Радио Уређај RU-20
(Collins PRC-515)
Техничко Упутство

(за штампање на А4 формату)

Yugoslav RU-20 (Collins PRC-515) Radio Set
Instruction Book

(for printing on 8.5x11 in. letter size format)

523-0769144-001211
1 July 1978

Rockwell
International

instruction book

COLLINS AN/PRC-515 RADIO SET

Collins Telecommunications
Products Division
Electronic Systems Group
Rockwell International
Cedar Rapids, Iowa 52406

Printed in the United States of America

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

TABLE OF CONTENTS (Cont)

(Missing page)

(Missing page)

LIST OF ILLUSTRATIONS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

INTRODUCTION

This manual contains second and third line maintenance instructions for Radio Set AN/PRC-515. It includes a description of the equipment, maintenance procedures, illustrated parts list, and schematics. Throughout the manual, common names are used for nonmenclatured items of Radio Set AN/PRC-515 and several nomenclatured accessory items. The common names are:

NOMENCLATURE	COMMON NAME
Receiver-Transmitter Group OR-5007/URC	receiver-transmitter group
Radio Receiver-Transmitter RT-5047/URC	receiver-transmitter
Receiver-Transmitter Control C-5310/URC	control
Amplifier-Coupler AM-5280/URC	amplifier-coupler
Storage Battery BB-706/U	battery
Radio Set Harness MT-5167/PRC-515	pack frame
Antenna AS-5093/PRC-515	whip antenna
Handset H-5017/GR	handset
Headset-Microphone H-5016/PRC-515	headset
Electrical Power Cable Assembly CX-5229/PRC-515	battery cable
Battery Charger PP-5267/U	battery charger
Direct Current Generator G-5002/PRC-515	generator
Telegraph Key KY-5033/PRC-515	telegraph key
Antenna AS-5094/PRC-515	dipole antenna
Antenna Counterpoise AS-5095/PRC-515	antenna counterpoise

Additional manuals that support Radio Set AN/PRC-515 include:

Radio Set AN/PRC-515 Operator's Manual

Radio Test Set AN/PRM-501

Radio Test Set AN/PRM-502

Battery Charger PP-5267/U Maintenance Manual

SECTION I

DESCRIPTION

1.1 PURPOSE

Radio Set AN/PRC-515 (figure 1-1) is a backpack, single-sideband, high-frequency receiver-transmitter that provides tactical voice and CW communications in the 2.0000- to 29.9999-MHz frequency range with a channel spacing of 100 Hz.

1.2 EQUIPMENT SUPPLIED

Equipment supplied as part of Radio Set AN/PRC-515, is shown in figure 1-2, and is listed in table 1-1.

1.3 ACCESSORY EQUIPMENT

Accessory equipment available for use with Radio Set AN/PRC-515 is shown in figure 1-3 and is listed in table 1-2.

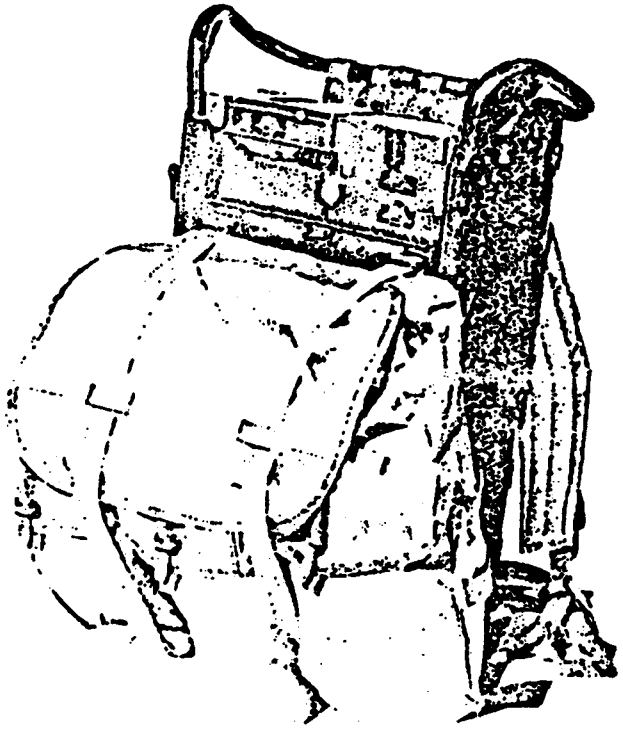
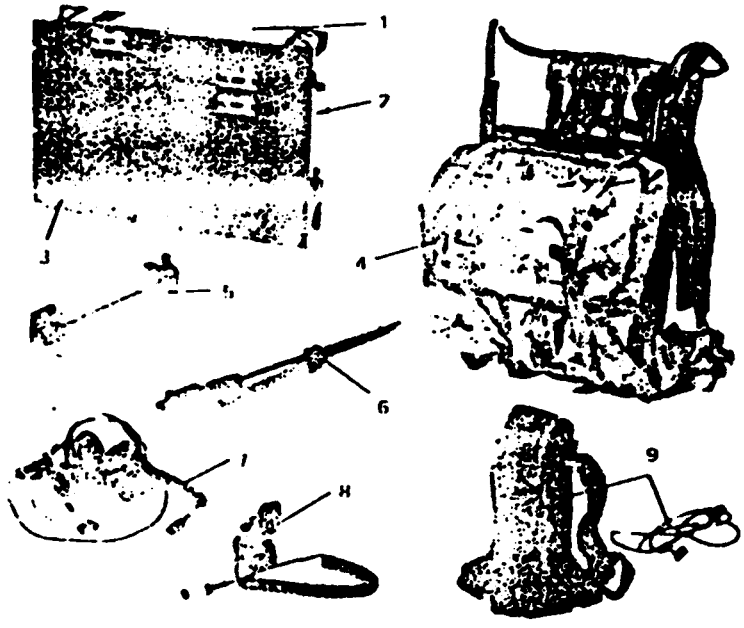


