance level. Procedures for locating defective wiring, rf cable assemblies, and non-captive piece parts mounted on the RT unit main frame assembly are provided in Chapter 4, General Support Maintenance. If a fault cannot be isolated to a module, or modules, the fault may be in the internal components of the parent boards or chassis, and the Radio Set will require depot level maintenance.

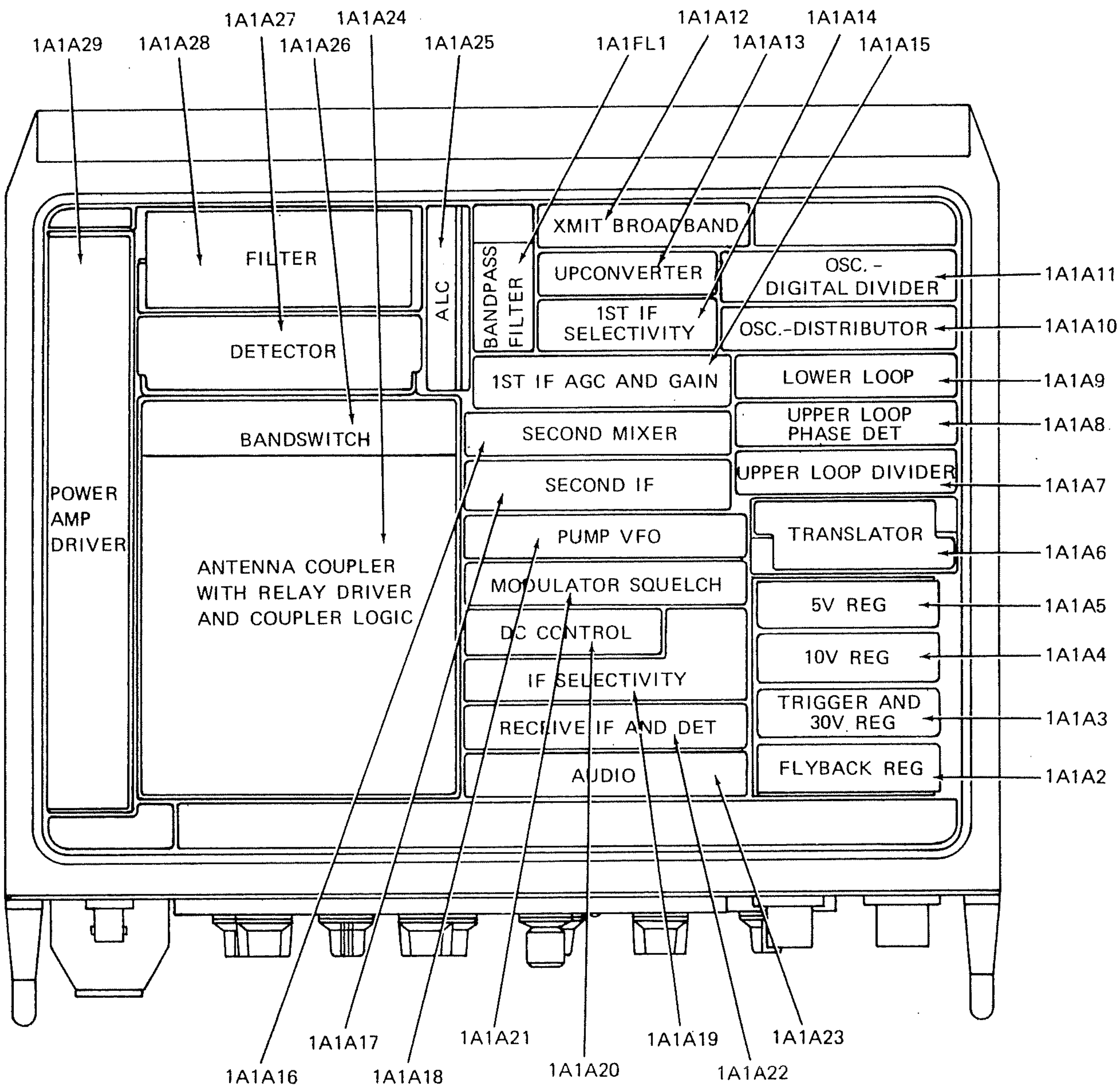



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Figure 3-1. Module locations

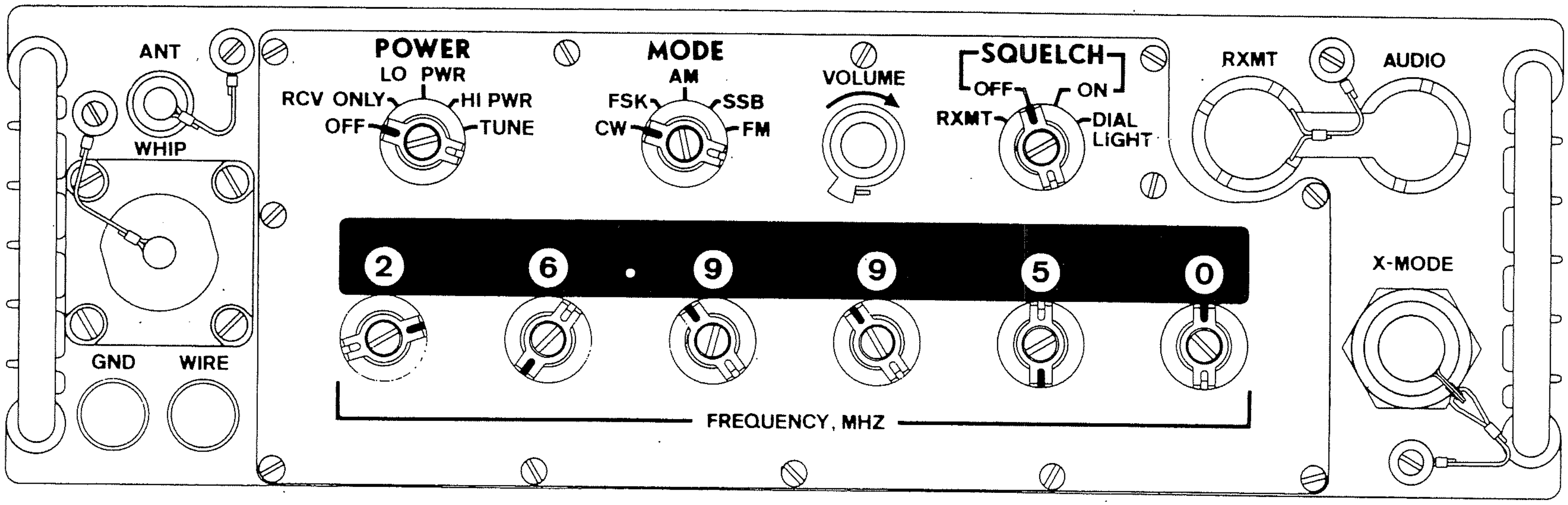


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Figure 3-2. Front panel controls

a. Faulty Module. When a faulty module is located, remove and replace the faulty module with a like serviceable item. Check RT unit for normal operation. Replace covers and secure connectors. Follow the instructions provided in Section IV.

b. Faulty Chassis. If a fault is determined to be in the internal components of the parent boards or chassis, replace covers and secure connectors. Forward the faulty RT unit to depot maintenance for repair.

3-5. Missing Function Table.

The missing function table contained in table 3-1 provides failure symptoms relative to a malfunction in a section or module of the RT unit determined during system testing and refers the user to a fault isolation table. The fault isolation table provides the troubleshooting procedures to isolate the malfunctioning module.

Table 3-1. Missing Function Table

| Description of failure symptoms | Refer to table |
|---|---|
| **Audio** | |
| Loss of audio (except for noise). | 3-2 |
| Loss of audio (no sound). | 3-3 |
| Loss of audio in headphone during transmission. | 3-4 |
| **Receive Only** | |
| Loss of receive capability. | 3-2 |
| Loss of receive capability in AM mode only. | 3-6 |
| Loss of receive capability in CW, FSK, SSB or AM modes. | 3-11 |
| Loss of receive capability in FM mode only. | 3-10 |
| Loss of receive capability in CW, FSK, and SSB modes. | 3-15 |
| **Transmit Only** | |
| Loss of transmit capability. | 3-5 |
| Loss of transmit capability on any one selected frequency band in all modes, or on all but one frequency band in all modes. | 3-6 |
| Loss of transmit capability in FM mode only. | 3-13 |
| Loss of transmit capability in AM mode only. | 3-15 |
| Loss of transmit capability in FSK mode only. | 3-16 |

Table 3-1. Missing Function Table - Continued

| Description of failure symptoms | Refer to table |
|---|---|
| Loss of transmit capability in CW mode only. | 3-16 |
| Loss of transmit capability in CW, FSK, AM and SSB modes. | 3-13 |
| Loss of transmit capability in CW, FSK, AM and SSB modes. Receives all modes and transmits FM only. | 3-12 |
| Loss of transmit capability in CW, FSK, SSB and FM modes. | 3-15 |
| Loss of transmit capability in CW and FSK modes. | 3-8 |
| Loss of transmit capability. Retransmit operates in all modes. | 3-19 |
| Loss of high power output from transmitter. | 3-17 |
| <u>Receive and Transmit</u> | |
| Loss of receive and transmit capability below 35 MHz. | 3-7 |
| Loss of receive and transmit capability above 35 MHz. | 3-7 |
| Loss of receive and transmit capability on any one selected frequency in all modes. | 3-22 |
| Loss of receive and transmit capability in AM mode only. | 3-15 |
| Loss of receive and transmit capability in FM mode. | 3-15 |

Table 3-1. Missing Function Table - Continued

| Description of failure symptoms | Refer to table |
| --- | --- |
| Miscellaneous | |
| Loss of retransmit capability. | 3-9 |
| AGC degraded on all modes. | 3-18 |
| Loss of squelch operation. | 3-12 |
| Loss of tune capability. | 3-14 |
| Loss of secure FM mode operation. | 3-20 |
| Loss of FM modulation. | 3-12 |
| Loss of AM modulation. | 3-21 |

3-6. Fault Isolation Tables.

Fault isolation tables 3-2 through 3-22 provide step by step procedures and reference the necessary tests required to isolate a malfunction to a module or modules of the RT unit.

CAUTION

This equipment contains transistor circuits. Observe the following precautions to prevent damage to the components.

1. Test equipment requires an isolation transformer in the power supply circuits.
2. Use a coupling capacitor before connecting the test equipment directly to transistor circuits (not necessary for multimeters or VTVM's).
3. OBSERVE BATTERY POLARITY. Polarity reversal may damage transistors.

Table 3-2. Fault Isolation Flow Chart, Loss of Audio Except for Noise, Loss of Receive Capability

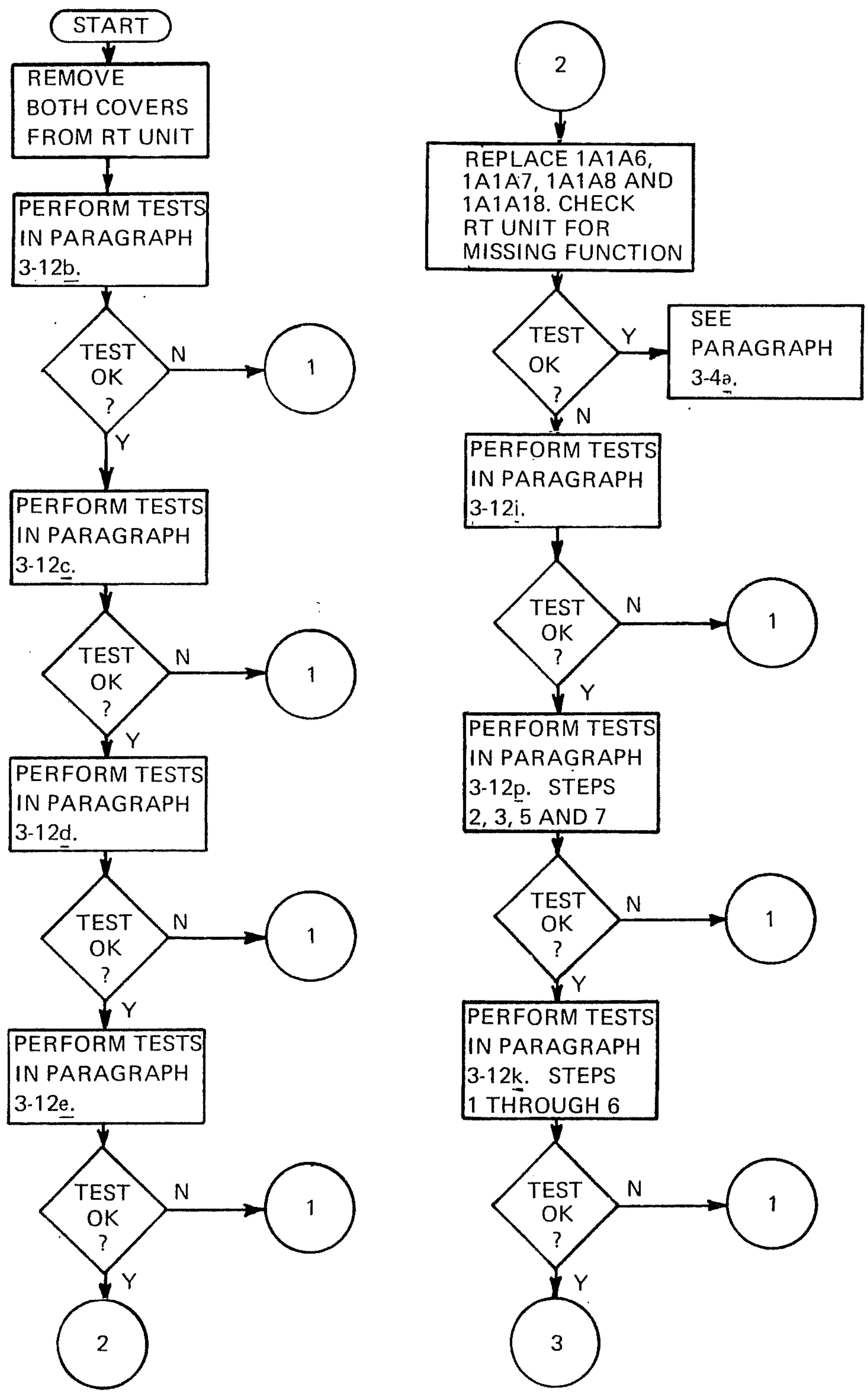


Table 3-2. Fault Isolation Flow Chart, Loss of Audio Except for Noise, Loss of Receive Capability - Continued

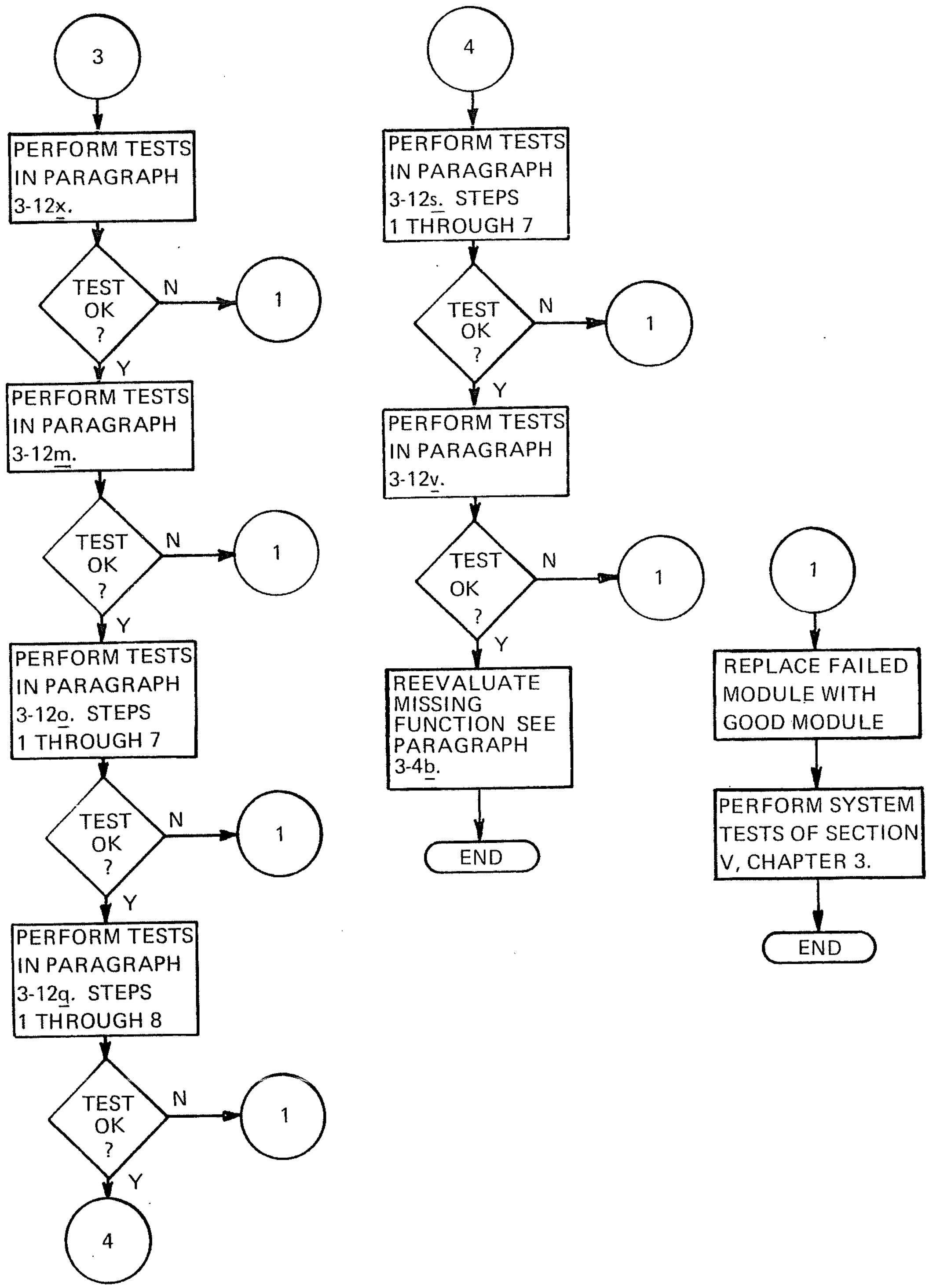


Table 3-3. Fault Isolation Flow Chart, Loss of Audio Sound

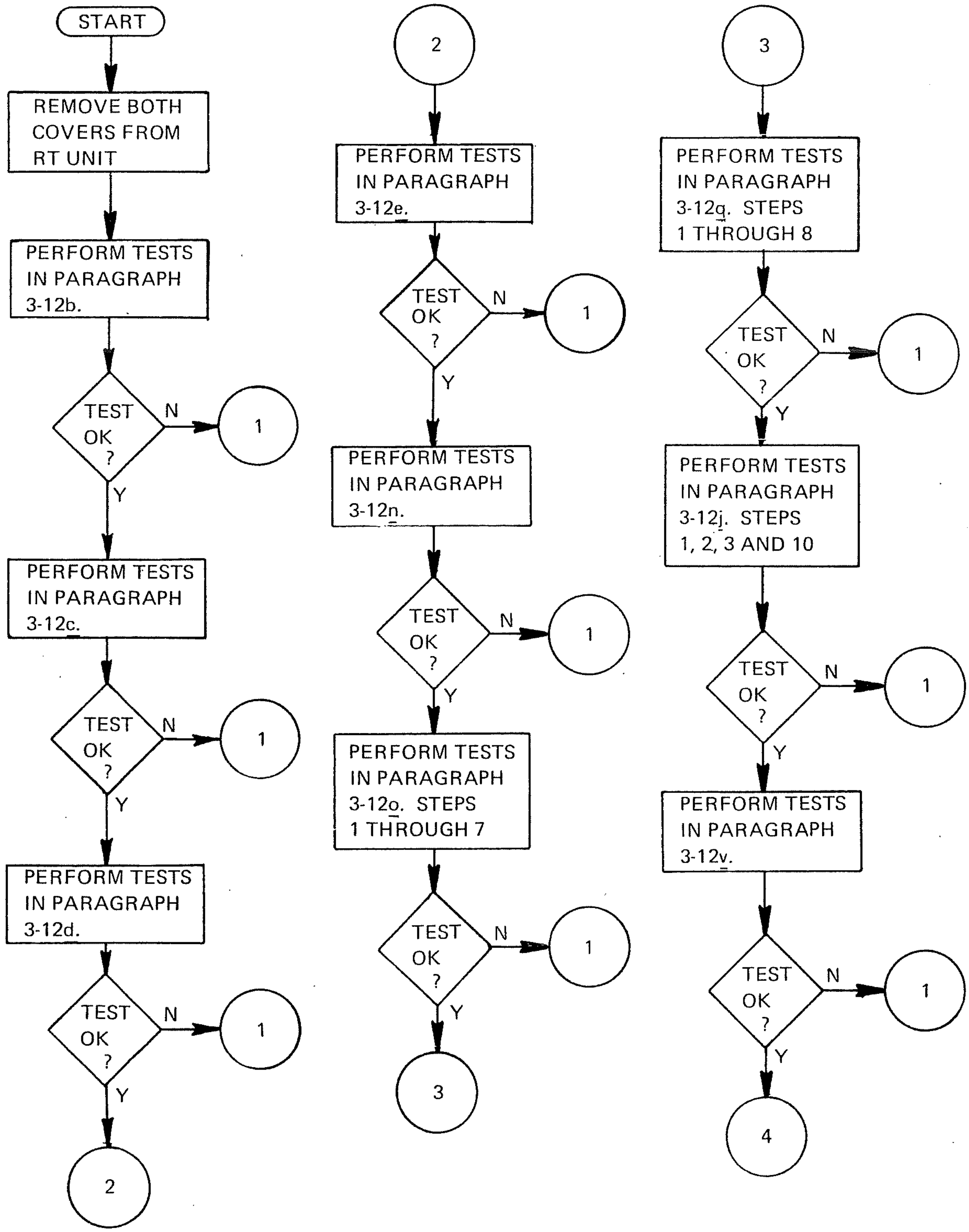


Table 3-3. Fault Isolation Flow Chart, Loss of Audio Sound - Continued

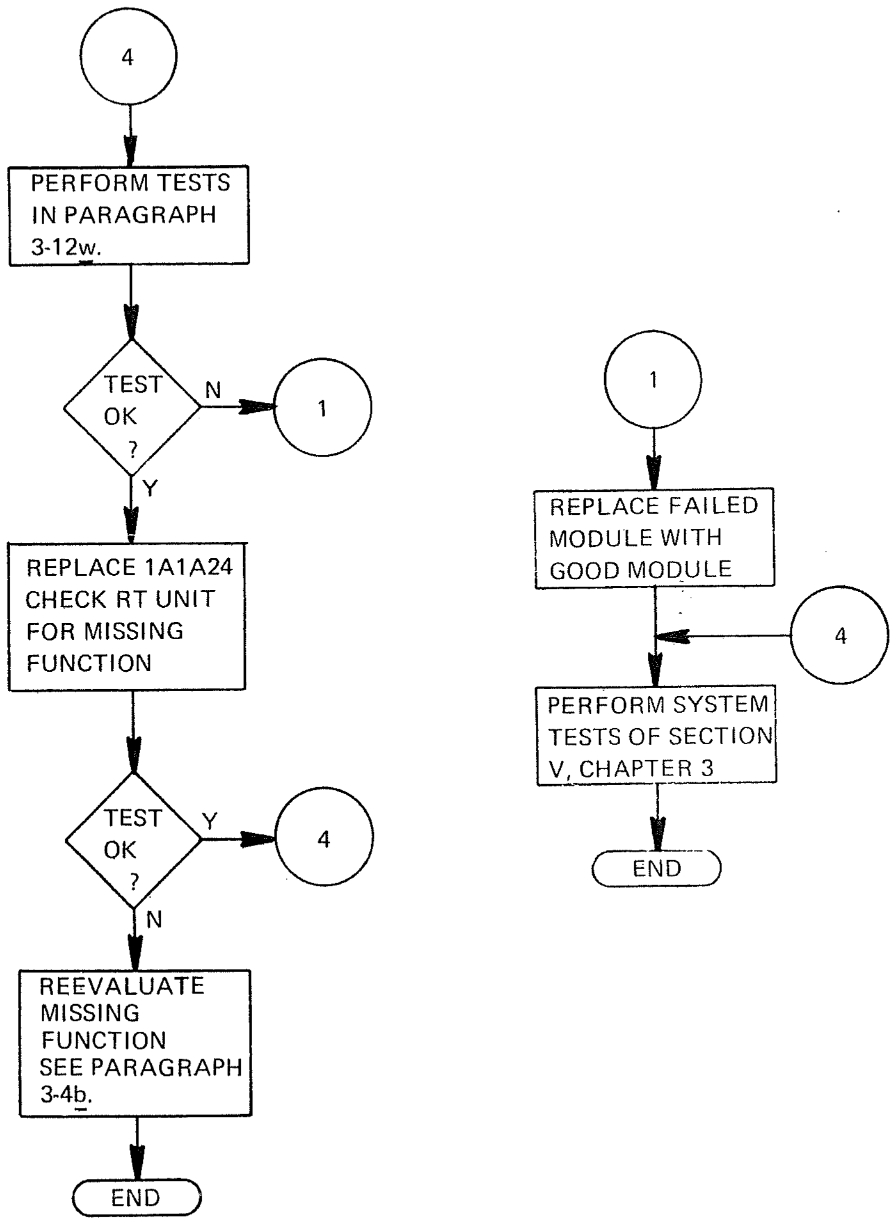


Table 3-4. Fault Isolation Flow Chart, Loss of Audio in Headphone During Transmission

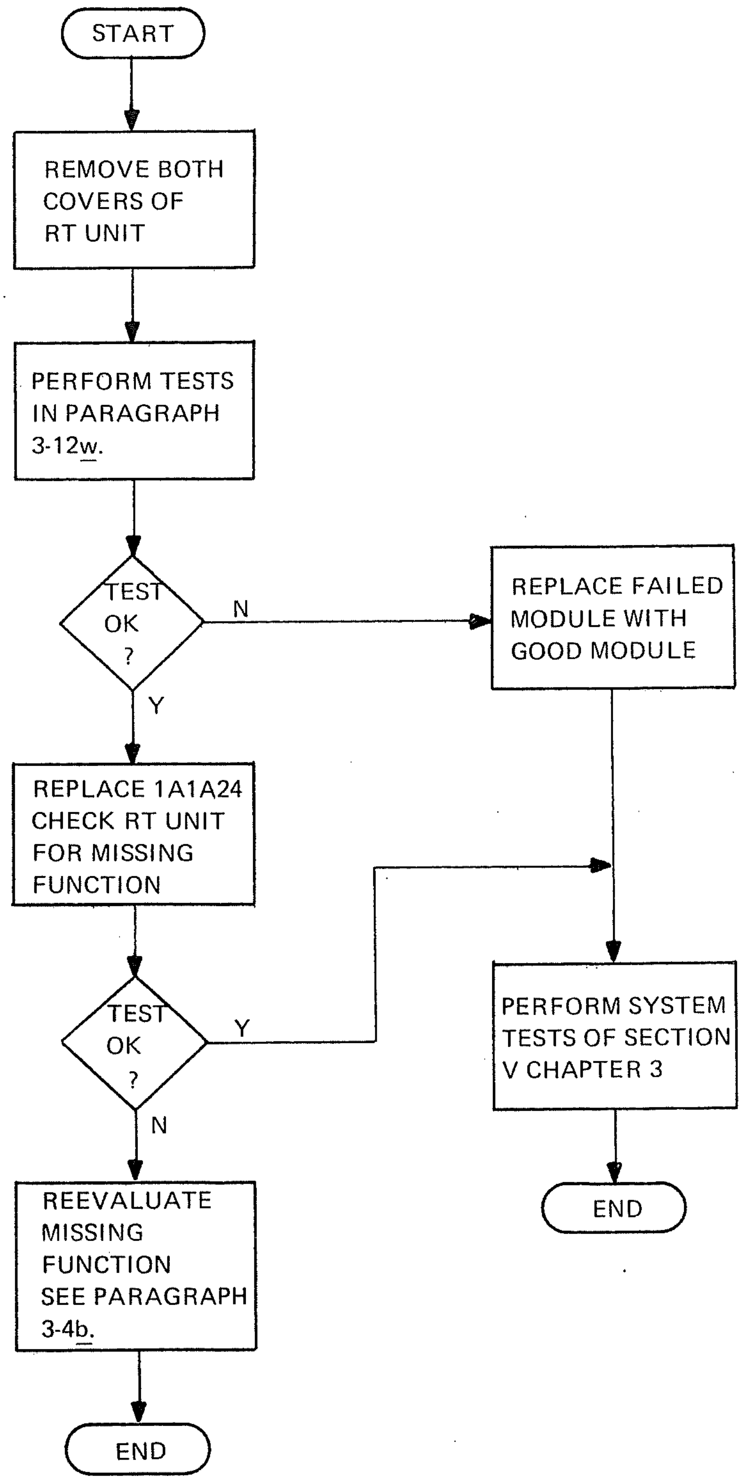


Table 3-5. Fault Isolation Flow Chart, Loss of Transmit Capability

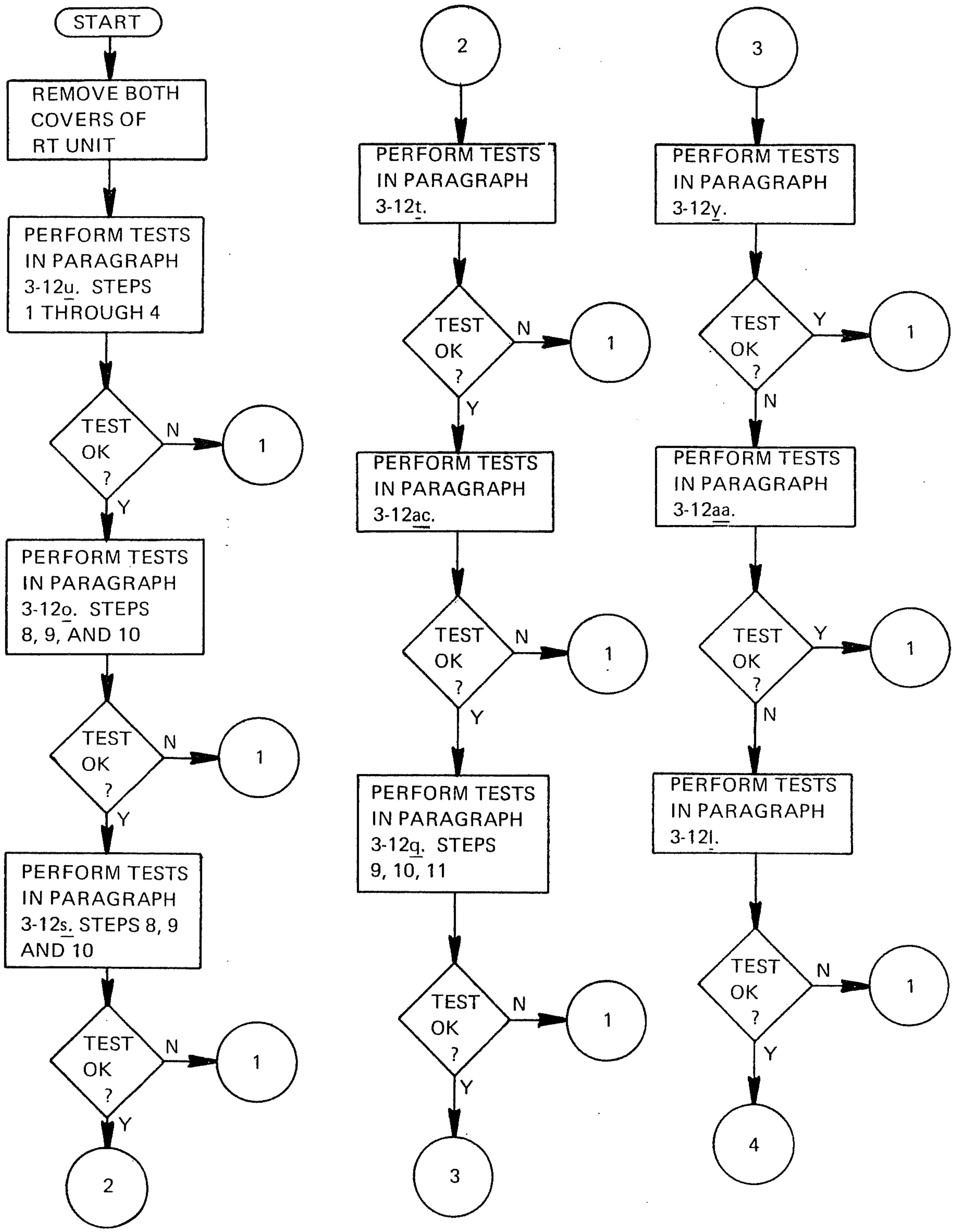


Table 3-5. Fault Isolation Flow Chart, Loss of Transmit Capability - Continued

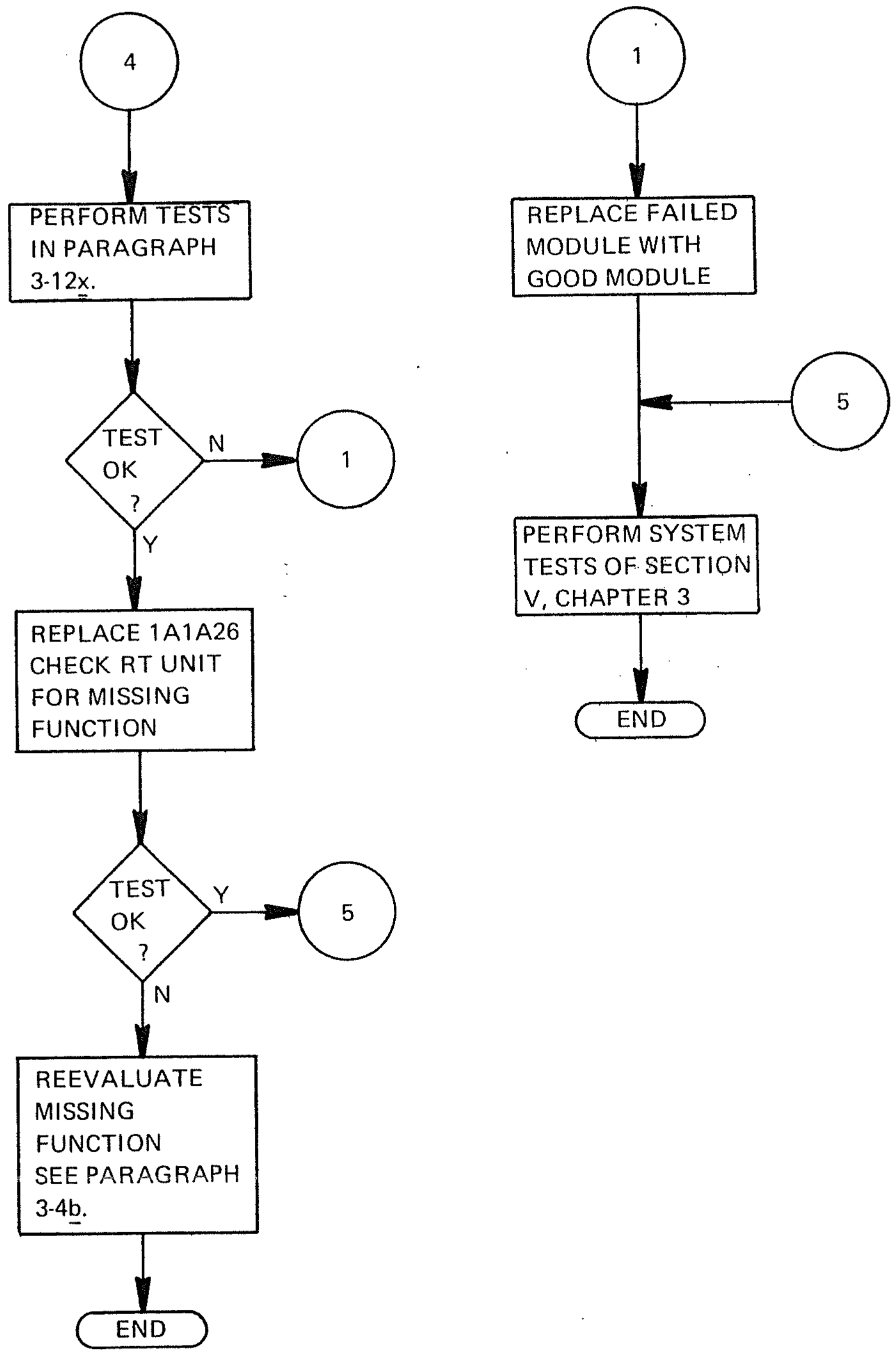


Table 3-6. Fault Isolation Flow Chart, Loss of Transmit Capability on Any One Selected Frequency Band in All Modes or Loss of Transmit Capability on All But One Frequency Band in All Modes

