UNCLASSIFIED

# TECHNICAL MANUAL



for

# DUAL-DIVERSITY RECEIVER TERMINAL DDR-6E

THE TECHNICAL MATERIEL CORPORATION

MAMARONECK, N. Y. OTTAWA, CANADA

Issue Date: 1 October 1960

# TABLE OF CONTENTS

## SECTION 1—GENERAL DESCRIPTION



## SECTION 2—INSTALLATION



## SECTION 3—OPERATOR'S SECTION



## SECTION 3—OPERATOR'S SECTION (C nt.)



## SECTION 4—PRINCIPLES OF OPERATION

## TABLE OF CONTENTS (C nt.)

### SECTION 4—PRINCIPLES OF OPERATION (Cont.)



### SECTION 5—TROUBLE-SHOOTING



### SECTION 5—TROUBLE-SHOOTING (Cont.)



### SECTION 6—MAINTENANCE



### SECTION 7—PARTS LIST

### SECTION 8—SCHEMATIC DIAGRAMS

### APPENDIX I – ACCESSORY EQUIPMENT

# LIST OF ILLUSTRATIONS

## SECTION 1—GENERAL DESCRIPTION



## SECTION 2—INSTALLATION



## SECTION 3—OPERATOR'S SECTION



## SECTION 4—PRINCIPLES OF OPERATION



## SECTION 4—PRINCIPLES OF OPERATION (Cont.)



## SECTION 5—TROUBLE-SHOOTING

## LIST OF ILLUSTRATIONS (C nt.)

### SECTION 5—TROUBLE-SHOOTING (Cont.)



### SECTION 8—SCHEMATIC DIAGRAMS



### APPENDIX I

# LIST OF TABLES

## SECTION 1—GENERAL DESCRIPTION



## SECTION 2—INSTALLATION



## SECTION 3—OPERATOR'S SECTION



## SECTION 5—TROUBLE-SHOOTING



## SECTION 6—MAINTENANCE



## APPENDIX I

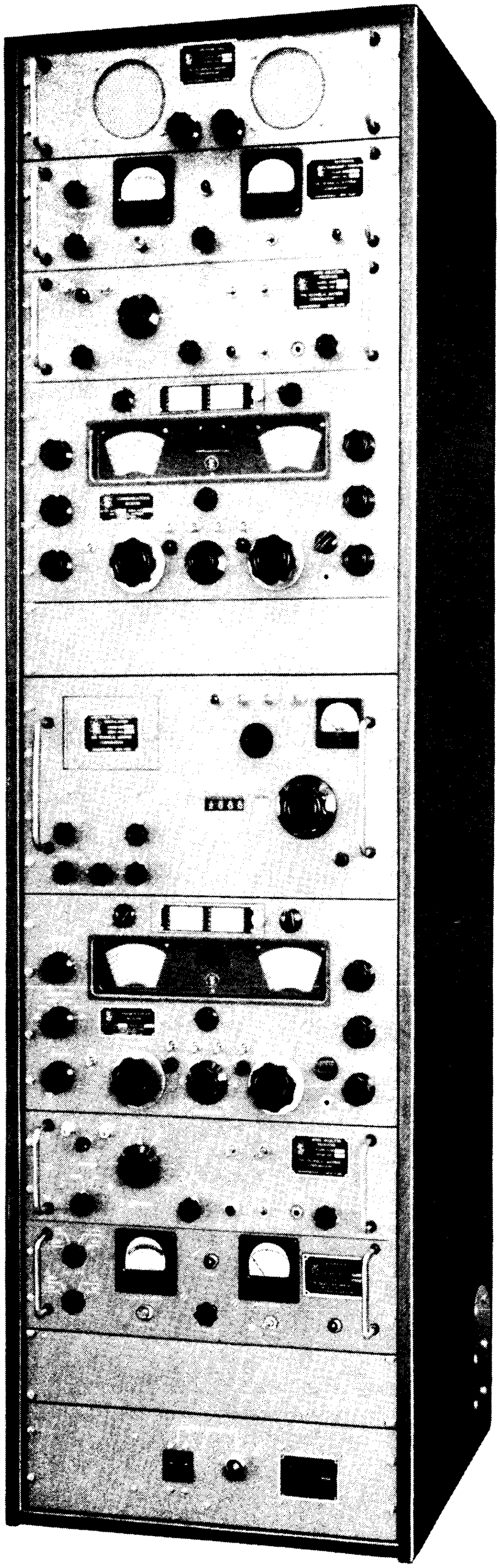


Figure 1-1. DDR-6E Receiver Terminal

# SECTION 1
# GENERAL DESCRIPTION

## 1-1. INTRODUCTION.

The combined operation of the Dual-Diversity Receiver Terminal DDR-6E and a radio transmitter terminal constitutes a high-frequency radio send-receive terminal. As an example, consider the DDR-6E combined with a Radio Transmitting Set GPT-10K(H), as used in the Mercury System. Their parameters are such that a number of these terminals, properly located, will afford reliable world-wide communication. The combined send-receive terminal is designed to operate with voice frequency communication facilities, telephone or teletype. The high degree of reliability is obtained by using single sideband transmission, high-powered transmitters, and dual-diversity reception (both space and sideband). A three-volume manual, entitled "Transmitting Set, Radio, Model GPT-10K," describes the transmitter terminal; this single-volume companion manual describes the receiver terminal in detail.

As shown in figure 1-1, the DDR-6E is housed in a single 6-foot cabinet. The items of equipment comprising the DDR-6E are listed in table 1-1. The DDR-6E may be supplemented by a second cabinet that contains such auxiliary equipment as may be specified by the customer. Several items of equipment which may be housed in the auxiliary cabinet are briefly described in the Appendix to this manual.

## 1-2. FUNCTIONAL DESCRIPTION OF DDR-6E RECEIVER TERMINAL.

a. OVERALL TERMINAL. - Incoming RF signals are applied to two Communications Receivers GPR-90RXD, via their associated space-diversity antennas. For reasons of optimum stability, the HFO, IFO, and BFO circuits in the receivers are not used. In the DDR-6E, the highly stable HFO and IFO outputs of a Variable Frequency Oscillator VOX-3 are applied to the receivers. The IF output of each receiver is routed to an associated Single Sideband Converter (sometimes referred to as a receiving mode selector) MSR-6 which extracts the audio intelligence contained in the transmitted sideband. Each MSR-6 provides the BFO circuit for the signal processed by the associated receiver. The single sideband operation of the MSR-6's results in higher grade signals than those which could be obtained by double sideband operation of conventional receivers. An Automatic Frequency Control Unit AFC-1, associated with each MSR-6, shifts the converter frequency in step with variations in the transmitter frequency so that the received signal is properly demodulated. The audio output of each MSR-6, monitored on Loudspeaker Panel LSP-7, may be routed to tone multiplexing equipment via an audio and teletype patching panel (not supplied as part of the DDR-6E), then to phones or teletypewriters.

Primary power (115 volts AC at 60 cps) is applied to the GPR-90RXD's, the MSR-6's, and the AFC-1's via a Sola Constant Voltage Regulator and a Power Control Panel DCP-1. The AC input to the VOX-3 bypasses the main power switch in the DCP-1; primary regulated power is continuously applied to the VOX-3 for purposes of frequency stability. A blower assembly mounted on the rear door of the cabinet provides forced air cooling for the DDR-6E components. Terminal strips mounted on a panel at the lower rear portion of the cabinet provide the facilities for terminating telephone lines, and the like, as required.

b. COMMUNICATIONS RECEIVER GRP-90RXD. (See figure 1-2.) - The GPR-90RXD is a general coverage communications receiver with a frequency range of 0.54 to 31.5 mc, distributed over six bands, and is capable of receiving AM, CW, MCW, FS, and SSB signals. Tuning is provided with full electrical bandspread, and a 100-kc crystal-controlled calibrator provides 100-kc markers throughout the tuning range.

The 17-tube circuit of the GPR-90RXD provides a sensitivity that averages better than one micro-volt for a 10-db signal-to-noise ratio. Dual conversion is employed in bands, 4, 5, and 6 for improved image rejection. The input provides for a 75-ohm unbalanced antenna and the output may be terminated in 4-, 8-, 16-, or 600-ohm voice coils or headphones. A front panel S-meter indicates relative signal strength and also permits accurate tuning.

The RF SELECTIVITY switch provides six steps of IF selectivity: 0.25 to 2 kc on crystal filter, and 7 kc at 6 db down in noncrystal operation. Audio selectivity is controlled by a 3-position (NORMAL, LOW-PASS, and 1200 PEAK) switch. When set to 1200 PEAK, the audio bandwidth at 10 db down from the peak can be varied from 600 to 1600 cps by means of the AUDIO SPREAD control.

In addition to the normal local oscillator, the GPR-90RXD permits the use of 10 precisely adjustable crystal positions available from the front panel plus a rear deck input for an external high stability control oscillator or synthesizer. A series type noise limiter is employed to effectively reduce ignition or other pulse type noise. The limiter can be turned on by a front panel limiter switch.

The frequency of the beat frequency oscillator is controlled by the BFO PITCH control which varies the audio beat note on CW signals from zero to ±3 kc. The high stability of this BFO makes it possible to receive SSB signals.

When receiving SSB or ISB signals in the DDR-6E, the BFO circuit in the GPR-90RXD is turned off. The BFO function is then provided by the associated MSR-6.

The receiver operates on 115- and 230-volt, 60-cycle AC power although provision is made for operation from an external power supply or batteries for emergency service in areas where AC power is not available.

General descriptive characteristics of the GPR-90RXD are presented in table 1-2-a.

c. VARIABLE FREQUENCY OSCILLATOR VOX-3. (See figure 1-3.) - The VOX is a precision, direct-reading, variable-frequency device which is designed to provide HF and MF oscillator injection with extremely high stability.

The VOX provides the following:

(1) HF output voltage, continuously variable over the range of 2 to 64 mc.

(2) Crystal-controlled HF output voltage over the range of 2 to 64 mc (frequency dependent on crystals used).

(3) Crystal-controlled BFO voltage over the range of 300 to 1000 kc (frequency dependent on crystals used) for dual-conversion superheterodyne receivers such as the GPR-90RXD.

(4) Crystal-controlled IFO voltage over the range of 3.2 to 3.9 mc (frequency dependent upon crystals used) for dual-conversion superheterodyne receivers.

Sufficient output is available from any of the foregoing to control as many as three receivers in diversity. The VOX incorporates a highly stable variable-frequency oscillator, (1) above, with an extremely accurate counter-type dial. Master oscillator frequency - determining elements are contained in a temperature-stabilized oven, the components of which are carefully selected for high-stability operation. In addition to the variable-frequency feature, provision is made for as many as three crystal-controlled positions for HF injection, (2) above. Additional crystal oscillators provide crystal-controlled BFO voltage, (3) above, and a 3.2 to 3.9-mc crystal-controlled RF output, (4) above, for dual conversion receivers. General descriptive characteristics of the VOX are presented in table 1-2-b.

d. SINGLE SIDEBAND CONVERTER MSR-6. (See figure 1-4.) - The MSR-6 is used in the DDR-6E to sharpen the overall skirt selectivity of the GPR-90RXD greatly, thus rejecting unwanted adjacent signals or interference without degrading the desired signal. A mechanical and electrical bandspread tunes through the IF bandpass of the signal provided by the GPR-90RXD, greatly simplifying the tuning of single sideband signals since final tuning is accomplished at the MSR-6 rather than at the GPR-90RXD. This effective vernier permits precise tuning of single sideband or exalted carrier amplitude-modulated signals within cycles of correct tone. Either sideband may be selected; either with the bandpass tuning feature or by inverting the oscillator separation. CW, MCW, and frequency-shaft signals may be easily tuned with the bandspread feature. The use of two MSR-6 units with either one or two GPR-90RXD's also provides independent sideband reception.

For purposes of extreme stability, the frequency of the first oscillator of the MSR-6 is referenced to a 17-kc crystal-controlled oscillator in an AFC-1 unit. As a result, demodulation is such that the required audio is always translated into the correct audio frequency spectrum.

The VFO feature of the MSR-6 permits operation with any GPR-90RXD whose IF circuits are tuned to a center frequency of 455 kc. However, when the oscillator is switched to crystal control and the proper crystals inserted, almost any GPR-90RXD IF may be accommodated.

The audio output of the MSR-6 is available in three levels:

(1) 2 watts for 600-ohm line or 8-ohm loudspeaker.

(2) 150 milliwatts for 600-ohm line or 8-ohm loudspeaker.

(3) 0 dbm/1 milliwatt for 600-ohm telephone line.

General descriptive characteristics of the MSR-6 are presented in table 1-2-c.

e. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1. (See figure 1-5.) - The AFC-1 comprises a feedback loop which effectively locks the carrier output of the first mixer in the MSR-6 to that of the AFC-1 17-kc crystal-controlled oscillator. The AFC-1 circuits compare the carrier output of the MSR-6 with the AFC-1's 17-kc crystal-controlled oscillator output frequency. Should either oscillator drift, the AFC-1 circuits develop a DC level whose amplitude corresponds to the amount of frequency change. This DC level is fed back to the MSR-6 where the frequency of the first oscillator is shifted in the proper direction to offset the detected drift. Simultaneously, the frequency change or drift is indicated on the A.F.C. INDICATOR meter of the AFC-1. If the carrier signal fades during the frequency correction period, a memory circuit in the AFC-1 retains the drift information for a predetermined interval, thus holding the first oscillator at the corrected frequency. Without this feature, the MSR-6 first oscillator frequency would shift to such a degree that the received signal would be lost. An alarm circuit goes on a FADE ALARM lamp during signal fade conditions, alerting operating personnel to this situation.

The AFC-1 also provides an AVC voltage for the GPR-90XRD during reception of single-sideband signals. The attack time of this voltage can be set to the desired speed (slow, medium, or fast) in order to suit a particular reception condition. In order that the AFC-1 may function properly, it is necessary that the transmitter contain a carrier 10, 20, or 30 db below the level of the intelligence being transmitted. This carrier is the locking mechanism for the receiving system. General descriptive characteristics of the AFC-1 are presented in table 1-2-d.

f. LOUDSPEAKER PANEL LSP-7. - As shown in figure 1-1, the LSP-7 is the uppermost panel in the DDR-6E. The LSP-7 contains two 4-inch permanent magnet speakers which are matched to the outputs of the MSR-6's in the cabinet. Connection to each speaker is made through an associated terminal strip mounted adjacent to the speaker at the rear of the LSP-7 panel. A resistive pad associated with each speaker permits output level adjustment without mismatching.

g. POWER CONTROL PANEL DCP-1. - The DCP-1, shown in figure 1-1, occupies the bottom position of the DDR-6E cabinet. The DCP-1 controls the 115-volt AC output of a Sola constant voltage regulator. This regulated AC output is applied to the GPR-90RXD's, the MSR-6's, and the AFC-1's in the cabinet. (AC input to the VOX-3 is not controlled by the DCP-1. The VOX is always connected to the regulated AC output of the voltage regulator.) The front panel of the DCP-1 contains a single switch and power indicator lamp.

## 1-3. REFERENCE DATA.

Tables 1-3, 1-4-a, 1-4-b, 1-4-c, and 1-4-d contain reference data pertinent to the items of equipment comprising the DDR-6E.

### TABLE 1-1. DDR-6E, EQUIPMENT SUPPLIED

| QUANTITY PER EQUIPMENT | NAME OF UNIT | TMC DESIGNATION | DIMENSIONS* WIDTH | HEIGHT | DEPTH | NET* WEIGHT |
|---|---|---|---|---|---|---|
| 2 | Communications Receiver | GPR-90RXD | 19 | 10-1/2 | 15 | — |
| 2 | Automatic Frequency Control Unit | AFC-1 | 19 | 4-3/4 | 13 | — |
| 2 | Single Sideband Converter | MSR-6 | 19 | 5-1/4 | 13-1/2 | 24 |
| 1 | Variable Frequency Oscillator | VOX-3 | 19 | 10-1/2 | 16 | 70 |
| 1 | Power Control Panel | DCP-1 | 19 | 5-1/4 | 4 | — |
| 1 | Loudspeaker Panel | LSP-7 | 19 | 5-1/4 | — | — |
| 1 | Fan Assembly | — — | — | — | — | — |
| 1 | Constant Voltage Regulator (Sola Type CV) | — — | — | — | — | — |

*Unless otherwise stated, dimensions are in inches, weight in pounds.

### TABLE 1-2-a. ELECTRICAL CHARACTERISTICS OF THE GPR-90RXD

| ITEM | CHARACTERISTIC |
|---|---|
| Frequency range: | 0.54 to 31.5 mc in six bands. |
| Type of reception: | AM, CW, MCW, FS, and SSB. |
| Tuning system: | Accurately calibrated main tuning dial plus full electrical bandspread. |
| Input impedance: | 75 ohms unbalanced. |
| Output inpedance: | 4, 8, 16, and 600 ohms plus headphones. |
| Output level: | 2-watt high quality audio output. |
| Sensitivity: | Better than 1 microvolt for 10 db signal-to-noise ratio. |
| Noise figure: | Better than 6 db. |
| Image ratio: | Averages 85 db. |
| Selectivity: | Variable in six steps from 250 cps to 5 kc, 5 crystal and 1 noncrystal position. |
| AVC characteristic: | With and 80-db change in the input signal, the output remains constant within 12 db. |
| Audio selectivity: | Specially designed audio selectivity control with variable bandwidth. |
| Noise limiter: | A highly effective series type noise limiter is provided. |
| Metering: | Calibrated S-meter. |
| VFO stability: | Better than 0.002 percent on first three bands and 0.003 percent on three bands. |
| Crystal stability: | Dependent upon crystal being used. |
| Crystal calibrator: | Provides 100-kc markers throughout tuning range. |
| BFO circuit: | Variable frequency BFO. |
| Hum level: | Better than 60 db. |
| Primary power: | 115 or 230 volts, 50 or 60 cycles, approximately 90 watts. |

### TABLE 1-2-b. ELECTRICAL CHARACTERISTICS OF THE VOX-3

| ITEM | CHARACTERISTIC |
|---|---|
| HF OSCILLATOR | |
| Frequency range: | 2 to 64 mc continuous. |
| Output impedance: | 75 ohms coaxial. |
| Output level: | 2 watts throughout basic range of 2 to 4 mc and 0.5 watt, 4 to 64 mc, adjustable. |
| Output connections: | Three BNF RF connectors. |
| Crystal frequencies: | 2 to 4 mc for output frequencies of 2 to 64 mc. |

## TABLE 1-2-b. ELECTRICAL CHARACTERISTICS OF THE VOX-3 (C nt.)

| ITEM | CHARACTERISTIC |
|---|---|
| Crystal unit: | CR-18/U |
| Crystal position: | Three each, available on front panel switch. |
| Output voltage: | Sinusoidal with no spurious frequencies. |
| Stability: | 20 cycles per mc for 0- to 50- degree change in ambient termperature. 5 cycles per mc at 20 ±5°C. |
| Calibration: | Direct reading calibration in cycles per second from 2 to 4 mc. |
| Readability: | 20 cycles per mc. |
| Resetability: | 20 cycles per mc to a calibrated frequency. |
| Line voltage change effects: | 10 cycles for ±10% change in line voltage. |
| Humidity effects: | No appreciable change for 50- to 95-percent humidity. |
| HF oscillator calibration: | Against 100-kc crystal oscillator at 50-kc points. |
| Frequency range: | 300 to 1000 kc |
| Output level: | 6 volts across 1000 ohms with output level control. |
| Output connections: | Three BNC RF connectors. |
| Crystal holders: | CR-45/U |
| Crystal position: | Two each, available on rear panel switch. |
| OSCILLATOR | |
| Frequency range: | 3.2 to 3.9 mc (crystal oscillator). |
| Output level: | 2 volts in 75 ohms. |
| Crystal type: | CR-18/U |
| Output connections: | Three BNC RF connectors. |
| Primary power: | 110 or 220 volts, 50 or 60 cps. Approximately 100-watt average or 250-watt peak, depending upon cycling of oven heating elements. |

## TABLE 1-2-c. ELECTRICAL CHARACTERISTICS OF THE MSR-6

| ITEM | CHARACTERISTIC |
|---|---|
| Input frequency range: | 452 to 458 kc when MSR-6 oscillator is variable or normal crystal is used. 0.225 to 1.5 mc when MSR-6 oscillator is crystal-controlled only. |
| Input voltage range: | 0.1 to 10 volts RMS. |
| Input impedance: | 240K ohms. |
| Filter characteristics: | 3.2 kc at 3 db points; 5.2 kc at 45 db points. |
| AVC characteristic: | With a 40-db change in the signal, the output remains constant within 9 db. |
| AVC speeds: | Slow or fast. |

## TABLE 1-2-c. ELECTRICAL CHARACTERISTICS OF THE MSR-6 (C nt.)

| ITEM | CHARACTERISTIC |
|---|---|
| Output: | High: 2 watts, 8 and 600 ohms; Low: 0 dbm, 600 ohms; 150 milliwatts, 8 and 600 ohms. |
| Output impedances: | Loudspeaker, 8 ohms; Line, 600 ohms; Headphones, high or low. |
| Primary power: | 110 or 220 volts, 50 or 60 cycles, 65 watts. |
| Operating modes: | AM, CW, MCW, FSK, SSB, and ISB. Selectable upper or lower sidebands. |

## TABLE 1-2-d. ELECTRICAL CHARACTERISTICS OF THE AFC-1

| ITEM | CHARACTERISTIC |
|---|---|
| Frequency correction range: | ±1000 cps. |
| Input impedance: | 75 ohms. |
| Output impedance: | 10,000 ohms. |
| Output level: | Approximately 0.25 volt. |
| Primary power: | 115 or 230 volts, 50 or 60 cycles. |
| Carrier filter bandwidth: | 25 cycles at 3-db points. |
| Alarm features: | Carrier fade alarm provided by front panel FADE ALARM lamp. Rear terminals provide remote alarm indicator signal. |
| Stability: | Follows transmitted carrier within ±4 cps. |
| Memory characteristics: | Remains at last detected carrier position for minimum of 1 minute in event of deep fade. |
| Carrier suppression: | Operates with pilot carriers supressed 10, 20 and 30 db below any tone of two tone test. |
| Reset feature: | Reset circuit permits zeroing of carrier drift indication. |
| Input and output connections: | BNC connectors and terminal strip. |

## TABLE 1-3. ELECTRON TUBE COMPLEMENT

| MSR-6 | AFC-1 | GPR-90RXD | VOX-3 | TUBE |
|---|---|---|---|---|
| 2 | 1 | | 3 | 12AU7 |
| 1 | | | | 12AT7 |
| 1 | | | | 6J6 |
| 1 | | 3 | | 6AG5 |
| 1 | 1 | 5 | | 6BA6 |
| 2 | | 1 | 1 | 6BE6 |
| 1 | | 1 | | 6AL5 |
| 1 | | | 6 | 6AG5 |
| 1 | | | | 5Y3 |
| 1 | 2 | 1 | 1 | OA2 |

| MSR-6 | AFC-1 | GPR-90RXD | VOX-3 | TUBE |
|---|---|---|---|---|
| | 2 | 1 | | 6AU6 |
| | 2 | 1 | | 12AX7 |
| | 1 | | | 6U8 |
| | 1 | | 1 | 6AB4 |
| | | 1 | | 6DC6 |
| | | 1 | | 6V6 |
| | | 1 | | 6CB6 |
| | | 1 | | 5U4G |
| | | | 1 | 6C4 |
| | | | 1 | 5V4G |

### TABLE 1-4-a. FRONT PANEL CONTROLS OF THE GPR-90RXD

| CONTROL | FUNCTION |
|---|---|
| HFO switch: | Selects local oscillator mode. |
| XTAL PHASE control: | Adjusts center frequency of crystal filter. |
| RF SELECTIVITY switch: | Adjusts bandpass width of crystal filter. |
| AUDIO GAIN control: | Adjusts audio output level. |
| CAL switch: | Applies power to 100-kc oscillator. |
| MAIN TUNING control: | Tunes receiver to desired frequencies. |
| SEND-REC switch: | Applies B+ to receiver circutis. |
| MANUAL-AVC switch: | Permits application of AVC voltage to approprate circuits. |
| ANT. TUNE control: | Tunes receiver input to antenna. |
| RANGE SELECTOR switch: | Selects tuning range. |
| LIMITER switch: | Permits reduction of impulse-type noise. |
| BFO switch: | Applies power to beat frequency oscillator. |
| BAND SPREAD control: | Permits fine tuning of receiver. |
| AUDIO SPREAD control: | Adjusts audio bandwidth when AUDIO SELECTOR switch is in 1200 PEAK position. |
| RF GAIN control: | Adjusts gain of RF and IF amplifiers. |
| Power switch (part of RF GAIN control): | Applies primary power to receiver. |
| BFO PITCH control: | Varies frequency of beat frequency oscillator. |
| AUDIO SELECTOR switch: | Adjusts audio bandwidth. |
| XTAL ADJ. control: | Adjusts crystal frequencies in local crystal oscillator. |
| S-meter: | Indicates relative signal strength of carrier signals. |
| PHONES jack: | Permits headphone monitoring of audio signal. |

### TABLE 1-4-b. FRONT PANEL CONTROLS OF THE VOX-3

| CONTROL | FUNCTION |
|---|---|
| POWER switch (compartment behind door): | Applies line voltage to or disconnects line voltage from power supply circuit. |
| HFO switch (compartment behind door): | Applies DC plate voltage to HFO vacuum tubes. |
| IFO switch (compartment behind door): | Applies DC plate voltage to IFO vacuum tube. |
| BFO switch (compartment behind door): | Applies DC screen voltage to BFO vacuum tube. |

### TABLE 1-4-b. FRONT PANEL CONTROLS OF THE VOX-3 (C nt.)

| CONTROL | FUNCTION |
|---|---|
| BEAT ON-OFF switch (compartment behind door): | Applies 100-kc oscillator to one of mixer (V103) vacuum tube grids. Other grid receives output of VMO (cathode V302). |
| METER selector switch (compartment behind door): | Enables meter to measure output of HFO, IFO, BFO, and VMO. |
| PHONES jack (compartment behind door): | Enables plugged-in receiver to receive beat tones. |
| TUNING selector switch: | Tunes HFO output circuit. Used to maximize meter reading with METER selector switch in HFO position. |
| OUTPUT potentiometer: | Controls level of output of HFO circuit. |
| BAND-MCS selector switch: | Controls tuning elements in HFO circuit. |
| XTAL FREQ padding capacitor: | Enables small changes in crystal frequency. Used only when VOX uses a crystal for RF output. |
| CALIBRATE potentiometer: | Calibrates VMO with 100-kc oscillator at check points. |
| MASTER OSCELLATOR FREQUENCY knob: | Controls output frequency of VMO. |
| XTAL selector switch: | Determines whether VOX's output is produced by crystals in positions 1, 2, 3, and by its VMO. |
| MASTER OSCILLATOR FREQUENCY dial: | Registers output frequency of VOX and tunes main oscillator. |
| OUTPUT Meter: | Registers level of VOX's RF outputs in line with position of METER selector switch located in compartment behind door. |
| ZERO BEAT indicator: | Indicates beat tones when calibrating VMO with 100-kc oscillator at check points. |
| OUTER OVEN indicator: | Goes on when outer oven is receiving heat. |
| INNER OVEN indicator: | Goes on when inner oven is receiving heat. |
| MAIN POWER indicator: | Goes on when VOX is receiving 60-cycle power. |
| BFO ADJ potentiometer (chassis mounted at top). | Controls BFO output level. |
| BFO XTAL SW (chassis mounted at rear): | Determines which of two crystals is used for BFO beats. |

### TABLE 1-4-c. FRONT PANEL CONTROLS OF THE MSR-6

| CONTROL | FUNCTION |
|---|---|
| POWER switch: | Applies AC power to MSR-6. |
| SIDEBAND switch: | Selects either upper or lower sideband. |
| SIDEBAND U indicator: | Goes on when unit is operated in upper sideband mode. |
| SIDEBAND L indicator: | Goes on when unit is operated in lower sideband mode. |

## TABLE 1-4-c. FRONT PANEL CONTROLS OF THE MSR-6 (C nt.)

| CONTROL | FUNCTION |
|---|---|
| MANUAL-XTAL switch: | In MANUAL position, permits manual setting of bandspread oscillator frequency. In XTAL position, bandspread oscillator frequency is fixed to frequency of internal crystal. |
| BANDSPREAD control: | Enables incoming signals to be tuned across the band of the bandpass filter. |
| AVC ON-OFF switch: | When set to ON, permits AVC control of IF amplifier. |
| AVC FAST-SLOW switch: | Permits selection of appropriate AVC speeds for various signal conditions. |
| BFO switch: | When set to ON, permits second oscillator of MSR-6 to reinsert carrier for suppressed carrier operation or provide tone for CW operation. |
| PHONES jacks: | Permits headphone monitoring of audio output. |
| AUDIO GAIN control: | Permits adjustment of audio output level. |
| OUTPUT LEVEL switch (rear apron): | Permits selection of high or low audio output. |

## TABLE 1-4-d. FRONT PANEL CONTROLS OF THE AFC-1

| CONTROL | FUNCTION |
|---|---|
| CARRIER COMPENSATOR switch: | Adjusts degree of 17-kc carrier input attenuation for different values of carrier suppression. |
| A.G.C. SELECTOR switch: | Provides different levels of AGC attack for the GPR-90RXD. |
| A.F.C. RESET switch: | Disables AFC circuit to permit tuning. |
| POWER switch: | Applies AC power to AFC-1. |
| A.F.C. INDICATOR meter: | Indicates degree of frequency drift and degree of correction already applied. |
| FADE ALARM indicator: | When on, indicates signal fade condition. |
| CARRIER LEVEL meter: | Indicates relative carrier level. |
| FADE ALARM LEVEL control: | Adjusts level at which alarm operates and memory circuit assumes control. |

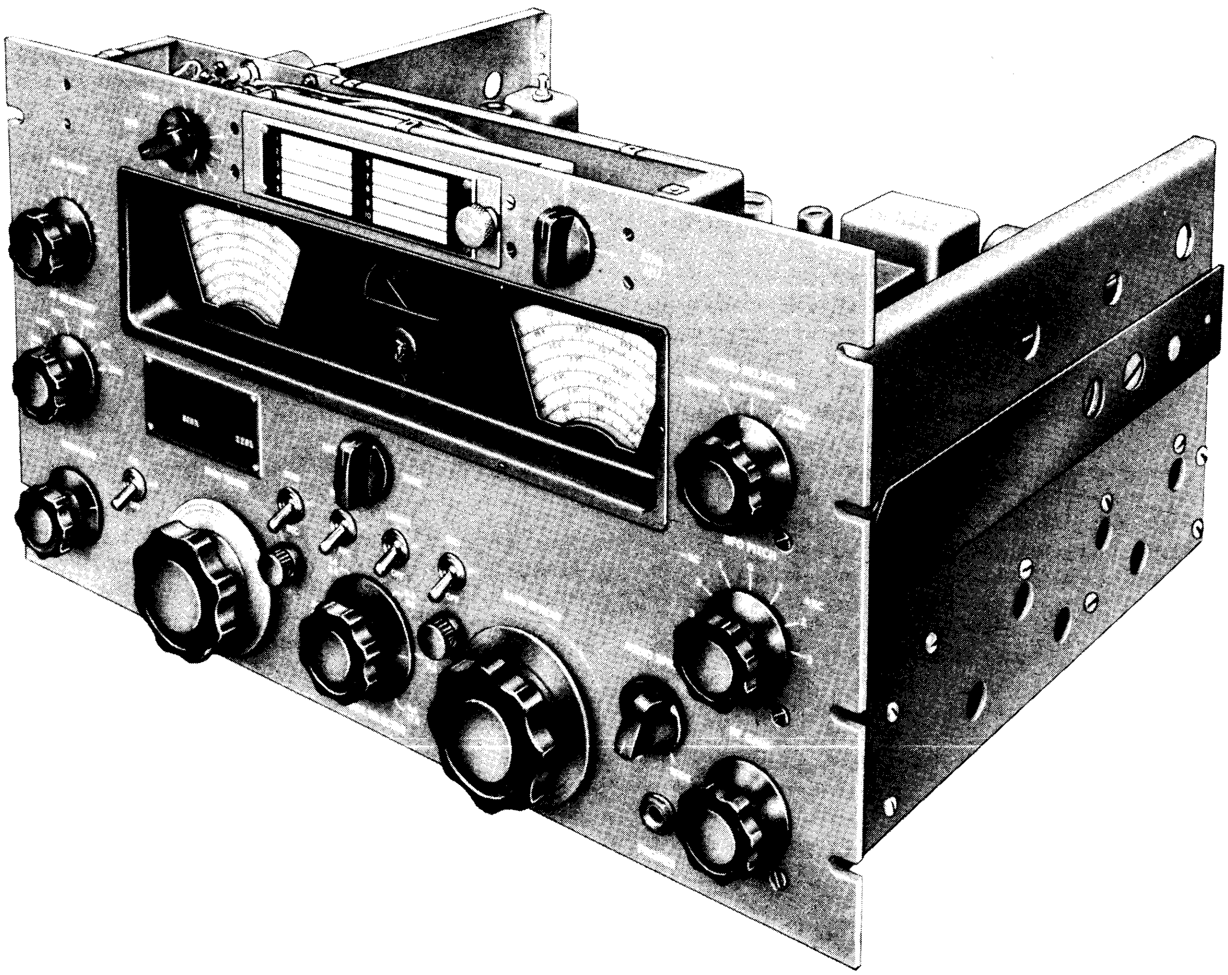


Figure [illegible] ceiver GPR-90RXD

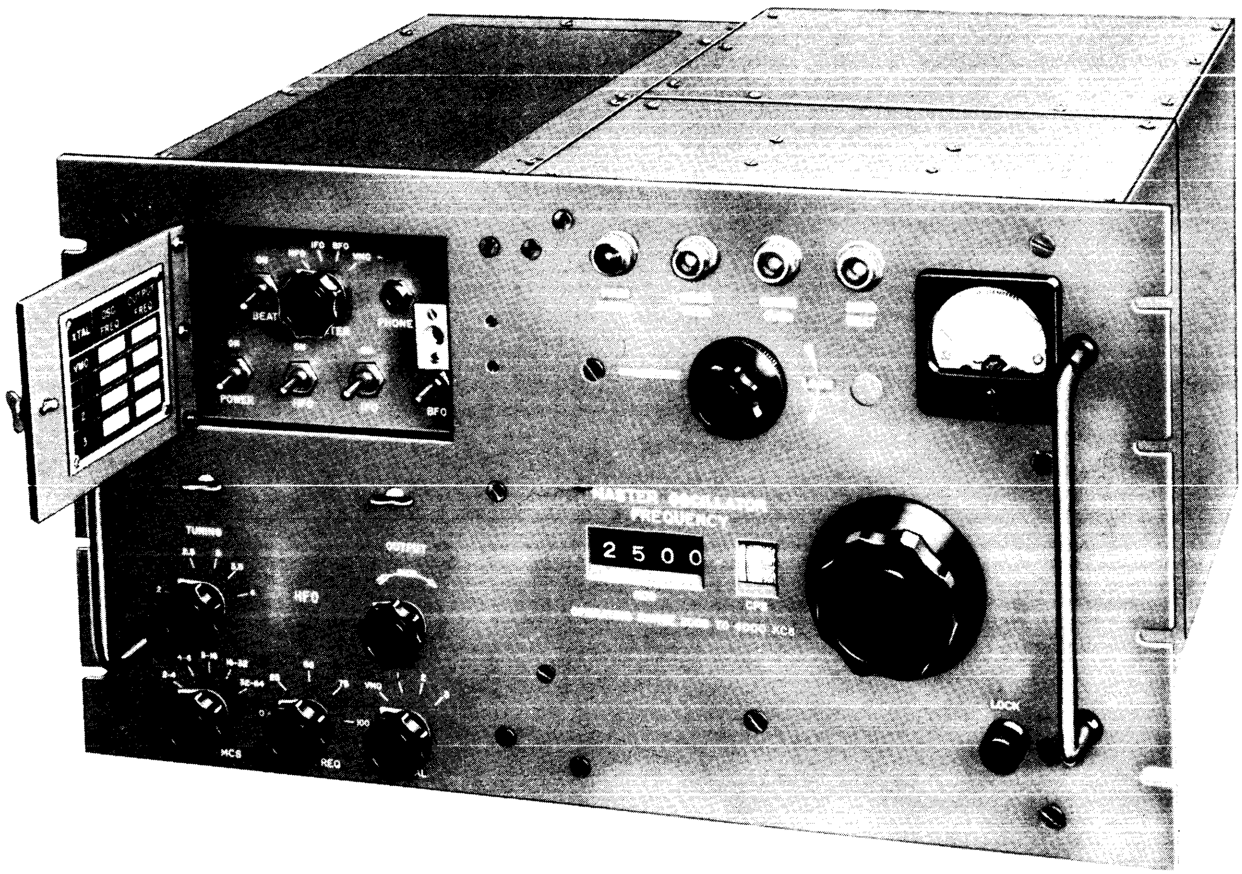



Figure 1-3. Variable Frequency Oscillator VOX-3

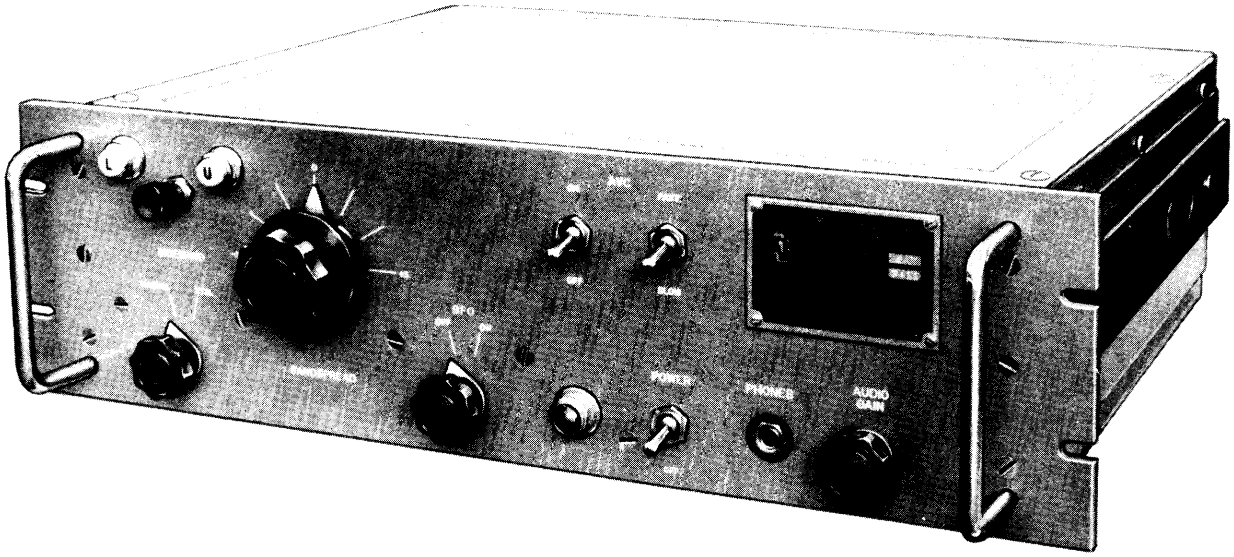



Figure 1-4. Single Sideband Converter MSR-6

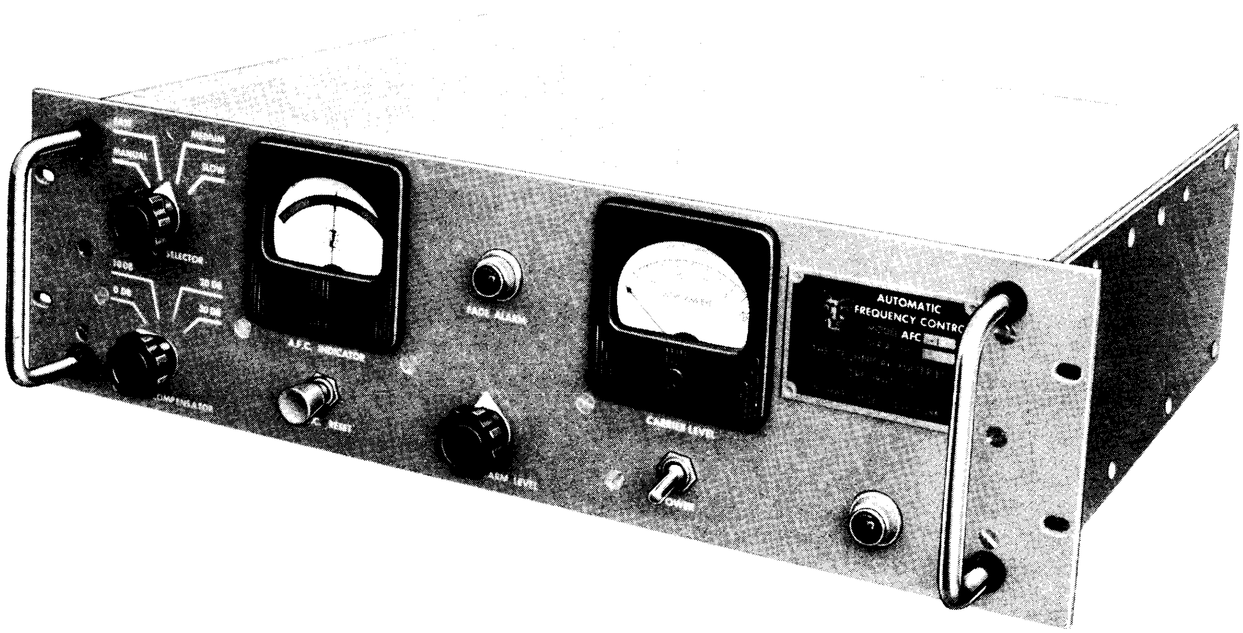



Figure 1-5. Automatic Frequency Control Unit AFC-1

# SECTION 2
# INSTALLATION

## 2-1. GENERAL.

This section outlines the procedures for the installation and interconnection of the various components of the DDR-6E. These components are shipped in four wooden packing cases. Table 2-1 lists the contents, dimensions, and weight of each case. The weights listed are for fully packed units, including equipment and packing material.

## 2-2. UNPACKING.

Transport the packing cases to the installation site prior to unpacking. Select a location where the equipment may be unpacked without exposure to the elements. When selecting a site, allow sufficient area around the cabinet for ventilation. Outline dimensions of the DDR-6E are shown in figure 2-1.

Carefully unpack the largest wooden container first. Figure 2-2 illustrates the packaging method utilized for the VOX-3; the method is typical of the various DDR-6E components. The equipment should be unpacked at the site where it is to be used.

The unpacking procedure is as follows:

(1) Place the packing case near the operating site.

(2) Cut and fold back the steel straps at the top of the case.

(3) Remove the nails with a nail puller. Remove the cover and one side of the packing case. Remove the two pieces of lumber nailed to the wooden box near the top.

(4) Remove the spare parts carton on top of the waterproof outer carton. Check the contents of the spare parts carton against the packing slip.

(5) Carefully remove the waterproof outer carton from the packing case. Open the top of the carton and then the moisture-vaporproof barrier.

(6) Open the top of the inner carton and remove the technical manual, the corrugated filler, the desiccant, and the acid-free tissue.

(7) Remove the unit from the inner carton.

(8) Inspect the equipment for possible damage incurred during shipment.

## 2-3. INSTALLATION OF DDR-6E RECEIVER TERMINAL COMPONENTS.

Each major component in the DDR-6E is equipped with two slides, one on each side of the chassis. These slides have been designed to fit into grooves in corresponding slides secured to the inner side surfaces of the cabinet. (See figure 2-3.)

To install a major component in the DDR-6E cabinet, withdraw the appropriate pair of cabinet slides by first depressing the spring-loaded cabinet locks which lock them into the cabinet. Pull the cabinet slides out to their fully extended positions. Carefully fit the tongued slides on the sides of the unit to be installed into the grooved cabinet slides and slide the unit in until it hits the stops. Depress the spring-loaded unit locks on each unit slide so that the unit may be pushed into the cabinet. Push in the unit as far as it will go. With the unit in place in the cabinet, insert the panel screws and tighten in place.

## 2-4. CABINET INTERCONNECTIONS.

a. INITIAL INSPECTION. - Inspect the cases and their contents immediately for possible damage. Unpack the equipment carefully. Inspect all packing material for parts that may have been shipped as "loose items." Although the carrier is liable for any damage in the equipment, Technical Materiel Corporation will assist in describing and providing for repair or replacement of damaged items. Each major component is shipped with tubes and crystals installed. Check that all such components are properly seated in their sockets.

b. INTERCONNECTING PROCEDURE. - All cable assemblies are mounted inside the cabinet and are properly marked. After the cabinet is installed, interconnect the units as shown in figure 2-4. Refer to the overall schematics of the major components included in Section 8. Notice that two 1200-ohm, 1-watt resistors must be connected across the 600-ohm speaker terminals on the rear of each GPR-90RXD. It should be particularly noted that main power for the VOX-3 is taken from the convenience outlet on the rear of the DCP-1 and not from the power strip on the side of the cabinet. This particular arrangement is necessary so that main power to the VOX-3 oven elements is not removed when the main power switch on the DCP-1 is set to OFF.

Figure 2-5 shows two cabling arrangements between various sections of the VOX-3: short cable interconnections under normal operating conditions (when the VOX's assemblies are closely associated physically), and extended cable interconnections used under servicing conditions (when the VOX's power supply section is physically remote from its other two sections).

## 2-5. INITIAL ADJUSTMENT.

a. GPR-90RXD. - The GPR-90RXD's have been factory tested and aligned. After unpacking and installation in the cabinet, these units are ready for use. No adjustments other than the normal setting of operating controls are necessary.

b. VOX-3. - After unpacking and installation in the cabinet, the VOX-3 should be warmed up and adjusted.

### CAUTION

The VOX-3 is a high stability precision instrument and requires an initial warm-up period of at least 48 hours of continuous duty. Thereafter, the unit should never be turned off unless detailed repairs become necessary. Failure to comply with this procedure results in degradation of the instrument's accuracy.

### NOTE

Since AC power for the VOX-3 bypasses the DCP-1, the main power switch on the DCP-1 does not affect the operation of the VOX-3.

### NOTE

After the 48-hour warm-up period, the POWER switch (open front panel door) should be ON and the ovens should have reached a stable condition.

The VOX-3 is calibrated at the factory before shipment. However, it is necessary to check the calibration after installation. This is done by checking the calibration at 2, 000, 000 and 4, 000, 000 cycles on the zero beat indicator. If calibration at either of these points is in error by more than 500 cycles, calibrate the oscillator as follows:

(1) Set the BEAT ON - OFF switch (open front panel door) to ON.

(2) Plug headphones into the jack marked PHONES (open front door panel).

(3) Turn the BAND-MCS switch on front panel to 2-4.

(4) Turn the XTAL switch on front panel to VMO.

(5) Turn the MASTER OSCILLATOR FREQUENCY dial to 2000 KCS 000 CPS.

(6) Tune the CALIBRATE dial for zero beat on the phones and also on the ZERO BEAT indicator. The VMO's 2, 000, 000-cycle output now coincides in frequency with the 100-kc calibrating oscillator's 20th harmonic.

(7) Turn the MASTER OSCILLATOR FREQUENCY dial to 4000 KCS 000 CPS.

(8) Adjust the trimmer capacitor, behind circular disc (located on the front panel) between the CALIBRATE dial and the VOX-3's meter, to give zero beat on the phones and also on the ZERO BEAT indicator. The VMO's 4, 000, 000-cycle output now coincides in frequency with the 100-kc calibrating oscillator's 40th harmonic.

(9) Repeat steps (5) and (6) to compensate for the newly adjusted position of the trimmer capacitor.

(10) Repeat steps (7) and (8) to compensate for the newly adjusted position of the CALIBRATE dial.

(11) Readjust the trimmer capacitor to optimum zero beat condition at the two extremes of the 2- to 4-mc band.

### NOTE

After calibration the error at 2,000,000 and 4,000,000 cycles should not exceed 500 cycles. The error for all intermediate frequencies then falls within limits also.

Since other frequency bands are obtained by multiplication of the 2- to 4-mc band, the oscillator is adjusted throughout its entire frequency.

c. MSR-6. - The MSR-6's have been factory tested and adjusted. After unpacking and installation in the cabinet, turn the TONE THRESHOLD control on each chassis fully counterclockwise and set the OUTPUT LEVEL switch (on the rear apron) to LOW position. The MSR-6's are then ready for use.

### NOTE

The audio output of the MSR-6 may be set for low or high levels. If the output of the MSR-6 is to be fed into telephone lines, the OUTPUT LEVEL switch must be set to LOW. HIGH is used only when 2.0 watts is required in a 600-ohm load.

d. AFC-1. - The AFC-1's have been factory tested and adjusted. After unpacking and installation in the rack, each AFC-1 is ready for use after the following checkout is performed:

(1) Set the CARRIER COMPENSATOR switch on the front panel to 0 DB.

(2) Apply a 3.3-microvolt signal within the 5.4- to 9.7-mc band to the antenna input jack on the rear apron of the associated GPR-90RXD. This should be done with RANGE SELECTOR switch in the 5.4- 9.6 position. Tune the VOX-3 and receiver so that the applied signal generator frequency is received.

(3) Adjust the AGC control on the AFC-1 chassis until a VTVM indicates a 0.3-volt level at input jack J1 on the MSR-6.

(4) Repeat steps (1), (2), and (3) for the other AFC-1.

**TABLE 2-1. SHIPPING CONTAINERS AND CONTENTS**

| CONTENTS | DIMENSIONS (inches) L W H | WEIGHT (pounds) |
|---|---|---|
| One TMC Model RAK with one TMC Model DCP-1 and one TMC Model LSP-7. | 25-1/2 x 23-1/2 x 79-1/4 | 390 |
| Two TMC Model MSR-6's and two TMC Model AFC-1's. | 37 x 23 x 23 | 235 |
| Two TMC Model GPR-90RXD's. | 43 x 25-1/2 x 17-1/2 | 210 |
| One TMC Model VOX-3. | 24-1/2 x 16 x 27 | 122 |

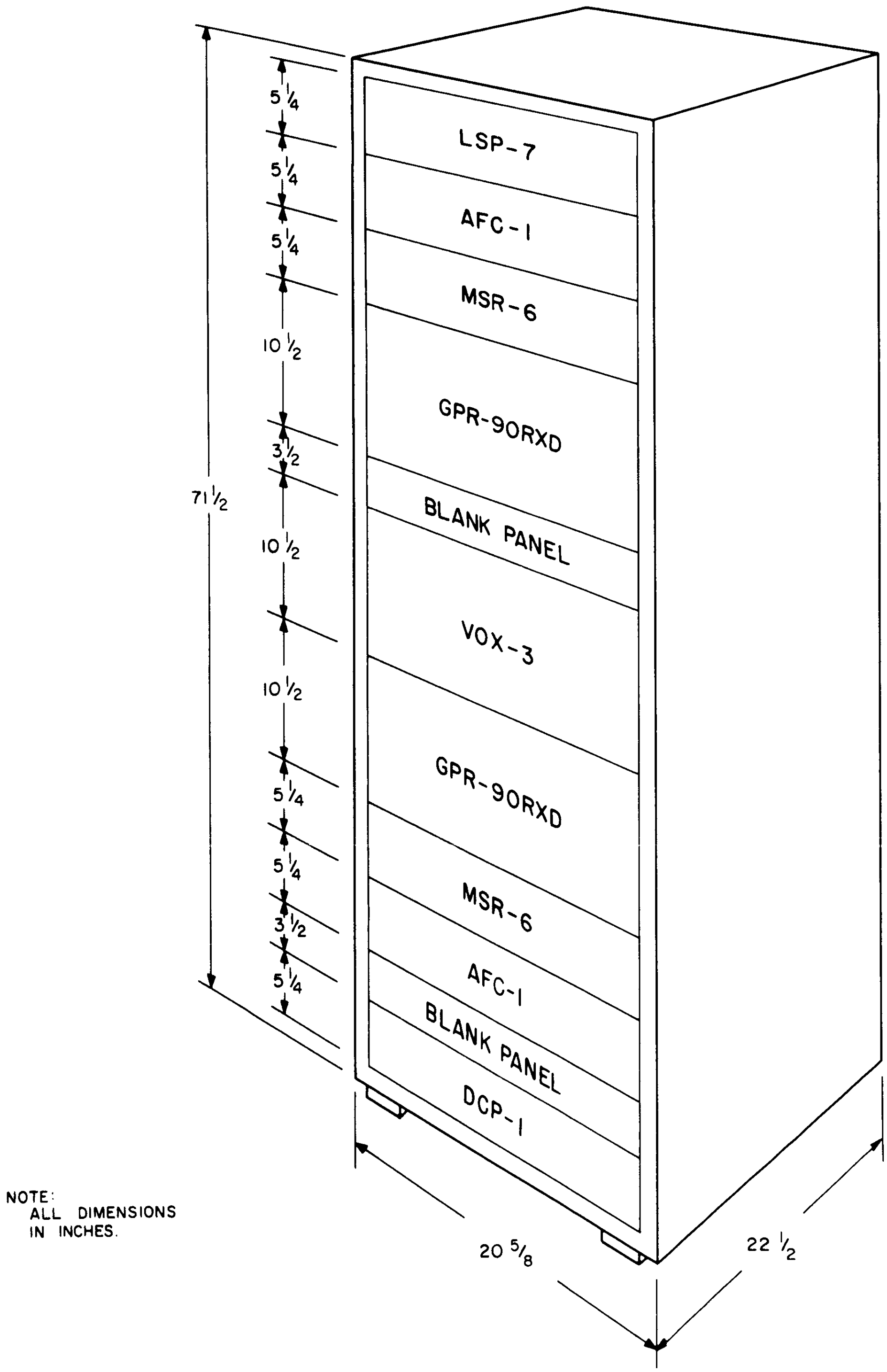



Figure 2-1. Outline Demensional Drawing, DDR-6E

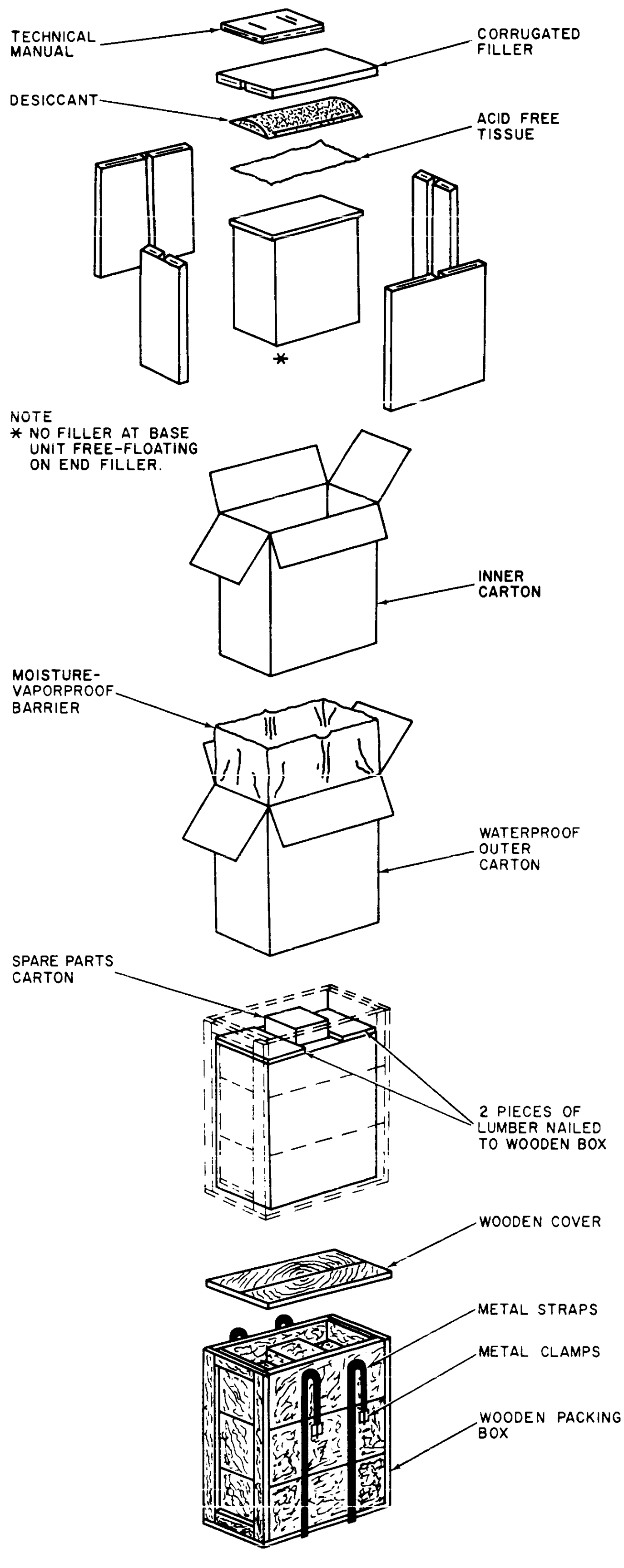



Figure 2-2. Typical Packaging Diagram

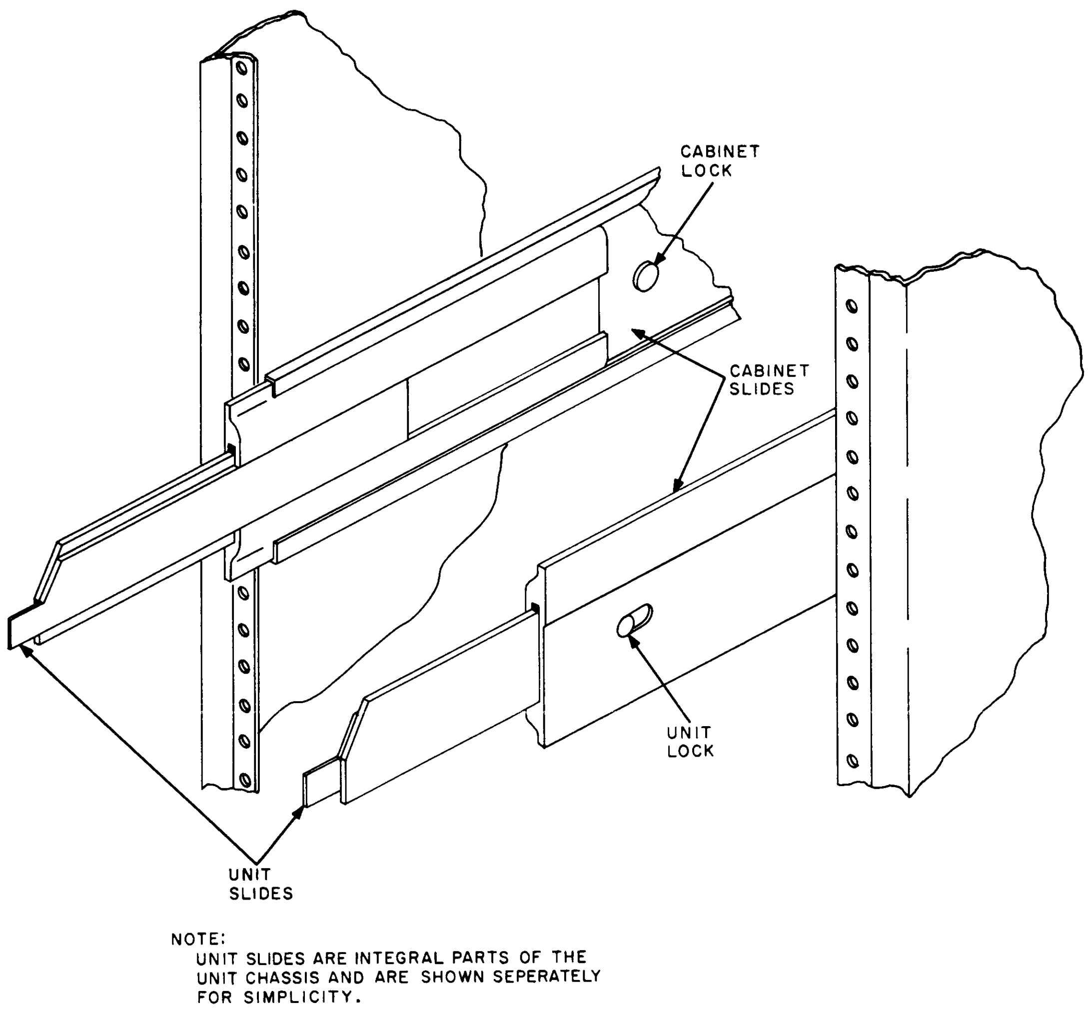



Figure 2-3. Cabinet and Chassis Slide Details

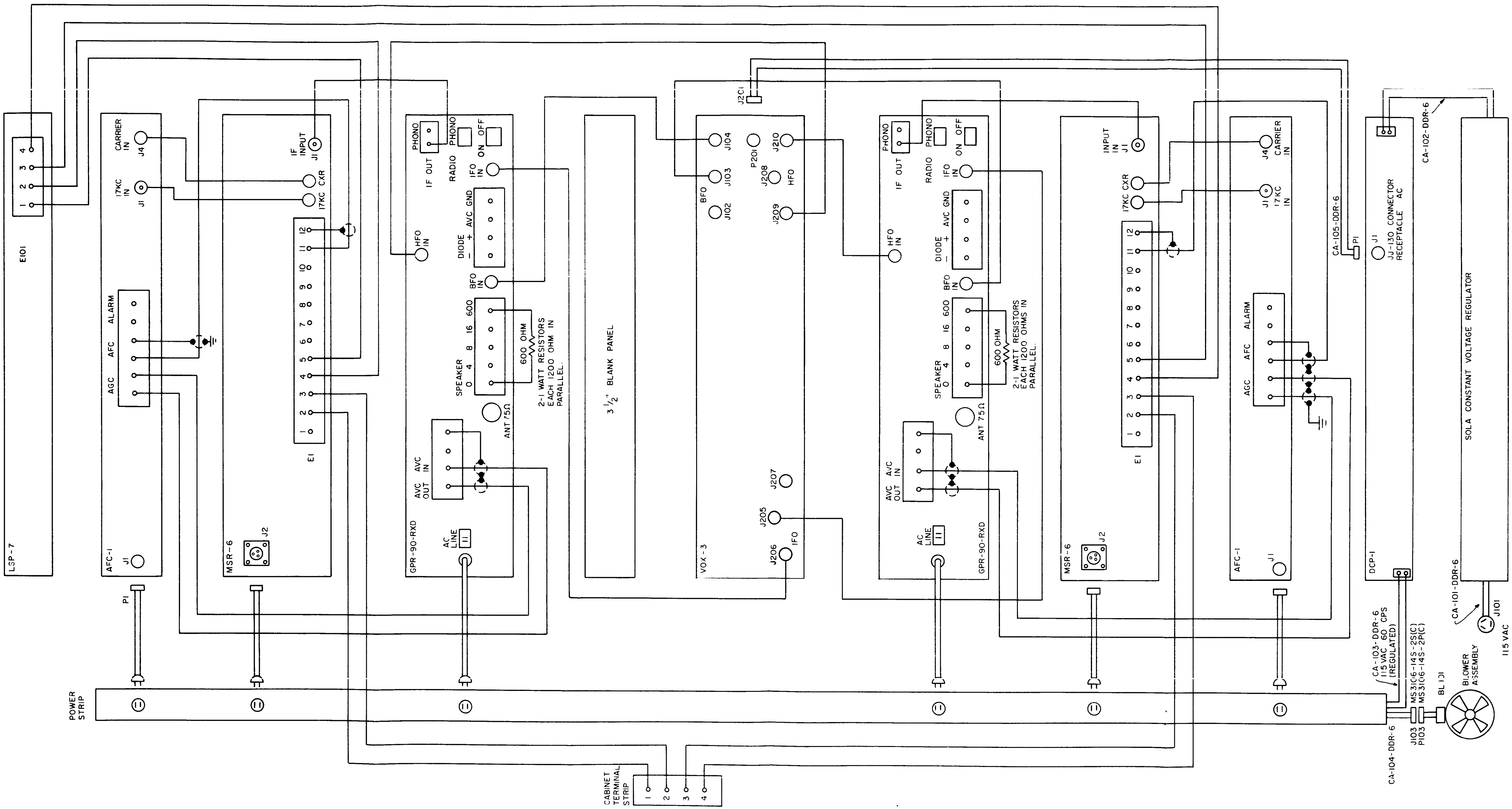
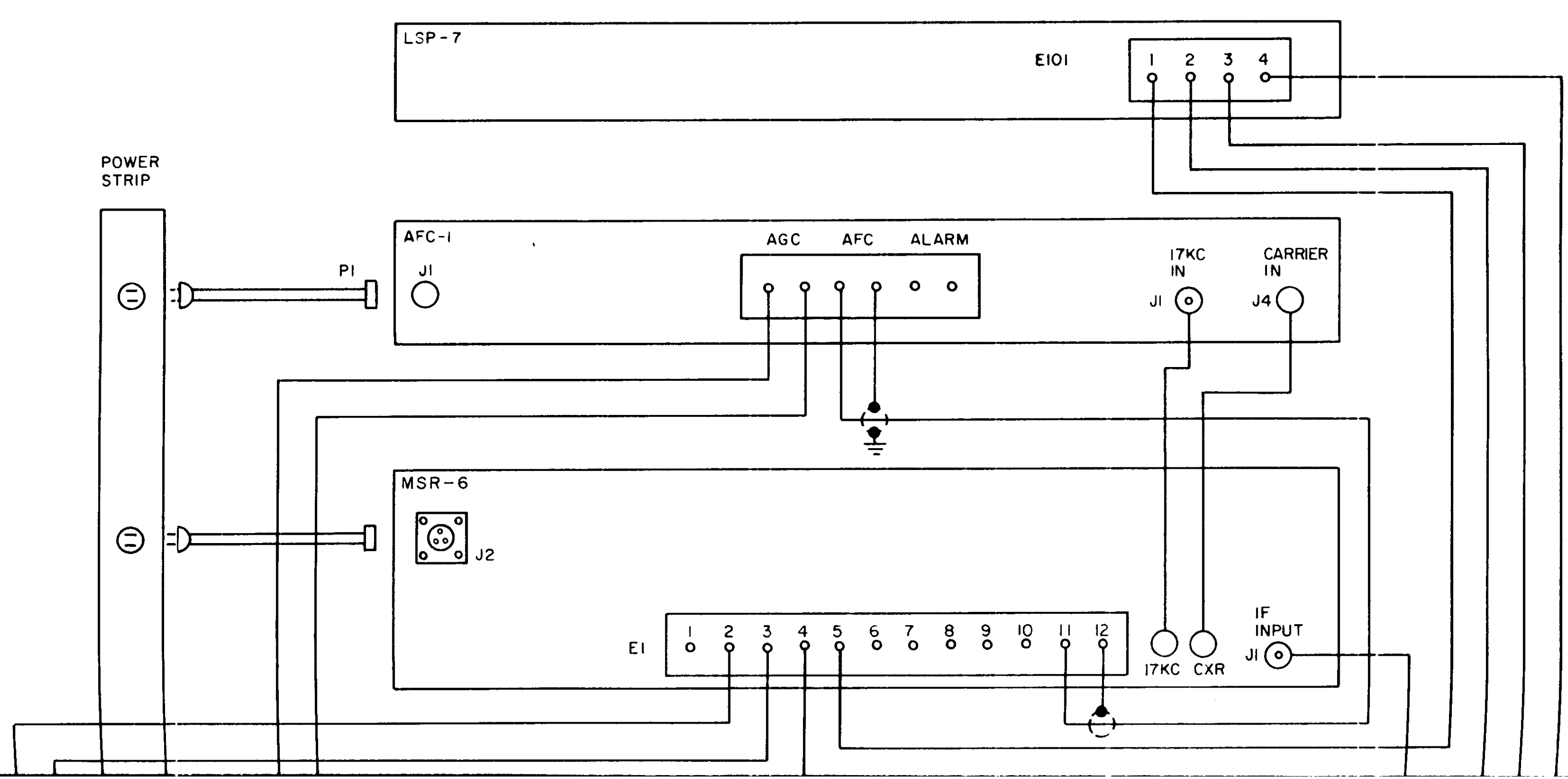
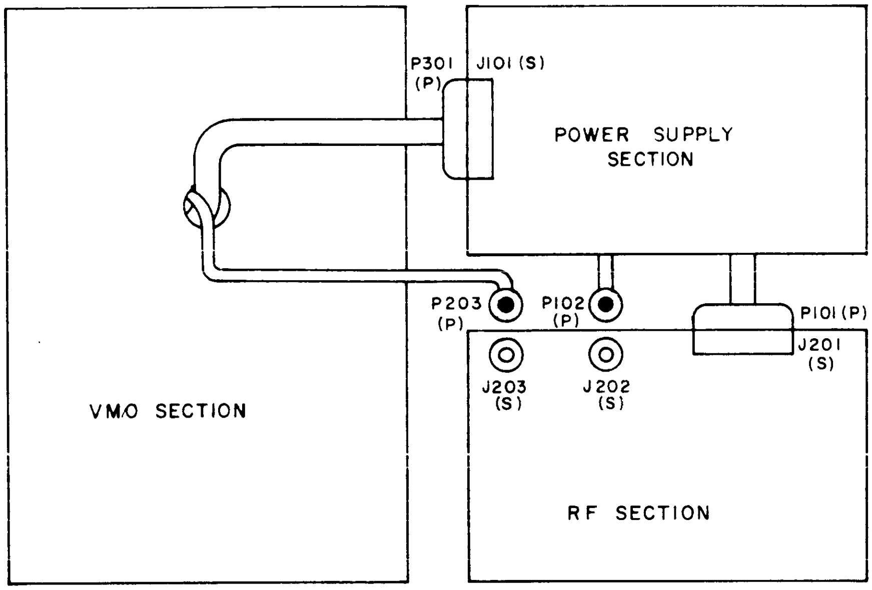


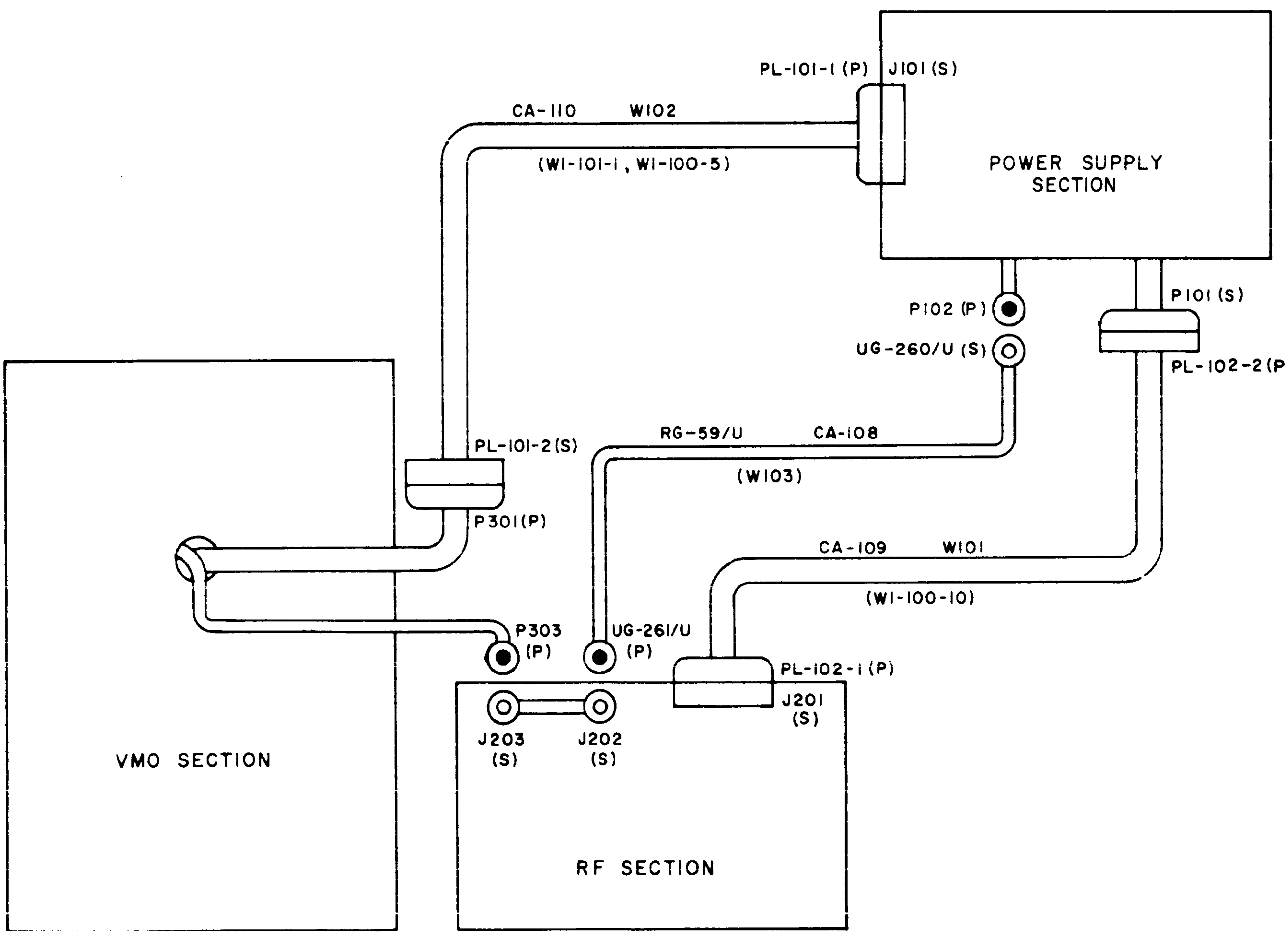

Figure 2-4. Wiring Diagram, DDR-6E



LSP-7
E101
1 2 3 4
POWER
STRIP
AFC-1
J1
P1
AGC
AFC
ALARM
17KC
IN
J1
CARRIER
IN
J4
MSR-6
J2
E1
1 2 3 4 5 6 7 8 9 10 11 12
17KC
CXR
IF
INPUT
J1




SKETCH A – CABLES UNDER NORMAL CONDITIONS




SKETCH B – CABLES UNDER SERVICING CONDITIONS

Figure 2-5. VOX Cabling, Normal and Servicing Conditions

# SECTION 3
# OPERATOR'S SECTION

## 3–1. GENERAL.

This section contains detailed instructions for the operation of the DDR-6E. The operating procedures presented below for the DDR-6E and for its principal units make frequent reference to table 3-1 and figure 3-1. Close coordination between the operating procedures and these references will facilitate an understanding of the procedures. In this section, operation of the VOX-3 is presented first, (paragraph 3-2), since effective operation of the DDR-6E is dependent upon a complete understanding of the VOX-3's use in this system. In the overall operation of the DDR-6E for single sideband reception, GPR-90RXD, MSR-6, and AFC-1 units are operated as described in paragraph 3-3. More general modes of operation are presented in paragraphs 3-4 through 3-6. These instructions will permit the operator to make maximum use of the system elements.

It must be kept in mind that the DDR-6E is basically a dual-diversity (space or tone frequency) system. As such, it consists of two GPR-90RXD's, two MSR-6's, and two AFC-1's. Since all these units must be operated to receive one RF signal, it is necessary to drive both GPR-90RXD's from a common local oscillator. This requirement is fulfilled by the inclusion of the VOX-3 in the system. The VOX-3 simultaneously provides local oscillator input to both GPR-90RXD's, thus ensuring that both will demodulate the same incoming signal.

The operation of the DDR-6E is similar to a standard communications receiver. However, in the DDR-6E, the local oscillator does not automatically track the incoming RF signals. The VOX-3 provides the HFO and IFO signals. Two receiving groups (each consisting of a GPR-90RXD, an MSR-6, and an AFC-1) must be adjusted separately and similarly for dual-diversity reception.

There are two methods of tuning the system. In the first, the GPR-90RXD dials are set to the signal frequency; in the second, the GPR-90RXD dials are tuned approximately 2 kc off the signal frequency. The former method is referred to as normal tuning and the latter as off-center tuning. Off-center tuning is utilized when the maximum bandwidth of the DDR-6E is desired on a single sideband. Whichever method is used, the two tuning procedures are common to all modes of operation.

## 3–2. VARIABLE FREQUENCY OSCILLATOR VOX-3.

a. GENERAL INSTRUCTIONS. - For oscillator stability, the VOX-3 must be left turned on continuously and should be turned off only in the event of failure. In the DDR-6E, the primary power input to the VOX-3 bypasses the power switch on the DCP-1 so that when any of the associated panel assemblies are turned off, the VOX-3 will continue to operate. Interconnection between the VOX-3 and associated units is accomplished through the use of BNC-type connectors and terminal strips.

The following calibration assumes that the initial adjustments, described in Section 2 of this manual, were previously carried out.

b. CALIBRATION. - The VOX-3 is the master oscillator for the two GPR-90RXD's. For maximum accuracy, the VOX-3 must always be calibrated before use as close as practical to the frequency desired. For this purpose, the VOX is provided with a calibrating circuit. Located with the VOX's oven is a VMO and a 100-kc crystal-controlled calibrating oscillator. At numerous check points, harmonics of the VMO and the 100-kc oscillator correspond; consequently, at these check points, a zero-beat indicating device (headphones and/or indicating lamp) may be used to adjust the VMO to its proper frequency. At a VMO frequency of 2,200,000 cps, for example, a check point exists; namely, the fundamental of the VMO and the 22nd harmonic of the 100-kc oscillator. At a VMO frequency of 2,214,286 cps, a check point also exists; namely, the seventh harmonic of the VMO and the 155th harmonic of the 100-kc oscillator. Again at a VMO frequency of 2,216,667 cps, another check point exists; namely, the sixth harmonic of the VMO and the 133rd harmonic of the 100-kc oscillator. Table 3-2 shows a number of check points in the 2.2- to 2.3-mc frequency range. The 100-kc check points automatically cover 50- and 25-kc check points. (A 100-kc crystal will generate not only harmonics of the 100-kc fundamental but also harmonics of the 50- and 25-kc subtones.) The subtone harmonics, however, are considerably weaker than the fundamental harmonics. Similar check points to those indicated in the 2.2- to 2.3-mc range exist in the 2.3- to 2.4-mc range and in each higher 0.1-mc range.

To make these check point calibrations, the operator should perform the following procedure:

| Step | Operation |
|---|---|
| 1 | Set POWER switch 41 to ON position. MAIN POWER indicator 49 should go on. |
| 2 | Set BEAT ON-OFF switch 42 to ON position. |
| 3 | Plug headphones into PHONES jack 46. |

4 Turn BAND-MCS switch 55 to the desired band and XTAL switch 57 to VMO position. The operator should set MASTER OSCILLATOR FREQUENCY dial 59, which is marked directly in CPS, and turn this control until the dial reads to the nearest 50-kc point of the desired frequency. In order to calculate the correct dial reading, the operator must remember to divide the desired frequency by 2 for the 4- to 8-mc band, by 8 for the 16- to 32-mc band, etc. For accurate calibration and resetability, care must be taken to rotate the dial in the same direction (preferably from a lower dial reading to the higher) in order to prevent any error due to backlash. Then, by varying CALIBRATE control 48, a zero-beat indication will be obtained in the headset and on ZERO BEAT indicator 52. With a little experience, the operator will find that the visual indication alone is adequate, although he may continue to use the phones as an added convenience. The VOX has now been properly corrected for the dial region to be used and should be returned to the required frequency setting.

5 When the calibration procedure has been concluded, the operator must be certain that he sets BEAT ON-OFF switch 42 to OFF position. At the same time, METER switch 44 should be turned to HFO and HFO switch 43 set to ON position.

6 The operator should now rotate TUNING knob 54 to a position roughly approximating the master oscillator frequency dial, at which point he will obtain a reading on the front panel milliammeter with OUTPUT control 58. TUNING knob 54 will have been set properly when the highest milliammeter reading is obtained.

In the event that a HFO crystal is used in place of the variable master oscillator, proceed as follows:

| Step | Operation |
|---|---|
| 1 | Turn POWER switch 41 to ON position. |
| 2 | Turn HFO switch 43 to ON position. |
| 3 | Turn METER switch 44 to HFO position. |
| 4 | Turn XTAL switch 57 to proper position. |
| 5 | Turn BAND-MCS switch 55 to proper band. |
| 6 | "Trim" the crystal by tuning XTAL FREQ trimmer 56 until the exact frequency is set, and peak with TUNING knob 54 as described above. |

c. OPERATING INSTRUCTIONS AFTER CALIBRATION.

| Panel Designation | Operation | Result |
|---|---|---|
| POWER (41) | ON | MAIN POWER indicator 49 goes on. |
| HFO (43) | ON | INNER OVEN/OUTER OVEN indicators indicate a long warm-up period. Refer to CAUTION below. |
| METER (44) | HFO, IFO, BFO, VMO | |
| XTAL (57) | VMO or 1, 2, 3 | Selects the source for VOX's 2- to 64-mc output, namely, VOX's master oscillator (VMO) or an alternate VOX oscillator whose frequency is controlled by crystals 1, 2, and 3. |
| BAND-MCS (55) | Proper band | Selects proper multiplier for VOX's master oscillator. |
| MASTER OSCILLATOR FREQUENCY (60) | Desired oscillator frequency | |
| OUTPUT (58) | Desired level | |
| TUNING (54) | Maximize meter reading | May require a decrease in OUTPUT potentiometer. |

**CAUTION**

The VOX-3 is a high stability precision instrument and requires an initial warm-up period of at least 48 hours of continuous duty. Thereafter, the unit should never be turned off unless detailed repairs become necessary. Failure to comply with this procedure results in degradation of the instrument's accuracy.

d. APPLICATION OF VOX-3 AS MASTER OSCILLATOR IN THE DDR-6E. - The DDR-6E is ready to be tuned after it has been installed in the cabinet, connected, and the VOX-3 has completed its initial warm-up period of 48 hours. Whenever it is desired to tune up to a particular frequency, the VOX must be set according to the operating frequency determined by the operating bands of the receivers. The VOX dial settings are different for the lower three bands and the higher three bands because the receivers use single- and double-conversion, respectively, for these bands. Below 5.4 mc, the HFO must be set 455 kc above the signal frequency. Above 5.4 mc, the HFO must be set 3.955 mc above the signal frequency. The following chart will serve to minimize the small amount of arithmetic involved:

**NOTE**

For frequencies below 5.4 mc, the IFO switch on the VOX-3 must be set to off; for frequencies above 5.4 mc, to ON. A 3.5-mc crystal is already installed in the VOX-3 to provide the IFO output.

| Received Signal Frequency | VOX-HFO Output* | VOX Band | VOX - VMO Dial Setting* |
|---|---|---|---|
| Below 5.4 mc | Fr + 455 kc | 2-4 mc | Fr + 455 |
| | Fr + 455 kc | 4-8 mc | (Fr + 455)/2 |
| Above 5.4 mc | Fr + 3.955 kc | 8-16 mc | (Fr + 3.955)/4 |
| | Fr + 3.955 kc | 16-32 mc | (Fr + 3.955)/8 |
| | Fr + 3.955 kc | 32-64 mc | (Fr + 3.955)/16 |

*Fr signifies GPR-90RXD frequency.

## 3-3. SYSTEM OPERATION.

a. NORMAL TUNING.

| Step | Unit | Operation | Purpose |
|---|---|---|---|
| 1 | DCP-1 | Set circuit breaker 61 to ON position. | Applies primary power to AC strip in cabinet and energizes cabinet fan. |
| 2 | Both GPR-90RXD's | Set HFO switch 24 to EXT. | Selects VOX-3 as the local oscillator. |
| 3 | | Set RF SELECTIVITY switch 28 to NON XTAL. | Selects widest IF response. |
| 4 | | Adjust AUDIO GAIN control 29 fully counterclockwise. | |
| 5 | | Set CAL switch 30 to OFF. | Disables 100-kc oscillator. |
| 6 | | Set MANUAL-AVC switch 33 to AVC. | Permits AVC operation. |
| 7 | | Set LIMITER switch 35 to OFF. | Disables noise limiter. |
| 8 | | Set BFO switch 36 to OFF. | Disables BFO. |
| 9 | | Set BAND SPREAD control 37 to 100. | Maintains main tuning dial calibration. |
| 10 | | Set SEND-REC switch 32 to REC. | Applies B+ power to unit. |
| 11 | | Set XTAL PHASE control 23 to 0. | Sets crystal filter to nominal center frequency. |

| Step | Unit | Operation | Purpose |
|---|---|---|---|
| 12 | | Set MAIN TUNING control 31 to desired signal frequency (Fr). | Tunes receiver to desired signal frequency. |
| 13 | | Set RANGE SELECTOR switch 34 to band determined by step 12. | Selects appropriate tuning range. |
| 14 | | AUDIO SPREAD control 38, BFO PITCH control 40, AUDIO SELECTOR switch 27, and XTAL ADJ. control 26 may be left in any position. | |
| 15 | | Adjust RF GAIN control 39 fully clockwise. | Applies primary power to the receiver and adjusts RF gain to maximum. |
| 16 | Both MSR-6's | Set SIDEBAND switches 18 and 13 to MANUAL and either U or L (depending upon sideband being received). | Permits manual tuning of oscillator and selects desired sideband for detection. |
| 17 | | Set AVC switches 16 and 17 to OFF and SLOW. | Disables AVC control of first MSR-6 amplifier. |
| 18 | | Set POWER switch 21 to on position. | Applies primary power to MSR-6. |
| 19 | Both AFC-1's | Turn CARRIER COMPENSATOR switch 7 to the amount of carrier suppression utilized by the transmitter. If this value is not known, set this control for best reception (30 DB). | Provides proper amount of carrier attenuation for optimum AFC-1 operation. |
| 20 | | Set A.G.C. SELECTOR switch 3 to SLOW. | Selects proper amount of AGC attack for the GPR-90RXD during SSB reception. |
| 21 | | Set POWER switch 10 to the on position. | Applies primary power to the AFC-1. |
| 22 | VOX-3 | Set BAND-MCS switch 55 to position determined by the desired signal frequency. | Selects appropriate multiplier to obtain desired output frequency. |
| 23 | | Set XTAL switch 57 to VMO. | Selects the variable frequency oscillator as the frequency source. |
| 24 | | Set BFO switch 47 to the OFF position. | Disables BFO. |
| 25 | | Set IFO and HFO switches 45 and 43 to ON. (If received frequency is less than 5.4 mc, IFO switch 45 may be left in off position.) | Enables IFO and HFO circuits. |
| 26 | | Set BEAT switch 42 to off position. | Disables 100-kc oscillator. |
| 27 | | Set MASTER OSCILLATOR FREQUENCY dial 59 to frequency determined by desired signal frequency. Refer to chart in paragraph 3-2d. | Determines required output frequency. |

If the desired signal frequency is known, set MASTER OSCILLATOR FREQUENCY dial 59 on the VOX to the appropriate frequency before tuning the GPR-90RXD's. With BAND SPREAD control 37 log scales set at 100, tune the receivers around the signal frequency until the clearest audio signal is heard. Tune the BAND SPREAD controls on the GPR-90RXD's and MSR-6's until the best audio is obtained.

