CHAPTER 8

OPERATING PRINCIPLES OF A REPRESENTATIVE SSB TRANSCEIVER, AN/URC-32 (PART I)

INTRODUCTION

The Radio Set AN/URC-32 (fig. 8-1) is a manually operated radio communications transceiver for operation in the 2- to 30-mc (high-frequency) range with a transmit peak-envelope-power (pep) of 500 watts. The AN/URC-32 is designed for single-sideband transmission, and for reception on upper sideband, lower sideband, or two independent sidebands with separate audio and i-f channels for each sideband. In addition to single-sideband operation, provisions are included for a-m (carrier reinserted), c-w, or fsk operation.

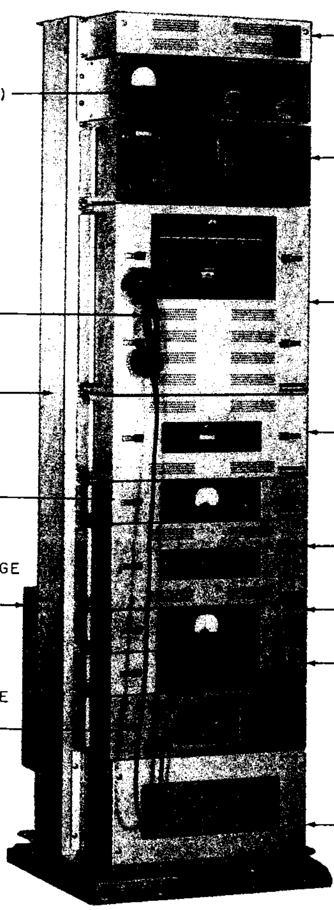

Figure 8-1.—Radio Set AN/URC-32.

The frequency range of 2 to 30 mc is covered in four bands. The desired operating frequency is selected in 1-kc increments on a direct-reading frequency counter. Frequency accuracy and stability are controlled by a self-contained frequency standard. Provisions are made for using an external frequency standard such as an AN/URQ-9.

The complete discussion of the AN/URC-32 is discussed in two parts: chapters 8 and 9 of this training course. Chapter 8 presents a block diagram, functional description, and circuit operation of the dynamic handset, handset adapter, audio and control unit, sideband generator, and c-w and fsk unit. Chapter 9 is a detailed discussion of the frequency generator, power amplifier, and frequency comparator.

RADIO SET AN/URC-32 BLOCK DIAGRAM

As stated, the transmitter of the Radio Set AN/URC-32 (fig. 8-2) produces voice, c-w, or fsk modulated signals on a single-sideband r-f carrier, or a compatible amplitude modulated r-f carrier. Voice input signals from the dynamic handset are fed to the handset adapter. Input signals (c-w, or remote audio) from a remote control unit also are applied to the handset adapter permitting the operator to select either the local or remote audio input. Teletypewriter signals are applied directly to the c-w and fsk unit which provides separate audio tones for the mark and space conditions. These frequencies are later converted to the required frequency-shift signals for fsk transmission.

The output from the handset adapter is amplified in the audio and control unit. Two separate audio input paths to the audio and control

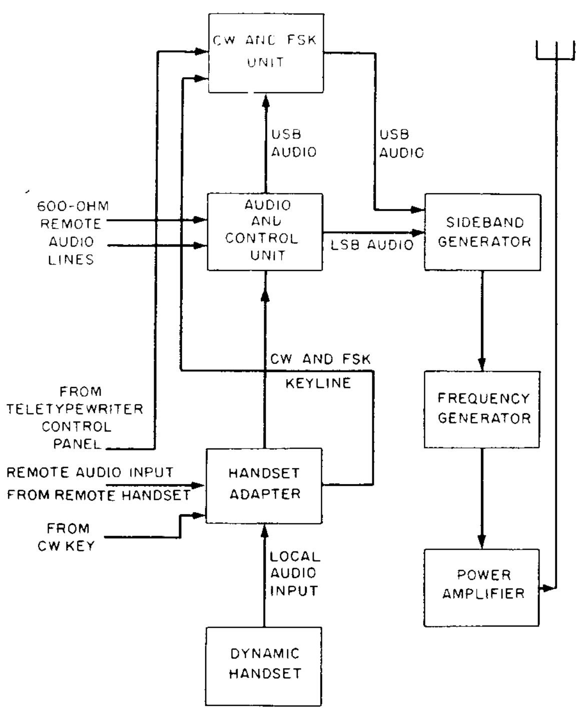

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Figure 8-2.—Radio Set AN/URC-32, transmit function block diagram.

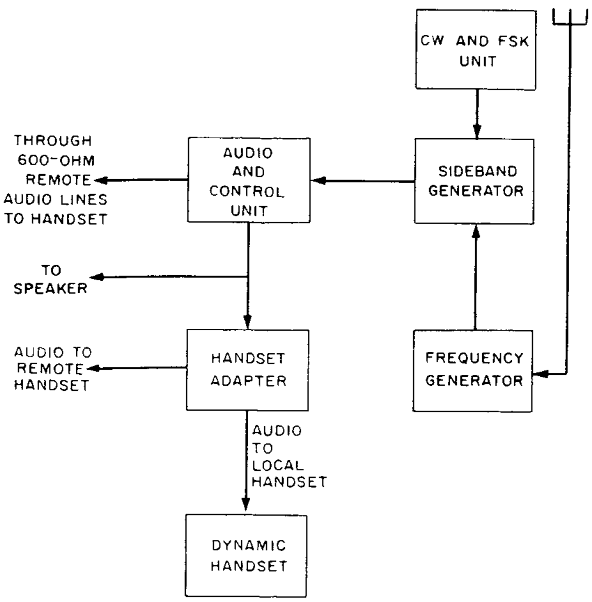

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Figure 8-3.—Radio Set AN/URC-32, receive function block diagram.

unit are provided through the 600-ohm remote audio lines.

The audio and control unit amplifies the audio signal and feeds it to the sideband generator. During single-sideband voice operation, the audio and control unit output is fed through a selector switch in the c-w and fsk unit. For c-w or fsk operation, the c-w and fsk unit supplies audio tones to the sideband generator.

The sideband generator converts the audio input to the selected sideband of a 300 kc intermediate frequency. The modulated 300-kc output is fed to the frequency generator. This unit provides the necessary number of heterodyning processes (while preserving the signal intelligence) to produce the selected carrier frequency in the 2- to 30-mc range. The output signal is amplified in the power amplifier to the required peak-envelope-power of 500 watts and fed to the antenna.

During receive operation (fig. 8-3) the antenna input signal in the range from 2 to 30 mc is heterodyned in the frequency generator so that the output will be a modulated 300-kc signal. This signal is detected and amplified in the sideband generator, further amplified in the audio and control unit, and fed to the speaker.

During c-w reception, the c-w and fsk unit supplies a 300.550-kc signal to the sideband generator as a beat frequency for the received signal. The beat frequency can be changed over a range of ± 1 kilocycle.

DYNAMIC HANDSET

The dynamic handset (fig. 8-4) consists of a noise-canceling dynamic microphone incorporating a transistor amplifier, a dynamic receiver, and a push-to-talk switch. The dynamic handset has the same plug-in connections, output impedance, and output level as the Navy 51007A carbon handset, which makes these two units interchangeable. However, the dynamic handset provides improved audio quality over a carbon handset.

Both the transmitter and receiver are sealed plug-in units. The transmitter contains the noise-canceling dynamic microphone and the transistor amplifier. The receiver is a standard 600-ohm dynamic telephone receiver.

The push-to-talk button for the handset transmitter (fig. 8-5) applies 12 volts to a push-to-talk relay coil. The contacts of this relay (shown later) control the various circuits of the transmitter. Since the 12-volt supply operates the transistor amplifier circuit of the transmitter, it is important to observe the polarity indicated on the schematic.

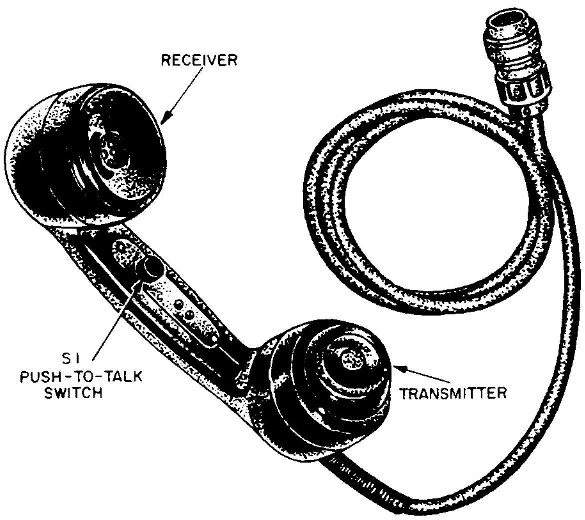

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Figure 8-4.—Dynamic handset.

HANDSET ADAPTER

The handset adapter (fig. 8-6) permits local operation of a transmitter-receiver using the dynamic handset described above, or remote operation using a Radio Set Control C-1138/UR, and the Dynamic Handset AN/URC-32. Local or remote operation is selected by the handset control on the front panel. A connector on the front panel is provided for the handset.

In the LOCAL position, handset switch, S1 (fig. 8-7) connects the audio output from the receiver (terminals 5 and 6) to the handset (terminals A and B), and connects the audio output from the handset transmitter to the system transmitter. Also, in local operation, the key line is connected to contact 4 of relay K1. Contacts 4 and 3 of K1 are open (as shown) for receive operation. When the handset push-to-talk button is depressed, relay K1 energizes, and contacts 4 and 3 close to apply a ground to the key line. This, in turn, operates the various control circuits of the transmitter.

A 12-volt power source supplies power for K1 and the handset microphone. This supply uses transformer, T1, and rectifiers, CR1-CR4, in a full-wave dry-disc bridge rectifier circuit.

In the REMOTE position, handset switch, S1, connects the audio output from the receiver to the remote control circuits, and also connects the audio output from the remote control circuit to the transmitter. In remote operation, the key line and 12 volts from the handset adapter power supply are connected to the remote controls.

AUDIO AND CONTROL UNIT

The audio and control unit (fig. 8-8) is a dual-channel amplifier which can provide audio inputs from two 600-ohm balanced lines, a 600-ohm unbalanced line, or a high impedance microphone. In the normal AN/URC-32 installation, the 600-ohm balanced lines and the dynamic microphone input are not used.

BLOCK DIAGRAM

On transmit, when using the 600-ohm unbalanced input, the audio signal from the handset adapter is fed to the audio and control unit via audio transformer, T6 (fig. 8-9). This input, after amplification, can be applied to the upper

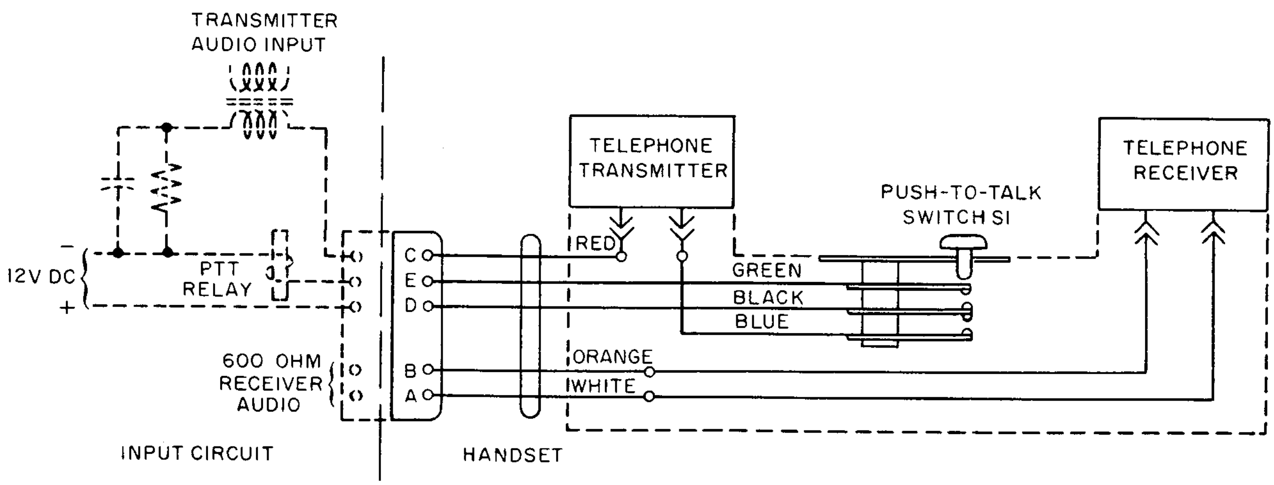

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Figure 8-5.—Dynamic handset, schematic diagram.

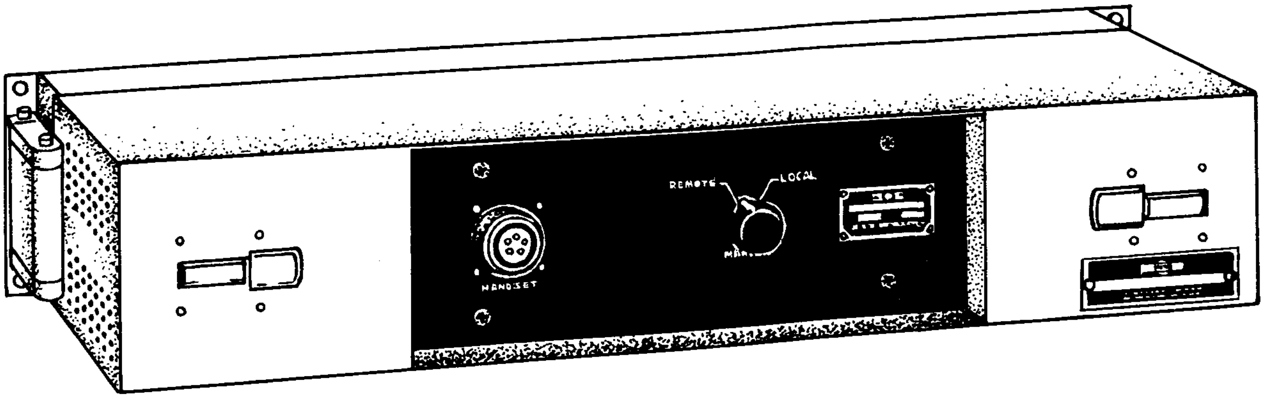

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Figure 8-6.—Handset adapter.