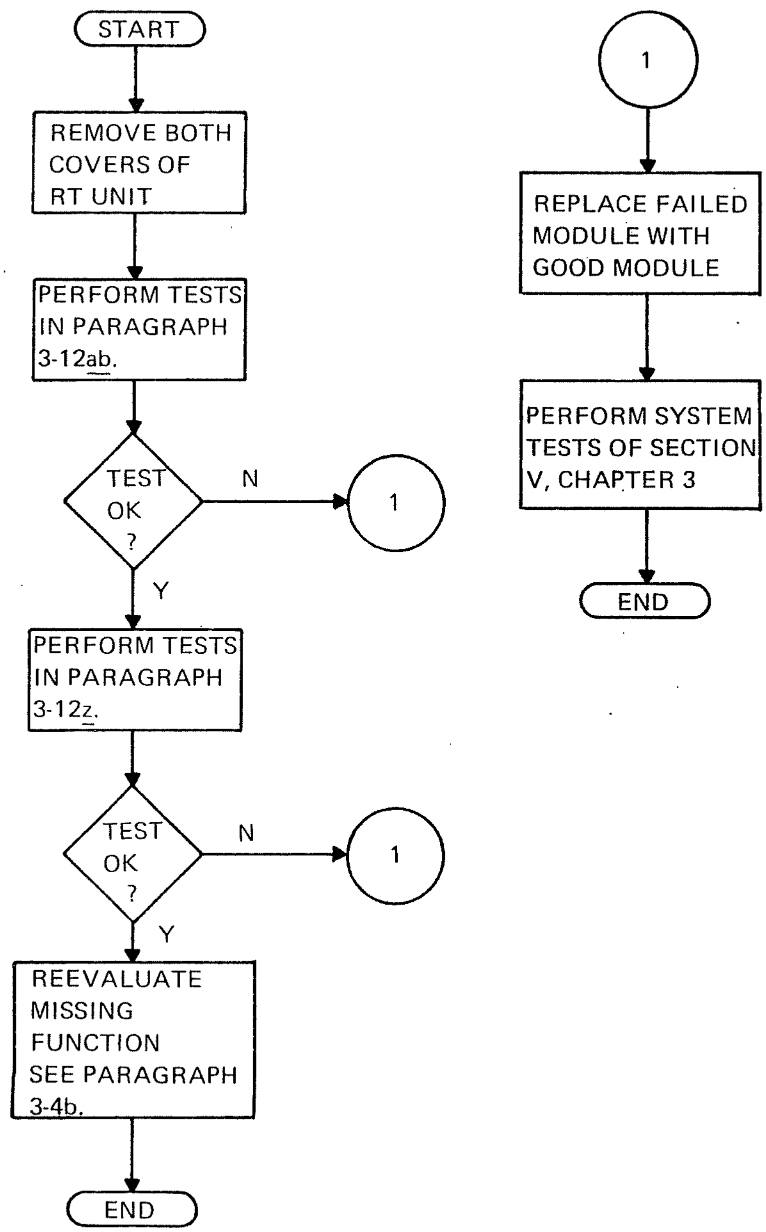


Table 3-7. Fault Isolation Flow Chart, Loss of Receive and Transmit Capability

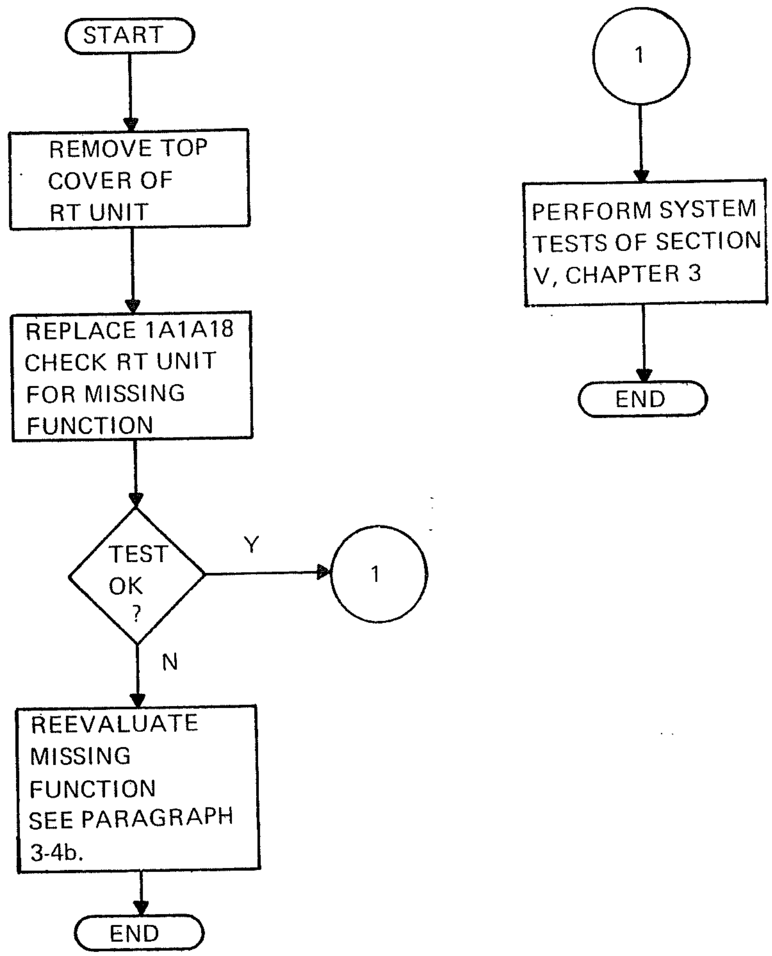


Table 3-8. Fault Isolation Flow Chart, Loss of Transmit Capability in CW and FSK Modes

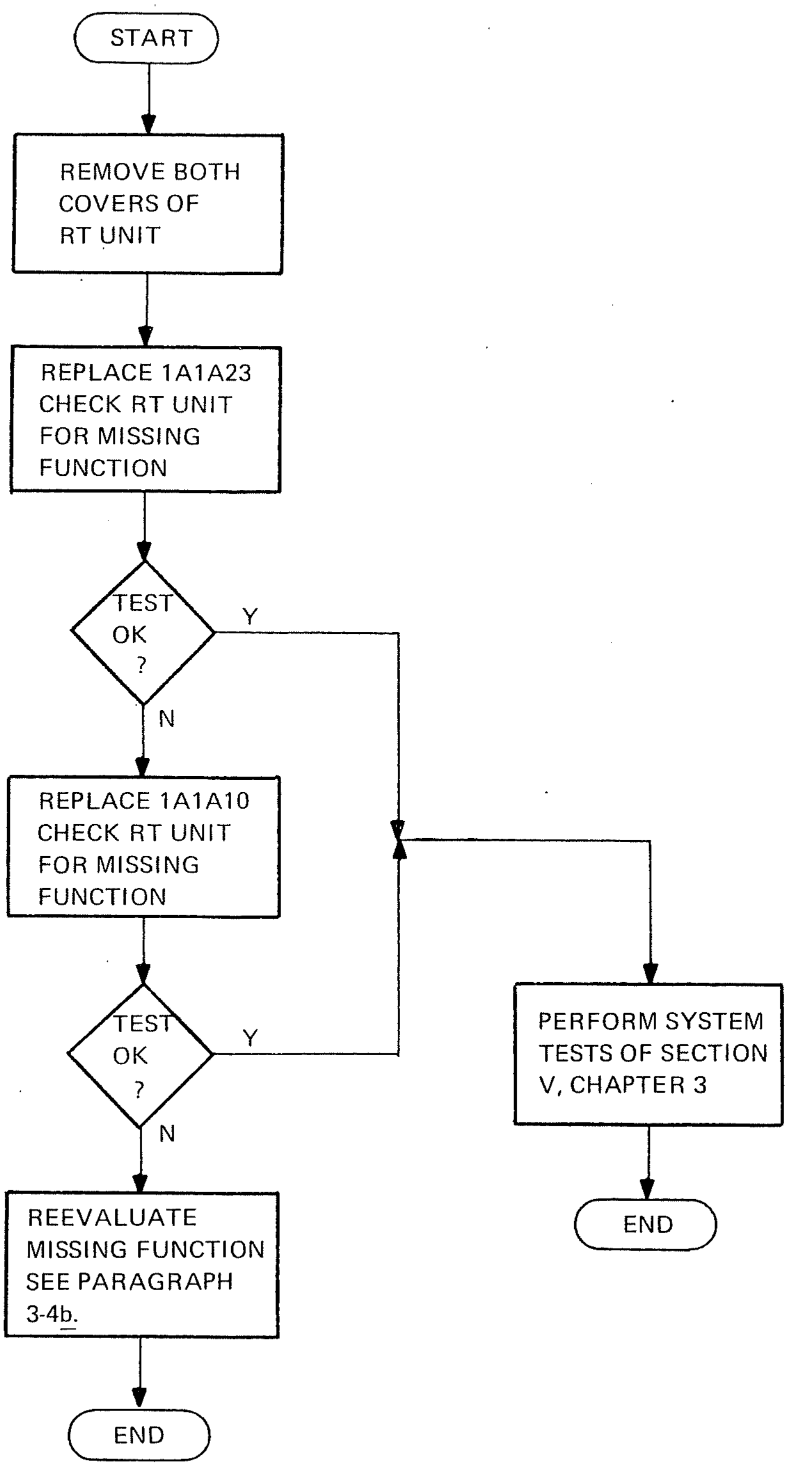


Table 3-9. Fault Isolation Flow Chart, Loss of Retransmit Capability

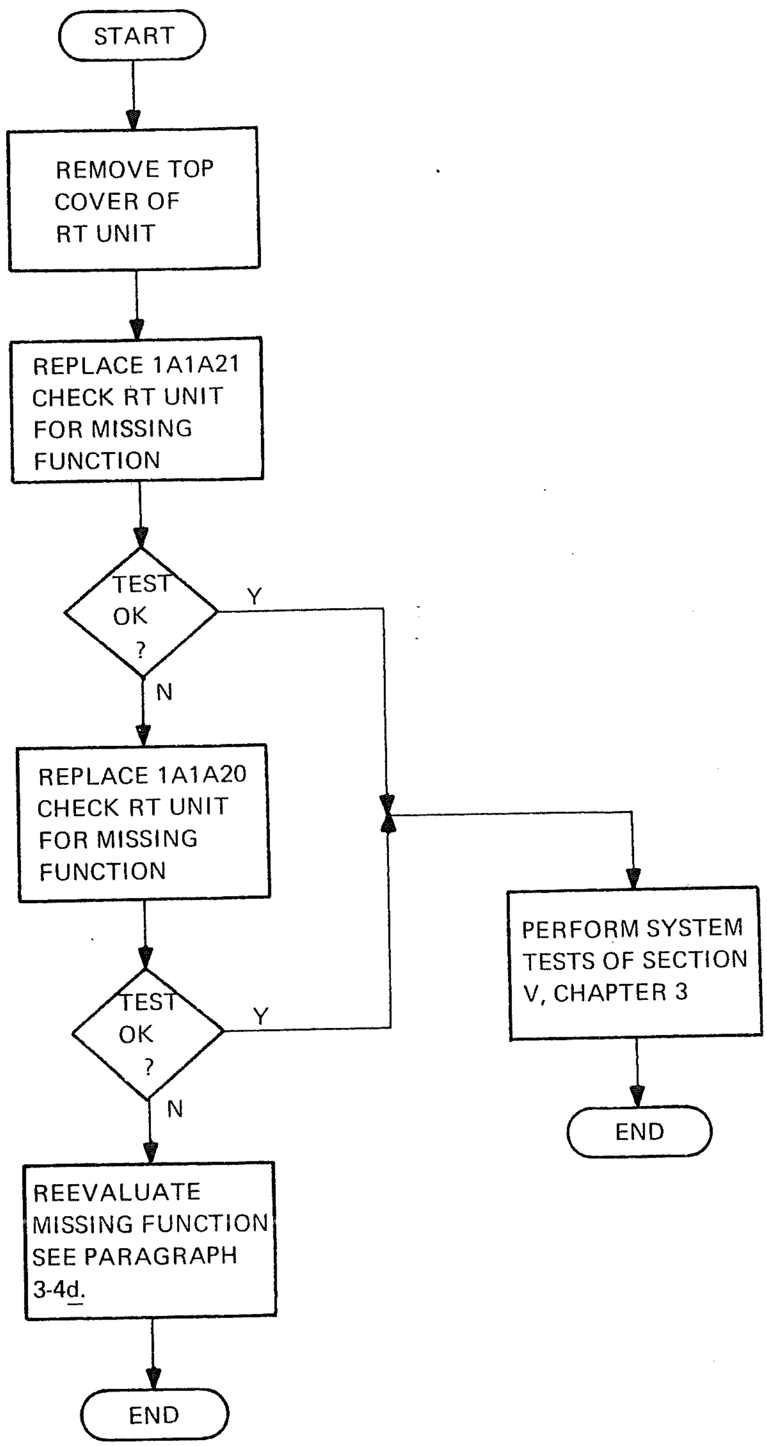


Table 3-10. Fault Isolation Flow Chart, Loss of Receive Capability in FM Mode Only

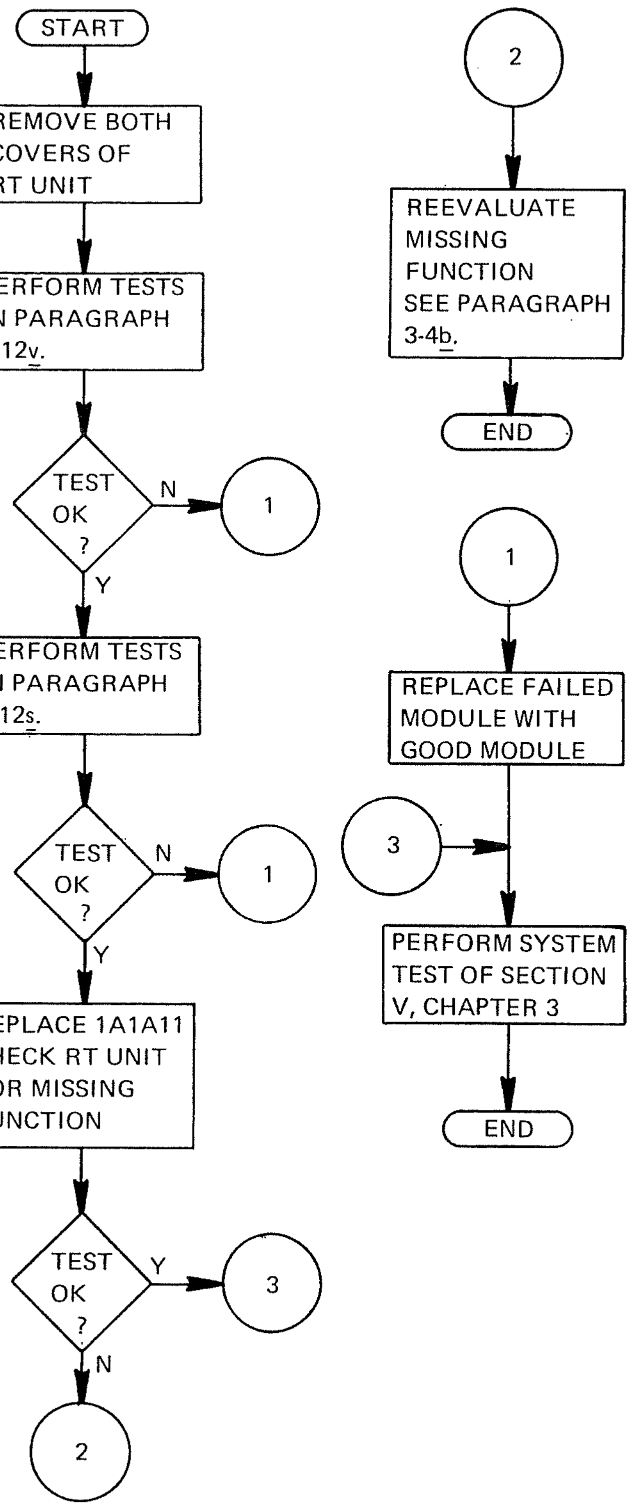


Table 3-11. Fault Isolation Flow Chart, Loss of Receive Capability in CW, FSK, AM and SSB Modes

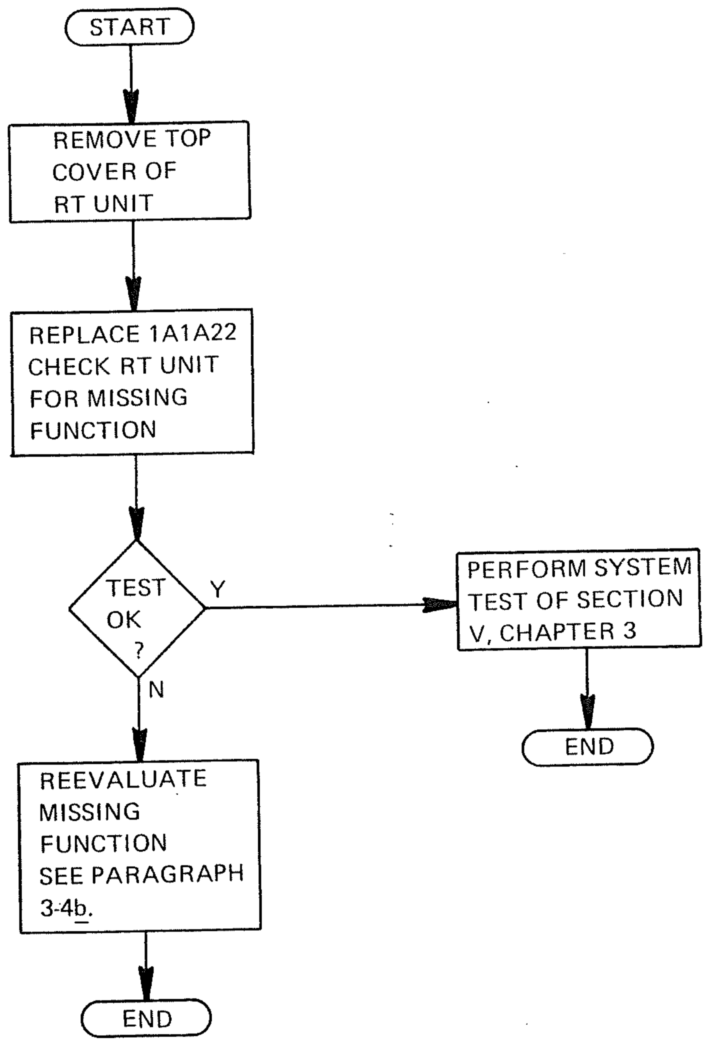


Table 3-12. Fault Isolation Flow Chart, Loss of Transmit Capability in AM, FSK, CW and SSB Modes. Receives All Modes and Transmits on FM Only. Loss of Squelch Operation

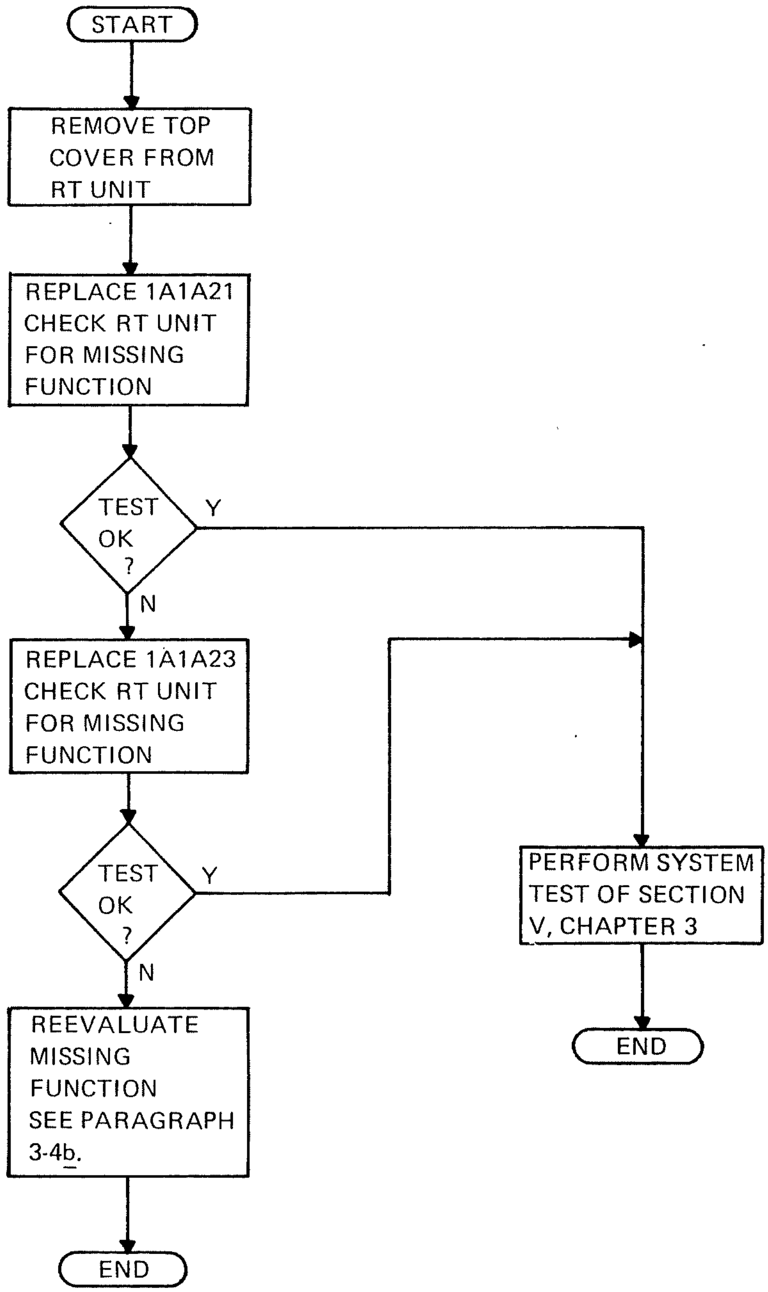


Table 3-13. Fault Isolation Flow Chart, Loss of Transmit Capability in FM Mode Only or CW, FSK, SSB and AM Modes Only

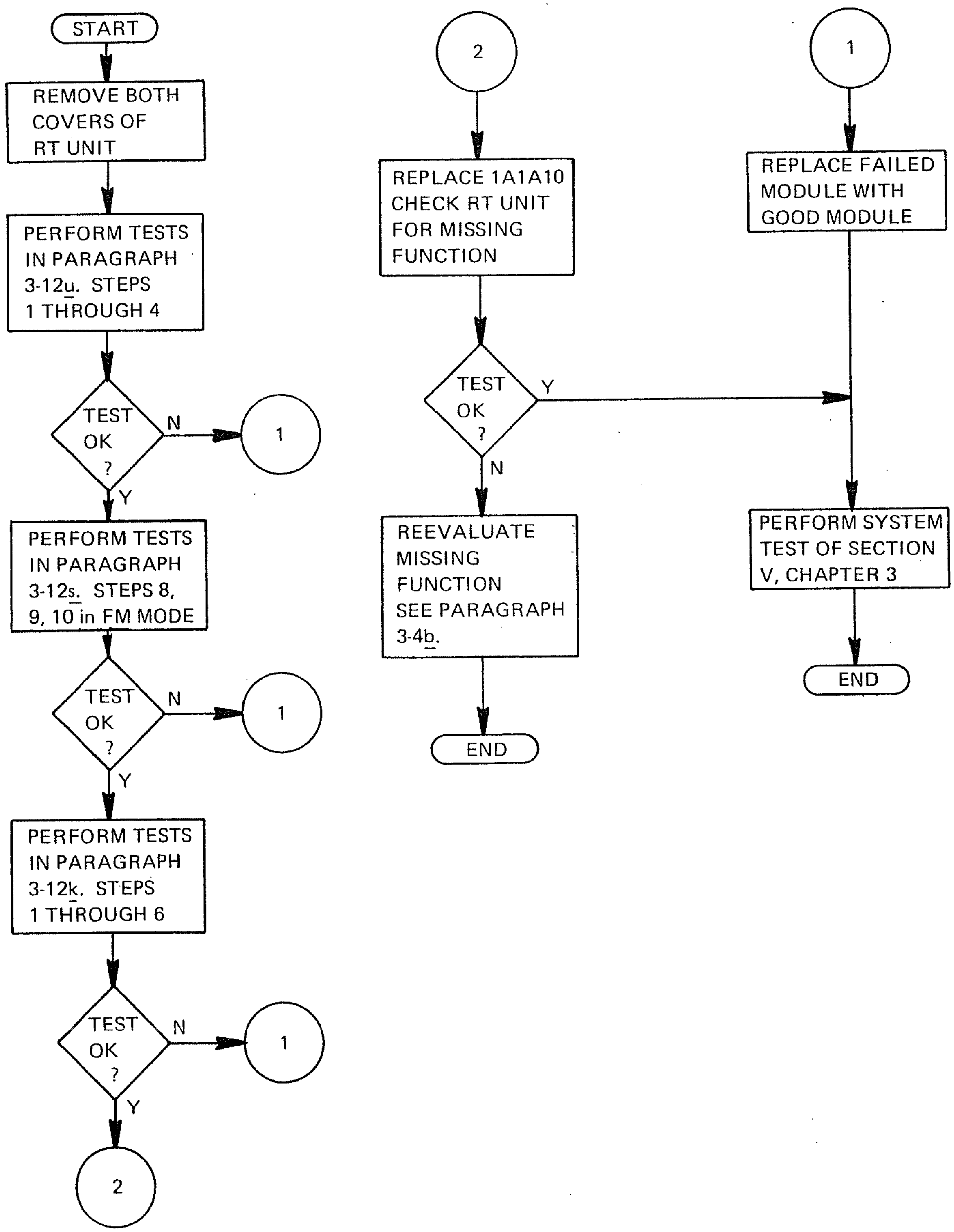


Table 3-14. Fault Isolation Flow Chart, Loss of Tune Capability

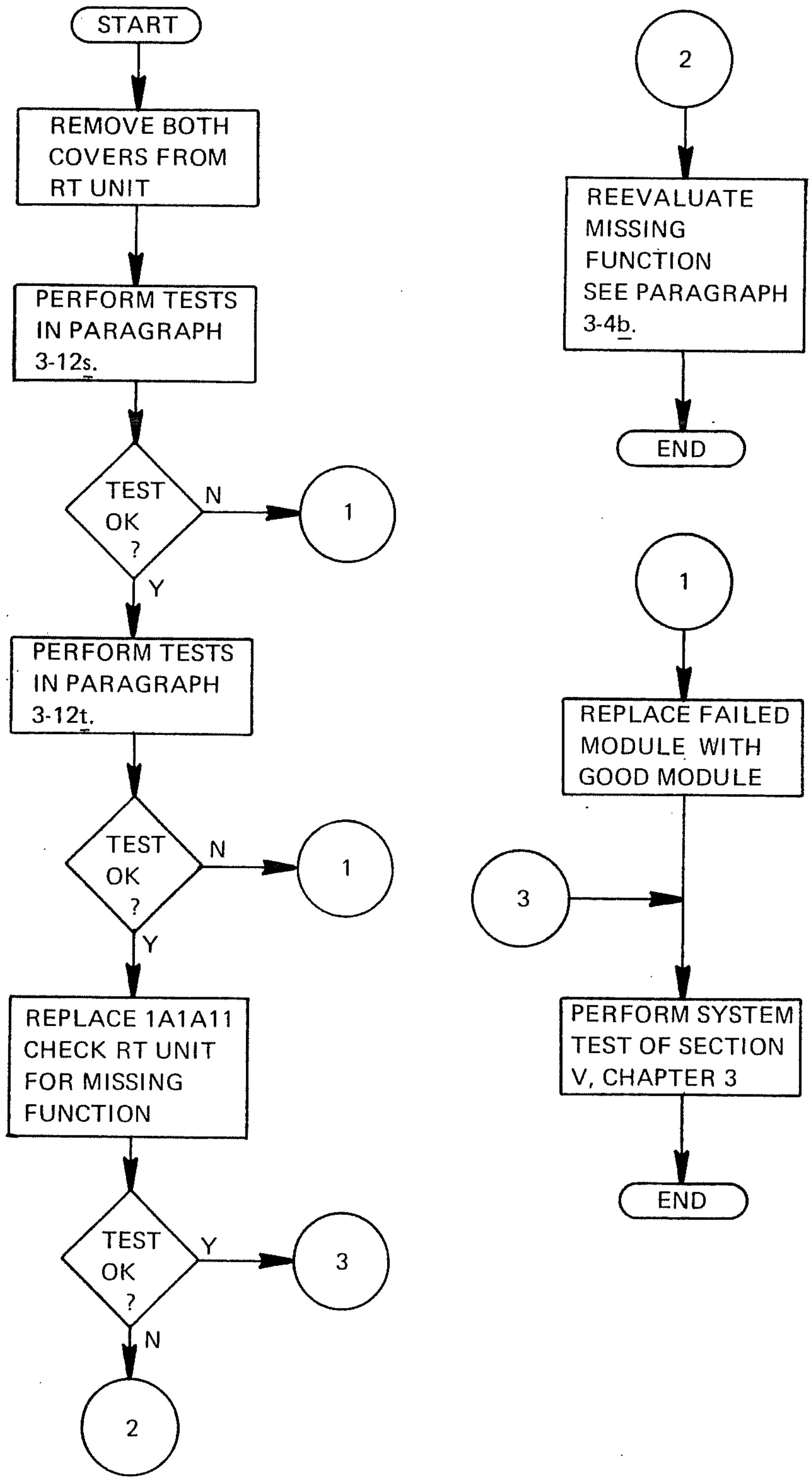


Table 3-15. Fault Isolation Flow Chart, Loss of Receive Capability in CW, FSK and SSB Modes and Loss of Transmit Capability in Any or All Modes

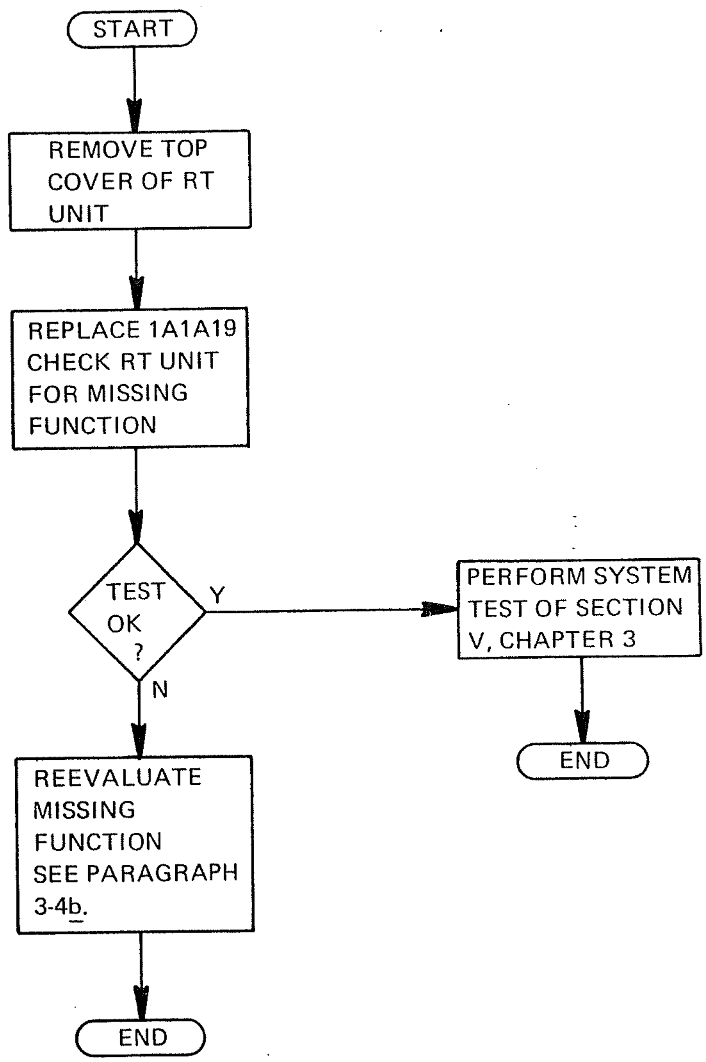


Table 3-16. Fault Isolation Flow Chart, Loss of Transmit Capability in CW and/or FSK Modes

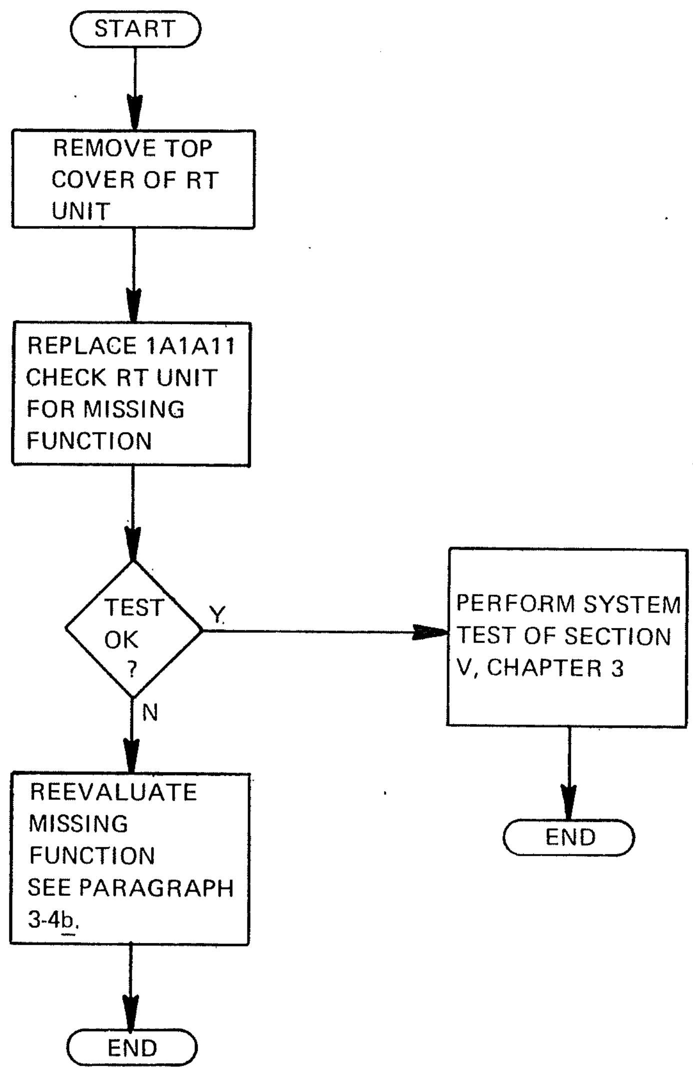


Table 3-17. Fault Isolation Flow Chart, Loss of High Power Output from Transmitter

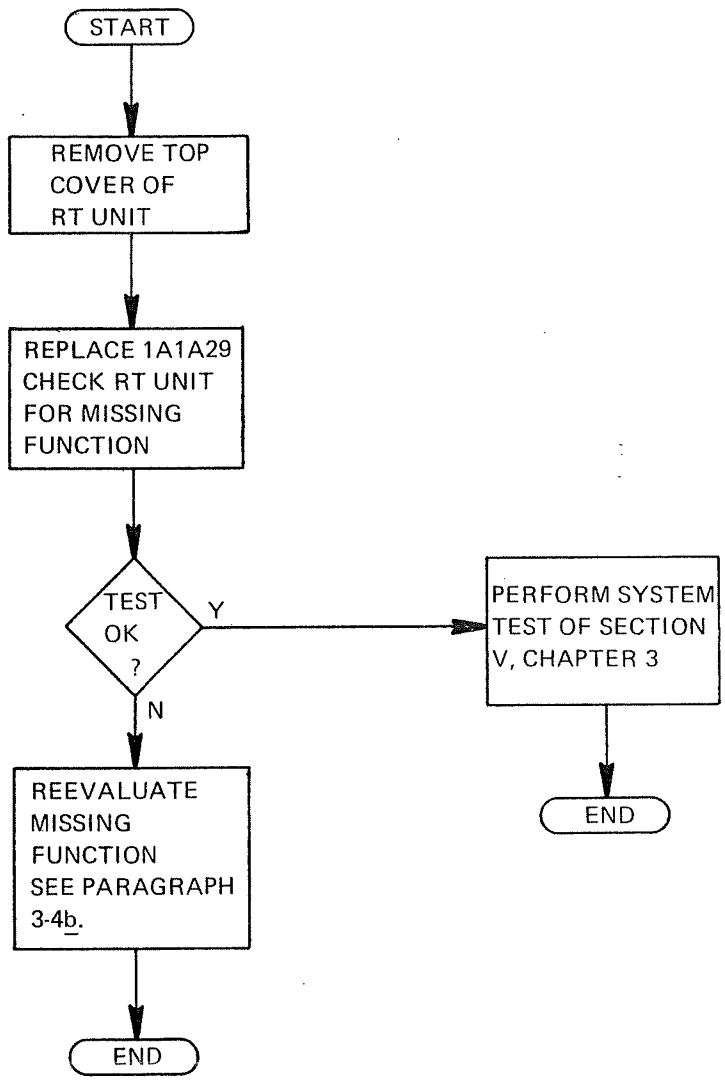


Table 3-18. Fault Isolation Flow Chart, AGC Degraded in All Modes

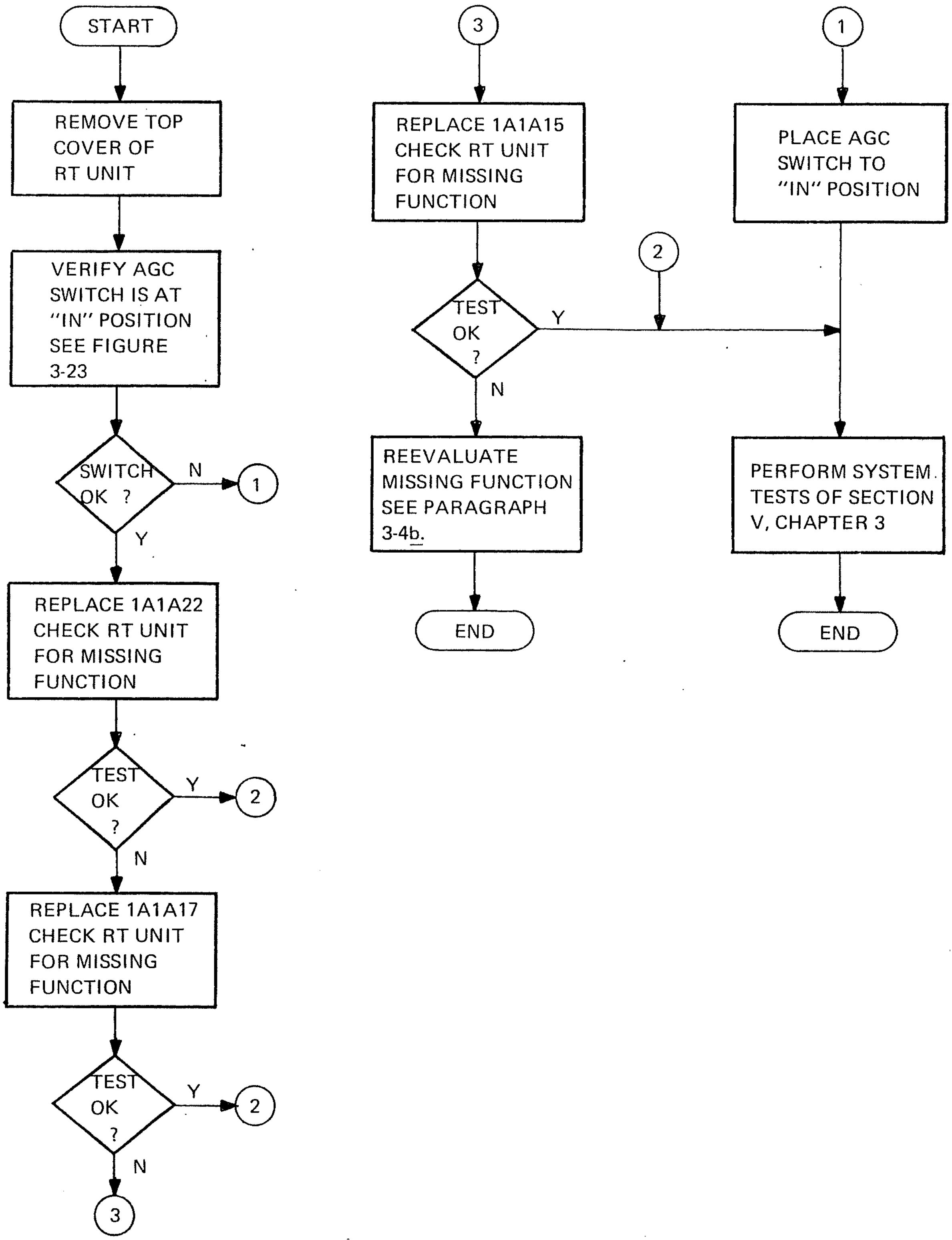


Table 3-19. Fault Isolation Flow Chart, Loss of Transmit Capability, Retransmit Operates in All Modes