The position of FADE ALARM LEVEL control 9 on each AFC-1 is determined by the existing noise level. To adjust this control to the correct position, tune the GPR-90RXD's to a no-signal frequency and adjust FADE ALARM LEVEL control 9 until FADE ALARM lamp 5 flickers on and off. This effect is caused by the varying random noise level.

The position of CARRIER COMPENSATOR switch 7 determined by the amount of carrier suppression utilized at the transmitter site. For 30-db suppression, CARRIER COMPENSATOR switch 7 should be set to 30 DB; for 20-db suppression, to 20 DB; for 10-db suppression, to 10 DB; for AM, to 0 DB. If the amount of suppression is not known, the operator should adjust the CARRIER COMPENSATOR switch for best reception.

If the A.F.C. INDICATOR meter indicates other than 0, depress A.F.C. RESET pushbutton 8 and adjust the tuning controls on the GPR-90RXD's and MSR-6's as necessary to obtain a zero reading. This should be done without losing intelligibility.

If it is desired to receive a station whose exact frequency is not known, some of the controls on the GPR-90RXD's should be temporarily repositioned from the positions indicated in paragraph 3-3a. This procedure will quickly locate the particular station. Set the following controls to the positions indicated; HFO switch 24 to VAR, BFO switch 36 to on position, BAND SPREAD control 37 to 100. All the other front panel controls on the GPR-90RXD's should remain as indicated in paragraph 3-3a.

The GPR-90RXD's are now utilizing their own local oscillators. Set SEND-REC switch 32 on one of the GPR-90RXD's to SEND and tune the other GRP-90RXD until the particular station is located. Tune until the best audio is heard. Now, set SEND-REC switch 32 just tuned to SEND and reset the corresponding switch on the other GPR-90RXD to REC. Tune the second GPR-90RXD in the same manner as the first. After tuning the GPR-90RXD, set the following controls to the positions indicated: HFO switch 24 to EXT, BFO switch 36 to OFF, SEND-REC switch 32 to REC.

Set the VOX frequency according to the chart in paragraph 3-2d. Adjust the VOX and the GPR-90RXD simultaneously until the best audio is heard. The procedure from this point on is identical with that outlined in paragraph 3-3a. Adjust controls 1 and 2 for desired volume.

b. OFF-CENTER TUNING. - Set the controls on all units in the positions indicated for normal tuning. Refer to paragraph 3-3a. The only difference between the two tuning methods is the tuning procedure.

If the desired signal frequency is known, set the MASTER OSCILLATOR FREQUENCY dial on the VOX according to the following chart. This chart differs from the one in paragraph 3-2d in that the corrections for off-center tuning have been taken into account.

| Received Signal | VOX-HFO Output * | VOX Band | VOX-VMO |
|---|---|---|---|
| Frequency | | | Dial Setting |
| Below 5.4 mc | Fr + (455±2) kc ** | 2-4 mc | Fr+(455±2)** |
| | Fr + (455±2) kc ** | 4-8 mc | Fr+(455±2)/2 ** |
| Above 5.4 mc | Fr + (3,955 ±2) kc ** | 8-16 mc | (Fr+3955±2)/4 ** |
| | Fr + (3,955 ±2) kc ** | 16-32 mc | (Fr+3955±2)/8 ** |
| | Fr + (3,955 ±2) kc ** | 32-64 mc | (Fr + 3,955±2) /16 ** |

*Fr signifies GPR-90RXD frequency.

** Plus for upper sideband reception and minus for lower sideband reception.

After the VOX has been set, tune the GPR-90RXD's 2 kc above the signal frequency for upper sideband reception or 2 kc below the signal frequency for lower sideband reception, until maximum S-meter deflection is observed. Tune the BAND SPREAD controls on the GPR-90RXD's for any fine adjustments. Tune MSR-6 BAND SPREAD control 15 for intelligibility, the direction of rotation depending upon which sideband is being transmitted. The appropriate SIDEBAND lamp should glow.

## 3-4. COMMUNICATIONS RECEIVER GPR-90RXD.

a. AM RECEPTION.

| Step | Operation | Purpose |
|---|---|---|
| 1 | Set SEND-REC switch 32 to REC. | Applies B+ power to unit. |
| 2 | Set RF SELECTIVITY switch 28 to NON XTAL. | Selects widest IF response. |
| 3 | Set MANUAL-AVC switch 33 to AVC. | Permits AVC operation. |
| 4 | Set BFO switch 36 to OFF. | Disables BFO. |
| 5 | Set CAL switch 30 to OFF. | Disables 100-kc oscillator. |
| 6 | Set RANGE SELECTOR switch 34 to desired band. | Selects appropriate tuning range. |
| 7 | Set HFO switch 24 to VAR. | Selects local oscillator, within the unit, to beat against the incoming RF to produce the IF. |
| 8 | Adjust RF GAIN control 39 fully clockwise. | Applies primary power to the unit and adjusts RF gain to maximum. |
| 9 | Set RADIO-PHONO switch (on the rear apron) to RADIO. | Connects audio amplifier to detector. |
| 10 | Set SSB switch (on the rear apron) to OFF. | Permits normal operation of detector. |

When the received signal is accompanied by excessive background noise (other than ignition or pulse type), increasing the RF selectivity of the GPR-90RXD will improve the signal-to-noise ratio. The selectivity should be increased up to the point where a phone signal becomes unintelligible. An almost obliterated signal can sometimes be pulled through the noise hash and received perfectly by the combined use of the RF and audio selectivity controls.

If the signal being received is interfered with or heterodynes with an adjacent carrier, adjust XTAL PHASE control 23 to reduce the interference.

Turning HFO switch 24 in any of the 10 crystal positions permits the GPR-90RXD to receive 10 channels, utilizing a crystal-controlled local oscillator to produce the intermediate frequency. If it is desired to obtain reception on frequencies not covered by the 10 crystals, turn HFO switch 24 to EXT and connect an external synthesizer to EXT jack J5.

b. CW RECEPTION. - To place the GPR-90RXD in operation for the reception of CW signals, the controls and switches are set to the same positions as those outlined in paragraph 3-4a for AM reception except that BFO switch 36 is set to ON.

After turning on the BFO, tune in a CW signal. Adjust the BFO PITCH control for a pleasing tone.

**NOTE**

CW reception may be accomplished with the AVC switch in the ON or OFF positions. However, best reception is usually obtained by turning the AVC off, retarding the RF gain and increasing the audio gain.

c. SSB RECEPTION. - To place the GPR-90RXD in operation for the reception of single-sideband signals, the controls and switches are set to the same positions as those outlined in paragraph 3-4a for AM reception except that BFO switch 36 and SINGLE SIDEBAND switch S9 (on rear apron) are each set to the ON position.

Single sideband signals are characterized by the lack of a carrier, unintelligibility, and fluctuations of the S-meter. To obtain proper reception, the carrier must be reinserted by turning on the BFO.

Tune in the single sideband signal for maximum S-meter deflection. Turn the RF GAIN control down until the signal is barely audible. Turn on the BFO and tune the BFO PITCH control very slowly until the reception becomes intelligible. If intelligibility cannot be attained, rotate the BFO PITCH control in the opposite direction. The direction of rotation is dependent upon which sideband the transmitting station is utilizing. In all cases, the BFO PITCH control should be turned very slowly.

**NOTE**

Because of the slow tuning rate on the BAND SPREAD dial, it is often possible to tune SSB signals by retarding the RF gain, boosting the audio and setting the BFO pitch to zero. Rotating the BAND SPREAD dial slowly will then bring in the station.

d. S-METER. - The S-meter performs a dual function; it provides a visual means of accurately tuning the GPR-90RXD to the incoming signal, and it indicates the relative signal strength. The AVC switch must be in the ON position for the S-meter to operate correctly.

## 3-5. SINGLE SIDEBAND CONVERTER MSR-6.

a. NORMAL TUNING OF GPR-90RXD TO SIGNAL FREQUENCY.

(1) SINGLE SIDEBAND RECEPTION.

| Step | Operation | Purpose |
|---|---|---|
| 1 | Tune the GPR-90RXD to the desired signal frequency. | |
| 2 | Set GPR-90RXD MANUAL-AVC switch 33 to the AVC position. | Permits automatic volume control of GPR-90RXD by AFC-1. |
| 3 | Set MSR-6 AVC switches 16 and 17 to OFF and SLOW. | Prevents AVC operation. |
| 4 | Set MSR-6 BFO switch 19 to ON. | |
| 5 | Set MSR-6 SIDEBAND switches 18 and 13 to MANUAL and either U or L (depending upon sideband being received). | Permits manual tuning of MSR-6 and selects desired sideband for detection. |
| 6 | Tune MSR-6 and/or GPR-90RXD for intelligibility. | |

| Step | Operation | Purpose |
|---|---|---|
| 7 | For crystal operation, set MSR-6 to XTAL. Depress pushbutton for desired sideband. | Selects crystal for desired sideband detection. |

**NOTE**

A 472- and a 438-kc crystal must be in sockets 42 and 41, respectively.

| Step | Operation | Purpose |
|---|---|---|
| 8 | Tune the GPR-90RXD for intelligibility. | |

(2) AM RECEPTION.

| Step | Operation | Purpose |
|---|---|---|
| 1 | Tune the GPR-90RXD to the desired signal frequency. | |
| 2 | Set the GPR-90RXD MANUAL-AVC switch 33 to the AVC position. | |
| 3 | Set MSR-6 AVC switches 16 and 17 to ON and FAST. | Enable AVC operation on first MSR-6 amplifier. |
| 4 | Set MSR-6 BFO switch 19 to OFF. | |
| 5 | Set MSR-6 to MANUAL or XTAL. | |
| 6 | Tune GPR-90RXD for intelligibility. | |

(3) EXALTED CARRIER OPERATION. - For exalted carrier operation, set MSR-6 AVC switch 17 to FAST. After this is done, operation is identical with single sideband reception.

(4) CW AND FS RECEPTION. - Set the GPR-90RXD for CW reception and operate the MSR-6 for AM reception. This may be accomplished in MANUAL or XTAL mode.

b. OFF-CENTER TUNING OF GPR-90RXD TO SIGNAL FREQUENCY.

(1) SINGLE SIDEBAND RECEPTION.

| Step | Operation | Purpose |
|---|---|---|
| 1 | Tune the GPR-90RXD 2 kc above the signal frequency for upper sideband reception or 2 kc below the signal frequency for lower sideband reception. | |
| 2 | Set GPR-90RXD MANUAL-AVC switch 33 to the AVC position. | Permits automatic volume control of GPR-90RXD by AFC-1. |
| 3 | Set MSR-6 AVC switches 16 and 17 to OFF and SLOW. | Disables AVC operation of first MSR-6 amplifier. |
| 4 | Set MSR-6 BFO switch 19 to ON. | |

| Step | Operation | Purpose |
|---|---|---|
| 5 | Set MSR-6 SIDEBAND switches 18 and 13 to MANUAL and either U or L (depending upon sideband being received). | Permits manual tuning of MSR-6 and selects desired sideband for detection. |
| 6 | Tune MSR-6 and/or GPR-90RXD for intelligibility. | |
| 7 | For crystal operation, set MSR-6 to XTAL. Depress pushbutton for desired sideband. | Selects crystal for desired sideband detection. |
| | **NOTE** A 472- and a 438-kc crystal must be in sockets 42 and 41, respectively. | |
| 8 | Tune the GPR-90RXD for intelligibility. | |

(2) AM RECEPTION.

| Step | Operation | Purpose |
|---|---|---|
| 1 | Tune the GPR-90RXD 1.6 kc above or below the signal frequency, the choice depending upon the sideband desired. | |
| 2 | Set GPR-90RXD MANUAL-AVC switch 33 to the AVC position. | |
| 3 | Set MSR-6 AVC switches 16 and 17 to ON and FAST. | Enable AVC operation on first MSR-6 amplifier. |
| 4 | Set MSR-6 BFO switch 19 to OFF. | |
| 5 | Set MSR-6 to MANUAL or XTAL. | |
| 6 | Tune the GPR-90RXD for intelligibility. | |

(3) EXALTED CARRIER OPERATION. - For exalted carrier operation, set MSR-6 AVC switch 17 to FAST. After this is done, operation is identical with single sideband reception.

(4) CW AND FS RECEPTION. - Set the GPR-90RXD for CW reception and operate the MSR-6 for AM reception. This may be accomplished in MANUAL or XTAL mode.

## 3-6. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1.

Since operation of the AFC-1 is intimately related to operation of the overall DDR-6E, it cannot be treated as a separate operational unit. Operation of the AFC-1 as part of the DDR-6E is covered in paragraph 3-3.

## 3-7. OPERATOR'S MAINTENANCE.

a. COMMUNICATIONS RECEIVER GPR-90RXD. - There are several maintenance operations which can be performed on the GPR-90RXD by the operator when trouble is encountered. If normal operating procedures produce unsatisfactory results, the operator should proceed as follows:

(1) Check the power supply by noting whether dial lamp is on, indicating whether power is being applied to the GPR-90RXD.

**CAUTION**

Never replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, DO NOT replace it a second time until the cause has been corrected.

(2) If no power is evident, check fuse on rear apron. Replace bown fuse with fuse of equal value.

(3) Check the tubes since the most common cause of operational failure is usually tube failure. Checking the tubes will often save many hours of unnecessary trouble-shooting. The location of tubes in the GPR-90RXD is shown in figure 5-2.

b. VARIABLE FREQUENCY OSCILLATOR VOX-3. - The operator should make minor adjustments of tuning controls to verify precise oscillator output frequency and level, note general condition of panel switches, observe whether panel indicator lamps go on properly, and check the condition of the oven and power fuses as well as the condition of the tubes. Operators should not perform any emergency measures unless properly authorized to do so. If such authorization is given, it should be preceded by a short course of instruction.

(1) REPLACEMENT OF FUSES.

**CAUTION**

Never replace a fuse with one of higher rating unless continued operation is more important than probable damage to the equipment. If a fuse burns out immediately after replacement, DO NOT replace it a second time until the cause has been located and corrected.

Two separate fusing systems are incorporated in the VOX, one to protect the ovens, and the other to protect the power supply proper. If the front panel pilot light marked MAIN POWER (control designated 49 on figure 3-1) fails to go on when the unit is turned on, then the fuse marked POWER, on the rear of the power supply chassis, must be changed. (There is a remote possibility that the pilot lamp itself is faulty, but this is rare.)

In the event of an oven fuse failure, both pilot lights referring to the ovens do not go on. The ovens, then, also begin to cool. In this case, the oven fuse, which is on the power supply chassis rear, must be replaced.

(2) REPLACEMENT OF TUBES. - The location of all tubes in the VOX is indicated in figures 5-4-a and 5-4-b. The tubes may be checked visually to see if they are on or warm. The VOX has been so designed that the power chassis can be completely withdrawn in a matter of seconds. A set of tracks has been provided for this purpose and the operator can slip the unit out by simply half turning four snap fasteners, two of which are located on the front panel and two of which are located under the rear of the power supply chassis. Tube replacement is accomplished by disconnecting the power supply as described above. Such disconnection, which automatically removes power from the oven, should not last for more than approximately 5 minutes if good oven stability is to be maintained. If more detailed repairs become necessary, 6-foot extension cables must be used to maintain oven power. Tubes should be carefully removed and tested, and when replaced, care should be taken to install tube shields.

c. SINGLE SIDEBAND CONVERTER MSR-6. - If normal operation procedure produces unsatisfactory results, the operator should proceed as follows:

(1) Check the power supply by noting whether pilot lamp is on, indicating whether power is being applied to the MSR-6.

(2) If pilot lamp fails to go on, operate the SIDEBAND switch and observe sideband switching action. This serves as an alternate means of checking since the sideband switching relay operates directly from the 110-volt line.

**CAUTION**

Never replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, DO NOT replace it a second time until the cause has been corrected.

(3) If no power is evident, check fuse on the rear apron. Replace blown fuse with fuse of equal value.

(4) Check the tubes since the most common cause of operational failure is usually tube failure. Checking the tubes will often save many hours of unnecessary trouble-shooting. The location of tubes in the MSR-6 is shown in figure 5-6.

d. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1. - If normal operation procedure produces unsatisfactory results, the operator should proceed as follows:

(1) Check the power supply by noting whether the pilot lamp is on, indicating whether power is being applied to the AFC-1.

**CAUTION**

Never replace a fuse with one of higher rating. If a fuse burns out immediately after replacement, DO NOT replace it a second time until the cause has been corrected.

(2) If no power is evident, check fuse on the rear apron. Replace blown fuse with fuse of equal value.

(3) If the fuse is intact, check input power cables and associated connectors for an open conductor or a loose or broken connection at connector.

(4) Check the power supply silicon rectifiers.

(5) Check the tubes since the most common cause of operational failure is usually tube failure. Checking the tubes will often save many hours of unnecessary trouble-shooting. The location of tubes in the AFC-1 is shown in figure 5-8.

**NOTE**

Often a tube tested in a tube checker will test good but malfunction under actual circuit conditions. Therefore, substitution with a known good tube is recommended.

e. LOUDSPEAKER PANEL LSP-7. - There is no operator's maintenance associated with the LSP-7.

f. POWER CONTROL PANEL DCP-1. - The operator should observe that the power indicator lamp on the DCP-1 goes on properly when the ON-OFF switch is set to ON. There is no other operator's maintenance required.

TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS

| SERIAL DESIGNATION (SEE FIGURE 3-1) | PANEL DESIGNATION (SEE FIGURE 3-1) | COMPONENT DESIGNATION ON OVERALL SCHEMATIC DIAGRAM |
|---|---|---|
| LOUDSPEAKER PANEL LSP-1 | | |
| 1 | Attenuator (No designation) | T Pad R101 |
| 2 | Attenuator (No designation) | T Pad R102 |
| AUTOMATIC FREQUENCY CONTROL UNIT AFC-1 | | |
| 3 | A.G.C. SELECTOR | Knob (4-position) selector switch S2 |
| 4 | A.F.C. INDICATOR | Meter M1 |
| 5 | FADE ALARM | Indicator I2 |
| 6 | CARRIER LEVEL | Meter M2 |
| 7 | CARRIER COMPENSATOR | Knob (4-position) selector switch S1 |
| 8 | A.F.C. RESET | Push-button switch S3 |
| 9 | FADE ALARM LEVEL | Knob potentiometer R53 |
| 10 | POWER | Toggle switch S4 |
| 11 | Power on lamp (no designation) | Indicator I1 |
| SINGLE SIDEBAND CONVERTER MSR-6 | | |
| 12 | L | Indicator I1 |
| 13 | SIDEBAND | Push-button switch S6 |
| 14 | U | Indicator I2 |
| 15 | BANDSPREAD | Knob capacitor C28 |
| 16 | AVC ON-OFF | Toggle switch S2 |
| 17 | AVC FAST-SLOW | Toggle switch S1 |
| 18 | MANUAL-XTAL | Knob (2-position) selector switch S4 |
| 19 | BFO | Knob (2-position) selector switch S5 |
| 20 | Power on lamp (No designation) | Indicator I3 |
| 21 | POWER | Toggle switch S7 |
| 22 | AUDIO GAIN | Knob potentiometer R30 |
| COMMUNICATIONS RECEIVER GPR-90RXD | | |
| 23 | XTAL PHASE | Knob capacitor C42 |
| 24 | HFO | Knob (12-position) selector switch S12 |

TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS (Cont.)

| SERIAL DESIGNATION (SEE FIGURE 3-1) | PANEL DESIGNATION (SEE FIGURE 3-1) | COMPONENT DESIGNATION ON OVERALL SCHEMATIC DIAGRAM |
|---|---|---|
| COMMUNICATIONS RECEIVER GPR-90RXD (Cont.) | | |
| 25 | S-meter (No designation) | Meter M1 |
| 26 | XTAL ADJ. | Knob capacitor C149 |
| 27 | AUDIO SELECTOR | Knob (3-position) selector switch S5 |
| 28 | RF SELECTIVITY | Knob (6-position) selector switch S2 |
| 29 | AUDIO GAIN | Knob potentiometer R68 |
| 30 | CAL | Toggle switch S11 |
| 31 | MAIN TUNING | Knob capacitor C9 |
| 32 | SEND-REC | Toggle switch S9 |
| 33 | MANUAL-AVC | Toggle switch S3 |
| 34 | RANGE SELECTOR | Knob (6-position) selector switch S1 |
| 35 | LIMITER | Toggle switch S4 |
| 36 | BFO | Toggle switch S8 |
| 37 | BAND SPREAD | Knob capacitor C8 |
| 38 | AUDIO SPREAD | Knob variable resistor R71 |
| 39 | RF GAIN | Knob potentiometer R81 |
| 40 | BFO PITCH | Knob capacitor C99 |
| 63 | ANT. TUNE | Knob capacitor C140 |
| VARIABLE FREQUENCY OSCILLATOR VOX-3 | | |
| 41 | POWER | Toggle switch S101 |
| 42 | BEAT ON-OFF | Toggle switch S104 |
| 43 | HFO | Toggle switch S103 |
| 44 | METER | Knob (4-position) selector switch S107 |
| 45 | IFO | Toggle switch S102 |
| 46 | PHONES | Telephone jack J105 |
| 47 | BFO | Toggle switch S106 |
| 48 | CALIBRATE | Knob (slug inductance) L301 |
| 49 | MAIN POWER | Indicator I302 |

## TABLE 3-1. TABLE OF EQUIVALENT CONTROL DESIGNATIONS (C nt.)

| SERIAL DESIGNATION (SEE FIGURE 3-1) | PANEL DESIGNATION (SEE FIGURE 3-1) | COMPONENT DESIGNATION ON OVERALL SCHEMATIC DIAGRAM |
|---|---|---|
| VARIABLE FREQUENCY OSCILLATOR VOX-3 (Cont.) | | |
| 50 | INNER OVEN | Indicator I301 |
| 51 | OUTER OVEN | Indicator I304 |
| 52 | ZERO BEAT | Indicator I303 |
| 53 | Output meter (No designation) | Meter M301 |
| 54 | TUNING | Knob (5-position) selector switch C225, A, B, C, and D |
| 55 | BAND-MCS | Knob (5-position) selector switch S202, A, B, C, and D |
| 56 | XTAL FREQ | Knob variable capacitor C210 |
| 57 | XTAL | Knob (4-position) selector switch S201, A, B, C, and D |
| 58 | OUTPUT | Knob potentiometer R215 |
| 59 | MASTER OSCILLATOR FREQUENCY (dial) | |
| 60 | MASTER OSCILLATOR FREQUENCY (knob) | Knob variable capacitor C301 and C302 |
| POWER CONTROL PANEL DCP-1 | | |
| 61 | Power switch (No designation) | Circuit breaker CB1 |
| 62 | Power on lamp (No designation) | Indicator I1 |

## TABLE 3-2. VOX'S CHECK-OUT POINTS; VMO VS 100-KC CALIBRATING OSCILLATOR

| VMO FREQUENCY | VMO HARMONIC | 100-KC FUNDAMENTAL HARMONIC | 50-KC HALF-TONE HARMONIC |
|---|---|---|---|
| 2,200,000 | 5 | 110 | 220 |
| 2,205,000 | 10 | --- | 441 |
| 2,210,000 | 10 | 221 | 442 |
| 2,212,500 | 4 | --- | 177 |
| 2,220,000 | 5 | 111 | 222 |
| 2,225,000 | 4 | 89 | 178 |
| 2,228,571 | 7 | 156 | 312 |
| 2,230,000 | 10 | 223 | 446 |

**TABLE 3-2. VOX'S CHECK-OUT POINTS; VMO VS 100-KC CALIBRATING OSCILLATOR (C nt.)**

| VMO FREQUENCY | VMO HARMONIC | 100-KC FUNDAMENTAL HARMONIC | 50-KC HALF-TONE HARMONIC |
|---|---|---|---|
| 2,233,333 | 3 | 67 | 134 |
| 2,240,000 | 5 | 112 | 224 |
| 2,245,000 | 10 | --- | 449 |
| 2,250,000 | 4 | 89 | 178 |
| 2,255,000 | 10 | --- | 451 |
| 2,260,000 | 5 | 113 | 226 |
| 2,266,667 | 3 | 68 | 136 |
| 2,271,428 | 7 | 159 | 318 |
| 2,275,000 | 4 | 91 | 182 |
| 2,280,000 | 5 | 114 | 228 |
| 2,283,333 | 6 | 137 | 274 |
| 2,285,714 | 7 | 160 | 320 |
| 2,290,000 | 10 | 229 | 458 |
| 2,295,000 | 10 | --- | 459 |
| 2,300,000 | 1 | 23 | 46 |

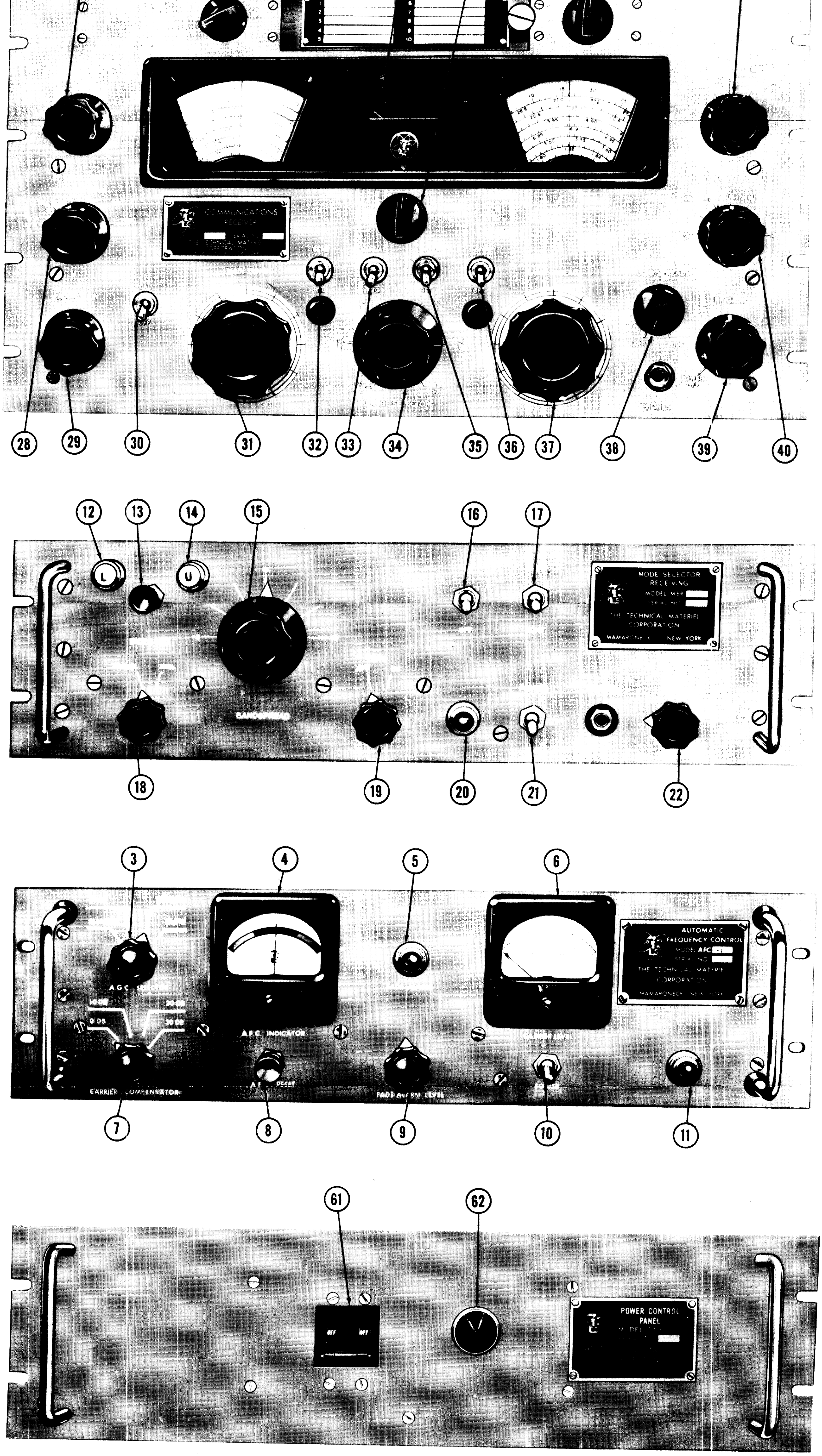
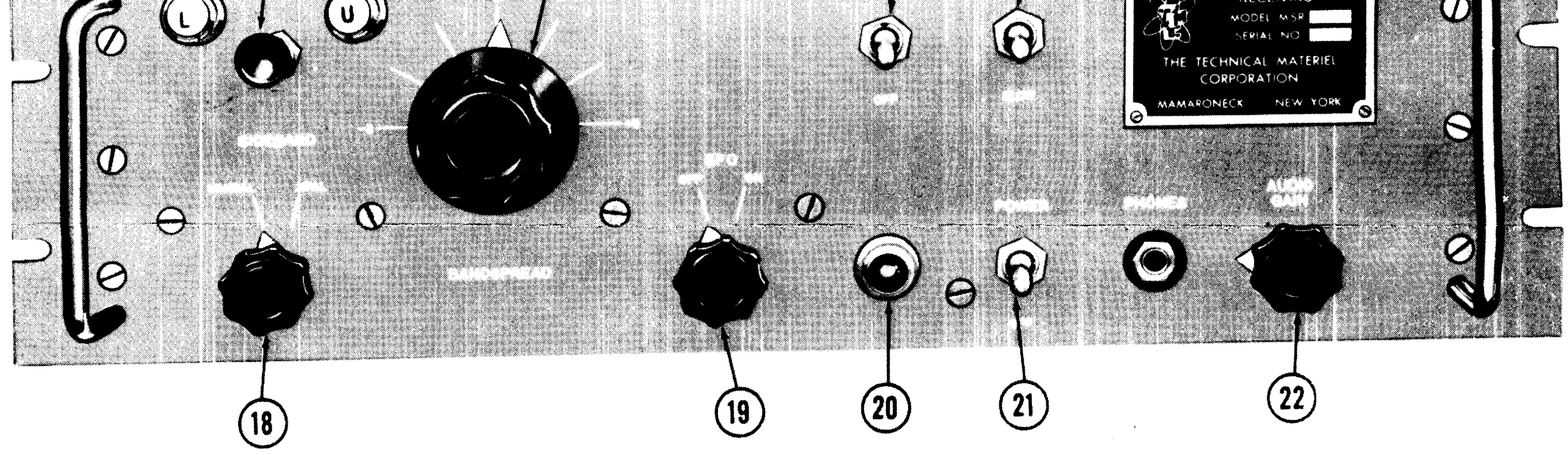
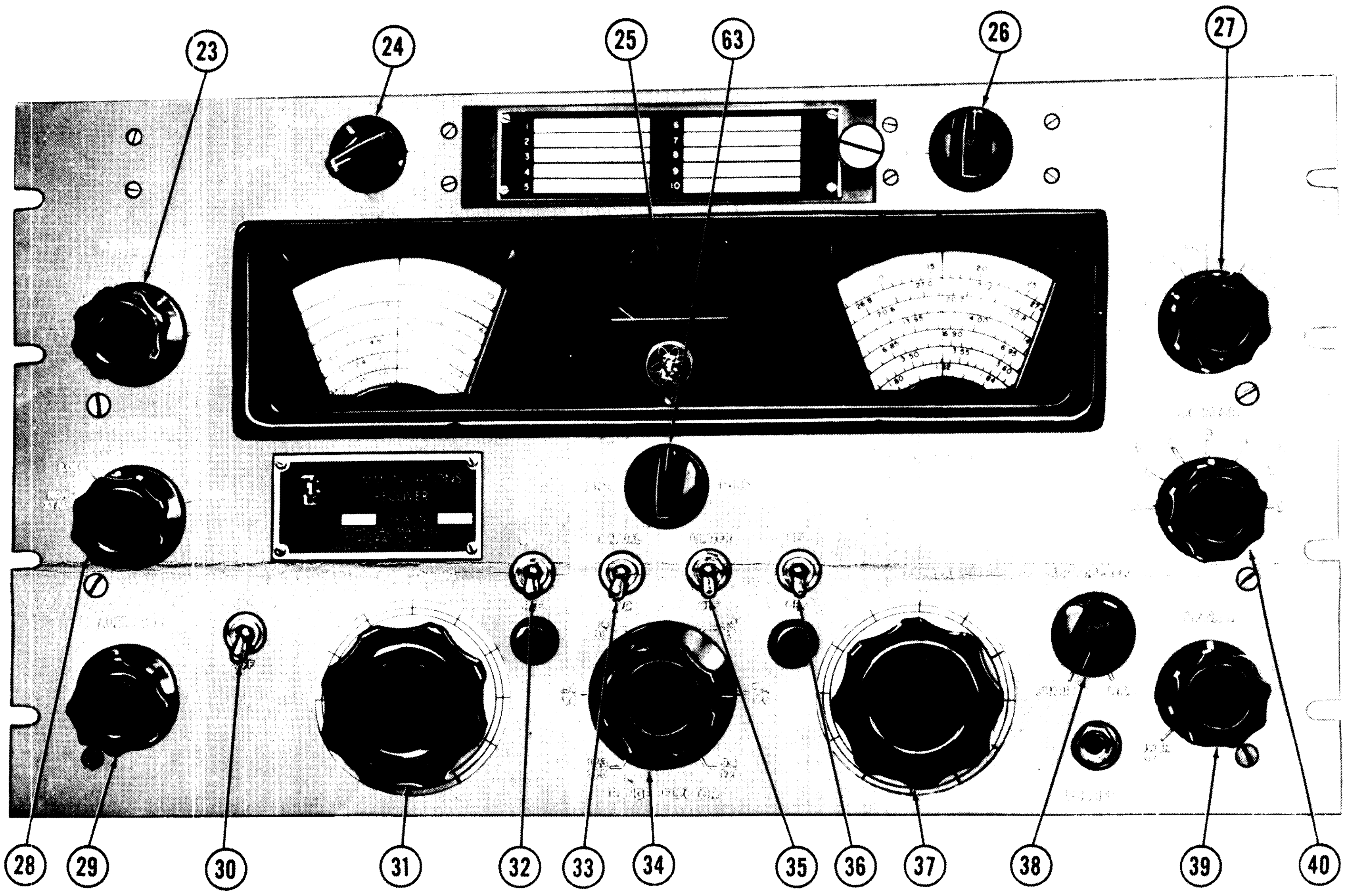
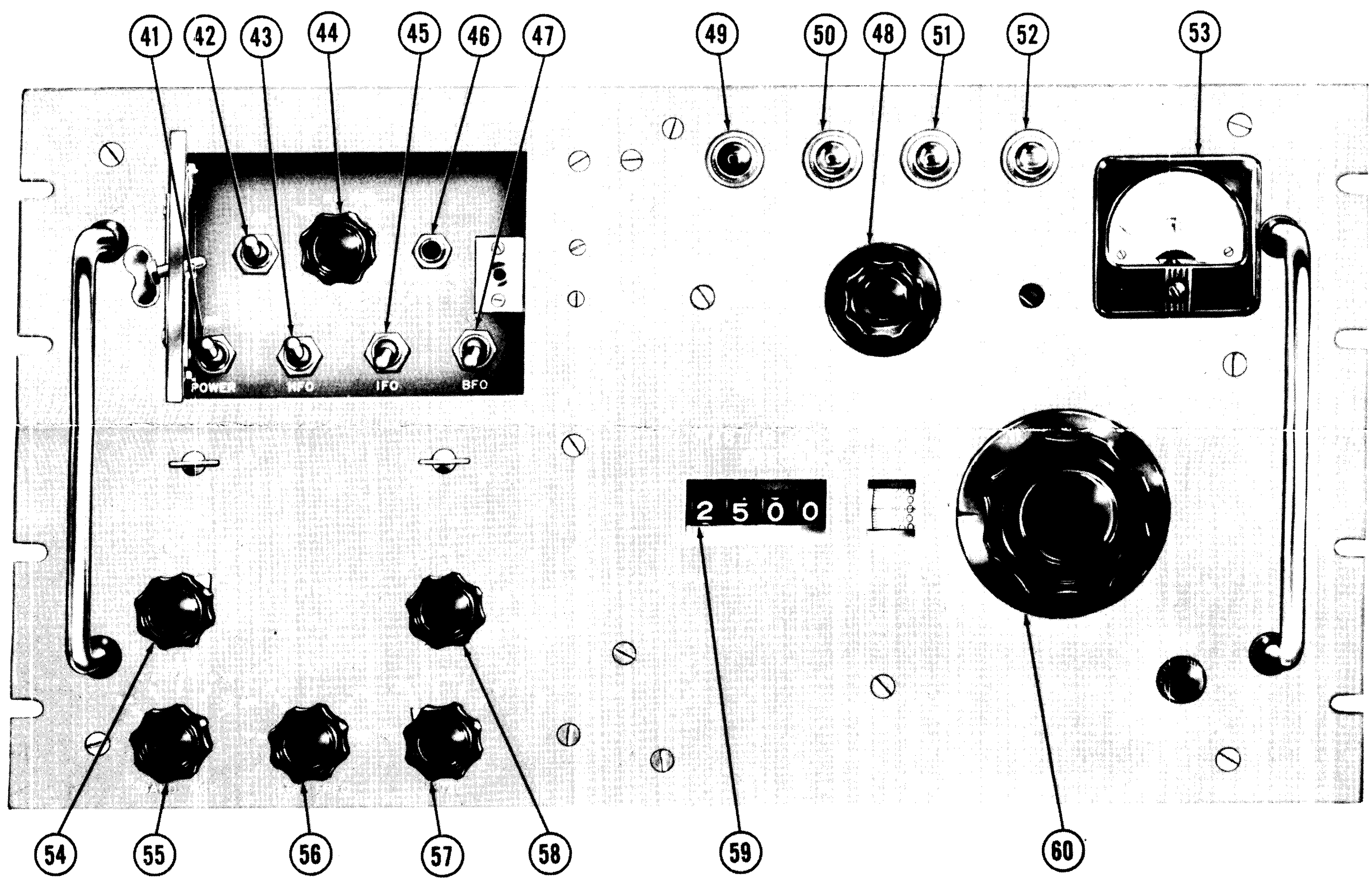
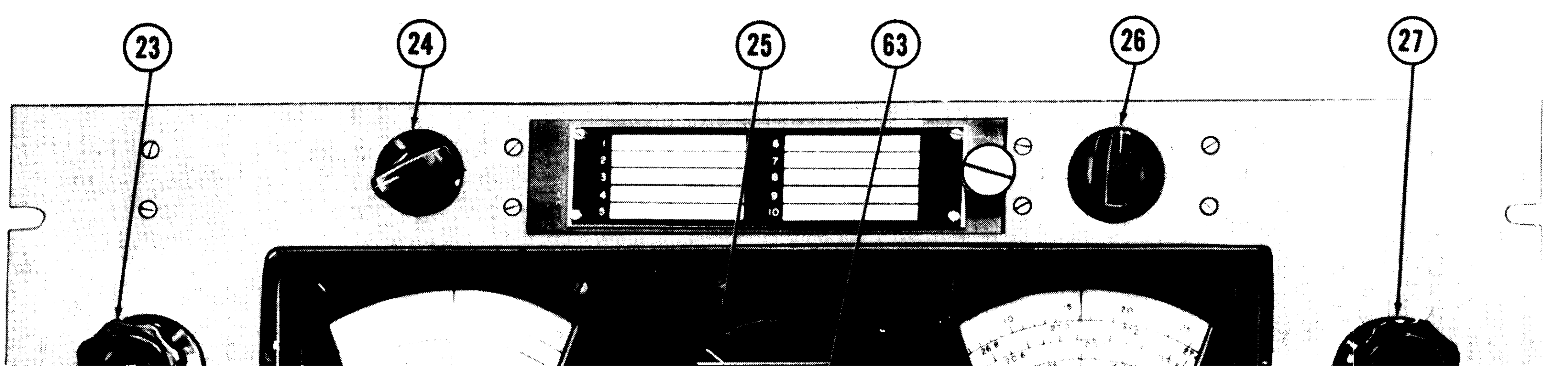


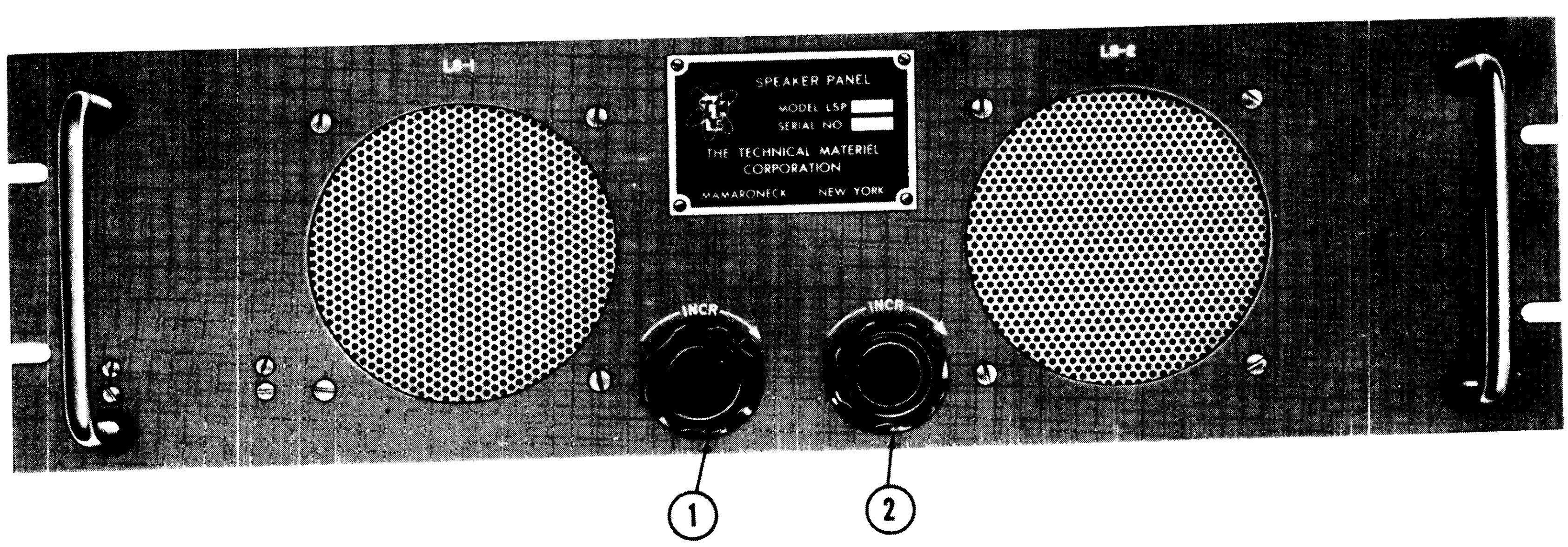

Figure 3-1. DDR-6E Operating Controls

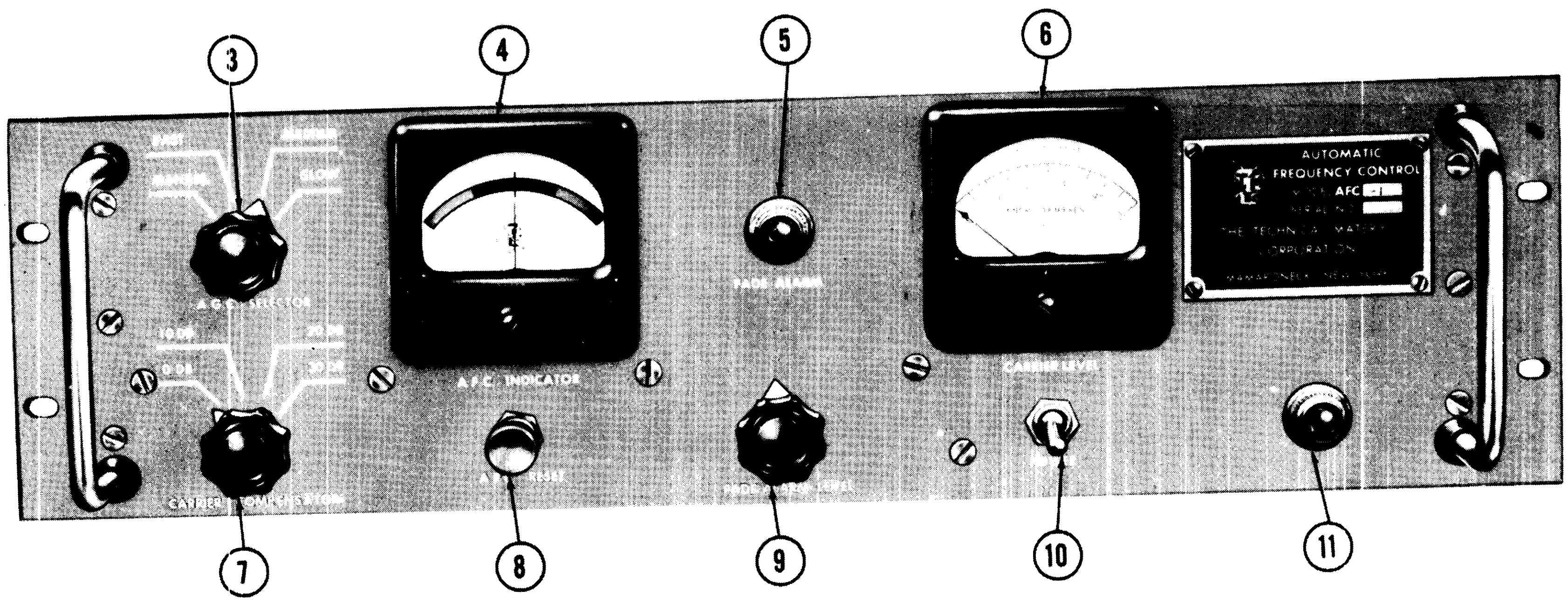

MODEL MSR
SERIAL NO
THE TECHNICAL MATERIEL CORPORATION
MAMARONECK NEW YORK
18
19
20
21
22

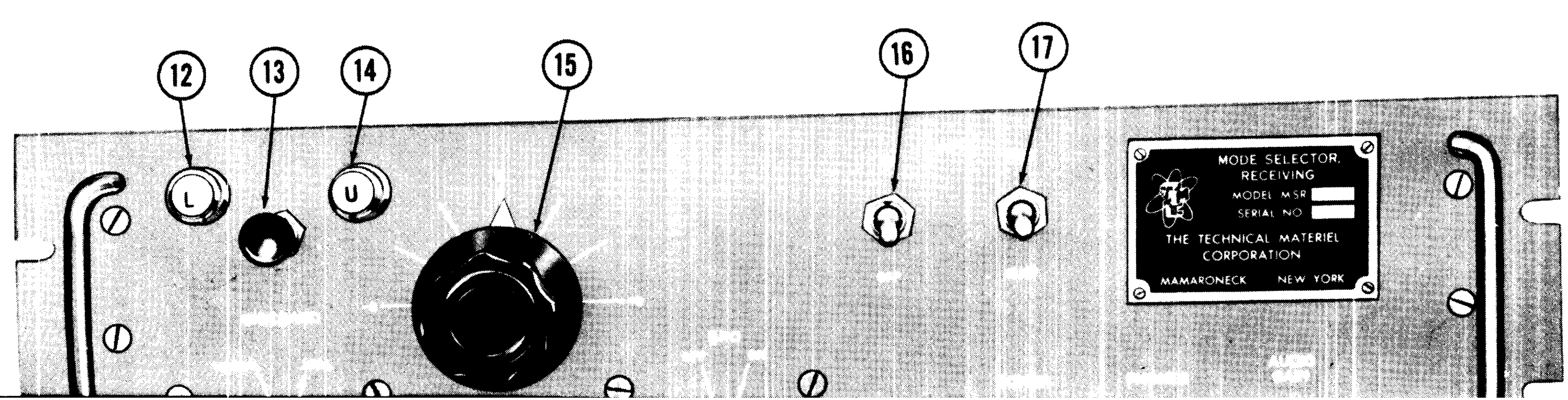

23
24
25
63
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40


41
42
43
44
45
46
47
49
50
48
51
52
53
POWER
WFO
IFO
BFO
2500
54
55
56
57
58
59
60


23
24
25
63
26
27


SPEAKER PANEL
MODEL LSP
SERIAL NO
THE TECHNICAL MATERIEL CORPORATION
MAMARONECK NEW YORK
INCR
INCR
1
2


AUTOMATIC FREQUENCY CONTROL
AFC
THE TECHNICAL MATERIEL CORPORATION
A.F.C. INDICATOR
FADE ALARM
3
4
5
6
7
8
9
10
11


MODE SELECTOR, RECEIVING
MODEL MSR
SERIAL NO
THE TECHNICAL MATERIEL CORPORATION
MAMARONECK NEW YORK
L
U
12
13
14
15
16
17

# SECTION 4
# PRINCIPLES OF OPERATION

## 4–1. GENERAL.

This section covers the principles of operation of the overall DDR-6E, as well as each of the rack-mounted components contained therein.

## 4–2. DDR-6E RECEIVER TERMINAL, BLOCK DIAGRAM ANALYSIS.

Basically, the DDR-6E constitutes a highly stable extremely reliable dual-diversity receiving system. Each of the dual receiver sections consists of a GPR-90RXD, an MSR-6, and an AFC-1. The common local oscillator input required for simultaneous operation of the two receiver sections is derived from the highly stable VOX-3. This arrangement permits both receiver sections to receive the same RF signal.

As shown in figure 4-1, the two RF inputs to the DDR-6E may be applied to the two GPR-90RXD's from either separate antennas or from a common antenna via an antenna multicoupler. Although basically stable in design, the frequency stability of the GPR-90RXD circuits is further enhanced by using the extremely stable HFO and IFO outputs of the VOX-3. The oscillator signals are simultaneously injected into both GPR-90RXD's, thus providing master oscillator control of the dual-diversity receivers. The 455-kc outputs of the two GPR-90RXD's are applied to respective MSR-6's which contain facilities for sideband selection, tuning, and demodulation.

The AFC-1 associated with each MSR-6 compares the frequency of the oscillator in the MSR-6 with its own crystal-controlled 17-kc oscillator frequency and generates a DC control signal which effectively prevents carrier-to-oscillator drift, thus preventing sideband carrier drift. Each AFC-1 also controls the AVC action of its associated GPR-90RXD, preventing signal level changes. The audio output of each MSR-6 may be applied to an audio patch panel or tone converter, as required by the installation.

## 4–3. COMMUNICATIONS RECEIVER GPR-90RXD.

a. INTRODUCTION. (See figure 4-2.) - The GPR-90RXD is capable of receiving AM, CW, MCW, FS, and SSB signals over a 0.54- to 31.5-mc range in six bands. The RF signal, derived from either a 75-ohm unbalanced antenna or an antenna coupler, is applied to two-stage RF amplifier V1 and V2. The RF gain of these stages is controlled by the setting of RF GAIN control R81, the cathode bias resistor for IF amplifier V6. Thereafter, the amplified RF signal is converted by V3 and V4 to a 455-kc intermediate frequency for use by the MSR-6. For improved image rejection, double conversion is used on the upper three bands.

Three methods of producing the intermediate frequency are available. Local oscillator V12 may be used in conventional fashion. Second, 10 channels may be received with 10 precisely adjustable crystals controlling a second local oscillator, V17. Finally, provision is made for the use of an external high stability control oscillator, or synthesizer. In the DDR-6E, the first and second oscillator inputs are normally supplied by the HFO and IFO outputs, respectively, of VOX-3.

The 455-kc IF signal developed as a result of either single or double conversion passes through an IF crystal filter which permits variation of the bandwidth from 250 cps to 5 kc. XTAL PHASE control C42, used in conjunction with this circuit, reduces heterodyne and interfering signals.

The IF signal level is raised by IF amplifiers V6, V7, and V8 and is then routed through IF OUT jack J1A to the MSR-6 where single sideband intelligence is selected and detected. The IF output of amplifier V8 is also applied to diode detector V9A in the GPR-90RXD where it is demodulated. Diode V9B, a series noise limiter, effectively reduces impulse type noise. An AVC stage, V10A, in conjunction with an AVC control circuit in the AFC-1, provides AVC control for the IF and RF stages of the GPR-90RXD.

A Hartley-type BFO, V13, is used for detection of CW signals; its output is injected into the detector plate circuit. Provision is made in the GPR-90RXD for an externally generated BFO signal.

The detector output is amplified by an audio amplifier consisting of voltage amplifier V10B and power amplifier V11. The audio output circuit provides the means for matching voice coil impedances of 4, 8, 16, and 600 ohms, as well as headphones. The ADUIO SELECTOR and AUDIO SPREAD controls provide variation of the audio response of the audio amplifier. The response may be varied between one which is essentially flat to one whose bandwidth is 1200 cps at a center frequency of approximately 1100 cps.

For calibrating the GPR-90RXD, the output of 100-kc calibration oscillator V16 is injected at the GPR-90RXD input. The harmonic output of the oscillator permits calibration of the GPR-90RXD throughout its frequency bands.

The power supply consists of a full-wave rectifier, the output of which is heavily filtered by a pi-type filter for effective hum reduction. Hum produced by the filament supply is minimized by a hum balancing potentiometer. Voltage regulator V15 provides 150-volt regulated DC power.

b. RF AMPLIFIERS. (See figure 4-3.) - The RF voltage delivered by the antenna is inductively coupled to first RF amplifier V1 via RF transformers L28 through L33 and wafers $S1_{AA}$ and $S1_A$ of the RANGE SELECTOR switch. ANT. TUNE control C140 peaks the RF input circuit to the particular antenna used with the GPR-90RXD. The RF output of V1 is coupled to V2 via separate coupling networks (depending on the band selected) and wafers $S1_B$ and $S1_C$ of the RANGE SELECTOR switch. Inductive coupling is used in bands 1 through 3; RC coupling is used for bands 4 through 6. The amplified output of V2 is applied through coupling networks and wafers $S1_D$ and $S1_E$ of the RANGE SELECTOR switch to first converter V3.

The gain of both RF stages is controlled by RF GAIN control R81 in the common cathode return circuit. The RF amplifiers are tuned by MAIN TUNING capacitor C9, sections of which are connected across the selected tuned circuits by the RANGE SELECTOR switch. BAND SPREAD control C8 provides electrical bandspread for the RF circuits.

c. HIGH FREQUENCY OSCILLATOR. - Oscillator V12 is a Hartley type which provides an RF signal 455 kc above that of the incoming signal. (See figure 4-4A.) When switch S13 is turned to position 4 and HFO switch S12 is turned to VAR, oscillator V12 receives 150-volt plate voltage and is tuned by two sections of MAIN TUNING capacitor C9. The tank circuits for the oscillator are selected by RANGE SELECTOR switch S1. This is accomplished simultaneously with the selection of the coupling circuits used in the RF amplifiers. Figure 4-4A is a simplified schematic diagram which shows the HFO circuit elements arranged for band 1 operation. As shown in this figure, the bandspread feature of the GPR-90RXD is not used in band 1 operation. The HFO circuit elements in figure 4-4B are arranged for band 2 operation and typify the circuit arrangement for the next four bands: 3, 4, 5, and 6. The circuit and its function is identical with band 2 operation except for the addition of BAND SPREAD capacitor C8, component values, and contact position of RANGE SELECTOR switch S1.

Crystal oscillator/amplifier V17 is used when the GPR-90RXD is tuned for operation in 1 of the 10 crystal-controlled channels or when an external synthesizer supplies the HFO input. (See figure 4-5.) The latter is the normal operating condition for the DDR-6E; VOX-3 supplies the HFO input at jack J5. When operating this way, HFO switch S12 is turned to the EXT position, causing switch S13 to be turned automatically to position 5.

When operating with a crystal-controlled channel, switch S13 is also turned to position 4 while HFO switch S12 is turned to the desired crystal position. The frequency generated by the selected crystal can be slightly adjusted by rotating XTAL ADJ. control C149.

d. FIRST AND SECOND CONVERTERS. (See figure 4-6.) - The signal output from RF amplifier V2 is applied to the control grid of first converter V3, and the output of the local oscillator in use (V12 or V17) is applied to the cathode of V3. These signals mix to produce an IF signal, the frequency of which is dependent upon the band in use. When operating in bands 1, 2, or 3, the IF signal is 455 kc. This signal is applied through buffer IF amplifier V5 and IF transformer T5 to IF amplifier V6 through a crystal filter. When the GPR-90RXD is operated in these bands, single conversion is used. The gain is extremely high at this time since second converter V4 is not used. (Second converter V4 is a pentagrid converter, the gain of which is usually less than unity.) Since the attenuating property of the second converter is not available during single conversion, the gain of the first converter is substantially reduced by injecting a positive voltage into the cathode circuit of V3. In this way, the gain of the GPR-90RXD is kept fairly constant on all bands and stability is assured on the lower three bands.

In the three higher bands, double conversion is used. In this case, the frequency of the IF produced in first converter V3 is 3.955 mc. First converter V3 is permitted to operate at high gain for operation in these bands. The output of V3 is mixed with a 3.5-mc voltage developed in second converter oscillator V4. The oscillator portion of V4 is crystal controlled. The output of this tube is a 455-kc voltage which is applied to first IF transformer T5.

When the GPR-90RXD is used as a dual-diversity receiver (as in the DDR-6E), an external oscillator is connected to EXTERNAL IFO INPUT jack J8. This action ensures that the oscillator portions of the second converters and oscillators of both GPR-90RXD's are synchronized at 3.5 mc. At this time the crystal oscillator portion of V4 is disabled by permitting diode CR1 in the cathode circuit of V4 to conduct.

e. IF AMPLIFIERS. (See figure 4-7.) - The output of first IF transformer T5 is applied to a crystal filter. RF SELECTIVITY switch S2 determines the selectivity of the IF amplifier. In the NON XTAL position, crystal Y1 is shorted out. In the remaining positions, crystal Y1 is utilized. As RF SELECTIVITY switch S2 is rotated clockwise, more and more resistance is put in series with the crystal bridge circuit. This action effectively raises the Q of the circuit, producing a more selective filter reponse. XTAL PHASE control C42 is used to eliminate or reduce the effects of heterodyne or interfering signals.

The IF amplifier consists of three transformer coupled stages: V6, V7, and V8. The gain of the amplifier may be varied by two controls; IF GAIN control R106 and RF GAIN control R81. When RF GAIN control R81 is varied, the RF amplifier is also affected. IF GAIN control R106 is left undisturbed after the desired IF gain is achieved.

S-meter M1 is connected in the screen grid circuit of the second IF amplifier. This meter responds to changes in signal level, as controlled by the AVC input to IF amplifier V6. The meter may be adjusted by varying S-METER ADJ control R50.

In the DDR-6E, the IF output of V8 is routed through IF OUT jack J1A to the MSR-6.

f. AUTOMATIC VOLUME CONTROL. - The AVC detector is a triode connected in the diode configuration. (See figure 4-7.) The IF output at the plate of the third IF amplifier V8 is coupled to the plate of AVC detector V10A. The intermediate frequency is rectified and the resulting DC voltage, which is proportional to the signal strength, is the AVC signal. This signal is fed back to the grids of the RF and IF amplifiers. Variations in signal strength thus cause the gain of these stages to vary, stabilizing the output of the GPR-90RXD.

As used in the DDR-6E, the AVC output of AVC detector V10A is routed through the AFC-1 prior to application to the IF and RF amplifiers. The AFC-1 contains facilities for varying the attack time of the AVC voltage as required for particular reception conditions.

g. BEAT FREQUENCY OSCILLATOR. (See figure 4-8.) - The BFO, which is centered at 455 kc, is injected at the detector plate. The BFO stage, V13, is made operable by applying 150 volts to the plate and screen circuits with BFO switch S8 in the ON position. The output frequency may be varied ±3 kc by adjusting BFO PITCH control C99.

An external BFO may be inserted at EXTERNAL BFO INPUT jack J7. The BFO output of the VOX-3 is applied to the GPR-90RXD at this jack in the DDR-6E.

h. DETECTOR AND NOISE LIMITER. (See figure 4-9.) - The output of the third IF transformer is coupled through IF transformer T8 to detector V9A. The IF signal is demodulated and filtered; the remaining audio information is applied to audio amplifier V10B.

When LIMITER switch S4 is set to the ON position, series noise limiter V9B is inserted across the detected output. The noise limiter effectively reduces impulse type noise. With LIMITER switch S4 set to the OFF position, the noise limiter diode is short circuited and becomes inoperative.

i. AUDIO AMPLIFIERS. (See figure 4-10.) - Triode V10B is the first audio amplifier. Three inputs may be applied to the grid of this amplifier. With RADIO-PHONO switch S6 in the PHONO position, the output of a high impedance phonograph cartridge may be connected to PHONO INPUT jack J1 and the audio amplifier may be utilized. (See figure 4-9.) For full output, 0.15 volt is required. When RADIO-PHONO switch S6 is set to the RADIO position, the GPR-90RXD will operate normally. When SSB switch S7 is set to the ON position, the audio output of the detector is shorted to ground. (For SSB operation, the MSR-6 provides audio signals.)

By means of AUDIO SELECTOR switch S5 and AUDIO SPREAD control R71, the response of the audio amplifier may be controlled from an essentially flat response to a 1200-cps wide response (at -10 db) at a center frequency of approximately 1100 cps. (See figure 4-10.)

Volume is controlled by rotating AUDIO GAIN control R68. The output of V10B is applied to second audio amplifier V11, a power pentode. This amplifier is capable of delivering 2 watts of audio to 4-, 8-, 16-, or 600-ohm voice coils. Provision is also made for the use of headphones at PHONES jack J2. When headphones are used, the speaker is disabled.

j. 100-KC CALIBRATOR. (See figure 8-1.) - The GPR-90RXD may be calibrated with the crystal-controlled 100-kc oscillator V16. When CAL switch S11 is set to ON, power is applied to the oscillator. At this time, the oscillator output applies 100-kc harmonics to the GPR-90RXD input. The output of the oscillator is of sufficient amplitude to provide 100-kc markers throughout the entire tuning range of the GPR-90RXD.

k. POWER SUPPLY. (See figure 8-1.) - The power supply is a heavily filtered full-wave rectifier which supplies 250 volts of unregulated power and 150 volts of regulated power to the various GPR-90RXD circuits. The 150-volt regulator, V15, is a gas tube.

Provision is made for the use of external DC power by placing a battery plug (with the connections shown in figure 8-1) into AUXILIARY POWER socket X1. When the GPR-90RXD is to be used with the normal 115-volt, 60-cps power at plug P2, AC plug P11 must be placed in AUXILIARY POWER socket X1.

When external DC power is used, the requirements are 180 to 300 volts DC at 100 milliamperes and 6 volts at 5 amperes. Power for external accessories is available at ACCESSORY POWER SOCKET X2 (250 volts DC at 10 milliamperes and 6.3 volts AC at 0.6 ampere).

## 4-4. VARIABLE FREQUENCY OSCILLATOR VOX-3.

a. INTRODUCTION. (See figure 4-11.) - As shown in figure 4-11, the VOX consists of a power supply (section 1), an RF chassis (section 2), and the VMO (section 3). The schematic diagram of the VOX-3 is shown in figure 8-2. Electrically, the VMO is a precision, variable frequency device that provides 2 to 4 mc to the HFO chain (whose elements are located on the RF chassis) as well as to the mixer in the calibrating chain (whose elements are located on the power supply chassis). The VMO also supplies a standard calibrating frequency of 100 kc to the aforementioned mixer.

The RF chassis extends the 2- to 4-mc oscillator frequencies by multiplication to the 2- to 64-mc range: it also provides an oscillator circuit (with a socket for Crystal CR-18/U that operates in the 3.2- to 3.9-mc IF range) for HF injection.

The power supply chassis provides a calibrating chain containing the aforementioned mixer, a 300-

to 1000-kc beat frequency oscillator circuit (for dual conversion superheterodynes), and the VOX's power supply (+300 volts unregulated, +150 volts regulated, and 6.3 volts filament).

The VMO is a highly stable frequency-determining device due to its enclosure in a finely engineered double oven. (See figure 4-12.) As an added precaution, the resonant portion of the circuit is very lightly coupled to its associated vacuum tube element and this, in turn, is isolated from external influences by a cathode follower.

b. VMO SECTION. (See figure 4-13.) - VMO tube V301 oscillates at frequencies between 2 and 4 mc and is tuned by capacitors C301, C302, and C303. R320 provides the necessary tube bias; L302 is an RF choke to ground; R301 and C307 provide the necessary decoupling action for V301. Twin-triode V302 performs the double function of a cathode follower (to impose less shunting effect on the preceding stage) and a crystal-controlled 100-kc oscillator. R302 is the unbypassed cathode resistor across which the output is taken. L303 and C308 provide filtering action to keep the RF out of the power supply by bypassing it through C308 and offering as high as impedance in L303 as practicable for the 300-volt B+ supply. The output from the second part of V302 is taken across R305. R306 supplies the necessary grid bias. Crystal Y301 resonates near 100 kc and may be "pulled" by means of capacitor C311 (a screwdriver control mounted on the rear of the oven chassis), which is not to be disturbed after its initial factory setting. R304 is the plate load and C309 is a coupling capacitor.

As shown in figure 4-12, the oven itself is enclosed within an inner and outer shell, each of which is a temperature-controlled entity. The outer shell is maintained, within small limits, at a given temperature by the combination of S303, which is a bimetallic temperature-sensitive switch, and heating elements R309 and R310. The inner shell is a vernier on the outer shell. R307 and R308, the inner shell heating elements, are controlled by an accurate mercury thermostat (S301). The entire assembly contains a large mass of metal and insulating materials distributed throughout its cross section so that its heat inertia is high and, consequently, the oven temperature is extremely stable.

Functions of front panel controls that apply to this section are as follows:

(1) MASTER OSCILLATOR FREQUENCY knob C301 and C302. Variable capacitor control designated 60 on figure 3-1. Varies the output frequency of the master oscillator within its operating range of 2 to 4 mc. The associated dial, designated 59 on figure 3-1, indicates the oscillator's output frequency. It is important to observe the requirement that at all times the operating range of 2000 to 4000 kc is not exceeded. The dial can be turned beyond these limits but, if the departures are appreciable, variable capacitors C301 and C302 may not reset properly with dial indications and the oscillator may require partial disassembly in order to effect proper readjustment. Due to frequency multipliers in the VOX's RF section, the VOX's outputs are as follows:

| BAND-MCS Selector Switch (Figure 3-1, designation 55) | MASTER OSCILLATOR FREQUENCY | VOX's Frequency |
|---|---|---|
| 2-4 | f | f |
| 4-8 | f | 2f |
| 8-16 | f | 4f |
| 16-32 | f | 8f |
| 32-64 | f | 16f |

(2) Small cover plate at left of meter M301. Screwdriver control undesignated on figure 3-1. Refer to (3) below.

(3) CALIBRATE L301. Slug inductance control designated 48 on figure 3-1. These two controls, (2) and (3), are used in "zero beating" the output of the master oscillator (2 to 4 mc) against the 100-kc standard oscillator. For example, at 2 mc, the 2-mc fundamental of the master oscillator will "zero beat" with the 20th harmonic of the 100-kc standard oscillator.

(4) ZERO BEAT I303. Indicator designated 52 on figure 3-1. During calibration of master oscillator vs 100-kc standard oscillator, the indicator goes off when a harmonic of the 100-kc oscillator matches a harmonic of the 2- to 4-mc master oscillator.

(5) INNER OVEN I301. Indicator designated 50 on figure 3-1. Refer to (6) below.

(6) OUTER OVEN I304. Indicator designated 51 on figure 3-1.

These indicators, (5 and 6), are on when the ovens are being heated by resistors R307 and R308 and R309 and R310, respectively. This requires closing of switches S301 and S302 and S303, respectively.

(7) MAIN POWER I302. Indicator designated 49 on figure 3-1. Indicates filaments of tubes V103, V104, and V105 contained in power supply chassis are receiving 6.3-volt filament supply.

(8) Meter M301. Meter designated 53 on figure 3-1. In conjunction with METER selector switch designated 44 on figure 3-1, indicates output level of HFO, IFO, BFO, or VMO.

The chassis-mounted control that applies to this section is 100KC ADJ vernier capacitor C311 located on rear oven chassis.

c. RF SECTION.

(1) HFO CHAIN. (See figure 4-14.) - The output of cathode follower V302, located in the VMO section (figure 4-13), feeds triode V202 which is used either as an amplifier or as a crystal oscillator; the position of XTAL switch S201 is the controlling factor. When it is tuned to VMO, the tube operates as an RC amplifier; when it is tuned to 1, 2, or 3, the stage is a

conventional crystal-controlled oscillator having three crystal positions. Crystals Y202, Y203, and Y204 may be inserted into the circuit according to the necessary operating conditions required. XTAL FREQ capacitor C210 is a crystal trimmer and R207 provides the necessary grid bias. C243 is a blocking condenser to prevent DC from entering the crystal. R208 is the load resistor while C211 and R209 provide decoupling action. This stage is capacitively coupled by C212 to the grid of tetrode V203.

Tube V203 is also an RF amplifier which features a peaking coil (L202) designed to produce uniform gain over the 2- to 4-mc range. The output of this tube is controlled by variable OUTPUT potentiometer R215 which changes the screen grid bias. R214 and R217 are dropping resistors to provide correct biasing voltage on the screen grids of V203 and also V204. C215 and C216 are bypass capacitors. R213 and C213 provide decoupling action while R212 is the plate load resistor. R210 and R211 provide the necessary bias on the grid and cathode, respectively, while C214 is the conventional cathode bypass to ground. C217 is the coupling capacitor between stages.

Tubes V204, V205, V206, and V207, used in conjunction with BAND-MCS switch S202, are voltage multipliers of the second harmonic of each preceding stage.

BAND-MCS S202 is a four-section, five-position, rotary-type switch. The "A" wafer of the switch controls the screen voltage bias on tubes V203 and V204. R216 and R233 are the dropping resistors involved. The "B" wafer of the switch connects either coil L203 and L205 to be used for the proper tank circuit with variable air dielectric tuning capacitor C225 containing four sections, the former for 2-4 mc and the latter for 4-8 mc. The coils, L206, L207, and L208, are also used with variable tuning capacitor C225 to produce outputs of 8-16 mc, 16-32 mc, and 32-64 mc, respectively.

The output in milliamperes is metered by the detector circuit built in around crystal CR202. This crystal rectifies the RF current; C238 is a coupling capacitor; capacitor C237 provides filtering action; resistor R232 acts as the load resistor of the crystal. C220, C221, and R220 are all decoupling devices while L204 is an RF choke to prevent RF from flowing through the DC power lines. Wafer "C" adds more B+ voltage to each successive multiplier whenever called for in use. The "D" wafer is the output selector. The HFO band may be picked off from 2-4, 4-8, 8-16, 16-32, and 32-64 mc from positions marked A through E, respectively.

Functions of front panel controls that apply to this section are as follows:

(a) XTAL S201. Switch control designated 57 on figure 3-1. Selects circuit determining VOX's master frequency oscillator. In position VMO, the VOX's 2- to 4-mc oscillator (located in the oven) is the master oscillator; in positions 1, 2, and 3, the VOX's crystal oscillator stage (V202) is the master oscillator.

(b) XTAL FREQ C210. Variable capacitor control designated 56 on figure 3-1. When VOX's crystal oscillator stage (V202) is used as the master oscillator, it "pulls" the crystal frequency a limited amount to obtain the desired output frequency.

(c) OUTPUT R215. Potentiometer control designated 58 on figure 3-1. Controls RF output level of VOX.

(d) BAND-MCS S202. Switch control designated 55 on figure 3-1. Controls RF multiplying factor of VOX's 2- to 4-mc oscillator, namely 1 for 2-4 mc output; 2 for 4-8 mc output; 4 for 8-16 mc output; 8 for 16-32 mc output; 16 for 32-64 mc output.

(e) TUNING C225. Switch control designated 54 on figure 3-1. Tunes HFO output circuits; should be used in conjunction with meter designated 53 on figure 3-1 during tuning operation; that is, maximizing meter deflection.

Chassis-mounted controls that apply to this section are as follows:

(a) Coaxial jacks J208, J209, J210 are located at the rear of the RF chassis.

(b) Coaxial jacks J202 and J203 are located at the rear of the RF chassis.

(2) IFO CIRCUIT. (See figure 4-15.) - The IFO uses an oscillator circuit having a socket for a Crystal CR-18/U for the range of 3.2 to 3.9 mc (nominally 3.5 mc). C202, C203, and R203 provide a low bandpass filter while C242 is the crystal-coupling capacitor. The second half of the tube is a class C amplifier whose tuned plate circuit is link-coupled to the output jacks. The tank circuit is tuned by L201 near a nominal frequency of 3.5 mc. A germanium-diode rectifier, CR201, and its associated filter network produce a DC level proportional to the RF output voltage. This DC level is fed to front panel meter M301 so that the output indication is available to the operator or technician. (Full-scale deflection is approximately equivalent to 10 volts RMS of RF voltage.)

Chassis-mounted controls that apply to this section are coaxial jacks J205, J206, J207 located at the rear of the RF chassis.

d. POWER SUPPLY CHASSIS.

(1) CALIBRATING CHAIN. (See figure 4-16.) - A high stable 100-kc crystal oscillator against which the VMO is calibrated is contained within the oven enclosure of the VMO section (figure 4-13). When the 100-kc oscillator is turned on, both the 100-kc and the VMO oscillator voltages are fed to mixer V103. Here the difference frequency between one of the 100-kc oscillator's harmonics and the VMO's harmonics is passed by filter action of capacitors C111, C112, and resistor R108. This is a low-pass filter with a rising characteristic at very low frequencies. The audio signal is then amplified successively by the first and second halves of V104. BEAT ON-OFF toggle switch S104 turns on or off the 100-kc oscillator's

plate supply. This switch is designated 42 on figure 3-1. ZERO BEAT indicator I303 on the front panel (control designated 52 on figure 3-1) is connected into the plate circuit of the final amplifier so that the zero beat may be seen by the flickering of the neon lamp. Headphones may be plugged in at the output of the final amplifier, at jack J105, in order to pick up the zero beat frequency audibly. The circuit, built around crystal CR101 containing C105, C106, and R102, is for metering the VMO output.

(2) BFO CIRCUIT. (See figure 4-17.) - This stage is also a crystal oscillator but it has two crystal positions, either one of which may be chosen by means of BFO toggle switch S106. The output jacks are capacitively coupled to the tank through an output control. The output voltage is controlled by potentiometer R116 mounted on the rear of the power supply chassis. Metering of the outputs is accomplished in the same manner as described in paragraph 4-4c(1).

(3) POWER SUPPLY. (See figure 4-18.) - Transformer T101 supplies the necessary power and filament voltages. V101 is a full-wave vacuum tube rectifier with choke (L101) filter output. C104 provides low impedance paths to grounds for any RF current while R101 is used to limit the current passing through tube V102. This tube is a glow discharge regulator type whose output voltage is held constant and provides +150 volts.

Functions of front panel controls that apply to this section are as follows:

(a) POWER S101. Toggle switch control designated 41 on figure 3-1. Applies power to the VOX.

(b) PHONES J105. Jack designated 46 on figure 3-1. Audible monitor of "zero beat" between VOX's 100-kc and master frequency oscillators.

(c) BEAT ON-OFF S104. Toggle switch control designated 42 on figure 3-1. Supplies B+ to VOX's 100-kc oscillator so that mixer V103 in calibrating chain receives 100-kc and VMO oscillator voltages for production of beat tones.

(d) HFO S103. Toggle switch control designated 43 on figure 3-1. Connects B+ to HFO tubes V202 through V207.

(e) IFO S102. Toggle switch control designated 45 on figure 3-1. Connects B+ to IFO tube V201.

(f) BFO S106. Toggle switch control designated 47 on figure 3-1. Connects B+ to BFO tube V105.

Chassis-mounted controls that apply to this section are as follows:

(a) Coaxial jacks J102, J103, J104 are located on the rear of the power supply chassis.

(b) Toggle switch S105 (on the rear of the power supply chassis) selects one of the two crystals (Y101 or Y102) in BFO stage.

(c) Jones-type jack J101 is located on the rear of the power supply chassis.

(d) Potentiometer R116 is located on the rear of the power supply chassis.

## 4-5. SINGLE SIDEBAND CONVERTER MSR-6.

a. INTRODUCTION. (See figure 4-19.) - The MSR-6 is designed to improve the performance and simplify the operation of the GPR-90RXD in the reception of single sideband, carrier wave, modulated carrier wave, or frequency-shift signals. This attribute of the MSR-6 greatly sharpens the overall skirt selectivity of the GPR-90RXD, increasing the rejection of unwanted adjacent signals or interference without detrimental effect on the desired signal. The resulting signal-to-noise ratio is thus greatly increased. In addition, tuning of single sideband signals is greatly simplified since the final tuning is done at the MSR-6, not the GPR-90RXD. One of the features that contributes to the simplification of tuning single sideband signals by the MSR-6 is its electrical and mechanical bandspread. This tuning feature permits tuning over the IF bandpass, thus enabling single sideband or exalted carrier amplitude modulated signals to be tuned within cycles of correct tone. Either sideband of a received signal can be selected, either with the bandpass tuning feature or by inverting the oscillator separation. Frequency shift, carrier wave, and modulated carrier wave signals are easily tunable with the bandspread feature. The operational controls of the MSR-6 are similar in function and effect as those on the GPR-90RXD and may be operated from the front panel of the MSR-6 or from a remote source.

As shown in figure 4-19, the MSR-6 contains its own IF amplifier, local oscillator, demodulators, AVC, and audio circuits, all of which operate from a self-contained power supply. Sideband selection is achieved by varying the frequency of the first oscillator which may be either manually or crystal controlled. Sideband carrier drift is minimized during "manual" oscillator control by referencing the frequency of first oscillator V7 (as sampled at the output of first mixer V3) to that of BFO oscillator V5A by means of the AFC-1 and reactance control V8 in the MSR-6. Sideband switching and BFO selection can be controlled remotely from the MSR-6 if so desired. The audio circuits in the MSR-6 provide high- or low-power audio outputs which may be matched to loudspeakers or headphones, as required.

b. SINGLE SIDEBAND RECEPTION. (See figure 4-20.) - The undetected 455-kc IF output of the GPR-90RXD is the input to the MSR-6. Figure 4-20A illustrates typical upper sideband reception of a 10-mc single sideband transmission; typical reception lower sideband is shown in figure 4-20B. The output of the GPR-90RXD is a normal 455-kc IF signal with the positions of the sidebands reversed because the oscillator operates above the signal frequency. The 455-kc IF signal is applied to the first mixer of the MSR-6 where it is mixed with an oscillator signal, the frequency of which is 17 kc higher than the IF carrier (472 kc). The output of the first mixer contains the upper and lower sidebands distributed in their original position about a 17-kc carrier. This output is applied through bandpass filter Z1 which effectively removes the undesired sideband. The remaining single sideband intelligence is heterodyned in the second mixer and passed to the audio circuits.

The method shown in figure 4-20 is not the optimum arrangement because half of the bandpass space of the GPR-90RXD IF is not used. A more desirable method is achieved with GPR-90RXD shifted operation as shown in figure 4-21. For reception of the upper sideband, the GPR-90RXD is detuned to 10.002 mc, resulting in a first oscillator frequency of 13.957 mc. (See figure 4-21A.) Since the bandpass of the first mixer stage is centered about 3.955 mc, the received signal is shifted by 2 kc, placing the upper sideband within the bandpass and sliding the lower sideband off the response curve. After passing through the second mixer, the upper sideband appears in the IF bandpass and is applied to the first mixer of the MSR-6. The MSR-6 first oscillator is also detuned by 2 kc to accommodate the shifted IF input signal, and the upper sideband information is passed through Z1 to the second mixer. The reception of lower sideband signals is accomplished in a similar manner with the GPR-90RXD and MSR-6 detuned 2 kc below the incoming signal. (See figure 4-21B.)

c. OTHER MODES OF OPERATION. - Slight modifications of procedure may be made to enable the MSR-6 to detect other forms of modulation. The MSR-6 detects normal CW signals if the GPR-90RXD or MSR-6 bandspread is detuned approximately 1 kc to provide a beat signal with the 17-kc BFO in the AFC-1. Frequency-shift signals are received in a similar manner, except that the degree of detuning is so chosen that a space is produced at 2125 cps and a mark is produced at 2975 cps. Normal AM modulation will also be accepted by the MSR-6 by removing the 17-kc BFO, the incoming carrier being converted to 17 kc by the MSR-6. In order to accomplish this, the GPR-90RXD or MSR-6 bandspread must be detuned by approximately 400 cps to allow the 17-kc carrier to pass through bandpass filter Z1. The use of the MSR-6 sharpens the overall skirt selectivity of the receiving system by providing, in effect, vernier control of the IF bandpass.

d. FIRST MIXER. (See figure 4-22.) - The incoming IF signal is applied to V2, which provides a stage of AVC controlled amplification. The IF output of V2 is RC coupled to first mixer V3 where it is heterodyned with the output of first oscillator V7. The center frequency of this oscillator is determined by the position of sideband switching relay K2 which causes the oscillator tank circuit to be tuned to either 438 or 472 kc. The type of oscillator control depends upon the setting of MANUAL-XTAL switch S4. When S4 is set to XTAL, sideband switching relay K2 provides either a 438-kc crystal for lower sideband reception or a 472-kc crystal for upper sideband reception. When S4 is set to MANUAL, the crystals are removed from the oscillator circuit and the oscillator frequency is changed by adjusting BANDSPREAD capacitor C28. When operating in the MANUAL position, the first oscillator is automatically referenced to that of the second oscillator, V5A, by the combined operation of an external AFC-1 and reactance control V8.

Reactance control V8 is connected across the tank circuit of first oscillator V7. The dual-triode stage introduces a reactive impedance the maximum amplitude of which causes the frequency of first oscillator V7 to vary as much as ±3 kc. The maximum DC input (applied from AFC-1) necessary to produce a 3-kc change is 4.5 volts DC. If the frequency of second oscillator V5A drifts, the DC input to V8 shifts, causing the reactance of V8 to change, and shifting the frequency of oscillator V7 accordingly. This arrangement ensures that the sideband carrier does not drift.

e. AUTOMATIC VOLUME CONTROL. (See figure 4-23.) - The gain of IF amplifier V2 is controlled by AVC amplifier and rectifier V1. The IF signal is amplified by V1A and detected by V1B. The time constant of the output circuit of V1B may be changed by a factor of 10 with AVC FAST-SLOW switch S1. Switch S1 is set to FAST for normal reception of signals having a carrier. The SLOW position provides a longer time constant for SSB, CW, or frequency-shift IF inputs. IF amplifier V2 may be operated at full gain by setting AVC ON-OFF switch S2 to OFF.

f. SECOND MIXER. (See figure 4-24.) - The purpose of the second mixer stage is to provide reinsertion of the carrier during SSB reception, and to provide an audible beat note for CW and frequency-shift signals. The output of bandpass filter Z1 is applied to second mixer V4 via BFO relay K1. Relay K1 may be energized by setting BFO switch S5 to ON or by reception of a remote ground signal. When S5 is in the OFF position, relay K1 is deenergized and no plate voltage is applied to BFO oscillator V5A. Mixer V4 detects AM signals and passes its output to audio filter Z2. When a beat frequency is desired, or a carrier must be reinserted for single sideband detection, BFO relay K1 switches the incoming signal to the control grid of second mixer V4 and applies plate voltage to oscillator V5A. BFO oscillator V5A is a crystal type circuit with a fixed output of 17 kc. The oscillator output is also coupled through a transformer and cabled to the AFC-1 as a reference frequency for the AFC control circuit.

g. SIDEBAND SWITCHING. (See figure 4-25.) - The selection of upper or lower sideband reception may be made locally at the MSR-6 by depressing SIDEBAND pushbutton S6 or remotely by driving relay driver V9A into cutoff. In either case, sideband relay K2 is energized. This action changes the center frequency of first oscillator V7 as previously described. In addition, K2 changes the fundamental frequency of tone generator V9B and energizes the proper panel lamp on the MSR-6 to indicate which sideband is being received.