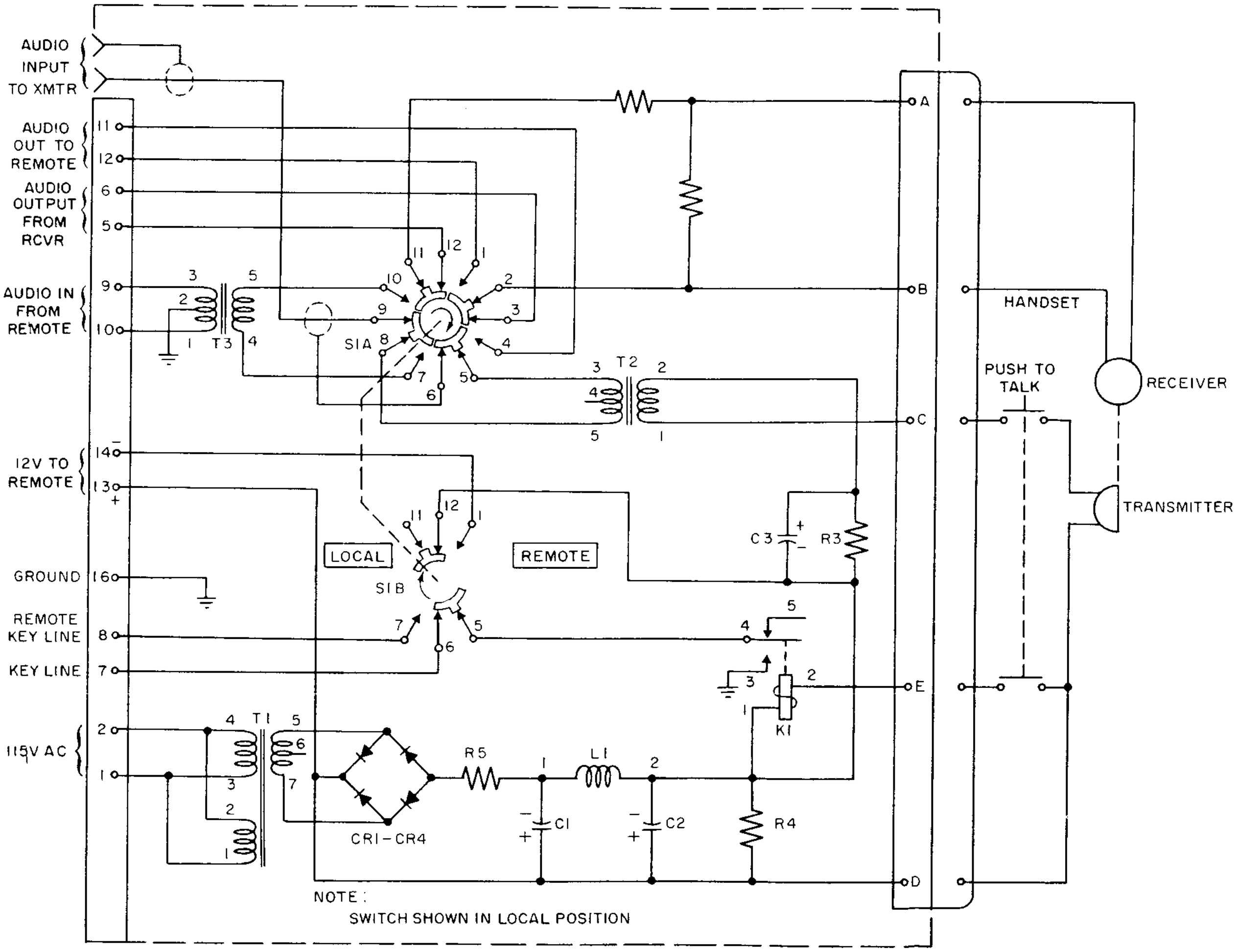

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Figure 8-7.—Handset adapter, schematic diagram.

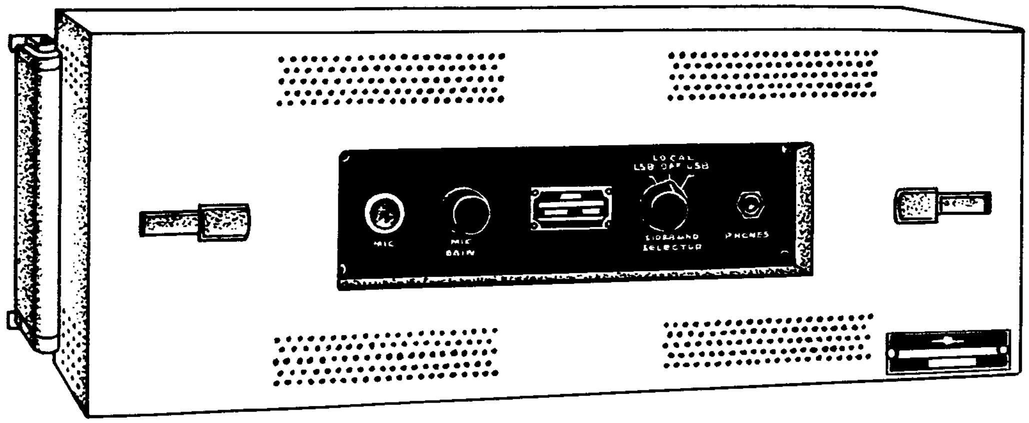

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Figure 8-8.—Audio and control unit.

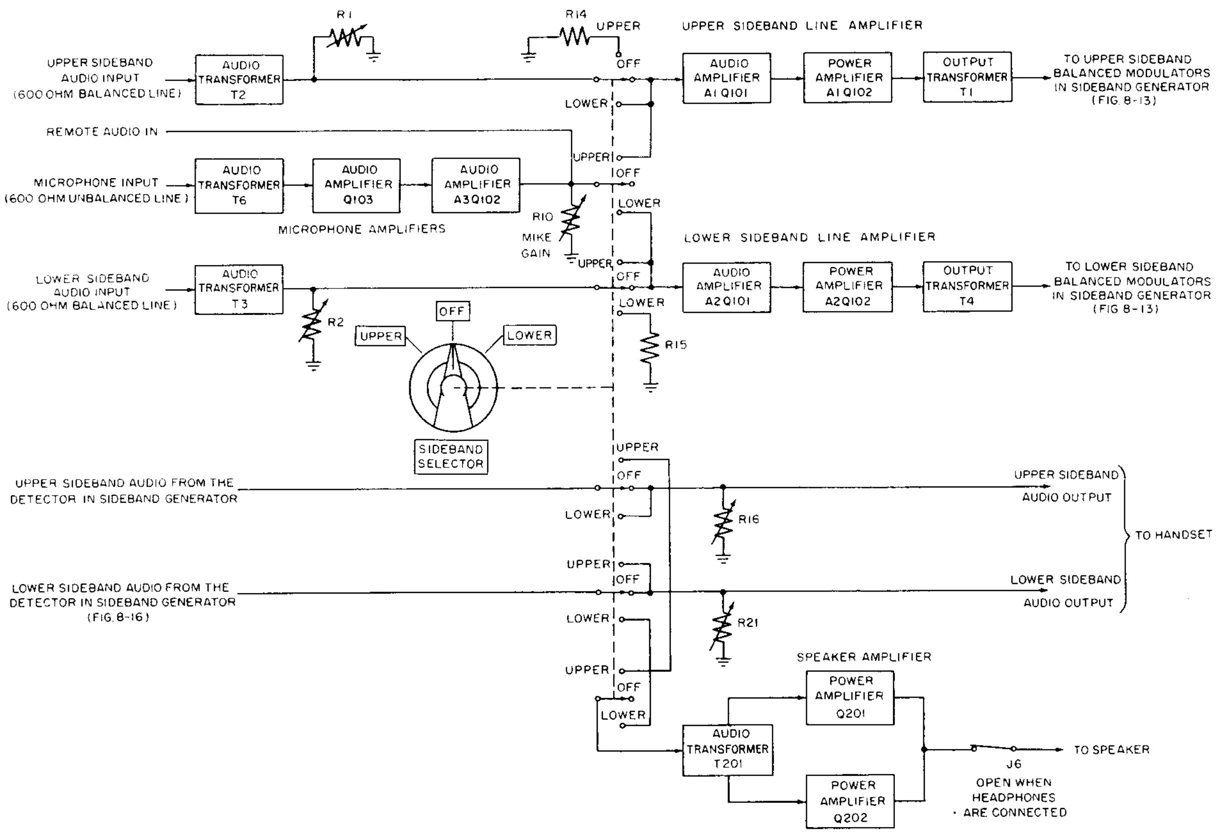

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Figure 8-9.—Audio and control unit, block diagram.

sideband (usb) line amplifier or to the lower sideband (lsb) line amplifier in the audio and control unit.

The sideband selector switch controls the signal transmission and reception. With the switch in the OFF position, the microphone amplifier circuits and the remote audio input are disconnected from the line amplifiers. This also connects the upper and lower sideband audio line inputs to the line amplifiers.

With the sideband selector switch in the UPPER position, the microphone audio or remote audio is fed into the upper sideband line amplifier. This also selects the upper sideband audio output from the sideband generator and applies it to the speaker amplifier circuits.

The reverse of this action happens when the sideband selector is placed in the LOWER position. When earphones (not shown) are plugged into the phone jack on the front panel (fig. 8-8) the audio output normally fed to the speaker is removed.

The upper and lower sideband line amplifiers (fig. 8-9) are controlled by the upper and lower sideband audio inputs. With the sideband selector switch in the OFF position, the two sideband amplifiers can be used either individually or simultaneously.

Assume the audio input is on the upper sideband. This input is coupled by audio transformer, T2, and the sideband selector switch (in the OFF position), to the first upper sideband line amplifier, A1Q101, for amplification. The amplified output of A1Q101 is coupled to the power amplifier, A1Q102, for further amplification. The output is fed via T1 to the upper sideband balanced modulator in the sideband generator. The gain of the sideband line amplifier is controlled by attenuator, R1. The operation of both the upper and lower sideband line amplifiers is the same.

When the sideband selector switch is in the UPPER position, the upper sideband audio is removed from the audio amplifier, A1Q101, and is correctly terminated by R14. Either the microphone amplifier circuit or the remote audio is then connected to the audio amplifier, A1Q101.

With the sideband selector switch in the LOWER position, the lower sideband audio is removed from A2Q101 and correctly terminated by R15. The microphone amplifier circuits are then connected to the audio amplifier, A2Q101.

CIRCUIT OPERATION

The upper and lower sideband line amplifiers (subassemblies A1 and A2, fig. 8-10), and the microphone amplifier (subassembly A3) each contain two transformer coupled common emitter PNP transistor amplifiers. The impedance of each input stage is approximately 100 ohms.

Amplifier Subassemblies

The microphone input from the mike jack is applied across T6 and developed across R111 and R112. The voltage across R112 is applied between the base and emitter of the first amplifier, Q103, of the microphone amplifier subassembly, A3. The remote audio input, which is also amplified in the microphone amplifier, is developed across the voltage divider comprising R8, R9, and R27. Resistor R27 is paralleled by the series combination of R113, R114, and R26. The voltage developed at the R113-R114 junction serves as the input to Q103.

Audio signals at the microphone jack, J5, are fed through T6 and amplified in microphone transistor amplifier subassembly, A3. Amplified signals at the T103 secondary are fed to the sideband selector switch, S1A, via the mike gain control. Switch S1A selects either the lower sideband or upper sideband line amplifiers to amplify the microphone, A3, output. The switch is shown in the LOWER position. In this position, the amplified microphone output signal at the mike gain control is fed through S1A (contacts 2 and 3) to the lower sideband line amplifier, A2, the output of which is applied through T4 to the balanced modulators.

If the J5 microphone input is not being used, a remote audio input at J7 can be applied to A1 and A2 through S1A. The balanced usb and lsb audio line input is fed across T2 and T3, respectively, through the sideband selector switch, S1A, to either the upper or lower sideband amplifier.

The circuit operation of each of the subassemblies is the same, therefore, the circuit operation of only the upper sideband amplifier is treated here.

Power for operating the audio and control unit circuits (+28 volts d-c) is fed into the unit via terminal 15 of J8. Resistors R101 and R102 at the amplifier (Q101) input establish the base-emitter bias for the stage. The base is held positive to ground by the amount of the voltage developed across R101. The emitter is held more positive by taking its potential from the positive side of R102 (+28 vdc). Thus, PNP transistor, Q101, is biased between base and emitter in the forward direction (negative on the base, and positive on the emitter). The input bias voltage is equal to the difference in the voltages across R102 and R103.

The signal voltage from S1A appears across R109 and R108 in series. The voltage at the junction of these resistors is coupled through C101 and applied in the base-emitter circuit of Q101 across R102. The signal voltage increases or decreases the base-emitter forward bias, and the resulting base-emitter current. This action causes relatively large variations to occur in the emitter-collector current through the primary of output transformer, T101.

Because the transistor is operated class A, and the input and output impedances are of the same order of magnitude, the output voltage across T101 is greater than that at the input but varies at the same rate.

The output from Q101 across T101 is coupled through C103 to the base of amplifier, Q102. This signal appears between the base and emitter of Q102.