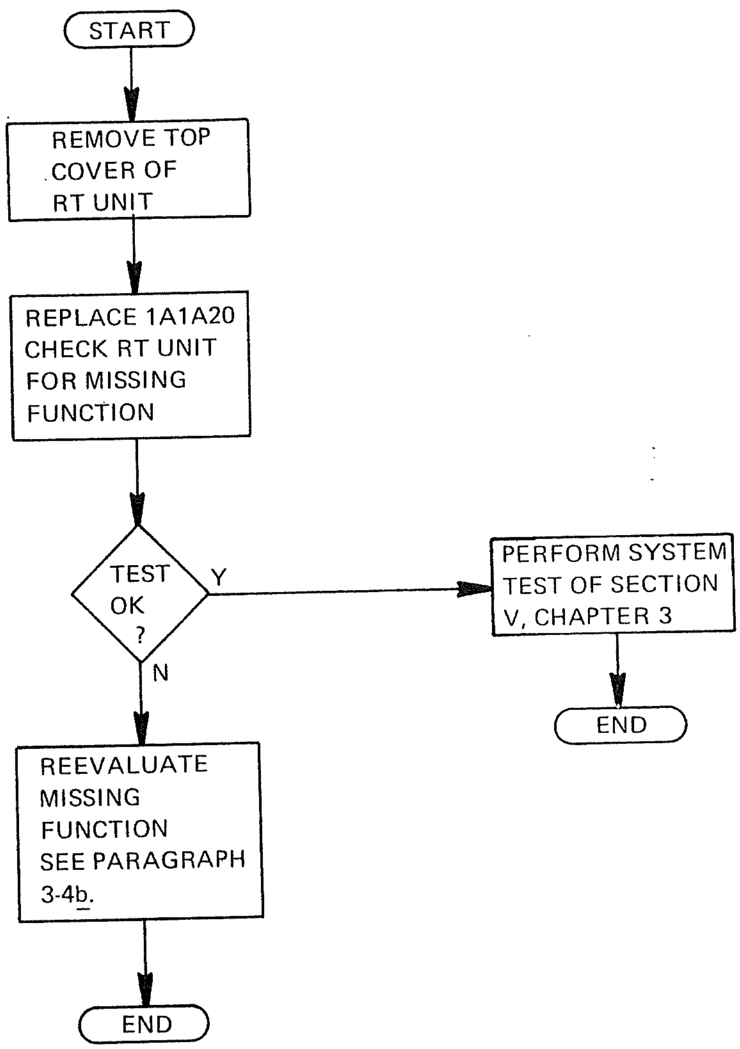


Table 3-20. Fault Isolation Flow Chart, Loss of Secure FM Mode Operation

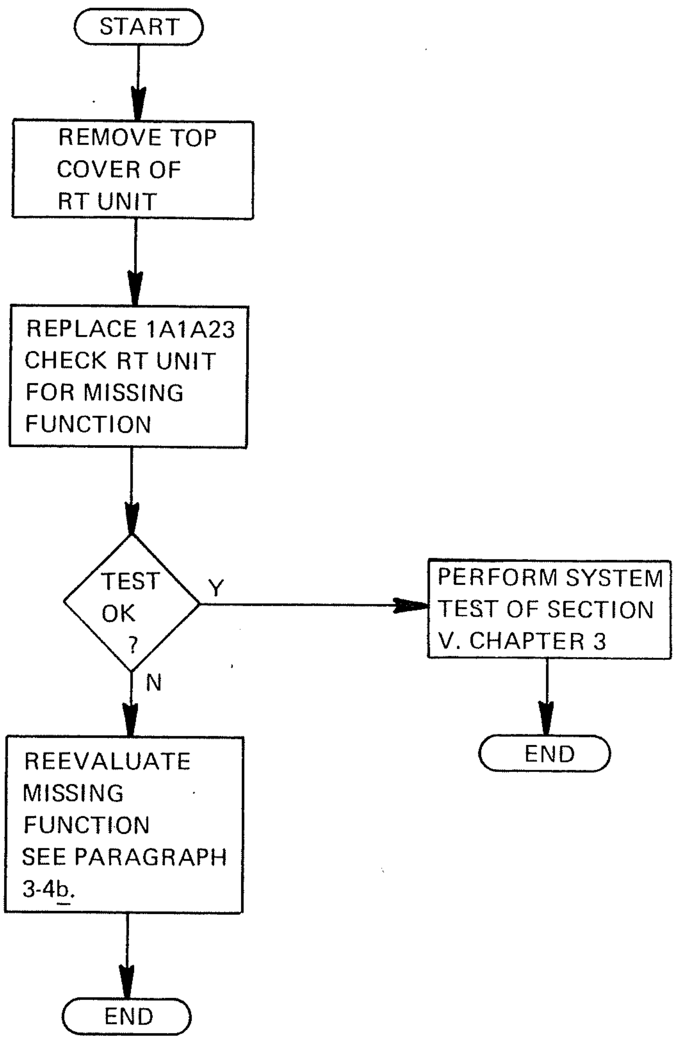


Table 3-21. Fault Isolation Flow Chart, Loss of AM Modulation Only

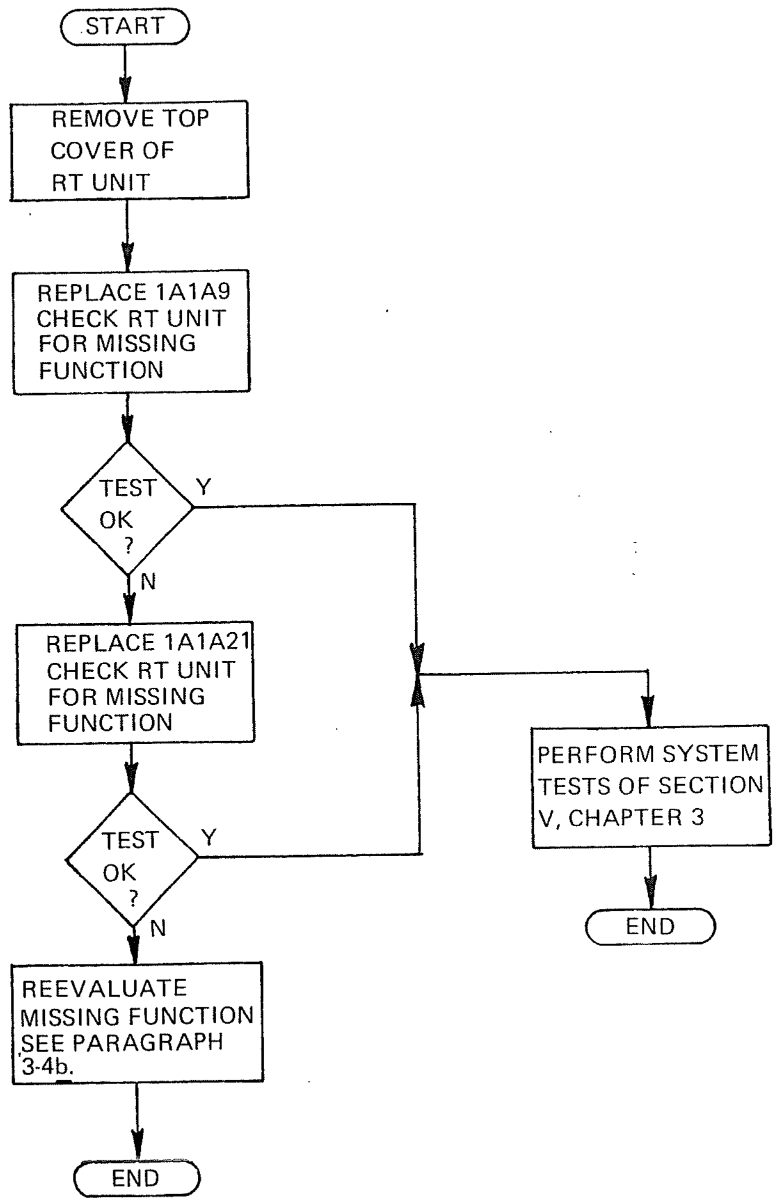
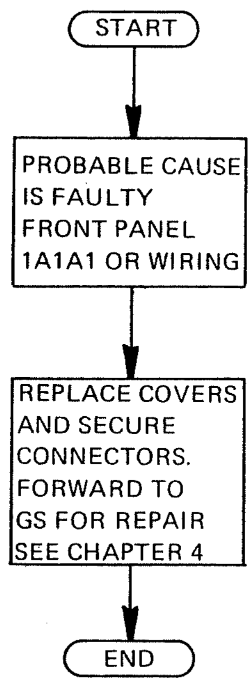


Table 3-22. Fault Isolation Flow Chart, Loss of Receive and Transmit Capability on Any One Selected Frequency in All Modes



## Section IV. MAINTENANCE OF AN/PRC-70 RADIO SET

### 3-7. Adjustment and Alignment.

The AN/PRC-70 requires no adjustment or alignment.

### 3-8. Repair.

Repair of the AN/PRC-70 is accomplished by replacement of faulty modules with useable modules. Replacement of non-captive parts on the case assembly is carried out by general support maintenance (refer to Chapter 4).

### 3-9. Assembly and Disassembly.

a. Removing Radio Set Covers. To remove the top and bottom covers from the AN/PRC-70, remove the screws that secure the top and bottom covers to the main frame.

b. Removing and Replacing Modules. See figure 3-1 for module location.

(1) To remove modules 1A1A2 through 1A1A23, and 1A1A25 insert a screwdriver tip in the slot provided on the module and pry it up by using the compartment edge for leverage (see figure 3-3).

(2) To replace modules 1A1A2 through 1A1A23, and 1A1A25 insert module in slides provided and push down until connector mates firmly.

(3) Removal of antenna coupler module 1A1A24. See figure FO-7.

(a) Connect battery or external power to RT unit.

(b) Set POWER switch to RCV ONLY position. Set FREQUENCY MHZ controls to read 13.0000.

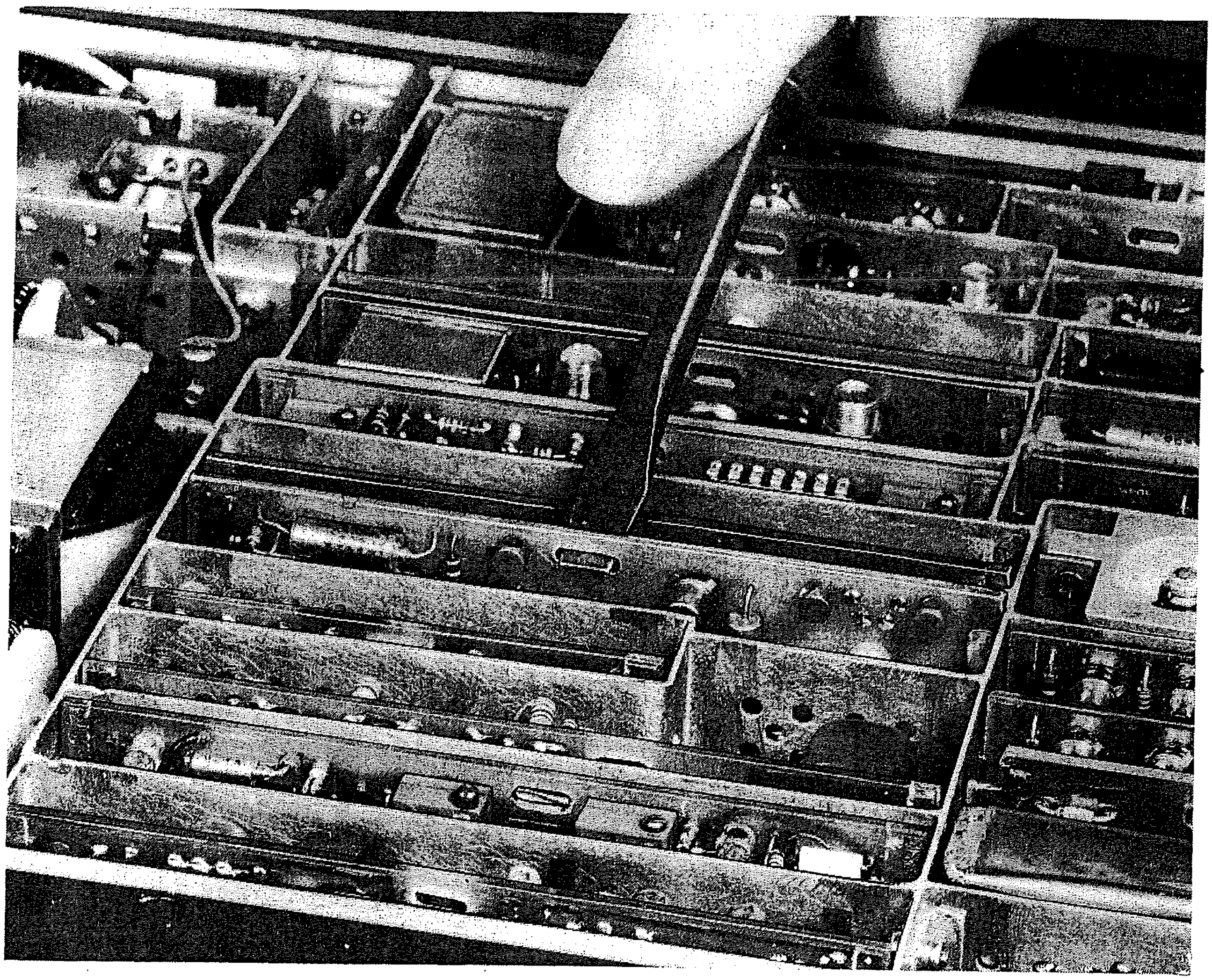


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Figure 3-3. Module removal

(c) Set POWER switch to OFF and remove battery or external power. Remove top and bottom covers from RT unit.

(d) If battery or external power is not available, locate the gear near the bandswitch motor on the underside of the RT. Manually rotate the gear until the coupling positions indicated in figure FO-7, view A is achieved.

(e) Remove connector 1A1A27P2 from 1A1A24A1J1.

(f) Remove 1A1A31P1 from 1A1A29J2.

(g) From the top of the RT unit, remove six screws and washers holding the coupler in place. (See figure FO-7, view C).

NOTE

Screws will fall out if RT unit is turned over. Wait until coupler is removed then remove screws until needed for reassembly.

CAUTION

When tapping on the coupler in the next step be very careful to tap lightly to prevent damage to the coupler assembly.

(h) From the top of the RT unit, use a flat blade screwdriver and place it alternately on the front left corner and right rear corner of the coupler and tap gently until the coupler is free of connectors 1A1A24A1P1 and 1A1A24A1J2. (See figure FO-7, view C).

(i) Remove the coupler assembly through the bottom of the RT unit.

(4) Replacement of antenna coupler module 1A1A24. See figure FO-7.

(a) Perform step 3-9b. (3)(d) and align coupler assembly coupling.

CAUTION

Take care not to bend connector pins when installing coupler network.

(b) Insert coupler through bottom of RT unit and push up to mate connectors.

(c) Install six screws and washers removed in step 3-9b. (3)(g). Tighten screws until coupler is pulled up into the RT unit.

(d) Connect 1A1A31P1 to 1A1A29J2 and 1A1A27P2 to 1A1A24A1J1. Replace RT unit covers.

(5) Removal of bandswitch module, 1A1A26. See figure FO-7.

(a) Perform all steps of paragraph 3-9b. (3).

(b) Remove four screws, two washers and nut plate shown on figure FO-7, view B.

(c) Disconnect 1A1A26P1 from 1A1A32J1.

(d) Remove bandswitch module through the bottom of the RT unit. Move 1A1A26P1 cabling to clear the module from the RT unit.

(6) Replacement of bandswitch module, 1A1A26. See figure FO-7.

(a) Remove ALC module, 1A1A25 as described in paragraph 3-9b. (1).

(b) Align bandswitch module coupling to mate with the detector coupling as shown in figure FO-7, view A.

(c) Insert bandswitch module through the bottom of the RT unit. Move 1A1A26P1 cabling to clear the module for installation.

(d) Insert the nut plate into the ALC module enclosure and mount the bandswitch module to the RT unit and nut plate using the four screws and the washers removed in paragraph 3-9b. (5)(b).

(e) Connect 1A1A26P1 to 1A1A32J1.

(f) Replace ALC module as described in paragraph 3-9b. (2).

(g) Perform all steps of paragraph 3-9b. (4). Replace RT unit covers.

(7) Removal of detector module 1A1A27. See figure FO-7.

(a) Perform steps (a) through (e) of paragraph 3-9b. (3).

(b) Remove coaxial connector from K5 to 1A1A27J1.

(c) Remove detector module by inserting screwdriver into slot and carefully prying upward until detector is released. See figure 3-3.

(8) Replacement of detector module 1A1A27. See figure FO-7.

(a) Align detector and other module couplings as shown in figure FO-7, view A.

(b) Insert detector module into proper track and press down until 1A1A27P1 mates with 1A1A32J2.

(c) Connect 1A1A27P2 to 1A1A24J1 and coaxial connector from K5 to 1A1A27J1.

(d) Replace top and bottom RT covers.

(9) Removal of filter module 1A1A28. See figure FO-7.

(a) Connect battery or external power to RT unit.

(b) Set POWER switch to RCV ONLY position. Set FREQUENCY MHZ controls to read 17.0000.

(c) Set POWER switch to OFF and remove battery or external power. Remove top and bottom covers from RT unit.

(d) If battery or external power is not available,locate the gear near the bandswitch motor on the underside of the RT unit. Manually rotate the gear until the couplings are positioned 180 degrees opposite of the position indicated in figure FO-7, view A.

(e) Disconnect 1A1A28P1 from 1A1J7 which is located on the shield between filter and detector module.

(f) Remove filter module by inserting screwdriver into slot and carefully prying upward until filter is released. See figure 3-3.

(10) Replacement of filter module 1A1A28. See figure FO-7.

(a) Align RT unit and filter couplings as indicated in paragraph 3-9b. (9)(d).

(b) Insert filter into proper track and press down until 1A1A28P2 mates with coaxial connector on the underside of the RT unit.

(c) Connect 1A1A28P1 to 1A1J7 on shield between filter and detector module.

(d) Replace top and bottom covers.

(11) Removal of power amplifier and driver module 1A1A29.

(a) Remove top cover on RT unit.

(b) Use a 9/64" hex wrench and remove six screws with seal washers, on the outside of the RT unit, that are used to attach the power amplifier and driver module. Retain hardware for reassembly.

(c) Pull the power amplifier and driver module up to release connectors 1A1A29P1, J1 and J2 and remove from the RT unit.

(12) Replacement of power amplifier and driver module 1A1A29.

(a) Place power amplifier and driver module into the proper enclosure on the RT unit and push carefully to properly seat 1A1A29P1, J1 and J2.

CAUTION

When mounting power amplifier and driver module do not use any hardware other than that designed for mounting. Improper length screws will cause mechanical or electrical damage to the RT unit.

(b) Align module with mounting holes and insert six screws with seal washers.

(c) Tighten screws with 9/64" hex wrench to secure module to RT unit.

(d) Replace top cover on RT unit.

(13) Removal of bandpass filter 1A1FL1.

(a) Remove top and bottom cover from RT unit.

(b) From the bottom of the RT unit loosen and remove the two screw-on coaxial connectors to 1A1FL1J1 and J2.

(c) Remove the bandpass filter module from the top of the RT unit by inserting screwdriver into slot and carefully prying upward until the filter is released.

(14) Replacement of bandpass filter 1A1FL1.

(a) Place module in proper enclosure and press firmly into place.

(b) Connect screw-on coaxial connectors to 1A1FL1J1 and J2.

(c) Replace top and bottom cover on RT unit.

(15) For removal and replacement of module 1A1A1, refer to Chapter 4, General Support Maintenance Instructions.

## Section V. DIRECT SUPPORT TESTING PROCEDURES

3-10. General.

This section provides system tests and module tests for the RT unit. The system tests reveal symptoms to be used in troubleshooting. They also indicate proper operation after replacement of a faulty module. The module tests provide instructions for isolating a faulty module. Follow the procedural steps in the order given and set all controls accurately.

3-11. System Tests.

The following procedures verify serviceability of the RT unit after maintenance. These procedures also provide indications of failures for use in troubleshooting. The front panel controls of the RT unit are shown on figure 3-2. Equipment test setup diagrams are shown on figures 3-4 through 3-6.

NOTE

> If the RT unit fails to meet one or more of the following tests, refer to table 3-1 for a description of the failure symptom and the corresponding troubleshooting table.

a. Receiver Sensitivity Test.

(1) Preliminary setup.

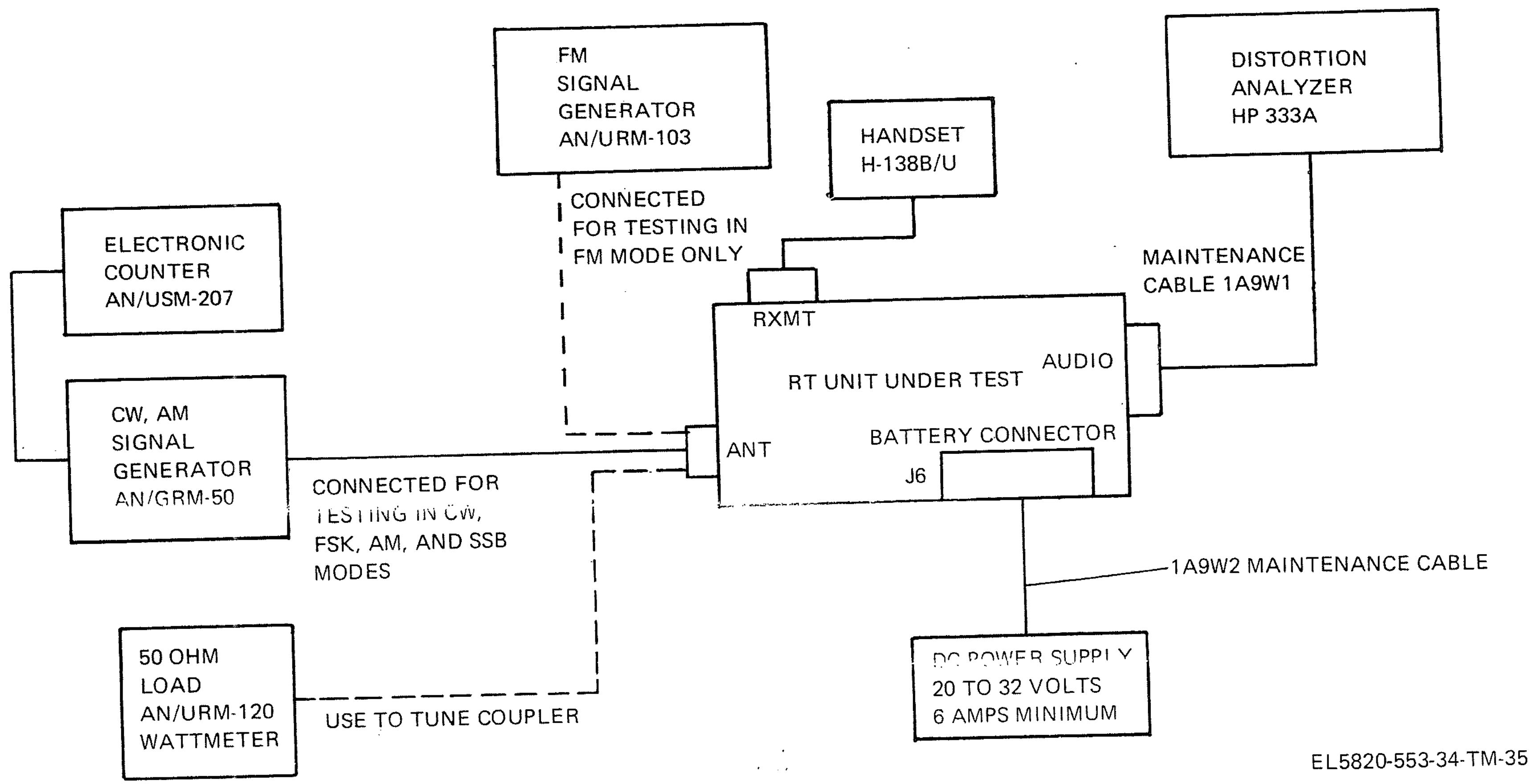



Figure 3-4. Receiver sensitivity, AGC, and squelch test setup

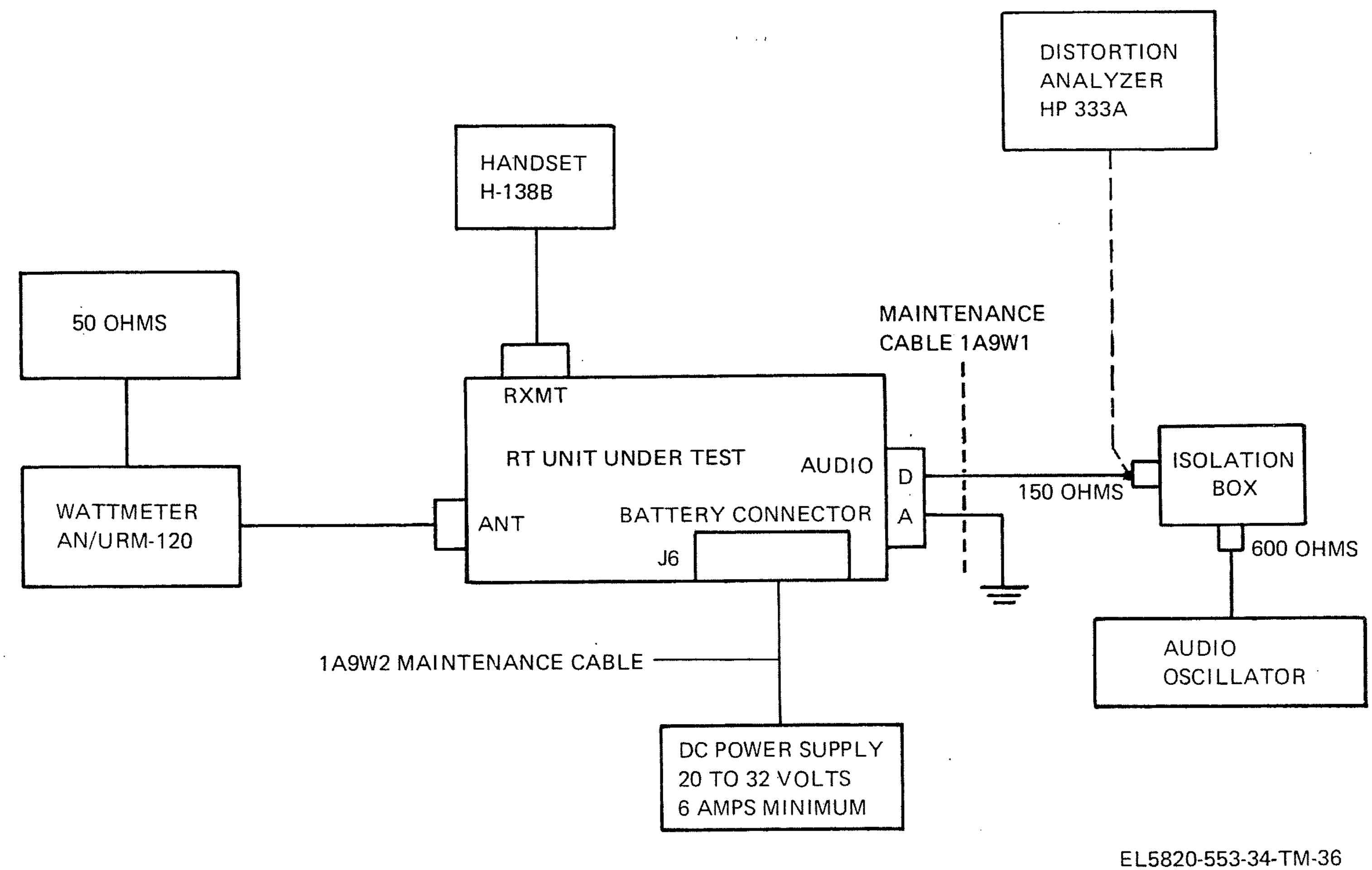



Figure 3-5. Transmitter power output test setup

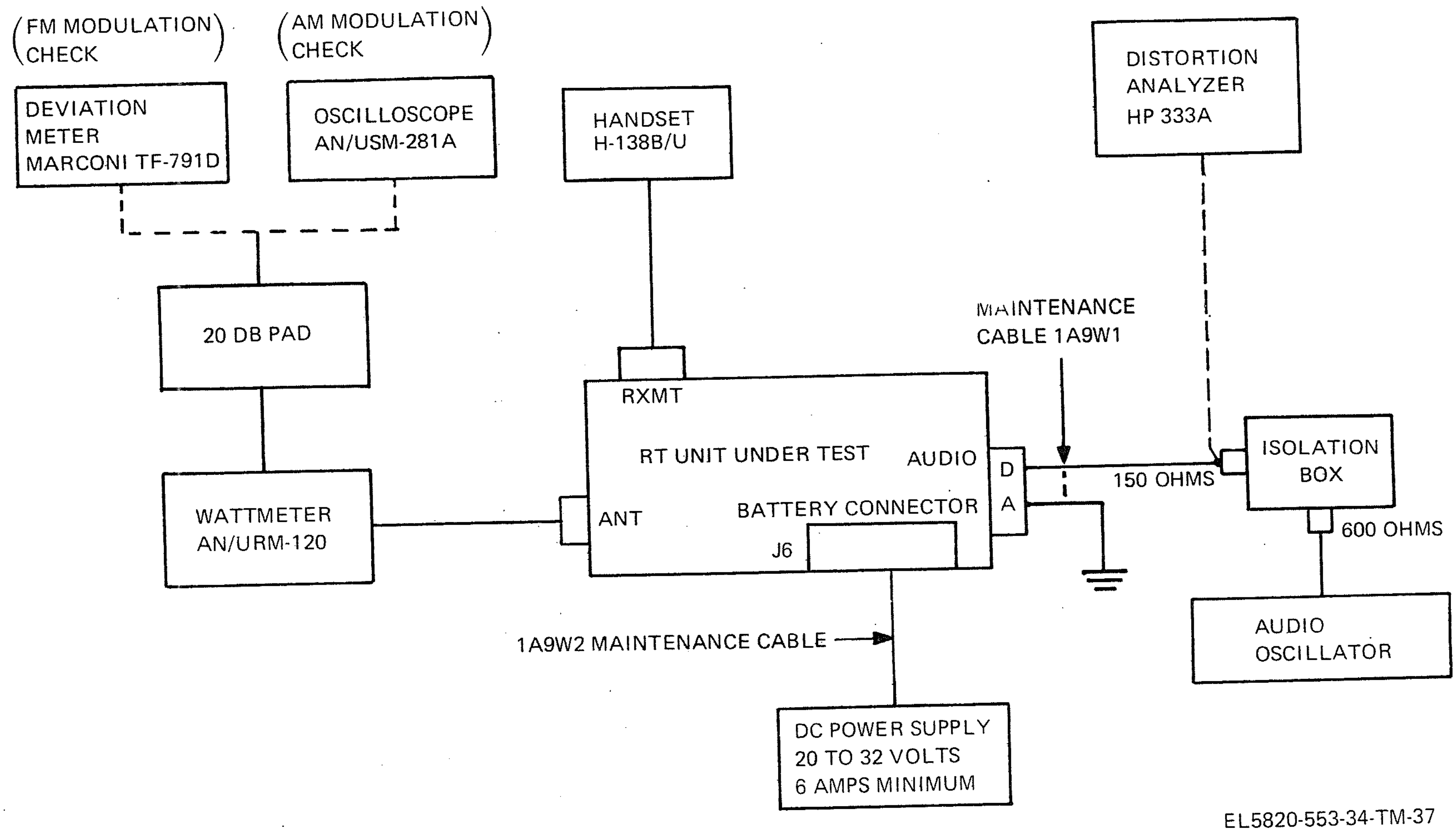



Figure 3-6. Transmitter power output modulation test setup

(a) Check that POWER and SQUELCH switches are set to OFF.

(b) Inspect the RT unit for external defects or damage. This can be done at the organizational maintenance level (refer to TM 11-5820-553-12).

(c) Remove the top cover and verify that the plug-in modules are properly seated and inspect for any loose or broken wires.

(d) Connect equipment as shown on Figure 3-4.

(e) Set VOLUME control to mid range.

(f) Set Distortion Analyzer Meter Range switch to 3 VOLTS.

(2) AM mode.

(a) Set MODE switch to AM.

(b) Set FREQUENCY MHz controls for a frequency between 2 and 34 MHz. Use setting for all modes.

(c) Set POWER switch to RCV ONLY, then momentarily to TUNE, and release to HI PWR.

NOTE

The RCV ONLY position of POWER switch causes the antenna coupler to home. The momentary TUNE position setting causes the coupler to fine tune. A no-tune alarm will be audible in handset/headset if the coupler does not tune or if the VSWR exceeds desirable limits.

(d) Set the Signal Generator for 30 percent AM signal at 1 kHz modulation for the frequency selected. Monitor the signal with the Electronic Counter.

(e) Set the signal level for 2.5 microvolts for frequencies below 20 MHz and to 1.9 microvolts for frequencies above 20 MHz.

(f) Adjust the VOLUME control for an audio output of 1.5 volts.

(g) Adjust the Distortion Analyzer SET LEVEL control for a zero reference. Null out the 1 kHz signal and the Distortion Analyzer meter will indicate 10 dB minimum SINAD.

(3) SSB mode.

(a) Set MODE switch to SSB.

(b) Set POWER switch to RCV ONLY, then momentarily to TUNE, and release to HI PWR.

(c) Set the Signal Generator for an RF input signal 1 kHz above the RT unit frequency. Monitor the signal on the Electronic Counter.

(d) Set the signal input level to 0.375 microvolts for frequencies above 20 MHz and to 0.5 microvolts for frequencies below 20 MHz.

(e) Adjust the VOLUME control for an audio output of 1.5 volts.

(f) Adjust the Distortion Analyzer SET LEVEL control for a zero reference. Null out the 1 kHz signal and the Distortion Analyzer meter shall indicate 10 dB minimum SINAD.

(4) FSK mode.

(a) Set MODE switch to FSK.

(b) Repeat steps (3)(b) through (f) above.

(5) CW mode.

(a) Set MODE switch to CW.

(b) Repeat steps (3)(b) through (f) above.

(6) FM mode.

(a) Set FREQUENCY MHZ controls for a frequency between 35 and 65 MHz.

(b) Connect FM Signal Generator as shown on figure 3-4.

(c) Set MODE switch to FM.

(d) Set POWER switch to RCV ONLY, then momentarily to TUNE, and release to HI PWR.

(e) Set VOLUME control to mid range.