When the system is being controlled remotely, some means must be provided to indicate which sideband has been selected within the MSR-6. This is accomplished by the use of tone generator V9B which provides a 500-cps tone in the audio output when K2 is in the upper sideband position and a 2.5-kc tone when K2 is in the lower sideband position. The tone is generated by oscillator V9B whose plate voltage is present only when BFO relay K1 is energized.

When used (during remote operation only), tone oscillator V9B operates in conjunction with relay driver V9A. Relay driver V9A is normally conducting, with its plate current energizing relay K3. The bias provided to the cathode of tone oscillator V9B via TONE THRESHOLD control R60 prevents V9B from oscillating so that no sideband tone is heard. If an increasingly negative DC voltage from a remote source is applied to the control grid of relay driver V9A, the plate voltage of V9A rises. When this voltage, which is coupled to the control grid of V9B, is sufficient to overcome the oscillator bias, a sideband identification tone is generated by V9B and applied to second mixer V4. If the remote DC voltage is reduced still further, sufficient negative voltage is applied to the grid of V9A to cut off its plate current. Relay K3 is then deenergized. This action applies 120 volts AC to sideband relay K2, switching the center frequency of first oscillator V7 and tone generator V9B. If the remote DC input is restored to its original level, relay K3 is reset to the energized position. For local operation, K2 is energized directly by depressing SIDEBAND pushbutton S6.

h. AUDIO OUTPUT CIRCUIT. (See figure 4-26.) - Audio amplification is provided by audio amplifiers V5B and V6. When OUTPUT LEVEL switch S8 is set to the HIGH position, two stages of amplification provide a power output of 2 watts at an output impedance of either 8 or 600 ohms. When OUTPUT LEVEL switch S8 is set to LOW, degenerative feedback reduces the audio output to 150 milliwatts at 8 or 600 ohms. Voltage dividers also provide a 1-milliwatt output for a 600-ohm telephone line. The MSR-6 output may be monitored with headphones connected at PHONES jack J3.

i. POWER SUPPLY. (See figure 8-3.) - The MSR-6 is a self-powered unit that uses a full-wave rectifier and a 150-volt gas type voltage regulator tube. The power transformer may be operated from a 110- or 220-volt AC 60-cycle input. A 6 foot electrical power cable assembly is used to match a standard male power plug to power input jack J2.

## 4-6. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1.

a. INTRODUCTION. (See figure 4-27.) - The AFC-1 contains several unique circuit features specifically designed for use with the MSR-6. The AFC-1 features include frequency control of the MSR-6 oscillator, visual indication of both applied carrier level and carrier frequency drift by front panel meters, visual lamp indication when the carrier signal fades due to atmospheric conditions, and a unique memory circuit which enables the AFC-1 to hold the MSR-6 oscillator on frequency regardless of signal fade conditions.

Frequency control of the MSR-6 oscillator by the AFC-1 is accomplished by comparing the 17-kc carrier output of the MSR-6 to a 17-kc reference signal generated in the AFC-1. If the two signals do not coincide, a control voltage developed in the AFC-1 is fed back to the reactance control in the MSR-6. The reactance control in turn corrects the MSR-6 oscillator frequency, thereby maintaining the desired IF frequency of 17 kc in the MSR-6. The AFC-1 also maintains this function when a loss of the carrier signal occurs due to fading caused by atmospheric conditions. By providing this function, the AFC-1 eliminates the necessity for continuous retuning of the MSR-6 each time the MSR-6 oscillator drifts or when the carrier signal fades. The AFC-1 corrects the 17-kc carrier developed in the MSR-6 for variations in frequency as high as 1000 cps.

Front panel controls, CARRIER COMPENSATOR, A.G.C. SELECTOR, FADE ALARM LEVEL, and A.F.C. RESET, are provided for carrier level adjustment, selection of agc attach time or action, fade alarm adjustment, and AFC defeat, respectively. Carrier level, AFC drift voltage, and signal fade condition are visually indicated by front panel indicators, CARRIER LEVEL meter, A.F.C. INDICATOR meter, and FADE ALARM indicator, respectively.

b. CARRIER AMPLIFIER CIRCUITS. (See figure 4-28.) - The 17-kc carrier output of the MSR-6 is coupled to the AFC-1 through transformer TF 138 and applied to first carrier amplifier V1 via CARRIER COMPENSATOR switch S1. This switch provides a means by which the input level to V1 can be adjusted. First carrier amplifier V1 operates in class A to amplify the carrier signal to a level of sufficient amplitude to overcome the losses incurred by the 17-kc carrier filter into which the output of V1 is fed. This interstage 17-kc carrier filter removes the sideband frequencies, leaving only the 17-kc carrier frequency to be further amplified by second carrier amplifier V2. Amplifier V2 also operates in class A and develops its output across an LC circuit which is resonant at 17 kc. The signal developed across the LC circuit is applied to carrier rectifier V6A and V6B, and to limiter V3.

c. LIMITER. (See figure 4-28.) - Limiter V3 is a dual-triode, cathode-coupled limiter. Its function is to limit the amplitude of the carrier signal to a predetermined level to provide a near-constant carrier level and to remove noise pulses. The relatively constant output of limiter V3 is fed to the grid of phase detector amplifier V4A.

d. CARRIER RECTIFIER AND AVC CIRCUIT. (See figure 4-29.) - Carrier rectifier V6A and V6B is a dual diode, with V6A providing the AVC voltage and V6B the carrier level voltage. The rectified AVC voltage developed at the plate of V6A is routed to the GPR-90RXD and to first carrier amplifier V1 in the AFC-1 via the agc level potentiometer and the A.G.C. SELECTOR switch. The AGC level potentiometer permits the AVC voltage to be adjusted to a predetermined level. The A.G.C. SELECTOR switch selects the desired agc attack time or action. When turned to the MANUAL position, the A.G.C. SELECTOR switch removes the AFC-1 developed AVC voltage from the GPR-90RXD and restores the GPR-90RXD AVC.

The rectified carrier-level voltage at the plate of V6B is applied to the CARRIER LEVEL meter and to memory lock and fade alarm V7. The magnitude or level of the carrier is indicated on the CARRIER LEVEL meter.

e. MEMORY LOCK AND FADE ALARM. (See figure 4-29.) - Memory lock and fade alarm V7 is essentially a Schmitt trigger with V7A controlling the current flow through V7B. This action is necessary in order to energize or deenergize relay K1. The memory lock and fade alarm V7, in conjunction with relay K1, provides the following functions:

(1) Places memory follower V5 into memory operation when the carrier fades.

(2) Lights FADE ALARM indicator I2 when the carrier fades.

Dual triode V7 operates as follows: When the carrier signal is present, a negative voltage is applied to the grid of V7A from carrier rectifier V6B. So biased, V7A draws a minimum of plate current. Since the grid of V7B is directly coupled to the plate of V7A, minimum bias is applied to the grid of V7B. This bias causes V7B to draw plate current, energizing relay K1. Consequently, the fade alarm power source is removed from the FADE ALARM lamp and the output of the phase detector is applied to the grid of memory follower V5. If the carrier signal should fade as a result of atmospheric conditions, a zero voltage condition exists at the grid of V7A, causing its plate current to increase. The increase in V7A plate current causes a large negative bias to be applied to the grid of V7B, cutting it off. Once cut off, relay K1 is deenergized. As a result, the fade alarm power source is applied to the FADE ALARM lamp causing it to go on, and the output of the phase detector is removed from the grid of V5. With the output of the phase detector removed from the grid of V5, the memory follower is placed into memory operation. The point of cutoff for V7B is made adjustable by the FADE ALARM LEVEL potentiometer and is arbitrary due to the fact that signal conditions vary from one site to another. To provide correct action, the operating parameters of memory lock and fade alarm V7 must be adjusted to suit a particular condition at the equipment location.

f. 17-KC CRYSTAL OSCILLATOR AND AMPLIFIER. (See figure 4-30.) - The 17-kc crystal oscillator V9 provides a highly stable frequency output to which the MSR-6 carrier frequency output is compared. The oscillator is essentially a series mode Butler-type oscillator circuit in which the frequency determining element, the crystal, is sustained in oscillation by substantial positive feedback provided by amplifier V9A. The 17-kc output of V9B is developed across the LC circuit and applied simultaneously to the 17-kc amplifier V4B and via transformer TF 138 to the MSR-6 as the 17-kc reference input. The amplified 17-kc output of V4B is RC-coupled to the phase detector.

g. PHASE DETECTOR. (See figure 4-31.) - The 17-kc carrier output of the limiter is applied to the phase detector via amplifier V4A. The phase detector diodes and associated resistors and capacitors comprise a Wheatstone bridge. The bridge configuration is balanced out by means of the balance potentiometer. The phase detector provides a means by which a phase or frequency difference can be detected between the carrier and 17-kc reference signal. The phase detector operates as follows: If both signals are in phase coincidence, no phase difference is detected, and a zero-volt condition exists at the output of the phase detector. If a phase difference occurs, the phase shift is sensed by the phase detector, the bridge becomes unbalanced, and a DC voltage is developed with the amplitude proportional to the phase difference. This voltage is applied to memory follower V5 grid via the closed contacts of relay K1.

h. MEMORY FOLLOWER. (See figure 4-31.) - Memory follower V5 provides a control voltage which is fed to the reactance control in the MSR-6 during no-signal fade and signal fade conditions. V5, in conjunction with constant current pentode V8, comprises a bootstrap amplifier. The signal is applied between grid and cathode of the amplifier and the output of V5 is taken from between cathode and ground. The bootstrap amplifier has the desired characteristics for reproducing rapid level changes such as from the phase detector output without distortion or phase reversal. In addition, a low impedance output is provided without the usual signal loss that is experienced if a cathode follower were utilized in its place. Constant current pentode V8, because of its relatively high plate resistance, maintains a nearly constant current through V5, thus assuring linear operation of V5. During no-signal fade conditions, the closed contacts of relay K1 apply the drift signal from the phase detector output to the grid of V5. As a result, the 4-microfarad capacitor in the grid circuit of V5 charges to the level of the drift signal and a voltage corresponding to the drift signal is developed across the cathode load of V5. This potential is applied as a control voltage to the MSR-6 reactance control via terminals 5 and 6 of terminal board E1. The reactance control then corrects the MSR-6 oscillator frequency correspondingly, maintaining the same frequency difference between the two signals prior to the frequency drift. If the carrier signal fades, the contacts of relay K1 open, removing the phase detector output from the grid of V5. During carrier fade periods, memory follower V5 functions as its name implies. This stage retains the drift signal voltage applied to it prior to the carrier signal fading. This is accomplished by the charge developed across the 4-microfarad capacitor in its grid circuit. This voltage now biases V5 instead of the actual drift signal voltage. As a result, V5 continues to operate and provides a control voltage at its output that corresponds to the original drift signal voltage. By this action of V5, the oscillator in the MSR-6 is continually corrected for drift regardless of carrier signal fade conditions. Otherwise, each time the carrier signal faded, the MSR-6 oscillator would drift, making it necessary to retune the MSR-6 continuously. Once the carrier signal is again received, the circuit functions as described for normal no-signal fade condition.

The A.F.C. RESET pushbutton provides a means by which the AFC action can be disabled when it is necessary to tune to another signal. When depressed, the A.F.C. RESET pushbutton grounds the grid of the memory follower, preventing a control voltage to be developed across the cathode load of memory follower V5.

The A.F.C. INDICATOR meter is a center scale indicator utilizing a three-color scale left and right of its center. The function of the meter is to provide an indication by color of the extent of frequency drift detected by the phase detector. The colors on the A.F.C. INDICATOR meter scale and the range of frequencies each color represents are as follows:

(1) Green - 0 to 500 cps

(2) Yellow - 500 to 1000 cps

(3) Red - 1000 to 1250 cps

The A.F.C. INDICATOR meter indicates the above by measuring the output of memory follower V5. Initially, by means of the DRIFT ADJ potentiometer, the meter is adjusted to a zero-volt reference from which it operates. Otherwise, a false AFC voltage would be indicated by the meter and a true drift voltage indication could not be produced. The polarity of the voltage across the V5 cathode load with respect to the zero reference causes the A.F.C. INDICATOR meter pointer to swing either left or right of its center scale reading whenever frequency correction is made.

i. POWER SUPPLY CIRCUIT. (See figure 8-4.) - The power supply, consisting of a universal power transformer, bridge rectifier, and voltage regulators, provides the AFC-1 with the required AC filament source and regulated +150 and -150 volts DC for operation. Rectification is provided by the bridge rectifier and the DC voltage regulation by regulators V10 and V11. The output of the bridge rectifier is LC-filtered to assure a minimum of ripple.

## 4-7. LOUDSPEAKER PANEL LSP-7.

As shown in figure 8-5, the LSP-7 consists of two 8-ohm permanent magnet loudspeakers and associated resistive pads. When driven by the audio outputs of the associated MSR-6's the speakers permit monitoring of the received signals.

## 4-8. POWER CONTROL PANEL DCP-1.

As shown in figure 8-6, the 115-volt regulated AC output of the Sola voltage regulator in the DDR-6E cabinet is applied to ON-OFF switch S1. With the switch set to the ON position, lamp DS1 goes on and primary power is applied through the convenience outlet strip in the DDR-6E cabinet to the GPR-90RXD's, the MSR-6's, and the AFC-1's. The regulated AC input to the VOX-3 is not controlled by the DCP-1; AC power is wired directly to the VOX-3 so that the latter can be maintained in standby for purposes of frequency stability.

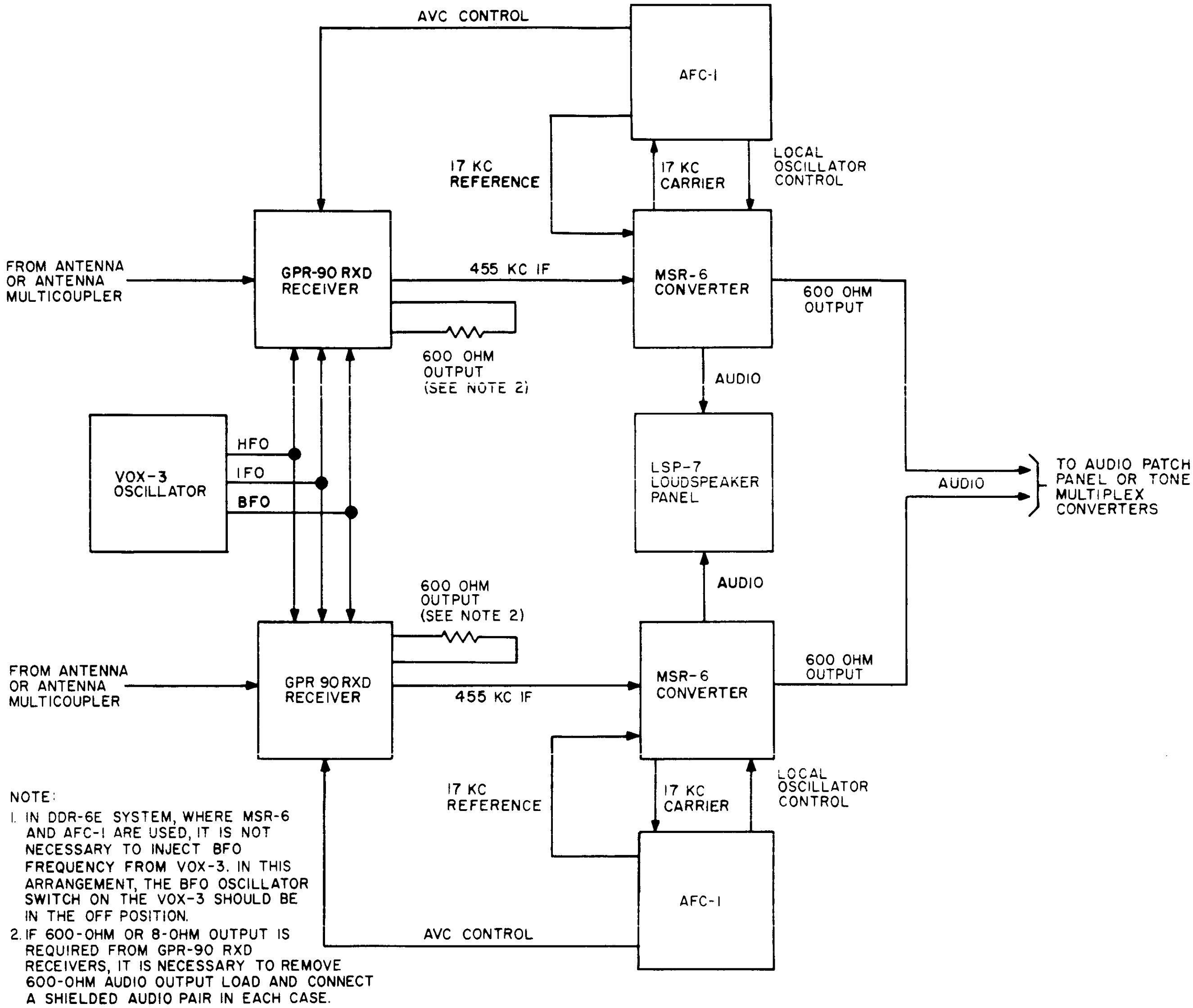
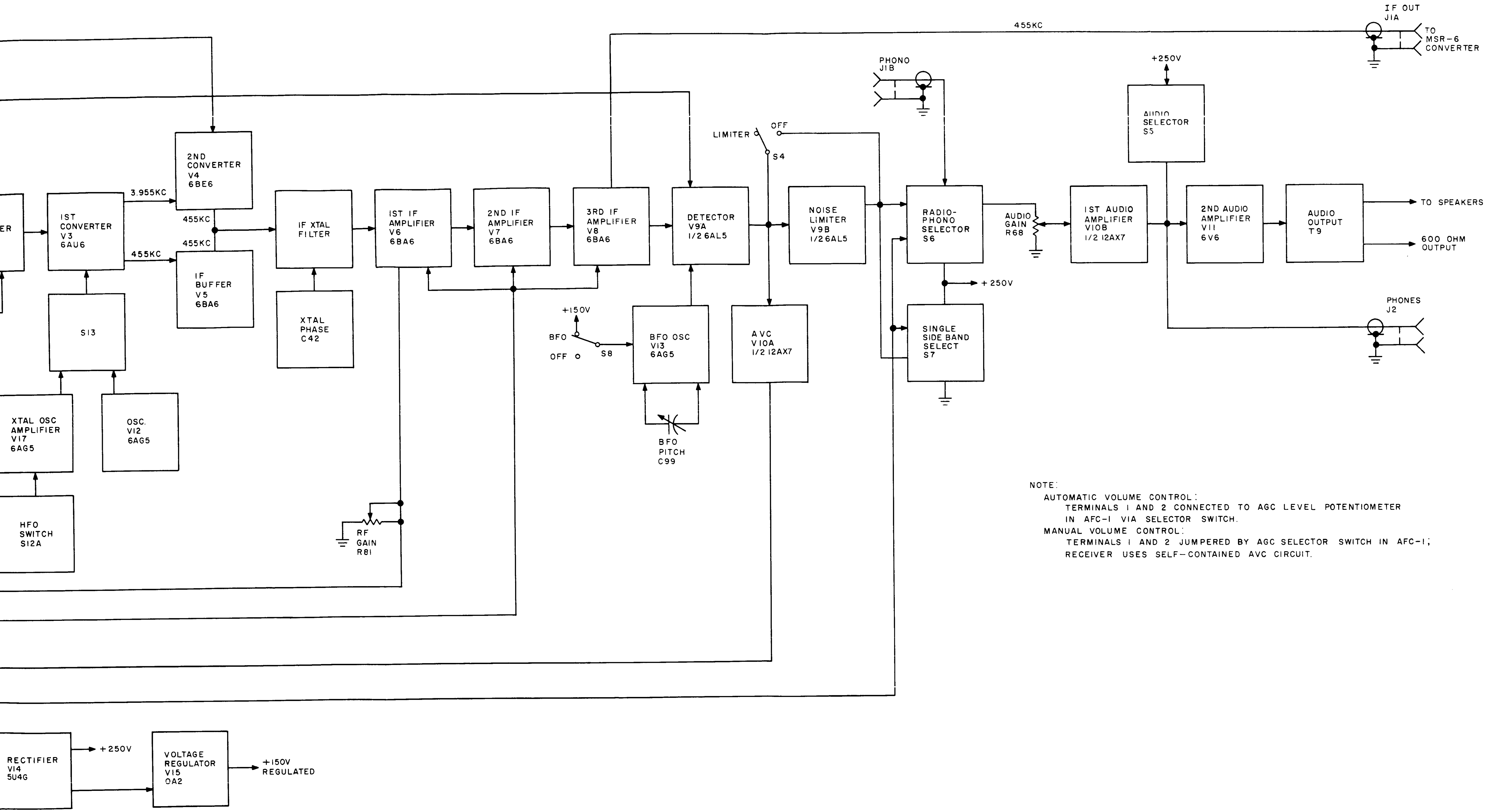
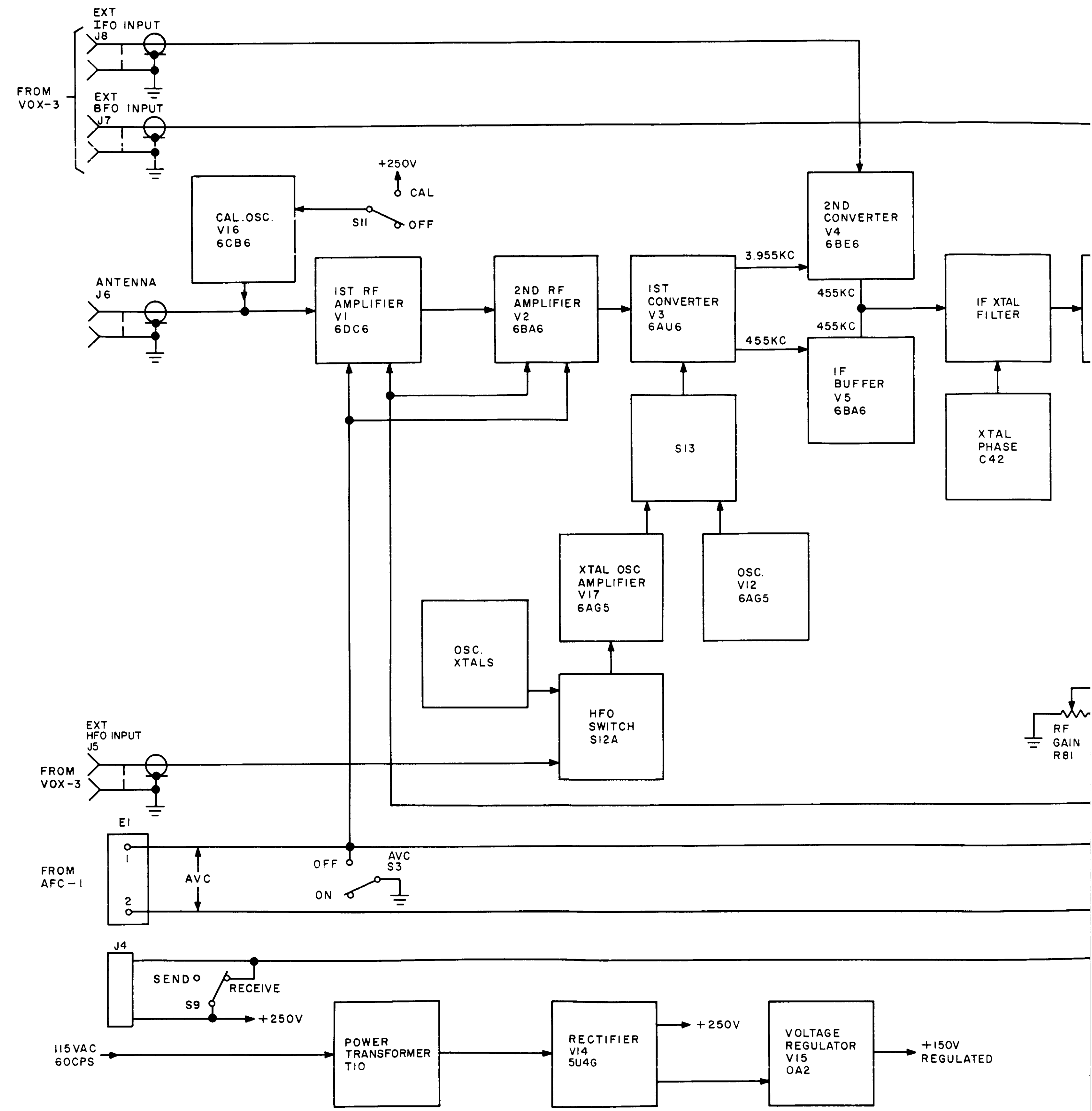



Figure 4-1. Block Diagram, DDR-6E

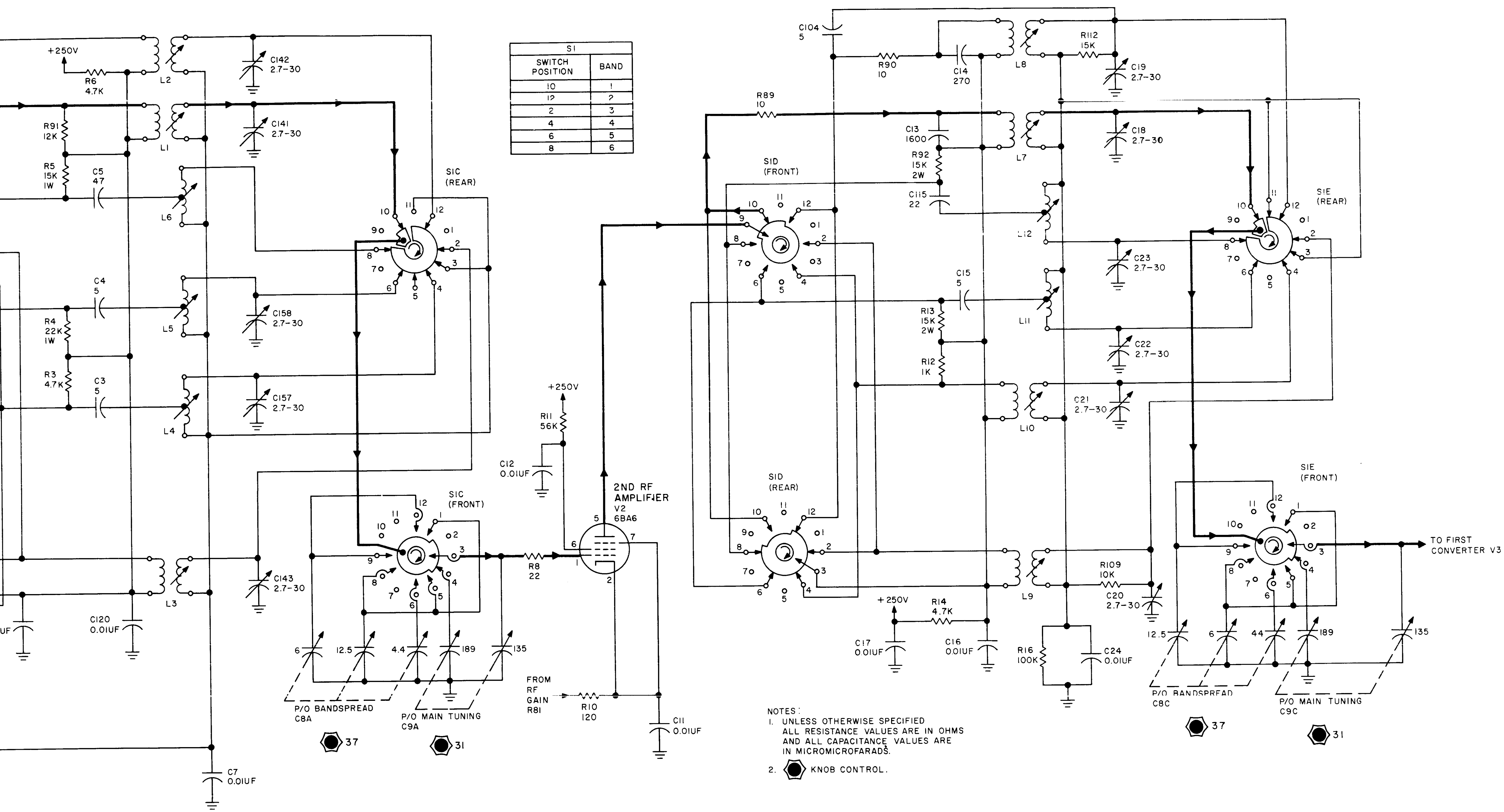



NOTE:
AUTOMATIC VOLUME CONTROL:
TERMINALS 1 AND 2 CONNECTED TO AGC LEVEL POTENTIOMETER IN AFC-1 VIA SELECTOR SWITCH.
MANUAL VOLUME CONTROL:
TERMINALS 1 AND 2 JUMPERED BY AGC SELECTOR SWITCH IN AFC-1; RECEIVER USES SELF-CONTAINED AVC CIRCUIT.

Figure 4-2. Block Diagram, GPR-90RXD



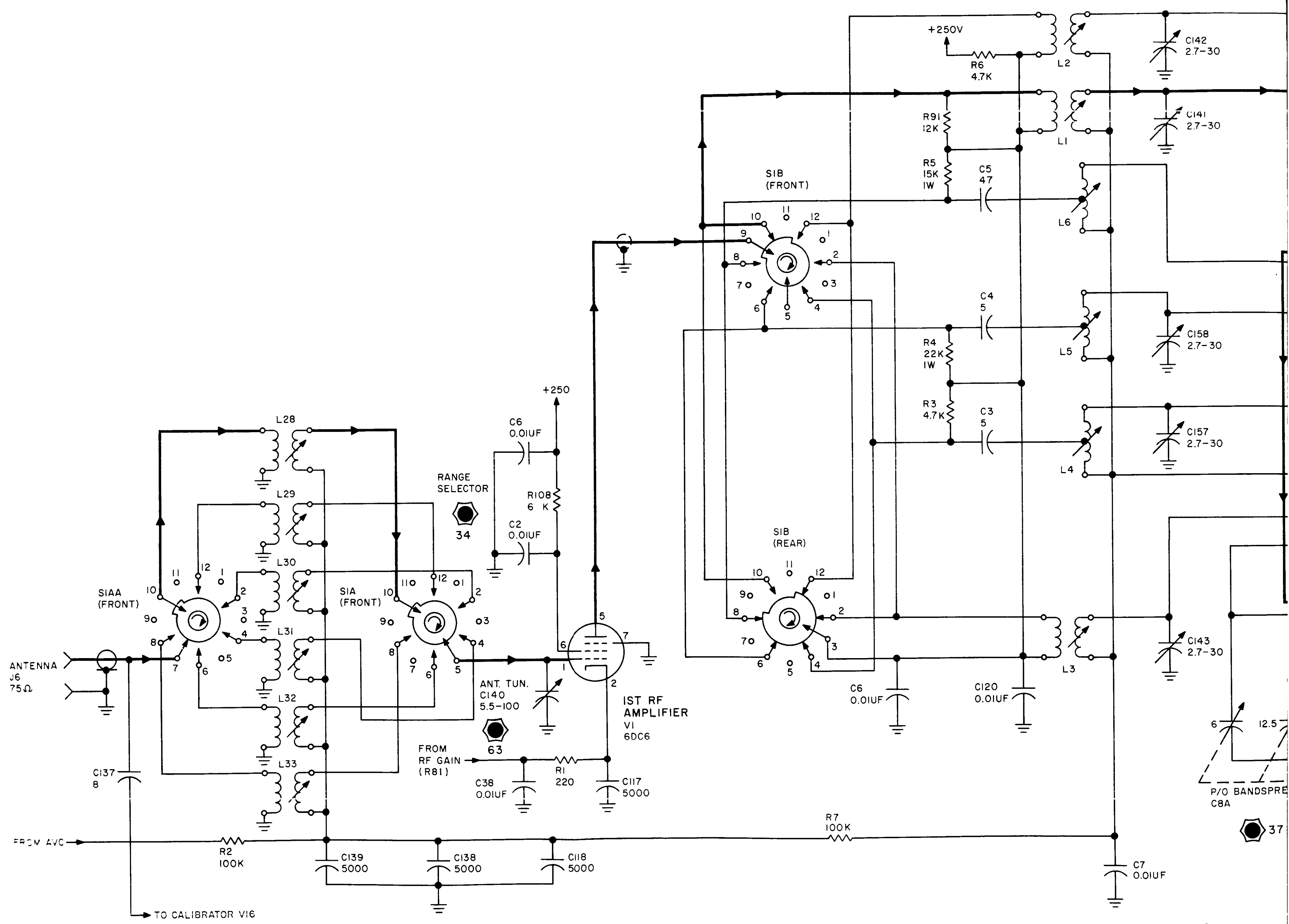
EXT IFO INPUT J8
EXT BFO INPUT J7
FROM VOX-3
+250V
CAL
OFF
S11
CAL.OSC. V16 6CB6
ANTENNA J6
IST RF AMPLIFIER V1 6DC6
2ND RF AMPLIFIER V2 6BA6
IST CONVERTER V3 6AU6
3.955KC
455KC
2ND CONVERTER V4 6BE6
455KC
455KC
IF BUFFER V5 6BA6
IF XTAL FILTER
XTAL PHASE C42
S13
XTAL OSC AMPLIFIER V17 6AG5
OSC. V12 6AG5
OSC. XTALS
HFO SWITCH S12A
RF GAIN R81
EXT HFO INPUT J5
FROM VOX-3
E1
1
2
FROM AFC-1
AVC
OFF
ON
AVC S3
J4
SEND
RECEIVE
S9
+250V
115VAC 60CPS
POWER TRANSFORMER T10
RECTIFIER V14 5U4G
+250V
VOLTAGE REGULATOR V15 OA2
+150V REGULATED



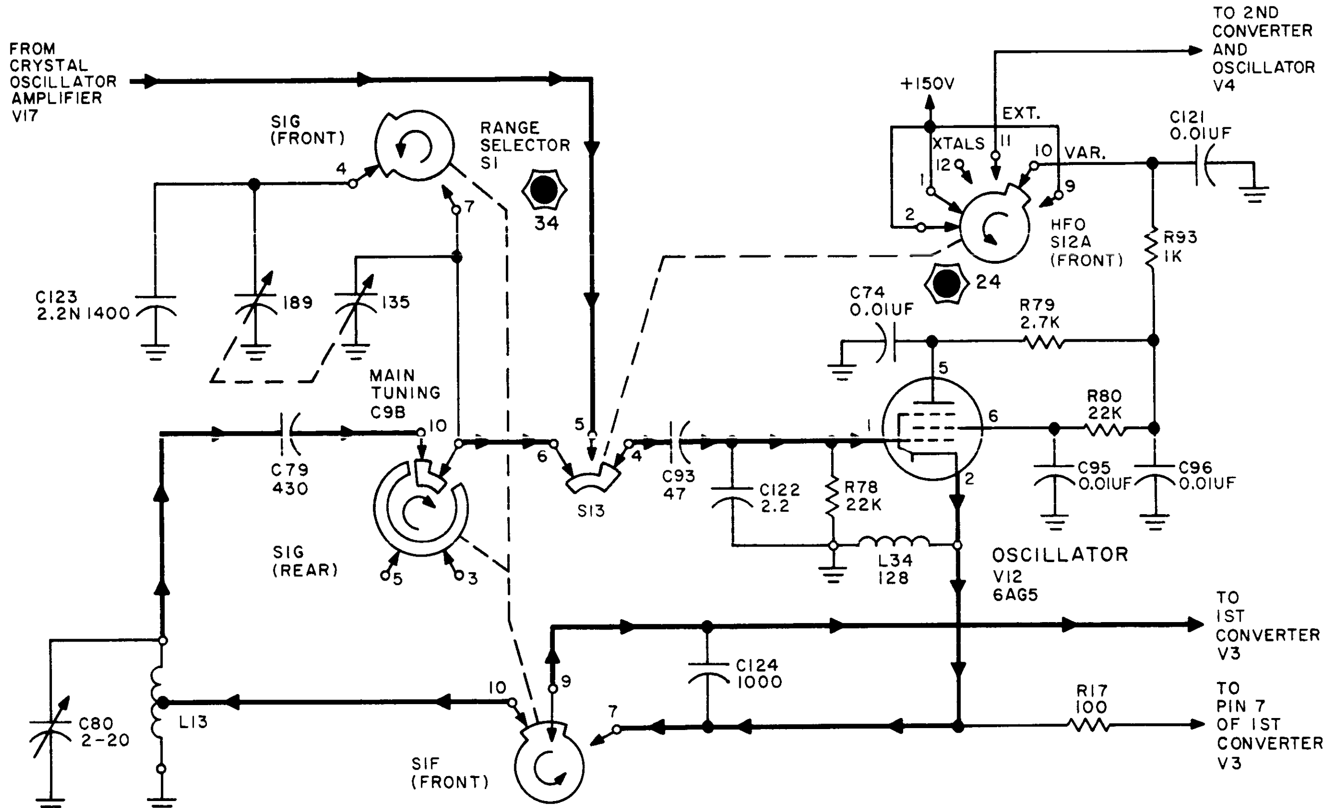

| S1 | |
|---|---|
| SWITCH POSITION | BAND |
| 10 | 1 |
| 12 | 2 |
| 2 | 3 |
| 4 | 4 |
| 6 | 5 |
| 8 | 6 |

NOTES:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
2. KNOB CONTROL.

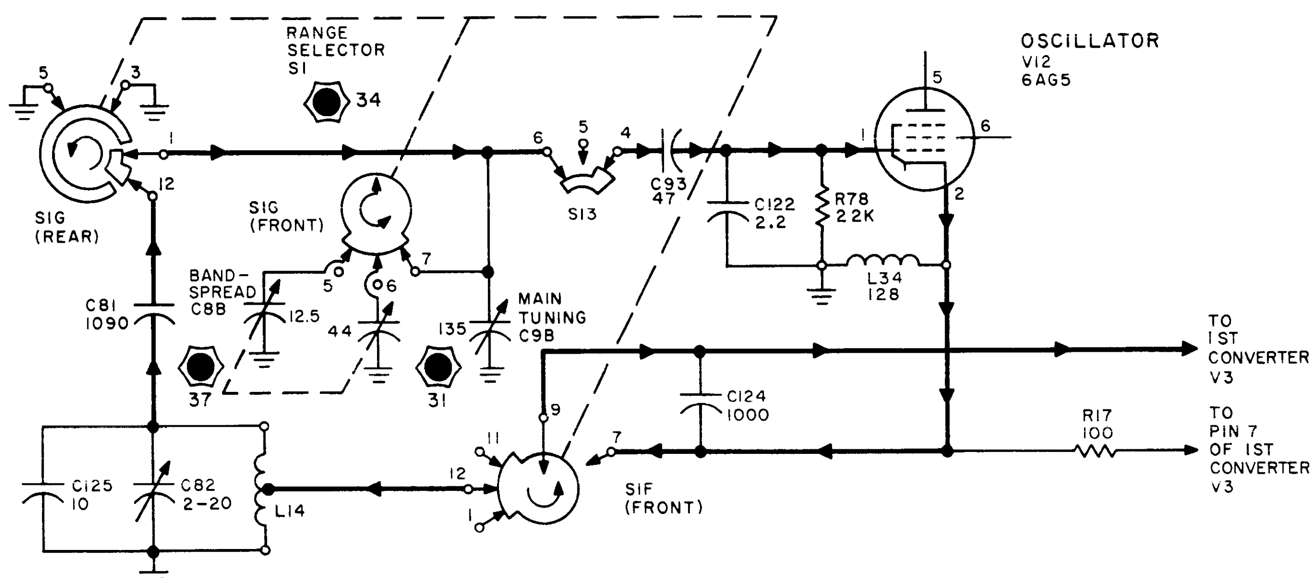
Figure 4-3. Schematic Diagram, GPR-90RXD, RF Amplifiers



+250V
R6 4.7K
L2
C142 2.7-30
R91 12K
L1
C141 2.7-30
R5 15K 1W
C5 47
S1B (FRONT)
L6
C4 5
R4 22K 1W
L5
C158 2.7-30
R3 4.7K
C3 5
L4
C157 2.7-30
L28
+250
C6 0.01UF
RANGE SELECTOR
34
R108 6 K
C2 0.01UF
L29
S1B (REAR)
L30
S1AA (FRONT)
S1A (FRONT)
L31
C143 2.7-30
L3
ANTENNA J6 75Ω
ANT. TUN. C140 5.5-100
C6 0.01UF
C120 0.01UF
L32
1ST RF AMPLIFIER V1 6DC6
63
FROM RF GAIN (R81)
L33
C137 8
C38 0.01UF
R1 220
C117 5000
P/O BANDSPREAD C8A
37
R7 100K
FROM AVC
R2 100K
C139 5000
C138 5000
C118 5000
C7 0.01UF
TO CALIBRATOR V16



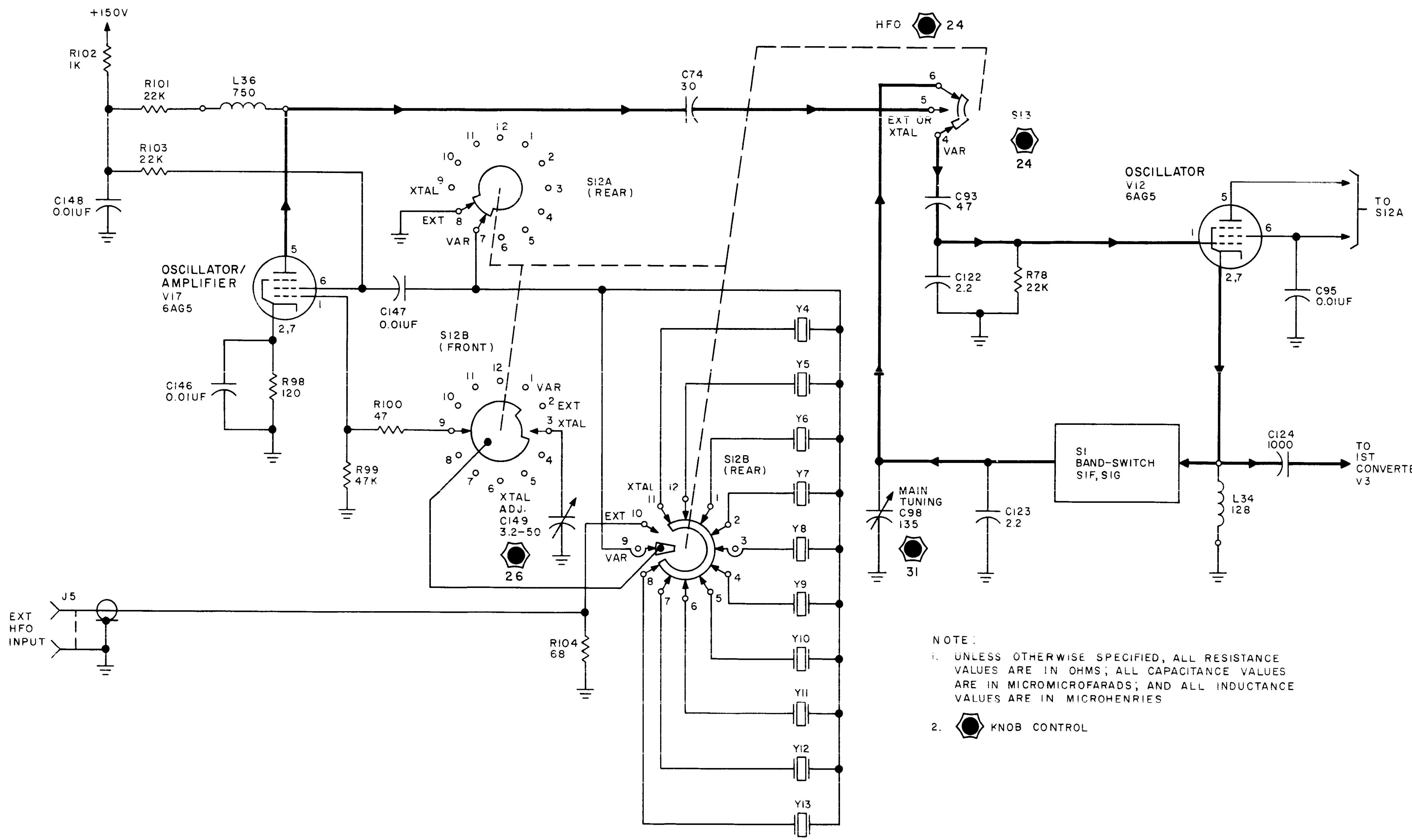

(A) BAND 1 OPERATION




(B) BAND 2 OPERATION

NOTES:
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS; ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS; ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
2. SWITCH S13
   A. S13 IS IN POSITION 4 WHEN HFO SWITCH S12 IS IN POSITION VAR.
   B. S13 IS IN POSITION 5 WHEN HFO SWITCH S12 IS IN POSITION EXT. AND XTALS.
3. (knob symbol) KNOB CONTROL.

Figure 4-4. Schematic Diagram, GPR-90RXD, HFO

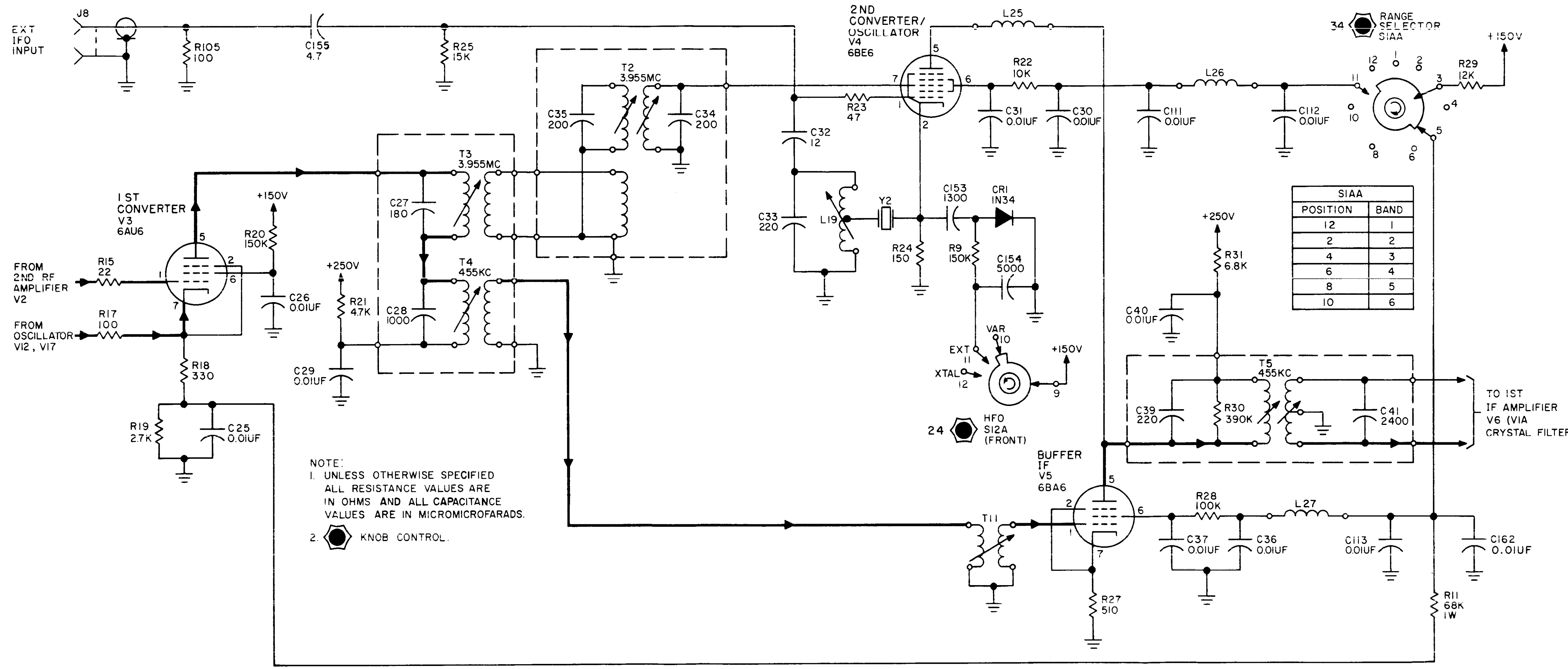



NOTE:

1. UNLESS OTHERWISE SPECIFIED, ALL RESISTANCE VALUES ARE IN OHMS; ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS; AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES

2. ⬢ KNOB CONTROL

Figure 4-5. Schematic Diagram, GPR-90RXD, Crystal Oscillator/Amplifier




| S1AA | |
|---|---|
| POSITION | BAND |
| 12 | 1 |
| 2 | 2 |
| 4 | 3 |
| 6 | 4 |
| 8 | 5 |
| 10 | 6 |

Figure 4-6. Schematic Diagram, GPR-90RXD, First and Second Converters

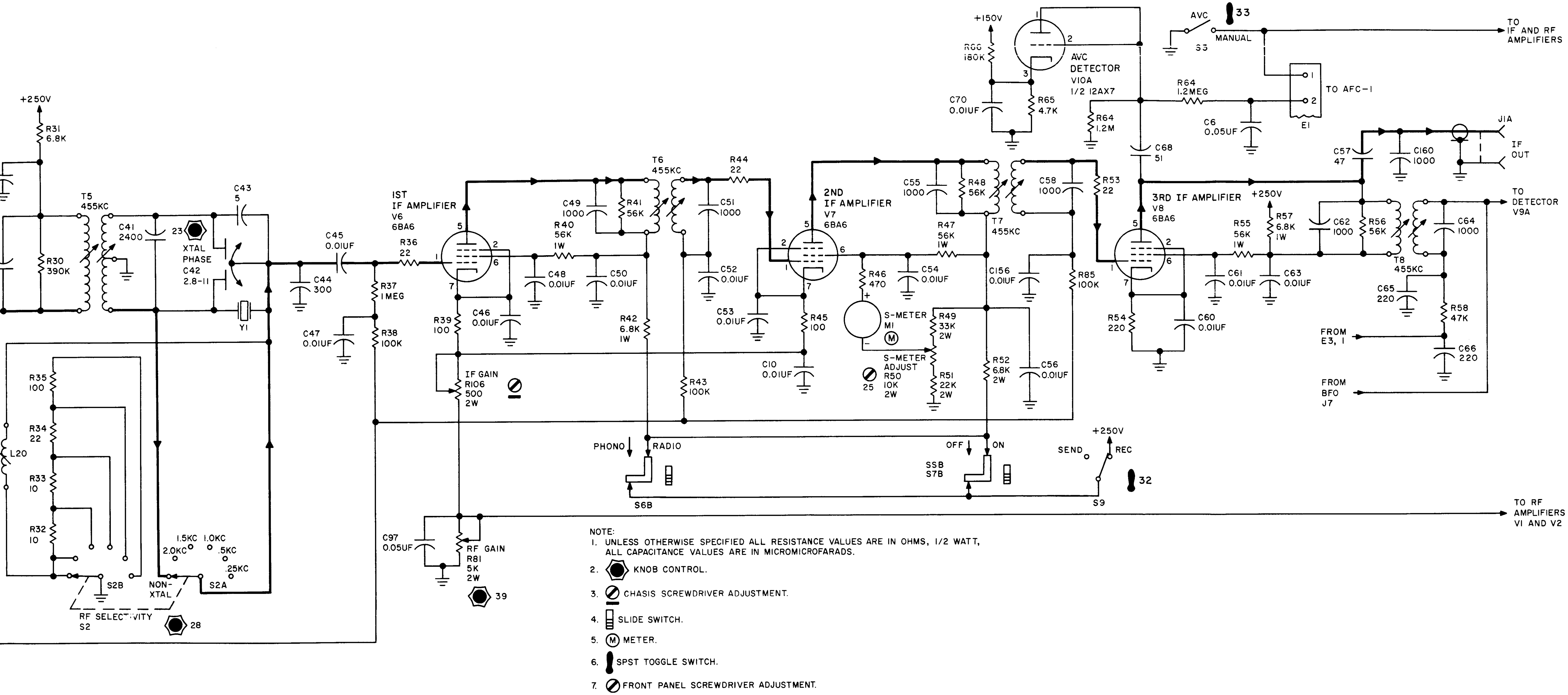
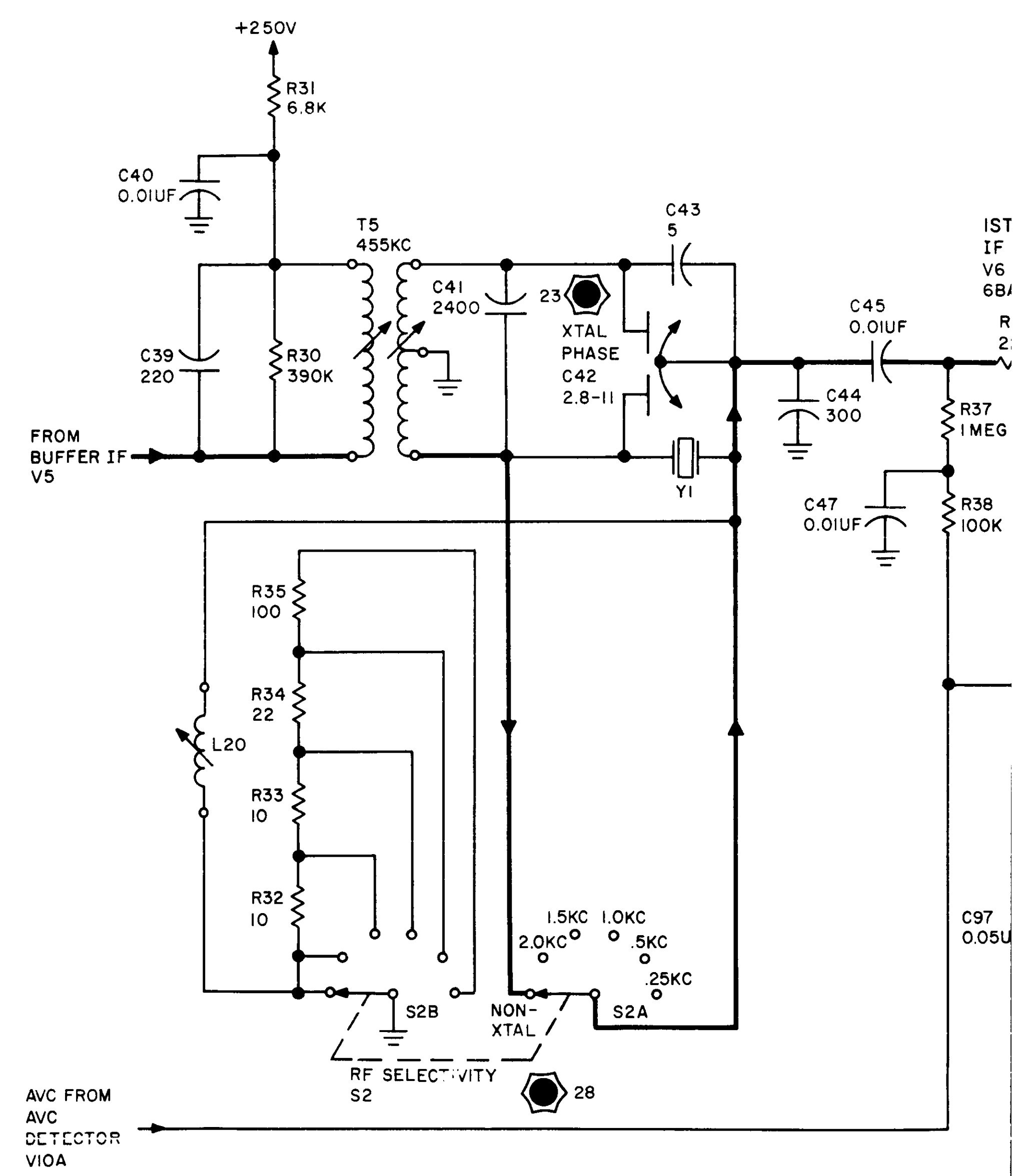



Figure 4-7. Schematic Diagram, GPR-90RXD, IF Amplifiers and AVC Detector



+250V
R31 6.8K
C40 0.01UF
T5 455KC
C39 220
R30 390K
FROM BUFFER IF V5
C41 2400
23
XTAL PHASE C42 2.8-11
C43 5
Y1
C45 0.01UF
C44 300
IST IF V6 6B
R37 1MEG
R38 100K
C47 0.01UF
R35 100
R34 22
R33 10
R32 10
L20
S2B
NON-XTAL
1.5KC 1.0KC
2.0KC
.5KC
.25KC
S2A
RF SELECTIVITY S2
28
AVC FROM AVC DETECTOR V10A
C97 0.05U

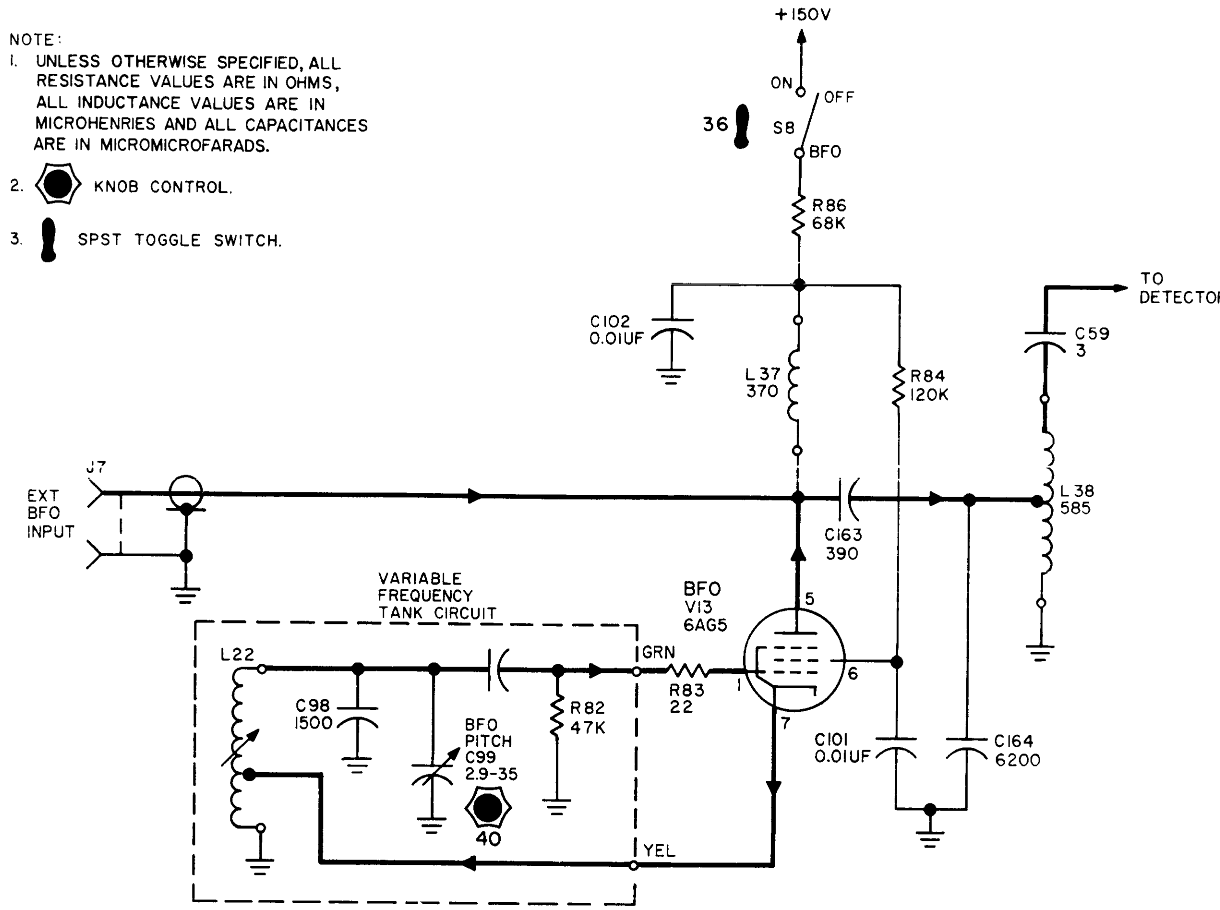



Figure 4-8. Schematic Diagram, GPR-90RXD, BFO

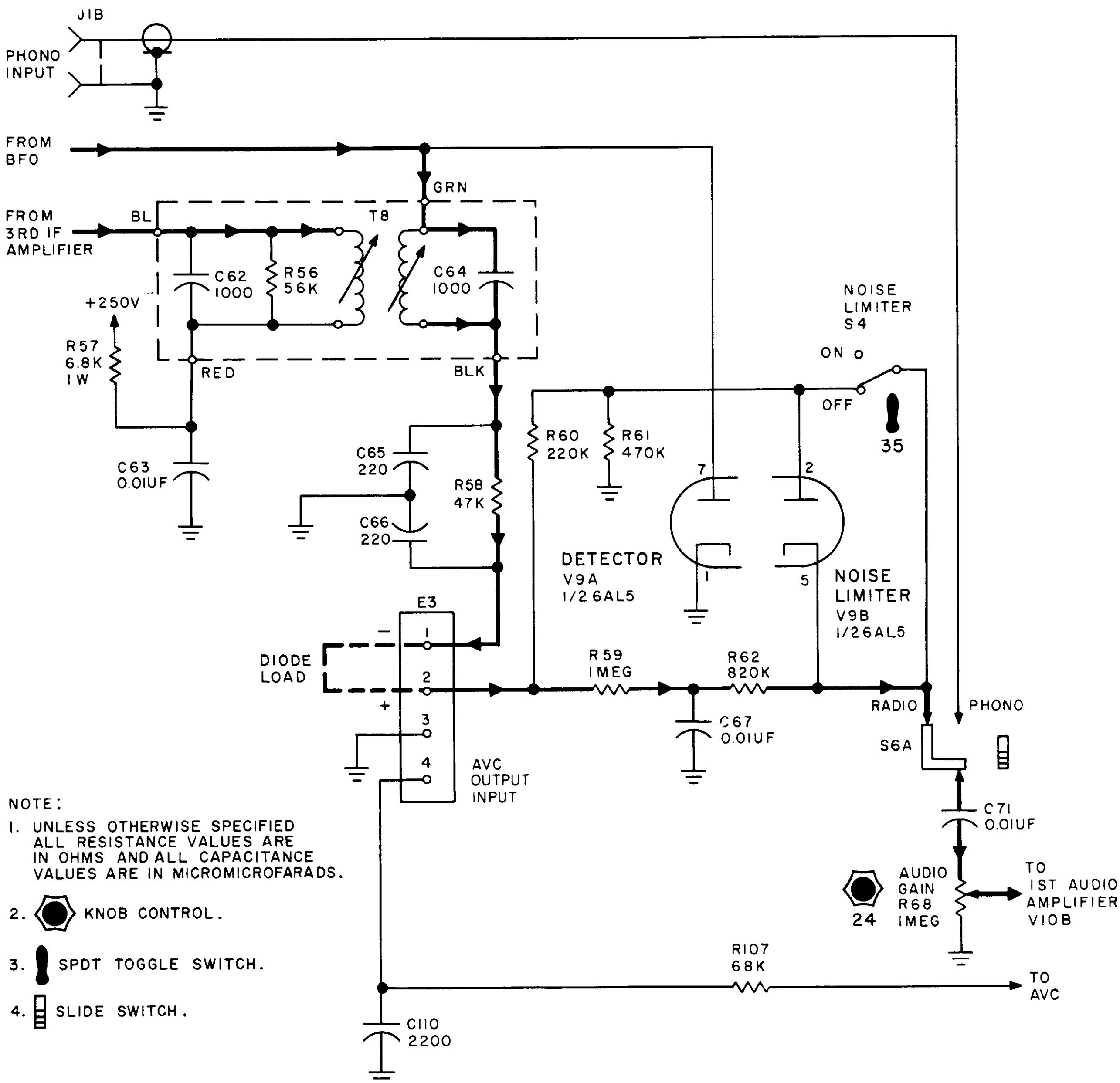



Figure 4-9. Schematic Diagram, GPR-90RXD, Detector and Noise Limiter

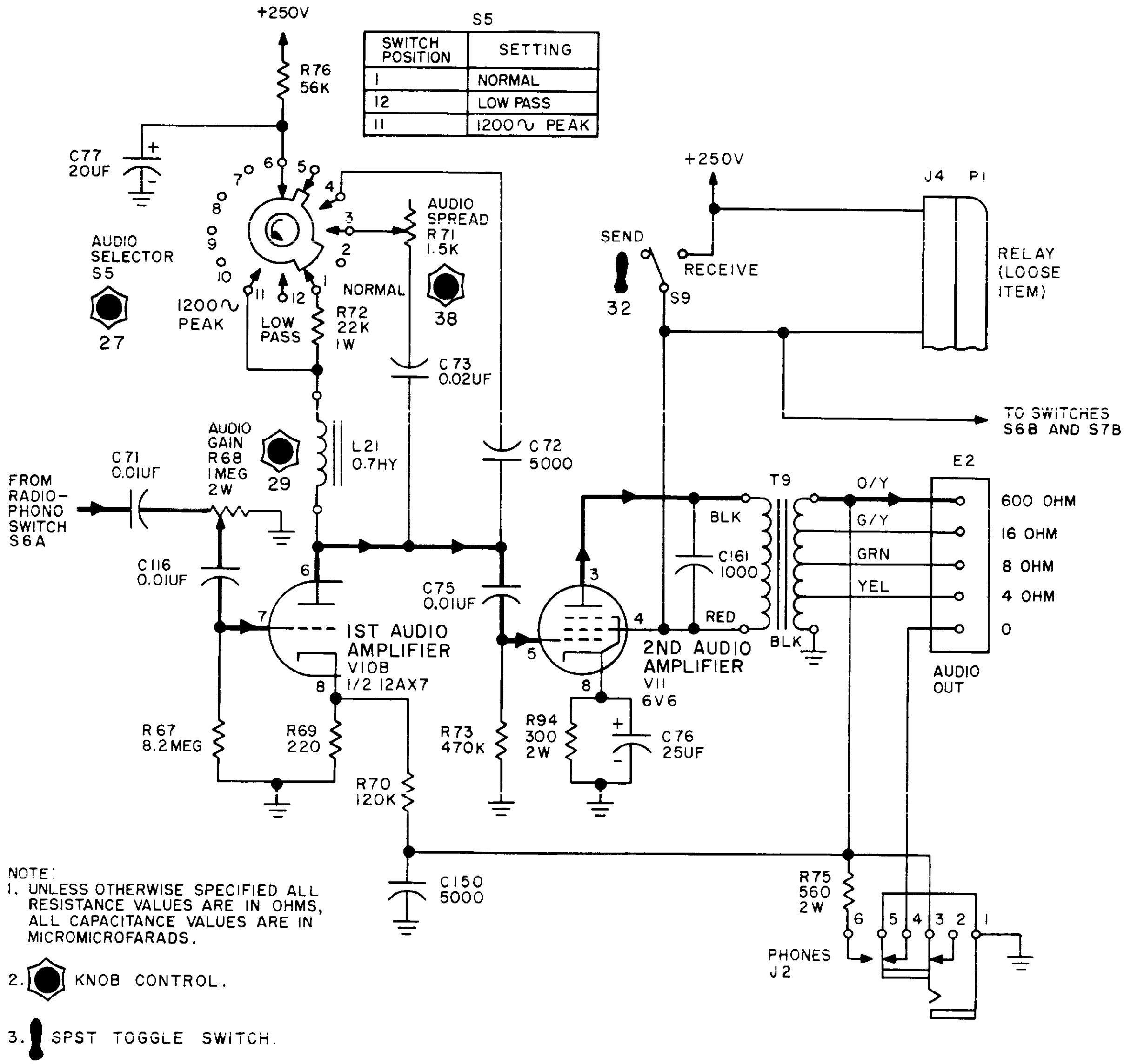



Figure 4-10. Schematic Diagram, GPR-90RXD, Audio Amplifier

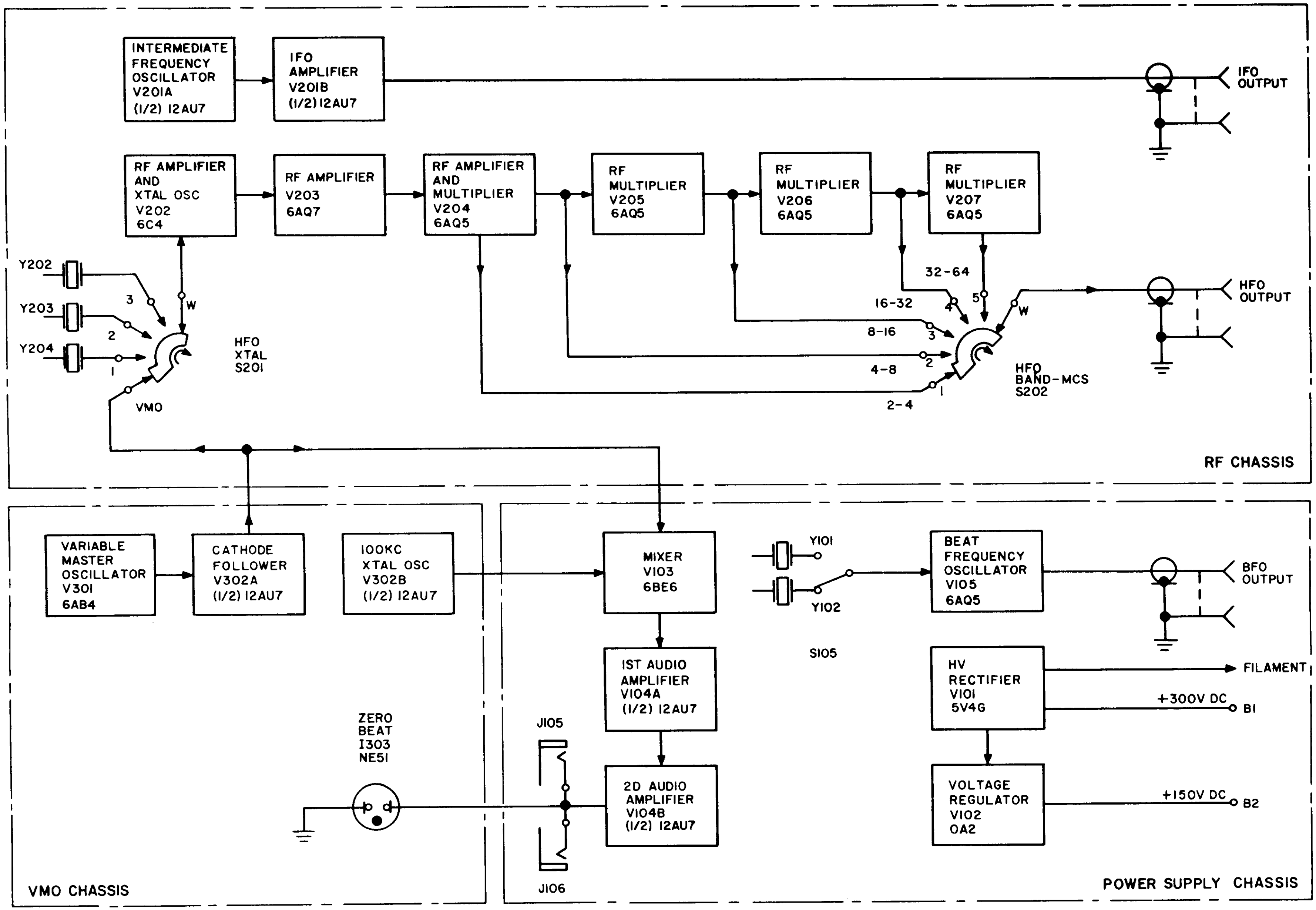



Figure 4-11. Block Diagram, VOX-3

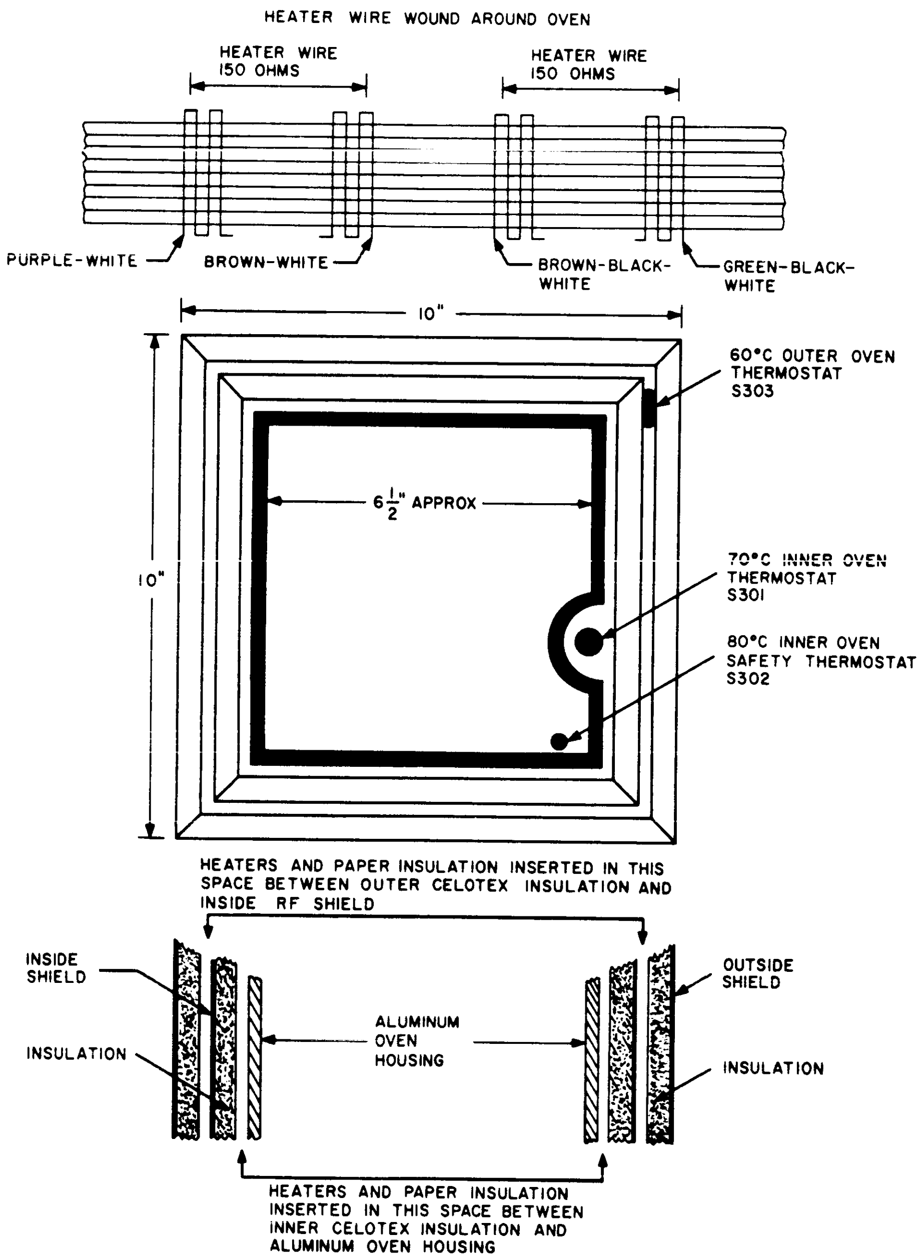



Figure 4-12. Oven Details, VOX-3

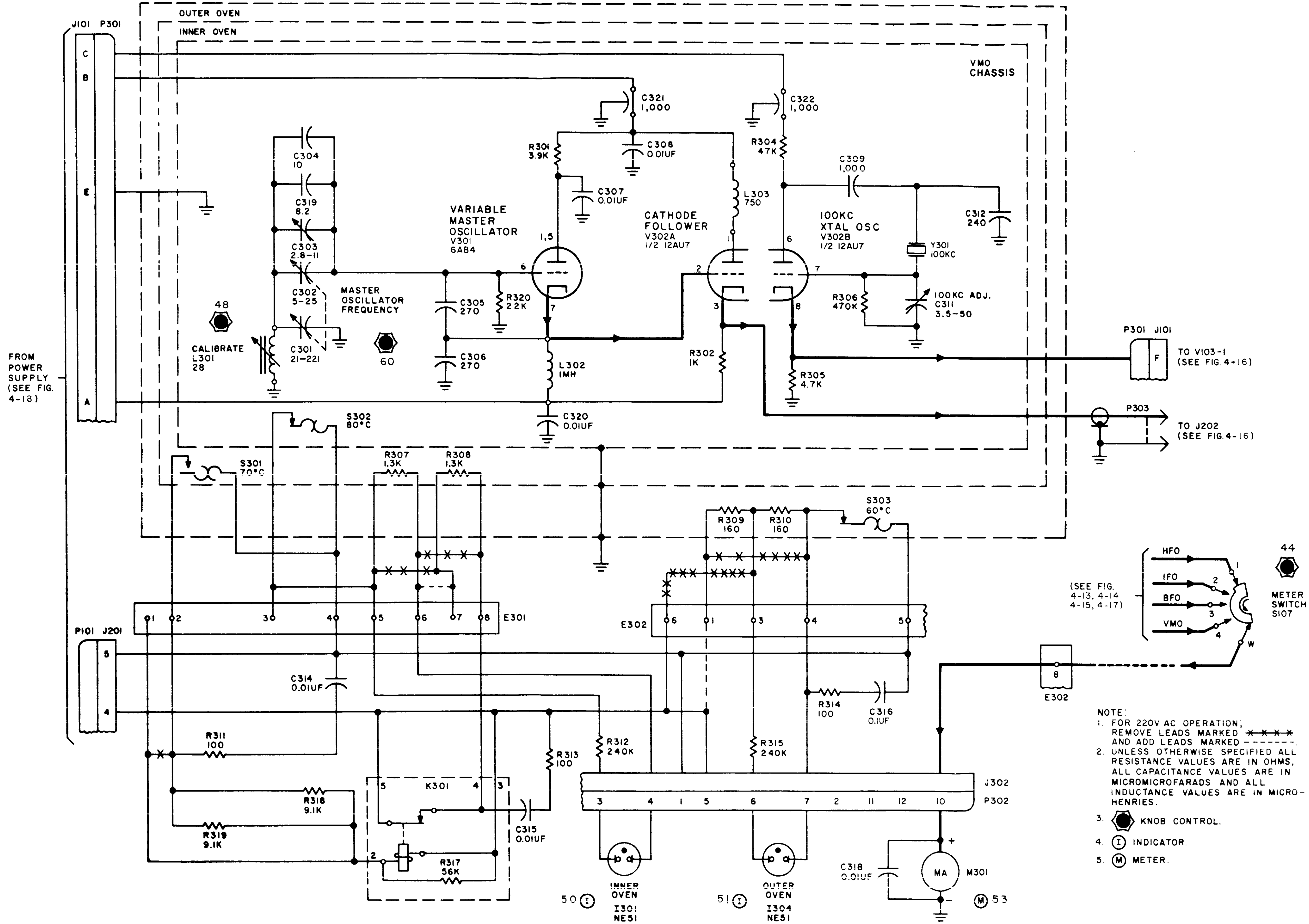



Figure 4-13. Schematic Diagram, VOX-3, VMO Section

NOTE:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
2. KNOB CONTROL.