The operation of Q102 is similar to that of Q101. Both stages employ PNP transistors. The bias voltage between the base and emitter of Q102 is equal to the excess of the voltage across R104 over that across R106 (base negative, emitter positive for forward bias). The collector is grounded through the primary of T102 and is negative with respect to the emitter and base.

The Q102 output at the secondary of T102 is fed through terminal F of P1 and J1 to the primary of T1. The secondary output of T1 is fed to the upper sideband balanced modulator.

A portion of the Q102 output is applied to the Q102 base-emitter circuit via R105 as negative feedback. This action compensates for temperature changes and reduces distortion of the output signal.

Assume a positive-going input signal at the input of Q101. Because of the 180-degree phase shift in Q101, the output across the T101 primary will be negative-going. The T101 secondary applies a negative-going input to Q102, whereupon a positive-going output appears across the primary of T102. A portion of the negative-going output at terminal 3 of T102 is coupled through R110 as the feedback voltage to the base of Q101 which opposes the positive-going input at this point. This action decreases the gain of Q101. The overall gain of the subassembly is approximately 40 db.

Speaker Amplifier

You will recall from the block diagram discussion that during reception, the sideband generator (fig. 8-2) produces a detected output which is applied to the speaker amplifier in the audio and control unit. The speaker amplifier provides 3-watts output to drive a speaker. The circuit consists of Q201 and Q202.

The input to the speaker amplifier from the sideband generator is fed through the sideband selector switch, sections S1B and S1C, to the primary of T5. The T5 secondary output is developed across the primary of T201 in parallel with R205. The value of the input audio is adjusted by this resistor. The output of the amplifier is coupled through C201 to the speaker transformer, T7.

The input circuits to Q201 and Q202 are operated in push-pull just at cutoff. The only forward bias on these transistors is the small d-c potential developed across the 6-5 and 3-4 windings of T201. Resistors R201 and R202 limit the base-emitter current of their respective amplifiers during quiescence to almost zero.

Capacitor C201 is connected to the electrical center of the two amplifiers. During quiescence, C201 charges to about 14 volts. The charge path is from ground through the 1-2 winding of T7, the closed contacts of J6, C201, R203, and the 3-4 winding of T201 to the +28 volt supply.

Now assume an instantaneous input at T201 which yields the uncircled polarities at the secondary. The two amplifiers (Q201 and Q202) are biased just at cutoff and the input polarity across the two sections of the T201 secondary is 180-degrees out-of-phase. This causes the input signal to aid the conduction of one of the amplifiers and opposes the conduction of the other. The instantaneous voltage at the 5-6 winding of T201 (uncircled) forward biases the base-emitter circuit of Q202. During the same instant, the uncircled polarities at the 3-4 winding of T201 apply a reverse bias to Q201, which drives this amplifier further into cutoff. For the uncircled polarities, Q202 is conducting, while Q201 is cut off.

Assume that the induced voltage in T201 is increasing. The Q202 base-emitter current is increasing because of the increasing signal voltage component in the 5-6 winding of T201. This action increases the Q202 collector current. The path for this current is from ground, the collector circuit of Q202, the emitter circuit of Q202, R202, R203 (Q201 cutoff), the 3-4 winding of T201 and the +28 volt supply.

The increasing voltage across R203 subtracts from the +28 volt supply to cause a reduction in voltage between terminal 5 of T201 and ground. The negative-going component causes C201 to discharge. The discharge path is through the T7 primary, ground, the collector emitter (conducting) circuit of Q202, and R202. The accompanying change in current is coupled through T7 as the audio signal component to the speaker.

Now assume that the input polarity reverses (circled polarity marks). Terminal 5 of T201 is negative and terminal 6 is positive. The signal voltage induced between these terminals is assumed to be increasing. The polarity is in the backward direction of the base-emitter circuit of Q202 so that the base-emitter current is driven into cutoff and no collector current flows.

At the same time the voltage induced in the 3-4 winding of T201 has a polarity that permits the voltage to drive the base-emitter circuit of Q201 in the forward direction. Thus the base-emitter current of Q201 increases and this action increases the collector current of Q201. The path for this current is from ground through R204, the 5-6 winding of T201 (Q202 cutoff), the collector circuit of Q201, the emitter circuit of Q201, R201, and the +28 volt supply.

The increasing voltage across R204 comprises the signal component appearing between terminal 5 of T201 and ground. As the voltage rises, C201 charges through the T7 primary, the collector of Q201, the emitter of Q201, R201, to the +28 volt supply. The accompanying current change is coupled through T7 to the speaker line as the audio signal.

Resistors R201 and R202 produce self-bias to stabilize the operating points of the transistors during temperature changes. Where R201 and R202 are unable to control the effect of excessive temperature rise, F201 protects the transistors from the resulting current.

SIDEBAND GENERATOR

The sideband generator (fig. 8-11) translates audio frequencies to intermediate frequencies during transmit condition, and intermediate frequencies to audio frequencies during receive conditions.

TRANSMIT FUNCTION

The block diagram of the sideband generator is shown in figure 8-12. The balanced modulator, carrier generator, and transmitter gain control (t-g-c) limits operate during transmit condition. The audio input to the sideband generator (fig. 8-12) is taken from the secondaries of T1 and T4 on the audio and control unit (fig. 8-10) and applied to the sideband generator via T3 and T4. Audio input transformer, T3 and T4, couple upper sideband and lower sideband audio inputs to the vox circuit (explained later) and to the balanced modulators. The balanced modulators modulate a 300-kc carrier to produce separate and distinct upper and lower sideband signals with the carrier suppressed. The 300-kc carrier is produced in the carrier generator by tripling the 100-kc reference oscillator signal from the frequency generator (discussed later).

The balanced modulator contains two 300-kc balanced modulators. Because of a frequency inversion in the r-f tuner, the lower sideband balanced modulator is followed with an upper sideband filter and the upper sideband balanced modulator is followed with a lower sideband filter. The inversion process which takes place in the r-f tuner is explained in chapter 9 of this training course.

The outputs of the balanced modulator are connected in parallel and fed to the transmitter gain control. The t-g-c circuit is controlled by a t-g-c voltage which is received from the power amplifier unit. This circuit maintains the 300-kc

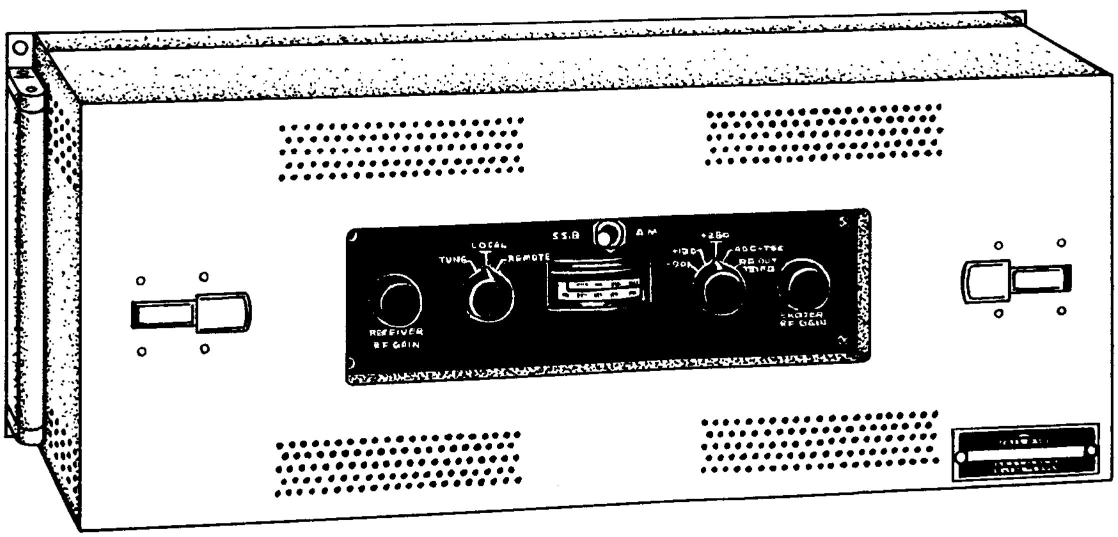

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Figure 8-11.—Sideband generator.

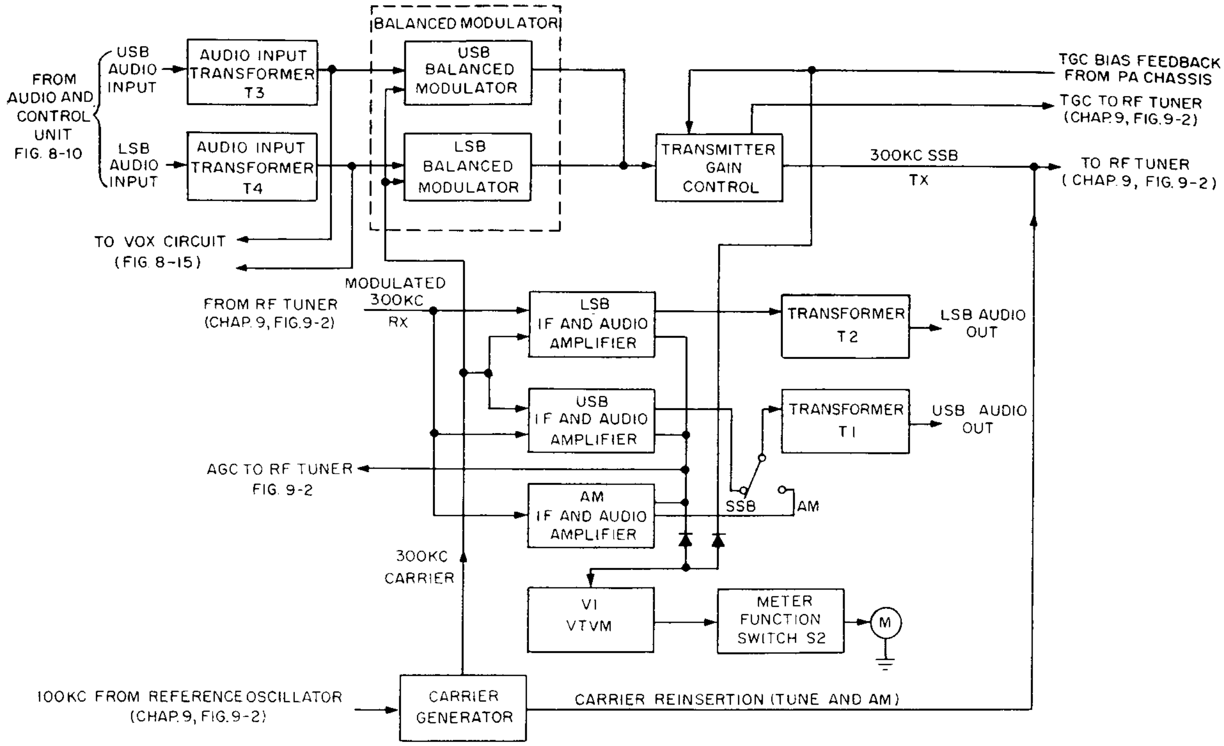

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Figure 8-12.—Sideband generator, block diagram.

i-f output voltage at a sufficiently low level to prevent overdriving any of the subsequent stages.

The 300-kc ssb signals are fed via line TX to the r-f tuner and power amplifier (described in chapter 9). During tune and a-m transmit conditions only, the unmodulated 300-kc carrier generator output is reinserted in the upper sideband signal at the output of the sideband generator. Reinsertion of the carrier at the transmitter eliminates reinsertion at the receiver and the necessity for having special equipment to receive the transmitted signal. The absence of the lower sideband does not affect the quality of the received signal. However, only one sideband plus carrier is transmitted, and the received signal is considerably weaker than it would be for double-sideband a-m operation.

RECEIVE FUNCTION

The i-f/a-f amplifiers (lsb, usb, and a-m) operate only during the receive condition to amplify the modulated 300-kc i-f signal from the r-f tuner (via line RX). These units also demodulate the signal and amplify the detected audio. A 300-kc carrier is reinserted into the lsb and usb i-f/a-f amplifiers from the carrier generator.

When the front panel ssb a-m switch is in the a-m position, the lsb and usb i-f/a-f amplifiers are disabled. The carrier generator (a-m receive only) also is disabled as will be shown later. The audio output from the a-m i-f/a-f amplifier is fed through the ssb a-m switch in the a-m position to the usb audio out lines via T1. The a-m i-f/a-f amplifier is disabled when the ssb a-m switch is in the ssb position.

TRANSMIT CIRCUIT

Balance Modulator

The balanced modulator (fig. 8-13) includes two balanced modulators which are identical except for the band-pass characteristics of their individual mechanical filters. Two separate audio inputs are provided to the unit; one to the upper sideband balanced modulator section, and one to the lower sideband balanced modulator section. This provision allows the audio input signal to be switched to either or both input connections so that the output may be upper sideband, lower sideband, or twin sideband with suppressed carrier.