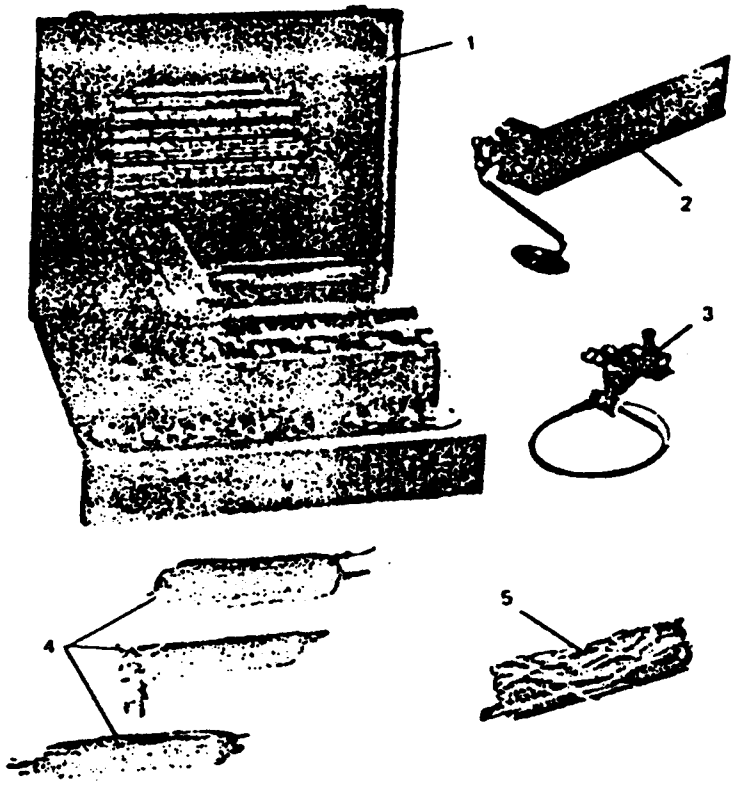
Figure 1-1. Radio Set AN/PRC-515



1. RECEIVER-TRANSMITTER CONTROL C-5310/URC
2. RADIO RECEIVER-TRANSMITTER RT-5047/URC
3. AMPLIFIER-COUPLER AM-5280/URC
4. RADIO SET HARNESS MT-5167/PRC-515
5. STORAGE BATTERY BB-706/U
6. ANTENNA AS-5093/PRC-515
7. HEADSET-MICROPHONE H-5016/PRC-515
8. HANDSET H-5017/GR
9. ELECTRICAL POWER CABLE ASSEMBLY CX-5229/PRC-515

TPA-0797-017

Figure 1-2. Equipment Supplied



1. BATTERY CHARGER PP-5267/U
2. DIRECT CURRENT GENERATOR G-5002/PRC-515
3. TELEGRAPH KEY KY-5033/PRC-515
4. ANTENNA AS-5094/PRC-515
5. ANTENNA COUNTERPOISE AS-5095/PRC-515

TPA-0298-017

Figure 1-3. Accessory Equipment

QTY	NOMENCLATURE	COLLINS PART NUMBER
*1	Radio Receiver-Transmitter RT-5047/URC	622-2148-002
*1	Receiver-Transmitter Control C-5310/URC	622-2553-003
*1	Amplifier-Coupler AM-5280/URC	622-2149-001
2	Storage Battery BB-706/U	629-5703-001
1	Radio Set Harness MT-5167/PRC-515	629-3425-002
1	Antenna AS-5093/PRC-515	629-5702-001
1	Handset H-5017/GR	637-1952-001
1	Headset-Microphone H-5016/PRC-515	635-5148-001
1	Electrical Power Cable Assembly CX-5229/PRC-515	629-3428-001

*These items make up Receiver-Transmitter Group OR-5007/URC (Collins part number 622-1407-002).

Table 1-1. Equipment Supplied

NOMENCLATURE	COLLINS PART NUMBER
Battery Charger PP-5267/U	629-3416-003
Direct Current Generator G-5002/PRC-515	629-3415-001
Telegraph Key KY-5033/PRC-515	637-1949-001
Antenna AS-5094/PRC-515	622-3073-001
Antenna Counterpoise AS-5095/PRC-515	629-5896-001

Table 1-2. Accessory Equipment

1.4 EQUIPMENT SPECIFICATIONS

Frequency range	2 to 29.9999 MHz in 0.1-kHz increments.
Modes	Upper sideband (USB), amplitude modulation equivalent (AM), and continuous wave (CW).
Power output	20 watts (high power) or 2 watts (low power) nominal peak envelope or average power into 50 ohms with 1.3:1 vswr.
Duty cycle	Continuous for 12-hour period at 1:9 transmit voice/receive ratio using one Storage Battery BB-706/U
Tuning time	4 seconds nominal and 7 seconds maximum (after frequency selection is made).
Receiver sensitivity	
USB	-113 dB mW, 50-ohm rf input for a signal + noise/noise ratio of not less than 10 dB.
AM	-102 dB mW, 30% modulated, 50-ohm rf input for a signal + noise/noise ratio of not less than 10 dB.
Audio input	-56 to -26 dB mW into 600 ohms to develop rated rf output.
Audio output	10 mW into 600 ohms, adjustable with volume control.
Primary power	22 to 30 V dc (25.2 V dc nominal), 60 watts nominal on transmit CW and 1.5 watts nominal on receive (provided by Storage Battery BB-706/U).
Total weight	12.7 kg (28 lb).
Temperature range	
Operating	-54 to +65°C (-65.2 to +149°F).
Storage	-60 to +75°C (-76 to +167°F).
Operating altitude	3,048 metres (10,000 feet).
Operating humidity	95 percent relative humidity.

1.5 EQUIPMENT DESCRIPTION

1.5.1 Receiver-Transmitter Group OR-5007/URC

Receiver-Transmitter Group OR-5007/URC is a compact lightweight receiver-transmitter consisting of three units: Radio Receiver-Transmitter RT-5047/URC, Receiver-Transmitter Control C-5310/URC, and Amplifier-Coupler AM-5280/URC. When mechanically latched together, these units are electrically connected through mating connectors. All operating controls are located under a hinged cover on the control.

1.5.2 Storage Battery BB-706/U

Storage Battery BB-706/U is a rechargeable nickel-cadmium 1.8-Ah battery that latches beneath the receiver-transmitter group. It supplies dc power for 12 hours of operation at a 1:9 transmit voice/receive duty cycle.

1.5.3 Radio Set Harness MT-5167/PRC-515

Radio Set Harness MT-5167/PRC-515 is a lightweight, rugged pack frame with adjustable straps. It can hold, simultaneously, a receiver-transmitter group, a battery, and either a Direct Current Generator G-5002/PRC-515 or a spare battery. The field pack, part of the pack frame, has compartments to store all the accessory items except the battery charger.

1.5.4 Antenna AS-5093/PRC-515

Antenna AS-5093/PRC-515 is a 2.4-metre (8-foot) whip antenna that can be easily folded for storage. It has a shock absorbing mount and detent positioning device capable of ±90° front-to-back movement in 45° increments.

1.5.5 Handset H-5017/GR

Handset H-5017/GR has an earpiece, a microphone, a push-to-talk (ptt) switch, and connects to the control by means of a coiled cord.

1.5.6 Headset-Microphone H-5016/PRC-515

Headset-Microphone H-5016/PRC-515 has two earpieces, a boom microphone, a ptt switch, a headband, and connects to the control by means of a coiled cord.

1.5.7 Electrical Power Cable Assembly CX-5229/PRC-515

The CX-5229/PRC-515 is a 1.5-metre (5-foot) cable and a canvas bag with an adjustable shoulder strap. It allows the battery to be carried under the operator's outer clothing during very cold weather.

1.5.8 Battery Charger PP-5267/U

Battery Charger PP-5267/U is a portable battery charger that will discharge and charge six batteries simultaneously. It operates from either 28-V dc or 110-V ac power source.

1.5.9 Direct Current Generator G-5002/PRC-515

Direct Current Generator G-5002/PRC-515 is a hand-operated generator that can be latched between the receiver-transmitter group and the battery to extend operating time indefinitely.

charging rates are indicated by lamps; green for normal operation and red for high charging rate.

1.5.10 Telegraph Key KY-5033/PRC-515

Telegraph Key KY-5033/PRC-515 is adjustable in tension and gap and connects to the control by means of a 0.9-metre (3-foot) flexible cord and connector. The telegraph key can be attached to the operator's thigh with a strap.