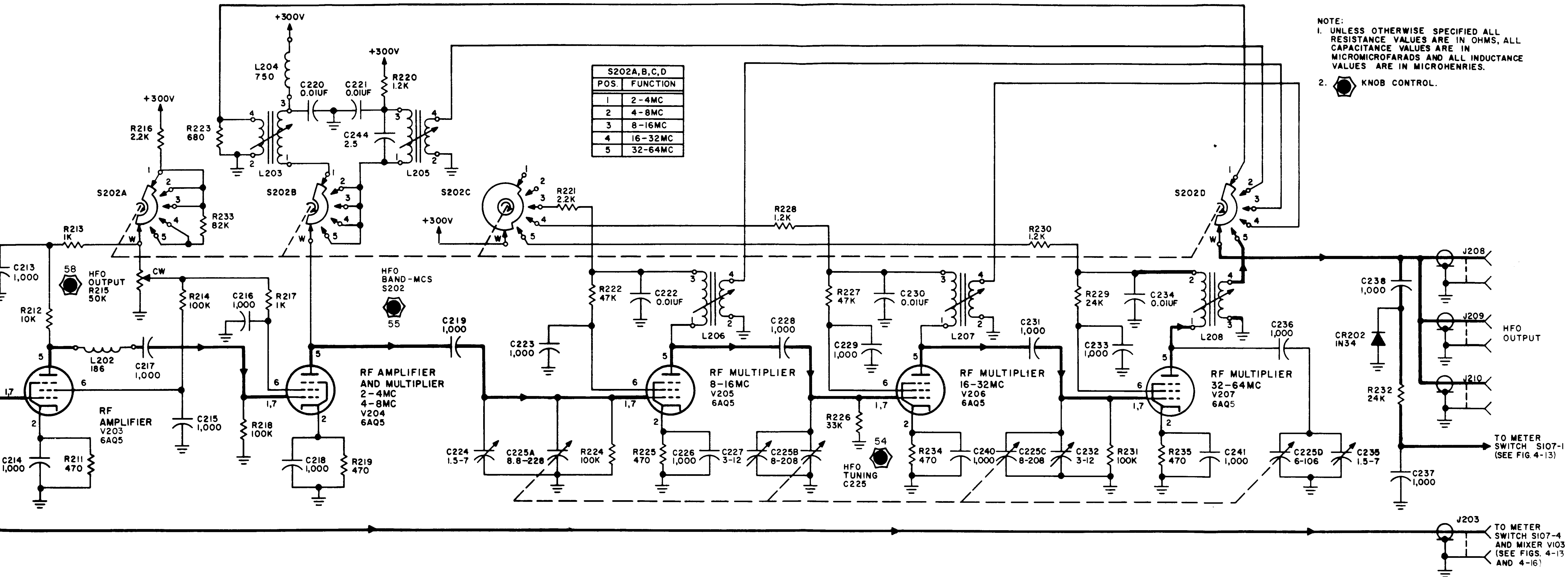
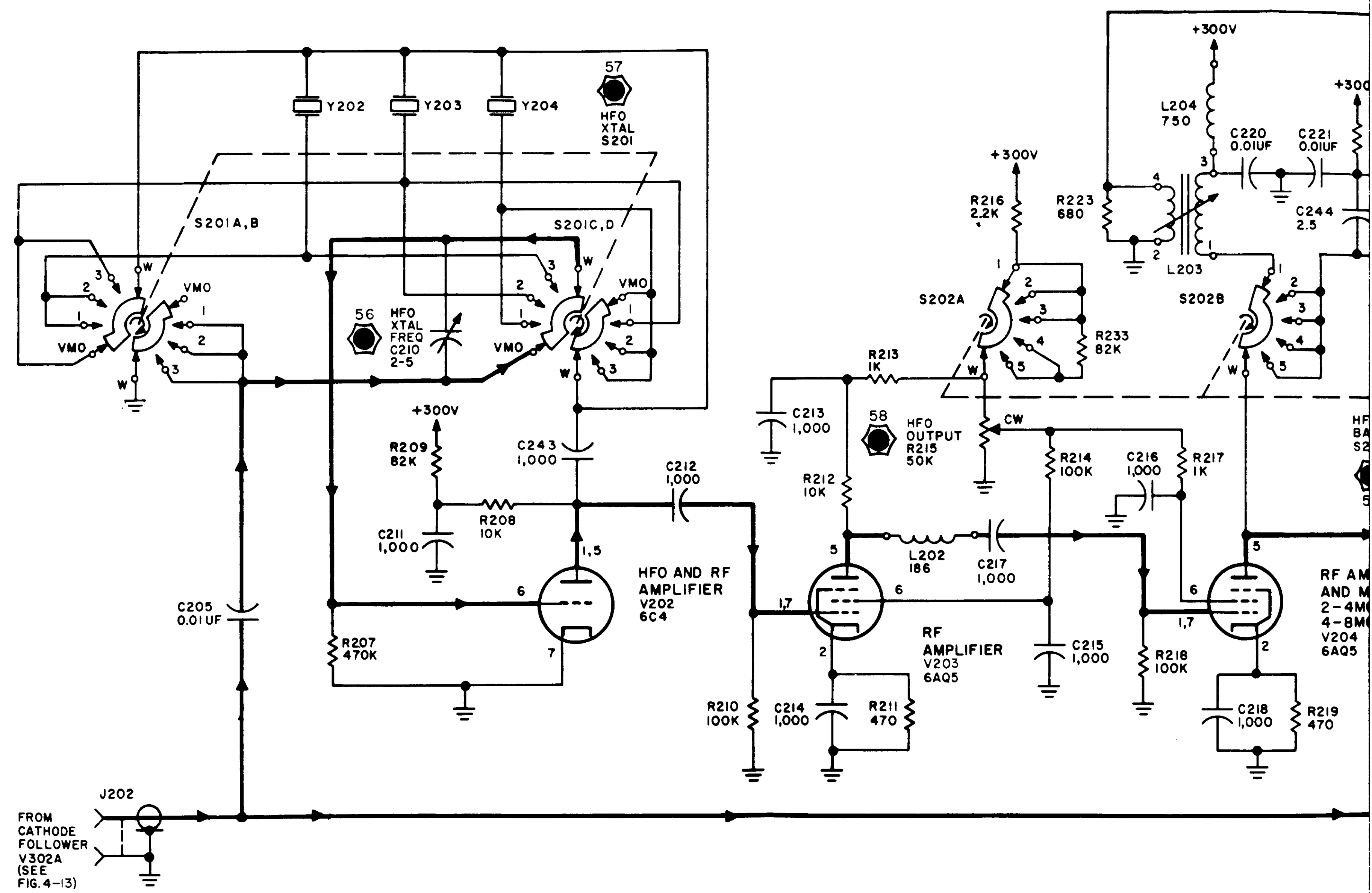
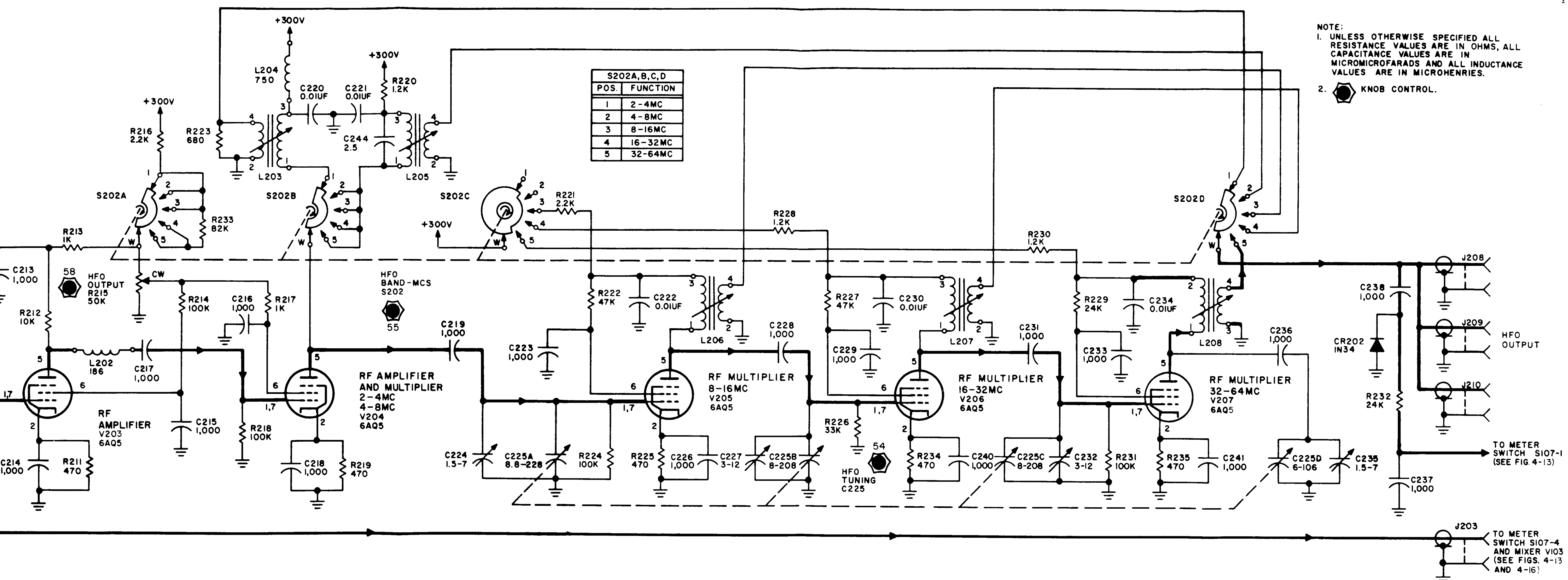



Figure 4-14. Schematic Diagram, VOX-3, HFO Chain



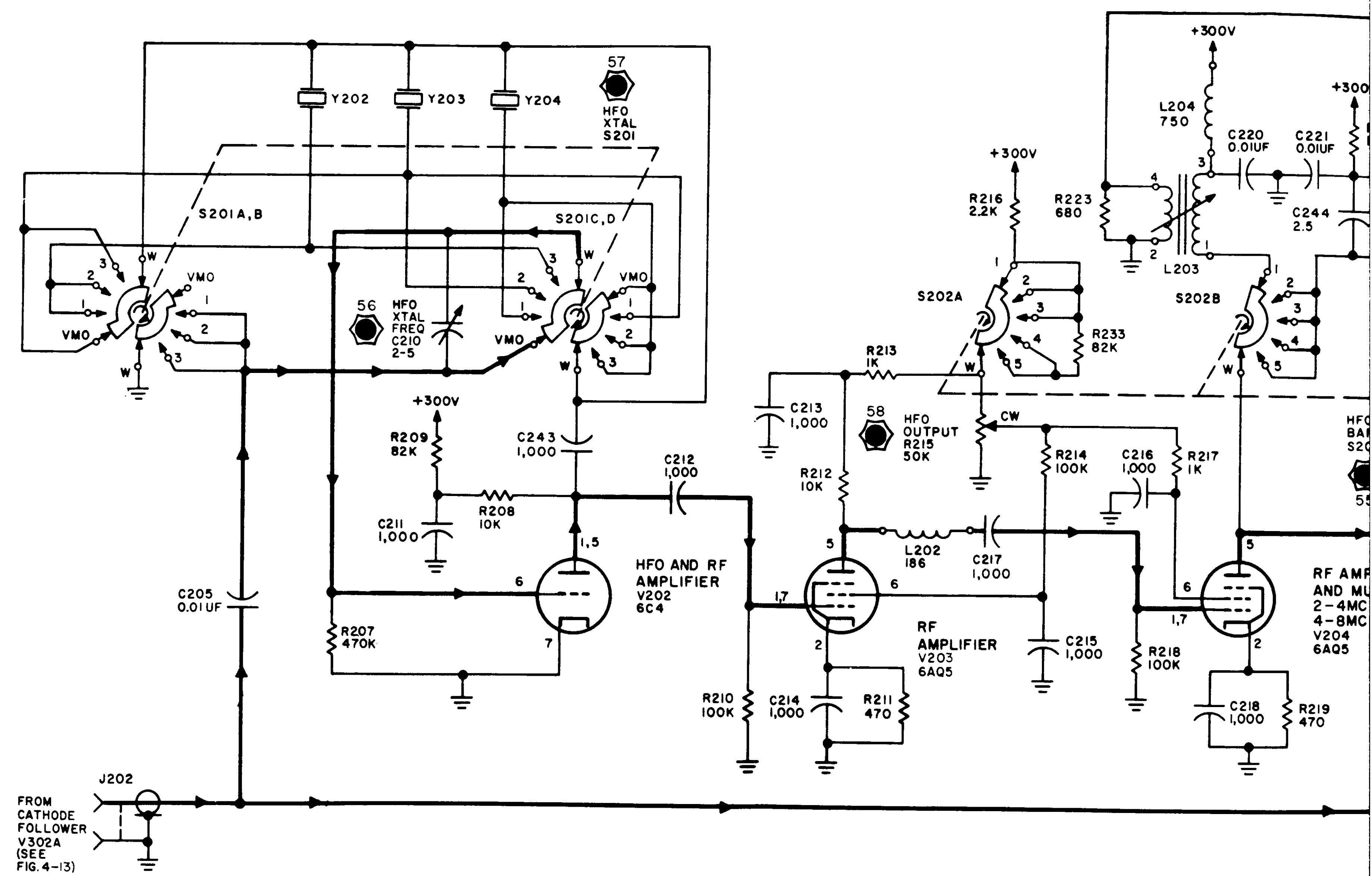
Y202
Y203
Y204
57
HFO XTAL S201
S201A,B
S201C,D
VMO
W
56
HFO XTAL FREQ C210 2-5
+300V
R209 82K
C211 1,000
R208 10K
C243 1,000
C212 1,000
HFO AND RF AMPLIFIER V202 6C4
R207 470K
C205 0.01UF
J202
FROM CATHODE FOLLOWER V302A (SEE FIG. 4-13)
R210 100K
C214 1,000
R211 470
RF AMPLIFIER V203 6AQ5
R212 10K
C213 1,000
R213 1K
58
HFO OUTPUT R215 50K
CW
L202 186
C217 1,000
C215 1,000
R214 100K
C216 1,000
R217 1K
R218 100K
C218 1,000
R219 470
S202A
R216 2.2K
R233 82K
R223 680
L203
L204 750
C220 0.01UF
C221 0.01UF
C244 2.5
S202B
RF AM AND M 2-4M 4-8M V204 6AQ5

NOTE:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS AND ALL INDUCTANCE VALUES ARE IN MICROHENRIES.
2. KNOB CONTROL.




| S202A,B,C,D | |
|---|---|
| POS. | FUNCTION |
| 1 | 2-4MC |
| 2 | 4-8MC |
| 3 | 8-16MC |
| 4 | 16-32MC |
| 5 | 32-64MC |

Figure 4-14. Schematic Diagram, VOX-3, HFO Chain


Y202
Y203
Y204
57
HFO XTAL S201
S201A,B
S201C,D
VMO
W
56
HFO XTAL FREQ C210 2-5
+300V
R209 82K
C211 1,000
R208 10K
C243 1,000
C212 1,000
HFO AND RF AMPLIFIER V202 6C4
R207 470K
C205 0.01UF
J202
FROM CATHODE FOLLOWER V302A (SEE FIG.4-13)
R213 1K
C213 1,000
58
HFO OUTPUT R215 50K
CW
R212 10K
L202 186
C217 1,000
RF AMPLIFIER V203 6AQ5
R210 100K
C214 1,000
R211 470
R214 100K
C215 1,000
C216 1,000
R217 1K
R218 100K
R216 2.2K
S202A
R233 82K
R223 680
L204 750
L203
C220 0.01UF
C221 0.01UF
C244 2.5
S202B
C218 1,000
R219 470
RF AMP AND MU 2-4MC 4-8MC V204 6AQ5

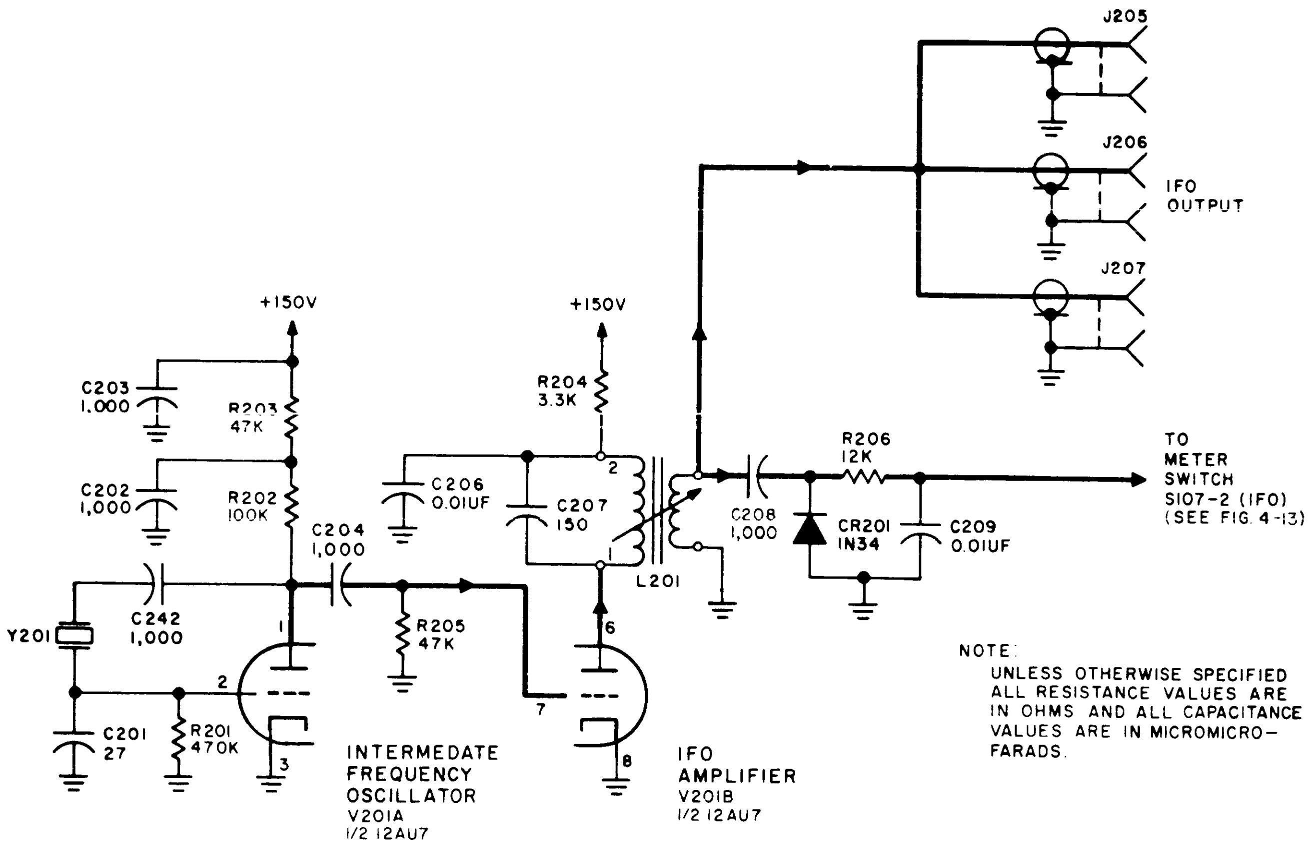



Figure 4-15. Schematic Diagram, VOX-3, IFO Circuit

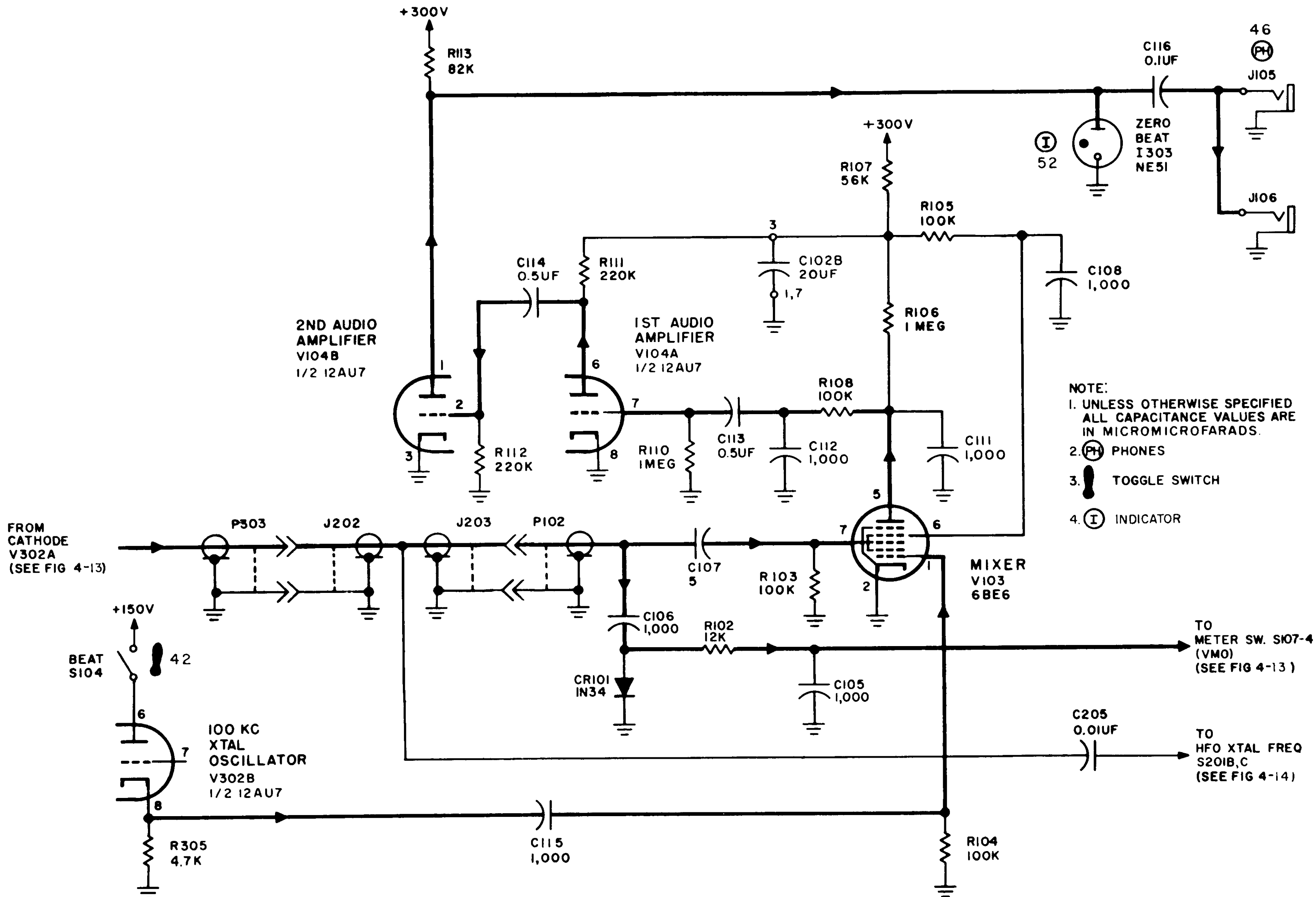



Figure 4-16. Schematic Diagram, VOX-3, Calibrating Chain

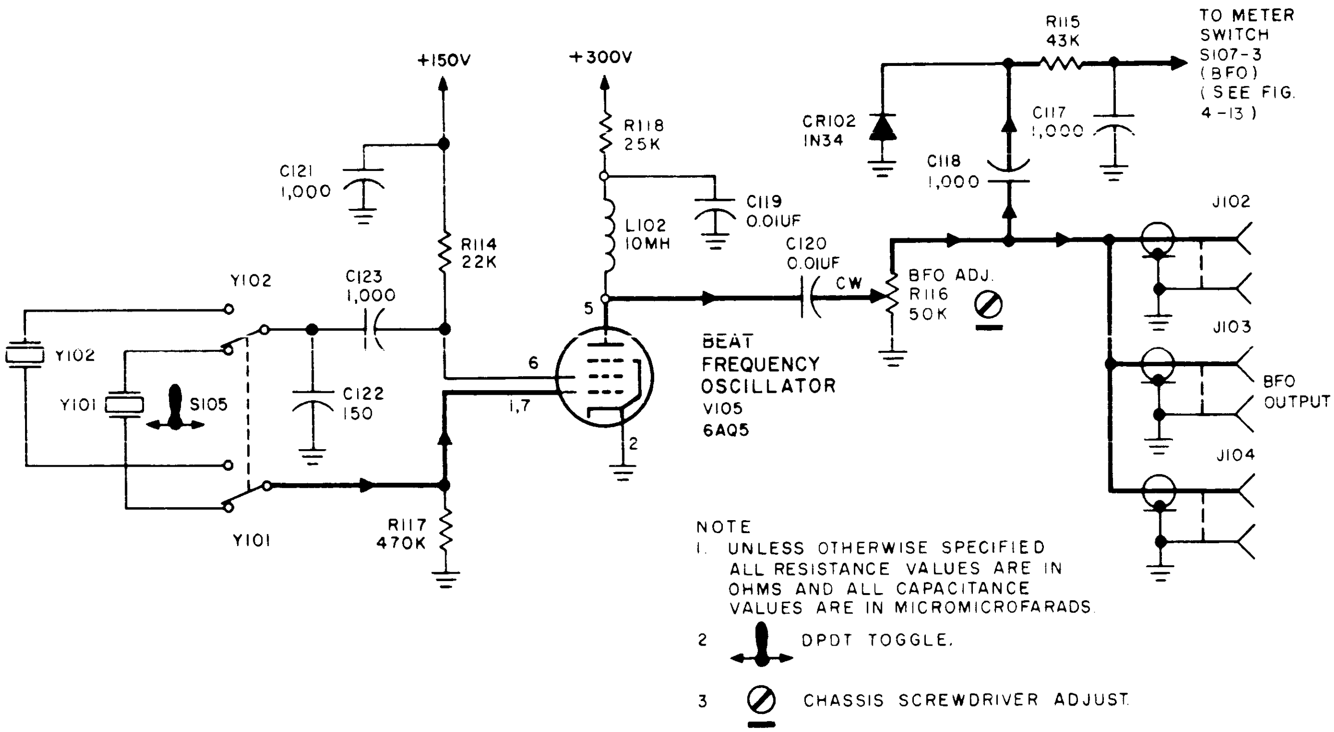



Figure 4-17. Schematic Diagram, VOX-3, BFO Circuit

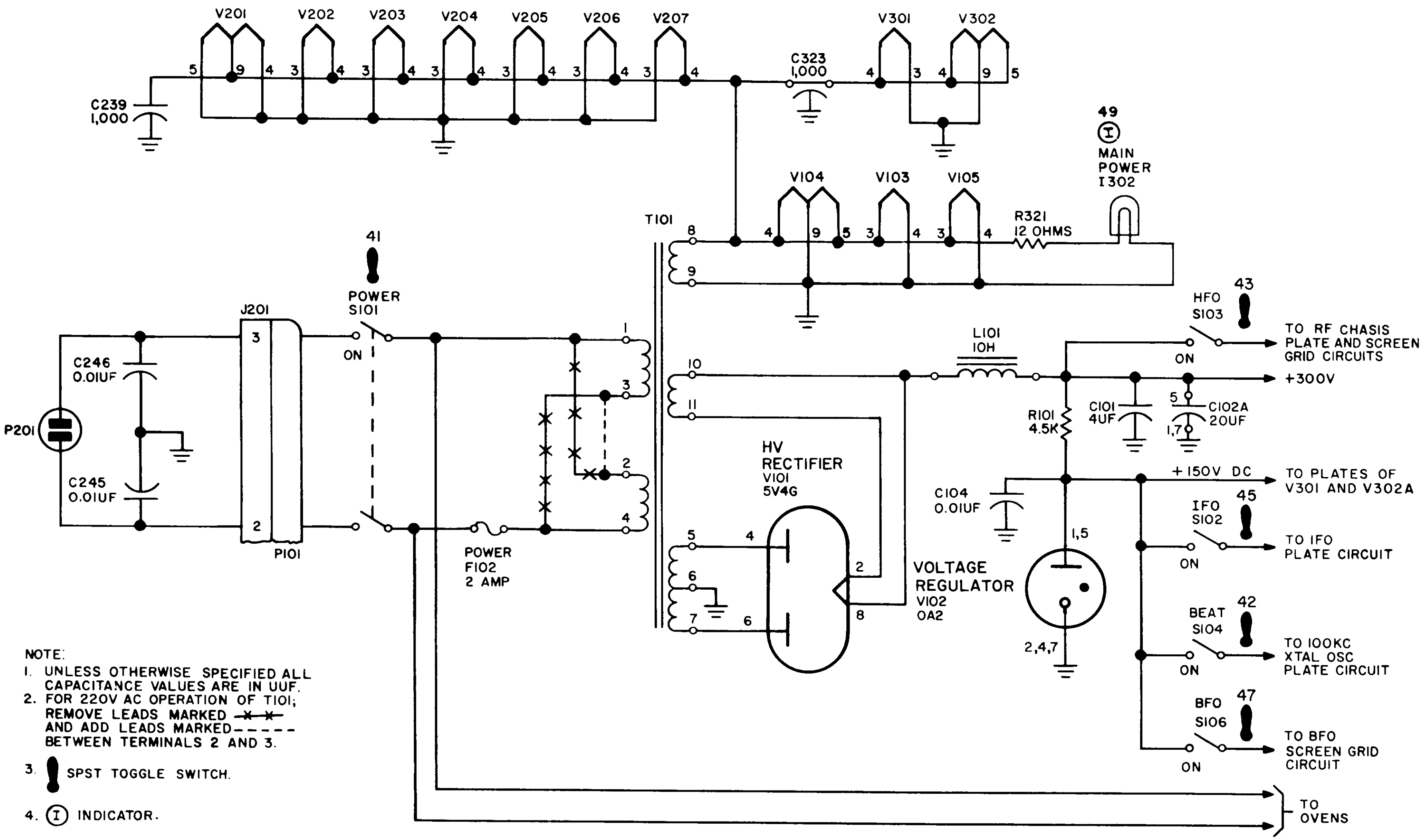



Figure 4-18. Schematic Diagram, VOX-3, Power Supply

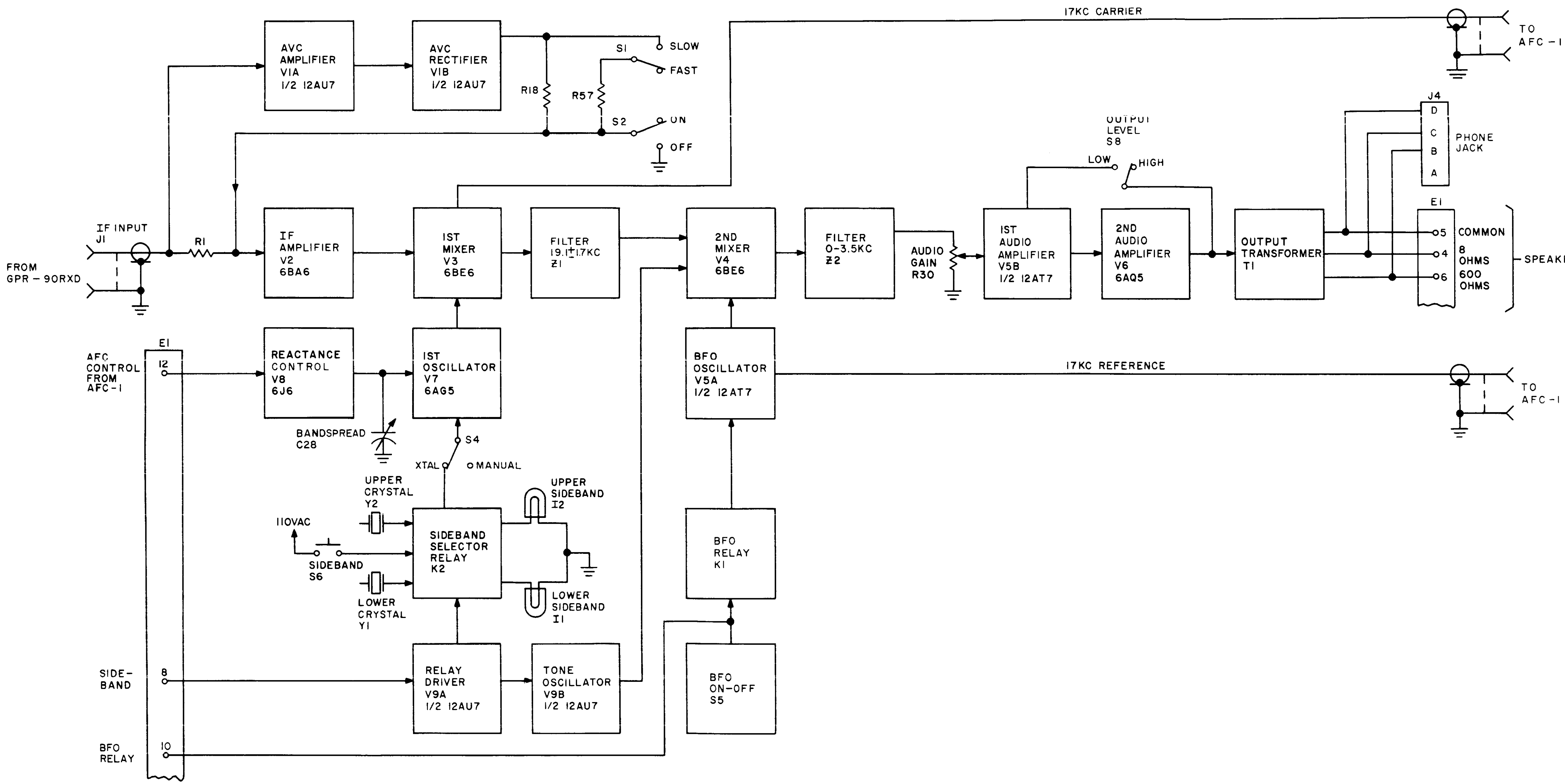



Figure 4-19. Block Diagram, MSR-6

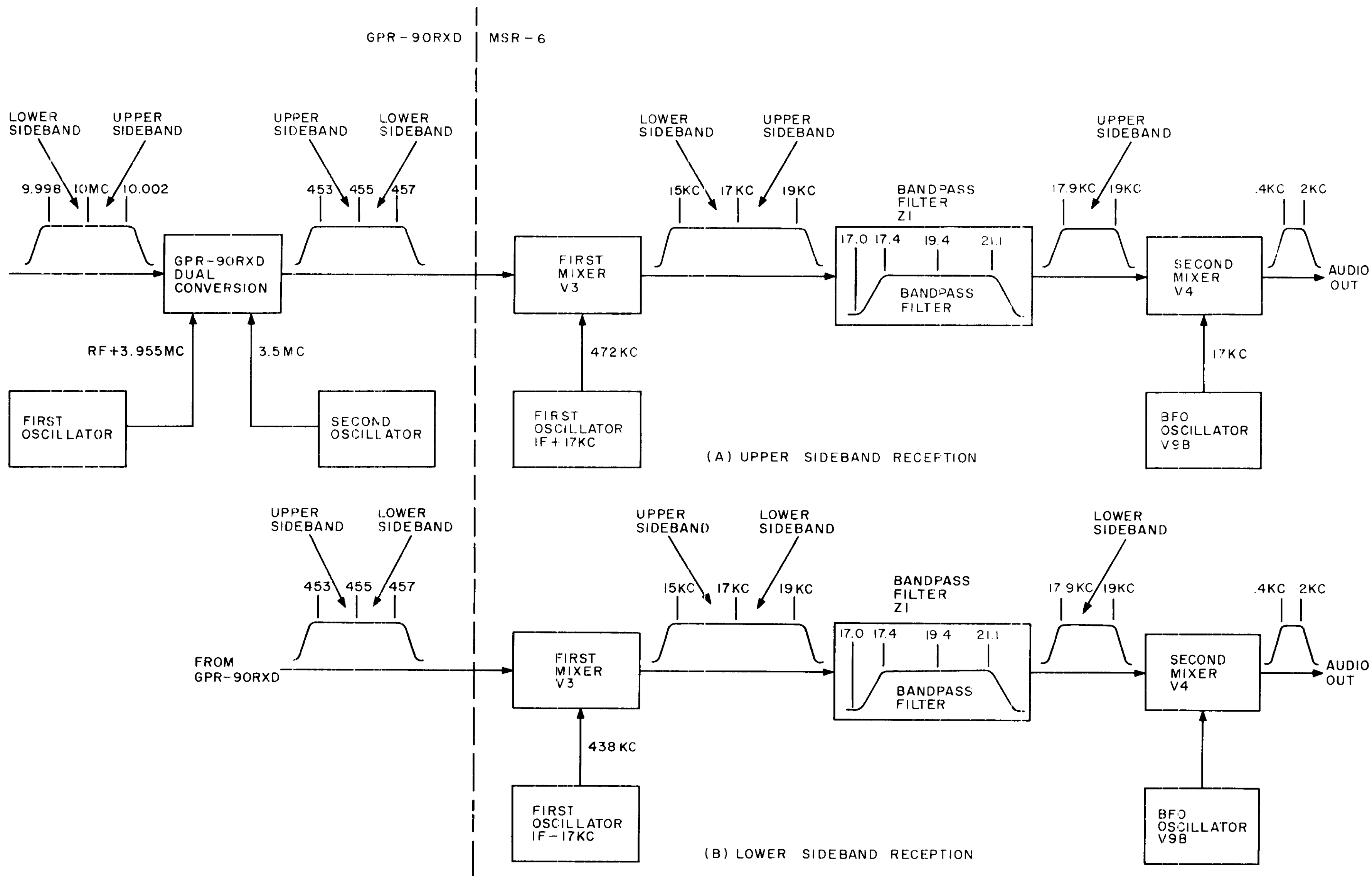



Figure 4-20. Block Diagram, MSR-6, Single Sideband Reception with Normal Centered Operation

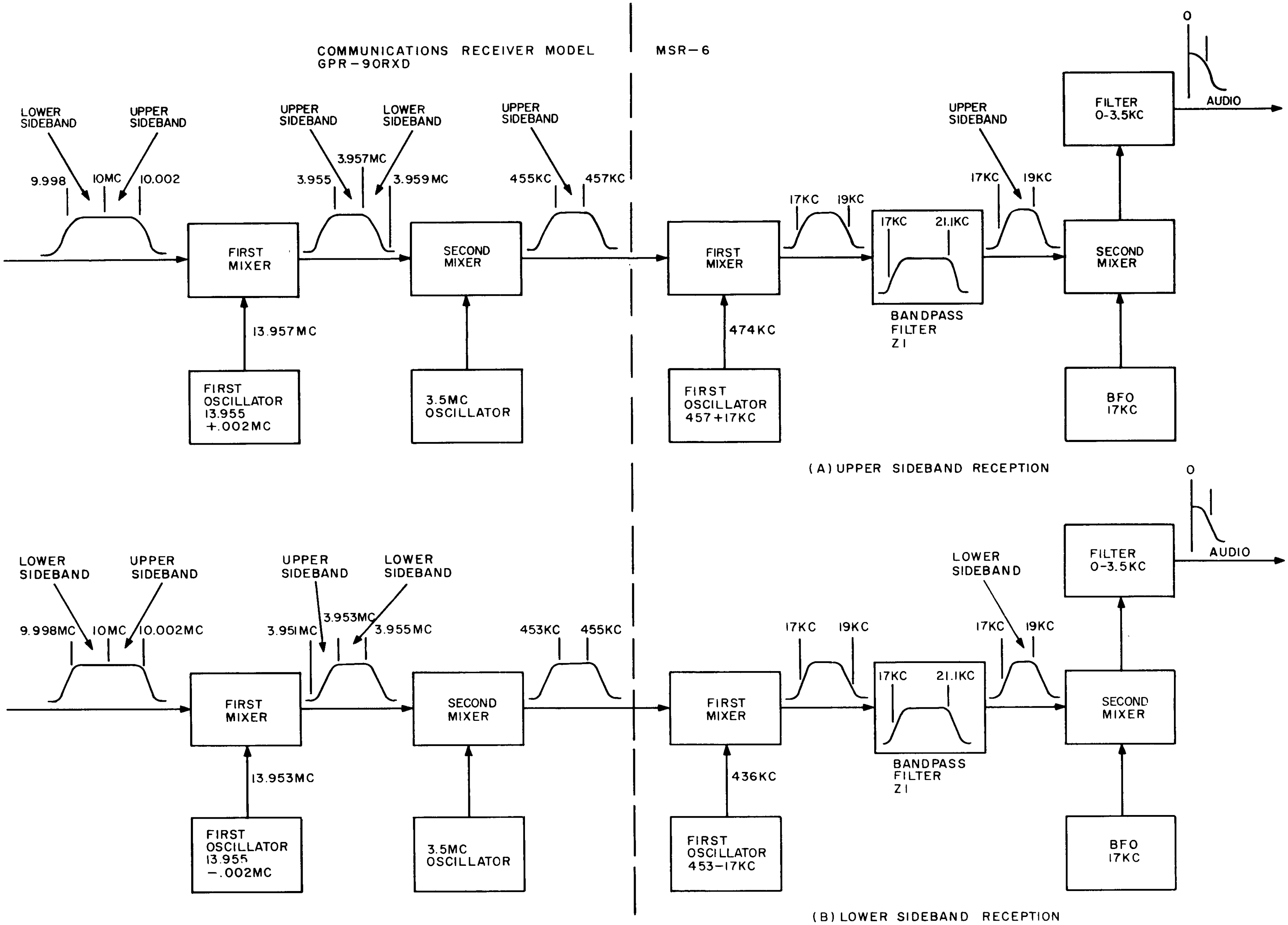



Figure 4-21. Block Diagram, MSR-6, Single Sideband Reception with Shifted Receiver Operation

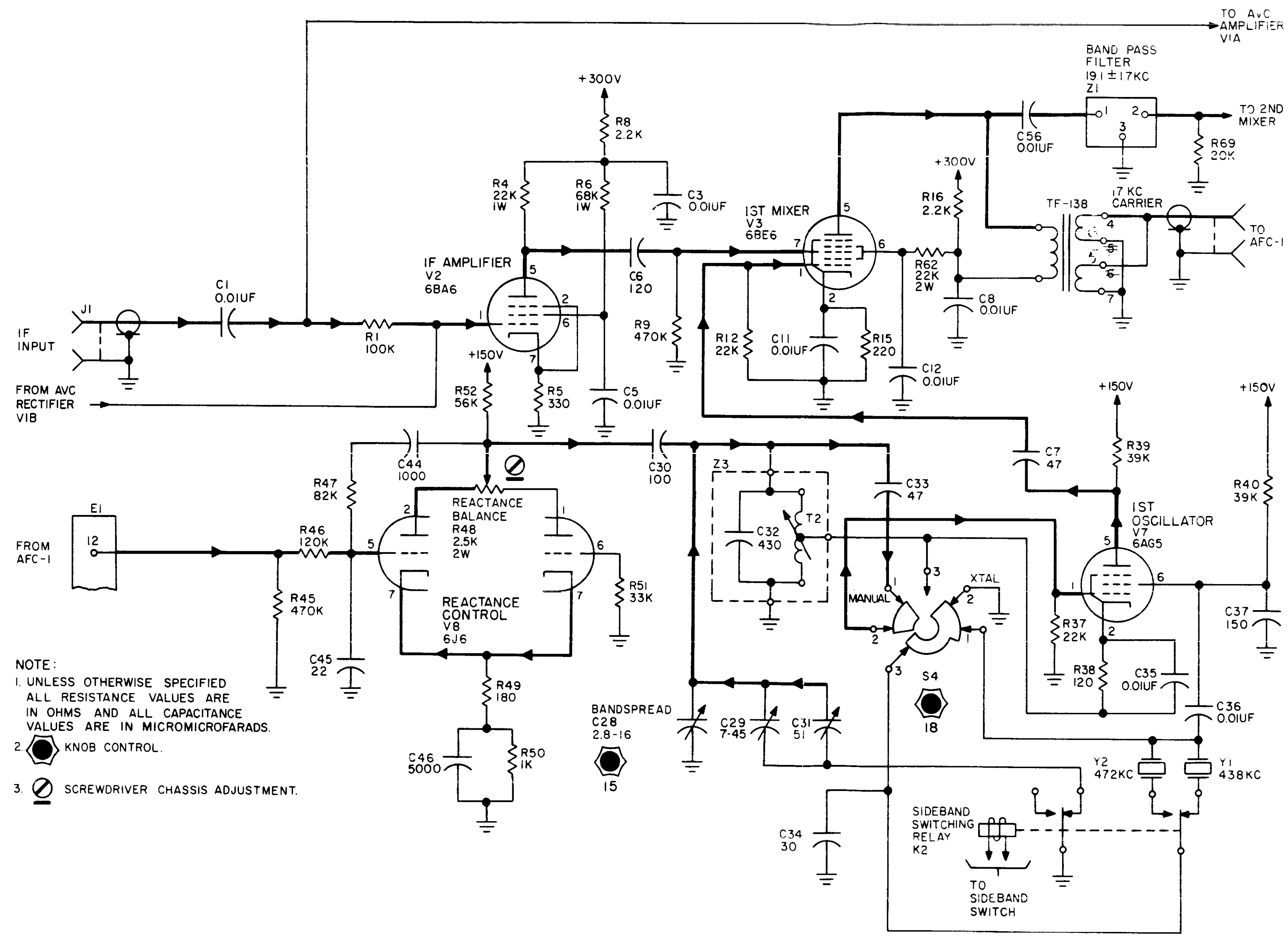
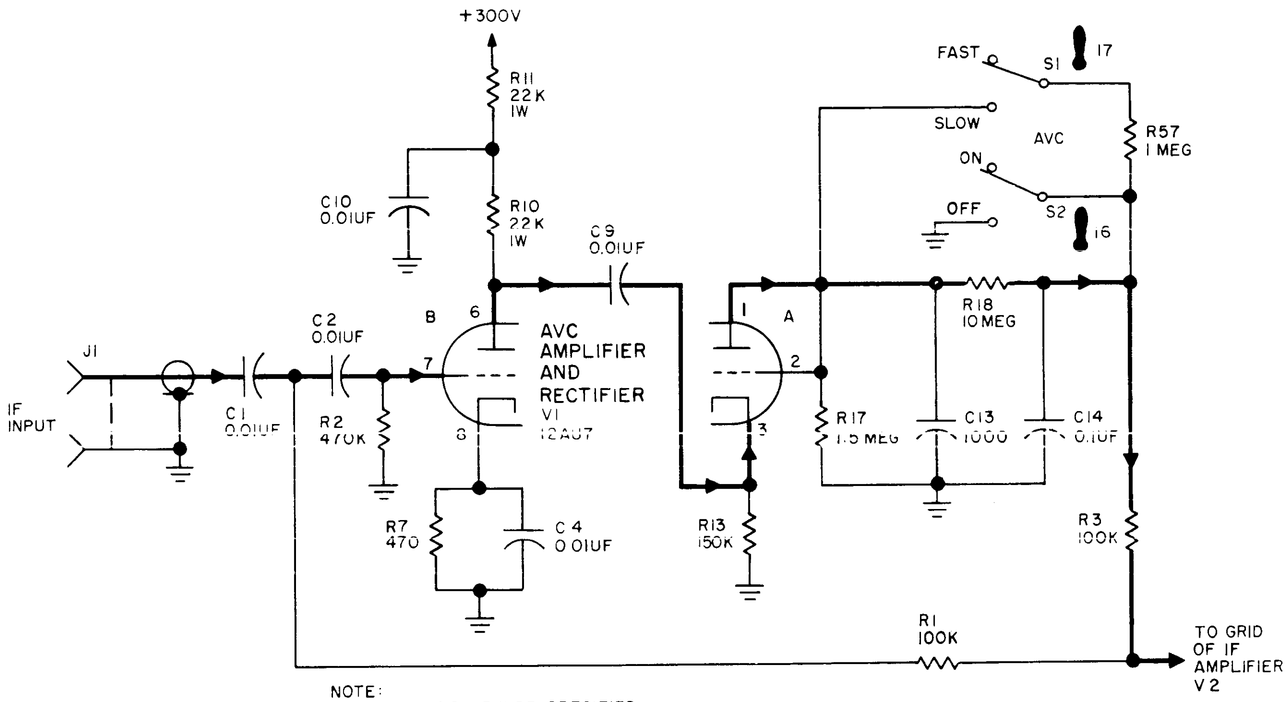



Figure 4-22. Schematic Diagram, MSR-6, Reactance Control, First Mixer and Oscillator




NOTE:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS
2. SPST TOGGLE SWITCH.

Figure 4-23. Schematic Diagram, MSR-6, AVC Amplifier and Rectifier

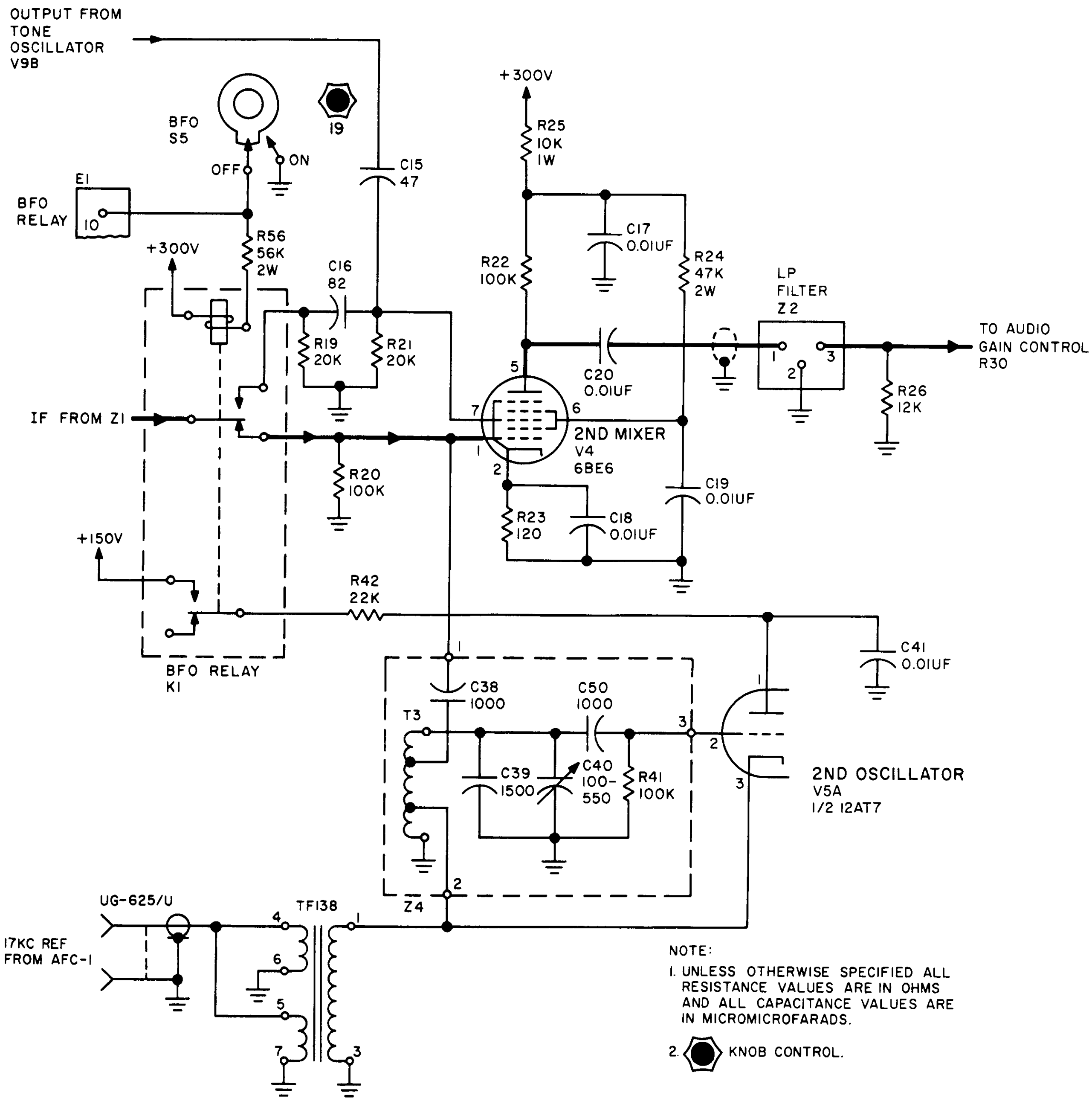



Figure 4-24. Schematic Diagram, MSR-6, Second Mixer

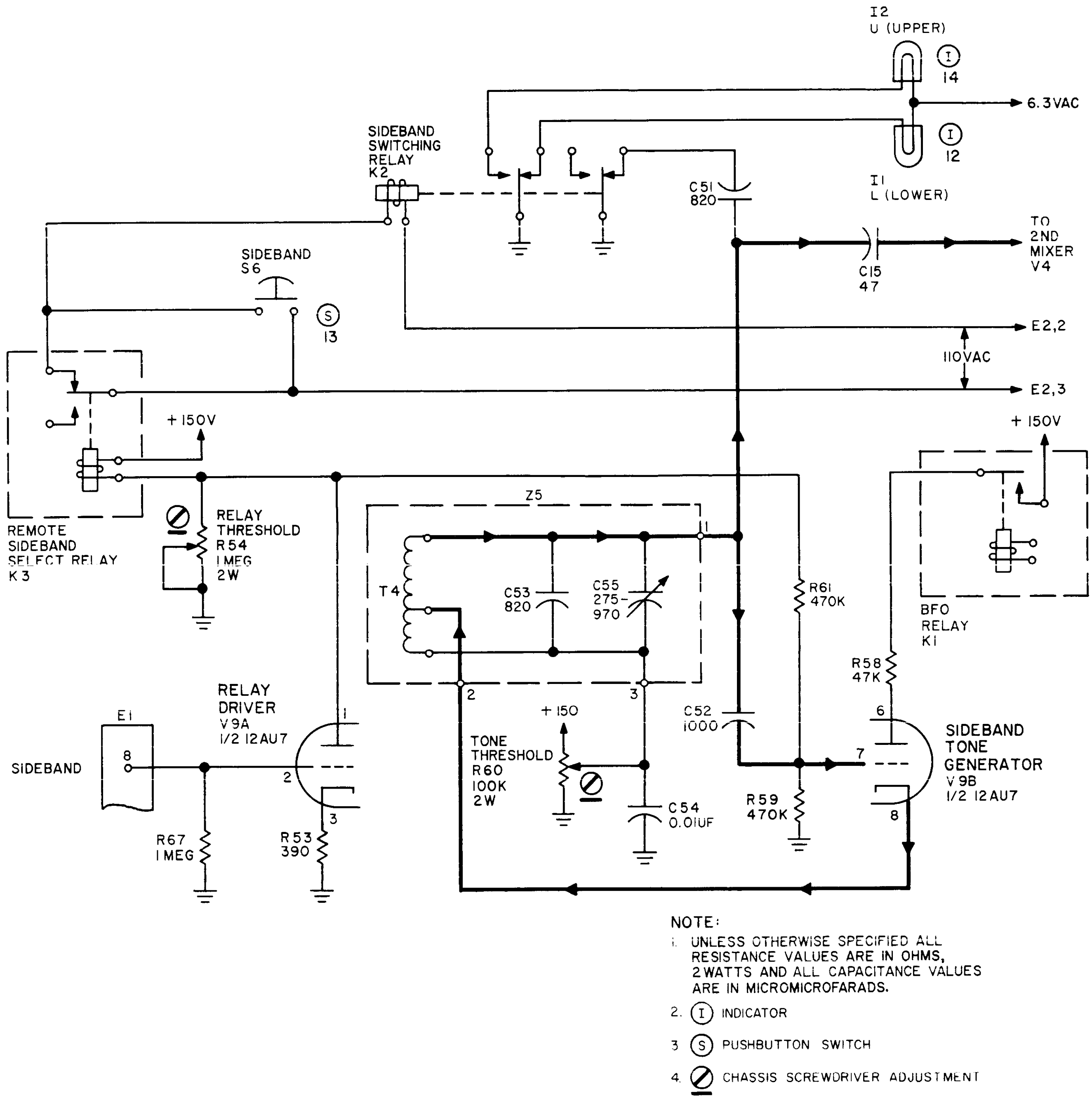



Figure 4-25. Schematic Diagram, MSR-6, Sideband Tone Generator and Remote Sideband Select Circuit

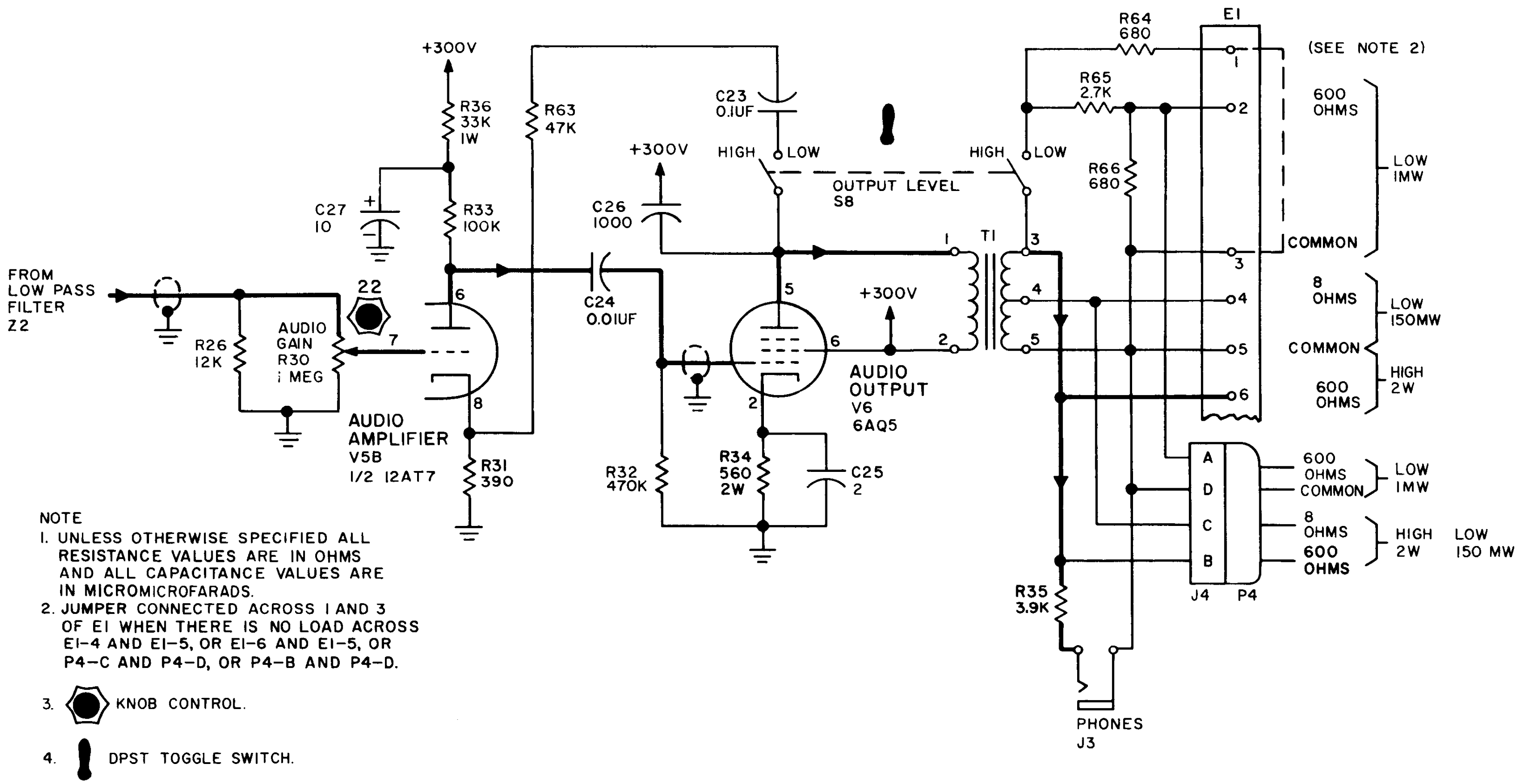



Figure 4-26. Schematic Diagram, MSR-6, Audio Amplifier

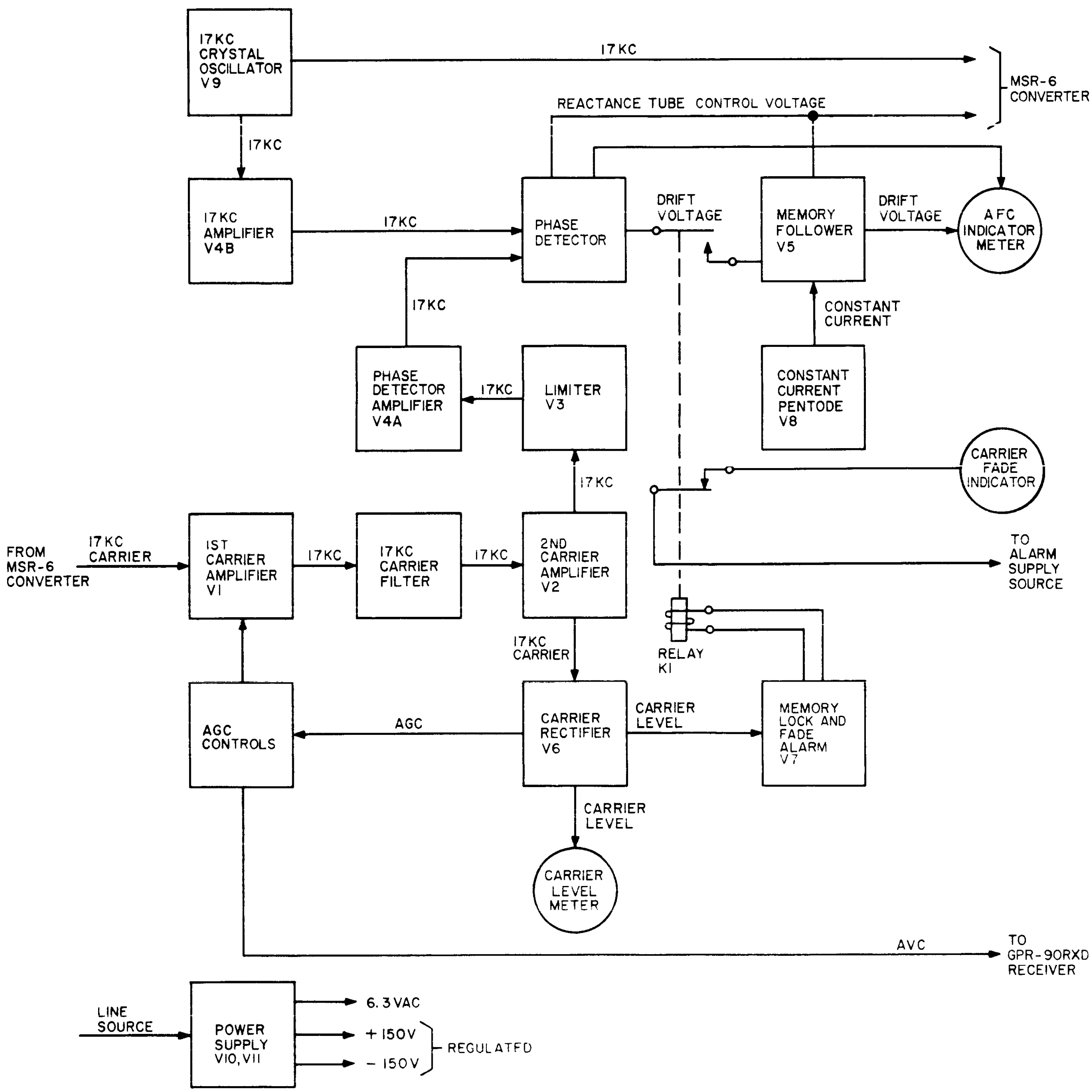



Figure 4-27. Block Diagram, AFC-1

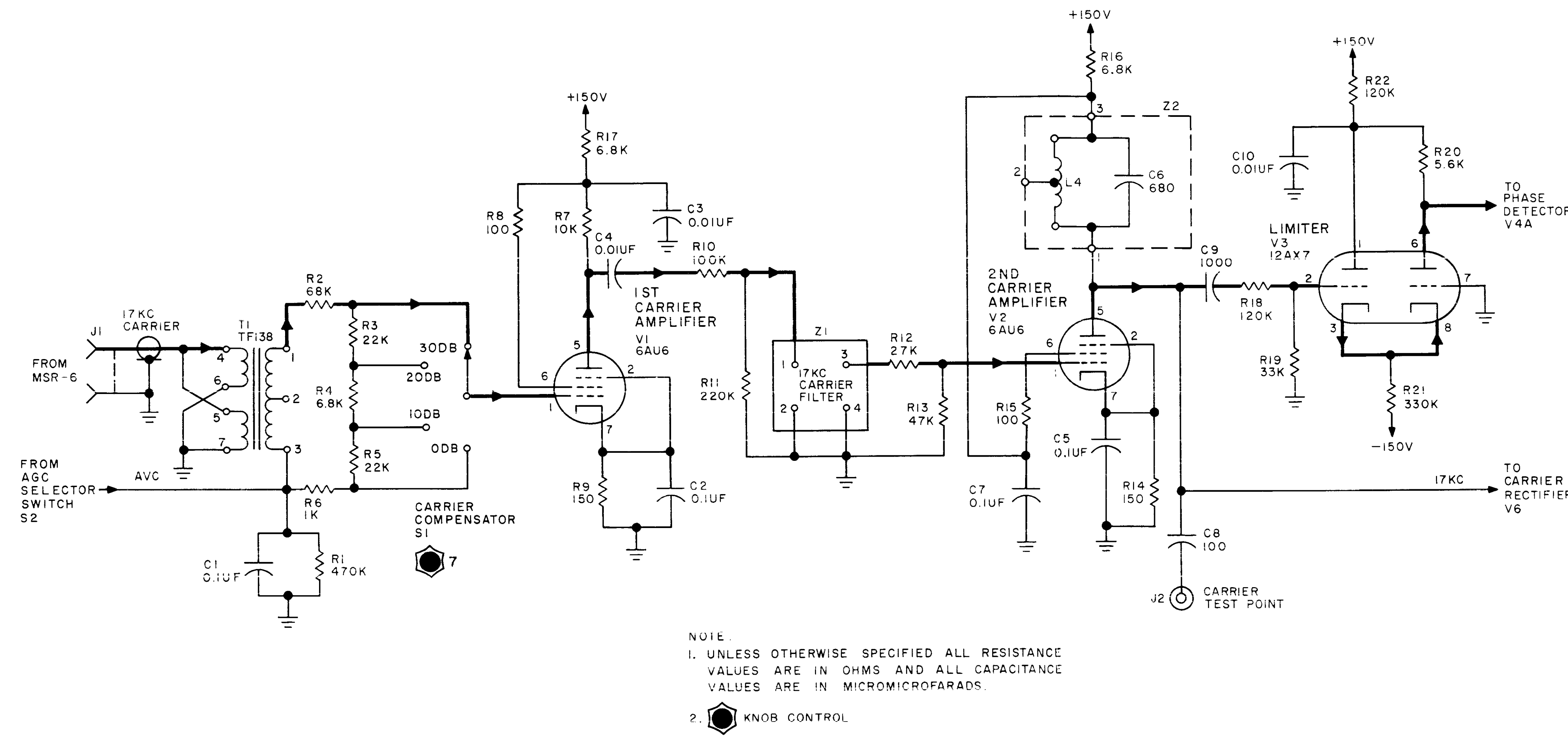



Figure 4-28. Schematic Diagram, AFC-1, Carrier Amplifiers and Limiter

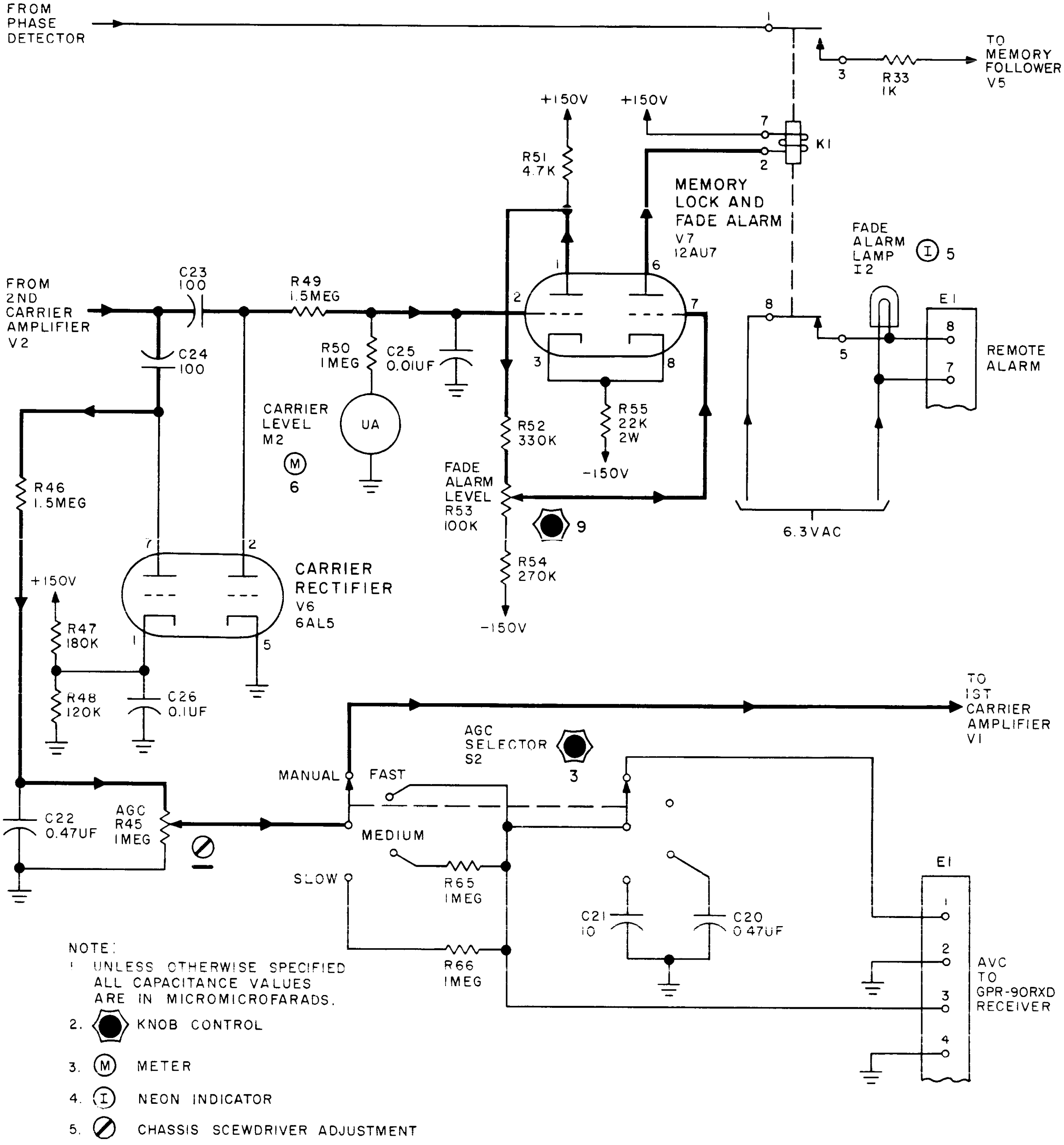



Figure 4-29. Schematic Diagram, AFC-1, Automatic Volume Control, Memory Lock, and Fade Alarm Circuits

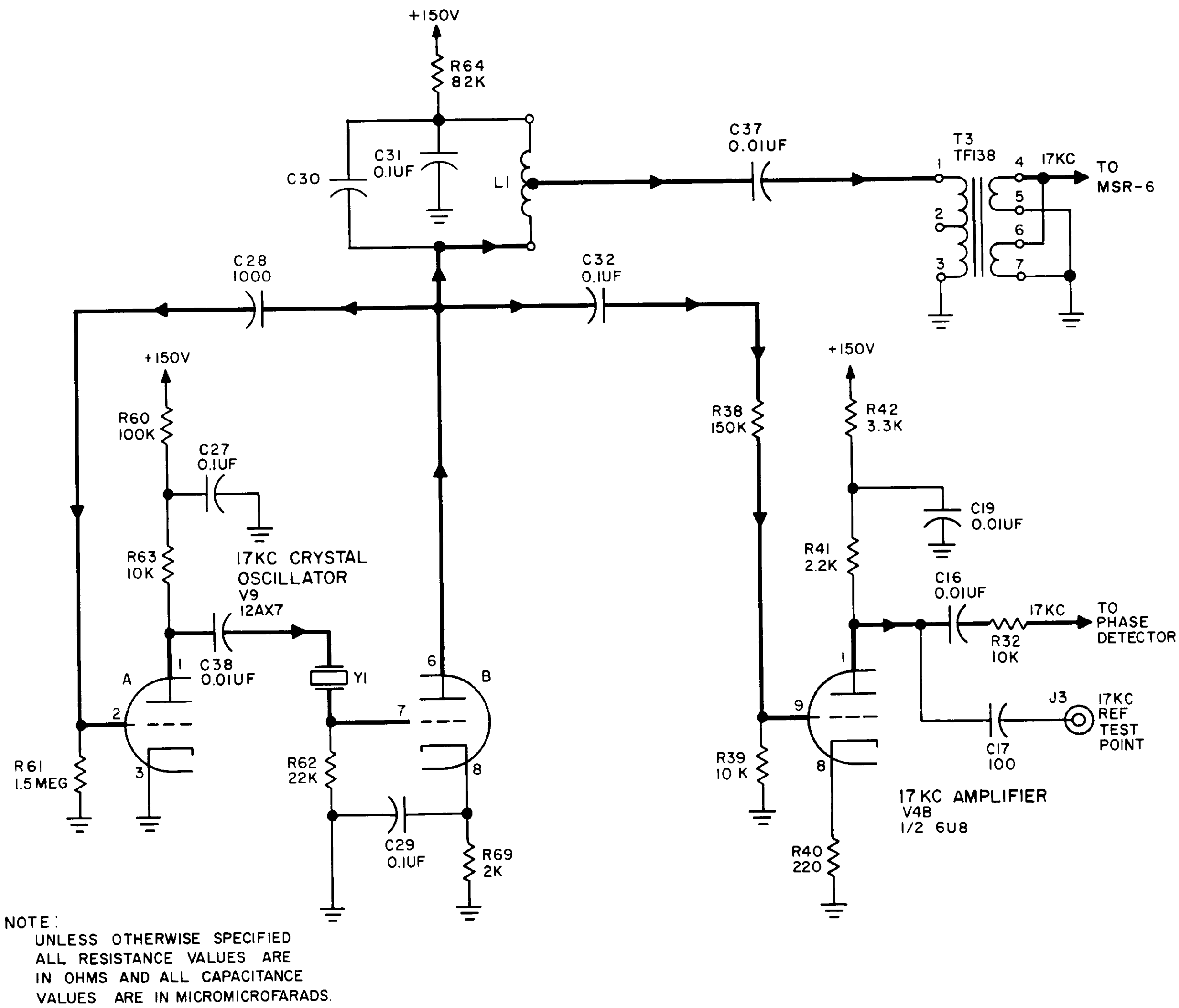



Figure 4-30. Schematic Diagram, AFC-1, 17-kc Crystal Oscillator and Amplifier

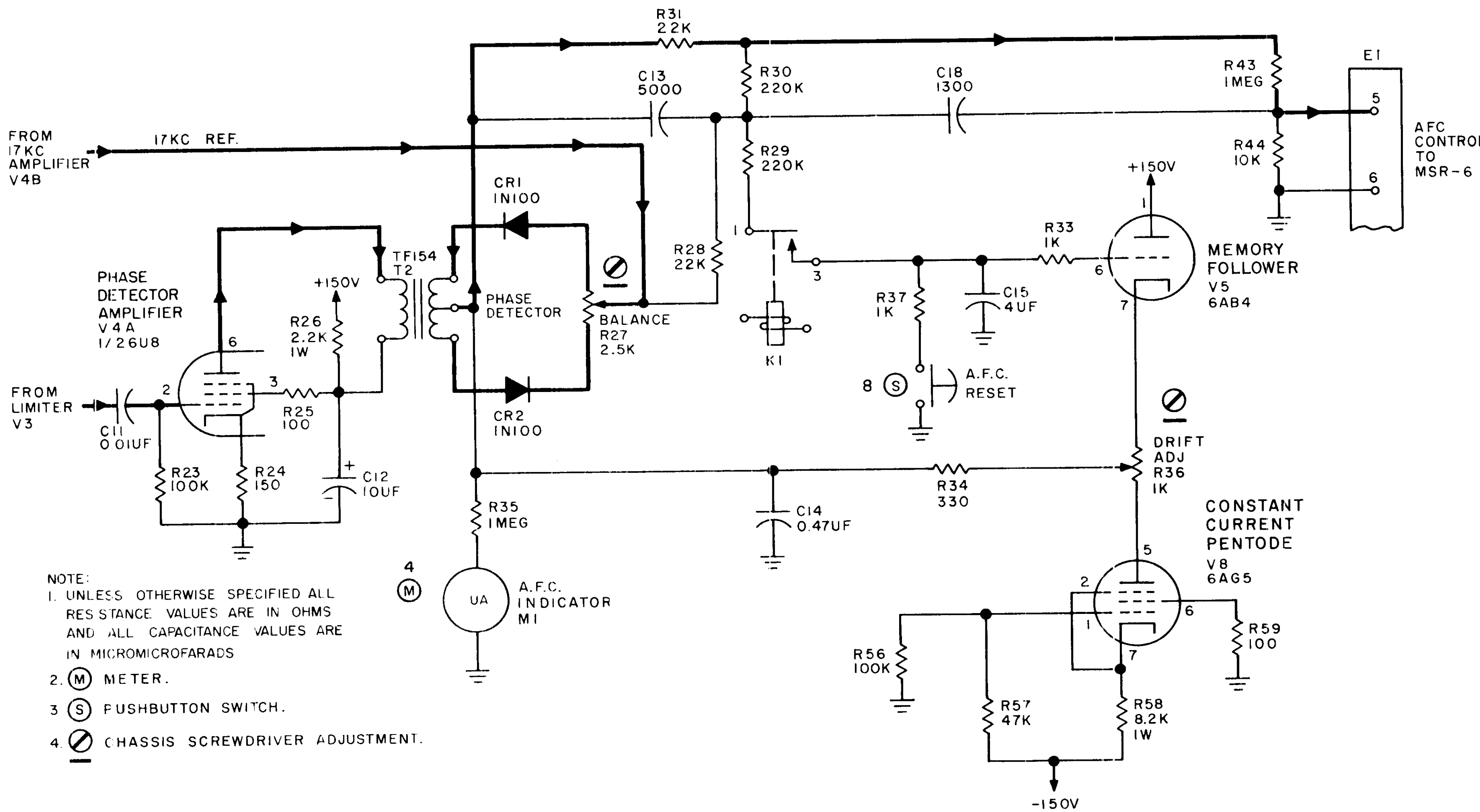



Figure 4-31. Schematic Diagram, AFC-1, Phase Detector and Memory Follower

# SECTION 5
# TROUBLE-SHOOTING

## 5-1. GENERAL.

Trouble-shooting is the method of locating and diagnosing equipment troubles and maladjustments; the information necessary to remedy the equipment troubles and maladjustments is reserved for Section 6 of the manual under the heading "Maintenance."

Trouble-shooting tools may, for convenience, be divided into the following six categories:

a. Accurate schematic diagrams.

b. Tables of voltage and resistance; waveform data.

c. Location data (photographs with callouts of the major electronic equipment elements).

d. Trouble-shooting techniques.

e. Trouble-shooting charts based on operating procedures.

f. Trouble-shooting procedures based on circuit sectionalization.

Trouble-shooting techniques are about the same for all types of electronic equipment and are covered briefly in the following paragraph.

## 5-2. TROUBLE-SHOOTING TECHNIQUES.

a. GENERAL CONSIDERATIONS. - When a piece of equipment has been working satisfactorily and suddenly fails, the cause of failure may be apparent either because of circumstances occurring at the time of failure or because of symptoms analogous to past failures. In this case, it is unnecessary to follow a lengthy and orderly course of trouble-shooting in order to localize and isolate the faulty part.

A second short cut in trouble-shooting is to ascertain that all tubes and fuses are in proper working order and that the equipment receives proper supply voltages. Many times this method will eliminate further investigation.

A third short cut is to examine the equipment, section by section, for burned out elements, charring, corrosion, arcing, excessive heat, dirt, dampness, etc.

It is important to recognize that defective elements may have become defective due to their own weakness or to some contributing cause beyond their control.

b. TROUBLE-SHOOTING CHARTS BASED ON OPERATING PROCEDURES. - The general purpose of these charts is to narrow the area of trouble to one or more sections of the equipment in order to minimize the labor of locating the source of trouble. These charts present a prescribed order "to turn on" the equipment, indicate what to expect as each step is taken, and give clues as to possible "troubled areas" when some expectation is not realized.

c. TABLES OF VOLTAGE AND RESISTANCE; WAVEFORM DATA. - These tables give nominal values of voltage-to-frame and resistance-to-frame, generally at tube elements and sometimes at connectors and terminal board elements. Large deviations from the nominal values should be carefully investigated. During this process, accurate schematic diagrams and location data are highly essential. Schematic diagrams of the equipment covered in this manual are contained in Section 8.

A good oscilloscope is a good trouble-shooting tool. It may be connected to a number of critical points along a circuit to detect extraneous voltages, distorted waveforms, and other symptoms of trouble.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - Equipments usually consist of a number of subassemblies or sections. It is frequently helpful to treat these subassemblies or sections as independent entitites. In so doing, however, they must be properly powered. Observations may then be made with VTVMs, CROs, or other test equipment at selected points under given types and magnitudes of injection voltages. Again, the subassemblies or sections may be examined for rated performance, according to specification, for the presence of extraneous grounds, for opens, or unusual voltages.

## 5-3. SERVICING TECHNIQUES.

### WARNING

Extreme care should be exercised when measuring voltages. Voltages as high as 300 volts are present in some of the units.

a. Careless replacement of parts often makes new faults inevitable. Note the following points:

(1) Before a part is unsoldered, note the positions of the leads. If the part, such as a transformer or switch, has a number of connections, tag each of the leads.

(2) Be careful not to damage other leads by pulling or pushing them out of the way.

(3) Do not allow drops of solder to fall into the set. They may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

b. The bottom of each chassis is easily accessible. Simply remove the screws holding the particular unit to the rack and pull the unit out as far as it goes by grasping the front panel handles. Raise the handles, and the unit will rotate on pins holding it to the slide rails. The unit will lock in place with the underside exposed. Figure 5-1 shows the VOX-3 in the service position prior to removal of covers.

## 5-4. COMMUNICATIONS RECEIVER GPR-90RXD.

a. VOLTAGE AND RESISTANCE DIAGRAMS. - Figure 5-2 shows the voltage-to-chassis and resistance-to-chassis measurements at the vacuum tube pins in the GPR-90RXD under the conditions stated.

b. LOCATION DATA. - Figures 5-3 -a and 5-3-b locate the major electronic elements of the GPR-90RXD.

c. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. - Refer to table 3-1 for interpretation of control designations. Refer to table 5-1.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - The following paragraphs present trouble-shooting procedures which are keyed to functional sections of the GPR-90RXD.

(1) POWER SUPPLY. - If the dial lamp fails to go on with power switch S10 (mounted on RF GAIN control R81) in the on position, check fuse F1. If no DC power appears in the chassis, check rectifier V14, power supply filter network (C104 and L23), and SEND-REC switch S9. Inspect the power supply for any signs of discoloration due to arcing and loose connections. Any one of the above symptoms mentioned could cause the GPR-90RXD to be inoperative. (See figure 5-2.) Check the tube pin socket voltages with a reliable 20,000 ohms-per-volt meter.

Check the voltage across voltage regulator V15 for 150 volts. V15 could short and prevent the chassis from receiving full voltage output. A faulty voltage regulator would cause the various oscillators to malfunction.

(2) CHASSIS. - If, after the power supply has been checked out the GRP-90RXD still does not operate correctly, inspect all the tubes and see that the filaments are glowing, replacing any tubes as necessary. If the filaments are good, note the operation of the S-meter. If the S-meter operates correctly, the fault is probably in V8, V9, V10, or V11. If not, check the RF and IF circuits first. The quickest method of locating the trouble is to utilize the voltage and resistance diagram, figure 5-2.

## 5-5. VARIABLE FREQUENCY OSCILLATOR VOX-3.

a. GENERAL. - As pointed out in paragraph 4-4-a, the VOX consists of the power supply (section 1), the RF chassis (section 2), and the VMO (section 3). The voltage and resistance diagrams, figures 5-4-a and 5-4-b, make use of this division of equipment.

b. VOLTAGE AND RESISTANCE DIAGRAMS. - Figures 5-4-a and 5-4-b show voltage and resistance-to-chassis and voltage-to-chassis measurements at vacuum tube pins and other selected points in the VOX under the conditions stated.

c. LOCATION DATA. - Figures 5-5-a through 5-5-c are layout diagrams with callouts of the major electronic equipment elements of the VOX.

d. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. - Refer to table 3-1 for interpretation of control designations. Refer to table 5-2.

e. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - The following paragraphs present selected specification performance data of the VOX.

(1) HFO CHAIN. - The oven is the heart of the VOX, and improper functioning will greatly hamper oscillation stability. The inner and outer ovens are thermostatically controlled to 70°C and 60°C, respectively. An inner oven safety thermostat, S302, set at 80°C protects the unit in case of excessive temperatures due to sticking or mechanical failure of thermostat, S301. Figure 4-13 illustrates the operation of the thermostat switch circuits both for 110 and 220 volts. In normal operation, thermostat S301 is open and relay K301 is closed. When the temperature reaches 70°C, S301 closes, thus energizing the coil of relay K301 which in turn opens up the contacts of the relay. In the event that S301 should fail due to sticking, etc., safety switch S302 opens at 80°C, thus preventing further current from passing through the heating elements, R307 and R308. The oven neon bulbs on the front panel give good indication as to normal operation of the inner and outer ovens. In normal operation, the operator should see the OUTER OVEN pilot lamp blink alternately "on" for approximately 5 seconds and "off" for approximately 90 seconds. In the event that thermostat S301 is malfunctioning, the inner oven continues to heat until safety switch S302 is open at 80°C. When the temperature reaches 80°C, the inner oven pilot blinks erratically at short intervals, instead of the usual 90 seconds, in normal operation. At this point the operator should check the thermostat on S301 in the rear of the unit and replace S301 if the thermostat reads well over 70°C.

To check the VMO output, simply turn METER switch to VMO and notice the deflection of the milliammeter on the front panel which should read approximately 0.9 milliampere. Next, check the voltages and resistances on tubes V301 and V302. Last, check the circuit components for proper voltages and resistances. R302 is a critical resistor.

Once it has been established that the VMO is operating properly, any succeeding stage to the HFO output may be checked and traced, stage by stage, to its fault. This may be accomplished as follows:

(a) Turn METER switch to HFO.

(b) Turn MASTER OSCILLATOR FREQUENCY knob to desired output frequency.

Then, notice the deflection in the needle of the milliammeter on the front panel. If, for example, the user wishes to operate on 20 mc, a null reading on the meter indicates a fault somewhere between the 16- to 32-mc stage (V206, L207, and C225) and/or each preceding stage to initial amplifier V202. Next, the operator should change his dial reading for the 8- to 16-mc band, switch to the 8- to 16-mc band switch, and notice any output on the milliammeter. The usual test procedure is recommended for checking the two amplifier output tubes, V203 and V204.

(2) IFO. - The output of the IFO may be checked again by switching METER switch S107 to IFO position and observing the output reading on the milliammeter. The critical components in this circuit are variable condenser C207, coil L201, crystal Y201, and grid bias resistor R205.

(3) BFO. - The BFO output may be checked again in the manner described above for the IFO. Critical components are C120, L102, R117, and variable resistor R116 together with crystals Y101 and Y102.

(4) CALIBRATING CHAIN. - The calibrating chain has been designed for stable and trouble free operation and is the least likely circuit in the unit to develop trouble. The main components of this chain are the VMO output and the 100-kc oscillator circuit. The VMO output may be checked in the manner already described. The 100-kc output may be checked by connecting an oscilloscope to pin 1 of tube V103. Improper mixer action by V103 and faulty low-pass filtering components also contribute to trouble.

(5) POWER SUPPLY. - A major fault in the power supply would abruptly cut off the B+ supply voltages to all the tubes. If there is no reading on the milliammeter for any position on the meter switch of the front panel, this is a good indication of power supply failure. The voltages on transformer T101 and tubes V101 and V102 should be checked to determine if anything is wrong.

**NOTE**

The front panel milliammeter circuits have been so adjusted that the following relationships exist in each of the METER switch positions:

HFO position - output meter reads 20 volts full scale.

IFO position - output meter reads 10 volts full scale.

BFO position - output meter reads 20 volts full scale.

VMO position - output meter reads 10 volts full scale.

## 5-6. SINGLE SIDEBAND CONVERTER MSR-6.

a. VOLTAGE AND RESISTANCE DIAGRAM. - Figure 5-6 shows resistance-to-chassis and voltage-to-chassis measurements at vacuum tube pins under the conditions stated.

b. LOCATION DATA. - Figures 5-7-a and 5-7-b locate the major electronic elements of the MSR-6.

c. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. - Refer to table 3-1 for interpretation of control designations. Refer to table 5-3.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - Careful observation of the performance of the MSR-6 sectionalizes the fault to a particular stage or circuit. The MSR-6 may be divided into three main operating sections:

(1) Oscillator and mixer circuits.

(2) Audio circuits.

(3) Power supply.

If the panel lamp fails to glow when POWER switch S7 is set to the up position, check fuse F1. Replace if necessary. If the fuse is not at fault, replace the lamp. General malfunction of the MSR-6 means that the power supply should be checked first by using the voltage and resistance diagram, figure 5-6. Check the pin resistances of tube V10 if fuse F1 opens after being replaced. If not, check the voltages at tubes V10 and V11. If V11 is defective, the power supply output voltage could be low or cause the oscillators to be unstable.

If no audio is heard at all with AUDIO GAIN control R30 fully clockwise, the trouble is very probably associated with tubes V5B or V6. Check the filaments before making voltage measurements. If a very low hum is heard with the MSR-6 at maximum audio gain and the hum disappears as the gain is reduced, the fault lies in the oscillator and mixer circuit.

The purpose of the MSR-6 is to assure stable reception at the DDR-6E. Assuming that the AFC-1 is operating correctly and the reception is heard to be unstable, the following paragraph should help to localize the fault.

To ascertain that first and second oscillators V7 and V5A, respectively, are operating correctly in conjunction with the AFC-1, apply the signal voltage at pin 3 of filter Z1 to the vertical terminals of a CRO and the signal voltage at pin 3 of V5 to the horizontal terminals. A Lissajous figure indicating zero beat should be observed. If necessary, adjust trimmer capacitor C29 until zero beat is indicated. BANDSPREAD control C28 should be set at zero center. If a Lissajous figure cannot be obtained at all, check tubes V3 and V7 if the vertical component is absent. If there is no horizontal component, check tube V5A. If the Lissajous figure indicates a large deviation from a zero beat, check tube V8. Check tube V4 if instability persists.