(f) Set FM Signal Generator for 8 kHz deviation, 1 kHz rate signal at the RT unit frequency. Set the input level to 0.6 microvolts.

(g) Adjust VOLUME control for an audio output of 1.5 volts.

(h) Adjust Distortion Analyzer SET LEVEL control for a zero reference. Null out the 1 kHz signal and the Distortion Analyzer meter will indicate 10 dB minimum SINAD.

b. Receiver AGC and Squelch Test

(1) AGC test.

(a) Connect test equipment as shown in figure 3-4.

(b) Set MODE switch to SSB.

(c) Set FREQUENCY MHZ controls for a frequency between 2 and 65 MHz.

(d) Set POWER switch to RCV ONLY, then momentarily to TUNE, and release to HI PWR.

(e) Set Signal Generator for an RF input signal at 1 kHz above the RT unit frequency. Monitor frequency on Electronic Counter.

(f) Set signal input level to 1.0 millivolt.

(g) Adjust VOLUME control for an audio output of 1.5 volts.

(h) Reduce the RF input signal level to 100 microvolts. The Distortion Analyzer meter shall indicate an audio output level minimum of 0.75 volts.

(i) Increase the RF input signal level to 300 millivolts. The audio output shall not exceed 2.24 volts.

(2) Squelch test.

(a) Adjust Signal Generator for a frequency of 3.0004 MHz and an output level of 1 millivolt.

(b) Adjust VOLUME control on RT unit for a level of 1.5 volts audio output to the Distortion Analyzer meter.

(c) Set SQUELCH switch to ON and observe that the meter readout remains.

(d) Set SQUELCH switch to OFF and reset Signal Generator for 3.0020 MHz.

(e) Adjust RT unit VOLUME control for a level of 1.5 volts audio output to Distortion Analyzer meter.

(f) Set SQUELCH switch to ON and observe that the meter reading does not remain.

c. Transmitter Power Output

(1) Preliminary setup.

(a) Set POWER and SQUELCH switches on RT unit to OFF.

(b) Connect equipment as shown in figure 3-5.

(2) CW, FSK, AM, and SSB mode, HI PWR and LO PWR.

(a) Set radio set MODE switch to AM.

(b) Set FREQUENCY MHZ switches on RT unit for a frequency between 2 and 65 MHz.

(c) Set RT unit POWER switch to RCV ONLY and then momentarily to TUNE. Allow 10 seconds to elapse for the set to complete tuning before proceeding. The POWER switch should now be in HI PWR position.

(d) Set the Audio Oscillator for a 3 millivolt input signal (as measured on the Distortion Analyzer) at a frequency of 1 kHz.

(e) Key the transmitter with the press-to-talk switch on the handset. Verify that the wattmeter indicates the value specified in table 3-23 for the frequency and mode selected for HI PWR.

(f) Repeat steps (b) through (e) for FSK, CW, and SSB MODE switch positions.

(g) Repeat steps (a) through (f) with the POWER switch in LO PWR position.

(3) AM carrier only HI PWR and LO PWR.

(a) Disconnect Audio Oscillator from RT unit.

(b) Repeat steps (2)(a) through (2)(c) and step (2)(e) with the POWER switch in HI PWR position.

Table 3-23. Transmitter Power Output Levels

| Mode | Frequency range | | | | | |
|---|---|---|---|---|---|---|
| | 2 to 50 MHz | | 51 to 76 MHz | | 30 to 50 MHz | |
| | Lo pwr | Hi pwr | Lo pwr | Hi pwr | Lo pwr | Hi pwr |
| CW, FSK, AM, SSB | greater than 1 watt (1.9 to 4.74 w) (9.74 to 15.39 $\mu$V) | greater than 26 watts (31.2 to 38.6 w) (34.51 to 43.45 $\mu$V) | greater than 0.5 watt (1.26 to 4.74 w) (7.95 to 15.39 $\mu$V) | greater than 12 watts (15.9 to 38.6 w) (28.17 to 43.45 $\mu$V) | | |
| FM | | | greater than 0.5 watt (1.9 to 4.74 w) (9.74 to 15.39 $\mu$V) | greater than 12 watts (31.2 to 38.6 w) (34.51 to 43.45 $\mu$V) | greater than 1 watt (1.26 to 4.74 w) (7.95 to 15.39 $\mu$V) | greater than 26 watts (15.9 to 38.64 w) (28.17 to 43.45 $\mu$V) |

Table 3-23. Transmitter Power Output Levels - Continued

| Mode | Frequency range | | | | | |
|---|---|---|---|---|---|---|
| | 2 to 50 MHz | | 51 to 76 MHz | | 30 to 50 MHz | |
| | Lo pwr | Hi pwr | Lo pwr | Hi pwr | Lo pwr | Hi pwr |
| AM Carrier Only | greater than 0.25 watt (0.47 to 1.18 w) (4.87 to 7.697 $\mu$V) | greater than 7 watts (9.44 to 5.95 w) (21.73 to 17.25 $\mu$V) | greater than 0.20 watt (0.32 to 1.18 w) (3.97 to 7.697 $\mu$V) | greater than 7 watts (9.44 to 3.96 w) (21.73 to 14.08 $\mu$V) | | |

(c) Repeat steps (2)(a) through (2)(c) and step (2)(e) with the POWER switch in LO PWR position.

(4) FM mode power out

(a) Reconnect the Audio Oscillator to the RT unit as shown in figure 3-5.

(b) Set RT unit MODE switch to FM.

(c) Set FREQUENCY MHZ switches on the RT unit for a frequency between 30 and 65 MHz.

(d) Set the POWER switch to RCV ONLY and then momentarily to TUNE. Allow 10 seconds to elapse for the set to complete tuning before proceeding. POWER switch is now in HI PWR position.

(e) Set the Audio Oscillator for a 3 millivolt input signal (as measured on the Distortion Analyzer) at a frequency of 1 kHz.

(f) Key the transmitter with the press-to-talk switch on the handset. Verify that the wattmeter indicates the value specified in table 3-23 for the FM frequency selected for HI PWR.

(g) Set the POWER switch to LO PWR and repeat step (f) for LOW PWR reading.

d. <u>AM Modulation Check.</u>

(1) Connect the equipment as shown in figure 3-6.

(2) Set radio set MODE switch to AM.

(3) Set FREQUENCY MHZ switches on RT unit for a frequency of 6 MHz.

(4) Set RT unit POWER switch to RCV ONLY and then momentarily to TUNE. Allow 10 seconds to elapse for the set to complete tuning before proceeding. Set the POWER switch to LO PWR.

(5) Set the Audio Oscillator for a 3 millivolt input signal (as measured on the Distortion Analyzer) at a frequency of 1 kHz.

(6) Key the transmitter with the press-to-talk switch on the handset.

(7) Monitor the RF output on the Oscilloscope. Observe the RF envelope. It should be modulated greater than 50 percent.

e. <u>FM Modulation Check.</u>

(1) Connect equipment as shown in figure 3-6.

(2) Set radio set MODE switch to FM and FREQUENCY MHZ control to 35.0000.

(3) Repeat steps (4) through (6) of paragraph 3-11d.

(4) Monitor the FM deviation on the deviation meter for a reading of plus or minus 8 to 10 kHz.

f. Retransmit Test.

(1) Connect equipment as shown in figure 3-7(A).

(2) Set the following switches and controls to the position indicated.

| Switch/Control | Position |
|---|---|
| MODE | SSB |
| POWER | RCV ONLY |
| SQUELCH | RXMT |
| FREQUENCY MHZ | 03.0000 |
| VOLUME | Mid-range |

(3) Set RF Signal Generator to 3.001 MHz, unmodulated, at a level of 1.0 millivolt.

(4) Monitor J3-B, RXMT connector, for an audio output level of 5 to 10 millivolts on the voltmeter function of the Distortion Analyzer.

(5) Turn POWER switch to OFF and connect equipment as shown in figure 3-7(B).

(6) Turn POWER switch to ON.

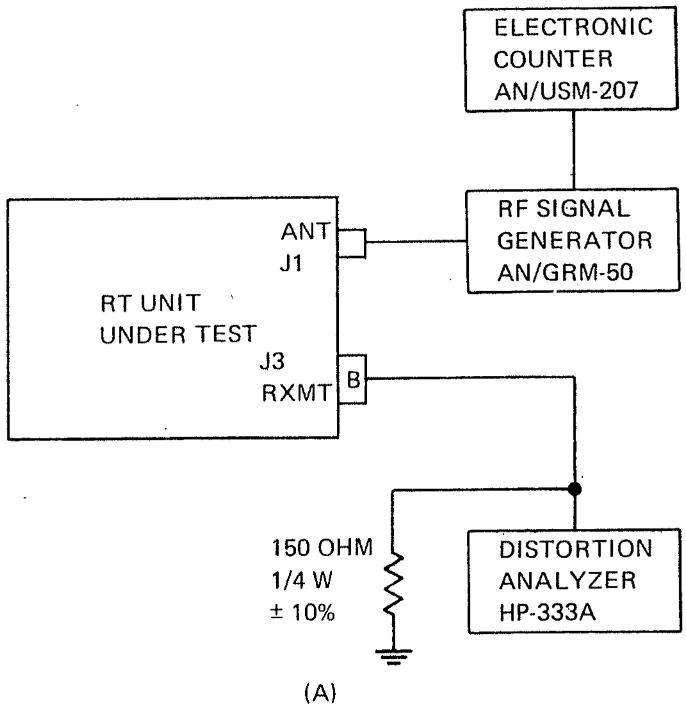
(7) Set RF Signal Generator to 3.001 MHz, unmodulated, at a level of 1.0 millivolt.

(8) With multimeter connected as shown, set OHMS to R × 1 scale, and monitor for a reading less than 50 ohms.

(9) Remove Signal Generator input to the RT unit and observe a reading, on the R × 100 scale, greater than 10,000 ohms.

3-12. Module Tests

The following paragraphs describe the procedures required to isolate a faulty module when directed by Fault Isolation Tables 3-2 through 3-22. Since the receiver-transmitter is tested as a unit, all module tests are performed by probing the test points located on top of the modules or by probing the proper parent board terminal on the bottom of the RT unit. Connector and cable part numbers are indicated in the procedures and/or the test diagrams whenever they might be helpful in assembling the various test setups. Plug terminal and jack locations on the parent boards are shown on figures FO-4 and FO-5. Operating controls referenced in the test procedures are shown on figure 3-2. Instructions for fabricating the test cables are provided in figure 3-8. The instructions provided in Section IV for removing and reinstalling modules shall be carefully followed.



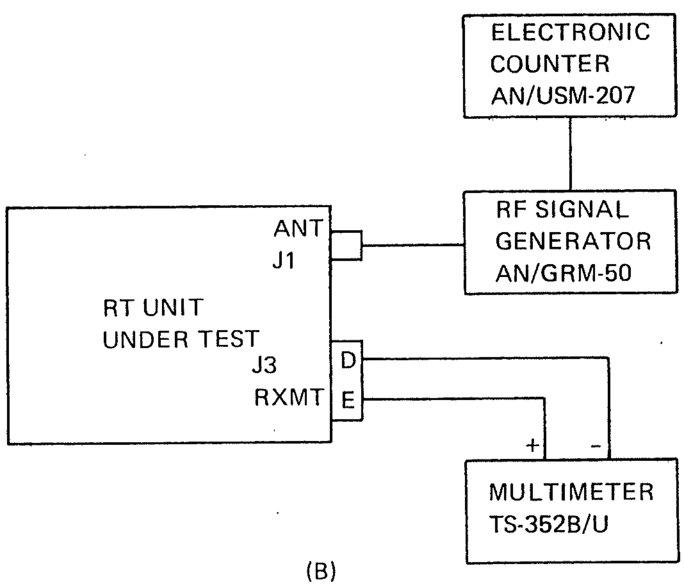




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Figure 3-7. Retransmit test setup

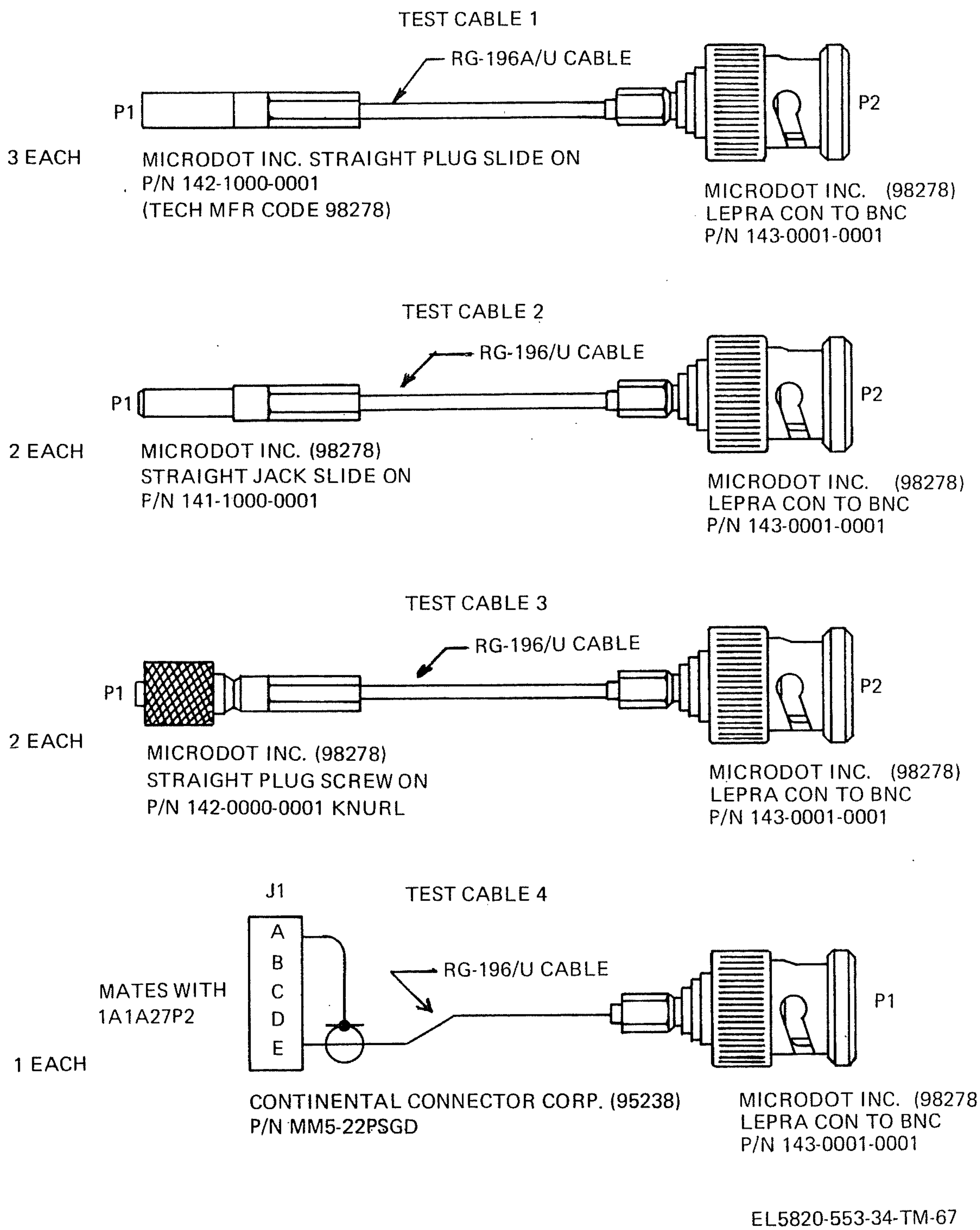


Figure 3-8. Test cable fabrication

CAUTION

When transmitter tests are performed a dummy load of 50 ohms (50 watts) or equivalent must be connected to the ANT connector on the RT unit.

a. Frequency Selector Module Isolation Test (1A1A1). The Frequency Selector module consists of FREQUENCY MHZ selection switches, POWER, MODE and SQUELCH switches and a VOLUME control. These switches and controls may be fault isolated through the use of a multimeter to determine proper resistance and continuity checks. Figure FO-3 is a schematic diagram of the module and will aid in determining the condition of the module. Replacement of the module with a known good module will confirm troubleshooting analysis. Removal and installation of the module are part of general support maintenance (refer to Chapter 4).

b. Power Supply, Flyback Regulator Module Isolation Test (1A1A2).

(1) Set up test equipment as shown in figure 3-9.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

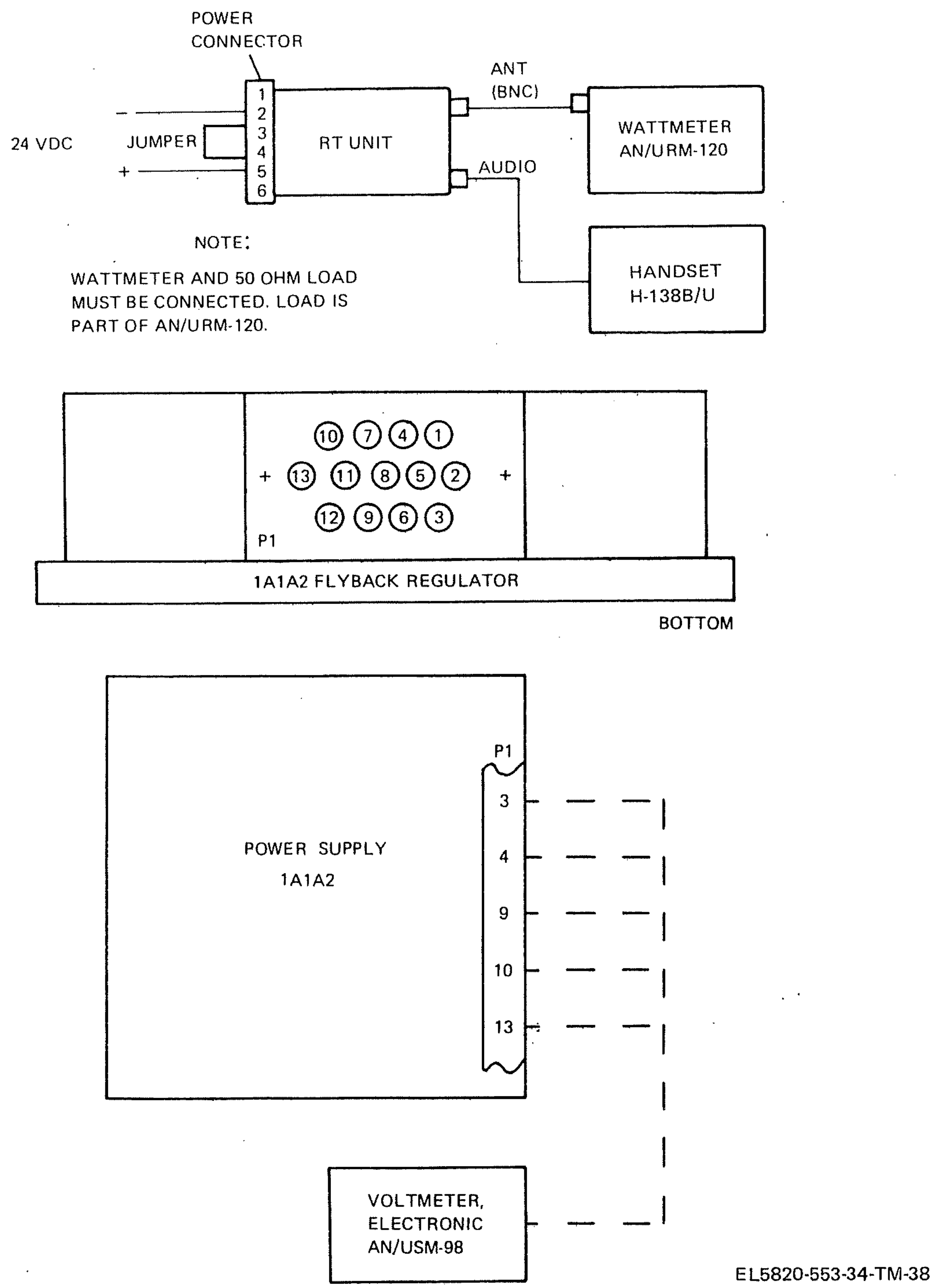


Figure 3-9. Power supply, flyback regulator (1A1A2) test setup

(3) Using the electronic voltmeter, monitor the pins shown on figure 3-9 and observe the following limits. Figure FO-4 shows the location of the module.

| Test Point | Limits |
|---|---|
| P1-3 | +24 Vdc ±5% |
| P1-4 | +38 Vdc ±5% |
| P1-9 | + 5 Vdc ±5% |
| P1-10 | - 5 Vdc ±5% |
| P1-13 | + 5 Vdc ±5% |

c. Power Supply, Trigger and 30-Volt Regulator Module Isolation Test (1A1A3).

(1) Set up test equipment as shown in figure 3-10.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

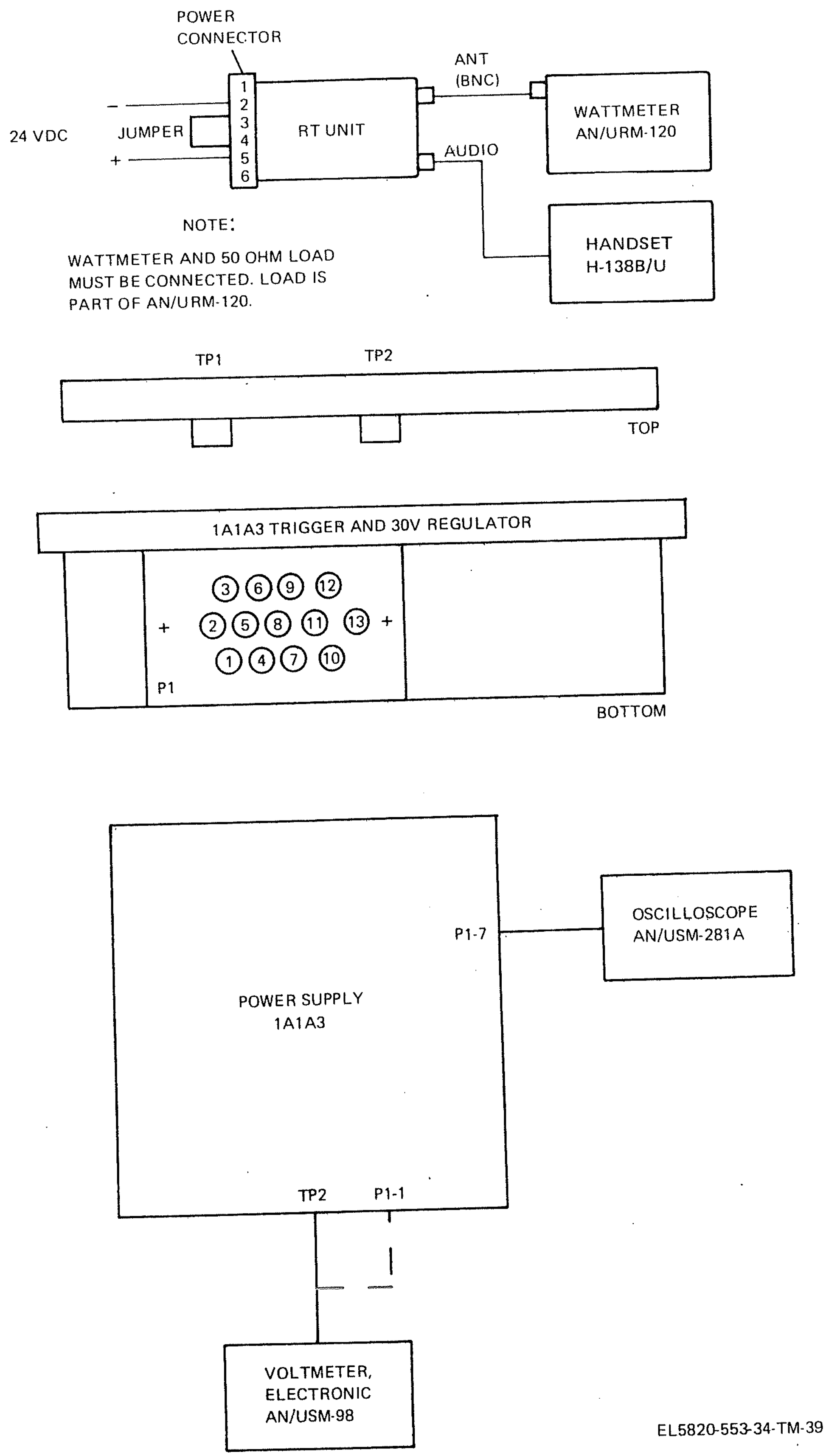


Figure 3-10. Power supply, trigger and 30-volt regulator (1A1A3), test setup

(3) Using the electronic voltmeter, monitor terminal P1-1 (see figure 3-10) and observe the following limit: +30 Vdc ±0.5%. Figure FO-4 shows location of the module.

(4) Using the oscilloscope monitor P1-7 to ground. Observe a 24 volt, 5 ± 2 microsecond pulse at 70 ± 10 microsecond repetition rate.

d. <u>Power Supply, 10-Volt Regulator Module Isolation Test (1A1A4).</u>

(1) Set up test equipment as shown in figure 3-11.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

(3) Using the electronic voltmeter, monitor the test points or terminals shown on figure 3-11 and observe the following limits.

| Test Point | Limits |
|---|---|
| TP-1 | + 5 Vdc ± 5% |
| TP-2 | +10 Vdc ± 5% |

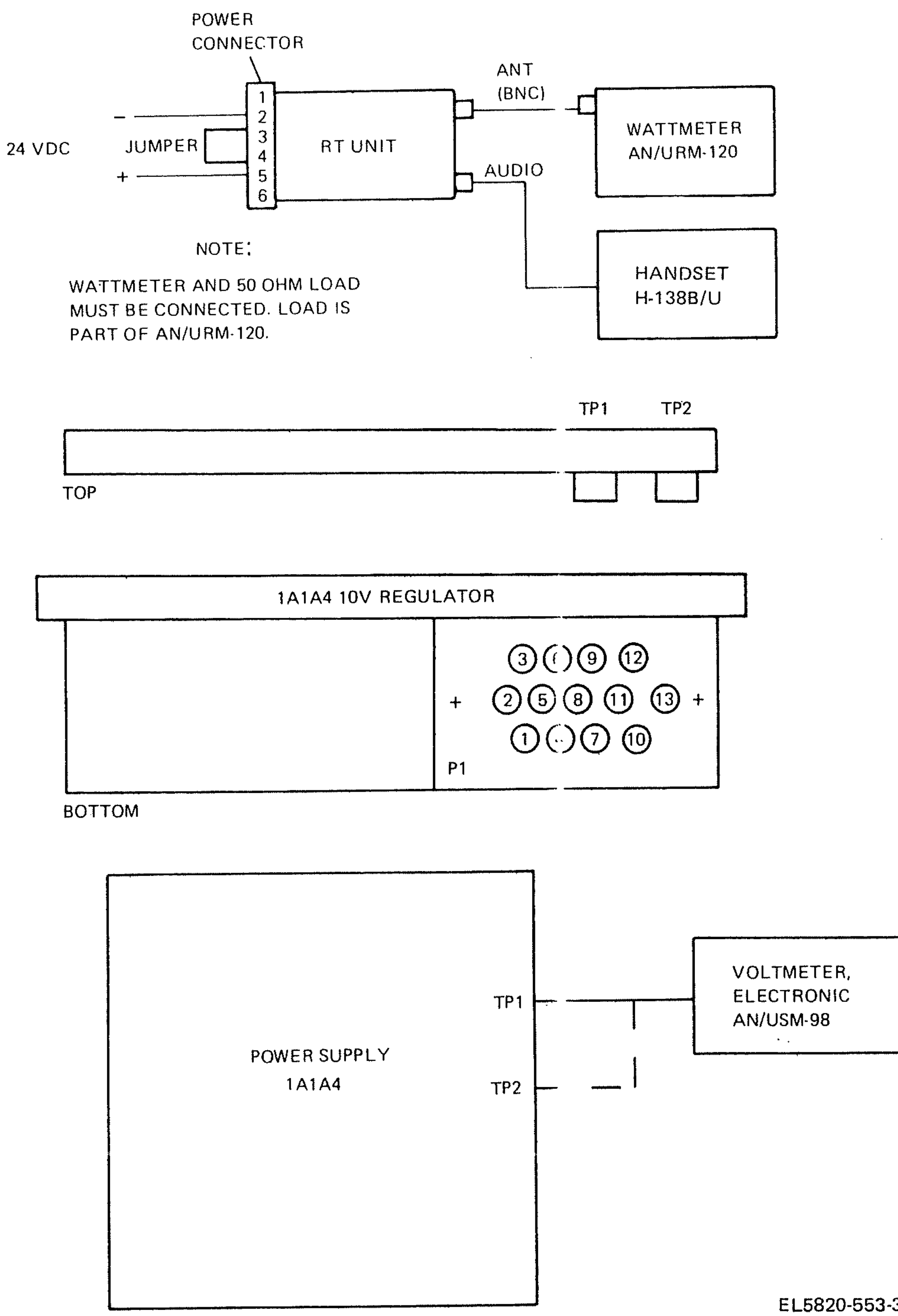


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Figure 3-11. Power supply, 10-volt regulator (1A1A4), test setup

e. Power Supply, 5-Volt Regulator Module Isolation Test (1A1A5).

(1) Set up test equipment as shown on figure 3-12.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

(3) Using the electronic voltmeter, monitor the test points shown on figure 3-12 and observe the following limits.

| Test Point | Limits |
|---|---|
| TP-1 | + 5 Vdc ± 5% |
| TP-2 | - 5 Vdc ± 5% |

f. Translator Module Isolation Test (1A1A6).

(1) Set up test equipment as shown in figure 3-13.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 10 MHz |
| POWER | RCV ONLY |

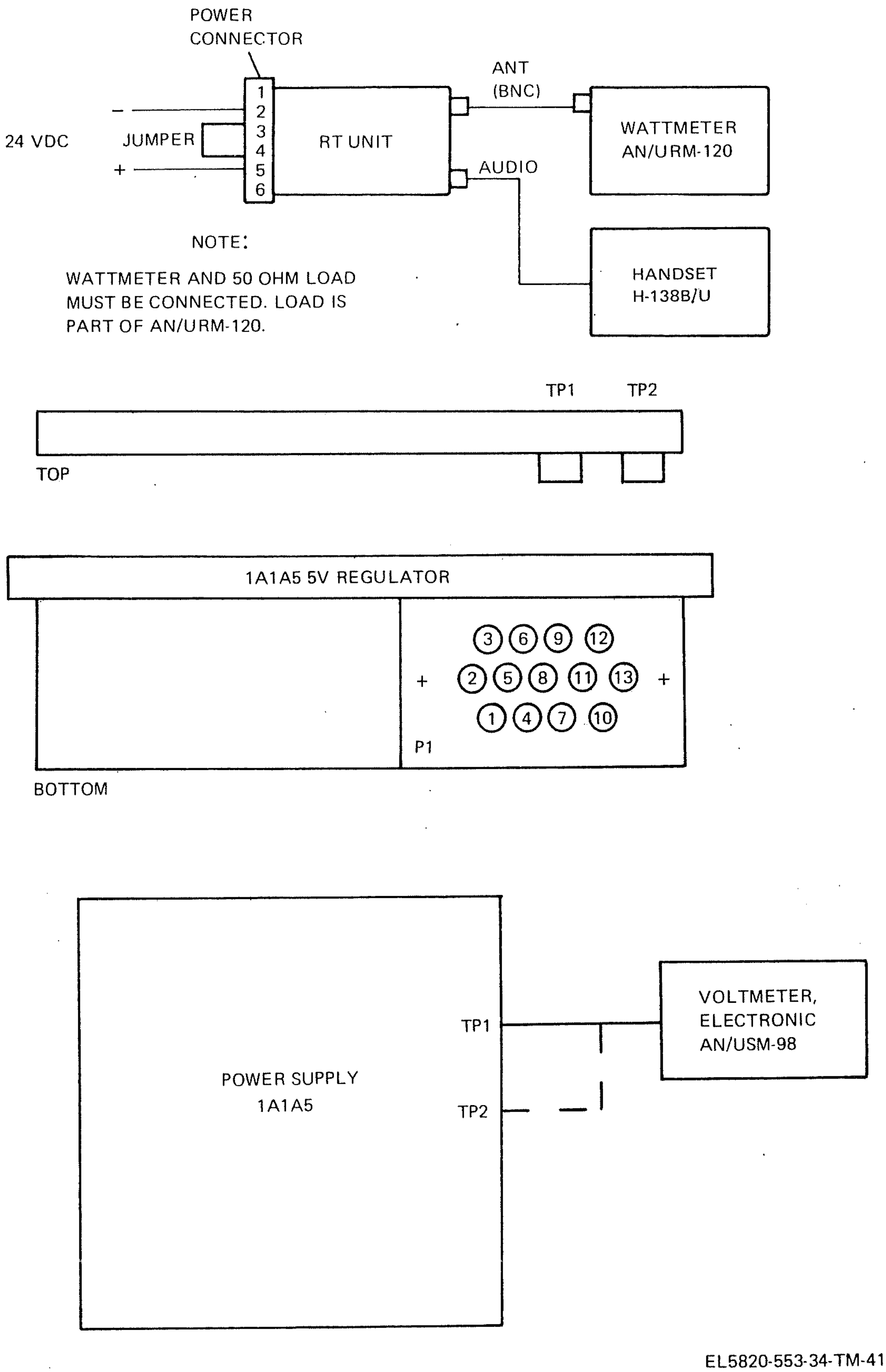


Figure 3-12. Power supply, 5-volt regulator (1A1A5), test setup

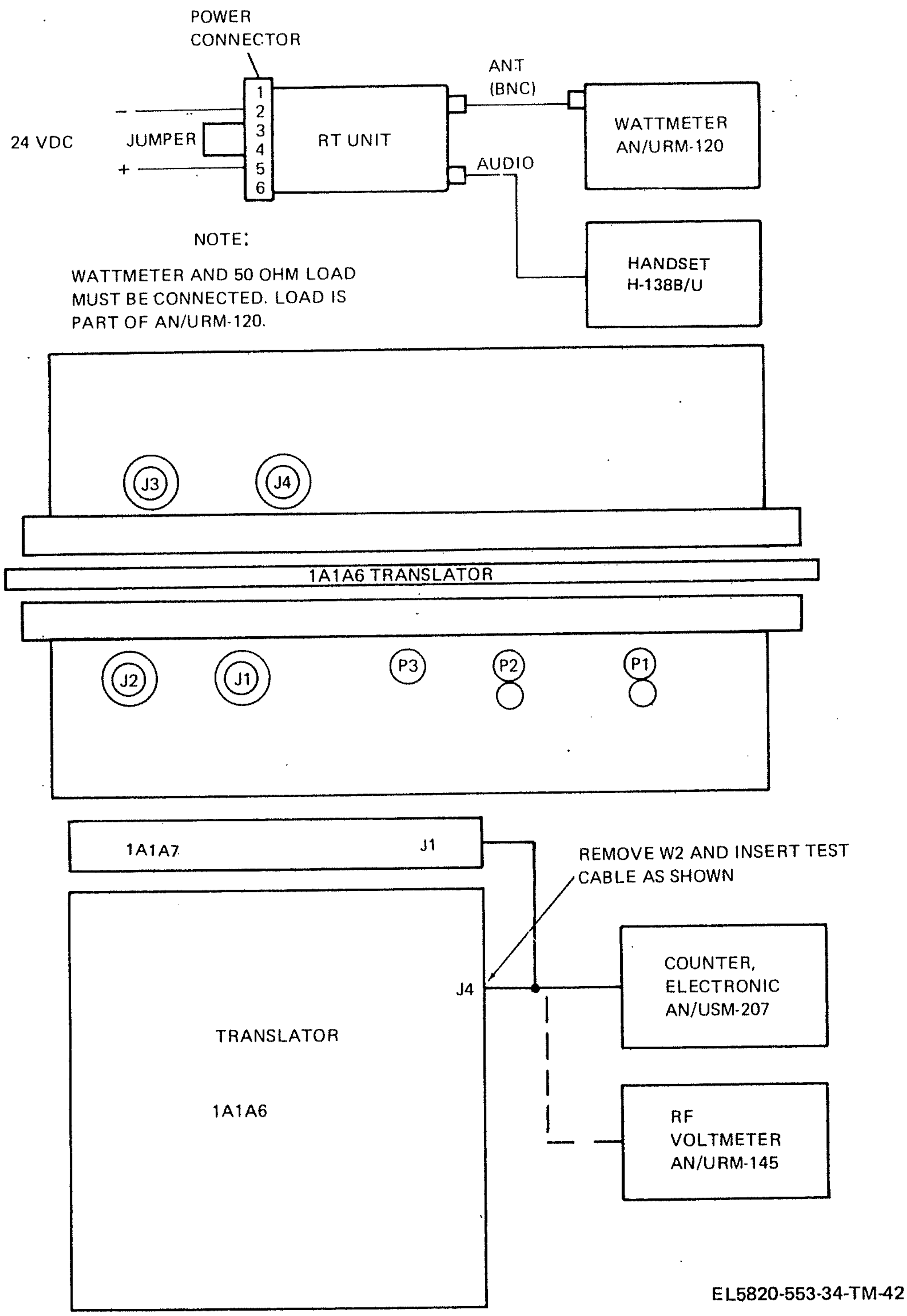


Figure 3-13. Translator (1A1A6) test setup

(3) Using the electronic counter, monitor at J4 as shown on figure 3-13 for a frequency reading of 6.7 MHz ± 100 Hz above the frequency selected.

(4) Using the electronic voltmeter, monitor at J4 for a level greater than 32 millivolts.