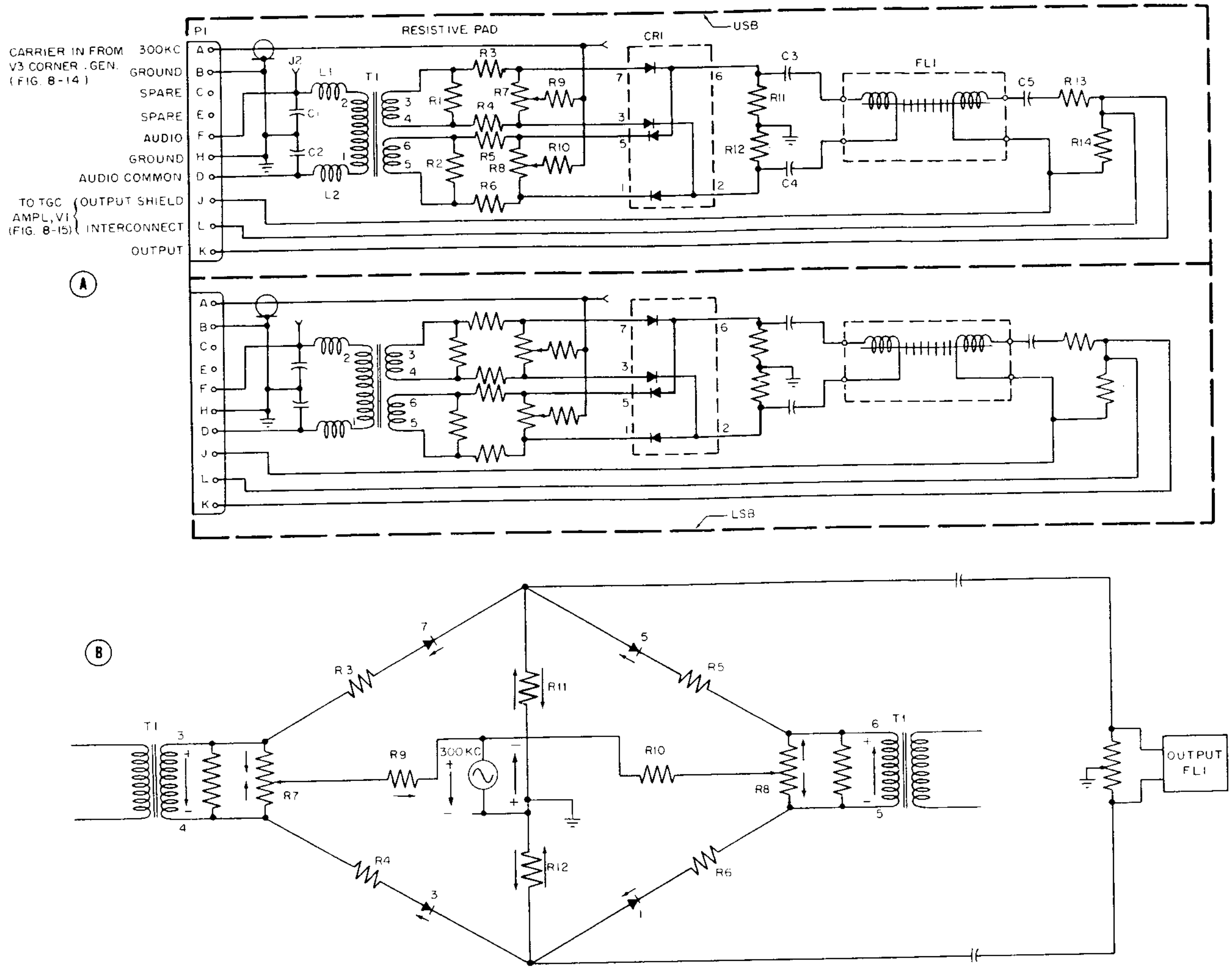

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Figure 8-13.—Balanced modulator.

The action of both of the balanced modulators is identical. The following discussion describes the operation of only the upper sideband balanced modulator section. The two balanced modulators are called upper and lower sideband balanced modulators because of the frequency relationship between the final transmitted sideband signal and the suppressed carrier. (The upper sideband at the output of the transmitter contains the sum of the audio frequency components and the carrier; the lower sideband contains the difference between the carrier and the audio frequency components.)

Approximately 1.0 volt rms audio input signal is introduced into the balanced modulator via terminals F and D of P1. This signal is fed from the audio and control unit or from the c-w and fsk unit (fig. 8-2), depending on the mode of operation. The signal is applied to a 1:2 step-up impedance matching transformer, T1.

The audio signal from the two secondary windings of T1 is coupled through two separate resistive pads and applied across a germanium diode bridge which includes CR1. The resistive pads match the impedance of T1 to that of CR1 and attenuate the audio signal approximately 30 db to produce a 1-to-10 audio-to-carrier-level ratio at the diodes. This ratio prevents the audio signal from initiating diode conduction in the bridge.

The 300-kc r-f carrier from the carrier generator (fig. 8-12) is injected into the balanced modulator (fig. 8-13, A) terminal A1 P1, through isolating resistors, R9 and R10. This signal is applied to the diode bridge circuit through potentiometers, R7 and R8. These potentiometers balance the diode bridge so that no carrier frequency is coupled into the output signal (fig. 8-13, B). Filters C1-L1 and C2-L2 (fig. 8-13, A) isolate the injected carrier signal from the audio circuits.

With no audio signal input, no output signal will appear across the bridge circuit load, R11 and R12. The r-f carrier applied to the bridge causes diode-pairs 7-3 and 5-1 to conduct on alternate half-cycles. This produces outputs across R11 and R12 on both half-cycles that are equal in amplitude and opposite in phase. This action results in r-f carrier suppression across the load.

When the audio signal is introduced across the bridge circuit, the r-f carrier causes the diode-pairs to act as a high frequency switch with diodes 7 and 3 conducting on one half-cycle, and diodes 5 and 1 conducting on the other. This action switches the audio at the carrier (300-kc) switching frequency, and produces a modulated output signal containing the sum and difference frequencies that constitute the upper and lower sidebands. The equal and opposite voltages across R11 and R12 at the carrier frequency eliminate the carrier at the output. The sideband frequencies appearing across R11 and R12 are additive and do not cancel at the bridge output. This type of balanced modulator produces approximately 45 db suppression of the carrier frequency across the bridge output.

The double-sideband suppressed carrier output signal appears across load resistors R11 and R12, and is coupled through C3 and C4, respectively, to mechanical filter, FL1. Because of the band-pass characteristics of FL1, the r-f carrier is suppressed an additional 20 db, and the unwanted sideband is suppressed 60 db. The single-sideband suppressed carrier signal output of FL1 is applied to impedance matching resistors, R13 and R14.

Outputs available are upper sideband, lower sideband, or both. When a single-sideband mode is selected, the signal is taken directly from the filter associated with the particular balanced modulator section.

The a-m mode of operation is also possible with the AN/URC-32. However, the a-m signal is not produced until the 300-kc carrier signal is reinserted in the final stages of the sideband generator. This process is explained later.

The output of each of the balanced modulator sections is approximately 5.0 mv. This signal is applied through a shielded lead to the transmitter gain control unit (fig. 8-12).

Carrier Generator

The carrier generator (fig. 8-14) triples a 100-kc signal from a 100-kc reference oscillator (discussed later) to produce a 300-kc signal. This signal is necessary for r-f carrier insertion to the balanced modulator during the transmit condition, and for carrier reinsertion to the usb or lsb i-f/a-f amplifiers during reception.

When receiving, the 300-kc output of the carrier generator is used by beat-type detectors of the i-f/a-f amplifier units to demodulate the i-f single-sideband signal. The 300-kc output from the carrier generator has the same stability as that of the reference oscillator.

The 100-kc input signal to the carrier generator is introduced through terminal K of receptacle P1, coupled through C1, and impressed across R1 at the control grid of the multiplier stage, V1. The plate-tank circuit of V1, comprising L1, C3, C4, and C5, is tuned to 300-kc. Application of the 100-kc voltage on the control grid causes a 300-kc component to be developed in the plate circuit. Capacitor C5 permits tuning of the plate-tank frequency.

The output of the multiplier stage is taken from a capacitive voltage divider (C3 and C4), and applied to the control grid of the output amplifier, V2. Amplifier V2 has both of its triode sections connected in parallel providing higher transconductance with less plate resistance, and maintaining stage gain with lower output impedance.

Two separate 300-kc outputs are taken from the plate of V2. One output is coupled through C11 and applied to terminal A of P1, while the other output is coupled through C12 and applied to terminal C of P1. These two 300-kc signals are used as the carrier frequencies for the balanced modulators (fig. 8-13) when transmitting, and as carrier insertion in the usb and lsb i-f/a-f amplifiers when receiving.

An additional output from V2 (fig. 8-14) is coupled through C8 to the grid of carrier amplifier V3. This amplifier supplies a carrier reinsertion signal for a-m transmit operation or a-m reception. A ground is placed on the cathode of the carrier amplifier circuit when the a-m ssb switch is in the a-m position. The ground circuit is completed by the action of the a-m ssb relay, K2. The cathode of V3 is also grounded when the tune-local-remote switch is in the TUNE position as shown. When the cathode is grounded, V3 conducts to produce an output.

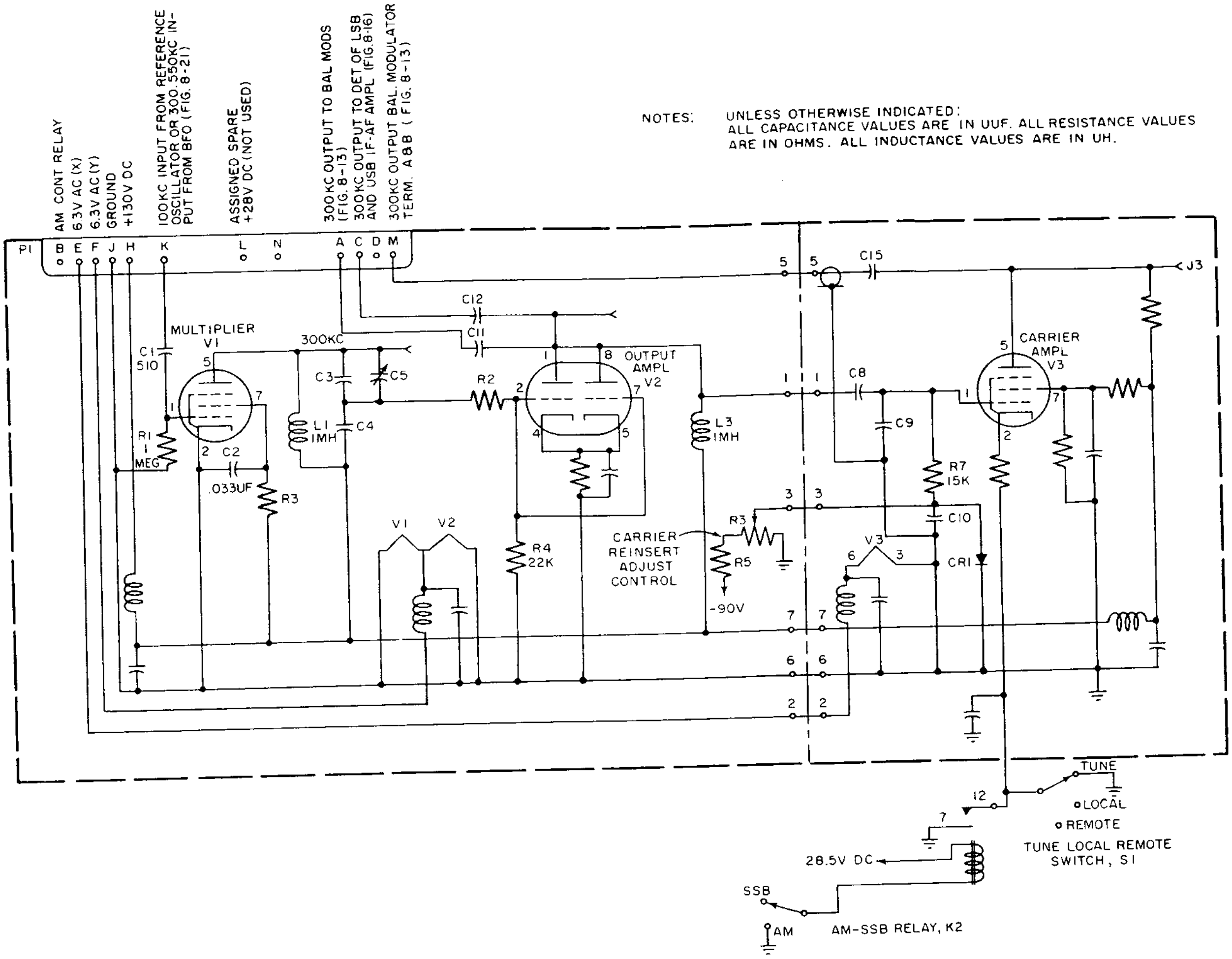

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Figure 8-14.—Carrier generator.

The output of V3 is controlled by a bias voltage applied to the grid by carrier reinsert adjust control, R3. This control is adjusted to provide a carrier reinsertion signal equal in power to the sideband signal at the output of the sideband generator (fig. 8-12). The 300-kc carrier reinsertion signal from the plate of the carrier amplifier, V3 (fig. 8-14) is coupled through C15 to the transmitter r-f mixer, V1A, in the r-f tuner (discussed in ch. 9).

Transmitter Gain Control

The transmitter gain control unit automatically adjusts the amount of i-f signal which is delivered to the r-f tuner and to the power amplifier. It ensures that the power amplifier stage is operating near its maximum power capability, but that it is not being overdriven. This action is accomplished by controlling the gain of a t-g-c amplifier, V1 (fig. 8-15).

The output signal from the balanced modulator (fig. 8-13) is coupled through input transformer, T1 (fig. 8-15) and through C2 to the control grid of V1.

A sampling circuit in the power amplifier (shown later) provides a direct current via terminal C (whenever there is power amplifier grid current) which is fed back to the control grid of the t-g-c amplifier. This current produces a voltage across R2 and R3 which is proportional to the power amplifier grid drive. The voltage developed across R2 and R3 is negative toward the grid of V1. This voltage controls the gain of the t-g-c amplifier and therefore the amplitude of the signal fed to the r-f tuner. The action is similar to automatic volume control used in receiver audio applications.