If the trouble is not one of operational stability, check tubes V1 and V2. Absence of the sideband tone indicates a fault at tube V9.

## 5-7. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1.

a. VOLTAGE AND RESISTANCE DIAGRAM. - Figure 5-8 shows resistance-to-chassis measurements at vacuum tube pins under the conditions stated.

b. LOCATION DATA. - Figures 5-9-a through 5-9-b and major electronic elements of the AFC-1.

c. TROUBLE-SHOOTING CHART BASED ON OPERATING PROCEDURES. - Refer to table 3-1 for interpretations of control designations. Refer to table 5-4.

d. TROUBLE-SHOOTING PROCEDURES BASED ON CIRCUIT SECTIONALIZATION. - The following paragraphs present trouble-shooting procedures which are keyed to functional sections of the AFC-1.

(1) POWER SUPPLY. - If the pilot lamp fails to go on with the POWER switch set to the on position, check the input power fuse. If there is B+ failure, check the bridge rectifier and power supply LC filter network. Visually inspect the power supply for any signs of component discolorization due to overheating, arcing, or shorts. Check for loose soldered connections. Any one of the above symptoms mentioned could cause the AFC-1 to be inoperative. (See figure 5-8.) Check the tube pin socket voltages with a reliable VTVM.

(2) CHASSIS. - If, after the power supply has been checked out, the AFC-1 still does not operate, visually inspect all the tubes and see that the filaments are on, replacing any tubes as necessary. If the tube filaments are on, note the operation of the CARRIER LEVEL meter. If the CARRIER LEVEL meter operates correctly, the fault is probably in V3, V4, V5, V7, V8, V9, or the phase detector diodes. If not, and the FADE ALARM lamp is on instead, check the carrier amplifiers, carrier rectifier, and memory lock and fade alarm circuits first. The quickest method of locating the trouble is to utilize the voltage and resistance diagram, figure 5-8.

### TABLE 5-1. TROUBLE-SHOOTING CHART, COMMUNICATIONS RECEIVER GPR-90RXD

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 1 | Set GPR-90RXD controls and switches for AM reception. RF GAIN control R81 should be adjusted fully clockwise. After a 1-minute warm-up period, tune the GPR-90RXD through band 2, observe the S-meter, and listen to the audio, adjusting AUDIO GAIN control R68 as required. | S-meter M1 should deflect each time a station is tuned as indicated by the audio output. Front panel lamps glow. | If none of the normal indications are present, check fuse F1 and replace if necessary. Repeat step 1. If the fuse opens, check tubes V14 and V15 and their associated circuits.<br><br>If S-meter M1 fluctuates as the GPR-90RXD is tuned and no audio is heard, check tubes V11, V10, V9, and V8 in that order.<br><br>If S-meter M1 fluctuates very weakly, check tubes V7, V6, V5, and V3.<br><br>If S-meter M1 does not deflect at all, check tubes V12, V7, V6, V5, V3, V2, and V1. |
| 2 | Turn RANGE SELECTOR switch S1 to 9.4-17.8. | S-meter M1 should deflect each time a station is tuned. | If S-meter M1 fluctuates very weakly or not at all, check tube V4. |
| 3 | Set CAL switch S11 to the ON position. | S-meter M1 should deflect at 100-kc intervals. | Check tube V16 and its associated circuit. |
| 4 | Set GPR-90RXD controls and switches for CW reception. Tune the GPR-90RXD over any band. | Audio beats should be heard each time a carrier is tuned. | Check tube V13 and its associated circuit. |

## TABLE 5-1. TROUBLE-SHOOTING CHART, COMMUNICATIONS RECEIVER GPR-90RXD (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 5 | Set GPR-90RXD controls and switches for SSB reception. Tune in an SSB station. | Nondistorted audio should be heard. | Check tube V13 and its associated circuit. |
| 6 | Set GPR-90RXD controls for AM reception; turn HFO switch S12 to any of the 10 crystal positions and switch S13 to position 5. Tune in the particular channel as determined by the crystal chosen. | Normal AM reception should be heard. | Tune to a different channel. Check tube V17 and switches S12 and S13. |

## TABLE 5-2. TROUBLE-SHOOTING CHART, VARIABLE FREQUENCY OSCILLATOR VOX-3

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 1 | Set POWER switch S101 to ON position. | MAIN POWER (red) indicator I302, INNER OVEN indicator I301, and OUTER OVEN indicator I304 should all go on. After a sufficient time has elapsed during the warm-up period (approximately 6 hours), the operator observes the OUTER OVEN pilot indicator alternately go on: ON for approximately 5 seconds and OFF for approximately 30 seconds. The INNER OVEN pilot indicator should alternately go on: ON for approximately 90 seconds and OFF for 90 seconds. | Set POWER switch S101 to OFF position. Check continuity of fuses F101, F102, and the power cord. Check the input power. In the event the OUTER OVEN pilot indicator remains on, the 60°C thermostate is sticking (closed). Should the OUTER OVEN pilot indicator not go on, replace the 60°C thermostat or pilot indicator lamp. In the event the INNER OVEN pilot indicator remains on, the 70°C thermostat is sticking or relay K301 is faulty. At 80°C, safety switch will open the circuit to the INNER OVEN; this allows the INNER OVEN pilot indicator to blink erratically instead of the prescribed 90-second interval. |
| 2 | Set HFO, IFO, and BFO switches to their ON positions.<br><br>Turn METER selector switch S107 concurrently to each of the above positions. | Applies power to each section.<br><br>Monitors the output of each section. | In the event of no output from any section, turn power OFF and check all connections and continuity of the meter.<br><br>No output from the HFO section, check continuity of switch S103, plug P101 (pin 11), and jack 201 (pin 8).<br><br>No output from the IFO section, check continuity of switch S102 and visually inspect all connections.<br><br>No output from the BFO section, check continuity of switch S106 and visually inspect all connections. |

**TABLE 5-2. TROUBLE-SHOOTING CHART, VARIABLE FREQUENCY OSCILLATOR VOX-3 (C nt.)**

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 3 | Set BEAT ON-OFF switch S104 to ON position. | Applies power to the 100-kc calibration oscillator. ZERO BEAT pilot indicator will go on at any 100- or 50-kc checkpoint. | If the beat frequency can be heard aurally and the ZERO BEAT pilot indicator does not go on, the malfunction is either the ZERO BEAT pilot indicator or socket. Check continuity and connections. |
| | Plug headphones into PHONES jack J105. | Monitors ZERO BEAT aurally. | If the ZERO BEAT pilot indicator does not go on and the beat frequency cannot be heard aurally, the fault is in BEAT ON-OFF switch S104 or in the BFO circuit. |
| 4 | Turn XTAL selector switch S201 to VMO. Concurrently turn METER selector switch S107 to VMO. | Connects the VOX's VMO output to the HFO input. Notice the deflection of output meter M301 (miliammeter) on the front panel; it should indicate approximately 0.9 ma. | If there is no output from the VMO section indicated on the output meter, visually check the position and connections of METER selector switch S107 and XTAL selector switch S201. Check tubes V301 and V302. |
| 5 | Turn BAND-MCS selector switch S202 through the various bands of frequency. Be sure that the METER selector switch is positioned at HFO. | Needle deflection of 0.5 ma on the output meter on all bands. | In the event that there is no needle deflection on any frequency band selected on the BAND-MCS switch, visually check all connections to the BAND-MCS and METER selector switches. |
| 6 | Turn MASTER OSCILLATOR FREQUENCY knob C302 to the nearest 100-kc division of the 2- to 4-mc VMO frequency. Plug in headphones. Rotate TUNING knob in one direction only. Vary the CALIBRATE control. | A zero beat will be detected in the headphones and ZERO BEAT indicator I303 will go on at each 100-kc checkpoint. | If there is no zero beat on the ZERO BEAT pilot indicator or aural indication on the headphones, 100-kc oscillator crystal or VMO section may be faulty. Power supply and/or mixer-audio section may be defective. |
| 7 | With the HFO switch in the ON position and the METER select switch returned to the HFO position, turn the XTAL switch to the 1 position. Turn the BAND-MCS switch to the 2-4 mc band. "Trim" the XTAL selected by rotating (tuning) XTAL FREQ knob (trimmer) until the exact frequency is set, and then pick the signal with the TUNING knob. | Maximum nominal deflection on the output meter should be approximately 0.75 ma. | Should there be no needle deflection, visually check all the connections to the 1 position on XTAL control. If these are normal, the fault is in the HFO section. |

## TABLE 5-2. TROUBLE-SHOOTING CHART, VARIABLE FREQUENCY OSCILLATOR VOX-3 (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 8 | Turn TUNING knob to a position approximately that of the MASTER OSCILLATOR FREQUENCY dial. Adjust the TUNING knob to peak output meter. | TUNING knob will be set properly when the highest needle deflection on the output meter is obtained. | If the meter reading fails to peak, visually check all the connections on TUNING knob. If these are normal, the fault is in the HFO section. |
| 9 | Turn OUTPUT knob R215 for a 0.2-mil needle deflection on output meter M301. | Needle deflection on the meter is 0.2 ma. | If this deflection cannot be obtained, visually check all output and output meter connections. If they remain normal, the fault is in the HFO section. |
| 10 | Turn TUNING control C225 for maximum deflection on output meter. | Maximum needle deflection on the meter. | In the event of a malfunction, visually check all tuning and meter connections. If they remain normal, the fault is in the HFO section. |
| 11 | Repeat the procedure outlined in steps 8 through 10; change XTAL switch to position 2 or 3, respectively. | | |

## TABLE 5-3. TROUBLE-SHOOTING CHART, SINGLE SIDEBAND CONVERTER MSR-6

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 1 | Set main POWER switch S7 to the up position. | Panel indicator lamp I3 glows. | Check panel indicator lamp I3. Check fuse F1 and replace if necessary. Repeat step 1. If the fuse opens, check tubes V10 and V11. |
| 2 | Set the GPR-90RXD and MSR-6 for SSB reception. | | |
| 3 | a. Locate a SSB station transmitting an upper sideband and tune the GPR-90RXD 2 kc above the signal frequency. | Steady, clear audio should be heard. | If no audio is heard at all, check tubes V6 and V5B. If only a very low volume can be achieved, check OUTPUT LEVEL switch S8. If the audio distorts, replace tube V8. If tube V8 is not at fault, check tubes V7 and V5A. If V7 and V5A are not at fault, check the AFC-1. If the audio level is unsteady or unreasonably high at a low setting of AUDIO GAIN control R30, check tube V1. If the output is low or absent and none of the above remedies apply, check tubes V2, V3, and V4. |

TABLE 5-3. TROUBLE-SHOOTING CHART, SINGLE SIDEBAND CONVERTER MSR-6 (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 3 (Cont.) | b. With MANUAL-XTAL switch S4 in the MANUAL position, tune MSR-6 BANDSPREAD control C28 +2 kc above zero center for intelligibility.<br><br>c. Set MANUAL-XTAL switch S4 to the XTAL position; place a 474-kc crystal in socket Y2. Tune the GPR-90RXD for intelligibility. | | |
| 4 | a. Locate a SSB station transmitting a lower sideband and tune the GPR-90RXD 2 kc below the signal frequency.<br><br>b. With MANUAL-XTAL switch S4 in the MANUAL position, tune MSR-6 BANDSPREAD control C28 2 kc below zero center for intelligibility.<br><br>c. Set MANUAL-XTAL switch S4 to the XTAL position; place a 436-kc crystal in socket Y1. Tune the GPR-90RXD for intelligibility. | Same as step 3. | Same as step 3. |
| 5 | Set the GPR-90RXD and MSR-6 for AM reception. | Clear audio should be heard. | Except for tubes V5A and V9B, the same remedies apply for AM reception as for SSB reception. Tubes V9B and V5A are not used for AM reception. |
| 6 | a. With the MSR-6 set on UPPER and MANUAL-XTAL switch S4 in the MANUAL position, tune the GPR-90RXD 1.6 kc above the signal frequency.<br><br>b. Tune MSR-6 BANDSPREAD control C28 +2 kc above zero center.<br><br>c. Set MANUAL-XTAL switch S4 to the XTAL position.<br><br>Insert a 474-kc crystal in socket Y2. Retune the GPR-90RXD 1.6 kc above the signal frequency. | | |

#### TABLE 5-3. TROUBLE-SHOOTING CHART, SINGLE SIDEBAND CONVERTER MSR-6 (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 7 | a. Set the MSR-6 on LOWER and MANUAL-XTAL switch S4 to the MANUAL position. Tune the receiver 1.6 kc below the signal frequency.<br><br>b. Tune MSR-6 BAND-SPREAD control C28 -2 kc below zero center.<br><br>c. Set MANUAL-XTAL switch S4 to the XTAL position. Insert a 436-kc crystal in socket Y1. Retune the GPR-90RXD 1.6 kc below the signal frequency. | | |

#### TABLE 5-4. TROUBLE-SHOOTING CHART, AUTOMATIC FREQUENCY CONTROL UNIT AFC-1

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 1 | Set the AFC-1 controls and switches for operation as outlined in paragraph 3-3. After a few minutes warmup, tune the MSR-6 to a signal. Observe the CARRIER LEVEL meter and the A. F. C. INDICATOR meter. | Front panel lamps go on. CARRIER LEVEL meter should indicate received signal. A.F.C. INDICATOR meter should indicate a drift voltage after a few minutes of operation.<br><br>**NOTE**<br><br>The FADE ALARM lamp should go on whenever the MSR-6 is not tuned to a signal, but the lamp should go out when a signal is received. | If none of the normal indications are present, check the input power fuse. If the fuse is open, replace it and repeat step 1. If the above condition continues, check tubes V10, V11, bridge rectifier, and associated circuit elements.<br><br>If the CARRIER LEVEL meter does not indicate, check tubes V1, V2, V3, and associated circuit elements.<br><br>If the CARRIER LEVEL meter does indicate and the FADE ALARM lamp remains on, check tubes V6, V7, relay K1, and associated circuit.<br><br>If an AFC voltage is not indicated by the A. F. C. INDICATOR meter after several minutes of operation (with MSR-6 tuned to a signal) check tubes V3, V4, V5, V8, phase detector diodes, and associated circuit elements. Check the 17-kc circuit components. |

## TABLE 5-4. TROUBLE-SHOOTING CHART, AUTOMATIC FREQUENCY CONTROL UNIT AFC-1 (C nt.)

| STEP | CONTROL OPERATED | NORMAL INDICATION | REMEDY |
|---|---|---|---|
| 2 | Rotate CARRIER COMPENSATOR control either clockwise or counterclockwise. | CARRIER LEVEL meter should indicate an increase or decrease, respectively, in level. | If a zero scale reading is indicated by the meter at any one step of the control rotation, check that contact in the control for looseness or corrosion. |
| 3 | Tune the MSR-6 slightly off the carrier frequency. | FADE ALARM lamp should go on. A.F.C. INDICATOR meter should continue to indicate AFC voltage. | If FADE ALARM lamp does not operate correctly, refer to paragraph 3-3 for fade alarm adjustment.<br><br>If the adjustment fails to provide correct FADE ALARM lamp operation, check tubes V7, relay K1, and associated circuit.<br><br>If the FADE ALARM lamp does operate, but the A.F.C. INDICATOR meter indicates zero or center scale at this time, check the 4-microfarad capacitor in the grid circuit of V5 for an open condition. |
| 4 | Tune MSR-6 to a signal. Depress the A.F.C. RESET pushbutton.<br><br>**NOTE**<br><br>Allow at least a few minutes to enable frequency drift to build up. Otherwise, the A.F.C. INDICATOR meter will indicate zero or center scale as a result of a no-drift condition. | A.F.C. INDICATOR meter should indicate zero or center scale. | If the A.F.C. INDICATOR meter continues to indicate the AFC voltage, check the A.F.C. RESET switch contacts. |

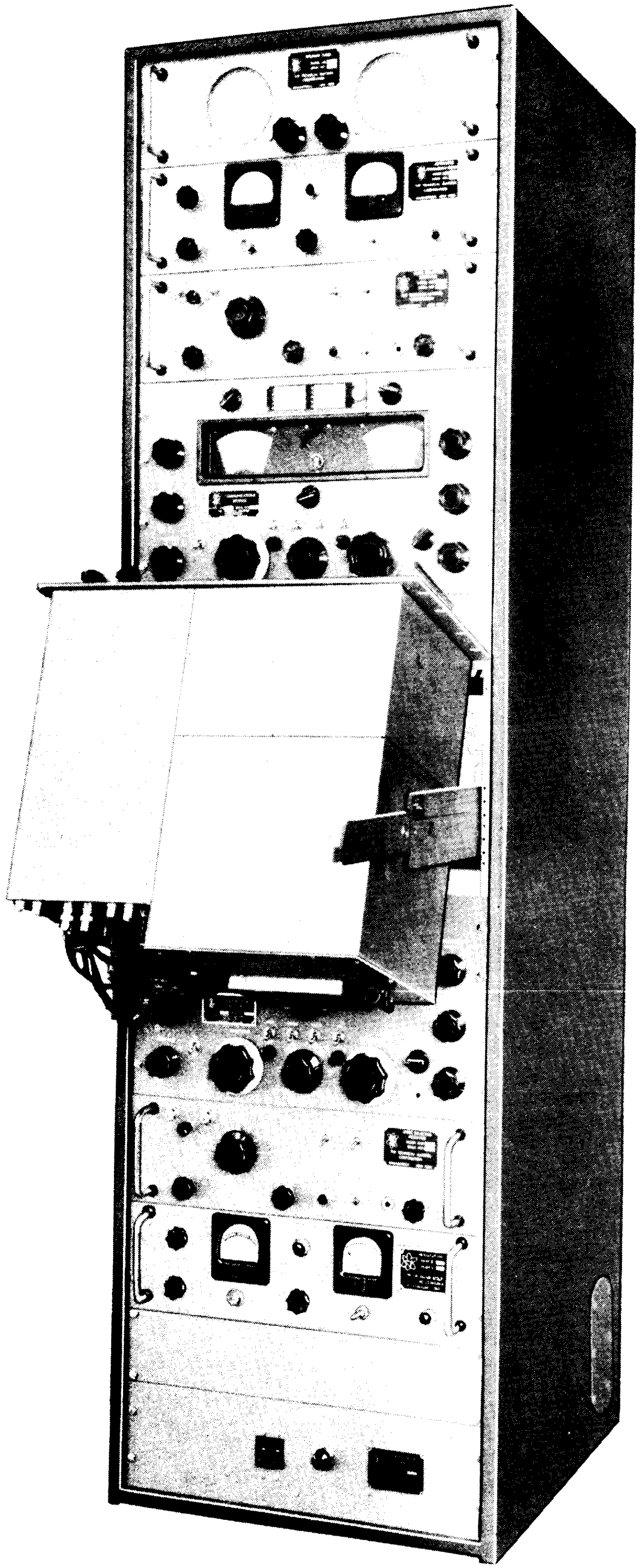
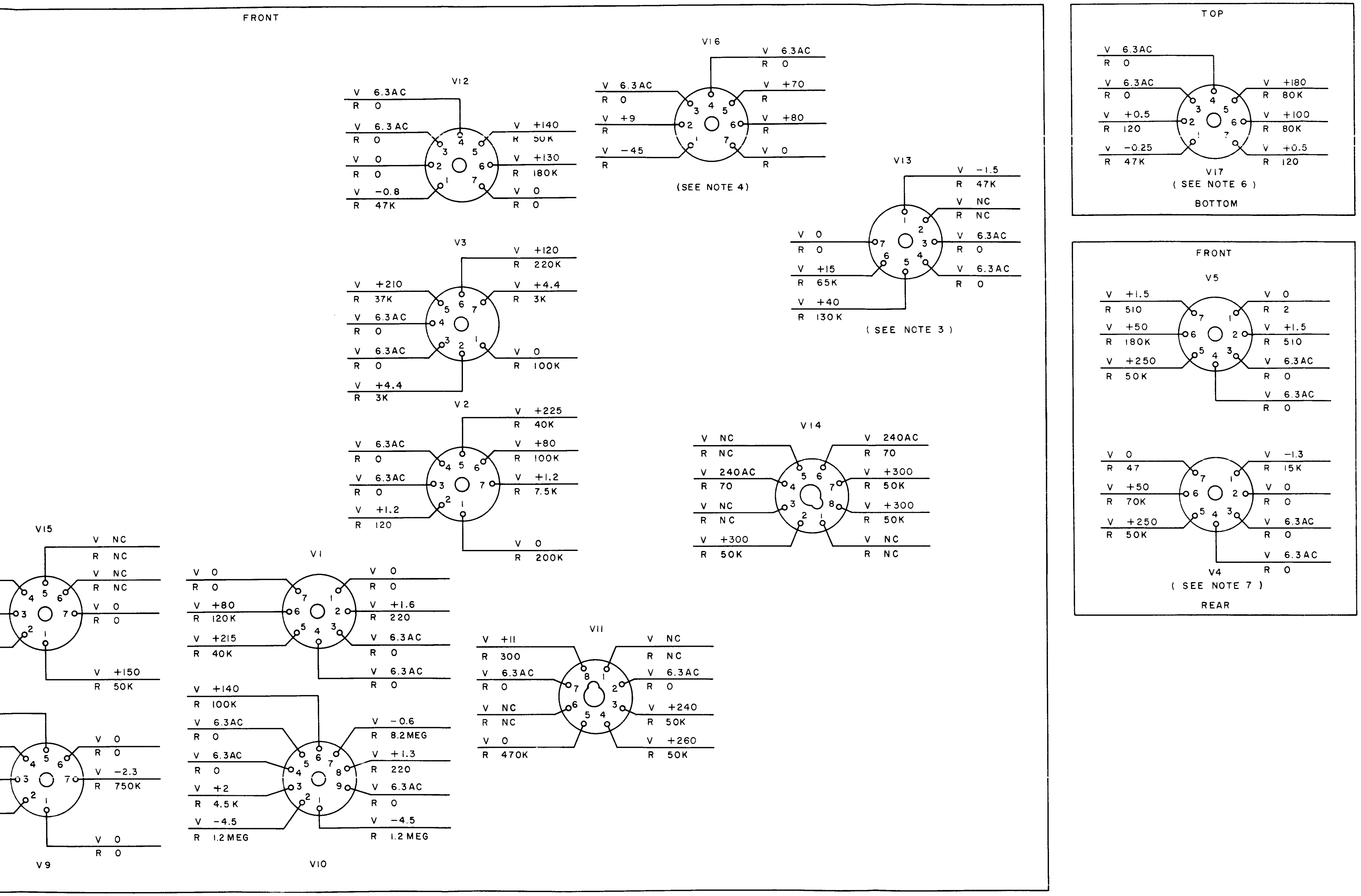


Figure 5-1. VOX-3 in Service Position




CONDITIONS:

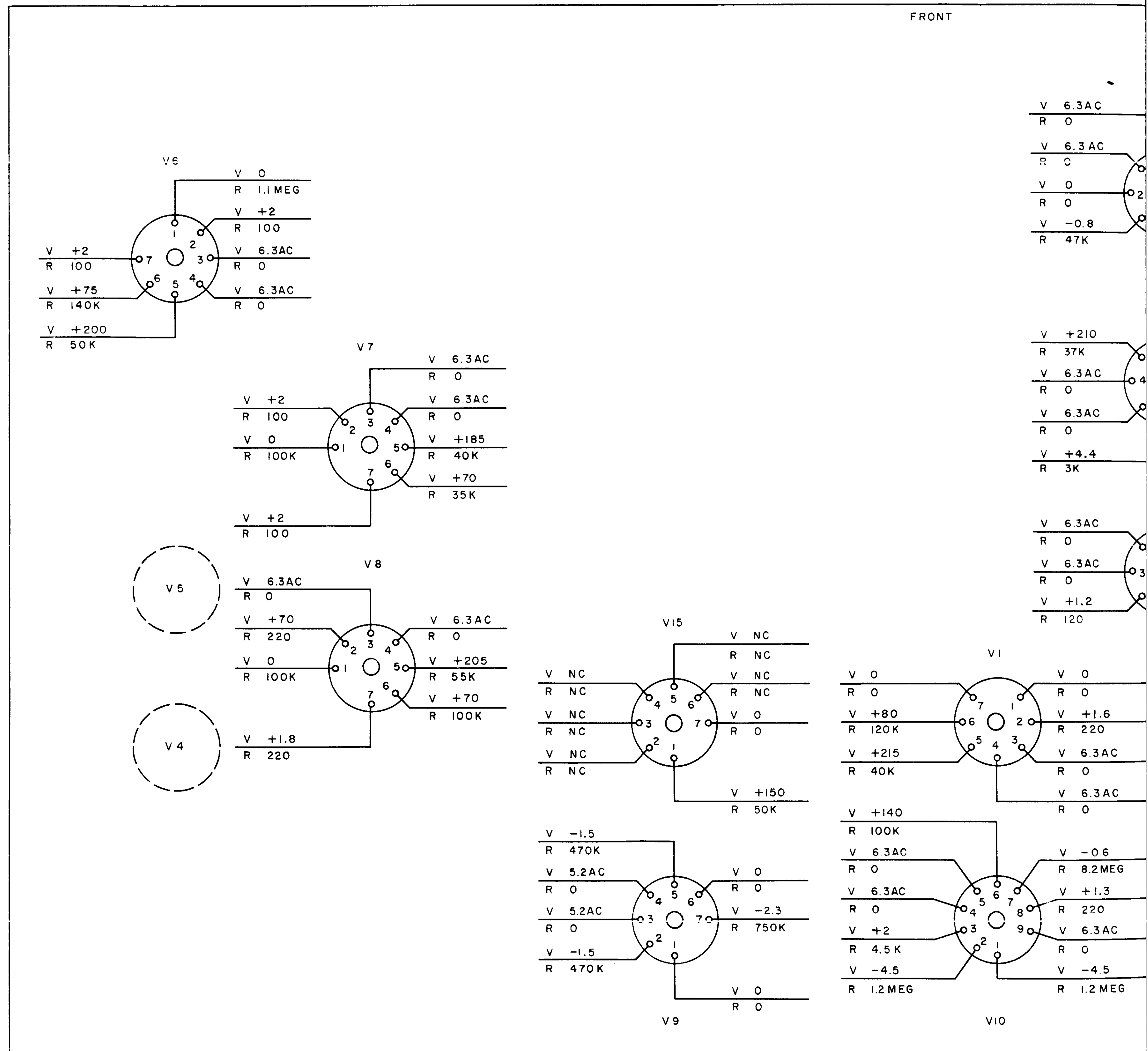
VOLTAGE MEASUREMENTS

1. ALL MEASUREMENTS MADE TO CHASSIS GROUND, EXCEPT FILAMENT VOLTAGES WHICH ARE MEASURED ACROSS THE FILAMENTS.
2. RANGE SELECTOR 1.4 – 3.3
   AUDIO GAIN FULLY COUTERCLOCKWISE
   SEND / REC REC
   MANUAL / AVC UP POSITION
   LIMITER / OFF OFF
   BFO / OFF OFF
   CAL / OFF OFF
3. V13 MEASUREMENTS MADE WITH BFO / OFF SWITCH IN UP POSITION.
4. V16 MEASUREMENTS MADE WITH CAL / OFF SWITCH IN UP POSITION.
5. V12 MEASUREMENTS MADE WITH HFO SWITCH IN VAR POSITION.
6. V17 MEASUREMENTS MADE WITH HFO SWITCH IN EXT. POSITION.
7. V4 MEASUREMENTS MADE WITH RANGE SELECTOR SWITCH IN 9.4 – 17.8 POSITION.
8. MEASUREMENTS MADE WITH VTVM.

RESISTANCE MEASUREMENTS:

1. PRIMARY POWER REMOVED.
2. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS.
3. ALL MEASUREMENTS MADE TO CHASSIS GROUND EXCEPT FILAMENT RESISTANCES WHICH ARE MEASURED ACROSS THE FILAMENTS.
4. SEE NOTE 3 OF VOLTAGE MEASUREMENTS.
5. SEE NOTE 4 OF VOLTAGE MEASUREMENTS.
6. SEE NOTE 5 OF VOLTAGE MEASUREMENTS.
7. SEE NOTE 6 OF VOLTAGE MEASUREMENTS.
8. SEE NOTE 7 OF VOLTAGE MEASUREMENTS.
9. SEE NOTE 2 OF VOLTAGE MEASUREMENTS.
10. SEE NOTE 8 OF VOLTAGE MEASUREMENTS.

Figure 5-2. Voltage and Resistance Diagram, GPR-90RXD


FRONT
V6
V7
V8
V5
V4
V15
V9
V1
V10

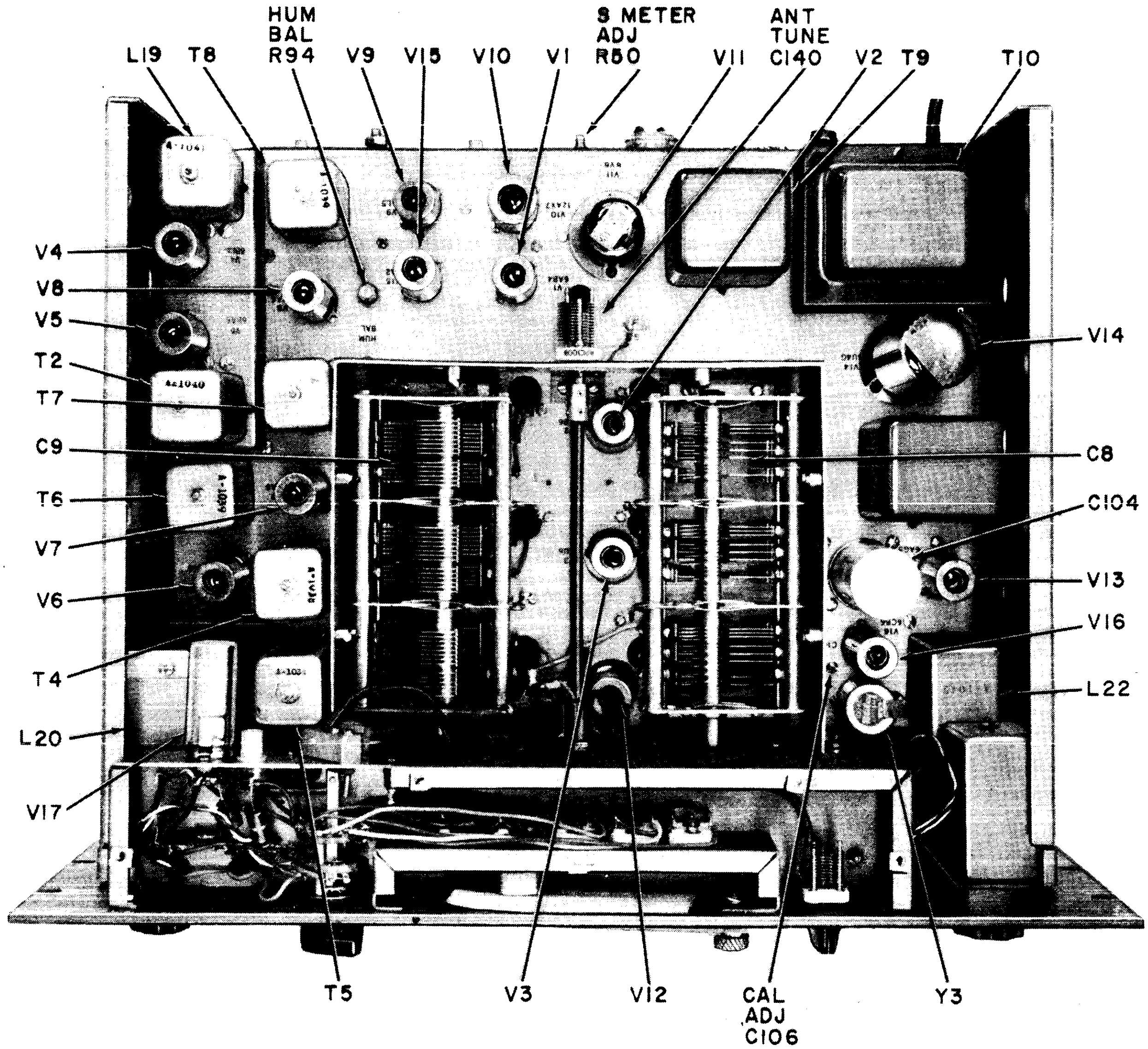



Figure 5-3-a. Location of Major Electronic Components, GPR-90RXD, Top View

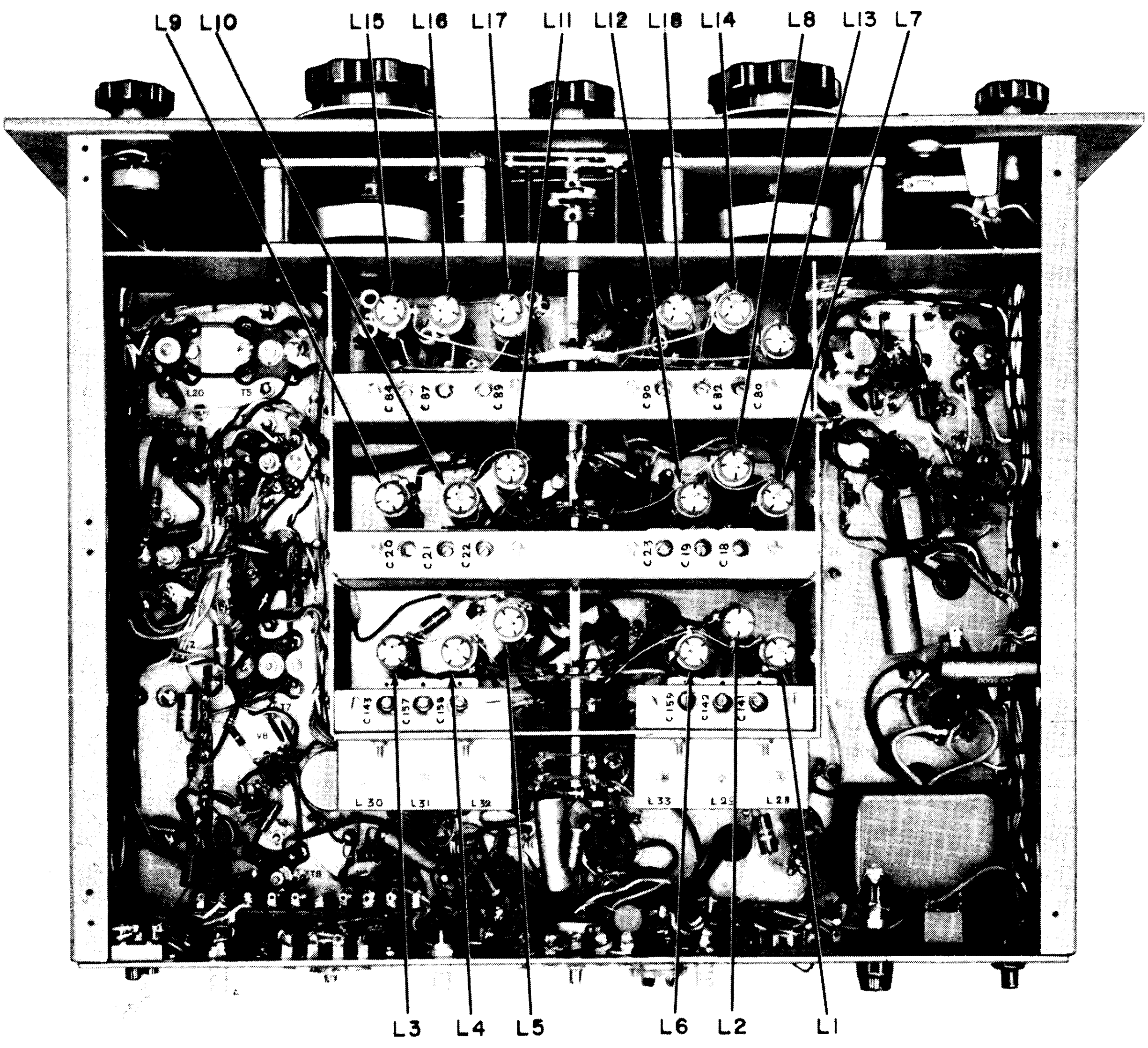
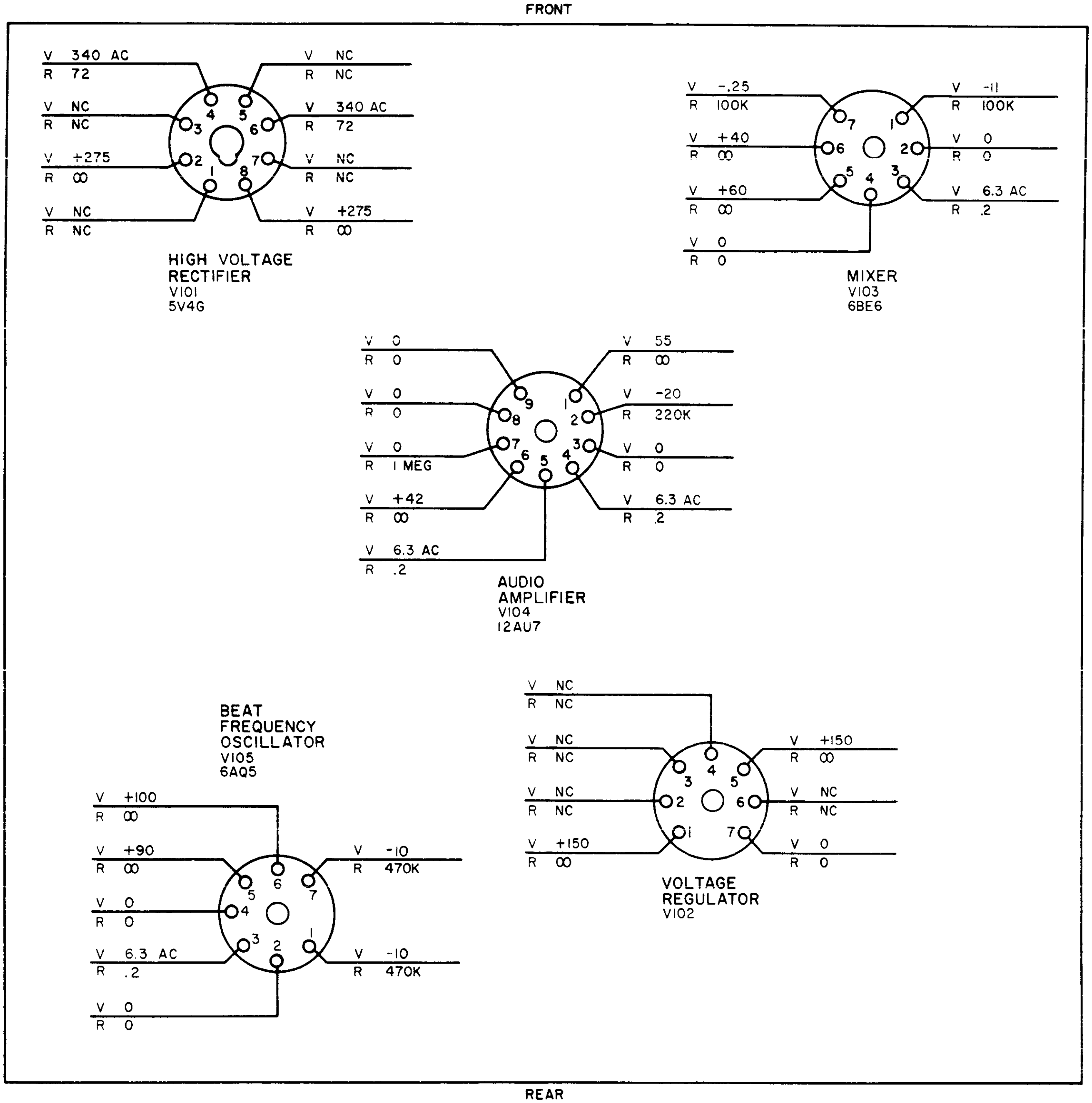


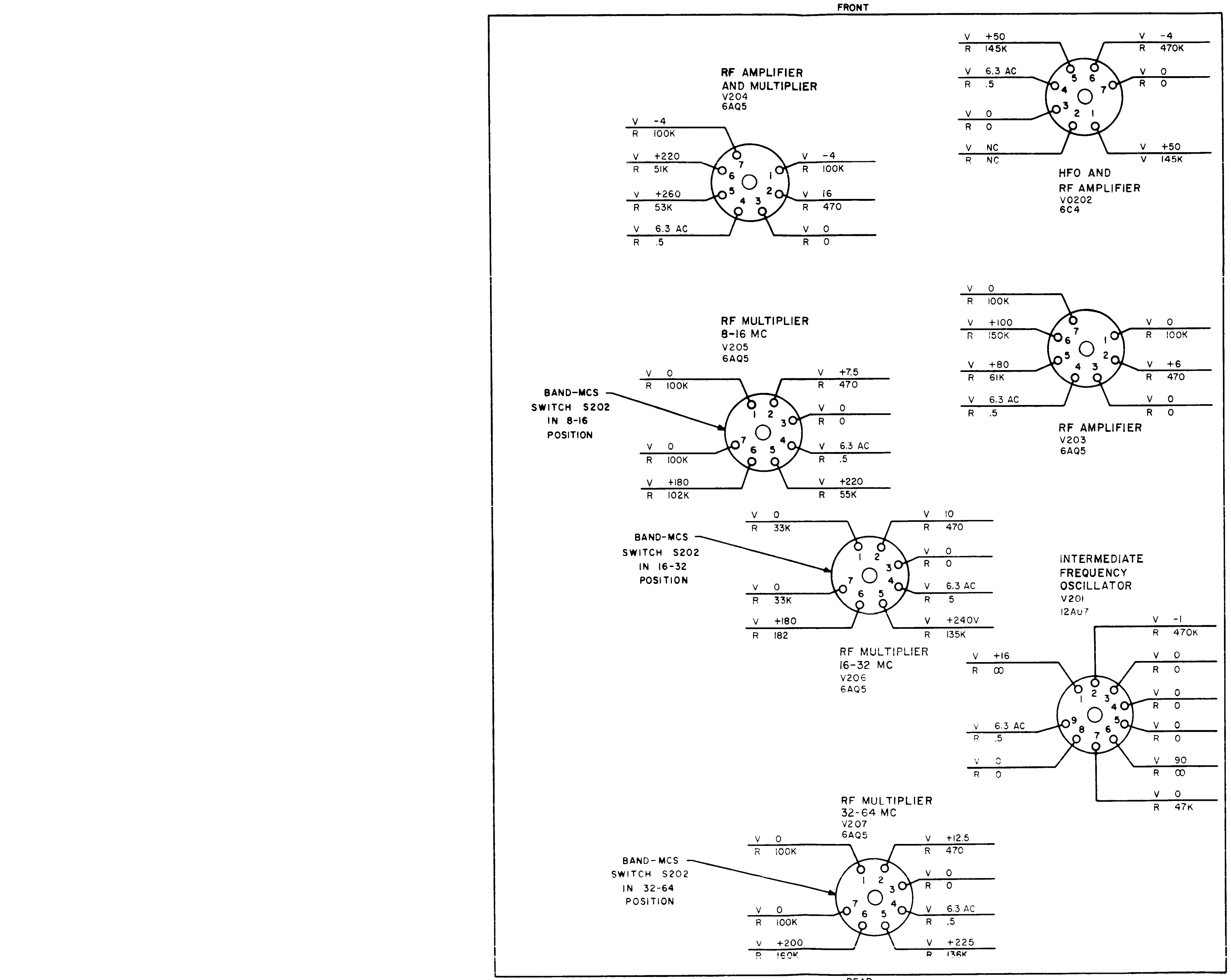

Figure 5-3-b. Location of Major Electronic Components, GPR-90RXD, Bottom View




NOTE:

1. UNLESS OTHERWISE SHOWN, RESISTANCES ARE IN OHMS. VOLTAGES AND RESISTANCES ARE MEASURED FROM TUBE SOCKET PINS TO GROUND WITH A 20,000 OHMS-PER-VOLT METER. FOR RESISTANCES ONLY, MEASUREMENTS ARE MADE WITH ALL THE INTER-CHASSIS CONNECTORS DISCONNECTED.
2. UNLESS OTHERWISE NOTED, ALL MEASUREMENTS ARE MADE WITH THE BAND-MCS SWITCH IN THE 2-4 POSITION; POWER, HFO, IFO, AND BEAT SWITCHES IN THE ON POSITION; TUNING CONTROL TO THE APPROXIMATE FREQUENCY OF THE VMO; OUTPUT CONTROL MAXIUM CLOCKWISE; XTAL SWITCH TO VMO.
3. VOLTAGES ARE DC UNLESS OTHERWISE INDICATED.
4. VOLTAGE READING ABOVE LINE, RESSISTANCE READING BELOW LINE.
5. ∞ INDICATES INFINITY.

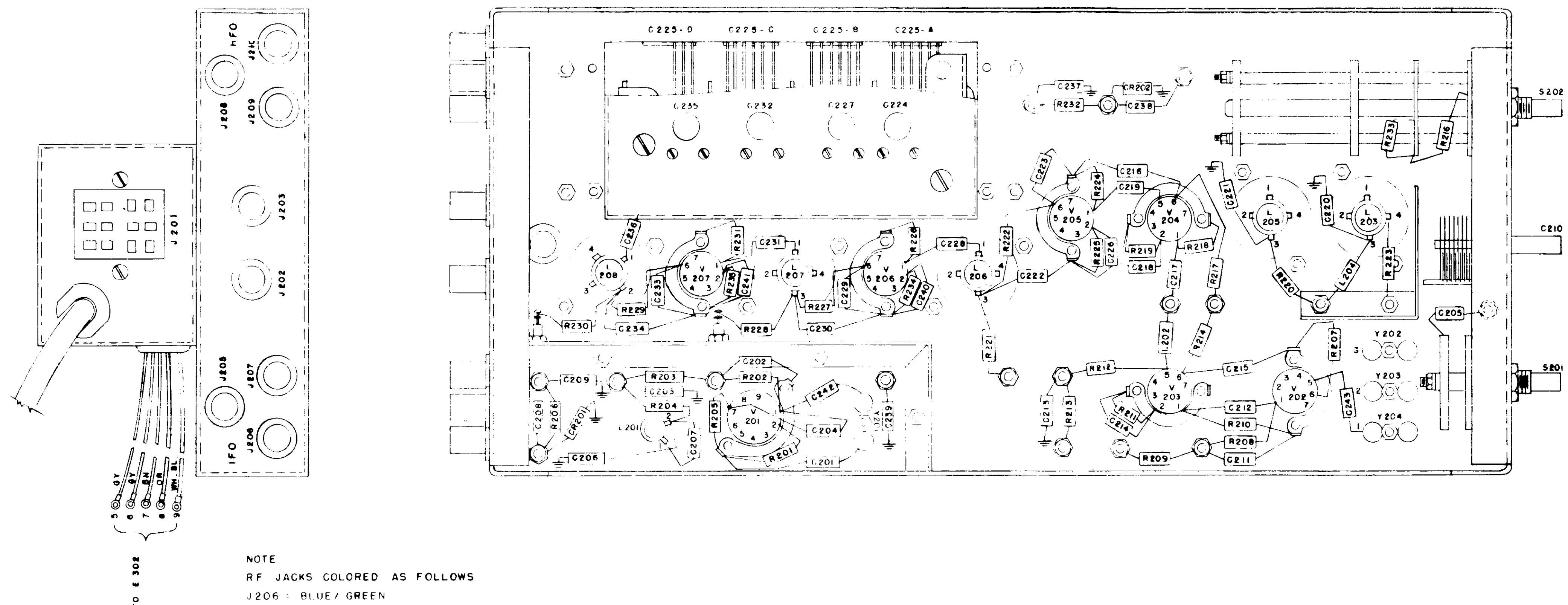
Figure 5-4-a. Voltage and Resistance Diagram, Power Supply, VOX-3




NOTE:

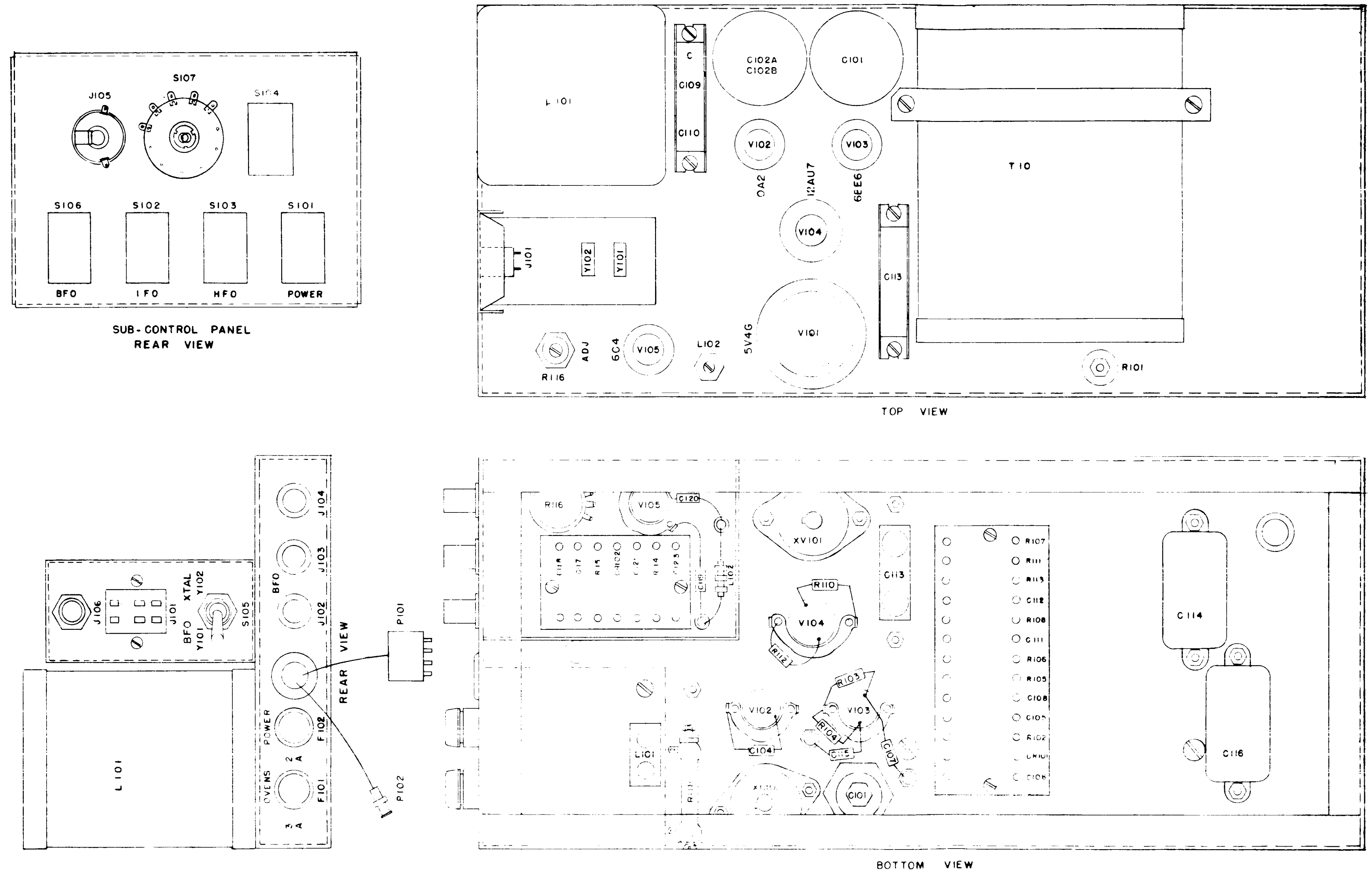
1. UNLESS OTHERWISE SHOWN, RESISTANCES ARE IN OHMS. VOLTAGES AND RESISTANCES ARE MEASURED FROM TUBE SOCKET PINS TO GROUND WITH A 20,000 OHMS-PER-VOLT METER. FOR RESISTANCES ONLY, MEASUREMENTS ARE MADE WITH ALL THE INTER-CHASSIS CONNECTORS DISCONNECTED.
2. UNLESS OTHERWISE NOTED, ALL MEASUREMENTS ARE MADE WITH THE BAND-MCS SWITCH IN THE 2-4 POSITION; POWER, HFO, IFO, BFO, AND BEAT SWITCHES IN THE |ON| POSITION; TUNING CONTROL TO THE APPROXIMATE FREQUENCY OF THE VMO; OUTPUT CONTROL MAXIMUM CLOCKWISE; XTAL SWITCH TO VMO.
3. VOLTAGES ARE DC UNLESS OTHERWISE INDICATED.
4. VOLTAGE READINGS ABOVE LINE, RESISTANCE READINGS BELOW LINE.
5. ∞ INDICATES INFINITY.

Figure 5-4-b. Voltage and Resistance Diagram, RF Chassis, VOX-3



NOTE
RF JACKS COLORED AS FOLLOWS
J206 : BLUE / GREEN
J207 : BLUE / YELLOW
J209 : RED / GREEN
J210 : RED / YELLOW

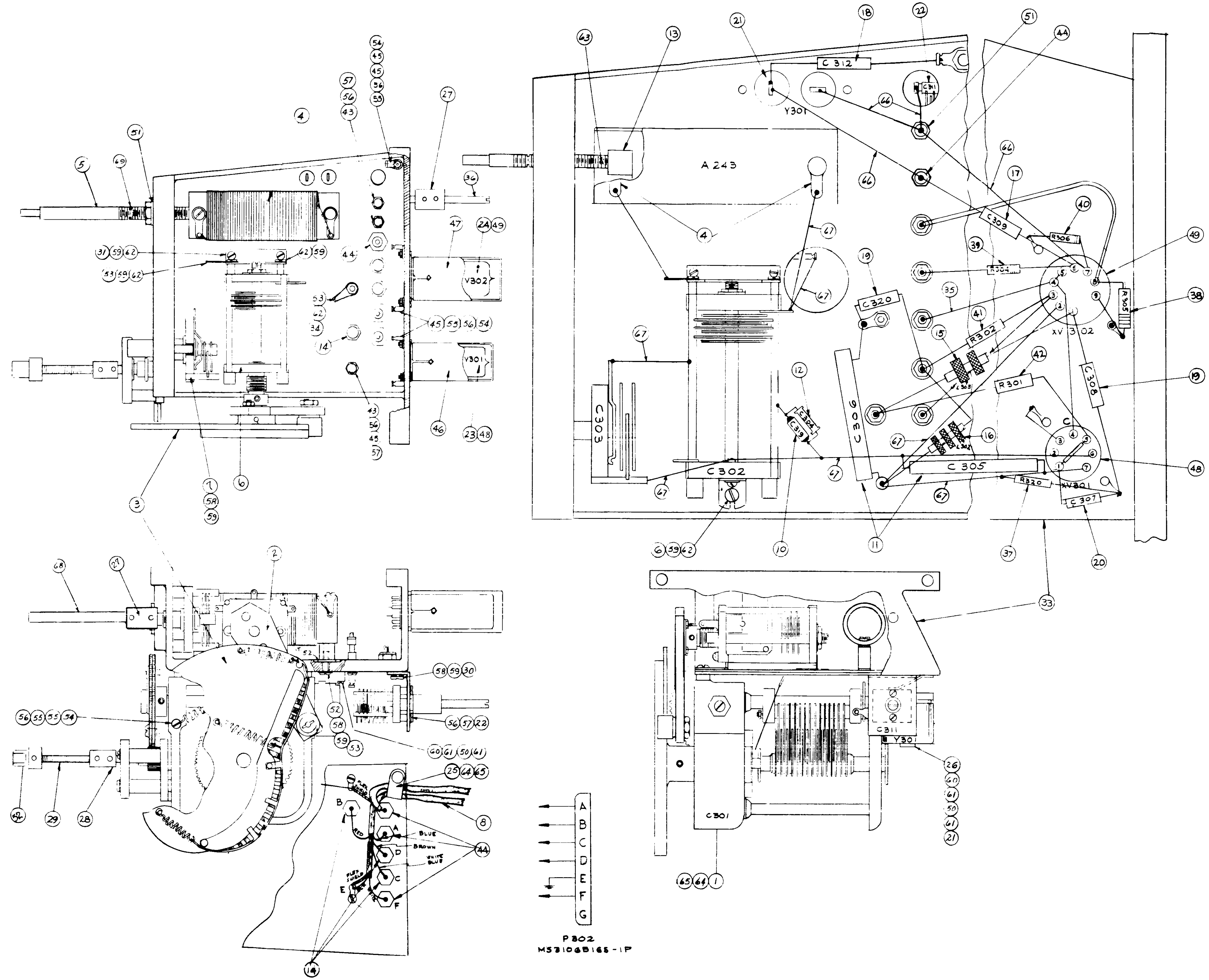
Figure 5-5-a. Layout Diagram,
VOX-3, RF Chassis




SUPERCEDES
CMS070-C

NOTE:
R.F JACKS COLORED AS FOLLOWS:
J102 = BLACK / YELLOW.
J104 = BLACK / GREEN.

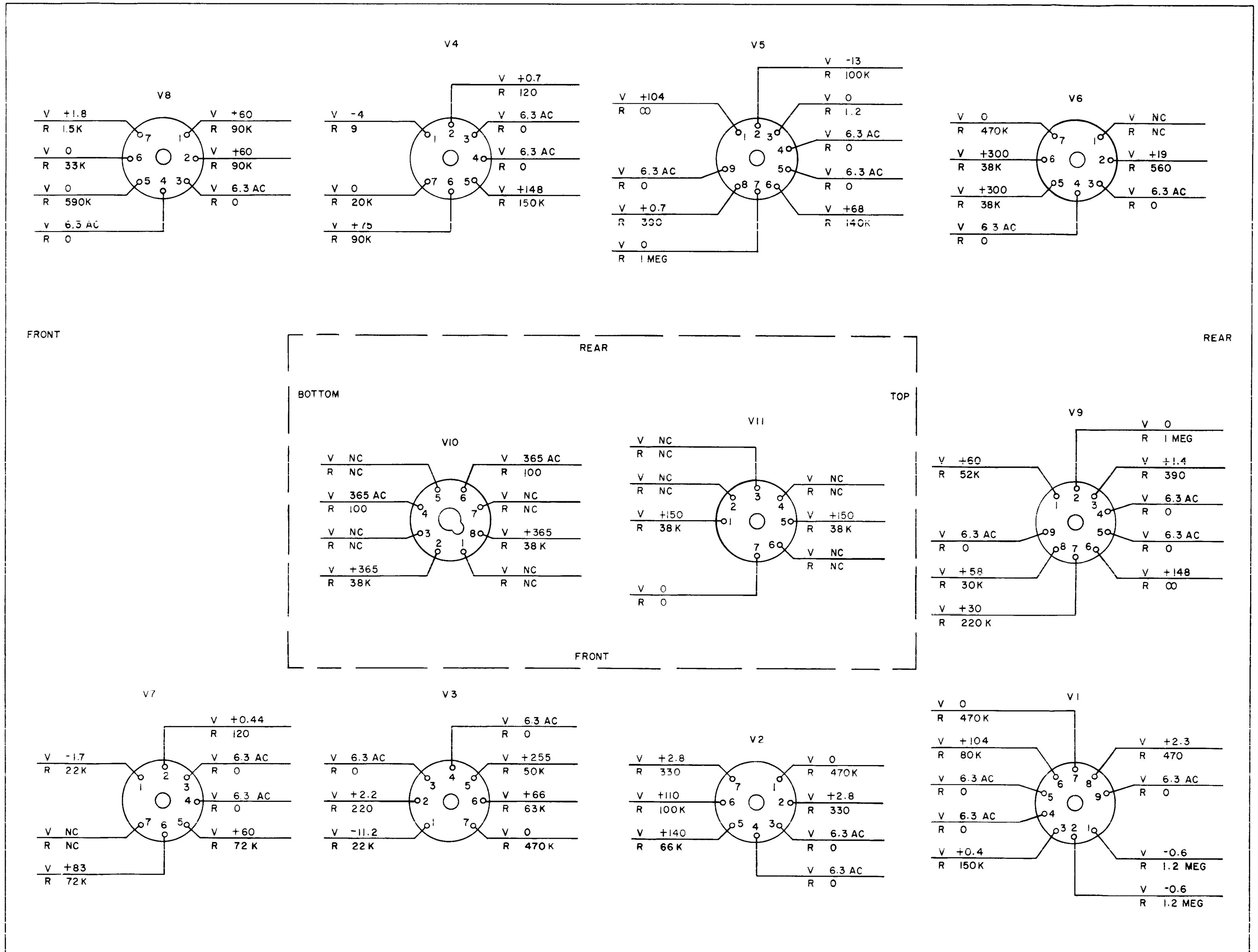
Figure 5-5-b. Layout Diagram,
VOX-3, Power Supply Chassis




| REQ. | ITEM | PART NO. | DESCRIPTION | SYMBOL |
|---|---|---|---|---|
| X | 70 | BS-100 | SOLDER, SOFT | |
| 1 | 69 | SP-138 | SPRING, CLIP | |
| 1 | 68 | PX-239 | OSC. COND. EXT. SHAFT | |
| X | 67 | WL-100-4 | WIRE, BUSS (SIZE 16) | |
| X | 66 | WL-100-5 | WIRE, BUSS (SIZE 18) | |
| 4 | 65 | LWE08MRN | LOCKWASHER, EXT | |
| 4 | 64 | SCBS0832BN8 | SCREW, MACHINE | |
| 1 | 63 | PN-109-2 | PIN, ROLL | |
| 4 | 62 | SCBS0632BN4 | SCREW, MACHINE | |
| 4 | 61 | WA-109-18 | WASHER, FIBER | |
| 2 | 60 | SCBS0440BN10 | SCREW, MACHINE | |
| 8 | 59 | LWE06MRN | LOCKWASHER, EXT. | |
| 5 | 58 | SCBS0632BN6 | SCREW, MACHINE | |
| 6 | 57 | SCBS0440BN4 | SCREW, MACHINE | |
| 12 | 56 | LWE04MRN | LOCKWASHER, EXT | |
| 7 | 55 | NTH0440BN6 | NUT, HEX. | |
| 5 | 54 | SCBS0440BN6 | SCREW, MACHINE | |
| 3 | 53 | TE-104-2 | TERMINAL, LOCKING | |
| 2 | 52 | WA-12C | WASHER, FIBRE | |
| 1 | 51 | LWI37MRN | LOCKWASHER, INT. | |
| 1 | 50 | TS-105-1 | SOCKET, CRYSTAL | XY301 |
| 1 | 49 | TS-103P01 | SOCKET, TUBE | XV302 |
| 1 | 48 | TS-102P01 | SOCKET, TUBE | XV301 |
| 1 | 47 | TS103U02 | SHIELD, TUBE | |
| 1 | 46 | TS102U02 | SHIELD, TUBE | |
| 7 | 45 | TE-149-.120 | LUG, SOLDER | |
| 3 | 44 | TE-114-2 | TERMINAL, FEED-THRU, INSULATED | |
| 3 | 43 | TE-102-2 | TERMINAL, TURRET | |
| 1 | 42 | RC30GF392K | RESISTOR, FIXED COMPOSITION | R301 |
| 1 | 41 | RC30GF102K | ↑ | R302 |
| 1 | 40 | RC20GF474K | | R-306 |
| 1 | 39 | RC20GF473K | | R-304 |
| 1 | 38 | RC20GF472K | ↓ | R-305 |
| 1 | 37 | RC20GF223K | RESISTOR, FIXED COMPOSITION | R-320 |
| 1 | 36 | PX-259 | SHAFT, OSC. COND. EXT. | |
| X | 35 | WL-100-7 | WIRE, BUSS (SIZE 22) | |
| 1 | 34 | NTH0632BN8 | NUT, HEX | |
| 1 | 33 | PM-501 | CHASSIS, OSC. MACHING (LD- | |
| 1 | 32 | PM-319 | COUPLING, MAIN SHAFT | |
| 1 | 31 | MS-582 | BRACKET, CONDENSER | |
| 1 | 30 | MS-309 | BRACKET, OSC. CONDENSER | |
| 1 | 29 | MC-123 | COUPLING, FLEXIBLE SHAFT | |
| 1 | 28 | MC-107 | COUPLING | |
| 2 | 27 | MC-102 | COUPLING, SWITCH SHAFT | |
| 1 | 26 | CU-106 | CLAMP, CRYSTAL | |
| 1 | 25 | CU-102-5 | CLAMP, "G" TYPE | |
| 1 | 24 | 12AU7 | TUBE, ELECTRON | V302 |
| 1 | 23 | 6AB4 | TUBE, ELECTRON | V301 |
| 1 | 22 | CT-103 | CAPACITOR, VARIABLE | C311 |
| 1 | 21 | CR-100-1 | CRYSTAL UNIT | Y301 |
| 1 | 20 | CM35B103J | CAPACITOR, FIXED, MICA | C307 |
| 2 | 19 | CM35B103K | CAPACITOR, FIXED, MICA | C308 C320 |
| 1 | 18 | CM20C241J | CAPACITOR, FIXED, MICA | C312 |
| 1 | 17 | CM20B102J | CAPACITOR, FIXED, MICA | C309 |
| 1 | 16 | CL-101-2 | CHOKE, R.F. | L302 |
| 1 | 15 | CL-100-5 | CHOKE, R.F. | L303 |
| 3 | 14 | CK-70A102M | CAPACITOR, FEED-THRU, CERAMIC | C321 322-323 |
| 1 | 13 | CI-117 | TUNING SLUG P/o L301 | |
| 1 | 12 | CC107RG.00C | CAPACITOR, FIXED, CERAMIC | C306 |
| 2 | 11 | CM200F270F | CAPACITOR, FIXED, CERAMIC | C305 C308 |
| | 10 | CC-102-5 | CAPACITOR, FIXED, MICA | C319 |
| | 9 | CA-282 | CABLE, R.F. | P301 |
| | 8 | CA-281 | CABLE, MO. POWER | P302 |
| 1 | 7 | CB-121 | CAPACITOR, VARIABLE | C303 |
| 1 | 6 | CB-105 | CAPACITOR, VARIABLE | C302 |
| | 5 | A-1578 | TUNING SLUG ASS'Y. | P/o L301 |
| | 4 | A-243 | COIL ASS'Y. | L301 |
| | 3 | A-584 | CAM, SUB-ASS'Y | |
| | 2 | A-588 | CAM FOLLOWER ARM SUB ASS'Y | |
| | 1 | A-1000 | SUB-ASSEMBLY CAP, VAR. AIR | C301 |

A-1742

Figure 5-5-c. Layout Diagram, VOX-3, VMO Chassis




CONDITIONS:

VOLTAGE MEASUREMENTS:

1. LINE VOLTAGE IS 115 VAC 60 CPS
2. USE A VTVM FOR THESE MEASUREMENTS
3. BFO ON
   SIDEBAND MANUAL
   AUDIO GAIN CLOCKWISE
   AVC OFF
4. NO SIGNAL
5. ALL MEASUREMENTS MADE TO CHASSIS GROUND EXCEPT FILAMENTS. FILAMENT VOLTAGES MEASURED ACROSS FILAMENTS.

RESISTANCE MEASUREMENTS:

1. ALL POWER OFF.
2. PRIMARY POWER REMOVED.
3. ALL MEASUREMENTS MADE TO CHASSIS GROUND.
4. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS.
5. ∞ INDICATES INFINITY.

Figure 5-6. Voltage and Resistance Diagram, MSR-6

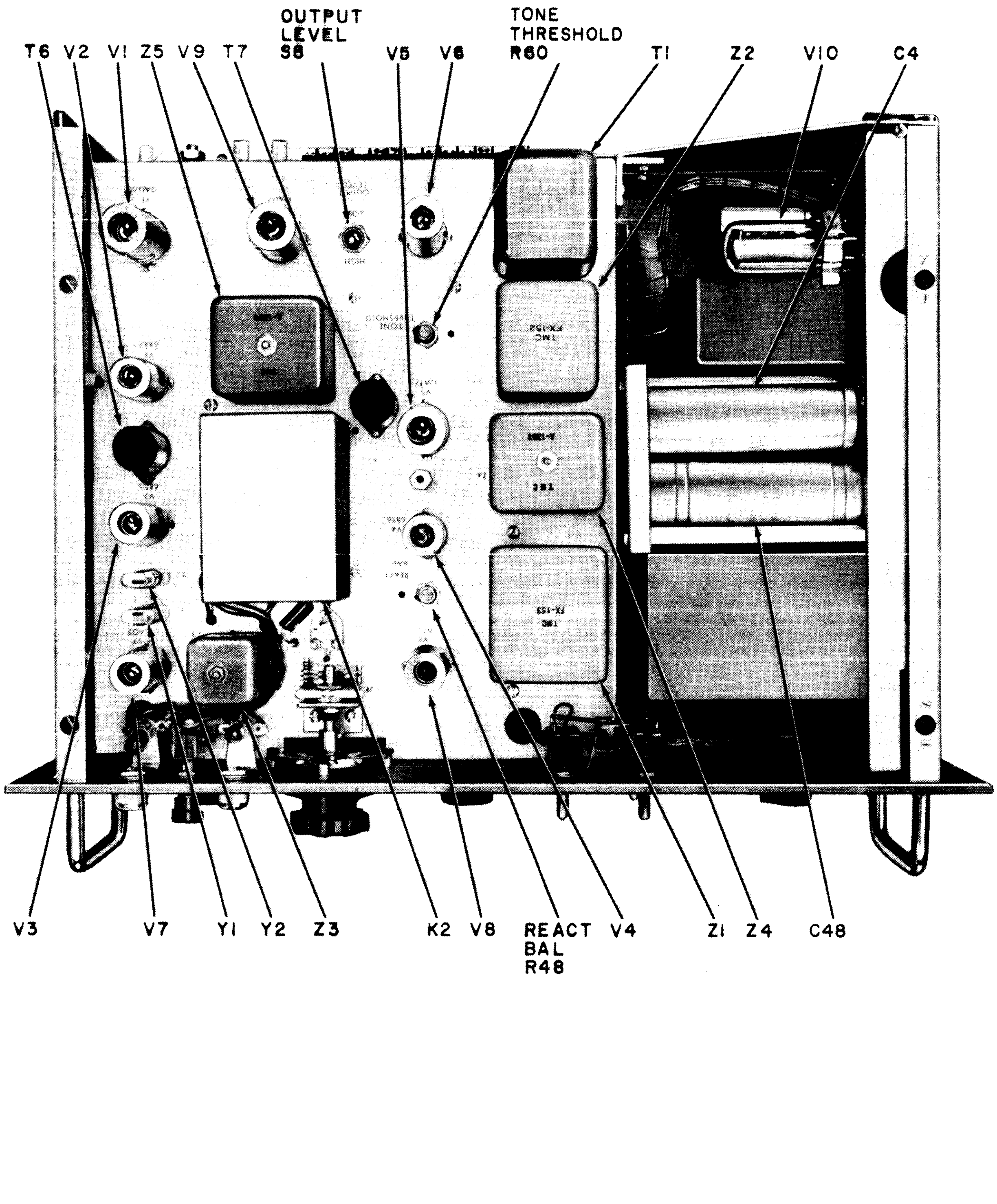



Figure 5-7-a. Location of Major Electronic Components, MSR-6, Top View

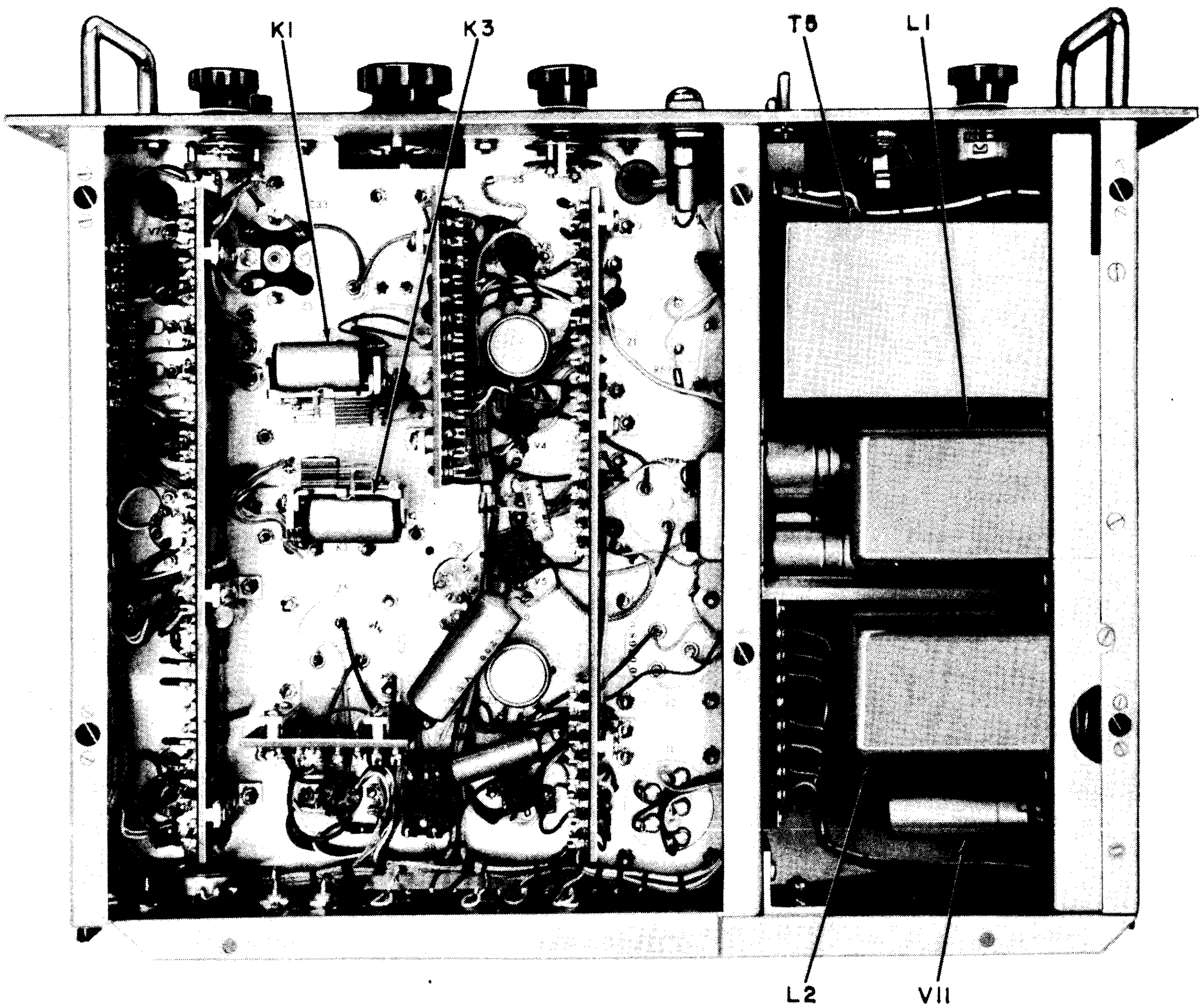
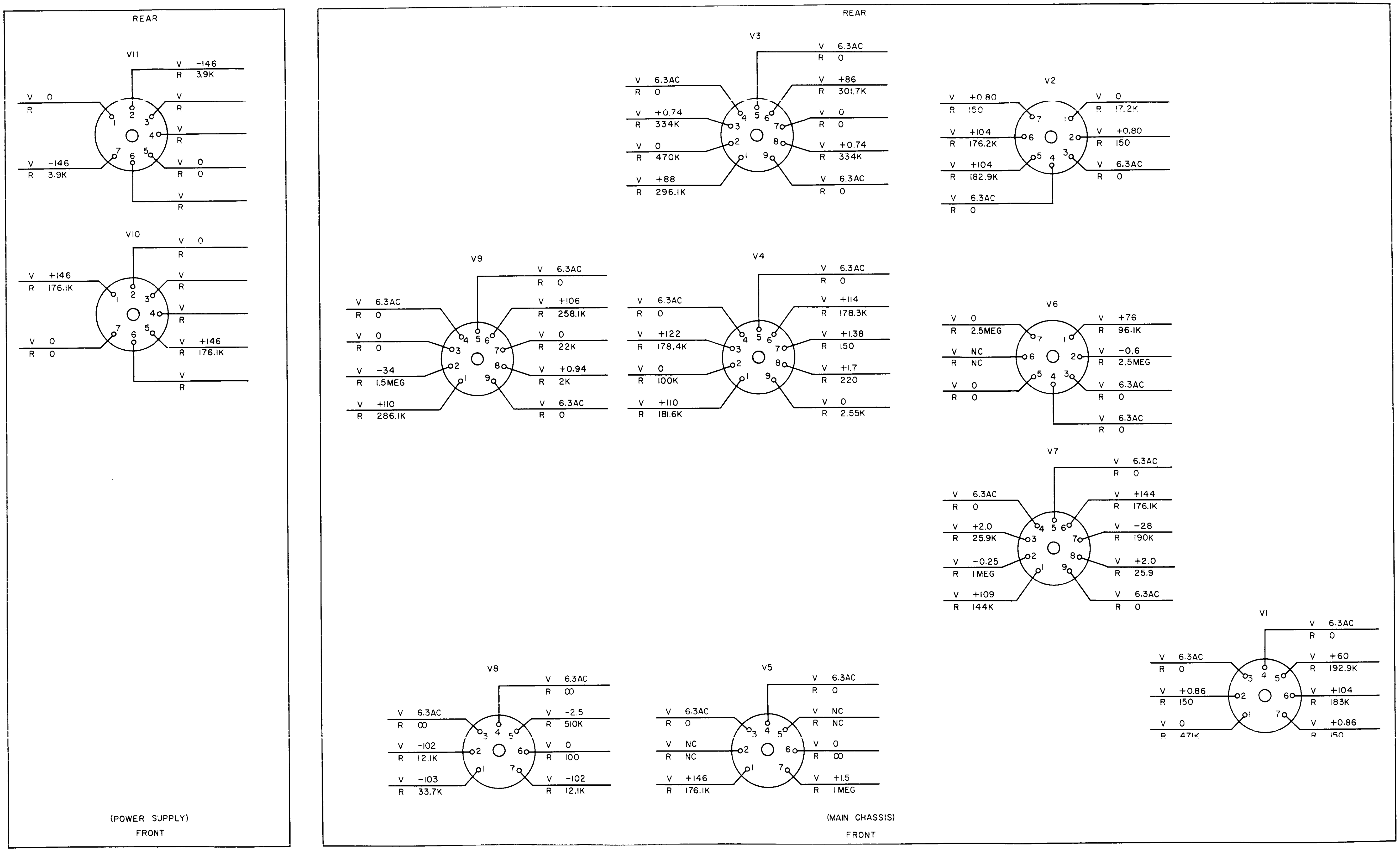



Figure 5-7-b. Location of Major Electronic Components, MSR-6, Bottom View




CONDITIONS:
1. A.G.C. SELECTOR SWITCH SET TO FAST.
2. CARRIER COMPENSATOR SWITCH SET TO ODB.
3. FADE ALARM LEVEL CONTROL SET TO FULL CLOCKWISE POSITION.
4. READINGS MADE WITH VTVM.
5. VOLTAGES AND RESISTANCES MEASURED TO GROUND.

Figure 5-8. Voltage and Resistance Diagram, AFC-1

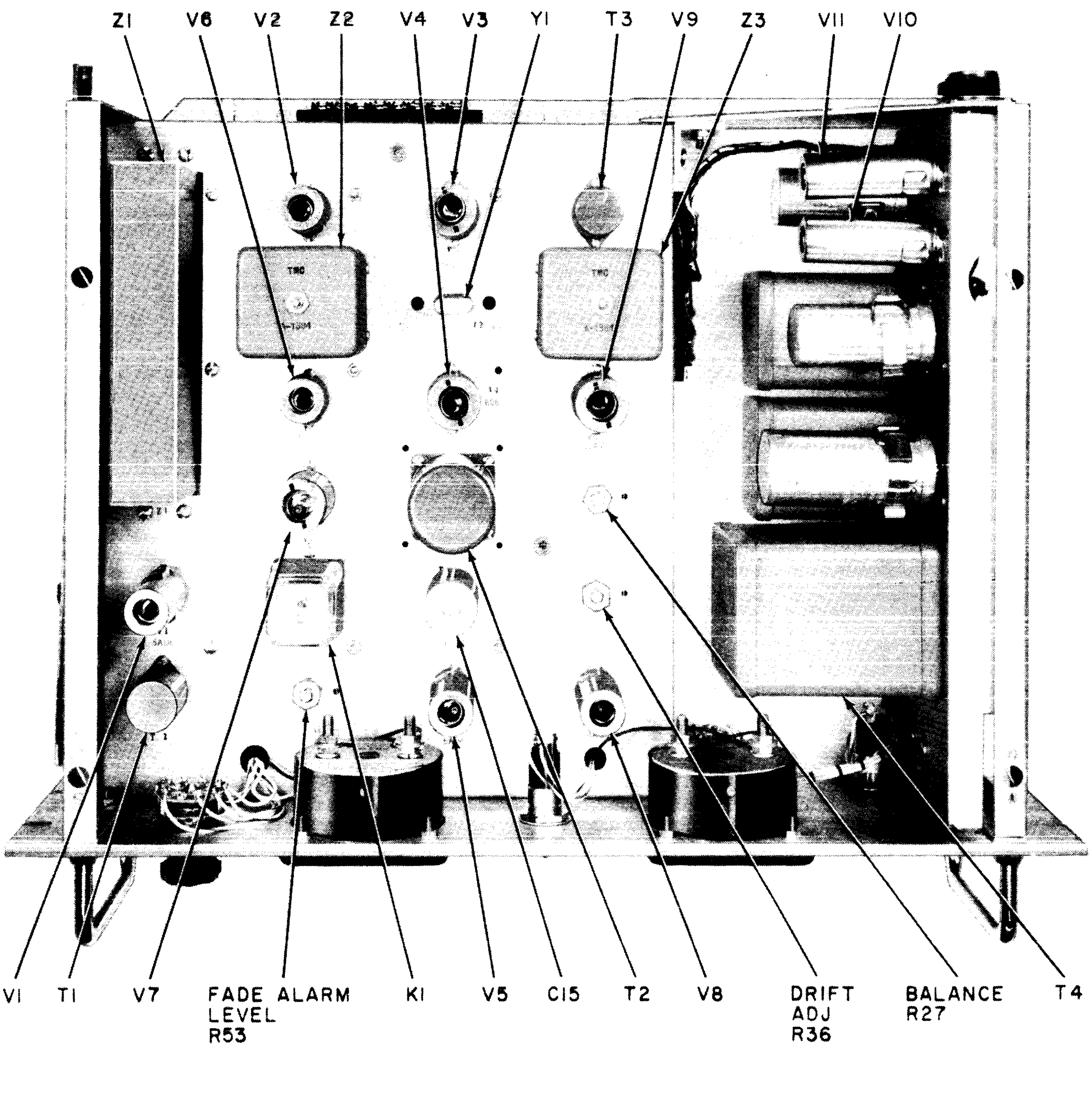



Figure 5-9-a. Location of Major Electronic Components, AFC-1, Top View

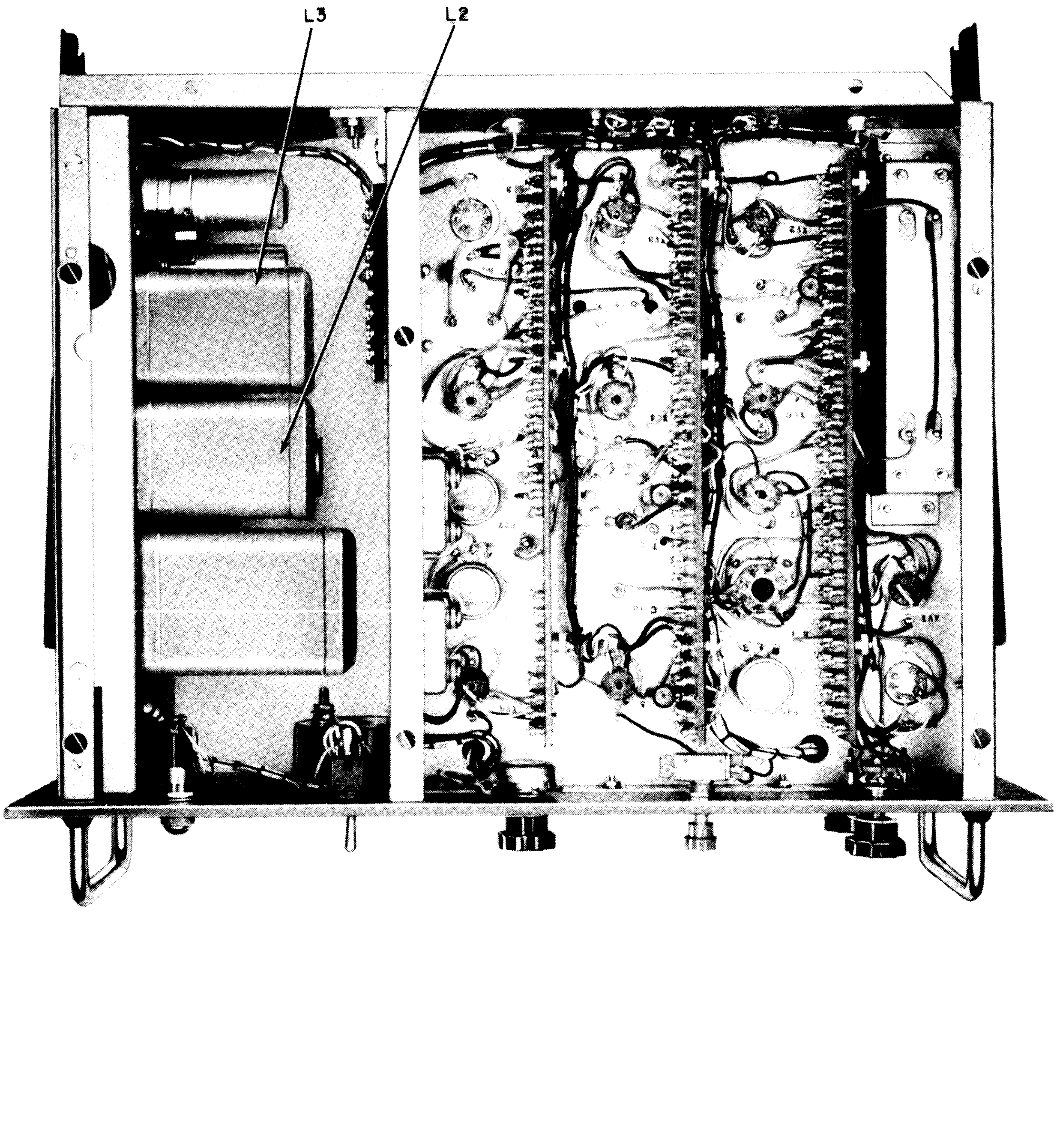



Figure 5-9-b. Location of Major Electronic Components, AFC-1, Bottom View

# SECTION 6
# MAINTENANCE

## 6-1. GENERAL.

The maintenance data contained in this section falls into two categories: preventive maintenance and corrective maintenance. The purpose of preventive maintenance is to minimize equipment breakdown by performing periodic checks and those procedures which tend to maintain normal operation. Corrective maintenance may be considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments. The diagnostic type of information is presented under trouble-shooting (Section 5); remedial type of information is presented in this section.