1.5.11 Antenna AS-5094/PRC-515

Antenna AS-5094/PRC-515 is a dipole antenna that consists of two 35.67-metre (117-foot) braided wires, wrapped on individual plastic bobbins, and allows long-range communications. Each wire has a 30.48-metre (100-foot) throwing line attached. The two wires are connected to a center junction, which is connected to the receiver-transmitter with a 15.25-metre (50-foot) coaxial feeder line.

1.5.12 Antenna Counterpoise AS-5095/PRC-515

The AS-5095/PRC-515 provides a ground plane in low electrical conductivity areas. It consists of four 10-metre (32.8-foot) braided wires and a 1.8-metre (6-foot) feeder cable connected to a center junction. The wires and feeder cable are wrapped on a plastic bobbin for storage.

1.6 OPERATING CONFIGURATIONS AND OPTIONS

1.6.1 Standard Configuration

The standard configuration consists of the receiver-transmitter group and the battery installed in the pack frame. The whip antenna is connected to the antenna connector on the amplifier-coupler, and the handset or the headset is connected to one of the audio connectors on the control. For CW operation, the telegraph key is connected to one of the audio connectors. This configuration is used for missions of up to 12 hours operating time and communications distances up to 25 kilometres (15.5 miles).

1.6.2 Spare Battery Option

When missions of up to 24 hours operating time are required, a spare battery is latched to the bottom of the operational battery. The spare battery is not electrically connected to the system. When the operating battery is discharged, it is interchanged with the spare.

1.6.3 Generator Option

For cases of isolated or extended missions, a generator can be used to maintain battery charge. The generator connects between the receiver-transmitter group and the battery. A clip on the pack frame secures the generator crank.

1.6.4 Cold Weather Configuration

During cold weather of 0°C (32°F) and colder, the battery must be kept warm to obtain sufficient mission time. The battery cable allows the battery to be removed from the receiver-transmitter group and to be carried in a battery bag under the operator's outer clothing.

1.6.5 Antenna Options

In dry or rocky terrain of low electrical conductivity, the antenna counterpoise provides a ground plane for the whip antenna. The four braided wires of the antenna counterpoise are laid out on the ground, and the feedline connector is plugged into the coaxial BNC connector on the amplifier-coupler.

For extended communications ranges, the whip antenna is replaced with the dipole antenna. The dipole antenna can be erected using available structures such as buildings or trees. Each end of the dipole terminates in a bobbin that allows adjustment of the length. Marking on the braided wire facilitates selection of the proper length for the desired operating frequency. The antenna feedline is plugged into the coaxial BNC connector on the amplifier-coupler.

1.7 PRINCIPLES OF OPERATION

Figure 1-4 is a block diagram of Radio Set AN/PRC-515, including optional accessory items and figure 1-5 is a block diagram of the receiver-transmitter group.

1.7.1 Receive Functional Theory

The receiver-transmitter group is in the receive mode whenever the push-to-talk (ptt) or CW key line is open. In the receive mode, the receive-transmit relays in power amplifier A3A4 and broadband amplifier A1A3 bypass these amplifiers and connect the antenna rf signal to mixer A1A2 where it is converted to a 5-MHz if signal.

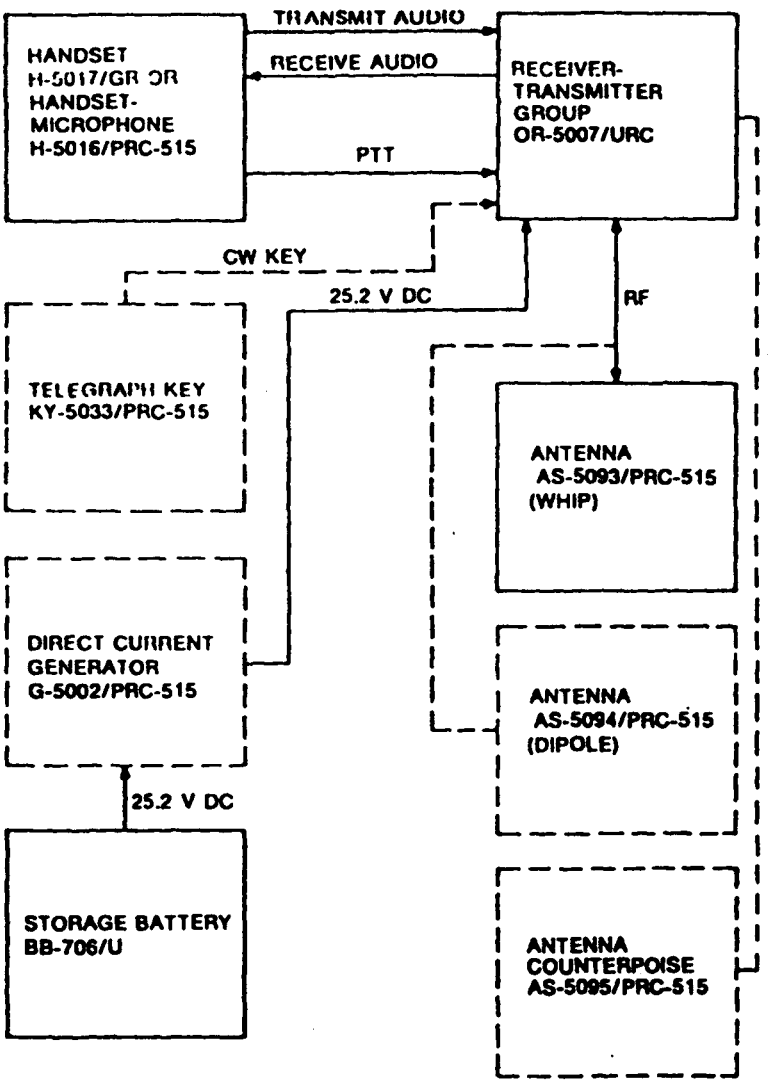
Mixer A1A2 consists of two mixer circuits and a 115-MHz filter. The first mixer circuit mixes the rf signal with a variable injection signal (117 to 145 MHz) from frequency synthesizer A1A6. The variable injection frequency is controlled by frequency selectors on the control. The output of the first mixer is passed through a 115-MHz bandpass filter to the second mixer. In the second mixer the 115-MHz if signal is mixed with a 110-MHz injection signal to produce a 5-MHz if signal. The 5-MHz if signal is fed to if/af amplifier A1A5 where it is converted to an audio signal.

If/af amplifier A1A5 performs USB or AM detection depending on the position of the MODE selector on the control. The detection circuits receive a 5-MHz injection signal from frequency synthesizer A1A6. The volume control on the control sets the audio input level of A1A5. The receive audio A1A5 is coupled through a filter in the control and is parallel connected to the two audio connectors on the control.

1.7.2 Transmit Functional Theory

The receiver-transmitter group is in the transmit mode whenever the ptt or CW key line is closed. During CW operation, a delay circuit in A1A5 maintains the transmit mode during normal CW key open periods (1 second maximum).

On voice operation, the transmit audio signal is passed through a filter in the control to if/af amplifier A1A5 in the radio receiver-transmitter. In A1A5, the voice signal is amplified and applied to a balanced modulator. The balanced modulator uses a 5-MHz injection signal from frequency synthesizer A1A6 to produce a 5-MHz double-sideband signal, which is passed through a SSB filter to produce a single-sideband (SSB) signal. In AM, the 5-MHz carrier is reinserted after the SSB filter to produce an equivalent AM signal consisting of the SSB signal and a 5-MHz carrier.