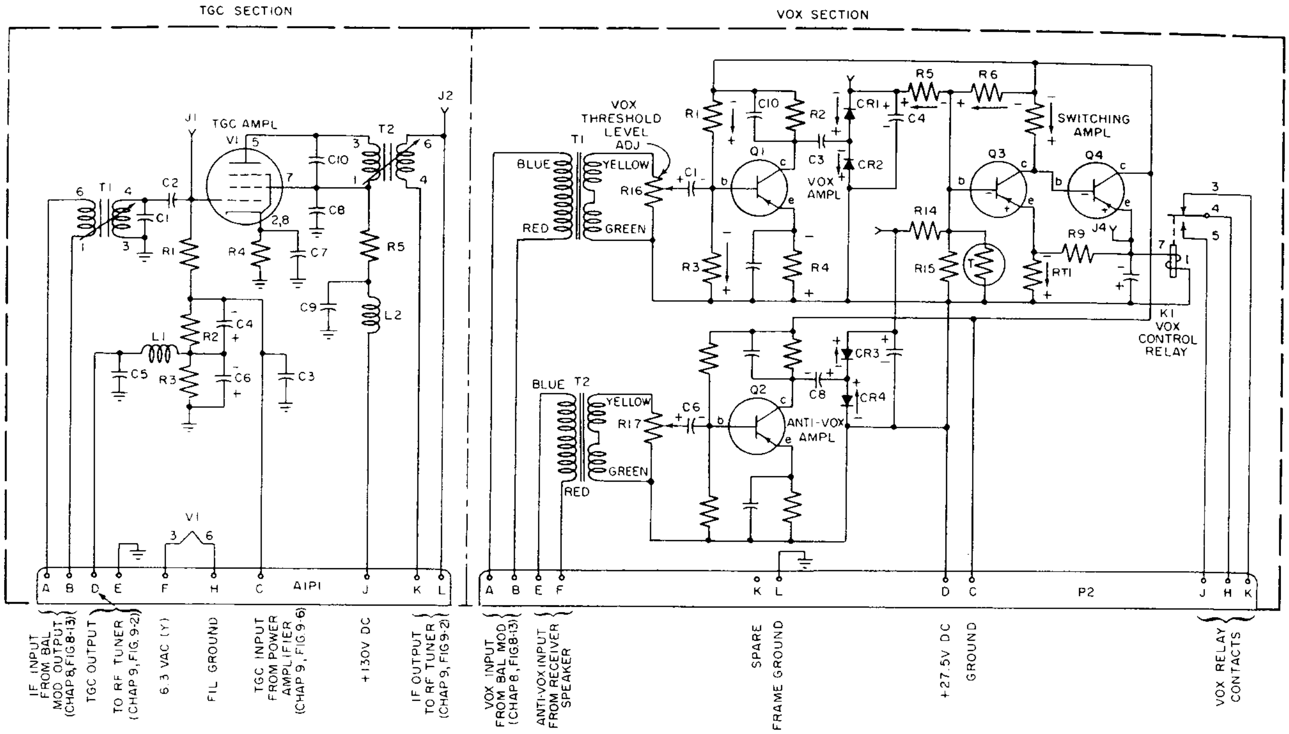

Figure 8-15.—Tgc-vox anti-vox. 32.149

Filters in the feedback line comprising R2-C4 and R3-C6, determine the response time of the t-g-c circuit. The output, taken at the junction of the two filters, is fed to the r-f tuner for automatic gain control of the transmit i-f amplifiers.

When voice operate control (vox) is desired, the vox section of the t-g-c-vox unit automatically keys the transmitter whenever a predetermined level of input signal appears on the audio input line. An anti-vox circuit is incorporated to prevent the transmitter from being keyed by feedback from the receiver speaker.

The audio input to the vox circuit is taken from the T3 and T4 secondaries of the sideband generator (fig. 8-12) and applied to T1 (fig. 8-15). Resistor R16 provides a vox threshold level adjustment. The output of Q1 is rectified by CR1 and CR2, and the d-c voltage is amplified by Q3 and Q4 (cascade connected PNP transistor switching amplifiers). The output of Q4 operates vox relay, K1.

Thermistor, T, compensates for the effect of temperature change on the collector current of Q3. For example, if the temperature increases, the resistance of T will decrease. This action causes increased current in R6 and a decrease in the forward bias in the Q3 base-emitter circuit, with an accompanying tendency to check the rise in collector current.

The anti-vox amplifier, Q2, is similar to the vox amplifier, Q1. The receiver audio output is coupled through T2 and developed across anti-vox level adjust control, R17. The voltage at the R17 arm is coupled through C6 to the base of Q2. The output of the anti-vox amplifier is rectified by CR3 and CR4, and this voltage is applied to Q3 at the junction of R14 and R15. This signal opposes the vox voltage to Q3 from Q1.

RECEIVE CIRCUIT

Lsb I-f/A-f Amplifier

The lsb i-f/a-f amplifier (fig. 8-16) amplifies the i-f signal received from the mixer stage of the r-f tuner (discussed in ch. 9). This unit also detects and amplifies the audio signal.

The signal containing the 300-kc sideband intelligence is coupled from the r-f tuner to the first i-f amplifier, V1. The output of V1 is taken from a tuned plate circuit and fed to a mechanical filter, FL1. A frequency inversion that takes place in the r-f tuner, interchanges the two incoming sidebands. Thus, to pass the

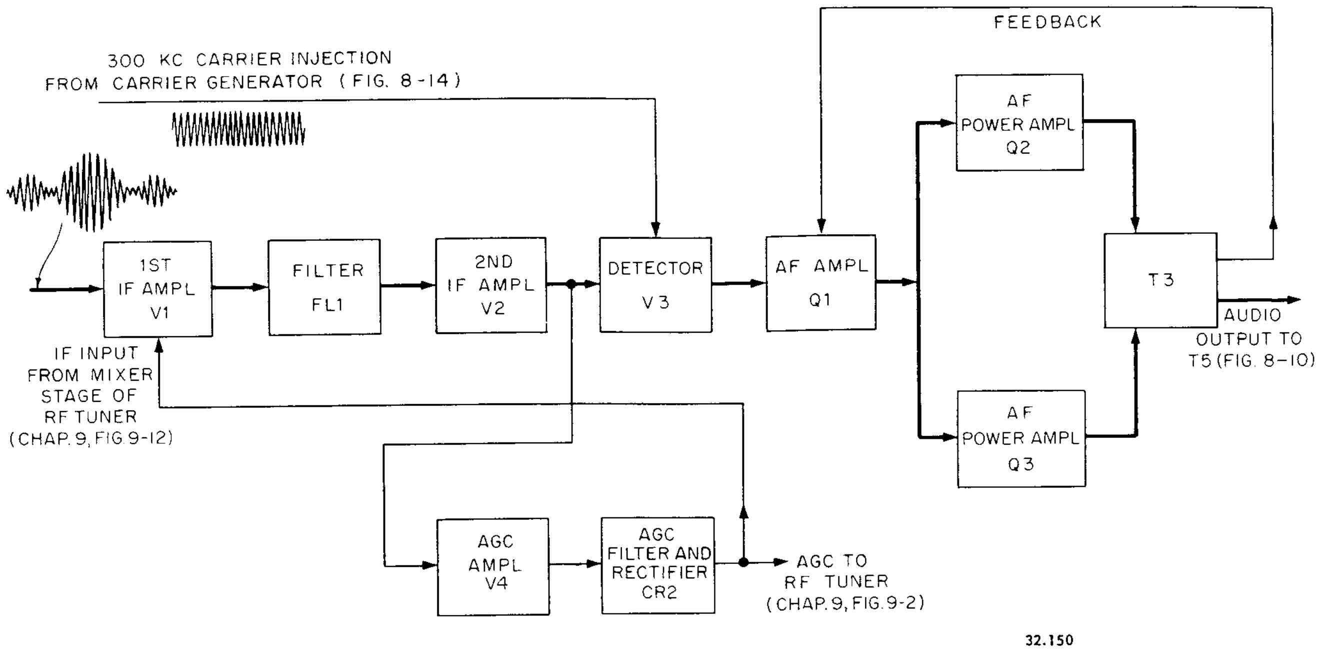

Figure 8-16.—Lsb or usb i-f/a-f amplifier, block diagram.

lower sideband component, FL1 is capable of passing frequencies from 300 to 303 kc.

The output of FL1 is applied to the second i-f amplifier, V2. The amplified output of V2 is applied to the control grid of detector stage V3 (fig. 8-17).

Detector V3 is a "beat-type" or "product" detector in which a 300-kc carrier from the carrier generator (fig. 8-14) is mixed with the 300 to 303 kc lower sideband signal from the r-f tuner. The 300-kc carrier injection signal is coupled through C12 (fig. 8-17) to the suppressor grid of V3. The i-f input from V2 (fig. 8-16) is applied across T1 (fig. 8-17) to the control grid of V3. The difference frequency (0 to 3 kc) is recovered as audio intelligence. This signal is coupled from the plate of V3 through a low-pass filter consisting of L2, C15, and C14. The filter rejects the product frequencies and allows only the audio (difference frequency) signal to pass. The demodulated audio signal is coupled through C17 and C18 to the a-f transistor amplifier, Q1 (fig. 8-17).

The audio output of Q1 drives a transistorized push-pull amplifier output stage which comprises Q2 and Q3. The output at the T3 secondary is fed through the sideband selector switch (fig. 8-10), and through two additional stages of audio amplification to the speaker.

The amplifier action of Q1 is similar to that of Q101 (fig. 8-10), previously discussed, except that the polarities of the bias supply are reversed (Q1 is an NPN-type and Q101 is a PNP-type transistor). The T2 output is applied to the base-emitter circuits of Q2 and Q3 in push-pull. Transistors, Q2 and Q3 are also NPN transistors. The circuit arrangement is easier to identify as push-pull than the previously described push-pull speaker amplifier circuit driven by the T3 output.

On one half cycle of the audio input to Q2 and Q3 (terminal 3 of T2, plus, and terminal 5, minus) the forward base-emitter voltage of Q2 is increased and that of Q3 is decreased. This action increases the collector current of Q2 and decreases that of Q3. On the next half cycle of the audio input signal the polarities of the terminals of T2 are reversed (terminal 3, minus, and terminal 5, plus); the collector current of Q2 decreases as the collector current of Q3 increases.

For both half cycles, the push-pull action in T3 is additive across the 6-7 secondary winding.

The small transformers used in the audio stages of the i-f/a-f amplifier (fig. 8-17) are subject to saturation at low frequencies with consequent attenuation of these frequencies. To compensate for this attenuation, negative feedback from a separate secondary winding of T3 is coupled back to audio amplifier, Q1. The feedback reduces the gain of the stages slightly

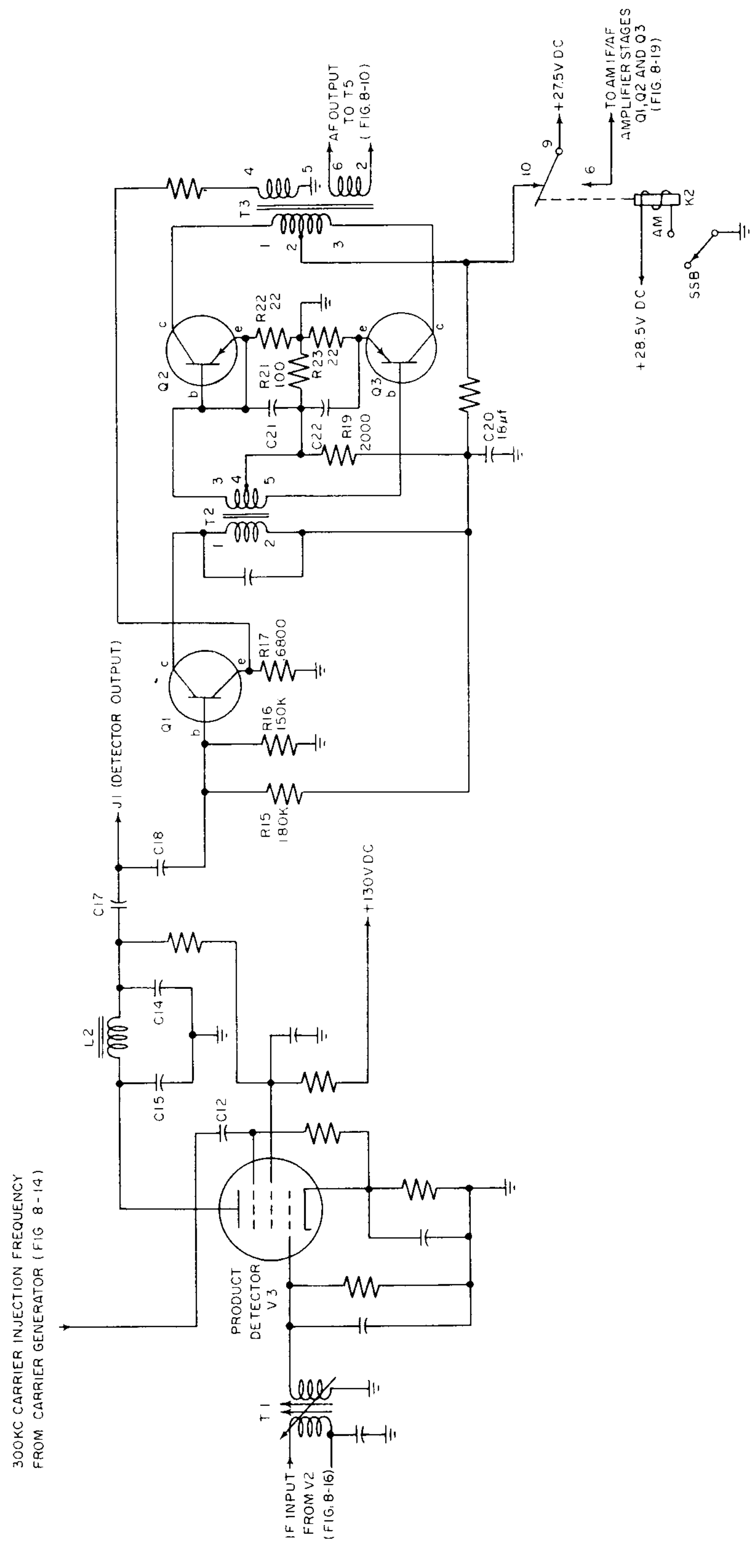

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Figure 8-17.—Product detector stage of i-f/a-f amplifier.

but improves the low-frequency response. The output level of lsb i-f/a-f amplifier is approximately 17 milliwatts into a 150-ohm load.