## 6-2. COMMUNICATIONS RECEIVER GPR-90RXD.

a. PREVENTIVE MAINTENANCE.

(1) In order to prevent actual failure of the GPR-90RXD's it is suggested that a schedule of preventive maintenance be set up and adhered to.

(2) At periodic intervals (at least every six months) the GPR-90RXD's should be removed from the cabinet for cleaning and inspection. The chassis wiring should be inspected for dirt, corrosion, charring, discoloring or grease; in particular, the tube socket should be carefully inspected for evidence of deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with triclorethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

### WARNING

Carbon tetrachloride ($CCI_4$) may be used only if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

(3) Test each tube, one at a time, in a reliable tube tester, replacing tube in socket from which it was removed if its measured characteristics are within the manufacturer's tolerances (usually +20 percent from tube manual values). Replace only those tubes which are found to be below par; recommended procedure is once every three months.

(4) When replacing the GPR-90RXD in the cabinet, ensure that all terminal screw connections at the rear of the GPR-90RXD are tight.

b. CORRECTIVE MAINTENANCE.

(1) GENERAL. - Corrective maintenance of the GPR-90RXD's is limited to alignment of their tank circuits, S meters, and hum balance adjustments. The circuits of the GPR-90RXD have been carefully aligned by factory personnel. Realignment of the GPR-90RXD should not be attempted until all other causes of faulty operation have been investigated. Alignment should not be required unless the GPR-90RXD has been tampered with or some component part replaced in the stages containing tuned circuits. Alignment should be made only by personnel familiar with GPR-90RXD's and experienced with their alignment.

(2) IF ALIGNMENT. - The low frequency should be aligned first. Remove the dust cover over the tuning capacitor shield compartment by removing the knurled nuts. Couple the signal generator to the lug of the middle section of the main tuning capacitor. (See figure 5-3-a.) Connect the oscillator return to ground by means of a short wire with alligator clips on each end. Connect the 600-ohm, 10-watt load and the AC voltmeter across the 600-ohm speaker terminals. Set the following controls and switches as follows:

| | |
|---|---|
| RANGE SELECTOR switch | .54- 1.4 |
| AVC switch | MANUAL |
| LIMITER switch | OFF |
| BFO switch | OFF |
| SEND-REC switch | REC |
| AUDIO SELECTOR switch | NORMAL |
| RF GAIN control | Fully clockwise |
| AUDIO GAIN control | Fully clockwise |
| MAIN TUNING control | Half capacity |
| XTAL PHASE control | 0 |

(3) 455 KC. - Turn the RF SELECTIVITY to the NON XTAL position and the signal generator frequency to 455 kc, modulated 30 percent at 400 cycles. A pair of headphones may be used for monitoring purposes. Adjust the signal generator output until some deflection is noted on the output meter. Peak IF transformers T8, T7, T6, T5 (top and bottom), and T4 (top) for maximum output. (See figures 5-3-a and 5-3-b for the location of these adjustments.) During alignment,

the signal generator output should be progressively reduced to prevent GPR-90RXD overload. Turn the RF SELECTIVITY control to the 2.0KC position and adjust the signal generator frequency for maximum meter deflection. In this way the signal generator frequency is made to coincide with the 455-kc crystal frequency in the GPR-90RXD IF. The frequency of the generator should not be disturbed for the remainder of the 455-kc IF and BFO alignment. Again peak transformers T8, T7, T6, and T5 (top and bottom), T4 (top), and coil L20 for maximum output.

(4) BFO. - Turn off the signal generator modulation and set the BFO PITCH control to zero. Turn the BFO switch to the on position and adjust coil L22 for a zero beat.

(5) 3.955 MC. - Turn the RANGE SELECTOR switch to the 5.4- 9.6 position. Set the signal generator to 3.955 mc, modulated 30 percent at 400 cycles. Adjust second converter coil, L19, until an output is indicated. Since adjustment of L19 permits the 3.5-mc crystal-controlled oscillator to operate over a small frequency range, it must be set approximately in the middle of this range for stable operation. To determine stable oscillator operation, momentarily turn the GPR-90RXD off and on. If the GPR-90RXD continues to operate after interruption, L19 is set correctly. When the oscillator coil is adjusted to 3.5 mc, adjust transformers T3 (bottom) and T2 (top and bottom) for maximum output.

During this test, use sufficient generator output, but not enough to overload the GPR-90RXD. This completes the IF alignment. Remove the signal generator leads from the tuning capacitor and the oscillator ground. Replace the dust cover over the tuning capacitor compartment.

(6) RF ALIGNMENT. - The frequencies for the RF alignment and the location of these adjustments are shown in figure 5-3-b. The lowest frequency band is aligned first, followed by the next higher band. The alignment procedure for the broadcast band will be described so that the remaining bands can be aligned in a similar manner. The signal generator is coupled to the antenna jack.

**NOTE**

The generator output impedance should be subtracted from 75 ohms to obtain the proper antenna dummy resistor. The same GPR-90RXD control settings should be used as in the case of IF alignment, except that the RF SELECTIVITY control is set to the NON XTAL position and the BAND SPREAD dial is locked to 100 on the logging calibration.

Set the MAIN TUNING dial and the signal generator frequency to 0.56 mc. The signal generator should be modulated 30 percent at 400 cycles and the output meter connected across the output terminals. Adjust oscillator slug L13 first, using sufficient signal generator output to obtain meter deflection, followed by coils L7 and L1 to obtain maximum output. The signal generator output should be progressively decreased as GPR-90RXD sensitivity increases with each tuned circuit. Set the GPR-90RXD and signal generator dials to 1.4 mc and adjust capacitors C80 and C18 in that order for maximum output. Repeat the above procedure very carefully and until there is no further improvement in sensitivity and frequency calibration. The remaining stages are aligned in a similar manner and are listed in table 6-1. The image frequency listed for each signal frequency should be checked to ascertain that the oscillator, V12, is operating above the signal frequency.

(7) S-METER CALIBRATION. - Turn the RANGE SELECTOR switch to 5.4 - 9.6, AVC switch to on, RF SELECTIVITY switch to NON XTAL, RF GAIN control to maximum, signal generator and GPR-90RXD MAIN TUNING control to 14 mc. Apply 50 microvolts to the GPR-90RXD antenna terminals; tune the GPR-90RXD to the signal; and adjust resistor R50, R106, and the ANT. TUNE control for an S-9 reading on the S-meter.

(8) HUM BALANCE ADJUSTMENT. - Connect a high impedance AC voltmeter with a 3-millivolt range or a sensitive oscilloscope across the 600-ohms audio output load. Ground the GPR-90RXD to an external ground. Adjust the RF GAIN and AUDIO GAIN controls to their maximum settings. Adjust hum balance control R94 for minimum meter or oscilloscope deflection.

## 6-3. VARIABLE FREQUENCY OSCILLATOR VOX-3.

a. GENERAL. - The VOX has been designed to provide long term trouble free operation under continuous duty conditions. It is recommended that any maintenance to the equipment be done by a competent technician. The oven and the components contained therein are precision made. The two enclosed tubular thermostats (S302 and S303) and the thermionic switch (S301) may be replaced easily at the rear of the unit; but in the event that maintenance to the oven section of the unit is required, the unit should be returned to the factory for repairs. For maintenance to the RF and power supply sections, three service cable assemblies are supplied to enable the operator to service the VOX while maintaining primary power to the ovens. The cable assemblies supplied with each VOX are as follows:

| | | |
|---|---|---|
| (1) | Part No. CA108, W101 | Power Supply-Multiplier Interconnect; 12 Contact. |
| (2) | Part No. CA109, W102 | Power Supply-Master Oscillator Interconnect; Six contact. |
| (3) | Part No. CA110, W103 | R.F. Cable; Power Supply-Multiplier Interconnect; Single Contact. |

Figure 2-5 shows the three service cables connected properly for maintenance operation, allowing the ovens to function as usual during the maintenance period.

b. PREVENTIVE MAINTENANCE.

(1) In order to prevent actual failure of the equipment due to corrosion, tube failure, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

(2) At periodic intervals (at least every six months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring of all components inspected for dirt, corrosion, charring, discoloring, or grease; in particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with triclorethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

## WARNING

Carbon tetrachloride (CCI4) may be used only if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

(3) Test each tube, one at a time, in a reliable tube tester, replacing tube in socket from which it was removed if its measured characteristics are within the manufacturer's tolerances (usually ±20 percent from tube manual values). Replace only those tubes which are found to be below par; recommended procedure is once every three months.

(4) When replacing the VOX-3 in the rack, ensure that all terminal screw connections at the rear of the equipment are tight.

c. CORRECTIVE MAINTENANCE.

(1) GENERAL. - During its initial calibration, the VOX-3 is set so that relatively little rotation of CALIBRATE control (designated 48 on figure 3-1) is necessary to correct the dial at any particular check point. As the unit continues to age and experiences varying degrees of shock and vibration, some increase in this degree of rotation may occur. If, after the dial has been calibrated at 2 mc, more than two complete revolutions of the CALIBRATE control are necessary to calibrate any other 50-kc checkpoint on the dial, then the ends of the dial should be reset by the procedure outlined in paragraph 6-3c(3).

The continuous natural abuse that a unit receives in the field may also slightly disturb the 100-kc standard. In order to obtain maximum accuracy a recalibration of the crystal standard should be made regularly as outlined in paragraph 6-3c(2).

## CAUTION

The following operations should be performed by duly authorized and properly instructed personnel only.

Corrective maintenance is limited to calibrations of the 100-kc standard oscillator and the master oscillator and to test procedures for the RF chassis and the power supply chassis. No maintenance is given for the repair of the oven or oven components because such repair is practical only in the factory.

(2) 100-KC STANDARD CALIBRATIONS. - In order to perform this operation correctly it is necessary to obtain either a GPR-90RXD or a primary standard such as a Hewlett-Packard Electronic Counter Model 524C. The GPR-90RXD must be capable of receiving radio station WWV which is operated by the Central Radio Propagation Laboratory, National Bureau of Standards, Washington, D.C. This station emits a carrier of extreme frequency stability at 2.5, 5, 10, 15, 20, and 25 mc for precisely such purposes as the calibration of communications equipment. Allow at least a 6-hour warm-up period and proceed as follows:

(a) Using the GPR-90RXD, "pick up" WWV. It is preferable to use the 2.5- or 5-mc signal, if either can be obtained at the particular location being used.

(b) Loosely couple the HFO output into the antenna post of the GPR-90RXD.

(c) Tune the VOX's VMO in the region of 2.5 mc and obtain a "zero beat" between the VOX and the WWV signal on the GPR-90RXD. Since GPR-90RXD's are almost never designed for very low-frequency audio response, it is useless to attempt to obtain a beat indication through the use of headphones. Instead, it is suggested that some form of S-meter be used. If the GPR-90RXD has no such self-contained device, it can readily be made by connecting a microammeter in series with a suitable resistance directly across the GPR-90RXD's detector DC output. When zero beat is approached and the coupling from the VOX to the GPR-90RXD antenna is proper, deep and clearly discernible dips will be seen on the S-meter.

(d) Now, while observing the beat indicating lamp on the VOX front panel, set C311, the 100-kc ADJ vernier capacitor located on the rear oven chassis, until a "zero beat" has been obtained between the VOX's VMO and 100-kc standard. When both beats can be observed simultaneously to be within a few cycles of the zero point, then a satisfactory calibration has been made. This means, in reality, that the 100-kc standard has been set against WWV with the VOX's VMO serving only an function.

The frequency with which the above operations should be performed is purely a function of the type of service to which the unit is subject. For some base station installations, intervals of six months will be adequate; however, for more rugged conditions, experience may indicate the need for a proportionately shorter interval.

(3) MASTER OSCILLATOR. - Before attempting to adjust the VOX's VMO, the full procedure outlined in the preceding paragraph must be followed. In

addition, perform the adjustments given in paragraph 2-5b of this volume designated "Initial Adjustment". These are repeated below for convenience.

**CAUTION**

The VOX is a high stability precision instrument and requires an initial warm-up period of at least 48 hours of continuous duty. Thereafter, the unit should never be turned off unless detailed repairs become necessary. Failure to comply with this procedure will result in degradation of the instrument's accuracy.

**NOTE**

After the 48-hour warm-up period, the POWER switch (open front panel door) should be ON and the ovens should have reached a stable condition.

(a) Set the BEAT ON-OFF switch (open front panel door) to ON.

(b) Plug headphones into the jack marked PHONES (open front panel door).

(c) Turn the BAND-MCS switch on front panel to 2-4.

(d) Turn the XTAL switch on the front panel to VMO.

(e) Turn the MASTER OSCILLATOR FREQUENCY dial to 2000 KCS 000 CPS.

(f) Turn the CALIBRATE dial for zero beat on the phones and also on the ZERO BEAT indicator. The VMO's 2,000,000-cycle output now coincides in frequency with the 100-kc calibrating oscillator's 20th harmonic.

(g) Turn the MASTER OSCILLATOR FREQUENCY dial to 4000 KCS 000 CPS.

(h) Adjust the trimmer capacitor, behind circular disc (located on the front panel) between the CALIBRATE dial and the VOX-3's meter, to give zero beat on the phones and also on the ZERO BEAT indicator. The VMO's 4,000,000-cycle output now coincides in frequency with the 100-kc calibrating oscillator's 40th harmonic.

(i) Repeat steps (e) and (f) to compensate for the newly adjusted position of the trimmer capacitor.

(j) Repeat steps (g) and (h) to compensate for the newly adjusted position of the CALIBRATE dial.

(k) Readjust the trimmer capacitor to optimum zero beat condition at the two extremes of the 2- to 4-mc band.

Since other frequency bands are obtained by multiplication of the 2- to 4-mc band, the oscillator is adjusted throughout its entire frequency.

In making the adjustments given above, observe the following precautions:

1. In setting the MASTER FREQUENCY OSCILLATOR dial to 2, 000, 000, note the direction of approach.

2. In resetting the dial to 4, 000, 000, approach this point from the same direction used previously. If, for example, the first point was approached from 2, 002, 000, then the second point must be approached from 4, 002, 000.

3. During the screwdriver adjustment of C303 for zero beat (through the capped hole adjacent to the CALIBRATE knob), monitor VOX's VMO on a convenient receiver to make certain that C303 is being varied in a manner which brings the VMO's frequency toward the 4-mc zero beat and not in the direction of a neighboring 50-kc checkpoint. It should never be necessary to vary the C303 control more than a few complete revolutions.

4. Repeat the total procedure outlined above; that is, adjust the CALIBRATE knob to 2 mc and C303 to 4 mc, until it is possible to obtain a zero beat at both 2 and 4 mc without further adjustment being necessary. The ends will then be correct and the CALIBRATE knob will be closest to its correct mean.

5. Once this procedure has been completed, the setting of C303 should not be disturbed again until a recalibration is deemed necessary. This operation is sometimes required after the first year of service and then seldom performed again.

(4) ALIGNMENTS. - The following alignment of the RF chassis and the power supply chassis is abstracted from TMC's test procedures on these assemblies:

(a) BFO CIRCUIT LOCATED ON POWER SUPPLY CHASSIS.

1. Connect all cables.

2. Insert a 455-kc crystal in each BFO crystal socket.

3. Connect a 1000-ohm load resistor to BFO output connector jack (J102).

4. Set POWER switch (S101) to ON position.

5. Turn METER switch (S107) to BFO position and set BFO switch (S106) to ON position.

6. Rotate BFO adjust potentiometer (R116) fully clockwise for maximum output on meter (M301).

(b) CALIBRATE CIRCUIT LOCATED ON POWER SUPPLY CHASSIS.

1. Turn METER switch (S107) to VMO; maximum output on meter is 10 volts full scale.

2. Set BEAT ON-OFF switch (S104) to ON position. Tune the MASTER OSCILLATOR FREQUENCY control knob; the ZERO BEAT indicator (I303) should go on at each 100-kc checkpoint. Should the ZERO BEAT indicator not go on exactly at each 100-kc interval, refer to paragraphs 6-3c(2) and 6-3c(3) for corrective procedure. (The power supply does not contain any adjustments to compensate for an erroneous zero beat.)

(c) IFO CIRCUIT LOCATED ON RD CHASSIS. - Turn METER switch (S107) to IFO position and set IFO plate switch (S102) to ON position. Maximum full-scale deflection is 10 volts. Peak the IFO output as indicated on the meter with variable capacitor C207.

(d) HFO CIRCUIT LOCATED ON RF CHASSIS. - The RF chassis consists principally of RF multipliers extending from 2 to 64 mc. Its alignment is like any ordinary alignment of a tuned circuit; however, the common trimmer capacitor used on both the 2- to 4- and 4- to 8-mc bands involved a compromise setting to fulfill the requirements of both bands. The best alignment procedure depends upon available test facilities and skills.

## 6-4. SINGLE SIDEBAND CONVERTER MSR-6.

a. GENERAL. - The MSR-6 has been designed for long term trouble free duty. Little attention beyond normal preventive maintenance is required. It is recommended that any maintenance to the equipment be performed by a competent technician.

b. PREVENTIVE MAINTENANCE. - To prevent equipment failure as a result of corrosion, dust, or other destructive ambient conditions, it is suggested that the inside of the chassis be thoroughly inspected for signs of dirt, dampness, molding, charring or corrosion every six months. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with triclorethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

### WARNING

Carbon tetrachloride ($CCl_4$) may be used only if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

All components in the MSR-6 have been carefully selected to ensure maximum efficiency in operation. If the sensitivity should drop and tube failure is suspected, test each tube in a reliable tube tester. The measured characteristic of the tube should be within the manufacturer's tolerances (usually ±20 percent from tube manual values). No special selection is necessary in the event of tube replacement, but the operator should remember that tubes of the same type vary slightly in their individual characteristics.

c. CORRECTIVE MAINTENANCE.

(1) GENERAL. - Corrective maintenance is limited to alignment of the bandspread oscillator for upper and lower sidebands, alignment of the 17-kc oscillator, and alignment of the sidetone generator for lower and upper sidebands. These oscillators have been aligned to their correct frequencies at the factory. Readjustment is required only when the performance of the MSR-6 is impaired; for example, when the bandspread oscillator is off scale with a signal centered on 455 kc. The oscillators may be aligned either with an accurate signal generator or with a GPR-90RXD as the signal source.

(2) ALIGNMENT WITH SIGNAL GENERATOR.

(a) ALIGNMENT OF BANDSPREAD OSCILLATOR AT UPPER SIDEBAND. - Set MANUAL-XTAL switch S4 to MANUAL; then proceed as follows:

1. Apply a 472.0-kc signal from an RF signal generator to IF input jack J1.

2. Connect an oscilloscope to pin 5 of first mixer stage V3.

3. Switch the MSR-6 to UPPER sideband operation.

4. Short terminals 11 and 12 on terminal board E1.

5. Turn BANDSPREAD control to zero.

6. Adjust the core of oscillator coil T2 for zero beat indication on oscilloscope (steady horizontal trace).

(b) ALIGNMENT OF BANDSPREAD OSCILLATOR AT LOWER SIDEBAND.

1. Switch the MSR-6 to LOWER sideband operation.

2. Set the RF signal generator 438.0 kc.

3. Adjust trimmer capacitor C28 for zero beat indication on oscilloscope.

4. Remove short from terminals 11 and 12 of E1.

(c) ALIGNMENT OF REACTANCE CONTROL.

1. Connect a source of DC, variable between 0 and 10 volts between terminals 11 and 12 of E1.

2. Vary the DC voltage between ±1.5 volts. This should result in a balanced shift of approximately ±4 kc in either upper or lower sideband operation.

3. If frequency deviation is unbalanced, adjust REACT BAL control R48 until balance is obtained.

(d) ALIGNMENT OF 17-KC OSCILLATOR.

1. Apply a 17.0-kc audio signal to pin 7 of second mixer V4.

2. Connect oscilloscope to pin 5 of second mixer V4.

3. Set BFO switch S5 to ON.

4. Adjust trimmer capacitor C40 (located on Z4) for zero beat indication on oscilloscope.

(e) ALIGNMENT OF REMOTE SIDEBAND SELECTOR CIRCUIT.

1. Connect variable DC source between terminals 7 and 8 of E1 (negative input to terminal 8).

2. Vary DC input voltage from 0 to -9 volts. Sideband switching should occur between -7.5 and -8.0 volts.

3. If necessary, adjust potentiometer R54 until above condition is satisfied.

(f) ALIGNMENT OF SIDETONE GENERATOR.

1. Set BFO switch S5 to ON.

2. Connect VTVM to pin 7 of second mixer V4.

3. Vary the DC supply connected to pins 7 and 8 of E1 from 0 to -9 volts. As the DC voltage approaches -5.0 volts, sideband tone generator V9B should start to oscillate. Increasing the DC input voltage to -9.0 volts should increase the amplitude of oscillation to 2.5 volts.

**NOTE**

Oscillations will start at two threshold conditions. The proper condition produces increased output as control voltage becomes more negative.

4. Set MSR-6 to LOWER sideband operation.

5. Adjust trimmer capacitor C55 (located on Z5) for 500-cps note.

6. Switch MSR-6 to UPPER sideband operation. Output frequency will be approximately 2.5 kc.

**NOTE**

When the sidebands are reversed because of an additional frequency conversion (with the oscillator frequency above the IF) in the GPR-90RXD in use, align the tone generator as per steps 7 through 9 below.

7. Set MSR-6 to UPPER sideband operation.

8. Adjust trimmer capacitor C55 for 500-cps note.

9. Switch MSR-6 to LOWER sideband operation. Output frequency will be approximately 2.5 kc.

(3) ALIGNMENT WITH GPR-90RXD.

(a) Tune in a stable signal so that the carrier passes through the center of the IF. In the GPR-90RXD, set the IF filter to its narrowest position.

(b) Set MANUAL-XTAL switch S4 on MSR-6 to XTAL position (at either 472 or 438 kc).

(c) Set BFO switch S5 to ON position.

(d) Adjust trimmer capacitor C40 (located on Z4) until zero beat is obtained.

(e) Set BANDSPREAD control C28 to zero.

(f) Set MSR-6 to UPPER sideband operation.

(g) Set MANUAL-XTAL switch S4 to MANUAL.

(h) Adjust coil T2 in Z3 for zero beat condition.

(i) Switch MSR-6 to LOWER sideband operation.

(j) Adjust trimmer capacitor C29 for zero beat condition.

## 6-5. AUTOMATIC FREQUENCY CONTROL UNIT AFC-1.

a. GENERAL. - The AFC-1 has been designed for long term trouble free duty. Little attention beyond normal preventive maintenance is required. It is recommended that any maintenance to the equipment be performed by a competent technician.

b. PREVENTIVE MAINTENANCE. - To prevent equipment failure as a result of corrosion, dust, or other destructive ambient conditions, it is suggested that the inside of the chassis be thoroughly inspected for signs of dirt, dampness, molding, charring, or corrosion every six months. Dust may be removed by a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethylene or ethylenedichloride. Remove dirt or grease from other parts with any good dry cleaning fluid.

**WARNING**

Carbon tetrachloride ($CCl_4$) may be used only if great care is exercised because it is a toxic substance. Do not inhale its fumes. Avoid contact with skin.

All components in the AFC-1 have been carefully selected to ensure maximum efficiency in operation. If the unit should malfunction and tube failure is suspected, test each tube in a reliable tube tester. The measured characteristic of the tube should be within the manufacturer's tolerances (usually ±20 percent from tube manual values). No special selection is necessary in the event of tube replacement, but the operator should remember that tubes of the same type vary slightly in their individual characteristics.

c. CORRECTIVE MAINTENANCE.

(1) GENERAL. - Corrective maintenance is limited to adjustment of the BALANCE and DRIFT ADJ. controls which are located on the top of the chassis. These controls have been adjusted at the factory. However, readjustment of the BALANCE control may be necessary to correct for the aging of the phase detector bridge components. The DRIFT ADJ. control may need readjustment when the memory follower tube or the constant current pentode is replaced.

(2) ADJUSTMENT PROCEDURE.

(a) ADJUSTMENT OF DRIFT ADJ. CONTROL.

1. With no signal input to the AFC-1, the FADE ALARM lamp should glow. Depress the A.F.C. RESET pushbutton and adjust the DRIFT ADJ. control until the A.F.C. INDICATOR meter indicates center scale.

2. Release the A.F.C. RESET pushbutton.

(b) ADJUSTMENT OF BALANCE CONTROL.

1. Remove the crystal from socket Y1 to disable the 17-kc oscillator.

2. Turn the CARRIER COMPENSATOR switch to 0 DB.

3. Inject a 17-kc carrier into the 17 KC CARRIER jack on the rear apron. Adjust the level of this carrier so that the FADE ALARM lamp just goes out. The FADE ALARM LEVEL control may require adjustment to attain this condition.

4. Depress and release the A.F.C. RESET pushbutton. Adjust the BALANCE control until the A.F.C. INDICATOR meter remains at center scale.

**TABLE 6-1. ALIGNMENT DATA, GPR-90RXD**

| BAND | SIGNAL GENERATOR AND RECEIVER DIAL SETTING | ADJUST FOR MAXIMUM OUTPUT IN ORDER GIVEN OSC | MIXER | RF | IMAGE FREQUENCY APPEARS ON SIGNAL GENERATOR DIAL* |
|---|---|---|---|---|---|
| 1 | .56 mc | L13 | L7 | L1 | 1.47 mc |
| | 1.4 mc | C80 | C18 | Ant. Tune | 2.31 mc |
| 2 | 1.5 mc | L14 | L8 | L2 | 2.41 mc |
| | 3.2 mc | C82 | C19 | Ant. Tune | 4.11 mc |
| 3 | 3.3 mc | L15 | L9 | L3 | 4.21 mc |
| | 5.5 mc | C84 | C20 | Ant. Tune | 6.41 mc |
| 4 | 5.6 mc | L16 | L10 | L4 | 13.51 mc |
| | 9.5 mc | C87 | C21 | Ant. Tune | 17.41 mc |
| 5 | 9.8 mc | L17 | L11 | L5 | 17.71 mc |
| | 17.5 mc | C89 | C22 | Ant. Tune | 25.41 mc |
| 6 | 18.0 mc | L18 | L12 | L6 | 25.91 mc |
| | 31.0 mc | C90 | C23 | Ant. Tune | 38.91 mc |

* Use sufficient signal generator output.

# SECTION 7
# PARTS LIST

## INTRODUCTION

Reference designations have been assigned to identify all maintenance parts of the equipment. They are used for marking the equipment (adjacent to the part they identify) and are included on drawings, diagrams, and the parts list. The letters of a reference designation indicate the kind of part (generic group), such as resistor, amplifier, electron tubes, etc. The number differentiates between parts of the same generic group. Parts of the same first major unit are numbered from 1 to 199; parts of the second 201 to 299, etc. Two consecutive series of numbers have been assigned to major units in which there are more than 100 parts of the same generic group. Sockets associated with a particular plug-in device, such as electron tube of fuse, are identified by a reference designation which includes the reference designation of the plug-in device. For example, the socket for fuse F7 is designated XF7. The parts for each major unit are grouped together. Column 1 lists the reference series of each major unit, followed by the reference designations of the various parts in alphabetical and numerical order. Column 2 gives the name and describes the various parts. Major part assemblies are listed in their entirety; subparts of a major assembly are listed in alphabetical and numerical order with reference to its major assembly. Column 3 indicates how the part is used within a major component. Column 4 lists each Technical Materiel Corporation part number.

## TABLE OF CONTENTS

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C1 | CAPACITOR, fixed: ceramic; .01 ufd, +80 -20%; 500 wvdc. | Decoupling | CC-100-16 |
| C2 | Same as C1. | Bypass V1 | CC-100-16 |
| C3 | CAPACITOR, fixed: ceramic; 5 uuf, ±0.25 uufd; 500 wvdc. | Coupling L4 | CC21SL050C |
| C4 | Same as C3. | Coupling L5 | CC21SL050C |
| C5 | CAPACITOR, fixed: ceramic; 47 uuf, ±10%, 500 wvdc. | Coupling L6 | CC21SL470K |
| C6 | Same as C1. | R.F. Bypass | CC-100-16 |
| C7 | Same as C1. | Bypass | CC-100-16 |
| C8A, B, & C | CAPACITOR, variable: air tuning; bandspread, 3 sections; I & II ant./mixer A) 8.0 - 6.3 uuf, B) 8.6 - 12.9 uuf, C) 9.7 - 38.5 uuf; III A) 7.0 - 7.0 uuf, B) 8.0 - 12.9 uuf, C) 7.5 - 38.5 uuf, ±0.5 uuf. | Bandspread | CB-131 |
| C9A, B, & C | CAPACITOR, variable: air dielectric; three main sections; six subsections; three with 11 plates; three with 15 plates; 8.5 - 135 uufd. each 11 plate sect. 10.5 - 189 uuf. ea. 15 plate sect. | Main Tuning | CB-130 |
| C10 | CAPACITOR, fixed: ceramic; .1 uf, ±80 -20%; 500 wvdc. | Bypass V6 | CC-100-28 |
| C11 | Same as C1. | Bypass V2 | CC-100-16 |
| C12 | Same as C1. | Bypass V2 | CC-100-16 |
| C13 | CAPACITOR, fixed: mica; 1600 uuf, char. D; 500 wvdc. | Plate V2 | CM20D162F |
| C14 | CAPACITOR, fixed: mica; 270 uuf, ±2%, char. C; 300 wvdc. | Plate V2 | CM15C271G |
| C15 | Same as C3. | Coupling L11 | CC21SL050C |
| C16 | Same as C1. | B+ Bypass | CC-100-16 |
| C17 | Same as C1. | B+ Bypass | CC-100-16 |
| C18 | CAPACITOR, variable: mica; 3 sections (Section 1); 27 - 30 uuf, each section. | Mixer Trimmer | CX-101 |
| C19 | Section 2 of C18. | Mixer Trimmer | P/O CX-101 |
| C20 | Section 3 of C18. | Mixer Trimmer | P/O CX-101 |
| C21 | Same as C18. (Section 1) | Mixer Trimmer | CX-101 |
| C22 | Section 2 of C21. | Mixer Trimmer | P/O CX-101 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C23 | Section 3 of C21. | Mixer Trimmer | P/O CX-101 |
| C24 | Same as C1. | Grid Return | CC-100-16 |
| C25 | Same as C1. | Bypass V3 | CC-100-16 |
| C26 | Same as C1. | Screen Bypass V3 | CC-100-16 |
| C27 | CAPACITOR, fixed: mica; 180 uuf, ±2%; char. D; 500 wvdc. | IF Tank P/O T3 | CM20D181G |
| C28 | CAPACITOR, fixed: mica; 1,000 uuf, ±2%; char. D; 500 wvdc. | IF Tank P/O T4 | CM20D102G |
| C29 | Same as C1. | Bypass T4 | CC-100-16 |
| C30 | Same as C1. | Bypass V4 | CC-100-16 |
| C31 | Same as C1. | Bypass V4 | CC-100-16 |
| C32 | CAPACITOR, fixed: ceramic; 120 uuf, ±20%; 500 wvdc. | Coupling V4 | CC-101-4 |
| C33 | CAPACITOR, fixed: mica; 220 uuf, ±2%; char. D; 500 wvdc. | OSC. Tank P/O L19 | CM20D221G |
| C34 | CAPACITOR, fixed: mica; 200 uuf, ±2%; char. D; 500 wvdc. | IF Tank P/O T2 | CM20D201G |
| C35 | Same as C34. | IF Tank P/O T2 | CM20D201G |
| C36 | Same as C1. | Bypass V5 | CC-100-16 |
| C37 | Same as C1. | Bypass V5 | CC-100-16 |
| C38 | Same as C1. | R.F. Bypass | CC-100-16 |
| C39 | Same as C33. | IF Tank P/O T5 | CM20D221G |
| C40 | Same as C1. | Bypass T5 | CC-100-16 |
| C41 | CAPACITOR, fixed: mica; 2400 uuf, ±2%; char. D; 500 wvdc. | IF Tank P/O T5 | CM20D242G |
| C42 | CAPACITOR, variable: air dielectric; 1 section 3 plates; 2.8 - 11 uuf. | XTAL Phasing | CT-105-1 |
| C43 | CAPACITOR, fixed: mica; 5 uuf, ±20%; char. C; 300 wvdc. | XTAL Filter Y1 | CM15C050M |
| C44 | CAPACITOR, fixed: mica; 300 uuf, ±2%; char. D; 500 wvdc. | XTAL Filter Y1 | CM20D301G |
| C45 | Same as C1. | Coupling V6 | CC-100-16 |
| C46 | Same as C1. | Bypass V6 | CC-100-16 |
| C47 | Same as C1. | AVC Return | CC-100-16 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C48 | Same as C1. | Screen Bypass V6 | CC-100-16 |
| C49 | Same as C28. | IF Tank P/O T6 | CM20D102G |
| C50 | Same as C1. | Bypass T6 | CC-100-16 |
| C51 | Same as C28. | IF Tank P/O T6 | CM20D102G |
| C52 | Same as C1. | AVC Bypass | CC-100-16 |
| C53 | Same as C1. | Cathode Bypass V7 | CC-100-16 |
| C54 | Same as C1. | Screen Bypass V7 | CC-100-16 |
| C55 | Same as C28. | IF Tank P/O T7 | CM20D102G |
| C56 | Same as C1. | Bypass T7 | CC-100-16 |
| C57 | Same as C5. | IF Output | CC21SL470K |
| C58 | Same as C28. | IF Tank P/O T7 | CM20D102G |
| C59 | CAPACITOR, fixed: ceramic; 3 uuf, ±0.25 uufd; char. SL; 500 wvdc. | BFO Injection T7 | CC21SL030C |
| C60 | Same as C1. | Cathode Bypass V8 | CC-100-16 |
| C61 | Same as C1. | Screen Bypass V8 | CC-100-16 |
| C62 | Same as C28. | IF Tank P/O T8 | CM20D102G |
| C63 | Same as C1. | Bypass T8 | CC-100-16 |
| C64 | Same as C28. | IF Tank P/O T8 | CM20D102G |
| C65 | CAPACITOR, fixed: ceramic; 220 uufd, ±10%; 500 wvdc. | RF Filter T8 | CC-101-3 |
| C66 | Same as C65. | RF Filter T8 | CC-101-3 |
| C67 | Same as C1. | Bypass V9 | CC-100-16 |
| C68 | CAPACITOR, fixed: ceramic; 51 uuf, ±2%; 500 wvdc. | Coupling V9 | CC21SL510G |
| C69 | CAPACITOR, fixed: paper; .05 uf, +40% -20%; 400 wvdc. | Time Constant | CN-100-3 |
| C70 | Same as C1. | Bypass V10 | CC-100-16 |
| C71 | Same as C1. | Coupling V10 | CC-100-16 |
| C72 | CAPACITOR, fixed: ceramic; .005 uf, G.M.V.; 500 wvdc., disc type. | Low Pass Filter | CC-100-15 |
| C73 | CAPACITOR, fixed: ceramic; .02 uf, ±80% -20%; 500 wvdc.; disc type. | Audio Filter | CC-100-24 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C74 | CAPACITOR, fixed: ceramic; dielectric; 30 uuf, ±5%; 500 wvdc. | OSC. Injection S13 | CC26CH300J |
| C75 | Same as C1. | Coupling V11 | CC-100-16 |
| C76 | CAPACITOR, fixed: electrolytic; 25 uf, ±10%; 150 wvdc. | Bypass V11 | CE-100 |
| C77 | CAPACITOR, fixed: electrolytic; 20 uf, 250 wvdc. | Bypass V11 | CE-103-5 |
| C78 | CAPACITOR, fixed: ceramic; dielectric; 47 uuf, ±5%; 500 wvdc. | OSC. Injection HFO, S1F | CC21SL470J |
| C79 | CAPACITOR, fixed: mica; 430 uuf, char. D; 500 wvdc. | Padder L13 | CM20D431F |
| C80 | CAPACITOR, variable: air dielectric; one sect., 21 plates; 2.7 - 19.6 uuf. | OSC Trimmer L13 | CB-122-4 |
| C81 | CAPACITOR, fixed: mica; .01 uf, char. D; 500 wvdc. | Padder L14 | CM20D1091F |
| C82 | Same as C80. | Trimmer L14 | CB-122-4 |
| C83 | CAPACITOR, fixed: ceramic; 750 uuf, ±5%; 500 wvdc. | Padder L15 | CC45UJ751J |
| C84 | Same as C80. | Trimmer L15 | CB-122-4 |
| C85 | CAPACITOR, fixed: ceramic; 91 uuf, ±5%; 500 wvdc. | Padder L16 | CC35CG910J |
| C86 | CAPACITOR, fixed: ceramic; 4.7 uuf, ±.25%; 500 wvdc. | Tank L16 | CC20UJ4R7C |
| C87 | Same as C80. | Trimmer L16 | CB-122-4 |
| C88 | CAPACITOR, fixed: ceramic; 330 uuf, ±5%; 500 wvdc. | Padder L17 | CC45SH331J |
| C89 | Same as C80. | Trimmer L17 | CB-122-4 |
| C90 | Same as C80. | Trimmer L18 | CB-122-4 |
| C91 | Same as C86. | Tank L18 | CC20UJ4R7C |
| C92 | CAPACITOR, fixed: ceramic; 390 uufd, ±5%; 500 wvdc. | Padder L18 | CC45SH391J |
| C93 | Same as C78. | Coupling V12 | CC21SL470J |
| C94 | Same as C1. | Plate Return V12 | CC-100-16 |
| C95 | Same as C1. | Bypass V12 | CC-100-16 |
| C96 | Same as C1. | Bypass V12 | CC-100-16 |
| C97 | Same as C69. | Bypass R81 | CN-100-3 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C98 | CAPACITOR, fixed: mica; 1500 uuf, ±2%; char. D; 500 wvdc. | BFO Tank P/O L22 | CM20D152G |
| C99 | CAPACITOR, variable: air dielectric; 1 section, 14 plates; 2.9 - 35 uuf, 500 wvdc. | BFO Pitch P/O L22 | CT-104-4 |
| C100 | Same as C65. | Grid Coupling P/O L22 | CC-101-3 |
| C101 | Same as C1. | Screen Bypass V13 | CC-100-16 |
| C102 | Same as C1. | Bypass V13 | CC-100-16 |
| C103 | Same as C1. | AC Line Bypass | CC-100-16 |
| C104 A & B | CAPACITOR, fixed: electrolytic; dual unit; 40 uf; each section, 450 wvdc. | B+ Filter V14 | CE-102-1 |
| C105 A & B | CAPACITOR, fixed: ceramic; two sections; .01 uf, 500 wvdc; ea., disc type. | Fil. Bypass V6 | CC-100-23 |
| C106 | CAPACITOR, variable: air dielectric; 1 section, 19 plates; 3.2 - 50 uuf, 500 wvdc. | Cal Adjust V16 | CT-104-3 |
| C107 | Same as C73. | Bypass | CC-100-24 |
| C108 | Same as C1. | AC Line Bypass | CC-100-16 |
| C109 | Same as C3. | Coupling L12 | CC21SL050L |
| C110 | CAPACITOR, fixed: ceramic; .002 uf, GMC, 500 wvdc, disc type. | Decoupling | CC-100-11 |
| C111 | Same as C1. | B+ Bypass | CC-100-16 |
| C112 | Same as C1. | B+ Bypass | CC-100-16 |
| C113 | Same as C1. | B+ Bypass | CC-100-16 |
| C114 | CAPACITOR, fixed: ceramic; 6.8 uuf, ±.5%; 500 wvdc. | Tank L15 | CC20UJ6R8D |
| C115 | CAPACITOR, fixed: ceramic; 22 uuf, ±10%; 500 wvdc. | Coupling L12 | CC21SL220K |
| C116 | Same as C1. | Grid Bias V10 | CC-100-16 |
| C117 | Same as C72. | Cathode Bias V1 | CC-100-15 |
| C118 | Same as C72. | Series Tank | CC-100-15 |
| C119 | Same as C73. | Bypass | CC-100-24 |
| C120 | Same as C1. | Series Tank | CC-100-16 |
| C121 | Same as C1. | B+ Bypass V12 | CC-100-16 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C122 | CAPACITOR, fixed: ceramic; 2.2 uuf, ±.5% uufd; 500 wvdc. | Temp Comp.V12 | CC-101-9 |
| C123 | Same as C122. | Temp Comp. S1G | CC-101-9 |
| C124 | CAPACITOR, fixed: mica; .001 uf, ±10%; char. B; 500 wvdc. | DC Blocking | CM20B102K |
| C125 | CAPACITOR, fixed: ceramic; 10 uuf, ±5%; 500 wvdc. | Tank L14 | CC20UJ100J |
| C126 | CAPACITOR, fixed: ceramic; 4.7 uuf, ±.25 uufd; 500 wvdc. | Tank L17 | CC20RH4R7C |
| C127 | Same as C83. | Padder L15 | CC45UJ751J |
| C128 | CAPACITOR, fixed: ceramic; 180 uuf, ±5%; 500 wvdc. | Padder L15 | CC35UJ181J |
| C129 | CAPACITOR, fixed: ceramic; 220 uuf, ±5%; 500 wvdc. | Padder L16 | CC45SH221J |
| C130 | CAPACITOR, fixed: ceramic; 100 uuf, ±5%; 500 wvdc. | Padder L17 | CC32SH101J |
| C131 | CAPACITOR, fixed: ceramic; 390 uuf, ±5%; 500 wvdc. | Padder L18 | CC45TH391J |
| C132 | Same as C10. | Bypass | CC-100-28 |
| C133 | Same as C10. | Bypass | CC-100-28 |
| C134 | Same as C1. | Cathode Bypass V16 | CC-100-16 |
| C135 | Same as C1. | Feedback V16 | CC-100-16 |
| C136 | CAPACITOR, fixed: ceramic; 150 uuf, ±10%; 500 wvdc. | Screen Bypass V16 | CC-101-2 |
| C137 | CAPACITOR, fixed: ceramic; 8 uuf, ±2%; 500 wvdc. | Coupling | CC21SL080G |
| C138 | Same as C72. | Series Tank | CC-100-15 |
| C139 | Same as C72. | Series Tank | CC-100-15 |
| C140 | CAPACITOR, variable: air tuning; 100 uuf, 27 plates; air gap = 0.015 nominal; 600V RMS. | Bypass V1 | CB-132-100B |
| C141 | Same as C18 (Section 1). | Series Tank | CX-101 |
| C142 | Same as C18 (Section 2). | Series Tank | P/O CX-101 |
| C143 | Same as C18 (Section 3). | Series Tank | P/O CX-101 |
| C144 | Same as C1. | Fil. Bypass V4 | CC-100-16 |
| C145 | Same as C1. | Fil. Bypass V4 | CC-100-16 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C146 | Same as C1. | Cathode Bypass V17 | CC-100-16 |
| C147 | Same as C1. | Screen Bypass V17 | CC-100-16 |
| C148 | Same as C1. | B+ Bypass V17 | CC-100-16 |
| C149 | CAPACITOR, variable: air dielectric; 1 section, 19 plates; 3.2 - 50 uuf, 500 wvdc. | Freq. Adjust | CT-104-1 |
| C150 | Same as C72. | Bypass J2 | CC-100-15 |
| C151 | Same as C1. | Fil. Bypass V8 | CC-100-16 |
| C152 | Same as C1. | Fil. Bypass V8 | CC-100-16 |
| C153 | CAPACITOR, fixed: mica; .0013 uf, ±2%; char. B; 500 wvdc. | Coupling V4 | CM20B132G |
| C154 | Same as C72. | R.F. Bypass V4 | CC-100-15 |
| C155 | Same as C86. | IFO Input | CC20UJ4R7C |
| C156 | Same as C1. | AVC Bypass T7 | CC-100-16 |
| C157 | Same as C18 (Section 1). | Series Tank | CX-101 |
| C158 | Same as C18 (Section 2). | Series Tank | P/O CX-101 |
| C159 | Same as C18 (Section 3). | Series Tank | P/O CX-101 |
| C160 | Same as C124. | Bypass V8 | CM20B102K |
| C161 | CAPACITOR, fixed: paper; .001 uf, +60 -20%; 600 wvdc; plastic tubular case. | Decoupling V11 | CN-100-9 |
| C162 | Same as C1. | Decoupling V5 | CC-100-16 |
| C163 | CAPACITOR, fixed: mica; 390 uuf, ±10%; char. B; 500 wvdc. | Coupling V13 | CM20B391K |
| C164 | CAPACITOR, fixed: mica; .006 uf, ±10%; char. B; 500 wvdc. | B+ Bypass V13 | CM20B622K |
| C165 | Same as C10. | Filter X2 | CC-100-28 |
| C166 | Same as C10. | Filter X2 | CC-100-28 |
| CR1 | DIODE, XTAL. | Electronic Sw. | 1N34A |
| E1 | STRIP, terminal: feed through; four 6-32 binder lead screws with solder lugs. | AVC External Terminal Conn. | TM-116-4 |
| E2 | STRIP, terminal: feed through; five 6-32 binder head screws with solder lugs, Phenolic body. | Audio Output | TM-116-5 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| E3 | Same as E1. | Terminal Conn. | TM-116-4 |
| F1 | FUSE, cartridge: 2 amp. | AC Line Fuse | FU-100-2 |
| I1 | LAMP, incandescent: miniature; 6-8 volts; 250 ma dc; T-3-1/4 frosted bulb; bayonet base. | Dial Light | BI-101-44(AF) |
| I2 | Same as I1. | Dial Light | BI-101-44(AF) |
| I3 | LAMP, incandescent: 6-8V; 250 ma; T-3-1/4 clear bulb; bayonet base. | Meter Light | BI-101-44 |
| J1A | JACK, tip: electrical; dual contact; phono type. | IF Output | JJ-144 |
| J1B | Same as J1A. | Phone Input | JJ-144 |
| J2 | JACK, telephone: normally closed. | Phones | JJ-132 |
| J3 | CONNECTOR, receptacle: electrical; female; 2 prong; 10 amps @ 250V, 15 amps @ 125V. | AC Line | JJ-145 |
| J4 | CONNECTOR, receptacle: electrical; female; 2 prong; polarized; one 5/32" dia pin hole, one 1/8" dia pin hole. | Relay Input | JJ-146 |
| J5 | CONNECTOR, receptacle: electrical; 1 female contact; 52 ohms; BNC type. | External | UG-625/U |
| J6 | Same as J5. | Antenna | UG-625/U |
| J7 | Same as J5. | BFO Input | UG-625/U |
| J8 | Same as J5. | IF Input | UG-625/U |
| L1 | TRANSFORMER, RF: tuned; Q-pri = 45, sec = 60; L(uh) pri = 138, sec = 195; freq pri = 790 kc, sec = 790 kc. | 2nd RF Band 1 | TT-101 |
| L2 | TRANSFORMER, RF: tuned; 1.43-3.3 mc; primary, 32.5 uh ±1.6 uh, Q = 40, secondary, 27.5 uh ±1.4 uh, Q = 90. | 2nd RF Band 2 | A-897 |
| L3 | TRANSFORMER, RF: tuned; 3.2-5.6 mc; primary, 190 uh ±9.5 uh, Q = 50, secondary, 9.7 uh ±.048 uh, Q = 85. | 2nd RF Band 3 | A-898 |
| L4 | COIL, RF: tuned; 5.4-9.6 mc; 3.4 uh ±5%, Q = 120. | 2nd RF Band 4 | A-901 |
| L5 | COIL, RF: tuned; 9.4-17.8 mc; 1.1 uh ±5%, Q = 110. | 2nd RF Band 5 | A-900 |
| L6 | TRANSFORMER, RF: tuned; 17.3-31.5 mc; .3 uh, Q = 115. | 2nd RF Band 6 | A-905 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| L7 | TRANSFORMER, RF: tuned; 535-1.45 mc; primary, 280 uh ±14 uh, Q = 50, secondary, 195 uh ±10 uh, Q = 60. | 3rd RF Band 1 | A-961 |
| L8 | TRANSFORMER, RF: tuned; Q-pri = 40, sec = 90; L(uh) pri = 94, sec = 27.5; freq(mc) pri = .790, sec = 2.5. | 3rd RF Band 2 | TT-109 |
| L9 | TRANSFORMER, RF: tuned; Q-pri = 55, sec = 85; L(uh) pri = 9.0, sec = 9.7; freq(mc) pri = 7.9, sec = 2.5. | 3rd RF Band 3 | TT-108 |
| L10 | TRANSFORMER, RF: tuned; 5.4-9.6 mc; primary, 5 uh ±25 uh, Q = 78, secondary, 3.4 uh ±.2 uh, Q = 120. | 3rd RF Band 4 | A-964 |
| L11 | COIL, RF: tuned; 9.4-17.8 mc; 1.1 uh ±.05 uh, Q = 115. | 3rd RF Band 5 | A-965 |
| L12 | TRANSFORMER, RF: tuned; 17.3-31.5 mc; .3 uh, Q = 115. | 3rd RF Band 6 | A-966 |
| L13 | TRANSFORMER, RF: tuned; .990-1.905 mc; 111 uh ±5 uh, Q = 95; tapped @ 71 uh ±4 uh, Q = 85; +13.6 uh ±.6 uh, Q = 55. | OSC. Band 1 | A-894 |
| L14 | TRANSFORMER, RF: tuned; 1.885-3.755 mc; 20.5 uh ±1 uh, Q = 100 ±5; tapped @ 13.5 uh ±.6 uh, Q = 90 ±5. | OSC. Band 2 | A-896 |
| L15 | TRANSFORMER, RF: tuned: 3.655-6.055 mc; 8.2 uh ±.4 uh, Q = 100; tapped @ 5.5 uh ±.25 uh, Q = 85 ±6. | OSC. Band 3 | A-899 |
| L16 | TRANSFORMER, RF: tuned; 9.355-13.555 mc; 1.66 uh ±.08 uh, Q = 80; tapped @ 1.12 uh ±.05 uh, Q = 75. | OSC. Band 4 | A-903 |
| L17 | TRANSFORMER, RF: tuned; 9.355-13.555 mc; 0.76 uh, 10.08 uh, Q = 225; tapped @ 0.05 uh, 10.05 uh. | OSC. Band 5 | A-1356 |
| L18 | TRANSFORMER, RF: tuned; 21.255-35.455 mc; 0.25 uh, 10.03 uh, Q = 145; tapped @ 1-1/4 turns. | Oscillator | A-1355 |
| L19 | TRANSFORMER, RF: tuned; 7.2 uh ±5%; Q = 110. | 2nd Converter | A-1041 |
| L20 | COIL, RF: tuned; 250 uh ±10 uh; Q = 80. | Xtal Filter Load | A-944 |
| L21 | COIL, peaking: 700 millihenries; ±5%; Q = 55 ±10%; DC resistance, 60-75 ohms. | Audio Filter | CL-117 |
| L22 | TRANSFORMER, RF: tuned; 75 uh ±4 uh, Q = 80; tapped @ 33 uh ±1.5 uh. | BFO OSC. | A-1043 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| L23 | REACTOR, filter: 11.4 henries; 125 ma max. current; 250 ohms, insulated for 2500 volts, RMS. | RF Choke | TF-158 |
| L24 | COIL, RF: fixed; 11.0 uh. | P/O Low Pass Filter | CL-134-3 |
| L25 | COIL, RF: 200 uh, wound on resistor, RC30GF822K. | RF Choke V4 | CL-108-6 |
| L26 | COIL, RF: 128 uh. | B+ Choke | CL-177 |
| L27 | Same as L26. | B+ Choke | CL-177 |
| L28 | TRANSFORMER, RF: tuned; Q-pri = 8, sec = 50; L(uh) pri = 10, sec = 340; freq(mc) pri = 25, sec = .790. | 1st RF Band 1 | TT-102 |
| L29 | TRANSFORMER, RF: tuned; Q-pri = 45, sec = 85; L(uh) pri = 1.4, sec = 75; freq(mc) pri = 2.5, sec = .790. | 1st RF Band 2 | TT-103 |
| L30 | TRANSFORMER, RF: tuned; Q-pri = 20, sec = 75; L(uh) pri = .32, sec = 19.0; freq(mc) pri = 25, sec = 2.5. | 1st RF Band 3 | TT-104 |
| L31 | TRANSFORMER, RF: tuned; Q-pri = 90, sec = 100; L(uh) pri = 42, sec = 7.0; freq(mc) pri = 25, sec = 7.9. | 1st RF Band 4 | TT-105 |
| L32 | TRANSFORMER, RF: tuned; Q-pri = 120, sec = 100; L(uh) pri = .3, sec = 2.5; freq(mc) pri = 25, sec = 7.9. | 1st RF Band 5 | TT-106 |
| L33 | TRANSFORMER, RF: tuned; Q-pri = 100, sec = 155; L(uh) pri = .15 ±5%, sec = .8 ±5%; freq(mc) pri = 25, sec = 25. | 1st RF Band 6 | TT-107 |
| L34 | Same as L26. | Cathode Choke V12 | CL-177 |
| L35 | Same as L24. | P/O Low Pass Filter | CL-134-3 |
| L36 | COIL, RF: 750 uh; ±20% 100 ma max. current; 17 ohms; bakelite body. | Plate Choke V17 | CL-100-5 |
| L37 | COIL, RF: fixed; 370 uh; Q = 70, freq = 790 kc; wire - #36, double silk Litz. | BFO Plate | CL-230 |
| L38 | COIL, RF: fixed; 585 uh; Q = 80, freq = 790 kc; wire - #36, double silk Litz. | BFO Output | CL-231 |
| M1 | METER, "S" type: white and red; illuminated dial, w/a 6.3 VAC pilot light. | Sensitivity Meter | MR-107 |
| P1 | CONNECTOR, plug: electrical; male; two prong; polarized; one 5/32" dia pin hole, one 1/8" dia pin hole. | Relay Plug | PL-123 |
| P2 | P/O W1. | Power Input | P/O W1 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| PL1 | CONNECTOR, plug: electrical; 8 prong, octal; polarized; w/associated wiring. | AC Oper Plug | A-1021 |
| R1 | RESISTOR, fixed: comp.; 220 ohms ±10%; 1/2 watt. | Cathode Bias V1 | RC20GF221K |
| R2 | RESISTOR, fixed: comp.; 100K ohms ±10%; 1/2 watt. | AVC Bias V1 | RC20GF104K |
| R3 | RESISTOR, fixed: comp.; 4700 ohms ±5%; 1/2 watt. | Plate Load L4 | RC20GF472J |
| R4 | RESISTOR, fixed: comp.; 22K ohms ±5%; 1 watt. | Plate Load L5 | RC32GF223J |
| R5 | RESISTOR, fixed: comp.; 15K ohms ±5%; 1 watt. | Plate Load L6 | RC32GF153J |
| R6 | RESISTOR, fixed: comp.; 4700 ohms ±10%; 1 watt. | B+ Decoupling | RC32GF472K |
| R7 | Same as R2. | AVC Bias | RC20GF104K |
| R8 | RESISTOR, fixed: comp.; 2200 ohms ±10%; 1/2 watt. | Suppressor V2 | RC20GF220K |
| R9 | RESISTOR, fixed: comp.; 150K ohms ±10%; 1/2 watt. | Degeneration V4 | RC20GF154K |
| R10 | RESISTOR, fixed: comp.; 120 ohms ±10%, 1/2 watt. | Cathode Bias V2 | RC20GF121K |
| R11 | RESISTOR, fixed: comp.; 56K ohms ±10%; 1/2 watt. | Screen Load V2 | RC20GF563K |
| R12 | RESISTOR, fixed: comp.; 1K ohm ±10%; 1/2 watt. | Load L10 | RC20GF102K |
| R13 | RESISTOR, fixed: comp.; 15K ohms ±5%; 2 watt. | Plate Load L11 | RC42GF153J |
| R14 | RESISTOR, fixed: comp.; 4700 ohms ±10%; 1/2 watt. | B+ Bypass | RC20GF472K |
| R15 | Same as R8. | Suppressor V3 | RC20GF220K |
| R16 | Same as R2. | Grid Bias L12 | RC20GF104K |
| R17 | RESISTOR, fixed: comp.; 100 ohms ±5%; 1/2 watt. | OSC. Injector V9 | RC20GF101J |
| R18 | RESISTOR, fixed: comp.; 330 ohms ±10%; 1/2 watt. | Degeneration V3 | RC20GF331K |
| R19 | RESISTOR, fixed: comp.; 2700 ohms ±10%; 1/2 watt. | Cathode Bias V3 | RC20GF272K |
| R20 | Same as R9. | Screen Load V3 | RC20GF154K |
| R21 | Same as R14. | B+ Decoupling T4 | RC20GF472K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R22 | RESISTOR, fixed: comp.; 10K ohms ±10%; 1/2 watt. | Screen Load V4 | RC20GF103K |
| R23 | RESISTOR, fixed: comp.; 47 ohms ±10%; 1/2 watt. | Suppressor V4 | RC20GF470K |
| R24 | RESISTOR, fixed: comp.; 150 ohms ±10%; 1/2 watt. | Cathode Bias V4 | RC20GF151K |
| R25 | RESISTOR, fixed: comp.; 15K ohms ±5%; 1/2 watt. | Grid Leak P/O L19 | RC20GF153J |
| R26 | Same as R23. | Suppressor V4 | RC20GF470K |
| R27 | RESISTOR, fixed: comp.; 510 ohms ±5%; 1/2 watt. | Cathode V5 | RC20GF511J |
| R28 | Same as R2. | Screen Load V5 | RC20GF104K |
| R29 | RESISTOR, fixed: comp.; 12K ohms ±10%; 1 watt. | B+ Decoupling | RC32GF123K |
| R30 | RESISTOR, fixed: comp.; 390K ohms ±10%; 1/2 watt. | Shunting, P/O T5 | RC20GF394K |
| R31 | RESISTOR, fixed: comp.; 6800 ohms ±10%; 1/2 watt. | B+ Decoupling | RC20GF682K |
| R32 | RESISTOR, fixed: comp.; 10 ohms ±5%; 1/2 watt. | Xtal Filter Y1 | RC20GF100J |
| R33 | Same as R32. | Xtal Filter Y1 | RC20GF100J |
| R34 | RESISTOR, fixed: comp.; 22 ohms ±5%; 1/2 watt. | Xtal Filter Y1 | RC20GF220J |
| R35 | Same as R17. | Xtal Filter Y1 | RC20GF101J |
| R36 | Same as R8. | Limiter V6 | RC20GF220K |
| R37 | RESISTOR, fixed: comp.; 1 meg ±10%; 1/2 watt. | Isolation V6 | RC20GF105K |
| R38 | Same as R2. | AVC Bias | RC20GF104K |
| R39 | Same as R17. | Cathode Bias V6 | RC20GF101J |
| R40 | RESISTOR, fixed: comp.; 56K ohms ±10%; 1 watt. | Screen Load V6 | RC32GF563K |
| R41 | Same as R11. | Shunt, P/O T6 | RC20GF563K |
| R42 | RESISTOR, fixed: comp.; 6800 ohms ±10%; 1 watt. | B+ Decoupling | RC32GF682K |
| R43 | Same as R2. | AVC Bias T2 | RC20GF104K |
| R44 | Same as R8. | Suppressor V7 | RC20GF220K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R45 | Same as R17. | Cathode Bias V7 | RC20GF101J |
| R46 | RESISTOR, fixed: comp.; 470 ohms ±10%; 1 watt. | Meter Bridge | RC20GF471K |
| R47 | Same as R40. | Screen Load V7 | RC32GF563K |
| R48 | Same as R11. | Shunt, P/O T7 | RC20GF563K |
| R49 | RESISTOR, fixed: comp.; 27K ohms ±10%; 2 watts. | Meter Bridge | RC42GF273K |
| R50 | RESISTOR, variable: comp.; 10K ohms ±20%; linear, 2 watts. | Meter Adj. | RV4ATSA103B |
| R51 | RESISTOR, fixed: comp.; 22K ohms ±5%; 2 watts. | Meter Bridge | RC42GF223J |
| R52 | RESISTOR, fixed: comp.; 6800 ohms ±10%; 2 watts. | B+ Decoupling T7 | RC42GF682K |
| R53 | Same as R8. | Suppressor V8 | RC20GF220K |
| R54 | Same as R1. | Cathode Bias V8 | RC20GF221K |
| R55 | Same as R40. | Screen Load V8 | RC32GF563K |
| R56 | Same as R11. | Shunt P/O T8 | RC20GF563K |
| R57 | Same as R42. | B+ Decoupling T8 | RC32GF682K |
| R58 | RESISTOR, fixed: comp.; 47K ohms ±10%; 1/2 watt. | Load V9 | RC20GF473K |
| R59 | Same as R37. | Noise Limiter V9 | RC20GF105K |
| R60 | RESISTOR, fixed: comp.; 220K ohms ±10%; 1/2 watt. | Load V9 | RC20GF224K |
| R61 | RESISTOR, fixed: comp.; 470K ohms ±10%; 1/2 watt. | Load V9 | RC20GF474K |
| R62 | RESISTOR, fixed: comp.; 820K ohms ±10%; 1/2 watt. | Noise Limiter V9 | RC20GF824K |
| R63 | RESISTOR, fixed: comp.; 1.2 megs ±10%; 1/2 watt. | AVC V10 | RC20GF125K |
| R64 | Same as R63. | Volt. Divider V10 | RC20GF125K |
| R65 | Same as R14. | Cathode Bias V10 | RC20GF472K |
| R66 | RESISTOR, fixed: comp.; 180K ohms ±10%; 1/2 watt. | Volt. Divider V10 | RC20GF184K |
| R67 | RESISTOR, fixed: comp.; 8.2 megs ±10%; 1/2 watt. | Grid Leak V10 | RC20GF825K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R68 | RESISTOR, variable: comp.; 1 meg ±10%; linear, 2 watts. | Audio Gain | RV4ATRD105D |
| R69 | Same as R1. | Cathode Bias V10 | RC20GF221K |
| R70 | RESISTOR, fixed: comp.; 120K ohms ±10%; 1/2 watt. | Feedback V10 | RC20GF124K |
| R71 | RESISTOR, variable: comp.; 1500 ohms ±10%; linear, 2 watts. | Audio Spread | RV4ATSC152B |
| R72 | Same as R4. | Plate Load | RC32GF223J |
| R73 | Same as R61. | Grid Leak V11 | RC20GF474K |
| R74 | RESISTOR, fixed: comp.; 300 ohms ±5%; 2 watts. | Cathode Bias V11 | RC42GF301J |
| R75 | RESISTOR, fixed: comp.; 560 ohms ±10%; 2 watts. | Phase Shunt J2 | RC42GF561K |
| R76 | Same as R11. | B+ Decoupling | RC20GF563K |
| R77 | RESISTOR, fixed: comp.; 680K ohms ±10%; 1/2 watt. | Plate Load V16 | RC20GF684K |
| R78 | RESISTOR, fixed: comp.; 22K ohms ±10%; 1/2 watt. | Grid Leak V12 | RC20GF223K |
| R79 | Same as R19. | Plate Load V12 | RC20GF272K |
| R80 | Same as R78. | Screen Load V12 | RC20GF223K |
| R81 | RESISTOR, variable: comp.; 5K ohms ±10%; 2 watts. | RF Gain | RV4BTRD502E |
| R82 | Same as R58. | Grid Leak V13 | RC20GF473K |
| R83 | Same as R8. | Suppressor V13 | RC20GF220K |
| R84 | Same as R70. | Screen Load V13 | RC20GF124K |
| R85 | Same as R2. | AVC Bias | RC20GF104K |
| R86 | RESISTOR, fixed: comp.; 68K ohms ±10%; 1/2 watt. | Volt. Divider V13 | RC20GF683K |
| R87 | RESISTOR, fixed: wire wound; 5000 ohms ±10%; 20 watts. | Bleeder V14 | RW-110-30 |
| R88 | RESISTOR, fixed: comp.; 4.7 ohms ±5%; 1 watt. | Volt. Divider V9 | RC32GF4R7J |
| R89 | RESISTOR, fixed: comp.; 10 ohms ±10%; 1/2 watt. | Suppressor L7 | RC20GF100K |
| R90 | Same as R89. | Suppressor L8 | RC20GF100K |
| R91 | RESISTOR, fixed: comp.; 12K ohms ±5%; 1/2 watt. | Suppressor V1 | RC20GF123J |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R92 | Same as R13. | Load L12 | RC42GF153J |
| R93 | RESISTOR, fixed: comp.; 1000 ohms ±5%; 1/2 watt. | Decoupling V12 | RC20GF102J |
| R94 | RESISTOR, variable: wire wound; 250 ohms ±10%; 2 watts; linear taper. | Hum Balance | RA101ASSA-251A |
| R95 | RESISTOR, fixed: comp.; 270K ohms ±10%; 1/2 watt. | Screen V16 | RC20GF274K |
| R96 | Same as R31. | Cathode Bias V16 | RC20GF682K |
| R97 | Same as R61. | Grid V16 | RC20GF474K |
| R98 | Same as R10. | Cathode Bias V17 | RC20GF121K |
| R99 | Same as R58. | Grid Leak V17 | RC20GF473K |
| R100 | Same as R23. | Volt. Dropping | RC20GF470K |
| R101 | RESISTOR, fixed: comp.; 22K ohms ±10%; 1 watt. | Plate Load V17 | RC32GF223K |
| R102 | Same as R12. | Plate Load V17 | RC20GF102K |
| R103 | Same as R78. | Screen Load V17 | RC20GF223K |
| R104 | RESISTOR, fixed: comp.; 68 ohms ±10%; 2 watts. | Terminating J5 | RC42GF680K |
| R105 | Same as R17. | Terminating J8 | RC20GF101J |
| R106 | RESISTOR, variable: comp.; 500 ohms ±20%; linear, 2 watts. | IF Gain | RV4ATXA501B |
| R107 | Same as R86. | Volt. Dropping | RC20GF683K |
| R108 | Same as R86. | Screen Load V1 | RC20GF683K |
| R109 | Same as R22. | Load L9 | RC20GF103K |
| R110 | Same as R11. | Load L28 | RC20GF563K |
| R111 | RESISTOR, fixed: comp.; 68K ohms ±10%; 1 watt. | Voltage Dropping | RC32GF683K |
| R112 | Same as R25. | Load L8 | RC20GF153J |
| S1AA | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 6 contacts (1 common), rear 3 contacts (1 common), bakelite ins. | Bandswitch | WS-118 |
| S1A | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 6 contacts (1 common), rear 6 contacts (1 common), bakelite ins. | Bandswitch | WS-117 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| S1B | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 7 contacts (1 common), rear 7 contacts (1 common), bakelite ins. | Bandswitch | WS-100-6 |
| S1C | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 8 contacts (1 common), rear sect., 8 contacts; bakelite ins; brass terminals; silver plated. | Bandswitch | WS-100-3 |
| S1D | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 7 contacts (1 common), rear sect., 7 contacts (1 common), bakelite ins; brass terminals, S.P. | Bandswitch | WS-100-2 |
| S1E | Same as S1C. | Bandswitch | WS-100-3 |
| S1F | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 7 contacts (1 common), rear sect., 7 contacts (1 common), bakelite ins; brass terminals, S.P. | Bandswitch | WS-100-4 |
| S1G | WAFER, switch: (P/O A-1899) shorting, rotary type; front sect., 8 contacts (1 common), rear sect., 8 contacts, bakelite ins; brass terminals; silver plated. | Bandswitch | WS-100-5 |
| S2A, B | SWITCH, rotary: non-shorting; one sect.; S.P.; six positions, bakelite ins; brass terminals; S.P., 1/4" dia shaft, 2-7/8" long. | RF Selectivity | SW-147 |
| S3 | SWITCH, toggle: SPST; 3 amps @ 250 volts, 6 amps @ 125 volts, battery type. | AVC | ST-103-1-62 |
| S4 | Same as S3. | Noise Limiter | ST-103-1-62 |
| S5 | SWITCH, rotary: non-shorting; 2 sect., S.P.; 3 positions, bakelite ins; brass contacts and wipers, silver plated; 1/4" dia shaft, 7/8" long. | Audio Selectivity | SW-156 |
| S6A, B | SWITCH, sliding: DPDT; 5 amps @ 125 volts. | Radio Phono | SW-163 |
| S7A, B | Same as S6A, B. | Radio Phono | SW-163 |
| S8 | Same as S3. | BFO | ST-103-1-62 |
| S9 | Same as S3. | Send, Receive | ST-103-1-62 |
| S10 | P/O R81. | Power ON-OFF | P/O R81 |
| S11 | Same as S3. | Calibrate | ST-103-1-62 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| S12A, B | SWITCH, 12 position: shorting rotary type; front sect., 5 contacts (1 common), rear sect., 1 contact (1 common), bakelite ins. | HFO | SW-273 |
| S13 | SWITCH, rotary: non-shorting; one sect., S.P.; 2 positions 30° ∡ of throw; glass melamine ins., silver alloy contact and wipers, 1/8" dia shaft, 1-9/32" long. | HFO | SW-203 |
| T1 | NOT USED. | | |
| T2 | TRANSFORMER, RF: tuned; primary, 6.2 uh ±5%, Q = 110; secondary #1, 6.2 uh ±5%, Q = 110; secondary #2, 2 turns. | 2nd Converter | A-1040 |
| T3 | TRANSFORMER, assy RF: tuned; winding #1, 95 uh, Q = 82; winding #2, 6.2 uh, Q = 110. | Comp. IF | A-1038 |
| T4 | Same as T3. | Comp. IF | P/O T3 |
| T5 | TRANSFORMER, RF: tuned; primary, 415 uh, ±5%, Q = 90; secondary, 40 uh, ±5%, Q = 65. | Crystal Filter | A-1034 |
| T6 | TRANSFORMER, RF: tuned; 455 kc; primary, 95 uh ±5 uh, Q = 75; secondary, 95 uh ±5 uh, Q = 75. | 1st IF | A-1039 |
| T7 | Same as T6. | 2nd IF | A-1039 |
| T8 | Same as T6. | 3rd IF | A-1039 |
| T9 | TRANSFORMER, RF: output; 100 - 10,000 cps ±3 db; primary, 5000 ohms, 55 ma max.; secondary, 600 Ω, tapped at 16.8 and 4 Ω, 4 and 10 watts max. output, insulated for 1000 volts. | Output | TF-159 |
| T10 | TRANSFORMER, power: primary, 115/230V, 50/60 cps; secondary #1, 5V @ 3 A; secondary #2, 275-0-275V @ 110 ma; secondary #3, 6.3V @ 5.65A; insulated for 1000 volts. | Power | TF-169 |
| T11 | AUTOTRANSFORMER: 128 uh ±5%, Q = 100. | 2nd Converter | A-989 |
| V1 | TUBE, electron: semiremote - cutoff pentode; 7 pin miniature. | 1st RF Amp. | 6DC6 |
| V2 | TUBE, electron: remote cutoff pentode; 7 pin miniature. | 2nd RF Amp. | 6BA6 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| V3 | TUBE, electron: sharp cutoff pentode; 7 pin miniature. | 1st Converter | 6AU6 |
| V4 | TUBE, electron: pentagrid converter; 7 pin miniature. | 2nd Converter and OSC. | 6BE6 |
| V5 | Same as V2. | Buffer | 6BA6 |
| V6 | Same as V2. | 1st IF Amp. | 6BA6 |
| V7 | Same as V2. | 2nd IF Amp. | 6BA6 |
| V8 | Same as V2. | 3rd IF Amp. | 6BA6 |
| V9 | TUBE, electron: duo diode; 7 pin miniature. | Noise Limiter | 6AL5 |
| V10 | TUBE, electron: high Mu twin triode; 9 pin miniature. | Audio Amp. | 12AX7 |
| V11 | TUBE, electron: beam power tube; 8 pin octal metal type. | 2nd Audio Amp. | 6V6 |
| V12 | TUBE, electron: sharp cutoff pentode; 7 pin miniature. | Oscillator | 6AG5 |
| V13 | Same as V12. | BFO | 6AG5 |
| V14 | TUBE, electron: full wave vacuum rectifier; 8 pin glass octal. | Rectifier | 5U4G |
| V15 | TUBE, electron: voltage regulator; 7 pin miniature. | Volt. Regulator | 0A2 |
| V16 | TUBE, electron: sharp cutoff pentode; 7 pin miniature. | 100 kc OSC. | 6CB6 |
| V17 | Same as V12. | Xtal OSC. Amp. | 6AG5 |
| W1 | CABLE ASSEMBLY, power: electrical; 2 cond., 6 ft. 3 in. long; w/integral male plug one end. | Line Cord | CA-102-2 |
| X1 | SOCKET, electron tube: detail. | Power Socket | TS-101P01 |
| X2 | Same as X1. | Accessory Socket | TS-101P01 |
| XF1 | FUSEHOLDER, extractor post type: 250V, 15 amp. | F1 Socket | FH-100-2 |
| XI1 | SOCKET, bracket: for miniature, bayonet base; T3-1/4 bulb; rt. angled, down turned. | I1 Socket | TS-107-2 |
| XI2 | Same as XI1. | I2 Socket | TS-107-2 |
| XI3 | SOCKET, lamp: for miniature bayonet base; T3-1-1/4 bulb; 10 in. leads for insertion into rear of meter. | I3 Socket | TS-127 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| XV1 | SOCKET, electron tube: 7 pin miniature. | V1 Socket | TS-102P01 |
| XV2 | Same as XV1. | V2 Socket | TS-102P01 |
| XV3 | Same as XV1. | V3 Socket | TS-102P01 |
| XV4 | Same as XV1. | V4 Socket | TS-102P01 |
| XV5 | Same as XV1. | V5 Socket | TS-102P01 |
| XV6 | Same as XV1. | V6 Socket | TS-102P01 |
| XV7 | Same as XV1. | V7 Socket | TS-102P01 |
| XV8 | Same as XV1. | V8 Socket | TS-102P01 |
| XV9 | Same as XV1. | V9 Socket | TS-102P01 |
| XV10 | SOCKET, electron tube: 9 pin miniature. | V10 Socket | TS-103P01 |
| XV11 | Same as X1. | V11 Socket | TS-101P01 |
| XV12 | SOCKET, electron tube: ceramic; 7 pin miniature. | V12 Socket | TS-102C01 |
| XV13 | Same as XV1. | V13 Socket | TS-102P01 |
| XV14 | Same as X1. | V14 Socket | TS-101P01 |
| XV15 | Same as XV1. | V15 Socket | TS-102P01 |
| XV16 | Same as XV1. | V16 Socket | TS-102P01 |
| XV17 | Same as XV1. | V17 Socket | TS-102P01 |
| XY3 | SOCKET, Xtal. | Y3 Socket | TS-105 |
| XY4 | SOCKET, Xtal: .486 in. spacing for .050 in. pin dia. | Y4 Socket | TS-104-1 |
| XY5 | Same as XY4. | Y5 Socket | TS-104-1 |
| XY6 | Same as XY4. | Y6 Socket | TS-104-1 |
| XY7 | Same as XY4. | Y7 Socket | TS-104-1 |
| XY8 | Same as XY4. | Y8 Socket | TS-104-1 |
| XY9 | Same as XY4. | Y9 Socket | TS-104-1 |
| XY10 | Same as XY4. | Y10 Socket | TS-104-1 |
| XY11 | Same as XY4. | Y11 Socket | TS-104-1 |
| XY12 | Same as XY4. | Y12 Socket | TS-104-1 |

## COMMUNICATIONS RECEIVER GPR-90RXD

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| XY13 | Same as XY4. | Y13 Socket | TS-104-1 |
| Y1 | CRYSTAL UNIT, quartz: 455 kc; ±.02%; 2 in. solder leads. | Xtal Filter | CR-102 |
| Y2 | CRYSTAL UNIT, quartz: 3.5 mcs. | Osc. V4 | CR-103 |
| Y3 | CRYSTAL UNIT, quartz: 100 kc. | 100 kc Osc. | CR-100 |