NOTE:
BROKEN LINES INDICATE OPTIONAL ACCESSORY ITEMS.

TP5-2539-019

Figure 1-4. Radio Set AN/PRC-515, Block Diagram

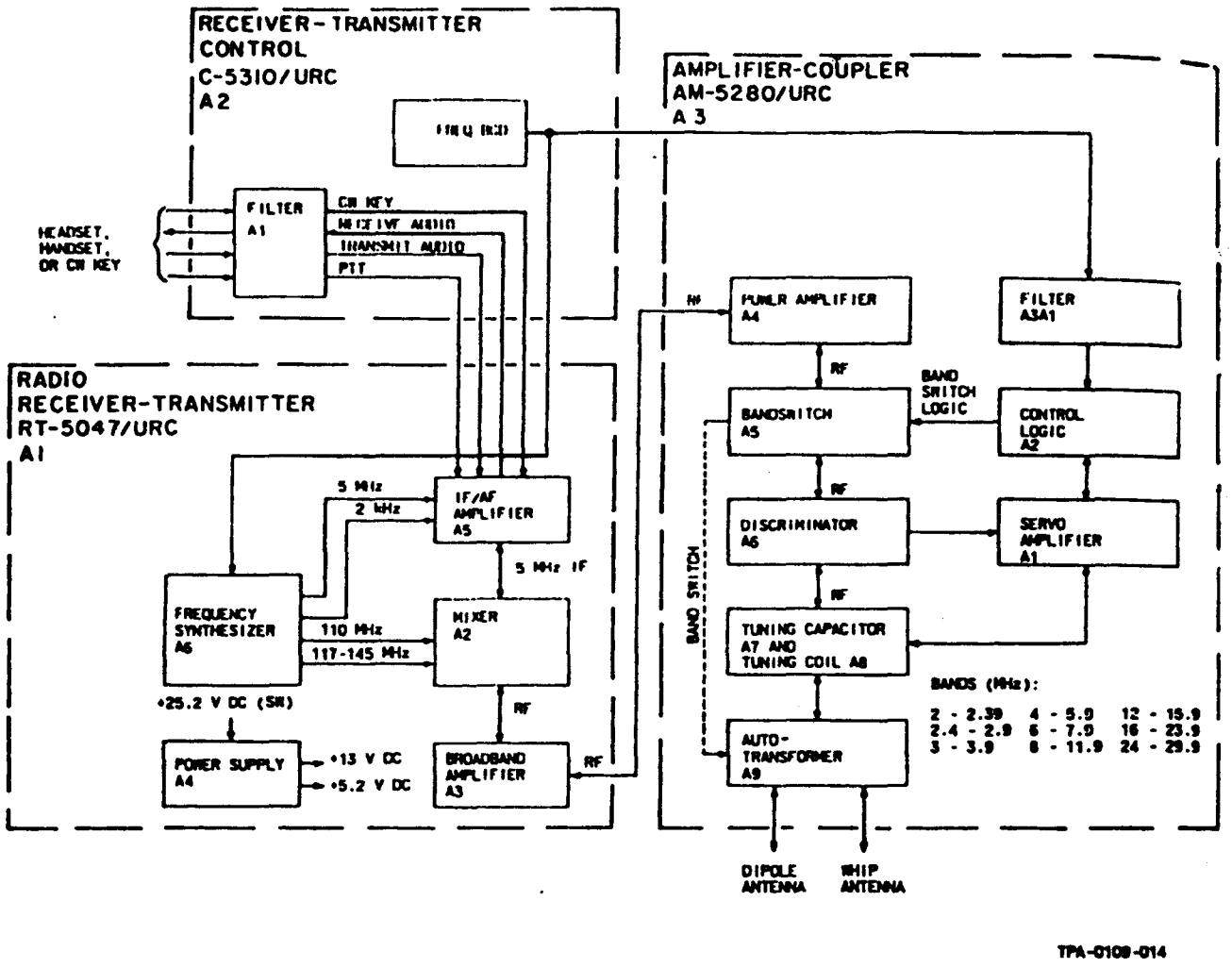


Figure 1-5. Receiver-Transmitter Group or OR -5007/URC, Block Diagram

On CW operation, the CW key line is filtered in the control and applied to if/af amplifier A1A5 in the radio receiver-transmitter. A CW keying circuit in A1A5 applies a keyed 2-kHz signal to the input of the balanced modulator. The 2-kHz signal is obtained from frequency synthesizer A1A6.

Mixer A1A2 converts the 5-MHz voice or CW if signal to an rf signal of the desired frequency. Mixer A1A2 consists of two mixers and a 115-MHz bandpass filter. In the first mixer circuit, the 5-MHz if signal is mixed with a 110-MHz injection signal from frequency synthesizer A1A6. The output of this mixer is fed through a 115-MHz bandpass filter to the second mixer. In the second mixer, the 115-MHz if signal is mixed with a variable injection frequency (117 to 145 MHz) from frequency synthesizer A1A6 to produce the desired rf signal frequency. The variable injection frequency is controlled by frequency selectors on the control.

The output of mixer A1A2 is amplified to approximately 250 mW by broadband amplifier A1A3 and applied to power amplifier A3A4. Power amplifier A3A4 amplifies the output to 2 watts or 20 watts depending upon the setting of the POWER/PUISSANCE switch on the control. The output of power amplifier A3A4 is fed through bandswitch A3A5, discriminator A3A6, tuning capacitor A3A7, tuning coil A3A8, and autotransformer A3A9 to the antenna. When connected, the whip antenna is used. When the whip antenna is disconnected, a switch in the amplifier-coupler selects the dipole antenna.

1.7.3 Tuning Functional Theory

Whenever power is turned on or a new frequency is selected, the control applies a rechannel pulse to if/af amplifier A1A5. If/af amplifier A1A5 processes the rechannel pulse and applies it to frequency synthesizer A1A6 and control logic A3A2. Frequency synthesizer A1A6 generates a new variable injection frequency based on binary coded decimal (bcd) information received from the frequency selectors on the control. Control logic A3A2 also receives bcd frequency information from the selector switches and provides band-switching information to bandswitch A3A5. During synthesizer frequency changing and band switching, the transmit circuit is disabled. When band switching is complete, control logic A3A2 advances to a standby condition. In this condition, frequency synthesizer A1A6 and bandswitch A3A5 are tuned to the new frequency, but tuning capacitor A3A7 and tuning coil A3A8 are tuned to the old frequency. The receive circuits are operational, but the transmit circuits are disabled.

Final tuning is initiated by momentarily pressing the ptt switch or the CW key. Control logic A3A2 now advances to the tune state and (1) a 2-kHz audio tone is applied to the operator's headset; (2) a transmit signal at the selected frequency is supplied to the amplifier-coupler for tuning; (3) the transmitter is keyed; and (4) tuning capacitor A3A7 and tuning coil A3A8 are servo tuned to the new frequency using the output of discriminator A3A6. When vswr remains below approximately 1.3:1 for 300 milliseconds, control logic A3A2 advances to the operate state and the transmitter is unkeyed. Tuning is now complete.