In the ssb position of the ssb a-m switch, K2 is deenergized, as shown, and +27.5 volts d-c is applied to the transistor stages of the i-f/a-f amplifier through contacts 9 and 10 of K2. During a-m operation, the ssb a-m switch is in the a-m position and K2 is energized. This action removes the +27.5 volts from the i-f/a-f amplifier and applies this voltage through contacts 6 and 9 of K2 to the a-m i-f/a-f amplifier.

An automatic gain control (a-g-c) system (fig. 8-18) is employed in the lower sideband i-f/a-f amplifier to maintain the output signal at a nearly constant level. The a-g-c voltage is derived by taking a portion of the i-f signal from the secondary of T1, amplifying it in the a-g-c amplifier, V4, rectifying it with the crystal diode, CR2, filtering and applying the resulting negative voltage to supplement the bias on the control grids of the i-f amplifiers, V1 and V2.

The rectified voltage from CR2 is filtered by the network consisting of C23, C24, C25, R25, and R26. This filter employs a double time-constant. The upper section, comprising C23 and R25, has a short time-constant relative to the lower section comprising C24 and R26. This provision is necessary to compensate for lack of an r-f carrier in the single-sideband signal. The characteristics of single-sideband transmission cause voice intelligence to be transmitted in groups of r-f energy since no r-f carrier is present in the absence of a voice input. Consequently, an a-g-c action is necessary which will maintain a nearly constant operating gain of the i-f amplifiers between groups of intelligence. At the same time, a-g-c action on the average audio level within the speech groups is necessary. The double time-constant of the filter circuit accomplishes this function.

The portion of the filter consisting of C24 and R26 is effective primarily between speech groups. This filter provides fast response and slow release characteristics.

The a-g-c voltage is applied through a gating diode, CR1, to the r-f tuner (discussed in ch. 9) and to a metering circuit in the frequency generator. The gating diode prevents a-g-c interaction between the lsb and usb i-f/a-f amplifier units because these two circuits are connected in parallel at the output of the subassemblies.

The a-g-c circuit of the lsb i-f/a-f amplifier will limit the output of this subassembly to a maximum of 8-db rise for approximately an 80-db rise of input. Combined with the a-g-c control in the r-f tuner, the a-g-c circuit will limit the lsb i-f/a-f amplifier output to an 8-db rise for a 100-db rise of a signal at the antenna.

Usb I-f/A-f Amplifier

The usb i-f/a-f amplifier differs from the lsb i-f/a-f amplifier only in the bandpass characteristics of the filter between the first and second i-f amplifiers. As a result of a frequency inversion in the r-f tuner, the mechanical filter of the usb i-f/a-f amplifier has a pass-band of

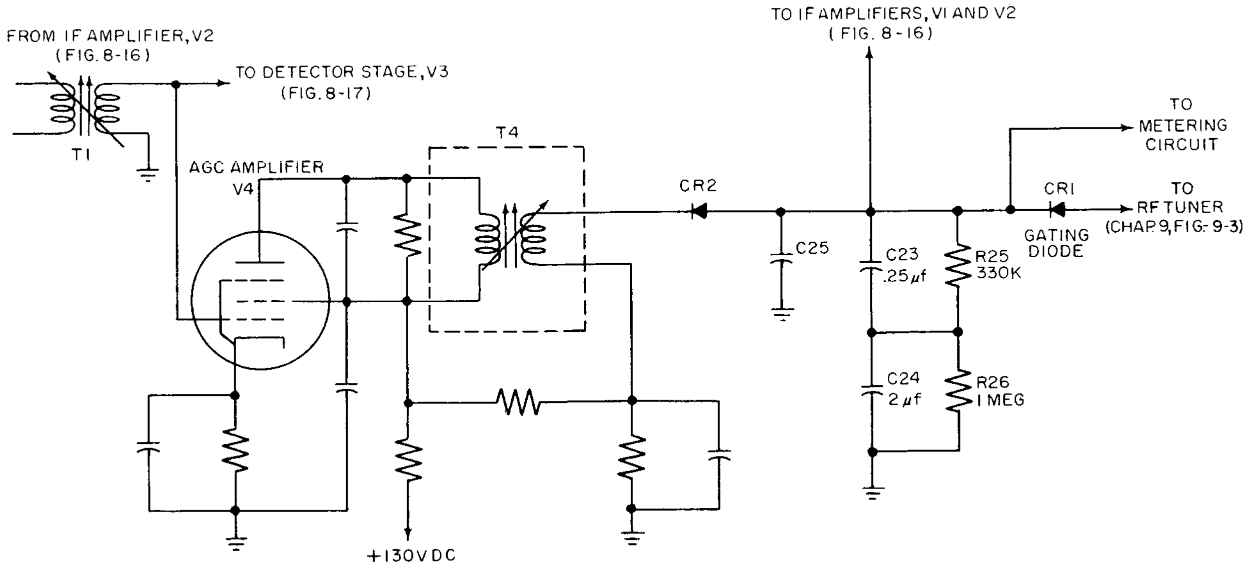

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Figure 8-18.—Agc system of i-f/a-f amplifier.

297 to 300 kc so that it passes only the received upper sideband of the 300-kc i-f signal.

A-m I-f/A-f Amplifier

The a-m i-f/a-f amplifier (fig. 8-19) provides for reception of amplitude modulated (a-m) signals. The first two stages of i-f amplication are identical with the first two stages of the lsb i-f/a-f amplifier except for the pass-bands of their respective filters. The mechanical filter of the a-m i-f/a-f amplifier has a 6-kc pass-band to accommodate double-sideband (with carrier) a-m signal, while the mechanical filters of the usb and lsb i-f/a-f amplifiers each have a 3-kc pass-band, as discussed, for passing single-sideband suppressed carrier signals.

An additional i-f amplifier stage provides the higher gain needed in the a-m unit for diode detection. The output of the third i-f amplifier is applied to a conventional a-m diode detector, CR1. The audio signal from the detector is applied to the a-f amplifier stages, which are identical to the a-f circuits used in the single-sideband i-f/a-f amplifiers.

C-W AND FSK UNIT

The c-w and fsk unit (fig. 8-20) enables the AN/URC-32 transceiver to be operated in the c-w and fsk modes of operation. On fsk transmit operation (tone modulation), the c-w and fsk unit converts the keying input from a teletypewriter current loop to audio tones of 1,575 cps for space (no loop current) and 2,425 cps for mark (loop current). On c-w transmit operation (actually mcw) the unit provides a keyed audio tone of 1,000 cps or 1,500 cps as selected by the OSC control switch on the front panel.

During fsk receive operation, the c-w and fsk unit provides a bfo (beat-frequency oscillator)

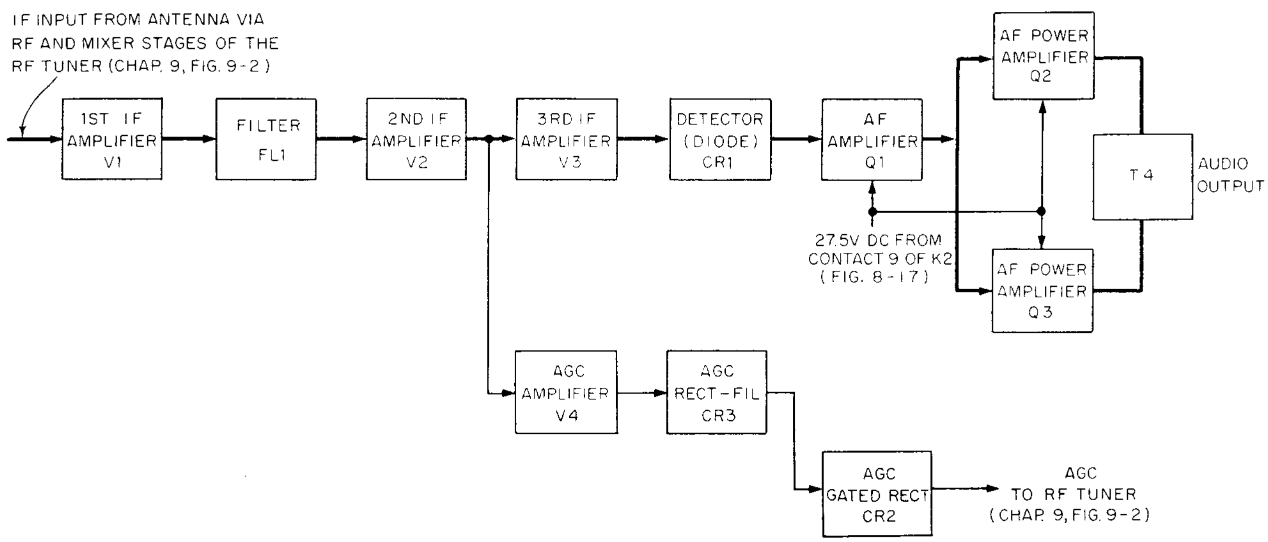

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Figure 8-19.—A-m i-f/a-f amplifier, block diagram.

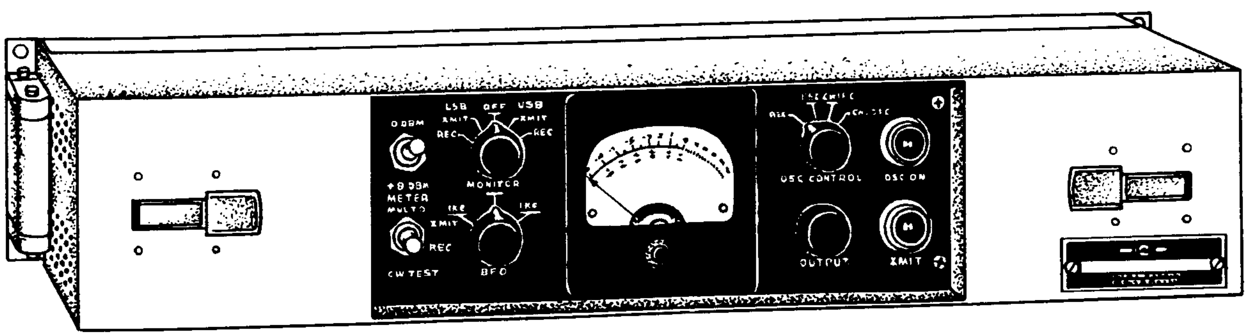

Figure 8-20.—C-w and fsk unit.

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signal which is required for c-w reception. This signal is centered on 300 - 550-kc, and is variable approximately 1 kc above or below this frequency.

The c-w and fsk unit (fig. 8-21) consists of: (1) an oscillator-buffer-amplifier (V1A, V1B, and V2A, (2) a bfo (Q1), (3) a c-w break-in relay and relay amplifier (V2B), and (4) a monitor circuit (via S2). The monitoring circuit contains a meter, M1, which is used for monitoring the receive and transmit audio outputs of the audio and control unit, and for monitoring the output of the c-w and fsk unit.

The function of the c-w and fsk unit is determined by the position of the oscillator control switch, S1, which is located on the front panel. In the OFF position, S1C disables the c-w and fsk unit by removing the B+ voltage (+130 v) from the circuits. Also, in this position, S1E connects the usb transmit audio input line from the audio and control unit to the usb transmit audio output line which is connected to the usb balanced modulators of the sideband generator (fig. 8-13). Thus, in the OFF position, the c-w and fsk unit circuits (fig. 8-21) are deenergized, and the voice input signals from the handset are transmitted.

When S1 is moved one position (from the position shown) fsk signals will be transmitted. In the final two positions of S1, c-w signals will be transmitted.

During fsk and c-w operation, the usb transmit audio input line from the audio and control unit is disconnected, and the output of the oscillator-buffer-amplifier circuit is connected to the usb transmit audio output line. In the fsk position, the frequency of the oscillator, V1A, is shifted from 1,575 cps for space to 2,425 cps for mark by the teletypewriter loop input.

In the c-w positions, the oscillator frequency is 1,000 cps (corresponding to the 1-kc position) or 1,500 cps (corresponding to the 1.5 kc position) depending on the setting of oscillator control switch, S1, on the front panel. Buffer stage, V1B, permits passage of the V1A oscillator output when the c-w and fsk key line is completed to ground.

C-W AND FSK OSCILLATOR

The oscillator, V1A, frequency is adjusted, as determined by the mode of operation, by changing the components in the grid-cathode tank circuit. With S1B in the fsk position, the tuned circuit of oscillator, V1A, consists of L1, C3, and the capacitors in the fsk circuit. The teletypewriter input signal at pin 1 of J1 determines which capacitors of the fsk keying circuit are inserted in the tuned circuit, and therefore determines the frequency of the oscillator.

The fsk keying input circuit has a relatively high impedance. Therefore, if the c-w and fsk unit is to be used with a teletypewriter operating on a standard loop current, an external resistor of approximately 1,250 ohms should be placed across the signal line to permit the 20-, 30-, or 60-ma loop current to develop a positive voltage pulse of 25 to 50 volts at the input terminal.

With no current in the teletypewriter loop (corresponding to space condition) voltage divider, R11, and the teletypewriter terminating resistor in parallel with R12, applies a negative voltage across CR2 and CR3 from the -90 volt bias line. This causes CR2 and CR3 to conduct. With CR2 and CR3 conducting, C4 and C5 are placed in the tuned circuit of the oscillator in parallel with C6 and C7. This action produces an oscillator output frequency from V1A of 1,575 cps, which represents the space condition fsk output frequency.

When a mark current is present in the teletypewriter loop, a positive voltage is developed across the external resistor in parallel with R12. This voltage exceeds the negative voltage which appears across R12 and the external resistor during the space condition, and the direction of current through these resistors changes direction from downward through the resistors to upward.