## VARIABLE FREQUENCY OSCILLATOR VOX-3

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C101 | CAPACITOR, fixed: paper; 4 mfd, ±10%; char. F; 600 wvdc; oil filled and impregnated, hermetically sealed cylindrical metal case. | B+ RF Bypass V101 | CP40C2FF405K |
| C102 A, B | CAPACITOR, fixed: dry electrolytic; polarized; dual unit; 20 mfd, each section, 450 wvdc; char. E. | B+ Filter Cap., V103 | CE52E200R |
| C103 | NOT USED. | | |
| C104 | CAPACITOR, fixed: mica; .01 mfd, ±10%; char. B, 300 wvdc. | RF Bypass Cap., V102 | CM35B103K |
| C105 | CAPACITOR, fixed: mica; 1000 mmfd, ±10%; char. B, 500 wvdc. | VMO Meter Bypass Cap., V103 | CM20B102K |
| C106 | Same as C105. | VMO Meter RF Coup. Cap., V103 | |
| C107 | CAPACITOR, fixed: mica; 5 mmfd, ±20%; char. B, 500 wvdc. | VMO Mixer Coup. Cap., V103 | CM20B050M |
| C108 | Same as C105. | Mixer Screen Bypass Cap., V103 | |
| C109 | NOT USED. | | |
| C110 | NOT USED. | | |
| C111 | Same as C105. | Mixer Plate Filter Cap., V103 | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C112 | Same as C105. | Mixer Plate Filter Cap. V103 | |
| C113 | CAPACITOR, fixed: paper; .5 mfd, ±10%; char. E; 600 wvdc; oil filled and impregnated, hermetically sealed metal case. | Mixer Output Coup. Cap. V104 | CP69B1EF504K |
| C114 | CAPACITOR, fixed: paper; .5 mfd, ±10%; char. E; 600 wvdc; oil filled and impregnated, hermetically sealed bathtub case. | Audio Output Coup. Cap. V104 | CP53B1EF504K |
| C115 | Same as C105. | 100 Kc Mixer Coup. Cap. V103 | |
| C116 | CAPACITOR, fixed: paper; .1 mfd, ±10%; char. E; 600 wvdc; oil filled and impregnated, hermetically sealed bathtub case. | Phone Coupling Cap., J105 | CP53B1EF104K |
| C117 | Same as C105. | BFO Meter Decoupling Cap., S107 | |
| C118 | Same as C105. | BFO Meter Coupling Cap., J104 | |
| C119 | Same as C104. | BFO Plate Filter Cap., V105 | |
| C120 | Same as C104. | BFO Tank Cap., V105 | |
| C121 | Same as C105. | BFO Voltage Div. Cap., V105 | |
| C122 | CAPACITOR, fixed: mica; 150 mmfd, ±5%; char. C; 500 wvdc. | BFO Xtal Load Cap., S105 | CM20C151J |
| C123 | Same as C105. | BFO Xtal Coup. Cap., V105 | |
| CR101 | CRYSTAL UNIT, rectifying: germanium. | VMO Output Rect. V103 | 1N34 |
| CR102 | Same as CR101. | BFO Output Rect. J103 | |
| F101 | FUSE, cartridge: 3 amp. | Oven Fuse | FU-100-3 |
| F102 | FUSE, cartridge: 2 amp. | Power Fuse | FU-100-2 |
| J101 | CONNECTOR, receptacle: female; 6 contacts. | PS - Oven Interconnect | MS3102A-16S-1S |
| J102 | CONNECTOR, receptacle: coaxial; female; BNC type, single holt mtg. | BFO Output | UG-625/U |
| J103 | Same as J102. | BFO Output | |
| J104 | Same as J102. | BFO Output | |
| J105 | JACK, telephone: open circuit; insulated. | Phone Input | JJ-034 |
| J106 | Same as J105 | Phone Input | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| L101 | REACTOR, filter: 10 henries at 125 ma DC, 60 volts, 120 cps; DC resistance approx. 150 ohms; insulated for 1000 volts, RMS; in accordance with MIL-T-27, GR. 1, CL.A, FAM. .05. | B+ Filter Choke, V101 | TF-5001 |
| L102 | COIL, RF: 10 millihenries; 100 ma. max. current; DC resistance approx. 30 ohms, bakelite body. | BFO Tank Coil V105 | CL-101-4 |
| P101 | CONNECTOR, plug: male; polarized; twelve contacts, w/cable clamp. | PS-RF Interconnect | PL-102-1 |
| P102 | CONNECTOR, plug: coaxial; male contact; BNC type. Part of W104. | P/O VMO Input Cable V104 | UG-88/U |
| P103 | CONNECTOR, plug: AN pin type; 7 contacts rated at 20 amps. Part of W102. | P/O Service Cable W102 | MS3106B-16S-1P |
| P104 | CONNECTOR, plug: AN socket type; 7 contacts rated at 20 amps. Part of W102. | P/O Service Cable W102 | MS3106B-16S-1S |
| P105 | Same as P101. Part of W101. | P/O Service Cable W101 | |
| P106 | CONNECTOR, plug: female; polarized; twelve contacts; w/cable clamp. Part of W101. | P/O Service Cable W101 | PL-102-2 |
| P107 | CONNECTOR, plug: male; coaxial; BNC type for RG-59/U. Part of W103. | P/O Service Cable W103 | UG-260/U |
| P108 | CONNECTOR, plug: female; coaxial; BNC type for RG-59/U. Part of W103. | P/O Service Cable W103 | UG-261/U |
| R101 | RESISTOR, fixed: wire wound; 4500 ohms, ±10%, 10 watts. | B+ Dropping Res., V102 | RW-109-47 |
| R102 | RESISTOR, fixed: composition; 12000 ohms, ±5%, 1/2 watt. | Diode Load Res., CR101 | RC20GF123J |
| R103 | RESISTOR, fixed: composition; 100, 000 ohms, ±10%, 1/2 watt. | Mixer Grid Leak Res., V103 | RC20GF104K |
| R104 | Same as R103. | Mixer Grid Leak V103 | |
| R105 | Same as R103. | Mixer Screen Dropping Res., V103 | |
| R106 | RESISTOR, fixed: composition; 1 megohm; ±10%, 1/2 watt. | Mixer Plate Load Res., V103 | RC20GF105K |
| R107 | RESISTOR, fixed: composition; 56, 000 ohms; ±10%, 1/2 watt. | Mixer Plate Filter Res., V103 | RC20GF563K |
| R108 | Same as R103. | Mixer Output Filter Res., V103 | |
| R109 | NOT USED. | | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R110 | Same as R106. | Audio Grid Leak Res., V104 | |
| R111 | RESISTOR, fixed: composition; 220,000 ohms, ±10%, 1/2 watt. | Audio Plate Load Res., V104 | RC20GF224K |
| R112 | Same as R111. | Grid Leak Res., V104 | |
| R113 | RESISTOR, fixed: composition; 82,000 ohms, ±10%, 2 watts. | Audio Cathode Res., V104 | RC42GF823K |
| R114 | RESISTOR, fixed: composition; 22,000 ohms, ±10%, 1/2 watt. | Audio Plate Res., V105 | RC20GF223K |
| R115 | RESISTOR, fixed: composition; 43,000 ohms, ±5%, 1/2 watt. | Diode Load Res., J103 | RC20GF433J |
| R116 | RESISTOR, variable: composition; 50,000 ohms, ±20%, 2 watts. | BFO Output Control V105 | RV4ATSA503B |
| R117 | RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. | BFO Grid Leak Res., V105 | RC20GF474K |
| R118 | RESISTOR, fixed: wire wound; 25,000 ohms, ±10%, 10 watts. | BFO Plate Fil. Res., V105 | RW-109-38 |
| S101 | SWITCH, toggle: DPST; 3 amp, 250 volts, phenolic body. | Main Power Switch | ST22K |
| S102 | SWITCH, toggle: SPST; 3 amp, 250 volts, phenolic body. | IFO Plate Switch | ST12A |
| S103 | Same as S102. | HFO Plate Switch | |
| S104 | Same as S102. | 100 Kc Osc. ON/OFF Switch | |
| S105 | SWITCH, toggle: DPDT; 3 amp, 250 volts, phenolic body. | BFO-Crystal Switch | ST22N |
| S106 | Same as S102. | BFO-Plate Switch | |
| S107 | SWITCH, rotary: one section, four position; mycalex insulation, contacts and wipers silver plated; 1/4 in. drive shaft, 5/8 in. long. | Meter Switch | SW-105 |
| T101 | TRANSFORMER, filament and power: primary 110/220 volts, 50/60 cps; secondary, #1, 5 volts, 3 amps; secondary, #2, 350-0-350 volts, 125 ma; secondary, #3, 6.3 volts, 4 amps; hermetically sealed rectangular metal case; 11 solder lug terminals; insulated for 1250 volts RMS in accordance with MIL-T-27, GR.1, CL. A, FAM. 03. | Main Power | TF-105 |
| V101 | TUBE, electron: full wave rectifier; octal. | HV Rectifier | 5V4G |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| V102 | TUBE, electron: voltage regulator; 7 pin miniature. | Volt. Regulator | 0A2 |
| V103 | TUBE, electron: heptode converter; 9 pin miniature. | Mixer | 6BE6 |
| V104 | TUBE, electron: medium mu duo triode; 9 pin miniature. | Audio Amp | 12AU7 |
| V105 | TUBE, electron: beam power amplifier; 7 pin miniature. | BFO | 6AQ5 |
| W100 | NOT USED. | | |
| W101 | CABLE ASSEMBLY: special purpose; electrical; P101 to J201; consists of 6 ft. of 12 conductor cable; one PL-102-1 connector, P105; and one PL-102-2 connector, P106, (for servicing only). | PS-Mult. Interconnector Extension | CA-109 |
| W102 | CABLE ASSEMBLY: special purpose; electrical; J101 to P301; consists of 6 ft. of 6 conductor cable; one MS3106B-16S-1P connector, P103; and one MS3101B-16S-1S connector, P104, (for servicing only). | PS-MO Interconnect Extension | CA-502 |
| W103 | CABLE ASSEMBLY: RF: P102 to J203; consists of 6 ft. of RG-59/U coaxial cable; one UG-260/U connector, P107; and one UG-261/U connector, P108, (for servicing only). | PS-Mult. Interconnector Extension | CA-108 |
| W104 | CABLE ASSEMBLY: RF: V103 to J203; consists of 17-1/2 in. of RG-58/U coaxial cable; 3 in. of flexible shield; one inner and outer ferrule; and one UG-88/U connector, P102. | PS-Mult. Interconnect | CA-204 |
| XC102 | SOCKET, tube: octal; ceramic. | C102 Socket | TS101P01 |
| XF101 | HOLDER, fuse: extractor post type for single AGC type fuse; stationary end terminal. | F101 Socket | FH-100-2 |
| XF102 | Same as XF101. | F102 Socket | |
| XV101 | Same as XC102. | V101 Socket | |
| XV102 | SOCKET, tube: 7 pin miniature. | V102 Socket | TS102P01 |
| XV103 | Same as XV102. | V103 Socket | |
| XV104 | SOCKET, tube: 9 pin miniature. | V104 Socket | TS103P01 |
| XV105 | Same as XV102. | V105 Socket | |
| XY101 | SOCKET, crystal: .486 in. spacing for .050 in. pin dia. | Y101 Socket | TS-104-1 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| XY102 | Same as XY101. | Y102 Socket | |
| Y101 | CRYSTAL UNIT, quartz: 300-1000 Kcs, ±.01%. (Supplied only on customers request.) | BFO Xtal | CR-25/U |
| Y102 | Same as Y101. | BFO Xtal | |
| C201 | CAPACITOR, fixed: mica; 27 mmfd, ±5%, char. C, 500 wvdc. | IFO Xtal Load Cap., V201 | CM20C270J |
| C202 | Same as C105. | IFO Plate Filter Cap., V201 | |
| C203 | Same as C105. | IFO Plate Filter Cap., V201 | |
| C204 | Same as C105. | IFO Grid Coup. Cap., V201 | |
| C205 | Same as C104. | VMO Coup. Cap. J203 | |
| C206 | Same as C104. | IFO Amp. Plate Cap., V201 | |
| C207 | Same as C122. | IFO Amp. Tank Cap., V201 | |
| C208 | Same as C105. | IFO Meter Coup. Cap., J206 | |
| C209 | Same as C104. | IFO Meter Bypass Cap., J206 | |
| C210 | CAPACITOR, variable: air dielectric; one section, 14 plates; 3.9-50 mmfd, 500 wvdc. | HFO Xtal Trimmer V202 | CT-100-1 |
| C211 | Same as C105. | RF Amp. Plate Filter Cap. V202 | |
| C212 | Same as C105. | RF Amp. Grid Coup. Cap. V202 | |
| C213 | Same as C105. | RF Amp. Plate Filter Cap. V203 | |
| C214 | Same as C105. | RF Amp. Cathode Bypass Cap. V203 | |
| C215 | Same as C105. | RF Amp. Screen Bypass Cap. V203 | |
| C216 | Same as C105. | RF Amp. Screen Bypass Cap. V204 | |
| C217 | Same as C105. | RF Amp. Grid Coup. Cap. V204 | |
| C218 | Same as C105. | RF Amp. Cathode Bypass Cap. V204 | |
| C219 | Same as C105. | RF Input Grid Coup. Cap. V205 | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C220 | Same as C104. | 2-4 Mc Plate Filter Cap. S202B | |
| C221 | Same as C104. | 4-8 Mc Plate Filter Cap. S202B | |
| C222 | Same as C104. | 8-16 Mc Plate Filter Cap. V205 | |
| C223 | Same as C105. | RF Mult. Screen Bypass Cap. V205 | |
| C224 | CAPACITOR, variable: ceramic; 1.5-7 mmfd, char. A; 500 wvdc. | 4-8 Mc Trimmer V205 | CV11A070 |
| C225 A, B, C, D | CAPACITOR, variable: air dielectric; four sections; Section A - 8.8 to 228 mmfd; Section B - 8 to 208 mmfd; Section C - 8 to 208 mmfd; Section D - 6 to 106 mmfd. | HFO Tuning Cap. V205 | CB-100 |
| C226 | Same as C105. | RF Mult. Cathode Bypass Cap. V205 | |
| C227 | CAPACITOR, variable: ceramic; 3-12 mmfd, char. A, 500 wvdc. | 8-16 Mc Trimmer V205 | CV11A120 |
| C228 | Same as C105. | 16-32 Mc Grid Coupling V206 | |
| C229 | Same as C105. | 16-32 Mc Screen Bypass Cap. V206 | |
| C230 | Same as C104. | 16-32 Mc Plate Filter Cap. V206 | |
| C231 | Same as C105. | 32-64 Mc Grid Coupling Cap. V207 | |
| C232 | Same as C227. | 16-32 Mc Trimmer V206 | |
| C233 | Same as C105. | 32-64 Mc Screen Bypass Cap. V207 | |
| C234 | Same as C104. | 32-64 Mc Plate Filter Cap. V207 | |
| C235 | Same as C224. | 32-64 Mc Trimmer V207 | |
| C236 | Same as C105. | 32-64 Mc Coupling Cap., V207 | |
| C237 | Same as C105. | HFO Meter Filter Cap., J209 | |
| C238 | Same as C105. | HFO Meter Coupling Cap., J209 | |
| C239 | Same as C105. | RF Chassis Filament Bypass Cap. | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C240 | Same as C105. | 16-32 Mc Cathode Bypass Cap. V206 | |
| C241 | Same as C105. | 32-64 Mc Cathode Bypass Cap. V207 | |
| C242 | Same as C105. | IFO Xtal Coupling Cap., V201 | |
| C243 | Same as C105. | HFO Xtal DC Blocking Cap. V202 | |
| C244 | CAPACITOR, fixed: ceramic; 2.5 mmfd, ±10%, 500 wvdc. | 4-8 Mc Trimmer Cap., S202B | CC-101-1 |
| C245 | CAPACITOR, fixed: mica; .01 mfd, ±5%; char. C, 300 wvdc. | RF Bypass Cap., J201 | CM35C103J |
| C246 | Same as C245. | RF Bypass Cap., J201 | |
| CR201 | Same as CR101. | IFO Output Rectifier, V201 | |
| CR202 | Same as CR101. | HFO Output Rectifier, J209 | |
| J201 | CONNECTOR, receptacle: female; polarized; twelve contacts. | PS-Mult. Conn. | JJ-118-2 |
| J202 | Same as J102. | VMO Interconnect | |
| J203 | Same as J102. | VMO Interconnect | |
| J204 | NOT USED. | | |
| J205 | Same as J102. | IFO Output | |
| J206 | Same as J102. | IFO Output | |
| J207 | Same as J102. | IFO Output | |
| J208 | Same as J102. | IFO Output | |
| J209 | Same as J102. | IFO Output | |
| J210 | Same as J102. | IFO Output | |
| L201 | TRANSFORMER, RF: tuned; primary, 44 turns, #32 DSC, 13.15 microhenries, ±2.75 microhenries, Q = 67.5, ±2.5; secondary, 4 turns, #32 DSC. | IFO Tank Coil, V201 | A-242 |
| L202 | COIL, RF: fixed; 183 turns, #36 DSC, .168 millihenries, ±.01 millihenries, Q = 35; wound on a 2.2 megohm resistor, ±10%, 1 watt, RC30GF225K. | RF Amp. Peaking Coil, V203 | A-244 |
| L203 | TRANSFORMER, RF: tuned; primary, 66-1/2 turns, #32 DSC, 35.25 micro-henries, ±10.75 microhenries, Q = 103, ±3; secondary, 5-1/2 turns, #32 DSC. | 2-4 Mc Tank Coil, S202B | A-245 |

## VARIABLE FREQUENCY OSCILLATOR VOX-3

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| L204 | COIL, RF: 750 microhenries, ±20%; 100 ma max. current; DC resistance approx. 17 ohms; bakelite body. | RF Choke, S202B | CL-100-5 |
| L205 | TRANSFORMER, RF: tuned; primary, 23-1/2 turns, #32 DSC, 10.4 microhenries, ±3.6 microhenries, Q = 115, ±5; secondary, 3-1/2 turns, #32 DSC. | 4-8 Mc Tank Coil, S202A | A-246 |
| L206 | TRANSFORMER, RF: tuned; primary, 14-1/2 turns, #20 DSC, 2.47 microhenries, ±.73 microhenries, Q = 95.5, ±12.5; secondary, 2-1/2 turns, #20 DSC. | 8-16 Mc Tank Coil, V205 | A-247 |
| L207 | TRANSFORMER, RF: tuned; primary, 5-1/2 turns, #20 DSC, .67 microhenries, ±.21 microhenries, Q = 122.5, ±7.5; secondary, 1-1/2 turns, #20 DSC. | 16-32 Mc Tank Coil, V206 | A-248 |
| L208 | TRANSFORMER, RF: tuned; primary, 2-3/4 turns, #20 DSC, .2225 microhenries, ± .0475 microhenries, Q = 125, ±5%; secondary, 3/4 turns, #20 DSC. | 32-64 Mc Tank Coil, V207 | A-249 |
| P201 | CONNECTOR, plug. Part of W201. | P/O AC Input Cable | |
| R201 | Same as R117. | IFO Grid Leak Res., V201 | |
| R202 | Same as R103. | IFO Plate Load Res., V201 | |
| R203 | RESISTOR, fixed: composition; 47,000 ohms, ±10%, 1/2 watt. | IFO Decoupling Res., V201 | RC20GF473K |
| R204 | RESISTOR, fixed: composition; 3,300 ohms, ±10%, 1/2 watt. | IFO Decoupling Res., V201 | RC20GF332K |
| R205 | Same as R203. | IFO Amp. Grid Leak | |
| R206 | Same as R102. | IFO Output Diode Load Res., V201 | |
| R207 | Same as R117. | HFO Grid Leak Res., V202 | |
| R208 | RESISTOR, fixed: composition; 10,000 ohms, ±10%, 1/2 watt. | HFO Plate Load Res., V202 | RC20GF103K |
| R209 | Same as R113. | HFO Decoupling Res., V202 | |
| R210 | Same as R103. | RF Amp. Grid Leak Res., V203 | |
| R211 | RESISTOR, fixed: composition; 470 ohms, ±10%, 1/2 watt. | RF Amp. Cathode Res., V203 | RC20GF471K |
| R212 | RESISTOR, fixed: composition; 10,000 ohms, ±10%, 2 watts. | RF Amp. Plate Load Res., V203 | RC42GF103K |
| R213 | RESISTOR, fixed: composition; 1,000 ohms, ±10%, 1 watt. | RF Amp. Decoupling Res., V203 | RC30GF102K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R214 | Same as R103. | RF Amp. Screen Dropping Res., V203 | |
| R215 | RESISTOR, variable: wire wound; 50,000 ohms, ±10%, 3 watts. | HFO Output Control, V203 | RA100ASRD503A |
| R216 | RESISTOR, fixed: composition; 2,200 ohms, ±10%, 2 watts. | Screen Dropping Res., S202A | RC42GF222K |
| R217 | RESISTOR, fixed: composition; 1,000 ohms, ±10%, 1/2 watt. | Screen Dropping Res., V204 | RC20GF102K |
| R218 | Same as R103. | Mult. Grid Leak Res., V204 | |
| R219 | Same as R211. | Mult. Cathode Bias Res., V204 | |
| R220 | RESISTOR, fixed: composition; 1,200 ohms, ±10%, 2 watts. | Mult. Decoupling Res., S202B | RC42GF122K |
| R221 | Same as R216. | 8-16 Mc Mult. Decoupling Res., V205 | |
| R222 | Same as R203. | 8-16 Mc Mult. Screen Dropping Res., V205 | |
| R223 | RESISTOR, fixed: composition; 680 ohms, ±10%, 2 watts. | Amp. Parasitic Suppressor, S202B | RC42GF681K |
| R224 | Same as R103. | 8-16 Mc Mult. Grid Leak Res., V205 | |
| R225 | Same as R211. | 8-16 Mc Mult. Cathode Bias Res., V205 | |
| R226 | RESISTOR, fixed: composition; 33,000 ohms, ±10%, 1/2 watt. | 16-32 Mc Mult. Grid Leak Res., V206 | RC20GF333K |
| R227 | Same as R203. | 16-32 Mc Mult. Screen Dropping Res., V206 | |
| R228 | Same as R220. | 16-32 Mc Mult. Decoupling Res., V206 | |
| R229 | RESISTOR, fixed: composition; 24,000 ohms, ±5%, 1/2 watt. | 32-64 Mc Mult. Screen Dropping Res., V207 | RC20GF243J |
| R230 | Same as R220. | 32-64 Mc Mult. Decoupling Res. V207 | |
| R231 | Same as R103. | 32-64 Mc Mult. Grid Leak Res. V207 | |
| R232 | Same as R229. | HFO Output Diode Load Res. J209 | |
| R233 | Same as R113. | Band Change Screen Dropping Res., S202A | |

## VARIABLE FREQUENCY OSCILLATOR VOX-3

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R234 | Same as R211. | 16-32 Mc Mult. Cathode Bias Res., V206 | |
| R235 | Same as R211. | 32-64 Mc Mult. Cathode Bias Res., V207 | |
| S201 A, B, C, D | SWITCH, rotary: non-shorting; two section, four position; mycalex insulation; contacts and wipers silver plated; 1/4 in. drive shaft, 5/8 in. lg. | Xtal Switch | SW-106 |
| S202 A, B, C, D | SWITCH, rotary; four sections, five position; section one, shorting, phenolic insulation; section two, non-shorting, phenolic insulation; section three and four, non-shorting, mycalex insulation; contacts and wiper silver plated; 1/4 in. drive shaft, 1/2 in. lg. | HFO Band Switch | SW-108 |
| V201 | Same as V104. | IFO Amp. | |
| V202 | TUBE, electron: HF power triode; 7 pin miniature. | HFO & RF Amp. | 6C4 |
| V203 | Same as V105. | RF Amp. | |
| V204 | Same as V105. | RF Amp. & Mult. 2-4, 4-8 Mc. | |
| V205 | Same as V105. | RF Mult. 8-16 Mc. | |
| V206 | Same as V105. | RF Mult. 16-32 Mc. | |
| V207 | Same as V105. | RF Mult. 32-64 Mc. | |
| W201 | CABLE, power: AC; consists of 1 moulded male plug, P201; and 6 ft. of 16/30-SJ cable. | AC Line Cord | CA-102-2 |
| XV201 | Same as XV104. | V201 Socket | |
| XV202 | Same as XV102. | V202 Socket | |
| XV203 | Same as XV102. | V203 Socket | |
| XV204 | Same as XV102. | V204 Socket | |
| XV205 | Same as XV102. | V205 Socket | |
| XV206 | Same as XV102. | V206 Socket | |
| XV207 | Same as XV102. | V207 Socket | |
| XY201 | Same as XY101. | Y201 Socket | |
| XY202 | Same as XY101. | Y202 Socket | |
| XY203 | Same as XY101. | Y203 Socket | |
| XY204 | Same as XY101. | Y204 Socket | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| Y201 | CRYSTAL UNIT, quartz: 3.2 to 3.9 Mcs, ±.005% (Supplied only on customer's request). | IFO Xtal | CR-18/U |
| Y202 | CRYSTAL UNIT, quartz: 2 to 64 Mcs, ±.005% (Supplied only on customer's request). | HFO Xtal | CR-18/U |
| Y203 | CRYSTAL UNIT, quartz: 2 to 64 Mcs, ±.005% (Supplied only on customer's request). | HFO Xtal | CR-18/U |
| Y204 | CRYSTAL UNIT, quartz: 2 to 64 Mcs, ±.005% (Supplied only on customer's request). | HFO Xtal | CR-18/U |
| C301 | Not a replaceable part. Part of Z301. | VMO Tuning Cap., V301 | |
| C302 | Not a replaceable part. Part of Z301. | VMO Correction Cap., V301 | |
| C303 | Not a replaceable part. Part of Z301. | VMO Trimmer, V301 | |
| C304 | Not a replaceable part. Part of Z301. | VMO Padder, V301 | |
| C305 | Not a replaceable part. Part of Z301. | VMO Grid Coup. Cap., V301 | |
| C306 | Not a replaceable part. Part of Z301. | VMO Cathode Coup. Cap., V301 | |
| C307 | Not a replaceable part. Part of Z301. | VMO Plate Bypass Cap., V301 | |
| C308 | Not a replaceable part. Part of Z301. | Cath. Follower Plate Bypass Cap., V302 | |
| C309 | Not a replaceable part. Part of Z301. | 100 Kc Plate Coupling Cap., V302 | |
| C310 | NOT USED. | | |
| C311 | Not a replaceable part. Part of Z301. | 100 Kc Adjust V302 | |
| C312 | Not a replaceable part. Part of Z301. | 100 Kc Output Cap., V302 | |
| C313 | NOT USED. | | |
| C314 | Same as C104. | Inner Oven Therm. Arc Supp. E301 | |
| C315 | Same as C104. | Relay Arc Supp. K301 | |
| C316 | CAPACITOR, fixed: paper; .1 mfd, +40 -10%; 400 wvdc; plastic tubular case. | Outer Oven Therm. Arc Suppressor J302 | CN-100-4 |
| C317 | NOT USED. | | |
| C318 | Same as C104. | Meter Bypass Cap., P302 | |
| C319 | Not a replaceable part. Part of Z301. | VMO Temperature Compensation Cap., V301 | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C320 | Not a replaceable part. Part of Z301. | RF Bypass | |
| C321 | Not a replaceable part. Part of Z301. | RF Bypass | |
| C322 | Not a replaceable part. Part of Z301. | RF Bypass | |
| C323 | Not a replaceable part. Part of Z301. | RF Bypass | |
| E301 | BOARD, terminal: barrier type; eight 6-32 x 1/4 in. binding head machine screws. | Inner Oven Connections | TM-102-8 |
| E302 | BOARD, terminal: barrier type; nine 6-32 x 1/4 in. binding head machine screws. | Outer Oven Connections | TM-102-9 |
| I301 | LAMP, neon: miniature; 110 volts, 1/25 watt; T-3-1/4 clear bulb; bayonet base. | Inner Oven Ind. | BI-100-51 |
| I302 | LAMP, incandescent: miniature; 6-8 volts, 250 ma, DC; T-3-1/4 clear bulb; bayonet base. | Power Indicator | BI-101-44 |
| I303 | Same as I301. | Zero Beat Ind. | |
| I304 | Same as I301. | Outer Oven Ind. | |
| J301 | NOT USED. | | |
| J302 | Same as J201. | Internal VMO Connector | |
| K301 | RELAY ASSEMBLY, AC: 4500 ohms DC; hermetically sealed; one winding; 90 v. operating voltage; socket mounted. (Consists of R317.) | Thermostat Control | A-123 |
| L301 | Not a replaceable part. Part of Z301. | VMO Tank Coil V301 | |
| L302 | Not a replaceable part. Part of Z301. | VMO Cathode Choke, V301 | |
| L303 | Not a replaceable part. Part of Z301. | RF Choke | |
| M301 | METER, milliammeter: DC; 0-1 ma; square case. | Testmeter | MR-100-1 |
| P301 | CONNECTOR, plug: used on W301; not a replaceable part; part of Z301. | VMO Power Conn. | |
| P302 | Same as P101. | VMO Connector | |
| P303 | CONNECTOR, coaxial: used on W302; not a replaceable part; part of Z301. | VMO Input | |
| R301 | Not a replaceable part. Part of Z301. | VMO Plate Filter V301 | |
| R302 | Not a replaceable part. Part of Z301. | Cath. Follower Load Res., V302 | |
| R303 | NOT USED. | | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R304 | Not a replaceable part. Part of Z301. | 100 Kc Plate Filter Res., V302 | |
| R305 | Not a replaceable part. Part of Z301. | 100 Kc Cath. Load Res., V302 | |
| R306 | Not a replaceable part. Part of Z301. | 100 Kc Grid Leak Res., V302 | |
| R307 308 | RESISTOR, fixed: wire wound; heater element, two sections, 1,300 ohms each section; insulated. | Inner Oven Heater Element E301 | RR-105 |
| R309 | RESISTOR, fixed: wire wound; heater element, two sections, 160 ohms each section; insulated. | Outer Oven Heater Element E302 | RR-106 |
| R311 | RESISTOR, fixed: composition; 100 ohms, ±10%, 1/2 watt. | Inner Thermo. Arc Supp. E301 | RC20GF101K |
| R312 | RESISTOR, fixed: composition; 240,000 ohms, ±5%, 1/2 watt. | Inner Oven Ind. Protector E301 | RC20GF244J |
| R313 | Same as R311. | Relay Arc Supp. | |
| R314 | Same as R311. | Outer Oven Therm. Arc Supp. E302 | |
| R315 | Same as R312. | Outer Oven Ind. Protector E302 | |
| R316 | NOT USED. | | |
| R317 | Same as R107. Part of K301. | Relay Bleeder Res., K301 | |
| R318 | RESISTOR, fixed: composition; 9,100 ohms, ±5%, 2 watts. | Volt. Dropping Res., E301 | RC42GF912J |
| R319 | Same as R318. | Volt. Dropping Res., E301 | |
| R320 | Not a replaceable item. Part of Z301. | | |
| R321 | RESISTOR, fixed: composition; 12 ohms, ±10%, 2 watts. | Power Ind. Series Dropping Res., E302 | RC42GF120K |
| S301 | SWITCH, thermostatic: bi-metallic; operates at 70°C, ±0.5°C. | Inner Oven Thermostat | A-1236 |
| S302 | SWITCH, thermostatic: bi-metallic; operates at 80°C, ±2°C. | Inner Oven Safety Thermo. | SS-100-3 |
| S303 | SWITCH, thermostatic: bi-metallic; operates at 60°C, ±2°C. | Outer Oven Thermostat | SS-100-1 |
| V301 | TUBE, electron: RF power triode; 7 pin miniature. Part of Z301. | VMO | 6AB4 |
| V302 | Same as V104. Part of Z301. | Cath. Follower & 100 Kc Xtal Osc. | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| W301 | CABLE ASSEMBLY, RF: VMO to J101; consists of various size, length and color SRIR cable; 20 in. of flexible shield; 16-1/2 in. of sleeving; and one connector MS3106B-16S-1P, P301. | VMO-PS Cable | CA-281 |
| W302 | CABLE ASSEMBLY, RF: VMO to J202; consists of 18 in. of RG-58/U; 3 in. of flexible shield; one inner and outer ferrule; and one connector, UG-260/U, P303. Part of Z301. | VMO-Mult. Cable | CA-282 |
| XI301 | LIGHT, indicator: with clear white lens for miniature bayonet base T-3-1/4 bulb. | I301 Socket | TS-106-2 |
| XI302 | LIGHT, indicator: with red frosted lens for miniature bayonet base T-3-1/4 bulb. | I302 Socket | TS-106-1 |
| XI303 | Same as XI301. | I303 Socket | |
| XI304 | Same as XI301. | I304 Socket | |
| XK301 | Same as XC102. | K301 Socket | |
| XV301 | Not a replaceable item. Part of Z301. | V301 Socket | |
| XV302 | Not a replaceable item. Part of Z301. | V302 Socket | |
| XY301 | Not a replaceable part. Part of Z301. | Y301 Socket | |
| Y301 | Not a replaceable part. Part of Z301. | 100 Kc Osc. | |
| Z301 | OSCILLATOR ASSEMBLY, variable: consists of C301, 302, 303, 304, 305, 306, 307, 308, 309, 311, 312, 319, 320, 321, 322, 323; L301, 302, 303; P301, 303; R301, 302, 304, 305, 306, 320; V301, 302; W301, 302; XV301, 302; XY301; Y301.<br><br>NOTE: TMC Part A0-100, Oscillator Assembly, is replaced in this equipment as a unit. It requires precise alignment at the factory before use. The assembly will be repaired and aligned free of charge if returned to our plant, transportation charges paid. | Master Oscillator | A0-100 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C1 | CAPACITOR, fixed: ceramic; .01 uf, ±80 -20%; 500 wvdc. | Input Coupling P1 | CC-100-16 |
| C2 | Same as C1. | AVC Blocking | |
| C3 | Same as C1. | Decoupling; V1A | |
| C4 | Same as C1. | Cathode Bypass; V1A | |
| C5 | Same as C1. | RF Bypass; V2 | |
| C6 | CAPACITOR, fixed: ceramic; 120 uuf, ±20%; 500 wvdc. | Coupling; V3 | CC-101-4 |
| C7 | CAPACITOR, fixed: ceramic; 47 uuf, ±10%; 500 wvdc. | Coupling; V7 | CC21SL470K |
| C8 | Same as C1. | Decoupling; V3 | |
| C9 | CAPACITOR, fixed: paper; 01 uf, +40 -20%; 400 wvdc; plastic tubular case. | Coupling; V1A | CN-100-1 |
| C10 | Same as C1. | Decoupling; V1A | |
| C11 | Same as C1. | Cathode Bypass; V3 | |
| C12 | Same as C1. | RF Bypass; V3 | |
| C13 | CAPACITOR, fixed: ceramic; .001 uf, ±200 uuf; 500 wvdc, disc type. | RF Bypass; V1B | CC-100-9 |
| C14 | CAPACITOR, fixed: mylar; .1 uf, +5%, 200 wvdc, char. C. | AVC Filter; V1B | CN108C1003J |
| C15 | Same as C7. | Coupling; V4 | |
| C16 | CAPACITOR, fixed: ceramic; 82 uuf, ±5%; 500 wvdc. | Coupling; V4 | CC26SL820J |
| C17 | Same as C1. | Decoupling; V4 | |
| C18 | Same as C1. | Cathode Bypass; V4 | |
| C19 | Same as C1. | RF Bypass; V4 | |
| C20 | Same as C9. | Coupling; V4 | |
| C21 | NOT USED. | | |
| C22 | NOT USED. | | |
| C23 | CAPACITOR, fixed: paper; .1 uf, +40% -10%; 400 wvdc; plastic tubular case. | Coupling; V6 | CN-100-4 |
| C24 | Same as C9. | Coupling; V5B | |
| C25 | CAPACITOR, fixed: plastic; 2 uf, ±10%; 200 wvdc. | Cathode Bypass; V6 | CN108C2004K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C26 | Same as C13. | Audio Bypass | |
| C27 | CAPACITOR, fixed: electrolytic; 10 uf, 300 wvdc. | PS Filter; V6 | CE64C100N |
| C28 | CAPACITOR, variable: air; 2.8-16 uuf; 1200 V rms. | Bandspread Adj. | CB-135-4 |
| C29 | CAPACITOR, variable: ceramic; 7-45 uuf; char. C; 500 wvdc. | Bandspread Comp. | CV11C450 |
| C30 | CAPACITOR, fixed: ceramic; 100 uufd, ±5%; 500 wvdc. | Feedback; V8 | CC32CH101J |
| C31 | CAPACITOR, fixed: mica; 51 uuf, ±5%; 500 wvdc. | Bandspread Comp. | CM20E510J |
| C32 | CAPACITOR, fixed: mica; 430 uuf, ±2%; 500 wvdc. Not a replaceable item. Part of Z3. | P/O Bandpass Filter Z3 | CM20D431G |
| C33 | CAPACITOR, fixed: ceramic. | Coupling; S4 | CC32CH470J |
| C34 | CAPACITOR, fixed: ceramic; 30 uuf, ±5%; 500 wvdc. | Grid Bypass; S4 | CC21SL300J |
| C35 | Same as C1. | Cathode Bypass; V7 | |
| C36 | Same as C1. | Feedback; V7 | |
| C37 | CAPACITOR, fixed: ceramic; 150 uuf, ±10%; 500 wvdc. | B+ Bypass; V7 | CC-101-2 |
| C38 | CAPACITOR, fixed: mica; .001 uf, ±2%; 500 wvdc. Part of Z4. | P/O 17 Kc Osc. Tank Z4 | CM20D102G |
| C39 | CAPACITOR, fixed: mica; 1500 uuf, ±2%; 500 wvdc. Part of Z4. | Tank; Z4 | CM20D152G |
| C40 | CAPACITOR, variable: mica; 100-550 uuf; 250 wvdc; 4 slates. Part of Z4. | Trimmer; Z4 | CV-100-304 |
| C41 | Same as C1. | Decoupling; V5A | |
| C42 | NOT USED. | | |
| C43 | NOT USED. | | |
| C44 | Same as C13. | Feedback; V8 | |
| C45 | CAPACITOR, fixed: ceramic; 22 uuf, ±5%; 500 wvdc. | Grid Bypass; V8 | CC21SL220J |
| C46 | CAPACITOR, fixed: ceramic; .005 uf, G.M.V., 500 wvdc; disc type. | RF Bypass; V8 | CC-100-15 |
| C47A, B | CAPACITOR, fixed: ceramic; two sections; .01 uf, 500 wvdc; ea, disc type. | Line Filter | CC-100-23 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C48 | CAPACITOR, fixed: paper; 4 uf, ±10%; char. F; 600 wvdc; oil filled and impregnated. | Filter; V10 | CP41B1FF405V |
| C49A, B | CAPACITOR, fixed: dry electrolytic; polarized; 35 uf ea. section, 450 wvdc; char. F. | Filter; V10 | CE52F350R |
| C50 | Same as C38. | Coupling; Z4 | |
| C51 | Same as C33. | Compensating; Z5 | |
| C52 | CAPACITOR, fixed: mica; .001 uf, ±5%; 500 wvdc. | Coupling; V9B | CM20D102J |
| C53 | CAPACITOR, fixed: mica; 820 uuf, ±2%; 500 wvdc. Part of Z5. | Tank; Z5 | CM20D821G |
| C54 | Same as C1. | Bypass; Z5 | |
| C55 | CAPACITOR, variable: mica; 100-550 uuf; 250 wvdc, 6 slates. Part of Z5. | Trimmer; Z5 | CV-100-306 |
| C56 | Same as C9. | Coupling; V3 | |
| C57 | Same as C1. | Decoupling; V7 | |
| E1 | TERMINAL BOARD, barrier type: plastic; 12 terminals, screw w/feed thru solder lug type. | Input Terminal Board | TM-100-12 |
| E2 | TERMINAL BOARD, barrier type; eight 6-32 screws and solder lug terminals. | Internal Terminal Board | TM-100-8 |
| E3 | NOT USED. | | |
| E4 | TERMINAL BOARD, phenolic: 12 terminals; right angle spread lug type (supplied as a loose item). | Fanning Strip | TM-105-12-AL |
| F1 | FUSE, cartridge: 3 amps; 250 V; instantaneous. | Main Power | FU-100-3 |
| I1 | LAMP, incandescent: 6-8V; 150 ma; T-3-1/4 clear bulb; bayonet base. | Lower Band Ind. | BI-101-47 |
| I2 | Same as I1. | Upper Band Ind. | |
| I3 | Same as I1. | Power ON/OFF | |
| J1 | CONNECTOR, receptacle: electrical; one female contact; 52 ohms; BNC type. | IF Input | UG-625/U |
| J2 | CONNECTOR, receptacle: electrical; 3 contacts, male. | Power Input | MS3102A165-5P |
| J3 | JACK, telephone: tip and sleeve; bushing mounted; fits plug J-055. | Phone | JJ-034 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| J4 | NOT USED. | | |
| J5 | NOT USED. | | |
| J6 | NOT USED. | | |
| J7 | Same as J1. | 17 Kc Input | |
| J8 | Same as J1. | 1st Mixer Output | |
| K1 | RELAY, armature: DPDT; .32 w, 20,000 ohms. | BFO | RL-105 |
| K2 | RELAY, armature: impulse type; 4 PDT; 115 VAC, 60 cps. | Sideband Switching | RL-118-17A115-60A |
| K3 | Same as K1. | Auto. Sideband Switching | |
| L1 | REACTOR, fixed: 15 henries; 85 ma. DC; 285 ohms; 2500 VRMS, test. | Filter Choke; V10 | TF5000 |
| L2 | Same as L1. | Filter Choke; V10 | |
| P1 | CONNECTOR, coaxial: male contact; BNC type. | IF Input | UG-260/U |
| P2 | CONNECTOR, plug: electrical; 3 contacts. | Mates w/J2 | MS3106A16S-5S |
| P3 | Not a replaceable item. Part of W1. | Input Power | P/O W1 |
| P4 | NOT USED. | | |
| P5 | NOT USED. | | |
| P6 | NOT USED. | | |
| P7 | Same as P1. | 17 Kc Input | |
| P8 | Same as P1. | 1st Mixer Output | |
| R1 | RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. | Grid Limiter; V2 | RC20GF104K |
| R2 | RESISTOR, fixed: composition; 470,000 ohms, ±10%, 1/2 watt. | Grid Detector; V1A | RC20GF474K |
| R3 | Same as R1. | Voltage Dropping; V2 | |
| R4 | RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1 watt. | Plate Load; V2 | RC32GF223K |
| R5 | RESISTOR, fixed: composition; 330 ohms, ±10%; 1/2 watt. | Cathode Bias; V2 | RC20GF331K |
| R6 | RESISTOR, fixed: composition; 68,000 ohms, ±10%; 1/2 watt. | Screen Load; V2 | RC32GF683K |
| R7 | RESISTOR, fixed: composition; 470 ohms, ±10%; 1/2 watt. | Cathode Bias; V1A | RC20GF471K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R8 | RESISTOR, fixed: composition; 2200 ohms, ±10%; 1/2 watt. | Voltage Dropping; V2 | RC20GF222K |
| R9 | Same as R2. | Grid Detector; V3 | |
| R10 | Same as R4. | Plate Load; V1A | |
| R11 | Same as R4. | Voltage Dropping; V1A | |
| R12 | RESISTOR, fixed: composition; 22,000 ohms, ±10%; 1/2 watt. | Grid Detector; V3 | RC20GF223K |
| R13 | RESISTOR, fixed: composition; 150,000 ohms, ±10%; 1/2 watt. | Cathode Bias; V1B | RC20GF154K |
| R14 | NOT USED. | | |
| R15 | RESISTOR, fixed: composition; 220 ohms, ±10%; 1/2 watt. | Cathode Bias; V3 | RC20GF221K |
| R16 | Same as R8. | Voltage Dropping; V3 | |
| R17 | RESISTOR, fixed: composition; 1.5 megohms, ±10%; 1/2 watt. | AVC Load; V1B | RC20GF155K |
| R18 | RESISTOR, fixed: composition; 10 megohms, ±10%; 1/2 watt. | AVC Time Constant | RC20GF106K |
| R19 | RESISTOR, fixed: composition; 20,000 ohms, ±5%; 1/2 watt. | Grid Detector; V4 | RC20GF203J |
| R20 | Same as R1. | Grid Detector; V4 | |
| R21 | Same as R19. | Grid Detector; V4 | |
| R22 | Same as R1. | Plate Load; V4 | |
| R23 | RESISTOR, fixed: composition; 120 ohms, ±10%; 1/2 watt. | Cathode Bias; V4 | RC20GF121K |
| R24 | RESISTOR, fixed: composition; 47,000 ohms, ±10%; 2 watts. | Screen Load; V4 | RC42GF473K |
| R25 | RESISTOR, fixed: composition; 10,000 ohms, ±10%; 1 watt. | Voltage Dropping, V4 | RC32GF103K |
| R26 | RESISTOR, fixed: composition; 12,000 ohms, ±10%; 1/2 watt. | Grid Detector; V5B | RC20GF123K |
| R27 | NOT USED. | | |
| R28 | NOT USED. | | |
| R29 | NOT USED. | | |
| R30 | RESISTOR, variable: composition; 1 megohm, ±20%; 2 watt; audio taper. | Audio Gain | RV4ATRD105D |
| R31 | RESISTOR, fixed: composition; 390 ohms, ±10%; 1/2 watt. | Cathode; V5B | RC20GF391K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R32 | Same as R2. | Grid Detector; V6 | |
| R33 | Same as R1. | Plate Load; V5B | |
| R34 | RESISTOR, fixed: composition; 560 ohms, ±10%; 2 watts. | Cathode Bias, V6 | RC42GF561K |
| R35 | RESISTOR, fixed: composition; 3900 ohms, ±10%; 1/2 watt. | Impedance Match; J3 | RC20GF392K |
| R36 | RESISTOR, fixed: composition; 33,000 ohms, ±10%; 1 watt. | Voltage Dropping; V6 | RC32GF333K |
| R37 | Same as R12. | Grid Detector; V7 | |
| R38 | Same as R23. | Cathode Bias; V7 | |
| R39 | RESISTOR, fixed: composition; 39,000 ohms, ±10%; 1/2 watt. | Plate Load; V7 | RC20GF393K |
| R40 | Same as R39. | Screen Load; V7 | |
| R41 | RESISTOR, fixed: composition; 100,000 ohms, ±10%; 1/2 watt. Part of Z4. | Cathode Bias; V5A | RC20GF104K |
| R42 | Same as R12. | Plate Load; V5A. | |
| R43 | NOT USED. | | |
| R44 | NOT USED. | | |
| R45 | Same as R2. | Grid Detector; V8 | |
| R46 | RESISTOR, fixed: composition; 120,000 ohms, ±10%; 1/2 watt. | Grid Detector; V8 | RC20GF124K |
| R47 | RESISTOR, fixed: composition; 82,000 ohms, ±10%; 1/2 watt. | Voltage Dropping; V8 | RC20GF823K |
| R48 | RESISTOR, variable: composition; 2500 ohms, ±10%; 2 watts, linear taper. | Reactance Balance | RV4ATSA252A |
| R49 | RESISTOR, fixed: composition; 180 ohms, ±10%; 1/2 watt. | Cathode Degen; V8 | RC20GF181K |
| R50 | RESISTOR, fixed: composition; 1000 ohms, ±10%; 1/2 watt. | Cathode Bias; V8 | RC20GF102K |
| R51 | RESISTOR, fixed: composition; 33,000 ohms, ±10%; 1/2 watt. | Grid Detector; V8 | RC20GF333K |
| R52 | RESISTOR, fixed: composition; 56,000 ohms, ±10%; 1/2 watt. | Plate Load; V8 | RC20GF563K |
| R53 | Same as R31. | Cathode Bias; V9A | |
| R54 | RESISTOR, variable: composition; 1 megohm, ±20%; 2 watts. | Relay Threshold | RV4ATXA105B |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R55 | RESISTOR, fixed: wire wound; 4500 ohms, ±5%; 10 watts. | Voltage Dropping; V11 | RW-109-47 |
| R56 | RESISTOR, fixed: composition; 56,000 ohms, ±10%; 2 watts. | Voltage Dropping; S5 | RC42GF563K |
| R57 | RESISTOR, fixed: composition; 1 megohm, ±10%; 1/2 watt. | AVC TC; V1B | RC20GF105K |
| R58 | RESISTOR, fixed: composition; 47,000 ohms, ±10%; 1/2 watt. | Plate Load; V9B | RC20GF473K |
| R59 | Same as R2. | Grid Detector; V9B | |
| R60 | RESISTOR, variable: composition; 100,000 ohms, ±10%; 2 watts, linear taper. | Tone Threshold | RV4ATSA104B |
| R61 | Same as R2. | Plate Load; V9A | |
| R62 | RESISTOR, fixed: composition; 22,000 ohms, ±10%; 2 watts. | Screen Load; V3 | RC42GF223K |
| R63 | Same as R58. | Audio Feedback; V5B | |
| R64 | RESISTOR, fixed: composition; 680 ohms, ±10%; 1/2 watt. | Audio Trans Load | RC20GF681K |
| R65 | RESISTOR, fixed: composition; 2700 ohms, ±10%; 1/2 watt. | 30 db Pad; T1 | RC20GF272K |
| R66 | Same as R64. | 30 db Pad; T1 | |
| R67 | Same as R57. | Grid Detector; V9A | |
| R68 | NOT USED. | | |
| R69 | Same as R19. | Filter Load; Z1 | |
| S1 | SWITCH, toggle: SPST; 6 amps; 125 VAC, 28° angle of throw; solder lug terminals. | AVC | ST12A |
| S2 | Same as S1. | AVC ON/OFF | |
| S3 | NOT USED. | | |
| S4 | SWITCH, rotary: 1 section; 2 position; 2 moving contacts; 6 fixed contacts. | Manual-Xtal | SW-226 |
| S5 | SWITCH, rotary: 1 section; 2 position; 1 moving contact; 2 fixed contacts. | BFO | SW-194 |
| S6 | SWITCH, push: SPST; 1 amp at 250 V, normally open. | Sideband | SW168SPST 2N0BB |
| S7 | SWITCH, toggle. | Main Power | ST22K |
| S8 | Same as S7. | Output Level | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| T1 | TRANSFORMER, audio frequency: plate coupling type; primary = 5000 Ω, 35 ma; secondary = 600 Ω, 5 watts max. | Output audio | TF-100 |
| T2 | Not a replaceable item. Part of Z3. | P/O Bandpass Filter | P/O Z3 |
| T3 | TRANSFORMER, AF: total inductance = 42.5 - 44.5 mhy; Q = 20; unit encapsulated in plastic. Part of Z4. | Oscillator Tank | TF-177 |
| T4 | TRANSFORMER, AF: total inductance = 42.5 - 44.5 mhy. Part of Z5. | Oscillator Tank | TF-178 |
| T5 | TRANSFORMER, power: primary; 105V, 115V, 125V, 210V, 230V, 50/60 cps, single phase; hermetically sealed. | Main Power | TF-196 |
| T6 | TRANSFORMER, audio: primary 20,000 ohms CT; secondary 150, 600 ohms; 4 ma DC in pri ±2 db 200 to 10,000 cps. | Mixer Output | TF-138 |
| T7 | Same as T6. | | |
| V1 | TUBE, electron: medium - mu duo - triode; 9 pin miniature. | AVC AMP/RECT. | 12AU7 |
| V2 | TUBE, electron: remote cutoff RF pentode; 7 pin miniature. | IF AMP | 6BA6 |
| V3 | TUBE, electron: lepode converter; 7 pin miniature. | 1st Mixer | 6BE6 |
| V4 | Same as V3. | 2nd Mixer | |
| V5 | TUBE, electron: duo triode; 9 pin miniature. | 2nd Osc. Audio Amp. | 12AT7 |
| V6 | TUBE, electron: beam power amplifier; 7 pin miniature. | Audio Output | 6AQ5 |
| V7 | TUBE, electron: sharp cutoff RF pentode; 7 pin miniature. | 1st Osc. | 6AG5 |
| V8 | TUBE, electron: duo - triode; 7 pin miniature. | React. Mod. | 6J6 |
| V9 | Same as V1. | Relay Driver Sideband Tone Gen. | |
| V10 | TUBE, electron: full-wave rectifier; octal base. | Power Rect. | 5Y3GT |
| V11 | TUBE, electron: voltage regulator. | Voltage Regulator | 0A2 |
| W1 | POWER CABLE, AC: 3 wire; c/o P2, 3. | Power Input | CA-385 |
| XC49 | SOCKET, electron tube: octal. | Socket for C49 | TS-101-P01 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| XF1 | FUSEHOLDER, extractor post type: 250V, 15 amp. | Socket for F1 | FH-100-2 |
| XI1 | SOCKET, lamp: T-3-1/4 bayonet base. | Socket for I1 | TS-133 |
| XI2 | Same as XI1. | Socket for I2. | |
| XI3 | LIGHT, indicator: w/red frosted lens; for miniature bayonet base T-3-1/4 bulb. | Socket for I3 | TS-106-1 |
| XV1 | SOCKET, electron tube: 9 pin miniature. | Socket for V1 | TS-103-P01 |
| XV2 | SOCKET, electron tube: 7 pin miniature. | Socket for V2 | TS-102-P01 |
| XV3 | Same as XV2. | Socket for V3 | |
| XV4 | Same as XV2. | Socket for V4 | |
| XV5 | Same as XV1. | Socket for V5 | |
| XV6 | Same as XV2. | Socket for V6 | |
| XV7 | Same as XV2. | Socket for V7 | |
| XV8 | Same as XV2. | Socket for V8 | |
| XV9 | Same as XV1. | Socket for V9 | |
| XV10 | Same as XC49. | Socket for V10 | |
| XV11 | Same as XV2. | Socket for V11 | |
| XY1 | SOCKET, crystal: .486" spacing for .050" pin dia. | Socket for Y1 | TS-104-1 |
| XY2 | Same as XY1. | Socket for Y2 | |
| Y1 | CRYSTAL UNIT, quartz: 438 Kc, +0.01%; includes holder HC-6/U. | Frequency Devise | CR-46/U-.4380-P |
| Y2 | CRYSTAL UNIT, quartz: 472 Kc, +0.01%; includes holder HC-6/U. | Frequency Devise | CR-47/U-.4720-P |
| Z1 | FILTER, low-pass: 3500 cps; cut-off freq. | Filter | FX-152 |
| Z2 | FILTER, bandpass: 19.1 Kc; 3.4 Kc bandwidth; 10,000 ohms impedance. | Filter | FX-153 |
| Z3 | TRANSFORMER, RF: 790 Kc; c/o C32; T2. | Filter | A-1387 |
| Z4 | OSCILLATOR NETWORK, AF: 17 Kc; c/o C38, 39, 40, 50; R41; T3. | Oscillator | A-1381 |
| Z5 | OSCILLATOR NETWORK, AF: 43.5 mhy; c/o C33; 55; T4. | Oscillator | A-1384 |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C1 | CAPACITOR, fixed: ceramic; .1 uf +80, -20%; 500 wvdc. | Audio Filter | CC-100-28 |
| C2 | Same as C1. | Cathode Bypass | |
| C3 | CAPACITOR, fixed: ceramic; .01 uf, +80, -20%; 500 wvdc. | RF Bypass | CC-100-16 |
| C4 | Same as C3. | Coupling V2 | |
| C5 | Same as C1. | Cathode Bypass V2 | |
| C6 | CAPACITOR, fixed: mica; 820 uuf, ±2%; char. D, 500 wvdc. | P/O Z2 | CM20D821G |
| C7 | CAPACITOR, fixed: mylar dielectric; 0.1 uf, ±10%; 200 wvdc. | Voltage Divider V2 | CN106C104K |
| C8 | CAPACITOR, fixed: ceramic; 100 uuf, ±20 uuf; 500 wvdc disc. | Test Point Filter | CC-100-3 |
| C9 | CAPACITOR, fixed: ceramic; 0.001 uf, ±200 uuf; 500 wvdc disc. | Coupling V3 | CC-100-9 |
| C10 | Same as C7. | RF Bypass V3 | |
| C11 | Same as C3. | Coupling V4A | |
| C12 | CAPACITOR, fixed: electrolytic; 10 uf; 300 wvdc. | Dc Filter V4A | CE64C100N |
| C13 | Same as C3. | Voltage Divider T2 | |
| C14 | CAPACITOR, fixed: paper; 0.47 uf, ±10%; 200 wvdc. | RF Bypass T2 | CP-106C474-2 |
| C15 | CAPACITOR, fixed: paper; 4 uf; 200 wvdc. | RF Bypass V5 | CP-110-1 |
| C16 | Same as C3. | Coupling V4B | |
| C17 | CAPACITOR, fixed: mica; 0.001 uf, ±2%; char. E; 500 wvdc. | Output Filter V4B | CM20E102G |
| C18 | CAPACITOR, fixed: mica; 1300 uuf, ±2%; char. E; 500 wvdc. | Phase Lead Voltage | CM20E132G |
| C19 | Same as C7. | Coupling V4B | |
| C20 | Same as C14. | RF Bypass S1 | |
| C21 | Same as C12. | Dc Filter S1 | |
| C22 | Same as C14. | RF Bypass V6 | |
| C23 | Same as C8. | RF Bypass V6 | |
| C24 | Same as C8. | RF Bypass V6 | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| C25 | Same as C3. | RF Bypass V6 | |
| C26 | Same as C1. | Voltage Divider V6 | |
| C27 | Same as C7. | RF Bypass V9 | |
| C28 | Same as C17. | Coupling V9 | |
| C29 | Same as C1. | Cathode Bypass V9 | |
| C30 | Same as C6. Part of Z3. | P/O Z3 | |
| C31 | Same as C7. | RF Bypass V9 | |
| C32 | Same as C3. | Coupling V4B | |
| C33A, B | CAPACITOR, fixed: ceramic, two section; 0.01 uf; 500 wvdc; ea. disc. | Line Filter | CC-100-23 |
| C34A, B | CAPACITOR, fixed: dry electrolytic polarized; 35 uf, each section; 450 wvdc; char. F. | Line Filter | CE52F350R |
| C35 | CAPACITOR, fixed: electrolytic; polarized; 45 uf; 350 wvdc. | Filter V11 | CE51F450P |
| C36 | Same as C35. | Filter V11 | |
| C37 | Same as C3. | Output Filter Z3 | |
| C38 | Same as C3. | Input Filter V9 | |
| C39 | CAPACITOR, variable: mica; 100-550 uuf; 250 wvdc; 6 plates. Part of Z3. | Osc. Tuning L1 | CV-100-306 |
| C40 | Same as C39. Part of Z2. | Tank Tuning L4 | |
| CR1 | DIODE, germanium. | Rectifier | 1N-100 |
| CR2 | Same as CR1. | Rectifier | |
| CR3 | DIODE, silicon: rectifier. | Rectifier Power Supply | DD-101-1 |
| CR4 | Same as CR3. | Rectifier Power Supply | |
| CR5 | Same as CR3. | Rectifier Power Supply | |
| CR6 | Same as CR3. | Rectifier Power Supply | |
| E1 | TERMINAL BOARD, barrier type: plastic; 8 terminals; screw w/feed thru solder type lug. | Terminal Board Receiver | TM-100-8 |
| E2 | Same as E1. | Terminal Board Power Supply | |
| F1 | FUSE, cartridge: time lag; 1 amp. | Line Fuse | FU-102-1 |
| I1 | LAMP, incandescent: 6-8V; 150 ma. | Power Ind. Fil. | BI-101-47 |
| I2 | Same as I1. | Fade Alarm | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| J1 | CONNECTOR, receptacle: electrical; one female contact; 52 ohms; BNC type. | 17 Kc Carrier Input | UG-625/U |
| J2 | JACK, receptacle: red body; silver plated contact; for 0.081" diam. pin; 7/8" long x 3/8" diam. O/A dimensions. | Carrier Test | JJ-114-2 |
| J3 | Same as J2. | 17 Kc Test Point | |
| J4 | Same as J1. | 17 Kc Output | |
| J5 | CONNECTOR, receptacle: male. | Power Input | MS3102A16S-5P |
| K1 | RELAY, armature: octal; plug in type DPDT; 10,000 Ω ; coil current 5 ma. | Memory Lock/Fade Alarm Rly. | RL-140 |
| L1 | TRANSFORMER, AF: inductance; 42.5 - 44.5 mh; 9.5 - 11.5 Ω . Part of Z3. | 17 Kc Osc. Coil | TF-178 |
| L2 | REACTOR, filter: 10 hy 70 ma; 280 Ω max; 1500 VRMS test. | Filter Choke | TF-5006 |
| L3 | Same as L2. | Filter Choke | |
| L4 | Same as L1. Part of Z2. | P/O 17 Kc Network | |
| M1 | METER, 25-0-25 ma: approximate res. 2000 Ω . | AFC Indicator | MR-143 |
| M2 | METER, 0-50 ma: approximate res. 2000 Ω . | Carrier Level | MR-141 |
| P1 | CONNECTOR, coaxial: male contact; BNC type. | 17 Kc Carrier Input | UG-260/U |
| P2 | Same as P1. | 17 Kc Output | |
| P3 | Part of W1. | Power Supply | |
| P4 | CONNECTOR, plug: female. Part of W1. | Power Supply | MS3106A16S-5S |
| R1 | RESISTOR, fixed: composition; 470,000 Ω , ±10%; 2 watts. | Imped. Load T1 | RC20GF474K |
| R2 | RESISTOR, fixed: composition; 68,000 Ω , ±10%; 2 watts. | Voltage Divider S1 | RC20GF683K |
| R3 | RESISTOR, fixed: composition; 22,000 Ω , ±10%; 2 watts. | Voltage Divider S1 | RC20GF223K |
| R4 | RESISTOR, fixed: composition; 6800 Ω , ±10%; 2 watts. | Voltage Divider S1 | RC20GF682K |
| R5 | RESISTOR, fixed: composition; 2200 Ω , ±10%; 2 watts. | Voltage Divider S1 | RC20GF222K |
| R6 | RESISTOR, fixed: composition; 1000 Ω , ±10%; 2 watts. | Voltage Divider S1 | RC20GF102K |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R7 | RESISTOR, fixed: composition; 10,000 Ω, ±10%; 2 watts. | Voltage Divider V1 | RC20GF103K |
| R8 | RESISTOR, fixed: composition; 100 Ω, ±10%; 2 watts. | Screen Load V1 | RC20GF101K |
| R9 | RESISTOR, fixed: composition; 150 Ω, ±10%; 2 watts. | Cathode Res. V1 | RC20GF151K |
| R10 | RESISTOR, fixed: composition; 100,000 Ω, ±10%; 2 watts. | Voltage Divider V1 | RC20GF104K |
| R11 | RESISTOR, fixed: composition; 220,000 Ω, ±10%; 2 watts. | Voltage Divider V1 | RC20GF224K |
| R12 | RESISTOR, fixed: composition; 27,000 Ω, ±10%; 2 watts. | Current Limiting V2 | RC20GF273K |
| R13 | RESISTOR, fixed: composition; 47,000 Ω, ±10%; 2 watts. | Bias Load V2 | RC20GF473K |
| R14 | Same as R9. | Cathode Res. V2 | |
| R15 | Same as R8. | Screen Load V2 | |
| R16 | Same as R4. | Current Limiting Z2 | |
| R17 | Same as R4. | Current Limiting V1 | |
| R18 | Same as R1. | Current Limiting V3 | |
| R19 | RESISTOR, fixed: composition; 33,000 Ω, ±10%; 2 watts. | Bias Load V3 | RC20GF333K |
| R20 | RESISTOR, fixed: composition; 5600 Ω, ±10%; 2 watts. | Plate Load V3 | RC20GF562K |
| R21 | RESISTOR, fixed: composition; 330,000 Ω, ±10%; 2 watts. | Cathode Res. V3 | RC20GF334K |
| R22 | RESISTOR, fixed: composition; 120,000 Ω, ±10%; 2 watts. | Current Limiting V3 | RC20GF124K |
| R23 | Same as R10. | Grid Limiter V4A | |
| R24 | Same as R9. | Cathode Res. V4A | |
| R25 | Same as R8. | Screen Load V4A | |
| R26 | RESISTOR, fixed: composition; 2200 Ω, ±10%; 1 watt. | Current Limiting | RC32GF222K |
| R27 | RESISTOR, variable: composition; 2500 Ω, ±10%; 2 watts. | Balance Adj. | RV4ATXA252A |
| R28 | Same as R3. | Current Limiting | |
| R29 | Same as R11. | Voltage Divider | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R30 | Same as R11. | Phase Voltage Divider | |
| R31 | Same as R7. | Phase/Memory Voltage Divider | |
| R32 | Same as R7. | Voltage Divider V4B | |
| R33 | Same as R6. | Grid Limiter V5 | |
| R34 | RESISTOR, fixed: composition; 330 Ω, ±10%; 2 watts. | Voltage Divider V5 | RC20GF331K |
| R35 | RESISTOR, fixed: composition; 1 meg Ω, ±10%; 2 watts. | Current Limiting M1 | RC20GF105K |
| R36 | RESISTOR, variable: composition; 1000 Ω, ±20%; 2 watts. | Drift Adjust. V5 | RV4ATXA102B |
| R37 | Same as R6. | Current Limiting K1 | |
| R38 | RESISTOR, fixed: composition; 150,000 Ω, ±10%; 2 watts. | Grid Coupling V4A, V9 | RC20GF154K |
| R39 | Same as R7. | Grid Limiter V4B | |
| R40 | RESISTOR, fixed: composition; 220 Ω, ±10%; 2 watts. | Cathode Res. V4B | RC20GF221K |
| R41 | Same as R5. | Voltage Divider V4B | |
| R42 | RESISTOR, fixed: composition; 3300 Ω, ±10%; 2 watts. | Voltage Divider V4B | RC20GF332K |
| R43 | Same as R35. | Phase Voltage Divider E1 | |
| R44 | Same as R3. | Phase Voltage Divider E1 | |
| R45 | RESISTOR, variable: composition; 1 meg Ω, ±20%; 2 watts. | A.G.C. Level V6 | RV4ATXA105B |
| R46 | RESISTOR, fixed: composition; 1.5 meg Ω, ±10%; 2 watts. | Current Limiting V6 | RC20GF155K |
| R47 | RESISTOR, fixed: composition; 180,000 Ω, ±10%; 2 watts. | Voltage Divider V6 | RC20GF184K |
| R48 | Same as R22. | Voltage Divider V6 | |
| R49 | Same as R46. | Coupling V6 to V7 | |
| R50 | Same as R35. | Grid Load V7 | |
| R51 | RESISTOR, fixed: composition; 4700 Ω, ±10%; 2 watts. | Plate Loading V7 | RC20GF472K |
| R52 | Same as R21. | Voltage Divider V7 | |
| R53 | RESISTOR, variable: composition; 100,000 Ω, ±20%; 2 watts. | Alarm Adjust V7 | RV4ATRD104B |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| R54 | RESISTOR, fixed: composition; 270,000 Ω, ±10%; 1/2 watt. | Voltage Divider V7 | RC20GF274K |
| R55 | RESISTOR, fixed: composition; 22,000 Ω, ±10%; 2 watts. | Cathode Res. V7 | RC42GF223K |
| R56 | Same as R10. | Voltage Divider V8 | |
| R57 | Same as R13. | Grid Load V8 | |
| R58 | RESISTOR, fixed: composition; 8200 Ω, ±10%; 1 watt. | Cathode Resistor V8 | RC32GF822K |
| R59 | Same as R8. | Voltage Divider V8 | |
| R60 | Same as R10. | Voltage Divider V9 | |
| R61 | Same as R46. | Grid Limiter V9 | |
| R62 | Same as R3. | Grid Load V9 | |
| R63 | Same as R7. | Plate Load V9 | |
| R64 | RESISTOR, fixed: composition; 82,000 Ω, ±10%; 2 watts. | Voltage Divider Z3 | RC20GF823K |
| R65 | Same as R35. | Voltage Divider S2 | |
| R66 | Same as R35. | Voltage Divider S2 | |
| R67 | RESISTOR, wire wound: 1000 Ω, 70 ma; 5 watts. | Current Limiting V10 | RW-107-34 |
| R68 | RESISTOR, wire wound: 2250 Ω, 47 ma; 5 watts. | Current Limiting V11 | RW-107-41 |
| R69 | RESISTOR, fixed: composition; 2000 Ω, ±10%; 2 watts. | Cathode Res. V9 | RC20GF202K |
| S1 | SWITCH, rotary: oak type F; one section; SP4T; contacts shorting silver plated brass. | Carrier Compensator | SW-277 |
| S2 | SWITCH, rotary: oak type F; one section; 2P4T. | A.G.C. Comp. | SW-120 |
| S3 | SWITCH, snap on button: momentary contact; SPST, 1 amp at 250 V; 3 amps at 125 V. | AFC Reset | SW168SPST 2N0BR |
| S4 | SWITCH, toggle. | Power ON/OFF | ST22K |
| T1 | TRANSFORMER, audio: primary, 20,000 ct; secondary, 150/600 Ω, ±2 db. | Audio XFMR | TF-138 |
| T2 | TRANSFORMER, audio frequency: plate coupling type; primary, 30,000 Ω ct; secondary, 50, 125, 200 or 500 Ω; +19 dbm maximum operating level; response ±2 db from 30-20,000 cps. | Audio XFMR | TF-154 |

## AUTOMATIC FREQUENCY CONTROL AFC-1

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| T3 | Same as T1. | Audio XFMR | |
| T4 | TRANSFORMER, power: primary; 105v/ 115v/125v/210v/230v/50-60 cps.; secondary; 175v/0/175v and 6.3v/ 6.3v ct. | Power XFMR | TF-225 |
| V1 | TUBE, electron: sharp cut-off pentode; miniature; 7 pin. | 1st Carrier Amp. | 6AU6 |
| V2 | Same as V1. | 2nd Carrier Amp. | |
| V3 | TUBE, electron: high mu twin triode; miniature; 9 pin. | Limiter | 12AX7 |
| V4A | TUBE, electron: triode - pentode converter; miniature; 9 pin. | Phase Det. Amp. | 6U8 |
| V4B | Part of V4A. | 17 Kc Amp. | |
| V5 | TUBE, electron: high mu triode; miniature; 7 pin. | Memory Follower | 6AB4 |
| V6 | TUBE, electron: twin diode; miniature; 7 pin. | Carrier Rect. | 6AL5 |
| V7 | TUBE, electron: med. mu twin triode; miniature; 9 pin. | Memory Lock & Fade Alarm | 12AU7 |
| V8 | TUBE, electron: sharp cut-off pentode; miniature; 7 pin. | Constant Current | 6AG5 |
| V9 | Same as V3. | 17 Kc Oscillator | |
| V10 | TUBE, electron: voltage regulator; miniature; 7 pin. | +150 Voltage Regulator | 0A2 |
| V11 | Same as V10. | -150 Voltage Regulator | |
| W1 | CABLE, AC: 3 wire; consists of P3 & P4. | Power Supply | CA-385 |
| XC34 | SOCKET, octal: 8 pin. | For C34A, B | TS-101-P01 |
| XC35 | Same as XC34. | For C35 | |
| XC36 | Same as XC34. | For C36 | |
| XF1 | FUSEHOLDER, extractor post type: 250v; at 15 amp. | Holder F1 | FH-100-2 |
| XI1 | LIGHT, indicator: w/red frosted lens; for miniature bayonet base T3-1/4 bulb. | Socket for I1 | TS-106-1 |
| XI2 | Same as XI1. | Socket for I2 | |
| XK1 | Same as XC34. | Socket for Relay K1 | |
| XV1 | SOCKET, 7 pin: miniature. | For 6AU6 V1 | TS-102-P01 |
| XV2 | Same as XV1. | For 6AU6 V2 | |

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| XV3 | SOCKET, 9 pin: miniature. | For 12AX7 V3 | TS-103-P01 |
| XV4 | Same as XV3. | For 6U8 V4A, B | |
| XV5 | Same as XV1. | For 6AB4 V5 | |
| XV6 | Same as XV1. | For 6AL5 V6 | |
| XV7 | Same as XV3. | For 12AU7 V7 | |
| XV8 | Same as XV1. | For 6AG5 V8 | |
| XV9 | Same as XV3. | For 12AX7 V9 | |
| XV10 | Same as XV1. | For 0A2 V10 | |
| XV11 | Same as XV1. | For 0A2 V11 | |
| XY1 | SOCKET, crystal: 0.486" spacing for 0.050" pin diameter. | For Xtal Unit Y1 | TS-104-1 |
| Y1 | XTAL UNIT, quartz: 17 Kc; pin type. | Oscillator | CR-50/U-017P |
| Z1 | FILTER, bandpass: 17 Kc crystal; input/output impedance, 75K. | Carrier Filter | FX-163 |
| Z2 | NETWORK, 17 Kc: c/o C6, 40, L4. | 17 Kc Tank Circuit | A-1384 |
| Z3 | Same as Z2. C/o C30, 39, L1. | 17 Kc Tuned Circuit | |

## LOUDSPEAKER PANEL LSP-7

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| E101 | TERMINAL STRIP, barrier type; 4 terminals. | Input Strip | TM-102-4 |
| LS101 | LOUDSPEAKER, 4 inch: 3-4 ohms, 2 watts; 5" o.d. x 3-1/2" i.d. x 2" dp. | Speaker | LS-101 |
| LS102 | Same as LS101. | Speaker | |
| R101 | ATTENUATOR, fixed: "T" pad, 4 ohms, 4 watts continuous, 36 db max. attenuation. | Attenuator, LS101 | RV-107-T4 |
| R102 | Same as R101. | Attenuator, LS102 | |

## POWER CONTROL PANEL DCP-1

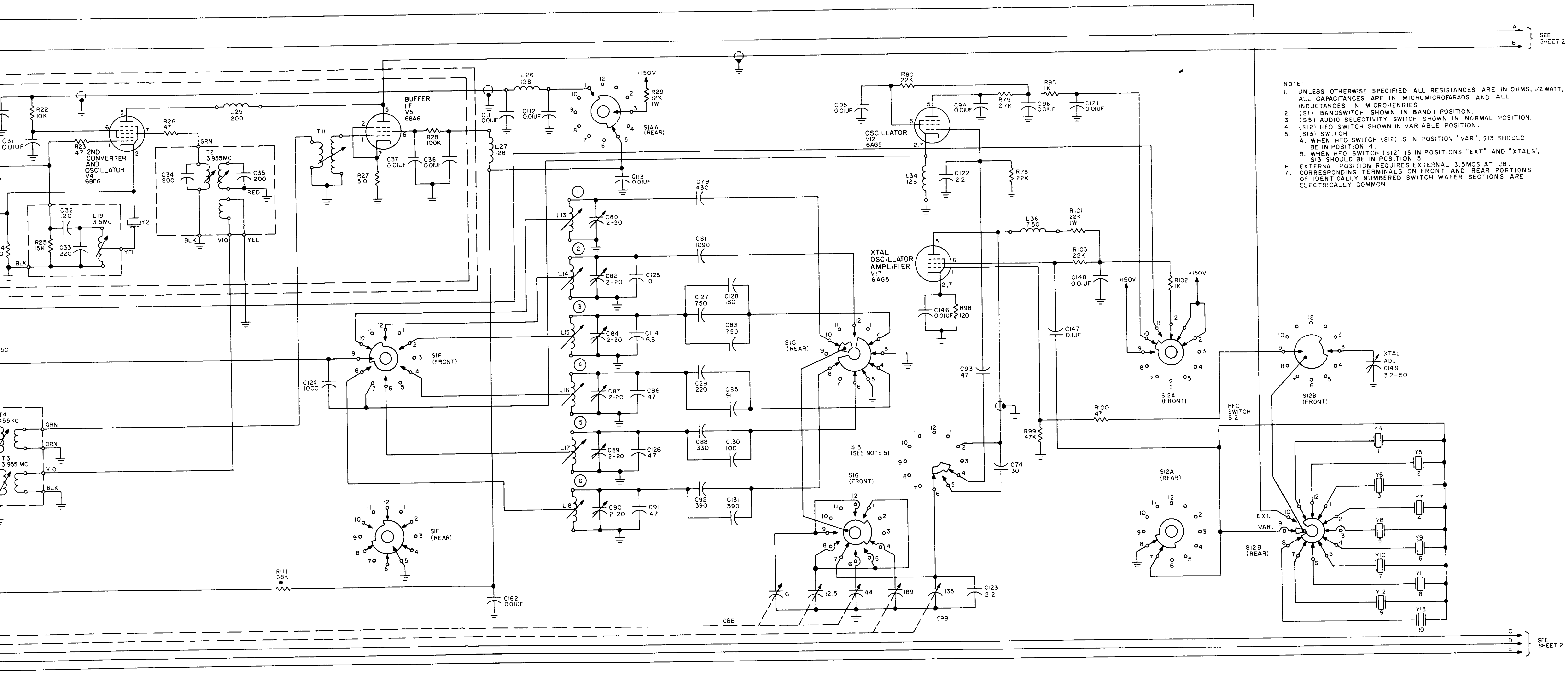
| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| CB1 | BREAKER, circuit: 110/230 VAC; 10 amps, double pole. | Power ON-OFF | SW-251 |
| E1 | TERMINAL, strip: barrier type; 3 terminals. | Input DCP-1 | TM-118-2 |
| E2 | Same as E1. | Output DCP-1 | TM-118-2 |
| I1 | LAMP, incandescent: double contact; 115-125 V, 6 watts; 5-6 clear bulb; bayonet base. | Power Indicator | BI-102-2 |
| J1 | CONNECTOR, receptacle: female; polarizes; 125 V, 15 amps; 250 V, 10 amps. | AC Outlet | JJ-130 |
| R1 | RESISTOR, fixed: wire wound; 2500 ohms, 25 watts. | Dropping Resistor for I1 | RW-111-25 |
| XI1 | INDICATOR, light: with lens; 2-3/4" lg. | Socket, I1 | TS-114-11 |

## CONTROL PATCH PANEL CPP-4C

| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| E101 thru E109 | TERMINAL BOARD, barrier type: twelve 6-32 screws and solder lug terminals; 2-7/8" lg. x 7/8" wd. x 3/4" h. 0/a; four 11/64" mtg. holes on 2-5/8" x 5/16" mtg. centers. | Power Connections | TM-100-12 |
| J1 thru J26 | JACK, connector: intregal; P/O J101, 102, 103. | Telephone | P/O JP-100 |
| J101 | JACK, assembly: audio type; c/o J1 thru J26. | Row 1, "IN" Jack Panel | JP-100 |
| J102 | Same as J101. | Row 2, "IN" Jack Panel | |
| J103 | Same as J101. | Row 3, "IN" Jack Panel | |
| W101 | CABLE ASSEMBLY, audio patch: single; c/o two plugs, PJ-DS1 equivalent, 2 feet of insulated shielded cable. | Audio Patch | CA-566-2 |
| W102 | Same as W101. | | |
| W103 | Same as W101. | | |
| W104 | Same as W101. | | |
| W105 | Same as W101. | | |
| W106 | Same as W101. | | |

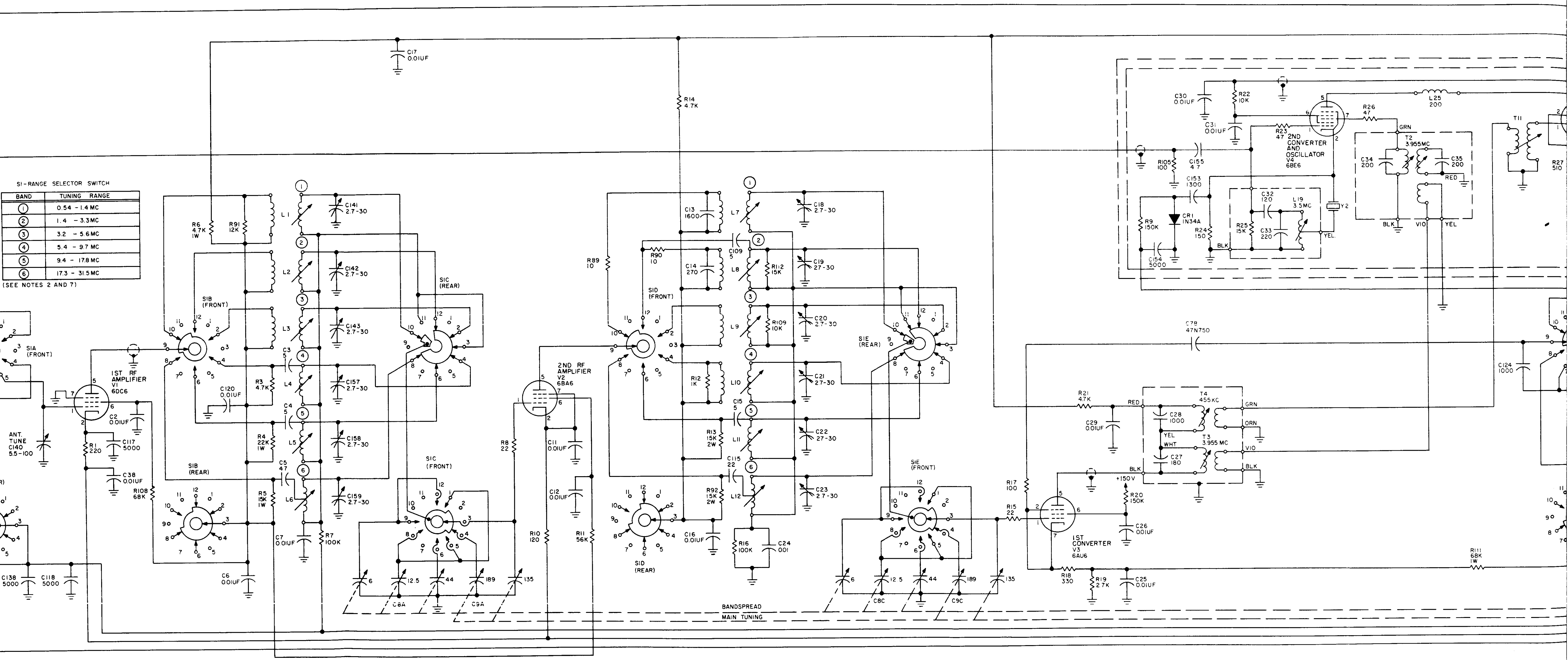
| SYM | DESCRIPTION | FUNCTION | TMC PART NO. |
|---|---|---|---|
| J1 | CONNECTOR, receptacle: series QDS dielectric: Teflon. | Antenna | JJ-187 |
| J2 | Same as J1. | Output 1 | |
| J3 | Same as J1. | Output 2 | |
| J4 | Same as J1. | Output 3 | |
| J5 | Same as J1. | Output 4 | |
| P1 | CONNECTOR, plug: special Universal; QDS. | Mates w/J1 | PL-149 |
| P2 | Same as P1. | Mates w/J2 | |
| P3 | Same as P1. | Mates w/J3 | |
| P4 | Same as P1. | Mates w/J4 | |
| P5 | Same as P1. | Mates w/J5 | |
| T1 | TRANSFORMER, high frequency distribution: frequency range 2-30 Mc; input Z = 70 $\Omega$, unbalanced; output Z = 70 $\Omega$, unbalanced. | | TR-137 |

# SECTION 8
# SCHEMATIC DIAGRAMS




NOTE:
1. UNLESS OTHERWISE SPECIFIED ALL RESISTANCES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCES ARE IN MICROMICROFARADS AND ALL INDUCTANCES IN MICROHENRIES
2. (S1) BANDSWITCH SHOWN IN BAND 1 POSITION.
3. (S5) AUDIO SELECTIVITY SWITCH SHOWN IN NORMAL POSITION.
4. (S12) HFO SWITCH SHOWN IN VARIABLE POSITION.
5. (S13) SWITCH
   A. WHEN HFO SWITCH (S12) IS IN POSITION "VAR", S13 SHOULD BE IN POSITION 4.
   B. WHEN HFO SWITCH (S12) IS IN POSITIONS "EXT" AND "XTALS", S13 SHOULD BE IN POSITION 5.
6. EXTERNAL POSITION REQUIRES EXTERNAL 3.5MCS AT J8.
7. CORRESPONDING TERMINALS ON FRONT AND REAR PORTIONS OF IDENTICALLY NUMBERED SWITCH WAFER SECTIONS ARE ELECTRICALLY COMMON.