During transmit operation, the vswr is continuously monitored and if it goes above 1.3:1 for more than 2 seconds, a retune cycle is initiated. In retune, the servo amplifiers are enabled and the servo motors are driven by discriminator phasing and loading inputs, derived from the transmitter voice envelope, until the vswr is below 1.3:1 for more than 300 milliseconds.

Transmit operation is checked by a tune incomplete monitor circuit in control logic A3A2. A fault condition occurs if (1) the tune or retune cycle is not completed or (2) the rf voltage at the junction of the tuning coil and tuning capacitor exceeds 850 volts peak. When a fault condition occurs, tuning stops, the transmit circuit is disabled, and an interrupted 2-kHz tone (beeping) is applied to the operator's headset. A tune incomplete condition is reset by rechanneling the frequency selectors on the control.

1.7.4 Receiver-Transmitter Group OR-5007/URC Detailed Theory

1.7.4.1 Receiver-Transmitter Control A2, C-5310/URC

Refer to figure 4-14, schematics section of this manual. When Receiver-Transmitter Control C-5310/URC (control) is mechanically latched to Radio Receiver-Transmitter RT-5047/URC (receiver-transmitter), connector A2P1 is mated with A1A1J1 (as shown on figure 4-1, schematics section). Connectors J1 and J2 of A2 are connected in parallel to simultaneously accommodate any two of three audio I/O devices: Handset H-5017/GR, Headset-Microphone H-5016/PRC-515, and Telegraph Key KY-5033/PRC-515. The signals of the audio I/O device(s), CW KEY, PTT, RCV/XMT AUDIO, are filtered by the LC filter

network connected to each of the signal lines. The control provides OFF control for the receiver-transmitter group through mechanical linkage of a switch contact to the wiper arm of potentiometer A2R1. When A2R1 is rotated to the maximum counterclockwise (ccw) position, detent occurs (switch contact opens) and the +25.2-V dc (SW) voltage is removed from A2P1-36 and -49. Rotating A2R1 clockwise (cw) from the detent, closes the switch and applies +25.2 V dc from A2P1-24 and -30 to A2P1-36 and -49. Further rotation of A2R1 toward maximum cw increases the audio gain (AF GAIN HIGH) of the af amplifier stage of the receiver-transmitter. Rotating A2R1 ccw decreases af gain. When +25.2 V dc is switched to A2P1-36 and -49, the voltage is also applied to the lamp circuits of frequency selector switches A2S1 through A2S6. The switches are then illuminated when lamp test switch A2S7 is depressed and ground is applied. This illuminates switches A2S1 through A2S6 when the operator needs light to read the frequency or wants to make a lamp check. Frequency selection is made by actuating the appropriate switches until the desired frequency is read in the window adjacent to each switch. The frequency switches provide binary coded decimal (bcd) signals, representing the selected frequency, to which the receiver-transmitter and Amplifier-Coupler AM-5280/URC (amplifier-coupler) automatically tune. Operating modes, USB or AM, are selected by switch A2S8. An open circuit at A2P1-23 selects the AM (USB) function, whereas, a ground at A2P1-23 selects AM. Operating power level, HI PWR or LO PWR, is selected by switch A2S9. A ground at A2P1-27 places the radio in LOW POWER (2 watts) operation. An open at A2P1-27 selects LOW POWER (22 watts) operation. A rechannel signal (ground) is applied to A2P1-38 (RCP) whenever one or more of switches A2S1 through A2S6 are actuated.

1.7.4.2 Radio Receiver-Transmitter A1, RT-5047/URC

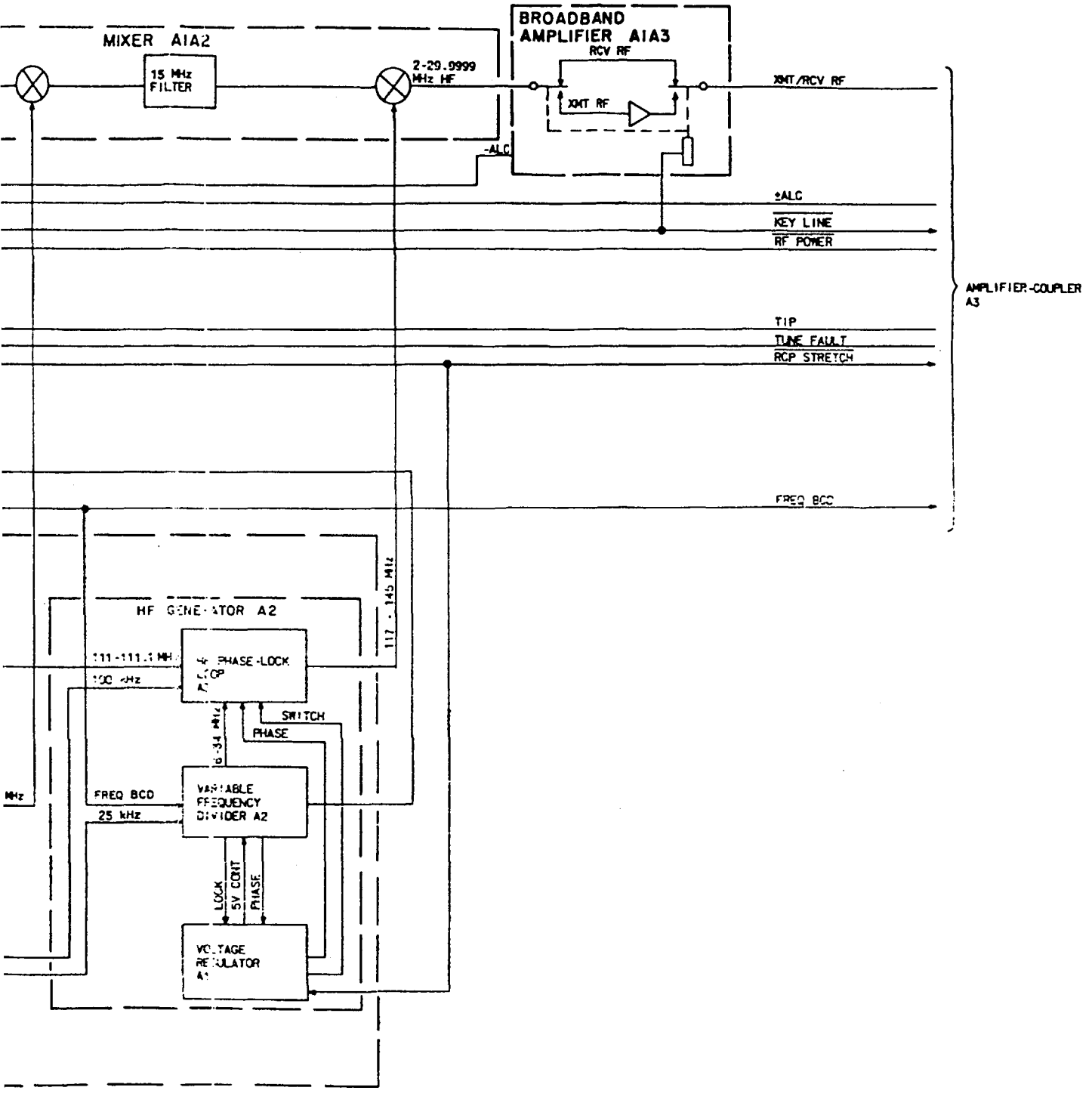
Refer to figure 1-6. The radio receiver-transmitter performs frequency translation and amplification of af to rf (transmit function) and rf to af (receive function) with five subassemblies: if/af amplifier (A1A5), mixer (A1A2), broadband amplifier (A1A3), frequency synthesizer (A1A6), and power supply (A1A4). If/af amplifier A1A5 provides af/if amplification, modulation/demodulation, if selectivity, and logic processing of control functions. Mixer A1A2 provides up and down conversion for the received or transmitted signals. Broadband amplifier A1A3 amplifies the transmit rf to approximately 250 mW to drive the power amplifier circuits of amplifier-coupler A3. Frequency synthesizer A1A6 generates and supplies injection frequencies to the mixer for up and down conversion, and carrier injection frequency and tone frequency to the if/af amplifier. Power supply A1A4 converts +25.2 volts dc (SW) into regulated +13-volt and -5.2-volt dc outputs for distribution to the other subassemblies.