(5) Reconnect cable 1A1A31W2 to 1A1A6J4.

g. Upper Loop Divider Module Isolation Test (1A1A7).

(1) Set up test equipment as shown in figure 3-14.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

(3) Using the oscilloscope monitor 1A1A7P1 (see figure 3-14) for a +3 Vdc ± 1 V pulse at a 10 microsecond repetition rate.

(4) Using the oscilloscope monitor pin 1A1A7P3-V for a 10 Vdc ± 5% level at a 10 microsecond repetition rate.

h. Upper Loop Phase Detector Module Isolation Test (1A1A8).

(1) Set up test equipment as shown in figure 3-15.

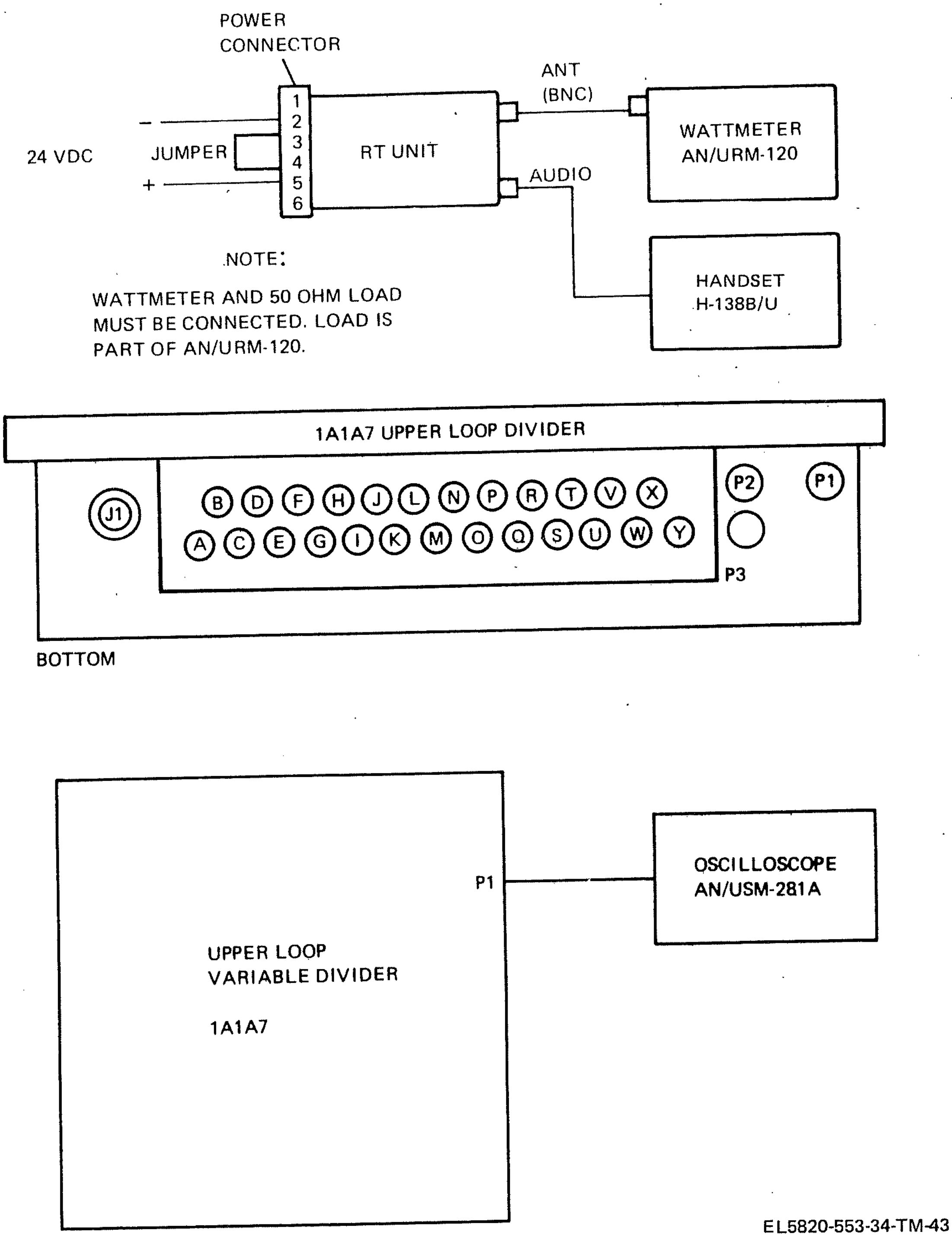


Figure 3-14. Upper loop divider (1A1A7), test setup

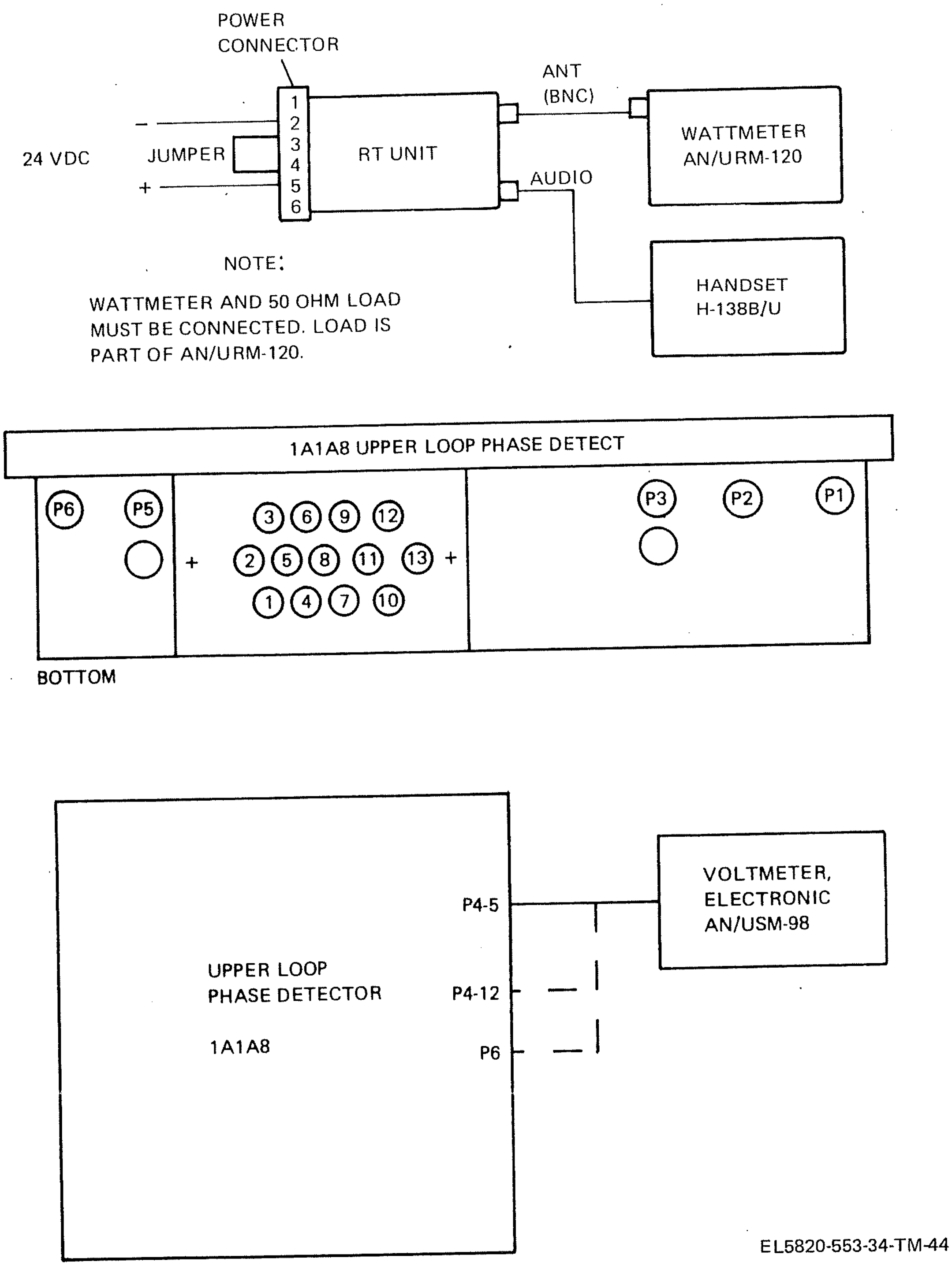


Figure 3-15. Upper loop phase detector (1A1A8), test setup

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 2 to 76 MHz |
| POWER | RCV ONLY |

(3) Using the electronic voltmeter, monitor 1A1A8P4 pin 5 (see figure 3-15) for a voltage level of +5 ± 0.5 Vdc.

(4) While monitoring the voltage in step (3) set the FREQUENCY MHZ controls to 35.0000 and observe that the voltage drops momentarily while the bandswitch is changing, indicating an Out-of-Lock condition.

(5) Using the electronic voltmeter, monitor 1A1A8P6 and observe a voltage level of 4 to 18 Vdc. Note this reading.

(6) Set the FREQUENCY MHZ controls to 34.0000 and observe the voltage at P6 varies and returns to approximately the same voltage as step (5).

(7) Using the electronic voltmeter monitor 1A1A8P4-12 and observe a voltage level of 8 to 18 Vdc. Note this reading.

(8) Rotate the FREQUENCY MHZ controls from 34.0000 to 02.0000 by selecting 34.0000, 24.0000, 14.0000, 04.0000 and 02.0000 and observe that the voltage of step (7) decreases as each frequency selection is made. Set the FREQUENCY MHZ controls to 35.0000 and rotate the controls from 35.0000 to 75.0000 in 10 MHz steps and note that the voltage increases as each frequency selection is made.

i. Lower Loop Module Isolation Test (1A1A9).

(1) Set up test equipment as shown in figure 3-16.

(2) Set the following switches to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQELCH | OFF |
| FREQUENCY MHZ | 30.0000 |
| POWER | RCV ONLY |

(3) Using the electronic counter, monitor at 1A1A9J1, figure 3-16 and observe a frequency reading of 4.7550 MHz ± 100 Hz.

NOTE

The last 3 digits of the frequency selected on the FREQUENCY MHZ switches must be 000 to obtain a reading of 4.7550 MHz.

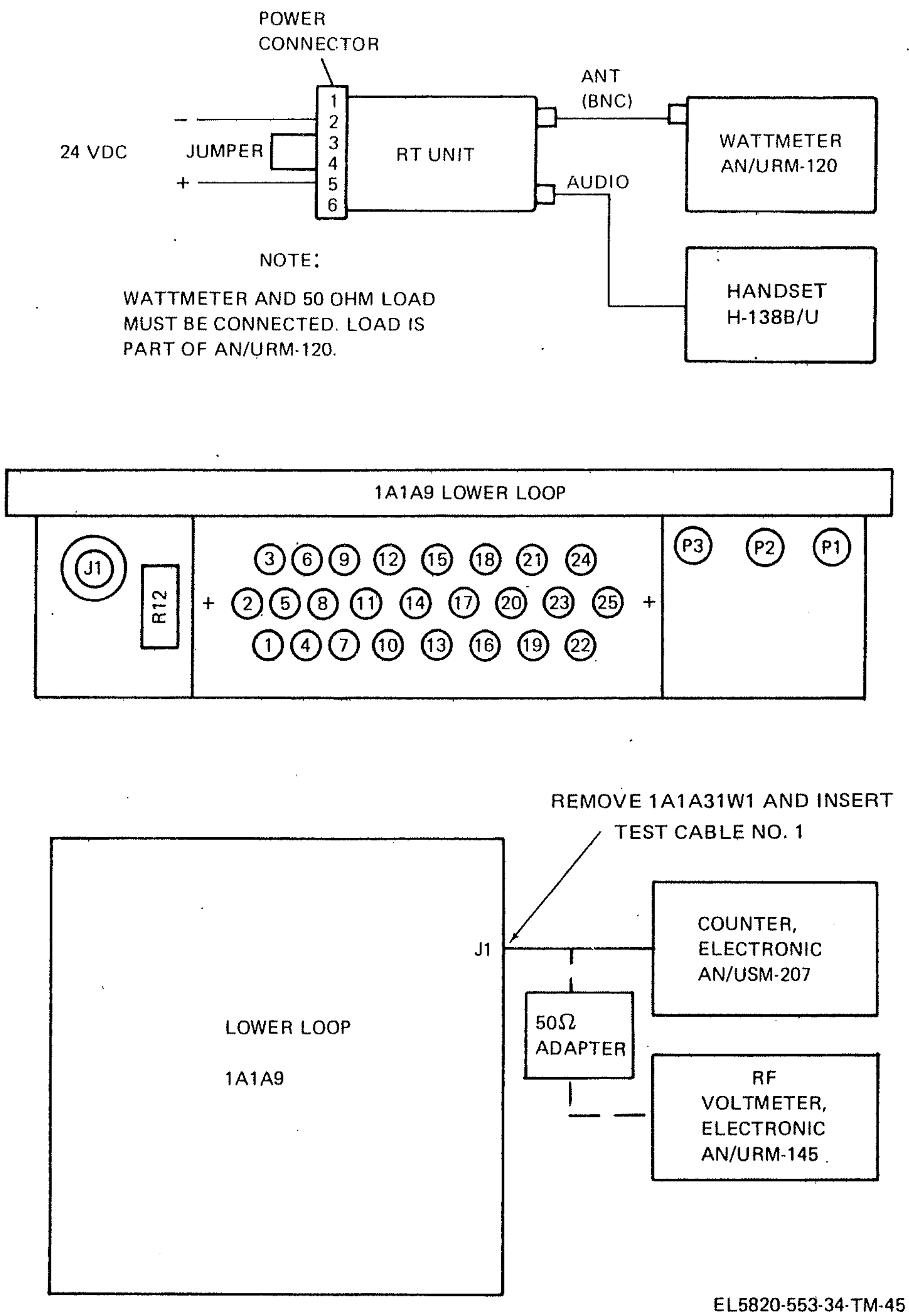


Figure 3-16. Lower loop (1A1A9), test setup

(4) Set the FREQUENCY MHZ controls to the following settings and observe the indicated frequency readings.

| Settings | Frequency Readings (±100 Hz) |
|---|---|
| 30.0001 | 4.7551 |
| 30.0002 | 4.7552 |
| 30.0003 | 4.7553 |
| 30.0004 | 4.7554 |
| 30.0005 | 4.7555 |
| 30.0006 | 4.7556 |
| 30.0007 | 4.7557 |
| 30.0008 | 4.7558 |
| 30.0009 | 4.7559 |
| 30.0010 | 4.7560 |
| 30.0020 | 4.7570 |
| 30.0030 | 4.7580 |
| 30.0040 | 4.7590 |
| 30.0050 | 4.7600 |
| 30.0060 | 4.7610 |
| 30.0070 | 4.7620 |
| 30.0080 | 4.7630 |

| Settings | Frequency Reading (±100 Hz) |
|---|---|
| 30.0090 | 4.7640 |
| 30.0100 | 4.7650 |
| 30.0200 | 4.7750 |
| 30.0300 | 4.7850 |
| 30.0400 | 4.7950 |
| 30.0500 | 4.8050 |
| 30.0600 | 4.8150 |
| 30.0700 | 4.8250 |
| 30.0800 | 4.8350 |
| 30.0900 | 4.8450 |

(5) Using the RF voltmeter with the 50 ohm adapter, monitor the voltage at 1A1A9J1, figure 3-16, and observe an output level of greater than 70 millivolts at the FREQUENCY MHZ control settings listed in steps (2) and (4).

(6) Reconnect cable 1A1A31W1 to 1A1A9J1.

j. Oscillator Distributor Module Isolation Test (1A1A10).

(1) Set up test equipment as shown in figure 3-17.

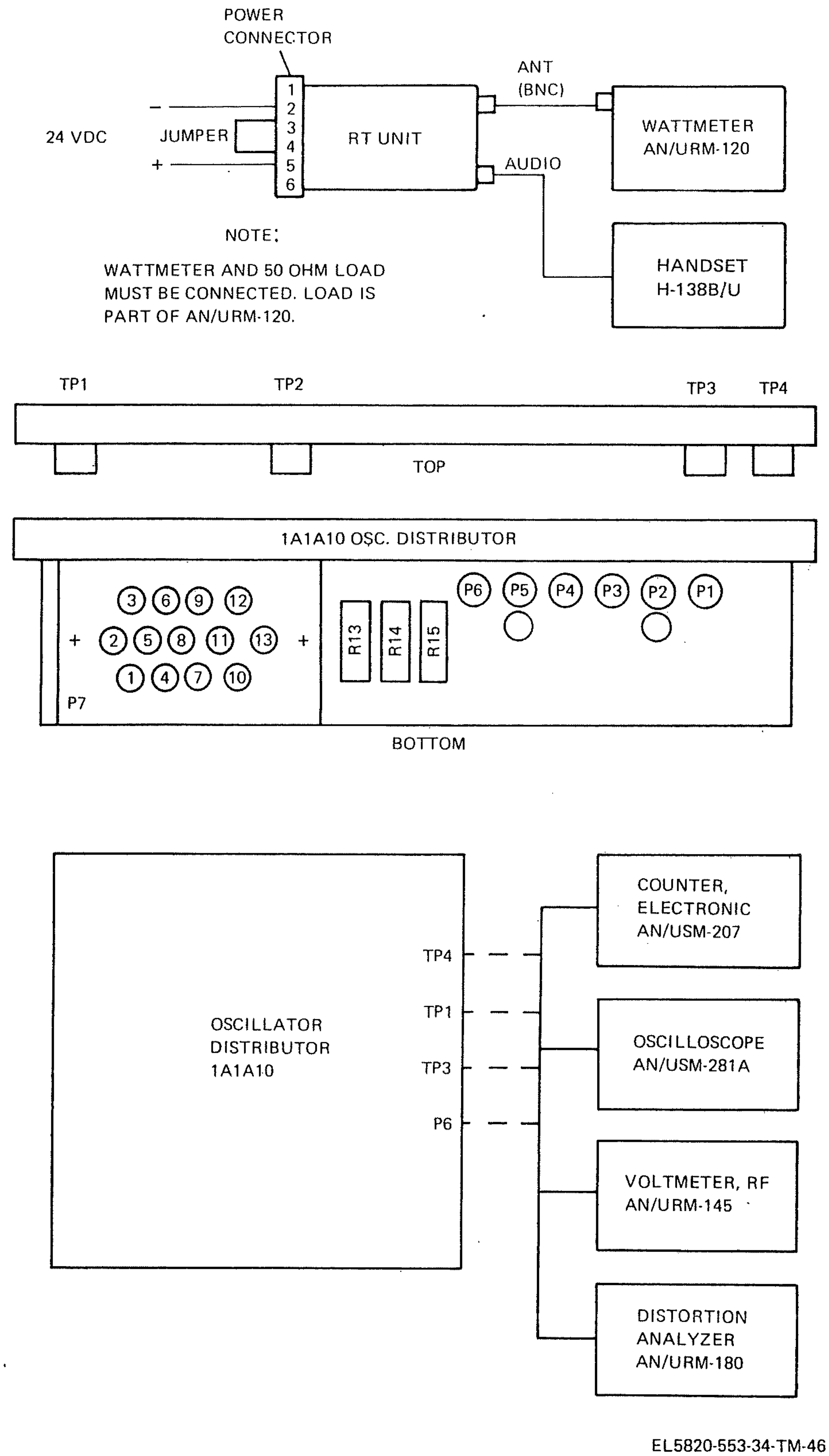


Figure 3-17. Oscillator-distributor (1A1A10), test setup

CAUTION

The POWER switch is spring loaded in the TUNE position and will automatically return to HI PWR position when released. DO NOT hold the POWER switch in the TUNE position for more than a few seconds. After release, select the POWER switch setting indicated by the test procedure.

(2) Set the following switches and controls to the position indicated.

| Switch | Position |
| --- | --- |
| MODE | CW |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 30.0000 |
| POWER | TUNE (momentarily) then LO PWR |

(3) Using the electronic counter monitor the following 1A1A10 test points and terminals, figure 3-17 and observe the frequencies indicated.

| TP and Term | Frequency |
| --- | --- |
| TP-1 | 455.000 kHz ± 25 Hz |
| P6 | 11.000 MHz ±25 kHz |

(4) Set MODE switch to FM and key the handset. Monitor TP-3 for a frequency of 150 Hz ± 25 Hz.

(5) Unkey the handset.

(6) Using the oscilloscope, monitor TP-4, figure 3-17, and observe the audio tone signals with the conditions stated in the following steps.

(7) Set MODE switch to CW, key the handset and observe a tone signal with a period of 500 ± 50 microseconds. Unkey the handset.

(8) Set the MODE switch to FSK, key the handset and observe a tone signal with a period of 630 ± 50 microseconds.

(9) As the handset is unkeyed a second tone is heard and observed with a period of 410 ± 50 microseconds.

NOTE

If the tone is not measured the first time, key the Handset and release again to obtain the second tone signal. Repeat as necessary to make the measurement.

(10) Using the RF voltmeter, monitor the following 1A1A10 test points and terminals, figure 3-17, and observe the voltage levels indicated.

| TP and Term | Level |
|---|---|
| TP-1 | Greater than 200 millivolts |
| P-6 | Greater than 100 millivolts |

(11) Set the MODE switch to FM, key the handset and monitor TP-3, figure 3-17, for a voltage level greater than 250 millivolts on the Distortion Analyzer. Unkey the handset.

(12) Set the MODE switch to CW, key the handset, and using the Distortion Analyzer, VOLTMETER function, monitor TP-4 for a voltage level greater than 20 millivolts. Unkey the handset.

(13) Set the MODE switch to FSK, key the handset and using the Distortion Analyzer, VOLTMETER function, monitor TP-4 for a voltage level greater than 20 millivolts.

(14) As the handset is unkeyed a second tone will be heard. Monitor this tone for a voltage level greater than 20 millivolts. Refer to the NOTE in step (9).

k. Oscillator-Digital Divider Isolation Test (1A1A11).

(1) Set up test equipment as shown in figure 3-18.

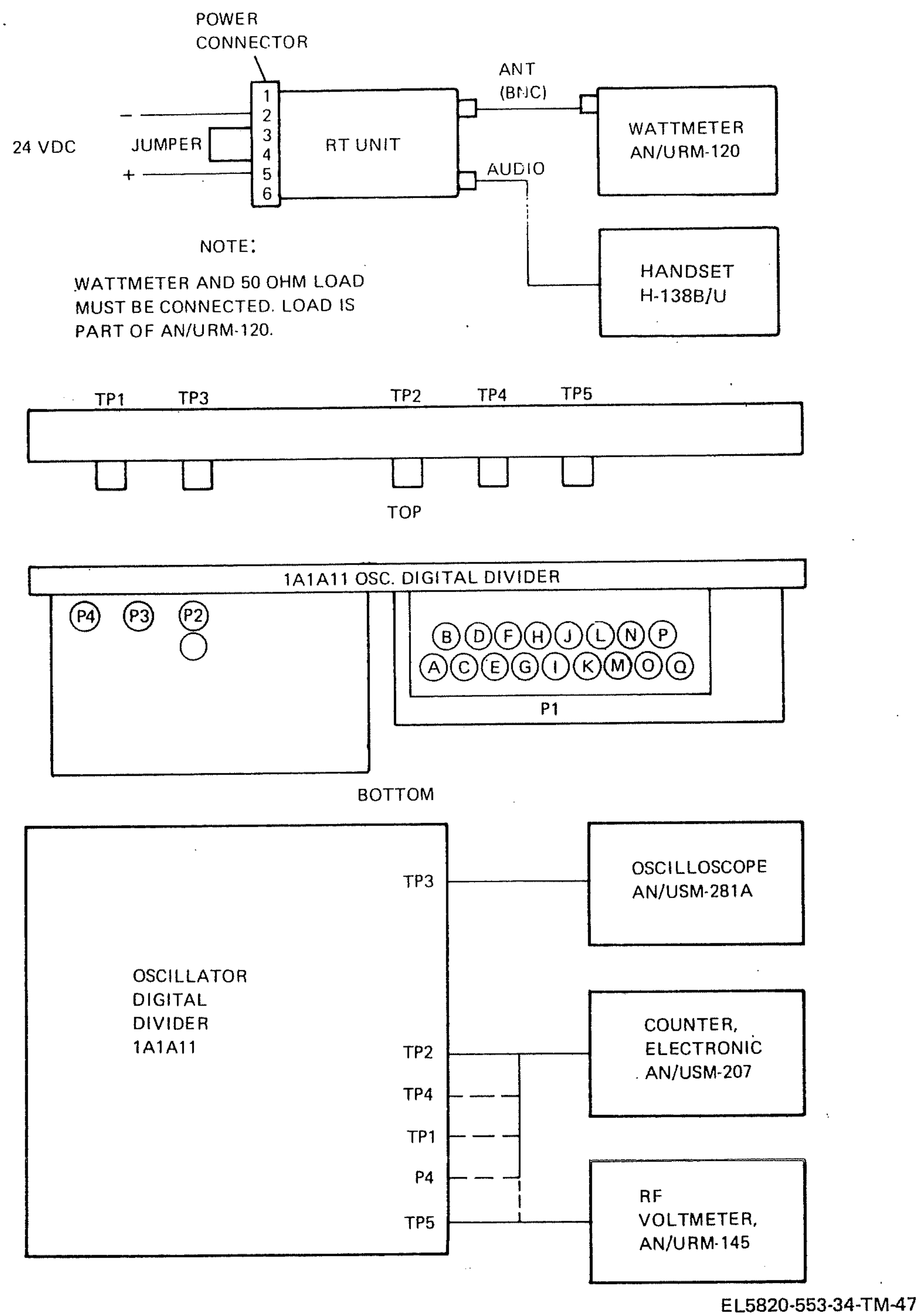


Figure 3-18. Oscillator digital divider (1A1A11), test setup

CAUTION

The POWER switch is spring loaded in the TUNE position and will automatically return to HI PWR position when released. DO NOT hold the POWER switch in the TUNE position for more than a few seconds. After release select the POWER switch setting indicated by the test procedure.

(2) Set the following switches and controls to the position indicated.

| Switch | Position |
|---|---|
| MODE | CW |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 30.0000 |
| POWER | TUNE (momentarily then LO PWR |

(3) Using the oscilloscope monitor the following 1A1A11 test point, figure 3-18, and observe the signal indicated.

| TP and Term | Pulse Width (microseconds) | Pulse Amplitude (volts) | Pulse Frequency (kHz) |
|---|---|---|---|
| TP-3 | 500 ± 10 | 10 ± 1 | 1 ± 0.1 |

(4) Using electronic counter, monitor the following 1A1A11 test points and terminal, figure 3-18, for the frequencies indicated.

| TP and Term | Reading |
|---|---|
| P-4 | 4.5 MHz ± 25 Hz |
| TP-1 | 455.0 kHz ± 25 Hz |
| TP-2 (Key Handset) | 2.0 kHz ± 10 Hz |
| TP-4 (MODE: FM) | 150 Hz ± 2 Hz |
| TP-2 (MODE: FSK) | |
| (Key Handset) | 1.57 kHz ± 10 Hz |
| (Release Handset) | 2.43 kHz ± 10 Hz |

NOTE

If the tone is not measured the first time, key the Handset and release again to obtain the second tone signal. Repeat as necessary to make the measurement.

(5) Set MODE switch to CW. Using the RF voltmeter, monitor 1A1A11P4, figure 3-18, for a voltage level greater than 85 millivolts.

(6) Using the RF voltmeter, monitor 1A1A11TP5, figure 3-18, for a voltage level greater than 150 millivolts.

(7) Set POWER switch to RCV ONLY and then back to the LO PWR position. Set MODE switch to AM. Key the handset and monitor it for a No-Tune condition, indicated by a pulsing tone in the handset. Return MODE switch to CW.

l. Transmit Broadband Module, Isolation Test (1A1A12).

(1) Set up test equipment as shown in figure 3-19.

CAUTION

The POWER switch is spring loaded in the TUNE position and will automatically return to HI PWR position when released. DO NOT hold the POWER switch in the TUNE position for more than a few seconds. After release, select the POWER switch setting indicated by the test procedure.

(2) Set the following switches and controls to the positions indicated.

| Switch | Position |
|---|---|
| MODE | CW |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 30.0000 |
| POWER | TUNE (momentarily then LO PWR |

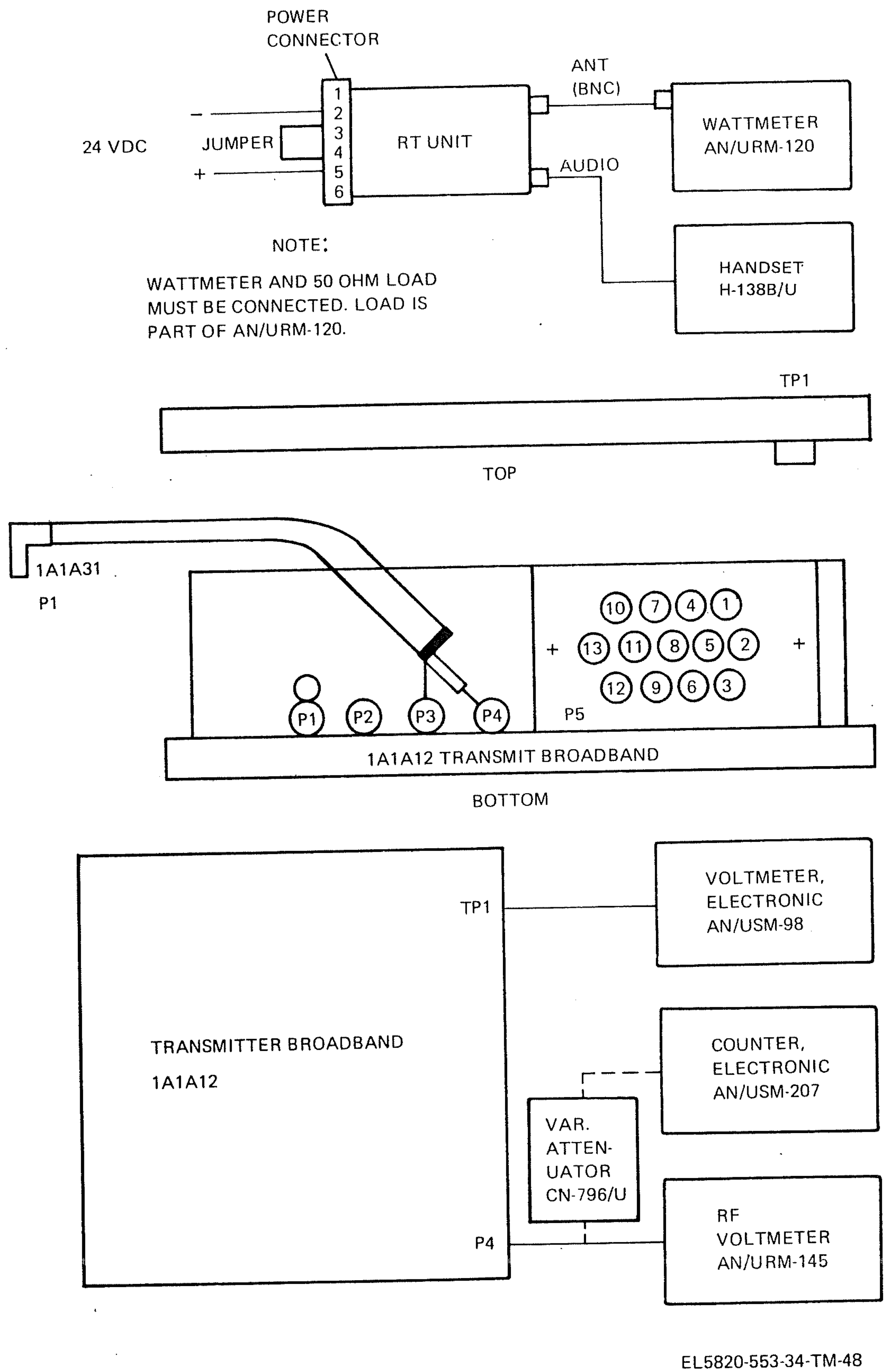


Figure 3-19. Transmitter broadband (1A1A12), test setup

(3) Using the electronic voltmeter, monitor 1A1A12TP1, figure 3-19. Key the handset and observe a voltage level of +0.9 to +1.5 Vdc. Unkey the handset.

(4) Using the electronic counter with 10 dB attenuation in the input, monitor 1A1A12P4 (see figure 3-19). Key the handset and observe a frequency of 30.0020 MHz ± 50 Hz. Unkey the handset.

(5) Disconnect cable 1A1A31P1 (see figure 3-19) and connect RF voltmeter with 50 ohm termination to 1A1A31P1. Key the handset and observe a voltage level of 1.0 to 3.0 Vrms. Unkey the handset.

(6) Disconnect cable from 1A1FL1J2 and connect signal generator to cable.

(7) Set signal generator for 3.0000 MHz with a level of 45 millivolts. Key the handset.

(8) Monitor 1A1A31P1 with RF voltmeter with 50 ohm termination. Observe a voltage level of 1.8 ± 0.4 volts.

(9) Reconnect cable from 1A1FL1J2.

(10) Reconnect cable 1A1A31P1.

m. Upconverter Module Isolation Test (1A1A13).

(1) Set up test equipment as shown in figure 3-20.

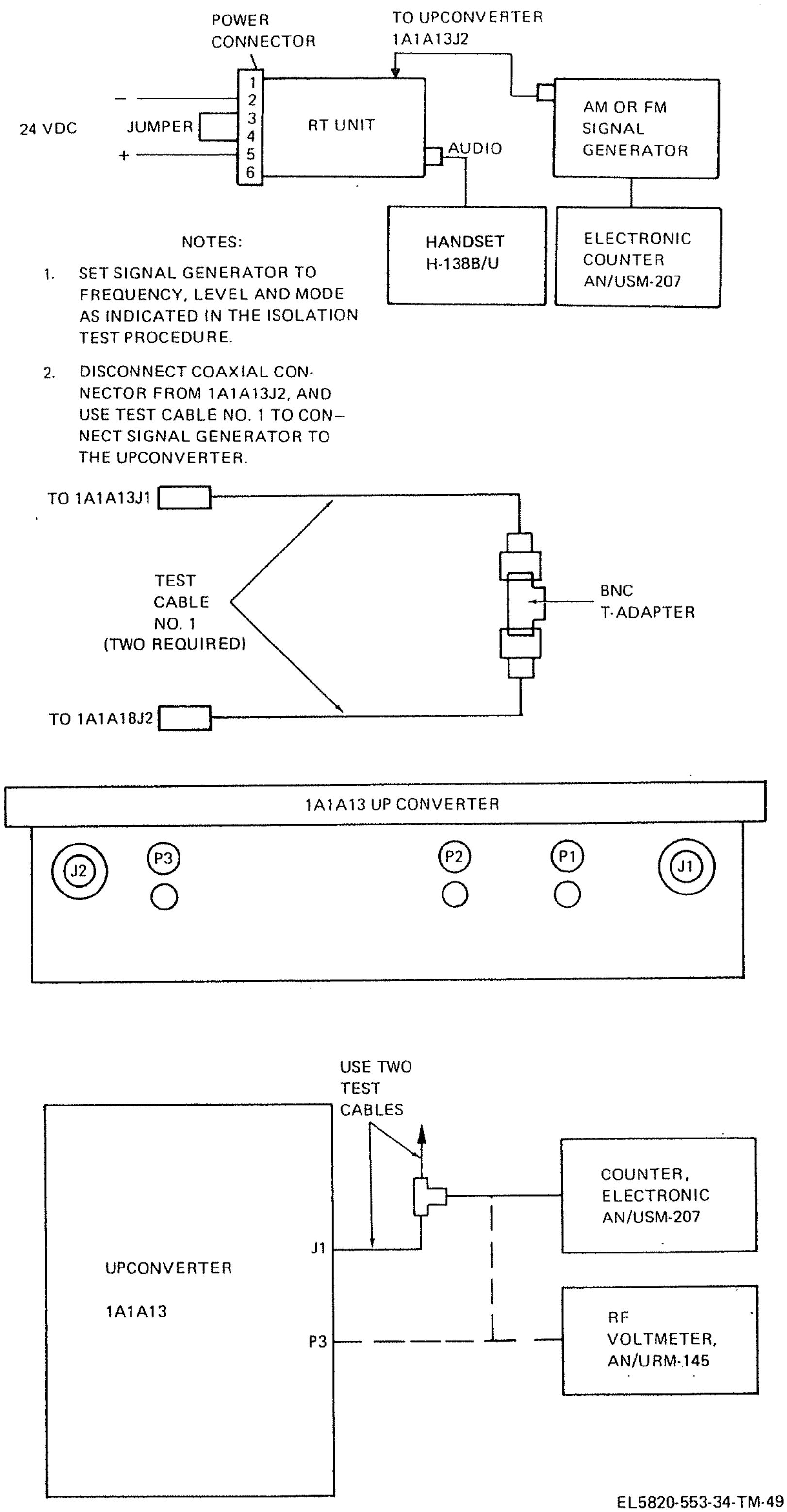


Figure 3-20. Upconverter (1A1A13), test setup

(2) Set the following switches and controls to the position indicated.

| Switch | Position |
| --- | --- |
| MODE | SSB |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 03.0000 |

(3) Disconnect 1A1A31W5 cable between 1A1A13J1 and 1A1A18J2 on the receiver-exciter parent board and connect test cables as shown on figure 3-20 using BNC T-adapter.

(4) Set POWER switch to RCV ONLY.

(5) Using the electronic counter, monitor 1A1A13J1 through the BNC T-adapter for a frequency of 114.455 MHz ± 1 kHz.