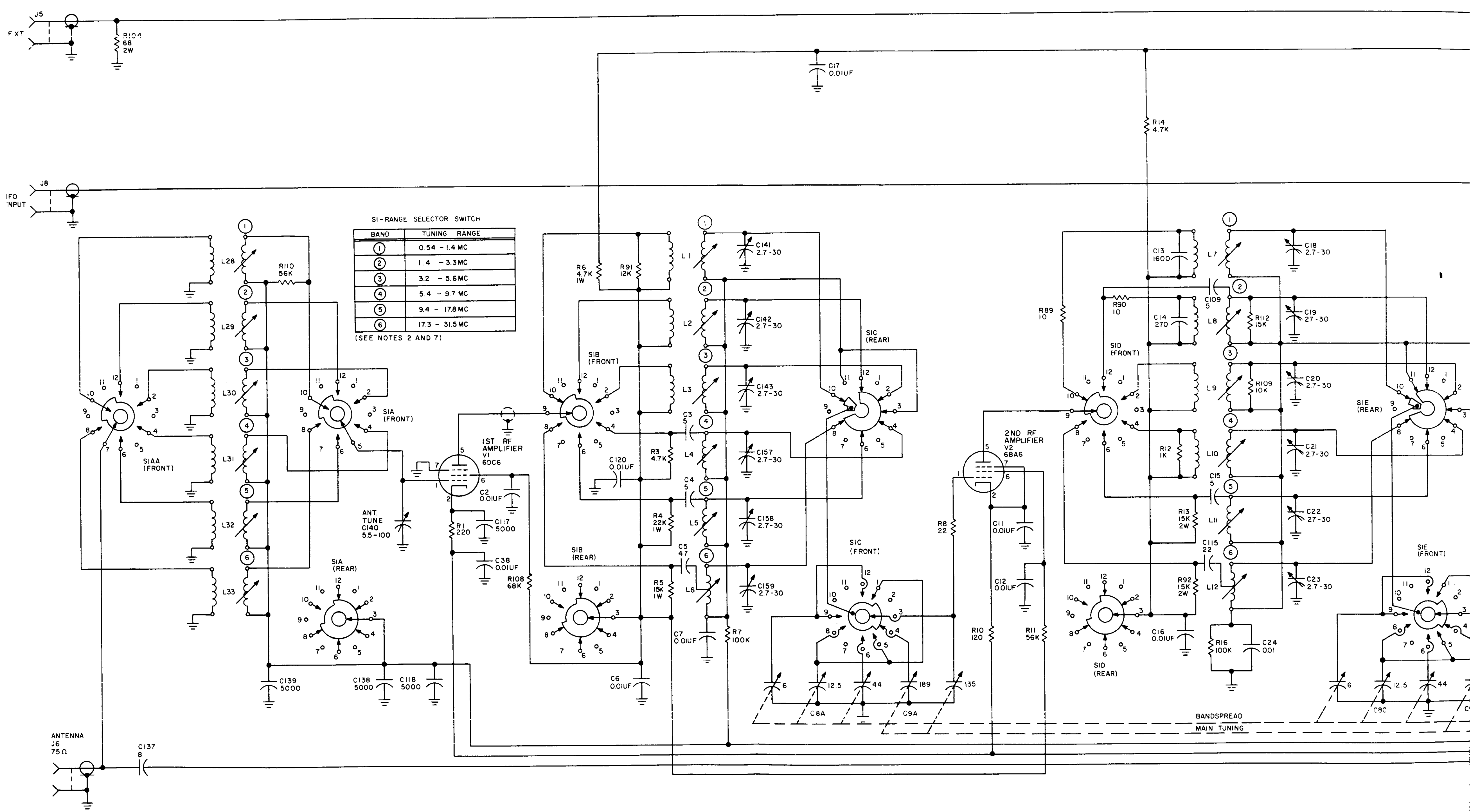
Figure 8-1. Schematic Diagram, GPR-90RXD (Sheet 1 of 2)




S1-RANGE SELECTOR SWITCH

| BAND | TUNING RANGE |
| --- | --- |
| ① | 0.54 - 1.4 MC |
| ② | 1.4 - 3.3 MC |
| ③ | 3.2 - 5.6 MC |
| ④ | 5.4 - 9.7 MC |
| ⑤ | 9.4 - 17.8 MC |
| ⑥ | 17.3 - 31.5 MC |

(SEE NOTES 2 AND 7)



S1-RANGE SELECTOR SWITCH

| BAND | TUNING RANGE |
|---|---|
| 1 | 0.54 - 1.4 MC |
| 2 | 1.4 - 3.3 MC |
| 3 | 3.2 - 5.6 MC |
| 4 | 5.4 - 9.7 MC |
| 5 | 9.4 - 17.8 MC |
| 6 | 17.3 - 31.5 MC |

(SEE NOTES 2 AND 7)
J5
EXT
J8
IFO INPUT
ANTENNA J6 75 Ω
1ST RF AMPLIFIER V1 6DC6
2ND RF AMPLIFIER V2 6BA6
ANT. TUNE C140 5.5-100
S1AA (FRONT)
S1A (FRONT)
S1A (REAR)
S1B (FRONT)
S1B (REAR)
S1C (FRONT)
S1C (REAR)
S1D (FRONT)
S1D (REAR)
S1E (FRONT)
S1E (REAR)
BANDSPREAD
MAIN TUNING

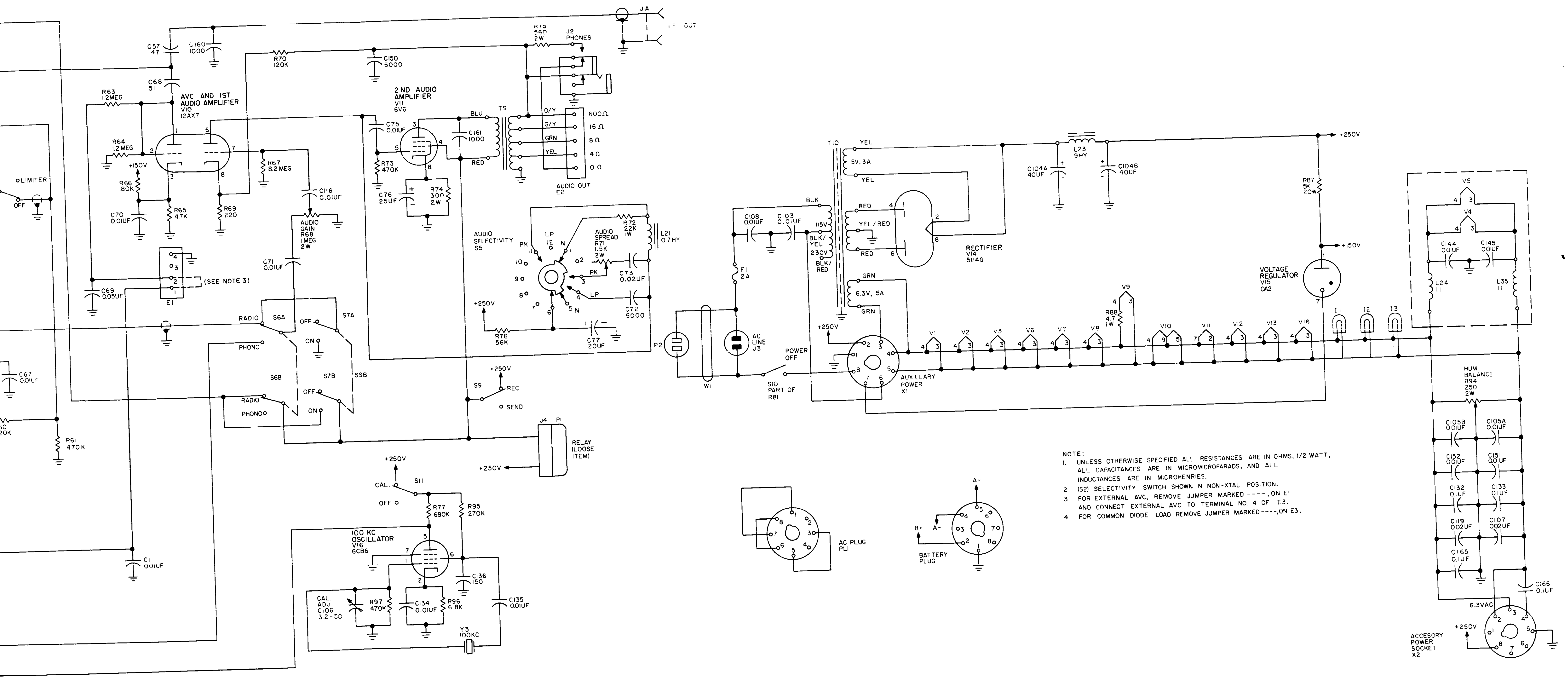
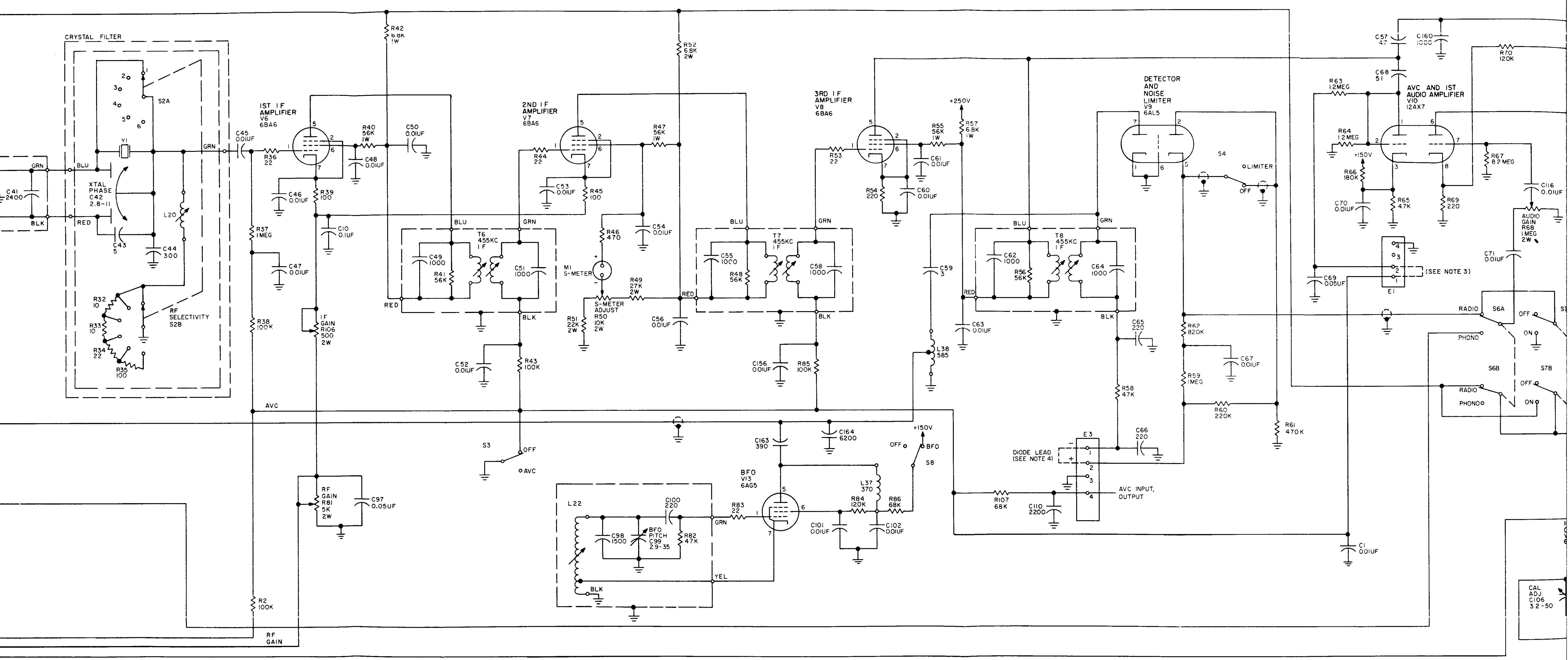
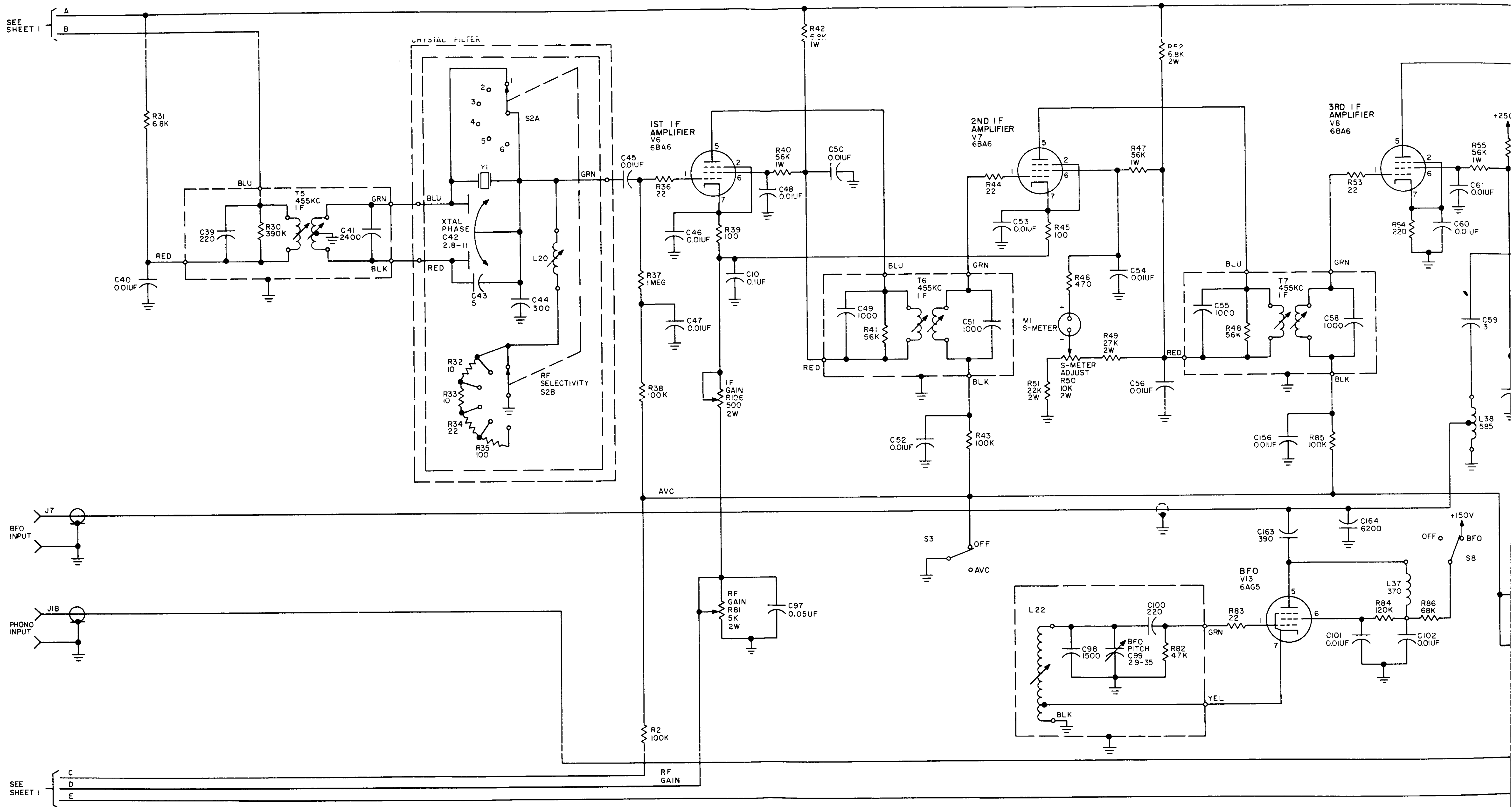
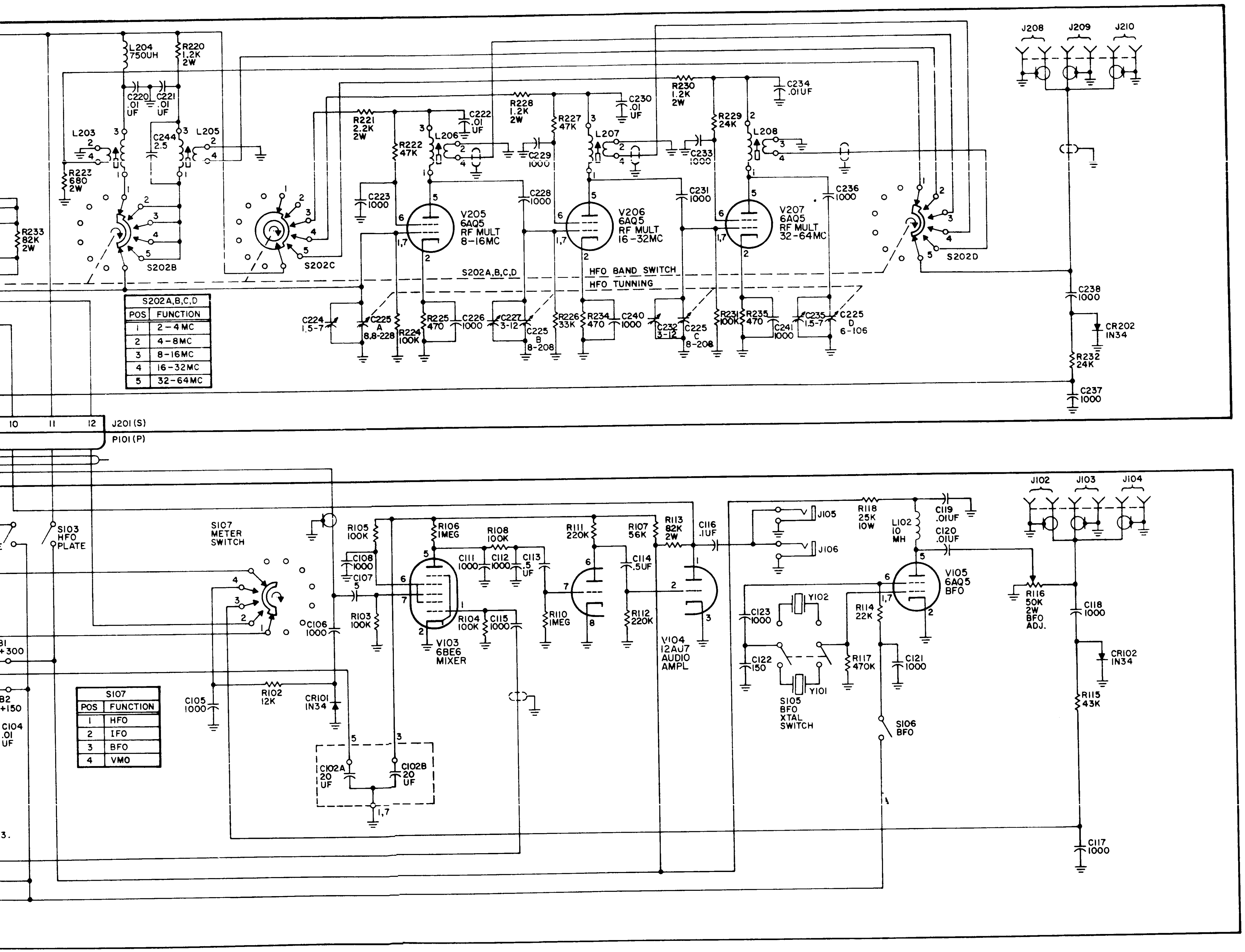



Figure 8-1. Schematic Diagram, GPR-90RXD (Sheet 2 of 2)



CRYSTAL FILTER
XTAL PHASE C42 2.8-11
RF SELECTIVITY S2B
S2A
1ST IF AMPLIFIER V6 6BA6
2ND IF AMPLIFIER V7 6BA6
3RD IF AMPLIFIER V8 6BA6
T6 455KC IF
T7 455KC IF
T8 455KC IF
M1 S-METER
S-METER ADJUST R50 10K 2W
IF GAIN R106 500 2W
RF GAIN R81 5K 2W
AVC
RF GAIN
S3
OFF
AVC
BFO V13 6AG5
BFO PITCH C99 2.9-35
L22
+150V
+250V
S8
DETECTOR AND NOISE LIMITER V9 6AL5
S4
LIMITER
DIODE LEAD (SEE NOTE 4)
AVC INPUT, OUTPUT
E3
AVC AND 1ST AUDIO AMPLIFIER V10 12AX7
AUDIO GAIN R68 1MEG 2W
(SEE NOTE 3)
E1
RADIO
PHONO
S6A
S6B
S7B
CAL ADJ C106 3.2-50


SEE SHEET 1
A
B
C
D
E
CRYSTAL FILTER
S2A
Y1
XTAL PHASE C42 2.8-11
C43 5
C44 300
L20
RF SELECTIVITY S2B
R32 10
R33 10
R34 22
R35 100
T5 455KC IF
C39 220
R30 390K
C41 2400
R31 6.8K
C40 0.01UF
BLU
RED
GRN
BLK
1ST IF AMPLIFIER V6 6BA6
C45 0.01UF
R36 22
R37 1MEG
C47 0.01UF
R38 100K
C46 0.01UF
R39 100
C10 0.1UF
R40 56K 1W
C48 0.01UF
C50 0.01UF
R42 6.8K 1W
IF GAIN R106 500 2W
RF GAIN R81 5K 2W
C97 0.05UF
R2 100K
RF GAIN
AVC
T6 455KC IF
C49 1000
R41 56K
C51 1000
C52 0.01UF
R43 100K
S3
OFF
AVC
2ND IF AMPLIFIER V7 6BA6
R44 22
C53 0.01UF
R45 100
R47 56K 1W
C54 0.01UF
R46 470
M1 S-METER
S-METER ADJUST R50 10K 2W
R49 27K 2W
R51 22K 2W
C56 0.01UF
R52 6.8K 2W
T7 455KC IF
C55 1000
R48 56K
C58 1000
C156 0.01UF
R85 100K
3RD IF AMPLIFIER V8 6BA6
R53 22
R54 220
C60 0.01UF
C61 0.01UF
R55 56K 1W
C59 3
L38 585
J7
BFO INPUT
J18
PHONO INPUT
C163 390
C164 6200
+150V
OFF
BFO
S8
BFO V13 6AG5
L37 370
R84 120K
R86 68K
C101 0.01UF
C102 0.01UF
R83 22
L22
C98 1500
BFO PITCH C99 2.9-35
C100 220
R82 47K
YEL




| S202A,B,C,D | |
|---|---|
| POS | FUNCTION |
| 1 | 2-4MC |
| 2 | 4-8MC |
| 3 | 8-16MC |
| 4 | 16-32MC |
| 5 | 32-64MC |

| S107 | |
|---|---|
| POS | FUNCTION |
| 1 | HFO |
| 2 | IFO |
| 3 | BFO |
| 4 | VMO |

| 100 SERIES | |
|---|---|
| LAST SYMBOLS | MISSING SYMBOLS |
| C123 | C103,C109,C110 |
| CR102 | |
| F102 | |
| J106 | |
| L102 | |
| P108 | |
| R118 | R109 |
| S107 | |
| T101 | |
| V105, W104 | |
| Y102 | |

| 200 SERIES | |
|---|---|
| LAST SYMBOLS | MISSING SYMBOLS |
| C246 | |
| CR202 | |
| J210 | J204 |
| L208, P201 | |
| R235 | |
| S202 | |
| V207, W201 | |
| Y204 | |

| 300 SERIES | |
|---|---|
| LAST SYMBOLS | MISSING SYMBOLS |
| C323 | C310,C313,C317 |
| E302 | |
| I304 | |
| J302 | J301 |
| K301 | |
| L303 | |
| M301 | |
| P303 | |
| R321 | R303, R316 |
| S303 | |
| V302, W302 | |
| Y301, Z301 | |

NOTES — UNLESS OTHERWISE SPECIFIED

1 - ALL CAPACITORS ARE IN MICRO-MICROFARADS

2 - ALL RESISTORS ARE 1/2 WATT

3 - ALL SWITCHES ARE SHOWN IN POSITION 1

4 - ALL COILS ARE IN MILLIHENRIES

5 - ALL CRYSTALS ARE SUPPLIED ONLY UPON CUSTOMERS REQUEST

SERVICING INTERCONNECT CABLES

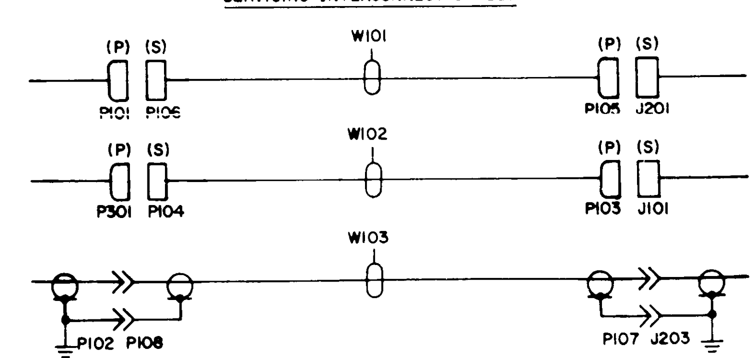
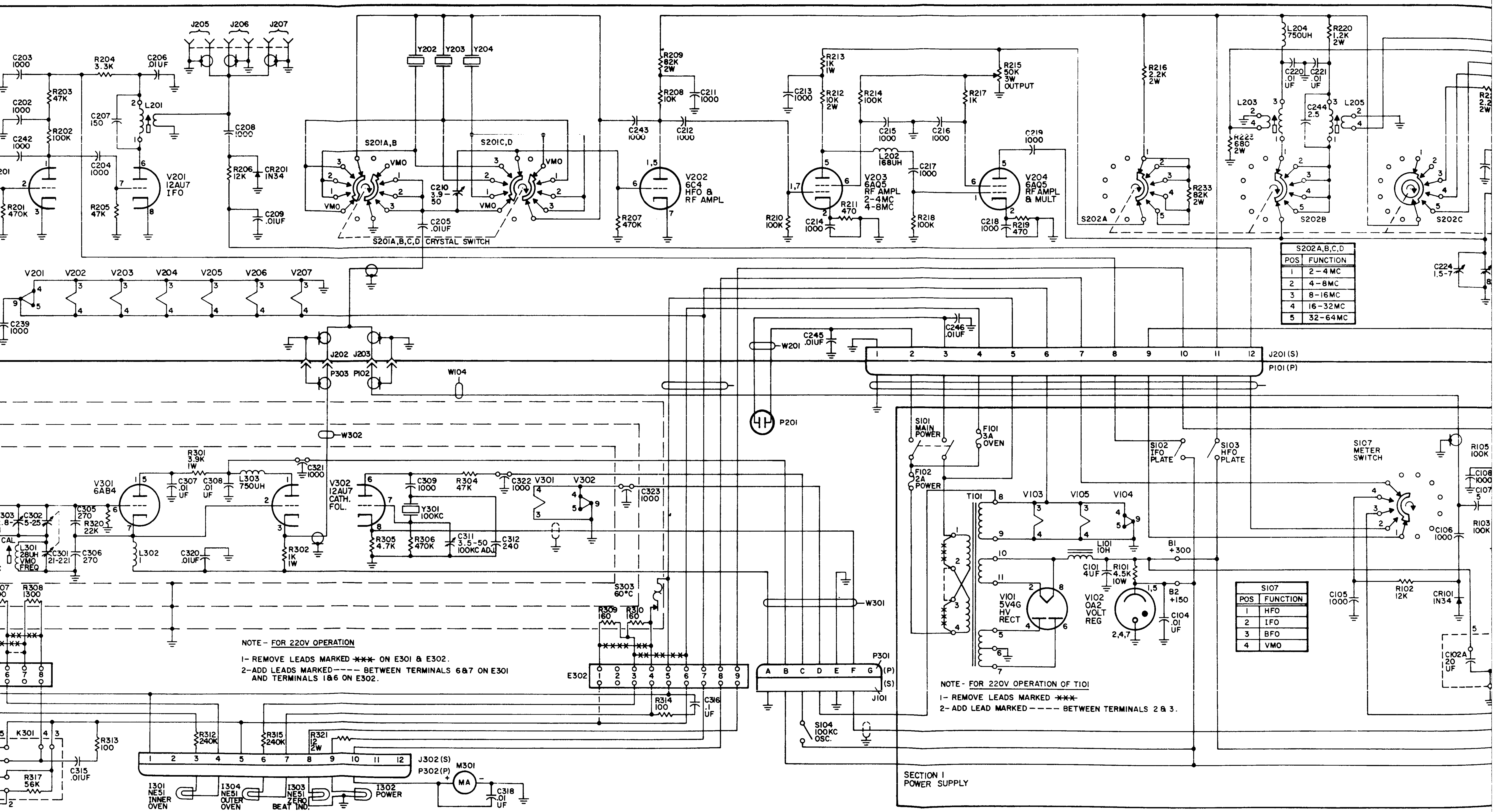
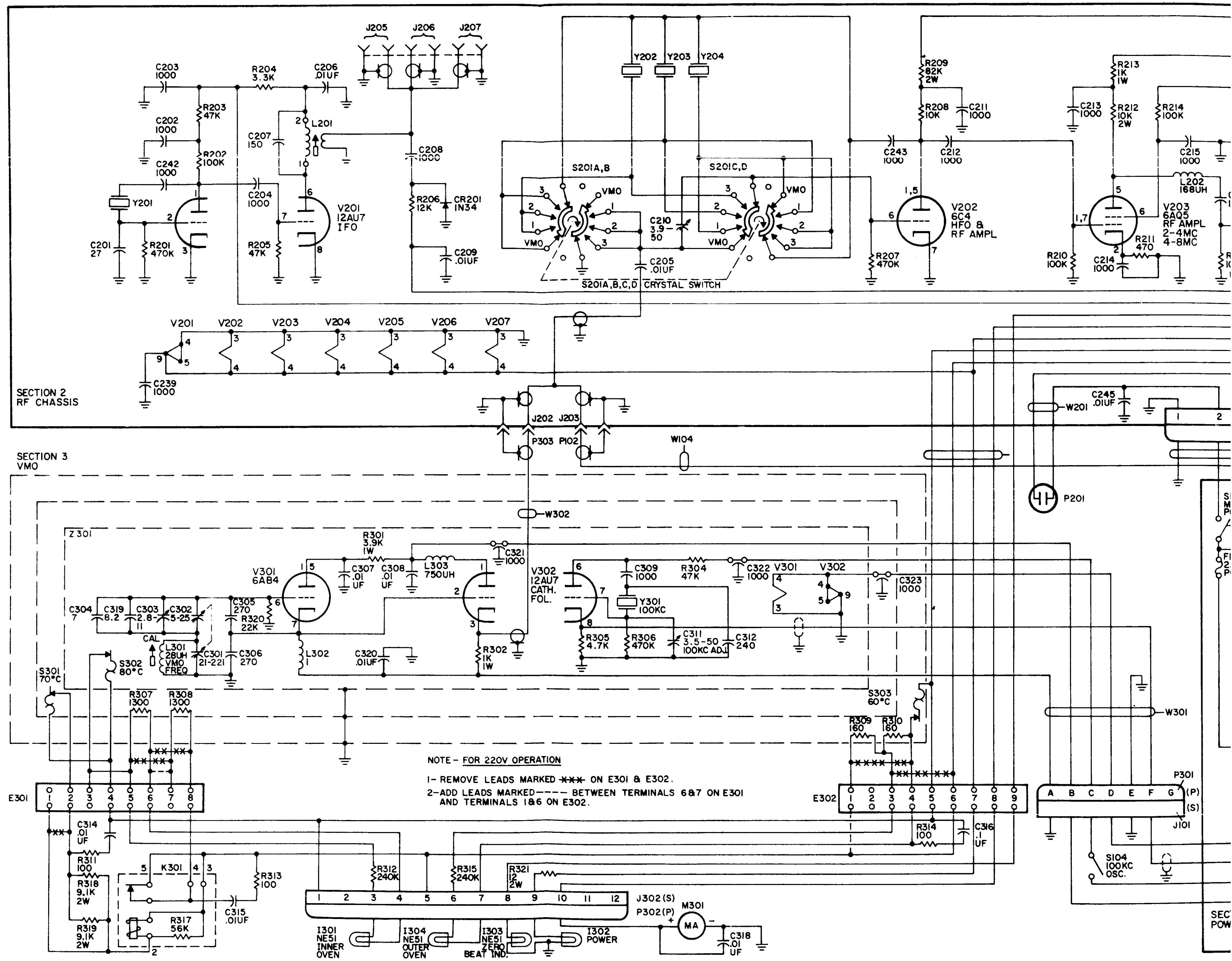
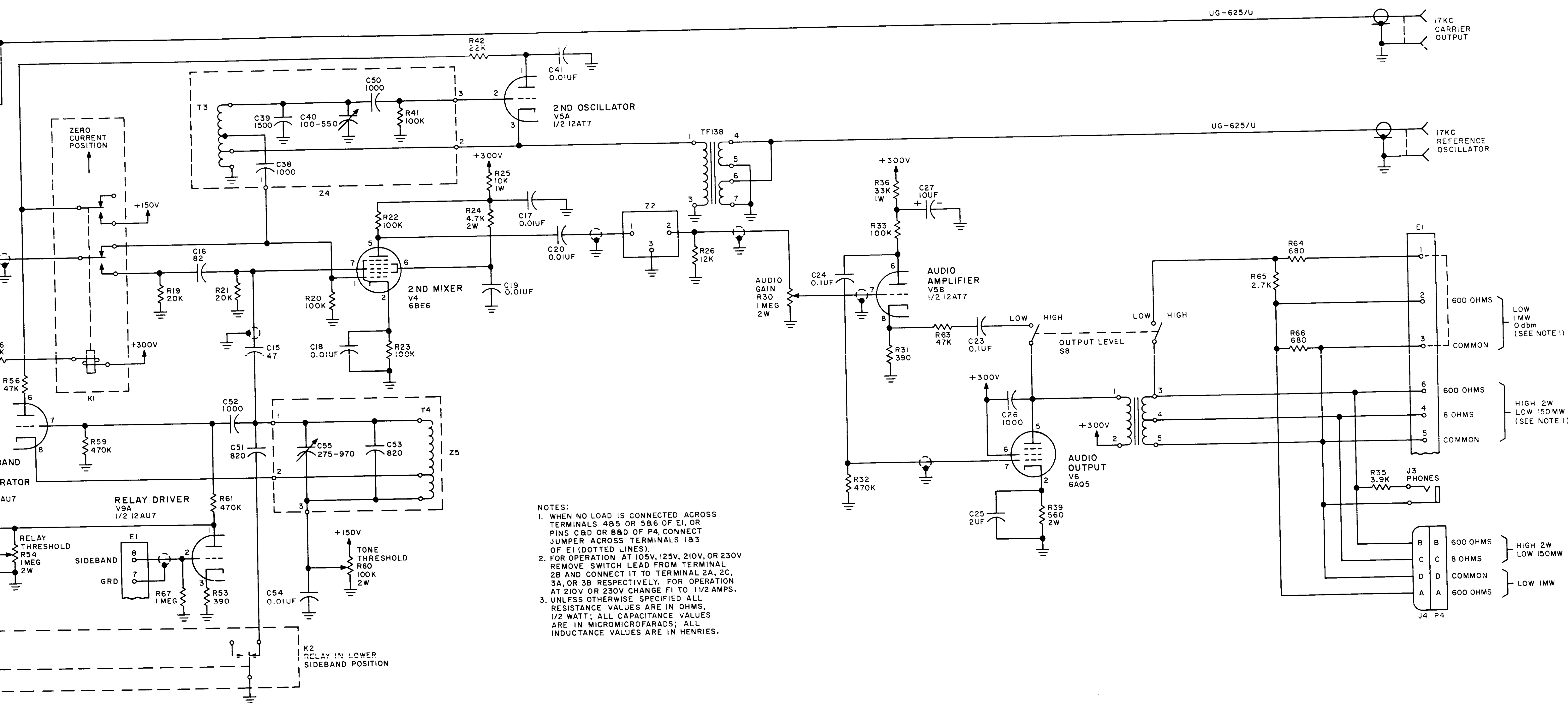



Figure 8-2. Schematic Diagram, VOX-3



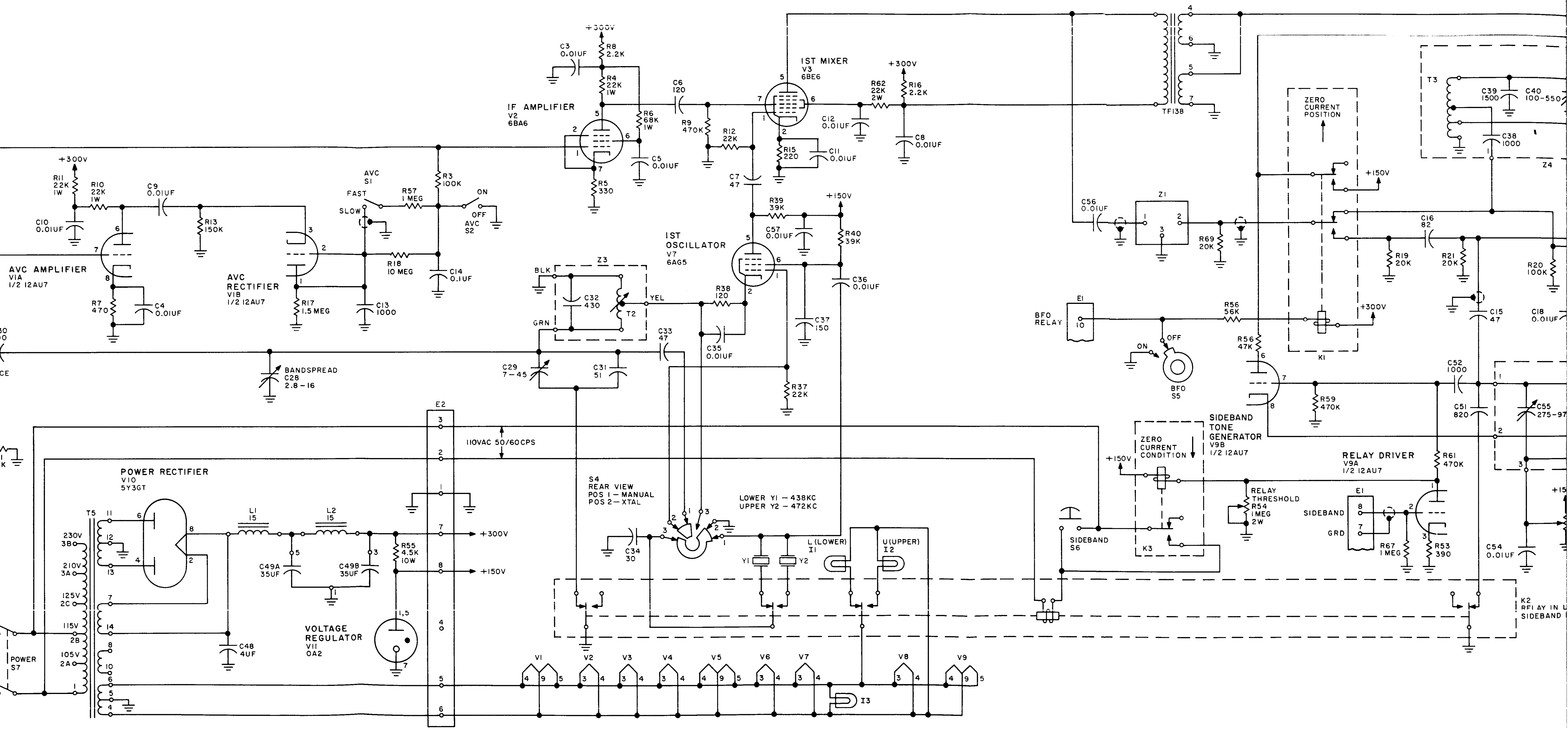
S201A,B,C,D CRYSTAL SWITCH
S202A,B,C,D
POS FUNCTION
1 2-4MC
2 4-8MC
3 8-16MC
4 16-32MC
5 32-64MC
S107
POS FUNCTION
1 HFO
2 IFO
3 BFO
4 VMO
NOTE - FOR 220V OPERATION
1- REMOVE LEADS MARKED -XXX- ON E301 & E302.
2-ADD LEADS MARKED---- BETWEEN TERMINALS 6&7 ON E301 AND TERMINALS 1&6 ON E302.
NOTE - FOR 220V OPERATION OF T101
1- REMOVE LEADS MARKED -XXX-
2- ADD LEAD MARKED---- BETWEEN TERMINALS 2 & 3.
SECTION I POWER SUPPLY

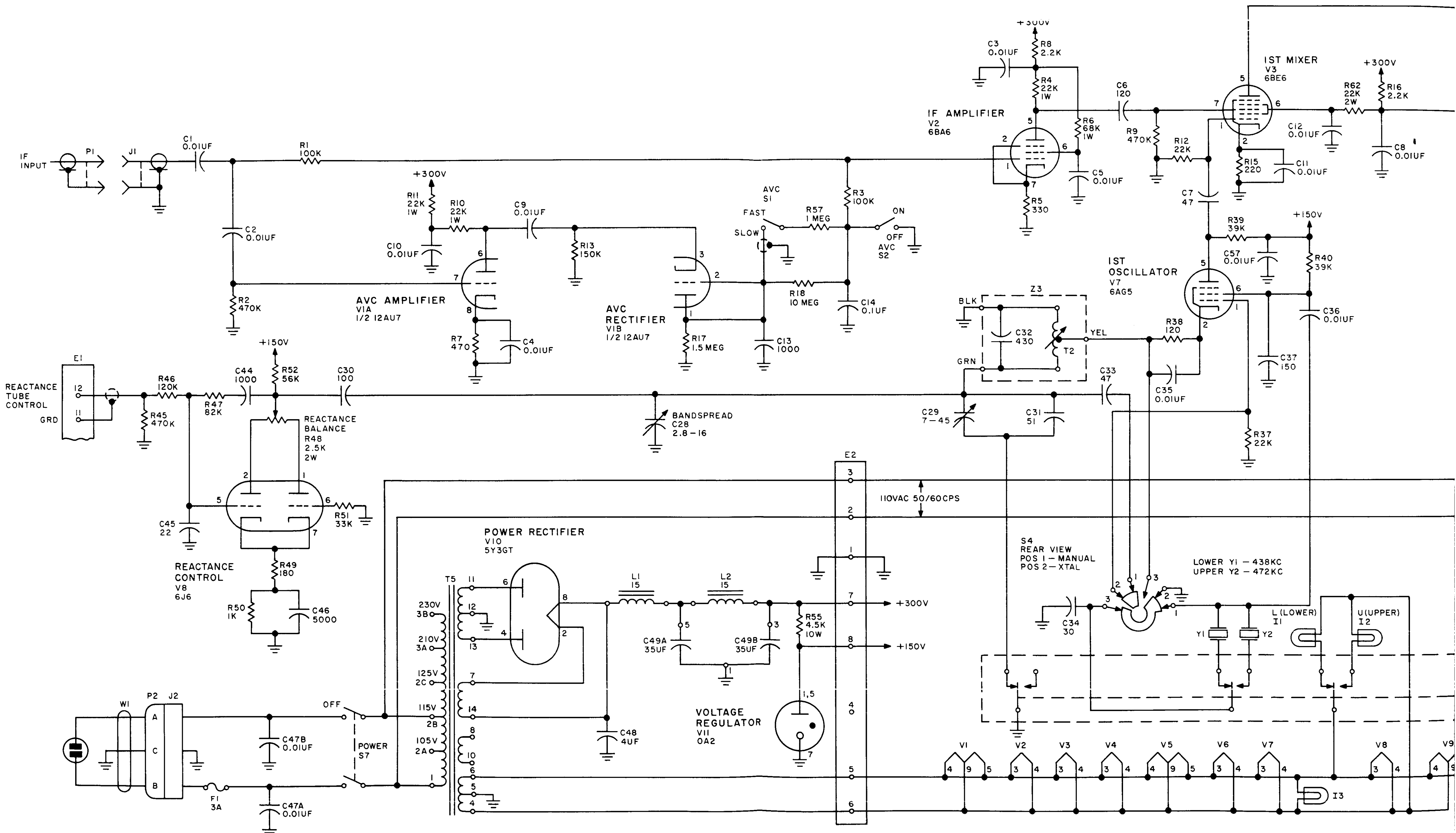

SECTION 2
RF CHASSIS
SECTION 3
VMO
S201A,B,C,D CRYSTAL SWITCH
V201 12AU7 IFO
V202 6C4 HFO & RF AMPL
V203 6AQ5 RF AMPL 2-4MC 4-8MC
V301 6AB4
V302 12AU7 CATH. FOL.
NOTE - FOR 220V OPERATION
1- REMOVE LEADS MARKED -xxx- ON E301 & E302.
2-ADD LEADS MARKED---- BETWEEN TERMINALS 6&7 ON E301 AND TERMINALS 1&6 ON E302.
I301 NE51 INNER OVEN
I304 NE51 OUTER OVEN
I303 NE51 ZERO BEAT IND.
I302 POWER



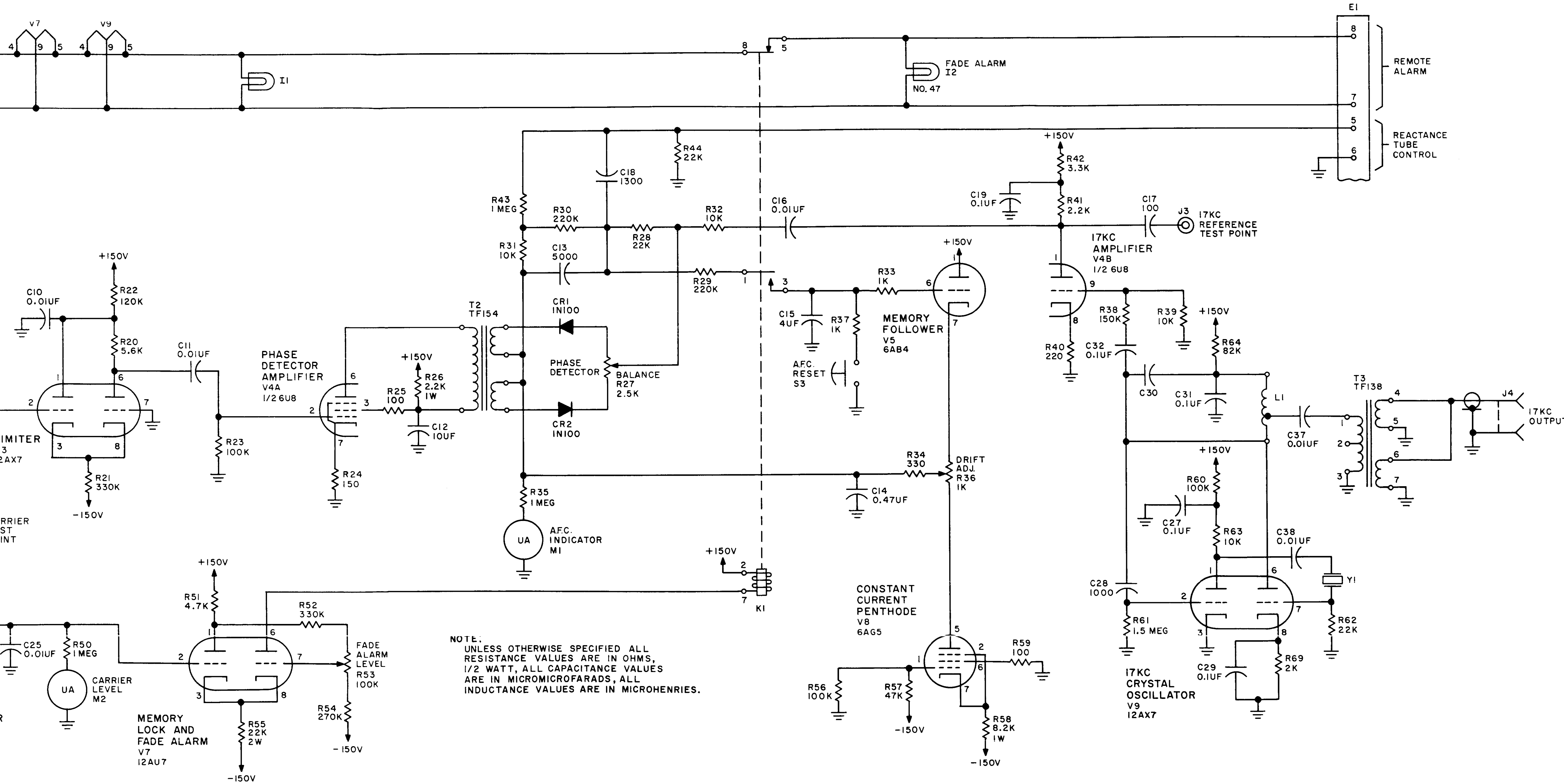

NOTES:
1. WHEN NO LOAD IS CONNECTED ACROSS TERMINALS 4&5 OR 5&6 OF E1, OR PINS C&D OR B&D OF P4, CONNECT JUMPER ACROSS TERMINALS 1&3 OF E1 (DOTTED LINES).
2. FOR OPERATION AT 105V, 125V, 210V, OR 230V REMOVE SWITCH LEAD FROM TERMINAL 2B AND CONNECT IT TO TERMINAL 2A, 2C, 3A, OR 3B RESPECTIVELY. FOR OPERATION AT 210V OR 230V CHANGE F1 TO 1 1/2 AMPS.
3. UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT; ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS; ALL INDUCTANCE VALUES ARE IN HENRIES.

Figure 8-3. Schematic Diagram, MSR-6


IF AMPLIFIER
V2
6BA6
IST MIXER
V3
6BE6
IST OSCILLATOR
V7
6AG5
AVC AMPLIFIER
VIA
1/2 12AU7
AVC RECTIFIER
VIB
1/2 12AU7
POWER RECTIFIER
V10
5Y3GT
VOLTAGE REGULATOR
VII
OA2
SIDEBAND TONE GENERATOR
V9B
1/2 12AU7
RELAY DRIVER
V9A
1/2 12AU7
ZERO CURRENT POSITION
ZERO CURRENT CONDITION
RELAY THRESHOLD
R54
1MEG
2W
S4
REAR VIEW
POS 1 – MANUAL
POS 2 – XTAL
LOWER Y1 – 438KC
UPPER Y2 – 472KC
L (LOWER) I1
U (UPPER) I2
I3
110VAC 50/60CPS
BANDSPREAD
C28
2.8 – 16
BFO RELAY
BFO
S5
SIDEBAND
S6
AVC
S1
FAST
SLOW
AVC
S2
ON
OFF
POWER
S7
K1
K2
RELAY IN U SIDEBAND
K3
T5
TF138
T2
T3
Z1
Z3
Z4
E1
E2
+300V
+150V
YEL
BLK
GRN
GRD

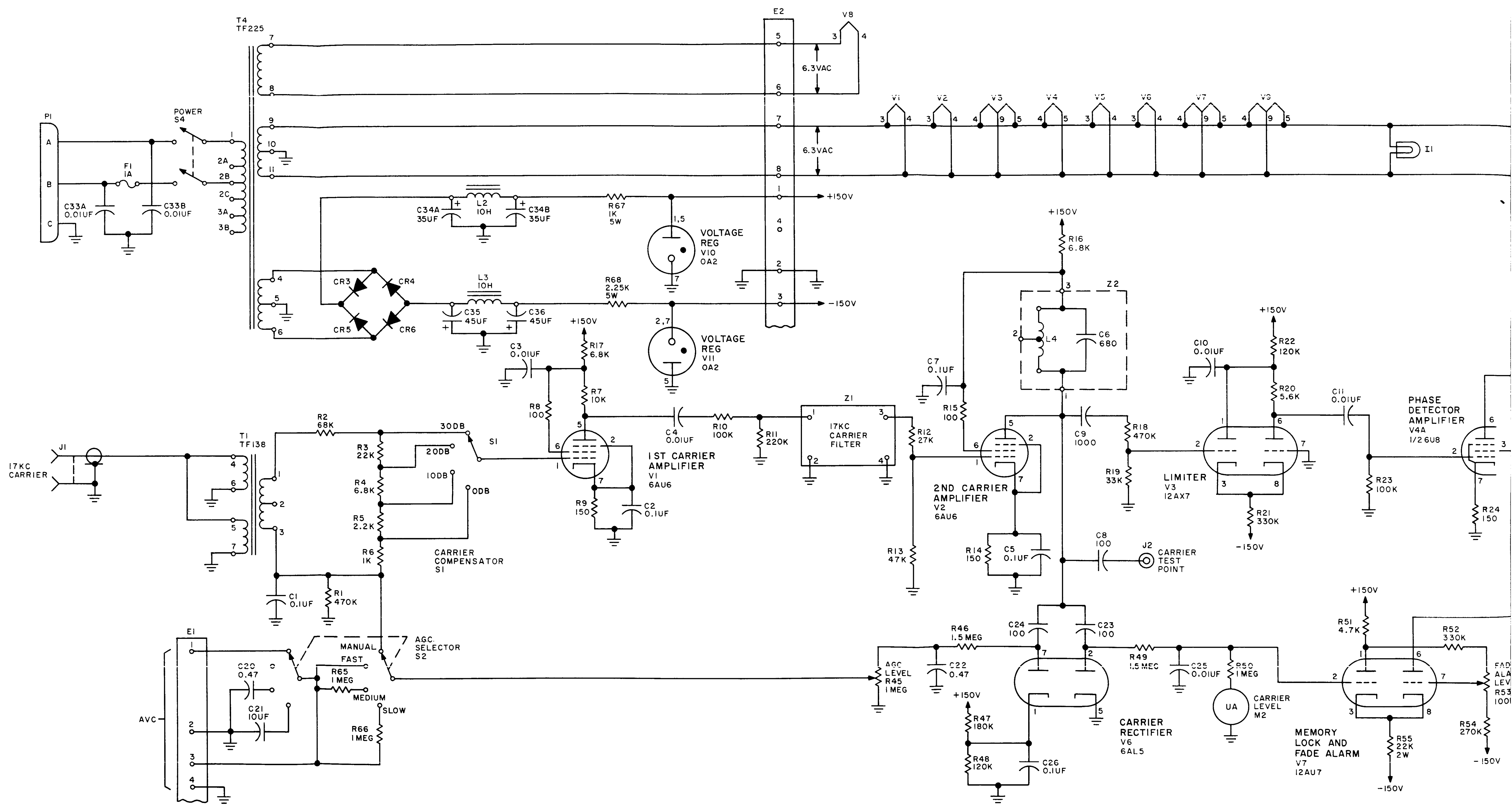


IF INPUT
P1
J1
C1 0.01UF
R1 100K
C2 0.01UF
R2 470K
+300V
R11 22K 1W
R10 22K 1W
C10 0.01UF
C9 0.01UF
R13 150K
AVC AMPLIFIER
V1A
1/2 12AU7
R7 470
C4 0.01UF
AVC RECTIFIER
V1B
1/2 12AU7
R17 1.5 MEG
C13 1000
AVC S1
FAST
SLOW
R57 1 MEG
R18 10 MEG
R3 100K
C14 0.1UF
ON
OFF
AVC S2
IF AMPLIFIER
V2
6BA6
C3 0.01UF
R8 2.2K
R4 22K 1W
R6 68K 1W
C5 0.01UF
R5 330
C6 120
R9 470K
R12 22K
C7 47
1ST MIXER
V3
6BE6
R15 220
C11 0.01UF
C12 0.01UF
R62 22K 2W
R16 2.2K
C8 0.01UF
+150V
R39 39K
C57 0.01UF
R40 39K
1ST OSCILLATOR
V7
6AG5
C36 0.01UF
C37 150
R37 22K
R38 120
C35 0.01UF
Z3
BLK
C32 430
T2
YEL
GRN
C29 7-45
C31 51
C33 47
REACTANCE TUBE CONTROL
E1
GRD
R46 120K
R45 470K
R47 82K
C44 1000
R52 56K
REACTANCE BALANCE
R48 2.5K 2W
C30 100
BANDSPREAD
C28 2.8-16
C45 22
R51 33K
REACTANCE CONTROL
V8
6J6
R49 180
R50 1K
C46 5000
E2
110VAC 50/60CPS
S4
REAR VIEW
POS 1 - MANUAL
POS 2 - XTAL
LOWER Y1 - 438KC
UPPER Y2 - 472KC
C34 30
Y1
Y2
L (LOWER) I1
U (UPPER) I2
I3
POWER RECTIFIER
V10
5Y3GT
T5
230V 3B
210V 3A
125V 2C
115V 2B
105V 2A
L1 15
L2 15
C49A 35UF
C49B 35UF
C48 4UF
R55 4.5K 10W
+300V
+150V
VOLTAGE REGULATOR
V11
0A2
W1
P2
J2
OFF
POWER S7
C47B 0.01UF
C47A 0.01UF
F1 3A
V1
V2
V3
V4
V5
V6
V7
V8
V9

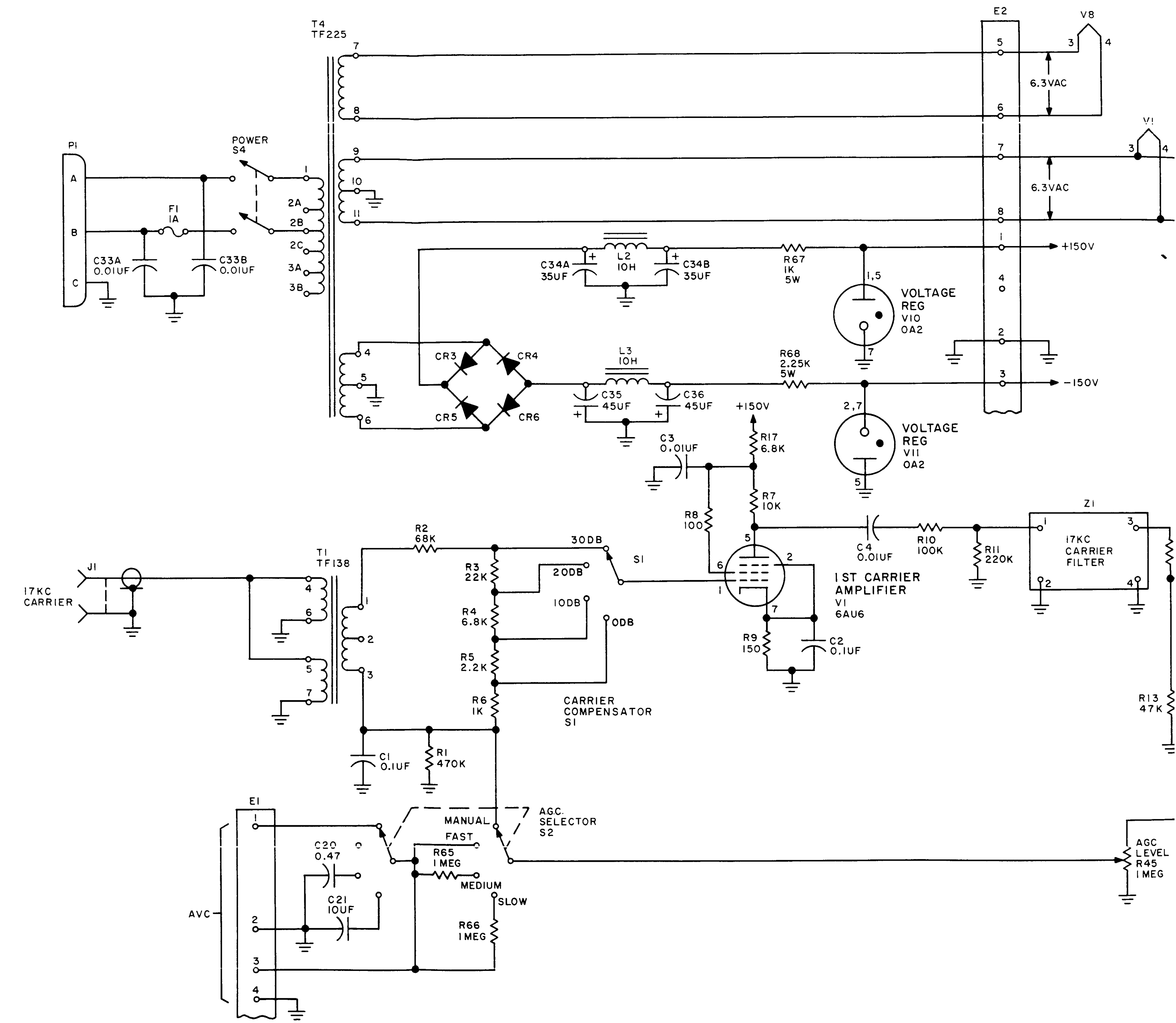



NOTE:
UNLESS OTHERWISE SPECIFIED ALL RESISTANCE VALUES ARE IN OHMS, 1/2 WATT, ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS, ALL INDUCTANCE VALUES ARE IN MICROHENRIES.

Figure 8-4. Schematic Diagram, AFC-1



T4 TF225
E2
V8
6.3VAC
6.3VAC
V1
V2
V3
V4
V5
V6
V7
V9
I1
P1
POWER S4
F1 1A
C33A 0.01UF
C33B 0.01UF
C34A 35UF
L2 10H
C34B 35UF
R67 1K 5W
+150V
VOLTAGE REG V10 OA2
CR3
CR4
CR5
CR6
L3 10H
C35 45UF
C36 45UF
R68 2.25K 5W
-150V
VOLTAGE REG V11 OA2
+150V
R16 6.8K
Z2
L4
C6 680
C7 0.1UF
R15 100
+150V
R17 6.8K
C3 0.01UF
R8 100
R7 10K
C4 0.01UF
R10 100K
R11 220K
Z1
17KC CARRIER FILTER
R12 27K
C9 1000
R18 470K
R19 33K
+150V
C10 0.01UF
R22 120K
R20 5.6K
C11 0.01UF
PHASE DETECTOR AMPLIFIER V4A 1/2 6U8
J1
17KC CARRIER
T1 TF138
R2 68K
R3 22K
R4 6.8K
R5 2.2K
R6 1K
30DB
20DB
10DB
0DB
S1
CARRIER COMPENSATOR S1
1ST CARRIER AMPLIFIER V1 6AU6
R9 150
C2 0.1UF
2ND CARRIER AMPLIFIER V2 6AU6
R13 47K
R14 150
C5 0.1UF
C8 100
J2 CARRIER TEST POINT
LIMITER V3 12AX7
R21 330K
-150V
R23 100K
R24 150
C1 0.1UF
R1 470K
E1
AVC
C20 0.47
C21 10UF
MANUAL
FAST
R65 1MEG
MEDIUM
SLOW
R66 1MEG
AGC SELECTOR S2
AGC LEVEL R45 1MEG
R46 1.5MEG
C22 0.47
C24 100
C23 100
+150V
R47 180K
R48 120K
C26 0.1UF
CARRIER RECTIFIER V6 6AL5
R49 1.5MEG
C25 0.01UF
R50 1MEG
UA
CARRIER LEVEL M2
+150V
R51 4.7K
R52 330K
MEMORY LOCK AND FADE ALARM V7 12AU7
R55 22K 2W
-150V
R54 270K
-150V


T4
TF225
E2
V8
6.3VAC
V1
P1
POWER
S4
F1
1A
C33A
0.01UF
C33B
0.01UF
C34A
35UF
L2
10H
C34B
35UF
R67
1K
5W
+150V
VOLTAGE
REG
V10
OA2
CR3
CR4
CR5
CR6
L3
10H
C35
45UF
C36
45UF
R68
2.25K
5W
-150V
VOLTAGE
REG
V11
OA2
+150V
R17
6.8K
C3
0.01UF
R7
10K
R8
100
C4
0.01UF
R10
100K
R11
220K
Z1
17KC
CARRIER
FILTER
R13
47K
1ST CARRIER
AMPLIFIER
V1
6AU6
R9
150
C2
0.1UF
J1
17KC
CARRIER
T1
TF138
R2
68K
30DB
20DB
10DB
0DB
S1
R3
22K
R4
6.8K
R5
2.2K
R6
1K
CARRIER
COMPENSATOR
S1
C1
0.1UF
R1
470K
E1
AVC
C20
0.47
C21
10UF
MANUAL
FAST
R65
1MEG
MEDIUM
SLOW
R66
1MEG
AGC
SELECTOR
S2
AGC
LEVEL
R45
1MEG

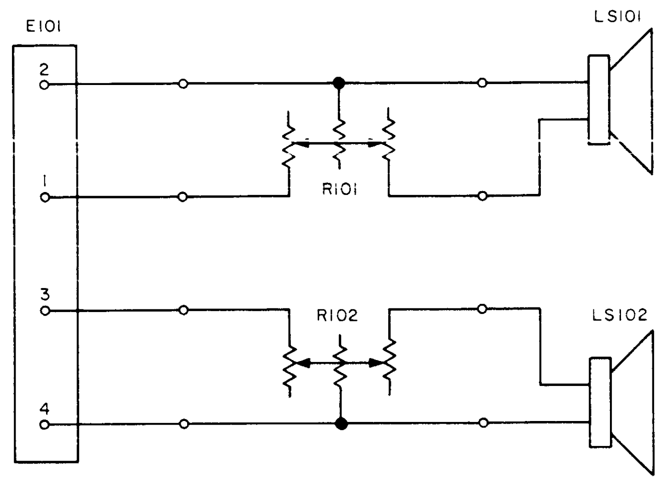



Figure 8-5. Schematic Diagram, LSP-7

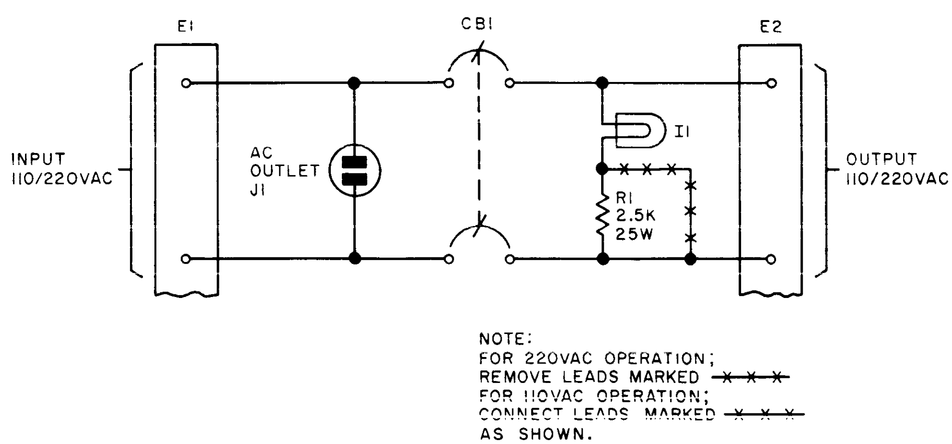



Figure 8-6. Schematic Diagram, DCP-1

# APPENDIX I
# ACCESSORY EQUIPMENT

## A-1. GENERAL.

This appendix briefly describes several items of accessory equipment which can be used with the DDR-6E. The decision to use one or more of these accessories depends on the requirements imposed by the particular DDR-6E installation site.

Table A-1 identifies the accessories described in this appendix.

## A-2. ANTENNA MULTICOUPLER AMC 6-5.
(See figure A-1.)

Antenna Multicoupler AMC 6-5 may be used at the DDR-6E as a broadband antenna coupling device, permitting operation of several GPR-90RXD's with a common antenna. As many as six GPR-90RXD's may be independently operated over a band of 2 to 30 mc from a nonresonant type antenna. Various AMC 6-5 models are available, designed to operate with antennas having impedances varying between 50 to 600 ohms, balanced or unbalanced. All models have an output impedance of 70 ohms to match input impedances at the antenna terminals of most GPR-90RXD's. When used in a receiving system, the AMC 6-5 provides a general improvement in noise factor and a 3 db increase in overall gain. Design of the AMC 6-5 is such that generated spurious response is minimized and considerable attenuation of signals reradiated from receiver to receiver or receiver to common antenna is obtained.

The AMC 6-5 consists essentially of a preamplifier, two delay lines and six output stages, an oscillator and metering circuit, and a self-contained power supply. (See figure A-2.) The single antenna input is applied to the broadband preamplifier stage which then drives six output stages through a pair of distribution lines. The six isolated RF outputs may then be applied to six GPR-90RXD's which can be operated independently. During test, the RF output of an oscillator associated with the metering circuit is applied to the input of the preamplifier stage, and the signal delivered by each output stage may be separately switched to a front panel meter for observation.

As shown in figure A-1, the AMC 6-5 is designed for installation in a standard 19-inch rack. The front panel contains a power ON-OFF switch, a FILTER IN-OUT switch, a DYNAMIC TEST switch, and a test meter. The main electrical components are mounted in a chassis attached to the panel assembly. A self-contained power supply occupies the rear portion of the chassis; a broadband amplifier circuit occupies the front portion. A preamplifier subassembly which contains input and output transformers and a broadband push-pull amplifier stage is secured to the front right side of the chassis. All connections to the preamplifier are made through quick release plug and socket connections. The rear apron of the chassis contains the coaxial jacks for the antenna RF input and the RF outputs to the receivers, as well as the main AC input socket and main power fuse. Figure A-3 is a schematic diagram of the AMC 6-5. Electrical characteristics of the AMC 6-5 are listed in table A-2.

## A-3. COMMUNICATIONS PATCH PANEL CPP-4C.

a. Communications Patch Panel CPP-4C provides the facilities for patching to the input or output of any one unit in the DDR-6E. The CPP-4C permits the operator to apply an external signal source into any one of the units, or if it is desired, to connect the output of a unit to external equipments. In addition, by using a patch cable, any combination of units within the rack can be patched or connected together by simply inserting the cable plugs into the correct jacks. This facility is accomplished by 78 dual-circuit jacks which are divided into three rows, each of which contains 26 jacks. (See figure A-4.) These three rows of jacks are marked ROW 1 IN, ROW 2 MON, and ROW 3 OUT. Each ROW 1 IN and ROW 3 OUT jack may be connected to a unit input and output, respectively. Each pair of input and output jacks is connected in series. In this manner, with no plug inserted, the two jacks may be used to route the signal output from one unit to the input of another. Patchcords may then be used to patch various combinations of units together. Each ROW 2 MON jack bridges a pair of series-connected ROW 1 IN and ROW 3 OUT jacks thus permitting signal flow between the two units to be monitored externally. Terminal boards E101 through E108 provide the means by which the input and output of each unit in the rack is connected to its respective jack.

The CPP-4C is designed for operation with DC and audio circuits. Figure A-4 is the schematic diagram of the CPP-4C.

## A-4. RF PATCH PANEL QDP-38A.

RF Patch Panel QDP-38A is comprised of eight quick-disconnect type coaxial connectors. (See figure A-5.) The purpose of the QDP-38A is to increase the versatility of an antenna system used in various transmitting and receiving schemes. Connection from an antenna to a connector is made at the rear of the panel. Any combination of antennas terminated in the QDP-38A can be patched, by use of patchcords, to either a receiver or transmitter.

These connectors are designed to be used with cables such as RG-8, 10, 11, and 12/U. Voltages up to 4000 volts can be accommodated by these connectors without regard to breakdown. The QDP-38A does not have plugs or switches.

## A-5. ANTENNA DISTRIBUTION UNIT HFD-6.

Antenna Distribution Unit HFD-6 is a passive antenna distribution unit consisting of a specially designed broadband transformer with a single input and four outputs. (See figure A-6.) These units allow four receivers to operate from a single antenna with minimum interaction and insertion loss. Electrical characteristics are listed in table A-3.

### TABLE A-1. DDR-6E ACCESSORIES

| NAME OF UNIT | TMC DESIGNATION | DIMENSIONS* | | | |
|---|---|---|---|---|---|
| | | WIDTH | HEIGHT | DEPTH | WEIGHT |
| Antenna Multicoupler | AMC 6-5 | 19 | 8-3/4 | 12 | 46 |
| Communications Patch Panel | CPP-4C | 19 | 7-1/8 | 8-1/2 | 17-1/2 |
| RF Patch Panel | QDP-38A | 19 | 5-1/4 | 4 | 6-1/4 |
| Antenna Distribution Unit | HFD-6 | 19 | 1-7/8 | 5-1/2 | 2-1/2 |

*Unless otherwise stated, dimensions are in inches, weight in pounds.

### TABLE A-2. ELECTRICAL CHARACTERISTICS OF THE AMC 6-5

| ITEM | CHARACTERISTIC |
|---|---|
| Frequency response: | 2 to 30 mc (flat within ±2.0 db). |
| Gain: | 3 db nominal over 2 to 30 mc (FILTER switch to IN). |
| Noise factor: | Less than 10 db over specified frequency range. |
| Intermodulation characteristics: | Equivalent antenna voltage of an intermodulated signal will be down at least 50 db with respect to the level of either of two equal amplitude signals whose equivalent antenna voltages to produce the intermodulated signal are 250,000 uv for 70-ohm antenna. |
| Harmonic distortion | Negligible under conditions shown directly above. |
| Input filter for broadcast band: | When used, provides at least 35-db attenuation for frequencies below 1.2 mc. Insertion loss is 3 db at 2 mc, zero through specified frequency range. |
| Input impedance characteristics: | VSWR less than 1.8/1 at nominal impedance. |

TABLE A-2. ELECTRICAL CHARACTERISTICS OF THE AMC 6-5 (C nt.)

| ITEM | CHARACTERISTIC |
|---|---|
| Isolation: | Output to output: 60 db minimum. |
| | Output to input: 60 db minimum. |
| Output signal uniformity: | Minimum signal output from any output jack is not less than 75 percent of voltage at any other jack when mutual conductance of tubes is at least 80 percent of rating. |
| Nominal input impedance: | 70 ohms unbalanced (other impedances available). |
| Output impedance characteristics: | Provides stated frequency response and gain when loaded with 70 ohms. |
| Primary power supply: | 115 or 230 volts, 60 cps, 150 watts. |

TABLE A-3. ELECTRICAL CHARACTERISTICS OF THE HFD-6

| ITEM | CHARACTERISTIC |
|---|---|
| Frequency range: | 2 to 30 mc. |
| Frequency response: | Flat within 1 db. |
| Insertion loss: | Approximately 1 db. |
| Input impedance: | 70 ohms unbalanced. |
| Output impedance: | 70 ohms unbalanced. |

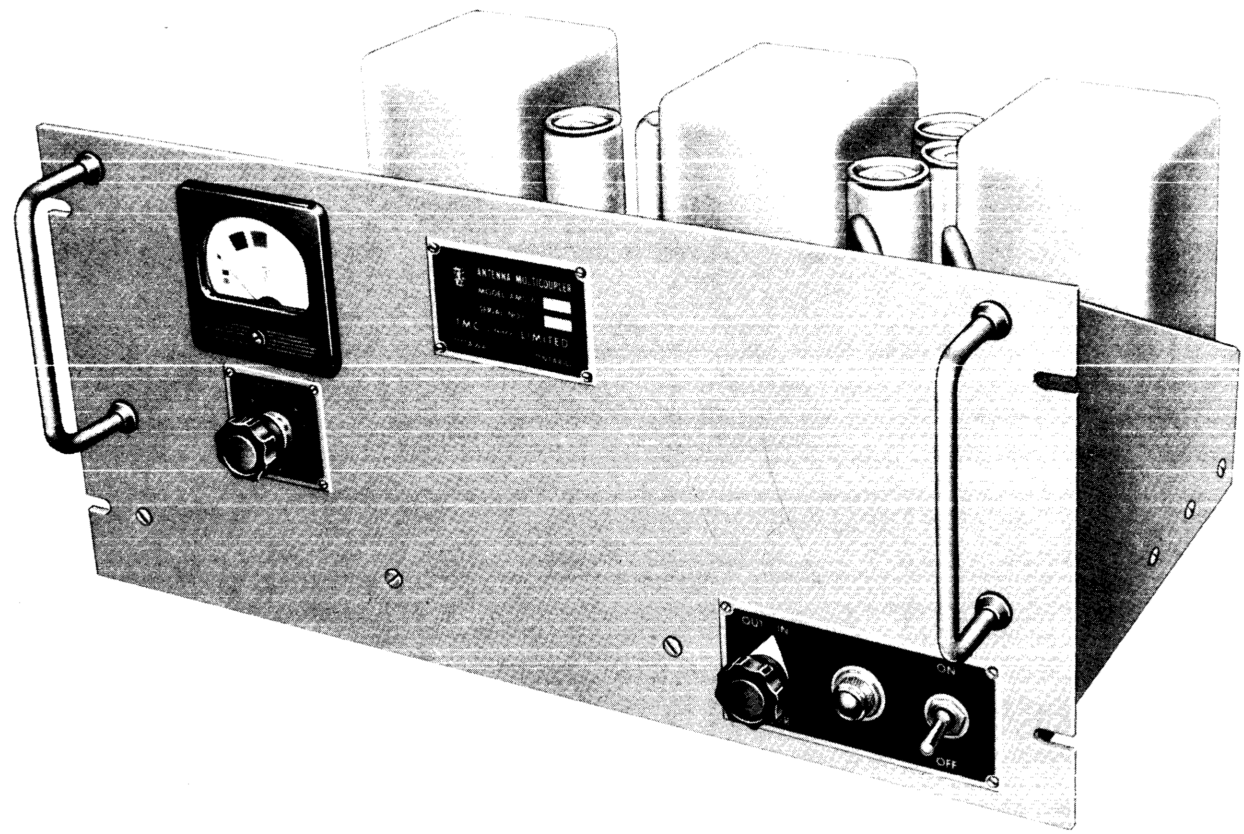



Figure A 1. Antenna Multicoupler, AMC 6-5

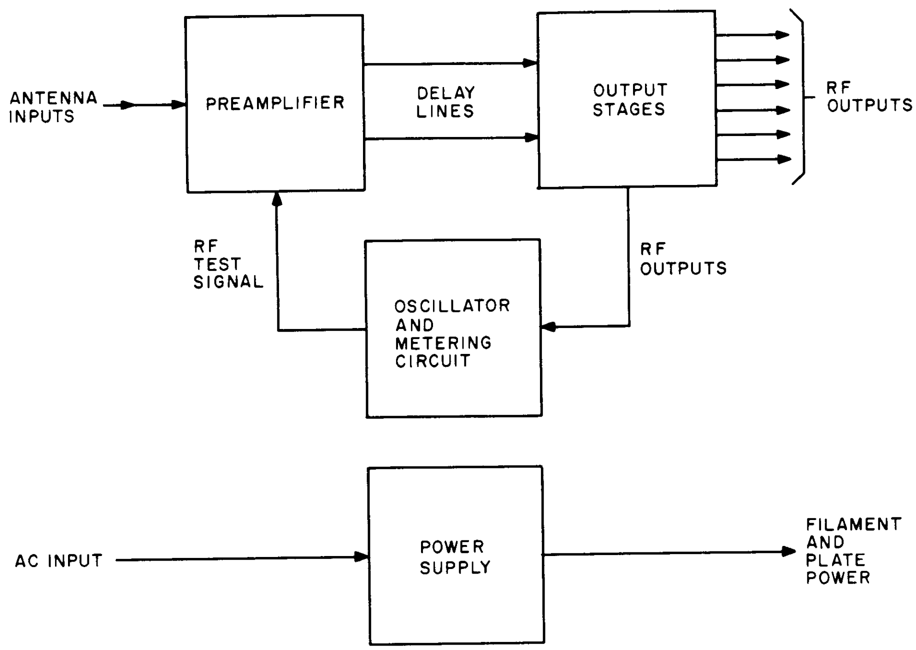
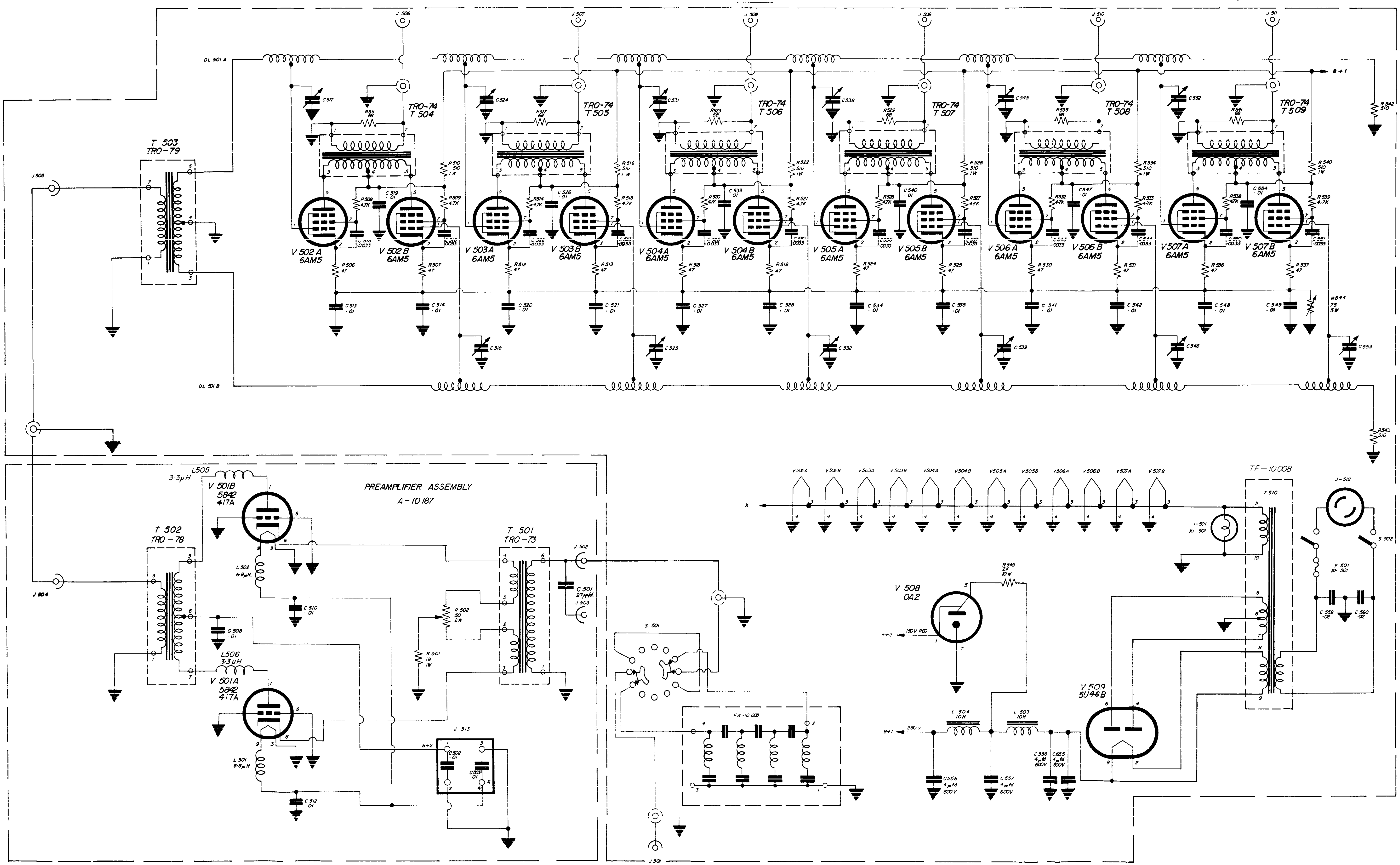
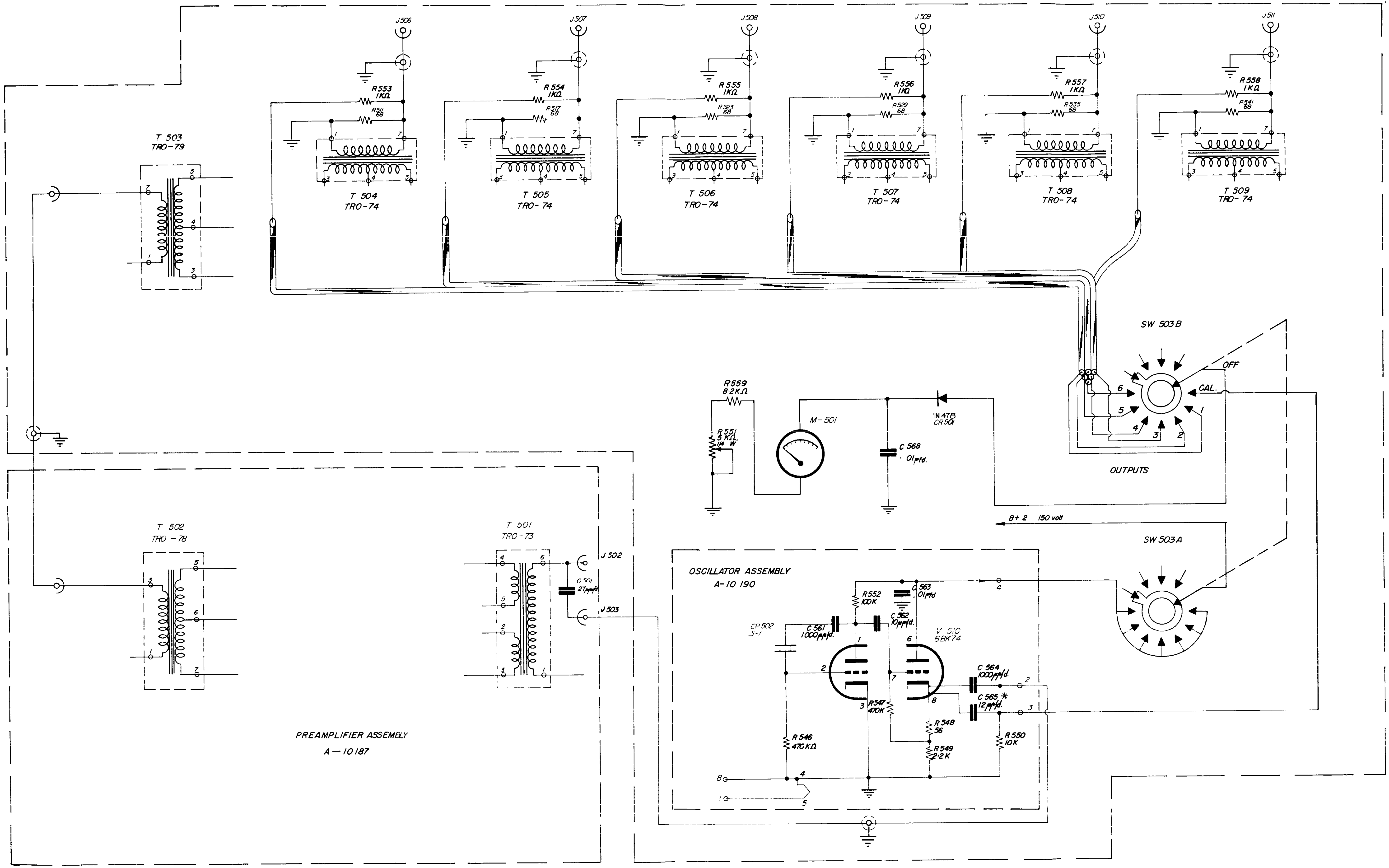



Figure A-2. Block Diagram, AMC 6-5




NOTE ALL CAPACITORS IN μfd UNLESS OTHERWISE STATED
ALL RESISTORS 1/2W UNLESS OTHERWISE STATED

Figure A-3. Schematic Diagram, AMC 6-5 (Sheet 1 of 2)




ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE STATED

* NOMINAL VALUE-THIS VALUE ADJUSTED IN MANUFACTURE TO PROVIDE PROPER CALIBRATION LEVEL

Figure A-3. Schematic Diagram, AMC 6-5 (Sheet 2 of 2)

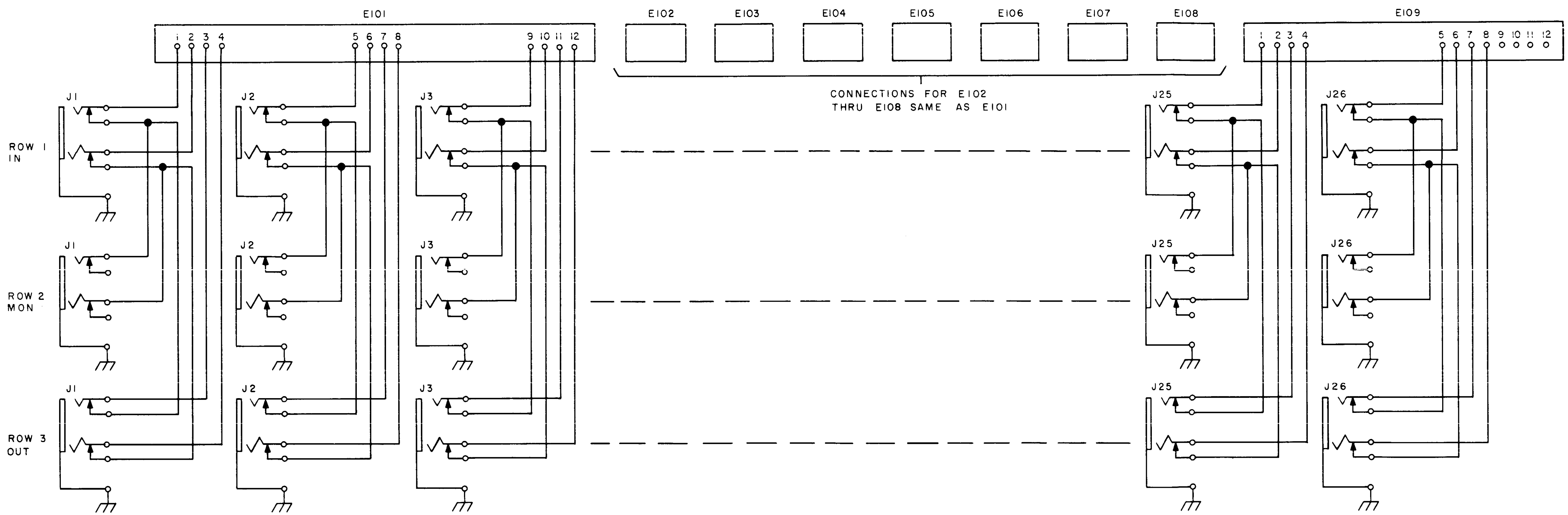



Figure A-4. Schematic Diagram, CPP-4C

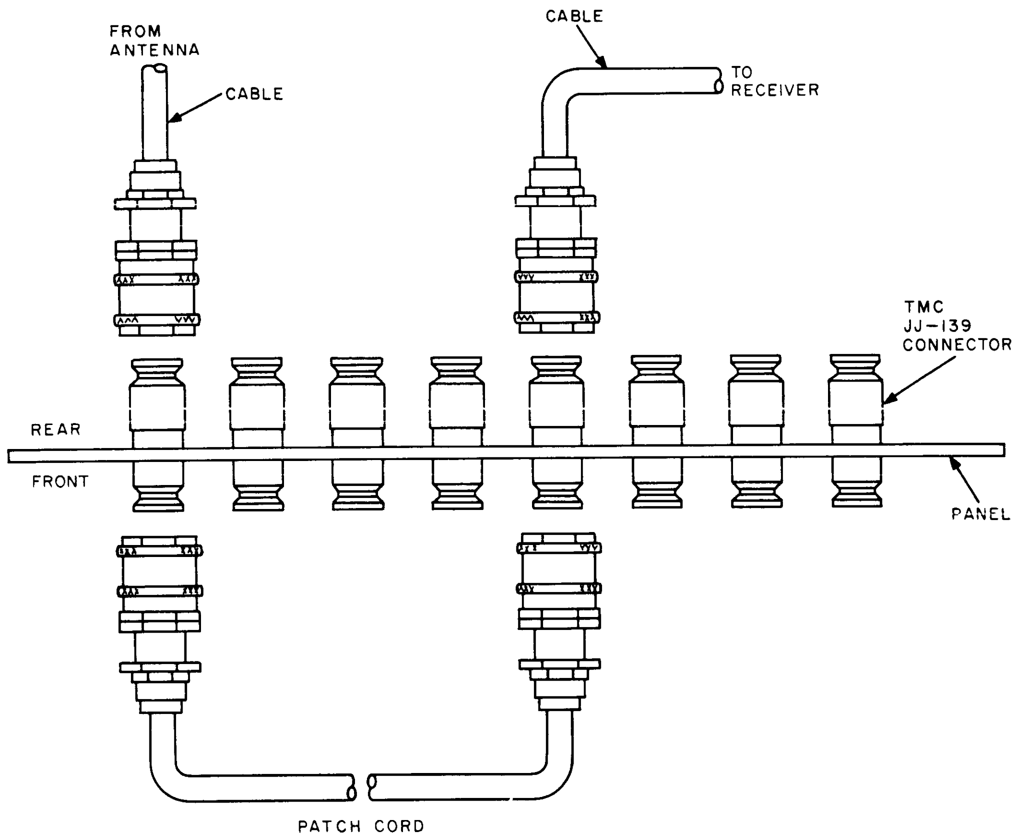



Figure A-5. RF Patch Panel, QDP-38A

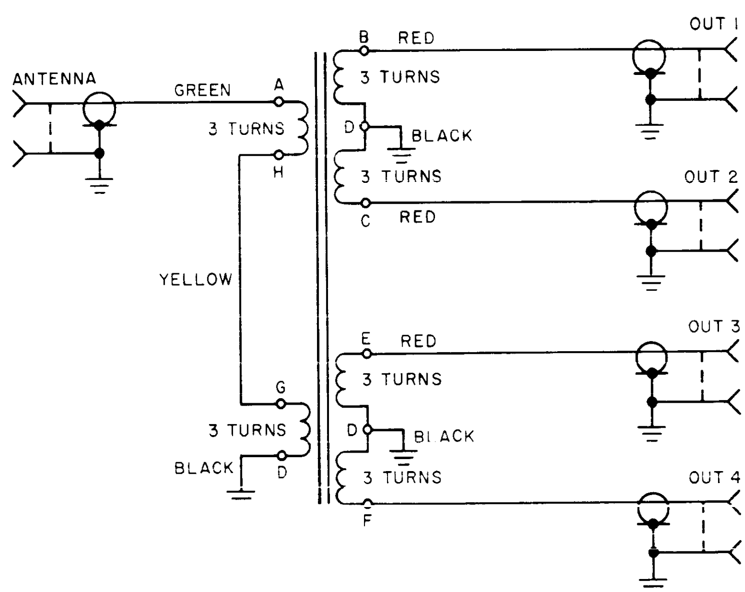



Figure A-6. Schematic Diagram, HFD-6