1.7.4.2.1 Receiver Theory

Refer to figure 4-14, schematics section. At control A2 the operator selects either the USB or AM mode and the operating frequency. When A2 is turned on, tuning is complete, the radio is unkeyed, and receive operation of Radio Set AN/PRC-515 is in effect.

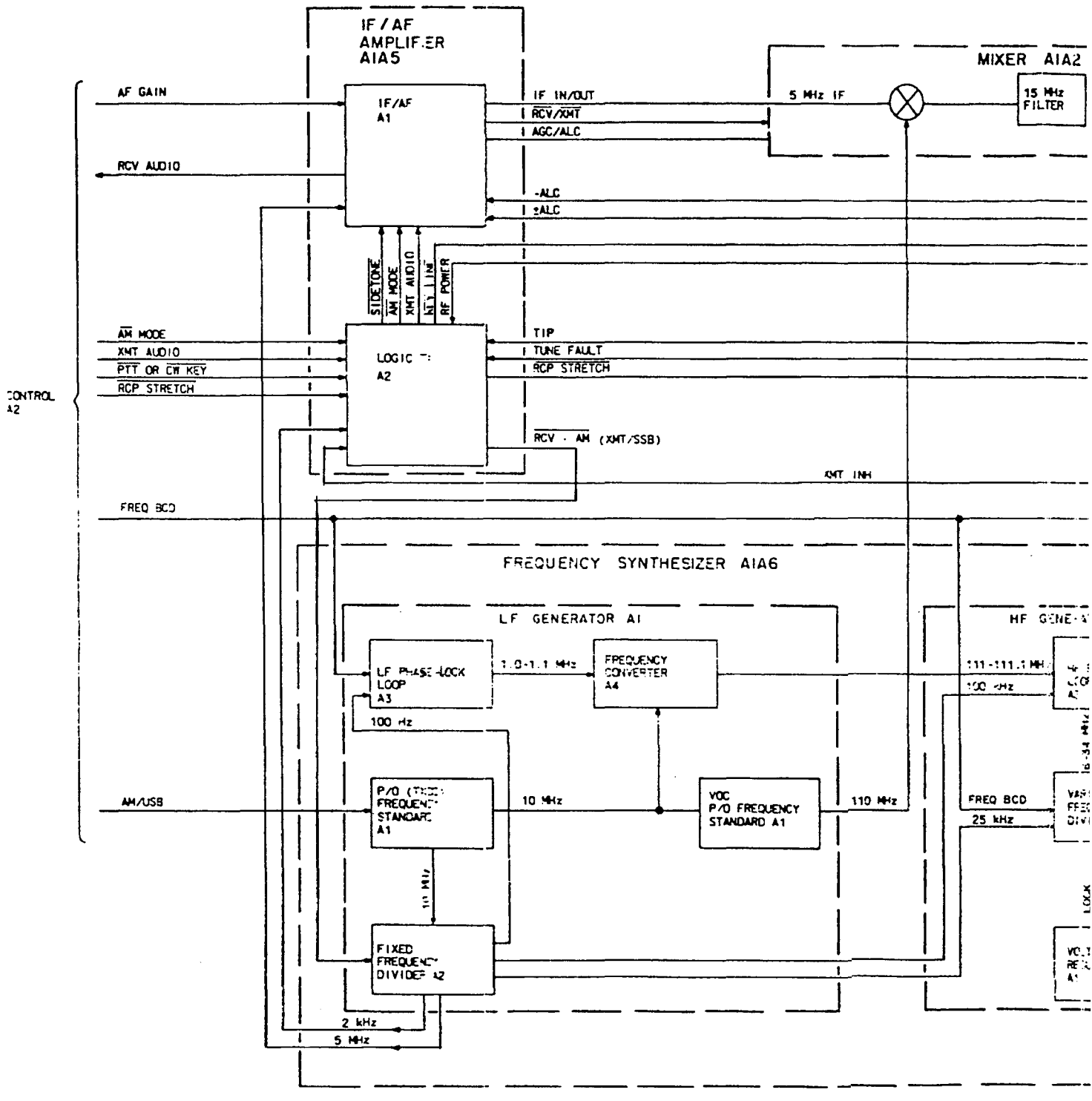
1.7.4.2.1.1 Broadband Amplifier A1A3

Refer to figure 1-7 in this section and figure 4-3 of the schematic section. The received signal is coupled from amplifier-coupler A3 through chassis A1A1 to connector A1A1J3/A1A1P1-12 and on to relay A1A3K1-A2. With the radio unkeyed, relay A1A3K1 is de-energized and relay contacts A2/A3 and B2/B3 are closed. This routes the received rf from P1-12 through the limiter and LC filter network to A1A1J3/A1A3P1-2.



TP5-0171-014

Figure 1-6. Radio Receiver-Transmitter RT-5047/URC, Block Diagram


IF / AF
AMPLIFIER
A1A5
MIXER A1A2
AF GAIN
IF/AF
A1
IF IN/OUT
RCV/XMT
AGC/ALC
5 MHz IF
15 MHz
FILTER
RCV AUDIO
-ALC
±ALC
SIDETONE
AM MODE
XMT AUDIO
RF POWER
AM MODE
XMT AUDIO
PTT OR CW KEY
RCP STRETCH
LOGIC
A2
TIP
TUNE FAULT
RCP STRETCH
RCV - AM (XMT/SSB)
XMT INH
CONTROL
A2
FREQ BCD
FREQUENCY SYNTHESIZER A1A6
LF GENERATOR A1
LF PHASE-LOCK
LOOP
A3
1.0-1.1 MHz
FREQUENCY
CONVERTER
A4
100 Hz
AM/USB
10 MHz
VOC
P/O FREQUENCY
STANDARD A1
110 MHz
FREQ BCD
25 kHz
FIXED
DIVIDER A2
2 kHz
5 MHz