(6) Using the RF voltmeter, monitor 1A1A13J1 through the BNC T-adapter for a voltage level greater than 200 millivolts.

(7) Connect signal generator to 1A1A13J2 and adjust for 1 kHz above the frequency selector setting at a 120 millivolt level.

(8) Using the RF voltmeter, monitor 1A1A13P3 (see figure 3-20) for a voltage level greater than 50 millivolts.

(9) Reconnect cable disconnected for the test.

n. First IF Selectivity Module, Isolation Test (1A1A14).

(1) Set up test equipment as shown in figure 3-21.

(2) Set the following switches and controls to the position indicated.

| Switch | Position |
|---|---|
| MODE | CW |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 03.0000 |
| POWER | RCV ONLY |

(3) Set signal generator to 3.000 MHz unmodulated at an output level of 300 millivolts. Monitor the signal generator with the electronic counter for the correct frequency.

(4) Using the electronic counter, monitor 1A1A14P2 (figures FO-4 and 3-21), for a frequency reading of 111.455 MHz ± 5 kHz.

(5) Adjust the signal generator output level to 100 millivolts.

(6) Using the RF voltmeter, monitor 1A1A14P7 (figures FO-4 and 3-21) for a voltage level greater than 40 millivolts.

(7) Using the RF voltmeter, monitor 1A1A14P2 for a voltage level greater than 90 millivolts.

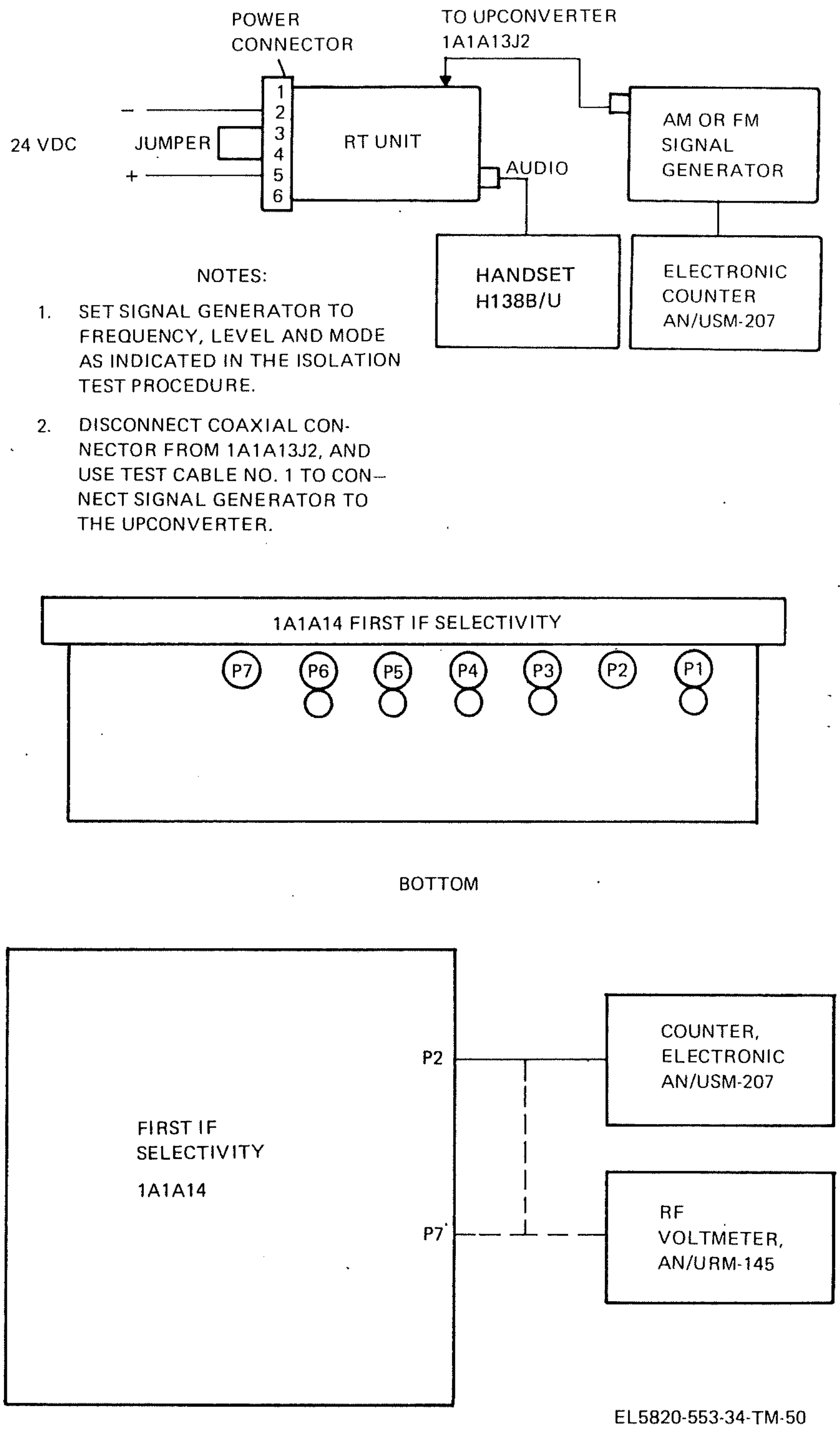


Figure 3-21. First IF selectivity (1A1A14), test setup

(8) Set the MODE switch to AM and the POWER switch to LO PWR. Disconnect the signal generator and key the handset.

(9) Repeat step (6) for an output level greater than 70 millivolts.

(10) Repeat step (7) for an output level greater than 150 millivolts. Unkey the Handset.

(11) Reconnect cable 1A1A31W7 to 1A1A33J2.

o. First IF AGC and Gain Module, Isolation Test (1A1A15).

(1) Set up test equipment as shown in figure 3-22.

(2) Set the following switches and controls to the position indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 03.0000 |
| POWER | RCV ONLY |

(3) Refer to figure 3-22 and set the AGC switch to the OUT position.

(4) Set the signal generator to 3.000 MHz unmodulated at an output level of 300 millivolts. Monitor the signal generator with the electronic counter for the correct frequency.

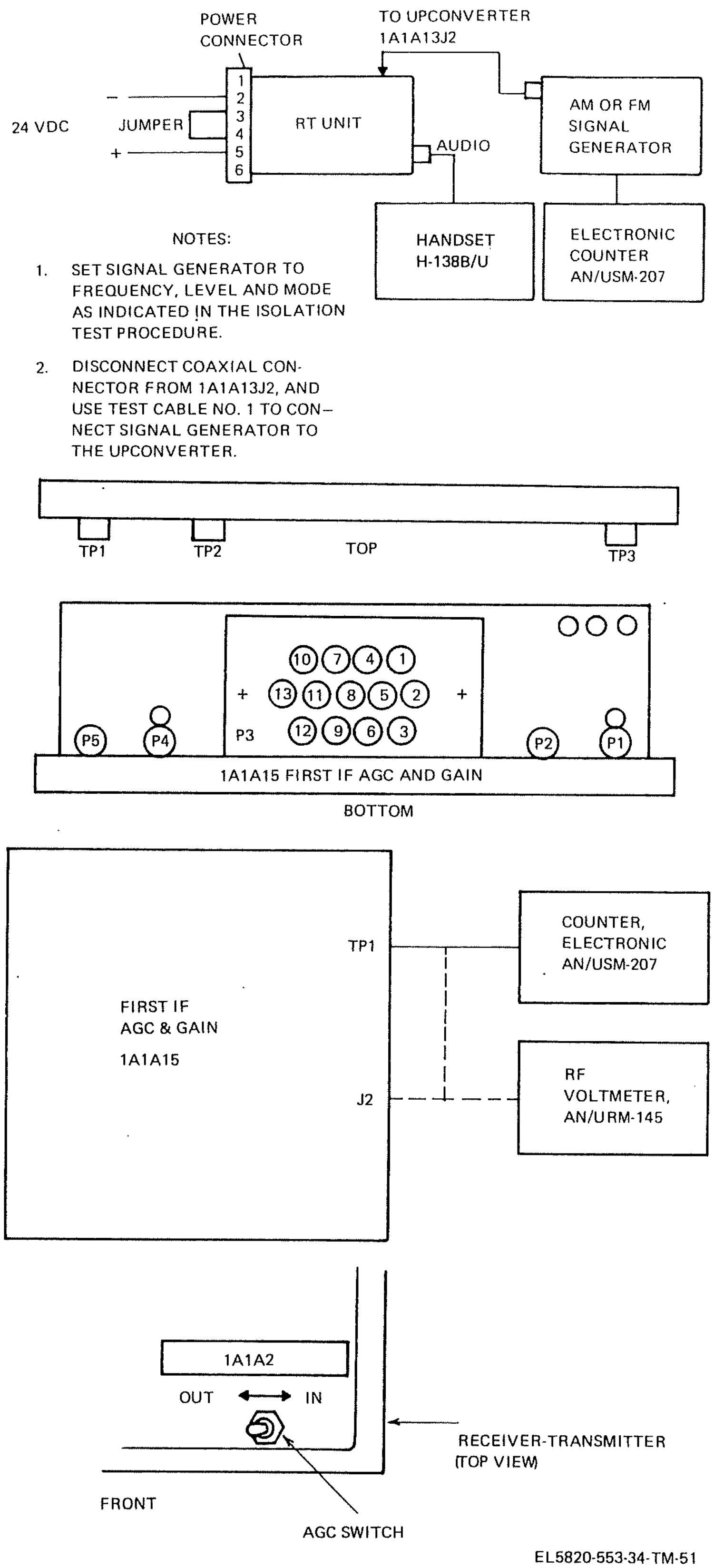


Figure 3-22. First IF AGC and gain (1A1A15), test setup

(5) Using the electronic counter, monitor 1A1A15TP1, figure 3-22 for a frequency of 111.455 MHz ± 5 kHz.

(6) Set the output level of the signal generator to 100 millivolts. Using the RF voltmeter, monitor 1A1A15P2 (figures FO-4 and 3-22) for a voltage level greater than 100 millivolts.

(7) Using the RF voltmeter, monitor 1A1A15P5 for a voltage level greater than 600 millivolts.

(8) Set the POWER switch to LO PWR, disconnect the signal generator, and key the handset.

(9) Repeat step (6) for a voltage level greater than 120 millivolts.

(10) Repeat step (7) for a voltage level greater than 30 millivolts.

p. Second Mixer Module Isolation (1A1A16).

(1) Connect the equipment as shown on figure 3-23.

(2) Disconnect cable 1A1A31W4 from 1A1A16J1 and 1A1A6J2.

(3) Connect electronic counter to 1A1A16J1 as shown on figure 3-23.

(4) Set signal generator to 3.000 MHz ± 100 Hz at a 100 millivolt level.

(5) Set RT switches to positions indicated.

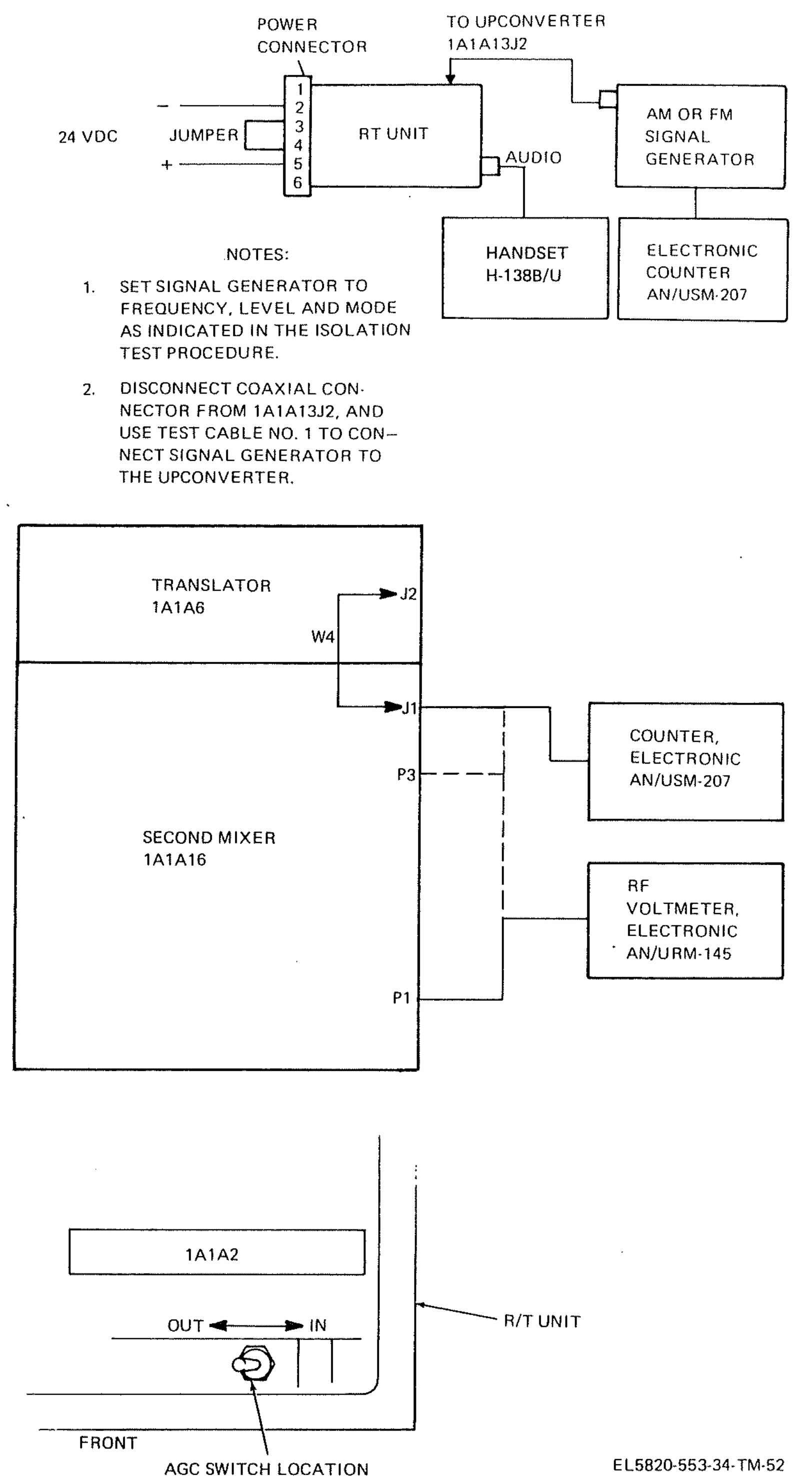


Figure 3-23. Second mixer (1A1A16), test setup

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 03.0000 |
| VOLUME | Mid-range |
| POWER | RCV ONLY |

(6) Set AGC switch in RT unit to OUT position as shown on figure 3-23.

(7) Electronic counter indicates 100.00 MHz ± 3 kHz.

(8) Set RT unit POWER switch to OFF. Disconnect electronic counter from 1A1A16J1. Connect RF voltmeter and 50 ohm adapter to 1A1A16J1. Meter should indicate more than 100 millivolts. Reconnect 1A1A31W4.

(9) Set RT unit POWER switch to RCV ONLY.

(10) Monitor 1A1A16P3, figure FO-4, with electronic counter. Counter indicates 11.455 MHz ± 100 Hz.

(11) Monitor 1A1A16P3 with the RF voltmeter. Meter indicates more than 150 millivolts.

(12) Reconnect cable to 1A1A16P3.

(13) Set AGC switch to IN position.

q. Second IF Module Isolation Test (1A1A17).

(1) Connect the equipment as shown on figure 3-24.

(2) Set signal generator to 3.000 MHz ± 100 Hz at a 100 millivolt level.

(3) Set RT unit switches to the positions indicated.

| Switch | Position |
|---|---|
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | 03.0000 |
| VOLUME | Mid-range |
| POWER | RCV ONLY |

(4) Set AGC switch in RT unit to OUT position as shown on figure 3-23.

(5) Monitor the signal frequency at 1A1A17P1 with the electronic counter as shown on figure 3-24. Refer to figure FO-4 for location of 1A1A17P1. The frequency should be 11.455 MHz ± 100 Hz.

(6) Reduce the signal generator input level to 10 millivolt.

(7) Monitor the voltage level at 1A1A17P1 with the RF voltmeter. The meter should indicate more than 20 millivolts.

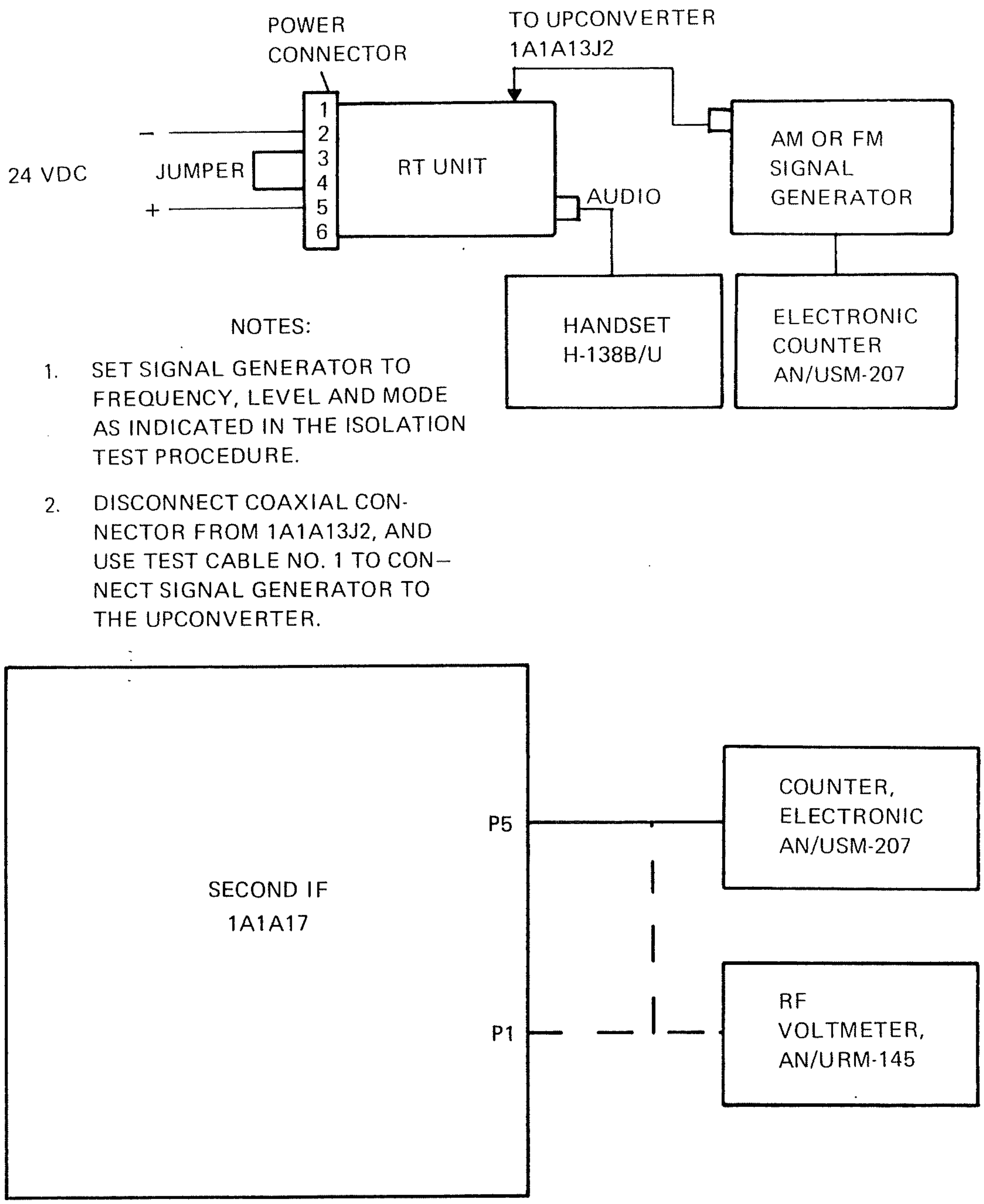


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Figure 3-24. Second IF (1A1A17), test setup

(8) Monitor the voltage level at 1A1A17P5 with the RF voltmeter. The meter should indicate more than 300 millivolts. Disconnect signal generator.

(9) Set the RT unit POWER switch to LO PWR and the MODE switch to CW.

(10) Key the transmitter with the handset and monitor the voltage level at 1A1A17P1 with the RF voltmeter. The meter indicates more than 70 millivolts.

(11) Key the transmitter with the handset and monitor the voltage level at 1A1A17P5 with the RF voltmeter. The meter indicates more than 20 millivolts. Set AGC switch to IN position (figure 3-23).

r. Pump VFO Module Isolation Test (1A1A18).

(1) Connect the equipment as shown on figure 3-25.

(2) Disconnect cable 1A1A31W3 from 1A1A6J3 and 1A1A18J1 (see figure FO-4 for location of 1A1A6J3 and 1A1A18J1).

(3) Connect the electronic counter between 1A1A18J1 and 1A1A6J3 as shown on figure 3-25.

(4) Set the RT unit switches to the positions indicated.

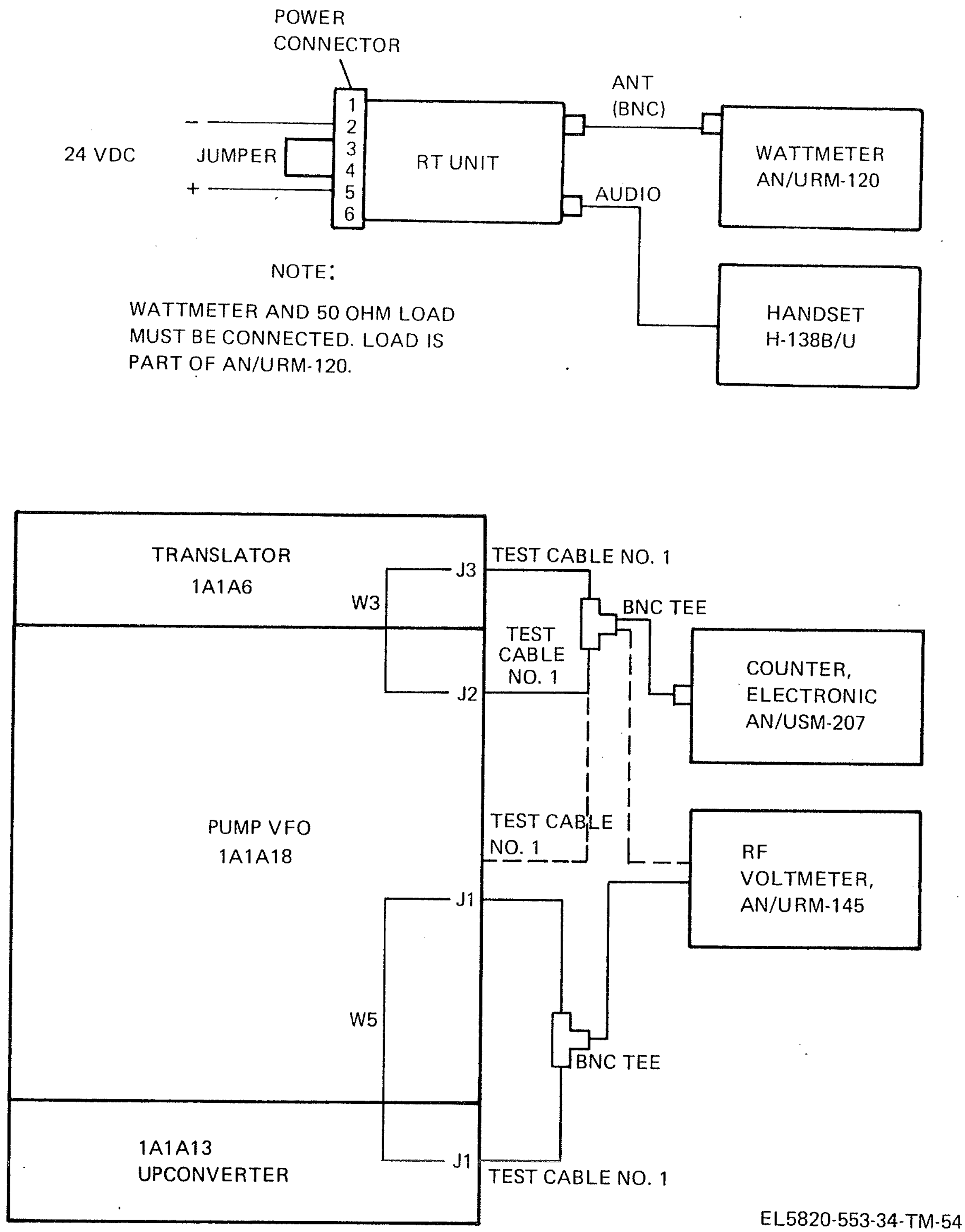


Figure 3-25. Pump VFO (1A1A18), test setup

| Switch | Position |
|---|---|
| MODE | AM |
| FREQUENCY MHZ | 30.0000 |
| POWER | RCV ONLY |

(5) The electronic counter indicates 141.455 MHz ± 5 kHz. Set the FREQUENCY MHZ switches on the RT unit to 50.0000. The electronic counter indicates 161.455 MHz ± 5 kHz.

(6) Set POWER switch to OFF.

(7) Connect the RF voltmeter between 1A1A6J3 and 1A1A18J1 in place of the electronic counter.

(8) Set the POWER switch to RCV ONLY. The RF voltmeter indicates more than 500 millivolts.

(9) Set POWER switch to OFF.

(10) Reconnect cable 1A1A31W3 between 1A1A6J3 and 1A1A18J1.

(11) Disconnect cable 1A1A31W5 from 1A1A18J2 and 1A1A13J1 (see figure FO-4 for location of 1A1A18J2).

(12) Connect the RF voltmeter between 1A1A18J2 and 1A1A13J1 as shown in figure 3-25.

(13) Set POWER switch to RCV ONLY. The RF voltmeter indicates more than 200 millivolts.

(14) Set POWER switch to OFF and reconnect cable W5 between 1A1A18J2 and 1A1A13J1.

s. IF Selectivity Module Isolation Test (1A1A19).

(1) Connect equipment as shown on figure 3-26.

(2) Remove second IF module 1A1A17 from the RT unit.

(3) Connect the signal generator and RF voltmeter to 1A1A19 module as shown on figure 3-26.

(4) Adjust signal generator for 11.454 MHz at a 300 millivolt level. Monitor with the electronic counter.

(5) Set the RT switches to the positions indicated.

| Switch | Position |
|---|---|
| POWER | RCV ONLY |
| FREQUENCY MHZ | 2 to 76 MHz |
| MODE | AM |

(6) The RF voltmeter indicates greater than 30 millivolts at 1A1A19-P3.

(7) Connect equipment as shown in figure 3-27.

(8) Set POWER switch to LO PWR.

(9) Monitor RF voltmeter for a level of 10 millivolts minimum at 1A1A19P7.

(10) Replace second IF module 1A1A17.

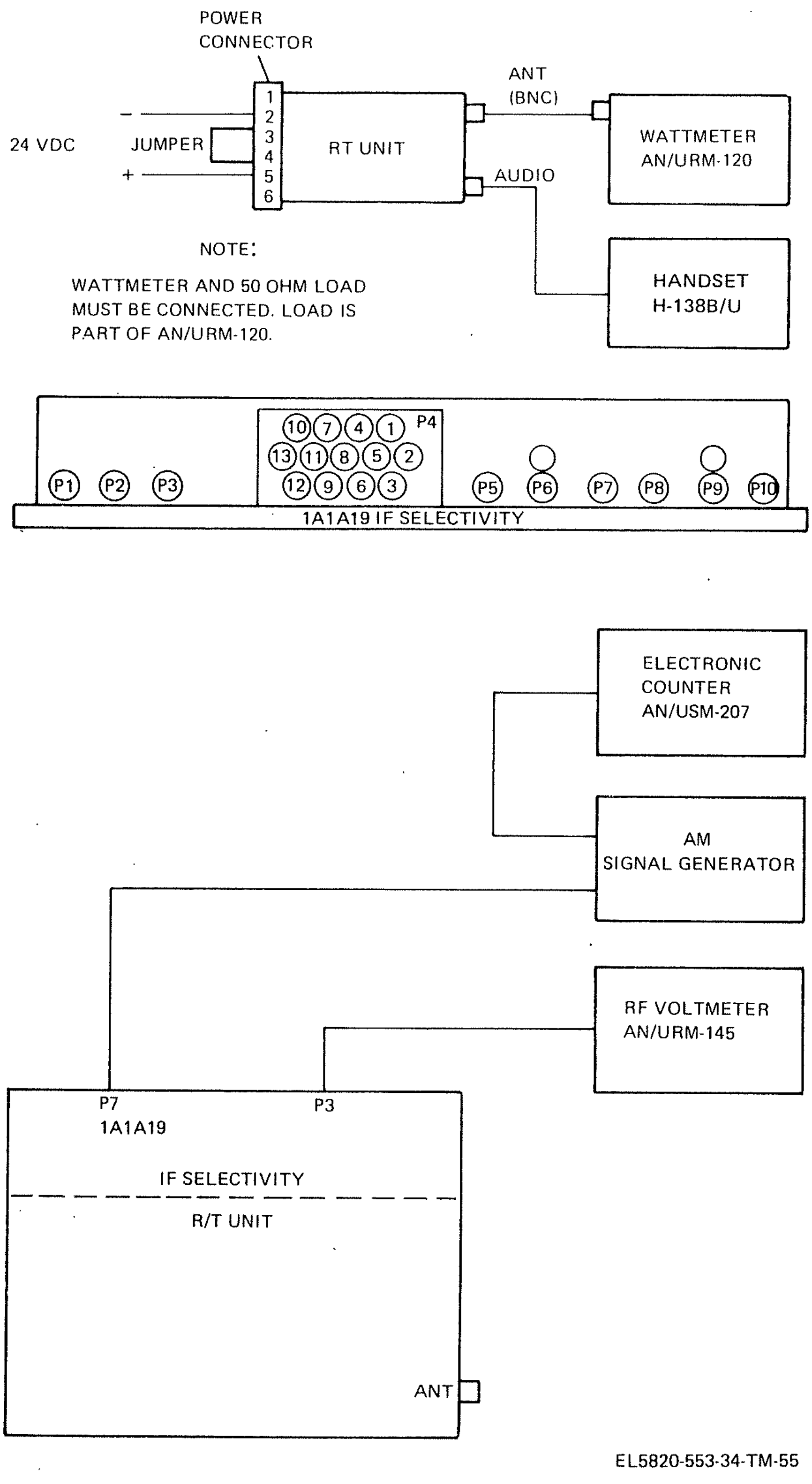


Figure 3-26. IF selectivity (1A1A19), receive test setup

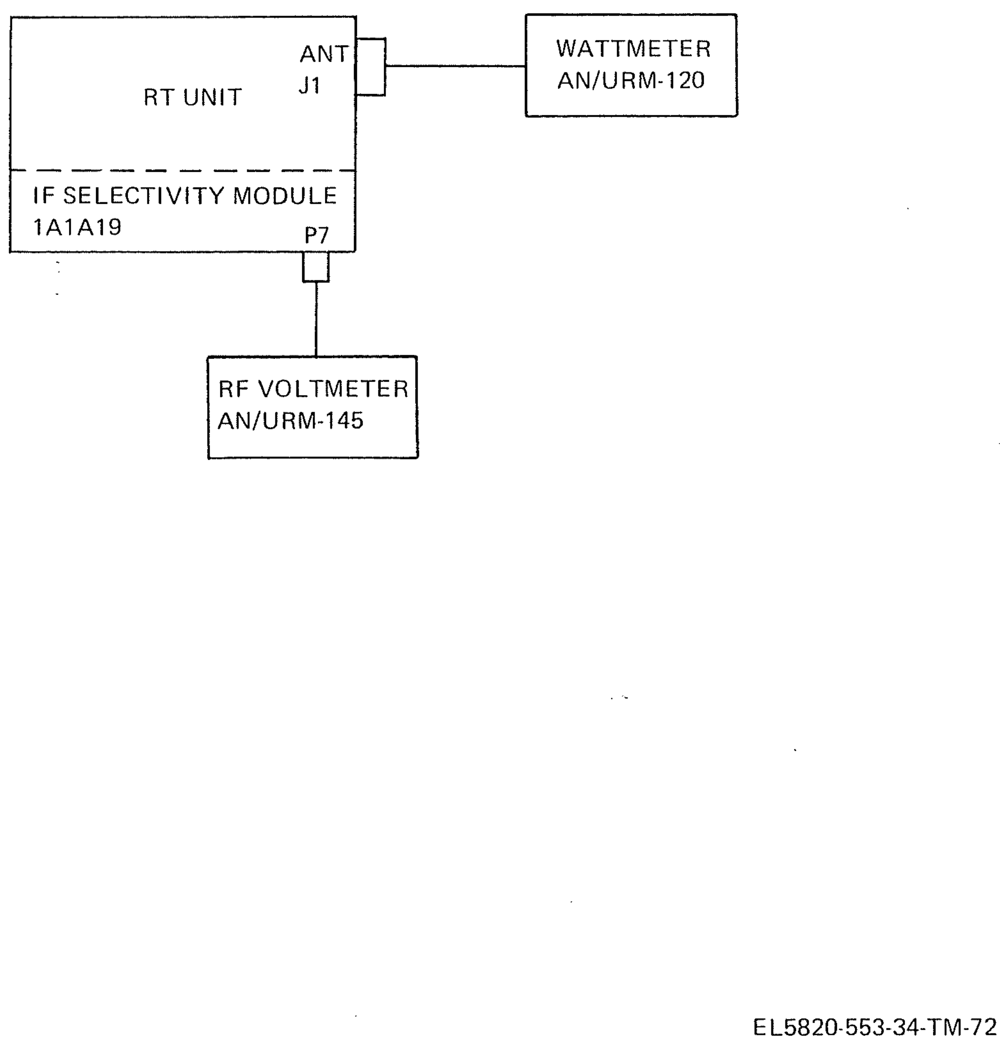


Figure 3-27. IF selectivity (1A1A19), transmit test setup

t. DC Control Module Isolation Test (1A1A20).

(1) Connect test equipment as shown on figure 3-28.

(2) Set RT unit switches to the positions indicated.

| Switch | Position |
|---|---|
| SQUELCH | OFF |
| FREQUENCY | 30.0000 |
| POWER | TUNE/LO PWR |
| MODE | FSK |

(3) Key the handset and monitor 1A1A20TP2 with the DC voltmeter for +10 ± 0.5 Vdc as shown on figure 3-28. Release key and notice delay before level shifts.

(4) Set the MODE switch to CW. Key the handset and monitor 1A1A20TP4 for +10 ± 0.5 Vdc. Release key and notice delay before level shifts.

(5) Monitor 1A1A20P1, pin 2 for +12 ± 0.6 Vdc. Refer to figure 3-28 for location of P1, pin 2.

(6) Monitor 1A1A20TP1 for +4.5 to +5.0 Vdc. Key the handset and monitor 1A1A20TP1 for 0 Vdc.

(7) Set the MODE switch to FSK. Key the handset and monitor 1A1A20TP3 for +10 ± 0.5 Vdc.

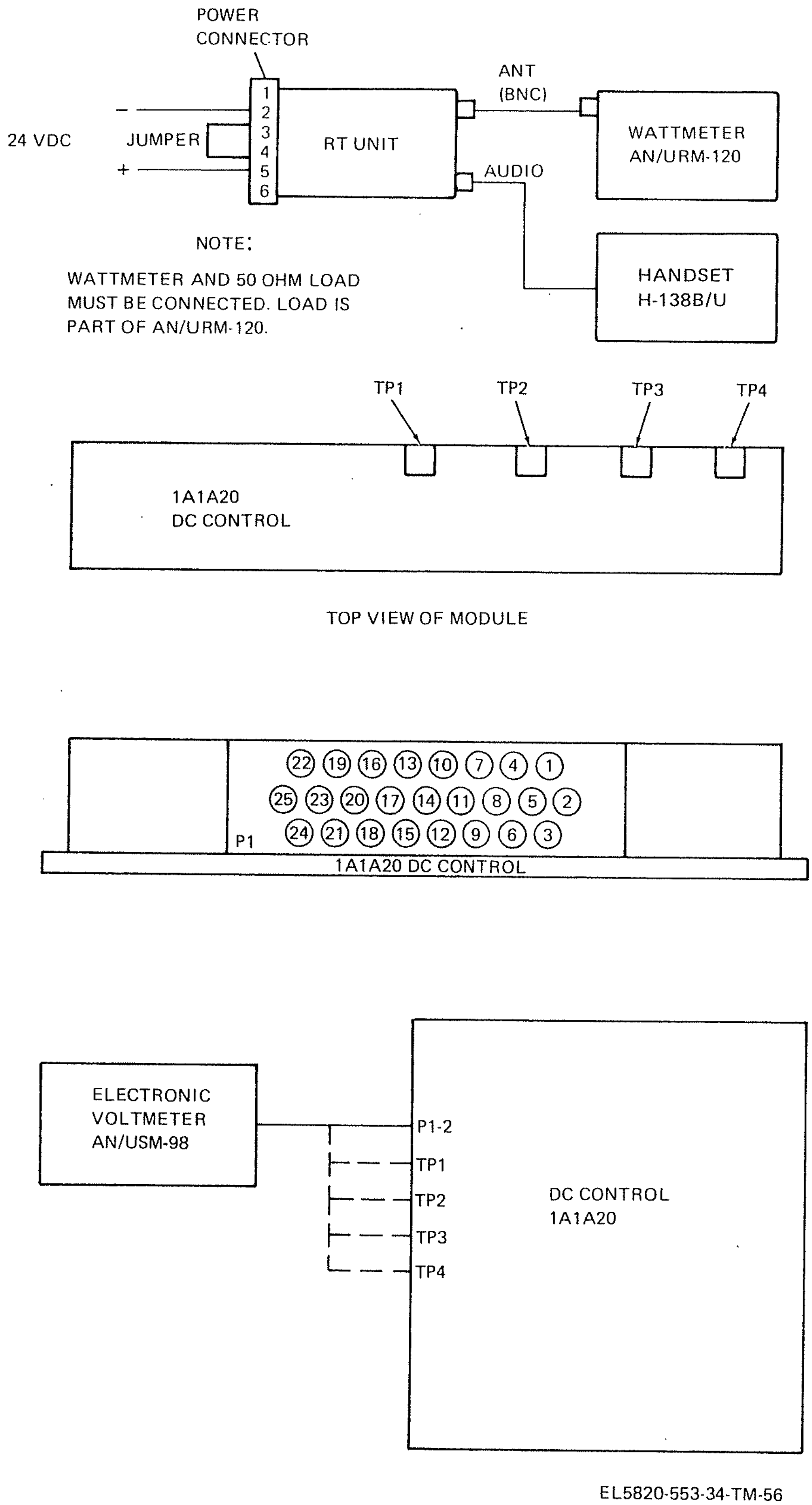


Figure 3-28. DC control (1A1A20), test setup

u. Modulator Squelch Module, Isolation Test (1A1A21).