The resulting positive voltage at the R12-CR2 junction cuts off CR2 and CR3, and effectively removes C4 and C5 from the tuned circuit of the oscillator. The oscillator frequency changes to a higher frequency (as a result of the decrease in capacitance) to produce 2,425 cps. This frequency corresponds to the mark condition of the fsk output. The oscillator signal is fed through the buffer, V1B, the output amplifier, V2A, S1E, and S1F, to the usb transmit audio output lines.

In the c-w 1-kc position of S1, section S1B removes the capacitors in the fsk keying input circuit and inserts C8 in the oscillator tank. This tunes the oscillator to 1 kc. In the c-w 1.5-kc position, C9 is connected in the oscillator tank circuit to tune the oscillator to 1,5 kc.

BUFFER AND OUTPUT AMPLIFIER

The output of the oscillator, V1A, is fed to the grid of buffer, V1B. In the fsk position (12), S1A applies a ground to grid resistor, R8, and the buffer stage functions continuously. In the two c-w positions (1 and 2) of S1A, the buffer

(V1B) is biased to cutoff. The cutoff voltage is applied to the V1B grid through R8 and R9 from the junction of R10 and R17 which are connected from the -90 volt supply to ground. The buffer is keyed by the c-w and fsk line which applies a ground (when closed) to the junction of R10 and R17 through contacts 1 and 4 (or 5) of S1D. Thus, closing the c-w key removes the bias from the buffer stage, and V1B passes the oscillator (V1A) output.

The V1B output is fed through a bandpass filter which rejects 3 kc. On c-w operation, C18 is connected in the filter input path by S1G in parallel with C17, and the filter attenuates the second harmonic of 1.5 kc and the third harmonic of 1 kc. During fsk operation (position 12), S1G removes C18 from the filter input circuit, and the second harmonic of the 1,575 cps space frequency is attenuated.

The filtered output from V1B is developed across output control R19. The T1 secondary provides a 600-ohm balanced output (CT grounded) via S1F and S1E (c-w and fsk positions 5, 6, and 7) to the usb audio output line. In the OFF position (as shown), S1E connects the usb transmit audio input line directly to the usb transmit audio output line.

C-W BREAK-IN RELAY CIRCUIT

The c-w break-in relay circuit, comprising relay amplifier, V2B, and keying relay, K1, applies a ground to the transmit key line via pin 2 and pin 16 of J1 when the c-w key is closed, and maintains this ground via pin 11 of J1 through the normal c-w key open intervals of a c-w transmission. In the two c-w positions, S1H (pins 4 & 5) connects the c-w and fsk key line through R16 and R18 to the grid of relay amplifier, V2B. The plate circuit relay, K1, operates on a fast response and a delayed release principle. This is accomplished by controlling the grid voltage of V2B from two R-C circuits, one with a short time-constant, and one with a long time-constant.

In the initial key-up condition, C13 charges to approximately -20 volts through R10, R16, and R18, from the -90 volt supply. The voltage across C13 maintains V2B in cutoff, and K1 is deenergized.

When the c-w key is closed, a ground is applied to the c-w and fsk key line and C13 is discharged through the small forward resistance of CR4, pins 4 or 5 of S1H, the key and ground, or via pins 2 and 16 of J1. This represents a short time-constant as compared to the charge path through R16 and R18. The discharge of C13 removes the negative bias voltage from the grid of V2B, the tube conducts, and K1 is energized, thereby placing a ground on the transmit key line via pin 11 of J1.

When the c-w key is opened, the ground is removed from the c-w and fsk key line, and C13 is charged through the high resistance of R16 and R18. When the voltage at the tap of R18 reaches the cutoff value of V2B, K1 is deenergized and ground is removed from the transmit key line.

The long time-constant of R10, R16, R18, and C13, provides the time delay necessary to maintain the transceiver in the transmit condition during the normal key-open interval of a c-w transmission. When S1H is in the OFF or fsk positions (1, 2, or 3), the c-w and fsk key line is connected directly through contacts 1 and 2 (or 3) to the transmit key line. The c-w and fsk key line can then be used as a remote transmit key line.

BEAT-FREQUENCY OSCILLATOR

The beat-frequency oscillator (bfo) circuit consists of a transistor oscillator, Q1, and a switching diode, CR1, which disconnects the 100-kc input signal at J2 from the 100-kc output signal jack, J3 on fsk receive operation. During all modes of operation except fsk receive, the 100-kc signal input from the reference oscillator at J2 (discussed in ch. 9) is fed through J3 to the carrier generator (fig. 8-14) where it is multiplied to produce the 300-kc i-f signal. Diode CR1 is maintained in a conducting state by a bias voltage obtained from the voltage divider comprising R1 and R2 across the +130 volt supply. In the OFF and c-w positions of S1, S1D completes the d-c path through CR1 from ground contacts 8 and 7 of S1D, R25, R26, R3, CR1, and R1 to the +130 volt supply.

Because the peak amplitude of the 100-kc input signal at J2 is smaller than the voltage from the C5-CR1 junction to ground, CR1 will remain conducting during the application of the complete 100-kc sine wave signals. The output voltage variations from CR1 are developed across R3, R25, and R26. The 100-kc input from J2 is fed via J3 to the carrier generator for all modes of operation except fsk receive.

During fsk transmit condition, the ground on the CR1 anode is completed through contacts 7 and 9 of S1D when the transmit key line is closed. Thus, during fsk transmit, the 100-kc signal is coupled through CR1 to the carrier generator, and the 300-kc i-f signal is produced in the normal manner.

During fsk receive operation, +28 volts d-c is applied to the transmit key line through indicator lamp, DS1, and R13. This positive potential is applied through contacts 9 and 7 of S1D, R25, R26, and R3, to the cathode of CR1. Since this potential is more positive than the positive voltage applied to the anode of CR1, the diode cuts off during fsk receive operation, thereby disconnecting J2 and J3.

The positive voltage on the transmit key line is fed through CR5 and a filter comprising R27, C16, R4, and C4, to the bfo circuit, Q1. This action energizes the bfo.

The frequency of the bfo circuit is determined by parallel resonant tank circuit, L1, C9, C10, and C11, in the collector circuit. The feedback signal from the L1 tap to ground is coupled through C7 to increase emitter forward bias current when collector current is increasing. When Q1 saturates, the feedback potential from L1 momentarily drops to zero. As forward bias decreases, collector current decreases and the feedback from the L1 tank decreases the base-emitter current. This action sustains oscillation in the tank circuit. Inductor L1 can be adjusted for a center frequency of 300.550 kc. Capacitor C11 provides a method of varying the frequency approximately 1 kc above or below the center frequency.

The output signal from the bfo is taken from the tap on L1 and fed through C8 to the output jack, J3. This signal is amplified in the carrier generator and used as a beat-frequency signal with the received fsk signals.

CONTROL CIRCUITS

The AN/URC-32 is keyed to transmit by applying a ground to a transmit key line. The method by which this ground is supplied to the transmit key line depends upon the mode of operation and the position of the handset switch on the handset adapter and OSC control switch on the c-w and fsk unit.

During voice operation, the OSC control switch is set to OFF. This deenergizes the c-w and fsk unit circuits and connects the transmit key line to the handset switch. When the handset switch is in the LOCAL position, a ground is applied to the transmit key line by a relay in the handset adapter. The relay (K1 in the handset adapter) is energized when the push-to-talk button on the local handset is depressed. This action closes the K1 contacts to ground the transmit key line.

When the handset switch is in the REMOTE position, the transmit key line is connected to the remote key line. The ground is supplied to the line by a push-to-talk relay in the remote phone unit.

For fsk operation, the OSC control switch (on the c-w and fsk unit) is set to the fsk position and the handset switch is set to REMOTE. This energizes the fsk circuits of the c-w and fsk unit, and connects the transmit key line to the remote key line. A ground is then applied to the remote key line at the teletypewriter control panel.

For c-w operation, the OSC control switch S1 (fig. 8-22) is set to either the c-w 1 kc or the c-w 1.5 kc position, and the handset switch is set to REMOTE. This action applies B+ to the c-w circuits of the c-w and fsk unit, and connects the remote key line to the c-w key line of the c-w and fsk unit. The remote key line becomes a c-w key input, and is grounded by the c-w key.

When the c-w key is open, the grid of buffer stage, V1B, is blocked by a high negative potential. When the key is closed, the V1B negative grid bias is reduced and the oscillator signal from V1A is allowed to pass. With V2B conducting, the break-in relay, K1, is energized, to apply a ground to the transmit key line. This action keys the transmitter carrier.

The break-in relay, K1, incorporates a delay circuit which holds the transceiver in transmit operation during normal c-w key-open intervals. When K1 in the c-w and fsk unit is deenergized, the ground for the transmit key line is removed by the K1 contacts.

Grounding the key line energizes the receive transmit relays of the AN/URC-32 and the antenna coupler. When transmitting, K1 in the sideband generator applies the transmit audio signals to the balanced modulator via oscillator control S1 in the OFF position. The relay also closes the contacts which are used to operate an antenna bypass circuit in a remote antenna tuner (such as the AN/BRA-3) when different transmitting and receiving frequencies are used (crossband operation). A separate receiver unit must be used during crossband operation.

With the antenna tuner bypass switch in the REMOTE position (not shown), the antenna tuner is bypassed when the relay contacts are open (receive condition). When crossband operation is not being used, the bypass switch in the antenna tuner should be in the TUNER-IN position to decrease the transmit keying time. The increase in transmit keying time during crossband operation is due to the transmit keying circuit being interlocked through the antenna tuner bypass circuit so that the AN/URC-32 is not keyed

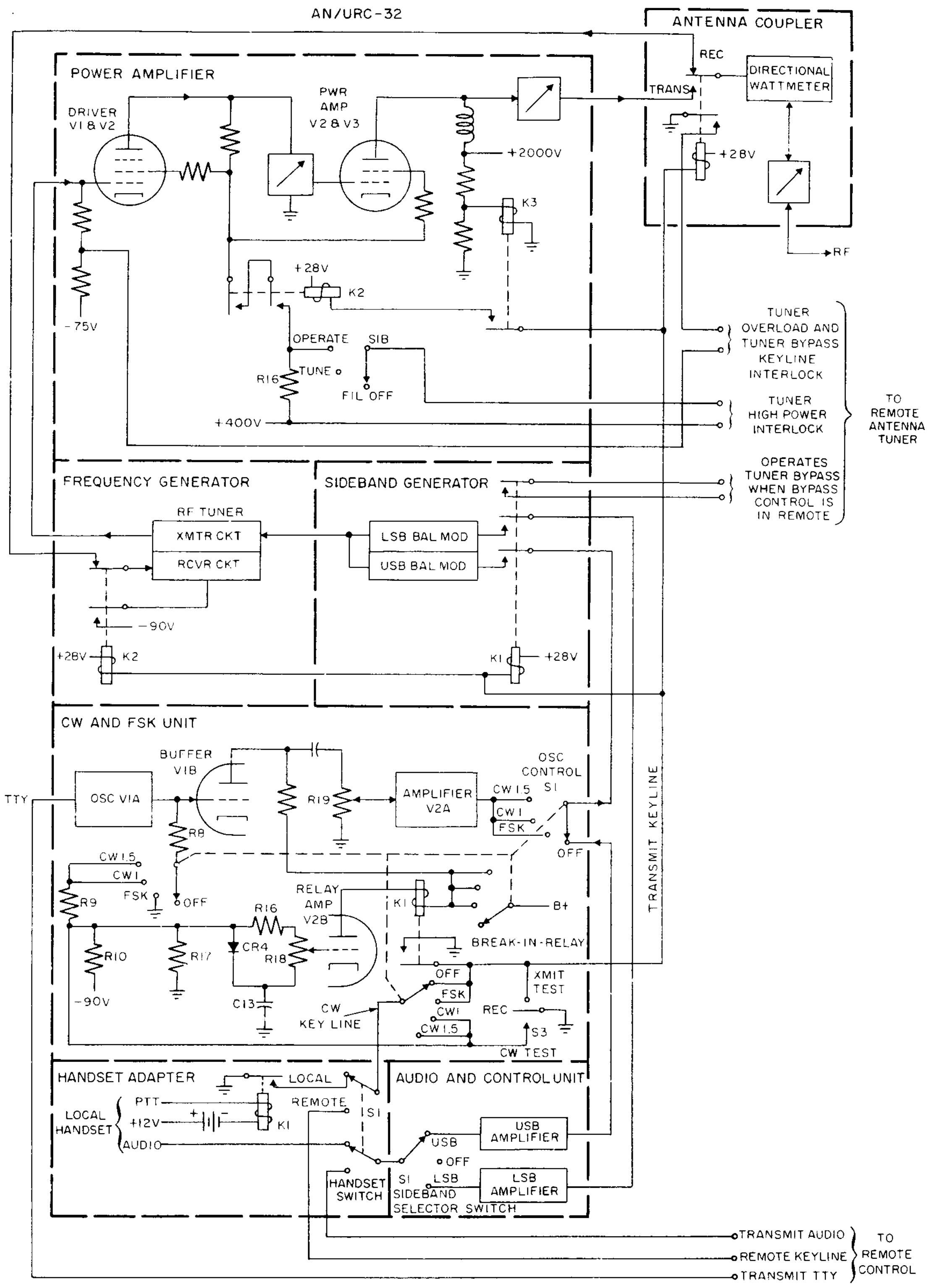

Figure 8-22.—Control circuits. 32.156

to transmit until the tuner bypass circuit of the remote antenna tuner switches from the BYPASS to the TUNER-IN position. When c-w keying is used in the AN/URC-32, this time lag may result in a partial loss of the first character of the code message.