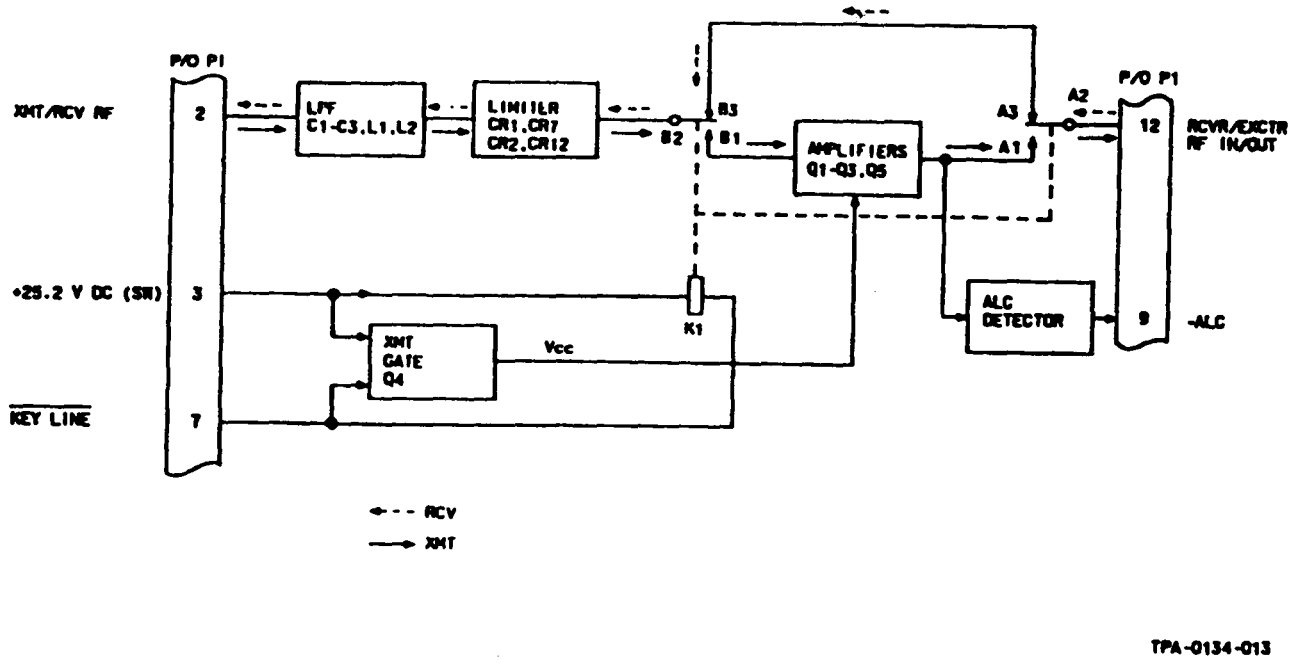


Figure 1-7. Broadband Amplifier (Receive or Transmit), Simplified Schematic Diagram

1.7.4.2.1.2 Mixer A1A2

Refer to figure 1-8 of this section and figures 4-1 and 4-2 of the schematic section. The receive rf (AM or USB) is routed by chassis wiring from broadband amplifier A1A3 to A1A1J2/A1A2P1-14. The control inputs supplied to A1A2 are $\overline{\text{XMT}}$ and $\overline{\text{RCV}}$ logic, and the AGC/ALC DRIVE from A1A5. During receive mode, RCV ($\overline{\text{XMT}}$) logic at A1A2P1-5 is high and the XMT ($\overline{\text{RCV}}$) logic at A1A2P1-6 is low. The RCV logic is applied to injection amplifier transistors Q9 and Q13, which in turn switches on diodes CR2, CR3, CR6, and CR8. The fixed and variable injection frequencies are now applied to the receive up conversion mixer Q1 and Q2 and the receive down conversion mixer Q11 and Q12. The XMT logic switches Q10 and Q14 are off, which disables both transmit mixers.

The receive rf (2-29.9999 MHz) from P1-14 passes through the low-pass LC filter, switching diode CR2, transformer T1, and on to the gates of the up conversion mixer FET's Q1 and Q2. FET's Q3 and Q4 neutralize the gate-to-drain capacity of Q1 and Q2. The receive rf is mixed with the variable injection frequency (117-144.9999 MHz) to obtain 115-MHz if, which is applied to the 115-MHz filter through diode CR3. The 115-MHz if out of the filter passes through diode CR6 and transformer T5 to the bases of down conversion mixer transistors Q11 and Q12. The 115-MHz if is mixed with fixed injection (110-MHz) to produce a 5-MHz if. The 5-MHz if (with upper and lower sidebands reversed) is coupled by transformer T6 through diode CR8 to P1-2 (IF OUT).

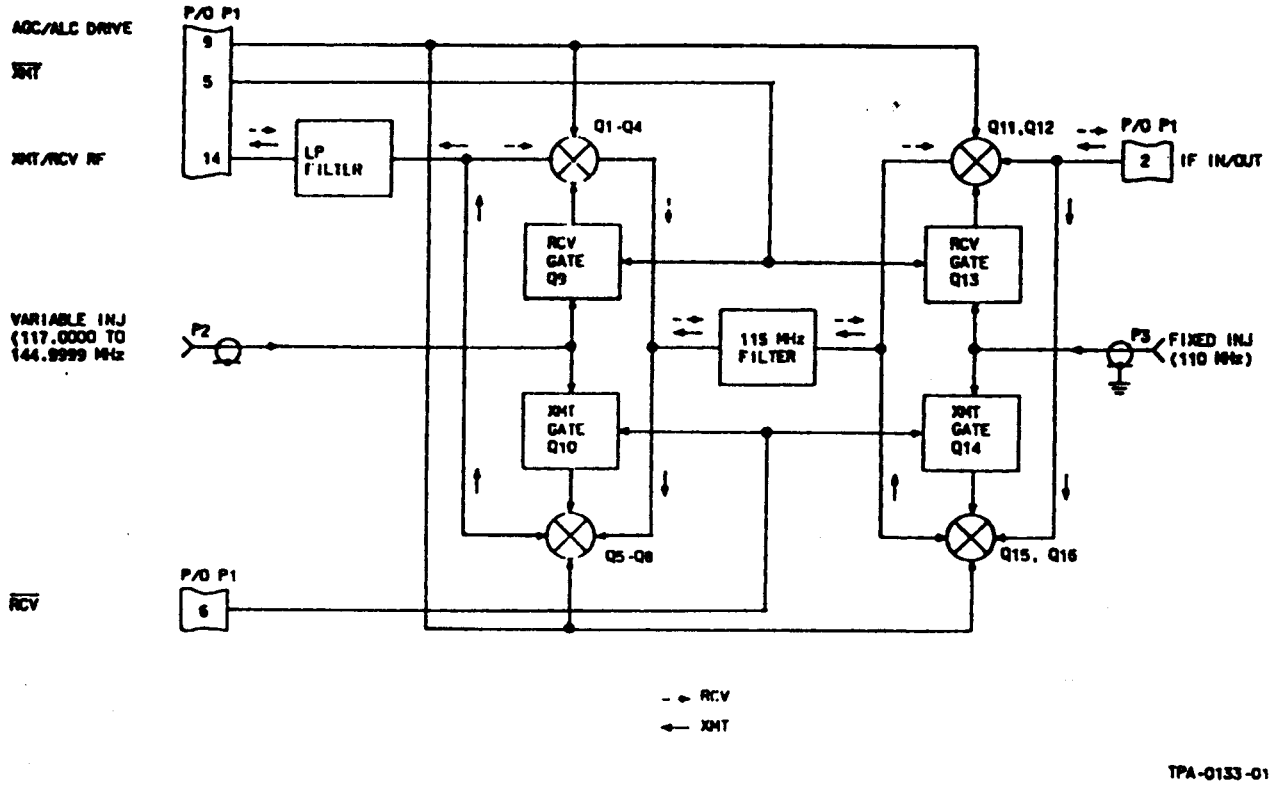


Figure 1-8. Mixer (Receive or Transmit), Simplified Schematic Diagram

When the receive rf input signals are below AGC threshold, the electron flow is through i ductors L3 and L16, bypassing diodes CR1 and CR7. As the rf input signal increases, th AGC/ALC DRIVE voltage at P1-9 decreases, permitting conduction by diodes CR1 and CI As the current of diodes CR1 and CR7 increases, the rf and if signals are shunted to ground, reducing the signal gain.