(1) Connect test equipment as shown in figure 3-29 (sheet 1 and view A of sheet 2).

(2) Set RT unit switches and controls to the position indicated.

| Switch | Position |
|---|---|
| MODE | FM |
| SQUELCH | OFF |
| VOLUME | Mid-range |
| FREQUENCY MHZ | 30.0000 |
| POWER | LO PWR |

(3) Remove the IF Selectivity module, 1A1A19. Key the handset.

(4) Using the RF voltmeter, monitor 1A1A21TP2 (figure 3-29) for a voltage level of 140 ± 50 millivolts.

(5) Set RT unit POWER switch to OFF. Reinstall module removed in step (3).

(6) Set MODE switch to SSB.

(7) Connect Audio Oscillator to red plug on maintenance cable 1A9W1.

(8) Set Audio Oscillator to 1000 Hz at a level of 3 millivolts (with radio as the load).

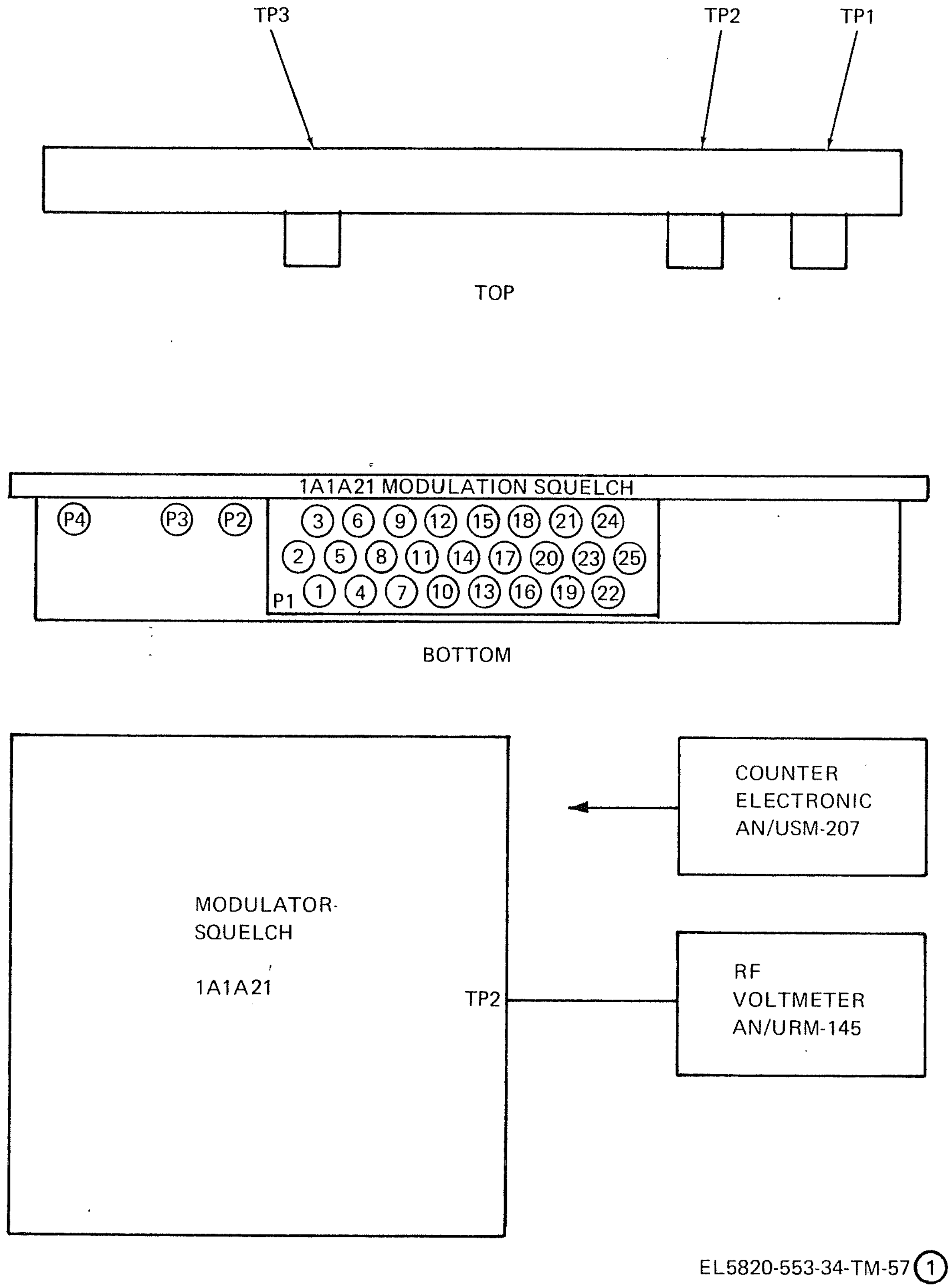


Figure 3-29. Modulator squelch (1A1A21), test setup (sheet 1 of 2)

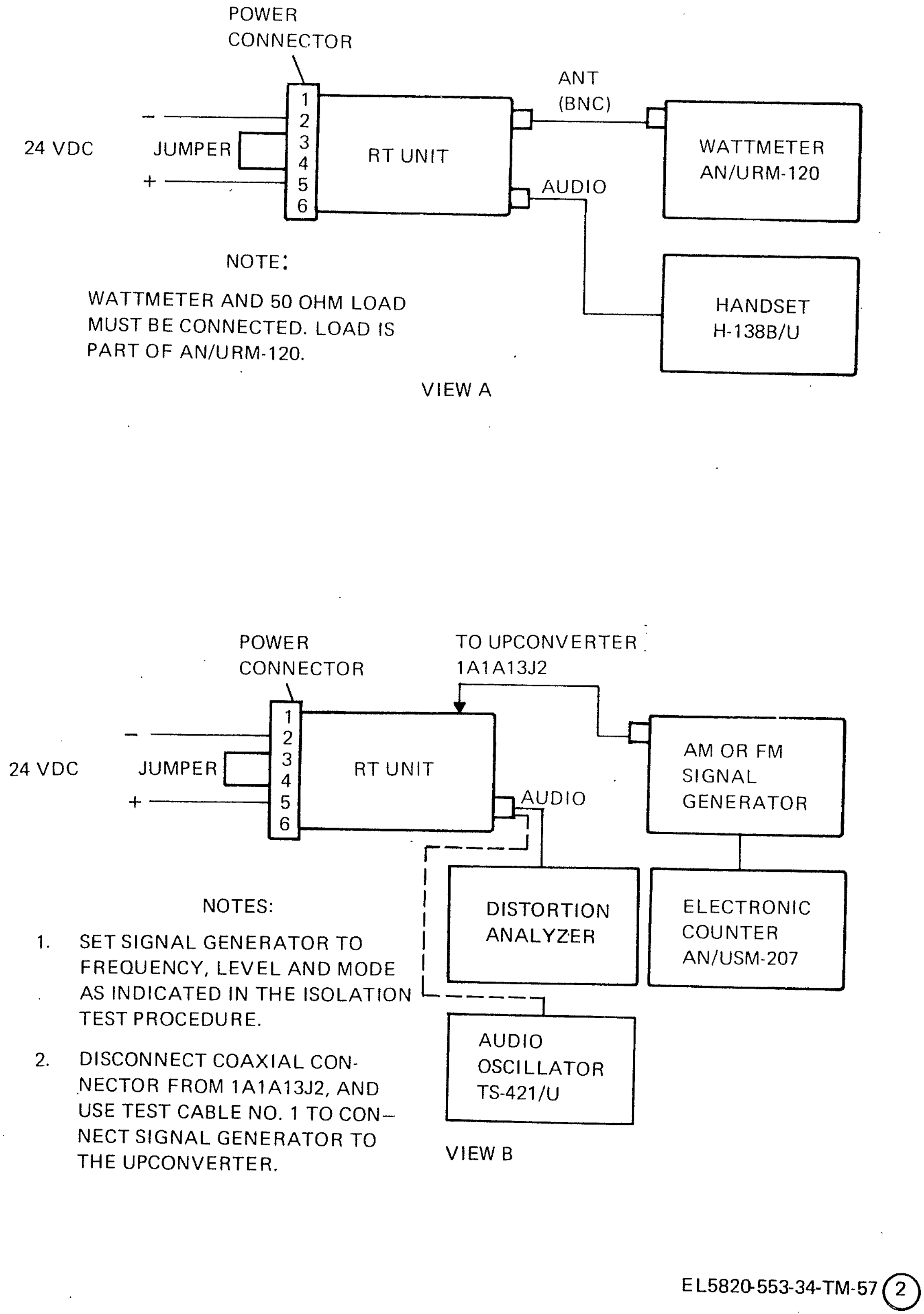


Figure 3-29. Modulator squelch (1A1A21), test setup (sheet 2 of 2)

(9) Remove transmit broadband module 1A1A12.

(10) Key handset and monitor 1A1A21TP1 (figure 3-29) for a voltage level greater than 100 millivolts.

(11) Unkey handset. Reinstall transmit broadband module 1A1A12.

(12) Connect test equipment as shown in figure 3-29 (sheet 1 and review B of sheet 2). Set FREQUENCY MHZ switches to 3.0000 MHz.

(13) Adjust signal generator for a frequency of 2.0004 MHz using the electronic counter.

(14) Set RT MODE switch to SSB, POWER switch to RCV ONLY and SQUELCH switch to OFF.

(15) Connect maintenance cable 1A9W1 to the RT unit AUDIO connector. Connect the receive audio plug (which is a black banana plug) on 1A9W1 to the Distortion Analyzer.

(16) Set the signal generator output level to 1 millivolt.

(17) Adjust VOLUME control on RT unit for a level of 1.5 volts output on the Distortion Analyzer meter.

(18) Set SQUELCH switch to ON and observe that the meter readout remains.

(19) Set SQUELCH switch to OFF and adjust the signal generator for 3.0020 MHz.

(20) Adjust VOLUME control on RT unit for a level of 1.5 volts output on the Distortion Analyzer meter.

(21) Set SQUELCH switch to ON and observe that the meter reading decreases.

v. Receive IF and Detection Module Isolation Test (1A1A22).

(1) Connect test equipment as shown on figure 3-30.

(2) Set RT unit POWER switch to RCV ONLY and MODE switch to CW.

(3) Adjust signal generator to 1 kHz above frequency selected at a 100 millivolt level. Monitor the frequency with electronic counter.

(4) Set the range switch as required on the Distortion Analyzer to monitor TP2 on 1A1A22 (figure 3-30) for an output greater than 10 millivolts.

(5) Set RT unit MODE switch to FSK and then to SSB and monitor TP2 for an output greater than 10 millivolts at each position.

(6) Set MODE switch to AM.

(7) Adjust signal generator to frequency selected, modulated 30%, 1 kHz.

(8) The output at TP2 shall be greater than 10 millivolts.

(9) Set FREQUENCY MHZ switches to 32.0000.

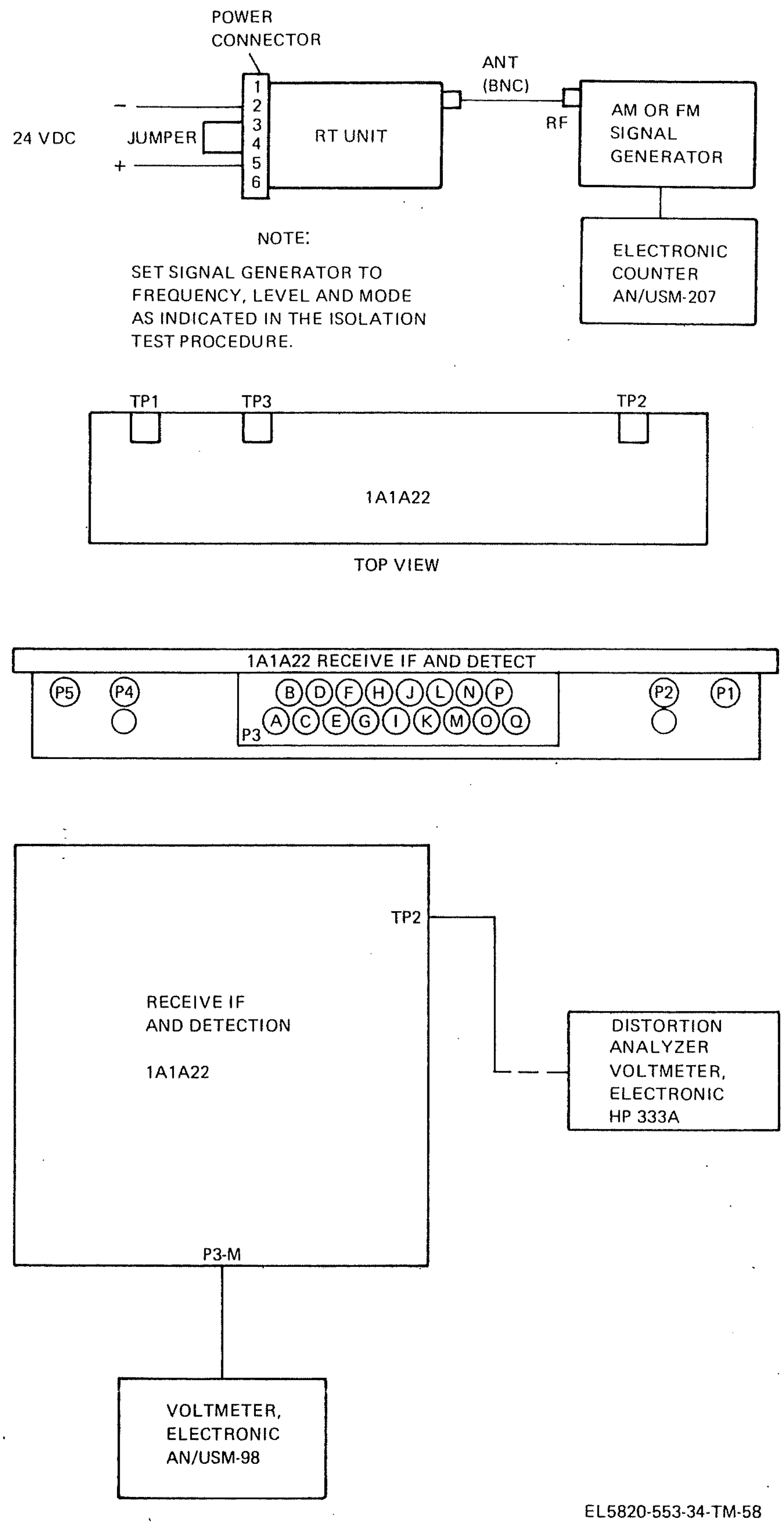


Figure 3-30. Receive IF and detection (1A1A22), test setup

(10) Connect the FM signal generator as shown on figure 3-30. Adjust the FM signal generator for 8 kHz deviation, 1 kHz signal at the frequency selected on the RT unit. Set the input level to 100 millivolts.

(11) Set MODE switch to FM and monitor TP2 for an output greater than 10 millivolts.

(12) Measure the voltage level at 1A1A22P3 pin M for -4 to +10 Vdc with the electronic voltmeter. Refer to figure FO-4 for location of P3 pin M.

w. Audio Module Isolation Test (1A1A23).

(1) Connect test equipment as shown on figure 3-31.

(2) Set RT unit POWER switch to RCV ONLY and FREQUENCY MHZ switches to 3.0000.

(3) Set RF signal generator to 3.0010 MHz at a 100 millivolt level. Monitor the frequency with the electronic counter.

(4) Set RT unit MODE switch to SSB and the VOLUME control fully clockwise (max.).

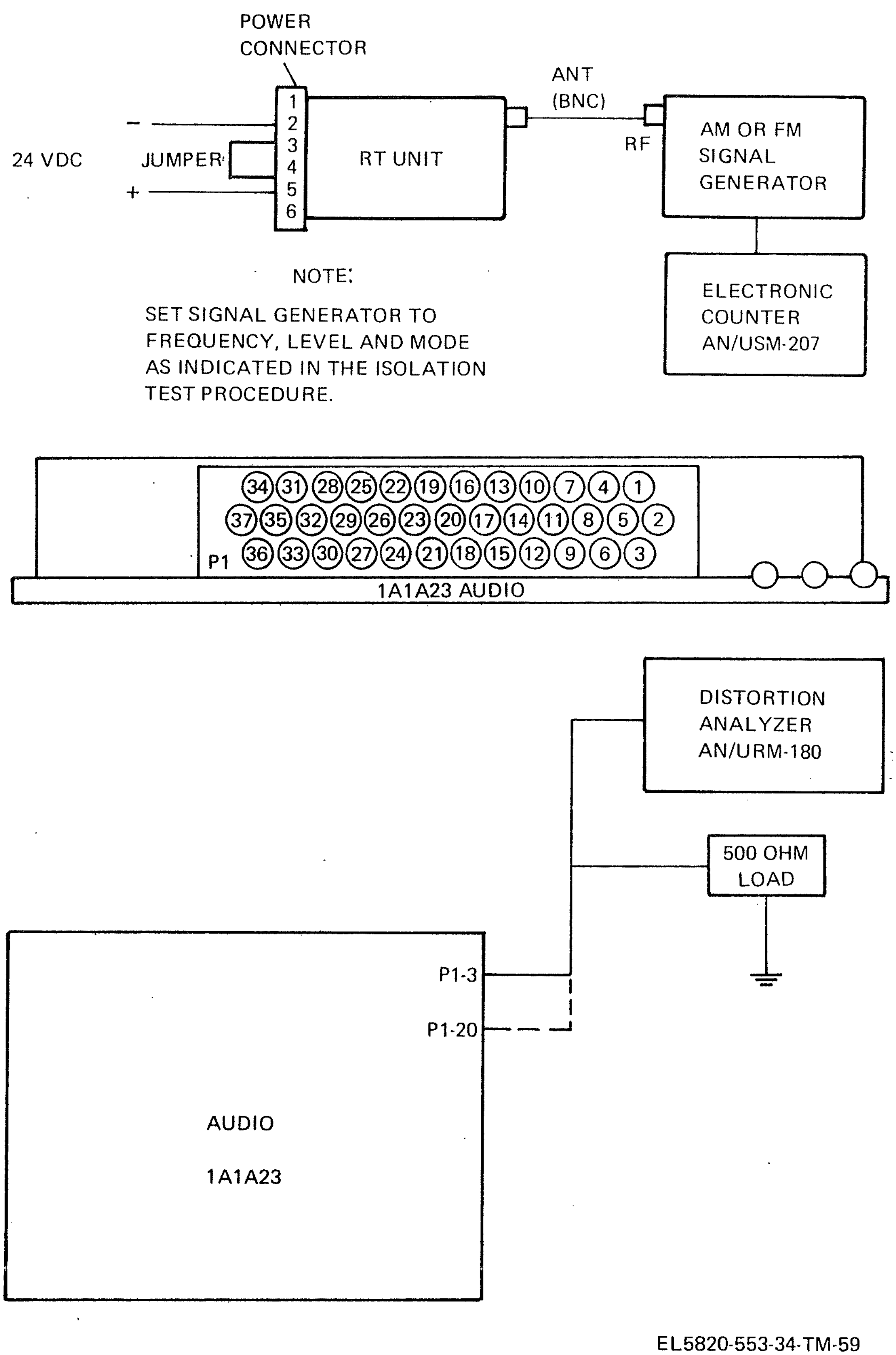


Figure 3-31. Audio (1A1A23), test setup

(5) Monitor the voltage at 1A1A23P1 pin 3 (see figure FO-4 for location of P1 pin 3) with the Distortion Analyzer through a 500 ohm load as shown on figure 3-31. The meter shall indicate 2.75 Vrms minimum.

(6) Monitor the voltage at 1A1A23P1 pin 20 (see figure FO-4 for location) with the Distortion Analyzer. Voltage shall be greater than 0.75 Vrms.

x. Antenna Coupler Module Isolation Test (1A1A24).

(1) Remove metal cover from module 1A1A27.

(2) Remove the connector from 1A1A27P2.

(3) Connect the test equipment as shown on figure 3-32.

(4) Set the RT unit MODE switch to AM and the FREQUENCY MHZ switches to 30.0000.

(5) Set the POWER switch to TUNE momentarily, and then to HI PWR.

(6) Key the transmitter with the handset. Monitor and record the power level at 1A1A27P2. (See figure FO-5 for location of 1A1A27P2).

(7) Reconnect the connector to 1A1A27P2 and connect the wattmeter to ANT connector on the RT unit.

(8) Set POWER switch momentarily to TUNE and release. POWER switch returns to HI POWER.

(9) Key the transmitter with the handset. Monitor and record the power level at 1A1J1 (ANT connector on RT unit) with the wattmeter.

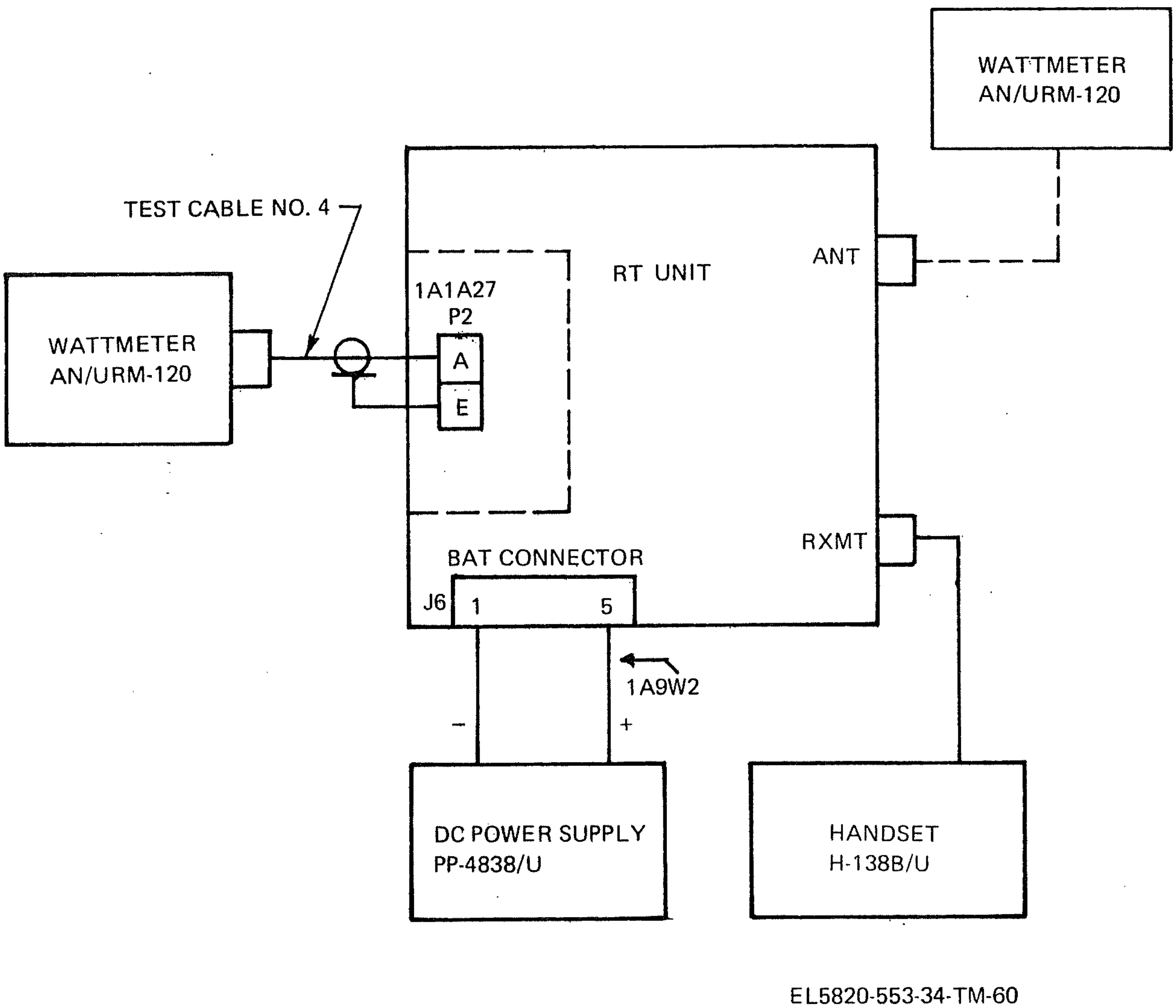


Figure 3-32. Coupler (1A1A24), test setup

(10) Subtract the reading obtained in step (9) from the reading of step (6). Should be 5 watts maximum.

y. ALC Module Isolation Test (1A1A25)

(1) Connect equipment as shown on figure 3-33.

(2) Set the RT switches to the positions indicated.

| Switch | Position |
|---|---|
| FREQUENCY MHZ | 30.0000 |
| POWER | TUNE/HI PWR |
| MODE | AM |

(3) Key the transmitter with the handset and monitor the voltage level at 1A1A25TP3 with the multimeter. The voltage level should be 0 to +5 Vdc.

z. Bandswitch Module Isolation Test (1A1A26)

(1) If a defect is suspected in the bandswitch, disconnect connectors 1A1A26P1 and P2. Remove the bandswitch module.

(2) Replace with a known good module. If defect is not corrected, replace original module and continue troubleshooting.

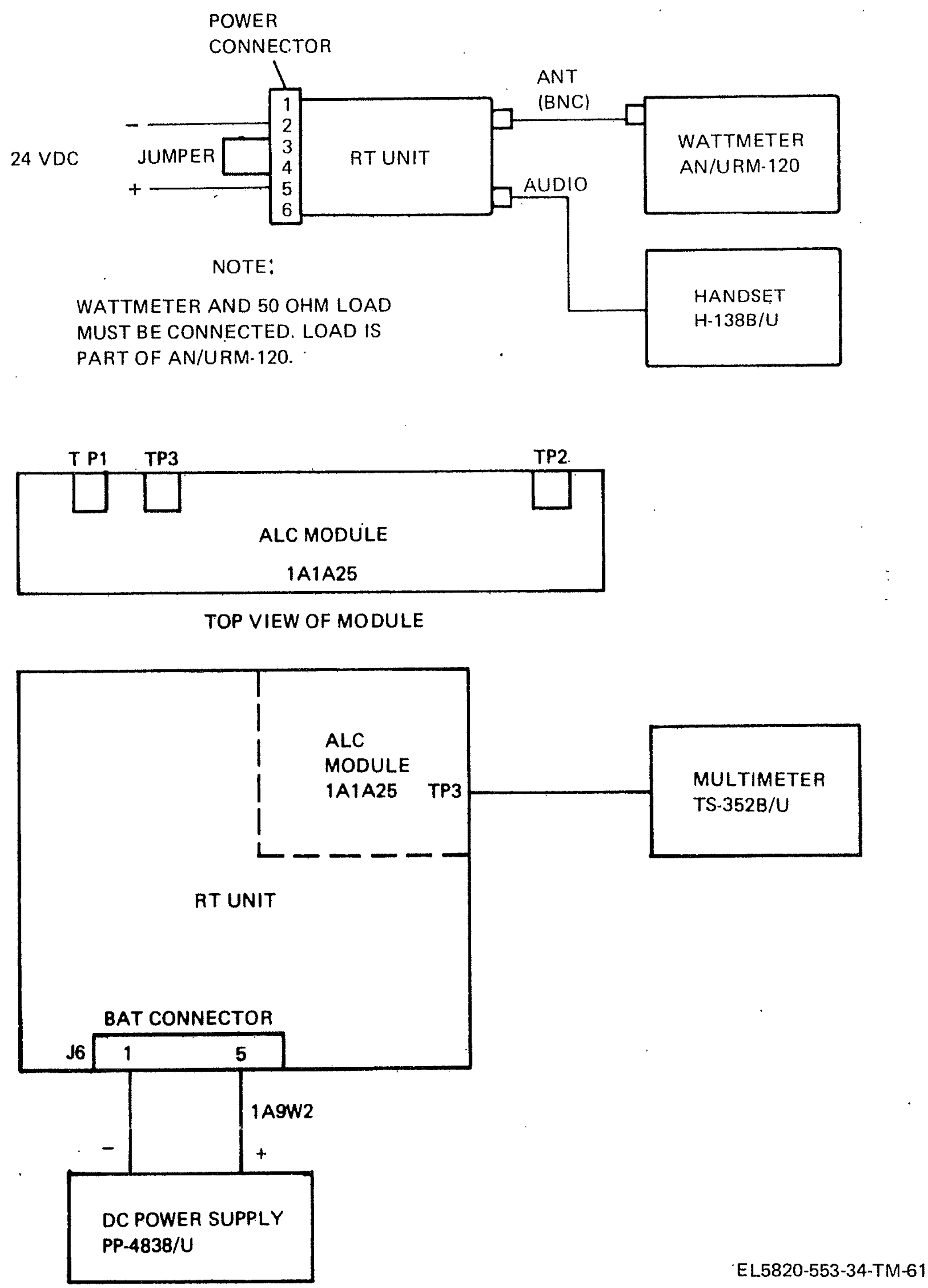


Figure 3-33. ALC (1A1A25), test setup

aa. Detector Module Isolation Test (1A1A27)

(1) Set RT unit switches to the positions indicated.

| Switch | Position |
|---|---|
| FREQUENCY MHZ | 30.0000 |
| MODE | AM |
| POWER | TUNE/HI PWR |

(2) Remove metal cover (clips on over module) and disconnect cable from 1A1A27J1. Connect test equipment to cable as shown on figure 3-34. (Refer to figure FO-5 for location of 1A1A27J1).

(3) Key the transmitter with the handset and monitor and record the power level output at 1A1A27J1.

(4) Disconnect the wattmeter and reconnect the cable to 1A1A27J1.

(5) Disconnect the connector at 1A1A27P2 and connect the test cable between 1A1A27P2 and the wattmeter as shown on figure 3-32. (See figure FO-5 for location of 1A1A27P2).

(6) Key the transmitter with the handset and monitor and record the power level at 1A1A27P2. There shall be less than 3 watts difference between that recorded in step (3) and (6).

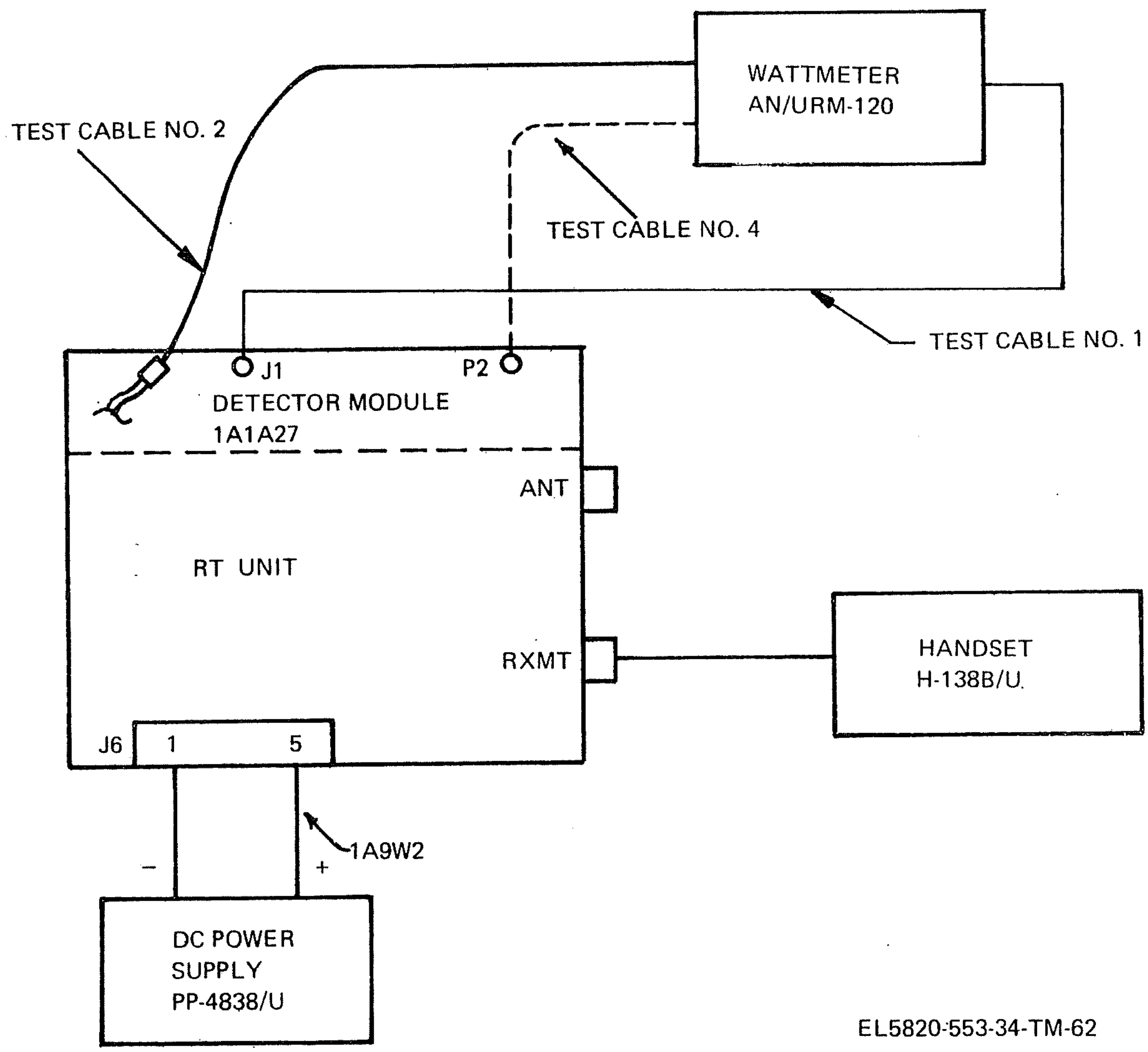


Figure 3-34. Detector (1A1A27), test setup

(7) Reconnect cable to 1A1A27P2 and replace metal cover on module.

ab. Filter Module Isolation Test (1A1A28).

(1) Connect test equipment to filter module as shown on figure 3-35. Refer to figure FO-5 for location of 1A1A28P2.

(2) Set RT unit switches to the positions indicated.

| Switch | Position |
|---|---|
| POWER | RCV ONLY |
| MODE | AM |
| SQUELCH | OFF |
| FREQUENCY MHZ | As required |

(3) Set signal generator to the frequency bands indicated below at a level of 100 millivolts. Set FREQUENCY MHZ switches as shown below and monitor P1 with RF voltmeter. RF Voltmeter shall indicate greater than 80 millivolts as signal generator sweeps through each band.

| Signal Generator MHz at 100 mV to P2 | FREQUENCY MHZ Selector |
|---|---|
| 2.0 to 3.0 | 02.5000 |
| 3.0 to 4.0 | 03.5000 |
| 4.0 to 6.0 | 05.0000 |

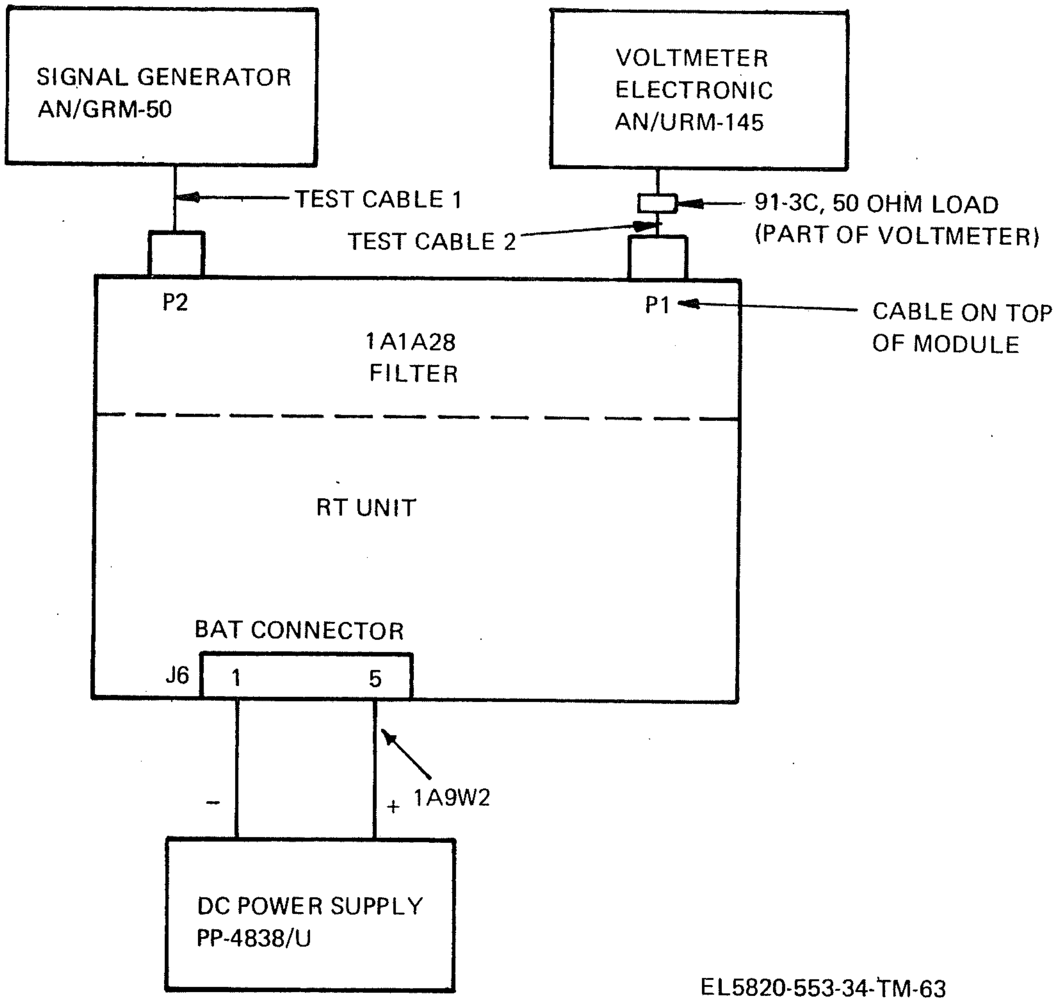


Figure 3-35. Filter (1A1A28), test setup

| Signal Generator MHz at 100 mV to P2 | FREQUENCY MHZ Selector |
|---|---|
| 6.0 to 10.0 | 08.0000 |
| 10.0 to 14.0 | 12.0000 |
| 14.0 to 20.0 | 17.0000 |
| 20.0 to 30.0 | 25.0000 |
| 30.0 to 40.0 | 35.0000 |
| 40.0 to 60.0 | 50.0000 |
| 60.0 to 76.0 | 70.0000 |

ac. Power Amplifier and Driver Module Isolation Test (1A1A29).