In the transmit condition, K2 in the frequency generator, disables the receiver circuit of the r-f tuner by applying a cutoff bias voltage to the grids of the receiver stages, and by disconnecting the receive r-f input from the antenna to the r-f tuner. Relay, K2, in the power amplifier applies voltage to the driver screens and plates, and to the power amplifier screens. This relay is interlocked through contacts of relay, K3, which prevents the operation of K2 when the power amplifier plate voltage is not applied.

The output level of the power amplifier is controlled by the tune-operate switch, S1B. This switch controls the driver plate and screen voltage and the power amplifier screen voltage by inserting a dropping resistor, R16, in the 400-volt supply line during the tune or low level condition of the transmitter. For high power operation, this resistor is shorted out through tune-operate switch, S1B, and the tuner high power interlock (not shown). The antenna tuner high power interlock prevents high power operation when the antenna tuner is not tuned to the operating frequency.

The relay in the antenna coupler switches from the receiver input circuit in the frequency generator to the transmitter output circuit of the power amplifier. Auxiliary contacts on the relay apply a ground through an antenna bypass interlock to remove the disabling bias applied to the driver grids of the power amplifier unit during transmission. The antenna bypass interlock prevents r-f drive power from being applied to the power amplifier when the antenna tuner is bypassed.

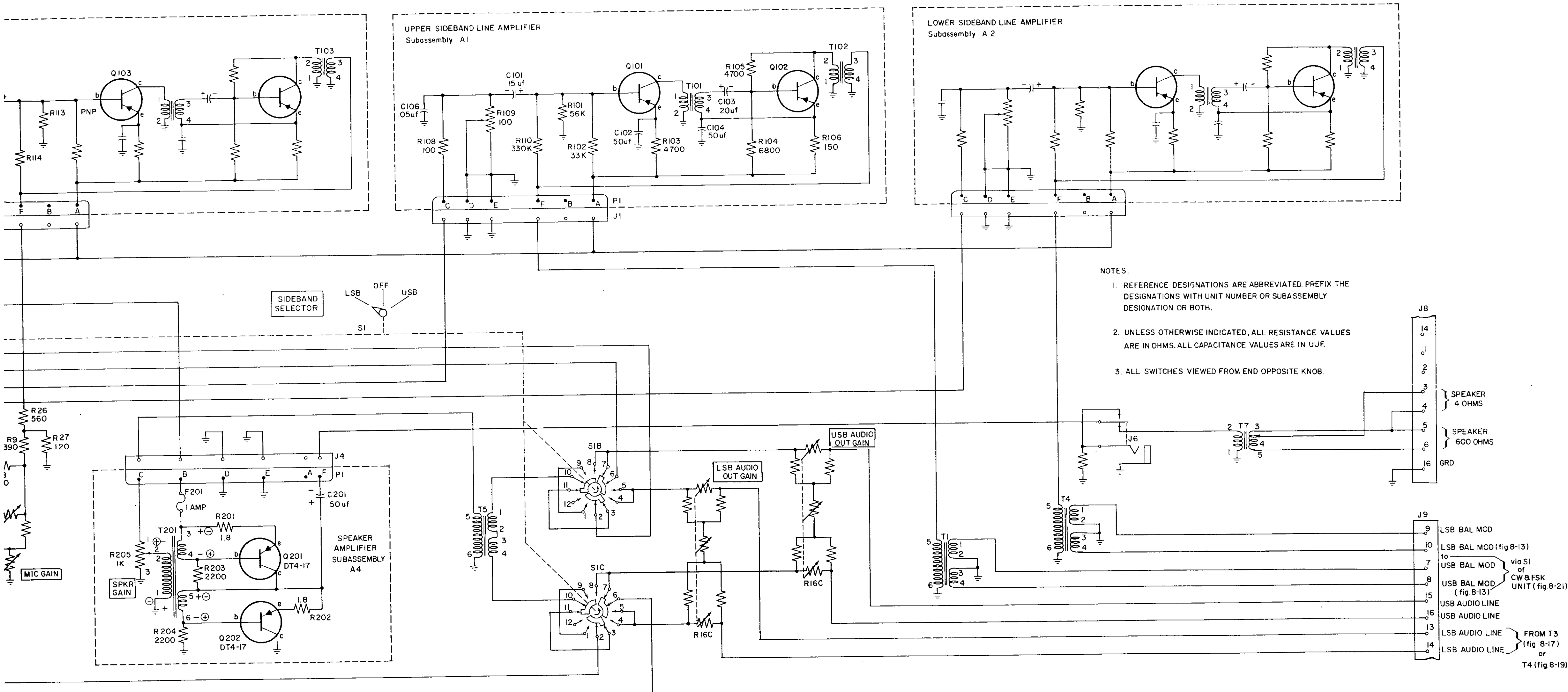

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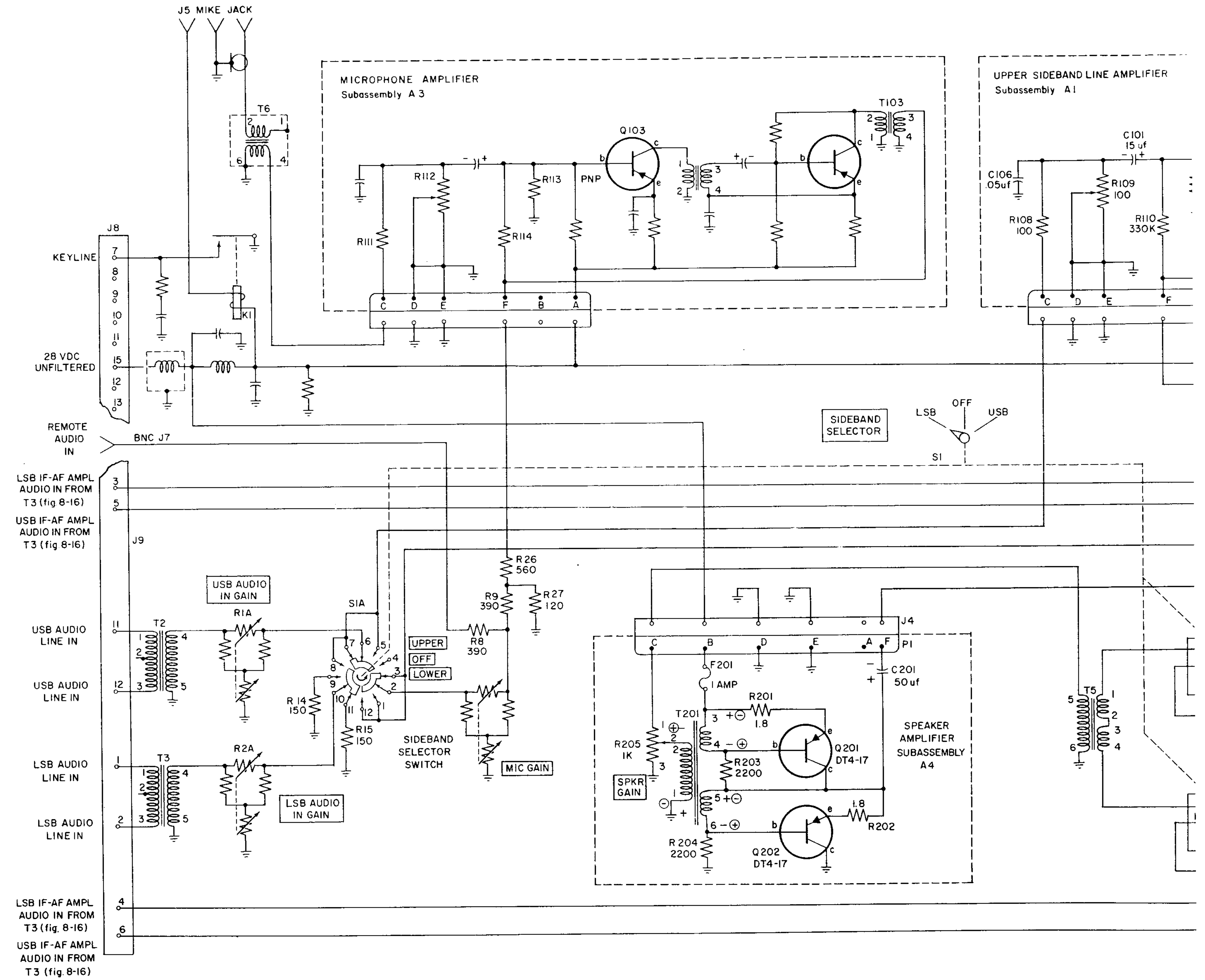
Figure 8-10.—Audio and control unit, schematic diagram.


J5 MIKE JACK
T6
MICROPHONE AMPLIFIER
Subassembly A3
Q103
T103
PNP
R111
R112
R113
R114
UPPER SIDEBAND LINE AMPLIFIER
Subassembly A1
C101
15 uf
C106
.05uf
R109
100
R108
100
R110
330K
J8
KEYLINE
28 VDC
UNFILTERED
K1
REMOTE
AUDIO
IN
BNC J7
SIDEBAND
SELECTOR
LSB
OFF
USB
S1
LSB IF-AF AMPL
AUDIO IN FROM
T3 (fig 8-16)
USB IF-AF AMPL
AUDIO IN FROM
T3 (fig 8-16)
J9
R26
560
R9
390
R27
120
R8
390
USB AUDIO
IN GAIN
R1A
S1A
UPPER
OFF
LOWER
USB AUDIO
LINE IN
T2
R14
150
R15
150
SIDEBAND
SELECTOR
SWITCH
MIC GAIN
LSB AUDIO
LINE IN
T3
R2A
LSB AUDIO
IN GAIN
J4
P1
F201
1 AMP
C201
50 uf
R201
1.8
T201
R205
1K
SPKR
GAIN
R203
2200
Q201
DT4-17
SPEAKER
AMPLIFIER
SUBASSEMBLY
A4
R204
2200
Q202
DT4-17
R202
1.8
T5
LSB IF-AF AMPL
AUDIO IN FROM
T3 (fig. 8-16)
USB IF-AF AMPL
AUDIO IN FROM
T3 (fig. 8-16)

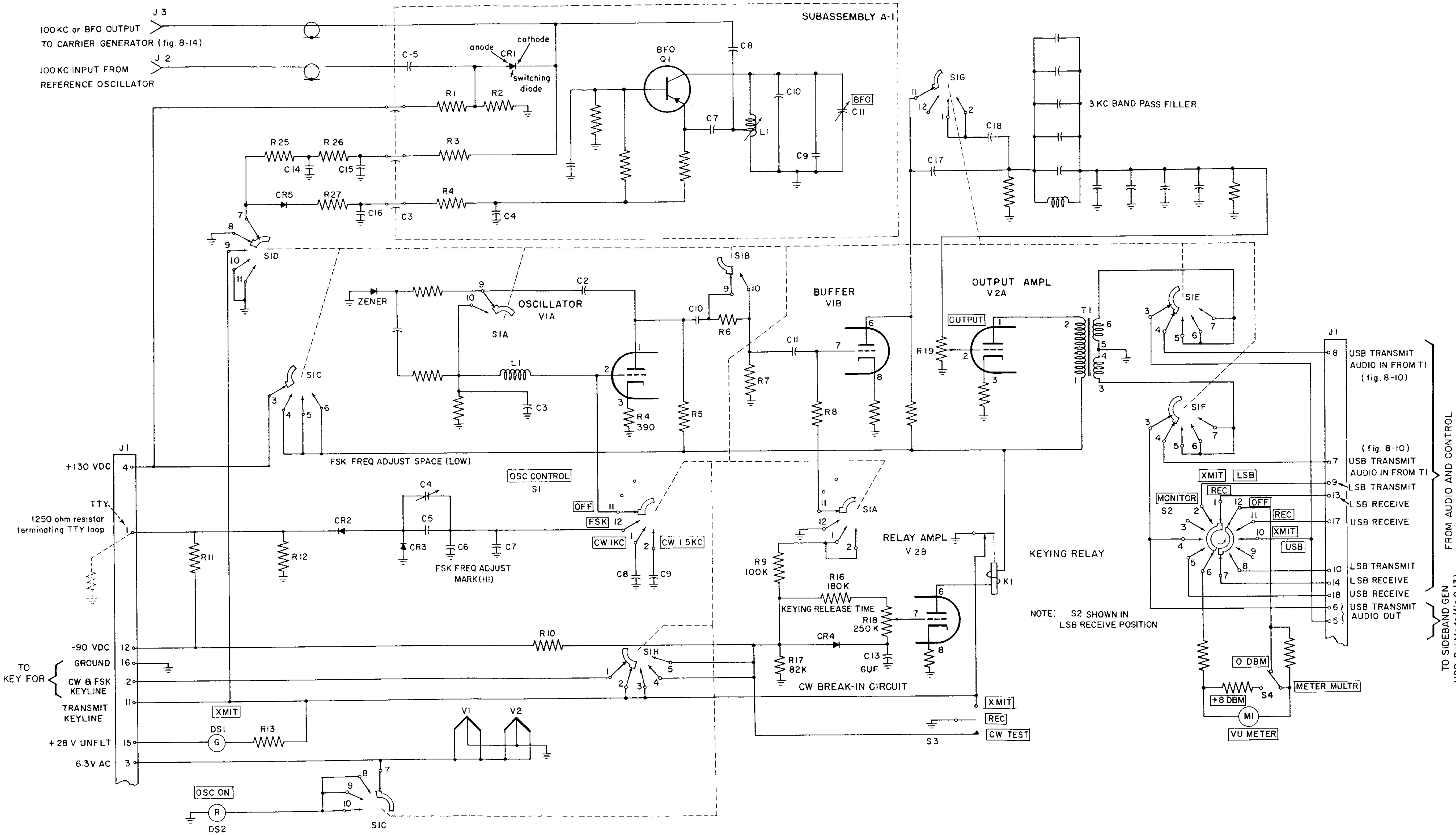


Figure 8-21.—C-w and fsk unit, schematic diagram.

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