1.7.4.2.1.3 If/Af A1A5A1

a. AM Receive. Refer to figure 1-9 of this section and figures 4-1 and 4-5 of the schematic section. The IF IN signal is applied from A1A2P1/A1A1J2-2 to A1A1J5/ A1A5A1P1-2. When in AM mode, the 5-MHz if signal is coupled from A1A5A1P1-2 (IF IN), to the base of amplifier switch transistor Q2. With the radio in AM mode, $\overline{\text{RCV}}\cdot\text{AM}$ logic (ground) at P2-30 is applied to the base of transistor Q2, biasing it o and allowing the AM receive if to be applied to filter AM filter FL1 and then on to a plifier switch transistor Q19, which is also biased on by +5.2-volt logic (RCV.AM) P2-13. Transistors Q1 and Q20 are biased off during AM mode.

The receive if output of transistor Q19 passes through if amplifier transistors Q21 through Q24 on to AGC/AM audio detector transistor Q25. The detected af output o transistor Q25 is applied to the input of AM switch U3B and to the AGC hang circuit transistors Q29 through Q32. As the collector current of transistor Q32 increases transistor Q8 of the ALC/AGC DRIVE circuit, the output voltage of transistor Q6 d creases. This decrease in voltage to inductors L1, L2, and L3 permits diodes CR CR7, and CR8 to conduct, which maintains the gain of transistors Q19, Q21, and Q

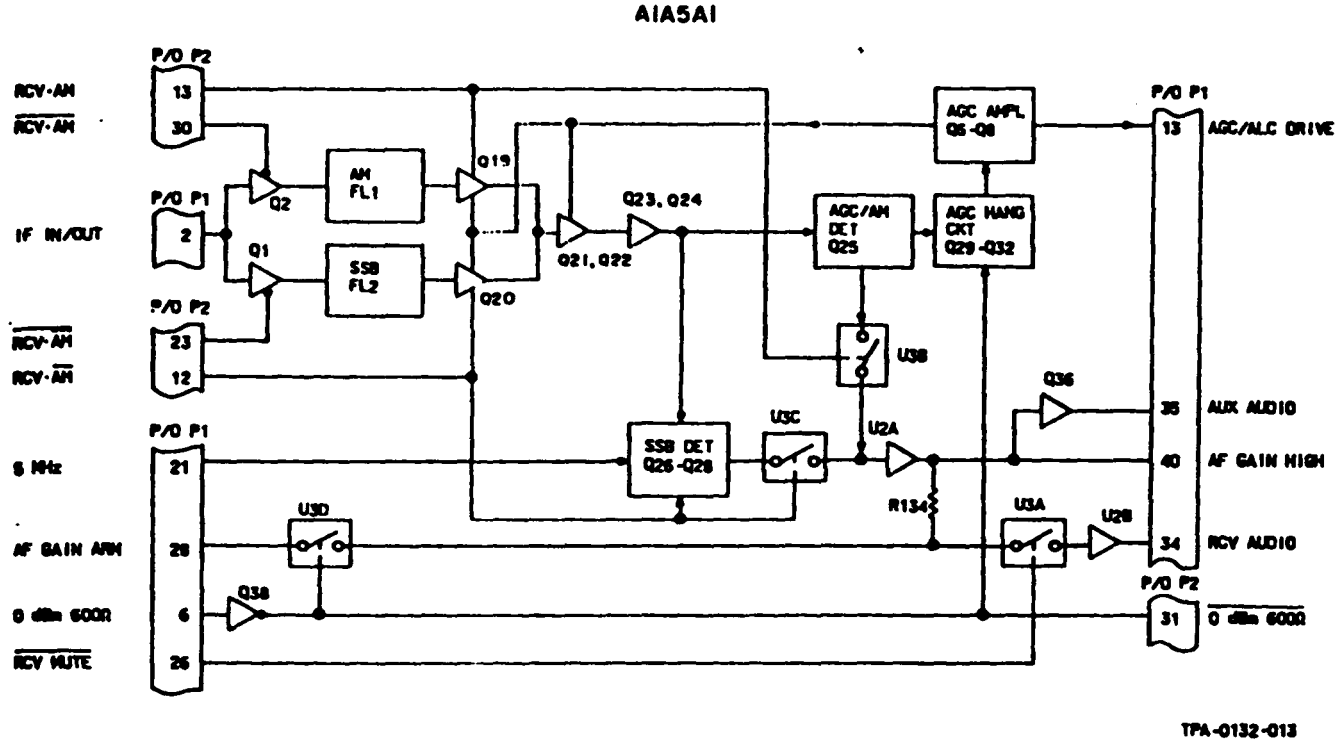


Figure 1-9. If/Af (A1A5A1) Receive, Functional Block Diagram

proportionate to the received signal level. The dc voltage output of transistor Q6 is also supplied to A1A2 from P1-13 (AGC DRIVE).

The presence of RCV·AM logic at the control element of switch U3B switches the AM receive audio to the output element of the switch. This audio is then coupled by capacitor C55 to the first audio amplifier U2A. The output of audio amplifier U2A is applied to R134, and to P1-40 (AF GAIN HIGH), which connects to variable resistor R1 (af gain) of control A2. The audio level at the input to audio mute gate, switch U3A, is controlled by A2R1 and voice/data gate, switch U3D. Switch U3A is gated by $\overline{\text{RCV MUTE}}$ logic. With the radio in normal receive operation, no tuning occurring, the $\overline{\text{RCV MUTE}}$ logic enables switch U3A and the audio is coupled by capacitor C61 to the second af amplifier U2B. The receive audio is amplified and coupled to A1A5P1/A1A1J5-34 on to A1A1J1/A2P1-43 (RCV AUDIO) for routing to the audio I/O device(s) connected to the control.

b. USB Receive. Refer to figures 4-1 and 4-5, schematics section, and figure 1-9 of this section. The 5-MHz USB receive if is applied to A1A5A1 on the same signal line that AM receive if is applied. The USB receive if is coupled to switch transistors Q1 and Q2. With Q1 gated on by $\overline{\text{RCV·AM}}$ logic (P2-23), when the radio is in USB mode, the receive if output of Q1 is direct coupled to lower sideband filter FL2 (the sidebands are inverted in A1A2 so lower sideband is the upper sideband). Then the receive if passes through transistor Q20 when $\overline{\text{RCV·AM}}$ gating logic is present. This couples the 5-MHz if to if amplifiers, transistors Q21 through Q24. The gain of transistors Q20 through Q22 is controlled by AGC/ALC DRIVE in the same manner as noted in AM receive mode of