(1) Connect test equipment as shown in figure 3-36.

(2) Set the RT switches to the positions indicated.

| Switch | Position |
|---|---|
| FREQUENCY MHZ | 30.0000 |
| POWER | TUNE/HI PWR |
| MODE | CW |

(3) Key the handset. Observe wattmeter power level at 1A1A29J1 of 33 ± 5 watts.

(4) Monitor input to 1A1A29 at 1A1A31P1 with RF voltmeter and 91-6C 50 ohm load. Meter indicates 1 to 3 Vrms. Unkey handset.

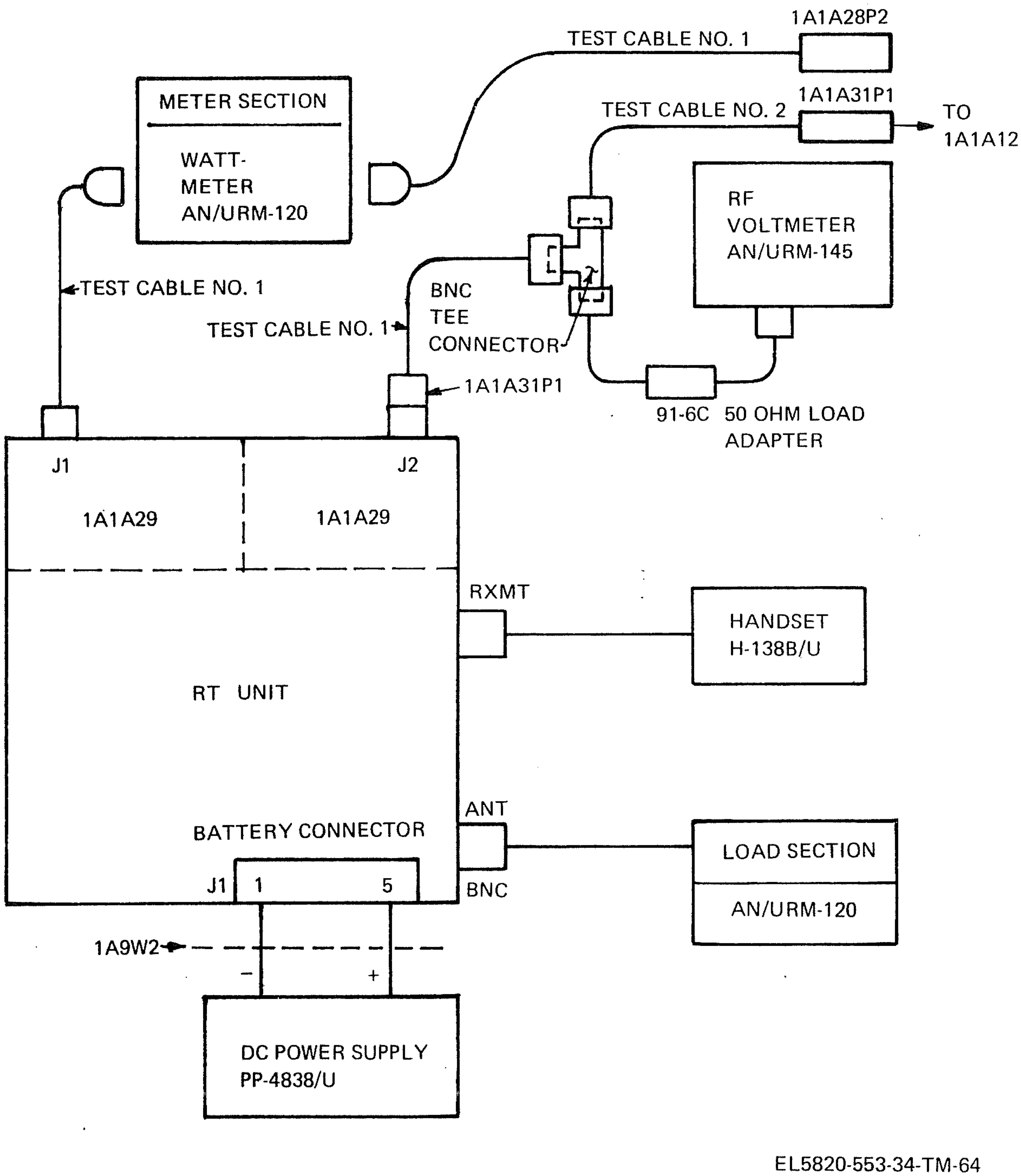


Figure 3-36. Power amplifier and driver (1A1A29), test setup

(5) Set the RT switches to the positions indicated.

| Switch | Position |
|---|---|
| POWER | LO PWR |
| MODE | AM |
| FREQUENCY MHZ | 30.0000 |

(6) Key the handset. Observe wattmeter power level at 1A1A29J1 of 3 ± 1 watt. Unkey handset.

(7) Reconnect the cables disconnected in step (1).

ad. Bandpass Filter Module Isolation Test (1A1FL1).

(1) Connect test equipment as shown in figure 3-37.

(2) Set RT POWER switch to OFF.

(3) Set signal generator for 100 millivolts and sweep through 2 to 76 MHz range while connected to J1. The RF voltmeter indication from J2 should be greater than 90 millivolts through the range of inputs.

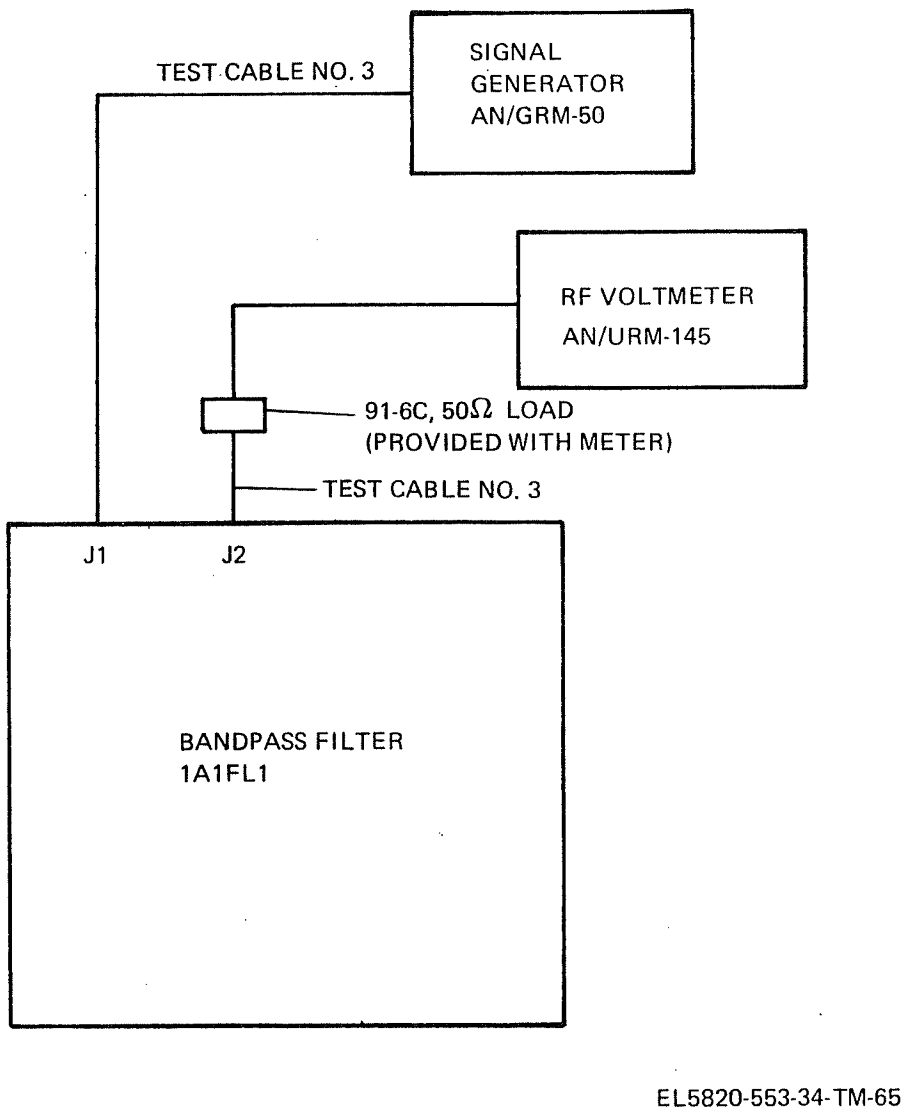


Figure 3-37. Bandpass filter (1A1FL1), test setup

# CHAPTER 4

# GENERAL SUPPORT MAINTENANCE INSTRUCTIONS

## Section I. GENERAL

### 4-1. Scope.

This chapter describes the general support maintenance requirements for Radio Set AN/PRC-70. These requirements include inspection, maintenance, and modifications. Use the procedure of paragraph 4-4 to isolate defective wiring components, RF cable assemblies, and non-captive piece parts mounted on the receiver-transmitter main frame assembly 1A1A30. Figure FO-6 shows the receiver-transmitter main frame interconnecting wiring diagram. If the direct support maintenance instructions of Chapter 3 have been followed, and a particular radio set is still not operating properly, proceed as directed in the following paragraphs.

## Section II. MAINTENANCE OF AN/PRC-70 RADIO SET

4-2. Inspection Procedures.

a. Incoming and Outgoing Radio Sets. Radio Sets received from supply and sets which are to be returned to service shall be performance tested in accordance with the procedures contained in paragraph 3-11 to ensure operational readiness.

b. Semi-Annual Checks and Services.

(1) Internal visual and mechanical inspection except for modules.

(2) Clean and lubricate preformed packing, gaskets, and O-rings, with insulating silicon compound (FSN6850-880-7616).

4-3. Modules.

a. Incoming Modules. Individual modules received from supply shall be tested in RT units of known performance standards to preclude compounding malfunctions of a faulty RT unit.

b. Replacing Frequency Selector Module 1A1A1.

(1) Remove module 1A1A1, loosen the screws that hold 1A1A1 to the main frame. Disconnect the three cables from the RT unit. Unsolder three leads from VOLUME control. Mark leads for reassembly.

(2) To replace module 1A1A1, reconnect the three cables to the RT unit, resolder leads to VOLUME control being careful to dress the leads properly, and install the screws that hold 1A1A1 to the main frame.

c. Removing and Installing Logic Boards from Coupler Module 1A1A24. It is assumed that the module itself has already been removed as directed in paragraph 3-9.

(1) Logic boards No. 1 and No. 2 are held to 1A1A24 by a connector and can be separated from module 1A1A24 by pulling them apart. The logic boards are held together by six screws with spacers. Remove this hardware and pull the boards apart.

(2) To reassemble the module, place logic boards No. 1 and No. 2 together and tighten the six screws with spacers. Mate the connector on the logic board to the connector on 1A1A24. The module itself shall be installed as directed in paragraph 3-9.

4-4. Case Assembly (1A1A30) Troubleshooting.

If a problem still exists in the RT unit after performing the procedures contained in Chapter 3, the fault exists either in the parent board assemblies or the wiring and components external to the parent boards. While keeping in mind the symptoms discovered during the system testing of paragraph 3-11, use figure FO-6 as a guide and with a multimeter test the wiring between parent board assemblies 1A1A31 and 1A1A32 and the accessible components and wiring mounted on the mainframe. If 1A1A31 or 1A1A32 need to be removed or if the defect cannot be located and repaired, the RT unit must be forwarded to depot maintenance for repair.

## Section III. MODIFICATIONS

### 4-5. General.

Modifications of the AN/PRC-70 will normally be performed at depot level. In the event a modification is to be performed at general support level appropriate instructions and parts required will be supplied.

# CHAPTER 5

# MATERIAL USED IN CONJUNCTION WITH MAJOR ITEM

## 5-1. General

Operating instructions for the auxiliary equipment used with the AN/PRC-70 Radio Set are provided in TM 11-5820-553-12, Operator and Organizational Maintenance Manual. For maintenance and troubleshooting information on the auxiliary equipment, consult the applicable technical manual (refer to Appendix A).

## APPENDIX A

## REFERENCES

| Publication | Title |
|---|---|
| DA PAM 310-4 | Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, and Lubrication Orders |
| DA PAM 310-6 | Index of Supply Manuals (other than types 7, 8, and 9) |
| DA PAM 310-7 | Index of Modification Work Orders |
| SB11-573 | Painting and Preservation Supplies Available for Field Use for Electronics Command Equipment |
| SB38-100 | Preservation, Packaging, Packing, and Marking Materials, Supplies, and Equipment Used by the Army |
| SB700-20 | Army Adopted and Other Items of Materiel Selected for Authorization |
| SB700-20-1 | List of Reportable Items, Army Equipment Status Reporting System |
| TB746-10 | Field Instructions for Painting and Preserving Electronics Command Equipment |

| Publication | Title |
|---|---|
| TM11-5815-313-12 | Operator and Organizational Maintenance Manual, Recorder-Reproducer Set, Signal Data RO-291/GSH-6 |
| TM11-5820-477-12 | Organizational Maintenance Manual, Radio Set Control Groups AN/GRA-39 and AN/GRA-39A |
| TM11-5820-553-20P | Organizational Maintenance Repair Parts and Special Tools List, Radio Set AN/PRC-70 |
| TM11-5835-224-12 | Operator and Organizational Maintenance Manual, Coderburst Transmission Group AN/GRA-71 |
| TM38-750 | The Army Maintenance Management System (TAMMS) |
| TM740-90-1 | Administrative Storage of Equipment |
| TM750-244-2 | Procedures for Destruction of Electronics Material to Prevent Enemy Use (Electronics Command) |

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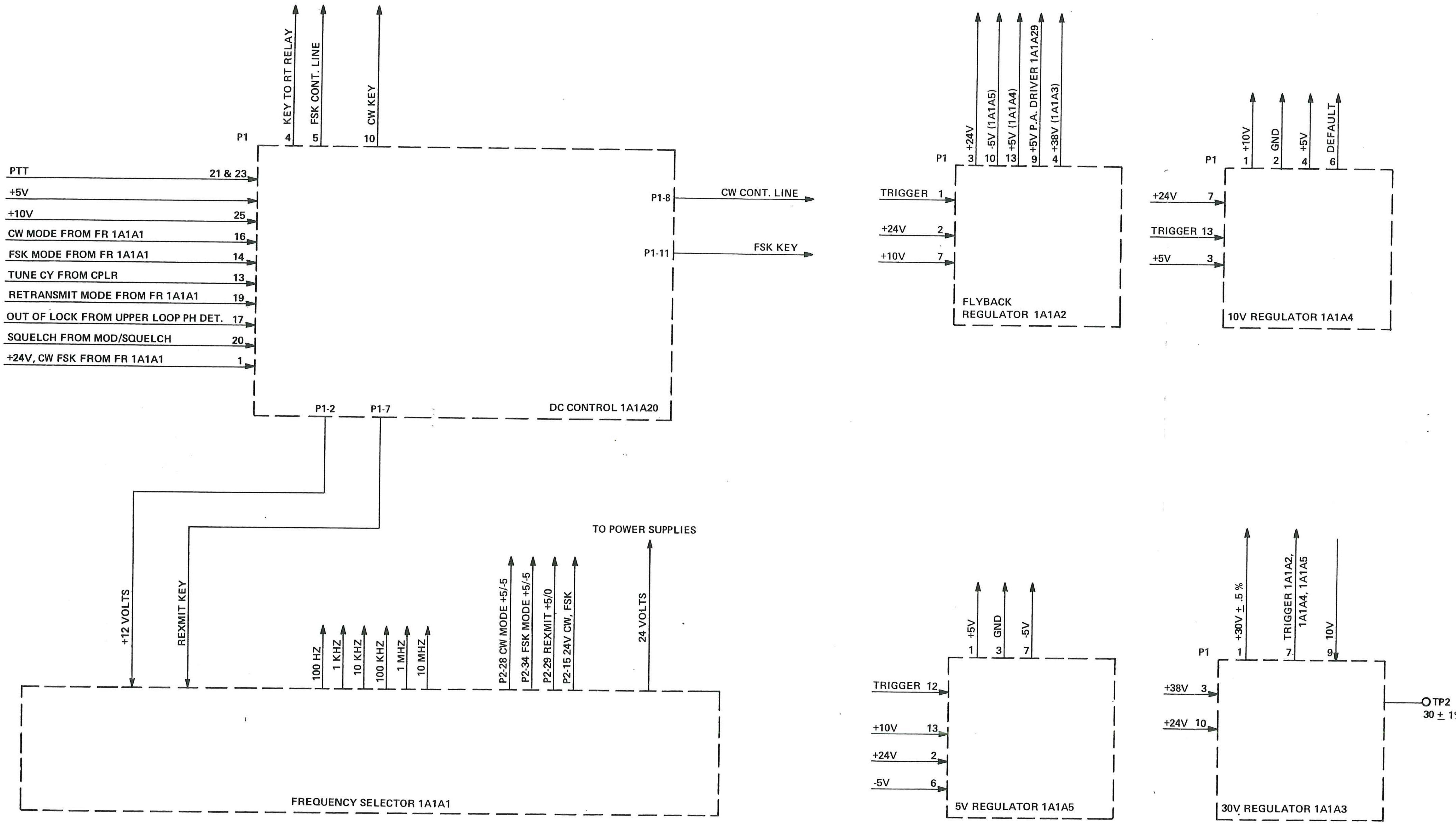



EL5820-553-34-TM-2 (2)

Figure FO-2. Receiver-transmitter block diagram (sheet 2 of 2)

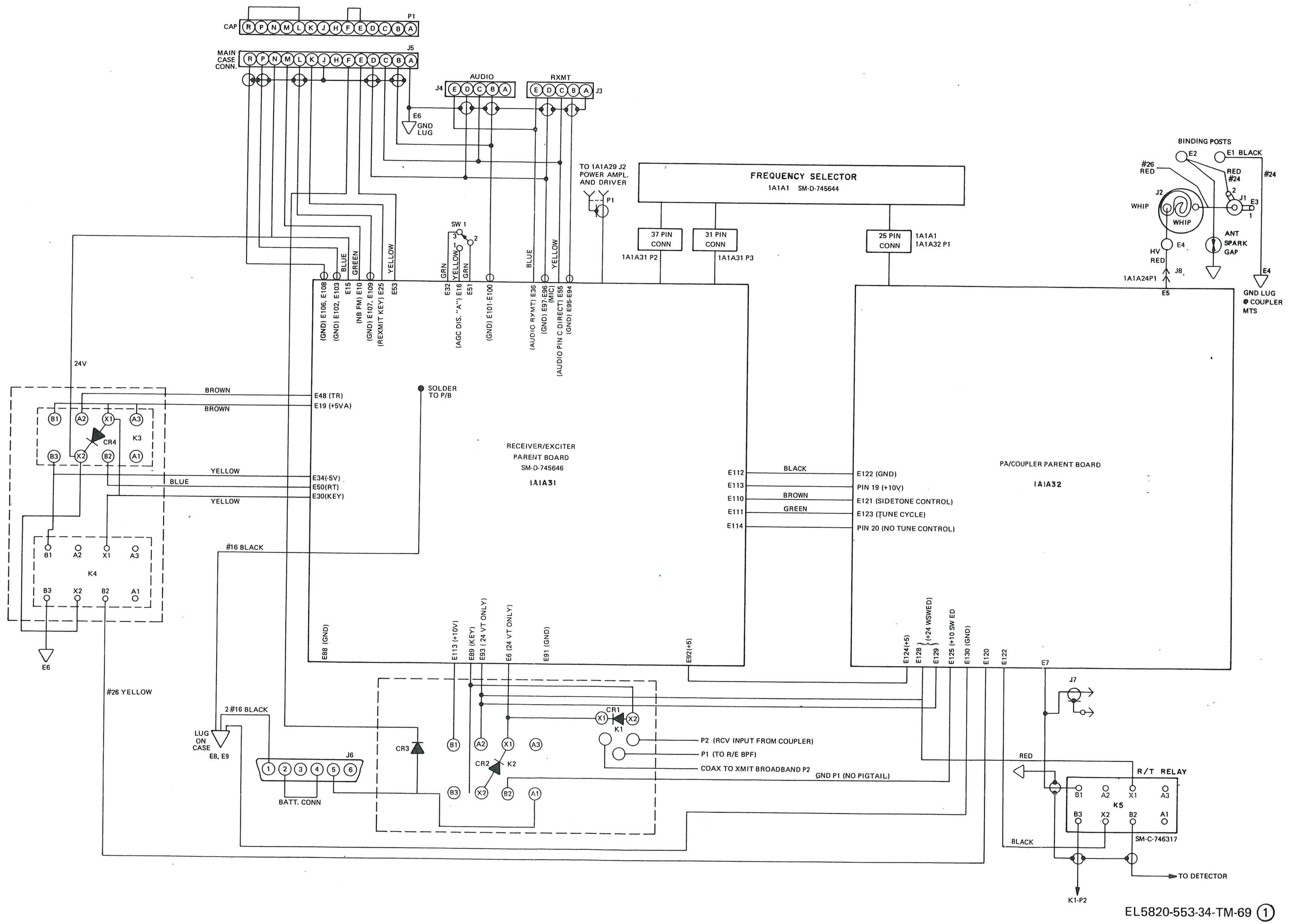



Figure FO-6. Case assembly (1A1A30), interwiring diagram (sheet 1 of 3)

| Receiver Exciter Parent Bd. | 31 Pin Conn | 37 Pin Conn | Frequency Selector | 25 Pin Conn | PA/Coupler | Main Case & Assemblies |
|---|---|---|---|---|---|---|
| E1 | | 17 | Mode S2R-5 | | | |
| E2 | | 37 | Mode S2R-4 | | | |
| E3 | * | 36 | | | | |
| E4 | | 33 | E7 | | | |
| E5 | | 35 | Mode S2R-3 | | | |
| E6 | | 30 | SQ S1F-6 | | | |
| E7 | | | NC | | | |
| E8 | | 34 | Mode S2R-2 | | | |
| E9 | | | NC | | | |
| E10 | | | | | | Secur Pin M |
| E11 | | 29 | SQ S1F-8 | | | |
| E12 | | | NC | | | |
| E13 | | 28 | Mode S2R-1 | | | |
| E14 | | 18 | PWR S1P-8 | | | |
| E15 | | | | | | Secur Pin N |
| E16 | | | | | | SW 1 |
| E17 | | 15 | Mode S1F-6 | | | |
| E18 | | 32 | E56 | | | |
| E19 | | | | | | K3-A3, B1 |
| E20 | | 31 | Mode S2R-7 | | | |
| E21 | | 14 | Mode S1R-8 | | | |
| E22 | | 7 | E39 | | | |
| E23 | 6 | | GND | | | |
| E24 | | 19 | SQ S1R-3 | | | |
| E25 | | | | | | J5-K |
| E26 | 10 | | GND | | | |
| E27 | | | NC | | | |
| E28 | 17 | | E9 | | | |
| E29 | | 9 | Mode S1R-4 | | | |
| E30 | | | NC | | | K3-X1, K4-X1 |
| E31 | | | NC | | | |
| E32 | | | | | | SW 1 |
| E33 | | | NC | | | |
| E34 | | | | | | K3 K4 A3 B1 B3 |
| E35 | 31 | * | | | | |
| E36 | | | | | | Audio Rexmit Pin E |
| E37 | 29 | | PWR S1F-2 | | | |
| E38 | 5 | | S2C-4 | | | |
| E39 | 29 | | E21 | | | |
| E40 | 11 | | Spare | | | |
| E41 | 3 | | Spare | | | |
| E42 | | | | | | Coax GND for E45 |
| E43 | | | Coax GND for E60 | | | |
| E44 | 2 | | E28 | | | |
| E45 | | | E50 | | | |
| E46 | | | NC | | | |
| E47 | | | NC | | | |
| E48 | | | | | | K3-A2 |
| E49 | | | NC | | | |
| E50 | | | | | | K3-B2 |
| E51 | | | | | | SW 1-Cont |
| E52 | 4 | | SQ S1R-10 | | | |
| E53 | | | | | | J5-E |
| E54 | | | Spare(E39) | | | |
| E55 | | | | | | J3,J4,J5-E |
| E56 | | | Spare(E40) | | | |
| E57 | 3 | | Spare(E41) | | | |
| E58 | 8 | | SQ S1F-1 | | | |
| E59 | 7 | | E8 | | | |
| E60 | | | E22 | | | |
| E61 | | 1 | E30 | | | |
| E62 | | 5 | E46 | | | |
| E63 | | 2 | E11 | | | |
| E64 | | 21 | E18 | | | |
| E65 | | 20 | E51 | | | |
| E66 | | 22 | E37 | | | |
| E67 | | 24 | E47 | | | |
| E68 | | 25 | E12 | | | |
| E69 | 27 | | E34 | | | |

| Receiver Exciter Parent Bd. | 31 Pin Conn | 37 Pin Conn | Frequency Selector | 25 Pin Conn | PA/Coupler | Main Case & Assemblies |
|---|---|---|---|---|---|---|
| E70 | | 6 | E57 | | | |
| E71 | | 3 | E36 | | | |
| E72 | 24 | | E42 | | | |
| E73 | 22 | | E41 | | | |
| E74 | 23 | | E1 | | | |
| E75 | 25 | | E25 | | | |
| E76 | 26 | | E3 | | | |
| E77 | | 13 | E38 | | | |
| E78 | | 8 | E52 | | | |
| E79 | | 4 | E53 | | | |
| E80 | | 12 | E5 | | | |
| E81 | | 16 | E54 | | | |
| E82 | 21 | | E45 | | | |
| E83 | 19 | | E48 | | | |
| E84 | 18 | | E19 | | | |
| E85 | 1 | | E16 | | | |
| E86 | | 27 | E55 | | | |
| E87 | | 26 | E15 | | | |
| E88 | | | | | | J6-1 |
| E89 | | | | | | K1-X2, K2-X2 |
| E90 | | | | | | K1-X1, K2-X2 |
| E91 | | | | | E130 | |
| E92 | | | | | E124 | |
| E93 | | | | | E128, E129 | K2-A2 |
| E94 | | | | | | Coax GND for E95 |
| E95 | | | | | | Rexmit Pins B |
| E96 | | | | | | Coax GND for E97 |
| E97 | | | | | | Secur Audio Rexmit Pin D |
| E98 | | | | | | GND VC |
| E99 | | | VC High Pot | | (BLK) | |
| E100 | | | | | | Coax GND for E101 |
| E101 | | | | | | Secur Audio Pin B |
| E102 | | | | | | Coax GND for E103 |
| E103 | | | | | | Secur Pin P |
| E104 | | | VC Low Pot - | | (BRN) | |
| E105 | | | VC Wiper | | (White) | |
| E106 | | | | | | Coax GND for E108 |
| E107 | | | | | | Coax GND for E109 |
| E108 | | | | | | Secur Pin R |
| E109 | | | | | | Secur Pin L |
| E110 | | | | | E121 | |
| E111 | | | | | E123 | |
| E112 | | | | | E122 | |
| E113 | | | | 19 | | K2-B1 |
| E114 | | | | 20 | | |
| E115 | | | NC | | | |
| E116 | | | NC | | | |
| | | | E7 | 1 | | |
| | | | E31 | 2 | | |
| | | | E32 | 3 | | |
| | | | E6 | 4 | | |
| | | | E48 | 5 | | |
| | | | E2 | 6 | | |
| | | | E40 | 7 | | |
| | | | E23 | 8 | | |
| | | | E27 | 9 | | |
| | | | E26 | 10 | | |
| | | | PWR-(S1A7) | 11 | | |
| | | | E35 | 12 | | |
| | | | PWR S2F-3 | 13 | | |
| | | | PWR S1R-3 | 14 | | |
| | | | PWR S2R-1 | 15 | | |
| | | | NC | 16 | | |
| | | | NC | 17 | | |
| | | | Mode S2R-3 | 18 | E127 | |
| | | | NC | 19 | | |
| | | | NC | 20 | | |
| | | | NC | 21-25 | | |
| | | | | | E120 | KH-B2 |

EL5820-553-34-TM-69 (3)

Figure FO-6. Case assembly (1A1A30), interwiring diagram (sheet 3 of 3)

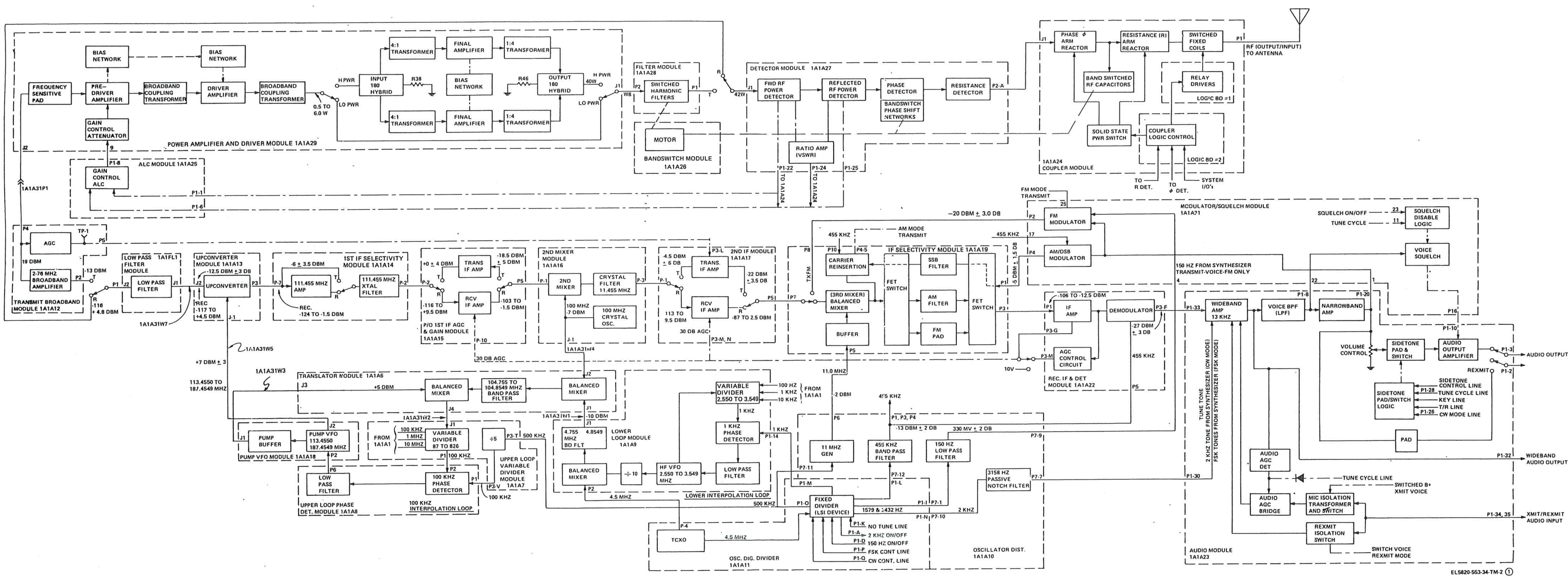
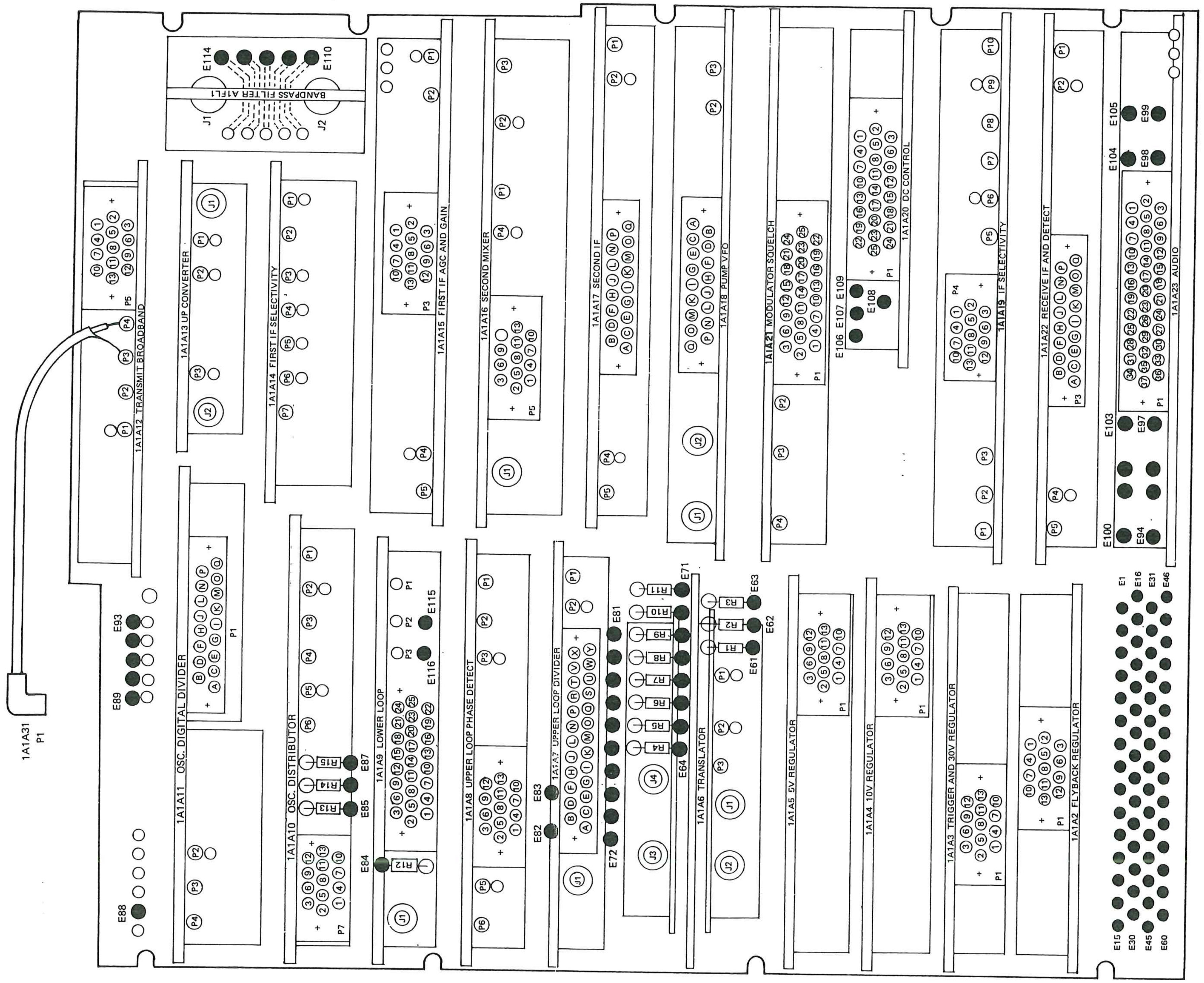


Figure FO-2. Receiver-transmitter block diagram (sheet 1 of 2)



COAX CABLE HOOK-UP CHART

| REF DES | FROM | TO |
|---|---|---|
| 1A1A31W1 | 1A1A6J1 | 1A1A9J1 |
| 1A1A31W2 | 1A1A7J1 | 1A1A6J4 |
| 1A1A31W3 | 1A1A6J3 | 1A1A18J1 |
| 1A1A31W4 | 1A1A6J2 | 1A1A16J1 |
| 1A1A31W5 | 1A1A18J2 | 1A1A13J1 |
| 1A1A31W7 | 1A1A13J2 | 1A1FL1J1 |

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Figure FO-4. Receiver/Exciter parent board (1A1A31), bottom view